START HERE

Amplify Science

Grade K

Instructional sampler

Amplify.

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Amplify Science

Suggested review experience

Welcome to Amplify Science! In your program sample, you'll find resources and program materials to help you in your review. We recommend exploring the materials in the following order:

1. Instructional sampler

This is what you're holding in your hands right now. The instructional sampler gives you high-level insights into the program's development and approach, information about the various program materials, and a step-by-step walkthrough of how to dig into the online experience for a thorough review.

2. Student print materials

Review the student print materials included in your sample. In this box, you have all of the print student materials used over the course of the year, including Student Investigation Notebooks and Student Books.

3. Exemplar print Teacher's Guide

Review the Teacher's Guide included in the box. The print Teacher's Guide is a printed version of the digital Teacher's Guide and allows you to plan for and deliver most instruction in the program. You'll need to access certain materials for instruction (projections, videos, etc.) via the digital Teacher's Guide.

4. Digital Teacher's Guide

Explore the digital version of the Teacher's Guide, as well as other program features, by visiting amplify.com/sciencek5. A guided tour will familiarize you with navigating the program and its features.

amplify.com/sciencek5

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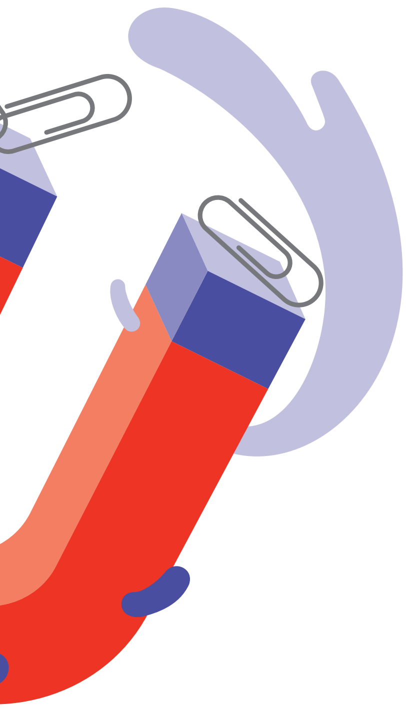



Gary's Sand Journal

About the program

About Amplify Science

In every unit of Amplify Science, students take on the roles of scientists and engineers to figure out real-world phenomena. Students actively investigate compelling questions by finding and evaluating evidence then developing convincing arguments.

In an Amplify Science classroom, students:

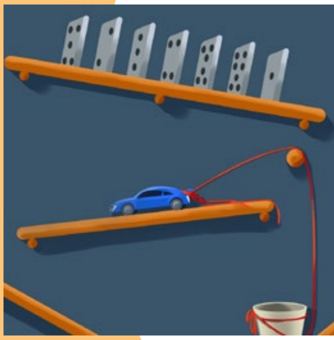
- ✔ Collect evidence from a variety of sources.
- ✔ Make sense of evidence in a variety of ways.
- ✔ Formulate convincing scientific arguments.

Built for new science standards and three-dimensional learning

The Next Generation Science Standards have raised the bar in science education. We set out to create a science program that educators can leverage to bring three-dimensional learning to life for their students. Educators who adopt Amplify Science have access to a comprehensive curriculum complete with detailed lesson plans, hands-on activities and materials, digital tools, embedded assessments, and robust teacher supports.

Amplify Science meets higher expectations for science teaching and learning:

- Anchor phenomena, explored through diverse interdisciplinary contexts, serve as the foundation for compelling, coherent storylines.
- Research-based multimodal learning allows students to develop expertise in all Science and Engineering Practices (SEPs) and deep understanding of Disciplinary Core Ideas (DCIs) and Crosscutting Concepts (CCCs) through experiences within a wide variety of contexts.
- Modeling tools enable students to create, and later revise, visualizations of their ideas of key scientific phenomena at critical points in the curriculum.
- Embedded engineering in units focused on engineering and technology emphasize that there's not always one right answer, as students balance competing constraints to design the best justifiable solutions.

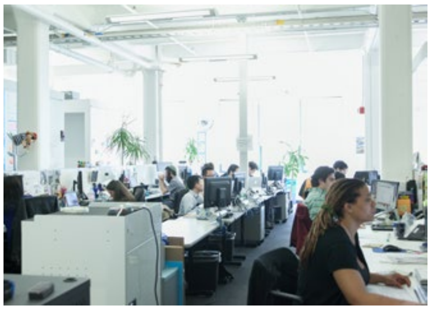


A powerful partnership

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

UC Berkeley's Lawrence Hall of Science has more than 40 years of experience improving K–12 science education. With 20 percent of K–12 classrooms using a Hall-developed instructional resource, and with legacy programs that include FOSS®, Seeds of Science/Roots of Reading®, GEMS®, SEPUP, and Ocean Science Sequences, the Hall's team has a deep understanding of what makes programs effective.

As the Hall's first K–5 science curriculum designed to address the new science standards, Amplify Science reflects state-of-the-art practices in science teaching and learning. Amplify's partnership with LHS runs through 2032 to ensure the program is continually enhanced and updated.



Amplify.

A pioneer in K–12 education since 2000, Amplify is leading the way in next-generation curriculum and assessment. Our captivating core and supplemental programs in ELA, math, and science engage all students in rigorous learning and inspire them to think deeply, creatively, and for themselves. Our formative assessment products turn data into practical instructional support to help all students build a strong foundation in early reading and math. All of our programs provide teachers with powerful tools that help them understand and respond to the needs of every student. Today, Amplify serves five million students in all 50 states.

Hear from our program authors

For 15 years, I've been fortunate to lead an outstanding team of scientists and educators as director of the Learning Design Group at UC Berkeley's Lawrence Hall of Science. We are extremely proud of Amplify Science and appreciate your taking the time to review the program. We developed Amplify Science to reflect the latest thinking and research about science teaching and learning. Along the way, we undertook extensive field testing to ensure our new program works well in real classrooms, with real students and teachers.

I think you'll find that Amplify Science stands apart from other middle school science programs in the following ways: a research-based, multimodal pedagogical approach where students learn to think like scientists and engineers by investigating real-world problems; a balanced blend of hands-on, digital, and literacy activities that are highly engaging and effective; embedded assessments that support differentiation for diverse learners; and robust teacher support for successful implementation. I hope you enjoy exploring the curriculum as much as we enjoyed creating it.

Sincerely,

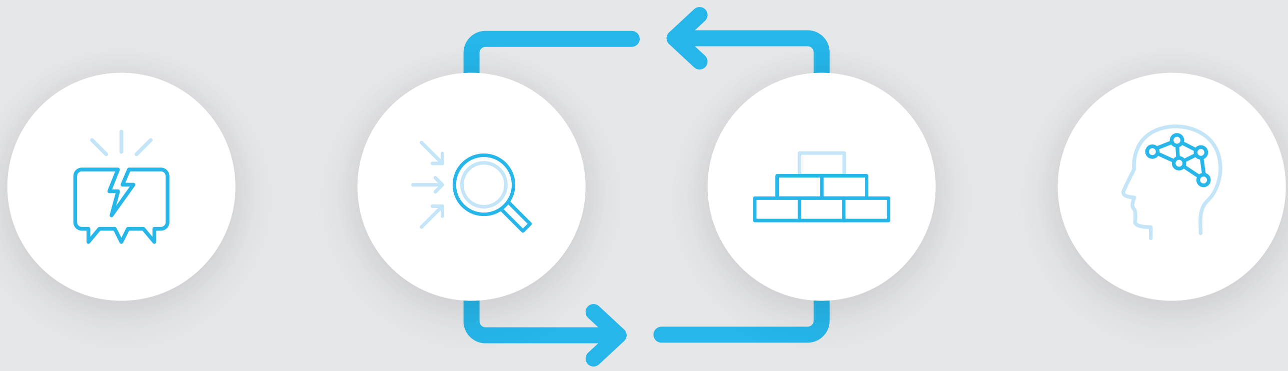
Jacqueline Barber

Jacqueline Barber
Director, Learning Design Group,
Lawrence Hall of Science

A unique, phenomena-based approach

In each Amplify Science unit, students inhabit the role of a scientist or engineer in order to investigate a real-world problem. These problems provide relevant, 21st-century contexts through which students investigate different scientific phenomena.

To investigate these phenomena, students collect evidence from multiple sources and through a variety of modalities. They move back and forth from firsthand investigation to secondhand analysis and synthesis, formulating an increasingly complex explanation of the target phenomenon. Each unit also provides students with opportunities to apply what they have learned to solve new problems in different contexts. This enables students to demonstrate a deep understanding of phenomena and practices.



Engage students with a real-world problem

Explore evidence from multiple sources

Construct increasingly complex explanations

Apply knowledge to solve a different problem

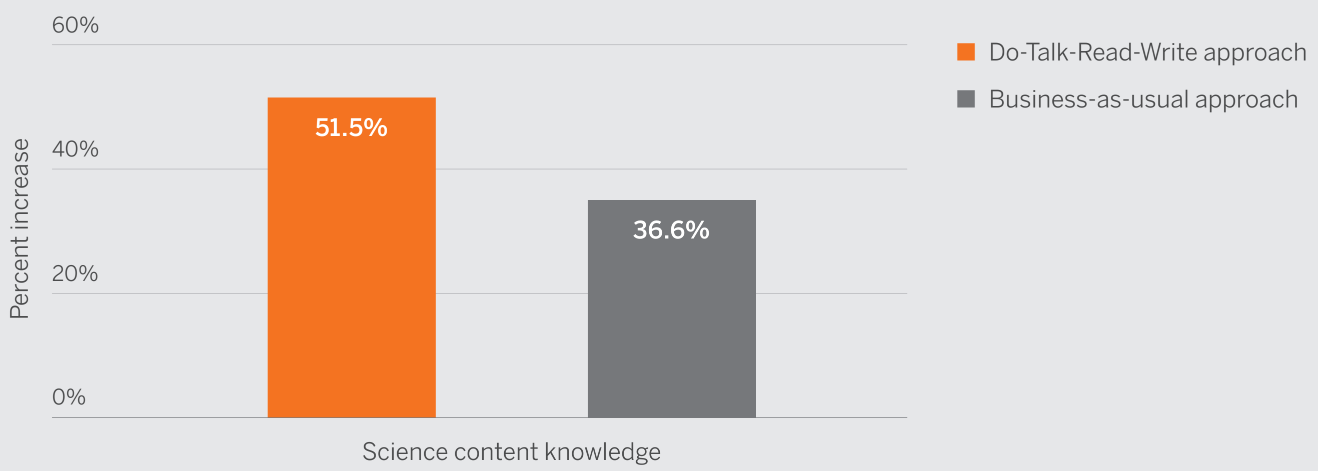
Grounded in research and proven effective

UC Berkeley's Lawrence Hall of Science, the authors behind Amplify Science, developed the Do, Talk, Read, Write, Visualize approach, and gold-standard research shows that it works. Our own efficacy research is pretty exciting, too.

Instructional model

Amplify Science is rooted in the research-based, iterative Do, Talk, Read, Write, Visualize model of learning. Three third-party gold-standard studies provide evidence that students who learn through the Do, Talk, Read, Write approach (used in the *Seeds of Science/Roots of Reading®* program, which formed the foundation for the Amplify Science approach) saw the following benefits:

- Students using a Do, Talk, Read, Write approach significantly outperformed other students receiving their usual science instruction in the areas of science content knowledge and science vocabulary.
- English Language Learners (ELLs) significantly outperformed other ELLs in science content knowledge and science vocabulary.



Source: Cervetti, Barber, Dorph, Pearson, & Goldschmidt, 2012; Duesbury, Werblow, & Twyman, 2011; Wang & Herman, 2005

Program structure

Units per year

Grades K–2: **3**

Grades 3–5: **4**

Unit types

Although every Amplify Science unit provides a three-dimensional learning experience, each unit contains multiple science and engineering practices, but has one of the following specific practices as its focus.

Investigation

Investigation units focus on the process of strategically developing investigations and gathering data to answer questions. Students are first asked to consider questions about what happens in the natural world and why, and are then involved in designing and conducting investigations that produce data to help answer those questions.

Modeling

These Amplify Science units emphasize opportunities for students to engage in the practice of modeling. Students use physical models, investigate with computer models, and create their own diagrams to help them visualize what might be happening on the nanoscale.

Course structure

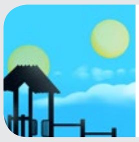
Each unit includes two dedicated assessment days.

Key: A Argumentation E Engineering Design I Investigation M Modeling

Kindergarten

Needs of Plants and Animals
22 lessons I

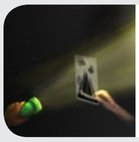
Pushes and Pulls
22 lessons E



Sunlight and Weather
22 lessons M

Grade 1

Animal and Plant Defenses
22 lessons M



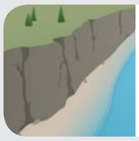
Light and Sound
22 lessons E

Spinning Earth
22 lessons I

Grade 2

Plant and Animal Relationships
22 lessons I

Properties of Materials
22 lessons E



Changing Landforms
22 lessons M

Engineering design

Engineering design solves complex problems by applying science principles to the design of functional solutions, and iteratively testing those solutions to determine how well they meet pre-set criteria. All Amplify Science engineering design units are structured to make the development of such solutions the central focus.

