Shell Education

GRADE 4

180 Days of PRACTICE

HANDS-ON STEAM

Science | Technology | Engineering | Arts | Mathematics

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PRACTICE

GRADE

4

HANDS-ON STEAM

Science | Technology | Engineering | Arts | Mathematics

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Research

The Importance of STEAM Education

STEAM education is a powerful approach to learning that continues to gain momentum and support across the globe. STEAM is the integration of science, technology, engineering, the arts, and mathematics to design solutions for real-world problems. Students must learn how to question, explore, and analyze natural phenomena. With these skills in hand, students understand the complexity of available information and are empowered to become independent learners and problem solvers.

The content and practices of STEAM education are strong components of a balanced instructional approach, ensuring students are college- and career-ready. The application of STEAM practices in the classroom affords teachers opportunities to challenge students to apply new knowledge. Students of all ages can design and build structures, improve existing products, and test innovative solutions to real-world problems. STEAM instruction can be as simple as using recycled materials to design a habitat for caterpillars discovered on the playground and as challenging as designing a solution to provide clean water to developing countries. The possibilities are endless.

Blending arts principles with STEM disciplines prepares students to be problem solvers, creative collaborators, and thoughtful risk-takers. Even students who do not choose a career in a STEAM field will benefit because these skills can be translated into almost any career. Students who become STEAM proficient are prepared to answer complex questions, investigate global issues, and develop solutions for real-world challenges. Rodger W. Bybee (2013, 64) summarizes what is expected of students as they join the workforce:

> As literate adults, individuals should be competent to understand STEM-related global issues; recognize scientific from other nonscientific explanations; make reasonable arguments based on evidence; and, very important, fulfill their civic duties at the local, national, and global levels.

Likewise, STEAM helps students understand how concepts are connected as they gain proficiency in the Four Cs: creativity, collaboration, critical thinking, and communication.

Research *(cont.)*

Defining STEAM

STEAM is an integrated way of preparing students for the twenty-first century world. It places an emphasis on understanding science and mathematics while learning engineering skills. By including art, STEAM recognizes that the creative aspect of any project is integral to good design—whether designing an experiment or an object.

Science

Any project or advancement builds on prior science knowledge. Science focuses on learning and applying specific content, cross-cutting concepts, and scientific practices that are relevant to the topic or project.

Technology

This is what results from the application of scientific knowledge and engineering. It is something that is created to solve a problem or meet a need. Some people also include the *use* of technology in this category. That is, tools used by scientists and engineers to solve problems. In addition to computers and robots, technology can include nets used by marine biologists, anemometers used by meteorologists, computer software used by mathematicians, and so on.

Engineering

This is the application of scientific knowledge to meet a need, solve a problem, or address phenomena. For example, engineers design bridges to withstand huge loads. Engineering is also used to understand phenomena, such as in designing a way to test a hypothesis. When problems arise, such as those due to earthquakes or rising sea levels, engineering is required to design solutions to the problems. On a smaller scale, a homeowner might want to find a solution to their basement flooding.

Art

In this context, art equals creativity and creative problem-solving. For example, someone might want to test a hypothesis but be stumped as to how to set up the experiment. Perhaps you have a valuable painting. You think there is another valuable image below the first layer of paint on the canvas. You do not want to destroy the painting on top. A creative solution is needed. Art can also include a creative or beautiful design that solves a problem. For example, the Golden Gate Bridge is considered both an engineering marvel and a work of art.

