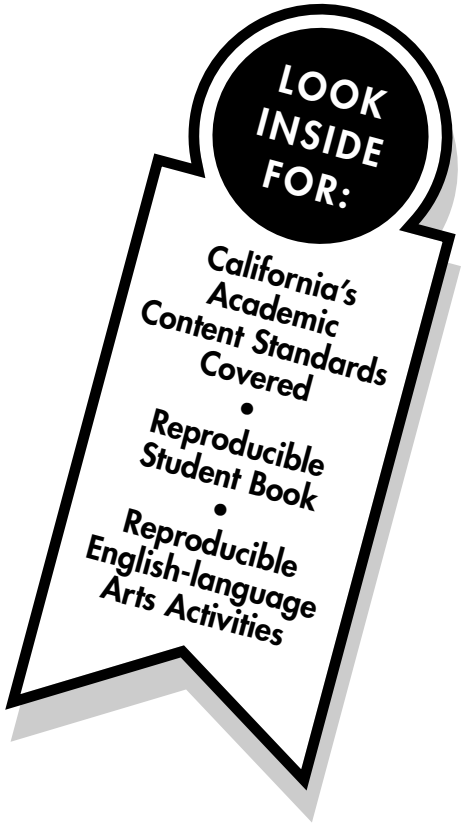
SCIENCE • GRADE 4

Below Level

California Content Standards
Physical Sciences: 1.A
Physical Sciences: 1.E
Physical Sciences: 1.F
Physical Sciences: 1.G

Electrical Energy



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Electrical Energy
California's Content Standards Met

GRADE 4 SCIENCE

PHYSICAL SCIENCES: 1—Electricity and magnetism are related effects that have many useful applications in everyday life. As a basis for understanding this concept:

- **a.** Students know how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.
- **e.** Students know electrically charged objects attract or repel each other.
- **f.** Students know that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.
- **g.** Students know electrical energy can be converted to heat, light, and motion.

GRADE 4 ENGLISH LANGUAGE ARTS

1.0 WORD ANALYSIS, FLUENCY, AND SYSTEMATIC VOCABULARY DEVELOPMENT

Vocabulary and Concept Development 1.2—Apply knowledge of word origins, derivations, synonyms, antonyms, and idioms to determine the meaning of words and phrases.

Vocabulary and Concept Development 1.6—Use sentence and word context to find the meaning of unknown words.

2.0 READING COMPREHENSION

Comprehension and Analysis of Grade-Level-Appropriate Text 2.3—Make and confirm predictions about text by using prior knowledge and ideas presented in the text itself, including illustrations, titles, topic sentences, important words, and foreshadowing clues.

Comprehension and Analysis of Grade-Level-Appropriate Text 2.5—Compare and contrast information on the same topic after reading several passages or articles.

Below Level

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Student Book

Electrical Energy

Print pages 5–18 of this PDF for the student book.

How to Make the Student Book

- **The student book is contained on pages 5–18 of this PDF. It begins on the next page.**
- **To make one student book, or a two-sided master copy that can be photocopied, you will print on both sides of seven sheets of 8.5" x 11" paper.**
- **Do a test printout of one book first to familiarize yourself with the procedure.**
- **Follow these instructions carefully.**

First–Select the Paper

Since you will be printing on both sides of the sheets of paper, select a good quality white paper. We recommend using at least a 22lb sheet.

Second–Check Printer Settings

Be sure you have the correct page setup settings for your computer and printer. You will print these pages in landscape format.

Third–Print EVEN Pages

Open the PDF of the book you want to print. Select print from your file menu. In your printer's dialogue box enter pages 5–18 to print. Then select EVEN pages only. It is important to print only the EVEN pages first. Click "Print" to print the even pages. (**Important note**: The first page that prints will be blank. DO NOT discard this page. It will be needed to print the cover in the next step.)

Forth–Print ODD Pages

When the even pages have printed, flip the stack of pages over to print the odd pages. Place the stack back in your printer. Select print from the file menu again. In your printer's dialogue box, select ODD pages. Click "Print" to print the odd the pages.

Fifth–Fold the Book

You now have a complete book. Check to be sure the pages are in the correct order with the book's cover as the top page. Then fold the stack of paper in half.

