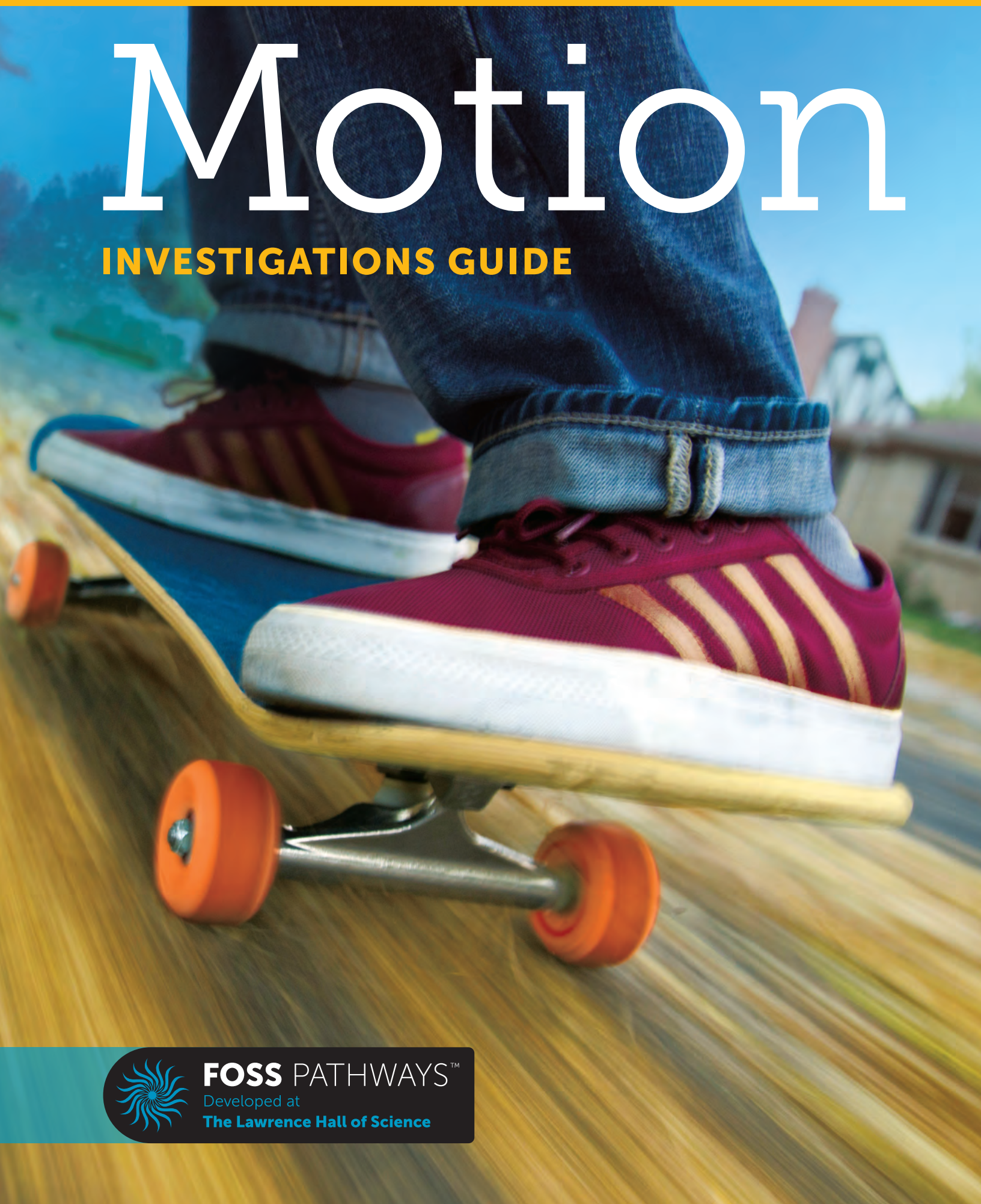
SAMPLER

Motion

INVESTIGATIONS GUIDE



FOSS PATHWAYS™
Developed at
The Lawrence Hall of Science

PreK–5 science that meets the challenge of our time

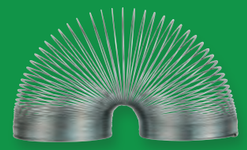
Welcome to new FOSS® Pathways™. Now as never before, the world needs scientific thinkers—to view the world thoughtfully, approach challenges analytically, and embrace opportunities enthusiastically. For educators to help unlock this potential in their students, they need powerful tools that work for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

