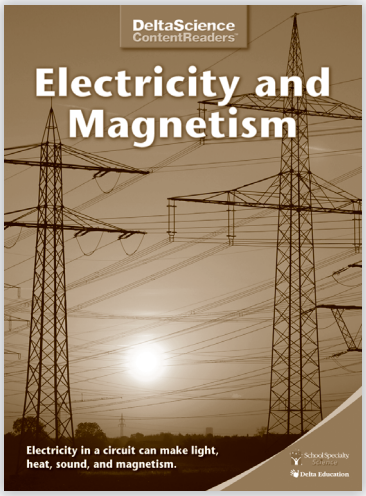


Red Edition
Grade 3–4
reading level

Purple Edition
Grade 4–5
reading level

Objectives

- Understand that electric charge is a property of matter.
- Compare static electricity and current electricity.
- Describe the flow of electricity in electric circuits.
- Understand magnets, magnetism, and magnetic fields.
- Explain how electricity and magnetism are related.
- Explore what electromagnets are and why they are useful.
- Explain how generators make electric current.
- List different sources of energy for making electricity.
- Discuss how electric energy is changed to forms of energy we can use.
- Understand how an electric motor works.

Reading Comprehension Skills

Preview the Book ◆ Compare and Contrast

How to Read Charts ◆ Main Idea and Details

Skillbuilders are available for this title.

Supporting English Learners

Activate Prior Knowledge Enhance English Learners' ability to organize what they already know about electricity and magnetism. Tie new information to students' own experiences, and then relate it to the science concepts in each section. Make explicit connections to new learning and concepts covered in previous sections.

Summary

What is electricity, and how is it related to magnetism? In the Delta Science Content Reader *Electricity and Magnetism*, students first explore atoms and electric charge. Students compare static electricity and current electricity, as well as series circuits and parallel circuits. Then they explore the relationship between electricity and magnetism. They apply this knowledge to develop an understanding of how generators produce electricity. They also learn about both renewable and nonrenewable resources used to power generators. The book concludes with a discussion of how we change electric energy to other forms of energy.

Science Background

Electricity is the interaction of electric charges. Electric charge is a fundamental property of matter. Atoms contain protons (positively charged), electrons (negatively charged), and neutrons (not charged). Most atoms are neutral, but if they gain or lose electrons, they become charged.

An electric charge that builds up on an object is called static electricity. In contrast, a steady flow of electric charge is known as electric current. Electric current requires a pathway to flow through, called a circuit. If the pathway is disrupted, the current stops—the circuit is open. If the pathway is restored, the current flows again—the circuit is closed.

Electricity and magnetism are linked. An electric current produces a magnetic field (the invisible force surrounding a magnet), and a magnetic field produces electric current in a wire. These two fundamental principles comprise electromagnetism. An electromagnet is made by coiling wire around a piece of iron. When current is passed through the wire, a magnetic field is produced. The field magnetizes the iron. Electromagnetism also forms the basis of the electric motor, in which electricity is converted to mechanical energy, and the generator, in which mechanical energy is converted to electricity.

What Is Electricity?

(pages 2–9)

Before Reading

Discuss the Cover

Cover Image Discuss the photograph on the cover of *Electricity and Magnetism*. Use the information on the inside front cover to support the discussion.

Science Statement Discuss the science statement. Say: *A circuit is a special kind of path for electricity. You'll learn more about that as you read. What are some examples of electricity making heat, light, or sound?*

Build Reading Skills (page 2)

Preview the Book Use Build Reading Skills on page 2 to review how to preview the book. Discuss the steps. Then model previewing the words in bold type.

> **Think Aloud** *Why are some words set in bold type? I know that sometimes in science books, science vocabulary is set in bold type. Maybe that's what's happening here. To see if I'm right, I'll look at the Vocabulary box on page 3. The terms* electricity *and* electric charge *are both Vocabulary words. Are they set in bold type later in the book? Yes, I see them on page 4. I was right: the words in bold type are Vocabulary words.*

Guide students as they finish previewing *Electricity and Magnetism*. Focus on nonfiction text features.