Sixth–Staple the Book

Use an extended-length stapler to staple the pages together. Place three staples in the spine of the book.

Please note that printers vary in how they output pages. Do a test printing with one book and adjust the procedure as necessary.

If you want to make a one-sided master copy, print ALL pages 5–18 at once. Then select "one-sided to two-sided" on the copy machine.

BL

Electrical Energy
California's Content Standards Met

GRADE 4 SCIENCE

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GRADE 4 ENGLISH LANGUAGE ARTS

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FOCUS ON CALIFORNIA STANDARDS

SCIENCE • GRADE 4

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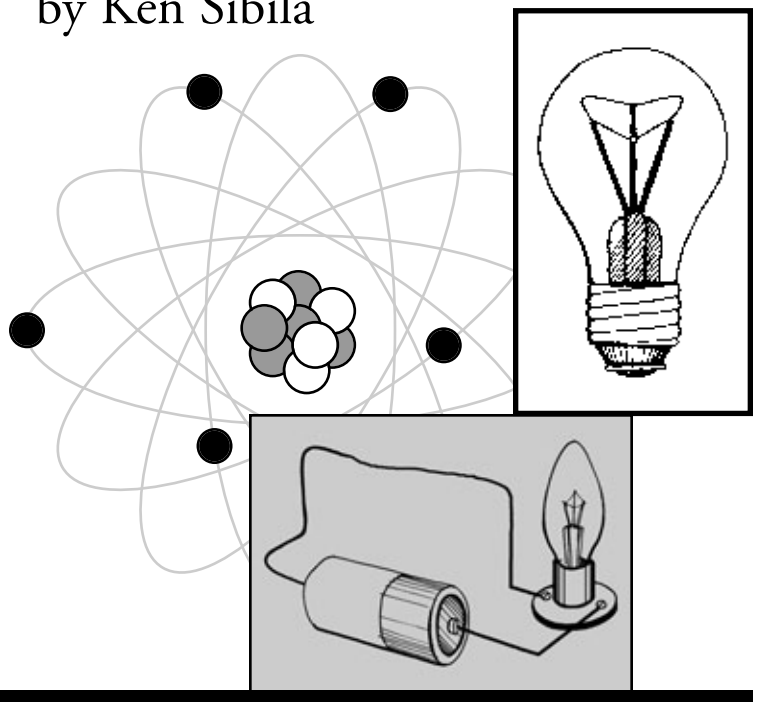
Electrical Energy

by Ken Sibila



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Electrical Energy

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Table of Contents

INTRODUCTION

What Is Electricity?

Look around the room you are in right now. How many things in the room are using electricity?

What if the electricity is turned off? What would it be like in the room?

Electricity is important to your life. But what is electricity? To answer this question, you must first understand the atom.

CHAPTER 1

The Atom

Everything in the world is made up of tiny pieces called atoms. Atoms are very, very small. They are far too small for you to see.

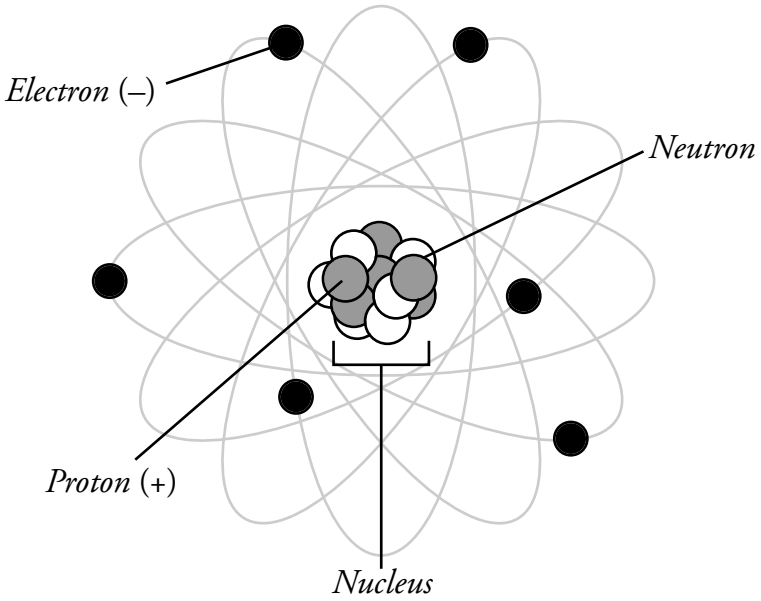
Look at the dot on this letter *i*. The dot has millions of atoms.

