ROBBINSVILLE PUBLIC SCHOOLS

OFFICE OF CURRICULUM AND INSTRUCTION

SCIENCE

6th Grade Integrated Science

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Course Philosophy

Science and science education are essential to the lives of everyone. By learning science, students become informed and involved citizens as well as innovative thinkers. This course is structured around The Next Generation Science Standards (NGSS), where students apply their knowledge and skills to master these new science standards. The NGSS embody a new vision for how students learn science by combining core ideas with cross-cutting concepts and science and engineering practices. They emphasize the practice of scientific inquiry and analysis, and provide students with a variety of interactions that shift the cognitive expectation from simple answers to higher-level, critical-thought responses. Explicit strategies guide the learner while hands-on investigations focus on open-ended inquiry. By introducing students to new concepts with phenomena, students actively discover the knowledge and skills required to solve real-world problems. This course strives to educate students in science and engineering in order to prepare them for today's technologically advanced world.

Course Description

The 6th grade integrated science program is structured and based on the Next Generation Science Standards. Integrated science is a revolutionary science program that provides students with science topics that span many scientific disciplines. This course integrates multiple disciplines to enable students to make relevant connections and generate meaningful associations with the real world. By integrating crucial critical thinking skills, students enhance content and skills in all disciplines. This course helps students think about, read about, write about, and talk about science. It elevates thinking and learning by engaging students with phenomena, and with problem-based activities to anchor each topic. Students will connect science, technology, engineering, and mathematics with STEM activities that fuel innovation, problem solving, collaboration, and reasoning—skills needed for future careers. This blended print and digital curriculum prepares students for the challenges of tomorrow.

Core and Supplemental Instructional Materials

Core Materials	Supplemental Materials
● Elevate Science Course 1 by Pearson Education	● Teacher created resources ● Various internet activities ● TedED ● Brain POP ● National Geographic ● IXL ● Newsela ● EdPuzzle ● Kesler Station Labs ● Khan Academy ● Crash Course ● PBS Digital Learning

Social Emotional Learning Connections

Below are the five core SEL Competencies as outlined by CASEL, and examples of how each may be addressed within this curriculum

Self-awareness: The ability to accurately recognize one's emotions and thoughts and their influence on behavior. This includes accurately assessing one's strengths and limitations and possessing a well-grounded sense of confidence and optimism.

Example 1: Students will reflect on their learning at the end of class by using an exit slip to gauge their understanding of the day's lesson. Encourage student self-reflection on things they have learned, things they need to work on, and goals they need to set.

Example 2: Students will use journal writings about their observations about their communities and the world they live in. By practicing reflective writing every day, this can help students learn to consider their thoughts and feelings in a self-aware way.

Self-management: The ability to regulate one's emotions, thoughts, and behaviors effectively in different situations. This includes managing stress, controlling impulses, motivating oneself, and setting and working toward achieving personal and academic goals.

Example 1: Incorporate stress management techniques in the classroom (e.g., deep breathing, stretching, yoga movements, and affirmations), and identify appropriate settings for each of these strategies.

Example 2: Students will reflect on their learning by completing self-reflection checklists and reflecting on their progress and skills after assessments and projects. This will also give students a chance to discuss how teams are working together and whether everyone is getting their chance to take part.

Social awareness: The ability to take the perspective of and empathize with others from diverse backgrounds and cultures, to understand social and ethical norms for behavior, and to recognize family, school, and community resources and supports.

Example 1: When learning about minerals, students will learn about the harsh conditions that miners face while mining minerals found in cell phones in Africa, South America and China.

Example 2: Students will share opinions on engineer designs to show how glaciers, rivers, and Earth's natural processes change the land; Students will understand perspectives of others and empathize with others when presenting erosion models to classmates.

Relationship skills: The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. This includes communicating clearly, listening actively, cooperating, resisting inappropriate social pressure, negotiating conflict constructively, and seeking and offering help when needed.

Example 1: Have students perform different roles in cooperative learning groups (i.e., leader, recorder, reporter, time-keeper) to develop and practice communication skills.

Example 2: In order to resolve an issue in a relationship, teach students how to calmly discuss the problem, brainstorm solutions, and come to an appropriate decision.

Responsible decision-making: The ability to make constructive and respectful choices about personal behavior and social interactions based on consideration of ethical standards, safety concerns, social norms, the realistic evaluation of consequences of various actions, and the well-being of self and others.

Example 1: Encourage students to use their listening skills and be open minded to other opinions. Let students share their views on current events or relevant topics such as the impact of social media on our well-being.

Example 2: Give students a range of options for completing and submitting assignments. For example, the QUEST projects can be done in a format of their choice, such as giving a class presentation, creating a video, or building a website.

Integration of 21st Century Themes and Skills

Educational Technology

Standards: 8.1.P.C.1, 8.1.8.A.4, 8.2.8.B.7

- **Communication and Collaboration: 8.1.P.C.1** Collaborate with peers by participating in interactive digital games or activities.
    - Example: Students will work in pairs to complete interactivities and research about 3D printers (in States of Matter unit). They will collaborate their ideas to design a tool that can be created with a 3D printer for use in the space station.

- **Technology Operations and Concepts: 8.1.8.A.4** Graph and calculate data within a spreadsheet and present a summary of the results.
    - Example: Students will create a digital graph (via Google Sheets) to show how the temperatures of 2 different cups of water change over time. They will then discuss the relationship seen in the graph to show their understanding of heat transfer.

- **Technology and Society: 8.2.8.B.7** Analyze the historical impact of waste and demonstrate how a product is upcycled, reused or remanufactured into a new product.
    - Example: Students will research mineral (metal) extraction and mining and how they have affected countries in Africa, as well as how they contaminate the environment. Students will research how these minerals are limited natural resources that should be recycled or reused rather than wasted.

Career Ready Practices

Standards: CRP2, CRP4, CRP11

CRP2. Apply appropriate academic and technical skills.
Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation

- Example: Students will read case studies for various scientific topics to learn about different types of science and the skills and requirements a person needs in order to become that type of scientist.

CRP4. **Communicate clearly and effectively and with reason:** Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

- Example: Students will demonstrate clear communication by making claims based on research, evidence and reasoning. They will be able to provide persuasive evidence to communicate their ideas effectively and articulately. They will debate their ideas in class discussions while respectfully listening to their peers ideas and reflecting on the perspectives of others.

CRP11. Use technology to enhance productivity: Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.

- Example: Students will utilize the online platform for Pearson Elevate. They will use virtual readings, interactivities, notebooks, labs and quizzes. They will also be using Google Classroom for alternate assignments that they will complete and submit digitally through their school accounts.

Robbinsville Ready 21st Century Skill Integration

The following skills will be embedded throughout the curriculum and instruction of this course.

Collaborative Team Member: Robbinsville students will learn more by working together than in isolation. As educational theorist Lev Vygotsky advocated, learning is a social process. Many workplaces today encourage employees to work in teams to solicit diverse perspectives, brainstorm new ideas and/or products, and solve problems. Further, collaboration fosters interpersonal relationships, self-management skills, cooperation, and a sense of collective responsibility. Collaborative team members are able to work with diverse groups of people who hold a variety of perspectives.

Effective Communicator: Robbinsville students must be able to clearly articulate their ideas orally, in writing, and across various media in order to successfully connect to the world around them. As the world becomes increasingly globalized, communication is more than just sharing one's ideas. Effective communicators are able to communicate their convictions, actively listen and analyze others' work to identify perspective and/or potential bias.

Emotionally Intelligent Learner: Robbinsville students who are emotionally intelligent learn to be empathetic, demonstrate integrity and ethical behavior, are kind, are self-aware, willing to change, and practice self-care. They are better able to cope with the demands of the 21st century digital society and workplace because they are reliable, responsible, form stable and healthy relationships, and seek to grow personally and professionally. Emotionally intelligent people are able to manage their emotions, work effectively on teams and are leaders who can grow and help to develop others.

Informed and Involved Citizen: Robbinsville students need to be digital citizens who are civically and globally aware. The concept of what it means to be "literate" has evolved along with 21st century technological and cultural shifts. Our progressive vision of literacy entails having our students explore real world problems in the classroom. Informed and involved citizens are able to safely and accurately communicate with people all around the world and are financially, environmentally and informationally literate.

Innovative Thinker: Robbinsville students must encompass innovative thinking skills in order to be successful lifelong learners in the 21st century world. As stated by Karl Fisch and Scott McLeod in the short film Shift Happens, "We are currently preparing students for jobs that don't yet exist . . . using technologies that haven't been invented . . . in order to solve problems we don't even know are problems yet." Innovative thinkers are able to think analytically, solve problems critically, creatively engage in curiosity and tinkering, and demonstrate originality.

Resilient and Self-Directed Learner: Robbinsville students need to take risks and ultimately make independent and informed decisions in an ever-changing world. Author of Life, the Truth, and Being Free, Steve Maraboli stated, "Life doesn't get easier or more forgiving, we get stronger and more resilient." Self-directed scholars of the 21st century are able to set goals, initiate resolutions by seeking creative approaches, and adjust their thinking in light of difficult situations. Resilient students are able to take risks without fear of failure and overcome setbacks by utilizing experiences to confront new challenges. Resilient and self directed scholars will consistently embrace opportunities to initiate solutions and overcome obstacles.

