# Arkansas Science Standards Alignment to FOSS Next Generation

GRADE 6-PS3

# Energy

## Performance Expectation 6-PS3-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **PS3.A: Definitions of Energy**<br>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.<br><br>**PS3.B: Conservation of Energy and Energy Transfer**<br>Energy is spontaneously transferred out of hotter regions or objects and into colder ones. | **Energy and Matter**<br>The transfer of energy can be tracked as energy flows through a designed or natural system.<br><br>**ETS1.A: Defining and Delimiting an Engineering Problem**<br><br>**ETS1.B: Developing Possible Solutions** |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Chemical Interactions Second Edition** Investigations Guide:
- Investigation 6, Parts 1-2
- Investigation 8, Parts 3-4

GRADE 6-PS3

# Energy

## Performance Expectation 6-PS3-4

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Planning and Carrying Out Investigations**<br><br>**Scientific Knowledge is Based on Empirical Evidence** | **PS3.B: Conservation of Energy and Energy Transfer**<br>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. | **Scale, Proportion, and Quantity**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Chemical Interactions Second Edition** Investigations Guide:

Investigation 5, Parts 1-3

GRADE 6-PS3

# Energy

## Performance Expectation 6-PS3-5

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence**<br><br>**Scientific Knowledge is Based on Empirical Evidence**<br>Science knowledge is based upon logical and conceptual connections between evidence and explanations | **PS3.B: Conservation of Energy and Energy Transfer**<br>When the motion energy of an object changes, there is inevitably some other change in energy at the same time. | **Energy and Matter**<br>Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion). |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Chemical Interactions Second Edition** Investigations Guide:

Investigation 5, Parts 3-4

GRADE 6-LS1

# Structure, Function, and Information Processing

## Performance Expectation 6-LS1-1

*Students who demonstrate understanding can:*

***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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Planning and Carrying Out Investigations**<br><br>**Interdependence of Science, Engineering, and Technology** | **LS1.A: Structure and Function**<br>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). | **Scale, Proportion, and Quantity**<br>Phenomena that can be observed at one scale may not be observable at another scale. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Diversity of Life Next Generation** Investigations Guide:

- Investigation 1, Parts 1-2
- Investigation 3, Parts 1-4
- Investigation 4, Parts 1-4

GRADE 6-LS1

# Structure, Function and Information Processing

## Performance Expectation 6-LS1-2

*Students who demonstrate understanding can:*
**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **LS1.A: Structure and Function**<br>Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. | **Structure and Function**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Diversity of Life Next Generation** Investigations Guide:
- Investigation 3, Parts 1, 2, and 4
- Investigation 4, Parts 1-3

GRADE 6-LS1

# Structure, Function, and Information Processing

## Performance Expectation 6-LS1-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence**<br><br>**Science is a Human Endeavor**<br>**Scientists** | **LS1.A: Structure and Function**<br>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. | **Systems and System Models**<br>Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Diversity of Life Next Generation** Investigations Guide:

Investigation 5, Parts 2-3
Investigation 7, Part 2

GRADE 6-LS1

# Structure, Function, and Information Processing

**Performance Expectation 6-LS1-8**

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| **Obtaining, Evaluating, and Communicating Information** | **LS1.D: Information Processing**<br>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 | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

***This standard is not met in the recommended scope and sequence for Arkansas.***

GRADE 6-LS1

# Growth, Development, and Reproduction of Organisms

## Performance Expectation 6-LS1-4

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence** | **LS1.B: Growth and Development of Organisms**<br>Animals engage in characteristic behaviors that increase the odds of reproduction.<br><br>Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. | **Cause and Effect**<br>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Diversity of Life Next Generation** Investigations Guide:

Investigation 6, Part 4

GRADE 6-LS1

# Growth, Development, and Reproduction of Organisms

## Performance Expectation 6-LS1-5

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **LS1.B: Growth and Development of Organisms**<br>Genetic factors as well as local conditions affect the growth of the adult plant. | **Cause and Effect**<br>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Diversity of Life Next Generation** Investigations Guide:

Investigation 6, Part 2

GRADE 6-LS3

# Growth, Development, and Reproduction of Organisms

## Performance Expectation 6-LS3-2

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **LS1.B: Growth and Development of Organisms**<br>Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.<br><br>Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited<br><br>**LS3.B: Variation of Traits**<br>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. | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural systems |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Diversity of Life Next Generation** Investigations Guide:

Investigation 4, Parts 1-2

Investigation 6, Parts 1 and 3

GRADE 6-ESS2

# Earth’s Systems

## Performance Expectation 6-ESS2-4

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| **Developing and Using Models** | **ESS2.C: The Roles of Water in Earth’s Surface Processes**<br>Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.<br><br>Global movements of water and its changes in form are propelled by sunlight and gravity. | **Energy and Matter**<br>Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Weather and Water Second Edition** Investigations Guide:

- Investigation 1, Parts 1-2 (foundational)
- Investigation 7, Parts 1-3
- Investigation 9, Parts 1-3
- Investigation 10, Part 4

GRADE 6-ESS3

# Human Impacts

## Performance Expectation 6-ESS3-3

*Students who demonstrate understanding can:*

**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).]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| **Constructing Explanations and Designing Solutions**<br><br>**Science Addresses Questions About the Natural and** | **ESS3.C: Human Impacts on Earth Systems**<br>Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.<br><br>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. | **Cause and Effect**<br>Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.<br><br>**Connections to Engineering, Technology, and Applications of Science**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 7 with Earth History Second Edition:*

*Earth History Investigations Guide:*

*Investigation 8, Parts 2-3*

GRADE 6-ESS3

# Human Impacts

## Performance Expectation 6-ESS3-4

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence** | **ESS3.C: Human Impacts on Earth Systems**<br>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. | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural or designed systems<br><br>**Influence of Science, Engineering, and Technology on Society and the Natural World**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Weather and Water Second Edition** Investigations Guide:

Investigation 9, Part 1

GRADE 6-ESS2

# Weather and Climate

## Performance Expectation 6-ESS2-5

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Planning and Carrying Out Investigations** | **ESS2.C: The Roles of Water in Earth's Surface Processes**<br>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.<br><br>**ESS2.D: Weather and Climate**<br>Because these patterns are so complex, weather can only be predicted probabilistically. | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural or designed systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Weather and Water Second Edition** Investigations Guide:

- Investigation 1, Part 2 (foundational)
- Investigation 2, Parts 1-2 (foundational)
- Investigation 3, Part 1 (foundational)
- Investigation 3, Part 2
- Investigation 6, Parts 2-3
- Investigation 8, Parts 1-2
- Investigation 10, Part 4

GRADE 6-ESS2

# Weather and Climate

## Performance Expectation 6-ESS2-6

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **ESS2.C: The Roles of Water in Earth's Surface Processes**<br>Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.<br><br>**ESS2.D: Weather and Climate**<br>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.<br><br>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. | **Systems and System Models**<br>Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Weather and Water Second Edition** Investigations Guide:

- Investigation 4, Parts 1-3 (foundational)
- Investigation 5, Part 1 (foundational)
- Investigation 5, Part 2
- Investigation 6, Parts 2-3
- Investigation 8, Part 2
- Investigation 9, Parts 2-3
- Investigation 10, Part 4

GRADE 6-ESS3

# Weather and Climate

## Performance Expectation 6-ESS3-5

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| **Asking Questions and Defining Problems** | **ESS3.D: Global Climate Change**<br>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. | **Stability and Change**<br>Stability might be disturbed either by sudden events or gradual changes that accumulate over time. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Weather and Water Second Edition** Investigations Guide:

Investigation 10, Parts 1-3

GRADE 6-ETS1

# Engineering, Technology, and Applications of Science

## Performance Expectation 6-ETS1-1

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Asking Questions and Defining Problems** | **ETS1.A: Defining and Delimiting Engineering Problems**<br>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. | **Influence of Science, Engineering, and Technology on Society and the Natural World**<br>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.<br><br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Chemical Interactions Second Edition** Investigations Guide:

Investigation 6, Parts 1-2

Investigation 8, Part 3

GRADE 6-EST1

# Engineering, Technology, and Applications of Science

## Performance Expectation 6-ETS1-2

*Students who demonstrate understanding can:*

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

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence** | **ETS1.B: Developing Possible Solutions**<br>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Chemical Interactions Second Edition** Investigations Guide:

Investigation 6, Parts 1-2
Investigation 8, Part 3

GRADE 6-EST1

# Engineering, Technology, and Applications of Science

## Performance Expectation 6-ETS1-3

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data** | **ETS1.B: Developing Possible Solutions**<br>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.<br><br>**ETS1.C: Optimizing the Design Solution**<br>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. | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Chemical Interactions Second Edition** Investigations Guide:

Investigation 6, Parts 1-2
Investigation 8, Part

GRADE 6-EST1

# Engineering, Technology, and Applications of Science

## Performance Expectation 6-ETS1-4

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **ETS1.B: Developing Possible Solutions**<br>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.<br><br>Models of all kinds are important for testing solutions.<br><br>**ETS1.C: Optimizing the Design Solution**<br>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. | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Chemical Interactions Second Edition** Investigations Guide:

Investigation 6, Parts 1-2

Investigation 8, Part

GRADE 7-PS1

# Structure and Properties of Matter

## Performance Expectation 7-PS1-1

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **PS1.A: Structure and Properties of Matter**<br>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.<br><br>Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). | **Scale, Proportion, and Quantity**<br>Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or small. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 2, Parts 1-2*
*Investigation 7, Parts 1-2*
*Investigation 9, Parts 1-3*
*Investigation 10, Parts 1-2*

GRADE 7-PS1

# Structure and Properties of Matter

## Performance Expectation 7-PS1-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **PS1.A: Structure and Properties of Matter**<br>Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it<br><br>**PS1.B: Chemical Reactions**<br>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. | **Structure and Function**<br>Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.<br><br>**Interdependence of Science, Engineering, and Technology**<br>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.<br><br>**Influence of Science, Engineering and Technology on Society and the Natural World**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 2, Part 2*

GRADE 7-PS1

# Structure and Properties of Matter

## Performance Expectation 7-PS1-4

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **PS1.A: Structure and Properties of Matter**<br>Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.<br><br>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.<br><br>The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.<br><br>**PS3.A: Definitions of Energy**<br>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<br><br>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. | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural or designed systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 3, Parts – 1-3*
*Investigation 4, Parts 1-3*
*Investigation 5, Parts 1-3*
*Investigation 7, Part 1*
*Investigation 8, Parts 1-4*

GRADE 7-PS1

# Chemical Reactions

## Performance Expectation 7-PS1-2

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data**<br><br>Scientific Knowledge is Based on Empirical Evidence<br><br>Science knowledge is based upon logical and conceptual connections between evidence and explanations. | **PS1.A: Structure and Properties of Matter**<br>Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.<br><br>**PS1.B: Chemical Reactions**<br>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. | **Patterns**<br>Macroscopic patterns are related to the nature of microscopic and atomic-level structure. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 1, Parts 1-2*
*Investigation 3, Part 1*
*Investigation 7, Parts 1-2*
*Investigation 9, Parts 2-3*
*Investigation 10, Parts 1-2*

GRADE 7-PS1

# Chemical Reactions

## Performance Expectation 7-PS1-5

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models**<br><br>**Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena**<br>Laws are regularities or mathematical descriptions of natural phenomena. | **PS1.B: Chemical Reactions**<br>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.<br><br>The total number of each type of atom is conserved, and thus the mass does not change | **Energy and Matter**<br>Matter is conserved because atoms are conserved in physical and chemical processes. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 9, Parts 2-3*
*Investigation 10, Parts 1-2*

GRADE 7-PS1

# Chemical Reactions

## Performance Expectation 7-PS1-6

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **PS1.B: Chemical Reactions**<br>Some chemical reactions release energy, others store energy.<br><br>**ETS1.B: Developing Possible Solutions**<br>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.<br><br>**ETS1.C: Optimizing the Design Solution**<br>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 the characteristics may be incorporated into the new design.<br><br>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. | **Energy and Matter**<br>The transfer of energy can be tracked as energy flows through a designed or natural system. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 8, Part 3*

