INTRODUCTION

Water is the most important substance on Earth. Water dominates the surface of our planet, changes the face of the land, and defines life. These powerful pervasive ideas are introduced here. The Water Module provides students with experiences to explore the properties of water, changes in water, interactions between water and other earth materials, and how humans use water as a natural resource. In this module, students will

- Conduct surface-tension experiments.
- Observe and explain the interaction between masses of water at different temperatures and masses of water in liquid and solid states.
- Construct a thermometer to observe that water expands as it warms and contracts as it cools.
- Investigate the effect of surface area and air temperature on evaporation, and the effect of temperature on condensation.
- Investigate what happens when water is poured through two earth materials—soil and gravel.
- Design and construct a waterwheel and use it to lift or pull objects.
- Use field techniques to compare how well several soils drain.
## Module Summary

<table>
<thead>
<tr>
<th>Module</th>
<th>Focus Questions</th>
</tr>
</thead>
</table>
| Inv. 1: Water Observations | What happens when water falls on different surfaces?  
How many drops of water can you put on a penny?  
How does water move on a slope?  
What happens outdoors when rains falls on natural materials? |
| Inv. 2: Hot Water, Cold Water | What happens to water when it gets hot? cold?  
What happens when hot or cold water is put into room-temperature water?  
How does water change when it gets really cold?  
Where should an animal go to stay warm or to stay cool? |
| Inv. 3: Water Vapor | What happens to wet paper towels overnight?  
What affects how fast water evaporates?  
How does surface area affect evaporation?  
What causes moisture to form on the side of a cup?  
Where can you find hidden water in our schoolyard? |
| Inv. 4: Waterworks | What happens when water is mixed with earth materials?  
Does water have the power to do work?  
Do all soils drain water at the same rate? |
## Water Module

### Module Matrix

<table>
<thead>
<tr>
<th>Concepts/Elements</th>
<th>Reading</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Water forms beads on waterproof materials and soaks into absorbent materials.</td>
<td><strong>Science Resources</strong></td>
<td><strong>Embedded Assessment</strong></td>
</tr>
<tr>
<td>• Surface tension is the skinlike surface of water that pulls it together into the smallest possible surface area (a sphere), and can be disrupted by the addition of soap.</td>
<td>“A Report from the Blue Planet”</td>
<td>Survey</td>
</tr>
<tr>
<td>• Water moves downhill. The angle of the slope and the amount of water affect flow.</td>
<td>“Surface Tension”</td>
<td><strong>Investigation 1 I-Check</strong></td>
</tr>
<tr>
<td>• Water expands when heated and contracts when cooled.</td>
<td><strong>Science Resources</strong></td>
<td></td>
</tr>
<tr>
<td>• Density determines whether objects float or sink in water. A material that floats in water is less dense than the water; a material that sinks is more dense.</td>
<td>“Water: Hot and Cold”</td>
<td><strong>Embedded Assessment</strong></td>
</tr>
<tr>
<td>• Cold water is more dense than warm water.</td>
<td>“Ice Is Everywhere”</td>
<td>Science notebook entries</td>
</tr>
<tr>
<td>• Water expands when it freezes; ice is less dense than liquid water.</td>
<td></td>
<td>Response sheet</td>
</tr>
<tr>
<td>• Ice melts when heated; water freezes when cooled.</td>
<td></td>
<td><strong>Benchmark Assessment</strong></td>
</tr>
<tr>
<td>• Evaporation is the process by which liquid (water) changes into gas (water vapor).</td>
<td><strong>Science Resources</strong></td>
<td><strong>Investigation 2 I-Check</strong></td>
</tr>
<tr>
<td>• Temperature, greater surface area, and moving air (wind) increase the rate of evaporation.</td>
<td>“Drying Up”</td>
<td></td>
</tr>
<tr>
<td>• Condensation is the process by which gas (water vapor) changes into liquid water; it occurs on a cool surface.</td>
<td>“Surface-Area Experiment”</td>
<td></td>
</tr>
<tr>
<td>• Evaporation and condensation are processes in the water cycle.</td>
<td>“The Water Cycle”</td>
<td></td>
</tr>
<tr>
<td>• Soil is rock particles mixed with organic material called humus.</td>
<td><strong>Science Resources</strong></td>
<td><strong>Embedded Assessment</strong></td>
</tr>
<tr>
<td>• Soils can be described by their properties, including capacity to retain water.</td>
<td>“Water: A Vital Resource”</td>
<td>Survey</td>
</tr>
<tr>
<td>• Flowing water can be used to do work; waterwheels are machines powered by flowing water.</td>
<td>“Natural Resources”</td>
<td><strong>Investigation 3 I-Check</strong></td>
</tr>
<tr>
<td>• Water and soil are renewable resources.</td>
<td>“The Power of Water”</td>
<td></td>
</tr>
<tr>
<td>• People can conserve natural resources.</td>
<td>“Ellen Swallow Richards: An Early Ecologist”</td>
<td></td>
</tr>
<tr>
<td>• “Solar Disinfection System”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Science Resources**
- “A Report from the Blue Planet”
- “Surface Tension”
- “Which Way Does It Go?”
- “Water: Hot and Cold”
- “Ice Is Everywhere”
- “Drying Up”
- “Surface-Area Experiment”
- “The Water Cycle”
- “Water: A Vital Resource”
- “Natural Resources”
- “The Power of Water”
- “Ellen Swallow Richards: An Early Ecologist”
- “Solar Disinfection System”

**Embedded Assessment**
- Science notebook entries
- Response sheet
- Scientific practices
- Benchmark Assessment
- Survey
- Investigation 1 I-Check
- Investigation 2 I-Check
- Investigation 3 I-Check
- Posttest
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” (National Research Council, A Framework for K–12 Science Education, 2011).

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 below for the FOSS Elementary Program. 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 national framework. Modules at the bottom of the table form the foundation in the primary grades. The core ideas develop in complexity as you proceed up the columns.

Information about the FOSS learning progression appears in the conceptual framework (page 7), which shows the structure of scientific knowledge taught and assessed in this module, and the content sequence (pages 12–13), a graphic and narrative description that puts this single module into a K–8 strand progression.
In addition to the science content development, every 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.

