FOCUS ON SCIENCE

Physical Science

Electricity and Magnetism

On Level

Electrical Energy

LOOK INSIDE FOR:

- Core Curriculum Covered
- Student Book
- Assessments and Reading Activities

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Electrical Energy

What are the properties of electricity and magnetism?

CORE CURRICULUM STATEMENTS

Energy exists in many forms, and when these forms change energy is conserved.

Energy exists in various forms: heat, electric, sound, chemical, mechanical, light.

Energy can be transferred from one place to another.

Some materials transfer energy better than others (heat and electricity).

Energy and matter interact: water is evaporated by the Sun's heat; a bulb is lighted by means of electrical current; a musical instrument is played to produce sound; dark colors may absorb light, light colors may reflect light.

Electricity travels in a closed circuit.

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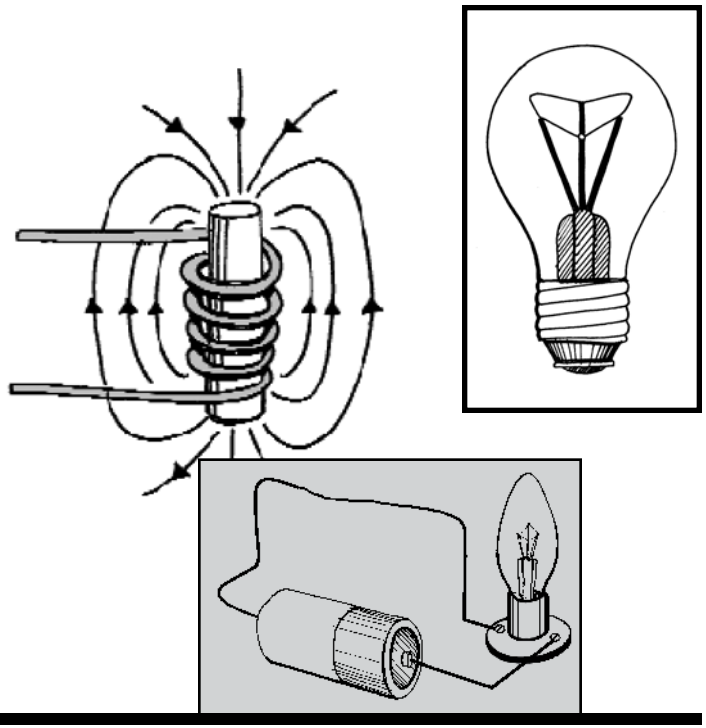
by Ken Sibila



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Curriculum materials for **your** content standards

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– Predict –
What do you think you will learn from this book?

INTRODUCTION

Electricity Is Energy

You can't hear it or smell it. You can't taste it or hold it. You can't even see it. But you know electricity exists.

Look around the room you are in right now. How many things in the room use electricity? Walk around the building you are in. Count the number of items that use electricity. Now imagine there is no electricity. What would it be like in that room and building?

Electricity lights up your home, cooks your food, and powers your computer. It is hard to imagine living without electricity.

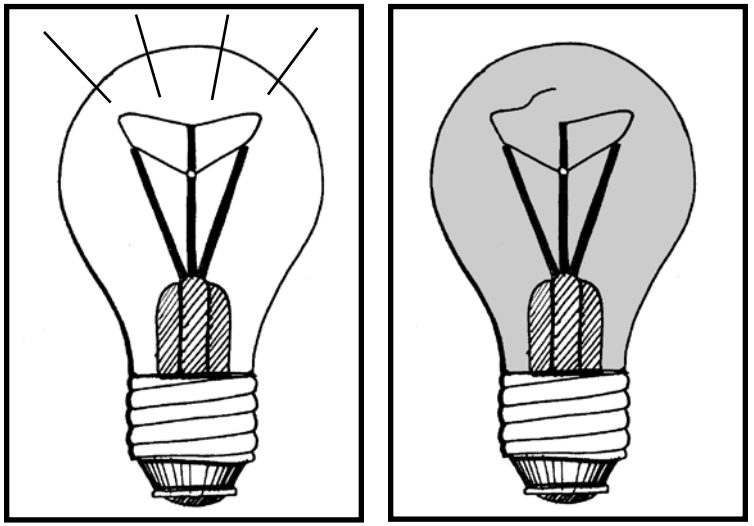
Electricity is an important energy source. It provides us with light and heat. It can also provide us with sound and magnetic forces. How can electricity do this? Read on to find out.