- Prompt them to look at the headings, photographs, captions, and diagrams. Ask questions such as *Why do you think that feature is there? How will it help you understand what you read?*
- Prompt them to look at other bold Vocabulary words. Guide the class in looking up a Vocabulary word in the Glossary.

K-W-L Chart Have students begin a K-W-L chart. They should add to it after each section.

What I Know	What I Want to Learn	What I Learned
Electricity makes lights work.	How can electricity make magnetism?	

Make a Connection (page 3)

Make a Connection Discuss the Make a Connection question. Use this discussion to build background and activate prior knowledge about electricity. (Possible answers: We probably wouldn't have computers, televisions, or CD players. We might have to cook food differently, maybe by burning wood or other fuel. We might need candles to light our homes.)

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Read the Vocabulary words aloud. Explain to students that they will see these words in bold in this section. Start a Venn diagram on the board. Label one circle *Static Electricity* and the other *Current Electricity*. Label the space where the circles overlap *Both*. Have students sort other Vocabulary words into each circle as they read.

During Reading

Electric Charge (page 4)

- Ask: *Where does electricity come from?* (Electricity is caused by the movement of electrons.)
- Ask: *What kind of electric charges do protons, electrons, and neutrons have?* (Protons have a positive charge, electrons have a negative charge, and neutrons have no charge.)

Checkpoint (Electrons can move from atom to atom. Some atoms wind up with more electrons than protons and some with more protons than electrons. An atom with more electrons than protons has a negative charge. An atom with fewer electrons than protons has a positive charge.)

Static Electricity (page 5)

- Ask: *How do objects become charged?* (when objects rub together and electrons move from one object to another)
- Ask: *What is static discharge?* (when objects lose their charge and become neutral again)
- Explain that the Lightning Safety box on page 6 lists only some lightning safety rules. A complete list is available from the Web site for the National Oceanic and Atmospheric Administration (NOAA). Be sure to review this list with students.

Checkpoint (The objects will attract each other.)

Current Electricity (page 7)

- Any instruction about electricity should include a discussion of safety issues. Take time to review *all* electricity safety rules with your students. A partial list appears here:

√	Never unplug any electrical device by tugging on its cord; instead, pull on the plug itself.
√	Do not overload wall outlets or power strips.
√	Never use an electrical device when your hands are wet or you are standing in water.
√	Never touch downed power lines or objects that are in contact with them.
√	Never stick your finger or any object other than a plug into an electrical outlet.
√	Never use electrical devices that have broken or frayed cords.

Checkpoint (Electric current passes easily through conductors but not through insulators.)

Electric Circuits (page 8)

- Ask: *What three things make up an electric circuit?* (a source of electric charge, a device that needs electric energy to work, and wire that links the source and the device in a loop)
- Ask: *If a whole string of lights goes dark when one bulb burns out, what kind of circuit do the lights run on? Explain.* (series circuit; When one bulb burns out, the current stops flowing.)
- Direct students to look at the diagram of a parallel circuit on page 9. Ask: *How many paths are in this parallel circuit?* (three)

Checkpoint (Current can flow only if the circuit is closed.)

After Reading

Reflect on Reading (page 9) Before students begin drawing their circuit diagrams, review the circuit diagram and symbols on page 8. Be sure they understand the meaning of each symbol and how the diagram corresponds to the simple circuit illustration.

Apply Science Concepts (page 9) This activity applies a concept from Find Out About on page 3. If possible, hold up an electrical plug. Point out the metal parts of the plug that go into the wall and the part we hold on to when plugging in the cord. Ask: *Why do plugs have plastic where you hold them?* (It is an insulator, which keeps us from getting shocked.)

How Are Electricity and Magnetism Related? (pages 10–13)

Before Reading

Build Reading Skills (page 10)

Compare and Contrast Use Build Reading Skills on page 10 to review how to compare and contrast. Discuss the tips. Then point out the photographs of two devices gripping metal on pages 10–11.

> **Think Aloud** *How can I compare these two pieces of machinery? They are both large, and they are both being used to pick up pieces of metal. How can I contrast them? The claw-shaped one on the left picks up the metal pieces by grabbing them. The round one on the right seems to be a magnet. It looks as if the metal is sticking to it.*

Guide students as they compare and contrast the photographs on page 12 illustrating how unlike poles attract and like poles repel. Students can apply the skill in the Reflect on Reading activity on page 13.