Argumentation (grades 3–5)

These Amplify Science units emphasize opportunities for students to engage in the practice of argumentation. As students move up the K–5 grades, they focus on important aspects of argumentation in an intentional sequence.

Grade 3


Balancing Forces
22 lessons M


Inheritance and Traits
22 lessons I


Environments and Survival
22 lessons E

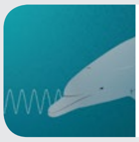

Weather and Climate
22 lessons A

Grade 4


Energy Conversions
22 lessons E


Vision and Light
22 lessons I


Earth's Features
22 lessons A


Waves, Energy, and Information
22 lessons M

Grade 5


Patterns of Earth and Sky
22 lessons I


Modeling Matter
22 lessons M

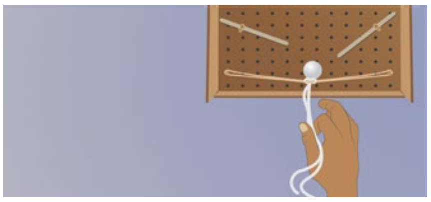

The Earth System
26 lessons E


Ecosystem Restoration
22 lessons A

Phenomena and student roles in grades K–5

In every Amplify Science unit, students take on the role of scientists or engineers—marine biologists, geologists, water resource engineers, and more—to solve a real-world problem. These engaging roles and phenomena bring science to life in your classroom.

Examples



KINDERGARTEN

Pushes and Pulls

How can we create a pinball machine for our class?

Anchor phenomenon: Pinball machines allow people to control the direction and strength of forces on a ball.

Students take on the role of pinball machine engineers as they investigate the effects of forces on the motion of an object. They conduct tests in their own prototypes (models) of a pinball machine and use what they learn to contribute to the design of a class pinball machine. Over the course of the unit, students construct a foundational understanding of why things move in different ways.

GRADE 1

Animal and Plant Defenses

How can a sea turtle survive in the ocean after an aquarium releases it?

Anchor phenomenon: Spruce the Sea Turtle lives in an aquarium and will soon be released back into the ocean, where she will survive despite ocean predators.

Students play the role of marine scientists. In their role, students apply their understanding of plant and animal defense structures to explain to aquarium visitors how a sea turtle and her offspring can defend themselves from ocean predators when they are released into the wild.

GRADE 2

Changing Landforms

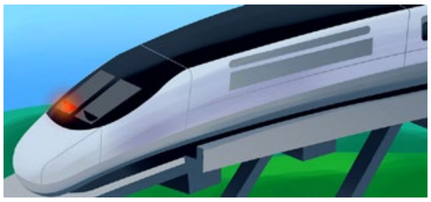
Why is the edge of the ocean cliff closer to the flagpole than it used to be?

Anchor phenomenon: The cliff that Oceanside Recreation Center is situated on appears to be receding over time.

The director of the Oceanside Recreation Center gets a scare when a nearby cliff collapses overnight. Research reveals that the distance between the recreation center's flagpole and the edge of the cliff has changed over time. **Students play the role of geologists and work to figure out why the cliff has changed over time.** Based on what they learn about erosion, they advise on whether it is safe to keep the center open even though the cliff is changing.

GO ONLINE

To read about the anchor phenomena and student roles for every Amplify Science unit, visit amplify.com/sciencek5.



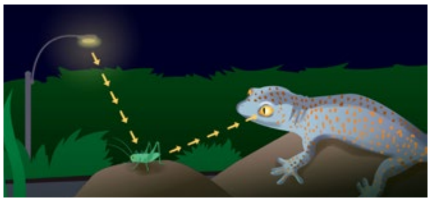
GRADE 3

Balancing Forces

How is it possible for a train to float?

Anchor phenomenon: The town of Faraday is getting a new train that floats above its tracks.

People in Faraday are excited to hear that a new train service will be built for their city, but concerned when they hear that it will be a floating train. **Students take on the role of scientists in Faraday to figure out how a floating train works in order to explain it to the city's residents.** They develop models of how the train rises, floats, and then falls back to the track, and then write an explanation of how the train works.



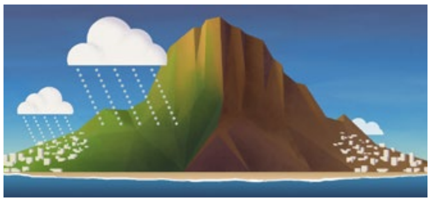
GRADE 4

Vision and Light

Why is an increase in light affecting the health of Tokay geckos in a Philippine rainforest?

Anchor phenomenon: The population of Tokay geckos in a rainforest in the Philippines has decreased since the installation of new highway lights.

As conservation biologists, students work to figure out why a population of Tokay geckos has decreased since the installation of new highway lights in the rainforest. Students use their understanding of vision, light, and information processing to figure out why an increase in light in the geckos' habitat is affecting the population.



GRADE 5

The Earth System

Why is East Ferris experiencing a water shortage and what can the city do about it?

Anchor phenomenon: East Ferris, a city on one side of the fictional Ferris Island, is experiencing a water shortage, while West Ferris is not.

The cities of East Ferris and West Ferris are located on different sides of a mountain on the fictional Ferris Island. East Ferris is having a water shortage while West Ferris is not. **As water resource engineers, students learn about the Earth system to help figure out what is causing the water shortage problem and design possible solutions, including freshwater collection systems and proposals for using chemical reactions to treat wastewater.**

Approach to assessment

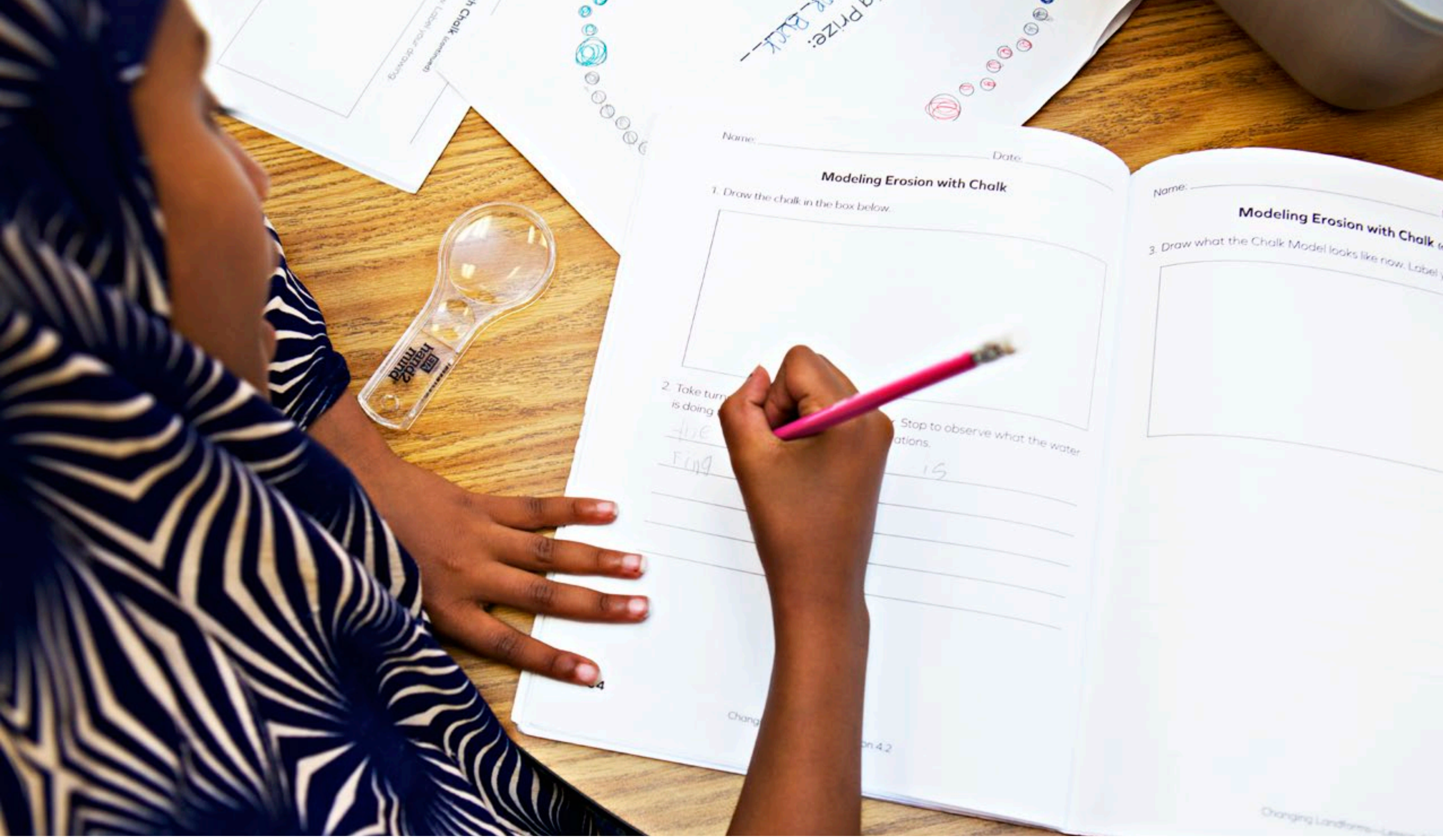
The Amplify Science assessment system is grounded in the principle that students benefit from regular and varied opportunities to demonstrate understanding through performance.

Each unit includes a range of formative assessments embedded in instruction with the goal of providing regular, actionable information to the teacher with minimal impact on instructional time.

The variety of assessment options for Amplify Science K–5 include:

F **Formative** S **Summative**

Formative	Formative
Pre-Unit Assessment These assessments make use of discussion, modeling, and written explanations to gauge student knowledge prior to starting a unit.	**On-the-Fly Assessments (OtFAs)** Multidimensional assessments integrated regularly throughout the lessons. OtFA opportunities were designed to help a teacher make sense of student activity during a learning experience and to provide evidence of how a student is coming to understand core concepts and developing dexterity with SEPs and CCCs. **Self-Assessments** Once per chapter, students are given a brief opportunity to reflect on their own learning, ask questions, and reveal ongoing wonderings about unit content. Students respond to a consistent set of prompts each time, ensuring that their own progress is visible to them. **Critical Juncture Assessments** Each chapter includes an integrated multidimensional performance task that supports students' consolidation of the ideas encountered in the chapter and provides insight into students' developing understanding. Examples include writing scientific explanations, engaging in argumentation, developing and using models, and designing engineering solutions.



Summative

End-of-Unit Assessment

Assessments toward the end of each unit feature a combination of targeted discussions, student-generated models, and written explanations or arguments to enable students to demonstrate understanding and growth at the conclusion of a unit.

NGSS BENCHMARK ASSESSMENTS

Developed by Amplify, the Next Generation Science Standards (NGSS) Benchmark Assessments give you insight into how your students are progressing toward mastery of the three dimensions and performance expectations of the NGSS ahead of high-stakes end-of-year assessments. They are given 3–4 times per year, depending on the grade level, and are delivered after specific units in the recommended Amplify Science scope and sequence.


KINDNESS

Engaging materials

Hands-on investigations in grades K–5

Hands-on learning is an essential part of Amplify Science, and is integrated into every unit. Students actively participate in science, playing the roles of scientists and engineers as they gather evidence, think critically, solve problems, and develop and defend claims about the world around them. Every unit includes hands-on investigations that are critical to achieving the unit's learning goals.

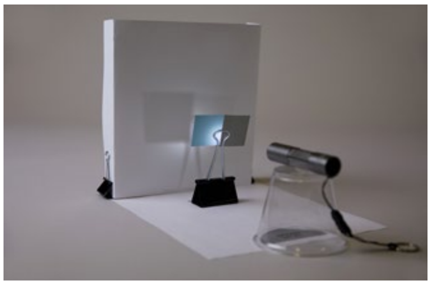
Examples

KINDERGARTEN

Pushes and Pulls

Showcasing the Box Models (Lesson 5.3)

In Lesson 5.2 of Pushes and Pulls, students synthesize what they have figured out about force and motion to create a culminating design for their pinball machine models. Students incorporate a launcher, flippers, and bumpers into their model to help their pinball reach a target. Students then test their models to observe whether or not their solutions work as expected, and then make any additional modifications as necessary.

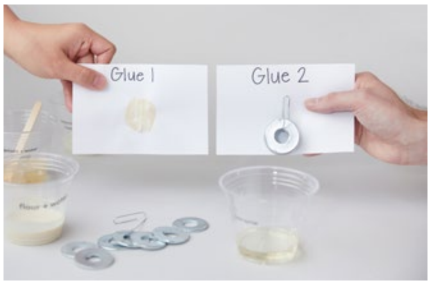


GRADE 1

Light and Sound

Investigating Materials That Do Not Block (Lesson 3.1)

By Lesson 3.1 of Light and Sound, students have figured out that not all materials block light to create a dark area on a surface. Partners use their Investigation Kits to test non-blocking materials (clear plastic, tinted plastic, and wax paper) in comparison to cardboard, a known blocking material. Students use their observations of these materials comparisons to discuss what may cause variation in the brightness of the areas created on a surface.



