INTRODUCTION TO PERFORMANCE EXPECTATIONS

"The NGSS are standards, or goals, that reflect what a student should know and be able to do; they do not dictate the manner or methods by which the standards are taught. . . . Curriculum and assessment must be developed in a way that builds students' knowledge and ability toward the PEs [performance expectations]" (*Next Generation Science Standards*, 2013, page xiv).

This chapter shows how the NGSS Performance Expectations are bundled in the **Human Systems Interactions Course** to provide a coherent set of instructional materials for teaching and learning. This chapter also provides details about how this FOSS course fits into the matrix of the FOSS Program (page 39). Each FOSS module K–5 and middle school course 6–8 has a functional role in the FOSS Conceptual Framework that were developed based on a decade of research on science education and the influence of *A Framework for K–12 Science Education* (2012) and *Next Generation Science Standards* (NGSS, 2013).

The FOSS curriculum provides a coherent vision of science teaching and learning in the three ways described by the NRC *Framework*. First, FOSS is designed around learning as a developmental progression, providing experiences that allow students to continually build on their initial notions and develop more complex science and engineering knowledge. Students develop functional understanding over time by building on foundational elements (intermediate knowledge). That progression is detailed in the conceptual frameworks.

Second, FOSS limits the number of core ideas, choosing depth of knowledge over broad shallow coverage. Those core ideas are addressed at multiple grade levels in ever greater complexity. FOSS investigations at each grade level focus on elements of core ideas that are teachable and learnable at that grade level.

Third, FOSS investigations integrate engagement with scientific ideas (content) and the practices of science and engineering by providing firsthand experiences.

Teach the course with the confidence that the developers have carefully considered the latest research and have integrated into each investigation the three dimensions of the NRC *Framework* and NGSS, and have designed powerful connections to the Common Core State Standards for English Language Arts.

Contents

The NGSS Performance Expectations bundled in this module include

Life Sciences
MS-LS1-1 (foundational)
MS-LS1-3
MS-LS1-7
MS-LS1-8

DISCIPLINARY CORE IDEAS

A Framework for K–12 Science Education has four core ideas in life sciences.

LS1: From molecules to organisms: Structures and processes
LS2: Ecosystems: Interactions, energy, and dynamics
LS3: Heredity: Inheritance and variation of traits
LS4: Biological evolution: Unity and diversity

The questions and descriptions of the core ideas in the text on these pages are taken from the NRC *Framework* for grades 6–8 to keep the core ideas in a rich and useful context.

The performance expectations related to each core idea are taken from the NGSS for middle school.

Disciplinary Core Ideas Addressed

The **Human Systems Interactions Course** connects with the NRC *Framework* 6–8 grade band and the NGSS performance expectations for the middle school grades. The course focuses on core ideas for life sciences primarily and physical science secondarily.

Life Sciences

Framework core idea LS1: From Molecules to Organisms: Structures and Processes—How do organisms live, grow, respond to their environment, and reproduce?

- **LS1.A: Structure and function**
  How do the structures of organisms enable life's functions? [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). Unicellular organisms (microorganisms), like multicellular organisms, need food, water, a way to dispose of waste, and an environment in which they can live.

  Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues or organs that are specialized for particular body functions.]

- **LS1.C: Organization for matter and energy flow in organisms**
  How do organisms obtain and use the matter and energy they need to live and grow? [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. Animals obtain food from eating plants or eating other animals. 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. In most animals and plants, oxygen reacts with carbon-containing molecules (sugars) to provide energy and produce carbon dioxide; anaerobic bacteria achieve their energy needs in other chemical processes that do not require oxygen.]

- **LS1.D: Information processing**
  How do organisms detect, process, and use information about the environment? [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. Changes in the structure and functioning of many millions of interconnected nerve cells allow combined inputs to be stored as memories for long periods of time.]

The following NGSS Grade 6–8 Performance Expectations for LS1 are derived from the Framework disciplinary core ideas above.

- **MS-LS1-1.** Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living cells, and understanding that living things may be made of one cell or many and varied cells.]
- **MS-LS1-3.** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]
- **MS-LS1-7.** 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.]
- **MS-LS1-8.** Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

REFERENCES

National Research Council. *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: National Academies Press, 2012.

