### Science and Engineering Practices

**Asking Questions and Defining Problems**
- Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to more complex questions involving multiple ideas and aspects of science.
- Example questions that can be investigated based on patterns such as cause and effect relationships:
  - 3-PS2-3: Tell why a charged bar attracts a neutral object and how the size of the charge on the bar affects the distance at which the object will be attracted.
- Define a simple problem that can be solved through the development of a new or improved object or tool.

**Planning and Carrying Out Investigations**
- Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on grades K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Example questions that can be investigated based on patterns such as cause and effect relationships:
  - 3-PS2-3: Tell why a charged bar attracts a neutral object and how the size of the charge on the bar affects the distance at which the object will be attracted.
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or to test a design solution.

**Connections to Nature of Science**
- Science knowledge is based on empirical evidence:
  - Scientific findings are based on recognizing patterns.
- Scientific investigations use a variety of methods:
  - Science investigations use a variety of methods, tools, and techniques.

### Disciplinary Core Ideas

#### PS2.A: Forces and Motion
- Each force acts on one particular object and has both strength and direction. An object at rest typically has multiple forces acting on it, but they add 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.)
- 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.)
- Objects in contact exert forces on each other. (3-PS2-1)
- 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)

### Crosscutting Concepts

#### Patterns
- Patterns of change can be used to make predictions.

#### Cause and Effect
- Cause and effect relationships are routinely identified.
- Cause and effect relationships are routinely identified, tested, and used to explain change.

### New York State Next Generation Learning Standards Connections

**ELA/Literacy**
- **3R3**: Develop and answer questions to locate relevant and specific details in a text to support an answer or inference. (3-PS2-1, 3-PS2-3)
- **3W6**: Conduct research to answer questions, including self-generated questions, and to build knowledge. (3-PS2-1, 3-PS2-2)
- **3W7**: Recall relevant information from various sources or gather information from multiple sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1, 3-PS2-2)

**Mathematics**
- **MP.2**: Reason abstractly and quantitatively. (3-PS2-1)
- **MP.5**: Use appropriate tools strategically. (3-PS2-1)
- **NY-3.MD.2**: Measure and estimate liquid volumes and masses of objects using 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. (3-PS2-1)

*Connection boxes updated as of September 2018*

---

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the “Disciplinary Core Ideas” section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).*
**New York State P-12 Science Learning Standards**

3. Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:

3-LS2.1. Construct an argument that some animals form groups that help members survive. [Clarification Statement: Examples of groups could include a herd of cattle, a swarm of bees, a flock of geese, a pod of whales, etc.]

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms. (Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.)]

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.* [Clarification Statement: Examples of environmental changes could include both natural and human-influenced changes in land characteristics, water distribution, temperature, food, and other organisms. (Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.)]

 [*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the “Disciplinary Core Ideas” section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).]

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing and Interpreting Data</td>
<td>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</td>
<td>Cause and Effect</td>
</tr>
<tr>
<td>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.</td>
<td>• When the environment changes in ways that affect a place’s physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary to 3-LS4-4)</td>
<td>• Cause and effect relationships are routinely identified and used to explain change. (3-LS2-1),(3-LS4-3)</td>
</tr>
<tr>
<td>Engaging in Argument from Evidence</td>
<td>LS2.D: Social Interactions and Group Behavior</td>
<td>Scale, Proportion, and Quantity</td>
</tr>
<tr>
<td>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed worlds.</td>
<td>• (NYSED) Being part of a group helps some animals obtain food, defend themselves, and survive. Groups may serve different functions and vary dramatically in size. (Note: Moved from K-2) (3-LS2-1)</td>
<td>• Observable phenomena exist from very short to very long time periods. (3-LS4-1)</td>
</tr>
<tr>
<td>• Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (Note: Moved from K-2) (3-LS4-1)</td>
<td>• For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)</td>
<td>• A system can be described in terms of its components and their interactions. (3-LS4-4)</td>
</tr>
<tr>
<td>• Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)</td>
<td>LS4.D: Biodiversity and Humans</td>
<td>Connections to Engineering, Technology, and Applications of Science</td>
</tr>
<tr>
<td>• Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)</td>
<td></td>
<td>Interdependence of Science, Engineering, and Technology</td>
</tr>
<tr>
<td>Connections to other DCIs in third grade: 3.ESS2.B (3-LS4-3); 3.ESS3.B (3-LS4-4)</td>
<td>Connections to Nature of Science</td>
<td>• Knowledge of relevant scientific concepts and research findings is important in engineering. (3-LS4-4)</td>
</tr>
<tr>
<td>Articulation of DCIs across grade levels: K.ESS3.A (3-LS4-3); 3-LS4-4; 1.LS1.A (3-LS4-4); 1.LS1.B (3-LS2-1); 2.LS2.A (3-LS4-3); 3-LS4-4; 2.LS4.D (3-LS4-3); 3-LS4-4; 4.ESS1.C (3-LS4-3); 4.ESS3.B (3-LS4-4); 4.ETS1.A (3-LS4-4); MS.LS2.A (3-LS2-1); 3-LS4-1; 3-LS4-3; 3-LS4-4; MS.LS2.C (3-LS4-4); MS.LS4.A (3-LS4-1); MS.LS4.B (3-LS4-3);</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

