Circuit Diagrams

- What is included in a circuit diagram?
- Circuit diagrams use symbols to represent parts of a circuit, including a source of electrical energy and devices that are run by the electrical energy.

Circuit Diagrams

An **electric circuit** is a complete path through which charge can flow.

- A circuit diagram shows one or more complete paths in which charge can flow.
- Arrows show the direction of current, from positive to negative. The direction of current is defined as the direction in which positive charges would flow, but electrons flow in the opposite direction.

Series Circuits

- How do series and parallel circuits differ?
- If one element stops functioning in a series circuit, none of the elements can operate.
- If one element stops functioning in a parallel circuit, the rest of the elements still can operate.

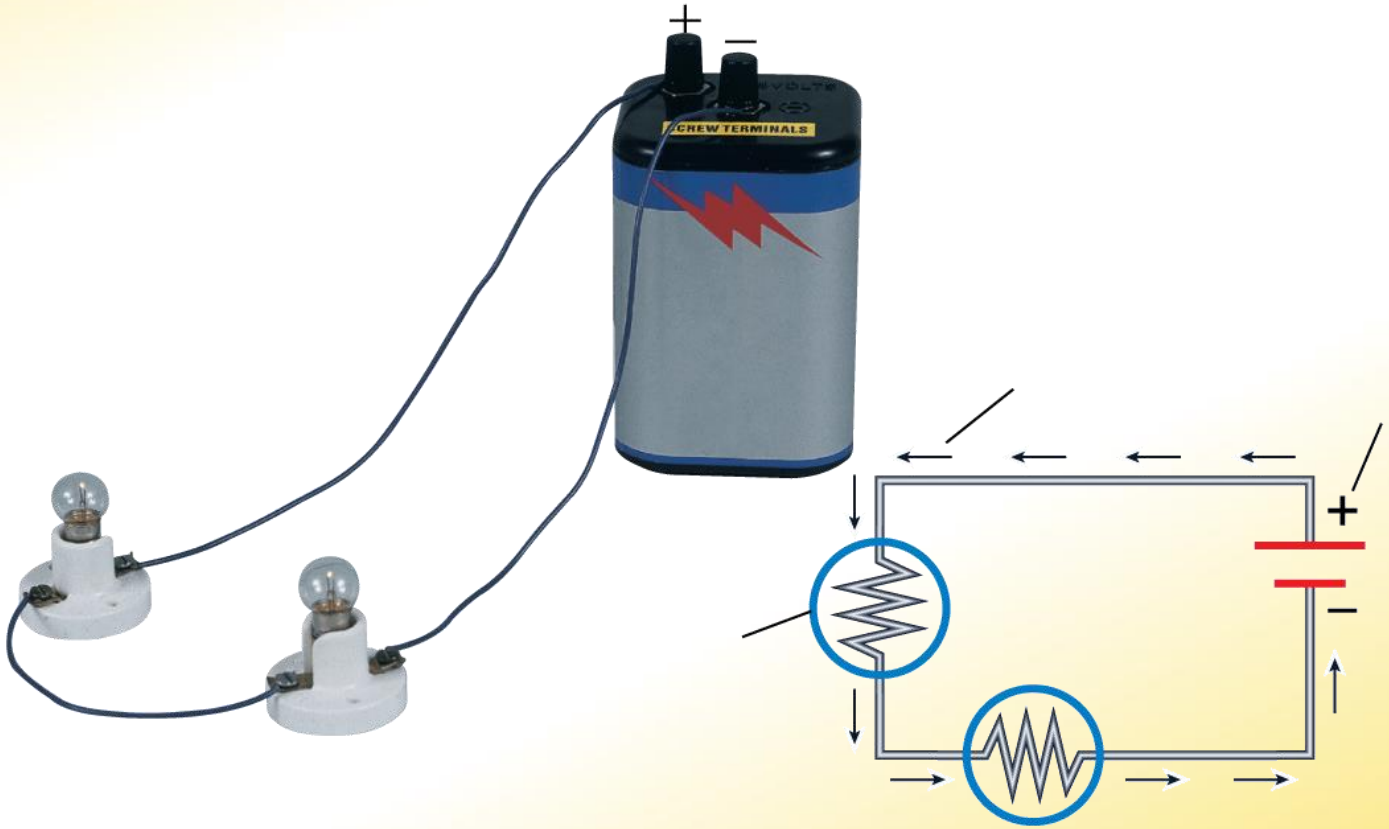
Series Circuits

In a **series circuit,** charge has only one path through which it can flow.

- If one bulb burns out in a series circuit, it becomes an open circuit.
- The bulbs in a circuit are a source of resistance. Adding bulbs to a series circuit increases the resistance. The current decreases, and each bulb shines less brightly.

Series Circuits

A series circuit has one path that each charge can follow.