Each tiny atom is made up of even smaller parts. Turn the page to see a picture showing one atom.

Parts of an Atom

An atom is like our solar system. The sun is in the center. The center of an atom is called the nucleus. The nucleus is made of tiny parts. These tiny parts are called protons and neutrons.

Electrons spin around the nucleus. The electrons are like planets spinning around the sun.



Protons and electrons have an electrical charge. Protons have a positive charge. Look for + (plus) in the picture to see protons. Electrons have a negative charge. Look for the – (minus) in the picture to see electrons.

Most of the time, atoms have the same number of positive protons and negative electrons. The atoms are balanced.

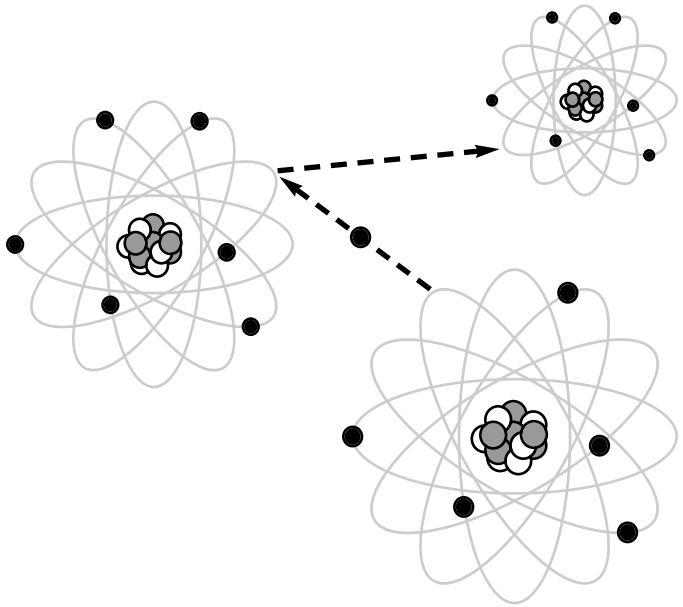
The atom shown in the picture is balanced. It has six protons and six electrons.

All atoms want to be balanced. Balanced atoms have no electrical charge.

Electrons Can Move

Electrons can move away from their atoms. Rubbing two things together can cause electrons to move.

Think about a balanced atom. The number of positive protons is the same as the number of negative electrons. But what happens when one negative electron leaves its atom? Its atom will be left with more positive protons. Its atom will not be balanced. The atom will have a positive charge.



The electron that leaves its atom will go to a different atom. Now this new atom will have more negative electrons. The new atom will not be balanced. It will have a negative charge.

Remember all atoms want to be balanced. They want to have the same number of protons and electrons. So an atom that has a positive charge will take an electron that has a negative charge. Then the atom will be balanced.

Many, many electrons move from atom to atom. These moving electrons create electricity.

Why are electrons important in making electricity?

CHAPTER 2

Static Electricity

Have you ever reached for a doorknob and been shocked? This happens because electrons from the carpet jumped to your body. This gave your body a negative charge.

The metal doorknob had a positive charge. Negative electrons jumped from your fingers to the doorknob. That caused a spark. This is static electricity.

What happens when electrons jump away from their atoms?

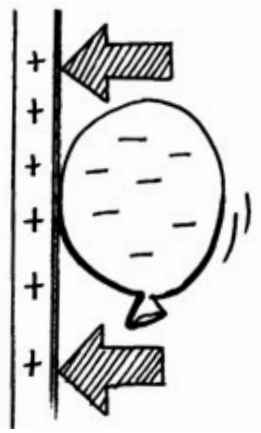
Atoms Attract

Atoms with a positive charge pull toward, or attract, atoms with a negative charge. Positive charges and negative charges attract. Here is a way to show this.

Rub a balloon full of air against your hair. Then hold it against a wall. When you let go of the balloon, it sticks to the wall. Why does this happen?

