Chemistry-10

Summit High School
Summit, NJ

Grade Level / Content Area:

10th Grade
Chemistry

Developed by
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Summit High School
2020-2021

Length of Course: 1 year

Course of Study

Unit 1: Study of Matter Using Experimental Methods (4-Weeks)

1. Categorization of matter (3-days)
    a. Defining Elements, compounds, heterogeneous and homogeneous mixtures
    b. General phase description
    c. Melting ice in fresh and saltwater lab
2. Laboratory techniques and Safety (3-days)
    a. Safety quiz
    b. Laboratory procedures and expectations
    c. Analysis and recording data.
    d. Density lab
3. Chemical and physical properties and changes (5-days)
    a. Distinguish between chemical and physical properties
    b. Physical separation techniques
    c. Distinguish between chemical and physical changes
    d. Evidence for chemical changes
    e. Iron, salt and sand lab: formal write-up
    f. Copper (II) Chloride + Aluminum lab
4. Scientific measurement (4-days)
    a. Scientific Notation
    b. Significant figures
    c. Qualitative vs. Quantitative
    d. Interpretation vs. observation
    e. Measure for Measure Lab
5. Dimensional analysis: Unit conversions (metric and non metric) (1-day)

Unit 2: Atomic Structure, Nuclear Chemistry and Stellar Chemistry (5.5-Weeks)

1. Historical development of atomic structure and the scientific process (3-days)
    a. Dalton: “The age of discovery”
    b. Thomson: Cathode ray tube and the plum pudding model
    c. Rutherford: Gold foil experiment and new model
2. General description of the periodic table. (3-days)
    a. 3 major subatomic particles
    b. Isotopes and ions
    c. Mass #, atomic #, charge table
3. The Nucleus and Formation of the Universe “The Big Bang Theory” (10-days)
    a. Formation of elements in stars
    b. Fusion: Nuclear transmutation
    c. Life Cycle of a star
    d. General description of the Universal origin from a point of singularity.
    e. The 4 pillars of evidence from the big bang
4. Change in composition of nucleus through nuclear reactions (8-days)

a. Forces within the nucleus
b. Radioactive Stability: Band of stability
c. Completing nuclear equations
d. Types of nuclear decay
e. Rate of Decay (½ Lives)
f. ½ Life activity (Penny flipping)

5. Fission: Uses of atomic energy (4-days)
    a. Energy from nuclear reactions: Nuclear binding energy
    b. Nuclear chain reactions
    c. Nuclear power plants
6. Radiation in the center of the Earth and plate tectonics (3-days)
    a. Sources of heat in the Earth's interior
    b. Plate Tectonics and Convection currents
    c. Dating rocks with radioactive isotopes

Unit 3: Periodicity and Atomic Emission Spectra (4-Weeks)

1. Electromagnetic Spectrum (3-days)
    a. Relationship between energy, wavelength and frequency
    b. Photoelectric Effect, the quantum nature of electromagnetic radiation.
2. Bohr atom (2-days)
    a. Behavior of electrons in atoms and the hydrogen spectra
    b. Quantum relationship between electrons and light and the structure of the atom.
3. Quantum mechanical atom (3-days)
    a. De Broglie and the quantum nature of matter
    b. Shroedinger and quantum numbers
    c. Arrangement of the elements in the periodic table
4. Patterns of chemical properties (3-days)
    a. Mendeleev and the modern periodic table
    b. Electron configurations
5. Periodic properties and periodic trends (5-days)
    a. Nuclear pull and the properties of elements
    b. Atomic Radii
    c. Ionization energy
    d. Reactivity
    e. Periodic trends lab

Unit 4: Bonding and Chemical Reactions (5.5 Weeks + 1 week for MT)

1. Chemical bonding (18-days)
    a. Ionic Bonds (5-days)
        i. General description and properties
        ii. Predicting formulas
        iii. Naming ionic compounds
        iv. Ionic bonding ppt lab
    b. Covalent bonds (6-days)
        i. General description and properties

ii. Lewis structures
iii. Predicting polarity
iv. VSEPR theory model lab

c. Metallic bonds (2-days)
i. General description and properties
ii. Alloys and properties

d. Intermolecular forces (5-days)
i. Structure of types of intermolecular forces
ii. Classification of solids lab

Midterm

1. Chemical reactions (5-days)
    a. Balancing chemical reactions
    b. Classifying chemical reactions
    c. Types of reactions lab

Unit 5: Calculations in Chemistry (3-Weeks)

1. The Mole (6-days)
    a. Mass - mole number of particles conversions
    b. Percent composition
    c. Copper (II) sulfate pentahydrate lab
    d. Empirical and Molecular formulas
    e. Mg + O_2 lab
2. Stoichiometry (6-days)
    a. Mass - mass calculations
    b. Limiting and excess reagents
    c. Percent yield
    d. Sodium bicarbonate lab

