Next Generation Science Standards (NGSS) Cluster/Item Specifications

Specifications for Grades 3-5

Version Control Table

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Introduction

This document presents *cluster specifications* for use with the Next Generation Science Standards (NGSS). These standards are based on the Framework for K-12 Science Education. The present document is not intended to replace the standards, but rather to present guidelines for the development of items and item clusters used to measure those standards.

The remainder of this section provides a very brief introduction to the standards and the framework, an overview of the design and intent of the item clusters, and a description of the cluster specifications that follow. The bulk of the document is composed of cluster specifications, organized by grade and standard.

Background on the framework and standards

The Framework for K-12 Science Education are organized around three core dimensions of scientific understanding. The standards are derived from these same dimensions:

- Disciplinary Core Ideas: The fundamental ideas that are necessary for understanding a given science discipline. The core ideas all have broad importance within or across science or engineering disciplines, provide a key tool for understanding or investigating complex ideas and solving problems, relate to societal or personal concerns, and can be taught over multiple grade levels at progressive levels of depth and complexity.

- Science and Engineering Practices: The practices are what students DO to make sense of phenomena. They are both a set of skills and a set of knowledge to be internalized. The SEPs reflect the major practices that scientists and engineers use to investigate the world and design and build systems.

- Cross-Cutting Concepts: These are concepts that hold true across the natural and engineered world. Students can use them to make connections across seemingly disparate disciplines or situations, connect new learning to prior experiences, and more deeply engage with material across the other dimensions. The NGSS requires that students explicitly use their understanding of the CCCs to make sense of phenomena or solve problems.

- There is substantial overlap between and among the three dimensions. For example, the cross-cutting concepts are echoed in many of the disciplinary core ideas. The core ideas are often closely intertwined with the practices. This overlap reflects the nature of science itself. For example, we often come to understand and communicate causal relationships by employing models to make sense of observations. Even within a dimension, overlap exists. Quantifying characteristics of phenomena is important in developing an understanding of them, so employing computational and mathematical thinking in the construction and use of models is a very common scientific practice, and one of the cross-cutting concepts suggests that scientists often infer causality by observing patterns. In short, the dimensions are not orthogonal.

The framework envisions effective science education as occurring at the intersection of these interwoven dimensions: students learn science by doing science—applying the practices through the lens of the cross-cutting concepts to investigate phenomena that relate to the content of the disciplinary core ideas.

Item clusters

Each item cluster is designed to engage the examinee in a grade-appropriate, meaningful scientific activity aligned to a specific standard.

Each cluster begins with a phenomenon, an observable fact or design problem that engages student interest and can be explained, modeled, investigated, or designed using the knowledge and skill described by the standard in question.

What it means to be observable varies across practices. For example, a phenomenon for a performance expectation exercising the a*nalyze data* practice may be observable through regularities in a data set, while standards related to the *development and use of models* might be something that can be watched, seen, felt, smelled, or heard.

What it means to be observable also varies across grade levels. For example, elementary-level phenomena are very concrete and directly observable. At the high school level, an observation of the natural world may be more abstract--for example, “observing” changes in the chemical composition of cells through the observation of macroscopic results of those changes on organism physiology, or through the measurement of system- or organ-level indications.

Content limits refine the intent of the performance expectations and provide limits on what may be asked of items in the cluster to structure the student activity. The content limits also reflect the disciplinary core ideas learning progressions that are present in the K-12 Framework for Science Education.

The task or goal should be explicitly stated in the stimulus or the first item in the cluster: statements such as “In the questions that follow, you will develop a model that will allow you to identify moons of Jupiter,” or “In the questions below, you will complete a model to describe the processes that lead to the steam coming out of the teapot.”

Whereas item clusters have been described elsewhere as “scaffolded,” they are better described as providing structure to the task. For example, some clusters begin with students summarizing data to discover patterns that may have explanatory value. Depending on the grade level and nature of the standard, items may provide complete table shells or labeled graphs to be drawn, or may require the student to choose what to tabulate or graph. Subsequent items may ask the student to note patterns in the tabulated or graphed data and draw on domain content knowledge to posit explanations for the patterns.

These guidelines for clusters do not appear separately in the specifications. Rather, they apply to all clusters.

Structure of the cluster specifications

The item cluster specifications are designed to guide the work of item writers and the review of item clusters by stakeholders.

Each item cluster has the following elements:

- The text of the performance expectations, including the practice, core idea, and cross-cutting concept.
- Content limits, which refine the intent of the performance expectations and provide limits of what may be asked of examinees. For example, they may identify the specific formulae that students are expected to know or not know.
- Vocabulary, which identifies the relevant technical words that students are expected to know, and related words that they are explicitly not expected to know. Of course, the latter category should not be considered exhaustive, since the boundaries of relevance are ambiguous, and the list is limited by the imagination of the writers.
- Sample phenomena, which provide some examples of the sort of phenomena that would support effective item clusters related to the standard in question. In general, these should be guideposts, and item writers should seek comparable phenomena, rather than drawing on those within the documents. Novelty is valued when applying scientific practices.
- Task demands comprise the heart of the specifications. These statements identify the types of items and activities that item writers should use, and each item written should be clearly linked to one or more of the demands. The verbs in the demands (e.g., *select, identify, illustrate, describe*) provide guidance on the types of interactions that item writers might employ to elicit the student response. We avoid explicitly identifying interaction types or item formats to accommodate future innovations and to avoid discouraging imaginative work by the item writers.
- For each cluster we present, the printed documentation includes the cluster, the task demands represented by each item, and its linkage to the practice and cross-cutting concept identified in the performance expectation.

Item cluster specifications follow, organized by grade and standard.

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-PS2-1
Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.</td></tr>
<tr><td>Dimensions</td><td>Planning and Carrying Out Investigations
• Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.</td><td>PS2.A: Forces and Motion
• Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give 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. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)

PS2.B: Types of Interactions
• Objects in contact exert forces on each other.</td><td>Cause and Effect
• Cause and effect relationships are routinely identified.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples could include an unbalanced force on one side of a ball can make it start moving, and balanced forces pushing on a box from both sides will not produce any motion at all.

Content Limits
• Assessment is limited to gravity being addressed as a force that pulls objects down.
• Assessment is limited to one variable at a time: number, size, or direction of forces.
• Assessment does include normal force, but not by name or magnitude.
• Assessment does not include quantitative force size, only qualitative and relative.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Velocity, acceleration, mass, friction, vector, quantitative, relative, scale, weight (mass • gravity), Newtons, normal force.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Example Phenomena for 3-PS2-1:
• Kids of the same size and strength play a game of tug of war. When the same number of kids are on each side, a ribbon tied to the rope does not move. When more kids are on one side, the rope moves in that direction.
• A ball rests on the ground, unmoving. When it is gently kicked, it moves slowly in the direction it was kicked. When it is kicked harder, it moves more quickly in the direction it was kicked.
• A box is sitting in the center of a table. Strings attached to the left and right sides of the box hang over the sides of the table. Identical weights can be attached to the end of these strings.
• A flat track with posts and rubber bands on either ends of the track. The student can pull a car back different distances to gather data.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Assemble, complete, or identify, from a collection including distractors, the essential components of an investigation that studies balanced and unbalanced forces on an object at rest and/or in motion.</td></tr>
</table>

2.	Identify the variables in the investigation that are held constant and which are changing, and define important factors in the design including number of trials, methods, and techniques.
3.	Identify the observations that should be collected in an investigation of an object's motion to determine the forces on the object and the causes of those forces.
4.	Observe, collect, and record data from observations of the forces acting on an object at rest and/or in motion after forces of different strengths and/or directions are applied, including both balanced and unbalanced forces. ***(SEP/DCI/CCC)**
5.	Identify from a list, including distractors, the effects of forces on an object's motion and the cause of those forces.
6.	Make predictions about the effects of changes in the motion of an object given specific forces. Predictions can be made by manipulating components of the investigation, completing illustrations, or selecting from lists with distractors.

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-PS2-2
Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.</td></tr>
<tr><td>Dimensions</td><td>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 or to test a design solution.</td><td>PS2.A Forces and Motion
• 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.</td><td>Patterns
• Patterns of change can be used to make predictions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a seesaw.

Content Limits
• Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.
• <u>Students do not need to know:</u> Newton’s laws of motion, Law of Conservation of Energy</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Frequency, amplitude, displacement, equilibrium position, oscillate, momentum, velocity, vector, elastic collision, inelastic collision, friction, acceleration of gravity, work, power, mechanical advantage, Coulomb’s law, Faraday cage, induction, conduction, electron, proton, atom, controlled variable, dependent variable, independent variable, kinetic energy, potential energy, average.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-PS2-2:
• A boy and a girl play on a swing set. In 10 tries, the girl cannot get the boy to swing higher than the height she released him.
• A beach ball stays in the same location in a pool of wavy water. A beach ball floats in a pool. A child jumps into the pool, causing waves. The ball rises and falls with the waves but stays in the same basic spot in the pool.
• A ball can be thrown farther when a person launches the ball from a plastic ball thrower rather than from his/her bare hand.
• A marble is rolled down a slide. It takes five seconds for the marble to reach the bottom of the slide. The same marble is rolled down another slide. This time, it takes the marble two seconds to reach the bottom of the slide.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify the output data that should be collected in an investigation of an object’s motion.</td></tr>
<tr><td colspan="4">2. Make and/or record observations about an object’s motion as it repeats a pattern over time.</td></tr>
<tr><td colspan="4">3. Generate or construct graphs, tables, assemblages of illustrations and/or labels of data that highlight patterns, trends, or correlations in the pattern of an object’s motion. This may include sorting out distractors. * (SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">4. Summarize data to highlight trends, patterns, or correlations in the motion of an object.</td></tr>
</table>

5. Use relationships identified in the data to predict/infer the future motion of an object. ***(DCI/CCC)**
6. Identify patterns or evidence in the data that supports predictions/inferences about an object's future motion.*** (DCI/CCC)**

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-PS2-3
Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.</td></tr>
<tr><td>Dimensions</td><td>Asking Questions and Defining Problems
• Ask questions that can be investigated based on patterns such as cause and effect relationships.</td><td>PS2.B: Types of Interactions
• Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.</td><td>Cause and Effect
• Cause and effect relationships are routinely identified, tested, and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets.
• Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.

Content Limits
• Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity. Limit to strictly qualitative observations.
• Limit content to ask questions about how electric and magnetic objects interact, and the investigation of these phenomena within the scope of the classroom.
• Students should be able to identify the direction of the force, but not the shape of the magnetic or electric field.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Coulombs Law, Amperes Law, force fields, test charge, protons, neutrons, electrons, field gradients, insulator, conductor.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Example Phenomena for 3-PS2-3:
• A magnet is placed near a paper clip and the paper clip moves to touch the magnet.
• A bottle cap dropped past a magnet is captured by the magnet but a spoon is not.
• A balloon rubbed against a sweater attracts a whole grain oat O-shaped cereal attached to a string.
• A magnet floats on top of another magnet when aligned correctly.
• A magnet touching the underside of a glass table can move a piece of metal sitting above it on top of the table.
• Two opposite poled magnets suspended by strings in air will levitate.
• Magnetic filings placed around a magnet will move into a pattern around the magnet.
• Two electrically charged balls rubbed with wool will repel each other.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
</table>

1. Select or identify from a collection, questions that will help clarify the properties that are correlated with the strength or direction of the forces in the phenomenon. In addition to plausible distractors, distractors may also include non-testable ("nonscientific") questions. ***(SEP;DCI;CCC)**
2. Make and/or record observations about how the size of the forces, both magnetic and electric, depend on different characteristics such as strength/orientation of the magnet, the amount of electric charge, materials, etc.
3. Identify, describe, or select from a collection, characteristics, properties, features, and/or processes to be manipulated or held constant, while gathering information to answer a well-articulated question about the cause and effect relationships of electric or magnetic interactions. ***(SEP;DCI;CCC)**
4. Select or describe conclusions relevant to the question posed which are supported by the data, especially inferences about causes and effects, related to static electricity and/or magnetism.
5. Predict outcomes when properties or proximity of the objects are changed, given the inferred cause and effect relationships, related to static electricity and/or magnetism.