Robbinsville Public Schools
Scope, Sequence, Pacing and Assessment

6th Grade Science

Unit Title	Unit Understandings and Goals	Recommended Duration/ Pacing	Assessments			
			Formative	**Summative**	**Common Benchmark Assessments** (mid-course and end of course **only**)	**Alternative Assessments** (projects, etc. **when appropriate**)
Unit 1: Introduction of Matter	How do scientists classify matter? Is it based on its physical properties? Measurable properties? Ability to change state or change form? Students learn that all of these concepts apply when identifying matter. They are important to know so that proper materials are combined (or not combined). They also lead to advancements in technology such as superconductivity and the maglev train.	3 Weeks (Approximately 13 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How can you use science to make special effects?" Performance-Based Assessment "Help Out with the Wildlife"

Unit 2: Solids, Liquids, and Gases	In this topic, students examine solids, liquids, and gases based on their physical properties. This includes their reactions to temperature changes, and their relationship to pressure and volume at the particle level.	3 Weeks (Approximately 15 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How can you use solids, liquids and gases to lift a car?" Performance-Based Assessment "Melting Ice"
Unit 3: Energy	Energy us around us all day, every day. We use energy in all facets of our lives, whether we are sleeping, talking, cooking, or simply reading a book. With this topic, students earn the nature and role of energy in the world and apply concepts related to kinetic and potential energy to demonstrate how energy is transferred and transformed. Students use this information to trace energy through a system, understand where energy comes from, how and why energy is used, and make informed decisions about the role of energy to accomplish a specific task.	3-4 Weeks (Approximately 19 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How can you build a complicated machine to do something simple?" Performance-Based Assessment "3, 2, 1… Liftoff"

Unit 4: Thermal Energy	Thermal energy and heat transfer are important concepts in many real-world situations, such as melting metals for industrial use, cooking and baking, and fashioning outerwear for specific purposes. While investigating energy transformations, students analyze the relationships among thermal energy, temperature, transfer of heat energy, and changes in states of matter.	3 Weeks (Approximately 14 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How can you keep hot water from cooling down?" Performance-Based Assessment "Testing Thermal Conductivity"
Unit 5: Introduction to Earth's Systems	In this topic, students explore Earth's systems. While studying Earth's systems, students will recognize the importance of understanding the interactions between Earth's systems and how those systems affect each other.	3+ Weeks (Approximately 16 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project - How can you predict the effects of a forest fire? Performance-Based Assessment "Modeling a Watershed"

Unit 6: Weather in the Atmosphere	The impact of weather and climate on severe storms is the context of this topic. While studying water in the atmosphere and the interactions between air masses, students recognize the direct relationship between weather and climate.	4-5 Weeks (Approximately 23 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How can you prepare for severe weather?" Performance-Based Assessment "Water From Trees"
Unit 7: Mineral and Rocks in the Geosphere	Earth's processes are at the center of this topic. Students learn the processes by which rocks and minerals form and how they are recycled as a result of energy flow.	4 Weeks (Approximately 19 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How can you depict Earth Processes in a Movie Script?" Performance-Based Assessment "The Rock Cycle in Action"

Unit 8: Plate Tectonics	Throughout this topic, students evaluate evidence of plate motion and the continued impact of plate tectonics on Earth's surface. Students recognize the relationship between plate boundaries and the resulting changes to Earth's surface over varying time scales.	4 Weeks (Approximately 19 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How safe is it to hike around Mount Rainier?" Performance-Based Assessment: "Modeling Sea-Floor Spreading"
Unit 9: Earth's Surface Systems	This topic deals with mechanical and chemical weathering, the formation of soil, and erosion and deposition from multiple causes. Students will identify the various causes of erosion and deposition and how these processes change Earth's surface by building up or tearing down features.	4 Weeks (Approximately 20 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How can I design and build an artificial island?" Performance-Based Assessment "Materials on a Slope"

Unit 10: Living Things in the Biosphere	In this topic, students will explore living things, including how and why organisms are classified. Students will also learn about viruses, bacteria, protists, fungi, plants and animals and how organisms from these various groups impact humans.	4 Weeks (Approximately 20 days)	Interactivities Hands-on investigative labs Virtual labs Enrichment activities QUEST project check-ins Teacher and peer feedback Open-ended/ scaffolded questions	Lesson checks Lesson quiz Unit assessment QUEST project rubric Teacher feedback and comments	Content SGO Skills SGO	QUEST project "How can you design a field guide to organize living things?" Performance-Based Assessment "It's Alive!"

Robbinsville Public Schools

Unit #1: Introduction to Matter

Enduring Understandings:	**Essential Questions:**
● Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. ● Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	● How can we observe, measure, and use matter? ● How do particles combine to form the variety of matter on observes? ● How do substances combine or change (react) to make new substances? ● How does one characterize and explain these reactions and make predictions about them?

Interdisciplinary Connections

NJSLS Mathematics 6.G.A.2 Apply the formula $V=lwh$ and $V=bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

- Example: Students will calculate the volume of a regular object and irregular object using water displacement.

NJSLS Mathematics 6.RP.A.2 Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and the use rate language in the context of a ratio.

- Example: Students will apply reasoning skills by identifying the ratio of hydrogen and oxygen atoms before and after a reaction.

Career/Real World Connections

Careers

- Chemists study the composition of matter and its properties. Chemists carefully describe the properties they study in terms of quantities, with detail on the level of molecules and their component atoms.
- Art conservation - Over time, art can fade, decay, or get dirty. Conservation scientists find ways to restore art by examining its properties. They look at texture, color, and age of the paint, the condition of the canvas, and the materials used to make the paint. Then the scientists can determine chemical properties of the painting.

Real World Connections

- Special Effects - Movie directors and producers have been dazzling audiences with their special effects since people started making movies. Early movies used miniature models of people, places and things to create realistic settings and images when using the actual place or object was impossible. Later, matte paintings, robots and make-up were used to trick audiences.

- Surface tension - The cohesive forces between liquid molecules are responsible for the phenomenon known as surface tension. The molecules at the surface of a glass of water do not have other water molecules on all sides of them and consequently they cohere more strongly to those directly associated with them. The stronger cohesion between the water molecules as opposed to the attraction of the water molecules to the air makes it more difficult to move an object through the surface than to move it when it is completely submersed.

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MS-PS1-1 MS-PS1-2	What is matter made of? What properties describe matter? How can you classify different types of matter? How can matter be measured? What properties of matter can be determined through measurement? How are changes in matter related to changes in energy? What is the difference between a physical change and a chemical change?	Students compare the physical and chemical properties of matter and model the arrangement of atoms. They also compare homogeneous and heterogeneous mixtures. Students measure weight, mass, colume, and density as physical properties of after. They also investigate how measurement can determine properties of matter. Students investigate how atoms rearrange during a chemical change. They also use text to support the idea that energy and matter are related. **CCC.3 Scale. Proportion and Quantity** Students will create models of various scales that can be used to study phenomena such as atoms and molecules which are too small to observe. **CCC.5 Energy and Matter** Students will describe the physical difference between rainwater and ice crystals such as snow. **CCC.1 Patterns** Students will identify patterns in atomic-level structure related to a substance's visible macroscopic structure. <u>Key terms:</u> - matter - substance - physical property	<u>Phenomena:</u> - Water freezing instantly in very cold air temperatures - Why does cutting an onion make you cry? https://thewonderofscience.com/phenomenon/2018/7/12/why-does-cutting-an-onion-make-you-cry - Aerogels- World's Lightest Solids https://thewonderofscience.com/phenomenon/2018/7/9/aerogels-worlds-lightest-solids - Burning Steel Wool https://thewonderofscience.com/phenomenon/2018/7/8/burning-steel-wool - Indestructable Coating- Polyurea https://thewonderofscience.com/phenomenon/2018/7/9/indestructible-coating-polyurea - Elephant Toothpaste https://thewonderofscience.com/phenomenon/2018/5/13/elephant-toothpaste - Milk and soap experiment https://thewonderofscience.com/phenomenon/2018/7/11/milk-and-soap-experiment - Slime https://thewonderofscience.com/phenomenon/2018/5/13/slime - Water hat https://www.ngssphenomena.com/#/water-hat/	<u>Elevate Interactivities</u>: - What Makes Up Matter? - Molecules and Extended Structures - Calculating Density - Weight on the Moon - Properties of Matter <u>Hands-On Labs:</u> - The Nuts and Bolts of Formulas - Modeling Atoms and Molecules - Observing Physical Properties - Physical and Chemical Changes - Is a New Substance Formed?	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUEST project "How can you use science to make special effects?" Performance-Based Assessment "Help Out with the Wildlife" - Students will design a procedure to remove the salt, sand, and iron filings from a nearby pond after a hurricane.

		- chemical property - atom - element - molecule - compound - mixture - mass - volume - weight - density - physical change - chemical change	**SEP.2 Developing and Using Models** Develop models to describe the atomic composition of simple molecules and extended structures. **SEP.4 Analyzing and Interpreting Data** Analyse and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. Hands-On Labs Virtual Labs Online webquests Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning		

Robbinsville Public Schools

Unit #2: Solids, Liquids, and Gases

Enduring Understandings:	**Essential Questions:**
● Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. ● In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. ● The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.	● What causes matter to change from one state to another? ● How do particles combine to form the variety of matter on observes?

Interdisciplinary Connections

NJSLS Mathematics 7.RP.2.c Represent proportional relationships by equations.

- Example: Students will determine the unknown variable with the ideal gas law, $PV = nRT$

NJSLS Mathematics 8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph.

- Example: Students plot points to graphically illustrate Charles's Law with *degree Kelvin* along the x-axis and *mL* along the y-axis.

Career/Real World Connections

Careers

- Structural engineers - Solids tend to expand when heated and contract when cooled. Because of this, engineers include metal expansion joints in their designs.
- Condensed matter physicists study the physical properties of condensed phases of matter, such as liquids and solids. They study phenomena ranging from superconductivity to liquid crystals.
- Plasma physicists study plasmas, which are considered a distinct state of matter and occur naturally in stars and interplanetary space and artificially in neon signs and plasma screen televisions. Many plasma physicists study ways to create possible fusion reactors that might be a future source of energy.

