FOSS Elementary Module Sequences

	PHYSICAL SCIENCE		EARTH SCIENCE		LIFE SCIENCE	
	MATTER	ENERGY AND CHANGE	DYNAMIC ATMOSPHERE	ROCKS AND LANDFORMS	STRUCTURE/ FUNCTION	COMPLEX SYSTEMS
6	Mixtures and Solutions	Motion, Force, and Models	Weather on Earth	Sun, Moon, and Planets	Living Systems	
	Measuring Matter	Energy and Electromagnetism	Water	Soils, Rocks, and Landforms	Structures of Life	Environments
	Solids and Liquids	Balance and Motion	Air and Weather	Pebbles, Sand, and Silt	Plants and Animals	Insects and Plants
K	Materials in Our World		Trees and Weather		Animals Two by Two	

Contents

FOSS Domains and Strands

- Physical Science Domain
  - Matter
  - Energy and Change
- Earth Science Domain
  - Dynamic Atmosphere
  - Earth's Place in the Universe (bridges both strands)
  - Rocks and Landforms
- Life Science Domain
  - Structure and Function
  - Complex Systems

INTRODUCTION

The FOSS Third Edition elementary modules available for 2013–14 are organized into three domains: physical science (blue), earth science (orange), and life science (green). Each domain is divided into two strands, as shown in the table above for the FOSS Elementary Program. Each strand represents a set of core ideas in science and has a conceptual framework.

The sequence in each strand relates to the core ideas described in *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (National Research Council, 2012). Modules at the bottom of the table form the foundation in the primary grades. The core ideas develop in complexity as you progress up the columns.

The purpose of this document is to provide information about the FOSS learning progressions and how those progressions reflect the vision of the national Framework and connect to the performance expectations in the Next Generation Science Standards (NGSS). The FOSS learning progression for each strand is captured in the **content sequence, a** graphic and narrative description that put modules into a K–8 strand progression for that strand, and the **conceptual framework**, which shows the structure of scientific knowledge taught and assessed.

The disciplinary core ideas from the national Framework and the related grade-level performance expectations (NGSS) appear after each FOSS domain description along with the titles of the modules that address each expectation. This format for displaying the NGSS performance expectations focuses on the learning progression for those ideas across the elementary grades. The recommended FOSS K–8 sequence with NGSS connections appears on the last page.

PHYSICAL SCIENCE

FOSS Content Sequence for Matter K–8

NOTE
This content sequence represents the FOSS strand progression, which is closely aligned with a credible K–8 learning progression.

	MATTER	
Module or course	**Matter has structure**	**Matter interacts**
Chemical Interactions	• Matter is made of atoms. • Substances are defined by chemical formulas. • Elements are defined by unique atoms. • The properties of matter are determined by the kinds and behaviors of its atoms. • Atomic theory explains the conservation of matter.	• During chemical reactions, particles in reactants rearrange to form new products. • Energy transfer to/from the particles in a substance can result in phase change. • During dissolving, one substance is reduced to particles (solute), which are distributed uniformly throughout the particles of the other substance (solvent).
Mixtures and Solutions	• Solid matter can break into pieces too small to see. • Mass is conserved (not created or lost) during changes. • Properties can be used to identify substances (e.g. , solubility). • Relative density can be used to seriate solutions of different concentrations.	• A mixture is two or more intermingled substances. • Dissolving occurs when one substance disappears in a second substance. • A chemical reaction occurs when substances mix and new products result. • Melting is an interaction between one substance and heat.
Measuring Matter	• Properties of matter (solid, liquid, gas) can be described using measurement (length, mass, volume, temperature). • Measurement can be used to confirm that the whole is equal to its parts.	• Solids melt into liquids when heated; liquids freeze into solids when cooled. • Liquids evaporate into gas when heated; gases condense into liquids when cooled. • Different substances change state at different temperatures. • A mixture is two or more intermingled substances. • Mass is conserved when objects or materials are mixed.
Solids and Liquids	• Common matter is solid, liquid, and gas. • Solid matter has definite shape. • Liquid matter has definite volume. • Gas matter has neither definite shape nor volume and expands to fill containers. • Intrinsic properties of matter can be used to organize objects (e.g., color, shape).	• Solids interact with water in various ways: float, sink, dissolve, swell, change. • Liquids interact with water in various ways: layer, mix, change color. • Substances change state (e.g., melt or freeze) when heated or cooled.
Materials in Our World	• Wood, paper, fabric, soil, and rock are examples of solid materials. • Solid objects are made of solid materials. • Solid objects have properties that can be described and compared. • The whole (object) can be broken down into smaller pieces.	• Wood, paper, and fabric can be changed by sanding, coloring, tearing, etc. • Common materials can be changed into new materials (papermaking, weaving, etc.). • Water can change to ice in a freezer, and ice can change to water in a room. • Water and soil mix to form mud.