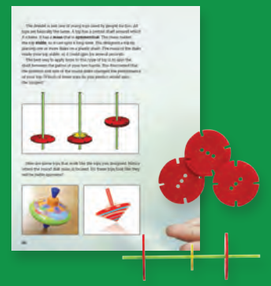
The Full Option Science System™ (FOSS) was conceived to enlist students not as passive recipients of information, but as active investigators of phenomena. That principle has proven its worth for 150,000 teachers and 4 million students across all 50 states, building a legacy of student engagement and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



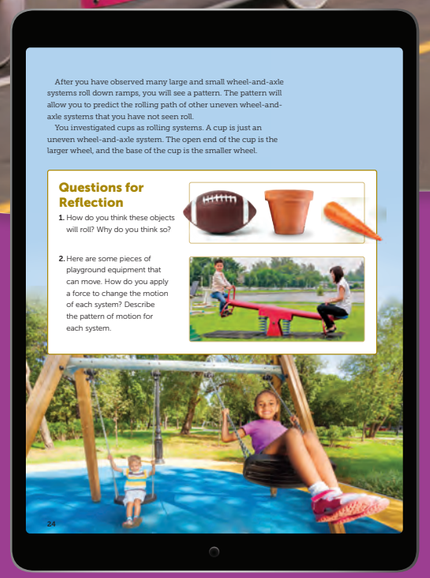
Teaches through a multimodal approach to resonate with every student

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

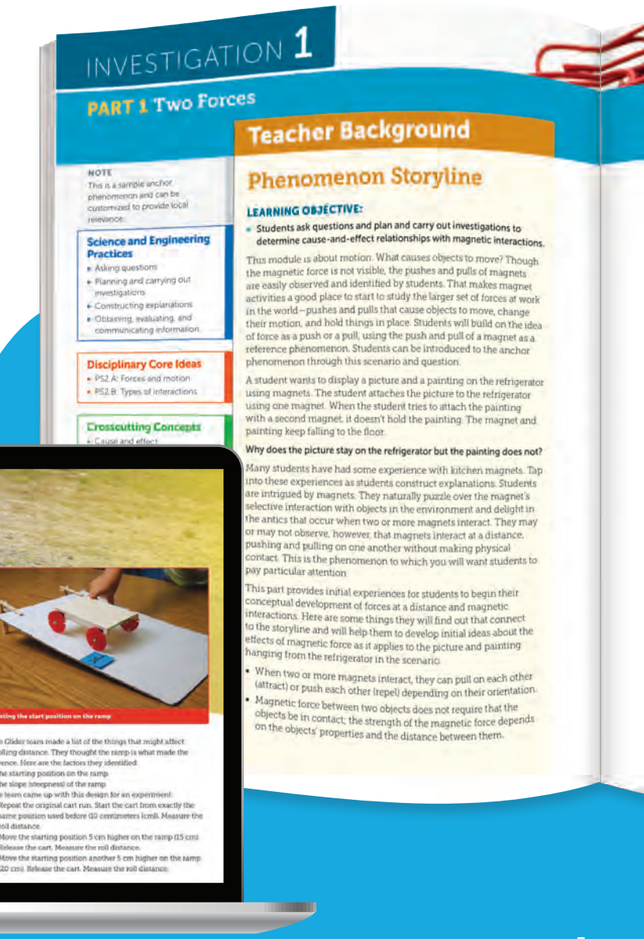
Research-based and field-tested assessments accurately measure student learning and progress. A variety of formative assessment tools provide evidence of students' use of the three dimensions and their knowledge of phenomena.