**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 argumentation 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—oral and in writing—with tables, diagrams, graphs, and equations, in collaboration with peers.

*Water Module*
BACKGROUND FOR THE CONCEPTUAL FRAMEWORK in Water

The Wondrous Liquid

How would you answer the question “What is 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. We might well think of ourselves as measures of water carried around in complex containers. Because we are essentially water, water is the baseline, the standard against which everything else is compared. Consequently, it is intuitive to describe water in terms of what it isn’t: water has no color, no odor, no taste, and is not heavy or light, having a density almost the same as our bodies. However, to an alien life-form from a methane or ammonia planet whose chemical history is fundamentally different, pure water might have a very offensive odor, taste like sour grapes, and prove toxic if ingested.

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.

To the chemist, water is a molecule composed of two atoms of hydrogen and one atom of oxygen \((\text{H}_2\text{O})\). The atoms are joined by chemical bonds. Water is more complex than this formula suggests, but for our purposes, this simple formula will suffice.

Where Is the Water?

On planet Earth, water is found naturally everywhere—in puddles, ponds, streams, and 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 percent 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 ocean has become a repository 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 percent 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 underground aquifers, glaciers, and the atmosphere is harder to get for human use.

**Water’s Unique Properties**

Water has some unique properties. It is the only material that occurs naturally on Earth 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 forms to exist. Water changes into a solid, or freezes, when it cools to 0°C. It melts, or changes into a liquid, when it warms to above 0°C. And when water is heated to 100°C, it changes into a gas.

The general rule that governs the behavior of matter is that when matter gets hot, it expands; when matter gets cold, it contracts. Most liquids contract steadily as they get colder and colder. But not water! When water cools below 4°C, it begins to expand and continues to expand until it freezes into a solid at 0°C. Water is the only substance that behaves this way. If water is trapped in a closed space, the pressure created by expansion during freezing is enough to burst water pipes and fracture rock formations.

Because water expands as it freezes, a given mass of water will occupy a greater volume as ice than it will as liquid water. This means ice is less dense than liquid water. If ice were more dense than water, ice would long ago have accumulated in Earth’s lakes and oceans from the bottom up, and virtually all the water on the planet would be permanently frozen. Earth might be an ice planet instead of a water planet.

Water boils and turns into water vapor at 100°C. Individual energized water molecules leave the liquid, changing into invisible gas in the process. As gas, water enters the atmosphere, becoming part of the complex mixture of gases called air.
Water vapor is not tiny droplets of water. Water vapor is a true gas, dispersed in the air as individual water molecules, in the same league with oxygen, helium, nitrogen, and carbon dioxide.

Water can also vaporize at temperatures below its boiling point. Both ice and liquid water can evaporate into the air. Rain puddles evaporate when exposed to the Sun’s radiation, and ice cubes in the freezer slowly disappear into the air. Factors that affect the rate of evaporation include the size of the surface area, the speed of the air moving over the water’s surface, and the temperature.

Warm air can hold more water vapor than cool air, but there is a limit to how much water vapor the air can hold. When the limit is reached, the number of molecules evaporating from the water’s surface equals the number of molecules going from vapor to liquid. On hot, humid days you feel uncomfortable and sticky because the air is filled to capacity with water vapor, a condition called 100 percent humidity.

Surface Tension

Did you ever watch a dripping faucet and note how water forms a “drop” shape with a point on top as it falls? This simple observation is misleading. A split second after the drop starts its plunge, in response to gravity, the drop is traveling too fast to see. So we are left with an incomplete idea of a drop, based on its appearance just as it leaves the faucet. If we had a slow-motion movie of the drop falling, we could see clearly that the drop immediately pulls itself into a sphere.

This shape change is the effect of surface tension, the skinlike surface that covers water where it interfaces with air. A small quantity of water will quickly pull itself into a sphere, the geometric shape with the smallest surface-to-volume ratio. When water is at rest in a cup, basin, or lake, the same skinlike surface forms at the top where the water meets the air. Water’s strong surface tension enables it to support objects, such as sewing needles and insects called water striders.
Where Did the Water Come From?

How did water come to Earth? Modern theories consider volcanoes to be the source of most of Earth’s water. It is thought that a very large amount of water existed in the assemblage of dust that was compressed by gravitational forces billions of years ago to form the Sun and its planets. Water trapped inside Earth was released to the atmosphere through volcanic eruptions. (Today, volcanic emissions are about 80 percent water vapor by volume.) Because Earth was very hot during its formative years, the water remained water vapor in the atmosphere.

When Earth cooled to below 100°C, the massive accumulation of vapor began to condense and fall as rain. Scientists think that it rained hard and continuously for many millions of years as Earth continued to cool. In time, the low places on Earth’s surface were covered with water to a great depth, and the ocean formed. It was probably in the primitive ocean that life began.

Over the billions of years of Earth history, water from the ocean evaporated into the atmosphere, cooled, condensed into a liquid or solid, and fell back to Earth as precipitation. As water flowed back to the ocean, this continual recycling of water eroded Earth’s surface. If it weren’t for the ongoing mountain-building forces, Earth’s surface would have been leveled and covered by one vast ocean long ago.

The water cycle has been operating ever since the first water vapor condensed and fell back to Earth. A significant amount of water doesn’t find its way directly back to the ocean. It gets waylaid in lakes and underground aquifers. It can take many different routes between the atmosphere, Earth’s surface, and the ocean. Evaporation and condensation can happen at any point along the way.

Most scientists agree that Earth’s total water supply doesn’t change much. They have calculated the total supply to be about 1,360,000,000 cubic kilometers (km³). Of that amount, only 65,000 km³ (a fraction of 1 percent) is in motion; the rest is stored in the ocean, glaciers and lakes, or underground.
Water Use and Water Quality

Several properties of water determine its quality and how it can be used. Taste, odor, salinity, and color are just some of these properties. The quality of drinking water is very different from the quality of water required to cool car engines, irrigate crops, or wash trucks.