Mathematics

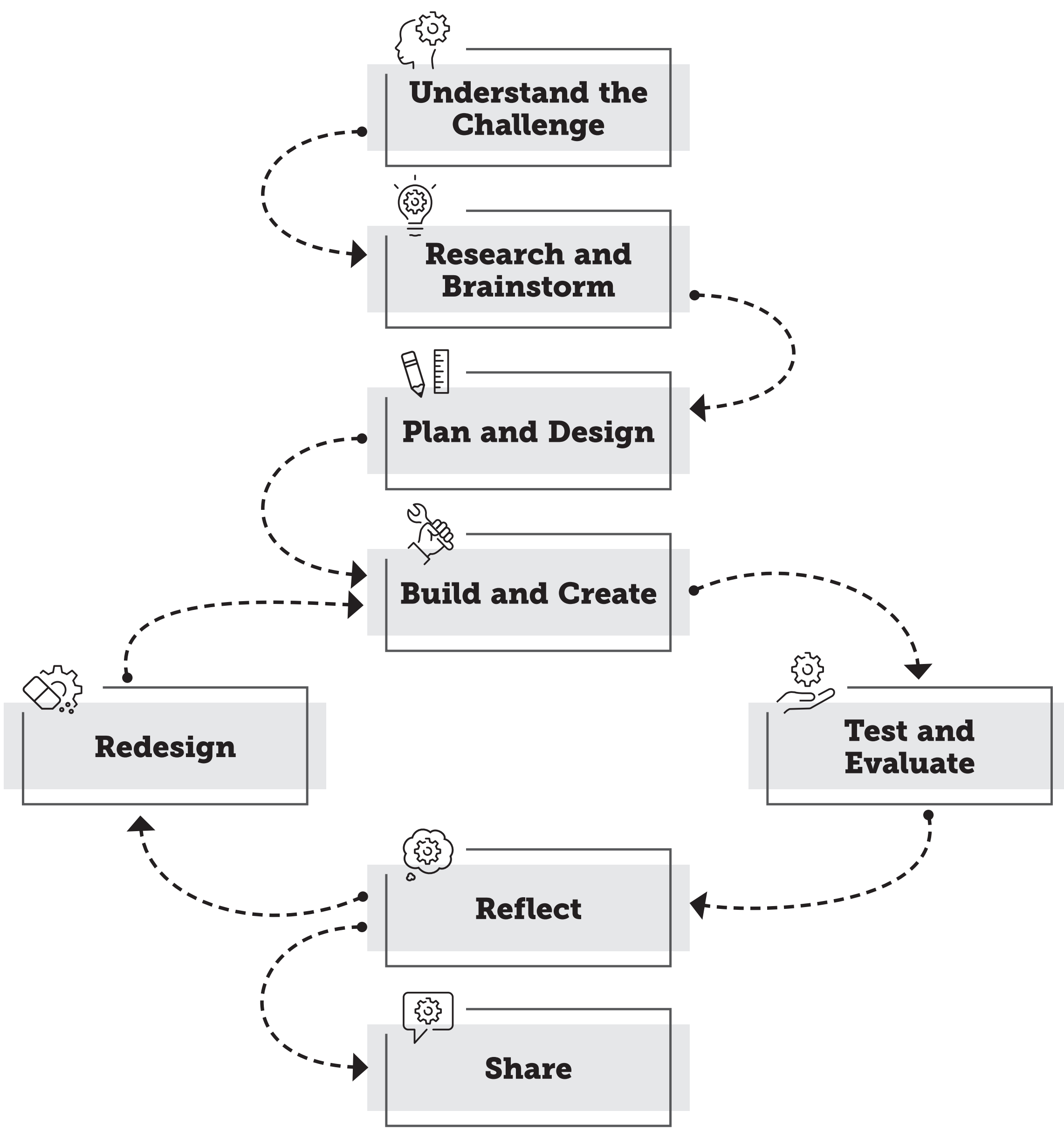
This is the application of mathematics to real-world problems. Often, this includes data analysis—such as collecting data, graphing it, analyzing the data, and then communicating that analysis. It may also include taking mathematical measurements in the pursuit of an answer. The idea is not to learn new math, but rather to apply it; however, some mathematics may need to be learned to solve the specific problem. Isaac Newton, for example, is famous for *inventing* calculus to help him solve problems in understanding gravity and motion.

Research *(cont.)*

The Engineering Design Process

The most essential component of STEAM education is the engineering design process. This process is an articulated approach to problem solving in which students are guided through the iterative process of solving problems and refining solutions to achieve the best possible outcomes. There are many different versions of the engineering design process, but they all have the same basic structure and goals. As explained in Appendix I of NGSS (2013), "At any stage, a problem-solver can redefine the problem or generate new solutions to replace an idea that just isn't working out."

Each unit in this resource presents students with a design challenge in an authentic and engaging context. The practice pages guide and support students through the engineering design process to solve problems or fulfill needs.



Research *(cont.)*

How to Facilitate Successful STEAM Challenges

There are some basic rules to remember as your students complete STEAM challenges.

Both independent and collaborative work should be included.

Astronaut and inventor Ellen Ochoa is well-known for working a robotic arm in space. About that experience she said, "It's fun to work the robotic arm, in part because it's a team effort." She recognized that she was getting credit for something amazing that happened because of the collaborative work of hundreds of people.

Students need time to think through a project, both on their own and together with others. It is often best to encourage students to start by thinking independently. One student may think of a totally different solution than another student. Once they come together, students can merge aspects of each other's ideas to devise something even better.

Failure is a step in the process.

During the process of trying to invent a useful light bulb, Thomas Edison famously said, "I have not failed. I've just found 10,000 ways that won't work." People are innovating when they are failing because it is a chance to try something new. The STEAM challenges in this book intentionally give students chances to improve their designs. Students should feel free to innovate as much as possible, especially the first time around. Then, they can build on what they learned and try again.

Some students get stuck thinking there is one right way. There are almost always multiple solutions to a problem. For example, attaching train cars together used to be very dangerous. In the late nineteenth century, different solutions to this problem were invented in England and the United States to make the process safer. Both solutions worked, and both were used! Encourage students to recognize that there are usually different ways to solve problems. Discuss the pros and cons of the various solutions that students generate.

Research *(cont.)*

How to Facilitate Successful STEAM Challenges *(cont.)*

Getting inspiration from others is an option.

Students worry a lot about copying. It is important to remind them that all breakthroughs come on the shoulders of others. No one is working in a vacuum, and it is okay to get inspiration and ideas from others. It is also important to give credit to the people whose work and ideas inspired others. Students may see this as cheating, but they should be encouraged to see that they had a great enough idea that others recognized it and wanted to build on it.

The struggle is real—and really important.

Most people do not like to fail. And it can be frustrating not to know what to do or what to try next. Lonnie Johnson, engineer and toy inventor, advises, "Persevere. That's what I always say to people. There's no easy route." Try to support students during this struggle, as amazing innovations can emerge from the process. Further, students feel great when they surprise themselves with success after thinking they were not going to succeed.

Materials can inspire the process.

Students may be stumped about how they are going to build a boat…until you show them that they can use clay. A parachute is daunting, but a pile of tissue paper or plastic bags might suddenly make students feel like they have some direction. On the other hand, materials can also instantly send the mind in certain directions, without exploring other options. For this reason, consider carefully the point at which you want to show students the materials they can use. You might want them to brainstorm materials first. This might inspire you to offer materials you had not considered before.