CONCEPTUAL FRAMEWORK
Physical Science, Matter for K–6

Matter Has Structure

Concept A Matter exists in three states (solid, liquid, and gas), which have observable properties.

Concept B Matter has physical properties that can be observed and quantified.

Concept C Matter is made of particles too small to see.

Matter Interacts

Concept A Mass of material is conserved.

Concept B Change of temperature can produce changes in physical state.

Concept C During physical interactions, substances form mixtures in which the interacting substances retain their original properties.

Concept D During chemical interactions, starting substances (reactants) change into new substances (products).

NOTE

This table is a brief summary of the matter core ideas described in *A Framework for K–12 Science Education*. This presentation does not represent a model instructional sequence, but rather a simple listing of major conceptual ideas.

PHYSICAL SCIENCE

FOSS Content Sequence for Energy and Change K–8

	ENERGY AND CHANGE	
Module or course	**Motion and Stability: Forces and Interactions**	**Energy Transfer and Conservation**
Electronics	• A circuit is a pathway through which electric current (energy) can transfer to produce light and other effects. • Voltage (electromotive force) is the push that moves electric current through a circuit. • Resistance is a property of materials that impedes the flow of electric current. • There is a relationship (Ohm's law) between resistance, voltage, and electric current in a circuit.	• Energy can be moved from place to place by electric currents. • Current (electric energy) is the amount of charge moving past a point in a conductor in a unit of time. • The sum of the voltage drops in a circuit is equal to the voltage available at the source. • Voltage drop is proportional to resistance. • Resistances in series add; resistances in parallel add inversely.
Force and Motion	• A net force is the sum of the forces acting on a mass; a net force applied to a mass results in acceleration of the mass. • Gravity is a force pulling two masses toward each other; the strength of the force depends on the objects' masses. • The heavier the object, the greater the force needed to achieve the same change in motion.	• When two objects interact, each one exerts a force on the other, causing energy transfer between them. • Friction increases energy transfer to the surrounding environment by heating or accelerating the interacting materials.
Motion, Force, and Models	• Any change of motion requires a force. Each force has a strength and a direction. • Gravity is a force of attraction between all objects with mass. • Patterns of motion can be observed; when there are regular patterns of motion, future patterns can be predicted. • An object at rest typically has multiple forces acting on it, but they add to give a zero net force.	• Objects in motion have energy. The faster an object is moving, the more energy it has. • When objects collide, energy can be transferred from one object to another, thereby changing their motion; a larger force causes a larger change in motion • Kinetic energy is energy of motion; potential energy is energy of position. For identical objects at rest, the objects at higher heights have more potential energy than objects at lower heights.
Energy and Electromagnetism	• Magnets interact with each other and with materials that contain iron. • Like poles of magnets repel each other; opposite poles attract. The magnetic force declines as the distance between the magnets increases. • Conductors are materials through which electric current can flow; all metals are conductors.	• Energy is present whenever there is motion, electrical current, sound, light, or heat. • Electricity (electric current) transfers energy that can produce heat, light, sound, and motion. Electricity can be produced from a variety of sources. • A circuit is a system that includes a complete pathway through which electric current flows from a source of energy to its components. • Energy can be generated by burning fossil fuels or harnessing renewable energy sources such as solar, wind, hydroelectric, and geothermal.
Balance and Motion	• Objects can be balanced in many ways; counterweights can balance an object. • Pushing or pulling on an object can change the speed or direction of its motion (rolling, rotation, vibration) and can start or stop it. • Magnetic force acts at a distance to make objects move by pushing or pulling.	• A bigger push or pull makes things go faster. • Sound comes from vibrating objects. • Larger objects vibrate slowly and produce low-pitched sound; smaller objects vibrate quickly and produce high-pitched sounds.

CONCEPTUAL FRAMEWORK
Physical Science: Energy and Change for K–6

Motion and Stability: Forces and Interactions

Concept A The motion of an object is determined by the sum of the forces (pushes and pulls) acting on it.

Concept B All interactions between objects arise from a few types of forces, primarily gravity and electromagnetism.

Energy Transfer and Conservation

Concept A Energy is a quantitative property (condition) of a system that depends on the motion and interactions of matter and radiation within the system.

Concept B The total change of energy in any system is always equal to the total energy transferred into or out of the system. When two objects interact, each one exerts a force on the other, and these forces can transfer energy.

Concept C Waves are a repeating pattern of motion that transfers energy from place to palce without displacement of matter. Electromagnetic waves can be detected over a wide range of frequencies; some can be observed by humans, others can be detected by designed technologies.

TEACHING NOTE

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

PS1: Matter and Its Interactions

PS2: Motion and Stability: Forces and Interactions

PS3: Energy

PS4: Waves and Their Applications in Technologies for Information Transfer

National Framework Disciplinary Core Ideas and Associated NGSS

Physical Science K–5

Core idea PS1: Matter and Its Interactions—How can one explain the structure, properties, and interactions of matter?

