A Correlation of

Pearson
Interactive Science
Arkansas Edition, ©2017

To the

Arkansas
Science Standards 2015
Grades 6-8
Introduction

The following document demonstrates how the *Interactive Science Custom Edition: Life, Earth, Physical ©2017* program supports the Arkansas Department of Education K-12 Science Standards 2015. Correlation references are to the Student and Teacher Editions and online Inquiry and Quest/STEMQuest activities.

*Interactive Science* is a middle school science program composed of three texts addressing life, earth, and physical science topics that makes learning personal, engaging, and relevant for today's student. *Interactive Science* features an innovative Write-in Student Edition that enables students to become active participants in their learning and truly connect the Big Ideas of science to their world. Additional STEM activities embedded throughout the program enable students to interact with science and engineering practices and cross-cutting concepts in order to promote higher-order, critical-thinking skills that result in improved performance.

**Digital Resources**

**Interactive Science Digital Path for Students**
Students have access to a wealth of digital resources to explore, explain and elaborate. Students can work at their own pace on assignments, receive immediate feedback on assessment resources, and turn assignments in online.

**Student Edition eText**
The student eText can be read onscreen like a traditional book with the convenience of tools of notes, highlights and bookmarks. Untamed Science Videos make science come alive for students. Virtual labs provide opportunities to complete activities that are too expensive or take too much time.

**Interactive Science Digital path for Teachers**
Digital resources can be used with a single computer and LCD projector, computer stations or with interactive whiteboard technology. Create groups and track mastery and progress at PearsonRealize.com

**Online Quests and STEM Quests** are problem-based learning activities designed to allow students to solve real world topics at each grade level using hands-on, investigative, and collaborative skills. A focus on science and engineering practices requires students to apply what they have learned to new situations and new content.
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**Energy**

Students who demonstrate understanding can:

**6-PS3-3** Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* [AR Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a polystyrene foam cup.][Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

**TE only:**

**6-PS3-4** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice have melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.][Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

**TE only:**

**6-PS3-5** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [AR Clarification Statement: Examples of empirical evidence used in arguments could include a diagram, flowchart, or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object.][Assessment Boundary: Assessment does not include calculations of energy.]

**TE only:**

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>
</table>
| **Planning and Carrying Out Investigations** | **PS3.A: Definitions of Energy**  
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (6-PS3-3, 6-PS3-4)  
**SE/TE:**  
6-7, Scenario Investigation, Where Is the Battery? | **Scale, Proportion, and Quantity**  
- Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (6-PS3-4)  
**SE/TE:**  
8-11, Temperature, Thermal Energy, and Heat  
**TE Only:**  
11, Quick Lab, Temperature and Thermal Energy | **Energy and Matter**  
- Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion). (6-PS3-5) |
### Constructing Explanations and Designing Solutions

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.

- Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (6-PS3-3)

**SE/TE:**
6-7, Scenario Investigation, Where Is the Battery?

### Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on 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 worlds.

- Construct, use, 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. (6-PS3-5)

**TE Only:**
19, Differentiated Instruction, Clothes from the Dryer

### PS3.B: Conservation of Energy and Energy Transfer

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (6-PS3-5)

**TE Only:**

- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (6-PS3-4)

**SE/TE:**
18, Specific Heat

**TE Only:**
19, Differentiated Instruction, Clothes from the Dryer
19, Differentiated Instruction, Space Shuttle Tiles

- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (6-PS3-3)

**SE/TE:**
12-15, How Is Heat Transferred?

**TE Only:**
12, Inquiry Warm-Up, What Does It Mean to Heat Up?
14, Build Inquiry, Heat Flow from Lamps
15, Quick Lab, Visualizing Convection Currents

### ETS1.A: Defining and Delimiting an Engineering Problem

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (6-PS3-3)

**SE/TE:**
6-7, Scenario Investigation, Where Is the Battery?
420-423, Stem Activity, It's All Water Under the Dam

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**Connections to Nature of Science**

### Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations (6-PS3-4, 6-PS3-5)

**SE/TE:**
8-11, Temperature, Thermal Energy, and Heat
18, Specific Heat

**TE Only:**
11, Quick Lab, Temperature and Thermal Energy
19, Differentiated Instruction, Clothes from the Dryer
19, Differentiated Instruction, Space Shuttle Tiles

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**SE = Student Edition  TE = Teacher's Edition**
**ETS1.B: Developing Possible Solutions**

- A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (6-PS3-3)

**SE/TE:**

6-7, Scenario Investigation, Where Is the Battery?
420-423, Stem Activity, It's All Water Under the Dam

**Connections to other DCIs in sixth grade:**

6. ESS2.D (6-PS3-3, 6-PS3-4); 6. ESS3.D (6-PS3-4)

**Connections to other DCIs across grade levels:**

4. PS3.B (6-PS3-3); 4. PS3.C (6-PS3-4, 6-PS3-5); 7. PS1.B (6-PS3-4);
8. PS3.A (6-PS3-4, 6-PS3-5); 8. PS3.B (6-PS3-3, 6-PS3-4, 6-PS3-5)

**Common Core State Standards Connections:**

**ELA/Literacy –**

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (6-PS3-5)
RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (6-PS3-3, 6-PS3-4)
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
WHST.6-8.1 Write arguments focused on discipline content. (6-PS3-5)
WHST.6-8.7 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. (6-PS3-3, 6-PS3-4)

**Mathematics –**

MP.2 Reason abstractly and quantitatively. (6-PS3-4, 6-PS3-5)
6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (6-PS3-5)
6.SP.B.5 Summarize numerical data sets in relation to their context. (6-PS3-4)
Structure, Function, and Information Processing

Students who demonstrate understanding can:

6-LS1-1  Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on gathering evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]

TE only:

6-LS1-2  Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]

TE only:

6-LS1-3  Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems. [Assessment Boundary: Assessment is limited to circulatory, excretory, digestive, respiratory, muscular, and nervous systems. Assessment does not include the mechanism of one body system independent of others.]

TE only:

6-LS1-8  Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

TE only:

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

**Science and Engineering Practices**
- Developing and Using Models
  - Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
    - Develop and use a model to describe phenomena. (6-LS1-2)

**Disciplinary Core Ideas**
- LS1.A: Structure and Function
  - All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (6-LS1-1)

**Crosscutting Concepts**
- Cause and Effect
  - Cause and effect relationships may be used to predict phenomena in natural systems. (6-LS1-8)

**SE/TE**
- 173-177, What Is the Role of the Nervous System?
- 179, What Causes Animals to Move?
- 244, Nervous System

**TE Only**
- 172, Inquiry Warm-Up, Sending Signals
- 173, Teacher Demo, Stimulus and Response
- 174, Quick Lab, Design a Nervous System
### Planning and Carrying Out Investigations
Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.
- Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (6-LS1-1)

**TE Only:**
35, Quick Lab, Observing Cells

### Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on 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(s).
- Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (6-LS1-3)

**TE Only:**
49, Quick Lab, Tissues, Organs, Systems
237, Differentiated Instruction, Plant Organization
237, Quick Lab, Observing Cells and Tissue

### Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.
- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (6-LS1-8)

**TE Only:**
177, Differentiated Instruction, Snake Senses
177, Differentiated Instruction, Summarize Sense Organs
177, Quick Lab, Compare Nervous Systems

### Scale, Proportion, and Quantity
- Phenomena that can be observed at one scale may not be observable at another scale. (6-LS1-1)

**TE Only:**
34-35, What Is the Cell Theory?

### Systems and System Models
- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (6-LS1-3)

**TE Only:**
49, Differentiated Instruction, Cells in Tissues
49, Quick Lab, Tissues, Organs, Systems
232, Inquiry Warm-Up, How Is Your Body Organized
235, Differentiated Instruction, Levels of Organization
237, Differentiated Instruction, Body Systems
237, Differentiated Instruction, Plant Organization
237, Teacher Demo, All Systems Go
237, Quick Lab, Cells and Tissue

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**SE/TE:**
41-47, How Do the Parts of a Cell Work?
44-45, Figure 3, Ells in Living Things
56-61, How Do Materials Move Into and Out of Cells?

**TE Only:**
43, Differentiated Instruction, Division of Labor
45, Differentiated Instruction, Compare and Contrast
45, Differentiated Instruction, Cell Diversity
56, Inquiry Warm-Up, Diffusion in Action
57, Teacher Demo, Cell Membrane Function
59, Differentiated Instruction, Diffusion
59, Differentiated Instruction, Osmosis in rivers and Oceans
61, Differentiated Instruction, Exocytosis

- In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (6-LS1-3)

**SE/TE:**
34-35, What Is the Cell Theory?
232-237, How Is Your Body Organized?

**TE Only:**
35, Quick Lab, Observing Cells

**SE/TE:**
48-49, How Do Cells Work Together in an Organism?
232-237, How Is Your Body Organized?

**TE Only:**
49, Differentiated Instruction, Cells in Tissues
49, Quick Lab, Tissues, Organs, Systems
232, Inquiry Warm-Up, How Is Your Body Organized
235, Differentiated Instruction, Levels of Organization
237, Differentiated Instruction, Body Systems
237, Differentiated Instruction, Plant Organization
237, Teacher Demo, All Systems Go
237, Quick Lab, Cells and Tissue
**LS1.D: Information Processing**

- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (6-LS1-8)

**SE/TE:**
- 173-177, What Is the Role of the Nervous System?
- 179, What Causes Animals to Move?
- 244, Nervous System

**TE Only:**
- 172, Inquiry Warm-Up, Sending Signals
- 173, Teacher Demo, Stimulus and Response
- 174, Quick Lab, Design a Nervous System
- 177, Differentiated Instruction, Snake Senses
- 177, Differentiated Instruction, Summarize Sense Organs
- 177, Quick Lab, Compare Nervous Systems

**Structure and Function**

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore complex natural structures/systems can be analyzed to determine how they function. (6-LS1-2)

**SE/TE:**
- 41-47, How Do the Parts of a Cell Work?
- 44-45, Figure 3, Cells in Living Things
- 56-61, How Do Materials Move Into and Out of Cells?

**TE Only:**
- 43, Differentiated Instruction, Division of Labor
- 45, Differentiated Instruction, Compare and Contrast
- 45, Differentiated Instruction, Cell Diversity
- 56, Inquiry Warm-Up, Diffusion in Action
- 57, Teacher Demo, Cell Membrane Function
- 59, Differentiated Instruction, Diffusion
- 59, Differentiated Instruction, Osmosis in rivers and Oceans
- 61, Differentiated Instruction, Exocytosis

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

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

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (6-LS1-1)

**SE/TE:**
- 34-35, What Is the Cell Theory?

**TE Only:**
- 35, Quick Lab, Discovery of the Cell

**Connections to Nature of Science**

**Science is a Human Endeavor**

- Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (6-LS1-3)

**SE/TE:**
- 34-35, What Is the Cell Theory?

**TE Only:**
- 35, Quick Lab, Discovery of the Cell
Connections to other DCIs in sixth grade: N/A

Connections to other DCIs across grade levels: 4.LS1.A (6-LS1-2); 4.LS1.D (6-LS1-8)

<table>
<thead>
<tr>
<th>Common Core State Standards Connections:</th>
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<td>ELA/Literacy -</td>
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<tr>
<td><strong>RST.6-8.1</strong></td>
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<tr>
<td><strong>RI.6.8</strong></td>
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<tr>
<td><strong>WHST.6-8.1</strong></td>
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<td><strong>WHST.6-8.7</strong></td>
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<td><strong>WHST.6-8.8</strong></td>
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<td><strong>SL.6.5</strong></td>
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<tr>
<td>Mathematics -</td>
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<tr>
<td><strong>6.EE.C.9</strong></td>
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</tbody>
</table>
Growth, Development, and Reproduction of Organisms

Students who demonstrate understanding can:

6-LS1-4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]

TE only: 159A, Performance Expectation Activity, “Growth, Development, and Reproduction of Organisms”

6-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

TE only: 159B, Performance Expectation Activity, “Growth, Development, and Reproduction of Organisms”

6-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

TE only: 103A, Performance Expectation Activity, “Growth, Development, and Reproduction of Organisms”

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

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<th>Disciplinary Core Ideas</th>
<th>Crosscutting Concepts</th>
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<tbody>
<tr>
<td><strong>Developing and Using Models</strong> Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</td>
<td><strong>LS1.B: Growth and Development of Organisms</strong> Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (6-LS3-2) <strong>SE/TE:</strong> 96-97, What Happens During Meiosis? 138, How Do Plants Reproduce? 203-207, How Do Animals Reproduce? <strong>TE Only:</strong> 202, Inquiry Warm-Up, Making More 205, Differentiated Instruction, Aphids 205, Differentiated Instruction, Compare and Contrast 205, Teacher Demo, Variation and Selection 207, Differentiated Instruction, Asexual Reproduction of a Polyp 207, Differentiated Instruction, Gemmules 207, Quick Lab, Types of Reproduction</td>
<td><strong>Cause and Effect</strong> Cause and effect relationships may be used to predict phenomena in natural systems. (6-LS3-2) <strong>SE/TE:</strong> 96-97, What Happens During Meiosis? 138, How Do Plants Reproduce? 203-207, How Do Animals Reproduce? <strong>TE Only:</strong> 205, Teacher Demo, Variation and Selection</td>
</tr>
</tbody>
</table>
Constructing Explanations and Designing Solutions

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 knowledge, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (6-LS1-5)

**TE Only:**
88, Quick Lab, Patterns of Inheritance

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on 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(s).

- Use an oral and written argument 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. (6-LS1-4)

**TE Only:**
209, Differentiated Instruction, Internal Fertilization in Fishes

- Animals engage in characteristic behaviors that increase the odds of reproduction. (6-LS1-4)

**SE/TE:**
208-209, How Do External and Internal Fertilization Differ?

**TE Only:**
209, Differentiated Instruction, Internal Fertilization in Fishes

- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (6-LS1-4)

**SE/TE:**
133, Seed Dispersal
136-143, Plant Reproduction

**TE Only:**
133, Build Inquiry, Modeling Seed Dispersal
136, Inquiry Warm-Up, Make the Pollen Stick
137, Quick Lab, Plant Life Cycles
139, Differentiated Instruction, Plant Life Cycle
139, Differentiated Instruction, Asexual Versus Sexual Reproduction
139, Differentiated Instruction, Life Cycles of Mosses and Ferns
141, Differentiated Instruction, Gymnosperm Life Cycle
141, Differentiated Instruction, Gymnosperm Reproduction
141, Build Inquiry, The Scoop on Cones
143, Differentiated Instruction, Angiosperm Reproduction
143, Differentiated Instruction, Flower and Fruit Roles
143, Differentiated Instruction, Allergies
143, Quick Lab, Where Are the Seeds?

- Genetic factors as well as local conditions affect the growth of the adult plant. (6-LS1-5)

**SE/TE:**
89-91, How Do Genes and the Environment Interact?

113, What Do Plants Need to Live Successfully on Land?

