

Madison Public Schools



# Science Program

A Framework for Integrated Teaching and Learning

Science Program  
Madison Public Schools  
10 Campus Drive  
Madison, CT 06443  
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## Introduction

The Madison Curriculum Renewal Process addresses the need for the continual improvement and / or **updating of the schools' instructional programs through the periodic re-examination** of curriculum. The process is recursive and usually occurs within the same cycle as the Board of Education's Framework for Strategic Planning. The full cycle includes fourteen steps.

The Science committee has completed the eight steps of curriculum renewal. After review of the curriculum by the Administrative Council, the Superintendent of Schools and the Board of Education, the steps of implementation, program monitoring and evaluation will be initiated.

Science teachers examined many resources including state and national standards and frameworks for Science learning as well as science **curricular programs nationwide. The articulation of the guide's goals** and standards across grade levels has been examined carefully and has been achieved to the satisfaction of the Science committee charged with the development of the guide. The committee believes that the Madison Public School System has developed a quality Science program that is planned, ongoing, and systematic.

David J. Klein,  
Superintendent

Anita L. Rutlin,  
Assistant Superintendent

## Structure of the Program Guide

The guide is organized into six (6) sections. This overview section provides direction for understanding the contents of the guide.

The Components and Framework sections provide descriptions of the program components, including such elements as philosophy, goals, design and understandings.

The Standards and Indicators for Scope and Sequence of Instruction section states the scope (breadth and depth) of subject content and sequence (order of presentation) to master the subject with understanding – to acquire knowledge and skill for handling key tasks in science. It is the overall logic for learning: 1) a design that is back loaded from expected performances; 2) application of the content based on clear performance goals; and 3) a sequence that enables learning and then proficient performing. Objectives have been identified for grade levels and / or for courses. Objectives for learners introduced at earlier grade levels may not be restated at later grade levels, even though periodic reinforcement occurs. The curriculum facilitates learning content incrementally, progressing by tackling increasingly complicated ideas and aspects of proficient performance.

The Program Implementation: Guidelines and Strategies section provides guidelines and strategies for implementing the curriculum described in the preceding sections of the guide. This includes descriptions of various components of instruction -- delivery, requirements, time, technology, student support -- as well as professional growth and development plus coordination, supervision and evaluation.

The Program Monitoring and Evaluation section provides guidelines and procedures for assessing the overall effectiveness of the curriculum program. There are recommendations for annual program monitoring and questions to frame program evaluation.

The Program Resources section includes Science Safety Manuals for Elementary, Middle and High School use as well as a guide for Scientific Process Skills for elementary students. Also included are instructional websites and the works consulted in creating the program guide.

The Appendices follow and include references to the Connecticut Core Science Curriculum Framework and Standards, National Science Education Standards, and the Framework for 21<sup>st</sup> Century Learning that provides the foundation to insure that the science learning is current and appropriate to the needs of the 21<sup>st</sup> century.

## Intent and Acknowledgments

The Science Curriculum Committee believes that students should become confident in their skills and realize the value of science education as they progress through a challenging curriculum that stresses scientific reasoning and inquiry skills.

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# **Program Guide**



## Program Component Descriptions

### Philosophy

An effective curriculum design needs to incorporate a philosophy, i.e., a statement of beliefs. The philosophy reflects national trends based on **research and effective practice**. It also incorporates the school district's beliefs regarding the content area. Research studies, curriculum frameworks, and assessment are referenced. An effective philosophy mirrors a vision statement and prepares the system to meet the needs of its students for the 21<sup>st</sup> century.

### Goals

Goals address what students should know and be able to do after experiencing a quality curriculum in grades K-12. **Connecticut's Common Core of Learning states that all educated citizens must possess a core of basic enabling skills and competencies that provide the critical intellectual foundations for broader acquisition of knowledge.** Goals that are established for Science explain those given competencies.

### Design

Understanding by Design or UbD is a framework developed by Grant Wiggins and Jay McTighe and published by the Association for Supervision and Curriculum Development. It is a tool for educational planning focused on **"teaching for understanding."** The emphasis of UbD is on **"backward design," the practice of looking at outcomes in order to design curriculum units, performance assessments and classroom instruction.** The teacher starts with the classroom outcomes and then plans the curriculum, prepares assessments that help determine student mastery, and chooses activities and materials that foster student learning.

UbD expands on **"six facets of understanding,"** which include students being able to explain, interpret, apply, have perspective, empathize, and have self-knowledge about a topic. **"Teaching for Understanding" should be evident in course design, teacher and student attitudes, and the classroom learning environment.** There should be systematic curriculum design with distinctions between the enduring understandings and essential questions. Students should be familiar with the essential questions, performance requirements, and evaluation criteria at the beginning of each unit or course.

### Enduring Understandings

Understandings are characterized as:

- Statements that summarize insights that students are expected to remember.
- Inferences that students must draw, realize, or grasp, based on learning.
- Insights that link facts and skills to **"big ideas" in meaningful ways that are related to the "real world"**.

### Conceptual Structure

The science framework is organized around eleven conceptual themes and guiding questions in the earth, life and physical sciences. Each theme is addressed by several content standards that spiral through the grades, each time being treated with greater depth and breadth, in accordance with developmental appropriateness for the students.

## **Benchmarks of Student Progress**

Benchmarks include identified assignments and assessments that serve as markers for incremental student progress at different points in a grade level or course.

## **Learning Environment**

The learning environment addresses the ambiance in which the students work. It is an environment which encourages active participation through listening, watching, speaking, reading, and writing. It describes the **science classroom / lab where the student's engagement, understanding, and development of process and inquiry skills are nurtured.**

## **Program Implementation**

The implementation section will be dynamic. As the curriculum is available electronically, changes and updates will be ongoing. Recent revisions to the grade level expectations in the Connecticut K-8 Science Curriculum Standards in the Connecticut Core Science Framework have had a subsequent effect on the curriculum.

The focus of implementation includes instructional delivery, requirements, time, and technology. Professional development, supervision and evaluation facilitate implementation.

## **Program Monitoring and Evaluation**

Program Evaluation addresses the effectiveness of the program from a student performance stance. The effectiveness of the designated curriculum is determined by whether the students are progressively gaining proficiency in science as evidenced by benchmark assignments and assessments, unit and course tests, Connecticut Mastery Tests, and Connecticut Academic Performance Tests.

## **Resources**

The Resources section includes Science Safety Guides for Elementary Science Safety, Middle School Science Safety, and High School Science Safety as well as websites and works consulted in the development of this document.

## **Appendices**

The appendices contain reference materials such as the Connecticut Core Science Curriculum Framework, National Science Education Standards, and the Framework for 21<sup>st</sup> Century Skills.

# **Science Program Framework**



**Vision of Science Education:** A quality science education fosters a population that:

- Experiences the richness and excitement of knowing about the natural world and understanding how it functions.
- Uses appropriate scientific processes and principles in making personal decisions.
- Engages intelligently in public discourse and debate about matters of scientific and technological concern.
- Applies scientific knowledge and skills to increase economic productivity.

## **Vision for Scientific Literacy**

Global interdependence, rapid scientific and technological innovation, the need for a sustainable environment, economy and society, and the pervasiveness of science and technology in daily life reinforce the importance of scientific literacy. Scientifically literate individuals can more effectively interpret information, solve problems, make informed decisions, accommodate change and create new knowledge. Science education is a key element in developing scientific literacy and in building a strong future for Madison's students.

Scientific literacy is an evolving combination of the science-related attitudes, skills and knowledge students need to develop inquiry, problem-solving, and decision-making abilities, to become lifelong learners, and to maintain a sense of wonder about the world around them. Learning experiences based on standards and expectations will provide students with many opportunities to explore, analyze, evaluate, synthesize, appreciate and understand the interrelationships among science, technology, society and the environment that will affect their personal lives, careers and future.

## **Mission of Science Education**

Scientifically literate students possess the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs and economic productivity.

## **Goals for Science Education**

To promote scientific literacy, science education will...

- encourage students at all grades to develop a critical sense of wonder and curiosity about scientific and technological endeavors.
- enable students to use science and technology to acquire new knowledge and solve problems, so that they may improve the quality of their own lives and the lives of others.
- prepare students to critically address science-related societal, economic, ethical and environmental issues.
- provide students with a proficiency in science that creates opportunities for them to pursue progressively higher levels of study, prepares them for science-related occupations, and engages them in science-related activities appropriate to their interests and abilities.
- develop in students of varying aptitudes and interests a knowledge of the wide variety of careers related to science, technology and the environment.

## **The Need for Science Education**

**"In this changed world, knowledge of math and science is paramount."** (U.S. Department of Education, 2006) It is essential that students are taught the skills necessary to compete and succeed in higher education and the workforce. **The study and "work of science relies on basic human qualities such as reasoning, insight, energy, skills and creativity – as well as on scientific habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas."** (National Science Standards)

People of both genders and of all social and ethnic backgrounds with diverse talents engage in activities of science including engineering, research and health professionals and related fields. Scientists in all fields may work in teams or alone but they must communicate extensively with others. For progress in science, the exchange of ideas, information, data and materials is essential. This communication goes well beyond research facilities or universities crossing national boundaries and spanning the globe. Therefore, the development of good communication skills is needed in addition to inquiry skills including the forming of a scientific question, the testing of a hypothesis, designing and performing a valid experiment, collecting valid and useful data, analyzing data, and drawing conclusions.

## Philosophy

To promote scientific literacy, it is crucial to recognize how students learn, how science can best be taught, and how learning can be assessed. Students are curious, active learners who have individual interests, abilities and needs. They come to school with various personal and cultural experiences and prior knowledge that generate a range of attitudes and beliefs about science and life.

Students learn most effectively when their study of science is rooted in concrete learning experiences, related to a particular context or situation, and applied to their world. The ideas and understandings that students develop can be progressively extended and reconstructed as students grow through their experiences and in their ability to conceptualize. Learning involves the process of linking newly constructed understandings with prior knowledge and adding new contexts and experiences to current understandings.

Development of scientific literacy is supported by instructional environments that engage students in the **processes of...**

- scientific inquiry: students address questions about natural phenomena, involving explorations as well as focused investigations.
- technological problem solving (design process): students seek answers to practical problems requiring the application of their science knowledge in various ways.
- decision making: students identify issues and pursue science knowledge that will inform the issues.

It is through these processes that students discover the significance of science in their lives and come to appreciate the interrelationships of science, technology, society and the environment.

Each of the processes is a potential starting point for approaching science learning. These processes may encompass a variety of learning approaches for exploring new ideas for development specific investigations and for applying the ideas that are learned.

To achieve the vision of scientific literacy, students must increasingly become engaged in the planning, development and evaluation of their own learning experiences. They should have the opportunity to work cooperatively with other students, to initiate investigations, to communicate their findings, and to complete projects that demonstrate their learning. To assist teachers in planning for instruction, assessment, evaluation and reporting, science teachers recommend:

- At the beginning of each unit of instruction, the expected student learning outcomes and performance criteria are identified. It is important that the student learning outcomes and performance criteria correspond with state and national standards and expectations. The communication between students and teachers helps to clearly establish what needs to be accomplished, thereby assisting in the learning process.
- When students are aware of expected outcomes, they will be more focused on the essential learning and more likely to assess their own progress. Furthermore, they can participate in assessment as learning to meet expectations. Assessment must be valid, reliable and fair to students.



## Guiding Principles

Guiding principles form the basis of an effective science education program. They address the complexity of the science content and the methods by which science content is best taught. They clearly define the attributes of a quality science curriculum at the elementary, middle, and high school levels.

Effective science programs:

- are based on standards and use standards-based instructional materials.
- develop **students' command of the** language of science used in the standards.
- reflect a balanced, comprehensive approach that includes the teaching of inquiry along with direct instruction and reading.
- use multiple instructional strategies and provide students with multiple opportunities to master the standards.
- include continual assessment of students' **knowledge and understanding**.
- engage all students in learning and prepare and motivate students for further instruction in science.
- use technology to teach students, assess their knowledge, develop information resources, and enhance computer literacy.
- have adequate instructional resources as well as library-media and administrative support.
- use standards-based connections with other core subjects to reinforce science teaching and learning.

## K-12 Conceptual Themes and Guiding (Essential) Questions

The conceptual themes and the guiding questions together with the content standards and grade level expectations contribute to students' abilities to have enduring understandings and to respond to the guiding (essential) questions.

### Properties of Matter

How does the structure of matter affect the properties and uses of materials?

- Properties of Objects (K)
- Properties of Materials (2)
- States of Matter (3)
- Elements, Compounds and Mixtures (6)
- Chemical Reactions (9)
- Carbon Compounds (9)

### Energy Transfer and Transformations

What is the role of energy in our world?

- Electricity and Magnetism (4)
- Physics of Sound (4)
- Light (5)
- Energy and Work (7)
- Energy Conservation and Transformation (9)
- Electrical Forces (9)

### Forces and Motion

What makes objects move the way they do?

- Position and Motion of Objects (1)
- Forces and Motion (5)
- Forces and Motion (8)

### Matter and Energy in Ecosystems

How do matter and energy flow through ecosystems?

- Food Chains - Wetlands (4)
- Ecosystems (6)

**Structure and Function**

How are organisms structured to ensure efficiency and survival?

- Needs of Living Things (1)
- Life Cycles of Animals (1)
- Life Cycles of Plants (2)
- Responses to Stimuli (5)
- Human Body Systems (7)
- Cell Structure and Function (10)

**Heredity and Evolution**

What processes are responsible for life's unity and diversity?

- Characteristics of Living Things (K)
- Adaptations (3)
- Reproduction and Heredity (8)
- Genetics (10)
- Evolution (10)

**The Changing Earth**

How do materials cycle through the Earth's systems?

- Properties of Soils (2)
- Properties of Rocks and Minerals (4)
- Cycles of Matter in Earth's Systems (9)

**Energy and Earth's Systems**

How do external and internal sources of energy affect the Earth's systems?

- Weather Patterns (K)
- Land and Water Interactions (3)
- Weather and Seasons (6)
- The Changing Earth (7)

**Earth and the Solar System**

How does the position of Earth in the solar system affect conditions on our planet?

- Earth, Moon and Sun (5)
- The Solar System (8)

**Science and Technology in Society**

How do science and technology affect the quality of our lives?

- Shelters (K)
- Measuring Tools (1)
- Food Resources - Nutrition (2)
- Conservation of Materials (3)
- Batteries, Bulbs and Magnets (4)
- Optical Technologies (5)
- Water Quality (6)
- Food Technology (7)
- Building Bridges (8)
- Energy and Power Technologies (9)
- Polymers (9)
- Human Environmental Impacts (9)
- Living with Microorganisms (10)
- Biotechnology (10)
- Human Population Growth (10)

## Science Practices

**Understand Scientific Explanations:** Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.

**Generate Scientific Evidence Through Active Investigations:** Students master the conceptual, mathematical, physical and computational tools that need to be applied when constructing and evaluating claims.

**Reflect on Scientific Knowledge:** Scientific knowledge builds on itself over time.

**Participate Productivity in Science:** The growth of scientific knowledge involves critique and communication, which are social practices that are governed by a core set of values and norms.

## Benchmarks of Student Progress

Effective teaching and learning begins with the needs of students and reflects their developmental stages. We recognize the need for a solid conceptual foundation in science and the development of science inquiry skills in order to apply their knowledge and continue to learn.

**By the end of 2<sup>nd</sup> grade,** students will have developed a “wonder” about the natural world and the ability to observe, describe and apply basic process skills.

**By the end of 5<sup>th</sup> grade,** students will have developed “descriptions” of basic natural phenomena and the ability to perform simple experiments and record accurate data.

**By the end of 8<sup>th</sup> grade,** all students will have developed basic “explanations” for natural phenomena, and the ability to ask good questions and apply experimental procedures to collect and analyze data.

**By the end of 10<sup>th</sup> grade,** all students will have developed an “interest” in global issues and the ability to collect, analyze and use data to explore and explain related science concepts.

**By the end of 12<sup>th</sup> grade,** all students will have developed a “deep understanding” of science concepts and principles and prepared for future studies and/or careers.

*(CT State Department of Education, 2005)*

Integrated Science and Biology as gateway courses, which we believe will encourage students to complete four credits of science study including advanced life, earth and physical science courses.



# **Content Standards & Indicators**

**Kindergarten – Grade 4**



**Content Standards & Indicators**  
**for Kindergarten**





### Course Description

<b>ELEMENTARY SCHOOL</b>			
1. Course Title <b>Kindergarten General Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed		
2. Transcript Title/Abbreviation <b>Science</b>	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media		
3. Transcript Course Code/Number N/A			
4. Program Contact Information  Name: Anita Rutlin  Title/Position: Assistant Superintendent  School: Central Office Madison Town Campus 10 Campus Drive, P.O. Drawer 71 Madison, CT 06443	6. Grade Level: Kindergarten  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable  8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)		
10. Pre-Requisites: N/A			
11. Brief Course Description Kindergarten science is taught in four units throughout the school year. Students are actively engaged in science through investigations. As part of the spiraling curriculum, aspects of life science, earth science and physical science are taught each year. The life science unit is Heredity and Adaptations. The physical science units are Properties of Matter and Shelters. The earth science unit is Energy in the Atmosphere and Weather.			
12. Course Goals A guided inquiry program gives students the opportunity to explore topics and concepts through investigations. Participating in this hands-on program helps students: <ol style="list-style-type: none"> <li>1. To foster a life long enjoyment of learning science.</li> <li>2. To observe science in the world around them.</li> <li>3. To meet the science standards for Connecticut Public Schools.</li> </ol>			
13. Course Outline <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;">               1. Properties of Matter                2. Heredity and Adaptations             </td> <td style="width: 50%; border: none;">               3. Energy in the Atmosphere and Weather                4. Science and Technology in Society - Shelters             </td> </tr> </table>		1. Properties of Matter 2. Heredity and Adaptations	3. Energy in the Atmosphere and Weather 4. Science and Technology in Society - Shelters
1. Properties of Matter 2. Heredity and Adaptations	3. Energy in the Atmosphere and Weather 4. Science and Technology in Society - Shelters		
14. Instructional Methods and/or Strategies <ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Full class instruction and discussions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Modeling</li> <li>▪ Guided inquiry activities</li> </ul>		
15. Assessment Methods and/or Tools <ul style="list-style-type: none"> <li>▪ Teacher Observation</li> <li>▪ Embedded Assessment Activities</li> </ul>	<ul style="list-style-type: none"> <li>▪ Response to writing prompts and class discussions</li> </ul>		
16. Assessment Criteria The common assessments are based on the Madison curriculum and the Connecticut standards and grade level expectations for science. A variety of assessment tools are employed to get the most accurate understanding of individual achievement possible.			

<b>LEARNING STRAND</b> <b>Unit: Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific Inquiry is a thoughtful and coordinated attempt, to search out, describe, explain, and predict natural phenomena.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you make observations about objects, organisms, and the environment?</li> <li>▪ How do you use simple measuring tools to gather data and extend the senses?</li> <li>▪ How do you use observed patterns to make predictions?</li> <li>▪ How do you use standard measuring tools to collect data and nonstandard measures to make comparisons?</li> <li>▪ How can physical properties be used to order and sort objects and organisms?</li> <li>▪ How do you locate relevant science information in printed resources?</li> <li>▪ How do bar graphs represent information?</li> </ul>
<b>KNOWLEDGE &amp; LEARNING</b> <i>The student will know...</i> <ul style="list-style-type: none"> <li>▪ Use the senses and simple measuring tools to make observations and collect data.</li> <li>▪ Use standard tools to measure and describe physical properties such as weight, length and temperature and nonstandard measures to estimate and compare the sizes of objects.</li> <li>▪ Count, order and sort objects by their properties.</li> <li>▪ Make predictions based on observed patterns.</li> <li>▪ Ask questions about objects, organisms and the environment.</li> <li>▪ Read, write, listen and speak about observations of the natural world.</li> <li>▪ Seek information in books, magazines and pictures and present information in words and drawings.</li> <li>▪ Represent information in bar graphs.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> Internet resources Books from the Library Media Center  <b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Inquiry activities and investigations</li> <li>▪ Guided reading</li> </ul> <b>ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Inquiry literacy questions</li> </ul>

<b>LEARNING STRAND</b> <b>Unit: Properties of Matter --</b> <i>How does the structure of matter affect the properties and uses of materials?</i> <i>CT Standard K.1 – Objects have properties that can be observed and used to describe similarities and differences.</i>	
<b>ENDURING UNDERSTANDING</b> Some properties can be observed with the senses, and others can be discovered by using simple tools or tests.	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How can simple measuring tools be used to observe common objects and sort them into groups based on size, weight, shape or color?</li> <li>▪ How can objects be sorted according to the materials of which they are made?</li> <li>▪ How can objects be sorted into groups based on properties such as flexibility, attraction to magnets, and whether they float or sink in water?</li> <li>▪ How can objects in a group be described in mathematical terms using quantitative relationships such as same as, more than, less than, equal, etc.?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that ...</i> <ul style="list-style-type: none"> <li>▪ Humans have five senses that they use to observe their environment. A specific sense organ is associated with each sense.</li> <li>▪ Objects have properties that can be observed using the senses. Examples include size, weight, shape, color, texture, transparency, etc. An <b>object's observable</b> properties do not include the <b>object's name or its uses</b>.</li> <li>▪ Sorting objects into groups based on one (or more) of their properties makes it possible to observe and describe their similarities and differences.</li> <li>▪ Placing objects in order based on their size or weight makes it possible to observe patterns and describe relationships among the objects in a group.</li> <li>▪ Objects can be described and sorted based on the materials from which they are made (for example, wood, paper, fabric, plastic, glass or metal). Objects can be made of a mixture of materials.</li> <li>▪ Objects can be described and sorted based on the results of simple tests. Simple tests include actions such as bending, squeezing, holding it near a magnet or putting it in water. Objects can be described as magnetic/nonmagnetic, flexible/not flexible, hard/soft, a floater/sinker, etc.</li> <li>▪ The heaviness of objects can be compared using the sense of touch. Balances and scales are measurement tools that allow people to observe and compare the heaviness of objects more accurately. Objects can be sorted into groups that have the same heaviness, or into groups that are</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ STC: <i>Comparing and Measuring</i></li> <li>▪ Plastic containers to hold water</li> <li>▪ Objects that can be sorted or tested for sinking and floating</li> </ul>
	<b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Provide a variety of materials and simple measuring tools for each group of students. Have them measure the length of the objects and sort them accordingly. Then have the students sort the same objects according to height.</li> <li>▪ Have students test to see if objects can sink or float and sort the objects accordingly.</li> <li>▪ Have students sort the objects according to their own criteria. Allow the students to weigh the objects, squeeze or bend them, or try other simple tests that allow them to sort the objects according to a characteristic. Have students move from group to group to try to identify the criteria used by the original group to sort the objects.</li> </ul>
	<b>ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Students should be able to successfully sort objects physically or on paper in a variety of ways according to the characteristics of the objects using simple tools.</li> </ul> <b>GRADE LEVEL EXPECTATIONS</b> Assessments <b>MUST</b> measure the ability of students to: <ul style="list-style-type: none"> <li>▪ Match each of the five senses with its associated body part and the kind of</li> </ul>

<p>“more heavy than” or “less heavy than” a given object.</p> <ul style="list-style-type: none"> <li>▪ The temperature of the air, water or bodies can be compared using the sense of touch. A thermometer is a measurement tool that allows people to compare temperatures more accurately.</li> <li>▪ Objects can be sorted into groups based on measurements of their size. Nonstandard units for measuring size include hands, footsteps, pennies or paper clips.</li> </ul>	<p>information it perceives.</p> <ul style="list-style-type: none"> <li>▪ Make scientific observations using the five <b>senses, and distinguish between an object’s</b> observable properties and its name or its uses.</li> <li>▪ Classify organisms or objects by one and two observable properties and explain the rule used for sorting (e.g., size, color, shape, texture or flexibility).</li> <li>▪ Use simple tools and nonstandard units to estimate and predict properties such as heaviness, magnetic attraction and float/sink.</li> <li>▪ Describe properties of materials such as wood, plastic, metal, cloth or paper and sort objects by the material from which they are made.</li> <li>▪ Count, order and sort objects by their observable properties.</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Use the senses and simple measuring tools, such as rulers and equal-arm balances, to observe common objects and sort them into groups based on size, weight, shape or color.</li> <li>▪ Sort objects made of materials such as wood, paper and metal into groups based on properties such as flexibility, attraction to magnets, and whether they float or sink in water.</li> <li>▪ Count objects in a group and use mathematical terms to describe quantitative relationships such as: same as, more than, less than, equal, etc.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** senses, observe, observation, property, sort, classify, material, float, sink, flexible, heavy, magnetic, nonmagnetic, thermometer

**KEY SCIENCE VOCABULARY:**

<b>LEARNING STRAND</b>	
<b>Unit: Heredity and Adaptations --</b> <i>What processes are responsible for life's unity and diversity?</i> <i>CT Standard K.2 - Many different kinds of living things inhabit the Earth.</i>	
<b>ENDURING UNDERSTANDING</b> Living things have certain characteristics that distinguish them from nonliving things, including growth, movement, reproduction and response to stimuli.	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How are the appearance and behaviors of plants, birds, fish, insects, and mammals (including humans) similar?</li> <li>▪ How are the appearance and behaviors of plants, birds, fish, insects, and mammals (including humans) different?</li> <li>▪ How are the appearance and behaviors of adults similar to their offspring?</li> <li>▪ How are the appearance and behaviors of adults different from their offspring?</li> <li>▪ How can living and nonliving things be distinguished from one another by describing their characteristics?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that ...</i> <ul style="list-style-type: none"> <li>▪ Things in our environment can be classified based on whether they are alive, were once alive or whether they were never alive.</li> <li>▪ Growth is an observable characteristic common to living things.</li> <li>▪ Reproduction is an observable characteristic common to living things. Living things can be classified into groups based on the different ways they reproduce. For example, some living things lay eggs, while others produce seeds or give birth. Offspring generally resemble their parents but are not identical to them.</li> <li>▪ Many living things move in response to their environment, but movement alone is not evidence of life. For example, cars and the wind both move, but they are not alive.</li> <li>▪ Plants and animals are living things. Plants have characteristics (such as roots, stems, leaves and flowers) that animals do not have. Animals have characteristics (such as body parts and body coverings) that plants do not have.</li> <li>▪ Animals can be classified into groups based on generally similar characteristics such as number of legs, type of body covering, or way of moving. Some animal groups are reptiles, insects, birds, fish and mammals.</li> <li>▪ Members of the same group of animals can look and behave very differently from each other. For example, goldfish and sharks are both fish, but there are distinct differences in their size, color and lifestyle. In addition, all goldfish are not identical to each other and neither are all sharks.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Pictures of plants</li> <li>▪ Pictures of animals in different stages of life</li> <li>▪ Picture books about plants and animals</li> <li>▪ Posters of ecosystems</li> </ul> <b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Have students examine posters of ecosystems and identify things as alive, once alive or never alive.</li> <li>▪ Discuss with students what living things do that nonliving things do not do – grow and reproduce.</li> <li>▪ Discuss how movement alone does not indicate something is living. Machines move and are not alive.</li> <li>▪ Show pictures of well-know organisms and have students sort them according to how they reproduce (laying eggs, giving birth, making seeds).</li> <li>▪ Have students match baby animals with what they look like as adults. Include easy ones such as dogs as well as more difficult ones such as mosquitoes. Have students observe the similarities and differences.</li> <li>▪ Have students observe the basic parts of plants: roots, stems, leaves, flowers. These can be seen using a classroom plant or going outside to observe plants.</li> <li>▪ Have students compare the plant parts to animal parts.</li> <li>▪ Show students pictures of animals and have them sort them according to criteria of choice such as the number of legs, type of body</li> </ul>

<ul style="list-style-type: none"> <li>Plants can be classified into groups based on similarities in the appearance of their leaves, stems, blossoms or fruits. Some plant groups are grasses, vegetables, flowering plants and trees.</li> <li>Members of the same group of plants can look and behave very differently from each other. For example, although oaks and palms are trees, their size, shape, leaves and bark are very different. In addition, all oak trees are not identical to each other and neither are all palms.</li> </ul>	<p>covering, etc.</p> <ul style="list-style-type: none"> <li>Members of the same animal group can look very different from one another. (Examples: fish) This can be shown using pictures or a picture book about animals. It can also be done by having students draw a picture of a dog. The pictures can be shared and compared.</li> <li>Using pictures and some poster tacky substance (such as FunTack) have the students sort pictures of plants according to criteria. Have them explain why they sorted as they did.</li> </ul>
	<p><b>ASSESSMENT METHODS</b></p> <p><b>GRADE LEVEL EXPECTATIONS</b> Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>Observe and describe differences between living and nonliving things in terms of growth, offspring and need for energy from food.</li> <li>Sort and count living and nonliving things in the classroom, the schoolyard and in pictures.</li> <li>Use nonstandard measures to estimate and compare the height, length, or weight of different kinds of plants and animals.</li> <li>Observe and write, speak or draw about similarities and differences between plants and animals.</li> <li>Match pictures or models of adults with their offspring (animals and plants).</li> <li>Recognize varied individuals as examples of the same kind of living thing (e.g., different color rabbits are all rabbits; different breeds of dogs are all dogs).</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>Describe the similarities and differences in the appearance and behaviors of plants, birds, fish, insects and mammals (including humans).</li> <li>Describe the similarities and differences in the appearance and behaviors of adults and their offspring.</li> <li>Describe characteristics that distinguish living from nonliving things.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** classify, reproduction, offspring, characteristics, reptile, insect, mammal

<p><b>LEARNING STRAND</b>  <b>Unit: Energy in the Earth's Systems</b> - <i>How do external and internal sources of energy affect the Earth's systems?</i>  <i>CT Standard K.3 – Weather conditions vary daily and seasonally.</i></p>	
<p><b>ENDURING UNDERSTANDING</b>  Daily and seasonal weather conditions affect what we do, what we wear and how we feel.</p>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ In what ways do weather conditions change from day to day?</li> <li>▪ What are the seasonal weather patterns in Connecticut?</li> <li>▪ How do changes in daily and seasonal weather conditions affect what we do?</li> <li>▪ How do changes in daily and seasonal weather conditions affect what we wear?</li> <li>▪ How do changes in daily and seasonal weather conditions affect how we feel?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Student should understand that...</i></p> <ul style="list-style-type: none"> <li>▪ The sun is the source of heat and light that warms the land, air and water. Variations in the amount of sunlight that reach the earth cause the weather.</li> <li>▪ Weather conditions can be observed and described as sunny, cloudy, rainy, foggy, snowy, stormy, windy, hot or cold. Weather observations can be made based on how we feel, what we see or hear, or by using weather measurement instruments such as thermometers.</li> <li>▪ Changes in weather conditions can be recorded during different times of day, from day to day, and over longer periods of time (seasonal cycle). Repeated observations can show patterns that can be used to predict general weather conditions. For example, temperatures are generally cooler at night than during the day and colder in winter than in spring, summer or fall.</li> <li>▪ Weather influences how we dress, how we feel, and what we do outside.</li> <li>▪ Weather affects the land, animals and plants, and bodies of water.</li> <li>▪ <b>When the temperature is below “freezing,” water</b> outside freezes to ice and precipitation falls as snow or ice; when the temperature is above freezing, ice and snow melt and precipitation falls as rain.</li> <li>▪ Clouds and fog are made of tiny drops of water. Clouds have different shapes, sizes and colors that can be observed and compared. Some cloud types are associated with precipitation and some with fair weather.</li> <li>▪ Wind is moving air. Sometimes air moves fast and sometimes it hardly moves at all. Wind speed can be estimated by observing the things that it moves, such as flags, tree branches or sailboats.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ Chart</li> <li>▪ Timeline</li> </ul> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Have students record daily weather on a chart in the classroom.</li> <li>▪ Have the students create weekly timelines of the temperature and rainfall and paste them on the wall adding to them each week.</li> <li>▪ (This can be done by all students or one student can be selected to do it each day.) Have a cardboard cut-out of a girl and a boy wearing minimal clothing (shorts and a tee shirt). Have cut outs of different clothing and have a student dress the doll for the day considering the weather conditions. (The doll can be made as a paper doll with a magnet on its back so it will adhere to a whiteboard or something else magnetic. Place magnets on the back of the clothing pieces and put the clothes on the dolls on this way.)</li> <li>▪ Students can be asked each day how they feel and see if a pattern arises over time as to what the weather is and how they feel.</li> <li>▪ Activity cancellations can be discussed when they are cancelled due to weather conditions.</li> <li>▪ A book can be read describing how animals survive during the winter.</li> <li>▪ When the weather is snowy, students can describe the precipitation and the melting of the snow.</li> <li>▪ On a nice day, take the students outside for some cloud-gazing. Have them compare the clouds. Talk about the formation of clouds and have the students draw pictures of what they see. Come back into the classroom and</li> </ul>

	<p>have students draw pictures of what clouds look like at other times and talk about why that might be.</p> <ul style="list-style-type: none"> <li>▪ Observe wind one day looking at how it affects trees, flags and other things.</li> </ul>
	<p><b>ASSESSMENT METHODS</b></p> <p><b>GRADE LEVEL EXPECTATIONS</b>                  Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>▪ Use the senses to observe daily weather conditions and record data systematically using organizers such as tables, charts, picture graphs, or calendars.</li> <li>▪ Analyze weather data collected over time (during the day, from day to day, and from season to season) to identify patterns and make comparisons and predictions.</li> <li>▪ Observe, compare and contrast cloud shapes, sizes and colors, and relate the appearance of clouds to fair weather or precipitation.</li> <li>▪ Write, speak or draw ways that weather influences humans, other animals and plants.</li> <li>▪ Make judgments about appropriate clothing and activities based on weather conditions.</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe and record daily weather conditions.</li> <li>▪ Relate seasonal weather patterns to appropriate choices of clothing and activities.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** weather, season (winter, spring, summer, fall), thermometer, precipitation, freezing, melt

**KEY SCIENCE VOCABULARY:**



<b>LEARNING STRAND</b> <b>Unit: Science and Technology in Society - Shelters</b> <i>CT Standard K.4 - Some objects are natural, while others have been designed and made by people to improve the quality of life.</i>	
<b>ENDURING UNDERSTANDINGS</b> Humans select both natural and man-made materials to build shelters based on local climate conditions, properties of the materials, and their availability in the environment.	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How can the types of building materials used to build homes be described?</li> <li>▪ What properties make these materials useful?</li> <li>▪ Why do people living in different regions use different building materials?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Student should understand that...</i> <ul style="list-style-type: none"> <li>▪ People need shelters to keep warm or cool, dry and safe. Shelters are made of materials that have properties that make them useful for different purposes.</li> <li>▪ People in different regions of the world build different kinds of shelters, depending on the materials available to them, the local climate and their customs.</li> <li>▪ Traditionally, people have built shelters using materials that they find nearby. Today, people build houses from materials that may come from far away.</li> <li>▪ People who live in forested regions have traditionally built shelters using wood and/or leaves from nearby trees.</li> <li>▪ People who live in regions with clay soils have traditionally built shelters using bricks or adobe made from clay.</li> <li>▪ People who live in snowy regions have traditionally built shelters using snow and ice.</li> <li>▪ People who live in regions with large animals have traditionally built shelters using animal skins.</li> <li>▪ Although they may look quite different, most shelters have walls, roofs and an entrance/exit; some shelters have doors, windows and floors. Walls, roofs and windows are made of materials that have specific properties. For example, walls require materials that are rigid, windows require materials that are transparent, and roofs require materials that are water-resistant.</li> <li>▪ Animals build shelters using materials that are easily available to them. The materials they use have properties that help the animals stay warm or cool, dry and safe.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Internet resources</li> <li>▪ Drawing materials</li> </ul> <b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Have students draw a picture of their home or dream homes. Display the drawings and compare them looking for the materials from which the houses have been made.</li> <li>▪ Compare homes in different climates looking at the materials from which they are made. Have students explain why the homes were built using those materials.</li> <li>▪ Have students identify what most shelters have in common (walls, roofs, etc.).</li> <li>▪ Have students look at materials used, such as windows and roofing materials, and explain why these are required.</li> <li>▪ Look at pictures of animal homes and the materials from which they are made.</li> </ul> <b>ASSESSMENT METHODS</b> <b>GRADE LEVEL EXPECTATIONS</b> Assessments MUST measure the ability of students to: <ul style="list-style-type: none"> <li>▪ Conduct simple tests to compare the properties of different materials and their usefulness for making roofs, windows, walls or floors (e.g., waterproof, transparent, strong).</li> <li>▪ Seek information in books, magazines and pictures that describes materials used to build shelters by people in different regions of the world.</li> <li>▪ Compare and contrast the materials used by humans and animals to build shelters.</li> </ul> <b>CMT CORRELATION</b> <ul style="list-style-type: none"> <li>▪ Describe the types of materials used by people to build houses and the properties that make the materials useful.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** shelter, rigid, transparent

**KEY SCIENCE VOCABULARY:**



**Content Standards & Indicators**  
**for Grade 1**



### Course Description

ELEMENTARY SCHOOL		
1. Course Title <b>Grade 1 General Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	
2. Transcript Title/Abbreviation <b>Science</b>	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media	
3. Transcript Course Code/Number N/A		
4. Program Contact Information  Name: Anita Rutlin  Title/Position: Assistant Superintendent  School: Central Office Madison Town Campus 10 Campus Drive, P.O. Drawer 71 Madison, CT 06443	6. Grade Level: 1  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable  8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)	
10. Pre-Requisites None		
11. Brief Course Description First grade science is taught in units of study throughout the school year. Students are actively engaged in science through investigations. As part of the curriculum, aspects of life science and physical science are taught. The life science units include the Basic Needs and Life Cycles of Plants and Animals. The physical science topics are Measurement and Forces and Motion.		
12. Course Goals The first grade science program gives students the opportunity to explore topics and concepts through guided investigations. Participating in this hands-on program helps students: <ol style="list-style-type: none"> <li>1. To foster a life long enjoyment of learning science.</li> <li>2. To observe science in the world around them.</li> <li>3. To meet the science standards for Connecticut Public Schools.</li> </ol>		
13. Course Outline 1. Forces and Motion: Shadows and Objects 2. Structure and Function: Basic Needs of Plants and Animals 3. Structure and Function: Life Cycles 4. Science and Technology in Society: Measurement (Interdisciplinary)		
14. Instructional Methods and/or Strategies <ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Full class instruction and discussions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Modeling</li> <li>▪ Guided inquiry activities</li> </ul>	
15. Assessment Methods and/or Tools <ul style="list-style-type: none"> <li>▪ Teacher observations with rubrics</li> </ul>	<ul style="list-style-type: none"> <li>▪ Embedded task assessment activities</li> <li>▪ Science journal and class discussions</li> </ul>	
16. Assessment Criteria The common assessments are based on the Madison curriculum as well as Connecticut standards and grade level expectations for science. A variety of assessment tools are employed to get observations of individual performance of grade level expectations.		

<b>LEARNING STRAND</b> <b>Unit: Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific Inquiry is a thoughtful and coordinated attempt, to search out, describe, explain, and predict natural phenomena.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you make observations about objects, organisms, and the environment?</li> <li>▪ How do you use simple measuring tools to gather data and extend the senses?</li> <li>▪ How do you use observed patterns to make predictions?</li> <li>▪ How do you use standard measuring tools to collect data and nonstandard measures to make comparisons?</li> <li>▪ How can physical properties be used to order and sort objects and organisms?</li> <li>▪ How do you locate relevant science information in printed resources?</li> <li>▪ How do bar graphs represent information?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Student should understand that...</i> <ul style="list-style-type: none"> <li>▪ Use the senses and simple measuring tools to make observations and collect data.</li> <li>▪ Use standard tools to measure and describe physical properties such as weight, length and temperature and nonstandard measures to estimate and compare the sizes of objects.</li> <li>▪ Count, order and sort objects by their properties.</li> <li>▪ Make predictions based on observed patterns.</li> <li>▪ Ask questions about objects, organisms and the environment.</li> <li>▪ Read, write, listen and speak about observations of the natural world.</li> <li>▪ Seek information in books and pictures and present information in words and drawings.</li> <li>▪ Represent information in bar graphs.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> AIMS, Delta Modules, STC <u>Comparing and Measuring</u> Module, <u>Growing with Math</u> Topics <i>Introduction to the Processes</i>
	<b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Inquiry activities and investigations</li> <li>▪ Guided reading</li> </ul>
	<b>ASSESSMENT METHODS</b> Inquiry literacy questions

<b>LEARNING STRAND</b> <b>Unit: Forces and Motion - <i>What makes objects move the way they do?</i></b> <i>CT Standard 1.1 - The sun appears to move across the sky in the same way every day, but its path changes gradually over the seasons.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>An object's <b>position</b> can be described by locating it relative to another object or the background.</li> <li>An object's <b>motion</b> can be described by tracing and measuring its position over time.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>Can an object be in front of, behind, next to, inside of, above or below another object?</li> <li>Can an object be paced to the left or right of another object?</li> <li>Does the size of an object change by moving closer or farther away?</li> <li>Does the sun move or does the earth move?</li> <li>Why does it look like the sun moves?</li> <li>What makes a shadow?</li> <li>How do the length and direction of shadows change during the day?</li> <li>How can the motion of objects be changed by pushing and pulling?</li> <li>How do objects move (spinning, bouncing, rolling, flying and sailing)?</li> <li>What is motion? What is force? What sets an object in motion? What is position?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>An object's <b>position</b> can be described by comparing it to the position of another stationary object. One object can be <i>in front of, behind, next to, inside of, above or below</i> another object.</li> <li>The sun's <b>position</b> in the daytime sky can be described relative to stationary objects on Earth. For example, the sun can be "just above the treetops," "high or low in the sky," or "on the other side of the school."</li> <li>The description of an object's <b>position</b> from one observer's point of view may be different from that reported from a different observer's viewpoint. For example, a box of crayons <b>between two students is near Susan's left hand but near John's right hand.</b></li> <li>When an observer changes <b>position</b>, different words may be needed to describe an <b>object's position</b>. For example, when I am <b>sitting on the bench the sun is "behind" me;</b> when I <b>move to the slide, the sun is "in front of" me.</b></li> <li>The same object when viewed from close up <u>appears</u> larger than it does when viewed from far away (although the actual size of the object does not change.) For example, a <b>beach ball held in one's arms appears</b> larger than it does when viewed from across the</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>"How Do Objects Move?"</li> <li>"Determining an Object's Position"</li> <li>"Which Ball is Larger?"</li> <li>Science NetLinks <i>Making Objects Move</i></li> <li>AIMS lesson: "It's a Force, Of Course!"</li> <li><b>Literacy:</b> <u>Forces and Motion</u> by Catherine Welch; <u>On the Move</u> by Wendy Madgwick; <u>Forces Around Us</u> by Sally Hewitt</li> <li>Science: <i>Movement and Shadow</i></li> <li>"Me and My Shadow"</li> <li>"My Shadow is Following Me"</li> <li><b>Literacy:</b> <u>The Sun is Always Shining Somewhere</u> by Allen Fowler; <u>What Makes a Shadow?</u> by Clyde Bolla; <u>Nothing Sticks Like a Shadow</u> by Ann Tompert; <u>Me and My Shadow</u> by Melinda Lilly; <u>Shadows</u> by Carolyn Otto; <u>The Biggest Shadow in the Zoo</u> by Jack Kent</li> </ul>
	<b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>Teach Motion &amp; Position Lessons</li> <li>Students will observe how the size of an object appears to change based on its position from the child; use clear plastic clip boards to record</li> <li>Teach Science NetLinks <i>Making Objects Move</i></li> <li>Teach AIMS lesson <i>It's a Force, Of Course!</i></li> <li>Teach Science: <i>Movement and Shadow</i></li> <li>Utilize high-touch high-tech: <u>Force of Habit</u></li> <li>Students will observe the position of the sun and their shadows, during three times throughout a</li> </ul>

<p>playground.</p> <ul style="list-style-type: none"> <li>▪ An object's <b>position</b> can be described using words ("near the door"), numbers (10 centimeters away from the door) or labeled diagrams.</li> <li>▪ Things <b>move</b> in many ways, such as <i>spinning, rolling, sliding, bouncing, flying or sailing</i>.</li> <li>▪ An object is in <b>motion</b> when its position is changing. <b>Because the sun's position changes</b> relative to objects on Earth throughout the day, it appears to be moving across the sky.</li> <li>▪ Motion is caused by a push or a pull. A push or pull is called a <b>force</b>.</li> <li>▪ An object can be set in motion by <b>forces</b> that come from direct contact, moving air, magnets or by gravity pulling it down toward the earth.</li> <li>▪ Pushes and pulls can start motion, stop motion, speed it up, slow it down or change its direction.</li> <li>▪ <b>Changes in the sun's position throughout the day</b> can be measured by observing changes in shadows outdoors. Shadows occur when light is blocked by an object. <b>An object's shadow</b> appears opposite the light source. Shadow lengths depend on the position of the light source.</li> </ul>	<p>day</p> <ul style="list-style-type: none"> <li>▪ Utilize high-touch high-tech: <u><a href="#">The Shadow Knows</a></u></li> <li>▪ Teach Scientific Literacy and Key Science vocabulary</li> </ul>
	<p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Teacher observations during activities, investigations and discussions</li> <li>▪ <b>Responses in student's science journal</b> investigation and discussions</li> <li>▪ Record of shadows</li> <li>▪ <i>Changes in Motion: Push &amp; Pull</i> Assessment</li> <li>▪ Flagpole Assessment</li> <li>▪ Completion of appropriate AIMS &amp; Science NetLinks projects</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>▪ Compare and contrast the relative positions of objects in words (in front of, behind, next to, inside of, above or below) and numbers (by measuring its distance from another object).</li> <li>▪ Apply direct and indirect pushes and pulls to cause objects to move (change position) in different ways (e.g., straight line, forward and backward, zigzag, in a circle).</li> <li>▪ Classify objects by the way they move (e.g., spinning, rolling, and bouncing).</li> <li>▪ Conduct simple experiments and evaluate different ways to change the speed and direction of <b>an object's motion</b>.</li> <li>▪ Observe <b>record and predict the sun's position at</b> different times of day (morning, noon, afternoon or night).</li> <li>▪ Conduct simple investigations of shadows and analyze how shadows change as the position of the sun (or an artificial light source) changes.</li> </ul> <p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe how the motion of objects can be changed by pushing and pulling.</li> <li>▪ Describe the apparent movement of the sun across the sky and the changes in the length and direction of shadows during the day.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** position, motion, shadow, force

**KEY SCIENCE VOCABULARY:** behind, in front of, next to, above, below, larger, smaller, appears, closer, further, distance, investigate, rotate, spinning, sliding, rolling, bouncing, flying, sailing, sun  
Hypothesis: An educated guess

Mass: The amount of matter in an object

Movement: The act of moving

Pull To apply force to cause motion toward the source

Push To apply pressure for the purpose of moving



<p><b>LEARNING STRAND: Structure and Function - <i>How are organisms structured to ensure efficiency and survival?</i></b>  <b>Unit: Basic Needs of Plants and Animals</b>  <i>CT Standard 1.2 - Living things have different structures and behaviors that allow them to meet their basic needs.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Animals need air, water and food to survive.</li> <li>▪ Plants need air, water and sunlight to survive.</li> <li>▪ Animals use structures to move around.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What do plants need to survive?</li> <li>▪ What do animals need to survive?</li> <li>▪ How do plants obtain water and sunlight?</li> <li>▪ How do animals take in air, get water and food?</li> <li>▪ How do animals move to survive?</li> <li>▪ What body parts help them to survive in their habitat?</li> <li>▪ How do animals rely on their senses to survive?</li> <li>▪ How and what do animals eat?</li> <li>▪ What do the stem, leaf, flower or fruit do for a plant?</li> <li>▪ How do plants make new plants?</li> <li>▪ Where do plants get their food? How do plants stay healthy and strong?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Students should understand that...</i></p> <p>GRADE LEVEL CONCEPT 1.2.a.</p> <ul style="list-style-type: none"> <li>▪ All living things (organisms) need air, water and food to stay alive and grow; they meet these needs in different ways.</li> <li>▪ Most animals move from place to place to find food and water. Some animals have two legs, four legs, six legs or more for moving. Other animals move using fins, wings or by slithering.</li> <li>▪ Animals get air in different ways. For example, humans breathe with lungs, while fish breathe with gills.</li> <li>▪ Animals get food in different ways. Some animals eat parts of plants and others catch and eat other animals.</li> <li>▪ Animals get water in different ways. Some animals have special body parts, such as noses, tongues or beaks that help them get water.</li> <li>▪ Fictional animals and plants can have structures and behaviors that are different than real animals and plants.</li> </ul> <p>GRADE LEVEL CONCEPT 1.2.b.</p> <ul style="list-style-type: none"> <li>▪ Plants absorb sunlight and air through their leaves and water through their roots.</li> <li>▪ Plants use sunlight to make food from the air and water they absorb.</li> <li>▪ Plants have various leaf shapes and sizes that help them absorb sunlight and air.</li> <li>▪ Plant roots grow toward a source of water.</li> <li>▪ Plant stems grow toward sunlight.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ Science Anytime Dinosaur Museum             <ul style="list-style-type: none"> <li>- Fossils-Infering from Footprints</li> <li>- Toothy Grin</li> <li>- How Do Dinosaurs Protect Themselves?</li> <li>- Circle of Life</li> </ul> </li> <li>▪ Dinosaur Research Project</li> <li>▪ Camouflage Scavenger Hunt</li> <li>▪ Science Anytime Dinosaur Museum             <ul style="list-style-type: none"> <li>- Legs, Legs, Legs</li> </ul> </li> <li>▪ Live Birth vs. Egg Hatching</li> <li>▪ <b>Literacy:</b> <u>Dinosaurs and Prehistoric Animals</u> by Helen Frost; <u>Dinosaurs</u> by Richard Fergusson; <u>Is It a Living Thing?</u> by Bobbie Kalman; <u>Who Hops?</u> by Katie Davis</li> <li>▪ Delta Science Module III: <u>From Seed to Plant</u> <ul style="list-style-type: none"> <li>-Activity 14 Caring for Plants</li> <li>-Activity 7 How Big are They?</li> <li>-Activity 8 How much Water?</li> <li>-Activity 10 Looking at Leaves</li> <li>-Activity 11 Plants and Sun</li> </ul> </li> <li>▪ <b>Literacy:</b> <u>Ten Seeds</u> by Ruth Brown; <u>Plants!</u> By Molly Smith; <u>One Bean</u> by Anne Rockwell</li> <li>▪ Supplementary Sheets</li> </ul> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Develop the science process of inferring by studying fossil footprints.</li> <li>▪ Develop the science process of formulating models:             <ul style="list-style-type: none"> <li>-make a model of a plant eater’s head</li> <li>-make a model of a meat eater’s head</li> </ul> </li> <li>▪ Make a flip book of dinosaur body structures for</li> </ul>

defense.

- Develop knowledge of habitat with a circle of life including food, water, air, and shelter.
- Have a scavenger hunt to teach the science term of camouflage for survival.
- To understand dinosaur movement, make models of lizard and dinosaur legs.
- Study how animals continue living through being born or being hatched.
- Plant marigold seeds to review how to take care of plants properly.
- Measure plants as they grow and compare the rates of growth of various plants.
- Water plants according to three different watering schedules.
- Compare **plants' responses to the different** watering schedules.
- Draw conclusions about how much water plants need.
- **Play "Leaf Game" where students observe** various kinds of leaves closely and note their different characteristics.
- Examine several leaves and draw pictures.
- Place plants in directional sunlight and observe how the plants respond.
- Students should discover that plants always turn their leaves and bend their stems towards the light.

#### **ASSESSMENT METHODS**

- Teacher observations with during investigations, experiments or activities
- Science journals and class discussions
- Dinosaur Research Project
- How to get Food and Water (Assessment)
- How Do we Move (Assessment)
- *From Seed to Plant* unit assessment activity sheet 2 part A #2 & B #3 & #4

#### **GRADE LEVEL EXPECTATIONS**

Assessments MUST measure the ability of students to:

- Infer from direct observation and print or electronic information that most animals and plants need water, food and air to stay alive.
- Identify structures and behaviors used by mammals, birds, amphibians, reptiles, fish and insects to move around, breathe and obtain food and water (e.g., legs/wings/fins, gills/lungs, claws/fingers, etc.)
- Sort and classify plants by observable characteristics (e.g., leaf shape/size, stem or trunk covering, type of flower or fruit).
- Use senses and simple measuring tools to

	<p>measure the effects of water and sunlight on plant growth.</p> <ul style="list-style-type: none"> <li>▪ Compare and contrast information about animals and plants found in fiction and nonfiction sources.</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe the different ways that animals, including humans, obtain water and food.</li> <li>▪ Describe the different structures plants have for obtaining water and sunlight.</li> <li>▪ Describe the structures that animals, including humans, use to move around.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** organism, plant, animal, energy, breathe, lungs, gills, absorb

**KEY SCIENCE VOCABULARY:** structure, function, senses, danger, body parts, creeping, muscles, skeleton, size, vision, soil, water sprinkler, seed, leaves, veins, stem, chlorophyll, flower, roots



<b>LEARNING STRAND: Structure and Function</b> - <i>How are organisms structured to ensure efficiency and survival?</i> <b>Unit: Life Cycles</b> <i>CT Standard 1.3 - Organisms change in form and behavior as part of their life cycles.</i>	
<p><b>ENDURING UNDERSTANDING</b></p> <p>Some organisms undergo metamorphosis during their life cycles; other organisms grow and change, but their basic form stays essentially the same.</p>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are the stages in the life cycle of an animal?</li> <li>▪ In what order do the stages of an animal life cycle occur?</li> <li>▪ What is metamorphosis?</li> <li>▪ What animals experience metamorphosis?</li> <li>▪ What are some animals that do <b>not</b> experience metamorphosis?</li> <li>▪ How do ladybugs change in form and behavior as part of their life cycle?</li> <li>▪ How do animals that do not metamorphose grow and carry on the life cycle?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>▪ Plants and animals have life cycles that include a predictable sequence of stages: they begin life, develop into adults, reproduce and eventually die.</li> <li>▪ Animals produce offspring of their own kind. Offspring closely resemble their parents, but individuals vary in appearance and behavior.</li> <li>▪ Animals are either born alive (for example, humans, dogs and cows) or hatched from eggs (for example, chickens, sea turtles or crocodiles).</li> <li>▪ Animals change throughout their lives. Many animals begin life as smaller, less capable forms of the adult. As they develop, they grow larger and become more independent (for example, humans or robins).</li> <li>▪ Some animals change dramatically in structure and function during their life cycle in a process called <b>metamorphosis</b>.</li> <li>▪ Ladybugs are insects that go through <b>metamorphosis</b>. Ladybug eggs hatch into larvae that feed on aphids. Then larvae enter a pupa stage from which adult ladybugs emerge. As ladybugs get spots and grow, they lay eggs and the cycle begins again.</li> <li>▪ Frogs are amphibians that undergo <b>metamorphosis</b> during their life cycle. As they grow, frogs develop different structures that help them meet their basic needs in water and then on land. <ul style="list-style-type: none"> <li>○ Tadpoles (polliwogs) hatch from eggs,</li> </ul> </li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p>LHS GEMS: <a href="#">Ladybugs Guide</a></p> <ul style="list-style-type: none"> <li>-Poster</li> <li>-Activity 1: Student Observation &amp; Ladybug Journal</li> <li>-Activity 3: Eggs &amp; Baby Ladybugs</li> <li>-Activity 4: Ladybug Pupa and Life Cycle Life Cycles Packet <ul style="list-style-type: none"> <li>- Ladybug Life Cycle</li> <li>- Butterfly Life Cycle</li> <li>- Frog Life Cycle</li> </ul> </li> </ul> <p>Life Cycles with and without Metamorphosis</p> <p><b>Literacy:</b> <a href="#">The Grouchy Ladybug</a> by Eric Carle; <a href="#">A Ladybug's Life</a> by John Himmelman; <a href="#">Helpful Ladybugs</a> by Molly Smith; <a href="#">First the Egg</a> by Laura Seeger; <a href="#">Ladybug, Ladybug</a> by Ruth Brown</p> <p>Teacher Resources from the Internet</p> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ <a href="#">Ladybugs</a> - Students learn about ladybug body structure, life cycle, defensive behavior, and favorite foods. Students do observations.</li> <li>▪ Make Literacy Connections with Ladybug library books, poems</li> <li>▪ Study other animals that metamorphose – Butterfly and Frog</li> <li>▪ Study animals life cycles without metamorphosis</li> </ul> <p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Teacher observations with during investigations, experiments or activities</li> <li>▪ Life Cycle Project</li> <li>▪ Assessment – the Life Cycle of the Ladybug</li> <li>▪ Science journal responses to questions and</li> </ul>

<p>live in water, breathe using gills, and swim using a tail. As they <b>metamorphose</b> into frogs, tadpoles lose their gills and their tails.</p> <ul style="list-style-type: none"> <li>○ Adult frogs live on land <u>and</u> in water. They breathe air using lungs and develop webbed feet and hinged legs for swimming in water and hopping on land. After a female frog mates, she lays her eggs, and the cycle begins again.</li> </ul> <ul style="list-style-type: none"> <li>▪ Butterflies are insects that undergo <b>metamorphosis</b> during their life cycle. As they go through egg, larva, pupa (chrysalis) and adult stages, butterflies develop different structures that help them meet their basic needs in very different ways: <ul style="list-style-type: none"> <li>○ Caterpillars hatch from eggs, live on plants, get food by chewing leaves and move about using legs. As they <b>metamorphose</b> into butterflies inside a chrysalis, they develop wings, antennae and different mouth parts.</li> <li>○ Butterflies live on land and in the air. They get food by sucking nectar from flowers and move around primarily using wings to fly. After a female butterfly mates, she searches for the proper host plant to lay her eggs, and the cycle begins again.</li> </ul> </li> <li>▪ Comparing the life cycle stages of different organisms show how animals are alike in some ways and unique in other ways.</li> </ul>	<p>class discussions</p> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>▪ Explain that living things experience a life cycle that includes birth, growth, reproduction and death.</li> <li>▪ Distinguish between animals that are born alive (e.g., humans, dogs, cows) and those that hatch from eggs (e.g., chickens, sea turtles, crocodiles).</li> <li>▪ Compare and contrast the changes in structure and behavior that occur during the life cycles of animals that undergo metamorphosis with those that do not.</li> <li>▪ Analyze recorded observations to compare the metamorphosis stages of different animals, and make predictions based on observed patterns.</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe the changes in organisms, such as frogs and butterflies, as they undergo metamorphosis.</li> <li>▪ Describe the life cycles of organisms that grow but do not metamorphose.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** life cycle, egg, metamorphosis, metamorphose, structures (body parts), amphibian, tadpole, gills, lungs, insect, caterpillar

**KEY SCIENCE VOCABULARY:** egg, spawn, polliwogs, larva, pupa, chrysalis, aphids, algae

<p><b>LEARNING STRAND</b>  <b>Science and Technology in Society</b> - <i>How do science and technology affect the quality of our lives?</i>  <b>Unit: Measurement</b>  <i>CT Standard 1.4 – The properties of materials and organisms can be described more accurately through the use of standard measuring units.</i></p>	
<p><b>ENDURING UNDERSTANDING</b>  Various tools can be used to measure, describe and compare different objects and organisms.</p>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ Which are more accurate -- non-standard units or standard units of measure?</li> <li>▪ How can non-standard measurement units be used to describe an object or organism?</li> <li>▪ What systems of measurement do we use in the United States?</li> <li>▪ Can you share which specific tools are best used to measure different quantities?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>▪ Observations can be expressed in words, pictures or numbers. Measurements add accuracy to observations.</li> <li>▪ Objects and organisms can be described using nonstandard measurement units, such as hand-lengths, pencil-lengths, handfuls, etc.</li> <li>▪ Standard measurement units are more accurate than nonstandard units because they have consistent values agreed on by everyone. <b>For example, "My caterpillar is one finger long" is much less accurate than "My caterpillar is 4 centimeters long."</b></li> <li>▪ Scientists and nonscientists all over the world use the metric system of measurement.</li> <li>▪ In the United States, the customary measurement system is used in daily life.</li> <li>▪ Equivalent values between the metric and customary measurement systems can be estimated (for example, 1 inch is a little more than 2 centimeters).</li> <li>▪ Specific tools are used to measure different quantities: <ul style="list-style-type: none"> <li>○ Metric rulers are used to measure length, height or distance in centimeters and meters.</li> <li>○ Customary rulers measure length, height or distance in inches, feet or yards.</li> <li>○ Balances and scales are used to compare and measure the heaviness of objects.</li> <li>○ Grams and kilograms are units that express mass; ounces and pounds are units that express weight.</li> <li>○ Graduated cylinders, beakers and measuring cups are tools used to measure the volume of liquids.</li> <li>○ Volume can be expressed in milliliters</li> </ul> </li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ Non-standard measurement tools</li> <li>▪ Standard measurement tools</li> <li>▪ <u>Growing with Mathematics</u> Units 3,7, and 9</li> <li>▪ Science notebook/journals</li> <li>▪ Teacher Resources from the Internet  Meet the Measurements (Core Knowledge)  First Graders Measure Up! (Core Knowledge)  Magnificent Measurement (NCTM Illuminations)</li> </ul> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ <u>Growing with Mathematics</u> Unit 9: Explore using standard units of measure to communicate measurement in a universal manner.</li> <li>▪ <u>Growing with Mathematics</u> Units 3,7, 9: Use nonstandard units or physical referents to estimate answers to measurement problems involving length, area, weight, temperature, volume and capacity, and then justify the reasonableness of the answers. Use nonstandard units, references or direct comparison of objects (appearance, to order objects by length, area and capacity).</li> <li>▪ Using the metric system students will measure the length/height of their growing plants as a part of <u>From Seed to Plant</u> Activity 7.</li> <li>▪ Using known size, dimension and weight of objects as non-standard measures, students will compare the size, dimension and weight of dinosaurs listed in meters and kilograms.</li> </ul> <p>*As a part of Morning Meeting/Calendar activities students will be exposed to thermometers and their use in daily living by keeping track of daily temperatures.</p> <p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Teacher Observations during investigations,</li> </ul>

<p>(mL), liters (L), cups or ounces.</p> <ul style="list-style-type: none"> <li>o Thermometers are tools used to measure temperature; thermometers can indicate temperature in degrees Celsius or degrees Fahrenheit, or both.</li> </ul>	<p>activities, and problem solving</p> <ul style="list-style-type: none"> <li>▪ <u>Growing with Mathematics</u> topic assessments pertaining to measurement</li> <li>▪ <u>Growing with Mathematics</u> student workbook pages</li> <li>▪ Science notebook/journal responses</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>▪ Use nonstandard and standard measurements to describe and compare the weight, length, and size of objects and organisms. GWM 3.8, 3.9, 3.10, 7.8, 7.9, 7.10, 9.8, 9.9</li> <li>▪ Show approximate size of a centimeter, meter, inch, foot and yard using referents such as a finger, a hand or a book. GWM 3.8, 3.9, 3.10, 9.8, 9.9, 9.10</li> <li>▪ Select appropriate tools for measuring length, height, weight or liquid volume.</li> <li>▪ Use metric and customary rulers to measure length, height or distance in centimeters, meters, inches, feet and yards. GWM 3.8, 3.9, 3.10, 9.8, 9.9, 9.10</li> <li>▪ Use balances and scales to compare and measure the heaviness of objects and organisms in kilograms, grams, pounds and ounces. GWM 7.8, 7.9, 7.10 (<i>Add scales, kilograms, grams, pounds, ounces to math lessons</i>)</li> <li>▪ Use graduated cylinders, beakers and measuring cups to measure the volume of liquids in milliliters, liters, cups and ounces. GWM 7.5, 7.6, 7.7 (<i>Add graduated cylinders, measuring cups, ounces to math lessons</i>)</li> <li>▪ Use thermometers to measure air and water temperature in degrees Celsius and degrees Fahrenheit. (<i>Daily Meeting – Class graph</i>)</li> <li>▪ Make graphs to identify patterns in recorded measurements such as growth or temperature over time. (<i>Temperature – Daily Meeting; growth – From Seed To Plant: Activity 7 "How Big Are They?"</i>)</li> </ul> <p><b>CMT CORRELATION</b></p> <ul style="list-style-type: none"> <li>▪ Estimate, measure and compare the sizes and weights of different objects and organisms using standard and nonstandard measuring tools.</li> </ul>
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**SCIENTIFIC LITERACY TERMINOLOGY:** centimeter, meter, gram, kilogram, milliliter, liter, graduated cylinder, thermometer, Celsius, Fahrenheit

**KEY SCIENCE VOCABULARY:** inches, feet, yards, graphs, measuring cups, beakers, ounces, pounds, scales, balances, weight  
Volume: the space an object takes up



## SCIENTIFIC LITERACY TERMINOLOGY: GRADE 1

This list is intended as a guide for teachers. While not exhaustive, it includes vocabulary that should be used, as appropriate, by teachers and students during everyday classroom discourse. It is not intended for student memorization.

absorb	To take in, soak up
adaptation (adapt)	The process of changing to new conditions which can be physical or behavioral
amphibian	An animal able to live both on land and in water
analyze	To study carefully
attract	To draw in by physical force
average	The typical, usual, or ordinary result of a set of data
balance	A device for weighing things
breathe	To take in and push out air
butterfly	An insect with four thin wings. Caterpillars change into butterflies.
camouflage	The disguising of people, animals, or things, to make them look like what is around them
Celsius	The metric system for measuring temperature
centimeter	A unit of length in the metric system
characteristic	Showing a special feature or quality
classify	To put into groups or classes; sort
climate	The usual weather that occurs in a place, including the average temperature and amounts of rain or wind
collect data	To gather information using tables and charts
compare	To look at two or more things to see how they are alike or different
conclusion	A decision made after careful thinking using evidence to support your opinion
conduct (an experiment)	To lead, guide, or direct an experiment
conserve	To use carefully, not to waste
cycle	A series of events that is regularly repeated in the same order
data	Information that is gathered during an experiment – facts and figures
decrease	To make or become less or smaller
describe	To use words to explain how something looks, feels, or acts
determine	To make a decision
diagram	A labeled drawing that shows how something works
dissolve	To mix thoroughly with a liquid
draw a conclusion	Analysis of results from an experiment
environment	Surroundings and conditions that effect natural processes
erode, erosion	To wear away or become worn
evaluate	To find out, judge, or estimate the value of
evidence	Facts or data that help find out the truth and support a conclusion

experiment	A procedure that is carried out to investigate a scientific question
explain, explanation	To make clear or understandable
explore	To examine in order to discover
extinct	No longer in existence; an extinct animal or plant has died out
Fahrenheit	A measurement of temperature
fair test	A test that compares two or more things by keeping everything the same except the thing being compared. A race is a fair test. Everyone starts at the same place and at the same time and ends in the same place. The only thing that is different is the speed of the runners.
findings	The results of a study or investigation
force	A force sets an object in motion by direct contact (a push or a pull) or indirect contact (air, magnets, or gravity)
germinate	To sprout
gills	The organ of a fish that is used for taking oxygen from water
graduated cylinder	A cylindrical container used for measuring volume
gram	The metric unit for measuring mass
graph	A diagram used to show the relationship between things
gravity	A pulling force between two objects that causes smaller objects to move towards the center of the Earth
habitat	The place where an animal or plant lives, such as a woods or a lake
hand lens	A tool used to magnify things
identify	To find out or tell exactly who a person is or what an object is
increase	To make or become greater or larger
insect	A tiny animal with six legs, three body parts (head, thorax, and abdomen), 2 antennae, and 2 eyes
investigate	To study something closely and in an organized way
kilogram	One thousand grams
layer	A single thickness or deposit of material
length	The distance from one end of something to the other
lens	A tool used to see things clearly
life cycle	All the changes a plant or animal goes through between its birth and its death. The stages in the life of a plant. New plants come from older plants.
liter	A unit of volume i.e., capacity for liquids in the metric system
lungs	Organs used for breathing
magnifying glass	A tool used to enlarge objects
mammal	A warm blooded animal that has hair and a backbone; is warm-blooded, and feeds their young milk
mass	The amount of matter in an object It is measure in grams.
materials	Supplies
metal	A substance that usually has a shiny surface, can be melted, and can conduct

	heat and electricity
metamorphosis	A complete change in appearance or form; complete transformation that occurs when an insect or animal passes through separate stages of growth and development
meter, meter stick	Basic unit of length in metric system, similar to a yard
milliliters	One thousandth of a liter
mineral	The ingredients that make up rocks
mixture	Something made by mixing
motion	The change in position of an object caused by a force
nutrients	Something that living things need to grow and stay healthy
object	Anything that is not alive the can be seen or touched
observe, observation	To use your senses to study something closely
opinion	A belief based on what one thinks or feels; not on actual facts
organism	Any living thing such as a plant or animal
oxygen	A colorless gas in the air that living things need to survive
pattern	Anything that repeats itself
perform an experiment	Conducting a test to prove something
photosynthesis	A process by which green plants use light energy to change carbon dioxide and water into glucose and oxygen
position	The way in which something is placed or arranged
predict, prediction	To say what you think is going to happen; a guess based on what you know so far
procedure	A set of specific steps that tells you how to do something
property	Something about an object that tells what it is
range	The extent to which something can vary
record (data)	Something written down to preserve facts or information
recycle	To treat materials that have been thrown away in order to use them again
reflect	To give back an image of
sand	Loose grains of worn rock
scale	Tool used to weigh things
scientific observation	To see and pay attention to an experiment in science
season	One of the four natural division of the year -- fall, winter, spring, summer
seed dispersal	The scattering of seeds
separate	To pull or take apart

sequence	The order in which things occur
shadow	The dark figure cast on a surface by an object that is between the surface and the light source
soil	<b>The loose top layer of the Earth's surface in which plant life can grow</b>
sort	To put things in groups on the basis of a property, such as color, shape, class, kind or size
speed	The condition of moving or acting rapidly
surface	The outermost layer
survive	To stay alive
temperature	Relative hotness or coldness as measured on a standard scale
texture	The feel of an object; for example, glass has a smooth texture, and sandpaper has a rough texture
thermometer	A tool used to measure temperature
transparent	Light can pass through
weigh, weight	A measurement of how heavy something is; the pull of gravity on an object (force that gravity exerts on a mass) <b>Weight changes; mass doesn't. An astronaut in space has mass, but is weightless.</b>

## Science Grade 1 Books for the Library

Standards and Grade Level Expectations: 1.2.1, 1.2.2, 1.3.2

Dinosaurs and Prehistoric Animals (Pebbles Plus series) by Helen Frost Capstone Press 2005  
First Encyclopedia of Dinosaurs and Prehistoric Life (Usborne Internet –Linked) by Sam Taplin Scholastic 2004  
Dinosaurs by Richard Ferguson DK Publishing 2007  
Is It a Living Thing? by Bobbie Kalman Crabtree 2008

Standard and Grade Level Expectation: 1.2.3

Ten Seeds by Ruth Brown Alfred Knopf 2001  
Plants! (TFK Science Scoops series) by Brenda Iasevoli Harper Collins 2006  
One Bean by Anne Rockwell Walker Publishing 1999

Standards and Grade Level Expectations: 1.3.1, 1.3.2, 1.3.3

**A Ladybug's Life by John Himmelman Children's Press 1998**  
Helpful Ladybugs (No Backbone series) by Molly Smith Bearport 1974  
First the Egg by Laura Seeger Roaring Brook Press 2007

Standard and Grade Level Expectation: 1.1.4

Forces and Motion (Fact Finders series) by Catherine Welch Capstone Press 2006  
On the Move (Science Starters series) by Wendy Madgwick Raintree Steck-Vaughn 1999  
Who Hops by Katie Davis Voyager Books Harcourt  
Forces Around Us (**It's Science series**) by Sally Hewitt Franklin Watts 1997

Standard and Grade Level Expectation: 1.1.6

Nothing Sticks Like a Shadow By Ann Tompert Houghton Mifflin 1984  
Me and My Shadow (Read and Do Science series) by Melinda Lilly 2006  
Shadows (Scholastic Science Readers) by Carolyn Otto Scholastic 2001.  
The Biggest Shadow in the Zoo by Jack Kent Parents Magazine 1981



**Content Standards & Indicators**  
**for Grade 2**





## Course Description

ELEMENTARY SCHOOL				
1. Course Title <b>Grade 2 General Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media		
2. Transcript Title/Abbreviation <b>Science</b>				
3. Transcript Course Code/Number: N/A				
4. Program Contact Information  Name: Anita Rutlin  Title/Position: Assistant Superintendent  School: Central Office Madison Town Campus 10 Campus Drive, P.O. Drawer 71 Madison, CT 06443	6. Grade Level: 2			
		7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable		
		8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____		
		9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)		
10. Pre-Requisites: None				
11. Brief Course Description Second grade science is taught in three units of study throughout the school year. Scientific inquiry, literacy and numeracy are integrated throughout the units. Students are engaged in science instruction through investigations. As part of the spiraling curriculum, aspects of life science, earth science, and physical science are taught each year. A Nutrition Expedition is an interdisciplinary study of science and health education. The physical science unit is Solids, Liquids and Gases. Life and earth sciences are combined in a unit of Soil and Plants that helps student explore the relationship between soil and plants.				
12. Course Goals The second grade science program gives students the opportunity to explore topics and concepts through investigations. Participating in this hands- <b>on program helps student...</b> 1. To foster a life long enjoyment of learning and the learning of science. 2. To observe science in the world around them. 3. To meet the grade level expectations of science standards for Connecticut Public Schools.				
13. Course Outline 1. Properties of Matter: Solids, Liquids and Gases 2. Structure and Function & Changing Earth: Soil and Plants 3. Science and Technology in Society: Nutrition				
14. Instructional Methods and/or Strategies <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> <ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Interactive class instruction</li> </ul> </td> <td style="width: 50%; border: none; vertical-align: top;"> <ul style="list-style-type: none"> <li>▪ Demonstrations and modeling</li> <li>▪ Guided inquiry activities and investigations</li> </ul> </td> </tr> </table>			<ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Interactive class instruction</li> </ul>	<ul style="list-style-type: none"> <li>▪ Demonstrations and modeling</li> <li>▪ Guided inquiry activities and investigations</li> </ul>
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15. Assessment Methods and/or Tools <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> <ul style="list-style-type: none"> <li>▪ Quizzes and Unit assessments</li> <li>▪ Teacher observations</li> </ul> </td> <td style="width: 50%; border: none; vertical-align: top;"> <ul style="list-style-type: none"> <li>▪ Performance tasks</li> <li>▪ <b>Responses in student's science journal to investigations and class discussions</b></li> </ul> </td> </tr> </table>			<ul style="list-style-type: none"> <li>▪ Quizzes and Unit assessments</li> <li>▪ Teacher observations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Performance tasks</li> <li>▪ <b>Responses in student's science journal to investigations and class discussions</b></li> </ul>
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16. Assessment Criteria Assessment of learning is based on the Madison curriculum and Connecticut standards with grade level expectations for science. For investigations and projects, students are given direction and templates for completing the work. Student scientists record their work in Science Journals. Observations, student responses in science journals, and common unit assessments are employed to determine individual student achievement.				

<b>LEARNING STRAND</b> <b>Unit: Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific Inquiry is a thoughtful and coordinated attempt, to search out, describe, explain, and predict natural phenomena.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you make observations about objects, organisms, and the environment?</li> <li>▪ How do you use simple measuring tools to gather data and extend the senses?</li> <li>▪ How do you use observed patterns to make predictions?</li> <li>▪ How do you use standard measuring tools to collect data and nonstandard measures to make comparisons?</li> <li>▪ How can physical properties be used to order and sort objects and organisms?</li> <li>▪ How do you locate relevant science information in printed resources?</li> <li>▪ How do bar graphs represent information?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>▪ Use the senses and simple measuring tools to make observations and collect data.</li> <li>▪ Use standard tools to measure and describe physical properties such as weight, length and temperature and nonstandard measures to estimate and compare the sizes of objects.</li> <li>▪ Count, order and sort objects by their properties.</li> <li>▪ Make predictions based on observed patterns.</li> <li>▪ Ask questions about objects, organisms and the environment.</li> <li>▪ Read, write, listen and speak about observations of the natural world.</li> <li>▪ Seek information in books, magazines and pictures and present information in words and drawings.</li> <li>▪ Represent information in bar graphs.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>  FOSS Modules Delta Science Modules  <b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Guided inquiry activities and investigations</li> <li>▪ Guided reading</li> </ul> <b>ASSESSMENT METHODS</b>  Inquiry literacy questions

<b>LEARNING STRAND: Properties of Matter</b> - <i>How does the structure of matter affect the properties and uses of materials?</i> <b>Unit: Solids, Liquids and Gases</b> <i>CT Standard 2.1 - Materials can be classified as solid, liquid or gas based on their observable properties.</i>	
<p><b>ENDURING UNDERSTANDING</b></p> <p>Solids tend to maintain their own shapes, while liquids tend to assume the shapes of their containers, and gases fully fill their containers.</p>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are the three states of matter?</li> <li>▪ How can we tell if matter is a solid, a liquid or a gas?</li> <li>▪ How can you describe the differences between a solid and a liquid, or a liquid and a gas?</li> <li>▪ How are solids different from liquids and gases?</li> <li>▪ How are solids, liquids, and gases represented in our daily lives?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b></p> <p><i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>▪ All materials (matter) take up space. Matter can be classified by whether it is in solid, liquid or gas form. Each state of matter has unique properties.</li> <li>▪ Solids are the only state of matter that keep their own shape. <b>A solid's shape can only be changed</b> if a force is applied to it, such as hammering, slicing or twisting. Solids can be hard, soft, bouncy or stretchy.</li> <li>▪ Solids take up a certain amount of space (volume); the volume does not change if the solid is placed in different containers.</li> <li>▪ Liquids do not have their own shape; they go to the bottom of a container and take on the shape of the part of the container they occupy. Liquids pour and flow from a higher point to a lower point; some liquids flow faster than others.</li> <li>▪ Liquids have a definite volume. When a liquid is poured into different containers, the shape of the liquid may change, but the volume does not.</li> <li>▪ Gases do not have a definite shape; they take on the shape of whatever container they occupy. For example, the air in an inflated balloon can be squeezed and reshaped.</li> <li>▪ Gases do not have a definite volume; they spread out in all directions to fill any size container, or they keep spreading in all directions if there is no container. For example, blowing even a small amount of air into a balloon immediately fills the entire balloon; the smell of baking bread eventually fills the entire house and even outside.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ <u>FOSS: Solids and Liquids</u></li> <li>▪ Investigation 1: Solids</li> <li>▪ Part 1 - Introduce Solids</li> <li>▪ Part 2 – Sort Solid Objects</li> <li>▪ Part 3 – Construct with Solids</li> <li>▪ Investigation 2: Liquids</li> <li>▪ Part 1 – Liquids in Bottles</li> <li>▪ Part 2 – Proper ties of Liquids</li> <li>▪ Part 3 – Liquid Level</li> <li>▪ Investigation 3: Bits and Pieces</li> <li>▪ Part 1 – Solids in Containers</li> <li>▪ Part 2 – Separating Soup Mix</li> <li>▪ Part 3 – Solids in Bottles</li> <li>▪ Part 4 – Separating Beads with Screens</li> <li>▪ Investigation 4: Solids and Liquids with Water</li> <li>▪ Part 1 – Solids and Water</li> <li>▪ Part 2 – Liquids and Water</li> <li>▪ Part 3 – Toothpaste Investigation</li> <li>▪ <u>Dancing Raisins Experiment</u></li> <li>▪ <a href="http://www.fossweb.com">http://www.fossweb.com</a></li> <li>▪ <b>Literacy related to Matter:</b>  <u>All About Solids, Liquids &amp; Gases</u> by Schlessinger (Science Library)  <u>Floating and Sinking</u> by Ellen Sturm Niz  <u>What is a Liquid?</u> by Jennifer Boothroyd  <u>What is a Solid?</u> by Jennifer Boothroyd  <u>What is a Gas?</u> by Jennifer Boothroyd  <u>Experiments with Solids, Liquids, and Gases</u> by Salvatore Tocci  <u>Matter</u> by Christine Webster  <u>States of Matter</u> by Fiona Bayrock  <u>Change It!, Solids, Liquids, Gases and You</u> by Adrienne Mason</li> </ul> <p>Videos: All about Solids, Liquids &amp; Gases; All about Properties of Matter</p> <ul style="list-style-type: none"> <li>▪ High-touch high-tech program: <u>What's the Matter</u></li> <li>▪ A science notebook/journal</li> </ul>

	<ul style="list-style-type: none"> <li>Venn Diagram</li> </ul>
	<p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Keep Journal on Investigations &amp; Activities</li> <li>Read and discuss Matter related books</li> <li><b>Generate a Venn diagram or "T" chart to compare the different properties of matter (liquid vs. solids, gases vs. liquids, etc.)</b></li> </ul>
	<p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Teacher observations during investigations and activities</li> <li>Solids and Liquids assessment</li> <li>Responses in science journal to investigations, activities and class discussions</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b> Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>Compare and contrast the properties that distinguish solids, liquids and gases.</li> <li>Classify objects and materials according to their state of matter.</li> <li>Measure and compare the sizes of different solids.</li> <li>Measure and compare the volume of a liquid poured into different containers.</li> <li>Design a fair test to compare the flow rates of different liquids and granular solids.</li> </ul>
	<p><b>CMT CORRELATION</b></p> <ul style="list-style-type: none"> <li>Describe differences in the physical properties of solids and liquids.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** property, classify, matter, state of matter, solid, liquid, gas, volume

**KEY SCIENCE VOCABULARY:**

<p><b>LEARNING STRANDS: Structure and Function and The Changing Earth</b> - <i>How are organisms structured to ensure efficiency and survival? How do materials cycle through the Earth's systems?</i></p> <p><b>Unit: Soil and Plants</b></p> <p><i>CT Standard 2.2 – Plants change their forms as part of their life cycles.</i></p> <p><i>CT Standard 2.3 - Earth materials have varied physical properties which make them useful in different ways.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Soils have different properties and compositions that make them useful in different ways.</li> <li>▪ Soils can be described by their color, texture and capacity to retain water.</li> <li>▪ Soils support the growth of many kinds of plants, including those in our food supply.</li> <li>▪ The life cycles of flowering plants include seed germination, growth, flowering, pollination and seed dispersal.</li> <li>▪ Flowering plants have a life cycle that involves changes in growth and structure that ensures production of new plants.</li> <li>▪ Other living things depend on plant reproduction to supply the food they need.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are the properties by which soils are sorted?</li> <li>▪ What properties of soil are important for plant growth?</li> <li>▪ How can you classify soils?</li> <li>▪ How can you describe the use of soil in plant growth?</li> <li>▪ How can you describe the life cycle of a plant?</li> <li>▪ What are the conditions necessary for flowering plants to grow?</li> <li>▪ How does the plant change during its life?</li> <li>▪ How can you describe the effects of light and water on seed germination and plant growth?</li> <li>▪ How are plants connected with other living things?</li> <li>▪ How do the properties of earth materials differ?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b></p> <p><i>Students should understand that...</i></p>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p>
<ul style="list-style-type: none"> <li>▪ Soil is a mixture of pieces of rock (particles), living and once living things (humus), water and air. The components of soil can be separated using sieves and settlement tests.</li> <li>▪ There are different types of soil that vary from place to place. Soil properties can be observed and compared. Soils can be classified by properties such as color, particle size, or amount of organic material (humus). Digging a deep hole shows that soils are often found in layers that have different colors and textures.</li> <li>▪ The size of the particles in soils gives the soil its texture. Soils can be classified by how they feel: Sandy soils feel gritty, silty soils feel powdery, clay soils feel sticky, and soils with small rocks feel rough and scratchy.</li> <li>▪ The broken rocks that make up soils can be tiny (silt and clay), medium (sand), or large (pebbles). Soils can be classified by the size of their particles.</li> <li>▪ <b>A soil's texture affects how it packs together;</b> soils that pack together tightly hold less air and water than soils that stay loosely packed.</li> <li>▪ There are different types of soil that vary from place to place. Some soil types are suited for supporting the weight of buildings and highways; other soil types are suited for planting food crops or forest growth.</li> </ul>	<ul style="list-style-type: none"> <li>▪ FOSS-<u>Pebbles, Sand, and Silt</u></li> <li>▪ Investigation 4: Soil Explorations Parts 1-3 and Extensions</li> <li>▪ <b>Literacy</b> - Soil: <u>Microlife that Lives in Soil</u> by Steve Parker; <u>Soil</u> by Adele Richardson</li> <li>▪ FOSS-<u>New Plants</u></li> <li>▪ Investigation-1: Brassica Seeds: 1-3 &amp; Extensions</li> <li>▪ Investigation-2: Grass and Grain Seeds: 1-3; Extensions</li> <li>▪ Investigation-3: Stems: Parts 1-3 &amp; Extensions</li> <li>▪ Investigation-4: Bulbs and Roots: 1-2 &amp; Extensions</li> <li>▪ <b>Literacy</b> - Seed and plant: <u>How a Seed Grows</u> by Helene J. Jordan, <u>From Seed to Plant</u> by Allan Fowler, <u>A Seed is Sleepy</u> by Dianna Hutts Aston &amp; Sylvia Long, and <u>The Tiny Seed</u> by Eric Carle.</li> <li>▪ Video: Plant Life Cycle</li> <li>▪ <u>Science Notebook/Journal</u> <ul style="list-style-type: none"> <li>○ Soil Study (AIMS)</li> <li>○ Which Soil Works Best?</li> <li>○ Look at Life in the Soil</li> <li>○ Make a Worm Farm</li> <li>○ What do Plants Need to Grow?</li> <li>○ The Seed Within</li> <li>○ Inside a Seed</li> <li>○ Stem Study</li> <li>○ Root Study</li> <li>○ Parts of a Flower</li> </ul> </li> <li>▪ High-touch high-tech Programs: <u>Give Me Dirt &amp; Smarty Plants</u></li> </ul>

<p>GRADE LEVEL CONCEPT 2.3.b.</p> <ul style="list-style-type: none"> <li>▪ Many plants need soil to grow. Soil holds water and nutrients that are taken in (absorbed) by plant roots.</li> <li>▪ Soil is a habitat for many living things. Some organisms live in the soil and others live on the soil. Worms and other underground animals create spaces for air, water and plant roots to move through soil.</li> <li>▪ <b>Plants we eat (“crops”) grow in different soil types.</b> Plant height, root length, number of leaves, and number of flowers can all be affected by how much water, air and organic material the soil holds.</li> <li>▪ To support the growth of different plants, people can change the properties of soils by adding nutrients (fertilizing), water (irrigating) or air (tilling).</li> <li>▪ Flowering plants progress through a sequenced life cycle. First, seeds sprout (germinate), then seedlings grow into adult plants with leaves and flowers. If the flowers are pollinated, seeds develop that will grow into new plants to continue the life cycle.</li> <li>▪ Roots, stems, leaves, flowers and seeds are structures that develop during different stages of the <b>plant’s life cycle</b>.</li> <li>▪ Seeds contain the beginnings of a new plant (embryo) and the food (energy source) the new plant needs to grow until it is mature enough to produce its own food. Different plant varieties produce seeds of different size, color and shape.</li> <li>▪ Environmental conditions, such as temperature, amount of light, amount of water and type of soil, affect seed germination and plant development.</li> <li>▪ <b>A plant’s seed will grow into a new plant that resembles but is not identical to the parent plant or to other new plants.</b> For example, marigold plants produce marigold seeds that grow into new marigold plants. Individual marigolds, however, vary in height, number of leaves, etc.</li> <li>▪ Seedlings are young plants that produce the structures that will be needed by the plant to survive in its environment. Roots and leaves begin to grow and take in nutrients, water and air; and the stem starts to grow towards sunlight.</li> </ul>	<p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ <b>ENGLISH/ LANGUAGE ARTS CONNECTIONS</b> <ul style="list-style-type: none"> <li>-How can you make a new plant from an old plant <b>if you don’t have seeds?</b></li> <li>-Farmer John planted 5 shiny blue seeds in his <b>garden. All of a sudden...</b></li> <li>-A farmer is having trouble growing the corn on his farm. The first field of corn plants started to grow and then just died. He needs your help before he plants the next field. Write and explain 4 things that you know about plants that you can tell the farmer to help this corn grow corn cobs. Draw and label a healthy corn plant.</li> <li>-Flowers are beautiful and are everywhere. There are many different colors, shapes, and sizes of flowers located all over the world. A citizen from Antarctica has come to your school to visit for the week and one of his questions is <b>about flowers. He wants to know how a flower’s life cycle works and why are flowers important to people and insects.</b></li> </ul> </li> <li>▪ Bobby the bee is flying from flower to flower in search of pollen. From which part of the flower will Bobby find the pollen, and what will he do with it?</li> <li>▪ If you were given a class assignment to grow a plant, what would you do to your soil to provide your plant with the best living environment?</li> </ul>
	<p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Teacher observations during experiments or activities</li> <li>▪ <i>Soil and Plants</i> Science journal</li> <li>▪ Response to investigations and class discussions in Science journal</li> <li>▪ Assessment Pre and Post study of seeds and plants, “Parts of a Flower”</li> </ul>

- Adult plants form more leaves that help the plant collect sunlight and air to make its food. They produce flowers that are the structures responsible for reproduction.
- Flowers have structures that produce pollen, attract pollinators and produce seeds that can grow into new plants. Some flowers have structures that develop into fruits, berries or nuts that contain the seeds that can grow into new plants.
- Some seeds fall to the ground and germinate close to the parent plant; other seeds are carried (dispersed) by wind, animals, or water to places far away. The structure of the seed is related to the way it is dispersed.

#### GRADE LEVEL EXPECTATIONS

Assessments MUST measure the ability of students to:

- Use senses and simple tools (e.g., sieves and beakers) to separate soil components such as rock fragments, water, air, and plant remains.
- Classify soils by properties such as color, particle size (sand, silt or clay), or amount of organic material (loam).
- Explain the importance of soil to plants, animals and people.
- Evaluate the quality of different soils in terms of observable presence of air, water, living things and plant remains.
- Conduct fair tests to investigate how different soil types affect plant growth and write conclusions supported by evidence.
- Use senses and simple tools to observe and describe the roots, stems, leaves, flowers and seeds of various plants (including trees, vegetables and grass.)
- Use magnifiers to observe and diagram the parts of a flower.
- Describe the functions of roots, stems, leaves, flowers and seeds in completing a **plant's life cycle**.
- Record observations and make conclusions about the sequence of stages in a **flowering plant's life cycle**.
- Compare and contrast how seeds of different plants are adapted for dispersal by water, wind or animals.
- Conduct a fair test to explore factors that affect seed germination and plant growth.

#### CMT CORRELATIONS

- Describe the life cycles of flowering plants as they grow from seeds, proceed through maturation and produce new seeds.
- Explore and describe the effects of light and water on seed germination and plant growth.
- Sort different soils by properties, such as particle size, color and composition.
- Relate the properties of different soils to their capacity to retain water and support the growth of certain plants.

**SCIENTIFIC LITERACY TERMINOLOGY:** life cycle, structures (body parts), seed, germinate, reproduce, flower, pollen, pollinator, seed dispersal, soil, property, classify, mixture, particles, humus, sand, silt, clay, texture, nutrients

**KEY SCIENCE VOCABULARY:** alfalfa, alike, amount, different, brassica, bud, bulb, cutting, fertilizer, grain, ingredient, carbon dioxide, sprout, structures, flower, mold, node, pollen, pollinator, potato eye, sample, vermiculite *Humus* is plant material that has decayed or rotted.

**MATERIALS USED FOR SOIL AND PLANTS UNIT:****Consumable***Located in Pebbles, Sand and Silt:*

Potting soil  
 Paper plates  
 Self-seal freezer Ziploc bags - gallon size  
 9 oz. plastic cups  
 Plastic spoons

*Located in New Plants:*

Potting soil  
 16 oz. plastic cups  
 cotton balls  
 jumbo, clear straws  
 white removable labels 1 cm x 4.5 cm  
 bottle of liquid plant fertilizer  
 1 package alfalfa seeds  
 1 package brassica rapa seeds  
 1 package rye grass seeds  
 1 package wheat seeds

**Non-consumable***Located in Pebbles, Sand, Silt:*

Basins  
 Magnifying lenses  
 Screens  
 Metal spoons  
 Vials with caps  
 Bags of sand, gravel, pebbles  
 ¼ liter containers

*Located in New Plants:*

Florescent bulbs  
 Lamp fixture  
 Planter trays  
 Basins  
 Bottle brush  
 Cup lids  
 25 ml vials with caps

**BOOKS USED FOR Science Content Reading Soil and Plants Grade 2:**

Flowers by Stone, Lynn M.  
Fruit by Stone, Lynn M.  
Seeds by Stone, Lynn M.  
Stems by Stone, Lynn M.  
Roots by Stone, Lynn M.  
Leaves by Stone, Lynn M.  
Fruits by Farndon, John  
Stems by Farndon, John  
Seeds by Farndon, John  
Leaves by Farndon, John  
Roots by Farndon, John

How do plants grow? by Stewart, Melissa  
The Tiny Seed by Carle, Eric  
Disgusting Plants by Miller, Connie Colwell  
Microlife that Lives in Soil by Parker, Steve  
Soil by Richardson, Adele



<b>LEARNING STRAND: Science and Technology in Society - <i>How do science and technology affect the quality of our lives?</i></b> <b>Unit: Nutrition</b> <i>CT Standard 2.4 - Human beings, like all other living things, have special nutritional needs for survival.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The essential components of balanced nutrition can be obtained from plant and animal sources.</li> <li>▪ People eat different foods in order to satisfy nutritional needs for carbohydrates, proteins and fats.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How can you obtain the essential components of a balanced nutrition?</li> <li>▪ Which different food groups meet our nutritional needs? (What are the nutrition basics?)</li> <li>▪ Which sources are used to obtain the five food groups?</li> <li>▪ How can you describe which nutritional needs are necessary for survival?</li> <li>▪ How can you describe how people in different cultures use different food sources to meet their needs?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Students should understand that...</i></p> <p>GRADE LEVEL CONCEPT 2.4.a.</p> <ul style="list-style-type: none"> <li>▪ People need to eat a variety of foods to get the energy and nutrients they need to grow, move and stay healthy. Foods are classified as grains, fruits, vegetables, dairy, meats and beans, and oils.</li> <li>▪ Some foods people eat come from plants that grow wild or are planted by farmers as crops. A fruit is the ripened part of a flower; vegetables are the roots, stems, leaves or flowers of plants.</li> <li>▪ Some foods people eat come from animals that are wild or are raised on ranches. Meat, fish, dairy products and eggs all come from animals.</li> <li>▪ The types of crops that can grow in an area depend on the climate and soil. Some foods are grown and sold by local farms, and some foods are grown far away and transported to local grocery stores.</li> </ul> <p>GRADE LEVEL CONCEPT 2.4.b.</p> <ul style="list-style-type: none"> <li>▪ All people need the same basic nutrients to grow, move and stay healthy; different cultures satisfy these needs by consuming different foods.</li> <li>▪ The level of energy and nutrients individuals need depends on their age, gender and activity levels.</li> <li>▪ Most foods contain a combination of nutrients. Labels on food packages describe the nutrients contained in</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ <a href="#">Little D's Nutrition Expedition</a> Background Information, Lessons and Materials</li> <li>▪ <b>Little D's Part 1: Why teach nutrition?</b></li> <li>▪ <b>Little D's Part 2: What are the nutrition basics?</b></li> <li>▪ <b>Little D's Part 3: How do you put the nutrition basics together to eat a nutritious diet?</b></li> <li>▪ <b>Little D's Part 4: Special Nutrition Concerns for Children</b></li> <li>▪ <a href="#">Little D's Nutrition Expedition</a> Kit</li> <li>▪ Poster displaying the food groups (Little D, The Five-Food-Group Dragon)</li> <li>▪ <b>Literacy about Nutrition:</b> <i>The New Food Guide Pyramid – Meat and Beans</i> by Emily K. Green; <i>The New Food Guide Pyramid: Healthy Eating</i> by Emily K. Green; <i>Looking After Myself, Health and Diet</i> by Sally Hewitt; <i>Eating Right, Healthy Eating, Healthy Choices</i> by Cathy Senker; <i>The Edible Pyramid Good Eating Every Day</i> by Loreen Leedy; <i>Good Enough to Eat, A Kid's Guide to Food and Nutrition</i> by Lizzy Rockwell</li> <li>▪ <i>Books about Different Food in Different Cultures:</i> <i>Meals Around the World</i>; <i>Tony and the Pizza Champions</i> by Tony Gemignani; <i>The Magic Pomegranate</i> by Peninnah Schram; <i>One Hen: How One Small Loan Made a Big Difference</i> by <b>Katie Milway</b>; <b>Let's Eat! A comer!</b> by Pat Mora; <b>Hiromi's Hands</b> by Lynne Barasch; <i>The Have a Good Day Café</i> by Frances &amp; Ginger Park; <b>Grandma Lena's Big Ol' Turnip</b> by Denia Hester; <i>Berry Magic</i> by Teri Sloat; <i>One Green Apple</i> by Eve Bunting</li> <li>▪ High touch high tech program: <i>Nutty Nutrients</i></li> <li>▪ Food package labels</li> <li>▪ Science notebook/journal</li> <li>▪ Venn Diagram</li> <li>▪ Extension Activities: Five Food Group Bingo; Brown Bagging It; Food Group Concentration; Fishing for Foods Game</li> </ul>

<p>the food and how much energy the food provides (calories).</p> <ul style="list-style-type: none"> <li>▪ Breads, cereals, rice and pasta are sources of carbohydrates, which provide energy.</li> <li>▪ Meat, poultry, fish, beans, eggs and nuts are sources of protein, which keeps the body working properly.</li> <li>▪ Fruits and vegetables are sources of vitamins and minerals, which keep the body healthy.</li> <li>▪ Nuts, meats and fish are sources of fats and oils, which provide energy.</li> </ul>	<p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ <u>Little D’s Nutrition Expedition</u> Activities: 1. Meet the Royal Food Family, 2. Sir Milford and Lady Holly’s Milk Group, 3. King Henry’s Meat Group 4. Princess Peapod’s Vegetable Group, 5. Queen Anna Banana’s Fruit Group, 6. Prince Waffle’s Grain Group, 7. We Need All Five, 8. The Dragon’s Tail, 9. Smart Snacking Dragon, 10. Healthfully Ever After.</li> <li>▪ Demonstrate how to utilize the Science notebook /journal to <b>keep track of the student’s daily food intakes</b></li> </ul>
	<ul style="list-style-type: none"> <li>▪ Discuss and record how students could change their daily diet to meet recommended nutritional needs</li> <li>▪ Create a Food Group Wall Dragon displaying the five food groups. The students can add food to each food group throughout the unit.</li> <li>▪ Research how other cultures use different food sources to meet their nutritional needs. Create small groups and give each group a country to study. The students will then report on their country and share what they have learned. <b>Students will use a Venn diagram or “T” chart to display</b> their information, in comparison to our culture. They may also cut out various pictures of food from the internet for display.</li> </ul>
	<p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ <u>Little D’s Nutrition Expedition</u> Pre- and Post-Test</li> <li>▪ Responses to investigations and class discussions with Grade Level Expectation Science Journal</li> <li>▪ Teacher observations of activities with Check Sheet</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS:</b></p> <p>Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>▪ Explain that food is a source of carbohydrates, protein and fats — nutrients that animals and humans convert to energy they use to stay alive.</li> <li>▪ Classify foods into groups based on their source and relate common foods to the plant or animal from which they come.</li> <li>▪ Give examples of ways people can improve soil quality and crop growth (e.g., irrigation, fertilizer, pest control).</li> <li>▪ Compare and contrast how different cultures meet needs for basic nutrients by consuming various foods.</li> <li>▪ Evaluate the nutritional value of different foods by analyzing package labels.</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Identify the sources of common foods and classify them by their basic food groups.</li> <li>▪ Describe how people in different cultures use different food sources to meet their nutritional needs.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** nutrient, crop, grain, carbohydrate, protein, dairy, fats, oils, energy

**KEY SCIENCE VOCABULARY:**

## SCIENTIFIC LITERACY TERMINOLOGY: GRADE 2

This list is intended as a guide for teachers. While not exhaustive, it includes vocabulary that should be used, as appropriate, by teachers and students during everyday classroom discourse. It is not intended for student memorization.

absorb	To take in, soak up
adaptation (adapt)	The process of changing to new conditions
aluminum	A light weight, silver-white metal
analyze	To study carefully
atmosphere	The gas that surrounds a body in space
atom	A tiny building block of matter
attract	To draw by exciting interest or emotion
average	The typical, usual, or ordinary
balance	A device for weighing things; a tool for comparing mass
breathe	To take in and push out air
butterfly	An insect with four thin wings Caterpillars change into butterflies.
cactus	One of many kinds of plants, with thick, spiny stems without leaves
camouflage	The disguising of people, animals, or things, to make them look like what is around them
centimeter	A unit of length in the metric system
characteristic	Showing a special feature or quality
classify	To put into groups or classes; sort
clay	A firm kind of earth made up of small particles
climate	The usual weather that occurs in a place, including the average temperature and amounts of rain or wind
collect data	To gather information
compare	Discuss similarities and differences of items
conclusion	A decision made after careful thinking
condensation	The action of changing from a gas into a liquid
conduct (an experiment)	To lead, guide, or direct an experiment
conserve	To use carefully, not to waste
cork	A light, spongy bark
cycle	A series of events that is regularly repeated in the same order
data	Facts or figures that are collected during an experiment
decrease	To make or become less or smaller
describe	To use words to explain how something looks, feels or acts
determine	To make a decision
diagram	A drawing that shows how something works
dissolve	To mix thoroughly To change from a solid to a liquid

draw a conclusion	To make a decision after careful thinking
droplets	A small quantity of liquid
environment	Surroundings and conditions that effect natural processes
erode, erosion	To wear away or become warn
evaluate	To find out, judge, or estimate the value of
evaporate	To change into a vapor or gas
evaporation	The action of a liquid changing into a gas
evidence	Facts or signs that help one find out the truth
experiment	A procedure that is carried out to investigate a scientific question
explain, explanation	To make clear or understandable
explore	To go into or travel through an unknown place
Fahrenheit	A measurement of temperature
findings	The results of a study or investigation
flexible	Objects that can bend
float	To be at the top of liquid or air
force	Something as a pull or push that changes the speed of direction in which something moves
freeze	To change from a liquid to a solid
gas	<b>Matter that spreads to fill the space it's in;</b> matter that does not have its own shape or volume
germinate	To begin to grow or sprout
graph	A diagram used to show the relationship between things
gravity	The natural force that causes smaller objects to move towards the center of the Earth
hand lens	A tool used to magnify things
humid, humidity	Having a large amount of water or water vapor in the air
identify	Who a person is, or what a thing is
increase	To make or become greater or larger
insect	A tiny animal with six legs
investigate	To study something closely and in an organized way
layer	A single thickness, a coating, or sheet of material covering a surface
length	The distance of a thing measured from one end to the other
lens	A tool used to see things clearly
life cycle	The stages in the life of a plant New plants come from older plants.
liquid	Matter that flows and takes the shape of the container it is in
liter	A unit of capacity for liquids in the metric system
lungs	Organs used for breathing
magnifying glass	A tool used to enlarge objects

mammal	A warm blooded animal that has hair and a backbone
materials	Tools need to do a certain job
matter	Anything that takes up space and has mass
melt	To change from a solid to a liquid
metal	A substance that is usually shiny and hard It is found underground.
meter, meter stick	A basic unit of length
mineral	The ingredients that make up rocks
mirror	A piece of glass you can see yourself in
mixture	Something made of two or more kinds of matter mixed together
motion	Any change in the position of an object
nutrients	Something that living things need to grow and stay healthy
object	Anything that is not alive that people can see or touch
observe, observation	To see and pay attention to; watch
opinion	A belief based on what one thinks or feels; not on actual facts
organism	Any living thing such as a plant or animal
oxygen	A colorless gas in the air that living things need to survive
pattern	Anything that repeats itself
pebble	A small rock
perform an experiment	Conducting a test to prove something
photosynthesis	A process by which green plants use light energy to change carbon dioxide and water into glucose and oxygen
pitch	The degree of a slant
pluck	To remove by pulling off or out
predict, prediction	A guess based on what you know so far about you think is going to happen
procedure	A set of specific steps that tells you how to do something
property	Things we know about objects by looking at them or feeling them
range	The extent to which something can vary
record (data)	Something written down to preserve facts or information
recycle	To treat materials that have been thrown away in order to use them again
reflect	To give back an image of
result	Something that happens because of something else; consequence
reuse	To use again
sand	Loose grains of warn rock
scale	Tool used to weigh things
scientific observation	To see and pay attention to an experiment in science
seed dispersal	The scattering of seeds
separate	To pull or take apart

sequence	The order in which things occur
silt	Fine particles of Earth found at the bottom of lakes and rivers
sink (float)	To go down or cause to go down under the surface
soil	<b>The loose top layer of the Earth's surface in which plant life can grow</b>
solid	Matter that has its own shape and volume
solution	Mixture with two or more kinds of matter mixed evenly
sort	To arrange things on the basis of property such as color, kind, or size
speed	The condition of moving or acting rapidly
state of matter	One way matter exists -- solid, liquid, or gas
stopwatch	A device used for measuring time
surface	The outermost layer
survive	To stay alive
telescope	A tool used to make objects appear closer
temperature	Relative hotness or coldness as measured on a standard scale
texture	The look or feel of a surface
thermometer	A tool used to measure temperature
transparent	Light can pass through
weigh, weight	The measure of how heavy something is or the gravitational force on

**Content Standards & Indicators**  
**for Grade 3**





### Course Description

ELEMENTARY SCHOOL				
1. Course Title <b>Grade 3 General Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media		
2. Transcript Title/Abbreviation <b>Science</b>	3. Transcript Course Code/Number N/A			
4. Program Contact Information  Name: Anita Rutlin  Title/Position: Assistant Superintendent  School: Central Office Madison Town Campus 10 Campus Drive, P.O. Drawer 71 Madison, CT 06443	6. Grade Level: 3  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable  8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)			
10. Pre-Requisites : N/A				
11. Brief Course Description Third grade science is taught in units of study that have scientific inquiry, literacy and numeracy integrated throughout the units. Students are engaged in science instruction through activities and investigations. As part of the spiraling curriculum, aspects of life science, earth science, and physical science are taught each year. The life science unit is Adaptations to Habitats; the physical science unit is Properties of Matter; and the earth science unit examines <b>Water in relation to energy in earth's systems</b> .				
12. Course Goals The third grade science program gives students the opportunity to explore topics and concepts through investigations. Participating in this hands-on program helps students: <ol style="list-style-type: none"> <li>1. To appreciate the concepts of science as part of their larger world via interdisciplinary activities.</li> <li>2. To foster a life long enjoyment of learning and the learning of science.</li> <li>3. To develop a growing appreciation for science as part of their evolving education.</li> <li>4. To ensure students meet the science standards and grade level expectations for Connecticut Public Schools.</li> </ol>				
13. Course Outline 1. Properties of Matter / Science and Technology in Society: States of Matter and Soggy Paper 2. Heredity and Evolution: Adaptations to Habitats – Plants and Animals 3. <b>Energy in Earth's Systems:</b> Water				
14. Instructional Methods and/or Strategies <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Full class instruction and discussions</li> </ul> </td> <td style="width: 50%; border: none;"> <ul style="list-style-type: none"> <li>▪ Modeling and demonstrations</li> <li>▪ Guided inquiry activities and investigations</li> </ul> </td> </tr> </table>			<ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Full class instruction and discussions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Modeling and demonstrations</li> <li>▪ Guided inquiry activities and investigations</li> </ul>
<ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Full class instruction and discussions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Modeling and demonstrations</li> <li>▪ Guided inquiry activities and investigations</li> </ul>			
15. Assessment Methods and/or Tools <ul style="list-style-type: none"> <li>▪ Quizzes and Unit assessments</li> <li>▪ Embedded task and performance assessment in class activities and investigations</li> </ul>				
16. Assessment Criteria Assessments are based on the Madison curriculum and Connecticut standards with grade level expectations for science. For investigations and projects, students are given a rubric or checklist of grading criteria before doing the work. Observations, student science journals, and common unit assessments are employed to determine individual student achievement.				

LEARNING STRAND <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Scientific Inquiry is a thoughtful and coordinated attempt, to search out, describe, explain, and predict natural phenomena.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How do you develop testable questions?</li> <li>▪ How do you make observations about objects, organisms, and the environment?</li> <li>▪ How do you design and conduct simple investigations employing simple equipment and measuring tools to gather data and extend the senses?</li> <li>▪ How do you use data to construct reasonable explanations?</li> <li>▪ How do you use mathematics to analyze, interpret, and present data?</li> <li>▪ How do you analyze, critique and communicate investigations using words, graphs and drawings?</li> <li>▪ How do you locate relevant science information when searching the Web?</li> </ul>
<p><b>KNOWLEDGE &amp; LEARNING</b> <i>The student will ...</i></p> <ul style="list-style-type: none"> <li>▪ Identify questions that can be answered through scientific investigation.</li> <li>▪ Make predictions.</li> <li>▪ Design a simple investigation to test a question.</li> <li>▪ Use tools and techniques that are appropriate for the design of the investigation for making observations and gathering data.</li> <li>▪ Accurately collect and record appropriate data.</li> <li>▪ Use mathematical operations to analyze and interpret data.</li> <li>▪ Interpret and create appropriate graphs to present relationships between variables.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Report findings and conclusions in various formats using relevant vocabulary and supporting evidence.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p>FOSS and Delta Science Modules  <a href="http://www.exploratorium.edu/ifi/workshops/fundamentals/index.html">http://www.exploratorium.edu/ifi/workshops/fundamentals/index.html</a></p> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Demonstrations</li> <li>▪ Guided inquiry activities and investigations</li> <li>▪ Guided internet research</li> <li>▪ Performance tasks</li> </ul> <p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ CMT embedded task "<i>Soggy Paper</i>"</li> <li>▪ Selected Responses</li> <li>▪ Constructed Responses</li> </ul>

<p><b>LEARNING STRAND:</b>  <b>Unit: Properties of Matter</b> - <i>How does the structure of matter affect the properties and uses of materials?</i>  <i>CT Standard 3.1 – Materials have properties that can be identified and described through the use of simple tests.</i>  <i>CT Standard 3.4 – Earth materials provide resources for all living things, but these resources are limited and should be conserved.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Heating and cooling cause changes in some of the properties of materials.</li> <li>Decisions made by individuals can impact the global supply of many resources.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What are the three States of Matter?</li> <li>How does heating and cooling cause changes to the property of a material?</li> <li>How do Reducing, Reusing, and Recycling conserve earth materials?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>Material has properties that are directly observable; examples include its state of matter or its size, shape, color or texture. Other properties can only be observed by doing something to the material (simple tests). Materials can be sorted and classified based on their testable properties.</li> <li>Some materials dissolve (disappear) when mixed in water; others accumulate on the top or the bottom of the container. The temperature of water can affect whether, and at what rate, materials dissolve in it.</li> <li>Some materials, such as sponges, papers and fabrics, absorb water better than others.</li> <li>Some materials float when placed in water (or other liquids such as cooking oil or maple syrup); others sink to the bottom of the container.</li> <li>Some materials conduct heat better than others. Materials that are poor heat conductors are useful for keeping things cold or hot.</li> <li>The physical properties of a material can be changed, but the material remains the same. For example, a block of wood can be cut, sanded or painted, but it is still wood.</li> <li>Heating and cooling cause materials to change from one state of matter to another and back again. Adding heat can cause solids to melt into liquids (for example, chocolate, ice cream, butter or wax); removing heat (cooling) can cause liquids to harden into solids (for example, hot candle wax hardens as it cools).</li> <li>Adding heat can cause water to boil and evaporate into a gas in the air (for example, steam rises from heated water); removing heat (cooling) can cause water vapor to condense into liquid water (for example, warm steam hitting a cold mirror). Water outdoors or in an open container evaporates without boiling (for</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Delta Science Module: <a href="#">States of Matter</a></li> <li>FOSS: <a href="#">Water</a></li> <li>"Soggy Paper" CT Embedded Task</li> <li>Books on Matter and Ecology</li> </ul> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>DSM Activity 1 – What Is a Solid?</li> <li>DSM Activity 2 – What Is a Liquid?</li> <li>DSM Activity 3 – What Is a Gas?</li> <li>DSM Activity 4 – Melting Ice</li> <li>DSM Activity 5 – Hurry Up or Slow Down</li> <li>DSM Activity 7 – Measuring Melting Points</li> <li>FOSS Water Investigation 2 Part 2 Sinking and Floating</li> <li>Liquid Levels</li> <li>Displacement Experiment</li> <li>"Soggy Paper" CT Science Curriculum</li> <li>Magnets</li> <li>Read Ecology books, such as <a href="#">The Lorax</a> by Dr. Seuss; <a href="#">Reduce, Reuse and Recycle</a> by Elizabeth Wallace; <a href="#">What if We Ran Out of Fossil Fuels?</a> by Kimberly N. Miller; <a href="#">Water: a Vital Resource</a>; <a href="#">Waste not Want Not - Recycling</a></li> <li>Posters promoting Earth Day</li> <li>Assemblies/Programs: <a href="#">high-touch high-tech: "Global Fever", "Green Machine"</a></li> <li>Read books about Magnets: <a href="#">Magnets</a> by Angela Royston; <a href="#">Magnetic and Non-Magnetic</a> by Angela Royston</li> </ul> <p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Responses to investigations and activities in the student's Science Journal</li> <li>Responses to assessment questions in student's Science Journal</li> <li>"Soggy Paper" embedded, performance task</li> <li>Properties of Matter Assessment</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b>  Assessments MUST measure the ability of students to:</p>

- example, puddles, ponds, fish tanks, etc.)
- Water may exist as a solid, liquid or gas, depending on its temperature. If water is turned into ice and then the ice is allowed to melt, the amount of water is the same as it was before freezing.
  - Liquid water becomes solid water (ice) when its temperature cools to 0 degrees Celsius (32 degrees Fahrenheit). Warming ice to a temperature above 0 degrees Celsius (above 32 degrees Fahrenheit) causes it to melt into liquid water.
  - The supply of many natural resources such as fossil fuels, metals, fresh water and fertile soil is limited; once they are used up or contaminated they are difficult or impossible to replace.
  - Human actions can affect the survival of plants and animals. The products of the fuels people burn affect the quality of the air. Waste and chemicals from factories, farms, lawns and streets affect the quality of the water and soil.
  - Humans can extend the use of some natural resources by reducing the amounts they use (for example, driving less to reduce the amount of gasoline used; turning off faucets not in use).
  - Humans can extend the use of some natural resources by recycling, or collecting used materials and processing them into new materials (for example, collecting waste paper or plastic bottles and making them into new products).
  - Humans can extend the use of some natural resources by reusing products instead of buying new ones (for example, washing containers that food is packaged in and using them again to store different foods or objects).
  - Humans can extend the use of some natural resources by replacing what they use (for example, planting new trees to replace those that are cut for lumber or paper; purifying dirty water from storm drains and discharging clean water back into a river).
  - Humans can extend the use of some natural resources by reducing the amounts they use (for example, driving less to reduce the amount of gasoline used; turning off faucets when not in use).
  - Some natural resources are useful to people in their raw form (for example, fresh water, soil or air); other natural resources must be modified to meet human needs (for example, petroleum must be extracted from rocks and refined into gasoline, heating oil or plastics; wood from
- Compare and contrast the properties of solids, liquids and gases.
  - Demonstrate that solids, liquid and gases are all forms of matter that take up space and have weight.
  - Carry out simple tests to determine if materials dissolve, sink or float in water and conduct heat or attract to magnets.
  - Classify materials based on their observable properties, including state of matter.
  - Design and conduct fair tests to investigate the absorbency of different papers, write conclusions based on evidence, and analyze why similar investigations might produce different results.
  - Explain the role of heating and cooling in changing matter from one state to another during freezing, melting, evaporation and condensation.
  - Describe ways people use earth materials, such as fossil fuels, trees, water, soils and rocks as natural resources to improve their lives.
  - Summarize nonfiction text to explain how humans use technology to obtain energy and make materials from natural resources.
  - Explain advantages and disadvantages of renewable and nonrenewable energy sources that can be used for making electricity, fueling cars or heating homes.
  - Design and conduct experiments to evaluate the effectiveness of different insulating materials for keeping a substance warm or cold (i.e., conducting heat).
  - Use mathematics to estimate, measure and graph the quantity of a natural resource (e.g., water, paper) used by an individual (or group) in a certain time period.
  - Distinguish among reducing, reusing, recycling and replacing as conservation techniques.

trees must be proceeded to make paper).

- Earth materials that occur in nature include rocks, minerals, soils, water and the gases of the atmosphere. Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy.

**CMT CORRELATIONS**

- Sort and classify materials based on properties such as dissolving in water, sinking and floating, conducting heat, and attracting to magnets.
- Describe the effect of heating on the melting, evaporation, condensation and freezing of water.
- Describe how earth materials can be conserved by reducing the quantities used, and by reusing and recycling materials rather than discarding them.

