

Grade 6 Science

Grade(s):	☐ K ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	☒ 6 ☐ 7 ☐ 8	☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ Other _____
Discipline/Course:	Discipline: Science Course: Grade 6 Science		
Course Title:	Grade 6 Science		
Prerequisite(s):	N/A		
Course Description: <i>Program of Studies</i>	<p>Grade 6 Science immerses students in the practices of scientists and engineers as they investigate compelling real-world questions about energy, weather and climate, forces that shape Earth, and the cellular basis of life. At the start of the unit, students learn how light energy and thermal energy interact with matter to help explain our everyday experiences such as how we see a reflection in a mirror and why a cold drink gets warmer over time. Next, students apply what they have learned about energy transfer to explore how weather and climate are driven by energy and water cycling, how Earth's surface changes through plate tectonics and rock cycling, and how natural hazards occur and affect communities. In the final unit, students learn how cells and body systems work together to support life. Each unit in Grade 6 Science is anchored in a meaningful phenomenon that encourages students to ask questions, analyze evidence, develop models, and construct explanations based on scientific reasoning. As they investigate phenomena, students strengthen critical thinking, collaboration, and scientific communication skills while learning to use evidence to explain patterns and predict outcomes. By the end</p>		

	<p>of Grade 6, students will have developed a deeper understanding of energy transfer, Earth's dynamic systems, and structure and function in organisms, preparing them for more advanced studies in life, Earth, and physical sciences in subsequent grades.</p>
Course Essential Questions:	<ul style="list-style-type: none"> • Why do we sometimes see different things when looking at the same object? • How can containers keep stuff from warming up or cooling down? • How does water circulate through the Earth's systems? • What causes the weather? • How does the Earth's surface change over time? • Where do natural hazards happen and how do we prepare for them? • How do living things heal?
Course Enduring Understandings:	<ul style="list-style-type: none"> • When light shines on an object, it can be reflected or transmitted through the object, depending on the object's material. • Matter exists in different states (solid, liquid, gas) depending upon the motion and distance between particles. • Energy always flows from warmer objects or areas to cooler ones. • Water's ability to change state makes it a powerful vehicle for moving energy through the atmosphere, oceans, and land. • Energy transformations are the "engine" behind weather, climate, and geological change. • Energy and matter cycling drive small (e.g., weathering) and large (e.g., tectonic changes) changes to the Earth's surface. • Natural hazards are not random: they result from specific geologic processes that can be studied, understood, and predicted. • All living things, whether unicellular or multicellular, are composed of cells. • Specialized cells group together to form tissues and organs, which then function as interconnected body systems.

Duration: Credit:	☐ Semester ☒ Full-Year	☐ 0.5 Credit (s) ☐ 1.0 Credit(s) ☐ 1.5 Credit(s) ☒ N/A
Course Materials/Resources:	<i>OpenSciEd Grade 6</i> Core Knowledge Science Student Readers: <i>Light & Matter; Thermal Energy; Weather, Climate, and Water Cycling; Plate Tectonics & Rock Cycling; Natural Hazards; and Cells & Systems</i>	
FPS Course Academic Expectation(s):	☒ Exploring and Understanding (EU) ☐ Synthesizing and Evaluating (SE) ☐ Creating and Constructing (CC) ☐ Conveying Ideas (CI) ☒ Collaborating Strategically (CS) ☐ Using Communication Tools (UCT)	
Year at a Glance (Units):	Unit 1 - Light and Matter (~20 classes/5 weeks) Unit 2 - Thermal Energy (~32 classes/8 weeks) Unit 3 - Weather, Climate, & Water Cycling (~32 classes/8 weeks) Unit 4 - Plate Tectonics & Rock Cycling (~20 classes/5 weeks) Unit 5 - Natural Hazards (~20 classes/5 weeks) Unit 6 - Cells & Systems (~20 classes/5 weeks)	

Unit Number and Title:	Unit 1 - Light and Matter
Duration:	~ 20 classes/ 5 weeks
Resource(s):	<i>OpenSciEd Unit 6.1 Light & Matter</i> Core Knowledge Science Student Reader: <i>Light & Matter</i>
Unit Overview:	<p>This unit on light and matter begins with a perplexing phenomenon of one-way mirrors and how this material can act as both a mirror and a window at the same time. Students directly observe and investigate the one-way mirror phenomenon using a scaled box model built from two combined boxes with a flashlight in one box, darkness in the other box, and a one-way mirror in between the two. Through this initial investigation, students figure out that the one-way mirror acts like a mirror on the light side of the system and a window on the dark side of the system. This experience prompts students to wonder: Why do we sometimes see different things when looking at the same object?</p> <p>During the unit, students learn how to ask testable questions about the phenomenon and how to model what they figure out to explain the phenomenon. Through their investigations, students learn that light changes direction (refracts) when it travels between different transparent materials. They also figure out that the one-way mirror transmits about half the light and reflects about half the light that shines on it due to its microscale structures. Finally, to further explain the one-way mirror phenomenon, students also learn that when a light input is detected by sense receptors in our eye, it is turned into a signal that travels along the optic nerve to the brain, which processes it into what we see. By the end of the unit, students are able to develop a consensus model to explain the unseen light interactions between people and the one-way mirror.</p>

Learning Goals	
Standard(s):	<p><i>Next Generation Science Standards:</i></p> <p>Disciplinary Core Ideas (DCIs)</p> <p>PS4.B Electromagnetic Radiation</p> <ul style="list-style-type: none"> • When light shines on an object, it is reflected or transmitted through the object, depending on the object's material. • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends <p>LS1.D Information Processing</p> <ul style="list-style-type: none"> • Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. <p>Science and Engineering Practices (SEPs):</p> <p>Asking Questions and Defining Problems</p> <ul style="list-style-type: none"> • Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. • Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. • Ask questions to determine relationships between independent and dependent variables and relationships in models. <p>Developing and Using Models</p> <ul style="list-style-type: none"> • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. • Develop or modify a model—based on evidence—to match what happens if a variable or

