

Electricity and Magnetism

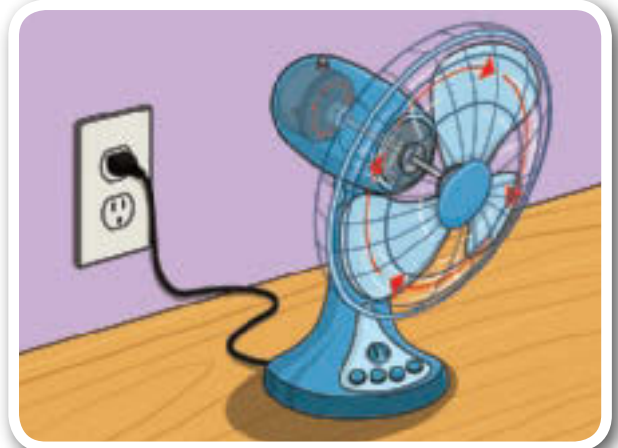
current electricity



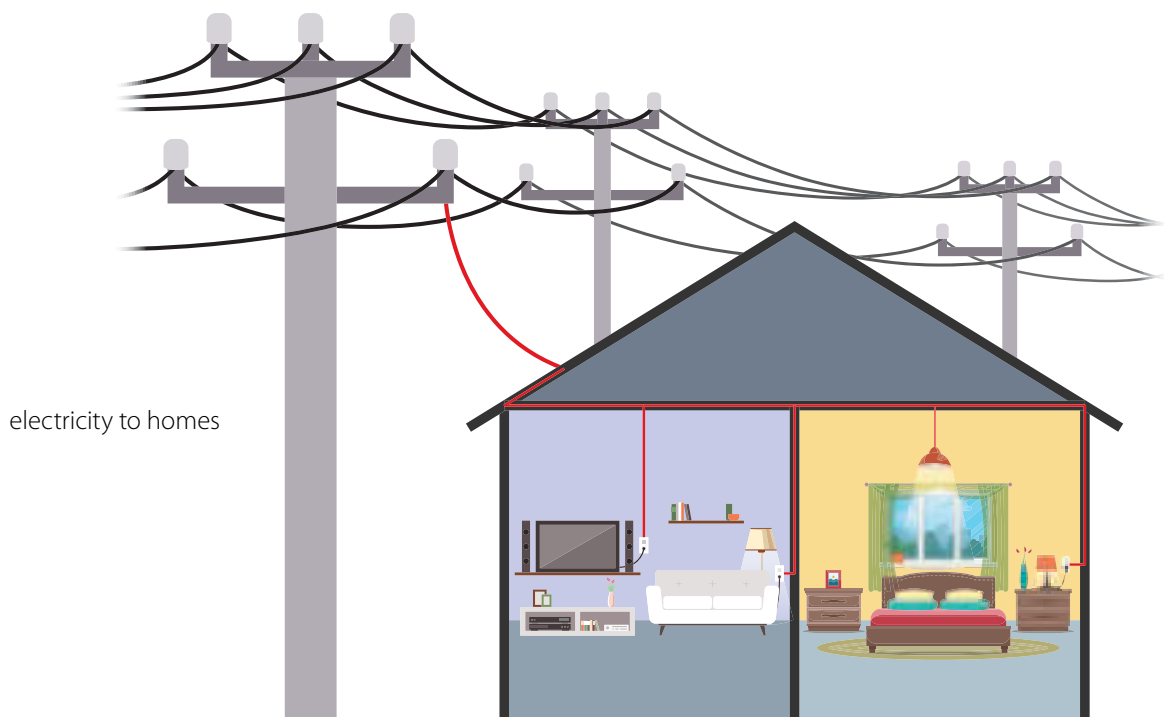
Teacher Guide



static electricity



magnets and motion



electricity to homes

Electricity and Magnetism

Teacher Guide



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Electricity and Magnetism

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Electricity and Magnetism

Teacher Guide

Core Knowledge Science™ 2

Introduction

ABOUT THIS UNIT

The Big Idea

This unit focuses on the scientific concept of electricity and how people use electricity to make things work.

Students are familiar with many devices that use electricity based on day-to-day life. Students understand that certain devices need to be plugged in or turned on to work. However, they may not understand that the energy behind that work is generated by electricity because they cannot see it. In fact, the only experience students may have witnessing electricity is while watching a lightning storm. Electricity generated for everyday use often comes from human-made sources like batteries and power plants.

In this unit, students will trace the path of electricity from the power plant, through their home, and to wall sockets. They will explore different devices that use electricity, as well as safety precautions around the use of electricity. Students will also investigate how magnets are used to produce electricity.

In this unit, students investigate phenomena associated with electricity and magnetism. They will further explore magnetism in Grade 3 Unit 1 *Investigating Forces* and electricity in Grade 4 Unit 1 *Energy Transfer and Transformation*.

Note to Teachers and Curriculum Planners

This unit introduces Grade 2 students to real-world examples and fundamental concepts of electricity and generators of electricity using devices such as magnets. The following are preliminary considerations for planning and instruction relative to this unit:

- Students in Grade 2 have not yet learned the scientific definitions of *charge*, *force*, or *power*. Nor do they yet have any concept of particles that make up matter upon which to build the concept of charges. Students will experience the concept of static electricity as a phenomenon they can observe and influence, but they are not expected to explain its cause in any way. The same is true of current electricity and magnetic force.

Note to Core Knowledge Teachers

Thanks to ongoing research in the field, our understanding of how children learn continues to evolve. In the subject area of science, in particular, students benefit from not just reading about concepts and

ideas, but from hands-on experiences. Following the release of the Next Generation Science Standards (NGSS), the Core Knowledge Foundation used this opportunity to update and enhance the science portion of the *2010 Core Knowledge Sequence*. The result of this effort is the revised *K–5 Core Knowledge Science Sequence*.

While there have been some shifts in the grade levels at which certain topics are recommended, the fundamental principles of pedagogy inherent to the Core Knowledge approach, such as the importance of building a sequential, coherent, and cumulative knowledge base, have been retained.

NGSS does not prescribe a unit specifically about electricity, but the Core Knowledge Foundation retains this content in the *K–5 Core Knowledge Science Sequence*. You may notice that this unit differs slightly in organization from the NGSS units in the CKSci program. Lessons in the NGSS CKSci units are comprised of multiple segments that build to students' demonstration of a complex Performance Expectation. Because *Electricity and Magnetism* is not designed to support any specific NGSS Performance Expectation, the instructional episodes are not grouped into multipart lessons. As such, they are identified simply as *lessons* instead of *lesson segments*.

Online Resources



To download the *K–5 Core Knowledge Science Sequence*, use the links found in the Online Resources Guide.

www.coreknowledge.org/cksci-online-resources

This science unit, aligned to the *K–5 Core Knowledge Science Sequence*, embodies Core Knowledge's vision of best practices in science instruction and knowledge-based schooling, such as the following:

- building students' knowledge of core ideas in life, physical, and Earth sciences, as well as engineering design;
- developing scientific practices that give students' firsthand experience in scientific inquiry, engineering, and technology; and,
- connecting scientific learning to concepts across various disciplines, such as mathematics and literacy.

Related NGSS Dimensions*

This unit, *Electricity and Magnetism*, provides the opportunity to further reinforce the following NGSS Dimensions.

Engineering and Design Performance Expectations:

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

*NEXT GENERATION SCIENCE STANDARDS (NGSS) is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and their endorsement is not implied.

Sources:

NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

National Research Council. 2012. *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Committee on a Conceptual Framework for New K–12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Science and Engineering Practices:

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Constructing explanations (for science) and designing solutions (for engineering)

Crosscutting Concepts:

- Cause and effect
- Systems and system models

Online Resources



For detailed information about the NGSS References, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

BUILDING SCIENCE KNOWLEDGE

What Students Should Already Know

The concept of progressions, articulated in the National Research Council's *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, is very much aligned to the Core Knowledge principle of building new knowledge on prior knowledge. According to the NRC, students build “progressively more sophisticated explanations of natural phenomena” over the course of many years of schooling. “Because learning progressions extend over multiple years, they can prompt educators to consider how topics are presented at each grade level so that they build on prior understanding and can support increasingly sophisticated learning.” In schools following NGSS recommendations, teachers can build on the “prior understandings” captured in the following summaries of NGSS Disciplinary Core Ideas:

PS2.A: Forces and Motion

- Pushes and pulls can have different strengths and directions.
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.

PS2.B: Types of Interactions

- When objects touch or collide, they push on one another and can change motion.

PS3.C: Relationship Between Energy and Forces

- A bigger push or pull makes things speed up, slow down, or change direction more quickly.

ETS1.A: Defining Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems have many acceptable solutions.

What Students Need to Learn

For this unit, the *Core Knowledge Science Sequence* specifies the following content and skills. Specific learning objectives are provided in each lesson throughout the unit.

Lesson 1: What Is Lightning?

- Introduce a unifying phenomenon storyline.
- Describe evidence that electricity is present.

Lesson 2: What Has Electricity?

- Identify examples of things people use that require electricity.
- Express the danger associated with electricity and list safety rules.

Lesson 3: What Are the Types of Electricity?

- Compare and contrast static electricity and electric current.

Lesson 4: It's Not Magic...It's Static!

- Observe evidence of the presence of static electricity.
- Compare the invisible pushes and pulls of static electricity with those of magnets.

Lesson 5: What Are the Sources of Electricity?

- Trace the path of electricity in a home from a power plant, through lines, to wall sockets.
- Compare and contrast devices that plug into wall sockets with those that use batteries.

Lesson 6: What Is a Circuit?

- Describe a simple circuit.
- Identify the battery, wire, and bulb in a simple circuit.

Lesson 7: Building a Simple Circuit

- Assemble a simple circuit to light a bulb.
- Explain why an incomplete circuit does not allow a bulb to light up.

Lesson 8: Magnets and Electricity

- Compare and contrast an electric motor that makes a fan spin with a spinning generator that produces electricity.

Lesson 9: Magnets and Rotating Motion

- Explore how magnets can make something rotate.

Lesson 10: Science in Action: A Day with an Electrician

- Recognize the basic practice of an electrician.
- Describe physical features and importance of insulated wire.

What Teachers Need to Know

Supportive information on the content standards and the science they address is provided throughout the lessons at points of relevance:

Know the Standards: These sections, found later in this Teacher Guide, explain what to teach and why, with reference to NGSS and Core Knowledge expectations, as well as connections to relevant math and reading language arts standards.

Know the Science: These sections provide supporting, adult-level, background information or explanations related to specific science concepts, examples, or Disciplinary Core Ideas.

USING THE STUDENT BOOK

Student Book



The *Electricity and Magnetism* Student Book includes seven chapters, intended to be read aloud by the teacher as the students look at images on each page.

As you will note when you examine the Student Book, minimal text is included on each page. Instead, colorful photos and engaging illustrations dominate the Student Book pages. The design of the Student Book in this way is intentional because students in Kindergarten–Grade 2 are just learning to read. At these grade levels, students are learning how to decode written words, so the complexity and amount of text that these young students can actually read is quite limited.

While some advanced students may be able to read words on a given page of the Student Book, as a general rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

The intent of the Grades K–2 CKSci lessons is to build students’ understanding and knowledge of science concepts, as well as of associated practices and skills. It is for this very reason that in Grades K–2 CKSci, the core content of each lesson is reinforced to students using a teacher Read Aloud, accompanied by example images and diagrams. Cognitive science research has clearly documented the fact that students’ listening comprehension far surpasses their reading comprehension well into the late elementary and early middle school grades. Said another way, students are able to understand and grasp far more complex ideas and text that they hear read aloud than they would ever be able to read or comprehend when they read to themselves. For a more thorough discussion of listening and reading comprehension and the underlying cognitive science research, teachers may want to refer to Appendix A of the Common Core State Standards for English Language Arts, noting in particular the Speaking and Listening section of the appendix.

Use this link to download the CKSci Online Resources for this unit, where the specific link to this appendix can be found:

www.coreknowledge.org/cksci-online-resources

USING THE TEACHER GUIDE

Pacing

The *Electricity and Magnetism* unit is one of five units in the Grade 2 CKSci series. We encourage teachers to complete all units during the school year. Each Core Lesson requires thirty to forty-five minutes of instruction time. The time it takes to complete a full lesson depends on class size and individual circumstances. Each lesson concludes with a Check for Understanding, providing the teacher with an opportunity for formative assessment.

At the end of this unit Introduction, you will find a blank Pacing Guide on page 12, which you may use to plan how you might pace the lessons, as well as when to use the various other resources in this unit. We strongly recommend that you preview the unit in full before beginning and create your pacing guide before teaching the first lesson. As a general rule, we recommend that you spend no more than 15 days teaching the *Electricity and Magnetism* unit so that you have time to teach the other units in the Grade 2 CKSci series.

The Core Lessons

- Lesson time: Most Core Lessons constitute one classroom session of thirty to forty-five minutes. Some lessons cover two or three days of instruction. Some single-day activities and performance tasks might require setting aside a longer block of time.
- Lesson order: The lessons are coherently sequenced to build from one to the next, linking student engagement across lessons and helping students build new learning on prior knowledge.

Unit Big Question: Why do the lights sometimes go out during a thunderstorm?		Lesson Questions
Lesson 1	What Is Lightning?	Where can you see evidence of electricity?
Lesson 2	What Has Electricity?	What familiar devices are powered by electricity?
Lesson 3	What Are the Types of Electricity?	How are static electricity and electric current different?
Lesson 4	It's Not Magic...It's Static!	What does evidence of static electricity look like?
Lesson 5	What Are the Sources of Electricity?	Where does the electricity that powers our familiar devices come from?
Lesson 6	What Is a Circuit?	What is a circuit?
Lesson 7	Building a Simple Circuit	How can we build a simple circuit?
Lesson 8	Magnets and Electricity	How do electric motors and electricity generators use magnets?
Lesson 9	Magnets and Rotating Motion	Can the push of a magnet make something rotate?
Lesson 10	Science in Action: A Day with an Electrician	What does an electrician do?

Activity Pages

Activity Pages



AP 1.1

AP 2.1

AP 3.1

AP 4.1

AP 5.1

AP 6.1

AP 7.1

AP 8.1

AP 9.1

Black line reproducible masters for Activity Pages, as well as an Answer Key, are included in Teacher Resources on pages 73–82. The icon shown to the left appears throughout the Teacher Guide wherever Activity Pages (AP) are referenced.

Lesson 1—What Can We Do with and without Electricity? (AP 1.1)

Lesson 2—Electricity Scavenger Hunt (AP 2.1)

Lesson 3—Types of Electricity (AP 3.1)

Lesson 4—Static Stations (AP 4.1)

Lesson 5—Follow the Electricity (AP 5.1)

Lesson 6—Will the Bulb Light Up? (AP 6.1)

Lesson 7—Simple Circuits (AP 7.1)

Lesson 8—Motors and Generators (AP 8.1)

Lesson 9—Magnets and Rotation (AP 9.1)

Online Resources for Science

Online Resources



For each CKSci unit, the Teacher Guide includes references to online resources (including external websites and downloadable documents) to enhance classroom instruction. Look for the icon on the left.

Use this link to download the CKSci Online Resources for this unit:

www.coreknowledge.org/cksci-online-resources

Teaching Strategies

Start with the familiar.

Lead with an experience. Begin each lesson with a demonstration, activity, or question about a phenomenon to engage students and focus their attention on the topic. Start with the familiar. Every science topic introduced to students relates in some way to their known world and everyday experiences. The purpose of every lesson is to build a bridge between what is familiar to students and broader knowledge about the way the world works.

Ask driving questions.

The unit is governed by a Big Question, and each lesson poses a more specific sub-question as students are introduced to new science content. Use these questions to engage students in conversation and help them think about how their own real-world experiences relate to the topic.