New York State Next Generation Learning Standards Connections:

**ELA/Literacy**

3R1 Develop and answer questions to locate relevant and specific details in a text to support an answer or inference. (3-LS2-1),(3-LS4-1),(3-LS4-3),(3-LS4-4)

3R2 Determine a theme or central idea and explain how it is supported by key details; summarize portions of a text. (3-LS4-1),(3-LS4-3),(3-LS4-4)

3R3 In informational texts, describe the relationship among a series of events, ideas, concepts, or steps in a text, using language that pertains to time, sequence, and cause/effect. (3-LS2-1),(3-LS4-1),(3-LS4-3),(3-LS4-4)

3W1 Write an argument to support claim(s), using clear reasons and relevant evidence. (3-LS2-1),(3-LS4-1),(3-LS4-3),(3-LS4-4)

3W7 Recall relevant information from experiences or gather information from multiple sources; take brief notes on sources and sort evidence into provided categories. (3-LS4-1)

3SL4 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. (3-LS4-3),(3-LS4-4)

**Mathematics**

MP.2 Reason abstractly and quantitatively. (3-LS4-1),(3-LS4-3),(3-LS4-4)

MP.4 Model with mathematics. (3-LS2-1),(3-LS4-1),(3-LS4-3),(3-LS4-4)

MP.5 Use appropriate tools strategically. (3-LS4-1)

NY-3.NBT Number and Operations in Base Ten (3-LS2-1)

NY-3.MD.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs. (3-LS4-3)

NY-3.MD.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. (3-LS4-1)

*Connection boxes updated as of September 2018
The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).

The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the “Disciplinary Core Ideas” section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).

NY-3.MD.3
Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled picture graph or scaled bar graphs. (3-ESS2-1)
New York State P-12 Science Learning Standards

4. Energy

Students who demonstrate understanding can:

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. (Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.)

4-PS3-2. Make observations to provide evidence that energy is conserved as it is transferred and/or converted from one form to another. (Clarification Statement: Examples of forms of energy could include sound, light, heat, and electrical.) (Assessment Boundary: Assessment does not include quantitative measurements of energy.)

4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide. (Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.) (Assessment Boundary: Assessment does not include quantitative measurements of energy.)

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. (Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into energy of motion of a vehicle, light, or sound; batteries that convert chemical energy to electrical energy; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.) (Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.)

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (Clarification Statement: Examples of renewable energy resources could include wind, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fission materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.)

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

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking Questions and Defining Problems</td>
<td>PS3.A: Definitions of Energy</td>
<td>Cause and Effect</td>
</tr>
<tr>
<td>Constructing Explanations and Designing Solutions</td>
<td>PS3.C: Relationship Between Energy and Forces</td>
<td>Connections to Engineering, Technology, and Applications of Science</td>
</tr>
<tr>
<td>Obtaining, Evaluating, and Communicating Information</td>
<td>PS3.D: Energy in Chemical Processes and Everyday Life</td>
<td>Interdependence of Science, Engineering, and Technology</td>
</tr>
<tr>
<td></td>
<td>ESS3.A: Natural Resources</td>
<td>Science and the Natural World</td>
</tr>
<tr>
<td></td>
<td>ESS3.C: Human Impact on the Environment</td>
<td>Science as a Human Endeavor</td>
</tr>
</tbody>
</table>

