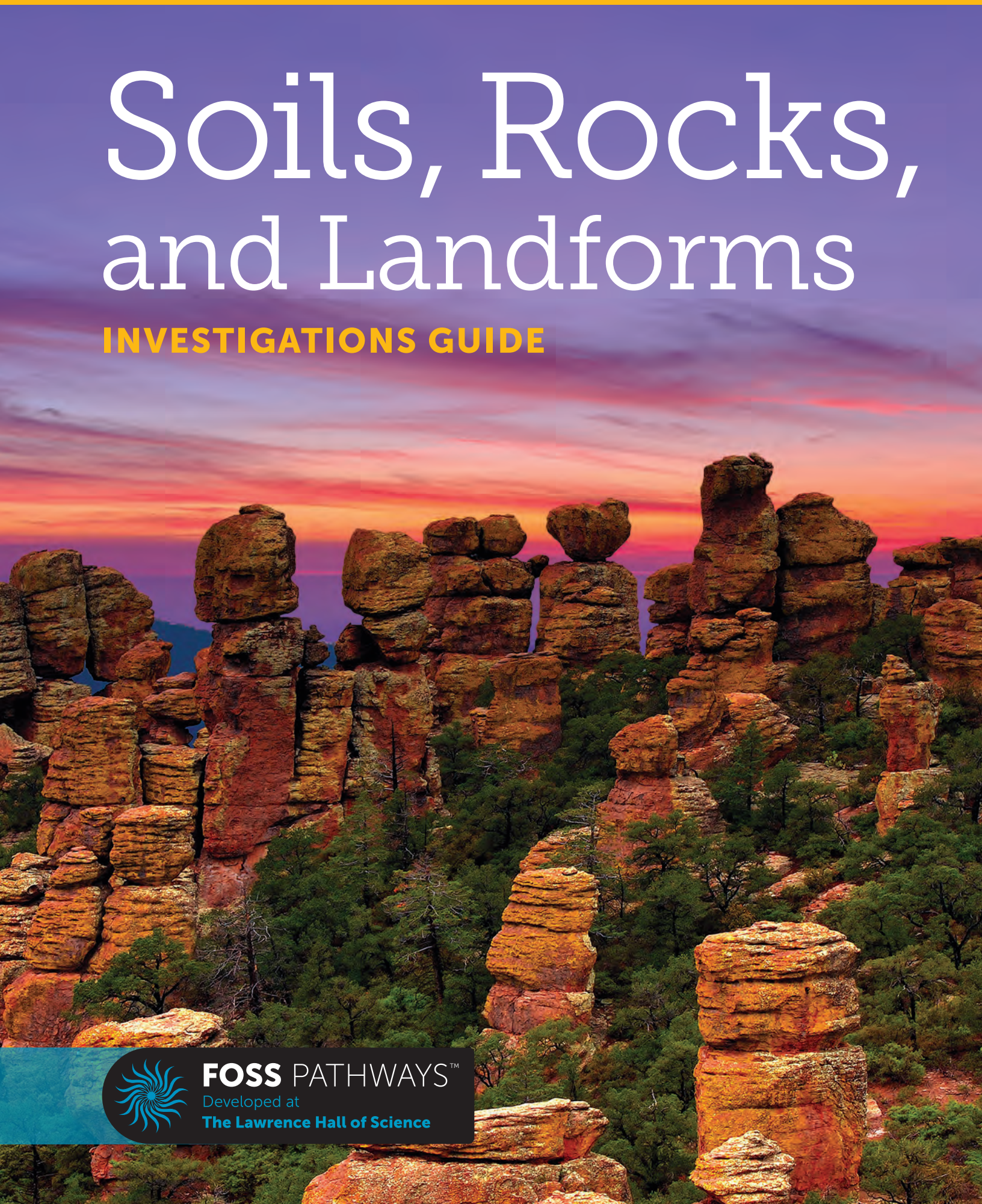
SAMPLER

Soils, Rocks, and Landforms

INVESTIGATIONS GUIDE



FOSS PATHWAYS™
Developed at
The Lawrence Hall of Science

PreK–5 science that meets the challenge of our time

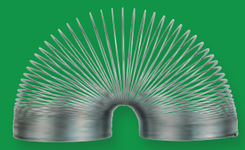
Welcome to new FOSS® Pathways™. Now as never before, the world needs scientific thinkers—to view the world thoughtfully, approach challenges analytically, and embrace opportunities enthusiastically. For educators to help unlock this potential in their students, they need powerful tools that work for 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

