

# K.Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment

## K.Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment

Students who demonstrate understanding can:

- K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.** [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and that all living things need water.]
- K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.** [Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]
- K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.** [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas, and grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]
- K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.\*** [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]

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	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Use a model to represent relationships in the natural world. (K-ESS3-1)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> <li>Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-LS1-1)</li> </ul> <p><b>Engaging in Argument from Evidence</b> 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(s).</p> <ul style="list-style-type: none"> <li>Construct an argument with evidence to support a claim. (K-ESS2-2)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> <li>Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. (K-ESS3-3)</li> </ul> <p>-----</p> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Scientists look for patterns and order when making observations about the world. (K-LS1-1)</li> </ul>	<p><b>LS1.C: Organization for Matter and Energy Flow in Organisms</b></p> <ul style="list-style-type: none"> <li>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. (K-LS1-1)</li> </ul> <p><b>ESS2.E: Biogeology</b></p> <ul style="list-style-type: none"> <li>Plants and animals can change their environment. (K-ESS2-2)</li> </ul> <p><b>ESS3.A: Natural Resources</b></p> <ul style="list-style-type: none"> <li>Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1)</li> </ul> <p><b>ESS3.C: Human Impacts on Earth Systems</b></p> <ul style="list-style-type: none"> <li>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. (secondary to K-ESS2-2),(K-ESS3-3)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>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. (secondary to K-ESS3-3)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns in the natural and human designed world can be observed and used as evidence. (K-LS1-1)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Events have causes that generate observable patterns. (K-ESS3-3)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>Systems in the natural and designed world have parts that work together. (K-ESS2-2),(K-ESS3-1)</li> </ul>

Connections to other DCIs in kindergarten: **K.ETS1.A** (K-ESS3-3)

Articulation of DCIs across grade-levels: **1.LS1.A** (K-LS1-1),(K-ESS3-1); **2.LS2.A** (K-LS1-1); **2.ETS1.B** (K-ESS3-3); **3.LS2.C** (K-LS1-1); **3.LS4.B** (K-LS1-1); **4.ESS2.E** (K-ESS2-2); **4.ESS3.A** (K-ESS3-3); **5.LS1.C** (K-LS1-1); **5.LS2.A** (K-LS1-1),(K-ESS3-1); **5.ESS2.A** (K-ESS2-2),(K-ESS3-1); **5.ESS3.C** (K-ESS3-3)

Common Core State Standards Connections:

ELA/Literacy –

- RI.K.1** With prompting and support, ask and answer questions about key details in a text. (K-ESS2-2)
- W.K.1** Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book. (K-ESS2-2)
- 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. (K-ESS2-2),(K-ESS3-3)
- 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). (K-LS1-1)
- SL.K.5** Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1)

Mathematics –

- MP.2** Reason abstractly and quantitatively. (K-ESS3-1)
- MP.4** Model with mathematics. (K-ESS3-1)
- K.CC** Counting and Cardinality (K-ESS3-1)
- K.MD.A.2** Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference. (K-LS1-1)

\*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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## K-2.Engineering Design

### K-2.Engineering Design

Students who demonstrate understanding can:

- K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**
- K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**
- K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

