
The following documents show the May 2012 Draft NGSS performance expectations grouped by topics.

# Elementary

May 7, 2012

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# K.OTE Organisms and Their Environments

## OTE Organisms and Their Environments

Students who demonstrate understanding can:

**a. Use observations and information to classify living things as plants or animals based on what they need to survive.** [Clarification Statement: To survive and grow, animals need food, water, and air. Plants need water, light, and air to live and grow.]

**b. Use observations to describe how plants and animals depend on the air, land, and water where they live to meet their needs, and they in turn, can change their environment.** [Clarification Statement: Examples of how plants and animals change their environment could include ants making anthills, plant roots breaking concrete, or beavers building dams.]

**c. Use observations and information to identify patterns in how animals get their food.** [Clarification Statement: Animals get their food by various means. Some animals eat plants, some eat other animals, and some eat both.]

**d. Provide evidence that humans' uses of natural resources can affect the world around them, and share solutions that reduce human impact.** [Clarification Statement: Examples of how humans' uses of natural resources can affect the world include cutting trees for lumber and paper products or discarding plastic bags and other waste that affects animal habitats. Humans can reduce their impact by recycling and avoiding littering.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations to collect data which can be used to make comparisons. (a)

**Analyzing and Interpreting Data**
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use and share pictures, drawings and/or writings of observations. (c)
- Use observations to describe patterns and relationships in order to answer scientific questions and solve problems. (b),(c),(d)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

- Read and comprehend grade-appropriate texts and use other media to acquire scientific information. (d)
- Critique and communicate information with others in oral and/or written forms using models, drawings, writing, or numbers. (d)

### Disciplinary Core Ideas

**LS1.C: Organization for Matter and Energy Flow in Organisms**

- All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (a),(c)

**ESS2.E: Biogeology**

- Plants and animals (including humans) depend on the land, water, and air to live and grow. They in turn can change their environment (e.g., the shape of land, the flow of water). (b)

**ESS3.A: Natural Resources**

- Living things need water, air, and resources from the land, and they try to live in places that have the things they need. Humans use natural resources for everything they do: for example, they use soil and water to grow food, wood to burn to provide heat or to build shelters, and materials such as iron or copper extracted from the earth to make cooking pans. (a),(d)

**ESS3.C: Human Impacts on Earth Systems**

- Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things—for example, by reducing trash through reuse and recycling. (d)

### Crosscutting Concepts

**Patterns**
Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (a),(c)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Therefore, taking natural materials to make things impacts the environment. (d)

*Connections to other DCIs in this grade-level:* **K.WEA**

*Articulation of DCIs across grade-levels:* **4.PSE, 4.E, 5.MEE, 5.ESI**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.K.2** With prompting and support, identify the main topic and retell key details of a text.
**W.K.2** Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
**SL.K.1** Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
**SL.K.3** Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

*Mathematics –*

**MP.3** Construct viable arguments and critique the reasoning of others.
**MP.7** Look for and make use of structure.
**K.CC.6** Compare numbers.
**K.MD.3** Classify objects and count the number of objects in each category.

# K.SPM Structure and Properties of Matter

## K.SPM Structure and Properties of Matter

Students who demonstrate understanding can:

**a. Make observations that matter exists as different materials, which can be described and classified by their observable properties and their uses.** [Clarification Statement: Observable properties could include color, texture, and hardness.]

**b. Compare and share observations of solids and liquids at room temperature.**

**c. Plan and carry out investigations to test the idea that warming some materials causes them to change from solid to liquid and cooling causes them to change from liquid to solid.** [Clarification Statement: Students could investigate substances like butter, chocolate, ice, cheese, or ice cream. Students should be able to have the opportunity to see that not all substances' phase changes with temperature.] [Assessment Boundary: Only a qualitative description of temperature should be used.]

**d. Distinguish between opinions and evidence in determining whether objects in a given set occur naturally or are manufactured.** [Clarification Statement: Examples of natural and manufactured objects could be a wooden dowel which has been made to be smooth and a tree limb which is not naturally smooth.]

**e. Ask questions and share information about the natural materials from which human-made products are built.** [Clarification Statement: Examples of natural and manufactured objects could be a wooden dowel which has been made to be smooth and a tree limb which is not naturally smooth.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Asking Questions and Defining Problems**
Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.

- Ask questions about observations of the natural and designed world. (e)

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan carry out investigations collaboratively. (c)
- Make observations to collect data which can be used to make comparisons (a),(b),(c)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing explanations and designing solutions.

- Distinguish between opinions and evidence. (d)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and progresses to evaluate the merit of ideas and methods.

- Critique and communicate information with others in oral and/or written forms using models, drawings, writing, or numbers. (b),(e)
- Record observations, thoughts, and ideas. (b),(e)

### Disciplinary Core Ideas

**PS1.A: Structure and Properties of Matter**

- Different kinds of matter exist (e.g., wood, metal, water) and many of them can be either solid or liquid, depending on temperature. (a),(b),(c)
- Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured. (a),(d)

**ETS2.A: Interdependence of Science, Engineering, and Technology**

- People encounter questions about the natural world every day. (a),(b),(c),(d),(e)

**ETS2.B: Interactions of Engineering, Technology, Science, Society, and the Natural Environment**

- Every human-made product is designed by applying some knowledge of the natural world and is built by using materials derived from the natural world, even when the materials are not themselves natural—for example, spoons made from refined metals. (d),(e)

### Crosscutting Concepts

**Patterns**
Patterns in the natural and human designed world can be observed, used to describe phenomena and used as evidence. (a),(b)

**Cause and Effect**
Events have causes that generate observable patterns. Simple tests can be designed to gather evidence to support or refute student ideas about causes. (c)

**Energy and Matter**
Objects may break into smaller pieces, be put together into larger pieces, or change shapes. (e)

***Connections to Engineering, Technology and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Therefore, taking natural materials to make things impacts the environment. (d)

*Connections to other DCIs in this grade-level:* **N/A**

*Articulation of DCIs across grade-levels:* **2.ECS, 2.SPM**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**W.K.2** Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
**W.K.7** Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them).
**W.K.8** With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
**SL.K.3** Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

*Mathematics –*

**MP.3** Construct viable arguments and critique the reasoning of others.
**MP.7** Look for and make use of structure.
**K.MD.3** Classify objects and count the number of objects in each category.

# K.WEA Weather

## WEA Weather

Students who demonstrate understanding can:

a. **Carry out an investigation to determine the effect of sunlight on natural materials on Earth's surface.** [Clarification Statement: Examples of natural resources on the Earth's surface that can be investigated are rocks, water, soil, or sand.] [Assessment Boundary: Quantitative comparisons of data are limited to comparing numbers.]

b. **Observe, record, and share findings of local weather over a period of time.** [Clarification Statement: Students can observe local weather data such as sunlight, wind, snow, rain, and temperature over multiple time periods such as hourly, daily, weekly, and over the school year.] [Assessment Boundary: Climate is not assessed.]

c. **Develop, use, and share representations of weather conditions to describe changes over time and identify patterns.** [Assessment Boundary: Not to include histograms and line graphs.]

d. **Analyze weather data to determine that some kinds of severe weather are more likely to occur than others in the local region.** [Clarification Statement: Students can use weather data to compare likelihood of events such as rain vs. hurricane; typical temperature vs. heat wave; wind vs. tornado.] [Assessment Boundary: Limited to students' local region.]

e. **Ask questions and obtain information on how forecasting of severe weather can help keep people safe.** [Assessment Boundary: Students are not expected to make measurements of weather data or to forecast weather.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Asking Questions and Defining Problems**
Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.
- Ask questions about observations of the natural world. (e)

**Developing and Using Models**
Modeling in K–2 builds on prior experiences and progresses to include identifying, using, and developing models that represent concrete events or design solutions.
- Develop and use models (i.e., diagrams, drawings, physical replicas) that represent amounts, relative scales (bigger, smaller), and patterns. (c)

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Plan and carry out investigations collaboratively. (a)
- Evaluate different ways of observing and/or measuring an attribute of interest. (a)
- Make observations and/or measurements to collect data which can be used to make comparisons. (a)
- Identify questions and make predictions based on prior experiences. (a)

**Analyzing and Interpreting Data**
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Use observations to note patterns in order to answer scientific questions and solve problems. (d)

**Using Mathematics and Computational Thinking**
Mathematical and computational thinking at the K–2 level builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world.
- Use data to identify patterns in the natural and designed worlds. (d)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
- Read and comprehend grade-appropriate texts and/or use other reliable media to acquire scientific information. (e)
- Critique and communicate information with others in oral and/or written forms using models, drawings, writing, or numbers. (b)
- Record observations, thoughts, and ideas. (b)

### Disciplinary Core Ideas

**PS3.B: Conservation of Energy and Energy Transfer**
- Sunlight warms Earth's surface. (a)

**ESS2.D: Weather and Climate**
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (b),(c),(d)

**ESS3.B: Natural Hazards**
- Some kinds of severe weather are more likely than others in a given region. (d)
- Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (d),(e)

**ETS1.A: Defining and Delimiting an Engineering Problem**
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (e)

**ETS2.B: Interactions of Engineering, Technology, Science, Society, and the Natural Environment**
- People depend on various technologies in their lives; human life would be very different without technology. (e)

### Crosscutting Concepts

**Patterns**
Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (b),(c)

**Cause and Effect**
Events have causes that generate observable patterns. Simple tests can be designed to gather evidence to support or refute student ideas about causes. (a)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Therefore, taking natural materials to make things impacts the environment. (e)

*Connections to other DCIs in this grade-level:* **K.OTE**

*Articulation of DCIs across grade-levels:* **1.SF, 2.ECS, 3.WCI, 4.E**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.K.2** With prompting and support, identify the main topic and retell key details of a text.
**W.K.2** Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
**SL.K.3** Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
**SL.K.5** Add drawings or other visual displays to descriptions as desired to provide additional detail.

*Mathematics –*

**MP.2** Reason abstractly and quantitatively.
**MP.7** Look for and make use of structure.
**K.MD.3** Classify objects and count the number of objects in each category.