NGSS Lead States. *Next Generation Science Standards: For States, by States.* Washington, DC: National Academies Press, 2013.

National Governors Association Center for Best Practices and Council of Chief State School Officers. *Common Core State Standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects*, Washington, DC: 2010.

Physical Sciences

Framework core idea PS3: Energy—How is energy transferred and conserved?

- **PS3.D: Energy in chemical processes and everyday life**
  How do food and fuel provide energy? If energy is conserved, why do people say it is produced or used? [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.

  Both the burning of fuel and cellular digestion 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.]

This core idea is secondary to MS-LS1-7 above.

Science and Engineering Practices Addressed

1. Asking questions

- Identify and/or clarify evidence and/or the premise(s) of an argument.

2. Developing and using models

- Develop and/or use a model to predict and/or describe phenomena.
- Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.

3. Planning and carrying out investigations

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

SCIENCE AND ENGINEERING PRACTICES

A Framework for K–12 Science Education (National Research Council, 2012) describes eight science and engineering practices as essential elements of a K–12 science and engineering curriculum.

The learning progression for this dimension of the framework is addressed in *Next Generation Science Standards* (National Academies Press, 2013), volume 2, appendix F. Elements of the learning progression for practices recommended for grades 6–8 as described in the performance expectations appear in bullets below each practice.

4. Analyzing and interpreting data

- Analyze and interpret data to provide evidence for phenomena.

5. Using mathematics and computational thinking

- Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.

6. Constructing explanations

- Apply scientific ideas, principles, and/or evidence to construct, revise, and/or use an explanation for real-world phenomena, examples, or events.

7. Engaging in argument from evidence

- Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.
- Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon (or a solution to a problem).

8. Obtaining, evaluating, and communicating information

- Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).
- Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.
- Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.

CROSSCUTTING CONCEPTS

A Framework for K–12 Science Education describes seven crosscutting concepts as essential elements of a K–12 science and engineering curriculum. The crosscutting concepts listed here are those recommended for grades 6-8 in the NGSS and are incorporated into the learning opportunities in the **Human Systems Interactions Course**.

The learning progression for this dimension of the framework is addressed in volume 2, appendix G, of the NGSS. Elements of the learning progression for crosscutting concepts recommended for grades 6–8, as described in the performance expectations, appear after bullets below each concept.

Crosscutting Concepts Addressed

Patterns: *Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.*

- Patterns in rates of change and other numerical relationships can provide information about natural and human-designed systems.
- Patterns can be used to identify cause-and-effect relationships.

Cause and effect: *Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.*

- Cause-and-effect relationships may be used to predict phenomena in natural or designed systems.

Scale, proportion, and quantity: *In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.*

- The observed function of natural and designed systems may change with scale.
- Phenomena that can be observed at one scale may not be observable at another scale.

Systems and system models: *A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.*

- Systems may interact with other systems; they may have subsystems and be a part of larger complex systems.
- Models are limited in that they only represent certain aspects of the system under study.

Energy and matter: *Tracking energy and matter flows into, out of, and within systems helps one understand their system's behavior.*

- Within a natural (or designed system), the transfer of energy drives the motion and/or cycling of matter.

Structure and function: *The way an object is shaped or structured determines many of its properties and functions.*

- 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 and designed structures/systems can be analyzed to determine how they function.

Connections to the Nature of Science

- **Scientific knowledge is based on empirical evidence.** Scientific knowledge is based on logical and conceptual connections between evidence and explanations. Science disciplines share common rules of obtaining and evaluating empirical evidence.
- **Scientific knowledge is open to revision in light of new evidence.** The certainty and durability of scientific findings vary. Scientific findings are frequently revised and/or reinterpreted based on new evidence.
- **Science is a way of knowing.** Science is both a body of knowledge and processes and practices used to add to that body of knowledge. Scientific knowledge is cumulative and many people from many generations and nations have contributed to scientific knowledge. Science is a way of knowing used by many people, not just scientists.
- **Scientific knowledge assumes an order and consistency in natural systems.** Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. Science carefully considers and evaluates anomalies in data and evidence.
- **Science is a human endeavor.** Men and women from different social, cultural, and ethnic backgrounds work as scientists and engineers. Scientists and engineers rely on human qualities such as persistence, precision, reasoning, logic, imagination, and creativity. They are guided by habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. Advances in technology influence the progress of science, and science has influenced advances in technology.
- **Science addresses questions about the natural and material world.** Scientific knowledge is constrained by human capacity, technology, and materials. Science limits its explanations to systems that lend themselves to observation and empirical evidence. Scientific knowledge can describe consequences of actions but is not responsible for society's decisions.

