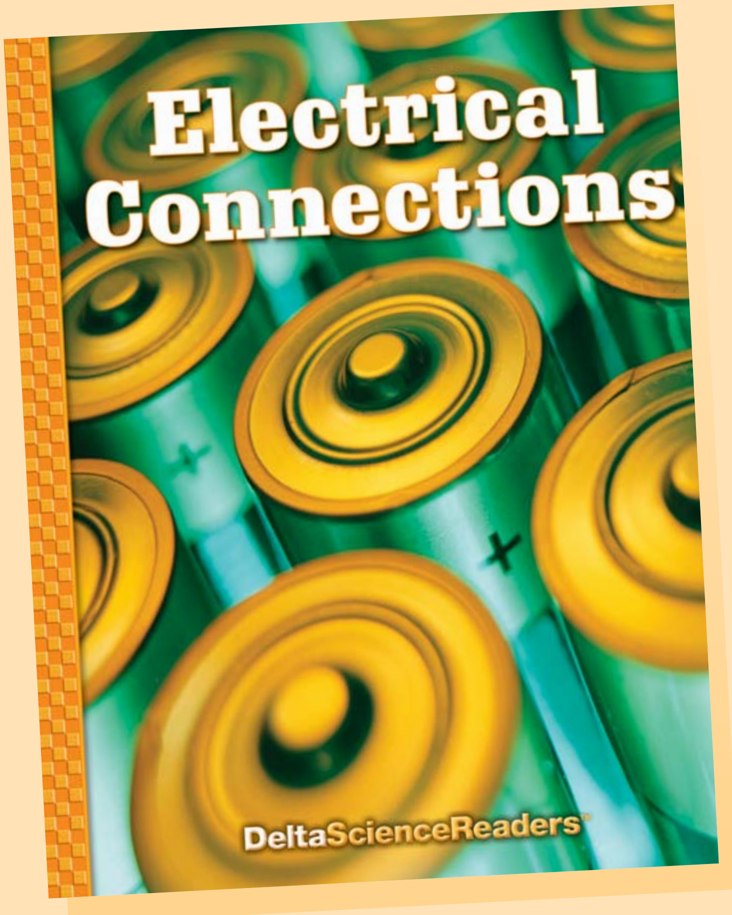
Delta Science Reader *Electrical Connections*
Teacher's Guide



In the Delta Science Reader ***Electrical Connections,*** students read about electric charge, electric force, and how objects become charged. They find out about the detection and discharge of static electricity. Next they learn about the energy delivered by electric current as it flows through circuits, and they become familiar with circuit components, types, and diagrams. Then they find out how the relationship between electricity and magnetism is utilized in motors, electromagnets, galvanometers, and generators. Students read about sources of electric energy, kinds of current, and everyday uses of electric power in homes, schools, and businesses. These concepts are applied to the real world as students find out about safety issues and conservation concerns related to electricity.

DELTA SCIENCE READERS for grades 6–8 are content-rich, 24-page informational texts that present key science concepts and vocabulary. They cover important science topics in an accessible, engaging format.

TEACHER'S GUIDES for Delta Science Readers for grades 6–8 contain general background information for linking science and literacy, assessment, and including all learners, as well as a comprehensive teaching plan. The teaching plan features three-step lessons and spotlight panels on science, literacy, and meeting individual needs.

Contents

INTRODUCTION

Delta Science Readers for grades 6–8 are content-rich, 24-page informational texts. Based on key science standards for the topic, they are used in conjunction with hands-on kits or as stand-alone texts.

As students reach middle school, their reading abilities and knowledge of literacy skills and strategies greatly affect their success in understanding informational text. Middle school readers often need guidance in reading for information, especially as the content load of the text increases and becomes more complex. This guide provides the middle school teacher with both science and literacy support to help students learn.

Science and Literacy

Delta Science Readers are outstanding resources for building both science knowledge and literacy skills and strategies. Students interacting with informational text are exploring language fully, exercising all four aspects of literacy: reading, writing, speaking, and listening.

