INTRODUCTION

To a primary student, the oak on the corner, the pines at the park, and the mulberry tree at school are all phenomena. Systematic investigation of trees over the seasons will bring students to a better understanding of the place of trees 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 anchor phenomenon for this module is that trees are plants that live and grow through the seasons. The driving questions are what do trees need to live and grow?, how does weather affect trees?, and what changes do trees cause in their surroundings?

The Trees and Weather Module provides students with solid experiences to help them develop an understanding of what plants (and animals) need to survive and the relationship between their needs and where they live. By monitoring local weather, students experience the patterns and variations in weather and come to understand the importance of weather forecasts to prepare for severe weather.

Throughout the module, students engage in science and engineering practices by asking questions, participating in collaborative investigations, observing, recording, and interpreting data to build explanations, and obtaining information from photographs. Students gain experiences that will contribute to an understanding of the crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; systems and system models; structure and function; and stability and change.

The NGSS Performance Expectations bundled in this module include:

**Life Sciences**
- K-LS1-1 *

**Earth and Space Sciences**
- K-ESS2-1
- K-ESS2-2 *
- K-ESS3-1 *
- K-ESS3-2

**Physical Sciences**
- K-PS3-1

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

* The FOSS Animals Two by Two Module also addresses these performance expectations with a focus on animals.

**NOTE**
The three modules for grade K in FOSS Next Generation are
- Materials and Motion
- Trees and Weather
- Animals Two by Two
<table>
<thead>
<tr>
<th>Investigation Summary</th>
<th>Guiding and Focus Questions for Phenomena</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inv. 1: Observing Trees</strong></td>
<td>Students engage with the phenomenon of 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.</td>
</tr>
<tr>
<td><strong>What makes a tree a tree?</strong></td>
<td>What did we learn about our schoolyard trees?</td>
</tr>
<tr>
<td></td>
<td>What are the parts of trees?</td>
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<td></td>
<td>What shapes are trees?</td>
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<tr>
<td></td>
<td>Which trees have similar shapes?</td>
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<td></td>
<td>What can we find out about our adopted trees?</td>
</tr>
<tr>
<td></td>
<td>What do trees need to grow?</td>
</tr>
<tr>
<td><strong>Inv. 2: Observing Leaves</strong></td>
<td>Students engage with the phenomenon of 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, <em>Our Very Own Tree</em>.</td>
</tr>
<tr>
<td><strong>How are leaves the same and different?</strong></td>
<td>What can we observe about leaves?</td>
</tr>
<tr>
<td></td>
<td>What shapes are leaves?</td>
</tr>
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<td></td>
<td>How are leaves different?</td>
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<tr>
<td></td>
<td>How are leaf edges different?</td>
</tr>
<tr>
<td></td>
<td>What can we observe about leaves?</td>
</tr>
<tr>
<td><strong>Inv. 3: Observing Weather</strong></td>
<td>Students engage with the phenomenon of local 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.</td>
</tr>
<tr>
<td><strong>What is weather, where does it happen, and how does it affect us?</strong></td>
<td>What is the weather today?</td>
</tr>
<tr>
<td></td>
<td>How can we measure the air temperature?</td>
</tr>
<tr>
<td></td>
<td>What does a wind sock tell us about the wind?</td>
</tr>
<tr>
<td><strong>Inv. 4: Trees through the Seasons</strong></td>
<td>Students engage with the phenomenon of 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. They observe how trees can change their surroundings. Students discuss the guiding questions for the module.</td>
</tr>
<tr>
<td><strong>How do trees change through the seasons?</strong></td>
<td>How do trees change their surroundings?</td>
</tr>
<tr>
<td></td>
<td>What do fall trees look like?</td>
</tr>
<tr>
<td></td>
<td>What do winter trees look like?</td>
</tr>
<tr>
<td></td>
<td>What do spring trees look like?</td>
</tr>
</tbody>
</table>
### Module Matrix

**Content Related to Disciplinary Core Ideas**

- Trees are living plants.
- Trees have structures: branches, leaves, trunk, and roots.
- Trees differ in size and shape.
- Plants have basic needs: water, light, air, nutrients, and space.
- Plants and animals can change their surroundings.

- Different kinds of trees have different leaves.
- Leaves have properties: size, shape, tip, edge, texture, and color.
- Leaf properties vary.
- Leaves can be described and compared by their properties.

- Weather is the condition in the air outdoors and can be described; weather changes.
- Temperature is how hot or cold it is; thermometers measure temperature.
- Sunlight warms Earth’s surface.
- Wind is moving air; a wind sock indicates wind direction and speed.
- Weather forecasts help people prepare for the severe weather that is likely in that area.