CHAPTER 1

Electrical Circuits

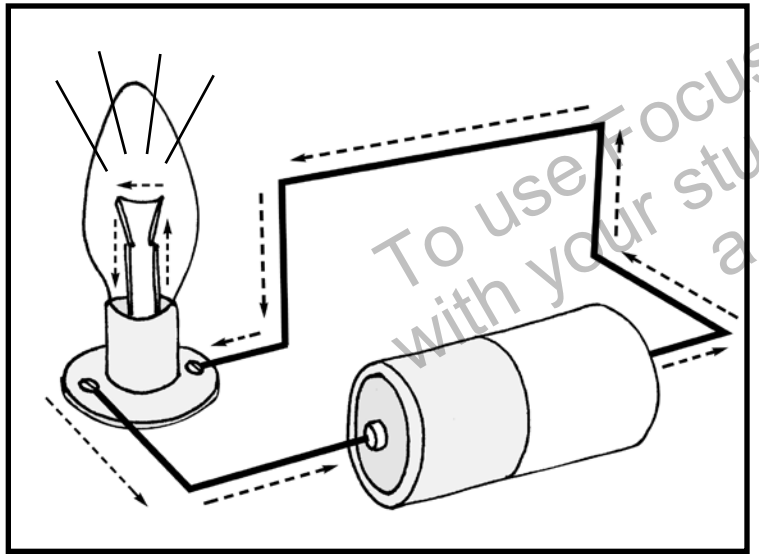
You turn a switch on a lamp. Suddenly, light appears. How does that happen? A light bulb has a tiny wire in it. Electricity enters the light bulb and passes through the wire, called a filament. The wire heats up. This causes the wire to glow, creating light.

After a while, the wire wears out and breaks. The electricity can no longer flow through the wire. The bulb cannot produce heat or light any more.



Closed Circuit

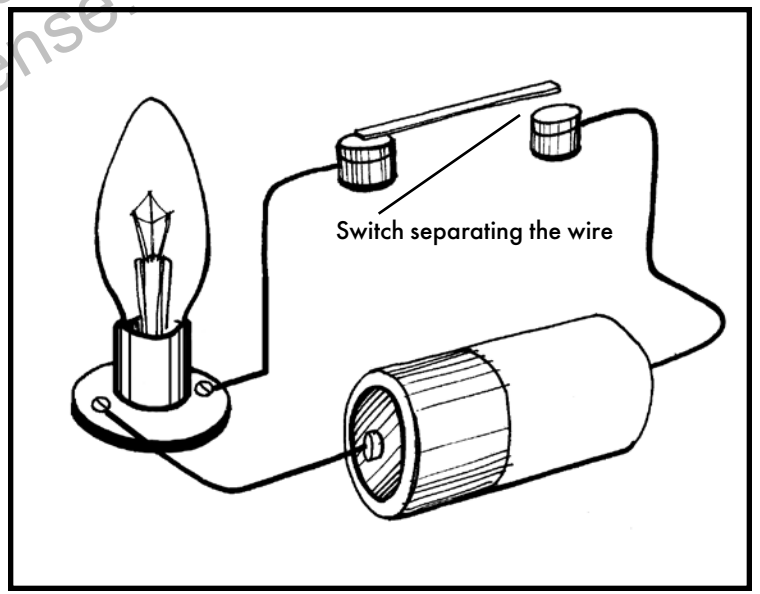
How does electricity get to the light bulb? The light bulb is connected to a power source by wires. Electricity flows from the power source through the filament. Then it returns to the power source through another wire. This electrical loop is called a closed circuit.