Rubbing the balloon makes electrons move. Electrons jump from your hair to the balloon. Now the balloon has more electrons. This gives it a negative charge.

The wall has a positive charge. The negative charges in the balloon attract the positive charges in the wall. This causes the balloon to stick to the wall.

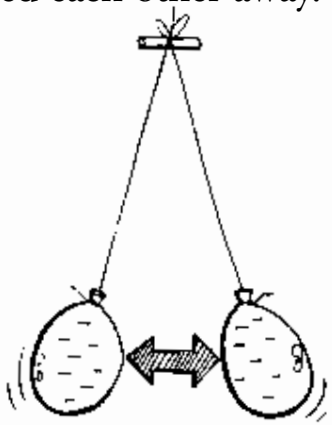


Atoms Repel

Atoms with a similar charge move away from, or repel, each other. Negative charges repel each other. Positive charges repel each other as well.

Try this. Take two balloons and tie a string to each one. Rub the two balloons against a piece of wool. Hold them by the strings next to each other. The balloons will move apart.

Rubbing the balloons against the wool gave each of them a negative charge.
So the balloons pushed each other away.

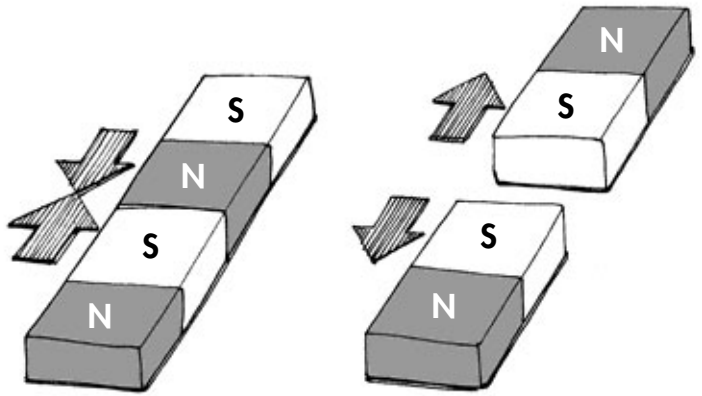


repel: to drive or force away

Magnets

You have learned that a negative and a positive charge attract each other. Two negative or two positive charges repel each other.

Magnets attract and repel, too. Magnets have north and south poles. A north pole and a south pole attract. Two north poles repel each other. Two south poles repel each other, too.



CHAPTER 3

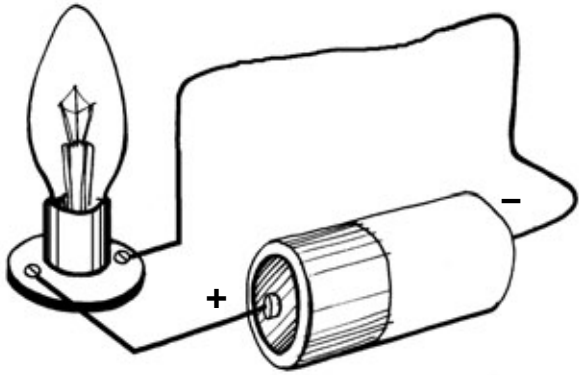
Electric Circuits

Electrons move through a metal wire to make an electric current. A circuit is a loop that the electric current flows around.

Closed Circuit

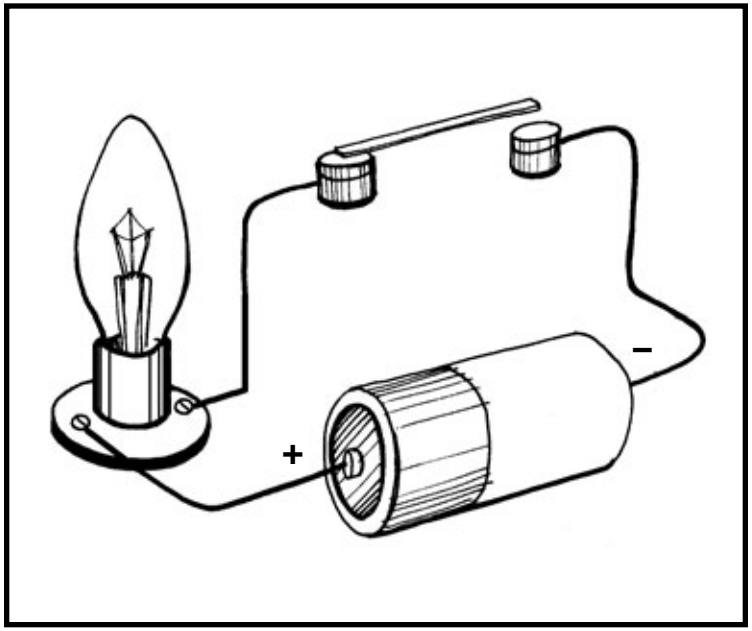
Electrons need an unbroken loop of wire in order to flow. This loop is called a closed circuit.

