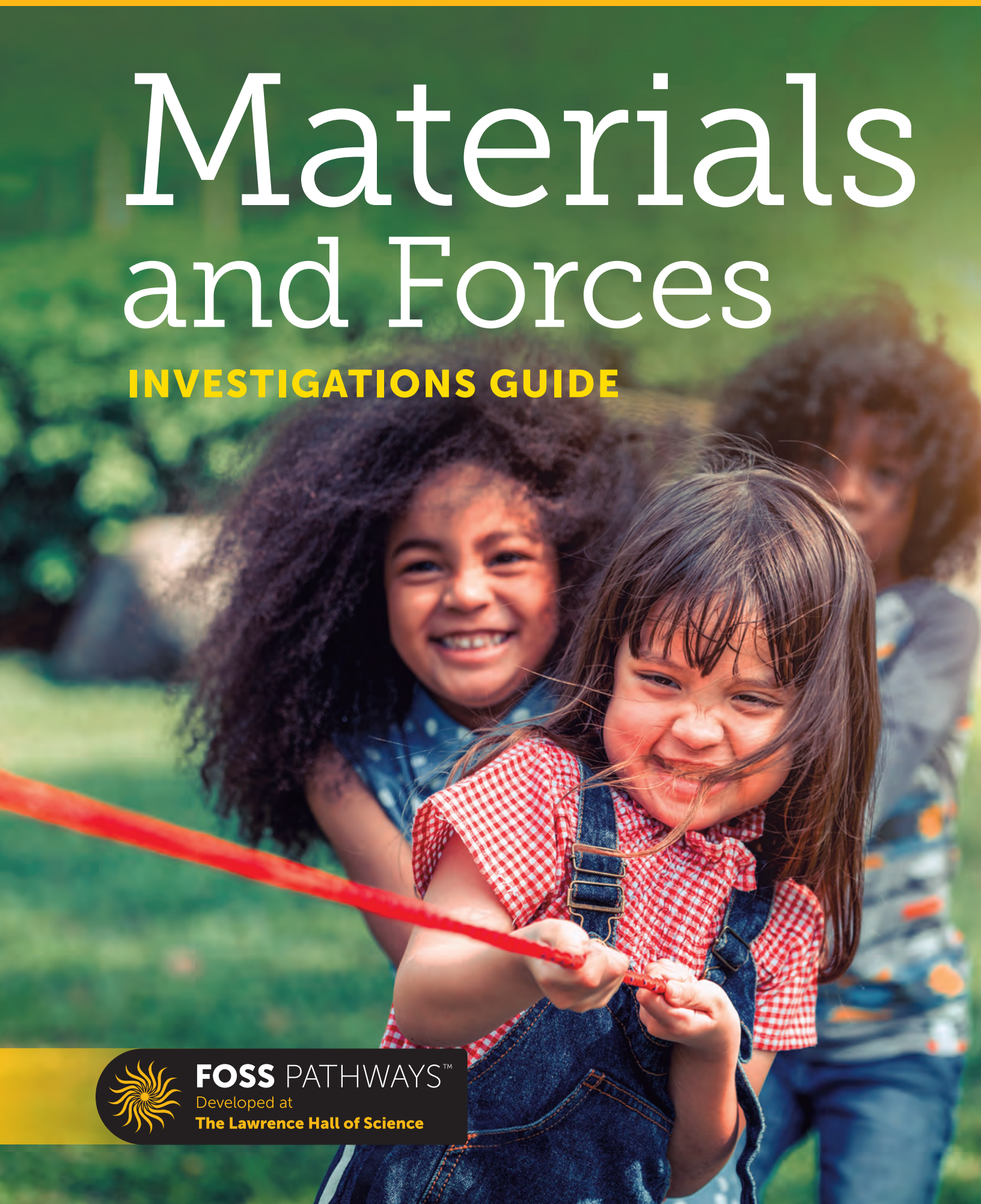
SAMPLER

Materials and Forces

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

FOSS®, a longtime leader in science education, has stepped forward to meet that challenge with the newly streamlined FOSS Pathways™. Pathways was designed to provide teachers with everything they need to meet standards in the time they have allotted to teach science. In these pages, you will see how Pathways:

Aligns to national science standards using three-dimensional teaching, learning, and assessment

Incorporates the digital tools for a flexible multimedia experience

Lends flexibility to teach in the class time allotted for science

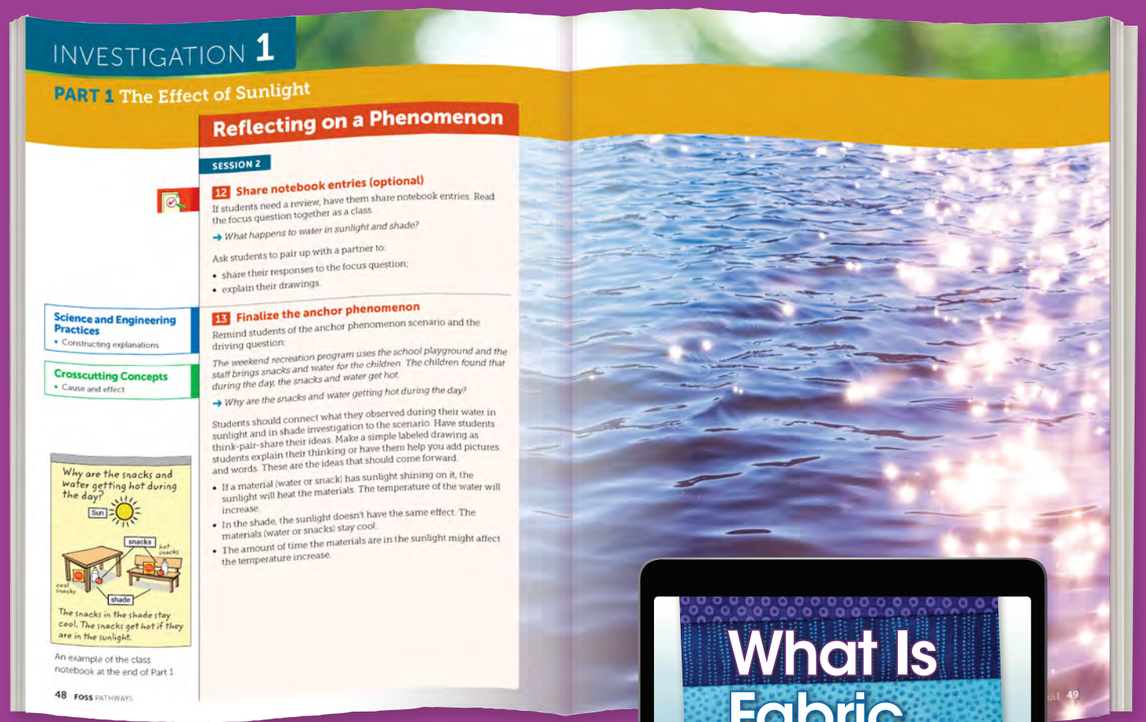
Utilizes a multimodal approach to resonate with every student

Immerses students in figuring out local and relevant phenomena and engineering problems

Provides unmatched teacher 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

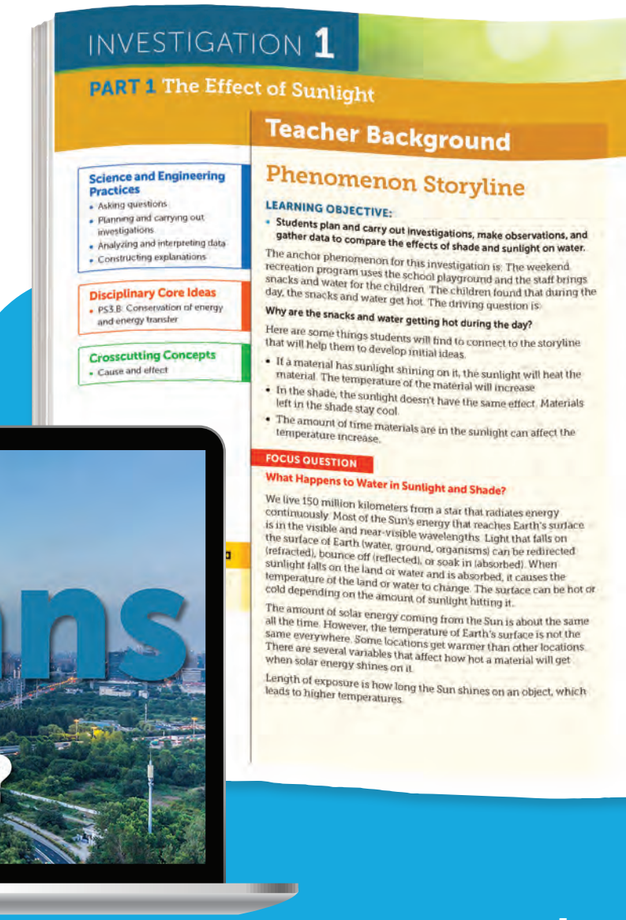
Research-based and field-tested assessments accurately measure student learning and progress. A variety of formative assessment tools provide evidence of students' use of the three dimensions and their knowledge of phenomena.