Encourage scientific thinking.	<p>Approach the lessons with students not as learning about science but as learning about the world with a scientific mind. Science learning models science practice.</p> <p>Throughout the lessons, encourage students to ask questions about what they observe, do, and read. Record relevant questions in a prominent place in the classroom. Guide students back to these questions as opportunities to answer them emerge from readings, demonstrations, and activities.</p>
Use continuous Core Vocabulary instruction.	<p>During instruction, emphasize Core Vocabulary terms and their meanings in context rather than relying on isolated drill for memorization of definitions. Through scaffolded questioning, encourage students to come up with definitions in their own words and to use the words in their own sentences.</p> <p>Core Vocabulary words for each lesson, as well as Language of Instruction, other key terms teachers are encouraged to use in discussing topics with students, are provided at the start of each lesson. You can find Core Vocabulary and Language of Instruction definitions in the Glossary on pages 83–84.</p>
Emphasize observation and experience.	<p>Lessons employ various ways for students to learn, including watching, listening, reading, doing, discussing, and writing.</p>
Use science practices.	<p>Give students opportunities to discover new content knowledge through investigation and to use their new knowledge both in problem-solving exercises and as evidence to support reasoning. Students learn what science and engineering practices are by engaging in those same practices as they learn.</p>
Make frequent connections.	<p>Use a combination of demonstrations and reading materials, rich with examples, to help students recognize how the science concepts they are learning apply in their everyday lives. Prompt students to relate lesson content to their own experiences, to relate the new and unfamiliar to the familiar, and to connect ideas and examples across disciplines.</p>
Monitor student progress.	<p>Use verbal questioning, student work, and the Check for Understanding assessments at the end of each lesson to monitor progress during each lesson and to measure understanding at the conclusion of the unit. Many lessons provide tips to help you support students who need further explanations or clarifications.</p>

Effective and Safe Classroom Activities

Online Resources



Conducting safe classroom demonstrations and activities is essential to successful elementary science education. The following resources provide Core Knowledge's recommendations for developing effective science classroom activities.

These resources, included at the back of the Teacher Guide on pages 85–89, consist of the following:

- Classroom Safety for Activities and Demonstrations
- Strategies for Acquiring Materials

- Advance Preparation for Activities and Demonstrations
- What to Do When Activities Don't Give Expected Results

These resources may also be accessed within the CKSci Online Resources Guide for this unit, available at

www.coreknowledge.org/cksci-online-resources

MATERIALS AND EQUIPMENT

The unit requires a large variety of materials to support various ways of learning (including doing, discussing, listening, watching, reading, and writing). Prepare in advance by collecting the materials and equipment needed for all the demonstrations and hands-on investigations.

- Roll paper, poster board, or a bulletin board should be dedicated at the beginning of the unit to serve as a question board to cumulatively document and return to student questions. The question board is referred to in the materials for lessons in which it is used but is not repeated in the materials listed here.
- Internet access and the means to project images/videos for whole-class viewing are also required in many lessons but are not repeated below.

Lesson 1 What Is Lightning?

- flashlight

Lesson 2 What Has Electricity?

- flashlight
- stapler
- box of pens/pencils
- rolls of tape/tape dispenser
- lunch box
- blocks or art supplies
- variety of classroom electronics (e.g. electric hole puncher, computer monitor, lamp, fan, projector, television, router/modem)

Lesson 3 What Are the Types of Electricity?

- N/A

Lesson 4 It's Not Magic...It's Static!

- plastic rod
- pieces of cloth (3, plus 1 for teacher demonstration)
- plastic (grocery) bag
- inflated balloon
- carton of salt
- tin of black pepper
- plastic spoon
- disposable bowl
- foam plates (2)
- wool cloth
- plastic comb
- torn pieces of paper
- timer

Lesson 5 What Are the Sources of Electricity?

- flashlight
- lamp with light bulb

Lesson 6 What Is a Circuit?

- rubber ball
- single-throw light switch
- yellow markers (1 per student)

Lesson 7 Building a Simple Circuit

- D-cell batteries (1 per group)
- 8–10 inches of coated/insulated copper wire (2 per group)
- electrical tape (2 inches per group)
- scissors (1 pair per group)
- wire strippers
- flashlight bulbs (1 per group)

Lesson 8 Magnets and Electricity

- N/A

Lesson 9 Magnets and Rotating Motion

- compass (1 per group)
- magnet wands or bar magnets with labeled poles (1 per group)
- paper or plastic cup (1 per group)

Lesson 10 Science in Action: A Day with an Electrician

- discarded power cord (1 foot per group)
- scissors (1 pair per group)
- craft trays (1 per group, optional)

ELECTRICITY AND MAGNETISM PACING

_____’s Class

Note to Teacher: *Electricity and Magnetism* is intended to be taught as the fourth unit of Grade 2 CKSci.

Week 1

Day 1

Day 2

Day 3

Day 4

Day 5

--	--	--	--	--

Week 2

Day 6

Day 7

Day 8

Day 9

Day 10

--	--	--	--	--

Week 3

Day 11

Day 12

Day 13

Day 14

Day 15

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UNIT 4

Electricity and Magnetism

OVERVIEW

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lessons	Lesson Questions	Advance Preparation
1. What Is Lightning?	Where can you see evidence of electricity?	Read Student Book, Chapter 1.
2. What Has Electricity?	What familiar devices are powered by electricity?	Read Student Book, Chapter 2. Set up materials for student investigation.
3. What Are the Types of Electricity?	How are static electricity and electric current different?	Read Student Book, Chapter 3.
4. It's Not Magic...It's Static! (two class sessions)	What does evidence of static electricity look like?	Gather and set up materials for student investigation.
5. What Are the Sources of Electricity?	Where does the electricity that powers our familiar devices come from?	Read Student Book, Chapter 4. Prepare materials for student investigation.
6. What Is a Circuit?	What is a circuit?	Read Student Book, Chapter 5. Prepare class for student investigation.
7. Building a Simple Circuit	How can we build a simple circuit?	Prepare materials for student investigation.
8. Magnets and Electricity	How do electric motors and electricity generators use magnets?	Read Student Book, Chapter 6. Prepare means to project images/video to class.
9. Magnets and Rotating Motion	Can the push of a magnet make something rotate?	Gather and set up materials for student investigation.
10. Science in Action: A Day with an Electrician (two class sessions)	What does an electrician do?	Read Student Book, Chapter 7. Gather materials for student investigation.

What's the Story?

Electricity is the type of energy that enables many familiar household devices to work. It makes light bulbs work, warms heat-producing appliances, and powers the movement of devices with moving parts. Electricity powers every device in a home that plugs into a wall socket. Electricity also powers devices that run on batteries. The current electricity that operates devices that plug in is produced in electric power plants. The electricity is transferred in power lines to homes and other buildings.

Static electricity is a different type of electricity. It is the electricity on the surface of objects. Static electricity can be observed in lightning and in the spark that sometimes can jump from a fingertip to a doorknob. Static electricity can also be observed as an invisible push or pull between materials. Magnets also generate invisible pushes and pulls. This property of magnets makes them useful in mechanical motors that rotate because of electricity.

In Lessons 1–3, 5, 6, 8, and 10, students listen and read along with teacher Read Aloud of Student Book Chapters 1–7. Students identify many devices that use electricity, differentiate between current and static electricity, identify the makeup of a circuit, and relate magnets to electrical devices. Reading about electricity and magnetism is reinforced by teacher demonstrations. Students further explore their environment and investigate through manipulation of objects and materials.

In Lesson 4, students observe and influence the effects of static electricity by manipulating hands-on materials.

In Lesson 7, students assemble a simple circuit to figure out that electricity must flow in a complete circuit.

In Lesson 9, students use a magnet to manipulate a compass to demonstrate that magnets can induce rotating motion.

In short, **electricity and magnetism are involved in the operation of many familiar devices.**

Helping students look for electricity and magnetism in the operation of familiar devices lays the groundwork for cause-and-effect thinking and a problem-solving mindset as they continue learning.

LESSON 1

What Is Lightning?

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: Where can you see evidence of electricity?

Tie to the Anchoring Phenomenon: During a thunderstorm, many different things can happen. Not only do storms bring a lot of rain and loud booming noises, but they can also cause the electricity to go out. Some students may be familiar with having lost power temporarily during a storm.

AT A GLANCE

Learning Objectives

- ✓ Introduce a unifying phenomenon storyline.
- ✓ Describe evidence that electricity is present.

Instructional Activities

- teacher Read Aloud
- class discussion
- teacher demonstration

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

electric/electrical electricity lightning

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

appliance electric line electrical storm power outage
power utility pole

Instructional Resources

Student Book



Ch. 1

Student Book, Chapter 1

"Lightning Outside, Lights Out Inside!"

Activity Page



AP 1.1

Activity Page

What Can We Do with and without Electricity? (AP 1.1)

Materials and Equipment

Collect or prepare the following item:

- flashlight

THE CORE LESSON 1

1. Introduce the Big Question.

Ask a volunteer to state the Big Question that you'll be answering in this unit—**Why do the lights sometimes go out during a thunderstorm?**

Make sure students are sitting still in their seats, and then turn the lights off in the classroom to simulate a power outage. Explain that this is what it is like when the lights go out during a storm. Invite students to describe this experience by asking what they can hear, see, or sense around them.

Turn on the flashlight, shining it up at the ceiling. Talk about how flashlights—or candles—are good to have to help you see in the dark when the lights are out. Turn the classroom lights back on.

Invite students to recap any experiences they may have had with power outages or blackouts. **Ask students** to describe what they remember about the event, such as if it happened during the daytime or at night and how long the power was out.

Tell students that before they can answer the unit's Big Question about the lights going out during a thunderstorm, they first need to understand more about electricity.

2. Read together: “Lightning Outside, Lights Out Inside!”

Student Book



Ch. 1

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 2

Differentiation

Ask students to turn to page 2 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Lightning Outside, Lights Out Inside!” and tell them to pay special attention to what causes the lights to go out as you read.

Ask students to look at the picture on page 2. Explain that the picture introduces us to the main character, Eva. Talk about what she is doing (setting the table).

LITERAL—What is the weather like where Eva lives?

» It is stormy; there is lightning; it is windy and raining; there is thunder.

CORE VOCABULARY—Explain that **lightning** is a bolt of electricity that occurs naturally outside. It happens between the clouds (or air) and the ground.

LITERAL—What is the difference between thunder and lightning?

» Lightning flashes and thunder rumbles.

SUPPORT—Discuss what students know about lightning. Invite students to share whether they have seen flashes of lightning before. **Ask**, What did it look like? How did it make you feel when you saw it?

INFERENTIAL—What do you think caused the lights to go out at Eva’s house? (See **Know the Science**.)

» Sample answer: Maybe the lightning struck something outside.

Know the Science

TEACHER DEVELOPMENT

Thunder and Lightning: Thunder and lightning can occur at similar times during a thunderstorm. Although thunder is loud and can sometimes make your windows rattle, it is not a cause for power outages. Additionally, the mere presence of lightning does not cause power outages. Rather, lightning has to strike something, like a utility pole, for it to disrupt the flow of electricity. Students will read about the possible causes for why Eva’s house lost its power on the next page. Although we always think of lightening moving from clouds to the ground, it also can move from the ground up to clouds.

Ask students to look at the picture on page 3. Talk about what students notice in the picture. Explain that the picture is dim or dark because the lights have gone out in the house. In the background, they can see a bolt of bright lightning outside the window.

LITERAL—What is going on at Eva’s house?

- » The lights are out.
- » The TV went off.
- » The microwave stopped.
- » The lights on the stove are dark.
- » The fridge went quiet.

SUPPORT—Explain that when the electrical power “goes out,” it means that electricity is no longer being supplied to a house. Explain that it is often a long distance between where electrical power is generated and where houses are. Anywhere between the power plant and a house is susceptible to being harmed by lightning. You might want to diagram this and save the drawing for later in the unit.

SUPPORT—Give students examples of things that use electrical power. For example, the computer needs power to turn on. You cannot use a remote-controlled toy without some kind of electrical power. Clarify that all of the objects in Eva’s house that have turned off (i.e., the television, fridge, microwave, etc.) use electrical power to work.

CHALLENGE—Invite students to work in pairs to come up with a list of objects (e.g., toys, electronics, appliances, etc.) that need electrical power to work.

EXTEND—**Ask students** to discuss what life would be like without electrical power.

LITERAL—What could have caused the power to go out at Eva’s house?

- » A tree limb could have fallen on electric lines.
- » Lightning might have struck a utility pole.

Pages 4

Ask students to look at the picture on page 4. Talk about what students notice in the picture. Explain that the picture shows the neighborhood without any electricity.

CORE VOCABULARY—Explain that **electricity** is a form of energy that causes a change to get things to work. Electricity causes the bulbs to shine in the classroom. It powers televisions, radios, and computers, too. Objects that are **electric/electrical** require electricity to run.

INFERENTIAL—How do you think the picture would look if the neighborhood had electricity?

- » Sample answer: You would see lights on in the houses or outside on the street.

INFERENTIAL—Do you think the other houses in the neighborhood had their televisions, refrigerators, and microwaves turn off during the storm? Why?

- » Sample answer: Yes, because those need electricity to work, and the houses in the neighborhood do not have electricity.

LITERAL—What is the only kind of light that Eva can see outside?

- » lightning

Page 5

Differentiation

Ask students to look at the picture on page 5. Explain that Eva seems to be settling in with the idea of not being able to watch television.

LITERAL—Why can't Eva watch television?

- » The TV is off because the electricity is out. The TV needs electricity to work.

SUPPORT—Explain that appliances are objects that are designed to perform special tasks and are often found in kitchens, bathrooms or laundry areas in a home. For example, the refrigerator is an appliance and so is a washing machine.

Ask students to name other examples of appliances.

LITERAL—How do you know if something, like an appliance, has electricity?

- » It will work; it will turn on; it will do something it is supposed to do.

INFERENTIAL—What would have happened if the electricity had gone out at Eva's house before their dinner was ready? Why? (See **Know the Standards.**)

- » Sample answer: The dinner would not have been cooked because they need electricity to make their kitchen appliances work.

Know the Standards

TEACHER DEVELOPMENT

CCC 2 Cause and Effect: Electricity is a form of energy and power that causes things to work. On page 5 of the Student Book, students read about the effects that not having electricity has on Eva's family and home. For example, their kitchen appliances will only work if there is electricity.

INFERENTIAL—Why does Eva’s mom suggest dining by candlelight? (Remind students of what happened when you turned out the lights in the classroom.)

» so they can see while they eat dinner

3. List different types of activities.

Activity Page



AP 1.1

Distribute What Can We Do with and without Electricity? (AP 1.1). Have students draw pictures or write words to identify activities they can do with electricity in the left column and activities they can do without electricity in the right column.

Students may discuss their ideas in pairs or small groups but should record on their own Activity Pages.

Circulate around the room, and use prompts such as “What kinds of things would you suggest Eva do with her parents if she does not have electricity at home?”

If time permits, invite students to share their list of activities and see which pairs or groups of students have similar ideas.

4. Check for understanding.

Monitor Progress

Formative Assessment

Review student responses in the two columns on What Can We Do with and without Electricity? (AP 1.1) to determine student understanding of the following concepts:

- Electricity makes certain objects work, like appliances.
- Without electricity, you cannot do such things as use lights, watch TV, or play on the computer.

See the Activity Page Answer Key for correct answers and sample student responses.

LESSON 2

What Has Electricity?

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: What familiar devices are powered by electricity?

Tie to the Anchoring Phenomenon: Lightning is a type of electricity that people can see as a bright bolt in the sky during a thunderstorm. However, we cannot see the electricity that is used to power our homes and personal devices. This electricity comes from a human-made source rather than a natural one. Even though we can't see electricity, we still know that it exists because it supplies power to the things that we use every day.

AT A GLANCE

Learning Objectives

- ✓ Identify examples of things people use that require electricity.
- ✓ Express the danger associated with electricity and list safety rules.

