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 were bundled in the Pebbles, Sand, and Silt Module to provide a coherent set of instructional materials for teaching and learning.

This chapter also provides details about how this FOSS module 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 frameworks 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 module with the confidence that the developers have carefully considered the latest research and have integrated into each investigation the three dimensions of the Framework and NGSS, and have designed powerful connections to the Common Core State Standards for English Language Arts.

Contents

Introduction to Performance Expectations .................. 29
FOSS Conceptual Framework ............................... 38
Background for the Conceptual Framework in Pebbles, Sand, and Silt ............ 40
Connections to NGSS by Investigation .................... 46
Recommended FOSS Next Generation K–8 Scope and Sequence .................. 50

The NGSS Performance Expectations bundled in this module include:

Earth and Space Sciences
2-ESS1-1
2-ESS2-1
2-ESS2-2
2-ESS2-3

Physical Sciences
2-PS1-1
2-PS1-2

Engineering, Technology, and Applications of Science
K–2 ETS1-1
K–2 ETS1-2
K–2 ETS1-3
Disciplinary Core Ideas Addressed

The Pebbles, Sand, and Silt Module connects with the NRC Framework for the grades K–2 grade band and the NGSS performance expectations for grade 2. The module focuses on core ideas for earth science, matter, and engineering design.

Earth and Space Sciences

Framework core idea ESS1: Earth’s place in the universe—What is the universe, and what is Earth’s place in it?

- ESS1.C: The history of planet Earth
  How do people reconstruct and date events in Earth’s planetary history? [Some events on Earth occur in cycles, like day and night, and other have a beginning and an end, like a volcanic eruption. Some events, like an earthquake, happen very quickly; others such as the formation of the Grand Canyon, occur very slowly, over a time period much longer than one can observe.]

The following NGSS Grade 2 Performance Expectation for ESS1 is derived from the Framework disciplinary core ideas above.

- 2-ESS1-1. Make observations from media to construct an evidence-based account that Earth events can occur quickly or slowly. [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly, and erosion of rocks, which occurs slowly.]

Framework core idea ESS2: Earth’s systems—How and why is Earth constantly changing?

- ESS2.A: Earth materials and systems
  How do the major Earth systems interact? [Wind and water can change the shape of the land. The resulting landforms, together with the materials on the land, provide homes for living things.]

- ESS2.B: Plate tectonics and large-scale system interactions
  Why do the continents move, and what causes earthquakes and volcanoes? [Rocks, soils, and sand are present in most areas where plants and animals live. There may also be rivers, streams, lakes, and ponds. Maps show where things are located. One can map the shapes and kinds of land and water in any area.]
• **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?* [Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. It carries soil and rocks from one place to another and determines the variety of life forms that can live in a particular location.]

The following NGSS Grade 2 Performance Expectations for ESS2 are derived from the Framework disciplinary core ideas above.

• **2-ESS2-1.** Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land. [Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]

• **2-ESS2-2.** Develop a model to represent the shapes and kinds of land and bodies of water in an area. [Assessment Boundary: Assessment does not include quantitative scaling in models.]

• **2-ESS2-3.** Obtain information to identify where water is found on Earth and that it can be solid or liquid.

**REFERENCES**


DISCIPLINARY CORE IDEAS

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

The questions and descriptions of the core ideas in the text on these pages are taken from the NRC Framework for the grades K–2 grade band 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 grade 2.

Physical Sciences

Framework core idea PS1: Matter and its interactions—How can one explain the structure, properties, and interactions of matter?

• PS1.A: Structure and properties of matter
  How do particles combine to form the variety of matter one observes? [Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties, by its uses, and by whether it occurs naturally or is manufactured. Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces. Objects or samples of a substance can be weighed, and their size can be described and measured. (Boundary: Volume is introduced only for liquid measure.)]

The following NGSS Grade 2 Performance Expectations for PS1 are derived from the Framework disciplinary core ideas above.