GRADE 2

Properties of Materials

Making Our Second Glue and Setting Up Tests (Lesson 3.5)

In Lesson 3.5 of Properties of Materials, students apply the evidence that they have collected about the properties of glue ingredients to create a recipe for a glue that meets a series of design goals. Students use available ingredients to create their unique glue and then set up a fair test with partners that will allow them to compare the properties of their glues.

GO ONLINE

For a complete materials list and to see more example activities, visit amplify.com/sciencek5.

Hands-on Flextensions

Hands-on Flextensions are additional, optional investigations that are included at logical points in the learning progression and give students an opportunity to dig deeper if time permits. These activities offer teachers flexibility to choose to dedicate more time to hands-on learning.

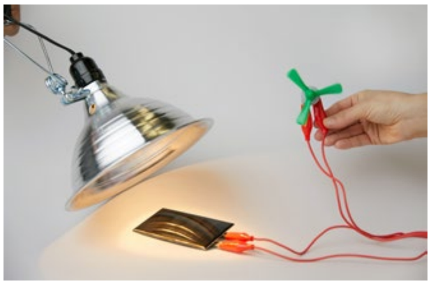
Materials referenced in Hands-on Flextension activities will either be included in the unit kit or are easily sourced. Supporting resources such as student worksheets will be included as downloadable PDF files.

GRADE 3

Inheritance and Traits

Exploring Inheritance (Lesson 2.4)

In Lesson 2.4 of Inheritance and Traits, students investigate how traits are passed down from parents to offspring by building clay creature offspring. Students work in pairs to make clay creature offspring with specific traits based on instructions that were randomly inherited from two parent creatures. In the discussion following the activity, students compare creatures and observe that, although the offspring inherited instructions from the same parents, there is variation in traits among siblings.



GRADE 4

Energy Conversions

Designing Wind Turbines (Lesson 3.4)

In Lesson 3.4 students are introduced to their first hands-on design challenge: to design and build a wind turbine. Students receive two proposed solutions to the blackout problem in Ergstown, both of which are intended to bring more energy to the electrical system: installing solar panels or installing wind turbines. In order to make an informed choice between the two proposed solutions, students are given a design challenge: to build a wind turbine that meets certain design criteria. Students then engage in the design cycle as they explore the available materials and plan, make, and test their wind turbine designs.

GRADE 5

The Earth System

Observing Substances and Mixing Substances (Lesson 5.1)

In Lesson 5.1 of The Earth System, students investigate how new substances form. Students observe a chemical reaction by mixing calcium chloride, baking soda, and phenol red solution. They discuss and record their observations of the substances before, during, and after the reaction.

GO ONLINE

Preview all Student Books in grades K–5 at amplify.com/sciencek5.

Student Books

About the books

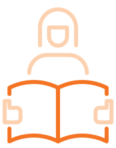
Each unit of Amplify Science K–5 includes five unique Student Books written by the Lawrence Hall of Science specifically for the program. The five books in each unit include one book for approximately every five days of instruction and one reference book that students draw upon throughout the unit.

These content-rich nonfiction and informational texts provide opportunities for students to search for evidence relevant to their firsthand investigations, see science practices and dispositions modeled, extend their science knowledge, provide real world connections as they master reading-to-learn and close reading skills, and construct evidence-based arguments.

Instructional approach

Beginning and young readers have unique developmental needs, and science instruction should support these students in reading more independently as they progress through sections of content, the school year, and each grade.

One way Amplify Science meets these needs is by strategically deploying different modes of reading throughout each unit: Read-Aloud, Shared Reading, and Partner Reading.



Read-Aloud

In the Read-Aloud mode, the teacher reads the book while students listen. During a Read-Aloud, the teacher models fluent and expressive reading, demonstrates strategic reading, thinks aloud about the content of the book, introduces new vocabulary, and facilitates students' comprehension as the class gathers information to figure out a science idea. In grades K–1, all Student Books are also included as Big Books for read-alouds.

Shared Reading

In the Shared Reading mode, the teacher and students interact with the book together. Shared Reading provides additional opportunities for students to observe the teacher as an expert reader, to actively join in the discussion about the book, and to practice using a focal comprehension strategy.

Partner Reading

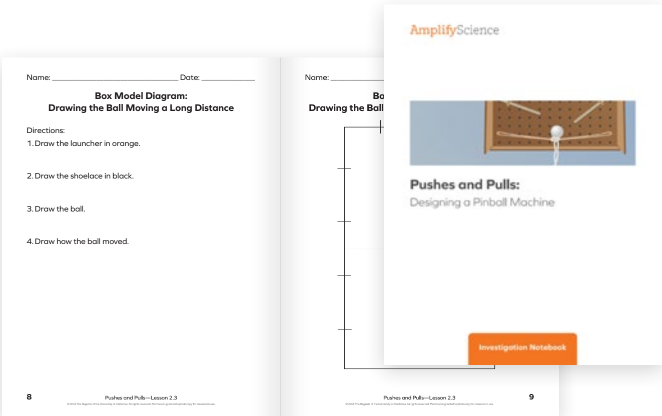
In Partner Reading mode, two students work together to read or gather information from a book. Partner Reading provides opportunities for each student in a pair to be the reader and the supporter while reading a text.

ñ SPANISH LANGUAGE SUPPORT

All Student Books are also available in Spanish.

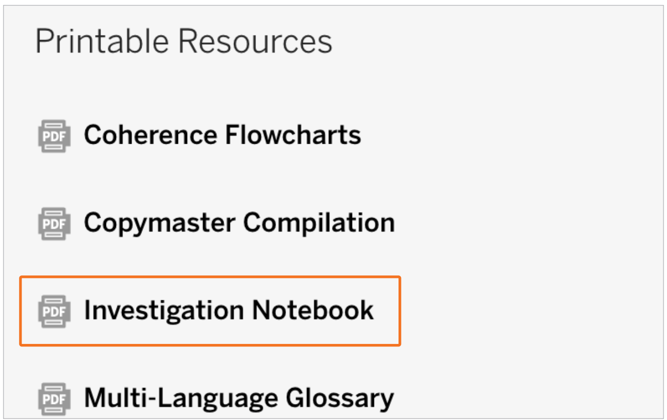
Student Investigation Notebooks

Every unit in Amplify Science has a Student Investigation Notebook, where students record data and observations, make drawings, and complete writing tasks. Scaffolding supports for reading and writing activities are also included in each notebook.



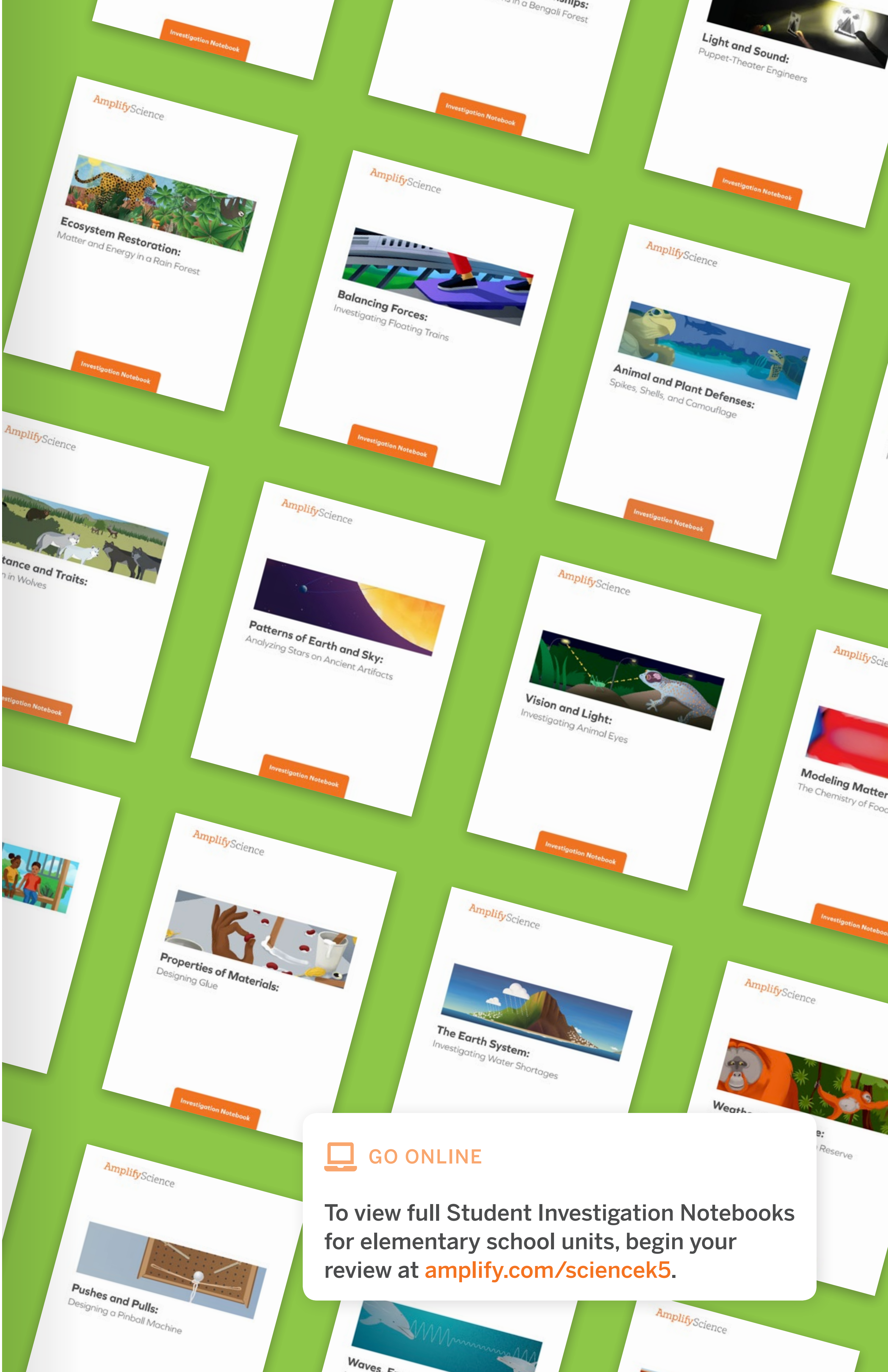
In grades K–5, one copy of the Student Investigation Notebook is included in each unit's materials kit for use as a blackline master.

The Student Investigation Notebook for each unit is also available as a downloadable PDF on the Unit Guide page of the digital Teacher's Guide.



ñ SPANISH LANGUAGE SUPPORT

All Student Investigation Notebooks are also available in Spanish.



GO ONLINE

To view full Student Investigation Notebooks for elementary school units, begin your review at amplify.com/sciencek5.

Digital resources

Students have access to a variety of digital tools to enrich their learning throughout the Amplify Science K–5 program.

Grades K–1

In kindergarten and grade 1, students observe various types of media (videos, images, etc.) through teacher projections. In these grade levels, however, students are not expected to access their own digital experiences.

Grades 2–3

In grades 2 and 3, some student-facing technology is available, with four to five lessons per unit that have activities where students can use science practice tools to to aid in the modeling, graphing, and sorting of information related to the unit's central problem. (A unit has 22 lessons total.)

Grades 4–5

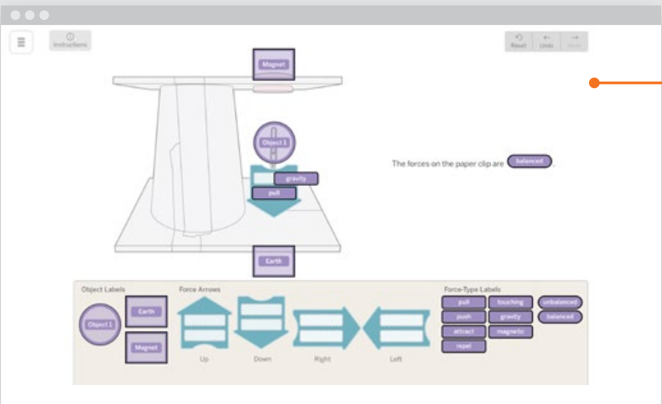
Students in grades 4 and 5 use digital tools and simulations more frequently, with 30-40 percent of lessons including opportunities to use a digital tool.

Videos

Videos are incorporated into Amplify Science units across grades K–5. Whenever a video is present, the teacher projects the video to the students from their own device. Students are never prompted to access videos themselves in Amplify Science grades K–5. If a teacher does not have internet access in the classroom, they can download videos before class.

Practice Tools

A collection of unit-specific digital apps, Practice Tools include simple drag-and-drop activities or easy-to-use data-entry tools to aid students with sorting, modeling, or visualizing information. Practice Tools are included in each unit in grades 2–5, appearing in approximately three to five lessons per unit.