Real World Connections

- Hydraulics systems convert pressurized oil into mechanical energy, making them more efficient than other types of motors. Hydraulic pumps move fluid through the system while valves control the flow. Filtration systems keep fluid clean and remove water and air from hydraulic fluid. Seals keep fluid in and contaminants out to ensure the system runs efficiently. Hydraulic motors convert hydraulic energy to rotary energy for powering lifts, fans, and other equipment.
- Strengthening metals for jewelry - jewelers add other metals to silver and gold because these metals tend to be too soft for jewelry on their own. Sterling silver is 92.5% silver mixed with mostly copper, and gold is mixed with silver and copper to make it stronger and less expensive.

- Double boiler - Recipes requiring melted chocolate often suggest melting the chocolate in a double boiler. A double boiler is made with a pan set over another pan. Water is placed in the bottom pan and is brought to a boil. Chocolate is placed in the top pan and is heated more slowly than it would in a pan directly on the stove.
- Cryosurgery generally uses liquid nitrogen to freeze unwanted, harmful cells. At room temperature, nitrogen is a colorless, odorless gas. However, when it undergoes extreme cold, it condenses into a liquid (around -200 degrees Celsius). At this temperature, it instantly freezes anything it touches, and can destroy cells upon contact.
- Many sports use inflated balls, including basketball, football, and soccer. In regulation play, the balls must be inflated to a specific pressure. In the United States, the unit for pressure is pounds per square inch, or psi. Rules about ball inflation allow small variations in pressure.

Guiding / Topical Questions with Specific Standards		**Content, Themes, Concepts, and Skills**	**Teaching Strategies**	**Instructional Resources and Materials**	**Assessment Strategies**
MS-PS1-4	What are the similarities and differences between solids, liquids, and gases? What is the relationship between particle motion and state of matter? How does thermal energy play a role in particle motion and changes of state? What happens to particles during changes of state between solids, liquids, and gases? How does pressure affect the change of state from liquid to gas? How do changes in particle motion of a gas affect physical properties? How are the temperature, pressure, and volume of a gas related?	Students analyze and develop models to explain how particle arrangement and behavior define each of the three states of matter. Students use scientific reasoning to determine the effects of thermal energy and pressure on matter at the particle level. Students examine the relationship between temperature, pressure, and volume as they apply to particle behavior of gases. **CCC.1 Patterns** Students use observations from experiments with solids, liquids and gases to explain each state of matter. **CCC.2 Cause and Effect** Students will describe cause-and effect relationships related to the role thermal energy plays in particle motion and changes in state. **CCC.7 Stability and Change** Students identify how candles melt and harden, and identify which processes must occur for objects to melt or harden. Key terms:	Phenomena: - Aerogels - https://thewonderofscience.com/phenomenon/2018/7/9/aerogels-worlds-lightest-solids - Reusable heat packs https://thewonderofscience.com/phenomenon/2018/7/8/reusable-heat-packs - Supercooled water https://thewonderofscience.com/phenomenon/2018/7/9/supercooled-water - The collapsing Train Car https://thewonderofscience.com/phenomenon/2018/6/10/the-collapsing-train-car - Rising bread (Charles's Law in the Oven) **SEP.2 Developing and Using Models** Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	Elevate Interactivities: - Properties of Solids, liquids and gases - Particles and states of matter - A Matter of Printing - Determining the State of Matter - States of Matter - Changing States - Thermal Energy and Changes of State - Gas Laws - A Hot-Air Balloon Ride Hands-On Labs: - Solid, liquid or Gas - Properties of Matter - Mirror, Mirror - How Can Air Keep Chalk From Breaking?	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUEST project "How can you use solids, liquids and gases to lift a car?" Performance-Based Assessment "Melting Ice" - Students investigate and compare the melting rates of ice water at two different temperatures.

		- solid - liquid - surface tension - viscosity - gas - thermal energy - temperature - melting point - freezing point - vaporization - billing point - evaporation - condensation - sublimation - pressure - Boyle's Law - Charles's Law	**SEP.6 Constructing Explanations and Designing Solutions** Predict how particle motion plays a part in ice-skating. Discuss observations of what happens to air-filled objects after they are left out in the sun and when they are left out in the cold. Hands-On Labs Virtual Labs Online webquests Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning	- Testing Charles's and Boyle's Laws - Phases of Matter CER: What effect does the amount of thermal energy have on water? States of Matter https://www.nasa.gov/pdf/544895main_PS3_States_of_Matter_C1.pdf Middle School Chemistry https://www.middleschoolchemistry.com/lessonplans/chapter1 PBS videos and lessons on states of matter https://nj.pbslearningmedia.org/subjects/science/physical-science/matter-and-interactions/states-of-matter/ States of Matter simulations https://phet.colorado.edu/en/contributions/view/3195	

Robbinsville Public Schools

Unit #3: Energy

Enduring Understandings:	**Essential Questions:**
● A system of objects may also contain stored (potential) energy, depending on their relative positions. ● When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. ● Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. ● The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. ● Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. ● When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	● What is meant by conservation of energy? ● How is energy transferred between objects or systems? ● How does energy cause change? ● How are forces related to energy? ● How do food and fuel provide energy?

Interdisciplinary Connections

NJSLS Mathematics 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

- Example: Students will use the equation for work to determine the value of the variables: work, force and distance (work is calculated by multiplying the force by the amount of movement of an object (W = F * d).

NJSLS Mathematics 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

- Example: Students will use a data table showing the numbers of the Colorado Rockies' home runs at home and away. They will use this data to determine the ratio of home runs hit at home vs. away.

Career/Real World Connections

Careers

- Energy engineers make the world more energy efficient by carrying out a wide range of work that involves research, design, and construction. Some energy engineers explore new methods of obtaining energy, while others develop ways to integrate renewable energy sources into the existing power grid. They also work with architects to incorporate clean energy sources in new construction.

Real World Connections

- The Domino Effect - When a domino falls, much of its potential energy is converted to kinetic energy, or energy of motion. Falling dominoes slide against one another, and their bottoms slip against the surface they're on. Both movements create friction. As a result, some energy is converted into heat and sound.
- Throughout history, humans have developed several devices to make work easier. The most notable of these are known as the "six simple machines": the wheel and axle, the lever, the inclined plane, the pulley, the screw, and the wedge. Because work is defined as force acting on an object in the direction of motion, a machine makes work easier to perform by accomplishing one or more of the following functions: transferring a force from one place to another, changing the direction of a force, increasing the magnitude of a force, or increasing the distance or speed of a force. Simple machines are devices with no, or very few, moving parts that make work easier. Many of today's complex tools are just combinations or more complicated forms of the six simple machines
- Gravitational forces (or G-forces) refer to the kinetic energy of an object compared to the force of gravity, which is 9.8 meters per second. Gravitational potential energy represents the potential an object has to do work as a result of being located at a particular position in a gravitational field.
- Rockets require an enormous amount of energy in order to escape Earth's gravitational pull. Rockets use the potential energy in special fuels to launch. This fuel is ignited, transforming the potential energy into chemical energy The chemical energy is converted into mechanical energy in the form of kinetic energy as the rocket lifts off and expels exhaust, and as thermal energy as the rocket gives off heat.

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MS-PS3-1 MS-PS3-2 MS-PS3-3 MS-PS3-4 MS-PS3-5	How is energy related to motion and force? What are the relationships among energy, motion, force and work? What determines an object's kinetic energy? What factors affect potential energy? What is the relationship between potential and kinetic energy? How can different forms of energy be classified, quantified, and measured?	Students use text evidence and mathematical models to define energy, motion, force, and work and to determine their relationships. Students model the relationship between kinetic and potential energy. Students use scientific evidence to identify and relate different forms of energy. Students model proportional relationships to explain that energy is neither created nor destroyed? **CCC.2 Cause and Effect** Students explain how energy and force cause power, motion and work.	Phenomena: - Rube Goldberg machines https://thewonderofscience.com/phenomenon/2018/7/8/amazing-rube-goldberg-machines - The Gravity Light https://thewonderofscience.com/phenomenon/2018/7/9/the-gravity-light - Magnetic Cannon https://thewonderofscience.com/phenomenon/2017/10/8/ps2-motion-and-stability-forces-and-interactions - Pendulums https://thewonderofscience.com/msps35#phenomena - Newton's Cradel https://thewonderofscience.c	Elevate Interactivities: - Things That Have Energy - Understanding Machines - Levers - Get the Ball Rolling - Force and Energy - Applying Energy - Interpret Kinetic Energy Graphs - Racing for Kinetic Energy - Roller Coasters and Potential Energy - Types of Energy - Forms of Energy - Everyday Energy Transformations - Take It to the Extreme Hands-On Labs: - What Would Make a Card Jump?	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUEST project "How can you build a complicated machine to do something simple?" Performance-Based Assessment "3, 2, 1… Liftoff" - Students will develop a model that

	How are different forms of energy related to each other? In what ways can energy change from one form to another? How is energy transferred? How does the law of conservation of energy apply to transformations and transfers?	**CCC.3 Scale, Proportion and Quantity** Students will integrate quantitative information to explain the relationship between potential and kinetic energy **CCC.5 Energy and Matter** Students will use models to represent relationships among different forms of energy. <u>Key terms:</u> - energy - motion - force - work - power - kinetic energy - potential energy - gravitational potential energy - elastic potential energy - mechanical energy - nuclear energy - thermal energy - chemical energy - electrical energy - electromagnetic radiations - pivot - Law of conservation of energy	om/phenomenon/2018/4/30/giant-newtons-cradle - Drinking Bird https://thewonderofscience.com/phenomenon/2017/10/7/drinking-bird **SEP.1 Asking Questions and Defining Problems** Students will be able to ask questions and identify the problem when a non-electric doorbell that a science student makes doesn't work properly. **SEP.2 Developing and using Models** Develop a model to demonstrate the phenomena of energy transfer. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. **SEP.5 Using Mathematics and Computational Thinking** Evaluate expressions to identify the linear relationship of gravitational potential energy and the nonlinear relationship of kinetic energy. **SEP.7 Engaging in Argument from Evidence** Construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	- What Work Is - Mass, Velocity, and Kinetic Energy - Energy, Magnetism, and Electricity - Making a Flashlight Shine - Law of Conservation of Energy <u>Engineering Activities</u> - Designing a Prosthetic Limb by discovering the properties of materials and changes in energy BP Energy lessons https://www.bp.com/content/dam/bp/country-sites/en_us/united-states/home/documents/community/science-fair-book-bp-intermediate.pdf Exploring Energy https://www.teachengineering.org/curricularunits/view/ucd_energy_unit PBS Energy Labs https://www.pbs.org/wgbh/nova/labs/about-energy-lab/educator-guide/ Energy Detectives https://www.energy.gov/sites/prod/files/2014/06/f16/basics_energydetectives.pdf NEA Clean Energy Education http://www.nea.org/tools/clean-energy-education.html	explains the relationship between potential and kinetic energy in a rocket system.