Make a Connection (page 11)

Make a Connection Discuss the Make a Connection question. Use this discussion to build background and activate prior knowledge about electricity and magnetism. (Possible answer: It would be useful because you could release the metal once you moved it to where you wanted it to go.)

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Read the Vocabulary words aloud. Explain to students that they will see these words in bold in this section. Start a concept web on the board with *Magnetism* in the center. Have students add related words to the web as they read.

During Reading

Magnets (page 12)

- Explain that a magnetic field is an invisible, three-dimensional field of force around a magnet.

Checkpoint (A refrigerator door must contain iron, cobalt, or nickel.)

Electromagnets (page 13)

- Ask: *What forms around a wire when an electric current flows through it?* (a magnetic field)
- Adult supervision is always necessary when building electromagnets. The battery used should not be of high voltage and should not be left connected for too long. Otherwise, it could get hot and burn someone's hands.

Checkpoint (Wrap more wire coils around the nail, or add more current to the wire.)

After Reading

Reflect on Reading (page 13) (Possible answer: Magnets: can be permanent or temporary; Electromagnets: are temporary, can be turned on and off, can be made stronger, use an electric current; Both: attract the metals iron, cobalt, and nickel and other magnets, have one north-seeking pole and one south-seeking pole)

Apply Science Concepts (page 13) This activity applies a concept from Find Out About on page 11. Allow students to move around the classroom with a magnet and test their ideas.

How Do We Get Electricity? (pages 14–19)

Before Reading

Build Reading Skills (page 14)

How to Read Charts Use Build Reading Skills on page 14 to review how to read charts. Discuss the tips. Point out the chart on page 19, and model how to use the column headings and row headings.

Think Aloud *From the title, I know that this chart is about renewable sources of energy for making electricity. I'll look at the headings to see what the chart will show me. The column headings are* Energy Source, Description, Advantages, and Disadvantages. *The row headings name different renewable energy sources. So the chart will explain how these energy sources work and some good and bad things about them.*

Guide students as they use the headings to identify advantages and disadvantages of different energy sources. Students can apply the skill in the Reflect on Reading activity on page 19.

Make a Connection (page 15)

Make a Connection Discuss the Make a Connection question. Use this discussion to build background and activate prior knowledge about sources of energy for making electricity. (Possible answers: Wind is everywhere; wind does not cause pollution.)

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Read the Vocabulary words aloud. Explain to students that they will see these words in bold in this section. Start a T-chart on the board. Label one column *Nonrenewable Resources* and the other *Renewable Resources*. Have students suggest examples of each as they read.

During Reading

Generators (page 16)

- Discuss the diagram of how a generator works. Emphasize that students should read the steps in the order they are numbered. Guide students to understand how each step leads to the next.
- Ask: *What makes an electric current in a generator?* (a wire coil spinning in a magnetic field)
- Ask: *Why does a generator need a turbine?* (to turn the wire coil in the magnetic field)

Checkpoint (Generators use magnetic fields to make electric current.)

Energy Resources (page 17)

- Ask: *What are two problems with using fossil fuels?* (They cannot be replaced once they are used up; burning them makes pollution.)

Checkpoint (Possible answers: Nonrenewable resources: coal, oil, natural gas; Renewable resources: Sun, wind, heat deep inside Earth, moving water)

After Reading

Reflect on Reading (page 19) Remind students to look in every column of the chart for information they can use to compare and contrast the energy sources they chose. Ask questions such as *How are the energy sources' advantages the same? Different?*

Apply Science Concepts (page 19) This activity applies a concept from Find Out About on page 15. As students brainstorm three reasons, remind them to use the chart on page 19 to find details that support each reason.

How Do We Use Electricity? (pages 20–23)

Before Reading

Build Reading Skills (page 20)

Main Idea and Details Use Build Reading Skills on page 20 to review main idea and details. Discuss the tips. Then read aloud the first paragraph under the head "Electric Motors" on page 22, and model identifying the main idea and details.

