INTRODUCTION

The Sun, Moon, and Planets Module has four investigations that focus on Earth’s place in the solar system. In this module, students will

- Observe and compare shadows during a school day.
- Relate the position of the Sun in the sky to the size and orientation of an object’s shadow.
- Use physical models to explain day and night.
- Record observations of the night sky.
- Observe and record changes in the Moon’s appearance every day for a month.
- Analyze observational data to discover the sequence of changes that occur during the Moon’s phase cycle.
- Make and interpret a model of the Earth, Moon, and Sun system.
- Classify planets by their various properties.
- Record and display the organization of the solar system graphically.
- Identify several constellations as stable, predictable patterns of stars.
- Use models to build explanations.
### SUN, MOON, AND PLANETS

#### Overview

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<th>Module Summary</th>
<th>Focus Questions</th>
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<tr>
<td><strong>Inv. 1:</strong> Sun and Earth</td>
<td>Students trace their shadows in the morning and afternoon. They use this information to monitor the position of the Sun as it moves across the sky. After using a compass to orient a Sun tracker, students make hourly records of the position of the shadow cast by a golf tee. Back in the classroom, students use flashlights to reproduce the shadow movements. Students imagine an observer on Earth (their head) and position themselves around a lamp to observe day and night. They discover that rotation of Earth produces day and night.</td>
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<tr>
<td><strong>Inv. 2:</strong> Earth’s Moon</td>
<td>Students take a field trip to the schoolyard to look for the Moon. After recording the Moon’s appearance, the class starts a Moon calendar, on which they record the Moon’s appearance every day for a month. After observing the day Moon, students begin 4 days of night-sky observations for entries on the Moon calendar. Students grapple with the size and distance relationships among the Moon, Earth, and the Sun, and build a model of the Earth-Moon-Sun system. Students analyze the Moon observations to discover the sequence of changes. They learn the phase names and correlate the lunar cycle to the Moon’s position in its orbit around Earth.</td>
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<tr>
<td><strong>Inv. 3:</strong> Solar System</td>
<td>Students work in pairs with solar system cards. Based on previous knowledge, information on the cards, and information provided by the teacher, students organize the objects into a model of the solar system. Students observe a demonstration of a ball swinging in a circle on the end of a string. They analyze the orbit of the ball to determine why it travels in a circle. Gravity is introduced as the force that pulls on planets to change their direction of travel to produce circular orbits.</td>
</tr>
<tr>
<td><strong>Inv. 4:</strong> Patterns in the Sky</td>
<td>Students are introduced to constellations as patterns of stars. Students simulate Earth’s rotation to observe the appearance of stars rising in the east, and setting in the west. Students observe a demonstration of why different stars are visible in different seasons. Students watch a video that shows how star brightness, distance, and alignment converge to produce constellations. It also discusses telescopes and their important role in acquiring information in astronomy research.</td>
</tr>
<tr>
<td>Content</td>
<td>Reading</td>
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</table>
| Shadows are the dark areas where light is blocked. | **Science Resources Book**  
“Changing Shadows”  
“Sunrise and Sunset”  
| **Embedded Assessment**  
Science notebook entries  
Response sheet  |
| Shadows change during the day because the position of the Sun changes in the sky. | **Science Resources Book**  
“The Night Sky”  
“Comparing the Size of Earth and the Moon”  
“Apollo 11 Space Mission”  
“Changing Moon”  
“Lunar Cycle”  
“Eclipses”  
| **Embedded Assessment**  
Science notebook entries  
Scientific practices  |
| The length and direction of a shadow depends on the Sun’s position in the sky. | **Media**  
“All about the Moon”  
| **Benchmark Assessment**  
Investigation 1 I-Check  |
| Day is the half of Earth’s surface illuminated by sunlight; night is the half its surface is in shadow. | **Media**  
“Plants and the Solar System”  
| **Benchmark Assessment**  
Investigation 2 I-Check  |
| The cyclical change between day and night is the result of a rotating Earth near a stationary Sun. | **Media**  
“All about the Moon”  
| **Benchmark Assessment**  
Investigation 3 I-Check  |

Night sky objects include Moon, stars, and planets.  
Earth and several other planets orbit the Sun and the Moon orbits Earth.  
The Moon can appear in the night or day sky.  
The Moon is smaller than Earth and orbits at a distance equal to about 30 Earth diameters.  
The Sun is 12,000 Earth diameters away from Earth and is more than 100 times larger than Earth.  
The Moon changes its appearance (phase) in a regular 4-weeks pattern.  
Moon phase is the portion of the illuminated half of the Moon that is visible from Earth.

