INTRODUCTION

The giant sequoia is the most massive living organism on Earth. It is a tree, magnificent in dimension and awe inspiring in its longevity and durability.

To a primary student, the oak on the corner, the pines at the park, and the mulberry tree at school are all giants. Systematic investigation of trees over the seasons will bring students to a better understanding of trees’ place at school and in the community. Students will observe day-to-day changes in weather over the year, as well as the impact weather has on living things. The Trees and Weather Module provides students with solid experiences to help them know plants and their place on Earth. In this module, students will:

- Observe and compare trees, using the senses.
- Observe and compare the shapes of leaves; compare leaf shapes to geometric shapes.
- Identify trees as resources that are used in everyday life.
- Observe weather by using senses and simple tools.
- Communicate observations made about different kinds of trees, leaves, and weather conditions orally and through drawings.
- Observe and record seasonal changes to living things.
# Module Summary

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Description</th>
<th>Focus Questions</th>
</tr>
</thead>
</table>
| Inv. 1: Observing Trees | Students begin their study of trees by looking at the variety and structure of trees in the schoolyard. They work with representational materials to look more closely at the shapes of trees and their parts. They adopt schoolyard trees to observe changes through the year. A living tree becomes part of the classroom for several weeks, and students complete the investigation by planting their class tree on the school grounds. | What did we learn about our schoolyard trees?  
What are the parts of trees?  
What shapes are trees?  
Which trees have similar shapes?  
What can we find out about our adopted trees?  
What do trees need to grow? |
| Inv. 2: Observing Leaves | Students begin with a schoolyard walk, focusing on the leaves of trees. They match leaves with geometric shapes, go on a leaf hunt to compare properties of leaves, work at centers with representational materials, and make a leaf book. This investigation concludes with a story, *Our Very Own Tree.* | What can we observe about leaves?  
What shapes are leaves?  
How are leaves different?  
How are leaf edges different? |
| Inv. 3: Observing Weather | Students share what they know about weather and how it relates to air. A class weather monitor begins recording daily weather observations on a class calendar. Students use weather pictures to indicate five basic types of weather. They use a thermometer to measure relative temperature (how hot or cold it is) and make a wind sock to observe the wind direction and speed. Students observe and compare objects in the sky during the day and at night. | What is the weather today?  
How can we measure the air temperature?  
What does a wind sock tell us about the wind? |
| Inv. 4: Trees through the Seasons | Students extend their understanding of trees as a growing, changing, living part of their world. During each season, students visit the schoolyard trees; observe their twigs, leaves, flowers, and seeds; and compare them to those from a previous season. | What do fall trees look like?  
What do winter trees look like?  
What do spring trees look like? |

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Full Option Science System
<table>
<thead>
<tr>
<th>Content</th>
<th>Reading</th>
<th>Assessment</th>
</tr>
</thead>
</table>
| - Trees are living plants.  
  - Trees have structures: branches, leaves, trunk, and roots.  
  - Trees differ in size and shape.  
  - Trees have basic needs: light, air, nutrients, water, and space. | **Science Resources Book**  
“Where Do Trees Grow?” | **Embedded Assessment**  
Teacher observation |
| - Different kinds of trees have different leaves.  
  - Leaves have properties: size, shape, tip, edge, texture, and color.  
  - Leaves properties vary.  
  - Leaves can be described and compared by their properties. | **Books**  
*How Do We Learn? Our Very Own Tree* | **Embedded Assessment**  
Teacher observation |
| - Weather is the condition in the air outdoors and can be described.  
  - Temperature is how hot or cold it is; thermometers measure temperature.  
  - Wind is moving air; a wind sock indicates wind direction and speed.  
  - Weather changes.  
  - The Sun, the Moon, and clouds are objects we see in the sky. | **Science Resources Book**  
“Up in the Sky”  
“Weather” | **Embedded Assessment**  
Teacher observation |
| - Seasons change in a predictable annual pattern: fall, winter, spring, and summer.  
  - Bark, twigs, leaves, buds, flowers, fruits, and seeds are parts of trees.  
  - The buds on twigs grow into leaves or flowers.  
  - Trees change through the seasons.  
  - Some trees produce seeds that can grow into new trees of the same kind.  
  - Some trees lose their leaves in winter; others do not.  
  - Trees are living, growing plants. | **Science Resources Book**  
“My Apple Tree”  
“Orange Trees”  
“Maple Trees” | **Embedded Assessment**  
Teacher observation |
FOSS CONCEPTUAL FRAMEWORK