# 1.SF Structure and Function

## 1.SF Structure and Function

Students who demonstrate understanding can:

a. **Observe and analyze the external structures of animals to explain how these structures help the animals meet their needs.** [Clarification Statement: External structures on animals allow them to gather, catch, eat, and chew food.]

b. **Make observations to explain that animals, including people, have body parts that they use to obtain and convey information, which the animal responds to with behaviors that help them grow and survive.** [Clarification Statement: Animals use body parts such as eyes, ears, nose, and skin to obtain information. Animals have developed behaviors such as the ability to find food or escape from a predator to respond to that information.]

c. **Make observations and describe that plants have different parts that help them survive, grow, produce more plants and respond to external inputs.** [Clarification Statement: Plants use different parts such as roots, stems, leaves, flowers, and fruits to help them survive, grow and produce more plants. Plants are also able to respond to external inputs such as leaves turning toward the sun to acquire more sunlight.]

d. **Ask questions to define a problem and design an object that replicates the function (use) of a structure (part) present in an animal or a plant to address the problem.** [Clarification Statement: Examples of a device could be a device to pick up small objects based on an animal structure such as a bird beak.]

e. **Gather and use data to explain that young animals and plants grow and change, and not all individuals of the same kind of organism look exactly the same.** [Clarification Statement: An example could be how puppies in the same litter look different.] [Assessment Boundary: Complete life cycles are not included.]

f. **Obtain and share information to explain that patterns of behaviors between parents and offspring promote survival.** [Clarification Statement: An example could be how adults feed their young.]

g. **Use observations and information as evidence that animals form groups of varying size and to describe how being part of a group can help individuals survive.** [Clarification Statement: Animals form groups of varying size such as pairs, family groups, and large herds to obtain food, defend themselves, and cope with change.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Asking Questions and Defining Problems**
Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.
- Ask questions about observations of the natural and designed world. (d)

**Analyzing and Interpreting Data**
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Use observations to note patterns and relationships in order to answer scientific questions and solve problems. (a),(c)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence or ideas in constructing explanations and designing solutions.
- Use information from observations to construct explanations about investigations. (b),(e)
- Use tools and materials provided to design a solution to a specific problem. (d)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
- Read and comprehend grade-appropriate texts and use other reliable media to acquire scientific information. (f),(g)
- Record observations, thoughts, and ideas. (f)

### Disciplinary Core Ideas

**PS4.C: Information Technologies and Instrumentation**
- People use their senses to learn about the world around them. Their eyes detect light, their ears detect sound, and they can feel vibrations by touch. (b)

**LS1.A: Structure and Function**
- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. (a),(b),(d)
- Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive, grow, and produce more plants. (c)

**LS1.B: Growth and Development of Organisms**
- Plants and animals have predictable characteristics at different stages of development. Plants and animals grow and change. (e)
- Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (f)

**LS1.D: Information Processing**
- Animals have body parts that capture and convey different kinds of information needed for growth and survival—for example, eyes for light, ears for sounds, and skin for temperature or touch. Animals respond to these inputs with behaviors that help them survive (e.g., find food, run from a predator). Plants also respond to some external inputs (e.g., turn leaves toward the sun). (b),(c)

**LS2.A: Interdependent Relationships in Ecosystems**
- They [animals] use their senses to find food and water, and they use their body parts to gather, catch, eat, and chew the food. (a),(b)

**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. (g)

**LS3.A: Inheritance of Traits**
- Organisms have characteristics that can be similar or different. Young animals are very much, but not exactly, like their parents and also resemble one other animals of the same kind. Plants also are very much, but not exactly, like their parents and resemble other plants of the same kind. (e)

**LS3.B: Variation of Traits**
- Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (e)

**ETS1.A: Defining and Delimiting an Engineering Problem**
- Before beginning to design a solution, it is important to clearly understand the problem. (d)

### Crosscutting Concepts

**Patterns**
Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (e),(f),(g)

**Structure and Function**
The shape and stability of structures of natural and designed objects are related to their function(s). (a),(b),(c)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Therefore, taking natural materials to make things impacts the environment. (d)

*Connections to other DCIs in this grade-level:* **1.LS**

*Articulation of DCIs across grade-levels:* **K.WEA, 2.PP, 2.IOS, 3.SFS, 3.EIO, 4.LCT, 4.WAV**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.1.2** Identify the main topic and retell key details of a text.
**RI.1.10** With prompting and support, read informational texts appropriately complex for grade.
**W.1.2** Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.
**MP.3** Construct viable arguments and critique the reasoning of others.
**MP.7** Look for and make use of structure.
**...G.2** Reason with shapes and their attributes.

# 1.LS Light and Sound

## S Light and Sound

Students who demonstrate understanding can:

a. **Investigate to describe that objects can be seen only when light is available to illuminate them.**

b. **Obtain and communicate information that very hot objects give off their own light.** [Assessment boundary: Examples of very hot objects that give off their own light are fire and the sun.]

c. **Investigate that some materials allow light to pass through, others only allow some light to pass through, and some materials block all of the light, creating a dark shadow.**

d. **Investigate to describe how mirrors and prisms redirect light.** [Assessment Boundary: Only descriptions from the observations of the phenomenon of light being redirected from a mirror and a prism to be included.]

e. **Carry out investigations to provide evidence that vibrating matter creates sound and that sound can cause matter to vibrate.** [Clarification Statement: Examples of vibrating matter that creates sound could be tuning forks or plucking a stretched string. An example of how sound can cause matter to vibrate could be holding a piece of paper near a speaker.]

f. **Design a device that uses light or sound to send a signal over a distance.** [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," or drum beats.]

g. **Provide evidence that communicating over distances is important in our daily lives.** [Assessment Boundary: Technological details for how communication devices work should not be included.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan and carry out investigations collaboratively. (a),(c),(d),(e)
- Evaluate different ways of observing an attribute of interest. (a),(c),(d),(e)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence or ideas in constructing explanations and designing solutions.

- Use tools and materials provided to design a solution to a specific problem. (f)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

- Read and comprehend grade-appropriate texts and use other reliable media to acquire scientific information. (b),(g)
- Record observations, thoughts, and ideas. (b),(g)

### Disciplinary Core Ideas

**PS4.A: Wave Properties**

- Sound can make matter vibrate, and vibrating matter can make sound. (e)

**PS4.B: Electromagnetic Radiation**

- Objects can be seen only when light is available to illuminate them. Very hot objects give off light (e.g., a fire, the sun). (a),(b)
- Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them (i.e., on the other side from the light source), where the light cannot reach. (c)
- Mirrors and prisms can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (d)

**PS4.C: Information Technologies and Instrumentation**

- People also use a variety of devices to communicate (send and receive information) over long distances. (f)

**ETS2.B: Interactions of Engineering, Technology, Science, on Society and the Natural Environment**

- People depend on various technologies in their lives; human life would be very different without technology. (g)

### Crosscutting Concepts

**Cause and Effect**
Events have causes that generate observable patterns. Simple tests can be designed to gather evidence to support or refute student ideas about causes. (a),(b),(c),(d),(e)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science, on Society and the Natural World**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Therefore, taking natural materials to make things impacts the environment. (f)

*Connections to other DCIs in this grade-level:* **1.SF**

*Articulation of DCIs across grade-levels:* **2.ECS, 3.SFS, 4.WAV**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**W.1.2** Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.
**SL.1.1** Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.
**SL.1.5** Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.
**MP.3** Construct viable arguments and critique the reasoning of others.
**1.MD.3** Measure lengths indirectly and by iterating length units.

# 1.PC Patterns and Cycles

## 1.PC Patterns and Cycles

tudents who demonstrate understanding can:

a. **Investigate and compare how some natural events occur quickly and other natural events occur slowly.** [Clarification Statement: Quickly occurring natural events could include rain storms or gusts of wind. Slower events could be the change of seasons.]

b. **Record and share observations about how some events have cycles; whereas, other events have a clear beginning and end.** [Clarification Statement: Observations can be made about cycles such as day and night while using storms as examples of events that begin and end.]

c. **Obtain information and share observations to determine simple patterns of natural objects in the sky.** [Clarification Statement: Examples of patterns could be that the sun rises in one part of the sky and sets in another or that stars are visible at night.]

d. **Analyze and share observations about sunrise and sunset to identify and describe seasonal changes.**

e. **Obtain information and communicate that there are tools that allow people to see more objects in the sky and in greater detail.** [Clarification Statement: Information can be obtained using telescopes, binoculars, or reliable media. For example, as a result of these tools, we can see more stars and study the moon in greater detail.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations and/or measurements to collect data which can be used to make comparisons. (a)
- Identify questions and make predictions based on prior experiences. (a)

**Analyzing and Interpreting Data**
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use and share pictures, drawings, and/or writings of observations where appropriate. (b),(c),(d)
- Use observations to note patterns and relationships in order to answer scientific questions. (b),(d)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

- Read and comprehend grade-appropriate texts and/or use other reliable media to acquire scientific and technical information. (c),(e)
- Critique and communicate information or design ideas with others in oral and/or written forms using models, drawings, writing, or numbers. (c)

### Disciplinary Core Ideas

**ESS1.A: The Universe and its Stars**

- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (c),(d)
- At night one can see the light coming from many stars with the naked eye, but telescopes make it possible to see many more and to observe them and the moon and planets in greater detail. (e)

**ESS1.B: Earth and the Solar System**

- Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (c),(d)

**ESS1.C: The History of Planet Earth**

- Some events on Earth occur in cycles, like day and night, and others have a beginning and an end, like a volcanic eruption. (b)
- Some events, like an earthquake, happen very quickly; others, such as the formation of the Grand Canyon, occur very slowly, over a time period much longer than one can observe. (a)

### Crosscutting Concepts

**Patterns**
Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. (b),(c),(d)

**Stability and Change**
Some things stay the same while other things change. Things may change slowly or rapidly. (a)

***Connections to Engineering, Technology, and Applications of Science***

**Interdependence of Science, Engineering, and Technology**
Science and engineering involve the use of tools to observe and measure things. (e)

*Connections to other DCIs in this grade-level:* **N/A**

*Articulation of DCIs across grade-levels:* **4.PSE, 5.SSS**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.1.2** Identify the main topic and retell key details of a text.
**RI.1.10** With prompting and support, read informational texts appropriately complex for grade
**W.1.2** Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.
**SL.1.5** Add drawings or other visual displays to descriptions when appropriate to clarify ideas, thoughts, and feelings.

*Mathematics –*

**MP.2** Reason abstractly and quantitatively.
**MP.7** Look for and make use of structure.
**1.MD.3** Tell and write time.