*denotes those task demands which are deemed appropriate for use in stand-alone item development
TD1 and TD3 **must be used together.

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-PS2-4
Define a simple design problem that can be solved by applying scientific ideas about magnets.</td></tr>
<tr><td>Dimensions</td><td>Asking Questions and Defining Problems
• Define a simple problem that can be solved through the development of a new or improved object or tool.</td><td>PS2.B: Types of Interactions
• Electric and Magnetic forces between a pair of objects do not require the objects to be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart, and, for forces between two magnets, on their orientation relative to each other.</td><td>Interdependence of Science, Engineering, and Technology
• Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.

Content Limits
• Students only need to know the basics about magnets. They do not need to know about the magnetic field and how it is shaped for different objects, etc.
• Students do not need to know how a magnet can magnetize other objects; they just need to know that it does. For example, a paper clip is not magnetic but will be attracted to a magnet. (The student does not need to know anything about magnetic domains.)
• Students do not need to know how electricity and magnetism are coupled (that moving electrons create a magnetic field and that a changing magnetic field creates a current).
• Students do not need to know anything about magnets except that they can repel/attract each other based on their orientation relative to each other.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Ampere’s law, force fields, field gradients, conductor, orientation, magnetic field, exert, interaction, electromagnetism, Faraday’s law.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-PS2-4:
• The shower leaks because the curtain is not secured to the bottom of the bathtub.
• Things continually fall out of a handbag because the latch is not secure.
• While working on a project, pencil shavings were dropped on the carpet and the vacuum may not have cleaned them all up.
• The refrigerator door won’t stay closed, making it difficult to keep food cool.
• Two carts used in experiments keep damaging each other when they collide.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify or assemble from a collection, including distractors, the relevant aspects of the problem that given design solutions, if implemented, will resolve/improve.</td></tr>
<tr><td colspan="4">2. Articulate, describe, illustrate, or select the relationships, interactions, and/or processes to be explained OR to be used to solve the problem. This may entail sorting relevant from irrelevant information or features.</td></tr>
<tr><td colspan="4">3. Express or complete a causal chain explaining how the repulsion or attraction of magnets will solve the problem that has been identified. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram, or completing cause-and-effect chains.</td></tr>
</table>

4. Using given data, propose/illustrate/assemble a potential device (prototype) or solution.
5. Describe, identify, and/or select information needed to support an explanation about the proposed solution.

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS1-1
Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models
• Develop models to describe phenomenon.</td><td>LS1.B: Growth and Development of Organisms
• Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.</td><td>Patterns
• Patterns of change can be used to make predictions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Changes organisms go through during their lifetime form a pattern.

Content Limits
• Assessment of plant life cycles is limited to those of flowering plants.
• Assessment does not include details of human reproduction.
• <u>Students do not need to know:</u> the alternation of generations life cycle, the human reproductive system, mitosis and meiosis.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Organism, breed, diverse, transfer, development, germination, reproductive system, organ, cell, tissue, egg, fertilize, genetic, unicellular, multicellular, specialized cell, sperm, cell differentiation, cell division, variation, juvenile, metamorphosis, chrysalis, pupa, spores, pistil, stamen, ovary, anther, filament, sepal, receptacle, ovule, stigma, style.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-LS1-1:
• A young moth builds a soft case around it called a cocoon and a young butterfly builds a hard case called a chrysalis.
• A young ladybug looks very different from an adult ladybug.
• Plants and animals both form eggs.
• A pea planted in the ground grows into a new pea plant.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Select the components needed to model the phenomenon. Components might include stages of life cycles such as birth, growth, reproduction, and death.</td></tr>
<tr><td colspan="4">2. Assemble or complete an illustration or flow chart that is capable of representing the patterns in life cycles of different types of organisms.</td></tr>
<tr><td colspan="4">3. Manipulate the components of a model to demonstrate the changes, properties, processes and/or events that act to result in a phenomenon.</td></tr>
<tr><td colspan="4">4. Make predictions about the effects of changes in life cycles on organisms. Predictions can be made by manipulating model components, completing illustrations, or selecting from a list with distractors.</td></tr>
<tr><td colspan="4">5. Given models or diagrams of life cycles, identify relevant components such as birth, growth, reproduction, and death, and how the life cycles are different in each scenario.</td></tr>
<tr><td colspan="4">6. Identify missing components, relationships, or other limitations of the model of a life cycle.</td></tr>
<tr><td colspan="4">7. Describe, select, or identify the relationships among components of a model that describe the patterns of life cycles among different organisms.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS2-1
Construct an argument that some animals form groups that help members survive.</td></tr>
<tr><td>Dimensions</td><td>Engaging in Argument from Evidence
• Construct an argument with evidence, data, and/or a model.</td><td>LS2.D: Social Interactions and Group Behavior
• Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.</td><td>Cause and Effect
• Cause and effect relationships are routinely identified and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Focus is on how being part of a group helps animals obtain food, defend themselves, and cope with changes, and does not cover how group behavior evolved as a result of a survival advantage.

Content Limits
• Assessment does not include the evolution of group behavior.
• <u>Students do not need to know</u>: social hierarchy in animal groups (pecking order, dominance, submissive, altruism).</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Organism, social, relative, predation, gene/genetic, hereditary, harmful, beneficial, variation, probability, adaptation, decrease, increase, behavioral, variation, ecosystem, pecking order, dominance/submissive behavior, hierarchy, migrate, defend.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-LS2-1:
• In Yellowstone National Park, a wolf preys on a much larger bison.
• In the Atlantic Ocean, bottlenose dolphins capture fast-swimming tuna in the open ocean.
• In the Willamette Valley, a colony of beavers builds a dam.
• A colony of ants protects its nests.
• A male honey bee returns to a hive each day.
• As an ant approaches, a termite bangs its head against the wall of its nest.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify patterns or evidence in the data that support inferences and/or determine relationships about the effect of group membership on survival of an animal.</td></tr>
<tr><td colspan="4">2. Understand and generate simple bar graphs or tables that document patterns, trends, or relationships between group membership and survival.</td></tr>
<tr><td colspan="4">3. Sort observations/evidence into those that appear to support or not support an argument.</td></tr>
<tr><td colspan="4">4. Based on the provided data, identify or describe a claim regarding the relationship between survival of an animal and being a member of a group.</td></tr>
<tr><td colspan="4">5. Identify, summarize, select or organize given data or other information to support or refute a claim regarding the relationship between group membership and survival of an animal. *(SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">6. Using evidence, explain the relationship between group membership and survival. *(SEP/DCI/CCC)</td></tr>
</table>

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS3-1
Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.</td></tr>
<tr><td>Dimensions</td><td>Analyzing and Interpreting Data
• Analyze and interpret data to make sense of phenomena using logical reasoning.</td><td>LS3.A: Inheritance of Traits
• Many characteristics of organisms are inherited from their parents.

LS3.B: Variation of Traits
• Different organisms vary in how they look and function because they have different inherited information</td><td>Patterns
• Similarities and differences in patterns can be used to sort and classify natural phenomena.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statement
• Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings.

Content Limits
• Emphasis is on organisms other than humans.
• Assessment does not include genetic mechanisms of inheritance and prediction of traits, including concepts of dominant/recessive traits or sex-linked traits.
• Assessment is limited to non-human examples.
• Graphs and charts can include bar graphs, pictographs, pie charts, tally chart.
• Types of math can include simple fractions, simple addition/subtraction.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Transfer, variation, allele, hereditary information, identical, Punnett square, transmission, gene, genetic, genetic variation, dominant trait, recessive trait.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">For this performance expectation the phenomena are sets of data. Those are the observed facts that the kids will look at to discover patterns. Below, we enumerate some of the patterns that might comprise the data sets (phenomena) to be analyzed.

Example Phenomena for 3-LS3-1:
• Two corn plants in a garden reproduce. In the next generation, the offspring vary in height. (Augmentation: We will provide a data table displaying each member of the subsequent generation and the relevant trait possessed.)
• Over a four-year period, the offspring of two tall blueberry plants always grow taller than the offspring of two nearby short blueberry plants. (Augmentation: We will provide a data table of the number of offspring of each plant height over a four-year period, correlated with the parent plants.)</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Organize or summarize data to highlight trends, patterns, or correlations between the traits of offspring and those of their parents and/or siblings.* (SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">2. Generate graphs or tables that document patterns, trends, or correlations in inheritance of traits. * (SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">3. Identify patterns or evidence in the data that support inferences about inheritance of traits from parents to offspring.* (SEP/DCI/CCC)</td></tr>
</table>

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS3-2
Use evidence to support the explanation that traits can be influenced by the environment.</td></tr>
<tr><td>Dimensions</td><td>Constructing explanations and designing solutions
• Use evidence (e.g., observations, patterns) to support an explanation.</td><td>LS3.A: Inheritance of Traits
• Other characteristics result from individuals’ interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.
LS3.B: Variation of Traits
• The environment also affects the traits that an organism develops.</td><td>Cause and Effect
• Cause-and-effect relationships are routinely identified and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of the environment affecting a trait could include normally tall plants that are grown with insufficient water and are stunted; and, a pet dog that is given too much food and little exercise and becomes overweight.

Content Limits
• Focus on physical traits.
• Do not use human traits.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Organism, variation, version, harmful/beneficial, increase/decrease, trend.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-LS3-2:
• The arctic fox is white in winter but turns brown in the summer.
• Flamingoes are born gray, but some become very pink as they grow.
• Trees growing on the edge of cliffs are often bent.
• A goldfish in a pond grows larger than one in a fish bowl.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Describe or select the relationships, interactions, or processes to be explained. This may entail sorting relevant from irrelevant information or features.</td></tr>
<tr><td colspan="4">2. Express or complete a causal chain explaining that traits can be influenced by the environment. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram, or completing cause-and-effect chains.</td></tr>
<tr><td colspan="4">3. Identify evidence supporting the inference of causation that is expressed in a causal chain.</td></tr>
<tr><td colspan="4">4. Use an explanation to predict changes in the trait of an organism given a change in environmental factors.</td></tr>
<tr><td colspan="4">5. Describe, identify, and/or select information needed to support an explanation of environmental influence on traits.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS4-1
Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.</td></tr>
<tr><td>Dimensions</td><td>Analyzing and Interpreting Data
• Analyze and interpret data to make sense of phenomena using logical reasoning, mathematics, and/or computation.</td><td>LS4.A: Evidence of Common Ancestry and Diversity
• Some kinds of plants and animals that once lived on Earth are no longer found anywhere.
• Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.</td><td>Scale, Proportion, and Quantity
• Observable phenomena exist from very short to very long periods.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of data could include type, size, and distributions of fossil organisms.
• Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.
• Focus is on the fossils and environment in which the organisms lived, not how the fossils got to where they are today.
• Data can be represented in tables and/or various graphic displays.
• Data collected by different groups can be compared and contrasted to discuss similarities and differences in their findings.

Content Limits
• Assessment does not include identification of specific fossils or present plants and animals.
• Assessment is limited to major fossil types and relative ages.
• Graphs and charts can include bar graphs, pictographs, pie charts, and tally charts.
• Types of math can include simple addition/subtraction.
• Standard units that can be used to measure and describe physical quantities such as weight, time, temperature, and volume.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Chronological order, fossil record, radioactive dating, descent, ancestry, evolution, evolutionary, genetic, relative, rock layer.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">For this performance expectation, the phenomena are sets of data. Those are the observed facts that the students will look at to discover patterns. Below, we enumerate some of the patterns that might comprise the data sets (phenomena) to be analyzed.

