Bristol Public Schools

Office of Teaching & Learning

Department	K-5 Science
Department Philosophy	Bristol Public Schools science programing provides students with knowledge of the science and engineering practices, crosscutting concepts, and the core ideas of science and engineering to engage in public discussions on science related issues, to be critical consumers of scientific information related to their everyday lives, and continue to learn science throughout their lives. To ensure this level of scientific literacy, Bristol Public Schools anchor science units in phenomena, this practice promotes student ownership of learning and supports student application of the science content as it pertains to the real world. In each science unit, students work to explain phenomena through the applications of the three dimensions of the Next Generation Science Standards: (1) science and engineering practices, (2) disciplinary core ideas, and (3) cross cutting concepts. Bristol's use phenom-based units and the three dimensions ensure that students connect with and build a deep conceptual understanding of science concepts. Throughout the kindergarten through grade 12 experience, this philosophy provides all Bristol students with the skills and concepts to be scientifically literate adults.
Course	Grade 4 NGSS Science
Course Description for Program of Studies	The performance expectations in fourth grade help students formulate answers to questions such as: What are waves and what are some things they can do? How can water, ice, wind and vegetation change the land? What patterns of Earth's features can be determined with the use of maps? How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals? What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem? Fourth grade performance expectations include PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas from the NRC Framework. Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. Students are expected to develop understanding of the effects of weathering or

	the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of patterns; cause and effect; energy and matter; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the fourth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate. **Items in bold are a priority.**
Grade Level	4
Pre-requisites	
Credit (if applicable)	

District Learning Expectations and Standards	Unit 1	Unit 2	Unit 3
4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.	x		
4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.	x		
4-ESS1-1.Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	x		
4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	x		
3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	x	x	x
4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.		x	
4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.		x	
4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.		x	
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.		x	
4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.		x	
4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.			x
4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.			x

4 ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.			x
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.			x
4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.			x

UNIT 1: National Parks

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Skills/Concepts	Academic Vocabulary
4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.	**SEP**	**Constructing Explanations and Designing Solutions** ● Use evidence (e.g., measurements, observations, patterns) to construct an explanation.	Skills ● Use evidence to construct an explanation ● Relate speed of a object to its energy Concepts ● Measurements, observations, and patterns can be used as evidence ● The faster an object moves, the more energy it has ● Energy can be transferred in various ways between objects	● Evidence ● Energy ● Transfer
	DCI	**PS3.A: Definitions of Energy** ● The faster a given object is moving, the more energy it possesses.		
	CCC	**Energy and Matter** ● Energy can be transferred in various ways and between objects.		
4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.	**SEP**	**Asking Questions and Defining Problems** ● Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.	Skills ● Ask questions that can be investigated ● Predict outcomes based on energy and collision investigations Concepts ● Outcomes of investigations can be used to describe cause and effect relationships ● Energy is present and can move from place to place by moving objects, sound, light, or electric current ● Energy can be transferred between objects ● In collisions, some energy is transferred to the surrounding air as heat and/or sound ● When objects collide, contact forces transfer energy to change the object's motion	● Predict ● Patterns ● Cause ● Effect ● Sound ● Light ● Electric current ● Heat ● Collide ● Motion
	DCI	**PS3.A: Definitions of Energy** ● Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **PS3.B: Conservation of Energy and Energy Transfer** ● Energy is present whenever there are moving objects, sound, light or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. **PS3.C: Relationship Between Energy and Forces** ● When objects collide, the contact forces transfer energy so as to change the object's motions.		

	CCC	**Energy and Matter** ● Energy can be transferred in various ways and between objects.		
4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	**SEP**	**Constructing Explanations and Designing Solutions** ● Identify the evidence that supports particular points in an explanation.	Skills ● Identify evidence that supports an explanation ● Support an explanation for changes in a landscape over time Concepts ● Local, regional, and global rock patterns reveal changes over time ● The presence and location of fossils indicate the order of rock formation ● Patterns can be used as evidence	● Explanation ● Local ● Regional ● Global ● Rock Formation ● Earthquake ● Fossil ● layers
	DCI	**ESS1.C: The History of Planet Earth** ● Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed.		
	CCC	**Patterns** ● Patterns can be used as evidence to support an explanation.		
4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	**SEP**	**Planning and Carrying Out Investigations** ● Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	Skills ● Make observations and measurements to produce data ● Use evidence/data as the basis for an explanation of weathering and erosion Concepts ● We use evidence to explain phenomena ● Rainfall can shape the land and effects the types of living things that are found in a region ● Water, ice, sind, living organisms and gravity break rocks, soils, and sediments into smaller particles and move them around ● Living things affect the physical characteristics of their regions ● Cause and effect relationships can be identified, tested, and used as evidence to explain change	● Observation ● Measurement ● Data ● Phenomenon ● Rainfall ● Water ● Ice ● Wind ● Organism ● Gravity ● Soil ● Sediment ● Particles ● Physical characteristics ● change
	DCI	**ESS2.A: Earth Materials and Systems** ● Rainfall helps to shape the land and effects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils and sediments into smaller particles and move them around. **ESS2.E: Biogeology** ● Living things affect the physical characteristics of their regions.		
	CCC	**Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change.		