Some students or groups will need different types of support.

If possible, have students who need additional support manipulate materials, play with commercial solutions, or watch videos to get ideas. For students who need an additional challenge, consider ways to make the challenge more "real world" by adding additional realistic criteria. Or, encourage students to add their own criteria.

How to Use This Resource

Unit Structure Overview

This resource is organized into 12 units. Each three-week unit is organized in a consistent format for ease of use.

Week 1: STEAM Content

Day 1 **Learn Content**	Students read text, study visuals, and answer multiple-choice questions.
Day 2 **Learn Content**	Students read text, study visuals, and answer short-answer questions.
Day 3 **Explore Content**	Students engage in hands-on activities, such as scientific investigations, mini building challenges, and drawing and labeling diagrams.
Day 4 **Get Creative**	Students use their creativity, imaginations, and artistic abilities in activities such as drawing, creating fun designs, and doing science-related crafts.
Day 5 **Analyze Data**	Students analyze and/or create charts, tables, maps, and graphs.

Week 2: STEAM Challenge

Day 1 **Understand the Challenge**	Students are introduced to the STEAM Challenge. They review the criteria and constraints for successful designs.
Day 2 **Research and Brainstorm**	Students conduct additional research, as needed, and brainstorm ideas for their designs.
Day 3 **Plan and Design**	Students plan and sketch their designs.
Day 4 **Build and Create**	Students use their materials to construct their designs.
Day 5 **Test and Evaluate**	Students conduct tests and/or evaluation to assess the effectiveness of their designs and how well they met the criteria of the challenge.

Week 3: STEAM Challenge Improvement

Day 1 **Reflect**	Students answer questions to reflect on their first designs and make plans for how to improve their designs.
Day 2 **Redesign**	Students sketch new or modified designs.
Day 3 **Rebuild and Refine**	Students rebuild or adjust their designs.
Day 4 **Retest**	Students retest and evaluate their new designs.
Day 5 **Reflect and Share**	Students reflect on their experiences working through the engineering design process. They discuss and share their processes and results with others.

How to Use This Resource *(cont.)*

Pacing Options

This resource is flexibly designed and can be used in tandem with a core curriculum within a science, STEAM, or STEM block. It can also be used in makerspaces, after-school programs, summer school, or as enrichment activities at home. The following pacing options show suggestions for how to use this book.

Option 1

This option shows how each unit can be completed in 15 days. This option requires approximately 10–20 minutes per day. Building days are flexible, and teachers may allow for additional time at their discretion.

	Day 1	Day 2	Day 3	Day 4	Day 5
Week 1	Learn Content	Learn Content	Explore Content	Get Creative	Analyze Data
Week 2	Understand the Challenge	Research and Brainstorm	Plan and Design	Build and Create	Test and Evaluate
Week 3	Reflect	Redesign	Rebuild and Refine	Retest	Reflect and Share

Option 2

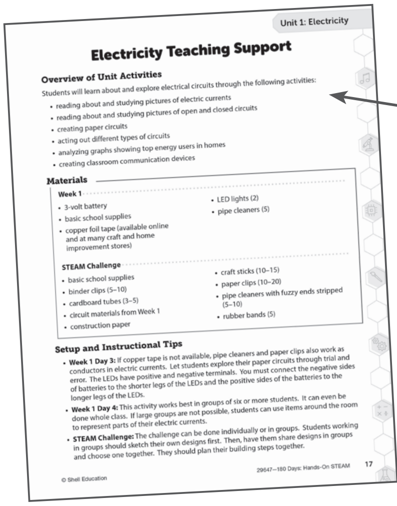
This option shows how each unit can be completed in fewer than 15 days. This option requires approximately 45–60 minutes a day.

	Day 1	Day 2
Week 1	Learn Content Explore Content	Get Creative Analyze Data
Week 2	Understand the Challenge Research and Brainstorm Plan and Design	Build and Create Test and Evaluate
Week 3	Reflect Redesign Rebuild and Refine	Retest Reflect and Share

How to Use This Resource *(cont.)*

Teaching Support Pages

Each unit in this resource begins with two teaching support pages that provide instructional guidance.



Unit 1: Electricity

Electricity Teaching Support

Overview of Unit Activities

Students will learn about and explore electrical circuits through the following activities:

- reading about and studying pictures of electric currents
- reading about and studying pictures of open and closed circuits
- creating paper circuits
- acting out different types of circuits
- analyzing graphs showing top energy users in homes
- creating classroom communication devices

Materials

Week 1

- 3-volt battery
- basic school supplies
- copper foil tape (available online and at many craft and home improvement stores)
- LED lights (2)
- pipe cleaners (5)

STEAM Challenge

- basic school supplies
- binder clips (5–10)
- cardboard tubes (3–5)
- circuit materials from Week 1
- construction paper
- craft sticks (10–15)
- paper clips (10–20)
- pipe cleaners with fuzzy ends stripped (5–10)
- rubber bands (5)

Setup and Instructional Tips

- **Week 1 Day 3:** If copper tape is not available, pipe cleaners and paper clips also work as conductors in electric currents. Let students explore their paper circuits through trial and error. The LEDs have positive and negative terminals. You must connect the negative sides of batteries to the shorter legs of the LEDs and the positive sides of the batteries to the longer legs of the LEDs.
- **Week 1 Day 4:** This activity works best in groups of six or more students. It can even be done whole class. If large groups are not possible, students can use items around the room to represent parts of their electric currents.
- **STEAM Challenge:** The challenge can be done individually or in groups. Students working in groups should sketch their own designs first. Then, have them share designs in groups and choose one together. They should plan their building steps together.