• 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]
• 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. [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.]
Introduction to Performance Expectations

Engineering, Technology, and Applications of Science

Framework 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? [A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. Asking questions, making observations, and gathering information are helpful in thinking about problems. Before beginning to design a solution, it is important to clearly understand the problem.]

- ETS1.B: Developing possible solutions
  What is the process for developing potential design solutions? [Designs can be conveyed through sketches, drawings or physical models. These representations are useful in communicating ideas for a problem’s solutions to other people. To design something complicated, one may need to break the problem into parts and attend to each part separately but must then bring the parts together to test the overall plan.]

- ETS1.C: Optimizing the design solution
  How can the various proposed design solutions be compared and improved? [Because there is always more than one possible solution to a problem, it is useful to compare designs, test them, and discuss their strengths and weakness.]

The following NGSS Grades K–2 Performance Expectations for ETS1 are derived from the Framework disciplinary core ideas above.

- 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.

- 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.

- 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.
Framework core idea ETS2: Links among engineering, technology, science, and society—How are engineering, technology, science, and society interconnected?

- **ETS2.A: Interdependence of science, engineering, and technology**
  What are the relationships among science, engineering, and technology? [People encounter questions about the natural world every day. There are many types of tools produced by engineering that can be used in science to help answer these questions through observation or measurement. Observations and measurements are also used in engineering to help test and refine design ideas.]

- **ETS2.B: Influence of engineering, technology, and science on society and the natural world**
  How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world? [People depend on various technologies in their lives; human life would be very different without technology. Every human-made product is designed by applying some knowledge of the natural world and is built by using materials derived from the natural world, even when the materials are not themselves natural—for example, spoons made from refined metals. Thus, developing and using technology has impacts on the natural world.]

Note: There are no separate performance expectations described for core idea ETS2 (see volume 2, appendix J, for an explanation and elaboration).
Science and Engineering Practices Addressed

1. **Asking questions and defining problems**
   - Ask questions based on observations to find more information about the natural and/or designed world(s).
   - Define a simple problem that can be solved through the development of a new or improved object or tool.

2. **Developing and using models**
   - Distinguish between a model and the actual object, process, and/or events the model represents.
   - Compare models to identify common features and differences.
   - Develop and/or use a model to represent amounts, relationships, relative scales, and/or patterns in the natural world.
   - Develop a simple model based on evidence to represent a proposed object or tool.

3. **Planning and carrying out investigations**
   - Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.
   - Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons.
   - Make predictions based on prior experiences.

4. **Analyzing and interpreting data**
   - Record information (observations, thoughts, and ideas).
   - Use and share pictures, drawings, and/or writings of observations.
   - Use observations (firsthand or from media) to describe patterns and/or use relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
   - Analyze data from tests of an object or tool to determine if it works as intended.

5. **Using mathematics and computational thinking**
   - Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs.

6. **Constructing explanations and designing solutions**
   - Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
   - Compare multiple solutions to a problem.
7. Engaging in argument from evidence
   • Construct an argument with evidence to support a claim.
   • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.

8. Obtaining, evaluating, and communicating information
   • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s).
   • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question.
   • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Crosscutting Concepts Addressed

Patterns
   • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Cause and effect
   • Events have causes that generate observable patterns.

Scale, proportion, and quantity
   • Relative scales allow objects and events to be compared and described.

Energy and matter
   • Objects may break into smaller pieces, be put together into larger pieces, or change shapes.

Stability and change
   • The shape and stability of structures of natural and designed objects are related to their function(s).
Connections: Understandings about the Nature of Science

Scientific investigations use a variety of methods.
- Scientific investigation begin with a question. Scientists use different ways to study the world.

Scientific knowledge is based on empirical evidence.
- Scientists look for patterns and order when making observations about the world.
- Many events are repeated.

Science is a way of knowing.
- Science knowledge informs us about the world.

Science addresses questions about the natural and material world.
- Scientists study the natural and material world.

Science is a human endeavor.
- Science effects everyday life.