**SCIENTIFIC LITERACY TERMINOLOGY:** physical property, state of matter, solid, liquid, gas, water vapor, dissolve, absorb, conduct, attract, melt, freeze, boil, evaporate, condense, displacement, natural resources, recycle, reuse, replace, reduce



<b>LEARNING STRAND: Heredity and Evolution - <i>What processes are responsible for life's unity and diversity?</i></b> <b>Unit: Adaptations to Habitats</b> <i>CT Standard 3.2 – Organisms can survive and reproduce only in environments that meet their basic needs.</i>	
<p><b>ENDURING UNDERSTANDING</b></p> <p>Plants and animals have structures and behaviors that help them survive in different environments.</p>	<p><b>ESSENTIAL QUESTIONS</b></p> <p>How do plant and animal physical and behavioral adaptations allow them to survive in certain environments?</p> <p>How do plant and animal physical and behavioral adaptations allow them to obtain food?</p> <p>How do plant and animal physical and behavioral adaptations allow them to protect themselves from predators?</p>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>▪ Plants have structural adaptations that allow them to survive and thrive in certain biomes. Animals have physical and/or behavioral adaptations that allow them to survive in certain environments. Adaptations are passed from parents to offspring. Individuals that happen to be bigger, stronger or faster can have an advantage over others of the same species for finding food and mates.</li> <li>▪ Animals have behavioral and structural adaptations for getting food. Structural adaptations include things such as specialized teeth for tearing meat or grinding grasses; specialized beaks for cracking seeds, snatching insects, tearing meat or spearing fish; sharp claws for grasping; keen sense of smell, or long, sticky tongues for reaching food. Behavioral adaptations include actions such as following herds of prey animals, spinning webs or stalking.</li> <li>▪ Animals have behavioral and structural adaptations for protection from predators. Some animals have camouflage that allows them to stay concealed by blending in with their surroundings; some animals look like other animals to avoid being eaten. Structural adaptations include things such as sharp quills, hard shells or antlers. Behavioral adaptations include actions such as staying absolutely still, producing a bad odor, appearing or sounding scary, or fleeing.</li> <li>▪ Animals have behavioral and structural adaptations for surviving harsh environmental conditions. Animals that live in cold climates have insulating body coverings such as blubber, down or thick undercoats that keep them warm. Animals that live in hot climates keep cool by releasing heat from big ears or by panting, or by living underground. Some animals survive seasonal changes by slowing down body functions (hibernating in dens, tunnels</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p>FOSS Science Stories <i>Structures of Life</i>            Science DVDs and Library books  <i>Who's Home in the Biome</i> (AIMS)  <u>Non-Fiction Read &amp; Write</u> <i>Animals &amp; Habitats</i>  <b>"Plant Parts" &amp; "Making Food" handouts</b>  <i>New Plant Discovery</i> (AIMS)  <u>Zoobook</u> website</p> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <p><b>Literacy</b> - Library Books to read to students:  <u>What Do You Know About Animal Adaptations?</u> – 20 Questions: Science, Suzanne Slade, PowerKids Press  <u>Cold, Colder, Coldest, Animals That Adapt to Cold Weather</u> by Michael Dahl, Picture Window Books  <u>Hot, Hotter, Hottest, Animals That Adapt to Great Heat</u> by Michael Dahl, Picture Window Books  <u>Animals with No Eyes: Cave Adaptation</u> Kelly R. Barnhill  <u>Surviving Death Valley: Desert Adaptation</u> by Pamela Dell  <u>Monsters of the Deep: Deep Sea Adaptation</u> Kelly Regan Barnhill, Capstone Press  <u>How Do Animals Adapt?</u> The Science of Living Things            Bobbie Kalman, Crabtree Publishing Company  <u>Super Survivors, Amazing Nature</u> by Tim Knight  <u>How Plants Survive</u> by Kathleen V. Kudlinski  <u>Seeds, Stems, and Stamens, The Ways Plants Fit Into Their World</u> Susan E. Goodman, Millbrook Press</p> <ul style="list-style-type: none"> <li>▪ Science Assemblies/Programs: high-touch            high-tech: Biome Sweet Home</li> </ul> <p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Teacher observation during experiments and activities</li> <li>▪ <i>Biome in a Box</i> Project</li> <li>▪ <i>Animals &amp; Habitats</i> booklet</li> <li>▪ Animal Adaptations book</li> <li>▪ Responses to investigations in <b>student's</b> Science Journal</li> </ul>

<p>or mud) or moving to more favorable conditions (migrating).</p> <ul style="list-style-type: none"> <li>▪ Plants have adaptations for getting the sunlight they need to survive. Examples include growing or facing toward sunlight and sending out chutes or tendrils to get taller than neighboring plants.</li> <li>▪ Plants have adaptations for protection from predators. Examples include spines, thorns and toxins e.g., poison ivy.</li> <li>▪ Plants have adaptations for surviving in different environmental conditions. Examples include dropping leaves in winter when sunlight and water are limited, having needle-shaped leaves that shed snow, or surviving drought by storing water in thick stems.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Adaptations to Habitats Assessment</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b> Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>▪ Compare and contrast the external features and behaviors that enable different animals and plants (including those that are extinct) to get food, water, and sunlight; find mates; and be protected in specific land and water habitats.</li> <li>▪ Explain how behaviors such as hibernation, dormancy and migration give species advantages for surviving unfavorable environmental conditions.</li> <li>▪ Give examples of ways animals benefit from camouflage.</li> <li>▪ Evaluate whether an adaptation gives a plant or animal a survival advantage in a given environment.</li> <li>▪ Design a model of an organism whose adaptations give it an advantage in a specific environment.</li> </ul> <p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe how different plants and animals are adapted to obtain air, water, food and protection in specific land habitats.</li> <li>▪ Describe how different plants and animals are adapted to obtain air, water, food and protection in water habitats.</li> </ul>
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**SCIENTIFIC LITERACY TERMINOLOGY:** adaptation, advantage, camouflage, hibernation, migration

**KEY SCIENCE VOCABULARY:**

*Dormancy* inactive or not growing

*Environment* The surroundings of a plant or animal

*Habitat* where an organism naturally lives

*Nutrient* a material used by a living organism to help it grow and develop

*Predator* an animal that hunts and catches other animals for food

*Survival* continues to live in unusual conditions

*Thrive* to grow fast and stay healthy

*Tundra* is cold frozen land most of the year



<b>LEARNING STRAND: Energy in Earth's System</b> - <i>How do external and internal sources of energy affect the Earth's systems?</i> <b>Unit: Water</b> <i>CT Standard 4.3 – Water has a major role in shaping the earth's surface.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>Water circulates through the Earth's crust, oceans and atmosphere.</li> <li>Heating and cooling cause changes in some of the properties of materials.</li> <li>Scientists use equipment and measuring tools to collect data about factors that affect erosion.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li><b>How does the sun's energy impact</b> the water cycle?</li> <li>Why does water not accumulate on the surface of the earth after it rains?</li> <li>What are the ways in which water circulates throughout the earth?</li> <li>What factors contribute to the movement of water throughout the earth?</li> <li>How does moving water affect erosion and river formation?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>Water is continuously moving between the <b>Earth's</b> surface and the atmosphere in a process called the water cycle. Water evaporates from the surface of the earth, rises into the air and cools, condenses, collects in clouds, and falls again to the surface as precipitation. The energy that causes the water cycle comes from the sun.</li> <li>Most precipitation that falls to Earth goes directly into oceans. Some precipitation falls on land and accumulates in lakes and ponds or is absorbed by soil.</li> <li>Rain or snowmelt in high elevations flows downhill in streams that collect in lower elevations to form rivers flowing downhill to an ocean.</li> <li>Water moving across the earth in streams and rivers pushes soil and breaks down pieces of rock in a process called erosion. The moving water carries away rock and soil from some areas and deposits them in other areas, creating new land forms or changing the course of a stream or river.</li> <li>The amount of erosion in an area, and the type of earth material that is moved, are affected by the amount of moving water, by the speed of the moving water, and by how much vegetation covers the area.</li> <li>Rivers carve out valleys as they move between <b>mountains or hills. The speed of the river's flow</b> depends on the slope of the land. The speed of the <b>river's flow affects the shape of the river's course</b> (straight or meandering), the shape of the valleys it carves (u-shaped or v-shaped) and the amount of earth material that is pushed along or left behind in floodplains and deltas.</li> <li>Water moving in ocean waves carries sand, shells and debris away from some coastal areas and</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>  FOSS: <u>Water</u> <ul style="list-style-type: none"> <li>Water Investigation 3 Water Vapor Parts 1 &amp; 2 Evaporation Part 4 Condensation</li> <li>Water Investigation 4 Water Works Part 1 Water in Earth Materials</li> <li><b>Literacy:</b> <i>Which Way Does It Go?</i> (Water Lesson 1-2); <b>Water Dance</b> (1997) and <b>Cloud Dance</b> (2000) by Thomas Locker <b>Cracking Up A Story about Erosion</b> by Bailey and Lilly</li> </ul> <b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>FOSS Science Stories: <i>The Water Cycle</i> &amp; Water Cycle Wheel</li> <li>FOSS Science Stories: <i>Evaporation and Condensation</i></li> <li><u>Follow a River</u> with <b>A River's Run</b> activity</li> <li><b>Erosion &amp; Dirtmeister's Science Lab</b></li> <li>Science Assemblies/Programs: <u>high-touch high-tech: Water Water Everywhere</u></li> <li>CT Eli Whitney Water Center Activities</li> <li>Connecticut River Museum</li> </ul> <b>ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>Investigations and Activities in <b>student's</b> Science Journal including FOSS Investigation Response Sheets</li> <li><b>A River's Run project</b></li> <li><b>Dirtmeister's Erosion</b> Experiment &amp; Report</li> <li><u>Water</u> Assessment</li> </ul> <b>GRADE LEVEL EXPECTATIONS</b> Assessments MUST measure the ability of students to: <ul style="list-style-type: none"> <li><b>Describe the role of the sun's energy</b> (i.e., heating and cooling) in the continuous cycling of water between the earth and the atmosphere through</li> </ul>

<p>deposits them in new areas, changing the shape of the coastline.</p> <ul style="list-style-type: none"> <li>Erosion is <b>constantly reshaping the earth’s land</b> surface. Sometimes the effects of erosion are immediate (for example, a flash flood or a hurricane) and sometimes the effects of erosion take a long time (for example, the changing course of a river or the carving of the Grand Canyon).</li> </ul>	<p>evaporation, condensation and precipitation.</p> <ul style="list-style-type: none"> <li>Use models to demonstrate that topography causes precipitation landing on earth to move in streams and rivers from higher to lower elevations.</li> <li>Design and conduct simple investigations to determine how moving water (flowing downhill or in ocean waves) causes changes to the land, the coastline or the course of a stream or river.</li> <li>Pose testable questions and employ simple equipment and measuring tools to collect data about factors that affect erosion (e.g., type of earth material in an area, volume of moving water, slope of land, vegetation coverage).</li> <li>Present evidence to support a scientific claim about the relationship between the amount and speed of moving water and the size of earth materials moved (e.g., silt, pebbles, boulders).</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li><b>Describe how the sun’s energy impacts the water cycle.</b></li> <li>Describe the role of water in erosion and river formation.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** water cycle, evaporate, condense, condensation, precipitation, water vapor, erosion, valley, floodplain, delta

**KEY SCIENCE VOCABULARY:** landform, deposition, oxbow lake, rivulets, runoff, sediment, tributaries

## Science – Grade 3

### DVDs

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#### **Science Clips for Children: Characteristics of Plants**

*Schlessinger Media – A Division of Library Video Company*

18 minutes, Closed Caption

#### **Plant Life for Children: All About Plant Adaptation**

*Schlessinger Science Library – A Division of Library Video Company*

23 minutes, Closed Caption

#### **Animal Life for Children: All About Animal Adaptations**

*Schlessinger Science Library – A Division of Library Video Company*

23 minutes, Closed Caption

#### **Properties of Matter, Part 1**

School Videos

SchoolMedia, Inc. – Physical Science Grades K-4

20 minutes

#### **Physical Science for Children: All About Properties of Matter**

*Schlessinger Science Library – A Division of Library Video Company*

23 minutes, Closed Caption

#### **Phases of Matter – Bill Nye the Science Guy**

Disney Educational Productions

26 minutes, Closed Caption

## Science – Grade 3

### Nonfiction and Fiction Books for Science from the Library

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#### ***Water Science Unit***

##### **Which Way Does It Go?**

(Water Lesson 1-2)

##### **Water Dance**

Thomas Locker

##### **Cloud Dance**

Thomas Locker

##### **Cracking Up: A Story about Erosion**

Jacqui Bailey and Matthew Lilly

#### ***Properties of Matter Science Unit***

##### **Magnets, My World of Science**

Angela Royston, Heinemann Library a Division of Pearson

##### **Magnetic and Nonmagnetic, My World of Science**

Angela Royston, Heinemann Library a Division of Pearson

##### **Floating and Sinking, Our Physical World**

Ellen Sturm Niz, First Facts by Capstone Press

##### **Matter, Discovering Science**

Rebecca Hunter, Raintree Steck-Vaughn Publishers, Harcourt

##### **Matter, Solids, Liquids, and Gases, Science All Around Me**

Mir Tamim Ansary, Rigby Interactive Library, Rigby Education

##### **What is a Gas?**

Jennifer Boothroyd, First Step Nonfiction

##### **What is a Liquid?**

Jennifer Boothroyd, First Step Nonfiction

##### **What is a Solid?**

Jennifer Boothroyd, First Step Nonfiction

##### **Experiments with Solids, Liquids, and Gases**

Salvatore Tocci, Children's Press, Division of Scholastic

##### **Solids, Liquids, Gases, Simply Science**

Charnan Simon, Compass Point Books

##### **Solids, Liquids, and Gases, Science Around Us**

Darlene R. Stille, The Child's World

**Everyday Physical Science Experiments with Liquids**, Science Surprises  
Amy French Merrill, The Rosen Publishing Group's PowerKids Press

**Everyday Physical Science Experiments with Solids**, Science Surprises  
Amy French Merrill, The Rosen Publishing Group's PowerKids Press

**Solids, Liquids, and Gases**, Starting with Science  
Ontario Science Centre, Kids Can Press

**The Lorax**  
Dr. Suess

**Reduce, Reuse and Recycle**  
Elizabeth Wallace

**What if We Ran Out of Fossil Fuels?**  
Kimberly N. Miller

***Adaptations in Habitats Science Unit***

**What Do You Know About Animal Adaptations?** – 20 Questions: Science  
Suzanne Slade, PowerKids Press

**Cold, Colder, Coldest, Animals That Adapt to Cold Weather**  
Michael Dahl, Picture Window Books

**Hot, Hotter, Hottest, Animals That Adapt to Great Heat**  
Michael Dahl, Picture Window Books

**Animals with No Eyes, Cave Adaptation**  
Kelly Regan Barnhill, Capstone Press

**Surviving Death Valley, Desert Adaptation**  
Pamela Dell, Capstone Press

**Monsters of the Deep, Deep Sea Adaptation**  
Kelly Regan Barnhill, Capstone Press

**How Do Animals Adapt?** The Science of Living Things  
Bobbie Kalman, Crabtree Publishing Company

**Super Survivors, Amazing Nature**  
Tim Knight, Heinemann Library, Division of Reed Elsevier

**How Plants Survive**  
Kathleen V. Kudlinski, Chelsea House Publishers

**Seeds, Stems, and Stamens, The Ways Plants Fit Into Their World**  
Susan E. Goodman, Millbrook Press, Lerner Publishing Group



## SCIENTIFIC LITERACY TERMINOLOGY: Grade 3

This list is intended as a guide for teachers. While not exhaustive, it includes vocabulary that should be used, as appropriate, by teachers and students during everyday classroom discourse. It is not intended for student memorization.

absorb	To take in, soak up
adaptation (adapt)	The process of changing to new conditions
aluminum	A light weight, silver-white metal
analyze	To study carefully
atmosphere	The gas that surrounds a body in space
attract	To draw by exciting interest or emotion
average	The typical, usual, or ordinary
balance	A device for weighing things
beaker	A cylindrical container used in a laboratory for liquids
biome	A biome is an area on Earth that has similar geography, climate, plants, and animals. There are land biomes and water biomes.
breathe	To take in and push out air
camouflage	The disguising of people, animals, or things, to make them look like what is around them
Celsius	The metric system for measuring temperature
centimeter	A unit of length in the metric system
characteristic	Showing a special feature or quality
classify	To put into groups or classes; sort
clay	A firm kind of earth made up of small particles
climate	The usual weather that occurs in a place, including the average temperature and amounts of rain or wind
collect data	To gather information
compare	Discuss similarities and differences of items
conclusion	A decision made after careful thinking
condense	To make more dense or compact
condensation	The action of changing from a gas into a liquid
conduct (an experiment)	To lead, guide, or direct an experiment
conserve	To use carefully, not to waste
cork	A light, spongy bark
cycle	A series of events that is regularly repeated in the same order
data	Facts or figures collected during an experiment
decrease	To make or become less or smaller
describe	To use words to explain how something looks, feels or acts
determine	To make a decision

diagram	A drawing that shows how something works
displacement	To remove from the normal position or location
dissolve	To mix thoroughly To change from a solid to a liquid
draw a conclusion	Analysis of results from an experiment
droplets	A small quantity of liquid
drought	The lack of water
ecosystem	A balance of plants and animals living and working together in a self contained environment
environment	Surroundings and conditions that effect natural processes
erode, erosion	To wear away or become worn
evaporate	To change into a vapor or gas
evaporation	The action of a liquid changing into a gas
evidence	Facts or signs that help one find out the truth
experiment	A procedure that is carried out to investigate a scientific question
explain, explanation	To make clear or understandable
explore	To go into a travel through an unknown place
extinct	No longer alive anywhere on earth
Fahrenheit	A measurement of temperature
fair test	An experiment where the variables are held consistent
findings	The results of a study or investigation
float	To be at the top of liquid or air
freeze	To change from a liquid to a solid
gas	Matter that spreads to fill the space <b>it's in</b>
germinate	To begin to grow or sprout
graduated cylinder	A cylindrical container used for measuring volume
gram	The metric unit for measuring mass
graph	A diagram used to show the relationship between things
gravity	The natural force that causes smaller objects to move towards the center of the Earth
habitat	Where an organism naturally lives
hand lens	A tool used to magnify things
hibernate, hibernation	Extended period of sleep
humid, humidity	Having a large amount of water or water vapor in the air
hypothesis	Question or purpose for conducting an experiment
identify	To find out or tell exactly who or what an object is
increase	To make or become greater or larger
insect	A tiny animal with six legs
insulate, insulator	Type of material used for keeping objects warm or cold



investigate	To study something closely and in an organized way
kilogram	One thousand grams
layer	A single thickness, a coating, or sheet of material covering a surface
length	The distance of a thing measured from one end to the other
lens	A tool used to see things clearly
life cycle	The stages in the life of a plant New plants come from older plants
liquid	Matter that flows and takes the shape of the container it is in
liter	A unit of capacity for liquids in the metric system
magnifier	To make larger
magnifying glass	A tool used to enlarge objects
mass	The amount of matter in an object
materials	Supplies
melt	Physical change of states from solid to liquid
meter, meter stick	A metric unit of linear measure
migrate, migration	To move or change location
milliliters	One thousandth of a liter
mineral	The ingredients that make up rocks
mixture	Something made by mixing
natural resources	Any substance that comes from the earth
nutrients	Something that living things need to grow and stay healthy
object	Anything that is not alive that people that people can see or touch
observe, observation	To see and pay attention to; watch
offspring	The result of animals reproducing (babies)
opinion	A belief based on what one thinks or feels; not on actual facts
organism	Any living thing such a as a plant or animal
oxygen	A colorless gas in the air that living things need to survive
pattern	Anything that repeats itself
perform an experiment	Conducting a test to prove something
photosynthesis	A process by which green plants use light energy to change carbon dioxide and water into glucose and oxygen
precipitation	Any form of water falling from a cloud
predict, prediction	A guess based on what you know so far about what you think is going to happen
procedure	Sequence of steps to perform an experiment
process	The scientific method
property	A characteristic of a material something that you can observe such as color, smell, and taste
range	The extent to which something can vary
record (data)	Something written down to preserve facts or information

recycle	To treat materials that have been thrown away in order to use them again
reflect	To give back an image of
reproduce	To produce new plants or animals
result	Something that happens because of something else; consequence
reuse	To use again
sand	Loose grains of worn rock
scale	Tool used to weigh things
scientific observation	To see and pay attention to an experiment in science
seed dispersal	The scattering of seeds
separate	To pull or take apart
sequence	The order in which things occur
sink (float)	To go down or cause to go down under the surface
soil	<b>The loose top layer of the Earth's surface</b> in which plant life can grow
solid	Matter that holds its own shape
sort	To arrange according to property such as color, class, shape, size
state of matter	Solid, liquid, or gas.
surface	The outermost layer
survive	To stay alive
temperature	Relative hotness or coldness as measured on a standard scale
tension(surface)	The skin like surface on the water that pulls it together into the smallest possible volume
testable	Able to test
texture	The look or feel of a surface
thermometer	A tool used to measure temperature
transparent	Light can pass through
volume	How much space matter takes up
water cycle	The sequence of condensation and evaporation of water on earth causing clouds and rain and other forms of precipitation
weigh, weight	The measure of how heavy something is or of the gravitational force on an object

**Content Standards & Indicators**  
**for Grade 4**



**Course Description**

<b>ELEMENTARY SCHOOL</b>				
1. Course Title <b>Grade 4 General Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed			
2. Transcript Title/Abbreviation <b>Science</b>	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media			
3. Transcript Course Code/Number N/A				
4. Program Contact Information  Name: Anita Rutlin  Title/Position: Assistant Superintendent  School: Central Office Madison Town Campus 10 Campus Drive, P.O. Drawer 71 Madison, CT 06443	6. Grade Level: 4  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable  8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)			
10. Pre-Requisites: None				
11. Brief Course Description Fourth grade science is taught in units of study throughout the school year. Students are engaged in science class through activities and investigations. As part of the spiraling curriculum, aspects of life science, earth science, and physical science are taught each year. The life science component is integrated within the Wetlands unit. The earth science unit is Earth Materials. The physical science units include Magnetism and Electricity and the Physics of Sound.				
12. Course Goals The fourth grade science program gives students the opportunity to explore topics and concepts through investigations. Participating in this hands-on program helps students: <ol style="list-style-type: none"> <li>1. To appreciate the concepts of science as part of their larger world via interdisciplinary activities.</li> <li>2. To foster a life long enjoyment of learning and the learning of science.</li> <li>3. To develop a growing appreciation for science as part of their evolving education.</li> <li>4. To ensure students meet the science standards and grade level expectations for Connecticut Public Schools.</li> </ol>				
13. Course Outline <ol style="list-style-type: none"> <li>1. Core Scientific Inquiry, Literacy and Numeracy</li> <li>2. Energy Transfer and Transformations: Physics of Sound</li> <li>3. Matter and Energy in Ecosystems: Wetlands</li> <li>4. The Changing Earth: Earth Materials</li> <li>5. Science and Technology in Society: Magnetism and Electricity</li> </ol>				
14. Instructional Methods and/or Strategies <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Full class instruction and discussions</li> </ul> </td> <td style="width: 50%; border: none;"> <ul style="list-style-type: none"> <li>▪ Modeling</li> <li>▪ Guided inquiry activities and investigations</li> </ul> </td> </tr> </table>			<ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Full class instruction and discussions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Modeling</li> <li>▪ Guided inquiry activities and investigations</li> </ul>
<ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Full class instruction and discussions</li> </ul>	<ul style="list-style-type: none"> <li>▪ Modeling</li> <li>▪ Guided inquiry activities and investigations</li> </ul>			
15. Assessment Methods and/or Tools <ul style="list-style-type: none"> <li>▪ Quizzes and Unit assessments</li> <li>▪ Embedded task and assessments in class activities and investigations</li> </ul>				
16. Assessment Criteria The common assessments are based on the Madison curriculum and Connecticut standards and grade level expectations for science. For authentic assessments and projects, students are given a rubric or checklist of grading criteria before doing the work. A variety of assessment tools are employed to get the most accurate understanding of individual student achievement possible.				

<b>LEARNING STRAND</b> <b>Unit: Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific Inquiry is a thoughtful and coordinated attempt, to search out, describe, explain, and predict natural phenomena.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you develop testable questions?</li> <li>▪ How do you make observations about objects, organisms, and the environment?</li> <li>▪ How do you design and conduct simple investigations employing simple equipment and measuring tools to gather data and extend the senses?</li> <li>▪ How do you use data to construct reasonable explanations?</li> <li>▪ How do you use mathematics to analyze, interpret, and present data?</li> <li>▪ How do you analyze, critique and communicate investigations using words, graphs and drawings?</li> <li>▪ How do you locate relevant science information when searching the Web?</li> </ul>
<b>KNOWLEDGE &amp; LEARNING</b> <i>The student will ...</i> <ul style="list-style-type: none"> <li>▪ Identify questions that can be answered through scientific investigation.</li> <li>▪ Make predictions.</li> <li>▪ Design a simple investigation to test a question.</li> <li>▪ Use tools and techniques that are appropriate for the design of the investigation for making observations and gathering data.</li> <li>▪ Accurately collect and record appropriate data.</li> <li>▪ Use mathematical operations to analyze and interpret data.</li> <li>▪ Interpret and create appropriate graphs to present relationships between variables.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Report findings and conclusions in various formats using relevant vocabulary and supporting evidence.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> FOSS and Delta Science Modules
	<b>INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Guided-inquiry activities and investigations</li> <li>▪ Guided internet research</li> <li>▪ Performance tasks</li> </ul>
	<b>ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Connecticut Framework <b>embedded task "Go with the Flow"</b></li> <li>▪ Research projects/activities</li> <li>▪ Inquiry literacy questions</li> </ul>

<b>LEARNING STRAND: Energy Transfer and Transformations</b> - <i>What is role of energy in our world?</i> <b>Unit: Physics of Sound</b> <i>CT Standard 5.1 - Sound and light are forms of energy.</i>	
<p><b>ENDURING UNDERSTANDING</b></p> <p>Sound is a form of energy that is produced by the vibration of objects and is transmitted by the vibration of air and objects.</p>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are the properties of sound that make them identifiable?</li> <li>▪ How are sounds made?</li> <li>▪ How are volume and pitch different?</li> <li>▪ How does the length affect the rate of vibration and therefore the pitch?</li> <li>▪ How does tension affect the rate of vibration and therefore the pitch?</li> <li>▪ What materials and variables affect how you hear sound?</li> <li>▪ How does sound travel?</li> <li>▪ How is sound affected when it travels through the three states of matter?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b></p> <p><i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>▪ There are a variety of sounds in our environment. Sounds have characteristics --loudness, pitch and quality, <b>timbre</b>, that allow them to be identified.</li> <li>▪ For sound to occur, there must be a vibrating object, a material through which the vibrations are transferred e.g., air or water, and a receiver e.g., an ear, to perceive the sound.</li> <li>▪ Objects can be caused to vibrate by actions i.e., striking, strumming, bowing, plucking or blowing.</li> <li>▪ Sounds can vary in loudness, <b>volume</b>. Volume is affected by the strength of the force causing the vibration. For example, striking a drum forcefully or gently produces sounds with different volumes.</li> <li>▪ Sounds can have a high or low tone, <b>pitch</b>. Pitch depends on the speed of the vibration. Objects that vibrate quickly have a high pitch, while those that vibrate slowly have a low pitch.</li> <li>▪ Pitch is affected by characteristics such as the shape, length, tension or thickness of the vibrating material e.g., the vibrating material may be a string, a glass, a wire or a drum.</li> <li>▪ Sound travels (is <b>transmitted</b>) through materials by causing them to vibrate. Sound is not transmitted if there are no materials to vibrate. Solids, liquids and gases (air) transmit sound differently.</li> <li>▪ Sounds can be reflected or absorbed, depending on the properties of the material it hits.</li> <li>▪ Sound tends to bounce off smooth, hard surfaces, producing an echo; sound tends to be absorbed by soft, porous surfaces, producing a muffled sound.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p>FOSS – “Physics of Sound”  STOMP Curriculum Guide  <b>Literacy:</b> <u>Adventures in Sound with Max Axiom, Super Scientist</u> by Emily Sohn  High touch high tech: <i>Vibes</i></p> <hr/> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ <i>FOSS Investigation 1 Dropping In</i></li> <li>▪ Part 1 Drop Challenge</li> <li>▪ <b>Part 3 Sound and Vibrations &amp; STOMP “Salt Voice Prints”</b></li> <li>▪ <i>FOSS Investigation 2 Good Vibrations</i></li> <li>▪ Part 1 Vibration and Pitch</li> <li>▪ Part 2 Length and Pitch &amp; Exploratorium “Sound Sandwich”</li> <li>▪ Part 3 Tension and Pitch</li> <li>▪ <i>FOSS Investigation 3 How Sound Travels</i></li> <li>▪ <b>STOMP Lesson 6 “How Sounds Get Where They’re Going”</b></li> <li>▪ Part 1: Sounds through Air and Water</li> <li>▪ Part 2 Sounds Through Solids</li> <li>▪ <i>FOSS Investigation 4</i></li> <li>▪ Part 1 Sound Challenges</li> <li>▪ <b>STOMP Lesson 3 “Amplifying Sounds”</b></li> </ul> <hr/> <p><b>ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Responses to Investigations and Assessment <b>Questions in student’s</b> Science Journal: <ul style="list-style-type: none"> <li>-Response Sheet: Dropping In</li> <li>-Science Journal: How are sounds made? What happens to make a sound louder or quieter? Describe in words and draw a picture.</li> </ul> </li> <li>▪ Response Sheet: Good Vibrations</li> <li>▪ Science Journal: What happens to the pitch and vibrations when the length of the sound source</li> </ul>

	<p>changes?</p> <ul style="list-style-type: none"> <li>▪ Science Journal: What happens to the pitch when the tension on a sound source changes? What happens to the pitch when different thicknesses of string or rubber bands are plucked?</li> <li>▪ Sounds through Air Investigation Student Sheet No.13</li> <li>▪ Sounds Through Water Investigation Student Sheet No. 14</li> <li>▪ Sounds Through Solids Investigation Student Sheet No. 16</li> <li>▪ Assessment: Rubber-Band Instrument</li> <li>▪ Science Journal: Which types of materials reflect sound well? Which types of materials absorb sound? How could you tell?</li> <li>▪ <u>Sound Assessment</u></li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ul style="list-style-type: none"> <li>▪ Generalize that vibrating objects produce sound if the vibrations are transferred from the object through another material (e.g., air, solid, and liquid).</li> <li>▪ Demonstrate how the loudness, pitch and quality/timbre of sound can be varied.</li> <li>▪ Design and conduct investigations to determine factors that affect pitch.</li> <li>▪ Describe the properties of materials that reflect or absorb sound.</li> <li>▪ Analyze properties of materials that cause sound to be reflected or absorbed, then apply findings to design a device that reflects or absorbs sound.</li> <li>▪ Construct simple musical instruments (e.g., rubber band guitars, drums, etc.) that produce sounds with various pitches, volume and timbres.</li> </ul> <p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe the factors that affect the pitch and loudness of sound produced by vibrating objects.</li> <li>▪ Describe how sound is transmitted, reflected and/or absorbed by different materials.</li> </ul>
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**SCIENTIFIC LITERACY TERMINOLOGY:** vibration, volume, pitch, transmit, reflect, absorb

**KEY SCIENCE VOCABULARY:** amplitude, amplification, frequency, transfer, intensity, quality, resonant frequencies, nodes, waves  
Volume: loudness or softness



<p><b>LEARNING STRAND: Matter and Energy in Ecosystems</b> - <i>How do matter and energy flow through ecosystems?</i>  <b>Unit: Wetlands</b>  <i>CT Standard 4.2 - All organisms depend on the living and nonliving features of the environment for survival.</i></p>	
<p><b>ENDURING UNDERSTANDING</b>                  When the environment changes, some organisms survive and reproduce and others die or move to new locations.</p>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are the characteristics of wetlands and why are they important to wildlife and humans?</li> <li>▪ How do temperature, soil, and wildlife vary in different locations moving from the ocean beach to the salt marsh?</li> <li>▪ What physical and behavioral characteristics of wildlife such as beavers, birds, fiddler crabs, and snails allow them to thrive in wetland habitats?</li> <li>▪ What are the structures of plants such as cattails, quillwort, and glasswort that help them thrive in wetland habitats?</li> <li>▪ What are the components of a salt marsh food chain and what are the steps in this cycle?</li> <li>▪ What are the components of a food web in a salt marsh and how are they interconnected?</li> <li>▪ How does habitat loss and degradation affect populations of migrating water birds?</li> <li>▪ How are the lives of the plants and animals in the salt marsh affected by the changing tides, and how are these organisms equipped to live in this dynamic ecosystem?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>▪ Living and nonliving things interact in land and water environments called ecosystems. Every ecosystem has certain conditions (abiotic factors) and a variety of living things (<b>organisms</b>) that are adapted for survival in those conditions. <b>Abiotic factors</b> include the quality and amount of air, sunlight, water and soil, as well as the terrain and climate.</li> <li>▪ Organisms depend on other organisms and on the nonliving things in an ecosystem to meet their basic needs for food, water and protection.</li> <li>▪ Plants use energy from the sun to produce their own food from air and water. The type of soil, amount of water and temperature range in an area determine the plants that grow there.</li> <li>▪ Animals that live in an area get their energy and nutrients either directly or indirectly from plants that grow there; <b>herbivores</b> consume only plants, <b>carnivores</b> consume animals, and <b>omnivores</b> consume both animals and plants. <b>Decomposers</b> consume plant and animal waste and remains, returning</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ <a href="#">Project WILD Aquatic K-12 Curriculum and Activity Guide</a></li> <li>▪ <a href="#">WOW! The Wonders of Wetlands, An Educator's Guide</a></li> <li>▪ Department of Environmental Protection guided Field Studies</li> <li>▪ Project Learning Tree Activity Guide</li> <li>▪ <b>Literacy:</b> <a href="#">Weird Friends</a> by Jose Aruego &amp; Ariane Dewey. Gulliver Books; <a href="#">Marvels in the Muck</a> by Doug Wechsler; <a href="#">Animal Survivors of the Wetlands</a> by Barbara Somerville; <a href="#">Marshes and Swamps</a> by Phillip Johansson; <a href="#">Butternut Hollow Pond</a> by Brian Heinz; <a href="#">Saving Oceans and Wetlands</a> by Jen Green</li> <li>▪ <a href="#">Oil Spill!</a> by Melvin Berger &amp; Paul Mirocha</li> </ul> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Field Study (Fall and Spring) at Hammonasset State Park in wetlands environment</li> <li>▪ <a href="#">Fall Field Study Activities</a>:                         <ul style="list-style-type: none"> <li>- Marsh Munchers, Aquatic WILD, p.34</li> <li>- Hot Foot, Adapted from VA: Your Backyard Classroom</li> <li>- Marsh March, Adapted from VA: Your Backyard Classroom</li> <li>- Wetlands Weirdos (Fiddler Crabs/Glasswort)</li> </ul> </li> </ul>

**nutrients** to the soil where they are used again by plants.

- **Some of the sun's energy is transferred** from one organism to another when a plant or animal is consumed by another animal. A **food chain** is a simple model that illustrates the passage of energy from one organism to another. **Food webs** are more realistic models that show the varied energy-passing relationships among plants and animals in an ecosystem.
- Environments are always changing. Some changes occur naturally; examples include disease outbreaks, violent storms, forest fires sparked by lightning. Other changes are caused by human activity; examples include establishing conservation areas, passing laws to control pollution, clearing forests for agriculture or construction, applying chemicals to lawns and crops, burning fossil fuels, etc.
- Changes in an environment are sometimes beneficial to organisms and sometimes harmful. For example, a newly created beaver pond provides habitat that attracts frogs and raccoons to an area; but trees, earthworms and moles are no longer able to survive in the area.
- When environments change, some organisms can accommodate the change by eating different foods or finding different shelters e.g., hawks nest on city buildings and consume pigeons and rats. Those organisms that can no longer meet their basic needs die or move to new locations.

- *Spring Field Study Activities*:
  - Wetlands Metaphors, Aquatic WILD (Refresher)
  - Just Ducky, Flying WILD
  - Basics of Birding
  - Bird Behavior Scavenger Hunt, Flying WILD
  - Migration Headache, Aquatic WILD, p. 15
- *Classroom Instructional Activities*:
  - "Wetland Metaphors," Project WILD Aquatic p.39
  - "Marsh Market" part II: "What's for Lunch?" WOW: Wonders of Wetlands p.111
  - "Marsh Munchers" Project WILD Aquatic p.34
  - "Crash: A Tale of Two Species" video thirteen WNET NY cpb
  - "Marsh Market" part I: "Make a "Living" Wetland Food Web" WOW: Wonders of Wetlands p.109
  - "Salt Marsh Players", Project WET p.99
  - "Hydropoly" WOW: Wonders of Wetlands p.260
  - "Bill Nye: Wetlands" Video

#### ASSESSMENT METHODS

- Performance assignments are designed to evaluate student participation and comprehension, including posters, models, webs, and chains.
- Response to assessment questions in **student's Science Notebooks**
- *Life in a Salt Marsh* project

#### GRADE LEVEL EXPECTATIONS

Assessments MUST measure the ability of students to:

- Give examples of ways that living and nonliving things are interdependent within an ecosystem.
- Draw diagrams showing **how the sun's energy** enters and is transferred from producers to consumers in a local land or aquatic food chain.
- Design and conduct simple investigations to record interactions among producers, consumers, herbivores, carnivores, omnivores and decomposers in an ecosystem.
- Analyze food webs to describe how energy is transferred from plants to various animals in an ecosystem.
- Distinguish between naturally occurring changes in ecosystems and those caused by human activity.
- Predict the effect an environmental change, such as drought or forest destruction, might have on the community of living things.

**CMT CORRELATIONS**

- Describe how animals, directly or indirectly, depend on plants to provide the food and energy they need in order to grow and survive.
- Describe how natural phenomena and some human activities may cause changes to habitats and their inhabitants.

**SCIENTIFIC LITERACY TERMINOLOGY:** ecosystem, habitat, organism, abiotic factors, nutrients, producer, consumer, herbivore, carnivore, omnivore, decomposer, food chain, food web

**KEY SCIENCE VOCABULARY:** tertiary consumer, secondary consumer, primary consumer, primary producer, hydrology, marsh, wetland



<p><b>LEARNING STRAND: The Changing Earth</b> - <i>How do materials cycle through the Earth's systems?</i>  <b>Unit: Earth Materials</b>  <i>CT Standard 3.3 - Earth materials have different physical and chemical properties.</i></p>	
<p><b>ENDURING UNDERSTANDING</b>  Rocks and minerals have properties that may be identified through observation and testing; these properties determine how earth materials are used.</p>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How is inquiry used to investigate our environment?</li> <li>▪ How do rocks and minerals cycle through our environment?</li> <li>▪ What are the three types of rocks and how are they formed?</li> <li>▪ What properties can we use to describe and classify rocks?</li> <li>▪ What properties can we use to identify minerals?</li> <li>▪ What are the similarities and differences between rocks and minerals?</li> <li>▪ How can you use different tools to determine the hardness a rock?</li> <li>▪ Based on specific properties, what are the best uses for different rocks and minerals?</li> <li>▪ What can you conclude when one mineral can scratch another?</li> <li>▪ What kind of tests can be conducted to determine what minerals are inside a rock?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>▪ <b>Earth is mainly made of rock.</b> Rocks on the earth's surface are constantly being broken down into smaller and smaller pieces, from mountains to boulders, stones, pebbles and small particles that make up soil.</li> <li>▪ Rocks can be sorted based on properties, such as shape, size, color, weight or texture.</li> <li>▪ Properties of rocks can be used to identify the conditions under which they were formed.</li> <li>▪ <b>Igneous</b> rocks are formed when melted rock cools, hardens and forms crystals. Melted rock that cools slowly inside a volcano forms large crystals as it cools. Melted rock that cools rapidly <b>on the earth's surface forms small crystals</b> (or none at all).</li> <li>▪ <b>Sedimentary</b> rocks are formed underwater when small particles of sand, mud, silt or ancient shells/skeletons settle to the bottom in layers that are buried and cemented together over a long period of time. They often have visible layers or fossils.</li> <li>▪ <b>Metamorphic</b> rocks are formed when igneous or sedimentary rocks are reheated and cooled or pressed into new forms. They often have bands, streaks or clumps of materials.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ FOSS – “Earth Materials”</li> <li>▪ <i>Sedimentary Rocks, Igneous Rocks, Metamorphic Rocks, The Rock Cycle</i></li> <li>▪ <b>Bill Nye The Science Guy “Rocks &amp; Minerals”</b></li> <li>▪ <u>The Pebble in My Pocket</u> by Meredith Hooper</li> <li>▪ <u>Rocks in His Head</u> by Carol Otis Hurst</li> <li>▪ <u>Everybody Needs a Rock</u> by Byrd Baylor</li> </ul> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ FOSS Investigation 1 Mock Rocks</li> <li>▪ Part 1 Investigating Mock Rocks</li> <li>▪ Part 2 Taking Rocks Apart</li> <li>▪ Part 3 Observing Crystals</li> <li>▪ FOSS Investigation 2 Scratch Test</li> <li>▪ Part 1: Observing Minerals</li> <li>▪ Part 2: Testing for Hardness</li> <li>▪ Part 3: Observing Crystals (second activity)</li> <li>▪ FOSS Investigation 3 Calcite Quest</li> <li>▪ Part 1: Detecting Calcite</li> <li>▪ Part 2: Looking for More Evidence</li> <li>▪ <b>FOSS Science Stories: Earth Materials “Where Do Rocks Come From?” Investigation #4 p.34</b></li> <li>▪ Browse websites listed in Pacing Guide</li> <li>▪ Sedimentary Rocks</li> <li>▪ Igneous Rocks</li> <li>▪ Metamorphic Rocks</li> </ul>

- Rock properties make them useful for different purposes. Rocks that can be cut into regular shapes are useful for buildings and statues; rocks that crumble easily are useful for making mixtures such as concrete and sheetrock.
- All rocks are made of materials called minerals that have properties that may be identified by testing. Mineral properties include color, odor, streak, luster, hardness and magnetism.
- Minerals are used in many ways, depending on their properties. For example, gold is a mineral that is easily shaped to make jewelry; talc is a mineral that breaks into tiny grains useful for making powders.
- Earth materials that occur in nature include rocks, minerals, soils, water and gases of the atmosphere. Earth materials are natural resources that provide us with things we need to live, including food, clothing, water, air, shelter, land and energy.
- Some natural materials are useful to people in their raw form e.g., fresh water, soil or air. Other natural resources must be modified to meet human needs e.g., petroleum must be extracted from rocks and refined into gasoline, heating oil or plastics; wood from trees must be processed to make paper.

- *The Rock Cycle*
- **Literacy:** Rocks in His Head by Carol Otis Hurst
- FOSS Investigation 4 Take It for Granite (optional)
- Interactive Site: Learning Zone : Rock Cycle <http://www.oum.ox.ac.uk/thezone/rocks/cycle/index.htm#map>
- Interactive Rock Cycle Animation (optional) [www.classzone.com/books/earth\\_science/terc/content/investigations/es0602/es0602page02.cfm](http://www.classzone.com/books/earth_science/terc/content/investigations/es0602/es0602page02.cfm)
- Make rock candy (optional guided lesson) This activity takes several days to see the desired results and if chosen needs to be done early in the unit. The lesson takes one period but observations are done for 3-10 days.
- Fieldtrip of CT Geology (Joe Oslander)  
Take students on a bus tour of various rock formations:  
-Great Eastern Border Fault on Route 79 – sedimentary & metamorphic rocks  
-Lake Quonnipaug (North Madison) – sedimentary & igneous rocks

#### **ASSESSMENT METHODS**

- Teacher observations
- Rock information organizer for each type of rock – igneous, sedimentary, and metamorphic
- Maintain responses to investigations and discussions **in student's science notebook**
- Rocks and Minerals Unit Assessment
- Constructed Response- What are the three types of rocks and how are they formed?
- Constructed Response- Describe the process in which earth materials change.
- Constructed Response- Draw conclusions and defend the best uses for several (3 or more) rock properties.
  - Mock Rocks Response Sheet (No. 11)
  - Scratch Test Response Sheet (No. 15)
  - Mineral Properties Response Sheet (No. 14)
  - Calcite Quest Response Sheet (No.17)
  - Performance Assessment Scratch Test (No.7)
  - Performance Assessment Vinegar Test (No.8)

#### **GRADE LEVEL EXPECTATIONS**

Assessments MUST measure the ability of students to:

- Differentiate between rocks and minerals.
- Use the senses and simple measuring tools to gather data about various rocks and classify them based on observable properties (e.g., shape, size, color, weight, visible markings).
- Conduct simple tests to determine properties of different minerals (e.g., color, odor, streak, luster, hardness, magnetism), organize data in

	<p>a table, and use the data and other resources to identify unknown mineral specimens.</p> <ul style="list-style-type: none"> <li>▪ Summarize nonfiction text to compare and contrast the conditions under which igneous, metamorphic and sedimentary rocks are formed.</li> <li>▪ Observe and analyze rock properties (e.g., crystal size or layers) to infer the conditions under which the rock was formed.</li> <li>▪ Evaluate the usefulness of different rock types for specific applications (e.g., construction, countertops, statues or monuments).</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe the physical properties of rocks and relate them to their potential uses.</li> <li>▪ Relate the properties of rocks to the possible environmental conditions during their formation.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** property, classify, texture, igneous, sedimentary, metamorphic, fossil, crystal, mineral, natural resources

**KEY SCIENCE VOCABULARY:** magma, extrusive, intrusive, sediment, streaks, luster, magnetism





<b>LEARNING STRAND: Energy Transfer and Transformations</b> - <i>What is the role of energy in our world?</i> <b>Unit: Electricity and Magnetism</b> <i>CT Standard 4.4 – Electrical and magnetic energy can be transferred and transformed.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Electricity in circuits can be transformed into light, heat, sound and magnetic effects.</li> <li>▪ Magnets can make objects move without direct contact between the object and the magnet.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What kind of materials do magnets attract?</li> <li>▪ What happens when you bring two or more magnets together?</li> <li>▪ How do magnets interact with other objects?</li> <li>▪ Does an iron object have to touch a magnet to become a temporary magnet?</li> <li>▪ Does magnetic force go through all materials?</li> <li>▪ How do you get electricity from a source to a receiver?</li> <li>▪ How does electricity flow through a circuit?</li> <li>▪ What does a switch do in a circuit?</li> <li>▪ How do batteries and wires conduct electricity to light a bulb and make a motor run?</li> <li>▪ What types of materials are conductors of electricity and what materials are insulators?</li> <li>▪ How do you make a magnet that turns on and off? (combine understanding of electricity and magnetism)</li> <li>▪ How can the strength of an electromagnet be changed?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>     <i>Students should understand that...</i></p> <p>GRADE LEVEL CONCEPT 4.4.b.</p> <ul style="list-style-type: none"> <li>▪ Magnets pull on (<i>attract</i>) objects made of iron or that have iron in them. Materials can be identified using magnets, and mixtures of materials can be separated using magnets. (CT 3.1 Standard – Some materials are attracted to magnets. Magnetic materials contain iron.)</li> <li>▪ Some areas of a magnet have stronger magnetic attraction than other areas.</li> <li>▪ Magnets can pull (attract) or push (repel) other magnets.</li> <li>▪ The ends of a magnet are called <i>poles</i>. A magnet's poles are often referred to as <i>north</i> and <i>south</i>. When the <u>north</u> pole of one magnet is placed near the <u>north</u> pole of another magnet, they repel each other; when the <u>south</u> pole of one magnet is placed near the <u>south</u> pole of another magnet, they repel each other; when the <u>north</u> pole of one magnet is placed near the <u>south</u> pole of another magnet, they attract each other.</li> <li>▪ A magnet's push or pull can cause a magnetic object or another magnet to move without direct contact. The strength of a magnet's attractive force can be measured by recording the number or mass of the objects it attracts or the distance</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ FOSS "Magnetism and Electricity"</li> <li>▪ www.fossweb.com</li> <li>▪ Delta Science Content Reader <i>Electricity and Magnetism</i></li> <li>▪ School visit by Connecticut Light and Power including "Electrical Safety World" booklets and lesson plans.</li> </ul> <p><b>INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ FOSS Investigation 1-<i>The Force</i></li> <li>▪ Part 1: Investigating Magnets &amp; Materials Steps 9-22 Sheet #3 Magnetic Observations; Science Journal</li> <li>▪ FOSS Investigation 2 – <i>Making Connections</i></li> <li>▪ Part 1: Lighting a Bulb</li> <li>▪ Part 2: Making a Motor Run</li> <li>▪ Part 3: Finding Conductors and Insulators; Science Journal Sheet #10</li> <li>▪ FOSS Investigation 3 – <i>Advanced Connections</i></li> <li>▪ Part 1: Building Series Circuits</li> <li>▪ FOSS Investigation 4 – <i>Current Attractions</i></li> <li>▪ Part 1 Building an Electromagnet</li> <li>▪ Part 2 Changing Number of Winds Sheet #18 "Winding Electromagnets"</li> <li>▪ Delta Science Content Reader: <i>Electricity and Magnetism</i></li> </ul>

across which it attracts objects.

- When a magnet, or a magnetized object such as a compass needle, is allowed to swing freely, its **ends will point toward the earth's magnetic north and south poles.**
- Magnets and electromagnets have many uses in everyday life. Examples may include paper clip containers, refrigerator door seals, shower curtain weights, or a compass.

GRADE LEVEL CONDEPT 4.4.a.

- Electric current flows (*is transferred*) from an energy source (*battery*) through a continuous loop (*circuit*) and back to the source. A complete circuit (*closed circuit*) forms a closed loop that allows electric current to flow; an incomplete circuit (*open circuit*) has a break in the loop that prevents the flow of electric current.
- Complete circuits can be made by connecting wires, batteries and bulbs in certain sequences. Circuits are completed only when certain parts of a battery, a bulb or a wire are touching (*making contact*). Circuit diagrams show the relative positions of batteries, bulbs and wires in complete circuits.
- Conductors are materials that allow electric current to flow through them in an electric circuit. An open circuit can be completed by inserting a conductive material. If a bulb stays lit when an object is added to an electric circuit, the material is a conductor.
- Insulators are materials that do not allow electric current to flow through them in an electric circuit. If a bulb does not stay lit when an object is added to an electric circuit, the material is an insulator.
- Conductors can be tested to compare how easily they allow electricity to flow through them.
- Electrical energy is changed (*transformed*) into light and heat energy as it passes through a bulb in a circuit. Electrical energy can be transformed into sound energy as it passes through a bell or a radio in a circuit.
- Adding batteries or bulbs to a circuit can produce observable changes.
- Electricity flowing through an electrical circuit produces magnetic effects in the wires. The electromagnet can be turned on and off, and its strength can be varied and measured.

#### ASSESSMENT METHODS

- Responses to Assessment Questions in student's Science Journal
- Science Journal: Sheet #7 "The Flow of Electricity"
- Science Journal: Sheet #9
- Science Journal: Sheet #10
- Science Journal: Sheet #16 "Response Sheet Circuit Design"
- Science Journal: Sheet #18 "Winding Electromagnets"
- Delta Science Content Reader *Electricity and Magnetism* Booklet Test
- Curriculum Embedded Performance Task, Content Standard 4.4, **Go With the Flow** (mandatory)
- Magnetism and Electricity Assessment

#### GRADE LEVEL EXPECTATIONS

Assessments MUST measure the ability of students to:

- Construct complete (closed) and incomplete (open) series circuits in which electrical energy is transformed into heat, light, sound and/or motion energy.
- Draw labeled diagrams of complete and incomplete circuits and explain necessary components and how components must be arranged to make a complete circuit.
- Predict whether diagrammed circuit configurations will light a bulb.
- Develop a method for testing conductivity and analyze data to generalize that metals are good electrical conductors and nonmetals are not.
- Observe magnetic effects associated with electricity and investigate factors that affect the strength of an electromagnet.
- Describe materials that are attracted by magnets.
- Design procedures to move objects and separate mixtures of solids by using magnets.
- Investigate how magnets react with other magnets and analyze findings to identify patterns in the interactions between north and south poles of magnets.
- Give examples of uses of magnets (e.g., motors, generators, household devices).

#### CMT CORRELATIONS

- Describe how batteries and wires can transfer energy to light a bulb.
- Explain how simple electrical circuits can be used to determine which materials conduct electricity.
- Describe the properties of magnets, and how they can be used to identify and separate mixtures of solid materials.

**SCIENTIFIC LITERACY TERMINOLOGY:** magnet, attract, repel, iron, pole, force, electric current, energy source, battery, contact, complete (closed) circuit, incomplete (open) circuit, conduct, insulate, insulator

**KEY SCIENCE VOCABULARY:** electric circuit, contact, circuit, insulation, filament, Fahnestock clip  
conductor: through which current electricity passes easily  
electromagnet: a temporary magnet made when electric current flows through a wire coil wrapped around an iron or steel core  
generator: a device that uses motion to produce electric current  
magnetic field: the area around a magnet where its force to attract metals acts  
parallel circuit: a circuit that has more than one path for electric current to follow  
series circuit: a circuit that has only one path for electric current to follow



## SCIENTIFIC LITERACY TERMINOLOGY: Grade 4

This list is intended as a guide for teachers. While not exhaustive, it includes vocabulary that should be used, as appropriate, by teachers and students during everyday classroom discourse. It is not intended for student memorization.

absorb	To take in, soak up
adaptation (adapt)	The process of changing to new conditions which can be physical or behavioral
attract	To draw in by physical force
average	The typical, usual, or ordinary result of a set of data
balance	A device for weighing things
battery	A source of electricity
binoculars	A device that magnifies a far away object (such as a bird)
camouflage	The disguising of people, animals, or things, to make them look like what is around them
Celsius	The metric system for measuring temperature
centimeter	A unit of length in the metric system
characteristic	Showing a special feature or quality
circuit	A pathway through which electric current flows
classify	To put into groups or classes; sort
climate	The usual weather that occurs in a place, including the average temperature and amounts of rain or wind
collect data	To gather information using tables and charts
compare	Discuss similarities and differences of items
conclusion	A decision made after careful thinking using evidence to support opinion
conduct (an experiment)	To lead, guide, or direct an experiment
conserve	To use carefully, not to waste
crystal	A regularly shaped piece with angles and flat surfaces into which many substances solidify
cycle	A series of events that is regularly repeated
data	Facts, figures, and observations that are recorded from an experiment
decrease	To make or become less or smaller
describe	To use words to explain how something looks, feels or acts
determine	To make a decision
diagram	A labeled drawing that shows how something works
dissolve	To mix thoroughly with a liquid
draw a conclusion	Analysis of results from an experiment
ecosystem	A balance of plants & animals living & working together in a particular environment

environment	Surroundings and conditions that effect natural processes
erode, erosion	To wear away or become worn
evaluate	To find out, judge, or estimate the value of
evidence	Facts or data that help support a conclusion
experiment	A procedure that is carried out to investigate a scientific question
explain, explanation	To make clear or understandable
explore	To examine in order to discover
extinct	No longer alive anywhere on earth
Fahrenheit	A customary measurement of temperature
fair test	An experiment where all but one the variables are held constant
findings	The results of a study or investigation
force	Force sets an object in motion by direct contact (push or pull) or indirect contact (air, magnets or gravity)
gills	The organ of a fish that is used for breathing
graduated cylinder	A cylindrical container used for measuring volume
gram	The metric unit for measuring mass
guitar string	The part of a guitar that is plucked with the fingers or a pick
habitat	Where an organism naturally lives
hand lens	A tool used to magnify things
hibernate	Extended period of sleep
hypothesis	Question or purpose for conducting an experiment
identify	To find out or tell exactly who or what an object is
increase	To make or become greater or larger
insulate, insulator	A material that prevents the flow of electricity
investigate	To study something closely and in an organized way
kilogram	A metric measurement of mass equal to thousand grams
layer	A single thickness or deposit of material
length	The distance of a thing measured from one end to the other
lens	A tool used to see things clearly
life cycle	The stages in the life of an organism
liter	A unit of capacity for liquids in the metric system
magnet	An object that is attracted to iron, cobalt, and nickel
magnifier	To tool to make an object appear larger
magnifying glass	A tool used to enlarge objects
mass	The amount of matter in an object
materials	Supplies
metal	A substance that usually has a shiny surface, can be melted, and can conduct heat and electricity

metamorphosis	A complete change in appearance or form
meter, meter stick	A metric unit of linear measure.
migrate	To move or change location
migration	The movement of populations
milliliters	One thousandth of a liter
mineral	An ingredient of rock that cannot be broken down further
mixture	Something made by mixing
natural resources	Any substance that comes from the earth
nutrients	Something that living things need to grow and stay healthy
object	Anything that is not alive that people can see or touch
observe, observation	To see and pay attention to; watch
offspring	The result of animals reproducing (babies)
opinion	A belief based on what one thinks or feels; not on actual facts
organism	Any living thing such as a plant or animal
oxygen	A colorless gas in the air that living things need to survive
particles	Very small piece or amount; a speck Ex: grain of sand
pattern	Anything that repeats itself
pebble	A small round stone
perform an experiment	Conducting a test to prove something
photosynthesis	A process by which green plants use light energy to change carbon dioxide and water into glucose and oxygen
pitch (sound)	A highness or lowness of a musical sound
pluck (a string)	To pull at or let go; sharp pull or tug
predict, prediction	A guess based on what you know so far about what you think is going to happen
pressure	Force applied by one object to another object that is touching
procedure	Sequence of steps to perform an experiment
process	A series of steps that lead to a result (scientific method)
property	A characteristic of a material something that you can observe such as color, smell, and taste
range	The extent to which something can vary
record (data)	Something written down to preserve facts or information
recycle	To treat materials that have been thrown away in order to use them again
reflect	To send back light rays, heat, or sound from a surface
repel	When two magnets come together to push apart
reproduce	To produce new plants or animals
result	Something that happens because of something else; consequence
reuse	To use again
sand	Loose grains of worn rock

scale	Tool used to weigh objects
scientific observation	To look carefully, to analyze in an experiment in order to collect data
seed dispersal	The scattering of seeds
separate	To pull or take apart
sequence	The order in which things occur
soil	To go down or cause to go down under the surface
solid	Having a definite shape and mass Not liquid or gas
sort	To arrange according to property such as color, size, shape, class
stopwatch	Used for measuring short periods of time precisely
strum (a string)	Play on a string instrument by stroking the strings lightly with the fingers
surface	The outermost layer
survive	To stay alive
temperature	Relative hotness or coldness as measured on a standard scale
tension	Act of stretching or the condition of being stretched
testable	Able to test
texture	The look or feel of a surface
thermometer	A tool used to measure temperature
transparent	Light can pass through
vibrate, vibration	To move or cause to move back and forth rapidly
weigh, weight	To measure the mass or the gravitational force on an object



## Science Grade 4

### Fiction and Nonfiction Books for Science in the Library

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#### Earth Materials Science Unit

The Pebble in My Pocket by Meredith Hooper  
Rocks in His Head by Carol Otis Hurst  
Everybody Needs a Rock by Byrd Baylor

#### Wetlands Science Unit

A Day in the Salt Marsh by Kevin Kurtz  
Weird Friends: Unlikely Allies in the Animal Kingdom by Jose Aruego  
Oil Spill! By Melvin Berger and Paula Mirocha  
Marshes and Swamps: A Wetland Web of Life by Philip Johansson  
Butternut Hollow Pond by Brian J. Heinz  
Marvels in the Muck by Doug Wechsler  
Animal Survivors of the Wetlands by Barbara Somervill  
Saving Oceans and Wetlands by Jen Green

#### Magnetism and Electricity Science Unit

Electricity: From Amps to Volts by Christopher Cooper, Heinemann Library, Chicago, IL 2004  
Circuits, Shocks, and Lightning by Celeste A. Peters, Raintree Steck-Vaughn, Austin, TX 2000  
Thomas A. Edison by Paul Mason, Raintree Steck-Vaughn, New York, NY 2002

#### Physics of Sound Science Unit

Adventures in Sound with Max Axiom, Super Scientist by Emily Sohn



# **Content Standards & Indicators**

**Grades 5 - 8**



**Content Standards & Indicators**  
**for Grade 5**



**Course Description**

MIDDLE SCHOOL		
1. Course Title <b>Grade 5 General Science</b>	5. Subject Area	
2. Transcript Title/Abbreviation <b>Science</b>	<input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
3. Transcript Course Code/Number		
4. Program Contact Information  Name: Kathleen Brooks  Title/Position: Middle School Science Coordinator  School: Dr. Robert H. Brown Middle School 980 Durham Road Madison, CT 06443  Phone: 245-6475 X7082	6. Grade Level: 5	
	7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable	
	8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____	
	9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)	
10. Pre-Requisites N/A		
11. Brief Course Description The fifth grade science course is a general science course. It is part of a spiraling curriculum in which aspects of life science, physical science and earth/space science are addressed each school year. In grade five the life science topics include ecosystems and human senses. The physical science topics include the study of forces and motion and the properties of light. The earth/space science unit is a study of the Earth, moon and sun and the relationship between these celestial bodies.		
12. Course Goals The fifth grade science program is based on the belief that students should appreciate science as a process of inquiry. This is achieved through research, discussion, and hands-on experiences. Participating in an inquiry-based environment helps <ul style="list-style-type: none"> <li>▪ To foster a life long enjoyment of learning and the learning of science.</li> <li>▪ To view, through interdisciplinary connections, the concepts of science as part of the students' larger world.</li> <li>▪ To develop a growing appreciation for the outcomes of learning science as part of their evolving education.</li> <li>▪ To ensure students meet the science standards for Connecticut Public Schools.</li> </ul>		
13. Course Outline <ul style="list-style-type: none"> <li>▪ Light</li> <li>▪ Sense Perception                         <ul style="list-style-type: none"> <li>- Sight</li> <li>- Other senses</li> </ul> </li> <li>▪ Earth, Moon and Sun</li> <li>▪ Forces and Motion</li> <li>▪ Ecosystems                         <ul style="list-style-type: none"> <li>- Organisms</li> <li>- Food Chains and Food Webs</li> <li>- Connecticut Ecosystems</li> </ul> </li> <li>▪ Innovations</li> </ul>		

<p>14. Instructional Methods and/or Strategies</p> <ul style="list-style-type: none"><li>▪ Individual and small group work</li><li>▪ Full class instruction and discussions</li><li>▪ Lecture</li><li>▪ Modeling</li><li>▪ Inquiry-based activities</li><li>▪ PowerPoint presentations and notes</li><li>▪ Research</li></ul>
<p>15. Assessment Methods and/or Tools</p> <ul style="list-style-type: none"><li>▪ Pencil and paper quizzes</li><li>▪ Common unit assessments</li><li>▪ Performance assessments</li><li>▪ Lab reports</li><li>▪ Research papers and/or projects</li><li>▪ Assessments embedded in class activities</li></ul>
<p>16. Assessment Criteria</p> <p>The common assessments are based on the Madison curriculum as well as Connecticut standards and grade level expectations for science. For performance assessments and projects students are given a rubric or grading criteria before doing the work. A variety of assessment tools are employed to get the most accurate understanding of individual student achievement possible.</p>



<b>LEARNING STRAND Unit: Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How do you develop testable questions?</li> <li>▪ How do you make observations about objects, organisms, and the environment?</li> <li>▪ How do you design and conduct simple investigations employing simple equipment and measuring tools to gather data and extend the senses?</li> <li>▪ How do you use data to construct reasonable explanations?</li> <li>▪ How do you use mathematics to analyze, interpret, and present data?</li> <li>▪ How do you use words, graphs and drawings to analyze, critique and communicate investigations?</li> <li>▪ How do you locate relevant science information when searching the Web?</li> </ul>
<p><b>KNOWLEDGE &amp; LEARNING</b>     <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Identify questions that can be answered through scientific investigation.</li> <li>▪ Make predictions.</li> <li>▪ Design a simple investigation to test a question.</li> <li>▪ Use tools and techniques that are appropriate for the design of the investigation for making observations and gathering data.</li> <li>▪ Accurately collect and record appropriate data.</li> <li>▪ Use mathematical operations to analyze and interpret data.</li> <li>▪ Interpret and create appropriate graphs to present relationships between variables.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Report findings and conclusions in various formats using relevant vocabulary and supporting evidence.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ Calculators</li> <li>▪ Rulers</li> <li>▪ Protractors</li> <li>▪ Computers</li> <li>▪ Graph paper</li> <li>▪ Smart Board Technology</li> <li>▪ Sentence strips</li> <li>▪ Sharpie markers</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Inquiry activities and investigations</li> <li>▪ Guided Internet research</li> <li>▪ Integrate technology</li> <li>▪ Performance tasks</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Lab Reports</li> <li>▪ Research projects/activities</li> <li>▪ CMT-like inquiry questions</li> <li>▪ Open-ended questions requiring constructed responses</li> </ul>



<b>LEARNING STRAND Energy Transfer and Transformations</b> - <i>What is the role of energy in our world?</i> <b>Unit: Light</b> <i>CT Standard 5.1 - Sound and light are forms of energy.</i>	
<b>ENDURING UNDERSTANDING</b> <ul style="list-style-type: none"> <li>Light is a form of energy that travels in a straight line and can be reflected by a mirror, refracted by a lens, or absorbed by objects.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>Why do different materials reflect, refract or absorb light?</li> <li>How do different surfaces affect the properties of light?</li> <li>What affect do lenses have on light and the images we see?</li> <li>What affect do mirrors have on light and the images we see?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>Light travels in straight paths away from a source of illumination in all directions until it hits an object. Some sources of illumination produce their own light (e.g., the sun, fire, light bulb); other sources of illumination reflect light produced by something else (e.g., the moon or a mirror).</li> <li>Light interacts with objects in various ways; it can be <b>reflected</b> off the object, <b>absorbed</b> by the object, or <b>refracted</b> through the object.</li> <li>Materials can be classified based on how much light passes through them. <b>Transparent</b> materials allow most light to pass through them. <b>Translucent</b> materials allow some light to pass through them. <b>Opaque</b> materials do not allow any light to pass through them.</li> <li>Objects that have flat, smooth surfaces reflect light and produce a mirror-like image. Objects that have curved or uneven surfaces scatter the reflected light and produce distorted or blurry images.</li> <li>Light always reflects away from a mirror at the same <b>angle</b> that it hits the mirror. The angle of incoming light equals the angle of reflected light.</li> <li>Objects that block light traveling from a source produce shadows. The shape, length, direction and clarity of a shadow depend on the shape and position of the object.</li> <li>Light changes direction (<b>refracts</b>) as it passes from one transparent material to another (e.g., as it passes from air to water or through lenses).</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>DSM II Lenses and Mirrors</li> <li>Prisms</li> <li>Flashlights</li> <li>Lenses</li> <li>Magnifiers</li> <li>Plastic cups</li> <li>Beakers</li> <li>Teacher-created materials</li> <li>Miscellaneous products displaying the properties of transparent, translucent, opaque</li> <li>Laser pointers</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>Mirror Maze lab</li> <li>Build a Periscope</li> <li>Pitch Black Box</li> <li>Looking through convex and concave lenses</li> <li>Light reflection off flat, convex and concave mirrors</li> <li>Prism Observation</li> <li>Law of Reflection Activity</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>Mirror Maze lab activity</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> <li>Research project using technology tools</li> </ul> <b>GRADE LEVEL EXPECTATIONS</b> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>Provide evidence that light travels in straight lines away from a source in all directions.</li> <li>Investigate how light is refracted as it passes through a lens or through one</li> </ol>

	<p>transparent material to another.</p> <ol style="list-style-type: none"> <li>3. Demonstrate that white light is composed of many colors.</li> <li>4. Explain that all visible objects are reflecting some light to the human eye.</li> <li>5. Contrast the way light is reflected by smooth, shiny objects (e.g., mirror or pool of water) and how it is reflected by other objects.</li> <li>6. Measure angles to predict the path of light reflected by a mirror.</li> <li>7. Determine whether a material is opaque, transparent or translucent based on how light passes through it.</li> <li>8. Design and conduct light absorption experiments that vary the size, length, direction and clarity of a shadow by changing the position of the light-blocking object or the light source.</li> </ol>
	<p><b>CMT CORRELATION</b></p> <ul style="list-style-type: none"> <li>▪ Describe how light is absorbed and/or reflected by different surfaces.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** reflect, absorb, refract, transparent, translucent, opaque, angle, transfer

**KEY SCIENCE VOCABULARY:** shadow

<p><b>LEARNING STRAND Structure and Function</b> - <i>How are organisms structured to ensure efficiency and survival? How do science and technology affect the quality of our lives?</i></p> <p><b>Unit: Sense Perception</b></p> <p><i>CT Standard 5.2 - Perceiving and responding to information about the environment is critical to the survival of organisms.</i></p> <p><i>CT Standard 5.4 - Humans have the capacity to build and use tools to advance the quality of their lives.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>The structure and function of the sense organs influence how humans and animals perceive the world.</li> <li>The sense organs perceive stimuli from the environment and send signals to the brain through the nervous system.</li> <li>Advances in technology allow individuals to acquire new information about the world.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How do lenses correct vision?</li> <li>How is the structure of the eye like a camera?</li> <li>How does the structure of the eye help us see light and color?</li> <li>What affect does light have on the colors we perceive?</li> <li><b>What role do the senses play in an organism's survival?</b></li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>Animals have sense organs that are structured to gather information about their environment. Information perceived by the senses allows animals to find food, water, mates and protection.</li> <li>Each sense organ perceives specific kinds of stimuli. Some human senses are more or less developed than the senses of other animals.</li> <li>Sense organs transfer information through a network of nerves to the brain where it is interpreted and responded to. The brain responds by sending messages to all parts of the body. The type of response and the amount of time it takes for the response to occur vary depending on the stimulus.</li> <li>The human eye is structured to collect light through the cornea and the pupil. The amount of light that enters the eye is controlled by the iris. The <b>cornea</b> and the <b>lens refract</b> the light and <b>focus</b> it onto the <b>retina</b> and the optic nerve where it is transformed into electrical signals that are sent to different parts of the brain.</li> <li>For anything to be visible, light must be present. For a person to see an object, the light it <b>reflects</b> or produces must have a straight, unobstructed path to the eye.</li> <li>Human eyes have receptors for perceiving shades of red, orange, yellow, green, blue, indigo and violet.</li> <li>Sunlight (or "<b>white light</b>") is a combination of colors. White light passed through prisms, water droplets or diffraction gratings can be refracted to show its component colors: red, orange, yellow, green, blue, indigo and violet.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>FOSS Kit: Human Brain and Senses</li> <li>DSM II Color and Light</li> <li>Chromatography paper</li> <li>Mr. Sketch Markers</li> <li><b>Prisms/ CD's</b></li> <li>Optical Illusion instructional supplies</li> <li>Flashlights</li> <li>Color Wheels and Color Paddles</li> <li>Convex and Concave Lenses</li> <li>Chromatography paper</li> <li>Spin-art wheels</li> <li>Batteries</li> <li>Plastic test tubes and storage racks</li> <li>Food coloring</li> <li>U.V. Reading beads</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Kaleidoscope Project</li> <li>Chromatography Activity</li> <li>Spinning Wheels</li> <li>Eye Diagram Investigation</li> <li>Mixing Light and Mixing Color Activities</li> <li>UV Reacting Beads</li> <li>Corrective Vision Investigation</li> <li>Build a Model of the Eye</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>CMT Embedded Task: <u><i>Catch It!</i></u></li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> <li>Lab Reports</li> </ul>

- The perceived color of an object depends on the color of the light illuminating it and the way the light interacts with the object. The color humans see is the color that is reflected by the object. For example, an object that appears green is absorbing all colors except green, which is reflected to the eye.
- Human skin is structured to detect information related to **texture, temperature, pressure** and **vibration**. Each sensation has different receptors distributed around the body; some areas of the body have greater concentrations of receptors for certain sensations, making those areas more sensitive than others to texture, temperature, or pressure.
- Human noses are structured to collect and detect chemicals floating in the air (odors). Tiny hairs behind the nose have special receptors that respond to airborne chemicals and produce electrical signals that are transmitted to different parts of the brain by the olfactory nerve.
- Human tongues are sense organs that are structured for detecting chemicals dissolved in saliva (flavors). Taste buds respond to 4 basic tastes: salty, sweet, sour and bitter. Special receptors in taste buds respond to tastes and produce electrical signals that transmit information through nerves to different parts of the brain.
- People design **optical tools** (e.g., **binoculars, telescopes, eyeglasses** or **periscopes**) that enable them to see things better or to see what cannot be seen by human eyes alone. Optical tools change the path of light by reflecting or refracting it.
- Throughout history new optical technologies have led to new discoveries and understandings **that change people's lives**.
- **Periscopes** allow people to see things that are not within their line of sight (for example, around corners, over walls, under a table, or **above the ocean's surface from a submerged submarine**).
- **Telescopes** make distant objects appear larger (and therefore closer).
- **Magnifiers**, such as hand lenses, microscopes or make-up mirrors, make objects appear larger.

### GRADE LEVEL EXPECTATIONS

Assessments **MUST** measure the ability of students to:

1. Explain the role of sensory organs in perceiving stimuli (e.g., light/dark, heat/cold, flavors, pain, etc.) and sending signals to the brain.
2. Pose testable questions and design experiments to determine factors that affect human reaction time.
3. Conduct simple tests to explore the capabilities of the human senses.
4. Summarize nonfiction text to explain the role of the brain and spinal cord in responding to information received from the sense organs.
5. Identify the major structures of the human eye, ear, nose, skin and tongue, and explain their functions.
6. Draw diagrams showing the straight path of light rays from a source to a reflecting object to the eye, allowing objects to be seen
7. Describe the properties of different materials and the structures in the human eye that enable humans to perceive color.
8. Generalize that optical tools, such as binoculars, telescopes, eyeglasses or periscopes, change the path of light by reflecting or refracting it.
9. Construct simple periscopes and telescopes, and analyze how the placement of their lenses and mirrors affects the quality of the image formed.
10. Evaluate the best optical instrument to perform a given task.
11. Design and conduct simple investigations to determine how the shape of a lens or mirror (concave, convex, flat) affects the direction in which light rays travel.
12. Explain how eyeglasses or contact lenses improve vision by changing the path of light to the retina.

- The shape of a **lens** or mirror (**concave**, **convex** or flat) affects the direction in which light travels.
  - Telescopes focus light using a lens that refracts the light (refracting telescope) or a curved mirror that reflects the light (reflecting telescope).
  - Periscopes use flat mirrors to reflect light to change its path.
  - Magnifying glasses use convex lenses to refract light so that objects appear larger.
- Some human eyes do not focus light properly onto the **retina**. Eyeglasses are lenses that improve vision by changing the path of light (refracting it) so that it forms an image on the retina.
- Cameras have parts that function similarly to the human eye.

HUMAN EYE	CAMERA	FUNCTION
Eyelid	Lens cap	Protect interior parts
Pupil	Lens opening (aperture)	Control amount of light entering
Cornea, lens	Lens	Focus light rays on a point
Retina	Film (or digital medium)	Respond to light resulting in an image

13. Analyze the similarities and differences between structures of the human eye and those of a simple camera.

**CMT CORRELATIONS**

- Describe how light absorptions and reflection allow one to see the shapes and colors of objects.
- Describe the structure and function of the human senses and the signals they perceive.
- Compare and contrast the structures of the human eye with those of a camera.
- Describe the uses of different instruments, such as eyeglasses, magnifiers, periscopes and telescopes to enhance our vision.

**SCIENTIFIC LITERACY TERMINOLOGY:** sense organ, receptor, stimulus, response, nervous system, vibration, reflect, refract, cornea, iris, pupil, lens, retina, white light, absorb, optical tool, hand lens, magnifying glass, telescope, periscope, mirror, concave, convex, focus, camera, eye parts (See chart above.)

**KEY SCIENCE VOCABULARY:** temperature, texture, pressure





<p><b>LEARNING STRAND Earth in the Solar System</b> - <i>How does the position of Earth in the solar system affect conditions on our planet?</i></p> <p><b>Unit: Earth, Moon, Sun</b></p> <p><i>CT Standard 5.3 - Most objects in the solar system are in a regular and predictable motion.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>The positions of the Earth and moon relative to the sun explain the cycles of day and night, and the monthly moon phases.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What affect does gravity have on celestial bodies?</li> <li>How does <b>Earth's movement through space</b> explain recurrent phenomenon?</li> <li><b>What affect does the moon's position in space</b> have on its appearance to us on Earth?</li> <li>What properties of a celestial body affect its gravitational pull?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>The sun, Earth and its moon are spherical objects that move in two ways: they spin (<b>rotate</b>) and they change positions relative to each other (<b>revolve</b>).</li> <li>The sun is a star that produces light that travels in straight lines away from the sun in all directions. Light from the sun illuminates objects that <b>reflect</b> light, including Earth and its moon. The side of the Earth that is facing the sun experiences daylight; the side of the Earth facing away from the sun experiences night. All parts of the Earth experience a cycle that includes both day and night, providing evidence that the Earth is rotating on its axis.</li> <li>The amount of time it takes for the Earth to rotate once on its axis is regular and predictable (<b>24 hours</b>), and is called "a day." <b>Earth's rotation</b> makes it appear as if the sun is moving across the sky from east to west.</li> <li>The moon is a rocky object that revolves around the Earth in a circular path called an <b>orbit</b>. The amount of time it takes for the moon to revolve once around the Earth is about 29 days and is called a "<b>lunar month</b>."</li> <li>Half of the moon is always illuminated by the sun. Phases of the moon occur because a different portion of the lit half of the moon is visible from Earth each day as the moon revolves around the earth.</li> <li><b>The changes in the moon's phases occur in a regular and predictable sequence.</b> At predictable periods during the <b>lunar cycle</b>, the moon is visible in either the daytime or the nighttime sky.</li> <li>At the beginning of a lunar month, no lit part of the moon is visible from Earth (new moon). As</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Delta Kit: Earth, Moon, and Sun</li> <li>Moon Boxes</li> <li>Bill Nye videos</li> <li>Smart Board</li> <li>Lap tops</li> <li>Library Media Center resources</li> <li>Earth, moon, and sun model</li> <li>Light bulb fixtures</li> <li>String</li> <li>Duct tape</li> <li>Poster board</li> <li>Solar balloons</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Create scale models of Earth, moon, and sun</li> <li>Demonstrate scale distance between celestial bodies</li> <li>Model of <b>Earth's rotation</b> and revolution on axis and influence on seasonal changes</li> <li>Compare and contrast the forces of magnetism and gravity</li> <li>Mass vs. Weight activity</li> <li>Google Sky using laptops and Smart Board</li> <li>Looking for micrometeorites</li> <li><b>"what's out there" activity</b></li> <li>Internet Research: Duration of Daylight Hours comparison</li> <li>Moon phase investigation</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>Moon journals</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> </ul>

the moon progresses through the first two quarters of its complete trip around the Earth, larger portions of the right side of the moon are illuminated each day. When the moon has completed half its trip around the Earth, the full moon is illuminated. During the third and fourth quarters **of the moon's trip around the Earth**, the illuminated portion gradually decreases so only the left side is illuminated and finally no lit portion of the moon is visible from Earth again.

- Like the sun, the moon appears to rise at the eastern horizon and set at the western horizon due to the **earth's rotation**. From one day to the next, when observed at the same time from the **same location, the moon's position in the sky** varies in predictable ways.

#### **GRADE LEVEL EXPECTATIONS**

Assessments **MUST** measure the ability of students to:

1. Explain the motion of the Earth relative to the sun that causes Earth to experience cycles of day and night.
2. **Construct models demonstrating Earth's rotation on its axis, the moon's revolution around the Earth, and the Earth and moon revolving around the sun.**
3. Distinguish between the sun as a source of light and the moon as a reflection of that light.
4. **Observe and record the moon's appearance over time and analyze findings to describe the cyclical changes in its appearance from Earth (moon phases).**
5. Relate the moon phases to changes in the **moon's position relative to the Earth and sun** during its 29-day revolution around the Earth.

#### **CMT CORRELATIONS**

- Explain the cause of day and night based on the rotation of Earth on its axis.
- Describe the monthly changes in the **appearance of the moon, based on the moon's orbit around the Earth.**

**SCIENTIFIC LITERACY TERMINOLOGY:** sphere, illuminate, reflect, rotate, day/night cycle (24-hour rotation period), horizon, orbit, revolve, month (one lunar cycle), moon phase, new moon

#### **KEY SCIENCE VOCABULARY:**

<b>LEARNING STRAND: Forces and Motion - <i>What makes objects move the way they do?</i></b> <b>Unit: Forces and Motion</b> <i>CT Standard 4.1 – The position and motion of objects can be changed by pushing or pulling.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The size of the change in an object’s motion is related to the strength of the push or pull.</li> <li>▪ The more massive an object is, the less effect a given force will have on its motion.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ Why do objects move?</li> <li>▪ How do forces affect the motion of an object?</li> <li>▪ What affect does the mass/ weight have on the motion of an object?</li> <li>▪ How are force and mass related?</li> <li>▪ Why do we wear seatbelts?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that..</i>  GRADE LEVEL CONCEPT 4.1.a. <ul style="list-style-type: none"> <li>▪ An object is in <b>motion</b> when its position is changing. <b>Speed</b> describes how far an object moves in a given amount of time (e.g., miles per hour).</li> <li>▪ A <b>force</b> is a push or pull that can cause an object to move, stop, change speed or direction.</li> <li>▪ The greater the force, the greater the change in motion. For example, two people can push a heavy box that could not be pushed by one person alone.</li> <li>▪ Given an object, changing the amount of force applied to it causes measurable effects.</li> <li>▪ When an object does not move in response to a push or a pull, it is because another equal-sized force, such as <b>gravity</b> or <b>friction</b>, is counteracting the push or pull. <b>Gravity</b> (the <b>earth’s pulling force</b>) and <b>friction</b> (the force between two surfaces) are common forces that work against motion.</li> </ul> GRADE LEVEL CONCEPT 4.1.b. <ul style="list-style-type: none"> <li>▪ The amount of force needed to move an object <b>is related to the object’s mass</b>.</li> <li>▪ <b>The greater the object’s mass, the greater the force</b> needed to move it, stop it or change its speed or direction.</li> <li>▪ An object with a small mass is easier to stop or cause a change in motion than an object with a large mass.</li> <li>▪ Given the same amount of force, changing the mass of an object has measurable effects.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Lego cars</li> <li>▪ Onobots</li> <li>▪ Meter sticks</li> <li>▪ Latex-free rubber bands</li> <li>▪ Marbles of different materials</li> <li>▪ Weights</li> <li>▪ Ramps</li> <li>▪ Legos (general bricks)</li> <li>▪ <b>Newton’s Cradle</b></li> <li>▪ Coins</li> <li>▪ Rulers</li> <li>▪ Golf pencils</li> <li>▪ Poster board</li> <li>▪ Timers</li> <li>▪ Note cards</li> <li>▪ String</li> <li>▪ Nuts/bolts/washers</li> <li>▪ 200 gram weights</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Marble Run</li> <li>▪ Paper Football</li> <li>▪ Botmobile Car launch</li> <li>▪ Botmobile Tractor Pull with weight</li> <li>▪ Design a friction efficient vehicle</li> <li>▪ Car crash- inertia activity</li> <li>▪ Pop Rockets</li> <li>▪ Collision ball activity</li> <li>▪ Parachute lab</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b>  Performance Task: <ul style="list-style-type: none"> <li>▪ Marble Ramp</li> </ul> Other Assessments: <ul style="list-style-type: none"> <li>▪ Teacher-created quizzes</li> <li>▪ Common unit test</li> <li>▪ Lab Activities</li> </ul>

	<p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>1. Demonstrate that a force can cause an object to start moving, stop, or change speed or direction.</li> <li>2. Use measurement tools and standard units to compare and contrast the motion of objects such as toy cars, balls, model rockets or planes in terms of change in position, speed and direction.</li> <li>3. Design and conduct experiments to determine how the motion of objects is related to the mass of the object and the strength of the force applied.</li> <li>4. Describe how friction forces caused by air resistance or interactions between surface materials affect the motion of objects.</li> <li>5. <b>Predict the effect of an object's mass on its motion.</b></li> </ol>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe the effects of the strengths of pushes and pulls on the motion of objects.</li> <li>▪ Describe the effect of the mass of an object on its motion.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** motion, force, speed, gravity, mass, friction

**KEY SCIENCE VOCABULARY:**

<b>LEARNING STRAND Matter and Energy in Ecosystems - How do matter and energy flow through ecosystems?</b> <b>Unit: Connecticut Ecosystems</b> <i>CT Standard 6.2 – An ecosystem is composed of all the populations that are living in a certain space and the physical factors with which they interact.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Populations in ecosystems can be categorized as producers, consumers, and decomposers of organic matter.</li> <li>An ecosystem is the complete interplay between the living organisms and physical environment in a specific area.</li> <li>Abiotic and biotic factors interact within ecosystems.</li> <li>Populations in ecosystems are affected by biotic factors, such as other populations, and abiotic factors such as soil and water supply.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What influences do biotic and abiotic factors have on different ecosystems?</li> <li>How are populations affected by interactions of predator-prey and consumer-producer relationships?</li> <li>How can common food webs in different Connecticut ecosystems be described?</li> <li><b>What effect does the sun’s energy have on producers, consumers and decomposers within an ecosystem?</b></li> <li>How are populations in ecosystems affected by limiting factors?</li> <li>How are ecosystems affected by the impact of organisms living within their specific niche?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <p>GRADE LEVEL CONCEPTS 6.2.a.</p> <ul style="list-style-type: none"> <li>An <b>ecosystem</b> is the complex interplay between the living organisms and physical environment in a specific area.</li> <li>Ecosystems can be categorized into <b>abiotic</b> and <b>biotic</b> components. Abiotic components include nonliving things such as soil, minerals, climate, water, sunlight, and wind. Biotic components include all living things.</li> <li>Interactions among biotic and abiotic factors support the flow of energy and cycling of materials in ecosystems. For example, air temperature, availability of water and amount of wind influence the growth of certain species of plants in an area, plant species provide food for animal populations, and plants and animals cycle oxygen and carbon dioxide.</li> <li>Soil is a mixture of materials that includes weathered rocks and decomposed organic material, as well as air and water. Soils vary from place to place. The composition of soils affects how air and water move through the soil, and this influences the kinds of plants that can grow in it.</li> <li>Water is a mixture of materials that includes dissolved oxygen and minerals as well as suspended sediments and debris.</li> <li>Soil and water provide important habitats for plants and animals within ecosystems.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Prentice Hall: Science Explorer <u>Environmental Science</u></li> <li>Owl pellets</li> <li>Forceps</li> <li>Instructional posters</li> <li>Hand lenses</li> <li>Bill Nye video</li> <li>Planet Earth video</li> <li>Stick bug kit</li> <li>Thermometers</li> <li>Magazines</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Adaptations investigation</li> <li>Design an animal</li> <li>Explore the diversity of frogs in Connecticut</li> <li>Report on Explorer magazine article on ecosystems</li> <li>Dissect owl pellets</li> <li>Blubber Gloves</li> <li>Habitat models of Connecticut</li> <li>Outdoor classroom- pond studies</li> <li>Meigs Point Nature Center</li> <li>Kellogg Environmental Center lessons</li> <li>Create a creature</li> <li>Tadpole study, when available</li> <li>Stick bug lab</li> <li>Animal cards activity</li> <li>Heat loss lab</li> </ul>

<p>GRADE LEVEL CONCEPT 6.2.b.</p> <ul style="list-style-type: none"> <li>▪ The sun is the main source of energy on Earth. During <b>photosynthesis</b>, green plants use the energy of sunlight to change the elements in carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) into materials (simple carbohydrates) that are a source of energy for the plant to carry on its life processes.</li> <li>▪ Photosynthesis is affected by abiotic factors such as amount of sunlight, availability of water and air temperature.</li> <li>▪ Green plants are the producers in an ecosystem; they rely directly on sunlight to produce the materials they use for energy.</li> <li>▪ Plants are a source of energy (food) and nutrients for animals that consume them. Energy passed to <b>consumers</b> that eat plants came indirectly from the sun as a result of photosynthesis. Some animals consume plants, and other animals consume animals that eat plants in <b>predator-prey</b> relationships.</li> <li>▪ Consumers are adapted for eating different foods: <b>herbivores</b> are consumers that eat only plants; <b>carnivores</b> are consumers that eat only animals; <b>omnivores</b> are consumers that eat both plants and animals.</li> <li>▪ Decomposers (mainly bacteria and fungi) consume dead plants and animals and break down the organic materials, thus returning nutrients to the environment for reuse by other organisms.</li> <li>▪ Plants and animals within an ecosystem interact in various ways as they compete for limited resources. Relationships among organisms can be beneficial or harmful to one or both organisms.</li> <li>▪ <b>Food chains</b> are models that show how materials and energy are transferred from producers to different levels of consumers in an ecosystem. The basis of every food chain is the energy stored in green plants.</li> <li>▪ <b>Food webs</b> are models that show the complex variety of energy sources available to most consumers in an ecosystem.</li> <li>▪ Connecticut has forest and park ecosystems, as well as fresh water and marine ecosystems that include a variety of plants and animals.</li> <li>▪ An energy pyramid is a model that shows the use of energy in an ecosystem. A large number of producers and primary consumers support a smaller number of higher-level consumers due to the consumption and loss of energy at each consumer level.</li> </ul>	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Teacher-created quizzes</li> <li>▪ Common unit test</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>1. Analyze and interpret how biotic and abiotic factors interact within a given ecosystem.</li> <li>2. Design and conduct a scientific investigation to explore the porosity and permeability of soils and their ability to support different plant life.</li> <li>3. <b>Defend the statement, "The sun is the main source of energy on Earth."</b></li> <li>4. Express in general terms how plants and other photosynthetic organisms use the <b>sun's energy</b>.</li> <li>5. Investigate and report on the effects of <b>abiotic factors on a plant's ability to photosynthesize</b>.</li> <li>6. Compare and contrast how energy and matter flow in a Connecticut ecosystem, emphasizing the interactions among producers, consumers and decomposers.</li> <li>7. Identify local examples of predator-prey relationships and justify the impact of each type of population on the other.</li> <li>8. Create and interpret graphs that illustrate the fluctuation of populations over time.</li> <li>9. Distinguish a food chain from a food web and identify local examples of each.</li> <li>10. Explain the impact of environmental conditions such as climate, elevation, topography or water quality on food chains.</li> <li>11. Predict what will happen to a population based on current trends (fires, disease, over hunting, development) and defend the prediction.</li> </ol>
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<ul style="list-style-type: none"> <li>▪ Populations of species within an ecosystem are affected by the availability of resources such as food, water, living space, or mates. Populations can be reduced or increased by environmental changes caused by nature (for example, droughts, forest fires or disease) and by humans (climate change, land development or overhunting).</li> <li>▪ Predator-prey relationships help to maintain a balanced ecosystem. Increases or decreases in prey populations result in corresponding increases or decreases in predator populations. Fluctuations over time in populations of interacting species can be represented in graphs.</li> <li>▪ All organisms cause changes in the environment where they live. Some of the changes caused by organisms can be helpful to the ecosystem and others can damage the ecosystem.</li> </ul>	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe how abiotic factors, such as temperature, water and sunlight, affect the ability of plants to create their own food through photosynthesis.</li> <li>▪ Explain how populations are affected by predator-prey relationships.</li> <li>▪ Describe common food webs in different Connecticut ecosystems.</li> </ul>
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**SCIENTIFIC LITERACY TERMINOLOGY:** ecosystems, organism, population, biotic factor, abiotic factor, food chain, photosynthesis, producer, consumer, herbivore, carnivore, omnivore, food web, predator, prey

**KEY SCIENCE VOCABULARY:**





<p><b>LEARNING STRAND Science and Technology in Society - <i>How do science and technology affect the quality of our lives?</i></b>  <b>Unit: Innovations</b>  <i>CT Standard 8.4 – In the design of structures there is a need to consider factors such as function, materials, safety, cost and appearance.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>The form of a structure follows functions.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What factors could influence the design of a product?</li> <li>How does design influence the way something works?</li> <li>Why does innovation occur?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>Understand that materials, cost, and time affect the design of structures.</li> <li>Understand how structure can improve function.</li> <li>Appreciate that what consumers want influences the design of the product.</li> <li>Know that Science and Technology affect the quality of our lives.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>FOSS kit: Ideas and Inventions</li> <li>Washers</li> <li>Onobots</li> <li>String</li> <li>Paper</li> <li>Plastic bags</li> <li>Art supplies</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Design a Parachute</li> <li>Create a paper airplane</li> <li>Longest workable straw</li> <li>Paper cup pendulum</li> <li>Egg drop design</li> <li>Science in the News</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>Design a Parachute</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> <li></li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b>  Assessments MUST measure the ability of students to:  1. Use technology to simulate how engineers plan, test and revise designs given parameters including cost, time, safety and aesthetics.</p>

**KEY SCIENCE VOCABULARY:** balanced/unbalanced forces



**Content Standards & Indicators**  
**for Grade 6**



### Course Description

MIDDLE SCHOOL		
1. Course Title <b>Grade 6 General Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	
2. Transcript Title/Abbreviation <b>Science</b>	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media	
3. Transcript Course Code/Number		
4. Program Contact Information  Name: Kathleen Brooks  Title/Position: Middle School Science Coordinator  School: Dr. Robert H. Brown Middle School 980 Durham Road Madison, CT 06443  Phone: 245-6475 X7082	6. Grade Level: 6  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable  8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)	
10. Pre-Requisites- N/A		
11. Brief Course Description The sixth grade science course is a general science course. It is part of a spiraling curriculum in which aspects of life science, physical science and earth and space science are addressed in each school year. In grade six, the life science units include a study of the musculoskeletal system of the human body, cells, microbes, and plants. The physical science topic is an introduction to chemistry. The earth/space science topics are weather and climate.		
12. Course Goals The lower middle school science program is designed to provide <b>students with opportunities to "do"</b> science. Activities that are appropriate to the developmental levels of students, moving from concrete to abstract, are emphasized; the mode of instruction is inquiry-based. Investigations foster logical and independent thought, and group interaction is part of the classroom experience. Participating in an inquiry-based environment <ul style="list-style-type: none"> <li>▪ Provides opportunities for students to learn the skills of observation, investigation, experimentation, and research.</li> <li>▪ Assists students in the development of science literacy to make them more aware and understanding of the natural and physical world around them.</li> <li>▪ Ensures that students meet the science standards for Connecticut public schools.</li> </ul>		
13. Course Outline <ul style="list-style-type: none"> <li>▪ Weather and Climate               <ul style="list-style-type: none"> <li>- Atmosphere</li> <li>- Climate</li> <li>- Air Masses and Fronts</li> <li>- Winds</li> </ul> </li> <li>▪ Matter               <ul style="list-style-type: none"> <li>- Phases</li> </ul> </li> </ul>		

<ul style="list-style-type: none"><li>- Physical and Chemical Properties</li><li>- Physical and Chemical Change<ul style="list-style-type: none"><li>▪ Cells</li></ul></li><li>- Plant Cells</li><li>- Animal Cells<ul style="list-style-type: none"><li>▪ Microbes</li></ul></li><li>- Food Preservation<ul style="list-style-type: none"><li>▪ Human Musculoskeletal System</li><li>▪ Plants</li></ul></li><li>- Structure and Function</li></ul>
14. Instructional Methods and/or Strategies <ul style="list-style-type: none"><li>▪ Individual and small group work</li><li>▪ Whole class instruction and discussions</li><li>▪ Lecture</li><li>▪ Modeling</li><li>▪ Inquiry-based activities</li><li>▪ PowerPoint presentations and notes</li><li>▪ Research</li></ul>
15. Assessment Methods and/or Tools <ul style="list-style-type: none"><li>▪ Quizzes</li><li>▪ Common unit assessments</li><li>▪ Authentic assessments</li><li>▪ Lab reports</li><li>▪ Research papers and/or projects</li><li>▪ Embedded performance assessment in class activities</li></ul>
16. Assessment Criteria The common assessments are based on the Madison curriculum and Connecticut standards and grade level expectations for science. For authentic assessments and projects students are given a rubric or grading criteria before doing the work. A variety of assessment tools are employed to get the most accurate understanding of individual student achievement possible.

<b>LEARNING STRAND</b> <b>Unit: Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Scientific literacy includes also the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ Why is it critical to design and conduct appropriate types of scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you identify independent and dependent variables?</li> <li>▪ Why is it important to identify variables that need to be kept constant?</li> <li>▪ Why is it essential to assess the data that was collected, using mathematical operations to analyze and interpret data, and present relationship between variables in appropriate graphs?</li> <li>▪ Why is it essential to assess the validity of the experimental design identifying sources of error and the credibility of scientific claims in different sources of information?</li> <li>▪ Why is it important to communicate findings, using relevant scientific vocabulary and clear logic that are based on the results generated during the experiment?</li> </ul>
<b>KNOWLEDGE &amp; LEARNING</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Identify questions that can be answered through scientific investigation.</li> <li>▪ Formulate a testable hypothesis, in the "If..., then... because" format that is logically connected to the problem.</li> <li>▪ Design an experiment in which the independent and dependent variables are accurately identified and variables, which need to be, are kept constant.</li> <li>▪ Use appropriate tools and techniques that are appropriate for the design of the experiment for making observations and gathering data.</li> <li>▪ Accurately collect and record appropriate data.</li> <li>▪ Use mathematical operations to analyze and interpret data.</li> <li>▪ Interpret and create appropriate graphs to present relationships between variables.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Report findings and conclusions in various formats (i.e., lab reports) using relevant vocabulary, supporting evidence, and clear logic.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ General lab equipment</li> <li>▪ Safety equipment</li> <li>▪ Prentice Hall Explorer Series Texts</li> <li>▪ Unit specific materials as noted</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Inquiry activities and investigations</li> <li>▪ Guided internet research</li> <li>▪ Performance tasks</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Lab Reports</li> <li>▪ Research projects/activities</li> <li>▪ Inquiry literacy questions</li> </ul>





<b>LEARNING STRAND Properties of Matter</b> - <i>How does the structure of matter affect the properties and uses of materials?</i> <b>Unit: Matter</b> <i>CT Standard 6.1 – Materials can be classified as pure substances or mixtures, depending on their chemical and physical properties.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Mixtures are made of combinations of elements and/or compounds, and they can be separated by using a variety of physical means.</li> <li>Pure substances can be either elements or compounds, and they cannot be broken down by physical means.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How do changing levels of energy effect physical changes of matter?</li> <li>How can mixtures be separated using the properties of the substances from which they are made, such as particle size, density, solubility, and boiling point?</li> <li>How can general properties of matter be used to identify specific substances?</li> <li>How does the physical property of a substance determine its appropriate use?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <p>GRADE LEVEL CONCEPT 6.1.a.</p> <ul style="list-style-type: none"> <li>Everything is made of matter. Matter has two fundamental properties: it has <b>weight (mass)</b> and it takes up <b>space (volume)</b>.</li> <li>All matter has a variety of properties, some of which are characteristic of the <b>substance</b>. Characteristic properties do not depend on the amount of the substance as mass and volume do. <b>Properties</b> such as magnetic attraction, conductivity, density, pH, boiling point and solubility are characteristic properties that can be used to identify substances.</li> <li>Solids, liquids or gases can be combined to form <b>mixtures</b>. In a mixture, each substance keeps its individual properties. In some mixtures, each of the components can be seen (e.g., rocks, twigs, insects and leaves are visible components of soil); in other mixtures, the individual substances blend so well that they appear to be a single substance (e.g., oxygen, nitrogen and carbon dioxide are mixed together to form air).</li> <li>Mixtures can be separated using different methods, depending on the physical properties of the component substances. Filtering, <b>evaporating</b>, floating/settling, <b>dissolving</b>, and using magnets are all methods for separating mixtures based on the properties of their components.</li> <li>Solutions are mixtures that appear to be single substances because <b>particles</b> have dissolved and spread evenly throughout the mixture. Not all separation methods are effective for separating the components of solutions.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>General lab equipment</li> <li>General safety equipment</li> <li>Prentice Hall module: <a href="#">Matter</a></li> <li>Density cubes</li> <li>Marbles</li> <li>Clay</li> <li>Pebbles</li> <li>Food containers</li> <li>Iron filings</li> <li>Packing peanuts</li> <li>Cotton balls</li> <li>Blow dryer or other heat source</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Density Cube lab</li> <li>Displacement lab</li> <li>Flinking (Float/Sink) lab</li> <li>Practice using triple beam balance</li> <li>Determine the volume of regular shaped objects using mathematical formulas</li> <li>Mass versus weight planet poster</li> <li>Implementation of matter concepts through experimentation or demonstration</li> <li>Mass lab using food nutritional facts</li> <li>Boiling Point lab</li> <li>Separating mixtures-iron filings</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>Students will be asked to perform a lab activity involving determining the density of different cubes to identify what the substance is. They will formulate a hypothesis and perform the activity recording both qualitative and quantitative data. The data will be analyzed and</li> </ul>

	<p>conclusions will be drawn.</p> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Teacher-created quizzes</li> <li>▪ Common unit test</li> <li>▪ Learning activities</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>1. Explain that density (mass/volume) is a characteristic property that can be used to identify an element or substance.</li> <li>2. Differentiate between a mixture and an element or compound and identify examples.</li> <li>3. Conduct and report on an investigation that uses physical means such as particle size, density, solubility and magnetism to separate substances in a mixture.</li> </ol> <hr/> <p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Explain how mixtures can be separated by using properties of the substances from which they are made, such as particle size, density solubility and boiling point.</li> </ul>
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**SCIENTIFIC LITERACY TERMINOLOGY:** characteristic, property, mass, weight, volume, density, solubility, boiling point, mixture, solution, particle, atom, element, molecule, compound

**KEY SCIENCE VOCABULARY:** substance, evaporation, dissolve

<b>LEARNING STRAND Structure and Function --How are organisms structured to ensure efficiency and survival?</b> <b>Unit: Cells</b> <i>CT Standard 7.2 – Many organisms, including humans, have specialized organ systems that interact with each other to maintain dynamic internal balance.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>All organisms are composed of one or more cells; each cell carries on life-sustaining functions.</li> <li>Multicellular organisms need specialized structures and systems to perform basic life functions.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>How do the basic structures of a cell, such as nucleus, cytoplasm, mitochondria, and cell membrane, function to support life?</li> <li>How are organisms structured to ensure efficiency and survival?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>
<p>GRADE LEVEL CONCEPT 7.2.a.</p> <ul style="list-style-type: none"> <li>Living things have characteristics that distinguish them from nonliving things. Living things use energy, respond to their environment, grow and develop, produce waste and reproduce.</li> <li><b>Organisms</b> are made of tiny <b>cells</b> that perform the basic life functions and keep the organism alive. Many organisms (e.g., yeast, algae) are single-celled and many organisms (e.g., plants, fungi and animals) are made of millions of cells that work in coordination.</li> <li>All cells come from other cells and they hold the genetic information needed for cell division and growth. When a body cell reaches a certain size, it divides into two cells, each of which contains identical genetic information. This cell division process is called mitosis.</li> <li>The cell is filled with a fluid called <b>cytoplasm</b>; cells contain discrete <b>membrane</b>-enclosed <b>structures</b> called <b>organelles</b>. Each of the organelles performs a specific cellular function and it can be identified by its shape. <ul style="list-style-type: none"> <li>The <b>nucleus</b> contains the genetic materials (<b>chromosomes</b>), and it directs the cell activities, growth and division.</li> <li>The <b>mitochondrion</b> contains <b>enzymes</b> that break down sugars and release chemical energy. One cell can contain hundreds of mitochondria.</li> <li>The entire cell is surrounded by the <b>plasma</b> membrane which controls the flow of materials into and out of the cell.</li> </ul> </li> </ul> <p>GRADE LEVEL CONCEPT 7.2.b.</p> <ul style="list-style-type: none"> <li>Systems consist of parts that interact with and influence each other. Parts of a system work together to make the whole entity work. Similarly, each part of an animal body has a specific job to do, and all the different parts work together to support life.</li> <li>Although all cells have similar basic structures, in multicellular organisms cells have specialized shapes that enable them to perform specific roles (e.g., muscle, nerve, and skin cells can be identified by their</li> </ul>	<ul style="list-style-type: none"> <li>General lab equipment</li> <li>Safety equipment</li> <li>Prentice Hall module: <a href="#">Cells</a></li> <li>Prepared slides</li> <li>Microscopes</li> <li>Microviewers</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>Build a model of a cell</li> <li>Microviewer activities</li> <li>Draw and label diagrams of a plant and animal cells</li> <li>Compare cell to a real world model</li> <li>Look at plant and animal cells under microscopes</li> <li>Appropriate drawing and labeling of microscope view field</li> <li>Flow chart of interaction of cells, tissues, organs, and organ systems</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <p>Performance Tasks:</p> <ul style="list-style-type: none"> <li>Build a model of a cell and identify the cell parts</li> <li>Compare the structure and functions of a cell to a real-world model</li> <li>Illustrate the structural differences and function of various cell types found in multicellular organisms (muscle, bone)</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> </ul> <b>GRADE LEVEL EXPECTATIONS</b> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>Compare and contrast single-celled organisms with multicellular organisms.</li> <li>Illustrate and describe in writing the</li> </ol>

distinct shapes).

- Groups of similar cells are organized in tissues that have specific **functions** (e.g., providing support, connecting parts, carrying messages, protecting internal and external surfaces).
- Different **tissues** work together to form an organ, and organs work together as organ systems to perform essential life functions.

structure and the function of the following cell structures: cell membrane, cytoplasm, mitochondria and nucleus in an animal cell.

3. Explain how the structure and function of multicellular organisms (animals) is dependent on the interaction of cells, tissues, organs and organ systems.

**CMT CORRELATION**

- Describe the basic structures of an animal cell, including the nucleus, cytoplasm, mitochondria, and cell membrane, and how they function to support life.

**SCIENTIFIC LITERACY TERMINOLOGY:** structure, function, cell, organelle, cytoplasm, nucleus, cell membrane, mitochondria, tissues, organism, system

**KEY SCIENCE VOCABULARY:** chromosomes, enzymes

<b>LEARNING STRAND Science and Technology in Society - <i>How do science and technology affect the quality of our lives?</i></b> <b>Unit: Microbes</b> <i>CT Standard 7.4 - Technology allows us to improve food production and preservation, thus improving our ability to meet the nutritional needs of growing populations.</i>	
<b>ENDURING UNDERSTANDING</b> <ul style="list-style-type: none"> <li>▪ Various microbes compete with humans for the same sources of food.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How can freezing, dehydration, pickling, and irradiation prevent food spoilage caused by microbes?</li> <li>▪ How do microbes impact human life?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ol style="list-style-type: none"> <li>1. Microorganisms (<b>microbes</b>) are microscopic organisms, such as <b>bacteria</b>, yeast and mold, that are found almost everywhere: in air, soil and water, inside our bodies and in our foods.</li> <li>2. Bacteria are <b>single-celled organisms</b> that differ from other single-celled organisms in that they do not have organelles such as a nucleus, mitochondrion or chloroplast.</li> <li>3. Bacteria are an essential component of any food web because they break down complex organic matter into simple materials used by plants. Some bacteria can produce their own food through photosynthesis and others are consumers that compete for foods that humans eat.</li> <li>4. Some bacteria can be beneficial to humans. Certain bacteria live <b>symbiotically</b> in the digestive tracts of animals (including humans) and help break down food. Other bacteria are used by humans to purify waste water and to produce foods such as cheese and yogurt.</li> <li>5. Some bacteria are harmful to humans. They can spoil food, contaminate water supplies and cause infections and illness.</li> <li>6. Food preservation methods create conditions that kill bacteria or inhibit their growth by interfering <b>with the bacterium's life processes</b>. Food preservation methods include removing moisture by <b>dehydration</b> or salting, removing oxygen by vacuum-packing, lowering pH by <b>pickling</b>, lowering temperature by refrigerating or freezing, and destroying the bacterial cells by <b>irradiation</b> or heat (pasteurizing and cooking).</li> <li>7. Throughout history, humans have developed different methods to ensure the availability of safe food and water to people around the world.</li> </ol>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Prentice Hall module: <u>Bacteria to Plants</u></li> <li>▪ General lab equipment</li> <li>▪ General lab safety equipment</li> <li>▪ Dehydrator</li> <li>▪ Pickling materials</li> <li>▪ Plastic baggies</li> <li>▪ Microviewers</li> <li>▪ Magazines</li> <li>▪ Yogurt</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Microviewer activities</li> <li>▪ View pre-prepared slides and student-made slides under microscopes</li> <li>▪ 5 Station lab activity; Pro-scope, microscopes, microviewers, research history of microscope, power point presentations</li> <li>▪ Pickling lab</li> <li>▪ Dehydrating lab</li> <li>▪ Magazine activity</li> <li>▪ Picture activity</li> <li>▪ Yogurt activity</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <p>Performance Tasks:</p> <ul style="list-style-type: none"> <li>▪ Microbe Board Game</li> <li>▪ Analyze and record the various ways bacteria function in food webs.</li> <li>▪ Compare and contrast the effectiveness and safety of past and current methods of food preservation.</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Teacher-created quizzes</li> <li>▪ Common unit test</li> </ul> <b>GRADE LEVEL EXPECTATIONS</b> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>1. Investigate and describe in writing different types of microbes and the environmental conditions necessary for their survival.</li> <li>2. Describe the optimum conditions for rapid</li> </ol>

	<p>bacterial growth.</p> <ol style="list-style-type: none"> <li>3. Illustrate and describe the structural differences between bacterial and animal cells.</li> <li>4. Discover and discuss how humans use bacteria to produce food and identify examples.</li> <li>5. Compare and contrast the role of bacteria in food production and food spoilage.</li> <li>6. Evaluate and report how each method of food preservation including dehydration, pickling, irradiation and refrigeration works to stop or inhibit bacterial growth and give examples of each.</li> </ol>
	<p><b>CMT CORRELATION</b></p> <ul style="list-style-type: none"> <li>▪ Describe how freezing, dehydration, pickling and irradiation prevent food spoilage caused by microbes.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** microbe, bacteria, single-celled organism, dehydration, pickling, irradiation

**KEY SCIENCE VOCABULARY:** symbiotically

<p><b>LEARNING STRAND Structure and Function</b> - <i>How are organisms structured to ensure efficiency and survival?</i>  <b>Unit: Musculoskeletal System</b>  <i>CT Standard 7.2 – Many organisms, including humans, have specialized organ systems that interact with each other to maintain dynamic internal balance.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>Multicellular organisms need specialized structures and systems to perform basic life functions.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How does the musculo-skeletal system support life functions?</li> <li>How does the musculo-skeletal system allow movement?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b>  <i>Students should understand that...</i></p> <p>GRADE LEVEL CONCEPT 7.2.b.</p> <ul style="list-style-type: none"> <li>The human skeletal system includes bones joined together by <b>ligaments</b>. The skeletal system <b>functions</b> to shape and support the body, protect internal organs, enable movement, form blood cells, and store minerals such as calcium and phosphorous.</li> <li><b>Joints</b> are places where two bones come together and body movement can occur. The <b>structure</b> of a joint (e.g., ball and socket, hinge or pivot) determines the kind of movement possible at that point.</li> <li>The human muscular system includes skeletal, smooth and cardiac muscles. The skeletal muscles are attached to bones by <b>tendons</b> and they are responsible for the movement of the body. The cardiac muscle is responsible for the pumping action of the heart and the smooth muscles are related to the movement of the internal organs.</li> <li>The muscular and skeletal systems interact to support the body and allow movement.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>General lab equipment</li> <li>General lab safety equipment</li> <li>X-rays</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Interactive games for musculo-skeletal system</li> <li>Webquest games for musculo-skeletal system, such as build and label a skeleton</li> <li>Activities for gender differences of the musculo-skeletal system such as "Great Bone Mysteries"</li> <li>Joint isolation activity</li> <li><b>Muscle fatigue "tests"</b></li> <li>Create a creature flip book</li> <li>Model arm demonstration</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Performance Tasks:</p> <ul style="list-style-type: none"> <li>Unit activity including cells, microorganisms, and musculo-skeletal system</li> <li>Compare and contrast the structure and function of skeletal muscle with cardiac and smooth muscle.</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to meet these state expectations:</p> <ol style="list-style-type: none"> <li>Investigate and explain in writing the basic structure and function of the human skeletal system.</li> <li>Differentiate between the structures and range of motion associated with ball, socket and hinge joints and relate human joints to simple machines.</li> <li>Demonstrate how the muscles, tendons, ligaments and bones interact to support the human body and allow movement.</li> </ol>
	<p><b>CMT CORRELATION</b></p> <p>Explain how the human musculoskeletal system supports the body and allows movement.</p>

**SCIENTIFIC LITERACY TERMINOLOGY:** structure, function, tissue, organ, system

**KEY SCIENCE VOCABULARY:** tendons, ligaments, joints





<p><b>LEARNING STRAND Energy in Earth's Systems</b> - <i>How do external and internal sources of energy affect the Earth's systems</i>  <b>Unit: Weather and Climate</b>  <i>CT Standard 6.3 – Variations in the amount of the sun's energy hitting the Earth's surface affect daily and seasonal weather patterns.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>Local and regional weather are affected by the amount of solar energy the area receives and the proximity to a large body of water.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How do external and internal sources of <b>energy</b> affect the Earth's System?</li> <li>How does heating affect the movement of molecules?</li> <li>How do temperature, pressure and water content in the atmosphere affect local weather?</li> <li><b>How does the unequal heating of the Earth's surface cause winds?</b></li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>Earth is surrounded by layers of gases (<b>atmosphere</b>) that influence the environment and support life. Weather on Earth is caused by the daily changes in the temperature, <b>pressure</b> and amount of moisture in the lower atmosphere. Regions of the earth experience distinct long-term climate conditions caused, in part, by different amounts of solar energy they receive.</li> <li>Heat energy causes <b>molecules</b> to move. The molecules that make up all matter are in constant motion. Solids, liquids and gases differ in the movement and arrangements of their molecules. Molecules in gases move randomly and independently of one another. Molecules in liquids move around each other randomly, but are loosely held together by an attraction force. Molecules in solids are closely locked in a patterned position and can only vibrate back and forth.</li> <li>When heat energy is added to a substance, its molecules move faster (increased temperature) and spread apart from each other (become less <b>densely</b> arranged). When heat energy is removed, molecules move slower (decreased temperature) and come together (become more densely arranged).</li> <li>If enough heat energy is absorbed by a solid or a liquid, the molecules may overcome the forces holding them together and change to a new state of matter. Solids change to liquids (<b>melt</b>) and liquids change to gases (<b>vaporization</b>) when heat energy is absorbed from the surroundings. Conversely, heat energy is given off when gases change to liquids (<b>condensation</b>) or liquids change to solid (freezing).</li> <li>Different surfaces on Earth absorb and release solar energy at different rates. Land has a lower</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Prentice Hall module <u>Weather and Climate</u> (2009)</li> <li>General lab equipment</li> <li>Thermometers</li> <li>Magdeburg and vacuum pump</li> <li>Internet access / reference materials</li> <li>Weather maps</li> <li>Power Point Software</li> <li>Sand and lamps</li> <li>Zip-lock baggies</li> <li>Hot plate</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Weigh a flat Zip-lock bag and a Zip-lock bag filled with air to show that air has mass.</li> <li>Perform the activity on page 16 in the Prentice Hall module <u>Weather and Climate</u>.</li> <li>Graph the layers of the atmosphere according to temperature and altitude.</li> <li><b>Perform the Lab "How Clean is the Air?"</b> on pages 26-27 in the Prentice Hall module <u>Weather and Climate</u>.</li> <li>Do demonstrations showing the significance of air pressure utilizing imploding soda cans, magdeburg sphere and Cartesian divers.</li> <li>Perform demonstrations showing methods of heat transfer.</li> <li>Perform the <b>activity "Heating Earth's Surface"</b> on pages 40-41 in the Prentice Hall module <u>Weather and Climate</u> using it to help explain land breezes and sea breezes.</li> <li><b>Perform "What Is the Greenhouse Effect?"</b> on page 135 in the Prentice Hall module <u>Weather and Climate</u>. Two beakers with dirt may be used to replace the shoeboxes with construction paper.</li> <li>Draw a diagram of the water cycle.</li> </ul>

heat capacity than water; therefore land temperatures change more rapidly than water temperatures do. The surface temperature of large bodies of water, such as the oceans that cover a great deal of the earth, affects the temperature of the air above them.

- **Earth's atmosphere (air) is a mixture of different** amounts of gases (mainly nitrogen, followed by oxygen, carbon dioxide and water vapor). Air molecules constantly press on and around objects on Earth (air pressure). Due to the pulling force of **Earth's gravity, air close to Earth is denser than air** higher in the atmosphere; denser air causes greater air pressure.
- Wind is caused by air moving from areas of high pressure to low pressure. Cool, dense air is high pressure and tends to sink; warm, less dense air is low pressure and tends to rise. Local and **global winds** move in predictable patterns based on **uneven heating of Earth's surface**.
- Local winds can be influenced by atmospheric conditions, **terrain** (mountain, deserts) and closeness to large bodies of water. Near coastal areas, the day to night temperature and pressure differences between land and water cause local **winds to blow from ocean to land ("sea breeze") during day and from land to ocean ("land breeze") at night**.
- Global winds are caused by the circulation of cold, dense polar air and warm, less dense equatorial air. The rotation of the earth, combined with the location of the continents, causes bands of wind patterns on the earth. For example, weather tends to move generally from west to east.
- Large bodies of water absorb heat energy, causing water to evaporate. The amount of water vapor in the atmosphere (humidity) is dependant on the temperature of the air. Warm air holds more water vapor than cool air. As warm, humid air rises and cools, its molecules become more closely spaced and the water vapor condenses into tiny water droplets that are less dense than air (clouds).
- Weather on Earth is caused by daily variations in the temperature, pressure and humidity of different bodies of air (air masses). Warm, moist, less dense air masses rise, thus decreasing air pressure usually indicates that cloudy, wet, warmer weather is approaching. Cool, dry, denser air masses sink, thus increasing air pressure usually indicates clear, dry, cooler weather is approaching.
- When masses of warm, moist air interact with masses of cool, dry air, the boundary is called a warm front. The way in which the air masses

- Measure relative humidity using two thermometers or a sling psychrometer.
- Demonstrate how hail is made.
- View Weather Channel broadcasts.
- Perform the density of three waters lab.
- Using weather maps, examine the weather patterns for three consecutive days and predict the weather for the next day.
- Perform the **Edd-Head's Internet activity** predicting weather.
- Cloud layering activity
- Heat absorption activity
- Cloud maker activity
- Demonstrate the Coriolis Effect

#### SUGGESTED ASSESSMENT METHODS

Performance Tasks:

- The Density of Three Waters lab
- Compare the density of cold air to warm air and predict the impact of each on weather patterns

Other Assessments:

- Teacher-created quizzes
- Common unit test

#### GRADE LEVEL EXPECTATIONS

Assessments MUST measure the ability of students to:

1. Compare the composition and structure of **the Earth's atmospheric layers**.
2. Demonstrate how changes in temperature, pressure, moisture, and density of air affect weather patterns (e.g., air masses and air pressure.)
3. Describe in writing how solar energy drives **Earth's weather systems**.
4. Investigate and report on how the introduction of heat affects the motion of particles and the distance between them.
5. Illustrate the transfer of energy as matter changes phase.
6. Design, conduct and report in writing an investigation that reveals different substances absorb and release heat at different rates.
7. Research and give examples of heat transfer and local weather differences in Connecticut.
8. Investigate and explain the movement of **local winds, including "sea breezes" and "land breezes," based upon the uneven heating of the Earth's surface and a change in air pressure**.

<p>move past one another influences the type of weather that results. Weather predictions can be made based on the pattern of warm, wet, low pressure air being typically followed by cool, dry, high pressure air.</p> <ul style="list-style-type: none"> <li>Connecticut, and the northeast in general, often has rapidly changing weather because three patterns of moving air interact here: cold, dry air from the north, warm, moist air from the Atlantic ocean coastline, and air moving across the US from west to east.</li> </ul>	<ol style="list-style-type: none"> <li>Examine and explain that global winds are <b>caused by uneven heating of the Earth's surface</b> and the rotation of the Earth.</li> <li>Design a weather forecast based upon collected weather data.</li> </ol>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>Describe the effect of heating on the movement of molecules in solids, liquids and gases.</li> <li>Explain how local weather conditions are related to the temperature, pressure and water content of the atmosphere and the proximity to a large body of water.</li> <li>Explain how the uneven heating of the <b>Earth's surface causes winds</b> and affects the seasons.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** molecule, dense, solid, liquid, gas, melting, freezing, condense, evaporate, air pressure, humidity, air mass, cold/warm front, precipitation, global wind, sea breeze, land breeze.

**KEY SCIENCE VOCABULARY:** vaporization



**LEARNING STRAND Matter and Energy in Ecosystems - How do matter and energy flow through ecosystems?**

**Unit: Plants**

*CT Standard 6.2 – An ecosystem is composed of all the populations that are living in a certain space and the physical factors which they interact.*

**ENDURING UNDERSTANDINGS**

- Populations in ecosystems are affected by biotic factors, such as other populations, and abiotic factors, such as soil and water supply.
- Populations in ecosystems can be categorized as producers, consumers and decomposers of organic matter.

**ESSENTIAL QUESTIONS**

- How do basic cell structures specialize to support life in plants?
- How do soil properties affect plant growth?

**UNDERLYING CONCEPTS** *Students should understand that...*

- Ecosystems can be categorized into abiotic and biotic components. Abiotic components include nonliving things such as soil, minerals, climate, water, sunlight, and wind. Biotic components include all living things.
- An ecosystem is the complex interplay between the living organisms and physical environment in a specific area.
- Interactions among **biotic** and **abiotic** factors support the flow of energy and cycling of materials in **ecosystems**. For example, air temperature, availability of water and amount of wind influence the growth of certain species of plants in an area, plant species provide food for animal populations, and plants and animals cycle oxygen and carbon dioxide.
- Soil is a mixture of materials that includes weathered rocks and **decomposed** organic material, as well as air and water. Soils vary from place to place. The composition of soils affects how air and water move through the soil, and this influences the kinds of plants that can grow in it.
- Water is a mixture of materials that includes dissolved **oxygen** and minerals as well as suspended sediments and debris.
- Soil and water provide important habitats for plants (and animals) within ecosystems.

**GRADE LEVEL CONCEPT 6.2.b.**

- The sun is the main source of energy on Earth. During **photosynthesis**, green plants use the energy of sunlight to change the elements in carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) into materials (simple carbohydrates) that are a source of energy for the plant to carry on its life processes.
- Photosynthesis is affected by abiotic factors such as amount of sunlight, availability of water and

**INSTRUCTIONAL SUPPORT MATERIALS**

- Prentice Hall module: Bacteria to Plants
- Various seeds
- Plastic baggies
- Microscopes
- Plastic cups
- Iodine
- General lab safety equipment
- Various soil samples
- Plastic water bottles (20 oz.)
- Cheese cloth
- Clay
- Plants
- Stereoscopes
- Gloves

**SUGGESTED INSTRUCTIONAL STRATEGIES**

- Visit Outdoor Classroom, sketch plants and research various species
- Dissecting a Seed
- Demonstrate geotropism with radish seeds
- Seed germination with sandwich baggies
- Examination of roots and root hairs
- Leaf rubbings
- Examination of underside of leaves with stereoscopes
- Flower dissection using rhododendron
- Prediction of germination & germination rate
- Examination of soil
- CMT Embedded Task: "Dig In!"

**SUGGESTED ASSESSMENT METHODS**

- Performance Tasks:  
CMT Embedded Task: Dig In!
- Soil properties and water absorption
- Other Assessments:
- Teacher-created quizzes
  - Common unit test
  - Classroom labs

air temperature.

- Green plants are the **producers** in an ecosystem; they rely directly on sunlight to produce the materials they use for energy.
- Plants are a source of energy (food) and nutrients for animals that **consume** them. Energy passed to **consumers** that eat plants came indirectly from the sun as a result of photosynthesis. Some animals consume plants, and other animals consume animals that eat plants in **predator-prey relationships**.
- Plants (and animals) within an ecosystem interact in various ways as they compete for limited resources. Relationships among organisms can be beneficial or harmful to one or both organisms.
- Food chains are models that show how materials and energy are transferred from producers to different levels of consumers in an ecosystem. The basis of every food chain is the energy stored in green plants.
- Food webs are models that show the complex variety of energy sources available to most consumers in an ecosystem.
- Connecticut has forest and park ecosystems, as well as fresh water and marine ecosystems that include a variety of plants and animals.
- Populations of species within an ecosystem are affected by the availability of resources such as food, water, living space, or mates. Populations can be reduced or increased by environmental changes caused by nature (for example, droughts, forest fires or disease) and by humans (climate change, land development or overhunting).
- All organisms cause changes in the environment where they live. Some of the changes caused by organisms can be helpful to the ecosystem and others can damage the ecosystem.

#### **GRADE LEVEL EXPECTATIONS**

Assessments **MUST** measure the ability of students to:

1. Analyze and interpret how biotic and abiotic factors interact within a given ecosystem.
2. Design and conduct a scientific investigation to explore the porosity and permeability of soils and their ability to support different plant life.
3. **Defend the statement, "The sun is the main source of energy on Earth."**
4. Express in general terms how plants and other **photosynthetic organisms use the sun's energy.**
5. Investigate and report on the effects of abiotic **factors on a plant's ability to photosynthesize.**
6. Compare and contrast how energy and matter flow in a Connecticut ecosystem, emphasizing the interactions among producers, consumers and decomposers.
7. Identify local examples of predator-prey relationships and justify the impact of each type of population on the other.
8. Explain the impact of environmental conditions such as climate, elevation, topography or water quality on food chains.
9. Predict what will happen to a population based on current trends (fires, disease, over hunting, development) and defend the prediction.

#### **CMT CORRELATIONS**

- Describe how abiotic factors, such as temperatures, water and sunlight, affect the ability of plants to create their own food through photosynthesis.

**SCIENTIFIC LITERACY TERMINOLOGY:** ecosystem, organisms, population, biotic factor, abiotic factor, food chain, photosynthesis, producer, consumer, herbivore, carnivore, omnivore, food web, predator, prey

**KEY SCIENCE VOCABULARY:** decomposer, predator-prey relationships

**Content Standards & Indicators**  
**for Grade 7**





### Course Description

MIDDLE SCHOOL		
1. Course Title <b>Grade 7 General Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Science</b>		
3. Transcript Course Code/Number		
4. Program Contact Information  Name: Kathleen Brooks  Title/Position: Middle School Science Coordinator  School: Walter C. Polson Middle School 302 Green Hill Road Madison, CT 06443  Phone: 245-6475 X7082	6. Grade Level: 7  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable  8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)	
10. Pre-Requisites N/A		
11. Brief Course Description The seventh grade science course is a general science course. It is part of a spiraling curriculum in which aspects of life science, physical science and earth/space science are addressed each school year. In grade seven the life science topics include the study of the circulatory, digestive, and excretory systems of the human body. The physical science topics include the study of forces and motion, simple machines and bridge design. The <b>earth/space science topic is geology. In addition, an earth science / ecology unit on Connecticut's water resources is included.</b>		
12. Course Goals The upper middle school science program combines the development of logical, scientific thought processes with current scientific theories, terminology, and factual information. Participating in an inquiry-based learning environment <ul style="list-style-type: none"> <li>▪ Provides opportunities for students to practice the skills of observation, investigation, experimentation, and research.</li> <li>▪ Assists students in the development of scientific literacy to make them more aware and understanding of the natural and physical world around them.</li> <li>▪ Ensures students meet the science standards for Connecticut public schools.</li> <li>▪ Encourages students to become interested in science as well as to learn about careers in science.</li> </ul>		
13. Course Outline <ul style="list-style-type: none"> <li>▪ Circulation, Respiration, Excretion               <ul style="list-style-type: none"> <li>- Structure and Function</li> <li>- Defense Against Disease</li> </ul> </li> <li>▪ Geology               <ul style="list-style-type: none"> <li>- Plate Tectonics</li> <li>- Erosion and Glaciation</li> <li>- Basic Rock Types and Rock Formation</li> </ul> </li> <li>▪ Connecticut Water Resources               <ul style="list-style-type: none"> <li>- Fresh Water</li> </ul> </li> </ul>		

<ul style="list-style-type: none"> <li>- Salt Water</li> <li>- Septic and Sewer Systems</li> <li>▪ Forces and Motion <ul style="list-style-type: none"> <li>- Forces: Friction, Buoyant, Gravitational</li> <li>- <b>Newton's Laws of Motion</b></li> <li>- Momentum, Speed, and Acceleration</li> </ul> </li> <li>▪ Work and machines <ul style="list-style-type: none"> <li>- Forces and Work</li> <li>- Simple Machines</li> </ul> </li> <li>▪ Structures (Bridges) <ul style="list-style-type: none"> <li>- Structural Shapes and Materials</li> <li>- Bridge Designs</li> </ul> </li> </ul>
<p>14. Instructional Methods and/or Strategies</p> <ul style="list-style-type: none"> <li>▪ Individual and small group work</li> <li>▪ Whole class instruction and discussions</li> <li>▪ Lecture</li> <li>▪ Modeling</li> <li>▪ Inquiry-based activities</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Research</li> </ul>
<p>15. Assessment Methods and/or Tools</p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Common unit assessments</li> <li>▪ Authentic assessments</li> <li>▪ Lab reports</li> <li>▪ Research papers and/or projects</li> <li>▪ Embedded performance assessment in class activities</li> </ul>
<p>16. Assessment Criteria</p> <p>The common assessments are based on the Madison curriculum and Connecticut standards and grade level expectations for science. For authentic assessments and projects students are given a rubric or grading criteria before doing the work. A variety of assessment tools are employed to get the most accurate understanding of individual student achievement possible.</p>

<b>LEARNING STRAND</b> <b>Unit: Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific Inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Scientific literacy includes also the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ Why is it critical design and conduct appropriate types of scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you identify independent and dependent variables?</li> <li>▪ Why is it important to identify variables that need to be kept constant?</li> <li>▪ Why is it essential to assess the data that was collected, using mathematical operations to analyze and interpret data, and present relationship between variables in appropriate graphs?</li> <li>▪ Why is it essential to assess the validity of the experimental design identifying sources of error and the credibility of scientific claims in different sources of information?</li> <li>▪ Why is it important to communicate your findings, using relevant scientific vocabulary and clear logic that are based on the results generated during the experiment?</li> </ul>
<b>KNOWLEDGE &amp; LEARNING</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Identify questions that can be answered through scientific investigation.</li> <li>▪ Formulate a <b>testable hypothesis, in the "If..., then... because" format that is logically connected to the problem.</b></li> <li>▪ Design an experiment in which the independent and dependent variables are accurately identified and variables, which need to be, are kept constant.</li> <li>▪ Use appropriate tools and techniques that are appropriate for the design of the experiment, for making observations and gathering data.</li> <li>▪ Accurately collect and record appropriate data.</li> <li>▪ Use mathematical operations to analyze and interpret data.</li> <li>▪ Interpret and create appropriate graphs to present relationships between variables.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Report findings and conclusions in various formats (i.e., lab reports) using relevant vocabulary, supporting evidence, and clear logic.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Prentice Hall modules</li> <li>▪ Lab materials</li> <li>▪ Safety equipment</li> </ul> <hr/> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Inquiry activities and investigations</li> <li>▪ Guided internet research</li> <li>▪ Performance tasks</li> </ul> <hr/> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Lab Reports</li> <li>▪ Research projects/activities</li> <li>▪ Inquiry literacy questions</li> </ul> <p>Benchmarks</p> <ul style="list-style-type: none"> <li>▪ CMT Embedded Tasks (Modified Versiona): <ul style="list-style-type: none"> <li>- <i>"Feel the Beat"</i></li> <li>- <i>"Shipping and Sliding" Friction Lab</i></li> </ul> </li> </ul>



<b>LEARNING STRAND Structure and Function - <i>How are organisms structured to ensure efficiency and survival?</i></b> <b>Unit: Human Body (Circulation, Respiration, Excretion)</b> <i>CT Standard 7.2 – Many organisms, including humans, have specialized organ systems that interact with each other to maintain dynamic internal balance.</i>	
<b>ENDURING UNDERSTANDING</b> <ul style="list-style-type: none"> <li>Multicellular organisms need specialized structures and systems to perform basic life functions.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>Why are the basic anatomical structures of the human respiratory, circulatory, and excretory system so vital?</li> <li>How do the organ systems bring oxygen and nutrients to the cells and expel wastes?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>The major parts of the human respiratory <b>system</b> are the nose, <b>trachea</b>, <b>bronchi</b> and lungs. This system is responsible for breathing and exchange of gases between the body and its surroundings.</li> <li>The major parts of the human circulatory system are the heart, <b>arteries</b>, <b>veins</b> and <b>capillaries</b>. The right side of the heart pumps blood to the lungs for gas exchange; the left side of the heart pumps the oxygenated blood around the body.</li> <li>The blood is made up of <b>plasma</b>, red and white blood cells, and <b>platelets</b>. Its main role is to carry small food molecules and respiratory gases (oxygen and carbon dioxide) to and from cells. Blood cells are also responsible for destroying invading particles, preventing diseases and stopping bleeding after injuries.</li> <li>The respiratory and circulatory systems work together to provide all cells with oxygen and nutrients. <b>When the body's need for oxygen changes</b>, the circulatory and respiratory systems respond by increasing or decreasing breathing and heart rates. These changes can be measured by counting breaths, heartbeats or pulses per minute.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>Prentice Hall Science Explorer <u>Human Biology and Health</u></li> <li>Lab equipment</li> <li>Lab Safety equipment</li> <li>Microscopes</li> <li>Timers</li> <li>Stethoscopes</li> <li>Thermometers</li> <li>Limewater</li> <li>Bill Nye's "Circulation" video</li> <li>Food coloring and small beakers or cups</li> <li>Apples and plastic bags</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>Label the major anatomic parts of the human body corresponding to the circulatory, respiratory, and excretory systems.</li> <li>View microscopic specimens of the specialized cells, tissue and organ systems.</li> <li>Perform research on circulatory conditions.</li> <li><b>Perform the state embedded task "Feel the Beat."</b></li> <li>Demonstrate how perspiration affects body temperature.</li> <li>Show the Bill Nye's video "Circulation."</li> <li><b>Perform a "Circulatory Walk."</b></li> <li><b>Perform the activity "Excretion and Exercise."</b></li> <li>Design a poster or create a story, cartoon, poem, or song to show the complete path of a red blood cell through the human body.</li> <li>Demonstrate how more pressure affects blood flow using a squeeze bottle with water. Perform the A-B-O Lab (<i>p. 103 Human Biology and Health</i>).</li> <li><b>Perform the activity "How Does Filtering a Liquid Change the Liquid?"</b> (<i>p. 127 Human Biology and Health</i>).</li> <li>Perform testing for the presence of glucose and protein (<i>pp 132-133 Human Biology and Health</i>).</li> <li><b>Perform "The Skin as Barrier" as demonstration</b> (<i>pp 152-153 Human Biology and Health</i>).</li> </ul>

	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Benchmark: CMT Embedded Task: <i><b>"Feel the Beat"</b></i></p> <p>Performance Tasks:</p> <ul style="list-style-type: none"> <li>▪ Demonstrate how the heart functions to circulate and re-oxygenate blood in the human body.</li> <li>▪ Compare the structures and functions of the basic components of blood (plasma, platelets, red and white cells).</li> <li>▪ Analyze the interaction between the circulatory and respiratory systems as the demand for oxygen changes.</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Teacher-created quizzes</li> <li>▪ Common unit test</li> <li>▪ Lab activities</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to meet these state expectations:</p> <ol style="list-style-type: none"> <li>1. Label the major parts of the human respiratory system and explain in writing the function of each part (nasal cavity, trachea, bronchi, lungs and diaphragm).</li> <li>2. Label the major parts of the human circulatory system and explain in writing the function of each part (heart, veins, arteries and capillaries).</li> <li>3. Design and conduct controlled variable experiments to analyze the interaction between the circulatory and respiratory systems as the demand for oxygen changes.</li> </ol> <p><b>CMT CORRELATION</b></p> <ul style="list-style-type: none"> <li>▪ Describe the structures of the human digestive, respiratory and circulatory systems and explain how they function to bring oxygen and nutrients to the cells and expel waste materials.</li> </ul>
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**SCIENTIFIC LITERACY TERMINOLOGY:** structure, function, cell, mitosis, organelle, cytoplasm, nucleus, cell membrane, mitochondrion, tissue, organ, system

**KEY SCIENCE VOCABULARY:** trachea, bronchi, arteries, veins, capillaries, plasma, platelets

<p><b>LEARNING STRAND Energy in the Earth's Systems</b> -How do external and internal sources of energy affect the Earth's Systems?  <b>Unit: Geology</b>  <i>CT Standard 7.3 – Landforms are the result of the interaction of constructive and destructive forces over time.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Volcanic activity and the folding and faulting of <b>rock layers during the shifting of the Earth's crust</b> affect the formation of mountains, ridges, and valleys.</li> <li>Glaciation, weathering, and erosion change the <b>Earth's surface by moving earth materials from place to place.</b></li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How do external and internal sources of <b>energy affect the Earth's systems?</b></li> <li>How do folded and faulted rock layers provide evidence of the gradual up and down motion of <b>the Earth's crust?</b></li> <li>How do glaciation, weathering and erosion create and shape valleys and floodplains?</li> <li>How can the boundaries of tectonic plates be inferred from the location of earthquakes and volcanoes?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <p>GRADE LEVEL CONCEPT 7.3.a.</p> <ul style="list-style-type: none"> <li>Earth's surface is constantly being shaped and reshaped by natural processes. Some of these processes, like <b>earthquakes</b> and <b>volcanic</b> eruptions, produce dramatic and rapid change. Others, like <b>weathering</b> and <b>erosion</b>, usually work less conspicuously over longer periods of time.</li> <li><b>Glaciers</b> form in areas where annual snowfall is greater than the seasonal melt, resulting in a gradual build-up of snow and ice from one season to the next.</li> <li>Glaciers increase and decrease in size over long <b>periods of time, depending on variations in Earth's climate.</b></li> <li>Glaciers move slowly, spreading outward across a region or moving down a slope.</li> <li>Moving glaciers reshape the land beneath them by scraping, carving, transporting and depositing soil and rock.</li> <li>Glacial landforms have identifiable shapes. <b>Connecticut's landscape provides many examples</b> of glacial movement and deposition.</li> <li>Weathering and erosion work together as destructive natural forces. Both are forces that break down rock into small particles called <b>sediments</b>.</li> <li>Weathering is caused by physical, chemical or biological means. Rock properties, such as hardness, porosity or mineral content, influence susceptibility to weathering.</li> <li>Erosion loosens and transports sediment formed by weathering. Moving water and wind cause changes to existing landforms and create new landforms such as <b>valleys, floodplains, plateaus,</b></li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Prentice Hall module <b>Earth's Changing Surface</b> (2009)</li> <li>Prentice Hall Module <b>Inside Earth</b>(2008)</li> <li>Maps (on the computer and hard copies)</li> <li>GEMS kit for making topographic maps</li> <li>Stream tables</li> <li>Rock and mineral samples</li> <li>Mineral testing equipment</li> <li>General lab supplies</li> <li>Lab safety equipment</li> <li>Stereoscopes</li> <li>Proscope</li> <li>GEMS magnetic boards</li> <li>Internet access</li> <li>GPS</li> <li>Sand, toilet paper rolls, rulers</li> <li><b>"Shake, Rattle, and Roll" Set</b></li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Do the cut and paste activity showing the major lithospheric plates.</li> <li>Use maps and globes to find locations.</li> <li>Use maps to show the large variety of maps made for different purposes.</li> <li>Show students how to interpret a topographic map. Perform an activity how to make a topographic map. (Page 31 <b>Earth's Changing Surface</b>)</li> <li>Perform a rock shake activity to see how shaking and/or acid affect the rate of weathering of limestone.</li> <li>Examine rocks testing for their mineral content.</li> <li>Perform the <b>"Sand Hill" activity</b> (Page 70 <b>Earth's Changing Surface</b>)</li> <li>Perform a stream table activity (i.e., pages</li> </ul>

<p><b>canyons, caves or dunes.</b></p> <p>GRADE LEVEL CONCEPT 7.3.b.</p> <ul style="list-style-type: none"> <li>▪ <b>Earth’s surface features, such as mountains, volcanoes and continents, are the constantly-changing result of dynamic processes and forces at work inside the Earth.</b></li> <li>▪ The solid Earth has a <b>core, mantle and crust</b> each with distinct properties.</li> <li>▪ <b>Earth’s crust is broken into different “tectonic plates” that float</b> on molten rock and move very slowly. <b>Continental drift</b> is driven by <b>convection</b> currents in the hot liquid <b>mantle</b> beneath the crust.</li> <li>▪ The presence of plant and animal fossils of the same age found around different continent shores, along with the matching coastline shapes of continental land masses, provides evidence that the continents were once joined.</li> <li>▪ Tectonic plates meet and interact at divergent, convergent or transform boundaries. The way in which the plates interact at a boundary affects outcomes such as <b>folding, faulting, uplift or earthquakes</b>.</li> <li>▪ The folding and faulting of rock layers during the <b>shifting of the Earth’s crust causes the constructive</b> formation of mountains, ridges and <b>valleys</b>.</li> <li>▪ Mountain formation can be the result of <b>convergent</b> tectonic plates colliding, such as the Appalachians and the Himalayas; mountains may also be formed as a result of <b>divergent</b> tectonic plates moving apart and causing rifting as in East Africa or Connecticut.</li> <li>▪ Most volcanoes and earthquakes are located at tectonic plate boundaries where plates come together or move apart from each other. A geographic plot of the location of volcanoes and the centers of earthquakes allows us to locate tectonic plate boundaries.</li> <li>▪ The geological makeup of Connecticut shows evidence of various earth processes, such as continental collisions, rifting, and folding that have shaped its structure.</li> </ul>	<p>82-83 <u>Earth’s Changing Surface</u>)</p> <ul style="list-style-type: none"> <li>▪ Demonstrate the affect of moving air on sediment by blowing air through a straw at a container with a flat layer of cornmeal being careful not to blow it in the direction of students.</li> <li>▪ Using photographs, show evidence of processes that shape the surface of the Earth (i.e., glaciers, volcanoes, weathering and erosion, faulting, folding).</li> <li>▪ Show virtual tours from Eastern Connecticut State University website.</li> <li>▪ Locate the epicenter and focus of an earthquake on a diagram.</li> <li>▪ Plot the location of volcanoes and/or earthquakes comparing it to the location of plate boundaries.</li> <li>▪ <b>Utilize the “Shake, Rattle, and Roll”</b> equipment.</li> <li>▪ Use a Dichotomous Key to classify igneous, metamorphic and sedimentary rocks.</li> <li>▪ Use the magnetic boards from the GEMS kit to explore the concept of magnetic pole reversal.</li> <li>▪ Use the fault models or sponges to demonstrate faulting.</li> <li>▪ <b>Use the interactive CD “Plate Tectonics”</b> to show island formation from plumes, the formation of island arcs, and volcanic arcs, and evidence for plate tectonics as well as to review general concepts.</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>▪ Stream table activity</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Teacher-created quizzes</li> <li>▪ Common unit test</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>1. Illustrate and describe in writing the composition of the three major layers of the <b>Earth’s interior.</b></li> <li>2. <b>Explain how Earth’s internal energy</b> is transferred to move tectonic plates.</li> <li>3. Demonstrate the processes of folding and <b>faulting of the Earth’s crust.</b></li> <li>4. Correlate common geological features/events (deep sea trenches, mountains, earthquakes, volcanoes) with the location of plate boundaries.</li> </ol>



	<ol style="list-style-type: none"> <li>5. Compare geological features that result from constructive forces (e.g., mountains and ridges) with geological features that result from destructive forces (e.g., canyons and flood plains).</li> <li>6. Analyze and interpret data about the location, frequency and intensity of earthquakes.</li> <li>7. Compare and contrast the major agents of erosion and deposition of sediments: running water, moving ice, wave action, wind and mass movement due to gravity.</li> <li>8. Investigate and determine how glaciers <b>form and affect the Earth's surface as they</b> change over time.</li> <li>9. Distinguish between weathering and erosion.</li> <li>10. Observe and report on the geological events that are responsible for having shaped <b>Connecticut's landscape.</b></li> </ol>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Describe how folded and faulted rock layers provide evidence of gradual up and down <b>motion of the Earth's crust.</b></li> <li>▪ Explain how glaciation, weathering and erosion create and shape valleys and floodplains.</li> <li>▪ Explain how the boundaries of tectonic plates can be inferred from the location of earthquakes and volcanoes.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** Erosion, weathering, glacier, valley, floodplain, core, mantle, folds, fault/fault line, continent, tectonic plate, plate boundary, convection, mountains, volcano, earthquake.