GRADE 7-LS2

# Interdependent Relationships in Ecosystems

## Performance Expectation 7-LS2-2

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **LS2.A: Interdependent Relationships in Ecosystems**<br>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. | **Patterns**<br>Patterns can be used to identify cause and effect relationships. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Populations and Ecosystems Second Edition** Investigations Guide:

- Investigation 2, Part 1 (foundational)
- Investigation 3, Parts 1-3
- Investigation 5, Part 3
- Investigation 6, Part 2
- Investigation 7, Part 2

GRADE 7-LS2

# Interdependent Relationships in Ecosystems

**Performance Expectation 7-LS2-5**

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence**<br><br>**Addresses Questions About the Natural and Material World** | **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**<br>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.<br><br>**LS4.D: Biodiversity and Humans**<br>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.<br><br>**ETS1.B: Developing Possible Solutions**<br>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. | **Stability and Change**<br>Small changes in one part of a system might cause large changes in another part<br><br>**Influence of Science, Engineering, and Technology on Society and the Natural World** |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Populations and Ecosystems Second Edition** Investigations Guide:

Investigation 9, Parts 2-3

GRADE 7-LS1

# Matter and Energy in Organisms and Ecosystems

## Performance Expectation 7-LS1-6

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions**<br><br>**Scientific Knowledge is Based on Empirical Evidence**<br>Science knowledge is based upon logical connections between evidence and explanations. | **LS1.C: Organization for Matter and Energy Flow in Organisms**<br>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.<br><br>**PS3.D: Energy in Chemical Processes and Everyday Life**<br>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. | **Energy and Matter**<br>Within a natural system, the transfer of energy drives the motion and/or cycling of matter. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Diversity of Life Next Generation:*

*Diversity of Life Investigations Guide:*

*Investigation 1, Parts 1-2*

*Investigation 3, Parts 1-4*

*Investigation 4, Parts 1-4*

GRADE 7-LS1

# Matter and Energy in Organisms and Ecosystems

## Performance Expectation 7-LS1-7

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **LS1.C: Organization for Matter and Energy Flow in Organisms**<br>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.<br><br>**PS3.D: Energy in Chemical Processes and Everyday Life**<br>Cellular respiration in plants and animals involve 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. | **Energy and Matter**<br>Matter is conserved because atoms are conserved in physical and chemical processes. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Populations and Ecosystems Second Edition** Investigations Guide:

- Investigation 5, Parts 2 and 4
- Investigation 6, Part 1

GRADE 7-LS2

# Matter and Energy in Organisms and Ecosystems

## Performance Expectation 7-LS2-1

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data** | **LS2.A: Interdependent Relationships in Ecosystems**<br>Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.<br><br>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.<br><br>Growth of organisms and population increases are limited by access to resources. | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural or designed systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Populations and Ecosystems Second Edition** Investigations Guide:

- Investigation 1, Part 1-3 (foundational)
- Investigation 2, Parts 2-3
- Investigation 4, Parts 1-3
- Investigation 6, Part 3
- Investigation 7, Parts 2-3
- Investigation 9, Parts 1-3

GRADE 7-LS2

# Matter and Energy in Organisms and Ecosystems

## Performance Expectation 7-LS2-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models**<br><br>**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**<br>Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. | **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems**<br>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. | **Energy and Matter**<br>The transfer of energy can be tracked as energy flows through a natural system. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Populations and Ecosystems Second Edition** Investigations Guide:

Investigation 3, Parts 2 and 3
Investigation 5, Part 1-3
Investigation 6, Parts 2-4

GRADE 7-LS2

# Matter and Energy in Organisms and Ecosystems

## Performance Expectation 7-LS2-4

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence**<br><br>**Scientific Knowledge is Based on Empirical Evidence**<br>Science disciplines share common rules of obtaining and evaluating empirical evidence. | **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**<br>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. | **Stability and Change**<br>Small changes in one part of a system might cause large changes in another part. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Populations and Ecosystems Second Edition** Investigations Guide:

- Investigation 4, Part 3
- Investigation 7, Parts 1-3
- Investigation 8, Parts 1-3
- Investigation 9, Parts 1-3

GRADE 7-ESS2

# Earth's Systems

## Performance Expectation 7-ESS2-1

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **ESS2.A: Earth's Materials and Systems**<br>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. | **Stability and Change**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Earth History Second Edition** Investigations Guide:

- Investigation 2, Parts 1 and 4
- Investigation 3, Parts 1-2
- Investigation 5, Parts 1 and 3
- Investigation 7, Part 3
- Investigation 9, Parts 1-2

GRADE 7-ESS3

# Earth’s Systems

## Performance Expectation 7-ESS3-1

*Students who demonstrate understanding can:*

**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).]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **ESS3.A: Natural Resources**<br>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. | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural or designed systems.<br><br>**Influence of Science, Engineering, and Technology on Society and the Natural World**<br>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 |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Earth History Second Edition** Investigations Guide:

Investigation 6, Part 3
Investigation 8, Parts 1-3

GRADE 7-ESS2

# History of Earth

## Performance Expectation 7-ESS2-2

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **ESS2.A: Earth's Materials and Systems**<br>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.<br><br>**ESS2.C: The Roles of Water in Earth's Surface Processes**<br>Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. | **Scale Proportion and Quantity**<br>Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Earth History Second Edition** Investigations Guide:

- Investigation 2, Parts 2-3
- Investigation 3, Parts 1-2
- Investigation 5, Parts 1-3
- Investigation 7, Parts 1-4
- Investigation 8, Part 3
- Investigation 9, Parts 1-2

GRADE 7-ESS2

# History of Earth

## Performance Expectation 7-ESS2-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data**<br><br>**Scientific Knowledge is Open to Revision in Light of New Evidence**<br>Science findings are frequently revised and/or reinterpreted based on new evidence. | **ESS1.C: The History of Planet Earth**<br>Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.<br><br>**ESS2.B: Plate Tectonics and Large-Scale System Interactions**<br>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 | **Patterns**<br>Patterns in rates of change and other numerical relationships can provide information about natural systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Earth History Second Edition** Investigations Guide:

Investigation 6, Parts 2-3
Investigation 7, Parts 1, 2, and 4

GRADE 7-ESS3

# Human Impacts

## Performance Expectation 7-ESS3-2

*Students who demonstrate understanding can:*

**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).]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data** | **ESS3.B: Natural Hazards**<br>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. | **Patterns**<br>Graphs, charts, and images can be used to identify patterns in data.<br><br>**Influence of Science, Engineering, and Technology on Society and the Natural World**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Earth History Second Edition** Investigations Guide:

Investigation 6, Part 1
Investigation 8, Parts 2-3

GRADE 7-EST1

# Engineering, Technology, and Applications of Science

**Performance Expectation 7-ETS1-1**

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Asking Questions and Defining Problems** | **ETS1.A: Defining and Delimiting Engineering Problems**<br>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. | **Influence of Science, Engineering, and Technology on Society and the Natural World**<br>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.<br><br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 8, Part 3*

GRADE 7-EST1

# Engineering, Technology, and Applications of Science

**Performance Expectation 7-ETS1-2**

*Students who demonstrate understanding can:*

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

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence** | | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 8, Part 3*

GRADE 7-EST1

# Engineering, Technology, and Applications of Science

## Performance Expectation 7-ETS1-3

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data** | **ETS1.B: Developing Possible Solutions**<br>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.<br><br>Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.<br><br>**ETS1.C: Optimizing the Design Solution**<br>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. | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 8, Part 3*

GRADE 7-EST1

# Engineering, Technology, and Applications of Science

| Performance Expectation 7-ETS1-4 | | |
|---|---|---|
| *Students who demonstrate understanding can:* **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.** | | |
| **Science and Engineering Practices** | **Disciplinary Core Ideas** | **Crosscutting Concepts** |
| **Developing and Using Models** | **ETS1.B: Developing Possible Solutions**<br>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.<br><br>Models of all kinds are important for testing solutions<br><br>**ETS1.C: Optimizing the Design Solution**<br>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. | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 6 with Chemical Interactions Second Edition:*