Instructional Activities

- teacher Read Aloud
- class discussion
- question generation

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

danger **plug** **socket**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

appliance **cord** **power** **recharge**
shock **wire**

Instructional Resources

Student Book



Ch. 2

Activity Page



AP 2.1

Student Book, Chapter 2
“Things That Use Electricity”

Activity Page
Electricity Scavenger Hunt
(AP 2.1)

Materials and Equipment

Collect or prepare the following items:

- flashlight
- stapler
- box of pens/pencils
- rolls of tape/tape dispenser
- lunch box
- blocks or art supplies
- variety of classroom electronics (e.g., electric hole puncher, computer monitor, lamp, fan, projector, television, router/modem)

Advance Preparation

- Before class, set your objects around the classroom, placing them in various places where students will easily be able to spot them. Some of the objects in the list use electricity (some of which may not be able to be moved around), and others do not (they serve as decoys).
- Activity Page 2.1 requires students to find six objects that use electricity, so be sure there are at least six objects in your classroom for students to identify. If necessary, ask your school’s maintenance department if they can lend you some electronic objects for the activity.

THE CORE LESSON 2

1. Focus student attention.

Ask a volunteer to state the Big Question that you’ll be answering in this unit—**Why do the lights sometimes go out during a thunderstorm?**

Review with students what happened at Eva’s house in Chapter 1 of the Student Book.

- » A storm caused the electricity to go out at Eva’s house and also at the other houses on her block.
- » The power outage caused several things in her house to stop working, like the microwave, fridge, and television.

2. Read together: “Things That Use Electricity.”

Student Book



Ch. 2

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 6

Differentiation

Ask students to turn to page 6 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Things That Use Electricity,” and tell them to pay special attention to how Eva can tell whether an object uses electricity.

Ask students to look at the picture on page 6. Explain that the picture shows an electrical socket in the wall with an electrical cord that plugs into it. **Ask students** if this looks familiar and where they have seen these objects before.

CORE VOCABULARY—Explain that a **socket** is a small opening in a wall where electrical cords can be plugged in to get electricity.

CORE VOCABULARY—Explain that a **plug** is found on the end of an electrical cord and that it fits into a socket to help move electricity from the socket to the cord and into an electrical device.

SUPPORT—Use this opportunity to discuss electrical safety and the **danger** associated with electrical sockets. Remind students that they should never put their fingers or toes into a socket, or anything else except a plug on the end of an electrical device. Caution students against getting electrical sockets and plugs wet. Make sure students understand that it is best for adults to plug in electrical devices.

LITERAL—What does Eva look for to start her list? (See **Know the Standards 1.**)

- » She looks for all the electrical sockets and the things that are plugged into them.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 1 Asking Questions: Scientists ask questions to learn more about the natural world. Here, Eva is asking herself questions to investigate and find the things in her house that use electricity. Talk with students about the questions Eva is asking to determine whether or not something uses electricity. For example, Eva is asking herself whether an object has a plug or whether there is an outlet near an appliance.

Page 7

Differentiation

Ask students to look at the three pictures on page 7. Explain that Eva is beginning her hunt in the kitchen for objects that use electricity.

LITERAL—What appliances in the kitchen does Eva find that use electricity?

- » coffee pot
- » toaster
- » refrigerator
- » microwave
- » stove

EVALUATIVE—How does Eva know that the coffee pot and toaster use electricity?

- » They are both plugged into electrical sockets.

CHALLENGE—Invite students to think of other things in a kitchen that use electricity, such as blenders, electric kettles or can openers, rice makers, waffle makers, slow cookers, air fryers, or other appliances that they may see adults use.

Page 8

Differentiation

Ask students to look at the three pictures on page 8. Explain that Eva is now in the living room. Talk about what students see. Discuss whether these items look familiar. Before reading the page, ask students if they think the items pictured use electricity.

INFERENTIAL—Which items in the living room are plugged into a socket, and which ones aren't?

- » The lamp, television, video game console, and computer are plugged into a socket.
- » The ceiling fan and light are not plugged into a socket.

LITERAL—How does the ceiling fan get electricity if it is not plugged into a socket?

- » It is wired directly to the house's electricity through the ceiling.

INFERENTIAL—How would you know if electricity were powering a ceiling fan? How would you know if it were powering a lamp? (See **Know the Standards 2.**)

- » You would see the fan spinning, and the light on the lamp would be turned on.

Know the Standards

TEACHER DEVELOPMENT

2. CCC 2 Cause and Effect: Students should be getting more familiar with the cause-and-effect relationship between electricity and the objects they power. The objects are able to work (e.g., lights turning on, fans spinning) because of the electricity they receive.

SUPPORT—Use this opportunity to point out to students that electrical objects are either plugged into the wall socket or wired directly into a wall/ceiling. Explain that this is because electrical wires run throughout the inside of a house. They are hidden behind walls and ceilings.

Pages 9–10

Ask students to look at the three pictures on page 9. Explain that Eva is in the bathroom now.

LITERAL—What items in the bathroom use electricity?

- » light and fan
- » hair dryer
- » curling iron
- » electric toothbrushes
- » electric shaver

INFERENTIAL—How are the electric toothbrushes and the electric shaver different from other appliances in the bathroom? (See **Know the Science.**)

- » They use electricity to recharge.
- » They can work even when they are not plugged in.

LITERAL—How does Eva know that the hair dryer and curling iron use electricity?

- » They have cords that plug into the wall sockets.

Ask students to look at the three pictures on page 10. Explain that Eva is looking for electrical objects in her bedroom.

LITERAL—What items in Eva’s bedroom use electricity?

- » lamp
- » tabletop fan
- » night light

EVALUATIVE—What is the difference between how the tabletop fan in Eva’s room and the ceiling fan in the living room receive electricity?

- » Sample answer: The tabletop fan plugs in to get electricity; the ceiling fan gets electricity from wires hidden in the ceiling.

Know the Science

TEACHER DEVELOPMENT

Electricity and Batteries: Some electronic devices, like electric toothbrushes and shavers, have batteries that allow them to be used when they are not plugged into the wall socket. When the battery is part of a complete circuit, it provides the electrical potential energy to create electrical power. A battery is portable, which makes it appropriate for many devices. Students will learn more about batteries in Lesson 5 of this unit.

Ask students to look at the three pictures on page 11. Explain that Eva and her mother are now looking for electrical objects in the garage.

LITERAL—What items in the garage use electricity?

- » lawn mower
- » workbench light
- » power tools (drill and saw)
- » garage door

SUPPORT—You may need to clarify for some students that garage doors move up and down. This movement is powered by electricity. **Ask students** if the garage door in the picture has a cord.

- » It does.

3. Do a scavenger hunt.

Activity Page



AP 2.1

Distribute Electricity Scavenger Hunt (AP 2.1). Students will look around the classroom for six objects that use electricity and list or draw pictures of them in the boxes on the table. Students may conduct their scavenger hunts in pairs or small groups but should record on their own Activity Pages. Make sure you have placed the decoys prior to students beginning the hunt.

Preface the activity with a quick reminder about safety. Tell students that they are not allowed to touch any of the cords, wires, plugs, or sockets but that they are welcome to visually inspect things around the classroom.

Before students begin, prompt them to discuss how they will decide whether or not something uses electricity. **Ask students** what they will look for to make their determination.

- » Sample answer: We will look for wall sockets or objects that have cords with plugs on them.

Prompt students to think about how different objects work. Does it turn on or off? Does it move or make a noise? These are additional questions students can ask themselves when thinking about what uses electricity.

Differentiation

EXTEND—As a homework assignment, have students make a list of all the things that use electricity in their homes. Students may identify the same things that Eva did in Chapter 2, but they may also find additional objects that use electricity. Save some time in the next class session for students to share the types of things they found.

4. Check for understanding.

Monitor Progress

Formative Assessment

Review student findings on Electricity Scavenger Hunt (AP 2.1) to determine student understanding of the following concepts:

- Things that use electricity have cords with plugs.
- Things that use electricity plug into sockets.
- Things that use electricity can be wired directly into walls or ceilings.
- Things that use electricity can be turned on or off.

See the Activity Page Answer Key for correct answers and sample student responses.

LESSON 3

What Are the Types of Electricity?

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: How are static electricity and electric current different?

Tie to the Anchoring Phenomenon: Up until this point, students have been focusing on lightning and current electricity. Here, they will learn the difference between static and current electricity, which will prepare them for their hands-on investigations in Lesson 4.

AT A GLANCE

Learning Objective

- ✓ Compare and contrast static electricity and electric current.

Instructional Activities

- teacher Read Aloud
- class discussion

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

current electricity **power line** **static electricity**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

charge **electrical storm** **flow** **lightning**
spark **surface**

Instructional Resources

Student Book



Ch. 3

Student Book, Chapter 3
“Two Types of Electricity”

Activity Page



AP 3.1

Activity Page
Types of Electricity (AP 3.1)

THE CORE LESSON 3

1. Focus student attention.

Ask a volunteer to state the Big Question that you’ll be answering in this unit—**Why do the lights sometimes go out during a thunderstorm?**

Review with students what they have been learning about how to tell whether something uses electricity. Let students know that there is more than one type of electricity and that today they will learn about how the two types are alike and different.

2. Read together: “Two Types of Electricity.”

Student Book



Ch. 3

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Pages 12–13

Ask students to turn to page 12 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Two Types of Electricity,” and as you read, ask them to pay special attention to how the two types of electricity are different or similar.

Ask students to look at the picture on page 12. Talk about what students see in the picture. Point out the lightning that is visible in the sky through the window.

LITERAL—What does Eva want to know about electricity?

- » She wants to know how the storm made the electricity go out. She also wants to know why her mom cannot fix it.

EVALUATIVE—Do you think the electricity is back on at Eva’s house? Why or why not?

» No, because the room is still dark; they are using a candle for light.

Ask students to look at the two pictures on page 13. Talk about what students notice in each picture. For the picture on top, **ask students** if they have ever seen or experienced hair attracted to a balloon or clothes sticking together when they come out of a dryer.

CORE VOCABULARY—Explain that **static electricity** is a type of electricity that occurs on the surfaces of objects. Static electricity can transfer from one surface to another. It can cause a spark. Ask students to provide examples of static electricity that they have experienced.

CORE VOCABULARY—Explain that **current electricity** is a type of electricity that flows. This is the type of electricity that provides power to our homes.

LITERAL—What are the two types of electricity?

» static electricity and current electricity

INFERENTIAL—Which picture shows static electricity? Which picture shows current electricity?

» The picture of the girl’s hair being pulled toward the balloon shows static electricity.

» The picture of the appliances shows items that use current electricity.

EVALUATIVE—Which terms on the page describe how static electricity and current electricity move?

» Static electricity occurs when objects *rub* together; it can *go* from one surface to another.

» Current electricity *exists in wire*.

Differentiation

CHALLENGE—Challenge students to tell how static and current electricity are different and how they are similar.

Page 14

Ask students to look at the picture on page 14. Talk about what students notice in the picture. Focus on what the child in the picture is wearing (socks) and where he is standing (on carpet).

INFERENTIAL—What do you think is happening to the boy in the picture?

» He is getting a little shock!

Encourage students to share whether they have had any experiences getting a shock like the boy in the picture. **Ask students** to describe what the shock felt like.

LITERAL—Is a shock like the one the boy is getting in the picture caused by static or current electricity?

» It is from static electricity.

LITERAL—Remind students that static electricity occurs on surfaces. What are the surfaces involved in the static electricity that the boy is experiencing in this picture?

» the socks and the carpet

Differentiation

EXTEND—Invite students to learn about why touching something that is metal, like a doorknob, causes a shock. (See **Know the Science 1**.)

Pages 15–16

Ask students to look at the picture on page 15. Talk about the giant lightning bolt they see on the page. Emphasize that the lightning is in the sky, coming from the clouds.

LITERAL—What is needed for lightning to occur?

» clouds

EVALUATIVE—Describe how lightning moves.

» It can jump between clouds. It can also jump from a cloud to the ground.

INFERENTIAL—Why is lightning considered static electricity and not current electricity?

» It comes from the surfaces of clouds and not through wires.

Differentiation

SUPPORT—Invite a volunteer up to draw a picture for the class of lightning jumping between clouds. Invite a second volunteer to draw a picture of lightning jumping between the clouds and the ground.

EVALUATIVE—Which kind of static electricity is more dangerous, lightning or a static shock from a doorknob? Why?

» The lightning is more dangerous. It must have a greater electrical strength.

SUPPORT—Take a moment to emphasize safety protocols for students when lightning is visible in the sky. Remind students to stay indoors during storms that produce lightning.

Know the Science

TEACHER DEVELOPMENT

1. It's Shocking! Certain types of materials, such as the iron in a doorknob, are conductors of electricity. This means they allow the existence of an electrical field. This is why the boy in the picture feels a shock when he touches the doorknob. The spark occurs because of the conductive nature of the metal! Students will learn more about electricity when they build a circuit later in the unit.

Ask students to look at the picture on page 16. Explain that what they see in the picture are power lines. Talk with students about whether or not they have seen these outside. Point out that the power lines in this picture are located in the countryside.

CORE VOCABULARY—Explain that **power lines** are giant wires that carry electricity to your home. (See **Know the Science 2.**)

LITERAL—What does current electricity need to exist?

- » power lines; wires

EVALUATIVE—Where is the electricity in this picture?

- » in the wires

INFERENTIAL—What do people have to think about when they build power lines?

- » Who needs electricity?
- » Where does the electricity need to go?

Page 17

Ask students to look at the picture on page 17. Talk about what students see in the picture.

LITERAL—What are the different ways that power lines can break or be damaged?

- » Sample answer: A storm can make trees break and fall on power lines. Lightning can strike the wires.

INFERENTIAL—Why are trees a threat to power lines?

- » Sample answer: Trees are tall. If they fall over, they can fall on top of the power lines.

EVALUATIVE—Do you think these power lines in the picture still work? Why or why not?

- » Sample answer: No, because the trees broke them.

Know the Science

TEACHER DEVELOPMENT

2. Power Lines: Power lines allow electricity to be active over long distances. They all lead back to power plants, which is where the electricity originates. Power plants are facilities that generate electricity. In reality, a power plant establishes an electrical potential difference, which is called a voltage. Voltage is what traverses any electrical circuit. Power lines allow the electricity from power plants to reach people's homes, schools, and buildings. The lines themselves are suspended in the air by tower-like structures and utility poles. The grounding of wires into the earth allows for a complete circuit to and from the power plant generator.

LITERAL—Who fixes the power lines when they break?

» people who work for the power company

EVALUATIVE—Why do broken or damaged power lines cause people to lose power in their homes?

» because the electricity cannot flow to their homes

3. Compare and contrast types of electricity.

Activity Page



AP 3.1

Distribute Types of Electricity (AP 3.1). Students will use what they learned in Chapter 3 to complete the sentences about static electricity and current electricity. Students may discuss and collaborate with their peers in pairs but should record on their own Activity Pages.

Circulate around the room, and prompt students to think about what they know about static electricity and current electricity. If necessary, **ask students** to describe how they are different or similar. (See **Know the Standards**.)

4. Check for understanding.

Monitor Progress

Create a Venn diagram, and invite students to help you fill it in to help them review the similarities and differences between static electricity and current electricity.

Formative Assessment

Review student findings on Types of Electricity (AP 3.1) to determine student understanding of the following concepts:

- Lightning is an example of static electricity.
- Static electricity requires surfaces.
- Current electricity is what powers the appliances in our homes.
- Current electricity flows through power lines.

See the Activity Page Answer Key for correct answers and sample student responses.

Know the Standards

TEACHER DEVELOPMENT

SEP 1 Asking Questions: Questions are a guiding force in any scientific investigation. Help students figure out what questions they can ask that will help them decide if something uses static electricity or current electricity.

LESSON 4

It's Not Magic...It's Static!

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: What does evidence of static electricity look like?

Tie to the Anchoring Phenomenon: Students learned about static electricity in the previous lesson. Today students will investigate different ways that they can see evidence of static charges.