Reading Informational Text

Reading to gain information is markedly different from reading for literary experience or to perform a task. Informational text is often read nonlinearly, or selectively. From section to section, the difficulty level, concentration of new vocabulary, structural pattern, and unfamiliarity of content may vary. Use the following guidelines to help your students get the most out of reading nonfiction text.

Prereading. Help students anticipate content and predict learning outcomes before they begin to read. Always preview informational text with students so that they can develop a focused purpose for reading and be able to answer the question, "Why am I reading this?"

Reading Strategically. A number of reading strategies support the comprehension of science text, in part because of the strong relationship between science and reading comprehension skills. The following comprehension skills are common to both reading and science:

- Identify main ideas and supporting details
- Compare and contrast
- Relate cause and effect
- Trace a sequence of events
- Draw conclusions based on evidence
- Demonstrate critical thinking
- Generate questions
- Summarize information
- Interpret graphics
- Recognize patterns and relationships
- Make predictions

Some of these skills are applied in the process of extracting and processing information. Others are applied in more demanding ways as students evaluate, analyze, interpret, and synthesize ideas.

Monitoring Comprehension. Help students read actively. Active readers think about the organization and presentation of information and monitor their own comprehension. Provide these tips: reread difficult passages; vary the pace of reading; stop and think about a passage; ask questions; think aloud while reading; take notes; make a prediction about what will come next; or paraphrase what has been read. Also, some students can process and share information better when paired with a reading partner.

Using Graphic Organizers. Graphic organizers are diagrams that show the relationships among ideas. Unlike traditional outlines, graphic organizers are visual representations. They show, rather than tell about, associations among important facts and supporting details. Encourage students to create their own graphic organizers. The most effective ones are those generated by students themselves as they interact with information. Useful formats include the KWL chart (see p. T1), concept web, T-chart, Venn diagram, flowchart, and cycle chart.

Keeping Science Notebooks. Responding to informational text in writing promotes higher levels of understanding. Students should use their notebooks for all writing related to the topic. This can include graphic organizers, vocabulary lists, predictions, questions, observations, labeled illustrations and diagrams, personal discoveries, activity sheets, and note taking.

Building Science Vocabulary

Studying science involves learning specialized vocabulary terms. It may also mean relearning familiar words that have different meanings in science. Help students acquire new science vocabulary through multiple activities. Examples include analyzing word parts, understanding word origins, identifying word families, crafting definitions in their own words, role-playing or illustrating definitions, connecting new words to known words, using context clues, and using science language as they write and talk about science topics.

Previewing Vocabulary. When previewing the boxed vocabulary words for each section, you may wish to focus on the terms most critical to your curriculum needs. You may also wish to have students work in pairs or in small groups to share their ideas about words and meanings.

It is important for students to keep written records of their growing science language in their science notebooks. You may begin this record during the vocabulary preview, using any of the following ideas or your own method:

- Have students sort the vocabulary words into lists of terms they know and don't know. As they read and learn, the "Know" list should grow and the "Don't Know" list should shrink.
- Ask a volunteer to read the words out loud so students can hear correct pronunciations.
- Group related words together in a chart.
- Identify words that have familiar roots, prefixes, or suffixes.
- Note familiar words that have a special or different meaning in science.
- Let students select one vocabulary word they know and illustrate it or use it in an original sentence.

Reading and Vocabulary Growth. Support the natural link between science and literacy by making your science classroom a library as well as a laboratory. Make available other kinds of reading material about the topic in addition to the Delta Science Readers. Examples include nonfiction trade books, newspaper and journal articles, computer printouts from validated and reliable sources, textbooks, reference books such as almanacs and encyclopedias, posters, CD-ROMs, and so on. Seeing science concepts and vocabulary used in other contexts reinforces understanding.

*See the **Glossary** pages, T23–T24, for many additional suggestions on building vocabulary.*

Assessment Features

Students' knowledge and skills should be assessed in as many modalities as they are taught so that all students can show what they know. This Delta Science Reader teacher's guide offers a variety of tools and strategies for measuring student achievement throughout the learning process.

