



## INTRODUCTION

The **Energy Module** provides firsthand experiences in physical science dealing with the anchor phenomenon of energy. The five investigations focus on the concepts that energy is present whenever there is motion, electric current, sound, light, or heat, and that energy can transfer from one place to other. The driving question for the module is how does energy transfer between systems?

Students investigate electricity and magnetism as related effects and engage in engineering design while learning useful applications of electromagnetism in everyday life. Students conduct controlled experiments by incrementally changing variables to determine how to make an electromagnet stronger. They investigate how the amount of energy transfer changes when balls of different masses hit a stationary object. Students explore energy transfer through waves (repeating patterns of motion) that results in sound and motion. They gather information about how energy and fuels are derived from natural resources and how that affects the environment. They explore alternative sources of energy that use renewal resources.

Students interpret data from graphs to build explanations from evidence and make predictions of future events. They develop models to represent how energy moves from place to place in electric circuits and in waves. Students gain experiences that will contribute to the understanding of crosscutting concepts of patterns; cause and effect; systems and system models; and energy and matter.

## Contents

Introduction .....	1
Module Matrix .....	2
FOSS Components .....	8
FOSS Instructional Design .....	12
Differentiated Instruction for Access and Equity .....	20
FOSS Investigation Organization .....	23
Establishing a Classroom Culture .....	26
Safety in the Classroom and Outdoors .....	30
Scheduling the Module .....	31
FOSS Contacts .....	32

### The NGSS Performance Expectations bundled in this module include:

#### Physical Sciences

- 3-PS2-3
- 4-PS3-1
- 4-PS3-2
- 4-PS3-3
- 4-PS3-4
- 4-PS4-1
- 4-PS4-2
- 4-PS4-3

#### Earth and Space Sciences

- 4-ESS3-1

#### Engineering, Technology, and Applications of Science

- 3-5-ETS1-1
- 3-5-ETS1-2
- 3-5-ETS1-3

### ► NOTE

The three modules for grade 4 in FOSS Next Generation are

Energy

Soils, Rocks, and Landforms

Environments



## Module Summary

## Guiding and Focus Questions for Phenomena

### Inv. 1: Energy and Circuits

Students investigate the phenomenon of electric current in circuits, the pathways through which electricity flows. They work with a variety of components—D-cells, lightbulbs, motors, switches, and wires—and explore conductors and insulators. They explore series and parallel circuits and compare the functioning of the components in each circuit. They formulate and justify their predictions, based on their observations of electricity transferring energy to produce light and motion.

*How does energy transfer in a complete circuit?*

**What is needed to light a bulb?**

**What materials transfer electricity?**

**How can you light two bulbs brightly with one D-cell?**

**Which design is better for manufacturing long strings of lights—series or parallel?**

### Inv. 2: The Force of Magnetism

Students investigate the phenomenon of magnets and their interactions with materials and each other. Students go outdoors to find objects in the environment that are attracted to magnets. They conduct an investigation to determine if like or opposite poles of a magnet attract. They construct a simple compass and use it to detect magnetic effects. They also discover that magnetism can be induced in a piece of iron. They investigate the strength of the force of attraction between two magnets by graphing data to look for patterns of interaction.

*What affects magnetic force?*

**What materials stick to magnets?**

**What happens when two or more magnets interact?**

**What happens when a piece of iron comes close to or touches a permanent magnet?**

**What is the effect on the force of attraction between two magnets as the distance between them changes?**

The first two investigations provide the foundation for students to develop an understanding of electromagnetism in the next investigation.

Content Related to Disciplinary Core Ideas	Reading/Technology	Assessment
<ul style="list-style-type: none"> <li>• Energy is evident whenever there is motion, electric current, sound, light, or heat. Energy can transfer from place to place.</li> <li>• An electric circuit is a system that includes a complete pathway through which electric current flows from an energy source to its components.</li> <li>• Conductors are materials through which electric current can flow; all metals are conductors.</li> <li>• In a series circuit, there is a single pathway from the energy source to the components; in a parallel circuit, each component has its own direct pathway to the energy source.</li> <li>• The energy of two energy sources (D-cells or solar cells) adds when they are wired in series, delivering more power than a single source. Two cells in parallel have the same power as a single cell.</li> </ul>	<p><b>Science Resources Book</b>            “Edison Sees the Light”            “Energy Sources”            “Series and Parallel Circuits”            “Science Practices”            “Engineering Practices”            “Thinking Like an Engineer”            “Engineering a Solar Lighting System”</p> <p><b>Online Activities</b>            “Lighting a Bulb”            “Flow of Electricity”            “Tutorial: Simple Circuits”            “Tutorial: Conductors and Insulators”            “Turn on the Switch”            “Conductor Detector”            “D-cell Orientation”            “Tutorial: Series and Parallel Circuits”</p>	<p><b>Embedded Assessment</b>            Science notebook entries            Response sheet            Performance assessment</p> <p><b>Benchmark Assessment</b>  <i>Survey</i>  <i>Investigation 1 I-Check</i></p> <p><b>NGSS Performance Expectations</b>            4-PS3-2            4-PS3-4            3–5-ETS1-1            3–5-ETS1-2            3–5-ETS1-3</p>
<ul style="list-style-type: none"> <li>• Magnets interact with each other and with some materials.</li> <li>• Magnets stick to (attract) objects that contain iron. Iron is the only common metal that sticks to magnets.</li> <li>• All magnets have two poles, a north pole at one end (side) and a south pole at the other end (side). Like poles of magnets repel each other, and opposite poles attract.</li> <li>• Magnets are surrounded by an invisible magnetic field, which acts through space and through most materials.</li> <li>• When an iron object enters a magnetic field, the field induces magnetism in the iron object, and the object becomes a temporary magnet.</li> <li>• The magnetic force acting between magnets declines as the distance between them increases.</li> <li>• Earth has a magnetic field.</li> </ul>	<p><b>Science Resources Book</b>            “When Magnet Meets Magnet”            “Magnificent Magnetic Models”            “Make a Magnetic Compass”</p> <p><b>Video</b>  <i>All about Magnets</i></p> <p><b>Online Activities</b>            “Virtual Investigation: What Sticks and What Conducts?”            “Tutorial: Magnetic Poles”            “Tutorial: Magnetic Fields”            “Magnetic Poles”            “Magnetic Poles Quiz”</p>	<p><b>Embedded Assessment</b>            Science notebook entry            Response sheet            Performance assessment</p> <p><b>Benchmark Assessment</b>  <i>Investigation 2 I-Check</i></p> <p><b>NGSS Performance Expectations</b>            3-PS2-3            4-PS3-4</p>

## Module Summary

## Guiding and Focus Questions for Phenomena

### Inv. 3: Electromagnets

Students investigate the phenomenon of electromagnetism. Students learn how to use electricity to make an electromagnet. They explore the variables that influence the strength of the magnetism produced by their electromagnets. Students use all the concepts they have learned to engineer a simple telegraph system and communicate using a click code.