	<p>component of a system is changed.</p> <p>Constructing Explanations and Designing Solutions</p> <ul style="list-style-type: none"> • Construct an explanation using models or representations. • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. <p>Crosscutting Concepts (CCCs):</p> <p>Systems and System Models</p> <ul style="list-style-type: none"> • A system can be described in terms of its components and their interactions. • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. • Models can be used to represent systems and their interactions—such as inputs, processes and outputs— and energy, matter, and information flows within systems. <p>Structure and Function</p> <ul style="list-style-type: none"> • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function. <p>Cause and Effect</p> <ul style="list-style-type: none"> • Cause and effect relationships may be used to predict phenomena in natural or designed systems. <p><i>Common Core State Standards for Mathematics</i></p> <p>CCSS.MATH.CONTENT.5.NBT.1 Understand the place value system. Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.</p>
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CCSS.MATH.CONTENT.5.NBT.2 Understand the place value system. Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole number exponents to denote powers of 10

Common Core State Standards for English Language Arts

CCSS.ELA-LITERACY.SL.6.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

CCSS.ELA-LITERACY.SL.6.1.A: Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.

CCSS.ELA-LITERACY.SL.6.1.B: Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.

CCSS.ELA-LITERACY.SL.6.1.C: Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.

CCSS.ELA-LITERACY.SL.6.1.D: Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing.

CCSS.ELA-Literacy.SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.

CCSS.ELA-LITERACY.RST.6-8.2: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

CCSS.ELA-LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-LITERACY.W.6.1: Write arguments to support claims with clear reasons and relevant evidence.

CCSS.ELA-Literacy.W.6.1B: Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.

CCSS.ELA-Literacy.W.6.2.b: Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.

Essential Question(s):	Why do we sometimes see different things when looking at the same object?
Enduring Understanding(s):	<ul style="list-style-type: none"> • When light shines on an object, it can be reflected or transmitted through the object, depending on the object's material. • Light changes direction (refracts) when it travels between different transparent materials. • When a light input is detected by sense receptors in our eye, it is turned into a signal that travels along the optic nerve to the brain, which processes it into what we see.
Learning Goal(s): <i>Students will know and will be able to use their learning to:</i> *Note all NGSS learning goals NGSS are three-dimensional integrating a DCI, a SEP, and a CCC	Three-Dimensional Performance Expectations: MS-PS4-2* Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. <ul style="list-style-type: none"> • Conduct investigations to gather evidence for how light interacts with different materials. • Gather information from text to learn about the structure of materials. MS-LS1-8* Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. <ul style="list-style-type: none"> • Gather information from text about what happens when light enters the eye. • Develop a model to explain how light enters the eye and parts of the eye transform the light into signals that the brain processes to tell us what we see. *Both of these Performance Expectations are partially developed in this unit and further developed in later units/grade levels. Content: (Students will know...) <ul style="list-style-type: none"> • light travels in straight lines through a single medium. • the different ways light interacts with matter. <ul style="list-style-type: none"> ○ reflection ○ transmission ○ refraction • how light bends at the surfaces of convex lenses • structure and function of the eye. <ul style="list-style-type: none"> ○ cornea ○ iris

	<ul style="list-style-type: none"> ○ lens ○ retina ○ pupil ● that visual information/light is converted into signals that travel to the brain through the optic nerve. <p>Skills: (Students will be able to...)</p> <ul style="list-style-type: none"> ● investigate how light interacts with different materials and collect evidence about reflection and refraction. ● create and revise models to show how light travels, interacts with matter, reflects, and refracts. ● analyze observations and data from investigations to identify patterns in how light behaves when it encounters different materials. ● ask testable questions in which they will need to manipulate a variable in the system to observe its relationship to other variables. ● model how the eye detects and focuses light, and then transmits visual information to the brain via the optic nerve. ● construct written explanations for the anchoring phenomenon.
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Unit Number and Title:	Unit 2 - Thermal Energy
Duration:	~ 32 classes/ 8 weeks
Resource(s):	<i>OpenSciEd Unit 6.2 Thermal Energy</i> Core Knowledge Science Student Reader: <i>Thermal Energy</i>
Unit Overview:	The unit begins with a real-world phenomenon in which students compare a standard plastic cup with a new reusable plastic cup advertised to keep liquids colder longer. Through observation and experimentation, students discover that the liquid in the regular cup warms more quickly than the liquid in the specialty cup. This initial investigation encourages students to identify and evaluate the different

	<p>features of each cup that may influence how quickly thermal energy is transferred. Through a series of hands-on laboratory investigations, data analysis, and computer simulations, students learn that energy can be transferred by the absorption of light and by thermal energy moving from the warmer surrounding air to the cooler liquid. They develop an understanding of how thermal energy naturally transfers from warmer objects to cooler objects and how different materials and design features can slow or reduce that transfer.</p> <p>Throughout the unit, students deepen their understanding of the relationship between thermal energy, temperature, and particle motion while exploring concepts such as conduction, radiation, insulation, and energy transfer in everyday systems. They use scientific practices to ask questions, develop and revise models, analyze evidence, construct explanations, and apply their learning to solve problems. The unit culminates in an engineering design challenge in which students apply their understanding of thermal energy transfer to design, test, and refine a drink container that meets specific design criteria and constraints.</p>
Learning Goals	
Standard(s):	<p><i>Next Generation Science Standards:</i></p> <p>Disciplinary Core Ideas (DCIs)</p> <p>PS1.A: Structure and Properties of Matter</p> <ul style="list-style-type: none"> • 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. <p>PS3.A: Definitions of Energy</p> <ul style="list-style-type: none"> • The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms

	<p>or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.</p> <ul style="list-style-type: none"> • Temperature is not a measure of energy; the relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. • 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. <p>PS3.B: Conservation of Energy and Energy Transfer</p> <ul style="list-style-type: none"> • When the kinetic energy of an object changes, there is inevitably some other change in energy at the same time. • 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. • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. <p>PS4.B: Electromagnetic Radiation</p> <ul style="list-style-type: none"> • When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4) <p>ETS1.A: Defining and Delimiting an Engineering Problem</p> <ul style="list-style-type: none"> • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> • A solution needs to be tested and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-PS3-3) <p>Science and Engineering Practices (SEPs):</p> <p>Developing and Using Models</p> <ul style="list-style-type: none"> • Develop and/or use a model to predict and/or describe phenomena. • Develop a model to describe unobservable mechanisms.
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- Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
- Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed.
- Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.