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 21-43 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

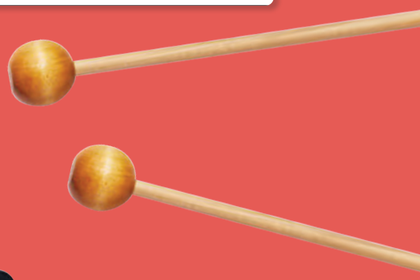
Clear integration of ELA/ELD skills and practices, with ties to standards and resources for engaging multilingual students

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 K NGSS Performance Expectations FOSS Materials and Forces Module
K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.
K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.
K-PS3-2. Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface.
K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.
K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.



Materials and Forces Investigations

Investigation 1: Getting to Know Materials

Part 1: The Effect of Sunlight
Part 2: Finding Out about Wood
Part 3: Finding Out about Paper
Part 4: Finding Out about Fabric

Investigation 2: Engineering Structures

Part 1: Building Structures
Part 2: Humans and the Environment
Part 3: Reuse and Recycle Resources

Investigation 3: Getting Things to Move

Part 1: Pushes and Pulls
Part 2: Colliding Objects
Part 3: Rolling Outdoors

Materials and Forces

Start here to begin your review of the Grade K Materials and Forces Investigations Guide.

Introduction

The **Materials and Forces Module** provides kindergartners with integrated experiences with physical science, earth science, and engineering core ideas that relate to students' interests. Students investigate that objects are made of materials—wood, paper, and fabric—and how material properties determine their use. Students use those materials to engineer structures, applying physical science ideas of energy transfer. Students investigate the source of natural materials and how they can be reused and recycled. Students come to understand that humans use natural resources for everything they do and that people impact the world around them. Students investigate these phenomena and related problem:

- Anchor phenomenon 1—Snacks getting hot on the playground
- Anchor problem 2—Keeping snacks and water cool
- Anchor phenomenon 3—Changes to the environment
- Anchor phenomenon 4—Balls roll in different directions

After building a repertoire of practices with natural materials students use some of those materials to investigate the effect of pushes and pulls on objects, and apply their intuitive notion of the concept of variables to change the speed and direction of rolling balls to achieve specific outcomes.

Students engage in science and engineering practices by asking questions, participating in collaborative investigations, observing, recording, and interpreting data to build explanations, and designing objects and systems to achieve outcomes. Students gain experiences with crosscutting concepts: patterns, cause and effect, and systems and system models.

CONTENTS

The NGSS Performance Expectations bundled in this module include:

Earth and Space Sciences
K-ESS2-2 *
K-ESS3-3

Physical Sciences
K-PS2-1 K-PS3-1 **
K-PS2-2 K-PS3-2

Engineering, Technology, and Applications of Sciences
K–2 ETS1-1 K–2 ETS1-3
K–2 ETS1-2

* K-ESS2-2 is also addressed in **Trees and Weather** and in **Animals Two by Two**.