FOSS has conceptual structure at the module level. The concepts are carefully selected and organized in a sequence that makes sense to students when presented as intended. In the last half decade, research has focused on learning progressions. The idea behind a learning progression is that core ideas in science are complex and wide-reaching—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 we can and should understand about them in our primary school years, and progressively more complex and sophisticated things we should know about them as we gain experience and develop our cognitive abilities. When we can determine those logical progressions, we can develop meaningful and effective curriculum.

FOSS has elaborated learning progressions for core ideas in science for kindergarten through grade 6. Developing the learning progressions involves identifying successively more sophisticated ways of thinking about core ideas 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). Most of this work is behind the scenes, never seen by the user of the FOSS Program. It does surface, however, in two places: (1) the conceptual framework represents the structure of scientific knowledge taught and assessed in a module, and (2) the conceptual flow is a graphic and narrative description of the sequence of ideas, presented in the Background for the Teacher section of each investigation.

The FOSS modules are organized into three domains: physical science, earth science, and life science. Each domain is divided into two strands, which represent a core scientific idea, as shown in the columns in the table: matter/energy and change, dynamic atmosphere/rocks and landforms, structure and function/complex systems. The sequence of modules 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.

**FOSS Elementary Module Sequences**

<table>
<thead>
<tr>
<th>PHYSICAL SCIENCE</th>
<th>EARTH SCIENCE</th>
<th>LIFE SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATTER</td>
<td>ENERGY AND CHANGE</td>
<td>DYNAMIC ATMOSPHERE</td>
</tr>
<tr>
<td>Mixtures and Solutions</td>
<td>Motion, Force, and Models</td>
<td>Weather on Earth</td>
</tr>
<tr>
<td>Measuring Matter</td>
<td>Energy and Electromagnetism</td>
<td>Water</td>
</tr>
<tr>
<td>Solids and Liquids</td>
<td>Balance and Motion</td>
<td>Air and Weather</td>
</tr>
<tr>
<td>K</td>
<td>Materials in Our World</td>
<td>Trees and Weather</td>
</tr>
</tbody>
</table>
In addition to the science content framework, every module provides opportunities for students to engage in and understand 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 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 tools (numbers, words, tables, graphs, images, diagrams, equations) to 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 the models.

**Using mathematics and computational thinking**
- Use mathematics and computation to represent physical variables and their relationships.

**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 the available evidence.

**Engaging in argument from evidence**
- Defend explanations, formulate evidence based on data, examine one’s own understanding in light of the evidence offered by others, and collaborate with peers in 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 and in discussions with peers.

*Trees and Weather Module*
CONCEPTUAL FRAMEWORK in Trees and Weather

This module provides foundational experiences with both life science and earth science concepts. In the FOSS Program, this module is part of the earth science strand. It emphasizes key earth science concepts including attributes of landforms and weather, and their effect on life on Earth. Students keep a weather calendar and monitor general weather conditions day by day. They focus on temperature and wind (moving air) as two important aspects of weather. They look at seasonal weather changes and their impact on trees. Students will come away with a respect for trees and other important resources, and know that they should, and can, be conserved.

Trees grow just about everywhere. They are found high in mountains and below sea level in arid, salty deserts. Some trees are adapted to withstand prolonged droughts, while others grow in water. Some are huge, weighing many tons, while others are only a few centimeters tall. Trees are well represented throughout the world, and everyone is familiar with trees of one kind or another from early childhood.