AT A GLANCE

Learning Objectives

- ✓ Observe evidence of the presence of static electricity.
- ✓ Compare the invisible pushes and pulls of static electricity with those of magnets.

Instructional Activities (2 Days)

- teacher demonstration
- student investigation

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

invisible **pull** **push**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

attract **cling** **repel**

Instructional Resources

Activity Page



AP 4.1

Activity Page

Static Stations (AP 4.1)

Materials and Equipment

Collect or prepare the following items:

- plastic rod
- pieces of cloth (3, plus 1 for teacher demonstration)
- plastic grocery bag
- inflated balloon
- carton of salt
- tin of black pepper
- plastic spoon
- disposable bowl
- foam plates (2)
- wool cloth
- plastic comb
- torn pieces of paper
- timer

Advance Preparation

Set up four stations around the classroom with the following materials:

- **Station 1 materials:** inflated balloon, piece of cloth
- **Setup instructions:** Place the inflated balloon next to the piece of cloth on a table or work surface.
- **Station 2 materials:** plastic spoon, salt, pepper, piece of cloth, disposable bowl
- **Setup instructions:** Place the salt and pepper containers next to each other. Place the spoon, cloth, and disposable bowl on the same work surface.
- **Station 3 materials:** foam plates, piece of cloth
- **Setup instructions:** Place the foam plates side by side on the table next to the cloth.
- **Station 4 materials:** plastic comb, piece of wool cloth, torn pieces of paper
- **Setup instructions:** Tear the paper into small pieces. Put the paper into a pile on the table. Place the rest of the materials nearby.

1. Day 1: Focus student attention on the Lesson Question.

As students gather, prepare for your demonstration by gathering the plastic rod, piece of cloth, and plastic grocery bag. Draw student attention to the plastic bag, and tell students that you will use static electricity to make the bag move without touching it, using the following steps:

1. Rub the rod with the cloth for forty to sixty seconds.
2. Lay the plastic bag flat on the floor, and rub the cloth against it for forty to sixty seconds.
3. Wave the rod over the plastic bag, and watch as it floats over the ground, dancing around in the direction of the rod.

Ask students to describe what they notice.

- » The bag is moving/floating.
- » The rod is causing the bag to move.

Discuss with students that rubbing the rod and plastic bag with the cloth made a static charge. Remind students that static electricity (like lightning) needs two surfaces. (See **Know the Science 1**.)

Ask students how they know that the static electricity was there, even though they could not see it.

- » We can see the plastic bag move with the rod. That is a kind of change.

Talk briefly about the fact that although static electricity is **invisible**, there are still observable ways to know that it is there. Static electricity creates invisible **pushes** and **pulls**.

Clarify the Lesson Question that you'll be answering in this unit—**What does evidence of static electricity look like?**

Know the Science

TEACHER DEVELOPMENT

1. How It Works: Classroom activities in static electricity usually involve rubbing two objects together. When this occurs, electrons move from one object to another so that one object becomes negative and one positive. When you rubbed the plastic rod with a cloth, the rod gained electrons and became negatively charged, and the cloth lost electrons and became more positively charged. When you then brought the rod to the plastic, the bag was affected by the electrical status of the rod. Is there a way to tell which object becomes positive and which negative when rubbed together? Yes. See the Online Resources guide for a link to a triboelectric effect chart: www.coreknowledge.org/cksci-online-resources

2. Preview the investigation.

Have students form four groups of mixed ability. Show students the four stations that are set up around the classroom. Explain that at each station, students will investigate evidence of static electricity. Walk students through the steps they will complete at each station. (See **Know the Science 2.**) Let students know that this investigation will be split into two days and that students will only do two stations (two investigations) per day.

- At Station 1, students will rub the cloth on the balloon for forty seconds. Then students will hold the balloon above their heads and observe what happens. (Students' hair will stick straight up in the direction of the balloon.)
- At Station 2, students will separate salt and pepper using static electricity. Students will thoroughly mix one spoonful of salt and one spoonful of pepper in the bowl. Then they will rub the spoon with the cloth for forty seconds. Finally, students will hold the spoon over the salt and pepper mixture and observe what happens. (The pepper should separate from the mixture and stick to the spoon. However, students may need to move the spoon around the mixture in order to attract the pepper.)
- At Station 3, students will make plates hover! First students will rub the base of one foam plate with the cloth for forty seconds. Then students will place that plate on the table, base-up. Next students will rub the base of the second plate with the cloth to charge it. Finally, students will try to place the base of the second plate on top of the first plate and see what happens. (The plates will repel.)
- At Station 4, students will rub the plastic comb with the wool cloth for forty seconds. Then students will hold the comb just above the pile of torn paper. (The paper will "jump up" and stick to the comb.)

Know the Science

TEACHER DEVELOPMENT

2. Static Stations: Rubbing surfaces with a cloth causes certain objects to become charged. When an object is rubbed by a cloth, it can either become positively charged or negatively charged. A table called a triboelectric series shows the charges that result when two objects are rubbed together.

3. Do the investigation.

Activity Page



AP 4.1

Distribute Static Stations (AP 4.1) to students prior to beginning the activity. Students will draw pictures to record the evidence of static electricity that they notice at each station. Let students know that they should complete their Activity Pages as they carry out the investigations.

Students will work in groups but should record on their own Activity Pages.

Have the groups start at different stations. Give groups an equal amount of time at each station before rotating to the next one, using the timer to tell you when they should switch.

As students work at each station, encourage them to take turns handling the materials so they all have a hands-on experience with rubbing the cloths, holding the balloons and combs, and mixing the salt and pepper. Groups can perform the investigation more than once at each station in order to give everyone in the group a chance to participate.

Circulate around the room, and provide assistance if you see groups handling the materials or performing the investigations incorrectly. Prompt students to think about what they know about static electricity and how to tell whether they are seeing evidence of it. (See **Know the Standards 1** and **2**.)

1. Day 2: Refocus student attention on the Lesson Question.

Remind students of the Lesson Question, and review the investigations that they conducted the previous day. Tell students that they will continue their investigation today when they visit the final two stations.

2. Continue the investigation.

Prompt students to continue the investigation with the final two stations on static electricity. Circulate around the room, and provide assistance to students as they carry out their investigations.

Remind students to complete Activity Page 4.1 by making drawings or writing sentences that describe their findings.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 1 Asking Questions: Questions are a guiding force in any scientific investigation. Help students figure out what questions they can ask that will help them decide whether a phenomenon that they observe is evidence of static electricity.

2. SEP 3 Planning and Carrying Out Investigations: Students carry out group investigations to observe evidence of static electricity.

3. Check for understanding.

Discuss with students the “pushing” and “pulling” motions that they noticed when the materials interacted as a result of static electricity. **Ask students** the following questions:

- Was the paper being pulled or pushed to the comb?
 - » pulled
- Was the foam plate being pulled or pushed by the static charge?
 - » pushed
- Was the pepper being pulled or pushed to the spoon?
 - » pulled

Ask students to describe how the invisible pushes and pulls of static electricity are similar to magnets. (See **Know the Standards 3**.)

- » Sample answer: Magnets can pull some things closer to them or push other things away. We cannot see the pulls and pushes of magnets. We also cannot see the pulls and pushes of static electricity.

Monitor Progress

Formative Assessment

Review student drawings on Static Stations (AP 4.1) to determine student understanding of the following concepts:

- Station 1: Hair is attracted to the balloon.
- Station 2: The pepper clings to the spoon, while the salt remains in the bowl.
- Station 3: The plates repel each other.
- Station 4: The paper is attracted to the comb.

See the Activity Page Answer Key for correct answers and sample student responses.

Know the Standards

TEACHER DEVELOPMENT

3. DCI PS2.A: During this hands-on activity, students build on what they learned in Kindergarten about pushes and pulls—specifically, that pushes and pulls can have varying strengths and directions and that moving objects can interact in ways that lead to changes in speed and direction. Students are not required to learn about noncontact pushes or pulls, such as those from magnets, in Kindergarten or Grade 1. However, you may find that many students will have prior knowledge of magnets from their own explorations and experiences. They will investigate these concepts further in Grade 3.

LESSON 5

What Are the Sources of Electricity?

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: Where does the electricity that powers our familiar devices come from?

Tie to the Anchoring Phenomenon: Up until this point, students have learned that some devices use electricity and that there are two different kinds of electricity. In this lesson, students will read about sources of electricity and how electricity extends from power plants, along power lines, to wall sockets inside homes and buildings.

AT A GLANCE

Learning Objectives

- ✓ Trace the path of electricity in a home from a power plant, through lines, to wall sockets.
- ✓ Compare and contrast devices that plug into wall sockets with those that use batteries.

Instructional Activities

- teacher Read Aloud
- class discussion

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

battery **power plant**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

source **wiring**

Instructional Resources

Student Book



Ch. 4

Student Book, Chapter 4
“Sources of Electricity”

Activity Page



AP 5.1

Activity Page
Follow the Electricity (AP 5.1)

Materials and Equipment

Collect or prepare the following items:

- flashlight
- lamp with light bulb
- internet access and the means to project images/video for whole-class viewing

Advance Preparation

- Remove the shade from the lamp so students can see the light bulb. Plug the lamp into an outlet so that it can be turned on.

THE CORE LESSON 5

1. Focus student attention on the Lesson Question.

Ask a volunteer to state the Big Question that you’ll be answering in this unit—**Why do the lights sometimes go out during a thunderstorm?**

Tell students that to answer this question, they will need to learn more about the source of electricity, or where it comes from. In this lesson they will explore the Lesson Question—**Where does the electricity that powers our familiar devices come from?**

Call on two students to help with a demonstration. After turning the classroom lights out, one student will turn a flashlight on and off. The other will turn a lamp on and off. Discuss the fact that the flashlight is not plugged in but still gives off light. Draw attention to the fact that the light is plugged into the socket in the wall and that it gives off light, too.

Summarize the observations. Both the flashlight and the light bulb give off light because of electricity. However, their sources of electricity are not the same.

2. Read together: “Sources of Electricity.”

Student Book



Ch. 4

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 18

Ask students to turn to page 18 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Sources of Electricity,” and tell them to pay special attention to where electricity comes from and how it gets into Eva’s home as you read.

Ask students to look at the two pictures on page 18. Talk about what they see in the pictures. The large picture shows batteries and flashlights. The inset picture shows a crank flashlight. Ask students if they have seen these objects before.

LITERAL—Why doesn’t Eva’s flashlight turn on?

» It needs new batteries.

CORE VOCABULARY—Explain that **batteries** are sources of electrical energy and that things that use batteries can operate even when they are not plugged into wall sockets. (See **Know the Science 1**.)

INFERENTIAL—What is similar about the flashlights that Eva’s dad gives to her and her mom? What is different about them?

» Both kinds of flashlights will help them see in the dark. They are different because one flashlight uses replaceable batteries and the other does not.

Differentiation

EXTEND—Have students research other examples of chemical energy besides batteries. Some may include food and gasoline.

Know the Science

TEACHER DEVELOPMENT

1. Chemical Energy: Batteries are devices that convert chemical energy into electrical energy that can be used to power certain devices. During certain types of chemical reactions, electrons become free. A battery is designed so that in a complete circuit, a voltage potential difference exists from one side of the battery to the other. An element such as a bulb, when placed within this circuit, will interact with the electrical potential (the voltage) of the battery.

Page 19

Ask students to look at the two pictures on page 19. Ask students to describe what they see in the larger picture. By now, students should be familiar with cords. In the inset picture, draw student attention to the batteries inside the flashlight.

INFERENTIAL—Where do you think the light bulb in the larger picture is getting its electrical energy?

» electricity through the cord from the ceiling

INFERENTIAL—Where do you think the flashlight is getting its electrical energy?

» the batteries inside it

INFERENTIAL—What is similar about the light bulb and the flashlight?

» They both need energy to work.

Differentiation

SUPPORT—Draw a Venn diagram where all students can see it to show the similarities and differences between light bulbs and flashlights. Their sources of electricity are different, but they both create light using electricity.

Page 20

Ask students to look at the two pictures on page 20. Explain that the larger picture shows a power plant. The inset picture shows power lines that run between the buildings in the community. Clarify that we see power lines outside all the time but that we rarely see power plants because they are often located in areas outside of town, though they may be present in urban areas. (See **Know the Science 2.**)

CORE VOCABULARY—Explain that a **power plant** is a facility where electrical energy is generated, or made. If necessary, remind students of the difference between current and static electricity.

LITERAL—How does the electrical energy from a power plant get to the buildings in a community?

» through power lines

Talk about what students notice about the power plant and the power lines. Draw their attention to the fact that there are a lot of lines—or wires—that they see in the pictures.

INFERENTIAL—Where do you think the electricity flows?

» It flows through the wires.

Know the Science

TEACHER DEVELOPMENT

2. Power Plants: This unit focuses on power plants that generate electrical energy using nonrenewable resources, such as coal. However, it does not introduce students to power plants that create electrical energy using renewable resources, such as hydroelectric power plants (which use water to create energy), solar power stations (which use sunlight), and wind turbine farms (which use wind).

Page 21

Ask students to look at the picture on page 21. Explain that the graphic shows how power lines bring electricity into a home to power lights, appliances, and other electrical objects. Talk about a home's internal wiring. Explain that there are wires that run throughout a house and are hidden behind the walls.

LITERAL—What makes the lamp in the house (in the picture) light up?

» electricity

LITERAL—Where is the electricity in the picture?

» in the wires; in the walls

INFERENTIAL—What would happen if an appliance were not plugged into the socket?

» It would not work. It would not get electricity.

Page 22

Ask students to look at the two pictures on page 22. Talk about the contrast of what they see in the pictures. The first picture shows a small area that is lit by a flashlight. The second picture shows a large city that receives its electricity from a power plant.

LITERAL—Which do you think lights up a neighborhood like Eva's: a battery or a power plant?

» a power plant

LITERAL—Which produces more current electricity: a power plant or a battery?

» a power plant

Differentiation

SUPPORT—Help students understand what kinds of objects batteries can be used to supply power to. For example, remote-controlled cars, cell phones, and other small toys or appliances can be powered by batteries, but neighborhoods, houses, and cities cannot. (See **Know the Science 3.**)

Page 23

Ask students to look at the three pictures on page 23. Talk about what students see in the pictures, and invite students to share where they have seen or used these types of devices.

Differentiation

CHALLENGE—Invite students to think about additional cordless/portable devices that use rechargeable batteries, using the examples on the page (cell phones and laptop computers) as a guide.

Know the Science

TEACHER DEVELOPMENT

3. Addressing Misconceptions: Students may be familiar with batteries on a small, toy-sized scale. Address any misconceptions that batteries are always small. Some batteries are large and are designed to power larger objects, such as vehicles.

LITERAL—Why do some objects store electricity?

» so that the electricity can be used later

EVALUATIVE—How would you describe *recharging* a battery?

» Sample answer: When you recharge a battery, you plug it into a socket in the house to transfer electrical energy to the battery so that it can work.

3. View examples of how electricity travels.

Online Resources



Show students a video about smart grids. See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

Lead student observations as they watch the video. Discuss Core Vocabulary, and **ask students** the following questions:

- Where is the source of electricity for a home?
 - » power plant
- How is electrical energy connected from power plants to people's homes?
 - » power lines
- Why do you think the way the electrical energy is carried is known as a power grid?
 - » because all the lines are connected

Activity Page



AP 5.1

Distribute Follow the Electricity (AP 5.1). Students will use what they read about in Chapter 4 to draw the path of electricity. Students may discuss and collaborate with their peers in pairs but should record on their own Activity Pages.

Circulate around the room, and prompt students to think about where electricity starts and where it ends up. If necessary, help students understand what is pictured on the Activity Page.

4. Check for understanding.

Formative Assessment

Review student findings on Follow the Electricity (AP 5.1) to determine student understanding of the following concepts:

- Electricity starts at a power plant.
- Electrical energy is transmitted through power lines.
- Power lines allow electrical energy to enter homes.
- Appliances receive the electricity.