The solar system includes the Sun and the objects that orbit it, including Earth, the Moon, seven other planets, their satellites, asteroids, and comets.  
The objects in the solar system vary in size, composition, and other characteristics, and can be classified based on those characteristics.  
The Sun is an average star and is composed mostly of hydrogen and helium.  
Gravity keeps the planets and other objects in orbit around the Sun.

Groups of stars form patterns called constellations.  
Stars are at different distances from Earth.  
Stars (constellations) appear to move together across the night sky because Earth rotates.  
Different constellations can be observed in the night sky during different seasons because Earth revolves around the Sun.  
Telescopes are instruments that magnify distant objects, making them look closer and larger.
FOSS CONCEPTUAL FRAMEWORK

In the last half decade, a significant amount of 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 curricula 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 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 8), 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—orally and in writing—with tables, diagrams, graphs, and equations—in collaboration with peers.
BACKGROUND FOR THE CONCEPTUAL FRAMEWORK in Sun, Moon, and Planets

Light and Shadows

Light is the flash, the glare, the colored sparkle, the bright twinkle, and the soft glow that fills our space. Light is an electromagnetic radiation. The source of light is a radiant object. The most familiar radiant object is the Sun, but lamp filaments, flames, flashes of electricity, and fireflies are also sources of light. These objects make light.

Opaque objects block the travel of light and produce an area where light is excluded. The dark area is shadow. Shadows seen on Earth during the day look black, but they are actually dark gray. Objects placed in the shadow of a car or tree are easily seen because of light scattering. Light interacts with gas molecules in the atmosphere and gets scattered and redirected in all directions. The result is that light waves always fill in the shadows to some extent. The Moon, in contrast, has no atmosphere to scatter light, so shadows are black there.

Up in the Sky

The natural objects in the heavens that we can observe directly include the Sun, Moon, and stars. The Sun is the most reliable and predictable of the bunch, and easiest to find. Upper-elementary students know that it “comes up” in the morning, is high overhead at midday, and “goes down” at night. They know where to look for it during the day, and might be able to predict when and where it will rise the next day. They might not realize, however, that the height to which it rises above the southern horizon changes with the season. Because of the tilt of Earth’s axis, North America gains a position where the Sun is more directly overhead as the summer solstice approaches. And the converse is true—the Sun dips lower and lower in the noon sky as the winter solstice approaches. Perhaps one of the most concrete ways to demonstrate this is to log the noon shadow of a convenient fixture, such as a tree or flagpole. The short shadow of summer betrays a more overhead position of the Sun.
The Moon is a trickier companion. It is visible sometimes at night and sometimes during the day. In fact, the Moon splits each month evenly between day and night. The Moon’s shape also appears to change with the Moon’s time of arrival and departure in the sky. The changes in shape are known as phases, and one complete pass through the phases, the lunar cycle, takes 4 weeks. Students can observe the Moon in three of its four key phases—first quarter, full Moon, and third quarter, each occurring 1 week apart. The new Moon, the fourth key phase, is invisible and is an important part of the lunar cycle. The cycle of phases is a product of the Moon’s 4-week orbit around Earth.

The Moon before the first quarter and after the third quarter is in the crescent phase, and the rounding Moon before and after the full Moon is in the gibbous phase. The Moon is said to be waxing as the visible portion increases from new to full, and waning from full to new. Understanding why we see phases of the Moon is hard because it involves the relative positions and motions of Sun, Earth, and Moon. The mechanism of Moon phases is conceptually difficult for young students, but they can successfully observe and record the changing shapes, learn their names, and learn the overall pattern of the changes in the Moon’s appearance.

Earth is a planet orbiting the Sun once every year. Earth is one of eight planets. Two of the others are in orbits between Earth and the Sun (Mercury and Venus), and five are in orbits outside Earth’s orbit (Mars, Jupiter, Saturn, Uranus, and Neptune). These eight planets and the Sun are the major players in the solar system.