Connections: Engineering, Technology, and Application of Science

Influence of engineering, technology, and science on society and the natural world.
- Every human-made product is designed by applying some knowledge of the natural world and is built by using natural materials.
FOSS CONCEPTUAL FRAMEWORK

In the last half decade, teaching and learning research has focused on learning progressions. The idea behind a learning progression is that core ideas in science are complex and wide-reaching, requiring years to develop fully—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 students can and should understand about these core ideas in primary school years, and progressively more complex and sophisticated things they should know as they gain experience and develop cognitive abilities. When we as educators can determine those logical progressions, we can develop meaningful and effective curriculum for students.

FOSS has elaborated learning progressions for core ideas in science for kindergarten through grade 8. Developing a learning progression involves identifying successively more sophisticated ways of thinking about a core idea 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. . . . Because learning progressions extend over multiple years, they can prompt educators to consider how topics are presented at each grade level so that they build on prior understanding and can support increasingly sophisticated learning. (National Research Council, A Framework for K–12 Science Education, 2012, p. 26)

The FOSS modules are organized into three domains: physical science, earth science, and life science. Each domain is divided into two strands, as shown in the table “FOSS Next Generation—K–8 Sequence.” Each strand represents a core idea in science and has a conceptual framework.

- Physical Science: matter; energy and change
- Earth and Space Science: dynamic atmosphere; rocks and landforms
- Life Science: structure and function; complex systems

The sequence in each strand relates to the core ideas described in the NRC 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.
Information about the FOSS learning progression appears in the conceptual framework (page 41, 43), which shows the structure of scientific knowledge taught and assessed in this module, and the content sequence (pages 44–45), a graphic and narrative description that puts this single module into a K–8 strand progression.

FOSS is a research-based curriculum designed around the core ideas described in the NRC Framework. The FOSS module sequence provides opportunities for students to develop understanding over time by building on foundational elements or intermediate knowledge leading to the understanding of core ideas. Students develop this understanding by engaging in appropriate science and engineering practices and exposure to crosscutting concepts. The FOSS conceptual frameworks therefore are more detailed and finer-grained than the set of goals described by the NGSS performance expectations (PEs). The following statement reinforces the difference between the standards as a blueprint for assessment and a curriculum, such as FOSS.

Some reviewers of both public drafts [of NGSS] requested that the standards specify the intermediate knowledge necessary for scaffolding toward eventual student outcomes. However, the NGSS are a set of goals. They are PEs for the end of instruction—not a curriculum. Many different methods and examples could be used to help support student understanding of the DCIs and science and engineering practices, and the writers did not want to prescribe any curriculum or constrain any instruction. It is therefore outside the scope of the standards to specify intermediate knowledge and instructional steps. (Next Generation Science Standards, 2013, volume 2, p. 342)
BACKGROUND FOR THE CONCEPTUAL FRAMEWORK in Pebbles, Sand, and Silt

There are two conceptual frameworks for the disciplinary core ideas in this module for grade 2—one with a focus on earth and physical science dealing with structures and interactions of earth materials and one on engineering design.

Studying Rocks

The oldest rocks on Earth we know about are approximately 3.8 to 4.3 billion years old. They were found on the shores of Hudson Bay in Northern Canada. Some of the mineral grains (zircon) found in Western Australia have been dated to an age of 4.4 billion years old. That makes rocks just about the oldest things you can collect (the oldest objects yet discovered are meteorites, 4.5 to 4.6 billion years old).

Rocks have been important to humans in many ways for thousands of years. Rocks provided early people with shelter, weapons, and a means for creating sparks to start fires for cooking and warmth. The ancient Egyptians built their pyramids out of rock, and the Greeks used stones called calculi for adding and subtracting. Hopi women used flat stones of different roughnesses to grind corn. Children during America’s colonial days wrote on flat pieces of rock called slate. Astronauts collected rocks during their visits to the Moon. They brought these rocks back to scientists who hoped to unlock the secrets of the solar system by studying the rocks.