| Connections to other DCIs in fourth grade: NA |

New York State Next Generation Learning Standards Connections: ELA/Literacy:

| 4R1 | Locate and refer to relevant details and evidence when explaining what a text says explicitly/implicitly and make logical inferences. (4-PS3-1) |
| 4R3 | In informational texts, explain events, procedures, ideas, or concepts, including what happened and why, based on specific evidence from the text. (4-PS3-1) |
| 4W2 | Write informative/explanatory texts to examine a topic and convey ideas and information relevant to the subject. (4-PS3-1) |
| 4W6 | Conduct research to answer questions, including self-generated questions, and to build knowledge through investigating multiple aspects of a topic. (4-PS3-2), (4-PS3-3), (4-PS3-4), (4-ESS3-1) |
| 4W7 | Recall relevant information from experiences or gather relevant information from multiple sources; take notes and categorize information, and provide a list of sources. (4-PS3-2), (4-PS3-3), (4-PS3-4), (4-ESS3-1) |
| 4W8 | Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1), (4-ESS3-1) |
| Mathematics: |
| MP.2 | Reason abstractly and quantitatively. (4-ESS3-1) |
| MP.4 | Model with mathematics. (4-ESS3-1) |
| NY-4.OA.1 | Interpret a multiplication equation as a comparison. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1) |

The performance expectations marked with an asterisk (*) can be integrated into the science content with engineering throughout the Practice or Disciplinary Core Idea. The text in the “Disciplinary Core Ideas” section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).
**NY-4.OA.3** Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. (4-PS3-4)

*Connection boxes updated as of September 2018*
## 4. Waves: Waves and Information

### 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; there is no net motion in the direction of the wave except when the water meets a beach. (Note: This grade boundary point was moved from K-2.) (4-PS4-1)
  - Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)

- **PS4.C: Information Technologies and Instrumentation**
  - Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)

- **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. (secondary to 4-PS4-3)

### Crosscutting Concepts

- **Patterns**
  - Similarities and differences in patterns can used to sort and classify natural (4-PS4-1)
  - Similarities and differences in patterns can used to sort and classify designed products. (4-PS4-3)

---

### Science and Engineering Practices

#### Developing and Using Models

- Modeling in 3–5 builds on K-2 experiences and progresses to representing events and design solutions.
  - Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)

#### Constructing Explanations and Designing Solutions

- 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.
  - Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)

---

### Scientific Knowledge is Based on Empirical Evidence

- Science findings are based on recognizing patterns. (4-PS4-1)

---

### Connections to Nature of Science

### New York State Next Generation Learning Standards Connections:

**ELA/Literacy**
- **4.R1.** Locate and refer to relevant details and evidence when explaining what a text says explicitly/implicitly and make logical inferences. (4-PS3-1)
  - Include digital media and/or visual displays in presentations to emphasize central ideas or themes. (4-PS4-1)

**Mathematics**
- **MP.4.** Model with mathematics. (4-PS4-1)

**NY-4.G.1.** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-1)

---

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the “Disciplinary Core Ideas” section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).*

---

*Connection boxes updated as of September 2018*
### 4. Structure, Function, and Information Processing

Students who demonstrate understanding can:

**4-PS4-2.** Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]

**4-LS1-1.** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

**4-LS1-2.** Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

---

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Developing and Using Models</strong></td>
<td><strong>PS4.B: Electromagnetic Radiation</strong></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Develop a model to describe phenomena. (4-PS4-2)</td>
<td>• An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)</td>
<td></td>
</tr>
<tr>
<td>• Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)</td>
<td><strong>LS1.A: Structure and Function</strong></td>
<td></td>
</tr>
<tr>
<td>Engaging in Argument from Evidence</td>
<td>• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)</td>
<td></td>
</tr>
<tr>
<td>Engaging in argument from evidence in 3–5 builds on 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(s).</td>
<td><strong>LS1.D: Information Processing</strong></td>
<td></td>
</tr>
<tr>
<td>• Construct an argument with evidence, data, and/or a model. (4-LS1-1)</td>
<td>• Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal’s brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)</td>
<td></td>
</tr>
</tbody>
</table>