- ***PS1.A: Structures and Properties of Matter.*** *How do particles combine to form the variety of matter one observes?*
- ***PS1.B: Chemical Reactions.*** *How do substances combine or change (react) to make new substances? How does one characterize and explain these reactions and make predictions about them?*

NGSS Performance Expectations for PS1

2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
Materials in Our World; ***Solids and Liquids***; ***Pebbles, Sand, and Silt*** *(Earth Science)*

2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
Materials in Our World; ***Solids and Liquids***; ***Pebbles, Sand, and Silt*** *(Earth Science)*

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.
Solids and Liquids

2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.
Materials in Our World; ***Solids and Liquids***

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.
Mixtures and Solutions

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
Measuring Matter; ***Mixtures and Solutions***

5-PS1-3. Make observations and measurements to identify materials based on their properties.
Measuring Matter; ***Mixtures and Solutions***

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
Measuring Matter; ***Mixtures and Solutions***

Core idea PS2: Motion and Stability: Forces and Interactions—How can one explain and predict interactions between objects and within systems of objects?

- ***PS2.A: Forces and Motion.*** *How can one predict an object's continued motion, changes in motion, or stability?*
- ***PS2.B: Types of Interactions.*** *What underlying forces explain the variety of interactions observed?*
- ***PS2.C: Stability and Instability in Physical Systems.*** *Why are some physical systems more stable than others?*

NGSS Performance Expectations for PS2

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
Balance and Motion

K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.
Balance and Motion

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
Balance and Motion; ***Motion, Force, and Models***

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
Balance and Motion; ***Motion, Force, and Models***

3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
Balance and Motion; ***Energy and Electromagnetism***

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.
Balance and Motion; ***Energy and Electromagnetism***

5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.
Motion, Force, and Models; Sun, Moon, and Planets *(Earth Science)*

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

- ***PS3.A: Definitions of Energy.*** *What is energy?*
- ***PS3.B: Conservation of Energy and Energy Transfer.*** *What is meant by conservation of energy? How is energy transferred between objects or systems?*
- ***PS3.C: Relationship between Energy and Forces.*** *How are forces related to energy?*
- ***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?*

NGSS Performance Expectations for PS3

K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.
Trees and Weather; ***Materials in Our World*** *(on materials outdoors)*, ***Air and Weather*** *(Earth Science)*

K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.
Easily done with ***Materials in Our World*** with construction.

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.
Motion, Force, and Models

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
Energy and Electromagnetism

4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.
Motion, Force, and Models

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
Energy and Electromagnetism

5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.
Living Systems *(Life Science)*; ***Environments*** *(Life Science)*; ***Structures of Life*** *(Life Science)*

Core idea PS4: Waves and their applications in technologies for information transfer—How are waves used to transfer energy and information?

- ***PS4.A: Wave Properties.*** *What are the characteristic properties and ehavior of waves?*
- ***PS4.B: Electromagnetic Radiation.*** *What is light? How can one explain the varied effects that involve light? What other forms of electromagnetic radiation are there?*
- ***PS4.C: Information Technologies and Instrumentation.*** *How are instruments that transmit and detect waves used to extend human senses?*

NGSS Performance Expectations for PS4

1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
Balance and Motion

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.
Energy and Electromagnetism

1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.
Solids and Liquids (transparent, translucent, etc); ***Energy and Electromagnetism***

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.
Energy and Electromagnetism

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
Not currently addressedin Third Edition. (Is addressed in Physics of Sound, Second Edition)

4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
Energy and Electromagnetism

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.
Energy and Electromagnetism (Morse code)