Planning and Carrying Out Investigations

- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how much data are needed to support a claim.
- Evaluate the accuracy of various methods for collecting data.
- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
- Collect data about the performance of a proposed object, tool, process or system under a range of conditions.

Analyzing and Interpreting Data

- Analyze and interpret data to provide evidence for phenomena.
- Analyze and interpret data to determine similarities and differences in findings.
- Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials).
- Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible.
- Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.

Constructing Explanations and Designing Solutions

- Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.

- Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.
- Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process, or system.
- Construct an explanation using models or representations.

Engaging in Argument from Evidence

- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

Crosscutting Concepts (CCCs):

Systems and System Models

- A system can be described in terms of its components and their interactions.
- Models can be used to represent systems and their interactions, including inputs, processes, and outputs; energy; matter; and information flows within systems.

Energy & Matter

- Matter is conserved because atoms are conserved in physical and chemical processes.
- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
- The transfer of energy can be tracked as energy flows through a designed or natural system.

Structure & Function

- Structures can be designed to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.
- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.
- Structures can be designed to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.

Common Core State Standards for Mathematics

	<p>CCSS.MATH.CONTENT.5.NBT.A.3 Read, write, and compare decimals to thousandths.</p> <p>CCSS.MATH.CONTENT.5.NBT.A.4 Use place value understanding to round decimals to any place.</p> <p>CCSS.MATH.CONTENT.6.SP.A.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.</p> <p>CCSS.MATH.CONTENT.6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, debits/credits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.</p> <p><i>Common Core State Standards for English Language Arts</i></p> <p>CCSS.ELA-LITERACY.SL.6.1.C: Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.</p> <p>CCSS.ELA-LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>CCSS.ELA-LITERACY.W.6.1.A: Introduce claim(s) and organize the reasons and evidence clearly.</p> <p>CCSS.ELA-LITERACY.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p> <p>CCSS.ELA-LITERACY.RST.6-8.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 6-8 texts and topics</i>.</p> <p>CCSS.ELA-LITERACY.RST.6-8.2: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p> <p>CCSS.ELA-LITERACY.RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>
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	<p>CCSS.ELA-LITERACY.W.6.1: Write arguments to support claims with clear reasons and relevant evidence.CCSS.ELA-LITERACY.W.6.1.B: Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.</p> <p>CCSS.ELA-LITERACY.W.6.1.C: Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons.</p>
Essential Question(s):	How can containers keep stuff from warming up or cooling down?
Enduring Understanding(s):	<ul style="list-style-type: none"> • Matter exists in different states (solid, liquid, gas) depending upon the motion and spacing of the particles. • Energy always flows from warmer objects to cooler ones. • Temperature is the measurement of the average kinetic energy of the particles in a substance. • Engineers design solutions to real-world problems by testing and revising possible solutions to determine how well they meet given criteria and constraints.
<p>Learning Goal(s): <i>Students will know and will be able to use their learning to:</i></p> <p>*Note all NGSS learning goals NGSS are three-dimensional integrating a DCI, a SEP, and a CCC</p>	<p>Three-Dimensional Performance Expectations:</p> <p>MS-PS1-4: 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.</p> <ul style="list-style-type: none"> • Explain that temperature is a measurement of the average kinetic energy of particles in a substance. • Develop particle models of solids, liquids, and gases to describe both distance between particles and motion. • Plan and carry out investigations to gather evidence to track changes in a system when thermal energy is added or removed. <p>MS-PS3-4: 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.</p>

	<p>MS-PS3-5: 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.</p> <ul style="list-style-type: none"> • Model thermal energy transfer between substances as the result of particle collisions (conduction). • Revise their models to include factors that minimize energy transfer by decreasing the opportunities for particle collisions. <p>MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <ul style="list-style-type: none"> • Model thermal transfer of energy due to absorption of light (radiation). <p>MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <ul style="list-style-type: none"> • Apply what they have learned about features that can slow energy transfer to design, build, test, and revise a cup system to keep a liquid cold. <p>Content: (Students will know...)</p> <ul style="list-style-type: none"> • thermal energy is associated with the motion of particles within matter. • temperature is a measure of the average kinetic energy/motion of particles in a substance. • particles in matter are constantly moving, and their motion changes as thermal energy is transferred. • thermal energy moves from warmer objects/regions to cooler objects/regions. • thermal energy can be transferred through direct interactions between particles (conduction). • movement of matter can transfer thermal energy (convection). • thermal energy can be transferred through electromagnetic radiation without direct contact between objects. • thermal energy can be transferred to other objects or the environment but does not disappear. • different materials transfer thermal energy differently, which helps explain why some materials are better insulators or conductors. • the properties of different materials affect thermal energy transfer.
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	<ul style="list-style-type: none"> ● heat is energy transferred from a warmer object or region to a cooler one because of a temperature difference. <p>Skills: (Students will be able to...)</p> <ul style="list-style-type: none"> ● develop and revise models to explain energy transfer at the particle scale. ● conduct investigations involving changes in temperature and thermal energy transfer, including controlling variables and collecting measurements. ● design, build, and test a container that minimizes energy transfer. ● carry out investigation to test different materials to determine which materials make for better insulators or conductors. ● construct evidence-based explanations to explain why temperature changes occur and how energy is transferred. ● use diagrams, models, data, and written or verbal explanations to communicate ideas about thermal energy.
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Unit Number and Title:	Unit 3 - Weather, Climate & Water Cycling
Duration:	~ 32 classes/ 8 weeks
Resource(s):	<i>OpenSciEd Unit 6.3 Weather, Climate & Water Cycling</i> Core Knowledge Science Student Reader: <i>Weather, Climate, and Water Cycling</i>
Unit Overview:	The unit starts out by anchoring students in the exploration of large storms from different locations across the country at different times of the year. These extreme weather events spark questions and ideas for investigations. In the first half of the unit, students investigate weather data specific to these events and the temperature profile of the atmosphere above Earth's surface. They conduct investigations into how sunlight affects the temperature of different surfaces and the air above them and how this contributes to cloud formation and growth. They conduct investigations to figure out how molecules in