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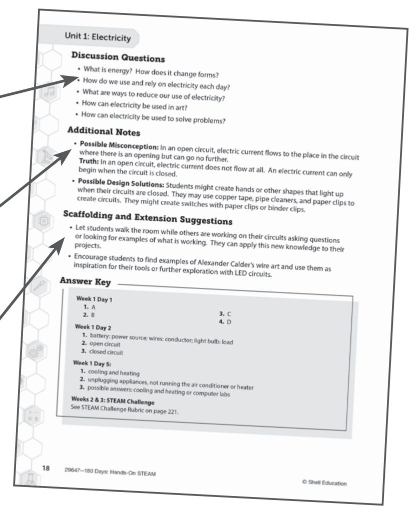
A clear overview of unit activities, weekly materials, safety notes, and setup tips helps teachers plan and prepare efficiently and with ease.

Discussion questions encourage students to verbalize their learning and connect it to their own lives.

Possible student misconceptions and design solutions further take the guesswork out of lesson planning.

Differentiation options offer ways to support and extend student learning.



Unit 1: Electricity

Discussion Questions

- What is energy? How does it change forms?
- How do we use and rely on electricity each day?
- What are ways to reduce our use of electricity?
- How can electricity be used in art?
- How can electricity be used to solve problems?

Additional Notes

- **Possible Misconception:** In an open circuit, electric current flows to the place in the circuit where there is an opening but can go no further.
  Truth: In an open circuit, electric current does not flow at all. An electric current can only begin when the circuit is closed.
- **Possible Design Solutions:** Students might create hands or other shapes that light up when their circuits are closed. They may use copper tape, pipe cleaners, and paper clips to create circuits. They might create switches with paper clips or binder clips.

Scaffolding and Extension Suggestions

- Let students walk the room while others are working on their circuits asking questions or looking for examples of what is working. They can apply this new knowledge to their projects.
- Encourage students to find examples of Alexander Calder's wire art and use them as inspiration for their tools or further exploration with LED circuits.

Answer Key

Week 1 Day 1
1. A
2. B
3. C
4. D

Week 1 Day 2
1. battery: power source; wires: conductor; light bulb: load
2. open circuit
3. closed circuit

Week 1 Day 5:
1. cooling and heating
2. unplugging appliances, not running the air conditioner or heater
3. possible answers: cooling and heating or computer labs

Weeks 2 & 3: STEAM Challenge
See STEAM Challenge Rubric on page 221.

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Materials

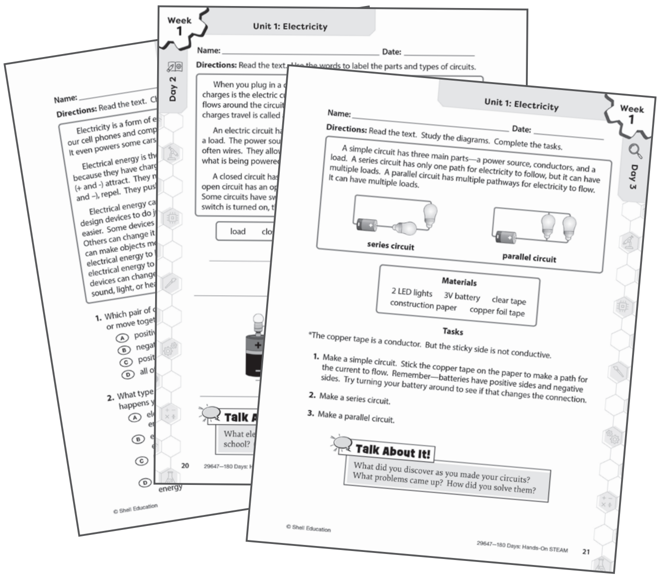
Due to the nature of engineering, the materials listed are often flexible. They may be substituted or added to, depending on what you have available. More material options require greater consideration by students and encourage more creative and critical thinking. Fewer material options can help narrow students' focus but may limit creativity. Adjust the materials provided to fit the needs of your students.

Approximate amounts of materials are included in each list. These amount suggestions are per group. Students are expected to have basic school supplies for each unit. These include paper, pencils, markers or crayons, glue, tape, and scissors.

How to Use This Resource *(cont.)*

Student Pages

Students begin each unit by learning about and exploring science-related content.


Unit 1: Electricity
Week 1
Day 3
Name: Date:
Directions: Read the text. Study the diagrams. Complete the tasks.

A simple circuit has three main parts—a power source, conductors, and a load. A series circuit has only one path for electricity to follow, but it can have multiple loads. A parallel circuit has multiple pathways for electricity to flow. It can have multiple loads.

series circuit
parallel circuit

Materials
2 LED lights
3V battery
clear tape
construction paper
copper foil tape

Tasks
*The copper tape is a conductor. But the sticky side is not conductive.
1. Make a simple circuit. Stick the copper tape on the paper to make a path for the current to flow. Remember—batteries have positive sides and negative sides. Try turning your battery around to see if that changes the connection.
2. Make a series circuit.
3. Make a parallel circuit.