			Students will use text evidence to define energy, motion, work and force, and determine the relationships among them. Hands-On Labs Virtual Labs Online webquests Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning		

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Unit #4: Thermal Energy

Enduring Understandings:	**Essential Questions:**
● Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. ● The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. ● When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	● What happens when heat flows from one object to another? ● How does molecular motion relate to thermal energy? ● How are thermal energy and temperature related?

Interdisciplinary Connections

NJSLS Mathematics MP.2 Reason abstractly and quantitatively.

- Example: Students will use equations to convert units from Celsius to Kelvin and Fahrenheit.

NJSLS Computer Science and Design Thinking 8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.

- Example: Students will describe how the concept of thermal energy applies to the concept of glass blowing.

Career/Real World Connections

Careers

- Thermal Engineering is a specialized sub-discipline of mechanical engineering and chemical engineering that deals with the movement of heat energy and transfer. The energy can be transformed between two mediums or transferred into other forms of energy. A thermal engineer will have knowledge of thermodynamics and the process to convert generated energy from thermal sources into chemical, mechanical, or electrical energy.
- HVAC technician - HVAC is an abbreviation for heating, ventilation, and air conditioning. A qualified HVAC technician is a technician who installs, maintains, and repairs heating, ventilation, air conditioning, and refrigeration systems that control the temperature and air quality in buildings.

Real World Connections

- Earth's climate and weather are determined by energy transfer. The energy that warms Earth comes from the Sun. Some places on Earth absorb more energy than others and become warmer, and heat travels from warmer places to cooler places by the movement of air and ocean currents; the movement of air and water by these currents contributes to climate and weather.

- The process of glassblowing involves using a very hot oven to soften the glass. The glassblower can then shape the glass because it is so pliable. The heat transfer from an oven or torch is transferred to the class, causing the glass particles to move faster. As the particles move faster and faster, the glass softens. Once the glass is flexible, glass blowers blow air into it forcing the glass to expand and change shape.
- Global Warming - thermal energy can be used to describe events related to climate change. Some greenhouse gases absorb energy. This slows the loss of heat to space, keeping Earth warmer than it otherwise would be (greenhouse effect).
- Hurricanes - Hurricanes take heat from the oceans and convert it to the energy of their winds. They take thermal energy and make mechanical energy out of it. The natural engine that is a hurricane is fueled by warm, moist air, so warmer ocean water from global warming evaporates more easily. That means that more heat energy makes its way into the atmosphere, causing bigger, more powerful hurricanes to develop.

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MS-PS3-3 MS-PS3-4 MS-PS3-5	What happens to a substance when it is heated? What is the difference between thermal energy and temperature? How is energy conserved during transformations? How do different materials respond to heat? How is friction related to thermal energy and temperature?	Students investigate the relationship between temperature, thermal energy, and heat. Students model various methods of heat transfer and describe what happens to energy during transformations. Students investigate and describe how different materials respond to heat. **CCC.3 Scale, Proportion, and Quantity** Students will construct graphs to identify the proportional relationship between Celsius and Fahrenheit scales. **CCC.5 Energy and Matter** Students will use text evidence to describe and explain how the total thermal energy of a system depends on the types, states, and amounts of matter present. <u>Key terms:</u> - thermal energy - heat - temperature - conduction - convection - convection current	<u>Phenomena:</u> - Earthships https://thewonderofscience.com/phenomenon/2018/7/5/earthships - Ice-cutting experiment https://thewonderofscience.com/phenomenon/2018/7/12/ice-cutting-experiment - Candle-Powered Car https://thewonderofscience.com/phenomenon/2018/7/8/candle-powered-car - Lava lamps **SEP.3 Planning and Carrying Out Investigations** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. **SEP.5 Using Mathematics and Computational Thinking**	<u>Elevate Interactivities</u>: - Flow of Thermal Energy - A Rising Thermometer - Methods of Thermal Energy Transfer - Heat and Reheat <u>Hands-On Labs:</u> - How Cold is the Water? - Temperature and Thermal Energy What is Heat? https://www.teachengineering.org/lessons/view/ucd_heat_lesson01 NASA- Heat, Temperature and Conduction https://ngss.nsta.org/Resource.aspx?ResourceID=229	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUEST project "How can you keep hot water from cooling down?" Performance- Based Assessment "Testing Thermal Conductivity" - Students will test three different metals to determine which one conducts the most thermal energy over a 10-minute interval, and use their results to select a metal for use as a heat sink.

		- radiation - conductor - insulator - specific heat - thermal expansion	Students will write a formula for converting temperature to degrees Celsius if given the temperature in Kelvin or Fahrenheit. **SEP.6 Constructing Explanations and Designing Solutions** Gather observations to judge temperature using senses, and explain why temperature can be hard to gauge without a thermometer. **SEP.7 Engaging in Argument from Evidence** Construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Hands-On Labs Virtual Labs Online webquests Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning	PBS - Thermal Energy Transfer https://nj.pbslearningmedia.org/resource/lsps07-sci-phys-thermalenergy/thermal-energy-transfer/ Ohio Energy- Thermal Energy; Save the Penguins https://ohioenergy.org/wp-content/uploads/2015/09/4-Thermal-Teacher-Lesson.docx	

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Unit #5: Intro to Earth's Systems

Enduring Understandings:	**Essential Questions:**
● Earth's systems can be broken down into individual components, which have observable measurable properties. ● Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally. ● 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. ● Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, crystallization, and precipitation, as well as downhill flows on land. ● Global movements of water and its changes in form are propelled by sunlight and gravity.	● How do matter and energy cycle through Earth's systems? ● How do changes in one part of the Earth system affect other parts of the system? ● In what ways can Earth processes be explained as interactions among Earth's spheres?

Interdisciplinary Connections

NJSLS Mathematics MP.2 Reason abstractly and quantitatively.

- Example: Students will interpret a graph showing Arctic Sea Ice Extent over time, and predict what would happen to the extent of sea ice in the Arctic if temperatures continue to rise.

NJSLS Social Studies 6.3.8.CivicsPR.4 Use evidence and quantitative data to propose or defend a public policy related to climate change.

- Example: Students will make a claim about the causes of global warming, providing evidence for their claim, and propose ways to reverse its effects.

NJSLS World Languages 7.1.IM.PRSNT.7 Compare cultural perspectives regarding the degradation of the environment of the target culture(s), including the effects of climate change, with those of students' own culture.

- Example: Students will share in discussion how different countries, especially those from their heritage, are dealing with the effects of climate change, and ways they are trying to help reduce their impacts.

Career/Real World Connections

Careers

- Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth (and sometimes on other planets). Study includes looking at landscapes to work out how the earth surface processes, such as air, water and ice, can mold the landscape. Geomorphologists study how the earth's surface is formed and changed by rivers, mountains, oceans, air, and ice.

- A cartographer is someone who makes maps through geospatial analysis and computer making. They also study maps to trace the spread of diseases and identify potential epidemics before they begin, helping save lives. Cartographers also make emergency maps during natural disasters which can be used by public health officials to help rescue efforts.
- Air traffic controllers coordinate movements of thousands of aircraft, keeping them at safe distances from each other as they travel. Much like the different layers of topography map or satellite imagery, an air traffic controller receives information from multiple air traffic management systems.

Real World Connections

- Crime rate impacts the amount of law enforcement officers assigned to a specific area, and the amount of law enforcement officers impacts the level of crime experienced in the area. When the components of a system both impact each other, this creates a feedback loop.
- Greenland's ice sheet has been melting at an advanced rate due to global warming and runs into the ocean. Sea levels have risen at an average rate of 1.5 cm every decade for the past century, but has doubled in the past 25 years. Higher sea levels threaten infrastructure, lives and property. The higher sea levels cause Florida to become more vulnerable to deadly storms and coastal flooding.
- Climate change - Water is released to the atmosphere through evaporation It then returns to Earth as rain and snow. Climate change influences the water cycle because as air temperatures increase, so does the amount of water that evaporates into the atmosphere. Warmer air can hold more water vapor, which can lead to more intense rainstorms that in turn cause major problems like flooding.