# 2.ECS Earth's Changing Surface

## ECS Earth's Changing Surface

Students who demonstrate understanding can:

a. **Obtain and communicate information that water exists in different forms within natural landscapes and determines the variety of life forms that can live there.** [Clarification Statement: Students should gather information on oceans, rivers, lakes, ponds and moisture in the soil.]

b. **Investigate how wind and water can move Earth materials from one place to another and change the shape of landforms.** [Clarification Statement: Examples of changing shapes of landforms could be sediments build up at the mouth of the river, building and rebuilding of sand dunes.]

c. **Design, test, and refine a technological solution that would prevent changes to land caused by wind or water and communicate the solution using sketches, drawings, or physical models.**

d. **Obtain and share information how landforms provide homes for living things.** [Clarification Statement: Examples of landforms that provide homes are caves used as shelters, marshes used for nesting grounds.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**
Modeling in K–2 builds on prior experiences and progresses to include identifying, using, and developing models that represent concrete events or design solutions.
- Distinguish between a model and the actual object, process, and events the model represents. (c)
- Compare models to identify common features and differences. (c)
- Develop and use models (i.e., diagrams, drawings, or physical replicas) that represent amounts, relative scales (bigger, smaller) and patterns. (c)

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Plan and carry out investigations collaboratively. (b)
- Identify questions and make predictions based on prior experiences. (b)

**Obtaining, Evaluating, and Communicating Information:**
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
- Read and comprehend grade-appropriate texts and use other reliable media to acquire scientific. (a),(d)
- Critique and communicate information or design ideas with others in oral and written forms using models and drawings. (c)
- Record observations, thoughts, and ideas. (a),(c)

### Disciplinary Core Ideas

**ESS2.A: Earth Materials and Systems**
- Wind and water can change the shape of the land. The resulting landforms, together with the materials on the land, provide homes for living things. (b),(c),(d)

**ESS2.C: The Roles of Water in Earth's Surface Processes**
- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. It carries soil and rocks from one place to another and determines the variety of life forms that can live in a particular location. (a),(b)

**ETS1.B: Developing Possible Solutions**
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (c)

**ETS1.C: Optimizing the Design Solution**
- Because there is always more than one possible solution to a problem, it is useful to compare designs, test them, and discuss their strengths and weaknesses. (c)

**ETS2.A: Interdependence of Science, Engineering, and Technology**
- Observations and measurements are also used in engineering to help test and refine design ideas. (c)

**ETS2.B: Interactions of Engineering, Technology, Science, Society, and the Natural Environment**
- Developing and using technology has impacts on the natural world. (c)

### Crosscutting Concepts

**Cause and Effect**
Events have causes that generate observable patterns. Simple tests can be designed to gather evidence to support or refute student ideas about causes. (a),(b)

**Systems and System Models**
Objects and organisms can be described in terms of their parts. Systems in the natural and designed world have parts that work together. (d)

*Connections to other DCIs in this grade-level:* **2.LOS, 2.SPM**

*Articulation of DCIs across grade-levels:* **1.LS, 3.WCI, 3.IF, 4.PSE, 4.E**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.2.10** By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 2–3 text complexity band proficiently, with scaffolding as needed at the high end of the range.

**W.2.2** Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.

**W.2.7** Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

**SL.2.1** Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.

**MP.7** Look for and make use of structure.

**2.MD.1** Measure and estimate lengths in standard units.

# 2.SPM Structure, Properties, and Interactions of Matter

## 2.SPM Structure, Properties, and Interactions of Matter

tudents who demonstrate understanding can:

**a. Evaluate natural or designed objects to explain how the properties of the materials suit different purposes.** [Clarification Statement: Examples of materials could be hard turtle shell for protection, soft pillows for comfort.]

**b. Collaborate with others to design an object built from a small set of pieces to solve a technological problem.** [Clarification Statement: Examples of technological problems could be transporting or supporting an object with blocks or construction sets.]

**c. Provide evidence that some changes caused by heating or cooling can be reversed and some cannot.** [Clarification Statement: Examples of reversible changes could be melting chocolate or freezing liquids. Irreversible changes could be cooking food.]

**d. Measure and compare the physical properties of objects.** [Clarification Statement: Students will measure and compare weight and size of objects.] [Assessment Boundary: Mass and weight are not distinguished at this grade level.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

### Science and Engineering Practices

**Analyzing and Interpreting Data**
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Make measurements of length using standard units to quantify data. (d)

**Using Mathematics and Computational Thinking**
Mathematical and computational thinking at the K–2 level builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world.
- Use standard units to measure and compare the lengths of different objects and display the data using simple graphs. (d)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence or ideas in constructing explanations and designing solutions.
- Use information from observations to construct explanations about investigations. (a)
- Use tools and materials provided to design a solution to a specific problem. (b)

**Engaging in Argument from Evidence**
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world.
- Distinguish arguments that are supported by evidence from those that are not. (c)
- Listen actively to others' arguments and ask questions for clarification. (c)

### Disciplinary Core Ideas

**PS1.A: Structure and Properties of Matter**
- Different properties are suited to different purposes. (a)
- A great variety of objects can be built up from a small set of pieces (e.g., blocks, construction sets). (b)
- Objects or samples of a substance can be weighed, and their size can be described and measured. (Boundary: volume is introduced only for liquid measure.) (d)

**PS1.B: Chemical Reactions**
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible (e.g., melting and freezing), and sometimes they are not (e.g., baking a cake, burning fuel). (c)

**ETS2.A: Interdependence of Science, Engineering, and Technology**
- There are many types of tools produced by engineering that can be used in science to help answer these questions through observation and measurement. (d)

### Crosscutting Concepts

**Scale, Proportion, and Quantity**
Relative scales allow objects to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Standard units are used to measure length. (a),(c),(d)

**Energy and Matter**
Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (b)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science, on Society and the Natural World**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Therefore, taking natural materials to make things impacts the environment. (b)

*Connections to other DCIs in this grade-level:* **2.PP, 2.ECS**

*Articulation of DCIs across grade-levels:* **K.SPM, 5.SPM**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**W.2.2** Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.

**W.2.7** Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

**SL.2.3** Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.

*Mathematics –*

**MP.2** Reason abstractly and quantitatively.

**MP.3** Construct viable arguments and critique the reasoning of others.

**2.MD.1,4** Measure and estimate lengths in standard units.

**2.MD.9,10** Represent and interpret data.

# 2.IOS Interdependence of Organisms and Their Surroundings

## 2.IOS Interdependence of Organisms and Their Surroundings

Students who demonstrate understanding can:

a. **Construct a representation in which plants and animals depend on their environment and each other to meet their needs.** [Assessment Boundary: Needs to be limited to food, water, shelter, and a favorable temperature for animals; light, water, and soil for plants.]

b. **Ask questions to clarify ideas about how plants may depend on animals for pollination or to move their seeds around.**

c. **Plan and carry out investigations to test whether plants from different settings have different needs for water, sunlight, and type of soil.** [Clarification Statement: Examples of different settings could be a sunny vs. shady area or a garden vs. a parking lot.]

d. **Observe and compare the many kinds of living things that are found in different areas.** [Clarification Statement: Examples of different areas could be salt vs. fresh water or desert vs. woodland.]

e. **Analyze a representation of a particular habitat showing the locations and shapes of both land and water features of that habitat and communicate how the land and water support animals and plants.** [Clarification Statement: Examples could include plants and animals in the school yard, a park, a pond, a terrarium, or an aquarium.]

f. **Construct an explanation about the effect of environmental changes – whether slow or rapid – on the survival of plants and animals that live there.** [Clarification Statement: Examples of slow or rapid environmental changes could be droughts or floods.]

g. **Obtain and communicate information that some kinds of animals and plants that once lived on Earth are no longer found anywhere, although others living now may resemble them.** [Clarification Statement: Examples elephants which resemble mammoths or tigers which resemble saber-tooth cats.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

### Science and Engineering Practices

**Asking Questions and Defining Problems**
Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.
- Ask questions about observations of the natural world. (b)

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Plan and carry out investigations collaboratively. (c)
- Make observations and measurements to collect data which can be used to make comparisons. (c)
- Identify questions and make predictions based on prior experiences. (c)

**Analyzing and Interpreting Data**
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Use and share pictures, drawings, and writings of observation where appropriate. (d),(e)
- Use observations to note patterns and relationships in order to answer scientific questions. (d)

**Using Mathematics and Computational Thinking**
Mathematical and computational thinking at the K–2 level builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world.
- Decide when to use qualitative vs. quantitative data. (c)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence or ideas in constructing explanations and designing solutions.
- Use information from observations to construct explanations about investigations. (f)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
- Read and comprehend grade-appropriate texts and use other reliable media to acquire scientific information. (g)
- Critique and communicate information with others in oral and written forms using models or drawings. (a)
- Record observations, thoughts, and ideas. (g)

### Disciplinary Core Ideas

**LS2.A: Interdependent Relationships in Ecosystems**
- Animals depend on their surroundings to get what they need, including food, water, shelter, and a favorable temperature. Animals depend on plants or other animals for food. (a)
- Plants depend on air, water, minerals (in the soil), and light to grow. (b)
- Animals can move around, but plants cannot, and they often depend on animals for pollination or to move their seeds around. (b)
- Different plants survive better in different settings because they have varied needs for water, minerals, and sunlight. (c)

**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**
- Organisms obtain the materials they need to grow and survive from the environment. Many of these materials come from organisms, and are used again by other organisms. (a)

**LS2.C: Ecosystem Dynamics, Functioning, and Resilience**
- The places where plants and animals live often change, sometimes slowly and sometimes rapidly. (f)
- When animals and plants get too hot or too cold, they may die. If they cannot find enough food, water, or air, they may die. (f)

**LS4.A: Evidence of Common Ancestry and Diversity**
- Some kinds of plants and animals that once lived on Earth (e.g., dinosaurs) are no longer found anywhere, although others now living (e.g., lizards) resemble them in some ways. (g)

**LS4.C: Adaptation**
- Living things can survive only where their needs are met. If some places are too hot or too cold or have too little water or food, plants and animals may not be able to live there. (f)

**LS4.D: Biodiversity and Humans**
- There are many different kinds of living things in any area, and they exist in different places on land and in water. (d)

**ESS2.B: Plate Tectonics and Large-Scale System Interactions**
- Rocks, soils, and sand are present in most areas where plants and animals live. There may also be rivers, streams, lakes, and ponds. Maps show where things are located. One can map the shapes and kinds of land and water in any area. (e)

### Crosscutting Concepts

**Scale, Proportion, and Quantity**
Relative scales allow objects to be compared and described (e.g., bigger and smaller; hotter and colder; faster and slower). Standard units are used to measure length. (c),(d),(e)

**Stability and Change**
Some things stay the same while other things change. Things may change slowly or rapidly. (f),(g)

*Connections to other DCIs in this grade-level:* **2.ECS**

*Articulation of DCIs across grade-levels:* **1.SF, 3.EIO, 4.PSE, 5.MEE**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.2.10** By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 2–3 text complexity band proficiently, with scaffolding as needed at the high end of the range.

**W.2.2** Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.

**SL.2.1** Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

*Mathematics –*

**MP.2** Reason abstractly and quantitatively.

**MP.3** Construct viable arguments and critique the reasoning of others.

**2.MD.1,4** Measure and estimate lengths in standard units.

**2.MD.10** Represent and interpret data.

# 2.PP Pushes and Pulls

## 2.PP Pushes and Pulls

Students who demonstrate understanding can:

a. **Investigate the effect of pushes and pulls in different directions on the resulting motion of objects.** [Assessment Boundary: Simultaneous pushes and pulls to be along a single line; pushes and pulls to be between objects in contact. Students not to be assessed on quantitative relationships.]

b. **Investigate the effect of pushes and pulls of different strengths on the resulting motion of objects.** [Assessment Boundary: Simultaneous pushes and pulls to be along a single line; pushes and pulls to be between objects in contact. Students not to be assessed on quantitative relationships.]

c. **Construct an explanation for why an object subjected to multiple pushes and pulls might stay in one place or move.** [Assessment Boundary: Pushes and pulls should be between objects in contact]

d. **Analyze data to determine the relationship between friction and the motion of objects.** [Clarification Statement: The data analyzed should be focused on observations on the interaction between objects and the type or slope of the surface. For example, an object sliding on rough vs. smooth surfaces on a slope.]

e. **Analyze data to determine the relationship between friction and the warming of objects.** [Clarification Statement: Data should be observations that allow students to compare the effects of rubbing two objects together.] [Assessment Boundary: Observation of warming is qualitative.]

f. **Develop and share a design solution to reduce friction between two objects.** [Clarification Statement: Examples of ways to reduce friction include putting lubricant on a surface to make objects slide more easily.]

g. **Plan and carry out investigations of how the change in motion and/or shape when objects touch or collide is related to the speed of the objects.** [Clarification Statement: Examples of investigations could include a ball or clay thrown against a wall at different speeds.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan and carry out investigations collaboratively. (g)
- Evaluate different ways of observing an attribute of interest. (g)
- Make observations to collect data which can be used to make comparisons. (a),(b),(g)
- Identify questions and make predictions based on prior experiences. (a),(b)

**Analyzing and Interpreting Data**
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use and share pictures, drawings, and writings of observation where appropriate. (d),(e)
- Use observations to note relationships in order to answer scientific questions and solve problems. (d),(e)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence or ideas in constructing explanations and designing solutions.