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	**SEP**	**Constructing Explanations and Designing Solutions** ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	Skills ● Generate multiple solutions to a problem ● Compare solutions based on how well they meet the criteria and constraints ● Research a problem ● Test a solution ● Communicate and share ideas with peers during the design process Concepts ● There are multiple solutions to a problem ● Solutions can be tested and compared based on how well they meet specified criteria and constraints ● A problem should be researched before beginning the solution design ● Sharing ideas can lead to an improved design ● Engineers improve technologies or develop new ones to increase benefits, decrease rists, and meet societal demands	● Compare ● Problem ● Solution ● Criteria ● Constraint ● Research ● Test ● Communicate ● Proposed ● Design process ● Improve ● Engineers ● Technology ● Benefit ● Risk ● Societal demand
	DCI	**ETS1.B: Developing Possible Solutions** ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. ● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.		
	CCC	**Influence of Science, Engineering, and Technology on Society and the Natural World** ● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.		

Possible Common Core State Standards Connections:

ELA/Literacy -

- RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)
- RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1)
- RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1)
- W.4.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)
- W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1)(4-PS3-3)
- W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1) (4-PS3-3) (4-PS3-1) (4-ESS2-1)
- W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1)(4-PS3-1)

Mathematics -

- MP.2 Reason abstractly and quantitatively. (4-ESS1-1)(4-ESS2-1)(3-5-ETS1-2)
- MP.4 Model with mathematics (4-ESS1-1)(4-ESS2-1)(3-5-ETS1-2)
- MP.5 Use appropriate tools strategically. (4-ESS2-1)(3-5-ETS1-2)
- 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. (4-ESS1-1)(4-ESS2-1

- 4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1)
- 3-5.OA Operations and Algebraic Thinking (3-ETS1-2)

UNIT 1 DETAILS

Unit Phenomenon: Slideshow with US Map Activity and Then and Now Photo Interactive from Arches National Park to consider how the National Parks provide evidence for the events that have led to the differences in topography across the United States.

Storyline:

The US National Parks provide a snapshot of differing landscapes found across the United States. Throughout the unit, students investigate various national parks and monuments in order to build their conceptual understanding of energy, collisions, weathering and erosion, rock layer patterns, and the relative age or time scale of landforms as indicated by the fossil profile present. Students become engineers as they generate design solutions to an erosion problem they identify on school grounds. In the culminating task, students develop a model explaining a National or State park landscape indicating the events that caused the current landform structures, as well as predict what the future landscape will look like, including all the internal and external forces and processes impacting the area.

Unit Essential Questions:

- How do the National Parks provide evidence for the events that have led to the differences in topography across the United States?
- How did the landforms that make up Grand Staircase (Escalante National Park) develop? What forces cause weathering and erosion?
- What is energy and how does it relate to the changing landscape? How does water help shape the land?
- What can humans do to prevent or decrease the damage caused by erosion or the rate of erosion in an area?
- How can patterns of rock formations and fossils tell us about Earth's history?

Learning Sequence # Essential Question	**Learning Targets:** I can (bold are priority)	**Assessment Strategy** SR - Selected Response CR - Constructed Response P - Performance O - Observation (behavioral)	**Priority NGSS Dimensions**			**Assessment**
(1) Why does the topography change across the United States? What possible forces are at work?	I Can ● **Make observations about the landscape in various regions of the United States-CR** ● **Generate possible explanations for process/forces that may have shaped land over time at the Arches-CR** ● **Ask questions about how/why the landscape varies across the United States for Driving Question Board-CR**		**SEP**	**DCI**	**CCC**	● Record and share with Notice/Wonder ● Use initial model drawing to offer brief explanation ● Create Driving Questions to post on class summary table
			● SEP: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. ● DCI: (ESS2.A)- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. ● CCC: Patterns can be used as evidence to support an explanation.			
(2)	I Can		**SEP**	**DCI**	**CCC**	● Post observations on

How did the landforms that make up Grand Staircase - Escalante National Park come to take their current shape? What forces cause weathering and erosion?	● **Make observations of various landscape/rock formations from Escalante Grand Staircase-CR** ● **Investigate forces that act on shape the land-P** ● **Define and provide examples of weathering and erosion-CR** ● **Summarize the similarities and differences between weathering and erosion-CR** ● **Construct an explanation of the cause and effect of landform changes over time-CR**	● SEP: Use evidence (e.g., measurements, observations, patterns) to construct an explanation. ● DCI: (ESS1.C)- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. (ESS2.A)- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. ● CCC: Patterns can be used as evidence to support an explanation. ● CCC: Cause and effect relationships are routinely identified, tested, and used to explain change.	images from Grand Staircase ● Record data from weathering and erosion investigation stations-identify forces at work ● Build class anchor charts on erosion/weathering ● Complete Venn diagram on Weathering and Erosion ● Use WIS/WIM to write a caption for landscape image ● Add to class summary table ● CFA-Explain forces impacting Grinnell Glacier Basin
(3) What is energy and how does it relate to the changing landscape? How does water help shape the land?	I Can ● **Conduct an investigation to observe the transfer of energy between objects-P** ● **Use data to explain how the mass of an object and the speed of an object can impact a resulting collision-P** ● **Identify energy transfer with evidence in landscape change-CR** ● **Compare high energy vs slow energy weathering and erosion events-CR** ● **Explain how water can shape the land-CR**	**SEP** | **DCI** | **CCC** ● SEP: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. ● SEP: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. ● DCI: (ESS2.A)- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (PS3.A)- The faster a given object is moving the more energy it possesses. (PS3.A)- Energy can be moved from place to place by moving objects. (PS3.B)- Energy is present whenever there are moving objects. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (PS3.C)- When objects collide, the contact forces transfer energy so as to change the object's	● Plan and conduct collision investigations with mass and speed as variables ● Analyze data from investigations to explain cause and effect relationships ● Use Give me 5 template to record evidence of erosion energy ● List and explain high and low energy weathering and erosion examples ● Add to class summary table ● Use slide images to explain water erosion and energy-CFA