**KEY SCIENCE VOCABULARY:** igneous, sedimentary, metamorphic, plateaus, canyons, caves, dunes, lithosphere, asthenosphere, Pangaea



<p><b>LEARNING STRAND Science and Technology in Society - <i>How do science and technology affect the quality of our lives?</i></b>  <b>Unit: Connecticut Water Resources</b>  <i>CT Standard 6.4 – Water moving across and through earth materials carries with it the products of human activities.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>Most precipitation that falls on Connecticut eventually reaches the Long Island Sound.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What is the affect of septic and sewage systems on the quality of surface and ground water?</li> <li>How might human activity impact water resources in Connecticut such as ponds, rivers, and the Long Island Sound?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <ul style="list-style-type: none"> <li>Water is essential for life and is a distinguishing feature of Earth among the planets in our solar system. Humans and other organisms use water in various ways.</li> <li>The surface of Earth is largely covered with water, most of which is saltwater found in oceans. Only freshwater is drinkable, and it is found on the land (surface water), beneath the ground (groundwater), and frozen in glaciers.</li> <li>Water is a <b>universal solvent</b> that dissolves and carries many substances through the environment (e.g., acid rain, calcium, carbon dioxide, oxygen, salt, metals, etc). Many substances that are dissolved in water may be either harmful (pollutants) or beneficial to organisms (minerals, oxygen, nutrients). Water temperature affects its ability to dissolve substances such as oxygen and salt.</li> <li>Some water that falls to Earth as precipitation soaks into the ground, some evaporates almost <b>immediately, and some moves across earth’s surfaces</b> filling streams, rivers and reservoirs. Factors affecting whether water seeps into the ground include the amount of rainfall, the length of time it falls, the <b>permeability</b> of the ground surface and subsurface, the saturation of the soil, and the steepness (<b>slope</b>) of the land.</li> <li><b>Water moving beneath the earth’s surface is</b> influenced by size of and spaces between the particles in rock and soils.</li> <li><b>Water moving across the earth’s surface is affected</b> by the shape and slope of the land and the properties of the surface materials it encounters. The area draining into a river system or other body of water is a watershed. Folds and faults in <b>Connecticut’s landform cause water to move</b> generally from north to south, eventually draining into Long Island Sound.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Prentice Hall Science Explorer <b>Earth’s Waters</b> (2008)</li> <li>Lab materials</li> <li>Internet access</li> <li>Water quality testing materials</li> <li>Topographic maps of watersheds</li> <li>Easel paper, markers, materials representing pollutants, masking tape</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Explain the role of septic and sewage systems. Compare and contrast them.</li> <li>Perform some water quality tests.</li> <li>Using topographic maps identify the watershed of a stream or river in Connecticut.</li> <li>Perform the <b>Project O</b> suggested activity demonstrating point source and non point source pollution in the Connecticut River.</li> <li>Design and perform an experiment to clean water after pollutants have contaminated it (filtering).</li> <li>Trace a drop of water as it falls to Earth. Have different groups of students trace the drop from a variety of locations making a flow chart or drawing of its travel.</li> <li>Perform a demonstration to show the desalination process (Page 56 in the Prentice Hall module <b>Earth’s Waters</b>).</li> <li>Collect data on the amount of water students use each day (using averages for showers, etc.) and compare their usage to national and global usage per capita.</li> <li>Brainstorm ways to conserve water and to reduce water pollution (i.e., rain collection to water gardens, drip irrigation).</li> </ul>

<ul style="list-style-type: none"> <li>▪ Water moving through a <b>watershed</b> picks up, suspends or dissolves various substances produced by nature and by human activities. The quality and usability of water depends on what materials have been picked up, carried and concentrated in the water.</li> <li>▪ Water quality is important to support a variety of aquatic life and for human consumption. Water quality is evaluated by measuring indicators such as levels of dissolved oxygen, pH, <b>turbidity</b> and the presence of other dissolved substances. Substances such as heavy metals (e.g., lead and aluminum), sulfur, fertilizers, road salt are pollutants that may be dissolved in surface water or ground water, making the water unhealthy.</li> <li>▪ Water entering Long Island Sound carries with it the products of human use. These pollutants negatively impact the aquatic life, commercial and recreational uses of the Sound.</li> <li>▪ <b>Point source pollution</b>, such as untreated sewage, industrial or recreational waste, can be discharged directly into the Sound if it is not regulated and controlled.</li> <li>▪ <b>Non-point source pollution</b> is difficult to trace or control because it originates across the large watershed area that drains into Long Island Sound. A major contaminant reaching Long Island Sound by way of watersheds is nitrogen.</li> <li>▪ Drinking water may come from groundwater sources accessed by drilling wells, or from surface water reservoirs.</li> <li>▪ <b>People's use of water adds waste products and harmful materials</b> to the water which must be removed before returning the water to the environment. <b>Wastewater</b> can be purified using various physical, biological and chemical processes.</li> <li>▪ <b>Septic systems</b> use settling and bacterial digestion to break down wastes in a holding tank; then the water is further purified as it is spread across a leaching field and percolates through layers of soil.</li> <li>▪ Sewage treatment facilities are required in densely populated areas. Sewage treatment facilities use multiple filtrations, biological and chemical methods to purify water before returning the water to the environment.</li> <li>▪ Laws, regulations and remedial actions have helped to protect and restore water resources.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Research laws that oversee the regulation of water use and water quality. Debate fabricated controversial issues regarding water quality such as the dumping of wastes in the ocean or a land fill being proposed for property near the school.</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>▪ Design and perform an experiment to clean water after pollutants have contaminated it (i.e., filtering).</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Teacher-created quizzes</li> <li>▪ Common unit test</li> <li>▪ Student research and debate on environmental issue</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>1. Discuss and chart the reasons why water is essential for life.</li> <li>2. Observe, analyze and record the unique physical and chemical properties of water.</li> <li>3. Research the differences in quantities between fresh water (solid and liquid) and salt water covering <b>the Earth's surface and</b> report on the impact to humans.</li> <li>4. Investigate and explain in writing how substances, both harmful and beneficial, dissolve in and are carried by surface and ground water.</li> <li>5. Use appropriate maps to locate and identify the major watersheds that drain into Long Island Sound and analyze how the topography influences the way water moves in the Long Island Sound watershed.</li> <li>6. Research and evaluate in writing the effects of common point and nonpoint water pollutants in Connecticut.</li> <li>7. Compare and contrast the general structures, processes and limitations of a septic system to a secondary wastewater treatment plant.</li> <li>8. Debate the effectiveness of a law designed to protect water resources.</li> </ol>
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**CMT CORRELATIONS**

- Explain the role of septic and sewage systems on the quality of surface and ground water.
- Explain how human activity may impact water resources in Connecticut, such as ponds, rivers, and the Long Island Sound ecosystems.

**SCIENTIFIC LITERACY TERMINOLOGY:** surface water, ground water, fresh water, salt water, pollutant, watershed, point source pollution, nonpoint source pollution, well, septic system, wastewater,

**KEY SCIENCE VOCABULARY:** runoff, sewer, turbidity, universal solvent, permeability, slope, topographic, brackish



<b>LEARNING STRAND Force and Motion - <i>What makes objects move the way they do?</i></b> <b>Unit: Forces and Motion</b> <i>CT Standard 8.1 – An object's inertia causes it to continue moving the way it is moving unless it is acted upon by a force.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The motion of an object can be described by its position, direction of motion and speed.</li> <li>▪ An unbalanced force acting on an object changes its speed and/or direction of motion.</li> <li>▪ Objects moving in circles must experience force acting toward the center.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How is the speed of a moving object calculated?</li> <li>▪ How is motion illustrated in graphs?</li> <li>▪ How can the qualitative relationships among force, mass and changes in motion be described?</li> <li>▪ How can the forces acting on an object moving in a circular path be described?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>▪ An object is said to be in motion when its position changes in relation to a point of reference. <b>An object's motion can be described</b> and represented graphically according to its position, direction of motion, and speed.</li> <li>▪ <b>Speed describes the change in an object's</b> position over a period of time, and is measured in units such as meters per second or miles per hour.</li> <li>▪ <b>Average speed</b> takes into account the different speeds at which an object moves over a period of time. Average speed is calculated by dividing the total distance traveled by the change in time, regardless of any changes in motion or direction during its travel.</li> <li>▪ Motion of objects can be represented on a distance vs. time line graph, with distance traveled as the vertical ("y") axis and time as the horizontal ("x") axis. The steepness and slant of the motion line vary depending on the speed and direction of the moving objects. A straight horizontal line indicates an object at rest.</li> <li>▪ In order for an object to change its motion, a push/pull (force) must be applied over a distance.</li> <li>▪ Forces can act between objects that are in direct contact, or they can act over a distance. There are forces of attraction, such as gravity or magnetism, and forces of resistance, such as friction and drag (air resistance). Forces are measured in <b>Newtons</b> or pounds using scales.</li> <li>▪ Forces can act simultaneously on an object from all directions with different strengths (<b>magnitudes</b>). When the magnitude and direction of all the forces acting on an object are combined, or added together, the total force (<b>net force</b>) determines the object's motion. Forces in opposite directions are subtracted; forces in the same direction are added.</li> <li>▪ If the strength of all the forces acting on an</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Prentice Hall module <u>Forces, Motion and Energy</u> (2009)</li> <li>▪ Wooden blocks, bricks, boxes</li> <li>▪ Spring scales</li> <li>▪ Carts and metal weights</li> <li>▪ Magnets</li> <li>▪ Friction blocks</li> <li>▪ Toys (i.e., rattlebacks, rubber balls, remote-controlled car, gyroscopes, airplanes)</li> <li>▪ Timers</li> <li>▪ Various surfaces</li> <li>▪ Newtonian demonstrator</li> <li>▪ Circular motion demonstrator</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Explore the effects of forces by working through stations involving buoyant force, magnetic force, elastic force, gravitational force, static electrical force, and friction.</li> <li>▪ Perform the state embedded task "Shipping and Sliding."</li> <li>▪ Design an experiment comparing rolling and sliding friction.</li> <li>▪ Solve problems using the formulas for force, momentum, and acceleration.</li> <li>▪ Demonstrate a noncontact force using a super magnet.</li> <li>▪ Explore motion using toys such as tops, gyroscopes, Frisbees, rattlebacks, and rubber balls.</li> <li>▪ Perform an activity flying toy airplanes or racing a remote-controlled car and calculate the speed of the object.</li> <li>▪ <b>Demonstrate Newton's Laws of Motion.</b></li> <li>▪ Predict the projectile motion of different masses as they roll down an incline and off a table to the floor.</li> </ul>

<p>object from one direction is equivalent to the strength of the forces from the opposite direction, then the forces cancel each other out, and are said to be balanced. <b>Balanced forces</b> keep an object moving with the same speed and direction, including keeping it at rest.</p> <ul style="list-style-type: none"> <li>If the net force acting on an object is not zero, then the forces are said to be unbalanced, and <b>the object's speed or direction will change, changing its motion (acceleration)</b>. Acceleration is any change in motion, and occurs when something speeds up, slows down or changes direction. On a <b>position time graph</b>, this would be indicated by a change in the steepness of the motion line, or by a curved line.</li> <li>The greater the <b>unbalanced force</b> on an object, the greater its change in motion (acceleration). The greater the mass of an object, the greater the force needed to change its acceleration. Given the same amount of force, an object with a greater mass will change acceleration less. The total <b>net force</b> acting on an object can be determined by measuring its mass and change in motion (acceleration).</li> <li>Some objects continuously change direction without changing speed, causing them to move in a circular path. <b>Circular motion</b> is caused by a constant unbalanced force that is constantly changing direction and pulling towards the center. If there were no force pulling the object toward the center, it would continue to move in a straight line in the direction it was moving before the force was removed.</li> </ul>	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Benchmark Task:</p> <ul style="list-style-type: none"> <li>CMT Embedded Task: Revised <i>"Shipping and Sliding"</i> Friction Lab</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>Demonstrate how forces, including friction, act on an object to change its position over time in relation to a fixed point of reference.</li> <li>Calculate the average speed of a moving object, and distinguish between instantaneous speed and average speed of an object.</li> <li>Create and interpret distance-time graphs for objects moving at constant and nonconstant speeds.</li> <li>Predict the motion of an object given the magnitude and direction of forces acting upon it (net force).</li> <li>Investigate and demonstrate how unbalanced forces cause acceleration (change in speed and/or <b>direction of an object's motion</b>).</li> <li>Assess in writing the relationship between an <b>object's mass and its inertia when at rest and in motion</b>.</li> <li>Express mathematically how the mass of an object and the force acting on it affect its acceleration.</li> <li>Design and conduct an experiment to determine how gravity and friction (air resistance) affect a falling object.</li> <li>Illustrate how the circular motion of an object is caused by a center-seeking force (<b>centripetal force</b>) resulting in the object's constant acceleration.</li> </ol>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>Calculate the average speed of a moving object and illustrate the motion of the object in graphs of distance over time.</li> <li>Describe the qualitative relationships among force, mass and changes in motion.</li> <li>Describe the forces acting on an object moving in a circular path.</li> </ul>

**SCIENTIFIC LITERACY TERMINOLOGY:** motion, point of reference, speed, constant speed, average speed, position-time graph, slope, force, friction, gravity, inertia, mass, acceleration, balanced/unbalanced forces, net force, circular motion, Newtons

**KEY SCIENCE VOCABULARY:** point of reference, centripetal force, magnitudes



<b>LEARNING STRAND Energy Transfer and Transformations - <i>What is the role of energy in our world?</i></b> <b>Unit: Work and Machines</b> <i>CT Standard 7.1 – Energy provides the ability to do work and can exist in many forms.</i>		
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>Work is the process of making objects move through the application of force.</li> <li>Energy can be stored in many forms and can be transformed into the energy of motion.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>How does the formula <math>W=FD</math> allow problems to be solved for force, distance, and work when lifting heavy objects?</li> <li>How are simple machines, such as inclined planes, pulleys, and levers used to create mechanical advantage?</li> <li>How are different types of stored (potential) energy used to make objects move?</li> </ul>	
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>	
<p>GRADE LEVEL CONCEPT 7.1.a.</p> <ul style="list-style-type: none"> <li>In order for an object to change its motion, a push/pull (<b>force</b>) must be applied over a distance.</li> <li>Forces can act between objects that are in direct contact, such as pulling directly on a string or <b>friction</b> acting on a sliding block. Forces can act over a distance, such as <b>gravity</b> or magnetism. Forces are measured in <b>Newtons</b> or pounds using <b>scales</b>.</li> <li><b>Work</b> is a scientific concept that expresses the mathematical relationship between the amount of force needed to move an object and how far it moves. For work to be done, a force must be applied for a distance in the same direction as the motion. An object that does not move has no work done on it, even if forces are being applied.</li> <li>Work (measured in <b>Joules</b>) is calculated by multiplying the force (measured in newtons) times the distance (measured in meters). When an object is lifted, the work done is the product of the force of gravity (<b>weight</b>) times the height the object is lifted. The amount of work done is increased if more force is applied or if the object is moved a greater distance.</li> <li><b>Simple machines</b> can be used to move objects. <b>People do “input” work on a simple machine which, in turn, does “output” work in moving an object.</b> Simple machines are not used to change the amount of work to move or lift an object; rather, simple machines change the amount of effort force and distance for the simple machine to move the object.</li> <li>Simple machines work on the principle that a small force applied over a long distance is equivalent work to a large force applied over a short distance.</li> <li>Some simple machines are used to move or lift an object over a greater output distance (snow shovel), <b>or change direction of an object’s motion, but most are used to reduce the amount of effort (input force) required to lift or move an object (output</b></li> </ul>	<ul style="list-style-type: none"> <li>Prentice Hall module <u>Forces, Motion, and Energy</u> (2009)</li> <li>Levers and pennies</li> <li>Inclined plane</li> <li>Weights</li> <li>Spring scales</li> <li>Pulleys, string, ring stands</li> <li>Internet access</li> <li>Samples of levers</li> </ul>	
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b>	<ul style="list-style-type: none"> <li>Perform a pennies and Levers activity and compare the forces when either the resistance force is closer to the fulcrum or the effort force is closer to the fulcrum.</li> <li>Use simple tools (i.e., hammer, wrench, pliers, broom) to demonstrate classes of levers.</li> <li>Perform a pulley activity to compare the mechanical advantage of various arrangements.</li> <li>Perform an inclined plane activity to determine what effect height has on the mechanical advantage of an inclined plane.</li> <li>Complete the Simple Machines Computer lab activity by visiting <a href="http://www.edheads.org/activities/simple-machines/">www.edheads.org/activities/simple-machines/</a></li> <li>Learn more about simple machines and to determine what simple machines make up four common compound machines.</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b>	<p>Performance Task</p> <ul style="list-style-type: none"> <li>Inclined plane activity</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> </ul>

<p><b>force).</b></p> <ul style="list-style-type: none"> <li>An <b>inclined plane</b> is a simple machine that reduces the effort force needed to raise an object to a given height. The effort force and distance and output force and distance depend on the length and height (steepness) of the inclined plane.</li> <li>A <b>pulley</b> is a simple machine that reduces the effort force needed to lift a heavy object by applying the force through a greater distance (pulling more rope through the pulley). The effort force and distance, output force and distance, and direction of motion all depend on the number of pulleys and their position.</li> <li>A <b>lever</b> is a simple machine that reduces the effort force needed to lift a heavy object by applying the force at a greater distance from the fulcrum of the lever. The effort force and distance, output force and distance, and direction of motion all depend on the position of the fulcrum in relationship to the input and output forces.</li> <li>The <b>mechanical advantage</b> of a simple machine indicates how useful the machine is for performing a given task by comparing the output force to the input force. The mechanical advantage is the number of times a machine multiplies the effort force. The longer the distance over which the effort force is applied, the greater the mechanical advantage of the machine.</li> <li>The mechanical advantage of a machine can be calculated by dividing the resistance force by the effort force. Most of the time the resistance force is the weight of the object in newtons.</li> <li>Simple machines always produce less work output than work put in, because some motion energy is converted to heat and sound energy by friction.</li> </ul> <p>GRADE LEVEL CONCEPT 7.1.b.</p> <ul style="list-style-type: none"> <li><b>Energy</b> is the ability to cause objects to change position (motion).</li> <li><b>Potential energy</b> is the capacity for doing work that a body possesses because of its position or condition. Gravitational potential energy (an object about to roll down a hill), elastic potential energy (a stretched rubber band) and chemical potential energy (carbohydrates in foods).</li> <li><b>Kinetic energy</b> is energy a body possesses because it is in motion.</li> <li>Energy is changed (<b>transformed</b>) from one form to another. For example, potential chemical energy of foods, which is often measured in Calories, is transformed by cells into heat, electrical and kinetic energy used in the body.</li> <li>When energy is transformed, the total amount of energy stays constant (is <b>conserved</b>).</li> <li>Work is done to lift an object, giving it gravitational</li> </ul>	<ul style="list-style-type: none"> <li>Word problem applications</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>Conduct simple experiments that show and explain how forces work to change the motion of an object.</li> <li>Calculate work done on an object as force or distance varies.</li> <li>Explain in writing how the six simple machines make work easier but do not alter the amount of work done on an object, and demonstrate how everyday objects function as simple machines.</li> <li>Determine ways to modify a simple machine (inclined plane, pulley and lever) to improve its mechanical advantage.</li> <li><b>Defend the statement, "Work output of a machine is always less than work input because of energy lost due to friction."</b></li> <li>Design and create a working compound machine from several simple machines.</li> <li>Use a diagram or model of a moving object (roller coaster, pendulum, etc.) to describe the conversion of potential energy into kinetic energy and vice versa.</li> <li>Discuss different forms of energy and describe how they can be converted from one form to another for use by humans (e.g., thermal, electrical, light, chemical, mechanical).</li> <li>Trace energy conversions that occur in the human body once food enters and explain the conversions in writing.</li> <li>Calculate potential and kinetic energy and relate those quantities to total energy in a system.</li> </ol> <p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>Explain the relationship among force, distance and work and use the relationship (<math>W = F \times D</math>) to calculate work done in lifting heavy objects.</li> <li>Explain how simple machines, such as inclined planes, pulleys and levers are used to create mechanical advantage.</li> <li>Describe how different types of stored (potential) energy can be used to make objects move.</li> </ul>
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<p>potential energy (weight x height). The gravitational potential energy of an object moving down a hill is transformed into kinetic energy as it moves, reaching maximum kinetic energy at the bottom of the hill.</p> <ul style="list-style-type: none"> <li>Some kinetic energy is always transformed into heat by friction; therefore, the object will never reach the same height it started from again without added energy.</li> </ul>	
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**SCIENTIFIC LITERACY TERMINOLOGY:** force, friction, gravity, weight, Newton, scale, work, joule, effort (input) force, output force, simple machine, lever, fulcrum, pulley, inclined plane, mechanical advantage, energy, potential energy, kinetic energy, energy transformation, conservation of energy

**KEY SCIENCE VOCABULARY:** output (resistance/load) force, Ideal Mechanical Advantage, Actual Mechanical Advantage



<b>LEARNING STRAND Science and Technology in Society - <i>How do science and technology affect the quality of our lives?</i></b> <b>Unit: Structures (Bridges)</b> <i>CT Standard 8.4 – In the design of structures there is a need to consider factors such as function, materials, safety, cost, and appearance.</i>	
<b>ENDURING UNDERSTANDING</b> <ul style="list-style-type: none"> <li>Bridges can be designed in different ways to withstand certain loads and potentially destructive forces.</li> </ul>	<b>ESSENTIAL QUESTION</b> <ul style="list-style-type: none"> <li>How are beam, truss and suspension bridges designed so they can withstand the forces that act on them?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that..</i> <ul style="list-style-type: none"> <li>A <b>force</b> is a push or a pull and is described by its strength and direction and can be caused by a moving or a stationary object. Forces are measured in <b>newtons</b> or pounds using <b>scales</b>.</li> <li>Forces can act simultaneously on an object from all directions with different strengths (magnitudes). When the magnitude and direction of all the forces acting on an object are combined, or added together, the total force (<b>net force</b>) <b>determines the object's motion</b>. Forces in opposite directions are subtracted; forces in the same direction are added.</li> <li>If the strength of all the forces acting on an object from one direction is equivalent to the strength of the forces from the opposite direction, then the forces cancel each other out, and are said to be <b>balanced</b>.</li> <li><b>Bridges</b> are elevated structures designed to support the movement of objects over a span. Two important forces at work in bridges are <b>tension</b> and <b>compression</b>.</li> <li>Bridges must support their own weight (<b>dead load</b>) and the weight of those objects that will cross over them or act on them from time to time, such as wind, snow and ice (<b>live load</b>). Bridges are kept stable by balancing the load forces with the supporting forces of the structure. These forces can cause parts of the bridge structure to push together (compression) or pull apart (tension).</li> <li>Different bridge designs distribute tension and compression forces in different ways, depending on the shapes of the parts of the structure. The biggest difference among bridge designs is the distances they can cross in a single span. Shapes commonly used in bridge design include arches, triangles and rectangles.</li> <li>Bridges are constructed of different materials whose properties and costs vary. Some materials are strong against compression forces but weak against tension forces; some materials resist fire, <b>corrosion</b> or weathering. Materials commonly used in bridge design include wood,</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>Index cards and masking tape</li> <li>K-nex kits</li> <li>Internet access</li> <li>Pictures of bridges</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>Build a bridge with four index cards to support various metal weights.</li> <li>Perform a pendulum lab and compare it to the motion of skyscrapers.</li> <li>Build structures using K-nex kits.</li> <li>Build towers or bridges out of straws, toothpicks and clay to support the weight of nails.</li> <li>Identify bridges in town and worldwide that fit the classification of four major bridge types.</li> <li>Use the interactive website on bridges <a href="http://www.pbs.org/wgbh/buildingbig/bridge">http://www.pbs.org/wgbh/buildingbig/bridge</a></li> <li>Compare the Tacoma-Narrows Bridge that collapsed to the one that replaced it.</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>Building bridge/towers to support nails</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> </ul>
<b>GRADE LEVEL EXPECTATIONS</b> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>Identify the forces acting on a truss, beam and suspension bridge, including compression, tension and gravity using models, pictures or diagrams.</li> <li>Explain in writing the advantages and disadvantages of truss, beam and suspension bridge design and visually identify each bridge.</li> <li>Conduct an experiment to discover and report <b>on a bridge's ability to support a load based on the interplay of tension and compression forces that result in a net force of zero.</b></li> <li>Use technology to simulate how engineers plan, test and revise bridge designs given parameters including cost, time, safety and aesthetics.</li> </ol>	

rope, aluminum, concrete and steel.

- A **beam bridge** balances the load by concentrating it entirely onto the two piers that support the bridge at either end. When a force pushes down on the beam, the beam bends. Its top edge is pushed together (compression), and its bottom edge is pulled apart (tension). The amount of bend depends on the length of the beam.
- A **truss bridge** uses rigid, interlocking beams to form a system of triangles that distribute the load among all parts of the structure, increasing the structural strength of the bridge.
- A **suspension bridge** uses cables suspended from tall towers to hold up the deck and distribute the load. The tension and compression forces acting on the beam are distributed among the cables (which experience tension) and the towers (which experience compression).
- Engineers and scientists build models of bridges, conduct controlled experiments to learn how they will withstand various stresses, and consider the benefits and trade-offs of various design alternatives.
- Bridge design is influenced by the length of the span, the properties of the materials and the environmental conditions, as well as by practical **considerations, such as the bridge's appearance, cost of materials or construction site challenges.**
- Bridges can fail because they have faulty parts, are used in ways that exceed what was intended by the design, or were poorly designed to begin with.

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#### CMT CORRELATION

- Explain how beam truss and suspension bridges are designed to withstand the forces that act on them.

**SCIENTIFIC LITERACY TERMINOLOGY:** balanced/unbalanced forces, net force, load, tension force, compression force, beam bridge, truss bridge, suspension bridge force

**KEY SCIENCE VOCABULARY:** dead load, live load, Newtons, tension, weathering, scale, motion, materials, span, I-beam, arch bridge

**Content Standards & Indicators**  
**for Grade 8**





**Course Description**

<b>MIDDLE SCHOOL</b>		
1. Course Title <b>Grade 8 General Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Science</b>	3. Transcript Course Code/Number	4. Program Contact Information  Name: Kathleen Brooks  Title/Position: Middle School Science Coordinator  School: Walter C. Polson Middle School 302 Green Hill Road Madison, CT 06443  Phone: 245-6475 X7082
6. Grade Level: 8		7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not Applicable
8. Unit Value <input checked="" type="checkbox"/> Full Year <input type="checkbox"/> Other: _____		9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)
10. Pre-Requisites N/A		
11. Brief Course Description The eighth grade science course is a general science course. It is part of a spiraling curriculum in which aspects of life science, physical science and earth/space science are addressed each school year. In grade eight the life science topics include the study of life processes at both the cellular and multi-cellular levels and genetics. The physical science topics include the study of chemistry, electromagnetic systems, light and sound. The earth/space science topic is astronomy. A unit of forensic science is also taught.		
12. Course Goals The upper middle school science program combines the development of logical, scientific thought processes with current scientific theories, terminology, and factual information. Participating in an inquiry-based learning environment <ul style="list-style-type: none"> <li>▪ Provides opportunities for students to practice the skills of observation, investigation, experimentation, and research.</li> <li>▪ Assists students in the development of science literacy to make them more aware and understanding of the natural and physical of the world around them.</li> <li>▪ Ensures students meet the science standards for Connecticut public schools.</li> <li>▪ Encourages students to become interested in science as well as to learn of careers in science.</li> </ul>		
13. Course Outline <ul style="list-style-type: none"> <li>▪ Astronomy                             <ul style="list-style-type: none"> <li>- Planetary Motion</li> <li>- Gravity in space</li> </ul> </li> <li>▪ Chemistry                             <ul style="list-style-type: none"> <li>- Atoms, Elements, Compounds</li> <li>- The Periodic Table of Elements</li> </ul> </li> <li>▪ Life Processes                             <ul style="list-style-type: none"> <li>- Life Processes in the Cell</li> <li>- Respiration vs. Photosynthesis</li> </ul> </li> </ul>		

- Human Nervous System and Senses
- Human Digestive System
- Genetics
  - **Mendel's Principles**
  - Punnett Squares
  - Pedigree
  - Genetic Disorders
- Electromagnetic Systems
  - Static Electricity
  - Current Electricity
  - Magnetism
- Light and Sound
  - Waves
  - Light
  - Sound
- Forensic Science

14. Instructional Methods and/or Strategies
- Individual and small group work
  - Whole class instruction and discussions
  - Lecture
  - Modeling
  - Inquiry-based activities
  - PowerPoint presentations and notes
  - Research

15. Assessment Methods and/or Tools
- Quizzes
  - Common unit assessments
  - Authentic assessments
  - Lab reports
  - Research papers and/or projects
  - Embedded performance assessment in class activities

16. Assessment Criteria
- The common assessments are based on the Madison curriculum and Connecticut standards and grade level expectations for science. For authentic assessments and projects students are given a rubric or grading criteria before doing the work. A variety of assessment tools are employed to get the most accurate understanding of individual student achievement possible.

<b>LEARNING STRAND</b> <b>Unit: Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific Inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.</li> <li>▪ Scientific literacy includes also the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ Why is it critical to design and conduct appropriate types of scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you identify independent and dependent variables?</li> <li>▪ Why is it important to identify variables that need to be kept constant?</li> <li>▪ Why is it essential to assess the data that was collected, using mathematical operations to analyze and interpret data, and present relationship between variables in appropriate graphs?</li> <li>▪ Why is it essential to assess the validity of the experimental design identifying sources of error and the credibility of scientific claims in different sources of information?</li> <li>▪ Why is it important to communicate your findings, using relevant scientific vocabulary and clear logic that are based on the results generated during the experiment?</li> <li>▪ How do you make connections to what is learned in science class to the real world?</li> </ul>
<b>KNOWLEDGE &amp; LEARNING</b> <i>The student will ...</i> <ul style="list-style-type: none"> <li>▪ Identify questions that can be answered through scientific investigation.</li> <li>▪ <b>Formulate a testable hypothesis, in the “If..., then... because” format that is logically connected to the problem.</b></li> <li>▪ Design an experiment in which the independent and dependent variables are accurately identified and variables, which need to be, are kept constant.</li> <li>▪ Use appropriate tools and techniques that are appropriate for the design of the experiment for making observations and gathering data.</li> <li>▪ Accurately collect and record appropriate data.</li> <li>▪ Use mathematical operations to analyze and interpret data.</li> <li>▪ Interpret and create appropriate graphs to present relationships between variables.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Report findings and conclusions in various formats (i.e., lab reports) using relevant vocabulary, supporting evidence, and clear logic.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Prentice Hall modules</li> <li>▪ Lab equipment</li> <li>▪ Safety equipment</li> <li>▪ Internet access</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during instruction</li> <li>▪ Inquiry activities and investigations</li> <li>▪ Guided internet research</li> <li>▪ Performance tasks</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>▪ “Ice and Salt” lab</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Lab Reports</li> <li>▪ Research projects/activities</li> <li>▪ CMT-like inquiry questions</li> </ul>



<p><b>LEARNING STRAND Earth in the Solar System</b> - <i>How does the position of Earth in the solar system affect conditions on our planet?</i>  <b>Unit: Astronomy</b>  <i>CT Standard 8.3 – The solar system is composed of planets and other objects that orbit the sun.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Gravity is the force that governs the motion of objects in the solar system.</li> <li>The motion of the Earth and moon relative to the sun causes daily, monthly and yearly cycles on Earth.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How does the position of Earth in the solar system affect conditions on our planet?</li> <li>How does gravity affect the orbital movement of planets in the solar system?</li> <li>How do the relative motion and relative position of the sun, Earth, and moon affect the seasons, phases of the moon and eclipses?</li> <li>How does the motion of Earth in relation to the sun explain the phenomena of the day and the year?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i></p> <p>GRADE LEVEL CONCEPT 8.3.a.</p> <ul style="list-style-type: none"> <li>Earth is part of a system of celestial bodies that are grouped together around a central star, the Sun. This system includes objects of different masses and composition such as planets, moons, asteroids, minor planets, and comets. These objects move in predictable paths determined by gravity.</li> <li><b>Gravity</b> is a force of attraction between two objects. The strength of gravitational force depends on the total mass of the two objects and the distance between them. The greater the total mass, the greater the force of gravity. The greater the distance between two objects, the less the force of gravity.</li> <li>The <b>difference between an object’s mass</b> and its <b>weight</b> is explained by gravity. Mass is the measure of the amount of matter in an object; weight is the force of gravity between an object and the celestial body it is on. Bodies in the solar system have different masses; therefore the same object has a different weight on each celestial body.</li> <li>Objects in the solar system are held in their predictable paths by the inward-pulling gravitational attraction of the very massive sun. The interaction of the center-pulling force of <b>gravity with a moving object’s inertia (tendency to keep moving)</b> keeps one object in circle-like motion (revolution) around another. This causes planets to orbit around the center of the solar system and moons to orbit around planets.</li> <li>The Earth and other planets move through space in two ways: <b>rotation</b> on an axis and <b>revolution</b> around the sun. Earth revolves around the sun in a near-circular path, explaining cyclical phenomena</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Module: Prentice Hall Science Explorer <u><a href="#">Astronomy</a></u> (2007)</li> <li>Models, balls, flashlights, Internet access, NASA materials including videos</li> <li>Lunar Samples on loan from NASA to a certified presenter</li> <li>Internet access</li> <li>Tide charts</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Using a model of the sun, Earth and moon, show the positions during eclipses.</li> <li>Draw a diagram of a lunar eclipse and a solar eclipse.</li> <li>Show the class a NASA video on living in space.</li> <li>Using the Internet, investigate the day and night sky using websites.</li> <li>Research astronomy topics and present them to the class.</li> <li>Make a travel brochure or poster inviting people to visit a planet.</li> <li>Create a question/answer book about what causes a day, month, year, etc.</li> <li>Make/interpret a graph of a local tide table and how it relates to the moon.</li> <li>Use the overhead projector and PowerPoint presentations to enhance lectures.</li> <li>Complete book assignments.</li> <li>See a presentation of the lunar samples on loan from NASA to a certified presenter.</li> </ul>

such as seasons and changes in visible star patterns (constellations).

- The time it takes for an object to complete one **revolution** around the sun depends on the speed at which it is moving and the size of its **orbit**. **Objects more distant from the sun's gravitational pull move slower than those that are closer. Earth's period of revolution is about 365 days (year); planets that are more distant from the sun take longer to orbit (revolve) around the sun, resulting in longer years.**

GRADE LEVEL CONCEPTS 8.3.b.

- Earth rotates around an **axis** or rotation, a line going through the center of the earth from the north pole to the south pole. The **tilt of Earth's axis** relative to its orbital path, combined with the spherical shape of the earth, cause differences in **the amount and intensity of the sun's light striking different latitudes** of the earth.
- Earth experiences **seasons** as northern or southern hemispheres are tilted toward the sun over the course of its 365-day revolution period. **Earth's tilt causes seasonal differences in the height of the perceived path of the sun and the number of hours of sunlight.** Seasons are not related to a change in distance between the Earth and the Sun, since that distance changes very little.
- The moon changes its position relative to the earth and sun as it revolves around the earth in a period of about 29 days. The same half of the moon is always reflecting light from the Sun; some of the reflected light reaches Earth. **Phases** of the moon are explained by changes in the angle at which the **sun's light strikes the moon and is reflected to Earth.** The relative position of the Sun, Earth and moon can be predicted given a diagram of a moon phase.

Performance Tasks:

- Create a Venn Diagram to compare and contrast a lunar eclipse and a solar eclipse.

Other Assessments:

- Write an explanation of the effect of gravity on the orbital movements of planets in the solar system.
- Make a drawing to explain how the relative motion and relative position of the sun, Earth and moon affect the seasons, phases of the moon and eclipses.
- Teacher-created quizzes
- Common unit test

### GRADE LEVEL EXPECTATIONS

Assessments MUST measure the ability of students to:

1. Relate the strength of gravitational force between two objects to their mass and the distance between the centers of the two objects and provide examples.
2. Describe in writing how gravitational attraction and the inertia of objects in the solar system keep them on a predictable elliptical pathway.
3. Distinguish between rotation of Earth on its axis and its elliptical revolution around the sun.
4. **Investigate and report in writing how the Earth's revolution around the sun affects changes in daylight and seasons.**
5. Compare the revolution times of all the planets and relate it to their distance from the sun.
6. Conduct and report on an investigation that **shows how the Earth's tilt on its axis and position around the sun relates to the intensity of light striking the Earth's surface.**
7. Use a model to demonstrate the phases of the moon relative to the position of the sun, Earth and moon.
8. Develop a model or illustration to show the relative positions of the Earth, sun and moon during a lunar and solar eclipse and explain how those positions influence the view from Earth.

- **Eclipses** occur when the moon, Earth and sun occasionally align in specific ways. A **solar eclipse** occurs when the moon is directly between the Earth and the sun (during **new moon phase**) and the moon blocks the sun's light, creating a moving shadow on parts of the earth. A **lunar eclipse** occurs when the Earth is directly between the moon and the sun (**full moon phase**), the Earth blocks the sun's light, casting a shadow over the moon.

Ocean **tides on Earth are caused by the moon's** gravitational force pulling on large bodies of water as the Earth and moon move around each other daily. The regular daily and monthly movement of the water (tides) can be predicted.

#### SUGGESTED ASSESSMENT METHODS

#### CMT CORRELATIONS

- Explain the effect of gravity on the orbital movements of planets in the solar system.
- Explain how the relative motion and relative position of the sun, Earth, and moon affect the seasons, phases of the moon and eclipses.

**SCIENTIFIC LITERACY TERMINOLOGY:** force, gravity, orbit, revolution, year, period, mass, weight, rotation, hemisphere, season, phase, new moon, solar eclipse, lunar eclipse, tides

**KEY SCIENCE VOCABULARY:** axis, phase, full moon, latitude, tilt waxing crescent, waning crescent, waxing gibbous, waning gibbous, first quarter, third/last quarter





<p><b>LEARNING STRAND Properties of Matter</b> – How does the structure of matter affect the properties and uses of materials?  <b>Unit: Chemistry</b>  <i>CT Standard 6.1 – Materials can be classified as pure substances or mixtures, depending on their chemical and physical properties.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Pure substances can be either elements or compounds and they cannot be broken down by physical means.</li> <li>Mixtures are made of combinations of elements and/or compounds, and they can be separated by using a variety of physical means.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How does the structure of matter affect the properties and uses of materials?</li> <li>How does the arrangement of the Periodic Table describe the properties of an element?</li> <li>How are the properties of elements different from the properties of compounds?</li> </ul>
<p><b>UNDERLYING CONCEPTS</b> <i>Students should understand that..</i></p> <ul style="list-style-type: none"> <li>All matter is made of <b>particles</b> called <b>atoms</b> that are too small to be seen without special magnification. For example, a gold ring can be broken into smaller and smaller pieces until the pieces are no longer visible.</li> <li>All matter is made of different combinations of about 100 pure substances called <b>elements</b>. The smallest particle of an element is an atom. Iron is an example of an element that is made up of only iron atoms.</li> <li>Each element has distinct <b>characteristic properties</b>. The Periodic Table of Elements is used to organize elements based on properties such as their reactivity, <b>state of matter</b>, <b>conductivity</b> or <b>density</b>. Element names are represented by letter symbols on the Periodic Table.</li> <li><b>Some elements, such as iron ("Fe") and aluminum ("Al"), are classified as <i>metals</i></b> because they have similar properties. Individual metallic elements have distinct characteristic properties (for example, sodium ("Na") is a light, soft metal that is nonmagnetic, while iron is a magnetic metal that is denser than sodium and aluminum).</li> <li><b>Some elements, such as carbon ("C"), hydrogen ("H"), oxygen ("O") and chlorine ("Cl"), are classified as <i>nonmetals</i></b>. Carbon is a nonmetal that occurs in several different forms (graphite, diamond, and coal), each of which has distinct properties. Hydrogen and oxygen are nonmetals that are similar in that they are both gases; however, each gas has distinct characteristic properties such as color and odor.</li> <li>Atoms can combine chemically to make a molecule of a new substance with new properties called a <b>compound</b>. A <b>molecule</b> is the smallest part of a compound and is made of atoms of different elements in specific</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Module: Prentice Hall Science Explorer <u>Chemical Interactions</u> (2008)</li> <li>General lab equipment</li> <li>Lab safety equipment</li> <li>Ice, salt, metals, HCl, calcium, pH indicators</li> <li>Internet access</li> <li>Plastic atoms of elements for overhead projector</li> <li>Periodic Table of Elements wall charts and student charts</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Present safety guidelines.</li> <li>Lecture using the overhead projector, computer images, or Power Point for enhancement.</li> <li>Give a lecture on the significant scientists who impacted the discovery of the atom.</li> <li>Create a list of identifying characteristics of a solid, a liquid, and a gas.</li> <li>Model how elements combine using the cross-over method and Lewis Dot Diagrams.</li> <li>Using the board, an overhead projector and manipulatives, show students how to demonstrate the Law of Conservation of Mass by balancing equations.</li> <li>Use a chart of the Periodic Table to describe the properties of common elements and the general organization of the table.</li> <li>Draw posters of the elements.</li> <li>Perform labs or demonstrations for the following: <ul style="list-style-type: none"> <li>Calcium and Water</li> <li>Neutralization Reactions, and</li> <li>Acid and Metal Reactions.</li> </ul> </li> <li>Complete an Element Spreadsheet utilizing Microsoft Excel.</li> <li>Draw a Bohr model of an atom.</li> <li>Facilitate a sing-along with students singing "The Element Song" following the words and music on an interactive website.</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p>

amounts. Unlike **mixtures**, compounds cannot be separated using the physical properties of the component elements.

- Compounds have different properties than the individual elements of which they are made. For example, table salt (NaCl) is a compound with different characteristic properties than the elements sodium and chlorine from which it is made; water (H<sub>2</sub>O) is a compound with different characteristic properties than the elements hydrogen and oxygen from which it is made. Different amounts of the same elements can produce compounds with different properties (e.g., water (H<sub>2</sub>O) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>)).
- In a **chemical reaction**, atoms can rearrange to form different molecules of new compounds. During photosynthesis, carbon dioxide (CO<sub>2</sub>) is taken in by green plants and combined with water (H<sub>2</sub>O). The carbon, hydrogen and oxygen atoms rearrange to make two new compounds: glucose (made of atoms of carbon, oxygen, and hydrogen) and oxygen gas (made of atoms of oxygen).
- In a chemical reaction, the same amount of matter (mass) is present at the start and the end, since the atoms are not created or destroyed but simply rearrange.

Performance Tasks:

- Perform the Ice and Salt lab and write a lab report utilizing formal lab writing techniques.
- Complete lab investigations abiding by all lab safety standards.
- Develop an explanation of the patterns by which the periodic table is organized, including the structure of atoms and the resulting properties of the elements.
- Use a periodic table to identify elements in a compound; to locate metals, semimetals and nonmetals; and predict the general characteristics of an element.

Other Assessments:

- Identify the different types of reactions when given chemical equations.
- Complete a worksheet describing the properties of common elements, such as oxygen, hydrogen, carbon, iron and aluminum.
- Teacher-created quizzes
- Common unit test

#### **GRADE LEVEL EXPECTATIONS**

Assessments **MUST** measure the ability of students to:

1. Describe the structure of the atom and its component parts.
2. Explain that density (mass/volume) is a characteristic property that can be used to identify an element or substance.
3. Compare and contrast the properties of a metal (aluminum, iron, etc.) with a nonmetal (oxygen, carbon, etc.).
4. Illustrate the differences in the physical and chemical properties of a molecule and the individual atoms that bonded to form that molecule.
5. Differentiate between a mixture and an element or compounds and identify examples.
6. Conduct and report on an investigation that uses physical means such as particle size, density, solubility and magnetism to separate substances in a mixture.
7. Use the patterns of the Periodic Table to locate metals, semimetals and nonmetals and predict the general characteristics of an element.

**CMT CORRELATIONS**

- Describe the properties of common elements, such as oxygen, hydrogen, carbon, iron and aluminum
- Describe how the properties of simple compounds, such as water and table salt, are different from the properties of the elements of which they are made.
- Explain how mixtures can be separated by using the properties of the substances from which they are made such as particle size, density, solubility and boiling point.

**SCIENTIFIC LITERACY TERMINOLOGY:** characteristic, property, mass, weight, volume, density, solubility, boiling point, mixture, solution, particle, atom, element, molecule, compound, metal, non-metal, chemical reaction

**KEY SCIENCE VOCABULARY:** state of matter, conductivity, soluble



<b>LEARNING STRAND Structure and Function</b> – How are organisms structured to ensure efficiency and survival? <b>Unit: Life Processes</b> <i>CT Standard 7.2 – Many organisms, including humans, have specialized organ systems that interact with each other to maintain dynamic internal balance.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ All organisms are composed of one or more cells.</li> <li>▪ Each cell carries on life-sustaining functions.</li> <li>▪ Multicellular organisms need specialized structures and systems to perform basic life functions.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do the basic structures of an animal cell function to support life?</li> <li>▪ How do the structures of the human digestive system function to bring nutrients to the cells and expel wastes?</li> <li>▪ How do the structures of the human nervous system function to support life?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>▪ All cells come from other cells and they hold the genetic information needed for <b>cell division</b> and growth. When a body cell reaches a certain size, it divides into two cells, each of which contains identical <b>genetic</b> information. This cell division process is called <b>mitosis</b>.</li> <li>▪ The cell is filled with a fluid called <b>cytoplasm</b>; cells contain discrete membrane-enclosed structures called <b>organelles</b>. Each of the organelles performs a specific <b>cellular function</b> and it can be identified by its shape. <ul style="list-style-type: none"> <li>- The <b>nucleus</b> contains the genetic materials (<b>chromosomes</b>), and it directs the cell activities, growth, and division.</li> <li>- The <b>mitochondrion</b> contains <b>enzymes</b> that break down sugars and release chemical energy. One cell can contain hundreds of <b>mitochondria</b>.</li> <li>- The entire cell is surrounded by the <b>plasma membrane</b>.</li> </ul> </li> <li>▪ Systems consist of parts that interact with and influence each other. Parts of a system work together to make the whole entity work. Similarly, each part of an animal body has a specific job to do, and all the different parts work together to support life.</li> <li>▪ Although all cells have similar basic structures, in <b>multicellular organisms</b> cells have specialized shapes that enable them to perform specific roles (e.g., muscle, nerve, and skin cells can be identified by their distinct shapes.)</li> <li>▪ The major parts of the human <b>digestive system</b> are the mouth, esophagus, stomach, small intestine and large intestine. This system is responsible for breaking down</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Prentice Hall Science Explorer <u><a href="#">Cells and Heredity</a></u> (2008)</li> <li>▪ Lab ware</li> <li>▪ Lab safety equipment</li> <li>▪ Microscopes</li> <li>▪ Stereoscopes</li> <li>▪ Digital microscope</li> <li>▪ Proscope</li> <li>▪ Video flex cam</li> <li>▪ LED projector</li> <li>▪ Dialysis tubing</li> <li>▪ Karo syrup</li> <li>▪ Ammonia</li> <li>▪ String</li> <li>▪ Prepared slides of cells</li> <li>▪ pH indicators</li> <li>▪ HCl</li> <li>▪ Neutralizing substances</li> <li>▪ “Optical Illusions” Power Point presentation</li> <li>▪ Materials for wet slides</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Review basic life processes such as digestion, respiration and excretion occur at the cellular level.</li> <li>▪ Review cells and cell structures by observing them using a microscope.</li> <li>▪ Use dialysis tubing with Karo syrup suspended in a beaker of water to observe osmosis.</li> <li>▪ Demonstrate diffusion of a gas by inverting a test tube with water and a few drops of phenolthalein covered by a single layer of dialysis tubing over a beaker containing a small amount of ammonia.</li> <li>▪ Label the main parts of the digestive system on a diagram.</li> <li>▪ Draw a flow chart of how an impulse passes from one neuron to another.</li> <li>▪ Project slides of neurons and a CT scan of a human brain for students to examine.</li> <li>▪ Compare and contrast respiration and</li> </ul>

<p>food, absorbing nutrients and water, and eliminating waste. The liver and pancreas support the functions of the major <b>digestive organs</b> by producing and releasing digestive liquids into the digestive tract.</p> <ul style="list-style-type: none"> <li>The nervous, immune and excretory systems interact with the digestive, respiratory and <b>circulatory systems to maintain the body's</b> dynamic internal balance (homeostasis).</li> </ul>	<p>photosynthesis.</p> <ul style="list-style-type: none"> <li>Show the PowerPoint presentation "Optical Illusions."</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Performance Tasks:</p> <ul style="list-style-type: none"> <li>Perform a lab to test products of their choice to settle stomach acid (i.e. antacids, milk, Tums, crackers, ginger ale).</li> <li>Determine and report on how a similar group of cells are organized in tissues that have specific functions.</li> <li>Analyze and illustrate how tissues form organs with specific functions that contribute to the larger system.</li> <li>Trace energy conversions that occur in the human body once food enters and explain the conversions in writing.</li> <li><b>Research and defend the statement, "Body systems are interdependent and act together to maintain the body's dynamic internal balance" (homeostasis).</b></li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>Teacher-created quizzes</li> <li>Common unit test</li> </ul> <p><b>GRADE LEVEL EXPECTATIONS</b></p> <p>Assessments MUST measure the ability of students to:</p> <ol style="list-style-type: none"> <li>Illustrate and describe in writing the structure and the function of the following cell structures: cell membrane, cytoplasm, mitochondria and nucleus in an animal cell.</li> <li>Label the major parts of the human digestive system and explain in writing the function of each part in the chemical and physical breakdown of food (mouth, esophagus, stomach, small intestine, large intestine and rectum).</li> </ol> <p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>Describe the basic structures of an animal cell, including the nucleus, cytoplasm, mitochondria and cell membrane, and how they function to support life.</li> <li>Describe the structures of the human digestive, respiratory and circulatory systems and explain how they function to bring oxygen and nutrients to the cells and expel waste materials.</li> <li>Explain how the human musculoskeletal system supports the body and allows movement.</li> </ul>
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**SCIENTIFIC LITERACY TERMINOLOGY:** structure, function, cell, cytoplasm, nucleus, cell membrane, tissue, organ system

**KEY SCIENCE VOCABULARY:** cell division, genetic, mitosis, cytoplasm, organelles, cellular function, nucleus, chromosomes, mitochondrion, enzymes, mitochondria, plasma membrane, multicellular organisms, digestive system, digestive organs

<b>LEARNING STRAND Heredity and Evolution - <i>What processes are responsible for life's unity and diversity?</i></b> <b>Unit: Genetics</b> <i>CT Standard 8.2 – Reproduction is a characteristic of living systems and it is essential for the continuation of every species.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Heredity is the passage of genetic information from one generation to another.</li> <li>▪ Some of the characteristics of an organism are inherited and some result from interactions with the environment.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ <b>What processes are responsible for life's unity and diversity?</b></li> <li>▪ What are the similarities and differences in meiosis and mitosis cell division?</li> <li>▪ How do the male sperm and the female egg explain sex determination in offspring?</li> <li>▪ How do inherited traits get passed to offspring?</li> <li>▪ How is the genetic information organized in genes on chromosomes?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i>  GRADE LEVEL CONCEPT 8.2.a. <ul style="list-style-type: none"> <li>▪ Living organisms must reproduce to continue the existence of their species. Through reproduction new individuals which resemble their parents are formed. All the organisms alive today arose from preexisting organisms.</li> <li>▪ All the cells in a <b>multicellular organism</b> result from a single fertilized egg cell, through a process of continuous cell divisions (<b>mitosis</b>). Instructions for how an organism develops are stored in <b>DNA</b> molecules which are part of the chromosomes inside the cell nucleus.</li> <li>▪ The <b>chromosomes</b> occur in matching pairs, and each cell in a multicellular organism contains the number of chromosomes that are typical of that species. For example, cells in human beings contain 23 pairs of chromosomes, 46 in all.</li> <li>▪ Organisms grow by increasing the number of body cells. During <i>mitosis</i>, a body cell first duplicates the chromosomes and then divides into two identical daughter cells, each one with a complete set of chromosomes.</li> <li>▪ Most multicellular organisms reproduce by <i>sexual</i> reproduction, in which new cells are produced by the combination of two germ cells (<b>gametes</b>). During <i>meiosis</i> matching chromosomes in each pair separate from each other so that each germ cell contains only half of the chromosomes of the original cell.</li> <li>▪ Mitosis and meiosis are similar processes in that they both result in the separation of existing cells into new ones. They differ in that the germ cells produced during meiosis have only one copy of each chromosome. When two germ cells unite during fertilization, the resulting <b>zygote</b> has two copies of each chromosome, one from each parent, ensuring maternal and paternal genetics</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Module: Prentice Hall Explorer <u>Cells and Heredity (2008)</u></li> <li>▪ DNA model</li> <li>▪ Videos</li> <li>▪ Microsoft Publishing software</li> <li>▪ Coins, construction paper, glue, scissors</li> <li>▪ Lego Genetics Kits</li> <li>▪ Internet access</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Use a Lego Genetics Kit to create chromosomes and go through cell division.</li> <li>▪ Use 3-D models of cells during cell division to show mitosis.</li> <li>▪ Observe prepared slides of cells are various stages of cell division.</li> <li>▪ Model how to use a Punnett Square.</li> <li>▪ Complete the worksheets practicing the use of Punnett Squares.</li> <li>▪ Model how to read a pedigree chart.</li> <li>▪ Perform the Gene/Jean activity forming facial features with the toss of two coins.</li> <li>▪ Analyze a pre-made pedigree chart tracing a genetic condition through multiple generations.</li> <li>▪ Create a pedigree chart tracing a particular genetic condition through several generations.</li> <li>▪ Show the video on genetics.</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b>  Performance Task: <ul style="list-style-type: none"> <li>▪ Research and create professional looking genetic pamphlets regarding a rare genetic disorder.</li> </ul> Other Assessments: <ul style="list-style-type: none"> <li>▪ List in order the stages of mitosis.</li> <li>▪ Identify the characteristics of each stage of</li> </ul>

at birth. Males produce millions of sperm over the course of their adult life. Females are born with a finite number of immature eggs in the ovaries that are released one at a time in a monthly cycle.

- Meiosis and gamete formation takes place in the reproductive organs; *testes* in males produce the sperm and *ovaries* in females produce the eggs.
- In humans, the reproductive organs are in place at birth, but are readied to perform their reproductive functions by hormones released during adolescence. Males produce millions of sperm over the course of their adult life. Females are born with a finite number of immature eggs in the ovaries that are released one at a time in a monthly cycle.
- In humans, if an egg is fertilized by a sperm in the **female's fallopian tube**, the resulting *zygote* may develop into a fetus in the female **uterus**. If **the egg is not fertilized, it will leave the female's** body in a monthly discharge of the uterine lining (menstrual cycle).
- A segment of DNA that holds the information for a specific **trait** is called a **gene**. Each chromosome in a pair carries the same genes in the same place, but there are different versions of each gene.
- In sexual reproduction, offspring of the same parents will have different combinations of genes and traits, creating genetic variability within the species. Sexual reproduction is the basis for the evolution of living organisms.

#### GRADE LEVEL CONCEPT 8.2.b.

- Gender in humans is a trait determined by genes carried by a special pair of chromosomes **identified as "X" and "Y"**. **Female gametes give only an "X" chromosome; male gametes can give either an "X" or a "Y"**. **The sperm that fertilizes the egg determines the sex of the offspring:** a zygote containing two X chromosomes will develop into a female and a zygote containing X and Y chromosomes will develop into a male.
- Most human traits are inherited from parents, but some are the result of environmental conditions. For example, eating and exercising habits may affect the body mass and shape of individuals in the same family.

mitosis.

- Compare and contrast mitosis and meiosis.
- Use a Punnett Square to demonstrate **Mendel's principles of heredity by** determining the expressed allele and identifying the genotype and phenotype ratios.
- Draw or build a model of the double helix shape of DNA.
- Teacher-created quizzes
- Common unit test

#### GRADE LEVEL EXPECTATIONS

Assessments MUST measure the ability of students to:

1. Relate the continued existence of any species to its successful reproduction and explain in writing the factors that contribute to successful reproduction.
2. Describe the structure, location and function of chromosomes, genes and DNA and how they relate to each other in the living cell.
3. Illustrate and chart the purpose, cell type (somatic and germ) and resulting chromosome count during cell division in mitosis and meiosis.
4. Identify the major structures in human male and female reproductive systems and explain where meiosis and gamete formation take place.
5. Investigate and report on the role of hormone production as it initiates and regulates the creation of male and female germ cells from birth through adolescence and into adulthood.
6. Compare and contrast the events and processes that occur when a human egg is fertilized or not fertilized.
7. Demonstrate the relationship of corresponding genes on pairs of chromosomes to traits inherited by offspring.
8. Describe in writing the role of the germ cells in the formation of the human zygote and its resulting 23 pairs of chromosomes, the 23rd of which determines gender and the other 22 of which determine the characteristics of that offspring.



	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Explain the differences in cell division in somatic and germ cells.</li> <li>▪ Describe the structure and function of the male and female human reproductive systems including the process of egg and sperm production.</li> <li>▪ Describe how genetic information is organized in genes on chromosomes and explain sex determination in humans.</li> </ul>
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**SCIENTIFIC LITERACY TERMINOLOGY:** multicellular organism, heredity, trait, chromosome, gene, DNA, species, mitosis, meiosis, gamete, adolescence, hormone, testes, sperm, ovary, egg, fallopian tube, uterus

**KEY SCIENCE VOCABULARY:** germ cell, genotype, phenotype, double helix



<b>LEARNING STRAND</b> <b>Unit: Electromagnetic Systems</b> <i>CT Standard 9.2 – The electrical force is a universal force that exists between any two charged objects.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Electric charges can accumulate on a surface as in static electricity or flow through a wire as in current electricity.</li> <li>▪ Moving electrical charges produce magnetic forces and moving magnets can produce electrical force.</li> <li>▪ Electrical current can be transformed into light through the excitation of electrons.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What is the role of electrical energy in our world?</li> <li>▪ What is the relationship among voltage, current and resistance in a simple series circuit?</li> <li>▪ How is electricity used to produce heat and light in incandescent bulbs and heating elements?</li> <li>▪ How are current and magnetism related?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>▪ An electric charge results when an object either gains or loses <b>electrons</b>.</li> <li>▪ <b>Static electricity</b> is the accumulation of electrical charges on the surface of an object.</li> <li>▪ The Law of Electric Charges states that like charges repel and unlike charges attract.</li> <li>▪ The distance between two charged objects affects the strength of an electric force (<b>Coulomb’s Law</b>).</li> <li>▪ Charges that build up on an object are static electricity; charges that flow through objects are current electricity.</li> <li>▪ <b>Amperage</b> is the amount of current passing a point in one second.</li> <li>▪ <b>Voltage</b> is the push of electricity.</li> <li>▪ <b>Resistance</b> is the opposition to current in an electric current.</li> <li>▪ Resistance produces heat.</li> <li>▪ An <b>ohm</b> is the resistance of electricity.</li> <li>▪ Charges easily flow through a conductor; charges cannot flow through an insulator.</li> <li>▪ <b>Ohm’s Law</b> shows the relationship between voltage, current, and resistance.</li> <li>▪ A <b>transformer</b> is a device used to raise or lower voltage.</li> <li>▪ A <b>generator</b> produces electricity.</li> <li>▪ An electrical circuit with a single path is a series circuit; an electrical circuit with multiple paths is a parallel circuit.</li> <li>▪ Electric current produces a magnetic field.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Module: Prentice Hall Science Explorer <u>Electricity and Magnetism (2007)</u></li> <li>▪ Magnets</li> <li>▪ Wires, bulbs, batteries, , buzzers, meters (i.e.; ammeter, volt meter, galvanometer)</li> <li>▪ Vande Graaff generator, plasma ball and other materials</li> <li>▪ Styrofoam cup</li> <li>▪ Internet access</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Demonstrate how to make an electromagnet noting the relationship of the number of coils to the strength of the magnet.</li> <li>▪ Perform activities using batteries, wires, lights, and meters.</li> <li>▪ Determine the maximum voltage possible using three D cell batteries.</li> <li>▪ Produce a series circuit using a battery and three lights.</li> <li>▪ Produce a parallel circuit using a battery and three lights.</li> <li>▪ Determine how amperage is affected by the number of devices using on battery and up to three lights.</li> <li>▪ Produce a circuit that allows one switch to control two devices.</li> <li>▪ Produce a circuit that allows one switch to control one of two devices.</li> <li>▪ Produce a combination circuit with a battery and three lights so that when one of the light bulbs is removed, the second bulb also goes out while the third bulb stays lit.</li> <li>▪ Produce a combination circuit using a battery and five light bulbs so that if the first light bulb is removed the second will not work as well; however lights 3, 4, and 5 still work. If light 4 is removed, the fifth light will go out; however,</li> </ul>

	<p>lights 1, 2, and 3 will work.</p> <ul style="list-style-type: none"> <li>▪ Make a series circuit with two lights and a parallel circuit with two lights and determine which circuit decreases the amperage of a circuit.</li> <li>▪ Demonstrate static electricity using an electrostatic box and Styrofoam cup.</li> <li>▪ Perform demonstrations using a Vande Graaff generator.</li> <li>▪ Perform demonstrations using a plasma ball.</li> <li>▪ Learn science inquiry skills</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Benchmark:</p> <ul style="list-style-type: none"> <li>▪ Science inquiry skills activity</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Teacher-created quizzes</li> <li>▪ Common unit test</li> </ul>
	<p><b>CMT CORRELATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Explain the relationships among voltage, current and resistance in a simple series circuit.</li> <li>▪ Explain how electricity is used to produce heat and light in incandescent bulbs and heating elements.</li> <li>▪ Describe the relationship between current and magnetism.</li> </ul>

**KEY SCIENCE VOCABULARY:** electrons, static electricity, amperage, voltage, resistance, ohm, Ohm's Law, transformer, generator, circuit, conductor, insulator, parallel circuit, series circuit

<b>LEARNING STRAND</b> <b>Unit: Light and Sound</b> <i>National Standard: Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion and sound.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Waves have characteristics and properties that do not depend on the type of wave.</li> <li>▪ Waves transfer energy, have measurable properties and behave in predictable ways.</li> <li>▪ Electrical current can be transformed into light through the excitation of electrons.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How is energy transmitted in the form of waves?</li> <li>▪ How does a change in energy affect the characteristics of a wave?</li> <li>▪ What are the characteristics of wave types?</li> <li>▪ How are wavelength, frequency and wave speed related?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that...</i> <ul style="list-style-type: none"> <li>▪ Energy can be transmitted from a source as waves.</li> <li>▪ Waves carry energy from one place to another.</li> <li>▪ Waves can transfer energy when they interact with matter.</li> <li>▪ <b>Transverse</b> and <b>longitudinal</b> waves exist in mechanical media, such as springs and ropes, and in the Earth as <b>seismic</b> waves.</li> <li>▪ Seismic waves, sound waves, and electromagnetic waves can be destructive or beneficial due to the transfer of energy.</li> <li>▪ Mechanical and electromagnetic waves have the same properties.</li> <li>▪ <b>Wavelength, frequency</b> and wave <b>speed</b> are related.</li> <li>▪ Factors that influence the basic properties of waves include frequency <b>amplitude</b>, wavelength, and speed.</li> <li>▪ Behaviors of waves include <b>refraction, reflection</b>, transmission and <b>absorption</b>.</li> <li>▪ Waves have characteristic behaviors, such as interference, <b>diffraction</b>, and <b>refraction</b>.</li> <li>▪ Waves travel through different media.</li> <li>▪ Sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.</li> <li>▪ The Doppler Effect results from the characteristic behavior of waves.</li> <li>▪ The wavelength and energy of waves in various parts of the <b>electromagnetic spectrum</b> include visible light, infrared, and ultraviolet <b>radiation</b>.</li> <li>▪ The electromagnetic spectrum in increasing frequencies includes microwaves, infrared light, visible light, ultraviolet light, X rays and Gamma rays.</li> <li>▪ The absorption and reflection of light waves by various materials result in the human perception of color.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Prentice Hall module <u>Sound and Light</u></li> <li>▪ Internet access</li> <li>▪ Light bench</li> <li>▪ Pig hologram</li> <li>▪ Sound tube, slinky and other demonstrators</li> <li>▪ Flashlights, mirrors, clay, easel paper</li> <li>▪ Lenses, mirrors, lasers, aquarium, and other materials needed for laser demonstration</li> <li>▪ Tuning forks</li> <li>▪ Wave tank</li> <li>▪ Graphing calculator, CBL2, light intensity probe</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Use lasers to demonstrate reflection and refraction.</li> <li>▪ Demonstrate diffraction using a wave tank.</li> <li>▪ Use a slinky to demonstrate transverse and standing waves.</li> <li>▪ Demonstrate real vs. virtual images using a hologram of the pig and a ruler with a paper screen.</li> <li>▪ Perform the light bench activity.</li> <li>▪ Demonstrate different types of waves using computer-generated models.</li> <li>▪ Use prisms and spectroscopes to observe properties of light.</li> <li>▪ Use tuning forks to experience vibration and sound.</li> <li>▪ Perform a demonstration for students using the sound tube and slinky with cones on the ends.</li> <li>▪ Find the angle of incidence and angle of reflection using a flashlight taped with duct tape and a mirror.</li> <li>▪ Determine where to place three mirrors to get a light beam to reflect to a particular spot on easel paper.</li> <li>▪ Demonstrate light intensity using a graphing calculator, CBL2 and light probe.</li> <li>▪ Calculate wavelength, frequency and wave</li> </ul>

	<p>speed using a mathematical formula.</p> <ul style="list-style-type: none"> <li>▪ Use a PowerPoint presentation or a computer simulation to explain the cause of the Doppler Effect and the changes waves undergo during the process.</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Conduct investigations demonstrating the characteristics of a wave -- wavelength, frequency, speed, amplitude.</li> <li>▪ Conduct investigation of longitudinal and transverse waves to determine how they are different.</li> <li>▪ Explain how energy is transferred through waves -- seismic, sound, electromagnetic.</li> <li>▪ Differentiate among reflection, refraction and absorption of various types of waves.</li> </ul> <p>Performance Task:</p> <ul style="list-style-type: none"> <li>▪ The light bench activity</li> </ul> <p>Other Assessments:</p> <ul style="list-style-type: none"> <li>▪ Teacher-generated quizzes</li> <li>▪ Common unit test</li> </ul>
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**KEY SCIENCE VOCABULARY:** amplitude, wavelength, frequency, speed, crest, trough, longitudinal, transverse, conduction, convection, radiation, seismic, reflection, interference, diffraction, refraction, absorption, electromagnetic spectrum

<b>LEARNING STRAND</b> <b>Unit: Forensic Science</b> <i>CT Standard: Scientific inquiry progresses through a continuous process of questions, data collection, analysis, and interpretation.</i>	
<b>ENDURING UNDERSTANDING</b> <ul style="list-style-type: none"> <li>Physical evidence can be used to help convict a person in a criminal trial or to settle civil cases.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>How are tools and techniques used to make observations and gather data in criminal and civil cases?</li> <li>How is scientific knowledge communicated in a court of law?</li> </ul>
<b>UNDERLYING CONCEPTS</b> <i>Students should understand that..</i> <ul style="list-style-type: none"> <li>Scientific method is used to solve forensic problems.</li> <li>Forensic science is used in criminal investigations.</li> <li>The principles of <b>forensic science</b> can be applied to a hypothetical crime.</li> <li>The scientific process can be used to solve a fictional crime.</li> <li>At the mock <b>crime scene, evidence</b> is searched for, isolated and recorded.</li> <li>Using proper forensic procedures, evidence is collected and packaged at a mock crime scene.</li> <li>Branches of forensic science include <b>ballistics, serology, fingerprinting, chromatography, DNA</b>, hair and fibers.</li> <li>There are scientific ways of finding latent prints for <b>fingerprint analysis</b>.</li> <li>There are basic properties and unique characteristics of fingerprints.</li> <li>There are appropriate techniques used to lift and evaluate readable latent fingerprints.</li> <li>DNA has physical properties and function.</li> <li>Paper chromatography can be used to determine which pen was used on a note.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>Ink pads and materials for fingerprinting and lifting latent prints</li> <li>Website for Overview of Fingerprints</li> <li>Chromatography paper</li> <li>Forensic Videos <b>including</b> "Eyewitness News" on eyewitnesses to a crime</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>View a crime and play the role of the eyewitness.</li> <li>Take a description and play the role of a forensic artist.</li> <li>Lift a latent print, compare to prints of a pool of suspects, and make a correct identification based on observation of characteristic patterns -- loop, arc and whorl.</li> <li>Identify the correct pen used on a ransom note through chromatography.</li> <li>Compare the DNA of suspects to identify the culprit.</li> <li>Do the activity "Accident or Murder" in Strengthening Your Science Instruction Using New and Innovative Forensic Science Strategies Resource Handbook (2007).</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> Performance Task: <ul style="list-style-type: none"> <li>Lifting of latent fingerprints</li> </ul> Other Assessments: <ul style="list-style-type: none"> <li>Identifying a criminal using fingerprints</li> </ul>
	<b>EXPECTED PERFORMANCES</b> <ul style="list-style-type: none"> <li>Identify questions that can be answered through scientific investigation.</li> <li>Design and conduct appropriate types of scientific investigations to answer different questions.</li> <li>Use appropriate tools and techniques to make observations and gather data.</li> <li>Use mathematical operations to analyze and interpret data.</li> <li>Provide explanations to investigated problems or questions.</li> </ul>

**KEY SCIENCE VOCABULARY:** crime scene, evidence, fingerprint analysis, forensic science, ballistics, serology, chromatography, DNA

# **Content Standards & Indicators**

**Grades 9 - 12**





### Course Description

HIGH SCHOOL		
1. Course Title <b>Biology - Honors</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Biology - Honors</b>		
3. Transcript Course Code/Number <b>00301</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 9 – 10   Level: I  7. Seeking "Honors" Distinction? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input checked="" type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____	
9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)		
10. Pre-Requisites Sophomores entering the course must have earned at least an A- in <u>both</u> Integrated Science I and II. Freshman entering the course must have earned at least a B+ in Algebra and an A- in 8 <sup>th</sup> grade science.		
11. Brief Course Description This course considers life on all levels of organization with an emphasis on how molecules are incorporated into cellular structures. The individual is considered as it relates to itself, other living things and the biomes of the world. Higher order thinking skills as well as advanced reading skills are necessary for success in this course. Laboratory investigations <b>test the student's ability to use these thinking skills, to</b> make observations, and formulate ideas about biological phenomena. Reflective, detailed, extensive, well written scientific laboratory reports are an integral part of the curriculum.		
12. Course Goals 1. Use the scientific/inquiry method to solve biological problems. 2. Analyze the possibilities and limits of science and technology. 3. Use technology effectively and responsibly. 4. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 5. Demonstrate respect for one's self, and strive to contribute to the success of others. 6. Understand and use safety procedures in lab investigations. 7. Integrate biochemistry with cell structure and processes. 8. Relate the fundamentals of genetics to biotechnology. 9. Discuss the interactions between humans and ecosystems. 10. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community.		

13. Course Outline		
Chapter/Unit	Activities	# of Weeks
Scientific Method/Evolution	<ul style="list-style-type: none"> <li>▪ Yeast lab with sugar- controlled experiment</li> <li>▪ Moth lab</li> </ul>	2
Measurement/Metric System	<ul style="list-style-type: none"> <li>▪ Equipment and measurement labs</li> </ul>	1
Chapter 1 – Basic Chemistry	<ul style="list-style-type: none"> <li>▪ Nutrients lab</li> <li>▪ Dehydration synthesis activities</li> <li>▪ pH lab</li> <li>▪ DNA activity</li> </ul>	4
Chapter 2 – Energy Flow	<ul style="list-style-type: none"> <li>▪ Enzyme lab</li> <li>▪ ATP activity</li> </ul>	2
Chapter 3 – Transport	<ul style="list-style-type: none"> <li>▪ Transport lab</li> <li>▪ Cell membrane posters</li> <li>▪ Human excretion</li> <li>▪ Human Respiration</li> </ul>	4
Chapter 4 – Photosynthesis – skim 4.8, skip section 4.9, skim section 4.6	<ul style="list-style-type: none"> <li>▪ Videos/worksheets,</li> <li>▪ Possible lab with elodea or substitute plant</li> <li>▪ Computer websites</li> </ul>	2
Chapter 6 – Cells	<ul style="list-style-type: none"> <li>▪ Microscope labs</li> <li>▪ Animal and plant labs</li> <li>▪ Computer websites</li> </ul>	2 ½
Chapter 5 Cellular Respiration – skim 5.8, skip 5.10	<ul style="list-style-type: none"> <li>▪ Possible yeast lab with different sugars</li> <li>▪ Computer websites</li> </ul>	2 ½
Chapter 8 Cell Cycle	<ul style="list-style-type: none"> <li>▪ Computer lab activities</li> <li>▪ Possible cut out activities</li> <li>▪ Computer websites</li> <li>▪ Mutation activities or pamphlets</li> </ul>	2
Chapter 7 Transport	<ul style="list-style-type: none"> <li>▪ Stomata lab</li> <li>▪ Transport structure in leaves</li> <li>▪ Pulse rate lab</li> </ul>	3
Chapter 12 Meiosis – only sections 12.1 and 12.2		1
Chapter 13 Genetics/Gene Expression	<ul style="list-style-type: none"> <li>▪ Human genetics activities</li> <li>▪ Investigations</li> <li>▪ Karyotyping</li> <li>▪ Probability activities</li> </ul>	4
Chapter 15 DNA Technology	<ul style="list-style-type: none"> <li>▪ Restriction enzyme cut out activity</li> <li>▪ Electrophoresis videos and activities</li> <li>▪ Lab</li> </ul>	3
Chapter 18 Classification	<ul style="list-style-type: none"> <li>▪ Looking at phyla specimens</li> </ul>	2

<p>14. Instructional Methods and/or Strategies</p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Laboratory investigations</li> <li>▪ Teacher demonstrations</li> <li>▪ Cooperative grouping</li> <li>▪ Audio Visual presentations</li> <li>▪ Response Cards by TurningTechnologies</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> </ul>
<p>15. Assessment Methods and/or Tools</p> <ul style="list-style-type: none"> <li>▪ Formative quizzes</li> <li>▪ Summative unit assessments</li> <li>▪ Final examination</li> <li>▪ Lab reports</li> <li>▪ Assessments evaluated with rubrics</li> <li>▪ Benchmark assessments</li> <li>▪ Video response summaries</li> <li>▪ Response Cards by TurningTechnologies</li> <li>▪ Research projects</li> </ul>
<p>16. Assessment Criteria</p> <p>Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a <i>common</i> scoring rubric or grading criteria.</p>
<b>HONORS COURSES ONLY</b>
<p>17. Indicate how this honors course is different from the standard course.</p> <p>The course is 1 full year and 1.5 credits. The labs are more extensive and graded with different rubrics from the standard biology course. There is a greater emphasis on the analysis and interpretation of data than the standard biology course.</p>

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>Content Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> <li>▪ Use and apply a scientific method as it applies to biological principles.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</b></li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicates the results of a scientific experiment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u><a href="#">BSCS Biology: A Molecular Approach</a></u> Glencoe McGraw Hill, 2001 Flinn Lab Safety Video
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Guided Internet research</li> <li>▪ Review appropriate use of lab equipment, experimental design and lab report writing</li> <li>▪ Yeast lab with sugar (CAPT Embedded Task)</li> <li>▪ Vitamin C lab *</li> <li>▪ Moth lab *</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Benchmarks *               <ul style="list-style-type: none"> <li>– Meet expectation for writing a conclusion/discussion for a lab</li> <li>– Meet expectation for explaining a concept using data in a written report</li> </ul> </li> <li>▪ Designer Airplanes</li> <li>▪ UV Beads activity</li> <li>▪ Introduction to lab equipment</li> <li>▪ Lab safety video and quiz</li> <li>▪ Measurement lab</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Basic Chemistry: Chemistry of Life</b>  <i>Content Standard: 10.1 Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>  <i>High School Enrichment Standards - Biology -- Cell Biology - The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>All living organisms are active (living) because of their abilities to link energy reactions to the biological reactions that take place within their cells.</li> <li>The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What roles do chemicals play in life?</li> <li>What is the importance of the molecular structure of molecules and their relationship to biology?</li> <li>What is the importance of chemical reactions in living organisms and the environment?</li> <li>How do various bonding types effect reactions inside living organisms or in the environment?</li> <li>What is the importance of water for the survival of living organisms?</li> <li>What is the significance of carbon as it relates to the complexity of organic compounds?</li> <li>What are the similarities and differences between carbohydrates, proteins, lipids and nucleic acids, including structure, function and examples?</li> <li>What is the purpose of each biological molecule (carbohydrate, protein, lipid, nucleic acids) for the survival of living organisms?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Describe the importance of the structure of atoms and molecules in terms of their function.</li> <li>Cite examples of important chemical reactions in living organisms and the environment.</li> <li>Draw examples of various bonding types and their purpose in different macromolecules.</li> <li>Explain, using specific examples, how water is important to the survival of living organisms.</li> <li>Analyze why carbon is such an important molecule in relation to living organisms.</li> <li>Design a chart comparing and contrasting the major groups of macromolecules.</li> <li>Discuss the role of each macromolecule in the survival of living organisms.</li> <li>Explain the importance of maintaining pH in living things.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>BSCS Biology: A Molecular Approach</u>  Glencoe McGraw Hill, 2001</p> <ul style="list-style-type: none"> <li>pH paper</li> <li>lab supplies for organic compounds lab</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Lecture / PowerPoint presentation</li> <li>Organic Compounds lab</li> <li>Dehydration synthesis activities</li> <li>pH lab</li> <li>DNA webquest *</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Benchmark * <ul style="list-style-type: none"> <li>Meets expectation for the effective and responsible use of technology</li> </ul> </li> <li>Quizzes</li> <li>Tests – General chemistry &amp; Organic chemistry</li> <li>Teacher observations</li> <li>Organic Compounds lab questions</li> <li>Ph Lab analysis questions</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Energy Flow</b>  <i>Content Standard: 10.1 Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>  <i>High School Enrichment Standards - Biology--Ecology - Stability in an ecosystem is a balance between competing effects.</i>  <i>Cell Biology - The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>▪ Energy is the capacity to do work.</li> <li>▪ All living organisms are active (living) because of their abilities to link energy reactions to the biological reactions that take place within their cells.</li> <li>▪ Living organisms rarely exist alone in nature.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Chemical reactions regulate life.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How do organisms use chemical energy to do work?</li> <li>▪ How does energy flow through an ecosystem?</li> <li>▪ How do the laws of thermodynamics allow us to predict the flow of energy in organisms and ecosystems?</li> <li>▪ Why are enzymes essential to life?</li> <li>▪ What is ATP and how is it used as an energy carrier?</li> <li>▪ What is the relationship among enzymes, energy and reaction rates?</li> <li>▪ How do environmental factors affect enzyme function?</li> <li>▪ Why is it important for most proteins, carbohydrates and fats to be digested?</li> <li>▪ How do different organisms obtain food and how does this relate to evolutionary adaptation?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p>
<ul style="list-style-type: none"> <li>▪ Explain the flow of energy through an ecosystem giving specific examples.</li> <li>▪ Identify examples of biotic and abiotic factors and explain how they are related in an ecosystem citing specific examples.</li> <li>▪ Compare and contrast movement of energy and movement of nutrients through a food web.</li> <li>▪ Describe the first and second laws of thermodynamics and their relationship to the flow of energy in an ecosystem.</li> <li>▪ Define metabolism, biosynthesis, and decomposition and explain how ATP connects these processes.</li> <li>▪ Compare and contrast extracellular digestion and intracellular digestion.</li> <li>▪ Explain why cells use different enzymes to catalyze different reactions.</li> <li>▪ Demonstrate the effect of various environmental changes on enzymes.</li> <li>▪ Describe digestion in humans.</li> </ul>	<p><u>BSCS Biology: A Molecular Approach</u>  Glencoe McGraw Hill, 2001</p> <ul style="list-style-type: none"> <li>▪ Lab supplies</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Lecture / PowerPoint presentation</li> <li>▪ Enzyme Lab</li> <li>▪ ATP activity</li> <li>▪ Digestive Disorder pamphlet</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Enzyme lab report</li> <li>▪ Chapter check: challenge and review questions</li> <li>▪ Teacher observations</li> <li>▪ Digestive disorder pamphlet</li> </ul>

<b>LEARNING STRAND</b>	
<b>Transport: Exchanging Materials</b>	
<i>High School Enrichment Standard – Biology -- Cell Biology - The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.</i>	
<b>ENDURING UNDERSTANDINGS</b>	<b>ESSENTIAL QUESTIONS</b>
<ul style="list-style-type: none"> <li>▪ Movement of materials across cell membranes is essential for maintaining homeostasis.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ There is a connection between the laws of thermodynamics and movement of molecules either down or against a concentration gradient.</li> </ul>	<ul style="list-style-type: none"> <li>▪ How does the structure of the cell membrane aid in its functions of protection, recognition and transport?</li> <li>▪ Why do cells need both active and passive transport methods to move materials across the cell membrane?</li> <li>▪ What is the importance of respiration for individual organisms and ecosystems?</li> <li>▪ What is the significance of the surface area of an exchange membrane such as the one in the gills of fish?</li> <li>▪ How have land-dwelling organisms adapted in order to obtain oxygen?</li> <li>▪ How have organisms adapted in order to remove waste products?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>
<ul style="list-style-type: none"> <li>▪ Draw a diagram of the structure of a cell membrane.</li> <li>▪ Illustrate types of cell transport.</li> <li>▪ Describe the process of diffusion and the special type called osmosis.</li> <li>▪ Chart the differences and similarities between active and passive transport.</li> <li>▪ Explain the importance of multiple transport methods for a cell.</li> <li>▪ Describe the process of respiration.</li> <li>▪ Compare human respiration to respiration in plants.</li> <li>▪ Explain how excretion is essential to maintaining homeostasis in organisms giving specific examples using unicellular organisms.</li> <li>▪ Describe how humans excrete wastes.</li> </ul>	<u>BSCS Biology: A Molecular Approach</u> Glencoe McGraw Hill, 2001 <ul style="list-style-type: none"> <li>▪ Lab supplies for transport lab</li> <li>▪ Video clip on united streaming</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b>
	<ul style="list-style-type: none"> <li>▪ Transport lab</li> <li>▪ Cell membrane posters</li> <li>▪ Video clips – passive and active transport</li> <li>▪ Respiration video</li> <li>▪ Lecture/PowerPoint presentations and notes</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b>
	<ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Check and challenge questions</li> <li>▪ Kidney worksheet</li> <li>▪ Teacher observations</li> <li>▪ Potato core lab report</li> <li>▪ Cell membrane posters and presentations</li> </ul>



<p><b>LEARNING STRAND</b>  <b>Photosynthesis</b>  <i>Content Standard: 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>  <i>High School Enrichment Standard – Biology -- Ecology – Stability in an ecosystem is a balance between competing effects.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ All living organisms are active (living) because of their abilities to link energy reactions to the biological reactions that take place within their cells.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Everything from cells to organisms to ecosystems is in a state of dynamic balance that must be controlled by positive or negative feedback mechanisms.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How is light energy conserved in ATP and NADPH during photosynthesis?</li> <li>▪ Why is photosynthesis important to humans?</li> <li>▪ How does the structure of the chloroplast relate to its function in photosynthesis?</li> <li>▪ What types of photosynthetic adaptations have evolved in response to environmental conditions?</li> <li>▪ What interactions exist between photosynthesis and cell respiration?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the process of photosynthesis.</li> <li>▪ Describe the relationship between the light reactions and the carbon dioxide-fixing reactions of photosynthesis.</li> <li>▪ Describe how the structure of the chloroplast relates to its function in photosynthesis.</li> <li>▪ Describe how the environment influences the rate of photosynthesis.</li> <li>▪ Explain how chemoautotrophs and photoautotrophs utilize the materials in their environment.</li> <li>▪ Outline the similarities and differences between photosynthesis and respiration.</li> <li>▪ Elaborate on how photosynthesis and respiration are dependent on each other.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>BSCS Biology: A Molecular Approach</u>  Glencoe McGraw Hill, 2001</p> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Videos</li> <li>▪ PowerPoint and outline notes on photosynthesis</li> <li>▪ Worksheets</li> <li>▪ Diagram and written summary of the light dependent and Calvin cycle reactions</li> <li>▪ Elodea lab</li> <li>▪ Computer websites</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Lab reports</li> <li>▪ Open-ended questions guided by textbook</li> <li>▪ Teacher observations</li> </ul>

<b>LEARNING STRAND</b> <b>Cells: Structure and Function</b> <i>Content Standard: 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>▪ All living organisms are active (living) because of their abilities to link energy reactions to the biological reactions that take place within their cells.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Everything from cells to organisms to ecosystems is in a state of dynamic balance that must be controlled by positive or negative feedback mechanisms.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How is the structure related to the function in cell organelles?</li> <li>▪ How do organelles function together in cell processes?</li> <li>▪ What are the similarities and differences between various types of cells (prokaryote vs. eukaryote, plant vs. animal, uni-cellular vs. multi-cellular)?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Elaborate how structure is related to the function of organelles.</li> <li>▪ Cite examples of interactions between different cell organelles.</li> <li>▪ Draw a diagram of the structure of a cell.</li> <li>▪ Compare and contrast prokaryotes and eukaryotes.</li> <li>▪ Describe how the cell walls of plants and bacterial cells are different and how they are similar.</li> <li>▪ Explain how the characteristics of biological macromolecules are important in the structure and function of cells.</li> <li>▪ Compare and contrast uni-cellular and multi-cellular organisms.</li> <li>▪ Describe the division of labor in a multi-cellular organism.</li> <li>▪ Explain the levels of structure in the biosphere.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>BSCS Biology: A Molecular Approach</u> Glencoe McGraw Hill, 2001 <ul style="list-style-type: none"> <li>▪ Plant and animal cell lab materials</li> <li>▪ Microscopes</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Lecture / PowerPoint presentations</li> <li>▪ Microscope labs</li> <li>▪ Animal and plant labs</li> <li>▪ Labeling various cell diagrams</li> <li>▪ Directed reading with text</li> <li>▪ Computer websites (cellsalive)</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Lab analysis questions</li> <li>▪ Open-ended questions</li> <li>▪ Teacher observations</li> <li>▪ Diagrams</li> </ul>

<b>LEARNING STRAND</b> <b>Cellular Respiration</b> <i>Content Standard: 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>▪ All living organisms are active (living) because of their abilities to link energy reactions to the biological reactions that take place within their cells.</li> <li>▪ Everything from cells to organisms to ecosystems is in a state of dynamic balance that must be controlled by positive or negative feedback mechanisms.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How is the structure related to the function in mitochondria?</li> <li>▪ How are the characteristics of ATP important in the energy reactions of cells?</li> <li>▪ What are the stages of cellular respiration?</li> <li>▪ What interactions exist between photosynthesis and cell respiration?</li> <li>▪ How does the environment affect the process of cellular respiration?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>
<ul style="list-style-type: none"> <li>▪ Draw a diagram of the structure of mitochondria, label where the different stages occur.</li> <li>▪ Compare and contrast aerobic and anaerobic respiration.</li> <li>▪ Explain how the structure of ATP is important in storing and releasing energy.</li> <li>▪ Explain the chemical reactions that occur in glycolysis, Krebs cycle and electron transport system.</li> <li>▪ Describe the relationship between photosynthesis and respiration.</li> </ul>	<u>BSCS Biology: A Molecular Approach</u> Glencoe McGraw Hill, 2001 <ul style="list-style-type: none"> <li>▪ Yeast and sugars lab materials</li> <li>▪ Assignment discovery video on energy and matter</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Lecture / PowerPoint presentations</li> <li>▪ Yeast and sugars lab</li> <li>▪ Computer websites</li> <li>▪ Assignment discovery video on energy and matter with worksheet</li> <li>▪ Textbook reading and notes</li> <li>▪ Diagramming the stages of Cell Respiration</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Quizzes (open and closed notes)</li> <li>▪ Test</li> <li>▪ Lab report on yeast respiration rate</li> <li>▪ Open-ended questions</li> <li>▪ Check and challenge questions</li> <li>▪ Teacher observations</li> </ul>

<b>LEARNING STRAND</b> <b>Cell Cycle</b> <i>Content Standard: 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>▪ All living organisms are active (living) because of their abilities to link energy reactions to the biological reactions that take place within their cells.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Everything from cells to organisms to ecosystems is in a state of dynamic balance that must be controlled by positive or negative feedback mechanisms.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What structures function in cell division?</li> <li>▪ How do organelles function together in cell processes?</li> <li>▪ What are the similarities and differences between cell division of prokaryotes and eukaryotes, and of plant and animal cells?</li> <li>▪ What is the significance of mitosis as it relates to growth, development and repair of cells?</li> <li>▪ How does mitosis ensure genetic continuity?</li> <li>▪ How is the structure of DNA important in cell division?</li> <li>▪ Why is regulation of the cell cycle important?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Draw a schematic diagram of the structure of DNA.</li> <li>▪ Describe the structure of DNA and explain the process of DNA replication.</li> <li>▪ Explain the major events of the cell cycle.</li> <li>▪ Draw a diagram of the cell in the various phases of the cell cycle.</li> <li>▪ Describe how the cell cycle is regulated.</li> <li>▪ Explain how cancer is caused by uncontrolled cell division.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>BSCS Biology: A Molecular Approach</u> Glencoe McGraw Hill, 2001 <ul style="list-style-type: none"> <li>▪ Laptops</li> <li>▪ microscope</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Lecture / PowerPoint presentations</li> <li>▪ Computer websites animation of DNA replication</li> <li>▪ DNA models (pop-beads, paper cut-outs)</li> <li>▪ Mitosis models (wiki sticks or clay)</li> <li>▪ Arizona onion root online lab</li> <li>▪ Mitosis lab using onion root/whitefish</li> <li>▪ Textbook reading and notes</li> <li>▪ Diagrams of the phases of the cell cycle</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Lab analysis questions</li> <li>▪ Lab drawings (on paper and with whiteboards)</li> <li>▪ Diagrams of the cell in various stages</li> <li>▪ Open-ended questions</li> <li>▪ Teacher observations</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Transport: Systems</b>  <i>High School Enrichment Standard – Biology -- Physiology – As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ All living organisms are active (living) because of their abilities to link energy reactions to the biological reactions that take place within their cells.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Everything from cells to organisms to ecosystems is in a state of dynamic balance that must be controlled by positive or negative feedback mechanisms.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What process is responsible for the movement of water and nutrients in plants?</li> <li>▪ How do transport systems contribute to the survival of multi-cellular organisms?</li> <li>▪ What is the difference between an open and closed circulatory system?</li> <li>▪ How can the major structures and functions of the human circulatory system be described?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Identify the transport systems found in plants.</li> <li>▪ Explain how water is transported in plants.</li> <li>▪ Explain the difference between water movement by capillary action and water movement explained by the cohesion-tension hypothesis.</li> <li>▪ Explain how nutrients are transported in plants.</li> <li>▪ Compare the circulatory system of unicellular organisms to the circulatory system in invertebrates.</li> <li>▪ Compare and contrast the circulatory systems in vertebrates (2, 3, 4- chambered hearts).</li> <li>▪ Describe the path of blood through the heart and vessels of a human.</li> <li>▪ Explain what blood pressure is and what affects it.</li> <li>▪ Describe the differences in function between erythrocytes and leukocytes.</li> <li>▪ Compare and contrast the circulatory system and the lymphatic system.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>BSCS Biology: A Molecular Approach</u>  Glencoe McGraw Hill, 2001</p> <ul style="list-style-type: none"> <li>▪ "The leaf" CD-Rom</li> <li>▪ Blood video clip (LMC, power mediaplus)</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Lecture / PowerPoint presentation</li> <li>▪ Make a comparison chart describing the components of blood.</li> <li>▪ Stomata lab</li> <li>▪ CD-Rom on transport structure in leaves</li> <li>▪ Cardiac 100 poster</li> <li>▪ Diagrams of human heart</li> <li>▪ Worksheets on transport systems</li> <li>▪ Internet animation on clotting</li> <li>▪ Blood typing lab</li> <li>▪ Heart rate lab</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Lab reports</li> <li>▪ Open-ended questions</li> <li>▪ Teacher observations</li> <li>▪ Label heart diagram</li> <li>▪ Blood typing analysis</li> <li>▪ Cardiac 100 poster graded by rubric</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Meiosis and Genetics</b>  <i>Content Standard: 10.4 – In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.</i>  <i>High School Enrichment Standards – Biology -- Genetics -- Mutation and sexual reproduction lead to genetic variation in a population. -- A multi-cellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Scientific research often leads to technological advances that can have positive and/or negative impacts upon society as a whole.</li> <li>▪ All species tend to maintain themselves from generation to generation using the same genetic code.</li> <li>▪ There are genetic mechanisms that lead to change over time, or evolution.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How does meiosis contribute to the heredity of organisms and populations?</li> <li>▪ What are the similarities and differences between mitosis and meiosis?</li> <li>▪ <b>What are the errors and exceptions to Mendel’s Laws?</b></li> <li>▪ What are the common patterns of inheritance?</li> <li>▪ How will genetic technologies contribute to our understanding and treatment of common human genetic diseases?</li> <li>▪ How does the structure of nucleic acids, genes and chromosomes relate to their function?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Diagram the stages of meiosis.</li> <li>▪ Discuss the function of meiosis and its importance to heredity.</li> <li>▪ Compare and contrast the processes of mitosis and meiosis.</li> <li>▪ Relate the process of meiosis to inheritance of traits.</li> <li>▪ Solve various types of Punnett Squares (mono and di-hybrid crosses).</li> <li>▪ <b>Discuss Mendel’s Laws using specific examples in organisms.</b></li> <li>▪ <b>Evaluate the errors and exceptions to Mendel’s Laws.</b></li> <li>▪ Explain the difference between co-dominance and incomplete dominance.</li> <li>▪ Explain polygenic inheritance and multiple gene inheritance.</li> <li>▪ Discuss the causes and symptoms of common human genetic diseases.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>BSCS Biology: A Molecular Approach</u>  Glencoe McGraw Hill, 2001</p> <ul style="list-style-type: none"> <li>▪ PTC taste paper</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <p>PowerPoint presentation and lecture notes  Punnett Squares practice problems  Human genetics activities  Karyotyping (online and paper)  Probability activities</p> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Activity analysis questions</li> <li>▪ Punnett Squares practice problems</li> <li>▪ Open-ended questions</li> <li>▪ Teacher observations</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Gene Expression</b>  <i>Content Standard: 10.4 – In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.</i>  <i>High School Enrichment Standards – Biology -- Genetics -- Mutation and sexual reproduction lead to genetic variation in a population. -- Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Scientific research often leads to technological advances that can have positive and/or negative impacts upon society as a whole.</li> <li>▪ All species tend to maintain themselves from generation to generation using the same genetic code.</li> <li>▪ There are genetic mechanisms that lead to change over time, or evolution.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How will genetic technologies contribute to our understanding and treatment of common human genetic diseases?</li> <li>▪ What is the relationship between the processes of replication, transcription, and translation?</li> <li>▪ How has our perception of DNA evolved through the discovery of its importance?</li> <li>▪ How does the structure of nucleic acids, genes and chromosomes relate to their function?</li> <li>▪ What are the ultimate causes of genetic errors?</li> <li>▪ How are the processes of transcription, translation and replication regulated?</li> <li>▪ What is the importance of DNA in future biotechnological advances?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Draw a schematic diagram of the structure of DNA.</li> <li>▪ Illustrate the processes of replication, transcription, and translation.</li> <li>▪ Evaluate the relationship of the processes of replication, transcription and translation.</li> <li>▪ Discuss the history of the discovery of DNA including relevant experiments.</li> <li>▪ Compare and contrast the three main types of RNA including structure and function.</li> <li>▪ Discuss the ultimate cause of genetic errors as it relates to translation.</li> <li>▪ Discuss how the processes of transcription, translation and replication are regulated.</li> <li>▪ Identify methods cells have to prevent mutation.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>BSCS Biology: A Molecular Approach</u>  Glencoe McGraw Hill, 2001</p> <ul style="list-style-type: none"> <li>▪ CD-Rom on DNA molecule of life</li> <li>▪ Pop beads</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Powerpoint presentation and lecture notes</li> <li>▪ Pop beads modeling gene expression</li> <li>▪ Cut-out activity on RNA types</li> <li>▪ Protein synthesis play</li> <li>▪ Designosaur activity</li> <li>▪ Snorks activity</li> <li>▪ Recipe for proteins</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Open-ended questions</li> <li>▪ Designosaur graded with rubric</li> <li>▪ Teacher observations</li> <li>▪ Gene expression activities</li> </ul>

<p><b>LEARNING STRAND</b>  <b>DNA Technology</b>  <i>Content Standard: 10.4 – In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.</i>  <i>High School Enrichment Standards – Biology - Genetics -- Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. -- The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Scientific research often leads to technological advances that can have positive and/or negative impacts upon society as a whole.</li> <li>▪ All species tend to maintain themselves from generation to generation using the same genetic code.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How has our perception of DNA evolved through the discovery of its importance?</li> <li>▪ How does the structure of nucleic acids, genes and chromosomes relate to their function?</li> <li>▪ What are the ultimate causes of genetic errors?</li> <li>▪ What is the importance of DNA in future biotechnological advances?</li> <li>▪ How are the processes of transcription, translation and replication regulated?</li> <li>▪ What legal and ethical problems have arisen from new DNA technologies?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Evaluate the relationship of the processes of replication, transcription and translation.</li> <li>▪ Discuss the history of the discovery of DNA including relevant experiments.</li> <li>▪ Debate the importance of DNA in future biotechnological advances.</li> <li>▪ Describe the following processes: DNA electrophoresis, cloning, genetic engineering and the Human Genome Project.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ <u>BSCS Biology: A Molecular Approach</u> Glencoe McGraw Hill, 2001</li> <li>▪ Electrophoresis video</li> <li>▪ pGlo Gene transformation lab materials</li> <li>▪ Gel electrophoresis materials</li> <li>▪ <u>Biology: Visualizing Life</u> Holt, 1998</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Powerpoint presentation and lecture notes</li> <li>▪ Websites on biotechnology</li> <li>▪ Article on cloning*</li> <li>▪ Read and take notes on the genetic engineering chapter in <u>Biology: Visualizing Life</u> Holt, 1998</li> <li>▪ pGlo Gene transformation lab</li> <li>▪ Restrictive enzyme cut out activity</li> <li>▪ Gel electrophoresis (DNA epicenter field trip)</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Gel electrophoresis and pGlo analysis questions</li> <li>▪ Open-ended questions</li> <li>▪ Teacher observations</li> <li>▪ Benchmark* <ul style="list-style-type: none"> <li>○ Meets expectations for reading critically and responding to scientific literature</li> </ul> </li> </ul>



<p><b>LEARNING STRAND</b>  <b>Classification: Biological Diversity</b>  <i>Content Standard: 10.5 – Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.</li> <li>▪ Evolution is the biological change of organisms that occurs over time. It is driven by the process of natural selection and accounts for the diversity of life on Earth.</li> <li>▪ Living organisms rarely exist alone in nature.</li> <li>▪ The structural levels of organisms ensure successful functioning in all living organisms and living systems (structure is related to function).</li> <li>▪ Everything from cells to organisms to ecosystems is in a state of dynamic balance that must be controlled by positive or negative feedback mechanisms.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What defines a species?</li> <li>▪ How do chemical and structural relationships indicate related ancestry?</li> <li>▪ What is the Linnaean classification system?</li> <li>▪ What are the kingdoms of life?</li> <li>▪ How do advances in technology change classification?</li> <li>▪ What are the three ways to classify a species?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Compare the differences and similarities between the kingdoms.</li> <li>▪ Compare and contrast eubacteria and archaeabacteria.</li> <li>▪ Explain how related ancestry can be indicated by chemical and structural relationships.</li> <li>▪ Demonstrate how the Linnaean system of groups and subgroups expresses the idea of a degree of relatedness.</li> <li>▪ Compare the Linnaean system of classification to phenetics and cladistics.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>BSCS Biology: A Molecular Approach</u>  Glencoe McGraw Hill, 2001</p>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Lecture / PowerPoint presentation</li> <li>▪ Textbook reading and notes</li> <li>▪ Examine phyla specimens</li> <li>▪ How to make a cladogram</li> <li>▪ Natural history presentations</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Test</li> <li>▪ Presentation graded with rubric</li> <li>▪ Open-ended questions</li> <li>▪ Teacher observations</li> <li>▪ Cladogram</li> <li>▪ Phyla specimen drawings and notes</li> </ul>

## Biology Honors

### 3. Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems

#### CAPT Lab Conclusion/Discussion Rubric

<b>Exceeds Expectations</b>	The student's discussion and analysis are related to the stated problem and fully supported by data. Their interpretation of results is thoroughly discussed.
<b>Meets Expectations</b>	The student's discussion and analysis are generally related to the stated problem and supported by data. Minor errors in the interpretation of results may be present. The student's discussion of the validity of their conclusions is limited.
<b>Meets Some Expectations</b>	The student's discussion and analysis are related to the problem and supported by data to a limited extent. Major errors in the interpretation of results may be present. There is little discussion of the validity of the conclusions.
<b>Does Not Meet Expectations</b>	The student's discussion and analysis are not related to the stated problem, not supported by data, or are missing. The student does not discuss the validity of the conclusions.

## Testing for Vitamin C

The recommended intake of vitamin C is 60 mg per day, which can come from different food sources. To determine the presence and the amount of vitamin C in different foods, there is a need to perform simple chemical tests. In this task, you will use a purple indicator to test for vitamin C.

### Your Task

First, you and your lab group will test a series of vitamin C solutions with known concentrations using the vitamin C indicator. Next, you and your lab group will design and conduct an experiment to compare the amount of vitamin C in various fruit juices. Then you will determine the concentration of vitamin C in each of the juices.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided. You may use additional materials and equipment if they are available.

**CAUTION: The vitamin C indicator will stain clothes and hands.**

### Materials

Vitamin C solution (1 mg/mL)	5 test tubes
Vitamin C indicator	Test tube rack
Apple juice	8 Plastic measuring cups
Pineapple juice	5 medicine droppers
White grape juice	Access to tap water
Graduated cylinder	Wax crayons
Paper towels for clean-up	
Safety goggles and lab apron	

### Part I: Testing a Vitamin C Solution

First, you will find out how many drops of a vitamin C solution (with a known concentration) it takes for the indicator to lose its purple color. You will investigate vitamin C solutions with varying concentrations and one solution (water) that has no vitamin C added. **The higher the concentration of vitamin C in the solution, the fewer drops it will take for, the indicator to lose its purple color.**

You have been given a solution containing 1.00 milligram (mg) of vitamin C per milliliter (mL) of water.

### Procedure:

- Using the table below, create vitamin C solutions with different concentrations by mixing the 1.00 mg/mL vitamin C solution with water in plastic cups. Be sure to label the cups with the corresponding concentration.
- Add 10 drops of the purple indicator to a clean test tube.
- Add drops of the 1.00 mg/mL vitamin C solution, one at a time, to the test tube containing the indicator. Shake the test tube gently after adding each drop.
- Keep adding drops of the vitamin C solution until the indicator loses its purple color. Record your results in the table below.
- Repeat steps 2-4 using the other vitamin C solutions you created in step 1.
- Create a line graph of your results.

Drops of 1.00 mg/mL Vitamin C Solution	Drops of Water Added	Concentration of New Vitamin C Solution (mg/mL)	Number of Drops of Vitamin C Solution Added to the Indicator
40	0	1.00	
30	10	.75	
20	20	.50	
10	30	.25	
0	40	0.00	

### Part II: Comparing the Amount of Vitamin C in Three Fruit Juices

Now you and your lab group will design and conduct an experiment to compare the amount of vitamin C in various fruit juices.

1. **In your own words, clearly state the problem you are going to investigate.** Include a clear identification of the independent and dependent variables that will be studied.
2. **Design an experiment to solve the problem.** Your experimental design should match the statement of the problem, should control for variables, and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate.
3. Write your experimental design and show your design your teacher before you begin your experiment.
4. **After receiving approval from your teacher, work with your lab group to carry out your experiment.** Your teacher's approval does not necessarily mean that your teacher thinks your experiment is well designed. It simply means that, in your teacher's judgment, your experiment is not dangerous or likely to cause an unnecessary mess.
5. **While conducting your experiment, take notes.** Include the results of your experiment. Tables, charts, and/or graphs should be used where appropriate and should be properly labeled.
6. **Use your results from Part I to determine the concentration of vitamin C in the juices tested.**



## iology Honors

### 1A. Read Effectively Rubric

#### *Scientific American* article with comprehension questions

<b>Exceeds Expectations</b>	The student independently applies effective reading strategies to understand, interpret, evaluate, and analyze text to acquire content knowledge about a current topic in science.
<b>Meets Expectations</b>	The student needs minimal assistance and applies effective reading strategies to understand, interpret, evaluate, and analyze text to acquire content knowledge about a current topic in science.
<b>Meets Some Expectations</b>	The student applies some reading strategies to understand, interpret, and attempt to analyze text to acquire content knowledge about a current topic in science. S/he may need some assistance to read and comprehend material at grade level.
<b>Does Not Meet Expectations</b>	The student has difficulty applying reading strategies without assistance to understand, interpret, and evaluate text to acquire content knowledge about a current topic in science.

## Reading a Scientific Article

Name:

Read the following article. While reading it, write down on this sheet the following:

- What is the subject/topic of the article?
  
  
  
  
  
  
  
  
  
  
- What are the key ideas in the article?
  
  
  
  
  
  
  
  
  
  
- What did you learn from the article (key ideas)?
  
  
  
  
  
  
  
  
  
  
- Write down all the questions that you would like to ask after reading this article (remember do not decide which of the questions are important and which are less important)
  
  
  
  
  
  
  
  
  
  
- From this list of questions, select the most interesting one that you would like to investigate (theoretically) or find more information.
  
  
  
  
  
  
  
  
  
  
- How would you find out more information/answer the question you selected?

## Biology Honors

### 2. Uses technology effectively and responsibly

#### DNA Webquest Rubric

<b>Exceeds Expectations</b>	The student independently selects a currently updated and authored website directly related to the lab discussion.
<b>Meets Expectations</b>	The student needs minimal assistance selecting an appropriate website directly related to the lab discussion. The website may be outdated <b>or</b> un-authored
<b>Meets Some Expectations</b>	The student needs some assistance selecting an appropriate website directly related to the lab discussion. The website is outdated <b>and/or</b> un-authored.
<b>Does Not Meet Expectations</b>	The student cannot select an appropriate website directly related to the lab discussion. The website is outdated <b>and</b> un-authored.



Name \_\_\_\_\_

Using web sites on the nucleic acids, DNA and RNA, find the following answers. Please site your sources in proper MLA form.

1. What elements make up DNA and RNA?
2. What are the monomers of nucleic acids?
3. What are the three parts of a nucleotide?
4. What are the 4 nitrogen bases found in DNA?
5. What is the name of the sugar in DNA? RNA?
6. What scientists discovered the shape of DNA? What is the shape called?
7. What nitrogen bases are purines?
8. What nitrogen bases are pyrimidines?
9. Why do purines bond to pyrimidines?

## Biology Honors

### 1 B. Writing Effectively Rubric

#### Peppered-moth Investigation - Analyzing data to explain and scientific concept

<b>Exceeds Expectations</b>	The student organizes, analyzes, and synthesizes the data from an activity on evolution by natural selection in order to accurately explain this scientific concept. The explanation is organized and developed. Word choice and syntax are accurate and appropriate. The student shows mastery in the conventions of Standard English in the written assignment.
<b>Meets Expectations</b>	The student needs minimal assistance in organizing, analyzing, and synthesizing data from an activity on evolution by natural selection in order to explain this scientific concept. The explanation is somewhat organized and developed. Word choice and syntax are accurate and appropriate. Errors in the conventions of Standard English are few in the written assignment.
<b>Meets Some Expectations</b>	The student requires additional explanations and models in order to organize, analyze and synthesize the data from an activity on evolution by natural selection. Writing is somewhat limited, and supporting evidence for this concept may be slightly inaccurate or simplistic. The student may require assistance to develop or organize his response. Word choice and syntax are consistent with grade level. There are some errors in the conventions of Standard English in the written assignment.
<b>Does Not Meet Expectations</b>	The student requires many additional explanations, models, and/or strategies in order to organize, analyze, and synthesize data from an activity on evolution by natural selection. The explanation for this concept does not focus on the supporting evidence. Ideas and concepts are often inaccurate, confusing, or unorganized. Inaccurate or limited vocabulary, syntax errors, and errors in the conventions of writing make the assignment ineffective.

## Investigations for Chapter 16

### Origin of New Species

#### Investigation 16A – Natural Selection

Charles Darwin collected many facts to support the theory of evolution by natural selection. Yet, he never examined some remarkable examples of natural selection that were going on around him in the English countryside, such as the selection process involving the peppered moth, *Biston betularia* (BIS ton bet choo LAR ee a).

The Industrial Revolution began in the middle of the eighteenth century. Since that time, tons of soot had been deposited around the industrial areas of England. Soot, the ash created from burning coal and wood, discolored and generally darkened the surfaces of trees, rocks, and other features of the landscape. It also destroyed the lichens that once grew in these areas. Lichens are associations of algae and fungi that frequently encrust the bark of trees. Many lichens are light in color. Before the Industrial Revolution, the peppered moths that lived among the trees also were light colored.

In 1848, the first dark-colored peppered moth was observed and recorded. A century later, 90 percent or more of the peppered moths in some areas were dark in color. More than 70 species of moths in England changed from light to dark coloration. Similar observations have been made in other industrial nations, including the United States. How did this striking change in coloration come about? Was the change related to the way in which one species is thought to evolve normally from another? Or was it a unique occurrence?

In this investigation, you will answer these questions by interpreting the results of some experiments. It will be helpful to keep the following information in mind:

1. Hereditary characteristics of parent organisms are passed on to their offspring.
2. Changes can occur in the hereditary material of the parents to produce offspring with characteristics different from those of the parents. These changes are known as mutations.

3. If the different form, called a mutant, survives and reproduces, it may pass on the new trait, or mutation, to future generations.

#### Materials (per team of 3)

paper and pencil

#### Procedure

1. Read the following description of an experiment with chemicals from soot: The peppered moth has a one-year life cycle. The egg hatches into a larva (caterpillar), which feeds on tree leaves. The animal then goes through a dormant stage and is finally transformed into an adult moth. In 1926, a British scientist fed leaves treated with certain chemicals found in soot to the larvae of light-colored moths. The larvae then were permitted to go through the normal life cycle. Eventually, the larvae changed into light-colored adult moths. These moths were allowed to mate and produce offspring. When the scientist counted these offspring, 8 percent of the new moths were found to be dark-colored. Because this rate of mutation was much higher than normal, the scientist claimed that the chemicals found in soot caused changes to the hereditary material that determines body color in the peppered moth. When the experiment was repeated by other scientists, however, their results showed much less than 8 percent dark-colored offspring. Moreover, it was found that light-colored moth larvae that were fed on unpolluted leaves produced about as many dark-colored moths as those fed on polluted leaves.
2. Answer Analysis questions 1 through 3.
3. Read the following description of an experiment in an unpolluted forest: More recently another experiment was performed with *Riston betularia*. A large number of both the light and dark forms of the moths were captured. The underside of each moth was marked with a small spot of paint for identification. Known numbers of these marked moths were then released in an unpolluted forest. After a period of time, moths were collected from this forest and the marked

ones were counted. Of 488 dark moths and 496 light moths released in an unpolluted forest, 34 dark moths and 62 light moths were recaptured.

4. Answer Analysis questions 4 through 6.
5. Read the following description of an experiment a light-colored tree:

In still another experiment, equal numbers of light and dark moths were placed on a light-colored tree in an unpolluted forest. These moths were kept under careful observation. Birds were seen to seize moths from the tree and rapidly carry them away. At the end of a day, approximately twice as many light moths as dark moths were left on the trees. Then the reverse experiment was performed. Equal numbers of light and dark moths were placed on a dark-colored tree in a polluted forest. At the end of the day, approximately twice as many dark-colored moths were left. Refer to Figure 16.6 in your textbook which shows the moths on both light and dark trees.

6. Answer Analysis questions 7 through 12.
7. Read the following passage that describes an observation in an unpolluted forest: In an old forest in Scotland, far removed from industrial cities, there is a species of moth called *Cleora repandata*. Of about 500 moths observed, approximately 50, 10 percent of the total population, were dark colored while 90 percent were light colored. When these moths rest on the bark of pine trees during the daytime, the dark form is more conspicuous. Observations have shown that many moths move from one tree trunk to another during the day if they are disturbed by ants or the heat of the sun. In flight, the dark moth is visible for a distance of about 18 meters, but the light moth is visible for a distance of more than 90 meters. Observers have reported seeing light moths captured in flight by birds.
8. Answer Analysis questions 13 through 17.

### Analysis

1. What is the value of an experiment that other scientists repeat with different results?
2. What errors could have been made by the scientist who performed the feeding experiment in 1926?
3. What was the control in the second experiment? Why was it necessary?
4. Why was the spot of paint placed on the under side of the moth rather than on top?
5. What may have happened to the moths that were not recaptured?
6. How do the results of this experiment give evidence of natural selection? How might this experiment be changed to give even better evidence of natural selection?
7. What is the chief predator of the peppered moth?
8. Assuming that equal numbers of light and dark moths are present on a light tree, which type of moth would most likely be preyed on? Why? What if the moths were on a dark tree?
9. Does the last experiment described in the procedure help support the conclusions you have drawn thus far? Explain.
10. Which type of moth is more apt to survive in a polluted forest? In an unpolluted forest?
11. Is it likely that dark-colored moths existed before the Industrial Revolution?
12. If any dark colored moths did exist before the Industrial Revolution, what probably happened to them?
13. Which body coloration is protective when the moths are resting during the daytime? Give evidence to support your view.
14. Which body coloration is protective when the moths are in daytime flight? Give evidence to support your view.

- 15.** Studies have shown that light-colored moths produce 1 dark moth in approximately 200,000 offspring. This is the mutation rate from light to dark, only 0.0005 percent. From, these data, how can you explain the fact that 10 percent of the total population of moths found in an unpolluted forest are dark?
- 16.** On the basis of your interpretation of the preceding experiments, write a short paragraph using these questions as a guide: How has the striking change in coloration of the English peppered moth population come about? (Use Darwin's theory of natural selection and apply it to what you have learned in this investigation.) Is the change related to the mechanisms by which one species is thought to evolve normally from another, or is it a special case of evolution found only in the English peppered moth? (Apply Darwin's ideas on the origin of new species.) Include an explanation of how the dark moth appeared and how the proportion of dark moths changed from 0.0005 percent to more than 90 percent in the polluted forests.
- 17.** Soot and factory pollution are subsiding as pollution-control measures are practiced in many industrial areas. Non-pollutant fuels may replace the coal-burning furnaces of present factories. Write a short paragraph predicting changes you might expect in the environment and the effect these changes will have on the: survival and reproduction of the two colors of peppered moth.