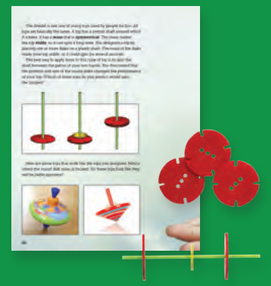
The Full Option Science System™ (FOSS) was conceived to enlist students not as passive recipients of information, but as active investigators of phenomena. That principle has proven its worth for 150,000 teachers and 4 million students across all 50 states, building a legacy of student engagement and 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



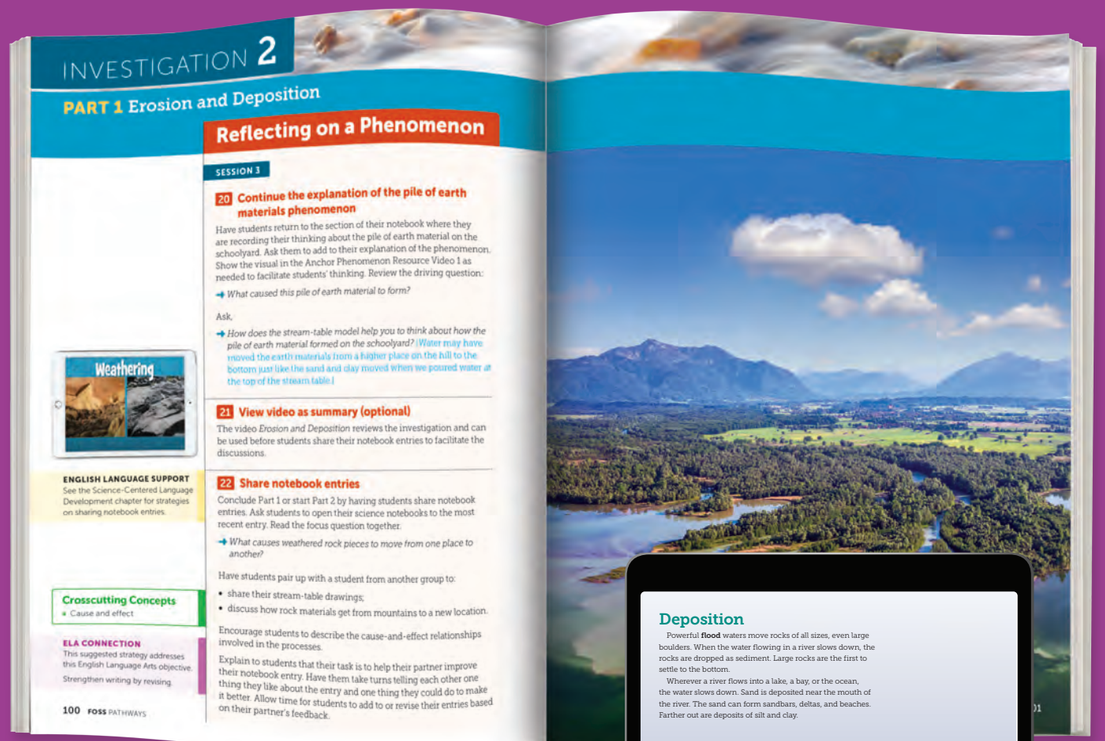
Teaches through a multimodal approach to resonate with every student