*What causes electromagnetism and how can we use it to transfer energy?*

**How can you turn a steel rivet into a magnet that turns on and off?**

**How does the number of winds of wire around a core affect the strength of the magnetism?**

**How can you reinvent the telegraph using your knowledge of energy and electromagnetism?**

### Inv. 4: Energy Transfer

Students observe the phenomenon of energy transfer that results in heat, light, sound, and motion. Students are introduced to sources of energy and components that store energy (potential energy of position or condition). They conduct structured investigations with steel balls and ramps to discover how the variable of starting position on the ramp affects the speed of the rolling ball. Using controlled experiments involving the transfer of potential energy into kinetic energy, students test the variables of mass and release position to find out how these variables affect energy transfer.

*How does energy transfer between objects or systems?*

**What do we observe that provides evidence that energy is present?**

**How does the starting position affect the speed of a ball rolling down a ramp?**

**What happens when objects collide?**

Content Related to Disciplinary Core Ideas	Reading/Technology	Assessment
<ul style="list-style-type: none"> <li>• A magnetic field surrounds a wire through which electric current is flowing.</li> <li>• The magnetic field produced by a current-carrying wire can induce magnetism in a piece of iron or steel.</li> <li>• An electromagnet is made by sending electric current through an insulated wire wrapped around an iron core.</li> <li>• The number of winds of wire in an electromagnet coil affects the strength of the magnetism induced in the core (more winds = more magnetism).</li> <li>• The amount of electric current flowing in an electromagnet circuit affects the strength of the magnetism in the core (more current = stronger magnetism).</li> <li>• A telegraph system is an electromagnet-based technology used for long-distance communication.</li> </ul>	<p><b>Science Resources Book</b>                      “Electricity Creates Magnetism”                      “Using Magnetic Fields”                      “Electromagnets Everywhere”                      “Morse Gets Clicking”</p> <p><b>Online Activities</b>                      “Kitchen Magnets”                      “Tutorial: Electromagnets”                      “Virtual Electromagnet”                      “Virtual Investigation: Electromagnetic Experiments”                      “Tutorial: Creating Graphs”                      “Tutorial: Interpreting Graphs”</p>	<p><b>Embedded Assessment</b>                      Response sheet                      Performance assessment                      Science notebook entry</p> <p><b>Benchmark Assessment</b>  <i>Investigation 3 I-Check</i></p> <p><b>NGSS Performance Expectations</b>                      3-PS2-3                      4-PS3-2                      4-PS3-4                      4-PS4-3                      3–5-ETS1-3</p>
<ul style="list-style-type: none"> <li>• Energy is evident whenever there is motion, electric current, sound, light, or heat. Energy can be transferred from place to place.</li> <li>• Objects in motion have energy. The faster a given object is moving, the more kinetic energy it has.</li> <li>• When objects collide, energy can transfer from one object to another, thereby changing their motion.</li> <li>• Kinetic energy is energy of motion; potential energy is energy of position. For identical objects at rest, the objects at higher heights have more potential energy than the objects at lower heights.</li> </ul>	<p><b>Science Resources Book</b>                      “Energy”                      “What Causes Change of Motion?”                      “Bowling”                      “Force and Energy”                      “Potential and Kinetic Energy at Work”</p> <p><b>Videos</b>  <i>Candle</i> (optional)  <i>Soccer</i> (optional)  <i>Ball on Table</i> (optional)  <i>Wagon</i> (optional)  <i>All about the Transfer of Energy</i></p>	<p><b>Embedded Assessment</b>                      Performance assessment                      Science notebook entry                      Response sheet</p> <p><b>Benchmark Assessment</b>  <i>Investigation 4 I-Check</i></p> <p><b>NGSS Performance Expectations</b>                      4-PS3-1                      4-PS3-2                      4-PS3-3</p>

## Module Summary

Students experience the phenomenon of waves through firsthand experiences using ropes, demonstrations with waves in water, spring toys, and a sound generator. They also use videos, animations, and readings to gather information. Through these experiences, students learn that waves are repeating patterns of motion that transfer energy from place to place. They analyze compression waves (sound waves) to learn the general properties of waves—amplitude, wavelength, and frequency.

Students use mirrors to experience reflecting light. They start by using mirrors outdoors to see objects behind them and to reflect a bright image of the Sun onto walls. In the classroom, they determine that a mirror can be used to reflect light. Students then use flashlights, mirrors, and water to observe light in numerous ways, reinforcing the idea that light can reflect and refract. Students build a conceptual model about how light travels.

Students use light wave energy to design series and parallel solar cell circuits and observe the effect on the speed of a motor. They observe that cells in series make the motor run faster, but cells in parallel do not deliver additional power to the motor. They read about alternative energy sources.

## Guiding and Focus Questions for Phenomena

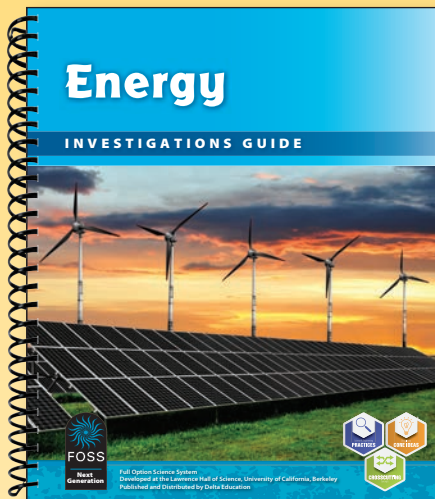
***What do waves have to do with energy?***