Connections to Engineering, Technology, and Applications of Science

- **Interdependence of science, engineering, and technology.** Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. Science and technology drive each other forward.

CONNECTIONS

See volume 2, appendix H and appendix J, in the *NGSS* for more on these connections.

For details on learning connections to Common Core State Standards English Language Arts and Math, see the chapters FOSS and Common Core ELA and FOSS and Common Core Math in *Teacher Resources*.

FOSS CONCEPTUAL FRAMEWORK

FOSS has conceptual structure at the course level. The concepts are carefully selected and organized in a sequence that makes sense to students when presented as intended. In the last half decade, research has been focused on learning progressions. The idea behind a learning progression is that **core ideas** in science are complex and wide-reaching—ideas such as the structure of matter or the relationship between the structure and function of organisms. From the age of awareness throughout life, matter and organisms are important to us. There are things we can and should understand about them in our primary school years, and progressively more complex and sophisticated things we should know about them as we gain experience and develop our cognitive abilities. When we as educators can determine those logical progressions, we can develop meaningful and effective curriculum.

FOSS has elaborated learning progressions for core ideas in science for kindergarten through grade 8. Developing the learning progressions involves identifying successively more sophisticated ways of thinking about core ideas over multiple years. "If mastery of a core idea in a science discipline is the ultimate educational destination, then well-designed learning progressions provide a map of the routes that can be taken to reach that destination" (National Research Council, *A Framework for K–12 Science Education*, 2012).

The FOSS modules (grades K–5) and courses (grades 6–8) are organized into three domains: physical science, earth science, and life science. Each domain is divided into two strands, which represent a core scientific idea, as shown in the columns in the table: matter/energy and change, atmosphere and Earth/rocks and landforms, structure and function/complex systems. The sequence of modules and courses in each strand relates to the core ideas described in the national framework. Modules at the bottom of the table form the foundation in the primary grades. The core ideas develop in complexity as you proceed up the columns.

In addition to the science content framework, every course provides opportunities for students to engage in and understand science practices, and many courses explore issues related to engineering practices and the use of natural resources.

The science content used to develop the FOSS courses describes what we want students to learn; the science and engineering practices describe how we want students to learn; and crosscutting concepts stitch the whole effort into a coherent fabric describing the whole natural world. Practices involve a number of habits of mind and philosophical orientations, and these, too, will develop in richness and complexity as students advance through their science studies. Science and engineering practices involve behaviors, so they can be best assessed while in progress. Thus, assessment of practices is based on teacher observation. The indicators of progress include students involved in the many aspects of active thinking, students motivated to learn, and students taking responsibility for their own learning.

FOSS Next Generation—K–8 Sequence

	PHYSICAL SCIENCE		EARTH SCIENCE		LIFE SCIENCE	
	MATTER	ENERGY AND CHANGE	ATMOSPHERE AND EARTH	ROCKS AND LANDFORMS	STRUCTURE/ FUNCTION	COMPLEX SYSTEMS
6–8	Waves; Gravity and Kinetic Energy Chemical Interactions Electromagnetic Force		Planetary Science Earth History Weather and Water		Heredity and Adaptation Populations and Ecosystems Diversity of Life; Human Systems Interactions	
5	Mixtures and Solutions		Earth and Sun		Living Systems	
4		Energy		Soils, Rocks, and Landforms	Environments	
3	Motion and Matter		Water and Climate		Structures of Life	
2	Solids and Liquids			Pebbles, Sand, and Silt	Insects and Plants	
1		Sound and Light	Air and Weather		Plants and Animals	
K	Materials and Motion		Trees and Weather		Animals Two by Two	

BACKGROUND FOR THE CONCEPTUAL FRAMEWORK
in Human Systems Interactions

Systems of the Human Body

To appreciate the wonder of being human requires a deep, dedicated systemic point of view. First it is necessary to understand that life happens in cells. You are the result of a mass of several trillion individual cells all working in concert. Whipping those cells into shape to produce you is a masterpiece of coordination. Those trillions of cells have a demanding set of support criteria that must be attended to continuously. No mean feat!