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

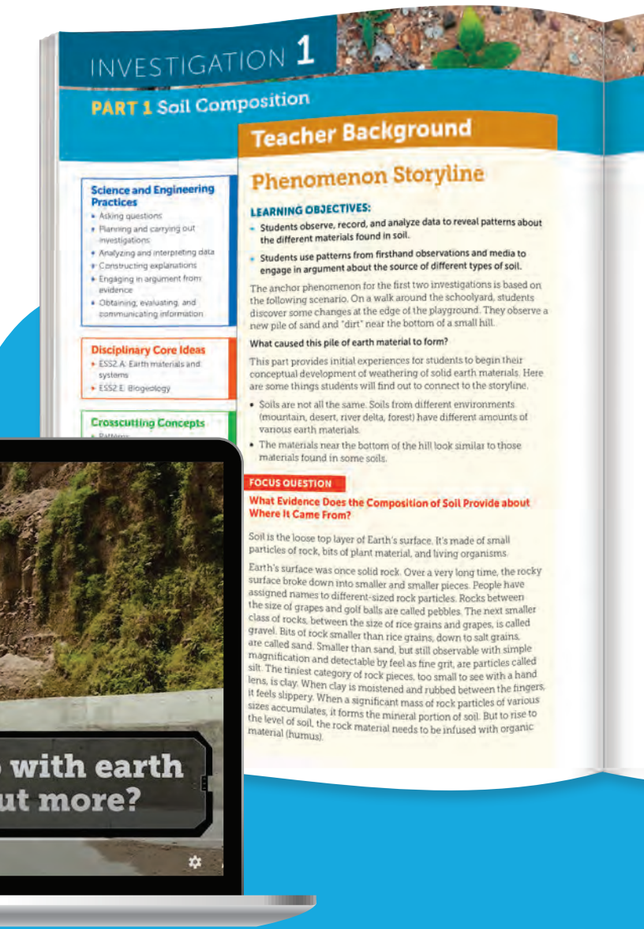
Research-based and field-tested assessments accurately measure student learning and progress. A variety of formative assessment tools provide evidence of students' use of the three dimensions and their knowledge of phenomena.

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 9-19 and 21-45 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

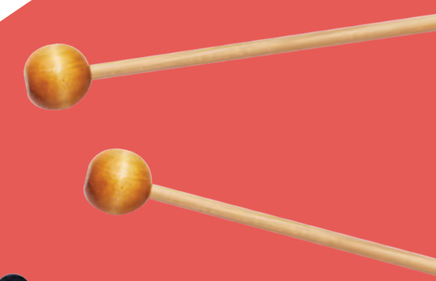
Clear integration of ELA/ELD skills and practices, with ties to standards and resources for engaging multilingual students

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.

How FOSS aligns to NGSS Performance Expectations

Grade 4 NGSS Performance Expectations	FOSS Soils, Rocks and Landforms	
	Investigation(s)	Benchmark Assessment
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.	**Investigation 4**	• Investigations 2 I-Check • Survey/Posttest
4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.	**Investigation 1** **Investigation 2**	• Investigations 1-2 I-Check • Survey/Posttest
4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.	**Investigation 3** **Investigation 4**	• Survey/Posttest
4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.	**Investigation 2** **Investigation 3** **Investigation 4**	• Survey/Posttest



Soils, Rocks, and Landforms Investigations

Investigation 1: Soils and Weathering

Part 1: Soil Composition
Part 2: Physical Weathering

Investigation 2: Landforms

Part 1: Erosion and Deposition
Part 2: Stream-Table Investigations
Part 3: Reducing Erosion Impact

Investigation 3: Mapping Earth's Surface

Part 1: Using Models and Topographic Maps
Part 2: Mount St. Helens Case Study

Investigation 4: Changes to Landforms

Part 1: Mapping Earthquakes and Volcanoes
Part 2: Interpreting Rock Layers

FOSS

Soils, Rocks, and Landforms

Start here to begin your review of the Grade 4 Soils, Rocks, and Landforms Investigations Guide

Introduction

The **Soils, Rocks, and Landforms Module** provides students with firsthand experiences with soils and rocks and modeling experiences using tools such as topographic maps and stream tables to engage with the surface of Earth's landscape—the shape and the composition of landforms and the stories they tell of past events.

