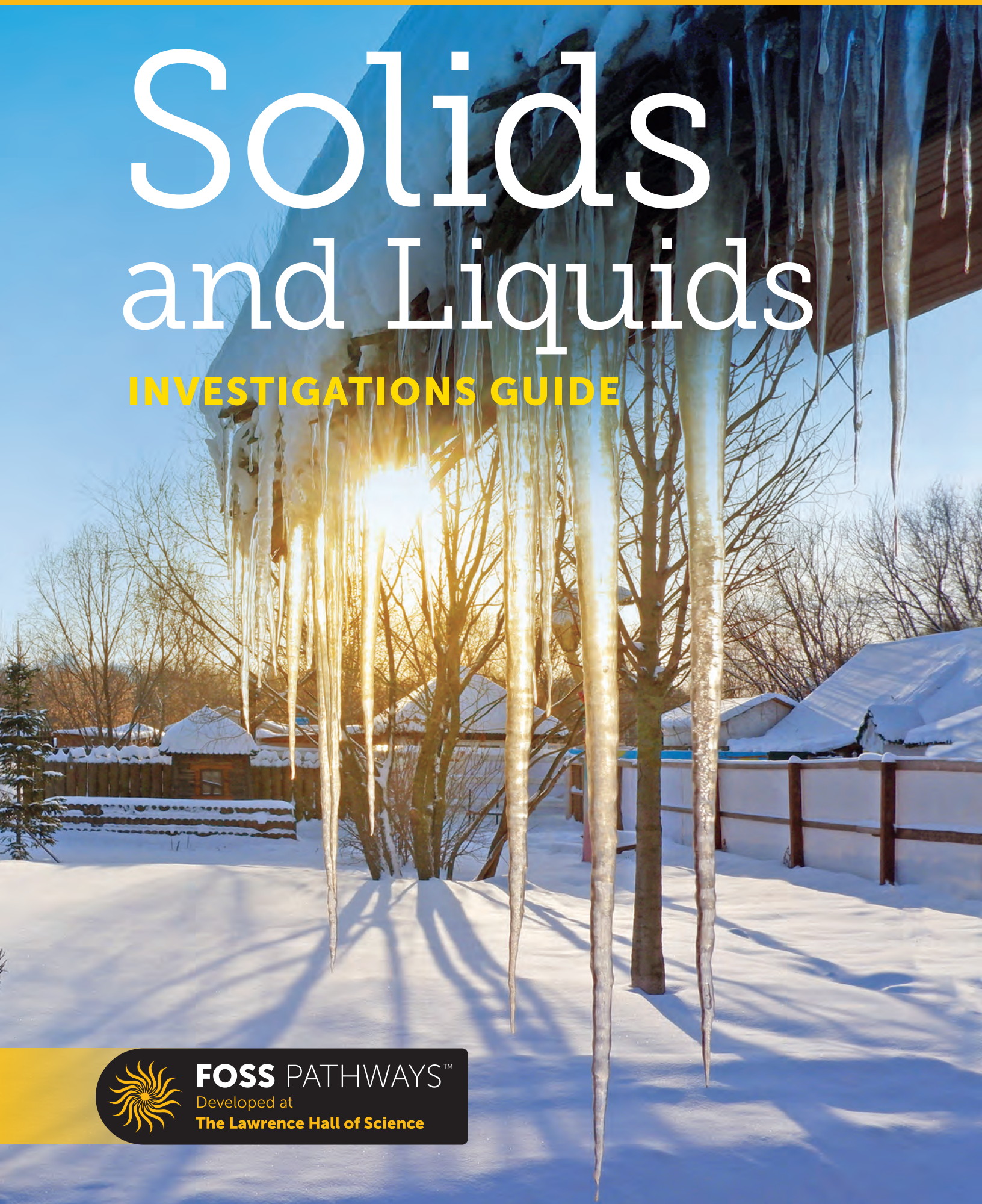
SAMPLER

Solids and Liquids

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

