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 Solids and Liquids 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 37). 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.
Disciplinary Core Ideas Addressed

The Solids and Liquids 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 matter, and engineering design.

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.)]

- 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? [Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible (e.g., melting and freezing) and sometimes they are not (e.g., baking a cake, burning fuel).]

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.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]
• 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. [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

• 2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

**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).
   - Ask or identify questions that can be answered by an investigation.

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.

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.
   - Compare predictions (based on prior experiences) to what occurred (observable events).
   - Analyze data from tests of an object or tool to determine if it works as intended.

5. **Using mathematics and computational thinking**
   - Use counting and numbers to identify and describe patterns in the natural and designed world(s).

6. **Constructing explanations and designing solutions**
   - Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
   - Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.
   - Compare multiple solutions to a problem.
7. **Engaging in argument from evidence**
   - Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument.
   - Construct an argument with evidence to support a claim.

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.

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**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.

**Structure and function**
- The shape and stability of structures of natural and designed objects are related to their function(s).

**Stability and change**
- Some things stay the same while other things change.
- Things may change slowly or rapidly.
Connections: Understandings about the Nature of Science

Scientific knowledge is based on empirical evidence.
  • Scientists look for patterns and order when making observations about the world.

Science models, laws, mechanisms, and theories explain natural phenomena.
  • Scientists search for cause-and-effect relationships to explain natural events.

Science addresses questions about the natural and material worlds.
  • Scientists study the natural and materials world.

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.

CONNECTIONS
See volume 2, appendix H and appendix J, in the NGSS for more on these connections.
For details on learning connections to Common Core State Standards English Language Arts and Math, see the chapters FOSS and Common Core ELA—Grade 2 and FOSS and Common Core Math—Grade 2 in Teacher Resources.
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 39, 41), which shows the structure of scientific knowledge taught and assessed in this module, and the **content sequence** (pages 42–43), 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 Solids and Liquids

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

Matter

Everything that we know of in the universe is either matter or energy. Matter is the stuff from which tangible objects such as people, pencils, mountains, and the ocean are made. Energy is the glue and drive that holds things together and moves them around. This module introduces primary students to fundamental ideas about matter.

Matter that we are likely to encounter in a typical day will be in one of three basic states: solid, liquid, or gas. Each state of matter has a precise molecular definition, but we are not interested in that in this module. Descriptive definitions at the macroscopic level serve our purposes much better.

Objects such as bricks, T-shirts, heads of lettuce, coins, baseball caps, and apples are solids. Solid objects have definite shape, and the shape does not change when the object moves from one place to another. When solids move from one container to another, they maintain the same shape they had before they moved.

Liquids, such as water, milk, gasoline, cooking oil, dishwashing detergent, molasses, and paint thinner, flow and pour. Liquids have no shape of their own, but they do have constant volume, so they can be kept in containers, either opened or closed. A liquid poured on a table will spread out to form a shapeless film. Liquids poured into containers take the shape of the container and fill it to a level. The surface of a liquid in a container is flat and parallel to the plane of the surface of Earth.

Gases, such as air, oxygen, helium, carbon dioxide, and methane, have no shape and no constant volume. They expand and contract readily, so they must be kept in closed containers. Gases expand to fill all the space in a container. Primary students will explore gases in more depth in the Air and Weather Module.

Solid materials composed of very small particles, such as sand, cornmeal, rice, sugar, and salt, have some of the characteristics of liquids. Granular or powdered materials pour and spill, and they appear to fill containers
to a level. Unlike liquids, however, powders do not form flat surfaces, and they can be made into piles and pushed into shapes.

Some materials, such as peanut butter, hair-styling mousse, toothpaste, and jelly, are composed of solids and liquids. These materials can be perplexing to students because the materials have some of the properties of solids and some of the properties of liquids. Students sometimes solve this quandary by describing a new state of matter—gel.

Interactions between solids, between liquids, and between solids and liquids produce a variety of results. Solids often don’t interact in any more provocative way than to make mixtures and layers. Mixtures of solids can be separated into their components, although separating them is sometimes a challenge.

Mixtures of liquids are often interesting. Liquids might intermix completely, producing diluted solutions, or they might react to produce new products, such as solids, gases, or a product with a color change. Liquids that don’t mix, such as oil and water, form layers.

When solids and liquids interact, all the results mentioned above are possible, plus others. Solids might float or sink in the liquid. The solid might soak up the liquid. The solid, or part of the solid, might dissolve in the liquid. Each new observation gives students something to think about and a new piece of information about the organization and behavior of the objects in their world.