Guiding / Topical Questions with Specific Standards		**Content, Themes, Concepts, and Skills**	**Teaching Strategies**	**Instructional Resources and Materials**	**Assessment Strategies**
MS-ESS2-1 MS-ESS2-4	What are the different components of the Earth system? What are the sources of energy for the processes that affect Earth? How can you model the cycling of matter in the Earth system? What are the different landforms found on Earth? What forces and energy make the different landforms?	Students will investigate and model the components of Earth's systems and the energy sources that drive the cycling of matter in Earth's systems. Students will investigate and model landforms. Students will also study the forces of energy that affect the geosphere, including how landforms are created. Students will investigate the places and forms in which water is found on Earth and how water is cycled through Earth's systems. **CCC.7 Stability and Change** Students will develop and use models to demonstrate how a system returns information about itself and that information results in change. **CCC.5 Energy and Matter**	Phenomena: - Yellowstone supervolcano https://thewonderofscience.com/phenomenon/2018/7/5/yellowstone-supervolcano - UAE Building a Mountain to Increase Rainfall https://thewonderofscience.com/phenomenon/2018/6/10/uae-building-a-mountain-to-increase-rainfall - Augmented Reality Sandbox https://thewonderofscience.com/phenomenon/2018/5/13/augmented-reality-sandbox - Saharan Desert Drift https://www.washingtonpost.com/news/speaking-of-science/wp/2016/05/11/how-dust-from-the-sahara-fuels-poisonous-bacteria	Elevate Interactivities: - Thermal Energy and the Cycling of Matter - Describing Systems - Fire and the Earth's Spheres - Forida Landforms - Constructive and Destructive Forces - Maps and Method - Disrupting the Geospheres - The Water Cycle - Floridan Aquifer System - Siting a Fish Farm - Impact on the Hydrosphere	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUESTproject - How can you predict the effects of a forest fire? Performance-Based Assessment "Modeling a Watershed" - Students will design and model the effects

	What are the various ways to model landforms? Where and in what features is water found on Earth? How does water cycle through Earth's systems?	Students will develop and use models to demonstrate how the sun's energy is the force that drives the water cycle. <u>Key terms:</u> - atmosphere - geosphere - hydrosphere - cryosphere - biosphere - energy - topography - landform - mountain - coastline - dune - river - delta - surveying - water cycle - evaporation - transpiration - condensation - precipitation - watershed - aquifer - well	-blooms-in-the-caribbean/?arc404=true - The Case of the Shrinking Sea (Aral Sea) **SEP.2 Developing and Using Models** Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. Hands-On Labs Virtual Labs Online webquests Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning	<u>Hands-On Labs:</u> - What Interactions Occur Within Earth's Systems? - Where Heat Flows - Interaction Action - Surface Features - Water on Earth Engineering design challenge: A Daring Bridge NASA- Connect the Spheres https://gpm.nasa.gov/education/lesson-plans/connect-spheres-earth-systems-interactions NOVA Earth's Systems https://nj.pbslearningmedia.org/collection/earths-systems/ Earth System Science Activities (SERC) https://serc.carleton.edu/serc/site_guides/ess_activities.html	of pollution on surface water in a watershed,

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Unit #6: Weather in the Atmosphere

Enduring Understandings:	**Essential Questions:**
● The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. ● Because these patterns are so complex, weather can only be predicted probabilistically. ● Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. ● Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. ● Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. ● Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. ● Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. ● The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. ● Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	● What determines weather on Earth? ● What regulates weather and climate?

Interdisciplinary Connections

NJSLS Mathematics MP.2 Reason abstractly and quantitatively.

- Example: Students will review a graph showing Arctic Sea Ice Extent and determine the trend in the data. They will also predict what will happen in the future based on this trend.

NJSLS Computer Science and Design Thinking 8.2.8.ETW.4 Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.

- Example: Students will analyze and interpret data to describe evidence that technological advances including cars, factories, and power plants have affected the water cycle, leading to changes in climate such as droughts and more intense storms.

Career/Real World Connections

Careers

- Meteorologists are scientists who study the weather and help keep the public safe by informing them about severe weather events. Meteorologists make predictions about the weather based on advanced monitoring techniques, measurement tools, and computer-based forecasting programs.
- A storm chaser is an atmospheric and space scientist who studies global patterns of atmospheric movement, fronts, temperature, and pressure systems looking for severe weather disturbances. Their job is to track the development and storms and collect data from the storm as it is occurring. The data is used to predict behavior of future storms and is used in media broadcasts about the storm. Weather broadcasts help towns prepare for severe weather and limit damage and destruction caused by storms.

Real World Connections

- The ozone layer is a region in the stratosphere that contains high concentrations of ozone gas. Ozone absorbs most of the sun's harmful ultraviolet light. During the twentieth century, many aerosol sprays contained chlorofluorocarbons (CFC's), which destroy ozone when they reach the upper atmosphere. A large hole formed in the ozone layer of the Southern Hemisphere, threatening animal and plant communities and causing a spike in skin cancer. In response, the United States and Europe banned CFCs in 1996, and as a result, the ozone hole is now shrinking.
- Pollution is a result of toxic chemicals that are released into the atmosphere and water sources. As the pollution enters the atmosphere, it mixes with the water vapor in the air. When the water vapor returns to Earth as precipitation, so do the dangerous toxins. Rain that contains toxins is referred to as acid rain and can harm plants. Vegetation plays a large role in the water cycle.
- The jet stream is a band of high winds that blow from the west to the east. Air masses are moved along by the jet stream and in turn have a major impact on the weather. By flying in a jet stream, planes traveling from west to east get a significant boost from the tailwind, which saves time and fuel. Conversely, planes flying in the opposite direction lose time and expend more fuel by flying into the headwind a jet stream produces, and pilots usually adjust their flying altitude to avoid them.
- Early detection of approaching storms plays a crucial part in public safety. Due to technological advancements, scientists can now predict the path of a storm and warn people to evacuate or take shelter.

Guiding / Topical Questions with Specific Standards	Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies

MS-ESS2-4 MS-ESS2-5 MS-ESS2-6 MS-ESS3-2 MS-PS1-4	What is the composition and structure of the Earth's atmosphere? How does energy from the Sun affect Earth's atmosphere? What processes make up the water cycle? How does energy drive the processes of the water cycle? How does the water cycle affect weather? How do global patterns, such as the jet stream, affect air masses? How do air masses interact to form fronts? How do the interactions of air masses result in changes in weather? How do meteorologists use the interactions of air masses to forecast changes in weather? How does technology aid in collecting and analyzing weather data? How do weather maps help to model current weather and predict future weather?	Students investigate the composition and structure of Earth's atmosphere and the way that energy from the sun affects Earth's atmosphere. Students investigate how water is always moving between the surface of Earth and the atmosphere, the processes that drive the water cycle, and how the water cycle affects the weather. Students investigate the movement of air masses of the different temperatures and humidities to identify the type of fronts and the types of weather that can develop. Students learn how meteorologists use direct observations, pattern analysis, and technology to predict the weather. Students examine and describe damage associated with severe storms, as well as measures that can be taken to ensure safety in a storm. **CCC.1 Patterns** Students will constrict explanations using reasoning to predict similar patterns by recognizing that pattern analysis is essential for weather forecasting. **CCC.2 Cause and Effect** Students will analyze cause-and-effect relationships in order to predict how temperature determines the type of precipitation for an area. **CCC.4 Systems and System Models** Students will develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. **CCC.5 Energy and Matter**	Phenomena: - Rainbows, moonbows - Rare cloud formations - Funnel clouds - Light pillars - The Driest Place on Earth https://thewonderofscience.com/phenomenon/2018/6/15/the-driest-place-on-earth - Why Does the Wind Blow? https://thewonderofscience.com/phenomenon/2018/6/15/why-does-the-wind-blow - Rolling Clouds https://youtu.be/OrQiTbuoE5Y **SEP.2 Developing and Using Models** Students will develop and use models to demonstrate water is always moving between the surface of Earth and the atmosphere. Students will develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. **SEP.3 Planning and Carrying Out Investigations** Students will collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. **SEP.4 Analyzing and Interpreting Data** Students will analyze and interpret data on natural hazards to forecast future catastrophic events and inform the	Elevate Interactivities: - Mountaintop Meal Preparations - Layers of the Atmosphere - Patterns in the Wind - Ways that Water Moves - Water Cycle - Interruptions in the water Cycle - Making Water Safe to Drink - Weather and Severe Weather - When Air Masses Collide - Mapping Out the Weather - All About Air Masses - Using Air Masses to Predict Weather - Weater Predicting - Tracking Weather - Predicting Severe Weather - Not in Kansas Anymore - Tinkering with Technology - Severe Weather Experiences Hands-On Labs: - Puddle Befuddlement - Effects of Altitude on the Atmosphere - Water in the Air - How Clouds and Fog Form	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUEST project "How can you prepare severe weather?" Performance-Based Assessment "Water From Trees" - Students explore the role of plants in the water cycle through direct observation. They will design and implement a four-day experiment to gather evidence that trees transpire.

	How does severe weather affect human life? How do humans protect themselves from severe weather?	Students will analyze and interpret data to describe evidence that water is continually evaporating and condensing from the atmosphere to form clouds. Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. <u>Key terms:</u> - atmosphere - air pressure - altitude - wind - water cycle - evaporation - condensation - dew point - humidity - relative humidity - precipitation - air mass - jet stream - front - cyclone - anticyclone - meteorologist - storm - thunderstorm - hurricane - tornado - storm surge - flood - drought	development of technologies to mitigate their effects. Students will develop and use models to demonstrate how air masses of different temperatures and humidity collide, resulting in a front. Hands-On Labs Virtual Labs Online webquests Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning	- Weather Fronts - Predicting Hurricanes Engineering Design Challenge: - Build a Dew Catcher - Catching Water With a Net NOAA- Weather and Atmosphere https://www.noaa.gov/education/resource-collections/weather-atmosphere NEA Weather Forecasting http://www.nea.org/tools/lessons/64127.htm Teach Engineering- Weather and Atmosphere https://www.teachengineering.org/curricularunits/view/cub_weather_curricularunit National Weather Service https://www.weather.gov/owlie/science_tp Scholastic- Weather and Climate https://www.scholastic.com/teachers/activities/teaching-content/weather-and-climate-13-st	

				udyjams-interactive-science-activities/	

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Unit #7: Minerals and Rocks in the Geosphere

Enduring Understandings:	**Essential Questions:**
● 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. ● Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.	● What events form Earth's rocks? ● How do rocks and minerals cycle through our environment? ● Why are rocks and minerals important to our health and to our economy?

Interdisciplinary Connections

NJSLS Mathematics 6.EE.A.2 Write, read, and evaluate expressions in which letters stand for numbers

- Example: Students will calculate density of minerals using the equation *Density= mass/volume.*

NJSLS Mathematics 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

- Example: Students will create a graph comparing Pressure vs. Depth Deep Inside Earth. They will determine the dependent and independent variable and analyze their relationship to explain how pressure is related to depth.