Unit 6: Changes of State and Aqueous Solutions (5.5-Weeks)

1. Changes of State (2-days)
    a. Atmospheric Pressure and Kelvin Temperature Scale
    b. Changes of State
    c. Vapor pressure curves and phase diagrams
2. Properties of Gases (6-days)
    a. Kinetic Molecular Theory
    b. Empirical Gas Laws
    c. Ideal Gas laws
    d. Gas Stoichiometry
    e. Airbag lab
    f. Eudiometer lab
3. Reactions in aqueous media (10-days)
    a. Properties of water
    b. Like Dissolves Like and the solution process
    c. Solubility and factors influencing rates of solution
    d. Saturated and unsaturated
    e. Molarity and Dilutions

f. Dissociation: electrolytes and nonelectrolytes
g. Net ionic equations
h. Acid Base Reactions
i. pH Scale
j. Titration lab

Unit 7: Energy in chemical and physical changes (2.5-Weeks)

1. Energy and chemical reactions (10-days)
    a. Thermal energy, Heat, Temperature
    b. Thermochemical Equations
    c. Endothermic and Exothermic reactions
    d. First 3 Laws of Thermodynamics
    e. Measuring heat: Specific heat lab
2. Energy Changes and States of Matter: (10-days)
    a. Calculating ΔH
    b. Measuring energy of phase changes: Melting ice lab
    c. Heats of solutions lab
    d. Hess's Law
    e. Measuring heat of chemical reactions MgO lab
    f. Energy in Food lab

Unit 8: Kinetics and Equilibrium (2.5-Weeks)

1. Kinetics (5-days)
    a. Collision theory
    b. Factors that affect the rate of a reaction
    c. Rate laws
    d. Mechanisms
    e. Iodine clock lab
2. Equilibrium (5-days)
    a. Definition
    b. K expressions
    c. LeChatelier's Principle
    d. Equilibrium lab

Unit 9: Independent Projects in Chemistry: Environmental Chemistry

Final Exam

Summit High School
Summit, NJ

10th Grade Chemistry

Course Description: Chemistry (412) is an inquiry based learning approach to developing the major chemistry concepts. It incorporates laboratory experiments and classroom discussion as well as traditional lectures and hands-on activities. The atomic theory, the nature of matter in its various phases, chemical periodicity, and the mole concept are studied early in the course. Among the basic principles included are energy, reaction rates, reaction equilibrium, and characteristics of chemical reactions, acid-base behavior, oxidation-reduction reactions and electrochemistry. Students apply their knowledge of algebra to solve chemistry problems. This course enables students to develop their quantitative skills and their communication skills. Students will be able to demonstrate an understanding of how chemical principles are applied to "real world" problems and processes. Topics in the media and popular culture will be used as a platform for discussing chemistry principles. In order to enhance scientific literacy and communication skills, each student will write a research paper and communicate their findings to the class.

Unit 1
Study of Matter Using Experimental Methods

NEXT GENERATION SCIENCE STANDARDS
HS-PS1:Matter and Its Interactions
HS-ESS2: Earth's Systems
HS.Engineering Design

Big Ideas: *Course Objectives / Content Statement(s)*

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8)
- Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)
- Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**
● Can the physical world be described without chemistry? ● What determines whether a substance will be a solid, liquid, or gas? ● How is the separation of mixtures critical to our economy and standard of living? ● Why is it important to differentiate between elements and compounds? ● What is the source of elements and what does that mean about the history of the universe? ● Could there be undiscovered elements existing in outer space? ● Can the history of the Earth be told with Chemistry?	Students will understand that… **Patterns** ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.(HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5) **Energy and Matter** ● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8) ● The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) **Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6) **Structure and Function**

	● The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5)

Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas	Examples, Outcomes, Assessments (4-Weeks)
PS1.A: Structure and Properties of Matter ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2) ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6) ● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4) **ESS2.A: Earth Materials and Systems** ● Evidence from deep probes and seismic waves, reconstructions of historic changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its places occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3)	**Instructional Focus** ● Review laboratory techniques, identification of different types of equipment and safety. ● Explain laboratory expectations and procedures. ● Distinguish between elements, compounds, heterogeneous and homogeneous mixtures ● Properties of elements found in compounds have completely different properties from those found in elemental form ● Recognize and interpret symbols for elements and formulas for compounds ● Describe the ways in which elements are assigned names and symbols, and some ways in which new elements have been discovered. ● General differences in the physical properties of solids, liquids, and gases are explained by the ways in which the atoms, ions, or molecules of the substances are arranged, and by the strength of the forces of attraction between the atoms, ions, or molecules. ● Distinguish between chemical and physical properties and changes ● Review physical separation techniques ● Explain evidence of chemical changes ● There is a vast history of discovering elements that continues with laboratory work today ● Many of the elements known today can be found on Earth ● Identify the different layers of the Earth and the composition of each. ● Explain which elements are found in each layer of the Earth. ● Change numbers from scientific notation to standard notation and vice versa ● Determine the number of significant figures in a measurement