Talk About It!
What did you discover as you made your circuits? What problems came up? How did you solve them?

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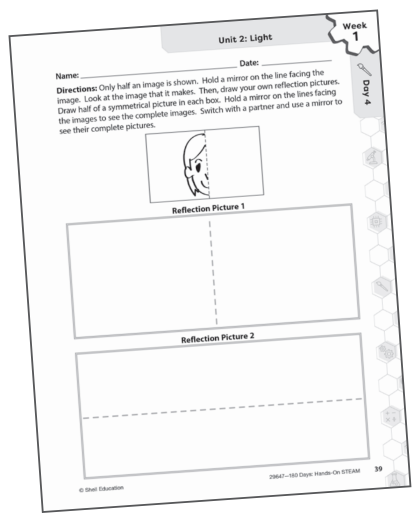
Activities in **Week 1** help build background science content knowledge relevant to the STEAM Challenge.


Unit 2: Light
Week 1
Day 4
Name: Date:
Directions: Only half an image is shown. Hold a mirror on the line facing the image. Look at the image that it makes. Then, draw your own reflection pictures. Draw half of a symmetrical picture in each box. Hold a mirror on the lines facing the images to see the complete images. Switch with a partner and use a mirror to see their complete pictures.

Reflection Picture 1
Reflection Picture 2

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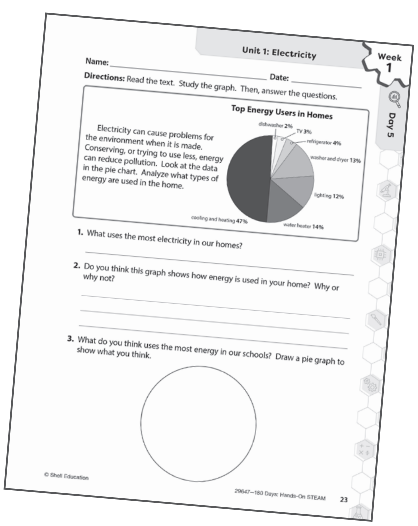
Creative activities encourage students to connect science and art.


Unit 1: Electricity
Week 1
Day 5
Name: Date:
Directions: Read the text. Study the graph. Then, answer the questions.

Electricity can cause problems for the environment when it is made. Conserving, or trying to use less, energy can reduce pollution. Look at the data in the pie chart. Analyze what types of energy are used in the home.

Top Energy Users in Homes

1. What uses the most electricity in our homes?
2. Do you think this graph shows how energy is used in your home? Why or why not?
3. What do you think uses the most energy in our schools? Draw a pie graph to show what you think.

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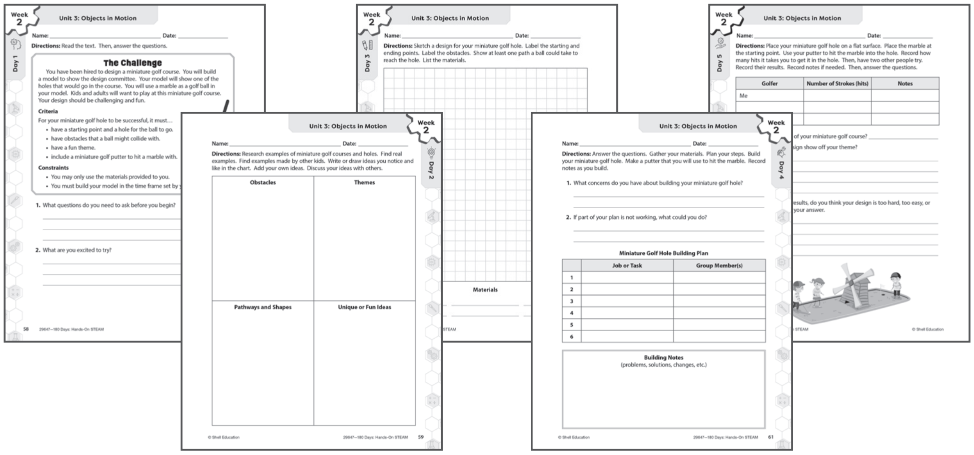
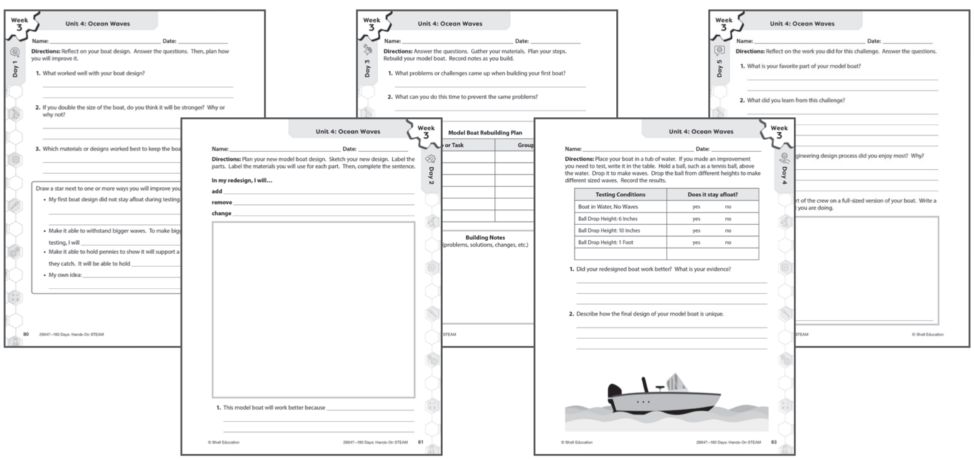
Graphs, charts, and maps guide students to make important mathematics and real-world connections.