**TE Only:**
88, Quick Lab, Patterns of Inheritance

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (6-LS1-4, 6-LS1-5)

**SE/TE:**
89-91, How Do Genes and the Environment Interact?

**TE Only:**
88, Quick Lab, Patterns of Inheritance
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (6-LS3-2)

**SE/TE:**
86-91, How Are Most Traits Inherited?
92-97, Chromosomes and Inheritance

**TE Only:**
88, Quick Lab, Patterns of Inheritance
92, Inquiry Warm-Up, Which Chromosome Is Which?
95, Differentiated Instruction, Visualize Chromosomes
95, Quick Lab, Chromosomes and Inheritance
97, Teacher Demo, Model Meiosis
97, Quick Lab, Modeling Meiosis
205, Teacher Demo, Variation and Selection

**LS3.B: Variation of Traits**
- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (6-LS3-2)

**SE/TE:**
93-95, How Are Chromosomes, Genes, and Inheritance Related?
96-97, What Happens During Meiosis?

**TE Only:**
92, Inquiry Warm-Up, Which Chromosome Is Which?
95, Differentiated Instruction, Visualize Chromosomes
95, Quick Lab, Chromosomes and Inheritance
97, Teacher Demo, Model Meiosis
97, Quick Lab, Modeling Meiosis
205, Teacher Demo, Variation and Selection
Connections to other DCIs in sixth grade:  N/A

Connections to other DCIs across grade levels:  3.LS1.B (6-LS1-4, 6-LS1-5); 3.LS3.A (6-LS1-5, 6-LS3-2); 3.LS3.B (6-LS3-2); 7.LS2.A (6-LS1-4, 6-LS1-5); 7.LS2.D (6-LS1-4); 8.LS3.A (6-LS3-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1  Cite specific textual evidence to support analysis of science and technical texts.  (6-LS1-4, 6-LS1-5, 6-LS3-2)
RST.6-8.2  Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (6-LS1-5)
RST.6-8.4  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (6-LS3-2)
RST.6-8.7  Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (6-LS3-2)
RI.6.8  Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (6-LS1-4)
WHST.6-8.1  Write arguments focused on discipline content. (6-LS1-4)
WHST.6-8.2  Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (6-LS1-5)
WHST.6-8.9  Draw evidence from informational texts to support analysis, reflection, and research. (6-LS1-5)
SL.6.5  Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information. (6-LS3-2)

Mathematics –

MP.4  Model with mathematics. (6-LS3-2)
6.SP.A.2  Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (6-LS1-4, 6-LS1-5)
6.SP.B.4  Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (6-LS1-4, 6-LS1-5)
6.SP.B.5  Summarize numerical data sets in relation to their context. (6-LS3-2)
Earth's Systems

Students who demonstrate understanding can:

6-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

**TE only:**
373A, Performance Expectation Activity, "Earth's Systems"

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

### Science and Engineering Practices

**Developing and Using Models**
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe unobservable mechanisms. (6-ESS2-4)

**SE/TE:**
330-331, How Does Water Move Through the Atmosphere?
331, Figure 1, Water Cycle
546, Figure 3, Cloud Formation

### Disciplinary Core Ideas

**ESS2.C: The Roles of Water in Earth's Surface Processes**
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (6-ESS2-4)

**SE/TE:**
330-331, How Does Water Move Through the Atmosphere?
331, Figure 1, Water Cycle
546, Figure 3, Cloud Formation

**TE Only:**
330, Inquiry Warm-Up, Where Did the Water Go?
331, Quick Lab, Water in the Air
- Global movements of water and its changes in form are propelled by sunlight and gravity. (6-ESS2-4)

**SE/TE:**
330-331, How Does Water Move Through the Atmosphere?
331, Figure 1, Water Cycle

### Crosscutting Concepts

**Energy and Matter**
- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (6-ESS2-4)

**SE/TE:**
330-331, How Does Water Move Through the Atmosphere?
331, Figure 1, Water Cycle

### Connections to other DCIs in sixth grade:
- 6.PS3.D (6-ESS2-4)

### Connections to other DCIs across grade levels:
- 3.PS2.A (6-ESS2-4); 4.PS3.B (6-ESS2-4); 5.PS2.B (6-ESS2-4); 5.ESS2.C (6-ESS2-4); 7.ESS2.C (6-ESS2-4); 8.PS2.B (6-ESS2-4); 8.PS3.B (6-ESS2-4); 8.PS4.B (6-ESS2-4)

### Common Core State Standards Connections:

**ELA/Literacy** -
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (6-ESS2-4)
- WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (6-ESS2-4)
- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (6-ESS2-4)
- SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. (6-ESS2-4)
- SL.6.5 Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information. (6-ESS2-4)

**Mathematics** -
- MP.4 Model with mathematics. (6-ESS2-4)
**Human Impacts**

Students who demonstrate understanding can:

**6-ESS3-3** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*

[Clarification Statement: Examples of the design process could include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts could include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

TE only:  
473B, Performance Expectation Activity, “Human Impacts”

**6-ESS3-4** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations or the rates of consumption of food and natural resources (such as freshwater, minerals, or energy). Examples of impacts could include changes to the appearance, composition, or structure of Earth’s systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

TE only:  
415B, Performance Expectation Activity, “Human Impacts”  
473B, Performance Expectation Activity, “Human Impacts”

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><strong>Constructing Explanations and Designing Solutions</strong></td>
<td><strong>ESS3.C: Human Impacts on Earth Systems</strong></td>
<td><strong>Cause and Effect</strong></td>
</tr>
<tr>
<td>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.</td>
<td></td>
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</tr>
<tr>
<td>▪ Apply scientific principles to design an object, tool, process or system. (6-ESS3-3)</td>
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</tr>
<tr>
<td><strong>SE/TE:</strong> 420-423, Stem Activity, It’s All Water Under the Dam</td>
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<tr>
<td><strong>TE only:</strong> 441, Quick Lab, Modeling Soil Conservation 463, Quick Lab, Cleaning Up Oil Spills 466, Teacher Demo, Modeling Oil Spill Clean-Up</td>
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<td><strong>SE/TE:</strong> 420-423, Stem Activity, It’s All Water Under the Dam</td>
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</tr>
<tr>
<td><strong>TE Only:</strong> 436, Inquiry Warm-Up, How Does Mining Affect the Land?</td>
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</tr>
<tr>
<td>437, Quick Lab, Land Use 441, Differentiated Instruction, Understanding Land Reclamation 441, Differentiated Instruction, The Dust Bowl and Beyond 441, Quick Lab, Modeling Soil Conservation 453, Differentiated Instruction, Charting the History of Pollution</td>
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</tr>
<tr>
<td><strong>SE/TE:</strong> 425-427, What Are the Types of Environmental Issues?</td>
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<tr>
<td><strong>TE Only:</strong> 424, Inquiry Warm-Up, How Do You Decided? 427, Quick Lab, Environmental Issues</td>
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<td></td>
</tr>
<tr>
<td>▪ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (6-ESS3-4)</td>
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<td><strong>SE/TE:</strong> 425-427, What Are the Types of Environmental Issues?</td>
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<tr>
<td><strong>Engaging in Argument from Evidence</strong></td>
<td><strong>Connections to Engineering, Technology, and Applications of Science</strong></td>
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<tr>
<td>--------------------------------------</td>
<td>---------------------------------------------------------------</td>
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<tr>
<td>Engaging in argument from evidence in 6-8 builds on 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(s).</td>
<td><strong>Influence of Science, Engineering, and Technology on Society and the Natural World</strong></td>
<td></td>
</tr>
<tr>
<td>▪ Construct an oral and written argument 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. (6-ESS3-4)</td>
<td>▪ All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (6-ESS3-4)</td>
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<tr>
<td><strong>SE/TE:</strong> 425-427, What Are the Types of Environmental Issues?</td>
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<tr>
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<tr>
<td>427, Quick Lab, Environmental Issues</td>
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<tr>
<td>454, Build Inquiry, Identify Indoor Pollutants</td>
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<tr>
<td>454, Quick Lab, How Acid Is Your Rain?</td>
<td>456, Build Inquiry, Model the Effects of CFCs on Ozone</td>
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<tr>
<td>459, Differentiated Instruction, Respiratory Health</td>
<td>463, Differentiated Instruction, Thermal Pollution</td>
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<tr>
<td>463, Differentiated Instruction, Model Decision Making</td>
<td>463, Quick Lab, Cleaning Up Oil Spills</td>
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<tr>
<td>465, Differentiated Instruction, Model the Effects of CFCs on Ozone</td>
<td>466, Teacher Demo, Modeling Oil Spill Clean-Up</td>
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<tr>
<td>466, Teacher Demo, Modeling Oil Spill Clean-Up</td>
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<tr>
<td>▪ Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (6-ESS3-3, 6-ESS3-4)</td>
<td>▪ 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. Thus technology use varies from region to region and over time. (6-ESS3-3)</td>
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<td><strong>Connections to Nature of Science</strong></td>
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<td></td>
<td><strong>Science Addresses Questions About the Natural and Material World</strong></td>
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<tr>
<td></td>
<td>▪ Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (6-ESS3-4)</td>
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</table>
## Connections to other DCIs in sixth grade:
N/A

## Connections to other DCIs across grade levels:
- **3.LS2.C** (6-ESS3-3, 6-ESS3-4);
- **3.LS4.D** (6-ESS3-3, 6-ESS3-4);
- **5.ESS3.C** (6-ESS3-3, 6-ESS3-4);
- **7.LS2.A** (6-ESS3-4);
- **7.LS2.C** (6-ESS3-3, 6-ESS3-4);
- **7.ESS2.C** (6-ESS3-3);
- **7.ESS3.A** (6-ESS3-4);
- **8.LS4.C** (6-ESS3-3, 6-ESS3-4);
- **8.LS4.D** (6-ESS3-3, 6-ESS3-4)

## Common Core State Standards Connections:

### ELA/Literacy –
- **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (6-ESS3-4)
- **WHST.6-8.1** Write arguments focused on discipline content. (6-ESS3-4)
- **WHST.6-8.7** 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. (6-ESS3-3)
- **WHST.6-8.8** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (6-ESS3-3)
- **WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (6-ESS3-4)

### Mathematics –
- **6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (6-ESS3-3, 6-ESS3-4)
- **6.RP.A.2** Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. (6-ESS3-3, 6-ESS3-4)
- **6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (6-ESS3-3, 6-ESS3-4)

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SE = Student Edition       TE = Teacher’s Edition
Weather and Climate

Students who demonstrate understanding can:

6-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, or visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]

**TE only:**
373B, Performance Expectation Activity, "Weather and Climate"

6-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models could be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]

**TE only:**
323A, Performance Expectation Activity, "Weather and Climate"
415A, Performance Expectation Activity, "Weather and Climate"

6-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, or agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence could include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide or methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

**TE only:**
415C, Performance Expectation Activity, "Weather and Climate"

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

### Science and Engineering Practices

**Asking Questions and Defining Problems**

Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Ask questions to identify and clarify evidence of an argument. (6-ESS3-5)

**TE Only:**

404, Inquiry Warm-Up, What Is the Greenhouse Effect?

### Disciplinary Core Ideas

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

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (6-ESS2-5)

**SE/TE:**

330-333, Water in the Atmosphere

34-337, Clouds

338-343, Precipitation

### Crosscutting Concepts

**Cause and Effect**

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (6-ESS2-5)

**SE/TE:**

328-329, Scenario Investigation, Predicting Weather Is No Sport

363-367, Predicting the Weather

**TE Only:**

363, Inquiry Warm-Up, Predicting Weather

367, Differentiated Instruction, Generalization about Fronts

367, Differentiated Instruction, Accuracy of Local Weather Reports
### Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (6-ESS2-6)

#### **TE Only:**
- 380, Inquiry Warm-Up, How Does Latitude Affect Climate?
- 383, Differentiated Instruction, Angles of Sunlight
- 383, Differentiated Instruction, Temperature Zones
- 383, Teacher Demo, Air Temperature and Altitude
- 384, Build Inquiry, Comparing Water and Soil
- 385, Lab Investigation, Sunny Rays and Angles
- 387, Differentiated Instruction, Illustrate Winds Crossing a Mountain Range
- 387, Quick Lab, Inferring United States Precipitation Patterns

### Planning and Carrying Out Investigations

Planning and carrying out investigations in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (6-ESS2-5)

#### **TE Only:**
- 328-329, Scenario Investigation, Predicting Weather
- 363, Inquiry Warm-Up, Predicting Weather Is No Sport
- 367, Differentiated Instruction, Generalization about Fronts
- 367, Differentiated Instruction, Accuracy of Local Weather Reports

### Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (6-ESS2-6)

#### **SE/TE:**
- 385, Ocean Currents

### Stability and Change

- Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (6-ESS3-5)

#### **SE/TE:**
- 404-409, Human Activities and Climate Change
- 404, Inquiry Warm-Up, What Is the Greenhouse Effect?

### Systems and System Models

- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (6-ESS2-6)

#### **SE/TE:**
- 381-385, What Factors Effect Temperature?
- 386-387, What Factors Effect Precipitation?

#### **TE Only:**
- 380, Inquiry Warm-Up, How Does Latitude Affect Climate?
- 383, Differentiated Instruction, Angles of Sunlight
- 383, Differentiated Instruction, Temperature Zones
- 383, Teacher Demo, Air Temperature and Altitude
- 384, Build Inquiry, Comparing Water and Soil
- 385, Differentiated Instruction, Compare Hemispheres
- 385, Lab Investigation, Sunny Rays and Angles
- 387, Differentiated Instruction, Illustrate Winds Crossing a Mountain Range
- 387, Quick Lab, Inferring United States Precipitation Patterns

### Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (6-ESS2-6)

#### **SE/TE:**
- 381-385, What Factors Effect Temperature?
- 386-387, What Factors Effect Precipitation?

#### **TE Only:**
- 380, Inquiry Warm-Up, How Does Latitude Affect Climate?
- 383, Differentiated Instruction, Angles of Sunlight
- 383, Differentiated Instruction, Temperature Zones
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- 384, Build Inquiry, Comparing Water and Soil
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- 387, Differentiated Instruction, Illustrate Winds Crossing a Mountain Range
- 387, Quick Lab, Inferring United States Precipitation Patterns

- Because these patterns are so complex, weather can only be predicted probabilistically. (6-ESS2-5)

#### **SE/TE:**
- 328-329, Scenario Investigation, Predicting Weather
- 363-367, Predicting the Weather Is No Sport

#### **TE Only:**
- 363, Inquiry Warm-Up, Predicting Weather
- 367, Differentiated Instruction, Generalization about Fronts
- 367, Differentiated Instruction, Accuracy of Local Weather Reports
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (6-ESS2-6)

**SE/TE:**
385, Ocean Currents  
385, Figure 4, Currents and Temperature  
**TE Only:**
385, Differentiated Instruction, Compare Hemispheres

**ESS3.D: Global Climate Change**

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (6-ESS3-5)

**SE/TE:**
404-409, Human Activities and Climate Change  
**TE Only:**
404, Inquiry Warm-Up, What Is the Greenhouse Effect?

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**SE = Student Edition**  
**TE = Teacher's Edition**
Connections to other DCIs in sixth grade: N/A

Connections to other DCIs across grade levels: 3.PS2.A (6-ESS2-6); 3.ESS2.D (6-ESS2-5),(6-ESS2-6); 5.ESS2.A (6-ESS2-5, 6-ESS2-6); 7.ESS2.A (6-ESS2-6, 6-ESS3-5); 7.ESS2.C (6-ESS2-5); 8.PS2.B (6-ESS2-6); 8.PS3.B (6-ESS2-6, 6-ESS3-5); 8.PS4.B (6-ESS3-5); 8.ESS1.B (6-ESS2-6)

Common Core State Standards Connections:

<table>
<thead>
<tr>
<th>ELA/Literacy -</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RST.6-8.1</td>
<td>Cite specific textual evidence to support analysis of science and technical texts. (6-ESS2-5, 6-ESS3-5)</td>
</tr>
<tr>
<td>RST.6-8.9</td>
<td>Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (6-ESS2-5)</td>
</tr>
<tr>
<td>WHST.6-8.8</td>
<td>Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (6-ESS2-5)</td>
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<td>SL.6.5</td>
<td>Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information. (6-ESS2-6)</td>
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<tr>
<th>Mathematics -</th>
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<tbody>
<tr>
<td>MP.2</td>
<td>Reason abstractly and quantitatively. (6-ESS2-5, 6-ESS3-5)</td>
</tr>
<tr>
<td>6.NS.C.5</td>
<td>Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (6-ESS2-5)</td>
</tr>
<tr>
<td>6.EE.B.6</td>
<td>Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (6-ESS3-5)</td>
</tr>
</tbody>
</table>
## Engineering, Technology, and Applications of Science

Students who demonstrate understanding can:

### 6-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**SE/TE:**
- 420-423, Stem Activity, It’s All Water Under the Dam

### 6-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

**SE/TE:**
- 420-423, Stem Activity, It’s All Water Under the Dam

### 6-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

**SE/TE:**
- 420-423, Stem Activity, It’s All Water Under the Dam

### 6-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

**SE/TE:**
- 420-423, Stem Activity, It’s All Water Under the Dam

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

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<th>Science and Engineering Practices</th>
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<tr>
<td><strong>Asking Questions and Defining Problems</strong></td>
<td><strong>ETS1.A: Defining and Delimiting Engineering Problems</strong></td>
<td><strong>Influence of Science, Engineering, and Technology on Society and the Natural World</strong></td>
</tr>
<tr>
<td>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (6-ETS1-1)</td>
<td>• The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (6-ETS1-1)</td>
<td>• All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (6-ETS1-1)</td>
</tr>
<tr>
<td><strong>SE/TE:</strong> 420, Stem Activity, It’s All Water Under the Dam: 1, Identify the Problem 420-421, Stem Activity, It’s All Water Under the Dam: 2-4, Do Research</td>
<td><strong>SE/TE:</strong> 420, Stem Activity, It’s All Water Under the Dam: 1, Identify the Problem 420-421, Stem Activity, It’s All Water Under the Dam: # 2-4, Do Research</td>
<td><strong>SE/TE:</strong> 420-423, Stem Activity, It’s All Water Under the Dam</td>
</tr>
<tr>
<td>Developing and Using Models</td>
<td></td>
<td></td>
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<tr>
<td>----------------------------</td>
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<td></td>
</tr>
<tr>
<td>Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
  - Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (6-ETS1-4) |
| **SE/TE:** | 421, Stem Activity, It's All Water Under the Dam: 5-6, Develop Possible Solutions  
422, Stem Activity, It's All Water Under the Dam: 12-13, Design and Test a Prototype |

