Electricity

Describing Circuits

Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.

Before	Statement	After
	5. In any electric circuit, current stops flowing in all parts of the circuit if a connecting wire is removed or cut.	
	6. The light energy given off by a flashlight comes from the flashlight's batteries.	

Read to Learn

Parts of an Electric Circuit

Devices such as lamps and computers contain electric circuits. Three common parts of most electric circuits are a source of electric energy, electrical devices that transform the electric energy, and conductors such as wires that connect the other components.

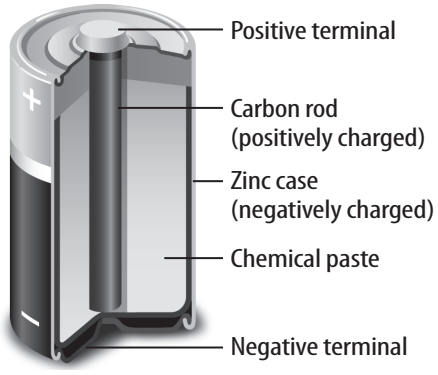
Electric Energy to Kinetic Energy

An energy source, such as a battery, produces an electric current in a circuit. Some electrical devices are designed to transform the electric energy of the current to kinetic energy—the energy of motion.

Batteries supply electric energy.

Batteries are often the source of electric energy for a circuit. Look at the figure. A battery contains chemicals. As the chemicals react, electrons in the battery concentrate at the negative terminal.

Battery



Key Concepts

- What are the basic parts of an electric circuit?
- How do the two types of electric circuits differ?

Mark the Text

Identify the Main Ideas Highlight two or three phrases in each paragraph that summarize the main ideas. After you have finished the lesson, review the highlighted text.

Key Concept Check

1. State What are the three basic parts of an electric circuit?

_____

_____

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Visual Check

2. Identify Circle the positive and negative terminals.

A Battery's Circuit When a closed circuit connects the terminals, electrons flow in the circuit from the battery's negative terminal to the positive terminal. If the circuit is closed, and the chemicals in the battery continue reacting, an electric current continues.

Reading Check

3. Explain how the electrons flow in a battery.

Electric circuits transform energy.

Energy transformations occur in all parts of an electric circuit. For example, a battery transforms stored chemical energy to the electric energy of electrons moving as an electric current. Electrical devices in the circuit transform most of the electric energy to other useful forms of energy. A lightbulb transforms electric energy to light. All parts of a circuit, including the energy source and the connection wires, transform some of the electric energy to wasted thermal energy.

ACADEMIC VOCABULARY
device
(noun) a piece of equipment

For example, electrons flowing in the filament of a lightbulb collide with the atoms that make up the filament. These collisions transfer the electrons' energy to the atoms. The atoms immediately release the energy in other forms, such as light and thermal energy.

Circuits and devices release wasted thermal energy. However, many modern electrical devices, such as compact fluorescent lamps (CFLs), are designed to waste less energy. CFLs conduct an electric current through a gas and do not use wire filaments. More energy transforms to light, and less is wasted as thermal energy.

Reading Check

4. Name What kind of wasted energy is released in circuits and devices?

Wires connect parts of a circuit.

Recall that an electric current flows in a circuit only if the circuit is closed. A circuit's energy source and device must be connected with some sort of conducting material. Metal wires often are used to complete circuits. Because of their low electric resistance, wires transform only a small amount of electric energy to wasted thermal energy. This leaves more energy available for useful devices in the circuit.