Preassessment Preassessments take place prior to learning and provide information on students' awareness and experience regarding the topics.

- **Access Prior Knowledge**—informal assessments of students' entry-level understanding.

Ongoing Assessment Ongoing, formative assessments are integrated into the daily teaching and learning process. They not only measure ongoing student progress but also provide insights for reshaping and improving instruction.

- **Read to Understand Questions**—self-assessments or more formal evaluations of student mastery of key concepts. Suggested answers are provided.
- **Alternative Assessments**—additional choices, usually nonverbal, that provide other ways for students to demonstrate competencies.
- **Meeting Individual Needs**—teaching ideas that serve as assessments for students who have difficulty communicating fluently.
- **Answers to Caption Questions**—self-assessments related to student interpretation of graphic elements.
- **Notebooks**—student responses to science text and experiences that reveal growth in level of understanding and ability to organize ideas.

Postassessment Postassessments, or summative assessments, are opportunities for students to demonstrate what they have gained as a result of the learning experience.

- **Review and Reflect**—summative assessments that show the degree to which students can recognize patterns and understand relationships in the overall subject matter.
- **Writing Links**—writing assignments that require students to apply and communicate knowledge.
- **Cover to Cover**—opportunity for students to synthesize learning by comparing and contrasting front and back cover photographs.
- **Unit Test**—selected-response and short-answer questions (with answer key), provided with this teacher's guide, that measure comprehension of key science vocabulary and concepts.

Including All Learners

All students can be active participants in the scientific process and can become scientifically literate citizens. Further, all teachers can successfully guide students to learn and enjoy science. Making science content universally accessible may require implementing different instructional strategies and accommodating multiple intelligences. The guidelines listed below will help you meet the challenges of your diverse classroom.

Hands-on Science

The science classroom is an ideal environment for diverse learners because of its reliance on hands-on exploration of the world. Research has shown that all students are highly motivated to learn science when actively engaged in hands-on activities. Hands-on investigations are therefore an essential component of science education. Hands-on, inquiry-based science helps extend the reach of instruction to all students while enhancing and reinforcing student learning.

English Language Learners

When reading informational science text, English Language Learners (ELLs) are confronted with the challenge of learning content while becoming proficient in English. They may have the cognitive ability to perform in class and understand scientific meanings, but they may be unable to communicate, by reading, writing, speaking, or even listening, with proficiency and confidence. Using effective strategies, teachers can make content more accessible while language learners improve their English.

- Reinforce reader content with hands-on activities.
- Simplify vocabulary, not content.
- Allow multiple opportunities to practice new vocabulary.
- Present information orally and visually.
- Allow ELLs to demonstrate science learning nonverbally.
- Assess science comprehension, not English fluency.
- Promote a classroom environment in which students are comfortable sharing ideas and taking risks.

Learners with Special Needs

Individual student needs, abilities, and disabilities vary widely, and the accommodations appropriate for each classroom will be unique. Begin with a student's individual educational plan (IEP). Tailor the presentation, classroom setup, teaching strategy, and materials to ensure student safety and to enable each student to participate as fully as possible.

- Present instruction in the context of real-world situations.
- Pair students who have difficulty reading with friends who read fluently.
- Allow extra time for completing activities.
- Assign one task at a time and give instructions in different ways.
- Introduce new vocabulary in different, meaningful ways.
- Review material more often.
- Repeat other students' comments and questions for everyone to hear clearly.

Advanced Learners

Advanced learners benefit from meaningful assignments that extend and enrich their knowledge of science. Encourage students who readily grasp the basics of science concepts and processes to deepen their explorations. Students performing above grade level can cultivate high levels of science thinking through further research, investigation, or other guided or independent projects.

- Provide enrichment opportunities for students who can and wish to work on independent projects.
- Ask questions that encourage creative or imaginative answers.
- Model thinking that leads to problem solving, synthesizing, analyzing, and decision making.
- Make available more sophisticated resources for exploring the topic.
- Invite students to present their research to the class in a format of their choosing.