Modeling Tool

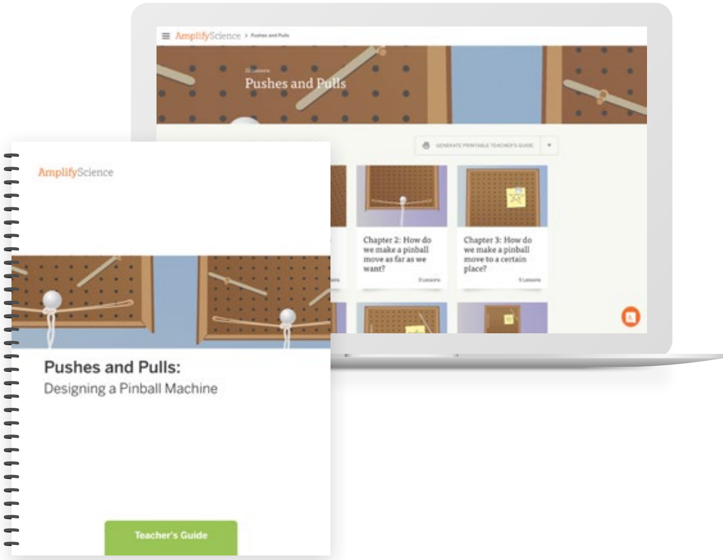
Data Tool

Teacher's Guides

Every unit of Amplify Science includes a comprehensive Teacher's Guide containing lesson plans, differentiation strategies, and other instructional supports and resources at the unit, lesson, and individual activity levels.

Plan for instruction

Teachers can access their lesson plans through the print or digital Teacher's Guides. Both formats include the same unit-level overview and preparation information, as well as step-by-step instructions for every activity in every lesson.



The Teacher's Guide contains step-by-step teaching instructions, which include:

- Teacher Supports, which note background information, pedagogical rationale, or instructional suggestions for the teacher.
- Possible Responses, which provide information about how to evaluate student work. These are found at the end of the Activity in a shaded box.
- On-the-Fly Assessments, which offer guidance for using formative assessment opportunities.

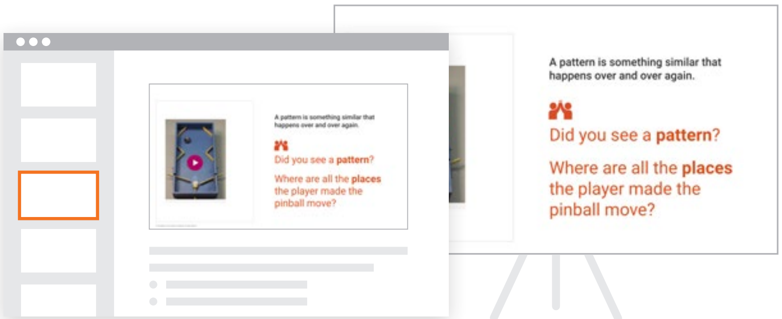
ñ SPANISH LANGUAGE SUPPORT

A Spanish add-on license gives teachers access to lesson projections, PDFs of print materials, and recommended in-class "teacher talk" moments in Spanish.

GO ONLINE

Log into the digital Teacher's Guide and explore digital tools in Amplify Science at amplify.com/sciencek5.

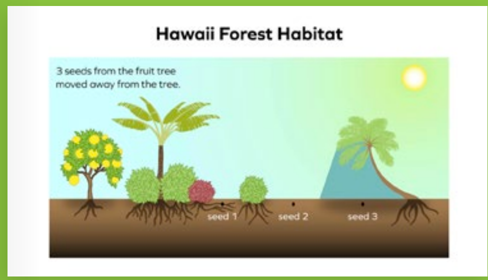
Deliver instruction

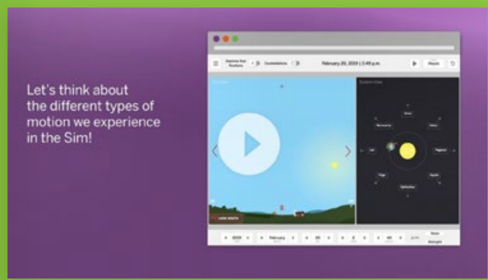


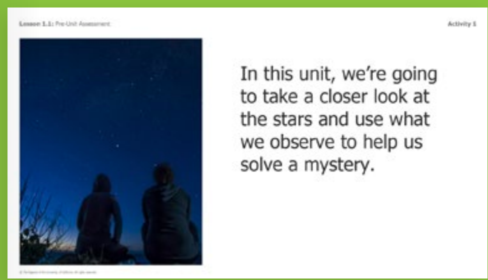
Classroom Slides

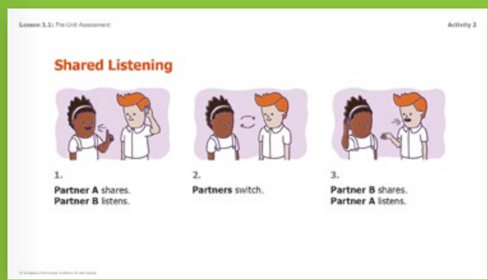
To make planning and delivering instruction faster and easier, Amplify has developed Classroom Slides for all K–5 lessons. Each lesson comes with a downloadable and editable PowerPoint file to help guide teachers and their students through the lesson with clearly-sequenced, engaging, and easy-to-follow images, videos, questions, and instructions.

Classroom Slides allow teachers to easily customize their lessons and streamline the in-class presentation experience. Slides take key lesson content—including student-facing questions, teacher prompts, activity transitions, and visuals—and put it in a logical sequence. At any time, teachers can feel free to change the wording, paste in a new visual, or link to their favorite YouTube video.









In your classroom

Grade K: Year at a glance

Grade K in Amplify Science contains three units, each containing 22 total lessons: 20 45-minute lessons and two dedicated assessment days.

Needs of Plants and Animals

22 Lessons

20 45-minute lessons
2 dedicated assessment days
Investigation focus

In *Needs of Plants and Animals: Milkweed and Monarchs*, students figure out that monarch caterpillars feed on milkweed plants, then investigate what milkweed plants need to grow by observing and recording plants under different water and light conditions.

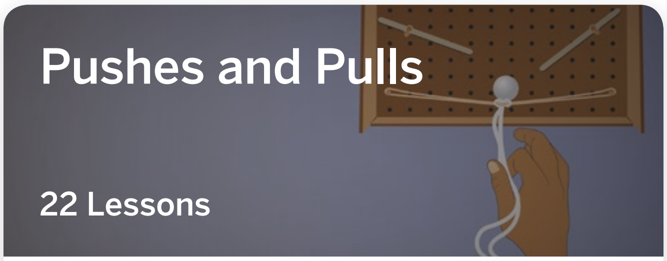
Student role and phenomena

Students assume the role of scientists to help a group of children from the fictional community of Mariposa Grove to explain why there are no more caterpillars in a community garden that was converted from a field which once had caterpillars. Students also advise the children on what they can do to attract the monarchs.

Insights

Books and time-lapse videos provide more opportunities for students to learn how plants get what they need to grow. Students also examine the ways that humans change their environments in order to meet their needs and explore how people can choose to share the places they live with other living things.

Focal NGSS Performance Expectations:
K-LS1-1 • K-ESS2-2 • K-ESS3-1 • K-ESS3-3



Pushes and Pulls

22 Lessons

20 45-minute lessons
2 dedicated assessment days
Engineering design focus

In *Pushes and Pulls: Designing a Pinball Machine*, students conduct tests on their own prototypes of a pinball machine (called Box Models) and use what they learn to solve the design problem of creating a Class Pinball Machine.

Student role and phenomena

In this unit, students will take on the role of pinball engineers to explore how pinball machines allow people to control the direction and strength of forces on a ball.

Insights

Regular circle-time discussions facilitate students' growing understanding of ideas related to force and motion, as well as their ability to use language to describe these fundamental ideas. In the process, students learn about how engineers design and test solutions to problems.

Focal NGSS Performance Expectations:
K-PS2-1 • K-PS2-2 • K-2-ETS1-1 • K-2-ETS1-2
K-2-ETS1-3

Sunlight and Weather

22 Lessons

20 45-minute lessons
2 dedicated assessment days
Modeling focus

Sunlight and Weather: Solving Playground Problems provides the foundation for understanding the mechanism underlying all weather—how the sun warms Earth's surface.

Student role and phenomena

In their role as weather scientists, students solve the problem of why students at one fictional school are too cold during morning recess, while students at another school are too hot during afternoon recess.

Insights

Through hands-on investigations and the use of physical models, students explore the warming effect of sunlight and figure out how to solve the schools' problems. Students extend their understanding of weather with an exploration of severe weather within the context of the schools.

Focal NGSS Performance Expectations:
K-PS3-1 • K-PS3-2 • K-ESS2-1 • K-ESS3-2

Deep dive: Pushes and Pulls

Take a closer look at the lessons and activities in the "Pushes and Pulls" unit.

CHAPTER 1 – DAY 1
Lesson 1.1
Pre-Unit Assessment

DAY 2
Lesson 1.2
Talking About Forces

DAY 3
Lesson 1.3
Forces Happen Between Two Objects

CHAPTER 2 – DAY 6
Lesson 2.1
Exploring Shorter and Longer Distances

DAY 7
Lesson 2.2
Strong and Gentle Forces

DAY 8
Lesson 2.3
Designing a New Launcher

DAY 11
Lesson 3.3
Direction and Strength

DAY 12
Lesson 3.4
Targets in the Box Model

DAY 13
Lesson 3.5
Applying Strength and Direction

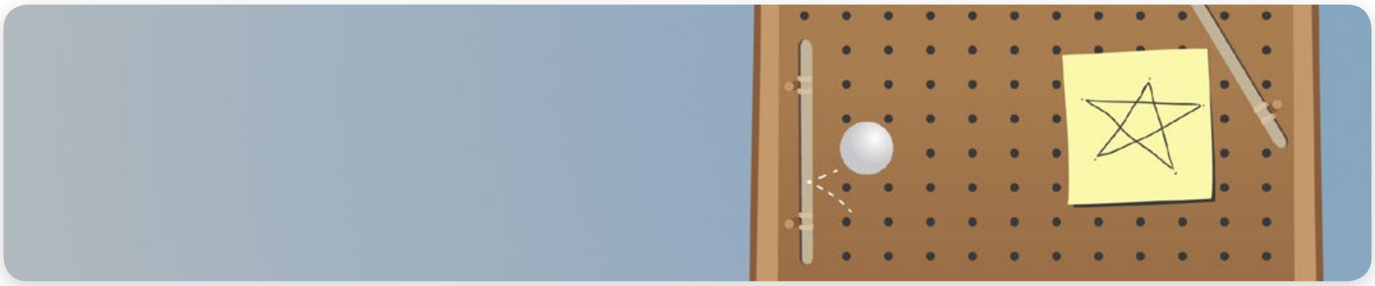
DAY 16
Lesson 4.3
Flippers and Bumpers

CHAPTER 5 – DAY 17
Lesson 5.1
Room 4 Solves a Problem

DAY 18
Lesson 5.2
Testing and Improving Our Box Models

DAY 21
Lesson 6.2
A Busy Day in Pushville

DAY 22
Lesson 6.3
End-of-Unit Assessment



DAY 4
Lesson 1.4
We Are Engineers

DAY 5
Lesson 1.5
Writing About Forces

CHAPTER 3 – DAY 9
Lesson 3.1
Movement in Different Directions

DAY 10
Lesson 3.2
Building with Forces

CHAPTER 4 – DAY 14
Lesson 4.1
Changing Direction

DAY 15
Lesson 4.2
Forces Change an Object's Direction

DAY 19
Lesson 5.3
Showcasing Our Box Models

CHAPTER 6 – DAY 20
Lesson 6.1
Searching for Forces

Lesson includes a reading activity with Student Books

Lesson includes a hands-on investigation

Lesson includes scientific writing activity

Dedicated assessment day

Lesson includes a discussion activity

Unit storyline: Pushes and Pulls

On the following pages, you'll find teacher and student sample pages and highlights of digital features for the "Pushes and Pulls" unit. Follow along with the print Teacher's Guide included in your sample or online with the digital Teacher's Guide.

Understanding how to control directional forces on a ball is the quest of many people—from soccer players to engineers developing forms of industrial automation to pinball machine players.

Pinball machines and their precursors have been around since the eighteenth century. The many variants have all involved launching a ball into a field of obstacles and targets, attempting to direct the path of the ball to achieve points. In this unit, students will take on the role of pinball engineers to explore how pinball machines allow people to control the direction and strength of forces on a ball, which serves as the anchor phenomenon of the unit.

They conduct tests on their own prototypes of a pinball machine (called Box Models) and use what they learn to solve the design problem of creating a Class Pinball Machine. Regular circle-time discussions facilitate students' growing understanding of ideas related to force and motion, as well as their ability to use language to describe these fundamental ideas. In the process, students learn about how engineers design and test solutions to problems. Students each contribute evidence from the tests they conduct using their Box Models to help make decisions about how to design the Class Pinball Machine, something that can remain in the classroom even after the unit is complete.

At the end of the unit, students use their new understanding of the phenomena of force and motion to identify pushes and pulls more broadly in their lives.

Sample unit walkthrough

Walkthrough progress PLAN TEACH ASSESS

Teacher sample page: Unit Overview

Unit Overview

Pushes and Pulls
Planning for the Unit

Unit Overview

What's in This Unit?