- 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.
- Trees are living, growing plants.
- Trees can change their surroundings.

**Reading/Technology**

- **Books**
  - *How Do We Learn?*
  - *Our Very Own Tree*

- **Video**
  - *Once There Was a Tree*

- **Online Activity**
  - "Leaf Sorting"

- **Science Resources Book**
  - "Where Do Trees Grow?"
  - "What Do Plants Need?"

- **Posters and Story**
  - "A Tree Comes to Class"

**Assessment**

- Embedded Assessment
  - Teacher observation

- **NGSS Performance Expectations**
  - K-LS1-1
  - K-ESS2-2
  - K-ESS3-1

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**Trees and Weather Module—FOSS Next Generation**

- Embedded Assessment
  - Teacher observation

- **NGSS Performance Expectations**
  - K-LS1-1
  - K-ESS2-1
  - K-ESS3-2
  - K-2-ETS1-2

- **Science Resources Book**
  - "Up in the Sky"
  - "Weather"

- **Video**
  - *Come a Tide*

- **Science Resources Book**
  - "My Apple Tree"
  - "Orange Trees"
  - "Maple Trees"

- **Videos**
  - *Once There Was a Tree*
  - *Summer*

- **Online Activity**
  - "Who Lives Here?"

- **Book**
  - *Our Very Own Tree*
FOSS COMPONENTS

Teacher Toolkit for Each Module

The FOSS Next Generation Program has three modules for kindergarten—Materials and Motion, Trees and Weather, and Animals Two by Two.

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

Investigations Guide. This spiral-bound document contains these chapters:

- Overview
- Framework and NGSS
- Materials
- Technology
- Investigations (four in this module)
- Assessment

INVESTIGATION 4 — Trees through the Seasons

GUIDING the Investigation

Part 9: Spring: Visiting Adopted Trees

6. Focus question: What do spring trees look like?

- When the focus question is on the chart in your notebook.
- What do spring trees look like?

Distribute a strip of paper with the focus question for students to glue above their notebook entries. They should use pictures and words to answer the question.

WRAP-UP

7. Share notebook entries

Conclude the spring part by having students share work with partners. Ask students to open their science notebooks and read the focus question together.

- What do spring trees look like?
- Ask students to pair up with a partner to:
  - Share their answers to the focus question.
  - Explain their drawings.
- Have students critique their work by sharing with a partner one thing they like about their entry and one thing they can do to improve it.

Have students pair up with a partner to:

- Discuss the patterns that students have observed in how trees and the weather change during the spring. Ask them to predict how the weather will change during the summer. Discuss the patterns that students have observed in how trees and the weather change during the spring. Ask them to predict how the weather will change during the summer.

8. Review vocabulary

Have students use the words from Parts 7–9. Have them think about the vocabulary they have learned during the spring. Ask students to use the words from Parts 7–9 to complete the sentences:

- Spring.
- Summer.
- Autumn.
- Winter.

9. Assess

- Some trees have leaves, but some have flowers. On the following chart, show the leaves and flowers on the trees that are growing.
- Some trees have leaves, but some have blossoms. On the following chart, show the leaves and blossoms on the trees that are growing.

STABILITY AND CHANGE

FOSS components. Stability and change

FOSS COMPONENTS

FOSS Next Generation Program has three modules for kindergarten—Materials and Motion, Trees and Weather, and Animals Two by Two.
FOSS Components

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

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

- FOSS Program Goals
- Planning Guide—Grade K
- Science and Engineering Practices—Grade K
- Crosscutting Concepts—Grade K
- Sense-Making Discussions for Three-Dimensional Learning—Grade K
- Access and Equity
- Science Notebooks in Grades K–2
- Science-Centered Language Development
- FOSS and Common Core ELA—Grade K
- FOSS and Common Core Math—Grade K
- Taking FOSS Outdoors
- Teacher Masters
- Assessment Masters

**Equipment for Each Module or Grade Level**

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

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

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**Center Instructions: Wind Direction**

**Materials**
- Sheets of construction paper, folded and hole punched
- Strips of crepe paper
- Pieces of yellow yarn
- Glue sticks or white glue
- Transparent tape
- Crayons or marking pens *

**Set Up the Center**

1. Give each student a piece of folded, punched construction paper. Students should write their names and draw a design on the front side (the side without the fold).