The fact that so many substances dissolve in water has a great effect on its quality. Most natural water carries some concentration of dissolved solids, usually salts, such as calcium sulfate or sodium chloride. Even rain contains dissolved salts. The concentration of salts in water is so small that it is expressed in parts per million (ppm). Distilled (pure) water has a salt concentration of 0 ppm. The water in Lake Michigan has been measured at 170 ppm, the ocean at 35,000 ppm, and the Dead Sea at 250,000 ppm.

Concentration of salts can change over time. The Great Salt Lake in Utah has been measured at 280,000 ppm during periods of low water and 150,000 ppm during periods of high water.

Putting Water to Work

Water has mass and flows downhill, urged on by the inexorable acceleration of gravity. Mass times acceleration equals force. If an object is placed in the path of flowing water, the force can be used to do some work. Early on, humans figured out that a waterwheel in a flowing or falling stream of water could create rotational motion. By harvesting the energy in moving water to turn the wheels of industry, humans could grind more grain, saw more lumber, and lift heavier loads more efficiently than they could by hand or with animals. Today, water and gravity still work together to turn the mammoth turbines in hydroelectric power plants.
Water’s Future

Hydrologists are the scientists who study Earth’s water supply and inform the management strategies that will help provide an adequate supply of water for the future. Reducing pollution, improving waste treatment, using water efficiently, recycling water for industry, and desalination are some of the global issues being studied at this time.

Environmental economists predict that water issues will be the most important world resource issues in this century. It has been suggested that the energy crisis of the late 20th century will pale in comparison to the water crisis of the decades ahead. The world climate is changing and bringing more severe weather (both floods and droughts). As the world population continues to grow (7 billion reached in October 2011), bringing with it the need for food and escalating expectations for higher standards of living, the demand placed on Earth’s resources will double and redouble many times. Water, the most precious of Earth’s jewels, will be the focal point of a conscientious rethinking of our relationship to a small water planet.

This is why FOSS devotes an entire module to a single molecule, H2O. We owe a lot to water. It defines our planet, it is the cradle of life, and it dominates the character of our global environments. And the water molecule is very interesting, behaving in ways that are unique and out of step with what we generally know to be the nature of the universe. FOSS wants students to start on a path of understanding that will help them appreciate the importance of water and its unique characteristics.
Dynamic Atmosphere Content Sequence

This table shows the five FOSS modules and courses that address the content sequence "dynamic atmosphere" 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 Water 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>
</table>
| 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. | - 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 | | |
| Air and Weather | - Air is matter (gas) and takes up space.  
- Weather describes conditions in the air outside.  
- Weather conditions 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.  
- 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. |
<table>
<thead>
<tr>
<th>Structure of Earth</th>
<th>Earth interactions</th>
</tr>
</thead>
</table>
| • Water is found almost everywhere on Earth, e.g., vapor, clouds, rain, snow, ice.  
• Surface tension is the skinlike surface of water that pulls it together into the smallest possible surface area.  
• 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 flows downhill; the steeper the slope, the faster water moves. Flowing water can do work.  
• Ice melts when heated; liquid water freezes when cooled.  
• The water cycle involves evaporation, condensation, precipitation, and runoff.  
• Temperature, greater surface area, and moving air (wind) increase the rate of evaporation.  
• Density determines whether objects float or sink in water. A material that floats in water is less dense than the water. |
The Water Module aligns with the NRC Framework. The module addresses these 3–5 grade band endpoints described for core ideas from the national framework for Earth's systems, and Earth and human activity.

Earth and Space Sciences

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

- ESS2.C: How do the properties and movements of water shape Earth’s surface and affect its systems? [Water is found almost everywhere on Earth: as humidity; as fog or clouds in the atmosphere; as rain or snow falling from clouds; as ice, snow, and running water on land and in the ocean; and as groundwater beneath the surface. The downhill movement of water as it flows to the ocean shapes the appearance of the land. Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.]

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

- ESS3.A: How do humans depend on Earth's resources? [All materials, energy, and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.]
- ESS3.C: How do humans change the planet? [Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.]
Engineering, Technology, and Applications of Science

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

• **ETS1.A**: What is a design for? What are the criteria and constraints of a successful solution? [Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.]

• **ETS1.C**: How can various proposed design solutions be compared and improved? [Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.]

Core idea ETS2: Links among engineering, technology, science, and society—How are engineering, technology, science, and society interconnected?

• **ETS2.A**: What are the relationships among science, engineering, and technology? [Tools and instruments (e.g., rulers, balances, thermometers, graduated cylinders, telescopes, microscopes) are used in scientific exploration to gather data and help answer questions about the natural world. Engineering design can develop and improve such technologies. Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. Knowledge of relevant scientific concepts and research findings is important in engineering.]

• **ETS2.B**: 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? [Over time, people’s needs and wants change, as do their demands for new and improved technologies. Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. When new technologies become available, they can bring about changes in the way people live and interact with one another.]
FOSS COMPONENTS

Teacher Toolkit

The Teacher Toolkit is the most important part of the FOSS Program. It is here that all the wisdom and experience contributed by hundreds of educators has been assembled. Everything we know about the content of the module, how to teach the subject, and the resources that will assist the effort are presented here. Each toolkit has three parts.

Investigations Guide. This spiral-bound document contains these chapters.
- Overview
- Materials
- Investigations (four in this module)

Teacher Resources. This three-ring binder contains these chapters.
- FOSS Introduction
- Assessment
- Science Notebooks in Grades 3–6
- Science-Centered Language Development
- Taking FOSS Outdoors
- FOSSweb and Technology
- Science Notebook Masters
- Teacher Masters
- Assessment Masters

The chapters contained in the Teacher Resources and the Spanish duplication masters can also be found on FOSSweb (www.FOSSweb.com) and on CDs included in the Teacher Toolkit.

FOSS Science Resources book. One copy of the student book of readings is included in the Teacher Toolkit.