NJSLS Social Studies 6.1.5.GeoPP.2: Describe how landforms, climate and weather, and availability of resources have impacted where and how people live and work in different regions of New Jersey and the United States.

- Example: Students will learn how mineral resources (such as gold) led people to travel west in the search for gold, leading to westward Expansion.

Career/Real World Connections

Careers

- Geologists are people who study Earth's structures and processes. There are many careers in geology, including volcanologists who study volcanoes and how, when, where, and why they form. They may also study historic and prehistoric volcanoes, such as those that erupted in what is now India around the time the non-avian dinosaurs went extinct approximately 65 million years ago. Other careers in geology include seismology, or the study of earthquakes, and paleontology, or the study of prehistoric life and Earth's ancient ecosystems.
- Geological Field Technicians will collect, examine and identify resources found beneath the earth's surface, in order to determine their mineral content, through this they are able to help indicate the potential area of a mine site.

Real World Connections

- Plate Tectonics- Because of convection currents in the Earth's mantle, the crust at Earth's surface is always moving. Examples of this can be seen all over the world. In Iceland, the Mid-Atlantic ridge is a place where two plates are moving away from each other, pushed apart by magma rising to the surface. This magma is a result of convection, and the movement of the plates results from convection currents. Part of the Mid-Atlantic Ridge is located above ground, in Iceland. People can actually walk between the two plates.
- Minerals are those elements on the earth and in foods that our bodies need to develop and function normally. Those essential for health include calcium, phosphorus, potassium, sodium, chloride, magnesium, iron, zinc, iodine, chromium, copper, fluoride, molybdenum, manganese, and selenium.
- Using Rocks as Building Materials - Many types of rocks can be used as construction materials including basalt, marble, limestone, sandstone, quartzite, travertine, slate, gneiss, laterite, and granite. The rocks used for building construction should be hard, durable, tough, and should be free from weathered soft patches of material, cracks, and other defects that are responsible for the reduction of strength and durability.

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MS-ESS2-1	How do geologists study Earth's layered interior? What roles do heat and pressure in Earth's interior play in the cycling of matter? What are the patterns and effects of convection in Earth's mantle? What are the characteristics and properties of minerals? What processes result in the formation of minerals?	Students investigate how scientists study Earth's materials and model its layers. Students study the processes that form minerals and the characteristics and properties of minerals. Students study the three basic types of rocks and how rocks form. Students investigate the materials that make up Earth, how they are continuously cycled, and what energy flows drive Earth's processes. **CCC.5 Energy and Matter**	Phenomena: - Desert Rose Selenite https://www.youtube.com/watch?v=huShfNiQG00 - **SEP.2 Developing and Using Models** Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. **SEP.6 Constructing Explanations and Designing Solutions** Students will construct a scientific explanation based on evidence for how the uneven distributions of	Elevate Interactivities: - Earth's Layers - Hot on the Inside - Comparing Earth and Mars - A Curious Word - The Deep Drill - Designing Satellites - So Many, Many Minerals - Mineral Management - Don't Take it for Granite - Is There a Geologist in the House? - Rocky Changes - Rock cycle - Rocks on the Move Hands-On Labs: - Mineral Mash-Up	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUEST project "How can you depict Earth processes in a movie script?" Performance- Based Assessment "The Rock

	What processes explains the distribution of mineral resources on Earth? What are the three major types of rocks and how do they form? How is the formation of rocks the result of the flow of energy and cycling of matter within Earth? How are Earth's materials cycled in the rock cycle? How does the flow of energy drive the processes of the rock cycle?	Students will develop a model to show how the cycling of Earth's processes are driven by the flow of energy from inside of the Earth. **CCC.7 Stability and Change** Students will develop and use models to demonstrate how processes that occur on Earth's surface and in the crust and mantle slowly change rock from one kind to another. <u>Key terms:</u> - seismic wave - crust - mantle - outer core - inner core - mineral - crystal - crystallization - igneous rock - sedimentary rock - sediment - metamorphic rock - rock cycle	Earth's mineral, energym and groundwater resources are the result of past and current geoscience processes. Hands-On Labs Virtual Labs Online webquests Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning	- A Sequined Rock - Name that Rock - Ages of Rocks - Build a Model of Earth - Heat and Motion in a Liquid - Growing a Crystal Garden - Make Your Own Stalagmites and Stalactites - Rock vs. Rock - Ages of Rocks - Paper or Plastic...or Rock? Engineering Design Challenge: "Examining Earth's Interior from Space" Case Study- "Mighty Mauna Loa" Evidence-based assessment: - What role does heat, pressure, and temperature in Earth's interior play in the cycling of matter? Geology.com https://geology.com/teacher/rocks.shtml PBS Geology- Rocks and Minerals https://nhpbs.org/kn/vs/scilab8f8.asp Scholastic - The Earth, Rocks and Minerals https://nhpbs.org/kn/vs/scilab8f8.asp Smithsonian - Minerals, Crystals and Gems http://www.smithsonianeduca	Cycle in Action" - Students are expected to plan and model the information of rocks with crayons or crayon rocks.

				tion.org/educators/lesson_plans/minerals/	

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Unit #8: Plate Tectonics

Enduring Understandings:	**Essential Questions:**
• Tectonic processes continually generate new ocean sea floor at ridges and destroy old seafloor at trenches. • 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. • The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. • Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	• How do geological processes change Earth's surface? • Why do the continents move, and what causes earthquakes and volcanoes?

Interdisciplinary Connections

NJSLS Mathematics MP.2 Reason abstractly and quantitatively.

- Example: Students will use evidence from GPS reading to predict how fast the North American Plate is moving away from the Mid-Atlantic Ridge.

NJSLS Social Studies 6.1.5.GeoSV.4: Use a variety of geographic representations to describe the similarities and differences between places in New Jersey, the United States, and the world (e.g., maps, data visualizations, graphs, diagrams, aerial and other photographs, GPS).

- Example: Students will use Google Earth to compare the topography and geologic differences among parts of the US and around the world, and identify how these geologic changes are a result of tectonic forces.

Career/Real World Connections

Careers

- Structural architects design buildings and other structures, taking into consideration safety, functionality and aesthetics. When planning the seismic safety of a building, structural engineers must design the support elements of shorter buildings to withstand greater forces than those of taller buildings.
- Seismologists actively study earthquakes and vibrations within the earth. Seismologists use sophisticated tools such as seismographs, which measure the intensity of an earthquake. They also use computers to help generate graphical models of the vibrations of the Earth.

Real World Connections

- Geothermal Energy - Internal energy from the ground close to a volcano can provide an unlimited supply of energy. This type of energy is referred to as geothermal energy. People can use this source of renewable energy rather than relying on fossil fuels.
- Earthquake early-warning systems use earthquake science and seismic monitoring technology to alert people when shaking waves generated by an earthquake are experienced. Currently, early detection systems only provide an advanced warning of seconds to minutes. Early-warning system technology is too new to support public warnings. Once the system has been fully developed, it will begin issuing public notifications.
- Lessons learned from Mount St. Helens - On May 18, 1980, Mount St. Helens surprised everyone by erupting, and it did so in a big way. The peak exploded, dropping by about 2500 meters and leaving a giant crater. The explosion wiped out 230 square miles of land, including homes, trees, and the people and animals that inhabited the region.

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MS-ESS2-2 MS-ESS2-3 MS-ESS3-2	What evidence supported the hypothesis of continental drift? What roles do mid-ocean ridges and ocean trenches play in the movement of plates? How do Earth's plates move? How do Earth's surface features support the theory of plate tectonics? What are the products of plate movement at different scales? How do plate movement and stress produce new landforms? What are earthquakes and tsunamis, and why do they occur?	Students investigate evidence that supports the hypothesis of continental drift and the existence of Pangaea. Students examine how convection drives plate motion and how the movement of Earth's plates has greatly changed the locations of the continents and the size and shape of the ocean basins. Students learn the ways that plates move at plate boundaries. Students learn how tension, shearing and compression produce faults and other features. Students then analyze these features and events at Earth's surface to determine their relationship with plate boundaries. Students examine the role that volcanic activity plays in shaping Earth's surfaces as well as the hazard that different types of volcanoes pose. In addition, students explore the relationship between plate tectonics and volcanic eruptions and landforms. **CCC.1 Patterns** Students analyze and interpret data about patterns in the Cascade Range to forecast the	Phenomena: - Pele's Hair - Snow Chimneys - Volcano from Space https://www.ngssphenomena.com/#/volcano-from-space/ - Geysers https://www.ngssphenomena.com/#/geiser-before-it-erupts/ - Marianas Trench https://thewonderofscience.com/phenomenon/2018/6/10/the-marianas-trench-deepest-ocean - Zealandia https://www.nationalgeographic.org/encyclopedia/zealandia/ **SEP.4 Analyzing and Interpreting Data** Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor	Elevate Interactivities: - Puzzling Pieces - Land and Sea-Floor Patterns - Slow and Steady - Puzzling Pieces - Relative Plate Motion - By No Fault of Their Own - Stressed to a Fault - Locating an Earthquake - Earthquake Engineering - Placing a Bay Area Stadium - Quaking and Shaking - Moving Volcanoes - Landforms from Volcanic Activity - Volcanoes Changing Earth's Surface Hands-On Labs: - How Are Earth's Continents Linked Together? - How Are the Continents Linked Together? - Piecing Together a Supercontinent - Patterns in the Cascade Range - Plate Interactions	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUEST project "How safe is it to hike around Mount Rainier?" Performance-Based Assessment: "Modeling Sea-Floor Spreading" - Students explore the reasons why building a pipeline that spans a divergent zone is a bad idea. They will design and conduct a model that demonstrates why the pipeline plan is a problem.