EARTH SCIENCE

Content Sequence for Dynamic Atmosphere K–8

	DYNAMIC ATMOSPHERE	
Module or course	**Structure of Earth**	**Earth interactions**
Weather and Water	• Weather is the condition of Earth's atmosphere at a given time in a local place; climate is the range of an area's weather conditions over years. • Weather happens in the troposphere. • Density is a ratio of a mass and its volume. • The angle at which light from the Sun strikes the surface of Earth is the solar angle. • Atomic theory explains the conservation of matter.	• Complex patterns of interactions determine local weather patterns. • Energy transfers from one place to another by radiation and conduction. • Convection is the circulation of a fluid that results from energy transfer in a fluid. • When air masses of different densities meet, weather changes. • The Sun's energy drives the water cycle and weather.
Weather on Earth	• Weather is described in terms of variables including temperature, humidity, wind, and air pressure. • Scientists observe, measure, and record patterns of weather to make predictions. • The Sun is the major source of energy that heats Earth; land, water, and air heat up at different rates. • Most of Earth's water is in the ocean.	• The different energy-absorbing properties of earth materials lead to uneven heating of Earth's surface and convection currents. • Evaporation and condensation contribute to the movement of water through the water cycle. • Climate—the range of an area's typical weather conditions—is changing globally; this change will impact all life.
Water	• Water is found almost everywhere on Earth, e.g., vapor, clouds, rain, snow, ice. • Water expands when heated, contracts when cooled, and expands when frozen. • Cold water is more dense than warmer water; liquid water is more dense than ice. • Soils retain more water than rock particles alone.	• Water moves downhill; the steeper the slope, the faster water moves. • Ice melts when heated; liquid water freezes when cooled. • Evaporation is the process by which liquid (water) changes into gas (water vapor). • Condensation is the process by which gas (water vapor) changes into liquid (water).
Air and Weather	• Air is a gas and is all around us. • Air is matter and takes up space. • Weather describes conditions in the air outside; it occurs both during the day and night. • Weather conditions (temperature, wind, snow, rain) can be measured using tools such as thermometers, wind vanes, anemometers, and rain gauges. • Clouds are made of liquid water drops. • Natural sources of water include streams, rivers, lakes, and the ocean.	• The Sun heats Earth during the day. • Wind is moving air. • The pressure from compressed air can move things; air resistance affects how things move. • Daily changes in temperature, precipitation, and weather type can be observed, compared, and predicted. • Each season has typical weather conditions that can be observed, compared, and predicted. • Weather affects animals and plants.
Trees and Weather	• Weather is the condition of the air outside; weather changes. • Temperature is how hot or cold it is, and can be measured with a thermometer. • Wind is moving air; wind socks indicate direction and speed.	• Each season has typical weather conditions that can be observed, compared, and predicted. • Trees change through the seasons.

CONCEPTUAL FRAMEWORK
Earth Science, Dynamic Atmosphere for K–6

Structure of Earth

Concept A The hydrosphere has properties that can be observed and quantified.

Concept B The atmosphere has properties that can be observed and quantified.

Concept C Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources.

Earth Interactions

Concept A Weather and climate are influenced by interactions of the Sun, the ocean, the atmosphere, ice, landforms, and living things.

EARTH SCIENCE

Content Sequence for Earth's Place in the Universe K–8

	EARTH'S PLACE IN THE UNIVERSE	
Module or course	**Structure**	**Interactions**
Planetary Science	• Earth and Sun are part of the Milky Way galaxy; many such systems exist in the universe. Gravity holds objects in orbit. • Earth's axis tilts at an angle of 23.5° and points toward the North Star. • The Moon has surface features that can be identified in telescope images. • Location or position can be described in terms of a frame of reference. • Scale can be expressed as a ratio when an object and its representation are measured in related units. • The temperature on planets in the solar system depends on two major variables—the distance from the Sun and the nature of the planet's atmosphere.	• Patterns of apparent motion of the Sun, the Moon, and stars can be observed, described, predicted, and explained with models. • Models of the solar system can explain tides, eclipses of the Sun and Moon, and motion of the planets relative to the stars. • Earth's spin axis is fixed in direction but tilted relative to its orbit around the Sun; seasons are a result of that tilt, as is differential intensity of light in different areas of Earth during the year. • Earth and the Moon have been and continue to be bombarded by meteoroids at the same rate. • The solar system formed during a sequence of events that started with a nebula.
Sun, Moon, and Planets	• The Moon can be observed both day and night, but the Sun only during the day. • Moon phase is the portion of the illuminated half of the Moon that is visible from Earth. • The solar system includes the Sun and other objects that orbit it (Earth and the Moon, other planets, moons, asteroids) • Stars are at different distances from Earth. The position of stars relative to one another creates patterns (constellations).	• Shadows change (length and direction) during the day because the position of the Sun changes in the sky. • The cyclical change between day and night is the result of a rotating Earth in association with a stationary Sun. • The pulling force of gravity keeps the planets and other objects in orbit. • Moon phases have a monthly cycle. • Earth revolves around the Sun, so we see different stars during each season.
Air and Weather	• The Moon can be seen sometimes at night and sometimes during the day. It looks different every day, but looks the same again about every 4 weeks. • There are more stars in the sky than anyone can easily see or count. • The Sun can be seen only in the daytime.	• The Sun and Moon can be observed moving across the sky; we see them at different locations in the sky, depending on the time of day or night.
Trees and Weather	• Objects can be seen in the sky.	• Trees change through the seasons.

CONCEPTUAL FRAMEWORK
Earth Science, Earth's Place in the Universe for K–6

Structure

Concept A Earth is part of a planetary system in the universe.

Interactions

Concept A Patterns of change and apparent motion can be observed, described, and explained with models.

NOTE
Earth's Place in the Universe bridges both the Dynamic Atmosphere Strand and the Rocks and Landforms Strand.