<table>
<thead>
<tr>
<th>Analyzing and Interpreting Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</td>
<td></td>
</tr>
</tbody>
</table>
  - Analyze and interpret data to determine similarities and differences in findings. (6-ETS1-3) |
| **SE/TE:** | 422, Stem Activity, It's All Water Under the Dam: 14-17, Test the Prototype  
423, Stem Activity, It's All Water Under the Dam: 20-22, Evaluate and Redesign |

<table>
<thead>
<tr>
<th>Engaging in Argument from Evidence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engaging in argument from evidence in 6–8 builds on 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.</td>
<td></td>
</tr>
</tbody>
</table>
  - Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (6-ETS1-2) |
| **SE/TE:** | 423, Stem Activity, It's All Water Under the Dam: 20-22, Evaluate and Redesign |

<table>
<thead>
<tr>
<th>ETS1.B: Developing Possible Solutions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (6-ETS1-4)</td>
<td></td>
</tr>
</tbody>
</table>
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (6-ETS1-2, 6-ETS1-3) |
| **SE/TE:** | 422, Stem Activity, It's All Water Under the Dam: 12-13, Design and Test a Prototype  
423, Stem Activity, It's All Water Under the Dam: 20-22, Evaluate and Redesign |

<table>
<thead>
<tr>
<th>ETS1.C: Optimizing the Design Solution</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process, some of those characteristics may be incorporated into the new design. (6-ETS1-3)</td>
<td></td>
</tr>
</tbody>
</table>
- The uses of technologies and 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. (6-ETS1-1) |
| **SE/TE:** | 420-423, Stem Activity, It's All Water Under the Dam|

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SE = Student Edition  
TE = Teacher’s Edition
The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (6-ETS1-4)

**SE/TE:**
422, Stem Activity, It's All Water Under the Dam: # 14-17, Test the Prototype

### Connections to 6-8.ETS1.A: Defining and Delimiting Engineering Problems include: Physical Science: (6-PS3-3)

### Connections to 6-8.ETS1.B: Developing Possible Solutions Problems include: Physical Science: (7-PS1-6, 6-PS3-3); Life Science: (7-LS2-5)

### Connections to 6-8.ETS1.C: Optimizing the Design Solution include: Physical Science: (7-PS1-6)

### Connections to other DCIs across grade levels:
- **3-5.ETS1.A** (6-ETS1-1, 6-ETS1-2, 6-ETS1-3); **3-5.ETS1.B** (6-ETS1-2, 6-ETS1-3, 6-ETS1-4); **3-5.ETS1.C** (6-ETS1-1, 6-ETS1-2, 6-ETS1-3, 6-ETS1-4)

### Common Core State Standards Connections:

**ELA/Literacy –**

<table>
<thead>
<tr>
<th>RST.6-8.1</th>
<th>Cite specific textual evidence to support analysis of science and technical texts.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(6-ETS1-1, 6-ETS1-2, 6-ETS1-3)</td>
</tr>
<tr>
<td>RST.6-8.7</td>
<td>Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (6-ETS1-3)</td>
</tr>
<tr>
<td>RST.6-8.9</td>
<td>Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (6-ETS1-2, 6-ETS1-3)</td>
</tr>
<tr>
<td>WHST.6-8.7</td>
<td>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. (6-ETS1-2)</td>
</tr>
<tr>
<td>WHST.6-8.8</td>
<td>Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (6-ETS1-1)</td>
</tr>
<tr>
<td>WHST.6-8.9</td>
<td>Draw evidence from informational texts to support analysis, reflection, and research. (6-ETS1-2)</td>
</tr>
<tr>
<td>SL.6.5</td>
<td>Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information. (6-ETS1-4)</td>
</tr>
</tbody>
</table>

**Mathematics –**

| MP.2 | Reason abstractly and quantitatively. (6-ETS1-1, 6-ETS1-2, 6-ETS1-3, 6-ETS1-4) |
Structure and Properties of Matter

Students who demonstrate understanding can:

7-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3-D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

TE only:
77A, Performance Expectation Activity “Structure and Properties of Matter

7-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form a synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]

TE only:
77B, Performance Expectation Activity “Structure and Properties of Matter

7-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings or diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

TE only:

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>
</table>
| **Developing and Using Models** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.  
  - Develop a model to predict and/or describe phenomena. (7-PS1-1, 7-PS1-4)  
**SE/TE:**  
6-7, Scenario Investigation, My Glass Is Leaking!  
8-15, States of Matter  
16-23, Changes of State  
24-25, How Are Pressure and Temperature of a Gas Related?  
26-27 How Are Volume and Temperature of a Gas Related?  
- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (7-PS1-1)  
**SE/TE:**  
40-41, Scenario Investigation, Bonding Super Heroes  
50-57, Ionic Bonds  
58-65, Covalent Bonds  
66-71, Bonding In Metals  
**TE Only:**  
65, Differentiated Instruction, Carbon Chains | **Cause and Effect**  
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (7-PS1-4)  
**SE/TE:**  
6-7, Scenario Investigation, My Glass Is Leaking!  
8-15, States of Matter  
16-23, Changes of State  
24-25, How Are Pressure and Temperature of a Gas Related?  
26-27 How Are Volume and Temperature of a Gas Related?  
69, Thermal Conductivity  
**TE Only:**  
10, Quick Lab, Modeling Particles  
13, Differentiated Instruction, Model Gases  
14, Teacher Demo, Demonstrate Gas Pressure |
Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (7-PS1-3)

**SE/TE:**
85, Properties of Matter

- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (7-PS1-4)

**SE/TE:**
11-12, How Do You Describe a Liquid
13-14, How Do You Describe a Gas

- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (7-PS1-4)

**SE/TE:**
11-12, How Do You Describe a Liquid
13-14, How Do You Describe a Gas
13, Figure 5, Gas

**TE Only:**
11, Differentiated Instruction, Measure Volume

- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

**SE/TE:**
9-10, How Do You Describe a Solid
56, Ionic Crystals
56, Figure 5, Halite
67, What Is the Structure of a Metal Crystal
67, Figure 1, Metallic Bonding

**TE Only:**
9, Build Inquiry, Observe Crystals
10, Teacher Demo, Classify Solids
10, Quick Lab, Modeling Particles
67, Quick Lab, Metal Crystals

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (7-PS1-1)

**SE/TE:**
9-10, How Do You Describe a Solid
40-41, Scenario Investigation, Bonding Super Heroes
50-57, Ionic Bonds
58-65, Covalent Bonds
66-71, Bonding In Metals

**TE Only:**
9, Build Inquiry, Observe Crystals
10, Teacher Demo, Classify Solids
10, Quick Lab, Modeling Particles
65, Differentiated Instruction, Carbon Chains
67, Quick Lab, Metal Crystals

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (7-PS1-3)

**TE Only:**
89, Differentiated Instruction, No Bulb, No Battery
91, Lab Investigation, Where's the Evidence
<table>
<thead>
<tr>
<th>Connections to Engineering, Technology, and Applications of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interdependence of Science, Engineering, and Technology</td>
</tr>
<tr>
<td>Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (7-PS1-3)</td>
</tr>
<tr>
<td>TE Only:</td>
</tr>
<tr>
<td>89, Differentiated Instruction, No Bulb, No Battery</td>
</tr>
<tr>
<td>91, Lab Investigation, Where's the Evidence</td>
</tr>
<tr>
<td>Influence of Science, Engineering and Technology on Society and the Natural World</td>
</tr>
<tr>
<td>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. Thus technology use varies from region to region and over time. (7-PS1-3)</td>
</tr>
<tr>
<td>TE Only:</td>
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<td>89, Differentiated Instruction, No Bulb, No Battery</td>
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<tr>
<td>91, Lab Investigation, Where's the Evidence</td>
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</table>

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<tr>
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<tbody>
<tr>
<td>The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (7-PS1-4)</td>
</tr>
</tbody>
</table>

| 6-7, Scenario Investigation, My Glass Is Leaking!             |
| 8-15, States of Matter                                       |
| 16-23, Changes of State                                      |

| TE Only:                                                     |
| 10, Quick Lab, Modeling Particles                            |
| 13, Differentiated Instruction, Model Gases                  |
| 15, Quick Lab, How Do Particles in a Gas Move?               |
| 16, Inquiry Warm-Up, What Happens When You Breathe on a Mirror? |
| 18, Lab Investigation, Melting Ice                           |
| 18, Teacher Demo, Measure Melting Point                      |
| 19, Build Inquiry, Evaporation                               |
| 20, Quick Lab, Keeping Cool                                  |
| 20, Differentiated Instruction, Observe Condensation         |
| 20, Differentiated Instruction, Defrosters                   |
| 21, Differentiated Instruction, Dry Ice                      |
| 21, Diff. Instruction, Diagram Changes                       |
| 23, Differentiated Instruction, Diagram Changes of State     |
| 23, Differentiated Instruction, Changing the Freezing Point of Water |
| 23, Quick Lab, Observing Sublimation                         |

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (7-PS1-3)</td>
</tr>
</tbody>
</table>

| 84-91, Observing Chemical Change                             |

| TE Only:                                                     |
| 84, Inquiry Warm-Up, What Happens When Chemicals React?      |
| 87, Differentiated Instruction, Table Salt                   |
| 87, Differentiated Instruction, Ripening                     |
| 87, Quick Lab, Observing Change                              |
| 89, Diff. Instruction, Changes in Wood                       |
| 89, Diff. Instruction, No Bulb, No Battery                   |
| 89, Teacher Demo, Hopping Corn                               |
| 90, Teacher Demo, A Toaster Reaction                        |
| 91, Differentiated Instruction, Changes in Energy            |
| 91, Differentiated Instruction, Mix It Up                    |
| 91, Lab Investigation, Where's the Evidence                  |
PS3.A: Definitions of Energy

- The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to 7-PS1-4)

**SE/TE:**
15, Temperature
69, Thermal Conductivity
114, Science Matters, Look, Ma, Warm Hands

- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (7-PS1-4)

**SE/TE:**
24-25, How Are Pressure and Temperature of a Gas Related?
25, Figure 1, Temperature and Gas Pressure
26-27 How Are Volume and Temperature of a Gas Related?
26, Figure 3 Charles' Law

**TE Only:**
25, Quick Lab, How Are Pressure and Temperature Related?
27, Quick Lab, Hot and Cold Balloons
Connections to other DCIs in seventh grade:

- **7.ESS2.C** (7-PS1-1, 7-PS1-4), **7.ESS3.A** (7-PS1-3)

Connections to other DCIs across grade levels:


Common Core State Standards Connections:

**ELA/Literacy** –

- **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (7-PS1-3)
- **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-PS1-1, 7-PS1-4)
- **WHST.6-8.8** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (7-PS1-3)

**Mathematics** –

- **MP.2** Reason abstractly and quantitatively. (7-PS1-1)
- **MP.4** Model with mathematics. (7-PS1-1)
- **6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (7-PS1-1)
- **6.NS.C.5** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (7-PS1-4)
### Chemical Reactions

Students who demonstrate understanding can:

**7-PS1-2** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. **[AR Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrochloric acid.]** [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.] **[AR Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrochloric acid.]** [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

**TE only:**
115A, Performance Expectation Activity “Chemical Reactions”

**7-PS1-5** Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. **[Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms that represent atoms.]** [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]

**TE only:**
115B, Performance Expectation Activity “Chemical Reactions”

**7-PS1-6** Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* **[AR Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical processes such as dissolving ammonium chloride or calcium chloride or chemical reactions such as burning.]** [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

**TE only:**
115C, Performance Expectation Activity “Chemical Reactions”

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

### Science and Engineering Practices

**Developing and Using Models**
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe unobservable mechanisms. (7-PS1-5)

**SE/TE:**
84-91, Observing Chemical Change
87, Figure 3, Breaking and Making Bonds

### Disciplinary Core Ideas

**PS1.A: Structure and Properties of Matter**
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (7-PS1-2)

**SE/TE:**
85, Properties of Matter

### Crosscutting Concepts

**Patterns**
- Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (7-PS1-2)

**SE/TE:**
84-91, Observing Chemical Change
**TE Only:**
84, Inquiry Warm-Up, What Happens When Chemicals React?
87, Quick Lab, Observing Change
89, Teacher Demo, Hopping Corn
90, Teacher Demo, A Toaster Reaction
91, Lab Investigation, Where's the Evidence
Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (7-PS1-2)

**TE Only:**
84, Inquiry Warm-Up, What Happens When Chemicals React?
87, Quick Lab, Observing Change
89, Teacher Demo, Hopping Corn
90, Teacher Demo, A Toaster Reaction
91, Lab Investigation, Where's the Evidence

### Constructing Explanations and Designing Solutions
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 knowledge, principles, and theories.

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (7-PS1-6)

**SE/TE:**
114, Design It
34-351, Stem Activity, Shake, Rattle and Roll

### Connections to Nature of Science
Scientific Knowledge is Based on Empirical Evidence
Science knowledge is based upon logical and conceptual connections between evidence and explanations. (7-PS1-2)

**SE/TE:**
84-91, Observing Chemical Change

**TE Only:**
84, Inquiry Warm-Up, What Happens When Chemicals React?
87, Quick Lab, Observing Change
89, Teacher Demo, Hopping Corn
90, Teacher Demo, A Toaster Reaction
91, Lab Investigation, Where's the Evidence

### PS1.B: Chemical Reactions
- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (7-PS1-2, 7-PS1-5)

**SE/TE:**
84-91, Observing Chemical Change

**TE Only:**
84, Inquiry Warm-Up, What Happens When Chemicals React?
87, Differentiated Instruction, Table Salt
87, Differentiated Instruction, Ripening
87, Quick Lab, Observing Change
89, Differentiated Instruction, Changes in Wood
89, Differentiated Instruction, No Bulb, No Battery
89, Teacher Demo, Hopping Corn
90, Teacher Demo, A Toaster Reaction
91, Differentiated Instruction, Changes in Energy
91, Differentiated Instruction, Mix It Up
91, Lab Investigation, Where's the Evidence

- The total number of each type of atom is conserved, and thus the mass does not change. (7-PS1-5)

**SE/TE:**
82-83, Scenario Investigation, The Pipeline Is Burning
96-101, How Is Mass Conserved During a Chemical Reaction?