<table>
<tr><td></td><td></td><td colspan="3">motions.
● CCC: Energy can be transferred in various ways and between objects.
● CCC: Cause and effect relationships are routinely identified, tested, and used to explain change.</td><td></td></tr>
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What can humans do to prevent or decrease the damage caused by erosion or the rate of erosion in an area?</td><td>I Can
● Identify an erosion problem on school grounds-P
● Make observations of how living things affect the physical characteristics of their regions-P
● Generate a variety of solutions to prevent or decrease the rate of erosion considering constraints-P
● Build and test erosion solutions in simulation-P
● Use qualitative and quantitative data to improve design solutions-P
● Reflect on simulated engineering design process-CR</td><td>SEP</td><td>DCI</td><td>CCC
● SEP: Use evidence (e.g., measurements, observations, patterns) to construct an explanation.
● SEP: Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
● SEP: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
● SEP: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.
● DCI: (ESS2.A)- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. motion.(ESS2.E)- Living things affect the physical characteristics of their regions. (ETS1.B)- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
● CCC: Patterns can be used as evidence to support an explanation.
● CCC: Cause and effect relationships are routinely identified, tested and used to explain change.</td><td>● Identify an erosion problem on school grounds-record measurements, evidence and patterns to help define the problem using design problem template
● Sketch and Design solutions-simulated erosion design challenge
● Test solutions
● Record and analyze data for trends to revise solutions
● Use discussion diamond to determine most promising design solutions
● Add to class summary table</td></tr>
<tr><td>(5)</td><td>I Can
● Demonstrate how patterns of rock layers can form and explain relative</td><td>SEP</td><td>DCI</td><td>CCC</td><td>● Investigate material layer folding to model landform images</td></tr>
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How can patterns of rock formations and fossils help us learn about Earth's history?	**age-P** ● **Explain that fossil presence and location indicate rock layer age and formation-CR.** ● **Identify and describe how major Earth forces (earthquakes, volcanoes, mountain building) that cause changes in rock layers and the landscape-CR.** ● **Explain National or State park landscape formation, indicating the events that caused the current landform structures, as well as predict what the future landscape will look like-P (culminating task)**	● SEP: Use evidence (e.g., measurements, observations, patterns) to construct an explanation. ● SEP: Identify the evidence that supports particular points in an explanation. ● SEP: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. ● SEP: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. ● DCI: (ESS1.C)- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. ● CCC: Patterns can be used as evidence to support an explanation. ● CCC: Cause and effect relationships are routinely identified, tested, and used to explain change.	● Generate a caption for WIS/WIM to show understanding of fossils in rock layer ● Develop (and revise) explanation of major earth forces-explore template ● Explain park landscape formations current and future in culminating task

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY
Students may believe that: ● Rocks can't be broken down ● Rocks do not change ● Weathering and erosion are the same thing. The two words can be used interchangeably ● Erosion happens quickly ● Erosion is always bad ● Plants don't affect rocks and soil ● Humans cause all erosion ● Humans cannot impact erosion ● Mountains are all the same age	K-PS2.B: When objects touch or collide, they push on one another and can change motion. 2-ESS2.A: Wind and Water can change the shape of land. 2-ESS1.C: Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. 3-PS2.A: Each force acts on one particular object and has both strength and direction. An object at rest typically has multiple forces acting on it, but they add up to zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. K-2-ETS1.A: A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable	3-5 ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

	solutions. Asking questions, making observations and gathering information are helpful in thinking about problems. Before beginning to design a solution, it is important to clearly understand the problem. (B) Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (C Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	

RESOURCES

Sample: Bundle Inventory-National Parks

www.nps.gov

- This unit also provides a means for students to gain access to the National Parks for themselves and their families. The *Every Kid in a Park* program through the US National Park Service offers fourth grade students a FREE pass to the US National Parks upon the completion of the curriculum-4 Activities.

UNIT 2: Bear Sense

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Skills/Concepts	Academic Vocabulary
4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	**SEP**	**Planning and Carrying Out Investigations** ● Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution	Skills ● Make observations ● Produce data as evidence ● Use evidence to explain phenomena or as basis to test a design solution Concepts ● We use evidence to support	● Observation ● Evidence ● Energy ● Sound ● Light ● Heat ● Electric Current ● Transfer
	DCI	**PS3.A: Definitions of Energy** ● Energy can be moved from place to place by		

		moving objects or through sound, light, or electric currents. **PS3.B: Conservation of Energy and Energy Transfer** ● Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. ● Light also transfers energy from place to place. ● Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.	an explanation ● Energy can be transferred between objects when they collide ● Collisions can change an object's motion ● In collisions, some energy is transformed into sound and heat ● Energy is present in moving objects, sound, light, or heat ● Energy can be transferred from place to place by electric currents ● Electric currents can produce motion, sound, heat and light	● Collision ● Motion
	CCC	**Energy and Matter** ● Energy can be transferred in various ways between objects.		
4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.	**SEP**	**Developing and Using Models** ● Develop a model to describe phenomena.	Skills ● Develop a model to describe phenomena ● Identify cause and effect relationships Concepts ● Models can be used to describe phenomena ● Light reflecting from an object allows it to be seen by the eye	● Model ● Eye ● Seen ● Surface ● Cause ● Effect
	DCI	**PS4.B: Electromagnetic Radiation** ● An object can be seen when light reflected from its surface enters the eyes.		
	CCC	**Cause and Effect** ● Cause and effect relationships are routinely identified.		
4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.	**SEP**	**Constructing Explanations and Designing Solutions** ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	Skills ● Generate and compare multiple solutions for information transfer ● Determine criteria and constraints for a design solution Concepts ● There are multiple solutions to a problem ● Solutions to a problem are limited by materials and resources ● Solutions can be tested and compared based on how well they meet specified	● Problem ● Solution ● Constraints ● Criteria ● Digitized information ● Transmit ● Degradation ● Receive ● Decode ● Patterns ● Similarities ● Differences ● Sort ● Classify
	DCI	**PS4.C: Information Technologies and Instrumentation** ● Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information - covert it from digitized form to voice - and vice versa.		