EARTH SCIENCE

Content Sequence for Rocks and Landforms K–8

	ROCKS AND LANDFORMS	
Module or course	**Structure of Earth**	**Earth interactions**
Earth History	• The geological time scale, interpreted from rock strata and fossils, provides a way to organize Earth's history. Lower layers are older than higher layers—superposition. • Earth's crust is fractured into plates that move over, under, and past one another. • Volcanoes and earthquakes occur along plate boundaries. • The rock cycle is a way to describe the process by which new rock is created.	• Landforms are shaped by slow, persistent processes driven by weathering, erosion, deposition, and plate tectonics. • Water's movement changes Earth's surface. • Energy is derived from the Sun and Earth's hot interior. • All Earth processes are the result of energy flowing and matter cycling within and among Earth's systems. • Evolution is shaped by geological conditions.
Soils, Rocks, and Landforms	• Soils are composed of different kinds and amounts of earth materials and humus; they can be described by their properties. • Rocks are made of minerals; rocks and minerals can be described and identified by their properties: hardness, streak, luster, and cleavage. • There are three kinds of rocks: igneous, sedimentary, and metamorphic. • Water exists in three states. • Earth materials are natural resources. Some resources are renewable, others are not.	• Physical and chemical weathering breaks rock into smaller pieces (sediments). • Erosion is the movement of sediments; deposition is the process by which sediments come to rest in another place. • Landslides, earthquakes, and volcanoes can produce significant changes in landforms in a short period of time. • Some changes happen quickly, others more slowly. • Some events happen in cycles; others have a beginning and an end. • Downhill movement of water as it flows to the ocean shapes land.
Water	• Water is found almost everywhere on Earth, e.g., vapor, clouds, rain, snow, ice. • Water expands when heated, contracts when cooled, and expands when frozen. • Cold water is more dense than warmer water; liquid water is more dense than ice. • Soils retain more water than rock particles alone.	• Water moves downhill; the steeper the slope, the faster water moves. Flowing water can do work. • Ice melts when heated; liquid water freezes when cooled.
Pebbles, Sand, and Silt	• Rocks are earth materials composed of minerals; rocks have properties. • Rock sizes include clay, silt, sand, gravel, pebbles, cobbles, and boulders. • The properties of different earth materials make them suitable for specific uses. • Water can be a solid, liquid, or gas.	• Smaller rocks result from weathering. • Water carries soils and rocks from one place to another. • Soil is made partly from weathered rock and partly from organic material. • Soils vary from place to place. Soils differ in their ability to support plants.
Materials in Our World	• Rocks, water, and soils are earth materials. • Rocks and soils have observable properties with which they can be described and sorted. • Land, air and water, and trees are natural resources.	• Water can change from solid to liquid when heated and from liquid to solid when cooled.

CONCEPTUAL FRAMEWORK
Earth Science, Rocks and Landforms for K–6

Structure of Earth

Concept A The geosphere (lithosphere) has properties that can be observed and quantified.

Concept B The hydrosphere has properties that can be observed and quantified.

Concept C Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources.

Earth Interactions

Concept A All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems.

TEACHING NOTE

A Framework for K–12 Science Education *has three core ideas in Earth and space sciences.*

ESS1: Earth's Place in the Universe

ESS2: Earth's Systems

ESS3: Earth and Human Activity

National Framework Disciplinary Core Ideas and Associated NGSS

Earth and Space Sciences K–5

Core idea ESS1: Earth's place in the universe—What is the universe, and what is Earth's place in it?

- ***ESS1.A: The Universe and Its Stars.*** *What is the universe, and what goes on in stars?*
- ***ESS1.B: Earth and the Solar System.*** *What are the predictable patterns by Earth's movement in the solar system?*
- ***ESS1.C: The History of Planet Earth.*** *How do people reconstruct and date events in Earth's planetary history?*

NGSS Performance Expectations for ESS1

1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted
Air and Weather

1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.
Air and Weather

2-ESS1-1. Make observations from media to construct an evidence-based account that Earth events can occur quickly or slowly.
Pebbles, Sand, and Silt; Soils, Rocks, and Landforms

4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
Earth History *(Middle School)*

5-ESS1-1. Support an argument that the apparent brightness of the sun and stars is due to their relative distances from Earth.
Sun, Moon, and Planets

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
Sun, Moon, and Planets; Weather on Earth

Core idea ESS2: Earth's systems—How and why is Earth constantly changing?

