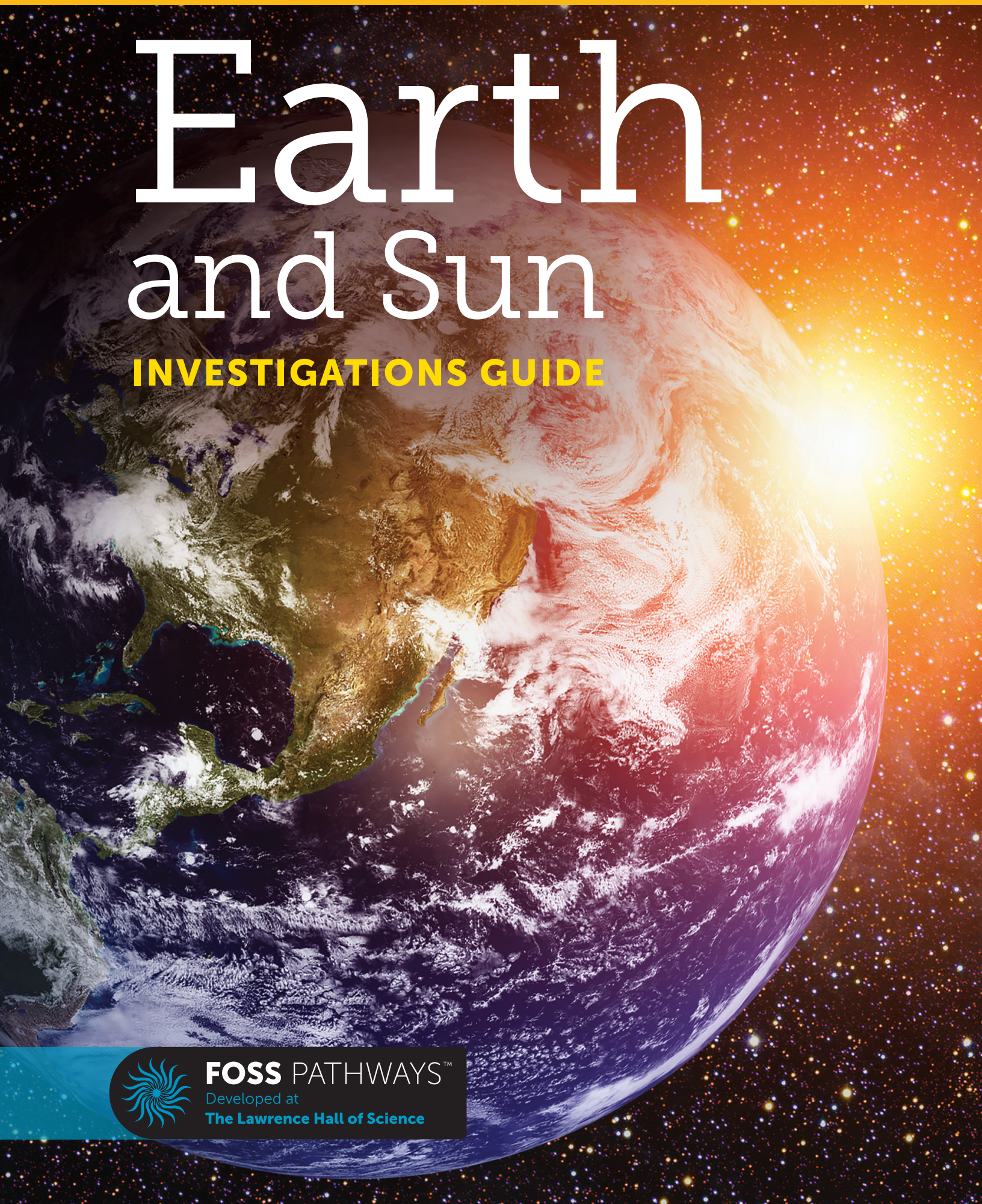
SAMPLER

Earth and Sun

INVESTIGATIONS GUIDE



FOSS PATHWAYS™
Developed at
The Lawrence Hall of Science

PreK–5 science that meets the challenge of our time

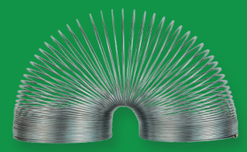
Welcome to new FOSS Pathways. Now as never before, the world needs scientific thinkers—to view the world thoughtfully, approach challenges analytically, and embrace opportunities enthusiastically. For educators to help unlock this potential in their students, they need powerful tools that work for the needs of today. A program that engages students of all backgrounds and experiences. Fully leverages modern digital technology. And does it all in the hours available.