Look at the diagram below. It shows a closed circuit. Electrons flow freely from the battery, through the wire, through the light bulb, and back to the battery. Nothing stops the flow of electrons.



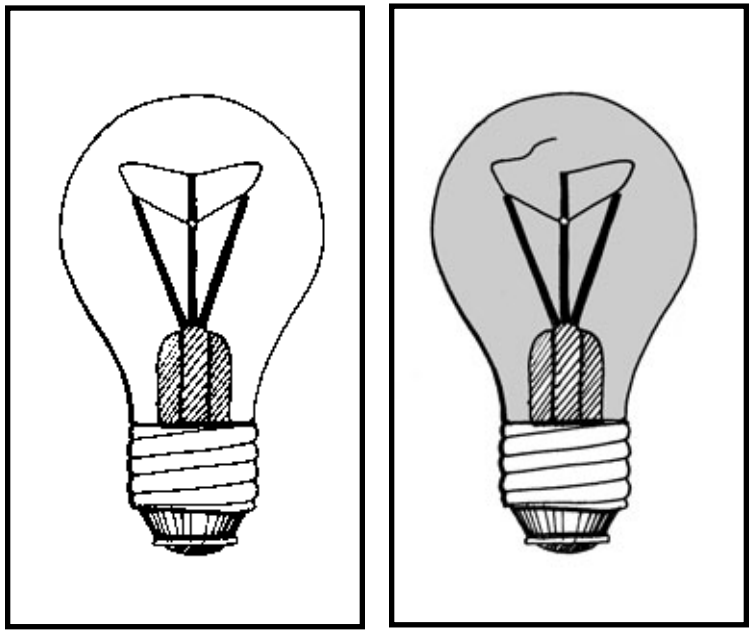
Open Circuit

Now look at this picture. It also shows an electrical circuit. A switch separates the wire. Now the circuit isn't closed. It is an open circuit. The electrons have no place to go. The electricity stops flowing through the circuit.



Here is another example of a circuit. A light bulb has a tiny wire in it. Electricity flows into the light bulb. It passes through the wire. The wire heats up and glows creating light.

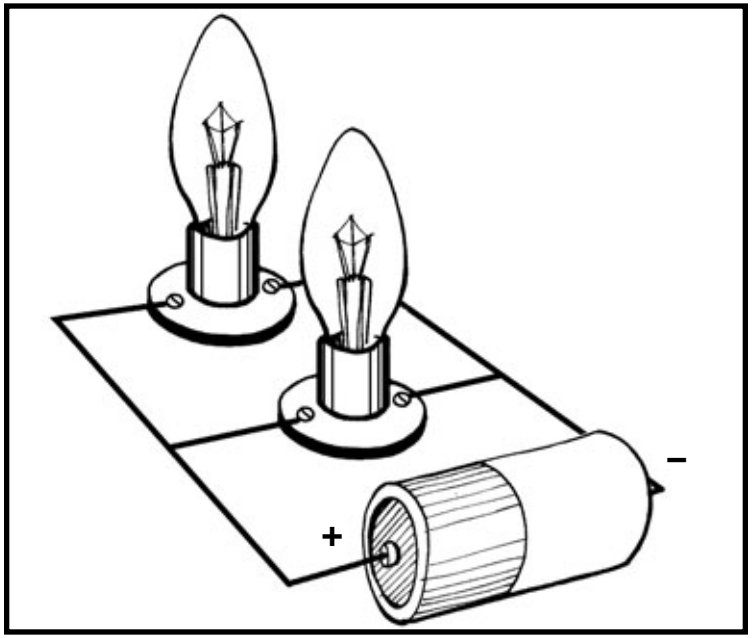
After a while, the wire wears out and breaks. The circuit is no longer closed. It becomes an open circuit. Electricity can no longer flow through the wire.