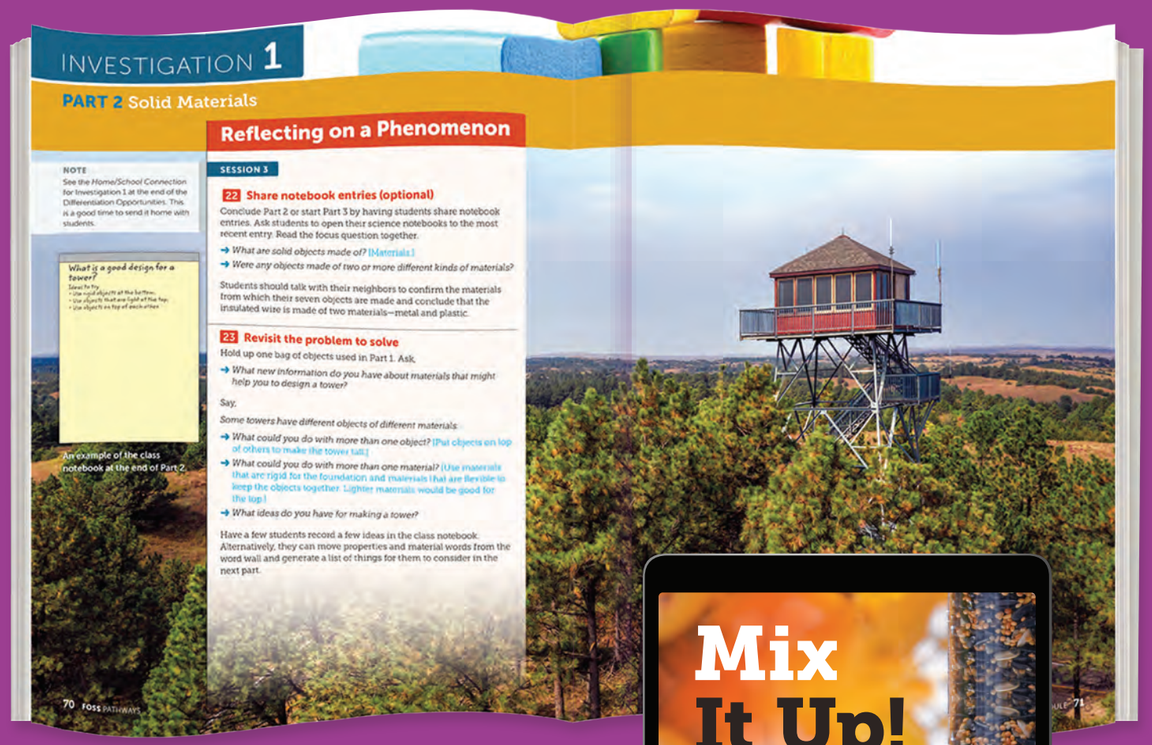
Utilizes a multimodal approach to resonate with every student