*See the **Meeting Individual Needs** spotlight panels throughout this guide for specific suggestions for including English Language Learners, learners with special needs, and advanced learners.*

About the Teaching Plan

The format and content of the three-step lesson plans and spotlight panels for each ***Think About . . .*** section in the student book are described below. Use the suggestions and strategies as appropriate for your teaching style and the needs of your students.

Three-step Lesson Plan

The lesson plan for each section begins with a list of **learning objectives.** The final objective in each list highlights one reading skill that promotes science comprehension.

1 Before Reading Before-reading strategies set the stage for reading each section. Prereading efforts are particularly important with informational text because the reader will encounter new and complex ideas, different text forms and structures, and unfamiliar vocabulary. Make the process less daunting by accessing prior knowledge and previewing the section.

Access Prior Knowledge. These discussion prompts help you engage and motivate students by linking the main ideas students will read about to their existing knowledge and experiences. In some cases, it may be appropriate to identify and address common misconceptions about the topic at this point.

Preview the Section. This is a "walk-through" of the section content and vocabulary. Point out or discuss the boxed Read to Understand questions and vocabulary words. These indicate the main topics and key terms covered in the section. Also, look together at the section title and subheads. Based on the preview, students can generate questions, make predictions, and set a purpose for reading this section.

2 Guide the Learning Help students interact with the text, monitor comprehension, and integrate new ideas with existing knowledge as they read. A variety of grouping strategies is suggested so that students may benefit from collaborative learning.

Discuss and Explore. These questions elicit student responses that demonstrate comprehension of facts and concepts. The science and literacy skills developed during reading include

- relate cause and effect
- identify the main idea and supporting details
- trace a sequence of events
- compare and contrast
- describe
- predict

Critical Thinking. These questions challenge students to dig deeper and exercise higher-order thinking skills, such as

- infer
- draw conclusions
- interpret
- summarize
- generate questions

3 Assess After-reading assessments for each *Think About . . .* section include

Read to Understand Answers. Sample answers to the Read to Understand questions are provided. The questions can function either as informal self-assessments for students or as part of an ongoing written or oral assessment of student progress.

Alternative Assessment. These assessment opportunities, such as hands-on demonstrations or visual presentations, accommodate multiple learning and communication modes.

*This teacher's guide offers opportunities for multiple measures of student progress. See **Assessment Features,** p. Tiii, for additional tools.*

Spotlight Panels

Special feature boxes appear on each page to provide additional support.

