START HERE

Amplify Science

Grade 4

Instructional sampler

Amplify.

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Amplify Science

Suggested review experience

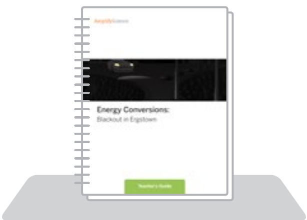
Welcome to Amplify Science! In your program sample, you'll find resources and program materials to help you in your review. We recommend exploring the materials in the following order:

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.

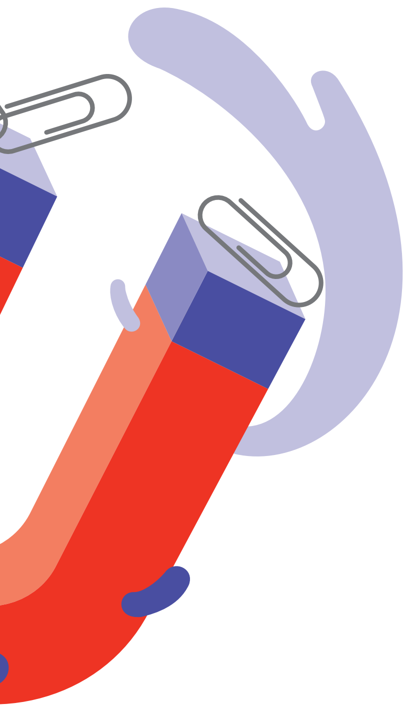
amplify.com/sciencek5

Table of contents

About the program

Engaging materials

In your classroom




Some white sand comes from coral reefs in the ocean. Coral reefs are made of many tiny coral animals stuck together. As the animals die, waves
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:

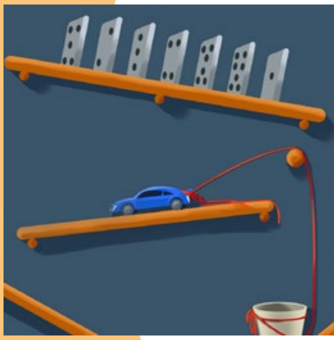
- ✔ **Collect evidence from a variety of sources.**
- ✔ **Make sense of evidence in a variety of ways.**
- ✔ **Formulate convincing scientific arguments.**

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.

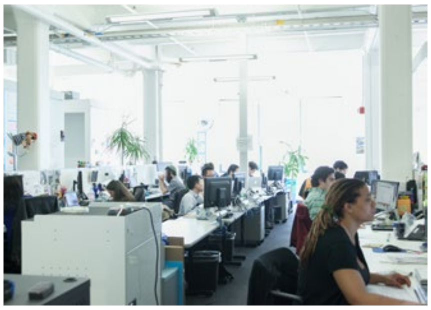


A powerful partnership

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,

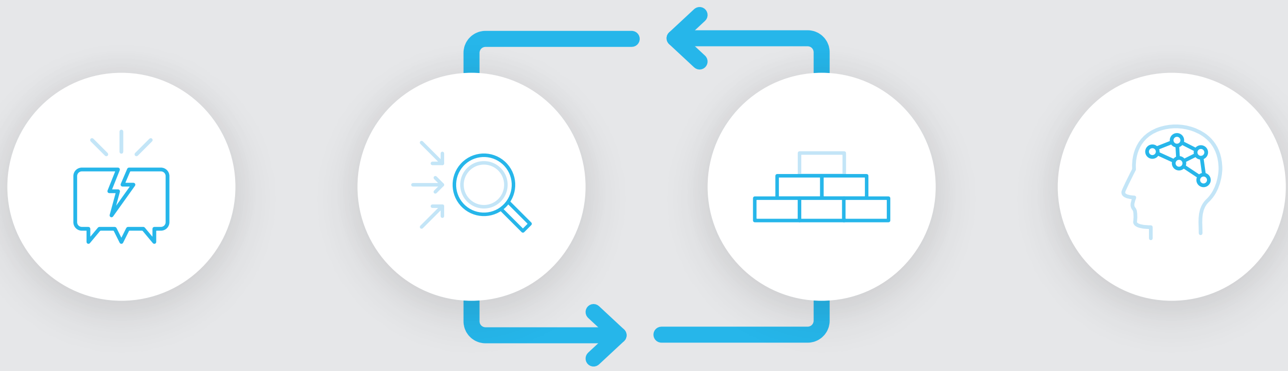
Jacqueline Barber

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

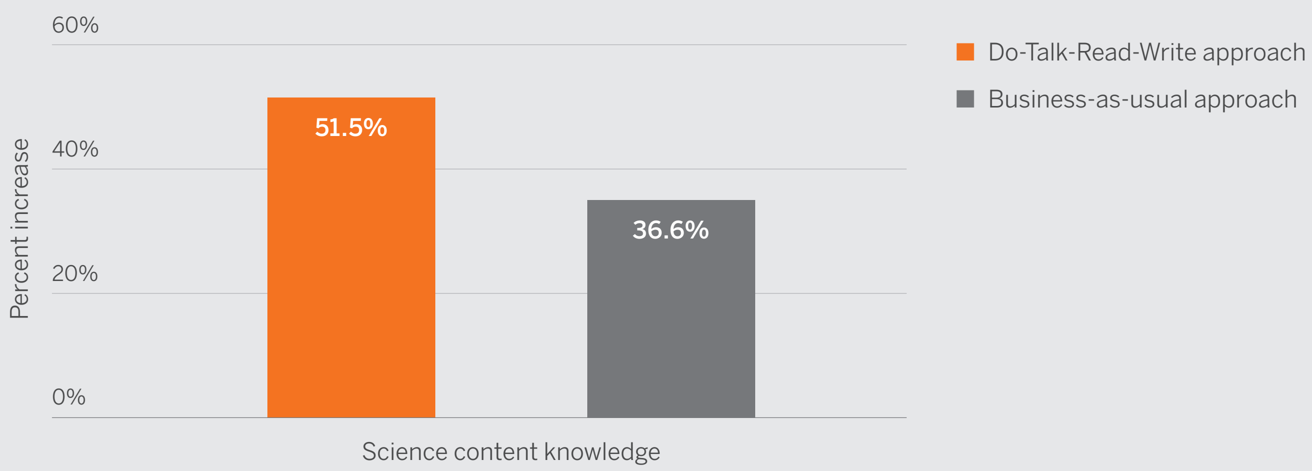
Grounded in research and proven effective

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

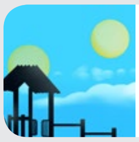
Each unit includes two dedicated assessment days.

Key: (A) Argumentation (E) Engineering Design (I) Investigation (M) Modeling

Kindergarten

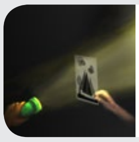

Needs of Plants and Animals
22 lessons (I)


Pushes and Pulls
22 lessons (E)


Sunlight and Weather
22 lessons (M)

Grade 1


Animal and Plant Defenses
22 lessons (M)

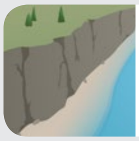

Light and Sound
22 lessons (E)


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

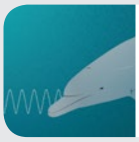

Weather and Climate
22 lessons A

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

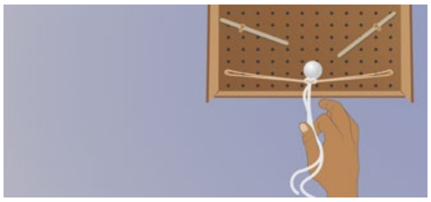

The Earth System
26 lessons E


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

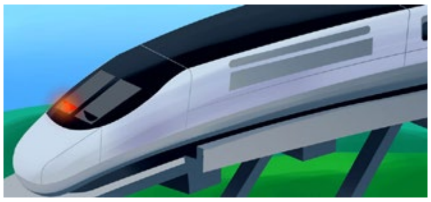
Why is the edge of the ocean cliff closer to the flagpole than it used to be?

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.



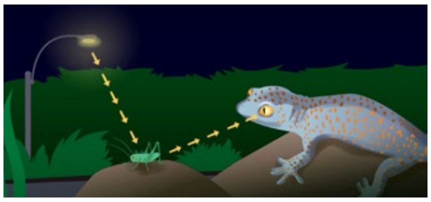
GRADE 3

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.



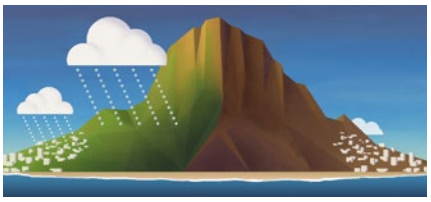
GRADE 4

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

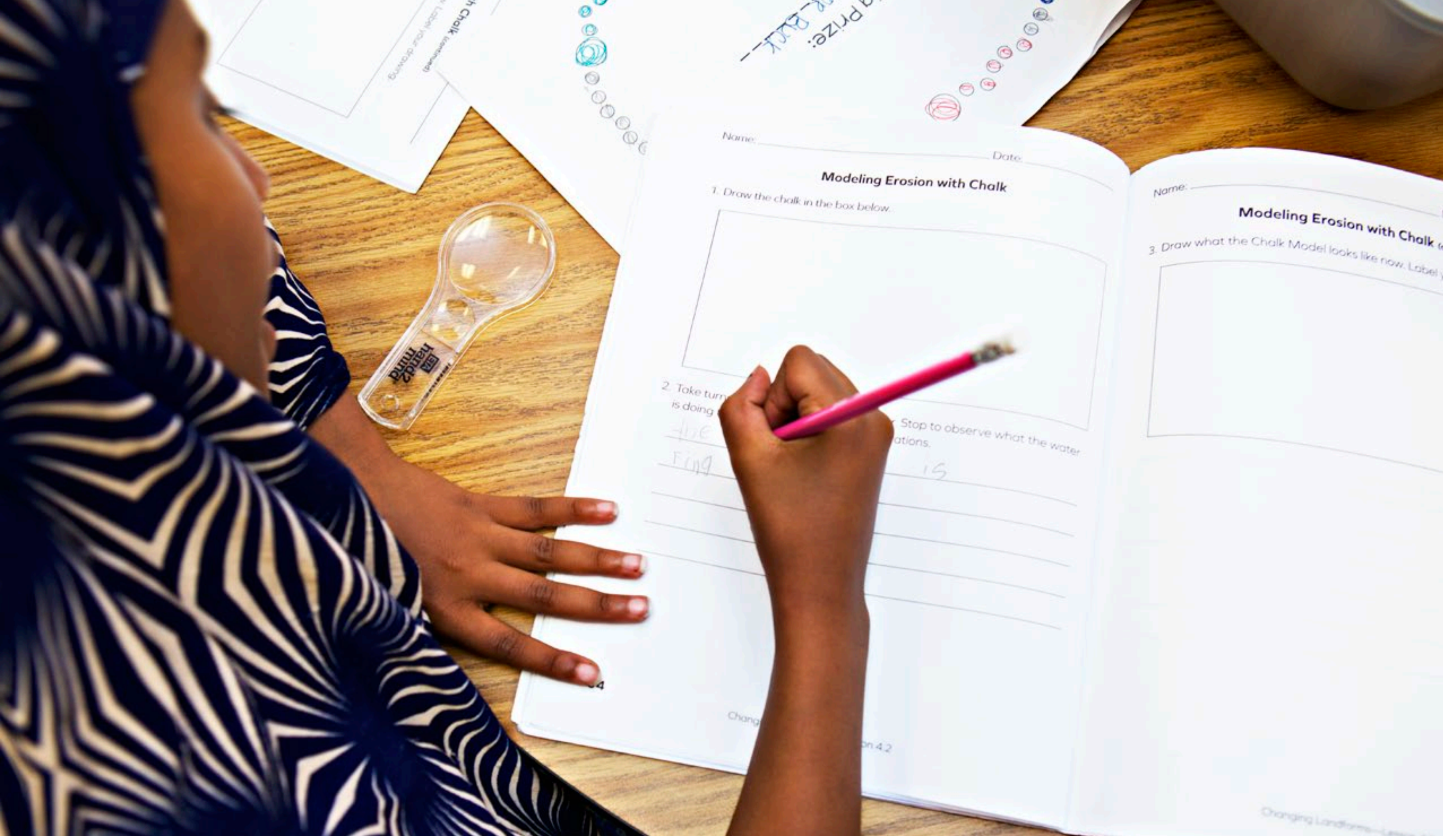
The Amplify Science assessment system is grounded in the principle that students benefit from regular and varied opportunities to demonstrate understanding through performance.

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
Gates 2nd Grade
CB Cart
#17

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.

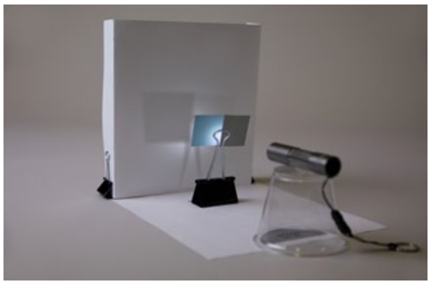
Examples

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.

