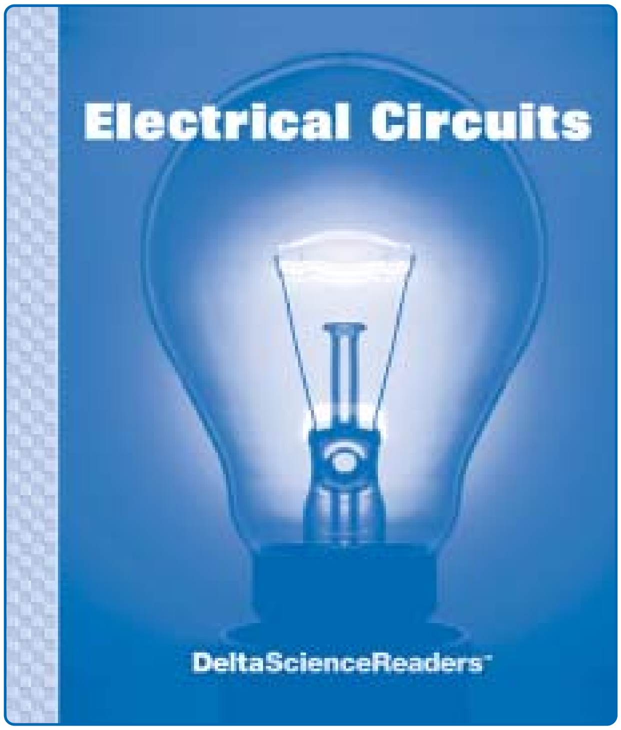
Delta Science Reader

Electrical Circuits



Delta Science Readers *are nonfiction student books that provide science background and support the experiences of hands-on activities. Every* ***Delta Science Reader*** *has three main sections: Think About . . . , People in Science, and Did You Know?*

Be sure to preview the reader Overview Chart on page 4, the reader itself, and the teaching suggestions on the following pages. This information will help you determine how to plan your schedule for reader selections and activity sessions.

Reading for information is a key literacy skill. Use the following ideas as appropriate for your teaching style and the needs of your students. The After Reading section includes an assessment and writing links.

Overview

In the Delta Science Reader *Electrical Circuits,* students read about electric charge, electric current, electrical circuits, and two ways in which electricity and magnetism are related. The book presents biographical sketches of key innovators in this field—Thomas Alva Edison, Alexander Graham Bell, and Lewis Howard Latimer—and describes the work of an electrician. Students also discover how water power is used to make electricity and how much energy various household appliances use.

Students will

- read about electricity, electric charge, and electric current
- explore electrical circuits and understand how to read a circuit diagram
- discover how electricity and magnetism are related
- discuss the function of a table of contents, headings, and a glossary
- interpret photographs and graphics—diagrams, a chart—to answer questions
- complete a KWL chart

READING IN THE CONTENT AREA SKILLS

- Compare and contrast conductors and insulators, series and parallel circuits
- Recognize cause-effect relationships related to electrical circuits
- Draw conclusions about electrical circuits
- Identify main ideas and supporting details
- Follow a sequence of events in the production of electricity by a generator
- Demonstrate critical thinking
- Interpret graphic devices
- Summarize

NONFICTION TEXT ELEMENTS

Electrical Circuits includes a table of contents, headings, photographs and illustrations, captions, diagrams, a chart, boldfaced terms, and a glossary.

CONTENT VOCABULARY

The following terms are introduced in context and defined in the glossary: *atom, attract, battery, battery terminal, circuit, closed circuit, conductor, discharge, electrical energy, electric charge, electric current, electricity, electric motor, electromagnet, energy, filament, generator, insulator, magnet, magnetic field, magnetic poles, magnetism, open circuit, parallel circuit, repel, resistance, series circuit, static electricity, switch, volt, voltage, watt.*

BEFORE READING

Build Background

Access students' prior knowledge of electricity and electrical circuits by displaying the cover, reading the title aloud, and inviting students to share what they know about the topic from their personal experiences and hands-on explorations in science.