2. Glue eight strips of crepe paper side by side along the long edge opposite the folded edge.

3. Tie one end of a piece of yarn to Hole 1 and the other end to Hole 3. Tie a second piece of yarn to Holes 2 and 4. (Students will probably need help.)

4. Roll the construction paper into a tube, and secure it with a piece of tape.

5. Tie the yarn loops with a single knot.

**Vocabulary**

- Streamers
- Wind sock

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**Trees and Weather Module—FOSS Next Generation**
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 Investigations Guide. Students read the articles in the book as they progress through the module. The articles cover specific concepts, usually after the concepts have been introduced in the active investigation.

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

NOTE

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

Weather

Weather is in the air.
Sometimes the weather is hot.
Sometimes the weather is cold.

Who is dressed for hot weather?
Who is dressed for cold weather?
Technology

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

With an educator account, you can customize your homepage, set up easy access to the digital components of the modules you teach, and create class pages for your students with access to online activities.

Ongoing Professional Learning

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

NOTE

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

NOTE

Look for professional development opportunities and online teaching resources on www.FOSSweb.com.
FOSS INSTRUCTIONAL DESIGN

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

The Elements of the FOSS Instructional Design

- Using Formative Assessment
- Integrating Science Notebooks
- Engaging in Science–Centered Language Development
- Accessing Technology
- Reading FOSS Science Resources Books
- Taking FOSS Outdoors

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

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

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

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

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

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

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

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

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

**Context: sharing, questioning, and planning.** Active investigation requires focus. The context of an inquiry can be established with a focus question about a phenomenon or challenge from you or, in some cases, from students. (How can we measure air temperature?) 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 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.

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

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

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

**Science Notebooks**

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

You will find the duplication masters for grades 1–5 presented in notebook format. They are reduced in size (two copies to a standard sheet) for placement (glue or tape) into a bound composition book. Full-sized masters for grades 3–5 that can be filled in electronically and are suitable for display are available on FOSSweb. Student work is entered partly in spaces provided on the notebook sheets and partly on adjacent blank sheets in the composition book. Look to the chapter in *Teacher Resources* called Science Notebooks in Grades K–2 for more details on how to use notebooks with FOSS.
Reading in FOSS Science Resources

The FOSS Science Resources book, available in print and interactive eBooks, are primarily devoted to expository articles and biographical sketches. FOSS suggests that the reading be completed during language-arts time to connect to the Common Core State Standards for ELA. When language-arts skills and methods are embedded in content material that relates to the authentic experience students have had during the FOSS active learning sessions, students are interested, and they get more meaning from the text material.

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

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

Engaging in Online Activities through FOSSweb

The simulations and online activities on FOSSweb are designed to support students’ learning at specific times during instruction. Digital resources include streaming videos that can be viewed by the class or small groups. Resources can be used to review the active investigations and to support students who need more time with the concepts.

The Technology chapter provides details about the online activities for students and the tools and resources for teachers to support and enrich instruction. There are many ways for students to engage with the digital resources—in class as individuals, in small groups, or as a whole class, and at home with family and friends.
Assessing Progress 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 leaves, you can provide more time at a center for sorting and recording observations in their notebooks.

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.
Taking FOSS Outdoors

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

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

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

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

### The Three Rs of Conservation

A natural resource is something found in nature that people need or use. Trees, soil, and water are some natural resources. Using them wisely is called conservation. How can you practice conservation? Follow the three Rs: reduce, reuse, and recycle!
Science-Centered Language Development and Common Core State Standards for ELA

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

In the Science-Centered Language Development chapter in Teacher Resources, we explore the intersection of science and language and the implications for effective science teaching and language development. Language plays two crucial roles in science learning: (1) it facilitates the communication of conceptual and procedural knowledge, questions, and propositions, and (2) it mediates thinking—a process necessary for understanding. For students, language development is intimately involved in their learning about the natural world. Science provides a real and engaging context for developing literacy and language-arts skills identified in contemporary standards for English language arts.

The most effective integration depends on the type of investigation, the experience of students, the language skills and needs of students, and the language objectives that you deem important at the time. The Science-Centered Language Development chapter is a library of resources and strategies for you to use. The chapter describes how literacy strategies are integrated purposefully into the FOSS investigations, gives suggestions for additional literacy strategies that both enhance students’ learning in science and develop or exercise English-language literacy skills, and develops science vocabulary with scaffolding strategies for supporting all learners. We identify effective practices in language-arts instruction that support science learning and examine how learning science content and engaging in science and engineering practices support language development.