A major advancement from a proven leader

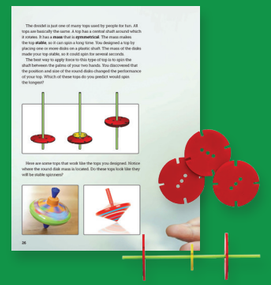
The Full Option Science System™ (FOSS) was conceived to enlist students not as passive recipients of information, but as active investigators of phenomena. That principle has proven its worth for 150,000 teachers and 4 million students across all 50 states, building a legacy of student engagement and test-score improvement. Now FOSS takes science education another significant step forward, with FOSS Pathways. This new PreK–5 core curriculum:

Aligns with today's national science standards and is adaptable to meet state and local requirements

Incorporates the digital tools for a flexible multimedia experience



Lends flexibility to teach in the class time allotted for science



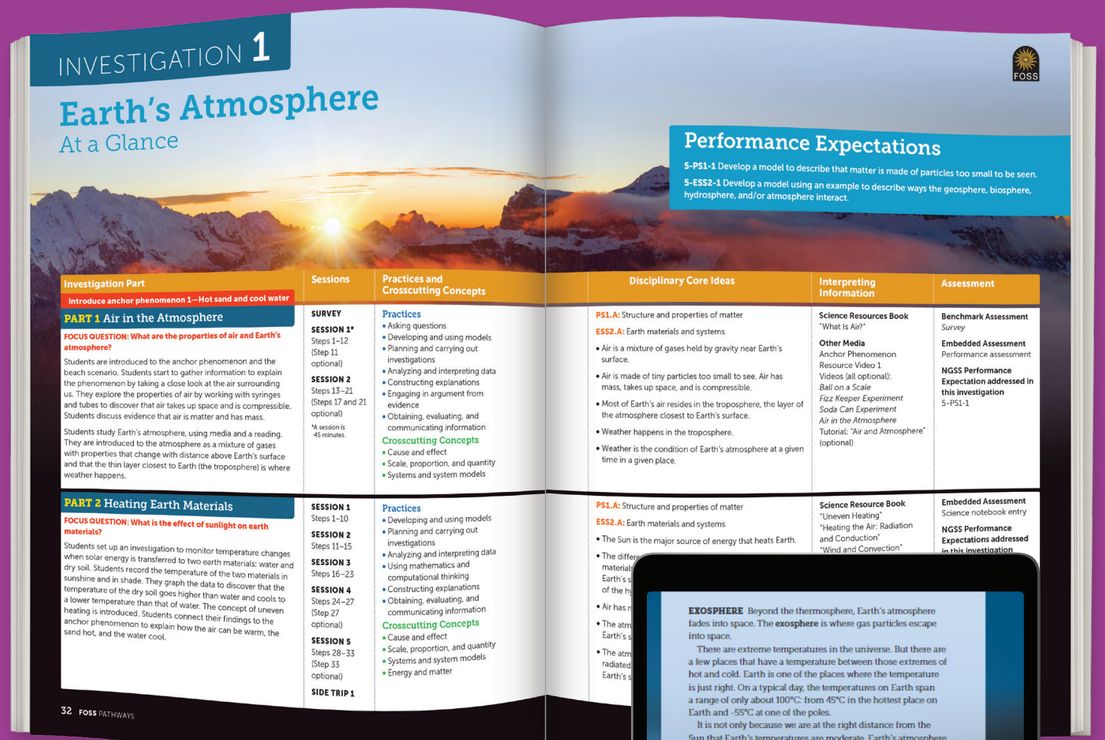
Teaches through a multimodal approach to resonate with every student

Engages students through coherent phenomenon storylines that are local and relevant

Provides unmatched educative support to teach phenomena-based science

How Pathways develops the scientific thinkers of tomorrow

New FOSS Pathways supports today's demand to develop scientifically literate thinkers and problem solvers in a multitude of ways.



A logical progression

Students develop core ideas in a relevant and coherent learning progression that allows them to construct an explanation of the phenomena they have experienced.