Student engagement with these ideas is driven by four anchor phenomena that drive students to investigate weathering by water, ice, wind, living organisms; breaking rocks into smaller pieces; erosion or movement of earth materials to new locations; and deposition, the result of that transport process that builds new land. They investigate these phenomena:

- Anchor phenomenon 1—pile of earth material on the schoolyard
- Anchor phenomenon 2—impact to Mount St. Helens
- Anchor phenomenon 3—earth-shaking events
- Anchor phenomenon 4—rock layers, flat and tilted

Students plan and carry out investigations by incrementally changing specific environmental conditions to determine the impact of changing the variables of slope and amount of water in stream tables. Students analyze and interpret data from diagrams and visual representations to build explanations from evidence and make predictions of future events. They develop model mountains and represent the landforms from different perspectives to look for change. Students gain experiences that will contribute to the understanding of the crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; systems and system models; and stability and change.

CONTENTS

The NGSS Performance Expectations bundled in this module include:

Earth and Space Sciences
4-ESS1-1
4-ESS2-1
4-ESS2-2
4-ESS3-2

Engineering, Technology, and Applications of Science
3–5 ETS1-2

NOTE

The three modules for grade 4 in FOSS Pathways are:

- Energy
- Soils, Rocks, and Landforms
- Senses and Survival

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 Soils and Weathering **Phenomenon 1—Pile of earth material on the schoolyard:** On a walk around the schoolyard, students discover some changes at the edge of the playground. They observe a new pile of sand and "dirt" near the bottom of the small hill. **Storyline:** Students plan and carry out investigations comparing properties of four different soils. They learn that soils are composed of essentially the same types of materials (inorganic earth materials and humus), but the amounts of the materials vary. They begin to explore how rocks break into smaller pieces through physical and chemical weathering. Students apply their understanding of the components of soil to the pile of earth materials on the schoolyard.	***What caused this pile of earth material to form?*** **FOCUS QUESTIONS:** **What evidence does the composition of soil provide about where it came from?** **What causes big rocks to break into smaller rocks?**	**ESS2.A:** Earth materials and systems **ESS2.E:** Biogeology • Soils can be described by their properties. • Soils are composed of different kinds and amounts of earth materials and humus. • Living things affect the characteristics of soil. • The composition of soil provides evidence of its origins. • Weathering is the breakdown of rocks and minerals at or near Earth's surface. • The physical-weathering processes of abrasion, freezing and thawing, and the pressure of tree roots (living things) break rocks and minerals into smaller pieces.	**Science and Engineering Practices** Asking questions Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Cause and effect Systems and system models	**4-ESS2-1:** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
INV. 2 Landforms **Revisit Phenomenon 1—Pile of earth material on the schoolyard:** On a walk around the schoolyard, students discover some changes at the edge of the playground. They observe a new pile of sand and "dirt" near the bottom of the small hill. **Storyline:** Students analyze and interpret the results of erosion and deposition of weathered earth material by flowing water. They use stream-table models to observe that water moves earth materials from one location to another. They investigate the variables of slope and water quantity and plan and conduct their own stream-table investigations. Their findings help students figure out how the earth material was carried to the location on the schoolyard. Students use an online activity, "Erosion Engineering," to collect data on the impact of landslides on human-made structures and compare the effect of four kinds of erosion barriers to reduce the impact.	***What caused this pile of earth material to form?*** **FOCUS QUESTIONS:** **What causes weathered rock pieces to move from one place to another?** **How does slope affect erosion and deposition? How do floods affect erosion and deposition?** **What solutions can we design to reduce the impact of erosion and deposition on human structures?**	**ESS2.A:** Earth materials and systems **ESS2.E:** Biogeology **ESS3.B:** Natural hazards **ETS1.B:** Developing possible solutions • Weathered rock material can be reshaped into new landforms by the processes of erosion and deposition. • Erosion is the transport (movement) of weathered rock material (sediment) by moving water or wind. • Deposition is the settling of sediment when the speed of moving water or wind declines. • The rate and volume of erosion relate directly to the energy of moving water or wind. • The energy of moving water depends on the mass of water in motion and its velocity. The greater the mass and velocity, the greater the energy. • Scale models can be used to gather data and make decisions about natural systems.	**Science and Engineering Practices** Asking questions and defining problems Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations and designing solutions Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Cause and effect Scale, proportion, and quantity Systems and system models Stability and change Energy and matter	**4-ESS2-1:** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. **4-ESS3-2:** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. **3–5-ETS1-2:** Generate and compare multiple solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Module Matrix
At a Glance CONTINUED