**TE Only:**
97, Build Inquiry, Still There
99, Differentiated Instruction, Drawings formulas and Equations
99, Differentiated Instruction, Balancing Challenges
99, Build Inquiry, A Balancing
101, Quick Lab, Is Matter Conserved

- The transfer of energy can be tracked as energy flows through a designed or natural system. (7-PS1-6)

**SE/TE:**
90, Changes in Energy
106, Graphing Changes in Energy
114, Science Matters, Look, Ma, Warm Hands
114, Design It

**TE Only:**
91, Differentiated Instruction, Changes in Energy
106, Quick Lab, Modeling Activation Energy
114, Science Matters, Look, Ma, Warm Hands

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**SE = Student Edition**

**TE = Teacher’s Edition**
### Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Laws are regularities or mathematical descriptions of natural phenomena. (7-PS1-5)

**SE/TE:**
82-83, Scenario Investigation, The Pipeline Is Burning
96-101, How Is Mass Conserved During a Chemical Reaction?
97, Build Inquiry, Still There
99, Differentiated Instruction, Drawings formulas and Equations
99, Differentiated Instruction, Balancing Challenges
99, Build Inquiry, A Balancing Act
101, Quick Lab, Is Matter Conserved

- Some chemical reactions release energy, others store energy. (7-PS1-6)

**SE/TE:**
90, Changes in Energy
106, Graphing Changes in Energy
114, Science Matters, Look, Ma, Warm Hands
114, Design It

**TE Only:**
91, Differentiated Instruction, Changes in Energy
106, Quick Lab, Modeling Activation Energy

### ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (7-PS1-6)

**SE/TE:**
114, Science Matters, Look, Ma, Warm Hands
114, Design It
348-351, Stem Activity, Shake, Rattle, and Roll

- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (7-PS1-6)

**SE/TE:**
114, Science Matters, Look, Ma, Warm Hands
114, Design It
348-351, Stem Activity, Shake, Rattle, and Roll
| Connections to other DCIs in seventh grade: | 7.LS2.B (7-PS1-5); 7.ESS2.A (7-PS1-2, 7-PS1-5) |
| Connections to other DCIs across grade levels: | 5.PS1.B (7-PS1-2, 7-PS1-5); 6.PS3.D (7-PS1-6); 8.PS3.A (7-PS1-6); 8.PS3.B (7-PS1-6) |

**Common Core State Standards Connections:**

**ELA/Literacy –**

RST.6-8.1 | Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (7-PS1-2) |
RST.6-8.3 | Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (7-PS1-6) |
RST.6-8.7 | Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-PS1-2, 7-PS1-5) |
WHST.6-8.7 | 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. (7-PS1-6) |

**Mathematics –**

MP.2 | Reason abstractly and quantitatively. (7-PS1-2, 7-PS1-5) |
MP.4 | Model with mathematics. (7-PS1-5) |
6.RP.A.3 | Use ratio and rate reasoning to solve real-world and mathematical problems. (7-PS1-2, 7-PS1-5) |
6.SP.B.4 | Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (7-PS1-2) |
6.SP.B.5 | Summarize numerical data sets in relation to their context. (7-PS1-2) |
### Interdependent Relationships in Ecosystems

Students who demonstrate understanding can:

**7-LS2-2**  
**Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.**  
[Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

**TE only:**  
185B, Performance Expectation Activity “Matter and Energy in Organisms and Ecosystems”

**7-LS2-5**  
**Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, or prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]**

**TE only:**  
231B, Performance Expectation Activity “Interdependent Relationships in Ecosystems”  
269C, Performance Expectation Activity “Interdependent Relationships in Ecosystems”

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><strong>Constructing Explanations and Designing Solutions</strong></td>
<td><strong>LS2.A: Interdependent Relationships in Ecosystems</strong></td>
<td><strong>Patterns</strong></td>
</tr>
<tr>
<td>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.</td>
<td>• Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (7-LS2-2)</td>
<td>• Patterns can be used to identify cause and effect relationships. (7-LS2-2)</td>
</tr>
<tr>
<td><strong>TE Only:</strong></td>
<td><strong>SE/TE:</strong></td>
<td><strong>SE/TE:</strong></td>
</tr>
<tr>
<td>175, Build Inquiry, Observe an Insect-Eating Plant</td>
<td>173-176, What Are Competition and Predation?</td>
<td>173-176, What Are Competition and Predation?</td>
</tr>
<tr>
<td>176, Quick Lab, Competition and Predation</td>
<td>177-179, What Are Three Types of Symbiosis</td>
<td>177-179, What Are Three Types of Symbiosis</td>
</tr>
<tr>
<td>179, Quick Lab, Types of Symbiosis</td>
<td><strong>TE Only:</strong></td>
<td><strong>TE Only:</strong></td>
</tr>
<tr>
<td></td>
<td>173, Differentiated Instruction, Niche vs. Habitat</td>
<td>173, Differentiated Instruction, Niche vs. Habitat</td>
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<td>175, Build Inquiry, Observe an Insect-Eating Plant</td>
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</tr>
<tr>
<td></td>
<td>175, Differentiated Instruction, Classify Roles</td>
<td>175, Differentiated Instruction, Classify Roles</td>
</tr>
<tr>
<td></td>
<td>176, Quick Lab, Competition and Predation</td>
<td>176, Quick Lab, Competition and Predation</td>
</tr>
<tr>
<td></td>
<td>177, Differentiated Instruction, Predator-Prey Interactions</td>
<td>177, Differentiated Instruction, Predator-Prey Interactions</td>
</tr>
<tr>
<td></td>
<td>177, Differentiated Instruction, Types of Symbiosis</td>
<td>177, Differentiated Instruction, Types of Symbiosis</td>
</tr>
<tr>
<td></td>
<td>179, Differentiated Instruction, Cowbirds</td>
<td>179, Differentiated Instruction, Cowbirds</td>
</tr>
<tr>
<td></td>
<td>179, Differentiated Instruction, Symbiosis</td>
<td>179, Differentiated Instruction, Symbiosis</td>
</tr>
<tr>
<td></td>
<td>179, Quick Lab, Types of Symbiosis</td>
<td>179, Quick Lab, Types of Symbiosis</td>
</tr>
</tbody>
</table>
### Engaging in Argument from Evidence
Engaging in argument from evidence in 6-8 builds on 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(s).
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (7-LS2-5)

**TE Only:**
250, Inquiry Warm-Up, How Much Variety Is There?
259, Quick Lab, Humans and Biodiversity

### LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (7-LS2-5)

**SE/TE:**
247, Nonnative Species
247, Figure 3, Damage by Nutria
250-251, What Is Biodiversity's Value?
268, Science Matters, Endangered No More

**TE Only:**
247, Differentiated Instruction, Effects of Nonnative Species
247, Differentiated Instruction, Nonnative Invaders
248, Differentiated Instruction, Energy Diagram
248, Differentiated Instruction, Modeling Consequences of Technology
249, Differentiated Instruction, Cause-and-Effect Flash Cards
249, Differentiated Instruction, Greenhouse Effect
250, Inquiry Warm-Up, How Much Variety Is There?
259, Quick Lab, Humans and Biodiversity

### LS4.D: Biodiversity and Humans
- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (7-LS2-5)

**SE/TE:**
247-249, How Do Human Activities Affect Ecosystems?
256-259, How Do Humans Affect Biodiversity?

**TE Only:**
248, Differentiated Instruction, Energy Diagram
248, Differentiated Instruction, Modeling Consequences of Technology
249, Differentiated Instruction, Cause-and-Effect Flash Cards
249, Differentiated Instruction, Greenhouse Effect
259, Quick Lab, Humans and Biodiversity

### Stability and Change
- Small changes in one part of a system might cause large changes in another part. (7-LS2-5)

**TE Only:**
247, Differentiated Instruction, Effects of Nonnative Species
247, Differentiated Instruction, Nonnative Invaders
248, Differentiated Instruction, Energy Diagram
248, Differentiated Instruction, Modeling Consequences of Technology
249, Differentiated Instruction, Cause-and-Effect Flash Cards
249, Differentiated Instruction, Greenhouse Effect
250, Inquiry Warm-Up, How Much Variety Is There?
259, Quick Lab, Humans and Biodiversity

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

#### Influence of Science, Engineering, and Technology on Society and the Natural World
- The use 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. Thus technology use varies from region to region and over time. (7-LS2-5)

**SE/TE:**
256-259, How Do Humans Affect Biodiversity?

**TE Only:**
250, Inquiry Warm-Up, How Much Variety Is There?
259, Quick Lab, Humans and Biodiversity
ETS1.B: Developing Possible Solutions

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (7-LS2-5)

SE/TE:
257-259, Protecting Biodiversity

TE Only:
259, Quick Lab, Humans and Biodiversity
259, Differentiated Instruction, Human Impact

Connections to other DCIs in seventh grade: N/A

Connections to other DCIs across grade levels: 1.LS1.B (7-LS2-2); 6.ESS3.C (7-LS2-5); 6.ESS3.D (7-LS2-5);
8.LS4.D (7-LS2-5)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (7-LS2-2)
RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (7-LS2-5)
RI.7.8 Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (7-LS2-5)

WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (7-LS2-2)
WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (7-LS2-2)

SL.7.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others’ ideas and expressing their own clearly. (7-LS2-2)
SL.7.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation. (7-LS2-2)

Mathematics –

MP.4 Model with mathematics. (7-LS2-5)
6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (7-LS2-5)
6.SP.B.5 Summarize numerical data sets in relation to their context. (7-LS2-2)
<table>
<thead>
<tr>
<th>Matter and Energy in Organisms and Ecosystems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students who demonstrate understanding can:</td>
</tr>
<tr>
<td><strong>7-LS1-6</strong> Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]</td>
</tr>
<tr>
<td><strong>TE only:</strong> 149A, Performance Expectation Activity “Matter and Energy in Organisms and Ecosystems”</td>
</tr>
<tr>
<td><strong>7-LS1-7</strong> Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]</td>
</tr>
<tr>
<td><strong>TE only:</strong> 149B, Performance Expectation Activity “Matter and Energy in Organisms and Ecosystems”</td>
</tr>
<tr>
<td><strong>7-LS2-1</strong> Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]</td>
</tr>
<tr>
<td><strong>TE only:</strong> 185A, Performance Expectation Activity “Matter and Energy in Organisms and Ecosystems” 269A, Performance Expectation Activity “Matter and Energy in Organisms and Ecosystems”</td>
</tr>
<tr>
<td><strong>7-LS2-3</strong> Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]</td>
</tr>
<tr>
<td><strong>TE only:</strong> 231A, Performance Expectation Activity “Matter and Energy in Organisms and Ecosystems”</td>
</tr>
<tr>
<td><strong>7-LS2-4</strong> Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]</td>
</tr>
<tr>
<td><strong>TE only:</strong> 185C, Performance Expectation Activity “Matter and Energy in Organisms and Ecosystems” 269B, Performance Expectation Activity “Matter and Energy in Organisms and Ecosystems”</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

**Developing and Using Models**
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe phenomena. (7-LS2-3)

**SE/TE:**
125-126, How Do Living Things Get Energy from the Sun (7-LS2-2)
195-197, What Are the Energy Roles in an Ecosystem?
198-201, How Does Energy Move Through an Ecosystem?
206-207, How Are Carbon and Oxygen Cycles Related?
208-209, How Does Nitrogen Cycle Through Ecosystems?
210-211, Figure 5, How do energy and matter move through ecosystems?
236-237, Scenario Investigation, Fantasy Food Chain

**TE Only:**
197, Differentiated Instruction, Observe a Local Habitat
197, Quick Lab, Observing Decomposition
199, Differentiated Instruction, Demonstrate Omnivores’ Relationships in a Food Web
200, Differentiated Instruction, Identify the Food Chains
200, Build Inquiry, Identify Available Energy
201, Differentiated Instruction, Visualize Energy Transfers
201, Lab Investigation, Ecosystem Food Chains
207, Differentiated Instruction, Two Cycles
207, Build Inquiry, Predict Carbon and Oxygen Cycling
207, Quick Lab, Carbon and Oxygen Blues
209, Differentiated Instruction, Nitrogen in the Soil
210, Quick Lab, Playing Nitrogen Cycle Roles
211, Differentiated Instruction, Compare and Contrast Cycles

### Disciplinary Core Ideas

**LS1.C: Organization for Matter and Energy Flow in Organisms**
- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (7-LS1-6)

**SE/TE:**
124-129, Photosynthesis

**TE Only:**
124, Inquiry Warm-Up, Where Does Energy Come From?
126, Quick Lab, Energy from the Sun
128, Teacher Demo, A Leaf’s Response to Light
129, Differentiated Instruction, The Photosynthesis Equation
129, Quick Lab, Looking at Pigments

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (7-LS1-7)

**SE/TE:**
130-133, What Happens During Cellular Respiration?
134-135, What Happens During Fermentation?

**TE Only:**
130, Inquiry Warm-Up, Cellular Respiration
133, Differentiated Instruction, All About Sugars
133, Lab Investigation, Exhaling Carbon Dioxide
135, Quick Lab, Observing Fermentation

### Crosscutting Concepts

**Cause and Effect**
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (7-LS2-1)

**SE/TE:**
167-169, What Factors Limit Population Growth?
172, Niche
173, Competition

**TE Only:**
156, Inquiry Warm-Up, What’s in the Scene
157, Quick Lab, Organisms and Their Habitats
159, Differentiated Instruction, Life without Oxygen
159, Teacher Demo, Observing Soil Components
159, Lab Investigation, World in a Bottle
169, Quick Lab, Elbow room
173, Differentiated Instruction, Competition

**Energy and Matter**
- Matter is conserved because atoms are conserved in physical and chemical processes. (7-LS1-7)

**SE/TE:**
130-133, What Happens During Cellular Respiration?
134-135, What Happens During Fermentation?

**TE Only:**
130, Inquiry Warm-Up, Cellular Respiration
133, Lab Investigation, Exhaling Carbon Dioxide
- Develop a model to describe unobservable mechanisms. (7-LS1-7)

**SE/TE:**
130-133, What Happens During Cellular Respiration?
134-135, What Happens During Fermentation?

**TE Only:**
130, Inquiry Warm-Up, Cellular Respiration
133, Lab Investigation, Exhaling Carbon Dioxide
135, Quick Lab, Observing Fermentation

### Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to provide evidence for phenomena. (7-LS2-1)

**TE Only:**
156, Inquiry Warm-Up, What's in the Scene
157, Quick Lab, Organisms and Their Habitats
159, Differentiated Instruction, Identify Biotic and Abiotic Factors
159, Differentiated Instruction, Life without Oxygen
159, Teacher Demo, Observing Soil Components
159, Lab Investigation, World in a Bottle

### LS2.A: Interdependent Relationships in Ecosystems

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (7-LS2-1)

**SE/TE:**
157-159, What Does an Organism Get From Its Environment?

**TE Only:**
156, Inquiry Warm-Up, What's in the Scene
157, Quick Lab, Organisms and Their Habitats
159, Differentiated Instruction, Identify Biotic and Abiotic Factors
159, Differentiated Instruction, Life without Oxygen
159, Teacher Demo, Observing Soil Components
159, Lab Investigation, World in a Bottle

- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (7-LS2-1)

**SE/TE:**
172, Niche
173, Competition

**TE Only:**
173, Differentiated Instruction, Niche vs. Habitat
173, Differentiated Instruction, Competition

- Growth of organisms and population increases are limited by access to resources. (7-LS2-1)

**SE/TE:**
167-169, What Factors Limit Population Growth?

**TE Only:**
169, Quick Lab, Elbow room
## Constructing Explanations and Designing Solutions

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 knowledge, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (7-LS1-6)

### TE Only:
- 124, Inquiry Warm-Up, Where Does Energy Come From?
- 126, Quick Lab, Energy from the Sun
- 128, Teacher Demo, A Leaf's Response to Light
- 129, Differentiated Instruction, The Photosynthesis Equation
- 129, Quick lab, Looking at Pigments

## Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on 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(s).

- Construct an oral and written argument 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. (7-LS2-4)

### TE Only:
- 238, Inquiry Warm-Up, How Communities Change
- 241, Quick Lab, Primary or Secondary
- 241, Differentiated Instruction, Local Succession
- 507, Quick Lab, How Can Algal Growth Affect Pond Life?

## LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (7-LS2-3)

### SE/TE:
- 125-126, How Do Living Things Get Energy from the Sun
- 195-197, What Are the Energy Roles in an Ecosystem?
- 198-201, How Does Energy Move Through an Ecosystem?
- 206-207, How Are Carbon and Oxygen Cycles Related?
- 208-209, How Does Nitrogen Cycle Through Ecosystems?
- 210-211, Figure 5, How do energy and matter move through ecosystems?
- 236-237, Scenario Investigation, Fantasy Food Chain

### TE Only:
- 197, Differentiated Instruction, Observe a Local Habitat
- 197, Quick Lab, Observing Decomposition
- 199, Differentiated Instruction, Demonstrate Omnivores' Relationships in a Food Web
- 200, Differentiated Instruction, Identify the Food Chains
- 200, Build Inquiry, Identify Available Energy
- 201, Differentiated Instruction, Visualize Energy Transfers
- 201, Lab Investigation, Ecosystem Food Chains
- 207, Differentiated Instruction, Two Cycles
- 207, Build Inquiry, Predict Carbon and Oxygen Cycling
- 207, Quick Lab, Carbon and Oxygen Blues
- 209, Differentiated Instruction, Nitrogen in the Soil
- 210, Quick Lab, Playing Nitrogen Cycle Roles

## Stability and Change

- Small changes in one part of a system might cause large changes in another part. (7-LS2-4)

### SE/TE:
- 162-166, How Do Populations Change in Size?
- 230, Science Matters, A Lake Can't Last Forever
- 238-241, How Do Ecosystems Change Over Time?
- 506, How Can Lakes Change?

### TE Only:
- 238, Inquiry Warm-Up, How Communities Change
- 241, Quick Lab, Primary or Secondary
- 241, Differentiated Instruction, Local Succession
- 507, Quick Lab, How Can Algal Growth Affect Pond Life?
- 507, Differentiated Instruction, Sequence Eutrophication
- 507, Differentiated Instruction, Fertilizers

### Connections to Nature of Science

#### Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (7-LS2-3)

### SE/TE:
- 125-126, How Do Living Things Get Energy from the Sun
- 195-197, What Are the Energy Roles in an Ecosystem?
- 198-201, How Does Energy Move Through an Ecosystem?
- 206-207, How Are Carbon and Oxygen Cycles Related?
- 208-209, How Does Nitrogen Cycle Through Ecosystems?
- 210-211, Figure 5, How do energy and matter move through ecosystems?
- 236-237, Scenario Investigation, Fantasy Food Chain
Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based upon logical connections between evidence and explanations. (7-LS1-6)

**SE/TE:**
124-129, Photosynthesis

**TE Only:**
124, Inquiry Warm-Up, Where Does Energy Come From?
126, Quick Lab, Energy from the Sun
128, Teacher Demo, A Leaf's Response to Light
129, Differentiated Instruction, The Photosynthesis Equation
129, Quick Lab, Looking at Pigments

- Science disciplines share common rules of obtaining and evaluating empirical evidence. (7-LS2-4)

**TE Only:**
238, Inquiry Warm-Up, How Communities Change
241, Quick Lab, Primary or Secondary Succession
241, Differentiated Instruction, Local Succession
507, Quick Lab, How Can Algal Growth Affect Pond Life?