- Use information from observations to construct explanations about investigations. (c),(f)
- Use tools and materials provided to design a solution to a specific problem. (f)

### Disciplinary Core Ideas

**PS2.A: Forces and Motion**

- Objects pull or push each other when they collide or are connected. Pushes and pulls can have different strengths and directions. (a),(b)
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (a),(b),(g)
- An object sliding on a surface or sitting on a slope experiences a pull due to friction on the object due to the surface that opposes the object's motion. (d)

**PS2.B: Types of Interactions**

- When objects touch or collide, they push on one another and can change motion or shape. (g)

**PS2.C: Stability and Instability in Physical Systems**

- Whether an object stays still or moves often depends on the effects of multiple pushes and pulls on it (e.g., multiple players trying to pull an object in different directions). It is useful to investigate what pushes and pulls keep something in place (e.g., a ball on a slope, a ladder leaning on a wall) as well as what makes something change or move. (c)

**PS3.C: Relationship Between Energy and Forces**

- A bigger push or pull makes things go faster. Faster speeds during a collision can cause a bigger change in shape of the colliding objects. (b),(g)

**PS3.D: Energy in Chemical Processes and Everyday Life**

- When two objects rub against each other this interaction is called friction. Friction between two surfaces can warm both of them (e.g., rubbing hands together). There are ways to reduce the friction between two objects. (d),(e),(f)

**ETS1.A: Defining Engineering Problems**

- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (f)

### Crosscutting Concepts

**Cause and Effect**
Events have causes that generate observable patterns. Simple tests can be designed to gather evidence to support or refute student ideas about causes. (a),(b),(d),(e),(g)

**Stability and Change**
Some things stay the same while other things change. Things may change slowly or rapidly. (c)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**
Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials. Therefore, taking natural materials to make things impacts the environment. (f)

*Connections to other DCIs in this grade-level:* **2.SPM**

*Articulation of DCIs across grade-levels:* **1.SF, 3.IF, 4.E**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**W.2.2** Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.
**W.2.7** Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).
**SL.2.1** Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.
**MP.3** Construct viable arguments and critique the reasoning of others.
**2.MD.10** Represent and interpret data.

# 3.WCI Weather, Climate, and Impacts

## WCI Weather, Climate, and Impacts

dents who demonstrate understanding can:

a. **Use mathematics and computational thinking to observe and record local weather data over time using standard units.** [Clarification Statement: Examples of weather data to observe includes temperature, precipitation, wind speed, or wind direction. Students should use standards units such as degrees and centimeters per year.]

b. **Analyze and interpret weather data to identify day-to-day variations as well as long-term patterns.** [Clarification Statement: Examples of weather data could include maps and forecasts. Students should address climate in terms of long term patterns.]

c. **Obtain information about different climatic areas to predict typical weather conditions expected in a particular season in a given area.** [Clarification Statement: Examples of climatic areas could include tropical, dry, temperate/moderate, tundra, cold, or polar. The focus is not on addressing each of the areas, rather students should be able to predict typical conditions based on a set of information.]

d. **Obtain and evaluate information about a variety of weather-related hazards that result from natural processes, as well as their environmental and societal impacts.** [Clarification Statement: Examples of natural processes could include severe weather, floods, or coastal erosion.] [Assessment Boundary: Natural hazards limited to weather-related hazards.]

e. **Collaboratively design, compare, and refine solutions that reduce the environmental or societal impact of a weather-related hazard.** [Clarification Statement: Examples of solutions to weather-related hazards could be physical models of barriers to prevent flooding or physical models of buildings that withstand high winds.] [Assessment Boundary: Natural hazards limited to weather-related hazards.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Analyzing and Interpreting Data**
Analyzing data in 3–5 builds on K–2 and progresses to introducing quantitative approaches to collecting data and multiple trials of qualitative observations.
- Compare data collected by different groups in order to discuss similarities and differences in their findings. (b)
- Use data to evaluate and refine design solutions. (e)

**Using Mathematics and Computational Thinking**
Mathematical and computational thinking at the 3–5 level builds on K–2 and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.
- Use mathematical thinking to compare alternative solutions to an engineering problem. (e)
- Analyze simple data sets for patterns that suggest relationships. (b)
  Use standard units to measure area, volume, weight, and temperature. (a)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.
- Compare and synthesize across texts and other reliable media to acquire generate appropriate scientific information. (c)
- Synthesize information in written text with that contained in corresponding tables, diagrams, and charts. (c),(d)
- Generate and communicate scientific information orally and in written formats using various forms of media, and may include tables, diagrams, and charts. (c)
- Use models to share findings or solutions in oral or written presentations, or extended discussions. (d)

### Disciplinary Core Ideas

**ESS2.D: Weather and Climate**
- Weather is the minute-by-minute to day-by-day variation of the atmosphere's condition on a local scale. 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. Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years to centuries. (a),(b),(c)

**ESS3.B: Natural Hazards**
- A variety of natural hazards result from natural processes (e.g. severe weather, floods, and coastal erosion). Humans can not eliminate natural hazards but can take steps to reduce their impacts. (d)

**ETS2.B: Interactions of Engineering, Technology, Science, Society, and the Natural Environment**
- When new technologies become available, they can bring about changes in the way people live and interact with one another. (e)

### Crosscutting Concepts

**Patterns**
Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena and designed products. Cyclic patterns of change related to time can be used to make predictions. (b),(c)

***Connections to Engineering, Technology, and Applications of Science***

**Interdependence of Science, Engineering, and Technology**
Science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies. (a)

**Influence of Engineering, Technology, and Science on Society and the Natural World**
People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another. (d),(e)

*Connections to other DCIs in this grade-level:* **N/A**

*Articulation of DCIs across grade-levels:* **K.WEA, 2.ECS, 4.LCT, MS.ESS-WC**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

*Consider adding RI.3,4,5,8*

**RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.
**RI.3.9** Compare and contrast the most important points and key details presented in two texts on the same topic.
**RI.3.10** By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 2–3 text
**SL.3.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.
**MP.7** Look for and make use of structure.
**3.MD.1,2** Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.
**3.MD.3** Represent and interpret data.

# 3.EIO Environmental Impacts on Organisms

## 3.EIO Environmental Impacts on Organisms

Students who demonstrate understanding can:

a. **Obtain, evaluate, and communicate information about the types of habitats in which organisms live, and ask questions based on that information.** [Clarification Statement: Examples of habitats could be ponds, woods, grasslands, or deserts. Questions could include how changes in habitats affect the organisms living there.]

b. **Obtain, evaluate, and communicate information that in any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.** [Clarification Statement: An example could be that plants that require a lot of water would not survive well in a desert.]

c. **Analyze data to describe how humans, like all other organisms, obtain living and non-living resources from their environment.** [Clarification Statement: Examples of living and non-living resources could include minerals, food, and energy.]

d. **Use models to evaluate how environmental changes in a habitat affect the number and types of organisms that live there; some remain, move in, move out, and/or die.** [Clarification Statement: Examples of environmental changes could be extra water in a normally dry area, pollution, or fire. An example of how environmental changes can affect organisms could be the effects of a decrease in grass on a rabbit population.]

e. **Use evidence to argue that some changes in an organism's habitat can be beneficial or harmful to the organism.**

f. **Obtain and communicate information about the characteristics of groups of organisms and evaluate how groups help organisms survive.** [Clarification Statement: The characteristics of organisms students should address are composition, organization, specialization, and stability. Examples of how groups help organisms survive could be worker bees supplying food and queens reproducing, female lions in a pride hunting and males patrolling the territory, or human families caring for children.] [Assessment Boundary: Detailed structure of social insect societies not to be included.]

g. **Use data about the characteristics of organisms and habitats to design an artificial habitat in which the organisms can survive.**

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

### Science and Engineering Practices

**Asking Questions and Defining Problems**
Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying qualitative relationships.
- Ask questions based on careful observations of phenomena and information. (a)

**Developing and Using Models**
Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.
- Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system. (d)

**Analyzing and Interpreting Data**
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Display data in tables and graphs, using digital tools when feasible, to reveal patterns that indicate relationships. (c)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.
- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or solution to a problem. (g)
- Apply scientific knowledge to solve design problems. (g)

**Engaging in Written and Oral Argument from Evidence**
Engaging in argument from evidence in 3–5 builds from K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world.
- Construct and/or support scientific arguments drawing on evidence, data, or a model. (e)
- Compare and refine multiple arguments based on the strengths and weaknesses of the evidence supporting the argument. (e)
- Respectfully provide and receive critique on the scientific arguments proposed by peers by citing relevant evidence and making logical arguments. (e)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.
- Compare and synthesize across texts and other reliable media to acquire and generate appropriate scientific information. (a),(b),(f)
- Generate and communicate scientific information orally and in written formats using various forms of media, and may include tables, diagrams, and charts. (a),(f)
- Use models to share findings or solutions in oral presentations, written presentations, and extended discussions and evaluate the merit and accuracy of ideas and methods. (d)

### Disciplinary Core Ideas

**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. (b),(g)

**LS2.D: Social Interactions and Group Behavior**
- Groups can be collections of equal individuals, hierarchies with dominant members, small families, groups of single or mixed gender, or groups composed of individuals similar in age. Some groups are stable over long periods of time; others are fluid, with members moving in and out. Some groups assign specialized tasks to each member; in others, all members perform the same or a similar range of functions. (e),(f)

**LS4.C: Adaptation**
- Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (b),(d),(e),(g)

**LS4.D: Biodiversity and Humans**
- Populations of organisms live in a variety of habitats, and change in those habitats affects the organisms living there. (a),(b)
- Humans, like all other organisms, obtain living and nonliving resources from their environments. (c)

### Crosscutting Concepts

**Cause and Effect**
Cause and effect relationships are routinely identified, tested, and used to explain change. Events that occur together with regularity might or might not be a cause and effect relationship. (d),(f)

**Systems and System Models**
A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. A system can be described in terms of its components and their interactions. (a),(b),(c),(e)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**
Over time, people's needs and wants change, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another. (g)

# 3.EIO Environmental Impacts on Organisms

**'O Environmental Impacts on Organisms *(continued)***

*ctions to other DCIs in this grade-level:* **3.SFS**

*Articulation of DCIs across grade-levels:* **1.SF, 2.IOS, MS.LS-NSA, MS.LS-IRE**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.3.10** By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 2–3 text complexity band independently and proficiently.