Support for students

Comprehensive support and multimodal instructional experiences engage learners of all languages and cultures, taking advantage of prior experiences so all students can reason scientifically.

Evidence of learning

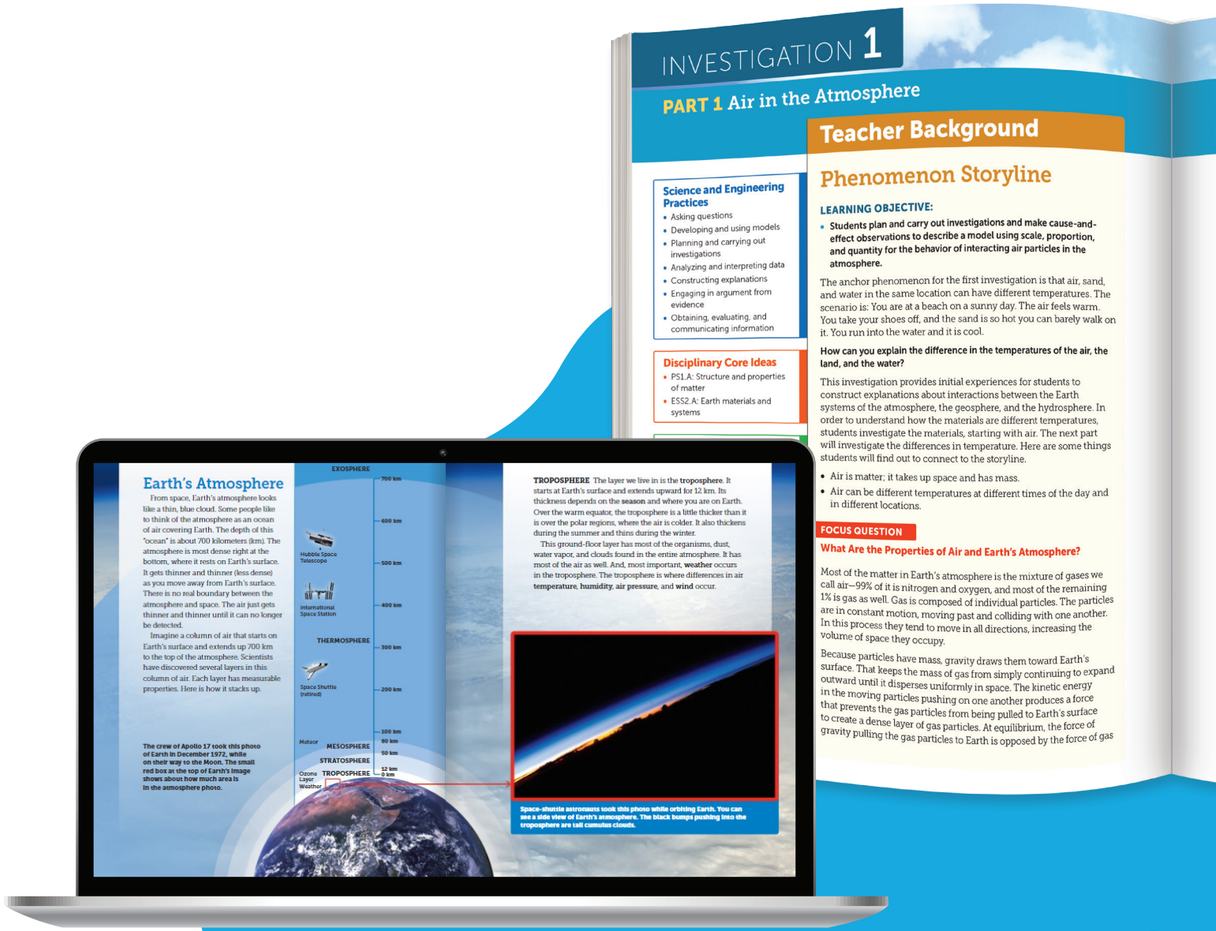
Research-based and field-tested assessments accurately measure student learning and progress. A variety of formative assessment tools provide evidence of students' use of the three dimensions and their knowledge of phenomena.

Support for teachers

Phenomena-based instruction is facilitated by appropriate educative support. This includes explicit background information needed for teachers to engage students in making the connection between the anchor phenomenon being investigated and the core ideas being exposed.