**LS2.C: Ecosystem Dynamics, Functioning, and Resilience**
- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (7-LS2-4)

**SE/TE:**
162-166, How Do Populations Change in Size?
230, Science Matters, A Lake Can't Last Forever
238-241, How Do Ecosystems Change Over Time?
506, How Can Lakes Change?

**TE Only:**
238, Inquiry Warm-Up, How Communities Change
241, Quick Lab, Primary or Secondary Succession
241, Differentiated Instruction, Local Succession
507, Quick Lab, How Can Algal Growth Affect Pond Life?

**PS3.D: Energy in Chemical Processes and Everyday Life**
- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (7-LS1-6)

**SE/TE:**
126, The Sun as an Energy Source
127-129, What Happens During Photosynthesis?

**TE Only:**
126, Quick Lab, Energy from the Sun
Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (7-LS1-7)

**SE/TE:**
130-133, What Happens During Cellular Respiration?

**TE Only:**
130, Inquiry Warm-Up, Cellular Respiration
133, Differentiated Instruction, All About Sugars
133, Lab Investigation, Exhaling Carbon Dioxide

**Connections to other DCIs in seventh grade:** 7.PS1.B (7-LS1-6, 7-LS1-7, 7-LS2-3); 7.ESS2.A (7-LS1-6, 7-LS2-3, 7-LS2-4); 7.ESS3.A (7-LS2-1, 7-LS2-4)

**Connections to other DCIs across grade levels:** 3.LS2.C (7-LS2-1, 7-LS2-4); 3.LS4.D (7-LS2-1, 7-LS2-4); 5.PS3.D (7-LS1-6, 7-LS1-7); 5.LS1.C (7-LS1-6, 7-LS1-7); 5.LS2.A (7-LS1-6, 7-LS2-1, 7-LS2-3); 5.LS2.B (7-LS1-6, 7-LS1-7, 7-LS2-3); 6.LS1.C (7-LS1-6, 7-LS1-7, 7-LS2-3); 6.ESS2.D (7-LS1-6); 6.ESS2.E (7-LS2-4); 6.ESS3.C (7-LS2-4); 8.PS3.B (7-LS2-3); 8.LS4.C (7-LS2-1, 7-LS2-4); 8.LS4.D (7-LS2-1, 7-LS2-4)

**Common Core State Standards Connections:**

**ELA/Literacy –**

- **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (7-LS1-6, 7-LS2-1, 7-LS2-4)
- **RST.6-8.2** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (7-LS1-6)
- **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-LS2-1)
- **RI.7.8** Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation. (7-LS2-4)
- **WHST.6-8.1** Write arguments to support claims with clear reasons and relevant evidence. (7-LS2-4)
- **WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (7-LS1-6)
- **WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (7-LS1-6, 7-LS2-4)
- **SL.7.5** Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (7-LS1-7, 7-LS2-3)

**Mathematics –**

- **6.EE.C.9** Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (7-LS1-6, 7-LS2-3)
Earth's Systems

Students who demonstrate understanding can:

7-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [AR Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. Arkansas specific examples of geologic materials include Karst, bauxite, and diamonds.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

TE only:
315A, Performance Expectation Activity “Earth's Systems”

7-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

TE only:
485A, Performance Expectation Activity “History of Earth”
539A, Performance Expectation Activity “History of Earth”

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

### Science and Engineering Practices

#### Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (7-ESS2-1)

**SE/TE:**
- 205, Figure 1 Water Cycle
- 207, Figure 2, Oxygen and Carbon Cycle
- 209, Figure 4, Nitrogen Cycle
- 210-211, Figure 5, How do energy and matter move through ecosystems? 498-499, Figure 3, The Water Cycle

### Disciplinary Core Ideas

#### ESS2.A: Earth's Materials and Systems
- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (7-ESS2-1)

**SE/TE:**
- 204-211, Cycles of Matter
- 498-499, What Is the Water Cycle

**TE Only:**
- 204, Inquiry Warm-Up, Are You Part of a Cycle?
- 205, Quick Lab, Following Water
- 207, Differentiated Instruction, Research Effects of Carbon Dioxide in the Atmosphere
- 207, Differentiated Instruction, Two Cycles
- 207, Build Inquiry, Predict Carbon and Oxygen Cycling
- 207, Quick Lab, Carbon and Oxygen Blues
- 209, Differentiated Instruction, Nitrogen in the Soil
- 210, Quick Lab, Playing Nitrogen Cycle Roles

### Crosscutting Concepts

#### Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (7-ESS3-1)

**SE/TE:**
- 204-211, Cycles of Matter
- 498-499, What Is the Water Cycle

**TE Only:**
- 204, Inquiry Warm-Up, Are You Part of a Cycle?
- 205, Quick Lab, Following Water
- 207, Differentiated Instruction, Research Effects of Carbon Dioxide in the Atmosphere
- 207, Quick Lab, Carbon and Oxygen Blues
- 209, Differentiated Instruction, Nitrogen in the Soil
- 210, Quick Lab, Playing Nitrogen Cycle Roles
- 211, Differentiated Instruction, Compare and contrast Cycles
- 211, Differentiated Instruction, Human Effects on Cycles of Matter
- 499, Differentiated Instruction, What Drives the Water Cycle?
- 499, Lab Investigation, Water From Trees
### Constructing Explanations and Designing Solutions

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.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (7-ESS3-1)

**TE Only:**
- 248, Differentiated Instruction, Energy Diagram
- 248, Differentiated Instruction, Modeling Consequences of Technology
- 249, Differentiated Instruction, Cause-and-Effect Flash Cards
- 249, Differentiated Instruction, Greenhouse Effect
- 400, Inquiry Warm-Up, How Can You Keep Soil from Washing Away?
- 402, Quick Lab, Using It Up
- 463, Lab Investigation, Fossil Fuels
- 467, Differentiated Instruction, Explain Solar Technologies

**SE/TE:**
- 211, Differentiated Instruction, Compare and Contrast Cycles
- 211, Differentiated Instruction, Human Effects on Cycles of Matter
- 499, Differentiated Instruction, What Drives the Water Cycle?
- 499, Lab Investigation, Water From Trees

### ESS3.A: Natural Resources

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (7-ESS3-1)

**TE Only:**
- 244, Inquiry Warm-Up, How Do Your Interact with Your Environment?
- 246, Quick Lab, How Do Humans Impact Environments?
- 248, Differentiated Instruction, Energy Diagram
- 248, Differentiated Instruction, Modeling Consequences of Technology
- 249, Differentiated Instruction, Cause-and-Effect Flash Cards
- 249, Differentiated Instruction, Greenhouse Effect
- 400-403, Soil Conservation
- 456-463, Fossil Fuels
- 464-473, Renewable Sources of Energy

**TE Only:**
- 244, Inquiry Warm-Up, Are You Part of a Cycle?
- 205, Quick Lab, Following Water
- 207, Differentiated Instruction, Research Effects of Carbon Dioxide in the Atmosphere
- 207, Differentiated Instruction, Two Cycles Build Inquiry, Predict Carbon and Oxygen Cycling
- 209, Differentiated Instruction, Nitrogen in the Soil
- 499, Differentiated Instruction, What Drives the Water Cycle?
- 499, Lab Investigation, Water From Trees

### Stability and Change

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (7-ESS2-1)

**TE Only:**
- 204, Inquiry Warm-Up, How Can You Keep Soil from Washing Away?
- 403, Quick Lab, Soil Conservation
- 463, Lab Investigation, Fossil Fuels
- 467, Differentiated Instruction, Illustrate Solar Power Plant
- 467, Differentiated Instruction, Explain Solar Technologies
- 470, Quick Lab, Design a Solar Cooker
- 471 Differentiated Instruction, Hydrogen Power Plants
- 473, Quick Lab, Producing Electricity

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

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

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (7-ESS3-1)

**TE Only:**
- 400, Inquiry Warm-Up, How Can You Keep Soil from Washing Away?
- 403, Quick Lab, Soil Conservation
- 463, Lab Investigation, Fossil Fuels
- 467, Differentiated Instruction, Illustrate Solar Power Plant
- 467, Differentiated Instruction, Explain Solar Technologies
- 470, Quick Lab, Design a Solar Cooker
- 471 Differentiated Instruction, Hydrogen Power Plants
- 473, Quick Lab, Producing Electricity
### Connections to other DCIs in seventh grade:
- **7.PS1.A** (7-ESS2-1, 7-ESS3-1)
- **7.PS1.B** (7-ESS2-1, 7-ESS3-1)
- **7.LS2.B** (7-ESS2-1)
- **7.LS2.C** (7-ESS2-1)

### Connections to other DCIs across grade levels:
- **4.PS3.B** (7-ESS2-1)
- **4.PS3.D** (7-ESS3-1)
- **4.ESS2.A** (7-ESS2-1)
- **4.ESS3.A** (7-ESS3-1)
- **5.ESS2.A** (7-ESS2-1)
- **6.LS1.C** (7-ESS2-1)
- **6.ESS2.E** (7-ESS2-1)
- **8.PS3.B** (7-ESS2-1, 7-ESS3-1)
- **8.PS4.B** (7-ESS2-4)

### Common Core State Standards Connections:

#### ELA/Literacy –
- **RST.6-8.1**
  - Cite specific textual evidence to support analysis of science and technical texts. (7-ESS3-1)
- **WHST.6-8.2**
  - Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (7-ESS3-1)
- **WHST.6-8.9**
  - Draw evidence from informational texts to support analysis, reflection, and research. (7-ESS3-1)
- **SL.7.5**
  - Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (7-ESS2-1)

#### Mathematics –
- **6.EE.B.6**
  - Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (7-ESS3-1)
- **7.EE.B.4**
  - 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. (7-ESS3-1)
History of Earth

Students who demonstrate understanding can:

7-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth’s surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

TE only:
343A, Performance Expectation Activity “History of Earth”
379A, Performance Expectation Activity “History of Earth”
409A, Performance Expectation Activity “History of Earth”
449A, Performance Expectation Activity “History of Earth”

7-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, or trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

TE only:
343B, Performance Expectation Activity “History of Earth”

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

Science and Engineering Practices
Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to provide evidence for phenomena. (7-ESS2-3)

TE Only:
329, Quick Lab, Reversing Poles
337, Differentiated Instruction, Create a Time Line

Disciplinary Core Ideas
ESS1.C: The History of Planet Earth
- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (7-ESS2-3)

SE/TE:
320-321, Scenario Investigation, Flight 7084 to Barcelona
326-331, Sea-Floor Spreading

TE Only:
329, Build Inquiry, Model of the Ocean Floor
329, Quick Lab, Reversing Poles
331, Differentiated Instruction, Ocean Floor Drawing
331, Differentiated Instruction, Travel Log
331, Lab Investigation, Modeling Sea-Floor Spreading

Crosscutting Concepts
Patterns
- Patterns in rates of change and other numerical relationships can provide information about natural systems. (7-ESS2-3)

TE Only:
325, Teacher Demo, Climate in North America
329, Quick Lab, Reversing Poles
337, Differentiated Instruction, Create a Time Line
Constructing Explanations and Designing Solutions

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.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (7-ESS2-2)

**SE/TE:**
322-325, Drifting Continents
332-337, The Theory of Plate Tectonics
348-351, Stem Activity, Shake, Rattle, and Roll
356-359, How Do Plate Movements Create New Landforms?
386-393, Rocks and Weathering
414-415, Scenario Investigation, Dunwich Is Done

**TE Only:**
325, Teacher Demo, Climate in North America
329, Quick Lab, Reversing Poles
331, Lab Investigation, Modeling Sea-Floor Spreading
336, Build Inquiry, Continent-Continent Collisions
337, Quick Lab, Mantle Convection Currents
338, Differentiated Instruction, Create a Time Line
357, Differentiated Instruction, Plate Movement
359, Differentiated Instruction, Appalachian Mountains
391, Teacher Demo, Chemical Weathering
391, Quick Lab, Rusting Away
393, Differentiated Instruction, Model Permeable Rock
420, Inquiry Warm-Up, How Does Moving Water Wear Away Rocks?
426, Build Inquiry, Compare and Contrast Deltas
428, Teacher Demo, Model How Carbonic Acid Forms
431, Lab Investigation, Modeling Sea-Floor Spreading
436, Build Inquiry, Continent-Continent Collisions
437, Differentiated Instruction, Create a Time Line
438, Build Inquiry, Locate River Features
439, Quick Lab, Shaping a Coastline

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Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

- Science findings are frequently revised and/or reinterpreted based on new evidence. (7-ESS2-3)

**SE/TE:**
322-325, Drifting Continents
332-337, The Theory of Plate Tectonics

**TE Only:**
325, Differentiated Instruction, Debate Continental Drift
325, Teacher Demo, Climate in North America
325 Quick Lab, Moving the Continents

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ESS2.A: Earth’s Materials and Systems

- The planet’s systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth’s history and will determine its future. (7-ESS2-2)

**SE/TE:**
326-331, Sea-Floor Spreading
332-337, The Theory of Plate Tectonics
348-351, Stem Activity, Shake, Rattle, and Roll
356-359, How Do Plate Movements Create New Landforms?
386-393, Rocks and Weathering
414-415, Scenario Investigation, Dunwich Is Done

**TE Only:**
322, Inquiry Warm-Up, How Are Earth’s Continents Linked Together?
325, Teacher Demo, Climate in North America
329, Quick Lab, Reversing Poles
331, Lab Investigation, Modeling Sea-Floor Spreading
336, Build Inquiry, Continent-Continent Collisions
337, Quick Lab, Mantle Convection Currents
338, Differentiated Instruction, Create a Time Line
357, Differentiated Instruction, Plate Movement
359, Differentiated Instruction, Appalachian Mountains
391, Teacher Demo, Chemical Weathering
391, Quick Lab, Rusting Away
393, Differentiated Instruction, Model Permeable Rock
420, Inquiry Warm-Up, How Does Moving Water Wear Away Rocks?
426, Build Inquiry, Compare and Contrast Deltas
428, Teacher Demo, Model How Carbonic Acid Forms
429, Quick Lab, Erosion Cube
430, Inquiry Warm-Up, How Do Glaciers Change the Land?
432, Quick Lab, Surging Glaciers
435, Quick Lab, Modeling Glaciers
439, Quick Lab, Shaping a Coastline

Scale Proportion and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (7-ESS2-2)

**TE Only:**
387, Quick Lab, Freezing and Thawing
393, Differentiated Instruction, Model Permeable Rock
420, Inquiry Warm-Up, How Does Moving Water Wear Away Rocks?
426, Build Inquiry, Compare and Contrast Deltas
428, Teacher Demo, Model How Carbonic Acid Forms
429, Quick Lab, Erosion Cube
430, Inquiry Warm-Up, How Do Glaciers Change the Land?
432, Quick Lab, Surging Glaciers
435, Quick Lab, Modeling Glaciers
439, Quick Lab, Shaping a Coastline
ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth’s plates have moved great distances, collided, and spread apart. (7-ESS2-3)

SE/TE:
322-325, Drifting Continents
332-337, The Theory of Plate Tectonics

TE Only:
322, Inquiry Warm-Up, How Are Earth’s Continents Linked Together?
325, Differentiated Instruction, Debate Continental Drift
325, Teacher Demo, Climate in North America
325 Quick Lab, Moving the Continents
332, Inquiry Warm-Up, Plate Interactions
335, Differentiated Instruction, Rift Valleys
335, Teacher Demo, Make a Model of Plates
336, Build Inquiry, Continent-Continent Collisions
337, Quick Lab, Mantle Convection Currents
337, Differentiated Instruction, Create a Time Line

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

- Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations. (7-ESS2-2)