Exactly what makes a plant a tree is not precisely defined. Trees usually have single woody stems, called trunks, that are covered in a tough outer layer called bark. Trees tend to be large, relatively long-lived organisms. But the definition is left up to the subjective determination of an individual observer.

When asked to point out a tree, virtually every kindergartner will do so without hesitation and will invariably be right.

For the sake of this module, trees are those big, living plants that grow in the schoolyard, along the streets, and around the homes in your community. They have thick trunks covered with rough bark. Higher up, the trunks give way to branches, and eventually each branch and twig terminates in leaves.

The study of trees is a study of the commonplace. But regard that tree from a fresh point of view, and you’ve just engaged in one of the delightful aspects of science—the power it has to make a mundane object or event provocative and exciting.

Some trees can be identified by the shape of their silhouettes. The distinctive shapes of the weeping willow and the coconut palm are easy to discern at a glance, but with a little experience, dozens of trees take on a distinctive shape in the eyes of the viewer.
Similarly, leaves of every tree have evolved so that they are unique in shape and size for each kind of tree. Many people can spot the characteristic shape of a maple leaf or a pine needle or the dramatic convolutions of an oak leaf. As the student is exposed to a greater array of leaves, they all start to reveal themselves as unique and understandable. Before long, a score of oaks or a dozen maples can be identified.

Although some students will demonstrate an amazing ability to discriminate and identify large numbers of trees, that is not a major goal of this module. These activities are designed to use trees as typical examples of plants. The strategies used to bring students into meaningful interaction with trees would work equally well to teach them about grasses, flowers, seaweeds, or mosses. The strategies encourage students to step up close and look at the fine structure, to step back and look at the gross structure, and to compare parts of one tree to the same parts of another. We want early-childhood students to come away with a developing concept of what makes a plant a tree, and to be able to describe some of the fine structure of trees. If students have opportunities to “adopt” and observe a tree over time, they will begin to understand change through the seasons—to discover what changes, what does not change, and when the changes take place.

In addition to the direct experiences with trees and the opportunities to manipulate representational and symbolic materials to enrich the direct experience, FOSS investigations promote communication of students’ observations and perceptions. Students talk, draw, and write to communicate their ideas.

During the development of the activities in this module, we asked students to draw a picture of a tree that would tell us about the tree they had adopted and observed in the schoolyard. We were surprised to see how similar many of the pictures were. They were drawn with massive rectangular trunks and round, green canopies right on top. We asked ourselves whether students were really looking at the trees. But we discovered that if we approached a tree, got low like a primary student, and looked up, we perceived a large rectangle topped with a green circular canopy. It was a delightful revelation to discover that kindergartners could see their tree better than the adults who were hovering around.

**Conceptual Framework**

**Earth Science, Dynamic Atmosphere: Trees and Weather**

**Structure of Earth**

**Concept A** The hydrosphere has properties that can be observed and quantified.
- Water exists in three states on Earth: solid, liquid, and gas.

**Concept B** The atmosphere has properties that can be observed and quantified.
- Wind is moving air.

**Concept C** Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources.
- People use earth materials to make and construct things.
- People can conserve resources.

**Earth Interactions**

**Concept A** Weather and climate are influenced by interactions of the Sun, the ocean, the atmosphere, ice, landforms, and living things.
- Energy that drives weather comes from the Sun.
- Weather describes the minute-by-minute, day-by-day variation of the atmosphere’s condition on a local scale.
- Scientists record weather patterns to make predictions.
Dynamic Atmosphere Content Sequence