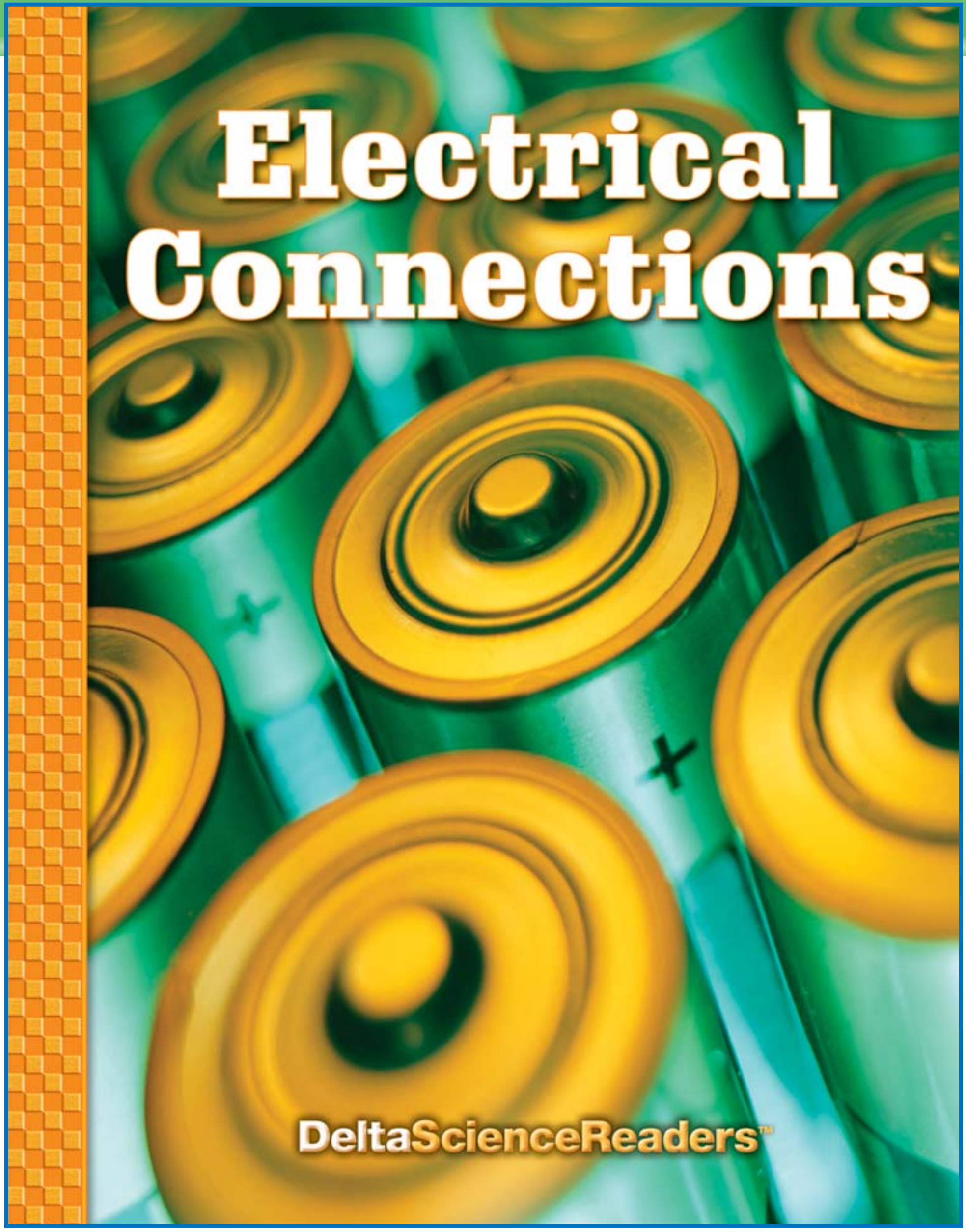
Science. Additional science background information, historical perspectives, and facts and figures of interest that support science instruction and can be shared with students as appropriate.

Literacy. Ideas for strengthening literacy skills in the areas of reading comprehension, vocabulary, notebooking, organizing ideas, and using the visuals.

Meeting Individual Needs. Suggestions for making science content and vocabulary accessible to English Language Learners and students with special needs and for including and challenging advanced learners.

*Teaching pages for **People in Science** and **Did You Know?** also offer suggestions for activating prior knowledge and building comprehension and include science spotlight panels. The Glossary pages provide many helpful vocabulary-building strategies.*

TEACHING *Electrical Connections*



The Delta Science Reader ***Electrical Connections*** presents the key science concepts related to electric charge, the flow of current in electric circuits, the interplay of electric and magnetic forces, and the use of electric power in everyday life. The book provides opportunities for students to engage in science inquiry by applying literacy skills and strategies to nonfiction text. Students explore science as they develop informational literacy.

Build Background

Front Cover. Access students' prior knowledge of electricity by displaying the front cover and discussing the title. *What do you see in this photograph?* (batteries) *What do you use batteries for?* (powering portable electronic devices, such as flashlights, remotes, personal audio players) *Why do you think there is a plus sign (+) near the top of the battery?* (Accept all ideas.) *How do you think batteries provide power for electronic devices?* (Accept all ideas.)

Encourage students to share what they know about electricity from their personal experiences and from previous explorations in science. Stimulate discussion with questions such as *What are some ways that you use electricity? What is static electricity? What is electric current?* Such discussions help students make connections between what they already know and new information that will be presented in the book. Based on the title and cover, have students predict what they might learn about in this book.