SE/TE:
384-385, Scenario Investigation, In Memory of Winifred
390, Agents of Weathering: Water
420-429, Water Erosion
430-435, Glacial Erosion
436-439, Wave Erosion
### TE Only:
- 386, Inquiry Warm-Up, How Fast Can It Fizz?
- 387, Quick Lab, Freezing and Thawing
- 391, Teacher Demo, Chemical Weathering
- 391, Quick Lab, Rusting Away
- 393, Differentiated Instruction, Model Permeable Rock
- 420, Inquiry Warm-Up, How Does Moving Water Wear Away Rocks?
- 425, Differentiated Instruction, Locate River Features
- 426, Build Inquiry, Compare and Contrast Deltas
- 428, Teacher Demo, Model How Carbonic Acid Forms
- 429, Quick Lab, Erosion Cube
- 430, Inquiry Warm-Up, How Do Glaciers Change the Land?
- 432, Quick Lab, Surging Glaciers
- 435, Quick Lab, Modeling Valleys
- 439, Quick Lab, Shaping a Coastline

### Connections to other DCIs in seventh grade:
- 7.PS1.B (7-ESS2-2); 7.LS2.B (7-ESS2-2)

### Connections to other DCIs across grade levels:

### Common Core State Standards Connections:

#### ELA/Literacy –
- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (7-ESS2-2, 7-ESS2-3)
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-ESS2-3)
- RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (7-ESS2-3)
- WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (7-ESS2-2)
- SL.7.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (7-ESS2-2)

#### Mathematics –
- MP.2 Reason abstractly and quantitatively. (7-ESS2-2, 7-ESS2-3)
- 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (7-ESS2-2, 7-ESS2-3)
- 7.EE.B.4 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. (7-ESS1-4, 7-ESS2-2, 7-ESS2-3)
### Human Impacts

Students who demonstrate understanding can:

**7-ESS3-2** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

379B, Performance Expectation Activity “Human Impacts”

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>
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<tr>
<td><strong>Analyzing and Interpreting Data</strong></td>
<td><strong>ESS3.B: Natural Hazards</strong></td>
<td><strong>Patterns</strong></td>
</tr>
<tr>
<td>Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</td>
<td>- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (7-ESS3-2)</td>
<td>- Graphs, charts, and images can be used to identify patterns in data. (7-ESS3-2)</td>
</tr>
<tr>
<td><strong>TE Only:</strong></td>
<td><strong>SE/TE:</strong></td>
<td><strong>TE Only:</strong></td>
</tr>
<tr>
<td>371, Differentiated Instruction, New Madrid Fault</td>
<td>368-373, Monitoring Earthquakes</td>
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<tr>
<td>373, Quick Lab, Earthquake Patterns</td>
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<td>373, Quick Lab, Earthquake Patterns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>373, Differentiated Instruction, Ring of Fire</td>
</tr>
</tbody>
</table>

Connections to other DCIs in seventh grade: N/A

Connections to other DCIs across grade levels: **3.ESS3.B (7-ESS3-2); 4.ESS3.B (7-ESS3-2); 6.ESS2.D (7-ESS3-2); 6.ESS3.D (7-ESS3-2)**

Common Core State Standards Connections:

**ELA/Literacy –**

- **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (7-ESS3-2)
- **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-ESS3-2)

**Mathematics –**

- **MP.2** Reason abstractly and quantitatively. (7-ESS3-2)
- **6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (7-ESS3-2)
- **7.EE.B.4** 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. (7-ESS3-2)
### Engineering, Technology, and Applications of Science

Students who demonstrate understanding can:

7-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**SE/TE:**
348-351, Stem Activity, Shake, Rattle, and Roll

7-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

**SE/TE:**
348-351, Stem Activity, Shake, Rattle, and Roll

7-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

**SE/TE:**
348-351, Stem Activity, Shake, Rattle, and Roll

7-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

**SE/TE:**
348-351, Stem Activity, Shake, Rattle, and Roll

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

### Science and Engineering Practices

**Asking Questions and Defining Problems**

Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (7-ETS1-1)

**SE/TE:**
348, Stem Activity, Shake, Rattle, and Roll:
1, Identify the Problem
348-349, Stem Activity, Shake, Rattle, and Roll: 2-4, Do Research

### Disciplinary Core Ideas

**ETS1.A: Defining and Delimiting Engineering Problems**

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (7-ETS1-1)

**SE/TE:**
348, Stem Activity, Shake, Rattle, and Roll:
1, Identify the Problem
348-349, Stem Activity, Shake, Rattle, and Roll: 2-4, Do Research

### Crosscutting Concepts

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

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (7-ETS1-1)

**SE/TE:**
348-351, Stem Activity, Shake, Rattle, and Roll
Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (7-ETS1-4)

SE/TE:
349, Stem Activity, Shake, Rattle, and Roll: 9-10, Design and Construct a Prototype

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to determine similarities and differences in findings. (7-ETS1-3)

SE/TE:
350-351, Stem Activity, Shake, Rattle, and Roll: 16-18, Evaluate and Redesign

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on 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.
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (7-ETS1-2)

SE/TE:
350-351, Stem Activity, Shake, Rattle, and Roll: 16-18, Evaluate and Redesign

ETS1.B: Developing Possible Solutions
- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (7-ETS1-4)

SE/TE:
350, Stem Activity, Shake, Rattle, and Roll: 350-351, Stem Activity, Shake, Rattle, and Roll: 16-18, Evaluate and Redesign
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (7-ETS1-2, 7-ETS1-3)

SE/TE:
349, Stem Activity, Shake, Rattle, and Roll: 5, Develop Possible Solutions
349, Stem Activity, Shake, Rattle, and Roll: 6-8, Choose One Solution
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (7-ETS1-3)

SE/TE:
350-351, Stem Activity, Shake, Rattle, and Roll: 16-18, Evaluate and Redesign
- Models of all kinds are important for testing solutions. (7-ETS1-4)

SE/TE:
349, Stem Activity, Shake, Rattle, and Roll: 9-10, Design and Construct a Prototype

ETS1.C: Optimizing the Design Solution
- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (7-ETS1-3)

SE/TE:
350-351, Stem Activity, Shake, Rattle, and Roll: 16-18, Evaluate and Redesign
- The uses of technologies and 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. (7-ETS1-1)

SE/TE:
348-351, Stem Activity, Shake, Rattle, and Roll
The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (7-ETS1-4)

**SE/TE:**
350, Stem Activity, Shake, Rattle, and Roll: 11-12, Test the Prototype

**Common Core State Standards Connections:**

**ELA/Literacy –**

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
(7-ETS1-1, 7-ETS1-2, 7-ETS1-3)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (7-ETS1-3)

RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (7-ETS1-2, 7-ETS1-3)

WHST.6-8.7 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. (7-ETS1-2)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (7-ETS1-1)

WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (7-ETS1-2)

**Mathematics –**

MP.2 Reason abstractly and quantitatively. (7-ETS1-1, 7-ETS1-2, 7-ETS1-3, 7-ETS1-4)

7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), 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. (7-ETS1-1, 7-ETS1-2, 7-ETS1-3)

7.SP Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (7-ETS1-4)
GRADE 8

**Waves and Electromagnetic Radiation**

Students who demonstrate understanding can:

8-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves applying both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

**TE Only:**
191A, Performance Expectation Activity “Waves and Electromagnetic Radiation”
227A, Performance Expectation Activity “Waves and Electromagnetic Radiation”

8-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

**TE Only:**
191B, Performance Expectation Activity “Waves and Electromagnetic Radiation”
227B, Performance Expectation Activity “Waves and Electromagnetic Radiation”
259A, Performance Expectation Activity “Waves and Electromagnetic Radiation”
301A, Performance Expectation Activity “Waves and Electromagnetic Radiation”

8-PS4-3 Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. [Clarification Statement: Emphasis is on the basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

**TE Only:**
259B, Performance Expectation Activity “Waves and Electromagnetic Radiation”

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><strong>Science and Engineering Practices</strong></th>
<th><strong>Disciplinary Core Ideas</strong></th>
<th><strong>Crosscutting Concepts</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Developing and Using Models</strong></td>
<td><strong>PS4.A: Wave Properties</strong></td>
<td><strong>Patterns</strong></td>
</tr>
<tr>
<td>Modeling in 6-8 builds on K-5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</td>
<td>• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (8-PS4-1)</td>
<td>• Graphs and charts can be used to identify patterns in data. (8-PS4-1)</td>
</tr>
<tr>
<td><strong>SE/TE:</strong></td>
<td><strong>SE/TE:</strong></td>
<td><strong>SE/TE:</strong></td>
</tr>
<tr>
<td>280-287, Refraction and Lenses</td>
<td>167, Characteristics of Waves</td>
<td>173, Figure 1, Amplitude</td>
</tr>
<tr>
<td>285, Figure 5, Concave Lens</td>
<td>172-177, Properties of Waves</td>
<td>174-175, Figure 2, Properties of Waves</td>
</tr>
<tr>
<td>Figure 7, Convex Lens</td>
<td><strong>TE Only:</strong></td>
<td><strong>TE Only:</strong></td>
</tr>
<tr>
<td><strong>TE Only:</strong></td>
<td>175, Differentiated Instruction, Make a Diagram</td>
<td>175, Differentiated Instruction, Make a Diagram</td>
</tr>
<tr>
<td>285, Differential Instruction, Diagramming a Mirage</td>
<td>175, Differentiated Instruction, Make a Presentation</td>
<td></td>
</tr>
<tr>
<td>286, Teacher Demo, Focal Pont</td>
<td>175, Teacher Demo, Speed of a Wave</td>
<td></td>
</tr>
</tbody>
</table>

**SE = Student Edition**  
**TE = Teacher’s Edition**
Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 6-8 level builds on K-5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (8-PS4-1)

SE/TE: 176, do the math!
TE Only: 177, Differential Instruction, Solve Problems

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.

- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (8-PS4-3)

SE/TE: 250, Figure 3, Using a Cell Phone
TE Only: 251 Differentiated Instruction, Cell Phone Towers

----------------------------------------
Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
Science knowledge is based upon logical and conceptual connections between evidence and explanations. (8-PS4-1)

SE/TE: 167, Characteristics of Waves
172-177, Properties of Waves

TE Only: 175, Teacher Demo, Speed of a Wave
175, Quick Lab, Properties of Waves
177, Differentiated Instruction, Solve Problems
177, Quick Lab What Affects the Speed of a Wave?

Structure and Function
Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (8-PS4-2)

SE/TE: 198-200, What Is Sound?
236, Wave Model of Light
280-287, Refraction and Lenses

TE Only: 236, Build Inquiry, Observe How Filters Polarize Light
286, Teacher Demo, Focal Point

- Structures can be designed to serve particular functions. (8-PS4-3)

SE/TE: 246-253, Wireless Communication

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

Influence of Science, Engineering, and Technology on Society and the Natural World
Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (8-PS4-3)

SE/TE: 246-253, Wireless Communication

----------------------------------------
Connections to Nature of Science

Science is a Human Endeavor
Advances in technology influence the progress of science and science has influenced advances in technology. (8-PS4-3)

SE/TE: 246-253, Wireless Communication
A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (8-PS4-2)

**SE/TE:**
179-181, What Changes the Direction of a Wave?
180, Figure 2, Refraction of Light Waves
236, Wave Model of Light
268-271, What Determines Color?
283, Prisms and Rainbows

**TE Only:**
236, Build Inquiry, Observe How Filters Polarize Light
237, Quick Lab, Waves of Particles?
283, Build Inquiry, Observing Refraction of Light

However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (8-PS4-2)

**SE/TE:**
234-237, The Nature of Electromagnetic Waves

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

Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (8-PS4-3)

**SE/TE:**
246-253, Wireless Communication

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

**Connections to other DCIs across grade levels:** 4.PS3.A (8-PS4-1); 4.PS3.B (8-PS4-1); 4.PS4.A (8-PS4-1); 4.PS4.B (8-PS4-2); 4.PS4.C (8-PS4-3); 6.ESS2.D (8-PS4-2); 7.ESS2.A (8-PS4-2); 7.ESS2.C (8-PS4-2)

**Common Core State Standards Connections: ELA/Literacy** -

| RST.6-8.1 | Cite specific textual evidence to support analysis of science and technical texts. (8-PS4-3) |
| RST.6-8.2 | Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (8-PS4-3) |
| RST.6-8.9 | Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (8-PS4-3) |
| WHST.6-8.9 | Draw evidence from informational texts to support analysis, reflection, and research. (8-PS4-3) |
| SL.8.5 | Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (8-PS4-1, 8-PS4-2) |

**Mathematics** -

| MP.2 | Reason abstractly and quantitatively. (8-PS4-1) |
| MP.4 | Model with mathematics. (8-PS4-1) |
| 6.RP.A.1 | Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (8-PS4-1) |
| 6.RP.A.3 | Use ratio and rate reasoning to solve real-world and mathematical problems. (8-PS4-1) |
| 7.RP.A.2 | Recognize and represent proportional relationships between quantities. (8-PS4-1) |
| 8.F.A.3 | Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (8-PS4-1) |
### Forces and Interactions

Students who demonstrate understanding can:

8-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.]

**TE Only:**
77A, Performance Expectation Activity “Forces and Interactions”

8-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.]

**TE Only:**
77B, Performance Expectation Activity “Forces and Interactions”

8-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, and 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.]

**TE Only:**
117A, Performance Expectation Activity “Forces and Interactions”
159A, Performance Expectation Activity “Forces and Interactions”

8-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 charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system or data generated from simulations or digital tools.] [Assessment Boundary: Assessment does not include Newton’s Law of Gravitation or Kepler’s Laws.]

**TE Only:**
77C, Performance Expectation Activity “Forces and Interactions”
463A, Performance Expectation Activity “Forces and Interactions”

8-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.]

**TE Only:**
117B, Performance Expectation Activity “Forces and Interactions”
159B, Performance Expectation Activity “Forces and Interactions”
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>
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<th>Crosscutting Concepts</th>
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<tbody>
<tr>
<td><strong>Asking Questions and Defining Problems</strong></td>
<td><strong>PS2.A: Forces and Motion</strong></td>
<td><strong>Cause and Effect</strong></td>
</tr>
<tr>
<td>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.</td>
<td>- 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). (8-PS2-1)</td>
<td>- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (8-PS2-3, 8-PS2-5)</td>
</tr>
<tr>
<td>▪ 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. (8-PS2-3)</td>
<td><strong>SE/TE:</strong></td>
<td><strong>SE/TE:</strong></td>
</tr>
<tr>
<td><strong>TE Only:</strong></td>
<td>60-61, What Is Newton's Third Law?</td>
<td>36-39, Stem Activity, Sail Away</td>
</tr>
<tr>
<td>136, Quick Lab, Current and Magnetism</td>
<td>62-63, Figure 5, What Makes a Bug Go Splat?</td>
<td>56-57, What Is Newton's First Law?</td>
</tr>
<tr>
<td>137, Quick Lab, Magnetic Fields from Electric Current</td>
<td><strong>TE Only:</strong></td>
<td>58-59 What Is Newton's Second Law?</td>
</tr>
<tr>
<td>138, Quick Lab, Modeling a Solenoid’s Magnetic Field</td>
<td>62-63, Figure 5, What Makes a Bug Go Splat?</td>
<td>62-63, Figure 5, What Makes a Bug Go Splat?</td>
</tr>
<tr>
<td><strong>Planning and Carrying Out Investigations</strong></td>
<td><strong>TE Only:</strong></td>
<td><strong>86, Electric Fields</strong></td>
</tr>
<tr>
<td>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 multiple variables and provide evidence to support explanations or design solutions.</td>
<td>128-133, Magnetic Fields</td>
<td><strong>135-137, How Are Electric Currents and Magnetic Fields Related?</strong></td>
</tr>
<tr>
<td>▪ 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. (8-PS2-2)</td>
<td><strong>TE Only:</strong></td>
<td>148, Induction of Electric Current</td>
</tr>
<tr>
<td><strong>SE/TE:</strong></td>
<td>36-39, Stem Activity, Sail Away</td>
<td>58, Teacher Demo, Force Affects Acceleration</td>
</tr>
<tr>
<td>36-39, Stem Activity, Sail Away</td>
<td><strong>TE Only:</strong></td>
<td>59, Quick Lab, Newton's Second Law</td>
</tr>
<tr>
<td><strong>Systems and System Models</strong></td>
<td><strong>TE Only:</strong></td>
<td>134, Inquiry Warm-Up, Electromagnetism</td>
</tr>
<tr>
<td>▪ Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (8-PS2-1, 8-PS2-4)</td>
<td>86, Teacher Dem, Electric Field Exerts a Force</td>
<td>136, Quick Lab, Electric current and Magnetism</td>
</tr>
<tr>
<td><strong>TE Only:</strong></td>
<td>146, Inquiry Warm-Up, Electric Current Without a Battery</td>
<td>137, Quick Lab, Magnetic Fields from Electric Current</td>
</tr>
<tr>
<td>61, Differentiated Instruction, Make a Rocket</td>
<td>149, Quick Lab, Inducing an Electric Current</td>
<td>146, Inquiry Warm-Up, Electric Current Without a Battery</td>
</tr>
</tbody>
</table>
- 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. (8-PS2-5)

**TE Only:**
134, Inquiry Warm-Up, Electromagnetism
86, Teacher Dem, Electric Field Exerts a Force
136, Quick Lab, Electric current and Magnetism
146, Inquiry Warm-Up, Electric Current Without a Battery
149, Quick Lab, Inducing an Electric Current

**Constructing Explanations and Designing Solutions**
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.
- Apply scientific ideas or principles to design an object, tool, process or system. (8-PS2-1)

**TE Only:**
61, Differentiated Instruction, Make a Rocket
61, Teacher Demo, Action-Reaction in Action

**Engaging in Argument from Evidence**
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.
- 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. (8-PS2-4)

**TE Only:**
440, Inquiry Warm-Up, What Factors Affect Gravity?

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**PS2.B: Types of Interactions**
- 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. (8-PS2-3)

**SE/TE:**
85-86, How Do Charges Interact
124-125, What Are the Properties of Magnets
126, How Do Magnetic Poles Interact?
137, What is a Magnetic Field Produced by a Current Like?
138-139, What Are the Characteristics of Solenoids and Electromagnets?