How can you tell which light bulb has a closed circuit?

Parallel Circuit

Sometimes two or more circuits are connected. This is called a parallel circuit. Look at the picture below. It has two circuits connected to each other. Do you see how both circuits are closed? The electrons can flow freely through them.



CHAPTER 4

Electricity Is Energy

Energy is anything that does work. You have energy. Your energy lets you run or ride a bike.

Electricity is also energy. Electricity can be changed into other forms of energy such as heat, light, motion, and sound.

Heat

How does a hair dryer work? Electrons flow through a piece of metal in the hair dryer. They bump into the atoms that make up the metal. This causes the atoms to heat up. The hair dryer heats up, too.

Light

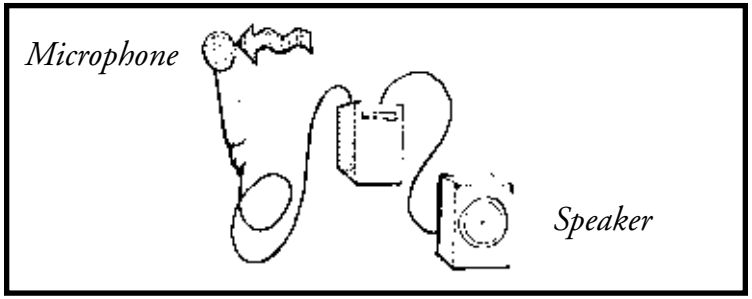
You already know how a light bulb works. An electric current passes through a thin wire. The wire heats up. Some of the heat energy turns into light energy.

Sound

How does the principal's voice travel from the school office to your classroom?

Your principal's voice causes **vibrations** in the air. These vibrations are picked up by a microphone in the office. They are changed to tiny **pulses**, or beats, of electricity.

These pulses travel through copper wire. The wire is connected to the speaker in your classroom. The speaker receives the pulses. This causes a paper cone in the speaker to vibrate. The vibrations from the paper cone push against the air. This causes sound waves. You hear the principal's voice.



vibration: a rapid motion back and forth
pulse: a regular beat

CHAPTER 5

Using Electricity Safely

Suppose a very strong current of electricity flowed through a thin wire. What might happen? The wire would become very hot and break. Why? The wire would not be thick enough to carry the strong current.

Have you ever seen several things plugged into one outlet? What might happen if each one is turned on at the same time? Heat would build up. The wires might catch fire.

Fuses are used to keep you safe. Fuses keep wires from getting too hot. Sometimes too much electrical power passes through a fuse. When this happens, the wire in the fuse breaks. This stops the flow of electricity.

Electricity is helpful to us in many ways. However, it must be used safely.

- Never plug too many things into one outlet.
- Be sure cords are the right size.
- Do not use cords with wires that are worn or ripped.

More Words to Know about Electricty

conductor—a material that carries electricity such as copper

insulator—a material that keeps electricity from flowing such as rubber

Glossary

conductor—a material that carries electricity such as copper

insulator—a material that keeps electricity from flowing such as rubber

pulse—a regular beat

repel—to drive or force away

vibration—a rapid motion back and forth

To Find Out More . . .

Want to learn more about electricity?

Try these books

Electricity (DK Eyewitness Books) by Steve Parker and Laura Buller. Dorling Kindersley, 2005.

*What Is Electricity? (*Rookie Read-About Science) by Lisa Trumbauer, Childrens Press, 2004.

The Science of Electricity & Magnetism: Projects and Experiments With Electricity And Magnets (Tabletop Scientist) by Steve Parker, Heinemann, 2005.