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	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.</p> <ul style="list-style-type: none"> <li>Ask questions based on observations to find more information about the natural and/or designed world. (K-2-ETS1-1)</li> <li>Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)</li> </ul> <p><b>Developing and Using Models</b> Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.</p> <ul style="list-style-type: none"> <li>Analyze data from tests of an object or tool to determine if it works as intended. (K-2-ETS1-3)</li> </ul>	<p><b>ETS1.A: Defining and Delimiting Engineering Problems</b></p> <ul style="list-style-type: none"> <li>A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1)</li> <li>Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)</li> <li>Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)</li> </ul> <p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"> <li>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. (K-2-ETS1-2)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)</li> </ul>	<p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)</li> </ul>
<p><i>Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:</i>  <b>Kindergarten:</b> K-PS2-2, K-ESS3-2  <i>Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:</i>  <b>Kindergarten:</b> K-ESS3-3, <b>First Grade:</b> 1-PS4-4, <b>Second Grade:</b> 2-LS2-2  <i>Connections to K-2-ETS1.C: Optimizing the Design Solution include:</i>  <b>Second Grade:</b> 2-ESS2-1</p>		
<p><i>Articulation of DCIs across grade-bands:</i> <b>3-5.ETS1.A</b> (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3); <b>3-5.ETS1.B</b> (K-2-ETS1-2),(K-2-ETS1-3); <b>3-5.ETS1.C</b> (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3)</p>		
<p><i>Common Core State Standards Connections:</i>  <b>ELA/Literacy –</b>  <b>RI.2.1</b> Ask and answer such questions as <i>who</i>, <i>what</i>, <i>where</i>, <i>when</i>, <i>why</i>, and <i>how</i> to demonstrate understanding of key details in a text. (K-2-ETS1-1)  <b>W.2.6</b> With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (K-2-ETS1-1),(K-2-ETS1-3)  <b>W.2.8</b> Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1),(K-2-ETS1-3)  <b>SL.2.5</b> Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (K-2-ETS1-2)  <b>Mathematics –</b>  <b>MP.2</b> Reason abstractly and quantitatively. (K-2-ETS1-1),(K-2-ETS1-3)  <b>MP.4</b> Model with mathematics. (K-2-ETS1-1),(K-2-ETS1-3)  <b>MP.5</b> Use appropriate tools strategically. (K-2-ETS1-1),(K-2-ETS1-3)  <b>2.MD.D.10</b> Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1),(K-2-ETS1-3)</p>		

# 1. Structure, Function, and Information Processing

## 1. Structure, Function, and Information Processing

Students who demonstrate understanding can:

- 1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.\*** [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]
- 1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.** [Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]
- 1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.** [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.]  
[Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]

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	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> <li>Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-LS3-1)</li> <li>Use materials to design a device that solves a specific problem or a solution to a specific problem. (1-LS1-1)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> <li>Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. (1-LS1-2)</li> </ul> <p>-----</p> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Scientists look for patterns and order when making observations about the world. (1-LS1-2)</li> </ul>	<p><b>LS1.A: Structure and Function</b></p> <ul style="list-style-type: none"> <li>All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)</li> </ul> <p><b>LS1.B: Growth and Development of Organisms</b></p> <ul style="list-style-type: none"> <li>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. (1-LS1-2)</li> </ul> <p><b>LS1.D: Information Processing</b></p> <ul style="list-style-type: none"> <li>Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1)</li> </ul> <p><b>LS3.A: Inheritance of Traits</b></p> <ul style="list-style-type: none"> <li>Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents. (1-LS3-1)</li> </ul> <p><b>LS3.B: Variation of Traits</b></p> <ul style="list-style-type: none"> <li>Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (1-LS3-1)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-LS1-2),(1-LS3-1)</li> </ul> <p><b>Structure and Function</b></p> <ul style="list-style-type: none"> <li>The shape and stability of structures of natural and designed objects are related to their function(s). (1-LS1-1)</li> </ul> <p>-----</p> <p><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>Every human-made product is designed by applying some knowledge of the natural world and is built by built using materials derived from the natural world. (1-LS1-1)</li> </ul>
<p><i>Connections to other DCIs in first grade: N/A</i></p> <p><i>Articulation of DCIs across grade-levels: K.ETS1.A (1-LS1-1); 3.LS2.D (1-LS1-2) 3.LS3.A (1-LS3-1); 3.LS3.B (1-LS3-1); 4.LS1.A (1-LS1-1); 4.LS1.D (1-LS1-1); 4.ETS1.A (1-LS1-1)</i></p> <p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p><b>RI.1.1</b> Ask and answer questions about key details in a text. (1-LS1-2),(1-LS3-1)</p> <p><b>RI.1.2</b> Identify the main topic and retell key details of a text. (1-LS1-2)</p> <p><b>RI.1.10</b> With prompting and support, read informational texts appropriately complex for grade. (1-LS1-2)</p> <p><b>W.1.7</b> Participate in shared research and writing projects (e.g., explore a number of “how-to” books on a given topic and use them to write a sequence of instructions). (1-LS1-1),(1-LS3-1)</p> <p><b>W.1.8</b> With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-LS3-1)</p> <p><i>Mathematics –</i></p> <p><b>MP.2</b> Reason abstractly and quantitatively. (1-LS3-1)</p> <p><b>MP.5</b> Use appropriate tools strategically. (1-LS3-1)</p> <p><b>1.NBT.B.3</b> Compare two two-digit numbers based on the meanings of the tens and one digits, recording the results of comparisons with the symbols <math>&gt;</math>, <math>=</math>, and <math>&lt;</math>. (1-LS1-2)</p> <p><b>1.NBT.C.4</b> Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning uses. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. (1-LS1-2)</p> <p><b>1.NBT.C.5</b> Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. (1-LS1-2)</p> <p><b>1.NBT.C.6</b> Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. (1-LS1-2)</p> <p><b>1.MD.A.1</b> Order three objects by length; compare the lengths of two objects indirectly by using a third object. (1-LS3-1)</p>		