How to Use This Resource *(cont.)*

Student Pages *(cont.)*



Week 2 introduces students to the STEAM Challenge. Activities guide students through each step of the engineering design process. They provide guiding questions and space for students to record their plans, progress, results, and thinking.



Week 3 activities continue to lead students through the cycle of the engineering design process. Students are encouraged to think about and discuss ways to improve their designs based on their observations and experiences in Week 2.

Quick Tip!

Staple all the student pages for each unit together, and distribute them as packets. This will allow students to easily refer to their learning as they complete the STEAM Challenges.

How to Use This Resource *(cont.)*

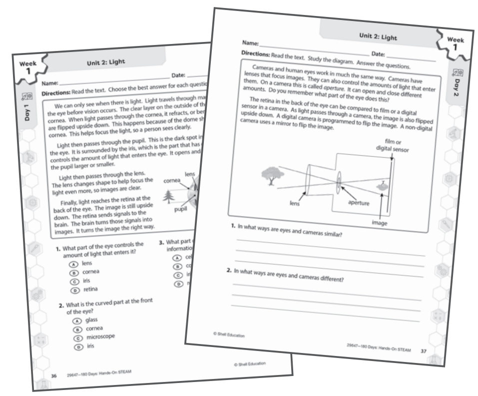
Assessment Options

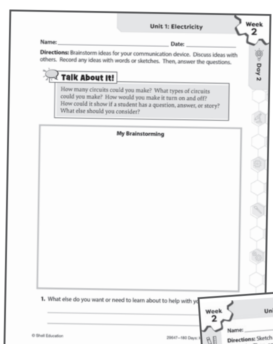
Assessments guide instructional decisions and improve student learning. This resource offers balanced assessment opportunities. The assessments require students to think critically, respond to text-dependent questions, and utilize science and engineering practices.

Progress Monitoring

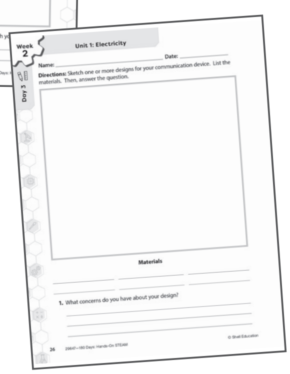
There are key points throughout each unit when valuable formative evaluations can be made. These evaluations can be based on group, paired, and/or individual discussions and activities.

- **Week 1** activities provide opportunities for students to answer multiple-choice and short-answer questions related to the content. Answer keys for these pages are provided in the Teaching Support pages.

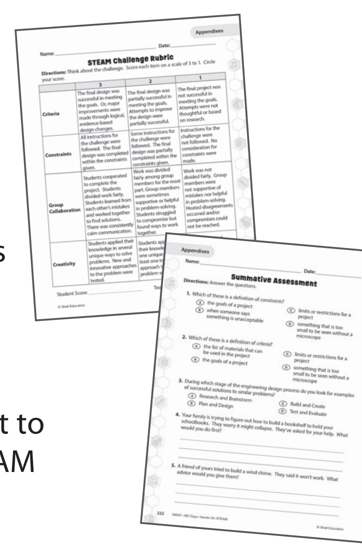




- **Talk About It!** graphics on student activity sheets offer opportunities to monitor student progress.



- **Week 2 Day 3: Plan and Design** is when students sketch their first designs. This is a great opportunity to assess how well students understand the STEAM challenge and what they plan to create. These should be reviewed before moving on to the Build and Create stages of the STEAM Challenges.



Summative Assessment

A rubric for the STEAM Challenges is provided on page 221. It is important to note that whether students' final designs were successful is not the main goal of this assessment. It is a way to assess students' skills as they work through the engineering design process. Students assess themselves first. Teachers can add notes to the assessment.

A short summative assessment is provided on page 222. This is meant to provide teachers with insight into how well students understand STEAM practices and the engineering design process.

Standards Correlations

Shell Education is committed to producing educational materials that are research and standards based. To support this effort, this resource is correlated to the academic standards of all 50 states, the District of Columbia, the Department of Defense Dependent Schools, and the Canadian provinces. A correlation is also provided for key professional educational organizations.

To print a customized correlation report for your state, visit our website at **www.tcmpub.com/administrators/correlations** and follow the online directions. If you require assistance in printing correlation reports, please contact the Customer Service Department at 1-800-858-7339.

Standards Overview

The Every Student Succeeds Act (ESSA) mandates that all states adopt challenging academic standards that help students meet the goal of college and career readiness. While many states already adopted academic standards prior to ESSA, the act continues to hold states accountable for detailed and comprehensive standards. Standards are designed to focus instruction and guide adoption of curricula. They define the knowledge, skills, and content students should acquire at each level. Standards are also used to develop standardized tests to evaluate students' academic progress. State standards are used in the development of our resources, so educators can be assured they meet state academic requirements.

Next Generation Science Standards

This set of national standards aims to incorporate science knowledge and process standards into a cohesive framework. The standards listed on page 16 describe the science content and processes presented throughout the lessons.