A battery is one type of electric power source. Electricity flows from the battery to the light bulb. Electricity then flows back to the battery.

Open Circuit

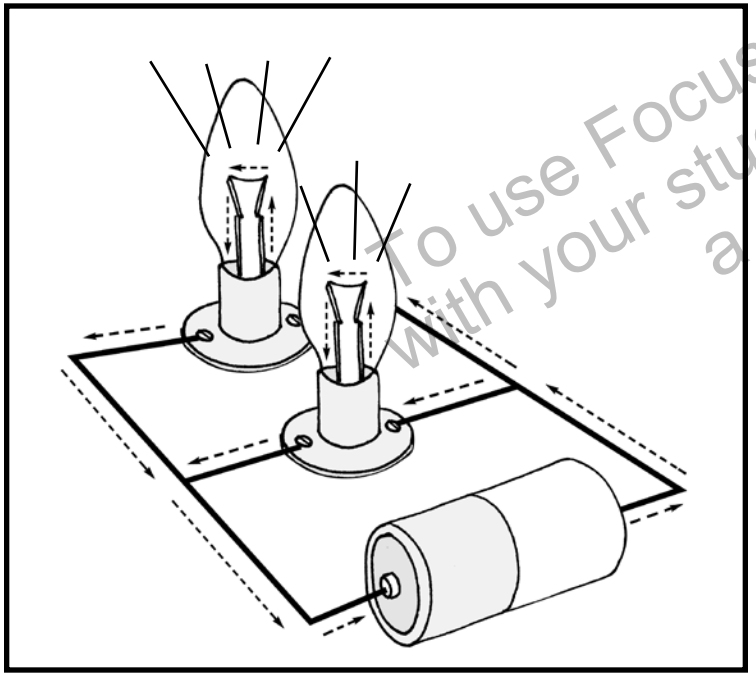
How do you turn a light bulb off? You turn a switch. Look at this diagram. A switch has been placed in the electrical loop. The switch separates the wire. Now electricty has no place to go. The electricity stops flowing through the circuit when the switch is open.



This light bulb will not produce light. The flow of electricity has been stopped by a switch.

Parallel Circuit

You can connect more than one light bulb to an electrical circuit. This is called a parallel circuit. Look at the diagram below. It shows two circuits connected to each other. Notice that there is no switch. Both circuits are closed. The electricity can flow freely through them.



Conductors and Insulators

You have probably plugged an electric cord into an outlet many times. The cord is made of copper wire on the inside and rubber on the outside. Copper is a good **conductor** of electricity. Electricity flows easily through copper.

The rubber on the outside of the cord is an **insulator**. Insulators do not allow electricity to flow. When you touch an electrical cord, the rubber prevents the electricity from flowing from the copper wire to you.

conductor: a material that carries electricity
insulator: a material that keeps electricity from flowing

CHAPTER 2

Static Electricity

Electricity can not only flow through material, it can also jump from one object to another.

Have you ever touched a doorknob and received an electric shock? This occurred because you walked across a carpet and your body picked up an electrical current. When you reached for the metal doorknob, electricity jumped from your fingertip to the doorknob creating a spark before you even touched it. This is an example of static electricity.

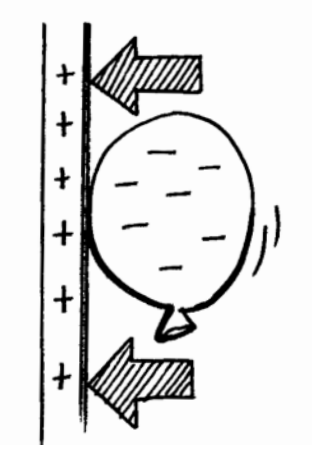
–Explain–
What causes static electricity?