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

Learning from Experience

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

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

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

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

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

FOSS for All Students

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

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

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

For some students, it might mean making vocabulary and language structures more explicit through new concrete experiences or through reading to students. It may help them identify and understand relationships and connections through graphic organizers. Interdisciplinary extensions in the arts, social studies, math, and language arts, as well as more advanced projects, are listed at the end of each investigation.

**English Learners**

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

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

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

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

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

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

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

Teaching notes and ELA Connections appear in blue boxes in the sidebars. These notes comprise a second voice in the curriculum—an educative element. The first (traditional) voice is the message you deliver to students. The second (educative) voice, shared as a teaching note, is designed to help you understand the science content and pedagogical rationale at work behind the instructional scene. ELA Connections boxes provide connections to the Common Core State Standards for English Language Arts.

The Getting Ready and Guiding the Investigation sections have several features that are flagged in the sidebars. These include icons to remind you when a particular pedagogical method is suggested, as well as concise bits of information in several categories.
The **safety** icon alerts you to potential safety issues related to chemicals, allergic reactions, and the use of safety goggles.

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

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

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

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

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

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

The **assessment** icon appears when there is an opportunity to assess student progress by using embedded assessment.

The **crosscutting concepts** icon indicates an opportunity to expand on the concept by going to *Teacher Resources*, Crosscutting Concepts chapter.

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

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

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

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

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

Part of being a kindergartner is learning how to work collaboratively with others. However, 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 Discussions

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.

At the beginning of the year, explain and discuss norms for sense-making discussions. You might start by together making a class poster with visuals to represent what it looks like, sounds like, and feels like when everyone is working and learning together. Model discussion protocols that give all students opportunities to speak and listen, such as think-pair-share. Review the norms before sense-making discussions, and leave time for reflecting on how well the group adhered to the norms. More strategies for developing oral discourse skills can be found in Sense-Making Discussions for Three-Dimensional Learning and the Science-Centered Language Development chapters in Teacher Resources on FOSSweb.
Collaborative Teaching and Learning

Collaborative learning requires a collective as well as individual growth mindset. A growth mindset is when people believe that their most basic abilities can be developed through dedication and hard work (see the research of Carol Dweck and her book *Mindset: The Psychology of Success*). As kindergartners learn to work together to make sense of phenomena and develop their inquiry and discourse skills, it’s important to recognize and value their efforts to try new approaches, to share their ideas, and ask questions. Remind students that everyone in the classroom is a learner, and that learning happens when we try to figure things out. Here are a few ways to help students develop a growth mind-set for science and engineering.

- **Praise effort, not right answers.** When students are successful at a task, provide positive feedback about their level of engagement and effort in the practices, e.g., the efforts they put into careful observations, how well they reported their observations, the relevancy of their questions, how well they connected or applied new concepts, and their use of new vocabulary, etc. Also, try to provide feedback that encourages students to continue to improve their learning and exploring, e.g., is there another way you could try? Have you thought about _____? Why do you think _____?

- **Foster and validate divergent thinking.** During sense-making discussions, continually emphasize how important it is to share emerging ideas and to be open to the ideas of others in order to build understanding. Model for students how you refine and revise your thinking based on new information. Make it clear to students that the point is not for them to show they have the right answer, but rather to help each other arrive at new understandings. Point out positive examples of students expressing and revising their ideas. For example, “Did you all notice how Carla changed her idea about _____?”

Establishing a classroom culture that supports three-dimensional teaching and learning centers on collaboration. Helping students to work together in pairs and small groups, and to adhere to norms for discussions, are ways to foster collaboration. These structures along with the expectations that students will be negotiating meaning together as a community of learners, creates a learning environment where students are compelled to work, think, and communicate like scientists and engineers to help one another learn.
Guides for Adult Helpers

On FOSSweb, you will find duplication masters for center instructions 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 and helping to guide the discussions. The sheets help that person keep the activity moving in a productive direction by suggesting questions and prompts to help students make sense of the phenomenon they are exploring. 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 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 Investigations Guide, but let students work at the center by themselves. Discussion might 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.
Managing Materials

The Materials section lists the items in the equipment kit and any teacher-supplied materials. It also describes things to do to prepare a new kit and how to check and prepare the kit for your classroom. Individual photos of each piece of FOSS equipment are available for printing from FOSSweb, and can help students and you identify each item. (Photo equipment cards are available in English and Spanish formats.)

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.

Safety Data Sheets (SDS) for materials used in the FOSS Program can be found on FOSSweb. If you have questions regarding any SDS, call Delta Education at 1-800-258-1302 (Monday–Friday, 8:00 a.m.–5:00 p.m. ET).