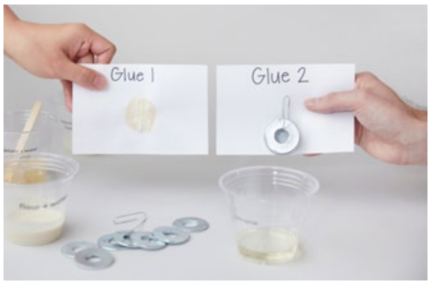


GRADE 1

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.

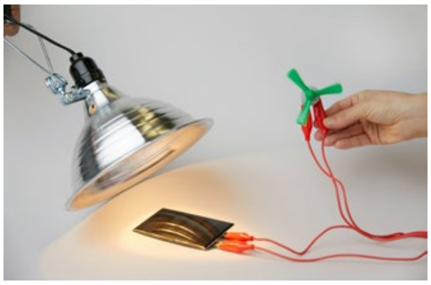
Materials referenced in Hands-on Flextension activities will either be included in the unit kit or are easily sourced. Supporting resources such as student worksheets will be included as downloadable PDF files.

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

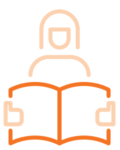
Each unit of Amplify Science K–5 includes five unique Student Books written by the Lawrence Hall of Science specifically for the program. The five books in each unit include one book for approximately every five days of instruction and one reference book that students draw upon throughout the unit.

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

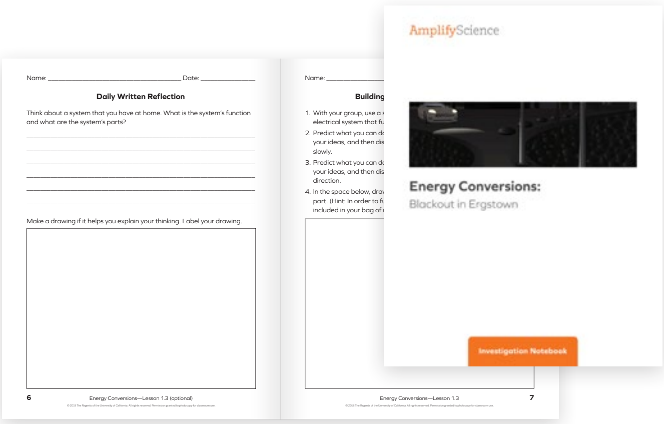
In Partner Reading mode, two students work together to read or gather information from a book. Partner Reading provides opportunities for each student in a pair to be the reader and the supporter while reading a text.

ñ SPANISH LANGUAGE SUPPORT

All Student Books are also available in Spanish.

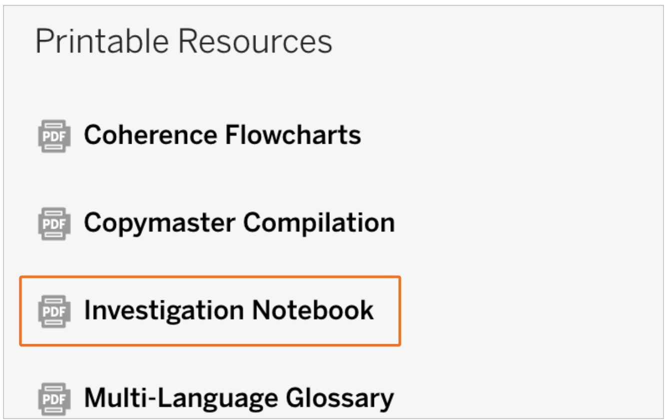
Student Investigation Notebooks

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

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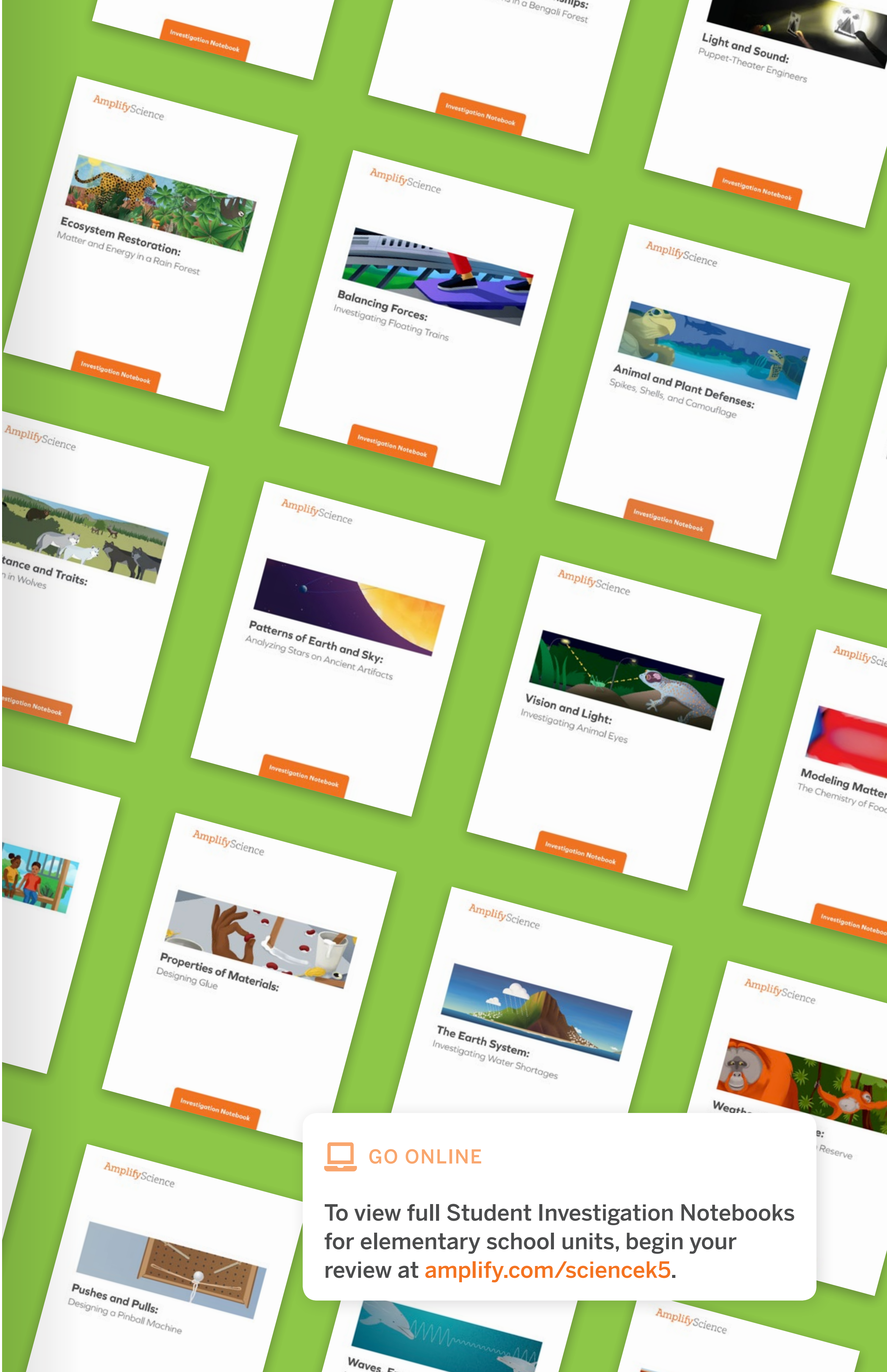


GO ONLINE

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

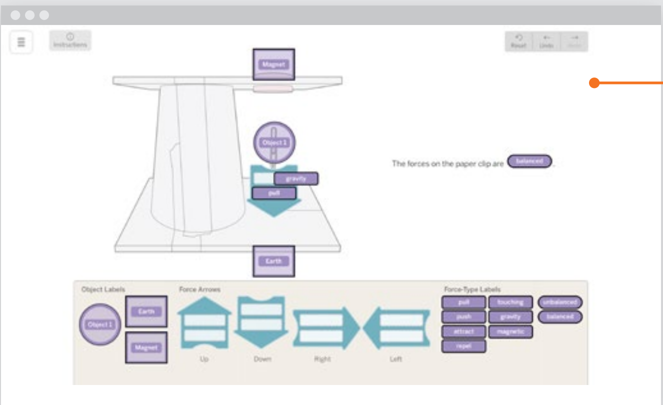
Students in grades 4 and 5 use digital tools and simulations more frequently, with 30-40 percent of lessons including opportunities to use a digital tool.

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

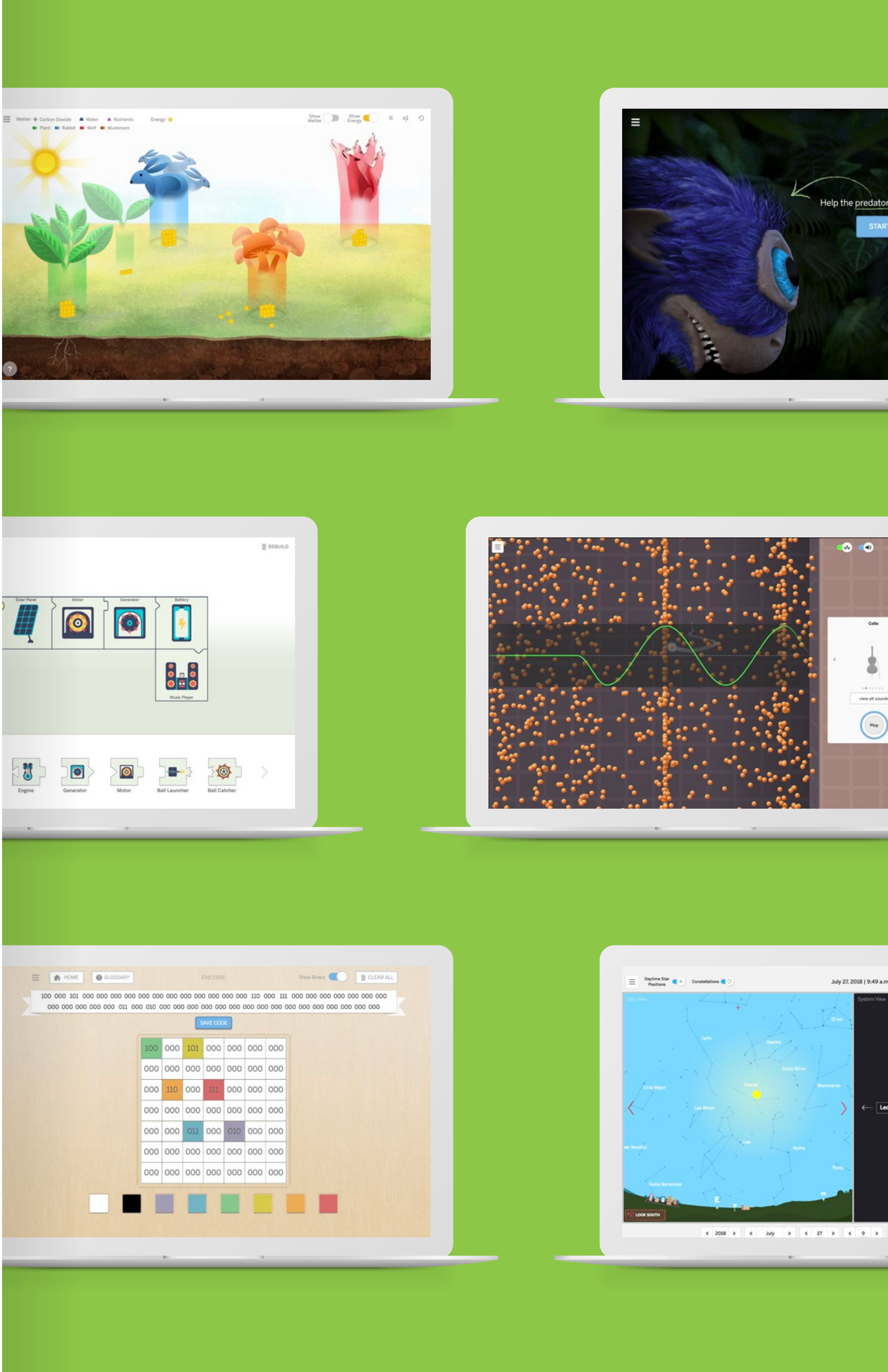
Data Tool

Digital simulations

One unit in grade 3 and all units in grades 4 and 5 include the opportunity to use a unique digital simulation (“Sim”). Sims allow students to explore scientific concepts that might otherwise be invisible or impossible to see with the naked eye.

Much like real scientists do, students will use these computer simulations to gain insight into processes that occur on the microscopic scale, or to speed up processes that might otherwise take thousands or millions of years to observe.