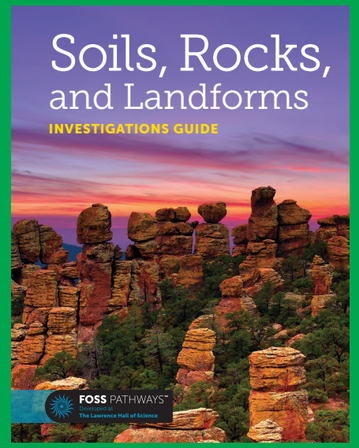
Phenomenon and Storyline	Driving Question and Focus Questions	Content and Disciplinary Core Ideas	Practices and Crosscutting Concepts	NGSS PEs
INV. 3 Mapping Earth's Surface **Problem—Hiking to the peak of a mountain:** A group of hikers have to solve a problem. They want to hike to the top of a volcanic peak and have selected a mountain in the Cascade Mountains for this adventure. They have a poster of the mountain and have been studying it, but they need more information about the terrain and elevations to decide on a hiking route. **Storyline:** Students are introduced to the study of topography by building a model of the mountain landform. Students use the foam model of Mount Shasta to create and analyze a topographic map to gather information to plan a hike. **Phenomenon 2—Impact to Mount St. Helens:** Students were looking at maps and images of the same volcanic mountain at different times. They observed some major differences in the landforms. **Storyline:** After determining that two topographic maps are the same mountain, students gather information about Mount St. Helens before and after its devastating eruption in 1980. Students describe how the loss of stability caused major changes to the landform.	***What kind of map do the hikers need and how will it help them to plan a route to the mountain peak?*** **FOCUS QUESTION:** **How can we represent the different elevations of a mountain?** ***How did the mountain change and what caused the change?*** **Focus question and driving question are the same.**	**ESS2.B:** Plate tectonics and large-scale system interactions **ESS3.B:** Natural hazards • A topographic map uses contour lines to show the shape and elevation of the land. • The change in elevation between two adjacent contour lines is always uniform. • The closer the contour lines, the steeper the slope and vice versa. • The surface of Earth is constantly changing; sometimes those changes take a long time to occur, and sometimes they happen rapidly. • Catastrophic events have the potential to change Earth's surface quickly. • Scientists monitor volcanoes as they erupt to learn more about the earth-changing events.	**Science and Engineering Practices** Asking questions Developing and using models Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Scale, proportion, and quantity Stability and change	**4-ESS2-2:** Analyze and interpret data from maps to describe patterns of Earth's features. **4-ESS3-2:** Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
INV. 4 Changes to Landforms **Phenomenon 3—Earth-shaking events:** Students in a classroom in South-Central Alaska dive under their desks when the building and its contents start shaking. They wait until the vibrations stop and evacuate with their teacher to the outdoors. People in the northern part of the state didn't feel the shaking. **Storyline:** Students use maps to analyze the location data for active volcanoes and large earthquakes around the world and observe that many of these events occur in a pattern on the edges of the Pacific Ocean. Students use the online USGS Latest Earthquakes Map displaying the Earth's tectonic-plate outlines to gather information about the cause of these effects. **Phenomenon 4—Rock layers, flat and tilted:** A family visits a natural outdoor site and finds large rock-layer formations with unusual stripes of red, pink, and yellow. Some of the layers are flat and others are tilted. In another site they discover fossils. **Storyline:** Students interpret rock layers and the presence of fossils to determine the history of a place. They integrate the processes of weathering, erosion, deposition, canyon-forming (downcutting), and uplifting, which result in the rock formations we observe on the surface of Earth today.	***Where do earthquakes and volcanoes occur around the world?*** ***What do rock layers and fossils tell us about the history of a place?*** **Focus questions and driving questions are the same.**	**ESS2.B:** Plate tectonics and large-scale system interactions **ESS3.B:** Natural hazards **ESS1.C:** History of planet Earth • Most earthquakes and volcanoes occur in patterns near the edge of continents. • A world map with latitude and longitude lines is a tool to arrange tectonic data. The Ring of Fire has a majority of active volcanoes and earthquake activity. • Catastrophic events have the potential to change Earth's surface quickly. • Fossils in sedimentary rock provide evidence of organisms that lived long ago as well as clues to changes in the landscape and past environments. • Sedimentary rocks form in horizontal layers and those layers provide information about the geological history of an area. • The surface of Earth is constantly changing; sometimes those changes take a long time to occur and sometimes they happen rapidly. • Landforms are constantly changing due to weathering, erosion, deposition, downcutting, and uplifting.	**Science and Engineering Practices** Asking questions Developing and using models Analyzing and interpreting data Constructing explanations Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Stability and change	**4-ESS1-1:** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. **4-ESS2-2:** Analyze and interpret data from maps to describe patterns of Earth's features.