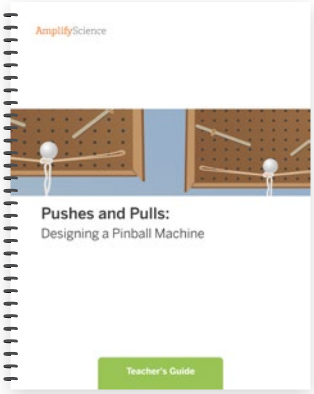
Understanding how to control directional forces on a ball is the quest of many people—from soccer players to engineers developing forms of industrial automation to pinball machine players. Pinball machines and their precursors have been around since the eighteenth century. The many variants have all involved launching a ball into a field of obstacles and targets, attempting to direct the path of the ball to achieve points. In this unit, students will take on the role of pinball engineers to explore how pinball machines allow people to control the direction and strength of forces on a ball, which serves as the anchor phenomenon of the unit. They conduct tests on their own prototypes of a pinball machine (called Box Models) and use what they learn to solve the design problem of creating a Class Pinball Machine. Regular circle-time discussions facilitate students' growing understanding of ideas related to force and motion, as well as their ability to use language to describe these fundamental ideas. In the process, students learn about how engineers design and test solutions to problems. Students each contribute evidence from the tests they conduct using their Box Models to help make decisions about how to design the Class Pinball Machine, something that can remain in the classroom even after the unit is complete. At the end of the unit, students use their new understanding of the phenomena of force and motion to identify pushes and pulls more broadly in their lives.

Why?

Directional forces (pushes and pulls) are evident everywhere in our world—from pushing a grocery cart to pulling a wagon. From an early age, children use trial and error to learn about the effects of pushing and pulling, and they come into kindergarten with this knowledge. This unit builds on students' inherent knowledge, with the goal of advancing their understanding so that they can begin to anticipate and articulate how pushes and pulls impact the motion of a ball. Students' increasing experience with and confidence in being able to predict and describe the effect of a specific type of push or pull will give rise to a growing understanding of forces and motion, as well as an expanded vocabulary and increased facility in describing both the causes and effects of forces on motion. Developing accurate, but accessible, science language at this early level will allow students to express ideas with precision while inviting meaningful discussions about the nature of basic phenomena, such as motion and forces. This will pave the way for understanding in later grades about the effects of balanced and unbalanced forces on the motion of an object, and for beginning to be able to notice patterns in an object's motion and be able to predict future motion.

How?

In Chapter 1, students view a video of a homemade pinball machine in action, and then are challenged to design a Class Pinball Machine that can do all the things they want it to do. The class learns about forces and engages in the design cycle to create a solution related to the Chapter 1 Question *How do we make a pinball start to move?* Students investigate starting movement by exploring a variety of familiar and new materials and by visualizing, which enables students to come to the conclusion that forces happen between objects. Students also read about how forces are exerted in the book *Talking about Forces* and learn about cause–and–effect relationships, which help them explain that objects begin to move when another object exerts a force on them. Students engage in their role of pinball engineers by first creating a Box Model—which allows them to try out their ideas—and then by drawing a diagram. By the end of the chapter, students have designed a launcher for the Class Pinball Machine. Meeting this first design goal helps students learn that engineers design solutions to try to make something new that people want or need. The purpose of this chapter is for students to gain experience with the design cycle, including finding out about problems and designing solutions; to understand that forces happen between two objects; and to recognize that an object starts to move when another object exerts a force on it.

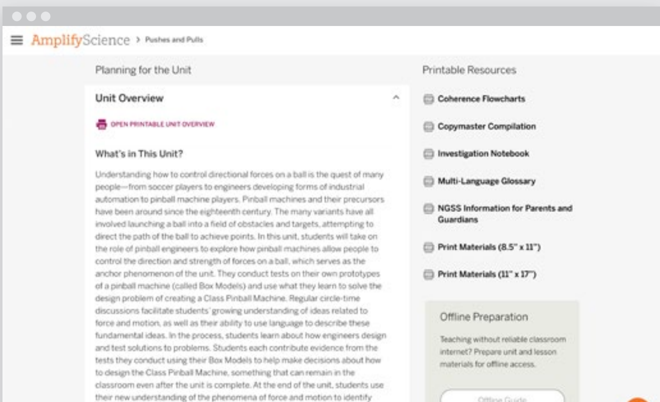


Find the Unit Overview in the exemplar Teacher's Guide included in your sample.

The Unit Overview provides you with an outline of the unit, including what the unit is about, why the unit was written this particular way, and how students will experience the unit. The Unit Overview is one of the most important documents for teachers to review before teaching a unit.

GO ONLINE

To access the Unit Overview in the digital Teacher's Guide, expand the "Unit Overview" section of the Unit Guide when you first click into a unit. The Unit Overview is also downloadable as a PDF.



Walkthrough progress PLAN TEACH ASSESS

Teacher sample page: Unit Map

Pushes and Pulls
Planning for the Unit

Unit Map

Unit Map

How can we create a pinball machine for our class?

Students take on the role of pinball engineers as they investigate the effects of forces on the motion of an object. They test their own prototypes (models) of a pinball machine and use what they learn to contribute to the design of a class pinball machine. Over the course of the unit, students construct a foundational understanding of why things move in different ways.

Chapter 1: How do we make a pinball start to move?

Students figure out: To make our pinball start to move, we must exert a force on the pinball. We can use a rubber band launcher to exert a force on the pinball.

How they figure it out: Students investigate how to make objects in the classroom start to move. They talk about cause and effect, read a book that introduces key scientific language and use it to practice talking about forces and observed motion. Finally, students create models for testing their ideas about making the pinball start to move.

Chapter 2: How do we make a pinball move as far as we want?

Students figure out: To make our pinball go the distance we want, the rubber band launcher has to exert a strong force. To make it go a short distance, the rubber band launcher has to exert a gentle force. Attaching a shoelace to the rubber band launcher can help us adjust the force.

How they figure it out: Students investigate how to make a pinball move short or long distances by testing their ideas in the Box Models. They describe how the launcher can be used to exert gentle and strong forces to move a pinball different distances.

Chapter 3: How do we make a pinball move to a certain place?

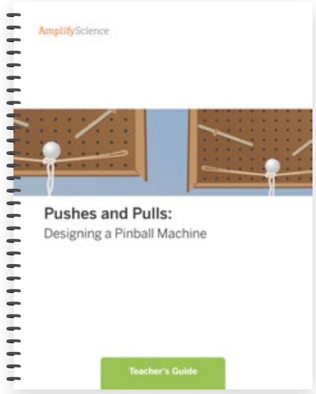
Students figure out: To get the pinball moving in the direction we want (left or right), we must exert a force on the pinball in the direction that we want it to move.

How they figure it out: Students investigate how to control the pinball's direction of movement by controlling the direction of applied forces. They read to obtain information from a book on building with forces and use this language to talk about forces moving in a particular direction.

Chapter 4: How do we make a moving pinball change direction?

Students figure out: To make a moving pinball change direction, we have to exert another force on it, either from a moving object or from a still object in its path.

How they figure it out: Students investigate how to change the direction of a moving pinball. Ultimately, the class decides whether and how to add flippers, targets, and a bumper to the Class Pinball Machine and use Explanation Language Frames to help them discuss and write about how forces cause a moving object to change direction.

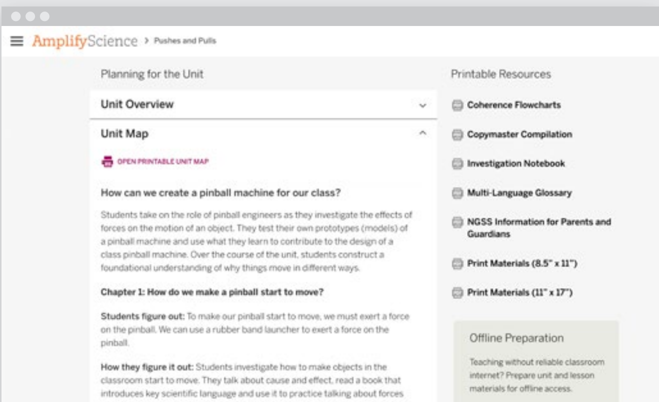


Find the Unit Map in the exemplar Teacher's Guide included in your sample.

The Unit Map is a summary that shows teachers how chapters within the unit build upon each other, what questions students will investigate, and what evidence sources they will use to figure those questions out.

GO ONLINE

To access the Unit Map in the digital Teacher's Guide, expand the "Unit Map" section of the Unit Guide when you first click into a unit. The Unit Map is also downloadable as a PDF.



Walkthrough progress PLAN **TEACH** ASSESS

Teacher sample page: Instructional Guide

Lesson 1.1
Activity 1

Pushes and Pulls
Lesson Guides

TEACHER-LED DISCUSSION
1 Introducing Students' Role as Engineers

Introducing Students' Role as Engineers

10 MIN

Students are introduced to their role as engineers and to the problem they will need to solve—how to design a pinball machine.

Instructional Guide

1. Lead Embodied Forces Routine. Ask students to stand up. Explain that they will act out being a moving pinball in a pinball machine. Model the actions with students, keeping your movements small and pointing in the direction of each movement. Set expectations for student movement before the activity begins.

- We are pinballs! Move to the left!
- Move to the right!
- Move toward me!
- Move to the back!
- And take a seat.

2. Introduce students' role as engineers. Let students know that to figure out how to make a pinball machine, they will need to think like engineers.

- There are different kinds of engineers that you might have heard about. One kind of engineer drives a train. You are going to be thinking and working as a different kind of engineer—an engineer who who makes things to solve problems.

3. Introduce What Engineers Do chart. Let students know you will be using this chart to talk about what engineers do and to show how students will be working as engineers. Point to the chart as you read.

- One thing engineers do is find out about a problem.

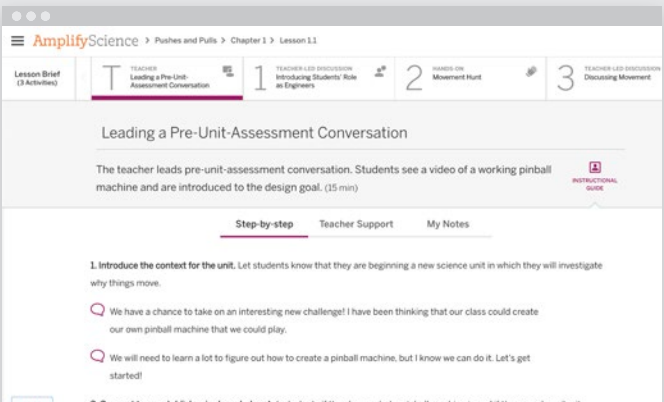
Find the Instructional Guide for Lesson 1.1 in the exemplar Teacher's Guide included in your sample.

The Instructional Guide contains step-by-step instructions for teachers, including teacher talk and discussion prompts.

In Lesson 1.1, students are introduced to the goal of designing a pinball machine for the class, motivating students to engage in working toward a solution to this problem. Students are also introduced to their role as engineers and to the chapter and investigation questions in order to focus their first investigation.

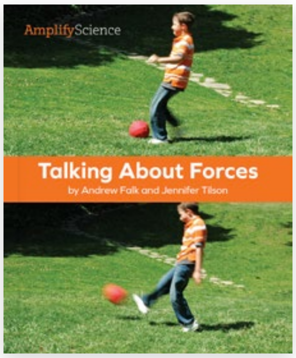
GO ONLINE

To access the Instructional Guide in the digital Teacher's Guide, click on any activity within a Lesson.



Walkthrough progress PLAN TEACH ASSESS

Student sample page: Student Book



Find the Student Book *Talking About Forces* in your sample and turn to page 7.

In Lesson 1.2, students practice speaking and writing about the relationship between force and motion in an activity where they look at everyday actions and note how they are connected to one another.

Then, in a Read-Aloud of the Student Book *Talking About Forces*, students are introduced to scientific language regarding the movements they have been exploring. They practice discussing pushes and pulls in terms of exerting forces and note how the because language frame helps explain what they have noticed about starting movement.