Rich digital resources

Digital resources for students and teachers are provided through FOSSweb on ThinkLink™. These multimedia materials are purposefully designed to enhance the learning experience and lend the flexibility to keep active science teaching viable if classroom circumstances change.



How FOSS Pathways aligns with today's standards

In this Sampler, pages 9-21 and 23-49 are provided from the teacher *Investigations Guide*. As you review, you will begin to witness the numerous ways that FOSS Pathways supports the development of tomorrow's scientists, engineers, and informed citizens. You'll see examples for:

Investigations driven by local, relevant phenomena and real-world problems

Instruction led by multimodal experiences that cognitively engage students to figure out phenomena

Identification of performances to meet targeted learning goals and elicit evidence of students' use of all three dimensions

Instructional support for teachers that provides an explicit connection between the phenomenon, three-dimensional learning, and multimodal learning experiences

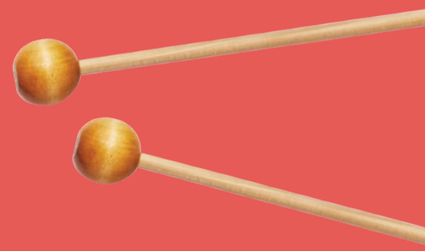
Clear integration of ELA/ELD skills and practices, with ties to standards and resources for engaging multilingual students

Cross-curricular activities that give students a choice and voice to differentiate instruction

▶ Images on this page include actual components, resources and/or materials provided in FOSS kits.

Alignment to NGSS Performance Expectations

Grade 5 NGSS Performance Expectations	FOSS Earth and Sun	
	Investigation(s)	Benchmark Assessment
5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen.	**Investigation 1**	• Investigations 1 -2 I-Check • Survey/Posttest
5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.	**Investigation 4**	• Investigation 1-2 I-Check • Survey/Posttest
5-ESS1-1: Support an argument that differences in the apparent brightness of the Sun compared to other stars is due to their relative distances from Earth.	**Investigation 4**	• Investigation 3 I-Check • Survey/Posttest
5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.	**Investigation 3** **Investigation 4**	• Investigation 3 I-Check • Survey/Posttest
5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.	**Investigation 1** **Investigation 2**	• Investigation 1-2 I-Check • Survey/Posttest
5-ESS2-2: Describe and graph the amounts and percentage of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.	**Investigation 2**	• Survey/Posttest
5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment.	**Investigation 2**	• Survey/Posttest



Earth and Sun Investigations

Investigation 1: Earth's Atmosphere

Part 1: Air in the Atmosphere
Part 2: Heating Earth Materials

Investigation 2: Earth's Water

Part 1: Water Cycle
Part 2: Climate Change

Investigation 3: Earth's Sun

Part 1: Sun Tracking
Part 2: Day and Night

Investigation 4: Looking out from Earth

Part 1: Orbits and Gravity
Part 2: The Stars
Part 3: Sky Modeler

Earth and Sun

▶ Start here to begin your review of the Grade 5 Earth and Sun Investigations Guide

Introduction

Earth is the third planet from the Sun. It travels around the Sun in a nearly circular orbit at a distance of about 150 million kilometers. Earth is water rich, with 71% of the planet's surface covered with water. It is surrounded by a shallow atmosphere of nitrogen (78%) and oxygen (21%), and small amounts of a lot of other gases. Students investigate the patterns observed in the sky over a day, a month, a year, and more, and their effect on Earth.

Four anchor phenomena drive the investigations.

- Anchor phenomenon 1—Hot sand and cool water
- Anchor phenomenon 2—Water movement
- Anchor phenomenon 3—In the shade then sunlight
- Anchor phenomenon 4—One or many stars

The **Earth and Sun Module** provides students with experiences to explore the properties of the atmosphere, the energy transfer from the Sun to Earth, and the dynamics of weather and water cycling in Earth's atmosphere. The constant renewal of water on Earth's land surfaces by the activities in the atmosphere is one of the defining characteristics of Earth, the water planet. Other experiences help students to develop and use models to understand Earth's place in the solar system, and the interactions of Earth, the Sun, and the Moon to reveal predictable patterns—daily length and direction of shadows, day and night, and the seasonal appearance of stars in the night sky. Students gain experiences that will contribute to the understanding of crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; systems and system models; and energy and matter.