● All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) **ESS1.C: The History of Planet Earth** ● Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6)	● Distinguish between qualitative and quantitative measurements and observations ● Record and interpret data appropriately ● Use dimensional analysis to convert between units of measurement
Differentiation	**Assessments**
Interdisciplinary Connections ● Writing: sufficient technical writing to achieve procedural objective ● Language: element names and symbols based on foreign languages ● History: How scientific techniques have evolved to allow the isolation of even more elements ● Earth Science: Identifying the different layers of the Earth and the composition of each. **Technology Integration** ● Excel used for data analysis and graphing. ● Online tutorials and virtual labs can be used for differentiation. **Media Literacy Integration** ● Use the "elements" video to stimulate interest in the topic ● Use the "Hindenburg" article to relate Chemistry to a historical event **Global Perspectives** ● Examine periodic tables from other countries to see how the study of Chemistry is similar and is different across the globe	**Sample Assessments:** ● At home activity: ice cube melting experiment ● Activity: determining density graphically ● Identification of Laboratory Equipment and their uses ● Lab: Mixture Separation ● Lab: Using Google Sheets for Density Determination ● Lab: Observing a Chemical Reaction ● Lab: Measure for Measure ● Chapter Tests and quizzes with multiple choice, short answer, calculations and open-ended questions.

Unit 2
Atomic Structure and Nuclear Chemistry and Stellar Chemistry

NEXT GENERATION SCIENCE STANDARDS
HS-PS1:Matter and Its Interactions
HS-PS4: Waves and Their Applications in Technologies for Information Transfer
HS-ESS1: Earth's Place in the Universe

Big Ideas: *Course Objectives / Content Statement(s)*

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Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

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- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**
● How do we know what we cannot see? ● Is all matter the same? ● How do scientific surprises advance understanding? ● What is an atom and how has that definition changed over time? ● Is there evidence that exists that suggests our current model of the atom is not sufficient? ● Where did all the elements on Earth originate? ● How do we know the universe is expanding? ● Are all forms of radiation harmful? ● Is nuclear power worth the risk? ● How does nuclear chemistry affect your everyday life? ● Why is nuclear power essential for many fields of medicine? ● How can nuclear power be useful as a future source of energy?	Students will understand that... **Patterns** ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5) **Energy and Matter** ● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8) ● The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) ● Energy cannot be created or destroyed-only moved between one place and another place, between objects and/or fields, or between systems (HS-ESS1-2) ● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-ESS1-3) **Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS1-6) ● Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1) **Structure and Function** ● Investigating or designing new systems or structures requires a detailed examination of the properties

	of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2- 6) ● The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5) **Cause and Effect** ● Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1) ● Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS4-4) Systems can be designed to cause a desired effect. (HS-PS4-5)

Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas	Examples, Outcomes, Assessments (5.5 Weeks)
PS1.A: Structures and Properties of Matter ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.(HS-PS1-3) (HS-PS2-6) **PS1.C: Nuclear Processes** ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (HS-PS1-8) ● Spontaneous radioactive decay follows a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.(HS-ESS1-6)	**Instructional Focus:** ● Development and refinement of modern atomic theory with a focus on benchmark experiments and the scientific process. ● Distinguish between protons, electrons and neutrons in terms of their location, mass and charge. Apply these ideas to the terms mass number, atomic number, isotopes and charge. ● Explain the formation of elements in stars. ● Describe the life cycle of a star ● Give a general description of the Universal origin from a point of singularity. ● Define the 4 pillars of evidence from the Big Bang ● Define nuclear reactions and identify the three different types of radiation that can be given off; alpha, beta and gamma radiation. ● Write and balance nuclear reactions to show the conservation of energy. ● Explain the Band of Stability ● Calculate the amount of nuclear material remaining using half life. ● Use radioactive dating to determine the age of objects found on Earth and relate to history of Earth's development ● Compare and contrast fission and fusion.

PS4.B: Electromagnetic Radiation ● When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-ray s, gamma ray s) can ionize atoms and cause damage to living cells. (HS-ESS1-2) **PS3.D: Energy in Chemical Processes and Everyday Life** ● Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (HS-ESS1-4) **ESS1.A : The Universe and Its Stars** ● The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) ● The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3) ● The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) ● Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2),(HS-ESS1-3) **ESS2.A: Earth Materials and Systems** ● Evidence from deep probes and seismic waves, reconstructions of historic changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its places occur primarily through thermal	● Describe the pro's and con's of nuclear power; including its role as an energy source for the future. ● Explain how nuclear power is used in different fields of medicine and the treatment of illnesses. ● Describe the sources of heat in the Earth's interior ● Review plate tectonics and convection currents.

convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3) **ESS2.B: Plate Tectonics and Large-Scale System Interactions** ● Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history (HS-ESS1-5) (HS-ESS2-1) ● Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (HS-ESS2-1) ● Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3) **PS3.A: Definitions of Energy** ● These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration. In some cases the relative position energy can be thought of as stored in fields. This last concept includes radiation, a phenomenon in which energy stored in fields moves across space (HS-PS3-2) **ESS1.C: The History of Planet Earth** ● Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6)	
Differentiation	**Assessments**
Interdisciplinary Connections	**Sample Assessments:**

● History: Connect scientific discoveries in various countries to the political and cultural climate in each location ● Mathematics: Statistical analysis of data collected. ● Earth Science: Use radioactive dating to determine the age of the Earth. Explaining sources of heat in the center of the Earth and movement of plate tectonics. **Technology Integration** ● Use spreadsheet and other analysis tools to examine the relationships of atoms on periodic table ● Online Phet interactive simulations on atoms, isotopes and ions ● Frontline Video: Radioactive Wolves, Fukushima Meltdown ● NOVA video on core sampling ● NOVA video: Life's Rocky Start **Media Literacy Integration** ● Use video clips and articles to stimulate interest in the topic ● Compare scientifically reviewed articles (e.g. Nature) to popular literature (e.g. Newsweek)for the same breakthrough. Relate this to the development of atomic theory. **Global Perspectives** ● Compare the development of atomic theory in other cultures as it relates to governmental structures. ● Participate in a Global Classroom Chat on a topic related to this unit	● Activity: create a timeline showing the significant developments of atomic theory. ● Lab: Candium (use candy to demonstrate how an average atomic mass is calculated) ● Lab: Radioactive Decay with Pennies ● Essay test on benchmark experiments including Rutherford Gold foil, Cathode Ray tube and Oil Drop experiment. ● Activity: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. ● Activity: Class debate on nuclear power ● Activity: Calculate annual nuclear radiation exposure from different environmental sources ● Chapter Tests and quizzes with multiple choice, short answer, calculations and open-ended questions.

Unit 3
Periodicity and Atomic Spectrum

NEXT GENERATION SCIENCE STANDARDS HS-PS1:Matter and Its Interactions HS-PS4: Waves and Their Applications in Technologies for Information Transfer HS-ESS1:Earth's Place in the Universe
Big Ideas: *Course Objectives / Content Statement(s)* **Developing and Using Models** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8)

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- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**
• How do we know what we cannot see? • Is all matter the same? • How do surprises advance understanding? • How did the behavior of electrons grow from the study of light? • Can the periodic table be used to predict the properties of undiscovered elements?	Students will understand that... **Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5) **Energy and Matter** • In nuclear processes, atoms are not conserved, but the total number of

● Is the use of trends as predictors in science useful or dangerous? ● Are all forms of radiation harmful? ● What happens when matter absorbs different types of radiation? ● How can radiation emitted from stars be used to determine their composition?	protons plus neutrons is conserved. (HS-PS1-8) ● The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) **Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas	Examples, Outcomes, Assessments (4 weeks)
PS1.A: Structures and Properties of Matter ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1) ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3) **Ps3.D: Energy in Chemical Processes** ● Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy (HS-PS4-5) **PS4.A: Wave Properties** ● The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing (HS-PS4-1) **PS4.B: Electromagnetic Radiation** ● Electromagnetic radiation (e.g., radio, microwaves, light) can be	**Instructional Focus:** ● Determine how wavelength and frequency can be used to determine the properties of different forms of electromagnetic radiation. ● Explain how the study of light led to the discovery of the quantum mechanical model of the atom. ● Describe the discovery of the organization of electrons in atoms in the context of experimentation, the properties of light and quantum theory and the wave model of the atom. ● Explain the photoelectric effect and how it led to the development of many technological tools we use today. ● Relate the organization of electrons (configurations) to the properties of atoms and the arrangement of the periodic table. ● Describe the development of the first periodic table and compare it to the one we use today. ● Explain and predict periodic properties and trends such as: atomic radii, ionization energies, electronegativity, chemical reactivity, metallic character and density. ● Determine the composition of stars by analyzing the spectra of light emitted. ● Introduce the astronomical evidence of the redshift of light from galaxies as an indication that the universe is currently expanding ● Determine if the evidence produced by astronomical light spectra supports the Big Bang Theory.

modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation,and the particle model explains other features (HS-PS4-3) ● When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells (HS-PS4-4) ● Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5) ● Atoms of each element emit and absorb characteristic frequencies of light.These characteristics allow identification of the presence of an element, even in microscopic quantities (HS-ESS1-2) **ESS1.A: The Universe and Its Stars** ● The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2), (HS-ESS1-3) ● The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2)	
Differentiation	**Assessments**
Interdisciplinary Connections ● History: Connect scientific discoveries in various countries to the political and cultural climate in each location ● Mathematics: Statistical analysis of data collected. ● Earth Science: Analysis of astronomical light spectra **Technology Integration**	**Sample Assessments:** ● Lab: Colorful Flames and Calculation of an Atomic Emission Spectrum ● Lab: Electron Configuration ● Lab: Periodic Trends ● Activity: Analyze line spectra from stars to determine composition of an unknown