Electrically Charged Objects Can Attract

Electrical charges in objects can attract or repel each other. Here is an activity to prove this.

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

When you rubbed the balloon against your hair or wool, the balloon picked up an electrical charge. The electrically charged balloon becomes attracted to a different electrical charge in the wall causing the balloon to stick to the wall.

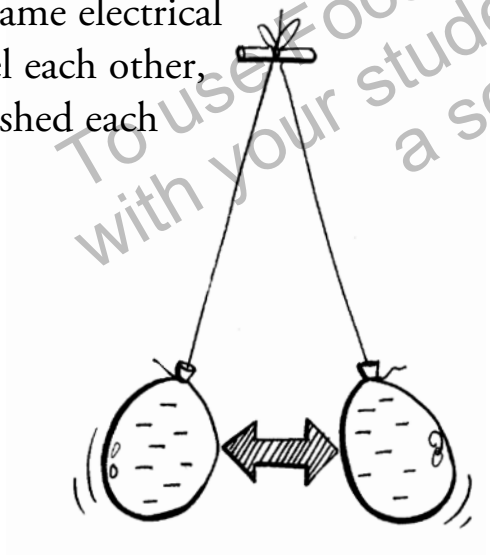


Electrically Charged Objects Can Repel

Objects with similar charges will repel each other. Try this.

Take two balloons and tie a string to each one. Rub the two balloons together. Then hold them by the strings and put them next to each other. The balloons will move apart.

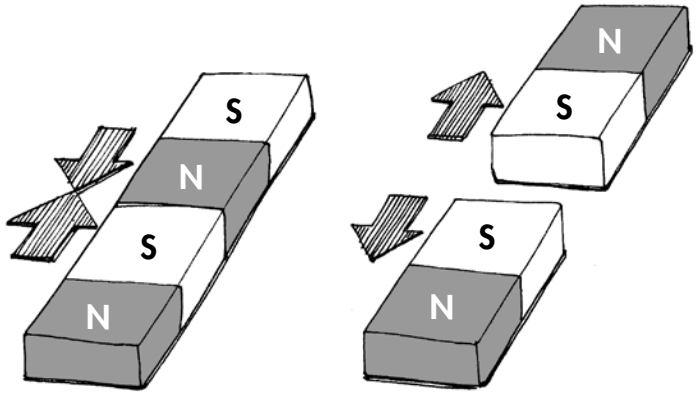
Rubbing the two balloons gave each of them the same electrical charge. Objects with the same electrical charge always repel each other, so the balloons pushed each other away.



Magnets

Magnets are objects that attract some metals. There is a strong connection between electricity and magnetism. With electricity, objects can attract or repel each other. The same goes for magnets. They have north and south pole. Similar magnetic poles repel each other, while unlike poles attract.

To attract magnets to each other, place opposite ends of two magnets near each other; they will attract each other. Placing like ends of two magnets near each other causes the two magnets to repel each other.



CHAPTER 3

Electricity Creates Heat and Motion

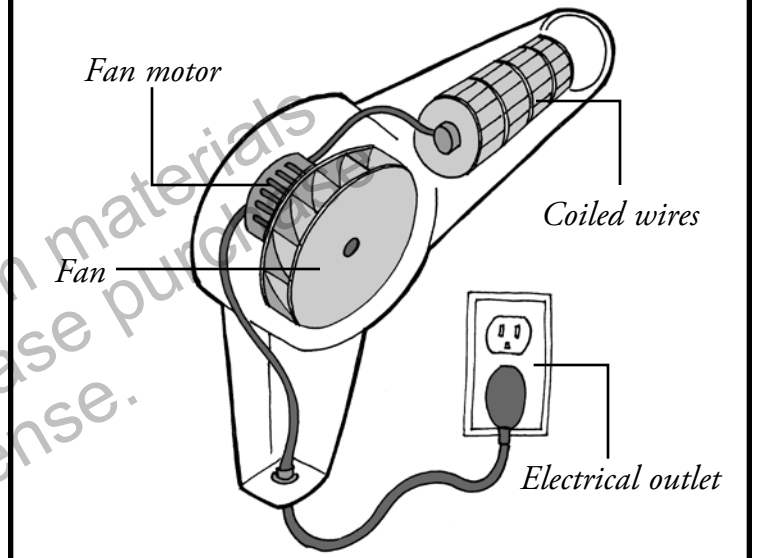
You just learned how electrical energy can be used to create light energy. It can also be used to create heat, which is called thermal energy. A hair dryer is an example.