	<p>different phases change states under different conditions, and they conduct investigations into why air moves the way it does as it is heated and cooled.</p> <p>The second half of the unit is anchored in the exploration of a weather report of a winter storm that affected large portions of the United States. The maps, transcripts, and video that students analyze show them that the storm was forecasted to produce large amounts of snow and ice accumulation in large portions of the northeastern part of the country within the next day. This case sparks questions and ideas for investigations around trying to figure out what could be causing such a large-scale storm and why it would end up affecting a different part of the country a day later. Through these investigations, students learn how the interactions of air masses, prevailing winds, proximity to the ocean, ocean currents, and surface elevation profiles work together to influence the weather and climate in different regions.</p>
Learning Goals	
Standard(s):	<p><i>Next Generation Science Standards:</i></p> <p>Disciplinary Core Ideas (DCIs)</p> <p>ESS2.C The Roles of Water in Earth’s Surface Processes</p> <ul style="list-style-type: none"> • Global movements of water and its changes in form are propelled by sunlight and gravity. • 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. • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. <p>ESS2.D: Weather and Climate</p>

- 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.
- Because these patterns are so complex, weather can only be predicted probabilistically.
- 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.

PS1.A: Structure and Properties of Matter

- 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.

PS3.A: Definitions of Thermal Energy

- When the kinetic energy of an object changes, there is inevitably some other change in energy at the same time.
- The idea that thermal energy transfer can occur through conduction is used to explain how the air above the ground is heated by it, and how warm rising air cools off as it moves higher up.

PS4.B: Electromagnetic Radiation

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
- The idea that light is absorbed by the ground and converted to thermal energy

Science and Engineering Practices (SEPs):

Developing and Using Models

- Develop and/or use a model to predict and/or describe phenomena.
- Develop a model to describe unobservable mechanisms.
- Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
- Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed.

Planning and Carrying Out Investigations

- Ask questions that can be investigated within the scope of the classroom and outdoor environments
- Plan an investigation independently and collaboratively
- Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.

Analyzing and Interpreting Data

- Analyze and interpret maps at multiple temporal and spatial scale scales and with multiple types of data overlays.
- Analyze maps from multiple locations in one lesson and then analyze two parallel sets of global maps from two different times of year.
- Analyze a time series set of national weather maps with multiple layers of overlaid data.

Crosscutting Concepts (CCCs):
Patterns

- Connect macroscopic patterns to microscopic or atomic-level structures.
- Use graphs and charts to find patterns in numerical relationships, helping to identify cause-and-effect mechanisms.

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Systems and System Models

- A system can be described in terms of its components and their interactions.
- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs— and energy, matter, and information flows within systems.

Matter and Energy

- Changes in a system can be described by examining how matter and energy move.
- The transfer of energy often drives the motion or cycling of matter within a system.

Common Core State Standards for Mathematics

CCSS.MATH.CONTENT.6.NS.C.5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.

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

CCSS.MATH.CONTENT.6.NS.C.8. Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include the use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.

Common Core State Standards for English Language Arts

CCSS.ELA-LITERACY.SL.6.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

CCSS.ELA-LITERACY.SL.6.1.C: Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.

CCSS.ELA-LITERACY.SL.6.1.D: Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing.

CCSS.ELA-LITERACY.SL.6.3: Delineate a speaker's argument and specific claims, distinguishing claims that are supported by reasons and evidence from claims that are not.

CCSS.ELA-LITERACY.SL.6.4: Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

CCSS.ELA-LITERACY.W.6.1: Write arguments to support claims with clear reasons and relevant evidence.

CCSS.ELA-LITERACY.W.6.1.A: Introduce claim(s) and organize the reasons and evidence clearly.

	<p>CCSS.ELA-LITERACY.W.6.1.B: Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.</p> <p>CCSS.ELA-LITERACY.W.6.1.C: Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons.</p> <p>CCSS.ELA-LITERACY.W.6.2: Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.</p> <p>CCSS.ELA-LITERACY.W.6.2.A: Introduce a topic; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.</p> <p>CCSS.ELA-LITERACY.W.6.2.B: Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.</p> <p>CCSS.ELA-LITERACY.W.6.2.C: Use appropriate transitions to clarify the relationships among ideas and concepts.</p> <p>CCSS.ELA-LITERACY.W.6.2.D: Use precise language and domain-specific vocabulary to inform about or explain the topic.</p> <p>CCSS.ELA-LITERACY.RST.6-8.2: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p>
Essential Question(s):	Why does a lot of hail, rain, or snow fall at some times and not others?
Enduring Understanding(s):	<ul style="list-style-type: none"> • Water's ability to change states (solid, liquid, gas) makes it a powerful vehicle for moving energy through the atmosphere, oceans, and land. • Energy transformations are the "engine" behind the cycling of water through Earth's systems which drives and shapes both short-term weather and long-term climate. • Earth is a dynamic, integrated system rather than isolated components.
Learning Goal(s): <i>Students will know and will be able to use their learning to:</i>	Three-Dimensional Performance Expectations: MS-PS1-4: 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.

***Note all NGSS learning goals NGSS are three-dimensional integrating a DCI, a SEP, and a CCC**

MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

- Carry out investigations to gather evidence to explain how water moves through different states.
- Make observations to understand the role of humidity and condensation in weather patterns.
- Understand that water molecules are attracted to each other, but when they are moving fast enough, they can break away from each other.

MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

- Use a simulation to model storm formation, manipulating variables to create different weather events.
- Analyze weather data to observe the components and patterns of various weather events.
- Model how the combination of humidity, temperature differentials, and updrafts result in cloud formation.
- Explain that differences in air density contribute to convection and movement of air.
- Compare and contrast various weather fronts.
- Explain how high/low pressure systems interact to cause changes in weather conditions.
- Read and interpret simple weather maps.

MS-ESS2-6: 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.

- Analyze data about global temperature and precipitation, comparing different locations and climates on Earth.
- Gather evidence from various resources to understand how prevailing wind patterns help predict global climate patterns.