### Course Description

HIGH SCHOOL		
1. Course Title <b>Integrated Science I</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Intgr. Science I</b>		
3. Transcript Course Code/Number <b>00316</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 9                      Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
8. Unit Value <input type="checkbox"/> .25 (30 days) <input checked="" type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester + 30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____		
9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)		
10. Pre-Requisites This course is offered to all freshmen without a prerequisite.		
11. Brief Course Description In Integrated Science I students will explore a variety of physical phenomena and methods used to acquire scientific knowledge. Topics considered for study include science skills, structure of matter, states and properties of matter, chemical interactions, energy, and carbon chemistry. The course relies heavily on inquiry based lab investigations, writing extensive lab reports, as well as mathematical problem solving in science.		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocols. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently. <b>6. Demonstrate respect for one's self, and strive to contribute to the success of others.</b>		

13. Course Outline <i>in presented order</i> :		
CHAPTER	CONCEPTS	ACTIVITY / INVESTIGATION
<b>1) Science Skills</b>	<ul style="list-style-type: none"> <li>▪ Using the scientific method</li> <li>▪ Introduction to significant figures</li> <li>▪ Introduction to dimensional analysis</li> <li>▪ Presenting scientific data/results</li> </ul>	Identifying variables*  Thickness of Aluminum Foil lab*
<b>4) Atomic Structure</b>	<ul style="list-style-type: none"> <li>▪ History of the atomic model</li> <li>▪ The structure of the atom</li> <li>▪ Modern atomic theory</li> </ul>	Flame test lab
<b>9) Carbon Chemistry</b>	<ul style="list-style-type: none"> <li>▪ Identifying carbon compounds</li> <li>▪ Natural and synthetic polymers</li> </ul>	<b>Elmer's/Borax Lab**</b> Paper vs. Plastic assignment **
<b>2) Properties of Matter</b>	<ul style="list-style-type: none"> <li>▪ Classifying matter</li> <li>▪ Physical properties</li> <li>▪ Chemical properties</li> </ul>	Identify chemical properties lab
13.3) Buoyancy	<ul style="list-style-type: none"> <li>▪ <b>Archimedes' principle</b></li> </ul>	Density of objects lab*
<b>3) States of Matter</b>	<ul style="list-style-type: none"> <li>▪ Solids, liquids, gases</li> <li>▪ Gas laws</li> <li>▪ Phase changes</li> </ul>	Boyles law lab Phase change demo/lab
13.1) Fluid Pressure	<ul style="list-style-type: none"> <li>▪ Water pressure</li> <li>▪ Air pressure</li> <li>▪ <b>Pascal's principle</b></li> <li>▪ Hydraulic systems</li> </ul>	FINAL EXAMINATION
* <i>Benchmark Activities</i> ** <i>Embedded Tasks</i>		
14. Instructional Methods and/or Strategies <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Laboratory investigations</li> <li>▪ Teacher demonstrations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Cooperative grouping</li> <li>▪ Audio Visual presentations</li> <li>▪ Response Cards by TurningTechnologies</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> </ul>	
15. Assessment Methods and/or Tools <ul style="list-style-type: none"> <li>▪ Formative quizzes</li> <li>▪ Summative unit assessments</li> <li>▪ Final examination</li> <li>▪ Lab reports</li> </ul>	<ul style="list-style-type: none"> <li>▪ Assessments evaluated with rubrics</li> <li>▪ Benchmark assessments</li> <li>▪ Video response summaries</li> <li>▪ Response Cards by TurningTechnologies</li> <li>▪ Research projects</li> </ul>	
16. Assessment Criteria Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a <i>common</i> scoring rubric or grading criteria.		
<b>Benchmark Assessments:</b> <ul style="list-style-type: none"> <li>- Identification of independent, dependent and controlled variables in an experiment</li> <li>- Differentiation of quantitative and qualitative data; representation of data on an appropriate graph</li> <li>- Develop a properly designed experiment given a problem and list of materials. Students are expected to perform the experiment using their own procedure and follow the appropriate lab report format as outlined in the rubric. This culminating activity assesses the student's ability to apply the scientific method.</li> </ul>		

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>Content Standard: Scientific knowledge is created and communicated.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present the relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<p><b>LEARNING OBJECTIVES</b>    <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</b></li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Physical Science: Concepts in Action</u>                      Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>▪ Materials for Aluminum foil lab investigation *</li> <li>▪ Internet access</li> <li>▪ Response cards</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Textbook ancillary materials</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ Aluminum Foil Lab investigation *</li> <li>▪ Significant Figure Internet investigation</li> <li>▪ Bart Simpson scientific method activity *</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Benchmark:</p> <ul style="list-style-type: none"> <li>▪ Meet course expectations for identifying components of the scientific method</li> <li>▪ Meet course expectations for constructing appropriate graphs for representing experimental data</li> </ul> <p>Other Assessments</p> <ul style="list-style-type: none"> <li>▪ Unit Test</li> <li>▪ Quizzes</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Response cards by TurningTechnologies</li> </ul>



<p><b>LEARNING STRAND</b>  <b>Atomic Structure</b>  <i>CT Standard 9.4: Atoms react with one another to form new molecules.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Atoms have a defined structure that gives each element its unique properties.</li> <li>Detailed observations can reveal information about objects and events that cannot be observed directly.</li> <li>The evolutionary model of the atom was developed through analysis and observations of controlled scientific experimentation.</li> <li>Atoms react with other atoms by sharing or exchanging subatomic particles.</li> <li>Atoms can combine to form more complex forms of matter.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How does the structure of the atom help to explain the properties of elements?</li> <li>How does the structure of the atom help to explain the ways in which atoms combine to form new compounds?</li> <li>How do the differences in the properties of subatomic particles help to explain the current model of the atom?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Describe ancient Greek models of matter.</li> <li>Use historical experiments to explain the development of the model of the atom.</li> <li>Identify the location and properties of a proton, neutron, and electron in the model of an atom.</li> <li>Distinguish the atomic number of an element from the mass number of an isotope, and use these numbers to describe the structure of atoms.</li> <li>Demonstrate the relationship between electrons and energy levels in an atom.</li> <li>Distinguish the ground state from excited states of an atom based on electron configurations.</li> <li>Explain how radiant energy can be absorbed and later released by an atom.</li> <li>Explain how the electron cloud model and probability represents the behavior and locations of electrons in atoms.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Physical Science: Concepts in Action</u>          Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>Hoffman apparatus</li> <li>Cathode ray</li> <li>Materials for Flame test lab investigation</li> <li>Video</li> <li>Response cards</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Modeled instruction</li> <li>PowerPoint presentations and notes</li> <li>Textbook ancillary materials</li> <li>Web-based instruction with Blackboard/finalsite</li> <li>Research</li> <li>Response cards</li> <li>Hoffman apparatus demonstration</li> <li>Cathode ray demonstration</li> <li>Construct Bohr models activity</li> <li>Flame Test lab investigation</li> <li>Assignment Discovery video on matter</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Quizzes</li> <li>Unit Test</li> <li>Investigations evaluated with rubrics</li> <li>Response cards by TurningTechnologies</li> </ul>



<b>LEARNING STRAND</b> <b>Carbon Chemistry</b> <i>CT Standard 9.5: Due to its unique chemical structure, carbon forms many organic and inorganic compounds.</i> <i>CT Standard 9.1: Energy cannot be created or destroyed; however, energy can be converted from one form to another.</i> <i>CT Standard 9.3: Various sources of energy are used by humans and all have advantages and disadvantages.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The structure of a carbon atom allows for millions of different arrangements.</li> <li>▪ Carbon exists in three distinct forms.</li> <li>▪ The properties of carbon are directly related to the number and arrangement of carbon atoms.</li> <li>▪ Hydrocarbons are molecules that contain carbon and hydrogen.</li> <li>▪ Fossil fuels exists in three forms and produce two primary products during combustion.</li> <li>▪ Materials produced from the cracking of petroleum are the starting points for the production of many synthetic compounds.</li> <li>▪ Chemical technologies products are synthetic fibers, pharmaceuticals, plastics and fuels.</li> <li>▪ Polymers can be classified as natural or synthetic polymers.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How is the structure of the three forms of carbon related to their properties?</li> <li>▪ How are the arrangement and number of carbon atoms in a hydrocarbon related to the properties?</li> <li>▪ How are the three forms of unsaturated hydrocarbons different? Similar?</li> <li>▪ How does the carbon atom's structure affect the type of bonds formed in organic molecules?</li> <li>▪ Where are the geographical locations where the different forms of fossil fuels can be found?</li> <li>▪ How can a solution such as crude oil be refined into simpler substances?</li> <li>▪ What are some characteristics of the incomplete combustion of a fossil fuel?</li> <li>▪ What are the two ways polymers are classified?</li> <li>▪ How can simple monomers be combined to create linear, branched and/or cross linked polymers?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Illustrate a carbon atom using a Bohr model.</li> <li>▪ Identify the valence electrons in a carbon molecule.</li> <li>▪ Differentiate between a general formula, molecular formula, and structural formula for a carbon molecule.</li> <li>▪ Explain the difference between Alkanes, Alkenes, and Alkynes.</li> <li>▪ Differentiate between an organic and an inorganic compound.</li> <li>▪ Describe the formation, composition, and uses of the three types of fossil fuels.</li> <li>▪ Distinguish between complete and incomplete combustion of fossil fuels.</li> <li>▪ Describe the effects of some products of the combustion of fossil fuels.</li> <li>▪ Distinguish a monomer from a polymer.</li> <li>▪ Describe the structures and functions of four types of natural polymers produced by organisms.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Physical Science: Concepts in Action</u> Prentice Hall, 2004 with ancillary materials <ul style="list-style-type: none"> <li>▪ Materials for polymer lab investigation ** (CAPT Embedded Task: Synthetic Polymers)</li> <li>▪ Materials for Super Ball lab investigation</li> <li>▪ Fractional distillation apparatus</li> <li>▪ Combustion engine demonstration (virtual)</li> <li>▪ Response cards</li> <li>▪ Videos</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Web based instruction with Blackboard/finalsite</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ Molecular model kits</li> <li>▪ Fractional distillation demonstration</li> <li>▪ Combustion engine demonstration</li> <li>▪ Polymer lab investigation ** (CAPT Task)</li> <li>▪ Super ball lab investigation</li> <li>▪ Videos on carbon and polymers</li> <li>▪ Persuasive essay research assignment (paper products vs. plastic products) ** (CAPT Task)</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Quizzes and Unit Test</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Response cards by TurningTechnologies</li> <li>▪ Persuasive essay research assignment ** (CAPT)</li> </ul>

<b>LEARNING STRAND</b> <b>Properties of Matter</b> <i>CT Standard 9.4: Atoms react with one another to form new molecules.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Matter that always has the same composition is classified as a pure substance.</li> <li>▪ Mixtures tend to retain some of the properties of their individual substances, and can be classified into three types.</li> <li>▪ Physical properties are characteristics of a material that can be observed or measured without changing the composition of the substances.</li> <li>▪ Chemical properties can be observed only when the substance in a sample changes into different substances.</li> <li>▪ The characteristics of physical changes are different than the characteristics of chemical changes.</li> <li>▪ Properties of matter can be used to confirm the identity of substances.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ Why are elements and compounds classified as pure substances?</li> <li>▪ How do mixtures differ from pure substances?</li> <li>▪ What is the main difference among solutions, suspensions, and colloids?</li> <li>▪ What are some examples of physical properties?</li> <li>▪ How can knowing a physical property be useful?</li> <li>▪ What processes can be used to separate mixtures?</li> <li>▪ What observations might indicate that a chemical change has occurred?</li> <li>▪ What is the difference between a physical and chemical change?</li> <li>▪ What properties of matter make up the density of a substance?</li> <li>▪ How can the identity of a pure substance be determined with density?</li> <li>▪ How can you determine if an object will sink or float?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Classify pure substances as elements or compounds.</li> <li>▪ Distinguish between pure substances from mixtures.</li> <li>▪ Classify mixtures as solutions, suspensions, or colloids.</li> <li>▪ Identify substances based on their density.</li> <li>▪ Describe how properties are used to choose a material.</li> <li>▪ Describe how distillation can be used to separate a solution.</li> <li>▪ Explain the evidence that indicates a physical or chemical change has occurred.</li> <li>▪ Explain how the identity of a pure substance can be determined with density.</li> <li>▪ Explain the effect of buoyancy on the apparent weight of an object.</li> <li>▪ Explain the relationship between the volume of fluid displaced by an object and the buoyant force acting on the object according to <b>Archimedes' principle</b>.</li> <li>▪ Describe the relationship among object density, fluid density, and whether an object sinks or floats in a fluid.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Physical Science: Concepts in Action</u> Prentice Hall, 2004 <ul style="list-style-type: none"> <li>▪ Ocean circulation classroom apparatus</li> <li>▪ Distillation apparatus</li> <li>▪ Density rod classroom demonstration</li> <li>▪ Materials for physical properties lab activity *</li> <li>▪ Materials for chemical properties lab activity</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Textbook ancillary materials</li> <li>▪ Web based instruction with Blackboard/finalsite</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ Convection demonstration with the ocean circulation apparatus</li> <li>▪ Distillation demonstration</li> <li>▪ Density rod demonstration</li> <li>▪ Physical Properties lab investigation *</li> <li>▪ Chemical Properties lab investigation</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <i>Benchmark:</i> Meet course expectations for generating a properly written scientific lab report <i>Other Assessments:</i> <ul style="list-style-type: none"> <li>▪ Unit Test and Quizzes</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Response cards by TurningTechnologies</li> </ul>

<p><b>LEARNING STRAND</b>  <b>States of Matter</b>  <i>CT Standard 9.4: Atoms react with one another to form new molecules.</i>  <i>CT Standard 9.1: Energy cannot be created or destroyed; however, energy can be converted from one form to another.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Materials can be classified as solids, liquids, or gases based on their shape and volume.</li> <li>The Kinetic Theory of matter says that all particles of matter are in constant motion.</li> <li>Thermal energy can be transferred by conduction, convection, and radiation only.</li> <li>Energy provides the ability to work &amp; exert force.</li> <li>Heat flows in one direction, hot to cold.</li> <li>Although there are forces of attraction among all forms of matter, it is the weakest in gases.</li> <li>The constant motion of particles in a gas allows a gas to fill a container of any shape and size.</li> <li>Pressure is the result of a force distributed over an area.</li> <li>A phase change is the reversible change that occurs when a substance changes from one state of matter to another.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How can shape and volume be used to classify materials?</li> <li>How can the kinetic theory and forces of attraction be used to explain the behavior of gases, liquids, and solids?</li> <li>What is the law of conservation of energy?</li> <li>How are energy and work related?</li> <li>What causes gas pressure in a closed container?</li> <li>What factors affect gas pressure?</li> <li>How are temperature, volume, and pressure of a gas related?</li> <li><b>What happens to a substance's temperature and a system's energy during a phase change?</b></li> <li>How are evaporation and boiling different?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Classify materials as solids, liquids, or gases.</li> <li>Explain the behavior of gases, liquids, and solids, using the kinetic theory of matter.</li> <li>Identify factors that affect gas pressure.</li> <li>Describe the conversions of energy from one form to another.</li> <li>Explain how energy is transferred by conduction, convection and radiation.</li> <li>State and apply the law of conservation of energy.</li> <li><b>Explain Charles's law, Boyle's law, and the combined gas law.</b></li> <li>Apply gas laws to solve problems involving gases.</li> <li>Explain how temperature can be used to recognize a phase change.</li> <li>Describe the effects of adding energy to matter in terms of the motion of atoms and molecules, and the resulting phase changes.</li> <li>Identify phase changes as endothermic or exothermic.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Physical Science: Concepts in Action</u>          Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>Super heated gas demonstration</li> <li><b>Pascal's principle demonstration</b></li> <li>Vacuum and Bell Jar demonstration</li> <li>Molecular motion apparatus</li> <li>Calculator Based Lab (CBL) temperature probes for phase change lab</li> <li>CBL pressure probes for Boyles law lab</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Modeled instruction</li> <li>PowerPoint presentations and notes</li> <li>Textbook ancillary materials</li> <li>Web instruction with Blackboard/finalsite</li> <li>Research</li> <li>Response card</li> <li>Molecular motion demonstration</li> <li>Vacuum and Bell Jar demonstration</li> <li><b>Pascal's principle demonstration</b></li> <li><b>Boyle's law lab activity with CBL probes</b></li> <li>Phase change lab activity with CBL probes</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Quizzes and Unit Test</li> <li>Investigations evaluated with rubrics</li> <li>Response cards by TurningTechnologies</li> <li>Appropriate use of technology</li> </ul>



## Identify the Controls and Variables

<p>Smithers thinks the drug AZT will cure AIDS. He takes 100 patients with AIDS and gives the drug to 50 of them (group A). To the other 50, he gives them a drug that looks just like AZT but is really just a sugar pill (group B). Both groups were told that they were getting a drug that would cure AIDS. After 6 months, 30 patients in group A reported having fewer symptoms. 10 people in group B reported having fewer symptoms.</p> 	<p>Identify the –</p> <ol style="list-style-type: none"> <li>1. Control Group</li> <li>2. Independent Variable</li> <li>3. Dependent Variable</li> <li>4. What should Smithers conclusion be?</li> <li>5. Why was group 8 given a sugar pill?</li> <li>6. Why do you think 10 people in group B reported feeling better?</li> </ol>
<p>Homer notices that his shower is covered in a strange green slime. His friend Barney tells him that coconut juice will get rid of the green slime. Homer decides to test this out by spraying half of the shower with coconut juice. He sprays the other half of the shower with water. After 3 days of "treatment" there is no change in the appearance of the green slime on either side of the shower.</p>	<p>7. What was the initial observation?</p> <p>Identify the -</p> <ol style="list-style-type: none"> <li>8. Control Group</li> <li>9. Independent Variable</li> <li>10. Dependent Variable</li> <li>11. What should Homer's conclusion be?</li> </ol>
<p>Bart believes that mice exposed to microwaves will become extra strong (maybe he's been reading too much RadioactiveMan). He decides to perform this experiment by placing 10 mice in a <i>microwave</i> for 10 seconds. He compared these 10 <i>mice</i> to another 10 mice that had not been exposed. His test consisted of a heavy block of wood that blocked the mouse food. He found that 8 out of the 10</p> 	<p>12. What was Bart's hypothesis?</p> <p>Identify the</p> <ol style="list-style-type: none"> <li>13. Control Group</li> <li>14. Independent Variable</li> <li>15. Dependent Variable</li> <li>16. What should Bart's conclusion be?</li> </ol>

<p>microwaved mice were able to push the block away. 7 out of the 10 nonmicrowaved mice were able to do the same.</p>	
<p>Krusty was told that a certain itching powder was the newest best thing on the market, it even claims to cause 50 % longer lasting itches. Interested in this product, he buys the itching powder and compares it to his usual produce. One test subject (A) is sprinkled with the original itching powder, and another test subject (8) is sprinkled with the Experimental itching power. Subject A reported having itches for 30 minutes, Subject 8 reported to have itches for 10 hours.</p>	<p>Identify the-</p> <p>17. Control Group</p> <p>18. Independent Variable</p> <p>19. Dependent Variable</p> <p>20. What should Krusty's conclusion be?</p>

**PHYSICAL SCIENCE / INTEGRATED SCIENCE I**

**EFFECTIVE CRITICAL THINKING STRATEGIES  
IN IDENTIFYING VARIABLES**

**3**

<p><b>Exceeds Expectations</b></p> <p align="center">90 - 100</p>	<p>The student independently interprets, analyzes, and evaluates a variety of information and data to make original predictions. S/he <b>accurately</b> identifies <b>all</b> of the independent, dependent, and controlled variables in an experiment.</p>
<p><b>Meets Expectations</b></p> <p align="center">75 - 89</p>	<p>The student independently interprets, analyzes, and evaluates a variety of information and data to make specific predictions. S/he <b>adequately</b> identifies <b>most</b> of the independent, dependent, and controlled variables in an experiment.</p>
<p><b>Meets Some Expectations</b></p> <p align="center">65 - 74</p>	<p>The student may need some assistance to interpret a variety of data to make general predictions. S/he <b>poorly</b> identifies <b>some</b> of the independent, dependent, and controlled variables in an experiment.</p>
<p><b>Does Not Meet Expectations</b></p> <p align="center">0 - 64</p>	<p>The student needs assistance to interpret information to make a prediction. S/he <b>did not identify</b> the independent, dependent, or controlled variables in an experiment.</p>



## Determining the Thickness of Aluminum Foil An Exercise in Graphing and Precision

**Background:**

Provide a clear description of the experiment, and a rationale for why the experiment was performed  
\*\*REFERENCE PAGE 26 & 27 IN YOUR TEXTBOOK\*\*

**Problem:**

1. How are the thickness and brand of aluminum foil related?
2. Which brand of foil is the cheapest/least expensive by volume?

**Hypotheses:**

1. State a hypothesis relating the brand of aluminum foil and thickness.  
Use the (If \_\_\_\_\_, then \_\_\_\_\_) format

<b>IV:</b>		

**DV:**

**CONSTANTS:**

**CONTROL: none in this lab.**

**Materials:**

▪ metric ruler	▪ balance
▪ three (3) different brands of aluminum foil	▪ graph paper
▪ scissors	

**Procedure:**

1. In your lab journal duplicate three “3” copies of the data table below for **each brand** of aluminum foil tested.

**BRAND NAME:** \_\_\_\_\_

Length (mm)	Area (mm <sup>2</sup> )	Mass (g)	Volume (mm <sup>3</sup> )	Thickness (mm)
50.0				
100.0				
200.0				

Average	
---------	--

Density of Aluminum = \_\_\_\_\_ g/mm<sup>3</sup>

- Cut out three squares of aluminum foil with sides of the following lengths from each brand of foil tested: **50.0 mm**, **100.0 mm**, and **200.0 mm**. **Label each foil square.**
- Calculate the area of each foil square using proper precision. (**NOTE: You may have to use scientific notation**) Record the area in your data tables.
- Mass each square of foil. Record the mass in your data tables.
- The density of aluminum is **2.71 g/cm<sup>3</sup>**. Convert the density into **g/mm<sup>3</sup>**. Record the new density below the data table.
- Determine the volume of the foil for each length. To determine the volume divide the mass of each length by the density in **g/mm<sup>3</sup>**. Using proper precision record the volume in the data tables.
- Determine the thickness of the foil for each length. Recall that volume is (**length x height x width**), and area is (**length x width**). By dividing the volume by the area the result equals the height “thickness” only. Using proper precision record the thickness in your data tables.
- In your lab journal duplicate a copy of the data table below. Complete the data table.

#### BRAND AND AVERAGE THICKNESS

BRAND	AVG. THICKNESS (mm)

- (The following **benchmark task** for the 9<sup>th</sup> grade science curriculum). Determine which graph would best represent the following data: One graph relates the **length** and **thickness** of each brand of foil tested. The second graph compares the **brand** and **average thickness**. Construct the graphs and include them in your lab journal. **Reference Chapter 1.4**
- Complete the summary questions.

## SUMMARY QUESTIONS

1. How many significant figures were there in your measurement of the length of each square of foil tested?
2. What effect, if any, did the length of foil have on the thickness of the foil?  
***Explain ...***
3. Which length of foil resulted in the most precise estimate of oil thickness?  
Explain why.
4. What factor(s) may have limited the precision of your measurements?
5. What is the cost (\$) per volume ( $\text{mm}^3$ ) for each brand of foil tested? *To answer this question you will need the total area (see box), average thickness (reference your calculations), and the cost of each brand of foil tested. You must show your work for full credit*

CHALLENGE QUESTION **REQUIRED**

1. Aluminum, like all matter, is composed of tiny particles called atoms. Each aluminum atom has a diameter of  $2.86 \times 10^{-10}\text{m}$ . Calculate how many atoms make up the average thickness of each brand of foil tested.

**WHAT YOU SHOULD CONSIDER WHEN DEVELOPING YOUR CONCLUSION AND DISCUSSION:**

1. Does your data support or refute your hypothesis?
2. Is there evidence of error in your data?
  - a. Explain how you know there is error (analyze data table and graphs)
  - b. Identify the error as instrumental, human, or a combination of the two.
3. Provide information from your procedure and/or your data that would help you answer the problem(s). *Try to include as much detail as possible. Offer a logical explanation for your results. (the amount of explaining varies among experiments)*
4. Explain how you think the experiment could be improved.

## PHYSICAL SCIENCE / INTEGRATED SCIENCE I

EFFECTIVE CRITICAL THINKING STRATEGIES  
IN CONSTRUCTING GRAPHS

## 3

<b>Exceeds Expectations</b>	The student <b><u>independently</u></b> collects, interprets, analyzes, and evaluates data to solve a problem. S/he <b><u>accurately</u></b> identifies data as quantitative or qualitative. S/he constructs the <b><u>appropriate graph</u></b> to represent the data. The graph is titled, properly scaled, labeled and accurately charted. The structure of the graph <b><u>does not</u></b> contain any errors.
<b>Meets Expectations</b>	The student <b><u>independently</u></b> collects, interprets, analyzes, and evaluates data to solve a problem. S/he <b><u>accurately</u></b> identifies data as quantitative or qualitative. S/he constructs the <b><u>appropriate graph</u></b> to represent the data. The graph is titled, scaled, labeled and charted. <b><u>Minor errors</u></b> in structure of the graph are present.
<b>Meets Some Expectations</b>	The student <b><u>independently</u></b> collects, interprets, analyzes, and evaluates data to solve a problem. S/he <b><u>accurately</u></b> identifies data as quantitative or qualitative. S/he constructs the <b><u>appropriate graph</u></b> to represent the data. The graph is titled, scaled, labeled and charted. <b><u>Significant errors</u></b> in structure of the graph are present.
<b>Does Not Meet Expectations</b>	The student independently collects data but <b><u>may require assistance</u></b> to interpret, analyze, and evaluate the data to solve a problem. S/he <b><u>inaccurately</u></b> identifies data as quantitative or qualitative. S/he constructs the <b><u>wrong graph</u></b> type or <b><u>requires assistance</u></b> to construct a graph to represent the data.

## LAB REPORT RUBRIC THICKNESS OF ALUMINUM FOIL

**F= 0 - 1.75    D = 2.0    C = 2.25    B = 2.5    A= 2.75 - 3.0**

### REPORT FORMAT .....

	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
Lab report contains a completed introduction which includes the <b>background, two problems, hypotheses, and variables for the problem</b>				
Lab report is written in a lab journal "IPS COURSE"				
Lab report contains a <b>materials</b> and a complete <b>procedure</b> section. The steps are listed in a <u>numbered format</u> .				
Lab report contains a results section, which includes <b>4 data tables and two separate graphs</b>				
Lab report contains a <b>summary question</b> section. <u>All</u> questions including challenge question are <u>attempted</u> .				
Lab report contains a <b>conclusion and discussion</b> section. A simple conclusion and a <u>developed response</u> that explains the results are included.	0= incomplete lab			
The overall report is <u>complete, legible, and properly organized</u> . Data tables, graphs, and other charts are <u>neatly constructed</u> .				

**Total Points:** / 21

Comments related to **REPORT FORMAT**:

### INTRODUCTION AND EXPERIMENTAL DESIGN .....

<i>Number next to each standard reflects the order of the lab report</i>	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
<b>1. Background:</b> Provides a <u>clear description</u> of the experiment and a <u>rationale</u> for why the experiment was performed				
<b>2. Problem:</b> Identifies <u>one</u> testable problem <u>directly related</u> to the investigation/hypothesis				
<b>3. Hypothesis:</b> Formulates a <u>properly written</u> and testable hypothesis <u>directly related</u> to problem # 1				
<b>4. Variables:</b> All variables including IV, DV, CONSTANTS, and CONTROL for the problem are correctly identified, labeled, and are <u>related to the procedure and results</u>				

**Total Points:** / 12

Comments related to **INTRODUCTION AND EXPERIMENTAL DESIGN**:

**PROCEDURE AND RESULTS .....**

	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
<b>1. Materials:</b> Provides a detailed list of all the materials used in the investigation.				
<b>2. Procedure:</b> Presents easy to follow numbered steps, which are logically sequenced, complete, and detailed.				
<b>3. Data Table:</b> Tables are correctly constructed and labeled with appropriate units. All data is present and accurate. Proper <u>precision</u> is used in <u>all</u> calculations.				
<b>4. Graphs:</b> Appropriate <u>line and/or bar graph(s)</u> are constructed on <u>graph paper</u> to represent the data				
Both Graphs are <u>titled</u> , correctly <u>scaled</u> and axes are correctly <u>labeled</u> with appropriate <u>units</u> . Data is correctly plotted on the graph.				

**Total Points:** / 15

Comments related to **PROCEDURE AND RESULTS:**

**CONCLUSION AND DISCUSSION .....**

<i>Number next to each standard reflects the order of the lab report</i>	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
<b>5. Questions:</b> All responses to the summary questions including the challenge question are correctly answered. Proper <u>precision</u> is used in the challenge question.				
<b>6. Conclusion:</b> The hypothesis is either supported or refuted, which is backed by <u>student observations</u> and <u>cited with data</u> collected during the investigation.				
Discusses the major findings and attempts to offer a <u>logical explanation</u> for the findings. Student attempts to provide answers to both problems in the activity.				
Provides recommendations for further study based on observed error during the investigation. Use of correct grammar / Spelling correct				

**Total Points:** / 12

Comments related to **CONCLUSION AND DISCUSSION:**

**PHYSICAL PROPERTIES LAB**  
**CH. 2 and 13.3 Density \* \*BENCHMARK\* \***

**PROBLEM:** (Reference Chapters 2 & 13.3 for help)

1. How is an object's ability to float in water related to its density?

<b>IV.</b>		
Less than water	Equal to water	Greater than water

**CONTROL:**

**DV:**

**C:**

**TASK:**

1. Write a hypothesis for the problem. Remember: **YOUR VARIABLES SHOULD REFLECT YOUR HYPOTHESIS.**
2. **Predict** if the objects will float or sink in water. Record your predictions in data table II before you begin collecting data.
3. Write a procedure to determine the mass, volume, and density of the substances.
4. Conduct the experiment and record your results (**using proper precision**) in the data tables
5. Calculate the % error for the experimental density values
6. Answer the questions
7. Complete a formal lab report in your lab journal (**see rubric**)

**FAQ'S BY STUDENTS:**

1. How will I determine the volume of an *irregular object*? What if the *irregular object* floats?
2. How will I determine the mass of water?
3. How can I be consistent with accuracy and precision?
4. How do I graph all the points on the graph?

**MATERIALS:**

2 Tekaform cylinders of different sizes	Ruler ( <i>if needed</i> )
2 Aluminum cylinders of different sizes	Balance
2 PVC cylinders of different sizes	Paper clip
2 Wooden marbles of different sizes	Graduated cylinder 25mL, 50mL, and 100
I White plastic anchor	
Water ( <i>room temperature 24°C</i> )	

**DATA TABLE I**

	<b>X</b>	<b>Y</b>
OBJECTS	VOLUME(cm <sup>3</sup> )	MASS (g)
sm Wood Marble		

**DATA TABLE II**

	<b>X</b>	<b>Y</b>	
OBJECTS	VOLUME(g/cm <sup>3</sup> )	FLOAT OR SINK Predicted	Observed
sm Wood Marble			



**AT THIS POINT YOU SHOULD COPY THE KNOWN DENSITY  
VALUES FROM THE BOARD AND CALCULATE % ERROR**

$$\frac{\text{Your Value} - \text{Known Value}}{\text{Known Value}} \times 100\%$$

**GRAPH:** Construct a graph to show the relationship between the mass and volume of substances in table 1. ***Include a legend ..*** Construct a second graph comparing the substances to their measured densities. ***Include a legend.***

**QUESTIONS #1-7**

1. What physical property of matter does the slope of the lines in graph # 1 represent?
2. Examine your graphs and data tables. What appears to be true about the density of objects that float in water? Objects that sink in water
3. What would be true about the density of an object that was suspended in water?
4. How would the density of an object change if it were cut in half? What if the sample size of each object was doubled? **Explain your reasoning.**
5. Would substances/objects that float in water also float in other liquids? What would you need to know about the other liquids to make an accurate prediction?
6. How might a change in temperature affect the density of a substance? Explain. (*Hint: Think about how temperature affects the volume of a substance*)
7. Can density be used to help identify a pure substance, a mixture or both? Explain



## PHYSICAL SCIENCE / INTEGRATED SCIENCE I

## WRITING A LAB REPORT RUBRIC

## 1B

<b>Exceeds Expectations</b>	The problem and hypothesis are stated <b><u>clearly and completely</u></b> . <b><u>Accurate</u></b> identification of the independent and dependent variables. The experimental design <b><u>matches</u></b> the stated problem. Variables are <b><u>held constant</u></b> . The procedures are clear, <b><u>complete</u></b> and replicable. A control <b><u>is included</u></b> when appropriate. Data are well organized and presented in an appropriate manner. Conclusions are fully supported by data and address the hypothesis. Reliability of data and validity of conclusions are thoroughly discussed.
<b>Meets Expectations</b>	The problem and hypothesis are stated <b><u>adequately</u></b> . <b><u>Adequate</u></b> identification of the independent and dependent variables. The experimental design <b><u>generally</u></b> matches the stated problem. Attempt at holding variables constant is made. Procedures are <b><u>generally</u></b> complete. Data are organized and presented in an appropriate manner. Minor errors or omissions may be present. Conclusions are generally supported by the data and address the hypothesis. <b><u>Minor errors</u></b> in interpretation of results may be present. Discussion and reliability of data and validity of conclusions is limited.
<b>Meets Some Expectations</b>	The problem and/or hypothesis are <b><u>poorly stated</u></b> . <b><u>Limited</u></b> identification of independent and dependent variable. The experimental design matches the stated problem to some extent. <b><u>Little attempt</u></b> to hold variables constant. Procedures are incomplete. Data are <b><u>poorly organized</u></b> or presented in an appropriate manner. <b><u>Major omissions</u></b> or errors may be present. Conclusions are supported by data and address the hypothesis to a limited extent. <b><u>Major errors</u></b> in interpretation or results may be present. There is little discussion of the reliability of the data or validity of conclusions.
<b>Does Not Meet Expectations</b>	The statement of the problem and/or hypothesis is very limited or <b><u>missing</u></b> . <b><u>No identification</u></b> of independent or dependent variables. The experimental <b><u>design does not match</u></b> the stated problem, is very incomplete or missing. There is no attempt to hold variables constant. Data are very <b><u>poorly organized</u></b> or presented in an inappropriate manner or missing. Conclusions are <b><u>not supported</u></b> by data, do not address the hypothesis or are missing. There is <b><u>no discussion</u></b> of the reliability of data or validity of conclusions.

## LAB REPORT RUBRIC DENSITY OF OBJECTS

**F= 0 - 1.75    D = 2.0    C = 2.25    B = 2.5    A= 2.75 - 3.0**

### REPORT FORMAT .....

	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
Lab report contains a <u>completed introduction</u> which includes the <b>background, problem, hypotheses,</b> and <u>all the variables</u> .				
Lab report is <u>written</u> in a lab <u>journal</u>				
Lab report contains a complete list of all <b>materials</b> and a complete <b>procedure</b> section. The steps are listed in a <u>numbered format</u> .				
Lab report contains a results section, which includes <b>Data Table 1 and 2, known values, % error calculations and two graphs</b>				
Lab report contains a <b>summary question</b> section. <u>All</u> questions are <u>attempted</u> .				
Lab report contains a <b>conclusion and discussion</b> section. A simple conclusion and a <u>developed response</u> that explains the results and answers the problem are included.	0= incomplete lab			
The overall report is <u>complete, legible,</u> and <u>properly organized</u> . Data tables, graphs, and other charts are <u>neatly constructed</u> .				

**Total Points:** / 21

Comments related to **REPORT FORMAT:**

### INTRODUCTION AND EXPERIMENTAL DESIGN .....

<i>Number next to each standard reflects the order of the lab report</i>	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
<b>1. Background:</b> Provides a <u>clear description</u> of the experiment and a <u>rationale</u> for why the experiment was performed				
<b>2. Problem:</b> Identifies <u>one</u> testable problem that is <u>directly related</u> to the investigation's procedure and results				
<b>3. Hypothesis:</b> Formulates a <u>properly written</u> and testable hypothesis <u>directly related</u> to the problem				
<b>4. Variables:</b> All variables including IV, DV, CONSTANTS, and CONTROL for the problem are correctly identified and are related to the <u>procedure and results</u>				

**Total Points:** / 12

Comments related to **INTRODUCTION AND EXPERIMENTAL DESIGN**

**PROCEDURE AND RESULTS .....**

	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
<b>5. Materials:</b> Provides a detailed list of <u>all</u> the materials used in the investigation.				
<b>6. Procedure:</b> Presents easy to follow numbered steps, which are logically sequenced, complete, accurate, and detailed. <u>Procedure must show that the experiment can be replicated to produce the same results</u>				
<b>7. Data Table:</b> Tables are correctly constructed and labeled with <u>appropriate units</u> . <u>All</u> data is present and correct, <u>all</u> calculations including <u>% error</u> are correct, and <u>all known values</u> are included				
<b>8. Graphs:</b> Appropriate <u>graph types</u> are constructed <u>on graph paper</u> to represent the data in tables 1 and 2				
Both Graphs are <u>titled</u> , correctly <u>scaled</u> and axes are correctly <u>labeled</u> with appropriate <u>units</u> . All data is correctly <u>plotted</u> on the graph.				

**Total Points:** / 15

Comments related to **PROCEDURE AND RESULTS:**

**CONCLUSION AND DISCUSSION .....**

<i>Number next to each standard reflects the order of the lab report</i>	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
<b>9. Questions:</b> <u>All responses</u> to the summary questions are correctly answered.				
<b>10. Conclusion:</b> The hypothesis is either supported or refuted, which is backed by <u>student observations</u> and <u>cited with data</u> collected during the investigation.				
Discusses the major findings and attempts to offer a <u>logical explanation</u> (apply concept of buoyancy) for the findings. Student provides an <u>accurate answer</u> to the problems based on collected data and knowledge of the topic. Provides <u>recommendations</u> for further study based on <u>observed error</u> during the investigation.				
Use of correct grammar / Spelling correct				

**Total Points:** / 12

Comments related to **CONCLUSION AND DISCUSSION:**

**Course Description**

<b>HIGH SCHOOL</b>		
1. Course Title <b>Integrated Science II</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Intgr. Science II</b>		
3. Transcript Course Code/Number <b>00317</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Chairperson, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 9    Level: 2	7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
		8. Unit Value <input type="checkbox"/> .25 (30 days) <input checked="" type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____
		9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)
10. Pre-Requisites This course is offered to all freshmen without a prerequisite. This course may be taken prior to Integrated Science I.		
11. Brief Course Description In Integrated Science II, students will explore the origin of our planet and the processes that continue to shape the <b>Earth system. Topics considered for study include astronomy, Earth's structure and motion, resources and environment, plate tectonics, and physical oceanography.</b> Students will engage in inquiry based lab investigations. Students are required to complete a research assignment.		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocols. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently. 6. <b>Demonstrate respect for one's self, and strive to contribute to the success of others.</b>		



## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum as well as Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

<p><b>LEARNING STRAND</b>  <b>Core Scientific Inquiry, Literacy, and Numeracy</b>  <i>Content Standard: Scientific knowledge is created and communicated.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</li> <li>Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>Apply both precision and accuracy in recording experimental data.</li> <li>Develop logical conclusions that are based on the analysis of experimental data.</li> <li>Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Earth Science</u> by Namowitz, Spaulding McDougal Littell, 2003</p> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Modeled instruction</li> <li>PowerPoint presentations and notes</li> <li>Textbook ancillary materials</li> <li>Web-based instruction with Blackboard/finalsite</li> <li>Research</li> <li>Inquiry investigations</li> <li>Response cards</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Class participation</li> <li>Lab Reports</li> <li>Unit Test</li> <li>Quizzes</li> <li>Response cards by TurningTechnologies</li> </ul> <p><i>Note: emphasis on scientific inquiry, literacy, and numeracy occurs within Integrated Science II</i></p>

<p><b>LEARNING STRAND</b>  <b>Astronomy: "Stars and Galaxies"</b>  <i>CT Standard 9.1: Energy cannot be created or destroyed; however, energy can be converted from one form to another.</i>  <i>CT Standard 9.3: Various sources of energy are used by humans and all have advantages and disadvantages.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Stars differ from one another in mass, size, temperature, and distance from Earth.</li> <li>▪ Astronomers analyze light from objects in space in order to learn about the composition and movement of the objects.</li> <li>▪ All stars are composed of similar matter, but mass regulates stars' color, brightness and life expectancy.</li> <li>▪ Stars are born, and they mature, grow old, and die; their lifespan and final form depend on their masses.</li> <li>▪ In nuclear fusion, matter is transformed directly into energy in a process that is several million times as energetic as chemical burning.</li> <li>▪ Billions of galaxies make up the universe, which, according to the big bang model, formed between 10 and 20 billion years ago.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the electromagnetic spectrum, and how does it help astronomers learn about stars?</li> <li>▪ What are the characteristics of a star?</li> <li>▪ What are the phases of a star's life cycle?</li> <li>▪ What are galaxies?</li> <li>▪ From where do scientists think the universe came?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the characteristics of the electromagnetic spectrum.</li> <li>▪ Explain techniques for analyzing light to obtain information about stars.</li> <li>▪ Explain the Doppler effect and how it gives information about star motions.</li> <li>▪ Explain why the positions of constellations in the sky change with the seasons.</li> <li>▪ List three units astronomers use to measure distances to stars.</li> <li>▪ Describe characteristics of stars, including mass, size, temperature, color, and luminosity.</li> <li>▪ Describe the birth of a star.</li> <li>▪ Compare and contrast the life cycle of a various stars.</li> <li>▪ Describe the remnants of supernovae.</li> <li>▪ Tell what a galaxy is and describe the various types of galaxies.</li> <li>▪ Explain the origin of the universe according to the big bang model.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Earth Science</u> by Namowitz, Spaulding McDougal Littell, 2003</p> <ul style="list-style-type: none"> <li>▪ Spectrum discharge tubes</li> <li>▪ Diffraction gratings / spectroscopes</li> <li>▪ Doppler effect apparatus</li> <li>▪ Video</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Textbook ancillary materials</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ Doppler effect demonstration</li> <li>▪ Spectroscopy lab investigation</li> <li>▪ Parallax lab investigation</li> <li>▪ Video: Journey into the Solar System</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Unit Test</li> <li>▪ Investigations evaluated by rubrics</li> <li>▪ Video response summary</li> <li>▪ Response cards by TurningTechnologies</li> </ul>



<p><b>LEARNING STRAND</b>  <b>Astronomy: "The Sun and The Solar System"</b>  <i>CT Standard 9.1: Energy cannot be destroyed; however, energy can be converted from one form to another.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The sun is vastly larger than any of the rest of the objects in the solar system.</li> <li>▪ The sun gets its energy from the fusion of light elements into heavier ones.</li> <li>▪ Throughout history scientists have developed models to account for their observations of the stars and the planets.</li> <li>▪ Earth formed from a whirling cloud of gas and debris into a multilayered sphere, which has since been losing heat.</li> <li>▪ Earth rotates on its axis once approximately every 24 hours, resulting in day and night.</li> <li>▪ Earth revolves around the sun in an elliptical orbit, causing seasonal variations.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ <b>What is the sun's structure and source of energy?</b></li> <li>▪ How have observations made by scientists in the past contributed to our understanding of the sun and the universe today?</li> <li>▪ How was Earth formed, and what are some characteristics of its structure?</li> <li>▪ What is rotation and what are its effects?</li> <li>▪ What is revolution and what are its effects?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Explain the structure of the sun and its energy source.</li> <li>▪ Describe the effects of sunspots, solar wind, and magnetic storms on Earth and explain the <b>role of Earth's magnetic field.</b></li> <li>▪ Describe the early models of the movements of the planets and stars.</li> <li>▪ <b>Explain Newton's Law</b> of Gravitation.</li> <li>▪ Explain how most scientists explain the formation of the solar system.</li> <li>▪ <b>Describe the Earth's size and shape and the arrangement of its layers.</b></li> <li>▪ <b>List three sources of Earth's heat.</b></li> <li>▪ <b>Describes Earth's magnetic field.</b></li> <li>▪ <b>Give evidence for Earth's rotation.</b></li> <li>▪ <b>Relate Earth's rotation to the day-night cycle.</b></li> <li>▪ <b>Give evidence for Earth's revolution around the sun.</b></li> <li>▪ <b>Describe Earth's path and rate of revolution.</b></li> <li>▪ Explain why seasons occur.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Earth Science</u> by Namowitz, Spaulding McDougal Littell, 2003</p> <ul style="list-style-type: none"> <li>▪ Solar energy lab materials</li> <li>▪ Angular momentum apparatus</li> <li>▪ Gyroscope platform apparatus</li> <li>▪ Videos</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Textbook ancillary materials</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ Solar energy lab investigation (CAPT Embedded Task)</li> <li>▪ Retrograde motion lab investigation</li> <li>▪ Chapter 4 group presentations</li> <li>▪ Video: Secrets of The Sun</li> <li>▪ Video: Origins of Earth</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Unit Test</li> <li>▪ Investigations / presentations evaluated with rubrics</li> <li>▪ Video response summaries</li> <li>▪ Response cards by TurningTechnologies</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Earth as a System</b>  <i>CT Standard 9.7: Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.</i>  <i>CT Standard 9.9: Some materials can be recycled, but others accumulate in the environment and may affect the balance of the Earth systems.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Scientists and others are beginning to view Earth as a system of interconnected and interacting parts, instead of a collection of unrelated parts.</li> <li>▪ The Earth system consists of four spheres that all affect one another: the atmosphere, the geosphere, the hydrosphere, and the biosphere.</li> <li>▪ Elements of Earth exist in essentially fixed amounts and are located in various chemical reservoirs.</li> <li>▪ The water cycle, carbon cycle, and the energy cycle all involve interactions among the four spheres of Earth.</li> <li>▪ The cyclical movement of matter between <b>reservoirs is driven by the Earth's internal</b> and external sources of energy.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is Earth system science?</li> <li>▪ <b>What are the Earth system's four spheres, and how do they affect one another?</b></li> <li>▪ <b>What are Earth's natural cycles and how do they work?</b></li> <li>▪ How does the internal energy of the Earth cause matter to cycle through its major reservoirs?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe how scientists view Earth today.</li> <li>▪ Compare and contrast open and closed systems.</li> <li>▪ Explain the significance of Earth as essentially a closed system.</li> <li>▪ Explain how internal and external energy of the Earth causes matter to cycle through it.</li> <li>▪ Describe the characteristics of the water, carbon, and energy cycles.</li> <li>▪ Analyze how humans interact with the water, carbon, and energy cycles.</li> <li>▪ Describe human efforts to reduce the consumption of raw materials and improve air and water quality.</li> <li>▪ Explain the short and long-term impacts of landfills and incineration of waste materials on the quality of the environment.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Earth Science</u> by Namowitz, Spaulding McDougal Littell, 2003</p> <ul style="list-style-type: none"> <li>▪ LMC classroom for internet activities</li> <li>▪ Portable laptop cart</li> <li>▪ ES0103 investigation handout</li> <li>▪ ES0104 investigation handout</li> <li>▪ Video</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Textbook ancillary materials</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ ES0103 internet investigation</li> <li>▪ ES0104 internet investigation</li> <li>▪ Video: The Next Industrial Revolution</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes</li> <li>▪ Unit Test</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Video response summary</li> <li>▪ Response cards by TurningTechnologies</li> <li>▪ Appropriate use of technology</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Environment Resources</b>  <i>CT Standard 9.3: Various sources of energy are used by humans and all have advantages and disadvantages.</i>  <i>CT Standard 9.6: Chemical technologies present both risks and benefits to the health and well-being of humans, plants and animals.</i>  <i>CT Standard 9.8: The use of resources by human populations may affect the quality of the environment.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Earth has renewable and nonrenewable <b>resources. Humans’ demand for and use of resources</b> sometimes exceeds the available supply.</li> <li>▪ Humans depend on a variety of energy resources, both renewable and nonrenewable, to meet their energy needs.</li> <li>▪ Human use of <b>Earth’s resources affects the</b> living and nonliving parts of the environment.</li> <li>▪ Human activities affect the atmosphere by producing air pollutants and other substances that contribute to problems such as acid rain and ozone depletion.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ <b>What types of resources are parts of Earth’s</b> environment, and how are they important to humans?</li> <li>▪ What are nonrenewable and renewable energy resources?</li> <li>▪ <b>How does the use of Earth’s resources affect Earth’s environment?</b></li> <li>▪ How are combustion by-products from industries and vehicles a major source of air pollution?</li> <li>▪ How can land development, transportation options, and consumption of resources affect the environment?</li> <li>▪ How do changes in the composition of the atmosphere lead to changes in the global climate?</li> <li>▪ How are the byproducts of modern industry deteriorating water quality?</li> <li>▪ What alternative energy sources are currently being explored to address the disadvantages of using fossil fuels?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Distinguish between renewable and nonrenewable resources.</li> <li>▪ Explain how the availability and use of minerals determine how long mineral reserves will last</li> <li>▪ Identify renewable and nonrenewable energy resources.</li> <li>▪ Explain how fossil fuels form.</li> <li>▪ Explain how heat is used to generate electricity.</li> <li>▪ Describe how humans use renewable and nonrenewable energy resources to meet their energy needs.</li> <li>▪ Describe how the use of renewable and nonrenewable resources affects the environment.</li> <li>▪ Explain how humans can slow the depletion of resources.</li> <li>▪ Discuss how human activities can affect the atmosphere.</li> <li>▪ Compare and contrast acid rain, smog, ozone depletion, and global warming.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Earth Science</u> by Namowitz, Spaulding McDougal Littell, 2003</p> <ul style="list-style-type: none"> <li>▪ LMC instruction for renewable energy research assignment *</li> <li>▪ LMC classroom for internet activities</li> <li>▪ ES01087 investigation handout **</li> <li>▪ Video(s)</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Textbook ancillary materials</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ ES01807 internet investigation **</li> <li>▪ Renewable energy research assignment * (CAPT Energy Uses in Connecticut)</li> <li>▪ Atmospheric CO<sub>2</sub> lab investigation</li> <li>▪ Video: Dimming the Sun</li> <li>▪ Video: Global Warming – What You Need to Know</li> </ul>

	<b>SUGGESTED ASSESSMENT METHODS</b>
	<p>Benchmark:</p> <ul style="list-style-type: none"><li>▪ Meet course expectations for independently generating a properly written and properly cited research assignment</li></ul> <p>Other Assessments:</p> <ul style="list-style-type: none"><li>▪ Quizzes</li><li>▪ Unit Test</li><li>▪ Investigations evaluated with rubrics</li><li>▪ Video response summary</li><li>▪ Response cards by TurningTechnologies</li><li>▪ Appropriate use of technology</li></ul>

<p><b>LEARNING STRAND</b>  <b>Earth’s Changing Surface</b>  <i>CT Standard 9.7: Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The lithosphere is broken into rigid plates that move in relationship to one another on the asthenosphere.</li> <li>▪ Boundaries between plates are described generally as divergent, convergent, or transform, depending on how the plates move relative to each other.</li> <li>▪ Three hypotheses describe how mantle convection, ridge push, and slab pull may cause plate movements.</li> <li>▪ <b>Plate movements have caused Earth’s continents</b> to change their positions on the globe over time.</li> <li>▪ The continental margins are the underwater edges of continents and include several types of topographical features.</li> <li>▪ The ocean basin has a wide range of topographical features. Natural forces change these features over time.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What evidence have scientists found to support the theory of plate tectonics?</li> <li>▪ What are important features of different types of plate boundaries?</li> <li>▪ What are some of the hypotheses scientists have about the cause of plate movement?</li> <li>▪ How have plate movements caused changes in <b>the positions and shapes of Earth’s landscapes?</b></li> <li>▪ What tools and methods do scientists use to study the ocean floor?</li> <li>▪ What are continental margins?</li> <li>▪ What are the topographical features of the ocean basin?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Discuss evidence used by Alfred Wegener to support his idea of continental drift.</li> <li>▪ Explain how the theory of plate tectonics helps to predict the locations of earthquakes and volcanoes.</li> <li>▪ Discuss the differences among the three types of plate boundaries.</li> <li>▪ Contrast the three different types of convergent boundaries.</li> <li>▪ Discuss mantle convection as a possible cause of plate movements.</li> <li>▪ Compare and contrast ridge push and slab pull.</li> <li>▪ <b>Explain how the Earth’s landmasses have</b> changed positions over the past 200 million years.</li> <li>▪ Discuss the roles of plate tectonics, igneous activity, and deposition in the formation of continental landmasses.</li> <li>▪ Describe the parts of the continental margin</li> <li>▪ Compare and contrast active and passive continental margins.</li> <li>▪ Describe the features of the ocean basin.</li> <li>▪ Explain how ocean basin features change over time.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Earth Science</u> McDougal Littell, 2003</p> <ul style="list-style-type: none"> <li>▪ Plate tectonic model</li> <li>▪ World seismicity map</li> <li>▪ Pacific Ocean topographic maps (12)</li> <li>▪ Atlantic Ocean topographic map</li> <li>▪ Video(s)</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Textbook ancillary materials</li> <li>▪ Web based instruction-Blackboard/finalsite</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ <b>CEEP Lab #1 “How Fast is The Ocean Floor Moving?”</b></li> <li>▪ <b>CEEP Lab #2 “Lithospheric Plates and Ocean basin Topography”</b></li> <li>▪ Video: The Wave That Shook The World</li> <li>▪ Video: The Living Machine</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes and Unit Test</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Video response assessment</li> <li>▪ Response cards</li> </ul>

# Energy and the Environment

## Research Assignment

### CAPT Embedded Task: Energy Uses in Connecticut

Each student is responsible for selecting an alternative renewable or nonrenewable energy technology and completing the following assignment.

Please type (12 pt font, double space, 1 inch margins) your response to the target questions that apply to your alternative energy technology. Your response must be a minimum of 4 pages in addition to your citations.

The United States and the rest of the Globe currently rely heavily on the use of fossil fuels as the primary energy source for fueling our economies. Alternative energy forms (*solar, wind, nuclear, hydro, geothermal, biomass and others*) are frequently debated as alternative ways of providing energy while decreasing our reliance on fossil fuels. *Your assignment is to select an alternative energy source and examine its potential as a fuel source for the future.* To keep the topic relevant to your daily lives, I ask that you also compare your chosen alternative energy to Connecticut's current energy profile. You will want to discuss some of the following issues with respect to the fuel source you choose when completing your assignment.

### TARGET QUESTIONS

1. How does the technology work? What are the principles (technical aspects) of operation?
2. How expensive "\$\$" is the technology? (compare to costs "\$\$" of fossil fuels)
3. What is/are the primary constraint(s) or limiting factor(s) associated with this technology?
4. Are there specific environmental concerns associated with the manufacture, distribution, use, or disposal of the technology?
5. Identify the stakeholders? (Who or what does/does not benefit from the manufacture, distribution, use or disposal of the energy technology?)
6. Is this technology currently used today? If so, how much, where, and in what form?
7. What % of the United State's total energy consumption is currently attributed to the application of the technology?
8. Examine Connecticut's energy profile. Is your energy technology a practical alternative to Connecticut's current source(s) of energy?
9. What are your personal feelings and observations? Are you in favor or against the use of the technology? *Be sure to summarize key points in your paper to support your position!*

Energies	What does this energy consist of?	Does it involve solar energy? Why?	Disadvantages	Advantages
Biomass				
Geothermal				
Hydrogen Fuel				
Hydro-Power				
Nuclear				
Wind				
Tidal				
Sun				

**EARTH SCIENCE /INTEGRATED SCIENCE II  
RESEARCH PAPER RUBRIC  
1B & 2**

<b>Exceeds Expectations</b>  <b>90 – 100</b>	The student understands not only the objective but also the implications of assignments. S/he writes in a variety of modes, with a clear focus or thesis. Supporting details are well developed and organized, showing both analysis and synthesis of ideas. Word choice and syntax are accurate and appropriate. The student shows mastery in the conventions of Standard English. The student successfully completes all parts of the writing process.
<b>Meets Expectations</b>  <b>75 – 89</b>	The student understands the objective of assignments and selects an appropriate mode of written expression with a focus or thesis. Supporting details show an understanding of the subject matter and an analysis of ideas. They are somewhat developed and organized. Word choice and syntax are accurate and appropriate. Errors in the conventions of Standard English are few. The student completes most parts of the writing process.
<b>Meets Some Expectations</b>  <b>65 – 74</b>	The student requires some additional explanations and models in order to understand the objective of assignments or to complete the writing process. With direction, s/he selects an appropriate mode. Writing has somewhat limited focus or thesis, and supporting ideas may be inaccurate, simplistic, and/or confused. The student may require assistance to develop or organize his response. Word choice and syntax are consistent with grade level. There are some errors in the conventions of Standard English.
<b>Does Not Meet Expectations</b>  <b>0 - 64</b>	The student misinterprets significant elements of writing assignments, selecting an inappropriate mode or using it incorrectly. The student requires many additional explanations, models, graphic organizers, and/or strategies in order to complete parts of the writing process. The writing has no clear focus or a very limited thesis. Ideas and concepts are often unorganized or inaccurate. Inaccurate or limited vocabulary, syntax errors, and errors in the conventions of writing make the writing ineffective.



## ENERGY AND THE ENVIRONMENT RESEARCH PAPER *RUBRIC*

### PAPER FORMAT

	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
Cover page including name, title, class and period				
Approved font, size, spacing and margins				
<b>4 page minimum</b> length excluding pictures and Works Cited page				
Works cited/bibliography for <b>cited text and pictures</b> (MLA format). <i>alphabetized</i> <i>*note* include all sources used for reference</i>				
All notes are turned in with the paper				
Completed energy comparison chart				

**Total Points:**

Comments related to *PAPER FORMAT* section:

### USE OF SOURCES

	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
Sources are current (dates provided in works cited)				
Sources are consistently related to the topic				
A variety of sources other than required sources (books, E-books journals, periodicals, and authored websites) were used. (min. of four) <i>*note * All sources including those that were not cited within the text of your paper</i>				
Source information (text & pictures) cited within text (MLA format)				

**Total Points:**

Comments related to *USE OF SOURCES* section:

**RESEARCH PAPER CONTENT**

	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
Principles of operation are detailed and <b>clearly described</b>				
The stakeholders are <b>clearly</b> identified and <b>discussed</b>				
Costs associated with the technology are compared to fossil fuels. <u>Monetary</u> comparisons are made and cited within the text. <b>Data supports statements</b>				
Current use/uses of the technology are discussed				
Constraints associated with the technology are discussed. <b>Data supports statements</b>				
Environmental concerns associated with the manufacture, distribution, use, and disposal of the technology are discussed. <b>Data supports statements</b>				
Comparisons to Connecticut’s current energy profile are discussed.				
The writer takes a position based on his/her interpretation and analysis of the research. The writer provides persona! opinions on points discussed within the text				
All information on the renewable energy comparison chart is <b>accurate</b> and <b>complete</b>				
<b>Total Points:</b>				

Comments related to **CONTENT** section:

**MECHANICS / ORGANIZATION**

	Undeveloped 0 – 1.75	Beginning 2.0 – 2.25	Developing 2.5	Accomplished 2.75 – 3.0
Introduction engaging and directed toward the body of the paper				
Text organization (paragraphs follow a logical sequence)				
Writing sophistication (varied sentences, mature vocabulary)				
Mixture of writer’s words with paraphrased/quoted ( <b>MLA</b> format) sources woven into text				
Use of correct grammar / Spelling correct				
Clear conclusion containing the topic sentence and a summary of the research				
<b>Total Points:</b>				

Comments related to **MECHANICS / ORGANIZATION** section:



### Course Description

HIGH SCHOOL		
1. Course Title <b>Biological Systems</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	
2. Transcript Title/Abbreviation <b>Biological Systems</b>	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media	
3. Transcript Course Code/Number <b>00312</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 10 – 12      Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input checked="" type="checkbox"/> 1.25 (2.5 trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites C or better in Integrated Science I and II		
11. Brief Course Description This course involves the study of the broad fundamental principles governing living things. The cell, classifications of living things, and various living systems are examined. It includes the study of plants and animals and how they function in their environment, the biosphere. Inquiry based laboratory investigations and scientific laboratory reports are designed to support concepts discussed in class and to teach concepts by inquiry.		
12. Course Goals 1. Demonstrate proficiency and fluency in communication to meet the literacy demands of the global community. 2. Use technology effectively and responsibly. 3. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 4. <b>Demonstrate respect for one's self, and strive to contribute to the success of others.</b> 5. Demonstrate the ability to successfully complete homework and laboratory assignments independently. 6. Conduct lab experiments safely using appropriate scientific protocols. 7. Analyze and synthesize scientific information as it relates to everyday living. 8. Demonstrate skills in using various types of biological instruments and scientific methodologies.		

13. Course Outline <i>in presented order:</i>		
UNIT / Chapter	CONCEPT	ACTIVITY
<b>THE NATURE OF LIFE</b>		
1) The Science of Biology	<ul style="list-style-type: none"> <li>▪ Lab safety</li> <li>▪ Lab equipment</li> <li>▪ Scientific method</li> </ul>	pH lab Yeast and Temperature lab
2) The Chemistry of Life	<ul style="list-style-type: none"> <li>▪ Enzymes</li> <li>▪ Chemical reactions</li> <li>▪ Carbon compounds</li> </ul>	Enzymes Lab (CAPT Embedded Task) Acid Rain (CAPT Embedded Task) Organic compounds in food lab
<b>ECOLOGY</b>		
3) The Biosphere	<ul style="list-style-type: none"> <li>▪ Energy flow</li> <li>▪ Cycles of matter</li> </ul>	Ecosystem WebQuest Bauer Farm study (local habitat)
4) Ecosystems and Communities	<ul style="list-style-type: none"> <li>▪ Climate</li> <li>▪ Biomes</li> <li>▪ Aquatic ecosystems</li> </ul>	Biome research project
5) Populations	<ul style="list-style-type: none"> <li>▪ Effects of growth</li> <li>▪ Human population</li> </ul>	Yeast Population Dynamics lab CAPT Embedded Task
<b>CELLS</b>		
7) Cell Structure and Function	<ul style="list-style-type: none"> <li>▪ History of the cell</li> <li>▪ Eukaryotic cell</li> <li>▪ Cell boundaries</li> <li>▪ Diversity of the cell</li> </ul>	Microscope lab Plant vs. Animal cell lab Osmosis diffusion lab
8) Photosynthesis	<ul style="list-style-type: none"> <li>▪ Energy and life</li> <li>▪ Photosynthesis overview</li> <li>▪ Reactions of photosynthesis</li> </ul>	
9) Cellular Respiration	<ul style="list-style-type: none"> <li>▪ The Krebs cycle</li> <li>▪ Electron transport</li> </ul>	
10) Cell Growth and Division	<ul style="list-style-type: none"> <li>▪ Cell growth</li> <li>▪ Cell division</li> <li>▪ Regulating the cell cycle</li> </ul>	<b>Internet "Root Mitosis" activity</b>
<b>GENETICS</b>		
11) Introduction to Genetics	<ul style="list-style-type: none"> <li>▪ Gregor Mendel</li> <li>▪ Probability</li> <li>▪ Punnett Square</li> <li>▪ Meiosis</li> </ul>	Human Traits Investigation (CAPT Embedded Task: Human Population Dynamics) Probability lab Human Karyotyping lab Pipe cleaner cheerios meiosis lab
12) DNA and RNA	<ul style="list-style-type: none"> <li>▪ DNA</li> <li>▪ Chromosome replication</li> <li>▪ RNA &amp; protein synthesis</li> <li>▪ Mutations</li> </ul>	Design-o-saur activity DNA extraction from cells
<b>EVOLUTION</b>		
15) Darwin's Theory of Evolution	<ul style="list-style-type: none"> <li>▪ <b>Life's diversity</b></li> <li>▪ Natural selection</li> <li>▪ Kingdoms and Domains</li> <li>▪ Modern Classification</li> </ul>	Jelly bellicus lab Bio-engineered Food (CAPT Task) Newspaper mice activity Mystic Aquarium field trip Natural history project

## 14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response Cards by TurningTechnologies
- Web-based instruction with Blackboard/finalsite
- Research

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>Content Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Formulate a <b>testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</b></li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicates the results of a scientific experiment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Biology</u> Prentice Hall, 2008 <hr/> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lecture instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Supplement textbook ancillary materials</li> <li>▪ Guided Internet research</li> </ul> <hr/> <b>SUGGESTED ASSESSMENT METHODS</b> Yeast Lab <i>**Benchmark**</i> <ul style="list-style-type: none"> <li>▪ CAPT Embedded Performance Task: Laboratory Investigation of Yeast Population Dynamics</li> </ul>

<p><b>LEARNING STRAND: THE NATURE OF LIFE</b>  <b>Science of Biology and The Chemistry of Life</b>  <i>CT Standard 10.3: Similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.</i>  <i>CT Standard 10.4: In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Genetic information is stored in genes that are located on chromosomes inside the cell nucleus.</li> <li>Most organisms contain homologous chromosomes in the cell nucleus inherited from parents.</li> <li>Most organisms have two genes for each trait, one on each of the homologous chromosomes in the cell nucleus.</li> <li>The principles of genetics and cellular chemistry can be used to produce new foods and medicines in biotechnological processes.</li> <li>Organic compounds make up all living things.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How can the genetic information of organisms be altered to make them produce new materials?</li> <li>How does meiosis contribute to the genetic variability of an organism?</li> <li>How can the Punnett Square technique be used to predict the distribution of traits in mono- and di-hybrid crossings?</li> <li>How can the probable mode of inheritance of traits (e.g., recessive/dominant, sex-linked) be deduced from pedigree diagrams showing phenotypes?</li> <li>What is the difference between genetic disorders and infectious diseases?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Describe the four groups of organic compounds.</li> <li>Identify the functions of the organic compounds in living things.</li> <li>Identify and describe the structure and function of nucleic acids.</li> <li>Identify the chemical properties of water.</li> <li>Identify acids and bases.</li> <li>Identify the use of enzymes in living cells.</li> <li>Identify the importance of enzymes in living cells.</li> <li>Identify and use the principles of probability and genetics.</li> <li>Explain Mendelian genetics.</li> <li>Use Pedigree diagrams.</li> <li>Use effective and efficient strategies for gathering information and materials, and thinking critically.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li><u>Biology</u> Prentice Hall 2008 and ancillary materials</li> <li>AV materials (LMC and departmental)</li> <li>General lab equipment</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Have students complete the worksheets from chapters 2 and 11 and 12</li> <li>Use appropriate websites to illustrate genetic problems</li> <li>Do enzyme lab with pectin, amylase, or enzyme of choice (CAPT Task: Enzymes)</li> <li>Have students perform PH lab</li> <li>Have students do activities with organic chemistry (food lab, cut outs etc.)</li> <li>Have students use Punnett Square technique to predict distribution of traits</li> <li>Have students view department PowerPoint presentations</li> <li>Lab activities for probability, human karyotyping, and human traits (CAPT Task)</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Quizzes, activities and homework</li> <li>Benchmark: CAPT Performance Task - Enzymes</li> <li>CAPT Performance Task - Acid Rain</li> <li>Computer based tests on chapters 2, 11 and 12</li> <li>Nucleic acid and genetics websites activities</li> <li>Internet activity on mitosis</li> <li>Ph lab</li> <li>Pedigree activity</li> </ul>



<p><b>LEARNING STRAND: ECOLOGY</b>  <b>The Biosphere, Ecosystems &amp; Communities, and Populations</b>  <i>CT Standard - 10.6: Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Human populations grow due to advances in agriculture, medicine, construction and the use of energy.</li> <li>▪ The size of a population of organisms is affected by many environmental factors.</li> <li>▪ Humans modify ecosystems as a result of rapid population growth, use of technology and consumption of resources.</li> <li>▪ Technological advances have effected human population growth.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>- How do populations grow?</li> <li>- How does competition affect growth?</li> <li>- What are the factors that affect population size?</li> <li>- Why does population growth differ in countries around the world?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the factors that affect the carrying capacity of the environment.</li> <li>▪ Discuss how energy flows through an ecosystem.</li> <li>▪ Explain the energy pyramid.</li> <li>▪ Explain how technological advances have affected the size and growth rate of human populations throughout history.</li> <li>▪ Analyze population graphs and or charts.</li> <li>▪ Explain how change in population density is affected by emigration, immigration, birth and death rates: relate these factors to the exponential growth of human populations.</li> <li>▪ Identify the biotic and abiotic components in the ecosystem.</li> <li>▪ Identify the key characteristics of land and aquatic biomes.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ <u>Biology</u> Prentice Hall, 2008</li> <li>▪ Ecosystem webquest</li> <li>▪ Bauer Farm or DHHS land field study</li> <li>▪ Worksheets and Audio Visual material for <u>Biology</u> chapters 3, 4, and 5</li> <li>▪ Websites on population growth</li> <li>▪ CAPT Embedded Task: Human Population Dynamics</li> <li>▪ CAPT Embedded Task: Yeast Population Dynamics</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Inquiry activities</li> <li>▪ Investigating growth of a population of bacteria</li> <li>▪ Yeast population growth lab</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>- Lab reports</li> <li>- Laboratory investigation scored with CAPT rubric</li> <li>- Powerpoint slide show for Human Population Dynamics</li> <li>- Section quizzes and chapter assessments</li> <li>- Unit tests</li> </ul>

<b>LEARNING STRAND: CELLS</b> <b>Cell Structure and Function, Photosynthesis, Cellular Respiration, and Cell Growth and Division</b> <i>CT Standard - 10.1: Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i> <i>CT Standard - 10.2: Microorganisms have an essential role in life processes and cycles on earth.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The cell is the basic unit of structure and function of all living things.</li> <li>▪ Complex living things are organized at different levels.</li> <li>▪ Living things are composed of cells which can interact in such a way that results in evolving chemical, physiological, and biological processes.</li> <li>▪ Cells and living things have optimal ranges for different conditions under which they perform life processes.</li> <li>▪ Most of the chemical activities of the cell are catalyzed by enzymes that function only in a narrow range of temperatures and acidity conditions.</li> <li>▪ The cell membrane regulates many of the cell's properties.</li> <li>▪ Microorganisms are an essential role in life processes and cycles on Earth.</li> <li>▪ Understanding the growth and spread patterns of bacteria and viruses enables the development of methods to prevent and treat infectious diseases.</li> <li>▪ The cellular processes of photosynthesis and respiration involve transformation of matter and energy.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How do cell structures differ among living things?</li> <li>▪ What is the general role of enzymes in metabolic cell processes?</li> <li>▪ What is the function of the cell membrane in supporting cell functions?</li> <li>▪ What are the processes of active and passive transport as it relates to cells?</li> <li>▪ What is the importance of cells in their role of homeostasis?</li> <li>▪ What are the similarities and differences between bacteria and viruses?</li> <li>▪ How are bacterial and viral infectious diseases transmitted?</li> <li>▪ How are bacteria and viruses both helpful as well as harmful to human beings?</li> <li>▪ How are bacteria and yeasts used to produce foods for human consumption?</li> <li>▪ How do environmental factors affect living things?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Explain the relationship between cell respiration and photosynthesis.</li> <li>▪ Discuss the importance of cell metabolism and its effect on homeostasis.</li> <li>▪ Identify the main steps in cellular respiration.</li> <li>▪ Identify the main steps in photosynthesis.</li> <li>▪ Explain the difference between meiosis and mitosis.</li> <li>▪ Relate the structure to the function of cells &amp; to the structures in which they make up in an organism.</li> <li>▪ Describe the processes of cell transport.</li> <li>▪ Differentiate between the cells of the six kingdoms.</li> <li>▪ Compare and contrast eukaryotic and prokaryotic cells and viruses.</li> <li>▪ Explain the life cycle of viruses and bacteriophages.</li> <li>▪ Describe how some infectious diseases are transmitted to humans.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ <u>Biology</u> Prentice Hall, 2008</li> <li>▪ Prepared slides of cells</li> <li>▪ Audio Visual materials on cells and cell functions (LMC and departmental)</li> <li>▪ Websites on cells such as Cells Alive and <a href="http://www.accessexcellence.org">www.accessexcellence.org</a></li> <li>▪ Microscopes</li> </ul>

<ul style="list-style-type: none"> <li>▪ Examine the role of antibiotics in the prevention and treatment of infectious diseases.</li> <li>▪ Explain the importance of bacteria and yeasts to human beings.</li> <li>▪ Relate the importance of meiosis and mitosis to genetic recombination.</li> <li>▪ Relate the importance of energy conversions in cells (ATP).</li> </ul>	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Diffusion lab (i.e., potato, cucumber or elodea)</li> <li>▪ CAPT investigation on cell transport</li> <li>▪ Worksheets from <u>Biology</u> chapter 7-10</li> <li>▪ Simulations of meiosis and mitosis</li> <li>▪ Internet worksheet on mitosis – Cells Alive</li> <li>▪ Posters or charts comparing meiosis and mitosis</li> <li>▪ Worksheets on ATP/ADP cycle</li> <li>▪ Microscope lab activities</li> </ul> <p>CD Rom on bacteria and viruses</p>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Teacher generated tests/quizzes</li> <li>▪ Lab reports on cell transport</li> <li>▪ Posters or worksheets evaluated with rubrics</li> </ul> <p><b>Worksheets on videos and DVD's</b></p>

<p><b>LEARNING STRAND: EVOLUTION</b>  <b>Darwin's Theory of Evolution</b>  <i>CT Standard - 10.5: Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments</i>  <i>CT Standard - 10.3: Similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Species survival is affected by many factors including the environmental changes as well as genetic factors.</li> <li>There is evidence supporting the theory of evolution.</li> <li>Mutations and recombination of genes create variability in populations.</li> <li>Changes in the environment may result in the selection of organisms that are better able to survive and reproduce.</li> <li>The principles of genetics and cellular chemistry can be used to produce new foods and medicines in biotechnological processes.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What is the process of altering genetic material to make new products?</li> <li>What is an example of how gene therapy has altered the lives of human beings for the better and for the worse?</li> <li>What are some risks and/or benefits of altering the genetic composition and cell products of organisms (bacteria etc.)?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Explain that Darwin's observations led to his theory of natural selection.</li> <li>Examine how mutations and adaptations apply to Darwin's theory of evolution</li> <li>Explain the scientific evidence that disproves Lamarck's theory of evolution.</li> <li>Explain how the difference between artificial and natural selection affects human beings and the process of evolution of many living things.</li> <li>Understand how genetics plays a role in evolution.</li> <li>Understand that vestigial structures such as the appendix provide evidence of human evolution.</li> <li>Identify how bioengineering/biotechnology is used to benefit humans</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li><u>Biology</u> Prentice Hall 2008</li> <li>Worksheets for <u>Biology</u> chapters 15, and parts of 13</li> <li>Cloning videos</li> <li>Extracting DNA lab</li> <li>Simulation labs in biotechnology</li> <li>CAPT Embedded Task: Bio-engineered Food</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Responses to questions in lab reports</li> <li>Response sheets for cloning videos</li> <li>Evidences of Evolution reports evaluated with rubrics</li> <li>Mice lab questions and answers</li> <li>Evolution videos</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Response sheets to evolution videos, cloning videos, biotechnology simulations</li> <li>Lab reports for questions on mice lab and extracting DNA lab</li> <li>Questions and discussion regarding the cloning of organisms</li> <li>Stem cell discussion</li> <li>Discussion of the benefits of genetic engineering for humans, for medicine and food</li> <li>Issues in <u>Biology</u> p. 330, "Do genetically modified foods need stricter controls?"</li> <li>Persuasive Pamphlet regarding Bio-engineered Food (CAPT Embedded Task)</li> </ul>

## How to Write a Lab Report

### General directions

Use section headings in the order given below

Use full sentences.

Make new data tables: do not attach tables from the lab.

**Title** - Use the one provided or create a title that is appropriate.

**Problem** - Compose a sentence or two describing the purpose of the investigation. What you are trying to solve?

**Independent and Dependent Variables** -List variables when asked for **Control** and **Constants**

**Hypothesis** - This is your prediction of what will occur based on prior knowledge or information from your textbook or notes.

**Materials** - List materials provided or materials you selected for use.

### Procedure

Use **numbers** to label the steps in your procedure. See the lab reports that I have given you as examples.

List any changes in the handout you might have been given.

Make the procedure easy to read and follow, so that the reader can repeat the steps you have given and get the same results. Check carefully for accuracy, completeness and precision. Use units when appropriate.

### Data Table

Make a neat, concise data table with vertical and horizontal columns and **INCLUDE UNITS** and labels.

Be sure to include averages when appropriate or the derived units (density, speed etc.).

For some reports, there will be data or analysis questions to answer in this section of the lab report.

### Graph

Use a title for the graph.

Draw and label the X and Y axes of the graph.

Determine appropriate scale for X and Y axes.

The independent variable is the X axis, and the dependent variable is the Y axis.

### Discussion

This is usually the most important part of the lab. This section usually has the highest point value. You should include the following topics in paragraph form. You should use more than one sentence for each answer.

- What if any trends did you notice?
- What were the major findings of the lab?
- Was the hypothesis supported by the data? Use data to support this response.
- How did your findings compare to the findings of others?
- What could be sources of error?
- What possible explanations can you offer for your findings?
- How does the experiment relate to what you are learning in class?
- Summarize your findings supported by data.

### Conclusion

Write one or two sentences that summarize the findings of the lab.

## Biological Systems

### Factors Affecting the Rate of Yeast Respiration

#### Problem

How does temperature affect the rate of respiration in yeast?

#### Hypothesis

Make a hypothesis based on your research and knowledge for YOUR Problem ONLY!  
Use "If..., then..." format.

#### Materials

Yeast solution	Beakers
Droppers	Stirrers
Test tubes	
Stoppers for test tubes	markers for test tubes
Glucose solution	
Hot plate	boiling stones
Ice	Water
Thermometers	rulers
Graduated cylinders	

#### General directions and cautions

Take 50 ml total of yeast solution (stir beaker before obtaining solution)

Be sure to label test tubes.

Use 15 ml of yeast in each test tube.

Use 10 ml of glucose.

Stir or swirl test tubes.

Use boiling stones in beakers of boiling water.

The lab experiment will have a reaction occur.

Don't measure the time.

Perform the experiment with all test tubes at same time.

Do not leave the thermometer in boiling water =100 degrees all the time

Due Date:

## Biological Systems Benchmark Rubric for Respiration Lab with Yeast

**Problem** - given

**Hypothesis** - 5 points for "If..., then..." format

**Materials** - given

**Variables** -15 points; list dependent, independent, control and constants (at least 3)

**Procedure** - 20 points; steps are labeled and numbered and can be followed; they are in full sentences

**Results/Data Tables** - 20 points; tables must include units, as well as indicate change in the height of bubbles. The report must be neat and clearly reflect the data.

**Discussion** - 30 points      The discussion includes:  
sources of error i.e., validity of experiment and results compared to other groups (5 points).  
a discussion of hypothesis i.e., was it correct or incorrect; explain (5 points).  
an answer to the problem (5 points).  
a discussion of fermentation (5 points).  
a discussion of why a warm temperature was the best (5 points).

**Conclusion** - 10 points; write two or three sentences in a succinct scientific manner summarizing the results or findings of the lab.

**Biological Systems  
Yeast Lab  
B Writing**

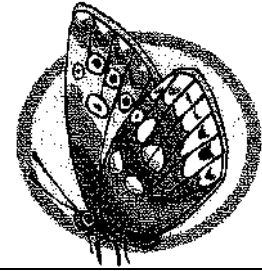
<p><b>Exceeds Expectations</b> 90 – 100</p>	<p>The student understands not only the objective but also the implications of the lab. S/he uses the proper format. S/he writes with a clear focus / hypothesis. Supporting evidence is well developed and organized, showing both analysis and synthesis of ideas. Word choice and syntax are accurate and appropriate. The student shows mastery in the conventions of Standard English.</p>
<p><b>Meets Expectations</b> 80 – 89</p>	<p>The student understands the objective of the lab, uses the proper format, and has focus / hypothesis. Supporting evidence shows an understanding of the subject matter and an analysis of ideas. Is somewhat developed and organized. Word choice and syntax are accurate and appropriate. Errors in the conventions of Standard English are few.</p>
<p><b>Meets Some Expectations</b> 70 – 79</p>	<p>The student requires some additional explanations and models in order to understand the objective of the lab or to complete the process. With direction, s/he selects an appropriate format. Writing has a somewhat limited focus or hypothesis, and supporting evidence may be inaccurate, simplistic, and/or confused. The student may require assistance to develop or organize his response. Word choice and syntax are consistent with grade level. There are some errors in the conventions of Standard English.</p>
<p><b>Does Not Meet Expectations</b> 0 - 69</p>	<p>The student misinterprets significant elements of the lab, selecting an inappropriate format. The student requires many additional explanations, models, and/or strategies in order to complete parts of the process. The writing has no clear focus or a very limited hypothesis. Ideas and concepts are often unorganized or inaccurate. Inaccurate or limited vocabulary, syntax errors, and errors in the conventions of writing make the writing ineffective.</p>



## Peppered Moth Simulation

**Objectives:**

- Describe the importance of coloration in avoiding predation
- Relate environmental change to changes in organisms
- Explain how natural selection causes populations to change



**Materials:**

- Sheet of white paper
- Newspaper
- Forceps
- Colored pencils
- Clock with second hand
- 30 newspaper circles (made with hole punch)
- 30 white circles (made with hole punch)

**Purpose:** In this lab, you will simulate how predators locate prey in different environments. You will analyze how color affects an organism's ability to survive in certain environments.

Industrial melanism is a term used to describe the adaptation of a population in response to pollution. One example of rapid industrial melanism occurred in populations of peppered moths in the area of Manchester, England from 1845 to 1890. Before the industrial revolution, the trunks of the trees in the forest around Manchester were light grayish-green due to the presence of lichens. Most of the peppered moths in the area were light colored with dark spots. As the industrial revolution progressed, the tree trunks became covered with soot and turned dark. Over a period of 45 years, the dark variety of the peppered moth became more common.

**Procedure:**

1. Place a sheet of white paper on the table and have one person spread 30 white circles and 30 newspaper circles over the surface while the other person isn't looking.
2. The "predator" will then use forceps to pick up as many of the circles as he can in 15 seconds.
3. This trial will be repeated with white circles on a newspaper background, newspaper circles on a white background, and newspaper circles on a newspaper background. Record the data in chart below.

		Starting Population		Number Picked up	
Trial	Background	Newspaper	White	White	Newspaper
1	white	30	30		
2	white	30	30		
3	newspaper	30	30		
4	newspaper	30	30		

### Analysis

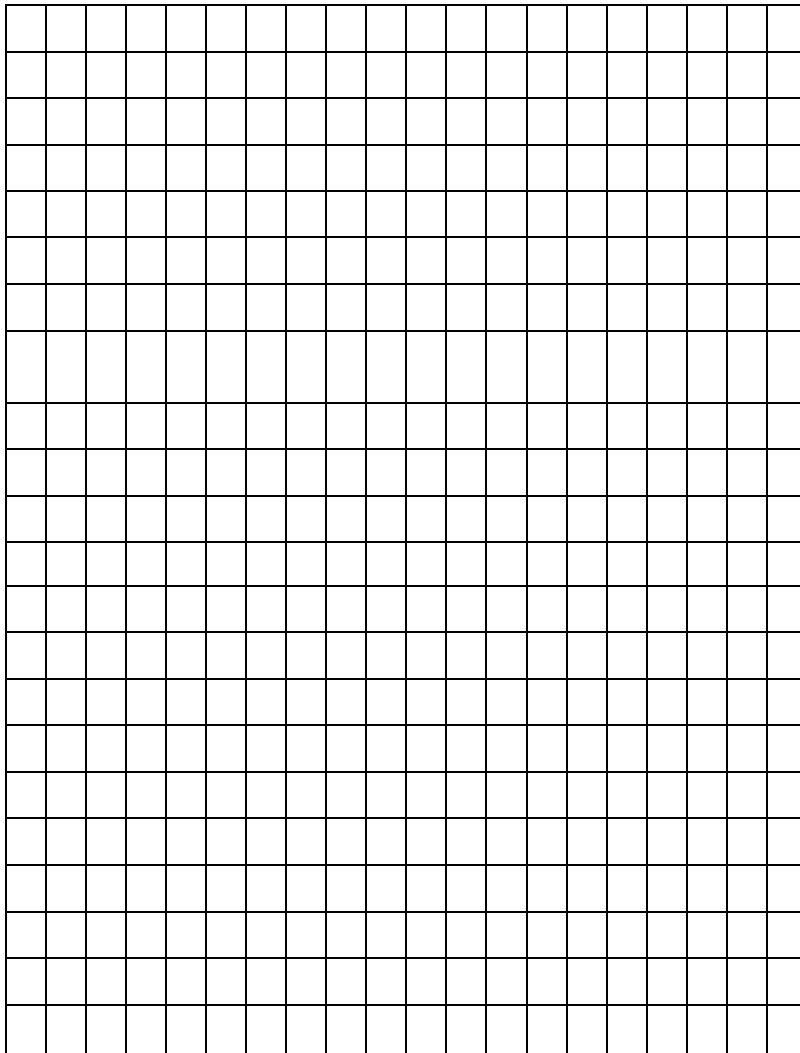
1. What did the experiment show about how prey are selected by predators?

2. What moth coloration is the best adaptation for a dark (newspaper) background? How do you know?

3. What would you expect the next generation of moths to look like after trial 1? What about the next generation after trial 3?

4. How does the simulation model natural selection?

5. Examine the table and construct a graph, Plot the years of the study on the X-axis, and the number of moths captured on the Y axis. You should have 2 lines on your graph -- one for light moths, and one for dark moths.



Year	# of Light Moths Captured	# of Dark Moths Captured
2	537	112
3	484	198
4	392	210
5	246	281
6	225	337
7	193	412
8	147	503
9	84	550
10	56	599

6. Explain in your own words what the graph shows.

7. Describe a situation where this type of selection might occur.

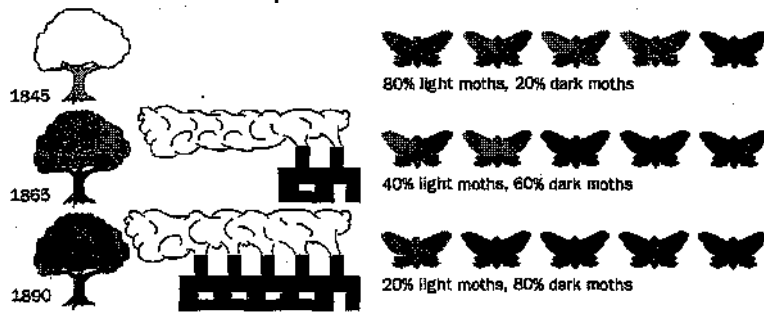
**CHAPTER** 10 | **Evolution and Natural Selection**

**Reteaching**

**Natural Selection in Action**

In the 1800s there were two varieties of a certain species of English moth—a light colored variety and a dark-colored variety. Both rested on trees, which had light colored bark. The coloring of the light moths served as camouflage on the light-colored trees, so the light moths were not as easily seen by predators as the dark moths were. But as industry in the cities increased, the trees became covered with dark soot. Over many generations, the moth populations adapted to the increased amount of soot.

Examine the diagrams and then answer the questions that follow.



1. H.B.D. Kettlewell's experiments demonstrated that natural selection was at work in the process shown above. His work had three steps. Referring to page 182 of your textbook, state what each of the steps of Kettlewell's work proved.

Step 1 \_\_\_\_\_

Step 2 \_\_\_\_\_

Step 3 \_\_\_\_\_

2. Why was the percentage of dark moths so small in 1845? \_\_\_\_\_

3. How did natural selection cause the percentage of dark moths to increase? \_\_\_\_\_

**Biological Systems  
Writing Rubric for  
Natural Selection / Evolution Activity  
1B**

<b>Exceeds Expectations</b>	Using supporting evidence from an activity on evolution by natural selection the student will organize, analyze and synthesize the data from the activity. Word choice and syntax are accurate and appropriate. The student shows mastery in the conventions of Standard English in the written assignment.
<b>Meets Expectations</b>	Using some supporting evidence from an activity on evolution by natural selection the student will organize, analyze and synthesize the data from the activity. Is somewhat developed and organized. Word choice and syntax are accurate and appropriate. Errors in the conventions of Standard English are few in the written assignment.
<b>Meets Some Expectations</b>	The student requires additional explanations and models in order to organize, analyze and synthesize the data from the activity on evolution by natural selection. With direction, s/he selects an appropriate format. Writing is somewhat limited, and supporting evidence may be slightly inaccurate or simplistic. The student may require assistance to develop or organize his response. Word choice and syntax are consistent with grade level. There are some errors in the conventions of Standard English in the written assignment.
<b>Does Not Meet Expectations</b>	The student requires many additional explanations, models, and/or strategies in order to complete parts of the writing process. The writing has no clear focus on the data. Ideas and concepts are often inaccurate, confusing or unorganized. Inaccurate or limited vocabulary, syntax errors, and errors in the conventions of writing make the assignment ineffective.

Names: \_\_\_\_\_ Date: \_\_\_\_\_

## **Biological Systems**

### **Diffusion Lab**

In this lab you will design your own experiment to test the permeability of polyethylene sandwich bags to starch and iodine.

**Problem statement:** Will the polyethylene membrane allow iodine to cross the membrane? Will the polyethylene membrane allow starch, a larger molecule than iodine, to cross the membrane?

**Hypothesis:**

**Materials:** (list all materials you use below)

**Procedures:** (list your procedures so specifically that someone else could repeat your experiment exactly by following your procedures alone)

**Observations:**

Initial observations:

Observations after **24** hours:

**Analysis:**

1. Did iodine molecules move through the membrane? \_\_\_\_\_

How do you know? \_\_\_\_\_

2. Did starch molecules pass through the membrane? \_\_\_\_\_

How do you know? \_\_\_\_\_

3. What can you infer from this experiment about movement of large and small molecules through a thin polyethylene membrane?

4. Does your data support your hypothesis? Explain why or why not.

Conclusions:

**Biological Systems  
Rubric for  
Gathering Information and Solving Problems  
#3**

<b>Exceeds Expectations</b>	The student will independently write a detailed, well organized, controlled reproducible procedure to solve the problem stated in the lab. (For example, How do different enzymes affect the rate of a chemical reaction?)
<b>Meets Expectations</b>	With minimal assistance the student will write a fairly well organized controlled reproducible procedure to solve the problem stated in the lab.
<b>Meets Some Expectations</b>	With some assistance the student will write a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow and it contains a control.
<b>Does Not Meet Expectations</b>	With a great deal of assistance the student writes a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow and does not contain a control.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Lab partners: \_\_\_\_\_

## Testing for Vitamin C

The recommended intake of vitamin C is 60 mg per day, which can come from different food sources. To determine the presence and the amount of vitamin C in different foods, there is a need to perform simple chemical tests. In this task, you will use a purple indicator to test for vitamin C.

### Your Task

First, you and your group will test a series of vitamin C solutions with known concentrations using the vitamin C indicator. Next, you and your lab group will design and conduct an experiment to compare the amount of vitamin C in various fruit juices. Then you will determine the concentration of vitamin C in each of the juices.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided. You may use additional materials and equipment if they are available.

**CAUTION: The vitamin C indicator will stain clothes and hands.**

### Materials

Vitamin C solution (1 mg/mL)	5 test tubes
Vitamin C indicator	Test tube rack
Apple juice	8 Plastic measuring cups
Pineapple juice	5 medicine droppers
White grape juice	Access to tap water
Graduated cylinder	Wax crayons
Paper towels for clean-up	
Safety goggles and lab apron	

### Part I: Testing a Vitamin C Solution

First, you will find out how many drops of a vitamin C solution (with a known concentration) it takes for the indicator to lose its purple color. You will investigate vitamin C solutions with varying concentrations and one solution (water) that has no vitamin C added. **The higher the concentration of vitamin C in the solution, the fewer drops it will take for the indicator to lose its purple color.**

You have been given a solution containing 1.00 milligram (mg) of vitamin C per milliliter (mL) of water.

### Procedure:

- Using the table below, create vitamin C solutions with different concentrations by mixing the 1.00 mg/mL vitamin C solution with water in plastic cups. Be sure to label the cups with the corresponding concentration.
- Add 10 drops of the purple indicator to a clean test tube.



Names: \_\_\_\_\_ Date: \_\_\_\_\_

Lab partners: \_\_\_\_\_

3. Add drops of the 1.00 mg/mL vitamin C solution, one at a time, to the test tube containing the indicator. Shake the test tube gently after adding each drop.
4. Keep adding drops of the vitamin C solution until the indicator loses its purple color. Record your results in the table below.
5. Repeat steps 2-4 using the other vitamin C solutions you created in step 1.
6. Create a line graph of your results.

Drops of 1.00 mg/mL Vitamin C Solution	Drops of Water Added	Concentration of New Vitamin C Solution (mg/mL)	Number of Drops of Vitamin C Solution Added to the Indicator
40	0	1.00	
30	10	.75	
20	20	.50	
10	30	.25	
0	40	0.00	

### Part II: Comparing the Amount of Vitamin C in Three Fruit Juices

Now you and your lab group will design and conduct an experiment to compare the amount of vitamin C in various fruit juices.

1. **In your own words, clearly state the problem you are going to investigate.** Include a clear identification of the independent and dependent variables that will be studied.
2. **Design an experiment to solve the problem.** Your experimental design should match the statement of the problem, should control for variables, and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate.
3. Write your experimental design and show your teacher your design before you begin your experiment.
4. **After receiving approval from your teacher, work with your lab group to carry out your experiment.** Your teacher's approval does not necessarily mean that your teacher thinks your experiment is well designed. It simply means that, in your teacher's judgment, your experiment is not dangerous or likely to cause an unnecessary mess.
5. **While conducting your experiment, take notes.** Include the results of your experiment. Tables, charts, and/or graphs should be used where appropriate and should be properly labeled.
6. **Use your results from Part I to determine the concentration of vitamin C in the juices tested.**

**Biological Systems  
Rubric for  
Gathering Information and Solving Problems  
#3**

<b>Exceeds Expectations</b>	The student will independently write a detailed, well organized, controlled reproducible procedure to solve the problem stated in the lab. (For example, How do different enzymes affect the rate of a chemical reaction?)
<b>Meets Expectations</b>	With minimal assistance the student will write a fairly well organized controlled reproducible procedure to solve the problem stated in the lab.
<b>Meets Some Expectations</b>	With some assistance the student will write a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow and it contains a control.
<b>Does Not Meet Expectations</b>	With a great deal of assistance the student writes a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow and does not contain a control.

## Biological Systems Scientific Method Investigation

**Problem** - How does salt water concentration affect the germination of seeds?

**Hypothesis** - Make one in your group. You might need to research seed germination using the books available or Internet resources.

### Materials

10 seeds

saltwater concentrations of 0.3%, 0.6%, 1% and 2%

paper towels for seeds in which to germinate

Each day, water will be available to moisten the paper towels containing the seeds.

Beakers if necessary

Any other materials you need can be obtained by asking the teacher

Be sure to include the parts of an experiment discussed in class and that you were quizzed on, i.e., variables, constants etc.

**Procedure** - Write a step by step procedure using numbers to solve the problem.

Make a data table to collect the data over the next 3-4 days (Time depends on room temperature and/or light.) Use good observation and measurement skills.

Investigate factors that affect seed germination.

**Biological Systems  
Rubric for  
Gathering Information and Solving Problems  
#3**

<b>Exceeds Expectations</b>	The student will independently write a detailed, well organized, controlled reproducible procedure to solve the problem stated in the lab. (For example, How do different enzymes affect the rate of a chemical reaction?)
<b>Meets Expectations</b>	With minimal assistance the student will write a fairly well organized controlled reproducible procedure to solve the problem stated in the lab.
<b>Meets Some Expectations</b>	With some assistance the student will write a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow and it contains a control.
<b>Does Not Meet Expectations</b>	With a great deal of assistance the student writes a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow and does not contain a control.

Names: \_\_\_\_\_ Date: \_\_\_\_\_

**Biological Systems**  
**Group Project**  
**Cell Structure and Function**

**Background:**

Cells are microscopic units that make up all living things. They are alive and exhibit all of the features of things. The cell is made up of many different parts and each of these parts has a role in the cell. These parts that make up a cell are called *organelles*, meaning "little organs". Without these organelles, the cell would not be able to survive.

**Assignment:**

Over the next 2-3 days, you will work in small groups to research two or three organelles. I will assign groups as well as which organelles you will be researching. Your research will include:

1. The name of the organelle
2. A description of the organelle's function *in your own words*
3. Why the organelle is important
4. Where the organelle is located in the cell
5. A citation page in MLA format

Once you have researched your organelle, you will draw a diagram of it that will be used in a large scale model of the cell made by the entire class. Once your research and drawing are complete, you will put together a presentation to teach the class about the functions of your assigned organelles. You decide how you would like to present your information. Some ideas/suggestions are PowerPoint presentations, posters, etc.

**Expectations:**

I expect that you will work as a team. One person should not be doing all the work! Your behavior and effort each class day will be graded and will become part of your final project grade. Finally, not only will you receive a grade from me, but also your group members will have a chance to evaluate your work.

**Biological Systems  
Rubric for  
Cell Structure and Function**

**2. Uses technology effectively and responsibly**

<b>Exceeds Expectations</b>	The student independently selects a currently updated and authored on-line print source related to the topic and creates a source citation page that follows correct MLA format.
<b>Meets Expectations</b>	The student needs minimal assistance selecting a currently updated and authored on-line appropriate website directly related to the topic and creates a source citation page.
<b>Meets Some Expectations</b>	The student needs assistance selecting an appropriate website directly related to the topic and needs assistance preparing the source citation page. The website might be outdated <b>and/or</b> un-authored.
<b>Does Not Meet Expectations</b>	The student cannot select an appropriate website directly related to the topic. The website is outdated <b>and</b> un-authored. The source citation page is incorrect or missing.

## Cell Project Grading Rubric

Name: \_\_\_\_\_ Organelle: \_\_\_\_\_

### Daily Points

#### Behavior in class (5 points each)

Day 1 \_\_\_\_\_

Day 2 \_\_\_\_\_

Day 3 \_\_\_\_\_

#### Effort in class (5 points each)

Day 1 \_\_\_\_\_

Day 2 \_\_\_\_\_

Day 3 \_\_\_\_\_

### What is your organelle's function and why it is important? (20 points)

\_\_\_\_\_

### Where is your organelle found in the cell? (20 points)

\_\_\_\_\_

### Diagram of your organelle (15 points)

\_\_\_\_\_

### Quality of Presentation (10 points)

\_\_\_\_\_

### Citation Page (5 points)

Benchmark: Using technology effectively

<b>Exceeds Expectations</b>	The student independently selects a currently updated and authored on-line print source related to the topic and creates a source citation page that follows correct MLA format.
<b>Meets Expectations</b>	The student needs minimal assistance selecting a currently updated and authored on-line appropriate website directly related to the topic and creates a source citation page.
<b>Meets Some Expectations</b>	The student needs assistance selecting an appropriate website directly related to the topic and needs assistance preparing the source citation page. The website might be outdated <b>and/or</b> un-authored.
<b>Does Not Meet Expectations</b>	The student cannot select an appropriate website directly related to the topic. The website is outdated <b>and</b> un-authored. The source citation page is incorrect or missing.

Total Points Possible = 100

Your Score: \_\_\_\_\_/100

Comments: \_\_\_\_\_

### Course Description

HIGH SCHOOL		
1. Course Title <b>General Biology</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>General Biology</b>		
3. Transcript Course Code/Number <b>00313</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 10    Level: 3  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester + 30days) <input checked="" type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites None		
11. Brief Course Description This introductory course will explore the basic structure and function of living things. Unicellular and multicellular forms of life will be examined as they relate to living things and the environment with emphasis on laboratory experiences. During the first trimester, a scientific method will be used to explore how living things continue to exist as part of the biospheres of the world. Emphasis will be placed on how organisms have evolved and how they have come to occupy specific places in the ecosystem. In the second trimester, major emphasis is the study of the human body and its impact on the biological world. Heredity and evolutionary concepts will be examined in relation to man.		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocols. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently <b>6. Demonstrate respect for one's self, and strive to contribute to the success of others.</b> 7. Analyze and synthesize scientific information in relation to everyday living.		



13. Course Outline Part 1: <i>Chapters taught in order of the text.</i>			
<b>Chapters Taught</b>	<b>Topics</b>	<b>Activities</b>	<b># of weeks</b>
1: Biology and You	<ul style="list-style-type: none"> <li>- Scientific Method</li> <li>- Measurement</li> <li>- Scientific tools</li> <li>- What is biology?</li> </ul>	<ul style="list-style-type: none"> <li>- <b>"A Controlled Experiment"</b> (yeast temperature lab)</li> <li>- Measurement Lab</li> <li>- Designer Airplanes Lab</li> </ul>	2
3: Chemistry of Life	<ul style="list-style-type: none"> <li>- Matter and Substances</li> <li>- Water and solutions</li> <li>- Carbon compounds</li> <li>- Enzymes</li> </ul>	<ul style="list-style-type: none"> <li>- Molecular models</li> <li>- Telltale Cabbage (pH)</li> <li>- Organic compound Lab</li> </ul>	2
4: Ecosystems	<ul style="list-style-type: none"> <li>- What is an ecosystem?</li> <li>- Energy flow in ecosystems</li> <li>- Water, Carbon, Oxygen, and Nitrogen cycles</li> </ul>	<ul style="list-style-type: none"> <li>- Field trip to Bauer Farm</li> </ul>	2
5. Populations and Communities	<ul style="list-style-type: none"> <li>- Populations</li> <li>- Interactions in Communities</li> <li>- Shaping Communities</li> </ul>	<ul style="list-style-type: none"> <li>- Population Growth (Quick Lab)</li> <li>- The Effect of Herbivores on a Plant Species (Quick Lab)</li> <li>- Yeast Population Growth Lab</li> </ul>	2
7: Cell Structure (include Ch. 8 and 9 – photosynthesis and cellular respiration)	<ul style="list-style-type: none"> <li>- Cell Theory</li> <li>- Structure and function of cell organelles</li> <li>- Overview of cell respiration and photosynthesis</li> <li>- Prokaryotes vs. Eukaryotes</li> </ul>	<ul style="list-style-type: none"> <li>- Introduction to <b>microscopes (letter "e")</b></li> <li>- Plant and Animal Cell Lab</li> <li>- Cell size and function activity</li> </ul>	3
10: Cell Growth and Division	<ul style="list-style-type: none"> <li>- Cell Cycle</li> <li>- Stages of mitosis</li> <li>- Cell cycle regulation and cancer</li> </ul>	<ul style="list-style-type: none"> <li>- Online mitosis (onion root tip, University of Arizona)</li> <li>- Cell Cycle Lab (from Visualizing Life book)</li> </ul>	4
11: Meiosis and Sexual Reproduction (sections 1 and 2)	<ul style="list-style-type: none"> <li>- Reproduction</li> <li>- Chromosome number</li> <li>- Stages of Meiosis</li> </ul>	<ul style="list-style-type: none"> <li>- Meiosis lab (with pipe cleaners)</li> <li>- Meiosis flip book</li> </ul>	2
12: Mendel and Heredity	<ul style="list-style-type: none"> <li>- <b>Mendel's experiments</b></li> <li>- Dominant and recessive alleles</li> <li>- Genotype and phenotype</li> <li>- Homozygous and heterozygous</li> <li>- Punnett Squares</li> <li>- Incomplete dominance and codominance</li> </ul>	<ul style="list-style-type: none"> <li>- Human inheritance Lab</li> <li>- Probability and dominant and recessive alleles activity (creating a human face)</li> <li>- Punnett Squares</li> </ul>	3

13: DNA, RNA, and Proteins (sections 1, 2, some of 3)	- Experiments to identify DNA - Structure of DNA - DNA replication - Gene expression and RNA (basic overview)	- DNA models (pop beads or paper helix) - DNA extractions	2
16: Evolutionary Theory	- Charles Darwin - Natural Selection - Evidence for evolution - Patterns of evolution	- Homologous structures coloring activity - Natural selection Lab	2
20. Bacteria and Viruses	- Bacteria - Viruses - Bacteria, Viruses, and Humans		2
13. Course Outline Part 2: Learning Strands taught in order of presentation.			

<b>Learning Strand</b>	<b>Chapters in Book</b>	<b>CT Standards</b>	<b>Weeks</b>
Biology and You	1	10.1	2
Chemistry of Life	3	10.1	2
Ecosystems	4	N/A	2
Population Ecology	5	10.6	2
Cells	7, parts of 8 & 9	10.2	3
Cell Growth and Cell Division	10, 11	10.3	4
DNA and Heredity	12, 13	10.4	5
Evolutionary Theory	16	10.5	2
Bacteria and Viruses	20	10.2	2
Microorganisms	20	10.3	2
14. Instructional Methods and/or Strategies <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Laboratory investigations</li> <li>▪ Teacher demonstrations</li> <li>▪ Cooperative grouping</li> <li>▪ Audio Visual presentations</li> <li>▪ Response Cards by TurningTechnologies</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> </ul>			

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>Content Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>How do you communicate your findings, using relevant scientific vocabulary and clear logic, that are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>
<ul style="list-style-type: none"> <li>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</li> <li>Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>Apply both precision and accuracy in recording experimental data.</li> <li>Develop logical conclusions that are based on the analysis of experimental data.</li> <li>Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<b>Biology</b> , Holt Rinehart Winston, 2008 <ul style="list-style-type: none"> <li>Laboratory instrumentation</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b>
	<ul style="list-style-type: none"> <li>Modeling during lectured instruction</li> <li>Inquiry investigation</li> <li>Textbook ancillary materials</li> <li>Guided Internet research</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b>
	<ul style="list-style-type: none"> <li>Scientific Method Practice worksheets</li> <li>CAPT embedded, open ended lab investigations</li> <li><b>"A Controlled Experiment"</b> (yeast temperature lab)</li> <li>Measurement Lab</li> <li>Designer Airplanes Lab</li> <li>UV Beads Lab</li> </ul>

<b>LEARNING STRAND</b> <b>Biology and You</b> <i>CT Content Standard 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Biology is the study of life.</li> <li>▪ There are many branches of biology including biochemistry, botany, cell biology, ecology, evolutionary theory, genetics, microbiology, physiology, and zoology.</li> <li>▪ All living things share seven properties of life (cellular organization, homeostasis, metabolism, responsiveness, reproduction, heredity, and growth).</li> <li>▪ Recognize how homeostasis plays a role in the maintenance of living systems.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What is biology?</li> <li>▪ <b>How are all of Earth’s organisms tied together</b> by common traits?</li> <li>▪ <b>How do all of Earth’s organisms rely on one</b> another for their survival?</li> <li>▪ What are the seven properties of life?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>
<ul style="list-style-type: none"> <li>▪ Define biology.</li> <li>▪ Describe the various branches of biology.</li> <li>▪ Identify and define the seven properties of life.</li> </ul>	<u>Biology</u> , Holt Rinehart Winston, 2008 <ul style="list-style-type: none"> <li>▪ PowerPoint presentation</li> <li>▪ Internet access</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Lecture enhanced by PowerPoint presentations</li> <li>▪ Have students relate five of the characteristics of life to an organism of their choice.</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Poster illustrating the seven features of life</li> <li>▪ Directed Reading worksheets</li> <li>▪ Active Reading worksheets</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Chemistry of Life</b>  <i>CT Content Standard 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell. Most of the chemical activities of the cell are catalyzed by enzymes that function only in a narrow range of temperature and acidity.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ All living and nonliving things are made of matter.</li> <li>▪ Matter is composed of atoms that bond together to make molecules.</li> <li>▪ Without the unique properties of water, life as we know it could not exist.</li> <li>▪ Living things are complex systems of interacting and evolving chemical, physical and biological processes.</li> <li>▪ Energy provides the ability to do work.</li> <li>▪ Energy is required by all living things to carry out life processes.</li> <li>▪ Proteins, carbohydrates, lipids and nucleic acids are the fundamental organic groups found in living things.</li> <li>▪ Enzymes decrease the amount of energy needed for reactions to occur in living systems.</li> <li>▪ DNA is responsible for storing the information needed for cell reproduction and survival.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How is water unique and how do substances dissolved in water affect its properties?</li> <li>▪ How do living things use energy?</li> <li>▪ What chemical processes occur in living things? How do they happen?</li> <li>▪ How are enzymes important in the chemical reaction of living systems?</li> <li>▪ What are the fundamental types of organic molecules found in living things? How are they used?</li> <li>▪ Why is DNA a critical component to modern biology?</li> <li>▪ What is the relationship between DNA, proteins and traits?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Distinguish between elements and compounds.</li> <li>▪ Describe the difference between covalent and ionic bonding.</li> <li>▪ Analyze how macromolecules are broken down into monomers for energy and other life processes.</li> <li>▪ Identify the function of the main nutrients needed by living things.</li> <li>▪ Identify the structure of DNA.</li> <li>▪ Describe how enzymes increase the speed of biochemical reactions.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Biology</u>, Holt Rinehart Winston, 2008</p> <ul style="list-style-type: none"> <li>▪ Items to represent elements</li> <li>▪ Molecular models</li> <li>▪ Food samples (simple sugar, starch, protein)</li> <li>▪ Indicators (iodine, methylene blue, etc.)</li> <li>▪ <a href="http://www.accessexcellence.org/">http://www.accessexcellence.org/</a> (Access Excellence)</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Molecular modeling</li> <li>▪ Telltale Cabbage (pH)</li> <li>▪ Organic Compound Lab</li> <li>▪ Concept mapping</li> <li>▪ Directed Reading</li> <li>▪ Active Reading</li> <li>▪ Demonstrations</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Concept map/web of molecules of life, elements of which they are composed, descriptions of monomers and polymers and their functions</li> <li>▪ Telltale Cabbage Lab conclusion (Benchmark)</li> <li>▪ Oral and written observations</li> <li>▪ Molecular Models – check for understanding</li> </ul>

<b>LEARNING STRAND</b> <b>Ecosystems</b> <i>CT Content Standard – Ecology: Stability in an ecosystem is a balance between competing effects.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The current state of any environment is maintained by the dynamic exchange of the processes that dictate its nature. Changes in any of the interacting processes will impact the current state (for better or worse).</li> <li>▪ Energy drives systems and cycles in our universe.</li> <li>▪ The elements of living things take many forms.</li> <li>▪ Structural and behavioral characteristics help an organism to survive in its environment.</li> <li>▪ Diverse habitats provide <b>the “needs of life”</b> for a variety of organisms.</li> <li>▪ The cycling of matter and the flow of energy are required for the functioning of ecosystems.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do matter and energy move through biospheres?</li> <li>▪ What relationships exist between living things?</li> <li>▪ How do structures differ among living things?</li> <li>▪ How is structure related to function?</li> <li>▪ How do ecosystems change over time?</li> <li>▪ How have human activities effected the environment?</li> <li>▪ <b>What needs are met by an organism’s surroundings?</b></li> <li>▪ What energy roles do organisms play in an ecosystem?</li> <li>▪ How are living things linked to each other and their environment?</li> <li>▪ How do human activities impact and alter the environment?</li> <li>▪ How can we conserve and protect our environment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Relate the availability of resources to growth/decline of populations.</li> <li>▪ Demonstrate the flow of energy in an ecosystem.</li> <li>▪ Examine the ways in which populations within communities interact.</li> <li>▪ Examine the carbon, nitrogen, oxygen, and water cycles.</li> <li>▪ Describe how structural and behavioral adaptations increase organisms' chances for survival in their environment.</li> <li>▪ Explain the importance of biodiversity.</li> <li>▪ Distinguish between the major terrestrial biomes.</li> <li>▪ Analyze human impact on ecosystems.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Biology</u> , Holt Rinehart Winston, 2008 <ul style="list-style-type: none"> <li>▪ Nets, buckets, etc.</li> <li>▪ Models</li> <li>▪ Predator-prey game materials</li> <li>▪ Books on Connecticut ecology and environmental law</li> <li>▪ Planet Earth DVD</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Field trip to Bauer Farm/nature walk</li> <li>▪ Cooperative group activities</li> <li>▪ Ecosystems demonstrations</li> <li>▪ Construct energy pyramids and food webs</li> <li>▪ Stream, pond or wetland field studies</li> <li>▪ Observations of biotic, abiotic and relationships between organisms</li> <li>▪ Research and present an environmental issue and its impact on the living ecosystem or on endangered species.</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Observations of field studies</li> <li>▪ Lab reports</li> <li>▪ Summary of article for class discussion</li> <li>▪ Test/quizzes</li> <li>▪ Research projects and presentations</li> <li>▪ Energy flow diagrams</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Population Ecology: Populations and Communities</b>  <i>CT Content Standard 10.6 – Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.</i>  <i>Human populations grow due to advances in agriculture, medicine, construction and the use of energy.</i>  <i>Humans modify ecosystems as a result of rapid population growth, use of technology and consumption of resources.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Population size is affected by many factors, including environmental factors.</li> <li>▪ Technological advances have effected human population growth and size.</li> <li>▪ The rapid increase in human population size has effected the environment.</li> <li>▪ Interactions between organisms are the basis of communities and are shaped by evolution.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are the factors that affect the size of a population?</li> <li>▪ How can population graphs be analyzed to explain population growth?</li> <li>▪ How have technological advances affected human population growth and size?</li> <li>▪ What are types of interactions between organisms in a community?</li> <li>▪ How does competition for resources affect species in a community?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Identify biotic and abiotic factors that determine the carrying capacity of an environment.</li> <li>▪ Describe the parts of an exponential growth curve.</li> <li>▪ Name and describe some technological advances that have affected human population growth and size.</li> <li>▪ Compare and contrast the various interactions that take place within a community.</li> <li>▪ Describe the results of competition among organisms in a community.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Biology</u>, Holt Rinehart Winston, 2008</p> <ul style="list-style-type: none"> <li>▪ Articles on human population and its effects</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Human Populations Dynamics STS</li> <li>▪ Yeast Population Dynamics embedded task</li> <li>▪ Labs – population, predator-prey</li> <li>▪ Discuss examples of feeding relationships and symbiotic relationships that exist in a chosen ecosystem.</li> <li>▪ The Effect of Herbivores on a Plant Species Lab</li> <li>▪ Population Growth Lab</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Test/quizzes</li> <li>▪ Lab reports</li> <li>▪ Projects</li> <li>▪ Presentations</li> <li>▪ Creating &amp; interpreting graphs – Population growth</li> </ul>



<p><b>LEARNING STRAND</b>  <b>Cells: Cell Structure</b>  <i>CT Content Standard 10.3 – Fundamental life processes depend on the physical structure and the chemical activities of the cell. Most of the chemical activities of the cell are catalyzed by enzymes that function only in a narrow range of temperature and acidity conditions.</i>  <i>The cellular processes of photosynthesis and respiration involve transformation of matter and energy.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Cells are the basic units of life.</li> <li>▪ Complex living things are organized in different levels.</li> <li>▪ Living things are complex systems of interacting and evolving chemical, physical and biological processes.</li> <li>▪ Change in any interacting process will impact cells/living things.</li> <li>▪ Cells/living things have optimal ranges for different environmental conditions in which they perform life processes.</li> <li>▪ The cell membrane regulates movement of substances in and out of a cell based on their size and chemical charge.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How do (cell) structures differ among living things?</li> <li>▪ How is structure related to function?</li> <li>▪ How is the cell membrane organized?</li> <li>▪ How does the cell membrane control movement of substances into and out of the cell?</li> <li>▪ How do environmental factors affect living things?</li> <li>▪ How are cells organized in complex multicellular organisms?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Relate the structure and function of cellular organelles to the overall performance of the cell and therefore the organism.</li> <li>▪ Analyze how materials move in and out of cells.</li> <li>▪ Differentiate between plant and animal cells.</li> <li>▪ Differentiate between prokaryotic and eukaryotic cells.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Biology</u>, Holt Rinehart Winston, 2008</p> <ul style="list-style-type: none"> <li>▪ Cell models</li> <li>▪ Prepared slides – mitosis, plant, animal, etc.</li> <li>▪ Play-Doh</li> <li>▪ Assignment Discovery: The Cell DVD</li> <li>▪ Microscopes</li> <li>▪ Internet for selected websites</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Microscope work</li> <li>▪ Cooperative group activities</li> <li>▪ Diagrams</li> <li>▪ Research projects</li> <li>▪ Directed Reading</li> <li>▪ Active Reading</li> <li>▪ Demonstrations</li> <li>▪ Venn Diagrams</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Tests and quizzes</li> <li>▪ <b>Microscope Labs (letter “e”, Plant and Animal Cells)</b></li> <li>▪ Research Project grades with rubric</li> <li>▪ Structure and Function of Organelles (Benchmark)</li> <li>▪ Class participation</li> <li>▪ Plant and Animal Cell diagrams</li> <li>▪ Cell City Activity</li> </ul>

<b>LEARNING STRAND</b> <b>Cell Growth and Cell Division: Meiosis and Sexual Reproduction</b> <i>CT Content Standard 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell. Most of the chemical activities of the cell are catalyzed by enzymes that function only in a narrow range of temperature and acidity.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Cells divide to produce other cells.</li> <li>▪ DNA directs cell division.</li> <li>▪ Cells go through a cell cycle to ensure new cells are identical to the old cells.</li> <li>▪ Cell growth, division, and the cell cycle are highly regulated by protein and environmental signals.</li> <li>▪ Cancer is caused by uncontrolled cell growth.</li> <li>▪ Understanding how to control cell growth may be the key to curing cancer.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ Why do cells divide?</li> <li>▪ How do cells prepare for cell division?</li> <li>▪ How do cells divide to produce more cells?</li> <li>▪ What are some of the factors that control cell growth and division?</li> <li>▪ How do feedback signals relate to the cell cycle?</li> <li>▪ How does cancer relate to the cell cycle?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Describe the stages of the cell cycle.</li> <li>▪ Identify and describe the phases of mitosis.</li> <li>▪ Describe the role of DNA in cell division.</li> <li>▪ Describe how cell division is regulated.</li> <li>▪ Explain the importance of learning how to control cell growth.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Biology</u> , Holt Rinehart Winston, 2008 <ul style="list-style-type: none"> <li>▪ Internet for selected websites</li> <li>▪ Prepared slides</li> <li>▪ Models of the stages of mitosis</li> <li>▪ Wiki sticks</li> <li>▪ Video: Ultimate Discovery: Human Body</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Cell Cycle Lab (from Visualizing Life book)</li> <li>▪ Mitosis in Plant Cells Lab</li> <li>▪ Online Mitosis (Onion root tips from University of AZ)</li> <li>▪ Visuals – video clips, diagrams, drawings</li> <li>▪ Active Reading</li> <li>▪ Directed Reading</li> <li>▪ Cancer websites</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Internet Activities (Cell Cycle, Mitosis drawings and descriptions and Onion Root Tips)</li> <li>▪ Phases of Mitosis cut out activity</li> <li>▪ Phases of Mitosis drawings</li> <li>▪ Tests and quizzes</li> <li>▪ Class participation</li> <li>▪ Phases of Mitosis modeling (with Wiki Sticks)</li> </ul>

<b>LEARNING STRAND</b> <b>DNA and Heredity</b> <i>CT Content Standard 10.3 – Similarities in the chemical and structural properties of DNA in all living organisms allow the transfer of genes from one organism to another.</i> <i>CT Content Standard 10.4 – In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.</i> <i>Genetic information is stored in genes that are located on chromosomes inside the cell nucleus.</i> <i>Changes in the environment may result in the selection of organisms that are better able to survive and reproduce.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ There is a process of inheriting traits from parents to offspring through genes.</li> <li>▪ Meiosis allows genetic information from two parents to combine and form offspring that are different from both parents.</li> <li>▪ Sexual reproduction increases variation in offspring.</li> <li>▪ Modern genetics is based on the work of Mendel and his explanations of heredity.</li> <li>▪ Predictions can be made using Punnett squares, pedigree or other methods to determine frequencies of genotypes and/or phenotypes in offspring.</li> <li>▪ Genetic mutations can be harmful and cause genetic disorders or they can be beneficial and offer advantages to organisms.</li> <li>▪ DNA is the blueprint from which all living things are made.</li> <li>▪ Traits are determined by proteins that are built according to instructions coded in DNA.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What are the stages of meiosis?</li> <li>▪ How are mitosis and meiosis similar? How are they different?</li> <li>▪ How are characteristics of living things passed on through generations?</li> <li>▪ How is information organized in a DNA molecule?</li> <li>▪ <b>How does Mendel’s work explain the simple patterns of heredity in pea plants?</b></li> <li>▪ How can Punnett squares and pedigrees be used to determine genotypic and phenotypic frequencies of offspring?</li> <li>▪ How does the process of meiosis and sexual reproduction affect the variation of offspring?</li> <li>▪ How do heredity and the environment interact to influence phenotype?</li> <li>▪ How are genetic disorders different from infectious diseases?</li> <li>▪ What is the shape of a DNA molecule?</li> <li>▪ What is the process of gene expression?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Compare sexual and asexual reproduction.</li> <li>▪ Describe the stages of meiosis.</li> <li>▪ <b>Describe Mendel’s Theory</b> and how it explains simple patterns of inheritance.</li> <li>▪ Apply the Punnett Squares to solve genetic problems.</li> <li>▪ Explain how events that occur during meiosis contribute to genetic variation and/or mutations.</li> <li>▪ Deduce the probable mode of inheritance of traits from pedigree diagrams showing phenotypes.</li> <li>▪ Compare and contrast genetic disorders and infectious diseases.</li> <li>▪ Describe the shape of DNA molecule.</li> <li>▪ Explain the major steps of DNA replication and why this process is important.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Biology</u> , Holt Rinehart Winston, 2008 <ul style="list-style-type: none"> <li>▪ DNA model or craft materials or pop beads to create a model</li> <li>▪ Clay (for meiosis modeling)</li> <li>▪ Meiosis video (from United Streaming)</li> <li>▪ Assignment Discovery Genetics (DVD)</li> <li>▪ Internet for selected websites</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Visuals (DVDs, video clips, animations, drawings)</li> <li>▪ Modeling – phases of meiosis with clay</li> <li>▪ Active Reading</li> <li>▪ Directed Reading</li> <li>▪ Sequencing Skills – phases of meiosis</li> <li>▪ PowerPoints – <b>Mendel’s experiments</b></li> <li>▪ Human inheritance lab</li> <li>▪ Probability and dominant and recessive alleles activity (creating a human face)</li> <li>▪ Punnett Squares</li> <li>▪ DNA models (pop beads or paper helix)</li> <li>▪ Genetic disorder research project</li> <li>▪ Labs – Blood typing – prepared slides or simulated lab</li> </ul>

	<ul style="list-style-type: none"><li>▪ Concept mapping</li></ul> <hr/> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"><li>▪ Quiz on Meiosis video</li><li>▪ Presentations – Genetic disorders project</li><li>▪ Tests and quizzes</li><li>▪ Class participation</li><li>▪ Genetic problems (probability and Punnett Squares)</li><li>▪ Teacher observations of drawings, meiosis modeling with clay, DNA pop beads</li><li>▪ Lab analysis questions (Blood Typing)</li></ul>
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<p><b>LEARNING STRAND</b>  <b>Evolutionary Theory</b>  <i>CT Content Standard 10.5 – Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.</i>  <i>Mutations and recombination of genes create genetic variability in populations.</i>  <i>Changes in the environment may result in the selection of organisms that are better able to survive and reproduce.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Many aspects of biology are explained by evolutionary theory.</li> <li>▪ Adaptation is any structural or behavioral changes in a species that takes place over time and helps the species to survive in its habitat.</li> <li>▪ Structural and behavioral characteristics help an organism to survive in its environment.</li> <li>▪ Changes in the environment may result in the selection of organisms that are better able to survive and reproduce.</li> <li>▪ There is evidence that supports the theory of evolution including fossil evidence, anatomical evidence, and DNA evidence.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is evolution by natural selection?</li> <li>▪ How do species become more diverse?</li> <li>▪ How do some species survive environmental changes while others do not?</li> <li>▪ How do species become extinct?</li> <li>▪ What evidence is used to support the Theory of Evolution, including the fossil record?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Explain how Darwin developed this theory of evolution from his experiences.</li> <li>▪ Describe the steps of natural selection as a mechanism for evolution.</li> <li>▪ Examine how mutations and adaptations apply <b>to Darwin’s theory of natural selection.</b></li> <li>▪ Explain how the many pieces of evidence scientists have discovered supports the theory of evolution.</li> <li>▪ Explain how new species arise as a result of evolution.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Biology</u>, Holt Rinehart Winston, 2008  Internet for selected websites  Materials for jelly bellicus (jelly beans, boxes, wood shavings)</p> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Cooperative group activities to illustrate natural selection– Jelly Bellicus</li> <li>▪ Peppered Moth internet activity</li> <li>▪ Create simulated model/poster of natural selection principles.</li> <li>▪ Active Reading</li> <li>▪ Directed Reading</li> <li>▪ Visuals - Homologous structures coloring activity, skeletons, PowerPoint pictures and diagrams</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Lab analysis questions – Jelly Bellicus, peppered moth internet activity</li> <li>▪ Presentations</li> <li>▪ Tests and quizzes</li> <li>▪ Class participation</li> <li>▪ Homologous structures coloring activity</li> <li>▪ Teacher observations</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Microorganisms: Bacteria and Viruses</b>  <i>CT Content Standard 10.2 – Microorganisms have an essential role in life processes and cycles on Earth. Understanding the growth and spread patterns of viruses and bacteria enables the development of methods to prevent and treat infectious diseases.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Microorganisms play an essential role in life processes and cycles on Earth.</li> <li>▪ Understanding the growth and spread patterns of bacteria and viruses enables the development of methods to prevent and treat infectious diseases.</li> <li>▪ Bacteria and viruses have a large impact on humans, from benefiting the environment to causing disease.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are the differences between bacteria and viruses?</li> <li>▪ How are bacteria and viruses both helpful and harmful to humans?</li> <li>▪ How can humans prevent and treat infectious diseases?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Compare and contrast the differences in structure of bacteria and viruses.</li> <li>▪ Compare and contrast the differences in the life cycles of bacteria and viruses.</li> <li>▪ Describe how infectious diseases are transmitted to humans by bacteria, viruses and other microorganisms.</li> <li>▪ Describe the roles of bacteria and viruses in the environment, industry, and research.</li> <li>▪ Examine the role of sanitation, vaccination, and antibiotic medications in the prevention and treatment of infectious diseases.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Biology</u>, Holt Rinehart Winston, 2008  Internet for selected websites</p> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Research and present infectious diseases (symptoms, vectors, treatments. Etc.)</li> <li>▪ Debate and explain the rationale <b>behind the “over prescribed” use of antibiotics.</b></li> <li>▪ Guest speaker – microbiologist, epidemiologist, lab technician, etc.</li> <li>▪ Read and summarize articles on related current issues of disease.</li> <li>▪ Lab activity – grow bacterial cultures, look at the effect of antibiotics on bacterial growth</li> <li>▪ Web quests</li> <li>▪ Venn diagrams (viruses vs. bacteria)</li> <li>▪ Visuals – posters, animations</li> <li>▪ Demonstrations</li> <li>▪ Active Reading</li> <li>▪ Directed Reading</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Posters (comparison of structures and life cycles of bacteria and viruses)</li> <li>▪ Tests and quizzes</li> <li>▪ Lab reports – growing bacteria</li> <li>▪ Projects and presentations – research on infectious diseases</li> <li>▪ Article summaries</li> <li>▪ Class participation</li> <li>▪ Debate – overuse of antibiotics</li> </ul>

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

Quick Lab

## Telltale Cabbage

Red cabbage contains a natural indicator that can be used to identify how acidic or basic a solution is.

### Procedure

1. Cut up a cabbage leaf into very tiny clippings by using scissors.
2. Put on safety goggles. Place the clippings in a beaker of warm water. Swirl the mixture. Wait several minutes until the water changes color.
3. Add several drops of lemon juice. Note any changes in appearance.
4. Add about 1/4 tsp of baking soda. Note any changes in appearance. Continue adding small amounts of baking soda, and observe-additional color changes.

### Analysis

1. **Describe** what happened when the leaf clippings were placed in warm water.

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2. **Describe** what happened when lemon juice (an acid) was added to the indicator solution.

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3. **Describe** what happened when the baking soda was added to the acidic solution.

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4. **Critical Thinking Inferring Relationships** from your observations, what do you think caused the reaction. when the baking soda and acidic solution were combined? \_\_\_\_\_

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**General Biology**  
**Telltale Cabbage Lab - using data to write a conclusion**

**1 B. Writing Effectively**

<b>Exceeds Expectations</b>	The student uses supporting evidence and data from the lab to write a well developed and organized conclusion. Word choice and syntax are accurate and appropriate. The student shows mastery in the conventions of Standard English.
<b>Meets Expectations</b>	The student uses some supporting evidence and from the lab to write a fairly well developed and organized conclusion. Word choice and syntax are accurate and appropriate. Errors in the conventions of Standard English are few.
<b>Meets Some Expectations</b>	The student uses supporting evidence and data which may be inaccurate, simplistic, and/or confused to write the lab conclusion. The student may require assistance to develop or organize his/her response. Word choice and syntax are consistent with grade level. There are some errors in the conventions of Standard English.
<b>Does Not Meet Expectations</b>	The student misinterprets significant evidence and data in the lab, selecting an inappropriate format. The student requires many additional explanations, models, and/or strategies in order to complete parts of the process. The writing has no clear focus. Ideas and concepts are often unorganized or inaccurate. Inaccurate or limited vocabulary, syntax errors, and errors in the conventions of writing make the writing ineffective.

Name \_\_\_\_\_ Date \_\_\_\_\_

## **Research Project Cell Structure and Function**

### **Background:**

Cells are microscopic units that make up all living things. They are alive and exhibit all of the features of living things. The cell is made up of many different parts and each of these parts has a role in the cell. These parts that make up a cell are called **organelles**, meaning "little organs". Without these organelles, the cell would not be able to survive.

### **Your Assignment:**

Over the next 2-3 days, you will research an assigned organelle and then create a PowerPoint presentation to teach the class about your organelle. Your PowerPoint presentation should include:

- A minimum of 5 slides
- A unique slide design
- Animation
- The name of the organelle
- A description of the organelle (what it looks like, what it's made of, etc.)
- An explanation of the organelle's function *in your own words*.
- Where the organelle is located in the cell
- A picture of the organelle
- A list of the resources you used cited in MLA Format

### **Expectations:**

I expect that everyone will create a PowerPoint presentation. Your behavior and effort each class day will be graded and will become part of your final project grade. This includes the day of the presentations. I expect that you will listen quietly to your classmates' presentations, ask questions when appropriate, and take notes. Finally, not only will you receive a grade from me, but your classmates will also have a chance to evaluate your presentation.

Name \_\_\_\_\_ Date \_\_\_\_\_

**Cell Project Grading Rubric**

<b>Criteria</b>	<b>Points Possible</b>	<b>Points Earned</b>
Behavior in Class		
Day 1	4	
Day 2	4	
Day 3	4	
Effort in Class		
Day 1	4	
Day 2	4	
Day 3	4	
Minimum of 5 slides	2	
Unique slide design	2	
Animation	2	
Name of organelle is included in presentation and spelled correctly	5	
Description of organelle is accurate and complete	15	
Explanation of function is accurate and complete	20	
Location of organelle is accurate	10	
Picture of organelle	5	
Sources are current, authored, and cited in MLA format	5	
Class evaluation	10	
Total	100	

Teacher Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**General Biology**  
**Cell Organelle Research Project**

**2. Uses technology effectively and responsibly**

<b>Exceeds Expectations</b>	The student independently selects a currently updated and authored websites directly related to the research project.
<b>Meets Expectations</b>	The student needs minimal assistance selecting an appropriate website directly related to the research project. The website may be outdated <b>or</b> un-authored
<b>Meets Some Expectations</b>	The student needs some assistance selecting an appropriate website directly related to the research project. The website is outdated <b>and/or</b> un-authored.
<b>Does Not Meet Expectations</b>	The student cannot select an appropriate website directly related to the research project. The website is outdated <b>and</b> un-authored.

Name \_\_\_\_\_ Date \_\_\_\_\_

## A Controlled Experiment Yeast Lab

The control is an important part of any scientific experiment. The control is the part of the experiment that remains unchanged throughout the experiment. It serves as a basis for comparison with any variable that you may introduce .

**PROBLEM:** Test the effect of temperature on the **metabolic** activity of yeast cells.

**HYPOTHESIS:** Create a hypothesis before proceeding.

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**MATERIALS:** Listed below are the materials that will be supplied to your group. If you think you will need something that is not provided, please ask. The teacher will make available additional materials if possible.

Test tubes (3)  
Test tube rack  
Beaker (3)  
Thermometer  
Marker  
Graduated cylinder  
Yeast culture (25 ml)  
Eyedropper  
Room temperature water (21° - 23°C)  
Warm water (30° - 35°C)  
Stopwatch  
Metric ruler

**PROCEDURE:** In groups of two you will design an experiment to test the metabolic activity of yeast. You will then carry out the experiment with your lab partner.

Note: It will take at least 15 minutes for the yeast to become active.



**ANALYSIS QUESTIONS**

1. In the lab that you have just completed, describe the things that are considered the constants.

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

2. Describe the control in this lab. \_\_\_\_\_

\_\_\_\_\_

3. Describe the independent variable in this lab. \_\_\_\_\_

\_\_\_\_\_

4. Describe the dependent variable in this lab. \_\_\_\_\_

\_\_\_\_\_

5. What can you conclude about the effects of temperature on the activity of yeast cells? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

6. Why does a good experiment only have one independent variable? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

7. In this lab we examined how higher temperatures affected the activity of yeast cells. Describe how you would set up an experiment to determine how colder temperatures effect the activity of yeast cells.

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**TABLE 1: TEAM DATA**

Temperature of Yeast Solution	Height at Start (mm)	Solution Height at Finish (mm)	Change in Height (mm)

**TABLE\2: CLASS DATA**

Team Number	Change in Height (mm)
1	
2	
3	
4	
5	
6	



**General Biology**  
**Yeast Lab - Writing a Procedure**

**3. Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems**

<b>Exceeds Expectations</b>	The student independently writes a detailed, well organized, controlled, and reproducible procedure to solve the problem stated in the lab. (For example, What is the effect of temperature on the metabolic activity of yeast cells?)
<b>Meets Expectations</b>	With a minimal assistance the student writes a fairly well organized, controlled, and reproducible procedure to solve the problem stated in the lab.
<b>Meets Some Expectations</b>	With some assistance, the student will write a procedure to solve the problem stated in the lab. The procedure is not well organized, confusing to follow, but does contain a control.
<b>Does Not Meet Expectations</b>	With a great deal of assistance the student writes a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow and does not contain a control.

### Course Description

HIGH SCHOOL		
1. Course Title <b>Human Biology</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Human Biology</b>		
3. Transcript Course Code/Number <b>00320</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 10 – 12      Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
	8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input checked="" type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____	
	9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)	
10. Pre-Requisite Successful completion of Biological Systems		
11. Brief Course Description Students will study the structure and function of each major system in the human body. Particular emphasis is placed on understanding how <b>the "well" body functions</b> to better understand the body when it becomes ill and requires the skills of the health care professional. Substantial time will be spent studying the disease process as it relates to the different body systems. Dissection of a fetal pig is included in this course in order to give students first hand experience with the various organs associated with the body systems. (Alternative assignments are available.)		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Use technology effectively and responsibly. 3. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 4. <b>Demonstrate respect for one's self, and strive to contribute to the success of others.</b> 5. Understand how the Human Body works in a healthy and diseased state. 6. Read articles in newspapers and popular journals with adequate understanding for topics of Human Biology.		