CONTENTS

The NGSS Performance Expectations bundled in this module include:

Earth Sciences
5-ESS1-1
5-ESS1-2
5-ESS2-1
5-ESS2-2
5-ESS3-1

Physical Sciences
5-PS1-1
5-PS2-1

NOTE

The three modules for grade 5 in FOSS Pathways are:

- Mixtures and Solutions
- Earth and Sun
- Living Systems

Module Matrix
At a Glance

Phenomenon and Storyline	Driving Question and Focus Questions	Content and Disciplinary Core Ideas	Practices and Crosscutting Concepts	NGSS PEs
INV. 1 Earth's Atmosphere **Phenomenon 1—Hot sand and cool water:** You are at a beach on a sunny day. The air feels warm. You take your shoes off, and the sand is so hot you can barely walk on it. You run into the water and it is cool. **Storyline:** Students investigate the phenomenon that air surrounds us—Earth's atmosphere. They explore air by working with syringes and tubes to discover that air takes up space and is compressible. They are introduced to the atmosphere as a mixture of gases with properties that change with altitude above Earth's surface. Students investigate the phenomenon of energy transfer on Earth. They investigate uneven heating by recording and graphing temperature changes when two earth materials absorb solar energy. They gather information about energy transfer by radiation and conduction and discuss mechanisms of energy transfer to and from the air. Students consider how the atmosphere, hydrosphere, and geosphere interact.	***How can you explain the difference in the temperatures of the air, the land, and the water?*** **FOCUS QUESTIONS:** **What are the properties of air and Earth's atmosphere?** **What is the effect of sunlight on earth materials?**	**PS1.A:** Structure and properties of matter **ESS2.A:** Earth materials and systems • Air is a mixture of gases held by gravity near Earth's surface. • Air has mass and takes up space; it is made of tiny particles too small to see. • Weather happens in the troposphere, the layer of the atmosphere closest to Earth's surface. • The Sun is the major source of energy that heats Earth. • The different energy-transferring properties of earth materials (soil and water) can lead to uneven heating of Earth's surface—interactions of the geosphere, hydrosphere, and atmosphere. • The atmosphere is heated by conduction between Earth's surfaces and air particles and by absorption of energy radiated directly from the Sun and reradiated from Earth's surfaces.	**Science and Engineering Practices** Asking questions Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Cause and effect Scale, proportion, and quantity Systems and system models Energy and matter	**5-PS1-1:** Develop a model to describe that matter is made of particles too small to be seen. **5-ESS2-1:** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
INV. 2 Earth's Water **Phenomenon 2—Water movement:** Students in their classroom are comparing two photographs—one of a local reservoir taken a few years ago during a drought, and a recent one taken after a month of heavy rain. They look out their classroom window to see the rain pouring down and the water flowing over the ground where it was dry just a few hours ago. **Storyline:** Students turn to the phenomenon of water on Earth. They consider why Earth is called the water planet. They investigate systems to observe condensation on cold surfaces and determine the components of the water cycle. Students explore the conditions that promote evaporation. They simulate the travels of a drop of water through the water cycle to explore the complexities of the process. Students are introduced to global climate change.	***Where does water come from, where does it go, and how does it move from place to place?*** **FOCUS QUESTIONS:** **How does water move through the hydrosphere, atmosphere, biosphere, and geosphere?** **What kinds of data about the hydrosphere help communities plan for climate change?**	**ESS2.A:** Earth materials and systems **ESS2.C:** The roles of water in Earth's surface processes **ESS3.C:** Human impacts on Earth systems • Most of Earth's water (97%) is salt water in the ocean; Earth's fresh water is found in many locations including water vapor in the atmosphere, lakes and rivers, soil, ground ice, ground water, and glaciers. • Evaporation and condensation redistribute water over Earth's surface. • The Sun's energy drives weather and climate. • People can protect Earth's resources and environments by doing things that conserve energy. These actions may slow Earth's climate change that is affecting water distribution on Earth. • NASA's Gravity Recovery and Climate Experiment (GRACE) is one of several missions using orbiting satellites to improve our understanding of water under the changing climate.	**Science and Engineering Practices** Asking questions Developing and using models Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Obtaining, evaluating, and communicating information **Crosscutting Concepts** Cause and effect Scale, proportion, and quantity Systems and system models Stability and change	**5-ESS2-1:** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. **5-ESS2-2:** Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. **5-ESS3-1:** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Module Matrix
At a Glance CONTINUED