Equipment Kit

The FOSS Program provides the materials needed for the investigations, including metric measuring tools, in sturdy, front-opening drawer-and-sleeve cabinets. Inside, you will find high-quality materials packaged for a class of 32 students. Consumable materials are supplied for two uses before you need to resupply. Teachers may be asked to supply small quantities of common classroom items.
FOSS Components

FOSS Science Resources Books

FOSS Science Resources: Water is a book of original readings developed to accompany this module. The readings are referred to as articles in the Investigations Guide. Students read the articles in the book as they progress through the module. The articles cover a specific concept, usually after that concept has been introduced in an active investigation.

The articles in Science Resources and the discussion questions provided in the Investigations Guide help students make connections to the science concepts introduced and explored during the active investigations. Concept development is most effective when students are allowed to experience organisms, objects, and phenomena firsthand before engaging the concepts in text. The text and illustrations help make connections between what students experience concretely and the ideas that explain their observations.

FOSSweb and Technology

The FOSS website opens new horizons for educators, students, and families, in the classroom or at home. Each module has an interactive site where students and families can find instructional activities, interactive simulations and virtual investigations, and other resources. FOSSweb provides resources for materials management, general teaching tools for FOSS, purchasing links, contact information for the FOSS Project, and technical support. You do not need an account to view this general FOSS Program information. In addition to the general information, FOSSweb provides digital access to PDF versions of the Teacher Resources component of the Teacher Toolkit and digital-only resources that supplement the print and kit materials.

Additional resources are available to support FOSS teachers. With an educator account, you can customize your homepage, set up easy access to the digital components of the modules you teach, and create class pages for your students with access to tutorials and online assessments.

Ongoing Professional Development

The Lawrence Hall of Science and Delta Education are committed to supporting science educators with unrivaled teacher support, high-quality implementation, and continuous staff-development opportunities and resources. FOSS has a strong network of consultants who have rich and experienced backgrounds in diverse educational settings using FOSS. Find out about professional-development opportunities on FOSSweb.

NOTE
To access all the teacher resources and to set up customized pages for using FOSS, log in to FOSSweb through an educator account.
FOSS INSTRUCTIONAL DESIGN

Each FOSS investigation follows a similar design to provide multiple exposures to science concepts. The design includes these pedagogies.

- Active investigation, including outdoor experiences
- Recording in science notebooks to answer the focus question
- Reading in FOSS Science Resources
- Assessment to monitor progress and motivate student reflection on learning

In practice, these components are seamlessly integrated into a continuum designed to maximize every student’s opportunity to learn. An instructional sequence may move from one pedagogy to another and back again to ensure adequate coverage of a concept.

FOSS Investigation Organization

Modules are subdivided into investigations (four in this module). Investigations are further subdivided into three to five parts. Each part of each investigation is driven by a focus question. The focus question, usually presented as the part begins, signals the challenge to be met, mystery to be solved, or principle to be uncovered. The focus question guides students’ actions and thinking and makes the learning goal of each part explicit for teachers. Each part concludes with students recording an answer to the focus question in their notebooks.

Investigation-specific scientific background information for the teacher is presented in each investigation chapter. The content discussion is divided into sections, each of which relates directly to one of the focus questions. This section ends with information about teaching and learning and a conceptual-flow diagram for the content.

The Getting Ready and Guiding the Investigation sections have several features that are flagged or presented in the sidebars. These include several icons to remind you when a particular pedagogical method is suggested, as well as concise bits of information in several categories.

Teaching notes appear in blue boxes in the sidebars. These notes comprise a second voice in the curriculum—an educative element. The first (traditional) voice is the message you deliver to students. It supports your work teaching students at all levels, from management to inquiry. The second educative voice, shared as a teaching note, is designed to help you understand the science content and pedagogical rationale at work behind the instructional scene.
The **safety** icon alerts you to a potential safety issue. It could relate to the use of a chemical substance, such as salt, requiring safety goggles, or the possibility of a student allergic reaction when students use latex, legumes, or wheat.

The small-group **discussion** icon asks you to pause while students discuss data or construct explanations in their groups. Often a Reporter shares the group’s conclusions with the class.

The **new-word** icon alerts you to a new vocabulary word or phrase that should be introduced thoughtfully. The new vocabulary should also be entered onto the word wall (or pocket chart). A complete list of the scientific vocabulary used in each investigation appears in the sidebar on the last page of the Background for the Teacher section.

The **vocabulary** icon indicates where students should review recently introduced vocabulary, often just before they will be answering the focus question or preparing for benchmark assessment.

The **recording** icon points out where students should make a science-notebook entry. Students record on prepared notebook sheets or, increasingly, on pages in their science notebooks.

The **reading** icon signals when the class should read a specific article in the *FOSS Science Resources* book, preferably during a reading period.

The **assessment** icon appears when there is an opportunity to assess student progress by using embedded or benchmark assessments. Some of the embedded-assessment methods for grades 3–6 include observation of students engaged in scientific practices, review of a notebook entry, and a response sheet.

The **outdoor** icon signals when to move the science learning experience into the schoolyard. It also helps you plan for selecting and preparing an outdoor site for a student activity.

The **engineering** icon indicates opportunities for addressing engineering practices—applying and using scientific knowledge. These opportunities include developing a solution to a problem, constructing and evaluating models, and using systems thinking.

The **EL note** in the sidebar provides a specific strategy to use to assist English learners in developing science concepts. A discussion of strategies is in the Science-Centered Language Development chapter.

To help with pacing, you will see icons for **breakpoints**. Some breakpoints are essential, and others are optional.
Active Investigation

Active investigation is a master pedagogy. Embedded within active learning are a number of pedagogical elements and practices that keep active investigation vigorous and productive. The enterprise of active investigation includes

- context: questioning and planning;
- activity: doing and observing;
- data management: recording, organizing, and processing;
- analysis: discussing and writing explanations.

**Context: questioning and planning.** Active investigation requires focus. The context of an inquiry can be established with a focus question or challenge from you or, in some cases, from students. (What happens to water when it gets hot? cold?) At other times, students are asked to plan a method for investigation. This might start with a teacher demonstration or presentation. Then you challenge students to plan an investigation, such as to find out if water has the power to do work. In either case, the field available for thought and interaction is limited. This clarification of context and purpose results in a more productive investigation.