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

<table>
<thead>
<tr>
<th>Module or course</th>
<th>Structure of Earth</th>
<th>Earth interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather and Water</td>
<td>• Weather is the condition of Earth’s atmosphere at a given time in a local place; climate is the range of an area’s weather conditions over years. • Weather happens in the troposphere. • Density is a ratio of a mass and its volume. • The angle at which light from the Sun strikes the surface of Earth is the solar angle.</td>
<td>• Complex patterns of interactions determine local weather patterns. • Energy transfers from one place to another by radiation and conduction. • Convection is the circulation of a fluid that results from energy transfer in a fluid. • When air masses of different densities meet, weather changes. • The Sun’s energy drives the water cycle and weather.</td>
</tr>
<tr>
<td>Weather on Earth</td>
<td>• Weather is described in terms of variables including temperature, humidity, wind, and air pressure. • Scientists observe, measure, and record patterns of weather to make predictions. • The Sun is the major source of energy that heats Earth; land, water, and air heat up at different rates. • Most of Earth’s water is in the ocean.</td>
<td>• The different energy-absorbing properties of earth materials lead to uneven heating of Earth’s surface and convection currents. • Evaporation and condensation contribute to the movement of water through the water cycle. • Climate—the range of an area’s typical weather conditions—is changing globally; this change will impact all life.</td>
</tr>
<tr>
<td>Water</td>
<td>• Water is found almost everywhere on Earth, e.g., vapor, clouds, rain, snow, ice. • Water expands when heated, contracts when cooled, and expands when frozen. • Cold water is more dense than warmer water; liquid water is more dense than ice. • Soils retain more water than rock particles alone.</td>
<td>• Water moves downhill; the steeper the slope, the faster water moves. • Ice melts when heated; liquid water freezes when cooled. • Evaporation is the process by which liquid (water) changes into gas (water vapor). • Condensation is the process by which gas (water vapor) changes into liquid (water).</td>
</tr>
<tr>
<td>Air and Weather</td>
<td>• Air is a gas and is all around us. • Air is matter and takes up space. • Weather describes conditions in the air. • Weather conditions can be measured. • Clouds are made of liquid water drops. • Natural sources of water include streams, rivers, lakes, and the ocean.</td>
<td>• The Sun heats Earth during the day. • Compressed air can move things. • Daily changes in weather conditions can be observed, compared, and predicted. • Each season has typical weather conditions. • Weather affects animals and plants.</td>
</tr>
<tr>
<td>Trees and Weather</td>
<td></td>
<td></td>
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</tbody>
</table>
The Trees and Weather Module aligns with the NRC Framework. The module addresses these K–2 grade band endpoints described for core ideas from the national framework for Earth’s systems and Earth and human activity.

**Earth and Space Sciences**

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

- **ESS2.D:** What regulates weather and climate?  [Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.]

- **ESS2.E:** How do living organisms alter Earth’s processes and structures?  [Plants and animals (including humans) depend on the land, water, and air to live and grow. They in turn can change their environment.]

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

- **ESS3.A:** How do humans depend on Earth’s resources?  [Living things need water, air, and resources from the land, and they try to live in places that have the things they need. Humans use natural resources for everything they do: for example, they use soil and water to grow food.]

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**Structure of Earth**

- Weather is the condition of the air outside; weather changes.
- Temperature is how hot or cold it is, and can be measured with a thermometer.
- Wind is moving air; wind socks indicate direction and speed.

**Earth interactions**

- Each season has typical weather conditions that can be observed, compared, and predicted.
- Trees change through the seasons.

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**TEACHING NOTE**

A Framework for K–12 Science Education has three core ideas in Earth and space sciences.

ESS1: Earth’s Place in the Universe

ESS2: Earth’s Systems

ESS3: Earth and Human Activity
FOSS COMPONENTS

Teacher Toolkit

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

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

Teacher Resources. This three-ring binder contains these chapters.
- FOSS Introduction
- Assessment
- Science Notebooks in Grades K–2
- Science-Centered Language Development
- Taking FOSS Outdoors
- FOSSweb and Technology
- Science Notebook Masters (for grades 1–6)
- Teacher Masters
- Assessment Masters

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

FOSS Science Resources. 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. In addition, you will be asked to supply small quantities of common classroom items.
FOSS Science Resources Books

*FOSS Science Resources: Trees and Weather* 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 experience organisms, objects, and phenomena firsthand before engaging the concepts in text. The text and illustrations help make connections between what students experience concretely and the ideas that explain their observations.