- Understand that the ocean is warmer near the equator and cooler near the poles; ocean currents can bring warmer waters toward the poles and cooler waters toward the equator; and more evaporation occurs over warmer ocean waters, resulting in more precipitation.

Content: (Students will know...)

- water continually moves among the atmosphere, land, oceans, and other reservoirs through processes such as evaporation, condensation, precipitation, and runoff.
- during evaporation liquid water gains energy and changes into water vapor.
- during condensation water vapor loses energy and changes into liquid water, forming clouds or droplets.
- water returns from the atmosphere to Earth's surface as precipitation in the form of rain, snow, sleet, or hail.
- energy from the Sun heats Earth's surface and atmosphere and drives the movement of water in the water cycle.
- Earth's surface and atmosphere are heated unevenly, contributing to differences in temperature and air movement (convection).
- differences in temperature affect air density, contributing to the movement of air and the development of weather patterns.
- water evaporates from Earth's surface and enters the atmosphere as water vapor.
- the atmosphere contains variable amounts of water vapor, which plays an important role in weather and climate.
- humidity describes the amount of water vapor in the air.
- as moist air rises and cools, the air can reach a point where it can no longer hold as much water vapor and the water vapor condenses into tiny liquid water droplets (or ice crystals under appropriate conditions) that accumulate to form clouds.
- differences in air pressure explain the movement of air masses and weather patterns.
- different types of weather phenomena.
 - hail
 - thunderstorms
 - hurricanes

	<ul style="list-style-type: none"> ○ floods ○ droughts ○ tornadoes ○ snowstorms ● when different air masses meet, the boundary between them is a front. ● interactions at fronts can cause changes in weather. ● weather results from interactions among temperature, water in the atmosphere, air movement, and other atmospheric conditions. ● climate describes patterns of weather over longer periods of time and across larger regions. ● how mountains/elevated landforms can result in a rain shadow effect (very dry regions near areas with abundant precipitation). ● how to distinguish between short-term atmospheric conditions (weather) and long-term patterns (climate). <p>Skills: (Students will be able to...)</p> <ul style="list-style-type: none"> ● develop particulate models to explain the motion of air and water molecules at different temperatures and in different levels of the atmosphere. ● read and interpret weather maps and draw models of weather phenomena. ● carry out investigations to investigate the interactions among temperature and the movement of air and water molecules. ● analyze air temperature, humidity levels, air pressure, wind, and elevation data to provide evidence to make weather predictions. ● compare weather and climate patterns across different locations and over different periods of time. ● use evidence to explain weather phenomena, including cloud formation, precipitation, and air movement. ● use evidence to explain regional climate differences. ● communicate explanations using models, data, diagrams, and written or oral arguments.
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Unit Number and Title:	Unit 4 - Plate Tectonics & Rock Cycling
Duration:	~ 20 classes/5 weeks
Resource(s):	<i>OpenSciEd Unit 6.4 Plate Tectonics and Rock Cycling</i> Core Knowledge Science Student Reader: <i>Plate Tectonics and Rock Cycling</i>
Unit Overview:	<p>This unit begins with an exploration of scientific discoveries after a Himalayan earthquake at Mount Everest. Students learn that Mount Everest has grown in elevation over the years. Students also discover that Mount Everest is steadily moving to the northeast every year. This leads to questions about whether changes are happening to other mountains in the world. Students analyze data from other mountain peaks and their surroundings and find that some mountains are also growing in elevation, like Mount Everest, while other mountains are decreasing or not changing in elevation.</p> <p>Throughout the unit, students investigate how the Earth's surface changes over time and develop models to explain the movement of Earth's tectonic plates and the cycling of rocks. Students analyze evidence from patterns in Earth's surface features, including the locations of continents, mountains, volcanoes, and earthquakes, to determine how the movement of tectonic plates shapes Earth's surface. They explore how processes occurring deep within Earth can drive plate movement and cause interactions between plates that result in earthquakes, volcanic activity, and the formation of mountains.</p> <p>Students also investigate how rocks are continually formed, broken down, transformed, and recycled through interactions among Earth's geosphere and other Earth systems. By using models and evidence to trace matter through the rock cycle, students develop an understanding that Earth's surface is dynamic and continually changing. Throughout the unit, students use scientific evidence, models, and explanations to connect large-scale Earth processes to observable changes in the landscape.</p>
Learning Goals	
Standard(s):	<i>Next Generation Science Standards:</i>

Disciplinary Core Ideas (DCIs)
ESS1.C: The History of Planet Earth

- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.
- Tectonic processes continually generate new ocean seafloor at ridges and destroy old seafloor at trenches.

ESS2.A: Earth's Materials and Systems

- 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 the matter that cycles produce chemical and physical changes in Earth's materials and living organisms.
- 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.

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- 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.

ESS2.C: The Roles of Water in Earth's Surface Processes

- Water's movements—both on land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.

Science and Engineering Practices (SEPs):
Developing and Using Models

- Develop and/or use a model to predict and/or describe phenomena.
- Develop a model to describe unobservable mechanisms.
- Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
- Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed.

Constructing Explanations and Designing Solutions

- Construct an explanation using models or representations (between causal and correlational