**Activity: doing and observing.** In the practice of science, scientists put things together and take things apart, observe systems and interactions, and conduct experiments. This is the core of science—active, firsthand experience with objects, organisms, materials, and systems in the natural world. In FOSS, students engage in the same processes. Students often conduct investigations in collaborative groups of four, with each student taking a role to contribute to the effort.

The active investigations in FOSS are cohesive, and build on each other and the readings to lead students to a comprehensive understanding of concepts. Through the investigations, students gather meaningful data.

**Data management: recording, organizing, and processing.** Data accrue from observation, both direct (through the senses) and indirect (mediated by instrumentation). Data are the raw material from which scientific knowledge and meaning are synthesized. During and after work with materials, students record data in their science notebooks. Data recording is the first of several kinds of student writing.

Students then organize data so they will be easier to think about. Tables allow efficient comparison. Organizing data in a sequence (time) or series (size) can reveal patterns. Students process some data into graphs, providing visual display of numerical data. They also organize data and process them in the science notebook.
Analysis: discussing and writing explanations. The most important part of an active investigation is extracting its meaning. This constructive process involves logic, discourse, and existing knowledge. Students share their explanations for phenomena, using evidence generated during the investigation to support their ideas. They conclude the active investigation by writing in their science notebooks a summary of their learning as well as questions raised during the activity.

Science Notebooks

Research and best practice have led FOSS to place more emphasis on the student science notebook. Keeping a notebook helps students organize their observations and data, process their data, and maintain a record of their learning for future reference. The process of writing about their science experiences and communicating their thinking is a powerful learning device for students. The science-notebook entries stand as credible and useful expressions of learning. The artifacts in the notebooks form one of the core elements of the assessment system.

You will find the duplication masters for grades 1–6 presented in notebook format. They are reduced in size (two copies to a standard sheet) for placement (glue or tape) into a bound composition book. Full-size duplication masters are also available on FOSSweb. Student work is entered partly in spaces provided on the notebook sheets and partly on adjacent blank sheets.
Reading in FOSS Science Resources

The FOSS Science Resources books emphasize expository articles and biographical sketches. FOSS suggests that the reading be completed during language-arts time. When language-arts skills and methods are embedded in content material that relates to the authentic experience students have had during the FOSS active learning sessions, students are interested, and they get more meaning from the text material.

Assessing Progress

The FOSS assessment system includes both formative and summative assessments. Formative assessment monitors learning during the process of instruction. It measures progress, provides information about learning, and is generally diagnostic. Summative assessment looks at the learning after instruction is completed, and it measures achievement.

Formative assessment in FOSS, called embedded assessment, occurs on a daily basis. You observe action during class or review notebooks after class. Embedded assessment provides continuous monitoring of students’ learning and helps you make decisions about whether to review, extend, or move on to the next idea to be covered.

Benchmark assessments are short summative assessments given after each investigation. These I-Checks are actually hybrid tools: they provide summative information about students’ achievement, and because they occur soon after teaching each investigation, they can be used diagnostically as well. Reviewing a specific item on an I-Check with the class provides another opportunity for students to clarify their thinking.

The embedded assessments are based on authentic work produced by students during the course of participating in the FOSS activities. Students do their science, and you look at their notebook entries. Within the instructional sequence, you will see the heading What to Look For in red letters. Under that, you will see bullet points telling you specifically what students should know and be able to communicate.
If student work is incorrect or incomplete, you know that there has been a breakdown in the learning/communicating process. The assessment system then provides a menu of next-step strategies to resolve the situation. Embedded assessment is assessment for learning, not assessment of learning. Assessment of learning is the domain of the benchmark assessments. Benchmark assessments are delivered at the beginning of the module (Survey) and at the end of the module (Posttest), and after each investigation (I-Checks). The benchmark tools are carefully crafted and thoroughly tested assessments composed of valid and reliable items. The assessment items do not simply identify whether or not a student knows a piece of science content. They identify the depth to which students understand science concepts and principles and the extent to which they can apply that understanding. Since the output from the benchmark assessments is descriptive and complex, it can be used for formative as well as summative assessment.

Completely incorporating the assessment system into your teaching practice involves realigning your perception of the interplay between good teaching and good learning, and usually leads to a considerably different social order in the classroom, with redefined student-student and teacher-student relationships.

13. Assess progress: notebook entry
Collect students’ notebooks. Have them turn them in open to the page that you will be reviewing. Check students’ observations on notebook sheet 1 and their answers to the focus question.

What to Look For
- Students organize data in a meaningful way.
- Students generate functional drawings.
- Students incorporate new vocabulary into the answer correctly.
Taking FOSS Outdoors

FOSS throws open the classroom door and proclaims the entire school campus to be the science classroom. The true value of science knowledge is its usefulness in the real world and not just in the classroom. Taking regular excursions into the immediate outdoor environment has many benefits. First of all, it provides opportunities for students to apply things they learned in the classroom to novel situations. When students are able to transfer knowledge of scientific principles to natural systems, they experience a sense of accomplishment.

In addition to transfer and application, students can learn things outdoors that they are not able to learn indoors. The most important object of inquiry outdoors is the outdoors itself. To today’s youth, the outdoors is something to pass through as quickly as possible to get to the next human-managed place. For many, engagement with the outdoors and natural systems must be intentional, at least at first. With repeated visits to familiar outdoor learning environments, students may first develop comfort in the outdoors, and then a desire to embrace and understand natural systems.

The last part of most investigations is an outdoor experience. Venturing out will require courage the first time or two you mount an outdoor expedition. It will confuse students as they struggle to find the right behavior that is a compromise between classroom rigor and diligence and the freedom of recreation. With persistence, you will reap rewards. You will be pleased to see students’ comportment develop into proper field-study habits, and you might be amazed by the transformation of students with behavior issues in the classroom who become your insightful observers and leaders in the schoolyard environment.