Rocks are the solid earth materials that compose the bulk of this planet. There are thousands of kinds of rocks—differences in their properties are what geologists use to recognize and distinguish them. There are a variety of methods and tools, but a geologist’s first observations are very similar to the ones students will make in this module. The macroscopic properties (color, texture, and grain size) observed in the field with the naked eye or a 10X hand lens, help geologists begin classifying the rocks. Back in the lab, more refined techniques can be applied that define the rock’s composition, age, and history.

The size of the rock grains or particles provides important clues to the history of a rock. There are several particle-size classification systems. The Wentworth scale is the one modified for these investigations.

Other scales have been devised by soil scientists, construction engineers, and the companies that collect, separate, and sell building materials. Most scales use the same terms to describe the particle sizes (e.g., pebble, gravel, sand) with little variance in size.
Soil scientists have developed some field tests that help identify the smaller particle sizes. Sand feels gritty when you rub it between your fingers. Silt feels rough but not gritty. Clay feels greasy or slick. Any combination of these particle sizes may be found in soil. Soil scientists become quite adept at estimating the amounts of each size in a ball of soil by squeezing a lump, or cast, in their hands. The sizes of material in the cast are judged by how easily it breaks or crumbles.

The kinds of rocks and types of soils vary from one place to another around the world, and even from neighborhood to neighborhood. But no matter where a rock or soil is found, the first steps toward studying it include the same types of observations made in these activities.

**Minerals and Rocks**

According to one estimate, over 4,000 different minerals have been identified in Earth’s crust, and new ones are still being discovered. Minerals are the basic ingredients that make up the crust. Minerals are chemical compounds that occur naturally, and their composition is expressed by a chemical formula, such as NaCl, salt.

Minerals may occur as deposits of pure materials, or they may be found in combination with other minerals, forming rocks. Each mineral in a rock has its own identifiable physical and chemical properties, which contribute to the properties of the rock.

**Soil**

What is soil? To the farmer, soil is the layer of earth material in which plants anchor their roots and from which they get the nutrients and water they need to grow. To a geologist, soil is the layer of earth materials at Earth’s surface that has been produced by weathering of rocks and sediments and that hasn’t moved from its original location. To an engineer, soil is any ground that can be dug up by earth-moving equipment and requires no blasting.

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**FOSS Conceptual Framework**

**CONCEPTUAL FRAMEWORK**

**Earth Science, Rocks and Landforms: Pebbles, Sand, and Silt**

**Structure of Earth**

**Concept A** The geosphere (lithosphere) has properties that can be observed and quantified.
- Rocks are the solid material of Earth and can be described by their properties. Rocks are composed of minerals.
- Rocks can be sorted into different sizes that include clay, silt, sand, gravel, pebbles, cobbles, and boulders.
- Soil is made partly from weathered rock and partly from organic materials. Soils vary from place to place and differ in their ability to support plants.
- Landforms and bodies of water can be represented in models and maps.

**Concept B** The hydrosphere has properties that can be observed and quantified.
- Water exists in three states on Earth: solid, liquid, and gas.
- Sources of water can be fresh (rivers, lakes, ponds) or salt water (ocean).

**Concept C** Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources.
- People use earth materials to make and construct things. The properties of different earth materials make them suitable for specific uses.

**Earth Interactions**

**Concept A** All Earth processes are the result of energy flowing and matter cycling within and among the planet’s systems.
- Wind and water can change the shape of the land.
- Weathering, caused by wind or water, causes larger rocks (boulders, cobbles) to break into smaller rocks (pebbles, gravel, sand, silt, clay).
- Some Earth events happen very quickly; others occur very slowly over a time period much longer than one can observe.
And to students, soil is dirt. In FOSS, soil is defined as a mixture of different-sized earth materials, such as gravel, sand, and silt, and an organic material called humus. Humus is the dark, musty-smelling stuff derived from the decayed and decomposed remains of plant and animal life. The proportions of these materials that make up soil differ from one location to another. All life depends on a dozen or so elements that must ultimately be derived from Earth’s crust. Soil has been called the bridge between earth material and life; only after minerals have been broken down and incorporated into the soil can plants process the nutrients and make them available to people and other animals.