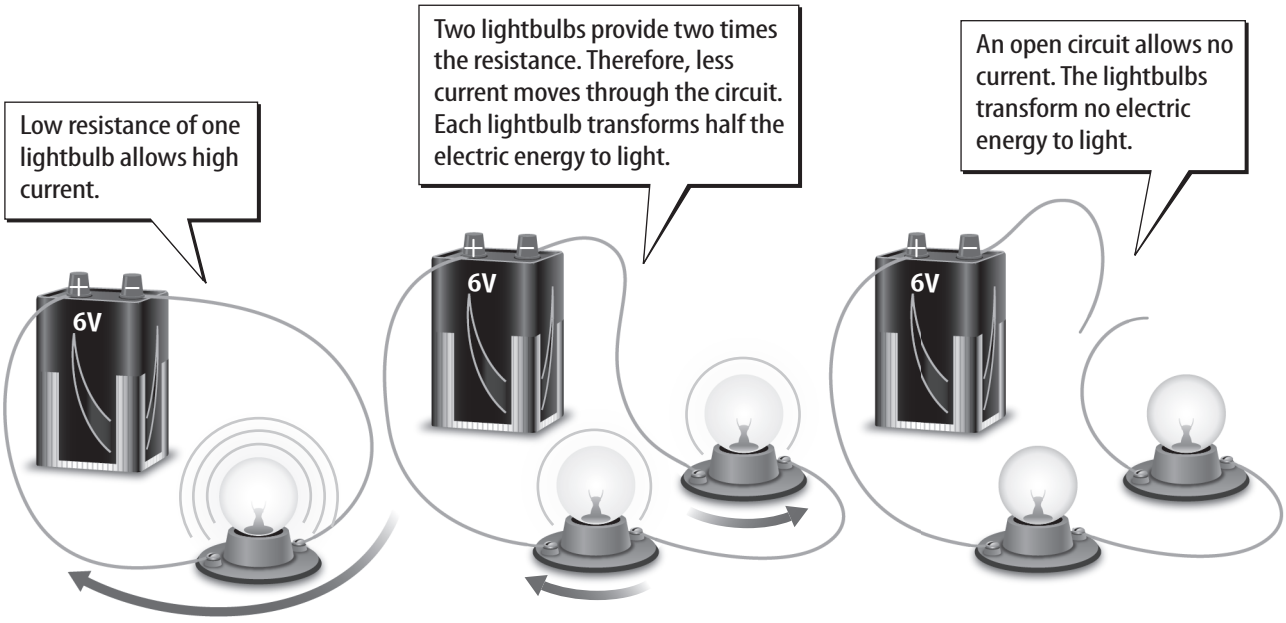
Series and Parallel Circuits

Some strings of holiday lights will not light if any bulbs are missing. Other strings of lights work when bulbs are missing. These two examples of lights represent two types of electric circuits—series circuits and parallel circuits.

Series Circuit—A Single Current Path

A **series circuit** *is an electric circuit with only one path for an electric current to follow.* Many strings of holiday lights are series circuits.

Series Circuit



In lights with series circuits, all the lightbulbs connect end-to-end in a single conducting loop. The figure above shows that breaking the loop at any point stops the current of electrons throughout the entire circuit. If a wire loop in a series circuit is broken, or open, all devices in the circuit will turn off. The amount of current in a circuit depends on the number of devices in the circuit. Adding devices to a series circuit adds resistance to the total circuit. In the figure above, the circuit on the left has one lightbulb. The bulb glows brightly. The middle image shows what happens when a second bulb is added to the circuit. Greater resistance reduces the current, and the bulbs glow more dimly.

Ohm's law states that when resistance increases and voltage remains the same, there is less current in the circuit. Because a string of holiday lights contains so many devices, the current through the circuit is low. The low current produces little thermal energy, making these lights safer.

Parallel Circuit—Multiple Current Paths

If the electrical devices in your home were connected as series circuits, you would need to turn on every electrical device just to watch TV. Luckily, devices in your home are connected to an electric source as a **parallel circuit**—*an electric circuit with more than one path, or branch, for an electric current to follow*.

If one branch of a parallel circuit is open, current continues through the other branches. As a result, when the TV is off, the kitchen light and refrigerator stay on.