**W.3.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**SL.3.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.

**SL.3.4** Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

*Mathematics –*

**MP.2** Reason abstractly and quantitatively.

**MP.3** Construct viable arguments and critique the reasoning of others.

**3.MD.3** Represent and interpret data.

# 3.SFS Structure, Function, and Stimuli

## 3.SFS Structure, Function, and Stimuli

Students who demonstrate understanding can:

a. **Investigate and explain how internal and external structures in plants serve functions of growth, survival, behavior, and reproduction.** [Clarification Statement: Examples of internal and external structures could include roots, thorns, or veins in leaves.] [Assessment Boundary: Emphasis on understanding the macroscale systems and their function, not microscopic processes.]

b. **Construct explanations of how structures in animals serve functions of growth, survival, reproduction, and behavior.** [Clarification Statement: Examples of internal and external structures could include heart, teeth, bones, brains, muscles, or skin.] [Assessment Boundary: Emphasis on understanding the macroscale systems and their function, not microscopic processes.]

c. **Design a device that replaces an external structure and analyze data on its physical properties to compare alternative solutions to the problem.** [Clarification Statement: Examples could include designing crutches or prostheses to replace a leg and testing the strength of different models or designing a grabber to replace a hand and testing its effectiveness.]

d. **Use observations and models to design a simple process to classify plants and animals based on their structures.** [Clarification Statement: Examples of categories of classification could be plants that make flowers, plants that make cones, and plants that make neither; vertebrates have backbones, mammals have hair, insects have six legs, or birds have feathers.] [Assessment Boundary: Students need to know that plants and animals can be classified but not use a classification chart.]

e. **Obtain information that animals have structures that allow them to respond to stimuli through instinct or memory.** [Clarification Statement: Examples of structures could be eyes, ears, or brain. Examples of responding to stimuli could be running from danger or learning the alphabet.]

f. **Investigate and explain that for an object to be seen, light must be reflected off the object and enter the eye.** [Clarification Statement: Examples of investigations could include students using mirrors to reflect light into the eye.] [Assessment Boundary: Emphasis on understanding the phenomenon that light traveling from the object to the eye determines what is seen.]

g. **Investigate and provide evidence that the color people see depends on the color of the available light sources as well as the properties of the surface of the object reflecting the light.** [Clarification Statement: Examples of investigations could be illuminating objects with different colors of light or illuminating objects that have different surfaces.] [Assessment Boundary: This phenomenon is observed, but no attempt is made to discuss what confers the color reflection and absorption properties on a surface.]

### Science and Engineering Practices

**Developing and Using Models**
Modeling in K–2 builds on prior experiences and progresses to include identifying, using, and developing models that represent concrete events or design solutions.
- Use simple models to describe phenomena concerning the functioning of a natural or designed system. (d)

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Make observations, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon or test a design solution. (a),(d),(f),(g)

**Using Mathematics and Computational Thinking**
Mathematical and computational thinking at the 3–5 level builds on K–2 and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.
- Use mathematical thinking and computational outcomes to compare alternative solutions to an engineering problem. (c)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.
- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or solution to a problem. (b),(c),(d)
- Apply scientific knowledge to solve design problems. (c),(d)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.
- Compare and synthesize across texts and other reliable media to acquire appropriate scientific information. (e)

### Disciplinary Core Ideas

**PS4.B: Electromagnetic Radiation**
- An object can be seen when light reflected from its surface enters the eyes; the color people see depends on the color of the available light sources as well as the properties of the surface. (f),(g)

**LS1.A: Structure and Function**
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (a),(b),(c)

**LS1.D: Information Processing**
- Different sense receptors are specialized for particular kinds of information, which may be then processed and integrated by the animal's brain, with some information stored as memories. Animals are able to use their perceptions and memories to guide their actions. Some responses to information are instinctive—that is, animals' brains are organized so that they do not have to think about how to respond to certain stimuli. (e)

**LS4.D: Biodiversity and Humans**
- Scientists have identified and classified many plants and animals. (d)

### Crosscutting Concepts

**Cause and Effect**
Cause and effect relationships are routinely identified, tested, and used to explain change. Events that occur together with regularity might or might not be a cause and effect relationship. (f),(g)

**Structure and Function**
Different materials have different substructures, which can sometimes be observed. Substructures have shapes and parts that serve functions. (a),(b),(e)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**
People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another. (c),(d)

*Connections to other DCIs in this grade-level:* **3.EIO**

*Articulation of DCIs across grade-levels:* **1.LS, 1.SF, 5.SSS, MS.LS-SFIP, MS.LS-IRE**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.3.10** By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 2–3 text complexity band independently and proficiently.

**W.3.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**SL.3.4** Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.

**MP.3** Construct viable arguments and critique the reasoning of others.

**MP.7** Look for and make use of structure.

**3.MD.1,2** Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.

**3.MD.3** Represent and interpret data.

# 3.IF Interactions of Forces

## 3.IF Interactions of Forces

dents who demonstrate understanding can:

**a. Investigate the motion of objects to determine observable and measurable patterns to predict future motions.** [Clarification Statement: Examples of motions are a ball rolling down a slide or a child swinging in a swing.] [Assessment Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity are not introduced.]

**b. Investigate the motion of objects by comparing the relative sizes and direction of forces on an object at rest to the forces on an object whose motion is changing.** [Clarification Statement: Examples investigations could include pulling a wagon or pushing on a heavy object that will not slide.] [Assessment Boundary: Dependence on variables of motion is to be tested one variable at a time. The size and direction of forces should be qualitative. Gravity only to be addressed as a force that pulls objects down.]

**c. Use models to explain the effects of balanced and unbalanced forces on a system.**

**d. Investigate the forces between two or more magnets to identify patterns.** [Clarification Statement: Examples of patterns could include strength of attraction and distance, attracting or repelling based on orientation.]

**e. Investigate the push-and-pull forces between objects not in contact with one another.** [Clarification Statement: Examples of objects could be force on hair from an electrically charged balloon or the force between two magnets.] [Assessment Boundary: Energy and gravity are not to be assessed. Assessment is limited to forces produced by objects that can be manipulated and observed by students.]

**f. Design and refine solutions to a problem by using magnets to move objects not in contact with one another.** [Clarification Statement: Examples of solutions could be to move a metal object through a maze or build a model of a maglev train.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education:*

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Construct a model using an analogy, example, or abstract representation to explain a scientific principle or design solution. (c)
- Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system. (c)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and carry out investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. (e)
- Make observations, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon. (b),(d)
- Formulate questions and predict reasonable outcomes based on patterns such as cause and effect relationships. (a)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.

- Apply scientific knowledge to solve design problems. (f)

### Disciplinary Core Ideas

**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 a 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. (b),(c)
- 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. (a)

**PS2.B: Types of Interactions**

- Objects in contact exert forces on each other (friction, elastic pushes and pulls). Electric, magnetic, and gravitational forces between a pair of objects do not require that the objects be in contact—for example, magnets push or pull at a distance. 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. (d),(e),(f)

**PS2.C: Stability and Instability in Physical Systems**

- A system can change as it moves in one direction (e.g., a ball rolling down a hill), shift back and forth (e.g., a swinging pendulum), or go through cyclical patterns (e.g., day and night). (a)
- Examining how the forces on and within the system change as it moves can help explain a system's patterns of change. (b)
- A system can appear to be unchanging when processes within the system are going on at opposite but equal rates (e.g., water behind a dam is at a constant height because water is flowing in at the same rate that water is flowing out). (c)
- Changes can happen very quickly or very slowly and are sometimes hard to see (e.g., plant growth). Conditions and properties of the objects within a system affect how fast or slowly a process occurs (e.g., heat conduction rates). (c)

**ETS2.A: 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. (f)

### Crosscutting Concepts

**Patterns**

Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena and designed products. Cyclic patterns of change related to time can be used to make predictions. (a),(d),(e)

**Systems and System Models**

A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. A system can be described in terms of its components and their interactions. (c)

**Stability and Change**

Change is measured in terms of differences over time and may occur at different rates. Some systems appear stable, but over long periods of time will eventually change. (b)

***Connections to Engineering, Technology, and Applications of Science***

**Interdependence of Science, Engineering, and Technology**

Science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies. (f)

*Connections to other DCIs in this grade-level:* **N/A**

*Articulation of DCIs across grade-levels:* **1.LS, 2.PP, 2.ECS, 4.WAV, 5.SSS, MS.PS-FM, MS.PS-IF**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

**SL.3.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.

**SL.3.3** Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.

**MP.2** Reason abstractly and quantitatively.

**MP.3** Construct viable arguments and critique the reasoning of others.

**3.MD.1** Solve problems involving measurement and estimation of intervals of time.

# 4.LCT Life Cycles and Traits

## 4.LCT Life Cycles and Traits

tudents who demonstrate understanding can:

a. **Investigate the life cycles of plants and animals to compare similarities and differences among organisms.** [Clarification Statement: Examples of organisms to compare could be flowering plants, butterflies, and frogs.] [Assessment Boundary: Reproduction is addressed as part of the process – birth, growth, development, reproduction, death – and the different ways organisms go through the process.]

b. **Use evidence to compare characteristics inherited from parents, characteristics caused by the environment, and those resulting from both.** [Clarification Statement: Examples of characteristics inherited from parents could be the ability to roll one's tongue or characteristics of domestic animals; characteristics caused by the environment could be a scar or language; and characteristics resulting from both could be height or some health conditions.] [Assessment Boundary: The mechanisms of inheritance are not to be included.]

c. **Provide evidence that offspring can inherit different information from their parents.** [Clarification Statement: Examples of different information that can be inherited could be different coat colors in dogs of the same litter or one sibling who needs glasses and another who does not.] [Assessment Boundary: The genetic mechanisms of inheritance are not to be included.]

d. **Obtain and communicate information about different versions of the same traits in different kinds of organisms.** [Clarification Statement: Examples of different kinds of animals having different versions of the same trait could include the different lengths, textures, and colors of feathers, hair, or fur of different animals.] [Assessment Boundary: The genetic mechanisms of inheritance are not to be included.]

e. **Use evidence to describe patterns of variation in a trait across individuals of the same kind of organism.** [Clarification Statement: Examples of variation in a trait across individuals of the same kind of organism could be different coloration of wolves or thickness of wool in sheep.] [Assessment Boundary: The genetic mechanisms of inheritance are not to be included.]

f. **Use evidence to explain how some characteristics that vary among individuals of the same kind of organism can provide advantages to survive, find mates, and reproduce.** [Clarification Statement: Examples of advantages could include animals that run faster are better escape predators or birds with brighter colored feathers are more likely to attract mates.]

g. **Obtain information to explain how breeders use variations in traits to produce desired types of domesticated organisms.** [Clarification Statement: Examples could be sheep that are bred for thicker wool coats or disease resistant corn that is used in cultivation.]