- ***ESS2.A: Earth and Materials and Systems.*** *How do the major Earth systems interact?*
- ***ESS2.B: Plate Tectonics and Large-Scale System Interactions.*** *Why do the continents move, and what causes earthquakes and volcanoes?*
- ***ESS2.C: The Roles of Water in Earth's Surface Processes.*** *How do the properties and movements of water shape Earth's surface and affect its systems?*
- ***ESS2.D: Weather and Climate.*** *What regulates weather and climate?*
- ***ESS2.E: Biogeology.*** *How do living organisms alter Earth's processes and structures?*

NGSS Performance Expectations for ESS2

K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.
Trees and Weather *(Life Science)*

K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.
Trees and Weather; Air and Weather

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
Pebbles, Sand, and Silt *(partial)****; Soils, Rocks, and Landforms***

2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.
Pebbles, Sand, and Silt, Air and Weather; Water

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.
Pebbles, Sand, and Silt; Air and Weather, Water

3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
Air and Weather, Weather on Earth

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.
Weather on Earth; Environments *(Life Science)*

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
Soils, Rocks, and Landforms

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.
Environments *(Life Science),* ecoregion maps with climate patterns, not topographic maps with surface features. (Addressed in *Landforms Module*, seond edition.)

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
Weather on Earth; Living Systems

5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
Weather on Earth

Core idea ESS3: Earth and human activity—How do Earth's surface processes and human activities affect each other?

- ***ESS3.A: Natural Resources.*** *How do humans depend on Earth's resources?*
- ***ESS3.B: Natural Hazards.*** *How do natural hazards affect individuals and societies?*
- ***ESS3.C: Human Impacts on Earth Systems.*** *How do humans change the planet?*
- ***ESS3.D: Global Climate Change.*** *How do people model and predict the effects of human activities on Earth's climate?*

NGSS Performance Expectations for ESS3

K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather
Trees and Weather

K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
Animals Two by Two, Plants and Animals

K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
Trees and Weather; Animals Two by Two *(Life Science)*

3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.
Soils, Rocks, and Landforms, partial (flood); ***Weather on Earth***

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
Energy and Electromagnetism; Weather on Earth

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
Soils, Rocks, and Landforms

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
Water; Weather on Earth; Energy and Electromagnetism (Physical Science); ***Environments*** (Life Science); ***Living Systems*** (Life Science); ***Mixtures and Solutions*** (Physical Science)

LIFE SCIENCE

Content Sequence for Focus on Structure and Function K–8

	LIFE SCIENCE	
Module or course	**Structure and Function**	**Complex Systems**
Human Brain		
Pop/Ecosystems		
Diversity of Life	• 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 level). • 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	• Food provides animals with the materials they need for body repair and growth and is digested to release the energy they need to maintain body warmth and to move. • 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. •Animals exhibit instinctive behavior and learned behaviors.
Environments		
Structures of Life	• A seed is living organism, containing the embryo of a plant. • Plants and animals have structures that function in growth, survival, and reproduction. • Reproduction is essential to the continued existence of every kind of organism. Organisms have diverse life cycles. • Plants and animals grow and change and have predictable characteristics at different stages of development. • Behavior of animals is influenced by internal and external cues. • Bones have several functions: support, protection, and movement.	• Organisms are related in food chains. • 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. • Many characteristics of organisms are inherited from parents; other characteristics result from interaction with the environment. • A skeleton is a system of interacting bones. The skeletons of humans and other mammals have many similarities.
Insects/Plants		
Plants and Animals	• 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.
Animals Two by Two **Trees and Weather**	• Animals have identifiable structures and behaviors • Animals and plants have basic needs. • Trees are living plants and have structures. • Trees go through predictable stages.	• Living things can survive only when their needs are met. • Individuals of the same kind (plants or animals) are recognizable as similar but can also vary in many ways.

CONCEPTUAL FRAMEWORK
Life Science: Focus on Structure and Function for K–6

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.

Concept B Reproduction is essential to the continued existence of every kind of organism. Organisms have diverse life cycles.

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

Complex Systems

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

Concept B Ecosystems are dynamic and change over time.

Concept C Heredity involves passing information from one generation to the next and introducing variation in traits between individuals in a population.

Concept D Biological evolution, the process by which all living things have evolved over many generations from common ancestors, explains both the unity and diversity of species.