See the Activity Page Answer Key for correct answers and sample student responses.

LESSON 6

What Is a Circuit?

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: What is a circuit?

Tie to the Anchoring Phenomenon: Students have learned about current electricity and will follow Eva through her journey of learning more about circuits to understand how electricity works.

AT A GLANCE

Learning Objectives

- ✓ Describe a simple circuit.
- ✓ Identify the battery, wire, and bulb in a simple circuit.

Instructional Activities

- teacher Read Aloud
- class discussion

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

circuit **connect** **switch**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

complete **conduct/conductor** **incomplete** **insulate/insulator**
loop

Instructional Resources

Student Book



Ch. 5

Student Book, Chapter 5
“What Is a Circuit?”

Activity Page



AP 6.1

Activity Page
Will the Bulb Light Up?
(AP 6.1)

Materials and Equipment

Collect or prepare the following items:

- rubber ball
- single-throw light switch
- yellow markers (1 per student)

Advance Preparation

Make space in the classroom for students to stand in a circle.

THE CORE LESSON 6

1. Focus student attention on the Lesson Question.

Ask a volunteer to state the Big Question that you’ll be answering in this unit—**Why do the lights sometimes go out during a thunderstorm?**

Tell students that to answer this question, they will need to learn more about how current electricity flows in a circuit. Share today’s Lesson Question—**What is a circuit?**

Invite students to stand in a circle. Hand one student a ball, and tell the student to pass the ball to the person on their right. Have students continue to do this until the ball travels all the way around the circle and back to the student who first held it.

As students are passing the ball, explain that this is similar to how electricity flows in a (direct) circuit. It goes around in a loop—or circle—to provide power to devices that need it.

2. Read together: “What Is a Circuit?”

Student Book



Ch. 5

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Page 24

Ask students to turn to page 24 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “What Is a Circuit?” and tell them to pay special attention as they read about how current electricity moves.

Ask students to look at the picture on page 24. Talk about the items that they see on the table in the picture: a battery, a light bulb, and two wires.

LITERAL—What is giving Eva and her mom enough light to see in the dark? Does it use electricity? How do you know?

- » They are using a candle, but a candle does not use electricity. It is not plugged into anything, and candles do not have batteries.

LITERAL—What are Eva and her mom building?

- » a circuit

CORE VOCABULARY—Explain that a **circuit** is the complete path in which electrical charge exists. Circuits require sources of electricity, like batteries. (See **Know the Science 1.**)

Page 25

Ask students to look at the picture on page 25.

LITERAL—What do you notice about the materials in this picture (compared to the previous picture)?

- » There is one wire connected to the bulb and the battery.

INFERENTIAL—What is the source of the electrical energy for this circuit?

- » the battery

INFERENTIAL—How would Eva and her mom know if it worked?

- » The light bulb would light up.

Page 26

Ask students to look at the picture on page 26.

CORE VOCABULARY—Explain that Eva’s mom **connected** the wires to the battery. This means that she attached them. They have to be connected for the electrical energy from the battery to travel through the wires to reach the bulb.

LITERAL—Did Eva and her mom’s circuit work this time? How do you know?

- » Yes, the light bulb lit up.

Know the Science

TEACHER DEVELOPMENT

1. Batteries: Standard household batteries in a simple circuit like a battery, wire, and light bulb can be wired positive to negative or negative to positive. In other cases, like in a flashlight, the batteries must be placed in specific directions.

SUPPORT—Remind students of the activity they did at the beginning of the lesson, when they passed the ball around the circle. Explain that they were passing the ball in a loop, which is similar to how electricity travels in a direct circuit.

Draw student attention to the idea that the electricity flows in a loop only when the circuit is complete.

Now have students form the circle again, but this time, rearrange students so that the circle is open and not closed (like a U-shape). Prompt students to pass the ball to the person on their right. When the ball reaches the last person before the circle opens, have the student hold onto the ball. Talk about how the ball represents electricity and that now it has nowhere to go. Therefore, this circuit is incomplete. The electrical energy cannot complete its loop. It cannot provide the electrical energy to the bulb. (See **Know the Science 2.**)

Page 27

Ask students to look at the picture on page 27. Explain that the picture shows light switches. Talk about where students have seen light switches in their homes (e.g., on walls, in bathrooms and kitchens, in hallways and bedrooms, etc.).

CORE VOCABULARY—Explain that a **switch** is a device that is used for making or breaking the connection of electricity in a circuit.

LITERAL—What are the two things a circuit can be?

» open or closed (or complete/incomplete)

INFERENTIAL—If a switch is on, is that an open or closed circuit?

» closed

INFERENTIAL—If a switch is off, is that an open or closed circuit?

» open

SUPPORT—If time permits, pass around a cheap, single-throw light switch so that students can see the connection/disconnection from the back side of the uninstalled switch. Talk with students about where the connected wires would go. Give students a chance to practice pushing the switch up and down (on and off). You can also demonstrate how a switch works by flipping the switch on the wall in your classroom. Have students say “open” or “closed” as you flip the switch on and off.

Know the Science

TEACHER DEVELOPMENT

2. Complete vs. Incomplete: It is a common misconception that electricity is the flow of electrons in a wire. In direct current, electrons move somewhat slowly through a wire. In alternating current, electrons merely move back and forth; they don’t “flow” at all. In reality it is the instantaneous establishment of an electromagnetic field rather than the movement of electrons that results in the form of energy we call electricity.

Page 28

Ask students to look at the two pictures on page 28. Explain that the first picture shows copper wire.

LITERAL—What does electricity usually flow through in houses?

- » copper wires

Differentiation

SUPPORT—Explain that copper is a type of material. Have students name other materials that they can think of.

- » Examples: cotton, wool, wood, steel, metal, silk, plastic, rubber, glass

EVALUATIVE—Why do you think it is important to keep the electricity only in the wires?

- » Sample answer: Electricity can be dangerous.
- » Sample answer: so the electricity stays in the loop
- » Sample answer: so the electricity travels to where it is supposed to go

EVALUATIVE—What would you do if you saw an electrical cord near water? (See **Know the Science 3.**)

- » Sample answer: Stay away from it.
- » Sample answer: Do not use it.
- » Sample answer: Tell an adult.

Page 29

Ask students to look at the three pictures on page 29. Talk about what students see in the pictures, and invite students to share where they have seen or used these types of devices.

LITERAL—Is it safe to touch electricity?

- » no

LITERAL—What materials do you see in the pictures that make the objects safe to use and touch?

- » plastic handle of the hair dryer; rubber grips of the wire cutters; plastic grips of the car jumper cables

Know the Science

TEACHER DEVELOPMENT

3. Water and Electricity: Most people know that it is dangerous to put electrical appliances near water. Most of the water we come into contact with on a daily basis has dissolved substances in it, like salts. The ions in this water are what make it such a great conductor of electricity. If you touch ionized water and electricity touches the water, the electricity will travel through the water to you. The truth is, pure water (such as distilled or deionized water) acts as an insulator. An insulator is a material that does not conduct electricity. Still, it's wise to always consider the juxtaposition of water and electricity as very dangerous.

EVALUATIVE—Why is it important that these objects are made from these materials?

» so they can protect you from the electricity

3. Check for understanding.

Activity Page



AP 6.1

Distribute Will the Bulb Light Up? (AP 6.1) along with a yellow marker or crayon to each student. Students will examine each electric circuit and decide whether the light bulb will light up based on whether the circuit is open or closed (incomplete or complete). If the bulb will light up, students will color the light bulb yellow.

Circulate around the room, and prompt students to think about what questions they can ask to help them decide whether the light bulb will light up. (See **Know the Standards 1.**) It may be necessary to remind students of how the light bulb lights up on the circuits they see on Activity Page 6.1. (See **Know the Standards 2.**)

Formative Assessment

Review student answers on Will the Bulb Light Up? (AP 6.1) to determine student understanding of the following concepts:

- Electricity flows through a closed, or complete, circuit.
- Electricity does not flow through an open, or incomplete, circuit.

See the Activity Page Answer Key for correct answers and sample student responses.

Know the Standards

TEACHER DEVELOPMENT

1. SEP 1 Asking Questions: Students can identify closed or open electrical circuits by asking themselves what they know about circuits. Examples of questions that students should ask themselves include, “Can the electricity travel all the way around in a loop?” or, “Does the loop break open somewhere?”

2. CCC 2 Cause and Effect: The energy from the battery causes electricity to travel through the wires to power the light bulb. The light bulb cannot turn on without the electricity from the battery. Students will get hands-on experience building small circuits in the next lesson.

LESSON 7

Building a Simple Circuit

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: How can we build a simple circuit?

Tie to the Anchoring Phenomenon: Students read about simple circuits in Chapter 5 of the Student Book. In this lesson, they will get to build a simple circuit in order to turn on a light bulb.

AT A GLANCE

Learning Objectives

- ✓ Assemble a simple circuit to light a bulb.
- ✓ Explain why an incomplete circuit does not allow a bulb to light up.

Instructional Activities

- teacher demonstration
- student investigation

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

circuit

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

assemble

complete/incomplete

contact

open/closed

Instructional Resources

Activity Page



AP 7.1

Activity Page

Simple Circuits (AP 7.1)

Materials and Equipment

Collect or prepare the following items:

- D-cell batteries (or AAA cell) (1 per group)
- 8–10 inches of coated/insulated copper wire (2 per group)
- electrical tape (2 inches per group)
- scissors (1 pair per group)
- wire strippers
- flashlight bulbs (1 per group)

Advance Preparation

- Cut the wire so each group has two pieces of wire that are 8-10 inches in length.
- Strip 2 inches of the insulating material off both ends of the wires.
- Cut 2-inch strips of electrical tape for each group.
- Make your own simple circuit ahead of time to show to the class.
- TIP: Make sure that the battery's output voltage matches the light bulb. If the voltage is too little or too much, the circuit will not work the way it is supposed to.

THE CORE LESSON 7

1. Focus student attention on the Lesson Question.

Share the Lesson Question—**How can we build a simple circuit?**

Draw student attention to your simple circuit. **Ask students** to describe the objects and materials they see.

» We see a battery, wires, and a light bulb.

Show students how your circuit works by attaching the wire to the base of the bulb and watching the light bulb light up. Let students know that today they will work on making a circuit to light a light bulb.

2. Preview the investigation.

Activity Page



AP 7.1

Have students form groups of mixed ability, and then distribute the materials to each group. Groups will need adequate workspace to build their simple circuits.

Distribute Simple Circuits (AP 7.1). Students will draw pictures to record what their simple circuits look like and answer questions to describe how they work. Students will work in groups but should record on their own Activity Pages.

3. Do the investigation.

Walk students step by step through the process for assembling their simple circuits. Leave ample time after each step for students to complete the task.

STEP 1: Study the battery to locate the + and – ends, which are written on cell batteries.

STEP 2: Attach the end of one wire to the negative end (smooth end) of the battery.

STEP 3: Cut a small amount of electrical tape, and use it to keep the wire in place.

STEP 4: Wrap the other end of that same wire around the base of the bulb.

STEP 5: Cut a small amount of electrical tape, and use it to keep that end in place.

STEP 6: Take the second wire, and attach one end of it to the positive end (bumpy end) of the battery.

STEP 7: Cut a small amount of electrical tape, and use it to keep that end in place.

STEP 8: Attach the other end of that same wire to the base of the bulb. This will complete the circuit, and the bulb will light up!

While students work, circulate around the room and provide assistance or repeat a step, if necessary. Encourage students to discuss who in the group will be responsible for things like holding the wire in place, cutting and placing the electrical tape, and other tasks.

Troubleshooting: If students are not able to make their bulbs light up, provide assistance and ensure they have set up their circuits correctly. Check for issues such as connection to the battery and base of the bulb and that the wires are not moving out of place because of loose tape.

Differentiation

SUPPORT—If students need help visualizing how the circuits should be set up and connected, draw a picture of how it should look and provide copies to students to use as a guide.

CHALLENGE—Challenge students to figure out how to get two light bulbs to light off of one battery.

EXTEND—Offer students the opportunity to take this investigation further by testing the conductivity and insulating properties of different materials, like aluminum foil, plastic, glass, wood, and paper. Instruct students to place the materials—one at a time—between the wire and the battery. Students can see whether or not the bulb still lights up. If it does, it means that the material conducts electricity. If it does not, then it means that the material is an insulator.

4. Continue the investigation.

Activity Page



AP 7.1

Make sure all groups have had a chance to light up their bulbs. Then, demonstrate what happens with an incomplete circuit. Instruct students to play around with the connections by disconnecting one of the ends of the wires and observing what happens. (See **Know the Standards 1** and **2**.)

Give students time at the end of class to work on their Activity Page (AP 7.1). Remind students that they should draw pictures of what their simple circuits look like and answer questions to describe how they work.

5. Check for understanding.

Monitor Progress

Formative Assessment

Review student drawings on Simple Circuits (AP 7.1) to determine student understanding of the following concepts:

- Closed circuits allow electricity to travel in a loop and light up the bulb.
- Open circuits cannot light up the light bulb.

See the Activity Page Answer Key for correct answers and sample student responses.

Know the Standards

TEACHER DEVELOPMENT

1. CCC 2 Cause and Effect: An incomplete circuit does not allow the electricity to travel through it. When the loop is open, the path of the electricity is interrupted. Students can learn this firsthand with their simple circuits.

2. SEP 3 Planning and Carrying Out Investigations: Students are given the opportunity to come up with a way—as a group—to make their circuits incomplete, or open, as a way of continuing their investigation of electricity.

LESSON 8

Magnets and Electricity

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: How do electric motors and electricity generators use magnets?

Tie to the Anchoring Phenomenon: Students have learned about electricity and how it travels, but now they will become familiar with the devices that produce electricity.

AT A GLANCE

Learning Objective

- ✓ Compare and contrast an electric motor that makes a fan spin with a spinning generator that produces electricity.

Instructional Activities

- teacher Read Aloud
- class discussion

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

magnet **rotate**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

generator **magnetic pole** **motor**

Instructional Resources

Student Book



Ch. 6

Activity Page



AP 8.1

Student Book, Chapter 6
“Magnets and Electricity”

Activity Page
Motors and Generators (AP 8.1)

Materials and Equipment

Collect or prepare the following items:

- internet access and the means to project images/video for whole-class viewing

THE CORE LESSON 8

1. Focus student attention.

Ask a volunteer to state the Big Question that you’ll be answering in this unit—**Why do the lights sometimes go out during a thunderstorm?**

Tell students that to answer this question, they will need to learn more about what makes electricity possible. Introduce today’s Lesson Question—**How do electric motors and electricity generators use magnets?**

2. Read together: “Magnets and Electricity.”

Student Book



Ch. 6

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 30

Ask students to turn to page 30 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Magnets and Electricity.” Tell them to pay special attention as they read to how electricity is produced.

Ask students to look at the picture on page 30. Talk about what they see in the picture. Explain that Eva’s dad is preparing a generator.

LITERAL—What makes the generator work?

» It uses fuel.

Differentiation

SUPPORT—Discuss with students that gasoline is an example of fuel. Talk about what people use gasoline for.

LITERAL—What produces the electricity?

» the motor

INFERENTIAL—Why does Eva’s dad plug the refrigerator into the generator?

- » so that the refrigerator gets electricity made by the generator and the food will stay cold

Page 31

Ask students to look at the picture on page 31. Explain that this is a picture of a very large generator. Compare this to the one Eva’s dad is using, which is very small and portable. The large generator pictured here is at a power plant. If necessary, remind students that a power plant is where electricity is made. (See **Know the Science 1.**)

LITERAL—What allows electricity to get to your house from the power plant?

- » power lines

INFERENTIAL—What do you think would happen if a generator at a power plant did not work?

- » It would not be able to make electricity.

INFERENTIAL—How would this affect people’s homes?

- » People would not be able to use anything in their homes that requires electricity.

Page 32

Ask students to look at the pictures on page 32. Remind students that they have seen this hand crank flashlight before.