Simulations are just one of several components teachers will use to teach a given scientific concept. The same concepts will be explored through hands-on activities, Student Books written for the unit, classroom discussions, and more. Each of these tools and techniques gives every student multiple opportunities and modalities through which to explore and ultimately figure out the scientific concept. Sims appear in five to nine lessons per unit in the grade 4 and grade 5 units.



Help the predator
REBUILD
Solar Panel
Motor
Generator
Battery
Music Player
Engine
Generator
Motor
Ball Launcher
Ball Catcher
Cello
Play
HOME
GLOSSARY
ENCODE
Show Binary
CLEAR ALL
SAVE CODE
July 27, 2018 | 9:49 a.m
LOOK SOUTH

Teacher’s Guides

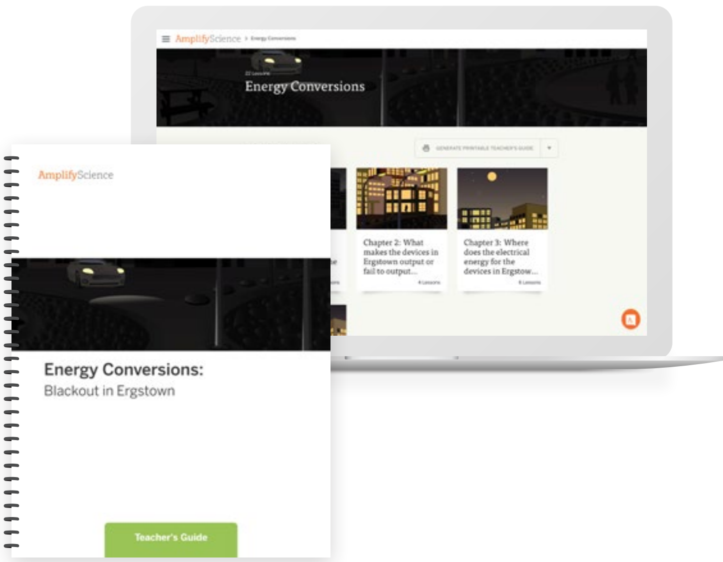
Every unit of Amplify Science includes a comprehensive Teacher’s Guide containing lesson plans, differentiation strategies, and other instructional supports and resources at the unit, lesson, and individual activity levels.

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.



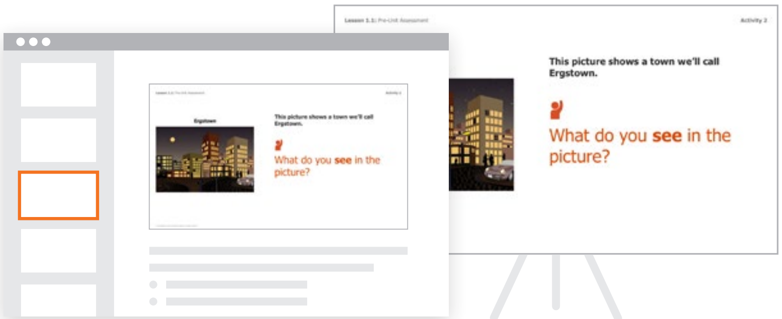
SPANISH LANGUAGE SUPPORT

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.

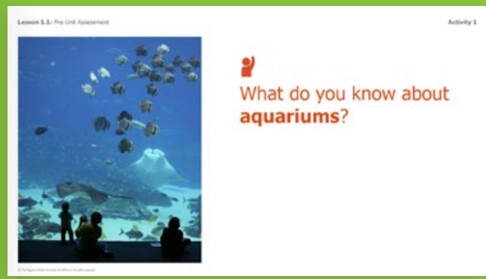
Deliver instruction

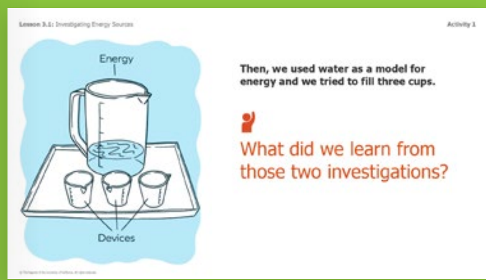


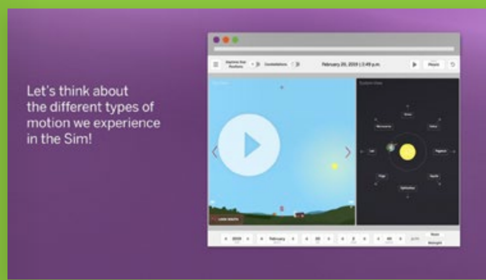
Classroom Slides

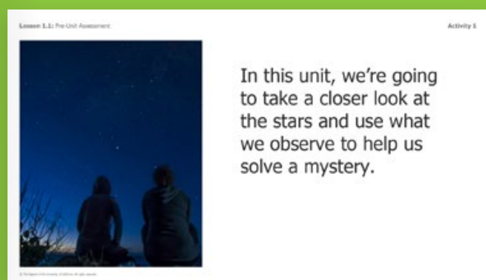
To make planning and delivering instruction faster and easier, Amplify has developed Classroom Slides for all K–5 lessons. Each lesson comes with a downloadable and editable PowerPoint file to help guide teachers and their students through the lesson with clearly-sequenced, engaging, and easy-to-follow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

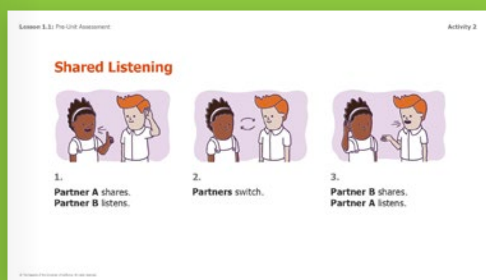
Classroom Slides allow teachers to easily customize their lessons and streamline the in-class presentation experience. Slides take key lesson content—including student-facing questions, teacher prompts, activity transitions, and visuals—and put it in a logical sequence. At any time, teachers can feel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









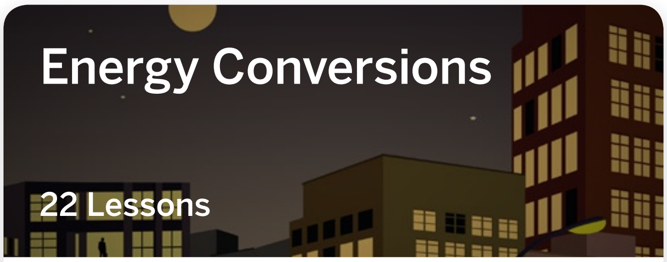


In your classroom

Grade 4: Year at a glance

Grade 4 in Amplify Science contains four units, each containing 22 total lessons: 20 60-minute lessons and two dedicated assessment days.

Energy Conversions



22 Lessons

20 60-minute lessons
2 dedicated assessment days
Engineering design focus

In *Energy Conversions: Blackout in Ergstown*, students learn about how energy is converted from one form to another, how it can be transferred from place to place, and the variety of energy sources that exist.

Student role and phenomena

Students take on the role of systems engineers for Ergstown, a fictional town that experiences frequent blackouts, the anchor phenomenon for the unit. Throughout the unit, they explore reasons why an electrical system may fail.

Insights

As they work to solve the problem of blackouts in Ergstown, students will use and construct devices that convert energy from one form to another, build an understanding of the electrical system, and learn to identify energy forms all around them.

Focal NGSS Performance Expectations:
4-PS3-1 • 4-PS3-2 • 4-PS3-4 • 4-ESS3-1
3-5 ETS1-1 • 3-5 ETS1-2 • 3-5 ETS1-3

Vision and Light

22 Lessons

20 60-minute lessons
2 dedicated assessment days
Investigation focus

In the *Vision and Light: Investigating Animal Eyes* unit, students investigate the role that animal senses, primarily vision, play in survival as they try to understand a realistic fictional problem with a real organism.

Student role and phenomena

Students assume the role of conservation biologists, working to figure out why a population of Tokay geckos has decreased since the installation of new highway lights in the rainforest.

Insights

Throughout their investigations, students use an interactive digital simulation, hands-on activities, reading, and discourse as they learn how animal eyes function, discovering that some animals see well in bright light and others see well in low light.

Focal NGSS Performance Expectations:
4-LS1-1 • 4-LS1-2 • 4-PS4-2

Earth’s Features

22 Lessons

20 60-minute lessons
2 dedicated assessment days
Argumentation focus

In the *Earth’s Features: Mystery in Desert Rocks Canyon* unit, students will construct scientific explanations and arguments about how the rocks and fossils in Desert Rocks National Park can be used to infer the environmental history of the area.

Student role and phenomena

Playing the role of geologists, students help the director of Desert Rocks National Park explain how and when a particular fossil formed and how it came to be in its current location.

Insights

Students use books, hands-on investigations, and the Earth’s Features simulation to figure out how fossils and sedimentary rock form and how different sediments build up in different environments, forming different rock in those environments. This helps them learn how to tell the environmental history of a place by observing the rock layers present.

Focal NGSS Performance Expectations:
4-ESS1-1 • 4-ESS2-1 • 4-ESS2-2 • 4-ESS3-2

Waves, Energy, and Information

22 Lessons

20 60-minute lessons
2 dedicated assessment days
Modeling focus

Students engage with several models of sound waves in the *Waves, Energy, and Information* unit to learn about how sound travels through materials and other important characteristics of sound. These models support discovery and understanding of how dolphins use sound to communicate.

Student role and phenomena

Students take on the role of marine scientists investigating how bottlenose dolphin mothers and their calves in the fictional Blue Bay National Park use patterns of sound to communicate across distances.

Insights

Models, as well as informational text and first-hand investigations with sound, help students visualize things that are not possible to see: how sound waves travel at the particle level and how a sound’s volume and pitch correspond to the amplitude and wavelength of the sound wave.

Focal NGSS Performance Expectations:
4-PS3-2 • 4-PS3-3 • 4-PS4-1 • 4-PS4-3
4-ESS3-2

Deep dive: Energy Conversions

Take a closer look at the lessons and activities in the "Energy Conversions" unit.

CHAPTER 1 – DAY 1
Lesson 1.1
Pre-Unit Assessment

DAY 2
Lesson 1.2
Introducing Systems

DAY 3
Lesson 1.3
Exploring Systems

DAY 6
Lesson 1.6
Writing an Argument About the Blackout

CHAPTER 2 – DAY 7
Lesson 2.1
Energy Converters

DAY 8
Lesson 2.2
Energy Past and Present

CHAPTER 3 – DAY 11
Lesson 3.1
Investigating Energy Sources

DAY 12
Lesson 3.2
Converting Energy from Sources

DAY 13
Lesson 3.3
Sunlight and Showers

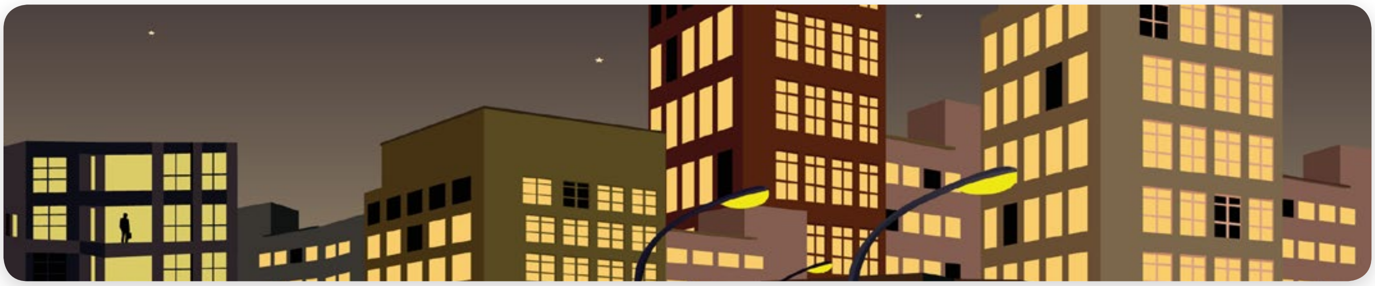
DAY 16
Lesson 3.6
Design Arguments About Converters

CHAPTER 4 – DAY 17
Lesson 4.1
Blackout!

DAY 18
Lesson 4.2
Investigating System Failure

CHAPTER 5 – DAY 21
Lesson 4.5
Arguments for System Improvements

DAY 22
Lesson 4.6
End-of-Unit Assessment



DAY 4
Lesson 1.4
Electrical Energy

DAY 5
Lesson 1.5
Forms of Energy

DAY 9
Lesson 2.3
Energy in the System

DAY 10
Lesson 2.4
Design Arguments About Devices

DAY 14
Lesson 3.4
Designing a Wind Turbine

DAY 15
Lesson 3.5
Redesigning Wind Turbines

DAY 19
Lesson 4.3
Improving the Electrical Grid

DAY 20
Lesson 4.4
System Improvements

Lesson includes a reading activity with Student Books

Lesson includes a hands-on investigation

Lesson includes scientific writing activity

Lesson includes use of digital modeling tools

Dedicated assessment day

Lesson includes a discussion activity

Unit storyline: Energy Conversions

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

The electrical system, our nation's network for producing and delivering electricity from suppliers to consumers, is essential to our lives and increasingly in the news. Understanding this critical system provides a unique context for students to learn about how energy is converted from one form to another, how it can be transferred from place to place, and the variety of energy sources that exist.