**Water**

Water is so common and familiar that we usually don’t think about it as something to be defined or described. To the biologist, water is the sanctuary in which life was born. The complex chemistry of life was then, as it is today, water based. To the geologist, water is a liquid earth material, one of the substances (along with solid rocks and minerals and atmospheric gases) that make up or come from Earth. Water plays a central role in sculpting the planet’s surface and in causing and moderating Earth’s weather and climate.

On planet Earth, water is found naturally everywhere—in puddles, ponds, streams, and in the ocean. Even though water covers nearly three quarters of our planet’s surface—hardly scarce—it is still the most precious substance on Earth. The ocean contains more than 97% of Earth’s supply of water. But because water has run through, washed over, and worn down the rocky crust for billions of years, the seas have become repositories for a huge burden of dissolved minerals, mostly salts. Although salt water is the one and only environment for thousands of life-forms on Earth, salt water will not support human life. Less than 3% of Earth’s water is fresh, and much of this fresh water is not readily accessible. The water in rivers and lakes is easy to scoop up to quench a thirst, but water in glaciers and the atmosphere is harder to get for human use.

Water has some unique properties. It is the only material that occurs naturally on Earth’s surface in all three states of matter: solid, liquid, and gas (water vapor). Earth’s temperature range, allied with the particular properties of water, allows all three states (forms) to exist.
Engineering Design

Science is a discovery activity, a process for producing new knowledge. Scientific knowledge advances when scientists observe objects and events, think about how their observations related to what is known, test their ideas in logical ways, and generate explanations that integrate the new information into understanding of the natural world. Thus the scientific enterprise is both what we know (content knowledge) and how we come to know it (practices). The practices that engineers use are very similar to science practices but also involve defining problems and designing solutions.

The process of engineering design, while it involves engineering practices, is considered a separate set of disciplinary core ideas in the Framework and in the NGSS. There are three basic ideas of engineering design: defining the problem, developing possible solutions, and comparing solutions to improve the design.

**Defining the problem** involves asking questions and making observations to obtain information about designing a specific structure.

**Developing possible solutions** involves making decisions about the materials available and thoughtfully making a design about how they can be used. They should communicate their solutions orally and with drawings and words.

**Comparing different solutions** involves testing several designs to see how well each one meets the challenge. Second graders are not expected to conduct tests with controlled variables, but they should be able to determine if the structure meets the challenge and if not, how it might be improved. Collaboration is an important aspect of engineering design: learning from the successes and failures of other design groups can be very productive. Students can engage in engineering practices without fully engaging in the iterative process of design.

In this module, students explore the disciplinary core ideas of engineering design in the context of investigating how earth materials are used by people and how to optimize the design solution. FOSS has a continuum of engagements in the engineering practices and process from short experiences to more in-depth experiences where students reflect on the core ideas about the design process.

_Pebbles, Sand, and Silt Module—FOSS Next Generation_
Rocks and Landforms Content Sequence

This table shows the five FOSS modules and courses that address the content sequence “rocks and landforms” for grades K–8. Running through the sequence are the two progressions—structure of Earth and Earth interactions. The supporting elements in each module (somewhat abbreviated) are listed. The elements for the Pebbles, Sand, and Silt Module are expanded to show how they fit into the sequence.