> **Think Aloud** *To find the main idea, I'll look for the topic sentence. The first sentence tells me that many devices change electric energy to the energy of motion. That sounds like a main idea. The other sentences give examples, or details. These details back up, or support, the main idea.*

Guide students as they practice finding the main idea and details in other paragraphs on page 22. Students can apply the skill in the Reflect on Reading activity on page 23.

Make a Connection (page 21)

Make a Connection Discuss the Make a Connection question. Use this discussion to build background and activate prior knowledge about how we use electricity. (Possible answers: lights, clocks, computer, television)

Find Out About Read each statement to help students set a reading purpose. Explain that these are the important topics that they will learn about in this section.

Vocabulary Start a concept web on the board with *Electric Motor* in the center. Have students suggest examples of devices with motors as they read.

During Reading

Using Electricity (page 22)

Checkpoint (Possible answers: Sound energy: CD player, television; Light energy: flashlight, streetlight)

Electric Motors (page 22)

- Remind students that a generator uses motion and a magnetic field to make electric current. An electric motor uses electric current to make motion.
- Many common devices have electric motors, including electric pencil sharpeners, fans, garage door openers, electric mixers, and vacuum cleaners.
- Ask: *What three parts make up an electric motor?* (a permanent magnet that does not move; a wire-coil electromagnet connected to a source of current electricity, such as a battery; a device that changes the direction of the electric current in the wire coil)
- Ask: *What happens when the poles of the electromagnet flip back and forth inside an electric motor?* (The electromagnet makes a half turn. The current changes direction so quickly that the electromagnet spins. The spinning coil can then move machine parts.)

Checkpoint (Electric motors change electric current to motion energy.)

After Reading

Reflect on Reading (page 23) Make sure students' webs show both a main idea and supporting details. (Possible answers: Main idea: electric energy must be changed to another form of energy before we can use it; Supporting details: radio changes electric energy to sound energy to hear music, oven changes it to thermal energy to cook food, light bulb changes it to light energy so we can see)

Apply Science Concepts (page 23) This activity applies a concept from Find Out About on page 21. Have partners discuss the labels and arrows on their pictures, as well as the answers to the questions. (Almost all electric devices with moving parts have electric motors.)

Continued on last page

Name: Date:

Test: **Electricity and Magnetism**

Part A: Vocabulary

atoms	electricity	magnetic field	magnetism
nonrenewable resources	renewable resources	static discharge	static electricity

Choose the correct vocabulary word for each definition. Write the word on the line.

1. To use _____, we change it into other kinds of energy, such as sound, heat, light, or motion.

2. Tiny building blocks of matter made up of protons, neutrons, and electrons are called _____.

3. When a positive or negative electric charge builds up on an object, that is called _____.

4. Lightning is an example of a very strong _____.

5. The force called _____ attracts certain metals.

6. A magnet's force acts in its _____, which reaches out from the magnet in all directions.

7. Moving water and wind are examples of _____.

8. Natural gas and oil are examples of _____.

Part B: Science Concepts

Mark the best answer to each question.

9. What causes an object to have a positive or negative electric charge?

Ⓐ The object gains or loses neutrons.
Ⓒ The object gains or loses protons.
Ⓑ The object gains or loses electrons.
Ⓓ The object gains or loses atoms.

10. How is an electromagnet different from a magnet?

Ⓐ It can be turned on and off.
Ⓒ It has magnetic poles.
Ⓑ It is a permanent magnet.
Ⓓ It can attract other magnets.

Test: **Electricity and Magnetism** *(continued)*

11. Which answer best explains how a generator uses a magnet to make electricity?

Ⓐ A magnetic field makes an electric current.

Ⓑ Electric current makes a magnetic field.

Ⓒ A magnet attracts objects that contain iron, cobalt, or nickel.

Ⓓ Magnetism is strongest at the magnetic poles.

12. Which answer best describes how an electric motor works?

Ⓐ The permanent magnet always repels the electromagnet.

Ⓑ The permanent magnet always attracts the electromagnet.

Ⓒ The changing current makes the electromagnet spin.

Ⓓ The changing current makes the permanent magnet spin.

Write the answer.