CORE VOCABULARY—Explain that a **magnet** is something that produces invisible pushes and pulls. Magnets push and pull each other and objects made of certain materials.

CORE VOCABULARY—Explain that to **rotate** means to turn. Invite students to use the word *rotate* in a sentence.

INFERENTIAL—How is a hand-crank flashlight like the battery on the simple circuits you made in the last lesson?

- » Sample answer: The hand crank provides mechanical energy that is converted to electrical energy. This is what gives the flashlight power to turn on. The battery in the simple circuit converts chemical energy to electrical energy to power its light bulb.

Know the Science

TEACHER DEVELOPMENT

1. Power Plant Generators: Clarify for students that only some power plant generators use natural gas. Most burn coal, which is another type of fuel. Hydroelectric power plants use running water to move the turbines that make electricity. While Grade 2 does not cover these details, it may be necessary to draw the comparison that power plants have generators but that they do not burn gasoline.

CHALLENGE—Challenge students to discuss how making electricity with a hand crank is different than making electricity with a battery. (See **Know the Science 2.**)

Page 33

Ask students to look at the pictures on page 33. Explain that the pictures show magnets. Talk about what students see on the magnets, such as the “N” and the “S” symbols. Then explain that these represent the opposite poles, or ends, on a magnet, where the magnet’s force is strongest. Point out the direction of the arrows. Discuss what students can assume about the magnets labeled a, b, c, and d on the page.

INFERENTIAL—If magnets a and b push each other, do you think these magnets move closer to or away from each other?

» away from each other

INFERENTIAL—If magnets c and d pull each other, do you think these magnets move closer to or away from each other?

» closer to each other

EVALUATIVE—What do you notice about how the poles on two magnets interact with each other?

» The poles that are different pull on each other. The poles that are alike push against each other.

Pages 34–35

Ask students to look at the two diagrams on pages 34 and 35. Explain that the diagram on page 34 shows an electric fan with a cord plugged into a wall socket.

INFERENTIAL—What can you tell about the fan blades based on the arrows?

» The blades are spinning.

LITERAL—Where is the electricity coming from?

» the plug in the wall socket

LITERAL—What does the motor use to make the blades spin?

» magnets

Draw student attention to the diagram on page 35. Explain that this is a diagram of a gas-powered generator and that there is a power cord attached that leads to a light bulb.

INFERENTIAL—What do the arrows on the diagram tell you about the generator?

» It is rotating.

Know the Science

TEACHER DEVELOPMENT

2. Hand Cranks and Batteries: A battery has the potential to convert chemical energy into electrical energy due to the chemical reactions (and release of electrons), that take place within the battery. When the battery is connected to a complete circuit, this results in the establishment of electric current. Hand cranks, on the other hand, rotate parts that are made of magnets and coiled wire. The mechanical energy provided to the crank is converted to electrical energy. (The hand-crank flashlight does have a battery that briefly stores the charge generated by the crank rotation.) When the generator is connected to a complete circuit, this also results in an electric current.

LITERAL—What is powering the generator?

- » fuel (gasoline)

LITERAL—Where do you think the magnets are?

- » inside the generator

LITERAL—What is the source of the electricity, and where does it extend to?

- » Sample answer: It comes from the generator and connects to the light bulb.

3. Demonstrate more examples.

Online Resources



Show the video of a hand-crank generator, starting at the beginning and ending at **1:05**. Replay the video if necessary. Have students describe how the magnets interact with the wire to produce electricity. **Ask students** why they think the faster you crank the generator, the more power it creates.

- » It makes the parts inside rotate faster.

LITERAL—What is the hand crank powering?

- » a light

INFERENTIAL—What do you think more volts means?

- » More power is generated.

See the Online Resources Guide for a link to the recommended video:

www.coreknowledge.org/cksci-online-resources

4. Check for understanding.

Activity Page



AP 8.1

Distribute Motors and Generators (AP 8.1), and tell students that they will complete the sentence frames to demonstrate what they learned about magnets and electricity. Students can work in pairs to discuss their answers but should record on their own Activity Pages.

Circulate around the room, and prompt students to think about what they know about magnets (invisible pushes and pulls) and electricity.

Monitor Progress

Formative Assessment

Review student answers on Motors and Generators (AP 8.1) to determine student understanding of the following concepts:

- When coiled wires move near magnets, electric currents can be established in the wires.
- Parts inside motors and generators need to rotate to produce electricity.
- Magnets are used to help generate electricity.
- An electric current is the flow of electrical charges inside of wires.

See the Activity Page Answer Key for correct answers and sample student responses.

LESSON 9

Magnets and Rotating Motion

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: Can the push of a magnet make something rotate?

Tie to the Anchoring Phenomenon: Students read about how magnets are used to help create electrical currents. Today, they will assemble a simple device that uses magnets to induce rotation.

AT A GLANCE

Learning Objective

- ✓ Demonstrate that magnets can make something rotate.

Instructional Activities

- ✓ teacher demonstration
- ✓ student investigation

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

magnet **rotate**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

magnetic pole **repel**

Instructional Resources

Activity Page



AP 9.1

Activity Page

Magnets and Rotation (AP 9.1)

Materials and Equipment

Collect or prepare the following items:

- compasses (1 per group)
- magnet wands or bar magnets with labeled poles (1 per group)
- paper or plastic cups (1 per group)
- internet and the means to project images/video for whole-class viewing

Advance Preparation

- Build your own rotating assembly to display as a visual aid for students to reference. See the instructions on page 63. Affix the compass to a small paper cup so you can carry the assembly around the room for students to see.

THE CORE LESSON 9

1. Focus student attention on the Lesson Question.

Ask students to summarize how magnets push and pull on each other.

» Opposite poles pull magnets toward each other. Same poles push apart.

Draw student attention to your rotating assembly. Remove the compass from the cup a few times so students can see how the compass balances freely on the cup. Use this opportunity to talk to students about how a compass works. (See **Know the Science 1.**)

Let students know that today they will each assemble a device like this and that then they will experiment with using a magnet to get the needle on the compass to rotate.

Ask students to think about the Lesson Question while they investigate—**Can the push of a magnet make something rotate?**

Know the Science

TEACHER DEVELOPMENT

1. A compass is a device that people use for navigation. It works by detecting Earth's magnetic field. The N on the needle of the compass points to Earth's magnetic north direction. Students will get to see how the needle on a compass moves around when in the presence of magnets.

2. Guide the investigation.

Have students form pairs. Distribute or have students collect their materials. Guide students through the process for assembling their designs, step by step. Leave ample time after each step for students to complete the task.

While students work, circulate around the room and provide assistance.

STEP 1: Flip the cup upside down.

STEP 2: Place the cup onto the work surface/table.

STEP 3: Set the compass flat on the cup, with the dial of the compass facing up. Make sure the compass will rest on the cup without being held.

STEP 4: Have one student slowly wave the magnet wand around the compass in a circular motion. Prompt students to discuss what they notice.

STEP 5: Have students switch roles so each student gets a chance to wave the magnet wand around the compass.

STEP 6: Emphasize that the investigation must be completed without touching the compass assembly at all.

STEP 7: Prompt students to move the magnet wand very gradually and watch how the needle of the compass moves.

NOTE: Set correct expectations for students. The objective is not to try to make the compass rapidly spin, just to watch the needle inside the compass rotate. (See **Know the Science 2.**)

Know the Science

TEACHER DEVELOPMENT

2. The compass itself will not spin. The needle of the compass demonstrates the concept of how rotation can be induced by magnets in a motor. The magnetic pushes and pulls that induce steady rotation in electric motors and generators result from precise arrangements of many magnets and from electromagnets that switch magnetic fields on and off and control polarity in a highly synchronized fashion. Concepts related to electromagnets—that they can be turned off and on and reverse polarity—are beyond the Grade 2 level. The relevant points for students to take away from this unit are the following:

- Motors and generators work because they have parts inside them that rotate.
- The rotating parts have magnets built into them.
- Invisible pushes and pulls from magnets can move a part inside a machine to make it rotate.

Troubleshooting: If students are not able to make their compass needles rotate, assist and ensure the following:

- Students have set up their assembly correctly.
- The compass is balanced freely and centered on the cup.
- Students are moving the magnet wands near the compass from a correct and controlled distance.
- Students are moving the magnet wands at a controlled pace/speed.

After students have had a chance to investigate on their own, demonstrate and provide explanation using your prebuilt teacher model. Show how to approach the compass with the magnet wand gradually and from different angles to find the correct alignment to yield a push or a pull that rotates the needle around in the compass.

Use the following question prompts as students investigate this magnetic field:

- Is your needle able to move? Describe the motion.
- How is this like the motion of a hand crank?

Differentiation

CHALLENGE—Challenge students to investigate how they can make the compass needle partially rotate using more magnets or placing them in different positions around the compass. (See **Know the Standards 1.**)

EXTEND—Offer students the opportunity to take this investigation further by seeing what would happen if they used other materials. (See **Know the Standards 2.**)

3. Discuss results.

Activity Page



AP 9.1

Distribute Magnets and Rotation (AP 9.1). Read the questions aloud to students, and discuss their answers as a group. Write key terms from students' verbal responses on the board, and allow students to use these words as a word bank to complete their own answers on the Activity Page.

Give students time to record what their devices look like and answer the questions to describe how they work.

Know the Standards

TEACHER DEVELOPMENT

1. CCC 2 Cause and Effect: Magnets use invisible pushes and pulls, which are types of forces that can make things work. If magnets repel each other, then this is a push. If magnets attract each other, then this is a pull. Here, magnets are making the needle in the compass rotate slightly.

2. SEP 3 Planning and Carrying Out Investigations: Students build models to see how rotation works in electric motors and electricity generators, which is something they have learned about in the Student Book.

4. Show a more complex example.

Online Resources



Explain to students that things that use motors, such as fans, have several magnets inside and that they are precisely arranged. To make a model that spins all the way around takes many magnets and careful construction. Show students a video of such a demonstration. You may wish to build one of these models yourself for students to experiment with in the classroom, but the construction is too challenging for students to build themselves.

See the Online Resources Guide for a link to the recommended video resource.

www.coreknowledge.org/cksci-online-resources

5. Check for understanding.

Monitor Progress

Formative Assessment

Review student drawings on Magnets and Rotation (AP 9.1) to determine student understanding of the following concepts:

- Magnets are the source of the force causing the needle to move.
- Magnetic forces are invisible.
- Magnets cause pushes and pulls.

See the Activity Page Answer Key for correct answers and sample student responses.

LESSON 10

Science in Action: A Day with an Electrician

Big Question: Why do the lights sometimes go out during a thunderstorm?

Lesson Question: What does an electrician do?

Tie to the Anchoring Phenomenon: Students join Eva as she discovers more about how people, including her mother, work with electricity.

AT A GLANCE

Learning Objectives

- ✓ Recognize the basic practice of an electrician.
- ✓ Describe physical features and importance of insulated wire.

Instructional Activities (2 Days)

- teacher Read Aloud
- class discussion

Core Vocabulary

Core Vocabulary: Core Vocabulary terms are those that students should learn to use accurately in discussion and in written responses. During instruction, expose students repeatedly to these terms. However, these terms are not intended for isolated drill or memorization.

electrician **invent**

Language of Instruction: The Language of Instruction consists of additional terms, not considered a part of Core Vocabulary, that you should use when talking about any concepts in this exercise. Students will benefit from your modeling the use of these words without the expectation that students will use or explain the words themselves. A Glossary at the end of this Teacher Guide lists definitions for both Core Vocabulary and Language of Instruction.

electric panel **install** **insulated wire** **patent**

Instructional Resources

Student Book



Ch. 7

Student Book, Chapter 7
“Science in Action: A Day with an Electrician”

Materials and Equipment

Collect or prepare the following items:

- discarded power cord (1 foot per group)
- scissors (1 pair per group)
- craft trays (1 per group, optional)

THE CORE LESSON 10

1. Day 1: Introduce the topic.

Remind students that they read about Eva and her mom and learned about electricity throughout the unit. Explain that today they will read more about how electricity is studied by people who work with it every day.

2. Read together: “Science in Action: A Day with an Electrician.”

Student Book



Ch. 7

While some advanced students may be able to read words on a given page of the Student Book, as a rule students should not be expected or asked to read aloud the text on the Student Book pages. The text in the Student Book is there so that teachers and parents can read it when sharing the Student Book with students.

Read Aloud Support

Page 36

Ask students to turn to page 36 of the Student Book and look at the images as you read aloud. Remind them that the title of this chapter is “Science in Action: A Day with an Electrician,” and tell them to pay special attention to the things electricians do and the materials they work with as you read.

Ask students to look at the picture on page 36. Talk about what they see Eva and her mom wearing.

LITERAL—What does Eva’s mom do for a living? (See **Know the Standards 1**.)

» She is an electrician.

CORE VOCABULARY—Explain that an **electrician** is someone who specializes in electrical wiring and installs or repairs electrical equipment.

Know the Standards

TEACHER DEVELOPMENT

1. Nature of Science: Science Is a Human Endeavor: Both men and women, such as Eva’s mom, can work as electricians. They can also work in other STEM fields, such as engineering, mathematics, robotics, and construction.

LITERAL—What is Eva’s mom going to show Eva?

- » how she puts electrical wires inside the walls of a house

INFERENTIAL—What do you think Eva’s mom uses the toolbox for?

- » Sample answer: carrying tools that help her with fixing wires, attaching wires

Page 37

Ask students to look at the picture on page 37. Explain that the picture shows a main circuit breaker. Emphasize that this is not something students should ever touch. It is only safe for adults to touch these.

LITERAL—Where does the electricity from power lines enter the house?

- » through the electric panel

INFERENTIAL—Why do you think Eva’s mom needs to attach wires to the box and run them to the home’s electrical sockets?

- » so electricity can be used throughout the house

LITERAL—What does Eva’s mom have to do before she works on the electrical wires?

- » make sure the electricity is turned off

INFERENTIAL—Why do you think it is so important for the electricity to be turned off before Eva’s mom works on the panel?

- » so she doesn’t touch any dangerous wires

Page 38

Ask students to look at the two pictures on page 38. Explain that if you were to open up the walls of your house or the school, you would see wires that look like the ones shown in the picture. Clarify that the electricity in these wires ends up at different places throughout a house or building.

LITERAL—What does construction of a wall begin with?

- » wood or metal frames

LITERAL—Does Eva’s mom do her work when the wall frames are open or closed?

- » open

EVALUATIVE—How do you think electricians, like Eva’s mom, figure out where to run the wires in a house or building?

- » Sample answer: They have to think about where people might want to use electricity in each room, where the light switches will be, and where the wall sockets will be.

CHALLENGE—Give students a simple blueprint of a house with an electric panel on the side, and challenge them to draw where they would put the wires.

Page 39

Ask students to look at the two pictures on page 39. Remind students that they learned about wall sockets earlier in the unit.

LITERAL—What is Eva’s mom installing?

- » an electrical socket

LITERAL—What does Eva see inside the wire’s plastic coating?

- » three wires wrapped together

EVALUATIVE—If the electric current travels in a loop, is that a closed or open circuit? (If necessary, remind students of the simple circuits they made and how the current traveled in a closed loop.)

- » closed

INFERENTIAL—What do you think would happen if Eva’s mom does not strip the plastic coating off the wires?

- » Sample answer: The copper part of the wires cannot be connected to the socket.

Page 40

Ask students to look at the picture on page 40. Explain that the picture is of Thomas Edison. Emphasize that Edison is one of the most widely known U.S. inventors. (See **Know the Standards 2** and **3**.)

LITERAL—How was Thomas Edison important in helping people understand how to use electricity?

- » He came up with ways for people to use electricity in their homes.

LITERAL—What is Edison famous for inventing? What did he build?

- » He is famous for inventing the first light bulb that worked well. He built one of the first electric power plants in the country.