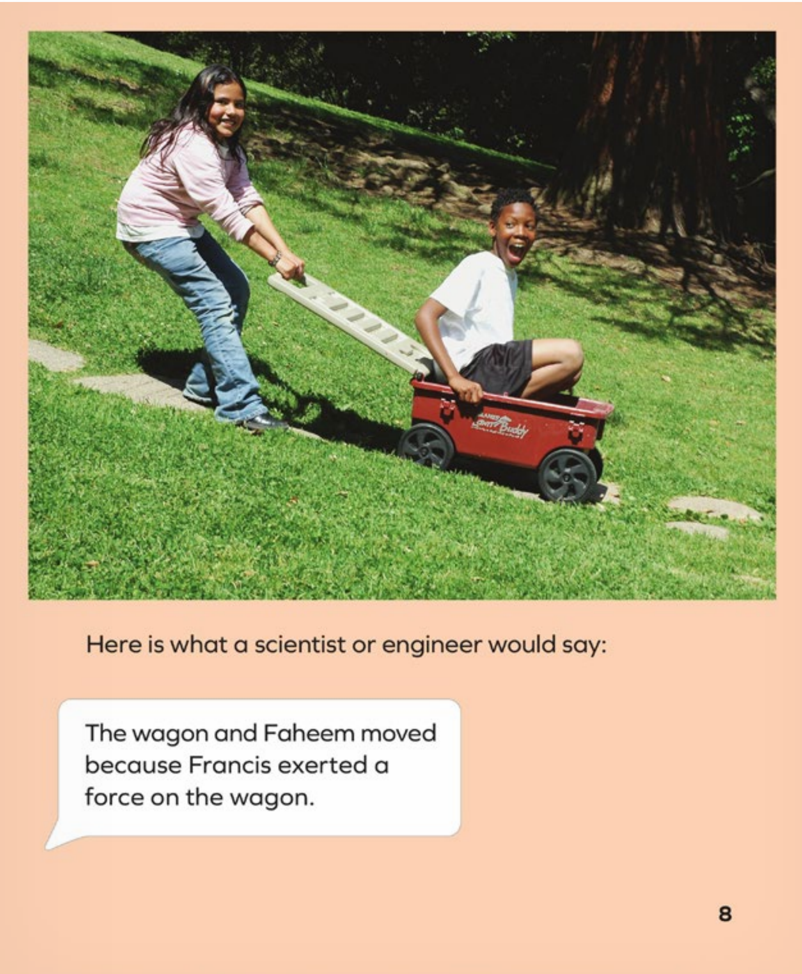
Faheem jumped into the wagon and asked for a ride. Francis pulled on the handle of the wagon, and the wagon rolled up the hill with Faheem in it!

What would a scientist or engineer say happened here?

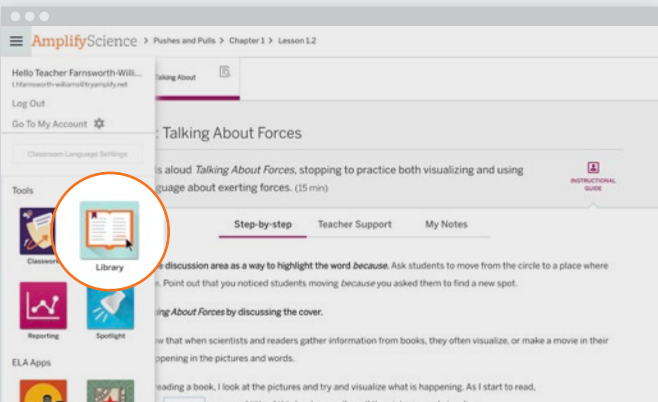
7

GO ONLINE

Student Books are accessible digitally via the Library in the Global Navigation Menu on the left side of the screen.



Classroom Slides, Lesson 1.2



Walkthrough progress PLAN TEACH ASSESS

Student sample pages: Diagramming and writing

Find the *Pushes and Pulls* Student Investigation Notebook in your sample and turn to page 6.

By Lesson 2.3, students have created Box Models and begun to iterate on the design of the Class Pinball Machine.

In Lesson 2.3, students use their Investigation Notebooks to create diagrams of the changes made to Box Models they have created. This helps students make sense of how they made a ball travel a short or long distance and provides a record of the changes for students to refer to later in the unit.

Name: ______________________ Date: __________

Box Model Diagram:
Drawing the Ball Moving a Short Distance

Directions:

1. Draw the launcher in orange.

2. Draw the shoelace in black.

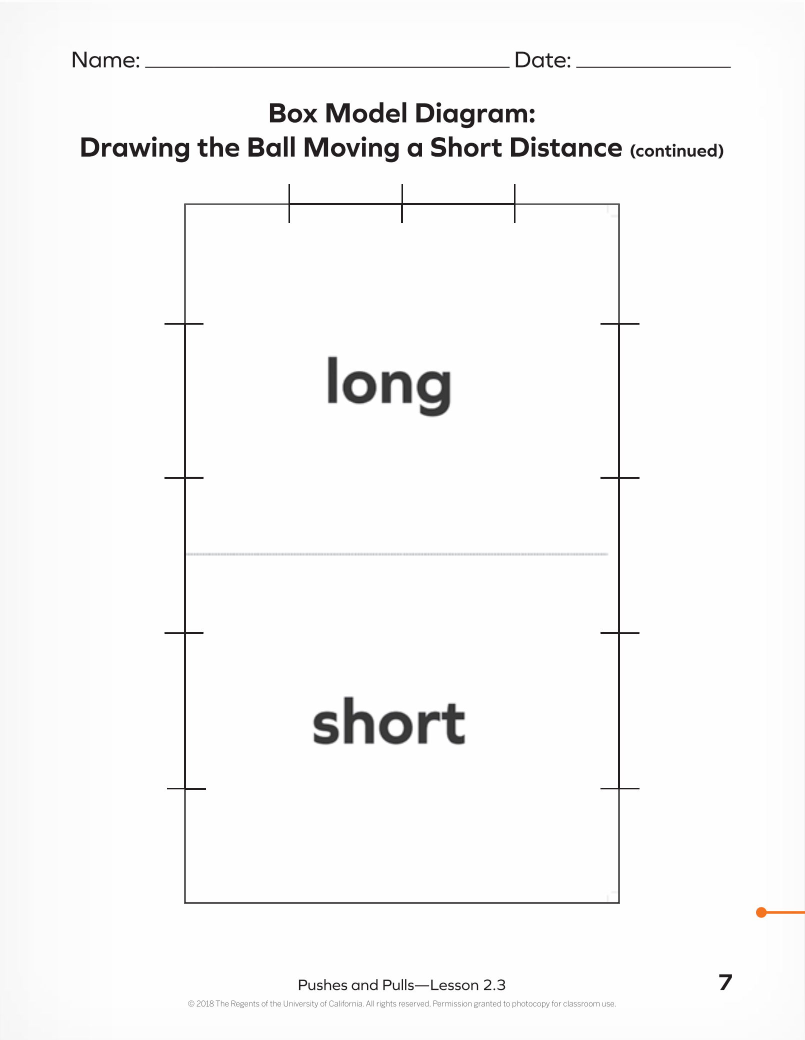
3. Draw the ball.

4. Draw how the ball moved.

6 Pushes and Pulls—Lesson 2.3

GO ONLINE

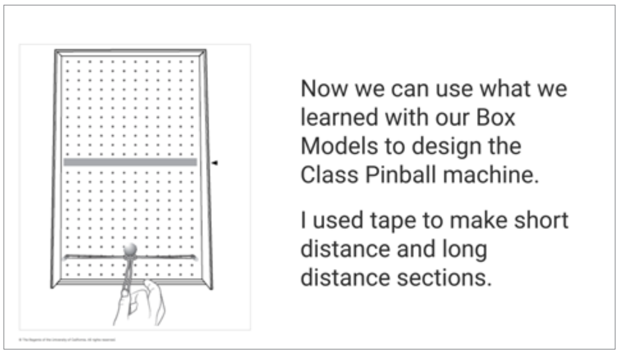
The full Student Investigation Notebook can be accessed digitally from the Printable Resources section of the Unit Guide.



Name: ______________________ Date: __________

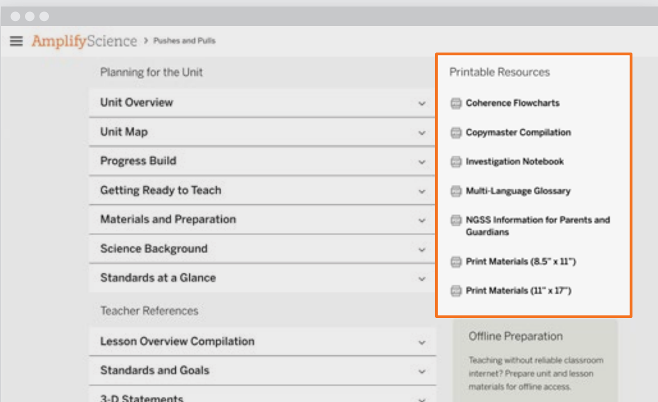
Box Model Diagram:
Drawing the Ball Moving a Short Distance (continued)

Pushes and Pulls—Lesson 2.3 7



Classroom Slides, Lesson 2.3

Students also participate in a shared writing activity to explain how strong and gentle forces move a pinball different distances.



Walkthrough progress PLAN TEACH ASSESS

Teacher sample page: Video

Lesson 3.1
Teacher Activity

Pushes and Pulls
Lesson Guides

TEACHER
Setting the Context with the Pinball Video

Setting the Context with the Pinball Video

5 MIN

The class watches the *Pinball* video and discusses the different places the pinball moved. The Chapter 3 Question is also introduced.

Instructional Guide

1. **Revisit students' role as pinball engineers.** Remind students of their work so far as engineers. Ask if they remember what problem they are working to design a solution for. [Making a pinball machine that does all the things they want it to do.]

2. **Review the *Pinball* video.** Point out that they first watched this video and focused on how the pinball started to move.

Why did the pinball start to move in the video?
[The launcher pushed it. The launcher exerted a force on the pinball.]

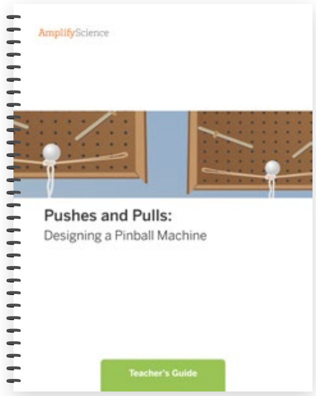
Then, mention that they watched the video a second time and focused on how the pinball moved different distances.

Why did the pinball move a short distance?
[The launcher gave a gentle push. The launcher exerted a gentle force.]

Why did the pinball move a long distance?
[The launcher gave a strong push. The launcher exerted a strong force.]

3. **Connect observing the video to asking a new question.** Model posing a new question based on where the pinball moved in the pinball machine.

We know engineers ask questions. Sometimes new questions come from their observations.



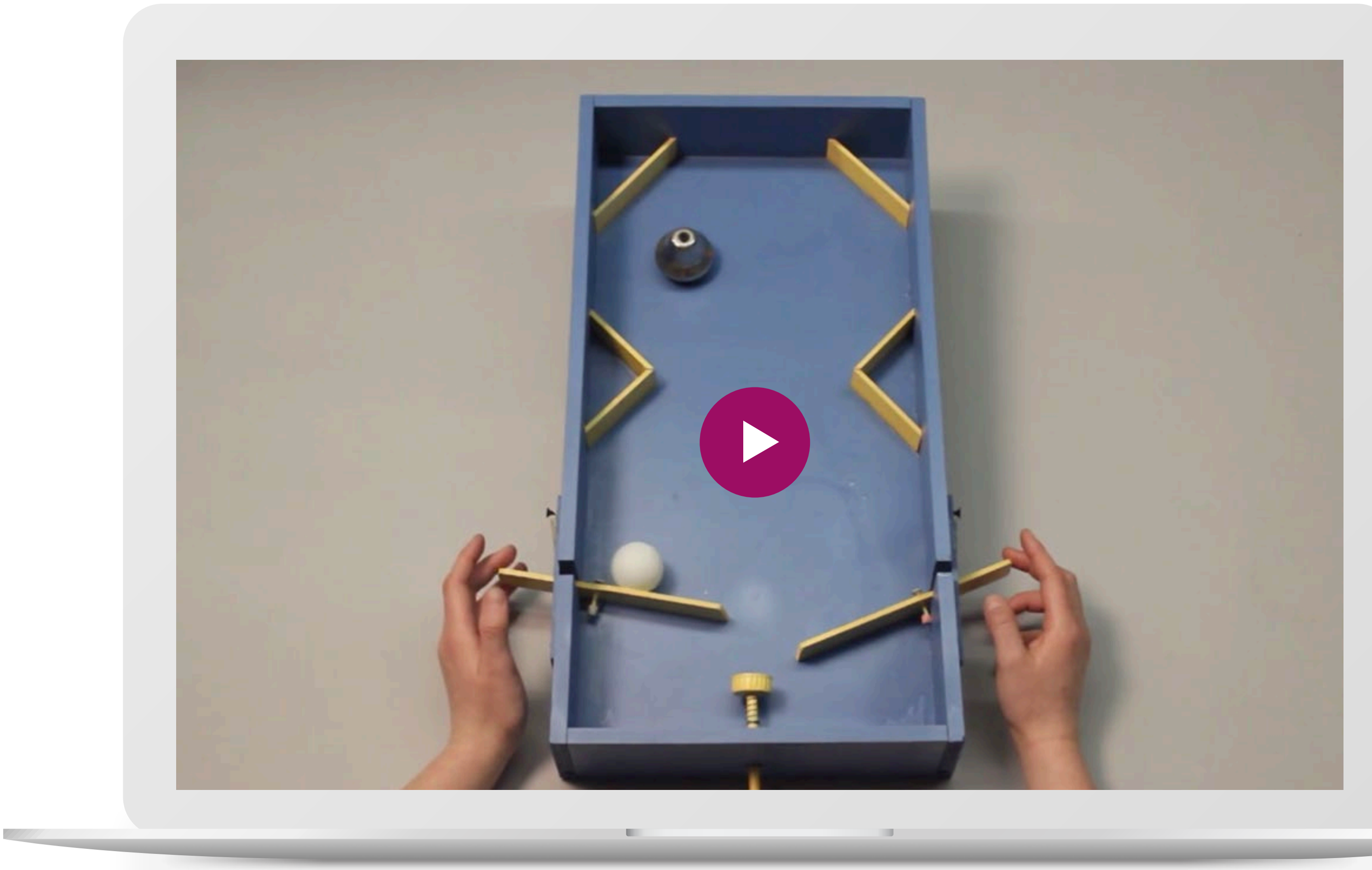
Turn to the Instructional Guide for Lesson 3.1 in the exemplar Teacher's Guide included in your sample.