Science Safety in the Classroom

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

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

Science Safety

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

1. Tell your teacher if you have any allergies.
2. Never put any materials in your mouth.
3. Dress appropriately for the weather and the outdoor experience.
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. 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.
8. Never release any living things into the environment unless you collected them there.
9. Always wash your hands with soap and warm water after handling plants, animals, and soil.
10. Return to the classroom with all of the materials you brought outside.
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).

<table>
<thead>
<tr>
<th>INVESTIGATION</th>
<th>PART</th>
<th>ORGANIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Observing Trees</td>
<td>1. Observing Schoolyard Trees</td>
<td>whole class</td>
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<tr>
<td>2. Tree Parts</td>
<td></td>
<td>whole class/center</td>
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<tr>
<td>3. Tree Puzzles</td>
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<td>center</td>
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<tr>
<td>4. Tree-Silhouette Cards</td>
<td></td>
<td>whole class/center</td>
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<tr>
<td>5. Adopt Schoolyard Trees</td>
<td></td>
<td>whole class</td>
</tr>
<tr>
<td>6. A Tree Comes to Class</td>
<td></td>
<td>whole class</td>
</tr>
<tr>
<td>2. Observing Leaves</td>
<td>1. Leaf Walk</td>
<td>whole class</td>
</tr>
<tr>
<td>2. Leaf Shapes</td>
<td></td>
<td>center</td>
</tr>
<tr>
<td>3. Comparing Leaves</td>
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<td>whole class</td>
</tr>
<tr>
<td>4. Matching Leaf Silhouettes</td>
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<td>center</td>
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<tr>
<td>5. Leaf Books</td>
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<tr>
<td>3. Observing Weather</td>
<td>1. Weather Calendar</td>
<td>whole class</td>
</tr>
<tr>
<td>2. Recording Temperature</td>
<td></td>
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<tr>
<td>3. Wind Direction</td>
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<tr>
<td>4. Trees through the Seasons</td>
<td>1. Fall: What Comes from Trees?</td>
<td>whole class/center</td>
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<tr>
<td>2. Fall: Food from Trees</td>
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<td>3. Fall: Visiting Adopted Trees</td>
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<td>whole class</td>
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<td>4. Winter: Evergreen Hunt</td>
<td></td>
<td>whole class</td>
</tr>
<tr>
<td>5. Winter: Twigs</td>
<td></td>
<td>center</td>
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<tr>
<td>6. Winter: Visiting Adopted Trees</td>
<td></td>
<td>whole class</td>
</tr>
<tr>
<td>7. Spring: Forcing Twigs</td>
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<td>center</td>
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<tr>
<td>8. Spring: Bark Hunt</td>
<td></td>
<td>whole class</td>
</tr>
<tr>
<td>9. Spring: Visiting Adopted Trees</td>
<td></td>
<td>whole class</td>
</tr>
</tbody>
</table>

**NOTE**

The investigations are numbered, and we suggest that they be conducted in order since the concepts build from investigation to investigation.

Be prepared—read the Getting Ready section thoroughly and review the teacher preparation video on FOSSweb.

Investigation 4 looks at seasonal changes and calls for scheduling activities throughout the year.
FOSS CONTACTS

General FOSS Program information
www.FOSSweb.com
www.DeltaEducation.com/FOSS

Developers at the Lawrence Hall of Science
FOSS@berkeley.edu

Customer service at Delta Education
www.DeltaEducation.com/contact.aspx
Phone: 1-800-258-1302, 8:00 a.m.–5:00 p.m. ET

FOSSmap (online component of FOSS assessment system)
FOSSmap.com/

FOSSweb account questions/access codes/help logging in
techsupport.science@schoolspecialty.com
Phone: 1-800-258-1302, 8:00 a.m.–5:00 p.m. ET

School Specialty online support
loginhelp@schoolspecialty.com
Phone: 1-800-513-2465, 8:30 a.m.–6:00 p.m. ET

FOSSweb tech support
support@fossweb.com

Professional development
www.FOSSweb.com/Professional-Development

Safety issues
www.DeltaEducation.com/SDS
Phone: 1-800-258-1302, 8:00 a.m.–5:00 p.m. ET
For chemical emergencies, contact Chemtrec 24 hours a day.
Phone: 1-800-424-9300

Sales and replacement parts
www.DeltaEducation.com/FOSS/buy
Phone: 1-800-338-5270, 8:00 a.m.–5:00 p.m. ET