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 3 NGSS Performance Expectations	FOSS Motion	
	Investigation(s)	Benchmark Assessment
3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.	**Investigation 1** **Investigation 2**	• Investigations 1 I-Check • Investigation 2–3 I-Check • Survey/Posttest
3-PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.	**Investigation 1** **Investigation 2**	• Investigations 2–3 I-Check • Survey/Posttest
3-PS2-3: Ask questions to determine cause-and-effect relationships of electric or magnetic interactions between two objects not in contact with each other.	**Investigation 1** **Investigation 2**	• Investigation 1 I-Check • Survey/Posttest
3-PS2-4: Define a simple design problem that can be solved by applying scientific ideas about magnets.	**Investigation 3**	• Investigation 1 I-Check • Survey/Posttest
3-5 ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	**Investigation 3**	• Survey/Posttest
3-5 ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	**Investigation 3**	• Investigations 2–3 I-Check
3-5 ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	**Investigation 3**	• Investigations 2–3 I-Check • Survey/Posttest

Motion Investigations

Investigation 1: Forces

Part 1: Two Forces
Part 2: Magnetic-Force Investigation
Part 3: More about Forces

Investigation 2: Patterns of Motion

Part 1: Wheel-and-Axle Systems
Part 2: Predicting Motion of New Systems
Part 3: Twirly Birds

Investigation 3: Engineering

Part 1: From Here to There
Part 2: Distance Challenge
Part 3: Investigating Start Position
Part 4: Magnetic Solutions

FOSS

Motion

▶ Start here to begin your review of the Grade 3 Motion Investigations Guide

Introduction

All interactions between common objects arise from a few types of forces, primarily gravity and electromagnetism. Change of motion is the result of forces—usually multiple forces—acting on an object. Forces have a direction and a strength. Objects in contact exert forces on each other; however, forces acting between objects do not require that the objects be in contact. If forces on an object are unbalanced, the motion of the object will change (stop, start, go slower or faster, or change direction). Patterns of motion can be observed; when there is a regular pattern of motion, future motion can be predicted.

Student engagement with these ideas in the **Motion Module** is driven by several anchor phenomena. Students work with magnets and paper clips, wheel-and-axle systems, and paper twirlers. They use their knowledge of forces and motion to enter the engineering design process and refine their understanding. They investigate these phenomena:

- Anchor phenomenon 1—artwork falling from the fridge
- Anchor phenomenon 2—objects falling and scattering
- Anchor phenomenon 3—riding a skateboard down a hill

Students engage in science and engineering practices as they investigate phenomena and collect data to answer questions about the effects of magnetic force and the force of gravity on objects. Students explore the crosscutting concepts of patterns; cause and effect; and systems and system models as they define problems in order to develop solutions. Students reflect on their own use of science and engineering practices and find out how others use these practices in their careers.

CONTENTS

The NGSS Performance Expectations bundled in this module include:

Physical Sciences
3-PS2-1
3-PS2-2
3-PS2-3
3-PS2-4

Engineering, Technology, and Applications of Science
3–5 ETS1-1
3–5 ETS1-2
3–5 ETS1-3

NOTE

The three modules for grade 3 in FOSS Pathways are:

- Water and Climate
- Motion
- Structures of Life

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 Forces **Phenomenon 1—Artwork falling from the fridge:** A student wants to display a picture and a painting on the refrigerator using magnets. The student attaches the picture to the refrigerator using one magnet. When the student tries to attach the painting with a second magnet, it doesn't hold the painting. The magnet and painting keep falling to the floor. **Storyline:** Students plan and carry out investigations about cause-and-effect relationships with magnetism and gravity. Through their direct experiences, students observe that both magnetism and gravity can pull and that magnetism can sometimes push. Both forces can cause movement at a distance. Through their firsthand investigations, students develop an evidence-based model of magnetic fields to explain the phenomenon. They have multiple experiences with a force's strength and direction and the effects resulting from balanced and unbalanced forces.	***Why does the picture stay on the refrigerator but the painting does not?*** **FOCUS QUESTIONS:** **What happens when magnets interact with other magnets and with paper clips?** **How does a magnetic field change when multiple magnets work together?** **What causes a change of motion?**	**PS2.A:** Forces and motion **PS2.B:** Types of interactions • Magnetic interaction between a pair of objects does not require that the objects be in contact. • The strength of the magnetic force between objects depends on the properties of the objects and the distance between them. • How magnets interact depends on the distance between them and their orientation. Sometimes magnets attract, and sometimes they repel. • Gravity is the force that pulls masses toward the center of Earth. • Electric interactions (static electricity) between a pair of objects does not require that the objects be in contact. • A force is a push or a pull. • Each force acting on an object has both strength and direction. • When an object is at rest, the sum of the forces acting on the object is zero; the forces are balanced. • Unbalanced forces (pushes or pulls) can cause change of motion.	**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	**3-PS2-2:** Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. **3-PS2-3:** Ask questions to determine cause-and-effect relationships of electric or magnetic interactions between two objects not in contact with each other.
INV. 2 Patterns of Motion **Phenomenon 2—Objects falling and scattering:** A person walking down an outdoor ramp is carrying a cardboard box of items. The items in the box are a tennis ball, a strip of paper, a lump of clay, a small toy car, a paper cup, a large cork, a marble magnet, and an empty can. The bottom of the box gives way, and all the items fall out. The items travel through the air, to the ramp, and move off in different ways to come to rest in different locations. **Storyline:** Students observe and measure the patterns of objects' motions in various situations. They plan and carry out investigations examining cause-and-effect relationships with wheel-and-axle systems with wheels of different sizes. They investigate paper twirly birds, a simple winged system that spins when it interacts with air, to determine the variables that affect twirly bird performance. These experiences provide evidence for patterns of motion of groups of objects and systems.	***What causes the items to move in different directions and travel different distances?*** **FOCUS QUESTIONS:** **How can we change the motion of wheel-and-axle systems rolling down ramps?** **What rules help predict where a rolling cup will end up?** **Student-created questions, e.g., What happens to the motion of a twirly bird when its design changes?**	**PS2.A:** Forces and motion • The patterns of an object's motion in various situations can be observed and measured. • A wheel-and-axle system with two sizes of wheels describes a curved path when rolled down a slope. The system curves toward the smaller wheel. • When past motion exhibits a regular pattern, future motion can be predicted from it. • A twirly bird is a simple winged system that spins when it interacts with air. • Twirly bird performance is affected by variables, including wing size, shape, and angle.	**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	**3-PS2-2:** Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Module Matrix
At a Glance CONTINUED