Visual Check

5. Assess What happens if one of the wires breaks or is cut?

Reading Check

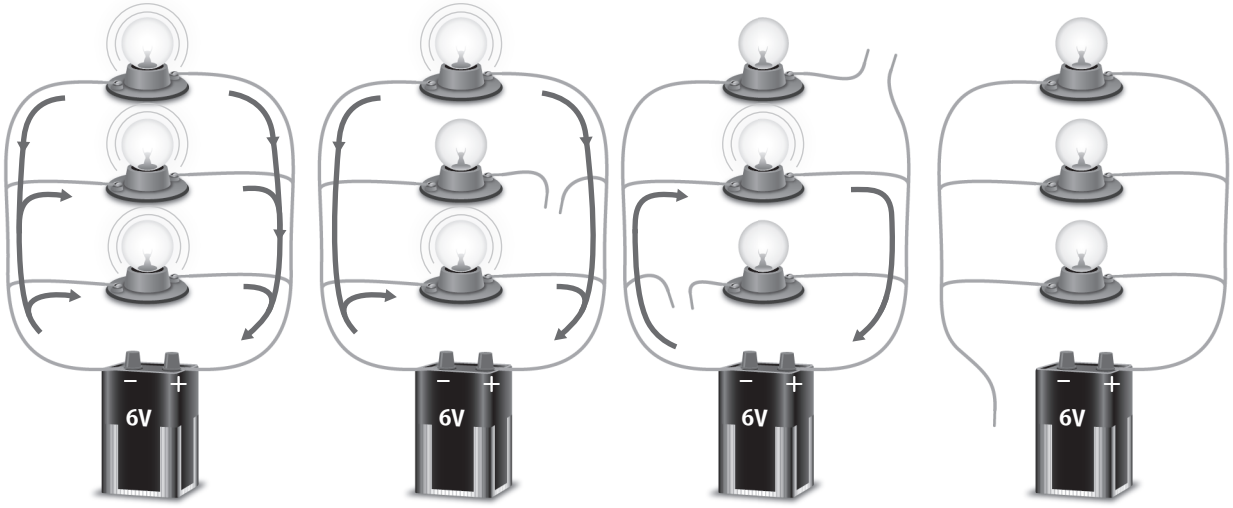
6. Analyze Why are parallel circuits used for devices in most homes?

Parallel Circuit

In a parallel circuit, each device has its own path through which current can flow.

If any of the paths of a parallel circuit is broken, current still can flow through the other devices.

However, if the circuit is open at the source of electric energy, no current can flow through any of the devices.



Visual Check

7. Analyze Why won't current flow when the circuit is open at the source?

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Key Concept Check

8. Contrast How do the two types of electric circuits differ?

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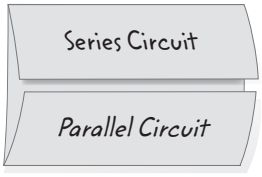
FOLDABLES®

Make a small vertical shutterfold book to illustrate and explain the different types of circuits.



The figure above shows a parallel circuit. Each device connects to the source with its own branch. The current in one branch has no effect on the current in other branches. However, adding branches to a parallel circuit does increase the total current through the source.

Electric Circuits in the Home

Large power plants generate the electric energy used in most homes and businesses. These power plants may be many kilometers away. A system of transmission wires carries the electric energy to all parts of the country.

Electric energy comes to your home through a main wire. The main wire travels through an electric meter. The meter measures the energy used in the electric circuits of your home. From the meter, the wire enters your house and goes to a box called the main panel. At the main panel, the main wire then divides into the branches of the parallel circuit.

Fuses, Circuit Breakers, and GFCI Devices

Recall that adding branches and devices to a parallel circuit increases the current through the source. Excess current can cause a circuit to get hot enough to cause a fire.

Fuses and Circuit Breakers The branches of a parallel circuit include either fuses or circuit breakers as safety devices to prevent disasters. They automatically open a circuit if the current becomes dangerously high. A fuse is a piece of metal that melts and breaks a circuit when a high current produces too much thermal energy. A circuit breaker is a switch that opens the circuit when the current is too great.

GFCIs Do any electric outlets in your home have two small buttons labeled *test* and *reset*? Those outlets are *ground-fault circuit interrupters* (GFCI). A GFCI protects you from electric shock. Imagine you are in the bathroom using a hair dryer. Then, accidentally, water is splashed on you and the hair dryer. Because water is an electric conductor, some of the electric current from the outlet flows through you and not through the hair dryer. This could be fatal. The GFCI senses that not all of the current is flowing through the hair dryer. It opens the circuit and stops the current, reacting as quickly as $\frac{1}{30}$ of a second.

Electric Safety

An electric shock can be painful—and sometimes deadly. Each year, more than 500 people die by accidental electric shock in the United States.

What causes an electric shock?

An electric current follows the path of least electric resistance to the ground. That path could be through any good electric conductor, such as metal, water, or your body. An electric shock occurs when an electric current passes through the human body. If you touch a bare electric wire or a faulty appliance while you are grounded, an electric current could pass through you to the ground, resulting in a dangerous shock.