		ETS1.C: Optimizing the Design Solution ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	criteria and constraints ● Digitized information can be successfully transmitted over long distances via cell phone or computers	
	CCC	**Patterns** ● Similarities and differences in patterns can be used to sort and classify designed products.		
4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	**SEP**	**Engaging in Argument from Evidence** ● Construct an argument with evidence, data, and/or a model.	Skills ● Construct an argument with evidence, data, or a model to relate structure to function Concepts ● Evidence, data, and models are used to support an argument ● Parts and interactions describe a system ● Plants and animals have specific internal and external structures ● Plant and animal structures are related to their survival function	● Data ● Plants ● Animals ● Internal ● External ● Structure ● Function ● Growth ● Survival ● Behavior ● Reproduction ● System ● Components ● Interaction
	DCI	**LS1.A: Structure and Function** ● Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.		
	CCC	**Systems and System Models** ● A system can be described in terms of its components and their interactions.		
4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	**SEP**	**Developing and Using Models** ● Use a model to test interactions concerning the functioning of a natural system.	Skills ● Use a model to show and test interactions of a system ● Describe a sensory system in terms of its parts and their interactions Concepts ● Components of a system interact ● Sense receptors are specialized to relay information to the brain ● Animals use perceptions and memories to guide their actions	● Sense ● Brain ● Respond ● Stimulus ● Perception ● Memory ● Action
	DCI	**LS1.D: Information Processing** ● Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.		
	CCC	**Systems and System Models** ● A system can be described in terms of its components and their interactions.		
3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem* **Ongoing throughout the year*	**SEP**	**Constructing Explanations and Designing Solutions** ● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	Skills ● Generate multiple solutions to a problem ● Compare solutions based on how well they meet the criteria and constraints ● Research a problem ● Test a solution ● Communicate and share	● Condition ● Test ● Design ● Research ● Improve ● Engineer ● Risk ● Benefit
	DCI	**ETS1.B: Developing Possible Solutions** ● Research on a problem should be carried out		

		before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. ● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	Concepts ideas with peers during the design process ● There are multiple solutions to a problem ● Solutions can be tested and compared based on how well they meet specified criteria and constraints ● A problem should be researched before beginning the solution design ● Sharing ideas can lead to an improved design ● Engineers improve technologies or develop new ones to increase benefits, decrease risks, and meet societal demands	
	CCC	**Influence of Science, Engineering, and Technology on Society and the Natural World** ● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.		

Possible Common Core State Standards Connections:

ELA/Literacy -

- RI.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information.*(4-PS4-3)*
- RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)
- W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)
- W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),
- W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-2)
- SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-2)*(4-LS1-2)*

Mathematics -

- 4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-2)
- 4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1)
- 3-5.OA Operations and Algebraic Thinking (3-ETS1-2)
- MP.2 Reason abstractly and quantitatively. (3-5-ETS1-2)
- MP.4 Model with mathematics. (3-5-ETS1-2)(4-PS4-2)
- MP.5 Use appropriate tools strategically. (3-5-ETS1-2)

UNIT 2 DETAILS

Unit Phenomenon: How does understanding bear senses and energy transfer allow for effective bear deterrent designs?

Storyline: Bears and humans have a history of both positive and negative interactions. This bundle explores some of the negative interactions, looking to investigate why these interactions occur, and how to best eliminate or at least reduce those occurrences through behavior modification(s) in the form of bear deterrents. Students build understanding of systems related to the transfer of energy and information. In order to better understand bears and how they react to different energy (stimuli), the students investigate the senses of both humans and bears. Students explore light, sound, smell, heat and electricity. For the culminating activity, the students present and compare their bear deterrent designs.

Unit Essential Questions:

- How does understanding bear senses and energy transfer allow for effective bear deterrent designs?
- How do organisms detect, process and use information about the environment?
- How does sound travel through different materials? How is energy transferred between objects or systems?
- How does light affect sight?
- How does heat affect odor intensity, and how does color affect temperature?
- How can electricity be used to detect a bear's presence? How can we use light or sound patterns to send a message?
- How can various design solutions be compared and improved?

Learning Sequence # Essential Question	**Learning Targets:** I can (bold are priority)	**Assessment Strategy** SR - Selected Response CR - Constructed Response P - Performance O - Observation (behavioral)	**Priority NGSS Dimensions**			**Assessment**
(1) How will understanding bear senses allow for effective bear deterrent designs?	I Can ● **Make observations on bear behavior-CR** ● **Generate initial questions to begin investigation of bear behavior, bear senses, and bear interactions with humans-CR** ● **Identify the unit problem we will collaboratively solve: how can we limit negative bear/human interaction?- CR**		**SEP**	**DCI**	**CCC**	● Record and share with Notice/Wonder chart ● Create a Driving Question Board ● Begin class summary table
			● SEP: Use a model to test interactions concerning the functioning of a natural system. ● DCI: (ETS1.B)- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. ● CCC: Cause and effect relationships are routinely identified.			
(2)	I Can ● **Identify and provide examples of animals' five senses-CR**		**SEP**	**DCI**	**CCC**	● Build concept map of five senses ● Record sensory station data and