Some example phenomena for 3-LS4-1:
• Fossil trees are found in sedimentary rocks in Antarctica.
• The Redwall Limestone in the Grand Canyon contains many different fossils including corals, clams, octopi, and fish.
• Whale fossils have been found in rocks in the Andes Mountains.
• Fossils of corals and snails are found in Iowa.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
</table>

1. Organize or summarize data to highlight trends, patterns, or correlations between plant and animal fossils and the environments in which they lived.
2. Generate graphs or tables that document patterns, trends, or correlations in the fossil record.
3. Identify evidence in the data that supports inferences about plant and animal fossils and the environments in which they lived.

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS4-2
Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.</td></tr>
<tr><td>Dimensions</td><td>Constructing Explanations and Designing Solutions
• Use evidence (e.g., observations, patterns) to construct an explanation.</td><td>LS4.B: Natural Selection
• Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.</td><td>Cause and Effect
• Cause and effect relationships are routinely identified and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
Examples of cause and effect relationships could be: plants that have larger thorns than other plants may be less likely to be eaten, and animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.
Content Limits
Differences between individuals helping or hurting chances of survival and reproduction should be included.
Data sets can include not only common trends but also outliers and anomalous data points.
Analysis of data should be limited to patterns and trends.
Students are not expected to evaluate the extent at which the sample is representative of a population.
<u>Students do not need to know</u>: Mechanisms or patterns of inheritance, detailed life cycles.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Natural and artificial selection, evolution, genetics, adaptation.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-LS4-2:
The same species of walking stick in California has two different color variations. The green walking sticks are found on bushes with thick green leaves, whereas the striped walking sticks are found on bushes with needle-like leaves.
In a given population, there are more male [X Bird] with larger, brighter feathers in the population than males with smaller, muted feathers.
Acacia trees that are browsed upon by X animal grow longer thorns at X height. Acacia trees that are browsed upon by Y animal grow longer thorns at Y height. Acacia trees that are not browsed upon at all do not grow longer thorns.
Io moths use eyespots on their inner wings to frighten predators away. Larger eyespots are more effective.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Articulate, describe, illustrate, or select the variations of characteristics to be explained. This may entail sorting relevant from irrelevant information or features.</td></tr>
<tr><td colspan="4">2. Identify evidence supporting the conclusion that the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.</td></tr>
<tr><td colspan="4">3. Describe, identify, and/or select information needed to support an explanation that a characteristic provides advantages in surviving and reproducing.</td></tr>
</table>

4.	Select or identify a prediction about survival or reproduction rates given a change in a characteristic. The prediction should follow from an explanation or causal relationship supported in earlier items.
5.	Identify additional evidence that would help clarify, support, or contradict a hypothesized relationship between characteristics of individuals and their chances of survival and reproductive rates.
6.	Express or complete a causal chain that explains how different characteristics among individuals of the same species provide advantages in survival and reproduction. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram or completing cause and effect chains.***(SEP/DCI/CCC)**
7.	Use evidence to construct an explanation for differences in survival and/or reproduction given a difference in traits between individuals of the same species. *(**SEP/DCI/CCC)**

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS4-3
Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.</td></tr>
<tr><td>Dimensions</td><td>Engaging in Argument from Evidence
• Construct an argument with evidence.</td><td>LS4.C: Adaptation
• For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.</td><td>Cause and Effect
• Cause-and-effect relationships are routinely identified and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.

Content Limits
• While students are not expected to know the definitions to vocabulary terms such as extinction, climate, and mimic, they are expected to know the general concepts behind these terms.
• <u>Students do not need to know:</u> mechanisms of natural selection and evolution of species.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Organism, threaten, impact, terrestrial, climate change, response, body plan, external, function, internal, invertebrate, adaptation, beneficial change, detrimental change, species diversity, gene, variation, artificial selection, natural selection.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-LS4-3:
• Desert plants are able to survive where there is little to no rain.
• Black bears survive the harsh winter months of their forest habitats by going into a deep sleep.
• The artic fox is better able to survive in colder climates than the red fox.
• Emperor penguins have special traits which help them survive in Antarctica.
• Compared to alligators, crocodiles can inhabit saltier water environments.
• African elephants can survive in hotter climates than Asian elephants.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Organize or summarize data to highlight trends, patterns, and/or determine relationships between the traits of an organism and survival in its environment.</td></tr>
<tr><td colspan="4">2. Understand and generate simple bar graphs or tables that document patterns, trends, or relationships between traits of an organism and its survival in a particular environment.</td></tr>
<tr><td colspan="4">3. Identify patterns or evidence in the data that supports inferences about characteristics of an organism and those of its environment.</td></tr>
<tr><td colspan="4">4. Based on the provided data, identify or describe a claim regarding the relationship between the characteristics of an organism and survival in a particular environment. *(SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">5. Evaluate the evidence to sort relevant from irrelevant information regarding survival of an organism in a particular environment.</td></tr>
</table>

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<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS4-4
Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.</td></tr>
<tr><td>Dimensions</td><td>Engaging in Argument from Evidence
• Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.</td><td>LS2.C: Ecosystem Dynamics, Functioning, and Resilience
• When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary)

LS4.D: Biodiversity and Humans
• Populations live in a variety of habitats, and change in those habitats affects the organisms living there.</td><td>Systems and System Models
• A system can be described in terms of its components and their interactions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.

Content Limits
• Assessment is limited to a single environmental change.
• Assessment does not include the greenhouse effect or climate change.
• Students do not need to know: greenhouse effect, ultraviolet (UV) radiation, nuclear disasters.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Ecosystem, biotic, abiotic, food web, producer, consumer, decomposer, photosynthesis, pollinate, adapt, energy flow, biosphere, sustain, predation, mutualism, carrying capacity, volcano, earthquake, drought, arid, blight.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-LS4-4
• A riverbank covered in milkweed eroded after strong rainstorms, causing part of the riverbank to fall into the river. The remaining land was bare with no plants. Prior to the storms, Monarch butterflies were present by the river, but they were not seen once the milkweed was gone.
• To help ornamental bushes grow, no other plants should grow in their immediate vicinity.
• Before stocking a lake with fish, the lake pollution needs to be reduced.
• A late frost threatens the orange groves in Georgia.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Articulate, describe, illustrate, or select the relationships, interactions, and/or processes involved when the types of plants and/or animals change as a result of environmental changes. This may entail sorting relevant from irrelevant information or features.</td></tr>
</table>

2.	Identify a problem that results when the types of plants and/or animals change as a result of environmental changes.
3.	Express or complete a causal chain explaining a solution to problem that results when the types of plants and/or animals change as a result of environmental changes. The causal chain should include the ecosystem before the environmental change, the environmental change, the problem to plants and animals resulting from the environmental change, the solution to the problem, and the effect(s) of the solution on the ecosystem. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram, or completing cause-and-effect chains. ***(SEP;DCI;CCC)**
4.	Identify and/or evaluate evidence related to a solution to a problem caused when the types of plants and/or animals change as a result of environmental changes. The evidence may support or refute the solution, or students may identify missing evidence.
5.	Evaluate a solution to a problem that results when the types of plants and/or animals change as a result of environmental changes, including how the solution may affect plants, animals, and/or other aspects of the ecosystem. ***(SEP;DCI;CCC)**
6.	Identify information or data needed to support or refute a claim regarding a problem resulting from an environmental change affecting the native plants and animals.

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-ESS2-1
Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.</td></tr>
<tr><td>Dimensions</td><td>Analyzing and Interpreting Data
• Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.</td><td>ESS2.D: Weather and Climate
• Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.</td><td>Patterns
• Patterns of change can be used to make predictions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of data could include average temperature, precipitation, and wind direction.

Content Limits
• Assessment of graphical displays is limited to pictographs and bar graphs.
• Assessment does not include climate change.
• <u>Students do not need to know:</u> probabilities or how to calculate them, fronts and pressure systems, the movements of weather systems.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Climate change, probability, anthropogenic change, latitude, longitude.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-ESS2-1:
• Vienna, Austria, records more sunny days in the summer than in the winter. Data: Average sunshine hours by month for the city, given as a table or graph.
• People in Florida can often go outside without jackets during the winter. Data: Months and Temperatures for Florida, given as table or graph.
• Visitors to the desert in Death Valley, California, were surprised to be rained on. Data: Months and Precipitation Averages for the region given as table or graph.
• Flags in California’s San Joaquin Valley are seen blowing to the SE for most of the year, but are seen blowing to the NW in winter months. Data: Monthly average wind direction (and maybe speed) for the region, given as a table or graphic with wind direction arrows.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Organize and/or arrange (e.g., using illustrations and/or labels), or summarize data to highlight trends, patterns, or correlations in weather patterns.* (SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">2. Generate/construct graphs, tables, or assemblages of illustrations and/or labels of data that document patterns, trends, or correlations in weather patterns. This may include sorting out distractors.* (SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">3. Use relationships and patterns identified in the data to predict weather.</td></tr>
<tr><td colspan="4">4. Identify patterns or evidence in the data that support conclusions about weather. **</td></tr>
</table>

*denotes those task demands which are deemed appropriate for use in stand-alone item development.

**TD4 can be used for stand-alone item development if paired with TD2.

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-ESS2-2
Obtain and combine information to describe climates in different regions of the world.</td></tr>
<tr><td>Dimensions</td><td>Obtaining, Evaluating, and Communicating Information
• Obtain and combine information from books and other reliable media to explain phenomena.</td><td>ESS2.D: Weather and Climate
• Climate describes a range of an area’s typical weather conditions and the extent to which those conditions vary over years.</td><td>Patterns
• Patterns of change can be used to make predictions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Content Limits
• Students do not need to know: complex interactions that cause weather patterns and climate, the role of the water cycle in weather.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Average, high/low pressure, air mass, altitude, humidity, radiation, water cycle.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-ESS2-2:
• Anchorage, Alaska has cool summers and very cold winters with a lot of snowfall.
• It often snows in Colorado in July, but it does not often snow in Kansas in July.
• On the western side of the Cascade Mountains of Oregon, it rains frequently, but on the eastern side, it does not.
• The temperature in London, England does not get very hot in summer or very cold in winter. (Will use Auckland as key for prediction; both are oceanic/maritime Cfb climates.)</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Organize and/or arrange data (including labels and symbols) regarding the climates in different regions to highlight/identify trends or patterns, or make comparisons/contrasts between different regions and/or climatically relevant aspects of their geology and/or geography.* (SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">2. Generate or construct tables or assemblages of data (including labels and symbols) that document the similarities and differences between climates of different regions (this includes completing incomplete maps).</td></tr>
<tr><td colspan="4">3. Analyze and interpret scientific evidence (including textural and numerical information as well labels and symbols) from multiple sources (e.g., texts, maps, and/or graphs) that help identify patterns in weather in regions of different climate. This includes communicating the analysis or interpretation.* (SEP/DCI)</td></tr>
<tr><td colspan="4">4. Analyze and interpret patterns of information on maps (including textural and numerical information as well labels and symbols) to explain, infer, or predict patterns of weather over time in a region. * (SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">5. Based on the information that is obtained and/or combined, identify, assert, describe, or illustrate a claim regarding the relationship between the location of a region and its climate, or the relationship between geological and/or geographical aspects/characteristics of a region and its climate. * (SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">6. Use spatial and/or temporal relationships identified in the obtained and/or combined climate data to predict typical weather conditions in a region.</td></tr>
<tr><td colspan="4">7. Organize and/or arrange data regarding the climate of a region to highlight/identify trends or relationships between the weather patterns of a region and its geology and/or geography.</td></tr>
<tr><td colspan="4">8. Analyze and interpret scientific evidence (including textural and numerical information as well labels and symbols) from multiple sources (e.g., texts, maps, and/or graphs) that helps identify patterns in climate based on geography and/or geology. This includes communicating the analysis or interpretation.</td></tr>
</table>

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-ESS3-1
Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.</td></tr>
<tr><td>Dimensions</td><td>Engaging in Argument from Evidence
• Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.</td><td>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. (Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)</td><td>Cause and Effect
• Cause-and-effect relationships are routinely identified, tested, and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Assessment Clarifications
• Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lighting rods.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Fault line, names of clouds/storms, magma, types of volcanoes, low/high pressure systems, El Niño, La Niña, jet stream.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Phenomena should refer to hazard and design solution.