When conditions are right, a sample of matter can change state. A substance can change state from solid to liquid, liquid to gas, solid to gas, or change in the other direction. When a substance changes from solid to liquid, we say it melted, or liquefied. When a substance changes from liquid to solid, we say it froze, or solidified. When a substance changes from liquid to gas, we say it evaporated, or vaporized. When a substance changes from gas to liquid, we say it condenses.

Melting ice, butter, or chocolate is pretty easy—you just heat the substance, and it changes from solid to liquid. That’s a change of state, and it is accomplished with heat. Transfer of heat is the key to all state changes. The composition of the materials is the same; they are just in a different molecular arrangement.
We are all familiar with water in its three states—ice, liquid water, water vapor—because those states exist in a temperature range we commonly experience (from 0°C to 100°C). Melting and freezing of water happen at the same temperature—0°C. The direction of energy transfer (from the environment to the water or away from the water to the environment) determines what we call the process. Some substances melt and freeze at lower temperatures (salt water, isopropyl alcohol, mercury), and some melt and freeze at higher temperatures (aluminum, copper, iron).

Mixtures can be made with any combination of gases, liquids, and solids. The components of a mixture are not changed by mixing with other materials. The resulting mass of a mixture is the sum of the masses of the components.

Sometimes when two (or more) materials are mixed, a different kind of mixture results. For example, when salt and water are mixed, the solid salt seems to disappear in the water. This process is called dissolving; we say that the salt dissolved in the water. This mixture is a solution.

When two solutions are mixed, another kind of change could take place—a chemical change. When this happens, the result is a chemical reaction. The starting substances (reactants) change into new substances (products). This concept is investigated in depth in grade 5.

**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). Scientists engage in a set of practices as they do their work and these are the same practices students use in their science investigations.

Engineers apply that understanding of the natural world to solve real-world problems. Engineering is the systematic approach to finding solutions to problems identified by people in societies. The fields of science and engineering are mutually supportive and scientists and engineers collaborate in their work. Often, acquiring scientific data requires designing and producing new technologies—tools, instruments, machines, and processes—to perform specific functions. 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 different solutions to improve the design.

**Defining the problem** involves asking questions and making observations to obtain information about designing a specific structure. In this module, students learn about two kinds of structures, towers and bridges, and use the same group of materials to design these structures.

**Developing possible solutions** involves making decisions about the materials available and thoughtfully making a design about how they can be used, in this case, to build a stable structure. 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. Identifying the differences between design solutions is important. Students need to know that “failure” is not only OK, but expected in engineering design. Having something fail drives you to improve the system and make progress. Collaboration is an important aspect of engineering design; learning from the successes and failures of other design groups can be very productive.

In this module, there is one investigation in which students explore the disciplinary core ideas of engineering design in the context of building towers and bridges. But students engage in engineering practices in other investigations without engaging in the full engineering design process. 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.

### CONCEPTUAL FRAMEWORK

**Engineering Design: Solids and Liquids**

<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concept A</strong></td>
<td>Defining and delimiting engineering problems. Asking questions, making observations, and gathering information are helpful in thinking about a problem. Before beginning to design a solution, it is important to clearly understand the problem.</td>
</tr>
<tr>
<td><strong>Concept B</strong></td>
<td>Developing possible solutions.</td>
</tr>
<tr>
<td></td>
<td>• 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.</td>
</tr>
<tr>
<td></td>
<td>• A great variety of objects can be built up from a small set of pieces.</td>
</tr>
<tr>
<td></td>
<td>• Different properties are suited to different purposes.</td>
</tr>
<tr>
<td><strong>Concept C</strong></td>
<td>Optimizing the design solution.</td>
</tr>
<tr>
<td></td>
<td>• Because there is always more than one possible solution to a problem, it is useful to compare and test designs.</td>
</tr>
</tbody>
</table>

**NOTE**

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

This table shows the five FOSS modules and courses that address the matter-content sequence for grades K–8. Running through the sequence are the two progressions—matter has structure, and matter interacts. The supporting elements in each module (somewhat abbreviated) are listed. The elements for the **Solids and Liquids Module** are expanded to show how they fit into the sequence.