In the *Energy Conversions* unit, students take on the role of systems engineers for Ergstown, a fictional town that experiences frequent blackouts, the anchor phenomenon for the unit.

Throughout the unit, they explore reasons why an electrical system may fail. Through firsthand experiences, discourse, reading, writing, and engaging with a digital simulation, students make discoveries about the way electrical systems work. Then, students apply what they have learned as they choose new energy sources and energy converters for the town, using evidence to explain why their choices will make the electrical system more reliable.

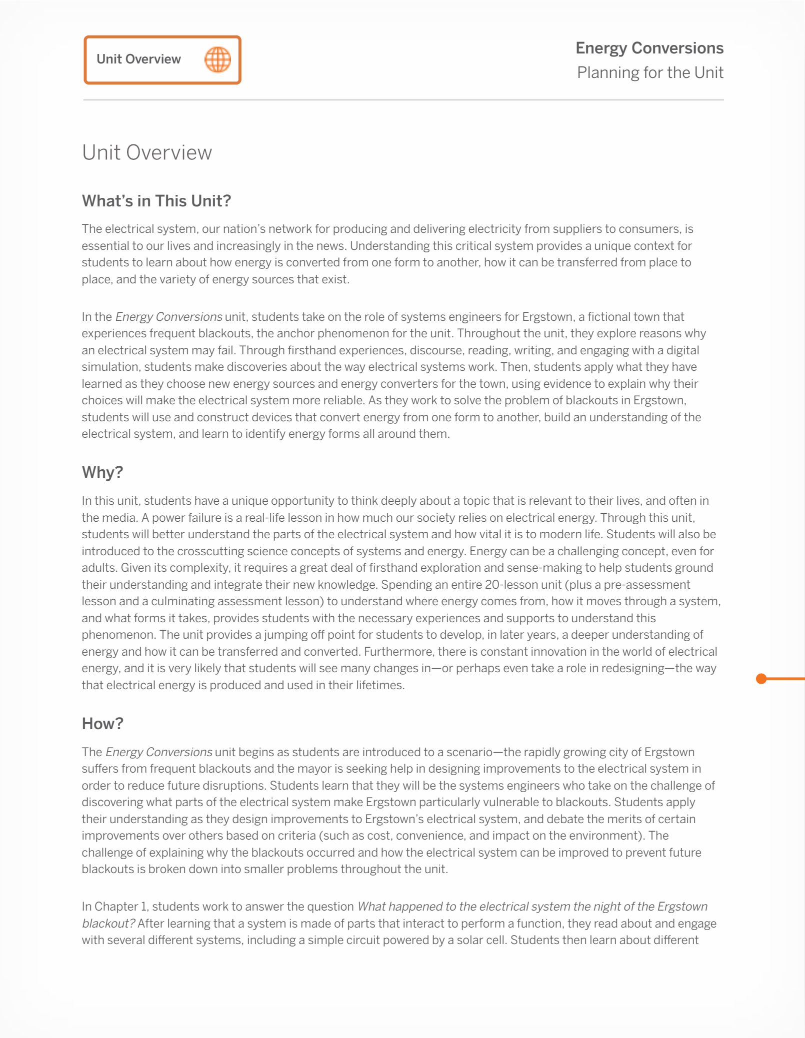
As they work to solve the problem of blackouts in Ergstown, students will use and construct devices that convert energy from one form to another, build an understanding of the electrical system, and learn to identify energy forms all around them.

IN YOUR CLASSROOM

Sample unit walkthrough

Walkthrough progress PLAN TEACH ASSESS

Teacher sample page: Unit Overview



Unit Overview

Energy Conversions
Planning for the Unit

Unit Overview

What's in This Unit?

The electrical system, our nation's network for producing and delivering electricity from suppliers to consumers, is essential to our lives and increasingly in the news. Understanding this critical system provides a unique context for students to learn about how energy is converted from one form to another, how it can be transferred from place to place, and the variety of energy sources that exist.

In the *Energy Conversions* unit, students take on the role of systems engineers for Ergstown, a fictional town that experiences frequent blackouts, the anchor phenomenon for the unit. Throughout the unit, they explore reasons why an electrical system may fail. Through firsthand experiences, discourse, reading, writing, and engaging with a digital simulation, students make discoveries about the way electrical systems work. Then, students apply what they have learned as they choose new energy sources and energy converters for the town, using evidence to explain why their choices will make the electrical system more reliable. As they work to solve the problem of blackouts in Ergstown, students will use and construct devices that convert energy from one form to another, build an understanding of the electrical system, and learn to identify energy forms all around them.

Why?

In this unit, students have a unique opportunity to think deeply about a topic that is relevant to their lives, and often in the media. A power failure is a real-life lesson in how much our society relies on electrical energy. Through this unit, students will better understand the parts of the electrical system and how vital it is to modern life. Students will also be introduced to the crosscutting science concepts of systems and energy. Energy can be a challenging concept, even for adults. Given its complexity, it requires a great deal of firsthand exploration and sense-making to help students ground their understanding and integrate their new knowledge. Spending an entire 20-lesson unit (plus a pre-assessment lesson and a culminating assessment lesson) to understand where energy comes from, how it moves through a system, and what forms it takes, provides students with the necessary experiences and supports to understand this phenomenon. The unit provides a jumping off point for students to develop, in later years, a deeper understanding of energy and how it can be transferred and converted. Furthermore, there is constant innovation in the world of electrical energy, and it is very likely that students will see many changes in—or perhaps even take a role in redesigning—the way that electrical energy is produced and used in their lifetimes.

How?

The *Energy Conversions* unit begins as students are introduced to a scenario—the rapidly growing city of Ergstown suffers from frequent blackouts and the mayor is seeking help in designing improvements to the electrical system in order to reduce future disruptions. Students learn that they will be the systems engineers who take on the challenge of discovering what parts of the electrical system make Ergstown particularly vulnerable to blackouts. Students apply their understanding as they design improvements to Ergstown's electrical system, and debate the merits of certain improvements over others based on criteria (such as cost, convenience, and impact on the environment). The challenge of explaining why the blackouts occurred and how the electrical system can be improved to prevent future blackouts is broken down into smaller problems throughout the unit.

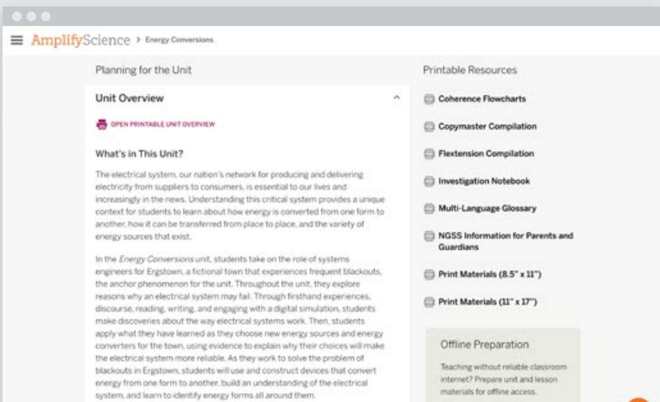
In Chapter 1, students work to answer the question *What happened to the electrical system the night of the Ergstown blackout?* After learning that a system is made of parts that interact to perform a function, they read about and engage with several different systems, including a simple circuit powered by a solar cell. Students then learn about different

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

Unit Map

Energy Conversions
Planning for the Unit

Unit Map

Why does Ergstown keep having blackouts?

Students take on the role of systems engineers for Ergstown, a fictional town that experiences frequent blackouts, and explore the reasons why an electrical system can fail. Students apply what they learn to choosing new energy sources and energy converters for the town, and then they prepare arguments for why their design choices will make the town's electrical system more reliable.

Chapter 1: What happened to the electrical system the night of the Ergstown blackout?

Students figure out: The devices stopped working in Ergstown because they weren't able to get electrical energy from the electrical system. To convert energy to light, heat, motion, or sound, devices need to be plugged into the wall and receive electrical energy. During the blackout, the devices weren't getting this electrical energy.

How they figure it out: Students investigate several different systems, including a simple circuit powered by a solar cell. They review evidence from the blackout and make an argument about what they think caused the blackout.

Chapter 2: What makes the devices in Ergstown output energy or fail to output energy?

Students figure out: Energy isn't created or destroyed. Devices can convert electrical energy to light, heat, motion, or sound when they get electrical energy because these are all forms of energy. When all the devices were running, they caused a blackout. The devices needed more energy from the electrical system than was available. Either the town was using too many devices, or the devices were not energy efficient. If more energy is needed from the electrical system than is available, a blackout can occur.

How they figure it out: Using the *Energy Conversions* Simulation, students explore different ways to convert energy from one form to another. They consider the relationship between the amount of energy used and the amount of energy in the electrical system. Finally, students write their first argument for how to solve the problem of blackouts in Ergstown.

Chapter 3: Where does the electrical energy for the devices in Ergstown come from?

Students figure out: Electrical energy that comes through the electrical grid must have a source and a source converter. There are many possible sources, such as fossil fuels, wind, water, and sunlight. Each source has a converter that changes the energy form of the source to electrical energy. Energy use in Ergstown could have caused a blackout if there wasn't enough energy coming from the source, there weren't enough source converters to convert energy from the source, or the source converters were broken.

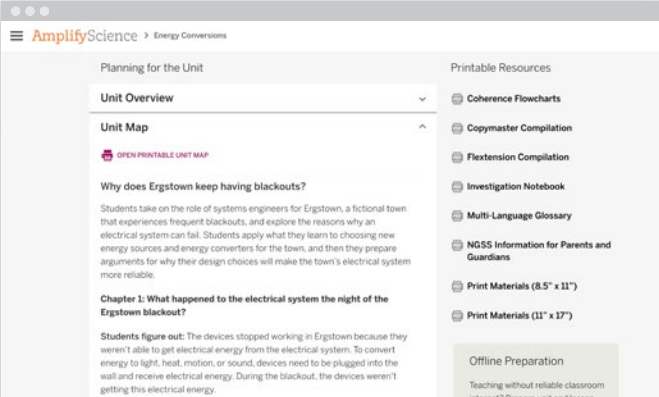
How they figure it out: By investigating why the hospital did not lose power, students discover a variety of energy sources that provide power to Ergstown. They read about solar devices and design and build a wind converter that can power an electrical device. They weigh the strengths and weaknesses of two possible solutions to the problem.

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 2

Energy Conversions
Lesson Guides

2 TEACHER-LED DISCUSSION
Introducing the Problem

Introducing the Problem

15 MIN

Students learn that Ergstown is experiencing frequent blackouts and that in order to prevent them, they must discover how the electrical system can be improved.

Instructional Guide

1. Project Problem with Ergstown: Slide 1 and launch the unit. Discuss the first Ergstown slide.

The unit we're beginning is called *Energy Conversions: Blackout in Ergstown*. In this unit, you will investigate why blackouts occur and come up with solutions to prevent them.

This picture shows a town we'll call Ergstown. What do you see in the picture?

Collect student responses.

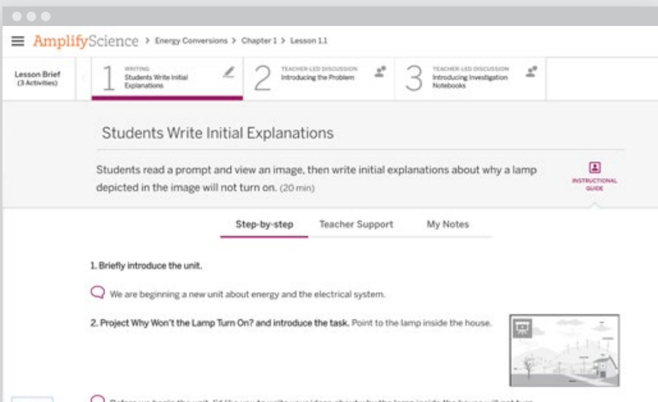
Find the Instructional Guide for Lesson 1.1 in the exemplar Teacher's Guide included in your sample.

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

In Lesson 1.1, students are introduced to their role as systems engineers for the fictional town of Ergstown by reading a message from the town's mayor. Students also view slides of a blackout in Ergstown and are introduced to the problem that they will investigate and design solutions for throughout the unit—how to design improvements to an electrical system in order to prevent future blackouts.