Some example phenomena for 3-ESS3-1:
• A building with a lightning rod is struck by lightning more often than the surrounding buildings.
• When the water level of the Feather River was high in February 2017, the water never rose higher than the levees around it, and no flooding occurred. When the water level of the Russian River was high in February 2017, the surrounding area flooded.
• A house built near the ocean in Surfside, New Jersey, sits on stilts/posts.
• A basement in a building fitted with a sump pump does not have mold while the basements of other nearby buildings have mold.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify or assemble from a collection, including distractors, the relevant aspects of the hazard that a given design solution resolves/improves.</td></tr>
<tr><td colspan="4">2. Using the given information, select or identify the criteria against which the design solution should be judged.</td></tr>
<tr><td colspan="4">3. Using given information, select or identify constraints that the design solution must meet.</td></tr>
<tr><td colspan="4">4. Identify missing components, relationships, or other limitations of the design solution.</td></tr>
<tr><td colspan="4">5. Use an explanation to predict the outcome of a hazard given a change in the design solution.</td></tr>
<tr><td colspan="4">6. Make a claim about the merit of the design solution that can be defended.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-PS3-1
Use evidence to construct an explanation relating the speed of an object to the energy of that object.</td></tr>
<tr><td>Dimensions</td><td>Constructing Explanations and Designing Solutions
• Use evidence (e.g., measurements, observations, patterns) to construct an explanation.</td><td>PS3.A: Definitions of Energy
• The faster a given object is moving, the more energy it possesses.</td><td>Energy and Matter
• Energy can be transferred in various ways and between objects.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Content Limits
• Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.
• Students are expected to know that energy can be expressed through sound, heat, light, and motion.
• <u>Students do not need to know:</u> Students do not need to know how to calculate speed, the change in speed (acceleration), or energy. This standard is limited to making strictly qualitative or comparative observations.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Potential energy, kinetic energy, thermal energy, acceleration, velocity.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-PS3-1:
• Craters on the moon vary greatly in size.
• One drum can be used to produce loud or quiet percussion sounds.
• A small bouncing basketball sounds louder than a large bouncing basketball.
• Damage caused during a high-speed collision is greater than when speeds are slower.
• A ceramic bowl dropped from a greater height will have a larger debris pattern.
• Similar water balloons can create different-sized splashes when they break.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Articulate, describe, illustrate, or select the relationships, interactions, and/or processes to be explained. This may entail sorting relevant from irrelevant information or features. *(DCI/SEP)**</td></tr>
<tr><td colspan="4">2. Express or complete a causal chain explaining that changes in energy and speed are related. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram, or completing cause-and-effect chains. *(DCI/SEP)</td></tr>
<tr><td colspan="4">3. Identify evidence supporting the inference of causation that is expressed in a causal chain.</td></tr>
<tr><td colspan="4">4. Use an explanation to predict how the speed of an object changes given a change in energy or how the expression of energy will change given a change in speed.</td></tr>
<tr><td colspan="4">5. Describe, identify, and/or select information needed to support an explanation.</td></tr>
</table>

*denotes those task demands which are deemed appropriate for use in stand-alone item development
**TD 1 should only be used if paired with TD2. TD 2 can be used alone.

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-PS3-2
Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</td></tr>
<tr><td>Dimensions</td><td>Planning and Carrying Out Investigations
• Make observations to produce data to serve as the basis for evidence for an explanation of a phenomena or to test a design solution.</td><td>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.</td><td>Energy and Matter
• Energy can be transferred in various ways and between objects.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Content Limits
• Assessment does not include quantitative measurements of energy.
• Identifying how energy is transferred (example: conduction vs. convection) is not part of this PE.
• <u>Students do not need to know</u>: Students do not need to know how to do energy calculations. This standard is limited to strictly making observations. Students should know that energy can be given off as heat or light, but not specifics such as convection, thermal radiation, etc.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Kinetic energy, potential energy, radiation, convection, transmission, reflection, decibels, resonance, friction, hertz, electromagnetic radiation, magnitude, motion energy, electric circuit, thermal, conservation of energy.</td></tr>
<tr><td colspan="4" align="center">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-PS3-2:
• A light bulb can be powered using the motion of a hamster wheel.
• A drinking glass can be broken by a person singing a certain note.
• An ice cube melts faster on darker colored paper than on lighter colored paper.
• A fan (with blades angled at 45 degrees) will spin when placed safely over burning candles.
• If the handle of a cooking pot is metal it will get hot, while if its rubber it will not.
• Touching a Van der Graaf generator will make your hair stick up.</td></tr>
<tr><td colspan="4" align="center">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4" align="center">Task Demands</td></tr>
</table>

1.	Identify the materials/tools needed for an investigation of how energy is transferred from place to place through heat, sound, light, or electric currents.
2.	Identify the data that should be collected in an investigation of how energy is transferred from one place to another through heat, sound, light, or electric currents.
3.	Make and/or record observations about the transfer of energy from one place to another via heat, sound, light, or electric currents. *** (SEP/DCI/CCC)**
4.	Interpret and/or communicate the data from an investigation. *** (SEP/DCI/CCC)**
5.	Select, describe, or illustrate a prediction made by applying the findings from an investigation.

*denotes those task demands which are deemed appropriate for use in stand-alone item development
**TD3 and TD4 <u>must be</u> used together.

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-PS3-3
Ask questions and predict outcomes about the changes in energy that occur when objects collide.</td></tr>
<tr><td>Dimensions</td><td>Asking Questions and Defining Problems
• Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.</td><td>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 objects' motions.</td><td>Energy and Matter
• Energy can be transferred in various ways and between objects.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.

Content Limits
• Assessment does not include quantitative measurements of energy.
• <u>Students do not need to know</u>: names of energy types, how to calculate energy or forces</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Kinetic energy, potential energy, friction, force fields, vector, magnitude, elastic, inelastic.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-PS3-3:
• A large wave crashes into the cliffs of Étretat and some rocks are knocked loose. A small wave then crashes into the cliffs.
• A person hits a nail with a hammer and the nail is driven into a board. The person swings the hammer again, but misses the nail.
• A person walks down a hallway. The sound of their shoes on the floor can be heard many feet away. The person then runs down the hallway.
• A bowler rolls a ball down a lane. It slams into the pins and knocks several of them down. After the pins are reset, the bowler rolls the ball down the lane again. The ball misses and knocks down no pins.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Select or identify from a collection, including distractors, questions that will help clarify the properties that are correlated with the changes in energy that occur in the phenomenon. In addition to distractors that are plausible responses, distractors may include non-testable ("nonscientific") questions.</td></tr>
<tr><td colspan="4">2. Identify, describe, or select from a collection, including distractors, characteristics to be manipulated or held constant while gathering information to answer a well-articulated question.</td></tr>
</table>

3. Select or describe conclusions relevant to the question posed and supported by the data, especially conclusions about causes and effects.
4. Predict outcomes when properties or proximity of the objects are changed, given the inferred cause-and-effect relationships.
5. Describe, identify, gather, and/or select information needed to identify patterns that can be used to predict outcomes about the changes in energy.

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-PS3-4
Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.</td></tr>
<tr><td>Dimensions</td><td>Constructing Explanations and Designing Solutions
• Apply scientific ideas to solve design problems.</td><td>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 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.

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
• Possible solutions to a problem are limited by 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.</td><td>Energy and Matter
• Energy can be transferred in various ways and between objects.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.

Content Limits
• Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Mass, net force, velocity, relative position, constant speed, direction of motion, direction of a force, deceleration, independent, economic, control, impact, inertia, Newton’s laws (1st, 2nd, 3rd), stationary, frame of reference, potential energy, mechanical energy, kinetic energy, conserve, motion energy, relative, chemical energy.</td></tr>
<tr><td colspan="4" align="center">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Engineering practices are built around meaningful design problems rather than phenomena; so for this standard, a design problem and associated competing solutions will replace phenomena.

Some examples of design problems for 4-PS3-4:
• A front door does not have an alarm. Any alarm that is added needs to be heard in the back hallway.
• A person hiking on a hot day needs to take a fan to stay cool. The fan must be small so that it does not add to the weight of the hiker’s pack but must also last the entire hike.
• The water in a house is heated with electricity purchased from a power company. A decision is made to instead heat the water using electricity generated with solar panels on the roof. The water heater must heat enough water to meet the needs of the home but the cost of installation and/or maintenance cannot exceed the family’s budget.</td></tr>
</table>

	• A motor is added to a toy car for a race. The motor must be able to move the car across a room at a high speed.

This Performance Expectation and associated Evidence Statements support the following Task Demands.
Task Demands
1. Express or complete a causal chain explaining how energy can be transferred via electric current to produce light, sound, heat, and/or motion. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram, or completing cause-and-effect chains.
2. Identify evidence supporting the inference of causation that is expressed in a causal chain.
3. Use an explanation to predict how the motion, sound, heat, or light of an object changes, given a change in electrical energy—or, how the expression of energy will change, given a change in the conversion of stored energy.
4. Identify or assemble from a collection, including distractors, the relevant aspects of the problem that given design solutions, if implemented, will resolve/improve. The design solution must convert energy from one form to another within the content limits.
5. Using given information, select or identify constraints that the device that converts energy from one form to another must meet OR criteria against which it should be judged.
6. Using given information, design, propose, illustrate, assemble, test, or refine a potential device (prototype) that converts energy from one form to another.

<table>
<tr><td>Performance Expectation</td><td colspan="3">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.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models
• Develop a model using an analogy, example, or abstract representation to describe a scientific principle.</td><td>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 (spacing between wave peaks).</td><td>Patterns
• Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.
• Acceptable clusters may include: amplitude and wavelength, motion of an object, or both.

Content Limits
• Limited to physically visible mechanical waves.
• Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.
• Examples of objects being moved by waves are limited to up and down motion. Horizontal motion is above grade level due to the other factors involved.
• Don’t directly reference energy. Energy is addressed in 4-PS3.
• <u>Students do not need to know</u>:
○ Types of waves: sound, light, non-periodic, compression
○ Particle movement
○ Quantitative models
○ Behaviors of waves: absorption, reflection, refraction, transmission, interactions with different materials (angle of incidence, amount of reflection or absorption, light being refracted into colors). Reflection is limited to the concept. How waves are reflected and the details of reflection (as well as other behaviors) are covered in MS-PS4-2.
○ Wave calculations
○ Motion of objects in the ocean due to ocean currents</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Electromagnetic, non-periodic, compression, particle, transmission, seismic wave, radio wave, microwave, infrared, ultraviolet, gamma rays, x-rays, angle of incidence, concave, convex, diffraction, constructive interference, destructive interference, resonance, refraction, absorption, reflection, pitch, sound wave, light wave.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-PS4-1:
• A boat floating in the ocean is tied to a pier. The boat rises and falls with the waves.
• Two students hold ends of a rope. One student lifts her end, and then drops it toward the ground. The rope forms a wave that travels from that student to the other student.
• The sand waves on a windy beach get bigger and more pronounced over time. They are regular and evenly spaced.</td></tr>
</table>