*Chemical Interactions Second Edition Investigations Guide:*
*Investigation 8, Part 3*

# Arkansas Science Standards Alignment to FOSS Next Generation

GRADE 8-PS4

## Waves and Electromagnetic Radiation

| Performance Expectation 8-PS4-1 |
|---|
| *Students who demonstrate understanding can:*<br>**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.**<br><br>*[Clarification Statement: Emphasis is on describing waves applying both qualitative and quantitative thinking.]*<br>*[Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]* |

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Using Mathematics and Computational Thinking** | **PS4.A: Wave Properties**<br>A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. | **Patterns**<br>Graphs and charts can be used to identify patterns in data. |

### PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Waves Next Generation** Investigations Guide:

Investigation 1, Parts 1-2
Investigation 2, Part 1

GRADE 8-PS4

# Waves and Electromagnetic Radiation

## Performance Expectation 8-PS4-2

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **PS4.A: Wave Properties**<br>A sound wave needs a medium through which it is transmitted<br><br>**PS4.B: Electromagnetic Radiation**<br>When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.<br><br>The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.<br><br>A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.<br><br>However, because light can travel through space, it cannot be a matter wave, like sound or water waves. | **Structure and Function**<br>Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:

Investigation 2, Parts 1,3
Investigation 3, Parts 1-4

GRADE 8-PS4

# Waves and Electromagnetic Radiation

## Performance Expectation 8-PS4-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| **Obtaining, Evaluating, and Communicating Information** | **PS4.C: Information Technologies and Instrumentation**<br>Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. | **Structure and Function**<br>Structures can be designed to serve particular functions.<br><br>**Influence of Science, Engineering, and Technology on Society and the Natural World**<br>Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.<br><br>**Science is a Human Endeavor**<br>Advances in technology influence the progress of science and science has influenced advances in technology. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Waves Next Generation** Investigations Guide:
Investigation 4, Parts 1-3

GRADE 8-PS2

# Forces and Interactions

## Performance Expectation 8-PS2-1

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **PS2.A: Forces and Motion**<br>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). | **Systems and System Models**<br>Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems.<br><br>**Influence of Science, Engineering, and Technology on Society and the Natural World**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Gravity and Kinetic Energy Next Generation** Investigations Guide
- Investigation 3, Parts 1-3
- Investigation 4, Parts 1-2

GRADE 8-PS2

# Forces and Interactions

## Performance Expectation 8-PS2-2

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Planning and Carrying Out Investigations**<br><br>**Scientific Knowledge is Based on Empirical Evidence**<br>Science knowledge is based upon logical and conceptual connections between evidence and explanations. | **PS2.A: Forces and Motion**<br>The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.<br><br>All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. | **Stability and Change**<br>Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:
- Investigation 1, Parts 1-3
- Investigation 2, Part 3
- Investigation 3, Part 2

**Gravity and Kinetic Energy Next Generation** Investigations Guide
- Investigation 2, Parts 1-3
- Investigation 3, Parts 1-3

GRADE 8-PS2

# Forces and Interactions

## Performance Expectation 8-PS2-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Asking Questions and Defining Problems** | **PS2.B: Types of Interactions**<br>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. | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural or designed systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:
- Investigation 2, Part 3
- Investigation 3, Parts 1, 3

GRADE 8-PS2

# Forces and Interactions

## Performance Expectation 8-PS2-4

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence**<br><br>**Scientific Knowledge is Based on Empirical Evidence**<br>Science knowledge is based upon logical and conceptual connections between evidence and explanations. | **PS2.B: Types of Interactions**<br>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. | **Systems and System Models**<br>Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Gravity and Kinetic Energy Next Generation** Investigations Guide

- Investigation 1, Part 1-3 (foundational)
- Investigation 2, Part 1

GRADE 8-PS2

# Forces and Interactions

## Performance Expectation 8-PS2-5

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| **Planning and Carrying Out Investigations** | **PS2.B: Types of Interactions**<br>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). | **Cause and Effect**<br>Cause and effect relationships may be used to predict phenomena in natural or designed systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:
- Investigation 2, Parts 1-3
- Investigation 3, Part 2