Cells need a steady supply of food, water, and oxygen. Full service at all times. The human system is replete with dozens of subsystems dedicated to servicing cells. Cells "eat" a very limited menu of simple chemical foods (nutrients). Leading the list is glucose, a cell's favorite source of energy. Cell nutrients are extracted from food that we eat. The digestive system is dedicated to the process of extracting nutrient chemicals from the complex mess of organic substances we ingest. Once the nutrients are separated from the other stuff, they diffuse from the digestive system into the blood.

Nutrients move along in the blood as it flows through the circulatory system. The signature feature of the circulatory system is an extensive network of blood vessels. A critically important fixture in the network of vessels is a heart, the durable muscle that pumps the blood to the lungs and then throughout the entire body.

The vessel network includes arteries, large vessels that divide and divide, branching out and getting smaller and smaller as they reach toward the cells in your body. When the arteries near their destinations, they divide one final time into tiny capillaries.

Capillaries are so numerous, small, and delicate that they come into contact with most cells in your body. The thin walls of the capillaries allow cell nutrients to pass from the bloodstream into the cells. The blood then continues on its way. The capillaries converge with one another into larger and larger vessels. These vessels—veins—carry the spent blood back to the heart.

The spent blood in veins eventually enter the right atrium. From there, blood enters the right ventricle, which pumps it to the lungs, where the circulatory system merges with the respiratory system. The blood releases its load of waste carbon dioxide into the lungs and picks up a fresh charge of oxygen. The refreshed blood collects

in the left atrium and then moves into the left ventricle, which pumps it out through the aorta into the body.

Round and round the blood goes, pushing about 25 trillion red blood cells on their way through the circulatory system with each cycle. Red blood cells live about 4 months, and then they die and are replaced. Your body manufactures red blood cells at the rate of 2 million per second. That's another subsystem that is tightly coordinated to ensure that the blood always has enough red blood cells to provide oxygen and remove carbon dioxide for all your trillions of cells on a continuous basis.

The circulatory system interacts with other systems to maintain the health of your cells. It works with the respiratory system to exchange gases, and with the digestive system to acquire nutrient chemicals that cells use for energy generation, growth, and structural repair. It also works with the hepatic (liver) system and renal (kidney) system. These two systems act as selective filters for removing specific classes of waste materials from the blood. These wastes are dumped into blood as it passes through the capillaries.

The nervous system is the complex electric system that coordinates and manages all the other systems in a human. It is managed by the central nervous system, which comprises the three parts of the brain (cerebrum, cerebellum, brain stem) and the spinal cord. The peripheral nervous system includes all the millions of receptor neurons that gather information from the environment, which is sent to the brain, and the network of motor neurons that convey action instructions from the brain to muscles and other tissues.

Everything that you do is managed by your nervous system. You can breathe and maintain a constant heart function even while sound asleep. You have neurons distributed throughout your body that monitor these and other functions, sending instructions to the proper places to keep your heart beating and your diaphragm pulling air into your lungs.

CONCEPTUAL FRAMEWORK
Life Science, Focus on Structure and Function: Human Systems Interactions

Structure and Function

Concept A All living things need food, water, a way to dispose of waste, and an environment in which they can live.

- The cell is the basic unit of life. All organisms are one or more cells.
- Aerobic cellular respiration is the process by which energy stored in food molecules is converted into usable energy for cells.
- In multicellular organisms, such as humans, cells form tissues, tissues form organs, and organs form organ systems (subsystems), which interact to serve the needs of the organism.
- The human body is a system of interacting subsystems (circulatory, digestive, endocrine, excretory, muscular, nervous, respiratory, skeletal).

Concept C Animals detect, process, and use information about their environment to survive.

- The nervous system is a human subsystem that functions to gather and synthesize information from the environment.
- Sensory receptors are structures that respond to stimuli by sending messages to the brain for processing and response.
- Neural pathways change and grow as information is acquired and stored as memories.