<table>
<thead>
<tr>
<th>Module or course</th>
<th>Structure of Earth</th>
<th>Earth interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth History (middle school)</td>
<td>• 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.</td>
<td>• 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.</td>
</tr>
<tr>
<td>Soils, Rocks, and Landforms (grade 4)</td>
<td>• Soils are composed of different kinds and amounts of earth materials (sediments) 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. Earth materials are natural resources.</td>
<td></td>
</tr>
<tr>
<td>Water and Climate (grade 3)</td>
<td>• Water is found almost everywhere on Earth (e.g., vapor, clouds, rain, snow, ice). Most of Earth's water is in the ocean. Water expands when heated, contracts when cooled, and expands when it freezes. Cold water is more dense than warmer water; liquid water is more dense than ice. Scientists observe, measure, and record patterns of weather to make predictions. Soils retain more water than rock particles alone.</td>
<td>• Water flows downhill. Ice melts when heated; water freezes when cooled. The water cycle is driven by the Sun and involves evaporation, condensation, precipitation, and runoff. Density determines whether objects float or sink in water. Climate is the range of an area's typical weather. A variety of natural hazards result from weather-related phenomena.</td>
</tr>
<tr>
<td>Pebbles, Sand, and Silt (grade 2)</td>
<td>• Land, air, water, and trees are natural resources.</td>
<td>• Water interacts with natural and human-made materials.</td>
</tr>
<tr>
<td>Materials and Motion (grade K)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Structure of Earth
- Rocks are earth materials composed of minerals; rocks can be described by their properties.
- Rock sizes include clay, silt, sand, gravel, pebbles, cobbles, and boulders.
- The properties of different earth materials (natural resources) make each suitable for specific uses.
- Natural sources of water include streams, rivers, ponds, lakes, marshes, and the ocean. Sources of water can be fresh or salt water.
- Water can be a solid, liquid, or gas.
- Landforms and bodies of water can be represented in models and maps.

## Earth interactions
- Smaller rocks (sand) result from the breaking (weathering) of larger rocks.
- Water carries soils and rocks from one place to another—erosion.
- Some Earth events happen very quickly; others occur very slowly.
- Wind and water can change the shape of the land.
- 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.
- Earth materials are commonly used in the construction of buildings and streets.

## The NGSS Performance Expections addressed in this module include:

### Earth and Space Sciences
- 2-ESS1-1
- 2-ESS2-1
- 2-ESS2-2
- 2-ESS2-3

### Physical Sciences
- 2-PS1-1
- 2-PS1-2

### Engineering, Technology, and Applications of Science
- K–2 ETS1-1
- K–2 ETS1-2
- K–2 ETS1-3

See pages 30–34 in this chapter for more details on the Grade 2 NGSS Performance Expectations.
# Connections to NGSS by Investigation

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Connections to Common Core State Standards—ELA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking questions</td>
<td>RI 1: Ask and answer questions to demonstrate understanding.</td>
</tr>
<tr>
<td>Planning and carrying out investigations</td>
<td>RI 4: Determine the meaning of words and phrases in the text.</td>
</tr>
<tr>
<td>Analyzing and interpreting data</td>
<td>RI 5: Know and use text features.</td>
</tr>
<tr>
<td>Constructing explanations</td>
<td>RI 6: Identify the main purpose of the text.</td>
</tr>
<tr>
<td>Engaging in argument from evidence</td>
<td>RI 7: Explain how images contribute to and clarify text.</td>
</tr>
<tr>
<td>Obtaining, evaluating, and communicating information</td>
<td>RI 9: Compare and contrast two texts on the same topic.</td>
</tr>
</tbody>
</table>

**Inv. 1: First Rocks**

<table>
<thead>
<tr>
<th>Developing and using models</th>
<th>RI 1: Ask and answer questions to demonstrate understanding.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning and carrying out investigations</td>
<td>RI 2: Identify the main topic of the text.</td>
</tr>
<tr>
<td>Analyzing and interpreting data</td>
<td>RI 3: Describe the connection between scientific ideas or concepts.</td>
</tr>
<tr>
<td>Using mathematics and computational thinking</td>
<td>RI 8: Describe how reasons support points the author makes in the text.</td>
</tr>
<tr>
<td>Constructing explanations</td>
<td>RF 4: Read with accuracy and fluency to support comprehension.</td>
</tr>
<tr>
<td>Engaging in argument from evidence</td>
<td>W 3: Write narratives.</td>
</tr>
<tr>
<td>Obtaining, evaluating, and communicating information</td>
<td>W 8: Recall information from experiences or gather information from provided sources to answer a question.</td>
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</table>