<table>
<tr><td></td><td>A surfer riding a wave stays up if she moves along the wave but falls as soon as she stops moving.</td></tr>
<tr><td colspan="2">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="2">Task Demands</td></tr>
<tr><td colspan="2">1. Select or identify the components of a model that are needed to describe wave behavior, patterns of wave creation, and/or the motion of objects carried on/by waves. Components might include the source, amplitude, frequency, and/or wavelength.</td></tr>
<tr><td colspan="2">2. Manipulate the components of a model to demonstrate properties, processes, and/or events that result in the patterns of wave behavior that are identified in the phenomenon. These patterns of wave behavior can include creation and replication of waves.</td></tr>
<tr><td colspan="2">3. Describe, select, or identify the relationships among components of a model that describe wave behavior, patterns of wave creation, and/or the motion of objects carried on or by a wave.</td></tr>
<tr><td colspan="2">4. Given a model of waves, illustrate the way in which the wave changes to yield a given result (more movement, less movement) and/or identify the result based on changes to the wave.</td></tr>
<tr><td colspan="2">5. Make predictions about the effects of changes in model components (e.g., energy of wave source, distance from wave source), the amplitude or wavelength of a wave, or motion of objects affected by the wave. Item writer: Do not directly reference the energy of the wave source. Instead, show the speed and size of the object causing the wave, etc.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-PS4-2
Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models
• Develop a model to describe phenomena.</td><td>PS4.B: Electromagnetic Radiation
• An object can be seen when light reflected from its surface enters the eyes.</td><td>Cause and Effect
• Cause-and-effect relationships are routinely identified.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Content Limits
• Assessment does not include:
o knowledge of specific colors reflected and seen;
o the cellular mechanisms of vision;
o how the retina works.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Particle, transmission, angle of incidence, angle of reflection, concave, convex, diffraction, constructive interference, destructive interference, refraction, absorption, wave, field, illuminate, diffuse reflection, specular reflection, spectrum, prism.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-PS4-2:
• A person can see a cat in the mirror. The cat is otherwise hidden from view.
• A performance is being watched by a person. Another person stands up and blocks the view.
• A flashlight is pointed at a door in a dark room. The door is the only object seen in the room.
• The moon is seen at night.
• The surface of a lake is very still. The reflection of a tree on the bank can be seen on the lake's surface.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify the components needed to model the phenomenon. Components might include the light, the light source, the object, the path the light follows, and the eye.</td></tr>
<tr><td colspan="4">2. Complete an illustration or flow chart that is capable of representing how light reflecting from objects and entering the eye allows objects to be seen. This <u>does not</u> include labeling an existing diagram.</td></tr>
<tr><td colspan="4">3. Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon.</td></tr>
<tr><td colspan="4">4. Make predictions about the effects of changes in the model, particularly using mirrors, changing positions of light sources, objects, and the eye.. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors.</td></tr>
<tr><td colspan="4">5. Identify missing components, relationships, or other limitations of the model.</td></tr>
<tr><td colspan="4">6. Describe, select, or identify the relationships among components of a model that describe how light reflecting from objects and entering the eye allows objects to be seen.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-PS4-3
Generate and compare multiple solutions that use patterns to transfer information.</td></tr>
<tr><td>Dimensions</td><td>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.</td><td>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—convert 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.</td><td>Patterns
• Similarities and differences in patterns can be used to sort and classify designed products.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of solutions could include:
    • drums sending coded information through sound waves;
    • using a grid of 1’s and 0’s, representing black and white, to send information about a picture;
    • using Morse code to send text.

Content Limits
• Students do not need to know:
    o the different parts of the electromagnetic spectrum (visible, microwave, x-ray, radio wave, etc.);
    o binary coding or how it works;
    o that light is made up of an electric and magnetic field;
    o transverse vs. longitudinal waves;
    o how information gets encoded;
    o how different forms of communicating information work (Morse code vs. something like a telephone).</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Amplitude, light emission, light refraction, transmit, wavelength, wave peaks, light wave, electromagnetic, frequency, radiation, wave packet, light scattering, light transmission, electric field, magnetic field, photon, radio wave, x-ray, binary, electron, pixel, CCD, transverse, longitudinal.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-PS4-3:
• In July 2015, the New Horizons Space Probe flew past Pluto. The space probe is tasked with taking detailed pictures of Pluto so that scientists on Earth can study its features. However, the spacecraft can only send sequences of numbers back to Earth.
• A man wants to send an urgent message to his wife who is a long distance away. It would take too long to drive to his wife and deliver the message himself. The only way he can communicate is through an electrical wire that is set up between the two locations.
• Two people want to communicate a number 1 through 10 over a large distance. They have no telephones or other means of communication. They are close enough that they can see or hear each other, however, a river separates them so they cannot reach each other.
• Two people want to communicate over a large distance. However, the power is out and so they cannot use the telephone. All they have is a string that is stretched between their</td></tr>
</table>

	two houses. Attached to the end of each string is a metal can. The messages they want to be able to send consists of numbers 1 through 10.

This Performance Expectation and associated Evidence Statements support the following Task Demands.
Task Demands
1. Articulate, describe, illustrate, or select the relationships, interactions, and/or processes to be explained. This may entail sorting relevant from irrelevant information or features.
2. Express or complete a causal chain explaining how each pattern is used to transmit information. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram, or completing cause-and-effect chains.
3. Identify evidence supporting the inference of causation that is expressed in a causal chain.
4. Use an explanation to compare the two solutions and select which one is better for the transmitting of information.
5. Describe, identify, and/or select information needed to support an explanation.

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-LS1-1
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.</td></tr>
<tr><td>Dimensions</td><td>Engaging in Argument from Evidence
• Construct an argument with evidence, data, and/or a model.</td><td>LS1.A: Structure and Function
• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.</td><td>Systems and System Models
• A system can be described in terms of its components and their interactions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.

Content Limits
• Assessment is limited to macroscopic structures within plant and animal systems.
• The student does not need to know about cellular structures like the nucleus, mitochondria, the Golgi apparatus or the endoplasmic reticulum.
• The student does not need to know: about organ systems like the circulatory system, reproductive system, or nervous system.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Cell, detect, response, body plan, circulatory system, digestive system, elastic, excretory system, external, intellectual, internal, invertebrate, muscular system, nervous system, organ, reproductive system, vertebrate, multicellular, stimulus, tissue, enzyme, xylem, phloem, parenchyma, and cambium cells.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-LS1-1:
• In a field of grass, a butterfly lands on one of the only red poppy flowers in sight.
• A manta ray has a flat circular body. Its fins spread out like wings from its body.
• A pelican can hold up to 3 gallons of water in its pouch.
• A student sees a hollow, brown copy of a cicada insect attached to the bark of a tree.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify evidence or patterns in the data that support inferences and/or determine relationships between a particular structure of an organism and a function that supports survival, growth, behavior, and reproduction.</td></tr>
<tr><td colspan="4">2. Understand and generate simple bar graphs or tables to document patterns, trends, or relationships between a particular structure of an organism and a function that supports survival, growth, behavior, and reproduction.</td></tr>
<tr><td colspan="4">3. Sort observations/evidence into those that appear to support or not support an argument.</td></tr>
<tr><td colspan="4">4. Based on the provided data, identify or describe a claim regarding the relationship between a structure of an organism and a function that supports survival, growth, behavior, and reproduction.</td></tr>
<tr><td colspan="4">5. Summarize or organize given data or other information to support or refute a claim regarding an organism’s structure and its function.</td></tr>
<tr><td colspan="4">6. Sort, tabulate, classify, separate, and/or categorize relevant from irrelevant information regarding an organism’s structure and its function.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">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.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models
• Use a model to test interactions concerning the functioning of a natural system.</td><td>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.</td><td>Systems and System Models
• A system can be described in terms of its components and their interactions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Emphasis is on systems of information transfer.

Content Limits
• Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Sensory, brain, cells, retina, pupil, saliva, salivary gland, vibration, cornea, iris, brainstem, consumer, nerve, optic nerve, nerve cell, nerve tissue, nerve impulse, connecting nerve, nerve fiber, organ system, reflex, reflex action, reaction time, cue.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-LS1-2:
• A bear cub in the woods cries out. Its mother immediately runs toward it.
• A deer walks in the woods. It turns suddenly and moves off in a different direction. A few minutes later, a skunk appears from the bushes.
• A cat sits on a stone wall. A mouse appears at the base of a nearby tree. The cat springs after the mouse.
• A hawk flies overhead. Suddenly, it dives toward the tall grass. A moment later, it returns to the sky, a snake in its claws.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Select or identify from a collection of potential model components the components needed to model the phenomenon. Components might represent organ systems or parts of a system needed for collection and/or processing of sensory information.</td></tr>
<tr><td colspan="4">2. Assemble or complete, from a collection of potential model components, an illustration or flow chart that is capable of representing the flow and/or processing of sensory information in an animal. This does not include labeling an existing diagram.</td></tr>
<tr><td colspan="4">3. Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon. *(SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">4. Given models or diagrams of the flow and/or processing of sensory information in an animal, identify responses to sensory inputs and how they change in each scenario OR identify the properties of organs and/or organ systems that allow animals to respond to sensory information. *(SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">5. Identify missing components, relationships, or other limitations of a model that shows the flow and/or processing of sensory information in an animal.</td></tr>
</table>

6. Describe, select, or identify the relationships among components of a model that describe how sensory information is processed or explain how an animal responds to sensory inputs.

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">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.</td></tr>
<tr><td>Dimensions</td><td>Constructing Explanations and Designing Solutions
• Identify the evidence that supports particular points in an explanation.</td><td>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.</td><td>Patterns
• Patterns can be used as evidence to support an explanation.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statement
• Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time, and a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.

Content Limits
• Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers.
• Assessment is limited to relative time.
• Excludes earthquakes—the clarification statement focuses on geomorphology and landscape change through time. The focus is not on tectonics, despite its mention in the DCI.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Rock strata, ocean basins, glaciation, watersheds, geological, mountain chains, igneous rock, metamorphic rock, sedimentary rock, terrestrial, aquatic.</td></tr>
<tr><td colspan="4" align="center">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Sample phenomena for 4-ESS1-1:
• The rock walls on both sides of the Grand Canyon contain layers with marine fossils, interspersed with layers containing terrestrial fossils.
• Church Rock, New Mexico, is a very dry place far from the sea. However, exposures of rocks in the area contain many fossils of marine organisms.
• Axel Heiberg Island in the Canadian Arctic is too cold for trees to grow. However, sedimentary rocks on the island preserve hundreds of fossil stumps from large evergreen trees.
• Sihetun, China, is dry and mountainous. Sedimentary rocks exposed in the area preserve thousands of fish fossils. These sedimentary rocks are sandwiched between lava flow rocks. There are no active volcanoes in this part of China.</td></tr>
<tr><td colspan="4" align="center">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4" align="center">Task Demands</td></tr>
<tr><td colspan="4">1. Describe, identify, and/or select evidence from patterns of rock formations and/or patterns of fossils in rock layers to support the explanations of changes in the landscape over time.</td></tr>
<tr><td colspan="4">2. Express or complete a causal chain explaining changes in patterns of fossils in rock layers.</td></tr>
<tr><td colspan="4">3. Identify patterns of rock formations and/or patterns of fossils in rock layers.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">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.</td></tr>
<tr><td>Dimensions</td><td>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.</td><td>ESS2.A: Earth Materials and Systems
• 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.</td><td>Cause and Effect
• Cause and effect relationships are routinely identified, tested, and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statement
• Examples of variables to test could include: angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.

Content Limits
• Students aren’t expected to know the flow of energy that causes the phenomena.
• Assessment is limited to one form of erosion.
• Assessment does not include chemical erosion.
• Students do not need to know: Sedimentation, Earth’s interior, crystallization, minerals, the rock cycle, dynamic forces, feedback interactions, constructive forces, or deformation.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Composition, slope, continental boundaries, trench, minerals, plate tectonics, topography.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-ESS2-1:
• Rocks in the bottom of a river are usually smooth, but the rocks sitting on the ground nearby often have sharp edges and corners.
• Near its start in Colorado, the bed of the North Platte River is covered with boulders. Some five hundred miles away in Nebraska, the bed of the river is mostly sand.
• New gullies appear in a gravel driveway after a heavy rain.
• Over the course of a summer there is a series of major storms. At the end of the season, the channel of a small stream running through a grassy park is significantly wider than it was before the storms.
• An asphalt road runs past a very large tree. Next to the tree the pavement is lifted and cracked.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify the factors that affect weathering or the rate of erosion by water, ice, wind, or vegetation.</td></tr>
<tr><td colspan="4">2. Identify from a list the materials/tools needed for an investigation of how wind affects the factors that affect weathering or the rate of erosion by water, ice, wind, or vegetation.</td></tr>
<tr><td colspan="4">3. Identify, among distractors, the outcome data that should be collected in the investigation.</td></tr>
<tr><td colspan="4">4. Make and/or record observations about how input factors affect relevant outcomes while using fair tests in which variables are controlled.* (SEP/DCI/CCC)</td></tr>
</table>

5. Make or communicate the conclusions from the investigation. Conclusions will be causal relationships.**

*denotes those task demands which are deemed appropriate for use in stand-alone item development

**TD5 can be used ONLY if used in concert with TD4

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-ESS2-2
Analyze and interpret data from maps to describe patterns of Earth’s features.</td></tr>
<tr><td>Dimensions</td><td>Analyzing and Interpreting Data
• Analyze and interpret data to make sense of phenomena using logical reasoning.</td><td>ESS2.B: Plate Tectonics and Large-Scale System Interactions
• The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes appear 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.</td><td>Patterns
• Patterns can be used as evidence to support an explanation.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Maps can include topographic maps of Earth’s land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.