Current as small as 0.01 A can produce a painful shock. More than 0.1 A of electric current can cause death. The voltage of household electric devices can cause dangerous amounts of current to pass through the body.

How can you be safe?

To help protect yourself from a deadly electric shock:

- Never use electric devices with damaged power cords.
- Stay away from water when using electric devices that are plugged into an outlet.
- Avoid using extension cords and never plug more than two home appliances into an outlet at once.
- Never allow any object that you are touching, such as a kite string or a ladder, to contact electric power lines.
- Do not touch anyone or anything that is touching a fallen electric wire.
- Never climb utility poles or fences that enclose electric power equipment.

Reading Check

9. Define What is a ground-fault circuit interrupter?

Reading Check

10. Describe Why is your body a good conductor?

Reading Check

11. Relate What measure of current can cause an electric shock?

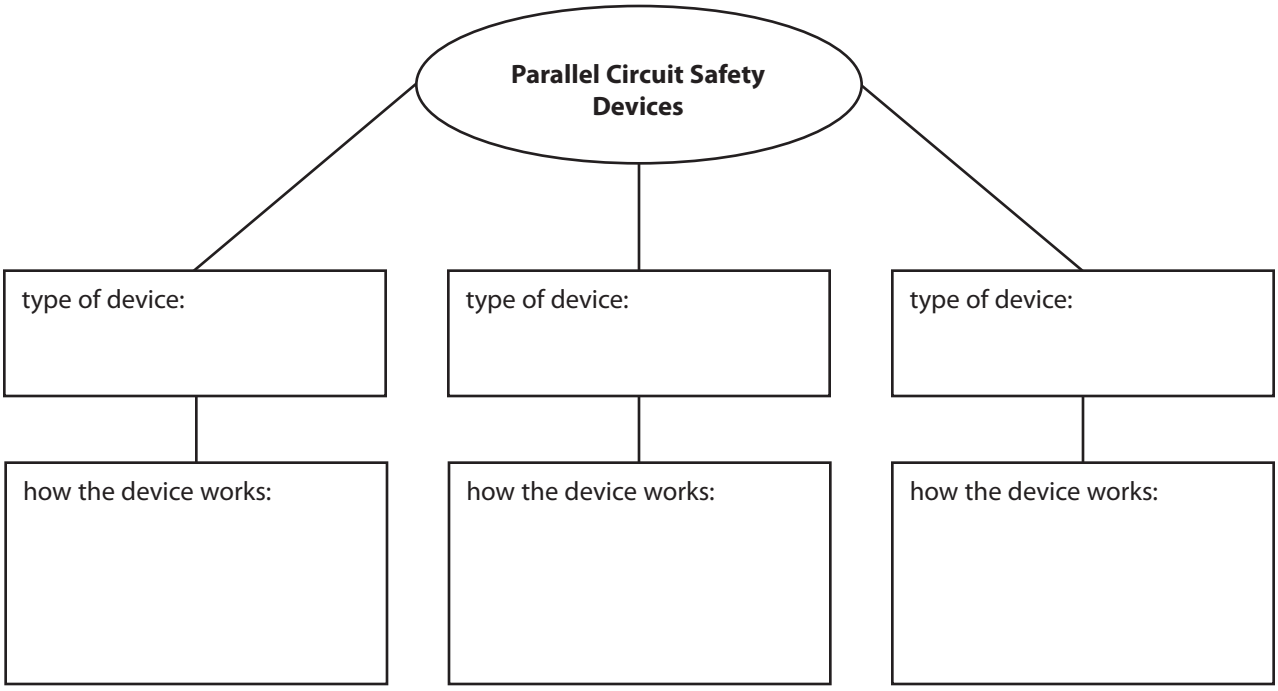
Mini Glossary

parallel circuit: an electric circuit with more than one path, or branch, for an electric current to follow

series circuit: an electric circuit with only one path for an electric current to follow

1. Review the terms and their definitions in the Mini Glossary. Write a sentence that describes how a series circuit works.

2. In the graphic organizer, name the types of parallel circuit safety devices and describe how each one works.



3. Use the phrases you highlighted to discuss electric safety.

What do you think NOW?

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?

Connect ED

Log on to ConnectED.mcgraw-hill.com and access your textbook to find this lesson's resources.

END OF LESSON