TESOL and WIDA Standards

In this book, the following English language development standards are met: Standard 1: English language learners communicate for social and instructional purposes within the school setting. Standard 3: English language learners communicate information, ideas and concepts necessary for academic success in the content area of mathematics. Standard 4: English language learners communicate information, ideas and concepts necessary for academic success in the content area of science.

Standards Correlations *(cont.)*

Each unit in this resource supports all the following NGSS Scientific and Engineering Practices and Engineering Performance Expectations for 3–5.

Scientific and Engineering Practices	Engineering Performance Expectations
Asking Questions and Defining Problems	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
Developing and Using Models	
Planning and Carrying Out Investigations	
Analyzing and Interpreting Data	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
Constructing Explanations and Designing Solutions	
Engaging in Argument from Evidence	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
Obtaining, Evaluating, and Communicating Information	

This chart shows how the units in this resource align to NGSS Disciplinary Core Ideas and Crosscutting Concepts.

Unit	Disciplinary Core Idea	Crosscutting Concept
Electricity	PS3.D: Energy in Chemical Processes and Everyday Life PS4.C: Information Technologies and Instrumentation	Energy and Matter; Patterns
Light	PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	Cause and Effect
Objects in Motion	PS3.C: Relationship Between Energy and Forces PS3.B: Conservation of Energy and Energy Transfer	Energy and Matter
Ocean Waves	PS4.A: Wave Properties	Patterns
Animal Senses	LS1.A: Structure and Function LS1.D: Information Processing	Systems and System Models
Food Webs	LS1.C: Organization for Matter and Energy Flow in Organisms LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Energy and Matter; Systems and System Models
How Animals Breathe	LS1.A: Structure and Function	Systems and System Models
Plant Adaptations	LS1.A: Structure and Function	Systems and System Models
Changing Land	ESS1.C: The History of Planet Earth ESS2.A: Earth Materials and Systems ESS3.B: Natural Hazards	Cause and Effect; Patterns
Earthquakes	ESS1.C: The History of Planet Earth SS2.B: Plate Tectonics and Large-Scale System Interactions ESS3.B: Natural Hazards	Cause and Effect; Patterns
Phases of the Moon	ESS1.B: Earth and the Solar System	Patterns; Scale, Proportion, and Quantity
Wind Power	ESS3.A: Natural Resources PS3.A: Definitions of Energy	Cause and Effect

Electricity Teaching Support

Overview of Unit Activities

Students will learn about and explore electrical circuits through the following activities:

- reading about and studying pictures of electric currents
- reading about and studying pictures of open and closed circuits
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- acting out different types of circuits
- analyzing graphs showing top energy users in homes
- creating classroom communication devices

Materials Per Group

Week 1

- 3-volt battery
- basic school supplies
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- pipe cleaners (5)

STEAM Challenge

- basic school supplies
- binder clips (5–10)
- cardboard tubes (3–5)
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Setup and Instructional Tips

- **Week 1 Day 3:** If copper tape is not available, pipe cleaners and paper clips also work as conductors in electric currents. Let students explore their paper circuits through trial and error. The LEDs have positive and negative terminals. You must connect the negative sides of batteries to the shorter legs of the LEDs and the positive sides of the batteries to the longer legs of the LEDs.
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Discussion Questions

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Additional Notes

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Scaffolding and Extension Suggestions

- Let students walk the room while others are working on their circuits asking questions or looking for examples of what is working. They can apply this new knowledge to their projects.
- Encourage students to find examples of Alexander Calder's wire art and use them as inspiration for their tools or further exploration with LED circuits.

Answer Key

Week 1 Day 1

1. A
2. B
3. C
4. D

Week 1 Day 2

1. battery: power source; wires: conductor; light bulb: load
2. open circuit
3. closed circuit

Week 1 Day 5

1. cooling and heating
2. unplugging appliances, not running the air conditioner or heater
3. possible answers: cooling and heating or computer labs

Weeks 2 & 3: STEAM Challenge

See STEAM Challenge Rubric on page 221.

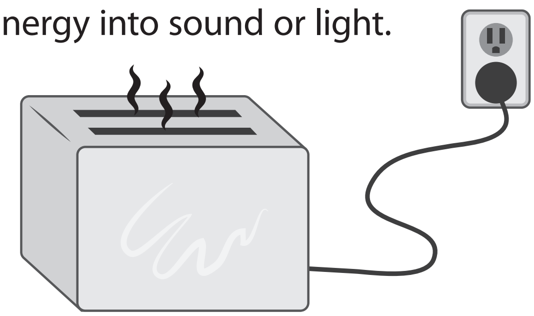
Name: ______________________________ Date: ______________

Directions: Read the text. Choose the best answer for each question.

Electricity is a form of energy. It is an important part of our lives. It powers our cell phones and computers. It keeps our lights on and warms our homes. It even powers some cars.

Electrical energy is the moving of tiny particles. These particles move because they have charges. They are negative or positive. Opposite charges (+ and -) attract. They move toward each other. Like charges, (+ and +) or (– and –), repel. They push away from each other.

Electrical energy can be changed into other types of energy. Engineers design devices to do just that. These devices solve problems or make life easier. Some devices can change electrical energy into sound or light. Others can change it to heat. Some devices can make objects move. A toaster changes electrical energy to heat. A lamp changes electrical energy to light. What other devices can change electrical energy into sound, light, or heat?