**Connections to other DCIs in fourth grade:** N/A

**Articulation of DCIs across grade-levels:**
- **1.PS4.B (4-PS4-2); 1.LS1.A (4-LS1-1); 1.LS1.D (4-LS1-2); 1.LS3.B (4-LS1-1); MS.PS4.B (4-PS4-2); MS.LS1.A (4-LS1-1), (4-LS1-2)**
- **MS.LS1.D (4-PS4-2), (4-LS1-2)**

New York State Next Generation Learning Standards Connections:

**ELA/Literacy**
- **4W1** Write an argument to support claim(s), using clear reasons and relevant evidence. (4-LS1-1)
- **4SL5** Include digital media and/or visual displays in presentations to emphasize central ideas or themes. (4-PS4-2), (4-LS1-2)

**Mathematics**
- **MP.4** Model with mathematics. (4-PS4-2)
- **NY-4.G.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-LS1-1)
- **NY-4.G.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetry figures and draw lines of symmetry. (4-PS3-4)

*Connection boxes updated as of September 2018*
New York State P-12 Science Learning Standards

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

Students who demonstrate understanding can:

4-ESS1. 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; tilted rock layers indicate past crustal movement; glacial scratches on rock formations indicating glacier movement; 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. 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 and/or loose Earth materials due to gravity, 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. 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. 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.]

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 the use of evidence to support explanations or design solutions.

• Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)

Analyzing and Interpreting Data

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.

• Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-1)

Constructing Explanations and Designing Solutions

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 in designing multiple solutions to design problems.

• Identify the evidence that supports particular points in an explanation. (4-ESS1-1)

• Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS2-3)

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth

• Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)

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. (4-ESS2-1)

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

• The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

ESS2.E: Biogeology

• Living things affect the physical characteristics of their regions. (4-ESS2-1)

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. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.)

ETS1.B: Designing Solutions to Engineering Problems

• Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS2-2)

Crosscutting Concepts

Patterns

• Patterns can be used as evidence to support an explanation. (4-ESS1-1), (4-ESS2-1)

Causation and Effect

• Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS1-1), (4-ESS2-3)

Connections to Engineering, Technology, and Applications of Science

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

• Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

• Science assumes consistent patterns in natural systems. (4-ESS1-1)

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

<table>
<thead>
<tr>
<th>Developing and Using Models</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
</table>
| **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.** | **PS1.A: Structure and Properties of Matter**  
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)  
- (NYSED) The total amount of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)  
- Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3) | **Cause and Effect**  
- Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4) |
| **Planning and Carrying Out Investigations** | **PS1.B: Chemical Reactions**  
- When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)  
- 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.) (5-PS1-2) | **Scale, Proportion, and Quantity**  
- Natural objects exist from the very small to the immensely large. (5-PS1-1)  
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2),(5-PS1-3) |
| **Using Mathematics and Computational Thinking**  
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. | **NY-5.NBT.1**: Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left. (5-PS1-1) | **Connections to Nature of Science**  
- Science assumes consistent patterns in natural systems. (5-PS1-2) |
| **Measure and graph quantities such as weight, time, temperature, and volume.** | **NY-5.NF.7** Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (5-PS1-1) | **Scientific Knowledge Assumes an Order and Consistency in Natural Systems**  
- Science assumes consistent patterns in natural systems. (5-PS1-2) |
| **NY-5.MD.1** Convert among different-sized standard measurement units within a given measurement system when the conversion factor is given. Use these conversions in solving multi-step, real-world problems. (5-PS1-2) | **NY-5.MD.3** Recognize volume as an attribute of solid figures and understand concepts of volume measurement. (5-PS1-1) | **Connections to other DCIs in fifth grade: N/A** |