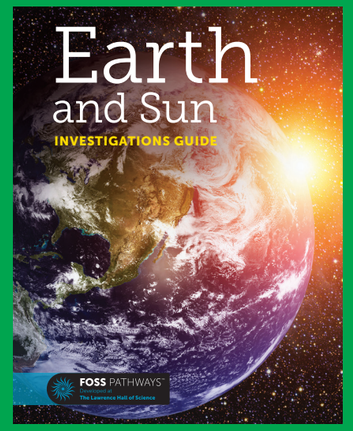
Phenomenon and Storyline	Driving Question and Focus Questions	Content and Disciplinary Core Ideas	Practices and Crosscutting Concepts	NGSS PEs
INV. 3 Earth's Sun **Phenomenon 3—In the shade then sunlight:** A family is planning on having lunch at the park on a clear, sunny day. When they arrive at 11 am, they sit down at a picnic table in the shade of a nearby tree. After 2 hours their table is not in the shade any more. **Storyline:** Students monitor the position of the Sun as it moves across the sky. After using a compass to orient a Sun tracker, students make hourly records of the position of the shadow cast by a golf tee. Students imagine an observer on Earth (their head) and position themselves around a lamp to observe day and night. They discover that rotation of Earth produces day and night. Students put the observed daily movement of the Sun phenomenon together with the phenomenon of day and night and use another model to resolve explanations for both phenomena.	***What causes the picnic table to be in the shade for part of the day and in the sunlight the other part?*** **FOCUS QUESTIONS:** **How and why does a shadow change during the day?** **What causes day and night?**	**ESS1.B:** Earth and the solar system • Shadows are the dark areas that result when light is blocked. • Shadows change during the day because the position of the Sun changes in the sky. • The length and direction of a shadow depends on the Sun's position in the sky. These daily shadow patterns are observable and predictable. • Day is the half of Earth's surface being illuminated by sunlight; night is the half of Earth's surface in its own shadow. • The cyclical change between day and night is the result of Earth's rotating on its own axis in association with the stationary Sun, Earth's star.	**Science and Engineering Practices** Asking questions Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Cause and effect Systems and system models	**5-ESS1-2:** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
INV. 4 Looking Out from Earth **Phenomenon 4—One or many stars:** Two friends who live in different parts of the world are talking on the phone. One says they can see only one large bright star in the sky. The other says they can see hundreds of small stars, but they aren't very bright. **Storyline:** Students are introduced to constellations as patterns of stars. They simulate Earth's rotation to observe the appearance of stars rising in the east and setting in the west. Students observe a demonstration of why different stars are visible in different seasons. Students use a digital simulation that shows how star brightness, distance, and alignment converge to produce a constellation. Students predict and check which constellation is in the center of the observation field from Earth each month (using a subset of the 88 official constellations identified). Students use the information gained in the investigation to explain the anchor phenomenon.	***How can you explain the difference in the appearance of the stars that each friend is observing?*** **FOCUS QUESTION:** **How can you explain why we see some natural objects only in the night sky, some only in the day sky, and some at both times?** **Why do stars appear to move across the night sky?** **Why do constellations appear to change location in the sky between seasons?**	**PS2.B:** Types of interactions **ESS1.A:** The universe and its stars **ESS1.B:** Earth and the solar system • Gravity is a pulling force between two masses; it is the force that pulls things toward the center of the Earth. • The pulling force of gravity keeps the Moon orbiting Earth and the Earth and other planets orbiting the Sun by changing their direction of travel. • Stars are at different distances from Earth. The Sun is the closest star to Earth so it appears brighter and larger than other stars. • Stars (constellations) appear to move together across the night sky because of Earth's rotation. • Because of the brightness of the Sun during the day, we can only see stars outside our solar system when we are on the dark half of Earth (at night). • Different constellations are observed in the night sky during different seasons because Earth revolves around the Sun.	**Science and Engineering Practices** Asking questions Developing and using models Analyzing and interpreting data Constructing explanations Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Cause and effect Scale, proportion, and quantity Systems and system models	**5-PS2-1:** Support an argument that the gravitational force exerted by Earth on objects is directed down. **5-ESS1-1:** Support an argument that the apparent brightness of the Sun and stars is due to their relative distances from Earth. **5-ESS1-2:** Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

FOSS Pathways includes:

Investigations Guide

The Investigations Guide is a spiral-bound guide containing everything you need to teach the module. FOSS active investigation lesson plans include:

- Three-dimensional learning objectives
- Relevant and local phenomena storylines with driving questions
- Sense-making discussions
- Embedded assessment and “What to Look For” guidance
- Vocabulary reviews
- English language support strategies
- ELA strategies and connections



Science Resources Student Book

The *FOSS Science Resources* student book contains readings developed to reinforce, extend, or apply core ideas covered during FOSS active investigations. Readings give students opportunities to:

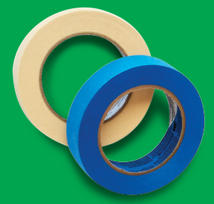
- Use text to obtain, evaluate, and communicate information
- Use evidence to support their ideas during sense-making discussions and focus question responses
- Integrate information from multiple sources
- Interpret graphs, diagrams, and photographs to build understanding

Available in print and as an interactive eBook in English and Spanish.

▶ Images on this page include actual components, resources and/or materials provided in FOSS kits.

Equipment Kit

FOSS provides the equipment needed for all the investigations, including metric measuring tools. Our high-quality, classroomtested materials are long-lasting and packaged by investigation to facilitate preparation and clean up. There is enough permanent equipment in each kit for 32 students. Consumable materials are supplied for three uses. Convenient grade-level and refill kits are available.



Technology

Online resources include duplication masters, eInvestigations Guide, teaching slides, FOSSmap online assessment, streaming videos, virtual investigations, and tutorials, as well as a library of teacher resources, including access and equity, three-dimensional teaching and learning, and environmental literacy.

SCAN HERE FOR A TOUR OF FOSSWEB!

FOSSweb on ThinkLink

FOSSweb digital resources are delivered on School Specialty's curriculum platform called ThinkLink.

- Supports single sign-on and class management with Google classroom and learning management systems.
- Provides access to both teacher and student digital resources, including duplication masters, teaching slides, FOSSmap online assessment, streaming videos, and online activities.

Teaching Slides

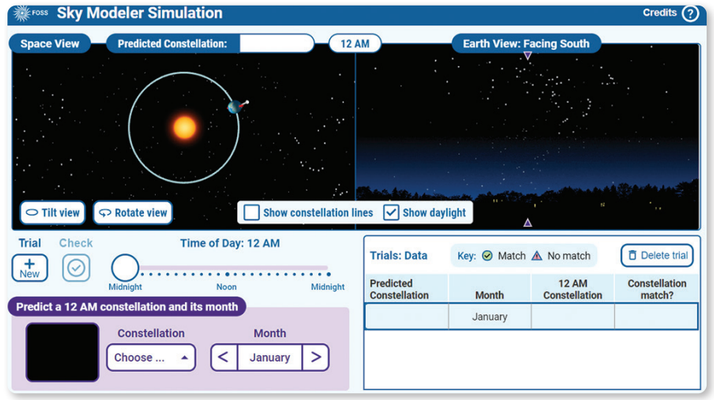
Downloadable and editable slides from FOSSweb can be used to facilitate each part of each investigation. Teaching slides are available as Google slides in English and Spanish.

Streaming Videos

New engaging content videos in English and Spanish were developed to specifically support FOSS investigations.

Online Activities

New engaging simulations developed to address core ideas in FOSS, and interactive virtual investigations and tutorials offer additional content support for students.



Interactive eBooks

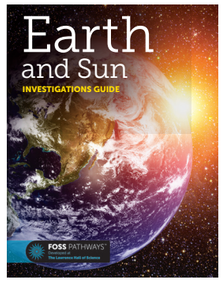
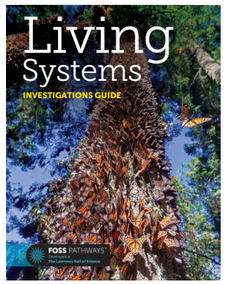
Keep your students engaged while teaching literacy skills with interactive *FOSS Science Resources* eBooks. The eBooks include integrated audio with text syncing and links to online activities and videos that bring the photos to life.

FOSSmap Online Assessment

Students in grades 3–5 can take summative assessments online with automatic coding of most responses. Student- and class-level reports help you identify the need for instructional next steps.