How do organisms detect, process and use information about the environment?	• **Explore senses at stations and connect how perceptions and memories guide responses-P** • **Explain at least one way that a plant and animal responds for survival-CR** • **Begin a bear deterrent design applying the cause and effect relationship between sense perceptions and remembered responses as a means of altering behaviors-P**	• SEP: Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • SEP: Develop a model to describe phenomena. • DCI: (PS3.B)- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (PS4.B)- An object can be seen when light reflected from its surface enters the eyes. (LS1.A)- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (LS1.D)- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. • CCC: Energy can be transferred in various ways and between objects. • CCC: Cause and effect relationships are routinely identified.	complete written response: how do senses influence our actions? • Explain one animal and plant survival behavior/structure • Draft bear deterrent design
(3) How does sound travel through different materials? How is energy transferred between objects or systems?	I Can • **Make observations and use data to explain how different materials conduct sound wave energy-P** • **Draw and label a sound wave model-CR** • **Incorporate sound energy transfer into the bear deterrent design-P**	**SEP** | **DCI** | **CCC** • SEP: Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • SEP: Develop a model to describe phenomena. • SEP: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. • SEP: Construct an argument with evidence, data, and/or a model. • SEP: Generate and compare multiple solutions to a problem based on how well they meet the criteria and	• Use Claim-Evidence-Reasoning template to explain impact of material on sound energy • Build class anchor chart on sound, including a visual of amplitude and wavelength • Add to class summary table and revise bear deterrent designs

		constraints of the design problem. ● DCI: (PS3.A)- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.B)- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (PS4.C)- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (LS1.A)- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (LS1.D)- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (ETS1.B)- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. ● CCC: Energy can be transferred in various ways and between objects. ● CCC: Cause and effect relationships are routinely identified. ● CCC: Similarities and differences in patterns can be used to sort and classify designed products.		
(4)	I Can ● **Make observations of how different amounts of light can impact**	**SEP**	**DCI**	**CCC**	● Share observations from engage/explore investigation

How does light affect sight?	**what I see-P** ● **Use an explanatory model to explain that light is necessary to see any object-CR** ● Explain how a specialized animal structure can impact vision-CR ● **Modify the bear deterrent design using the principles of light on sight-P**	● SEP: Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. ● SEP: Develop a model to describe phenomena. ● SEP: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. ● SEP: Construct an argument with evidence, data, and/or a model. ● DCI: (LS1.A)- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (PS3.A)- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.B)- Light also transfers energy from place to place. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (PS4.B)- An object can be seen when light reflected from its surface enters the eyes. ● CCC: Energy can be transferred in various ways and between objects. ● CCC: Cause and effect relationships are routinely identified. ● CCC: Similarities and differences in patterns can be used to sort and classify designed products.	● Build class concept map on sight ● Develop and use an explanatory model of light-sight ● Add to class summary table and revise bear deterrent designs
(5) How does heat affect odor intensity, and how does color affect temperature?	I Can ● **Explain the impact of temperature on odor intensity-P** ● **Generate and graph data from an investigation-P** ● **Analyze data and use it to support my claim-CR** ● **Incorporate the interactions of color, temperature, and odor intensity into the bear deterrent design-P**	**SEP** | **DCI** | **CCC** ● SEP: Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. ● SEP: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. ● SEP: Construct an argument with evidence, data, and/or a model.	● Use CER template to explain cause/effect relationship of temperature-smell investigation ● Create class graph on Color/Temperature ● Analyze data and use it support a claim-short form CER template ● Add to class summary table and revise bear deterrent designs

		● SEP: Use a model to test interactions concerning the functioning of a natural system. ● DCI: (PS3.A)- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.B)- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. Light also transfers energy from place to place. (LS1.A)- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (LS1.D)- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (ETS1.B)- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. ● CCC: Energy can be transferred in various ways and between objects. ● CCC: Cause and effect relationships are routinely identified. ● CCC: Similarities and differences in patterns can be used to sort and classify designed products.	
(6) How can we use electricity to detect a bear's presence?	I Can ● Demonstrate kinetic energy-P ● **Investigate how an electric current can be used to transfer energy to light energy-P** ● **Transmit a simple message with light or sound patterns-P** ● **Apply electrical energy to the bear deterrent design-P**	**SEP** | **DCI** | **CCC** ● SEP: Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.	● Design a kinetic energy transfer with material set ● Develop a complete circuit with wire, batter, light bulb ● Generate methods to transmit Dange/Helpr

How can we use light or sound patterns to send a message? How can various design solutions be compared and improved?	● **Present and compare various bear deterrent designs-P (culminating task)**	● SEP: Develop a model to describe phenomena. ● SEP: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. ● SEP: Construct an argument with evidence, data, and/or a model. ● SEP: Use a model to test interactions concerning the functioning of a natural system. ● SEP: Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. ● DCI: (PS3.A)- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (PS3.B)- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. Light also transfers energy from place to place. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (PS4.B)- An object can be seen when light reflected from its surface enters the eyes. (LS1.A)- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (LS1.D)- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (ETS1.B)- Research on a problem should be carried out before beginning to design a solution. Testing a	message with light or sound patterns ● Add to class summary table and revise bear deterrent designs ● Identify strengths and weaknesses in the final presentation of class bear deterrent designs

		solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. ● CCC: Energy can be transferred in various ways and between objects. ● CCC: Cause and effect relationships are routinely identified. ● CCC: Similarities and differences in patterns can be used to sort and classify designed products.	