A Note on Electric Safety

This teacher's guide contains many safe activities for exploring concepts related to electric charge and current. However, caution must always be exercised when experimenting with electricity. Always supervise students carefully during activities. Caution students throughout the unit that they should *never* experiment with the electricity that comes from a wall outlet. It is much more powerful than the electricity made by small batteries and could seriously injure someone or even cause death.

Preview the Book

In a preview, students scan the book quickly to see the structure and to find the main topics and most important text features. Have students preview *Electrical Connections* before reading.

Roadmap for Reading. Tell students that previewing is like looking at a map before taking a trip. It helps us know where we are going! Using a preview to anticipate content increases student interest in the material to be studied. For that

DeltaScienceReaders™

Electrical Connections

CONTENTS

Think About . . .

People in Science

Did You Know?

reason, a preview is a vital part of reading for information, or nonfiction reading. Use the preview to activate prior knowledge, make predictions about what the text will cover, and set a purpose for reading.

Table of Contents. Begin the preview with the table of contents. Think of the table of contents as an outline of the book. It lists the different parts of the book and the topics covered in each part. Page numbers are given for the main section headings. After students have skimmed the table of contents, ask if they have ever studied any of these topics before. Look at the photographs on the contents page. Can students guess where in the book they might find out about the objects pictured?

Text Features. Next, have students "walk through" the book. Ask them to look at the headings, subheadings, and graphics (photographs, diagrams, captions, illustrations, labels, graphs, and tables) and tell why they are helpful. Focus their attention on organizational features such as the boxed Read to Understand questions, boxed Vocabulary lists, boldfaced words, and Glossary.

For each new text feature students identify, have them ask questions: Why are these [*boxes*] here? What is the purpose of [*captions*]? How do these [*boldfaced words*] help us understand the topic? What if the book did not have [*labels*]?

Start a KWL Chart

Have students make a four-column KWL chart in their science notebooks. Based on the book's title and their preview, have them fill in the first two columns—What I Know (K) and What I Want to Know (W). Have students fill in the third column, What I Learned (L), as they work through the book. After students have finished reading about each topic, they can fill in the last column with questions they still have about the topic.

Conceptual Framework

Help students make meaning of the content covered in *Electrical Connections* by building a conceptual framework—a theme around which they can organize ideas and information. For this topic, such a framework might be **Electric charge is a fundamental property of matter; electric charges have electric energy if they are moving.** When electric charges are moving in a continuous flow, they create an electric current. Electric currents flowing in circuits power many of the devices we use in everyday life. These devices transform electric energy into light, heat, sound, and motion.

Begin by discussing students' experiences with electricity. Ask students if they have ever built simple circuits. Invite students to share experiences with static electricity. Ask students to describe their observations of lightning. Finally, have students brainstorm a list of electric safety rules.

OBJECTIVES
(pages 2–6)

- Explain that electric charge is a basic property of matter and that charges can interact.
- Understand that all charged objects exert electric force.
- Describe three ways that objects can become charged.
- Explain how static discharge occurs.
- Use reading skills such as identifying the main idea and supporting details to achieve science comprehension.

1 Before Reading

Access Prior Knowledge

Ask students questions to elicit their ideas about their personal experiences with static electricity. *Have you ever received a shock from touching someone or something? How did it happen?* (Accept all responses.)

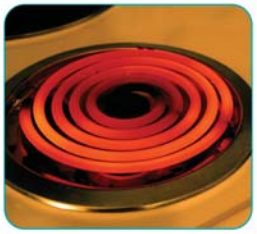
Have students predict what will happen if you rub an inflated balloon on your hair. Perform the demonstration. Hold the balloon against a wall and let go (it should appear to "stick" to the wall). Ask students to explain what they think is happening. (Accept all ideas.) Tell students they will learn how this effect is caused as they read the section.

Preview the Section

Use the Read to Understand questions to set a purpose for reading (answers on p. T6). Preview the Vocabulary words using one of the methods described on p. Tiii. Remind students that these important words appear in boldfaced type in the text and are defined in the Glossary. (See pp. T23–24 for vocabulary-building ideas.)

Think About . . .

What Is Electric Charge?



▲ **Figure 1** A stove converts electric energy into heat energy that cooks our food.