Complex Systems

Concept A Organisms and populations of organisms depend on their environmental interactions with other living things and with nonliving factors.

- The Sun provides energy that plants use to produce food molecules from carbon dioxide and water. The energy in food molecules is processed in the cells of most organisms to drive life processes.

Life Science Content Sequence

This table shows all the modules and courses grades 1–8 in the FOSS content sequence for Life Science with an emphasis on the modules/courses that inform the structure and function strand. The supporting elements in these modules (somewhat abbreviated) are listed. The elements for the **Human Systems Interactions** are expanded to show how they fit into the sequence.

	LIFE SCIENCE	
Module or course	**Structure and Function**	**Complex Systems**
Human Systems Interactions (middle school)		
Diversity of Life (middle school)	• All living things are made of cells (unicellular or multicellular). Special structures within cells are responsible for various functions. • Cells have the same needs and perform the same functions as more complex organisms. • All living things need food, water, a way to dispose of waste, and an environment in which they can live (macro and micro levels). • Plants reproduce in a variety of ways, sometimes depending on animal behaviors and specialized features for reproduction.	• Adaptations are structures or behaviors of organisms that enhance their chances to survive and reproduce in their environment. • Biodiversity is the wide range of existing life-forms that have adapted to the variety of conditions on Earth, from terrestrial to marine ecosystems.
Living Systems (grade 5)	• Food is digested to provide animals with the materials they need for body repair and growth and to release the energy they need to maintain body warmth and for motion. • Reproduction is essential to the continued existence of every kind of organism. • Humans and other animals have systems made up of organs that are specialized for particular body functions. • Animals detect, process, and use information about their environment to survive.	• Organisms obtain gases, water, and minerals from the environment and release waste matter back into the environment. • Matter cycles between air and soil, and among plants, animals, and microbes as these organisms live and die. • Organisms are related in food webs. • Some organisms, such as fungi and bacteria, break down dead organisms, operating as decomposers.
Structures of Life (grade 3)	• A seed is a living organism. • Plants and animals have structures that function in growth, survival, and reproduction. • Reproduction is essential to the continued existence of every kind of organism. • Plants and animals grow and change and have predictable characteristics at different stages. • Bones have several functions: support, protection, and movement.	• Organisms are related in food chains. • Animals exhibit different kinds of behaviors. • Different organisms can live in different environments; organisms have adaptations that allow them to survive in that environment. • Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. • A skeleton is a system of interacting bones. The skeletons of humans and other mammals have many similarities.
Plants and Animals (grade 1)	• Plants and animals have structures, and animals have behaviors that help the organisms grow and survive in their habitat. • Seeds and bulbs are alive. • Plants need water, light, air, and space. • Plants don't live forever. New plants can grow from seeds, bulbs, roots, and stems.	• Plants make their own food. • Animals eat plants and other animals. • A habitat is a place where plants and animals live. There are many different kinds of habitats.

Human Systems Interactions	Structure and Function	Complex Systems
	• The cell is the basic unit of life. All living things are one or more cells. • Aerobic cellular respiration i s the process by which energy stored in food molecules is converted into usable energy for cells. • In multicellular organisms, such as humans, cells form tissues, tissues form organs, and organs form organ systems (subsystems), which interact to serve the needs of the organism. • The human body is a system of interacting subsystems (circulatory, digestive, endocrine, excretory, muscular, nervous, respiratory, skeletal). • The nervous system is a human subsystem that functions to gather and synthesize information from the environment. • Sensory receptors are structures that respond to stimuli by sending messages to the brain for processing and response. • Neural pathways change and grow as information is acquired and stored as memories.	• The Sun provides energy that plants use to produce food molecules from carbon dioxide and water. The energy in food molecules is processed in the cells of most organisms to drive life processes.

NOTE

See the Assessment chapter at the end of this *Investigations Guide* for more details on how the FOSS embedded and benchmark assessment opportunities align to the conceptual frameworks and the learning progressions. In addition, the Assessment chapter describes specific connections between the FOSS assessments and the NGSS performance expectations.

The NGSS Performance Expectations addressed in this course include:

Life Sciences

MS-LS1-1
MS-LS1-3
MS-LS1-7
MS-LS1-8

See pages 32–34 in this chapter for more details on the Grades 6–8 NGSS Performance Expectations.