ADDITIONAL CONSIDERATIONS

COMMON MISCONCEPTIONS	PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT	ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY
Students may believe that: ● Once a bear has tasted human food, they will not eat wild food ● If you keep your garbage and compost in a garage, bears will not be attracted to your yard ● Bears have bad eyesight ● Reflected light is just shine or glare not something associated with seeing objects ● Light is not reflected in a predictable manner and angle ● Light travels from our eyes so we can see. ● Bears' super sense of smell makes up for poor eyesight ● Sound can only travel through air ● Sound moves faster in air than in solids (air is "thinner" and forms less of a barrier)	K-2-ETS1.A: A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. Asking questions, making observations and gathering information are helpful in thinking about problems. Before beginning to design a solution, it is important to clearly understand the problem. (B) Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (C Because there is always more than one possible solution to a problem, it is useful to compare and test designs. 1-PS4.A: Sound can make matter vibrate, and vibrating matter can make sound. 1-PS4.B: Objects can be seen if light is available to illuminate them or it they give off their own light. 1-PS4.C: People use a variety of devices to communicate and send and receive information over long distances. 1-LS1.A: All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp, objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, and fruit) that help them survive and grow. 1-LS1.D: Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive.	3-5 ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

	3-PS2.A: The patterns of an object's motion in various situations can be observed and measured: when that past motion exhibits a regular pattern, future motion can be predicted from it. 3-LS3.B: Different organisms vary in how they look and function because they have different inherited information.	

RESOURCES

Bundle Inventory-Bear Sense

UNIT 3: Earth's Energy-Forces That Move Earth

UNWRAPPED STANDARDS

Standard	Dimensions of the NGSS Standard		Skills/Concepts	Academic Vocabulary
4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.	**SEP**	**Constructing Explanations and Designing Solutions** ● Apply scientific ideas to solve design problems.	Skills ● Apply scientific ideas of energy ● Solve design problems Concepts ● Energy can be transferred from place to place ● Energy can be transferred from object to object ● Electric currents can produce motion, sound, heat and light ● Producing energy refers to the conversion of stored energy into a desired form for use ● Solutions to a problem are limited by materials and resources ● The success of a design solution is determined by its desired features ● Solutions can be compared based on how well they meet specified criteria	● Design ● Problem ● Solution ● Energy ● Stored energy ● Practical use ● Transfer ● Transform ● Electric current ● Motion ● Sound ● Heat ● Light ● Resource ● Material ● Criteria ● Constraints
	DCI	**PS3.B: Conservation of Energy and Energy Transfer** ● Energy can also be transferred from place to place by electric currents, which can then be used to locally produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. **PS3.D: Energy in Chemical Processes and Everyday Life** ● The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. **ETS1.A: Defining Engineering Problems (from 3-5 ETS 1-1)** ● Possible solutions to a problem are limited by the available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.		
	CCC	**Energy and Matter** ● Energy can be transferred in various ways and between objects.		
4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.	**SEP**	**Developing and Using Models** ● Develop a model using an analogy, example, or abstract representation to describe a scientific principle.	Skills ● Develop a wave model ● Describe and explain a scientific principle Concepts ● A model can be an analogy,	● Model ● Analogy ● Example ● Representation ● Scientific principal ● Wave

	DCI	**PS4.A: Wave Properties** ● Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. ● Waves of the same type can differ in amplitude (height of the wave) and wavelength (spaced between wave peaks).	an example, or an abstract representation ● A model can be used to describe a scientific principle ● Waves are regular patterns of motion ● Water waves moving across the surface go up and down without motion in the direction of the wave ● Waves can vary in their amplitude (height) and wavelength (space between waves) ● Patterns are used to sort, classify, and analyze rates of change	● Water ● Surface ● Amplitude ● Wavelength ● Peak ● Similarities ● Differences ● Tsunami ● Ocean wave ● Shallow ● Deep ● Sound ● Vibration ● Disturbance ● Compression ● Transverse
	CCC	**Patterns** ● Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.		
4 ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.	**SEP**	**Analyzing and Interpreting Data** ● Analyze and interpret data to make sense of phenomena using logical reasoning.	Skills ● Analyze and interpret data ● Use logical reasoning ● Use maps to identify and locate features ● Identify patterns as evidence ● Use patterns as evidence ● Develop and support explanations with evidence Concepts ● We use data to reason and make sense of phenomena ● Evidence is useful to support an explanation ● Locations of earth's features occur in patterns ● Earthquakes and volcanoes occur along boundaries between continents and oceans ● Mountain chains form inside or edges of continents ● Maps are useful to locate earth's features	● Analyze ● Interpret ● Mountain ● Ocean trench ● Earthquake ● Volcano ● Boundary ● Continent ● Map ● Feature ● Locate ● Pattern ● Evidence ● Support ● Explanation ● Tectonic Plate ● Interplate ● Intraplate ● Crust ● Fault ● Friction
	DCI	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** ● The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth.		
	CCC	**Patterns** ● Patterns can be used as evidence to support an explanation.		
4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	**SEP**	**Constructing Explanations and Designing Solutions** ● Apply scientific ideas to solve design problems. ● Use scientific information to design 2 or more solutions.	Skills ● Apply scientific ideas to solve problems ● Use scientific information to design solutions ● Test a solution	● Cause/effect relationship ● Natural hazards ● Eliminate ● Reduce ● Impact ● Conditions