<table>
<thead>
<tr>
<th>Module or course</th>
<th>Matter has structure</th>
<th>Matter interacts</th>
</tr>
</thead>
</table>
| **Chemical Interactions** (middle school) | - 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** (grade 5) | - 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. |
| **Motion and Matter** (grade 3) | - Measurement can be used to confirm that the mass of the whole is equal to the mass of its parts. | - A mixture is two or more intermingled substances.  
- A solution results when a solid material dissolves in a liquid.  
- Mass is conserved when objects or materials are mixed.  
- During chemical reactions, starting materials change into new materials. |
| **Solids and Liquids** (grade 2) | - Wood, paper, rock, and fabric are examples of solid materials.  
- Solid objects are made of solid materials.  
- Solid objects have properties.  
- The whole (object) can be broken into smaller pieces. | - Wood, paper, and fabric can be changed by sanding, coloring, tearing, etc.  
- Common materials can be changed into new materials (paper making, weaving, etc.).  
- Water can change to ice in a freezer, and ice can change to water in a room. |
| **Materials and Motion** (grade K) | - Wood, paper, rock, and fabric are examples of solid materials.  
- Solid objects are made of solid materials.  
- Solid objects have properties.  
- The whole (object) can be broken into smaller pieces. | - Wood, paper, rock, and fabric can be changed by sanding, coloring, tearing, etc.  
- Common materials can be changed into new materials (paper making, weaving, etc.).  
- Water can change to ice in a freezer, and ice can change to water in a room. |
FOSS Conceptual Framework

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

The NGSS Performance Expectations addressed in this module include:

**Physical Sciences**
- 2-PS1-1
- 2-PS1-2
- 2-PS1-3
- 2-PS1-4

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

See pages 30–32 in this chapter for more details on the Grade 2 NGSS Performance Expectations.

<table>
<thead>
<tr>
<th>Matter has structure</th>
<th>Matter interacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Common matter is known to us as solid, liquid, and gas.</td>
<td>• Solids have properties that determine how they can be used for construction.</td>
</tr>
<tr>
<td>• Solid matter has definite shape.</td>
<td>• Liquids have properties that determine their behavior when agitated or tipped.</td>
</tr>
<tr>
<td>• Liquid matter has definite volume but flows to fill a container to a level.</td>
<td>• Solids interact with water in various ways: float, sink, dissolve, swell, change.</td>
</tr>
<tr>
<td>• Gas matter has neither definite shape nor definite volume and expands to fill containers.</td>
<td>• Liquids interact with water in various ways: layer, mix, change color.</td>
</tr>
<tr>
<td>• Intrinsic properties of matter can be used to organize objects (e.g., color, shape, etc.).</td>
<td>• Substances change state (e.g., melt or freeze) when heated or cooled.</td>
</tr>
<tr>
<td></td>
<td>• Some changes to matter due to heating are reversible and some are irreversible.</td>
</tr>
</tbody>
</table>
# SOLIDS AND LIQUIDS — Framework and NGSS

## 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>Developing and using models</td>
<td>RI 1: Ask and answer questions to demonstrate understanding.</td>
</tr>
<tr>
<td>Planning and carrying out investigations</td>
<td>RI 2: Identify main topic of text.</td>
</tr>
<tr>
<td>Analyzing and interpreting data</td>
<td>RI 5: Know and use text features.</td>
</tr>
<tr>
<td>Constructing explanations and designing solutions</td>
<td>RI 7: Explain how images contribute to and clarify text.</td>
</tr>
<tr>
<td>Engaging in argument from evidence</td>
<td>RI 8: Describe how reasons support points the author makes in the text.</td>
</tr>
<tr>
<td>Obtaining, evaluating, and communicating information</td>
<td>RI 3: Describe the connection between scientific ideas or concepts.</td>
</tr>
<tr>
<td></td>
<td>RI 7: Explain how images contribute to and clarify text.</td>
</tr>
<tr>
<td></td>
<td>RI 8: Describe how reasons support points the author makes in the text.</td>
</tr>
<tr>
<td></td>
<td>W 5: Strengthen writing by revising and editing.</td>
</tr>
<tr>
<td></td>
<td>W 8: Gather information from provided sources to answer a question.</td>
</tr>
<tr>
<td>Inv. 1: Solids</td>
<td>SL 1: Participate in collaborative conversations.</td>
</tr>
<tr>
<td></td>
<td>SL 3: Ask and answer questions.</td>
</tr>
<tr>
<td></td>
<td>L 4: Determine or clarify the meaning of unknown or multiple meaning words and phrases (e.g., use glossaries).</td>
</tr>
<tr>
<td></td>
<td>L 5: Demonstrate understanding of word relationships and nuances in word meanings.</td>
</tr>
<tr>
<td>Asking questions</td>
<td>RI 3: Describe the connection between scientific ideas or concepts.</td>
</tr>
<tr>
<td>Developing and using models</td>
<td>RI 7: Explain how images contribute to and clarify text.</td>
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<td>RI 8: Describe how reasons support points the author makes in the text.</td>
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<tr>
<td>Analyzing and interpreting data</td>
<td>W 5: Strengthen writing by revising and editing.</td>
</tr>
<tr>
<td>Using mathematics and computational thinking</td>
<td>SL 1: Participate in collaborative conversations.</td>
</tr>
<tr>
<td>Constructing explanations</td>
<td>SL 2: Recount or describe key ideas.</td>
</tr>
<tr>
<td>Engaging in argument from evidence</td>
<td>SL 3: Ask and answer questions.</td>
</tr>
<tr>
<td>Obtaining, evaluating, and communicating information</td>
<td>SL 4: Recount an experience with appropriate facts and relevant descriptive details.</td>
</tr>
<tr>
<td>Inv. 2: Liquids</td>
<td>L 1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.</td>
</tr>
<tr>
<td></td>
<td>L 6: Use acquired words and phrases.</td>
</tr>
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</table>
### Disciplinary Core Ideas