h. **Obtain and communicate information that some characteristics of organisms have been used to inspire technology that meets societal needs.** [Clarification Statement: Students could identify technologies that utilize advantageous characteristics of organisms such as: sonar, insulated vests, camouflage fatigues, Velcro.] [Assessment Boundary: Mechanisms of production not included at this grade band. Focus is on utility only.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Make observations and measurements, collect data, and identify patterns that will provide evidence for explaining phenomena. (a)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.
- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or solution to a problem. (b),(e),(f),(g)

**Engaging in Argument from Evidence**
Engaging in argument from evidence in 3–5 builds from K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world.
- Support scientific arguments drawing on evidence, data, or a model. (c)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.
- Compare and synthesize across texts and other reliable media to acquire and generate appropriate scientific information. (d),(g),(h)
- Generate and communicate scientific information orally and in written formats using various forms of media and may include tables, diagrams, and charts. (d),(h)

### Disciplinary Core Ideas

**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 that include being born (sprouting in plants), growing, developing into adults, reproducing, and eventually dying. (a)

**LS3.A: Inheritance of Traits**
- Many characteristics of organisms are inherited from their parents. Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (b)

**LS3.B: Variation of Traits**
- Offspring acquire a mix of traits from their biological parents. Different organisms vary in how they look and function because they have different inherited information. In each kind of organism there is variation in the traits themselves, and different kinds of organisms may have different versions of the trait. (c),(d),(e)
- The environment also affects the traits that an organism develops—differences in where they grow or in the food they consume may cause organisms that are related to end up looking or behaving differently. (b)

**LS4.B: Natural Selection**
- Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (f),(h),(g)

**ETS2.B: Interactions of Engineering, Technology, Science, Society, and the Natural Environment**
- Over time, people's needs and wants change as do their demands for new and improved technologies. (h)

### Crosscutting Concepts

**Patterns**
Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena and designed products. Cyclic patterns of change related to time can be used to make predictions. (a),(e)

**Cause and Effect**
Cause and effect relationships are routinely identified, tested, and used to explain change. Events that occur together with regularity might or might not be a cause and effect relationship. (b),(c),(d),(f)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**
People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another. (g),(h)

*Connections to other DCIs in this grade-level:* **4.PSE**

*Articulation of DCIs across grade-levels:* **1.SF, 2.ECS, 2.IOS, 4.PSE, 5.ESI, MS.LS-GDRO**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.4.10** By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

**W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**SL.4.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

**SL.4.4** Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

*Mathematics –*

**1P.3** Construct viable arguments and critique the reasoning of others.

**4P.7** Look for and make use of structure.

**3.MD.3** Represent and interpret data.

# 4.PSE Processes that Shape the Earth

## PSE Processes that Shape the Earth

Students who demonstrate understanding can:

a. **Ask testable questions about the effects of moving water on the rate of erosion under various conditions and plan and carryout investigations to observe and document the effects.** [Clarification Statement: Examples of variables to test could be angle of slope, amount of vegetation, or volume of flow.] [Assessment Boundary: Ratios should not be included in quantitative analysis.]

b. **Obtain and communicate information about how patterns in tree rings and ice cores are used as evidence to describe the recent history of Earth's climate.** [Assessment Boundary: Students not to be assessed on their understanding of deep time.]

c. **Use evidence to explain how the physical characteristics of local areas are affected by the processes of weathering and erosion, including the activities of living organisms.** [Clarification Statement: Examples of activities of living organisms could be tree planting, beaver dams, or human-built dams and waterways.]

d. **Use evidence to construct an explanation that some rocks and minerals are formed from the remains of organisms.**

e. **Use evidence from the fossil record to construct an explanation for the relationship between types of organisms living today and types of organisms that lived in the past.**

f. **Use evidence to construct explanations for how environments today may be different from past environments in which fossilized organisms once lived.** [Clarification Statement: Examples of evidence of environments that have changed could be seashell fossils found on mountains or petrified wood found in deserts.]

g. **Obtain information about the locations of a variety of Earth's features and map the geographic patterns that emerge.** [Clarification Statement: Examples of features could be volcanoes and earthquakes that are often found at the boundaries of continents and the ocean floor or major mountain chains that often form near the edges of continents.]

h. **Analyze maps and other data to determine the likelihood of geological hazards occurring in an area and evaluate the possible effects on landforms and organisms.** [Assessment Boundary: Results of analysis and evaluation are qualitative.]

i. **Construct models, based on research, to test and refine various design solutions for reducing the impacts of geological hazards.**

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Asking Questions and Defining Problems**

Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying qualitative relationships.

- Identify scientific (testable) and non-scientific questions. (a)

**Developing and Using Models**

Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Construct and revise models collaboratively to measure and explain frequent and regular events. (g)
- Construct a model using an analogy, example, or abstract representation to explain a scientific principle. (i)
- Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system. (i)
- Identify limitations of models. (i)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and carry out investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. (a)
- Make observations and measurements, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon or test a design solution. (a)

**Analyzing and Interpreting Data**

Analyzing data in 3–5 builds on K–2 and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.

- Display data in tables and graphs, using digital tools when feasible, to reveal patterns that indicate relationships. (h)
- Use data to evaluate claims about cause and effect. (h)
- Compare data collected by different groups in order to discuss similarities and differences in their findings. (h)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.

- Use quantitative relationships to construct explanations of observed events (e.g., the distribution of plants in the back yard or why some things sink and others float). (e)

### Disciplinary Core Ideas

**LS4.A: Evidence of Common Ancestry and Diversity**

- Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments. Fossils can be compared with one another and to living organisms according to their similarities and differences. (d),(e),(f)

**ESS1.C: The History of Planet Earth**

- Earth has changed over time. Understanding how landforms develop, are weathered (broken down into smaller pieces), and erode (get transported elsewhere) can help to infer the history of the current landscape. (a),(f)
- 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. (g)
- Patterns of tree rings and ice cores from glaciers can help reconstruct Earth's recent climate history. (b)

**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. (a),(c)

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

- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features where people live and in other areas of Earth. (g)

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

- The downhill movement of water as it flows to the ocean shapes the appearance of the land. (a)

**ESS2.E: Biogeology**

- Living things affect the physical characteristics of their regions (e.g., plants' roots hold soil in place, beaver shelters and human-built dams alter the flow of water, plants' respiration affects the air). Many types of rocks and minerals are formed from the remains of organisms or are altered by their activities. (c),(d)

**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. (h),(i)

**ETS1.B: Designing Solutions to Engineering Problems**

- Research on a problem should be carried out—for example, through Internet searches, market research, or field observations—before beginning to design a solution. An often productive way to generate ideas is for people to work together to brainstorm, test, and refine possible solutions. (h),(i)

### Crosscutting Concepts

**Patterns**

Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena and designed products. Cyclic patterns of change related to time can be used to make predictions. (b),(g)

**Cause and Effect**

Cause and effect relationships are routinely identified, tested, and used to explain change. Events that occur together with regularity might or might not be a cause and effect relationship. (a),(c),(d),(h)

**Stability and Change**

Some stable systems are static while others change in different ways. Some systems appear stable, but over long periods of time will eventually change. (e),(f)

***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**

People's needs and wants change, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another. (i)

# 4.PSE Processes that Shape the Earth

## 4.PSE Processes that Shape the Earth *(continued)*

- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or solution to a problem. (d),(e),(f)
- Identify the evidence that supports an explanation. (d),(e)

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 3–5 builds from K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world.

- Construct and support scientific arguments drawing on evidence, data, or a model. (c)

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.

- Compare and synthesize across texts and other reliable media to acquire and generate appropriate scientific information. (b),(g)
- Synthesize information in written text with that contained in corresponding tables, diagrams, and charts. (g)
- Generate and communicate scientific information orally and in written formats using various forms of media and may include tables, diagrams, and charts. (b)
- Use models to share findings in oral and written presentations, and extended discussions. (g)

- Testing a solution involves investigating how well it performs under a range of likely conditions. (i)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (i)

*Connections to other DCIs in this grade-level:* **4.LCT, 4.WAV**

*Articulation of DCIs across grade-levels:* **K.OTE, K.WEA, 1.PC, 2.ECS, 2.IOS, 3.WCI, 5.ESI, MS.ESS-HE, MS.ESS-WC, MS.ESS-EIP, MS.LS-NSA. MS.ETS-ED**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.4.10** By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

**W.4.9** Draw evidence from literary or informational texts to support analysis, reflection, and research.

**SL.4.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

**SL.4.2** Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.

**MP.3** Construct viable arguments and critique the reasoning of others.

**MP.7** Look for and make use of structure.

**4.G.1** Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

**3.MD.2** Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.

# 4.E Energy

## E Energy

dents who demonstrate understanding can:

a. **Construct a simple explanation for the relationship between energy and motion.** [Clarification Statement: Examples could be that a faster ball will make a louder sound when it hits the wall than a slower one or a fast car has more energy than a slow car.] [Assessment Boundary: No attempt is made to give a precise definition of energy.]

b. **Carry out investigations to provide evidence that energy is transferred from place to place by sound, light, heat, electric currents, interacting magnets, and moving or colliding objects.** [Assessment Boundary: Quantitative measurements of energy are beyond the scope of assessment.]

c. **Obtain and communicate information for how technology allows humans to concentrate, transport, and store energy for practical use.** [Clarification Statement: Examples could be batteries in electrical devices, power grids, or gasoline stations.]

d. **Design and construct a device that converts energy from one form to another using given design criteria.** [Clarification Statement: Examples of devices could be a windmill, watermill, alarm circuit, bell, or solar oven.]

e. **Design and test a solution to a problem that utilizes the transfer of electric energy in the solution using given design constraints.** [Clarification Statement: Examples of solutions could be a flashlight, electric motor, or doorbell.]

f. **Develop a model using examples to explain differences between renewable and non-renewable sources of energy.** [Assessment Boundary: Should not include climate change.]

g. **Construct simple explanations for how forces on an object cause the object to change its energy.** [Clarification Statement: Examples of explanations could include how an unbalanced force is required to put an object in motion or stop the motion of an object.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Construct a model using an analogy, example, or abstract representation to explain a scientific principle or design solution. (f)
- Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a designed system. (e)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon or test a design solution. (b),(g)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.

- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or solution to a problem. (a),(h)
- Apply scientific knowledge to solve design problems. (d)

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.