	<p>relationships between data).</p> <ul style="list-style-type: none"> • Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. <p>Using Mathematics & Computational Thinking</p> <ul style="list-style-type: none"> • Use mathematical tools (equations, graphs, ratios) to describe and predict how variables in natural systems relate to each other. • Develop simplified representations (diagrams, equations, simulations) that capture the essential features of complex phenomena, allowing them to test ideas and make predictions without observing every real-world instance. • Recognize that mathematical patterns in data (trends, cycles) often reveal underlying scientific principles <p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none"> • Construct scientific arguments by connecting their claims to specific evidence from observations, experiments, or reliable sources—rather than relying on opinion or intuition. • Examine multiple possible explanations for a phenomenon and use evidence to determine which best fits the data. They learn to identify which explanation accounts for the most observations and has the fewest contradictions, developing critical thinking beyond accepting a single answer • Engage in respectful scientific discussion where they question each other's reasoning, identify weaknesses in arguments, and suggest improvements. <p>Crosscutting Concepts (CCCs):</p> <p>Cause and Effect</p> <ul style="list-style-type: none"> • Cause and effect relationships may be used to predict phenomena in natural and designed systems. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
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	<p><i>Common Core State Standards for Mathematics</i></p> <p>CCSS.MATH.CONTENT.4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.</p> <p>CCSS.MATH.CONTENT.5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.</p> <p>CCSS.MATH.CONTENT.5.NBT.A.3 Read, write, and compare decimals to thousandths.</p> <p>CCSS.MATH.CONTENT.5.NBT.A.4 Use place value understanding to round decimals to any place.</p> <p>CCSS.MATH.CONTENT.6.RP.A.2 Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.</p> <p><i>Common Core State Standards for English Language Arts</i></p> <p>CCSS.ELA-LITERACY.RI.6.3 Analyze in detail how a key individual, event, or idea is introduced, illustrated, and elaborated in a text (e.g., through examples or anecdotes).</p> <p>CCSS.ELA-LITERACY.SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>CCSS.ELA-LITERACY.SL.6.1.A Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.</p>
Essential Question(s):	What is happening to Earth's surface and why does it change over time?
Enduring Understanding(s):	<ul style="list-style-type: none"> • Evidence from rock strata, fossil distributions, and continental shapes support the idea that Earth continually changes over time. • The cycling of energy and matter drives small (e.g., weathering) and large (e.g., tectonic

changes) changes to Earth's surface.

- Tectonic plate motion is driven by Earth's internal heat energy.

Learning Goal(s):

Students will know and will be able to use their learning to:

***Note all NGSS learning goals NGSS are three-dimensional integrating a DCI, a SEP, and a CCC**

Three-Dimensional Performance Expectations:

MS-ESS1-4: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

- Analyze fossil evidence in rock layers to gather evidence that Earth's surface changes over time.

MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

- Create models of the internal structure of the Earth (including convection in the mantle).
- Apply thermal energy flow models to explain how heat from Earth's interior drives plate movement (uplift, bending, and cracking).
- Use models and evidence to explain seafloor spreading and how new crust forms.
- Create models of the movement of tectonic plates that cause earthquakes and mountain formation at plate boundaries.

MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

- Analyze data on the locations of earthquakes and fault lines to identify plate boundaries and changes in Earth's surface.
- Analyze data on the rates of the movement of different plates over different time scales to predict locations of continents in the past and the future.
- Gather information from text about how run-off and erosion changes the Earth's surface over time.
- Conduct investigations to explain how weathering, erosion, and rock cycling change Earth's surface.

MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Content: (Students will know...)

- Earth has distinct layers with different properties.
 - crust

- mantle
- core
- Earth's crust is divided into large tectonic plates that move relative to one another.
- Earth's tectonic plates have moved over time and continue to move to this day.
- convection in the mantle drives the movement of Earth's tectonic plates.
- interactions between plates occur at different types of boundaries, including convergent, divergent, and transform boundaries.
- at convergent boundaries, plates move towards one another and can result in mountain building or subduction.
- at divergent boundaries, plates move apart, allowing new crust to form, particularly at mid-ocean ridges.
- at transform boundaries, plates slide past one another which can cause earthquakes.
- a fault is a fracture or zone of fractures in Earth's crust along which rocks have moved.
- sudden movement along a fault can release energy and cause earthquakes.
- volcanoes occur when molten material from inside the Earth reaches the Earth's surface.
- rocks are continuously formed, broken down, altered, and recycled through geologic processes.
- different types of rocks are formed through different processes.
 - igneous
 - sedimentary
 - metamorphic
- matching continents, fossils, rock formations, seafloor features, and patterns of earthquakes/volcanoes provide evidence to support the theory of plate tectonics.
- geologic processes can occur over very long timescales (often millions of years) or very suddenly.
- Earth's surface continually changes due to surface level geological changes.
 - weathering
 - erosion
 - deposition
 - sedimentation

	<p>Skills: (Students will be able to...)</p> <ul style="list-style-type: none"> • analyze maps, rock/fossil evidence, earthquake and volcano patterns, and other geologic data to identify evidence of plate movement. • distinguish between causal and correlational relationships in Earth science data. • develop and revise models showing how tectonic plates move and how their interactions produce geologic features and events. • identify patterns in the locations of earthquakes, volcanoes, mountains, fossils, and rock formations and use those patterns as evidence for the theory of plate tectonics. • use models to explain processes that occur over very long geologic timescales. • explain how processes such as weathering, erosion, deposition, melting, and metamorphism interact within the rock cycle. • evaluate multiple lines of evidence and use them to support the explanation that Earth's plates move. • engage in respectful scientific discourse to collaboratively develop stronger explanations for geologic events. • use maps, diagrams, models, written explanations, and evidence-based arguments to communicate scientific information.
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Unit Number and Title:	Unit 5 - Natural Hazards
Duration:	~ 20 days/5 weeks
Resource(s):	<i>OpenSciEd Unit 6.5 Natural Hazards</i> Core Knowledge Science Student Reader: <i>Natural Hazards</i>
Unit Overview:	This unit engages students in understanding natural hazards through the real-world examples of earthquakes and tsunamis in Japan. Students begin by exploring the impacts of these natural disasters and investigating questions about what causes tsunamis, where they occur, how they are detected, and

	<p>how they affect coastal communities. Through scientific investigations, models, and analysis of evidence, students develop an understanding of the Earth processes that generate tsunamis and the factors that influence their movement and impact.</p> <p>As the unit progresses, students apply their scientific understanding to engineering design challenges focused on reducing the effects of tsunamis and improving community safety. They evaluate technologies used to detect hazards, communicate emergency alerts, and minimize damage. Students also examine the advantages of digital communication systems over analog systems for transmitting emergency information. The unit concludes with students using scientific and technical evidence to design solutions and communicate information about natural hazards to help communities prepare for and respond to these events.</p>
Learning Goals	
Standard(s):	<p><i>Next Generation Science Standards:</i></p> <p>Disciplinary Core Ideas (DCIs) ESS3.B. Natural Hazards</p> <ul style="list-style-type: none"> 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. <p>ETS1.A. Defining and Delimiting and Engineering Problem</p> <ul style="list-style-type: none"> The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. <p>ETS1.B. Developing Possible Solutions</p> <ul style="list-style-type: none"> There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. <p>PS4.C. Information Technologies and Instrumentation</p> <ul style="list-style-type: none"> Digitized signals are a more reliable way to encode and transmit information.