**How are waves involved in energy transfer?**

**How does light travel?**

**How can you make a motor run faster using solar cells?**

Content Related to Disciplinary Core Ideas	Reading/Technology	Assessment
<ul style="list-style-type: none"> <li>• Waves are a repeating pattern of motion that transfer energy from place to place. Some electromagnetic waves can be detected by humans (light); others can be detected by designed technologies (radio waves, cell phones).</li> <li>• There are sound waves, light waves, radio waves, microwaves, and ocean waves.</li> <li>• Waves have properties—amplitude, wave length, and frequency.</li> <li>• Light travels in straight lines and can reflect (bounce) off surfaces.</li> <li>• Light can refract (change direction) when it passes from one transparent material into another.</li> <li>• Matter can absorb light.</li> <li>• An object is seen only when light from that object enters and is detected by an eye.</li> <li>• White light is a mixture of all colors (wavelengths) of visible light.</li> <li>• Solar cells are designed technologies to transfer visible light into electricity.</li> <li>• The energy of two energy sources (D-cells or solar cells) adds when they are wired in series, delivering more power than a single source.</li> <li>• Two cells in parallel have the same power as a single cell.</li> <li>• Humans impact the environment by using natural resources to produce energy. Some resources are renewable over time and others are not.</li> </ul>	<p><b>Science Resources Book</b></p> <p>“Waves”            “More about Sound”            “Light Interactions”            “Throw a Little Light on Sight”            “More Light on the Subject”            “Alternative Sources of Electricity”            “Ms. Osgood’s Class Report”</p> <p><b>Videos</b></p> <p><i>Sound Energy</i>  <i>Waves</i>  <i>Real World Science: Sound</i>  <i>All about Waves</i>  <i>All about Light</i>  <i>Wave</i></p> <p><b>Online Activities</b></p> <p>“Tutorial: Reflection”            “Reflecting Light”            “Colored Light”            “Virtual Investigation: Color”</p>	<p><b>Embedded Assessment</b></p> <p>Science notebook entry            Response sheet            Performance assessment</p> <p><b>Benchmark Assessment</b></p> <p><i>Posttest</i></p> <p><b>NGSS Performance Expectations</b></p> <p>4-PS3-2            4-PS3-4            4-PS4-1            4-PS4-2            4-ESS3-1            3–5-ETS1-1            3–5-ETS1-2            3–5-ETS1-3</p>



## FOSS COMPONENTS

### Teacher Toolkit for Each Module

The FOSS Next Generation Program has three modules for grade 4—Energy, Environments, and Soils, Rocks, and Landforms.

Each module comes with a *Teacher Toolkit* for that module. 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
- Framework and NGSS
- Materials
- Technology
- Investigations (five in this module)
- Assessment

### INVESTIGATION 2 — The Force of Magnetism

**Materials for Steps 10–12**

- Spacers
- Recording dots (4 sets of 7)

**TEACHING NOTE**

It is important that students skip two spacers at this juncture and proceed to gather data for 3–6 spacers. In Step 13, students will use their data to predict the number of washers it will take to break the force with two spacers.

**SCIENCE AND ENGINEERING PRACTICES**

Planning and carrying out investigations  
Analyzing and interpreting data  
Using mathematics and computational thinking  
Constructing explanations  
Obtaining, evaluating, and communicating information

**DISCIPLINARY CORE IDEAS**

PS2.B: Types of interactions

**CROSSCUTTING CONCEPTS**

Patterns

218

Full Option Science System

### Part 3: Magnetic Force

b. To record data on the graph, have students find the number on the spacers axis that represents the number of spacers used in one test. They should run a finger up that line until they reach the line representing the number of washers (from the T-table) that it took to break the force.

In this example, it took 20 washers to break the force with zero spacers, 12 washers to break the force with one spacer, and so on.

c. Place a recording dot where the two lines cross. The place where the horizontal line and vertical line cross is called the intersection. It represents the relationship between the distance between two magnets (the number of spacers) and the force (the number of washers) needed to separate the two magnets.

d. Repeat this process for the other data (ordered pairs) in the table.

**POSSIBLE BREAKPOINT**

**13. Make predictions using the graph**

Have students look at the graph to predict the number of washers it will take to break the force of attraction when two spacers are placed between the magnets. It may help students predict if they first draw a best-fit line connecting the data points. In this case that best-fit line is a curved line.

Ask students to talk it over and to come up with a rationale for their predictions—causes-and-effect explanations (claims and evidence). Students might claim that the force between attracting magnets at a distance of two spacers should be greater than with three spacers but less than with one spacer based on the curved line relationship described by the graph of the collected data.

**14. Test the prediction**

After students make their predictions, they can use the equipment to determine the number of washers needed to break the force of attraction with a distance of two spacers. Have them fill in the T-table and graph, using the data.

**15. Clean up**

When the groups have completed their data collection and recording, have them disassemble the equipment, bag up washers, and collect the spacers. Have Getters return everything to the materials station.

These data suggest that it would take 9 washers to break the force with two spacers.

**CROSSCUTTING CONCEPTS**

Patterns  
Cause and effect  
Energy and matter

219

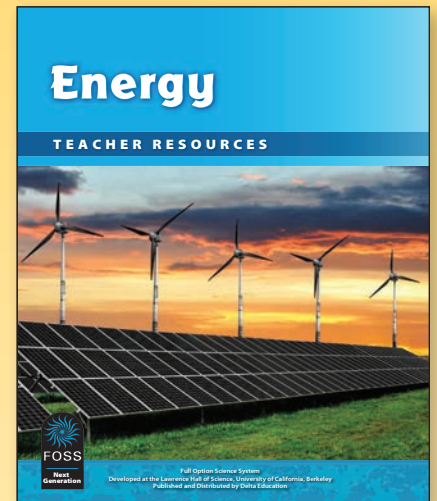
Energy Module—FOSS Next Generation



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

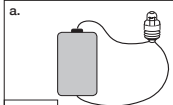
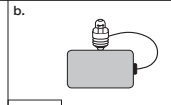
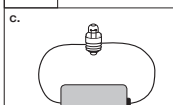
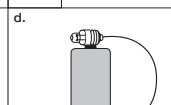
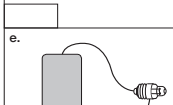
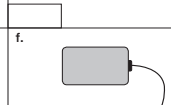
**Teacher Resources.** These chapters can be downloaded from FOSSweb and are also in the bound *Teacher Resources* book.

- FOSS Program Goals
- Planning Guide—Grade 4
- Science and Engineering Practices—Grade 4
- Crosscutting Concepts—Grade 4
- Sense-Making Discussions for Three-Dimensional Learning—Grade 4
- Access and Equity
- Science Notebooks in Grades 3–5
- Science-Centered Language Development
- FOSS and Common Core ELA—Grade 4
- FOSS and Common Core Math—Grade 4
- Taking FOSS Outdoors
- Science Notebook Masters
- Teacher Masters
- Assessment Masters



**Lighting Bulbs**

Write a prediction for each circuit in the small box. If you think it will light, write “yes.”  
If you think it won’t light, write “no.”

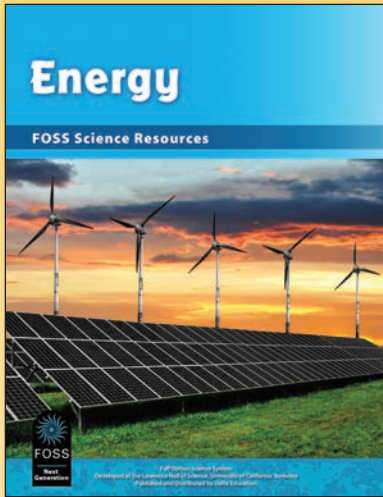
a.  <input style="width: 50px; height: 20px;" type="text"/>	b.  <input style="width: 50px; height: 20px;" type="text"/>
c.  <input style="width: 50px; height: 20px;" type="text"/>	d.  <input style="width: 50px; height: 20px;" type="text"/>
e.  <input style="width: 50px; height: 20px;" type="text"/>	f.  <input style="width: 50px; height: 20px;" type="text"/>

## Equipment for Each Module or Grade Level

The FOSS Program provides the materials needed for the investigations, 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 three uses before you need to resupply. Teachers may be asked to supply small quantities of common classroom materials.