- Compare and synthesize across texts and other reliable media to acquire and generate appropriate scientific and technical information. (c)
- Generate and communicate scientific and technical information orally and in written formats using various forms of media and may include tables, diagrams, and charts. (c)

### Disciplinary Core Ideas

**PS3.A: Definitions of Energy**

- The faster a given object is moving, the more energy it possesses. Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (Boundary: At this grade level, no attempt is made to give a precise or complete definition of energy.) (a),(b)

**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. (a)
- Light also transfers energy from place to place. For example, energy radiated from the sun is transferred to the earth by light. When this light is absorbed, it warms Earth's land, air, and water and facilitates plant growth. (b)
- 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 (e.g., moving water driving a spinning turbine which generates electric currents). (e)

**PS3.C: Relationship Between Energy and Forces**

- When objects collide, the contact forces transfer energy so as to change the objects' motions. Magnets can exert forces on other magnets or on magnetizable materials, causing energy transfer between them (e.g., leading to changes in motion) even when the objects are not touching. (a),(g)

**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—for example, the stored energy of water behind a dam is released so that it flows downhill and drives a turbine generator to produce electricity. (c),(d)
- It is important to be able to concentrate energy so that it is available for use where and when it is needed. For example, batteries are physically transportable energy storage devices, whereas electricity generated by power plants is transferred from place to place through distribution systems. (c)

**ESS3.A: Natural Resources**

- All materials, 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. (f)

**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. (d),(e)

**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. (e)

### Crosscutting Concepts

**Energy and Matter**

Matter is made of particles. Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. Energy can be transferred in various ways and between objects. (a),(b),(c),(f),(g),(h)

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***Connections to Engineering, Technology, and Applications of Science***

**Influence of Engineering, Technology, and Science on Society and the Natural World**

People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another. (d),(e)

# 4.E Energy

**4. E Energy *(continued)***

*Connections to other DCIs in this grade-level:* **4.WAV**

*Articulation of DCIs across grade-levels:* **K.OTE, K.WEA, 2.PP, 2.ECS, MS.PS-E, MS.PS-CR, MS.ESS-EIP, MS.ETS-ED**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.4.10** By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

**W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**W.4.9** Draw evidence from literary or informational texts to support analysis, reflection, and research.

**SL.4.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.

**MP.2** Reason abstractly and quantitatively.

**MP.3** Construct viable arguments and critique the reasoning of others.

**MP.7** Look for and make use of structure.

**4.MD.2** Solve problems involving measurement and conversion of measuremtns from a larger unit to a smaller unit.

# 4. WAV Waves

## WAV Waves

dents who demonstrate understanding can:

a. **Investigate the motions of waves on the surface of water to identify patterns.** [Assessment Boundary: Observations are qualitative, not quantitative.]

b. **Use a model to describe the amplitude and wavelength of waves.**

c. **Investigate how waves affect the motions of objects to provide evidence that waves transfer energy to objects as a wave passes.** [Clarification Statement: An example of evidence could be corks bobbing up and down as a wave passes.] [Assessment Boundary: Observations are qualitative not quantitative.]

d. **Investigate the interaction of two waves to describe how waves add or cancel one another depending on their relative phase.** [Clarification Statement: Examples of investigations could be two pebbles dropped in water or a slinky shaken at both ends to produce waves that cross.] [Assessment Boundary: The wave nature of light is not included and observations are qualitative, not quantitative.]

e. **Obtain and share information about naturally occurring waves which transfer energy.** [Clarification Statement: Naturally occurring waves should include ocean, sound, and seismic waves. Evidence that can be used to show transfer of energy could include coastal erosion or earthquake damage.]

f. **Design, refine, and evaluate a model to solve a problem of transferring information using mechanical waves that can be decoded and communicate the design to others.** [Clarification Statement: An example of transferring information could be drums that send information through sound waves.]

g. **Obtain and communicate information about modern devices that are used to transmit and receive digital information.** [Clarification Statement: An example of a modern device that can be used to transmit and receive digital information could be cell phones.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Construct a model using an analogy, example, or abstract representation to explain a scientific principle or design solution. (f)
- Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system. (b)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Discuss and evaluate appropriate methods and tools for collecting data. (a)
- Make observations, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon or test a design solution. (c),(d)
- Formulate questions and predict reasonable outcomes based on patterns such as cause and effect relationships. (c)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.

- Apply scientific knowledge to solve design problems. (f)

**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluate the merit and accuracy of ideas and methods.

- Compare and synthesize across texts and other reliable media to acquire and/or generate appropriate scientific and technical information. (e),(g)
- Synthesize information in written text with that contained in corresponding tables, diagrams, and charts. (e)
- Critique and communicate scientific and technical information orally and in written formats using various forms of media and may include tables, diagrams, and charts. (e),(g)

### Disciplinary Core Ideas

**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; it does not move in the direction of the wave—observe, for example, a bobbing cork or seabird—except when the water meets the beach. (Note: This grade band endpoint was moved from K–2). (a),(c)
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (b)
- Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (d)
- Earthquakes cause seismic waves, which are waves of motion in Earth's crust. (e)

**PS4.C: Information Technologies and Instrumentation**

- Digitized information (e.g., the pixels of a picture) can be stored for future recovery or 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. (g)

**ETS1.B: Developing Possible Solutions**

- There are many types of models, ranging from simple physical models to computer models. They can be used to investigate how a design might work, communicate the design to others, and compare different designs. (f)

**ETS2.A: Interdependence of Science, Engineering, and Technology**

- Knowledge of relevant scientific concepts and research findings is important in engineering. (f)

### Crosscutting Concepts

**Patterns**

Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena and designed products. Cyclic patterns of change related to time can be used to make predictions. (a),(b),(d)

**Energy and Matter**

Matter is made of particles. Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. Energy can be transferred in various ways and between objects. (c),(e)

***Connections to Engineering, Technology, and Applications of Science***

**Interdependence of Science, Engineering, and Technology**

Science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies. (f),(g)

*Connections to other DCIs in this grade-level:* **4.E, 4.PSE**

*Articulation of DCIs across grade-levels:* **1.LS, 3.IF, 5.SSS, MS.PS-WER, MS.ETS-ED**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.4.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

**RI.4.10** By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

**W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**SL.4.4** Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.

**MP.3** Construct viable arguments and critique the reasoning of others.

**7** Look for and make use of structure.

**A.5** Generate and analyze patterns.

# 5.SPM Structure, Properties, and Interactions of Matter

## 5. SPM Structure, Properties, and Interactions of Matter

Students who demonstrate understanding can:

a. **Use the model that matter is made of particles too small to be seen to describe and explain everyday phenomena.** [Clarification Statement: Examples of everyday phenomena could be inflating a balloon, effect of air on large objects, or the smell of food cooking.]

b. **Investigate physical properties of materials and use the properties to distinguish one material from another.** [Clarification Statement: Examples of physical properties can include salt dissolving in water while sand does not; copper wire conducting electric current and shoelaces do not; a metal spoon conducting heat and a wooden spoon does not.]

c. **Investigate the interaction of two or more substances to provide evidence that when different substances are mixed, one or more new substances with different properties may or may not be formed depending on the substances and the temperature.** [Clarification Statement: Examples of interactions forming new substances can include mixing baking soda and vinegar. Examples of interactions not forming new substances can include mixing baking soda and water.]

d. **Plan and carry out investigations to determine the effect on the total weight of a substance when the substance changes shape, phase, and/or is dissolved.** [Assessment Boundary: No attempt should be made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.]

e. **Investigate and determine the effect on the total weight of matter when substances interact to form new substances.** [Clarification Statement: Examples of interacting substances can include putting wet steel wool in a closed container and letting it rust, and mixing vinegar and milk in a closed container.] [Assessment boundary: Mass and weight are not distinguished at this grade level.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**
Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.
- Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system. (a)

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Plan and carry out investigations collaboratively, using fair tests in which variables are controlled and the number of trials considered. (c),(d),(e)
- Make observations, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon or test a design solution. (c),(c)

**Using Mathematics and Computational Thinking**
Mathematical and computational thinking at the 3–5 level builds on K–2 and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.
- Use standard units to measure area, volume, weight, and temperature. (c),(d)

### Disciplinary Core Ideas

**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 (e.g., by weighing or by its effects on other objects). For example, 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; the effects of air on larger particles or objects (e.g., leaves in wind, dust suspended in air); and the appearance of visible scale water droplets in condensation, fog, and, by extension, also in clouds or the contrails of a jet. (a)
- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish (e.g., sugar in solution, evaporation in a closed container). (c)
- Measurements of a variety of properties (e.g., hardness, reflectivity) can be used to identify materials. (b)

**PS1.B: Chemical Reactions**
- When two or more different substances are mixed, a new substance with different properties may be formed; such occurrences depend on the substances and the temperature. (c)
- No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (d),(e)

### Crosscutting Concepts

**Energy and Matter**
Matter is made of particles. Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. Energy can be transferred in various ways and between objects. (a),(d),(e)

**Structure and Function**
Different materials have different substructures, which can sometimes be observed. Substructures have shapes and parts that serve functions. (b),(c)

*Connections to other DCIs in this grade-level:* **5.MEE**

*Articulation of DCIs across grade-levels:* **2.SPM, MS.PS-SPM, MS.PS-CR**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**W.5.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
**W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research.

*Mathematics –*

**MP.2** Reason abstractly and quantitatively.
**MP.3** Construct viable arguments and critique the reasoning of others.
**MP.7** Look for and make use of structure.
**5.OA.1** Write and interpret numerical expressions.
**4.MD.2** Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

# 5.MEE Matter and Energy in Ecosystems

## MEE Matter and Energy in Ecosystems

Students who demonstrate understanding can:

a. **Construct models of food webs to explain the interrelationship among plants, animals, and fungi within ecosystems.**

b. **Use models to trace the cycling of particles of matter between the air and soil and among plants, animals, and microbes.** [Assessment Boundary: The emphasis is on students applying the particle model to explain how matter cycles; it does not include the chemistry of metabolism.]

c. **Use models to describe how decomposition eventually returns (recycles) some materials back to the soil for plants to use.**

d. **Ask questions about how food provides animals with the materials they need for body repair and growth and is digested by animals to release the energy they need to maintain body warmth and allow for motion.**

e. **Obtain and communicate information tracing the source of energy for burning fuel or digesting food back to energy from the sun that was captured by plants through a chemical process.**

f. **Use models to communicate that plants obtain matter to grow chiefly from the air and water, and energy to grow from the sun.** [Assessment Boundary: Details of photosynthesis are not included.]

g. **Plan and carry out investigations to determine the role of light in plant growth.** [Assessment Boundary: Details of photosynthesis are not included.]

h. **Design and construct a model to describe the interactions of systems within an ecosystem in terms of the flow of energy, cycling of matter, and the conditions for a healthy ecosystem.** [Clarification Statement: Examples of a healthy ecosystem are ones in which multiple species of different types are able to meet their needs or no new invasive species are introduced.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education:*

### Science and Engineering Practices

**Asking Questions and Defining Problems**
Asking questions and defining problems in grades 3–5 builds from grades K–2 experiences and progresses to specifying qualitative relationships.
- Ask questions based on careful observations of phenomena and information. (d)
- Ask questions of others to clarify ideas or request evidence. (d)

**Developing and Using Models**
Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.
- Construct and revise models collaboratively to measure and explain frequent and regular events. (f)
  Construct a model using an analogy, example, or abstract representation to explain a scientific principle. (b)
- Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system. (a),(c),(h)

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Make observations and measurements, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon. (g)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.
- Compare and synthesize across texts and other reliable media to acquire and generate appropriate scientific and technical information. (e)
- Synthesize information in written text with that contained in corresponding tables, diagrams, and charts. (e)

### Disciplinary Core Ideas

**PS3.D: Energy in Chemical Processes and Everyday Life**
- Food and fuel also release energy when they are digested or burned. When machines or animals "use" energy (e.g., to move around), most often the energy is transferred to heat the surrounding environment. (d)
- The energy released by burning fuel or digesting food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (d),(f)

**LS1.C: Organization for Matter and Energy Flow in Organisms**
- Animals and plants alike generally need to take in air and water, animals must take in food, and plants need light and minerals. Food provides animals with the materials they need for body repair and growth and is digested to release the energy they need to maintain body warmth and for motion. Anaerobic life, such as bacteria in the gut, functions without air. (h)
- Plants acquire their material for growth chiefly from air and water and process matter they have formed to maintain their internal conditions (e.g., at night). (e)

**LS2.A: Interdependent Relationships in Ecosystems**
- 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. Either way, they are "consumers." Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil for plants to use. (a),(b),(c)
- 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. (g)

**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**
- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. (b)
- Organisms obtain gases, water, and minerals from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (b),(h)

### Crosscutting Concepts

**Systems and System Models**
A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. A system can be described in terms of its components and their interactions. (a),(h)

**Energy and Matter**
Matter is made of particles. Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. Energy can be transferred in various ways and between objects. (b),(c),(d),(e),(f),(g)

*Connections to other DCIs in this grade-level:* **5.SPM, 5.ESI**

*Articulation of DCIs across grade-levels:* ***K.OTE*, 2.IOS, 3.EIO, 4.E, MS.LS-IRE, MS.LS-MEOE, MS.PS-E**

*Common Core State Standards Connections; [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

**RI.5.10** By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 4–5 text complexity band independently and proficiently.