● Use spreadsheet and other analysis tools to examine the relationships of atoms on periodic table ● Use video animations to show set up of historical experiments ● Online simulations to describe the photoelectric effect **Media Literacy Integration** ● Use video clips and articles to stimulate interest in the topic ● Compare scientifically reviewed articles (e.g. Nature) to popular literature (e.g. Newsweek)for the same breakthrough. Relate this to the development of atomic theory. **Global Perspectives** ● Compare the development of atomic theory in other cultures as it relates to governmental structures.	● Chapter Tests and quizzes with multiple choice, short answer, calculations and open-ended questions.

Unit 4
Bonding and Chemical Reactions

NEXT GENERATION SCIENCE STANDARDS HS-PS1:Matter and Its Interactions HS-PS2: Motion and Stability: Forces and Interactions
Big Ideas: *Course Objectives / Content Statement(s)* **Developing and Using Models** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8) ● Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) **Planning and Carrying Out Investigations** Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3) **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**
• Why do substances react? • How can we use the language of Chemistry to refer to substances by name or by formula? • How can we visually represent what is happening when a bond forms? • What determines the properties of substances, such as solubility in water and electrical conductivity? • How can we represent a chemical reaction both quantitatively and qualitatively? • What role does energy play in chemical reactions?	Students will understand that... **Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5) **Energy and Matter** • The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)
Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas	**Examples, Outcomes, Assessments (5.5 weeks)**

PS1.A: Structure and Properties of Matter ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1) ● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4) ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3) **PS2.B: Types of Interactions** ● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.(HS-PS2-6) **PS1.B: Chemical Reactions** ● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4), (HS-PS1-5) ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6) ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2), (HS-PS1-7)	**Instructional Focus**: ● Describe ion formation based on electron configuration ● Distinguish between ionic and covalent bonds in terms of electron behavior as well as the properties of compounds that contain each type. Recognize patterns of bonding from the periodic table. ● Describe metallic bonding and how it affects the properties of metals ● Write chemical formulas for ionic and binary molecular compounds ● Name (using the Stock system) ionic and binary molecular compounds ● Create Lewis structures for a variety of molecular compounds and polyatomic ions ● Describe and name the forces that hold molecules together ● Determine molecular polarity and describe its effect on the properties of a sample of matter ● Categorize matter as ionic, molecular, metallic, or network ● Classify chemical reactions as combination, decomposition, combustion, single replacement, or double replacement, acid-base or redox reactions ● Balance chemical equations ● Identify the differences in properties between elements and the compounds that they form. ● Discuss the formulation of new compounds such as pharmaceutical drugs through chemical reactions
Differentiation	**Assessments**
Interdisciplinary Connections ● Mathematics: balancing chemical equations	● Lab: Identify an Unknown Metal ● Lab: Lewis structures ● Lab: Types of Solids

● History: context of work by Antoine Lavoisier (French Revolution), other early chemists ● Earth Science: Identify chemical reactions that occur in the atmosphere that produce pollution ● Biology: As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. **Media Literacy Integration** ● Read article on hydrofluoric acid from scientific journal and then watch episode of ER about this acid—look for misleading info in ER episode—compare fiction vs. nonfiction representation of the topic ● Video: different types of chemical reactions that could not be performed in the classroom **Global Perspectives** ● Compare different naming systems used around the world	● Lab: Types of Chemical reactions ● Activity: Balancing chemical reactions ● Demonstrations for types of chemical reactions ● Chapter Tests and quizzes with multiple choice, short answer, calculations and open-ended questions.

Unit 5
Calculations in Chemistry

NEXT GENERATION SCIENCE STANDARDS HS-PS1:Matter and Its Interactions HS-PS3:Energy
Big Ideas: *Course Objectives / Content Statement(s)* **Developing and Using Models** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8) ● Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) **Planning and Carrying Out Investigations**

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**
• How can the interpretation or manipulation of quantitative data be used to determine the chemical composition of a substance? • How are balanced chemical equations used to calculate quantities of substances in chemical reactions? • Why is it important that we are able to determine a limiting reactant?	Students will understand that... **Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5) **Energy and Matter** • In nuclear processes, atoms are not conserved, but the total number of

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- How can you choose a level of accuracy that is appropriate to limitations on measurement when reporting quantities?