1. Which pair of charges will attract, or move together?

- (A) positive and negative
- (B) negative and negative
- (C) positive and positive
- (D) all of the above

2. What type of energy change occurs when you turn on a hair dryer?

- (A) electrical energy to light energy
- (B) electrical energy to heat energy
- (C) heat energy to electrical energy
- (D) sound energy to electrical energy

3. What is a device that changes electrical energy to sound energy?

- (A) iron
- (B) flashlight
- (C) speaker
- (D) nightlight

4. Like charges will _______ each other.

- (A) attract
- (B) shake
- (C) pull
- (D) repel

Name: ______________________ Date: ______________

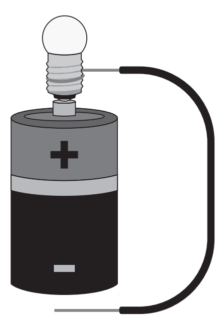
Directions: Read the text. Use the words to label the parts and types of circuits.

When you plug in a device, electric charges begin to flow. The flow of charges is the electric current. It starts at the power source. Then, the current flows around the circuit and back to the power source. The path that electric charges travel is called an *electric circuit*.

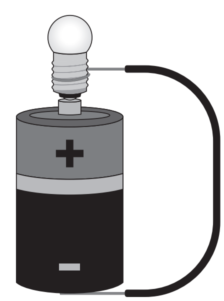
An electric circuit has three basic parts—a power source, a conductor, and a load. The power source is usually a battery or an outlet. The conductors are often wires. They allow charges to flow easily from place to place. The load is what is being powered. A load might be a buzzer, a lightbulb, or a motor.

A closed circuit has no gaps. This allows an electric current to flow. An open circuit has an opening in the path. An electric current cannot flow. Some circuits have switches. A switch can open or close a circuit. When a light switch is turned on, the circuit is closed.

load	closed	open	power source	conduction



______________________ **circuit**



______________________ **circuit**

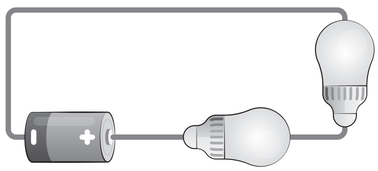
Talk About It!

What electrical devices do you turn on or use before you get to school? Can you count how many devices you use in one day?

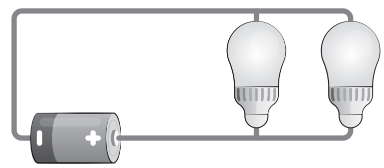
Name: ______________________________ Date: ______________

Directions: Read the text, and study the diagrams. Then, complete the tasks.

A simple circuit has three main parts—a power source, conductors, and a load. A series circuit has only one path for electricity to follow, but it can have multiple loads. A parallel circuit has multiple pathways for electricity to flow. It can have multiple loads.



series circuit



parallel circuit

Materials

2 LED lights　3V battery　clear tape
construction paper　copper foil tape

Tasks

*The copper foil tape is a conductor. But the sticky side is not conductive.

1. Make a simple circuit. Stick the copper tape on the paper to make a path for the current to flow. Remember—batteries have positive sides and negative sides. Try turning your battery around to see if that changes the connection.
2. Make a series circuit.
3. Make a parallel circuit.

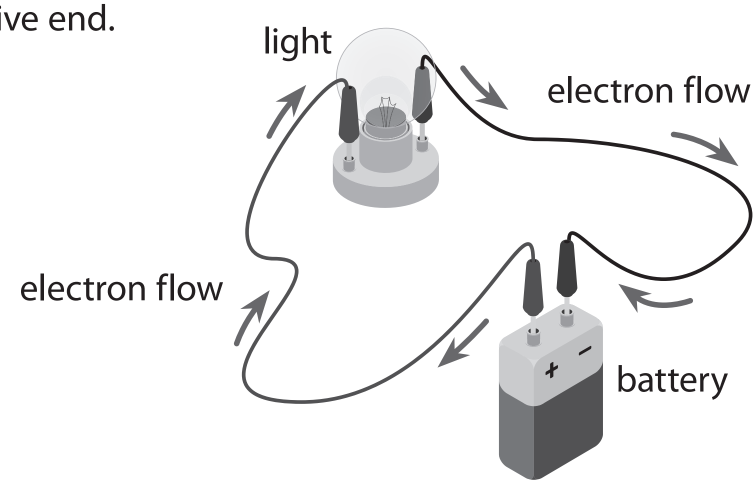
Talk About It!

What did you discover as you made your circuits? What problems came up? How did you solve them?

Name: ______________________________ Date: ______________

Directions: Read the text. Work with others to act out electric circuits. Plan and practice how to act out each scenario. Discuss the questions for each one. Then, perform your circuit models for others.

Electrons are the particles in an electric current that move. They have negative charges. They flow from the negative end of a battery to the positive end.



Circuit Scenarios

1. A simple, closed electric circuit powers a light.
   - How will you use your bodies to show each part of the electric circuit?
   - How will you show the electrons are moving?
   - How will you show the light has turned on?
2. The same circuit changes to an open circuit.
   - How will you show what changes would occur?
3. A series circuit powers three small lights.
   - How will this circuit need to be different?
4. A parallel circuit powers two small fans.
   - How will this circuit need to be different?
   - How will you show the fans are on?
5. Create your own circuit.
   - What type will it be?
   - What will be your load(s)?