** K-PS3-1 is also addressed in **Trees and Weather**.

NOTE

The three modules for grade K in FOSS Pathways are:

- Trees and Weather
- Materials and Forces
- Animals Two by Two

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 Getting to Know Materials **Phenomenon 1—Snacks getting hot on the playground:** The weekend recreation program uses the school playground, and the staff brings snacks and water for the children. The children found that during the day, the snacks and water get hot. **Problem 2—Keeping snacks and water cool:** The weekend recreation program needs a small structure somewhere on the playground to store and keep their water and snacks cool during the day. **Storyline:** Students determine that sunlight is causing the snacks and water to get hot. Their problem to solve is how to design a structure made of three materials (wood, paper, and/or fabric) to maintain the temperature of the snacks. Students plan and carry out investigations examining the source and properties of the three materials in order to apply this knowledge to their engineering design challenge in Investigation 2. Students gather information about how the production of these materials impacts the environment.	***Driving question:*** ***Why are the snacks and water getting hot during the day?*** **FOCUS QUESTION:** **What happens to water in sunlight and shade?** ***Driving question:*** ***How can we use materials to design a small outdoor structure to keep snacks and water cool?*** **FOCUS QUESTIONS:** **What is wood and how can it be used?** **What is paper and how can it be used?** **What is fabric and how can it be used?**	**PS3.B:** Conservation of energy and energy transfer **ESS2.E:** Biogeology **ESS3.C:** Human impacts on Earth systems **ETS1.A:** Defining and delimiting engineering problems • The Sun warms Earth's surface. • Wood is a material and can be described by properties. • Different kinds of wood come from different kinds of trees. Some kinds of woods are processed by people. • Wood is used for many things. • People make paper from wood. • People cut down trees in the environment for wood. • The properties of different papers determine their use. • Many objects are made from paper. • Fabric is a flexible material with a wide range of properties that determine their uses. • Fabric can be made of woven threads. • People grow plants and raise sheep to make fabric.	**Science and Engineering Practices** Asking questions 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	**K-PS3-1:** Make observations to determine the effect of sunlight on Earth's surface.* **K-PS3-2:** Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface. **K-ESS2-2:** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.* **K-2-ETS1-1:** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool. * These performance expectations are also addressed in K modules **Animals Two by Two** and **Trees and Weather**.

Module Matrix
At a Glance CONTINUED

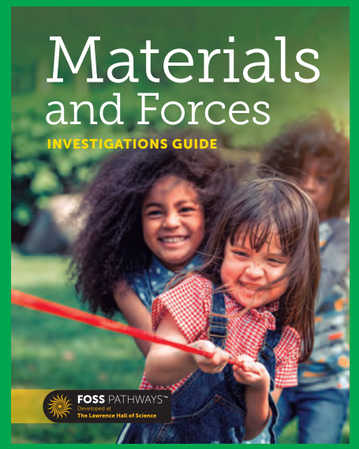
Phenomenon and Storyline	Driving Question and Focus Questions	Content and Disciplinary Core Ideas	Practices and Crosscutting Concepts	NGSS PEs
INV. 2 Engineering Structures **Problem 2—Keeping snacks and water cool:** The weekend recreation program needs a small structure somewhere on the playground to store and keep their water and snacks cool during the day. **Storyline:** Students use their data on properties of materials (wood, paper, and fabric) from Investigation 1 to design a small model structure using one or more of those materials to reduce the effects of sunlight on the recreation group's snacks and water. **Phenomenon 3—Changes to the environment:** Students are hiking in a forest and suddenly come to a large area with no trees. **Storyline:** Students engage in argument about the environmental impact of people producing wood, paper, and fabric to meet their needs. They discuss the 3Rs of conservation—reduce, reuse, and recycle—and apply those ideas to their engineering designs. They look for other solutions to human impact on the environment and through recycled materials. Students recycle paper to produce a new paper product.	*Driving question:* ***How can we use materials to design a small outdoor structure to keep snacks and water cool?*** **The focus and driving question are the same.** *Driving question:* ***What caused the sudden change to the forest?*** **FOCUS QUESTIONS:** **How do humans change the environment to meet their needs?** **What materials can we reuse or recycle?**	**PS3.B:** Conservation of energy and energy transfer **ESS2.E:** Biogeology **ESS3.C:** Human impacts on Earth systems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solutions • People use knowledge of the properties of materials to create useful structures. • The Sun warms Earth's surface. • Shade, area where sunlight is blocked, is cooler than an area in sunlight. • People make lumber and paper from wood. People cut down trees in the environment to use the wood. • People grow plants to make fabric. People raise sheep to get wool thread to weave fabric. • Sources of materials and the impact of harvesting them needs to be considered to reduce impact on the environment. • Paper, a resource, can be reused, recycled, and fabricated. • Land, air, water, and trees are natural resources. People reuse and recycle to conserve natural resources.	**Science and Engineering Practices** Asking questions and defining problems Developing and using models Analyzing and interpreting data Constructing explanations and designing solutions Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Cause and effect Systems and system models	**K-PS3-2:** Use tools and materials provided to design and build a structure that will reduce the warming effect of sunlight on Earth's surface. **K-ESS2-2:** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. **K-ESS3-3:** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment. **K-2-ETS1-2:** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. **K-2-ETS1-3:** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
INV. 3 Getting Things to Move **Phenomenon 4—Balls roll in different directions:** Two students were rolling balls down a hill on the playground. They each roll a ball down the hill. One ball rolls all the way to the soccer field. The other ball rolls in a different direction toward the slide. **Storyline:** Students turn from materials to forces and investigate the phenomenon of objects in motion. They put objects in motion by applying a pushing force with their hands followed by utilizing gravity to apply a pulling force to move balls down a slope in the classroom and the schoolyard. They plan and carry out investigations with balls and ramps to find cause-and-effect relationships with pushes and pulls and investigate collisions. They analyze data from tests, construct explanations, and use their understanding of forces to design a system to control the motion of a rolling object and explain how balls roll in different directions on different surfaces on the playground (flat area and side of a hill).	*Driving question:* ***What caused the balls to roll in different directions?*** **FOCUS QUESTIONS:** **What causes objects to move?** **What happens when objects collide?** **Where can balls roll on the schoolyard?**	**PS2.A:** Forces and motion **PS2.B:** Types of interactions **PS3.C:** Relationship between energy and forces **ETS1.A:** Defining and delimiting engineering problems • Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. • Gravity pulls things down. • A bigger push or pull can make things move faster. • When objects touch or collide, they push on one another, which can change motion.	**Science and Engineering Practices** Asking questions and defining problems Planning and carrying out investigations Analyzing and interpreting data Constructing explanations and designing solutions Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Cause and effect Systems and system models Scale, proportion, and quantity	**K-PS2-1:** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. **K-PS2-2:** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull. **K-2-ETS1-1:** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