**Inv. 2: River Rocks**

| RI 1: Ask and answer questions to demonstrate understanding. |
| RI 2: Identify the main topic of the text. |
| RI 3: Describe the connection between scientific ideas or concepts. |
| RI 8: Describe how reasons support points the author makes in the text. |
| RF 4: Read with accuracy and fluency to support comprehension. |
| W 3: Write narratives. |
| W 8: Recall information from experiences or gather information from provided sources to answer a question. |
| SL 1: Participate in collaborative conversations. |
| SL 2: Recount or describe key ideas. |
| SL 4: Recount an experience. |
| SL 5: Add drawings or other visual displays to recounts of experiences. |
| L 4: Determine or clarify the meaning of unknown or multiple-meaning words and phrases. |
| L 6: Use acquired words and phrases. |
## Disciplinary Core Ideas

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
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<tbody>
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<tr>
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| | Scale, proportion, and quantity |
| | Stability and change |

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## Crosscutting Concepts

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### ESS1.C: The history of planet Earth
- Some events happen very quickly; others occur very slowly over a time period much longer than one can observe. (2-ESS1-1)

### ESS2.A: Earth materials and systems
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### Science and Engineering Practices

**Inv. 3: Using Rocks**
- Defining problems
- Planning and carrying out investigations
- Analyzing and interpreting data
- Constructing explanations
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

**Inv. 4: Soil and Water**
- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

### Connections to Common Core State Standards—ELA

**RI 1:** Ask and answer questions to demonstrate understanding.
**RI 2:** Identify the main topic of the text.
**RI 3:** Describe the connection between scientific ideas or concepts.
**RI 4:** Read with accuracy and fluency to support comprehension.
**RI 5:** Know and use text features.
**RI 6:** Identify the main purpose of the text.
**RI 7:** Explain how images contribute to and clarify text.
**RF 4:** Read with accuracy and fluency to support comprehension.
**W 7:** Participate in shared research and writing projects.
**SL 1:** Participate in collaborative conversations.
**SL 2:** Recount or describe key ideas.
**SL 3:** Ask and answer questions.
**SL 4:** Recount an experience.
**SL 5:** Add drawings or other visual displays to recounts of experiences.
**L 4:** Determine or clarify the meaning of unknown or multiple-meaning words and phrases.

**PS1.A:** Structure and properties of matter
- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.
- Different properties are suited to different purposes.

**ETS1.A:** Defining and delimiting engineering problems
- Before beginning to design a solution, it is important to clearly understand the problem.

**ETS1.B:** Developing possible solutions
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

**ETS1.C:** Optimizing the design solution
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

**Cause and effect**
- Scale, proportion, and quantity
- Stability and change
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### Crosscutting Concepts

- Cause and effect
- Scale, proportion, and quantity
- Energy and matter

### ESS1.C: The history of planet Earth

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### Cause and effect

- Scale, proportion, and quantity

- Stability and change
## RECOMMENDED FOSS NEXT GENERATION K–8 SCOPE AND SEQUENCE

<table>
<thead>
<tr>
<th>Grade</th>
<th>Integrated Middle Grades</th>
</tr>
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</table>

*Half-length courses

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<tr>
<th>Grade</th>
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<tbody>
<tr>
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<td>Mixtures and Solutions</td>
<td>Earth and Sun</td>
<td>Living Systems</td>
</tr>
<tr>
<td>4</td>
<td>Energy</td>
<td>Soils, Rocks, and Landforms</td>
<td>Environments</td>
</tr>
<tr>
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<td>Motion and Matter</td>
<td>Water and Climate</td>
<td>Structures of Life</td>
</tr>
<tr>
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<td>Solids and Liquids</td>
<td>Pebbles, Sand, and Silt</td>
<td>Insects and Plants</td>
</tr>
<tr>
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<td>Sound and Light</td>
<td>Air and Weather</td>
<td>Plants and Animals</td>
</tr>
<tr>
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Full Option Science System