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protons plus neutrons is conserved. (HS-PS1-8)
- The total amount of energy and matter in closed systems is conserved. (HS-PS1-7)
- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

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<tr><th>Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas</th><th>Examples, Outcomes, Assessments

(3 Weeks)</th></tr>
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PS1.A: Structure and Properties of Matter

- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)

PS1.B: Chemical Reactions

- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4), (HS-PS1-5)
- In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)
- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2), (HS-PS1-7)

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Instructional Focus:

- Review the definition of a mole and its uses
- Perform multi-step problems to convert between units of mass, volume, representative particles and density
- Practice describing and calculating the continuous transfer of energy in a closed system.
- Using a balanced equation and stoichiometry to calculate the amount of reactants and products present in a chemical reaction.
- Determine the limiting reactant and use to calculate the amount of product that would be produced
- Determine the empirical and molecular formula of a compound
- Calculate theoretical yield and percent yield
- Calculate the percent composition for a sample of material
- Use balanced chemical equations to show the conservation of energy throughout a reaction
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities

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<tr><th>Differentiation</th><th>Assessments</th></tr>
<tr><td>Interdisciplinary Connections</td><td></td></tr>
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● Mathematics: Use mathematical representations of phenomena to support claims. ● Mathematics: Reason abstractly and quantitatively; Use units as a way to understand problems and to guide the solution of multi-step problems **Technology Integration** ● Online interactive simulations and virtual labs can be used for differentiation. ● Use spreadsheet and other analysis tools to examine data collected **Global Perspectives** ● Compare expectations of accuracy and precision for data collection and calculations from different parts of the world ● Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.	● Lab: Limiting Reactant and Percent Yield ● Lab: Determine Empirical and Molecular Formula ● Lab: Decomposition of Baking Soda ● Activity: Determine percent of sugar in a piece of gum ● POGIL: Balancing chemical equations ● Phet Simulation Assignment: Balancing chemical equations and types of reactions. ● Chapter Tests and quizzes with multiple choice, short answer, calculations and open-ended questions.

Unit 6
Phases of Matter and Aqueous Solutions

NEXT GENERATION SCIENCE STANDARDS HS-PS1:Matter and Its Interactions HS-PS2: Motion and Stability: Forces and Interactions HS-PS3:Energy
Big Ideas: *Course Objectives / Content Statement(s)* **Developing and Using Models** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. ● Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8) ● Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) **Planning and Carrying Out Investigations** Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. ● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on

the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**

• What factors affect the properties of the different states of matter? • How can matter exist at different states at the same temperature and pressure? • Has the composition of our atmosphere remained consistent over time? • Why is water a unique chemical substance? • What steps of the water cycle are natural purification techniques? • What happens to a substance when it dissolves? • Why are some substances soluble in water and others aren't?	Students will understand that... **Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5) **Energy and Matter** • The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas	**Examples, Outcomes, Assessments (5.5 weeks)**
PS1.A: Structure and Properties of Matter • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1) • A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4) • The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3) **PS2.B: Types of Interactions** • Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects.(HS-PS2-6) **PS1.B: Chemical Reactions**	**Instructional Focus:** <u>Changes of State</u> • Define Atmospheric pressure, how to measure, identifying units for pressure and how to convert between them. • Define the Kelvin Temperature scale and Absolute Zero • Review different states of matter, changes of state and phase diagrams. • Distinguish between boiling and evaporation. • Explain vapor pressure and reading vapor pressure curves • Describe the organization and forces between particles in the solid phase. • Identify and define an allotrope and amorphous solids. <u>Properties of Gases</u> • Define Kinetic Molecular Theory and how it describes the behavior of gases. • Derive graphically and define Boyles, Charles's and Gay-Lussac's law. • Use the combined gas law and ideal gas law to predict changes of gas behavior. Compare and contrast ideal and real gases.

● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4), (HS-PS1-5) ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present (HS-PS1-6)	● Apply the Ideal Gas Law to Reaction Stoichiometry. ● Use Dalton's law to calculate partial pressures. Predict Relative Rates of Diffusion Using Graham's Law ● Explain how the composition of the Earth's atmosphere has changed over time due to human activity ● Review the different chemical reactions involved in the production of carbon dioxide in our atmosphere <u>Reactions in Aqueous Solutions</u> ● Describe properties of water. ● Review the water cycle and the amount of fresh water found on Earth ● Describe the process by which solutes dissolve in solvents. ● Identify what factors affect the rate of dissolution. ● Use the "like dissolves like" rule to predict the solubility of one substance in another. ● Describe the factors that affect solubility including pressure, temperature and nature of components. ● Distinguish between strong and weak electrolytes. ● Review how to read a solubility curve and determine if a solution is saturated, unsaturated or supersaturated. ● Calculate the concentration of solution; Molarity. Distinguish between a dilute and concentrated solution and how to calculate concentration of a diluted solution. ● Describe Acid Base reactions, pH scale and titrations.
Differentiation	**Assessments**
Interdisciplinary Connections ● Determine the advantage of high-elevation training used by many professional athletes. ● Investigate the benefits of using a pressure cooker in the kitchen. ● Determine the effect of temperature and pressure on global weather patterns and ocean currents. ● Investigate the cause of sink-holes and formation of limestone caves. **Technology Integration** ● Excel used for data analysis and graphing.	● Investigation of Gas Properties Lab ● Volume of the Room Lab ● Collecting Gas over Water Lab ● Creating a Heating and Cooling Curve for Lauric Acid Lab. ● Developing the Kelvin Temperature Scale Lab ● Coca-Cola Calculations Lab ● Beer's Law Lab ● Acid Base Lab with pH investigation ● Titration Lab ● Demonstrations: surface tension, atmospheric pressure, chromatography...etc ● Activity: What is Oobleck?