The Sun is a star. In a dark location on a clear night, scores of other stars can be seen shining in the sky. They are distributed in patterns called constellations and asterisms, with names like Ursa Major, Scorpius, Capricornus, Perseus, Andromeda, Draco, and so on. The patterns we see today are pretty much the same as they were thousands of years ago when the first stargazers described and named the constellations. The stars appear to move across the sky during the night, but the geometric relationships between the stars don’t change much. Because Earth orbits the Sun, the visible night stars change with the seasons. But the same familiar patterns do return, exactly as they were a year ago.

On a dark night, a human can typically see 1000–2000 stars. This is but a minute fraction of the several hundred billion stars in our galaxy. The intensity of light reaching Earth from most of them is so low that it simply cannot stimulate a photoreceptor in the human eye.
When a telescope, a powerful light-capturing instrument, is positioned between the sky and the eye, stars in the deepest reaches of the galaxy snap into view, and details appear on closer objects, like the Moon, planets, and Sun.

The Sun, Moon, and Planets Module embraces huge concepts, huge not only because of the scope of the content, but because of the physical dimensions of the study subjects. The module includes a survey of the solar system in order to place Earth in a larger context. The solar system is defined by the star Sol, our Sun. Sol is attended by the myriad planets and other bodies orbiting it. The generic name for a system of planets orbiting a star (or stars) is planetary system. The specific name of our planetary system is solar system. There is only one solar system.

The best scientific estimates place the origin of the solar system about 4.65 billion years ago. Because the solar system is replete with so many fundamental substances, called elements, it is quite certain that there was a star in our neighborhood before our star came into being. The matter that streamed into the nascent universe at the time of the Big Bang was mostly hydrogen. The hydrogen condensed into stars in billions of locations in space and began their thermonuclear activity. A by-product of “burning” hydrogen in star furnaces is the production of larger atoms, specifically helium atoms. That’s what the Sun has been doing since its birth, and will continue to do for maybe another 5 billion years.

Interesting things happen at the end of stars’ lives. Large stars degenerate into novas or supernovas. It is during these incomprehensibly dramatic death throes that thermonuclear reactions synthesize larger and larger atoms—carbon, oxygen, nitrogen, iron, gold, uranium, and all the rest of the elements. The final act is annihilation of the star as it casts the products of its creative demise into

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Earth Science, Earth’s Place in the Universe: Sun, Moon, and Planets

**Structure**

**Concept A**
- Earth is part of a planetary system in the universe.
- The Moon can be seen sometimes at night and sometimes during the day. It looks different every day, but looks the same again about every 4 weeks.
- The Moon phase is the portion of the illuminated half of the Moon that is visible from Earth.
- The solar system includes the Sun and other objects that orbit it (Earth and the Moon, other planets, moons, asteroids, comets).
- Stars are at different distances from Earth. The position of stars relative to one another creates patterns (constellations).

**Interactions**

**Concept A**
- Patterns of change and apparent motion can be observed, described, and explained with models.
- Shadows change during the day because the position of the Sun changes in the sky.
- The cyclical change between day and night is the result of a rotating Earth in association with a stationary Sun.
- The pulling force of gravity keeps the planets and other object in orbit.
- Earth revolves around the Sun, so we see different stars during each season.
space. It was probably such a cloud of hydrogen and heavy elements that coalesced into a gigantic rotating mass of star dust. Over time it differentiated into a huge central mass, with smaller masses forming at intervals away from the central mass. The central mass condensed into the Sun, the small accumulations condensed into planets, and the solar system was born. The origin as a rotating cloud explains why the planets all orbit the Sun in the same direction and why the Sun and all the planets rotate on their axes in the same direction. They all emerged from a single process.

**Organization and Size**

The Sun dominates the solar system. It is far and away the largest object in the system—1,392,000 kilometers (865,000 miles) in diameter. That's almost twice as large as the orbit of the Moon around Earth! And 99.8% of the mass of the solar system resides in the Sun.

Planets orbit the Sun. Close to the Sun are the four small, rocky planets, the terrestrial planets. They are, in order by distance from the Sun, Mercury, Venus, Earth, and Mars. Beyond Mars, in an orbit where planetary scientists would expect to find a fifth planet, is a region of rocky rubble called the asteroid belt. Millions of relatively small asteroids orbit the Sun; only a handful are larger than 200 km in diameter. The exact reason for this rocky band is unknown. It might be the shattered remains of a fifth rocky planet that suffered a crushing collision with a large renegade object, reducing it to asteroids. More likely, the mass of the accumulation of matter at this distance from the Sun was insufficient to pull together as a planet. But it could yet accrete into a planet someday.