To stimulate discussion, ask questions such as these: *How do you think a light bulb works? What is electricity? How do we use electricity?*

Begin a class KWL chart by recording facts students know about electric current and electrical circuits in the K column. You may wish to copy the KWL chart and ask students to maintain their own charts as they read.

K What I Know	W What I Want to Know	L What I Learned	+ What I Want to Explore Further

Preview the Book

Take a few minutes to have students look through the book. Explain the steps involved in previewing nonfiction: think about the title, read the table of contents, read the headings, read boldfaced words, and examine any photographs, illustrations, charts, and graphics.

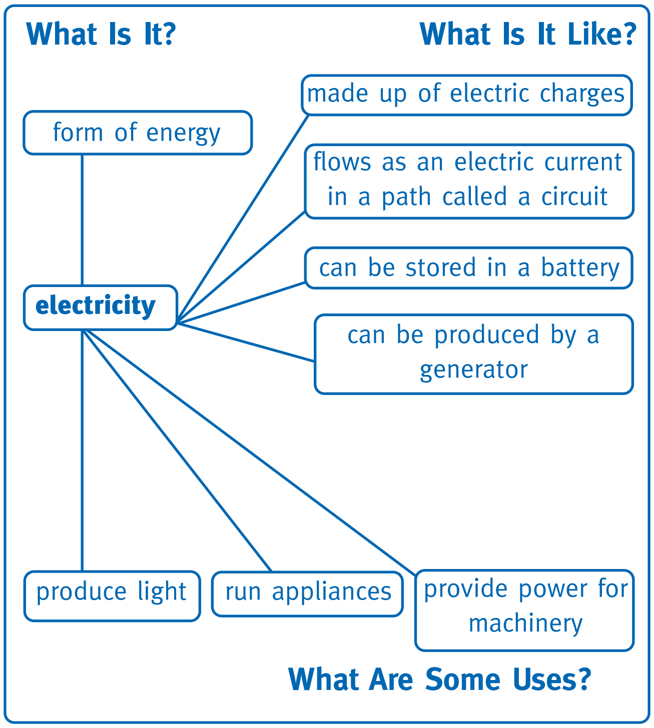
Call attention to the various nonfiction text elements and explain how each feature can help students understand what they read. Point out that the table of contents lists all the main headings in the book and their page numbers. Note that the headings in the Think About . . . section are in the form of questions. Ask, *How do the headings help you know what you will learn about?* (The text that follows will answer the question the heading asks.) Point to some of the illustrations and ask questions such as: *What does this picture show you? How do you think it will help you understand the text?* Explain that the words in boldface type are important words related to electricity and magnetism that students will learn when they read the book. Point out that these words are defined in the glossary. Choose one word and have students find its definition in the glossary.

Following the preview, ask, *What questions do you have about electrical circuits or electricity that you would like this book to answer?* Record students' responses in the W column of the KWL chart. Explain that they will complete the chart after they finish reading.

Preview the Vocabulary

You may wish to preview some of the vocabulary words before reading, rather than waiting to introduce them in the context of the book. Possibilities include creating a word wall, vocabulary cards, sentence strips, or a concept web.

For example, begin with students a word definition map such as the following. A word definition map is a visual representation of a word's meaning that provides the framework for the elements of a definition. You may wish to add to the definition map as you read.



▲ *Definition map for* ***electricity.***

Set a Purpose

Discuss with students what they might expect to find out when they read the book, based on their preview. Encourage them to use their individual questions and the questions in the KWL chart to set an overall purpose for reading.

GUIDE THE READING

Preview the book yourself to determine the amount of guidance you will need to give for each section. Depending on your schedule and the needs of your class, you may wish to consider the following options:

- **Whole Group Reading** Read the book aloud with a group or the whole class. Encourage students to ask questions and make comments. Pause as necessary to clarify and assess understanding.
- **Shared Reading** Have students form pairs or small groups and read the book together. Ask students to pause after each text section. Clarify the text as needed. Discuss any questions that arise or have been answered.
- **Independent Reading** Some students may be ready to read independently. Have them rejoin the class for discussion of the book. Check understanding by asking students to explain in their own words what they read.