13. Course Outline: (2 Trimesters)		
Unit/Chapter	Topics / Activities	# of Weeks
<b>UNIT 1</b> Organization of the Human Body – An Introduction to Human Biology	<ul style="list-style-type: none"> <li>▪ Overview of body systems</li> <li>▪ Interconnected nature of the body systems               <ul style="list-style-type: none"> <li>- Activity: Asian Tsunami Dominoes</li> </ul> </li> <li>▪ Planes of division               <ul style="list-style-type: none"> <li>- Activity: Play-doh animal sections</li> </ul> </li> <li>▪ Metric system review</li> </ul>	1
Biochemistry	<ul style="list-style-type: none"> <li>▪ Atoms, elements, molecules, compounds</li> <li>▪ Organization of the periodic table</li> <li>▪ Atomic structure</li> <li>▪ Acids, bases, and pH               <ul style="list-style-type: none"> <li>- Lab: Find the pH of common household solutions</li> </ul> </li> </ul> <p><b>Test: Organization of the Human Body and Biochemistry</b></p>	3 Days
Cells and Their Function	<ul style="list-style-type: none"> <li>▪ Cells, organelles, and mitosis</li> <li>▪ Cell transport, diffusion, osmosis, and tissues               <ul style="list-style-type: none"> <li>- Activity: Gummy bear diffusion/osmosis</li> </ul> </li> <li>▪ Cancer               <ul style="list-style-type: none"> <li>- Research project: oral PowerPoint presentation (Benchmark)</li> <li>- Video: Cancer Warriors</li> </ul> </li> </ul>	2
<b>UNIT 2</b> Nervous System	<ul style="list-style-type: none"> <li>▪ Video: Human Body – Pushing the Limits: Sensations</li> <li>▪ Organization of the nervous system, nerve cells, nerve impulses, reflexes, and reaction time               <ul style="list-style-type: none"> <li>- Lab: Card sorting reaction time lab</li> <li>- Lab: Card sorting reaction time inquiry lab</li> </ul> </li> <li>▪ Structure of the spinal cord and spinal cord disorders</li> <li>▪ Structure and function of the brain               <ul style="list-style-type: none"> <li>- Video: Human Body – Pushing the Limits: Brain Power</li> </ul> </li> </ul> <p><b>Quiz: Organization of the Nervous System and Spinal Cord</b></p> <ul style="list-style-type: none"> <li>▪ Activity: Nerve and brain poster</li> <li>▪ Lab: Fetal pig nervous system dissection               <ul style="list-style-type: none"> <li>- Dissection journal</li> </ul> </li> </ul>	2
Nervous System – Senses	<ul style="list-style-type: none"> <li>▪ Sight               <ul style="list-style-type: none"> <li>- Video: Human Body – Pushing the Limits: Sight</li> </ul> </li> <li>▪ Hearing and smell               <ul style="list-style-type: none"> <li>- Lab: Olfactory fatigue lab</li> <li>- Lab: Olfactory fatigue with coffee beans inquiry lab</li> </ul> </li> </ul> <p><b>Test: The Nervous System</b></p>	1
Endocrine System	<ul style="list-style-type: none"> <li>▪ Introduction to the endocrine system, hormones, receptors, and target cells.</li> <li>▪ Endocrine glands and disorders               <ul style="list-style-type: none"> <li>- Research project: Endocrine gland and disorder poster (Benchmark)</li> <li>- Activity: Endocrine poster scavenger hunt</li> </ul> </li> </ul>	1.5
<b>UNIT 3</b> Circulatory System – The Heart	<ul style="list-style-type: none"> <li>▪ Anatomy of the heart               <ul style="list-style-type: none"> <li>- Demonstration: Cow heart dissection</li> <li>- Activity: Heart tissue microscopy</li> <li>- Lab: Fetal pig circulatory system dissection</li> </ul> </li> <li>▪ Heart physiology               <ul style="list-style-type: none"> <li>- Activity: Taking pulse and blood pressure (resting and active)</li> <li>- Lab/Activity: ECG/EKG</li> </ul> </li> </ul>	2

	<ul style="list-style-type: none"> <li>▪ Heart disease and prevention <ul style="list-style-type: none"> <li>- Video: The Mysterious Human Heart - The Silent Killer</li> </ul> </li> <li>▪ Heart disease treatments <ul style="list-style-type: none"> <li>- Activity: Online virtual heart transplant (maybe)</li> <li>- Video: The Mysterious Human Heart - The Spark of Life</li> </ul> </li> </ul>	
<b>Midterm Exam</b>		
Blood	<ul style="list-style-type: none"> <li>▪ Functions of the blood</li> <li>▪ Blood constituents <ul style="list-style-type: none"> <li>- Lab: Microscopy – red and white blood cells</li> </ul> </li> <li>▪ Blood types <ul style="list-style-type: none"> <li>- Lab: “Who Trashed My Locker?!” (blood typing)</li> </ul> </li> <li>▪ Blood genetics</li> <li>▪ Counting blood cells <ul style="list-style-type: none"> <li>- Lab: Hemocytometers</li> </ul> </li> </ul>	2
Respiratory System	<ul style="list-style-type: none"> <li>▪ Anatomy of the respiratory system</li> <li>▪ Physiology of the respiratory system <ul style="list-style-type: none"> <li>- Lab: Lung capacity</li> <li>- Activity: Build-a-Lung</li> </ul> </li> <li>▪ Regulation of breathing <ul style="list-style-type: none"> <li>- Lab: Human respiration (LoggerPro)</li> </ul> </li> </ul> <p><b>Test: The Respiratory System</b></p>	2
	<b>Test: The Blood</b>	
<b>UNIT 4</b> Immune System	<ul style="list-style-type: none"> <li>▪ Bacteria and Viruses <ul style="list-style-type: none"> <li>- Structure</li> <li>- Reproductive cycles</li> <li>- Activity: Bacteria and Virus Poster</li> <li>- Lab: “Bacteria Everywhere!”</li> <li>- Movie: “Influenza 1918”</li> </ul> </li> <li><b>Quiz: Bacteria and Viruses</b></li> <li>▪ Immune System <ul style="list-style-type: none"> <li>- Components</li> <li>- How the immune system works</li> <li>- Activity: “Operation Antibody”</li> <li>- Movie: “Inside Look at the Flu”</li> </ul> </li> <li>▪ Vaccines and Antibiotics</li> </ul> <p><b>Test: The Immune System</b></p>	4
Digestive System	<ul style="list-style-type: none"> <li>▪ Anatomy and physiology of the digestive system <ul style="list-style-type: none"> <li>- Lab: Digestive system dissection</li> <li>- Movie: “Evolve: Guts”</li> <li>- Activity: Digestive system disorder brochure</li> </ul> </li> </ul>	1
<b>UNIT 5</b> Reproductive System	<ul style="list-style-type: none"> <li>▪ Movie: “Life’s Greatest Miracle”</li> <li>▪ Activity: Human development timeline</li> <li>▪ Male reproductive system anatomy and physiology</li> <li>▪ Female reproductive system anatomy and physiology</li> </ul>	2
<b>Final Exam</b>		

## 14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response cards
- Research

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative assessments
- Midterm examination
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response cards
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria.

**Benchmark assignments:**

- Cancer research project. Assesses the student's ability to validate information obtained through research. (IC: Speaking/Listening/Viewing and 2: Technology)
- Endocrine system poster project. Assesses the student's ability to validate information obtained through research. (IC: Speaking/Listening/Viewing and 2: Technology)

Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>Content Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic that are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</b></li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>The Human Body in Health and Disease</u> Lippincott Williams and Wilkins 2000
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Lab using metric units to measure length, mass, volume, and density.</li> <li>▪ Lab reports reflecting the usage of appropriate language and terminology including the concepts of a hypothesis, dependent and independent variables, and graphs.</li> <li>▪ Use appropriate tools and techniques to make observations and gather data.</li> </ul>

<b>LEARNING STRAND</b> <b>Body Organization, Biochemistry and Cells</b> <i>Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i> <i>Similarities in the chemical and structural properties of DNA in living organisms allow the transfer of genes from one organism to another.</i> <i>CT Standard 10.4 – In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.</i> <i>CT Standard: Enrichment High School Biology – As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside world.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The body is organized into atoms, molecules, cells, tissues, organs and organ systems.</li> <li>▪ All body systems are interconnected and rely on each other to work properly.</li> <li>▪ Constant input of energy is required to maintain this level of organization.</li> <li>▪ Cellular function is dependent on programmed instructions found in the DNA of the cell.</li> <li>▪ Cellular organization and thus life is dependent on the principles of physics and chemistry as they apply to a living changing and dynamic system.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What are the physical and chemical principles that apply to the homeostatic condition and thus maintain life?</li> <li>▪ How do the various body systems work together so that they work properly and efficiently?</li> <li>▪ How does glucose operate in the cell to provide the energy necessary for the continuation of life functions?</li> <li>▪ Where is DNA found in the cell and how does it communicate its blueprint to the cell?</li> <li>▪ What happens to a cell that causes it to die?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Describe the flow of energy from a level of high potential to lower potential.</li> <li>▪ Describe how the body is organized into increasing levels of complexity.</li> <li>▪ Define homeostasis as a state of constant harmony (ease) within the body.</li> <li>▪ Explain the process by which DNA is used to create proteins.</li> <li>▪ Explain the vital role that enzymes play in the development of a homeostatic environment within the cell.</li> <li>▪ Interpret the periodic table in terms of how the elements are organized.</li> <li>▪ Illustrate the atomic structure of various biologically active elements use the periodic table as a guide.</li> <li>▪ Use the periodic table to predict which elements are more likely to interact with each other to form compounds.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>The Human Body in Health and Disease</u> Lippincott Williams and Wilkins 2000 <ul style="list-style-type: none"> <li>▪ PowerPoint slides</li> <li>▪ Response cards</li> <li>▪ Dominoes</li> <li>▪ Gummy Bears</li> <li>▪ Household solutions of varying pH</li> <li>▪ Play-doh</li> <li>▪ Metric rulers and scales</li> <li>▪ Online video: Cancer Warriors</li> <li>▪ Laptop carts for lessons on the Internet</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Use dominoes to construct a domino course that models how body systems are connected</li> <li>▪ Use Gummy Bears to practice use of the metric system and determine changes in length, mass, volume, and density.</li> <li>▪ Research various topics surrounding cancer and present orally research (Benchmark)</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Formative quizzes</li> <li>▪ Summative test</li> <li>▪ Research project</li> <li>▪ Assessments evaluated with rubrics</li> <li>▪ Benchmark assessment</li> </ul>

<b>LEARNING STRAND</b> <b>The Nervous System, Spinal Cord and Endocrine System</b> <i>The brain, spinal cord and endocrine system are the three controlling systems of the body. Each system plays a specific role but all system work together to provide for balance and coordination.</i> <i>CT Standard 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i> <i>CT Standard: Enrichment High School Biology – As a result o the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside world.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ There are two main control systems in the body.</li> <li>▪ The brain and spinal cord have the fastest impulse speed and the most localized effect.</li> <li>▪ The endocrine system employs hormones, is slower and has a generalized effect, often over a long period of time.</li> <li>▪ Each system demonstrates the principle that structure often determines function in a body system.</li> <li>▪ The neuroendocrine mechanism illustrates the <b>“marriage” between the nervous system and the endocrine system.</b></li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How does the structure of a neuron influence its function?</li> <li>▪ What is the mechanism that determines when a <b>neuron will “fire” or become functional?</b></li> <li>▪ What happens in the brain when learning occurs?</li> <li>▪ What is the connection between sensory experience and learning?</li> <li>▪ What determines if a hormone will be successful in <b>influencing a particular cell to “turn on or off”?</b></li> <li>▪ Why do some cells respond to certain hormones and other cells do not?</li> <li>▪ What are some hormonal abnormalities and what kinds of treatment are available?</li> <li>▪ How does the brain control the endocrine system?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Illustrate the anatomy of a typical neuron.</li> <li>▪ <b>Describe the physiology of the “action potential” and the function of myelin.</b></li> <li>▪ Identify the four lobes of the brain.</li> <li>▪ List one function associated with each lobe of the brain.</li> <li>▪ Explain the process by which we are able to see a focused image.</li> <li>▪ Explain why certain people are unable to see a focused image.</li> <li>▪ Explain the process of smell.</li> <li>▪ Explain the concept of olfactory fatigue.</li> <li>▪ Explain the relationship between hormones, receptors, and target cells.</li> <li>▪ Research the names and functions of the most important hormones.</li> <li>▪ Research various endocrine glands, their associated diseases, and their treatments.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>The Human Body in Health and Disease</u> Lippincott Williams and Wilkins 2000 <ul style="list-style-type: none"> <li>▪ PowerPoint slides</li> <li>▪ Playing cards</li> <li>▪ Fetal pigs <b>and</b> dissection kits</li> <li>▪ Laptop carts for lessons on the Internet</li> <li>▪ Poster paper and other materials</li> <li>▪ Essential oils, Q-tips, coffee beans</li> <li>▪ Videos</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Research</li> <li>▪ Laboratory investigations</li> <li>▪ Cooperative grouping</li> <li>▪ Audio Visual presentations</li> <li>▪ Response cards</li> <li>▪ Create posters illustrating the anatomy of a nerve cell and the anatomy of the brain</li> <li>▪ Tests of students' reaction time.</li> <li>▪ Olfactory fatigue experiences</li> <li>▪ Research various endocrine glands and their associated disorders. (Benchmark)</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Informational posters constructed from research of endocrine glands and associated disorders</li> </ul>



<p><b>LEARNING STRAND</b>  <b>The Heart, Blood and Respiration</b>  <i>The blood, the heart, and respiration provide the mechanism for driving the life forces in the body. Each system provides for life giving oxygen to be provided so as to maintain cellular homeostasis.</i>  <i>CT Standard 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>  <i>CT Standard: Enrichment High School Biology – As a result o the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside world.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ There is an interrelationship between the blood, the heart and the lungs.</li> <li>▪ Each of the organ systems performs a different but vital role in maintaining the homeostasis of the healthy body.</li> <li>▪ The blood has many functions including maintaining body temperature, oxygenating tissues, and carrying antibodies from place to place.</li> <li>▪ The heart maintains the blood pressure and is the driving force behind circulation.</li> <li>▪ The lungs cause the body to excrete carbon dioxide and take in needed oxygen.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the relationship between the blood, heart and lungs with regard to maintaining homeostasis?</li> <li>▪ What is the role of erythrocytes and how are they formed in the blood?</li> <li>▪ What is the mechanism that keeps the human heart pumping at a regular rate?</li> <li>▪ What effect does blood pressure have on the normal functioning of the heart?</li> <li>▪ What is a heart attack and what causes it to happen?</li> <li>▪ Why does the chest have to move to take in air?</li> <li>▪ How does the volume/pressure relationship allow a person to breath?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the interrelationships between the blood, heart and lungs and their associated systems.</li> <li>▪ List the seven types of blood cells.</li> <li>▪ Describe what causes blood cells to be formed in the bone marrow.</li> <li>▪ Illustrate the anatomy of the human heart.</li> <li>▪ Describe the electrical mechanism that causes the heart to beat in a continuous manner.</li> <li>▪ Describe the mechanism and causative agents in a myocardial infarction.</li> <li>▪ Explain the mechanism by which the chest expands and contracts so as to cause inflation of the lungs.</li> <li>▪ Explain why individuals have different blood types.</li> <li>▪ Explain what Rh incompatibility is.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>The Human Body in Health and Disease</u>  Lippincott Williams and Wilkins 2000</p> <ul style="list-style-type: none"> <li>▪ Blood typing test kit</li> <li>▪ Sphygmomanometers and stethoscopes</li> <li>▪ Videos</li> <li>▪ Cow hearts</li> <li>▪ Fetal pigs</li> <li>▪ Dissection kits</li> <li>▪ Prepared slides of cardiac tissue and blood</li> <li>▪ Blood cell counting kit with hemocytometers</li> <li>▪ Laptop carts and Vernier EKG units</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint notes</li> <li>▪ Blood typing lab</li> <li>▪ Determining blood pressure using blood pressure cuff</li> <li>▪ Audio Visual presentations</li> <li>▪ Cow heart dissection demonstration</li> <li>▪ Fetal pig dissection</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Lab reports</li> <li>▪ Response cards</li> <li>▪ Formative quizzes</li> <li>▪ Summative test</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Disease and Immunity</b>  <i>The disease process and immunity are in a constant struggle to win control of the body. The immune system is the final defense against the death of the human.</i>  <i>CT Standard 10.2 - Microorganisms have an essential role in life processes and cycles on Earth.</i>  <i>CT Standard: Enrichment High School Biology – As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside world.</i>  <i>CT Standard: Enrichment High School Biology – Organisms have a variety of mechanisms to combat disease.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The body spends much energy attempting to prevent the onset of disease.</li> <li>▪ The body has various levels of defense or prevention mechanisms.</li> <li>▪ The body repairs itself and generates new cells as required.</li> <li>▪ Immunity is a condition that we are either born with or acquired to prevent the spread of disease.</li> <li>▪ Not everyone has the ability to develop all types of immunity.</li> <li>▪ Vaccines were created to help the immune system battle both viral and bacterial diseases.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What causes disease to occur?</li> <li>▪ Why do we feel tired and lethargic when we become sick?</li> <li>▪ What are some of the ways our body responds when it realizes we are getting sick?</li> <li>▪ What are the three levels of defense we have against the disease process?</li> <li>▪ Why is it that some become sick and others do not?</li> <li>▪ What is immunity?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the structural parts of a virus and bacterium.</li> <li>▪ Describe the process by which viruses and bacteria reproduce.</li> <li>▪ Explain the value of prevention as opposed to therapy.</li> <li>▪ List the three levels of defense that the body employs to prevent the disease process.</li> <li>▪ Describe the process by which the body fights infection.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u><a href="#">The Human Body in Health and Disease</a></u>  Lippincott Williams and Wilkins 2000</p> <ul style="list-style-type: none"> <li>▪ PowerPoint slides</li> <li>▪ Videos</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint notes</li> <li>▪ Audio Visual presentations</li> <li>▪ Research</li> <li>▪ Response cards</li> <li>▪ Bacteria/Virus poster project</li> <li>▪ "Bacteria Everywhere" lab</li> <li>▪ "Operation Antibody" audio/visual project</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Formative quiz</li> <li>▪ Summative test</li> <li>▪ Lab report</li> <li>▪ Research project</li> <li>▪ Assessments evaluated with rubrics</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Reproduction, Development, and Heredity</b>  <i>Reproduction, development, and heredity provide for cellular repair and continuation of the species.</i>  <i>Content Standard 10.4 - In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.</i>  <i>Content Standard 10.5 - Evolution and biodiversity are the result of genetic in constantly changing environments changes that occur over time.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Reproduction is the mechanism by which the body repairs itself and passes on traits to the next generation.</li> <li>▪ The goal of all living things is to continue the species and improve the next generation.</li> <li>▪ Sexual reproduction increases variability and thus helps to insure resistance from disease.</li> <li>▪ The male body is designed to manufacture and deliver sperm and the female body is designed to manufacture ova and nourish the developing fetus.</li> <li>▪ Sperm and ova are carriers of the DNA message and must be united for the next generation to occur.</li> <li>▪ The female body is specifically designed and hormonally driven to nourish the developing fetus for at least nine months.</li> <li>▪ The concepts of pair bonding and love are designed to provide two parents to care and nourish the young child.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ Why is sexual reproduction better than asexual reproduction (parthenogenesis)?</li> <li>▪ Why do the male and female members of the human race have different anatomical reproductive structures?</li> <li>▪ Can a human be produced if no sex act occurs between a male and female?</li> <li>▪ <b>Why do we have "love" in the human world and not in other forms of animal life?</b></li> </ul>
	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u>The Human Body in Health and Disease</u>                      Lippincott Williams and Wilkins 2000</p> <ul style="list-style-type: none"> <li>▪ PowerPoint slides</li> <li>▪ <b>Video: "Life's Greatest Miracle"</b></li> <li>▪ Poster/timeline materials</li> <li>▪ Laptop carts</li> <li>▪ Internet lessons</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Learn the anatomical structures in the male and female human reproductive system.</li> <li>▪ Learn how the process of gametogenesis occurs.</li> <li>▪ Appreciate the need for both sperm and ovum to be present at the moment of conception.</li> <li>▪ Illustrate the development of a human from conception to birth.</li> <li>▪ Debate the validity of human cloning.</li> <li>▪ Research the concept of stem cells and how they can be used to treat disease.</li> </ul>	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Cooperative grouping</li> <li>▪ Audio Visual presentations</li> <li>▪ Research</li> <li>▪ Human development timeline project</li> <li>▪ Human cloning debate</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Assessments evaluated with rubrics</li> <li>▪ Research project</li> <li>▪ Final examination</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Digestive System</b>  <i>CT Standard 10.1 – Fundamental life processes depend on the physical structure and the chemical activities of the cell.</i>  <i>CT Standard: Enrichment High School Biology – As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside world.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The function of the digestive system is to break down nutrients and deliver them to the blood.</li> <li>▪ The primary organs of the digestive system including the stomach, small and large intestines, and liver.</li> </ul>	<p><b>ESSENTIAL QUESTION</b></p> <ul style="list-style-type: none"> <li>▪ What happens when various digestive system organs fail to work properly?</li> </ul>
	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u>Hole's Essentials of Anatomy and Physiology</u>  David Shier, Jackie Butler, Ricki Lewis (2008)</p> <ul style="list-style-type: none"> <li>▪ PowerPoint notes</li> <li>▪ Laptops</li> <li>▪ Dissection supplies</li> <li>▪ Videos dealing with the digestive system.</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ learn the anatomy and physiology of the digestive system organs.</li> <li>▪ learn the pathology of various digestive system disorders.</li> </ul>	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Short lecture and diagram on the anatomy and physiology of the digestive system.</li> <li>▪ Fetal pig dissection.</li> <li>▪ Research project on the subject of digestive system disorders.</li> <li>▪ <b>Video: "Evlove – Guts"</b></li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Research project on the subject of digestive system disorders (brochure).</li> </ul>

## Cancer Research Project

### ***Introduction:***

In this unit we are learning about cells and tissues. Cancer is a disease that starts in the cells, spreads into tissues, and eventually, if not treated promptly, can lead to death. Cancer affected 12 million people in the year 2007, and is one of the leading causes of death in the United States. It is, therefore, very important to be exposed to the subject of cancer and learn as much as possible about how the disease starts, how it progresses, current treatments, cutting edge treatments, causes and risk factors, etc.

In groups of two (2) or three (3) you will conduct in-depth research on one (1) of the following topics:

### **Topic #1: What is cancer?**

- Explain how cancer starts.
- Explain how cancer spreads.
- Explain what cancer does that makes it so deadly.

### **Topic #2: Causes and risk factors associated with cancer.**

- Select a minimum of four (4) causes and/or risk factors.
- Explain how each of the selected causes and/or risk factors is associated with the onset of cancer.
- Describe how people can avoid the selected causes and/or risk factors and how they can, therefore, reduce their risk of cancer.

### **Topic #3: Cancer treatments**

- Current treatments and how they work (radiation, chemotherapy, surgery, etc.).
- Cutting edge treatments and how they work (if you can find any).
- Future treatments (if you can find any).

You will use the results of your research to construct a PowerPoint presentation. You will then present your research orally in front of the class using your PowerPoint presentation.

### ***Requirements:***

#### **1. Oral Presentation:**

- o You will prepare a five to ten minute oral presentation on your selected topic.
- o You will use PowerPoint to present your research to the class. The PowerPoint slides should contain written information about your selected topic as well as visuals (pictures, diagrams, charts, etc.).
- o Each member of the group should be involved in an equal part of the presentation.

## 2. Written Work:

- o You will prepare a written outline of the information that will be presented. This will be distributed to your classmates before the start of your presentation.
- o You will generate a quiz (no less than 10 questions) that will be completed by your classmates at the conclusion of your presentation. **DON'T MAKE THE QUIZ TOO DIFFICULT!** Remember, they are making a quiz for you to take .... you don't want them to take revenge.
- o A list of the references used in the standard MLA reference format.

### *Materials:*

These resources will be available to you for your research:

1. Your text book
2. The Internet
3. Books from the school library (maybe)
4. High school and college-level textbooks
5. Magazines, scientific journals, and/or periodicals.

Some guidelines for proceeding:

- We will go to the library as a class or use the laptop carts to search for information that you might need. I recommend that you start by reading about cancer in the textbook before searching for other sources. This may be a rather brief description, but it is a good starting point to acquaint you with cancer.
- Once you have done some research, brainstorm with your partner(s) about how you might present your topic to the class. You might need to divide the labor - have each group member read more about one particular aspect of your selected topic.

### *How it will be graded:*

- Outline - 25 points
- Quiz - 25 points
- Oral Presentation - 50 points

The total points earned for these three items will count as *two* test grades. Each person in the group will be graded independently on the oral presentation portion of the project.

### *Taking the quizzes:*

Everyone will take the other groups' quizzes. These will be open notes quizzes and will be taken immediately following a given group's oral presentation. ***All of your quiz scores will be averaged to produce a single test grade. If you do not have time to finish the quiz in class it can be finished for homework, but must be passed in the next day, or the grade will be a zero.***

### Cancer: Oral Presentation Rubric

<b>CATEGORY</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>Content</b>	Shows a full understanding of the topic.	Shows a good understanding of the topic.	Shows a good understanding of parts of the topic.	Does not seem to understand the topic very well.
<b>Visual Presentation</b>	Visual presentation is very well organized and completely supports the content.	Visual presentation is organized and mostly supports the content.	Visual presentation is slightly disorganized, but mostly supports the content.	Visual presentation is disorganized and does not support the content.
<b>Preparedness</b>	Student is completely prepared and has obviously rehearsed.	Student seems pretty prepared but might have needed a couple more rehearsals.	The student is somewhat prepared, but it is clear that rehearsal was lacking.	Student does not seem at all prepared to present.
<b>Volume</b>	Volume is loud enough to be heard by all audience members throughout the presentation.	Volume is loud enough to be heard by all audience members at least 90% of the time.	Volume is loud enough to be heard by all audience members at least 80% of the time.	Volume often too soft to be heard by all audience members.
<b>Vocabulary</b>	Uses vocabulary appropriate for the audience. Extends audience vocabulary by defining words that might be new to most of the audience.	Uses vocabulary appropriate for the audience. Includes 1-2 words that might be new to most of the audience, but does not define them.	Uses vocabulary appropriate for the audience. Does not include any vocabulary that might be new to the audience.	Uses several (5 or more) words or phrases that are not understood by the audience.
<b>Speaks Clearly</b>	Speaks clearly and distinctly all the time, and mispronounces no words.	Speaks clearly and distinctly most of the time, but mispronounces no words.	Speaks clearly and distinctly most of the time. Mispronounces some words.	Often mumbles or can not be understood. Mispronounces a number of words.
<b>Time-Limit</b>	Presentation is more than 5 and less than 10 minutes long.	Presentation is 5 minutes long.	Presentation is 3-4 minutes long.	Presentation is less than 3 minutes OR more than 10 minutes.

## Cancer Research Project Benchmark Rubric

**#3 Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems.**

<b>Exceeds Expectations</b>	The student independently collects, interprets, analyzes, and evaluates a variety of information and data and makes original insights and accurate conclusions.
<b>Meets Expectations</b>	The student independently collects, interprets, analyzes, and evaluates a variety of information and data to make pre-established insights and accurate conclusions.
<b>Meets Some Expectations</b>	The student may need some assistance collecting, interpreting, analyzing, and evaluating a variety of information and data to make pre-established insights and accurate conclusions.
<b>Does Not Meet Expectations</b>	The student needs assistance to gather information and make very general conclusions based on that information. Errors may be present in the student's conclusions.





### Course Description

HIGH SCHOOL		
1. Course Title <b>Chemistry - Honors</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Chemistry - Honors</b>		
3. Transcript Course Code/Number <b>00341</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 10 – 12    Level: 1  7. Seeking "Honors" Distinction? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input checked="" type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites Successful completion of Biological Systems with an average of B+ or better or Biology-Honors with a grade average of C+ or better, as well as completion of Level I or II Algebra I with a B+ or better and concurrent enrollment in Level I or II Algebra II.		
11. Brief Course Description This course emphasizes chemical principles, which are deduced from experiments performed by the student. The principles include: energy, rate and equilibrium, characteristics, chemical periodicity, and chemical bonding in gases, liquids, and solids. The student is required to keep a detailed journal of his/her laboratory experiments.		
12. Course Goals 1. Demonstrate proficiency and fluency in communication to meet the literacy demands of the global community. 2. Use technology effectively and responsibly. 3. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 4. Demonstrate respect for one's self, and strive to contribute to the success of others. 5. Demonstrate the ability to work on homework and laboratory assignments independently. 6. Demonstrate the ability to meet homework and lab report deadlines. 7. Demonstrate good homework habits by working on new material covered on a nightly basis. 8. Demonstrate the ability to apply chemistry concepts and synthesize connections among concepts.		

<b>13. Course Outline</b>	
<b>CHAPTER</b>	<b>*LABORATORY</b>
1) Introduction to Chemistry	Check-in, Safety Training and Safety Contract
2) Matter and Change	Physical and Chemical Properties
3) Scientific Measurement	Density Reporting Experimental Uncertainty
4) Problem Solving in Chemistry	Changes in Physical State
5) Atomic Structure and the Periodic Table (Atomic Theory)	Determining the Mass of Extremely Small Objects
6) Chemical Names and Formulas	Identifying Unknown Halides
7) Chemical Quantities	Moles of Copper and Iron Determination of the Diameter of the Copper Atom Empirical Formula Determination
8) Chemical Reactions (States of Matter & Energy of Chemical Changes)	Observing a Chemical Reaction Balanced Chemical Equations Types of Reactions Single Replacement Reactions Precipitation Reactions
9) Stoichiometry	Quantitative Study of a Chemical Reaction
10) States of Matter	Cooling Rates of Evaporating Liquids
11) Thermochemistry – Heat and Chemical Change	Heat of Fusion of Ice Heat of a Chemical Reaction Specific Heat of a Metal Energy of Foods
12) The Behavior of Gases (Gaseous State of Matter)	The Molar Relationship Involving Mass and Volume <b>Graham's Law</b> <b>Charles' Law</b> The Weights of Equal Volumes of Gases
13) Electrons in Atoms	Flame Tests
14) Chemical Periodicity	The Periodic Law
15) Ionic Bonding and Ionic Compounds	
16) Covalent Bonding	
17) Water and Aqueous Systems	Solvent Properties of Water
18) Solutions (The Chemistry of Solutions)	Properties of Solutions Factors Affecting Solution Formation Supersaturation
19) Reaction Rates and Equilibrium	Chemical Equilibrium: Qualitative Aspects Disturbing Equilibrium: <b>LeChatelier's</b> Principle Factors Affecting Reaction Rates
20) Acids and Bases	Characteristic Reactions of Acids Salt Hydrolysis

21) Neutralization	Neutralization Reactions A Solubility Product Constant Buffers Unknown Acid Titration
22) Oxidation-Reduction Reactions	Redox Titration of Iron Oxidation-Reduction Reactions
23) Electrochemistry	Measuring the Potential of Electrochemical Cells
<i>* Some experiments may be substituted for, or eliminated, based on availability of needed chemicals/equipment.</i>	
14. Instructional Methods and/or Strategies	
1. Modeled instruction	
2. Powerpoint presentations and notes	
3. Laboratory investigations	
4. Teacher demonstrations	
5. Cooperative grouping	
6. Audio visual presentations	
7. Response cards by Turning Technologies	
8. Web-based instruction with Blackboard/finalsite	
9. Research	
15. Assessment Methods and/or Tools	
<ul style="list-style-type: none"> <li>▪ Chapter tests</li> <li>▪ Unit examinations</li> <li>▪ Final examination</li> <li>▪ Laboratory reports</li> <li>▪ Chapter problem sets</li> <li>▪ Assessments evaluated with rubrics</li> <li>▪ Benchmark assessments</li> <li>▪ Video response summaries</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Formative quizzes and test preparation quizzes</li> <li>▪ Short term projects, such as portfolio mini units, and group or individual presentations</li> </ul>	
<p><b>Benchmark assessments include the following laboratory experiments:</b> The American Chemical Society's Final Examination will be administered to all students taking honors chemistry.</p>	
<ul style="list-style-type: none"> <li>▪ Observing a Chemical Reaction</li> <li>▪ Physical and Chemical Properties</li> <li>▪ Density</li> <li>▪ Empirical Formula Determination</li> <li>▪ Types of Reactions</li> <li>▪ Single Replacement Reactions</li> <li>▪ Precipitation Reactions</li> <li>▪ Quantitative Study of a Chemical Reaction</li> <li>▪ Heat of Fusion of Ice</li> <li>▪ Specific Heat of a Metal</li> </ul>	<ul style="list-style-type: none"> <li>▪ The Molar Relationship Involving Mass and Volume</li> <li>▪ <b>Graham's Law</b></li> <li>▪ Flame Tests</li> <li>▪ The Periodic Law</li> <li>▪ Solvent Properties of Water</li> <li>▪ Factors Affecting Solution Formation</li> <li>▪ Supersaturation</li> <li>▪ Chemical Equilibrium: Qualitative Aspects</li> <li>▪ Acid Base Titration</li> </ul>
16. Assessment Criteria	
<p>Assessments are based on the Madison Curriculum and Connecticut Standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a common scoring rubric or grading criteria.</p> <p>The <u>technology benchmark</u> used involves the students learning the proper use and functions of various laboratory equipment including, but not limited to: electronic balances, analytical measuring devices such as burets, pipets, and electronic thermometers, a wide assortment of computer-based probes and the needed software, which are used in conjunction with a classroom set of laptop computers.</p>	

The writing benchmark is incorporated through the requirement of students to prepare and submit laboratory reports. Some instructors accomplish this by requiring students to maintain, and submit for grading, a laboratory notebook. Others make use of prepare laboratory report forms that accomplish this task. Which ever method is used, the students must prepare their reports including not only all of the observations and interpretations involved in the experiment, but also must do so using proper grammar, punctuation, spelling, and sentence structure. The benchmarks for use of effective strategies for gathering information, critical thinking, and problem solving are inherent with the subject of science. Starting at the beginning of the course with the Scientific Method, the students are required to use ALL of these skills, on a DAILY BASIS, throughout the course; it is the ESSENCE OF SCIENCE.

### How Laboratory Reports will be Graded

Unless otherwise stated, this is how your lab report will be graded. Remember your report must reflect your individual effort to receive credit! Please refer to the information about integrity in the lab report as needed. Each completed lab report must have the following sections, unless otherwise stated. The sections will be evaluated using the criteria included below.

Title	
Date	
Materials and Safety	
Procedure	Does the procedure directly address the problem? Is the procedure written in such a way that it could be easily reproduced by another person?
Data and Observations	Were the measurements recorded correctly? Are the data presented clearly and neatly? Are the data meaningful and reliable?
Calculations	Are the calculations organized clearly? Are the calculations done correctly, including the use of units and significant figures?
Graphs (only required for some experiments)	Does the graph include a title? Are the axes labeled and are units included? Are the data points plotted correctly? Is the scale appropriate? Is the proper type of graph used? (line vs. bar) Does the graph include the line of best fit? Is the graph plotted correctly? (independent variable vs. dependent variable)
Conclusion	Does the conclusion address the purpose? Does the conclusion relate to the experimental results? Is there a discussion of all potential sources of errors?

### HONORS COURSES ONLY

17. Indicate how this honors course is different from the standard course.  
 Honors chemistry covers more material, performs more experiments, utilizes much more math-intensive word problems, and delves deeper into the theoretical concepts behind the various laws governing chemistry. Much more responsibility is placed on the student in analyzing experimental results and deducing logical conclusions based on experimental results.  
 In addition, the quantity and quality of quantitative problems is also much greater than covered in the standard course. It is assumed that all honor students have excellent, well-established study skills and good problem-solving skills.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design</b> and the credibility of scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..."</b> format, which is logically connected to the problem.</li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> <li>▪ Use dimensional analysis to solve a variety of multi-step problems.</li> <li>▪ Understand significant figures.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Chemistry: Principles and Reactions</u> Brooks/Cole Cengage Learning, 2009 <ul style="list-style-type: none"> <li>▪ General lab equipment (Balances, glassware, Bunsen burners, safety goggles, aprons and gloves)</li> <li>▪ Calculators</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Performance tasks</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided Internet research</li> <li>▪ Response cards by Turning Technologies</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ In class worksheets (collaborative)</li> <li>▪ Homework (individual)</li> <li>▪ Homework quizzes (individual)</li> <li>▪ Teacher observations</li> <li>▪ Student class participation</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Tests</li> <li>▪ Lab reports (design labs, collect data, analyze, draw conclusions)</li> <li>▪ Observing a Chemical Reaction (<i>Benchmark Assessment</i>)</li> <li>▪ Physical and Chemical Properties (<i>Benchmark Assessment</i>)</li> <li>▪ Density (<i>Benchmark Assessment</i>)</li> <li>▪ Determination of the diameter of a copper atom</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Atomic Theory</b>  <b>CT Standard: Atomic and Molecular Structure --</b> <i>The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The understanding of atomic structure was developed by many scientists and scientific thinkers over a period of more than 2000 years.</li> <li>▪ Atomic structure includes a positively charged nucleus, containing two types of subatomic particles (neutrons and protons), and an outer region of negatively charged electrons.</li> <li>▪ The configuration of atoms and molecules determines the properties of materials.</li> <li>▪ Elements exist in nature as isotopes, which differ in number of neutrons, and atomic mass.</li> <li>▪ In nuclear fission, matter is transferred directly into energy in a process that is several million times more energetic than combustion.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How can early experiments that led to the characterization of the nucleus and the discovery of electrons be explained?</li> <li>▪ What is the description of the general structure of the atom?</li> <li>▪ Why does atomic mass of isotopes vary for an element?</li> <li>▪ How would you determine the chart mass of an element, given isotope data?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe and explain the contribution that Thomson and Rutherford made to the development of the atomic theory.</li> <li>▪ <b>Explain how Bohr's model differed from its predecessors.</b></li> <li>▪ <b>Use Dalton's Atomic Theory</b> to define an atom.</li> <li>▪ Compare the nucleus to the atom, and include size, mass and charge in the answer.</li> <li>▪ Explain the quantum model of the atom, in terms of the relevance of the work of Dalton, Thomsen, Bohr, Rutherford, Millikan.</li> <li>▪ Describe the mass, charge, and location of the proton, neutron, and electron.</li> <li>▪ Understand the relationship and meaning of atomic number and mass number.</li> <li>▪ Define isotope.</li> <li>▪ Describe the general structure of the atom, and explain how the properties of the first 20 elements are related to their structure.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u><a href="#">Chemistry: Principles and Reactions</a></u> Brooks/Cole Cengage Learning, 2009</p> <ul style="list-style-type: none"> <li>▪ <b>Videos, such as "History of Atomic Theory"</b></li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Power point presentations, with interactive simulations, and imbedded practice problems</li> <li>▪ <b>Interactive games, such as "Its All in the Cards"</b></li> <li>▪ Lab investigations</li> <li>▪ Response cards by Turning Technologies</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ In class worksheets (collaborative)</li> <li>▪ Homework (individual)</li> <li>▪ Homework quizzes (individual)</li> <li>▪ Student class participation</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Tests</li> <li>▪ Lab reports (design labs, collect data, analyze, conclude)</li> <li>▪ Beanium</li> </ul>

<p><b>LEARNING STRAND</b>  <b>The Language of Chemistry</b>  <b>CT Standards: Atomic and Molecular Structure</b> -- <i>The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.</i>  <i>Conservation of matter and Stoichiometry</i> -- <i>The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.</i>  <i>Chemical Bonds</i> -- <i>Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Chemical symbols, formulas, and equations are understood internationally, and are written based upon universally accepted guidelines.</li> <li>The formula of a binary compound can be determined based on the positions of elements on the Periodic Table.</li> <li>The unit of measurement on which chemists rely to predict quantities in chemical reactions is the mole.</li> <li>Chemical equations are presented as balanced equations to satisfy the law of conservation of matter.</li> <li>Chemists make calculations involving quantities of reactants and products based on balanced chemical equations and yields.</li> <li>Emission of combustion by products, such as SO<sub>2</sub>, CO<sub>2</sub>, and NO<sub>x</sub>, by industries and vehicles is a major source of air pollution.</li> <li>During the burning of fossil fuels, stored chemical energy is converted to useable energy.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What are the descriptions for how atoms combine to form new substances by transferring electrons (ionic compounds) or by sharing electrons (molecular compounds)?</li> <li>How does the Periodic Table provide for the charge of a metal or a nonmetal, in an ionic compound?</li> <li>How can conversions be made among particles, mass, and moles of any substance?</li> <li>What is the difference between empirical and molecular formula? What is the significance of empirical formula in chemical analysis?</li> <li>How can predictions be made about which reactions will occur and what their products will be?</li> <li>How can you relate between different quantities in a balanced chemical reaction?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <p><b>Chemical Names and Formulas</b></p> <ul style="list-style-type: none"> <li>Differentiate between ionic compounds and molecular compounds, and between molecules and formula units.</li> <li>Explain that chemical bonds between atoms in molecules such as H<sub>2</sub>, CH<sub>4</sub>, NH<sub>3</sub>, H<sub>2</sub>CCH<sub>2</sub>, N<sub>2</sub>, CL<sub>2</sub>, and many large biological molecules are covalent.</li> <li>Write the chemical formula of binary or ternary ionic compounds, molecular compounds, or acids, given the name, and vice versa.</li> <li>Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).</li> </ul> <p><b>The Mole</b></p> <ul style="list-style-type: none"> <li>Define Avogadro's number as one mole equals 6.02 x 10<sup>23</sup> particles (atoms or molecules).</li> <li>Define gram atomic mass, gram molecular mass, gram formula mass, and molar mass from the chemical formula and a table of atomic masses.</li> <li>Relate mass, moles, volume, and number of particles for a given amount of a substance, at</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Chemistry: Principles and Reactions</u> Brooks/Cole  Cengage Learning, 2009</p> <ul style="list-style-type: none"> <li>General lab equipment</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Power point presentations with imbedded practice problems</li> <li>Modeling of concepts, followed by in class practice worksheets</li> <li>Frequent question and answer sessions</li> <li>Response cards by Turning Technologies</li> <li>Executing laboratory experiments</li> <li>Empirical Formula Determination (Benchmark Assessment)</li> <li>Types of Reactions (Benchmark Assessment)</li> <li>Precipitation Reactions (Benchmark Assessment)</li> <li>Quantitative Study of a Reaction (Benchmark Assessment)</li> <li>Single Replacement Reactions (Benchmark Assessment)</li> <li>Balanced Chemical Reactions</li> </ul>



standard temperature and pressure.

- Relate the mole concept to the density of a gas.
- Use percent composition to determine empirical and molecular formulas.
- Show that different compounds composed of the same two elements obey the Law of Multiple Proportions, using experimental data.
- Show that different samples of the same compound obey the Law of Definite Proportions, using experimental data.

**Chemical Equations**

- Identify reactants and products in a chemical equation.
- Understand that chemical reactions can be described by writing balanced equations.
- Use appropriate symbols to write an equation to accurately describe a chemical reaction.
- Classify a reaction as combination, single or double replacement, decomposition, or combustion.
- Predict the products of each of these reaction types, using appropriate references, such as the activity series, or solubility rules.
- Describe combustion reactions of hydrocarbons and their resulting by-products.

**Stoichiometry**

- Interpret a chemical equation for mole relationships of mass, particles, or volume.
- Define and apply the concepts of theoretical, actual, and percent yield.
- Explain how the release of sulfur dioxide into the atmosphere can form acid rain, and how acid rain affects water sources, organisms, and human made structures.
- Describe the availability, current uses, and environmental issues related to the use of fossil and nuclear fuels to produce electricity.

**SUGGESTED ASSESSMENT METHODS**

- In class worksheets (collaborative)
- Homework (individual)
- Homework Quizzes (individual)
- Student class participation
- Response cards by Turning Technologies
- Tests
- Lab reports (design labs, collect data, analyze, draw conclusions)

<p><b>LEARNING STRAND</b>  <b>The States of Matter, and the Energy of Chemical Changes</b>  <i>CT Standards: Chemical Bonds -- Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.  Conservation of Matter and Stoichiometry -- The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Differences in the general characteristics of the phases of matter are related to particle energy and the presence, or absence, of attractive or repulsive forces between particles.</li> <li>Differences in the general properties of different substances are related to intermolecular forces of attraction for liquid and gas phases, and the structure in which particles are held together in the solid phase.</li> <li>Energy cannot be created or destroyed; however, energy can be converted from one form to another.</li> <li>All chemical reactions either produce energy (are exothermic) or absorb energy (are endothermic), as a result of the breaking and making of chemical bonds.</li> <li>The spontaneity of a chemical reaction is a function of the relationship between the changes in temperature, entropy, and enthalpy.</li> <li>Various forms of energy are used by humans, and all have advantages or disadvantages.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How can you summarize the differences in the particle arrangement and average particle energy among particles in the solid, liquid, or gaseous form of a substance?</li> <li>How do intermolecular forces of attraction affect the vapor pressure, boiling point, and surface characteristics of a liquid?</li> <li>What is the explanation for the components of <b>Gibb's free energy equation, and the relevance</b> of the relevance is to spontaneity, in terms of endergonic and exergonic reactions?</li> <li>How is the enthalpy of a reaction calculated including definitions of exothermic and endothermic reactions?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <p><b>States of Matter</b></p> <ul style="list-style-type: none"> <li>Explain the significance of absolute zero, giving its value in degrees Celsius and Kelvin, and relate the average kinetic energy of the particles of a substance to temperature.</li> <li>Name and characterize the three states of matter.</li> <li>Describe the motion of particles of a gas, according to the Kinetic Theory.</li> <li>Explain that the atoms and molecules in liquids move in a random pattern, relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in solid form.</li> <li>Describe the effects of adding energy to matter in terms of the motion of atoms and molecules, and the resulting phase changes.</li> <li>Describe the nature of a liquid in terms of the attractive forces between particles.</li> <li>Explain why a liquid has a vapor pressure, and why a change in temperature causes a change in vapor pressure.</li> <li>Explain the significance of the unit cell to the shape of a crystal.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Chemistry: Principles and Reactions</u> Brooks/Cole Cengage Learning, 2009</p> <ul style="list-style-type: none"> <li>Vacuum pump apparatus for demonstrations</li> <li>Laptop computers with Loggerpro software for Energy of Foods / Energy of Fuels labs</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>PowerPoint presentations with imbedded practice problems.</li> <li>Modeling of concepts, followed by in-class practice worksheets</li> <li>Frequent question and answer sessions</li> <li>Response cards by Turning Technologies</li> <li>Execute selections from suggested labs: <ul style="list-style-type: none"> <li>-Cooling Rates of Evaporating Liquids</li> <li>-Heat of Fusion of Ice (Benchmark Assessment)</li> <li>-Heat of a Chemical Reaction</li> <li>-Specific Heat of a Metal (Benchmark Assessment)</li> <li>-Energy of Foods or Energy of Fuels</li> </ul> </li> <li>Demonstrations of: <ul style="list-style-type: none"> <li>-Phase change under vacuum</li> <li>-Comparative cooling rates</li> </ul> </li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p>

- Differentiate between different crystal systems and different unit cells within a crystal system.
  - Explain how different intermolecular forces of attraction, such as hydrogen bonds, Van der Waals forces, or dispersion forces affect the vapor pressure, boiling and melting points, volatility, and surface tension of the substance.
- Thermochemistry**
- Find the mass, heat change, temperature change, or specific heat, when any three of these values are given.
  - **Use Hess's Law to calculate the enthalpy change** in a chemical reaction.
  - **Use Gibb's Free Energy equation to determine spontaneity** of a chemical reaction.
  - Relate changes in entropy to changes of state, changes in temperature, and a change in the number of product particles, compared to the number of reactant particles.
  - Use standard entropies to calculate the change in entropy of a reaction.
  - Characterize the spontaneous and nonspontaneous reactions.
  - Distinguish between exergonic and endergonic reactions.
  - Define enthalpy and determine the energy changes that occur in a reaction.
  - Describe network solids and describe their properties.
- In class worksheets (collaborative)
  - Homework (individual)
  - Homework Quizzes (individual)
  - Student class participation
  - Response cards by Turning Technologies
  - Tests
  - Lab reports (design labs, collect data, analyze, draw conclusions)

<p><b>LEARNING STRAND</b>  <b>The Gaseous State of Matter</b>  <i>CT Standards: Chemical Bonds -- Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.  Conservation of Matter and Stoichiometry -- The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>The general behavior of a substance in the gaseous state can be described by the Kinetic Molecular Theory, which is based on observation.</li> <li>The average kinetic energy of particles of a substance in the gaseous state is related to the temperature of the substance in the Kelvin (absolute) scale.</li> <li>Particles of different substances will effuse at different rates, depending on the size (mass) of the particles.</li> <li>The specific response to a change in pressure, temperature, and /or volume of a substance in the gaseous state can be predicted by the combined gas law or one of <b>its corollaries, the Independent (Boyle's, Charles', and Gay-Lussac') Gas Laws.</b></li> <li>A gas in a mixture will behave the same and exert the same pressure as it would alone.</li> <li>The Ideal Gas Law is an empirical relationship that relates pressure, volume, temperature, and amount of a substance in the gaseous state of matter.</li> <li>The concept of an ideal gas is hypothetical, and an ideal gas does not actually exist; but under most temperature and pressure conditions, most gases behave ideally.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How does the Kinetic Molecular Theory predict the relationship between particles of a gas, and in turn, the behavior of a gas?</li> <li><b>How is Graham's Law related to the average kinetic energy of particles of a gas?</b></li> <li>What are the factors that determine which gas laws are used to solve word problems?</li> <li>What label (s) is (are) appropriate for each parameter for each gas law?</li> <li>Under what conditions will a real gas deviate from an ideal gas (or, the Ideal Gas Law)?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Use Kinetic Theory to explain gas pressure.</li> <li>State the value of standard temperature and pressure.</li> <li>State and explain the significance of <b>Avogadro's hypothesis.</b></li> <li>Predict the response of a gas to changes in pressure, volume, or temperature, using the appropriate gas law.</li> <li><b>Understand and apply Dalton's law</b> of partial pressures.</li> <li><b>Understand Avogadro's hypothesis as it applies to gases.</b></li> <li>Use the combined gas law to predict changes in temperature, pressure, or volume.</li> <li>Understand and use the Ideal Gas Law to solve word problems.</li> <li>Understand that the Ideal Gas Law is an empirical relationship that relates pressure,</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Chemistry: Principles and Reactions</u> Brooks/Cole Cengage Learning, 2009</p> <ul style="list-style-type: none"> <li><b>Glass tubes for Graham's Law Experiment</b></li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>PowerPoint presentations with imbedded practice problems</li> <li>Modeling of concepts, followed by in-class practice worksheets</li> <li>Frequent question and answer sessions</li> <li>Response cards by Turning Technologies</li> <li>Execute selections from suggested labs: <ul style="list-style-type: none"> <li>-The Molar Relationship Involving Mass and Volume (Benchmark Assessment)</li> <li><b>-Graham's Law (Benchmark Assessment)</b></li> <li><b>-Charles' Law</b></li> <li>-The Weights of Equal Volumes of Gases</li> </ul> </li> </ul>

<p>volume, temperature, and amount of a substance in the gaseous state of matter.</p> <ul style="list-style-type: none"><li>▪ Explain that the concept of an ideal gas is hypothetical, and an ideal gas does not actually exist; but under most temperature and pressure conditions, most gases behave ideally.</li><li>▪ Describe how human efforts to reduce consumption of raw materials can improve air quality.</li></ul>	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"><li>▪ In class worksheets (collaborative)</li><li>▪ Homework (individual)</li><li>▪ Homework Quizzes (individual)</li><li>▪ Student class participation</li><li>▪ Response cards by Turning Technologies</li><li>▪ Tests</li><li>▪ Lab reports (design labs, collect data, analyze, draw conclusions)</li></ul>
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<b>LEARNING STRAND</b> <b>Electrons, The Periodic Law and Chemical Bonds</b> <i>CT Standards: Atomic and Molecular Structure -- The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.</i> <i>Chemical Bonds -- Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons, protons, and between atoms and molecules.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Every element has a unique electron configuration, which is based on the structure of the principal energy levels, energy sublevels, and orbitals.</li> <li>▪ The electron configuration of any element is indicated by its placement on the Periodic Table of the Elements.</li> <li>▪ The Periodic Table is arranged in order of increasing atomic number and grouped by similar properties, but there are several additional trends that progress through each period (row) or each family of elements (column) on the Table.</li> <li>▪ The electromagnetic spectrum is the full range of wavelengths of radiation from the sun, and it includes visible light, heat energy, sound waves, and many other types of energy (microwave, radar, X-ray, and gamma radiation).</li> <li>▪ The tendencies for metals to form cations and for nonmetals to form anions are related to position on the Periodic Table and electron configuration.</li> <li>▪ The drive for atoms to form bonds is based on the stability of the noble gases and the octet rule.</li> <li>▪ The manner in which elements combine to form compounds and the resulting molecular geometries have a profound effect on the properties exhibited by the substance.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What is electron configuration in terms of an <b>element's location on the periodic table</b>?</li> <li>▪ What is the likelihood of electron configuration forming bonds?</li> <li>▪ What type of bonds will be formed from electron configuration?</li> <li>▪ What are the trends of physical and chemical properties along periods or in groups on the Periodic Table?</li> <li>▪ What are the different groups of the periodic table?</li> <li>▪ What is the significance of orientation and layout of the Periodic Table?</li> <li>▪ What is the character of the ionic bonding process?</li> <li>▪ What is the character of the molecular bonding process?</li> <li>▪ How can the shape, bond angles and polarity be predicted by using VSEPR theory?</li> <li>▪ How can the Molecular Bonding theory be summarized?</li> <li>▪ What is the importance of sigma, pi, and bonding and antibonding orbitals?</li> <li>▪ What is a description of metallic bonding?</li> <li>▪ How does metallic bonding structure affect the properties of a metal?</li> <li>▪ What is a description of network covalent bonding?</li> <li>▪ How does network covalent bonding structure affect the properties of an ionic compound?</li> <li>▪ What is a description of ionic bonding, with respect to crystal structure?</li> <li>▪ How does crystal structure affect the properties of an ionic compound?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i>  <b>Electron Configuration</b> <ul style="list-style-type: none"> <li>▪ Describe the general shape of s, p, d, and f orbitals.</li> <li>▪ Distinguish among principal energy level, energy sublevel, and atomic orbital.</li> <li>▪ Use the Aufbau Principle, the Pauli Exclusion Principle, and Hund's Rule to write the electron configuration of the elements.</li> <li>▪ Explain the importance of quantized energies of electrons.</li> <li>▪ Identify the electron configuration of any element based on its position on the Periodic Table.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u>Chemistry: Principles and Reactions</u> Brooks/Cole Cengage Learning, 2009 <ul style="list-style-type: none"> <li>▪ Discharge tubes and power supplies</li> <li>▪ Spectrophotometers</li> <li>▪ Three dimensional molecular model kits</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Power point presentations with imbedded practice problems.</li> <li>▪ Modeling of concepts, followed by in-class practice worksheets</li> <li>▪ Frequent question and answer sessions</li> </ul>

- Calculate the frequency and wavelength of light.
- Use the quantum theory to explain the photoelectric effect.

#### **The Periodic Law (Periodicity)**

- Identify trends in ionization energy, electro negativity, and the relative sizes of atom and ions.
- State the Periodic Law.
- Identify the different parts of the Periodic Table: metals, nonmetals, metalloids, representative elements, noble gases, transition metals, and rare earth metals.
- Identify the number of electrons available for bonding from the position on the Periodic Table.
- Explain why the electron configuration for chromium and copper are different than those assigned from the Aufbau filling diagram.
- Explain how electronegativity and ionization energy are related to bond type and formation.

#### **Ionic Bonding**

- Use Lewis dot structures to provide models of atoms, ions and molecules.
- State the importance of the Noble Gas electron configuration in the formation of ions.
- State and apply the octet rule.
- Describe the formation of an anion from an atom of a nonmetallic element.
- Describe the formation of a cation from an atom of a metallic element.

#### **Molecular Bonding**

- Predict the shape of simple molecules and their polarity from Lewis dot structures.
- Explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.
- Define single, double, and triple bonds.
- Define and recognize polarity.
- Define and give the characteristics of an ionic bond, covalent bond, polar covalent bond, and coordinate covalent bond.
- Describe the VSEPR theory and the relevance to molecular shape, specifically bond angles.
- Describe the Molecular Orbital theory with respect to pi and sigma orbitals, and bonding and antibonding orbitals.
- Describe orbital hybridization.
- Explain and give an example of resonance.
- Use the theory of metallic bonding to explain the physical properties of metals.
- Define bond dissociation energy.
- Explain the electrical conductivity of melted and aqueous solutions of ionic compounds.
- Understand how electronegativity relates to bonding.

- Response cards by Turning Technologies
- Use of three dimensional molecular models for demonstration and also in student activities and labs
- Use of discharge tubes to illustrate atomic emission spectra
- Lab investigations should include:
  - The Periodic Law (**Benchmark Assessment**)
  - Flame Tests (**Benchmark Assessment**)
  - Electron configuration

#### **SUGGESTED ASSESSMENT METHODS**

- In class worksheets (collaborative)
- Homework (individual)
- Homework quizzes (individual)
- Student class participation
- Response cards by Turning Technologies
- Tests
- Drawings of molecules
- Lab reports (collect data, analyze, draw conclusions)

<b>LEARNING STRAND</b> <b>The Chemistry of Solutions</b> <i>Big Idea: Everything is made of matter.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>The structure of the water molecule and the presence of hydrogen bonds in water are responsible for unique chemical and physical properties, which dictate many aspects of our world.</li> <li>The use of the natural resource water by human populations can affect the quality of our environment.</li> <li>The significance of polarity, electrolytes and physical conditions, such as temperature, particle size and agitation, affect solution formation and the nature of the solvation process.</li> <li>The relative amounts of solute and solvent in a solution are described by Molarity, Molality, mass and volume percent.</li> <li>Colligative properties depend on the amount of solute particles present, and include boiling point elevation, freezing point lowering, and vapor pressure lowering.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>How does the accumulation of metal and nonmetal ions used to increase agricultural productivity become a significant source of water pollution?</li> <li>What is hydrogen bonding?</li> <li>How does hydrogen bonding affect the properties of liquids in general, and water specifically?</li> <li>What are the physical conditions that affect solution formation, and what is the effect of each physical condition?</li> <li>What are definitions for the five terms for concentration?</li> <li>How is each term calculated?</li> <li>What is the reason for the change in boiling point, freezing point, or vapor pressure of a solvent, to which has been added a nonvolatile solute?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>Describe how human efforts to reduce consumption of raw materials can improve water quality.</li> <li>Explain how the accumulation of mercury, phosphates, and nitrates affects the quality of water and the organisms that live in rivers, lakes, and the ocean.</li> <li>Describe the hydrogen bonding that occurs in water, on the bases of the structure of the polar water molecule, and electronegativity.</li> <li>Use the concept of hydrogen bonding to explain the high surface tension, high boiling point, high specific heat, and high heat of vaporization of water.</li> <li>Define the terms; solution, aqueous solution, solute and solvent.</li> <li>List and explain the factors that affect the rate of dissolving.</li> <li>Understand how the concentration of a solution may be quantitatively described.</li> <li>Subjectively describe the strengths of a solution.</li> <li>Use the <b>rule of "like dissolves like" to predict the solubility of one substance in another.</b></li> <li>Characterize colloids and suspensions and explain how they differ from solutions.</li> <li>Describe the procedure for preparing a dilute solution of known concentration from a more concentrated solution.</li> <li>Distinguish among weak electrolytes, strong electrolytes and nonelectrolytes.</li> <li>Define and describe colligative properties.</li> <li>Use the concept of colligative properties to predict boiling points or freezing points of given solutions.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> Chemistry: Principles and Reactions Brooks/Cole Cengage Learning, 2009  <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>Power point presentations with imbedded practice problems</li> <li>Modeling of concepts, followed by In class practice worksheets</li> <li>Frequent question and answer sessions</li> <li>Response cards by Turning Technologies</li> <li>Lab investigations should include:               <ul style="list-style-type: none"> <li>-Solvent Properties of Water (Benchmark Assessment)</li> <li>-Properties of Solutions</li> <li>-Factors Affecting Solution Formation (Benchmark Assessment)</li> <li>-Supersaturation (Benchmark Assessment)</li> </ul> </li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>In class worksheets (collaborative)</li> <li>Homework (individual)</li> <li>Homework Quizzes (individual)</li> <li>Student class participation</li> <li>Response cards by Turning Technologies</li> <li>Tests</li> <li>Drawings of molecules</li> <li>Lab reports (collect data, analyze, draw conclusions)</li> </ul>



<b>LEARNING STRAND</b> <b>Reaction Rates and Equilibrium</b> <i>CT Standard: Reaction Rates -- Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Rates of chemical reactions are determined by collisions between reacting particles.</li> <li>▪ Reaction rates depend on such factors as concentration, temperature and pressure.</li> <li>▪ All reactions are reversible, and their equilibrium position can be described by the equilibrium constant.</li> <li>▪ <b>LeChatelier's principle predicts the response of a system at equilibrium to a change in concentration, pressure, volume, or temperature.</b></li> <li>▪ The rate of a chemical reaction is dependant on the kinetic order of the reaction, and the rate constant, which in turn is dependant on the rate determining step.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How does collision theory explain the process of a chemical reaction?</li> <li>▪ What is the underlying concept that summarizes <b>LeChatelier's Principle</b>?</li> <li>▪ What is meant by the order of a reaction?</li> <li>▪ What is the rate constant?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Use the collision theory to explain how the rate of a chemical reaction is influenced by the temperature, concentration, particle size of reactants, and catalysts.</li> <li>▪ Define chemical equilibrium in terms of equal rate of forward and reverse reactions in a reversible chemical reaction.</li> <li>▪ Relate the concept of the activated complex and activation energy to the rate of a reaction.</li> <li>▪ Write the rate law for a chemical reaction, given the order of each reactant.</li> <li>▪ <b>Using LeChatelier's principle, predict the direction in which equilibrium will shift in response to a change in concentration, pressure, volume, or temperature.</b></li> <li>▪ Discuss the reaction mechanism for a chemical reaction, given the potential energy diagram for the reaction.</li> <li>▪ Explain that catalysts increase reaction rate by lowering the activation energy of a chemical reaction.</li> <li>▪ Describe that the rate of a reaction is the increase in concentration of products over time, and the decrease in concentration of reactants over time.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Chemistry: Principles and Reactions</u> Brooks/Cole Cengage Learning, 2009  <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Power point presentations with imbedded practice problems</li> <li>▪ Modeling of concepts, followed by in-class practice worksheets</li> <li>▪ Frequent question and answer sessions</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Lab investigations should include:               <ul style="list-style-type: none"> <li>-Qualitative Aspects of Chemical Equilibrium (<b>Benchmark Assessment</b>)</li> <li>-Disturbing Equilibrium, <b>LeChatelier's Principle</b></li> <li>-Factors Affecting Reaction Rates</li> </ul> </li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ In class worksheets (collaborative)</li> <li>▪ Homework (individual)</li> <li>▪ Homework Quizzes (individual)</li> <li>▪ Student class participation</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Tests</li> <li>▪ Drawings of molecules</li> <li>▪ Lab reports (collect data, analyze, draw conclusions)</li> </ul>

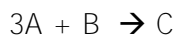
<b>LEARNING STRAND</b> <b>Acids and Bases</b> <i>Big Idea: Acids and bases can be defined in terms of hydrogen ions and hydroxide ions or in terms of electron pairs.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ General properties of acids and bases include taste, ability to react with each other in a neutralization reaction, and ability to change the color of various indicators.</li> <li>▪ Acids and bases are electrolytes.</li> <li>▪ Acids dissociate to produce hydronium ions, and some bases dissociate to produce hydroxide ions.</li> <li>▪ Water also dissociates into hydronium and hydroxide ions.</li> <li>▪ The pH scale is related to the concentration of hydronium ions logarithmically goes from 0 to 14, and is an indication of acidity of a solution.</li> <li>▪ The pOH scale is inversely related to pH.</li> <li>▪ Acids and bases can be characterized as Lewis, Arrhenius, or Bronsted-Lowry systems, based on structural and behavioral characteristics of the compounds.</li> <li>▪ The strength of acids and bases is determined by ionization and can be measured quantitatively by <math>K_a</math> or <math>K_b</math>.</li> <li>▪ Buffers are solutions that resist changes in pH when limited amounts of acid or base are added.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What are the general properties of acids and bases commonly found in households?</li> <li>▪ How can self ionization of water be explained?</li> <li>▪ How are pH and <math>[H^+]</math> related?</li> <li>▪ How are pOH and pH related?</li> <li>▪ How are pOH and <math>[OH^-]</math> related?</li> <li>▪ What is the difference between a strong acid (or base) and a concentrated acid (or base)?</li> <li>▪ What is the chemical composition of acids?</li> <li>▪ What is the chemical composition of bases?</li> <li>▪ How does pH change in neutralization reactions?</li> </ul>
<b>LEARNING OBJECTIVES The student will...</b> <ul style="list-style-type: none"> <li>▪ Define the general properties of acids and bases.</li> <li>▪ Define the self ionization of water.</li> <li>▪ Use the concentration of <math>H^+</math> OR <math>OH^-</math> to identify a solution as acidic or basic.</li> <li>▪ Describe acids and bases according to the three major acid-base theories: Arrhenius, Bronsted-Lowry, and Lewis.</li> <li>▪ Identify the conjugate acid - base pairs of the Bronsted-Lowry Theory.</li> <li>▪ Classify substances as acids, bases, or neutral based on the three acid base theories.</li> <li>▪ Calculate the gram equivalent mass of any acid or base.</li> <li>▪ Perform stoichiometric calculations involving acid – base reactions.</li> <li>▪ Calculate <math>K_a</math> or <math>K_b</math> from concentration or pH measurements.</li> <li>▪ Identify monoprotic, diprotic, and triprotic acids.</li> <li>▪ Explain the concept of titration, and include the relevance of the different weak / strong acid and base combinations.</li> <li>▪ Relate among pH, pOH, <math>[H^+]</math>, and <math>[OH^-]</math>, given log tables and a calculator.</li> <li>▪ Explain how a buffer system works using equations.</li> <li>▪ Use the concept of hydrolysis to explain why solutions of some salts are acidic or basic.</li> <li>▪ <b>Use LeChatelier’s principle to explain the common ion effect.</b></li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Chemistry: Principles and Reactions</u> Brooks/Cole Cengage Learning, 2009  <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Power point presentations with imbedded practice problems.</li> <li>▪ Modeling of concepts, followed by in-class practice worksheets</li> <li>▪ Frequent question and answer sessions</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Lab investigations should include:               <ul style="list-style-type: none"> <li>-Characteristic Reactions of Acids</li> <li>-Salt Hydrolysis</li> <li>-Neutralization Reactions</li> <li>-A Solubility Product Constant</li> <li>-Buffers</li> <li>-Acid Titration (<b>Benchmark Assessment</b>)</li> </ul> </li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ In class worksheets (collaborative)</li> <li>▪ Homework (individual)</li> <li>▪ Homework quizzes (individual)</li> <li>▪ Student class participation</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Tests</li> <li>▪ Drawings of molecules</li> <li>▪ Lab reports (collect data, analyze, draw conclusions)</li> </ul>

<b>LEARNING STRAND</b> <b>Electrochemistry</b> <i>Big Idea: Chemical energy can be converted to electric energy and electric energy to chemical energy.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ An oxidation process is one in which oxygen is gained by a species, the oxidation number of the species is increased, and electrons are lost by the species.</li> <li>▪ A reduction process is one in which oxygen is given up or lost by a species, the oxidation number of the species is decreased, and electrons are gained by the species.</li> <li>▪ If oxidation occurs, then reduction must also occur, and this is called redox (reduction in combination with oxidation).</li> <li>▪ There are two methods for balancing redox equation. One method is based on keeping track of electrons lost or gained in two half reactions; the other method is based on determining oxidation number of all involved species and adding coefficients as needed until balance is achieved.</li> <li>▪ Redox reactions that are spontaneous can be used to generate electrical energy in electrochemical cells.</li> <li>▪ In electrolytic cells, electrical energy is used to bring about desired redox reactions.</li> <li>▪ Any cell involving a redox reaction will include an anode, a cathode, and a bridge, or salt bridge.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What is the definition for oxidation and reduction?</li> <li>▪ Why do both the processes of oxidation and reduction always occur together?</li> <li>▪ How is a redox reaction balanced?</li> <li>▪ What are the basic components of a voltaic cell, an electrolytic cell, and an electrochemical cell?</li> <li>▪ How do voltaic cells work?</li> <li>▪ How do electrolytic cells work?</li> <li>▪ How do electrochemical cells work?</li> <li>▪ What are the characteristics of voltaic, electrolytic and electrochemical cells?</li> <li>▪ What are the key differences among voltaic, electrolytic and electrochemical cells?</li> </ul>
	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Chemistry: Principles and Reactions Brooks/Cole Cengage Learning, 2009</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Power point presentations with imbedded practice problems</li> <li>▪ Modeling of concepts, followed by in-class practice worksheets</li> <li>▪ Frequent question and answer sessions</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Lab investigations should include:               <ul style="list-style-type: none"> <li>-Redox Titration of iron</li> <li>-Oxidation-Reduction Reactions</li> <li>-Measuring Potential of Electrochemical Cells</li> </ul> </li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Describe the nature of electrochemical processes.</li> <li>▪ Define oxidation, reduction, oxidizing agents and reducing agents.</li> <li>▪ Determine the oxidation number of a given atom in a chemical equation and determine the number of electrons lost or gained.</li> <li>▪ Balance Redox reactions.</li> <li>▪ Sketch a voltaic cell, labeling the cathode, the anode and the direction of flow of electrons.</li> <li>▪ Identify the half cell in which oxidation takes place and the half cell in which reduction takes place.</li> <li>▪ Identify the substance being oxidized and the substance being reduced in a dry cell.</li> <li>▪ Define cell potential and describe how it is determined.</li> <li>▪ Define the standard electrode potential of an electrode.</li> <li>▪ Use standard electrode potentials to calculate the standard electromotive force of a cell.</li> <li>▪ Distinguish between electrolytic and voltaic cells.</li> </ul>	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ In class worksheets (collaborative)</li> <li>▪ Homework (individual)</li> <li>▪ Homework quizzes (individual)</li> <li>▪ Student class participation</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Tests</li> <li>▪ Drawings of molecules</li> <li>▪ Lab reports (collect data, analyze, draw conclusions)</li> </ul>

## Honors Chemistry - Sample Benchmark

- **Students will solve word problems involving following concepts:**
  - **dimensional analysis**
  - **heat changes in chemical and physical processes**
  - **gas laws problems involving temperature, volume, and the pressure of a contained gas**
  - **equilibrium constant expressions, entropy and free-energy changes that accompany physical and chemical processes, and rate laws for simple chemical reactions**
  - **oxidation-reduction reactions**
    - **(Use effective strategies for gathering information, critical thinking, problem solving)**

**Example:** Use the experimental data below to answer the following questions.



Trial	[A] in mol/L	[B] in mol/L	Initial rate (mol/L s)
1	0.20	0.20	0.292
2	0.40	0.20	0.584
3	0.20	0.40	0.146

- a) Derive the rate equation for this reaction. Include a numerical value for k, p and q. (8 points)

Grading rubric:

Incorrect value for p and q	-3 pts each
Correct values for p and q but k is wrong	-3 pts
Incorrect units for k	-1 pt

- b) Calculate the rate the reaction when 3 moles of substance A and 5 moles of substance B are placed in a 10 liter flask. (6 points)

Grading rubric:

Incorrect value for concentration of A or B	-3 pts each
A and B are correct but rate is wrong	-3 pts
wrong units	-1 pt

## Benchmark Trends In Electronic Configuration 1B, 3

Students will interpret trends in electronic configuration as they relate to physical and chemical properties by answering questions such as free-response question\* below:

“Suppose that a stable element with atomic number 119, symbol Q, has been discovered.

- a) Write the ground-state electron configuration for Q, showing only the valence-shell electrons.
- b) Would Q be a metal or a nonmetal? Explain in terms of electron configuration.
- c) On the basis of periodic trends, would Q have the largest atomic radius in its group or would it have the smallest? Explain in terms of electronic structure.
- d) What would be the likely charge of the Q ion in stable ionic compounds?
- e) Write a balanced equation that would represent the reaction of Q with water.
- f) Assume that Q reacts to form a carbonate compound.
  - i) Write the formula for the compound formed between Q and the carbonate ion,  $\text{CO}_3^{-1}$
  - ii) Predict whether or not the compound would be soluble in water. Explain your reasoning.”

- (Use effective strategies for gathering information, critical thinking, problem solving)
- (Write effectively)
- \*from the AP Chemistry 2006 Free-Response Questions”

<b>Exceeds Expectations</b>	The student independently collects, interprets, analyzes, and evaluates a variety of information and data to make original predictions or solve problems. S/he solves problems accurately and efficiently. The student understands not only the objective but also the implications of assignments. S/he writes with a clear focus or thesis. Supporting details are well developed and organized, showing both analysis and synthesis of ideas. Word choice and syntax are accurate and appropriate. The student shows mastery in the conventions of Standard English.
<b>Meets Expectations</b>	The student independently collects, interprets, analyzes, and evaluates a variety of information and data to make specific predictions or solve problems. S/he solves problems with few errors. The student understands the objective of assignments and selects an appropriate mode of written expression with a focus or thesis. Supporting details show an understanding of the subject matter and an analysis of ideas. They are somewhat developed and organized. Word choice and syntax are accurate and appropriate. Errors in the conventions of Standard English are few. The student completes most parts of the writing process, including evaluation.
<b>Meets Some Expectations</b>	The student may need some assistance to collect and interpret a variety of data to make general predictions or solve problems. S/he solves problems with some errors. The student requires some additional explanations and models in order to understand the objective of assignments or to complete the writing process. With direction, s/he selects an appropriate mode. Writing has a somewhat limited focus or thesis, and supporting ideas may be inaccurate, simplistic, and/or confused. The student may require assistance to develop or organize his response. Word choice and syntax are consistent with grade level. There are some errors in the conventions of Standard English.
<b>Does Not Meet Expectations</b>	The student needs assistance to gather information to make a prediction or solve problems. S/he solves problems with inefficiency and with significant errors. The student misinterprets significant elements of writing assignments, selecting an inappropriate mode or using it incorrectly. The student requires many additional explanations, models, graphic organizers, and/or strategies in order to complete parts of the writing process. The writing has no clear focus or a very limited thesis. Ideas and concepts are often unorganized or inaccurate. Inaccurate or limited vocabulary, syntax errors, and errors in the conventions of writing make the writing ineffective.

## Benchmark

### 3 Use effective strategies for gathering information, critical thinking, problem solving)

Students will solve word problems which involve the following concepts:

- dimensional analysis
- stoichiometry
- heat changes in chemical and physical processes
- gas laws problems involving temperature, volume, and the pressure of a contained gas
- equilibrium constant expressions, entropy and free-energy changes that accompany physical and chemical processes, and rate laws for simple chemical reactions

<b>Exceeds Expectations</b>	The student independently collects, interprets, analyzes, and evaluates a variety of information and data to make original predictions or solve problems with a clear approach (i.e. set up). S/he solves problems accurately and efficiently. All values are correctly and fully labeled. Scientific notation is correct, and the approach, or set up, is clearly defined.
<b>Meets Expectations</b>	The student independently collects, interprets, analyzes, and evaluates a variety of information and data to make specific predictions or solve problems. S/he solves problems with few errors, and with a clear approach, or set up. Most values are correctly or fully labeled. Scientific notation is well managed.
<b>Meets Some Expectations</b>	The student may need some assistance to collect and interpret a variety of data to make general predictions or solve problems. S/he solves problems with some errors. Approach, or solution set up is incomplete. Labels are missing or incorrect. S/he has difficulty managing scientific notation, and solution is not fully set up.
<b>Does Not Meet Expectations</b>	The student needs assistance to gather information to make a prediction or solve problems. S/he solves problems with inefficiency and with significant errors. Solutions are non-sequential, labels are not used, or not used correctly. Management of scientific notation is incorrect. Solution set up is incomplete, or missing.



### Course Description

HIGH SCHOOL		
1. Course Title <b>Chemistry</b>	5. Subject Area  <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Chemistry</b>		
3. Transcript Course Code/Number <b>00342</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 10 – 12    Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input checked="" type="checkbox"/> Other: <u>1.25</u> <u>(two trimester + 30 days)</u>  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites Successful completion of Biological Systems or Biology - Honors, as well as Algebra I (Level 1 or level 2) with a grade average of C+ or better. Students must have completed or be concurrently enrolled in Geometry.		
11. Brief Course Description Level II Chemistry deals with the properties of matter, changes in its composition, and practical applications of these changes. Topics are presented in a less rigorous manner than in Chemistry-Honors. Students are required to read scientific materials, perform laboratory experiments and write laboratory reports.		
12. Course Goals 1. Demonstrate proficiency and fluency in communication to meet the literacy demands of the global community. 2. Use technology effectively and responsibly. 3. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 4. Demonstrate respect for one's self, and strive to contribute to the success of others. 5. Demonstrate the ability to work on homework and laboratory assignments independently. 6. Demonstrate the ability to meet homework and lab report deadlines. 7. Demonstrate good homework habits by working on new material covered on a nightly basis. 8. Demonstrates the ability to apply chemistry concepts and synthesize connections among concepts.		



13. Course Outline	
CHAPTER	**LABORATORY
1) Introduction to Chemistry	Check-in, Safety Training and Safety Contract
2) Matter and Change (Matter, Change & Atomic Theory)	Physical & Chemical Properties
3) Scientific Measurement	Density Reporting Experimental Uncertainty
4) Problem Solving in Chemistry	Changes in Physical State
5) Atomic Structure and the Periodic Table	Determining the Mass of Extremely Small Objects
6) Chemical Names and Formulas (Language of Chemistry)	Identifying Unknowns
7) Chemical Quantities	Moles of Copper and Iron Empirical Formula Determination
8) Chemical Reactions	Observing a Chemical Reaction Types of Reactions Precipitation Reactions
9) Stoichiometry	Quantitative Study of a Chemical Reaction
10) <u>States of Matter</u>	Cooling Rates of Evaporating Liquids
*11) Thermochemistry – Heat and Chemical Change	Heat of a Chemical Reaction
12) The Behavior of Gases (The Gaseous State of Matter)	The Molar Relationship Involving Mass and Volume <b>Graham's Law</b>
13) Electrons in Atoms (Electrons, The Periodic Law & Chemical Bonds)	Flame Tests
14) Chemical Periodicity	The Periodic Law
15) Ionic Bonding and Ionic Compounds	
16) Covalent Bonding	
17) Water and Aqueous Systems	Solvent Properties of Water
18) Solutions (The Chemistry of Solutions)	Properties of Solutions Factors Affecting Solution Formation
*19) <u>Reaction Rates and Equilibrium</u>	Chemical Equilibrium: Qualitative Aspects
*20) <u>Acids and Bases</u>	Characteristic Reactions of Acids
* Chapters will be studied based on demonstrated student ability. ** Some experiments may be substituted for, or eliminated, based on availability of chemicals/equipment.	
14. Instructional Methods and/or Strategies <ol style="list-style-type: none"> <li>1. Modeled instruction</li> <li>2. PowerPoint presentations and notes</li> <li>3. Laboratory investigations</li> <li>4. Teacher demonstrations</li> <li>5. Cooperative grouping</li> <li>6. Audio visual presentations</li> <li>7. Response cards by Turning Technologies</li> <li>8. Web-based instruction with Blackboard/finalsite</li> <li>9. Research</li> </ol>	

## 15. Assessment Methods and/or Tools

- Chapter tests
- Unit examinations
- Final examinations
- Laboratory reports
- Chapter problem sets
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response cards by Turning Technologies
- Formative quizzes and test preparation quizzes
- Short term projects, such as portfolio mini units, and group or individual presentations

**The American Chemical Society's Final Examination will be administered to all students taking Level II Chemistry.**

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum and Connecticut Standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a common scoring rubric or grading criteria.

1. Trimester grades are based on chapter test average, homework average, laboratory report average, unit test averages and quiz averages
2. Trimester examination averages are weighted in at the conclusion of each trimester.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific Inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..."</b> format, which is logically connected to the problem.</li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> <li>▪ Use dimensional analysis to solve a variety of multistep problems.</li> <li>▪ Understand Significant figures.</li> <li>▪ Convert measurements within the metric system.</li> <li>▪ Distinguish between qualitative and quantitative measurements.</li> <li>▪ Define accuracy and precision.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Chemistry Prentice Hall, 2002</li> <li>▪ General Lab equipment (Balances, glassware, Bunsen burners, safety goggles, aprons and gloves)</li> <li>▪ Calculators</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided Internet research</li> <li>▪ Response cards by Turning Technologies</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ In class worksheets (collaborative)</li> <li>▪ Homework (individual)</li> <li>▪ Homework quizzes (individual)</li> <li>▪ Student class participation</li> <li>▪ Tests</li> <li>▪ Lab reports (design labs, collect data, analyze, draw conclusions)</li> <li>▪ Observing a Chemical Reaction</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Density (Benchmark Assessment)</li> </ul>

<b>LEARNING STRAND</b> <b>Matter, Change and Early Atomic Theory</b> <i>CT Standards: Conservation of Matter - The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.</i> <i>Chemical Bonds - Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.</i> <i>Atomic and Molecular Structure - The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Matter is defined as anything that has mass and takes up space.</li> <li>▪ The three phases of matter include solid, liquid, and gas.</li> <li>▪ All matter may be categorized as a pure substance or a mixture.</li> <li>▪ A physical change does not change the identity of a substance, but a chemical change does change the identity of a substance.</li> <li>▪ Compounds are composed of elements bonded together, and their structure can only be changed through chemical means.</li> <li>▪ Mixtures may be separated based on the physical property differences of the components of the mixture.</li> <li>▪ The understanding of atomic structure was developed by many scientists and scientific thinkers over a period of more than 2000 years.</li> <li>▪ Atomic structure includes a positively charged nucleus containing two types of subatomic particles (neutrons and protons) and an outer region of negatively charged electrons.</li> <li>▪ The configuration of atoms and molecules determines the properties of materials.</li> <li>▪ Elements exist in nature as isotopes, which differ in number of neutrons, and atomic mass.</li> <li>▪ In nuclear fission, matter is transferred directly into energy in a process that is several million times more energetic than combustion.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you distinguish between pure substances and mixtures?</li> <li>▪ What are the indications that a chemical reaction (or chemical change) has taken place?</li> <li>▪ How do you distinguish between a chemical property and a physical property?</li> <li>▪ How do you distinguish between an element and a compound?</li> <li>▪ What are explanations for early experiments that led to the characterization of the nucleus, and the discovery of electrons?</li> <li>▪ What is the description of the general structure of the atom?</li> <li>▪ Why does atomic mass of isotopes vary for an element ?</li> <li>▪ How would you determine the chart mass of an element, given isotope data?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i>  <b>Matter and Change</b> <ul style="list-style-type: none"> <li>▪ Name and characterize the three states of matter.</li> <li>▪ Distinguish between matter and a substance.</li> <li>▪ Classify given samples as a substance or a mixture.</li> <li>▪ Classify given samples as heterogeneous or homogeneous.</li> <li>▪ Describe the difference between an element and a compound.</li> <li>▪ Identify physical changes of matter.</li> <li>▪ Write the symbols of common elements, and write the names of common elements, given the symbol.</li> <li>▪ Identify changes of matter as chemical or</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u>Chemistry</u> Prentice Hall, 2002 <ul style="list-style-type: none"> <li>▪ General Lab equipment (Balances, glassware, Bunsen burners, safety goggles, aprons and gloves)</li> <li>▪ Calculators</li> <li>▪ <b>Videos, such as "History of Atomic Theory"</b></li> <li>▪ Supplies for Beanium (dried beans)</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Guided Internet research</li> </ul>

physical.

### Early Atomic Theory

- Describe and explain the contribution that Thomson and Rutherford made to the development of the atomic theory.
- **Use Dalton's Atomic Theory to define an atom.**
- Compare the nucleus to the atom, and include size, mass and charge in the answer.
- Describe the mass, charge, and location of the proton, neutron, and electron.
- Understand the relationship and meaning of atomic number and mass number.
- Define isotope.
- Describe the general structure of the atom, and explain how the properties of the first 20 elements are related to their structure.

- PowerPoint presentations, with interactive simulations, and imbedded practice problems
- **Interactive games, such as "Its All in the Cards"**
- Puzzle-like activities to reinforce patterns and trends of Periodic Table
- Lab investigations
- Creative writing assignments, such as **"Autobiography of an Element"**
- **Closure tasks, such as "Your Ticket out the Door"**

### SUGGESTED ASSESSMENT METHODS

- In class worksheets (collaborative)
- Homework (individual)
- Homework quizzes (individual)
- Student class participation
- Tests, including a Make up Your Own Test, assigned as a group assessment
- Lab reports (design labs, collect data, analyze, draw conclusions)
- Physical and Chemical Properties(**Benchmark Assessment**)
- Beanium
- Response cards by Turning Technologies

<p><b>LEARNING STRAND</b>  <b>The Language of Chemistry</b>  <i>CT Standards: Atomic and Molecular Structure - The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.</i>  <i>Conservation of Matter and Stoichiometry - The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.</i>  <i>Chemical Bonds - Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Chemical symbols, formulas, and equations are understood internationally, and are written based upon universally accepted guidelines.</li> <li>The formula of a binary compound can be determined based on the positions of elements on the Periodic Table.</li> <li>The unit of measurement which chemists rely on to predict quantities in chemical reactions is the mole.</li> <li>Chemical equations are presented as balanced equations to satisfy the law of conservation of matter.</li> <li>Chemists make calculations involving quantities of reactants and products based on balanced chemical equations and yields.</li> <li>Emission of combustion by products, such as SO<sub>2</sub>, CO<sub>2</sub>, and NO<sub>x</sub>, by industries and vehicles is a major source of air pollution.</li> <li>During the burning of fossil fuels, stored chemical energy is converted to useable energy.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What are the descriptions for how atoms combine to form new substances by transferring electrons (ionic compounds) or by sharing electrons (molecular compounds)?</li> <li>How does the Periodic Table provide for the charge of a metal or a nonmetal, in an ionic compound?</li> <li>How can conversions be made among particles, mass, and moles of any substance?</li> <li>What is the difference between empirical and molecular formula?</li> <li>What is the significance of empirical formula in chemical analysis?</li> <li>How can predictions be made about which reactions will occur and what the products will be?</li> <li>How can you relate between different quantities in a balanced chemical reaction?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <p><b>Chemical Names and Formulas</b></p> <ul style="list-style-type: none"> <li>Differentiate between ionic compounds and molecular compounds, and between molecules and formula units.</li> <li>Use the Periodic Table to determine the charge on an ion.</li> <li>Explain that chemical bonds between atoms in molecules such as H<sub>2</sub>, CH<sub>4</sub>, NH<sub>3</sub>, H<sub>2</sub>CCH<sub>2</sub>, N<sub>2</sub>, Cl<sub>2</sub>, and many large biological molecules are covalent.</li> <li>Write the chemical formula of binary or ternary ionic compounds, molecular compounds, or acids, given the name, and vice versa.</li> <li>Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).</li> </ul> <p><b>The Mole</b></p> <ul style="list-style-type: none"> <li>Define Avogadro's number as one mole equals 6.02 x 10<sup>23</sup> particles (atoms or molecules).</li> <li>Properly define gram atomic mass, gram molecular mass, gram formula mass, and molar mass, and determine from the chemical formula and a table of atomic masses.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Chemistry</u> Prentice Hall, 2002</p> <ul style="list-style-type: none"> <li>General lab equipment</li> <li>Video "Global Warming – What you Need to Know"</li> <li>How to determine your carbon footprint</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>PowerPoint presentations with imbedded practice problems</li> <li>Modeling of concepts, followed by in-class practice worksheets</li> <li>Frequent question and answer sessions</li> <li>Response cards by Turning Technologies</li> <li>Calculate Your Carbon Footprint, with global warming video.</li> <li>Execute laboratory experiments: <ul style="list-style-type: none"> <li>-Empirical Formula Determination (<b>Benchmark Assessment</b>)</li> <li>-Reactions of Halides</li> <li>-Types of Reactions (<b>Benchmark Assessment</b>)</li> <li>-Single Replacement Reactions (<b>Benchmark Assessment</b>)</li> </ul> </li> </ul>

- Relate mass, moles, volume, and number of particles for a given amount of a substance at standard temperature and pressure.
- Relate the mole concept to the density of a gas.
- Use percent composition to determine empirical and molecular formulas.

**Chemical Equations**

- Identify reactants and products in a chemical equation.
- Write a balanced equation when given the names or formulas of all reactants and products in a chemical equation.
- Understand that chemical reactions can be described by writing balanced equations.
- Use appropriate symbols to write an equation to accurately describe a chemical reaction.
- Classify a reaction as combination, single or double replacement, decomposition, or combustion.
- Predict the products of each of these reaction types, using appropriate references, such as the activity series, or solubility rules.
- Describe combustion reactions of hydrocarbons and their resulting by products.
- Understand that all chemical reactions either produce energy (are exothermic) or absorb energy (are endothermic) as a result of the breaking and making of chemical bonds.

**Stoichiometry**

- Interpret a chemical equation for mole relationships of mass, particles, or volume.
- Define and apply the concepts of theoretical, actual, and percent yield.
- Explain how the release of sulfur dioxide into the atmosphere can form acid rain, and how acid rain affects water sources, organisms, and man-made structures.
- Describe the availability, current uses and environmental issues related to the use of fossil and nuclear fuels to produce electricity.

**SUGGESTED ASSESSMENT METHODS**

- In class worksheets (collaborative)
- Homework (individual)
- Homework quizzes (individual)
- Student class participation
- Response cards by Turning Technologies
- Tests
- Lab reports (design labs, collect data, analyze, draw conclusions)

<p><b>LEARNING STRAND</b>  <b>The States of Matter</b>  <i>CT Standards: Conservation of Matter and Stoichiometry - The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.</i>  <i>Chemical Bonds - Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Differences in the general characteristics of the phases of matter are related to particle energy and the presence, or absence, of attractive or repulsive forces between particles.</li> <li>Differences in the general properties of different substances are related to intermolecular forces of attraction for liquid and gas phases, and the structure in which particles are held together in the solid phase.</li> <li>Energy cannot be created or destroyed; however, energy can be converted from one form to another.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How can you summarize the differences in the particle arrangement and average particle energy among particles in the solid, liquid, or gaseous form of a substance?</li> <li>How do intermolecular forces of attraction affect the vapor pressure, boiling point and surface characteristics of a liquid?</li> <li>How does structure on molecular level affect the properties of a solid?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <p><b>States of Matter</b></p> <ul style="list-style-type: none"> <li>Explain the significance of absolute zero, giving its value in degrees Celsius and Kelvin, and relate the average kinetic energy of the particles of a substance to temperature.</li> <li>Name and characterize the three states of matter.</li> <li>Describe the motion of particles of a gas according to the Kinetic Theory.</li> <li>Explain that the atoms and molecules in liquids move in a random pattern, relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in solid form.</li> <li>Describe the effects of adding energy to matter in terms of the motion of atoms and molecules, and the resulting phase changes.</li> <li>Describe the nature of a liquid in terms of the attractive forces between particles.</li> <li>Explain why a liquid has a vapor pressure, and why a change in temperature causes a change in vapor pressure.</li> <li>Explain the significance of the unit cell to the shape of a crystal.</li> <li>Differentiate between different crystal systems and different unit cells within a crystal system.</li> <li>Explain how different intermolecular forces of attraction affect the vapor pressure, boiling and melting points, volatility, and surface tension of the substance.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Chemistry</u> Prentice Hall, 2002</p> <ul style="list-style-type: none"> <li>Vacuum pump apparatus for demonstrations</li> <li>Laptop computers with Loggerpro software for Energy of Foods / Energy of Fuels labs</li> <li>Dry ice to model sublimation and for demonstrations</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>PowerPoint presentations with imbedded practice problems</li> <li>Modeling of concepts, followed by In class practice worksheets</li> <li>Frequent question and answer sessions</li> <li>Response cards by Turning Technologies</li> <li>Execute selections from suggested labs: <ul style="list-style-type: none"> <li>-Cooling Rates of Evaporating Liquids</li> <li>-Specific Heat of a Metal (<b>Benchmark Assessment</b>)</li> <li>-Energy of Foods , or Energy of Fuels</li> </ul> </li> <li>Demonstrations of : <ul style="list-style-type: none"> <li>-Phase change under vacuum</li> <li>-Comparative cooling rates</li> </ul> </li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>In class worksheets (collaborative)</li> <li>Homework (individual)</li> <li>Homework Quizzes (individual)</li> <li>Student class participation</li> <li>Response cards by Turning Technologies</li> <li>Tests</li> <li>Lab reports (design labs, collect data, analyze, draw conclusions)</li> </ul>



<b>LEARNING STRAND</b> <b>The Gaseous State of Matter</b> <i>CT Standards: Conservation of Matter and Stoichiometry - The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.</i> <i>Chemical Bonds - Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The general behavior of a substance in the gaseous state can be described by the Kinetic Molecular Theory, which is based on observation.</li> <li>▪ The average kinetic energy of particles of a substance in the gaseous state is related to the temperature of the substance in the Kelvin (absolute) scale.</li> <li>▪ Particles of different substances will effuse at different rates, depending on the size (mass) of the particles.</li> <li>▪ The specific response to a change in pressure, temperature, and /or volume of a substance in the gaseous state can be predicted by the Combined Gas Law or one of its corollaries, the Independent (Boyle's, Charles', and Gay-Lussac') Gas Laws.</li> <li>▪ A gas in a mixture will behave the same and exert the same pressure as it would alone.</li> <li>▪ The Ideal Gas Law is an empirical relationship that relates pressure, volume, temperature, and amount of a substance in the gaseous state of matter.</li> <li>▪ The concept of an ideal gas is hypothetical and an ideal gas does not actually exist, but under most temperature and pressure conditions, most gases behave ideally.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How does the Kinetic Molecular Theory predict the relationship between particles of a gas, and in turn, the behavior of a gas?</li> <li>▪ How is Graham's Law related to the average kinetic energy of particles of a gas?</li> <li>▪ What are the factors that determine which gas law to use, to solve word problems ?</li> <li>▪ What label (s) is (are) appropriate for each parameter for each gas law?</li> <li>▪ Under what conditions will a real gas deviate from an ideal gas (or, the Ideal Gas Law)?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Use Kinetic Theory to explain gas pressure.</li> <li>▪ State the value of standard temperature and pressure.</li> <li>▪ <b>State and explain the significance of Avogadro's hypothesis.</b></li> <li>▪ Predict the response of a gas to changes in pressure, volume or temperature, using the appropriate gas law).</li> <li>▪ <b>Understand and apply Dalton's law of partial pressures.</b></li> <li>▪ <b>Understand Avogadro's hypothesis as it applies to gases.</b></li> <li>▪ Use the combined gas law to predict changes in temperature, pressure or volume.</li> <li>▪ Understand and use the Ideal Gas Law to solve word problems.</li> <li>▪ Use the Ideal Gas Law to calculate among pressure, volume, temperature, and amount of a substance in the gaseous state of matter.</li> <li>▪ Differentiate between an ideal gas and a real gas.</li> <li>▪ Describe the motion of particles of a gas according to Kinetic Theory.</li> <li>▪ Describe how human efforts to reduce consumption of raw materials can improve air quality.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Chemistry</u> Prentice Hall, 2002 <ul style="list-style-type: none"> <li>▪ <b>Glass tubes for Graham's Law Experiment</b></li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ PowerPoint presentations with imbedded practice problems</li> <li>▪ Modeling of concepts, followed by in-class practice worksheets</li> <li>▪ Frequent question and answer sessions</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Execute selections from suggested labs</li> <li>▪ <b>Graham's Law (Benchmark Assessment)</b></li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ In class worksheets (collaborative)</li> <li>▪ Homework (individual)</li> <li>▪ Homework quizzes (individual)</li> <li>▪ Student class participation</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Tests</li> <li>▪ Lab reports (design labs, collect data, analyze, draw conclusions)</li> </ul>

<b>LEARNING STRAND</b> <b>Electrons, The Periodic Law and Chemical Bonds</b> <i>CT Standards: Chemical Bonds - Biological, chemical and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules.</i> <i>Atomic and Molecular Structure - The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Every element has a unique electron configuration, which is based on the structure of the principal energy levels, energy sublevels, and orbitals.</li> <li>▪ The electron configuration of any element is indicated by its placement on the Periodic Table of the Elements.</li> <li>▪ The Periodic Table is arranged in order of increasing atomic number and grouped by similar properties, but there are several additional trends that progress through each period (row) or each family of elements (column), on the Table.</li> <li>▪ The electromagnetic spectrum is the full range of wavelengths of radiation from the sun, and it includes visible light, heat energy, sound waves, and many other types of energy (microwave, radar, X-ray, and gamma radiation).</li> <li>▪ The tendencies for metals to form cations and for nonmetals to form anions are related to position on the Periodic Table and electron configuration.</li> <li>▪ The drive for atoms to form bonds is based on the stability of the noble gases and the octet rule.</li> <li>▪ The manner in which elements combine to form compounds and the resulting molecular geometries has a profound effect on the properties exhibited by the substance.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What is electron configuration in terms of an <b>element's location on the periodic table</b>?</li> <li>▪ What is the likelihood of electron configuration forming bonds?</li> <li>▪ What type of bonds will be formed from electron configuration?</li> <li>▪ What are the trends of physical and chemical properties along periods or in groups on the Periodic Table?</li> <li>▪ What are the different groups of the periodic table?</li> <li>▪ What is the significance of the orientation and layout of the Periodic Table?</li> <li>▪ What is the character of the ionic bonding process?</li> <li>▪ What is the character of the molecular bonding process?</li> <li>▪ How can the shape, bond angles and polarity be predicted by using VSEPR theory?</li> <li>▪ What is a description of metallic bonding?</li> <li>▪ How does metallic bonding structure affect the properties of a metal?</li> <li>▪ What is a description of network covalent bonding?</li> <li>▪ How does the network covalent structure affect the properties of an ionic compound?</li> <li>▪ What is a description ionic bonding with respect to crystal structure?</li> <li>▪ How does crystal structure affect the properties of an ionic compound?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <b>Electron Configuration</b> <ul style="list-style-type: none"> <li>▪ Describe the general shape of s, and p orbitals.</li> <li>▪ Distinguish among principal energy level, energy sublevel, and atomic orbital.</li> <li>▪ Use the Aufbau Principle, the Pauli Exclusion Principle, and Hund's Rule to write the electron configuration of the elements.</li> <li>▪ Identify the electron configuration of any element based on its position on the Periodic Table.</li> <li>▪ Calculate the frequency and wavelength of light.</li> </ul> <b>The Periodic Law (Periodicity)</b> <ul style="list-style-type: none"> <li>▪ Identify trends in (first) ionization energy, electronegativity and the relative sizes of atoms.</li> <li>▪ Identify the different parts of the Periodic Table: metals, nonmetals, metalloids, representative</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Chemistry</u> Prentice Hall, 2002 <ul style="list-style-type: none"> <li>▪ Discharge tubes, and power supplies.</li> <li>▪ Spectrophotometers</li> <li>▪ Three dimensional molecular model kits</li> <li>▪ Molecular models for Lewis Structures</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ PowerPoint presentations with imbedded practice problems</li> <li>▪ Modeling of concepts, followed by In class practice worksheets</li> <li>▪ Frequent question and answer sessions</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Use of three dimensional molecular models for demonstration and also in student activities and labs</li> </ul>

elements, noble gases, transition metals and rare earth metals.

- Understand how physical and chemical **properties are based on an element's placement** in a group or period of the Periodic Table.
- Identify the number of electrons available for bonding and the number of valence electrons from the position on the Periodic Table.
- Explain why the electron configuration for chromium and copper are different than those assigned from the Aufbau filling diagram.
- Explain how electronegativity and ionization energy are related to bond type and formation.

#### **Ionic Bonding**

- Use Lewis dot structures to provide models of atoms, ions and molecules.
- State the importance of the Noble Gas electron configuration in the formation of ions.
- State and apply the octet rule.
- Describe the formation of an anion from an atom of a nonmetallic element.
- Describe the formation of a cation from an atom of a metallic element.

#### **Molecular Bonding**

- Predict the shape of simple molecules and their polarity from Lewis dot structures.
- Explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.
- Define single, double and triple bonds.
- Define resonance.
- Define and recognize polarity.
- Define and give the characteristics of an ionic bond, covalent bond, polar covalent bond, and coordinate covalent bond.
- Describe the VSEPR theory and the relevance to molecular shape, specifically bond angles.
- Explain and give an example of resonance.
- Use the theory of metallic bonding to explain the physical properties of metals.
- Explain the electrical conductivity of melted and aqueous solutions of ionic compounds.
- Understand how electronegativity relates to bonding.

- Use of discharge tubes to illustrate atomic emission spectra
- Labs should include:
  - The Periodic Law (**Benchmark Assessment**)
  - Electron configuration
  - Properties of Solids
  - Flame Tests (**Benchmark Assessment**)
  - Lewis Structures of Molecules

#### **SUGGESTED ASSESSMENT METHODS**

- In class worksheets (collaborative)
- Homework (individual)
- Homework quizzes (individual)
- Student class participation
- Response cards by Turning Technologies
- Tests
- Drawings of molecules
- Lab reports (collect data, analyze, draw conclusions)

<b>LEARNING STRAND</b> <b>The Chemistry of Solutions</b> <i>Big Idea: Everything is made of matter.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The structure of the water molecule and the presence of hydrogen bonds in water are responsible for unique chemical and physical properties, which dictate many aspects of our world.</li> <li>▪ The use of the natural resource water by human populations can affect the quality of our environment.</li> <li>▪ The significance of polarity, electrolytes and physical conditions (such as temperature, particle size, and agitations) affect solution formation and the nature of the solvation process.</li> <li>▪ The relative amounts of solute and solvent in a solution are described by Molarity, Molality, mass and volume percent.</li> <li>▪ Colligative properties depend on the amount of solute particles present, and include boiling point elevation, freezing point lowering and vapor pressure lowering.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How does the accumulation of metal and nonmetal ions used to increase agricultural productivity become a significant source of water pollution?</li> <li>▪ What is hydrogen bonding?</li> <li>▪ How does hydrogen bonding affect the properties of liquids in general, and water, specifically.</li> <li>▪ What are the physical conditions that affect solution formation, and what is the effect of each physical condition ?</li> <li>▪ What are definitions for the five terms for concentration?</li> <li>▪ How is each term calculated?</li> <li>▪ How does the addition of a nonvolatile solute change the boiling point, freezing point, or vapor pressure of a solvent?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Describe how human efforts to reduce consumption of raw materials can improve water quality.</li> <li>▪ Explain how the accumulation of mercury, phosphates, and nitrates affects the quality of water and the organisms that live in rivers, lakes and the ocean.</li> <li>▪ Calculate the percent water in a hydrate and name a hydrate given the formula (or vice versa).</li> <li>▪ Describe the hydrogen bonding that occurs in water on the bases of the structure of the polar water molecule and electronegativity.</li> <li>▪ Use the concept of hydrogen bonding to explain the high surface tension, high boiling point and low vapor pressure of water.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Chemistry</u> Prentice Hall, 2002 <ul style="list-style-type: none"> <li>▪ <b>Lab supplies for "Marbling" activity (shaving cream, cardstock, and food coloring)</b></li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ PowerPoint presentations with imbedded practice problems</li> <li>▪ Modeling of concepts, followed by In class practice worksheets</li> <li>▪ Frequent question and answer sessions</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Demonstrations</li> <li>▪ Marbling (interdisciplinary art/science/history)</li> <li>▪ Labs should include:               <ul style="list-style-type: none"> <li>-Supersaturation (<b>Benchmark Assessment</b>)</li> <li>-Properties of Solutions</li> </ul> </li> </ul>

<ul style="list-style-type: none"><li>▪ Define the terms solution, aqueous solution, solute and solvent.</li><li>▪ Understand how the concentration of a solution may be quantitatively described.</li><li>▪ <b>Use the rule of "like dissolves like" to predict the solubility of one substance in another.</b></li><li>▪ Describe the procedure for preparing a dilute solution of known concentration from a more concentrated solution.</li><li>▪ Define and describe colligative properties.</li><li>▪ Use the concept of colligative properties to predict boiling points or freezing points of given solutions.</li></ul>	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"><li>▪ In class worksheets (collaborative)</li><li>▪ Homework (individual)</li><li>▪ Homework quizzes (individual)</li><li>▪ Student class participation</li><li>▪ Response cards by Turning Technologies</li><li>▪ Tests</li><li>▪ Drawings of molecules</li><li>▪ Lab reports (collect data, analyze, draw conclusions)</li></ul>
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<p><b>LEARNING STRAND</b>  <b>Reaction Rates and Equilibrium</b>  <i>CT Standard: Reaction Rates - Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>-Rates of chemical reactions are determined by collisions between reacting particles.</li> <li>-All reactions are reversible, and their equilibrium position can be described by the equilibrium constant.</li> <li>-<b>LeChatelier's principle predicts the response of a system at equilibrium to a change in concentration, pressure, volume, or temperature.</b></li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the underlying concept that summarizes <b>LeChatelier's Principle</b> ?</li> <li>▪ How is the equilibrium constant, K, determined from a chemical equation?</li> <li>▪ What is the significance of different values (very high or very low) of K?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>-Define chemical equilibrium in terms of a reversible reaction.</li> <li>-<b>Using LeChatelier's principle, predict the direction in which equilibrium will shift in response to a change in concentration, pressure, volume, or temperature.</b></li> <li>-Given a chemical equation, write the expression for the equilibrium constant.</li> <li>-Given concentration information and a chemical reaction (or equation), calculate the value for the equilibrium constant.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Chemistry</u> Prentice Hall, 2002</p>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>-Power point presentations with imbedded practice problems</li> <li>-Modeling of concepts, followed by In class practice worksheets</li> <li>-Frequent question and answer sessions</li> <li>-Labs should include:  Disturbing Equilibrium  <b>LeChatelier's Principle</b></li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>-In class worksheets (collaborative)</li> <li>-Homework (individual)</li> <li>-Homework quizzes (individual)</li> <li>-Student class participation</li> <li>-Response cards by Turning Technologies</li> <li>-Tests</li> <li>-Lab reports (collect data, analyze, draw conclusions)</li> </ul>

<b>LEARNING STRAND</b> <b>Acids and Bases</b> <i>Big Idea: Acids and bases can be defined in terms of hydrogen ions and hydroxide ions or in terms of electron pairs.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ General properties of acids and bases include taste, ability to react with each other in a neutralization reaction, and ability to change the color of various indicators.</li> <li>▪ Acids and bases are electrolytes.</li> <li>▪ Acids dissociate to produce hydronium ions, and some bases dissociate to produce hydroxide ions. Water also dissociates into hydronium and hydroxide ions.</li> <li>▪ The pH scale is related to the concentration of hydronium ions, logarithmically, goes from 0 to 14, and is an indication of acidity of a solution.</li> <li>▪ The pOH scale is inversely related to pH.</li> <li>▪ Acids and bases can be characterized as Lewis, Arrhenius, or Bronsted-Lowry systems based on structural and behavioral characteristics of the compounds.</li> <li>▪ The strength of acids and bases is determined by ionization, and can be measured quantitatively by <math>K_a</math> or <math>K_b</math>.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What are the general properties of acids and bases commonly found in households?</li> <li>▪ How can self ionization of water be explained?</li> <li>▪ How are pH and <math>[H^+]</math> related ?</li> <li>▪ How are pOH and pH related ?</li> <li>▪ How are pOH and <math>[OH^-]</math> related ?</li> <li>▪ What is the difference between a strong acid (or base) and a concentrated acid (or base)?</li> <li>▪ What is the chemical composition of acids?</li> <li>▪ What is the chemical composition of bases?</li> <li>▪ How does pH change in neutralization reactions?</li> </ul> <b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Chemistry</u> Prentice Hall 2002
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Define the general properties of acids and bases.</li> <li>▪ Define the self ionization of water.</li> <li>▪ Use the concentration of <math>H^+</math> OR <math>OH^-</math> to identify a solution as acidic or basic.</li> <li>▪ Describe acids and bases according to the three major acid-base theories: Arrhenius, Bronsted-Lowry, and Lewis.</li> <li>▪ Identify the conjugate acid - base pairs of the Bronsted-Lowry Theory.</li> <li>▪ Classify substances as acids, bases or neutral based on the three acid base theories.</li> <li>▪ Calculate the gram equivalent mass of any acid or base.</li> <li>▪ Calculate <math>K_a</math> or <math>K_b</math> from concentration or pH measurements.</li> <li>▪ Identify monoprotic, diprotic and triprotic acids.</li> <li>▪ Explain the concept of titration, and include the relevance of the different weak / strong acid and base combinations.</li> <li>▪ Relate among pH, pOH, <math>[H^+]</math>, and <math>[OH^-]</math>, given log tables and a calculator.</li> </ul>	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ PowerPoint presentations with imbedded practice problems</li> <li>▪ Modeling of concepts, followed by In class practice worksheets</li> <li>▪ Frequent question and answer sessions</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Labs should include:               <ul style="list-style-type: none"> <li>-Characteristic Reactions of Acids</li> <li>-Salt Hydrolysis</li> <li>-Neutralization Reactions</li> <li>-A Solubility Product Constant</li> <li>-Buffers</li> <li>-Acid Titration</li> </ul> </li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ In class worksheets (collaborative)</li> <li>▪ Homework (individual)</li> <li>▪ Homework quizzes (individual)</li> <li>▪ Student class participation</li> <li>▪ Response cards by Turning Technologies</li> <li>▪ Tests</li> <li>▪ Drawings of molecules</li> <li>▪ Lab reports (collect data, analyze, draw conclusions)</li> </ul>

### Course Description

HIGH SCHOOL		
1. Course Title <b>Advanced Placement Chemistry            University of Connecticut/Early College Experience            Chemistry 1127Q/1128Q</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>AP Chemistry</b>		
3. Transcript Course Code/Number <b>00351</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grades: 11-12    Level: 1  7. Seeking "Honors" Distinction? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input checked="" type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)	
10. Pre-Requisites Level I Chemistry and Level I Chemistry Teacher Recommendation		
11. Brief Course Description This course is designed to provide a foundation for more advanced courses in chemistry. Topics in the first half of the course include: atomic theory, laws and theories concerning the physical and chemical behavior of gases, liquids, solids and solutions; properties of some of the more familiar elements and their compounds; quantitative measurements illustrating the laws of chemical combinations. Topics in the second half of the course include: equilibrium in solutions and quantitative reactions of the common cations and anions. All students are encouraged to take the AP Chemistry Examination. <u>Students start laboratory experiments and UConn examinations at 7 am.</u>		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocols. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently. <b>6. Demonstrate respect for one's self, and strive to contribute to the success of others.</b>		



13. Course Outline:

**CHEMISTRY 1127Q (UCONN 1<sup>st</sup> semester)**

Chemistry: Principles and Reactions by Brooks &amp; Cole, Cengage Learning, 2009

**CHAPTER**

1 Matter and Measurements  
 2 Atoms, Molecules, and Ions  
 3 Mass Relations in Chemistry: Stoichiometry  
 EXAM I (CH 1-3, Experiments)

4 Reactions in Aqueous Solutions

5 Gases

EXAM II (CH. 4 –5 , Experiments)

6 Electronic Structure and the Periodic Table

7 Covalent Bonding  
 8 Thermochemistry  
 EXAM III (CH. 6 – 8, Experiments)

9 Liquids and Solids  
 FINAL EXAM (CHAPTERS 1 – 9, Experiments)

**LABORATORY**

Check-in & Safety Training and Safety Contract  
 Density  
 Stoichiometry, Chromatography, Fractional Crystallization

Determination of Chemical Formula  
 Analysis of Unknown Chloride  
 MM of a Solid Acid

Fe Determination  
 MM of a Volatile Liquid  
 Analysis of an Al-Zn Alloy  
 The Alkaline Earths & Halogens

Calorimetry

**CHEMISTRY 1128Q (UCONN 2<sup>nd</sup> semester)**

10 Solutions  
 11 Rate of Reaction  
 12 Gaseous Chemical Equilibrium  
 EXAM I (CH. 10-12, Experiments)

13 Acids and Bases

14 Equilibria in Acid-Base Solutions  
 15 Complex Ions  
 Exam II (CH. 13-15)

16 Precipitation Equilibria  
 17 Spontaneity of Reaction  
 18 Electrochemistry  
 EXAM III (CH. 16-18, Experiments)

19 Nuclear Reactions  
 FINAL EXAM (CHAPTERS 10-19, Experiments)

Molar Mass determination by Depression of the Freezing Point  
 Rates of Chemical Reactions I: The Iodination of Acetone  
 Some Nonmetals and Their Compounds

pH – Determination of the Equilibrium  
 Constant for a Chemical Reaction  
 Buffers and Their Properties  
 Determination of the Solubility Product of Lead (II) Iodide

Qualitative Analysis of Group I, II, and III  
 Ions and General Unknowns

14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations

- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response Cards by TurningTechnologies

15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics

- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects
- Chapter problem sets

## 16. Assessment Criteria

The technology benchmark used involves the students learning the proper use and functions of various laboratory equipment including, but not limited to:

- electronic balances
- analytical measuring devices such as balances, burets, pipets, and electronic thermometers.
- NOTE: The University does NOT allow the use of computers in the experiments performed in this course.

The writing benchmark is incorporated through the requirement of students to prepare and submit laboratory reports. The students must maintain a laboratory log book while performing experiments. At the conclusion of each lab session, students must submit initial copies of their data. They then must prepare their laboratory reports including not only all of the observations, calculations, and interpretations involved in the experiment, but also must do so using proper grammar, punctuation, spelling, and sentence structure. The benchmark for use of effective strategies for gathering information, critical thinking, and problem solving are inherent with the subject of science. Starting at the beginning of the course with the Scientific Method, the students are required to use ALL of these skills, on a DAILY BASIS, throughout the course; it is the ESSENCE OF SCIENCE.

The University of Connecticut provides all benchmark assessment criteria and determines the final point distribution (final grade). At the conclusion of each semester, the University sends a letter grade-points **earned grade distribution report**. Each student's point total is matched against this report and his/her final letter grade for the course is determined. Below is a sample of such a report. This report was for the second semester course (Chem 1128).

**Total Points Range for Final Letter Grades**

Here are the ranges for the final letter grade for Chem 1128. Numbers on the left reflect the total number of points accumulated during the semester. Maximum points that can be accumulated = 1000

920 - 1000 = A	769 - 720 = C
919 - 900 = A-	719 - 700 = C-
899 - 870 = B+	699 - 670 = D+
869 - 820 = B	669 - 620 = D
819 - 800 = B-	619 - 600 = D-
799 - 770 = C+	599 and below F

Overall average 760/1000

Final exam average 173/250

**HONORS COURSES ONLY**

17. Indicate how this honors course is different from the standard course.

**This is a true college course. As required, the course syllabus supplied by the University of Connecticut's Department of Chemistry is followed.** All exams, laboratory experiments, sectional exams, final exams, correcting rubrics, and final grading guidelines are followed so that our students are graded exactly as students taking the course at the University of Connecticut are graded. The instructor for the course is a University certified adjunct professor and is required to attend re-certification sessions at the University.



## AP CHEMISTRY

\*This course is the University of Connecticut's CHEM 127Q (1<sup>st</sup> sem) and CHEM 128Q (2<sup>nd</sup> sem).

### **A. Classroom Emphasis:**

1. The course is problem-solving based. Students are introduced to the various theories, laws, and concepts through assigned readings with reinforcement provided in lectures. Strong emphasis is placed on problem-solving and problem-solving techniques. In addition to assigned problems, copious amounts of problems are worked out during lectures with the assistance of the instructor.
2. **Students are allowed the use of a scientific calculator but "plotting calculators" are not allowed.**
3. Students are encouraged to work in groups on the solution of problems during class but are under an honor code when working on homework problems.

### **B. Laboratory Emphasis:**

1. The laboratory emphasizes laboratory safety, laboratory techniques, observations skills, and proper record keeping.
2. To allow sufficient time, class begins at 7 a.m. on laboratory days.
3. A pre-lab quiz is given the day before an experiment is to be performed. The quiz is based on the "Pre-Lab Assignment" which accompanies each experiment in the laboratory text.

### **C. Homework Problems:**

1. All homework problem sets are assigned by the Chemistry Department at the University of Connecticut.
2. All homework problem sets are collected, corrected, graded, and returned to students. The answer key is posted once the assignments are returned to the students.
3. Students are to work on homework problem sets on their own. They work under an honor code.

### **D. Testing:**

1. One-hour chapter tests are given at the conclusion of each chapter.
2. The University of Connecticut supplies three (3) Unit Exams during each semester. Each Unit Exam covers two (2) or three (3) chapters of work and is scheduled for a two-hour test time. The correcting rubric is supplied by the University of Connecticut and their rubric is fully adhered to.
3. The University of Connecticut supplies a three-hour Final Examination at the conclusion of each semester along with a correcting rubric. In addition, the university has the right to request that the final exams be sent to them for correction.

### **E. Topics Covered, by Chapter**

#### **1 Matter and Measurements**

**1.0 weeks**

- a. Types of Matter
  - i. Elements
  - ii. Compounds
  - iii. Mixtures
- b. Measurements
  - i. Length
  - ii. Volume
  - iii. Mass
  - iv. Temperature
  - v. Experimental Error; Significant Figures
    - a. Counting Significant Figures
    - b. Multiplication and Division
    - c. Addition and Subtraction
    - d. Exact number

- vi. Conversion Factors
  - a. One-Step Conversion
  - b. Multiple Conversion Factors
- c. Properties of Substances
  - i. Density
  - ii. Solubility
  - iii. Color; Absorption Spectrum

Homework Problems: 1,3,7,9,11,13,17,19,23,25,33,39,49,53

Laboratory: Check-in & Safety Training and Safety Contract

## **2 Atoms, Molecules, and Ions**

**1.5 weeks**

- a. Atoms and the Atomic Theory
  - i. Atomic Theory
- b. Components of the Atom
  - i. Protons
  - ii. Neutrons
  - iii. Electrons
  - iv. Atomic Number
  - v. Mass Number
  - vi. Nuclear Stability
- c. Introduction to the Periodic Table
  - i. Atomic Number
  - ii. Mass Number
  - iii. Atomic Size
  - iv. Ionization Energy
  - v. Electronegativity
  - vi. Density
  - vii. Ionic Size
  - viii. Metallic Character
- d. Molecules and Ions
  - i. Types of Formulas
  - ii. Formation of Monoatomic Ions
  - iii. Charges of Monoatomic Ions with Noble-Gas Structures
  - iv. Polyatomic Ions
  - v. Formulas of Compounds
- e. Formulas of Ionic Compounds
- f. Names of Compounds
  - i. Ionic
  - ii. Binary Molecular Compounds
  - iii. Acids

Homework Problems: 3,5,11,13,15,17,25,29,31,35,41,49

Laboratory: The Densities of Liquids and Solids (hands-on) (2.5 – 3 hr)

Emphasis: This experiment is performed to not only allow students to determine, with excellent precision, the density of a liquid and the density of a solid using the displacement of water, but also introduces them to the proper use of analytical balances.

**3 Mass Relations in Chemistry: Stoichiometry**      **2.0 weeks**

- a. Atomic Masses
  - i. Meaning of Atomic Masses
  - ii. Atomic Masses from Isotopic Composition
  - iii. Masses of Individual Atoms
- b. The Mole
  - i. Meaning
  - ii. Molar Mass
  - iii. Mole-Mass Conversions
- c. Mass Relations in Chemical Formulas
  - i. Mass Percent from Formulas
  - ii. Simplest Formula from Percent Composition
  - iii. Simplest Formula from Analytical Data
  - iv. Molecular Formula from Simplest Formula
- d. Mass Relations in Reactions
  - i. Balancing
  - ii. Mass Relations in Reactions
  - iii. Limiting Reactant, Theoretical Yield
  - iv. Actual Yield, Percent Yield

Homework Problems: 5,7,15,23,31,41,45,47,51,55,59,67,85

Laboratory: Resolution of Matter into Pure Substances:Chromatography (hands-on)(2.5 - 3 hr)

Emphasis: Students learn the techniques involved in paper chromatography by separating a mixture of ions, determining their  $R_f$  values, and then identifying the components of an unknown sample.

Resolution of Matter into Pure Substances:Fractional Crystallization (hands-on)(2.5 - 3 hr)

Emphasis: Students are given a sample containing silicon carbide, potassium nitrate, and copper (II) sulfate pentahydrate, with the hydrate present essentially as an impurity. They learn the proper techniques of separating and recovering the silicon carbide and potassium nitrate and determine the percent composition of their mixture.

EXAM I (CH 1-3, Experiments)

**4 Reactions in Aqueous Solutions**      **2.0 weeks**

- a. Solute Concentrations
  - i. Molarity
- b. Precipitation Reactions
  - i. Precipitation Diagram
  - ii. Stoichiometry
- c. Acid-Base Reactions
  - i. Acid
  - ii. Base
  - iii. Acid-Base Reactions
  - iv. Acid-Base Titrations
- d. Oxidation-Reduction Reactions
  - i. Oxidation Number
  - ii. Balancing Redox Reactions

Homework Problems: 1,3,5,11,15,19,27,33,39,41,49,51,55,57,61,65,69,73

Laboratory: Determination of a Chemical Formula (hands-on)(2.5 – 3 hr)

Emphasis: In this experiment, the compound whose formula is determined is  $\text{CuCl}_2 \cdot 2 \text{H}_2\text{O}$ . This compound is stoichiometrically clean, in that it does not tend to lose or absorb water, and can be obtained pure. It loses its water of hydration completely when heated to about  $110^\circ\text{C}$ . The copper it contains is reduced to the metal by aluminum. Chlorine content is obtained by difference. Students determine its percent composition and its empirical formula.

Analysis of an Unknown Chloride (hands-on)(2.5 – 3 hr)

Emphasis: Students are introduced to the proper techniques of quantitative analysis by titration. Students watch a demonstration of proper titration techniques and practice the technique the day before the experiment is performed.

## **5 Gases**

**2.0 weeks**

- a. Measurements on Gases
  - i. Pressure
  - ii. Barometer
  - iii. Manometer
    - a. open-end
    - b. closed-end
- b. The Ideal Gas Law
  - i. Variables
  - ii. Initial and Final State Problems
  - iii. Calculation of P, V, n, or T
- c. Gas Law Calculations
  - i. Calculations of Density or Molar Mass
  - ii. Volumes of Gases Involved in Reactions
- d. Stoichiometry of Gaseous Reactions
- e. Gas Mixtures: Partial Pressures and Mole Fractions
  - i. **Dalton's Law**
- f. Kinetic Theory of Gases
  - i. Expression for Velocity
  - ii. **Graham's Law**
- g. Real Gases

Homework Problems: 3,7,11,19,23,29,35,39,43,49,65

Laboratory: The Standardization of a Basic Solution and the Determination of the Molar Mass of a Solid Acid (hands-on)(2.5 – 3 hr)

Emphasis: Student use a prepared, standardized solution of hydrochloric acid to determine the concentration of a sodium hydroxide solution they prepare. They then use the standardized sodium hydroxide to determine the molecular mass of an unknown monoprotic acid.

EXAM II (CH. 4 –5 , Experiments)

**6 Electronic Structure and the Periodic Table** **2.0 weeks**

- a. Light, Photon Energies, and Atomic Spectra
- b. The Hydrogen Atom
  - i. Bohr Model
  - ii. Quantum Mechanical Model
- c. Quantum Numbers
  - i. Principal Energy Levels
  - ii. Sublevels
  - iii. Azimuthal Number
  - iv. Magnetic Spin
- d. Atomic Orbitals: Shapes and Sizes
- e. Electron Configurations in Atoms
- f. Orbital Diagrams of Atoms
- g. Electron Arrangements in Monatomic Ions
- h. Periodic Trends in the Properties of Atoms

Homework Problems: 1,5,9,17,21,23,27,31,37,39,45,49,57

Laboratory: Determination of Iron by Reaction with Permanganate – A Redox Titration  
(hands-on)(2.5 – 3 hr)

Emphasis: Students use a standardized solution of potassium permanganate to determine the percent iron in an unknown sample.

Molar Mass of a Volatile Liquid (hands-on)(2 hr)

Emphasis: Students determine the molar mass of a liquid using a vapor density flask of known volume.

**7 Covalent Bonding** **2.5 weeks**

- a. Lewis Structures; The Octet Rule
  - i. Rules for Writing Lewis Structures (Single Bonds)
  - ii. Electron-Deficient Structures
  - iii. Expanded Octets
  - iv. Resonance Forms
- b. Molecular Geometry
  - i. Two or Six Atoms Around Central Atom
  - ii. Unshared Electrons
  - iii. Multiple Bonding
- c. Polarity of Molecules
  - i. Bond Polarity
  - ii. Molecular Polarity
- d. Atomic Orbitals; Hybridization
  - i. Formation of Hybrid Orbitals
  - ii. Hybridization with 5 or 6 Electron Pairs
  - iii. Unshared Pairs
  - iv. Sigma and Pi Bonds

Homework Problems: 1,5,9,17,23,29,31,37,45,51,63

Laboratory: Analysis of an Al-Zn Alloy (hands-on)(3 hr)

Emphasis: Students determine the percent composition of an Al-Zn alloy by reaction with hydrochloric acid. They collect the hydrogen produced from a weighed sample of their alloy, measuring the volume, temperature and total pressure of the gas, and then use the Ideal Gas Law, taking into account the water vapor pressure, to calculate the number of moles of hydrogen produced by the sample.



**8 Thermochemistry****3.0 weeks**

- a. Principles of Heat Flow
  - i. Basic Concepts
  - ii. Endothermic
  - iii. Exothermic
- b. Measurements of Heat Flow; Calorimetry
  - i. Coffee-Cup Calorimeter
  - ii. Bomb Calorimeter
- c. Enthalpy
- d. Thermochemical Equations
  - i. Rules of Thermochemistry
- e. Enthalpies of Formation
- f. Bond Enthalpy
- g. The First Law of Thermodynamics

Homework Problems: 5,9,13,15,21,27,29,35,41,45,71,73

Laboratory: The Alkaline Earths and the Halogens – Two Families in the Periodic Table (hands-on)(2 hr)

Emphasis: Students determine the relative oxidizing strengths of the halogens. They then determine the relative solubilities of the alkaline earth cations. Lastly, they develop a systematic procedure for determining the presence of any Group 2 cation and any Group 17 anion in a solution. They use this information to determine the anion and cation present in an unknown.

EXAM III (CH. 6 – 8, Experiments)

**9 Liquids and Solids****2.0 weeks**

- a. Liquid-Vapor Equilibrium
  - i. Vapor Pressure
  - ii. Temperature Dependence of Vapor Pressure
  - iii. Boiling Point
  - iv. Critical Temperature
- b. Phase Diagrams
- c. Molecular Substances; Intermolecular Forces
  - i. General Properties
  - ii. Dispersion Forces
  - iii. Dipole Forces
  - iv. Hydrogen Bonds
- d. Network Covalent, Ionic, and Metallic Solids
- e. Crystal Structures
  - i. Unit Cells in Metals
    - a. Simple Cubic
    - b. Face-Centered Cubic
    - c. Body-Centered Cubic

Homework Problems: 1,3,7,15,19,21,23,25,31,35,49,59

Laboratory: Heat Effects and Calorimetry (hands-on)(2.5 – 3 hr)

Emphasis: Using a calorimeter, students determine the specific heat of an unknown metal, the heat of solution of an unknown solid, and the heat of neutralization of known solutions of hydrochloric acid and sodium hydroxide.

FINAL EXAMINATION – 1<sup>st</sup> Semester (CHAPTERS 1 – 9, Experiments)

**10 Solutions****2.0 weeks**

- a. Concentration Units
  - ii. Mole Fraction
  - iii. Mass Percent Solute
  - iv. Molality
  - v. Conversion Between Units
- b. Principles of Solubility
  - i. Nature of Solute and Solvent
  - ii. Effect of Temperature
  - iii. Effect of Pressure
- c. Colligative Properties of Nonelectrolytes
  - i. Vapor Pressure Lowering
  - ii. Boiling Point Elevation
  - iii. Freezing Point Depression
  - iv. Osmotic Pressure
- d. Colligative Properties of Electrolytes

Homework Problems: 3,7a,7b, 9c, 9d,11,15,17a, 17b, ,23,29,33,37,43, 59, 71

Laboratory: Molar Mass determination by Depression of the Freezing Point (hands-on)(2.5 hr)

Emphasis: Students first determine the freezing point of pure water, using a slurry of ice and water. They then add a known mass of an unknown to the slurry, and find the freezing point of the solution, thus determining the freezing point depression. This allows them to calculate the molality of the solution. Then they separate the solution from the ice, weight the solution, which contains all of the solute, and use this information to calculate the molar mass of the solute.

**11 Rate of Reaction****2.0 weeks**

- a. Meaning of Reaction Rate
- b. Reaction Rate and Concentration
- c. Reactant Concentration and Time
  - i. Zero-Order
  - ii. First-Order
  - iii. Second-Order
- d. Models for Reaction Rate
  - i. Collision Model
  - ii. Activated Complex
- e. Reaction Rate and Temperature
  - i. Arrhenius Equation
- f. Catalysis
- g. Reaction Mechanisms

Homework Problems:3, 9a, 9b, 11,13b, 13d, 17,21,25,37,43,45,51,75

Laboratory: Rates of Chemical Reactions I: The Iodination of Acetone (hands-on)(3 hr)

Emphasis: The students study the kinetics of the reaction between iodine and acetone. After gathering the data, they calculate the reaction orders with respect to acetone, hydrogen ion, and iodine; determine the rate constant for the reaction; and determine the energy of activation.