Teaching outdoors is the same as teaching indoors—except for the space. You need to manage the same four core elements of teaching: time, space, materials, and students. Because of the different space, new management procedures are required. Students can get farther away. Materials have to be transported. The space has to be defined and honored. Time has to be budgeted for getting to, moving around in, and returning from the outdoor study site. All these and more issues and solutions are discussed in the Taking FOSS Outdoors chapter in the Teacher Resources.

FOSS is very enthusiastic about this dimension of the program and looks forward to hearing about your experience using the schoolyard as a logical extension of your classroom.
Science-Centered Language Development

The FOSS active investigations, science notebooks, FOSS Science Resources articles, and formative assessments provide rich contexts in which students develop and exercise thinking and communication. These elements are essential for effective instruction in both science and language arts—students experience the natural world in real and authentic ways and use language to inquire, process information, and communicate their thinking about scientific phenomena. FOSS refers to this development of language process and skills within the context of science as science-centered language development.

In the Science-Centered Language Development chapter in Teacher Resources, we explore the intersection of science and language and the implications for effective science teaching and language development. We identify best practices in language-arts instruction that support science learning and examine how learning science content and engaging in scientific practices support language development.

Language plays two crucial roles in science learning: (1) it facilitates the communication of conceptual and procedural knowledge, questions, and propositions, and (2) it mediates thinking—a process necessary for understanding. For students, language development is intimately involved in their learning about the natural world. Science provides a real and engaging context for developing literacy, and language-arts skills and strategies support conceptual development and scientific practices. For example, the skills and strategies used for enhancing reading comprehension, writing expository text, and exercising oral discourse are applied when students are recording their observations, making sense of science content, and communicating their ideas. Students’ use of language improves when they discuss (speak and listen, as in the Wrap-Up/Warm-Up activities), write, and read about the concepts explored in each investigation.

There are many ways to integrate language into science investigations. The most effective integration depends on the type of investigation, the experience of students, the language skills and needs of students, and the language objectives that you deem important at the time. The Science-Centered Language Development chapter is a library of resources and strategies for you to use. The chapter describes how literacy strategies are integrated purposefully into the FOSS investigations, gives suggestions for additional literacy strategies that both enhance students’ learning in science and develop or exercise English-language literacy skills, and develops science vocabulary with scaffolding strategies for supporting all learners. The last section covers language-development strategies that are specifically for English learners.
FOSSWEB AND TECHNOLOGY

FOSS is committed to providing a rich, accessible technology experience for all FOSS users. FOSSweb is the Internet access to FOSS digital resources. It provides enrichment for students and support for teachers, administrators, and families who are actively involved in implementing and enjoying FOSS materials. Here are brief descriptions of selected resources to help you get started with FOSS technology.

Technology to Engage Students at School and at Home

Multimedia activities. The multimedia simulations and activities were designed to support students’ learning. They include virtual investigations and student tutorials that you can use to support students who have difficulties with the materials or who have been absent.

FOSS Science Resources. The student reading book is available as an audio book on FOSSweb, accessible at school or at home. In addition, as premium content, FOSS Science Resources is available as an eBook. The eBook supports a range of font sizes and can be projected for guided reading with the whole class as needed.

Home/school connection. Each module includes a letter to families, providing an overview of the goals and objectives of the module. Most investigations have a home/school activity providing science experiences to connect the classroom experiences with students’ lives outside of school. These connections are available in print in the Teacher Resources binder and on FOSSweb.

Student media library. A variety of media enhances students’ learning. Formats include photos, videos, an audio version of each student book, and frequently asked science questions. These resources are also available to students when they log in with a student account.

Recommended books and websites. FOSS has reviewed print books and digital resources that are appropriate for students and prepared a list of these media resources.

Class pages. Teachers with a FOSSweb account can easily set up class pages with notes and assignments for each class. Students and families can then access this class information online.
Technology to Support Teachers

**Teacher-preparation video.** The video presents information to help you prepare for a module, including detailed investigation information, equipment setup and use, safety, and what students do and learn through each part of the investigation.

**Science-notebook masters and teacher masters.** All notebook masters and teacher masters used in the modules are available digitally on FOSSweb for downloading and for projection during class. These sheets are available in English and Spanish.

**Assessment masters.** The benchmark assessment masters for grades 1–6 (I-Checks) are available in English and Spanish.

**Focus questions.** The focus questions for each investigation are formatted for classroom projection and for printing onto labels that students can glue into their science notebooks.

**Equipment photo cards.** The cards provide labeled photos of equipment supplied in each FOSS kit.

**Materials Safety Data Sheets (MSDS).** These sheets have information from materials manufacturers on handling and disposal of materials.

**Teacher Resources chapters.** FOSSweb provides PDF files of all chapters from the Teacher Resources binder.

- Assessment
- Science Notebooks
- Science-Centered Language Development
- Taking FOSS Outdoors
- FOSSweb and Technology

**Streaming video.** Some video clips are part of the instruction in the investigation, and others extend concepts presented in a module.

**Resources by investigation.** This digital listing provides online links to notebook sheets, assessment and teacher masters, and multimedia for each investigation of a module for projection in the classroom.

**Interactive whiteboard resources.** You can use these slide shows and other resources with an interactive whiteboard.

**Investigations eGuide.** The eGuide is the complete Investigations Guide component of the Teacher Toolkit in an electronic web-based format, allowing access from any Internet-enabled computer.

**NOTE**
The Spanish masters are available only on FOSSweb and on one of the CDs provided in the Teacher Toolkit.
Module summary. The summary describes each investigation in a module, including major concepts developed.

Module updates. These are important updates related to the teacher materials, student equipment, and safety guidelines.

Module teaching notes. These notes include teaching suggestions and enhancements to the module, sent in by experienced FOSS users.

FOSSmap and online assessments. A computerized assessment program, called FOSSmap, provides a system for students in grades 3–6 to take assessments online, and for you to review those assessments online and to assign tutorial sessions for individual students based on assessment performance. You generate a password for students to access and take the assessments online.

Most assessment items are multiple-choice, multiple-answer, or short-answer questions, but for one or two questions, students must write sentences. These open-response questions can be answered either online or using paper and pencil.