Delta Education can assist you with materials management strategies for schools, districts, and regional consortia.





## FOSS Science Resources Books

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

The articles in *Science Resources* and the discussion questions provided in *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.

### A Better Lightbulb

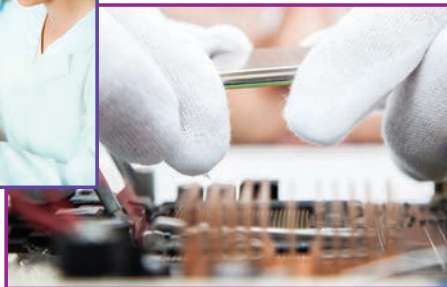
Think about Thomas Edison (1847–1931) working on the lightbulb. The filament burnt out too quickly. His team developed a plan to solve this problem. They made hundreds of different prototypes and tested them.

Think about the criteria for a solution to this problem: How do you make an inexpensive lightbulb that lasts a long time and uses little energy? Edison and his team found a good solution. Ever since, engineers have been designing light sources that meet new criteria.

What would the criteria be for a portable lighting system used in places without electricity? What would the constraints be?



Computer engineers work on designing new computer systems.



24

## Engineering a Solar Lighting System

In 2008, Dr. Laura Stachel was in northern Nigeria. There she observed emergency care at a state hospital. She realized that lack of reliable electricity was a huge problem. Because of frequent blackouts, midwives and doctors struggled to diagnose and treat women with pregnancy problems. Emergency surgeries were interrupted. Dr. Stachel worked with her husband, Hal Aronson, a solar energy educator in Berkeley, California, to solve the problem. They created a solar system to provide electricity for important parts of the hospital. Other health workers in the area began to ask for solar lighting for their clinics, too. Mr. Aronson and Dr. Stachel formed a nonprofit company, We Care Solar. Mr. Aronson designed the We Care Solar Suitcase. This solar system is easy to move, easy to install, durable, and inexpensive to maintain. Mr. Aronson sat down with FOSS to talk about how he engineered this device.

**Q: Can you describe the problem that you set out to solve?**

**A:** The primary problem is the lack of good-quality light, or any light at all. Good-quality light is needed to properly treat sick people. For example, doctors need to see where a mother is bleeding to be able to stop the bleeding.



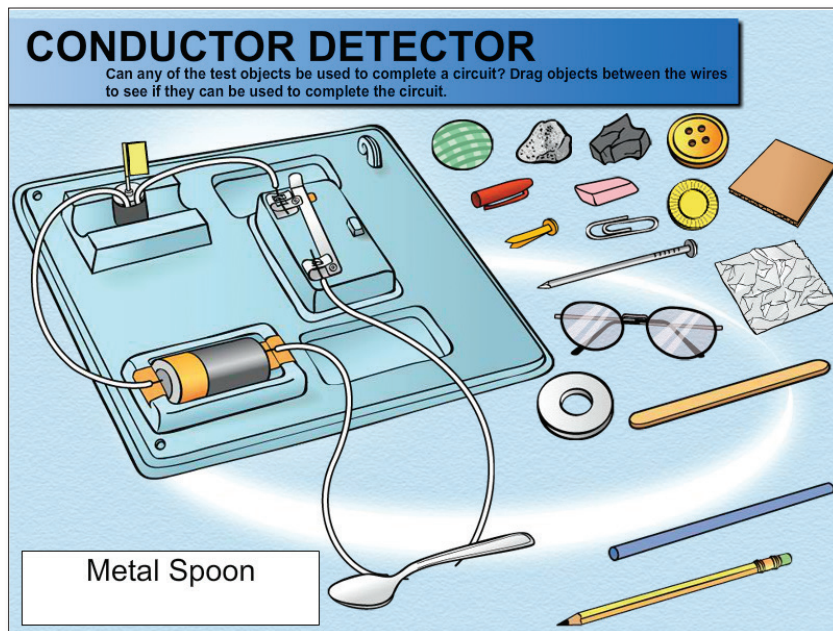
Mr. Aronson and Dr. Stachel

25

## Technology

The FOSS website opens new horizons for educators, students, and families, in the classroom or at home. Each module has digital resources for students and families—interactive simulations, virtual investigations, and online activities. For teachers, FOSSweb provides online teacher *Investigations Guides*; grade-level planning guides (with connections to ELA and math); materials management strategies; science teaching and professional development tools; contact information for the FOSS Program developers; and technical support. In addition, FOSSweb provides digital access to PDF versions of the *Teacher Resources* component of the *Teacher Toolkit*, digital-only instructional resources that supplement the print and kit materials, and access to FOSSmap, the online assessment and reporting system for grades 3–8.

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 Learning

The Lawrence Hall of Science and Delta Education strive to develop long-term partnerships with districts and teachers through thoughtful planning, effective implementation, and ongoing teacher support. FOSS has a strong network of consultants who have rich and experienced backgrounds in diverse educational settings using FOSS.

### ▶ NOTE

To access all the teacher resources and to set up customized pages for using FOSS, log in to FOSSweb through an educator account. See the Technology chapter in this guide for more specifics.

### ▶ NOTE

Look for professional development opportunities and online teaching resources on [www.FOSSweb.com](http://www.FOSSweb.com).

## FOSS INSTRUCTIONAL DESIGN

FOSS is designed around active investigation that provides engagement with science concepts and science and engineering practices. Surrounding and supporting those firsthand investigations are a wide range of experiences that help build student understanding of core science concepts and deepen scientific habits of mind.

### The Elements of the FOSS Instructional Design



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

- Active investigation in collaborative groups: firsthand experiences with phenomena in the natural and designed worlds
- Recording in science notebooks to answer a focus question dealing with the scientific phenomenon under investigation
- Reading informational text in *FOSS Science Resources* books
- Online activities to acquire data or information or to elaborate and extend the investigation
- Outdoor experiences to collect data from the local environment or to apply knowledge
- Assessment to monitor progress and inform student learning

In practice, these components are seamlessly integrated into a curriculum designed to maximize every student's opportunity to learn.

A **learning cycle** employs an instructional model based on a constructivist perspective that calls on students to be actively involved in their own learning. The model systematically describes both teacher and learner behaviors in a coherent approach to science instruction.