Content Limits
• <u>Students do not need to know:</u> the tectonic processes that form Earth’s features.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Geologic, impact, magnitude, frequency, sediment deposition, ancient, ocean basin, rock layer movement, formation, continental shelf, deform, density, tectonic process, distribution, oceanic crust, plate boundary/collision, seafloor spreading.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">For this performance expectation, the phenomena are the patterns of features on maps that the student examines. These patterns can sometimes be described with simple statements as shown below, but the actual phenomenon in each case is the pattern on the map. If descriptive statements are used, writers must be careful not to give the pattern or the point of the cluster away to the student.

Some example phenomena for 4-ESS2-2:
• There are active volcanoes in Alaska. There are no active volcanoes near Buffalo, New York. (If this statement were to be used to describe the map, then the students task would have to be something more than simply pointing out that there are volcanoes in Alaska and none near Buffalo, such as figuring out that Alaska is closer to a tectonic plate boundary than is New York.)
• Earthquakes occur often in western South America. Earthquakes almost never occur on the eastern side of the continent. (If this statement were to be used to describe the map, then the student’s task would have to be something more than simply pointing out that there are earthquakes on the eastern side more often than the western, such as figuring out that a plate boundary lies along the eastern coast of South America.)
• Many volcanoes are found in a ring around the Pacific Ocean. There are fewer found on the edges of the Atlantic Ocean. (If this statement were to be used to describe the map, then the students task would have to be something more than simply pointing out that there are many volcanoes around the Pacific and few around the Atlantic, such as figuring out that tectonic plate boundaries surround the Pacific Ocean.)
• There are no mountain ranges in Kansas. There are many mountains in Washington State. (If this statement were to be used to describe the map, then the students task would have to be something more than simply pointing out that there are mountains in Washington and none in Kansas, such as figuring out that Washington is closer to a tectonic plate boundary than Kansas.)</td></tr>
</table>

This Performance Expectation and associated Evidence Statements support the following Task Demands.
Task Demands
1. Organize, arrange, or summarize map data and/or symbols to highlight/describe patterns of geological features on Earth's surface. **
2. Generate/construct graphs, tables, or assemblages of illustrations and/or labels, of map data that document patterns of geological features on Earth's surface. This may include sorting out distractors. ***(SEP/DCI/CCC)**
3. Use relationships identified in the presented map data to predict the location of geological features on Earth's surface, such as mountain ranges, volcanoes, earthquake foci, and deep ocean trenches. ***(SEP/DCI/CCC)**
4. Identify evidence or patterns in map data that support inferences about the patterns of geological features on Earth's surface. ***(SEP/DCI/CCC)**

*denotes those task demands which are deemed appropriate for use in stand-alone item development
**TD1 may be used in combination with 2, 3, or 4 for stand-alone development.

<table>
<tr><td>Performance Expectation</td><td colspan="3">4-ESS3-1
Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment</td></tr>
<tr><td>Dimensions</td><td>Obtaining, Evaluating, and Communicating Information
• Obtain and combine information from books and other reliable media to explain phenomena</td><td>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.

OR

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.</td><td>Cause and Effect
• Cause and effect relationships are routinely identified and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of renewable energy resources could include:
o Wind energy
o Water behind dams
o Sunlight
• Examples of non-renewable energy resources are:
o fossil fuels
o fissile materials

• Examples of environmental effects could include:
o Loss of habitat due to dams
o Loss of habitat due to surface mining
o Air pollution from burning of fossil fuels

Content Limits
• The following things should be avoided:
o Casting fossil fuels in a negative light and alternative fuels in a positive light
o Pros and cons of one energy source vs. another
o Negative effects of extracting and burning coal
o Negative effects of fracking
o Cause and effect of acid rain
o The term “global warming”
o <u>Students do not need to know:</u>
• How natural resources are used to generate energy (scientific specifics regarding how burning coal creates energy/how wind produces energy etc.).</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Agricultural, biosphere, mineral, geological, hydrothermal, metal ore, organic, deposition, petroleum, derive, extract, natural gas, oil shale, sustainability, tar sand</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 4-ESS3-1
• A pipeline is built to transport oil from one location to another. As the oil moves across the landscape it leaks into a river along the way.</td></tr>
</table>

	• The Three Gorges dam was built along the Yangtze River in China to generate electricity. The Chinese dove tree lives along the Yangtze River. Building the dam affected this tree. • Several wind turbines are placed in a field to provide electricity to neighboring areas. To do this, forest land had to be cut down to provide space for the wind turbines. • Oil can be used to generate electricity. Oil can be found under the ocean. Seismic waves are used to locate the oil. Because of this, 100 melon head whales were displaced off the coast of Madagascar.

This Performance Expectation and associated Evidence Statements support the following Task Demands.
Task Demands
1. Organize and/or arrange (e.g., using illustrations and/or labels), or summarize data/information to highlight trends, patterns, or correlations.
2. Express or complete a causal chain explaining how energy and fuel that are derived from natural resources affect the environment. This may include indicating directions of causality in an incomplete model such as a flow chart or diagram, or completing cause and effect chains.***(SEP/DCI/CCC)**
3. Identify evidence supporting the inference of causation that is expressed in a causal chain.***(SEP/DCI/CCC)**
4. Identify patterns or evidence in the data that supports inferences about the effects that the usage of certain natural resources has on the environment.
5. Describe, identify, and/or Select information needed to support an explanation.

*denotes those task demands which are deemed appropriate for use in stand-alone item development

Performance Expectation	**4-ESS3-2** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* *This performance expectation integrates traditional science content with engineering through a practice or disciplinary core idea.

<table>
<tr><td>Dimensions</td><td>Constructing Explanations and Designing Solutions
• Generate and compare multiple solutions to a problem based on how well they meet the criteria and constrains of the design solution</td><td>ESS3.B: Natural Hazards
• 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: Designing Solutions to Engineering Problems
• Testing a solution involves investigating how well it performs under a range of likely condition (secondary to 4-ESS3-2)</td><td>Cause and Effect
• Cause and effect relationships are routinely identified, tested, and used to explain change.

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
• Engineers improve existing technologies to develop new ones to increase their benefits, to decrease known risks, and to meet societal demands.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.
Content Limits
• Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Agricultural, biosphere, mineral, geological, hydrothermal, metal ore, organic, deposition, petroleum, derive, extract, natural gas, oil shale, sustainability, tar sand</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">• Hurricanes generate high winds. Several building designs are being considered to construct buildings that could withstand the force of the wind.
• Eyjafjallajokull is an active volcano in Iceland. In preparation for future volcanic activity, several evacuation routes are being considered.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Organize and/or arrange (e.g., using illustrations and/or labels), or summarize data/information to highlight trends, patterns, or correlations in data regarding human activity and natural hazards.</td></tr>
<tr><td colspan="4">2. Express or complete a causal chain explaining how humans can reduce the impact of natural hazards.</td></tr>
<tr><td colspan="4">3. Identify evidence supporting the inference of causation that is expressed in a causal chain.</td></tr>
<tr><td colspan="4">4. Identify patterns or evidence in the data that supports inferences about the ways humans can reduce impacts of natural hazards.</td></tr>
</table>

5. Use an explanation to compare the two solutions and select which one is better for addressing the problem of the impact of natural hazards on humans, and explain how well each solution meets the criteria and constraints of the design solution.

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-PS1-1
Develop a model to describe that matter is made of particles too small to be seen.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models
• Use models to describe phenomena.</td><td>PS1.A: Structure and Properties of Matter
• Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects.</td><td>Scale, Proportion, and Quantity
• Natural objects exist from the very small to the immensely large.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.

Content Limits
• <u>Assessment does not include:</u> the atomic-scale mechanism of evaporation and condensation or the defining of the unseen particles.
• Students are expected to know that matter can neither be destroyed nor created.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Atom, compound, molecule, chemical bond, solution, homogenous, heterogeneous, colloid, solute, solvent, precipitant, precipitate, reactant, product, air pressure, law of conservation of matter.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 5-PS1-1:
• A hissing sound can be heard as a bicycle wheel deflates.
• A sour odor can be smelled from milk that has been kept too long (or expired).
• When you pump air out of a closed bottle that is partially filled with marshmallows, the marshmallows expand in size. However, when you open the bottle, the marshmallows shrink back to their original size.
• When you place a lit match into a glass bottle and a boiled egg is set on the bottle opening, the egg eventually gets sucked into the bottle.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Select or identify from a collection of potential model components, including distractors, the components needed to model the phenomenon. Components might include solid, liquid, or gas particles; particles of different substances; and representations of particle movement.</td></tr>
<tr><td colspan="4">2. Assemble or complete — from a collection of potential model components — an illustration, flow chart, or causal chain that is capable of representing the particle nature of matter. This does not include labeling an existing diagram.</td></tr>
<tr><td colspan="4">3. Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon.</td></tr>
<tr><td colspan="4">4. Make predictions about the effects of changes in the movements of, distances between, or phases of the particles of matter under investigation. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors.</td></tr>
</table>

5.	Provided with models or diagrams of the particles of matter under investigation, identify the properties of the particles under investigation and how they change in each scenario. The properties of the particles may include the relative motions of, distances between, and phases of the particles.
6.	Describe, select, or identify the relationships among components of a model that explains the observed effects of the particle nature of matter.

Performance Expectation	**5-PS1-2** Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.		
Dimensions	**Using Mathematics and Computational Thinking** • Measure and graph quantities such as weight to address scientific and engineering questions and problems.	**PS1.A: Structure and Properties of Matter** • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. **PS1.B: Chemical Reactions** • No matter what reaction or change in properties occurs, the total weight of the substances does not change.	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.
Clarifications and Content Limits	**Clarification Statements** • Examples of reactions or changes could include mixing, dissolving, and phase changes that form new substances. **Content Limits** • Assessment does not include distinguishing mass and weight. • <u>Students do not need to know:</u> structure of atoms, specific chemical equations.		
Science Vocabulary Students Are Not Expected to Know	Mass, atoms, molecules, rates.		
Phenomena			
Context/ Phenomena	Some example phenomena for 5-PS1-2: • A cup of water is taken out of the freezer and left on a counter. After some time, the frozen water melts. • A cup of hot tea can dissolve more sugar than a cup of cold tea, but they both weigh the same after the mixing is complete. • When mixed together, silver nitrate and sodium chloride forms a white solid that weighs the same as the individual silver nitrate and sodium chloride weighed. • When water, baking soda, and calcium chloride are mixed inside a freezer bag, the bag gets hot and expands. The expanded freezer bag weighs the same as the ingredients did when they were separate.		
This Performance Expectation and associated Evidence Statements support the following Task Demands.			
Task Demands			
1. Make simple calculations using given data to calculate or estimate the total weight of a substance after heating, cooling, or mixing.			
2. Measure or graph data that can be used to calculate or estimate the total weight of a substance after heating, cooling, or mixing.			
3. Describe and/or summarize data (e.g., using illustrations and/or labels) to identify/highlight trends, patterns, or correlations concerning the weight of the substances being investigated at the beginning and end of an investigation.			
4. Compile and/or select, from given information, the particular data needed for a specific inference about the total weight of substances. This can include sorting out the relevant data from the overall body of given information.			