When you want to dry your hair, you plug a hair dryer into an electric outlet. The outlet is the power source. However, the hair dryer does not turn on. Why?

The hair dryer has a switch which opens and closes the electrical circuit. When you flip the switch, it closes the circuit. Electricity can now flow through the hair dryer.

The electricity passes through a motor, which turns a fan. The fan blows air over coiled wires. The electricity also travels through the coiled wire. The wires become hot. The fan forces the hot air out of the hair dryer. Electrical energy is turned into heat. It also is turned into motion—the moving fan.

How a Hair Dryer Works



The cord is plugged into an electric outlet.

Electricity flows through the wire to the fan's motor, causing the fan to move.

Electricity flows to coiled wires, causing the coils to heat up.

Hot air blows out of the hair dryer.

CHAPTER 3

Electricity Creates Sound

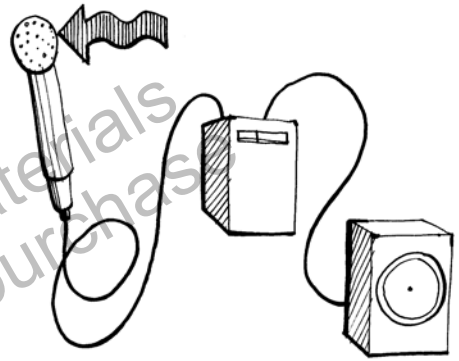
How does a voice travel from the principal's office to other rooms in the school during morning announcements?

When your principal speaks, sound waves from his or her voice cause vibrations in the air. These vibrations are picked up by a microphone and converted to tiny **pulses** of electricity.

These pulses travel through copper wire connected to the speaker. The speaker receives the pulses, which cause a paper cone in the speaker to vibrate. The vibrations from the paper cone push against the air in the room creating sound waves.

pulse: a regular beat

How a Microphone and Speaker Work



The principal speaks into a microphone.

Sound vibrations are picked up by the microphone and turned into pulses of electricity.

Pulses of electricity pass through a wire connected to a speaker.

The speaker receives the electric pulses, causing the speaker to vibrate.

The vibrations create sound waves.

CHAPTER 5

Studying Electricity

The word *electricity* came from the ancient Greek word *elektor* which means "beaming sun." The word *elector* was used by the Greeks to describe amber. Amber is tree sap that hardens into stone over millions of years. The Greeks noticed that when they rubbed amber against a piece of fur, the amber attracted dust, feathers, and other objects. They could not explain why this happened.

Dr. William Gilbert

Around 1600, a scientist named Dr. William Gilbert studied this effect and determined that amber, when rubbed against fur, could be made "electric." He thought that the friction of rubbing the two materials together created the electricity.

Benjamin Franklin

In 1747, Benjamin Franklin thought that all materials contained a single kind of electrical fluid and that rubbing moves this unseen fluid from one material to another. Franklin defined the electrical fluid as positive and the lack of fluid negative.

Hans Christian Oersted

Hans Christian Oersted was a teacher in Denmark. One day in 1820, he set up two **demonstrations**. First, he was going to show how an electric current heats a wire. Then he was going to show magnetism using a compass.

While Oersted was showing how electricity heats a wire, he looked at the compass. He noticed that when the electric current was switched on, the nearby compass needle moved.