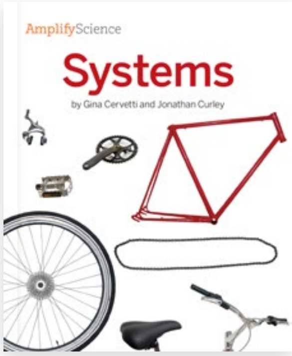
GO ONLINE

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

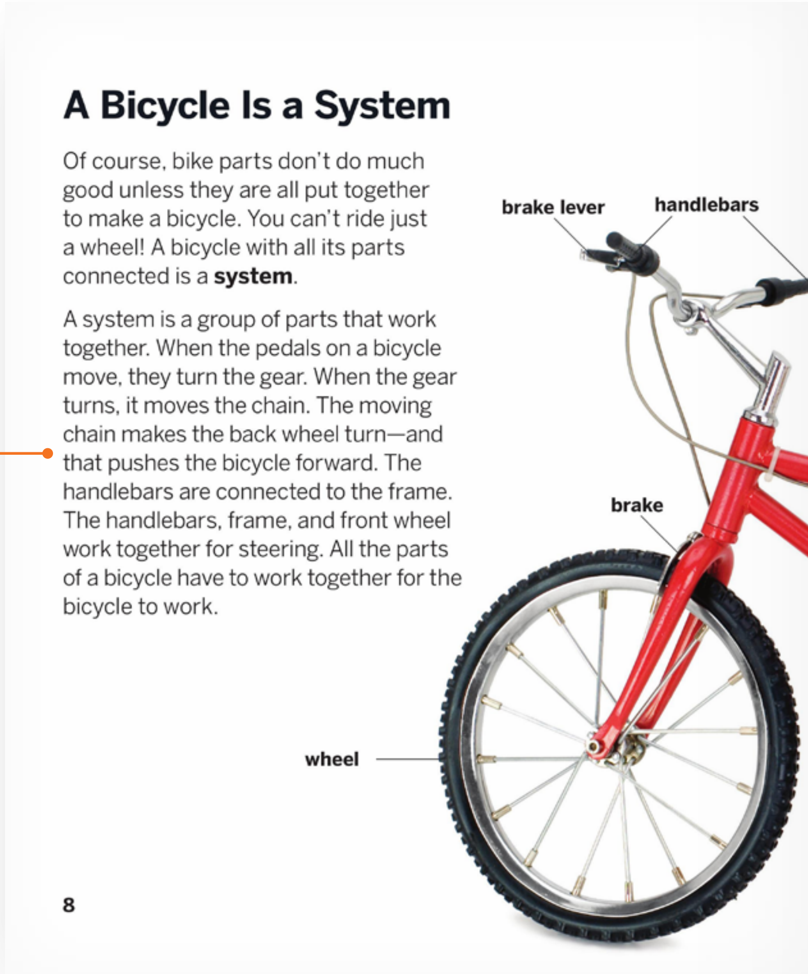


Find the *Systems* Student Book included in your sample and turn to page 8.

In Lesson 1.2, the teacher introduces the *Systems* Student Book, then introduces and models the reading strategy of synthesizing in order to prepare students to synthesize as they read the book with a partner.

In a partner reading activity, students apply the synthesizing strategy to generate new ideas to help them answer the first Investigation Question: *What is a system?*

A post-reading discussion provides students with an opportunity to hear the new ideas about systems their classmates have generated.



A Bicycle Is a System

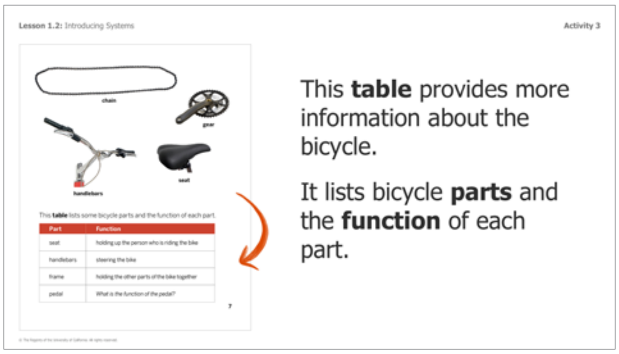
Of course, bike parts don't do much good unless they are all put together to make a bicycle. You can't ride just a wheel! A bicycle with all its parts connected is a **system**.

A system is a group of parts that work together. When the pedals on a bicycle move, they turn the gear. When the gear turns, it moves the chain. The moving chain makes the back wheel turn—and that pushes the bicycle forward. The handlebars are connected to the frame. The handlebars, frame, and front wheel work together for steering. All the parts of a bicycle have to work together for the bicycle to work.

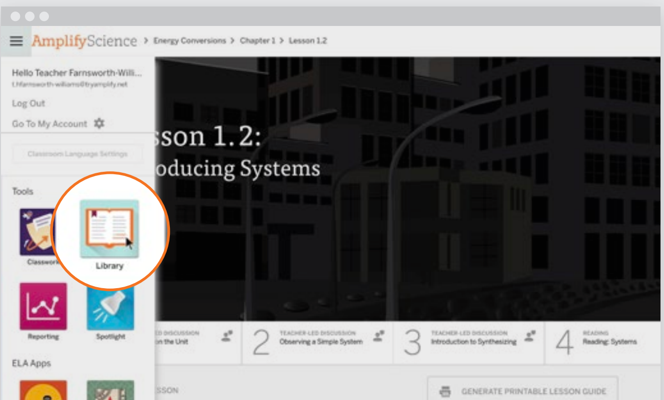
8

GO ONLINE

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

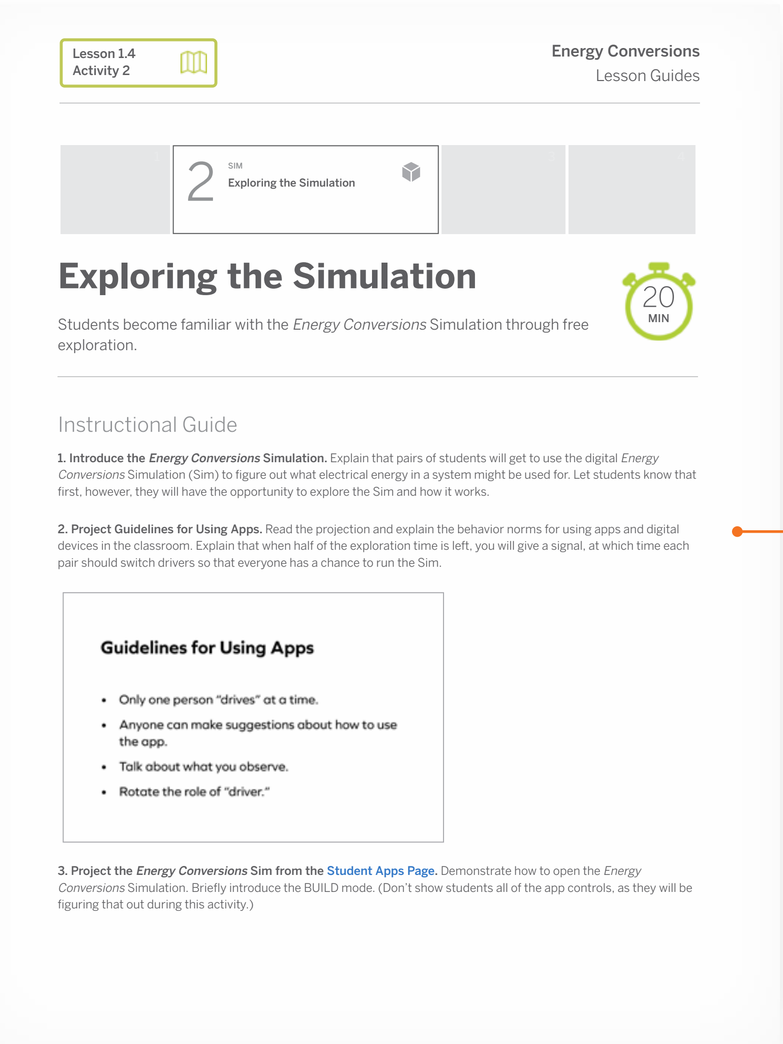


Classroom Slides, Lesson 1.2



Walkthrough progress PLAN **TEACH** ASSESS

Teacher and student sample page: Simulation



Lesson 1.4
Activity 2

Energy Conversions
Lesson Guides

2 SIM Exploring the Simulation

Exploring the Simulation

20 MIN

Students become familiar with the *Energy Conversions* Simulation through free exploration.

Instructional Guide

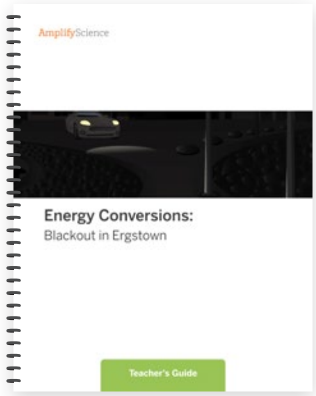
1. **Introduce the *Energy Conversions* Simulation.** Explain that pairs of students will get to use the digital *Energy Conversions* Simulation (Sim) to figure out what electrical energy in a system might be used for. Let students know that first, however, they will have the opportunity to explore the Sim and how it works.

2. **Project Guidelines for Using Apps.** Read the projection and explain the behavior norms for using apps and digital devices in the classroom. Explain that when half of the exploration time is left, you will give a signal, at which time each pair should switch drivers so that everyone has a chance to run the Sim.

Guidelines for Using Apps

- Only one person "drives" at a time.
- Anyone can make suggestions about how to use the app.
- Talk about what you observe.
- Rotate the role of "driver."

3. **Project the *Energy Conversions* Sim from the Student Apps Page.** Demonstrate how to open the *Energy Conversions* Simulation. Briefly introduce the BUILD mode. (Don't show students all of the app controls, as they will be figuring that out during this activity.)



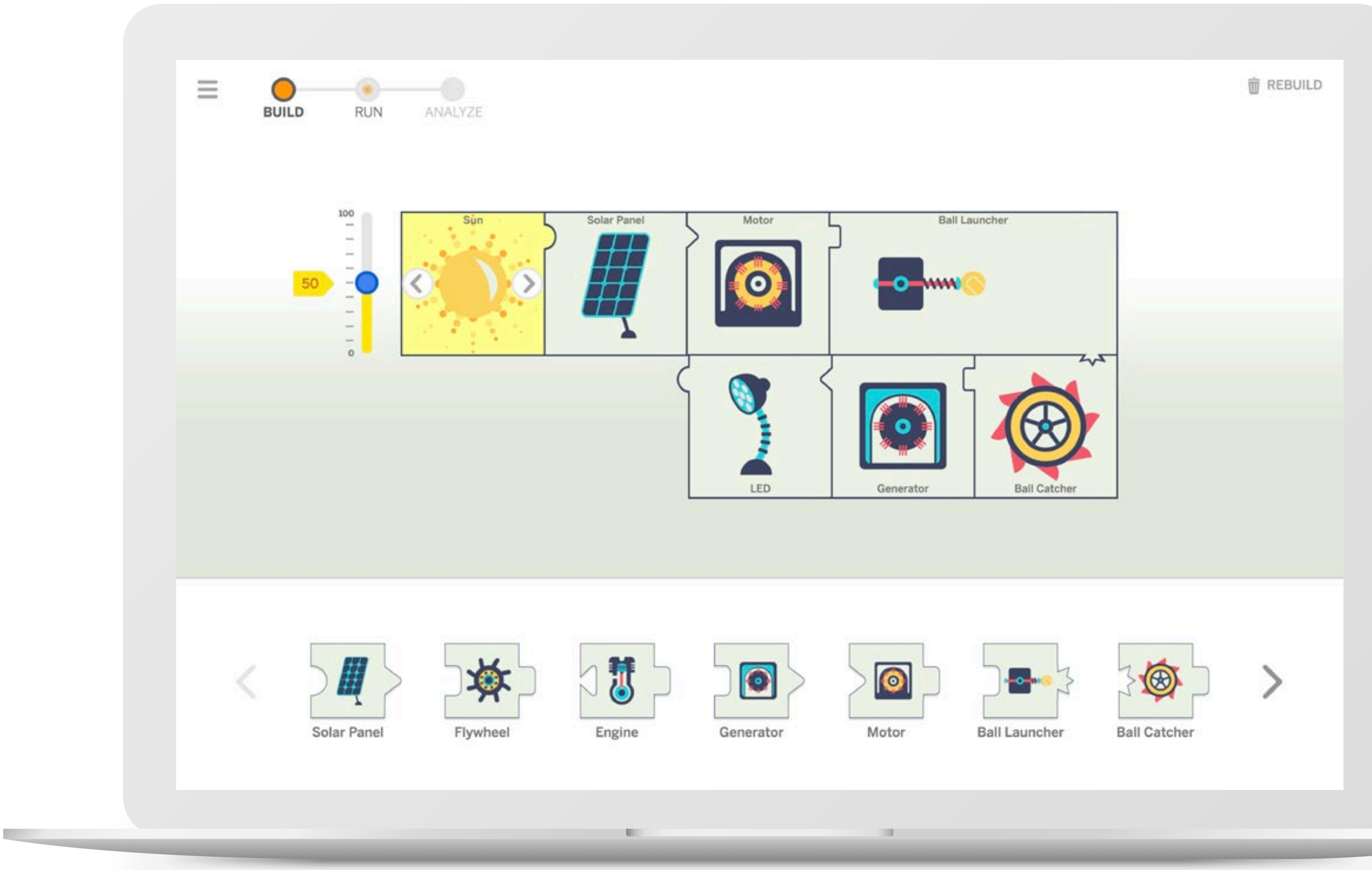
Turn to the Instructional Guide for Lesson 1.4 in the exemplar Teacher's Guide included in your sample.