Read to Understand

- What determines an atom's overall charge?
- What force causes charged objects to attract or repel each other?
- What are three ways an object can become charged?

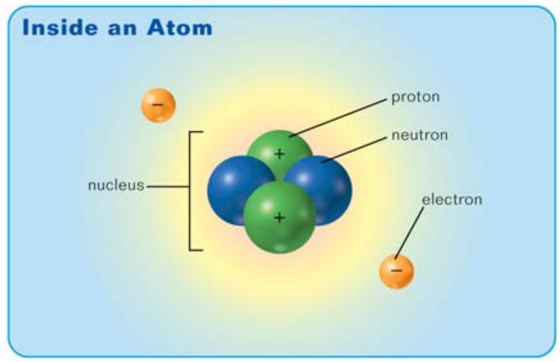
VOCABULARY

electric energy	charging by friction
electric charge	separation of charge
atom	charging by conduction
electron	charging by induction
proton	induced charge
neutron	electroscope
nucleus	static discharge
ion	grounding
static charge	lightning
static electricity	lightning rod
conductor	
insulator	
electric force	
electric field	

Most of us rely on electricity in almost every minute of every day. Many people use the word *electricity* to describe **electric energy.** Energy is the ability to do work or cause changes (Figure 1). A light bulb converts electric energy into light energy. Where does electric energy come from? The answer begins with charged particles.

Electric charge is a basic property of matter. You may know that all matter is made up of tiny building blocks called **atoms.** Atoms are composed of smaller, subatomic particles called protons, neutrons, and electrons. An **electron** has a negative (–) electric charge. A **proton** has a positive (+) electric charge. A **neutron** has no charge. Neutrons are neutral. Protons and neutrons make up the center, or **nucleus,** of an atom. Electrons move quickly around the nucleus (Figure 2).

The sum of all the charges in an atom determines the atom's overall, or net, charge. For example, when the number of electrons in an atom is equal to the number of protons, the atom has a net charge of zero. The electric charges of the subatomic particles are balanced. When the number of electrons and protons in an atom is not equal, the atom has either a net positive or a net negative charge. An atom with a net positive or net negative charge is called an **ion.**



▲ **Figure 2** Atoms contain negatively charged electrons, positively charged protons, and neutral neutrons. The atom shown is a helium atom. It has a net charge of zero.

2

SCIENCE

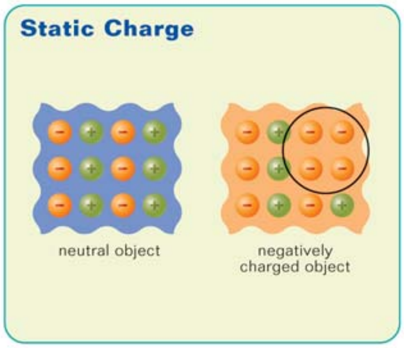
Background The force that holds together the particles—protons and neutrons—in the nuclei of atoms is very strong. The force that holds electrons in their orbits around the nucleus is much weaker. As a result, atoms frequently gain and lose these loosely held electrons when substances interact. (Atoms rarely gain or lose protons.) The atoms of some elements tend to share electrons when they bind together to form compounds. The atoms of other elements usually become ions, and ions with opposite charges form compounds. The electrical attraction that holds the ions together is called an ionic bond.

Provide students with three different colored beads, marbles, or foam balls to represent protons, neutrons, and electrons. Using Figs. 2 and 3 as guides, have students model atomic structure, balanced charge, and the formation of ions (by gaining or losing electrons). Have students count the protons and electrons in each atom they "make" to determine its charge.

Static Charge

Most of the time, materials or objects are electrically neutral. The number of electrons and the number of protons in an object are equal. However, electrons can be transferred from one object to another object. If a neutral object gains electrons, the object will have more negative charges than positive charges. This excess of negative charge causes the object to be negatively charged (Figure 3). If a neutral object loses electrons, the object will have an excess of positive charge. The object will be positively charged. An object's excess of positive or negative charge is called **static charge.** The buildup of charge on an object is sometimes referred to as **static electricity.** Most static charges are trillions of times larger than the charge of a single electron or proton.