A popular model describes a sequence of five phases of intellectual involvement known as the 5Es: engage, explore, explain, elaborate, and evaluate. The body of foundational knowledge that informs contemporary learning-cycle thinking has been incorporated seamlessly and invisibly into the FOSS curriculum design.

Engagement with real-world **phenomena** is at the heart of FOSS. In every part of every investigation, the investigative phenomenon is referenced implicitly in the focus question that guides instruction and frames the intellectual work. The focus question is a prominent part of each lesson and is called out for the teacher and student. The investigation Background for the Teacher section is organized by focus question—the teacher has the opportunity to read and reflect on the phenomenon in each part in preparing for the lesson. Students record the focus question in their science notebooks, and after exploring the phenomenon thoroughly, explain their thinking in words and drawings.

In science, a phenomenon is a natural occurrence, circumstance, or structure that is perceptible by the senses—an observable reality. Scientific phenomena are not necessarily phenomenal (although they may be)—most of the time they are pretty mundane and well within the everyday experience. What FOSS does to enact an effective engagement with the NGSS is thoughtful selection of scientific phenomena for students to investigate.

## ► NOTE

The anchor phenomena establish the storyline for the module. The investigative phenomena guide each investigation part. Related examples of everyday phenomena are incorporated into the readings, videos, discussions, formative assessments, outdoor experiences, and extensions.



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

**Context: sharing, questioning, and planning.** Active investigation requires focus. The context of an inquiry can be established with a focus question about a phenomenon or challenge from you or, in some cases, from students. (How can you get two bulbs to burn brightly?) 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 how the number of winds of wire around a core affect the strength of an electromagnet. 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 to lead students to a comprehensive understanding of concepts. Through investigations and readings, 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.

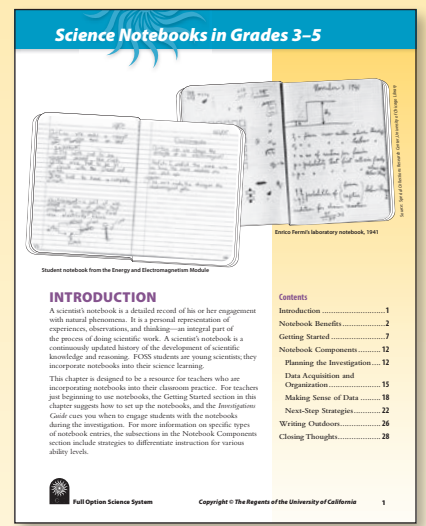
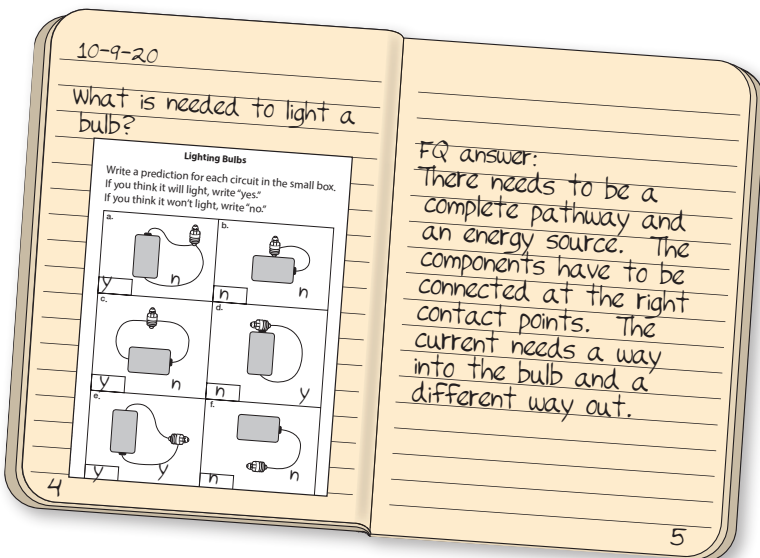
Students then organize data so they will be easier to think about. Tables allow efficient comparison. Organizing data in a sequence (time) or series (size) can reveal patterns. Students process some data into graphs, providing visual display of numerical data. They also organize data and process them 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 prior knowledge. Students share their explanations for phenomena, using evidence generated during the investigation to support their ideas. They conclude the active investigation by writing a summary of their learning as well as questions raised during the activity in their science notebooks.

## 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 exhibitions of the assessment system.

You will find the duplication masters for grades 1–5 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-sized masters for grades 3–5 that can be filled in electronically and are suitable for display are available on FOSSweb. Student work is entered partly in spaces provided on the notebook sheets and partly on adjacent blank sheets in the composition book. Look to the chapter in *Teacher Resources* called Science Notebooks in Grades 3–5 for more details on how to use notebooks with FOSS.





## Reading in FOSS Science Resources

The *FOSS Science Resources* books, available in print and interactive eBooks, are primarily devoted to expository articles and biographical sketches. FOSS suggests that the reading be completed during language-arts time to connect to the Common Core State Standards for ELA. 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.

Recommended strategies to engage students in reading, writing, speaking, and listening around the articles in the *FOSS Science Resources* books are included in the flow of Guiding the Investigation. In addition, a library of resources is described in the Science-Centered Language Development chapter in *Teacher Resources*.

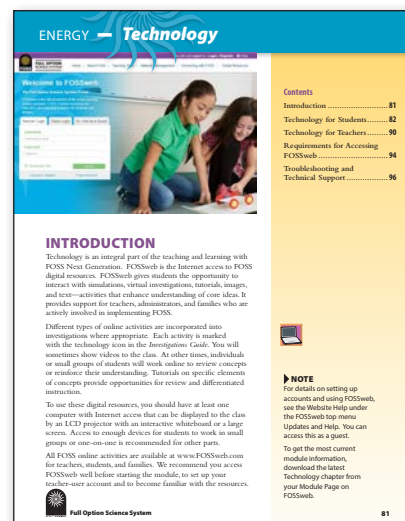
The FOSS and the Common Core ELA—Grade 4 chapter in *Teacher Resources* shows how FOSS provides opportunities to develop and exercise the Common Core ELA practices through science. A detailed table identifies these opportunities in the three FOSS modules for the fourth grade.



## Engaging in Online Activities through FOSSweb

The simulations and online activities on FOSSweb are designed to support students' learning at specific times during instruction. Digital resources include streaming videos that can be viewed by the class or small groups. Resources may also include virtual investigations and tutorials that students can use to review the active investigations and to support students who need more time with the concepts or who have been absent and missed the active investigations.

The Technology chapter provides details about the online activities for students and the tools and resources for teachers to support and enrich instruction. There are many ways for students to engage with the digital resources—in class as individuals, in small groups, or as a whole class, and at home with family and friends.