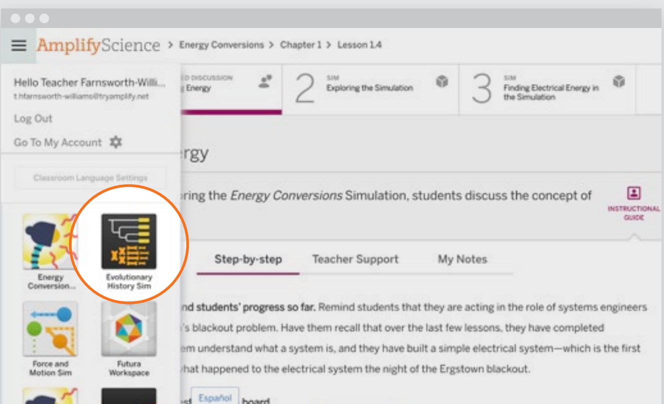
In Lesson 1.4, students have the opportunity to explore the *Energy Conversions* Simulation (Sim) for the first time and become familiar with its features.

Using the Sim, students search for devices for which electrical energy is the energy input. Later in the unit, students will use the Sim to set up, modify, and compare different energy system configurations in order to explore different energy sources and investigate how energy changes as it moves through a system.

GO ONLINE

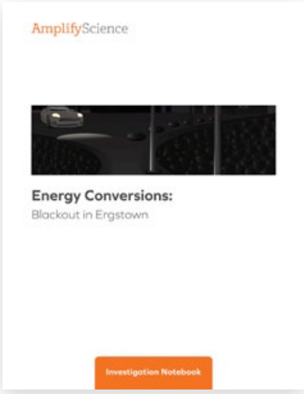
Sims are accessible at point-of-use in the digital Teacher's Guide or via the Global Navigation Menu on the left side of the screen.

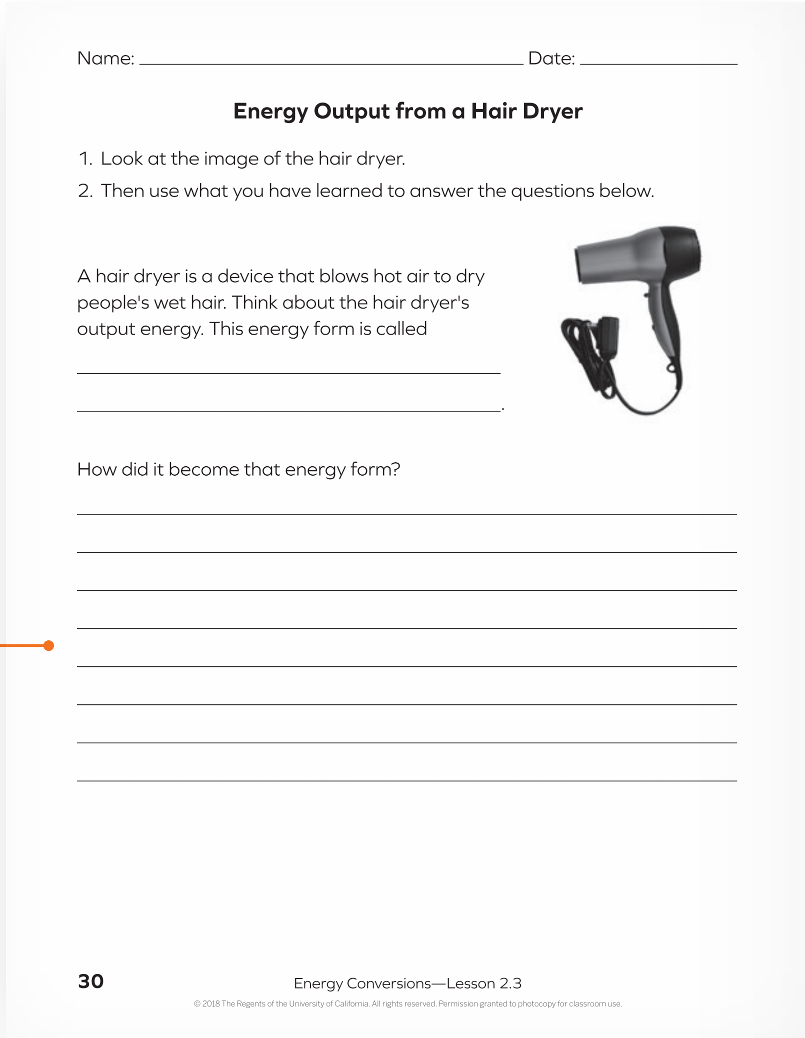

BUILD
RUN
ANALYZE
REBUILD
100
50
0
Sun
Solar Panel
Motor
Ball Launcher
LED
Generator
Ball Catcher
Solar Panel
Flywheel
Engine
Generator
Motor
Ball Launcher
Ball Catcher


AmplifyScience
Energy Conversions > Chapter 1 > Lesson 1.4
Step-by-step
Teacher Support
My Notes

Walkthrough progress PLAN **TEACH** ASSESS

Student sample page: Writing activity





Name: ______________________ Date: __________

Energy Output from a Hair Dryer

1. Look at the image of the hair dryer.
2. Then use what you have learned to answer the questions below.

A hair dryer is a device that blows hot air to dry people's wet hair. Think about the hair dryer's output energy. This energy form is called

____

______________________________.

How did it become that energy form?

____

____

____

____

____

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____

____

30 Energy Conversions—Lesson 2.3

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Find the *Energy Conversions* Student Investigation Notebook included in your sample and turn to page 30.

Lesson 2.3 includes a Critical Juncture Assessment. Students write about the energy conversion that takes place in a common electrical device, the hair dryer. This Critical Juncture Assessment is designed to reveal students' understanding of an essential idea—that devices convert electrical energy into other forms of energy.

GO ONLINE

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

Name: ______________________ Date: __________

Roundtable Discussion

1. With your group, assign Discussion Leader numbers from 1 to 4.
2. Discussion Leader 1 will ask the first Discussion Question and lead the group's discussion. The Discussion Leader may ask any of the Follow-up Questions to keep the discussion going.
3. Take turns asking questions until all four group members have had a turn leading the discussion.
4. Be ready to share your group's thinking with the class.

Discussion Questions:

Discussion Leader 1: Do you think the City Planner's solutions make sense? Why or why not?

Discussion Leader 2: How do you think the people of Ergstown will feel if they have to stop using some devices? Why do you think that?

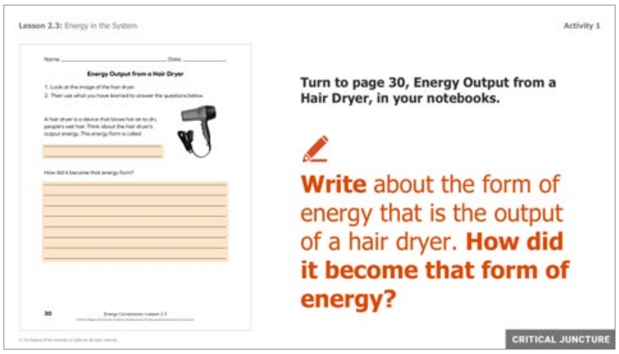
Discussion Leader 3: How do you think the people of Ergstown will feel about having the town install more LED lights to replace older lights? Why do you think that?

Discussion Leader 4: Which solution do you think best meets the criteria?

Follow-up Questions:

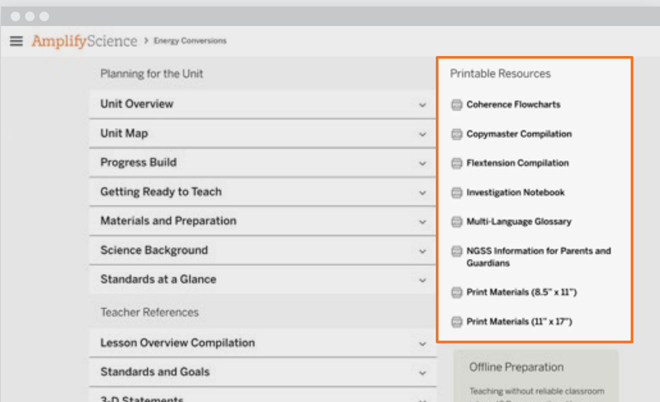
- What do you think?
- Why do you think so?
- Does anyone have a different idea?
- Do you agree or disagree? Why?

Energy Conversions—Lesson 2.3 **31**



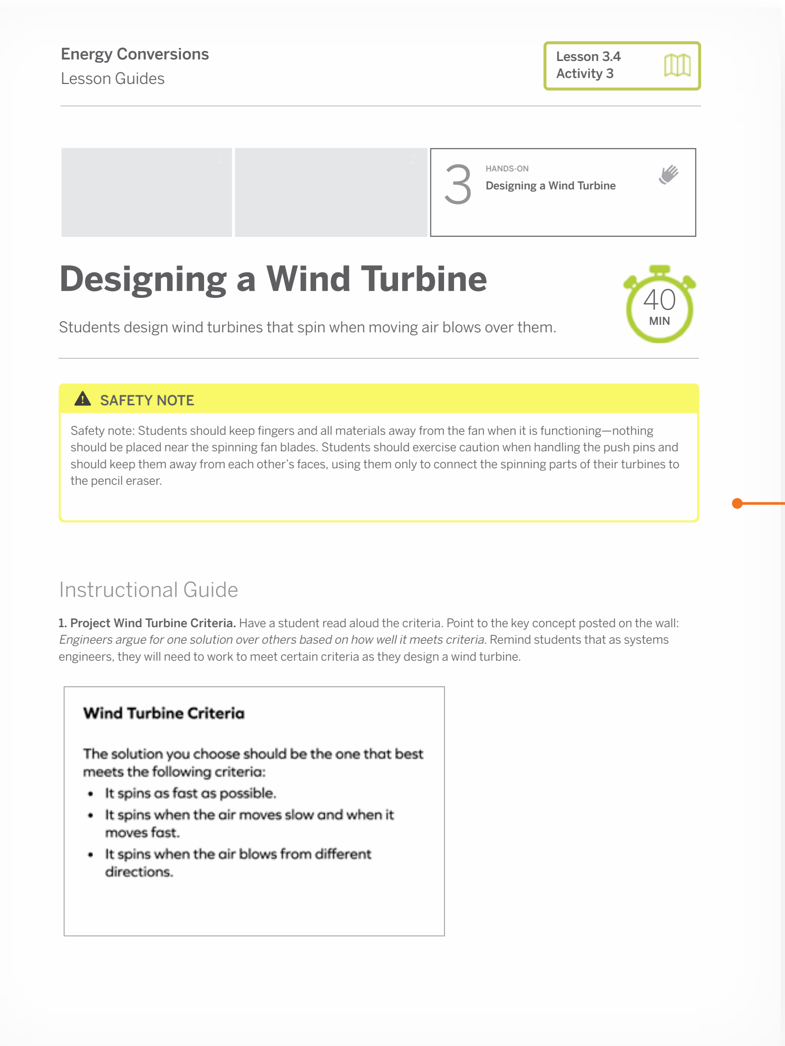
Classroom Slides, Lesson 2.3

Students are then introduced to possible design solutions and to the concept of criteria. Students learn that in engineering, solutions are assessed based on their success in meeting criteria. Students then use the Roundtable Discussion routine to discuss two possible solutions and which best meet the criteria.



Walkthrough progress PLAN TEACH ASSESS

Teacher sample page: Hands-on activity



Energy Conversions
Lesson Guides

Lesson 3.4
Activity 3

3 HANDS-ON
Designing a Wind Turbine

Designing a Wind Turbine

40 MIN

Students design wind turbines that spin when moving air blows over them.

SAFETY NOTE

Safety note: Students should keep fingers and all materials away from the fan when it is functioning—nothing should be placed near the spinning fan blades. Students should exercise caution when handling the push pins and should keep them away from each other's faces, using them only to connect the spinning parts of their turbines to the pencil eraser.