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## 2.Earth's Systems: Processes that Shape the Earth

### 2.Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

**2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.**

[Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

**2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.\***

[Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]

**2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.** [Assessment Boundary:

Assessment does not include quantitative scaling in models.]

**2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.**

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.</p> <ul style="list-style-type: none"> <li>Develop a model to represent patterns in the natural world. (2-ESS2-2)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.</p> <ul style="list-style-type: none"> <li>Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)</li> <li>Compare multiple solutions to a problem. (2-ESS2-1)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.</p> <ul style="list-style-type: none"> <li>Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)</li> </ul>	<p><b>ESS1.C: The History of Planet Earth</b></p> <ul style="list-style-type: none"> <li>Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)</li> </ul> <p><b>ESS2.A: Earth Materials and Systems</b></p> <ul style="list-style-type: none"> <li>Wind and water can change the shape of the land. (2-ESS2-1)</li> </ul> <p><b>ESS2.B: Plate Tectonics and Large-Scale System Interactions</b></p> <ul style="list-style-type: none"> <li>Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)</li> </ul> <p><b>ESS2.C: The Roles of Water in Earth's Surface Processes</b></p> <ul style="list-style-type: none"> <li>Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)</li> </ul> <p><b>ETS1.C: Optimizing the Design Solution</b></p> <ul style="list-style-type: none"> <li>Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (secondary to 2-ESS2-1)</li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3)</li> </ul> <p><b>Stability and Change</b></p> <ul style="list-style-type: none"> <li>Things may change slowly or rapidly. (2-ESS1-1),(2-ESS2-1)</li> </ul> <p>-----</p> <p><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>Developing and using technology has impacts on the natural world. (2-ESS2-1)</li> </ul> <p>-----</p> <p><b>Connections to Nature of Science</b></p> <p><b>Science Addresses Questions About the Natural and Material World</b></p> <ul style="list-style-type: none"> <li>Scientists study the natural and material world. (2-ESS2-1)</li> </ul>
<p><i>Connections to other DCIs in second grade:</i> <b>2.PS1.A</b> (2-ESS2-3)</p> <p><i>Articulation of DCIs across grade-levels:</i> <b>K.ETS1.A</b> (2-ESS2-1); <b>3.LS2.C</b> (2-ESS1-1); <b>4.ESS1.C</b> (2-ESS1-1); <b>4.ESS2.A</b> (2-ESS1-1),(2-ESS2-1); <b>4.ESS2.B</b> (2-ESS2-2); <b>4.ETS1.A</b> (2-ESS2-1); <b>4.ETS1.B</b> (2-ESS2-1); <b>4.ETS1.C</b> (2-ESS2-1); <b>5.ESS2.A</b> (2-ESS2-1); <b>5.ESS2.C</b> (2-ESS2-2),(2-ESS2-3)</p> <p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p><b>RI.2.1</b> Ask and answer such questions as <i>who</i>, <i>what</i>, <i>where</i>, <i>when</i>, <i>why</i>, and <i>how</i> to demonstrate understanding of key details in a text. (2-ESS1-1)</p> <p><b>RI.2.3</b> Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1),(2-ESS2-1)</p> <p><b>RI.2.9</b> Compare and contrast the most important points presented by two texts on the same topic. (2-ESS2-1)</p> <p><b>W.2.6</b> With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (2-ESS1-1),(2-ESS2-3)</p> <p><b>W.2.7</b> 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). (2-ESS1-1)</p> <p><b>W.2.8</b> Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1),(2-ESS2-3)</p> <p><b>SL.2.2</b> Recount or describe key ideas or details from a text read aloud or information presented orally or through other media. (2-ESS1-1)</p> <p><b>SL.2.5</b> Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. (2-ESS2-2)</p> <p><i>Mathematics –</i></p> <p><b>MP.2</b> Reason abstractly and quantitatively. (2-ESS2-1),(2-ESS2-1),(2-ESS2-2)</p> <p><b>MP.4</b> Model with mathematics. (2-ESS1-1),(2-ESS2-1),(2-ESS2-2)</p> <p><b>MP.5</b> Use appropriate tools strategically. (2-ESS2-1)</p> <p><b>2.NBT.A</b> Understand place value. (2-ESS1-1)</p> <p><b>2.NBT.A.3</b> Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. (2-ESS2-2)</p> <p><b>2.MD.B.5</b> Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. (2-ESS2-1)</p>		