## 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 predominantly diagnostic. Summative assessment looks at the learning after instruction is completed, and it measures achievement.

Formative assessment in FOSS, called **embedded assessment**, is an integral part of instruction, and occurs on a daily basis. You observe action during class in a performance assessment or review notebooks after class. Performance assessments look at students' engagement in science and engineering practices or their recognition of crosscutting concepts, and are indicated with the second assessment icon. 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.

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 observe the actions and look at their notebook entries. Bullet points in the Guiding the Investigation tell you specifically what students should know and be able to communicate.

**Benchmark assessments** include the *Survey*, *I-Checks*, *Posttest*, and interim assessments. The *Survey* is given before instruction begins. It provides information about students' prior knowledge. **I-Checks** are actually hybrid tools: they can provide summative information about students' achievement, but more importantly, they can be used formatively as well to provide diagnostic information. Reviewing specific items on an I-Check with the class provides additional opportunities for students to clarify their thinking. The *Posttest* is a summative assessment given after instruction is complete.

Interim assessments give students practice with items specifically designed to measure three-dimensional learning described by NGSS performance expectations. Interim assessment tasks generally begin with a scenario, and ask students to apply practices and crosscutting concepts as well as disciplinary core ideas to respond to the item. Interim assessment tasks can be administered during a module, at the end of the module, or as an end-of-year grade-level assessment.

All benchmark items are carefully designed to be valid, reliable, and accessible to all students. They focus on assessment *for* learning, and when accompanied by thoughtful self-assessment activities and feedback, contribute to the development of a growth mindset.



### ► TECHNOLOGY COMPONENTS OF THE FOSS ASSESSMENT SYSTEM

FOSSmap for teachers and online assessment for students are the technology components of the FOSS assessment system. Students in grades 3–5 can take assessments online. FOSSmap provides the tools for you to review those assessments online so you can determine next steps for the class or differentiated instruction for individual students based on assessment performance. See the Assessment chapter for more information on these technology components.



## 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.

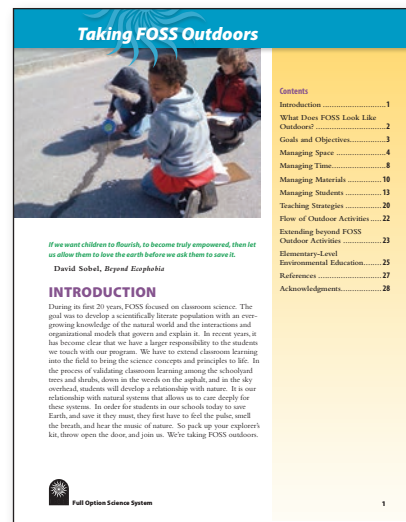
In addition to transfer and application, students can learn things outdoors that they are not able to learn indoors. The most important object of inquiry outdoors is the outdoors itself. To today's youth, the outdoors is something to pass through as quickly as possible to get to the next human-managed 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 classroom 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 *Teacher Resources*.

### NOTE

The kit includes a set of four *Conservation* posters so you can discuss the importance of natural resources with students.



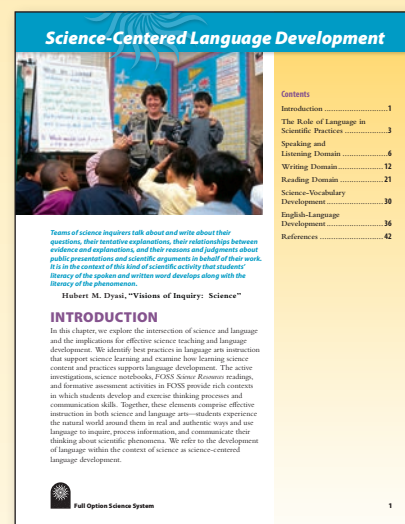
## Science-Centered Language Development and Common Core State Standards for ELA

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. 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 identified in contemporary standards for English language arts.

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. We identify effective practices in language-arts instruction that support science learning and examine how learning science content and engaging in science and engineering practices support language development.

Specific methods to make connections to the Common Core State Standards for English Language Arts are included in the flow of Guiding the Investigation. These recommended methods are linked to the CCSS ELA through ELA Connection notes. In addition, the FOSS and the Common Core ELA chapter in *Teacher Resources* summarizes all of the connections to each standard at the given grade level.



*“Active science by itself provides part of the solution to full inclusion and provides many opportunities at the same time for differentiated instruction.”*

## **DIFFERENTIATED INSTRUCTION FOR ACCESS AND EQUITY**

### **Learning from Experience**

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 Program). As this special-education science program expanded into fully integrated (mainstreamed) 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 and provides many opportunities at the same time for differentiated instruction.

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 guiding principles.

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

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

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

## FOSS for All Students

The FOSS Program has been designed to maximize the science learning opportunities for all students, including those who have traditionally not had access to or have not benefited from equitable science experiences—students with special needs, ethnically diverse learners, English learners, students living in poverty, girls, and advanced and gifted learners. FOSS is rooted in a 30-year tradition of multisensory science education and informed by recent research on UDL and culturally and linguistically responsive teaching and learning. 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 during the initial instruction phase. In addition, the **Access and Equity** chapter in *Teacher Resources* (or go to FOSSweb to download this chapter) provides strategies and suggestions for enhancing the science and engineering experiences for each of the specific groups noted above.

Throughout the FOSS investigations, students experience multiple ways of interacting with phenomena and expressing their understanding through a variety of modalities. Each student has multiple opportunities to demonstrate his or her strengths and needs, thoughts, and aspirations.

The challenge is then to provide appropriate follow-up experiences or enhancements appropriate for each student. For some students, this might mean more time with the active investigations or online activities. For other students, it might mean more experience and/or scaffolds for developing models, building explanations, or engaging in argument from evidence.

For some students, it might mean making vocabulary and language structures more explicit through new concrete experiences or through reading to students. It may help them identify and understand relationships and connections through graphic organizers.

For other students, it might be designing individual projects or small-group investigations. It might be more opportunities for experiencing science outside the classroom in more natural, outdoor environments or defining problems and designing solutions in their communities.

## Assessment and Extensions

The next-step strategies suggested during the self-assessment sessions following I-Checks provide opportunities for differentiated instruction. These strategies can also be used to provide targeted and strategic instruction for students who need additional specific support. For more on next-step strategies, see the Assessment chapter.

There are additional approaches and strategies for ensuring access and equity by providing appropriate differentiated instruction. The FOSS Program provides tools and strategies so that you know what students are thinking throughout the module. Based on that knowledge and what you know about your students' cultural and linguistic background, as well as their individual strengths and needs, read through the extension activities for additional ways to enhance the learning experience for your students. Interdisciplinary extensions in the arts, social studies, math, and language arts, as well as more advanced projects are listed at the end of each investigation. Use these ideas to meet the individual needs and interests of your students. In addition, online activities including tutorials and virtual investigations are effective tools to provide differentiated levels of instruction.