**TE Only:**
84, Inquiry Warm-Up, Can You Move a Can Without Touching It?
87, Differentiated Instruction, Model How Objects are Charged
126, Build Inquiry, Attraction and Repulsion
127, Differentiated Instruction, Demonstrate Attraction and Repulsion
136, Quick Lab, Current and Magnetism
137, Quick Lab, Magnetic Fields from Electric Current
138, Quick Lab, Modeling a Solenoid’s Magnetic Field

- 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. (8-PS2-4)

**SE/TE:**
53-55, What Factors Affect Gravity?
440-443, Gravity and Motion

**TE Only:**
440, Inquiry Warm-Up, What Factors Affect Gravity?

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**Stability and Change**
- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (8-PS2-2)

**SE/TE:**
62-63, Figure 5, What Makes a Bug Go Splat?

**TE Only:**
58, Teacher Demo, Force Affects Acceleration
59, Quick Lab, Newton’s Second Law

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

**Influence of Science, Engineering, and Technology on Society and the Natural World**
- 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. (8-PS2-1)

**TE Only:**
61, Differentiated Instruction, Make a Rocket
### Connections to Nature of Science

**Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (8-PS2-2, 8-PS2-4)

**SE/TE:**
- 53-55, What Factors Affect Gravity?
- 440-443, Gravity and Motion

- 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, or a ball, respectively). (8-PS2-5)

**SE/TE:**
- 86, Electric Fields
- 128-133, Magnetic Fields
- 135-137, How Are Electric Currents and Magnetic Fields Related?
- 148, Induction of Electric Current

**TE Only:**
- 134, Inquiry Warm-Up, Electromagnetism
- 86, Teacher Dem, Electric Field Exerts a Force
- 136, Quick Lab, Electric current and Magnetism
- 137, Quick Lab, Magnetic Fields from Electric Current
- 146, Inquiry Warm-Up, Electric Current Without a Battery
- 149, Quick Lab, Inducing an Electric Current

### Connections to other DCIs in eighth grade:

- 8.PS3.A (8-PS2-2); 8.PS3.B (8-PS2-2); 8.ESS1.A (8-PS2-4); 8.ESS1.B (8-PS2-4)

### Connections to other DCIs across grade levels:

- 3.PS2.A (8-PS2-1, 8-PS2-2); 3.PS2.B (8-PS2-3, 8-PS2-5); 5.PS2.B (8-PS2-4); 6.PS3.C (8-PS2-5)

### Common Core State Standards Connections:

**ELA/Literacy –**

- **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (8-PS2-1, 8-PS2-3)
- **RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (8-PS2-1, 8-PS2-2, 8-PS2-5)
- **WHST.6-8.1** Write arguments focused on discipline-specific content. (8-PS2-4)
- **WHST.6-8.7** 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. (8-PS2-1, 8-PS2-2, 8-PS2-5)

**Mathematics –**

- **MP.2** Reason abstractly and quantitatively. (8-PS2-1, 8-PS2-2, 8-PS2-3)
- **6.NS.C.5** 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. (8-PS2-1)
- **6.EE.A.2** Write, read, and evaluate expressions in which letters stand for numbers. (8-PS2-1, 8-PS2-2)
- **7.EE.B.3** 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. (8-PS2-1, 8-PS2-2)
- **7.EE.B.4** 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. (8-PS2-1, 8-PS2-2)
Students who demonstrate understanding can:

8-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. [AR Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sized rocks downhill, or getting hit by a plastic ball versus a tennis ball.]

**TE Only:**
31A Performance Expectation Activity “Energy”

8-PS3-2 Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include changing the direction/orientation of a magnet, a balloon with static electrical charge being brought closer to a classmate's hair, and the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves. Examples of models could include representations, diagrams, pictures, or written descriptions of systems.][Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

**TE Only:**
31B Performance Expectation Activity “Energy”

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>
</table>
| **Modeling in 6-8 builds on K-5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.** | **PS3.A: Definitions of Energy**  
- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (8-PS3-1)  
**SE/TE:**  
6-7, Scenario Investigation, Stuck at the Top 10-11, Kinetic Energy 10, Figure 2, Kinetic Energy 11, do the math!  
**TE Only:**  
11, Differentiated Instruction, Write Word Problems 13, Quick Lab, Mass, Velocity, and Kinetic Energy  
- A system of objects may also contain stored (potential) energy, depending on their relative positions. (8-PS3-2)  
**SE/TE:**  
6-7, Scenario Investigation, Stuck at the Top 12-13, Potential Energy  
**TE Only:**  
13, Differentiated Instruction, Dynamic Equilibrium | **Scale, Proportion, and Quantity**  
- Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (8-PS3-1)  
**SE/TE:**  
6-7, Scenario Investigation, Stuck at the Top 10-11, Kinetic Energy 10, Figure 2, Kinetic Energy 11, do the math!  
**TE Only:**  
11, Differentiated Instruction, Write Word Problems 13, Quick Lab, Mass, Velocity, and Kinetic Energy |
## Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (8-PS3-1)

**SE/TE:**
- 6-7, Scenario Investigation, Stuck at the Top
- 10, Figure 2, Kinetic Energy
- 11, do the math!

**TE Only:**
- 13, Quick Lab, Mass, Velocity, and Kinetic Energy

### Systems and System Models

Models can be used to represent systems and their interactions – e.g., processes, and outputs – and energy and matter flows within systems. (8-PS3-2)

**SE/TE:**
- 60-61, What Is Newton's Third Law of Motion?
- 87-89, How Does Charge Build Up?

**TE Only:**
- 61, Differentiated Instruction, Make a Rocket
- 61, Teacher Demo, Action-Reaction in Action

### Connections to other DCIs in eighth grade:
- **8.PS2.A** (8-PS3-1)

### Connections to other DCIs across grade levels:
- **4.PS3.B** (8-PS3-1); **6.PS3.C** (8-PS3-2)

## Common Core State Standards Connections:

### ELA/Literacy –

- **RST.6-8.1**
  Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (8-PS3-1)

- **RST.6-8.7**
  Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (8-PS3-1)

- **SL.8.5**
  Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (8-PS3-2)

### Mathematics –

- **MP.2**
  Reason abstractly and quantitatively. (8-PS3-1)

- **6.RP.A.1**
  Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (8-PS3-1)

- **6.RP.A.2**
  Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. (8-PS3-1)

- **7.RP.A.2**
  Recognize and represent proportional relationships between quantities. (8-PS3-1)

- **8.EE.A.1**
  Know and apply the properties of integer exponents to generate equivalent numerical expressions. (8-PS3-1)

- **8.EE.A.2**
  Use square root and cube root symbols to represent solutions to equations of the form x² = p and x³ = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. (8-PS3-1)

- **8.F.A.3**
  Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (8-PS3-1)
Space Systems

Students who demonstrate understanding can:

8-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.  [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]

TE only:
463B, Performance Expectation Activity  “Space Systems”

8-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.  [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).]  [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]

TE only:
463C, Performance Expectation Activity  “Space Systems”
515A, Performance Expectation Activity  “Space Systems”
559A, Performance Expectation Activity  “Space Systems”

8-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system.  [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, or spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust or atmosphere), surface features (such as volcanoes), or orbital radius. Examples of data include statistical information, drawings and photographs, or models.]  [Assessment Boundary: Assessment does not include recalling facts about properties of the planets or other solar system bodies.]

TE only:
515B Performance Expectation Activity  “Space Systems”

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><strong>Developing and Using Models</strong></td>
<td><strong>ESS1.A: The Universe and Its Stars</strong>&lt;br&gt;Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (8-ESS1-1)&lt;br&gt;&lt;br&gt;SE/TE: 426-431, The Sky From Earth&lt;br&gt;444-449, Phases and Eclipses&lt;br&gt;&lt;br&gt;TE Only:&lt;br&gt;426, Inquiry Warm-Up, Earth's Sky&lt;br&gt;431, Differentiated Instruction, Apparent Motion&lt;br&gt;444, Inquiry Warm-Up, How does the Moon Move?&lt;br&gt;446, Quick Lab, Moon Phases&lt;br&gt;449, Quick Lab, Eclipses&lt;br&gt;449, Differentiated Instruction, Modeling Eclipses</td>
<td><strong>Patterns</strong>&lt;br&gt;Patterns can be used to identify cause and effect relationships. (8-ESS1-1)&lt;br&gt;&lt;br&gt;SE/TE: 424-425, Scenario Investigation, Smearing Causes Seasons&lt;br&gt;426-431, The Sky From Earth&lt;br&gt;436-439, What Causes Seasons?&lt;br&gt;444-449, Phases and Eclipses&lt;br&gt;476-479, Introducing the Solar System&lt;br&gt;482-487, The Sun&lt;br&gt;489-495, The Inner Planets&lt;br&gt;496-503, The Outer Planets</td>
</tr>
</tbody>
</table>

SE = Student Edition  TE = Teacher’s Edition
<table>
<thead>
<tr>
<th><strong>Analyzing and Interpreting Data</strong></th>
<th><strong>Scale, Proportion, and Quantity</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.</td>
<td>▪ Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (8-ESS1-3)</td>
</tr>
<tr>
<td>▪ Analyze and interpret data to determine similarities and differences in findings. (8-ESS1-3)</td>
<td></td>
</tr>
<tr>
<td><strong>ESS1.B: Earth and the Solar System</strong></td>
<td></td>
</tr>
<tr>
<td>▪ The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (8-ESS1-2),(8-ESS1-3)</td>
<td></td>
</tr>
<tr>
<td><strong>SE/TE:</strong></td>
<td></td>
</tr>
<tr>
<td>504-509, Small Solar System Objects</td>
<td>507, Differentiated Instruction, Research Ceres</td>
</tr>
<tr>
<td>544-549, Star Systems and Galaxies</td>
<td>509, Quick Lab, Changing Orbits</td>
</tr>
<tr>
<td><strong>TE Only:</strong></td>
<td></td>
</tr>
<tr>
<td>431, Differentiated Instruction, Apparent Motion</td>
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<td>444, Inquiry Warm-Up, How Does the Moon Move?</td>
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<tr>
<td>491, Build Inquiry, Observe Mercury</td>
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<td>497, Quick Lab, Density Mystery</td>
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<td>503, Quick Lab, Create a Model of Saturn</td>
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<tr>
<td>549, Differentiated Instruction, Where In the Milky Way Are We?</td>
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<td>549, Quick Lab, A Spiral Galaxy</td>
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<td>476, Inquiry Warm-Up, Introducing the Solar System</td>
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<td>504-509, Small Solar System Objects</td>
<td></td>
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</tbody>
</table>

**SE = Student Edition**  **TE = Teacher’s Edition**
This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (8-ESS1-1)

- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (8-ESS1-2)

**SE/TE:**
424-425, Scenario Investigation, Smearing Causes Seasons
436-439, What Causes Seasons?

**TE Only:**
437, Differentiated Instruction, Model
437, Build Inquiry, Compare and Contrast Angles of Sunlight
439, Differentiated Instruction, Write and Model
439, Quick Lab, Reasons for the Seasons

- Models can be used to represent systems and their interactions.

**SE/TE:**
476-479, Introducing the Solar System
482-487, The Sun
489-495, The Inner Planets
496-503, The Outer Planets
504-509, Small Solar System Objects
544-549, Star Systems and Galaxies

**TE Only:**
476, Inquiry Warm-Up, How Big Is Earth?
479, Lab Investigation, Speeding Around the Sun
481, Quick Lab, Clumping Planets
485, Quick Lab, Layers of the Sun
487, Quick Lab, Viewing Sun Spots
488, Inquiry Warm-Up, Ring Around the sun
489, Quick Lab, Characteristics of the Inner Planets
491, Build Inquiry, Observe Mercury
491, Differentiated Instruction, Compare and Contrast Inner Planets
491, Teacher Demo, Venus's Rotation
496, Inquiry Warm-Up, How Big Are the Planets
497, Quick Lab, Density Mystery
498, Teacher Demo, Model the Great Red Spot
501, Teacher Demo, Compare and Contrast Planets
501, Differentiated Instruction, Create Fact Sheets
503, Quick Lab, Create a Model of Saturn
504, Inquiry Warm-Up, Collecting Micrometeorites
507, Differentiated Instruction, Research Ceres
509, Quick Lab, Changing Orbits
544, Inquiry Warm-Up, Why Does the Milky Way Look Hazy?
549, Differentiated Instruction, Where In the Milky Way Are We?
549, Differentiated Instruction, How Many Stars Are in the Universe?
549, Quick Lab, A Spiral Galaxy
Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (8-ESS1-3)

**SE/TE:**
476-479, Introducing the Solar System
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509, Quick Lab, Changing Orbits
### Connections to Nature of Science

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.
  
  (8-ESS1-1, 8-ESS1-2)

#### SE/TE:

- 424-425, Scenario Investigation, Smearing Causes Seasons
- 426-431, The Sky From Earth
- 436-439, What Causes Seasons?
- 444-449, Phases and Eclipses
- 476-479, Introducing the Solar System
- 482-487, The Sun
- 489-495, The Inner Planets
- 496-503, The Outer Planets
- 504-509, Small Solar System Objects
- 544-549, Star Systems and Galaxies

#### TE Only:

- 426, Inquiry Warm-Up, Earth's Sky
- 431, Differentiated Instruction, Apparent Motion
- 444, Inquiry Warm-Up, How does the Moon Move?
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- 501, Differentiated Instruction, Create Fact Sheets
| Connections to other DCIs in eighth grade: | **8.PS2.A** (8-ESS1-1, 8-ESS1-2); **8.PS2.B** (8-ESS1-1, 8-ESS1-2) |
| Connections to other DCIs across grade levels: | **3.PS2.A** (8-ESS1-1, 8-ESS1-2); **5.PS2.B** (8-ESS1-1, 8-ESS1-2); **5.ESS1.A** (8-ESS1-2); **5.ESS1.B** (8-ESS1-1, 8-ESS1-2, 8-ESS1-3); **7.ESS2.A** (8-ESS1-3) |
| Common Core State Standards Connections: | |
| **ELA/Literacy** | |
| RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (8-ESS1-3) | |
| RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (8-ESS1-3) | |
| SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (8-ESS1-1, 8-ESS1-2) | |
| **Mathematics** | |
| MP.2 Reason abstractly and quantitatively. (8-ESS1-3) | |
| MP.4 Model with mathematics. (8-ESS1-1, 8-ESS1-2) | |
| 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (8-ESS1-1, 8-ESS1-2, 8-ESS1-3) | |
| 7.RP.A.2 Recognize and represent proportional relationships between quantities. (8-ESS1-1, 8-ESS1-2, 8-ESS1-3) | |
| 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (8-ESS1-2) | |
| 7.EE.B.4 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. (8-ESS1-2) | |

503, Quick Lab, Create a Model of Saturn
504, Inquiry Warm-Up, Collecting Micrometeorites
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544, Inquiry Warm-Up, Why Does the Milky Way Look Hazy?
549, Differentiated Instruction, Where In the Milky Way Are We?
549, Differentiated Instruction, How Many Stars Are in the Universe?
549, Quick Lab, A Spiral Galaxy
History of Earth

Students who demonstrate understanding can:

8-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of Homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains or ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]

TE only:
419A, Performance Expectation Activity “History of Earth”

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

**Constructing Explanations and Designing Solutions**

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.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (8-ESS1-4)