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

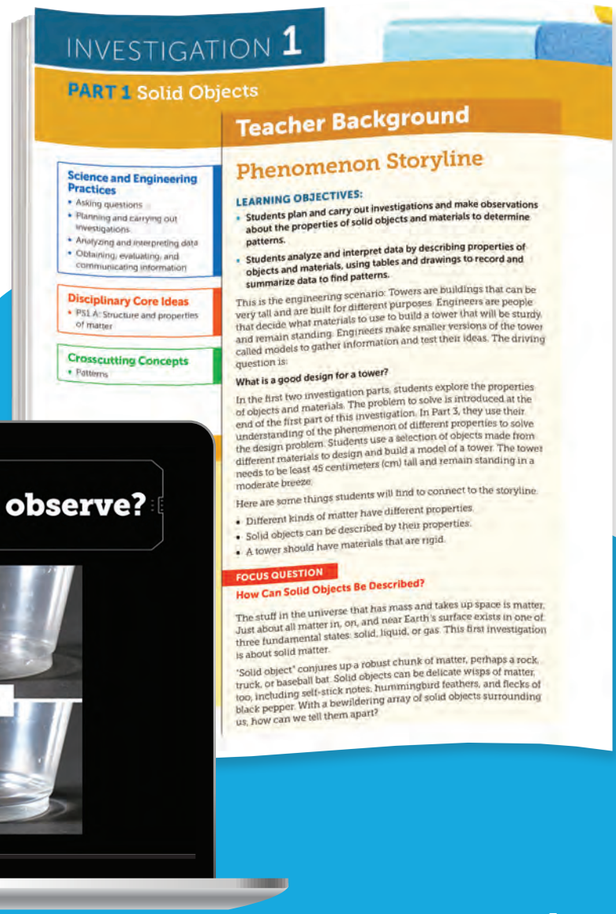
Research-based and field-tested assessments accurately measure student learning and progress. A variety of formative assessment tools provide evidence of students' use of the three dimensions and their knowledge of phenomena.

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 21-41 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 2 NGSS Performance Expectations	FOSS Solids and Liquids Module	
	Investigation(s)	Benchmark Assessment
2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	**Investigation 1** **Investigation 2** **Investigation 3**	• Investigations 1–2 I-Check • Investigation 3 I-Check
2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.	**Investigation 1**	• Investigations 1–2 I-Check
2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.	**Investigation 1**	• Investigations 1–2 I-Check
2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.	**Investigation 3**	• Investigations 1–2 I-Check • Investigation 3 I-Check
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.	**Investigation 1**	• Investigations 1–2 I-Check
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.	**Investigation 1**	• Investigations 1–2 I-Check
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.	**Investigation 1**	• Investigations 1–2 I-Check

Solids and Liquids Investigations

Investigation 1: Solids

Part 1: Solid Objects
Part 2: Solid Materials
Part 3: Construct with Solids

Investigation 2: Liquids

Part 1: Liquids in Bottles
Part 2: Properties of Liquids
Part 2: Comparing Solids and Liquids

Investigation 3: Changes to Solids and Liquids

Part 1: Mixing Solids and Liquids with Water
Part 2: Changing Properties
Part 3: Reversible or Not

Solids and Liquids

▶ Start here to begin your review of the Grade 2 Solids and Liquids Investigations Guide.

Introduction

This module provides grade 2 students with physical sciences core ideas dealing with matter and its interactions and engineering design. Students make and organize observations to find out how solid and liquid materials are similar and different; how the properties of solid and liquid materials determine how they can be used; and how materials can change with changes in temperature.

Students have firsthand experiences to observe, describe, and compare properties of common solids and liquids. They plan and carry out investigations to find out what happens when solids and water are mixed and when liquids and water are mixed. They gain firsthand experience with reversible changes caused by heating or cooling, and then through media expand their data collection. They construct an argument with evidence to support claims about reversible and irreversible changes to materials due to temperature changes.

Students investigate these problems and phenomena:

- A problem to solve 1—Design a model of a tower
- Anchor phenomenon 2—Pouring liquid water and solid water (ice)
- A problem to solve 3—Objects fell in water
- Anchor phenomenon 4—Objects stuck together

Students engage in science and engineering practices to collect data, to answer questions, and to define problems in order to develop solutions. Students gain experiences that will contribute to the understanding of crosscutting concepts of patterns; cause and effect; and energy and matter.