Depending on how a material's electrons behave, the material can be classified as either a conductor or an insulator. A **conductor** is a material whose electrons are held loosely. They can move easily from one atom to another. The copper in a wire is classified as a conductor. Electrons move easily along it. An **insulator** is a material whose electrons cannot move easily. Rubber and glass are insulators.



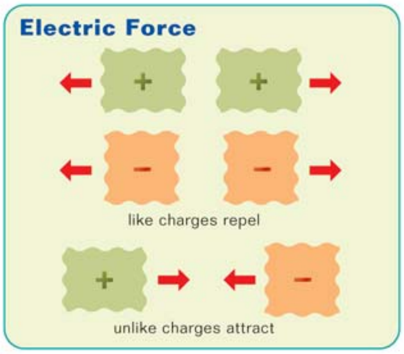
▲ **Figure 3** An object with an equal number of protons and electrons is neutral. An object with more electrons than protons is negatively charged.

Electric Force

All charged materials or objects exert a force called **electric force.** Materials with like static charges repel, or push each other away (Figure 4). For example, two positively charged materials repel each other. The same is true for two negatively charged materials. On the other hand, materials with opposite, or unlike, charges attract, or pull each other closer. For example, a negatively charged material and a positively charged material attract each other.

Recall that the nucleus of an atom is composed of positively charged protons and neutral neutrons. So the nucleus as a whole has a positive charge. The electrons around the nucleus are negatively charged. The electric force between the positively charged nucleus and the negatively charged electrons holds the atom together.

Charged objects do not have to touch each other for electric force to act between them. This is because electric force can act over a distance. The space around a charged object where electric force acts is called an **electric field.** Electric force acts between two objects when their electric fields interact.



▲ **Figure 4** Electric force causes charged objects to interact in certain ways. Objects with like charges repel, or push each other away. Objects with unlike charges attract each other.

SCIENCE

Background As a group, metals are good conductors of electricity. Silver, copper, gold, and aluminum are some of the best conductors. Most nonmetals, on the other hand, are good insulators of electricity. Ceramic is used in many high-voltage applications, such as transformers (see p. 17). Rubber and plastics are common insulators used in many everyday devices. Pure water and air are also insulators. Tap water and saltwater, however, are good conductors because of their impurities through which electricity can flow.

History Benjamin Franklin's famous kite flight in 1752 proved that lightning was the same phenomenon as electricity (then known only in its static form). Afterward, Franklin coined many of the terms used today to describe electricity, such as *positive, negative, charge, discharge, conductor,* and *battery.* His experiments also led him to invent the lightning rod to protect people from lightning's power.

2 Guide the Learning

Discuss and Explore

Main Idea and Supporting Details Have students identify the main idea, or most important point, under each subheading or paragraph as they read this section. Then have them list supporting details, which give more information. (Sample main idea for Static Charge: *Objects can become charged by gaining or losing electrons.* Sample supporting details: *If a neutral object gains electrons, it will become negatively charged. If a neutral object loses electrons, it will become positively charged.)*

Clarify *How does an ion differ from an atom?* (An atom is neutral. An ion has a positive or negative charge.)

Visualize Have students work in small groups to model static charge. Provide each group with ten small green squares marked "+" (protons) and ten small yellow squares marked "–" (electrons). Ask students to begin by creating two neutral "objects." (Each object should have five green squares and five yellow squares.) Using one of their neutral objects, have students model how an object can become positively charged (losing a yellow square) and negatively charged (gaining a yellow square). Explain that the electrons, rather than the protons, move because electrons are lighter and less tightly held. Have students refer to Fig. 3 as necessary.

Critical Thinking

Model Provide students with large cotton balls and small, lightweight objects, such as pencil cap erasers. Ask students to model the electric field (the cotton ball) around a charged object (the eraser). Students should place the eraser in the center of the fluffed-up cotton ball to show that the electric field is three-dimensional, extending in all directions around a charged object.