Grade Level Planning Guide

FOSS Pathways Modules Grade 5

FOSS Module	Module Overview/Bundled Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 Earth Science	Why do shadows change throughout the day? Why does the sky appear different to people located in different regions of the Earth? Students make observations and reveal patterns of Earth's position in the universe and the motion of the earth, moon, and stars to explain the brightness of stars and patterns of daily, monthly, and yearly changes in the sky. Students develop models of interactions between the atmosphere, hydrosphere, and geosphere and apply the ideas to construct an explanation of why sand is hot and the water cool at a beach on a sunny day. **NGSS PEs:** **Earth Sciences:** **5-ESS1-1** **5-ESS1-2** **5-ESS2-1** **5-ESS2-2** **5-ESS3-1** **Physical Sciences:** **5-PS1-1** **5-PS2-1**	**ESS1.A:** The universe and its stars **ESS1.B:** Earth and the solar system **ESS2.A:** Earth materials and systems **ESS2.C:** The roles of water in Earth's surface processes **ESS3.C:** Human impacts on Earth systems **PS1.A:** Structure and properties of matter **PS2.B:** Types of interactions	• Asking questions • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Using mathematics and computational thinking • Constructing explanations and designing solutions • Engaging in argument from evidence • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Energy and matter • Stability and change
 Physical Science	Students investigate changes in a pond in a park and are surprised by the change in appearance to the water. They design and construct investigations to make sense of the particles in mixtures and solutions, and they measure and graph materials to provide evidence for the conservation of matter. Students develop models to describe that matter is made of particles too small to be seen. Finally, they conduct investigations to determine whether the mixing of two or more substances results in new substances. **NGSS PEs:** **Physical Sciences:** **5-PS1-1** **5-PS1-2** **5-PS1-3** **5-PS1-4** **ETAS:** **3-5 ETS1-2** **Earth and Space Sciences:** **5-ESS3-1**	**PS1.A:** Structure and properties of matter **PS1.B:** Chemical reactions **ETS1.B:** Designing solutions to engineering problems **ESS3.C:** Human impacts on Earth systems	• Asking questions • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Using mathematics and computational thinking • Constructing explanations and designing solutions • Engaging in argument from evidence • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Energy and matter • Structure and function
 Life Science	Students learn about Dr. Salina Bryan, who has been studying a population of brine shrimp that live in Mono Lake, a large salt lake. Dr. Bryan has noticed that the size of the brine shrimp population and the amount of water in the lake has been decreasing in the last few years. Students design and conduct investigations and analyze data to figure out causes of the decrease in the number of brine shrimp, and the effect on the ecosystem. They explore the flow of matter and energy in ecosystems and develop models to describe how elements of the Earth's major systems support life. **NGSS PEs:** **Life Sciences:** **5-LS1-1** **5-LS2-1** **Physical Sciences:** **5-PS3-1** **Earth Sciences:** **5-ESS2-1** **5-ESS3-1**	**LS1.C:** Organization for matter and energy flow in organisms **LS2.A:** Interdependent relationships in ecosystems **LS2.B:** Cycles of matter and energy transfer in ecosystems **PS3.D:** Energy in chemical processes and everyday life **ESS2.A:** Earth materials and systems **ESS3.C:** Human impacts on Earth systems	• Asking questions • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Using mathematics and computational thinking • Constructing explanations • Engaging in argument from evidence • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • Systems and system models • Energy and matter

FOSS® Pathways is an engaging PreK–5 science program developed at the Lawrence Hall of Science for the Next Generation Science Standards (NGSS). This sampler will introduce you to the major components of the program and show examples from FOSS Pathways Earth and Sun Investigations Guide.

Recommended Scope and Sequence

FOSS Pathways

GRADE	PHYSICAL SCIENCE	EARTH SCIENCE	LIFE SCIENCE
PK		Observing Nature	
K	Materials and Forces	Trees and Weather	Animals Two by Two
1	Sound and Light	Changes in the Sky	Plants and Animals
2	Solids and Liquids	Water and Landforms	Insects and Plants
3	Motion	Water and Climate	Structures of Life
4	Energy	Soils, Rocks, and Landforms	Senses and Survival
5	Mixtures and Solutions	Earth and Sun	Living Systems

Learn more at **FOSSPathways.com**

Developed at:
The Lawrence Hall of Science
UNIVERSITY OF CALIFORNIA, BERKELEY

Published & distributed by:
Delta Education
School Specialty