LIFE SCIENCE

Content Sequence for Focus on Complex Systems K–8

	LIFE SCIENCE	
Module or course	**Structure and Function**	**Complex Systems**
Human Brain and Senses		
Population and Ecosystems	• Reproduction is essential to the continued existence of every kind of organism. • Plants, algae, and many microorganisms use energy from light to make sugars from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. • Animals obtain food from eating plants or eating other animals.	• An ecosystem is a web of interactions and relationships among the organisms and abiotic factors in an area. • Food webs are models that demonstrate how matter and energy are transferred between producers, consumers, and decomposers. • Adaptation by natural selection acting over generations is one important process by which species change over time in response to environmental conditions.
Diversity of Life		
Living Systems	• Food provides animals with the materials they need for body repair and growth and is digested to release the energy they need to maintain body warmth and to move. • 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. •Animals exhibit instinctive behavior and learned behaviors.
Environments	• Plants and animals have structures, and animals have behaviors that help the organisms grow and survive in their habitat. • Producers make their own food. • Animals obtain food from eating plants or eating other animals.	• An ecosystem is the interactions of organisms with one another and the abiotic environment. • Organisms have ranges of tolerance for environmental factors. • Organisms interact in feeding relationships in ecosystems (food chains and food webs). • Individuals of the same kind differ in their characteristics; differences may give individuals an advantage in reproducing.
Structures of Life		
Insects and Plants	• Insects need air, food, water, and space including shelter, and different insects meet these needs in different ways. • Plants and insects have structures that function in growth, survival, and reproduction. • Reproduction is essential to the continued existence of every kind of organism. Organisms have diverse life cycles. • Plants and insects grow and change and have predictable characteristics at different stages of development. • Adult plants and animals can have offspring.	• Bees and other insects help some plants by moving pollen from flower to flower. • There is variation in traits within one kind of organism. • Many characteristics of organisms are inherited from parents; other characteristics result from interaction with the environment.
Plants and Animals		
Animals Two by Two		

CONCEPTUAL FRAMEWORK

Life Science: Focus on Complex Systems for K–6

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.

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Concept D Biological evolution, the process by which all living things have evolved over many generations from common ancestors, explains both the unity and diversity of species.

TEACHING NOTE

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***

National Framework Disciplinary Core Ideas and Associated NGSS

Life Sciences K–5

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?***
- ***LS1.B: Growth and Development of Organisms.*** *How do organisms grow and develop?*
- ***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?*
- ***LS1.D: Information Processing.*** *How do organisms detect, process, and use information about the environment?*

NGSS Performance Expectations for LS1

K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.
Animals Two by Two; Trees and Weather

1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
Plants and Animals, Structures of Life

1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.
Plants and Animals

3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
Insects and Plants; Structures of Life

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
Structures of Life; ***Environments***; ***Living Systems***

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.
Living Systems

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.
Structures of Life; Environments; Living Systems

Core idea LS2: Ecosystems: Interactions, Energy, and Dynamics—How and why do organisms interact with their environment and what are the effects of those interactions?

- ***LS2.A: Interdependent Relationships in Ecosystems.*** *How do organisms interact with the living and nonliving environments to obtain matter and energy?*
- ***LS2.B: Cycles of Matter and Energy Transfer in Ecosystems.*** *How do matter and energy move through an ecosystem?*
- ***LS2.C: Ecosystem Dynamics, Functioning, and Resilience.*** *What happens to ecosystems when the environment changes?*
- ***LS2.D: Social Interaction and Group Behavior.*** *How do organisms interact in groups so as to benefit individuals?*

NGSS Performance Expectations for LS2

2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow.
Plants and Animals; ***Insects and Plants; Living Systems***

2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.
Insects and Plants; ***Structures of Life***

3-LS2-1. Construct an argument that some animals form groups that help members survive.
Not current addressed.

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
Environments, Living Systems

Core idea LS3: Heredity: Inheritance and Variation of Traits—How are characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics?

- ***LS3.A: Inheritance of Traits.*** *How are the characteristics of one generation related to the previous generation?*
- ***LS3.B: Variation of Traits.*** *Why do individuals of the same species vary in how they look, function, and behave?*

NGSS Performance Expectations for LS3

1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents.
Plants and Animals; Insects and Plants

3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
Structures of Life; ***Environments***; ***Living Systems***

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.
Structures of Life; ***Environments***

Core idea LS4: Biological Evolution: Unity and Diversity—How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans?

- ***LS4.A: Evidence of Common Ancestry and Diversity.*** *What evidence shows that different species are related?*
- ***LS4.B: Natural Selection.*** *How does genetic variation among organisms affect survival and reproduction?*
- ***LS4.C: Adaptation.*** *How does the environment influence populations of organisms over multiple generations?*
- ***LS4.D: Biodiversity and Humans.*** *What is biodiversity, how do humans affect it, and how does it affect humans?*

NGSS Performance Expectations for LS4

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.
Plants and Animals; Insects and Plants; Structures of Life

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago.
Structures of Life (not fossils but organisms from 10,000 years ago); ***Environments***

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.
Environments

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
Structures of Life; Environments

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change
Structures of Life; Environments

ENGINEERING CORE IDEAS

FOSS modules provide students with opportunities to engage in engineering experiences to develop solutions to problems, construct and evaluate models, and use systems thinking. The FOSS engineering icon indicates opportunities for addressing the core ideas of Engineering, Technology, and Applications of Science as described in *A Framework for K–12 Science Education*. The core ideas are listed below with the grade K-2 and 3–5 grade band expectations from the framework and associated NGSS.