\*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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## 3. Forces and Interactions

### 3. Forces and Interactions

Students who demonstrate understanding can:

- 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.** [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]
- 3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]
- 3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.** [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]
- 3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.\*** [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

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	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.</p> <ul style="list-style-type: none"><li>Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3)</li><li>Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)</li></ul> <p><b>Planning and Carrying Out Investigations</b> 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.</p> <ul style="list-style-type: none"><li>Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1)</li><li>Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2)</li></ul> <p>-----</p> <p><b>Connections to Nature of Science</b></p> <p><b>Science Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"><li>Science findings are based on recognizing patterns. (3-PS2-2)</li></ul> <p><b>Scientific Investigations Use a Variety of Methods</b></p> <ul style="list-style-type: none"><li>Science investigations use a variety of methods, tools, and techniques. (3-PS2-1)</li></ul>	<p><b>PS2.A: Forces and Motion</b></p> <ul style="list-style-type: none"><li>Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)</li><li>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. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)</li></ul> <p><b>PS2.B: Types of Interactions</b></p> <ul style="list-style-type: none"><li>Objects in contact exert forces on each other. (3-PS2-1)</li><li>Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4)</li></ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"><li>Patterns of change can be used to make predictions. (3-PS2-2)</li></ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"><li>Cause and effect relationships are routinely identified. (3-PS2-1)</li><li>Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3)</li></ul> <p>-----</p> <p><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Interdependence of Science, Engineering, and Technology</b></p> <ul style="list-style-type: none"><li>Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3-PS2-4)</li></ul>
<p>Connections to other DCIs in third grade: N/A</p> <p>Articulation of DCIs across grade-levels: <b>K.PS2.A</b> (3-PS2-1); <b>K.PS2.B</b> (3-PS2-1); <b>K.PS3.C</b> (3-PS2-1); <b>K.ETS1.A</b> (3-PS2-4); <b>1.ESS1.A</b> (3-PS2-2); <b>4.PS4.A</b> (3-PS2-2); <b>4.ETS1.A</b> (3-PS2-4); <b>5.PS2.B</b> (3-PS2-1); <b>MS.PS2.A</b> (3-PS2-1),(3-PS2-2); <b>MS.PS2.B</b> (3-PS2-3),(3-PS2-4); <b>MS.ESS1.B</b> (3-PS2-1),(3-PS2-2); <b>MS.ESS2.C</b> (3-PS2-1)</p> <p>Common Core State Standards Connections:</p> <p><i>ELA/Literacy</i> –</p> <p><b>RI.3.1</b> Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-PS2-1),(3-PS2-3)</p> <p><b>RI.3.3</b> 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. (3-PS2-3)</p> <p><b>RI.3.8</b> Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence). (3-PS2-3)</p> <p><b>W.3.7</b> Conduct short research projects that build knowledge about a topic. (3-PS2-1),(3-PS2-2)</p> <p><b>W.3.8</b> Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1),(3-PS2-2)</p> <p><b>SL.3.3</b> Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. (3-PS2-3)</p> <p><i>Mathematics</i> –</p> <p><b>MP.2</b> Reason abstractly and quantitatively. (3-PS2-1)</p> <p><b>MP.5</b> Use appropriate tools strategically. (3-PS2-1)</p> <p><b>3.MD.A.2</b> Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-PS2-1)</p>		