Know the Standards

TEACHER DEVELOPMENT

2. Nature of Science: Scientific Investigations Use a Variety of Methods: There are many different ways that scientists can study the natural world. Some scientists study things by experiencing and observing them. Other scientists perform tests or create models that they can use to study their ideas. For example, Thomas Edison may have observed the way electricity behaves to learn about its many uses and the risks associated with it.

3. SEP 1 Asking Questions: Scientific investigations begin with a question about the natural world. For example, Thomas Edison probably asked himself questions about electricity in order to lead him to his discoveries. Talk with students about what questions Edison might have asked to prompt his investigations.

CORE VOCABULARY—Explain that to **invent** means to come up with something that is new or has not existed before. Invite students to practice using the word *invent* in a sentence.

Page 41

Ask students to look at the picture on page 41. Explain that the picture shows the close views of copper wire, some inside black insulated coating.

LITERAL—What is Thomas Edison famous for inventing? (See **Know the Standards 4.**)

» insulated electrical wiring

Verify that students understand the meaning of the word *patent*, to get credit for inventing something for the first time and have the protected right to make money from the invention.

INFERENTIAL—Why was it important for the wrapping around the wire to be waterproof and fireproof?

» Sample answer: so the wire would be safe and keep the electricity inside it

INFERENTIAL—What does insulated electrical wire let people do?

» Sample answer: It lets people touch the wire safely; it allows people to have wiring installed in their homes without risk of fire.

LITERAL—In the picture, which parts of the wires are insulated coating?

» the black parts

1. Day 2: Facilitate the activity.

Remind students that they previously read about Eva’s mom, who works as an electrician, and Thomas Edison, who invented insulated wiring. Tell them that today they will do an activity where they get to look inside wires.

Have students form pairs, and distribute the materials. Explain that students have a piece of discarded power cord in front of them, which is something they might have seen before. They also have scissors. Explain that students will use the scissors to strip the cable apart so they can see the wires inside it.

Let students know that the cables are not connected to any electricity, so there is no risk of electric shock.

Know the Standards

TEACHER DEVELOPMENT

4. Nature of Science: Scientific Knowledge Is Based on Empirical Evidence: Electricity exists in nature, such as in the form of lightning, but it is also a type of energy that can be human-made. Thomas Edison studied the patterns of electricity, how it flows, and how it behaves or interacts with certain materials. He used these observations to come up with a way for people to work with electricity safely.

Caution students against cutting too much into the cable—this could snip away the wires. Students should use their scissors softly and try to just strip away the plastic, rather than cutting through the whole cable. Remind students to handle the scissors carefully to avoid cuts.

Circulate around the room as students work, encouraging students to take turns stripping the plastic coating off of the cable. When enough groups have stripped the plastic off, **ask students** to describe what they see and talk about their discoveries.

» We see three wires.

Ask students what the wires look like.

» There is a plastic coating around each wire.

Encourage students to look closely at the wires and see if they can see the metal inside them. Hold a discussion about how the wires work while students observe the wires they see before them. (See **Know the Science**.)

4. Check for understanding.

Monitor Progress

Formative Assessment

Review the stripped power cables to ensure students have successfully gotten through the cable to see the three wires inside. Ensure students understand the following:

- Electric currents require wires made of something that conducts electricity.
- Wires are protected by plastic coating, or insulated coating.
- Insulated coating lets people handle wires safely.

Know the Science

TEACHER DEVELOPMENT

Inside Wires: The plastic coating around the individual wires must come off for the metal wire to make contact to complete a circuit. Electricians need to strip the coating off to expose the metal in the wire. Then, the wires can be connected to the electricity.

Teacher Resources

Activity Pages

- What Can We Do with and without Electricity? (AP 1.1) 73
- Electricity Scavenger Hunt (AP 2.1) 74
- Types of Electricity (AP 3.1) 75
- Static Stations (AP 4.1) 76
- Follow the Electricity (AP 5.1) 77
- Will the Bulb Light Up? (AP 6.1) 78
- Simple Circuits (AP 7.1) 79
- Motors and Generators (AP 8.1) 80
- Magnets and Rotation (AP 9.1) 81

Activity Pages Answer Key: *Electricity and Magnetism* 82

Name _____

Date _____

What Can We Do with and without Electricity?

Write or draw activities you can do with and without electricity on the chart.

Activities We Can Do	
With Electricity	Without Electricity

Electricity Scavenger Hunt

Look around the classroom. See if you can find six objects that use electricity. List or draw them here.

1.	2.	3.
4.	5.	6.

Name _____

Date _____

Activity Page 3.1

Use with Lesson 3

Types of Electricity

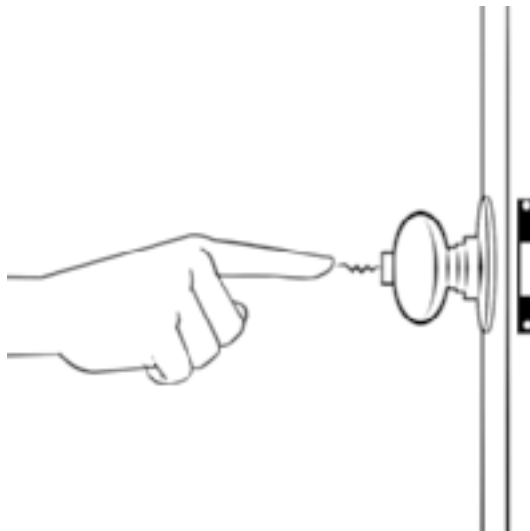
Write the word “current” or “static” to complete each sentence.



Lightning is an example of _____ electricity.



_____ electricity exists in power lines.



_____ electricity occurs on the surface of objects.



Your toaster at home is powered by _____ electricity.

Name _____

Date _____

Activity Page 4.1

Use with Lesson 4

Static Stations

Draw or write what you notice at each station.

Balloon station	Paper and comb station
Salt and pepper station	Foam plates station

Name _____

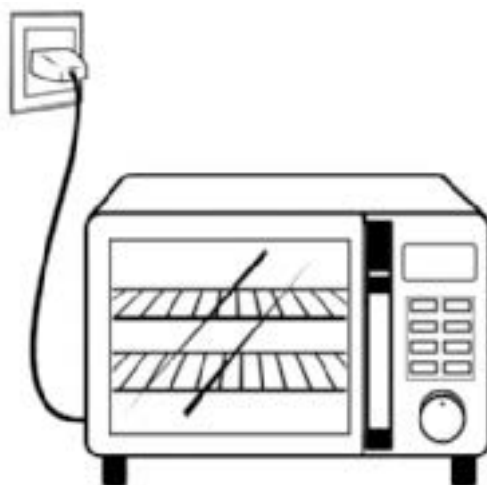
Date _____

Activity Page 5.1

Use with Lesson 5

Follow the Electricity

Draw arrows between the pictures to show the path of electricity.



Name _____

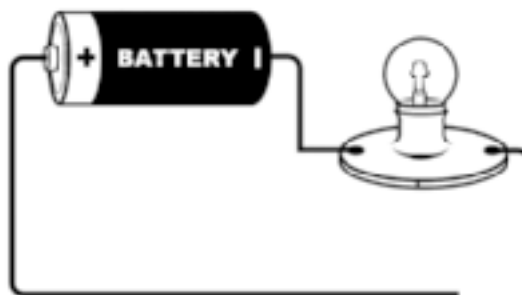
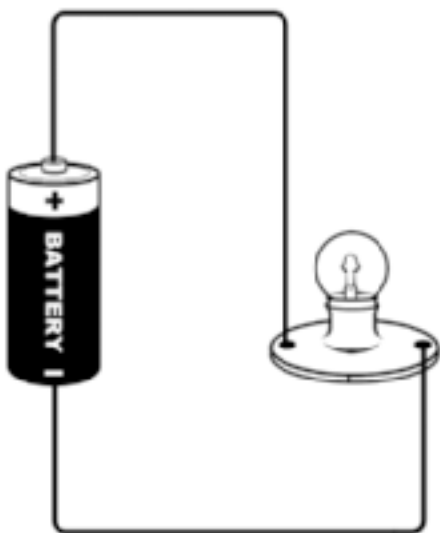
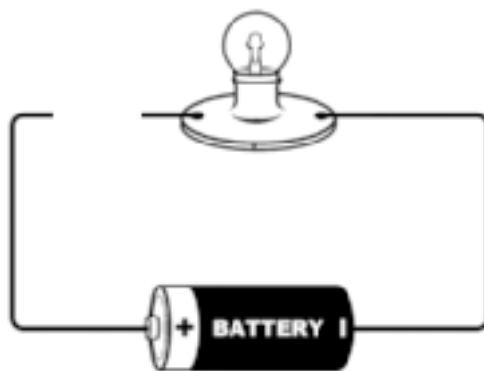
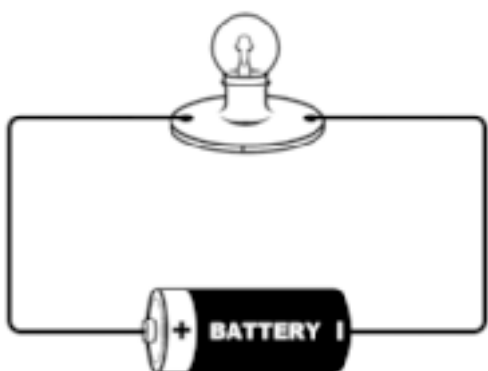
Date _____

Activity Page 6.1

Use with Lesson 6

Will the Bulb Light Up?

Decide if the bulb will light up. Color the bulb yellow if it will.



Name _____

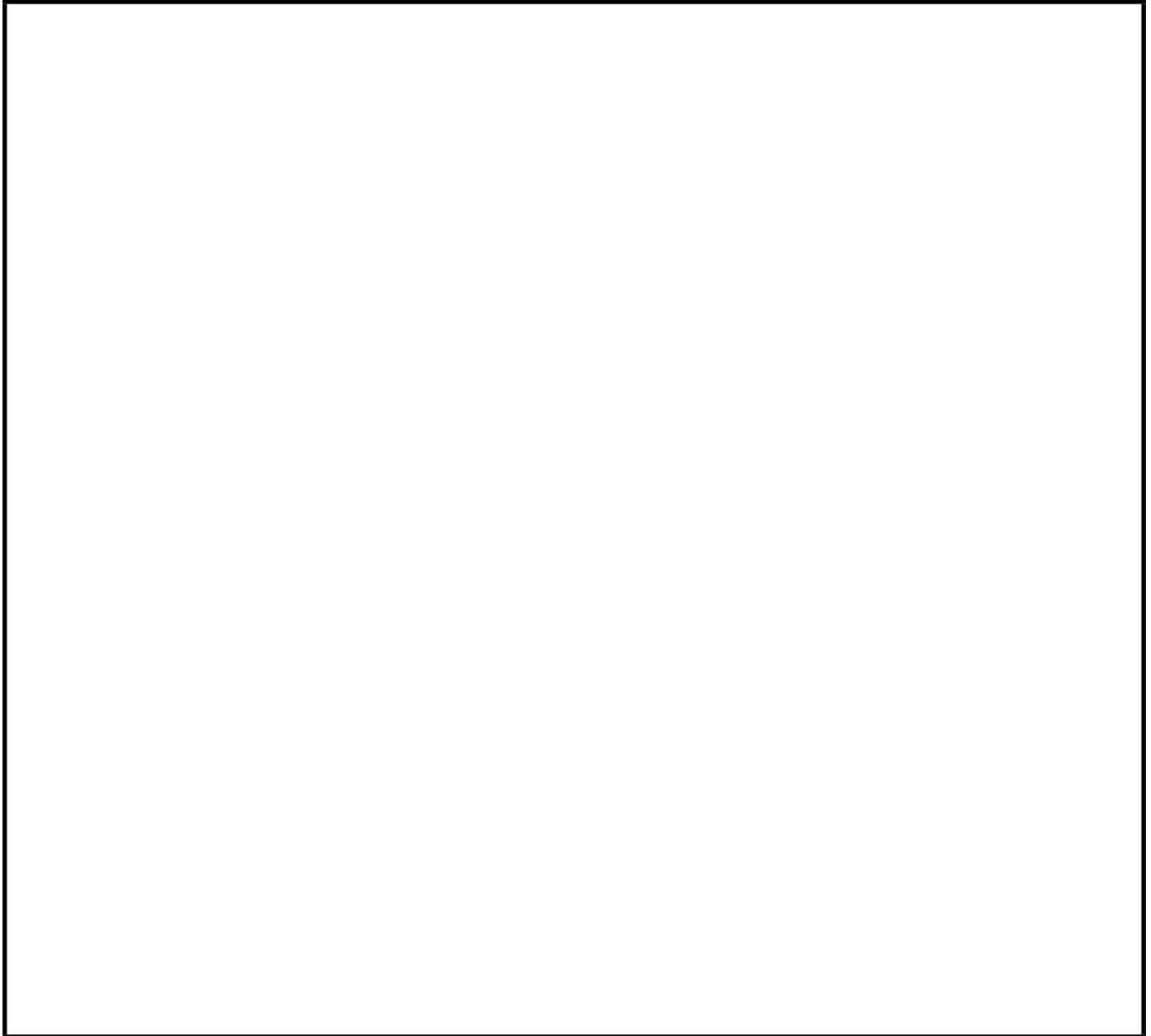
Date _____

Activity Page 7.1

Use with Lesson 7

Simple Circuits

Draw the simple circuit you made. Then answer the questions.



1. Which object is the source of electricity? _____
2. When the bulb lights up, is the circuit open or closed? _____
3. What happens when the circuit is incomplete? _____

Name _____

Date _____

Activity Page 8.1

Use with Lesson 8

Motors and Generators

Use the words in the box to complete each sentence. You can use the same words more than once.

magnets

fuel

rotates

stops

electricity

wires

1. When coiled wires move near _____, electricity results.
2. Turning the hand crank on the flashlight _____ the parts inside.
3. Electric currents need _____.
4. Motors and generators both need _____ to work.
5. An electric motor uses _____ and _____ to make parts rotate.
6. A small generator uses _____ to produce electricity.

Name _____

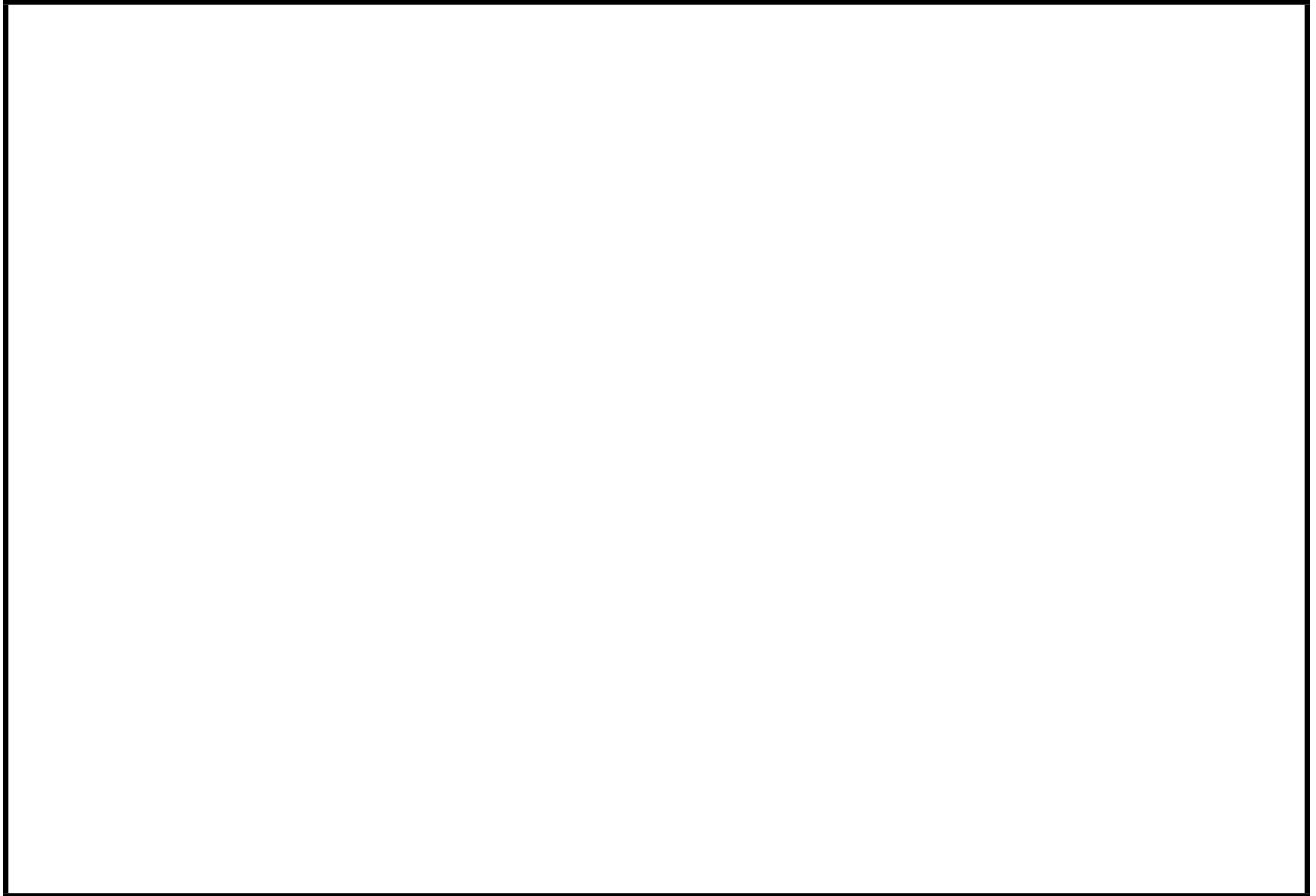
Date _____

Activity Page 9.1

Use with Lesson 9

Magnets and Rotation

Draw the rotation device you make. Then answer the questions.