	DCI	**ESS3.B: Natural Hazards** ● A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. **ETS1.B: Developing Possible Solutions** ● Testing a solution involves investigating how well it performs under a range of likely conditions.	● Identify and explain cause and effect relationships Concepts ● We use scientific ideas and information to design solutions ● Natural hazards can result from natural processes ● Humans cannot eliminate natural hazards but can reduce their impact ● Testing solutions involves investigating how well they perform under a range of likely conditions ● Energy can be transferred in various ways between objects ● Cause and effect relationships are used to explain change. ● Patterns can be observed and used as evidence to describe phenomena	
	CCC	**Energy and Matter** ● Energy can be transferred in various ways and between objects. **Cause and Effect** ● Cause and effect relationships are routinely identified, tested, and used to explain change. **Patterns** ● Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.		
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.	**SEP**	**Obtaining, Evaluating, and Communicating Information** ● Obtain and combine information from books and other reliable media to explain phenomena.	Skills ● Obtain information from multiple sources ● Organize information to explain phenomena ● Identify cause and effect relationships ● Use relationships to explain change Concepts ● We use multiple sources of information to explain phenomena ● Energy that humans use comes from natural resources ● Using natural resources for energy affects the environment in multiple ways ● Some resources are renewable, others are not ● Cause and effect relationships are used to explain change	● Obtain ● Combine ● Media ● Explain ● Phenomenon ● Fuel ● Natural source ● Environment ● Renewable resources ● Nonrenewable resources ● Wind ● Solar ● Hydrokinetic ● Electricity ● Geothermal ● Fossil Fuels ● Climate Change ● Nuclear ● Uranium
	DCI	**ESS3.A: Natural Resources** ● Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.		
	CCC	**Cause and Effect** ● Cause and effect relationships are routinely identified and used to explain change.		
3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how	**SEP**	**Constructing Explanations and Designing Solutions**	Skills ● Generate multiple solutions	● Condition ● Test

well each is likely to meet the criteria and constraints of the problem* **Ongoing throughout the year*		● Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	to a problem ● Compare solutions based on how well they meet the criteria and constraints ● Research a problem ● Test a solution ● Communicate and share ideas with peers during the design process Concepts ● There are multiple solutions to a problem ● Solutions can be tested and compared based on how well they meet specified criteria and constraints ● A problem should be researched before beginning the solution design ● Sharing ideas can lead to an improved design ● Engineers improve technologies or develop new ones to increase benefits, decrease rists, and meet societal demands	● Research ● Improve ● Engineer ● Risk ● Benefit
	DCI	**ETS1.B: Developing Possible Solutions** ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. ● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.		
	CCC	**Influence of Science, Engineering, and Technology on Society and the Natural World** ● Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.		

UNIT 3 DETAILS

Unit Phenomenon: Photos of damage from catastrophic natural events

Storyline:
This bundle focuses on the forces responsible for the movement of the Earth's surface (and everything on it), and it helps students build an understanding of waves, Earth's features and energy transfer. Students view slides showcasing the destructive forces of earthquakes, tsunamis, and volcanoes as a jumping off point for connecting all of these ideas. In doing so, they connect plate tectonics to the ever-changing Earth's crust. In the final learning sequence, students explore energy use, and compare renewable and nonrenewable energy resources. Students investigate how wind power works in an energy conversion design challenge. In the culminating task, students design and share a creative advertising campaign to promote the uses and benefits of wave energy (hydrokinetic) OR geothermal energy.

Unit Essential Questions:

- *What forces are responsible for the movement of the Earth's surface and everything on it?*
- *What energy and forces are acting on the Earth's crust during an earthquake?*
- *What are waves and how do they affect the Earth's crust and humans?*
- *Where does our energy come from?How are renewable and nonrenewable resources impacting our environment?*
- *How can we utilize renewable energy?*

Learning Sequence # Essential Question	**Learning Targets:** I can (bold are priority)	**Assessment Strategy** SR - Selected Response CR - Constructed Response P - Performance O - Observation (behavioral)	**Priority NGSS Dimensions**			**Assessment**
(1) What forces are responsible for the movement of the Earth's surface (and everything on it)?	I Can ● **Make observations on multiple examples of destruction-CR** ● **Generate and group questions on the possible causes of multiple examples of destruction-CR** ● **Locate "destruction" sites on world map to consider patterns-CR** ● **Develop an initial model to explain how an event happened-P**		**SEP**	**DCI**	**CCC**	● Record and share with Notice/Wonder ● Create a Driving Question Board ● Identify locations on World Map ● Develop initial model of destructive forces ● Complete class summary table
			● SEP: Develop a model using an analogy, example, or abstract representation to describe a scientific principle. ● DCI (ESS2.B): The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and			

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<td>oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (Students will not learn this content in this lesson)
● CCC: Cause and effect relationships are routinely identified, tested, and used to explain change.</td>
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<td>(2)