FOSSweb and Technology

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

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

Ongoing Professional Development

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

NOTE

*FOSS Science Resources: Trees and Weather* is also provided as a big book in the kit.

NOTE

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

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

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

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

FOSS Investigation Organization

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

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

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

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

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

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 assessments. Some of the embedded-assessment methods for grades K–2 include observation of students engaged in scientific practices and review of a notebook entry (drawing or text).

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 assist English learners in developing science concepts. A discussion of strategies is in the Science-Centered Language Development chapter.

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

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

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

**Context: questioning and planning.** Active investigation requires focus. The context of an inquiry can be established with a focus question or challenge from you or, in some cases, from students. (What shapes are leaves?) 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 what a wind sock tells us about the wind. In either case, the field available for thought and interaction is limited. This clarification of context and purpose results in a more productive investigation.

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

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

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

Data recording is the first of several kinds of student writing. Students then organize data so 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. Students conclude the active investigation by writing a summary of their learning in their science notebooks as well as questions raised during the activity.

Science Notebooks

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

Assessment and teaching must be woven together to provide the greatest benefit to both the student and the teacher. Assessing young students is a process of planning what to assess, and observing, questioning, and recording information about student learning for future reference. Observing students as they engage in the activity and as they share notebook entries (drawings and words) reveals their thinking and problem-solving abilities. Questioning probes for understanding. Both observing and questioning will give you information about what individual students can and can’t do, and what they know or don’t know. This information allows you to plan your instruction thoughtfully. For example, if you find students need more experience comparing the properties of leaves, you can provide more time at a center that focuses on comparing similar items or select extension activities that will continue to develop the ability to identify similarities and differences.

Use the techniques that work for you and your students and that fit with the overall kindergarten curriculum goals. The most detailed and reliable picture of students’ growth emerges from information gathered by a variety of assessment strategies.

FOSS embedded assessments for kindergarten allow you and your students to monitor learning on a daily basis as you progress through the Trees and Weather Module. You will find suggestions for what to assess in the Getting Ready section of each part of each investigation. For example, here is the Getting Ready step for Part 1 of the first investigation.
14. Plan assessment for Part 1

There are six objectives that can be assessed at any time during any part of this investigation.

**What to Look For**

- **Students ask questions.**
- **Students use their senses to observe living things.**
- **Students show respect for living things.**
- **Students record observations.**
- **Students communicate observations orally, in writing, and in drawings.**
- **Students use new vocabulary.**

Here are specific content objectives for this part.

- **Trees are living plants; trees have basic needs.**
- **Trees have structures.**
- **Trees are a natural resource.**

Focus on a few students each session. Record the date and a + or – on the Assessment Checklist.

Make copies of the Assessment Checklist, attach them to a clipboard, and carry them with you when students are engaged in the investigations. Record your observations as you interact with students, or take a few minutes after class to reflect on the lesson.

**TEACHING NOTE**

Because there are several opportunities for you to assess students on each objective, we suggest that you focus on six to ten students during each session rather than trying to assess the whole class at one time.
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.

Most investigations include 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 who have behavior issues in the classroom but who become insightful observers and leaders in the schoolyard environment.

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

Trees and Weather Module
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 that provides 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.

NOTE
The FOSS digital resources are available online at FOSSweb. You can always access the most up-to-date technology information, including help and troubleshooting, on FOSSweb. See the FOSSweb and Technology chapter for a complete list of these resources.
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 (grades 1–6) 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.

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

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

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

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

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

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

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

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

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

NOTE
The Spanish masters are available only on FOSSweb and on one of the CDs provided in the Teacher Toolkit.
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.


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. Strategies found effective with students with special needs and students who are learning English are incorporated into the materials and procedures used with all students.

English Learners

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

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

**Differentiated Instruction**

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

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

Students in primary grades are usually most comfortable working as individuals with materials. The abilities to share, take turns, and learn by contributing to a group goal are developing but are not reliable as learning strategies all the time. Because of this egocentrism and the need for many students to control materials or dominate actions, the FOSS kit includes a lot of materials. To effectively manage students and materials, FOSS offers some suggestions.