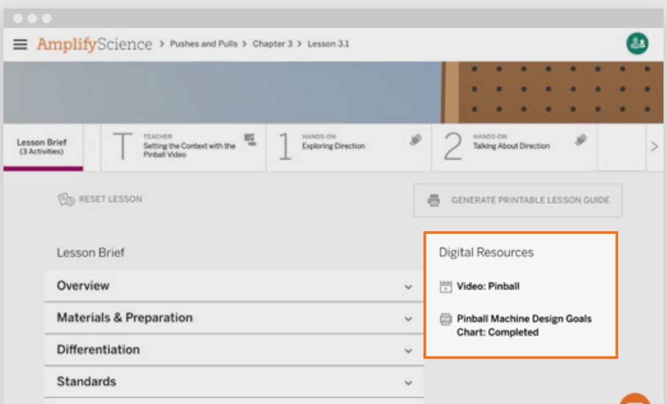
In Lesson 3.1, students watch the *Pinball* video to discuss how a pinball moves to different places. This discussion provides the context for the Chapter 3 question, *How do we make a pinball move to a certain place?*, and for what students will work to figure out in the chapter: Exerting a force of a particular strength and direction will move objects to a specific location.

After the video, students engage in a hands-on activity. In groups of three, students roll a tennis ball to one another as they discuss the different directions they are moving the ball.

GO ONLINE

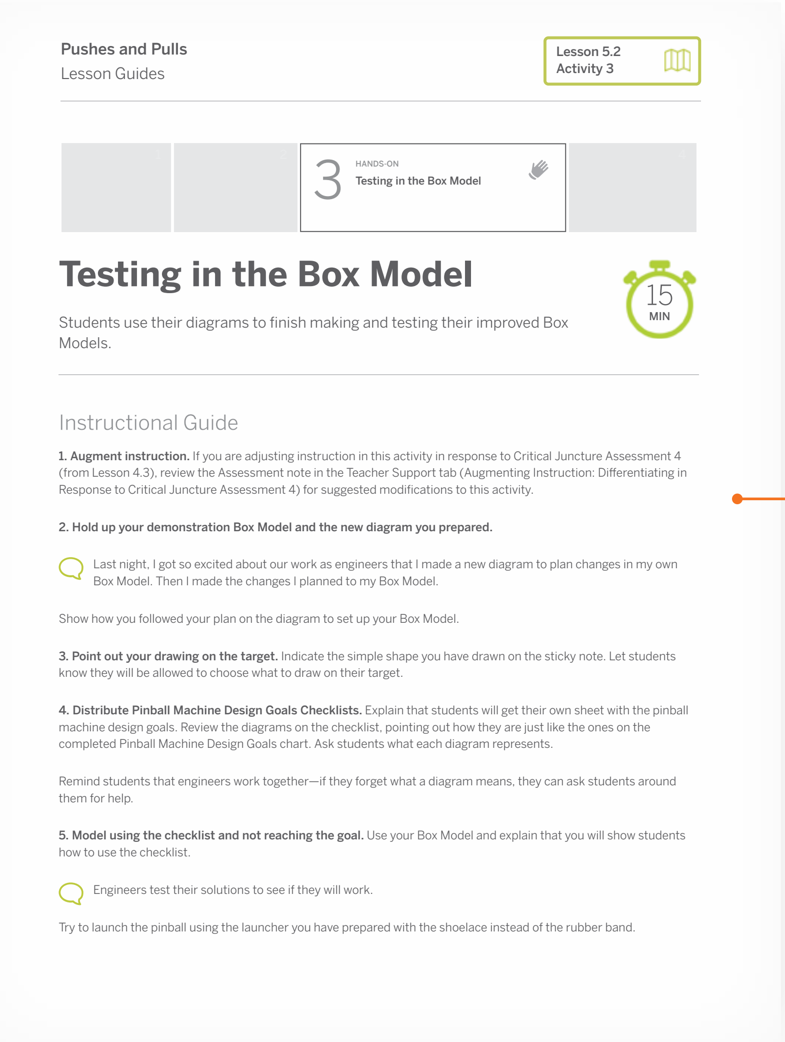
Videos can be downloaded before class from the Digital Resources section of the Lesson Brief. They can also be launched directly from the lesson's Instructional Guide.




AmplifyScience > Pushes and Pulls > Chapter 3 > Lesson 3.1
Lesson Brief (3 Activities)
T TEACHER Setting the Context with the Pinball Video
1 HANDS-ON Exploring Direction
2 HANDS-ON Talking About Direction
RESET LESSON
GENERATE PRINTABLE LESSON GUIDE
Lesson Brief
Overview
Materials & Preparation
Differentiation
Standards
Digital Resources
Video: Pinball
Pinball Machine Design Goals Chart: Completed

Walkthrough progress PLAN TEACH ASSESS

Teacher sample page: Hands-on activity



Pushes and Pulls
Lesson Guides

Lesson 5.2
Activity 3

3 HANDS-ON
Testing in the Box Model

Testing in the Box Model

15 MIN

Students use their diagrams to finish making and testing their improved Box Models.

Instructional Guide

1. **Augment instruction.** If you are adjusting instruction in this activity in response to Critical Juncture Assessment 4 (from Lesson 4.3), review the Assessment note in the Teacher Support tab (Augmenting Instruction: Differentiating in Response to Critical Juncture Assessment 4) for suggested modifications to this activity.

2. **Hold up your demonstration Box Model and the new diagram you prepared.**

Last night, I got so excited about our work as engineers that I made a new diagram to plan changes in my own Box Model. Then I made the changes I planned to my Box Model.

Show how you followed your plan on the diagram to set up your Box Model.

3. **Point out your drawing on the target.** Indicate the simple shape you have drawn on the sticky note. Let students know they will be allowed to choose what to draw on their target.

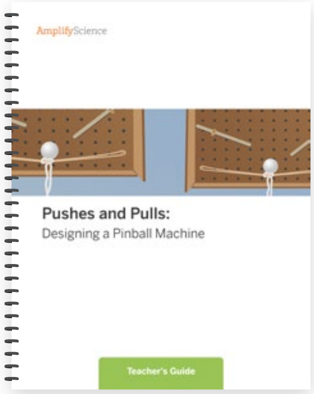
4. **Distribute Pinball Machine Design Goals Checklists.** Explain that students will get their own sheet with the pinball machine design goals. Review the diagrams on the checklist, pointing out how they are just like the ones on the completed Pinball Machine Design Goals chart. Ask students what each diagram represents.

Remind students that engineers work together—if they forget what a diagram means, they can ask students around them for help.

5. **Model using the checklist and not reaching the goal.** Use your Box Model and explain that you will show students how to use the checklist.

Engineers test their solutions to see if they will work.

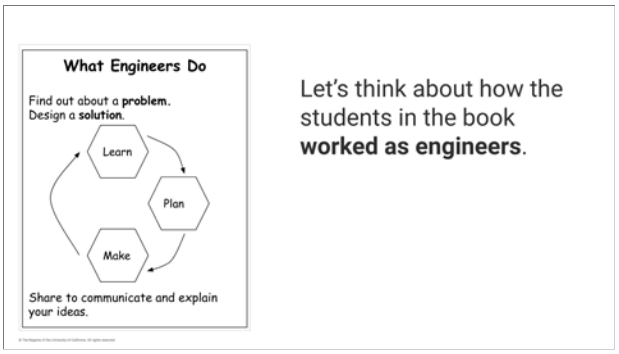
Try to launch the pinball using the launcher you have prepared with the shoelace instead of the rubber band.



Turn to the Instructional Guide for Lesson 5.2 in the exemplar print Teacher's Guide included in your sample.

In Lesson 5.2, students are ready to test their Box Model designs. Students use a ball to test all of the features they planned and made in their Box Model, making changes along the way. They make improvements so that their solution meets each goal on the provided Pinball Machine Design Goals chart.

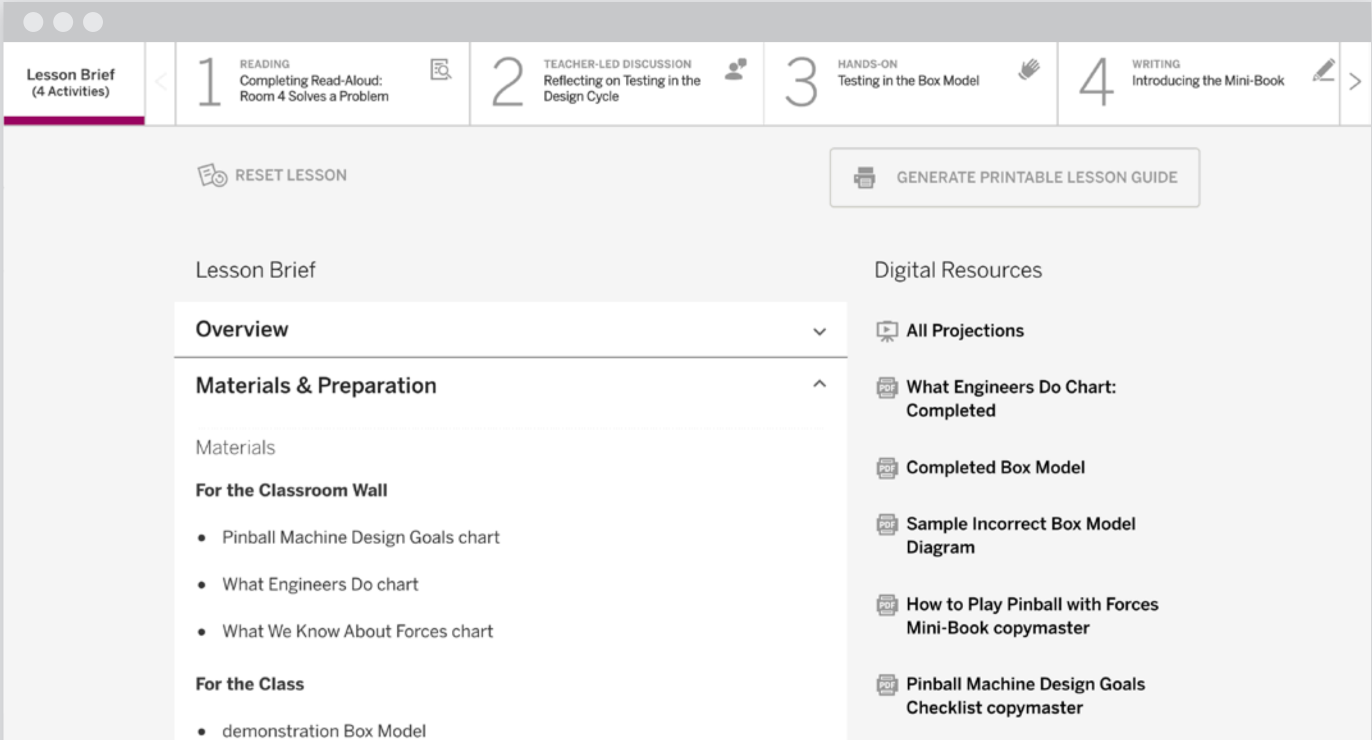
In the next lesson, students gain a sense of closure and accomplishment by sharing their Box Model with their peers.