**12 Gaseous Chemical Equilibrium****2.0 weeks**

- a. The  $\text{N}_2\text{O}_4\text{-NO}_2$  Equilibrium System
- b. The Equilibrium Constant Expression
  - i. Only Gases Involved
  - ii. Solids or Liquids as Well as Gases
  - iii. Aqueous Solutions
  - iv. Relation Between Equilibrium Constants
- c. Determination of K
- d. Application of the Equilibrium Constant
  - i. Determination of Direction of Reaction
  - ii. Extent of Reaction
- e. Effect of Changes in Conditions on an Equilibrium System
  - i. Adding or Removing a Gaseous Species
  - ii. Increase in Pressure  
Changes in Temperature

Homework Problems – 3, 7, 11,17,21,23,25,33,41,43,47,51

Laboratory: Some Nonmetals and Their Compounds (hands-on)(2 hr)

Emphasis: Students prepare several gases and learn to (1) test for odor, (2) test for support of combustion, and (3) test for acid-base properties. The gases prepared are nitrogen, iodine, bromine, carbon dioxide, sulfur dioxide, nitrogen dioxide, nitric oxide, ammonia, and hydrogen sulfide. Once they have completed the preparation and tests, they are given an unknown **compound and determine it's composition.**

EXAM I (Chapters 10 – 12, experiments)

**13 Acids and Bases****2.0 weeks**

- a. Bronsted-Lowry Acid-Base Model
- b. The Ion Product of Water
- c. pH and pOH
- d. Weak Acids and Their Equilibrium Constants
  - i. Molecules
  - ii. Cations
- e. Weak Bases and Their Equilibrium Constants
  - i. Molecules
  - ii. Anions Derived from Weak Acids
- f. Acid-Base Properties of Salt Solutions
  - i. Cations
  - ii. Anions
  - iii. Overall Results

Homework Problems: 1,9,13,19,23,25,31,33,39,45,49,55,59,76

Laboratory: pH – Determination of the Equilibrium Constant for a Chemical

Reaction (hands-on)(3 hr)

Emphasis: Students learn the proper use of a spectrophotometer while determining the equilibrium constant for the the iron (III) / thiocyanate system. This experiment represents the most intense calculations involved with any of the experiments and requires that they have solid understanding of the chemical system.

**14 Equilibria in Acid-Base Solutions****2.5 weeks**

- a. Buffers
  - i. Capacity of Buffers
- b. Acid-Base Indicators
- c. Acid-Base Titrations
  - i. Strong Acid-Strong Base
  - ii. Weak Acid-Strong Base
  - iii. Strong Acid-Weak Base
  - iv. Choice of Indicator

Homework Problems: 1,,5,9a,9c,15,17,21,27,31,39,41,43,45,56

Laboratory: pH Measurements – Buffers and Their Properties (hands-on)(2 hr)

Emphasis: Students determine the pH of acid/base solutions using indicators; determine the pH of aqueous solutions of acidic, basic, and neutral salts; study the buffer capacity of acetic acid-acetate ion, ammonium ion-ammonia, and hydrogen carbonate-carbonate buffer system; and prepare a buffer from a solution of a weak acid.

**15 Complex Ions****1.5 weeks**

- a. Composition of Complex Ions
  - i. A Complex Ion
  - ii. Nature of Ligands
- b. Geometry of Complex Ions
  - i. Coordination Number = 2
  - ii. Coordination Number = 4
  - iii. Coordination Number = 6
  - iv. Geometric Isomerism
- c. Electronic Structure of Complex Ions
  - i. Electronic Structure of Transition Metal Cations
  - ii. Crystal Field Model
    - a. High Energy
    - b. Low Energy
- d. Formation Constants of Complex Ions
  - i. Color

Homework Problems: 3,5,7,9,13,17,21,29,37,43

Laboratory: Determination of the Solubility Product of Lead (II) Iodide (hands-on)(2.5 – 3 hr)

Emphasis: Using a spectrophotometer, students determine the solubility product of lead (II) iodide.

EXAM II (Chapters 13 – 15, experiments)

**16 Precipitation Equilibria****1.5 weeks**

- a. Precipitate Formation; Solubility Product Constant ( $K_{sp}$ )
  - i. Expression for  $K_{sp}$
  - ii. Uses of  $K_{sp}$
- b. Dissolving Precipitates
  - i. Strong Acids
  - ii. Aqueous Ammonia
  - iii. Hydroxides

Homework Problems: 1,5,,9,13,17,21,27,31,37,41,55

Laboratory: Qualitative Analysis of Group I Cations (hands-on)(4 hr)

Emphasis: Students make use of techniques learned during the course to study the Group I cations. After completion of all tests on known solutions, students prepare a flow chart and analyze an unknown solution containing one or more of the Group I cations.

**17 Spontaneity of Reaction****2.0 weeks**

- a. Spontaneous Processes
  - i. Examples
  - ii. Factors Affecting
- b. Entropy,  $S$
- c. Free Energy,  $G$
- d. Standard Free Energy Change,  $\Delta G^\circ$ 
  - i. Calculation of  $\Delta G^\circ$  from  $\Delta H^\circ$  and  $\Delta S^\circ$
  - ii. Calculation of  $\Delta G^\circ$  at 25°C from  $\Delta G_f^\circ$
  - iii. Calculation of  $\Delta G$  from  $\Delta G^\circ$
- e. Effect of Temperature, Pressure, and Concentration on Reaction Spontaneity
- f. The Free Energy Change and the Equilibrium Constant
- g. Additivity of Free Energy Changes; Coupled Reactions

Homework Problems: 1,7,11,17,19,23,29,33,37,43,51,57,63,65,69,77,79

Laboratory: Qualitative Analysis of Group II Cations (hands-on)(4 hr)

Emphasis: Students make use of techniques learned during the course to study the Group II cations. After completion of all tests on known solutions, students prepare a flow chart and analyze an unknown solution containing one or more of the Group II cations.

**18 Electrochemistry****1.5 weeks**

- a. Voltaic Cells
  - i. Salt Bridge Cells
  - ii. Cell Notation
- b. Standard Voltages
- c. Relation Between  $E^\circ$ ,  $\Delta G^\circ$ , and  $K$ 
  - i. Determination of Whether Redox Reaction Will Occur
- d. Effect of Concentration on Voltage
  - i. Nernst Equation
- e. Electrolytic Cells
  - i. Cell Diagram
  - ii. Amount of Product Formed
- f. Commercial Cells
  - i. Electrolysis of Aqueous Sodium Chloride
  - ii. Lead Storage Battery

Homework Problems: 1,9,13,15,21,23,29,33,37,43,47,53,55,57

Laboratory: Qualitative Analysis of Group III Cations (hands-on)(4 hr)

Emphasis: Students make use of techniques learned during the course to study the Group III cations. After completion of all tests on known solutions, students prepare a flow chart and analyze an unknown solution containing one or more of the Group I cations.

EXAM III (Chapters 16 – 18, experiments)

## **19 Nuclear Reactions**

**1.0 weeks**

- a. Radioactivity
    - i. Natural
    - ii. Induced
  - b. Rate of Radioactive Decay
    - i. Activity
    - ii. Age of Organic Material
  - c. Mass-Energy Relations
    - i. Relation Between  $\Delta E$  and  $m$
- Calculations  
Mass Defect
- d. Nuclear Fission
  - e. Nuclear Fusion

Homework Problems: 3,9,11,15,21,27,31,35,37

Laboratory: Analysis of a General Unknown (hands-on)(4 hr)

Emphasis: Students make use of techniques learned during the Group I, Group II, and Group III analyses to identify the contents of a general unknown. This unknown may contain one or more of any of the cations in the three groups studied.

FINAL EXAMINATION – 2<sup>nd</sup> Semester (Chapters 10 –19, experiments)

## **F. Grading**

In an attempt to be as fair as possible to any high school student enrolled in a college course, students are given two separate grades for this course.

HIGH SCHOOL grade:

As with any other full-year course, students receive a trimester grade which appears on their report card and which is treated as any other high school report card grade. The following percentages are used to determine each trimester grade.

1<sup>st</sup> Trimester

UConn Exam I	CH. 1 – 3	15%
UConn Exam II	CH. 4 – 5	15%
Laboratory		15%
Chapter Tests		21%
Homework, and Lab Quizzes		15%
My 1 <sup>st</sup> Trimester Final Exam		19%

2 <sup>nd</sup> Trimester		
	UConn Exam III CH. 6 – 9	15%
	UConn Exam IV CH. 10 – 12	15%
	Labs	15%
	Chapter Tests	12%
	Homework, and Lab Quizzes	8%
	UConn 1 <sup>st</sup> Semester Exam	20%
	My 2 <sup>nd</sup> Trimester Final Exam	15%
3 <sup>rd</sup> Trimester		
	UConn Exam IV CH. 10 – 12	10%
	UConn Exam V CH. 13 – 15	10%
	UConn Exam VI CH. 16 – 18	10%
	Labs	15%
	Chapter Tests	12%
	Homework, and Lab Quizzes	8%
	UConn 2 <sup>nd</sup> Semester Exam	20%
	My 3 <sup>rd</sup> Trimester Exam	15%

**Determination of student's final high school grade** for course = 1/3 Trimester I + 1/3 Trimester II + 1/3 Trimester III final grades.

University of Connecticut Grade - this is the grade that is sent to the University of Connecticut and which they use to determine whether or not to award the student college credit. This grade is based upon the point distribution system used by the university. Following is a sample of the point distribution used by the university. Each semester, the university sends a copy of their final point distribution, which I use to determine the students final semester grade.

*Total Points Range for Final Letter Grades (Spring 2006)*

Here are the ranges for the final letter grade for Chem 128. Numbers on the left reflect the total number of points accumulated during the semester. Maximum points that can be accumulated = 1000

920 - 1000 =	A
919 - 900 =	A-
899 - 870 =	B+
869 - 820 =	B
819 - 800 =	B-
799 - 770 =	C+
769 - 720 =	C
719 - 700 =	C-
699 - 670 =	D+
669 - 620 =	D
619 - 600 =	D-
599 and below	F

Overall average 760/1000

Final exam average 173/250

In order to be awarded four (4) credits for the 1<sup>st</sup> semester, a student must receive a grade of "C" or better.

In order to be awarded four (4) credits for the 2<sup>nd</sup> semester, a student must have received a grade of "C" or better the 1<sup>st</sup> semester and must receive a grade of "C" or better for the 2<sup>nd</sup> semester.

#### 1<sup>st</sup> Semester Grade

UConn Exam I	CH. 1 – 3	15%	(150 points)
UConn Exam II	CH. 4 – 5	15%	(150 points)
UConn Exam III	CH. 6 – 9	15%	(150 points)
Laboratory		15%	(200 points)
Lab Quizzes		15%	(100 points)
1 <sup>st</sup> Semester UConn Final Exam		25%	(250 points)

#### 2<sup>nd</sup> Semester Grade

UConn Exam IV	CH. 10 – 12	15%	(150 points)
UConn Exam V	CH. 13 – 15	15%	(150 points)
UConn Exam VI	CH. 16 – 18	15%	(150 points)
Laboratory		15%	(200 points)
Lab Quizzes		15%	(100 points)
UConn 2nd Semester Final Exam		25%	(250 points)

#### G. Textbooks and Remedial Materials

1. Textbook: Chemistry: Principles and Reactions, Masterson and Hurley, Brooks/Cole Cengage Learning, 2009 6<sup>th</sup> Edition ISBN: 978-0-495-12671-3
2. Laboratory Textbook: Chemical Principles in the Laboratory, Slowinski, Wolsey, Materson, Brooks/Cole, 8<sup>th</sup> edition, 2005, ISBN: 0-534-42453-8
3. CD-ROM: Masterson & Hurley's General Chemistry Interactive CD-ROM, version 3.0, Vining, Kotz, Harmon, Cow Town Productions, inc., 2003, ISBN: 0-534-40885-0
4. Advanced Placement Review Textbook: AP Chemistry, Kaplan, Simon & Schuster, updated version used each year





### Course Description

Grades 9 - 12		
1. Course Title <b>Advanced Placement Physics (B)</b> <b>University of Connecticut, Early College Experience</b> <b>PHYS 1201 Q / PHYS 1202 Q</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>AP Physics (B)</b>		
3. Transcript Course Code/Number <b>00361</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 11 – 12    Level: 1	
7. Seeking "Honors" Distinction? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input checked="" type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____		
9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)		
10. Pre-Requisites B or better in Honors Algebra II		
11. Brief Course Description This course emphasizes the basic principles of physics using algebra and trigonometry. The topics include Newtonian mechanics (including rotation and oscillation) fluid mechanics, thermal physics, electricity and magnetism, waves and optics, and some topics of modern physics. The level and content of the course are typical of a first year general physics college course. This course prepares students for the Advanced Placement Physics B examination; all students are encouraged to take the AP examination.		
12. Course Goals 1. Demonstrate proficiency and fluency in communication to meet the literacy demands of the global community. 2. Use technology effectively and responsibly. 3. Apply effective strategies for gathering information/materials, thinking critically and solving problems. 4. Demonstrate respect for one's self, and strive to contribute to the success of others. 5. Successfully complete homework and lab assignments independently. 6. Collaborate as a productive team-member of a group in accomplishing challenging inquiry based experiments. 7. Conduct lab experiments safely using appropriate scientific protocols. 8. Analyze and synthesize the scientific information as it relates to everyday experience and surroundings.		

Physics: Principles with Applications Fifth Edition by Douglas C. Giancoli Prentice Hall, 2002
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<b>13. Course Units of Study:</b>	<b>Chapter</b>	<b># of Weeks</b>
1. Motion in One Dimension	Chapter 2	2 weeks
2. Vectors and Projectiles	Chapter 3	2 weeks
<b>3. Newton's Laws</b>	Chapter 4	3 weeks
4. Circular Motion and Gravitation	Chapter 5	1.5 weeks
5. Work and Energy	Chapter 6	2 weeks
6. Impulse and Momentum	Chapter 7	1.5 weeks
7. Rotational Motion	Chapter 8	2 weeks
8. Statics (Bodies in Equilibrium)	Chapter 9	1 week
9. Fluids	Chapter 10	1 week
10. Vibrations and Waves	Chapter 11	1 week
11. Sound	Chapter 12	1 week
12. Temperature, Kinetic Theory, Heat	Chapters 13 & 14	2 weeks
13. Thermodynamics	Chapter 15	1 week
14. Electric Charge, Fields, Potential	Chapters 16 & 17	2 weeks
15. DC circuits	Chapters 18 & 19	1 week
16. Magnetism, EMF, Motors, Generators	Chapters 20 & 21	2 weeks
17. Electromagnetic Waves	Chapter 22	1 week
18. Optics and Light Theory	Chapters 23 - 25	2 weeks
19. Special Relativity	Chapter 26	1.5 weeks
20. Quantum Physics	Chapters 27 & 28	1.5 weeks
21. Nuclear Physics	Chapters 30 & 31	2 weeks

## 14. Instructional Methods and/or Strategies

- Cooperative group work
- Differentiated instruction
- Lecture
- Independent learning
- Project based learning
- PowerPoint presentations and notes
- Laboratory investigations
- Web based instruction
- Teacher centered and student centered discussions, demonstrations and analyses

## 15. Assessment Methods and/or Tools

- Lab reports evaluated with rubrics
- Writing
- Quizzes
- Exams

## 16. Assessment Criteria

**Students will score at the "Meets Expectations" level for the laboratory assignments listed according to departmental/school-wide rubrics with exemplars of student work where appropriate; students will perform at or above a minimum grade of C. Exam grading will be in accordance with a teacher generated key.**

Benchmark Assignments:

- Computer-based Quadratic Projectile Motion Lab addresses academic expectations 1a, 1b, 1c, 2, and 3
- Optics series Labs addresses academic expectations 1a, 1b, 1c, 2, and 3
- Electric circuit series of labs addresses academic expectations 1a, 1b, 1c, 2, and 3
- Physics 1201 Q Exam (Exit exam provided by the University of Connecticut) addresses academic expectation 3
- Physics 1202 Q Exam (Exit exam provided by the University of Connecticut) addresses academic expectation 3

Trimester grades are based on homework completion, performance on assessments, performance on laboratory reports, and classroom participation/effort.

Final grades are based on a percentage of the trimester grade and up to 20% on the final exam grade.

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a common scoring rubric or grading criteria.

## HONORS COURSES ONLY

## 17. Indicate how this honors course is different from the standard course.

This course will give the accepted students the opportunity to earn eight (8) college credits from the University of Connecticut.

**The course follows the detailed "Curriculum Audit" approved by Advanced Placement (AP) and University of Connecticut Early College Experience (ECE).** This course will prepare the student for the AP Physics B examination.



# AP<sup>®</sup> PHYSICS B SYLLABUS

The AP Physics B course starts the last week of August and ends in the third week of June. The class meets for five 60-minute periods per week. The sequence and timing of the syllabus assumes coverage of the material during the complete school year of 180 days.

The AP test is in early May and we have approximately 25 days of school after the AP test. Approximately 85 percent of the historical AP test material is thoroughly covered in regular classes and lab activities prior to the AP exam. The remaining material is covered in special study sessions or as independent study assignments as sought by individual students.

Course content involves interactive lessons and frequent physical demonstrations, participation activities, and web-based demonstration modules. The course involves 20 traditional inquiry based labs with detailed reports. In the interest of time, efficiency and resource utilization several additional labs (“Mini labs”) are conducted by the entire class. These experiments are teacher-directed with student volunteers performing the experiment. Data analysis is student-directed either in lab-groups or individually as determined by the teacher.

A test is given upon completion of each unit. Several units have one or more quizzes designed to assess bench-mark or building-block topics.

Evaluation and Assessment:	Tests	30%
	Quizzes	10%
	Labs	20%
	Homework/Mini-Labs	20%
	Final Exam	20%

Textbook: *Physics: Principles with Applications -Fifth Edition*  
Douglas C. Giancoli ISBN 0-13-061143-3  
Prentice Hall, 2002

## Supplemental Resources:

*Problem Workbook-Holt Physics (worksheet masters)*  
Raymond A. Serway and Jerry S. Faughn  
ISBN 0-03-036833-2  
Holt, Rinehart and Winston, 2006

*Section Quizzes-Holt Physics (quiz masters)*  
Raymond A. Serway, and Jerry S. Faughn  
ISBN 0-03-036836-7  
Holt, Rinehart and Winston, 2006

## Supplemental Resources (cont'd):

*AP Advantage Physics B*  
James Mooney  
ISBN 1-4138-0491-8  
The Peoples Publishing Group, 2005

*Student Study Guide for Advanced Placement Physics B*  
 Hugh Henderson ISBN 0-471-26850-X  
 John Wiley & Sons, 2004

www.explorelarning demonstration and analysis “gizmos”

### **Unit 1: Motion in One Dimension** (2 weeks)

Primary resource: Giancoli Chapter 2 p 19-47

#### Topics

- Constant velocity motion
- Frame of reference
- Relative motion
- Basic vectors and directional meaning
- Define and apply definitions of displacement, average velocity, instantaneous velocity, and average acceleration
- Analysis involving kinematics equations, including basic problems involving free fall by using the value of the acceleration due to gravity
- Analyze motion graphs qualitatively and quantitatively, including calculations of the slope of the tangent of an x-versus-t graph, the slope of the v-versus-t graph, the area under the v-versus-t graph and the area under the a-versus-t graph

#### Lab #1 Motion in One Dimension

- Analyze the motion of an object and predict the resulting x vs. t, and v vs. t graphs. Predict when the acceleration is constant, and its sign.
- Evaluate x vs. t, and v vs. t graphs and produce the correct motion?
- Equipment: Pasco Motion sensor; computer.

#### Lab #2 Acceleration of Gravity

- Compute theoretical acceleration due to gravity based upon the angle of the ramp. Use Pasco Frictionless cart, motion sensor and computer software. Evaluate observed acceleration using various graphs (Slope, Least Square fit). Identify and discuss sources of error. Qualitatively assess the fractional effect of friction related to data taken at various angles.
- Equipment: Pasco Motion sensor, cart, computer, adjustable ramp, meter stick.

### **Unit 2: Vectors and Projectiles** (2 weeks)

Primary resource: Giancoli Chapter 3 p 48-76

#### Topics:

- Vectors and scalars
- Vector addition (graphical, parallelogram and component methods)
- Horizontal and vertical components of projectile motion
- Analysis of projectiles fired/launched horizontally and at an angle

**Lab #3: Projectile Motion**

- Predict where a projectile will land (ideal conditions-no error analysis) and evaluate the estimate based upon experimental results.
- Include a qualitative assessment of errors, and repeat the experiment attempting to obtain 4 out of 5 launches within a specified circular landing area.
- Repeat for various angles, launch velocities and launch heights.
- Equipment: projectile launcher, electronic photo-gate timer with laptop, large paper, tape measure, and meter sticks.

**Unit 3: Newton's Laws (3 weeks)**

Primary resource: Giancoli Chapter 4 p 77-111

**Topics:**

- Contact forces, field forces and causal agents
- Mass; weight; acceleration due to gravity
- □ Static friction; kinetic friction; rolling friction; fluid friction
- Effect of speed on friction
- Newton's first law of motion and objects in static equilibrium
- Free-body diagrams (understanding, interpretation and application)
- Newton's second law of motion (understanding and application)
- Analysis of objects in motion with constant acceleration; resultant force evaluation (horizontal surfaces, inclined planes, and pulley systems (Atwood's machines))
- Newton's third law of motion (understanding and application)
- Analysis and application of static and kinetic friction.

**Lab #4: Static Force Balance 1**

- Given two specified forces applied to a point, determine the third force that would be required to establish equilibrium. Use the Pasco Force balance table to verify results, and determine/analyze any error
- Include a qualitative assessment of errors, and repeat the experiment for several specified forces and angles.
- Equipment: Pasco Force table, various masses, Newton spring scale.

**Lab #5: Static Force Balance 2**

- Given a string suspended from two points on the ceiling, determine what angles and tensions will result in each leg of the string when the mass is suspended from teacher specified locations on the string. Use Newton spring scales and or Pasco Force sensors to evaluate theoretical results.
- Include a qualitative assessment of errors.
- Equipment: String, Masses, Newton spring scales, Pasco force sensors, meter sticks, protractors.

**Lab #6: Dynamic Force and Uniform Accelerated Motion**

- Using bathroom scales, student pushers, drivers and timers, Push the instructors' car with a constant force, measure the rate of acceleration and determine the mass of the car in kilograms. Several different groups with varying applied force. All groups conduct all analysis.



- Include a qualitative assessment of errors.
- Equipment: Automobile, bathroom scales, stopwatch, cones, long tape measure.

#### **Unit 4: Circular Motion and Gravitation** (1.5 weeks)

Primary resource: Giancoli Chapter 5 p 112-144

##### Topics:

- Uniform circular motion
- Centripetal acceleration (definition and derivation)
- Newton's Law of universal gravitation
- Satellites; weightlessness; Kepler's law
- Analysis of circumstances involving banking angles, the conical pendulum and motion in a vertical circle

##### Lab #7: Suspended Mass Centripetal Force

- Determine the period of rotation required to support various masses suspended through a 90-degree Force direction change tube. Use various radii and masses for trials. Confirm results and identify any sources of error.
- Equipment: Suspended Mass-Centripetal Force apparatus, stop-watch, and ruler.

#### **Unit 5: Work and Energy** (2 weeks)

Primary resource: Giancoli Chapter 6 p 145-179

##### Topics:

- Work (scientific definition of work as compared to the colloquial definition)
- Work done by a constant force; potential energy; kinetic energy; power.
- Work analysis using a force-versus-displacement graph.
- Conservative and non-conservative forces.
- Conservation of mechanical energy.
- Analysis using the work–energy principle involving situations of conservative and non-conservative forces.

##### Lab #8: Frictional Forces

- Determine the coefficients of static and kinetic friction on an aluminum surface for a block of wood having a smooth wooden face and a fur coated face. Identify any sources of error.
- Equipment: Inclined plane, inclinometer, meter stick.

#### **Unit 6: Impulse and Momentum** (1.5 weeks)

Primary resource: Giancoli Chapter 7 p 180-208

##### Topics:

- Impulse and momentum
- Newton's second law of motion in terms of momentum
- Change in momentum analysis using a force versus time graph
- Conservation of momentum (and Newton's third law)
- Elastic and inelastic collisions

- Conservation laws and applicability/analysis (collision types)
- Conservation of momentum (collisions in one and two dimensions)
- Linear vs. angular momentum
- Center of mass; evaluation and analysis.

Lab #9: Conservation of Linear Momentum and Energy

- Predict the outcome of several lab-cart collisions based upon specified initial mass and speed configurations.
- Equipment: Lab carts, photo-gates, masses, track, computer.

### Unit 7: Rotational Motion (2 weeks)

Primary resource: Giancoli Chapter 8 p 209-240

Topics:

- Work with angles measured in radians to compute angular velocity and angular acceleration.
- Moment of inertia; angular momentum; rotational kinetic energy
- Conservation of angular momentum for a rotating body.

Lab #10: Conservation of Angular Momentum

- Predict the period of rotation for a student on a frictionless rotating stool with arms/mass extended who then draws the masses to his/her chest.
- Experience the gyroscopic effect of the hand-held bicycle wheel demo and fully explain the effect of manipulating the wheel perpendicular to its axis of rotation.
- Equipment: Frictionless lab stool, masses, meter stick, stop-watch, hand-held bicycle wheel.

### Unit 8: Statics (Bodies in Equilibrium) (1 weeks)

Primary resource: Giancoli Chapter 9 p 241-252

Topics:

- Equilibrium; tensile and compressive forces of various configurations
- Static conditions based involving upon torque balance analysis
- Cantilever-beam and wire configurations
- Apply static concepts to basic human biomechanical activities and manipulations.

Mini Lab -group work with individual student analysis submissions. Cantilever beam and wire analysis.

### Unit 9: Fluids (1 week)

Primary resource: Giancoli Chapter 10 p 275-308

Topics:

- Density; specific gravity; pressure.
- Solve problems of Buoyancy and force.
- Fluid Dynamics; Bernoulli's principle; viscosity.
- Venturis; capillarity; surface tension; laminar flow; turbulent flow.

Mini Lab -group work with individual student analysis submissions. Atmospheric can crush. Students estimate the pressure involved and total force applied to the can.

**Unit 10: Vibrations and Waves (1 week)**

Primary resource: Giancoli Chapter 11 p 309--346

Topics:

- Simple harmonic motion; sinusoidal mathematic representations.
- Resonance; damping; interference; reflection.
- Application of the concepts of wave theory to mechanical and electromagnetic waves (velocity, wavelength, frequency, transverse, longitudinal).
- Simple pendulums and springs.

Lab #11: Resonance and Waves

- Predict and analyze the standing waves generated by the Pasco oscillator using stretch chord.
- Analyze and mathematically model the resonance associated with various metallic leafs driven by the Pasco oscillator.
- Analyze and model the nodal patterns associated metallic plate oscillations when driven by the Pasco oscillator.

**Unit 11: Sound (1 weeks)**

Primary resource: Giancoli Chapter 12 p 347-380

Topics:

- Sound wave theory, media effects, and temperature effects.
- Sound intensity and the unit of decibels.
- Fundamental and harmonic frequencies; basic application to music theory.
- Open tube and closed tube harmonic effects.
- Doppler theory/analysis/application.
- Interference phenomenon.

Mini Lab -group work with individual student analysis submissions. Open tube and closed tube exploration. Use Pasco sound frequency detector.

**Unit 12: Temperature, Kinetic Theory, Heat (2 weeks)**

Primary resource: Giancoli Chapter 13 p 381-416  
Chapter 14 p 417-442

Topics:

- Understand and use temperature scales, the gas laws and mole theory.
- Thermal expansion and thermal stresses.
- Properties of water (heat addition/loss, density effects, phase changes, triple-point, effects of pressure, vapor pressure, and dew point.)
- Heat, specific heat, latent heat, internal energy
- Systems involving heat transfer.
- Methods of heat transfer and real life connections/application/observation.

**Unit 13: Thermodynamics (1 week)**

Primary resource: Giancoli Chapter 15 p 443-475

## Topics:

- Laws of thermodynamics and application to system. Temperature scales, the gas laws and mole theory.
- Adiabatic, isothermal, isobaric, and isovolumetric processes.
- Heat Engine cycles and efficiency. Application to several 4-stroke automobile engines, and steam turbines.
- Carnot cycle; refrigeration cycle; heat pump theory.
- Entropy theory and systems involving energy transfer.

**Unit 14: Electric Charge, Fields, Potential (2 weeks)**Primary resource: Giancoli Chapter 16 p 476-501  
Chapter 17 p 502-526

## Topics:

- Charge, Static Electricity, Induced Charge,
- Coulomb's Law and associated vector analysis.
- Electric Fields, Field Lines, Forces, Electric Potential, Equipotential Lines
- Voltage, Energy, Capacitance, Dielectrics, Stored Charge, Potential Energy.

## Lab # 12 Charge and Potential Energy

- Experiment with various materials to develop a stored charge or induce a charge.
- Use the Van de Graff generator to personally experience a charge in various ways, and use the electric field developed to perform work with several "kit" experiments.
- Calculate the amount of charge stored on the Van de Graff Sphere based upon observable information.

**Unit 15: DC Circuits (1 week)**Primary resource: Giancoli Chapter 18 p 527-554  
Chapter 19 p 555-587

## Topics:

- Battery theory, Current,
- Conductivity, Resistivity, Resistance, Ohm's Law.
- Parallel and Series circuits (Resistive).
- Capacitors in Series and parallel
- Direct Current (DC) Alternating Current (AC)
- Household Circuits
- Electric Power.
- Circuits containing Resistors and Capacitors.
- Ammeters and Voltmeters



**Unit 17: Electromagnetic Waves (1 week)**

Primary resource: Giancoli Chapter 22 p 660-682

**Topics:**

- Changing electric field/magnetic field relationship. Maxwell's Equation and theory.
- Electromagnetic Spectrum.
- Speed wavelength frequency relationship.
- Measuring the speed of light.
- Visible light's part of the spectrum and the rainbow.

**Unit 18: Optics and Light Theory (2 weeks)**

Primary resource: Giancoli Chapter 23 p 683-722

Chapter 24 p 723-756

Chapter 25 p 757-791

**Topics:**

- Wave-fronts and ray-modeling.
- Reflection, plane mirrors, curved mirrors.
- Refraction, Snell's law, total internal reflection.
- Thin lenses, lens equation.
- Particle theory, Huygens principle
- Interference, Diffraction.
- Thin film interference.
- Spectroscopy and the spectrometer.
- Polarization
- Optical Instruments (the camera, the human eye, the telescope, the microscope, the periscope.)
- Aberrations of lenses and mirrors. Optical coatings. Resolution.

**Lab # 15 Color addition, Color Subtraction, Prism**

- Determine the colors that result from the addition of two or three primary colors on a white background.
- Investigate the results of illuminating different colored paper with different colored light.
- Use a prism to separate white light into its component colors and note the different angles at which the different colors are refracted.
- Investigate the refraction of different color light beams through the prism.

**Lab # 16 Snell's Law and Total Internal Reflection.**

- Use Snell's Law to determine the Index of Refraction of an acrylic prism.
- Determine the critical angle at which total internal reflection occurs for the acrylic prism.

**Lab # 17 Reflection (Plane Mirrors and Curved Mirrors)**

- Study ray reflection and determine the focal length and radius of curvature for various mirrors.

**Lab # 18** Lenses (Concave and Convex)

- Explore the difference between convex and concave lenses and determine the focal lengths of various lenses using the optics bench.
- Study ray reflection and determine the focal length and radius of curvature for various mirrors.

**Lab # 19** Telescope

- Use a combination of lenses to construct a telescope and determine its magnification
- Analyze the ray-paths of the telescope.

**Unit 19: Special Relativity** (1.5 weeks)

Primary resource: Giancoli Chapter 26 p 792-822

## Topics:

- Postulates of Relativity
- Time dilation, length contraction
- Four-dimensional space-time.
- Momentum and mass. Mass and energy.
- Relativistic addition of velocities

**Unit 20: Quantum Physics** (1.5 weeks)

Primary resource: Giancoli Chapter 27 p 823-858  
Chapter 28 p 859-886

## Topics:

- Particle properties
- Planck's quantum hypothesis
- Photons as particles, Photoelectric effect, Compton effect.
- Wave particle duality
- Wave nature of matter
- Atomic models; Atomic Spectra; deBroglie's hypothesis
- Quantum mechanics; Uncertainty principle

**Unit 21: Nuclear Physics** (2 weeks)

Primary resource: Giancoli Chapter 30 p 916-942  
Chapter 31 p 943-972

## Topics:

- Structure and properties of the nucleus
- Binding Energy; nuclear forces; mass defect
- Radioactivity; Periodical Table review; Conservation of nucleon number
- Alpha decay; beta decay; gamma decay
- Half life; decay rate; decay series
- Radioactive dating
- Detecting radiation; detectors
- Fission; Fusion; transmutations

- Radiation damage to matter/tissue; dosimetry; exposure and controls
- Radiation therapy
- Use Pasco Battery powered Electrical Exploration kit and a digital multi-meter to
- Measure currents, voltages, and resistances; compared observed values to theoreticals.

Lab # 20      Radiation Detection

- Use radiation detectors with various known sources to detect and measure radiation compared to background.
- Estimate the effect of distance on the radiation detected. Compare to observed radiation levels for several distances.
- Experiment with various types of shielding and not the effect on radiation detected.
- Evaluate the radiation properties of several common items. (smoke detector, glow in the dark items)



## Lab Summary

Lab #	Title/Topic	Activity/Objective Summary
1	Motion in One Dimension	<ul style="list-style-type: none"> <li>▪ Analyze the motion of an object and predict the resulting <math>x</math> vs. <math>t</math>, and <math>v</math> vs. <math>t</math> graphs. Predict when the acceleration is constant, and its sign.</li> <li>▪ Evaluate <math>x</math> vs. <math>t</math>, and <math>v</math> vs. <math>t</math> graphs and produce the correct motion?</li> <li>▪ Equipment: Pasco Motion sensor; computer.</li> </ul>
2	Acceleration of Gravity	<ul style="list-style-type: none"> <li>▪ Compute theoretical acceleration due to gravity based upon the angle of the ramp. Use Pasco Frictionless cart, motion sensor and computer software. Evaluate observed acceleration using various graphs (Slope, Least Square fit). Identify and discuss sources of error. Qualitatively assess the fractional effect of friction related to data taken at various angles.</li> <li>▪ Equipment: Pasco Motion sensor, cart, computer, adjustable ramp, meter stick.</li> </ul>
3	Projectile Motion	<ul style="list-style-type: none"> <li>▪ Predict where a projectile will land (ideal conditions-no error analysis) and evaluate the estimate based upon experimental results.</li> <li>▪ Include a qualitative assessment of errors, and repeat the experiment attempting to obtain 4 out of 5 launches within a specified circular landing area.</li> <li>▪ Repeat for various angles, launch velocities and launch heights.</li> <li>▪ Equipment: projectile launcher, electronic photo-gate timer with laptop, large paper, tape measure, and meter sticks.</li> </ul>
4	Static Force Balance 1	<ul style="list-style-type: none"> <li>▪ Given two specified forces applied to a point, determine the third force that would be required to establish equilibrium. Use the Pasco Force balance table to verify results, and determine/analyze any error</li> <li>▪ Include a qualitative assessment of errors, and repeat the experiment for several specified forces and angles.</li> <li>▪ Equipment: Pasco Force table, various masses, Newton spring scale.</li> </ul>
5	Static Force Balance 2	<ul style="list-style-type: none"> <li>▪ Given a string suspended from two points on the ceiling, determine what angles and tensions will result in each leg of the string when the mass is suspended from teacher specified locations on the string. Use Newton spring scales and or Pasco Force sensors to evaluate theoretical results.</li> <li>▪ Include a qualitative assessment of errors.</li> <li>▪ Equipment: String, Masses, Newton spring scales, Pasco force sensors, meter sticks, protractors.</li> </ul>
6	Dynamic Force and Uniform Accelerated Motion	<ul style="list-style-type: none"> <li>▪ Using bathroom scales, student pushers, drivers and timers, Push the instructor's car with a constant force, measure the rate of acceleration and determine the mass of the car in kilograms. Several different groups with varying applied force. All groups conduct all analysis.</li> <li>▪ Include a qualitative assessment of errors.</li> <li>▪ Equipment: Automobile, bathroom scales, stopwatch, cones, long tape measure.</li> </ul>

7	Suspended Mass Centripetal Force	<ul style="list-style-type: none"> <li>Determine the period of rotation required to support various masses suspended through a 90-degree Force direction change tube. Use various radii and masses for trials. Confirm results and identify any sources of error.</li> <li>Equipment: Suspended Mass-Centripetal Force apparatus, stop-watch, and ruler.</li> </ul>
8	Frictional Forces	<ul style="list-style-type: none"> <li>Determine the coefficients of static and kinetic friction on an aluminum surface for a block of wood having a smooth wooden face and a fur coated face. Identify any sources of error.</li> <li>Equipment: Inclined plane, inclinometer, meter stick.</li> </ul>
9	Conservation of Linear Momentum and Energy	<ul style="list-style-type: none"> <li>Predict the outcome of several lab-cart collisions based upon specified initial mass and speed configurations.</li> <li>Equipment: Lab carts, photo-gates, masses, track, computer.</li> </ul>
10	Conservation of Angular Momentum	<ul style="list-style-type: none"> <li>Predict the period of rotation for a student on a frictionless rotating stool with arms/mass extended who then draws the masses to his/her chest.</li> <li>Experience the gyroscopic effect of the hand-held bicycle wheel demo and fully explain the effect of manipulating the wheel perpendicular to its axis of rotation.</li> <li>Equipment: Frictionless lab stool, masses, meter stick, stop-watch, hand-held bicycle wheel.</li> </ul>
11	Resonance and Waves	<ul style="list-style-type: none"> <li>Predict and analyze the standing waves generated by the Pasco oscillator using stretch chord.</li> <li>Analyze and mathematically model the resonance associated with various metallic leafs driven by the Pasco oscillator.</li> <li>Analyze and model the nodal patterns associated metallic plate oscillations when driven by the Pasco oscillator.</li> </ul>
12	Charge and Potential Energy	<ul style="list-style-type: none"> <li>Experiment with various materials to develop a stored charge or induce a charge.</li> <li>Use the Van de Graff generator to personally experience a charge in various ways, and use the electric field developed to perform work with several “kit” experiments.</li> <li>Calculate the amount of charge stored on the Van de Graff Sphere based upon observable information.</li> </ul>
13	Circuit Construction and Analysis	<ul style="list-style-type: none"> <li>Use Pasco Battery powered Electrical Exploration kit and a digital multi-meter to design several circuits involving parallel and series circuits of light bulbs, resistors, batteries, and switches.</li> <li>Measure currents, voltages, and resistances; compared observed values to theoreticals and evaluate any inconsistencies.</li> </ul>
14	DC Motor Experiment	<ul style="list-style-type: none"> <li>Use the Lab-Volt variable power supply and the supplied magnets, coils, brush assemblies, and wiring to design and operate several DC motors. Note the speed to voltage relationship. Measure voltage and current using the analog meters while the motor is running and while it comes up to speed. Discuss the various relationships and phenomena.</li> </ul>
15	Color addition,	<ul style="list-style-type: none"> <li>Determine the colors that result from the addition of two or three primary colors on a white background.</li> </ul>

	Color Subtraction, Prism	<ul style="list-style-type: none"> <li>Investigate the results of illuminating different colored paper with different colored light.</li> <li>Use a prism to separate white light into its component colors and note the different angles at which the different colors are refracted.</li> <li>Investigate the refraction of different color light beams through the prism.</li> <li>Equipment: Pasco Light ray box and accessories</li> </ul>
16	Snell's Law and Total Internal Reflection.	<ul style="list-style-type: none"> <li>Use Snell's Law to determine the Index of Refraction of an acrylic prism.</li> <li>Determine the critical angle at which total internal reflection occurs for the acrylic prism.</li> <li>Equipment: Pasco Light ray box and accessories</li> </ul>
17	Reflection (Plane Mirrors and Curved Mirrors)	<ul style="list-style-type: none"> <li>Study ray reflection and determine the focal length and radius of curvature for various mirrors.</li> <li>Equipment: Pasco Light ray box and accessories</li> </ul>
18	Lenses (Concave and Convex)	<ul style="list-style-type: none"> <li>Explore the difference between convex and concave lenses and determine the focal lengths of various lenses using the optics bench.</li> <li>Study ray reflection and determine the focal length and radius of curvature for various mirrors.</li> <li>Equipment: Pasco Light ray box, track and accessories</li> </ul>
19	Telescope	<ul style="list-style-type: none"> <li>Use a combination of lenses to construct a telescope and determine its magnification</li> <li>Analyze the ray-paths of the telescope.</li> <li>Equipment: Pasco Light ray box, track and accessories</li> </ul>
20	Radiation Detection	<ul style="list-style-type: none"> <li>Use radiation detectors with various known sources to detect and measure radiation compared to background.</li> <li>Estimate the effect of distance on the radiation detected. Compare to observed radiation levels for several distances.</li> <li>Experiment with various types of shielding and note the effect on radiation detected.</li> <li>Evaluate the radiation properties of several common items. (smoke detector, glow in the dark items)</li> </ul>

## Lab: Acceleration down an inclined plane (30 points)

**Objective:** Investigate acceleration down an inclined plane. Compare "Theoretical Acceleration" ( $g \cdot \sin\theta$ ) to "Observed Acceleration" as measured by the Pasco CBL software.

**Materials:** Ramp, cart, motion sensor, meter stick, laptop with Pasco software.

**Procedure:**

1. Set up ramp, motion sensor, laptop. Use a cloth bundle to serve as a bumper and protect the cart from damage.
2. Compute the theoretical acceleration for each angle prescribed in the data table.
3. Set the ramp height for each trial using trigonometric ratios to establish the required angle for each step.
4. Coordinate lap-top operation and cart release to capture the data required. Repeat for each angle prescribed.

**Data Table:**

Trial #	Angle (degrees)	Theoretical Acceleration	Observed Acceleration	Percent Error $\frac{Theo - Obs}{Theo} \times 100\%$
1	0°	0.00		N/A
2	2°			
3	5°			
4	10°			
5	15°			
6	20°			
7	25°			
8	Spare			

**Analysis:** (Use separate paper)

1. Show one sample calculation and diagram for how you set the angle of the ramp using trigonometric ratios.
2. Calculate the theoretical acceleration for each trial. Show at least one sample calculation.
3. Calculate the Percent Error for each trial. Show at least one sample calculation.
4. Generate a quality line-graph (on graph paper) that clearly and accurately conveys your results as summarized in the data table. You are not limited to only two variables. The best graphs will include the angle vs. all 3 data columns.

**Questions:** (Use separate paper)

1. Does this activity confirm the relationship  $a = g \cdot \sin\theta$ , where  $g = 9.8\text{m/s}^2$ ? Why?
2. Does the percent error increase or decrease as the angle increases? Why?
3. What are some possible sources of error for this lab? Which are the most significant and how would you eliminate them.

**PHYSICS (Level 2)**  
**EFFECTIVE USE OF TECHNOLOGY**  
**KINEMATICS AND DYNAMICS LABORATORY EXPERIMENTS**

**1 B**

<b>Exceeds Expectations</b>	The student effectively presents raw data using a logical selection and combination of graphs, tables, charts, scales, and colors. Where appropriate, application software is utilized to process and present data. Labels, scales and units clearly communicate meaning, and facilitate understanding in the reader. Insightful and appropriate assumptions are well expressed. Thoughts are well formulated and clearly flow throughout the write-up referencing data, supporting calculations and the use of technology. Real world observations are included that connect effectively to the theory. Punctuation, spelling, and word usage are nearly flawless. Conclusions are well versed, fluent and coherent.
<b>Meets Expectations</b>	Raw data is adequately presented using a logical selection and combination of graphs, tables, charts, scales, and colors. Some lack of clarity or missing information may occur. Labels, scales and units clearly communicate meaning, and facilitate understanding in the reader. Assumptions are adequately expressed and display an understanding of the topic. Thoughts are well formulated and clearly flow throughout the write-up. Real world observations are included that connect effectively to the theory. Punctuation, spelling, and word usage are adequate. Conclusions are meaningful and well-expressed.
<b>Meets Some Expectations</b>	Raw data is presented using a logical selection and combination of graphs, tables, charts, scales, and colors. A significant lack of clarity or missing information may occur, but should be addressed in accompanying verbiage. Labels, scales and units clearly communicate meaning but the reader may have some difficulty understanding. Assumptions are adequately expressed but may not be fully developed or reflect complete mastery of the theory. Thoughts are adequately expressed, but may not always seem to flow logically through the document. Real world observations are discussed adequately and sufficiently connect to the theory. Punctuation, spelling, and word usage are adequate. Conclusions are meaningful and adequately expressed.
<b>Does Not Meet Expectations</b>	Raw data is poorly presented or missing. Labels, scales, and units are missing or not useful. Assumptions are poorly expressed or completely inappropriate. Thoughts are not adequately expressed in a fashion that conveys information to the reader, but may not always seem to flow logically through the document. Ideas and concepts are unorganized or inaccurate. Punctuation, spelling, and word usage are inadequate. Errors in the conventions of writing make the report ineffective.

**PHYSICS**  
**EFFECTIVE USE OF TECHNOLOGY**  
**KINEMATICS AND DYNAMICS LABORATORY EXPERIMENTS**  
**2**

<b>Exceeds Expectations</b>	The student independently collects, interprets, analyzes, and evaluates data using the Pasco lab equipment. (The student who exceeds expectations may be seen teaching others or leading the group). S/he independently explores ways to use the equipment to accomplish the experiment. The student is able to transfer data to other application software programs for further analysis or display. The student adjusts sample rates, inputs, and detectors appropriately. S/he is able to <b>manipulate the various graphs and use "best-fit" algorithms to mine the most meaningful data and conclusions from the experiment.</b>
<b>Meets Expectations</b>	The student independently collects, interprets, analyzes, and evaluates data using the Pasco lab equipment, but requires occasional assistance. S/he requires minimal coaching in using the equipment to accomplish the experiment. The student uses the data and evaluation tools to draw logical conclusions. The student adjust sample rates, inputs, and detectors appropriately, but may require minor assistance or coaching. <b>S/he is able to manipulate the various graphs and use "best-fit" algorithms to support the experiment.</b>
<b>Meets Some Expectations</b>	The student effectively collects, interprets, analyzes, and evaluates data using the Pasco lab equipment, but requires significant or repeat assistance. S/he requires coaching and some assistance in using the equipment to accomplish the experiment. The student makes some minor errors in interpreting the data or using the technology, but manages to draw logical conclusions and evidence learning. S/he is able to <b>manipulate the various graphs and use "best-fit" algorithms to support the experiment although s/he may require assistance from peers or teacher.</b>
<b>Does Not Meet Expectations</b>	The student was unable to successfully use the Pasco equipment and laptop despite significant assistance and coaching. The student collected incomplete data and/or missed significant portions. The student was unable to assemble the equipment and manage the technology to accomplish the most basic aspects of the experiment.

**PHYSICS**  
**EFFECTIVE CRITICAL THINKING STRATEGIES**  
**KINEMATICS AND DYNAMICS LABORATORY EXPERIMENTS**  
**3**

<b>Exceeds Expectations</b>	The student effectively collects, interprets, analyzes, and evaluates data to solve a problem. S/he applies reasonable and appropriate assumptions while displaying due diligence in the setup of the experiment. S/he understands and clearly makes highly effective use of the capabilities of the various detectors and interactive software to solve problems and evaluate the meaning of data. Calculations are technically accurate, appropriately accomplished and demonstrate clear mastery of the theory as applied to the physical application. Conclusions are correct and indicate insightful understanding and a readiness for higher challenges.
<b>Meets Expectations</b>	The student effectively collects, interprets, analyzes, and evaluates data to solve a problem. S/he applies reasonable and appropriate assumptions while displaying due diligence in the setup of the experiment. S/he understands and clearly makes highly effective use of the capabilities of the various detectors and interactive software to solve problems with minimum of error and assistance. S/he correctly evaluates the meaning of data using technology. Calculations are technically accurate and appropriately accomplished, but may contain minor errors. Conclusions are correct and appropriate.
<b>Meets Some Expectations</b>	The student effectively collects, interprets, analyzes, and evaluates data to solve a problem, although some important data may be missing, requiring the student to make logical assumptions. S/he displays due diligence in the setup of the experiment and in correctly executing clearly delineated steps. S/he makes reasonably effective use of the capabilities of the various detectors and interactive software to solve problems. Some error or difficulty with the equipment and its implementation is acceptable. S/he correctly evaluates the meaning of data using technology, although may have difficulty connecting the data observe to the theory using mathematical expression and calculations. Calculations and conclusions are technically accurate and reflect at least a qualitative understanding.
<b>Does Not Meet Expectations</b>	The student collected incomplete data and or missed significant portions. Interpretation and evaluation of the data indicates a lack of understanding. The student failed to demonstrate basic principals of the scientific method in setting up equipment and conducting a meaningful and effective controlled experiment. The equipment was not used to gather even the most basic level of quality data. Calculations and conclusions display a clear lack of conceptual understanding.

## Experiment 1: Color Addition

### EQUIPMENT NEEDED

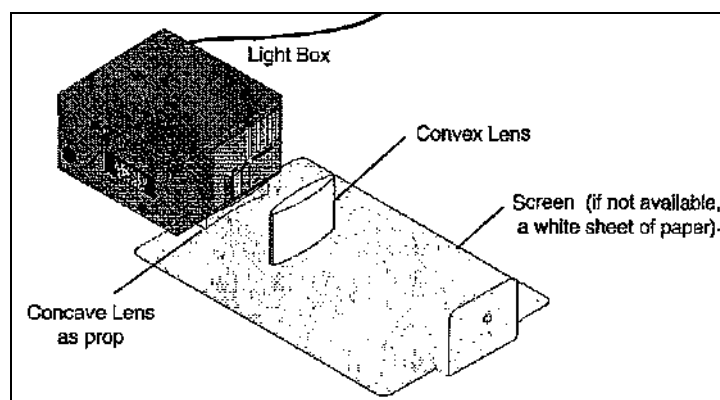
- Ray box (color rays) - Convex lens
- Colored paper (red, yellow, green, blue)

### Purpose

To determine the colors that result from the addition of two or three primary colors and to show the effect of illuminating colored objects with different colors of light.

### Procedure

- ① Place the ray box on a white sheet of paper on the table. Adjust the box so the primary colors are showing. If the white screen from the Optics Bench (OS-8518) is available, it can be laid flat on the table to make a good viewing platform for this experiment. It may be helpful to raise the front end of the box by approximately 1 cm (The concave lens works fine for this). This causes the colored rays to shine out a further distance.
- ② Place the convex lens near the ray box so it focuses the rays and causes them to cross each other at the focal point. What is the color of the light where the three rays come together? Record the result in Table 1.1. It may be helpful to crease the paper so it forms a wall upon which the focal point is projected. See Figure 1.1.



**Figure 1.1: Ray Box for color addition**

- ③ Now block the green ray with an opaque object. What color results from adding red and blue? Record the result in Table 1.1. Repeat Step 3, blocking one color each in succession and completing Table 1.1.

**Table 1.1 Results of Color Addition**

COLORS ADDED	RESULTING COLOR
red + blue + green	
red + blue	
red + green	
green + blue	



Shine the three primary colors on each of the colored sheets of paper. What color does each sheet of paper appear to be for each color of illuminating light? Record the results in Table 1.2.

**Table 1.2 Results of Reflection Off Colored Paper**

COLOR OF PAPER IN WHITE LIGHT	COLOR OF LIGHT RAY	COLOR OF PAPER IN COLORED LIGHT
	Red	
	Green	
	Blue	
	Red	
	Green	
	Blue	
	Red	
	Green	
	Blue	
	Red	
	Green	
	Blue	

## **Experiment 2: Prism**

### EQUIPMENT NEEDED

- Ray box (white ray)
- Rhombus

### Purpose

To show how a prism separates white light into its component colors and to show that different colors are refracted at different angles through a prism.

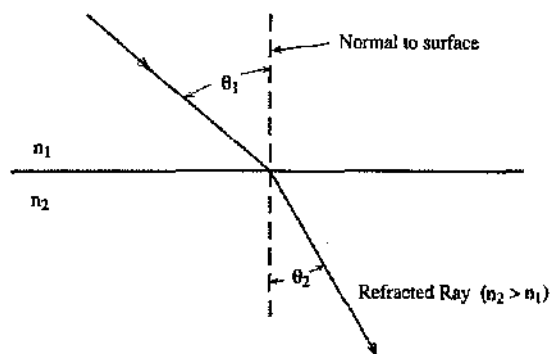
### Theory

According to Snell's Law,

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

the angle of refraction depends on the angle of incidence and the index of refraction of the material. See Figure 2.1. Because the index of refraction for light varies with the frequency of the light, white light which enters the material at a given angle of incidence will separate out into its component colors as each frequency is bent a different amount.

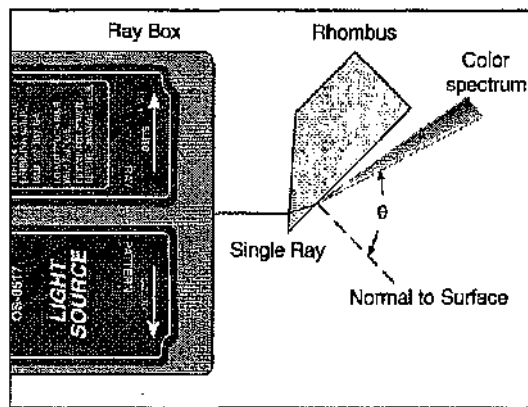
The rhombus is made of Acrylic which has an index of refraction of 1.497 for light of wavelength 486 nm in a vacuum, 1.491 for wavelength 589 nm, and 1.489 for wavelength 651 nm (red). Notice that in general for visible light, the index of refraction for Acrylic increases with increasing frequency.



**Figure 2.1: Refraction of Light**

## Procedure for Separating White light

- ① Place the ray box, label side up, on a white sheet of paper on the table. Adjust the box so one white ray is showing. If the white screen from the OS-S51S Optics Bench is available, it can be laid flat on the table to make a good viewing platform for this experiment.
- ② Position the rhombus as shown in Figure 2.2. The triangular end of the rhombus is used as a prism in this experiment. Keep the ray near the point of the rhombus for maximum transmission of the light.
- ③ Rotate the rhombus until the angle ( $\theta$ ) of the emerging ray is as large as possible and the ray separates into colors.
  - (a) What colors are seen and in what order are they?
  - (b) Which color is refracted at the largest angle?
  - (c) According to Snell's Law and the information given about the frequency dependence of the index of refraction for Acrylic, which color is predicted to refract at the largest angle?
- ④ Turn the ray box over and shine the three primary color rays into the rhombus at the same angle used for the white ray. Do the colored rays emerge from the rhombus parallel to each other? Why or why not?



**Figure 2.2**

## Experiment 3: Reflection – Plane and Curved Mirrors

### EQUIPMENT NEEDED

- Ray box (single and multiple white rays)
- Protractor (SE-8732)
- Metric rule
- Plane and curved mirrors
- Drawing compass (SE-8733)
- White paper

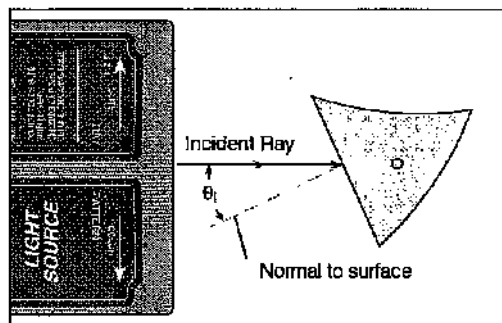
### Purpose

To study how rays are reflected and to determine the focal length and radius of curvature of different types of mirrors.

### Part I: Plane Mirror

#### Procedure

- ① Place the ray box, label side up, on a white sheet of paper on the table. Adjust the box so one white ray is showing.
- ② Place the mirror on the table and position the plane surface of the mirror at an angle to the ray so that the both the incident and reflected rays are clearly seen.
- ③ Mark the position of the surface of the plane mirror and trace the incident and reflected rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions.
- ④ On the paper, draw the normal to the surface. See Figure 3.1.
- ⑤ Measure the angle of incidence ( $\theta_i$ ) and the angle of reflection. Both these angles should be measured from the normal. Record the angles in Table 3.1.
- ⑥ Change the angle of incidence and measure the incident and reflected angles again. Repeat this procedure for a total of three different incident angles.
- ⑦ Adjust the ray box so it produces the three primary color rays. Shine the colored rays at an angle to the plane mirror. Mark the position of the surface of the plane mirror and trace the incident and reflected rays. Indicate the colors of the incoming and the outgoing rays and mark them with arrows in the appropriate directions.



**Figure 3.1**

**Table 3.1 Plane Mirror Results**

Angle of Incidence	Angle of Reflection

## Questions

- ① What is the relationship between the angle of incidence and the angle of reflection?
- ② Are the three colored rays reversed left-to-right by the plane mirror?

## Part II: Cylindrical Mirrors

### Theory

A concave cylindrical mirror will focus parallel rays of light at the focal point. The focal length is the distance from the focal point to the center of the mirror surface. The radius of curvature of the mirror is twice the focal length. See Figure 3.2.

### Procedure

- ① Using five white rays from the ray box, shine the rays straight into the concave mirror so the light is reflected back toward the ray box. See Figure 3.3. Draw the surface of the mirror and trace the incident and reflected rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions.
- ② The place where the five reflected rays cross each other is the focal point of the mirror. Measure the focal length from the center of the concave mirror surface to the focal point. Record the result in Table 3.2.
- ③ Use the compass to draw a circle that matches the curvature of the mirror. Measure the radius of curvature using a rule and record it in Table 3.2.
- ④ Repeat Steps I through 3 for the convex mirror. Note that in Step 2, the reflected rays are diverging for a convex mirror and they will not cross. Use a rule to extend the reflected rays back behind the mirror's surface. The focal point is where these extended rays cross.

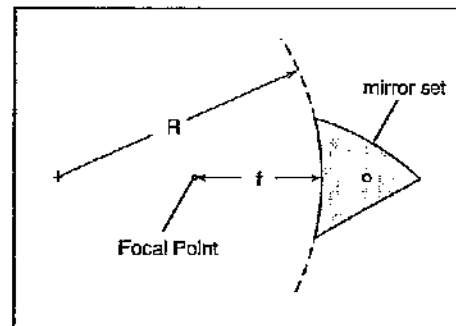


Figure 3.2

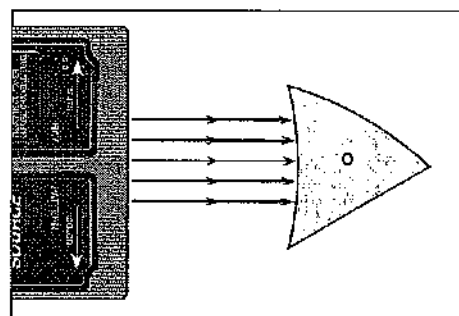


Figure 3.3

Table 3.2 Cylindrical Mirror Results

	Concave Mirror	Convex Mirror
Focal Length		
Radius of Curvature using compass		

## Questions

- ① What is the relationship between the focal length of a cylindrical mirror and its radius of curvature? Do your results confirm your answer?
- ② What is the radius of curvature of a plane mirror?

## Experiment 4: Snell's Law

### EQUIPMENT NEEDED

- Ray box (single white ray and colored rays)
- Rhombus
- Protractor (SE-8732)
- White paper

### Purpose

To use Snell's Law to determine the index of refraction of the acrylic rhombus.

### Theory

Snell's Law states

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

where  $\theta_1$  is the angle of incidence,  $\theta_2$  is the angle of refraction, and  $n_1$  and  $n_2$  are the respective indices of refraction of the materials. See Figure 4.1.

### Procedure

- ① Place the ray box, label side up, on a white sheet of paper on the table. Slide the ray mask until only one white ray is showing.
- ② Place the rhombus on the table and position it so the ray passes through the parallel sides as shown in Figure 4.2.
- ③ Mark the position of the parallel surfaces of the rhombus and trace the incident and transmitted rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions. Mark carefully where the ray enters and leaves the rhombus.
- ④ Remove the rhombus and on the paper draw a line connecting the points where the ray entered and left the rhombus.
- ⑤ Choose either the point where the ray enters the rhombus or the point where the ray leaves the rhombus. At this point, draw the normal to the surface.
- ⑥ Measure the angle of incidence ( $\theta_1$ ) and the angle of refraction with a protractor. Both these angles should be measured from the normal. Record the angles in Table 4.1.
- ⑦ Change the angle of incidence and measure the incident and refracted angles again. Repeat this procedure for a total of three different incident angles.

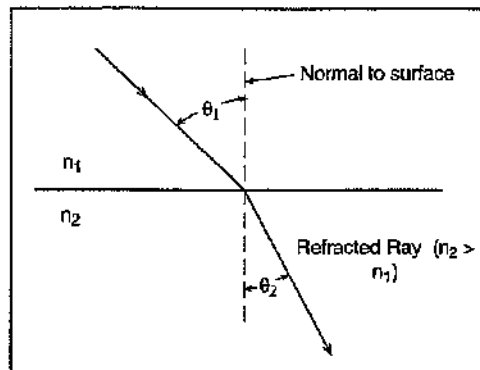


Figure 4.1

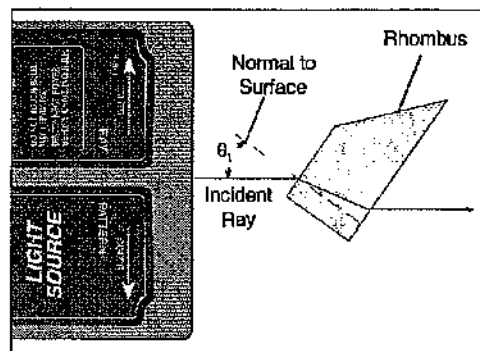


Figure 4.2

**Table 4.1 Data and Results**

Angle of Incidence	Angle of Refraction	n rhombus
Average index of refraction		

**Analysis**

- ① Using Snell's Law and your data, calculate the index of refraction for the Acrylic rhombus, assuming the index of refraction of air is one. Record the result for each of the three data sets in Table 4.1.
- ② Average the three values of the index of refraction and compare to the accepted value ( $n = 1.5$ ) using a percent difference.

**Question**

What is the angle of the ray that leaves the rhombus relative to the ray that enters the rhombus?

## Experiment 5: Total Internal Reflection

### EQUIPMENT NEEDED

- Ray box (single ray)
- Rhombus
- Protractor (SE-8732)
- White paper

### Purpose

To determine the critical angle at which total internal reflection occurs and to confirm it using Snell's Law.

### Theory

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

where  $\theta_1$  is the angle of incidence,  $\theta_2$  is the angle of refraction, and  $n_1$  and  $n_2$  are the respective indices of refraction of the materials. See Figure 5.1.

If a ray of light traveling from a medium of greater index of refraction to a medium of lesser index of refraction is incident with an angle greater than the critical angle ( $\theta_c$ ), there is no refracted ray and total internal reflection occurs. If the angle of incidence is exactly the critical angle, the angle of the refracted ray is 90 degrees. See Figure 5.2. In this case, using Snell's Law,

$$n \sin \theta_c = (1) \sin (90^\circ)$$

assuming the medium of lesser index of refraction is air with  $n_2 = 1$  and the medium of greater index of refraction is the Acrylic rhombus with  $n_1 = n = 1.5$ . Solving for the critical angle gives

$$\sin \theta_c = \frac{1}{n}$$

### Procedure

- ① Place the ray box, label side up, on a white sheet of paper on the table. Slide the ray mask until only one white ray is showing.
- ② Position the rhombus as shown in Figure 5.3. Do not shine the ray through the rhombus too near the triangular tip.

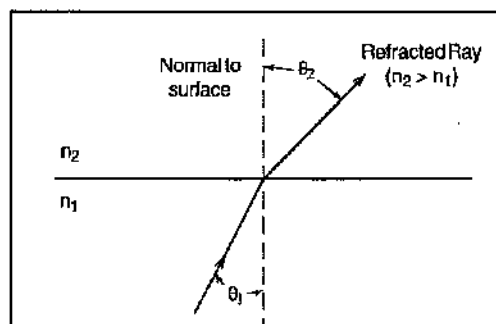


Figure 5.1

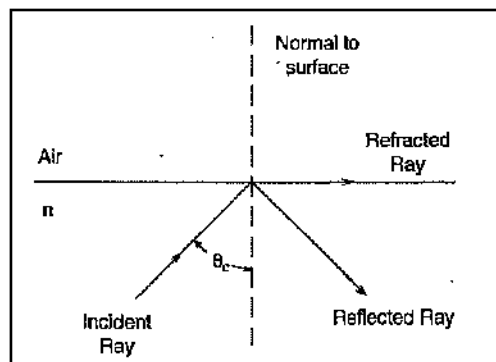


Figure 5.2

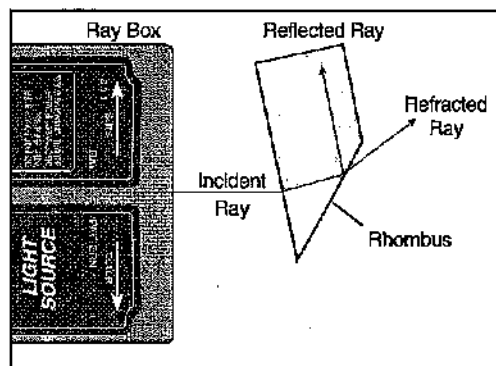


Figure 5.3



- ③ Rotate the rhombus until the emerging ray just barely disappears. Just as it disappears, the ray separates into colors. The rhombus is correctly positioned if the red has just disappeared.
- ④ Mark the surfaces of the rhombus. Mark exactly the point on the surface where the ray is internally reflected. Also mark the entrance point of the incident ray and mark the exit point of the reflected ray.
- ⑤ Remove the rhombus and draw the rays that are incident upon and that reflect off the inside surface of the rhombus. See Figure 5.4. Measure the total angle between these rays using a protractor. If necessary, you may extend these rays to make the protractor easier to use. Note that this total angle is twice the critical angle because the angle of incidence equals the angle of reflection. Record the critical angle here: \_\_\_\_\_
- ⑥ Calculate the critical angle using Snell's Law and the given index of refraction for Acrylic. Record the theoretical value here: \_\_\_\_\_
- ⑦ Calculate the percent difference between the measured and theoretical values:  
% difference- \_\_\_\_\_

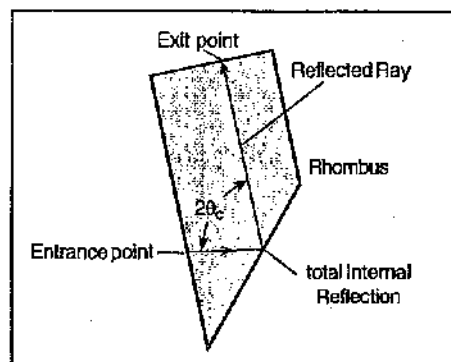


Figure 5.4

### Questions

- ① How does the brightness of the internally reflected ray change when the incident angle changes from less than  $\theta_c$ , to greater than  $\theta_c$ , ?
- ② Is the critical angle greater for red light or violet light? What does this tell you about the index of refraction

## **Experiment 6: Refraction – Convex and Concave Lenses**

### EQUIPMENT NEEDED

- Ray box (multiple white rays)
- Convex lens
- Concave lens
- Metric rule
- Second convex lens (optional)

### Purpose

To explore the difference between convex and concave lenses and to determine their focal lengths.

### Theory

Parallel rays of light passing through a thin convex lens cross at the focal point of the lens. The focal length is measured from the center of the lens to the focal point.

### Procedure

- ① Place the ray box on a white piece of paper. Using five white rays from the ray box, shine the rays straight into the convex lens. See Figure 6.1.

**NOTE:** Concave and Convex lenses have only one flat edge. Place flat edge on surface.

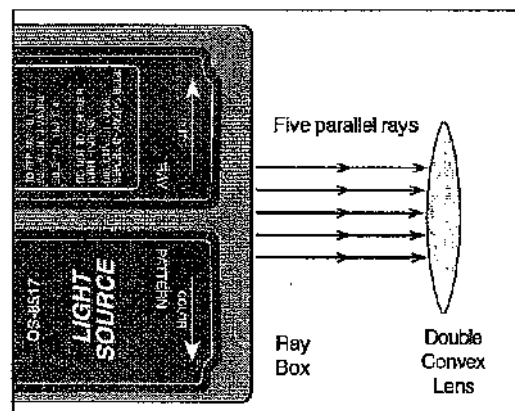
Trace around the surface of the lens and trace the incident and transmitted rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions.

- ② The place where the five refracted rays cross each other is the focal point of the lens. Measure the focal length from the center of the convex lens to the focal point. Record the result in Table 6.1.

**Table 6.1 Results**

	Convex Lens	Concave Lens
Focal Length		

- ③ Repeat the procedure for the concave lens. Note that in Step 2, the rays leaving the lens are diverging and they will not cross. Use a rule to extend the outgoing rays straight back through the lens. The focal point is where these extended rays cross.
- ④ Nest the convex and concave lenses together and place them in the path of the parallel rays. Trace the rays. What does this tell you about the relationship between the focal lengths of these two lenses?



**Figure 6.1**

- ⑤ Slide the convex and concave lenses apart to observe the effect of a combination of two lenses. Then reverse the order of the lenses. Trace at least one pattern of this type.
- ⑥ Place the convex lens in the path of the five rays. Block out the center 3 rays (the mirror on edge works well) and mark the focal point for the outer two rays. Next, block out the outer two rays (or slide the mask to the position that gives 3 rays) and mark the focal point for the inner 3 rays. Are the two focal points the same?
- ⑦ If you have a second convex lens, place both convex lenses in the path of the five rays. The distance between the lenses should be less than the focal length of the lenses. Compare the quality of the focus of this two lens system to the focus of a single lens. Do all five rays cross in the same place?

## Experiment 8: Apparent Depth

### EQUIPMENT NEEDED

- Ray box
- Rhombus
- Mirror (Used to block center rays)
- Convex lens
- Metric rule

### PART 1

#### Purpose

To determine the index of refraction using apparent depth.

#### Theory

Light rays originating from the bottom surface of a block of material refract at the top surface as the rays emerge from the material into the air. See Figure 8.1. When viewed from above, the apparent depth,  $d$ , of the bottom surface of the block is less than the actual thickness,  $t$ , of the block. The apparent depth is given by  $d = tn$ , where  $n$  is the index of refraction of the material

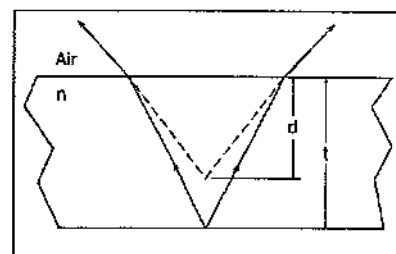


Figure 8.1

#### Procedure

- ① Place the ray box on a white piece of paper. Using five white rays from the ray box, shine the rays straight into the convex lens. See Figure 8.2. Place the mirror on its edge between the ray box and the lens so that it blocks the middle three rays, leaving only the outside two rays.
- ② Mark the place where the two rays cross each other.
- ③ Place the rhombus as shown in Figure 8.2. The bottom surface of the rhombus must be exactly at the point where the two rays cross. The crossed rays simulate the rays that emerge from the bottom of the rhombus block discussed in the theory.
- ④ Trace the bottom and top surfaces of the rhombus and trace the rays diverging from the top surface.
- ⑤ Remove the rhombus, turn off the light source, and trace the diverging rays back into the rhombus. The place where these rays cross (inside the rhombus) is the apparent position of the bottom of the rhombus when viewed from the top.
- ⑥ Measure the apparent depth,  $d$ , and the thickness,  $t$ .  
 $d =$  \_\_\_\_\_  
 $t =$  \_\_\_\_\_
- ⑦ Calculate the index of refraction of the material using  $n = td$ .  $n =$  \_\_\_\_\_
- ⑧ Calculate the percent difference between the measured value of the accepted value ( $n = 1.5$ ).  
 % difference = \_\_\_\_\_

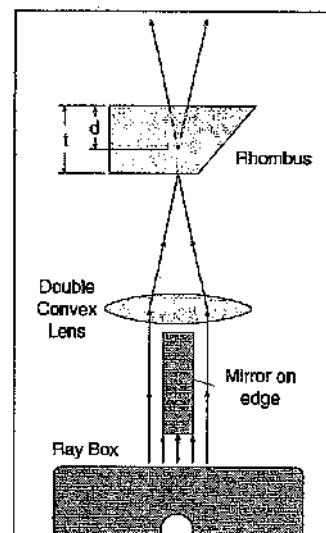


Figure 8.2

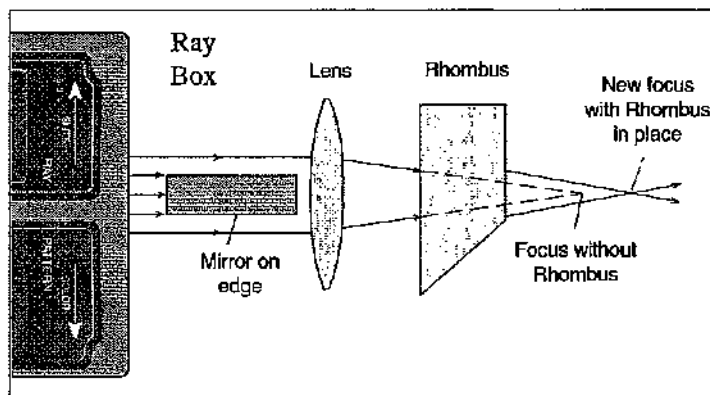
## PART II

### Theory

Parallel rays passing through a convex lens cross at the focal point of the lens. If a block with parallel sides is placed between the lens and the focal point, the point where the rays cross moves further from the lens. Since the thickness,  $t$ , of the block has an apparent depth,  $d$ , that is less than the thickness ( $d = t/n$ ), the point where the rays cross must move by an amount equal the difference between the actual thickness of the block and the apparent thickness of the block. Thus the distance,  $x$ , that the focal point moves is given by  $x = t - t/n$ , where  $n$  is the index of refraction of the block.

### Procedure

- ① Turn the light source on. Using a new sheet of paper, mark the place where the two rays cross.
- ② Set the rhombus between the lens and the place where the rays cross. See Figure 8.3. Mark the new place where the rays cross.
- ③ Move the rhombus to a new position, closer to the lens. Does the position of the focal point change?
- ④ Turn off the light source and measure the distance,  $x$ , between the marks.  $x =$  \_\_\_\_\_
- ⑤ Using the thickness of the rhombus from Part I and the distance  $x$ , calculate the index of refraction using  $n =$  \_\_\_\_\_
- ⑥ Calculate the percent difference between the measured value of the accepted value ( $n = 1.5$ ).  
% difference = \_\_\_\_\_



**Figure 8.3**

## Experiment 9: Focal Length of a Thin Lens

### EQUIPMENT NEEDED

-Bench (OS-85 I 8)  
-Convex lens

-Light source (object) (OS-8517)  
-Screen

### Purpose

To determine the focal length of a thin lens.

### Theory

For a thin lens:  $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

where  $f$  is focal length,  $d_o$  is the distance between the object and the lens, and  $d_i$  is the distance between the image and the lens. See Figure 9.1.

### Procedure

#### I. FOCAL LENGTH USING AN OBJECT AT INFINITY

- ① Using one of the positive lenses focus a distant light source on a paper.
- ② Measure the distance from the lens to the paper. This is the image distance.
- ③ Take the limit as the object distance goes to infinity in the Thin Lens Formula:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

Solve for the focal length.  $f =$  \_\_\_\_\_

#### II. FOCAL LENGTH BY PLOTTING $1/d_o$ vs. $1/d_i$

- a. On the optical bench, position the lens between a light source (the object) and a screen. Be sure the object and the screen are at least one meter apart.
- b. Move the lens to a position where an image of the object is formed on the screen. Measure the image distance and the object distance. Record all measurements in table 9. I .
- c. Measure the object size and the image size for this position of the lens.
- d. Move the lens to a second position where the image is in focus (Do not move the screen or Light Source). Measure the image distance and the object distance.
- e. Measure the image size for this position also.
- f. Move the screen toward the object until you can no longer find two positions of the lens where the image will focus. Then move the screen a few centimeters further away from the object. Repeat Parts b and d for this position of the screen and for 4 other intermediate positions of the screen. This will give you 6 sets of data points (a total of 12 data points).

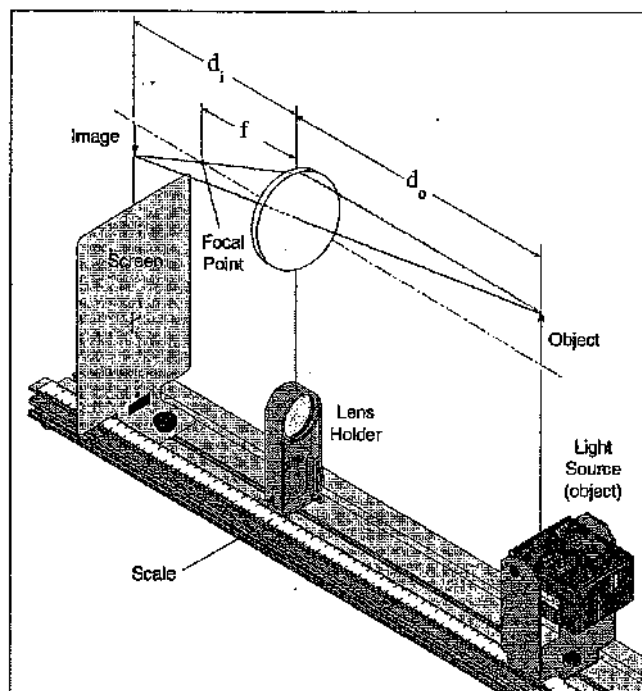


Figure 9.1

- g. Plot  $1/d_i$  vs.  $1/d_o$  using the 12 data points. This will give a straight line and the x- and y- intercepts are each equal to  $1/f$ .
- h. Find the percent difference between the two values of the focal length found from the intercepts. Then average these two values and find the percent difference between this average and the focal length found in Part I.
- i. For the first two sets of data points ONLY, use image and object distances to find the magnification at each position of the lens.

$$|M| = \frac{\text{image size}}{\text{object size}}$$

Find the percent differences.

**Table 9.1**

Object distance	Image distance	Image size	$1/d_o$	$1/d_i$
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

x - intercept \_\_\_\_\_ y - intercept \_\_\_\_\_

$f$  average \_\_\_\_\_ percent difference \_\_\_\_\_

### QUESTIONS

- ① Is the image formed by the lens erect or inverted?
- ② Is the image real or virtual? How do you know?
- ③ Explain why, for a given screen-object distance, there are two positions where the image is in focus.
- ④ Why is the magnification negative?

## Experiment 10: Telescope

### EQUIPMENT NEEDED

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>- Bench (OS-851S)</li> <li>- Screen with paper pattern<br/>(See back of manual for pattern)</li> </ul> | <ul style="list-style-type: none"> <li>- 2 convex lenses (focal lengths 10 cm and 20 cm)</li> <li>- Metric rule</li> </ul> |
|---|--|

### Purpose

To construct a telescope and determine the magnification.

### Theory

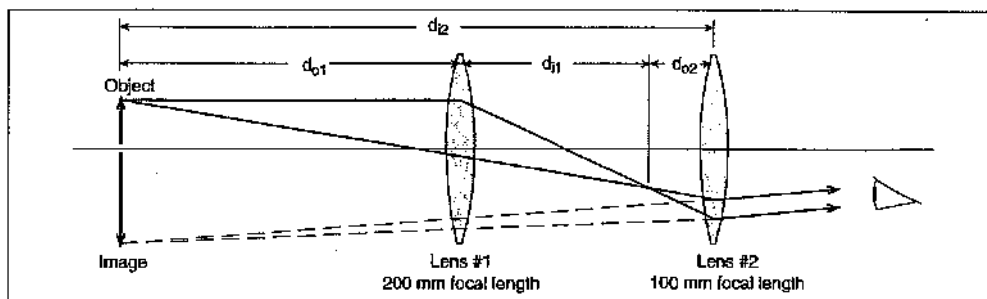


Figure 10.1

An astronomical telescope is constructed with two convex lenses. The ray diagram for this experiment (shown in Figure 10.1) indicates that the image is in the same plane as the object. Having the image in the same plane as the object allows the distance to the virtual image to be determined. For this experiment, it is assumed that the lenses are thin compared to the other distances involved. In this case the Thin Lens Formula may be used. This equation states:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

where  $f$  is focal length,  $d_o$ , is the distance between the object and the lens, and  $d_i$ , is the distance between the image and the lens.

The magnification of a two-lens system is equal to the multiplication of the magnifications of the individual lenses:

$$M = M_1 M_2 = \left( \frac{-d_{i1}}{d_{o1}} \right) \left( \frac{-d_{i2}}{d_{o2}} \right)$$

- ① Tape or use paper clips to fasten the paper pattern to the screen. The crosshatching on the screen acts as the object.
- ② The 200 mm lens is the objective lens (the one which is nearer to the object). The 100 mm lens is the eyepiece lens (the one which is nearer to the eye). Place the lenses near one end of the optical bench and place the screen on the other end. See Figure 10.2.

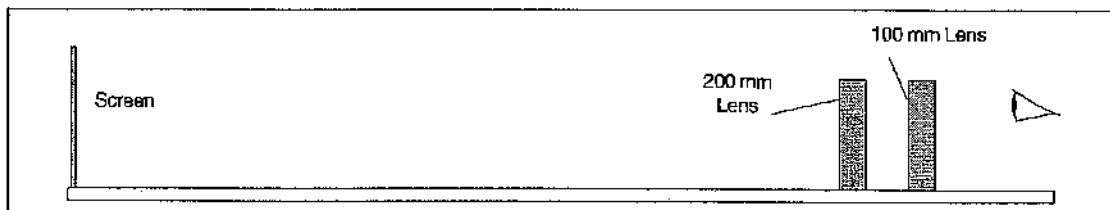


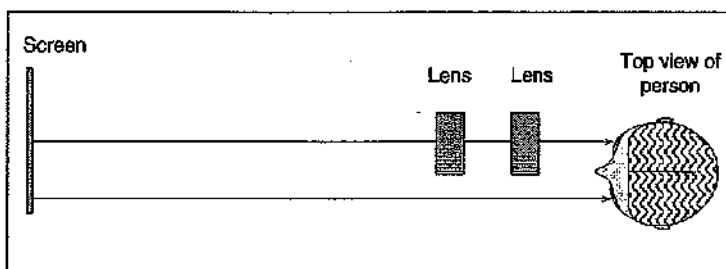
Figure 10.2



## Procedure

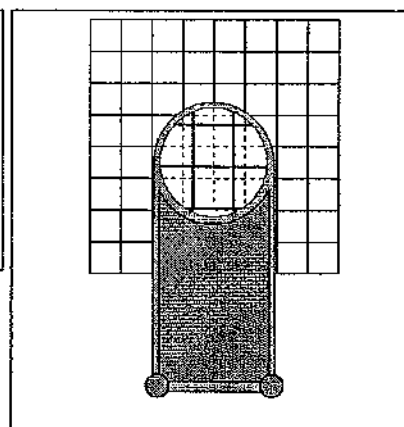
Focus the image of the object (the crosshatching on the screen) by moving the objective lens (the one which is closer to the object). To view the image, you must put your eye close to the eyepiece lens.

Eliminate the parallax by moving the eyepiece lens until the image is in the same plane as the object (screen). To observe the parallax, open both eyes and look through the lenses at the image with one eye while looking around the edge of the lenses directly at the object with the other eye. See Figure 10.3. The lines of the image (solid lines shown in Figure 10.4 inset) will be superimposed on the lines of the object (shown as dotted lines in Figure 10.4 inset). Move your head back -and-forth or up-and- down. As you move your head, the lines of the image will move relative to the lines of the object due to the parallax. To eliminate the parallax, move the eyepiece lens until the image lines do not move relative to the object lines when you move your head. When there is no parallax, the lines in the center of the lens appear to be stuck to the object lines.



**Figure 10.3**

**NOTE:** Even when there is no parallax, the lines may appear to move near the edges of the lens because of lens aberrations.



**Figure 10.4**

**NOTE:** Even when there is no parallax, the lines may appear to move near the edges of the lens because of lens aberrations.

- ① With the parallax now eliminated, the virtual image is now in the plane of the object. Record the positions of the lenses and the object in Table 10.1.
- ② Measure the magnification of this telescope by counting the number of squares in the object that lies along one side of one square of the image. To do this, you must view the image through the telescope with one eye while looking directly at the object with the other eye. Record the observed magnification in Table 10.1.
- ③ Remove the screen and look through the lenses at a distant object such as a meter stick at the opposite side of the room. Eliminate the parallax and determine the magnification. When viewing an object at infinity through a telescope, the magnification is the ratio of the focal lengths of the lenses. Check to see if this is true for your telescope.

### Analysis

To calculate the magnification complete the following steps and record the answers in Table 10.1:

- ① Determine  $d_{o1}$ , the distance from the object (paper pattern on screen) to the objective lens.
- ② Determine  $d_{i2}$ , the distance from the eyepiece lens and the image. Since the image is in the plane of the object, this is also the distance between the eyepiece lens and the object (screen).
- ③ Calculate  $d_{i1}$  using  $d_{o1}$  and the focal length of the objective lens in the Thin Lens Formula.
- ④ Calculate  $d_{o2}$  using  $d_{i2}$  and the focal length of the eyepiece lens in the Thin Lens Formula.
- ⑤ Calculate the magnification using:  $M = M_1 M_2 = \left( \frac{-d_{i1}}{d_{o1}} \right) \left( \frac{-d_{i2}}{d_{o2}} \right)$
- ⑥ Take a percent deviation between this value and the observed value.

**Table 10.1 Results**

Position of Objective Lens (200mm)	
Position of Eyepiece Lens (100mm)	
Position of Screen	
Observed Magnification	
$d_{o1}$	
$d_{i2}$	
$d_{i1}$	
$d_{o2}$	
Calculated Magnification	
Percent Difference	

### Questions

- ① Is the image inverted or erect?
- ② Is the image seen through the telescope real or virtual?

**PHYSICS**  
**EFFECTIVE WRITING**  
**OPTICS LABORATORY EXPERIMENTS**

**1. B**

<b>Exceeds Expectations</b>	The student effectively presents raw data using a logical selection and combination of graphs, tables, charts, scales, and colors. Where appropriate, application software is utilized to process and present data. Labels, scales and units clearly communicate meaning, and facilitate understanding in the reader. Insightful and appropriate assumptions are well expressed. Thoughts are well formulated and clearly flow throughout the write-up referencing data, supporting calculations and the use of technology. Real world observations are included that connect effectively to the theory. Punctuation, spelling, and word usage are nearly flawless. Conclusions are well versed, fluent and coherent.
<b>Meets Expectations</b>	Raw data is adequately presented using a logical selection and combination of graphs, tables, charts, scales, and colors. Some lack of clarity
<b>Meets Some Expectations</b>	
<b>Does Not Meet Expectations</b>	

### Course Description

HIGH SCHOOL		
1. Course Title <b>Advanced Placement Physics (C)</b> <b>University of Connecticut, Early College Experience (ECE)</b> <b>General Physics with Calculus: PHYS 1401 Q</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>AP Physics (C)</b>		
3. Transcript Course Code/Number <b>00363</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 11 – 12    Level: 1  7. Seeking "Honors" Distinction? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input checked="" type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)	
10. Pre-Requisites Successful completion of, or concurrent enrollment in AP Calculus (BC) or AP Calculus (AB)		
12. Brief Course Description AP Physics C is offered to students who have successfully completed or are concurrently enrolled in AP Calculus (BC) or AP Calculus (AB) and who are planning to study physical science or engineering in college. This course will prepare the student for the Mechanics portion of the AP Physics C exam. Electricity and magnetism will also be studied. The use of calculus in problem solving and derivations will increase as the course progresses and will be used freely in formulating principles and in solving problems when electricity and magnetism are studied. Students who are accepted into the UCONN ECE program get University of Connecticut college credits if they earn a UCONN grade of C or better. Students are encouraged to take the AP Physics C Examination.		
12. Course Goals 1. Demonstrate proficiency and fluency in communication to meet the literacy demands of the global community. 2. Use technology effectively and responsibly. 3. Apply effective strategies for gathering information/materials, thinking critically and solving problems. 4. Demonstrate respect for one's self, and strive to contribute to the success of others. 5. Successfully complete homework and lab assignments independently. 6. Collaborate as a productive team-member of a group in accomplishing challenging inquiry based experiments. 7. Conduct lab experiments safely and using appropriate scientific protocols. 8. Analyze and synthesize scientific information as it relates to everyday experience and surroundings.		

13. Sears and Zemansky's <u>University Physics</u> by Young and Freedman 12 <sup>th</sup> Edition Pearson/Addison Wesley, 2008		
Course Units of Study:		
<b>MECHANICS:</b>	<b>Chapter</b>	<b># of Weeks</b>
1. Units, Physical Quantities and Vectors	Chapter 1	1 week
2. Motion Along a Straight Line & Introduction to Calculus	Chapter 2	2 weeks
3. Motion in Two and Three Dimensions	Chapter 3	1.5 weeks
4. Newton's Laws of Motion and Applications	Chapters 4 & 5	3 weeks
5. Work and Kinetic Energy	Chapter 6	1.5 weeks
6. Potential Energy and Energy Conservation	Chapter 7	1.5 weeks
7. Momentum, Impulse and Collisions	Chapter 8	2 weeks
8. Rotation of Rigid Bodies	Chapter 9	1.5 weeks
9. Dynamics of Rotational Motion	Chapter 10	2 weeks
10. Equilibrium	Chapter 11	1 week
11. Periodic Motion	Chapter 13	2 weeks
12. Gravitation	Chapter 12	1 week
<b>ELECTROMAGNETISM:</b>	<b>Chapter</b>	<b># of Weeks</b>
13. Electric Charge and Electric Field	Chapter 21	1.5 weeks
<b>14. Gauss's Law</b>	Chapter 22	1.5 weeks
15. Electric Potential	Chapter 23	1.5 weeks
16. Capacitance and Dielectrics	Chapter 24	.5 week
17. Current, Resistance and Electromotive Force	Chapter 25	1.5 weeks
18. DC Circuits	Chapter 26	2 weeks
19. Magnetic Field & Magnetic Sources	Chapter 27	1.5 weeks
20. Sources of Magnetic Field	Chapter 28	1 week
21. Electromagnetic Induction	Chapter 29	1.5 weeks
22. Inductance	Chapter 30	.5 week
23. Alternating Current	Chapter 31	2 weeks
24. Electromagnetic Waves	Chapter 32	1 week

14. Instructional Methods and/or Strategies
<ul style="list-style-type: none"> <li>▪ Cooperative group work</li> <li>▪ Differentiated instruction</li> <li>▪ Lecture</li> <li>▪ Independent learning</li> <li>▪ Project based learning</li> <li>▪ Teacher centered and student centered discussions, demonstrations and analyses</li> </ul>
15. Assessment Methods and/or Tools
<ul style="list-style-type: none"> <li>▪ Lab rubrics</li> <li>▪ Writing</li> <li>▪ Quizzes</li> <li>▪ Exams</li> </ul>

## 16. Assessment Criteria

**Students will score at the “Meets Expectations” level for the laboratory assignments** listed according to departmental/school-wide rubrics. Exam grading will be in accordance with a teacher generated key.

Benchmark Assignments:

1. Computer-based incline plane lab
2. Optics series of labs
3. Electric circuit series of labs addresses academic expectations 1a, 1b, 1c, 2, and 3
4. Final exam (Exit exam provided by University of Connecticut) addresses academic expectation 3
5. AP Physics C Exam addresses academic expectation 3

Trimester grades are based on homework completion, performance on assessments, performance on laboratory reports, and classroom participation/effort

Final grades are based on a percentage of the trimester grade and up to 20% on the final exam grade.

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a common scoring rubric or grading criteria.

### HONORS COURSES ONLY

17. Indicate how this honors course is different from the standard course.

This course will give the accepted students the opportunity to earn four (4) college credits from the University of Connecticut.

**The course follows the detailed “Curriculum Audit” approved by Advanced Placement (AP) and the University of Connecticut Early College Experience (ECE).**

This course will prepare the student for the Mechanics portion of the AP Physics C examination.



## Syllabus

### AP Physics C - Mechanics

#### Course Overview

This course is intended to prepare the student for the mechanics portion of the AP C Physics exam. Electricity and magnetism will also be covered but will not be completed prior to the administration of the AP C Physics exam. The student also has the opportunity to apply for college credit through the UCONN Early College Experience program. First year calculus is a co-requisite for this course.

The course is problem-solving based. Students are introduced to the various theories, laws, and concepts of mechanics through assigned readings with reinforcement provided in lectures. Strong emphasis is placed on problem-solving and problem solving techniques. Homework, primarily problems will be assigned approximately 4 times per week. Classes will include interactive lessons and frequent physical demonstrations, as well as web-based demonstration modules. Tests will be administered upon completion of each unit.

There is also a lab component to the course. The labs are intended to reinforce and extend the concepts learned in class. At least one session per week will be spent on laboratory activities.

The class meets five days per week for one hour each class with every sixth class being seventy minutes long. Class size for the 2007/2008 school year is expected to be less than fifteen students.

Grading:        Tests and Quizzes – 70%  
                     Homework – 10%  
                     Labs and Lab Notebook – 20 %

Text:    Sears and Zemansky's University Physics by Young & Freedman,  
          11<sup>th</sup> edition (Pearson/Addison Wesley)



## **Course Outline**

### **Semester 1:**

1. Units, Physical Quantities, and Vectors (1 week) (Chapter 1)
2. Motion Along a Straight Line and Intro to Calculus (2 weeks) (Chapter 2)
3. Motion in Two and Three Dimensions (1½ weeks) (Chapter 3)
  - a. Projectile motion
  - b. Motion in a circle
  - c. Relative motion
4. Newton's Law's of Motion and Applications (3 weeks) (Chapters 4 and 5)
  - a. First law
  - b. Second law
  - c. Third law
  - d. Free-body diagrams
  - e. Friction
  - f. Dynamics of circular motion
5. Work and Kinetic Energy (1½ weeks) (Chapter 6)
  - a. Work
  - b. Kinetic Energy
  - c. Work-Energy theorem
  - d. Power
6. Potential Energy and Energy Conservation (1½ weeks) (Chapter 7)
  - a. Gravitational potential energy
  - b. Elastic potential energy
  - c. Conservative and non-conservative forces
  - d. Conservation of energy
  - e. Energy diagrams
7. Momentum, Impulse, and Collisions (2 weeks) (Chapter 8)
  - a. Momentum and impulse
  - b. Conservation of momentum
  - c. Elastic and inelastic collisions
  - d. Center of mass
8. Rotation of Rigid Bodies (1½ weeks) Chapter 9)
  - a. Angular velocity and acceleration
  - b. Relating linear and angular kinematics
  - c. Moment of Inertia
  - d. Rotational kinetic energy

9. Dynamics of Rotational Motion (2 weeks) (Chapter 10)
  - a. Torque
  - b. Rigid-body rotation about a moving axis
  - c. Work and power in rotational motion
  - d. Angular momentum
  - e. Conservation of angular momentum
10. Equilibrium (1 week) (Chapter 11)
  - a. Conditions for equilibrium
  - b. Center of gravity
11. Periodic Motion (2 weeks) (Chapter 13)
  - a. Simple Harmonic motion
  - b. Hooke's law
  - c. Pendulums
  - d. Damped Oscillations
12. Gravitation (1 week) (Chapter 12)
  - a. Newton's law of gravitation
  - b. Gravitational potential energy
  - c. Kepler's laws

**Semester 2 - Electromagnetism:**

13. Electric charge and electric field (1½ weeks) (Chapter 21)
14. Gauss's Law (1½ weeks) (Chapter 22)
15. Electric potential (1½ weeks) (Chapter 23)
16. Capacitance and dielectrics (½ week) (Chapter 24)
17. Current, resistance, and electromotive force (1½ weeks) (Chapter 25)
18. DC Circuits (2 weeks) (Chapter 26)
19. Magnetic field and magnetic sources (1½ weeks) (Chapter 27)
20. Sources of magnetic field (1 weeks) Chapter 28)
21. Electromagnetic induction (1½ weeks) (Chapter 29)
22. Inductance (½ week) (Chapter 30)
23. Alternating Current (2 weeks) (Chapter 31)
24. Electromagnetic Waves (1 week) (Chapter 32)

## Lab Overview

There is also a lab component to the course. The labs are intended to reinforce and extend the concepts learned in class. At least one session per week will be spent on laboratory activities. Students will keep a lab notebook which will be periodically collected and assessed. The lab grade will be 20% of the course grade.

Many of the labs are computer based using PASCO sensors and the PASCO Data Studio software.

## Lab Outline

### Semester 1:

- 1. Composition of Vectors:** A force table will be used to explore resolving vectors into components.
- 2. One dimensional Motion Graphs:** A sonic motion sensor will be used to generate plots of position, velocity, and acceleration.
- 3. Projectile Motion**
  - a. Projectile motion over level ground:** A projectile launcher will be used to explore the relationship between initial speed and angle on a projectile's flight over level ground.
  - b. Projectile motion:** A projectile launcher, photogates and a switch pad will be used to explore projectile motion where  $dy_i \neq dy_f$ .
- 4. Second Law**
  - a. Free fall:** Students will use various methods to explore the acceleration on an object due to the force of gravity.
  - b. Acceleration on a ramp:** A sonic motion sensor will be used to measure the acceleration of a cart on an incline with a hanging mass at the top of the incline opposing the component of force down the ramp.
- 5. Friction**
  - a. Friction over level ground:** A force sensor and a motion sensor will be used to investigate friction over level ground.
  - b. Friction on a ramp:** A force sensor and a motion sensor will be used to investigate friction on a ramp.
- 6. Centripetal Force:** Students will use the Pasco Rotational System to explore centripetal force.

7. **Bow:** Students will generate a force versus pulling distance graph and use this to determine the efficiency of a bow.
8. **Simple Machine Series:** Students will investigate a series of simple machines.
9. **Linear Momentum in Explosions:** Students will use carts on a dynamics track to simulate an explosion.
10. **Impulse:** Students will use a force sensor and a sonic motion detector to explore the relationship between impulse and change in momentum.
11. **Moment of Inertia:** Students will use the Pasco Rotational System to determine the moment of inertia for several objects, including a non-symmetrical object.
12. **Rotational Kinetic Energy:** Students will investigate rotational kinetic energy using a ramp, a steel ball, and the sensors of their choosing.
13. **Springs:** Students will use a motion sensor and a force sensor to analyze the harmonic motion of a mass-spring system.

### Semester 2:

14. **Electrostatics:** Students will use charged pith balls to investigate electrostatics.
15. **Equipotential Lines:** Students will use conductive paper to map equipotentials and field gradients.
16. **Simple Circuits**
  - a. **Ohm's law:** Students will use circuit boards and multimeters to explore Ohm's law.
  - a. **Kirchhoff's's Rules:** Students will use circuit boards and multimeters to explore Kirchhoff's rules.
17. **Magnetic field of a wire:** Students will measure the magnetic field around a current carrying wire when varying either the current in the wire or the distance from the wire.
18. **Induction and emf:** Students will use a magnetic probe and a voltmeter with the PASCO system to investigate electromagnetic induction.
19. **Alternating current:** Students will use the PASCO system to display voltage versus time to investigate inductance and capacitance in AC circuits.



### Course Description

HIGH SCHOOL		
1. Course Title <b>Physics, Level 2</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Physics</b>		
3. Transcript Course Code/Number <b>00362</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 11 – 12           Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input checked="" type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites C or better in Level 2 Algebra II; B or better in Level 3 Algebra II		
11. Brief Course Description This course provides the student with an introduction to the fundamental concepts of matter and energy. The ideas presented are developed in a progression from simpler to more complex. The principles studied in this course are force, momentum, energy and work, and electricity and magnetism. In addition, special topics studied may include wave motion, light and sound, and thermodynamics. Students are expected to learn the fundamental concepts of physics, to place physics in historical and societal context, and to further develop their understanding and application of both mathematics and the scientific process. There is a strong laboratory component to this course.		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocols. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently. <b>6. Demonstrate respect for one's self, and strive to contribute to the success of others.</b>		

## 13. Course Outline

**A. First Trimester**

- |   |         |                       |
|---|---------|-----------------------|
| 1. One dimensional motion                               | 2 weeks | (Newtonian Mechanics) |
| 2. Two dimensional motion                               | 2 weeks |                       |
| <b>3. Newton's laws of motion, (force and friction)</b> | 2 weeks |                       |
| 4. Circular motion and gravitation                      | 2 weeks |                       |
| 5. Work and energy                                      | 2 weeks |                       |
| 6. Simple machines (time permitting)                    | 1 week  |                       |

**B. Second Trimester**

- |                                      |         |                             |
|--------------------------------------|---------|-----------------------------|
| 1. Linear momentum and impulse       | 2 weeks |                             |
| 2. Thermodynamics                    | 2 weeks | (Heat & Thermodynamics)     |
| 3. Vibrations and waves              | 1 week  | (Waves and Optics)          |
| 4. Sound                             | 1 week  |                             |
| 5. Light                             | 2 weeks |                             |
| 6. Electric charge, field, potential | 1 week  | (Electricity and Magnetism) |
| 7. Electric circuits                 | 1 week  |                             |
| 8. Magnetism and induced currents    | 1 week  |                             |
| 9. Modern physics (time permitting)  | 1 week  |                             |

## 14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response Cards by TurningTechnologies
- Web-based instruction with Blackboard/FinalSite
- Research

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

## 17. History of Course Development

The course stems from the earliest thinking and wonders of mankind. Many concepts and theories developed out of necessity. Survival and the improvement of quality of life drove early inquiry, discovery and application. Succeeding years led to improved safety and advantage over neighboring tribes. In the modern world and in education, many of the same tenets apply as the theories of physics stretch the imagination and challenge past understanding.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>Content Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic that are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</b></li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of an experiment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u>Physics: Principles and Problems</u> Glencoe McGraw Hill, 2009  <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Cooperative group work</li> <li>▪ Differentiated instruction</li> <li>▪ Lecture</li> <li>▪ PowerPoint Presentations &amp; Notes</li> <li>▪ Laboratory Investigations</li> <li>▪ Web based Instruction</li> <li>▪ Independent learning</li> <li>▪ Teacher centered and student centered discussions, demonstrations and analyses</li> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided Internet research</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b>  Inclined Plane lab using computer software



<b>LEARNING STRAND: Motion and Forces</b> <b>2.0 Newtonian Mechanics</b> <i>CT Physics Standard: Newton's laws predict the motion of most objects.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Displacement, velocity, acceleration and time are all interrelated.</li> <li>▪ Acceleration is the link between force and mass.</li> <li>▪ Mechanical energy is connected through force and displacement, while momentum is connected through force and time.</li> <li>▪ <b>When forces are balanced, no acceleration occurs;</b> thus an object continues to move at a constant speed or stays at rest.</li> <li>▪ The law <math>F = ma</math> is used to solve motion problems that involve constant forces.</li> <li>▪ When one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction.</li> <li>▪ Applying a force perpendicular to the direction of motion causes a change of direction.</li> <li>▪ Circular motion requires the application of a constant force toward the center of the circle.</li> <li>▪ Newton's laws are not exact, but provide very good approximations unless an object is small enough that quantum effects become important.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ <b>How do Newton's Laws relate motion and force?</b></li> <li>▪ How do the laws of conservation apply to large, small and universal systems?</li> <li>▪ <b>Why do Newton's Laws of motion and gravitational theories explain circular motion?</b></li> </ul>
	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u>Physics: Principles and Problems</u> Glencoe McGraw Hill, 2009 <ul style="list-style-type: none"> <li>▪ Lab Equipment</li> <li>▪ Computer software, sensors, etc.</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Relate forces to linear motion and energy.</li> <li>▪ Compare circular motion (rotational) properties to their linear counterparts.</li> <li>▪ Relate the conservation laws to each other.</li> <li>▪ Relate Newtonian Mechanics to modern technologies such as, auto-safety and crash analysis.</li> <li>▪ Describe simple harmonic motion.</li> </ul>	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Lecture, question, answer, and discussion</li> <li>▪ Laboratory models of motion</li> <li>▪ Laboratory investigations and inquiry activities (displacement, velocity, acceleration and time)</li> <li>▪ Problem solving</li> <li>▪ Demonstrations</li> <li>▪ Cooperative group work</li> <li>▪ Differentiated instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Web based instruction</li> <li>▪ Independent learning</li> <li>▪ Teacher centered and student centered discussions and analyses</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Laboratory observation and follow-up documentation</li> <li>▪ Laboratory reports (essay, data, calculation, graph, synthesis and conclusion)</li> <li>▪ Projects (building mechanical devices)</li> <li>▪ Homework (readings, questions, problems)</li> <li>▪ Tests and quizzes</li> <li>▪ Student class participation</li> </ul>

<b>LEARNING STRAND</b> <b>3.0 Heat and Thermodynamics</b> <i>CT Physics Standard: Energy cannot be created or destroyed although, in many processes, energy is transferred to the environment as heat.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Thermodynamics is the basis for heat transfer throughout the universe.</li> <li>▪ Temperature and heat prescribe the activities of solids, liquids and gases in their applied states.</li> <li>▪ Kinetic theory and thermodynamics show the relationship of energy transfer between one form of energy and another.</li> <li>▪ Heat flow and work are two forms of energy transfer between systems.</li> <li>▪ The work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature.</li> <li>▪ The internal energy of an object includes the energy of random motion of the object's atoms and molecules. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.</li> <li>▪ Most processes tend to decrease the order of a system over time, so that energy levels eventually are distributed more uniformly.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How does friction dissipate energy in real life scenarios?</li> <li>▪ How do the laws of conservation apply to energy and work?</li> <li>▪ Why does thermal expansion play such an important role in engineering design?</li> <li>▪ <b>What properties of water enhance its utility as a thermal medium for doing work?</b></li> <li>▪ What properties of water have contributed to climate and life on the planet earth?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Apply the equations of heat transfer to lab investigations.</li> <li>▪ Evaluate how the laws of thermodynamics define the world around us and the kinetic theory.</li> <li>▪ Examine how steam generators and turbines produce electricity.</li> <li>▪ Discuss how the equations of heat transfer affect the design of efficient devices and home construction.</li> <li>▪ Demonstrate how thermal energy affects the characteristics of matter.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Physics: Principles and Problems</u> Glencoe McGraw Hill, 2009 <ul style="list-style-type: none"> <li>▪ Lab Equipment</li> <li>▪ Computer software, sensors, etc.</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Lecture, question, answer, and discussion</li> <li>▪ Laboratory models of motion</li> <li>▪ Laboratory investigations and inquiry activities (displacement, velocity, acceleration and time)</li> <li>▪ Problem solving</li> <li>▪ Cooperative group work</li> <li>▪ Differentiated instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Web based instruction</li> <li>▪ Independent learning</li> <li>▪ Project based learning</li> <li>▪ Teacher centered and student centered discussions, demonstrations and analyses</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Laboratory observation with follow-up documentation</li> <li>▪ Laboratory reports (essay, data, calculation, graph, synthesis and conclusion)</li> <li>▪ Projects (building mechanical devices)</li> <li>▪ Homework (readings, questions, problems)</li> <li>▪ Tests and quizzes</li> <li>▪ Student class participation</li> </ul>

<b>LEARNING STRAND: Waves</b> <b>4.0 Waves and Optics</b> <i>CT Physics Standard: Waves have characteristic properties that do not depend on the type of wave.</i>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Waves carry energy from one place to another.</li> <li>▪ Transverse and longitudinal waves exist in mechanical media, such as springs and ropes, and in the Earth as seismic waves.</li> <li>▪ Wavelength, frequency and wave speed are related.</li> <li>▪ Sound is a longitudinal wave whose speed depends on the transmission medium in which it propagates.</li> <li>▪ Radio waves, light and X-rays are different wave length bands in the spectrum of electromagnetic waves.</li> <li>▪ E-M wave speed depends on the media.</li> <li>▪ Wave characteristics include interference, diffraction, refraction and polarization.</li> <li>▪ Beats and the Doppler Effect result from the characteristic behavior of waves.</li> <li>▪ <b>Snell's Law provides an explanation for the operation of optical technology.</b></li> <li>▪ Transverse waves provide an explanation for the behavior of light.</li> <li>▪ Wave reflection is mathematically predictable.</li> <li>▪ Geometric optics and ray tracing illustrate reflection and lens behavior.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are the characteristics, behaviors and mathematical models of waves?</li> <li>▪ <b>How does Snell's Law predict how light will bend as it travels from one medium to another?</b></li> <li>▪ <b>How do Young's Double Slit experiment, Single Slit Diffraction and the colors of soap bubbles all support the wave nature of light?</b></li> <li>▪ How do the focal lengths and the radius of curvature of mirrors and lenses locate the position of created images based on location of an object in front of an optical device?</li> </ul>
	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u>Physics: Principles and Problems</u>            Glencoe McGraw Hill</p> <ul style="list-style-type: none"> <li>▪ Lab Equipment</li> <li>▪ Computer software, sensors, etc.</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Lecture, question, answer, and discussion</li> <li>▪ Laboratory models of motion</li> <li>▪ Cooperative group work</li> <li>▪ Differentiated instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Web based instruction</li> <li>▪ Independent learning</li> <li>▪ Teacher centered and student centered discussions and analyses</li> <li>▪ Laboratory investigations and inquiry activities (displacement, velocity, acceleration and time)</li> <li>▪ Problem solving</li> <li>▪ Demonstrations</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the characteristics and behavior of waves.</li> <li>▪ <b>Understand Snell's Law and how it is the basic of all optics.</b></li> <li>▪ Illustrate how the laws of reflection and refraction apply to all optical devices.</li> <li>▪ Predict image formation from lenses and mirrors.</li> <li>▪ <b>Determine how Snell's Law is the basis for all fiber optic communications.</b></li> <li>▪ Analyze the laws of reflection and refraction and predict image formation from lenses and mirrors.</li> </ul>	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Laboratory observation and follow-up documentation</li> <li>▪ Laboratory reports (essay, data, calculation, graph, synthesis and conclusion)</li> <li>▪ Projects (building mechanical devices)</li> <li>▪ Homework (readings, questions, problems)</li> <li>▪ Tests and quizzes</li> <li>▪ Student class participation</li> </ul>

**LEARNING STRAND: Electric and Magnetic Phenomena****5.0 Electricity and Magnetism**

*CT Physics Standard: Electric and magnetic phenomena are related and have many practical applications.*

**ENDURING UNDERSTANDINGS**

- Charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges.
- Protons and electrons are the essential particles of nature that contain electric charges.
- Chemical reactions are essentially electrical reactions and the basis for DC current.
- Plasma, the fourth state of matter, contains ions or free electrons or both and conducts electricity.
- Voltage is the energy per charge. Current is the rate of flow of a charge.
- Conductors, capacitors, resistors are the most basic components of an electrical circuit.
- The voltage or current in simple DC electric circuits can be predicted using Ohm's law.
- Any resistive element in a DC circuit dissipates energy, which heats the resistor.
- The power in any resistive circuit element can be calculated using the formula  $\text{Power} = I^2 R$ .
- Resistance regulates the current.
- **Ohm's Law and Joule's law describe the** relationships between voltage, current, resistance, energy and power.
- Magnetic fields are created by permanent magnets or by electrical current.
- Electromagnetism is the interaction between an electric field and a magnetic field.
- Magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.
- Changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.
- Electrical current and magnetic fields interact to power electric motors or generate electric power.

**ESSENTIAL QUESTIONS**

- How do charged particles exert forces on each other?
- How can multiple charges create positions of zero electric field?
- What is voltage?
- What is current?
- What is electrical resistance?
- How are current, voltage and resistance related?
- What does a capacitor do?
- What determines how much power is generated in a load resistor and an electrical circuit?
- How is direct current produced?
- How is alternating current produced?
- How is current induced in a magnetic field?

**LEARNING OBJECTIVES** *The student will...*

- Demonstrate an understanding of fields/forces.
- Create DC circuits and AC circuits.
- Analyze DC circuits and AC circuits.
- Explain the principles behind the fundamental electrical components (e.g., resistors, capacitors, inductors).
- Demonstrate how electrical components combine to create everyday electrical devices.
- Investigate fields and forces created by charged particles.
- **Demonstrate the vector nature of Coulomb's law** and electric fields.

**INSTRUCTIONAL SUPPORT MATERIALS**

Physics: Principles and Problems

Glencoe McGraw Hill 2009

- Lab Equipment
- Computer software, sensors, etc.

**SUGGESTED INSTRUCTIONAL STRATEGIES**

- Lecture, question, answer, and discussion
- Laboratory models of motion
- Laboratory investigations and inquiry activities (displacement, velocity, acceleration and time)
- Cooperative group work
- Differentiated instruction

- Create and analyze DC circuits and AC circuits.
- Apply the principles of Ohm's law to electrical components.
- Use Faraday's and Lenz's laws to explain electromagnetism and solve problems involving electromagnetic induction.

- PowerPoint presentations and notes
- Web based instruction
- Independent learning
- Project based learning
- Teacher centered and student centered discussions and analyses
- Problem solving
- Demonstrations

**SUGGESTED ASSESSMENT METHODS**

- Laboratory observation and follow-up documentation
- Laboratory reports (essay, data, calculation, graph, synthesis and conclusion)
- Projects (building mechanical devices)
- Homework (readings, questions, problems)
- Tests and quizzes
- Student class participation

## Experiment 1: Color Addition

### EQUIPMENT NEEDED

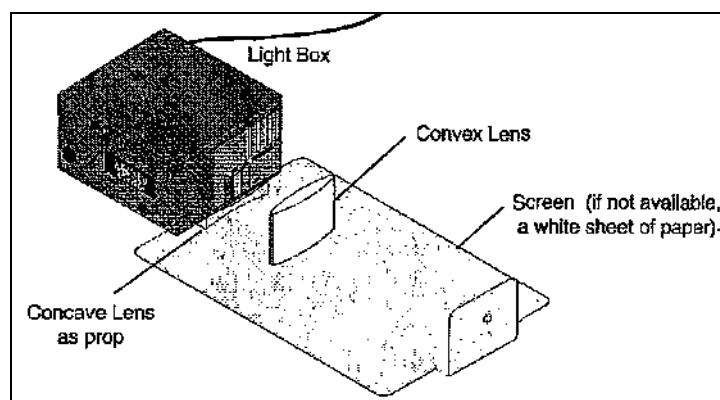
- Ray box (color rays) - Convex lens
- Colored paper (red, yellow, green, blue)

### Purpose

To determine the colors that result from the addition of two or three primary colors and to show the effect of illuminating colored objects with different colors of light.

### Procedure

- ① Place the ray box on a white sheet of paper on the table. Adjust the box so the primary colors are showing. If the white screen from the Optics Bench (OS-8518) is available, it can be laid flat on the table to make a good viewing platform for this experiment. It may be helpful to raise the front end of the box by approximately 1 cm (The concave lens works fine for this). This causes the colored rays to shine out a further distance.
- ② Place the convex lens near the ray box so it focuses the rays and causes them to cross each other at the focal point. What is the color of the light where the three rays come together? Record the result in Table 1.1. It may be helpful to crease the paper so it forms a wall upon which the focal point is projected. See Figure 1.1.



**Figure 1.1: Ray Box for color addition**

- ③ Now block the green ray with an opaque object. What color results from adding red and blue? Record the result in Table 1.1. Repeat Step 3, blocking one color each in succession and completing Table 1.1.

**Table 1.1 Results of Color Addition**

COLORS ADDED	RESULTING COLOR
red + blue + green	
red + blue	
red + green	
green + blue	

Shine the three primary colors on each of the colored sheets of paper. What color does each sheet of paper appear to be for each color of illuminating light? Record the results in Table 1.2.

**Table 1.2 Results of Reflection Off Colored Paper**

COLOR OF PAPER IN WHITE LIGHT	COLOR OF LIGHT RAY	COLOR OF PAPER IN COLORED LIGHT
	Red	
	Green	
	Blue	
	Red	
	Green	
	Blue	
	Red	
	Green	
	Blue	
	Red	
	Green	
	Blue	

## **Experiment 2: Prism**

### **EQUIPMENT NEEDED**

- Ray box (white ray)
- Rhombus

### **Purpose**

To show how a prism separates white light into its component colors and to show that different colors are refracted at different angles through a prism.

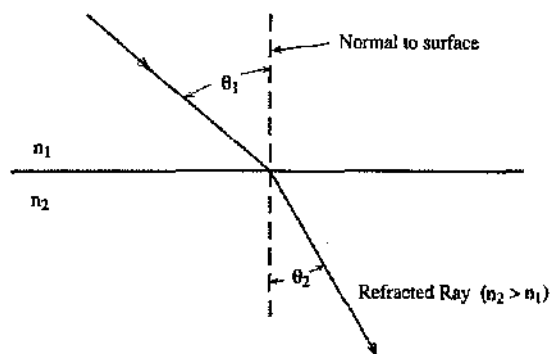
### **Theory**

According to Snell's Law,

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

the angle of refraction depends on the angle of incidence and the index of refraction of the material. See Figure 2.1. Because the index of refraction for light varies with the frequency of the light, white light which enters the material at a given angle of incidence will separate out into its component colors as each frequency is bent a different amount.

The rhombus is made of Acrylic which has an index of refraction of 1.497 for light of wavelength 486 nm in a vacuum, 1.491 for wavelength 589 nm, and 1.489 for wavelength 651 nm (red). Notice that in general for visible light, the index of refraction for Acrylic increases with increasing frequency.

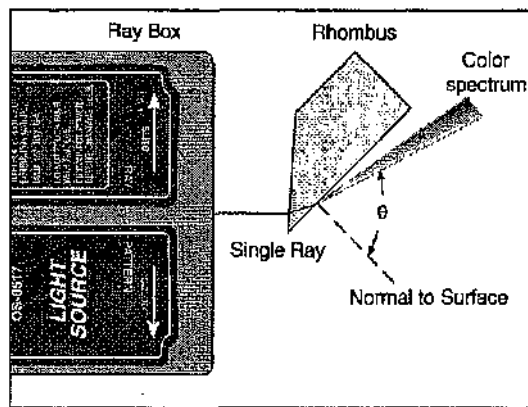


**Figure 2.1: Refraction of Light**



### Procedure for Separating White light

- ① Place the ray box, label side up, on a white sheet of paper on the table. Adjust the box so one white ray is showing. If the white screen from the OS-S51S Optics Bench is available, it can be laid flat on the table to make a good viewing platform for this experiment.
- ② Position the rhombus as shown in Figure 2.2. The triangular end of the rhombus is used as a prism in this experiment. Keep the ray near the point of the rhombus for maximum transmission of the light.
- ③ Rotate the rhombus until the angle ( $\theta$ ) of the emerging ray is as large as possible and the ray separates into colors.
  - (a) What colors are seen and in what order are they?
  - (b) Which color is refracted at the largest angle?
  - (c) According to Snell's Law and the information given about the frequency dependence of the index of refraction for Acrylic, which color is predicted to refract at the largest angle?
- ④ Turn the ray box over and shine the three primary color rays into the rhombus at the same angle used for the white ray. Do the colored rays emerge from the rhombus parallel to each other? Why or why not?



**Figure 2.2**

## Experiment 3: Reflection – Plane and Curved Mirrors

### EQUIPMENT NEEDED

- Ray box (single and multiple white rays)
- Protractor (SE-8732)
- Metric rule
- Plane and curved mirrors
- Drawing compass (SE-8733)
- White paper

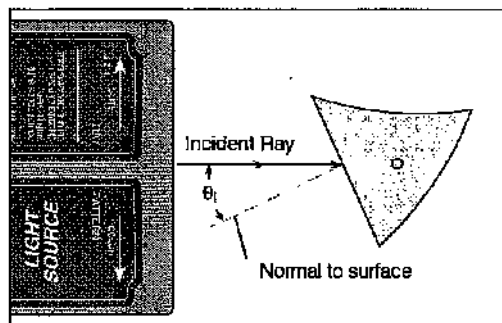
### Purpose

To study how rays are reflected and to determine the focal length and radius of curvature of different types of mirrors.

### Part I: Plane Mirror

#### Procedure

- ① Place the ray box, label side up, on a white sheet of paper on the table. Adjust the box so one white ray is showing.
- ② Place the mirror on the table and position the plane surface of the mirror at an angle to the ray so that the both the incident and reflected rays are clearly seen.
- ③ Mark the position of the surface of the plane mirror and trace the incident and reflected rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions.
- ④ On the paper, draw the normal to the surface. See Figure 3.1.
- ⑤ Measure the angle of incidence ( $\theta_i$ ) and the angle of reflection. Both these angles should be measured from the normal. Record the angles in Table 3.1.
- ⑥ Change the angle of incidence and measure the incident and reflected angles again. Repeat this procedure for a total of three different incident angles.
- ⑦ Adjust the ray box so it produces the three primary color rays. Shine the colored rays at an angle to the plane mirror. Mark the position of the surface of the plane mirror and trace the incident and reflected rays. Indicate the colors of the incoming and the outgoing rays and mark them with arrows in the appropriate directions.



**Figure 3.1**

**Table 3.1 Plane Mirror Results**

Angle of Incidence	Angle of Reflection

**Questions**

- ① What is the relationship between the angle of incidence and the angle of reflection?
- ② Are the three colored rays reversed left-to-right by the plane mirror?

**Part II: Cylindrical Mirrors**

**Theory**

A concave cylindrical mirror will focus parallel rays of light at the focal point. The focal length is the distance from the focal point to the center of the mirror surface. The radius of curvature of the mirror is twice the focal length. See Figure 3.2.

**Procedure**

- ① Using five white rays from the ray box, shine the rays straight into the concave mirror so the light is reflected back toward the ray box. See Figure 3.3. Draw the surface of the mirror and trace the incident and reflected rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions.
- ② The place where the five reflected rays cross each other is the focal point of the mirror. Measure the focal length from the center of the concave mirror surface to the focal point. Record the result in Table 3.2.
- ③ Use the compass to draw a circle that matches the curvature of the mirror. Measure the radius of curvature using a rule and record it in Table 3.2.
- ④ Repeat Steps I through 3 for the convex mirror. Note that in Step 2, the reflected rays are diverging for a convex mirror and they will not cross. Use a rule to extend the reflected rays back behind the mirror's surface. The focal point is where these extended rays cross.

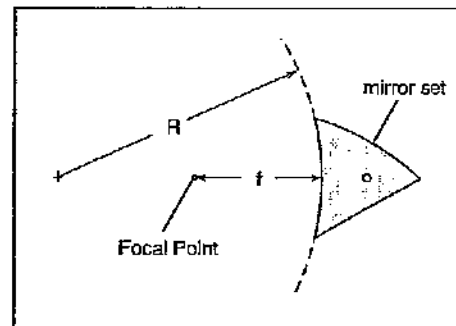


Figure 3.2

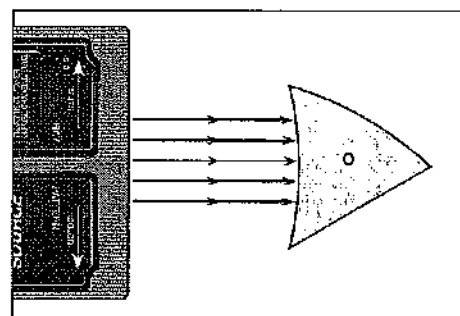


Figure 3.3

**Table 3.2 Cylindrical Mirror Results**

	Concave Mirror	Convex Mirror
Focal Length		
Radius of Curvature using compass		

**Questions**

- ① What is the relationship between the focal length of a cylindrical mirror and its radius of curvature? Do your results confirm your answer?
- ② What is the radius of curvature of a plane mirror?

## Experiment 4: Snell's Law

### EQUIPMENT NEEDED

- Ray box (single white ray and colored rays)
- Rhombus
- Protractor (SE-8732)
- White paper

### Purpose

To use Snell's Law to determine the index of refraction of the acrylic rhombus.

### Theory

Snell's Law states

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

where  $\theta_1$  is the angle of incidence,  $\theta_2$  is the angle of refraction, and  $n_1$  and  $n_2$  are the respective indices of refraction of the materials. See Figure 4.1.

### Procedure

- ① Place the ray box, label side up, on a white sheet of paper on the table. Slide the ray mask until only one white ray is showing.
- ② Place the rhombus on the table and position it so the ray passes through the parallel sides as shown in Figure 4.2.
- ③ Mark the position of the parallel surfaces of the rhombus and trace the incident and transmitted rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions. Mark carefully where the ray enters and leaves the rhombus.
- ④ Remove the rhombus and on the paper draw a line connecting the points where the ray entered and left the rhombus.
- ⑤ Choose either the point where the ray enters the rhombus or the point where the ray leaves the rhombus. At this point, draw the normal to the surface.
- ⑥ Measure the angle of incidence ( $\theta_1$ ) and the angle of refraction with a protractor. Both these angles should be measured from the normal. Record the angles in Table 4.1.
- ⑦ Change the angle of incidence and measure the incident and refracted angles again. Repeat this procedure for a total of three different incident angles.

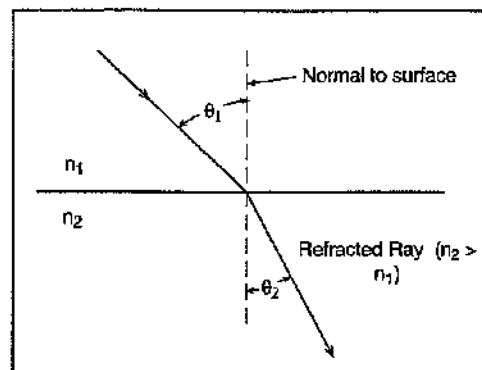


Figure 4.1

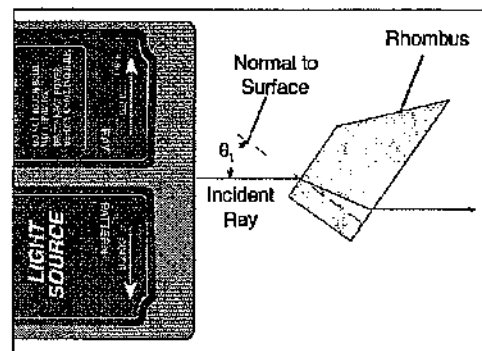


Figure 4.2

**Table 4.1 Data and Results**

Angle of Incidence	Angle of Refraction	n rhombus
Average index of refraction		

**Analysis**

- ① Using Snell's Law and your data, calculate the index of refraction for the Acrylic rhombus, assuming the index of refraction of air is one. Record the result for each of the three data sets in Table 4.1.
- ② Average the three values of the index of refraction and compare to the accepted value ( $n = 1.5$ ) using a percent difference.

**Question**

What is the angle of the ray that leaves the rhombus relative to the ray that enters the rhombus?

## Experiment 5: Total Internal Reflection

### EQUIPMENT NEEDED

- Ray box (single ray)
- Rhombus
- Protractor (SE-8732)
- White paper

### Purpose

To determine the critical angle at which total internal reflection occurs and to confirm it using Snell's Law.

### Theory

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

where  $\theta_1$  is the angle of incidence,  $\theta_2$  is the angle of refraction, and  $n_1$  and  $n_2$  are the respective indices of refraction of the materials. See Figure 5.1.

If a ray of light traveling from a medium of greater index of refraction to a medium of lesser index of refraction is incident with an angle greater than the critical angle ( $\theta_c$ ), there is no refracted ray and total internal reflection occurs. If the angle of incidence is exactly the critical angle, the angle of the refracted ray is 90 degrees. See Figure 5.2. In this case, using Snell's Law,

$$n \sin \theta_c = (1) \sin (90^\circ)$$

assuming the medium of lesser index of refraction is air with  $n_2 = 1$  and the medium of greater index of refraction is the Acrylic rhombus with  $n_1 = n = 1.5$ . Solving for the critical angle gives

$$\sin \theta_c = \frac{1}{n}$$

### Procedure

- ① Place the ray box, label side up, on a white sheet of paper on the table. Slide the ray mask until only one white ray is showing.
- ② Position the rhombus as shown in Figure 5.3. Do not shine the ray through the rhombus too near the triangular tip.