NOTE

A Framework for K–12 Science Education has two core ideas in engineering, technology, and applications of sciencebut only the first one is associated with K–5 NGSS.

ETS1: Engineering Design

ETS2: Links among Engineering, Technology, Science, and Society

Core idea ETS1: Engineering design—How do engineers solve problems?

- ***ETS1.A Defining and Delimiting an Engineering Problem.*** *What is a design for? What are the criteria and constraints of a successful solution?*
- ***ETS1.B: Developing Possible Solutions.*** *What is the process for developing potential design solutions?*
- ***ETS1.C: Optimizing the Design Solution.*** *How can the various proposed design solutions be compared and improved?*

NGSS Performance Expectations

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
Materials in Our World; Balance and Motion

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
Materials in Our World; Plants and Animals; Air and Weather; Balance and Motion; Solids and Liquids

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
Materials in Our World; Air and Weather; Balance and Motion; Solids and Liquids

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
Water; Measuring Matter; Energy and Electromagnetism; Motion, Force, and Models

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
Water; Energy and Electromagnetism; Motion, Force, and Models; Living Systems

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
Water; Energy and Electromagnetism; Motion, Force, and Models, Environments; Weather on Earth

SCIENTIFIC AND ENGINEERING PRACTICES

FOSS modules provide students with opportunities to develop scientific and engineering practices.

Asking questions and defining problems

- Ask questions about objects, organisms, systems, and events in the natural and human-made world (science).
- Ask questions to define and clarify a problem, determine criteria for solutions, and identify constraints (engineering).

Planning and carrying out investigations

- Plan and conduct investigations in the laboratory and in the field to gather appropriate data (describe procedures, determine observations to record, decide which variables to control) or to gather data essential for specifying and testing engineering designs.

Analyzing and interpreting data

- Use a range of media (numbers, words, tables, graphs, images, diagrams, equations) to represent and organize observations (data) in order to identify significant features and patterns.

Developing and using models

- Use models to help develop explanations, make predictions, and analyze existing systems, and recognize strengths and limitations of proposed solutions to problems.

Using mathematics and computational thinking

- Use mathematics and computation to represent physical variables and their relationships and to draw conclusions.

Constructing explanations and designing solutions

- Construct logical explanations of phenomena, or propose solutions that incorporate current understanding or a model that represents it and is consistent with available evidence.

Engaging in argument from evidence

- Defend explanations, develop evidence based on data, examine one's own understanding in light of the evidence offered by others, and challenge peers while searching for explanations.

Obtaining, evaluating, and communicating information

- Communicate ideas and the results of inquiry—orally and in writing—with tables, diagrams, graphs, and equations—in collaboration with peers.

NOTE

In addition to the science content development, every FOSS module provides opportunities for students to engage in and understand the importance of scientific practices, and many modules explore issues related to engineering practices and the use of natural resources. These practices and crosscutting concepts are from *A Framework for K–12 Science Eduction.*

CROSSCUTTING CONCEPTS

FOSS modules help develop students' understandings of concepts that bridge disciplinary core ideas and provide an organizational framework for connecting knowledge from different disciplines into a coherent and scientifically based view of the world.

- **Patterns.** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
- **Cause and effect: Mechanism and explanation.** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
- **Scale, proportion, and quantity.** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
- **Systems and system models.** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
- **Energy and matter: Flows, cycles, and conservation.** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
- **Structure and function.** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
- **Stability and change.** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of the system are critical elements of study.

RECOMMENDED FOSS K–8 SCOPE AND SEQUENCE, FALL 2013

Grade	Physical Science	Earth Science	Life Science
8	Electronics	Planetary Science, Second	Populations and Ecosystems
7	Chemical Interactions	Earth History, Second	Human Brain and Senses
6	Force and Motion	Weather and Water	Diversity of Life
5	Mixtures and Solutions	Weather on Earth Sun, Moon, and Planets	Living Systems
4	Energy and Electromagnetism Motion, Force, and Models	Soils, Rocks, and Landforms	Environments
3	Measuring Matter	Water	Structures of Life
2	Solids and Liquids	Pebbles, Sand, and Silt	Insects and Plants
1	Balance and Motion	Air and Weather	Plants and Animals
K	Materials in Our World	Trees and Weather	Animals Two by Two

The FOSS Third Edition program reflects the vision of the national Framework with learning progressions that address the disciplinary core ideas, scientific and engineering practices, and crosscutting concepts. The program develops scientific habits of mind and exposes the nature of science, and integrates the Common Core State Standards for ELA and math. The project developers at the Lawrence Hall of Science are committed to working closely with Delta Education, the FOSS publisher, to make grade-specific NGSS connections stronger and more explicit to help teachers prepare students to meet each performance expectation. Early implementers of FOSS Third Edition will be positioned to implement enhancements to the FOSS Third Edition program as they become available. Stay connected to FOSS.