After students have completed a benchmark assessment, FOSSmap automatically codes (scores) the multiple-choice, multiple-answer, and short-answer questions. You will need to check students’ responses for short-answer questions to make sure that the questions have been coded correctly. Students’ open-response questions are systematically displayed for coding. If students have taken any part of the test via paper and pencil, you will need to enter students’ answers on the computer for multiple-choice and multiple-answer questions (the computer automatically codes the answers), and to code the short-answer and open-response questions.

Once the codes are in the FOSSmap program, you can generate and display several reports.

The Code-Frequency Report is a bar graph showing how many students received each code. This graph makes it easy to see which items might need further instruction.

In the Class-by-Item Report, each item is presented in a text format that indicates a percentage and provides names of students who selected each answer. It also describes what a code means in terms of what students know or need to work on.

The Class-by-Level Report describes four levels of achievement. It lists class percentages and students who achieved each level.
The Class-Frequency Report has bar graphs indicating how many students achieved each level. The survey and posttest are shown on the same page for easy comparison. I-Checks appear on separate pages.

The Student-by-Item Report is available for each student. It provides information about the highest code possible, the code the student received, and a note describing what the student knows or what he or she needs to work on. This report also suggests online tutorials to assign to students who need additional help.

The Student Assessment Summary bar graph indicates the level achieved by individual students on all the assessments taken up to any point in the module. This graph makes it easy to compare achievement on the survey and posttest as well as on each I-Check.

**Tutorials.** You can assign online tutorials to individual students, based on how each student answers questions on the I-Checks and posttest. The Student-by-Item Report, generated by FOSSmap, indicates the tutorials specifically targeted to help individual students to refine their understandings. Tutorials are an excellent tool for differentiating instruction and are available to students at any time on FOSSweb.
UNIVERSAL DESIGN FOR LEARNING

The roots of FOSS extend back to the mid-1970s and the Science Activities for the Visually Impaired and Science Enrichment for Learners with Physical Handicaps projects (SAVI/SELPH). As those special-education science programs expanded into fully integrated settings in the 1980s, hands-on science proved to be a powerful medium for bringing all students together. The subject matter is universally interesting, and the joy and satisfaction of discovery are shared by everyone. Active science by itself provides part of the solution to full inclusion.

Many years later, FOSS began a collaboration with educators and researchers at the Center for Applied Special Technology (CAST), where principles of Universal Design for Learning (UDL) had been developed and applied. FOSS continues to learn from our colleagues about ways to use new media and technologies to improve instruction. Here are the UDL principles.

**Principle 1.** Provide multiple means of representation. Give learners various ways to acquire information and knowledge.

**Principle 2.** Provide multiple means of action and expression. Offer students alternatives for demonstrating what they know.

**Principle 3.** Provide multiple means of engagement. Help learners get interested, be challenged, and stay motivated.

The FOSS Program has been designed to maximize the science-learning opportunities for students with special needs and students from culturally and linguistically diverse origins. FOSS is rooted in a 30-year tradition of multisensory science education and informed by recent research on UDL. Procedures found effective with students with special needs and students who are learning English are incorporated into the materials and strategies used with all students.

**English Learners**

The FOSS multisensory program provides a rich laboratory for language development for English learners. The program uses a variety of techniques to make science concepts clear and concrete, including modeling, visuals, and active investigations in small groups at centers. Key vocabulary is usually developed within an activity context with frequent opportunities for interaction and discussion between teacher and student and among students. This provides practice and application
of the new vocabulary. Instruction is guided and scaffolded through carefully designed lesson plans, and students are supported throughout. The learning is active and engaging for all students, including English learners.

Science vocabulary is introduced in authentic contexts while students engage in active learning. Strategies for helping all primary students read, write, speak, and listen are described in the Science-Centered Language Development chapter. There is a section on science-vocabulary development with scaffolding strategies for supporting English learners. These strategies are essential for English learners, and they are good teaching strategies for all learners.

**Differentiated Instruction**

FOSS instruction allows students to express their understanding through a variety of modalities. Each student has multiple opportunities to demonstrate his or her strengths and needs. The challenge is then to provide appropriate follow-up experiences for each student. For some students, appropriate experience might mean more time with the active investigations. For other students, it might mean more experience building explanations of the science concepts orally or in writing or drawing. For some students, it might mean making vocabulary more explicit through new concrete experiences or through reading to students. For some students, it may be scaffolding their thinking through graphic organizers. For other students, it might be designing individual projects or small-group investigations. For some students, it might be more opportunities for experiencing science outside the classroom in more natural, outdoor environments.

There are several possible strategies for providing differentiated instruction. The FOSS Program provides tools and strategies so that you know what students are thinking throughout the module. Based on that knowledge, read through the extension activities for experiences that might be appropriate for students who need additional practice with the basic concepts as well as those ready for more advanced projects. Interdisciplinary extensions are listed at the end of each investigation. Use these ideas to meet the individual needs and interests of your students.
WORKING IN COLLABORATIVE GROUPS

Collaboration is important in science. Scientists usually collaborate on research enterprises. Groups of researchers often contribute to the collection of data, the analysis of findings, and the preparation of the results for publication.

Collaboration is expected in the science classroom, too. Some tasks call for everyone to have the same experience, either taking turns or doing the same things simultaneously. At other times, group members may have different experiences that they later bring together.

Research has shown that students learn better and are more successful when they collaborate. Working together promotes student interest, participation, learning, and self-confidence. FOSS investigations use collaborative groups extensively.

No single model for collaborative learning is promoted by FOSS. We can suggest, however, a few general guidelines that have proven successful over the years.

For most activities in upper-elementary grades, collaborative groups of four in which students take turns assuming specific responsibilities work best. Groups can be identified completely randomly (first four names drawn from a hat constitute group 1), or you can assemble groups to ensure diversity. Thoughtfully constituted groups tend to work better.

Groups can be maintained for extended periods of time, or they can be reconfigured more frequently. Six to nine weeks seems about optimum, so students might stay together throughout an entire module.