Access these Web sites

Kid Zone: Electric Avenue
http://www.aecl.ca/kidszone/atomicenergy/electricity/index.asp

NASAs Kids Science News Network
http://ksnn.larc.nasa.gov/home.html

The NASA Sci Files
http://scifiles.larc.nasa.gov/text/kids/D_ Lab/acts_electric.html

Index

ENGLISH-LANGUAGE ARTS • GRADE 4

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Comprehension and Analysis of Grade-Level-Appropriate Text: 2.5

English-language Arts Activities

Electrical Energy

Print pages 20–24 of this PDF for the reading activities.

Make Predictions

TRY THE SKILL

If you understand what you read, you should be able to predict what will happen in a certain situation.

For example, if an atom is positively charged, you can predict that it will accept an electron to regain its balance.

If a material does not allow electrons to flow through it, you can predict that it will be a good conductor.

You can also predict that the positive pole of a magnet will attract the negative pole of another magnet.

Read the questions. Then use the answer choices to make or support your predictions. Shade in the circle next to your choice.

1. The tiny filament in a light bulb breaks. What will happen next?

Ⓐ The circuit is now open, so the bulb will not light.
Ⓑ The circuit is now closed, so the bulb will not light.
Ⓒ The circuit is now open, so the bulb will light.
Ⓒ The circuit is now closed, so the bulb will light.

2. A microphone picks up the vibrations from a singer's voice. The vibrations are changed into tiny pulses of energy. What will happen next?

Ⓐ The pulses bump into atoms and cause heat.
Ⓑ The pulses bump into atoms and cause light.
Ⓒ The pulses cause a paper cone to vibrate.
Ⓒ The pulses cause the air to vibrate.

3. Mia goes down a slide. The rubbing causes electrons to move from the slide to her body. How will this affect her short, straight hair?

Ⓐ Her hair will stand straight out from her head because each strand now has a different charge.
Ⓑ Her hair will stand straight out from her head because each strand now has the same charge.
Ⓒ Her hair will lie flat against her head because each strand now has a different charge.
Ⓒ Her hair will lie flat against her head because each strand now has the same charge.

Compare and Contrast

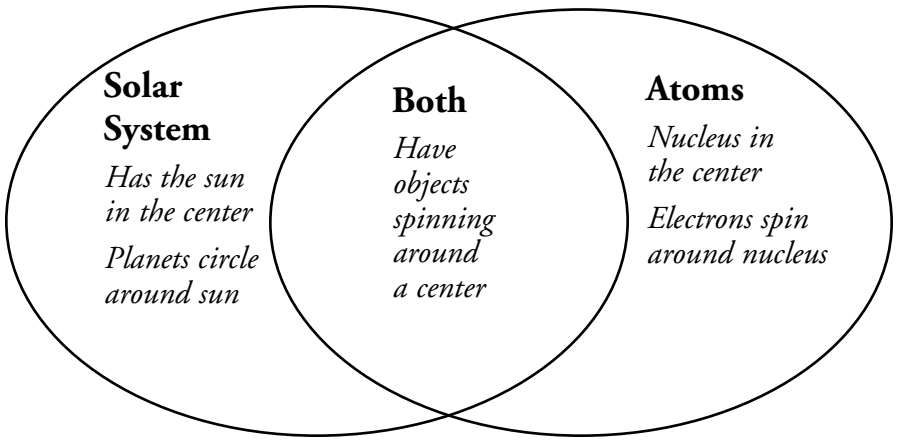
Comparing and contrasting can help you understand what you read.

- **Comparing tells how things are alike.**
- **Contrasting tells how things are different.**

Read this paragraph from *Electrical Energy*. Then, read the Venn diagram that compares and contrasts.

An atom is like our solar system. The sun is in the center. The center of an atom is called the nucleus. The nucleus is made of tiny parts. These tiny parts are called protons and neutrons.