He discovered that an electric current flowing through a wire could move the needle of a compass. His discovery showed the connection between electricity and magnetism.

demonstration: showing how something works

Johnstone Stoney

During the 1800s scientists discovered that an electric charge had a natural unit, which could not be divided any further. In 1891, Johnstone Stoney called this unit an electron. Later J.J. Thomson discovered the particle which carried that charge and the name electron was applied to it.

These studies were a good example of scientific research. A person thinks about why something occurs, studies it, and suggests an explanation. Each person learns from the next and challenges the explanation with new ideas and investigations. Over time, these scientific theories are proven to be correct or incorrect.

Glossary

conductor—a material that carries electricity

demonstration—showing how something works

insulator—a material that keeps electricity from flowing

pulse—a regular beat

repel—to drive or force away

resistance—a measure of the power of a material to resist the flow of electricity

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. Children's 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

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

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Published by FOCUScurriculum
866-315-7880
www.focuscurriculum.com

Order Number: PS-31QL

Created by Kent Publishing Services, Inc.
Designed by Signature Design Group, Inc.

Physical Science

Electricity and Magnetism

On Level

Assessments

Electrical Energy

Print pages 20–22 of this PDF for the assessments.

Electrical Energy

Check Understanding

Shade the circle next to the correct answer or write your answer on the lines provided.

1. One day in 1819, Hans Christian Oersted was demonstrating how an electric current heats a wire. While Oersted was showing this, he looked at a nearby compass. He noticed that when the electric current was switched on, the nearby compass needle moved. Why did the compass needle move?

Ⓐ A magnetic force flowed from the compass to the wire.

Ⓑ Electricity flowed through the wire, producing a magnetic force.

Ⓒ Thermal energy flowed through the wire to the compass.

Ⓓ Electricity flowed from the wire to the compass.

2. Copper allows electricity to easily flow through it. Copper is therefore called

Ⓐ an insulator

Ⓑ a resistor

Ⓒ a conductor

Ⓓ a magnet

3. Which object is the best conductor of electricity?

Ⓐ metal spoon

Ⓑ plastic fork

Ⓒ rubber ball

Ⓓ piece of wood

4. What form of energy causes a television to turn on?

Ⓐ mechanical

Ⓑ magnetic

Ⓒ sound

Ⓓ electric

5. Explain one reason a flashlight might ***not*** turn on.

_____

_____

_____

_____

_____

_____

Electrical Energy

Check Understanding

Write your answers in the boxes.

6. Electric stoves are used to heat and cook food. For example, you might turn a stove on and put a pot of soup on the stove to heat the soup before serving it. Create a 4-step flow chart that explains how an electric stove works.

Step 1

Step 2

Step 3

Step 4

Electrical Energy

Assessment Scoring Guidelines

1. Answer B is correct.

2. Answer C is correct.

3. Answer A is correct.

4. Answer D is correct.

5. The flashlight might have a switch that creates an open circuit.

The battery in the flashlight might not be transforming chemical energy into electrical energy.

The light bulb may have a broken wire creating an open circuit.

6. Step 1: A switch is turned to close the electrical circuit.

Step 2: An electric current flows through the stove.

Step 3: The electric current passed through a metal coil.

Step 4: The electrical energy is changed to heat energy and the coil begins to heat up.

Physical Science

Electricity and Magnetism

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English Language Arts Activities

Electrical Energy

Print pages 24–28 of this PDF for the reading activities.

Make Inferences

When you read, it is important to think about what you read and make inferences based on what you already know. You should be able to support your inferences with details from the book.

Here is a paragraph from *Electrical Energy*. The graphic organizer below shows one inference you can make and the details that support it.

You can't hear it or smell it. You can't taste it or hold it. You can't even see it. But you know electricity exists. Electricity lights up your home, cooks your food, and powers your computer. It is hard to imagine living without electricity.

Inference

Electricity is important in our lives.

Supporting Details

- Electricity lights up our homes.
- Electricity cooks our food.
- Electricity powers our computers.

TRY THE SKILL

Read this passage from *Electrical Energy*.