---

**Articulation of DCIs across grade-levels:**  
# New York State P-12 Science Learning Standards

## 5. Matter and Energy in Organisms and Ecosystems

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing and Using Models</td>
<td></td>
<td>Systems and System Models</td>
</tr>
<tr>
<td>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.</td>
<td>5-PS3.D: Energy in Chemical Processes and Everyday Life (5-PS3-1)</td>
<td>• A system can be described in terms of its components and their interactions. (5-LS2-1)</td>
</tr>
<tr>
<td>Use models to describe phenomena. (5-PS3-1)</td>
<td>5-LS1.C: Organization for Matter and Energy Flow in Organisms (5-PS3-1)</td>
<td>Energy and Matter</td>
</tr>
<tr>
<td>Develop a model to describe phenomena. (5-LS2-1)</td>
<td>5-LS1.C: Organization for Matter and Energy Flow in Organisms (5-PS3-1)</td>
<td>• Matter is transported into, out of, and within systems. (5-LS1-1)</td>
</tr>
<tr>
<td>Engaging in Argument from Evidence</td>
<td>5-LS2.A: Interdependent Relationships in Ecosystems (5-LS2-1)</td>
<td>• Energy can be transferred in various ways and between objects. (5-PS3-1)</td>
</tr>
<tr>
<td>Engaging in argument from evidence in 3–5 builds on 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(s).</td>
<td>5-LS2.B: Cycles of Matter and Energy Transfer in Ecosystems (5-PS3-1)</td>
<td></td>
</tr>
<tr>
<td>Support an argument with evidence, data, or a model. (5-LS1-1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Connections to Nature of Science

#### Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Science explanations describe the mechanisms for natural events. (5-LS2-1)

### New York State Next Generation Learning Standards Connections:

#### ELA/Literacy -
- SR1 Locate and refer to relevant details and evidence when explaining what a text says explicitly/implicitly and make logical inferences. (5-LS1-1)
- SR7 Analyze how visual and multimedia elements contribute to meaning of literary and informational texts. (5-PS3-1),(5-LS1-1)
- SW1 Write an argument to support claims with clear reasons and relevant evidence. (5-LS1-1)
- S5L5 Include digital media and/or visual displays in presentations to emphasize and enhance central ideas or themes. (5-PS3-1),(5-LS1-1)

#### Mathematics -
- MP.2 Reason abstractly and quantitatively. (5-LS1-1),(5-LS2-1)
- MP.4 Model with mathematics. (5-LS1-1),(5-LS2-1)
- MP.5 Use appropriate tools strategically. (5-LS1-1)
- NY-5.MD.1 Convert among different-sized standard measurement units within a given measurement system when the conversion factor is given. Use these conversions in solving multi-step, real world problems. (5-LS1-1)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the "Disciplinary Core Ideas" section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).
## 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, landscape shape, and climate; the influence of the atmosphere on landscapes 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 of salt 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 Earth's resources and environment.  
[Clarification Statement: Emphasis should be on how communities use information to sustain resources and the environment locally, regionally, nationally, and/or internationally.]

---

### Science and Engineering Practices

**Developing and Using Models**
- 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.  
  - Develop a model using an example to describe a scientific principle. (5-ESS2-1)

**Using Mathematics and Computational Thinking**
- 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.  
  - Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

**Obtaining, Evaluating, and Communicating Information**
- 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.  
  - Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS2-1)

---

### Disciplinary Core Ideas

**ESS2A: Earth Materials and Systems**
- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)

**ESS2C: The Roles of Water in Earth's Surface Processes**
- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)

**ESS3C: 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. (5-ESS3-1)

### Crosscutting Concepts

**Scale, Proportion, and Quantity**
- Standard units are used to measure and describe physical quantities such as weight, and volume. (5-ESS2-2)

**Systems and System Models**
- A system can be described in terms of its components and their interactions. (5-ESS2-1), (5-ESS3-1)

---

### Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
- Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)

---

### New York State Next Generation Learning Standards

**Connections: ELA/Literacy**
- **SR1** Locate and refer to relevant details and evidence when explaining what a text says explicitly/implicitly and make logical inferences. (5-ESS3-1)
- **SR7** Analyze how visual and multimedia elements contribute to meaning of literary and informational texts. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **SW7** Recall relevant information from experiences or gather relevant information from multiple sources; summarize or paraphrase; avoid plagiarism and provide a list of sources. (5-ESS2-2), (5-ESS3-1)
- **SW8** Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1)
- **SSSL5** Include digital media and/or visual displays in presentations to emphasize and enhance central ideas or themes. (5-ESS2-1), (5-ESS2-2)

**Mathematics**
- **MP-2** Reason abstractly and quantitatively. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **MP-4** Model with mathematics. (5-ESS2-1), (5-ESS2-2), (5-ESS3-1)
- **NY-5.G.2** 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)