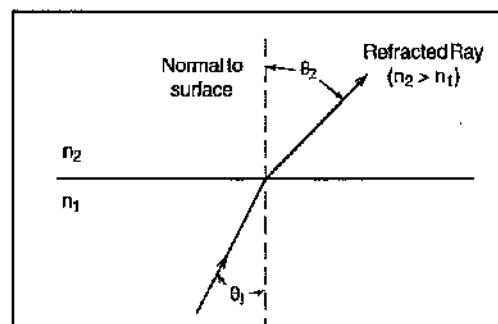


Figure 5.1

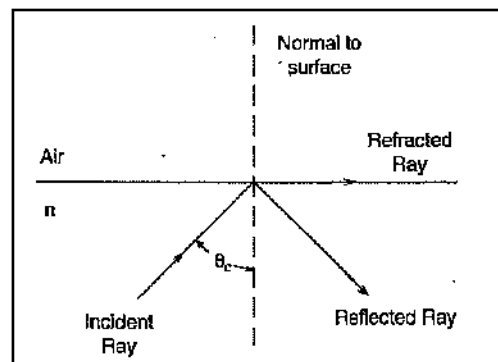


Figure 5.2

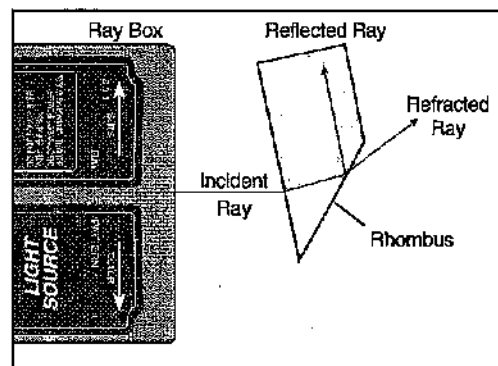


Figure 5.3

- ③ Rotate the rhombus until the emerging ray just barely disappears. Just as it disappears, the ray separates into colors. The rhombus is correctly positioned if the red has just disappeared.
- ④ Mark the surfaces of the rhombus. Mark exactly the point on the surface where the ray is internally reflected. Also mark the entrance point of the incident ray and mark the exit point of the reflected ray.
- ⑤ Remove the rhombus and draw the rays that are incident upon and that reflect off the inside surface of the rhombus. See Figure 5.4. Measure the total angle between these rays using a protractor. If necessary, you may extend these rays to make the protractor easier to use. Note that this total angle is twice the critical angle because the angle of incidence equals the angle of reflection. Record the critical angle here: \_\_\_\_\_
- ⑥ Calculate the critical angle using Snell's Law and the given index of refraction for Acrylic. Record the theoretical value here: \_\_\_\_\_
- ⑦ Calculate the percent difference between the measured and theoretical values:  
% difference- \_\_\_\_\_

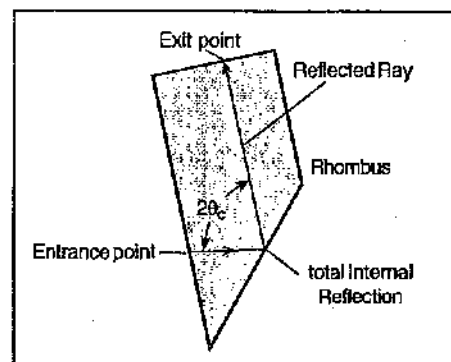


Figure 5.4

### Questions

- ① How does the brightness of the internally reflected ray change when the incident angle changes from less than  $\theta_c$ , to greater than  $\theta_c$ , ?
- ② Is the critical angle greater for red light or violet light? What does this tell you about the index of refraction

**PHYSICS (Level 2)**  
**EFFECTIVE CRITICAL THINKING STRATEGIES**  
**KINEMATICS AND DYNAMICS LABORATORY EXPERIMENTS**  
**3**

<b>Exceeds Expectations</b>	The student effectively collects, interprets, analyzes, and evaluates data to solve a problem. S/he applies reasonable and appropriate assumptions while displaying due diligence in the setup of the experiment. S/he understands and clearly makes highly effective use of the capabilities of the various detectors and interactive software to solve problems and evaluate the meaning of data. Calculations are technically accurate, appropriately accomplished and demonstrate clear mastery of the theory as applied to the physical application. Conclusions are correct and indicate insightful understanding and a readiness for higher challenges.
<b>Meets Expectations</b>	The student effectively collects, interprets, analyzes, and evaluates data to solve a problem. S/he applies reasonable and appropriate assumptions while displaying due diligence in the setup of the experiment. S/he understands and clearly makes highly effective use of the capabilities of the various detectors and interactive software to solve problems with minimum of error and assistance. S/he correctly evaluates the meaning of data using technology. Calculations are technically accurate and appropriately accomplished, but may contain minor errors. Conclusions are correct and appropriate.
<b>Meets Some Expectations</b>	The student effectively collects, interprets, analyzes, and evaluates data to solve a problem, although some important data may be missing, requiring the student to make logical assumptions. S/he displays due diligence in the setup of the experiment and in correctly executing clearly delineated steps. S/he makes reasonably effective use of the capabilities of the various detectors and interactive software to solve problems. Some error or difficulty with the equipment and its implementation is acceptable. S/he correctly evaluates the meaning of data using technology, although may have difficulty connecting the data observe to the theory using mathematical expression and calculations. Calculations and conclusions are technically accurate and reflect at least a qualitative understanding.
<b>Does Not Meet Expectations</b>	The student collected incomplete data and or missed significant portions. Interpretation and evaluation of the data indicates a lack of understanding. The student failed to demonstrate basic principals of the scientific method in setting up equipment and conducting a meaningful and effective controlled experiment. The equipment was not used to gather even the most basic level of quality data. Calculations and conclusions display a clear lack of conceptual understanding.





## Lab: Acceleration down an inclined plane (30 points)

**Objective:** Investigate acceleration down an inclined plane. Compare "Theoretical Acceleration" ( $g \cdot \sin\theta$ ) to "Observed Acceleration" as measured by the Pasco CBL software.

**Materials:** Ramp, cart, motion sensor, meter stick, laptop with Pasco software.

**Procedure:**

5. Set up ramp, motion sensor, laptop. Use a cloth bundle to serve as a bumper and protect the cart from damage.
6. Compute the theoretical acceleration for each angle prescribed in the data table.
7. Set the ramp height for each trial using trigonometric ratios to establish the required angle for each step.
8. Coordinate lap-top operation and cart release to capture the data required. Repeat for each angle prescribed.

**Data Table:**

Trial #	Angle (degrees)	Theoretical Acceleration	Observed Acceleration	Percent Error $\frac{Theo - Obs}{Theo} \times 100\%$
1	0°	0.00		N/A
2	2°			
3	5°			
4	10°			
5	15°			
6	20°			
7	25°			
8	Spare			

**Analysis:** (Use separate paper)

5. Show one sample calculation and diagram for how you set the angle of the ramp using trigonometric ratios.
6. Calculate the theoretical acceleration for each trial. Show at least one sample calculation.
7. Calculate the Percent Error for each trial. Show at least one sample calculation.
8. Generate a quality line-graph (on graph paper) that clearly and accurately conveys your results as summarized in the data table. You are not limited to only two variables. The best graphs will include the angle vs. all 3 data columns.

**Questions:** (Use separate paper)

4. Does this activity confirm the relationship  $a = g \cdot \sin\theta$ , where  $g = 9.8\text{m/s}^2$ ? Why?
5. Does the percent error increase or decrease as the angle increases? Why?
6. What are some possible sources of error for this lab? Which are the most significant and how would you eliminate them.

**PHYSICS (Level 2)**  
**EFFECTIVE USE OF TECHNOLOGY**  
**KINEMATICS AND DYNAMICS LABORATORY EXPERIMENTS**  
**2**

<b>Exceeds Expectations</b>	The student independently collects, interprets, analyzes, and evaluates data using the Pasco lab equipment. (The student who exceeds expectations may be seen teaching others or leading the group). S/he independently explores ways to use the equipment to accomplish the experiment. The student is able to transfer data to other application software programs for further analysis or display. The student adjusts sample rates, inputs, and detectors appropriately. S/he is able to <b>manipulate the various graphs and use "best-fit" algorithms to mine the most meaningful data and conclusions from the experiment.</b>
<b>Meets Expectations</b>	The student independently collects, interprets, analyzes, and evaluates data using the Pasco lab equipment, but requires occasional assistance. S/he requires minimal coaching in using the equipment to accomplish the experiment. The student uses the data and evaluation tools to draw logical conclusions. The student adjust sample rates, inputs, and detectors appropriately, but may require minor assistance or coaching. <b>S/he is able to manipulate the various graphs and use "best-fit" algorithms to support the experiment.</b>
<b>Meets Some Expectations</b>	The student effectively collects, interprets, analyzes, and evaluates data using the Pasco lab equipment, but requires significant or repeat assistance. S/he requires coaching and some assistance in using the equipment to accomplish the experiment. The student makes some minor errors in interpreting the data or using the technology, but manages to draw logical conclusions and evidence learning. S/he is able to <b>manipulate the various graphs and use "best-fit" algorithms to support the experiment</b> although s/he may require assistance from peers or teacher.
<b>Does Not Meet Expectations</b>	The student was unable to successfully use the Pasco equipment and laptop despite significant assistance and coaching. The student collected incomplete data and/or missed significant portions. The student was unable to assemble the equipment and manage the technology to accomplish the most basic aspects of the experiment.

### Course Description

HIGH SCHOOL		
1. Course Title <b>Advanced Placement Biology</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>AP Biology</b>		
3. Transcript Course Code/Number <b>00370</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grades: 11 – 12    Level: 1	
7. Seeking "Honors" Distinction? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input checked="" type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____		
9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)		
10. Pre-Requisites A in Biological Systems and Chemistry level II, B in Biology - Honors or Honors Chemistry		
11. Brief Course Description This course is designed to be the equivalent of a two–semester college introductory biology course usually taken by biology majors during their first year. The three major areas included in the course are molecules and cells, heredity and evolution, and organisms and populations. Major themes included are science as a process, evolution, energy transfer, continuity and change, structure and function, regulation, interdependence in nature and science, technology, and society. The laboratory experience is an important component of the course. Appropriate labs will be assigned to provide students with the opportunity to learn a variety of skills, facts, principles, and concepts of introductory level biology covered in lectures, reading, and discussions.		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocols. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently. <b>6. Demonstrate respect for one's self, and strive to contribute to the success of others.</b>		

Biology 7<sup>th</sup> Edition by Neil A. Campbell and Jane B Reece Benjamin-Cummings, 2007

13. Course Outline:

1. Ecology
2. Molecules and Cells
3. Genetics
4. Mechanism of Evolution
5. The Evolutionary History of Biological Diversity
6. Plant Form and Function
7. Animal Form and Function

14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio visual presentations
- Response Cards by TurningTechnologies
- Research

15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments/projects evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

16. Assessment Criteria

Students will score at the "Meets Expectations" level for the assignments below according to departmental/school-wide rubrics with samples of student work where appropriate.

Benchmark Assignments:

- (1) Test on cellular respiration: (1A, 1B, 1C, 3); the student will meet expectations when he or she is able to earn a grade of B on the examination.
- (2) Gel electrophoresis lab: (2); the student will meet expectations when he or she is able to set-up, run the lab, and complete the analysis for the lab.

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

17. Indicate how this honors course is different from the standard course.

The material is either new (membrane receptors) or in much greater depth than our honors biology course.

## Audit of Advanced Placement Biology

### Personal Philosophy

Biology is a fascinating and dynamic discipline. Prior to teaching, for approximately 10 years, I worked in several Research and Development laboratories. During that time, my love of the science flourished. Now I have the good fortune to bring that experience to the classroom where I get to share my enthusiasm as I assist a new generation of aspiring scientists on their journey. I strive to impress the importance of integrating all aspects of knowledge when approaching a novel situation as the key to success. I aim to create an environment where my students may confidently mature from simply memorizing content to actually utilizing that foundational knowledge to become pioneering problem-solvers.

### Eight Themes

There are eight major themes interwoven throughout the Advanced Placement Biology Course. These themes are an integral part of the course and provide cohesive structure as we navigate through a wide variety of course content

- (1). Science as process
- (2). Evolution
- (3). Energy transfer
- (4). Continuity and change
- (5). Relationship of structure to function
- (6). Regulation
- (7). Interdependence in nature
- (8). Science, technology and society

### Course Overview

We meet our students five days each week for 30 weeks. Regular class periods are 60 minutes in length. Labs take up about 25 percent of instructional time.

In the AP Biology course, our textbook is Campbell, Neil A., Jane B. Reece, *Biology*, 7<sup>th</sup> Edition. Benjamin Cummings, (2007). *BSCS Biology: A Molecular Approach*, 8<sup>th</sup> edition is used as a reference.

Our labs are mostly derived from the *AB Biology Lab Manual for Students*.

The students' grades are determined from the following components:

1. Tests: Half-hour tests are given at the conclusion of each chapter and an hour exam is given at the end of each unit.
2. Quizzes: 15 minutes quizzes are generally given after we have completed several sections of a chapter.
3. Homework questions are given on a weekly basis. These are derived from various sources including the text, questions I have devised, or biological material that may have been in the news. Homework questions are collected, graded, and returned to the students. Students are to work on homework questions on their own under the honor code.
4. Laboratory reports: In most cases students work collectively gathering data for labs. However, they are expected to do their own analyses and conclusions.

### Topics covered by chapter.

Chapter 1: Exploring life	2 days
Unit 8: Ecology	Summer reading and 4 weeks
Chapter 50: An Introduction to Ecology	
• Lab 12: AP Dissolved oxygen and aquatic primary productivity	
Chapter 51: Behavioral Ecology	
• Lab 11: AP Animal Behavior	
Chapter 52: Population Ecology	

Chapter 53: Community Ecology

Chapter 54: Ecosystems

Unit 1: Molecules and Cells

11 weeks

Chapter 2: The chemical context of life

- Homework assignments on types of bonds

Chapter 3: Water and the Fitness of the Environment

- Lab on pH. Teacher generated and deals with pH of various biological substances and their relationship to humans
- Lab (virtual) How does lab precipitation affect trees?

Chapter 4: Carbon and the Molecular Diversity of Life

- Lab on model building. Dry lab building types of functional groups

Chapter 5: The Structure and Function of Macromolecules

- Lab on molecular identification. (Teacher generated and uses chemicals to identify types of macromolecules)

Chapter 6 A Tour of the Cell

- Lab on types of cells. Teacher generated and uses live cells illustrate the differences between prokaryotes and several types of eukaryotes.
- Lab on relationship of surface area to volume from *BSCS Biology: A Molecular Approach*. This uses agar cubes of different sizes.

Chapter 7: Membrane Structure and Function

- Lab 1: AP Diffusion and osmosis

Chapter 8: An Introduction to Metabolism

- Lab 2: AP Enzyme Catalysis

Chapter 9: Cellular Respiration

- Lab 5: AP Cell Respiration

Chapter 10: Photosynthesis

- Lab 4: AP Plant Pigments and Photosynthesis

Chapter 11: Cell Communication

- Lab (Virtual) How do cell communicate with each other? from the Campbell Reece textbook

Chapter 12: The Cell Cycle

- Lab on onion root cells and whitefish embryo cells. This lab involves the use of prepared slides. It is followed by a lab quiz.
- Lab (simulation) of mitotic cell division using pipe cleaner

Unit 3: Genetics

8 weeks

Chapter 13: Meiosis And Sexual Life Cycles

- Lab 7: AP Genetics of organisms

Chapter 14: Mendel and the Gene Idea

- Lab: continuation of lab 7
- Lab on pea seeds from *BSCS Biology A Molecular Approach*

Chapter 15. The Chromosomal Basis of Inheritance

- Lab: continuation of lab 7

Chapter 16: The Molecular Basis of Inheritance

- Lab: DNA extraction from onion cells (obtained from a professional development day workshop)

Chapter 17: From Gene to Protein

- Lab: (virtual from text): How is a metabolic pathway analyzed?

Chapter 18: The Genetics of Viruses and Bacteria

- Lab: techniques in microbiology. Teacher generated. This lab involves plating of organisms from the room, identification of bacteria and fungi, and techniques of isolating bacteria from a particular colony.

Chapter 19: Eukaryotic Genomes

Chapter 20: DNA Technology and Genomics

- Lab 6: AP Molecular Biology

## Chapter 21: Genetic Basis of Development

## Unit 4: Mechanisms of Evolution

3 weeks

Chapter 22: Descent with Modification

Chapter 23: The Evolution of Populations

- Lab 8: AP Population Genetics and Evolution

Chapter 24: The Origin of Species

Chapter 25: Phylogeny and Systematics

## Unit 5: The evolutionary history of biological diversity

3 weeks

Chapter 26: The Tree of life

Chapter 27: Prokaryotes

- Activity: How has small size affected prokaryotic diversity? This is from Campbell Reece student workbook.

Chapter 28: Protists

- Survey of types of protists. Teacher generated. This lab will involve microscopic examination of various types of protists

Chapter 29: Plant Diversity I

Chapter 30: Plant Diversity II

Chapter 31: Fungi

- Survey of types of fungi. Teacher generated. This lab will involve microscopic and macroscopic examination of various types of fungi.

Chapter 32: An Introduction to Animal Diversity

Chapter 33: Invertebrates

- Survey of types. Teacher generated. This involves doing microscopic and macroscopic examination of various types of invertebrates.

Chapter 34: Vertebrates

## Unit 6: Plant Form and Function

2 weeks

Chapter 35: Plant Structure, Growth, and Development

Chapter 36: Transport in Vascular Plants

- Lab 9: AP lab on transpiration

## Unit 7: Animal Form and Function

5 weeks

Chapter 40: Basic Principles of Animal Form and Function

Chapter 41: Animal Nutrition

Chapter 42: Circulation and Gas Exchange

- Lab 11: AP lab on the physiology of the circulatory system

Chapter 43: The Immune System

Chapter 44: Osmoregulation and Excretion

- Urine lab from Carolina Biological

Chapter 45: Hormones and the Endocrine System

Chapter 48: Nervous System

- Lab on nervous system and response times. Teacher generated.

Chapter 49: Sensory and Motor Mechanisms

- Lab on human sense organs: Teacher generated. This lab involves how various receptors accommodate to stimuli of hot and cold. It also involves how touch receptors are not distributed equally over the body.



**AP BIOLOGY SCORING RUBRIC****3. Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems.**

<b>Exceeds Expectations</b>	The student independently collects, interprets, analyzes, and evaluates a variety of information and data to make original predictions or solve problems. <i>S/he</i> solves problems accurately and efficiently.
<b>Meets Expectations</b>	The student independently collects, interprets, analyzes, and evaluates a variety of information and data to make specific predictions or solve problems. <i>S/he</i> solves problems with few errors.
<b>Meets Some Expectations</b>	The student may need some assistance to collect and interpret a variety of data to make general predictions or solve problems. <i>S/he</i> solves problems with some errors.
<b>Does Not Meet Expectations</b>	The student needs assistance to gather information to make a prediction or solve problems. <i>S/he</i> solves problems with inefficiency and with significant errors.

**BENEDICT'S REAGENT TEST**

<b>PROBLEM:</b> How do various carbohydrate (glucose, fructose, galactose, maltose, sucrose, lactose, starch and gum Arabic) react with Benedict's reagent and Lugol's iodine solutions? If a color change results, what is the mechanism for the change in color?		(2 pt) _____
<b>MATERIALS:</b>		
<ul style="list-style-type: none"> <li>▪ Plastic cups</li> <li>▪ 2% solutions of carbohydrates (glucose, fructose, galactose, sucrose, maltose, lactose, starch, gum arabic)</li> <li>▪ water</li> <li>▪ Lugol's iodine solution</li> <li>▪ Benedict's reagent</li> <li>▪ Goggles/apron</li> </ul>	<ul style="list-style-type: none"> <li>▪ spot plate</li> <li>▪ marker</li> <li>▪ 10 ml graduated cylinder</li> <li>▪ eye droppers</li> <li>▪ test tube clamps</li> <li>▪ water bath</li> <li>▪ test tubes</li> <li>▪ test tube rack</li> </ul>	(3 ¾ pt) _____
<b>PROCEDURE:</b>		
1. Put on an apron and goggles.		
<i>Benedict's reagent test</i>		
2. Label each of 8 plastic with the name of a different carbohydrate: glucose, fructose, galactose, sucrose, maltose, lactose, starch gum arabic.		(1 pt) _____
3. Fill each plastic cup about 2/3 full with its corresponding carbohydrate from the stock bottle.		(1 pt) _____
4. Label a 9th plastic cup "water" and fill it 2/3 full with tap water.		(1 pt) _____
5. Obtain 10 test tubes and label each of 9 with a different carbohydrate and the 10th test tube with water.		(1 pt) _____
6. Place the labeled test tubes in a test tube rack.		(1 pt) _____
7. Using the graduated cylinder, add 10 ml of Benedict's reagent to each of the 10 test tubes.		(1 pt) _____
8. Using an eyedropper, add 30 drops of a particular carbohydrate and water to the correspondingly labeled test tube		(1 pt) _____
9. Using the clamps, place all 9 test tubes in a boiling water bath for 5 minutes.		(1 pt) _____
10. Using the clamps, remove the 9 test tubes from the water bath.		(1 pt) _____
11. Record observations.		(1 pt) _____
<i>Lugol's iodine test</i>		
12. Label 10 wells on the spot plate with the names of each of the 9 carbohydrate and water.		(1 pt) _____
13. Using an eyedropper, place 3 drops of each of the 9 carbohydrates and water into their respectively labeled wells.		(1 pt) _____
14. Using an eyedropper add 3 drops of Lugol's iodine solution to each of the 10 wells		(1 pt) _____
15. Record observations.		(1 pt) _____

<b>OBSERVATIONS:</b>	
<i>Benedict's reagent test</i>	
1. water: no change in blue color	(1 pt) _____
2. glucose: from blue to brick red color	(1 pt) _____
3. fructose: from blue to brick red color	(1 pt) _____
4. glucose: from blue to brick red color	(1 pt) _____
5. sucrose: no change in blue color	(1 pt) _____
6. maltose: blue to red orange color	(1 pt) _____
7. lactose: blue to red orange color	(1 pt) _____
8. starch: no change in blue color	(1 pt) _____
9. gum arabic: no change in blue color	(1 pt) _____
<i>Lugol's iodine test</i>	
10. With water, glucose, fructose, glucose, sucrose, maltose, lactose, and gum Arabic all of the mixture assumed the red brown color of the iodine. (no change)	(1 pt) _____
11. With starch, the red brown color of the iodine turned blue black.	(1 pt) _____
<b>ANALYSIS:</b>	
<i>Benedict's reagent test</i>	
1. This test allows scientists to detect the presence of all reducing sugars	(1 pt) _____
2. or sugars with a free reactive carbonyl group (aldehydes or alpha hydroxyl ketones)	(1 pt) _____
3. Glucose, fructose, and galactose have carbonyl groups and therefore show a positive Benedict's test.	(1 pt) _____

**COURSE DESCRIPTION**

<b>HIGH SCHOOL</b>		
1. Course Title <b>Introduction To Horticulture</b>	5. Subject Area	
2. Transcript Title/Abbreviation <b>Intro To Horticul</b>	<input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
3. Transcript Course Code/Number <b>00364</b>		
4. Program Contact Information	6. Grade: 11 – 12    Level: 3	
Name:            Paul Mezick	7. Seeking "Honors" Distinction?	
Title/Position:    Department Chair, Science	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
School:            Daniel Hand High School 286 Green Hill Road Madison, CT 06443	8. Unit Value	
	<input type="checkbox"/> .25 (30 days) <input checked="" type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____	
	9. Approval	
	<input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites Successful completion of 9 <sup>th</sup> and 10 <sup>th</sup> grade science.		
11. Brief Course Description This course is designed to introduce students to gardening and horticulture techniques. Time will be spent in the greenhouse, where students will conduct plant experiments and care for individual plant projects. In addition, students will spend time outdoors in the class garden, working on landscaping projects and caring for the nature trail on school property. The students will learn to use reference sources in planning and implementing their projects.		
12. Course Goals		
<ol style="list-style-type: none"> <li>1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems.</li> <li>2. Conduct lab experiments safely using appropriate scientific protocol.</li> <li>3. Use technology effectively and responsibly.</li> <li>4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community.</li> <li>5. Demonstrate the ability complete assignments independently.</li> <li>6. <b>Demonstrate respect for one's self, and strive to contribute to the success of others.</b></li> </ol>		

13. Course Outline		
UNIT	CONCEPT	ACTIVITY
<b>How to Grow Seedlings in a Greenhouse</b>		
1. Seed and Plant Selection	Annual vs. Perennial plants Space considerations Cost considerations	Seed Selection Lab
2. Soil Mixtures and Containers	Sterile Soil Preparation Seed Starter Containers	Sterile Soil Lab Seed Starter Kit Activity
3. Seed Planting	Soaking Seeds for Germination Soil Preparation and Use Seed Depth Labeling	Seed Planting Project
4. Greenhouse Management	Control of Temperature, Light, Humidity and Air Flow Daily Greenhouse Operations	Greenhouse Study and Use Set-Up/Clean-Up Duties
5. Watering Seedlings	Proper Watering Techniques Dangers of Over watering and Under watering.	Daily Plant Monitoring and Care
6. Transplanting Seedlings	When to Transplant How to Safely Transplant Proper Planting Depths	Transplanting Demonstration and Activity
7. Feeding Seedlings	Types of Fertilizers Preparation and Application of Fertilizers Frequency of Fertilization	Demonstration and Practice of Fertilizer Preparation/Application Record Keeping Lab/Practice
8. Insect and Disease Control	Types of Pesticides Preparation and Safe Application of Pesticides	Demonstration and Practice of Pesticide Preparation/Application
9. Stem Cuttings	Advantages of Stem Cuttings Selection of Plants/Cuttings Rooting Hormones Cuttings Planting and Care	Stem Cuttings Demonstration and Activity
<b>Soils and Plant Growth</b>		
10. Soil Testing	Soil Collection Techniques Soil Texture Major Soil Nutrients	Soil Collection Activity Soil Texture Lab Soil Nutrient Testing Lab
11. Fertilizing	Nutrient Effects on Plant Growth Liquid and Solid Fertilizers Proper Application of Fertilizers	Fertilizer Information Activity Demonstration and Practice of Fertilizer Preparation/Application
12. Composting	Compost Mixtures Maintenance of Compost Pile/Bin Uses for Compost	Weekly Oversight of Compost Bin Application of Compost to Outdoor Gardens
13. Mulching	Types of Mulch Uses for Mulch Application of Mulch	Garden Mulching Activity
14. Site Selection	Sun and Shade Gardens	Class Project: Site Selection

15. Soil Preparation	Wildflower Garden Techniques Vegetable Garden Techniques Flower Garden Techniques	Class Project: Wildflower Plantings Class Project: Vegetable and/or Flower Garden
<b>Landscape Plants and Sites</b>		
16. Landscape Design	Landscape Plant Identification Soil, Sunlight and Water Needs of Landscape Plants	Research Project and Power Point Presentation on a particular landscape plant on school property
17. Planting a Landscape Project.	Layout of a Flower/Vegetable Garden. Soil Preparation Plant Handling and Transplanting Techniques Mulching	Class Project: Flower Bed and/or Herb Spiral
18. Long-term Care of a Landscape Project	Watering and Feeding Schedules Pest Control Harvest of Flowers, Herbs or Vegetables	Class Project: Flower Bed and/or Herb Spiral Maintenance
<b>Horticulture and Art:</b>	<b>An Interdisciplinary Project</b>	
<p>14. Instructional Methods and/or Strategies</p> <ul style="list-style-type: none"> <li>▪ Modeled instruction</li> <li>▪ PowerPoint presentations and notes</li> <li>▪ Laboratory investigations</li> <li>▪ Teacher demonstrations</li> <li>▪ Cooperative grouping</li> <li>▪ Audio Visual presentations</li> <li>▪ Response Cards by TurningTechnologies</li> <li>▪ Web-based instruction with Blackboard/finalsite</li> <li>▪ Research</li> </ul>		
<p>15. Assessment Methods and/or Tools</p> <ul style="list-style-type: none"> <li>▪ Formative quizzes</li> <li>▪ Summative unit assessments</li> <li>▪ Final examination</li> <li>▪ Lab reports</li> <li>▪ Assessments evaluated with rubrics</li> <li>▪ Benchmark assessments</li> <li>▪ Video response summaries</li> <li>▪ Response Cards by TurningTechnologies</li> <li>▪ Research projects</li> </ul>		
<p>16. Assessment Criteria</p> <p>Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria.</p> <p><b>Benchmark Assignments:</b></p> <ul style="list-style-type: none"> <li>▪ Independent greenhouse project, growing and caring for an assortment of vegetables and flowers of the student's choosing. <ul style="list-style-type: none"> <li>○ 3-Use effective strategies for gathering information, critical thinking and problem solving.</li> </ul> </li> <li>▪ Research project on a specific landscape plant found on school property; a PowerPoint presentation will be made to the class. <ul style="list-style-type: none"> <li>○ 1C.-Speak, listen and view effectively.</li> </ul> </li> </ul> <p>Benchmark assignments are graded using a <i>common</i> scoring rubric or grading criteria.</p>		



<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>Content Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</b></li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Greenhouse access.</li> <li>▪ Tools and materials pertinent to greenhouse work</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Supplementary materials</li> <li>▪ Guided Internet research with selected websites</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Independent greenhouse project <i>*Benchmark*</i></li> <li>▪ Greenhouse Set-Up/Clean-Up Duties</li> </ul>



<p><b>LEARNING STRAND</b>  <b>How to Grow Seedlings in a Greenhouse</b>  <i>Content Standard 10.6 – Living organisms have the capacity of producing populations of unlimited size, but the environment can support only a limited number of individuals of each species.</i>  <i>Content Standard: Enrichment High School Biology – (Ecology) Stability in an ecosystem is a balance between competing effects.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Plant growth is dependent on proper input of moisture, nutrients and sunlight.</li> <li>▪ Control of plant growth factors can be accomplished in a well-managed greenhouse.</li> <li>▪ Decisions of seed selection, container types and soil types can enhance or deter success in the greenhouse.</li> <li>▪ Location of work space, tools and plant benches plays an important role in greenhouse management.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How does pre-soaking seeds ensure higher germination rates?</li> <li>▪ What are the four variables for plant growth that can be controlled in the greenhouse?</li> <li>▪ How does the proper choice of container, soil and seed lead to successful seed starting?</li> </ul>
<p><b>LEARNING OBJECTIVES</b>    <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Determine which plants to grow in the school greenhouse.</li> <li>▪ Prepare seeds for planting.</li> <li>▪ Select and use proper containers and soils when planting seeds.</li> <li>▪ Maintain the proper regimen of watering, transplanting and feeding seedlings.</li> <li>▪ Assist in maintaining a safe, clean and efficient working environment in the greenhouse.</li> <li>▪ Use fertilizers and pesticides in a safe and responsible manner to ensure that plant growth is maximized.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ Functioning greenhouse</li> <li>▪ Work benches</li> <li>▪ Tools and containers</li> <li>▪ Greenhouse soil mix</li> <li>▪ Vegetable, flower and herb seed packets</li> <li>▪ Fertilizers and environmentally friendly pesticides</li> <li>▪ Greenhouse management videos</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeling during lecture demonstrations</li> <li>▪ Research flower and/or vegetable types using seed catalogs and internet sources</li> <li>▪ Daily student maintenance of greenhouse plants</li> <li>▪ Audio visual presentations on greenhouse management</li> <li>▪ Proper use of minimum/maximum thermometer and hygrometer, soil pH meter and soil moisture/nutrient meter</li> <li>▪ Prepare work bench, water, feed and transplant seedlings on a daily basis</li> <li>▪ Clean the floors, benches, sink and counters on a daily basis</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Unit test</li> <li>▪ Video response summaries</li> <li>▪ <b>Daily assessment of "Greenhouse Set-Up/Clean-Up" crew</b></li> <li>▪ Ongoing assessment of growth and health of each student's plants</li> </ul>

<b>LEARNING STRAND</b> <b>Soils and Plant Growth</b> <i>Content Standard: Enrichment High School Earth Science – (Biogeochemical Cycles) Each element on Earth moves among reservoirs which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Plant growth is dependent on soil for root support, moisture and nutrients.</li> <li>▪ Decisions about landscape plant selection, as well as flower and vegetable types for home gardens, hinge on soil types and soil preparation.</li> <li>▪ Home gardeners and commercial landscapers must test and modify soils in order to optimize plant growth.</li> <li>▪ Use of organic methods of soil amendment, such as compost and mulch, can ensure success as well as protect the surrounding environment.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What are the essential nutrients and what are the effects of each on plant growth?</li> <li>▪ How is soil texture measured and assessed?</li> <li>▪ What are the proper ingredients of compost and how do you maintain a compost pile?</li> <li>▪ What are the benefits of using mulch in the garden?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Distinguish among the various soil types found in our region.</li> <li>▪ Determine which flowers, herbs and vegetables are best suited to our local soil types.</li> <li>▪ Maintain the proper mix of ingredients, moisture levels and aeration in the class compost bins.</li> <li>▪ Measure local soils for a variety of chemical and physical factors with the intent of maintaining healthy soil structure.</li> <li>▪ Prepare soil in all flower, herb and vegetable beds on school property before moving greenhouse plants into the garden.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Compost bins</li> <li>▪ Organic mulch</li> <li>▪ Soil nutrient/Soil texture test kits/Soil meters</li> <li>▪ Soil and Plant Growth videos</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Research soil types using library and internet resources</li> <li>▪ Audio visual presentations on soils and plant growth</li> <li>▪ Learn the proper method of taking soil samples for testing</li> <li>▪ Learn the proper use of soil meters and test kits for soil nutrients and soil texture</li> <li>▪ Research the soil and nutrient needs of their greenhouse-grown plants before transplanting these to the garden beds</li> <li>▪ Learn the proper methods for applying commercial fertilizers to maximize plant growth, yet minimize deleterious effects on the environment</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Unit test</li> <li>▪ Video response summaries.</li> <li>▪ Soil Nutrient lab investigation</li> <li>▪ Soil Texture lab investigation</li> <li>▪ Ongoing assessment of gardening skills as applied to outdoor projects</li> </ul>

<b>LEARNING STRAND</b> <b>Landscape Plants and Sites</b> Content Standard 10.6 – <i>Living organisms have the capacity of producing populations of unlimited size, but the environment can support only a limited number of individuals of each species.</i> Content Standard: Enrichment High School Biology – (Ecology) Stability in an ecosystem is a balance between competing effects.	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Landscape planting is both science and art, and combines practical skills and aesthetic sensibility.</li> <li>▪ Proper landscape design should take into account, soils, climate, plant availability and cost.</li> <li>▪ Maintenance of a commercially landscaped area, such as a school, should require no more manpower and cost than will be available on a long-term basis.</li> <li>▪ The benefits of well thought out landscape design include a pleasant environment for work or recreation, as well as research opportunities for students.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ Why are certain plants so commonly used in commercial landscaping?</li> <li>▪ What considerations for soil, moisture, sunlight and climate must be made when creating a design?</li> <li>▪ Is the selection and placement of plants on school property in keeping with the physical environment?</li> <li>▪ Are the plants in the school landscape likely to be easy to maintain for the foreseeable future?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Learn to identify each of the landscape trees, shrubs and ground cover on school property.</li> <li>▪ Determine the physical needs of selected landscape plants.</li> <li>▪ Explain how cost and ease of care influence the selection of landscape plants.</li> <li>▪ Cooperatively choose and prepare a site for either a garden bed or herb spiral on school property as a class project.</li> <li>▪ Successfully transplant greenhouse grown flowers, herbs and/or vegetables to new garden bed locations.</li> <li>▪ Maintain all garden beds, new and old, for the duration of the trimester.</li> <li>▪ Prepare and give a presentation to the class on a specific landscape plant.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Lap top computers with internet connection</li> <li>▪ Horticultural reference materials in school library</li> <li>▪ Light, soil pH and soil moisture meters</li> <li>▪ Landscaping tools</li> <li>▪ Landscaping videos</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lecture demonstrations</li> <li>▪ Audio visual presentations on landscaping</li> <li>▪ Work cooperatively in small teams on outdoor class projects</li> <li>▪ Conduct Internet and library research on a specific landscape plant; make PowerPoint presentation to class</li> <li>▪ Demonstrate understanding of proper tool selection and use on outdoor projects</li> <li>▪ Assess the soil, light and moisture conditions of selected landscape plants</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Research project on specific landscape plant <i>*Benchmark*</i></li> <li>▪ Video response summaries</li> <li>▪ Ongoing assessment of cooperative work skills as applied to outdoor projects</li> <li>▪ Site Assessment lab</li> </ul>

<b>LEARNING STRAND</b> <b>Horticulture and Art Interdisciplinary Project</b> <i>Content Standard: Scientific Inquiry – Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation. (D INQ.6 – Use appropriate tools and techniques to make observation and gather data.)</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The history of horticulture and garden design is intertwined with the visual arts.</li> <li>▪ Wild plants are the progenitors of our modern domestic plants.</li> <li>▪ Plant domestication began thousands of years ago using trial-and-error methods, and continues today using modern plant breeding techniques.</li> <li>▪ The creation of botanically inspired art is one application of a career choice inspired by plants.</li> <li>▪ Botanists use certain standard techniques in the collection and preservation of plants.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What techniques are used to collect and preserve plants for long-term study?</li> <li>▪ What is the connection between protection of endangered species and the collection and preservation of museum specimens?</li> <li>▪ How does an appreciation of the botanical arts enhance our appreciation and enjoyment of plants in general?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Learn to distinguish among the four plant types: tree, shrub, herb and vine.</li> <li>▪ Collect samples of each of the four plant types on school and/or Bauer Farm property.</li> <li>▪ Preserve and mount collected plants using botanical techniques.</li> <li>▪ Identify the plants in their collection using field guides to trees, shrubs and wildflowers.</li> <li>▪ Learn basic drawing, painting, bookmaking and/or other techniques as applicable to the specific interdisciplinary project.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <ul style="list-style-type: none"> <li>▪ Internet activities on selected websites</li> <li>▪ Planning time with art department colleagues</li> <li>▪ Horticultural reference materials in school library</li> <li>▪ Plant presses</li> <li>▪ Herbarium sheets and paste</li> <li>▪ Botanical labels</li> <li>▪ Art supplies</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lecture demonstrations</li> <li>▪ Plant Collection lab</li> <li>▪ Plant Preservation lab</li> <li>▪ Introductory art skills lab</li> <li>▪ Art studio project</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Botanical collection</li> <li>▪ Art project (e.g., watercolor sketches, folding book, pen and ink illustrations, sculpture)</li> </ul>

## Horticulture Scoring Rubric

**Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems.**

<b>Exceeds Expectations</b>	The student independently interprets, analyzes, and evaluates a variety of information and data to solve problems in the daily care of greenhouse plants. S/he solves problems accurately and efficiently, and germinates, grows and maintains healthy plants.
<b>Meets Expectations</b>	The student independently interprets, analyzes, and evaluates a variety of information and data to solve problems in the daily care of greenhouse plants. S/he solves problems with few errors, and germinates, grows and maintains healthy plants.
<b>Meets Some Expectations</b>	The student may need some assistance interpreting a variety of data to solve problems in the daily care of greenhouse plants. S/he solves problems with some errors, and germinates, grows and maintains healthy plants.
<b>Does Not Meet Expectations</b>	The student needs assistance in gathering information to solve problems in the daily care of greenhouse plants. S/he solves problems inefficiently and with significant errors, and germinates, grows and maintains healthy plants with difficulty.

**Demonstrates proficiency and fluency in communication to meet the literacy demands of the global community.**

**Speaking / Listening / Viewing**

<b>Exceeds Expectations</b>	The student applies effective and efficient listening and viewing strategies to understand, interpret, evaluate, and analyze material to acquire content knowledge regarding a specific landscape tree/shrub found on school property. S/he reflects and responds creatively to a variety of material, and delivers a fluent and coherent power point presentation on the tree/shrub chosen.
<b>Meets Expectations</b>	The student applies effective listening and viewing strategies to understand, interpret, evaluate, and analyze material to acquire content knowledge regarding a specific landscape tree/shrub found on school property. S/he reflects and responds to a variety of material and delivers a coherent power point presentation on the tree/shrub chosen.
<b>Meets Some Expectations</b>	The student applies some listening and viewing strategies to understand, interpret, evaluate, and attempt to analyze material to acquire content knowledge regarding a specific landscape tree/shrub found on school property. S/he may need assistance to respond to material. S/he may be reluctant to deliver a power point presentation on the tree/shrub chosen.
<b>Does Not Meet Expectations</b>	The student has difficulty applying listening and viewing strategies without assistance to understand, interpret, and evaluate material to acquire content knowledge regarding a specific landscape tree/shrub found on school property. The student's ability to respond to material or to deliver a power point presentation on the tree/shrub chosen is very limited.

**GREENHOUSE DAILY REPORT**

NAME \_\_\_\_\_

DATE \_\_\_\_\_

This report will be collected and graded every Friday. Be sure to provide a written description of your greenhouse work each day. In addition, fill out the appropriate areas on the reverse side of this sheet. Your grade depends on the thoroughness of this report.

MONDAYTUESDAYWEDNESDAYTHURSDAYFRIDAY

PROCEDURE	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Maximum and Minimum Air Temperature <b>A</b>					
Maximum and Minimum Relative Humidity <b>A</b>					
Soil Temperature <b>B</b>					
Soil PH <b>B</b>					
Soil Moisture <b>B</b>					
Watering <b>C</b>					
Fertilizer Application (list fertilizer) <b>C</b>					
Pesticide Application (list pesticide) <b>C</b>					

**A = Daily**

**B = Once a week**

**C = Use as needed**

# GREENHOUSE PLANTS

NAME \_\_\_\_\_

PLANT	NUMBER	COMMENTS



**GREENHOUSE SET-UP and CLEAN UP****SET-UP**

SOIL IN TRAYS	
SOIL MOISTENED	
RECORD TEMPS.	
RE-SET TEMPS.	

**CLEAN UP**

SWEEP FLOOR	
CLEAN COUNTER	
CLEAN SINK	
SPRAY BOTTLES RETURNED	
NEWSPAPER ON BENCH	
WATER FOR ABSENTEES	

NAME \_\_\_\_\_

NAME \_\_\_\_\_

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## Horticulture Scoring Rubric

**Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems.**

<b>Exceeds Expectations</b>	The student independently interprets, analyzes, and evaluates a variety of information and data to solve problems in the daily care of greenhouse plants. S/he solves problems accurately and efficiently, and germinates, grows and maintains healthy plants.
<b>Meets Expectations</b>	The student independently interprets, analyzes, and evaluates a variety of information and data to solve problems in the daily care of greenhouse plants. S/he solves problems with few errors, and germinates, grows and maintains healthy plants.
<b>Meets Some Expectations</b>	The student may need some assistance interpreting a variety of data to solve problems in the daily care of greenhouse plants. S/he solves problems with some errors, and germinates, grows and maintains healthy plants.
<b>Does Not Meet Expectations</b>	The student needs assistance in gathering information to solve problems in the daily care of greenhouse plants. S/he solves problems inefficiently and with significant errors, and germinates, grows and maintains healthy plants with difficulty.

## DHHS TREE AND SHRUB PRESENTATION Checklist

### POWER POINT

Your Power Point should include the following information:

1. Common name \_\_\_\_\_
  2. Scientific name \_\_\_\_\_
  3. Family name \_\_\_\_\_
  4. Habit and Form
    - Shape \_\_\_\_\_
    - Size (Height X Width) \_\_\_\_\_
    - Evergreen or Deciduous \_\_\_\_\_
  5. Description
    - Flowers \_\_\_\_\_
    - Fruit \_\_\_\_\_
    - Foliage \_\_\_\_\_
    - Bark \_\_\_\_\_
  6. Habitat
    - Native to what region of the U.S. or what country? \_\_\_\_\_
    - Prefers what habitat? \_\_\_\_\_
  7. Environmental Conditions! Planting Requirements
    - Sunlight \_\_\_\_\_
    - Soil pH \_\_\_\_\_
    - Soil moisture \_\_\_\_\_
    - Zone(s): \_\_\_\_\_
  8. Landscape Use(s) \_\_\_\_\_
  9. Propagation \_\_\_\_\_
  10. Insect, Disease and Other Problems \_\_\_\_\_
  11. Wildlife Benefits \_\_\_\_\_
  12. Other Uses \_\_\_\_\_
    - Medicinal value \_\_\_\_\_
    - Erosion prevention \_\_\_\_\_
    - Etc. \_\_\_\_\_
- PICTURE: \_\_\_\_\_
- Include at least one picture of the plant. \_\_\_\_\_
- BIBLIOGRAPHY: \_\_\_\_\_
- Include a bibliography that includes websites, books and magazine articles.
  - There must be a minimum of 3 references.
- MINIMUM LENGTH: \_\_\_\_\_
- Power Point should include at least 7 slides.

## DHHS TREE AND SHRUB PRESENTATION

**PURPOSE:** To create a Power Point presentation about one of the trees or shrubs which we have in our collection of landscape plants at DHHS.

**PROCEDURE:**

- A. You are to choose from among the plants listed below.
- B. Then you will research the plant using the internet and library books.
- C. Once you have created your Power Point, you will give a short lecture to the class.
- D. Your research will be kept on file as a reference source for future classes.

**LIST OF PLANTS:**

Arrowwood	Pyracantha
Bayberry	Redbud
Beach Rose (Rugosa rose)	Red Cedar
Clethra	Red maple
Heather	Rhododendron
Highbush Cranberry	St. Johnswort
Inkberry Holly	Silky Dogwood
Ground Juniper	Spirea
Leucothoe	Vinca
Star Magnolia	White pine
Paper birch	Oriental Cherry
White Cedar (Arborvitae)	Mountain Laurel
Potentilla	Ninebark
Winterberry Holly	

**POWER POINT**

Your Power Point should include the following information:

1. Common name
2. Scientific name
3. Family name
4. Habit and Form
  - Shape
  - Size (Height X Width)
  - Evergreen or Deciduous
5. Description
  - Flowers
  - Fruit
  - Foliage
  - Bark
6. Habitat
  - Native to what region of the U.S. or what country?
  - Prefers what habitat? (beach, edge of stream, open field, park, etc.)

## 7. Environmental Conditions/ Planting Requirements

- Sunlight
- Soil pH
- Soil moisture
- Zone(s): (Connecticut is zone 6.)

## 8. Landscape Use(s)

## 9. Propagation

## 10. Insect, Disease and Other Problems

## 11. Wildlife Benefits

## 12. Other Uses

- Medicinal value
- Erosion prevention
- Etc.

## PICTURE:

- Include at least one picture of the plant.

## BIBLIOGRAPHY:

- Include a bibliography that includes websites, books and magazine articles.
- There must be a minimum of 3 references.

## MINIMUM LENGTH:

- Power Point should include at least 3 slides.

**SUGGESTED WEBSITES**

[www.gwf.org](http://www.gwf.org)

[www.gardening.cornell.edu](http://www.gardening.cornell.edu)

[www.hort.uconn.edu/plants](http://www.hort.uconn.edu/plants)

[www.dnr.state.us.forestry/Education/ohiotrees](http://www.dnr.state.us.forestry/Education/ohiotrees)

[www.ces.ncsu.edu/depts/hort/consumer/factsheets/native/common\\_namea-e.html](http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/native/common_namea-e.html)

[www.landscape.cornell.edu](http://www.landscape.cornell.edu)

[www.google.com](http://www.google.com)

**POWER POINT PRESENTATION**

Name: \_\_\_\_\_

**HORTICULTURE****CATEGORY**

- |   |                |
|---|----------------|
| 1. Speaker can be heard by the audience.              | _____ 5 _____  |
| 2. Presentation is well organized.                    | _____ 10 _____ |
| 3. Presentation is creative/interesting.              | _____ 10 _____ |
| 4. Presentation is appropriate length.<br>(5 minutes) | _____ 5 _____  |
| 5. Speaker responds well to questions.                | _____ 5 _____  |

**TOTAL POINTS****\_\_\_\_\_ 35 \_\_\_\_\_****POWER POINT PRESENTATION**

Name: \_\_\_\_\_

**HORTICULTURE****CATEGORY**

- |   |                |
|---|----------------|
| 1. Speaker can be heard by the audience.              | _____ 5 _____  |
| 2. Presentation is well organized.                    | _____ 10 _____ |
| 3. Presentation is creative/interesting.              | _____ 10 _____ |
| 4. Presentation is appropriate length.<br>(5 minutes) | _____ 5 _____  |
| 5. Speaker responds well to questions.                | _____ 5 _____  |

**TOTAL POINTS****\_\_\_\_\_ 35 \_\_\_\_\_**

**HORTICULTURE POWER POINT**

Name: \_\_\_\_\_

Common name \_\_\_\_\_

Scientific name \_\_\_\_\_

Family name \_\_\_\_\_

Habit:

    Shape \_\_\_\_\_

    Size \_\_\_\_\_

    Decid/Ever. \_\_\_\_\_

Description:

    Flower \_\_\_\_\_

    Fruit \_\_\_\_\_

    Foliage \_\_\_\_\_

    Bark \_\_\_\_\_

Habitat:

    Native \_\_\_\_\_

    Preference \_\_\_\_\_

Planting Requirements:

    Sunlight \_\_\_\_\_

    Soil moisture \_\_\_\_\_

    Zone \_\_\_\_\_

Landscape uses \_\_\_\_\_

Propagation \_\_\_\_\_

Diseases \_\_\_\_\_

Wildlife \_\_\_\_\_

Other Uses \_\_\_\_\_

Picture(s) \_\_\_\_\_

Bibliography \_\_\_\_\_

## Horticulture Scoring Rubric

**Demonstrates proficiency and fluency in communication to meet the literacy demands of the global community.**

### Speaking / Listening / Viewing

<b>Exceeds Expectations</b>	The student applies effective and efficient listening and viewing strategies to understand, interpret, evaluate, and analyze material to acquire content knowledge regarding a specific landscape tree/shrub found on school property. S/he reflects and responds creatively to a variety of material, and delivers a fluent and coherent power point presentation on the tree/shrub chosen.
<b>Meets Expectations</b>	The student applies effective listening and viewing strategies to understand, interpret, evaluate, and analyze material to acquire content knowledge regarding a specific landscape tree/shrub found on school property. S/he reflects and responds to a variety of material and delivers a coherent power point presentation on the tree/shrub chosen.
<b>Meets Some Expectations</b>	The student applies some listening and viewing strategies to understand, interpret, evaluate, and attempt to analyze material to acquire content knowledge regarding a specific landscape tree/shrub found on school property. S/he may need assistance to respond to material. S/he may be reluctant to deliver a power point presentation on the tree/shrub chosen.
<b>Does Not Meet Expectations</b>	The student has difficulty applying listening and viewing strategies without assistance to understand, interpret, and evaluate material to acquire content knowledge regarding a specific landscape tree/shrub found on school property. The student's ability to respond to material or to deliver a power point presentation on the tree/shrub chosen is very limited.



## WEEKLY ARTICLE

### PURPOSE:

- Every week you will have the opportunity to read an article that pertains to some aspect of this course. The goal is to make you more aware of career opportunities, interesting discoveries and issues of importance. I hope that your interest will continue long after you have completed this course.

### METHODS:

- Each Friday, at the start of class, you will hand in a 1 to 2 page review of an article from a magazine, newspaper or internet website.
- The accumulated reviews will be worth 10% of your trimester grade.
- There will be 10 reviews due each trimester.
- If you are absent on Friday, your review is due the day after you return to class.
- Include the following information:
  1. Name of magazine, newspaper or website.
  2. Date of the issue.
  3. Author's name.
  4. Title of article.
  5. **Copy of any internet article.**

## Horticulture Scoring Rubric

### 2. Uses technology effectively and responsibly

<b>Exceeds Expectations</b>	The student can independently select and use appropriate internet sources to solve problems efficiently and creatively, including summary of and reaction to environment-related articles.
<b>Meets Expectations</b>	The student can select and use appropriate internet sources to solve problems effectively without making significant errors, including summary of and reaction to environment-related articles.
<b>Meets Some Expectations</b>	The student can select and use appropriate internet sources to solve problems but makes some errors and requires some assistance, including summary of and reaction to environment-related articles.
<b>Does Not Meet Expectations</b>	The student cannot select and use appropriate internet sources to solve problems without making many significant errors and requiring supervision; student fails to summarize and react to environment-related articles.



### Course Description

HIGH SCHOOL		
1. Course Title <b>Topics In Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Topics In Science</b>		
3. Transcript Course Code/Number <b>00366</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 11 – 12    Level: 3  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input checked="" type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites Successful completion of General Biology, Biological Systems or Biology - Honors		
11. Brief Course Description This course investigates how developments in physics, chemistry and biology relate to major issues in our society. Emphasis is placed on helping the student to develop skills in analyzing and reaching decisions on social issues in science using specific principles in science and relating these principles to life in our society. Discussion, reading and writing are major components of this course		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Use technology effectively and responsibly. 3. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 4. Demonstrate the ability complete assignments independently. 5. Demonstrate <b>respect for one's self, and strive to contribute</b> to the success of others.		

## 13. Course Outline

Topics covered:

- Cloning; Human Genome Project
- Stem Cell Research; Human Genome Project
- Surrogacy
- Organ Transplants
- Environmental Issues: Epidemics
- Diseases
- The Teenage Brain

## 14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response Cards by TurningTechnologies
- Web-based instruction with Blackboard/finalsite
- Research

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria.

Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

Response to science articles (demonstrates proficiency and fluency in communication to meet the literacy demands of the global community and uses technology effectively and responsibly)

Video questions and worksheets (reads, writes, speaks, listens and views effectively)

<p><b>LEARNING STRAND Cloning</b>  <b>Connecticut Standards</b>  <i>Genetics: Mutation and sexual reproduction lead to genetic variation in a population.</i>  <i>The genetic composition of cells can be altered by incorporation of exogenous DNA into cells.</i>  <i>Scientific Inquiry and Literacy: Read, interpret and examine the credibility and validity of scientific claims in different sources of information.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>The cloning has ethical, legal and social issues <b>in today's society.</b></li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How can cloning technologies be used?</li> <li>What are ethical issues of cloning?</li> <li>What are the legal issues of cloning?</li> <li>What are the social issues of cloning?</li> <li>Can organs be cloned for use in transplants?</li> <li>What are the risks of cloning?</li> <li>Should cloning be regulated?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Explain the process of cloning and the different types of cloning.</li> <li>Explain how cloning technologies can be used.</li> <li>Discuss the ethical, legal and social issues of cloning.</li> <li>Discuss the risks of cloning.</li> <li>Support positions on cloning using the information that has been researched for class.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p>Video on cloning  Video on Dolly  "Power of Genes" video  Human Genome Project Information website  Websites on genetic technology and cloning  Articles on cloning</p>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Students will assess the credibility of information in articles and write journal entries on the issues of cloning.</li> <li>Students will view the videos on cloning and discuss the concepts associated with cloning.</li> <li>Cooperative learning groups will be assigned different articles for jigsaw activities using PowerPoint and interactive white board presentations.</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Quizzes on cloning</li> <li>Journal entries evaluated with rubrics</li> <li>Presentations to the class evaluated with rubrics</li> </ul>

<p><b>LEARNING STRAND: Stem Cell Research</b></p> <p><b>Connecticut Standards</b></p> <p><i>Genetics: Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.</i></p> <p><i>The genetic composition of cells can be altered by incorporation of exogenous DNA into cells.</i></p> <p><i>Scientific Inquiry and Literacy: Read, interpret and examine the credibility and validity of scientific claims in different sources of information.</i></p> <p><i>Communicate about science in different formats, using relevant science vocabulary, support evidence and clear logic.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>▪ There are state and federal policies and legislation govern stem cell research.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ Why is stem cell research supported by some individuals and not others?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Identify the importance of stem cells in the body.</li> <li>▪ Explain the difference between stem cells and other cells in the body.</li> <li>▪ Prepare a position paper on stem cell research.</li> <li>▪ Present the position paper on stem cell research to the class.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ Internet, periodical and news articles</li> <li>▪ Websites on stem cell research</li> <li>▪ Stem Cell videos</li> <li>▪ Science journals</li> <li>▪ Human genome Project Information website</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Students will prepare a bibliography of reliable useful websites on stem cell research.</li> <li>▪ Students will write journal entries of their understanding regarding the controversy of stem cell research.</li> <li>▪ Students will write a persuasive essay explaining to others their point of view on stem cell research.</li> <li>▪ Students will debate the issues regarding stem cell research.</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Journal entries evaluated with rubrics</li> <li>▪ Quizzes</li> <li>▪ Position paper evaluated with a rubric</li> <li>▪ Debate evaluated with a rubric</li> </ul>

<p><b>LEARNING STRAND: Surrogacy</b>  <b>Connecticut Standards</b>  <i>Genetics: Mutation and sexual reproduction lead to genetic variation in a population.</i>  <i>A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization.</i>  <i>Scientific Inquiry and Literacy: Read, interpret and examine the credibility and validity of scientific claims in different sources of information.</i>  <i>Communicate about science in different formats, using relevant science vocabulary, support evidence and clear logic.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Surrogacy has become a popular solution to infertility problems.</li> <li>▪ Humans can reproduce in nontraditional ways.</li> <li>▪ In gestational surrogacy, <i>in vitro</i> fertilization is used to transfer the genetic mother's fertilized embryo into the surrogate mother's uterus.</li> <li>▪ Infertility has many causes that involve the woman's, the man's or both partners' reproductive systems.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What are reasons surrogacy has become more popular?</li> <li>▪ What are reasons a woman would be willing to be a surrogate mother?</li> <li>▪ What are some reasons couples would want/or not want to arrange to have a surrogate mother for their child?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Distinguish between amniocentesis, chorionic villi sampling, and karyotyping.</li> <li>▪ Understand reproductive biology and <i>in vitro</i> fertilization.</li> <li>▪ Understand causes of fertility problems.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p>Periodical and news articles  Selected websites  Science journal</p> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ The student will read articles on Reproductive Biology and report key concepts in class discussions.</li> <li>▪ The student will write journal entries in response to information presented in class about surrogate motherhood.</li> <li>▪ Speaker from a fertility clinic to present options for producing a baby.</li> <li>▪ The student will read articles on typical surrogate mother profiles and surrogate motherhood and report key concepts in class discussions.</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Reports evaluated with rubrics</li> <li>▪ Journal entries evaluated with rubrics</li> </ul>



<p><b>LEARNING STRAND: Organ Transplants</b>  <b>Connecticut Standards</b>  <i>Physiology: As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.</i>  <i>Scientific Inquiry and Literacy: Read, interpret and examine the credibility and validity of scientific claims in different sources of information.</i>  <i>Communicate about science in different formats, using relevant science vocabulary, support evidence and clear logic.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>Organ transplants can save lives and are in great demand.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>Why is it so difficult to get an organ transplant when needed?</li> <li>What are some of the legal ramifications involved in organ transplants?</li> <li>What is considered "brain-dead" by legal definition and various authorities?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Recognize the advances in biotechnology facilitating organ transplants.</li> <li>Recognize the medical problems that are associated with donated organs.</li> <li>Define brain-dead.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><i>National Geographic Channel support network</i></p> <ul style="list-style-type: none"> <li>Internet articles on organ transplants</li> <li>Video clips on organ transplants</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Students will prepare a bibliography of reliable useful websites on organ transplants.</li> <li>Students will write journal entries of their understanding regarding controversial issues of organ transplants.</li> <li>Students will debate controversial issues regarding transplanting organs.</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Quizzes</li> <li>Research project about the effects of drugs needed for successful organ transplants</li> <li>Discussion of living wills</li> </ul>

<p><b>LEARNING STRAND Environmental Issues: Epidemics</b>  <b>Connecticut Standards</b>  <i>Physiology: Organisms have a variety of mechanisms to combat disease.</i>  <i>Scientific Inquiry and Literacy: Read, interpret and examine the credibility and validity of scientific claims in different sources of information.</i>  <i>Communicate about science in different formats, using relevant science vocabulary, support evidence and clear logic.</i></p>	
<p><b>ENDURING UNDERSTANDING</b></p> <ul style="list-style-type: none"> <li>Epidemics can be prevented with disease control.</li> <li>The diseases such as H1N1 influenza impact our environment and the human population.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What is the impact of an epidemic?</li> <li>What is the impact of an outbreak of H1N1 influenza?</li> <li>Why is H1N1 influenza contagious?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Recognize the significance and impact of H1N1 influenza as well as transmission among humans.</li> <li>Explain to friends and family what steps can be taken to reduce the chance of contracting an infectious disease.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>Internet and periodical articles on epidemics</li> <li>Internet and news articles on H1N1 influenza</li> <li>CDC website information and instructional materials</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Read and respond to articles from the World Health Organization</li> <li>Read and report on news programs and Centers for Disease Control information regarding the environmental issues of infectious diseases</li> <li>Create a Public Service Announcement to prevent the spread of disease</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Research project on systems and methods of disease control</li> <li>Public Service Announcement</li> <li>Quizzes</li> </ul>

<p><b>LEARNING STRAND Diseases</b>  <b>Connecticut Standards</b>  <i>Physiology: Organisms have a variety of mechanisms to combat disease.</i>  <i>Scientific Inquiry and Literacy: Read, interpret and examine the credibility and validity of scientific claims in different sources of information.</i>  <i>Articulate conclusions and explanations based on research data, and assess results based on the design of an investigation.</i>  <i>Communicate about science in different formats, using relevant science vocabulary, support evidence and clear logic.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The human body has different barriers to protect itself from diseases.</li> <li>▪ The human body defends itself differently when infected by a virus as compared to bacteria.</li> <li>▪ In our environment only a small percentage of microorganisms actually cause diseases.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the impact of disease prevention in a community?</li> <li>▪ How is the body protected from diseases?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe what it means to be healthy.</li> <li>▪ Learn how the body is designed so that the systems to work together for protection.</li> <li>▪ Learn the basic physiology of the immune system.</li> <li>▪ Define key elements of the human immune system.</li> <li>▪ Describe ways to prevent the spread of germs that cause common infectious diseases.</li> <li>▪ Understand the difference between passive and active immunity.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li>▪ Centers for Disease Control and Prevention website</li> <li>▪ <i>The Ultimate Guide: Human Body</i> Video</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Online formative quizzes</li> <li>▪ Internet, periodical and news articles</li> <li>▪ Powerpoint and audio visual presentations</li> <li>▪ Science journal entries on disease topics, facts, and treatments</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Quizzes on the human immune system</li> <li>▪ Research project on a disease and its prevention</li> <li>▪ Reflection paper on personal health plan that protects against diseases</li> </ul>

## TOPICS IN SCIENCE Scoring Rubric

### 1. Demonstrates proficiency and fluency in communication to meet the literacy demands of the global community.

#### A. Reading

<b>Exceeds Expectations</b>	The student applies effective reading strategies to understand, interpret, evaluate, and analyze scientific articles to acquire content knowledge. S/he reads fluently for assignments.
<b>Meets Expectations</b>	The student applies effective reading strategies to understand, interpret, evaluate, and analyze scientific articles to acquire content knowledge.
<b>Meets Some Expectations</b>	The student applies some reading strategies to understand, interpret, evaluate, and attempt to analyze scientific articles to acquire content knowledge. S/he may need assistance to read material at grade level.
<b>Does Not Meet Expectations</b>	The student has difficulty applying reading strategies without assistance to understand, interpret, and evaluate scientific articles to acquire content knowledge.

#### B. Writing

<b>Exceeds Expectations</b>	The student writes and responds to scientific articles and/or videos with a clear focus and can support with details that are well developed and organized, showing both analysis and synthesis of ideas. Student responds fully to the assignments with word choice and syntax are accurate and appropriate. The student shows mastery in the conventions of Standard English. The student successfully completes all parts of the writing process, including peer and self-evaluation.
<b>Meets Expectations</b>	The student writes and responds to scientific articles and videos using some supporting details to show an understanding of the subject matter and an analysis of ideas. They are somewhat developed and organized. Word choice and syntax are accurate and appropriate. Errors in the conventions of Standard English are few. The student completes most parts of the writing process, including evaluation.
<b>Meets Some Expectations</b>	The student requires some additional explanations and models to write and respond to scientific articles and videos. With direction, s/he selects an appropriate mode. Writing has a somewhat limited supporting details.. The student may require assistance to develop or organize his response. Word choice and syntax are consistent with grade level. There are some errors in the conventions of Standard English.
<b>Does Not Meet Expectations</b>	The student requires many additional explanations, models, graphic organizers, and/or strategies in order to write and respond to scientific articles and videos in order to complete the writing process. The writing has no clear focus or no supporting details and inaccuracies. Inaccurate or limited vocabulary, syntax errors, and errors in the conventions of writing make the writing ineffective.

**C. Speaking / Listening / Viewing**

<b>Exceeds Expectations</b>	The student applies effective and efficient listening and viewing strategies to understand, interpret, evaluate, and analyze science videos to acquire content knowledge. S/he reflects and responds creatively to a variety of material, and delivers fluent and coherent oral / visual presentations.
<b>Meets Expectations</b>	The student applies effective listening and viewing strategies to understand, interpret, evaluate, and analyze material to acquire content knowledge. S/he reflects and responds to a variety of material and delivers coherent oral / visual presentations.
<b>Meets Some Expectations</b>	The student applies some listening and viewing strategies to understand, interpret, evaluate, and attempt to analyze material to acquire content knowledge. S/he may need assistance to respond to material. S/he may be reluctant to deliver oral / visual presentations.
<b>Does Not Meet Expectations</b>	The student has difficulty applying listening and viewing strategies without assistance to understand, interpret, and evaluate material to acquire content knowledge. The student's ability to respond to material or to deliver oral / visual presentations is very limited.

**2. Uses technology effectively and responsibly.**

<b>Exceeds Expectations</b>	The student can independently select and use appropriate technology to research information.
<b>Meets Expectations</b>	The student can select and use appropriate technology to research scientific information effectively without making significant errors.
<b>Meets Some Expectations</b>	The student can select and use appropriate technology to research information but makes some errors and requires some assistance.
<b>Does Not Meet Expectations</b>	The student cannot select and use appropriate technology to research information without making many significant errors and requiring supervision.

**3. Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems.**

<b>Exceeds Expectations</b>	The student independently collects, interprets and analyzes data related to a complex issue using the characteristics of a critical thinker.
<b>Meets Expectations</b>	The student collects, interprets, analyzes data related to a complex issue using the characteristics of a critical thinker.
<b>Meets Some Expectations</b>	The student may need some assistance to collect, interpret and analyze data using the characteristics of a critical thinker.
<b>Does Not Meet Expectations</b>	The student needs a great deal of assistance to gather information and analyze a complex issue using the characteristics of a critical thinker

NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

## **The Eyes of Nye: Cloning**

Thinking questions:

1. What are the pros and cons about patenting the process of nuclear transfer?
2. Dolly died at a young age. Why?
3. What is the difference between therapeutic and reproductive cloning?
4. What did scientists do to the rats? Why?

**TOPICS IN SCIENCE**  
**1 C Speaking / Listening / Viewing**  
**HUMAN GENOME OR CLONING VIDEO**

<b>Exceeds Expectations</b>	The student applies effective and efficient listening and viewing strategies to <b>effectively</b> understand, interpret, evaluate, and analyze science videos to acquire content knowledge. S/he reflects and responds <b>effectively and coherently</b> to the corresponding video sheet provided by the instructor.
<b>Meets Expectations</b>	The student applies effective listening and viewing strategies to <b>sufficiently</b> understand, interpret, evaluate, and analyze material to acquire content knowledge after viewing the video on the human genome or cloning. S/he reflects and responds coherently to the corresponding video sheet provided by the instructor.
<b>Meets Some Expectations</b>	The student applies <b>some</b> listening and viewing strategies to <b>adequately</b> understand, interpret, evaluate, and analyze material to acquire knowledge after viewing the video on the human genome or cloning. S/he <b>may need assistance</b> to respond to the corresponding video sheet provided by the instructor.
<b>Does Not Meet Expectations</b>	The student <b>has difficulty applying</b> listening and viewing strategies <b>without assistance</b> to understand, interpret, and evaluate material to acquire content knowledge after viewing the video on the human genome or cloning. S/he <b>requires assistance</b> to be able to respond to the corresponding video sheet provided by the instructor.

## **Bi-monthly article Benchmark Activity**

**Purpose-** Every other week you will have the opportunity to read an article that pertains to some aspect of this course. The goal is to make you more aware of career opportunities, interesting discoveries and issues of importance that might be political/scientific in nature. I hope your interest in such topics will continue long after you have completed this course.

### **Methods -**

- Every other Friday, at the start of class, you will hand in a 1 to 2 page review of an article from a magazine, newspaper or internet website.
- The accumulated reviews will count towards 15% of your trimester grade
- There will be 6 reviews due this trimester
- If you are absent on Friday, your review is due the day you return to class.
- If it is typed it can be no larger than font 14, double spaced. If I cannot read it, I will ask you to type it.
- Include the following information in your summary:
  1. name of magazine, newspaper or website - use proper format
  2. date of the article, issue etc
  3. authors name
  4. title of article
  5. copy of the internet article



**TOPICS IN SCIENCE  
WRITING SKILLS USING  
BI-MONTHLY ARTICLES**

**1 B**

<p style="text-align: center;"><b>Exceeds Expectations</b></p>	<p>The student understands not only the objective but also the implications of assignments. S/he writes in a variety of modes, with a clear focus or thesis. Supporting details are <b>well developed and organized</b>, showing both analysis and synthesis of ideas. Word choice and syntax are <b>accurate</b> and appropriate. The student shows <b>mastery</b> in the conventions of Standard English. The student successfully <b>completes all parts</b> of the writing process.</p>
<p style="text-align: center;"><b>Meets Expectations</b></p>	<p>The student understands the objective of assignments and selects an appropriate mode of written expression with a focus or thesis. Supporting details show an understanding of the subject matter and an analysis of ideas. They are <b>somewhat developed and organized</b>. Word choice and syntax are <b>accurate</b> and appropriate. <b>Errors</b> in the conventions of Standard English are few. The student completes most parts of the writing process.</p>
<p style="text-align: center;"><b>Meets Some Expectations</b></p>	<p>The student requires some additional explanations and models in order to understand the objective of assignments or to complete the writing process. With direction, s/he selects an appropriate mode. Writing has a somewhat limited focus or thesis, and supporting ideas may be inaccurate, simplistic, and/or confused. The student may require assistance to develop or organize his response. Word choice and syntax are consistent with grade level. There are some errors in the conventions of Standard English.</p>
<p style="text-align: center;"><b>Does Not Meet Expectations</b></p>	<p>The student <b>misinterprets significant elements</b> of writing assignments, selecting an inappropriate mode or using it incorrectly. The student <b>requires many additional explanations</b>, models, graphic organizers, and/or strategies in order to complete parts of the writing process. The writing has <b>no clear focus</b> or a very limited thesis. Ideas and concepts are <b>often unorganized or inaccurate</b>. <b>Inaccurate or limited vocabulary</b>, syntax errors, and errors in the conventions of writing make the writing ineffective.</p>

## Assignments and Topics for Critical Thinkers

Using the 6 characteristics of a critical thinker, choose one of the following issues. You may also see me if you have a complex issue you would like to investigate. This assignment will be worth two test grades. The due date is Wednesday December 18<sup>th</sup>.

1. Decide what you think about the issue -10 pts
2. List the evidence for your point of view 20 pts - you will have the opportunity to use resources in the classroom and the library
3. Seek other views and additional evidence. You need to interview 4 other people. Please include 2 adults and ask them why they have that view or opinion. We will come up with some general questions for this section in class together. 20 pts.
4. Decide which view is most reasonable and write 3 paragraphs, an introduction, a main body and a conclusion persuading your reader to accept your view. 50 pts
  - a. Introduction - minimum of 3 sentences
  - b. Main body - minimum of 10 sentences
  - c. Conclusion - minimum of 5 sentences

### Topics

- a. Do you favor subjecting animals to painful experiments in order to find cures for disease?
- b. Do you favor using stem cells for finding cures for disease?
- c. Do you believe one can be a sincere Christian and believe in the theory of Evolution?
- d. Do you favor a mandatory prison term for the first time DWI convictions?
- e. Why is prescription drug consumption the highest in the United States?
- f. Should insurance cover car accidents in the case of DWI?
- g. Who should pay for care for an orphan who terminally ill?
- h. Should the life of an Alzheimer's patient be prolonged?
- i. Is recycling practical?
- j. Is Health Care reform needed?

**TOPICS IN SCIENCE**  
**APPLYING CRITICAL THINKING SKILLS**  
**IN SCIENTIFIC CASE STUDIES**

**3**

<b>Exceeds Expectations</b>	The student <b>independently</b> collects, interprets and analyzes data related to a complex issue using <b>all of the</b> characteristics of a critical thinker.
<b>Meets Expectations</b>	The student <b>independently</b> collects, interprets and analyzes data related to a complex issue using some of the characteristics of a critical thinker.
<b>Meets Some Expectations</b>	The student <b>may need assistance</b> collecting, interpreting and analyzing data related to a complex issue using some of the characteristics of a critical thinker.
<b>Does Not Meet Expectations</b>	The student <b>requires assistance</b> collecting, interpreting and analyzing data related to a complex issue using <b>some or few</b> of the characteristics of a critical thinker.

### Course Description

HIGH SCHOOL		
1. Course Title <b>Introduction to Forensic Science</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Introduction to Forensic Science</b>		
3. Transcript Course Code/Number <b>00367</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 11 – 12    Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input checked="" type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites Successful completion of Biology - Honors or Biological Systems, or a B or better in General Biology		
11. Brief Course Description This course is designed for students interested in understanding what forensic science is and how it incorporates other fields of science, such as biology, chemistry and physics. It is an introductory course for students who have interest in pursuing a career in forensic science. A broad range of topics including observation techniques, DNA, hair, fiber and blood analysis and fingerprinting will be explored using laboratory techniques and activities. These topics will be applied and discussed in regards to forensic science and how these techniques are used to solve crimes.		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocol. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently. <b>6. Demonstrate respect for one's self, and strive to contribute to the success of others.</b>		

## 13. Course Outline

<b>Unit</b>	<b>Activities</b>	<b># of Weeks</b>
Introduction to Forensic Science	<ul style="list-style-type: none"> <li>▪ Anthropometry Activity</li> <li>▪ Specialists in Forensics web quest</li> <li>▪ Backpack Mystery</li> </ul>	1
The Crime Scene	<ul style="list-style-type: none"> <li>▪ Logic Puzzles</li> <li>▪ Deadly Picnic – Lab in Deductive Reasoning</li> <li>▪ Clue game</li> <li>▪ Crime Scene sketch</li> </ul>	2
Types of Evidence	<ul style="list-style-type: none"> <li>▪ Physical Evidence Flipcharts</li> <li>▪ Searching for Trace Evidence</li> </ul>	2
Hair and Fiber Evidence	<ul style="list-style-type: none"> <li>▪ Animal hair lab</li> <li>▪ Human hair lab</li> <li>▪ Fiber analysis lab</li> </ul>	1.5
Fingerprint Evidence	<ul style="list-style-type: none"> <li>▪ Inked fingerprint lab</li> <li>▪ Latent fingerprint lab</li> </ul>	1
Drug Evidence	<ul style="list-style-type: none"> <li>▪ Narcotics lab</li> <li>▪ <b>Napoleon's Death Activity</b></li> </ul>	1
Blood Evidence	<ul style="list-style-type: none"> <li>▪ Blood Typing internet activity</li> <li>▪ Blood Typing lab</li> <li>▪ Blood Spatter lab</li> </ul>	1
DNA Evidence	<ul style="list-style-type: none"> <li>▪ Paper Helix</li> <li>▪ DNA extraction lab</li> <li>▪ Case of the Crown Jewels – DNA fingerprinting</li> </ul>	1
Criminal Case Project	<ul style="list-style-type: none"> <li>▪ Group research project on real life criminal case</li> </ul>	1.5

## 14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response Cards by TurningTechnologies
- Web-based instruction with Blackboard/finalsite
- Research

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison curriculum and Connecticut State standards and grade level expectations for Science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a common scoring rubric or grading criteria.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of scientific claims</b> in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic that are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <p><u><a href="#">Forensic Science for High School</a></u> Kendall Hunt, 2006  <u><a href="#">Criminalistics: An Introduction to Forensic Science</a></u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>▪ Laboratory materials</li> </ul> <b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided Internet research with selected websites</li> </ul> <b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Laboratory analysis questions</li> <li>▪ Laboratory conclusions</li> <li>▪ Teacher observations</li> <li>▪ Research based projects</li> </ul>

<b>LEARNING STRAND</b> <b>Introduction to Forensic Science</b> <i>Content Standard</i> <i>Scientific Inquiry: Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Science is the method of observation and investigation used to understand our world.</li> <li>▪ Scientists today apply theories and techniques developed by past scientists to solve crimes.</li> <li>▪ Scientists work together and share findings in order to effectively draw conclusions and solve real world problems.</li> <li>▪ Forensic science is the application of science to criminal and civil law.</li> <li>▪ Forensic science involves the collaboration of many scientific specialists, both past and present.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What is Forensic Science?</li> <li>▪ How have the developments and research of past scientists contributed to the development of the field of forensic science as we know it today?</li> <li>▪ How are crimes solved?</li> <li>▪ Who is involved in solving crimes and what roles do they play?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Explain how research and discoveries of past scientists have contributed to the field of Forensic Science.</li> <li>▪ Describe the major federal and local crime laboratories and their functions.</li> <li>▪ Describe the roles of some of the specialists in forensic science (i.e., entomologists, serologists, odontologists, etc.).</li> <li>▪ List steps in pursuing justice.</li> <li>▪ Explain federal rules of evidence.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b>  <u>Forensic Science for High School</u> Kendall Hunt, 2006 <u>Criminalistics: An Introduction to Forensic Science</u> , Pearson Prentice Hall, 2004 <ul style="list-style-type: none"> <li>▪ Anthropometry activity (requires Bertillon card, meter stick, and string)</li> <li>▪ Computers with internet access</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ PowerPoint presentations</li> <li>▪ Lecture</li> <li>▪ Hands-on lab activity</li> <li>▪ Internet research with selected websites</li> <li>▪ Group work</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Lab questions and discussions</li> <li>▪ Teacher observations</li> <li>▪ Student participation</li> <li>▪ Tests and quizzes</li> </ul> <b>Expected Performance:</b> Articulate conclusions and explanations based on research data and assess results based on the design of the investigation.

<p><b>LEARNING STRAND</b>  <b>The Crime Scene</b>  <i>Content Standard:</i>  <i>Scientific Inquiry: Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain, and predict natural phenomena. Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Scientific problems, including crimes, must be solved by deductive reasoning: analyzing and synthesizing all observations and data in order to come to a conclusion.</li> <li>Crime scenes are extremely fragile; once disrupted or tampered with, they can never be regained.</li> <li>Observation skills are critical when investigating crime scenes; the notes and photos taken and the sketches drawn are used to help forensic investigators reconstruct the crime and determine the course of events.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What is deductive reasoning and how it is used to solve crimes?</li> <li>Why is it important for investigators to follow a protocol when processing a crime scene?</li> <li>Why is it important for crime scene investigators to thoroughly document the crime scene? How do they do this?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Apply deductive reasoning skills to fictitious "Who-dun-it?" cases.</li> <li>List and explain the appropriate steps in processing a crime scene.</li> <li>Describe the proper methods used to document a crime scene.</li> <li>Apply the documentation methods of note-taking and sketching to a simulated crime scene.</li> <li>Explain how the chain of custody of evidence is preserved.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Forensic Science for High School</u> Kendall Hunt, 2006  <u>Criminalistics: An Introduction to Forensic Science</u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>"The Deadly Picnic" – lab on deductive reasoning</li> <li>Logic Puzzles</li> <li>Clue board game</li> <li>Crime Scene Information packet with questions</li> <li>"The Case of the Cyanide Cocktail" – simulated crime scene to set up in the classroom</li> <li>Tape measures, rulers, colored pencils, graph paper (to sketch Cyanide Cocktail crime scene)</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Lecture and group discussion</li> <li>Homework (directed reading and questions)</li> <li>Group Work</li> <li>Games</li> <li>Performance Tasks</li> <li>Crime Scene Investigation – documenting the crime scene using notes and sketches</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Teacher observations (of work on logic puzzles, success in playing Clue, etc.)</li> <li>"Cyanide Cocktail" Activity – crime scene sketch, notes, and analysis questions</li> <li>Tests and quizzes</li> </ul> <p><b>Expected Performances</b></p> <ul style="list-style-type: none"> <li>Identify questions that can be answered through scientific investigation.</li> <li>Design and conduct appropriate types of scientific investigations to answer different questions.</li> <li>Use appropriate tools and techniques to make observations and gather data.</li> </ul>



<p><b>LEARNING STRAND</b>  <b>Types of Evidence</b>  <i>Content Standard</i>  <i>Scientific Inquiry: Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ There is always evidence left at a crime scene.</li> <li>▪ Matter, including forensic evidence, can be described, organized, classified, and analyzed to identify individual suspects.</li> <li>▪ A variety of different types of evidence are collected from crime scenes; some types have greater bearing on the case than others.</li> <li>▪ It is the combination of evidence collected that ultimately makes or breaks a criminal case.</li> <li>▪ When collecting and preserving evidence, proper scientific and legal precautions must be taken to insure the integrity of evidence is maintained.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ <b>What is Edmond Locard’s Exchange Principle</b> and how is it applied to a crime scene?</li> <li>▪ What is the value of different types of evidence found at a crime scene?</li> <li>▪ Why is it important for proper procedures to be followed when collecting and preserving evidence?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ List and describe the different types of evidence (physical, direct, circumstantial, etc.).</li> <li>▪ Compare and contrast the value of each type of evidence.</li> <li>▪ Distinguish between individual and class evidence and list examples of each.</li> <li>▪ Describe the different types of physical evidence that can be collected at a crime scene.</li> <li>▪ Practice using different search patterns to look for trace evidence and determine the pros and cons of each method.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Forensic Science for High School</u> Kendall Hunt, 2006  <u>Criminalistics: An Introduction to Forensic Science</u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>▪ Individual vs. Class evidence worksheet</li> <li>▪ Trace Evidence information packet with questions</li> <li>▪ Internet research with selected websites</li> <li>▪ Construction paper, markers, colored pencils, scissors, glue (for physical evidence flipcharts)</li> <li>▪ Large open area, such as a football field, to plant trace evidence</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <p><u>Forensic Science for High School</u> Kendall Hunt, 2005</p> <ul style="list-style-type: none"> <li>▪ Lecture with class discussion</li> <li>▪ Directed Reading</li> <li>▪ Performance Tasks</li> <li>▪ Research project (Create a flipchart describing 10 types of physical evidence their methods of collection)</li> <li>▪ Trace evidence collection using search patterns</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Homework (reading and questions)</li> <li>▪ Teacher observations (searching for evidence)</li> <li>▪ Student class participation</li> <li>▪ Flipchart project graded with rubric</li> <li>▪ Tests and quizzes</li> </ul> <p><b>Expected Performance</b>  Use appropriate tools and techniques to make observations and gather data.</p>

<p><b>LEARNING STRAND</b>  <b>Hair and Fiber Evidence</b>  <i>Content Standards</i>  <i>Scientific Inquiry: Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation.</i>  <i>Content Standard: 9.5 – Due to its unique chemical structure, carbon forms many organic and inorganic compounds. (building block for hair and fibers)</i>  <i>Enrichment Content Standards for High School Chemistry: The bonding characteristics allow the formation for many different organic molecules of varied sizes, shapes, and chemical properties, and provide the biochemical basis of life. (allow for differences in hair and fibers structure)</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Matter, including forensic evidence such as hair and fibers, can be described, organized, classified, and analyzed and can be used to identify suspects.</li> <li>▪ Evidence can be analyzed for its chemical components to uncover characteristics that are not always directly observable and thus can give insight to a crime.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the value of hair and fibers as trace evidence?</li> <li>▪ What information can be gained by studying hair and fiber evidence?</li> <li>▪ How are hair and fibers analyzed in a crime lab?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Identify, label, and distinguish between the main parts of a hair.</li> <li>▪ Analyze hair samples to distinguish between human hairs and hairs of other animal species.</li> <li>▪ Determine the identity of an unknown hair.</li> <li>▪ Describe the tools and techniques used to analyze fibers in a crime lab.</li> <li>▪ Distinguish between natural and synthetic fibers and give examples of each.</li> <li>▪ Analyze known fiber samples.</li> <li>▪ Determine the identity of an unknown fiber.</li> <li>▪ Explain the value of hairs and fibers as trace evidence.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Forensic Science for High School</u>, Kendall Hunt, 2006  <u>Criminalistics: An Introduction to Forensic Science</u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>▪ Prepared hair sample slides</li> <li>▪ Prepared fiber sample slides</li> <li>▪ Microscopes</li> <li>▪ Slides and coverslips</li> <li>▪ Hair information packet with questions</li> <li>▪ Fiber evidence case studies</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Microscope Labs * – comparing human hair to animal hair, comparing various human hair samples (different individuals, different parts of the body, etc.), comparing natural and synthetic fiber samples</li> <li>▪ Lecture with class discussion</li> <li>▪ Directed Reading</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Benchmark *</p> <ul style="list-style-type: none"> <li>▪ Meets expectations for gathering information and materials, thinking critically, and solving problems.</li> <li>▪ Hair Lab and Fiber Lab drawings and analysis questions</li> <li>▪ Homework (reading and questions)</li> <li>▪ Tests and quizzes</li> </ul> <p><b>Expected Performance</b>  Use appropriate tools and techniques to make observations and gather data.</p>

<p><b>LEARNING STRAND</b>  <b>Fingerprints</b>  <i>Content Standard</i>  <u>Scientific Inquiry</u>: <i>Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Biological evidence, such as fingerprints, contains discrete pieces of information that makes every organism unique.</li> <li>▪ Science ideas evolve as new information is uncovered.</li> <li>▪ Matter, including forensic evidence such as fingerprints, can be described, organized, classified, analyzed and used to determine the identity of a suspect.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ Why are fingerprints such a valuable piece of evidence?</li> <li>▪ How is fingerprint evidence collected and analyzed in order to determine the identity of a suspect?</li> <li>▪ How have computers made personal identification easier?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Define the three basic properties that allow individual identification by fingerprints.</li> <li>▪ Obtain an inked, readable fingerprint for each finger.</li> <li>▪ Explain the value of fingerprints as evidence.</li> <li>▪ Distinguish between the three main classes of fingerprints.</li> <li>▪ Examine fingerprints and classify them appropriately.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Forensic Science for High School</u> Kendall Hunt, 2006  <u>Criminalistics: An Introduction to Forensic Science</u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>▪ Fingerprint ink</li> <li>▪ Charcoal powder</li> <li>▪ Fiberglass brushes</li> <li>▪ Clear adhesive tape</li> <li>▪ Index cards</li> <li>▪ Illustrations of the 3 types of fingerprints</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Lecture with class discussion</li> <li>▪ Group work</li> <li>▪ Lab Activities – inked fingerprints and latent fingerprints</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Teacher observations</li> <li>▪ Lab analysis questions</li> <li>▪ Quizzes</li> </ul> <p><b>Expected Performance</b>  Assess the reliability of the data that was generated in the investigation.</p>

<p><b>LEARNING STRAND</b>  <b>Drug Evidence</b>  <i>Content Standard</i>  <i>Scientific Inquiry: Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Matter, including forensic evidence such as drugs, can be described, organized, classified, and analyzed.</li> <li>Evidence can be analyzed for its chemical components to uncover characteristics that are not always directly observable and thus can give insight to a crime.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How is drug evidence analyzed by the crime lab?</li> <li>How are drugs classified?</li> <li>What are the proper procedures for collecting and preserving drug evidence?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Distinguish between the 6 major classes of drugs and give examples of each.</li> <li>Explain the basis for the Controlled Substances Act's 5 schedules of drugs.</li> <li>Describe the various screening and confirmation tests performed on drug evidence.</li> <li>Explain how drugs should be properly collected and preserved.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Forensic Science for High School</u> Kendall Hunt, 2006  <u>Criminalistics: An Introduction to Forensic Science</u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>Narcotics Lab (from Wards)</li> <li>Text</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Lecture with class discussion</li> <li>Lab Activity – testing for the presence of cocaine</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Narcotics Lab analysis questions</li> <li>Quizzes</li> </ul> <p><b>Expected Performance</b>  Assess the reliability of the data that was generated in the investigation.</p>

<p><b>LEARNING STRAND</b>  <b>Blood Evidence</b>  <i>Content Standards</i>  <i>Scientific Inquiry:</i> Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation. Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain, and predict natural phenomena.  <i>Enrichment Content Standards for High School Biology:</i> Physiology – The complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide. (structure and function of blood)  <i>Enrichment Content Standards for High School Physics:</i> Motion and Forces – <b>Newton’s laws predict the motion of most objects</b> . (blood spatter)</p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Science ideas evolve as new information is uncovered.</li> <li>▪ Matter, including forensic evidence such as blood, can be described, organized, classified, and analyzed and can be used to determine the identity of a suspect.</li> <li>▪ Results from controlled experiments and research can be used to make predictions when applied to new circumstances.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the role of blood in the human body?</li> <li>▪ What is the value of blood as evidence?</li> <li>▪ How is blood type determined?</li> <li>▪ What information can be obtained by analyzing blood spatter patterns?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Distinguish between the components of blood and their functions.</li> <li>▪ Identify the characteristics of different blood types.</li> <li>▪ Determine the blood type of an unknown sample.</li> <li>▪ Compare blood spatter patterns from various circumstances.</li> <li>▪ Explore bloodstain patterns as a function of velocity, direction and height of fall.</li> <li>▪ Describe how blood evidence is collected, identified, and analyzed.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Forensic Science for High School</u> Kendall Hunt, 2006  <u>Criminalistics: An Introduction to Forensic Science</u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>▪ Simulated Blood Typing Kit (Wards)</li> <li>▪ Simulated Blood Spatter Kit (Wards)</li> <li>▪ Internet research with selected websites</li> <li>▪ Website – nobelprize.com (blood typing game)</li> <li>▪ Blood information packets and questions</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Lecture and class discussion</li> <li>▪ Lab Activities – blood typing and blood spatter labs</li> <li>▪ Internet activity – blood typing game</li> <li>▪ Directed Reading</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Lab Analysis Questions</li> <li>▪ Teacher observations - Internet activity</li> <li>▪ Homework (reading and questions)</li> <li>▪ Quizzes</li> <li>▪ Test</li> </ul>

<p><b>LEARNING STRAND</b>  <b>DNA Evidence</b>  <i>Content Standards</i>  <i>Scientific Inquiry:</i> Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation. Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain, and predict natural phenomena.  <i>Enrichment Standards for High School Biology:</i> Genetics – Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism. (DNA technology)</p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The DNA sequence of every organism is unique.</li> <li>▪ DNA technology allows scientists to manipulate and analyze DNA in order to make connections between crime scenes and suspects.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the value of DNA as evidence?</li> <li>▪ How is DNA extracted and characterized?</li> <li>▪ How can DNA be analyzed to make connections between crime scenes and suspects?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the structure of DNA.</li> <li>▪ Describe what makes each <b>person’s DNA unique</b>.</li> <li>▪ List and describe the steps of making a DNA fingerprint.</li> <li>▪ Analyze a DNA fingerprint to determine the identity of a criminal.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Forensic Science for High School</u> Kendall Hunt, 2006  <u>Criminalistics: An Introduction to Forensic Science</u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>▪ Paper Helix Activity – templates, construction paper, scissors, tape</li> <li>▪ “The Case of the Crown Jewels” Activity</li> <li>▪ DNA Extraction Lab materials (salt water, dish detergent, ethanol, test tubes)</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Demonstrations</li> <li>▪ Lecture with class discussion</li> <li>▪ Lab activity – DNA extraction</li> <li>▪ Create a paper model of a DNA fingerprint</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Lab Analysis Questions</li> <li>▪ Teacher observations</li> <li>▪ Poster of DNA fingerprint</li> <li>▪ Test</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Criminal Case Research Project</b>  <i>Content Standards</i>  <i>Scientific Inquiry: Scientific inquiry progresses through a continuous process of questioning, data collection, analysis, and interpretation. Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain, and predict natural phenomena. Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Criminal cases are solved by the coordinated effort of many specialists, scientists, and departments.</li> <li>▪ Scientists work together and share findings in order to effectively draw conclusions and solve real world problems.</li> <li>▪ Scientific problems, including crimes, must be solved by deductive reasoning: analyzing and synthesizing all observations and data in order to come to a conclusion.</li> <li>▪ There will always be evidence left behind at a crime scene.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How are real world crimes solved?</li> <li>▪ What steps are taken in order to effectively investigate, process, and bring a criminal case to trial?</li> <li>▪ What are some of the limitations of modern forensic science?</li> <li>▪ What are some of the challenges faced by forensic scientists and law enforcement officials?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Research a real life criminal case.</li> <li>▪ Explain the process of investigating a criminal case, including the crime committed, the collection and analysis of evidence, and the outcome of the case.</li> <li>▪ Explain the importance of evidence in the outcome of a criminal case.</li> <li>▪ Describe the limitations of modern forensic science when investigating a crime.</li> <li>▪ Describe challenges faced by forensic scientists.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Forensic Science for High School</u> Kendall Hunt, 2006  <u>Criminalistics: An Introduction to Forensic Science</u>, Pearson Prentice Hall, 2004</p> <ul style="list-style-type: none"> <li>▪ Internet research with selected websites</li> <li>▪ PowerPoint program</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Research project *</li> <li>▪ Student generated PowerPoint presentations</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Benchmark*</p> <ul style="list-style-type: none"> <li>- Student meets expectations for using technology effectively and responsibly</li> <li>▪ Research project graded with rubric</li> </ul>

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## **"Real Life" Criminal Case Project**

### ***The Assignment:***

*In groups of 2 or 3 you are to research any real life criminal case of your choice. You will create a PowerPoint presentation to teach the class about your criminal case. The PowerPoint presentation must include the following:*

A minimum of 10 slides.

A unique slide design

Animation

Title

Pictures illustrating the case

Background information

What should we know about the suspects/victims/time period, etc. to help us understand this case?

The crime committed

What happened?

The crime scene

Where?

What did it look like?

What evidence was collected?

The investigation

How long did it last?

What scientific tests were performed?

Were any mistakes made?

The suspects

Who?

Why were they suspects?

The trial (if there was one) and the outcome/verdict of the case

Any interesting facts about the case

Sources you used cited in MLA format

*This assignment will count as two test grades. You will be graded on the work you do each day in class and on the quality of the final presentation. This includes both the PowerPoint slides and the oral presentation. It is expected that each member of the group will participate in the presentation. The class will also evaluate your presentation. Please see the attached rubric for the breakdown of grading.*



Name: \_\_\_\_\_ Date: \_\_\_\_\_

### "Real Life" Criminal Case Project Grading Rubric

Criteria	Points Possible	Points Earned	Teacher Comments
<b>PowerPoint:</b>			
Copy of PowerPoint is turned in	5		
Minimum of 10 slides	5		
Animation	3		
Unique Slide Design	3		
No misspellings or grammatical errors	5		
Sources are cited in MLA format	5		
Criminal Case			
Title	2		
Background Information	5		
Explanation of the crime committed	5		
Description of the crime scene	10		
Explanation of the investigation	10		
Description of the suspects	5		
Description of the trial and outcome/verdict	5		
Pictures enhance the text	5		
Interesting facts	5		
<b>Oral Presentation</b>			
Speaks clearly and loudly	3		
Well organized and understandable	3		
All members share equally in the presentation	2		
Makes eye contact	2		
Able to answer questions correctly	2		
<b>Class Evaluation</b>	10		
<b>Total</b>	100		

## Forensics and Biotechnology Criminal Case Research Project

### 2. Uses technology effectively and responsibly

<b>Exceeds Expectations</b>	The student can independently select appropriate internet sources to research an actual crime. S/he selects websites that are currently updated and authored.
<b>Meets Expectations</b>	The student needs minimal assistance in selecting appropriate internet sources to research an actual crime. S/he selects websites that may be outdated <b>or</b> un-authored.
<b>Meets Some Expectations</b>	The student requires some assistance in selecting appropriate internet sources to research an actual crime. S/he selects websites that are outdated <b>and/or</b> un-authored.
<b>Does Not Meet Expectations</b>	The student cannot select appropriate internet sources to research an actual crime. S/he selects websites that are outdated <b>and</b> un-authored.

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## What's Hair?

### OBJECTIVE

You will identify different types of hair and determine the species of selection of unknown hairs.

### BACKGROUND INFORMATION

As a trace evidence forensic scientist, you are often asked to identify hairs found at crime scenes. Sometimes you need to know whether or not a hair is human and if not, what type of animal it is from. You also may need to know if a hair can differentiate two different animals of the same species. In this lab, you will create a set of reference hairs to help answer these questions.

### MATERIALS

Cat hair	Deer hair	Mouse hair
Horse hair	Woolly Mammoth hair	Dog hair
Rat hair	Human hair (3 types)	Hair (5 type sample)
Unknown hairs #1, 2, 3		
Compound light microscope		

### PROCEDURE

- Move from microscope station to station examining each hair sample under low, medium, and high power. Draw what you see under high power in the circles provided. Be sure to notice and label the:
  - medulla
  - cuticle
  - cortex
- For two of the hair of your choice determine the **medullary ratio** of them by measuring the diameter of the medulla and the diameter of the hair (this can be a rough estimate).
  - Express these two numbers as a fraction - called the **medullary** index.
  - Record this number in the data table provided.
- Repeat step #1 for the unknown hair stations (#1, 2, and 3). Compare the unknown hair sample to your controls to determine what types of hair they are.
  - Record your guesses in the data table provided.
- Move to the station with the slide containing the 5 types of hair. Try to determine which types of hair they are also.
  - Record your guesses in the space provided.
- Answer the analysis questions.

## Medullary Index

Hair Type	Medullary Index

## Identity of Unknown Hair Samples

Unknown Sample	Identity

## Five Types of Hair Guesses

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**Analysis Questions**

1. What type of hair was each of the unknowns? What specific characteristics helped you decide which type it was?
2. How can you tell human hair from animal hair?
3. How can investigators use hair evidence to help solve a crime? How is Locard's Exchange Principle applied to hair evidence?
4. What are the main parts to the morphology of the hair and explain each part?
5. Explain the different types of medulla that can be used to identify hair.

**Forensics and Biotechnology**  
**Laboratory Analysis - Evidence Collection**

**3. Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems**

<p><b>Exceeds Expectations</b></p> <p><b>27-30</b></p>	<p>The student independently collects, analyzes, interprets, and evaluates evidence and data collected from a simulated crime scene. S/he uses that information to make original predictions and solve problems accurately and efficiently. S/he presents her/his findings in a coherent manner.</p>
<p><b>Meets Expectations</b></p> <p><b>24/30 – 26/30</b></p>	<p>The student needs minimal assistance in collecting, analyzing, interpreting, and evaluating evidence and data collected from a simulated crime scene. S/he uses that information to make specific predictions and solve problems with few errors. S/he presents in a coherent manner.</p>
<p><b>Meets Some Expectations</b></p> <p><b>21/30 – 23/30</b></p>	<p>The student needs some assistance in collecting evidence and interpreting data from a simulated crime scene. S/he may need some assistance in using that information to make general predictions and solve problems. S/he solves problems with some errors and presents her/his findings in a coherent manner.</p>
<p><b>Does Not Meet Expectations</b></p> <p><b>&lt;20/30</b></p>	<p>The student needs significant assistance in gathering evidence and interpreting information and data from a simulated crime scene. S/he needs assistance in making predictions and solving problems. S/he solves problems inefficiently with significant errors and fails to present her/his findings in a coherent manner.</p>



**Course Description**

<b>HIGH SCHOOL</b>		
1. Course Title <b>Anatomy and Physiology</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Anatomy &amp; Phys.</b>		
3. Transcript Course Code/Number <b>00372</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 12      Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input checked="" type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites Successful completion of Biological Systems, Biology - Honors, Chemistry, or Human Biology		
11. Brief Course Description This course presents the student with an explanation of the structure of the human body and its processes. The skeletal, muscular, nervous, circulatory, respiratory and digestive systems are studied. Where possible, the subject matter is elucidated by laboratory investigation. This course is especially beneficial for a student considering a medical career.		
12. Course Goals 1. To help students understand the structure and function of a healthy human body. 2. To acquaint students with current research regarding application of medical science to the process of treating and curing disease. 3. To apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 4. To conduct lab experiments and dissections safely. 5. To use technology effectively and efficiently. 6. To demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 7. To demonstrate the ability to complete assignments independently. 8. To demonstrate respect for one's self, and strive to contribute to the success of others.		



13. Course Outline	
<u>Chapter / Unit</u>	<u>Topics</u>
One: The Human Body An Orientation	Relationship between anatomy and physiology, Levels of Structural Organization (cell→organism), Life Functions, Homeostasis, Anatomical Vocabulary
Three: Cells and Tissues	Review of cell structure and membrane transport Anatomy, cell physiology and four main tissue types
Seven: The Nervous System	Nervous system organization Nervous tissue anatomy and physiology (focus on nerve impulse conduction and reflex arc) Types of sensory receptors in skin Brain Dysfunctions Structure and function of CNS and PNS (and protection) Autonomic Nervous System
Eight: Special Senses	Major structure and function of eye in vision Major structure and function of ear in hearing and balance Major structure, function and location of smell and taste senses
Ten: Blood	Composition of blood Blood typing and transfusion reactions Hemopoiesis
Eleven: The Circulatory System	Anatomy and physiology of the heart and vessels Pathways of blood through the heart Cardiovascular disease and treatments
Five: The Skeletal System	Structure and function of bones and skeletal system Classification of bones (long, short, flat, irregular) The major anatomical areas of a long bone Bone formation and repair Types of fractures Bones of axial and appendicular skeleton
Six: The Muscular System	Similarities, differences, location of three types of muscle tissue The structure of skeletal muscle The events of muscle cell contraction. The different types of body movement. Criteria used in naming muscles.
Student text: <i>Essentials of Human Anatomy and Physiology</i> by Elaine Marieb Benjamin/Cummings Publishing Co 1994 In Science office: <i>Anatomy and Physiology Coloring Workbook: A Complete Study Guide (Text ancillary material)</i> In Room 219: <i>Essentials of Human Anatomy and Physiology</i> Lab Manual, Media Manager, Test Bank (Teacher materials) 2009	

## 14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response Cards by TurningTechnologies
- Web-based instruction with Blackboard/FinalSite
- Research

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a common scoring rubric or grading criteria.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>Content Standard: Scientific knowledge is created and communicated.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the credibility of scientific claims</b> in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic that are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</b></li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Essentials of Human Anatomy and Physiology</u> Pearson/Benjamin Cummings Publishing Co., 2009 <ul style="list-style-type: none"> <li>▪ Reflex lab</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided Internet research of selected websites</li> <li>▪ Extension of reflex/reaction time lab (Students design an experiment to test another variable that affects reaction time.)</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> Benchmark: <ul style="list-style-type: none"> <li>▪ <i>Project for application and integration of learning:</i> Have students present a current treatment option for one of the disorders presented in class (nervous system disorder, circulatory system, skeletal or muscular disorder).</li> <li>▪ Statistics about the procedure (e.g., survival rates, % of population afflicted, etc.)</li> <li>▪ Credible sources used and cited correctly</li> <li>▪ Background information on the testing done to approve the procedure (emphasize control and experimental groups; use appropriate vocabulary)</li> <li>▪ Conclusions about success of treatment using all relevant, credible information</li> </ul>

- Format could be PowerPoint presentation, poster, and/or lecture

Other Assessments:

- Unit Test
- Quizzes
- Investigations evaluated with rubrics
- Response cards by TurningTechnologies
- Lab report/questions on Reaction Time lab extension
- Lab on variables affecting heart rate

<p><b>LEARNING STRAND</b>  <b>Introduction to Anatomy and Physiology</b>  <i>Enrichment Content Standards for High School Science: Physiology -- As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Medical terminology is essential when describing anatomic structure and physiology.</li> <li>▪ These terms are universally known.</li> <li>▪ <b>Living things can be described, organized, and classified for understanding.</b></li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the relationship between anatomy and physiology?</li> <li>▪ What are the levels of organization in an organism?</li> <li>▪ Why is homeostasis important?</li> <li>▪ How is anatomical vocabulary used?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Recognize the organization levels- from cells to organism.</li> <li>▪ Relate homeostatic feedback mechanisms to proper body function</li> <li>▪ Apply terminology to describe body planes anatomical positions, etc.</li> <li>▪ Identify the body membranes and cavities.</li> </ul> <p>Explain the major structures of and functions for each of the major body systems:</p> <ul style="list-style-type: none"> <li>· Integumentary System</li> <li>· Skeletal System</li> <li>· Muscular System</li> <li>· Nervous System</li> <li>· Endocrine System</li> <li>· Circulatory System</li> <li>· Lymphatic System</li> <li>· Digestive System</li> <li>· Respiratory System</li> <li>· Urinary System</li> <li>· Reproductive System</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u><a href="#">Essentials of Human Anatomy and Physiology</a></u>  <u><a href="#">Pearson/Benjamin Cummings Publishing Co., 2009</a></u></p> <ul style="list-style-type: none"> <li>▪ <u><a href="#">Anatomy &amp; Physiology Coloring Workbook</a></u> (for copying diagrams)</li> <li>▪ Poster paper and markers</li> <li>▪ Internet / website activities</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Group work</li> <li>▪ Lecture</li> <li>▪ Poster summaries of 11 body systems</li> <li>▪ Question, answer, and discussion</li> <li>▪ Diagram labeling</li> <li>▪ Internet modules</li> </ul> <p><a href="http://www.wisc-online.com/objects/index_tj.asp?objID=AP15505">http://www.wisc-online.com/objects/index_tj.asp?objID=AP15505</a>  The Organization of the Human Body: Body Cavities  <a href="http://www.wisc-online.com/objects/index_tj.asp?objID=AP15305">http://www.wisc-online.com/objects/index_tj.asp?objID=AP15305</a>  Anatomical Terminology: Relative Position</p> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Homework (readings, questions, and diagramming)</li> <li>▪ Unit Test</li> <li>▪ Quizzes</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Response cards by TurningTechnologies</li> <li>▪ Class work (posters, internet module)</li> </ul>

<b>LEARNING STRAND</b> <b>Cell Structure and Function</b> <b>Characteristics of Tissues</b> <i>Content Standard</i> <i>Enrichment Content Standards for High School Science: Cell Biology -- The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Living things can be described, organized and classified for understanding.</li> <li>▪ Imbalances in the cell relate to imbalances in living things.</li> <li>▪ Cell is the basic structural and functional unit of all living things.</li> <li>▪ Different types of cells work together to form tissues that carry out specific functions.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What is the lowest level of organization in an organism?</li> <li>▪ What happens when homeostasis is not maintained?</li> <li>▪ What are the characteristics and functions of epithelial, connective, muscle and nervous tissues?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Identify the structure and function of the cell.</li> <li>▪ Describe various membrane transport mechanisms (endocytosis, exocytosis, etc.).</li> <li>▪ Describe the major structure and function of the four major tissue types.</li> <li>▪ Demonstrate where each major tissue type occurs within the human body.</li> <li>▪ Explain how glands are classified.</li> <li>▪ Illustrate and label the major tissue types using the microscope.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Essentials of Human Anatomy and Physiology</u> Pearson/Benjamin Cummings Publishing Co., 2009 <ul style="list-style-type: none"> <li>▪ Student class participation</li> <li>▪ Microscopic slides of representative tissue types</li> <li>▪ Osmosis lab materials</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Diffusion/Osmosis lab</li> <li>▪ Question, answer, and discussion</li> <li>▪ Lecture</li> <li>▪ Illustrations</li> <li>▪ Laboratory use of microscope to identify tissue types</li> <li>▪ Direct instruction</li> <li>▪ Web sites (histology)</li> <li>▪ Label diagrams</li> <li>▪ Outline text (create study guide)</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Laboratory observation and documentation</li> <li>▪ Homework (readings, questions, &amp; problems)</li> <li>▪ Unit Test</li> <li>▪ Quizzes</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Response cards by TurningTechnologies</li> <li>▪ Laboratory drawing assessments</li> <li>▪ Microscopic identification assessment</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Nervous System</b>  <i>Content Standard</i>  <i>Enrichment Content Standards for High School Science: Physiology</i>  <i>As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.</i></p> <ul style="list-style-type: none"> <li>▪ <i>The nervous system mediates communication between different parts of the body and the body's interactions with the environment.</i></li> <li>▪ <i>Feedback loops in the nervous system regulate conditions in the body.</i></li> <li>▪ <i>The neurons transmit electrochemical impulses.</i></li> <li>▪ <i>Sensory neurons, interneurons and motor neurons all have a role in sensation, thought and response.</i></li> </ul>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Human activities impact and alter cellular environments.</li> <li>▪ The nervous system senses, processes and responds to the environment.</li> <li>▪ Cells are a complex assemblage of interacting and changing chemical, physical and biological processes.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How are cellular environments impacted and altered by human activities?</li> <li>▪ How do chemical, physical and biological interactions take place at the cellular level?</li> <li>▪ What is the role of the nervous system?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Compare and contrast neurons to different glial cells in terms of structure and function.</li> <li>▪ Describe the general structure of a neuron relating to the events that lead to the conduction of the nerve impulse.</li> <li>▪ Discuss the role of neurotransmitters in neuron function.</li> <li>▪ Differentiate between the Central and Peripheral Nervous System.</li> <li>▪ Identify the parts and function of the spinal cord and brain. (reflex arc)</li> <li>▪ Describe the structure and function of the ear and eye.</li> <li>▪ Describe the location, structure and function of the olfactory and taste receptors.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u><a href="#">Essentials of Human Anatomy and Physiology</a></u>  Benjamin/Cummings Publishing Co., 1991, 1994</p> <ul style="list-style-type: none"> <li>▪ Meter stick for reflex lab</li> <li>▪ Cutaneous sensations kit</li> <li>▪ Visual Perceptions kit</li> <li>▪ DVDs: <i>The Human Body: Sensation</i> (Mezick)  <i>The Secret life of the Brain: The Teenage Brain</i> (Ferron)</li> <li>▪ Optical illusions- online and document</li> <li>▪ Ear model</li> <li>▪ Eye model</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Reflex lab</li> <li>▪ Diagrams of neurons</li> <li>▪ Nervous system PowerPoint presentations</li> <li>▪ Outline notes for PowerPoint presentations</li> <li>▪ Question, answer, and discussion</li> <li>▪ Lecture</li> <li>▪ Concept map on nervous system organization</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Lab activity for reflex lab</li> <li>▪ Homework questions</li> <li>▪ Unit Test</li> <li>▪ Quizzes</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Response cards by TurningTechnologies</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Blood and The Circulatory System</b>  <i>Content Standard</i>  <i>Enrichment Content Standards for High School Science: Physiology</i>  <i>As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Blood supplies all cells in the body with nutrients and removes waste.</li> <li>▪ The heart is the pump that cycles the blood through the body (systemic) and to the lungs (pulmonary circulation).</li> <li>▪ Imbalances in the blood relate to imbalances in the human body.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ Why is blood essential to the body?</li> <li>▪ How is blood circulated throughout the body?</li> <li>▪ What happens when homeostasis is not maintained?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the composition and volume of whole blood.</li> <li>▪ Describe the composition of plasma and discuss its importance in the body.</li> <li>▪ List blood cell types comprising the formed elements and describe the major functions of each type.</li> <li>▪ Define anemia, polycythemia, leukopenia, and leukocytosis, and list possible causes for each condition.</li> <li>▪ Describe the ABO and Rh blood groups.</li> <li>▪ Explain the basis for a transfusion reaction.</li> <li>▪ Describe the location of the heart in the body and identify its major anatomical areas on an appropriate model or diagram.</li> <li>▪ Trace the pathway of blood through the heart.</li> <li>▪ Explain the operation of the heart valves.</li> <li>▪ Define heart sounds and murmur.</li> <li>▪ Define and explain what causes atherosclerosis and list treatments.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Essentials of Human Anatomy and Physiology</u>          Pearson/Benjamin Cummings Publishing Co., 2009</p> <ul style="list-style-type: none"> <li>▪ ABO blood test kit</li> <li>▪ Candied Blood materials (red hots, sugar etc)</li> <li>▪ <b>Poster paper for "cardiac 100"</b></li> <li>▪ Stopwatches, heart rate monitors, blood pressure cuffs</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ ABO blood testing</li> <li>▪ Candied blood activity</li> <li>▪ Group work labs: Cardiac 100 and Blood Pressure/Pulse lab</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Unit Test</li> <li>▪ Quizzes</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Response cards by TurningTechnologies</li> </ul>



<p><b>LEARNING STRAND</b>  <b>The Skeletal System</b>  <i>Content Standard</i>  <i>Enrichment Content Standards for High School Science: Physiology</i>  <i>As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The skeletal system is instrumental in the support, movement, and protection of the body.</li> <li>▪ Bones are dynamic organs that interact and support other systems of the body.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What is the function of the skeletal system?</li> <li>▪ How can bones be described and what is their relationship to other systems in the body?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Describe the general structure and function of bone tissue.</li> <li>▪ Describe briefly the process of bone formation in the fetus and summarize the events of bone remodeling throughout life.</li> <li>▪ Name the four main kinds of bone. Identify the major anatomical areas of a long bone.</li> <li>▪ Name and describe the various types of fractures.</li> <li>▪ Differentiate between the axial and appendicular skeleton.</li> <li>▪ Identify and describe the features of the frontal, parietal, temporal, and occipital bones.</li> <li>▪ Identify the bones that comprise the skull, vertebral column, thoracic cage, pectoral girdle, upper limbs, pelvic girdle, and lower limbs.</li> <li>▪ Apply abnormal bone anatomy and physiology to explain disease.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Essentials of Human Anatomy and Physiology</u>  Pearson/Benjamin Cummings Publishing Co., 2009</p> <ul style="list-style-type: none"> <li>▪ Bone models</li> <li>▪ Skeleton</li> <li>▪ Bone diagrams</li> <li>▪ Fresh bone/joint (chicken wing)</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Construct/illustrate compact bone</li> <li>▪ Label parts of bone models</li> <li>▪ Label diagrams of human skeleton</li> <li>▪ Dissect fresh bone and joints</li> <li>▪ Lecture</li> <li>▪ Question, answer, and discussion</li> <li>▪ At the Clinic Questions</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Laboratory assessment and documentation of chicken wing dissection</li> <li>▪ Assessment of dissection techniques</li> <li>▪ Laboratory drawing assessment</li> <li>▪ Homework (readings, questions)</li> <li>▪ Labeling of diagrams</li> <li>▪ Unit Test</li> <li>▪ Quizzes</li> <li>▪ Investigations evaluated with rubrics</li> <li>▪ Response cards by TurningTechnologies</li> </ul>

<p><b>LEARNING STRAND</b>  <b>The Muscular System</b>  <i>Content Standard</i>  <i>Enrichment Content Standards for High School Science: Physiology</i>  <i>As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment.</i></p> <ul style="list-style-type: none"> <li>Actin, myosin, Ca<sup>2+</sup> and ATP have a role in the cellular and molecular basis of muscle contraction.</li> </ul>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>The muscular system plays a major role in movement, support and homeostasis of the human organism.</li> <li>The state of an organism is maintained by the dynamic interaction of the systems that comprise it.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>What is the function of the human muscular system?</li> <li>How does the muscular system help to maintain homeostasis?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Identify the tissues and layers of skeletal muscle.</li> <li>Describe the microscopic structure of the three types of muscle tissue.</li> <li>Explain the major events of skeletal muscle fiber contraction (Sliding Filament Theory).</li> <li>Understand that major muscles are named for their location, action, or shape.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Essentials of Human Anatomy and Physiology</u>  Pearson Benjamin Cummings Publishing Co., 2009</p> <ul style="list-style-type: none"> <li>Skeletal model</li> <li>Chicken wing for dissection</li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Label muscle diagrams</li> <li>Chicken wing dissection</li> <li>Lecture</li> <li>Question, answer, and discussion</li> <li>Web sites (getbodysmart.com)</li> <li>Video (National Geographic- LMC)</li> <li>Class discussion/debate</li> <li>Research</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>Laboratory reports with diagram assessment</li> <li>Laboratory observations and documentation</li> <li>Homework (readings, questions)</li> <li>Unit Test</li> <li>Quizzes</li> <li>Investigations evaluated with rubrics</li> <li>Response cards by TurningTechnologies</li> </ul>

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## **Anatomy and Physiology**

### **Inquiry Lab: What factors affect reflexes and reaction times?**

Your mission is to design an experiment, which will examine what things can affect reflexes and reaction times using the skills you learned such as reflex testing, using the reflex hammer, the pupil reflex, and testing someone's reaction time.

Did you ever wonder if your reaction time is faster or slower at different times of the day? What other types of changes can affect reaction time? What could make a difference? Start by stating a problem or making a statement to be investigated? For example "I believe that a full moon will affect reaction time." (You cannot use that one.) Then decide what steps need to be performed to test or investigate the problem. For example, you could test a person's reaction time during a full moon, the day before a full moon, etc. When you are composing your procedure, you need to figure out how to make sure you are only testing one variable at a time.

You will work with a partner(s) in constructing the experiment and gathering data, but every person needs to write their own report.

**The following guidelines are for your safety and success.**

1. All lab safety rules must be followed.
2. The teacher must check your problem and experimental procedure and approve it **before you begin.**
3. Every person has the right to refuse to be a test subject! Make sure you ask permission before you test somebody for any type of test reflex or reaction time. For example, if you are going to check a patellar reflex, you must ask the test subject for permission first, and also ask if they have any problems with the area to be tested. (Who knows maybe they had a nasty crash on their skateboard yesterday, you don't want to make it worse!!!)

Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Lab Partners: \_\_\_\_\_

### **Inquiry Lab: What factors affect blood pressure and heart rate? Lab Activity**

Did you ever run so hard you could feel your pulse beating in your ears? Have you ever gotten up too quickly from the couch and felt dizzy or light-headed? Have you ever felt your heart rate quicken before a big test or competition?

Your assignment is to design an experiment to test the effect of one of the factors we discussed in class on blood pressure and heart rate. In order to measure heart rate, you will choose a pulse point on your body and count the number of heartbeats you feel in one minute. In order to measure blood pressure, you will use sphygmomanometer, stethoscope, and technique we practiced in class. Before you begin, formulate a hypothesis to predict what effect your chosen factor will have on blood pressure and heart rate.

#### **Guidelines to follow:**

- Follow all safety rules.
- Let me check your procedure and hypothesis before you begin your experiment.
- Please inform me of any health concerns.
- You will be working in groups of four. Two students should first test the effect of your chosen factor on blood pressure while the other two students test the effect on heart rate. Then switch tests. Each group member should have the opportunity to be the subject and the tester for both blood pressure and heart rate.
- Be sure to record all data (you should have data for 4 people, including yourself).
- And remember, an accurate and reliable experiment is one that has been repeated at least three times.

#### **Materials**

Stop watch  
 Sphygmomanometer  
 Stethoscope  
 Pencil

**You will be writing a formal lab report for this lab. Your lab report should follow the format given at the beginning of the year. Include the following analysis questions in your lab report:**

1. Would there be a difference in blood pressure and heart rate if you stood on top of a table or sat down on the floor?
2. Compare the blood pressure and heart rate results. Are there any similarities or differences in the changes?
3. Why is high blood pressure a health concern?
4. Research and explain why smoking causes a rise in blood pressure.

**Inquiry lab: What affects reflexes and reaction times?  
What factors affect blood pressure and heart rate?  
Format for lab Write-up**

**Your lab report will have six sections.**

I. Title: Title should be descriptive (describe the main idea of the experiment that was done).

This should be short (less than ten words). Include your name first then follow with name of your lab partner.

II. Problem: State the reason the experiment was done. What was the experiment designed to investigate?

III. Materials: List all the materials which were used in the experiment including the safety equipment.

IV. Procedure: Summarize the experimental methods which were used to perform the experiment or test.

V. Results: Display results of your experiment. Include tables that display the data you collected. Also, create a graph with reaction time on the Y axis and the factors you wanted to examine on the x-axis.

VI. Conclusions: State what you can conclude from the results. Deal directly with the data here. Discuss how the data you collected explains, reinforces or does not reinforce the statement of the problem which you made in part II.

\*\*\*Benchmark Alert: Remember that one of the benchmark assignments for the course. The school-wide goal "Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems." Will be met if you and your lab partner are able to clearly document a procedure to test the problem you set out to investigate. \*\*\*

<b>Exceeds Expectations</b> 15/15-12/15 pts	The student will independently write a detailed, well organized, controlled, reproducible procedure to solve the problem stated in the lab. (For example, How do different activities affect the heart rate of an individual? or <b>What variables affect an individual's reaction time?</b> )
<b>Meets Expectations</b> 11/15-9/15 pts	With minimal assistance the student will write a fairly well organized controlled reproducible procedure to solve the problem stated in the lab.
<b>Meets Some Expectations</b> 8/15-6/15 pts	With some assistance the student will write a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow but it contains a control.
<b>Does Not Meet Expectations</b> 5/15-0/15 pts	With a great deal of assistance the student writes a procedure to solve the problem stated in the lab. The procedure is not well organized, is confusing to follow and does not contain a control.

Reflexes and Reaction Time / Heart Rate Blood Pressure Inquiry Lab  
Grading Rubric (65 points total)

Possible Points	Your response for maximum points
10 points	Lab report completed on time and neat. Late labs lose ten points per day. Lab due: _____
5 points	Appropriate <u>title</u> and <u>headings</u> (parts I-VI) (all underlined) Include name and date.
10 points	Clearly stated <u>problem</u> . What was the lab designed to test or measure? Does it consider both reflexes and reaction time?
15 points	Clearly written or outlined <u>procedure</u> and list of <u>materials</u> . Are Both reflexes and reaction time tested? Or Are both heart rate and blood pressure? * *Benchmark alert* *
10 points	Clear presentation of the results, including <u>tables</u> and a <u>graph</u> to display reaction time vs. your independent variable.
10 points	Clearly stated <u>conclusions</u> about your data and how it related to the problem.
5 points	Sharing experimental design and data with the class.

If the graph of reaction time vs. the independent variable is produced using excel you will receive 3 bonus points.

Comments:

Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Lab Partners: \_\_\_\_\_

### **Inquiry Lab: What factors affect blood pressure and heart rate? Lab Activity**

Did you ever run so hard you could feel your pulse beating in your ears? Have you ever gotten up too quickly from the couch and felt dizzy or light-headed? Have you ever felt your heart rate quicken before a big test or competition?

Your assignment is to design an experiment to test the effect of one of the factors we discussed in class on blood pressure and heart rate. In order to measure heart rate, you will choose a pulse point on your body and count the number of heartbeats you feel in one minute. In order to measure blood pressure, you will use sphygmomanometer, stethoscope, and technique we practiced in class. Before you begin, formulate a hypothesis to predict what effect your chosen factor will have on blood pressure and heart rate.

#### **Guidelines to follow:**

- Follow all safety rules.
- Let me check your procedure and hypothesis before you begin your experiment.
- Please inform me of any health concerns.
- You will be working in groups of four. Two students should first test the effect of your chosen factor on blood pressure while the other two students test the effect on heart rate. Then switch tests. Each group member should have the opportunity to be the subject and the tester for both blood pressure and heart rate.
- Be sure to record all data (you should have data for 4 people, including yourself).
- And remember, an accurate and reliable experiment is one that has been repeated at least three times.

#### **Materials**

Stop watch  
 Sphygmomanometer  
 Stethoscope  
 Pencil

**You will be writing a formal lab report for this lab. Your lab report should follow the format given at the beginning of the year. Include the following analysis questions in your lab report:**

5. Would there be a difference in blood pressure and heart rate if you stood on top of a table or sat down on the floor?
6. Compare the blood pressure and heart rate results. Are there any similarities or differences in the changes?
7. Why is high blood pressure a health concern?
8. Research and explain why smoking causes a rise in blood pressure.

### Course Description

HIGH SCHOOL		
1. Course Title <b>Principles of Ecology</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Princ of Ecology</b>		
3. Transcript Course Code/Number <b>00375</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 11 – 12      Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input checked="" type="checkbox"/> .75 (trimester+30days) <input type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____(date)	
10. Pre-Requisites Successful completion of Biological Systems or Biology - Honors		
11. Brief Course Description Ecology is defined as the relationship of organisms to their environment. Emphasis in this course is placed on the study of ecosystems, which are communities of living organisms and their non-living environments functioning together. The laboratory exercises will take place in the environmental study areas located on the school grounds, at Bauer Farm and at Hammonasset Beach State Park. Two research projects are required of each student in this course.		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocols. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently. <b>6. Demonstrate respect for one's self, and strive to contribute to the success of others.</b>		



## 13. Course Outline

**Chapter****Topics****How the Biosphere Supports and maintains Life**

- 1 A. Lithosphere, Hydrosphere, Atmosphere and Biosphere.  
B. Gaia hypothesis as it relates to A.

- 3 A. Changes in the environment.  
B. Needs of organisms.  
C. Species, populations and communities.

**Components and Functions of Ecosystems**

- 4 A. Roles of living organisms in the ecosystem.  
B. Ecosystem structure  
C. Energy flow in the ecosystem  
D. Chemical cycles

**Interactions and Adaptations Between Organisms and the Environment**

- 5 A. Habitats and niches  
B. Evolution and adaptation  
C. Populations and their limiting factors

- 6 A. Relationships among organisms  
B. Ecological succession  
C. Land biomes

**Forest and Aquatic Ecosystems**

- 9 A. Coniferous forests  
B. Deciduous forests  
C. Tropical rain forests

- 10 A. Aquatic biomes  
B. Standing water Ecosystems  
C. Flowing water Ecosystems

- 20/21 A. Uses for water  
B. Water treatment  
C. Types of water pollution

## 14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response Cards by TurningTechnologies
- Web-based instruction with Blackboard/finalsite
- Research

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

Benchmark Assignments/Assessments:

- Projects and Presentations on research topics of the student's choosing
- Use effective strategies for gathering information, critical thinking and problem solving
- Weekly reports on readings in environmental science topics from newspaper, magazine and Internet sources
- Use technology effectively and responsibly.