Tips for Reading

- If you spread out the reading over several days, begin each session by reviewing the previous day's reading and previewing what will be read in the upcoming session.
- Begin each text section by reading or having a volunteer read aloud the heading. Discuss what students expect to learn, based on the heading. Have students examine any illustrations or graphics and read accompanying captions and labels.

- Help students locate context clues to the meanings of words in boldface type. Remind them that these words are defined in the glossary. Provide help with words that may be difficult to pronounce.

- As appropriate, model reading strategies students may find helpful for nonfiction: adjust reading rate, ask questions, paraphrase, reread, visualize.

Think About . . . (pages 2–11)

Pages 2, 3 *What Is Electric Charge?* and *What Is Electric Current?*

- Spark interest by asking students whether they have ever gotten a little shock when touching something made of metal or petting a cat. Explain that they will discover the cause when they read page 2.

- After reading, discuss electric charges. Elicit that electric charge is a property of the atoms that make up all matter. Electric charges can be positive or negative. Ask, *What is static electricity?* (an electric charge made by rubbing two things together) *How does an electric charge cause a shock?* (The charge "jumps" from an object to you.)

- Have students read page 3 to learn about electric currents. Ask, *What is an electric current?* (a flow of electric charges) *What is the difference between a conductor and an insulator?* (A conductor lets electric current move easily. An insulator does not carry electric current well.) *What happens when an electric current flows through a resistor?* (The resistor gets hot and glows.) *How is this effect useful?* (It can produce heat, as in a toaster, or light, as in a light bulb.)

- If necessary, provide help with the pronunciation of *insulators* (IN-suh-late-urz) and *filament* (FIL-uh-muhnt).

Pages 4, 5 *What Is a Circuit?* and *What Are Series Circuits?*

- Ask students what the word *circuit* reminds them of. (circle) Explain that *circuit* comes from a Latin word that means "to go around." A circuit is like a circle in that the path ends up where it started.

- Read the text on page 4. Then direct students to look at the illustration at the bottom of page 4 and read the caption. Ask, *What is the difference between the two pictures?* (In the picture of the closed circuit, both wires are connected to the battery. In the picture of the open circuit, only one wire is connected.) *What happens when only one wire is connected?* (The bulb won't light.) *What is the cause?* (Current can't flow when the circuit is open.)

- Ask, *How does a switch turn something off or on?* (It opens and closes the circuit.)

- Students may be interested to know that the word *volt* comes from the name of Count Alessandro Volta (1745–1827), the Italian physicist who invented the first electric battery, which produced a continous flow of electric charge.

- If necessary, provide help with the pronunciation of *circuit* (SUR-kit).

- Direct attention to the illustration at the top of page 5. Have students describe what the picture shows. (a circuit with a wire connecting a battery and three light bulbs) Have students read page 5 to discover what a series circuit is.

- Ask, *What is a series circuit?* (a circuit in which all the parts are connected in a single loop) *What is the effect of turning off or removing one of the objects in a series circuit?* (The circuit opens, and the current cannot flow through the circuit.) *What effect does this have?* (The bulbs in the circuit do not light.)

- Point out that a series circuit has a practical use. *What is the result of connecting several batteries in a series?* (Their voltage is added together, making them stronger.)

Page 6 ***What Are Parallel Circuits?***

- Ask students if they know what *parallel* means. Explain, if necessary, that one meaning of parallel is “going in the same direction without crossing or meeting,” like railroad tracks. Tell them that they will learn what parallel means with regard to electricity when they read page 6.

- Ask, *What are the differences between a series circuit and a parallel circuit?* (In a series circuit, everything is connected in a single loop with just one path, so when one bulb in the circuit is off, the other bulbs in the circuit do not work. In a parallel circuit, the current for each bulb in the circuit has its own path, so when one bulb is off, other bulbs still stay on.)