These studies were a good example of scientific research. A person thinks about why something occurs, studies it, and suggests an explanation. Each person learns from the next and challenges the explanation with new ideas and investigations. Over time, these scientific theories are proven to be correct or incorrect.

Now complete this graphic.

Inference

Supporting Details

Question and Answer

You can monitor your understanding of what you read by asking questions about the topic and then reading to find the answer. Sometimes authors will even write a question in the text and then answer it. Read the paragraph from *Electrical Energy*.

When you want to dry your hair, you plug a hair dryer into an electric outlet. The outlet is the power source. However, the hair dryer does not turn on. Why?

The hair dyrer has a switch which opens and closes the electrical circuit. When you flip the switch, it closes the circuit. Electricity can now flow through the hair dryer.

What question could you ask?

Why doesn't a hair dryer turn on when you plug it in an outlet?

What is the answer?

The hair dryer has a switch which opens the electric circuit. You must flip the switch to create a closed circuit.

TRY THE SKILL

1. **Read the question. Then write an answer in your own words.**

   What is a parallel circuit?

2. **Now think of another question you could ask based on *Electrical Energy*. Write the question. Then, write an answer in your own words.**

   Question:

   Answer:

Main Idea and Supporting Details

The main idea is the writer's main point. Supporting details give more information about this main idea.

Read this paragraph. The graphic organizer shows the main idea and supporting details.

Around 1600, a scientist named Dr. William Gilbert studied this effect that the Greeks had discovered. Gilbert determined that amber, when rubbed against fur, could be made "electric." He thought that the friction of rubbing the two materials together created the electricity.

Main Idea

Dr. Gilbert believed that friction created electricity.

Supporting Details

- He studied findings from the ancient Greeks.
- He investigated the effect of rubbing amber against fur.

TRY THE SKILL

Read this passage from *Electrical Energy*.

You turn a switch on a lamp. Suddenly, light appears. How does that happen? A light bulb has a tiny wire in it. Electricity enters the light bulb and passes through the wire, called a filament. The wire heats up. This causes the wire to glow, creating light.

After a while, the wire wears out and breaks. The electricity can no longer flow through the wire. The bulb cannot produce heat or light anymore.

Now complete this graphic.

Main Idea

Supporting Details

Graphic Organizers

Graphic organizers help you organize information. You can use graphic organizers to help explain main points in your reports. You can also create a graphic organizer to help yourself understand and remember what you read.

Here are some common graphic organizers.

- **Time lines** show events in the order they occurred. One might show a timeline of scientific discoveries.
- **Line graphs** show changes over time. For example, a line graph could show changes in the temperature over the past 100 years.
- **Charts** can classify information into groups or categories. For example, a chart could show annual, biennial, and perennial plants. Charts can also help you record observations during an experiment.
- **Venn diagrams** are two overlapping circles. They help you compare and contrast two things. You describe each thing in one circle. Then you tell how they are alike in the overlapping part.

TRY THE SKILL

Use the words and phrases below to complete this chart. Add the words or phrases that go under each heading.

conductor	open	north pole	insulator	parallel
resistance	magnetic field		closed	south pole

Properties of Materials	Parts of a Magnet	Types of Circuits

Answer Key

Make Inferences

Inference: Ideas change as new knowledge is gained.

Supporting Details: People think of ideas to explain our world and investigate their ideas. They then suggest why things occur or how things work. Others test those ideas and either prove them correct or suggest other ideas. Each person learns from the next.

Question and Answer

1. A parallel circuit is one in which two or more circuits are connected together.

Main Idea and Supporting Details

Main Idea: A working light bulb is a closed circuit.

Supporting Details: Electricity enters the light bulb and passes through a filament. The filament heats up and glows, creating light. If the filament breaks, the circuit becomes open and the bulb no longer works.

Graphic Organizers

Properties of Materials

conductor insulator resistance

Parts of a Magnet

north pole south pole magnetic field

Types of Circuits

open parallel closed