Functional roles within groups can be determined by the members themselves, or they can be assigned in one of several ways. Each member in a collaborative group can be assigned a number or a color. Then you need only announce which color or number will perform a certain task for the group at a certain time. Compass points can also be used: the person seated on the east side of the table will be the Reporter for this investigation.

The functional roles used in the investigations follow. If you already use other names for functional roles in your class, use them in place of those in the investigations.
Getters are responsible for materials. One person from each group gets equipment from the materials station, and another person later returns the equipment.

One person is the Starter for each task. This person makes sure that everyone gets a turn and that everyone has an opportunity to contribute ideas to the investigation.

The Reporter makes sure that everyone has recorded information on his or her science notebook sheets. This person reports group data to the class or transcribes it to the board or class chart.

Getting started with collaborative groups requires patience, but the rewards are great. Once collaborative groups are in place, you will be able to engage students more in meaningful conversations about science content. You are free to “cruise” the groups, to observe and listen to students as they work, and to interact with individuals and small groups as needed.

When Students Are Absent

When a student is absent for a session, give him or her a chance to spend some time with the materials at a center. Another student might act as a peer tutor. Allow the student to bring home a FOSS Science Resources book to read with a family member. Each article has a few review items that the student can respond to verbally or in writing.

There is a set of two or three virtual investigations for each FOSS module for grades 3–6. Students who have been absent from certain investigations can access these simulations online through FOSSweb. The virtual investigations require students to record data and answer concluding questions in their science notebooks. Sometimes the notebook sheet that was used in the classroom investigation is also used for the virtual investigation.
SAFETY IN THE CLASSROOM AND OUTDOORS

Following the procedures described in each investigation will make for a very safe experience in the classroom. You should also review your district safety guidelines and make sure that everything you do is consistent with those guidelines. Two posters are included in the kit: Science Safety for classroom use and Outdoor Safety for outdoor activities.

Look for the safety icon in the Getting Ready and Guiding the Investigation sections that will alert you to safety considerations throughout the module.

Materials Safety Data Sheets (MSDS) for materials used in the FOSS Program can be found on FOSSweb. If you have questions regarding any MSDS, call Delta Education at 1-800-258-1302 (Monday–Friday, 8 a.m.–6 p.m. EST).

Science Safety in the Classroom

General classroom safety rules to share with students are listed here.

1. Listen carefully to your teacher’s instructions. Follow all directions. Ask questions if you don’t know what to do.
2. Tell your teacher if you have any allergies.
3. Never put any materials in your mouth. Do not taste anything unless your teacher tells you to do so.
4. Never smell any unknown material. If your teacher tells you to smell something, wave your hand over the material to bring the smell toward your nose.
5. Do not touch your face, mouth, ears, eyes, or nose while working with chemicals, plants, or animals.
6. Always protect your eyes. Wear safety goggles when necessary. Tell your teacher if you wear contact lenses.
7. Always wash your hands with soap and warm water after handling chemicals, plants, or animals.
8. Never mix any chemicals unless your teacher tells you to do so.
9. Report all spills, accidents, and injuries to your teacher.
10. Treat animals with respect, caution, and consideration.
11. Clean up your work space after each investigation.
12. Act responsibly during all science activities.

Science Safety

Listen carefully to your teacher’s instructions. Follow all directions. Ask questions if you don’t know what to do.

Tell your teacher if you have any allergies.

Never put any materials in your mouth. Do not taste anything unless your teacher tells you to do so.

Never smell any unknown material. If your teacher tells you to smell something, wave your hand over the material to bring the smell toward your nose.

Do not touch your face, mouth, ears, eyes, or nose while working with chemicals, plants, or animals.

Always protect your eyes. Wear safety goggles when necessary. Tell your teacher if you wear contact lenses.

Always wash your hands with soap and warm water after handling chemicals, plants, or animals.

Never mix any chemicals unless your teacher tells you to do so.

Report all spills, accidents, and injuries to your teacher.

Treat animals with respect, caution, and consideration.

Clean up your work space after each investigation.

Act responsibly during all science activities.

Outdoor Safety

Listen carefully to your teacher’s instructions. Follow all directions. Ask questions if you don’t know what to do.

Tell your teacher if you have any allergies. Let your teacher know if you have never been stung by a bee.

Never put any materials in your mouth.

Dress appropriately for the weather and the outdoor experience.

Stay within the designated study area and with your partner or group. When you hear the “freeze” signal, stop and listen to your teacher.

Never look directly at the Sun or at the sunlight being reflected off a shiny object.

Know if there are any skin-irritating plants in your schoolyard, and do not touch them. Most plants in the schoolyard are harmless.

Respect all living things. When looking under a stone or log, lift the side away from you so that any living thing can escape.

If a stinging insect is near you, stay calm and slowly walk away from it. Tell your teacher right away if you are stung or bitten.

Never release any living things into the environment unless you collected them there.

Always wash your hands with soap and warm water after handling chemicals, plants, or animals.

Never mix any chemicals unless your teacher tells you to do so.

Report all spills, accidents, and injuries to your teacher.

Treat animals with respect, caution, and consideration.

Clean up your work space after each investigation.

Act responsibly during all science activities.
SCHEDULING THE MODULE

The Getting Ready section for each part of an investigation helps you prepare. It provides information on scheduling the activities and introduces the tools and techniques used in the activity. Be prepared—read the Getting Ready section thoroughly.

Below is a suggested teaching schedule for the module. The investigations are numbered and should be taught in order, as the concepts build upon each other from investigation to investigation. We suggest that a minimum of 10 weeks be devoted to this module. Take your time, and explore the subject thoroughly.

Active-investigation (A) sessions include hands-on work with earth materials and tools, active thinking about experiences, small-group discussion, writing in science notebooks, and learning new vocabulary in context.

During Wrap-Up/Warm-Up (W) sessions, students share notebook entries.

Reading (R) sessions involve reading FOSS Science Resources articles.

I-Checks are short summative assessments.

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<tr>
<th>Week</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
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<td>START Inv. 1 Part 2</td>
<td>START Inv. 1 Part 3</td>
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<td>A</td>
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Water Module
### FOSS K–8 SCOPE AND SEQUENCE

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