● Online tutorials and virtual labs can be used for differentiation. **Media Literacy Integration** ● Compare and contrast scientific articles on global warming and/or acid rain from Times magazine and Scientific America magazine. **Global Perspectives** ● Identify filtration techniques used to purify dirty water around the world. ● Compare and contrast the amount of air pollution produced by different countries and determine what actions are being taken to reduce the amount. ● Investigate and determine the cause of fish kills that occur in different parts of the country.	● Chapter Tests and quizzes with multiple choice, short answer, calculations and open-ended questions.

Unit 7
Energy in Chemical and Physical Changes

NEXT GENERATION SCIENCE STANDARDS
HS-PS3: Energy
HS-PS2: Motion and Stability:Forces and Interactions

Big Ideas: *Course Objectives / Content Statement(s)*

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8)
- Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze,

represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**
• What is energy? • What is the difference between heat and temperature? • What factors affect the ability of material to absorb or release heat? • Are chemical and physical changes reversible? • What factors affect the amounts of product formed in a chemical reaction? • What factors determine whether or not a chemical reaction will happen?	Students will understand that… **Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5) **Energy and Matter** • The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) • Energy drives the cycling of matter within and between systems. (HS-ESS2-3) • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) • Energy cannot be created or destroyed-only moves between one place and another place, between

	objects and/or fields, or between systems. (HS-PS3-2) **Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6) **Systems and System Models** ● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-PS3-4)

Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas	Examples, Outcomes, Assessments (3 Weeks)
PS1.A: Structure and Properties of Matter ● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4) **PS1.B: Chemical Reactions** ● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4), (HS-PS1-5) ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present (HS-PS1-6) **PS3.A: Definitions of Energy** ● Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its	**Instructional Focus** <u>Thermodynamics</u> ● Distinguish between the system, surroundings and the universe. ● Identify exothermic and endothermic reactions ● Draw and interpret potential energy diagrams for chemical reactions. ● Identify the molar heat of reaction, activation energy, activated complex, and classify the reactions as endothermic or exothermic. ● Calculate the amount of heat (q) released during a chemical or physical change ● Identify the specific heat of an unknown metal ● Define calorimetry ● Define enthalpy of reaction ● Determine the heat of phase changes as well as heat of combustion and dissolution. ● Calculate the heat of reaction using Hess's Law or standard heat of formation ● Recognize the second Law of thermodynamics as it refers to the inevitable increase in entropy for the system and the universe for all spontaneous processes. ● Predict the relative entropies of chemical systems and calculate entropy using standard free entropy values. ● Define free energy and use its value to determine if a reaction is spontaneous. ● Perform calculations using the equation $\Delta G = \Delta H - T\Delta S$.

various possible forms. (HS-PS3-1), (HS-PS3-3) ● At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3) ● These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration. In some cases the relative position energy can be thought of as stored in fields. This last concept includes radiation, a phenomenon in which energy stored in fields moves across space (HS-PS3-2) **PS3.B: Conservation of Energy and Energy Transfer.** ● Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system (HS-PS3-1) ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4) ● Uncontrolled systems always evolve toward more stable states- that is, toward more uniform energy distribution. (HS-PS3-4)	
Differentiation	**Assessments**
Interdisciplinary Connections ● Weather: How specific heat is related to hurricanes ● Food and Nutrition: analyze how dietary Calories are measured and calculated **Technology Integration** ● Excel used for data analysis and graphing. Vernier or Pasco probes can be used to acquire concentration data. **Media Literacy Integration** ● Analyze how meteorologists use knowledge of thermal energy to determine the weather in their reports **Global Perspectives**	● Lab: Calorimetry ● Lab: Specific heat of an unknown metal ● Lab: Burning food lab ● Lab: Heats of Solution ● Spontaneity Lab ● Activity: Specific Heat and Hurricanes ● Demonstrations for specific heat ● Chapter Tests and quizzes with multiple choice, short answer, calculations and open-ended questions.