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## 4.Earth's Systems: Processes that Shape the Earth

### 4.Earth's Systems: Processes that Shape the Earth

Students who demonstrate understanding can:

- 4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]
- 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]
- 4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]
- 4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.\*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

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	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Planning and Carrying Out Investigations</b> 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.</p> <ul style="list-style-type: none"> <li>Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)</li> </ul> <p><b>Analyzing and Interpreting Data</b> Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.</p> <ul style="list-style-type: none"> <li>Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.</p> <ul style="list-style-type: none"> <li>Identify the evidence that supports particular points in an explanation. (4-ESS1-1)</li> <li>Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)</li> </ul>	<p><b>ESS1.C: The History of Planet Earth</b></p> <ul style="list-style-type: none"> <li>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. (4-ESS1-1)</li> </ul> <p><b>ESS2.A: Earth Materials and Systems</b></p> <ul style="list-style-type: none"> <li>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. (4-ESS2-1)</li> </ul> <p><b>ESS2.B: Plate Tectonics and Large-Scale System Interactions</b></p> <ul style="list-style-type: none"> <li>The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)</li> </ul> <p><b>ESS2.E: Biogeology</b></p> <ul style="list-style-type: none"> <li>Living things affect the physical characteristics of their regions. (4-ESS2-1)</li> </ul> <p><b>ESS3.B: Natural Hazards</b></p> <ul style="list-style-type: none"> <li>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. (4-ESS3-2) <i>(Note: This Disciplinary Core Idea can also be found in 3.WC.)</i></li> </ul> <p><b>ETS1.B: Designing Solutions to Engineering Problems</b></p> <ul style="list-style-type: none"> <li>Testing a solution involves investigating how well it performs under a range of likely conditions. <i>(secondary to 4-ESS3-2)</i></li> </ul>	<p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>Patterns can be used as evidence to support an explanation. (4-ESS1-1),(4-ESS2-2)</li> </ul> <p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1),(4-ESS3-2)</li> </ul> <p>-----</p> <p><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Engineering, Technology, and Science on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)</li> </ul> <p>-----</p> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b></p> <ul style="list-style-type: none"> <li>Science assumes consistent patterns in natural systems. (4-ESS1-1)</li> </ul>
<p>Connections to other DCIs in fourth grade: <b>4.ETS1.C</b> (4-ESS3-2)</p> <p>Articulation of DCIs across grade-levels: <b>K.ETS1.A</b> (4-ESS3-2); <b>2.ESS1.C</b> (4-ESS1-1),(4-ESS2-1); <b>2.ESS2.A</b> (4-ESS2-1); <b>2.ESS2.B</b> (4-ESS2-2); <b>2.ESS2.C</b> (4-ESS2-2); <b>2.ETS1.B</b> (4-ESS3-2); <b>2.ETS1.C</b> (4-ESS3-2); <b>3.LS4.A</b> (4-ESS1-1); <b>5.ESS2.A</b> (4-ESS2-1); <b>5.ESS2.C</b> (4-ESS2-2); <b>MS.LS4.A</b> (4-ESS1-1); <b>MS.ESS1.C</b> (4-ESS1-1),(4-ESS2-2); <b>MS.ESS2.A</b> (4-ESS1-1),(4-ESS2-2),(4-ESS3-2); <b>MS.ESS2.B</b> (4-ESS1-1),(4-ESS2-2); <b>MS.ESS3.B</b> (4-ESS3-2); <b>MS.ETS1.B</b> (4-ESS3-2)</p> <p>Common Core State Standards Connections:</p> <p><b>ELA/Literacy –</b></p> <p><b>RI.4.1</b> Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)</p> <p><b>RI.4.7</b> Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)</p> <p><b>RI.4.9</b> Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)</p> <p><b>W.4.7</b> Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1),(4-ESS2-1)</p> <p><b>W.4.8</b> Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1),(4-ESS2-1)</p> <p><b>W.4.9</b> Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1)</p> <p><b>Mathematics –</b></p> <p><b>MP.2</b> Reason abstractly and quantitatively. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2)</p> <p><b>MP.4</b> Model with mathematics. (4-ESS1-1),(4-ESS2-1),(4-ESS3-2)</p> <p><b>MP.5</b> Use appropriate tools strategically. (4-ESS2-1)</p> <p><b>4.MD.A.1</b> Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1),(4-ESS2-1)</p> <p><b>4.MD.A.2</b> Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1),(4-ESS2-2)</p> <p><b>4.OA.A.1</b> Interpret a multiplication equation as a comparison, e.g., interpret <math>35 = 5 \times 7</math> as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-2)</p>		