<table>
<thead>
<tr>
<th>PS1.A: Structure and properties of matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diff. 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. (2-PS1-1)</td>
</tr>
<tr>
<td>Diff. properties are suited to different purposes. (2-PS1-2, 2-PS1-3)</td>
</tr>
<tr>
<td>A great variety of objects can be built up from a small set of pieces. (2-PS1-3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ETS1.B: Developing possible solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>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. (K-2-ETS1-2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ETS1.C: Optimizing the design solution</th>
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<tbody>
<tr>
<td>Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)</td>
</tr>
</tbody>
</table>

### Crosscutting Concepts

- Patterns
- Systems and system models
- Structure and function

- Cause and effect
- Scale, proportion, and quantity

---

**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. (2-PS1-1)
<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Connections to Common Core State Standards—ELA</th>
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</thead>
<tbody>
<tr>
<td>Developing and using models</td>
<td>RI 2: Identify main topic of text.</td>
</tr>
<tr>
<td>Planning and carrying out</td>
<td>RI 3: Describe the connection between</td>
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<td>investigations</td>
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<td>Analyzing and interpreting data</td>
<td>RI 7: Explain how images contribute to and</td>
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<tr>
<td>Constructing explanations</td>
<td>clarify text.</td>
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<td>Engaging in argument from</td>
<td>RI 9: Compare and contrast two texts on the</td>
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<td>evidence</td>
<td>same topic.</td>
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<td>Obtaining, evaluating, and</td>
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<td>communicating information</td>
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<td></td>
<td>RI 1: Ask and answer questions to demonstrate</td>
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<td>RI 5: Know and use text features.</td>
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<td>clarify text.</td>
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<tr>
<td></td>
<td>W 8: Recall information from experiences to</td>
</tr>
<tr>
<td></td>
<td>answer a question.</td>
</tr>
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<td></td>
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<td>L 5: Demonstrate understanding of word</td>
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### Disciplinary Core Ideas

#### 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. (2-PS1-1)
- Different properties are suited to different purposes. (2-PS1-2)

#### PS1.B: Chemical reactions
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)

### Crosscutting Concepts

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- Cause and effect
- Energy and matter
- Stability and change

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**Connections to NGSS by Investigation**

**RI** 1: Ask and answer questions to demonstrate understanding.

**RI** 2: Identify main topic of text.

**RI** 3: Describe the connections between scientific ideas or concepts.

**RI** 5: Know and use text features.

**RI** 7: Explain how images contribute to and clarify text.

**W** 5: Strengthen writing by revising and editing.

**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.

**L** 5: Demonstrate understanding of word relationships and nuances in word meanings.

**L** 6: Use acquired words and phrases.
# RECOMMENDED FOSS NEXT GENERATION K–8

## SCOPE AND SEQUENCE

<table>
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<th>Grade</th>
<th>Physical Science</th>
<th>Earth Science</th>
<th>Life Science</th>
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<td>Mixtures and Solutions</td>
<td>Earth and Sun</td>
<td>Living Systems</td>
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<tr>
<td>4</td>
<td>Energy</td>
<td>Soils, Rocks, and Landforms</td>
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<tr>
<td>3</td>
<td>Motion and Matter</td>
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<tr>
<td>2</td>
<td>Solids and Liquids</td>
<td>Pebbles, Sand, and Silt</td>
<td>Insects and Plants</td>
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<td>1</td>
<td>Sound and Light</td>
<td>Air and Weather</td>
<td>Plants and Animals</td>
</tr>
<tr>
<td>K</td>
<td>Materials and Motion</td>
<td>Trees and Weather</td>
<td>Animals Two by Two</td>
</tr>
</tbody>
</table>

*Half-length courses

Physical Science content

Earth Science content

Life Science content

Engineering content