	How can the effects of earthquakes and tsunamis be mitigated? How is plate tectonics connected to volcanic eruptions and landforms? What role does volcanic activity play in shaping Earth's surface? What hazards do different types of volcanoes pose?	locations and likelihoods of future volcanic eruptions. **CCC.3 Scale, Proportion, and Quantity** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. **CCC.7 Stability and Change** Students will identify the direction of plate movement and predict the direction that the plates move. <u>Key terms:</u> - mid-ocean ridge - sea-floor spreading - subduction - ocean trench - divergent boundary - convergent boundary - transform boundary - stress - tension - compression - shearing - fault - earthquake - magnitude - tsunami - volcano - magma - lava - hot spot - extinct - dormant	structures to provide evidence of the past plate motions. **SEP.6 Constructing Explanations and Designing Solutions** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Hands-On Labs Virtual Labs Online webquests Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning	- Stressing Out - Analyze Earthquake Data to Identify Patterns - Signs of Eruption? - Moving Volcanoes Case Study: Australia on the Move Engineering Design: Designing to Prevent Destruction Plate Tectonics CER https://docs.google.com/document/d/1Mh8WvetPtrQZ4BFZAYvTgXrYF2K75zQsA_TweSUkRHc/edit National Geographic- Plate Tectonics https://www.nationalgeographic.org/topics/resource-library-plate-tectonics/?q=&page=1&per_page=25 PBS Plate Tectonics https://nj.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.lp_platetectonics/plate-tectonics/ National Park Service- Plate Tectonics https://www.nps.gov/subjects/geology/teaching-resources-plate-tectonics.htm Snack Tectonics https://www.windows2universe.org/teacher_resources/teach_snacktectonics.html Smithsonian- Plate Tectonics https://naturalhistory.si.edu/edu	

				cation/teaching-resources/earth-science/plate-tectonics	

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Unit #9: Earth's Surface Systems

Enduring Understandings:	**Essential Questions:**
● The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. ● Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	● What processes change Earth's surface? ● How do the properties and movements of water shape Earth's surface and affect its systems?

Interdisciplinary Connections

NJSLS Mathematics MP.2 Reason abstractly and quantitatively.

- Example: Students will construct a double-line graph and analyze and interpret the data to compare the weathering rates of limestone.

NJSLS Mathematics 7.RP.3 Use proportional relationships to solve multistep ratio and percent problems.

- Example: Students will analyze the proportional relationships in a graph of California Winter Precipitation to predict and explain the conditions that lead to a landslide.

Career/Real World Connections

Careers

- Soil conservationists are scientists who look for ways to replenish soil and to keep it from eroding. They plan the application of total resource management systems and provide conservation planning assistance from initial evaluation to completion. Soil conservationists possess a practical knowledge of the methods and techniques of soil, water, and environmental conservation as they relate to agricultural operations and land use measures.
- Civil engineers are responsible for all of the work that benefits the citizens of a society. After a natural disaster, civil engineers get involved in reconstruction efforts. Whether planning a new road or bridge, civil engineers must take into account the forces that change Earth's surface.

Real World Connections

- Erosion of Man-Made Structures- Rain can cause or worsen problems with the erosion of man-made structures. For example, Ennis House in Los Angeles was designed and built by Franklin Lloyd Wright for Charles and Mable Ennis in the early to mid-1920s. Over the years, it has appeared in movies as *House on Haunted Hill* (1958), *Blade Runner* (1982), and *Karate Kid Part III* (1989). Built on the slope of a hill, the house has always suffered from structural problems, but in 1994, an earthquake weakened a section of the retaining wall on the home's south side.

- Lascaux Caves- In the late summer of 1940, an 18-year-old named Marcel Ravidat discovered the entrance to a system of caves in the countryside near Montignac, France. He returned a few days later with friends, and together they found that the walls were covered in prehistoric art mostly depicting wild animals. The cave system became a popular tourist attraction, but by the mid 1950s, contamination from human beings including carbon dioxide and humidity, had begun to damage the art. The cave was later closed and the paintings restored.
- Sand dunes are the result of deposition by wind. Sand is a fine, granular material that is really very tiny pieces of rock, broken off from larger pieces of rock by weathering or some other erosive process. Sand can be easily picked up by the wind and carried away from its original location. Over time, as more and more sand gets deposited, sand dune(s) will form.

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MS-ESS2-2 MS-ESS3-2	How does erosion change Earth's surface? How does weathering change Earth's surface? How does soil form? How does erosion change Earth's surface? How does weathering change Earth's surface? How does soil form? What processes change Earth's surface? How does mass movement change Earth's surface? How does wind change Earth's surface? How does moving water change Earth's surface?	Students learn the two agents of weathering, mechanical and chemical weathering, and how these and other processes contribute to the formation of soil. Students investigate the forces, causes, and relationship between erosion and deposition, and explore how these processes help change Earth's surface features. Students model ways in which water causes erosion to learn how water creates landforms by carving out rock or building up sediment. Students learn how glacial movement carves out valleys in the land and deposits sediment to create new landforms, as well as how wave action contributes to the erosion and deposition of beaches. **CCC.1 Patterns** Students will explain how wind both builds up and wears down Earth's surface in a desert. **CCC.3 Scale, Proportion, and Quantity** Students observe models of geologic processes and phenomena (such as weathering and erosion) that can take place over a variety of size scales as well as a variety of time scales.	Phenomena: - Spherical boulders - How the Grand Canyon Formed https://thewonderofscience.com/phenomenon/2018/5/13/how-was-the-grand-canyon-formed - Augmented reality sandbox https://thewonderofscience.com/phenomenon/2018/5/13/augmented-reality-sandbox **SEP.4 Analyzing and Interpret Data** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. **SEP.6 Constructing Explanations and Designing Solutions** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. Hands-On Labs Virtual Labs Online webquests	Elevate Interactivities: - Dating Using Weathering Rates - Colors of the Sand - Classify the Forces of Weathering - Landslide Prevention - Classify the Forces of Weathering - Breaking it Down - Material Slope Angle - Predicting Disasters - Changing Landscapes - Learning rom Rocks - Carving a Canyon - Effects of Glaciers - Glacial Ice - Coastline Management Hands-On Labs: - How Does Gravity Affect Materials on a Slope? - Breaking Up is Hard to Do	Exit slips Project rubrics Lesson quizzes and unit test Lesson checks Reading checks QUEST project "How can I design and build an artificial island?" Performance-Based Assessment "Materials on a Slope" - Students plan and model the effects of gravity on erosion of sand hills. They will form a hypothesis about the relationship between the two and then plan and carry out a test of that hypothesis.

	What landforms form from water erosion and deposition? How does groundwater change Earth? How do glaciers change Earth's surface? How do waves change Earth's surface?	<u>Key terms:</u> - uniformitarianism - erosion - mechanical weathering - chemical weathering - soil - humus - sediment - deposition - mass movement - delation - sand dune - loess - runoff - stream - tributary - flood plain - delta - alluvial fan - groundwater - glacier - continental glacier - ice age - valley glacier - plucking - till - longshore drift	Topic Enrichments Graphic Organizers Scientific arguments (CER) Science Videos Science Stations Interactive Science Journals Digital Learning	- Freezing and Thawing - Small, Medium and Large - Raindrops Falling - Karst Topography - Mammoth Caves - Glacier in a Cup - Changing Coastlines Engineering Design Challenge: Stop a Landslide PBS- Earth's Ever Changing Surface https://nj.pbslearningmedia.org/resource/buac17-68-sci-ess-lpearthchangesurface/earths-ever-changing-surface/ Teach Earth Science - Weathering https://teachearthscience.org/weathering.html Common Sense Education- Our Changing Earth https://www.commonsense.org/education/lesson-plans/our-changing-earth The Changing Earth https://www.sausd.us/cms/lib/CA01000471/Centricity/Domain/105/Changing%20Earth%20Learning%20Journalfinal.pdf	

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Unit #10: Living Things in the Biosphere

Enduring Understandings:	**Essential Questions:**
● All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). ● Within cells, special structures are responsible for particular functions and the cell membrane forms the boundary that controls what enters and leaves the cell. ● In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.	● How do scientists define and organize living things? ● How do organisms obtain and use the matter and energy they need to live and grow?

Interdisciplinary Connections

NJSLS Mathematics 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationships between the dependent and independent variables using graphs and tables, and related these to the equation.

- Example: Students will use variables to write an expression to find the percentage of animals that swim compared to those that fly, or walk, run, or hop.

NJSLS World Languages 7.1.NM.IPRET.1: Identify familiar spoken and written words, phrases, and simple sentences contained in culturally authentic materials and other resources related to targeted themes.

- Example: Students will use a list of prefixes and suffixes in latin in order to help them understand science terms and scientific names that came from Latin and Greek cultures.

Career/Real World Connections

Careers

- Microbiologists study microorganisms such as bacteria, viruses, algae, fungi, and some types of parasites. They try to understand how these organisms live, grow, and interact with their environments.
- Evolutionary biologists study the changes that occur in plants and animals over time. They also look at the generational history of certain organisms so they can understand their origins. Evolutionary biologists might try to discover the earliest ancestors of modern humans or analyze a flu virus to understand how it develops resistance to vaccines. Their main objective is to study the origin of a particular species as well as document how its traits have changed throughout multiple generations.

Real World Connections

- New species are discovered all the time. Many times, certain organisms are already classified, but because of DNA analysis scientists determined that these organisms should be classified as a new species. Most new species that have been discovered are insects, but other types of new organisms, like certain marine life, are classified as well. Typically, newly discovered species are found in remote locations.
- Adult Stem Cells- Cell division regularly occurs in adults, and when skin tissue is damaged or dying, the adult stem cells divide and replenish tissue cells as necessary. Because adult stem cells can divide indefinitely, scientists are studying if it is feasible for a few cells to redevelop an organ.
- Diseases- Viruses are very tiny germs. They are made of genetic material inside of a protein coating. Viruses cause familiar infectious diseases such as the common cold, flu, and warts. They also cause severe illnesses such as HIV/AIDS, smallpox, and Ebola.
- Invasive Species- When a species is placed in a different ecosystem, it can become known as an invasive species: a species that can take over and damage a different population. For example, the kudzu plant from Asia is overgrowing sections of eastern North America. Kudzu is difficult to eradicate because the root system must be destroyed to kill the plant.