**TE Only:**
387, Lab Investigation, Exploring Geologic Time Through Core Samples

### Disciplinary Core Ideas

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

- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (8-ESS1-4)

**TE/TE:**
384-389, Relative Ages of Rocks
394-397, The Geologic Time Scale

**TE Only:**
384, Inquiry Warm-Up, Which Layer Is the Oldest?
387, Lab Investigation, Exploring Geologic Time Through Core Samples
397, Build Inquiry, Compare and Contrast Visuals

### Crosscutting Concepts

**Scale Proportion and Quantity**

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (8-ESS1-4)

**SE/TE:**
385, Figure 1, Rock Layers in the Grand Canyon
387, Figure 4, Index Fossils
388, Figure 5, Unconformities and Folding
396, Figure 2, The Geologic Time Scale

### Connections to other DCIs in eighth grade:

- 8.LS4.C (8-ESS1-4)

### Connections to other DCIs across grade levels:


### Common Core State Standards Connections:

**ELA/Literacy –**

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (8-ESS1-4)

**WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (8-ESS1-4)

**Mathematics –**

- 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (8-ESS1-4)

- 7.EE.B.4 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. (8-ESS1-4)
Growth, Development, and Reproduction of Organisms

Students who demonstrate understanding can:

**8-LS3-1** Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

**TE Only:**
341A, Performance Expectation Activity “Growth, Development, and Reproduction of Organisms”

**8-LS4-5** Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, or gene therapy); or, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]

**TE Only:**
341B, Performance Expectation Activity “Growth, Development, and Reproduction of Organisms”
371E, Performance Expectation Activity “Growth, Development, and Reproduction of Organisms”

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

### Science and Engineering Practices

**Developing and Using Models**
Modeling in K–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (8-LS3-1)

**TE Only:**
310, Teacher Demo, Unique Sequences
313, Teacher Demo, Modeling DNA Replication
313, Quick Lab, Modeling DNA Replication
314, Inquiry Warm-Up What Is RNA?
317, Quick Lab, Modeling Protein Synthesis
317, Differentiated Instruction, Codes for Amino Acids
318, Inquiry Warm-Up, Oops!
320, Quick Lab, Effects of Mutations

### Disciplinary Core Ideas

**LS3.A: Inheritance of Traits**
- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (8-LS3-1)

**SE/TE:**
308-313, The Genetic Code
314-317, How Cells Make Proteins
318-323, Mutations

**TE Only:**
310, Teacher Demo, Unique Sequences
313, Teacher Demo, Modeling DNA Replication
313, Quick Lab, Modeling the Genetic Code
314, Inquiry Warm-Up What Is RNA?
317, Quick Lab, Modeling Protein Synthesis
317, Differentiated Instruction, Codes for Amino Acids
318, Inquiry Warm-Up, Oops!
320, Quick Lab, Effects of Mutations

### Crosscutting Concepts

**Cause and Effect**
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (8-LS4-5)

**SE/TE:**
353, Artificial Selection

**TE Only:**
353, Differentiated Instruction, Plant Varieties

**Structure and Function**
- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (8-LS3-1)

**SE/TE:**
308-313, The Genetic Code
314-317, How Cells Make Proteins
318-323, Mutations

**TE Only:**
310, Teacher Demo, Unique Sequences
313, Teacher Demo, Modeling DNA Replication
313, Quick Lab, Modeling the Genetic Code

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**SE = Student Edition **
**TE = Teacher’s Edition**
**Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (8-LS4-5)

**LS3.B: Variation of Traits**

- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (8-LS3-1)

**SE/TE:**
318-323, Mutations

**TE Only:**
353, Differentiated Instruction, Plant Varieties

**LS4.B: Natural Selection**

- In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (8-LS4-5)

**SE/TE:**
353, Artificial Selection

**TE Only:**
353, Differentiated Instruction, Plant Varieties

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

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (8-LS4-5)

**SE/TE:**
353, Artificial Selection

**TE Only:**
353, Differentiated Instruction, Plant Varieties

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**Connections to Nature of Science**

- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (8-LS4-5)

**SE/TE:**
353, Artificial Selection

**TE Only:**
353, Differentiated Instruction, Plant Varieties

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**Connections to other DCIs in eighth grade:** 8.LS1.A (8-LS3-1); 8.LS4.A (8-LS3-1)

**Connections to other DCIs across grade levels:** 3.LS3.A (8-LS3-1, 8-LS3-2); 3.LS3.B (8-LS3-1); 6.LS1.A (8-LS3-1); 6.LS1.B (8-LS3-1); 6.LS3.B (8-LS3-1, 8-LS4-5)

**Common Core State Standards Connections:**

- **ELA/Literacy –**
  - RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. (8-LS3-1),(8-LS4-5)
  - RST.6-8.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (8-LS3-1)
  - RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (8-LS3-1)
  - WHST.6-8.8: Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (8-LS4-5)
  - SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (8-LS3-1)

- **Mathematics –** N/A
<table>
<thead>
<tr>
<th>Natural Selection and Adaptations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students who demonstrate understanding can:</td>
</tr>
<tr>
<td><strong>8-LS4-1</strong> Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of change in the level of complexity of anatomical structures in organisms or the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]</td>
</tr>
<tr>
<td>TE Only:</td>
</tr>
<tr>
<td>371A, Performance Expectation Activity “Natural Selection and Adaptations”</td>
</tr>
<tr>
<td><strong>8-LS4-2</strong> Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarities or differences of the gross appearance of anatomical structures.]</td>
</tr>
<tr>
<td>TE Only:</td>
</tr>
<tr>
<td>371B, Performance Expectation Activity “Natural Selection and Adaptations”</td>
</tr>
<tr>
<td><strong>8-LS4-3</strong> Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]</td>
</tr>
<tr>
<td>TE Only:</td>
</tr>
<tr>
<td>371C, Performance Expectation Activity “Natural Selection and Adaptations”</td>
</tr>
<tr>
<td><strong>8-LS4-4</strong> Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving and reproducing in a specific environment.</td>
</tr>
<tr>
<td>TE Only:</td>
</tr>
<tr>
<td>371D, Performance Expectation Activity “Natural Selection and Adaptations”</td>
</tr>
<tr>
<td><strong>8-LS4-6</strong> Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, or proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]</td>
</tr>
<tr>
<td>TE Only:</td>
</tr>
<tr>
<td>371F, Performance Expectation Activity “Natural Selection and Adaptations”</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

#### Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze displays of data to identify linear and nonlinear relationships. (8-LS4-3)

**SE/TE:**
359, Similarities in Early Development
359, Figure 1 Similarities in Development

**TE Only:**
383, Quick Lab, Modeling the Fossil Record
393, What the Fossil Record Shows

#### Using Mathematics and Computational Thinking

Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

- Use mathematical representations to support scientific conclusions and design solutions. (8-LS4-6)

**TE Only:**
357, Lab Investigation, Nature at Work

### Disciplinary Core Ideas

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

- The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (8-LS4-1)

**SE/TE:**
378-383, Fossils
384-389, The Relative Age of Rocks
390-393, Radioactive Dating

**TE Only:**
383, Quick Lab, Modeling the Fossil Record
383, Differentiated Instruction, Summarize What the Fossil Record Shows

- Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (8-LS4-2)

**SE/TE:**
358-361, Evidence of Evolution
371, Science Matters: Walking Whales

**TE Only:**
360, Build Inquiry, Observe Similar Species
361, Differentiated Instruction, Compare Animals
361, Differentiated Instruction, Oral Report

- Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (8-LS4-3)

**SE/TE:**
359, Similarities in Early Development
359, Figure 1 Similarities in Development

### Crosscutting Concepts

#### Patterns

- Patterns can be used to identify cause and effect relationships. (8-LS4-2)

**SE/TE:**
358-361, Evidence of Evolution
371, Science Matters: Walking Whales

**TE Only:**
360, Build Inquiry, Observe Similar Species
361, Differentiated Instruction, Compare Animals
361, Differentiated Instruction, Oral Report

- Graphs, charts, and images can be used to identify patterns in data. (8-LS4-1, 8-LS4-3)

**SE/TE:**
359, Similarities in Early Development
385, Figure 1, Rock Layers in the Grand Canyon
396, Figure 2, The Geologic Time Scale

**TE only:**
359, Figure 1 Similarities in Development

#### Cause and Effect

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (8-LS4-4, 8-LS4-6)

**SE/TE:**
346-347, Scenario Investigation, Worms Under Attack!
350-351, Galápagos Organisms
354-357, What Is Natural Selection?

**TE Only:**
351, Build Inquiry, Interpret Scientific Drawings
355, Build Inquiry, Observe Favorable Traits
355, Differentiated Instruction, Adaptation Before Selection
355, Differentiated Instruction, Research
357, Lab Investigation, Nature at Work
357, Differentiated Instruction, Design an Experiment
Constructing Explanations and Designing Solutions

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.

- Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (8-LS4-2)

**TE Only:**
- 360, Build Inquiry, Observe Similar Species
- 361, Differentiated Instruction, Compare Animals
- 361, Differentiated Instruction, Oral Report

- Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (8-LS4-4)

**TE Only:**
- 357, Lab Investigation, Nature at Work
- 357, Differentiated Instruction, Design an Experiment

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**Connections to Nature of Science**

**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (8-LS4-1, 8-LS4-2)

**SE/TE:**
- 358-361, Evidence of Evolution
- 371, Science Matters: Walking Whales
- 378-383, Fossils
- 384-389, The Relative Age of Rocks
- 390-393, Radioactive Dating

**TE Only:**
- 360, Build Inquiry, Observe Similar Species
- 361, Differentiated Instruction, Compare Animals
- 361, Differentiated Instruction, Oral Report
- 383, Quick Lab, Modeling the Fossil Record
- 383, Differentiated Instruction, Summarize What the Fossil Record Shows
- 393, Quick Lab, How Old Is It?

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**LS4.B: Natural Selection**

- Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (8-LS4-4)

**SE/TE:**
- 346-347, Scenario Investigation, Worms Under Attack!
- 350-351, Galápagos Organisms
- 354-357, What Is Natural Selection?

**TE Only:**
- 351, Build Inquiry, Interpret Scientific Drawings
- 355, Build Inquiry, Observe Favorable Traits
- 355, Differentiated Instruction, Adaptation Before Selection
- 355, Differentiated Instruction, Research
- 357, Lab Investigation, Nature at Work
- 357, Differentiated Instruction, Design an Experiment

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**LS4.C: Adaptation**

- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (8-LS4-6)

**SE/TE:**
- 346-347, Scenario Investigation, Worms Under Attack!
- 350-351, Galápagos Organisms
- 354-357, What Is Natural Selection?

**TE Only:**
- 351, Build Inquiry, Interpret Scientific Drawings
- 355, Build Inquiry, Observe Favorable Traits
- 355, Differentiated Instruction, Adaptation Before Selection
- 355, Differentiated Instruction, Research
- 357, Lab Investigation, Nature at Work
- 357, Differentiated Instruction, Design an Experiment

| Connections to other DCIs in eighth grade: | 8.LS3.A (8-LS4-2),(8-LS4-4); 8.ESS1.C (8-LS4-1),(8-LS4-2),(8-LS4-6) |
| Connections to other DCIs across grade levels: | 3.LS3.B (8-LS4-4); 3.LS4.A (8-LS4-1, 8-LS4-2); 3. LS4.B (8-LS4-4); 3.LS4.C (8-LS4-6); 7.LS2.A (8-LS4-4, 8-LS4-6); 7.LS2.C (8-LS4-6); 6.LS3.B (8-LS4-4, 8-LS4-6) |

Common Core State Standards Connections:

**ELA/Literacy –**

**RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (8-LS4-1, 8-LS4-2, 8-LS4-3, 8-LS4-4)

**RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (8-LS4-1, 8-LS4-3)

**RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (8-LS4-3, 8-LS4-4)

**WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (8-LS4-2, 8-LS4-4)

**WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (8-LS4-2, 8-LS4-4)

**SL.8.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (8-LS4-2, 8-LS4-4)

**SL.8.4** Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (8-LS4-2, 8-LS4-4)

**Mathematics –**

**MP.4** Model with mathematics. (8-LS4-6)

**6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (8-LS4-4, 8-LS4-6)

**6.SP.B.5** Summarize numerical data sets in relation to their context. (8-LS4-4, 8-LS4-6)

**6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (8-LS4-1, 8-LS4-2)

**7.RP.A.2** Recognize and represent proportional relationships between quantities. (8-LS4-4, 8-LS4-6)
Engineering, Technology, and Applications of Science

Students who demonstrate understanding can:

8-ETS1-1  Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

SE/TE:
36-39, Stem Activity, Sail Away

8-ETS1-2  Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

SE/TE:
36-39, Stem Activity, Sail Away

8-ETS1-3  Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

SE/TE:
36-39, Stem Activity, Sail Away

8-ETS1-4  Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

SE/TE:
36-39, Stem Activity, Sail Away

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

### Science and Engineering Practices

**Asking Questions and Defining Problems**
- Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
  - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (8-ETS1-1)

SE/TE:
36, Stem Activity, Sail Away: 1, Identify the Problem

### Disciplinary Core Ideas

**ETS1.A: Defining and Delimiting Engineering Problems**
- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (8-ETS1-1)

SE/TE:
36, Stem Activity, Sail Away: 1, Identify the Problem
36-37, Stem Activity, Sail Away: 2-5, Do Research

**ETS1.B: Developing Possible Solutions**
- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (8-ETS1-4)

SE/TE:
39, Stem Activity, Sail Away: 15-17, Evaluate and Redesign

### Crosscutting Concepts

**Influence of Science, Engineering, and Technology on Society and the Natural World**
- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (8-ETS1-1)

SE/TE:
36-39, Stem Activity, Sail Away
### Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (8-ETS1-4)

**SE/TE:**
38, Stem Activity, Sail Away:10, Design and Construct a Prototype

### Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (8-ETS1-3)

**SE/TE:**
38, Stem Activity, Sail Away:15-17, Evaluate and Redesign

### Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on 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.

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (8-ETS1-2)

**SE/TE:**
39, Stem Activity, Sail Away: 15-17, Evaluate and Redesign

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### There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (8-ETS1-2, 8-ETS1-3)

**SE/TE:**
39, Stem Activity, Sail Away: 15-17, Evaluate and Redesign

- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (8-ETS1-3)

**SE/TE:**
38, Stem Activity, Sail Away:10, Design and Construct a Prototype

### Models of all kinds are important for testing solutions. (8-ETS1-4)

**SE/TE:**
38, Stem Activity, Sail Away:10, Design and Construct a Prototype

### Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (8-ETS1-3)

**SE/TE:**
39, Stem Activity, Sail Away: 15-17, Evaluate and Redesign

- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (8-ETS1-4)

**SE/TE:**
38, Stem Activity, Sail Away:10, Design and Construct a Prototype
39, Stem Activity, Sail Away: 15-17, Evaluate and Redesign

### The uses of technologies and 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. (8-ETS1-1)

**SE/TE:**
36-39, Stem Activity, Sail Away
| Connections to 6-8.ETS1.A: Defining and Delimiting Engineering Problems include: **Physical Science**: (6-PS3-3)  
| Connections to 6-8.ETS1.B: Developing Possible Solutions Problems include: **Physical Science**: (7-PS1-6, 6-PS3-3); **Life Science**: (7-LS2-5)  
| Connections to 6-8.ETS1.C: Optimizing the Design Solution include: **Physical Science**: (7-PS1-6)  
| **Articulation to DCIs across grade levels**: **3-5.ETS1.A** (6-8-ETS1-1, 6-8-ETS1-2, 6-8-ETS1-3); **3-5.ETS1.B** (6-8-ETS1-2, 6-8-ETS1-3, 6-8-ETS1-4); **3-5.ETS1.C** (6-8-ETS1-1, 6-8-ETS1-2, 6-8-ETS1-3, 6-8-ETS1-4)  
| **Common Core State Standards Connections**:  
| **ELA/Literacy** –  
| RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (8-ETS1-1, 8-ETS1-2, 8-ETS1-3)  
| RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (8-ETS1-3)  
| RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic. (8-ETS1-2, 8-ETS1-3)  
| WHST.6-8.7 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. (8-ETS1-2)  
| WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (8-ETS1-1)  
| WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (8-ETS1-2)  
| **SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (8-ETS1-4)  
| **Mathematics** –  
| MP.2 Reason abstractly and quantitatively. (8-ETS1-1, 8-ETS1-2, 8-ETS1-3, 8-ETS1-4)  
| 7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), 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. (8-ETS1-1, 8-ETS1-2, 8-ETS1-3)  
| 7.SP Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (8-ETS1-4)  

**SE = Student Edition**  
**TE = Teacher’s Edition**