<p><b>LEARNING STRAND</b>  <b>Core Scientific Inquiry, Literacy, and Numeracy</b>  <i>CT Standard: Scientific knowledge is created and communicated.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>Why is it essential to assess the validity of the <b>experiment's design and the credibility of</b> scientific claims in different sources of information?</li> <li>How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</li> <li>Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>Apply both precision and accuracy in recording experimental data.</li> <li>Develop logical conclusions that are based on the analysis of experimental data.</li> <li>Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Environmental Science: Ecology &amp; Human Impact</u> by Bernstein, Winkler, Zierdt-Warshaw Addison Wesley, 1996</p> <ul style="list-style-type: none"> <li>Internet lessons from selected websites</li> <li>Bauer Farm field trips</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Modeling during lectured instruction</li> <li>Inquiry investigation</li> <li>Textbook ancillary materials</li> <li>PowerPoint presentations and notes</li> <li>Guided Internet research</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <p>Independent research project and presentation          *Benchmark*</p>

<b>LEARNING STRAND</b> <b>How the Biosphere Supports and Maintains Life</b> <i>Content Standard: Earth Science-(Biogeochemical Cycles) Each element on Earth moves among reservoirs which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.</i> <i>Content Standard: Earth Science-(Structure and Composition of the Atmosphere) Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The biosphere is subdivided into lithosphere, atmosphere and hydrosphere.</li> <li>▪ The biosphere accounts for only a narrow layer of the entire planet which is capable of supporting life.</li> <li>▪ Parts of the biosphere interact with one another and with living organisms.</li> <li>▪ Living organisms, through their activities, can have a profound effect on the biosphere.</li> <li>▪ The parts of the biosphere undergo change on both short term and long term schedules.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What three conditions, unique to planet Earth, are required to support living organisms?</li> <li>▪ How are the three rock types formed?</li> <li>▪ Where would you find examples of each rock type in the local area?</li> <li>▪ Why is fresh water such a precious commodity?</li> <li>▪ Which layer of the atmosphere is capable of sustaining life and what conditions prevail there?</li> <li>▪ What conditions exist in the hydrosphere that limit the depth to which most living organisms can penetrate?</li> <li>▪ How do volcanic activities modify climate?</li> <li>▪ How does El Nino impact both human activities and ecosystems in the Pacific basin and elsewhere?</li> <li>▪ How has glacial activity modified our local landscape?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Account for the physical conditions necessary to support life.</li> <li>▪ Describe the nature of the lithosphere.</li> <li>▪ Describe changes that occur in the lithosphere over time.</li> <li>▪ Describe the nature of the atmosphere.</li> <li>▪ Describe changes that occur in the atmosphere over time.</li> <li>▪ Describe the nature of the hydrosphere.</li> <li>▪ Describe changes that occur in the hydrosphere over time.</li> <li>▪ Describe the Gaia hypothesis and explain how it accounts for the interaction between living things and the biosphere.</li> <li>▪ Find examples of the three rock types in the local area.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Environmental Science: Ecology and Human Impact</u> Addison Wesley, 1996 2 <sup>nd</sup> Edition <ul style="list-style-type: none"> <li>▪ Textbook ancillary materials, chapters 1 and 3</li> <li>▪ PowerPoint presentations, "The Biosphere" and "Changes in the Biosphere"</li> <li>▪ Audio Visual materials: The Biosphere (LMC and Science department)</li> <li>▪ Field Guides to the Birds</li> <li>▪ Laboratory space and materials</li> <li>▪ Outdoor field study area</li> <li>▪ Lap top computers with Internet connection</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ "Changes in the Atmosphere" lab</li> <li>▪ "Geographic range" activity</li> <li>▪ Power point presentations: "The Biosphere" and "Changes in the Biosphere"</li> <li>▪ "New Frontiers" DVD</li> <li>▪ Modeling during lecture demonstrations</li> <li>▪ Teacher-lead discussion of the Gaia hypothesis and its controversial aspects</li> <li>▪ Worksheets/Study Guides for chapters 1 and 3</li> <li>▪ "El Nino" unit: selected readings and videos</li> <li>▪ Weekly report on environmental science topic *Benchmark*</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Unit tests, chapters 1 and 3</li> <li>▪ Lab reports</li> <li>▪ Homework assessment and review</li> <li>▪ Worksheets or response papers to videos/DVDs</li> <li>▪ Critique of "Weekly report"</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Components and Functions of Ecosystems</b>  <i>Content Standard: Enrichment High School Biology (Ecology) Stability in an ecosystem is a balance between competing effects.</i>  <i>Content Standard: Enrichment High School Earth Science (Biogeochemical Cycles) Each element on Earth moves among reservoirs which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Ecosystems are composed of producers, consumers, decomposers and the environment which supports them.</li> <li>All living things exist at one or more trophic levels within a food web.</li> <li>Energy flows through an ecosystem; much of it is dissipated though the activity of organisms or lost as heat.</li> <li>Nutrients, such as water, move through the carbon, nitrogen and phosphorus cycles among/between organisms and the environment on short or long term schedules.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>Why do ecologists confine their studies to a limited area such as a quadrant?</li> <li>Why are there so few tertiary consumers?</li> <li>What essential role can only be performed by bacteria and fungi?</li> <li>Why did the Osprey become a threatened species, and how have human efforts lead to its recovery?</li> <li>What essential activity of the nitrogen cycle is <b>performed by the "nitrogen-fixing" bacteria <i>Rhizopus</i></b>?</li> <li>How can the rising human population be fed efficiently without an increase in arable land?</li> <li>Why do human activities in the tundra, as compared to the rain forest, have a more drastic and immediate impact on the ecosystem?</li> <li>How has the New England hardwood forest been impacted by human activity and what new concerns for its continued health and productivity do we face today?</li> <li>Why does a young forest have a preponderance of understory trees, while a mature forest has more canopy trees?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>Identify and give examples of the levels of organization including population, community, ecosystem and biome.</li> <li>Describe how the connections in a food web determine both the complexity and stability of the ecosystem.</li> <li><b>Explain the "10% Rule" using an energy pyramid.</b></li> <li>Explain biological magnification of a toxin in an ecosystem and relate it to the energy pyramid.</li> <li>Describe the movement of nutrients through the Nitrogen, Carbon and Phosphorus cycles.</li> <li>Describe the role of producer, consumer and decomposer in the capture and transfer of nutrients and energy through an ecosystem.</li> <li>Compare and contrast variations in temperature and precipitation among the major terrestrial biomes.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <ul style="list-style-type: none"> <li><u>Environmental Science, Ecology and Human Impact</u> Addison-Wesley, 1996 2<sup>nd</sup> edition</li> <li>Textbook ancillary materials, chapter 4</li> <li>Audio Visual materials on components and functions of ecosystems (LMC and Science department)</li> <li>Laboratory space and materials</li> <li>Outdoor study area</li> <li>Lap top computers with Internet connection</li> <li>Poster board, construction paper and assorted classroom materials</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>Modeling during lecture demonstrations</li> <li>Students will research a specific biome and present a poster board or power point to the class.</li> <li><b>"Biological Magnification" lab</b></li> <li><b>"Forest Succession" lab</b></li> <li><b>Bauer Farm field trip: "Transect Study"</b></li> <li><b>Bauer Farm field trip: "Study Area Comparison, Field and Forest"</b></li> <li>Worksheets/Study Guide for chapter 4</li> <li>Carbon cycle and Nitrogen cycle videos</li> </ul>

	<ul style="list-style-type: none"> <li>▪ "Predators" DVD</li> <li>▪ Weekly report on environmental science topic *Benchmark*</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Unit test, chapter 4</li> <li>▪ Lab reports</li> <li>▪ Homework assessment and review</li> <li>▪ Worksheets or response papers to videos/DVDs</li> <li>▪ Review of and response to Bauer farm field trips</li> <li>▪ <b>Group "Biome" research and presentation</b></li> <li>▪ Assessment evaluated with rubric</li> <li>▪ <b>Critique of "Weekly report"</b></li> </ul>

<p><b>LEARNING STRAND</b>  <b>Interactions and Adaptations Between Organisms and the Environment</b>  <i>Content Standard 10.5: Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.</i>  <i>Content Standard 10.6: Living organisms have the capacity of producing populations of unlimited size, but the environment can support only a limited number of individuals of each species.</i>  <i>Content Standard: Enrichment High School Biology (Ecology) Stability in an ecosystem is a balance between competing effects.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>Each species has a unique niche within an ecosystem.</li> <li>Species can evolve to adapt to changing niches.</li> <li>Introduction of new species can lead to ecosystem disruption and possible extinction of native species.</li> <li>Growth of populations is controlled by limiting factors.</li> <li>Ecosystems change over time as a result of disruption and renewal in a process called succession.</li> <li>Chaos theory proposes the notion that relatively small changes can have large consequences due to the interconnectedness of organisms and their environment.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>Why do organisms rarely occupy their fundamental niche in natural ecosystems?</li> <li>How do several species of sandpiper manage to co-exist on the same mudflat?</li> <li>What evidence have you seen that Russian olive, Multiflora rose and Oriental bittersweet are in fact "invasive" species?</li> <li>Why does prey population change tend to precede a change in the population of its predator?</li> <li>What effect does the loss of a keystone predator have on the balance of species in an ecosystem?</li> <li>What changes will occur at Bauer farm if it is not mowed twice a year?</li> <li>Why would a devastating hurricane have similar effects on a thousand acre forest and on the trees in your backyard?</li> <li>Why do human populations worldwide seem to be growing exponentially, and what consequences do you see within your lifetime?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will ...</i></p> <ul style="list-style-type: none"> <li>Distinguish between the fundamental niche and the realized niche of an organism.</li> <li>Explain how closely related species can avoid direct competition with one another.</li> <li>Explain the concept of convergent evolution as a response to a similar niche of two unrelated species.</li> <li>Account for the unprecedented success of an "invasive" plant or animal species in our local environment.</li> <li>Describe the difference between density-dependent and density-independent limiting factors.</li> <li>Distinguish between primary and secondary succession in terrestrial communities.</li> <li>Explain the process of aquatic succession.</li> <li>Relate an account of a small change in an ecosystem that has had grand consequences in the long term.</li> <li>Describe the stage of succession for a local pond, such as Horse Pond or the Bauer farm ponds.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Environmental Science: Ecology and Human Impact</u>  Addison Wesley, 1996</p> <ul style="list-style-type: none"> <li>Textbook, ancillary materials, chapters 5 and 6</li> <li>Audio Visual materials on interactions and adaptations between organisms and the environment (LMC and Science department)</li> <li>Laboratory space and materials</li> <li>Outdoor study area</li> <li>Lap top computers with Internet connection</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>"Invasive Species" lab</li> <li>Bauer Farm field trip: "Old Field Succession"</li> <li>Bauer Farm field trip: "Invasive Species Survey"</li> <li>"Predator/Prey" lab</li> <li>"Estimating Population Size" lab</li> <li>Worksheets/Study Guide for chapter 5 and 6</li> <li>"Estuaries" video</li> <li>"Succession" video</li> <li>"Invaders" DVD</li> <li>Weekly report on environmental science topic  * <b>Benchmark</b> *</li> </ul>



	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"><li>▪ Unit tests, chapters 5 and 6</li><li>▪ Lab reports</li><li>▪ Homework assessment and review</li><li>▪ Worksheets or response papers to videos/DVDs</li><li>▪ Review of and response to Bauer farm field trips</li><li>▪ <b>Critique of "Weekly report"</b></li></ul>
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<p><b>LEARNING STRAND</b>  <b>Forest and Aquatic Ecosystems</b>  <i>Content Standard: Enrichment High School Biology (Ecology) Stability in an ecosystem is a balance between competing effects.</i>  <i>Content Standard: Enrichment High School Earth Science (Energy in the Earth System) Climate is the long-term average of a region's weather and depends on many factors.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Every ecosystem has a unique combination of organisms.</li> <li>▪ Variations between ecosystems are largely influenced by differences in temperature, precipitation and light availability.</li> <li>▪ Dominant ecosystems in our locale include deciduous forest, freshwater, estuarine and salt water.</li> <li>▪ Worldwide, forests are the most productive terrestrial biomes.</li> <li>▪ Though similar in many ways, standing and flowing freshwater systems contain unique communities of organisms due to physical differences.</li> <li>▪ Soils can vary by texture and nutrient content among terrestrial ecosystems.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ Why are conifer forest food webs relatively simple and unstable as compared to other forest types?</li> <li>▪ How does soil texture influence soil moisture?</li> <li>▪ Why is dissolved oxygen content higher in a stream than in a pond?</li> <li>▪ Why is a pond food web more complex than a stream food web?</li> <li>▪ How do seasonal climate changes influence the physical and biological parameters of a pond?</li> <li>▪ What factors influence the species composition of the deciduous forest in our area?</li> <li>▪ Which soil nutrients are most important for plant growth? Why?</li> <li>▪ Why are temperature and dissolved oxygen such important physical parameters in aquatic systems?</li> <li>▪ How do nitrate and phosphate levels influence plant growth?</li> <li>▪ How does turbidity affect productivity in ponds?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Distinguish among conifer, deciduous and tropical rain forest with regard to climatic limiting factors.</li> <li>▪ Compare the complexity of the food webs and biodiversity for the three forest biomes.</li> <li>▪ Perform tests for soil pH, nutrient content and texture and explain the significance of the results.</li> <li>▪ Participate in a Grapsid crab census and describe limiting factors that influence crab populations.</li> <li>▪ Collect biological, chemical and physical data for pond and stream, and describe the important differences between the two systems.</li> <li>▪ Describe threats to forests worldwide, including logging, pollution, soil erosion and nutrient depletion.</li> <li>▪ Collect biological and physical data in a forest, and describe the significance of the data with regard to forestry techniques.</li> <li>▪ Construct an aquatic organism food web based on collections made by the class in local streams/ponds.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Environmental Science: Ecology and Human Impact</u>  Addison Wesley, 1996</p> <ul style="list-style-type: none"> <li>▪ Textbook ancillary materials, chapters 9 &amp; 10</li> <li>▪ Audio Visual materials on forest and aquatic ecosystems (LMC and Science department)</li> <li>▪ Laboratory space and materials</li> <li>▪ Outdoor study area</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeling during lecture demonstrations</li> <li>▪ <b>Bauer Farm field trip: "Stream Study"</b></li> <li>▪ <b>Bauer Farm field trip: "Pond Study"</b></li> <li>▪ <b>"Soil Nutrients/Texture" lab</b></li> <li>▪ <b>Hammonasset field trips: "Rocky Shoreline, Seining the Shallows, Willard's Island Discovery Hike"</b></li> <li>▪ Worksheets/Study Guide for chapter 9 and 10</li> <li>▪ <b>"Deciduous Forests" DVD</b></li> <li>▪ <b>"Troubled Waters" DVD</b></li> <li>▪ <b>"Dangerous Catch" DVD</b></li> <li>▪ <b>"Dirty Secrets" DVD</b></li> <li>▪ <b>"Fresh Water" video</b></li> <li>▪ Weekly report on environmental science topic</li> <li>▪ <b>*Benchmark*</b></li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Unit tests, chapters 9 and 10</li> <li>▪ Lab reports</li> <li>▪ Homework assessment and review</li> </ul>

- Worksheets or response papers to videos/DVDs
- Review of and response to Bauer Farm field trips
- Review of and response to Hammonasset field trips
- **Critique of "Weekly report"**

## Ecology Scoring Rubric

### **Applies effective and efficient strategies for gathering information and materials, thinking critically, and solving problems.**

<b>Exceeds Expectations</b>	The student independently chooses a research topic, and collects, interprets, analyzes, and evaluates a variety of information and data to make original predictions or solve problems. S/he solves problems accurately and efficiently and presents her/his findings in a coherent manner.
<b>Meets Expectations</b>	The student independently chooses a research topic, and collects, interprets, analyzes, and evaluates a variety of information and data to make specific predictions or solve problems. S/he solves problems with few errors and presents her/his findings in a coherent manner.
<b>Meets Some Expectations</b>	The student may need some assistance in choosing a research topic, and in collecting and interpreting a variety of data to make general predictions or solve problems. S/he solves problems with some errors and presents her/his findings in a coherent manner.
<b>Does Not Meet Expectations</b>	The student needs assistance in choosing a research topic and in gathering information to make a prediction or solve problems. S/he solves problems inefficiently and with significant errors and fails to present her/his findings in a coherent manner.

### **Uses technology effectively and responsibly.**

<b>Exceeds Expectations</b>	The student can independently select and use appropriate internet sources to solve problems efficiently and creatively, including summary of and reaction to environment-related articles.
<b>Meets Expectations</b>	The student can select and use appropriate internet sources to solve problems effectively without making significant errors, including summary of and reaction to environment-related articles.
<b>Meets Some Expectations</b>	The student can select and use appropriate internet sources to solve problems but makes some errors and requires some assistance, including summary of and reaction to environment-related articles.
<b>Does Not Meet Expectations</b>	The student cannot select and use appropriate internet sources to solve problems without making many significant errors and requiring supervision; student fails to summarize and react to environment-related articles.

## WEEKLY ARTICLE

### **PURPOSE:**

- Every week you will have the opportunity to read an article that pertains to some aspect of this course. The goal is to make you more aware of career opportunities, interesting discoveries and issues of importance. I hope that your interest will continue long after you have completed this course.

### **METHODS:**

- Each Friday, at the start of class, you will hand in a 1 to 2 page review of an article from a magazine, newspaper or internet website.
- The accumulated reviews will be worth 10% of your trimester grade.
- There will be 10 reviews due each trimester.
- If you are absent on Friday, your review is due the day after you return to class.
- Include the following information:
  1. Name of magazine, newspaper or website.
  2. Date of the issue.
  3. **Author's name.**
  4. Title of article.
  5. Copy of any internet article.

## RESEARCH PROJECT IN ECOLOGY

### **PURPOSE:**

This project is intended to give you practical experience in research, experimental design, and completion of a hands-on scientific inquiry.

### **PROCEDURE:**

You will work **alone or in a group of two**. Your project should examine a specific problem in a natural ecosystem. It should not simply be a research paper nor should it be an experiment that is carried out in a laboratory situation.

### **MATERIALS:**

Often, the best projects are those that require a minimum of equipment. You will be allowed to borrow equipment from this classroom as needed. Some of the things available include microscopes, nets, plant press, tree sampling tools, water sampling kits, soil sampling kits, weather instruments, identification guides, and other books that can provide useful background information.

### **TIMETABLE:**

**Phase 1:** Due date: \_\_\_\_\_.

- A. We will use at least **one class period doing library research** to help you determine what topic you will study.
- B. You will write an **outline or short report of at least 2 pages**.
- C. This document will include a statement of the **problem**, a discussion of your **procedure**, and a list of all the **materials** you will use to carry out the project.
- D. You must **discuss your project with me** before this phase is due.

**Phase 2:** Due date: \_\_\_\_\_.

- A. This will be an **update of your project** and should include a presentation of the work you have done. This can be written, video, photographs or slides, specimens of plants, animals, soils, or any other information that shows me your fieldwork.
- B. You should include a **bibliography of references** that you have used.
- C. You are encouraged to **discuss with me any problems** that you are having well before this phase is due.

**Phase 3:** Due date: \_\_\_\_\_.

- A. The **completed project will be presented to the entire class** at this time.
- B. You may **use notes during your presentation**.

- C. The project can be presented as a **Power Point presentation, paper, video, poster, collection of organisms, photo or 35 mm slide essay, or any other appropriate form.**
- D. Your grade will be based on **60% content/ 40% presentation.**
- E. The 3 phases combined will total **35% (5%+5%+25%) of your trimester grade.**

### **SUGGESTED TOPICS:**

- Owl pellet study
- Study of the Beaver impact on Coan Pond, Rockland Preserve, Route 79.
- Migration Study: Hawk, Monarch, Green Darner
- Bird population census (Waterfowl, Gulls, Hawks, Swans, etc.)
- Stream invertebrate study (Fast water vs. Slow water)
- Invasive plant eradication project (Bittersweet, Japanese barberry, Purple loostrife, Phragmites)
- Invasive plant mapping project (BAUER FARM)
- Tree cavity survey
- Vernal pool mapping/Amphibian survey (DHHS PROPERTY)
- Live trapping study
- Rocky shoreline mapping
- Tree sampling project (DHHS PROPERTY)
- Bluebird trail maintenance (BAUER FARM or LAND TRUST PROPERTY)
- Bird feeder comparative study
- Pond community comparative study (BAUER FARM)
- Flying or crawling insect population study (Butterflies, beetles, bugs)
- Wildflower identification (Collect and photograph)

These are simply a few ideas that have worked in the past for other students. **By no means should you limit yourself to these choices.** In fact, it would be better if you devised your own plan, something that hasn't been done before. Please discuss your ideas with me in order to help you formulate your plan.

## ECOLOGY PROJECT

### GRADING CRITERIA

The final project in Ecology will be graded based on the following criteria:

**SCIENTIFIC ACCURACY**- Use of common names or scientific names. Use of metric or English units of measurement. Consistency in your observations 10 POINTS

**METHODS USED**- A full and accurate description of your field techniques, the equipment that you used, and any guides to identification that you used. Make it a "Show and Tell" presentation. 10 POINTS

**DATA COLLECTED AND PRESENTED**- Your data or information should be presented in a clear and coherent manner. Your data should be easily understood. 20 POINTS

**CONCLUSION**- Your conclusion should be based on the data that you have presented and should reflect some understanding of ecosystems and how they function. 20 POINTS

**ORAL PRESENTATION**- See attached sheet for details. 40 POINTS

**TOTAL** 100 POINTS



**ECOLOGY PROJECT SUMMARY**

Name \_\_\_\_\_

Name \_\_\_\_\_

Name \_\_\_\_\_

Please summarize who completed which aspects of your project. Thank you.

**ECOLOGY FINAL PROJECT**

**NAME** \_\_\_\_\_

<b>Category</b>	<b>Possible Points</b>	<b>Your Points</b>		
Scientific Accuracy	10			
Methods Used	10			
Data Collected/Presented	20			
Conclusions	20			
Oral Presentation	40			
<b>TOTAL</b>	<b>100</b>			

**ORAL PRESENTATION**

<b>Category</b>	<b>Possible Points</b>	<b>Your Points</b>		
1. Speaker can be heard by everyone.	<b>5</b>			
2. Presentation is well organized.	<b>5</b>			
3. Presentation is appropriate length. (10 minutes)	<b>5</b>			
4. Presentation is creative and interesting, with visual component.	<b>15</b>			
5. Speaker responds well to questions.	<b>10</b>			
<b>TOTAL</b>	<b>40</b>			



### Course Description

HIGH SCHOOL		
1. Course Title <b>Marine Science and Technology</b>	5. Subject Area <input type="checkbox"/> English <input type="checkbox"/> Mathematics <input checked="" type="checkbox"/> Science <input type="checkbox"/> Social Studies <input type="checkbox"/> World Language <input type="checkbox"/> Career & Tech Ed	<input type="checkbox"/> Visual Art <input type="checkbox"/> Music <input type="checkbox"/> Physical Education <input type="checkbox"/> Health Education <input type="checkbox"/> Special Education <input type="checkbox"/> Library Media
2. Transcript Title/Abbreviation <b>Marine Science &amp; Tech</b>		
3. Transcript Course Code/Number <b>00379</b>		
4. Program Contact Information  Name: Paul Mezick  Title/Position: Department Chair, Science  School: Daniel Hand High School 286 Green Hill Road Madison, CT 06443	6. Grade: 11 – 12      Level: 2  7. Seeking "Honors" Distinction? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No  8. Unit Value <input type="checkbox"/> .25 (30 days) <input type="checkbox"/> 0.5 (trimester equivalent) <input type="checkbox"/> .75 (trimester + 30days) <input checked="" type="checkbox"/> 1.0 (two trimester equivalent) <input type="checkbox"/> 1.5 (three trimester equivalent) <input type="checkbox"/> Other: _____  9. Approval <input checked="" type="checkbox"/> BOE Approved <input type="checkbox"/> Anticipated Approval _____ (date)	
10. Pre-Requisites Successful completion of Biological Systems or Biology-Honors or a B or better in General Biology		
11. Brief Course Description Marine science and technology explores the marine environment, examines the chemical, biological and geological properties of the sea as well as all stages of aquaculture based careers from boatbuilding and trapping to farming and maintenance of organisms. Boat construction, fishing rod building, physical, chemical, and ecosystem studies related to oceanography <b>will be part of this "hands on" course. Select</b> field trips will support the curriculum and provide school to career practical experience. Many forms of coastal ecology will also be explored including, water chemistry, rocky shore, sandy shore, estuaries and pelagic zones. In addition students who excel in this field will have an opportunity to intern in marine <b>related careers. Interdisciplinary projects will also be incorporated to widen the student's understanding</b> of maritime based careers and life.		
12. Course Goals 1. Apply effective and efficient strategies for gathering information and materials, thinking critically and solving problems. 2. Conduct lab experiments safely using appropriate scientific protocol. 3. Use technology effectively and responsibly. 4. Demonstrate proficiency and fluency in reading and writing to meet the literacy demands of the global community. 5. Demonstrate the ability complete assignments independently. <b>6. Demonstrate respect for one's self, and strive to contribute to the success of others</b>		

## 13. Course Outline

<b>Group Unit</b>	<b>Science</b>	<b>Tech Ed</b>	<b>Field Trips</b>
Marine Biology And Sampling Equipment	Marine Biology <ul style="list-style-type: none"> <li>Life in the Ocean</li> <li>Evolution in the marine environment</li> <li>Field Study Sampling Techniques</li> <li>Lab Report Writing</li> </ul>	Marine Sampling Equipment <ul style="list-style-type: none"> <li>Nets</li> <li>Traps</li> <li>Lures</li> </ul>	Hammonasset <ul style="list-style-type: none"> <li>Sandy Beach Study</li> <li>Marine Sampling Equipment Overview</li> </ul>
Ocean Life	Ocean Life Zones <ul style="list-style-type: none"> <li>Pelagic zones</li> <li>Benthic Zones</li> <li>Near shore</li> <li>Intertidal</li> </ul>	Fishing Rod Science <ul style="list-style-type: none"> <li>Modulus of elasticity</li> <li>Materials</li> <li>Evolution of the fishing rod</li> </ul>	Hammonasset <ul style="list-style-type: none"> <li>Marsh Study</li> </ul>
Ecosystems	Long Island Sound Ecosystems <ul style="list-style-type: none"> <li>Sandy Beach</li> <li>Rocky Shore</li> <li>Salt Marsh</li> </ul>	Fishing Rod Building <ul style="list-style-type: none"> <li>Parts ID</li> <li>Tools</li> <li>Fishing Rod Construction</li> </ul>	Hammonasset <ul style="list-style-type: none"> <li>Rocky Shore / Gaspid Crab Study</li> </ul>
Marine Related Technology	Environmental Awareness projects Marine nomenclature	Hands-on Projects Watercraft repair and maintenance	
Water Quality	Chemistry <ul style="list-style-type: none"> <li>Water Molecule</li> <li>Salt Water</li> <li>Salinity</li> <li>Density</li> <li>Temperature</li> </ul>	Boating Technology <ul style="list-style-type: none"> <li>Marine Propulsion</li> <li>Outboard Mechanics</li> <li>Construction Materials</li> <li>Fuel as a resource</li> <li>Ethanol vs. Gasoline</li> </ul>	Fence Creek <ul style="list-style-type: none"> <li>Water Testing</li> </ul>
Marine History	<ul style="list-style-type: none"> <li>Ancient Ideas</li> <li>Modern Theories</li> <li>Expeditions</li> <li>Technology</li> </ul>	<ul style="list-style-type: none"> <li>Local History</li> <li>Recreational/ Commercial Fishing</li> <li>Boating</li> <li>Earl Brockway</li> <li>Coastal Indian Fishing Technology</li> </ul>	West Wharf <ul style="list-style-type: none"> <li>Clam Seeding</li> <li>Boat Building</li> </ul>
Geology of Long Island Sound and Connecticut	Geology <ul style="list-style-type: none"> <li>Hutton to Plate Tectonics</li> <li>Oceans and Basins</li> <li>Geology of Atlantic</li> <li>Geology of LIS</li> <li>Coastlines and reefs</li> </ul>	Safe Boating <ul style="list-style-type: none"> <li>Navigation</li> <li>CT Boating Safety</li> </ul>	Hammonasset <ul style="list-style-type: none"> <li>Moraine Trail</li> <li>Seal Watch</li> </ul>
Classification	Classification <ul style="list-style-type: none"> <li>Bacteria and Protista</li> <li>Cnidarians, worms and mollusks</li> <li>Mammal groups</li> <li>Fish <ul style="list-style-type: none"> <li>-Cartilaginous</li> <li>-Boney</li> </ul> </li> </ul>	Marine Sampling Equipment Projects <ul style="list-style-type: none"> <li>Lobster Pots</li> <li>Crab Traps</li> <li>Boat Building</li> <li>Fish Ladders</li> </ul>	Seaview Beach <ul style="list-style-type: none"> <li>Steamer Clam Field Study</li> </ul>

## 14. Instructional Methods and/or Strategies

- Modeled instruction
- PowerPoint presentations and notes
- Laboratory investigations
- Teacher demonstrations
- Cooperative grouping
- Audio Visual presentations
- Response Cards by TurningTechnologies
- Web-based instruction with Blackboard/finalsite
- Research

## 15. Assessment Methods and/or Tools

- Formative quizzes
- Summative unit assessments
- Final examination
- Lab reports
- Assessments evaluated with rubrics
- Benchmark assessments
- Video response summaries
- Response Cards by TurningTechnologies
- Research projects

## 16. Assessment Criteria

Assessments are based on the Madison Curriculum and Connecticut standards and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assignments are graded using a *common* scoring rubric or grading criteria.

<b>LEARNING STRAND</b> <b>Core Scientific Inquiry, Literacy, and Numeracy</b> <i>CT Standard: Scientific knowledge is created and communicated.</i> <i>Note: This learning strand should be taught through the integration of the other learning strands. This learning strand is not meant to be taught in isolation as a separate unit.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Scientific inquiry is a thoughtful and coordinated attempt, through a continuous process of questioning, data collection, analysis and interpretation, to describe, explain, and predict natural phenomena.</li> <li>▪ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.</li> <li>▪ Scientific literacy includes the ability to read, write, discuss, and present coherent ideas about science.</li> <li>▪ Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.</li> <li>▪ Scientific numeracy includes the ability to use universal mathematical operations and procedures to calculate, analyze and present scientific data and ideas.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment?</li> <li>▪ How do you design and conduct appropriate types of controlled scientific investigations, using the appropriate tools and techniques, to make observations and gather data to answer various questions?</li> <li>▪ How do you assess the data, using mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms?</li> <li>▪ Why is it essential to assess the validity of the <b>experiment's design and the</b> credibility of scientific claims in different sources of information?</li> <li>▪ How do you communicate your findings, using relevant scientific vocabulary and clear logic, which are based on the results generated during the experiment?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ <b>Formulate a testable hypothesis, in the "If..., then..." format, which is logically connected to the problem.</b></li> <li>▪ Design a controlled experiment where the independent and dependent variables are accurately identified.</li> <li>▪ Utilize instrument methodology that is appropriate for the design of the experiment.</li> <li>▪ Record data in the appropriate units of measure, and be able to convert between different units of measure.</li> <li>▪ Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats.</li> <li>▪ Apply both precision and accuracy in recording experimental data.</li> <li>▪ Develop logical conclusions that are based on the analysis of experimental data.</li> <li>▪ Formulate reports, using relevant vocabulary, supporting evidence, and logic that accurately communicate the results of a scientific experiment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u><a href="#">Introductory Oceanography</a></u> Thurman & Trujillo Pearson Education, 2004 <ul style="list-style-type: none"> <li>▪ Laboratory instrumentation</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided internet research</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Constructive feedback</li> <li>▪ Performance assessment</li> <li>▪ Projects and Presentations</li> <li>▪ Projects and reports evaluated with rubrics</li> <li>▪ Self-assessment</li> <li>▪ Tests</li> <li>▪ Writing assignments</li> <li>▪ Student Portfolio</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Marine Biology and Sampling Equipment</b>  <i>CT Standards: Biology - Ecology: Stability in an ecosystem is a balance between competing effects.</i>  <i>Technology Education Standards (2007):</i>  <i>D. 21 Apply organizational and time management skills to classroom and laboratory activities.</i>  <i>D. 22 Present information in a clear, concise and appropriate manner.</i>  <i>D. 23 Use research techniques to support design development.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The environment is a complex assemblage of interacting and evolving chemical, physical and biological processes.</li> <li>▪ The current state of the environment is maintained by the dynamic exchange of the processes that dictate its nature.</li> <li>▪ Changes in any of the interacting processes will impact the current state of the environment.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ How is appropriate sampling equipment chosen for use in conducting a field study?</li> <li>▪ Why are certain species only found in specific areas of Hammonasset State Park?</li> <li>▪ How is data collected and analyzed in a field study?</li> <li>▪ How is the environment changed by physical, chemical, and biological factors?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Learn to identify each of the main species found in Hammonasset State Park.</li> <li>▪ Use collection devices during field studies to gather data for lab analysis.</li> <li>▪ Explain how the environment is changed by physical, chemical, and biological factors.</li> <li>▪ Understand proper field study techniques and their role in studying the environment.</li> <li>▪ Write lab reports based on field studies to show relationships in the natural environment.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u><a href="#">Introductory Oceanography</a></u> Thurman &amp; Trujillo          Pearson Education, 2004</p> <ul style="list-style-type: none"> <li>▪ Field Study Equipment             <ul style="list-style-type: none"> <li>◦ Seine nets &amp; Cast nets</li> <li>◦ Collection Buckets</li> <li>◦ Specimen Trays</li> <li>◦ Clip Boards &amp; Data Sheets</li> <li>◦ Measuring devices</li> </ul> </li> </ul>
	<p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Field Study Trips</li> <li>▪ Marine Sampling Equipment Overview</li> <li>▪ Class Lecture</li> <li>▪ Modeling during lecture</li> <li>▪ Net overview and practice</li> <li>▪ Student research of marine environments through use of field guides and internet sources</li> <li>▪ Students prepare for field work and clean up</li> </ul>
	<p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Constructive feedback</li> <li>▪ Performance assessment</li> <li>▪ Projects and Presentation</li> <li>▪ Reports and projects evaluated with rubrics</li> <li>▪ Self-assessment</li> <li>▪ Tests</li> <li>▪ Writing assignments</li> <li>▪ Student Portfolio</li> </ul>



<b>LEARNING STRAND</b> <b>Ocean Life</b> <i>10.1 Fundamental life processes depend on the physical structure and chemical activities of the cell.</i> <i>10.5 evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.</i> <i>Biology - Ecology: Stability in an ecosystem is a balance between competing effects.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The environment is a complex assemblage of interacting and evolving chemical, physical and biological processes.</li> <li>▪ Estuaries are critical habitats that provide a nursery environment for many marine organisms.</li> <li>▪ Estuaries are highly productive, dynamic and diverse communities that serve as a buffer zone between land and the ocean.</li> <li>▪ Diversity of marine organisms in Long Island Sound is a tool for measuring the health of Long Island Sound.</li> <li>▪ Diversity of species in benthic communities depends on their ability to adapt to the environmental conditions of their environment.</li> <li>▪ Pelagic animals mostly live in the upper surface waters of the open ocean; these animals have special adaptations to help them stay near the surface where most of the food supply is found.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ How does the coastal ocean vary in terms of salinity, temperature, and currents?</li> <li>▪ How are estuaries created and what types exist?</li> <li>▪ Why are coastal wetlands important?</li> <li>▪ How are marine organisms able to stay above the ocean floor?</li> <li>▪ How are pelagic organisms adapted to living in the open ocean?</li> <li>▪ What are the different groups of pelagic organisms?</li> <li>▪ What types of organisms live in benthic environments?</li> <li>▪ What are the environmental conditions of the ocean floor?</li> <li>▪ What are the properties of different benthic communities?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Discover how the coastal ocean varies chemically and physically.</li> <li>▪ Describe how Long Island Sound was created.</li> <li>▪ Explain how a fish bladder works.</li> <li>▪ Explain the importance of an estuary for both living and nonliving elements.</li> <li>▪ Describe the types of organisms found in the pelagic environment.</li> <li>▪ Describe the types of organisms found in the benthic environment.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Introductory Oceanography</u> Thurman & Trujillo Pearson Education, 2004 <ul style="list-style-type: none"> <li>▪ Computer lab</li> <li>▪ Video selections</li> <li>▪ CT Sea Grant books</li> <li>▪ Long Island Sound study books</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided Internet research</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Constructive feedback</li> <li>▪ Performance assessment</li> <li>▪ Projects and Presentations</li> <li>▪ Reports and projects evaluated with rubrics</li> <li>▪ Self-assessment</li> <li>▪ Tests</li> <li>▪ Writing assignments</li> <li>▪ Student Portfolio</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Long Island Sound Ecosystems</b>  <i>CT Standards:</i>  10.5 Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.  10.6 living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.  Biology - Ecology: Stability in an ecosystem is a balance between competing effects.</p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ Plants and animals that live in the Rocky intertidal zone where land, air and sea converge, survive in diverse and dynamic conditions that are impacted by tides and waves.</li> <li>▪ Salt Marshes are highly productive, dynamic and diverse communities that serve as a buffer zone between land and the ocean.</li> <li>▪ Plants and animals that live in the sandy beach zone where land, air and sea converge, survive in diverse and dynamic conditions that are impacted by tides and waves.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ What kinds of organisms occur along rocky shores?</li> <li>▪ What types of organisms live along the sandy beach?</li> <li>▪ What types of organisms live in a salt marsh?</li> <li>▪ What are the environmental conditions found in each Long Island Sound ecosystem?</li> <li>▪ Why are salt marshes so important to Long Island Sound?</li> <li>▪ How are organisms adapted to live in each Long Island Sound ecosystem?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Perform a field study of each Long Island Sound ecosystem found at Hammonasset State Park.</li> <li>▪ Write a detailed lab report based on the findings at each ecosystem.</li> <li>▪ Identify organisms found in each ecosystem.</li> <li>▪ Describe the importance of the salt marsh.</li> <li>▪ Identify the environmental conditions necessary for each ecosystem found in Long Island Sound.</li> <li>▪ Explain how organisms are adapted to live in each ecosystem.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Introductory Oceanography</u> Thurman &amp; Trujillo  Pearson Education, 2004</p> <ul style="list-style-type: none"> <li>▪ Field study equipment</li> <li>▪ Water testing equipment</li> <li>▪ Data collection devices</li> <li>▪ Measuring devices</li> <li>▪ Identification books</li> <li>▪ Collection buckets</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided Internet research</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Constructive feedback</li> <li>▪ Performance assessment</li> <li>▪ Projects &amp; Presentations evaluated with rubrics</li> <li>▪ Self-assessment</li> <li>▪ Tests</li> <li>▪ Writing assignments</li> <li>▪ Student Portfolio</li> </ul>

<b>LEARNING STRAND</b> <b>Marine Related Technologies and Hands-on Projects</b> <i>Technology Education Standards (2007):</i> <i>D.16 Identify and explore career opportunities.</i> <i>D.17 Explain the need to be a lifelong learner.</i> <i>D.18 Exhibit and take responsibility for behaviors in both school and work situations.</i> <i>D.19 Define and demonstrate a personal work ethic.</i> <i>E.30 Fabricate a prototype to support the chosen design.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ The experience of using marine related sampling equipment can be applied to a range of career choices.</li> <li>▪ The participation in hands-on projects provides an opportunity for development of a personal work ethic.</li> <li>▪ Marine biologists use several types of marine related technologies to access and collect organisms and data in an aquatic environment.</li> <li>▪ Being able to understand maritime related nomenclature will assist students in understanding and operating in marine related career fields.</li> <li>▪ Environmental awareness projects provide opportunity for skill building and career field applications.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What types of sampling equipment are used to collect and study organisms?</li> <li>▪ What is the connection between safe boating practices and scientific collection of data and organisms?</li> <li>▪ How can the development of a personal work ethic and becoming a lifelong learner help when entering into a career?</li> <li>▪ How can hands-on projects provide an opportunity for students to exhibit and take responsibility for behaviors in both school and work situations?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Learn basic skills and practices related to building a fishing rod.</li> <li>▪ Learn basic skills and practices related to building a boat.</li> <li>▪ Gather various marine organisms using commercially produced and student-built collection equipment.</li> <li>▪ Identify parts of a boat and major safety related items dealing with water craft.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Introductory Oceanography</u> Thurman & Trujillo Pearson Education, 2004 <ul style="list-style-type: none"> <li>▪ Access to work shop area</li> <li>▪ Work Benches</li> <li>▪ Woodworking tools</li> <li>▪ Fishing rod building materials and supplies</li> <li>▪ Project Storage Areas</li> <li>▪ Connecticut Safe Boating Curriculum</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Fishing Rod building project</li> <li>▪ Boat building project</li> <li>▪ Crab/Lobster pot building activity</li> <li>▪ Environmental awareness projects</li> <li>▪ Boating technology</li> <li>▪ Watercraft repair and maintenance</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Connecticut Safe Boating curriculum assessments</li> <li>▪ Benchmark Fishing Rod building activity</li> <li>▪ Boat building activity</li> <li>▪ Teacher created quizzes, activities &amp; homework</li> </ul>

<p><b>LEARNING STRAND</b>  <b>Water Quality of Long Island Sound</b>  <i>CT Science Standards: Biology - Ecology: Stability in an ecosystem is a balance between competing effects.</i>  <i>Earth Science - Biogeochemical Cycles: Each element on Earth moves among reservoirs which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.</i>  <i>9.4 Atoms react with one another to form new molecules.</i>  <i>9.5 Due to its unique form carbon forms many organic and inorganic compounds.</i>  <i>9.8 The use of resources by human populations may affect the quality of the environment.</i></p>	
<p><b>ENDURING UNDERSTANDINGS</b></p> <ul style="list-style-type: none"> <li>▪ The water molecule has a bend in its geometry, with the two hydrogen atoms on the same side of the oxygen atom, which gives the water its polarity and ability to form hydrogen bonds.</li> <li>▪ Water can dissolve more substances than any other liquid, <b>hence its name “the universal solvent”</b>.</li> <li>▪ Salinity is the total amount of dissolved solid material in water.</li> <li>▪ <b>Salinity varies greatly in the world’s oceans and also in Long Island Sound.</b></li> <li>▪ The presence of dissolved gases in salt water is extremely important to the organisms living there.</li> <li>▪ Many factors affect the quality of water in Long Island Sound.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <ul style="list-style-type: none"> <li>▪ Why does water have such unusual chemical properties?</li> <li>▪ How salty is the ocean and Long Island Sound?</li> <li>▪ How are factors like Ph, salinity, nitrogen, dissolved oxygen, carbon dioxide, and fecal coliforms related to the overall health of Long Island Sound?</li> <li>▪ What is a salt wedge and how do salt wedges affect an estuary?</li> <li>▪ What is the quality of the water found here along the Madison shoreline?</li> </ul>
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Study the unique chemical and physical properties of water.</li> <li>▪ Measure the physical and chemical properties of the water found in Long Island Sound.</li> <li>▪ Write reports based on field study findings.</li> <li>▪ Use data to help local government make decisions for town activities such as shell fishing.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Introductory Oceanography</u> Thurman &amp; Trujillo  Pearson Education, 2004</p> <ul style="list-style-type: none"> <li>▪ LaMotte water testing kits</li> <li>▪ Dissolved oxygen meter</li> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided Internet research</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Field study at local shoreline sites.</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Constructive feedback</li> <li>▪ Performance assessment</li> <li>▪ Projects and Presentation</li> <li>▪ Reports and projects evaluated with rubrics</li> <li>▪ Self-assessment</li> <li>▪ Tests</li> <li>▪ Writing assignments</li> <li>▪ Student Portfolio</li> </ul>

<b>LEARNING STRAND</b> <b>Maritime History in Madison and Long Island Sound</b> <i>History Standards: 2.9-10.2 Locate events, peoples and places in time and place studied relative to their own location.</i> <i>Scientific Inquiry &amp; Scientific Literacy</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Madison, Connecticut is a town of 18,000 residents located on the Shore of Long Island Sound a 20 minute drive east of New Haven. Located on I- 95, it is easily accessible. Its area of 37 square miles is comprised of sandy beaches, lowland areas and hills in the northern part of town. Incorporated as separate town in 1826 it was originally part of the Town of Guilford.</li> <li>▪ West Wharf was a working wharf where fisherman dried their nets and kept their boats.</li> <li>▪ West Wharf was also a site for boat building. Madison Beach Hotel began as a boarding house for shipyard workers and evolved into a hotel for summer visitors.</li> <li>▪ The four principal oceans are the Pacific, Indian, Atlantic, and Artic Oceans.</li> <li>▪ Long Island Sound is an estuary that was created during the last ice age by glaciers.</li> <li>▪ Indians used the shoreline to gather clams and also used the shells for their currency.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What are the four principal oceans on planet Earth?</li> <li>▪ What is Long Island Sound?</li> <li>▪ When was Long Island Sound discovered?</li> <li>▪ How did the Indians use our local waters?</li> <li>▪ Where is the deepest part of the ocean?</li> <li>▪ How was early exploration of the oceans achieved?</li> <li>▪ What were the famous scientific explorations and what did they discover?</li> <li>▪ What are the tools used to explore the world's oceans?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ View and visit historical sites around the Town of Madison.</li> <li>▪ Know the four principal oceans.</li> <li>▪ Know how the early explorers navigated with out help from GPS.</li> <li>▪ Know the important findings of the first scientific expeditions.</li> <li>▪ Know the tools used today for ocean exploration.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Introductory Oceanography</u> Thurman & Trujillo Pearson Education, 2004 <ul style="list-style-type: none"> <li>▪ Books on local maritime history</li> <li>▪ PowerPoint presentations on local history</li> <li>▪ Boat building supplies</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Field trips to Hammonasset and other local sites</li> <li>▪ Guest speakers on native American history</li> <li>▪ Work at West Wharf with the shell fish commission</li> <li>▪ Classroom instruction</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Constructive feedback</li> <li>▪ Performance assessment</li> <li>▪ Projects and presentations</li> <li>▪ Reports and projects evaluated with rubrics</li> <li>▪ Self-assessment</li> <li>▪ Tests</li> <li>▪ Writing assignments</li> <li>▪ Student Portfolio</li> </ul>

<b>LEARNING STRAND</b> <b>Geology of Long Island Sound and Connecticut</b> <i>CT Standards: Earth Science- Dynamic Earth Processes: Plate tectonics operation over geologic time has changed the patterns of land, sea and mountains on Earth's surface.</i>	
<b>ENDURING UNDERSTANDINGS</b> <ul style="list-style-type: none"> <li>▪ Geologic history in Connecticut can be summed up in two words—<b>"crunch and crack."</b></li> <li>▪ Evidence for this continental collision comes from the analysis of the terranes that make up Connecticut.</li> <li>▪ There are four major terranes in Connecticut.</li> <li>▪ Connecticut has been covered by ice at least two times, and maybe more.</li> <li>▪ Glaciation was an important factor in shaping <b>and creating Connecticut's coastline.</b></li> <li>▪ Glaciation is responsible for the formation of Long Island Sound.</li> </ul>	<b>ESSENTIAL QUESTIONS</b> <ul style="list-style-type: none"> <li>▪ What is the evidence found in Connecticut which supports Plate Tectonics?</li> <li>▪ Why is Connecticut explained as being <b>"crunched and cracked"</b>?</li> <li>▪ What are terranes?</li> <li>▪ What are the four types of terranes found in Connecticut and where can we find them today?</li> <li>▪ How do glaciers form?</li> <li>▪ How long ago was the last ice age, and what evidence do we see that it did in fact happen?</li> <li>▪ How did the glaciers make Long Island Sound and shape the Connecticut shoreline?</li> </ul>
<b>LEARNING OBJECTIVES</b> <i>The student will...</i> <ul style="list-style-type: none"> <li>▪ Explore the evidence for plate tectonics here in Connecticut.</li> <li>▪ Understand that Connecticut is made up of different terranes.</li> <li>▪ Use a geological map to locate the terranes and determine which terranes are found in Madison.</li> <li>▪ Take a field trip to look at the evidence for glaciation in Connecticut and hike along a recessional moraine.</li> </ul>	<b>INSTRUCTIONAL SUPPORT MATERIALS</b> <u>Introductory Oceanography</u> Thurman & Trujillo Pearson Education, 2004 <ul style="list-style-type: none"> <li>▪ Geology of Connecticut CD</li> <li>▪ Sea Grant pamphlets</li> <li>▪ DEP Website</li> <li>▪ Bedrock map of Connecticut</li> </ul>
	<b>SUGGESTED INSTRUCTIONAL STRATEGIES</b> <ul style="list-style-type: none"> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided internet research</li> <li>▪ Field trips to Hammonasset and other local sites</li> </ul>
	<b>SUGGESTED ASSESSMENT METHODS</b> <ul style="list-style-type: none"> <li>▪ Constructive feedback</li> <li>▪ Performance assessment</li> <li>▪ Projects and Presentations</li> <li>▪ Reports and projects evaluated with rubrics</li> <li>▪ Self-assessment</li> <li>▪ Tests</li> <li>▪ Writing assignments</li> <li>▪ Student Portfolio</li> </ul>

**LEARNING STRAND****Classification of Marine Organisms**

*CT Standards: 10.5 Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.*

*Biology- Ecology: Stability in an ecosystem is a balance between competing effects.*

**ENDURING UNDERSTANDINGS**

- To study the diversity of life, biologists use a classification system to name organisms and group them in a logical manner.
- The six-kingdom system of classification includes the kingdoms Eubacteria, Archaeobacteria, Protista, Fungi, Plantae, and Animalia.
- Organisms are now grouped into categories that represent lines of evolutionary descent.
- An animal is a multicellular, eukaryotic heterotroph whose cells lack cell walls.
- Animals are specialized to carry out the following essential functions: feeding, respiration, circulation, excretion, response, movement, and reproduction.
- Sponges are classified as animals because they are multicellular, heterotrophic, have no cell walls, and contain a few specialized cells.
- Cnidarians are soft-bodied, carnivorous animals that have stinging tentacles arranged in circles around their mouth; they are the simplest animals to have body symmetry and specialized tissues.
- Cnidarians include jellyfishes, hydras and their relatives, sea anemones, and corals.
- Flatworms are soft, flattened worms that have tissues and internal organ systems; they are the simplest animals to have three embryonic germ layers, bilateral symmetry, and cephalization.
- Roundworms are unsegmented worms that have pseudocoeloms and digestive systems with two openings, a mouth and an anus.
- Annelids are worms with segmented bodies who have a true coelom that is completely lined with mesoderm.
- Mollusks are soft-bodied animals that usually have an internal or external shell.
- Arthropods are classified based on the number and structure of their body segments and appendages, particularly their mouthparts.
- Crustaceans typically have two pairs of branched antennae, two or three body sections, and chewing mouthparts called mandibles.
- Echinoderms are characterized by spiny skin, five-part radial symmetry, an internal skeleton, a water vascular system, and suction-cup-like structures called tube feet.
- A chordate is an animal that has, for at least some stage of its life, a dorsal, hollow nerve

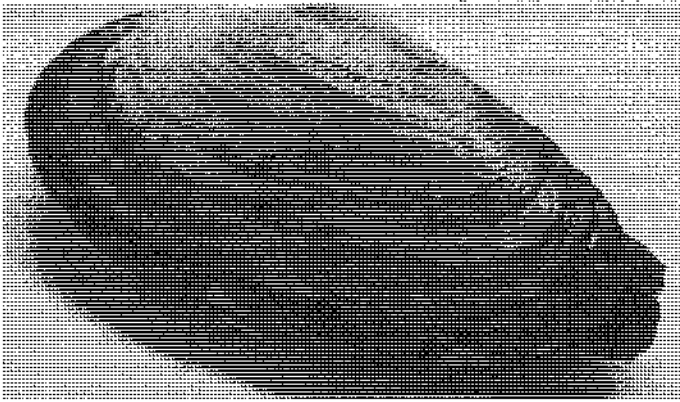
**ESSENTIAL QUESTIONS**

- How are living things classified?
- How are marine organisms classified?
- How many marine species exist?
- What is binominal nomenclature?
- What are the six kingdoms of life?
- What characteristics do all animals share in common with one another?
- Why are sponges classified as animals?
- What is a Cnidarian?
- What are the different groups of Cnidarians?
- What are the defining characteristics of flatworms?
- What are the defining characteristics of roundworms?
- What are the defining characteristics of annelids?
- What are the defining characteristics of mollusks?
- What are the defining characteristics of arthropods?
- What are the defining characteristics of echinoderms?
- What are the defining characteristics of chordates?
- What are the defining characteristics of fishes?
- What are the defining characteristics of mammals?

<p>cord; a notochord; pharyngeal pouches; and a tail that extends beyond the anus.</p> <ul style="list-style-type: none"> <li>▪ Fishes are aquatic vertebrates that are characterized by paired fins, scales, and gills.</li> <li>▪ In addition to having hair and the ability to nourish their young with milk, all mammals breathe air and are endotherms that generate their body heat internally.</li> <li>▪ Similar ecological opportunities on the different continents have produced some striking examples of convergent evolution in mammals.</li> </ul>	
<p><b>LEARNING OBJECTIVES</b> <i>The student will...</i></p> <ul style="list-style-type: none"> <li>▪ Explain how living things are organized for study.</li> <li>▪ Describe binomial nomenclature.</li> <li>▪ Know all of the main groups of marine organisms and the characteristics of each.</li> <li>▪ Name the six kingdoms of life.</li> <li>▪ List the characteristics that all animals have in common.</li> <li>▪ Explain what a sponge is and where sponges live.</li> <li>▪ Explain what a Cnidarian is and which types live in Long Island Sound.</li> <li>▪ Describe the defining features of flatworms, roundworms, and annelids.</li> <li>▪ Know the characteristics of mollusks.</li> <li>▪ Know the ecology of the steamer clam and where it can be found in Madison.</li> <li>▪ Study the life cycle of the oyster and observe its growth at 1 year and 2 years.</li> <li>▪ Be able to explain the characteristics of chordates including fish and mammals.</li> </ul>	<p><b>INSTRUCTIONAL SUPPORT MATERIALS</b></p> <p><u>Introductory Oceanography</u> Thurman &amp; Trujillo Pearson Education, 2004</p> <ul style="list-style-type: none"> <li>▪ Biology text</li> <li>▪ Preserved specimens</li> <li>▪ Internet sources</li> <li>▪ Sampling equipment</li> <li>▪ Dichotomous keys</li> <li>▪ Field manuals</li> </ul> <p><b>SUGGESTED INSTRUCTIONAL STRATEGIES</b></p> <ul style="list-style-type: none"> <li>▪ Field work</li> <li>▪ Internet activities</li> <li>▪ Lab work</li> <li>▪ Lecture</li> <li>▪ Modeling during lectured instruction</li> <li>▪ Inquiry investigation</li> <li>▪ Textbook ancillary materials</li> <li>▪ Guided internet research</li> </ul> <p><b>SUGGESTED ASSESSMENT METHODS</b></p> <ul style="list-style-type: none"> <li>▪ Constructive feedback</li> <li>▪ Performance assessment</li> <li>▪ Projects and Presentations</li> <li>▪ Reports and projects evaluated with rubrics</li> <li>▪ Self-assessment</li> <li>▪ Tests</li> <li>▪ Writing assignments</li> <li>▪ Student Portfolio</li> </ul>



## Soft Shell Clam Survey



### Problem

The Madison Shellfish Commission wants you to conduct a field survey of soft shell clams on Seaview Beach in Madison to determine if healthy populations of large sized soft shell clams are present in sufficient numbers to be harvested.

### Background Information

#### Location

Survey of soft shell clams *Mya arenaria* at Seaview Beach Land Spit - East of Waterbury Ave. shoreline access in Madison, CT.

#### Surface Area

The soft-shell clam bed can be found in a spit of land that extends out from the shore at its center approximately 140 feet from the shore. The base of the rocky spit is approximately 100 feet at the shore tapering to 50 feet farthest off shore at full ebb tide.

#### Soft-shell Clams

*Mya arenaria*, popularly called "steamers", "softshells", "longnecks" or "Ipswich clams", are clams that live buried in tidal mudflats most famously on the coast of New England, but their range extends much farther north to Canada and to the Southern states.

## Physiology

*Mya arenaria* has a calcium carbonate shell, which is very thin and easily broken, hence the name "soft-shells" (as opposed to their beach-dwelling neighbors, the thick-shelled quahogs).

It can be found living approximately 6-10 inches under the surface of the mud and extends a Siphon, which is used to draw in marine water that is filtered for food and expelled, up to the surface. The holes through which the water is drawn can often be seen at low tide and water may be visibly ejected from them when pressure is applied to the surrounding mud. These holes are helpful in locating the clams for digging.

## Clams in cooking

Soft-shell clams are edible and can be enjoyed in a variety of dishes. Before cooking, it is generally recommended that clams be stored in saltwater for a few days to facilitate the expulsion of sand from their digestive tracts. Some recommend that cornmeal be added to the water to give the clams something to filter from it.

Soft-shell clams can be eaten steamed, fried, or in clam chowder. "Steamers" (steamed soft-shell clams) are an integral part of the New England clam bake, where they are served steamed whole in the shell, then pulled from the shell at the table and dipped, first in the clam broth in which they were cooked, to rinse away sand, and then in butter.

## Procedure:

1. First establish three transects perpendicular to the shore.
2. The eastern edge transect will be approximately 80 feet long, the center transect will be approximately 140 ft. long and the western transect will be approximately 100 feet long.
3. Determine the surface area sampled.
4. Dig sample holes, 20" square and 12" deep, approximately 6 feet apart along each transect beginning farthest from shore. Because of the rocky condition of the bottom, short handled clam rakes or short handled 3 prong garden cultivators seem to work best.
5. Count all clams from each hole along each transect and record total clams indicating those over and under 2".
6. Record the numbers of clams caught in each hole along each transect.
7. Determine the population of clams greater than 2 inches and less than 2 inches within the sample area.

## Technique 1: Sampling

*A technique called sampling is sometimes used to estimate population size. In this procedure, the organisms in a few small areas are counted and projected to the entire area. For instance, if a biologist counts 10 squirrels living in a 200 square foot area, she could predict that there are 100 squirrels living in a 2000 square foot area.*

8. Project the amount of clams greater than 2 inches and less than 2 inches living in the Spit as a whole. Use the above example to help you determine this. Remember to find the total surface area of the spit before you do this.
9. Use these numbers to predict the overall health of the spit and make a decision as to whether the spit should be opened for recreational shell fishing.

**MARINE SCIENCE  
EFFECTIVE CRITICAL THINKING STRATEGIES  
IN WRITING LAB REPORTS**

**B**

<b>Exceeds Expectations</b>	The student understands not only the objective but also the implications of assignments. S/he writes in a variety of modes, with a clear hypothesis. Supporting data are well discussed and organized, showing both analysis and synthesis of ideas into a conclusion.
<b>Meets Expectations</b>	The student understands the objective of assignments and selects an appropriate mode of written expression with a hypothesis. Supporting data show an understanding of the subject matter and an analysis or discussion of ideas. The conclusions are somewhat developed and organized.
<b>Meets Some Expectations</b>	The student requires some additional explanations and models in order to understand the objective of assignments or to complete the writing process. With direction, s/he selects an appropriate mode. Writing has a somewhat limited focus or hypothesis, and data discussed may be inaccurate, simplistic, and/or confused. The student may require assistance to develop or organize his/her conclusion.
<b>Does Not Meet Expectations</b>	The student misinterprets significant elements of writing assignments, selecting an inappropriate mode or using it incorrectly. The student requires many additional explanations, models, graphic organizers, and/or strategies in order to complete parts of the writing process. The writing has no clear focus or a very limited hypothesis. data are often unorganized or inaccurate. Inaccurate or limited discussion and conclusion.

**MARINE SCIENCE  
EFFECTIVE CRITICAL THINKING STRATEGIES  
IN USING TECHNOLOGY TO MANUFACTURE A  
FISHING ROD OR BUILD A BOAT**

**2. Uses technology effectively and responsibly.**

<b>Exceeds Expectations</b>	The student can independently select and use appropriate technology to solve problems efficiently and creatively.
<b>Meets Expectations</b>	The student can select and use appropriate technology to solve problems effectively without making significant errors.
<b>Meets Some Expectations</b>	The student can select and use appropriate technology to solve problems but makes some errors and requires some assistance.
<b>Does Not Meet Expectations</b>	The student cannot select and use appropriate technology to solve problems without making many significant errors and requiring supervision.

## Marine Science and Technology Project: Fishing Rod

Grade Category	Grips	Reel Seat	Spine	Guide Placement	Wraps	Finish	Behavior/ Cleanup	Participation
<b>0</b>	Not assembled.	Not installed.	Not completed.	No Guides.	None completed.	Not applied.	Rude disrespectful.	Frequently absent.
<b>1 POOR</b>	Grips are sloppy, cracked and/or incomplete. Glue not applied or messy. Measurements <b>incorrect.</b>	Seat not installed and/or glues not applied or messy. Bushings not constructed correctly.	Rod not finished enough to evaluate spine placement.	Rod not completed enough to evaluate guide placement or guides are <b>missing.</b>	Rod not assembled enough to evaluate quality of the wraps.	The finish is applied bumpy with untidy edges and with bubbles. There are frayed <b>ends and excess epoxy</b> on guides or blank	Student behavior is poor and <i>he/she leaves area messy</i> at the end of the period. No cleanup tasks completed.	Participation is very little in project or <b>activities. Cuts</b> or leaves class early or is continuously tardy.
<b>2 WEAK</b>	Grips are sloppy but complete. Glue applied messy or not cleaned. Gaps present and/or <b>measurements may be incorrect.</b>	Seat not aligned with spine and glue is messy. Bushings constructed poorly.	The rod was built with the spine in the <b>wrong location.</b>	Guides are missing with the existing guides placed in the wrong location.	Wraps are not placed evenly, finished off or stacked correctly. Most <b>are missing or incomplete.</b>	The finish is applied unevenly most edges are sloppy. There are some bubbles or <b>excess epoxy on</b> guides or blank.	Student behavior is weak and <i>he/she</i> does very little during cleanup.	Participation is <b>weak, sometimes</b> tardy to class. No cuts.
<b>3 AVERAGE</b>	Grips are complete with a few epoxy marks visible. <b>Measurements correct.</b>	Seat is somewhat aligned with spine but glue is <b>messy.</b>	The rod was built with the spine close to <b>the correct</b> location.	All guides are <b>present but some</b> may be in the wrong location or not aligned to spine.	Most wraps are placed evenly, and finished off. Some gaps present in finished product.	The finish is applied evenly <b>some edges are</b> sloppy. There are no bubbles or <b>excess epoxy on</b> guides or blank.	Student behavior is average and <i>he/she</i> does help clean at the end of the period.	Average participation in activity and project. No cuts or tardies.
<b>4 PROFICIENT</b>	All components of grip assembly measured and put together correctly. Epoxy is applied appropriately and cleaned with denatured alcohol.	Seat is aligned <b>with spine</b> , bushings were well constructed and glue has been cleaned up with denatured alcohol.	The rod was built correctly with the reel seat and guides aligned with the spine.	All guides are placed correctly according to <b>measurements</b> , aligned and <b>secured</b> correctly.	All wraps are placed evenly, measured for symmetry and stacked correctly. No <b>gaps present in</b> finished product	The finish is applied evenly with neat edges and without bubbles. There are no frayed ends or <b>excess epoxy on</b> guides or blank.	Student behavior is excellent and <i>he/she</i> goes above and beyond to help cleanup at the end of the period.	Always engaged during projects. Does all assignment <b>and more. Present</b> and on time for all <b>classes.</b>
<b>TOTAL</b>								

**TOTAL:** \_\_\_\_\_

## Boat Building

### Project: Boat \_\_\_\_\_

Grade Category	Layout	Cutting	Glue	Fastener Placement	Rails	Finish	Behavior/Cleanup	Participation
0	No layout completed.	Not completed.	None used.	None used.	Not completed.	Not ready to begin finishing process.	Rude disrespectful.	Not present.
1 <b>POOR</b>	Components of boat not laid out correctly or symmetrically	<b>No components</b> of boat cut out correctly or symmetrically.	All glue joints are sloppy and <b>much excess</b> glue is present or gaps are present in glue joints.	All fasteners randomly placed. Most are not countersunk.	Rails not finished or installed.	Some work has been started to prepare finish.	Student behavior is poor and he/she <b>leaves area messy</b> at the end of the period. No cleanup tasks completed.	Participation is very little in project or activities. Cuts <b>or leaves class</b> early or is continuously tardy.
2 <b>WEAK</b>	Components of boat laid out but not symmetrically. Weak grasp of <b>measuring</b> .	<b>Few components</b> of boat cut out <b>correctly or</b> symmetrically. Many mistakes made.	<b>Most glue joints</b> are messy with excess glue present.	Some fasteners randomly placed. <b>Most are not countersunk</b> .	Rails are almost completed with <b>mistakes or</b> poorly placed fasteners.	Work has been started to prepare finish.	Student behavior is <b>weak, does not stay</b> on task. He/she does very little during cleanup.	Participation is weak, sometimes tardy to class. No cuts. Does not participate in class work.
3 <b>AVERAGE</b>	<b>Most components</b> of boat laid out correctly and symmetrically. Good grasp of <b>measuring</b> .	Some components of boat cut out correctly and symmetrically. Few mistakes made.	<b>Most glue joints</b> are clean and clear of any excess glue.	Most fasteners placed with <b>measurement</b> . Some are <b>countersunk</b> .	Rails are completed with a few poorly placed fasteners, planed and sanded.	Entire project was sanded and ready for finish.	Student behavior is <b>average, stays on task</b> and he/she does help clean at the end of the period most of the time.	Average participation in activity and project. No cuts or tardies.
4 <b>PROFICIENT</b>	All components of boat laid out correctly and symmetrically. Strong grasp of <b>measuring</b> .	All components of boat cut out correctly and symmetrically. No mistake made.	All glue joints are clean and clear of any <b>excess glue</b> .	All fasteners placed with <b>precise measurement</b> and care. All are countersunk.	Rails are completed and planed, sanded with no mistakes or poorly placed <b>fasteners</b> .	The finish is applied correctly and complete.	Student behavior is excellent, makes <b>good use of class</b> time and he/she goes above and beyond to help cleanup at the end of the period.	Always engaged during projects. Does all assignment and more. Present and on time for all <b>classes</b> .
<b>TOTAL</b>								

**TOTAL:** \_\_\_\_\_

## Marine Science and Technology Portfolio Evaluation Spring

Name: \_\_\_\_\_ Period: \_\_\_\_\_ Due Date: \_\_\_\_\_

### Portfolio Evaluation Sheet

	Student	Teacher
<b>Ships Logs</b>	_____	_____
-Do you have all ships logs from the entire year?		
-Are they neat and complete?		
<b>Field Trip Pictures</b>	_____	_____
-Do you have at least 12 pictures of activities we have done in MST?		
-Do they have appropriate captions regarding picture?		
-Captions must reflect what is happening in the photo and must be typed.		
<b>#1 Boat Building Portfolio Reflection</b>	_____	_____
- Reflect on your boat building project.		
- Did you use the 5 paragraph format? Is it typed and complete?		
<b>#2 Madison Shell Fishing Portfolio Reflection</b>	_____	_____
- Reflect on your contribution to Madison's Shell Fish Commission.		
- Did you use the 5 paragraph format? Is it typed and complete?		
<b>#3 Long Island Sound Ecosystem Portfolio Reflection</b>	_____	_____
-Reflect on all of the different ecosystems studied and found in Long Island Sound.		
- Did you use the 5 paragraph format? Is it typed and complete?		
<b>#4 Portfolio Reflection</b>	_____	_____
-Reflect on your activities?		
-Did you use the 5 paragraph format? Is it typed and complete?		
<b>Class Notes Section</b>	_____	_____
-Coastal Ecosystems, LIS Geology, CT Geology, Marine History		
-Classification - Marine Animals- Porifera - Cnidarians - Simple Worms		
-Study Guides, Handouts, Work sheets		
<b>Participation</b>	_____	_____
-Did you actively participate in all class activities?		
-Any class cuts?		
-All Papers and Lab reports turned in and complete?		
-Are all of your Ships Logs included in the portfolio?		
<b>Safety / Clean up / Behavior</b>	_____	_____
-Shop Projects, Fish tank maintenance, Field Trips		
<b>Portfolio Presentation</b>	_____	_____
-Is your portfolio neat and presentable?		
-Are all components included and handed in on time?		

**Total** \_\_\_\_\_

- 0 = Work is not done  
 1 - 3 = Work is complete but substantially below standard.  
 4 - 6 = Work is complete but all or part is below standard.  
 7 - 8 = Work meets the expectations of standard performance.  
 9 - 10 = Work achieves and exceeds the expectations of high-standard performance.



# **Program Implementation: Guidelines & Strategies**



## Instructional Delivery

Instruction in science is inquiry-based. Inquiry-based instruction engages students in designing and performing investigations to answer real world problems. During inquiry, the teacher acts as a facilitator to student activities. Students develop the testable question, collect data, analyze the results, and communicate the findings. As a result, connections are made between science concepts learned in the classroom and their application to the world in which students live. In addition, student interests are taken into account allowing some student ownership in what activities are performed in class.

Students, however, must learn basic skills needed to do inquiry. These include: the ability to identify questions and science concepts that guide investigations; the development of good experimental design; the use of appropriate tools and procedures for gathering data and analyzing and interpreting results; the proper use of mathematics; the development of explanations and descriptions based on evidence; and the communication of scientific procedures and explanations. In addition, students must learn to analyze the validity of data and address validity in their experimental design. These skills must be systematically taught through activities that are developmentally appropriate for students starting with simple activities, building to guided investigations, and resulting in inquiry experiences.

This systemic instruction of inquiry skills involves a carefully planned program, delivery that implements the objectives to be learned, and selection and sequence of the essential skills and strategies that are necessary to achieving those objectives. It also involves the application of the skills to investigations that enrich and enhance the learning of science content leading to a greater understanding of the content and the ability to make connections between concepts and the real world. In implementing systematic instruction, teachers:

- Allocate sufficient time to for students to develop essential skills.
- Organize information to minimize confusion that learners may experience.
- Introduce new information in manageable and sequential segments.
- Build on prior knowledge of the learner.
- Review previously taught skills and content.
- Integrate old knowledge strategically with new knowledge.
- Progress from skills in more easily managed contexts to more complex contexts.
- Include modifications, as necessary, for students who have special needs.

Inquiry-based instruction is demonstrated in science laboratory work. Laboratory experiences provide opportunities for students to interact directly with natural phenomena or with data collected using tools, materials, data collection techniques, models (including computer simulations and virtual labs) and the theories of science. These hands-on experiences are best suited to occur in a laboratory environment and/or field settings. At least 40% of instructional time is focused on or related to laboratory experiences. Science classes include laboratory experiences and reflect the processes of scientific inquiry. Students are provided multiple opportunities to connect the concepts with the techniques learned through laboratory work to construct new knowledge/understanding. Laboratory skills and processes should be part of the curriculum documents and instructed, modeled, practiced and assessed for understanding.

## Instruction Requirements

In effective science teaching:

- Teachers have and continually expand their content knowledge of science as well as their knowledge of teaching and learning.
- Teachers are able to select research-based instructional strategies that are appropriate to the instructional goals and to students' needs.
- Teachers effectively organize instruction around goals that are tied to the standards and direct students' scientific learning.
- Teachers use the results of assessment of both student learning and their own teaching to guide instruction.

- Teachers build relationships with students that are based in their knowledge of how their students think and learn.
- Teachers are active as members of science-learning, collaborative communities and use this to enhance their teaching.

## Instructional Time

Priority must be given to the teaching of science, and instructional time must be protected from interruptions.

- Adequate time is allocated to science. Secondary students receive from 53 to 70 minutes of science instruction, not including homework each school day. Elementary students receive 60 minutes of science instruction on alternating school days. Additional instructional time is allocated for students who are, for whatever reason, performing substantially below grade level in science. All students need to take science courses throughout high school.
- Learning time is extended through homework that increases in complexity and duration as students mature. Homework should be valued and reviewed. The purpose of homework is to reinforce concepts, practice skills previously taught or to have students apply their previously learned knowledge and skills to new problems. It should be assigned in amounts that are grade-level appropriate and, at least in the early grades, it should focus on independent practice and the application of skills already taught. For more advanced students, homework may be used as a means for exploring new concepts.
- During the great majority of allocated time, students are active participants in the instruction. Active can be described as the time during which students are engaged in thinking about science or doing science.
- Instructional time for science is maximized and protected from such interruptions as calls to the office, public address announcements, and extracurricular activities.

## Instructional Technology

Technology enhances the science program at Daniel Hand High School. Each of the classrooms used for science instruction has an LCD projector, sound system and a computer from which CDs can be played. Teachers can easily display PowerPoint presentations and access Internet sites.

All science courses include the use of appropriate tools for collecting and recording data. Students perform activities and investigations that require the use of basic laboratory ware as well as microscopes, probes, meters, and calculators. Specific courses may require the use of specialized equipment such as gas pressure gauges, accelerometers, or water quality testing materials. Additionally, the installation of **SMARTBOARDS in some classes has proved not only innovative to teachers' presentations, but also productive for student use and reference to notes given earlier in class.**

Technology is also used as an instructional tool at the middle school level. Each of the classrooms used for science at Walter C. Polson Middle School have a TV monitor and a computer from which CDs can be played. Three video flex-cams, several digital microscopes, a Proscope, and a few CBL2s with graphing calculators have been purchased for classroom use. In addition, there are two computer labs that teachers can reserve as well as two portable laptop labs. LCD projectors and SMARTBOARDS have been purchased and are in use as well. At the Dr. Robert H. Brown Middle School, teachers have computer work stations in the classrooms and laptops carts for classroom use. They may also reserve time in the two computer labs in the building. LCD projectors and SMARTBOARDS have been purchased and are in use as well. In addition, there is a projection microscope, several digital microscopes and a Proscope for use as instructional tools.

At the secondary school level, teachers have created their own web pages on finalsite, and they access websites, research tools such as SIRS, and ICON so that students have real world experiences. The State of Connecticut is providing access to Discovery Education Science for the middle schools. Science teachers at both middle schools have been trained to access the video clips, virtual labs, lessons, and other resources this site has to offer.

At the elementary schools, teachers have computer work stations in the classrooms. Teachers may also reserve time in the computer lab in the building, in which SMARTBOARDS have been installed and are in use as well. Students are learning to use the Internet with guided web browsing, spreadsheets, word processing, multimedia presentations, CDs, and DVDs for scientific inquiry.

## **Student Support**

Some students need less time and some students need more time to be able to demonstrate mastery or proficiency for any lesson, unit, course, year or program. One way that time becomes a variable used to better meet individual student needs is through the provision of more advanced or remedial / compensatory instruction for those students for whom traditional time allocations are not appropriate.

Students can be supported by:

- Teachers who use a variety of strategies and instructional materials and who differentiate instruction to meet individual student needs;
- Support staff who assist students with special needs; and
- Before and after school assistance and reviews for all students.

To provide student support within the classroom teachers can make use of the principles of backward design and differentiated instruction by:

### **1. Identify desired learning results for the subject and topics they teach.**

- Determine what students should know, understand, and be able to do as a result of the study.
- Specify big ideas worthy of understanding.
- Delineate enduring understandings on which the teacher and students will focus.
- State provocative, essential questions that will guide students' exploration of the big ideas.
- Articulate specific knowledge and skill that students will need for effective performance on the goals.

### **2. Determine acceptable evidence of student learning.**

- Decide what evidence will indicate that students understand the big ideas.
- Consider what performances will indicate that the learners understand and can apply what they have learned, and by what criteria those performances will be evaluated.
- Determine what will constitute evidence of student proficiency with the essential knowledge, understanding, and skill.

### **3. Plan learning experiences and instruction based on the first two principles.**

- Decide what essential knowledge, understanding, and skills need to be taught and coached.
- Determine how knowledge and skills should best be taught in light of the content goals.
- Plan ahead to ensure that learning is engaging and effective in the context of specified goals and needed evidence.

### **4. Regard learner differences as inevitable, important, and valuable in teaching and learning.**

- **Persist in developing greater understanding of each student's readiness to succeed with designated content goals** to enhance individual academic growth, interests that might connect with content goals to enhance motivation, and preferred modes of learning.
- Work with students, family, and school personnel to understand and address learners' backgrounds and experiences, including gender, culture, language, race, and personal strengths, and to address those factors in teaching and learning plans.

#### **5. Address learners' affective needs as a means of supporting student success.**

- Respond actively to students' need for affirmation, contribution, power, purpose, and challenge.
- Understand and respond to the reality that these needs are met in different ways for different students.
- Understand and respond to the reality that a student's motivation to learn is tethered to a sense of affirmation, safety, and success.

#### **6. Periodically review and articulate clear learning goals that specify what students should know, understand, and be able to do as a result of each segment of learning.**

- Ensure that each student has full access to essential knowledge, understanding, and skills in each segment of study.
- Ensure that tasks and assessments focus on essential knowledge, understanding, and skills designated in a segment of study.
- Ensure that all students reason and work at high levels.
- Ensure that all students have equally engaging and equally interesting tasks.

#### **7. Use systematic pre-assessment and ongoing assessment aligned with designated goals to make instructional decisions and adaptations.**

- Provide opportunities for students to build requisite competencies when assessment results indicate a student lacks precursor knowledge, understanding, or skill necessary for success with designated content goals.
- Provide opportunities for additional instruction, coaching, or practice when assessment results indicate such needs for a student or group of students.
- Provide opportunities to advance or extend knowledge when assessment results indicate that a student or group of students has achieved mastery of designated content goals.

#### **8. Employ flexibility in instructional planning and classroom routines to support success for each learner.**

- Use space, time, materials, student groupings, and modes of exploring and expressing learning flexibly to maximize the opportunity for success for a full range of learners when students work with tasks and assessments.
- Use multiple modes of presentation, illustrations linked to a wide range of cultures and experiences, and various support systems to maximize the opportunity for a full range of learner success when students work with tasks and assessments.
- Encourage each student to work at a level of complexity or degree of difficulty that is challenging for that student, and provide scaffolding necessary for each student to succeed at the new level of challenge.

#### **9. Gather evidence of student learning in a variety of formats.**

- Provide varied options for demonstrating what students know, understand, and can do.
- Ensure that students know what "success" looks like in their work including both nonnegotiable class requirements and student- or teacher-specified goals for individuals.

- Together, backward design and differentiation describe a comprehensive way of thinking about curriculum, assessment, and instruction, stemming from a shared understanding of what constitutes effective teaching and learning.

## Professional Growth

### Program Coordination

The effectiveness of the science program depends critically on the assignment of responsibility for program coordination to the program coordinators at the middle school and high school levels and the designated science liaisons at the elementary level. The program requires that (1) a vision be nurtured and advocated; (2) teachers be kept abreast of changes and professional development opportunities; and (3) curricular, instructional and assessment improvement be treated as ongoing processes.

Common means for increasing the articulation and coordination of the program are professional development workshops, science assessment program, department meetings of two or more consecutive grades and meetings of teachers teaching the same course or grade level. These meetings can facilitate teachers discussing student work, assessment results, concerns and problems so that the necessary adjustments curriculum, instruction and assessment can be made.

### Professional Development

In order to implement fully any curricular/technology changes, it is essential to provide professional development opportunities for science teachers. Training workshops and time to meet with colleagues enable teachers to learn and adapt research based methods of teaching and learning and instructional technology. Continued study maintains and improves the **teachers' level of proficiency, while participation** in state, regional and national science organizations provides an opportunity for exposure to the most recent developments and studies.

The goals of professional development should be to provide classroom teachers with the knowledge and skills they will need to implement the science content standards.

Professional development needs to provide teachers with a clear understanding of standards-based science expectations. Students need to know the goals and uses of the science they are taught, and teachers need to understand the basic goals of the standards and the importance of achieving those goals.

Teachers need to understand science inquiry and how to offer opportunities for their students to develop inquiry skills through inquiry-based instruction that is developmentally appropriate.

Teachers need to understand how the grade-level content they are teaching is related to the content taught in previous grades and how their teaching will prepare students for the science to be introduced in later grades.

Well designed instructional materials will greatly facilitate this goal. At the same time, in-service training or other activities will also be needed to show teachers how their teaching is an integral part of all grade-level standards and how they can develop strategies for linking their teaching to material for earlier and later grades.

Phase-in strategies for new curricula must be considered carefully. To maintain momentum, teachers should be provided the necessary support to implement new programs consistently and according to a given timeline.

Every student of science deserves to be taught by a teacher who has both the science content knowledge and teaching skills needed to implement the standards at each student's achievement level. The teacher must present science in ways that actively engage students in the learning of science and help them to apply it to the world around them.

Teachers need support in developing a repertoire of effective teaching strategies that allow them to implement a curriculum that balances problem solving, conceptual understanding and inquiry skills.

Teachers need a background in science that is considerably deeper and broader than the science they are expected to teach. Teachers at earlier grade levels need this background to understand how their teaching relates to the science content in later grades. Teachers at each grade level need to understand what students will encounter in subsequent grades, because teachers will then know which foundational skills taught at their grade level deserve the greatest attention and emphasis. To achieve this understanding, teachers need to acquire broad science content knowledge that enables them to comprehend the interrelationships of science concepts and inquiry skills across strands.

## **Professional Supervision and Evaluation**

Professional evaluation that supports the science program needs to reflect the requirements of an inquiry-based program. Administrators and the program coordinators are trained and knowledgeable about effective science curriculum, instruction and assessment based on standards. In addition, professional evaluation includes the preparation of an individual professional development plan, observations, conferences, reflections and reports.

## **Implementation**

The implementation section of this curriculum guide will be dynamic. As the teachers use the guide, they will add learning activities and performances which are aligned or illustrative of expected outcomes / common assessments previously agreed upon during the curriculum development process. The learning activities and performances that will result from implementation will ensure that the curriculum is enhanced or elaborated upon. The submitted activities and performances will become part of the school district's curriculum guide as suggested strategies and/or references for teachers and learners.



# **Program Monitoring and Evaluation**



## Program Monitoring

The purpose of program monitoring is to determine what is working, what is not working, what needs changing, and what's worth celebrating. Monitoring is a process used to determine if the planned curriculum, instruction and assessment of the renewed / revised program is user friendly and productive.

Monitoring in this sense is designed to examine the curriculum (design), the instruction (delivery) and the impact on student learning (results). Monitoring of a program is concerned with the total picture; i.e., the relationships between the teaching, the curriculum and the assessment of student performance.

Monitoring activities begin with a review of student progress conducted at the teacher level. Specifically, student participation in learning activities and skill development are reviewed by the teachers in order to draw conclusions on the effectiveness of the curriculum and the programmatic changes. In addition to student responsiveness, teachers can examine formal assessment measures such as unit tests, common performance assessments, final examinations, University of Connecticut ECE examinations, Generation 4 CMT Science results and Generation 3 CAPT Science results.

To measure the effectiveness of the program at schools, teachers and principals share their observations of the program's impact on student learning. Not only will school staff examine demonstrations of students' competencies, but also observations of safe practices and productive use of equipment, materials and time to explore **the program's effectiveness on student learning** as it pertains to their school or a specific grade level.

To determine the overall effectiveness of a program from a K-12 perspective, information is compiled from horizontal comparisons (grade spans across schools) and vertical (K-12) curricular mapping. Appropriate data from many sources is considered.

## Program Evaluation

Program evaluation is necessary to identify program merit and to systematically improve the procedures of planning, implementing and evaluating instruction. Program evaluation addresses three basic questions:

1. Is the program producing the desired results?
2. Is the program being implemented as intended?
3. Is the program plan appropriate?

*Is the program producing the desired results?*

This question is concerned with student outcomes. Are the students learning the objectives targeted for each grade level? Are the students being graduated from the program having achieved the program goals? The question informs the 12-K (backward) design and the K-12 articulation.

*Is the program being implemented as intended?*

This question focuses on whether the teachers are implementing the program with fidelity as defined in the curriculum and their subsequent teaching and learning maps. Common questions would be: Are the appropriate objectives being taught? Is enough time being spent on the objectives? Are appropriate instructional techniques and activities being used? Are the students being provided with sufficient practice and feedback? Program implementation evaluation can be performed by the grade level or at the school level. The purpose is to identify problems that are shared by several teachers with the intent of providing some form of support or assistance such as a staff development workshop.

*Is the program plan appropriate?*

This question is designed to look at the big picture and addresses questions such as: Should the number of objectives in the program be increased or decreased? Should the sequence of placement of any of the objectives be changed? Should the program objectives be revised? The evaluation of the program plan is typically done by the entire staff collectively. Periodic evaluation of the program plan is the process that gradually shapes and refines the program over time so that it achieves its stated goals.

Program evaluation facilitates the dynamic evolution of a functional science education curriculum. Program evaluation is designed to be a positive and proactive process that will ensure that students achieve the targeted objectives and goals of the program and that instruction is effective and efficient.

# Resources



# SAFETY

Teaching science through inquiry requires students to be engaged in hands-on work. Students must be involved in their learning by developing questions and designing ways to test a hypothesis. Younger students need the time to explore in a multi-sensory manner.

With less use of lecture and more use of investigation comes an added concern for safety. Safety rules need to be written and discussed with all students prior to any activity insuring that all students are aware of the rules and that they understand them. A Safety Acknowledgement Document should be sent home for students and/or parents to sign.

It is required by law ConnOSHA safety standards that schools develop a chemical hygiene plan and appoint a chemical hygiene officer for formal academic laboratories. For non-formal laboratory work in elementary science, ConnOSHA requires a written Hazard Communication Program. Teachers must be informed of the plan for their school and adhere to it. The chemical hygiene plan must be reviewed yearly and the teachers should receive a safety update each school year.

Connecticut State Department of Education offers these science safety manuals:

High School - [http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/science\\_safety.pdf](http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/science_safety.pdf)

Middle School - [http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/middleschool\\_sciencesafety.pdf](http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/middleschool_sciencesafety.pdf)

Elementary School - [http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/scisaf\\_cal.pdf](http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/scisaf_cal.pdf)

Professional best professional practices are also an expectation. Teachers should review safety position statements at NSTA.org to learn more about best practices.

There are a number of safety resources that should be available to teachers and all should become familiar with them. These include:

## **Print Resources**

Kwan, Terry and J. Texley. 2003. ***Inquiring Safely: A Guide for Middle School Teachers***. Arlington, VA: NSTA Press.

Kwan, Terry and J. Texley. 2002. ***Exploring Safely: A Guide for Elementary Teachers***. Arlington, VA: NSTA Press.

Roy, Kenneth Russell. 2007. ***The NSTA Ready Reference Guide to Safer Science***. Arlington, VA: NSTA Press.

Ryan, Kelly. 2001. ***Science Classroom Safety and Law***. Batavia, IL: Flinn Scientific, Inc.

Texley, Juliana, T. Kwan and J. Summers. 2004. ***Investigating Safely: A Guide for High School Teachers***. Arlington, VA: NSTA Press.





## MADISON PUBLIC SCHOOLS SCIENCE DEPARTMENT

### LABORATORY PROCEDURES

1. The science laboratory can provide you with exciting opportunities while learning and doing science. At all times the laboratory is a place for serious work. Fooling around or disruptive behavior will result in removal from the laboratory.
2. Always prepare for an experiment by reading the directions in the manual before you come to the laboratory. Follow the directions carefully and intelligently, noting all precautions. NOTE THE MSDS AND NFPA PRECAUTIONS FOR EACH CHEMICAL. Do not add to, omit, or change any of the directions unless your teacher instructs you to do so.
3. Know the location of the Chemical Safety Policy and the MSDS. The following MSDS information **MUST** be shared with students by the teacher and posted for direct access by students:
  - specific handling precautions
  - hazard identification
  - first aid measures
  - health hazards
  - personal protection
  - stability/reactivity
  - disposal techniques
  - other pertinent information (from MSDS) for each chemical.
4. Do only the experiments assigned and/or approved by your teacher. Unauthorized experimentation is prohibited.
5. Read the label of all containers to be sure of the contents and information provided by the MSDS and NFPA code. DO NOT USE ANY CHEMICALS STORED IN UNLABELED BOTTLES!
6. All solids and paper to be discarded must be placed in the chemical waste jar or other location directed by the teacher. Discard chemical waste as per MSDS and NFPA instructions. Follow directions for recycling products of your experiments per directions from your teacher.
7. Never discard matches, filter paper, or any other slightly soluble solids in the sink.
8. Know the location of the eye wash, hood, blanket station, and chemical spill cart, as well as the laboratory evacuation exit procedure. Sketch a diagram the lab area noting the locations of all safety equipment, exits, fire alarms, etc. and keep it handy. Note the location of the Chemical Safety Plan and MSDS envelope for experiments.
9. When working with corrosive materials, goggles, gloves, and lab aprons must be worn throughout the lab period until ALL your classmates have completed the lab and the chemicals are safely stored.
10. DO NOT TOUCH CHEMICALS WITH YOUR HANDS!
11. If acid or another corrosive chemical is spilled, wash with water for at least 15 minutes. Notify your teacher immediately.
12. **NEVER** taste a chemical solution.

13. No food (including candy or gum) or drink is allowed in the laboratory.
14. When observing the odor of a substance, do not hold your face directly over the container. Fan a little of the vapor toward you by sweeping your hand over the top of the container.
15. Allow ample time for hot glass to cool. Remember that hot glass looks like cool glass.
16. REPORT **ANY** ACCIDENT, EVEN A MINOR INJURY, TO YOUR TEACHER!
17. Long hair must be tied back securely!
18. **NEVER RETURN UNUSED CHEMICALS TO THE STOCK BOTTLES.** Do not put any object into a reagent bottle except the dropper with which it may be equipped.
19. Keep your apparatus and work area organized. Avoid spillage. If you do spill something, clean it up immediately using proper technique. Put your own equipment into your drawer and/or return any special apparatus to its proper place at the end of the period.
20. During clean-up time, attend to your assigned area duties. All duties must be completed before leaving the laboratory. Wash hands thoroughly with soap at the conclusion of each lab.
21. Respect your equipment and fellow laboratory workers.
22. Handle all spring-loaded and projectile devices with extreme caution to prevent accidental release or discharge.\*
23. Back packs and book bags must be stored under your table or on your chair out of the aisles to accommodate proper egress from the lab/classroom.
24. **STUDENTS ARE NOT TO WORK IN A LABORATORY UNLESS AN TEACHER IS PRESENT.** All student experiments are to be done under the direct supervision of an teacher, including students completing science projects, science fair projects, etc.
25. **OPEN TOE SHOES/SANDALS AND LOOSE FITTING CLOTHING OR JEWELRY ARE NOT PERMITTED DURING SPECIFICALLY DESIGNATED LABORATORY ACTIVITIES.** Your teacher will notify you in advance of the activity.
- \*26. Science department regulation states that safety goggles (flexible plastic with ventilating ports for chemical splash and glass breakage standard) must be worn by all students, teachers and visitors in the laboratory during work periods INCLUDING CLEAN-UP TIME in accordance with:

***Science Department Policy and CT State Statute:***

*"Any person who is working, teaching, observing, supervising, assisting, or engaging in any work, activity, or study in a public or private elementary or secondary school laboratory or workshop where the process used tends to damage the eyes or where protective devices can reduce the risk of injury to the eyes concomitant with such activity shall wear an eye protective device of industrial quality in the manner in which such device was intended to be worn."*

27. In order to maintain a safe working environment, teachers are required by the school's safety compliance officer to remove from the classroom, any student out of compliance.

## SAFETY ACKNOWLEDGEMENT FORM

**(Return this page to your science teacher after completing the required information below.)**

I have read and understood the Madison Public Schools laboratory procedures and have been present when they were discussed in class or discussed directly with my science teacher. I acknowledge the fact that the Science laboratory can have hazards which potentially could make it an unsafe place to work. It is critical that I follow the attached laboratory procedures to help make it a safer place to work and learn.

### TO THE STUDENT:

Print Student Name: \_\_\_\_\_

Student Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Course: \_\_\_\_\_ Teacher: \_\_\_\_\_

Yes, I wear contact lenses.

### TO THE PARENT/GUARDIAN:

I have read and discussed these safety rules with my child. I am confident that he/she understands these safety rules.

Parent Signature: \_\_\_\_\_ Date \_\_\_\_\_

*Description of my child's allergies/sensitivities, if any:*

## Material Safety Data Sheets (MSDS)

### Overview

A Material Safety Data Sheet (MSDS) is required under the OSHA Hazard Communication Standard. The MSDS is a detailed informational document prepared by the manufacturer or importer of a hazardous chemical. It describes the physical and chemical properties of the **product. MSDS's contain useful information such as flash point, toxicity, procedures for spills and leaks, and storage guidelines.**

Information included in a Material Safety Data Sheet aids in the selection of safe products, helps staff members understand the potential health and physical hazards of a chemical and describes how to respond effectively to exposure situations.

A MSDS may be useful but it can not substitute for prudent practices and comprehensive risk management. They are required as a part of any compliance obligation to be available and displayed prominently in the school science rooms/labs.

In the United States, Material Safety Data Sheets must be written in English and contain:

- the name of the chemical (same as on the label)
- the chemical and common names of the substance
- a listing of the ingredients
- a statement of the ingredients that are known carcinogens or that present other known hazards

In general, if a school purchases hazardous chemicals, a MSDS from the manufacture is also provided. It is the plan for the Madison Public Schools to have a specific area and container to house the MSDS information as labs / lessons are being taught in addition to having a notebook containing all MSDS information.

OSHA recommends that MSDSs follow the 16-section format established by the American National Standards Institute (ANSI) standard for preparation of MSDSs.

By following this recommended format, the information of greatest concern to students and workers is featured at the beginning of the data sheet, including information on chemical composition and first aid measures. More technical information that addresses topics such as the physical and chemical properties of the material and toxicological data appears later in the document. While some of this information (such as ecological information) is not required by the HCS, the 16-section MSDS is becoming the international norm. The 16 sections are:

1. Identification	9. Physical and chemical properties
2. Hazard(s) identification	10. Stability and reactivity
3. Composition/information on ingredients	11. Toxicological information
4. First-aid measures	12. Ecological information
5. Fire-fighting measures	13. Disposal considerations
6. Accidental release measures	14. Transport information
7. Handling and storage	15. Regulatory information
8. Exposure controls/personal protection	16. Other information

# SAMPLE MATERIAL SAFETY DATA SHEET (MSDS)

**FLINN SCIENTIFIC INC.**  
**"Your Safer Source for Science Supplies"**  
**Material Safety Data Sheet (MSDS)**

**MSDS #:** 47.00

## Section 1 — Chemical Product and Company Identification

### Ammonia Gas

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261  
CHEMTREC Emergency Phone Number: (800) 424-9300

## Section 2 — Composition, Information on Ingredients

Ammonia, Gas  
Synonym: anhydrous ammonia  
CAS#: 7664-41-7

## Section 3 — Hazards Identification

Colorless gas with a pungent odor.  
Moderately toxic by inhalation and ingestion. Severe irritant of eyes, respiratory tract and skin. Corrosive to eyes.  
Can cause breathing problems, chest pain, coughing and even suffocation. Can cause severe skin burns.  
Moderate fire risk.

Health-2  
Flammability-1  
Reactivity-0  
Exposure-3  
Storage-0  
0 is low hazard, 3 is high hazard

## Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.  
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.  
Eye: Immediately flush with fresh water for 15 minutes.  
External: Wash continuously with fresh water for 15 minutes.  
Internal: Give large quantities of water. Do not induce vomiting. Call a physician or poison control at once.

## Section 5 — Fire Fighting Measures

Moderate fire risk. Combustible gas.  
UEL: 25% LEL: 15% Autoignition Temperature: 1203 F  
**Fire Fighting Instructions:** Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

**NFPA CODE**  
H-3  
F-1  
R-0

## Section 6 — Accidental Release Measures

Close cylinder at once. Remove all ignition sources and ventilate room. If cylinder is leaking, evacuate the laboratory and call fire department with necessary breathing equipment.

## Section 7 — Handling and Storage

Store with the bottled gases in a secure area.  
Use and dispense in a hood.

## Section 8 — Exposure Controls, Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron.  
Use ventilation to keep airborne concentrations below exposure limits. Always wear a NIOSH-approved respirator with proper cartridges or a positive pressure, air-supplied respirator when handling this material in emergency situations (spill or fire). Exposure guidelines: TWA 25 ppm, STEL 35 ppm (NIOSH, ACGIH)

## Section 9 — Physical and Chemical Properties

Colorless gas with a pungent odor.  
Solubility: Soluble in water, moderately soluble in alcohol.  
Formula: NH<sub>3</sub>  
Formula Weight: 17.04  
Vapor Pressure: 8.75 atm (21 C)

Specific Gravity: Lighter than air.  
Relative density (air = 1) : 0.597 at 25 C.  
Melting Point: -77.7 C  
Boiling Point: -33.35 C  
Vapor Density: 0.6

## Section 10 — Stability and Reactivity

Avoid contact with strong oxidizers. Will react violently with all acids. Forms explosives compounds in contact with silver or mercury.  
Contact with halogens may cause spattering.

## Section 11 — Toxicological Information

Acute effects: Toxic, corrosive  
Chronic effects: N.A.  
Target organs: Respiratory system and eyes

ORL-RAT LD50: 350 mg/kg  
IHL-RAT LC50: 2000 ppm/4H  
SKN-RBT LD50: N.A.

N.A. = Not available, not all health aspects of this substance have been fully investigated.

## SAMPLE MATERIAL SAFETY DATA SHEET (MSDS)

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### Section 12 — Ecological Information

Data not yet available.

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### Section 13 — Disposal Considerations

Please consult with state and local regulations.

One option is to completely empty cylinder in an operating fume hood or outdoors. Avoid flames and sparks. Dispose of empty cylinder in trash, if non-refillable. Another option is to bubble the ammonia gas through water, then dispose of the resulting ammonium hydroxide solution using Flinn Disposal Method #10.

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### Section 14 — Transport Information

Shipping Name: Ammonia, Anhydrous, Liquefied

Hazard Class: 2.2 Non-flammable gas

UN Number: UN1005

N/A = Not applicable

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### Section 15 — Regulatory Information

TSCA-listed, EINECS-listed (231-635-3). RCRA D002.

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### Section 16 — Other Information

Consult your copy of the Flinn Scientific Catalog/Reference Manual for additional information about laboratory chemicals. This Material Safety Data Sheet (MSDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. Flinn Scientific Inc. assumes no legal responsibility for use or reliance upon this data.

## Web Resources

### **Connecticut High School Science Safety: Prudent Practices and Regulations**

Connecticut State Department of Education -

[http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890&sdenav\\_gid=1757](http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890&sdenav_gid=1757)

Science Safety – **Key Issues in Science Laboratory Safety** -

[http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890&sdenav\\_gid=1757](http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890&sdenav_gid=1757)

### ***Connecticut High School Science Safety Prudent Practices and Regulations:***

[http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/science\\_safety.pdf](http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/science_safety.pdf)

### ***Connecticut Middle School Science Safety Prudent Practices and Regulations:***

[http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/middleschool\\_sciencesafety.pdf](http://www.sde.ct.gov/sde/lib/sde/pdf/curriculum/science/safety/middleschool_sciencesafety.pdf)

### **Science Safety: Making the Connection**

Council of State Science Supervisors -

[http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890&sdenav\\_gid=1757](http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890&sdenav_gid=1757)

### **National Science Education Leadership Association**

<http://www.nsela.org/publications/publications2.html>

### **National Center for Education Statistics**

*NAEP Questions Tool*

<http://nces.ed.gov/nationsreportcard/itmrls>

Safety Web Links Recommended by the Connecticut State Department of Education:

- MSDS Online [www.msdsolnline.com](http://www.msdsolnline.com)
- NSTA Lab Science [www.nsta.org/handbook/labsci.asp](http://www.nsta.org/handbook/labsci.asp)
- Flinn Scientific Safety Pages [www.flinnsci.com](http://www.flinnsci.com)
- Environmental Protection Agency [www.epa.gov](http://www.epa.gov)
- Centers for Disease Control [www.cdc.gov](http://www.cdc.gov)
- Occupational Health and Safety Administration [www.osha.gov](http://www.osha.gov)
- National Fire Protection Association [www.nfpa.org](http://www.nfpa.org)
- NSTA best practices professional statements: <http://www.nsta.org/about/positions.aspx#list>

## **Curriculum Improvement Plan Worksheet**

**Identified strengths/weaknesses in student assessment and curriculum content**

**Recommendations**

**Necessary Actions**

**Persons responsible and completion dates**



## TEMPLATE FOR UNIT PLAN

### Conceptual Theme

**Unit Title:**

**Content Area Standard(s):**

**Enduring Understandings:**

**Essential Questions:**

**Underlying Concepts / Learning Objectives:**

### Evidence of Learning

**Grade Level or Course Expectations:**

**Benchmark / Assessment / Rubric**

**CMT / CAPT Correlation**

### Learning Plan

**Lessons / Activities: Scope and Sequence of Instruction:**

**Scientific Literacy Terminology**

**Instructional Resources and Materials**

## Works Consulted

Kwan, Terry, and Juliana Texley. Exploring Safely: A Guide for Elementary Teachers. Arlington, VA: NSTA Press, 2002.

Kwan, Terry, and Juliana Texley. Exploring Safely: A Guide for Middle School Teachers. Arlington, VA: NSTA Press, 2003.

Lowery, Lawrence F. Editor. Pathways to the Science Standards. Elementary School Edition. Arlington, VA: NSTA Press, 2000.

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Motz, LaMoine L., James T. Biehle, and Sandra S. West. Guide to Planning School Science Facilities. Arlington, VA: NSTA Press, 2007.

National Research Council. National Science Education Standards. Washington, DC: National Academy Press, 1996.

Rakow, Steven J. Editor. Pathways to the Science Standards. Middle School Edition. Arlington, VA: NSTA Press, 2000.

Roy, Kenneth Russell. Ready Reference Guide to Safer Science. Arlington, VA: NSTA Press, 2007.

Texley, Juliana, Terry Kwan, and John Summers. Investigating Safely: A Guide for High School Teachers. Arlington, VA: NSTA Press, 2004.

Texley, Juliana and Ann Wild, Editors. Pathways to the Science Standards. Second High School Edition. Arlington, VA: NSTA Press, 2004.

\_\_\_\_\_. Science Framework for California Public Schools. Sacramento, CA: California Department of Education, 2004.

# **Appendices**



# Scientific Process Skills for Elementary Students

## The Big Picture

- Scientific processes are tools that are needed to be scientifically literate
- Process skills are the vehicles through which you teach content – they are the focus of science as inquiry, or the thinking that goes along with content
- Process skills are consistent across all science content areas although they are introduced and applied as is developmentally appropriate
- Although there are great resources on teaching Scientific Process Skills as an isolated unit, it is imperative that they are included in every other unit of study as well.

## Background Information

The scientific process skills are the thinking skills applied in all subject areas

### ***The scientific process skills include but are not limited to:***

- **Observing** – the use of the five senses to gather data about objects and events. Example: Describing a pencil as yellow.
- **Communicating** – the use of the spoken and written words, graphs, drawings and diagrams to share information and ideas with others. Example: Describing the change in height of a plant over time in writing or through a graph.
- **Comparing** – the use of observations to ascertain similarities and differences in objects and events. Example: Placing drops of water onto different types of soil and comparing the absorption properties of the soils.
- **Classifying** – grouping objects or events according to similar properties Example: Placing all rocks having certain grain size or hardness into one group.
- **Measuring** – the use of standard or nonstandard units to determine length, mass, volume, time, etc. Example: Using a tool to measure the length of a table using non-standard, standard or metric units.
- **Predicting** – the use of data to forecast future events based on observations and inferences Example: Predicting the height of a plant in two weeks time based on a graph of its growth during the previous four weeks.
- **Inferring** – the use of logical thought process to show a relationship between observations or provide an explanation of an observation Example: Saying that the person who used a pencil made a lot of mistakes because the eraser was well worn.
- **Defining Operationally** – a definition framed in terms of your experiences. Example: Stating that “bean growth” will be measured in centimeters per week defines how much the bean grows using the students’ experience.
- **Formulating Models** – developing a conceptual or physical representation of an object or event. Examples: The students create an anatomically correct paper model of an insect.
- **Investigating**
  - *Formulating Hypotheses* – making an educated guess about the relationship of manipulated and responding variable that can be tested experimentally. Example: The greater the amount of organic matter added to the soil, the greater the bean growth.
  - *Controlling Variables* – identifying and controlling variable in order to determine their effect on the outcome of an experiment. Example: Realizing through past experiences that amount of light and water need to be controlled when testing to see how the addition of organic matter affects the growth of beans.
  - *Experimenting* – hypothesizing, designing an experiment to test the hypothesis, controlling variables, interpreting the data collected, and drawing conclusion. Example: The entire process of planning and conducting the experiment on the affect of organic matter on the growth of bean plants.

- *Interpreting Data* – analyzing and synthesizing data in order to draw a conclusion. Example: Recording data from the experiment on bean growth in a data table and forming a conclusion, which relates trends in the data to variables.
- *Relating* – the use of logical thought process to determine the relationships involving interactions, dependencies, and cause-and-effect between and among objects and events. Example: Students create a food web and investigate the interrelationship of all organisms within the food web by removing certain organisms to discover the effects of their omission on the entire community.
- *Applying* – the use of a logical thought process to put scientific knowledge to use. Example: Choosing the appropriate colored shirt on a hot summer day.

## Developing Process Skills

- Hands-on activities guided through well-chosen questioning strategies by teachers will enhance the application of process skills by students.
- Teachers act as facilitators not content experts, encouraging students to inquire, research and investigate answers to their inquiries.
- Guiding Questions:

### Observing – Ask:

- What is the most unique thing you noticed when you looked at your object or event?
- How can you find out what is making a sound?
- How can smells help you?
- What can you find out by tasting?
- What can touching tell you about an object?

### Communicating – Ask:

- What are all the ways you communicated about \_\_\_\_\_?

### Comparing – Ask:

- How is this alike or different from \_\_\_\_\_?

### Classifying – Ask:

- How could you divide your objects into two groups using another property?

### Measuring – Ask:

- How accurate was your estimate?
- How could you measure your object using a different unit?

### Predicting – Ask:

- How could you modify your prediction?

### Inferring – Ask:

- What are some other explanations for your observations?

### Defining Operationally – Ask:

- How could you revise your definition?

### Formulating Models – Ask:

- How are the actual thing and the model alike?
- How are the actual thing and the model different?

### Investigating – Ask:

- How accurate was your guess?
- Could you do the investigation another way?
- What other questions would you like to answer?
- Was this a fair test?
- What could you do to make this a fair test?

Project or Group Name \_\_\_\_\_

**Madison Public Schools**  
**Elementary Science Scoring Rubric for Projects**

Research Method	5 – Distinguished (Advanced)	3 – Satisfactory (Acceptable and Developing)	1 – Unsatisfactory (Beginning)	0-No Response
<p><i>1. Research Question / Prediction: (What do I want to find out?)</i></p> <p><i>Question - Is the problem identified and correctly stated?</i></p> <p><i>Prediction: Is the prediction testable and related to the problem?</i></p>	<ul style="list-style-type: none"> <li>▪ <b>Yes</b>, the question is realistic and appropriate limits have been set.</li> <li>▪ <b>Yes</b>, the prediction or hypothesis is logical and leads directly to the investigation. The researcher explains reasons for their prediction from the literature review or prior observation or experimentation.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Yes</b>, the question is defined but may lead to wrong conclusions.</li> <li>▪ <b>Yes</b>, the prediction relates to the question but may contain some flawed ideas.</li> <li>▪ <b>Yes</b>, but has multiple predictions or hypotheses.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>No</b>, suggests a question that is not testable, <b>but</b> the reader has some idea of what is being attempted.</li> <li>▪ <b>No</b>, the prediction does not relate to the question.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>No</b>, the question is missing.</li> <li>▪ <b>No</b>, the prediction or hypothesis is missing.</li> </ul>
<p><i>2. Experimental Procedure: (How will I find out and what are the steps I need to do?)</i></p> <p>Is the procedure logical and repeatable? For example, are the steps provided?</p> <p>Is the investigation designed so that it tests the <b>prediction or hypothesis</b>?</p> <p>Are enough tests conducted or samples used to provide enough data to <b>support or not support</b> the prediction or hypothesis?</p>	<ul style="list-style-type: none"> <li>▪ <b>Yes</b>, the plan has a very detailed list of equipment and materials and specific steps that are easily followed by some one else. Steps of the procedure are provided.</li> <li>▪ <b>Yes</b>, the investigation tests the prediction or hypothesis completely.</li> <li>▪ <b>Yes</b>, describes multiple tests or uses enough tests or samples to support or not support the hypothesis.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Yes</b>, lists some materials and steps, <b>but</b> it needs more detail and may be difficult for someone else to <u>repeat</u> in exactly the same way.</li> <li>▪ <b>Yes</b>, the procedure of investigation tests the original prediction or hypothesis <b>but</b> there may be some flaws apparent.</li> <li>▪ <b>Yes, but</b> only describes one or two tests or there is some doubt about having enough tests or samples to support or not support the hypothesis.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>No</b>, the procedure is very confusing or has serious flaws, <b>but</b> there is enough information so that the reader has an idea of what was done.</li> <li>▪ <b>No</b>, there appears to be only an awareness of question, prediction or hypothesis.</li> <li>▪ <b>No</b>, there is no description of how or if data is collected.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>No</b>, the procedure is missing. There is no attempt to design a test of the hypothesis.</li> </ul>
<p><i>3. Results / Data: (What information did I collect from my experiment?)</i></p> <p>Are the data appropriate for the stated prediction or hypothesis?</p> <p>Are the graphs and tables accurate and labeled correctly?</p> <p>Are the results summarized correctly in a brief narrative?</p> <p>Was a mean or average used when appropriate?</p>	<ul style="list-style-type: none"> <li>▪ <b>Yes</b>, the data is appropriate for the stated prediction or hypothesis.</li> <li>▪ <b>Yes</b>, the data is accurately recorded and organized with tables, graphs, or drawings Including labels and units.</li> <li>▪ <b>Yes</b>, the results are summarized correctly in sentence form.</li> <li>▪ <b>Yes</b>, a mean or average was used if appropriate.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Yes</b>, the data is appropriate to test the prediction or hypothesis.</li> <li>▪ <b>Yes</b>, the data is displayed accurately and labeled but may have some minor point missing.</li> <li>▪ <b>Yes</b>, the results were summarized but it is incomplete.</li> <li>▪ <b>No</b>, a mean or average was not used when needed.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>No</b>, the data does not help make any judgments about the prediction or hypothesis. There was only an incomplete attempt to include data or it was photocopied from a textbook.</li> <li>▪ <b>No</b>, results are incomplete, unlabeled and unusable.</li> <li>▪ <b>No</b>, a summary was not included.</li> <li>▪ <b>No</b>, a mean or average was not used when needed.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>No</b>, the data is missing.</li> <li>▪ <b>No</b>, there was no summary of results.</li> </ul>

Research Method	5 – Distinguished (Advanced)	3 – Satisfactory (Acceptable and Developing)	1 – Unsatisfactory (Beginning)	0-No Response
<p><b>4. Conclusion and Future Research</b> (What did I find out? What changes would I make to my experiment?)</p> <p>Does the student write about their prediction or hypothesis?</p> <p>Does the student indicate that their data <b>supported or did not support</b> the prediction or hypothesis?</p> <p>Are the conclusions and inferences logical and correct?</p> <p>Did the student suggest changes or improvements to the experiment for the future?</p>	<ul style="list-style-type: none"> <li>▪ <b>Yes</b>, the prediction or hypothesis is addressed.</li> <li>▪ <b>Yes</b>, the results of the data are clearly and accurately related to the prediction or hypothesis.</li> <li>▪ <b>Yes</b>, the conclusions are logical and correct.</li> <li>▪ <b>Yes</b>, identifies problems with the investigation and explains how the project could be extended or improved the next time it is performed.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Yes</b>, the prediction or hypothesis is addressed.</li> <li>▪ <b>Yes</b>, the results or data are related to the prediction or hypothesis, <b>but</b> there may be some minor errors present.</li> <li>▪ <b>Yes</b>, the conclusions and inferences are logical and correct with some minor errors present.</li> <li>▪ <b>Yes</b>, refers to some problems with the design of the investigation <b>but</b> does not suggest improvements or suggests future investigations, <b>but</b> does not identify problems with the investigation.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>No</b>, does not mention the prediction or hypothesis.</li> <li>▪ <b>No</b>, does not relate the data to the prediction or hypothesis.</li> <li>▪ <b>No</b>, there are major errors or the conclusions are not logical or correct.</li> <li>▪ <b>No</b>, does not suggest problems with the project and ways to improve it. Does not suggest future investigations.</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>No</b>, the conclusion is missing.</li> </ul>
<p><b>Total Scores:</b></p> <p><b>1. Question / Prediction</b></p> <p><b>2. Lit Review</b></p> <p><b>3. Expert Procedure</b></p> <p><b>4. Results / Data</b></p> <p><b>5. Conc /Future Res</b></p>	<p><b>Scores for District Assessment:</b></p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>			



## Elementary Science Individual Student Response Scoring Rubric for Accountability

Following completion of the project, each student was to have written a response to three general topics about their investigation. You are to read the response to these items and give **one overall rating** based on the student's response to each of the three questions. **This score should be an average of the score you would give on the three parts.**

- A complete statement of the problem or question investigated. The student should include their prediction or hypothesis.
- A short summary explaining what they found out from their data.
- An explanation about whether the data agreed or disagreed with their original prediction or hypothesis.

**Use the following rubric to assess the student individual responses.**

	<i><b>5</b></i> <i><b>Distinguished</b></i> <i><b>(Advanced)</b></i>	<i><b>3</b></i> <i><b>Satisfactory</b></i> <i><b>(Acceptable)</b></i>	<i><b>1</b></i> <i><b>Unsatisfactory</b></i> <i><b>(Beginning)</b></i>	<i><b>0</b></i> <i><b>No Response</b></i>
<b>Description of the question and prediction</b>	States clearly and precisely the problem investigated and the prediction or (hypothesis) tested.  Provides a great amount of detail.	The problem and the prediction are stated but some points may not be clear  Some minor misunderstandings may be present.	Gives a very brief or inadequate description. Does not communicate either the problem or the prediction. (e. g. plants)	No response or writes about an unrelated issue.
<b>Explanation of the results (conclusion)</b>	States a complete and logical explanation of the results.  May quote the results.	States a reasonable explanation of the results.  Some minor misunderstanding may be present.	Response does not explain the data or results.  Major errors are present or the response is so short it does not explain the results.	No response or writes about an unrelated issue.
<b>Explanation of how the results support or do not support the prediction</b>	States a complete and logical explanation of the connection between the data and the prediction.  May quote the results.	States a reasonable connection between the data and the prediction.  Some minor misunderstandings may be present.	Response does not explain the connection between the data and the prediction.  Explanation is very confused.	No response or writes about an unrelated issue.



# LABORATORY REPORT

## for Middle School

Name \_\_\_\_\_

Teacher \_\_\_\_\_

Date \_\_\_\_\_

### Title

#### I. Purpose:

The purpose is a statement of what you are trying to learn by performing this lab. It may be in the form of a question.

#### II. Hypothesis:

The hypothesis is your belief as to what the outcome of the lab will be and your reasoning behind it. This is an educated guess and does not need to be correct.

It should be written as an "If ... then" statement with an explanation.

"If... (the independent variable is changed, then ... (a changed measurement in the dependent variable) because ... (This is based on what you know so far about how the materials interact.)

**Independent Variable:** \_\_\_\_\_

**Dependent Variable:** \_\_\_\_\_

#### III. Materials:

The materials needed are noted. They should be listed neatly in columns.

#### IV. Procedure:

- 1.) The procedure is a numbered list of directions for performing the lab.
- 2.) It should be a step-by-step set of instructions explaining everything that is to be done.

**Control:** \_\_\_\_\_

**Constant:** \_\_\_\_\_

#### V. Data / Observations:

In this section record anything that you observe or measure. The observations should be both quantitative and qualitative. At times, measurements may be recorded in a table or a graph.

Be sure NOT to give any explanations or analysis in this section of the report.

#### VI. Conclusion:

The conclusion must be written in paragraph form. It should be three to five paragraphs in length and address the following:

- Restate the purpose of the lab and the hypothesis of the lab.
- State the results of the lab noting if the hypothesis was correct or incorrect using essential supporting data.
- Write a brief description of how the lab was performed. Note specific data such as the median or ranges of data to support the statements made.
- Discuss the overall validity of the experiment. What errors could have occurred while performing this lab? If given the chance to perform this lab again, what could be done differently to improve accuracy?
- Discuss what you learned by performing this lab. How can what was learned be applied to the real world?

## Middle School Lab Report Scoring Rubric

	<b>2</b>	<b>1</b>	<b>0</b>
<b>Proper Heading</b>	The heading is complete including name, teacher name, core, and date.	The heading is incomplete.	The heading is missing.
<b>Title</b>		The title is present.	The title is missing.
<b>Purpose or Scientific Question</b>		The purpose of the lab is stated.	The purpose of the lab is not stated.
<b>Hypothesis</b>	The hypothesis is complete with “If...then...and because...”	The hypothesis is incomplete with only the “If...then...”	The hypothesis is missing.
<b>Independent Variable</b>	The independent variable is clearly and accurately identified.	The independent variable is unclear or inaccurate.	The independent variable is not identified.
<b>Dependent Variable</b>	The dependent variable is clearly and accurately identified.	The dependent variable is unclear or inaccurate.	The dependent variable is not identified.
<b>Materials</b>	The materials list is complete and listed in columns.	The materials list is incomplete and/or is not listed in columns.	The materials list is not included.
<b>Procedure</b>	The procedure is written in clear steps and easy to follow.	The procedure is unclear or not written in steps.	The procedure is incomplete or missing.
<b>Control</b>		The control is accurately identified.	The control is not identified.
<b>Constants</b>	Two or more constants are accurately identified.	One constant is accurately identified.	No constant is accurately identified.
<b>Observation</b>	A table showing quantitative data is complete and accurate	Data is incomplete or inaccurate or not displayed in a table.	Data is not included.
	A graph of significant data is complete, accurate and neatly done.	A graph is incomplete or inaccurate.	A graph is missing.
	Qualitative observations are accurate and well-described.	Qualitative observations are incompletely described.	Qualitative observations are missing.
<b>Format</b>	The lab report is written/typed neatly and in the correct format.	The lab report is not written neatly or not in the correct format.	The lab report is not written neatly and not in the correct format.

	<b>2</b>	<b>1</b>	<b>0</b>
<b>Conclusion</b>		The purpose is restated.	The purpose is not restated.
	The hypothesis is noted as being correct or incorrect with an explanation.	The hypothesis is noted as being correct or incorrect with no explanation.	The accuracy of the hypothesis is not mentioned.
	The lab procedure is summarized accurately.	The lab procedure is summarized inaccurately or unclearly.	The lab procedure is not included.
	The results are stated with supporting data.	The results are stated with no supporting data.	The results are not stated.
		Possible errors are discussed.	Possible errors are not included.
	At least two things are noted that could be done to improve accuracy.	One thing is noted that could be done to improve accuracy.	Nothing is noted that could be done to improve accuracy.
	What you learned from the lab is noted including how it can apply to the real world.	What you learned from the lab or how the lab can apply to the real world is noted.	What you learned from the lab and how the lab can apply to the real world is not noted.

**Total Score:** \_\_\_\_ / **39** \_\_\_\_

**Grade:** \_\_\_\_\_



# Rubric for Scoring Curriculum Embedded High School Laboratory Investigations

## Statement of the Problem and Hypothesis

- 3 The problem and hypothesis are stated clearly and completely. Clear identification of independent and dependent variables.
- 2 The problem and hypothesis are stated adequately. Adequate identification of independent and dependent variables.
- 1 The problem and/or hypothesis are poorly stated. Poor identification of independent and dependent variable.
- 0 The statement of the problem and/or hypothesis is very limited or missing altogether. No identification of independent and dependent variables.

## Experimental Design

- 3 The experimental design matches the stated problem. Variables are held constant. The procedures are clear, complete and replicable. A control is included when appropriate.
- 2 The experimental design generally matches the stated problem. Attempt at holding variables constant is made. Procedures are generally complete. Minor modifications or clarifications may be needed.
- 1 The experimental design matches the stated problem to some extent. Little attempt to hold variables constant. Procedures are incomplete. Major modifications or clarifications may be needed.
- 0 The experimental design does not match the stated problem, is very incomplete or missing. There is no attempt to hold variables constant.

## Data Presentation

- 3 Data are well organized and presented in an appropriate manner.
- 2 Data are organized and presented in an appropriate manner. Minor errors or omissions may be present.
- 1 Data are poorly organized or presented in an inappropriate manner. Major omissions or errors may be present.
- 0 Data are very poorly organized or presented in an inappropriate manner or missing altogether.

## Conclusion

- 3 Conclusions are fully supported by data and address the hypothesis. Reliability of data and validity of conclusions are thoroughly discussed.
- 2 Conclusions are generally supported by data and address the hypothesis. Minor errors in interpretation of results may be present. Discussion of reliability of data and validity of conclusions is limited.
- 1 Conclusions are supported by data and address the hypothesis to a limited extent. Major errors in interpretation of results may be present. There is little discussion of the reliability of the data or validity of conclusions.
- 0 Conclusions are not supported by data, do not address the hypothesis or are missing. There is no discussion of the reliability of data or validity of conclusions.

Excellent performance	10-12 points
Proficient performance	7-9 points
Marginal performance	4-6 points
Unsatisfactory performance	0-3 points

## Sample End of Course Tests

1. Georgia

[www.doe.k12.ga.us/ci\\_testing.aspx?PageReq=CI](http://www.doe.k12.ga.us/ci_testing.aspx?PageReq=CI)

2. North Carolina

[pmhs.ucps.k12.nc.us/Academics/EOC\\_Review.php](http://pmhs.ucps.k12.nc.us/Academics/EOC_Review.php) -Biology

- [Virginia Released 2004 EOC Test Interactive](#)
- [Virginia Released 2005 EOC Test Interactive](#)
- [Virginia Released 2006 EOC Test Interactive](#)
- [Tennessee Practice Test in Science - Biology Focus Questions](#)
- [NC Test Item Sample Questions](#)
- [Multiple Choice Test Questions and Review Materials](#) - from Regents
- [EOC Released Test from Virginia - Interactive](#)
- [Texas Released 2000 EOC State Test Interactive](#)
- [Texas Released 2001 EOC State Test Interactive](#)
- [Texas Released 2002 EOC State Test Interactive](#)
- [Lew-Ports Biology Place](#) - Contains multiple choice interactive questions
- [Sample Quizzes for All Topics](#)
- [Mitosis & Meiosis Review Game](#)
- [Biology Review Games](#)
- [Mrs. Truman's EOC Review Website](#)

3. Virginia

[www.iq.poquoson.org/2005vasol/eocbio/eocbio05.htm](http://www.iq.poquoson.org/2005vasol/eocbio/eocbio05.htm)

4. Missouri

[dese.mo.gov](http://dese.mo.gov) > [Curriculum & Assessment](#)

End-of-Course Released Items

Biology	<a href="#">Card</a>	<a href="#">Released Form</a>	<a href="#">Released Form</a>
	<a href="#">PE Card</a>	<a href="#">Answer Key</a>	<a href="#">Released Rubric</a>

5. Louisiana

[www.doe.state.la.us/lde/saa/2617.html](http://www.doe.state.la.us/lde/saa/2617.html)

[Biology](#)

[Biology EOC Assessment Guide PDF](#)

6. Tennessee

[www.tennessee.gov/education/assessment/doc/AYPEOCBIO1\\_PT.pdf](http://www.tennessee.gov/education/assessment/doc/AYPEOCBIO1_PT.pdf)

7. Arkansas

[arkansased.org/testing/assessment/endofcourse.html](http://arkansased.org/testing/assessment/endofcourse.html)

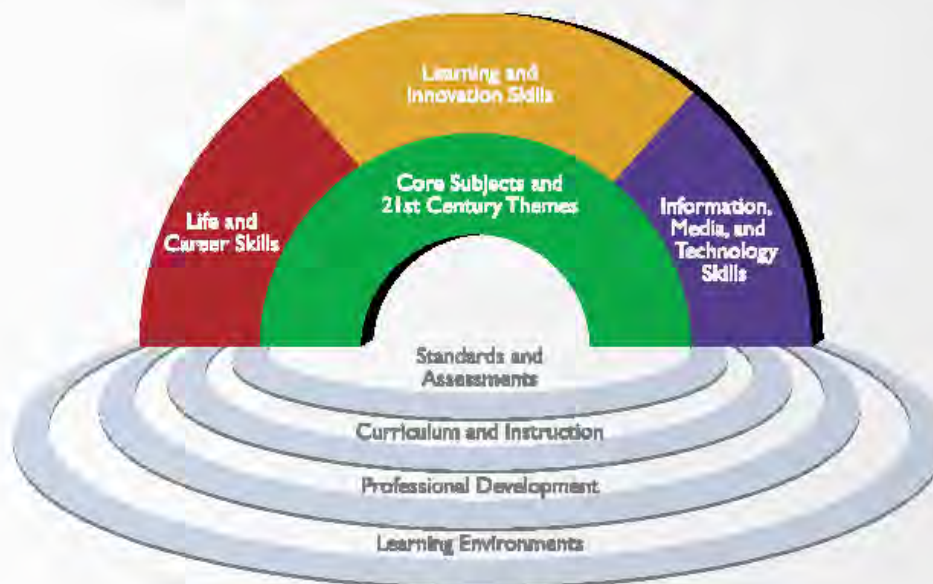




# Framework for 21st Century Learning

The Partnership for 21st Century Skills has developed a vision for 21st century student success in the new global economy.

## 21st Century Student Outcomes and Support Systems



## 21ST CENTURY STUDENT OUTCOMES

The elements described in this section as "21st century student outcomes" (represented by the rainbow) are the skills, knowledge and expertise students should master to succeed in work and life in the 21st century.

The Partnership for 21st Century Skills has developed a unified, collective vision for 21st century learning that will strengthen American education. The Partnership created the Framework for 21st Century Learning, which describes the skills, knowledge and expertise students must master to succeed in work and life. Only when a school or district combines the Framework with 21st century professional development, assessments and standards, can the American public be sure that high school graduates are prepared to thrive in today's global economy.

21st century skills represent the necessary student outcomes for the 21st century, i.e. students need to obtain Learning and Innovation Skills (creativity and innovation, critical thinking and problem solving, etc.), Information, Media and Technology Skills, Core Subjects and 21st Century Themes (global awareness, financial literacy, etc.) and Life and Career Skills (initiative and self-direction, among others) – the colored parts of the rainbow.

Publication date: 04/22/09

### Core Subjects and 21st Century Themes

Mastery of **core subjects and 21st century themes** is essential for students in the 21st century. Core subjects include English, reading or language arts, world languages, arts, mathematics, economics, science, geography, history, government and civics.

We believe schools must move beyond a focus on basic competency in core subjects to promoting understanding of academic content at much higher levels by weaving **21st century interdisciplinary themes** into core subjects:

- **Global Awareness**
- **Financial, Economic, Business and Entrepreneurial Literacy**
- **Civic Literacy**
- **Health Literacy**

### Learning and Innovation Skills

Learning and innovation skills are what separate students who are prepared for increasingly complex life and work environments in the 21st century and those who are not. They include:

- **Creativity and Innovation**
- **Critical Thinking and Problem Solving**
- **Communication and Collaboration**

### Information, Media and Technology Skills

People in the 21st century live in a technology and media-driven environment, marked by access to an abundance of information, rapid changes in technology tools and the ability to collaborate and make individual contributions on an unprecedented scale. To be effective in the 21st century, citizens and workers must be able to exhibit a range of functional and critical thinking skills, such as:

- **Information Literacy**
- **Media Literacy**
- **ICT (Information, Communications and Technology) Literacy**

### Life and Career Skills

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills, such as:

- **Flexibility and Adaptability**
- **Initiative and Self-Direction**
- **Social and Cross-Cultural Skills**
- **Productivity and Accountability**
- **Leadership and Responsibility**

## 21ST CENTURY SUPPORT SYSTEMS

Developing a comprehensive framework for 21st century learning requires more than identifying specific skills, content knowledge, expertise and literacies. An innovative support system must be created to help students master the multi-dimensional abilities required of them in the 21st century. The Partnership has identified five critical support systems that ensure student mastery of 21st century skills:

- **21st Century Standards**
- **Assessments of 21st Century Skills**
- **21st Century Curriculum and Instruction**
- **21st Century Professional Development**
- **21st Century Learning Environments**

For more information, visit the Partnership's website at [www.21stcenturyskills.org](http://www.21stcenturyskills.org).



### Member Organizations

- Adobe Systems, Inc.
- American Association of School Librarians
- Apple
- ASCD
- Atomic Learning
- Blackboard, Inc.
- Cable in the Classroom
- Cisco Systems Inc.
- Corporation for Public Broadcasting
- Dell, Inc.
- EF Education
- Education Networks of America
- Educational Testing Service
- Ford Motor Company Fund
- Gale, Cengage Learning
- Hewlett Packard
- Intel Corporation
- JA Worldwide®
- K12
- KnowledgeWorks Foundation
- Learning.com
- Learning Point Associates
- LEGO Group
- Lenovo
- McGraw-Hill
- Measured Progress
- Microsoft Corporation
- National Education Association
- Oracle Education Foundation
- Pearson
- PolyVision
- Quarasant!
- Scholastic Education
- Sesame Workshop
- Sun Microsystems, Inc.
- THINKronize
- Verizon
- Wireless Generation

## 21<sup>st</sup> Century Skills Overview

### Life and Career Skills

Today's life and work environments require far more than thinking skills and content knowledge. The ability to navigate the complex life and work environments in the globally competitive information age requires students to pay rigorous attention to developing adequate life and career skills.

### FLEXIBILITY AND ADAPTABILITY

#### *Adapt to Change*

- Adapt to varied roles, jobs responsibilities, schedules and context
- Work effectively in a climate of ambiguity and changing priorities

#### *Be Flexible*

- Incorporate feedback effectively
- Deal positively with praise, setbacks and criticism
- Understand, negotiate and balance diverse views and beliefs to reach workable solutions, particularly in multi-cultural environments

### INITIATIVE AND SELF-DIRECTION

#### *Manage Goals and Time*

- Set goals with tangible and intangible success criteria
- Balance tactical (short-term) and strategic (long-term) goals
- Utilize time and manage workload efficiently

#### *Work Independently*

- Monitor, define, prioritize and complete tasks without direct oversight

#### *Be Self-directed Learners*

- **Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise**
- Demonstrate initiative to advance skill levels towards a professional level
- Demonstrate commitment to learning as a lifelong process
- Reflect critically on past experiences in order to inform future progress

### SOCIAL AND CROSS-CULTURAL SKILLS

#### *Interact Effectively with Others*

- Know when it is appropriate to listen and when to speak
- Conduct themselves in a respectable, professional manner

#### *Work Effectively in Diverse Teams*

- Respect cultural differences and work effectively with people from a range of social and cultural backgrounds
- Respond open-mindedly to different ideas and values
- Leverage social and cultural differences to create new ideas and increase both innovation and quality of work

**PRODUCTIVITY AND ACCOUNTABILITY***Manage Projects*

- Set and meet goals, even in the face of obstacles and competing pressure
- Prioritize, plan and manage work to achieve the intended result

*Produce Results*

- Demonstrate additional attributes associated with producing high quality products including the abilities to:
  - Work positively and ethically
  - Manage time and projects effectively
  - Multi-task
  - Participate actively, as well as be reliable and punctual
  - Present oneself professionally and with proper etiquette
  - Collaborate and cooperate effectively with teams
  - Respect and appreciate team diversity
  - Be accountable for results

**LEADERSHIP AND RESPONSIBILITY***Guide and Lead Others*

- Use interpersonal and problem-solving skills to influence and guide others toward a goal
- Leverage strengths of others to accomplish a common goal
- Inspire others to reach their very best via example and selflessness
- Demonstrate integrity and ethical behavior in using influence and power

*Be Responsible to Others*

- Act responsibly with the interests of the larger community in mind