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## 5.Earth's Systems

### 5.Earth's Systems

Students who demonstrate understanding can:

- 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.** [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]
- 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]
- 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.**

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	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Developing and Using Models</b> Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> <li>Develop a model using an example to describe a scientific principle. (5-ESS2-1)</li> </ul> <p><b>Using Mathematics and Computational Thinking</b> Mathematical and computational thinking in 3–5 builds on K–2 experiences 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.</p> <ul style="list-style-type: none"> <li>Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)</li> </ul> <p><b>Obtaining, Evaluating, and Communicating Information</b> Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.</p> <ul style="list-style-type: none"> <li>Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)</li> </ul>	<p><b>ESS2.A: Earth Materials and Systems</b></p> <ul style="list-style-type: none"> <li>Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)</li> </ul> <p><b>ESS2.C: The Roles of Water in Earth's Surface Processes</b></p> <ul style="list-style-type: none"> <li>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. (5-ESS2-2)</li> </ul> <p><b>ESS3.C: Human Impacts on Earth Systems</b></p> <ul style="list-style-type: none"> <li>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. (5-ESS3-1)</li> </ul>	<p><b>Scale, Proportion, and Quantity</b></p> <ul style="list-style-type: none"> <li>Standard units are used to measure and describe physical quantities such as weight, and volume. (5-ESS2-2)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>A system can be described in terms of its components and their interactions. (5-ESS2-1),(5-ESS3-1)</li> </ul> <p style="text-align: center;">-----</p> <p style="text-align: center;"><i>Connections to Nature of Science</i></p> <p><b>Science Addresses Questions About the Natural and Material World</b></p> <ul style="list-style-type: none"> <li>Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)</li> </ul>
<p><i>Connections to other DCIs in fifth grade:</i> N/A</p> <p><i>Articulation of DCIs across grade-levels:</i> <b>2.ESS2.A</b> (5-ESS2-1); <b>2.ESS2.C</b> (5-ESS2-2); <b>3.ESS2.D</b> (5-ESS2-1); <b>4.ESS2.A</b> (5-ESS2-1); <b>MS.ESS2.A</b> (5-ESS2-1); <b>MS.ESS2.C</b> (5-ESS2-1),(5-ESS2-2); <b>MS.ESS2.D</b> (5-ESS2-1); <b>MS.ESS3.A</b> (5-ESS2-2),(5-ESS3-1); <b>MS.ESS3.C</b> (5-ESS3-1); <b>MS.ESS3.D</b> (5-ESS3-1)</p> <p><i>Common Core State Standards Connections:</i></p> <p><i>ELA/Literacy –</i></p> <p><b>RI.5.1</b> Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1)</p> <p><b>RI.5.7</b> 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. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)</p> <p><b>RI.5.9</b> Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1)</p> <p><b>W.5.8</b> Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2),(5-ESS3-1)</p> <p><b>W.5.9</b> Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)</p> <p><b>SL.5.5</b> Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-1),(5-ESS2-2)</p> <p><i>Mathematics –</i></p> <p><b>MP.2</b> Reason abstractly and quantitatively. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)</p> <p><b>MP.4</b> Model with mathematics. (5-ESS2-1),(5-ESS2-2),(5-ESS3-1)</p> <p><b>5.G.2</b> Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS2-1)</p>		

\*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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# MS.Forces and Interactions

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Students who demonstrate understanding can:

- MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.\***  
[Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]
- MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]
- MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.**  
[Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]
- MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]
- MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.]