## English Learners

The FOSS Program provides a rich laboratory for language development for English learners. A variety of techniques to make science concepts clear and concrete, including modeling, visuals, and active investigations in small groups. Instruction is guided and scaffolded through carefully designed lesson plans, and students are supported throughout.

Science vocabulary and language structures are introduced in authentic contexts while students engage in hands-on learning and collaborative discussion. Strategies for helping all students read, write, speak, and listen are described in the Science-Centered Language Development chapter. A specific section on English learners provides suggestions for both integrating English language development (ELD) approaches during the investigation and for developing designated (targeted and strategic) ELD-focused lessons that support science learning.

## FOSS INVESTIGATION ORGANIZATION

Modules are subdivided into **investigations** (five in this module). Investigations are further subdivided into three to five **parts**. Each investigation has a general guiding question for the phenomenon students investigate, and each part of each investigation is driven by a **focus question**. The focus question, usually presented as the part begins, engages the student with the phenomenon and 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.

The investigation is summarized for the teacher in the At-a-Glance chart at the beginning of each investigation.

Investigation-specific **scientific background** information for the teacher is presented in each investigation chapter organized by the focus questions.

The **Teaching Children about** section makes direct connections to the NGSS foundation boxes for the grade level—Disciplinary Core Ideas, Science and Engineering Practices, and Crosscutting Concepts. This information is later presented in color-coded sidebar notes to identify specific places in the flow of the investigation where connections to the three dimensions of science learning appear. The Teaching Children about section ends with information about teaching and learning and a conceptual-flow graphic of the content.

The **Materials** and **Getting Ready** sections provide scheduling information and detail exactly how to prepare the materials and resources for conducting the investigation.

**Teaching notes** and **ELA Connections** 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. 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. ELA Connection boxes provide connections to the Common Core State Standards for English Language Arts.

### FOCUS QUESTION

*What is needed to light a bulb?*

### SCIENCE AND ENGINEERING PRACTICES

Constructing explanations

### DISCIPLINARY CORE IDEAS

PS3.B: Conservation of energy and energy transfer

### CROSSCUTTING CONCEPTS

Systems and system models

#### TEACHING NOTE

*This focus question can be answered with a simple yes or no, but the question has power when students support their answers with evidence. Their answers should take the form "Yes, because \_\_\_\_."*

The **Getting Ready** and **Guiding the Investigation** sections have several features that are flagged 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.



The **safety** icon alerts you to potential safety issues related to chemicals, allergic reactions, and the use of safety goggles.



The small-group **discussion** icon asks you to pause while students discuss data or construct explanations in their groups.



The **new-word** icon alerts you to a new vocabulary word or phrase that should be introduced thoughtfully.



The **vocabulary** icon indicates where students should review recently introduced vocabulary.



The **recording** icon points out where students should make a science-notebook entry.



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



The **technology** icon signals when the class should use a digital resource on FOSSweb.



The **assessment** icons appear when there is an opportunity to assess student progress by using embedded or benchmark assessments. Some are performance assessments—observations of science and engineering practices, indicated by a second icon which includes a beaker and ruler.



The **outdoor** icon signals when to move the science learning experience into the schoolyard.



The **engineering** icon indicates opportunities for an experience incorporating engineering practices.



The **math** icon indicates an opportunity to engage in numerical data analysis and mathematics practice.



The **crosscutting concepts** icon indicates an opportunity to expand on the concept by going to *Teacher Resources, Crosscutting Concepts* chapter. This chapter provides details on how to engage students with that concept in the context of the investigation.



The **EL note** provides a specific strategy to use to assist English learners in developing science concepts.

EL NOTE

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

**POSSIBLE BREAKPOINT**



## ESTABLISHING A CLASSROOM CULTURE

### 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, language development, and self-confidence. FOSS investigations use collaborative groups extensively. Here are a few general guidelines for collaborative learning 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 and inclusion. Thoughtfully constituted groups tend to work better.

Groups can be maintained for extended periods of time, or they can be reconfigured 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.

The **Getter** is responsible for materials. One person from each group gets equipment from the materials station, and later returns the equipment.

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

The **Recorder** makes sure that everyone has recorded information in his or her science notebook and, as appropriate, records the group data and ideas.

The **Reporter** reports group data to the class or transcribes it to the board or class chart, and shares the main points of the group discussion during class discussion.

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 in more 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.

## Norms for Sense-Making Discussions

Setting up norms for discussion and holding yourself and your students accountable is the first step toward creating a culture of productive talk in the classroom that supports engagement in the science and engineering practices. Students need to feel free to express their ideas, and to provide and receive criticism from others as they work toward understanding of the disciplinary core ideas of science and methods of engineering.

Establish norms at the beginning of the school year. It is recommended that this be done together as a class activity. However, presenting a poster of norms to students and asking them to discuss why each one is important can also be effective. Before each sense-making discussion, review the norms. Review what it will look like, sound like, and feel like when everyone is following the agreements. You might have students work on one or two at a time as they are developing their oral discourse skills. After discussion, save a few minutes for reflection on how well the group or the class adhered to the norms and what they can do better next time. More strategies for supporting academic discourse can be found in the Sense-Making Discussions for Three-Dimensional Learning and Science-Centered Language Development chapters in *Teacher Resources* (also available as downloadable PDFs on FOSSweb).



**My Responsibilities**

I agree that I will...

- explain my ideas.
- listen to others and show that I am listening.
- ask questions when I am confused or can't hear.
- connect my ideas to others' (explain, add to, respectfully disagree).
- participate because all ideas lead to learning (speak loud and clear).

Modified from Talk Science Primer by Sarah Michaels and Cathy O'Connor

This poster is an example of student responsibilities that the class discussed and adopted as their norms.

## Managing Materials

The Materials section lists the items in the equipment kit and any teacher-supplied materials. It also describes things to do to prepare a new kit and how to check and prepare the kit for your classroom. Classroom volunteers and helpful students can also assist in setting up and preparing the materials.

Individual photos of each piece of FOSS equipment are available for printing from FOSSweb, and can help students and you identify each item. They can be used to support emerging readers and English language learners to acquire and use new vocabulary words necessary to engage in the investigations. (Photo equipment cards are available in English and Spanish formats.)

The FOSS Program designers suggest using a central materials distribution system. You organize all the materials for an investigation at a single location called the materials station. As the investigation progresses, one member of each group gets materials as they are needed, and another returns the materials when the investigation is complete. You place the equipment and resources at the station, and students do the rest. Students can also be involved in cleaning and organizing the materials at the end of a session. Be sure to work with students to Reduce, Reuse, and Recycle the materials used in science.