CONTENTS

The NGSS Performance Expectations bundled in this module include:

Physical Sciences
2-PS1-1
2-PS1-2
2-PS1-3
2-PS1-4

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

NOTE

The three modules for grade 2 in FOSS Pathways are:

- Water and Landforms
- Solids and Liquids
- Insects and Plants

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 Solids **A problem to solve 1—Design a model of a tower:** Towers are buildings that can be very tall and are built for different purposes. Engineers are people who decide what materials to use to build a tower that will be sturdy and remain standing. Engineers make smaller versions of the tower called models to gather information and test ideas. **Storyline:** Students explore solid objects, such as pieces of wood, plastic, and metal. Students observe, describe, and sort the objects according to their properties. They construct towers using the properties inherent in the materials to accomplish the task. They take the towers apart and use the same pieces to build a second structure. Students experience how the same set of small items can be used to create different larger objects.	*What is a good design for a tower?* **FOCUS QUESTIONS:** **How can solid objects be described?** **What are solid objects made of?** **What are the properties of successful towers?**	**PS1.A:** Structure and properties of matter **ETS1.A:** Defining and delimiting an engineering problem **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution • Solid is one state or phase of matter. Liquid and gas are the other states. • Objects are described and identified by their properties. • Objects are made of one or more materials. • Solid objects and materials can be sorted into groups (classified) by their properties. • Some properties of solid objects and materials make them appropriate for model tower and bridge construction. • Engineers use knowledge of material properties to design structures that solve problems.	**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 Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Cause and effect Energy and matter Structure and function	**2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. **2-PS1-2:** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. **2-PS1-3:** Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. **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.

Module Matrix
At a Glance CONTINUED

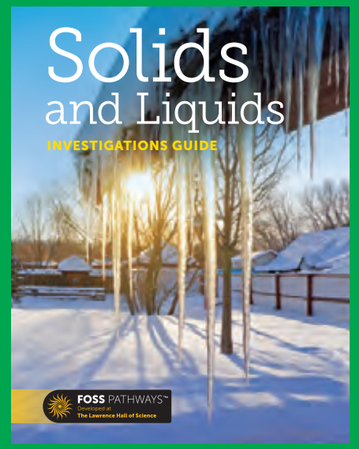
Phenomenon and Storyline	Driving Question and Focus Questions	Content and Disciplinary Core Ideas	Practices and Crosscutting Concepts	NGSS PEs
INV. 2 Liquids **Phenomenon 2—Pouring liquid water and solid water (ice):** A student observed a person at a picnic with a pitcher of ice and water. The person poured some of the contents from the pitcher into a glass. The water flowed smoothly, but the ice fell in chunks, making a splash. **Storyline:** Students investigate liquids in a variety of settings to become familiar with their properties. They learn and use precise liquid vocabulary terms. Students use representational materials to enhance their understanding of the unique behaviors of liquids. They pour the same volume of liquid into containers of different shapes to observe that liquids take the shape of their container and have flat, level surfaces.	***What makes ice (solid water) pour differently from liquid water?*** **FOCUS QUESTIONS:** **How are liquids different from each other?** **How can liquids be described?** **What properties of solids and liquids are the same, and what properties are different?**	**PS1.A:** Structure and properties of matter • Liquid is one common state of matter. • Liquids move freely in containers. • Liquids have many properties that help identify them. • Liquids go to the bottom of a container and take the shape of their containers; solids can hold their shape. • The surfaces of liquids are flat and level; small pieces of solids can form piles. • Liquids pour and flow; particles of solids pour or tumble. • Some materials have properties of both solids and liquids.	**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 Scale, proportion, and quantity	**2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
INV. 3 Changes to Solids and Liquids **A problem to solve 3—Objects fell in water:** Some small objects fell off the shelf above the sink and landed in water—cardboard squares, paper clips, dry beans, and chocolate chips. **Storyline:** This first part introduces the concept of change and reversible processes and uses interactions of objects (math counters) with water in a firsthand investigation. **Phenomenon 4—Objects stuck together:** A class uses various solid materials as math counters—cardboard squares, paper clips, dry beans, and chocolate chips. The counters are in a bowl near a sunny window. After several very warm days, the objects become stuck together. **Storyline:** Students investigate interactions between solids and water and liquids and water. They observe, describe, record, and categorize the results. They investigate firsthand melting and freezing of familiar liquids and solids. Students use a digital activity to further explore the changes to materials due to heating and cooling and find out that some changes are reversible and some are not.	***What will happen to the solid objects that fell into the water in the sink?*** ***What caused the objects to stick together? How can we get them unstuck so they can be used as math counters?*** **FOCUS QUESTIONS:** **What happens when solids are mixed with water? What about liquids mixed with water?** **How do the properties of materials change when they are heated or cooled?** **What materials can return to their original form after heating or cooling?**	**PS1.A:** Structure and properties of matter **PS1.B:** Chemical reactions • Some solids change when mixed with water; others do not. • Some materials return to their original form when they dry, but others do not. • Some liquids mix with water; others form layers. • Some changes when materials are mixed with water are reversible; some changes are not. • Melting is the change from solid to liquid. • Freezing is the change from liquid to solid. • Heat causes materials to melt; cold causes them to freeze. • Some changes due to heating and cooling are reversible; some changes are irreversible.	**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	**2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. **2-PS1-4:** Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