- Have students trace the circuit in the illustration at the bottom of the page to help them visualize the flow of current.

- Ask, *When would you use a series circuit?* (when you want to increase the voltage) *When would you use a parallel circuit?* (when you want to be able to turn one thing off while leaving other things on) Discuss why electrical devices in houses are wired in parallel circuits. Students should understand that people want to be able to use individual appliances without having to turn on all the others.

- If necessary, provide help with the pronunciation of *parallel* (PA-ruh-lel).

Page 7 ***What Are Circuit Diagrams?***

- Read the first two paragraphs on page 7 and have students study the diagrams. Ask, *Is the switch in the top diagram open or closed?* (open) *How would you show a closed switch?* (draw a line connecting the two dots)

- Ask, *Why do you think scientists developed a system of symbols to use in circuit diagrams?* Elicit ideas such as these: symbols make a circuit easy to draw and understand; everyone can recognize what a symbol stands for.

- Have students study the diagram of a series circuit and read the text. Have them answer the question. (The circuit will be open, so none of the bulbs will light.)

- Call attention to the diagram of a parallel circuit and read the text. Have students answer the question. (The first light bulb, or the one closest to the battery, would not light.)

Pages 8, 9 ***How Do Magnets Work?***

- After reading the heading, invite students to share their experiences with magnets. Encourage students to explain how magnets work, if they think they know.

- Have students look at the photographs on pages 8 and 9. Discuss what is shown.

- After reading the text, ask, *What is magnetism?* (the force that attracts iron or steel to a magnet) *What are a magnet’s poles?* (the places where the magnetism is strongest, usually the ends) *What happens when you place the north pole of one magnet near the south pole of another?* (They attract each other and stick together.) *What happens when you place two north poles or two south poles together?* (They repel each other and push each other away.)

- If a compass is available, let students examine it. Ask, *How does a compass use magnetism to show direction?* (The magnetic needle in a compass points to Earth's north magnetic pole.) Help students conclude that the north-seeking pole of the compass needle is actually the needle's south pole.

- Students may be interested to know that Earth has two "north poles." The geographic north pole, or true north, is the northernmost point on Earth's surface. Earth's axis runs through the geographic north and south poles. Compass needles point to Earth's magnetic north pole, located about 1,600 kilometers (1,000 miles) south of true north. Magnetic north is currently located in the Canadian Arctic, but shifts about 15 kilometers (9 miles) northwest every year!

- If you have a bar magnet and a compass available, you may wish to do the following experiment. You will need a bar magnet, a compass, strong tape, string, scissors, and a table or desk. Use the compass to find north, south, east, and west in your classroom. Cut one 12-inch piece of string. Tie each end to an end of the bar magnet. Cut one 3-foot piece of string. Tie one end to the middle of the string on the bar magnet. Tape the other end of the long string to the edge of a desk. Let the magnet hang freely. Make sure the magnet is level. Wait until it stops turning. Observe the bar magnet without touching it. *In which direction does the north-seeking pole of the bar magnet point?* (north)

Page 10 *What Is an Electromagnet?*

- After reading the first paragraph on page 10, you may wish to share with students the following information: An electric current produces a magnetic field. When electricity passes through wire wrapped around an iron core, such as a nail, the magnetic field causes tiny particles in the iron to line up in the same direction as the field. This creates an electromagnet. The more coils of wire wrapped around the nail, the stronger the electromagnet.

- After completing reading, ask, *What details support the main idea that an electromagnet is extremely useful?* (It can be turned on and off. It can be very strong.)

- If necessary, provide help with the pronunciation of *electromagnet* (i-lek-troh-MAG-nit).

  Invite interested students to do research on maglev (magnetic levitation) trains, a new kind of high-speed transportation using principles of electromagnetism to raise and move the trains.