*Connection boxes updated as of September 2018*

---

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the “Disciplinary Core Ideas” section is reproduced verbatim from A Framework for K–12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).*
New York State P-12 Science Learning Standards

5. Space Systems: Stars and the Solar System

Students who demonstrate understanding can:

5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down. [Clarification Statement: “Down” is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]

5-ESS1-1. Support an argument that the apparent brightness of the Sun compared to other stars is due to their relative distances from Earth. [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the Sun, moon, and some stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing and Interpreting Data</td>
<td>PS2.B: Types of Interactions</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Support an argument with evidence, data, or a model.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5-PS2-1),(5-ESS1-1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engaging in Argument from Evidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engaging in argument from evidence in 3-5 builds on 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(s).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Support an argument with evidence, data, or a model.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5-ESS1-2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engaging in Argument from Evidence</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Connections to other DCIs in fifth grade: N/A |

| Articulation of DCIs across grade-levels: 1.ESS1.A (5-ESS1-2); 1.ESS1.B (5-ESS1-2); 3.PS2.A (5-PS2-1),(5-ESS1-2); 3.PS2.B (5-PS2-1); MS.PS2.B (5-PS2-1); MS.ESS1.A (5-ESS1-1),(5-ESS1-2); MS.ESS1.B (5-PS2-1),(5-ESS1-1),(5-ESS1-2); MS.ESS2.C (5-PS2-1) |

| New York State Next Generation Learning Standards Connections: |
| ELA/Literacy - |
| 5R1 | Locate and refer to relevant details and evidence when explaining what a text says explicitly/implicitly and make logical inferences. (5-PS2-1),(5-ESS1-1) |
| 5R7 | Explain how claims in a text are supported by relevant reasons and evidence, identifying which reasons and evidence support which claims. (5-ESS1-1) |
| 5R8 | Write an argument to support claims with clear reasons and relevant evidence. (5-PS2-1), (5-ESS1-1) |
| 5S5 | Include digital media and/or visual displays in presentations to emphasize and enhance central ideas or themes. (5-ESS1-2) |
| Mathematics - |
| MP.2 | Reason abstractly and quantitatively. (5-ESS1-1),(5-ESS1-2) |
| MP.6 | Use appropriate tools strategically. (5-ESS1-1),(5-ESS1-2) |
| NY-5.NBT.2 | Use whole-number exponents to denote powers of 10. Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. (5-ESS1-1) |
| NY-5.G.2 | 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-ESS1-2) |

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the “Disciplinary Core Ideas” section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).
### 3-5. Engineering Design

**Students who demonstrate understanding can:**

<table>
<thead>
<tr>
<th>3-5-ETS1-1.</th>
<th>Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-5-ETS1-2.</td>
<td>Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</td>
</tr>
<tr>
<td>3-5-ETS1-3.</td>
<td>Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</td>
</tr>
</tbody>
</table>

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**

* Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

**Planning and Carrying Out Investigations**

* Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

**Constructing Explanations and Designing Solutions**

* Generate and compare multiple solutions to a problem based on how well each meets the criteria and constraints of the design problem. (3-5-ETS1-2)

### Disciplinary Core Ideas

**ETS1.A: Defining and Delimiting 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. (3-5-ETS1-1)

**ETS1.B: Developing Possible Solutions**

* Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)

* Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

### Crosscutting Concepts

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

* People’s needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)

* Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

### New York State Next Generation Learning Standards Connections:

<table>
<thead>
<tr>
<th>ELA/Literacy</th>
<th>MS.ETS1.A (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); MS.ETS1.B (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); MS.ETS1.C (3-5-ETS1-2); MS.ETS1.D (3-5-ETS1-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>Reason abstractly and quantitatively. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)</td>
</tr>
<tr>
<td></td>
<td>Modeling with Mathematics. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)</td>
</tr>
<tr>
<td></td>
<td>Use tools strategically. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)</td>
</tr>
<tr>
<td></td>
<td>Operations and Algebraic Thinking(3-5-ETS1-1),(3-5-ETS1-2)</td>
</tr>
</tbody>
</table>

*Connection boxes updated as of September 2018

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea. The text in the "Disciplinary Core Ideas" section is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas unless it is preceded by (NYSED).