What energy and forces are acting on the Earth’s crust during an earthquake?</td>
<td>I Can
● Make observations and use information to understand Moodus noises-CR
● Design and test earthquake proof structures-P
● Compare design effectiveness with supporting data in post building design analysis-P
● Obtain and use information from multiple sources to understand and explain cause-effect relationships of earthquakes-CR
● Explain and show what happens with various plate boundary movements-CR
● Describe and explain earthquake patterns on a map-CR
● Use evidence from the Interactive Map to explain relationships of tectonic plates to earthquakes and volcanoes-CR</td>
<td>SEP | DCI | CCC
● SEP: Apply scientific ideas to solve design problems.
● SEP: Use scientific information to design 2 or more solutions.
● SEP: Obtain and combine information from books and other reliable media to explain phenomena.
● SEP: Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.
● DCI: (ESS2.B)- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (ESS3.B)-A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (ETS1.B)-Testing a solution involves investigating how well it performs under a range of likely conditions.
● CCC: Energy can be transferred in various ways and between objects.
● CCC: Cause and effect relationships are routinely identified, tested, and used to explain change.
● CCC: Patterns in the natural world can be observed, used to describe</td>
<td>● Record and share observations and conclusions after podcast and article
● Design and test earthquake proof structures
● Analyze structure data for trends
● Explain cause and effect with Close Reading Template or Concept Map
● Explain motion on Plate Movement and Boundary Template
● Describe earthquake patterns on WIS/WIM Template
● Explain earthquake and volcanic relationship to plates on Discussion Diamond
● Complete class summary table</td>
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<tr><td></td><td></td><td colspan="3">phenomena, and used as evidence.</td><td></td></tr>
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What are waves and how do they affect the Earth’s crust and humans?</td><td>I Can
Explore sound with cup communicators-P
Explain how the cup communicators transfer sound -CR
Investigate water waves and record observations-P
Describe water waves with relevant vocabulary-CR
Compare surface water waves and tsunami waves with venn diagram and explanatory models-P
Obtain and organize information to explain the impact of tsunamis on land and people-CR
Revise initial models from LS 1 to determine cause/effect of destruction-P
Explain patterns of earthquakes, volcanoes, and tsunami locations on World Tectonic Plate Boundary Map-P</td><td>SEP</td><td>DCI</td><td>CCC</td><td>Investigate and explain sound wave transmission with cup communicators
Record data and thinking on Water Wave Evidence Log
Create Wave anchor chart
Explain similarities and differences in waves with venn diagram and explanatory models
Build concept map on tsunamis
Revise LS 1 models to explain cause and effect
Explain patterns on Tectonic Plate Boundary Map
Complete class summary table</td></tr>
<tr><td></td><td></td><td colspan="3">SEP: Develop a model to make sense of a phenomena
SEP: Identify and describe the relationships between components of the model
SEP: Use the model to describe multiple solutions.
SEP: Obtain and combine information from books and other reliable media to explain phenomena.
DCI (PS4.A)-Waves are regular patterns of motion; When waves move across the surface of deep water, the water goes up and down in place; There is no net motion of water in the direction of the waves except when the water meets the beach; Waves can be made in water by disturbing the surface. (ESS2.B)- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. The location of deep ocean trenches and earthquakes. (ESS3.B)-A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts.
CCC: Energy can be transferred in various ways and between objects.
CCC: Cause and effect relationships are routinely identified, tested, and used to explain change.
CCC: Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.</td><td></td></tr>
<tr><td>(4)</td><td>I Can</td><td>SEP</td><td>DCI</td><td>CCC</td><td>Share and post ideas on</td></tr>
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Where does our energy come from? How are renewable and nonrenewable resources impacting our environment? How can we utilize renewable energy?	● **Generate ideas and ask questions about the demands of energy for human transportation-CR** ● Observe and record types of energy use at school and at home-P ● **Categorize energy types and their sources-P** ● **Determine energy source trends and their implications-P** ● **Compare renewable and nonrenewable energy resources-CR** ● **Design and test windmills to demonstrate energy transfer-P** ● **Analyze windmill data-P** ● **Design and present a creative advertising campaign to promote the uses and benefits of wave energy or geothermal energy-P**	● SEP: Obtain and combine information from books and other reliable media to explain phenomena. ● SEP: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. ● SEP:Apply scientific ideas to solve design problems. ● SEP: Use scientific information to design 2 or more solutions. ● DCI: (PS3.B)-Energy can also be transferred from place to place by electric currents, which can then be used to locally produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (PS3.D)-Energy can be stored, transferred and converted. The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (ETS1.A)- Possible solutions to a problem are limited by the available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (ESS3.A)-Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (ETS1.B)-Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the process, and shared ideas can lead to improved designs. ● CCC: Relationships are routinely	human energy demands ● Record evidence of energy usage on template ● Analyze Energy Detective Data ● Build renewable and nonrenewable anchor charts ● Design, test, and analyze data-Windmill Challenge ● Design and present a renewable energy ad campaign

		identified and used to explain change. ● CCC: Energy can be transferred in various ways and between objects.	

ADDITIONAL CONSIDERATIONS		
COMMON MISCONCEPTIONS	**PRIOR KNOWLEDGE NEEDED TO MASTER STANDARDS FOR THIS UNIT**	**ADVANCED STANDARDS FOR STUDENTS WHO HAVE DEMONSTRATED PRIOR MASTERY**
Students may believe: ● The Earth has always looked the way it does now ● The Earth's crust does not change and/or move. ● That earthquakes only occur on the west coast of the United States (California) ● Continents do not move ● People can stop an earthquake ● Earthquakes happen randomly across the earth's surface ● The ground opens up during an earthquake ● That as waves move, matter moves along with them ● That sound waves move faster in air than in solids or liquids ● That waves do not have energy	K-2 ETS1.A: A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. Asking questions, making observations and gathering information are helpful in thinking about problems. Before beginning to design a solution, it is important to understand the problem. (B) Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (C Because there is always more than one possible solution to a problem, it is useful to compare and test designs. K-ESS3.B: Some kinds of severe weather are more likely than others in a given region. Weather sceinctins forecast severe weather so that the communities can prepare for and respond to these events. 2-ESS1.C: Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe.	3-5 ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time or cost. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

• Tsunamis and surf waves have all the same characteristics • The Earth has always looked the way it does now • Earth's natural resources are not finite. Instead they may believe that there is an endless supply of water, petroleum, and mineral resources. All we have to do is explore for more • We will never run out of natural resources such as coal, oil, water and other minerals. • Using fossil fuels has no negative impacts on the environment	2-ESS2.A: Wind and water can change the shape of the land. 3-ESS2.D: Scientists record patterns of weather across different time sand areas so that they can make predictions about what kind of weather might happen next. 4-ESS2.A: Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around. 4-PS3.A: Energy can be moved from place to place by moving objects or through sound, light, or electrical currents.	

RESOURCES

Bundle Inventory-Forces that Move Earth