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

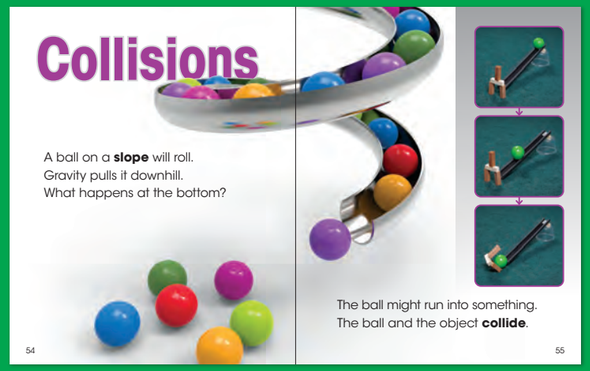


Science Resources Student Book

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

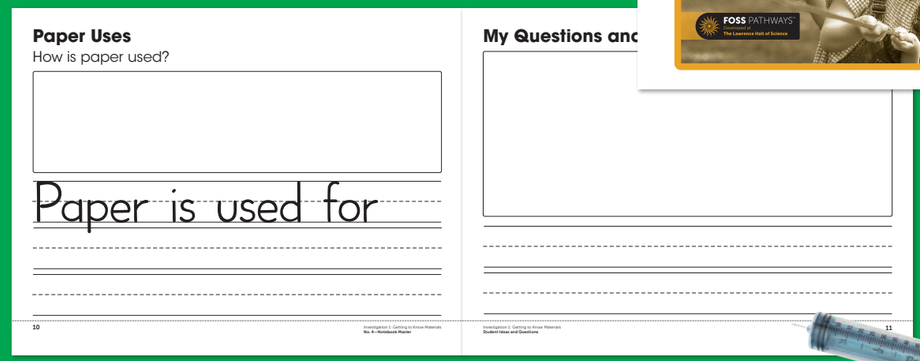
Available in print and as an interactive eBook in English and Spanish.