Page 11 *What Is a Generator?*

- Direct attention to the diagram on page 11 and explain that it shows how a machine called a generator produces electricity. Have students read each numbered step. Then have them read the text. Point out that the handle in the diagram at step 1 stands for the mechanical energy described in the text. Mechanical energy is needed to move the loops of wire.

- To check understanding, ask students to describe in their own words step by step how a generator produces electricity. (Energy causes a wire loop to spin between magnets, which forms an electric current in the loop. The electric current travels from the loop to metal rings. The rings spin against brushes. The electricity travels to the brushes, then to wires that carry the electricity to the place it will be used.)

People in Science (pages 12–13)

Thomas Alva Edison, Alexander Graham Bell, Lewis Howard Latimer, Electricians

- Before reading, access students' prior knowledge of Thomas Alva Edison, Alexander Graham Bell, and Lewis Howard Latimer by inviting them to share what they know about these people and their work. Explain that all three men made useful and important contributions to our lives through their work with electricity.

- After reading about Edison, ask, *Did any of the inventions mentioned surprise you? Which inventions didn't you know about? How does this new information make you feel about Thomas Edison?*

- Invite speculation about what made Edison's invention of the central electric light power station so important. *If there were no such thing as a central power station, how would people get electricity for their homes and businesses?* (Students may suggest that each location would have to have its own generator.) You may wish to tell students that buildings in which the loss of electricity would create problems, such as hospitals, usually have their own back-up generators for protection against power failures.

- After reading about Alexander Graham Bell, ask, *What do you think Bell would find most surprising about telephones today?* (Students may mention cordless telephones, cell phones, and wireless Internet connection.)

- After reading about Lewis Howard Latimer, invite students to speculate why an improved light bulb filament was an important invention. Explain, if necessary, that early filaments burned out quickly.

- Encourage students to share personal experiences with electricians and their work. If time permits, invite an electrician to visit the class and explain his or her work and the kind of equipment used in it. Have students prepare questions in advance to ask the visitor.

Further Facts

Thomas Alva Edison

- American inventor born in Milan, Ohio; died in West Orange, New Jersey.

- Set up his first laboratory in his father's basement at the age of 7.

- Developed hearing problems at an early age; his deafness motivated many of his inventions.

- Left school at the age of 12 to work selling newspapers and candy on the railroad; learned telegraphy during this time.

- Held a world record of 1,093 patents.

- Created the world's first industrial research laboratory.

- In 1892 constructed the world's first motion picture studio at his laboratory.

Alexander Graham Bell

- Scottish-born (Edinburgh) American audiologist and educator of the deaf; died in Nova Scotia, Canada.

- Bell's family was recognized as leading authorities in elocution—the art of public speaking—and speech correction; he trained in the family profession.

- Began his first studies in sound at the age of 17.

- Opened a school for training teachers of the deaf in Boston, Massachusetts, in 1872; became professor of vocal physiology at Boston University in 1873.

- Helen Keller was a friend of Bell's and visited the 1893 World's Fair with him. She participated in groundbreaking ceremonies for Bell's Volta Bureau building (an international information center for the deaf and hard of hearing).

Lewis Howard Latimer

- American inventor and engineer, born in Chelsea, Massachusetts.

- Parents were escaped slaves; his father was jailed in Boston as a fugitive slave and was about to be returned to Virginia when an African-American minister paid for his freedom.

- Considered a “Renaissance man” because of his abilities as an inventor and engineer and his talents as a poet, playwright, and visual artist.
- Published *Incandescent Electric Lighting,* a technical book that became a guide for lighting engineers, in 1890.
- In 1918 became a charter member of the Edison Pioneers.

Did You Know? (pages 14–15)

Page 14 *About Water Power*

- After reading the heading, ask students to share what they know about water power—power created by the force of water. Discuss any dams or power plants students have seen or visited.
- Go through each step of the diagram with students, guiding them to understand how a power station changes energy from moving water into electrical energy. You may wish to refer to the diagram of the generator on page 11 when you reach step 4.
- If necessary, provide help with the pronunciation of *reservoir* (REZ-ur-vwar) and *turbine* (TUR-buhn or TUR-bine).