Beyond the asteroids are four large planets composed mostly of gas and ice, the gas giant planets. They are Jupiter, Saturn, Uranus, and Neptune. Neptune’s orbit is 4.5 billion kilometers (2.8 billion miles) from the Sun. Compare this to the orbit of Mercury at 58 million kilometers (36 million miles) from the Sun. The last gas giant is 78 times farther away from the Sun than the first terrestrial planet.

The solar system continues into what is known as the outer solar system. The outer solar system starts with a large frozen belt of icy, rocky objects called the Kuiper Belt. The Kuiper Belt starts just beyond the orbit of Neptune and continues out to about 15 billion kilometers (9 billion miles) from the Sun. One notable Kuiper Belt object is Pluto, orbiting the Sun at an average distance of 5.9 billion kilometers (3.7 billion miles). Based on 2006 definitions, Pluto is now recognized as a dwarf planet. A dwarf planet is an object that a) orbits a star, b) is
sufficiently massive for gravity to pull it into a sphere, c) has not cleared its neighborhood of other matter in its orbit, and d) is not a satellite. Another recently discovered Kuiper Belt object, Eris (formerly known as 2003 UB313 or Planet X) is also considered a dwarf planet. Eris is way out in the outer reaches of the Kuiper Belt, 14.5 billion kilometers (9 billion miles) from the Sun. It is twice as large as Pluto, and so far out that the Sun would appear as an exceptionally bright star, not the fiery orb that rains light and heat on Earth.

Beyond the Kuiper Belt is a vast region of icy, rocky chunks known as the Oort cloud. It extends out to the frontier of deep space at some 22 trillion km (14 trillion miles) from the Sun. But unlike all the objects described up to this point, the Oort cloud is a sphere around the Sun at this great distance. All the planets, asteroids, and Kuiper Belt objects orbit in a plane, rather like riding along on a humongous phonograph disk revolving around the Sun. Oort cloud objects have different marching orders. They orbit the Sun, but not in the conventional plane.

It is believed that the Kuiper Belt and the Oort cloud are the spawning grounds for comets. Some of them are on radically elliptical orbits that bring them into the inner solar system once every few decades, like the much-celebrated Halley’s comet. Then they disappear into the outer solar system. Comets from the Oort cloud also revisit the inner solar system, but their interval may be a million years or more.

**Earth: The Big Picture**

Earth is the third planet from the Sun. Earth orbits in a nearly circular orbit at a distance of about 150 million kilometers (93 million miles). Earth is water rich, with about 71 percent of the planet’s surface covered with water. It is surrounded by a shallow atmosphere of nitrogen (78 percent) and oxygen (21 percent), and small amounts of a lot of other gases. The atmosphere extends about 500 kilometers (300 miles) above Earth’s surface, but most of the mass of the atmosphere is concentrated in the first 20 kilometers (12 miles), the troposphere. The atmosphere plays a major role in determining the conditions on Earth’s surface. It acts as both a shield against hazardous solar radiation and an insulating blanket, slowing energy exchange between Earth’s surface and space. And of critical importance, the atmosphere acts as a medium of transportation for both energy and matter around the planet. Students will be introduced to this important role of the atmosphere when they study other FOSS modules.
The Sun, Moon, and Planets 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 science and for engineering, technology, and the application of science.

**Earth and Space Sciences**

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

- **ESS1.A**: What is the universe, and what goes on in stars? [The Sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their size and distance from Earth.]

- **ESS1.B**: What are the predictable patterns caused by Earth’s movement in the solar system? [The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily and seasonal changes in the length and direction of shadows; phases of the Moon; and different positions of the Sun, Moon, and stars at different times of the day, month, and year.

Some objects in the solar system can be seen with the naked eye. Planets in the night sky change positions and are not always visible from Earth as they orbit the Sun. Stars appear in patterns called constellations, which can be used for navigation and appear to move together across the sky because of Earth’s rotation.