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

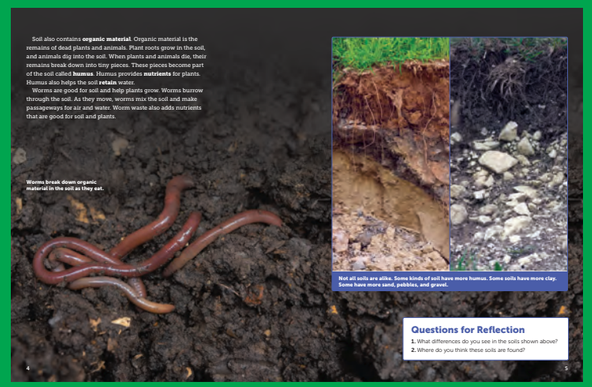


Science Resources Student Book

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

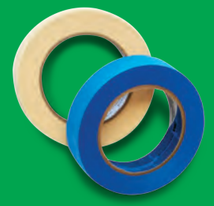
Available in print and as an interactive eBook in English and Spanish.



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

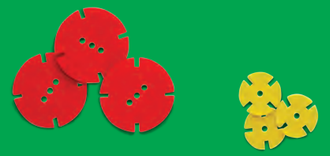
Equipment Kit

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!

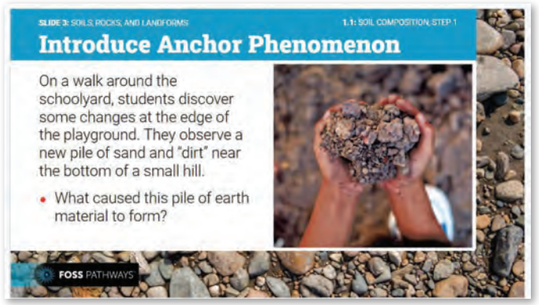
FOSSweb on ThinkLink

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.