	<p>Science and Engineering Practices (SEPs):</p> <p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. <p>Mathematics and Computation Thinking</p> <ul style="list-style-type: none"> • Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. • Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem. <p>Constructing Explanations and Designing Solutions</p> <ul style="list-style-type: none"> • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. <p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none"> • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. <p>Obtaining, Evaluating, and Communicating Information</p> <ul style="list-style-type: none"> • Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. • Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing. <p>Crosscutting Concepts (CCCs):</p> <p>Cause and Effect</p> <ul style="list-style-type: none"> • build a chain of event diagram that links together cause-and-effect relationships across science
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	<p>and engineering ideas</p> <p>System and System Models</p> <ul style="list-style-type: none"> Integrate chain of events with other system models that links components of subsystems with those science and engineering ideas <p>Stability and Change</p> <ul style="list-style-type: none"> consider the rate of onset of hazards and how quickly a “sudden event” can disrupt the stability of a system. This aspect of the crosscutting concept is used to consider an appropriate and timely response to an event. <p><i>Common Core State Standards for Mathematics</i></p> <p>CCSS.MATH.CONTENT.4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.</p> <p>CCSS.MATH.CONTENT.5.NBT.A.3 Read, write, and compare decimals to thousandths.</p> <p>CCSS.MATH.CONTENT.5.NBT.A.4 Use place value understanding to round decimals to any place.</p> <p><i>Common Core State Standards for English Language Arts</i></p> <p>CCSS.ELA-LITERACY.RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts.</p> <p>CCSS.ELA-LITERACY.SL.6.2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.</p> <p>CCSS.ELA-LITERACY.RST.6-8.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 6-8 texts and topics</i>.</p> <p>CCSS.ELA-LITERACY.RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</p>
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	CCSS.ELA-LITERACY.RST.6-8.10: By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.
Essential Question(s):	Where do natural hazards happen and how do we prepare for them?
Enduring Understanding(s):	<ul style="list-style-type: none"> • Natural hazards are not random: they result from specific geologic processes that can be studied, understood, and predicted. • The criteria and constraints of a design challenge are grounded in both what science tells us about the problem and practical limitations like cost, materials, and geography. • Engineering is an iterative process where designs are judged by how well they solve real problems under real conditions. Evaluation isn't about perfection—it's about finding practical solutions that balance scientific understanding with community needs.
Learning Goal(s): <i>Students will know and will be able to use their learning to:</i> *Note all NGSS learning goals NGSS are three-dimensional integrating a DCI, a SEP, and a CCC	Three-Dimensional Performance Expectations: MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. <ul style="list-style-type: none"> • Analyze data on where hazards have occurred in the past in order to determine where hazards may happen in the future and which communities are at risk. • Analyze wave models to make sense of how an earthquake-driven tsunami forms and moves to shore. • Construct an explanation that describes the geologic changes that cause a tsunami. • Gather information from text to understand how tsunamis are detected using a complex system of instruments (seismometers, surface buoys, tsunameters, and satellites). MS-PS4-3: Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. <ul style="list-style-type: none"> • Gather information from text to explain differences between analog and digital signals. • Gather information from texts to support the claim that digital signals are more reliable ways to transmit information. MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people

and the natural environment that may limit possible solutions.

- Understand that effective communication strategies include educating the community before a natural hazard happens in addition to alerting people when the hazard is happening.
- Gather information on structural solutions and technologies that may be employed to detect hazards, warn people, and reduce damage.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

- Gather information to investigate a natural hazard and then develop a communication plan for an identified stakeholder community at risk for the hazard.

Content: (Students will know...)

- natural processes can create hazards that pose risks to people and communities.
- earthquakes result from sudden movement in Earth's crust, often associated with movement along faults and tectonic plate interactions.
- volcanic eruptions can produce hazards such as lava, ash, gases, and other materials that affect people and environments.
- large disturbances of the ocean, particularly undersea earthquakes, can generate tsunami waves that travel across the ocean and impact coastlines.
- atmospheric processes and extreme weather events can pose risks to both people and infrastructure.
- heavy precipitation and other environmental conditions can produce flooding and create hazards for communities.
- gravity acting on unstable Earth materials can cause landslides, particularly when conditions such as steep slopes or water saturation are present.
- scientific data can reveal patterns that help scientists identify where and when hazards are more likely to occur.
- the impact of a hazard depends on factors such as location, population, infrastructure, and environmental conditions.
- humans can use scientific understanding and engineering to reduce the impacts of natural hazards.
- solutions to natural hazards can include changes to structures, infrastructure, land use, warning

	<p>systems, and emergency planning.</p> <ul style="list-style-type: none"> hazard mitigation solutions involve constraints and trade-offs. <p>Skills: (Students will be able to...)</p> <ul style="list-style-type: none"> analyze maps, graphs, historical records, and other data to identify patterns in the occurrence and impacts of natural hazards. construct and/or use multiple graphical displays (e.g., maps, scatter plots) of large data sets to identify linear relationships and distinguish between correlation and causation. use digital tools to build scatter plots with large data sets and look for patterns and trends between multiple variables. develop and use models to represent natural hazard processes and their potential impacts. construct written explanations using evidence to identify areas of risk for natural hazards and use relationships between variables to support a prediction of risk for natural hazards. gather, read, synthesize and evaluate information from multiple sources (e.g., text, data, maps, graphs, images) to learn how communities detect, warn, and communicate natural hazards. evaluate proposed solutions for reducing the impacts of natural hazards using criteria and constraints. compare solutions and consider trade-offs involving effectiveness, cost, feasibility, and other constraints. communicate recommendations and explanations using data, models, diagrams, and evidence.
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Unit Number and Title:	Unit 6 - Cells & Systems
Duration:	~ 20 classes /5 weeks
Resource(s):	<i>OpenSciEd Unit 6.6 Cells and Systems</i> Core Knowledge Science Student Reader: <i>Cells & Systems</i>