**Engineering, Technology, and Applications of Science**

**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.]
Earth’s Place in the Universe Content Sequence

This table shows the four FOSS modules and courses that address the content sequence “Earth’s place in the universe” for grades K–8. Running through the sequence are the two progressions—structure and interactions. The supporting elements in each module (somewhat abbreviated) are listed. The elements for the Sun, Moon, and Planets Module are expanded to show how they fit into the sequence.

<table>
<thead>
<tr>
<th>Module or course</th>
<th>Structure</th>
<th>Interactions</th>
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<tbody>
<tr>
<td>Planetary Science</td>
<td>• Earth and Sun are part of the Milky Way galaxy; many such systems exist in the universe. Gravity holds objects in orbit.</td>
<td>• Patterns of apparent motion of the Sun, the Moon, and stars can be observed, described, predicted, and explained with models.</td>
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<td>• Earth’s axis tilts at an angle of 23.5° and points toward the North Star.</td>
<td>• Models of the solar system can explain tides, eclipses of the Sun and Moon, and motion of the planets relative to the stars.</td>
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<td></td>
<td>• The Moon has surface features that can be identified in telescope images.</td>
<td>• Earth’s spin axis is fixed in direction but tilted relative to its orbit around the Sun; seasons are a result of that tilt, as is differential intensity of light in different areas of Earth during the year.</td>
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<td></td>
<td>• Location or position can be described in terms of a frame of reference.</td>
<td>• Earth and the Moon have been and continue to be bombarded by meteoroids at the same rate.</td>
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<td></td>
<td>• Scale can be expressed as a ratio when an object and its representation are measured in related units.</td>
<td>• The solar system formed during a sequence of events that started with a nebula.</td>
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<td></td>
<td>• The temperature on planets in the solar system depends on two major variables—the distance from the Sun and the nature of the planet’s atmosphere.</td>
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</tr>
<tr>
<td>Sun, Moon, and Planets</td>
<td>• The Moon can be seen sometimes at night and sometimes during the day. It looks different every day, but looks the same again about every 4 weeks.</td>
<td>• The Sun and Moon can be observed moving across the sky; we see them at different locations in the sky, depending on the time of day or night.</td>
</tr>
<tr>
<td>Air and Weather</td>
<td>• There are more stars in the sky than anyone can easily see or count.</td>
<td></td>
</tr>
<tr>
<td>Trees and Weather</td>
<td>• The Sun can be seen only in the daytime.</td>
<td>• Trees change through the seasons.</td>
</tr>
<tr>
<td></td>
<td>• Objects can be seen in the sky.</td>
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</table>
**Conceptual Framework**

**Structures**
- The Moon can be observed both day and night, but the Sun only during the day.
- Moon phase is the portion of the illuminated half of the Moon that is visible from Earth.
- The solar system includes the Sun and other objects that orbit it (Earth and the Moon, other planets, moons, asteroids).
- Stars are at different distances from Earth. The position of stars relative to one another creates patterns (constellations).

**Interactions**
- Shadows change (length and direction) during the day because the position of the Sun changes in the sky.
- The cyclical change between day and night is the result of a rotating Earth in association with a stationary Sun.
- The pulling force of gravity keeps the planets and other objects in orbit.
- Moon phases have a monthly cycle.
- Earth revolves around the Sun, so we see different stars during each season.
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)
• Assessment

Teacher Resources. This collection of resources has these chapters.

• FOSS Introduction
• 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.

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 restock. You might be asked to supply small quantities of common classroom items.
FOSS Components

FOSS Science Resources Books

FOSS Science Resources: Sun, Moon, and Planets 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 additional 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.

Sun, Moon, and Planets Module
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 might 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 3–4 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. 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 numerous 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/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 causes day and night? 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 “What does a model of the Earth, Moon, and Sun system look like?” 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, they observe systems and interactions, and they 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/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 notebooks. Data recording is the first of several kinds of student writing.

Students then organize data so that 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. And the science notebook entries stand as a credible and useful expression 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) in a bound composition book. Full-size duplication masters are also available on FOSSweb. Student work is entered partly in spaces provided in 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.

**FOSS Instructional Design**

16. Assess progress: notebook entry

Collect the notebooks at the end of the day. Look at students’ answers to the focus question to see if they can explain how and why shadows change during the day.