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	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Asking Questions and Defining Problems</b> Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.</p> <ul style="list-style-type: none"> <li>Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3)</li> </ul> <p><b>Planning and Carrying Out Investigations</b> Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use <u>multiple variables</u> and provide evidence to support explanations or design solutions.</p> <ul style="list-style-type: none"> <li>Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2)</li> <li>Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS-PS2-5)</li> </ul> <p><b>Constructing Explanations and Designing Solutions</b> Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> <li>Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)</li> </ul> <p><b>Engaging in Argument from Evidence</b> Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.</p> <ul style="list-style-type: none"> <li>Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)</li> </ul> <p>-----</p> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b></p> <ul style="list-style-type: none"> <li>Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2), (MS-PS2-4)</li> </ul>	<p><b>PS2.A: Forces and Motion</b></p> <ul style="list-style-type: none"> <li>For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1)</li> <li>The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)</li> <li>All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2)</li> </ul> <p><b>PS2.B: Types of Interactions</b></p> <ul style="list-style-type: none"> <li>Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)</li> <li>Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4)</li> <li>Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, a magnet, or a ball, respectively). (MS-PS2-5)</li> </ul>	<p><b>Cause and Effect</b></p> <ul style="list-style-type: none"> <li>Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3), (MS-PS2-5)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1), (MS-PS2-4),</li> </ul> <p><b>Stability and Change</b></p> <ul style="list-style-type: none"> <li>Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2)</li> </ul> <p>-----</p> <p><b>Connections to Engineering, Technology, and Applications of Science</b></p> <p><b>Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)</li> </ul>
<p>Connections to other DCIs in this grade-band: <b>MS.PS3.A</b> (MS-PS2-2); <b>MS.PS3.B</b> (MS-PS2-2); <b>MS.PS3.C</b> (MS-PS2-1); <b>MS.ESS1.A</b> (MS-PS2-4); <b>MS.ESS1.B</b> (MS-PS2-4); <b>MS.ESS2.C</b> (MS-PS2-2), (MS-PS2-4)</p>		
<p>Articulation across grade-bands: <b>3.PS2.A</b> (MS-PS2-1), (MS-PS2-2); <b>3.PS2.B</b> (MS-PS2-3), (MS-PS2-5); <b>5.PS2.B</b> (MS-PS2-4); <b>HS.PS2.A</b> (MS-PS2-1), (MS-PS2-2); <b>HS.PS2.B</b> (MS-PS2-3), (MS-PS2-4), (MS-PS2-5); <b>HS.PS3.A</b> (MS-PS2-5); <b>HS.PS3.B</b> (MS-PS2-2), (MS-PS2-5); <b>HS.PS3.C</b> (MS-PS2-5); <b>HS.ESS1.B</b> (MS-PS2-2), (MS-PS2-4)</p>		
<p>Common Core State Standards Connections: ELA/Literacy –</p>		

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<b>RST.6-8.1</b>	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions <i>(MS-PS2-1),(MS-PS2-3)</i>
<b>RST.6-8.3</b>	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. <i>(MS-PS2-1),(MS-PS2-2),(MS-PS2-5)</i>
<b>WHST.6-8.1</b>	Write arguments focused on <i>discipline-specific content</i> . (MS-PS2-4)
<b>WHST.6-8.7</b>	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. <i>(MS-PS2-1),(MS-PS2-2),(MS-PS2-5)</i>
<i>Mathematics –</i>	
<b>MP.2</b>	Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3)
<b>6.NS.C.5</b>	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1)
<b>6.EE.A.2</b>	Write, read, and evaluate expressions in which letters stand for numbers. <i>(MS-PS2-1),(MS-PS2-2)</i>
<b>7.EE.B.3</b>	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. <i>(MS-PS2-1),(MS-PS2-2)</i>
<b>7.EE.B.4</b>	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. <i>(MS-PS2-1),(MS-PS2-2)</i>

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