Small-Group Centers

Many of the kindergarten-level observations and investigations are conducted with small groups at a learning center. Limit the number of students at the center to six to ten at one time. When possible, each student will have his or her own equipment to work with. In some cases, students will have to share materials and equipment and make observations together. Primary students are good at working together independently.

As one group at a time is working at the center on a FOSS activity, other students will be doing something else. Over the course of an hour or more, plan to rotate all students through the center, or allow the center to be a free-choice station.

Whole-Class Activities

Introducing and wrapping up the center activities require you to work for brief periods with the whole class. FOSS suggests for these introductions and wrap-ups that you gather the class at the rug or other location in the classroom where students can sit comfortably in a large group.

Guides for Adult Helpers

In the Teacher Resources binder, you will find center instructions sheet duplication masters for some investigation parts. These sheets are intended as a quick reference for a family member or other adult who might be supervising the center. The sheets help that person keep the activity moving in a productive direction. The sheets can be laminated or slipped into a clear plastic sheet protector for durability.
When You Don’t Have Adult Helpers

Some parts of investigations are designed for small groups, with an aide or a student’s family member available to guide the activity and to encourage discussion and vocabulary development. We realize that there are many primary classrooms in which the teacher is the only adult present. Here are some ways to manage in that situation.

- Invite upper-elementary students to visit your class to help with the activities. They should be able to read the center instructions sheets and conduct the activities with students. Remind older students to be guides and to let primary students do the activities themselves.

- Introduce each part of the activity with the whole class. Set up the center as described in the Investigations Guide, but let students work at the center by themselves. Discussion may not be as rich, but most of the centers can be done independently by students once they have been introduced to the process. Be a 1-minute manager, checking on the center from time to time, offering a few words of advice or direction.

When Students Are Absent

When a student is absent for an activity, 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.
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. 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.
4. Stay within the designated study area and with your partner or group. When you hear the “freeze” signal, stop and listen to your teacher.
5. Never look directly at the Sun or at the sunlight being reflected off a shiny object.
6. Know if there are any skin-irritating plants in your schoolyard, and do not touch them. Most plants in the schoolyard are harmless.
7. Respect all living things. When looking under a stone or log, lift the side away from you so that any living thing can escape.
8. 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.
9. Never release any living things into the environment unless you collected them there.
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

The Getting Ready section for each part of the investigation helps you prepare. It provides information on scheduling the investigation and introduces the tools and techniques used in the investigation. The first item in the Getting Ready section gives an estimated amount of time the part should take. A general rule of thumb is to plan 10 minutes to introduce the investigation to the whole class, about 20–25 minutes at the center for each group, about 10 minutes to wrap up the activity with the whole class, and a few minutes to transition to the groups. Notebook sessions can be done with the whole class after everyone has participated in the center activities. All of the outdoor sessions are whole-class activities.

Below is a list of the investigations and parts and the format of the investigation (whole class, center, or a combination of the two).

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<th>PART</th>
<th>ORGANIZATION</th>
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<td>1. Observing Schoolyard Trees</td>
<td>whole class</td>
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<tr>
<td></td>
<td>2. Tree Parts</td>
<td>whole class/center</td>
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<td></td>
<td>3. Tree Puzzles</td>
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<td>2. Leaf Shapes</td>
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<td>3. Observing Weather</td>
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<td>5. Winter: Twigs</td>
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<td>6. Winter: Visiting Adopted Trees</td>
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<td>7. Spring: Forcing Twigs</td>
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<tr>
<td></td>
<td>9. Spring: Visiting Adopted Trees</td>
<td>whole class</td>
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## FOSS K–8 Scope and Sequence

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<td>Energy and Electromagnetism</td>
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<td>Measuring Matter</td>
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<td>1–2</td>
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<td>Solids and Liquids</td>
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<td>Plants and Animals</td>
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<tr>
<td>K</td>
<td>Materials in Our World</td>
<td>Trees and Weather</td>
<td>Animals Two by Two</td>
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