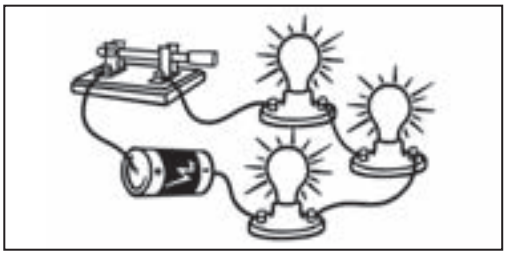
13. Explain current electricity. Use *conductor, insulator,* and *circuit* in your response.

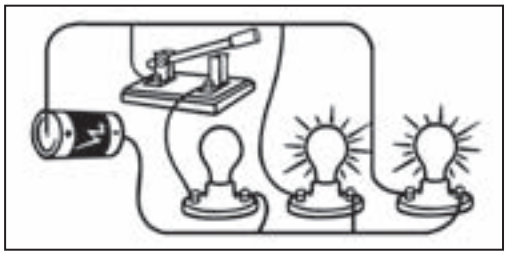
_____

_____

_____

14. Label the circuits shown below. Which type of circuit is used to run the devices in a house? Why do you think so?





_____ **circuit** _____ **circuit**

_____

_____

15. Why can using renewable resources be better than using nonrenewable ones?

_____

_____

Let's Review

(inside back cover)

Have students complete their K-W-L charts before answering these questions. Possible answers are shown.

1. **Cover Connection** (Electric energy in a closed circuit can be changed to other kinds of energy, such as light, heat, sound, and motion. Electric motors, generators, and electromagnets make the changes possible.)
2. (Static electricity is the buildup of electric charge on an object. It happens when an object gains or loses electrons. Current electricity is the flow of electric charge.)
3. (A magnetic field forms around a wire when electric current flows through it. So if you wrap a wire linked to a battery around an iron nail, the nail becomes an electromagnet.)
4. (Turbines are the source of the motion energy needed to make electricity. They turn a wire coil within a magnetic field.)
5. (Light: light bulbs, televisions, computers; Sound: CD players, radios, televisions, fans, blenders; Heat: light bulbs, ovens, toasters; Motion: fans, blenders, clocks)
6. **Compare and Contrast** (Both have a source of electric charge, devices that run on electricity, and wire that links the source of charge to the devices in a loop. They both might also have switches. In a series circuit, current flows on only one path, from device to device. In a parallel circuit, current flows in a different path to each device.)
7. **Write** (Journal entries should include examples of devices at home that could not be used without electricity, such as computers and televisions. They should also include examples of things that use batteries or do not use electricity that students used instead, such as flashlights and books.)

Try It! Guide students to remember that opposite charges attract. The balloon became charged when rubbed on the hair. Now it attracts things with the opposite charge, such as clothes or the wall.

Science at Home Have students find and draw switches of different appliances, tools, and devices. Challenge them to find many different types of switches, and see if they find and draw any that their classmates cannot identify.

Answers to Test

(Teacher's Guide pages 6–7)

1. electricity **2.** atoms **3.** static electricity **4.** static discharge **5.** magnetism **6.** magnetic field **7.** renewable resources **8.** nonrenewable resources **9.** B **10.** A **11.** A **12.** C **13.** Current electricity is the flow of electric charge. It flows through wires made of a material called a conductor. The wires are covered with a material called an insulator. Current flows through a path called a circuit. **14.** Left: series circuit; Right: parallel circuit. Houses are wired with parallel circuits so that you can turn each device on and off as needed. **15.** Renewable resources can be easily replaced or cannot be used up, unlike nonrenewable ones. They also make much less pollution than fossil fuels, which are nonrenewable.

ADDITIONAL ASSESSMENT OPPORTUNITIES Use the Checkpoints, Reflect on Reading, and Apply Science Concepts features and Let's Review questions as additional assessment opportunities.

Delta Science Content Readers are 24-page nonfiction student books with informative, engaging text and full-color photos and illustrations. The readers present key science content and vocabulary found on state tests, present key reading skills and strategies useful for reading informational text, support and extend the experiences and content of hands-on activities, promote scientific inquiry, and serve as a home-school link. **They are available in two editions: Red Edition for Grades 3–4 and Purple Edition for Grades 4–5.**

This teacher's guide is available online at
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