## 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. There are suggested interactive reading strategies for each article as well as embedded 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 3–5. 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.



## Collaborative Teaching and Learning

Collaborative learning requires a collective as well as individual growth mindset. A growth mindset is when people believe that their most basic abilities can be developed through dedication and hard work (see the research of Carol Dweck and her book *Mindset: The Psychology of Success*). As students work together to make sense of phenomena and develop their inquiry and discourse skills, it's important to recognize and value their efforts to try new approaches and their willingness to make their thinking visible. Remind students that everyone in the classroom, including you the teacher, will be learning new ideas and ways to think about the world. Where there is productive struggle, there is learning. Here are a few ways to help students develop a growth mind-set for science and engineering.

- **Praise effort, not right answers.** When students are successful at a task, provide positive feedback about their level of engagement and effort in the practices, e.g., the efforts they put into careful observations, how well they organized and interpreted their data, the relevancy of their questions, how well they connected or applied new concepts, and their use of precise vocabulary, etc. Also, try to provide feedback that encourages students to continue to improve their learning and exploring, e.g., is there another way to approach this question? Have you thought about \_\_\_\_? What evidence is there to support \_\_\_\_?
- **Foster and validate divergent thinking.** During sense-making discussions, continually emphasize how important it is to share emerging ideas and to be open to the ideas of others in order to build understanding. Model for students how you refine and revise your thinking based on new information. Make it clear to students that the point is not for them to show they have the right answer, but rather to help each other arrive at new understandings. Point out positive examples of students expressing and revising their ideas.

Establishing a classroom culture that supports three-dimensional teaching and learning centers on collaboration. Collaborative groupings, materials management, and norms are structures you can put into place to foster collaboration. These structures along with the expectations that students will be negotiating meaning together as a community of learners, creates a learning environment where students are compelled to work, think, and communicate like scientists and engineers to help one another learn.

## 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.

Safety Data Sheets (SDS) for materials used in the FOSS Program can be found on FOSSweb. If you have questions regarding any SDS, call Delta Education at 1-800-258-1302 (Monday–Friday, 8 a.m.–5 p.m. ET).



### Science Safety

- 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.



### Outdoor Safety

- 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. Let your teacher know if you have never been stung by a bee.
- 3 Never put any materials in your mouth.
- 4 Dress appropriately for the weather and the outdoor experience.
- 5 Stay within the designated study area and with your partner or group. When you hear the "freeze" signal, stop and listen to your teacher.
- 6 Never look directly at the Sun or at the sunlight being reflected off a shiny object.
- 7 Know if there are any skin-irritating plants in your schoolyard, and do not touch them. Most plants in the schoolyard are harmless.
- 8 Respect all living things. When looking under a stone or log, lift the side away from you so that any living thing can escape.
- 9 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.
- 10 Never release any living things into the environment unless you collected them there.
- 11 Always wash your hands with soap and warm water after handling plants, animals, and soil.
- 12 Return to the classroom with all of the materials you brought outside.



### 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.

## SCHEDULING THE MODULE

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 nine weeks be devoted to this module.

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

**Reading (R)** sessions involve reading *FOSS Science Resources* articles. Reading can be completed during language-arts time to make connections to Common Core State Standards for ELA (CCSS ELA).

During **Wrap-Up/Warm-Up (W)** sessions, students share notebook entries and engage in connections to CCSS ELA. These sessions can also be completed during language-arts time.

**I-Checks** are short summative assessments at the end of each investigation. Students have a short notebook review session the day before and a self-assessment of selected items the following day. (See the Assessment chapter for the next-step strategies for self-assessment.)

### NOTE

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 and review the teacher preparation video on FOSSweb.

Week	Day 1	Day 2	Day 3	Day 4	Day 5
	Survey				
1	START Inv. 1 Part 1	R/W	START Inv. 1 Part 2		R/W
	A		A		
2	START Inv. 1 Part 3	A/R/W	START Inv. 1 Part 4	R/Review	I-Check 1
	A		A/R		
3	Self-assess	START Inv. 2 Part 1	START Inv. 2 Part 2	A	R/W
		A/W	A		
4	START Inv. 2 Part 3	A/R	R	Review	I-Check 2
	A				
5	Self-assess	START Inv. 3 Part 1	A/R/W	START Inv. 3 Part 2	R/W
		A		A	
6	START Inv. 3 Part 3	A	R	Review	I-Check 3
	A				
7	Self-assess	START Inv. 4 Part 1	A	R/W	START Inv. 4 Part 2
		A			A
8	A/R/W	START Inv. 4 Part 3	A/R	R	Review
		A			
9	I-Check 4	Self-assess	START Inv. 5 Part 1	A	R/W
			A		
10	START Inv. 5 Part 2	A	R	R	R/W
	A				
11	START Inv. 5 Part 3	A/R	R	Review	Posttest
	A				

## **FOSS CONTACTS**

### ***General FOSS Program information***

[www.FOSSweb.com](http://www.FOSSweb.com)

[www.DeltaEducation.com/FOSS](http://www.DeltaEducation.com/FOSS)

### ***Developers at the Lawrence Hall of Science***

[foss@berkeley.edu](mailto:foss@berkeley.edu)

### ***Customer Service at Delta Education***

[www.DeltaEducation.com/contact.aspx](http://www.DeltaEducation.com/contact.aspx)

Phone: 1-800-258-1302, 8:00 a.m.–5:00 p.m. ET

### ***FOSSmap (online component of FOSS assessment system)***

<http://FOSSmap.com/>

### ***FOSSweb account questions/access codes/help logging in***

[techsupport.science@schoolspecialty.com](mailto:techsupport.science@schoolspecialty.com)

Phone: 1-800-258-1302, 8:00 a.m.–5:00 p.m. ET

### ***School Specialty online support***

[loginhelp@schoolspecialty.com](mailto:loginhelp@schoolspecialty.com)

Phone: 1-800-513-2465, 8:30 a.m. –6:00 p.m. ET

### ***FOSSweb tech support***

[support@fossweb.com](mailto:support@fossweb.com)

### ***Professional development***

[www.FOSSweb.com/Professional-Development](http://www.FOSSweb.com/Professional-Development)

### ***Safety issues***

[www.DeltaEducation.com/SDS](http://www.DeltaEducation.com/SDS)

Phone: 1-800-258-1302, 8:00 a.m.–5:00 p.m. ET

For chemical emergencies, contact Chemtrec 24 hours per day.

Phone: 1-800-424-9300

### ***Sales and replacement parts***

[www.DeltaEducation.com/FOSS/buy](http://www.DeltaEducation.com/FOSS/buy)

Phone: 1-800-338-5270, 8:00 a.m.–5:00 p.m. ET