5. Select, describe, or illustrate a prediction made by applying the findings from measurements or an investigation.
6. Use relationships identified in the data to explain that regardless of the type of change, the total weight of matter is conserved.

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-PS1-3
Make observations and measurements to identify materials based on their properties.</td></tr>
<tr><td>Dimensions</td><td>Planning and Carrying Out Investigations
• Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.</td><td>PS1.A: Structure and Properties of Matter
• Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)</td><td>Scale, Proportion, and Quantity
• Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids.
• Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility.

Content Limits
• Assessment does not include density or distinguishing between mass and weight.
• <u>Students do not need to know:</u> chemical reaction equations, balancing reaction equations, atomic-level processes.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Insulator, element, reaction, boiling point, melting point, molecule, forms of matter, reactant, chemical compound, chemical reaction.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 5-PS1-3:
• Sugar and flour are white powdery substances. Sugar is soluble in water and flour is not.
• Three mineral crystals sit on a table. The three crystals are all the same color, resembling clear glass. However, they are all different minerals. One of them is quartz, one of them is halite, and the third is calcite.
• Two nails are on a table. When a magnet is placed over the nails, one of them moves from the table and sticks to the magnet.
• Two pieces of wood are hit with a hammer. One piece of wood has a depression/dent where the hammer hit it. The other does not have a dent/depression.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify from a list, including distractors, the materials or tools needed to observe or measure properties of matter to identify unknown materials.</td></tr>
<tr><td colspan="4">2. Identify from a list, including distractors, the output data needed to identify or differentiate materials. **</td></tr>
<tr><td colspan="4">3. Make and/or record observations or measurements from the investigation of the properties of materials. *(SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">4. Interpret and/or communicate the data from the investigation of the properties of materials.</td></tr>
</table>

5. Make or communicate conclusions from the investigation of the properties of materials.

*denotes those task demands which are deemed appropriate for use in stand-alone item development
**TD2 may be used for stand-alone item if used with TD3

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-PS1-4
Conduct an investigation to determine whether the mixing of two or more substances results in new substances.</td></tr>
<tr><td>Dimensions</td><td>Planning and Carrying Out Investigations
• Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials are considered.</td><td>PS1.B: Chemical Reactions
• When two or more different substances are mixed, a new substance with different properties may be formed.</td><td>Cause and Effect
• Cause-and-effect relationships are routinely identified and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Students are not expected to be able to balance chemical equations, but should be able to complete simple mathematical (addition and subtraction) calculations in regard to starting materials and ending materials.

Content Limits
• Students are expected to know that matter is neither destroyed nor created.
• Students do not need to know: Chemical names, chemical symbols, general balanced equation {product + product → (yields) reactants}, and isotopes, specific chemical reaction types (e.g. oxidation, reduction, decomposition, and combustion).</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Reactant, product, atom, molecule, compound, chemical bond, law of conservation of mass, law of conservation of energy, intramolecular attractions, intermolecular attractions, solubility, solvent, solute, precipitant, rate of chemical reaction, acid, base, salt (as an ionic crystal), fusion, fission, homogeneous mixture, heterogeneous mixture, plasma, pH.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 5-PS1-4:
• A peach shrivels and becomes covered with mold.
• Over time, one metal changes color when exposed to rainwater. However, another metal exposed to rainwater does not.
• Portions of marble statues that are exposed to rainwater crack and crumble over time. Portions of marble statues that are sheltered develop a black coating over time.
• A bottle partially filled with vinegar sits on a counter. An empty balloon is partially filled with baking soda. When the open end of the balloon is stretched over the bottle top, a hissing/fizzing sound can be heard and the balloon expands.
• When sugar crystals are added to vinegar in a bowl, the crystals disappear. When crystals of baking soda are added to vinegar in a bowl, the mixture begins to bubble and foam.
• Table sugar exposed to an open flame transforms into a gooey, dark substance. Wood exposed to an open flame transforms into ash.
• Three trials are performed. In the first trial, blowing/exhaling air into water produces no visible result. In the second trial, a piece of paper that measures the amount of hydrogen is dipped into the water before adding air and after adding air. The color of the paper before air is added is different than the color of the paper after air is added. In the third trial, the resulting water from the second trial is heated and cooled. When a new paper is dipped into the water, the color of the paper is the same as the original color, before the air was blown into the water.
• When heated, a solid substance seems to melt and then to evaporate. However, the solid does not reform when cooled.</td></tr>
</table>

	• A mixture of corn starch and water will blend with stirring. The resulting mixture is slimy and acts more like a fluid. However, sudden pressure hardens the mixture and it acts more like a solid.

This Performance Expectation and associated Evidence Statements support the following Task Demands.
Task Demands
1. Identify from a list, including distractors, the properties that should be tested or the materials/tools needed in an investigation of the physical and chemical properties of the starting and ending substances involved in mixing.
2. Identify the outcome data that should be collected in an investigation of the physical and chemical properties of the starting and ending substances under investigation.
3. Make and/or record observations/data about the physical and chemical properties of the substances that are mixed and the substances resulting from the mixture.
4. Interpret and/or communicate the data from an investigation. This may include identifying/describing trends, patterns, or correlations among observations and data concerning the physical and chemical properties of the beginning and ending substances being investigated.
5. Explain or describe the causal processes that lead to the observed data.

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-PS2-1
Support an argument that the gravitational force exerted by Earth on objects is directed down.</td></tr>
<tr><td>Dimensions</td><td>Engaging in Argument from Evidence
• Support an argument with evidence, data, or a model.</td><td>PS2.B: Types of Interactions
• The gravitational force of Earth acting on an object near Earth’s surface pulls that object toward the planet’s center.</td><td>Cause and Effect
• Cause and effect relationships are routinely identified and used to explain change.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statement
• “Down” is a local description of the direction that points toward the center of the spherical Earth.

Content Limits
• Assessment does not include mathematical representation of gravitational force.
• Study of gravity is limited to gravity on Earth.
• <u>Students do not need to know</u>: Calculations for weight (weight = mass • gravity), free fall, terminal velocity, weightlessness, air resistance, friction, black holes, inertia, Newton’s law of universal gravitation, vacuum.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Attractive, direction of force, direction of motion, field, linear, nonlinear, gravitational energy, gravitational field, magnetic field, permeate.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Sample phenomena for 5-PS2-1:
• A hard rubber ball dropped in a pool falls more slowly than the same ball dropped on land.
• A feather released on top of a cliff on a breezy day seems to fly away, while a similar feather dropped on flat ground on a breezy day lands on the ground.
• A small piece of clay set on the top of a globe stays in place, but when you put it on the bottom of the globe it drops off. A piece of clay put at the real north pole stays in place, and also stays in place on the real south pole.
• A basketball flies in an arc before going through the basket.
• A ball thrown to a dog goes really high before it gets low enough for the dog to catch.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Sort observations into those that appear to support competing (given) arguments, or into those that support, contradict, or are not relevant to a given argument. Observations are from animations, simulations, or other given material.</td></tr>
<tr><td colspan="4">2. Sort, tabulate, classify, separate, and/ or categorize relevant from irrelevant evidence (observations) or data.</td></tr>
<tr><td colspan="4">3. Select from a given collection additional relevant observations that would help distinguish between competing arguments or the veracity of a single argument.</td></tr>
<tr><td colspan="4">4. Select, identify, or describe apparent counterexamples to a supported argument.</td></tr>
<tr><td colspan="4">5. Identify from a given collection or explain in writing flaws in observation that lead to an apparent counterexample, or explain the counterexample in terms of grade-level appropriate properties gravity, or other simple forces from earlier grade levels.</td></tr>
<tr><td colspan="4">6. Sort statements into categories such as facts, reasonable judgments based on available facts, and speculation.</td></tr>
</table>

7. Clearly articulate the evidence supporting and contradicting an argument, noting how the evidence supports or contradicts the argument (hand scored). ***(SEP/DCI/CCC)**
8. Predict outcomes when properties or proximity of the objects are changed, given the inferred cause and effect relationships. This can be done by describing outcomes, or selecting or identifying outcomes from lists.

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-PS3-1
Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models
• Use models to describe phenomena.</td><td>PS3.D: Energy in Chemical Processes and Everyday Life
• The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter.

LS1.C: Organization for Matter and Energy Flow in Organisms
• Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary)</td><td>Energy and Matter
• Energy can be transferred in various ways and between objects.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
Examples of models could include diagrams and flow charts.
Content Limits
Assessment does not include photosynthesis.
<u>Students do not need to know:</u> photosynthesis equation</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Photosynthesis, metabolism, atoms, chemicals, reaction, radiation</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/
Phenomena</td><td colspan="3">Some example phenomena for 5-PS3-1:
Cows eat grass that grew in the sun.
Termites eat the wood in trees.
Caterpillars eat leaves and grow big.
Koalas mainly eat eucalyptus leaves.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Select or identify, from a collection of potential model components, including distractors, the parts of a model need to describe the flow of energy among plants, animals, and the sun.</td></tr>
<tr><td colspan="4">2. Assemble or complete a model representing the flow of energy among plants, animals, and the sun.</td></tr>
<tr><td colspan="4">3. Manipulate the components of a model to demonstrate properties, processes, and/or events that result in the flow of energy among plants, animals, and the sun, including the relationships of organisms and/or the cycles of energy and/or matter.</td></tr>
<tr><td colspan="4">4. Articulate, describe, illustrate, select, or identify the relationships among components of a model that describe the movement of matter among plants, animals, and the sun.</td></tr>
<tr><td colspan="4">5. Make predictions about the effects of changes in model components including the substitution, elimination, or addition of energy and/or an organism and the result.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-LS1-1
Support an argument that plants get the materials they need for growth chiefly from air and water.</td></tr>
<tr><td>Dimensions</td><td>Engaging in Argument from Evidence
• Support an argument with evidence, data, or model.</td><td>LS1.C: Organization for Matter and Energy Flow in Organisms
• Plants acquire their material for growth chiefly from air and water.</td><td>Energy and Matter
• Matter is transported into, out of, and within systems.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.

Content Limits
• Assessment does not include photosynthesis or the photosynthesis reaction equation. Students should know that plants carry out photosynthesis for energy, but they do not need to know the specifics of the process or equation.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Plant structure, producer, chemical process, carbon, carbon dioxide, aerobic, anaerobic, molecule, sugars.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 5-LS1-1:
• A neoregelia plant sits on the branch of a much larger kapok tree in the Cloud Forest of South America.
• A plant grows in a classroom and the students weigh the soil every day. The weight of the soil does not change over time but the plant continues to grow.
• Spanish moss hangs from the branches of a live oak tree in the swamps of Louisiana.
• Strawberries sold in a supermarket were grown inside of a greenhouse without soil.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Sort observations into those that appear to support competing (given) arguments, or into those that support, contradict, or are not relevant to a given argument. Observations are from animations, simulations, or other given material.</td></tr>
<tr><td colspan="4">2. Sort, tabulate, classify, separate, and/or categorize relevant from irrelevant evidence (observations) or data.</td></tr>
<tr><td colspan="4">3. Select from a given collection additional relevant observations that would help distinguish between competing arguments or the veracity of a single argument.</td></tr>
<tr><td colspan="4">4. Select, identify, or describe apparent counterexamples to a supported argument.</td></tr>
<tr><td colspan="4">5. Identify from a given collection—or explain in writing—flaws in observation that lead to an apparent counterexample, or explain the counterexample in terms of grade-level appropriate properties of plant growth.</td></tr>
<tr><td colspan="4">6. Sort statements into categories such as facts, reasonable judgments based on available facts, and speculation.</td></tr>
<tr><td colspan="4">7. Articulate the evidence supporting and/or contradicting an argument that plants chiefly need air and water for growth.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-LS2-1
Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.</td></tr>
<tr><td>Dimensions</td><td><u>Developing and Using Models</u>
• <u>Develop a model to describe phenomena.</u></td><td><u>LS2.A: Interdependent Relationships in Ecosystems</u>
• <u>The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.</u>

<u>LS2.B: Cycles of Matter and Energy Transfer in Ecosystems</u>
• <u>Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases and water from the environment and release waste matter (gas, liquid, or solid) back into the environment.</u></td><td><u>Systems and System Models</u>
• <u>A system can be described in terms of its components and their interactions.</u></td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food.
• Examples of systems could include organisms, ecosystems, and Earth.