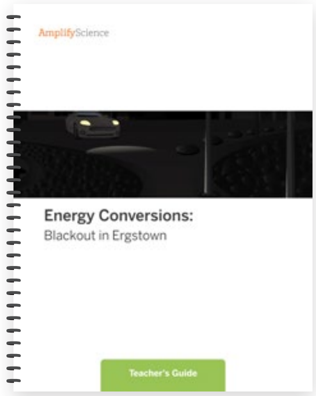
Instructional Guide

1. **Project Wind Turbine Criteria.** Have a student read aloud the criteria. Point to the key concept posted on the wall: *Engineers argue for one solution over others based on how well it meets criteria.* Remind students that as systems engineers, they will need to work to meet certain criteria as they design a wind turbine.

Wind Turbine Criteria

The solution you choose should be the one that best meets the following criteria:

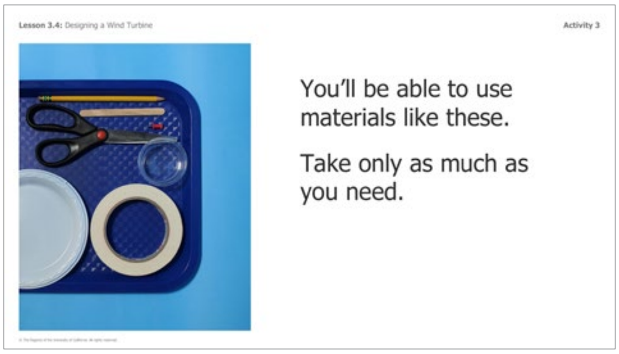
- It spins as fast as possible.
- It spins when the air moves slow and when it moves fast.
- It spins when the air blows from different directions.



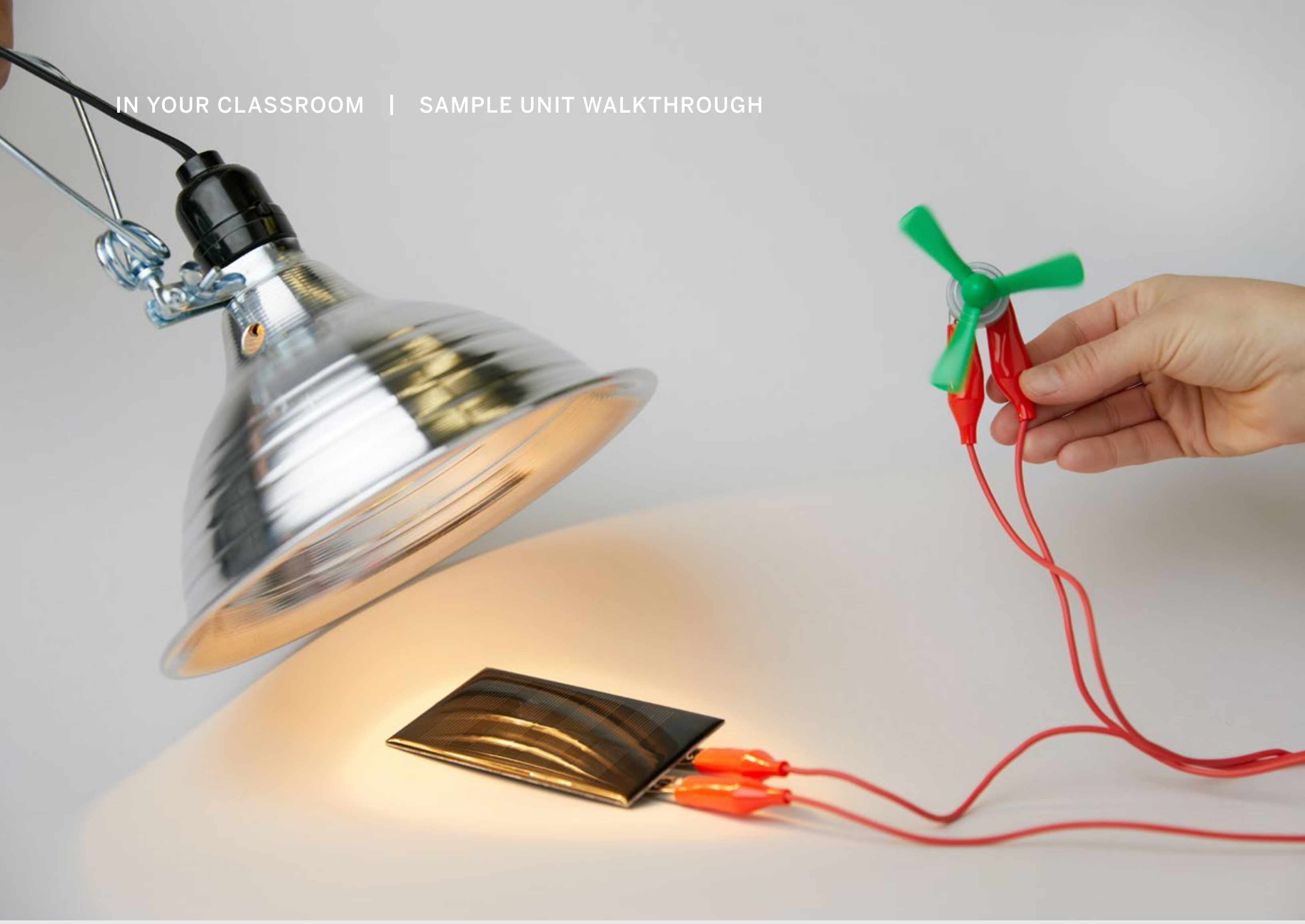
Turn to the Instructional Guide for Lesson 3.4 in the exemplar print Teacher's Guide included in your sample.

In Lesson 3.4, 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.

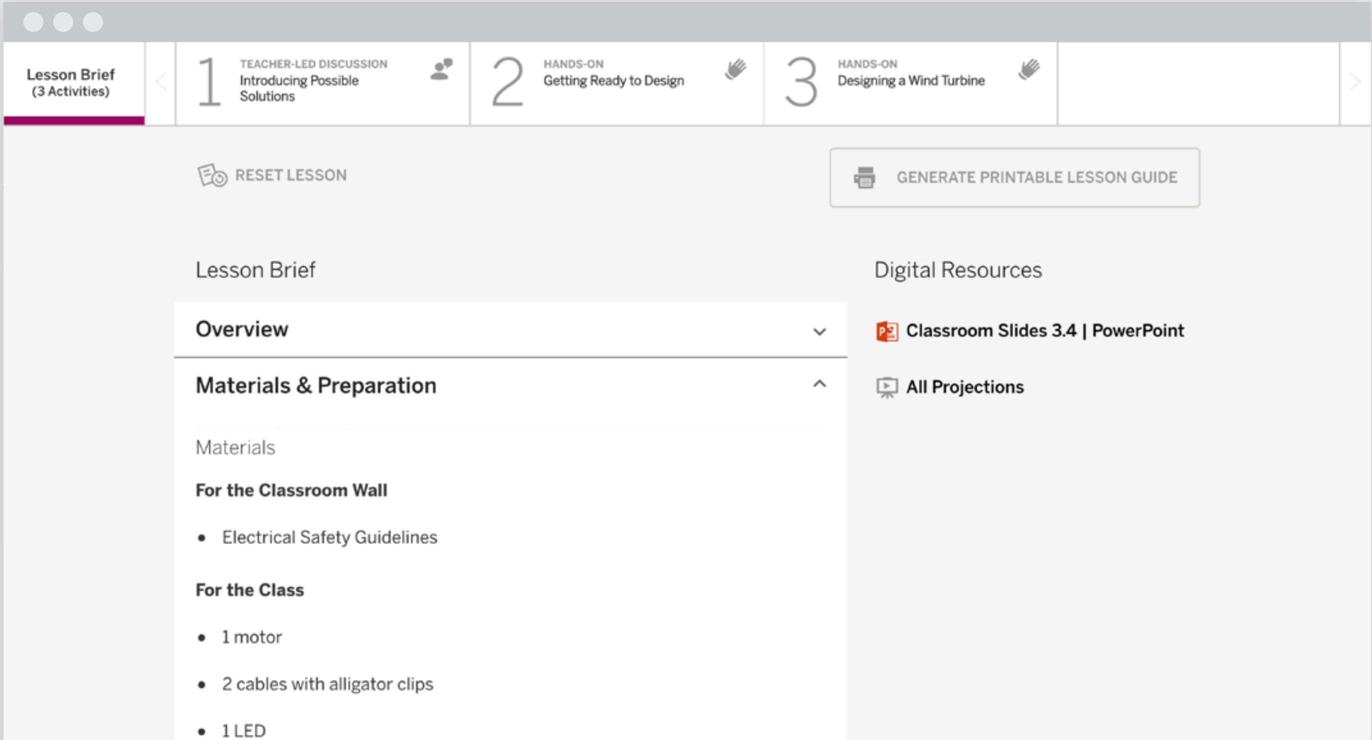


Classroom Slides, Lesson 3.4



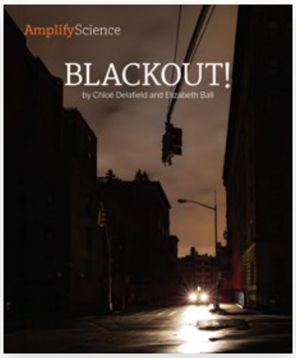
GO ONLINE

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 *Blackout!* Student Book in your sample and turn to page 4.

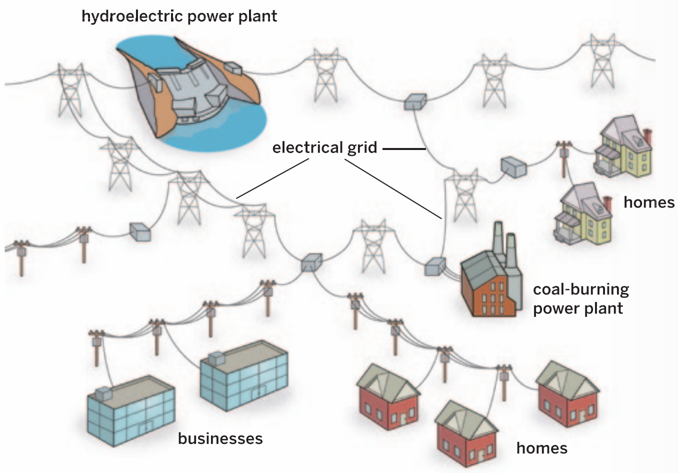
In Lesson 4.1, students review what they've learned about possible causes for blackouts as they revisit the *Systems* Student Book and read about system failure. After building a simple electrical system with the purpose of causing it to fail, students are introduced to *Blackout!* and pairs of students read the book to learn about various causes of system failure.

This activity provides an opportunity for an On-the-Fly Assessment of students' developing ability to synthesize information as a reading strategy.

Introduction

Electrical energy is all around us. It is working for us all the time. However, we usually don't think about it until it *stops* working. **Blackouts** remind us how much we use this **energy**.

The **system** that brings us electrical energy is huge. This system includes many different power plants. Power plants **convert** energy from different **sources** into electrical energy. The system also includes millions of miles of wires. These wires make up the **electrical grid**.



A system like this one brings electrical energy to your home.

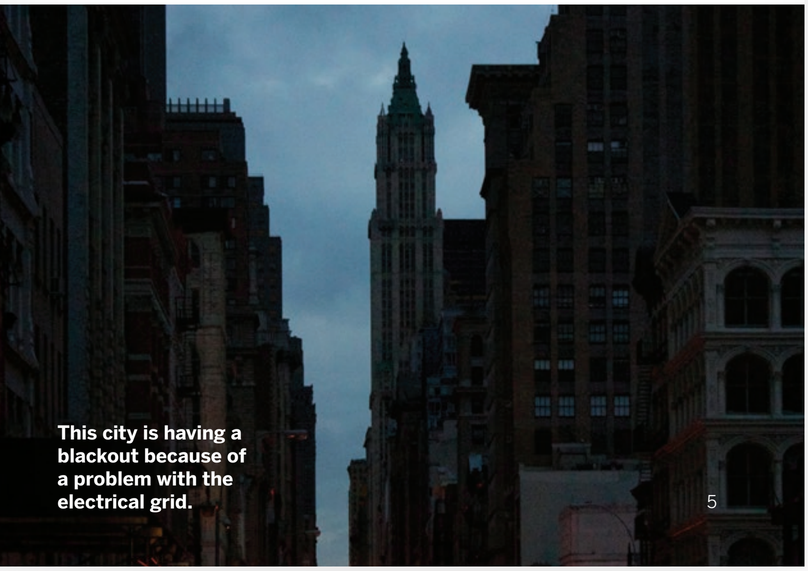
4

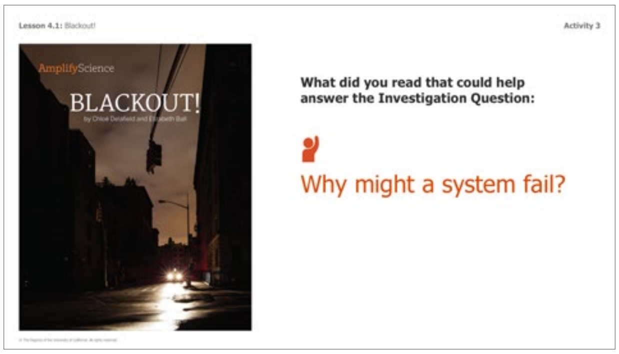
GO ONLINE

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.