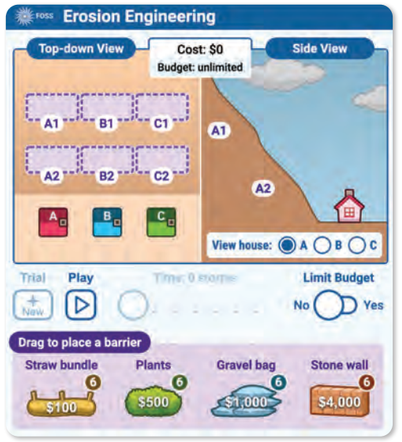


Streaming Videos

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

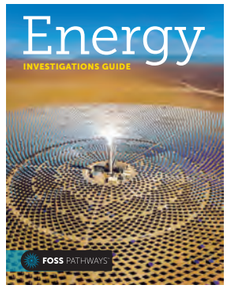
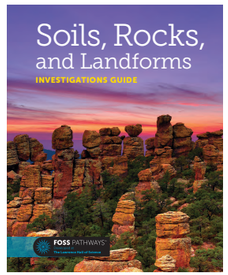
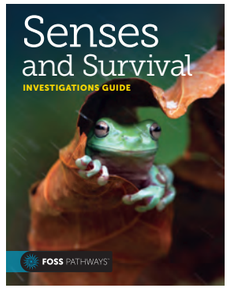
Keep your students engaged while teaching literacy skills with interactive *FOSS Science Resources* eBooks. The eBooks include integrated audio with text syncing and links to online activities and videos that bring the photos to life.

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 4

FOSS Module	Module Overview/Bundled Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 Physical Science	In the Energy Module, students investigate electricity and magnetism as related effects and engage in engineering design to convert energy from one form to another. They gather information about how energy is derived from natural resources and how that affects the environment and explore alternative sources of energy such as solar energy. Students interpret data to build explanations from evidence and make predictions of future events. They develop models to represent how energy moves from place to place in electric circuits and in waves. **NGSS PEs:** **Physical Sciences:** **4-PS3-1 4-PS4-1** **4-PS3-2 4-PS4-2** **4-PS3-3 4-PS4-3** **4-PS3-4** **Earth and Space Sciences:** **4-ESS3-1** **ETAS:** **3-5-ETS1-1** **3-5-ETS1-2** **3-5-ETS1-3**	**PS3.A:** Definitions of energy **PS3.B:** Conservation of energy and energy transfer **PS3.C:** Relationship between energy and forces **PS3.D:** Energy in chemical processes and everyday life **PS4.A:** Wave properties **PS4.B:** Electromagnetic radiation **PS4.C:** Information technologies and instrumentation **ESS3.A:** Natural resources **ETS1.A:** Defining and Delimiting Engineering Problems **ETS1.B:** Developing Possible Solutions **ETS1.C:** Optimizing The Design Solution	• Asking questions and defining problems • 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 • Systems and system models • Energy and matter
 Earth Science	In the Soils, Rocks, and Landforms module, students plan and carry out investigations by incrementally changing specific environmental conditions to determine the impact of changing the variables of slope and amount of water in stream tables. Students analyze and interpret data from diagrams and visual representations to build explanations from evidence and make predictions of future events. They develop model mountains and represent the landforms from different perspectives to look for change. Students gain experiences that will contribute to understanding of the crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; systems and system models; and stability and change. **NGSS PEs:** **Earth and Space Sciences:** **4-ESS1-1** **4-ESS2-1** **4-ESS2-2** **4-ESS3-2** **ETAS:** **3-5-ETS1-2**	**ESS1.C:** History of planet Earth **E:SS2.A:** Earth materials and systems **ESS2.B:** Plate tectonics and large-scale system interactions **ESS2.E:** Biogeology **ESS3.B:** Natural hazards **ETS1.B:** Developing possible solutions	• Asking questions and defining problems • 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 • Stability and change • Energy and matter
 Life Science	In the Senses and Survival Module, students plan and carry out investigations with stimulus and response to gather data to develop models and construct explanations. Students design physical models to understand how structures in a system function together to provide information and resources to organisms to support survival. Students gain experiences that will contribute to the understanding of these crosscutting concepts: cause and effect; systems and system models; and structure and function. **NGSS PEs:** **Life Sciences:** **4-LS1-1** **4-LS1-2** **ETAS:** **3–5-ETS1-1**	**LS1.A:** Structure and function **LS1.D:** Information processing	• 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	• Cause and effect • Systems and system models • Structure and function

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 Soils, Rocks, and Landforms 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**

Scan the QR code and explore additional FOSS Pathways Samplers today.

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