1. What is the needle doing? _____
2. What makes the needle move? _____

Activity Pages Answer Key: *Electricity and Magnetism*

This answer key offers guidance to help you assess your students' learning progress. Here you will find descriptions of the expectations and correct answers for each Activity Page of this unit.

What Can We Do with and without Electricity? (AP 1.1) **(page 73)**

Accept all reasonable responses.

Electricity Scavenger Hunt (AP 2.1) **(page 74)**

Accept all reasonable responses. Possible answers may include lights, computers, an electric pencil sharpener, a projector, a cell phone, an aquarium pump, and so on.

Types of Electricity (AP 3.1) **(page 75)**

top left: static; top right: current; bottom left: static; bottom right: current

Static Stations (AP 4.1) **(page 76)**

Student drawings should reflect the observed phenomena: attraction between the balloon and fabric or hair; attraction between paper and comb; attraction of pepper to spoon; repulsion between plates.

Follow the Electricity (AP 5.1) **(page 77)**

Directional arrows should point from the power plant to the power lines, from the power lines to the home, and from the home to the appliance.

Will the Bulb Light Up? (AP 6.1) **(page 78)**

Students should color the bulbs in the first and third (closed) circuits yellow.

Simple Circuits (AP 7.1) **(page 79)**

student drawings should indicate the battery, wires, and bulb and show a closed loop.

1. battery
2. closed
3. The electricity does not transfer; the bulb does not light up.

Motors and Generators (AP 8.1) **(page 80)**

1. magnets
2. rotates
3. wires
4. magnets
5. electricity, magnets
6. fuel

Magnets and Rotation (AP 9.1) **(page 81)**

1. turning around in the compass
2. magnet, invisible push

Glossary

Blue words and phrases are Core Vocabulary for the unit. **Bold-faced words and phrases** are Language of Instruction, additional vocabulary terms related to the unit that you should model for students during instruction. Vocabulary words are not intended for use in isolated drill or memorization.

A

- appliance, n.** a device that performs a specific task
- assemble, v.** to bring people or things together
- attract, v.** to pull toward something without touching

B

- battery, n.** a source of power that turns stored (chemical) energy into electricity

C

- charge, v.** to store electrical energy in a battery for later use
- circuit, n.** the complete path that electricity flows in
- complete, adj.** whole, finished
- cling, v.** to tightly hold on to something
- connected, adj.** attached to something
- conduct/conductor, v./n.** to let electricity flow through/a material that lets electricity flow through it
- contact, n.** to touch
- cord, n.** a flexible, thin rope or string
- current electricity, n.** a type of electricity that exists in wires

D

- danger, n.** the possibility of harm or risk

E

- electric/electrical, adj.** having electricity or charge
- electrical storm, n.** an electrical disturbance in the atmosphere
- electrician, n.** someone who specializes in electrical wiring and installs or fixes electrical equipment
- electricity, n.** a form of energy that gets things to work
- electric panel, n.** a box where electricity enters and is sent to different circuits in a home or place

G

- generator, n.** a device that converts mechanical energy into electrical energy

I

- incomplete, adj.** not whole, unfinished
- install, v.** to put in place so something is ready to use
- insulate, v.** to add material to something in order to protect from electricity, heat loss, or sound
- insulated wire, n.** a wire covered in material that resists electrical currents
- invent, v.** to come up with something that is new or has not existed before
- invisible, adj.** not visible or able to be seen

L

- lightning, n.** a bolt of electricity that occurs naturally outside
- loop, n.** a thing or process where the end connects to the beginning

M

- magnet, n.** something that produces invisible pushes and pulls
- magnetic pole, n.** the area at each end of a magnet
- motor, n.** a machine that uses electricity or fuel to do work

P

patent, n. a license for a certain period of time that keeps others from making, using, or selling someone's invention

plug, n. something found on an electrical cord that fits into a socket to access electrical energy

power, n. the rate of time it takes to deliver energy or do work

power lines, n. giant wires that let electricity get to your home

power outage, n. the loss of electricity to an area

power plant, n. a place where electrical energy is created for use

pull, v. to use force to bring something toward yourself

push, v. to use force to move something away from yourself

R

recharge, v. to put the capacity for electrical energy back into something like a battery

repel, v. to force something away

rotate, v. to turn about a central axis

S

shock, n. a sudden electric current through the body that can be painful

socket, n. a small opening where electrical cords can be plugged in to access electricity

source, n. the beginning of a place or something

spark, n. a bright electrical discharge

static electricity, n. a type of electricity that occurs on the surfaces of objects

surface, n. the outside layer of something

switch, n. a device that is used for making or breaking the connection of electricity in a circuit

U

utility pole, n. a tall pole that holds power lines above ground

W

wire, n. a thin metal thread that is flexible

wiring, n. a group of wires that form electric circuits

Classroom Safety for Activities and Demonstrations

In the Core Knowledge Science program (CKSci), activities and demonstrations are a vital part of the curriculum and provide students with active engagement related to the lesson content. The activities and demonstrations in this unit have been selected and designed to engage students in a safe manner. The activities and demonstrations make use of materials and equipment that are typically deemed classroom safe and readily available.

Safety should be a priority when engaged in science activities. With that in mind, observe the following safety procedures when the class is engaged in activities and demonstrations:

- Be aware of students who have food allergies, and adjust related activities or make materials substitutions as necessary. Check the ingredients of all food to make sure known allergies are not listed. Students with food allergies can still be affected even if they do not ingest the food item. Some common food allergies are peanuts, tree nuts (e.g., almonds, walnuts, hazelnuts, etc.), and cow's milk (rice milk is a good nut-free alternative).
- Report and treat any injuries immediately.
- Check equipment prior to usage, and make sure everything is clean and ready for use.
- Clean up spills or broken equipment immediately using the appropriate tools.
- Monitor student behavior to ensure they are following proper classroom and activity procedures.
- Do not touch your eyes, ears, face, or mouth while engaging in an activity or demonstration.
- Review each step of the lesson to determine if there are any safety measures or materials necessary in advance.
- Wear personal protective equipment (e.g., safety goggles, aprons, etc.) as appropriate.
- Check for allergies to latex and other materials that students may have, and take appropriate measures.
- Secure loose clothing, hair, or jewelry.
- Establish storage and disposal procedures for chemicals as per their Safety Data Sheet (SDS), including household substances such as vinegar and baking soda.

Copy and distribute the Student Safety Contract, found on the next page. Have a read-along, and have students agree to the expectations for students when engaged in science activities prior to the start of the first unit.

Online Resources



For additional support for safety in the science classroom, follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Student Safety Contract

When doing science activities, I will do the following:

- Report spills, breakages, or injuries to the teacher right away.
- Listen to the teacher for special instructions and safety directions. If I have questions, I will ask the teacher.
- Avoid eating or drinking anything during the activity unless told to by my teacher.
- Review the steps of the activity before I begin. If I have questions, I will ask the teacher.
- Wear safety goggles when working with liquids or things that can fly into my eyes.
- Be careful around electric appliances and unplug them, just by pulling on the plug, when a teacher is supervising.
- Keep my hands dry when using tools and devices that use electricity.
- Be careful to use safety equipment like gloves or tongs when handling materials that may be hot.
- Know when a hot plate is on or off and let it cool before touching it.
- Roll or push up long sleeves, keep my hair tied back, and secure any jewelry I am wearing.
- Return unused materials to the teacher.
- Clean up my area after the activity and wash my hands.
- Treat all living things and the environment with respect.

I have read and agree to the safety rules in this contract.

_____ / _____ / _____ /

Student signature and date

Print name

Dear Parent or Guardian,

During science class, we want to create and maintain a safe classroom. With this in mind, we are making sure students are aware of the expectations for their behavior while engaged in science activities. We are asking you to review the safety rules with your student and sign this contract. If you have any questions, please feel free to contact me.

_____ / _____ / _____ /

Parent or guardian signature and date

Strategies for Acquiring Materials

The materials used in the Core Knowledge Science program (CKSci) are readily available and can be acquired through both retail and online stores. Some of the materials will be reusable and are meant to be used repeatedly. This includes equipment such as scales, beakers, and safety goggles but also items such as plastic cups that can be safely used again. Often these materials are durable, can be cleaned, and will last for more than one activity or even one school year. Other materials are classified as consumable and are not able to be used more than once, such as glue, baking soda, and aluminum foil.

Online Resources



The Material Supply List for this unit's activities can be found online. Follow the links in the Online Resources Guide for this unit:

www.coreknowledge.org/cksci-online-resources

Ways to Engage with Your Community

The total cost of materials can add up for an entire unit, even when the materials required for activities and demonstrations have been selected to be individually affordable. And the time needed to acquire the materials adds up too. Reaching out to your community to help support STEM education is a great way to engage parents, guardians, and others with the teaching of science, as well as to reduce the cost and time of collecting the materials. With that in mind, the materials list can be distributed or used as a reference for the materials teachers will need to acquire to teach the unit.

Consider some of the following as methods for acquiring the science materials:

- **School Supply Drive**—If your school has a supply drive at any point in the year, consider distributing materials lists as wish lists for the science department.
- **Open Houses**—Have materials lists available during open houses. Consider having teams of volunteers perform an activity to show attendees how the materials will be used throughout the year.
- **Parent-Teacher Organizations**—Reach out to the local PTO for assistance with acquiring materials.
- **Science Fair Drive**—Consider adding a table to your science fair as part of a science materials drive for future units.
- **College or University Service Project**—Ask service organizations affiliated with your local higher education institutions to sponsor your program by providing materials.
- **Local Businesses**—Some businesses have discounts for teachers to purchase school supplies. Others may want to advertise as sponsors for your school/programs. Usually you will be asked for verifiable proof that you are a teacher and/or for examples of how their sponsorship will benefit students.

Remember: If your school is public, it will be tax exempt, so make sure to have a Tax Identification Number (TIN) when purchasing materials. If your school is private, you may need proof of 501(c)(3) status to gain tax exemption. Check with your school for any required documentation.

Advance Preparation for Activities and Demonstrations

Being properly prepared for classroom activities and demonstrations is the first step to having a successful and enriching science program. Advance preparation is critical to effectively support student learning and understanding of the content in a lesson.

Before doing demonstrations and activities with the class, do the following:

- Familiarize yourself with the activity by performing the activity yourself or with a team, and identify any issues or talking points that could be brought up.
- Gather the necessary materials for class usage. Consider if students will gather their materials at stations or if you will preassemble the materials to be distributed to the students and/or groups.
- Identify safety issues, such as food allergies, that could occur during an activity or demonstration, and plan and prepare how to address them.
- Review the Teacher's Guide before teaching, and identify opportunities for instructional support during activities and demonstrations. Consider other Support and/or Challenge opportunities that may arise as you work to keep students engaged with the content.
- Prepare a plan for postactivity collection and disposal of materials/equipment.

While engaged in the activity or demonstration, do the following:

- Address any emergencies immediately.
- Check that students are observing proper science safety practices as well as wearing any necessary safety gear, such as goggles, aprons, or gloves.
- When possible, circulate around the room, and provide support for the activity. Return to the Teacher Guide as students work, to utilize any Support and Challenge opportunities that will make the learning experience most meaningful for your students.

After the activity or demonstration, do the following:

- Use your plan for students to set aside or dispose of their materials as necessary.
- Have students wash their hands after any activity in which they could come in contact with any potentially harmful substances.

When engaging students in activities and demonstrations, model good science practices, such as wearing proper safety equipment, never eating during an investigation, etc. Good science practices at a young age will lead to students observing good science practices themselves and being better prepared as they move into upper-level science classes.

What to Do When Activities Don't Give Expected Results

Science activities and experiments do not always go according to plan. Microwave ovens, super glue, and X-rays are just some of the discoveries made when people were practicing science and something did not go according to plan. In your classroom, however, you should be prepared for what to do when activities don't give the expected results or when an activity doesn't work.

When going over an activity with an unexpected result, consider these points in discussion with your students:

- Was there an error in following the steps in order? You or the student may have skipped a step. To help control for this, have students review the steps to an investigation in advance and make a check mark next to each step as they complete it.
- Did students design their own investigation? Perhaps their steps are out of sequence, or they missed a step when performing the activity. Review and provide feedback on students' investigation plan to ensure the work is done in proper sequence and that it supports the lesson segment's guiding question.
- When measurements were taken, were they done correctly? It is possible a number was written down incorrectly; a measurement was made in error, such as a wrong unit of measure or quantity; or the starting or ending point of a measurement was not accurate.
- Did the equipment or materials contribute to the situation? For example, chemicals that have lost their potency or a scale that is not measuring accurately can contribute to the success or failure of an activity.

One of the greatest gifts a student can learn when engaged in science is to develop a curiosity for *why something happened*. Students may find it challenging or frustrating to work through a problem during an activity, but guiding them through the problem to figure out *why* something happened will help them to develop a better sense of how to do science.



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Core Knowledge **SCIENCE™**

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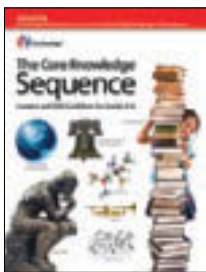
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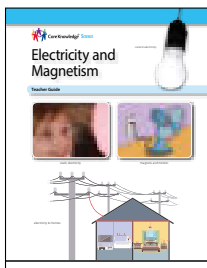
Electricity and Magnetism

Core Knowledge Science 2



What is the Core Knowledge Sequence?

The *Core Knowledge Sequence* is a detailed guide to specific content and skills to be taught in Grades K–8 in language arts, history, geography, mathematics, science, and the fine arts. In the domains of science, including Earth and space, physical, and life sciences, the *Core Knowledge Sequence* outlines topics that build systematically grade by grade to support student learning progressions coherently and comprehensively over time.



For which grade levels is this book intended?

In general, the content and presentation are appropriate for students in the early elementary grades. For teachers and schools following the *Core Knowledge Sequence*, this book is intended for Grade 2 and is part of a series of **Core Knowledge SCIENCE** units of study.

For a complete listing of resources in the
Core Knowledge SCIENCE series,
visit www.coreknowledge.org.

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