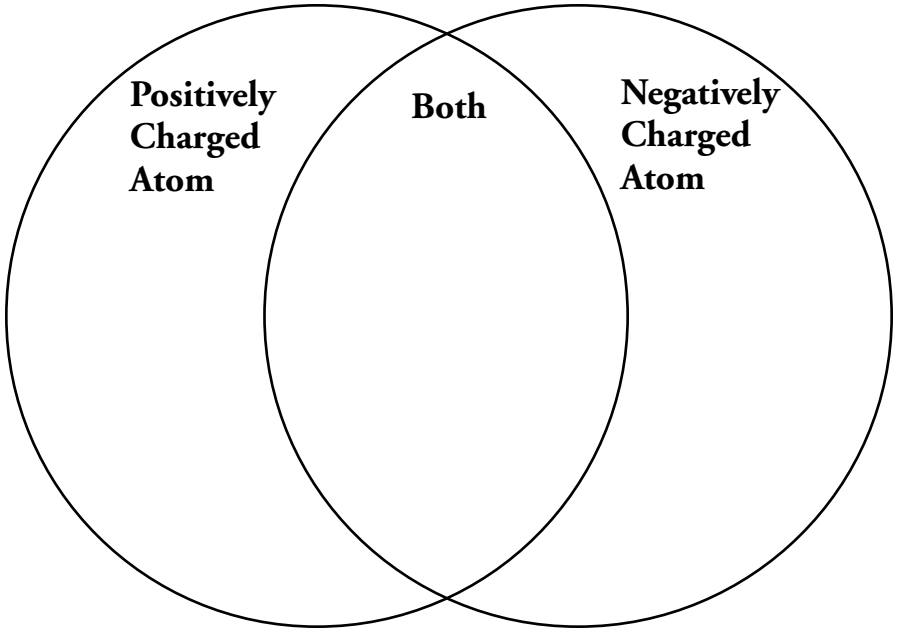
Electrons spin around the nucleus. The electrons are like planets spinning around the sun.



TRY THE SKILL

Read the paragraph. Think about comparing and contrasting. Then complete the Venn diagram.

Think about a balanced atom. The number of positive protons is the same as the number of negative electrons. But what happens when one negative electron leaves its atom? Then its atom will be left with more positive protons. Its atom will not be balanced. The atom will have a positive charge.



Context Clues

To figure out the meaning of an unknown word, look for words in the same sentence or nearby sentences that give you clues.

Read this passage. Try to figure out what *conductor* means.

Your TV has an electric cord that you plug into an outlet. The cord is made of copper wire on the inside and rubber on the outside. Copper is a good conductor of electricity. The electrons in copper easily flow from one atom to another creating an electric current.

What does the word *conductor* mean?

A conductor is a material that carries electricity. The last sentence gives you a clue. It states that electrons in copper easily flow from one atom to another. So a conductor is something that allows electrons to flow easily.

TRY THE SKILL

Read this passage. Answer the questions.

The rubber on the outside of the cord is an insulator. Insulators do not allow electrons to leave their atoms. Therefore, they do not carry an electric current.

The measure of how well a material allows electricity to move is called resistance. Rubber has a high resistance. Copper has a low resistance.

1. What does the word *insulator* mean in the selection?
Ⓐ material that allows electricity to flow through it
Ⓑ material that prevents electricity from flowing
Ⓒ material that is on the outside of something

2. Write a sentence of your own that correctly uses the word *resistance*.

_____

_____

_____

_____

Antonyms

Antonyms are words that have opposite meanings. Some examples of antonyms are:

end and *begin*

forward and *backward*

powerful and *weak*

capture and *release*

Read the paragraph. Look for the antonyms.

Positively charged atoms are attracted to negatively charged atoms. An atom with a negative charge will repel another atom with a negative charge.

What are the antonyms?

Negatively and *positively* are antonyms. *Attracted* and *repel* are also antonyms.

TRY THE SKILL

Read the paragraph. Underline the antonyms.

Magnets are objects that attract some metals. Like positive and negative charges, magnets attract and repel, too. Magnets have north and south poles. A north pole and a south pole attract. Two north poles repel each other. Two south poles repel each other, too.

Think of other antonyms that have to do with electricity. You'll find more antonyms in this book. Write them in the space below.

_____

_____

_____

_____

_____

Answer Key

Make Predictions

1. A
2. C
3. A

Compare and Contrast

Positively Charged Atoms: Has more protons than electrons

Negatively Charged Atoms: Has more electrons than protons

Both: Are still atoms

Context Clues

1. B

2. Sentences will vary but should indicate that students understand the meaning of the word *resistance*.

Antonyms

Antonyms include:

attract repel
negative positive
north south

Other antonyms in the book include:

gains loses
inside outside
conductor insulator
prevent allow
flow stop
open closed