CONNECTIONS TO NGSS BY INVESTIGATION

Science and Engineering Practices

Asking questions
Analyzing and interpreting data
Constructing explanations
Engaging in argument from evidence
Obtaining, evaluating, and communicating information

Connections to Common Core State Standards—ELA

Reading—Literacy in Science and Technical Subjects

1. Cite specific textual evidence to support analysis of science and technical texts.
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
10. Read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.

Writing—Literacy in Science and Technical Subjects

8. Gather relevant information from multiple print and digital sources, using search terms effectively.

Speaking and Listening

1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly.
3. Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.
4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

Language

4. Determine or clarify the meaning of unknown words or phrases.

4b. Use Greek or Latin affixes and roots as clues to the meaning of a word.

Disciplinary Core Ideas		Crosscutting Concepts
LS1.A: Structure and function • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). **(MS-LS1-1)** • 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. **(MS-LS1-3)**		Cause and effect Scale, proportion, and quantity Systems and system models Structure and function

Science and Engineering Practices

Developing and using models
Using mathematics and computational thinking
Constructing explanations
Obtaining, evaluating, and communicating information

Connections to Common Core State Standards—ELA

Reading—Literacy in Science and Technical Subjects

1. Cite specific textual evidence to support analysis of science and technical texts.
2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Writing—Literacy in Science and Technical Subjects

5. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
8. Gather relevant information from multiple print and digital sources, using search terms effectively.

Speaking and Listening

1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly.

Language

5. Demonstrate understanding of word relationships and nuances in word meaning.
6. Acquire and use academic and domain-specific words and phrases.

Disciplinary Core Ideas		Crosscutting Concepts
LS1.A: Structure and function • 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. **(MS-LS1-3)** **LS1.C: Organization for matter and energy flow in organisms** • 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. **(MS-LS1-7)** **PS3.D: Energy in chemical processes and everyday life** • Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. **(secondary to MS-LS1-7)**		Scale, proportion, and quantity Systems and system models Energy and matter

Science and Engineering Practices

Developing and using models
Planning and carrying out investigations
Analyzing and interpreting data
Using mathematics and computational thinking
Constructing explanations
Engaging in argument from evidence
Obtaining, evaluating, and communicating information

Connections to Common Core State Standards—ELA

Reading—Literacy in Science and Technical Subjects

1. Cite specific textual evidence to support analysis of science and technical texts.
2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
9. Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
10. Read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.

Writing—Literacy in Science and Technical Subjects

7. Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
8. Gather relevant information from multiple print and digital sources, using search terms effectively.
9. Draw evidence from informational texts to support analysis reflection, and research.

Speaking and Listening

1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on middle school topics, texts, and issues, building on others' ideas and expressing their own clearly.
3. Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.
6. Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.

Language

4. Determine or clarify the meaning of unknown words or phrases.
6. Acquire and use academic and domain-specific words and phrases.

Disciplinary Core Ideas		Crosscutting Concepts
LS1.A: Structure and function • 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. **(MS-LS1-3)** **LS1.D: Information processing** • Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. **(MS-LS1-8)**		Patterns Cause and effect Scale, proportion, and quantity Systems and system models Structure and function

RECOMMENDED FOSS NEXT GENERATION K–8 SCOPE AND SEQUENCE

Grade	Integrated Middle Grades					
6–8	Heredity and Adaptation*	Electromagnetic Force*	Gravity and Kinetic Energy*	Waves*	Planetary Science	
	Chemical Interactions		Earth History		Populations and Ecosystems	
	Weather and Water		Diversity of Life		Human Systems Interactions*	

*Half-length courses

Physical Science content *Earth Science content* *Life Science content* *Engineering content*

Grade	Physical Science	Earth Science	Life Science
5	Mixtures and Solutions	Earth and Sun	Living Systems
4	Energy	Soils, Rocks, and Landforms	Environments
3	Motion and Matter	Water and Climate	Structures of Life
2	Solids and Liquids	Pebbles, Sand, and Silt	Insects and Plants
1	Sound and Light	Air and Weather	Plants and Animals
K	Materials and Motion	Trees and Weather	Animals Two by Two