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:

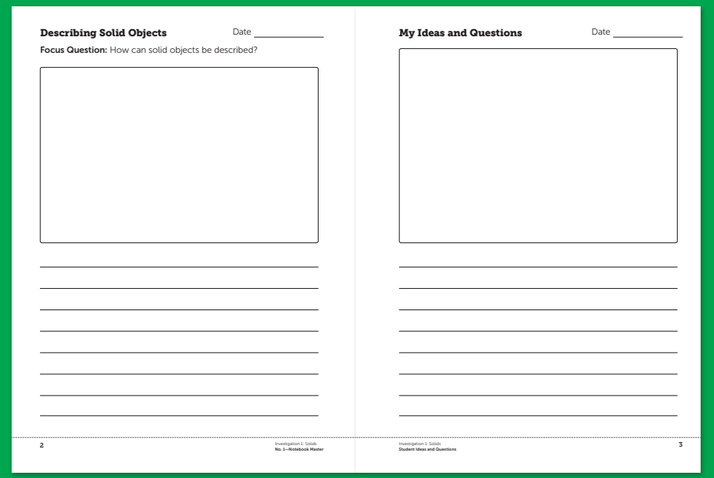
- Use text to obtain, evaluate, and communicate information
- Use evidence to support their ideas during sense-making discussions and focus question responses
- Integrate information from multiple sources
- Interpret graphs, diagrams, and photographs to build understanding

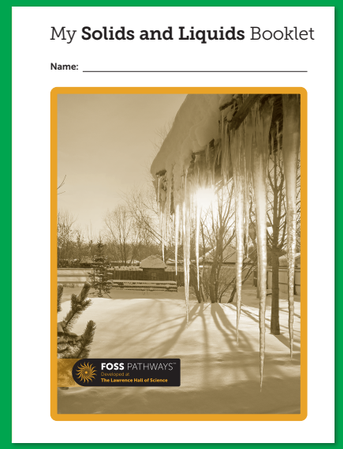
Available in print and as an interactive eBook in English and Spanish.

▶ 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

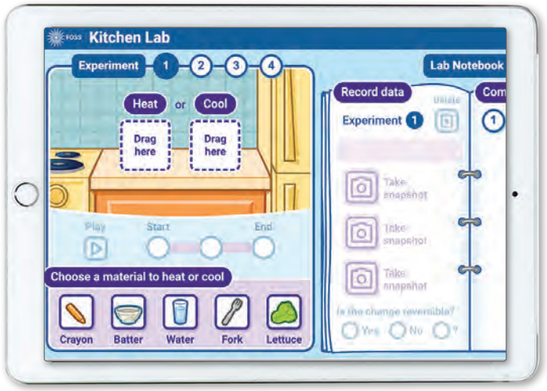
Downloadable and editable slides from FOSSweb can be used to facilitate each part of each investigation. Teaching slides are available as Google slides in English and Spanish.