Classroom Slides, Lesson 5.2

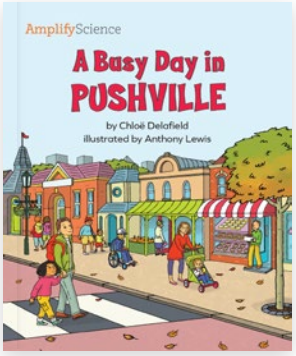
GO ONLINE

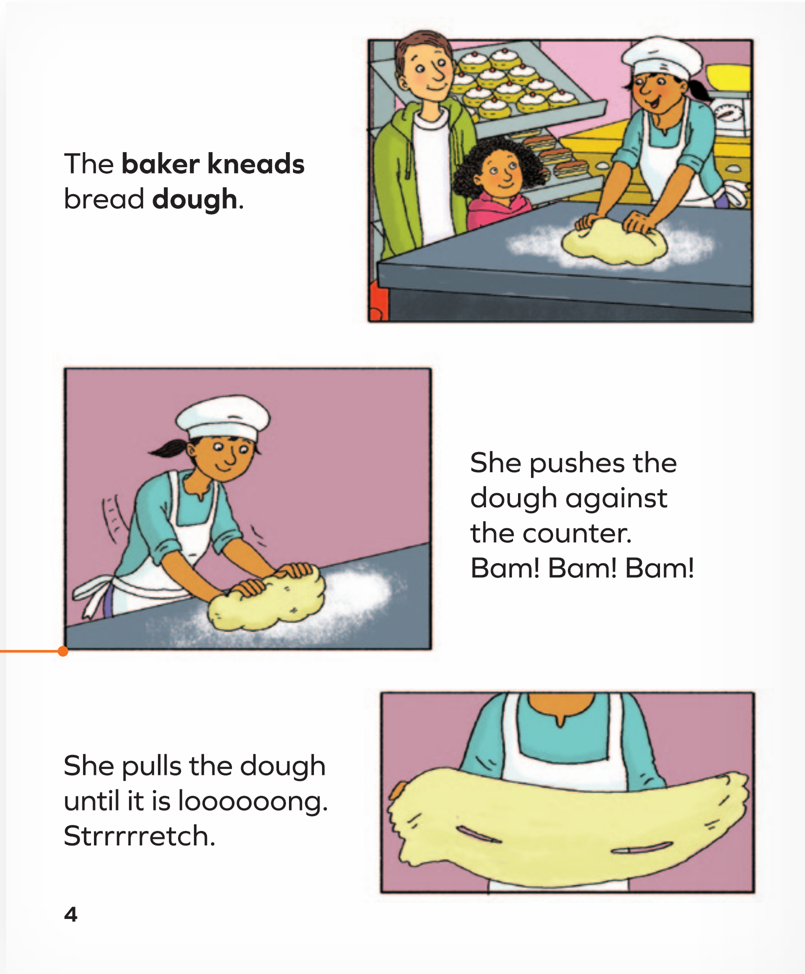
The Lesson Guide for each lesson includes a Materials & Preparation section, which details materials needed for that lesson and information on how to set up your classroom for the lesson.



Walkthrough progress PLAN TEACH ASSESS

Student sample pages: Student Book





Find the *A Busy Day in Pushville* Student Book included in your sample and turn to page 4.

In Lesson 6.2, a shared reading activity provides students the opportunity to describe with partners the different kinds of forces—left, right, strong, and gentle—that they find in the illustrations and text of *A Busy Day in Pushville*.

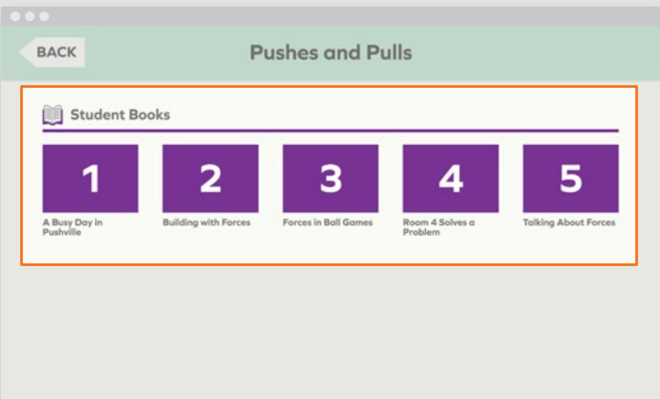
GO ONLINE

All Student Books for a unit are accessible on the Elementary Student Apps page, which is accessible via the Global Navigation Menu on the left side of the screen.

Classroom Slides, Lesson 6.2

Pulling together their ideas from the whole unit, students explain that objects started moving, moved a certain distance, or moved a certain direction because of the force exerted.

Lesson 6.2 ends with a student-to-student discussion with students consolidating their understanding of forces and motion by reflecting on artifacts and learning activities from each chapter of the unit.



Walkthrough progress PLAN TEACH ASSESS

Teacher sample page: End-of-Unit Assessment

Pushes and Pulls
Lesson Guides

Lesson 6.3
Activity 1

1 TEACHER-LED DISCUSSION
Talking with Students About the Pinball's Movement

Talking with Students About the Pinball's Movement

The teacher meets with students individually and plays Class Pinball Machine. Students explain how different movements are caused by forces.

Instructional Guide

1. **Have students sit with you, one at a time, with the Class Pinball Machine between you.**

2. **Introduce the task—talking about forces exerted on the pinball.** Point to the Class Pinball Machine.

We have learned a lot about how different kinds of forces make things, like the pinball, move in different ways. I am going to make the pinball move in our Class Pinball Machine, and I would like you to think and talk to me about the forces that are making the ball move.

3. **Launch the pinball so it moves in two different ways.**

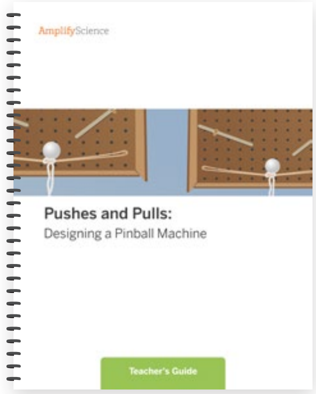
- **First launch:** Use the launcher to launch the pinball very gently to the right, making it move a short distance but not reach any of the bumpers.
- **Describe and trace the movement.** Trace the path of the pinball with your finger as you describe what you did.

We saw the pinball move a short distance toward this side of the pinball machine, and then it stopped.

- **Second launch:** Launch the pinball a second time so it moves to the left, hits the bumper, and bounces off in another direction.
- **Describe and trace the movement.** Trace the path of the pinball with your finger as you describe what you did.

We saw the pinball move a long distance toward the other side, then it moved this way, and then it stopped.

4. **Prompt the student to explain the forces that were exerted.**

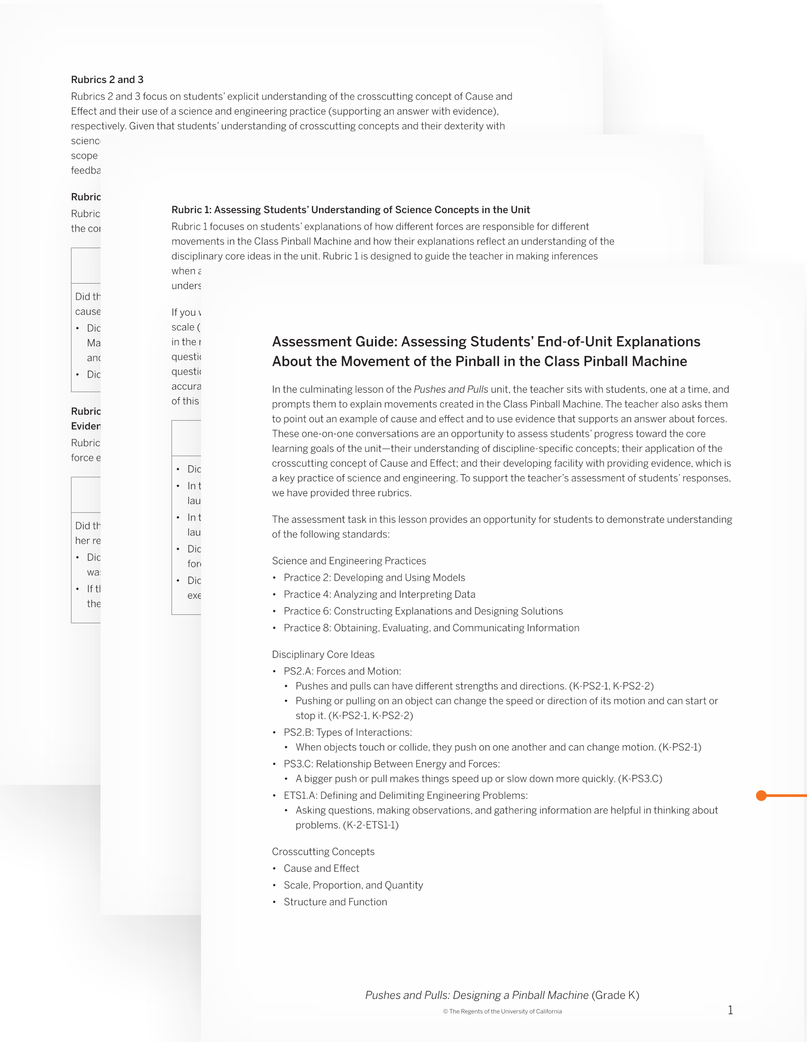


Find the Instructional Guide for Lesson 6.3 in the exemplar Teacher's Guide included in your sample.

The unit ends with an End-of-Unit Assessment in which the teacher meets with students individually and plays the Class Pinball Machine. Students explain how the different movements are caused by different forces and then identify cause and effect.

GO ONLINE

Navigate to the Lesson Brief for Lesson 6.3 and download the Assessment Guide from the Digital Resources section on the right side of your screen.



Rubrics 2 and 3

Rubrics 2 and 3 focus on students' explicit understanding of the crosscutting concept of Cause and Effect and their use of a science and engineering practice (supporting an answer with evidence), respectively. Given that students' understanding of crosscutting concepts and their dexterity with

Rubric 1: Assessing Students' Understanding of Science Concepts in the Unit

Rubric 1 focuses on students' explanations of how different forces are responsible for different movements in the Class Pinball Machine and how their explanations reflect an understanding of the disciplinary core ideas in the unit. Rubric 1 is designed to guide the teacher in making inferences

Assessment Guide: Assessing Students' End-of-Unit Explanations About the Movement of the Pinball in the Class Pinball Machine

In the culminating lesson of the *Pushes and Pulls* unit, the teacher sits with students, one at a time, and prompts them to explain movements created in the Class Pinball Machine. The teacher also asks them to point out an example of cause and effect and to use evidence that supports an answer about forces. These one-on-one conversations are an opportunity to assess students' progress toward the core learning goals of the unit—their understanding of discipline-specific concepts; their application of the crosscutting concept of Cause and Effect; and their developing facility with providing evidence, which is a key practice of science and engineering. To support the teacher's assessment of students' responses, we have provided three rubrics.

The assessment task in this lesson provides an opportunity for students to demonstrate understanding of the following standards:

Science and Engineering Practices
- Practice 2: Developing and Using Models
- Practice 4: Analyzing and Interpreting Data
- Practice 6: Constructing Explanations and Designing Solutions
- Practice 8: Obtaining, Evaluating, and Communicating Information

Disciplinary Core Ideas
- PS2.A: Forces and Motion:
  - Pushes and pulls can have different strengths and directions. (K-PS2-1, K-PS2-2)
  - Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1, K-PS2-2)
- PS2.B: Types of Interactions:
  - When objects touch or collide, they push on one another and can change motion. (K-PS2-1)
- PS3.C: Relationship Between Energy and Forces:
  - A bigger push or pull makes things speed up or slow down more quickly. (K-PS3.C)
- ETS1.A: Defining and Delimiting Engineering Problems:
  - Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)

Crosscutting Concepts
- Cause and Effect
- Scale, Proportion, and Quantity
- Structure and Function

Pushes and Pulls: Designing a Pinball Machine (Grade K) 1

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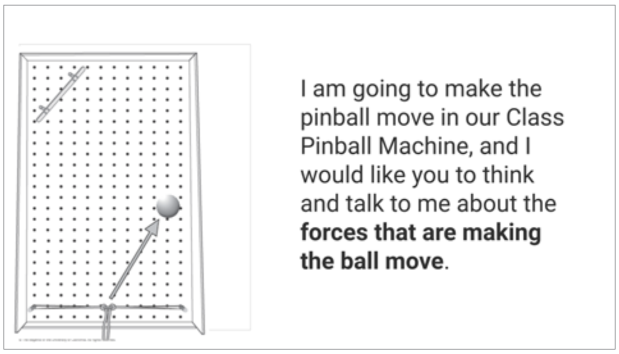
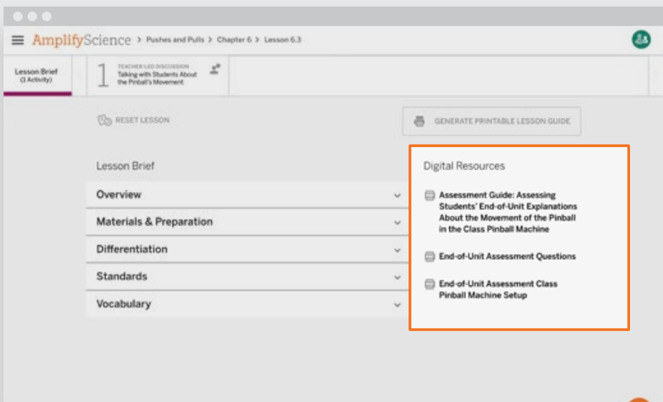


Classroom Slides, Lesson 6.3

For this assessment, rubrics are provided for assessing students' understanding of:

- science concepts in the unit.
- the crosscutting concept of cause and effect.
- the practice of supporting an answer with evidence.




phenol red
water
The **gardener** pulls on his gardening gloves. He pushes up his sleeves and gets a **rake**.
Then he pulls the rake to drag leaves across the lawn.
8
He pulls the rake again and again to bring all the leaves into a big pile. Then the pile is ready for kids to jump into!
9
START/STOP
LAP
ON/RESET
INDIAN OCEAN

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