**W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research.

**SL.5.4** Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

*Mathematics –*

**MP.2** Reason abstractly and quantitatively.

**MP.3** Construct viable arguments and critique the reasoning of others.

**MP.4** Model with mathematics.

**5.2** Graph points on the coordinate plane to solve real-world and mathematical problems.

# 5.ESI Earth Systems and Their Interactions

## 5.ESI Earth Systems and Their Interactions

Students who demonstrate understanding can:

a. **Obtain and communicate information about the various forms of water on Earth.** [Clarification Statement: The forms of water on Earth that students will address include vapor, fog or clouds in the atmosphere; rain or snow falling from clouds; ice, snow, and running water on land; moisture in soil and salt water in the ocean; and groundwater beneath the surface.] [Assessment Boundary: Focus is on the existence of different forms of water, not the cycling.]

b. **Use mathematical thinking to compare the relative abundance of salt water to fresh water and analyze data to identify the major locations of fresh water.**

c. **Construct models to describe systems interactions for the geosphere, hydrosphere, atmosphere, and biosphere and identify the limitations of the models.**

d. **Obtain and share information on the role of the ocean in supporting a variety of ecosystems and organisms, shaping landforms, and influencing climate.**

e. **Construct models to describe weather and climate patterns which are produced by the interactions among the atmosphere, the ocean, and landforms.**

f. **Obtain, evaluate, and communicate information describing the impacts human activities has on Earth's systems and generate examples of actions individuals and communities have taken to conserve Earth's resources and environments.**

g. **Design and evaluate a process or product to minimize unwanted outcomes of human activities on Earth's systems, while increasing benefits and meeting societal demands.** [Clarification Statement: Examples of processes or products could be designing a cost-effective water filtration system that reduces pollutants in a river; or conducting an energy audit and developing a plan to reduce energy use.]

h. **Provide evidence to explain how increases in Earth's temperature can affect humans and other organisms.** [Clarification Statement: Examples of effects on humans and other organisms can include changes in crop growing seasons, changes in coral reefs, and loss of habitat for penguins.] [Assessment Boundary: The Greenhouse effect and details of climate change are not included here.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

### Science and Engineering Practices

**Developing and Using Models**
Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.
- Construct and revise models collaboratively to measure and explain frequent and regular events. (c),(e)
- Identify limitations of models. (c)

**Analyzing and Interpreting Data**
Analyzing data in 3–5 builds on K–2 and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.
- Use data to evaluate claims about cause and effect relationships. (e)
- Use data to evaluate and refine design solutions. (g)

**Using Mathematics and Computational Thinking**
Mathematical and computational thinking at the 3–5 level builds on K–2 and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.
- Analyze simple data sets for patterns that suggest relationships. (b)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.
- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or solution to a problem. (f),(g),(h)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.
- Compare and synthesize across texts and other reliable media to acquire and generate appropriate scientific and technical information. (a),(d),(f)
- Synthesize information in written text with that contained in corresponding tables, diagrams, and charts. (a)
- Generate and communicate scientific and technical information orally and in written formats using various forms of media and may include tables, diagrams, and charts. (d),(f)

### Disciplinary Core Ideas

**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. (c)
- The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. (d)
- Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (d),(e)
- Human activities affect Earth's systems and their interactions at its surface. (f),(g)

**ESS2.C: The Roles of Water in Earth's Surface Processes**
- Water is found almost everywhere on Earth: as vapor; as fog or clouds in the atmosphere; as rain or snow falling from clouds; as ice, snow, and running water on land and in the ocean; and as groundwater beneath the surface. (a)
- 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. (b)

**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. For example, they are treating sewage, reducing the amounts of materials they use, and regulating sources of pollution such as emissions from factories and power plants or the runoff from agricultural activities. (f),(g)

**ESS3.D: Global Climate Change**
- If Earth's global mean temperature continues to rise, the lives of humans and other organisms will be affected in many different ways. (h)

**ETS2.B: Interactions of Engineering, Technology, Science, Society, and the Natural Environment.**
- Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), to decrease known risks (e.g., seatbelts in cars), and to meet societal demands (e.g., cell phones). (g)

### Crosscutting Concepts

**Systems and System Models**
A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. A system can be described in terms of its components and their interactions. (a),(b),(c),(d),(e),(f),(h)

*Connections to Engineering, Technology, and Applications of Science*

**Influence of Engineering, Technology, and Science on Society and the Natural World**
People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another. (g)

# 5.ESI Earth Systems and Their Interactions

**ESI Earth Systems and Their Interactions *(continued)***

*nections to other DCIs in this grade-level:* **5.MEE**

*Articulation of DCIs across grade-levels:* **K.OTE, 4.PSE, 4.LCT, MS.ESS-HI, MS.ESS-EIP, MS.ESS-ESP, MS.ETS-ETSS**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.5.3** Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.

**RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

**W.5.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

**SL.5.2** Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

*Mathematics –*

**MP.1** Make sense of problems and persevere in solving them.

**MP.2** Reason abstractly and quantitatively.

**MP.3** Construct viable arguments and critique the reasoning of others.

**4.MD.2** Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.

# 5.SSS Stars and the Solar System

## 5.SSS Stars and the Solar System

Students who demonstrate understanding can:

a. **Obtain and communicate information about the sizes of stars, including the sun, and their distances from Earth to explain their apparent brightnesses.**

b. **Provide evidence that Earth is spherical and the gravitational force of the Earth causes objects near the surface to be pulled toward the planet's center.**

c. **Use a model of a rotating, spherical Earth and the relative positions of the sun and moon to explain patterns in daily changes in length and direction of shadows, day and night, and the phases of the moon.** [Assessment Boundary: Seasons are not to be assessed.]

d. **Develop explanations for how patterns in the positions of stars and constellations can be used to navigate on Earth.**

e. **Gather evidence to investigate how lenses bend light and obtain information about the ways technology has used lenses to improve our ability to see objects.** [Clarification Statement: Examples of technology using lenses could include telescopes, microscopes, eye glasses, and jeweler's loupes.] [Assessment Boundary: Quantitative details of refraction not to be included.]

f. **Obtain, evaluate, and communicate information about the roles of science and technology in the design process for developing and refining devices to understand the universe.** [Clarification Statement: Examples of devices could include telescopes, computers and spacecraft.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*.

### Science and Engineering Practices

**Developing and Using Models**
Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.
- Construct and revise models collaboratively to measure and explain frequent and regular events. (c)
- Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system. (c)

**Planning and Carrying Out Investigations**
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Make observations and measurements, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon or test a design solution. (e)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in 3–5 builds on prior experiences in K–2 and progresses to the use of evidence in constructing multiple explanations and designing multiple solutions.
- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or solution to a problem. (d)

**Engaging in Argument from Evidence**
Engaging in argument from evidence in 3–5 builds from K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world.
- Construct and support scientific arguments drawing on evidence, data, or a model. (b)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 and progresses to evaluating the merit and accuracy of ideas and methods.
- Compare and synthesize across reliable texts and other reliable media to acquire and generate appropriate scientific and technical information. (a),(f)
- Synthesize information in written text with that contained in corresponding tables, diagrams, and charts. (a)
- Generate and communicate scientific information orally and in written formats using various forms of media and may include tables, diagrams, and charts. (a)

### Disciplinary Core Ideas

**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. (b)

**PS4.B: Electromagnetic Radiation**
- A great deal of light travels through space to Earth from the sun and from distant stars. Because lenses bend light beams, they can be used, singly or in combination, to provide magnified images of objects too small or too far away to be seen with the naked eye. (a),(e)

**PS4.C:Information Technologies and Instrumentation**
- Lenses can be used to make eyeglasses, telescopes, or microscopes in order to extend what can be seen. The design of such instruments is based on understanding how the path of light bends at the surface of a lens. (e)

**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 size and distance from Earth. (a)

**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 and seasonal changes in the length and direction of shadows; phases of the moon; and different positions of the sun, moon, and stars at different times of the day, month, and year. *[Note: Seasons are addressed in middle school.]* (c)
- Some objects in the solar system can be seen with the naked eye. Planets in the night sky change positions and are not always visible from Earth as they orbit the sun. Stars appear in patterns called constellations, which can be used for navigation and appear to move together across the sky because of Earth's rotation. (d)

**ETS2.A: Interdependence of Science, Engineering, and Technology**
- Tools and instruments (e.g., rulers, balances, thermometers, graduated cylinders, telescopes, microscopes) are used in scientific exploration to gather data and help answer questions about the natural world. Engineering design can develop and improve such technologies (e),(f)

### Crosscutting Concepts

**Patterns**
Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena and designed products. Cyclic patterns of change related to time can be used to make predictions. (c),(d)

**Cause and Effect**
Cause and effect relationships are routinely identified, tested, and used to explain change. Events that occur together with regularity might or might not be a cause and effect relationship. (b)

**Scale, Proportion, and Quantity**
Natural objects and observable phenomena exist from the very small to the immensely large. (a)

***Connections to Engineering, Technology, and Applications of Science***

**Interdependence of Science, Engineering, and Technology**
Science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies. (e),(f)

*Connections to other DCIs in this grade-level:* **N/A**

*Articulation of DCIs across grade-levels:* **1.PC, 3.SFS, 3.IF, 4.WAV, 4.PSE, MS.ESS-SS, MS.PS-WER, MS.PS-IF, MS.ETS-ETSS**

*Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]*

*ELA –*

**RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
**RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
**SL.5.2** Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

*Mathematics –*

**MP.2** Reason abstractly and quantitatively.
**MP.3** Construct viable arguments and critique the reasoning of others.
**MP.7** Look for and make use of structure.
**5.G.1** Graph points on the coordinate plane to solve real-world and mathematical problems.