● Use knowledge of specific heat, thermal energy and pressure of gases to analyze weather patterns around the world	

Unit 8
Kinetics and Equilibrium

NEXT GENERATION SCIENCE STANDARDS
HS.PS3: Energy
HS.PS2: Motion and Stability: Forces and Interactions

Big Ideas: *Course Objectives / Content Statement(s)*

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8)
- Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**
● Are chemical and physical changes reversible? ● What factors affect the amounts of product formed in a chemical reaction? ● How can the rate of a chemical reaction be measured and changed? ● What factors determine whether or not a chemical reaction will happen? ● How do the rates of chemical reactions directly impact our lives? ● Under what conditions can a reaction be manipulated to proceed in one particular direction. ● What is the difference between static and dynamic equilibrium	Students will understand that… **Patterns** ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5) **Energy and Matter** ● The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) **Stability and Change** ● Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas	**Examples, Outcomes, Assessments** **(2.5 Weeks)**
PS1.A: Structure and Properties of Matter ● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4) **PS1.B: Chemical Reactions**	**Instructional Focus** <u>Chemical Kinetics</u> ● Interpret and express the rate of a chemical reaction. ● Identify and analyze experimentally the factors that affect the rate. ● Write rate laws for chemical reactions and calculate the values of the order and the rate constant from initial rate data. ● Interpret mechanisms

● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4), (HS-PS1-5) ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present (HS-PS1-6) **PS3.B: Conservation of Energy and Energy Transfer.** ● Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system (HS-PS3-1) ● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4) ● Uncontrolled systems always evolve toward more stable states- that is, toward more uniform energy distribution. (HS-PS3-4)	<u>Chemical Equilibrium</u> ● Define chemical equilibrium in terms of the rates of forward and reverse reactions. ● Apply Le Chatelier's Principle to predict the effect of stress on a system at equilibrium. ● Use the value of the equilibrium constant to determine the position of equilibrium; calculate the value of the constant using experimental data. ● Use the ICE box method to solve equilibrium problems.
Differentiation	**Assessments**
Interdisciplinary Connections ● Mathematics: Statistical and/or graphical analysis of kinetic data set and calculate compound half-lives for first order reactions. **Technology Integration** ● Excel used for data analysis and graphing. Vernier or Pasco probes can be used to acquire concentration data. **Media Literacy Integration** ● Use online tutorials to explain reaction rates, specific heat and equilibrium **Global Perspectives**	● Disturbing Equilibrium Lab ● Factors that Affect Rate Lab ● Iodine Clock Reaction Lab ● Spontaneity Lab ● Demonstrations for specific heat ● Chapter Tests and quizzes with multiple choice, short answer, calculations and open-ended questions.

• Use knowledge of specific heat, thermal energy and pressure of gases to analyze weather patterns around the world	

Unit 9
Independent Projects in Chemistry

NEXT GENERATION SCIENCE STANDARDS
HS-PS1:Matter and Its Interactions
HS-PS2:Motion and Stability: Forces and Interactions
HS.PS3: Energy
HS-PS4: Waves and Their Applications in Technologies for Information Transfer
HS-ETS1: Engineering Design

Big Ideas: *Course Objectives / Content Statement(s)*

Developing and Using Models

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- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8)
- Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to support claims. (HS-PS1-7)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the

natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the Big Ideas?* **Cross Cutting Concepts**
● What is the purpose for studying the field of chemistry? ● Can information covered in the classroom be applied to everyday life experiences? ● Are all resources good resources? ● What are the ways in which we influence the environment through chemistry?	Students will understand that… ● Chemistry content covered in the classroom can be applied to real-life experiences. ● Being able to gather, comprehend, evaluate, synthesize and report on information and ideas is a necessary skill that students should have. ● It may be necessary to conduct original research from a variety of resources in order to answer questions or solve problems. ● Topics covered in class can often be further researched more in depth. ● The ever-changing field of technology influences new scientific discoveries that may cause scientists to modify existing theories and/or lead to new ones.

Areas of Focus: Proficiencies (Cumulative Progress Indicators) Disciplinary Core Ideas	**Examples, Outcomes, Assessments**
Delimiting Engineering Problems	**Instructional Focus:** ● Identify a topic of interest

● Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1) ● Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1) **ETS1.B: Developing Possible Solutions** ● When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3) **Research to Build and Present Knowledge:** ● Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.(WHST.9-12.7) ● Draw evidence from informational texts to support analysis, reflection, and research (WHST.9-12.9) **Integration of Knowledge and Ideas:** ● Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (RST.9-10.7) **Key Ideas and Details:** ● Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.(RST.11-12.1) **Text Types and Purposes:**	● Use appropriate sources to conduct research on the topic ● Conduct independent laboratory experiments as needed ● Present work in written and oral format

● Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes (WHST.9-12.2)	
Differentiation	**Assessments**
Interdisciplinary Connections ● Varies depending on topic chosen **Media Literacy Integration** ● Read scientifically reviewed articles and literature for information on research topics. **Technology Integration** ● Excel for graphing and analyzing data collected during student- designed experiments. Powerpoint or Prezi used for presentations. Laboratory instruments needed for student-designed experiments. **Global Perspectives** ● Varies depending on topic chosen	● Oral presentation with visual component ● Written component in student-selected format