Further Facts

Water Power

- The amount of energy generated in a power station is determined by the amount of water that flows and the height from the water surface to the turbines.
- The greater the distance the water falls, the more energy it produces.
- The first hydroelectric power plant in the world was constructed in Appleton, Wisconsin, in 1882. (The prefix *hydro-* means “water.”)
- The United States is the world’s leading producer of hydroelectric power.
- The world’s largest hydroelectric dam will be the Three Gorges Dam being constructed on the Yangtze River in China. When it is finished, the huge dam will be visible from the Moon and will produce 18,000 megawatts of power.

Page 15 *About Using Energy at Home*

- Before reading page 15, ask students to guess which appliance in their home uses the most energy. Have them read the chart to check their guesses. After reading the text, invite students to respond to the questions in the final paragraph.
- You may wish to tell students that appliances today are much more efficient and use far less energy than appliances did in the past. For example, a new refrigerator may use less than 650 kilowatt-hours (kWh) of electricity a year. A refrigerator made in 1973 used almost 2,000 kWh per year.
- Students may be interested to know that the word *watt* comes from the name of James Watt (1736—1819), a Scottish inventor who developed an improvement of the steam engine, invented the steam pressure gauge, and coined the term *horsepower.*
- If necessary, provide help with the pronunciation of *appliance* (uh-PLYE-uhnss).

AFTER READING

Summarize

Complete the KWL chart you began with students before reading by asking them to share the answers to their questions. Call on volunteers to retell each text section. Then have students use the information in the KWL chart to write brief summary statements.

Discuss with students how using the KWL strategy helped them understand and appreciate the book. Encourage them to share any other reading strategies that helped them understand what they read.

Direct attention to the fourth column in the chart and ask, *What questions do you still have about electricity and electrical circuits? What would you like to explore further?* Record students' responses. Then ask, *Where do you think you might be able to find this information?* (Students might mention an encyclopedia, science books, and the Internet.) Encourage students to conduct further research.

Review/Assess

Use the questions that follow as the basis for a discussion of the book or for a written or oral assessment.

1. What is the relationship between an electric charge and an electric current? (An electric current is a flow of electric charges.)
2. What is the difference between a series circuit and a parallel circuit? (In a series circuit, bulbs are connected one after another in a single loop. In a parallel circuit, the current for each bulb in the circuit has its own path.)
3. What is magnetism? (The force around a magnet that pulls iron or steel to the magnet.)
4. What is an electromagnet, and what makes it useful? (An electromagnet is a magnet made by wrapping wire around a piece of iron and sending an electric current through the wire. It is useful because its magnetism can be turned on and off.)

Writing Links/Critical Thinking

Present the following as writing assignments.

1. Using the electrical symbols that you learned about, draw a diagram of an electrical circuit. Include at least one switch and two or more bulbs. Then write a description of how your circuit works. Be sure to explain whether it is a series circuit or a parallel circuit. (Diagrams and descriptions will vary.) Ask students to describe (or draw) and explain other symbols they may use or know about (for example, street sign symbols or map key symbols).
2. Look at the photograph of lightning on page 2. Use what you have learned about electric charges to explain what causes lightning to jump between the sky and the ground. (Responses should express the concept of electric charges being discharged between objects with unlike charges.)
3. Remind students that the work of the three People in Science they studied—Edison, Bell, and Latimer—has made our lives easier in many ways. Have students write a letter to one of these scientists thanking him for one of his inventions. The letter should describe how the invention has made a contribution to people's lives. Review the form of a thank-you letter: heading, greeting, body, closing, and signature. Tell students to explain the purpose of the letter in the first sentence. The body of the letter should then expand on the purpose.

Science Journals: You may wish to have students keep the writing activities related to the reader in their science journals.

References and Resources

For trade book suggestions and Internet sites, see the References and Resources section of this teacher's guide.