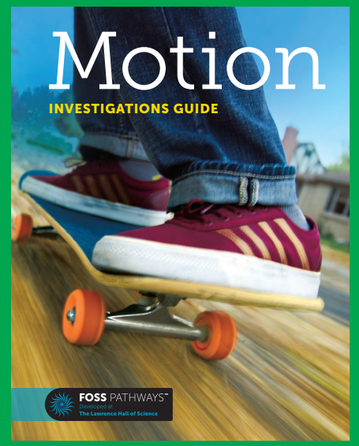
Phenomenon and Storyline	Driving Question and Focus Questions	Content and Disciplinary Core Ideas	Practices and Crosscutting Concepts	NGSS PEs
INV. 3 Engineering **Phenomenon 3—Riding a skateboard down a hill:** A child rides their skateboard down a nearby hill without pushing. They do this several more times. They are surprised to find that each time they stop at different places. **Storyline:** Students design a "cart" that can roll freely on a ramp and investigate the variables that affect the force of gravity-driven motion down a hill. Students investigate cause-and-effect relationships and use observed patterns of motion to design solutions to an engineering problem. The data gathered through this process will provide the evidence to explain why the child on the skateboard in the scenario stopped at different locations each time. There is a cause-and-effect pattern of motion when rolling objects have different start positions on a ramp. The pattern is that the higher the rolling object starts on the hill, the farther distance it will roll before stopping, and the lower the rolling object starts on the hill, the shorter the distance it will travel.	***What causes the skateboard to stop in different places?*** **FOCUS QUESTIONS:** **What are some important features of a cart system that will roll from here to there?** **How does the design of a cart affect the distance it travels?** **Student-created questions, e.g., How does start position affect how far a cart rolls?** **How can you use magnets to meet cart challenges?**	**PS2.A:** Forces and motion **PS2.B:** Types of interactions **ETS1.A:** Defining and delimiting engineering problems **ETS1.B:** Developing possible solutions **ETS1.C:** Optimizing the design solution • A force is a push or pull. • Gravity is the force that pulls masses toward the center of the Earth. • Unbalanced forces cause a change in motion. • When an object is at rest, the sum of the forces acting on the object is zero; the forces are balanced. • The strength of the magnetic force depends on properties of the objects and the distance between them. • Possible solutions to a problem are limited by available materials and resources (constraints). • The success of a designed solution is determined by considering the desired features of a solution (criteria). • Compare different solutions for how well each one meets the criteria. • Testing a solution involves evaluating how well it performs under a range of likely conditions. • Communicating with peers about proposed design solutions can lead to improved designs. • The pattern of an object's or a system's motion in various situations can be observed and measured. • When past motion exhibits a regular pattern, it can be used to predict future motion.	**Science and Engineering Practices** Asking questions and defining problems 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 **Crosscutting Concepts** Patterns Cause and effect Systems and system models	**3-PS2-1:** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. **3-PS2-4:** Define a simple design problem that can be solved by applying scientific ideas about magnets. **3–5 ETS1-1:** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. **3–5 ETS1-2:** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. **3–5 ETS1-3:** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

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

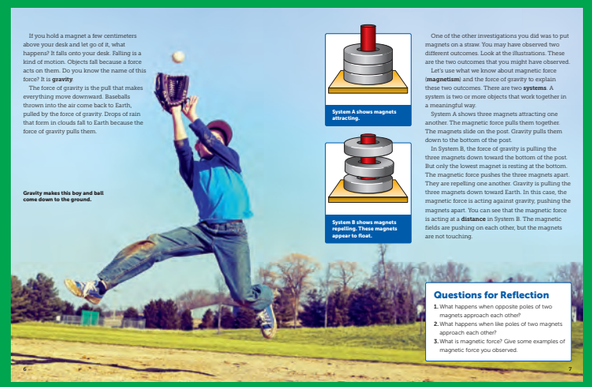


Science Resources Student Book

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

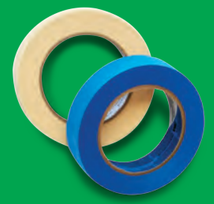
Available in print and as an interactive eBook in English and Spanish.



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

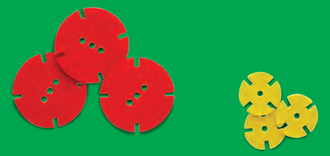
Equipment Kit

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!

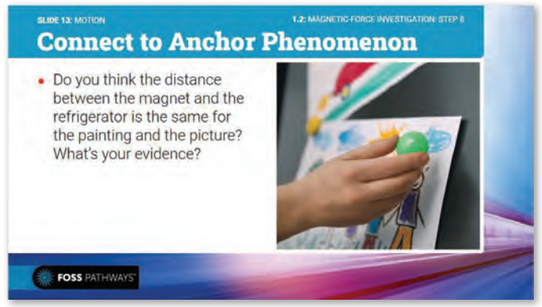
FOSSweb on ThinkLink

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.