Unit Overview:	<p>The unit is anchored in the exploration of a real-world case involving a middle schooler who sustained a significant injury necessitating surgical intervention and a cast. To explain the biological mechanisms underlying healing and recovery from an injury, students investigate the structure and function of cells and develop an understanding that cells are the fundamental unit of life. In addition, they explore how organisms are made of one or more cells and use observations and evidence to investigate the similarities and differences among plant, animal, and other types of cells. Through hands-on investigations, including the use of microscopes and models, students examine cells and their structures at increasingly smaller scales and develop explanations for how the parts of cells contribute to the functioning of living organisms.</p> <p>Throughout the unit, students develop and use models to explain how specialized cell structures perform specific functions and how cells work together to support the needs of an organism. Students connect the structures they observe at the cellular level to the functions they perform at the organism level, building an understanding of the relationship between structure and function in living systems.</p>
Learning Goals	
Standard(s):	<p><i>Next Generation Science Standards:</i></p> <p>Disciplinary Core Ideas (DCIs) LS1.A: Structure and Function</p> <ul style="list-style-type: none"> • 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.

Science and Engineering Practices (SEPs):
Developing and Using Models

- Develop and/or use a model to predict and/or describe phenomena.

Planning and Carrying Out Investigations

- Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.

Analyzing and Interpreting Data

- Analyze and interpret data to provide evidence for phenomena.
- Analyze and interpret data to determine similarities and differences in findings.

Engaging in Argumentation

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.

Asking Questions and Defining Problems

- Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.

Constructing Explanations and Designing Solutions

- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
- Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.

Obtaining, Evaluating, and Communicating Information

- Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).
- Gather, read, and synthesize information from multiple appropriate sources and assess the

credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.

Crosscutting Concepts (CCCs):

Systems and System Models

- A system can be described in terms of its components and their interactions.
- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs— and energy, matter, and information flows within systems.

Structure and Function

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.

Common Core State Standards for Mathematics

CCSS.MATH.CONTENT.4.NBT.B.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations.

CCSS.MATH.CONTENT.5.NBT.A.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

CCSS.MATH.CONTENT.4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit.

	<p>CCSS.MATH.CONTENT.6.RP.A.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>CCSS.MATH.CONTENT.6.RP.A.3.C: Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.</p> <p><i>Common Core State Standards for English Language Arts</i></p> <p>CCSS.ELA-LITERACY.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.</p> <p>CCSS.ELA-Literacy.RST.6-8.2: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.</p> <p>CCSS.ELA-LITERACY.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases, as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.</p> <p>CCSS.ELA-Literacy.SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>CCSS.ELA-Literacy.SL.6.1.A Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.</p> <p>CCSS.ELA-Literacy.SL.6.1.C: Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.</p> <p>CCSS.ELA-Literacy.SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally), and explain how it contributes to a topic, text, or issue under study.</p>
Essential Question(s):	How do living things heal?

Enduring Understanding(s):	<ul style="list-style-type: none"> • All living things, whether unicellular or multicellular, are composed of cells • The cell membrane is a selective, porous boundary that controls what enters and exits the cell, allowing essential materials like food to enter while removing waste. • Specialized cells group together to form tissues and organs, which then function as interconnected body systems
Learning Goal(s): <i>Students will know and will be able to use their learning to:</i> *Note all NGSS learning goals NGSS are three-dimensional integrating a DCI, a SEP, and a CCC	Three-Dimensional Performance Expectations: MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells <ul style="list-style-type: none"> • Conduct investigations using a microscope to observe cells and cell structures. • Analyze microscopic images to compare and contrast living and non-living things. • Compare and contrast unicellular and multicellular organisms. MS-LS1-2.* Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. <ul style="list-style-type: none"> • Gather information from text about the structures of cells and their functions. • Conduct investigations to gather evidence to explain the role of the cell membrane in cells. MS-LS1-3.* Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. <ul style="list-style-type: none"> • Observe a dissection to identify structure and function in a chicken wing. • Use data from observations to argue from evidence that organs and tissues are made of cells. • Observe microscopic images from body structures to identify different types of cells. • Gather information about different cell types (nerve, bone, skin, blood) and compare their structures based on their functions. • Explain how living things use cellular processes to grow and heal. • Develop a model to explain the interactions among human body systems. MS-LS1-8.* Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories <ul style="list-style-type: none"> • Develop a model to explain how sensory receptors gather information from the environment (stimuli) and transmit information to the brain. *These Performance Expectations are partially developed in this unit and further developed in Grade 7 and 8.

Content: (Students will know...)

- all living organisms are made of one or more cells, and the cell is the basic unit of living systems.
- all organisms can be categorized as either unicellular or multicellular.
- the levels of organization in multicellular organisms.
 - cells
 - tissues
 - organs
 - organ systems
- different body systems are made of specialized structures that work together to perform particular functions.
- cells, tissues, and organs work together in the digestive, respiratory, circulatory, or nervous systems.
- cells contain specialized structures that carry out particular functions.
 - cell membrane
 - nucleus
 - mitochondria
 - chloroplast
 - cell wall
- cytoplasm is the material within the cell where many cellular processes occur.
- plant and animal cells contain different structures which relate to differences in function.
- cells in multicellular organisms can have different structures and functions because they are specialized for particular jobs.
- cells can produce new cells, allowing organisms to grow and repair damaged tissues.

Skills: (Students will be able to...)

- develop models to explain structure and function in cells.
- compare different types of cells and relate differences in structure to differences in function.
- develop models to explain healing and growth in living things.

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| | <ul style="list-style-type: none">● use a microscope to observe cells and cell structures and investigate different body structures in various organisms.● analyze and interpret observational data, videos, and images to provide evidence that cell growth occurs.● use evidence to explain how specialized cells contribute to the function of an organism.● explain how interactions among cells, tissues, organs, and organ systems support the functioning of a multicellular organism |
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