**What to Look For**

- *Students write that the Sun’s position in the sky changes during the day.*
- *Students write that their shadow always points away from the position of the Sun in the sky, so shadow direction changes as the Sun moves across the sky.*
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 getting from the outdoor study site. All these and more issues and solutions are discussed in the Taking FOSS Outdoors chapter in 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 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 enhance 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*.

  - FOSS Introduction
  - 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.

**Module summary.** The summary describes each investigation in a module, including major concepts developed.

*Sun, Moon, and Planets Module*
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 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 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 might 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 might 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. Let your teacher know if you have never been stung by a bee.
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, nose, or eyes 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 10 weeks be devoted to this module. Take your time, and explore the subject thoroughly.

**Active-investigation (A)** sessions include hands-on work with physical systems 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 and discuss their answers to the focus questions.

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

**I-Checks** are short summative assessments at the end of each investigation. The next day, after you have coded the assessments, students self-assess their written responses on a few critical items to reflect on and improve their understanding.

### 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.

### NOTE
Review Investigation 2, Part 1, Night-Sky Observations, at the beginning of the module. Plan to start those observations during weeks 2–6 when there is a first-quarter Moon visible during the school day. This part will take 4 weeks of observations before you can conduct Part 3.

<table>
<thead>
<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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<tr>
<td></td>
<td><strong>START Inv. 1 Part 1</strong></td>
<td><strong>START Inv. 1 Part 2</strong></td>
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<tr>
<td></td>
<td><strong>A</strong></td>
<td><strong>A/W</strong></td>
<td><strong>A</strong></td>
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<td>2</td>
<td><strong>R/W</strong></td>
<td></td>
<td><strong>Review</strong></td>
<td><strong>I-Check 1</strong></td>
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<tr>
<td>3</td>
<td><strong>Self-assess</strong></td>
<td></td>
<td><strong>A</strong></td>
<td><strong>A</strong></td>
<td><strong>R/W</strong></td>
</tr>
<tr>
<td>4</td>
<td><strong>START Inv. 2 Part 2</strong></td>
<td><strong>A</strong></td>
<td><strong>R/W</strong></td>
<td><strong>Review</strong></td>
<td><strong>I-Check 3</strong></td>
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<td>5</td>
<td><strong>START Inv. 3 Part 1</strong></td>
<td><strong>A</strong></td>
<td><strong>R/W</strong></td>
<td><strong>START Inv. 3 Part 2</strong></td>
<td><strong>A</strong></td>
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<tr>
<td>6</td>
<td><strong>A</strong></td>
<td><strong>R/W</strong></td>
<td><strong>Review</strong></td>
<td><strong>I-Check 3</strong></td>
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<tr>
<td>7</td>
<td><strong>Self-assess</strong></td>
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<td><strong>A</strong></td>
<td><strong>A</strong></td>
<td><strong>R/W</strong></td>
</tr>
<tr>
<td>8</td>
<td><strong>START Inv. 4 Part 1</strong></td>
<td><strong>A</strong></td>
<td><strong>R/Review</strong></td>
<td><strong>I-Check 2</strong></td>
<td><strong>Self-assess</strong></td>
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<tr>
<td>9</td>
<td><strong>START Inv. 4 Part 2</strong></td>
<td><strong>A</strong></td>
<td><strong>A/R</strong></td>
<td><strong>Review</strong></td>
<td><strong>Posttest</strong></td>
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### FOSS K–8 Scope and Sequence

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<th>Grade</th>
<th>Physical Science</th>
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<th>Life Science</th>
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<td>Electronics</td>
<td>Planetary Science</td>
<td>Human Brain and Senses</td>
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<td>Chemical Interactions</td>
<td>Earth History</td>
<td>Populations and Ecosystems</td>
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<td></td>
<td>Force and Motion</td>
<td>Weather and Water</td>
<td>Diversity of Life</td>
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<td>4–6</td>
<td>Mixtures and Solutions</td>
<td>Weather on Earth</td>
<td>Living Systems</td>
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<td>Motion, Force, and Models</td>
<td>Sun, Moon, and Planets</td>
<td>Environments</td>
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<td>Energy and Electromagnetism</td>
<td>Soils, Rocks, and Landforms</td>
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<td>3</td>
<td>Measuring Matter</td>
<td>Water</td>
<td>Structures of Life</td>
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