**Gravity and Kinetic Energy Next Generation** Investigations Guide
- Investigation 2, Parts 1-2 (Foundational)

GRADE 8-PS3

# Energy

## Performance Expectation 8-PS3-1

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data** | **PS3.A: Definitions of Energy**<br>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. | **Scale, Proportion, and Quantity**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Gravity and Kinetic Energy Next Generation** Investigations Guide:

Investigation 3, Parts 1-2

GRADE 8-PS3

# Energy

## Performance Expectation 8-PS3-2

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **PS3.A: Definitions of Energy**<br>A system of objects may also contain stored (potential) energy, depending on their relative positions.<br><br>**PS3.C: Relationship Between Energy and Forces**<br>When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. | **Systems and System Models**<br>Models can be used to represent systems and their interactions – e.g., processes, and outputs – and energy and matter flows within systems. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:
Investigation 3, Parts 1-2

**Gravity and Kinetic Energy Next Generation** Investigations Guide:
Investigation 3, Parts 1-3

GRADE 8-ESS1

# Space Systems

## Performance Expectation 8-ESS1-1

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models**<br><br>**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**<br>Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. | **ESS1.A: The Universe and Its Stars**<br>Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.<br><br>**ESS1.B: Earth and the Solar System**<br>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. | **Patterns**<br>Patterns can be used to identify cause and effect relationships. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Planetary Science Second Edition** Investigations Guide:

- Investigation 1, Part 2
- Investigation 2, Parts 1-2
- Investigation 3, Parts 1-2
- Investigation 5, Parts 2-3

GRADE 8-ESS1

# Space Systems

| Performance Expectation8-ESS1-2 |
|---|
| *Students who demonstrate understanding can:*<br>**Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.**<br><br>*[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).]*<br>*[Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]* |

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models**<br><br>**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**<br>Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. | **ESS1.A: The Universe and Its Stars**<br>Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.<br><br>**ESS1.B: Earth and the Solar System**<br>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.<br><br>The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. | **Systems and System Models**<br>Models can be used to represent systems and their interactions. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Planetary Science Second Edition** Investigations Guide:

Investigation 7, Part 2

GRADE 8-ESS1

# Space Systems

## Performance Expectation 8-ESS1-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data** | **ESS1.B: Earth and the Solar System**<br>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. | **Scale, Proportion, and Quantity**<br>Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.<br><br>**Interdependence of Science, Engineering, and Technology**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Planetary Science Second Edition** Investigations Guide:

- Investigation 4, Parts 1-2
- Investigation 7, Part 1
- Investigation 8, Part 1

GRADE 8-ESS1

# History of Earth

## Performance Expectation 8-ESS1-4

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **ESS1.C: The History of Planet Earth**<br>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. | **Scale Proportion and Quantity**<br>Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

*This standard is met at Grade 7 with Earth History Second Edition:*

*Earth History Second Edition Investigations Guide:*
*Investigation 1, Part 3*
*Investigation 3, Part 3*
*Investigation 4, Parts 1-4*
*Investigation 9, Parts 1-2*

GRADE 8-LS3

# Growth, Development, and Reproduction of Organisms

## Performance Expectation 8-LS3-1

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **LS3.A: Inheritance of Traits**<br>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.<br><br>**LS3.B: Variation of Traits**<br>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. | **Structure and Function**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Heredity and Adaptation Next Generation** Investigations Guide:

Investigation 2, Parts 2-3
Investigation 3, Part 1

GRADE 8-LS4

# Growth, Development, and Reproduction of Organisms

## Performance Expectation 8-LS4-5

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Obtaining, Evaluating, and Communicating Information** | **LS4.B: Natural Selection**<br>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. | **Cause and Effect**<br>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.<br><br>**Interdependence of Science, Engineering, and Technology**<br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Heredity and Adaptation Next Generation** Investigations Guide:

Investigation 3, Part 3

GRADE 8-LS4

# Natural Selection and Adaptations

## Performance Expectation 8-LS4-1

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| --- | --- | --- |
| **Analyzing and Interpreting Data**<br><br>**Scientific Knowledge is Based on Empirical Evidence**<br>Science knowledge is based upon logical and conceptual connections between evidence and explanations.<br><br>**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**<br>Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. | **LS4.A: Evidence of Common Ancestry and Diversity**<br>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. | **Patterns**<br>Graphs, charts, and images can be used to identify patterns in data. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Heredity and Adaptation Next Generation** Investigations Guide:
Investigation 1, Parts 1-2

GRADE 8-LS4

# Natural Selection and Adaptations

## Performance Expectation 8-LS4-2

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions**<br><br>**Scientific Knowledge Assumes an Order and Consistency in Natural Systems**<br>Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. | **LS4.A: Evidence of Common Ancestry and Diversity**<br>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. | **Patterns**<br>Patterns can be used to identify cause and effect relationships. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Heredity and Adaptation Next Generation** Investigations Guide:

- Investigation 1, Part 2
- Investigation 2, Part 1

GRADE 8-LS4

# Natural Selection and Adaptations

## Performance Expectation 8-LS4-3

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data** | **LS4.A: Evidence of Common Ancestry and Diversity**<br>Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. | **Patterns**<br>Graphs, charts, and images can be used to identify patterns in data. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Heredity and Adaptation Next Generation** Investigations Guide:
Investigation 2, Part 1

GRADE 8-LS4

# Natural Selection and Adaptations

## Performance Expectation 8-LS4-4

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Constructing Explanations and Designing Solutions** | **LS4.B: Natural Selection**<br>Natural selection leads to the predominance of certain traits in a population, and the suppression of others. | **Cause and Effect**<br>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Heredity and Adaptation Next Generation** Investigations Guide:

Investigation 3, Parts 1-2

GRADE 8-LS4

# Natural Selection and Adaptations

## Performance Expectation 8-LS4-6

*Students who demonstrate understanding can:*

**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.]*

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Using Mathematics and Computational Thinking** | **LS4.C: Adaptation**<br>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. | **Cause and Effect**<br>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. |

## PROGRAM REFERENCES

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**Heredity and Adaptation Next Generation** Investigations Guide:

Investigation 3, Part 2

GRADE 8-ESTS1

# Engineering, Technology, and Applications of Science

## Performance Expectation 8-ETS1-1

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Asking Questions and Defining Problems** | **ETS1.A: Defining and Delimiting Engineering Problems**<br>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. | **Influence of Science, Engineering, and Technology on Society and the Natural World**<br>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.<br><br>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. |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:
Investigation 3, Part 3

**Gravity and Kinetic Energy** Investigation Guide:
Investigation 4, Parts 1-2

GRADE 8-ESTS1

# Engineering, Technology, and Applications of Science

## Performance Expectation 8-ETS1-2

*Students who demonstrate understanding can:*

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

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Engaging in Argument from Evidence** | **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. | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:
Investigation 3, Part 3

**Gravity and Kinetic Energy** Investigation Guide:
Investigation 4, Parts 1-4

GRADE 8-ESTS1

# Engineering, Technology, and Applications of Science

## Performance Expectation8 ETS1-3

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Analyzing and Interpreting Data** | **ETS1.B: Developing Possible Solutions**<br>There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.<br><br>Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.<br><br>**ETS1.C: Optimizing the Design Solution**<br>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. | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:
Investigation 3, Part 3

**Gravity and Kinetic Energy** Investigations Guide:
Investigation 4, Parts 1-2

GRADE 8-ESTS1

# Engineering, Technology, and Applications of Science

**Performance Expectation 8-ETS1-4**

*Students who demonstrate understanding can:*

**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.**

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Developing and Using Models** | **ETS1.B: Developing Possible Solutions**<br>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.<br><br>Models of all kinds are important for testing solutions.<br><br>**ETS1.C: Optimizing the Design Solution**<br>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. | |

## PROGRAM REFERENCES

The following **FOSS** elements address the performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts indicated below.

**Electromagnetic Force Next Generation** Investigations Guide:

Investigation 3, Part 3

**Gravity and Kinetic Energy** Investigation Guide:

Investigation 4, Parts 1-2