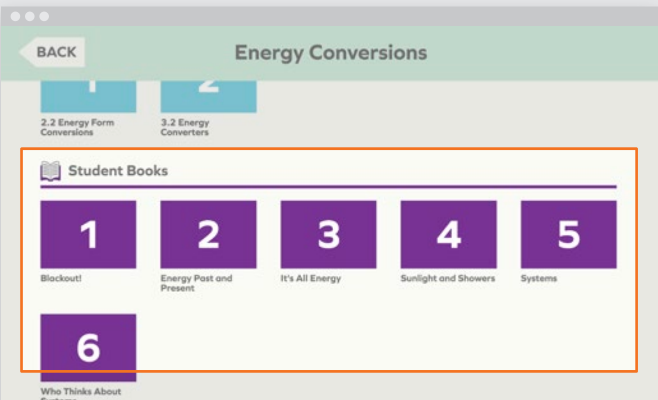
The grid brings energy to homes and businesses. When the grid and the other parts of the system work, we get energy. When the grid or another part of the system fails, we can be left in the dark.

This book has articles about **failures** in the electrical system. Each article is like one you might see in a newspaper or online. See what you can learn from these articles about different ways that parts can fail, causing the whole electrical system to fail.



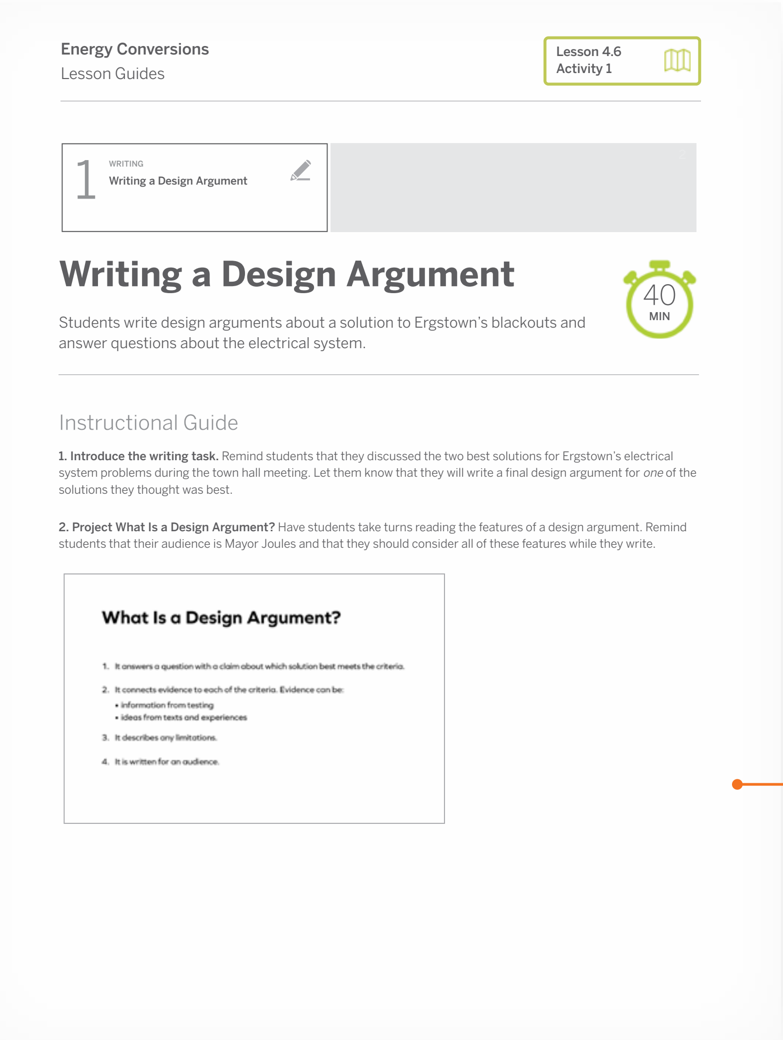


Classroom Slides, Lesson 4.1



Walkthrough progress PLAN TEACH ASSESS

Teacher sample page: End-of-Unit Assessment


Energy Conversions
Lesson Guides

Lesson 4.6
Activity 1

1 WRITING
Writing a Design Argument

Writing a Design Argument

40 MIN

Students write design arguments about a solution to Ergstown's blackouts and answer questions about the electrical system.

Instructional Guide

1. Introduce the writing task. Remind students that they discussed the two best solutions for Ergstown's electrical system problems during the town hall meeting. Let them know that they will write a final design argument for *one* of the solutions they thought was best.

2. Project What Is a Design Argument? Have students take turns reading the features of a design argument. Remind students that their audience is Mayor Joules and that they should consider all of these features while they write.

What Is a Design Argument?

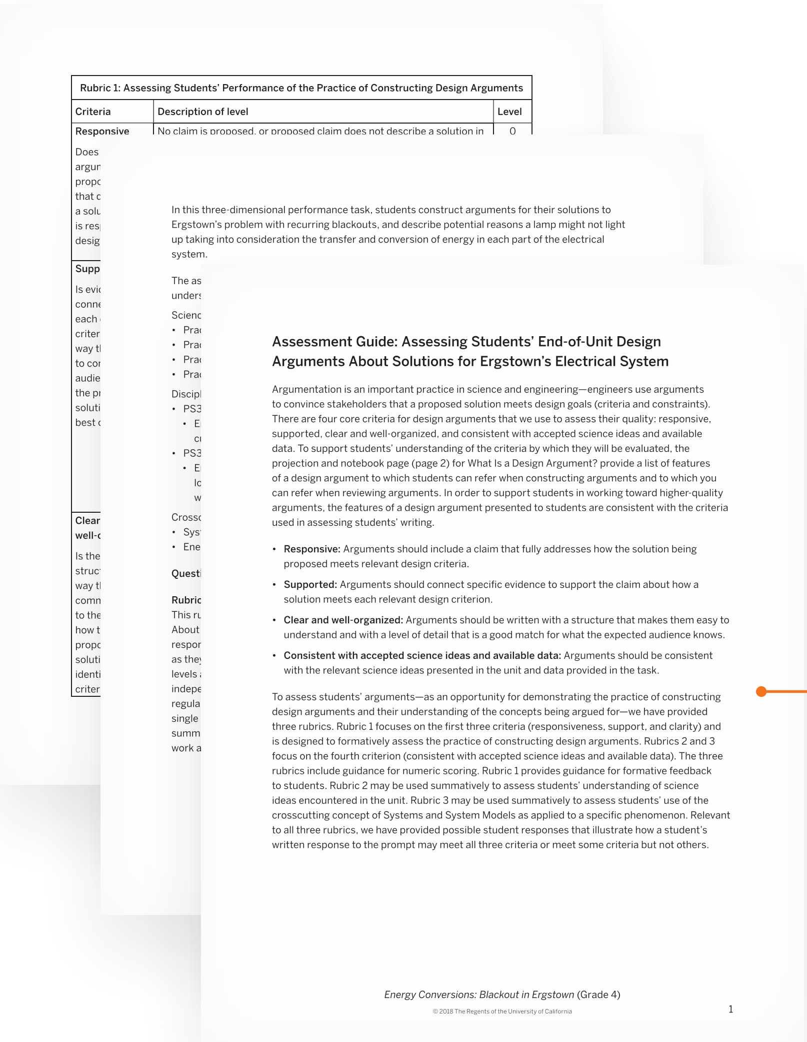
1. It answers a question with a claim about which solution best meets the criteria.
2. It connects evidence to each of the criteria. Evidence can be:
   - information from testing
   - ideas from texts and experiences
3. It describes any limitations.
4. It is written for an audience.

Find the Instructional Guide for Lesson 4.6 in the exemplar Teacher's Guide included in your sample.

The unit culminates with students applying all they have learned to write design arguments and answer questions about the electrical system.

GO ONLINE

Navigate to the Lesson Brief for Lesson 4.6 and download the Assessment Guide from the Digital Resources section on the right side of your screen.


Rubric 1: Assessing Students' Performance of the Practice of Constructing Design Arguments

In this three-dimensional performance task, students construct arguments for their solutions to Ergstown's problem with recurring blackouts, and describe potential reasons a lamp might not light up taking into consideration the transfer and conversion of energy in each part of the electrical system.

Assessment Guide: Assessing Students' End-of-Unit Design Arguments About Solutions for Ergstown's Electrical System

Argumentation is an important practice in science and engineering—engineers use arguments to convince stakeholders that a proposed solution meets design goals (criteria and constraints). There are four core criteria for design arguments that we use to assess their quality: responsive, supported, clear and well-organized, and consistent with accepted science ideas and available data. To support students' understanding of the criteria by which they will be evaluated, the projection and notebook page (page 2) for What Is a Design Argument? provide a list of features of a design argument to which students can refer when constructing arguments and to which you can refer when reviewing arguments. In order to support students in working toward higher-quality arguments, the features of a design argument presented to students are consistent with the criteria used in assessing students' writing.

- **Responsive:** Arguments should include a claim that fully addresses how the solution being proposed meets relevant design criteria.
- **Supported:** Arguments should connect specific evidence to support the claim about how a solution meets each relevant design criterion.
- **Clear and well-organized:** Arguments should be written with a structure that makes them easy to understand and with a level of detail that is a good match for what the expected audience knows.
- **Consistent with accepted science ideas and available data:** Arguments should be consistent with the relevant science ideas presented in the unit and data provided in the task.

To assess students' arguments—as an opportunity for demonstrating the practice of constructing design arguments and their understanding of the concepts being argued for—we have provided three rubrics. Rubric 1 focuses on the first three criteria (responsiveness, support, and clarity) and is designed to formatively assess the practice of constructing design arguments. Rubrics 2 and 3 focus on the fourth criterion (consistent with accepted science ideas and available data). The three rubrics include guidance for numeric scoring. Rubric 1 provides guidance for formative feedback to students. Rubric 2 may be used summatively to assess students' understanding of science ideas encountered in the unit. Rubric 3 may be used summatively to assess students' use of the crosscutting concept of Systems and System Models as applied to a specific phenomenon. Relevant to all three rubrics, we have provided possible student responses that illustrate how a student's written response to the prompt may meet all three criteria or meet some criteria but not others.

Energy Conversions: Blackout in Ergstown (Grade 4) 1

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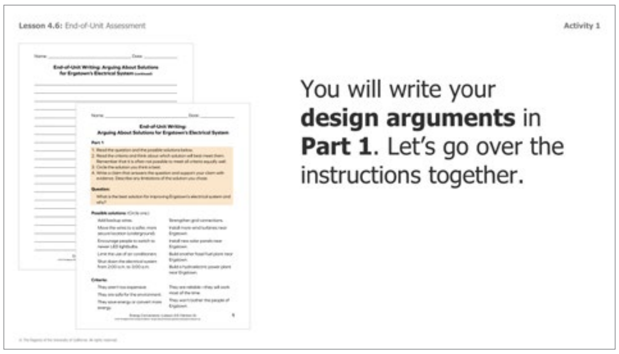
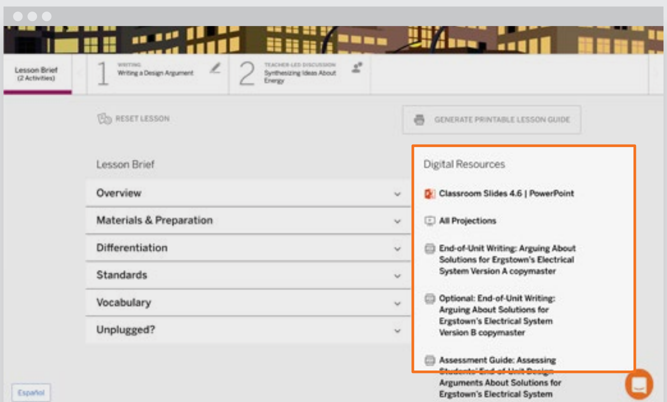


Classroom Slides, Lesson 4.6

Rubrics are provided for the teacher to assess students' writing along several dimensions, including their:

- Performance of the practice of constructing design arguments.
- Understanding of science ideas encountered in the unit.
- Understanding of the crosscutting concept of systems and system models.



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