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

Consumable Booklets

FOSS Booklets contain the Science Notebook Masters in a convenient booklet along with additional pages for writing and/or drawing opportunities and anchor phenomena explanations. There is one copy included in the kit. Additional copies are sold separately.

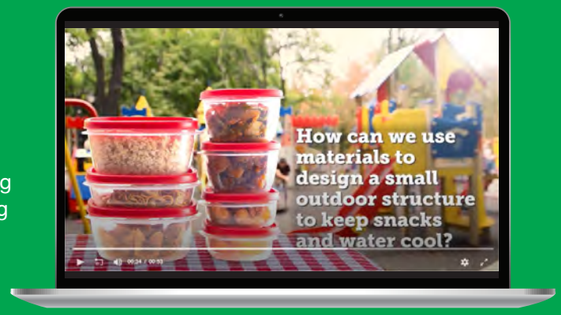


Equipment Kit

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 24 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

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

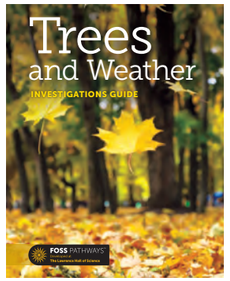
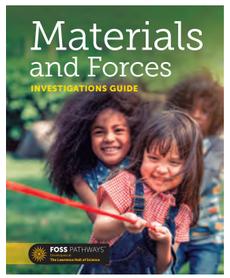
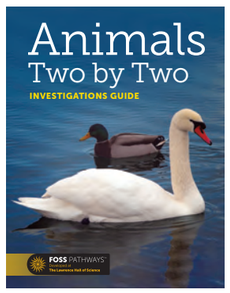
Keep your students engaged while teaching literacy skills with interactive *FOSS Science Resources* eBooks. The eBooks include integrated audio with text syncing and links to online activities and videos that bring the photos to life.

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 K

FOSS Module	Module Overview/Bundled Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 Earth Science	The Trees and Weather Module provides students with experiences to develop an understanding of what plants need to survive in their environment. Systematic investigation of trees over the seasons will bring students to a better understanding of trees at school and in the community. Students will observe day-to-day changes and patterns in weather over the year as well as the impact weather has on living things. **NGSS PEs:** **Life Sciences:** **K-LS1-1** **Earth Sciences:** **K-ESS2-1** **K-ESS2-2** **K-ESS3-1** **K-ESS3-2** **Physical Sciences:** **K-PS3-1**	**LS1.C:** Organization for matter and energy flow in organisms **ESS2.D:** Weather and climate **ESS2.E:** Biogeology **ESS3.A:** Natural resources **ESS3.B:** Natural hazards **PS3.B:** Conservation of energy and energy transfer	• 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 • Structure and function • Stability and change
 Physical Science	The Materials and Forces Module provides experiences that heighten students' understanding of the physical world as they perform tests to observe properties of materials such as wood, paper, and fabric. They learn about different materials to engineer a shade structure. Students observe and compare pushes and pulls, the speed and motion of moving objects, and collisions. **NGSS PEs:** **Physical Sciences:** **K-PS2-1** **K-PS2-2** **K-PS3-1** **K-PS3-2** **Earth Sciences:** **K-ESS2-2** **K-ESS3-3** **ETAS:** **K-2-ETS1-1** **K-2-ETS1-2** **K-2-ETS1-3**	**PS2.A:** Forces and motion **PS2.B:** Types of interactions **PS3.B:** Conservation of energy and energy transfer **PS3.C:** Relationship between energy and forces **ESS2.E:** Biogeology **ESS3.C:** Human impacts on Earth systems **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solutions	• 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	• Patterns • Cause and effect • Systems and system models • Scale, proportion, and quantity
 Life Science * Still in development	The Animals Two by Two Module provides young students with opportunities to observe differences in structure and behavior and to learn about basic needs of animals. **NGSS PEs:** **Life Science:** **K-LS1-1** **Earth Sciences:** **K-ESS2-2** **K-ESS3-1**	**LS1.C:** Organization for matter and energy flow in organisms **ESS3.A:** Natural resources **ESS2.E:** Biogeology	• 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	• Patterns • Cause and effect • Systems and system models

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 Materials and Forces 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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