Content Limits
• <u>Assessment does not include</u>: molecular explanations.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Chemical process, reaction, molecule, carbon, carbon dioxide, oxygen, sugar, aerobic, anaerobic.</td></tr>
<tr><td colspan="4" align="center">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 5-LS2-1:
• Insects in a terrarium only survive when bacteria and plants are present.
• A new fish tank must rest for 2–3 weeks with water before introducing fish or the fish die.
• Under a microscope, a sample of soil contains many bacteria, but a sample of desert sand does not.</td></tr>
</table>

	• Farmers put fish in stock tanks to keep them clean.

This Performance Expectation and associated Evidence Statements support the following Task Demands.
Task Demands
1. Select or identify from a collection of potential model components, including distractors, the parts of a model needed to describe the movement of matter among plants, animals, decomposers, and the environment. ***(SEP/DCI/CCC)**
2. Manipulate the components of a model to demonstrate properties, processes, and/or events that result in the movement of matter among plants, animals, decomposers, and the environment, including the relationships of organisms and/or the cycle(s) of matter and/or energy.
3. Articulate, describe, illustrate, select, or identify the relationships among components of a model that describe the movement of matter among plants, animals, decomposers, and the environment.
4. Make predictions about the effects of changes in model components, including the substitution, elimination, or addition of matter and/or an organism and the result.

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-ESS1-1
Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.</td></tr>
<tr><td>Dimensions</td><td>Engaging in Argument from Evidence
• Support an argument with evidence, data, or a model.</td><td>ESS1.A: The Universe and Its Stars
• The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.</td><td>Scale, Proportion, and Quantity
• Natural objects exist from the very small to the immensely big.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Content Limits
• Assessment is limited to relative distances, not sizes, of stars.
• Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage, etc.).
• Students do not need to know specific stars and their names.
• Students do not need to know anything about luminosity and how that is affected by the size/age of a star.
• Students do not need to know what flux is or how to calculate it.
• Assessment does not include absolute brightness.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Lunar phase, eclipse, celestial, mass, comet, light year, astronomical unit, emit, interstellar, fission, fusion, radiation, spectrum, star size, star composition, star formation, star types, luminosity, flux.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 5-ESS1-1:
• Most stars cannot be seen during the daytime but can be seen at night.
• The sun is never seen at the same time as other stars in the sky.
• Alpha Centauri A is larger than the sun but does not look as bright in the sky.
• Street lights that are farther away from you look dimmer.
• A car’s lights become brighter as it drives toward you at night.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Organize, arrange (e.g., using illustrations and/or labels), or summarize data to highlight trends, patterns, or correlations in how the brightness of stars is based on their relative distance from Earth. *(DCI/CCC)</td></tr>
<tr><td colspan="4">2. Generate/construct graphs, tables, or assemblages of illustrations and/or labels of data that document patterns, trends, or correlations in how the brightness of stars is based on their relative distance from Earth. This may include sorting out distractors. *(DCI/CCC)</td></tr>
<tr><td colspan="4">3. Describe, identify, and/or select information needed to support an explanation. *(SEP/DCI)</td></tr>
<tr><td colspan="4">4. Use relationships identified in the data to predict the distance of a star depending on its brightness, or vice versa. *(DCI/CCC)</td></tr>
<tr><td colspan="4">5. Identify patterns or evidence in the data that supports inferences about how the brightness of stars depends on their relative distance from Earth.</td></tr>
</table>

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<table>
<tr><td>Performance Expectation</td><td colspan="3">5-ESS1-2
Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.</td></tr>
<tr><td>Dimensions</td><td>Analyzing and Interpreting Data
• Represent data in graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.</td><td>ESS1.B: Earth and the Solar System
• The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.</td><td>Patterns
• Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Content Limits
• Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.
• While the names of celestial objects, stars, or constellations can be included, students are not expected to identify them.
• Objects to be used to assess this PE are limited to the sun, Earth’s moon, Earth, and stars/constellations visible in Earth’s night sky.
• “Positions of the moon” refers to its location in Earth’s sky and not its appearance (phase).
• Assessment does not include cause of seasons, lunar phases, or the position of the sun in the sky throughout the year.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Eclipse, celestial, comet, light year, astronomical unit, stellar.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 5-ESS1-2:
• The shadow cast by a sundial changes position and size throughout the day.
• A constellation that is viewed right above someone’s house at 8:00 p.m. one night can no longer be seen at 8:00 p.m. in a few months.
• The sun is seen in the sky only during the day
• It gets dark out after the sun goes below the horizon.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Organize, arrange (e.g., using illustrations and/or labels), or summarize data to highlight trends, patterns, or correlations in how the data changes over time. *(SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">2. Generate/construct graphs, tables, or groups of illustrations and/or labels of data that document patterns, trends, or correlations in how the data change over time. This may include sorting out distractors. *(SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">3. Use relationships identified in the data to predict whether or not the pattern will continue OR how the data will look at some time in the future. *(SEP/DCI/CCC)</td></tr>
<tr><td colspan="4">4. Identify patterns or evidence in the data that supports inferences about the phenomena.</td></tr>
</table>

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<table>
<tr><td>Performance Expectation</td><td colspan="3">5-ESS2-1
Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models
• Develop a model using an example to describe a scientific principle.</td><td>ESS2.A: Earth Materials and Systems
• Earth’s major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth’s surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.</td><td>Systems and System Models
• A system can be described in terms of its components and their interactions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements
• Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere.
• The geosphere, hydrosphere, atmosphere, and biosphere are each a system.

Content Limits
• Assessment is limited to the interactions of two systems at a time.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">troposphere, stratosphere, mesosphere, thermosphere, ionosphere, chaparral</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 5-ESS2-1:
• The land area found on the beaches around Nantucket Sound in 2016 were about three times the land area in the same location in 1984.
• In 2016, Tucson, Arizona received more rain between June and September than Yuma, Arizona received during the entire year.
• The amount of carbon dioxide in the atmosphere measured at Mauna Loa Observatory in April is 397 parts per million. The amount measured at the same location the previous September was 2% less.
• In 1980, the salt content in the freshwater Biscayne Aquifer in Florida was 50 milligrams per liter. In 1997, the salt content of the same water was 1,000 milligrams per liter.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Select or identify from a collection of potential model components, including distractors, the components needed to model the phenomenon. Components might include labels, text, steps in a process.</td></tr>
<tr><td colspan="4">2. Assemble or complete, from a collection of potential model components, an illustration or flow chart that is capable of representing how the geosphere, biosphere, hydrosphere, and/or atmosphere interact. This <u>does not</u> include labeling an existing diagram.
3. Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that act to result in the phenomenon.</td></tr>
<tr><td colspan="4">4. Make predictions about the effects of changes in the geosphere, biosphere, hydrosphere, or atmosphere on each other. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors.</td></tr>
</table>

5. Given models or diagrams of ways in which the geosphere, biosphere, hydrosphere, and/or atmosphere interact, identify relationships between the spheres and how a change in one causes a change in another.
6. Identify missing components, relationships, or other limitations of the model.

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-ESS2-2
Describe and graph the amounts of salt water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.</td></tr>
<tr><td>Dimensions</td><td>Using Mathematics and Computational Thinking
• Describe and graph quantities such as area and volume to address scientific questions.</td><td>ESS2.C: The Roles of Water in Earth's Surface Processes
• Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.</td><td>Scale, Proportion, and Quantity
• Standard units are used to measure and describe physical quantities such as weight and volume.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Content Limits
• Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.
• Students will not be provided a calculator.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Coastal, crust, internal, distribution, hydrological cycle.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3"><u>The phenomenon for these PEs are the given data</u>. Samples of phenomena should describe the data set(s) to be given in terms of patterns or relationships to be found in the data, and the columns and rows of a hypothetical table presenting the data, even if the presentation is not tabular. The description of the phenomenon should describe the presentation format of the data (e.g., maps, tables, graphs, etc.).

For this performance expectation the phenomena are a set of data on the relative volume of water in different reservoirs on Earth using standard units for weight or volume. Some example sets of data for 5-ESS2-2:
• Melting ice from the Arctic ice cap is currently adding fresh water to the very salty Arctic Ocean.
• Melting ice from the Greenland Ice Sheet is currently adding fresh water to the very salty Arctic Ocean.
• The Potomac River in the eastern United States is tidally influenced over XX% of its length. This tidal influence from the ocean results in the portion of the river near the ocean being a mixture of salt and fresh water and the portion of the river far from the ocean being fresh water.
• Salt water intrusion on Cape Cod, Florida, or California.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Illustrate, graph, or identify relevant features or data that can be used to calculate or estimate relationships between the relative volumes of water in different reservoirs on Earth.</td></tr>
<tr><td colspan="4">2. Calculate or estimate properties or relationships of the relative volumes of water in different reservoirs on Earth, based on data from one or more sources.</td></tr>
<tr><td colspan="4">3. Compile, from given information, the data needed for a particular inference about the relative volumes of water in different reservoirs on Earth. This can include sorting out the relevant data from the given information.</td></tr>
</table>

<table>
<tr><td>Performance Expectation</td><td colspan="3">5-ESS3-1
Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.</td></tr>
<tr><td>Dimensions</td><td>Obtaining, Evaluating, and Communicating Information
• Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.</td><td>ESS3.C: Human Impacts on Earth Systems
• Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.</td><td>Systems and System Models
• A system can be described in terms of its components and their interactions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">None</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Coastal, crust, internal, distribution, hydrological cycle, reservoir, hydrosphere, glacial movement, water capacity, glacial, hydrosphere, reservoir, feature, surface feature, wetland</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Engineering practices are built around meaningful design problems rather than phenomena. For this PE, there are 2 phenomena and 2 design problems.

Some example phenomena for 5-ESS3-1:
• In England in 1965, there were about 182,000 bee colonies. By 2010, there were about 83,000 bee colonies.
• There is a haze in the air in Beijing, China's capital city, which makes it hard to see long distances. The haze becomes worse on cold winter days.

Some example design problems for 5-ESS3-1:
• A company is going to put a new logging road in an area where grizzly bears live. The US Forest Service tells them that they need to pay attention to where they are going to put the road. The path of the road should be chosen so that it doesn't disturb grizzly bear habitat very much.
• A flower garden to attract honeybees is being built. The type and color of flowers, garden placement, flower placement, and other features are chosen to attract honeybees.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Identify, evaluate, combine, organize, and/or communicate information (from texts, illustrations, animations, simulations, tables, or graphs) that is needed to make an informed decision related to human impacts on natural systems, solve a particular design problem, or complete a specified task.</td></tr>
<tr><td colspan="4">2. Assemble or complete an illustration, graph, set of labels, or a flow chart that shows how the various pieces of information, which are needed to make an informed decision, solve a particular design problem, or complete a specified task, are interrelated. This <u>does not</u> include labeling an existing diagram.</td></tr>
<tr><td colspan="4">3. Identify patterns or evidence in the data that supports inferences about human impacts on natural systems or a particular solution to a design problem or task.</td></tr>
<tr><td colspan="4">4. Examine, identify or select positive or negative effects/implications of a community idea or design problem. This would include identifying potential positive or negative effects, especially when dealing with design</td></tr>
</table>

	solutions, and classifying the effects/implications as positive or negative and supporting those classifications with the relevant data.
5.	Formulate a design or make an inference or conclusion, based on identified or combined information, evidence or data related to human impacts on natural systems, solution of a particular design problem, or completion of a specified task.
6.	Evaluate a design or make an inference or conclusion, based on identified or combined information, evidence or data related to human impacts on natural systems, solution of a particular design problem, or completion of a specified task.