Guiding / Topical Questions with Specific Standards		Content, Themes, Concepts, and Skills	Teaching Strategies	Instructional Resources and Materials	Assessment Strategies
MS-LS1-1 MS-LS1-2 MS-LS1-3 MS-LS4-2	What evidence is there that all living things are made of cells? Where do living things come from? What do living things need to stay alive, grow and reproduce? How are living things classified into groups? How does the theory of evolution support the classification of organisms? What are all living things made of? What are the characteristics of viruses, bacteria, protists, and fungi?	Students will investigate evidence that living things are made of cells and where they come from. Students will also study what living things need to stay alive, grow, and reproduce. Students will explore how living things are classified, and how the theory of evolution supports the classification of organisms. Students will investigate the characteristics of viruses, bacteria, protists, and fungi, and how these organisms interact with nature and humans. Students will investigate the characteristics of plants and animals and how these organisms interact with nature and humans. **CCC.6 Structure and Function** Students will determine differences to identify the forms and functions of different plants. **CCC.7 Stability and Change**	Phenomena: - The Tough and Tiny Tardigrade **SEP.2 Developing and Using Models** Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. **SEP.3 Planning and Carrying Out Investigations** Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. **SEP.6 Constructing Explanations and Designing Solutions** Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between	Elevate Interactivities: - What All Living Things Have in Common - Mom's Car Must Be Alive - Under the Microscope - Classify It - Bacteriophage Treatments - Vaccine and Populations - Life as a Single Cell - There's Something Going Around - Discovering Rainforest Organisms - Modifying a Virus - Different Cells, Different Jobs - Identifying an Organism	Exit slips Project rubrics Hands-On Labs Virtual Labs Online webquests Topic Enrichments Lesson quizzes and unit test Lesson checks Reading checks Scientific arguments (CER) QUEST project "How can you design a field

	How do viruses, bacteria, protists, and fungi interact with nature and people? What makes animals and plants different in form and function? Which special structures inside plant and animal cells determine an organism's characteristics? How do similar cells work together to help plants and animals function? Which traits are unique to animals?	Students will describe how all organisms must maintain a stable internal environment in order to function properly. <u>Key terms:</u> - organism - cell - unicellular - multicellular - stimulus - response - spontaneous generation - homeostasis - species - classification - genus - binomial nomenclature - taxonomy - domain - evolution - convergent evolution - virus - host - vaccine - bacteria - protist - parasite - tissue - vascular plants - nonvascular plants - vertebrates - invertebrates - organ - mammals	modern and fossil organisms to infer evolutionary relationships. **SEP.7 Engaging in Argument from Evidence** Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. **SEP.8 Obtaining, Evaluating, and Communicating Information** Create a field guide of living organisms. Collect and gather information about living organisms, evaluate them and place into categories or groups based on their characteristics, and communicate results with the class.	- Organization of Organisms - So Many Cells <u>Hands-On Labs:</u> - Is It an Animal? - All Wound Up - Cheek Cells - Clean Up That Junk Drawer! - Living Mysteries - A Mystery Organism No More! - Classifying Seeds - Viruses by the Numbers - Life in a Drop of Pond Water - Algae and Other Plants Engineering Design Challenge: - Attack of the Viruses - A Disease Becomes a Cure	guide to organize living things?" Performance-Based Assessment "It's Alive!" - Students will observe several different types of living things and gather evidence to distinguish living things from nonliving things.

General Differentiated Instruction Strategies	
• Leveled texts • Chunking texts • Choice board • Socratic Seminar • Tiered Instruction • Small group instruction • Guided Reading • Sentence starters/frames • Writing scaffolds • Tangible items/pictures • Adjust length of assignment	• Repeat, reword directions • Brain breaks and movement breaks • Brief and concrete directions • Checklists for tasks • Graphic organizers • Assistive technology (spell check, voice to type) • Study guides • Tiered learning stations • Tiered questioning • Data-driven student partnerships • Extra time

Possible Additional Strategies for Special Education Students, 504 Students, At-Risk Students, and English Language Learners (ELLs)			
Time/General	**Processing**	**Comprehension**	**Recall**
• Extra time for assigned tasks • Adjust length of assignment • Timeline with due dates for reports and projects • Communication system between home and school • Provide lecture notes/outline	• Extra Response time • Have students verbalize steps • Repeat, clarify or reword directions • Mini-breaks between tasks • Provide a warning for transitions • Reading partners	• Precise step-by-step directions • Short manageable tasks • Brief and concrete directions • Provide immediate feedback • Small group instruction • Emphasize multi-sensory learning	• Teacher-made checklist • Use visual graphic organizers • Reference resources to promote independence • Visual and verbal reminders • Graphic organizers
Assistive Technology	**Assessments and Grading**	**Behavior/Attention**	**Organization**
• Computer/whiteboard • Tape recorder	• Extended time • Study guides	• Consistent daily structured routine	• Individual daily planner • Display a written agenda

• Spell-checker • Audio-taped books	• Shortened tests • Read directions aloud	• Simple and clear classroom rules • Frequent feedback	• Note-taking assistance • Color code materials

Enrichment

The goal of Enrichment is to provide learners with the opportunity to participate in extension activities that are differentiated and enhance the curriculum. All enrichment decisions will be based upon individual student needs.

- Show a high degree of intellectual, creative and/or artistic ability and demonstrate this ability in multiple ways.
- Pose questions and exhibit sincere curiosity about principles and how things work.
- The ability to grasp concepts and make real world and cross-curricular connections.
- Generate theories and hypotheses and pursue methods of inquiry.
- Produce products that express insight, creativity, and excellence.
- Possess exceptional leadership skills.
- Evaluate vocabulary
- Elevate Text Complexity
- Inquiry based assignments and projects
- Independent student options
- Tiered/Multi-level activities
- Purposeful Learning Center
- Open-ended activities and projects
- Form and build on learning communities
- Providing pupils with experiences outside the 'regular' curriculum
- Altering the pace the student uses to cover regular curriculum in order to explore topics of interest in greater depth/breadth within their own grade level
- A higher quality of work than the norm for the given age group.
- The promotion of a higher level of thinking and making connections.
- The inclusion of additional subject areas and/or activities (cross-curricular).
- Using supplementary materials in addition to the normal range of resources.

English Language Learner (ELL) Resources

- Learning style quiz for students- http://www.educationplanner.org/students/self-assessments/learning-styles-quiz.shtml
- "Word clouds" from text that you provide-http://www.wordle.net/
- Bilingual website for students, parents and educators: http://www.colorincolorado.org/
- Learn a language for FREE-www.Duolingo.com
- Time on task for students-http://www.online-stopwatch.com/
- Differentiation activities for students based on their Lexile-www.Mobymax.com
- WIDA-http://www.wida.us/
- Everything ESL - http://www.everythingESL.net
- ELL Tool Box Suggestion Site http://www.wallwisher.com/wall/elltoolbox
- Hope4Education - http://www.hope4education.com
- Learning the Language http://blogs.edweek.org/edweek/learning-the-language/
- FLENJ (Foreign Language Educators of NJ) 'E-Verse' wiki: http://www.flenj.org/Publications/?page=135
- OELA - http://www.ed.gov/offices/OBEMLA
- New Jersey Department of Education- Bilingual Education information http://www.state.nj.us/education/bilingual/

Special Education Resources

- Animoto -Animoto provides tools for making videos by using animation to pull together a series of images and combining with audio. Animoto videos or presentations are easy to publish and share. https://animoto.com
- Bookbuilder -Use this site to create, share, publish, and read digital books that engage and support diverse learners according to their individual needs, interests, and skills. http://bookbuilder.cast.org/
- CAST -CAST is a non-profit research and development organization dedicated to Universal Design for Learning (UDL). UDL research demonstrates that the challenge of diversity can and must be met by making curriculum flexible and responsive to learner differences. http://www.cast.org
- CoSketch -CoSketch is a multi-user online whiteboard designed to give you the ability to quickly visualize and share your ideas as images. http://www.cosketch.com/
- Crayon -The Crayon.net site offers an electronic template for students to create their own newspapers. The site allows you to bring multiple sources together, thus creating an individualized and customized newspaper. http://crayon.net/ Education Oasis -Education Oasis offers a collection of graphic organizers to help students organize and retain knowledge – cause and effect, character and story, compare and contrast, and more! http://www.educationoasis.com/printables/graphic-organizers/
- Edutopia -A comprehensive website and online community that increases knowledge, sharing, and adoption of what works in K-12

education. We emphasize core strategies: project-based learning, comprehensive assessment, integrated studies, social and emotional learning, educational leadership and teacher development, and technology integration. http://www.edutopia.org/

- Glogster -Glogster allows you to create "interactive posters" to communicate ideas. Students can embed media links, sound, and video, and then share their posters with friends. http://edu.glogster.com/?ref=personal
- Interactives – Elements of a Story -This interactive breaks down the important elements of a story. Students go through the series of steps for constructing a story including: Setting, Characters, Sequence, Exposition, Conflict, Climax, and Resolution. http://www.learner.org/interactives/story/index.html
- National Writing Project (NWP) -Unique in breadth and scale, the NWP is a network of sites anchored at colleges and universities and serving teachers across disciplines and at all levels, early childhood through university. We provide professional development, develop resources, generate research, and act on knowledge to improve the teaching of writing and learning in schools and communities. http://www.nwp.org
- Pacecar -Vocab Ahead offers videos that give an active demonstration of vocabulary with audio repeating the pronunciation, definition, various uses, and synonyms. Students can also go through flash cards which give a written definition and visual representation of the word. http://pacecar.missingmethod.com/