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

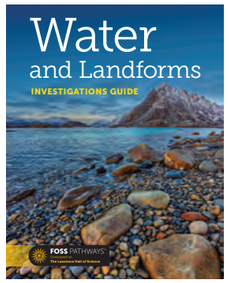
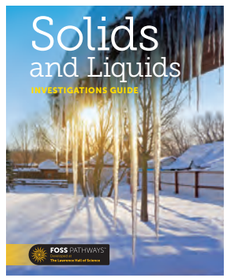
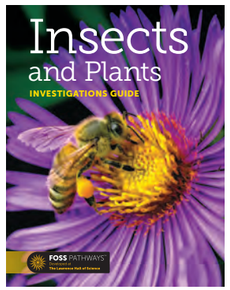
Keep your students engaged while teaching literacy skills with interactive *FOSS Science Resources* eBooks. The eBooks include integrated audio with text syncing and links to online activities and videos that bring the photos to life.

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 2

FOSS Module	Module Overview/Bundled Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 Earth Science * Still in development	The Water and Landforms Module provides experiences with Earth's natural resources—rocks, soil, and water—and provides opportunities for students to engage in science and engineering practices. Students explore the natural world by using simple tools to observe and describe the properties of earth materials. **NGSS PEs:** **Earth and Physical Sciences:** **2-ESS1-1** **2-ESS2-1** **2-ESS2-2** **2-ESS2-3** **2-PS1-1** **ETAS:** **K-2-ETS1-3**	**ESS1.C:** The history of planet Earth **ESS2.A:** Earth materials and systems **ESS2.B:** Plate tectonics and large-scale system interactions **ESS2.C:** The roles of water in Earth's surface processes **PS1.A:** Structures and properties of matter **ETS1.C:** Optimizing the design solution	• Asking questions • Planning and carrying out investigations • Analyzing and interpreting data • Constructing explanations • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • Stability and change • Scale, proportion, and quantity
 Physical Science	In the Solids and Liquids Module, students observe, describe, and compare properties of common solids and liquids through firsthand experience. They plan and carry out investigations to find out what happens when solids and water are mixed and when liquids and water are mixed. They gain firsthand experience with reversible and irreversible changes caused by heating or cooling, and then expand their data collection through a simulation. They use evidence to engage in argumentation and support claims about reversible and irreversible changes to materials due to temperature changes. **NGSS PEs:** **Physical Sciences:** **2-PS1-1** **2-PS1-2** **2-PS1-3** **2-PS1-4** **ETAS:** **K-2-ETS1-1** **K-2-ETS1-2** **K-2-ETS1-3**	**PS1.A:** Structure and properties of matter **ETS1.A:** Defining and delimiting an engineering problem **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 • Constructing explanations and designing solutions • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • Energy and matter • Structure and function
 Life Science * Still in development	The Insects and Plants Module builds understanding of growth and development of plants by observing new organisms over time. Students see the life cycles of insects unfold in real time and compare the structures and functions exhibited by each species to reveal patterns. At the same time, they grow a flowering plant in the classroom and gain experience with pollination, seed dispersal, and the ways in which plants and insects interact in feeding relationships. **NGSS PEs:** **Life Sciences:** **2-LS2-1** **2-LS2-2** **2-LS4-1** **ETAS:** **K-2-ETS1-2**	**LS1.B:** Growth and development of organisms **LS2.A:** Independent relationships in ecosystems **LS4.D:** Biodiversity and humans **ETS1.B:** Developing possible solutions	• Asking questions • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Constructing explanations • Obtaining, evaluating, and communicating information	• Patterns • Cause and effect • 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 Solids and Liquids 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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The Lawrence Hall of Science
UNIVERSITY OF CALIFORNIA, BERKELEY

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