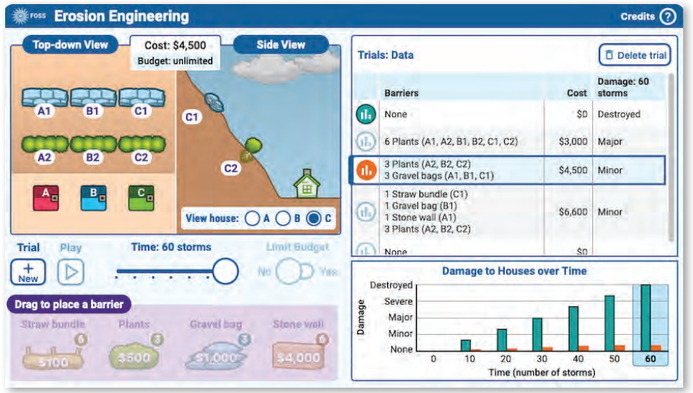


Streaming Videos

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

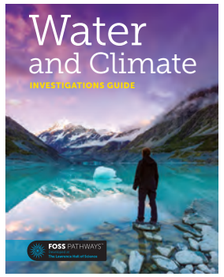
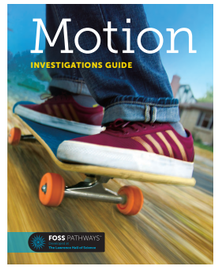
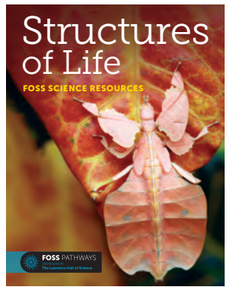
Keep your students engaged while teaching literacy skills with interactive *FOSS Science Resources* eBooks. The eBooks include integrated audio with text syncing and links to online activities and videos that bring the photos to life.

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 3

FOSS Module	Module Overview/Bundled Performance Expectations	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
 Earth Science	In the Water and Climate Module, students engage in science and engineering practices as they investigate the role of water in weather and how weather conditions change around the world and throughout the year while exploring the crosscutting concepts of patterns; cause and effect; and scale, proportion, and quantity. They are introduced to the nature of science, how science affects everyday life, and the influence of engineering, technology, and science on society and the natural world. **NGSS PEs:** **Earth and Space Sciences:** **3-ESS2-1** **3-ESS2-2** **3-ESS3-1**	**ESS2.D:** Weather and climate **ESS3.B:** Natural hazards **ESS2.C:** The roles of water in Earth's surface processes	• 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 • Scale, proportion, and quantity
 Physical Science	In the Motion Module, students engage in science and engineering practices as they investigate phenomena and collect data to answer questions about the effects of magnetic force and the force of gravity on objects. Students explore the crosscutting concepts of patterns; cause and effect; and systems and system models as they define problems in order to develop solutions. Students reflect on their own use of science and engineering practices and find out how others use these practices in their careers. **NGSS PEs:** **Physical Sciences:** **3-PS2-1** **3-PS2-2** **3-PS2-3** **3-PS2-4** **ETAS:** **3-5 ETS1-1** **3-5 ETS1-2** **3-5 ETS1-3**	**PS2.A:** Forces and motion **PS2.B:** Types of interactions **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
 Life Science	In the Structures of Life Module, students observe, compare, categorize, and care for organisms. Students engage in science and engineering practices to investigate the structures and behaviors of organisms and learn how the structures function in growth, survival, and reproduction. Students look at the interactions between organisms of the same kind, among organisms of different kinds, and between the environment and populations of organisms over time. Students focus on these crosscutting concepts to develop understandings about organisms and population survival—patterns; cause and effect; scale, proportion, and quantity; systems and system models; and structure and function. **NGSS PEs:** **Life Sciences:** **3-LS1-1** **3-LS2-1** **3-LS3-1** **3-LS3-2** **3-LS4-1** **3-LS4-2** **3-LS4-3**	**LS1.A:** Structure and function **LS1.B:** Growth and development of organisms **LS2.D:** Social interactions and group behaviors **LS3.A:** Inheritance of traits **LS3.B:** Variation of traits **LS4.C:** Adaptation	• 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

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 Motion 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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