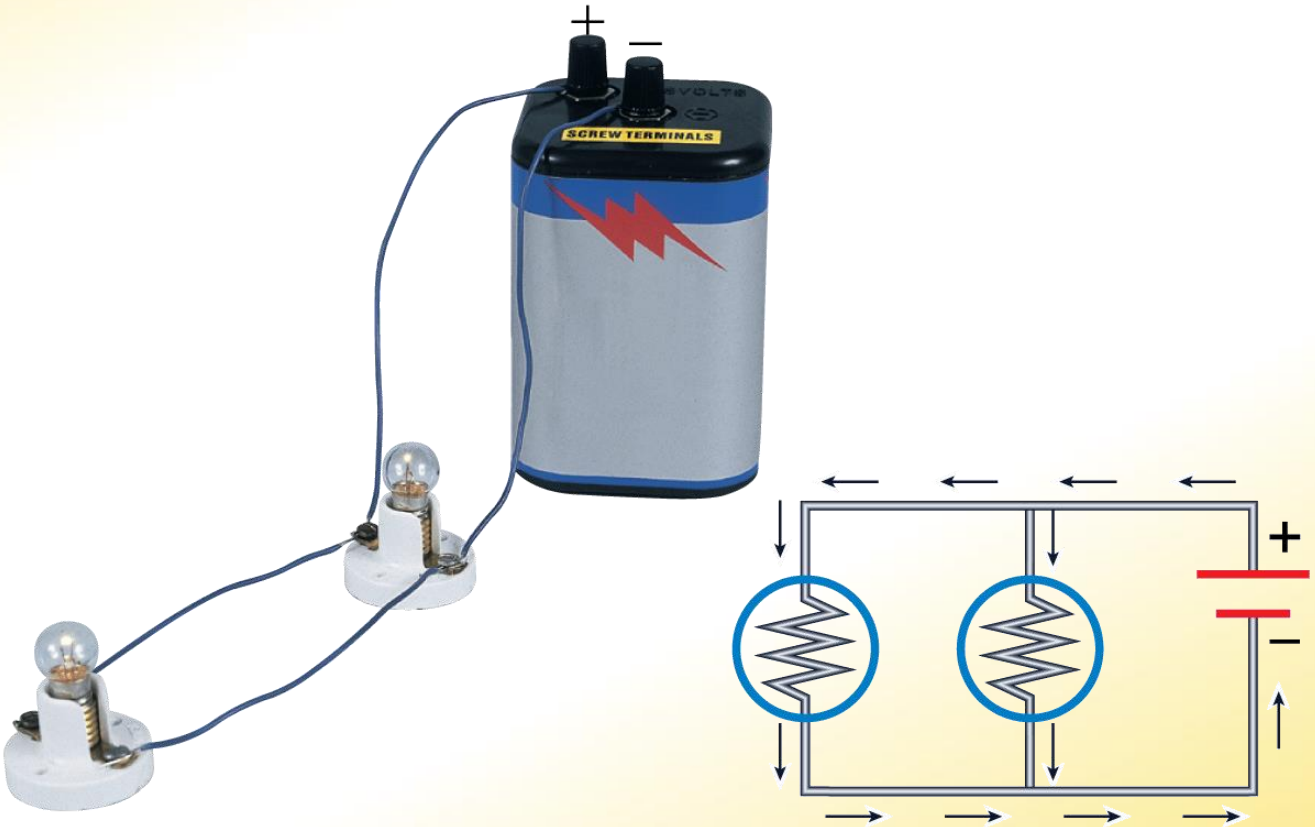
Parallel Circuits

A **parallel circuit** is an electric circuit with two or more paths through which charges can flow.

- If one bulb in a parallel circuit burns out, charge still flows along the other path, and the other bulb stays lit.
- In a home, electric circuits are wired in parallel so they can operate independently.

Parallel Circuits

A parallel circuit has more than one path each charge can follow.



Power and Energy Calculations

- **How do you calculate electric power and electrical energy use?**
- **Electric power can be calculated by multiplying voltage by current.**

Power and Energy Calculations

The rate at which electrical energy is converted to another form of energy is **electric power.** Recall that power is the rate of doing work.

The unit of electric power is the joule per second, or watt (W). Power often is measured in thousands of watts, or kilowatts (kW).

Power

$$P = V \times I$$

Power and Energy Calculations

Math Practice

1. A clothes dryer uses about 27 amps of current from a 240-volt line. How much power does it use?

Answer:

$P = I \times V = (240\ \text{V})(27\ \text{A}) = 6500\ \text{W}$

Power and Energy Calculations

Math Practice

2. A camcorder has a power rating of 2.3 watts. If the output voltage from its battery is 7.2 volts, what current does it use?

Answer:

$I = P/V = (2.3\ \text{W})/(7.2\ \text{V}) = 0.32\ \text{A}$

Power and Energy Calculations

Math Practice

3. A power tool uses about 12 amps of current and has a power rating of 1440 watts. What voltage does the tool require?

Answer:

$V = P/I = (1440\ \text{W})/(12\ \text{A}) = 120\ \text{V}$

Power and Energy Calculations

An appliance's power rating lets you know how much power it uses under normal conditions. An electric stove uses about 6000 watts, and a microwave oven uses about 1000 watts.

Find the electrical energy used by an appliance by multiplying power by time.

Electrical Energy

$$E = P \times t$$

Electrical Safety

- What devices make electricity safe to use?
- Correct wiring, fuses, circuit breakers, insulation, and grounded plugs help make electrical energy safe to use.

Electrical Safety

Correct wiring is not enough to prevent electrical accidents.

Most household circuits usually have an average voltage of 120 volts. Each device that is turned on increases the current. If the current exceeds the circuit's safety limit, the wire may overheat.

Electrical Safety

Home Safety

A **fuse** prevents current overload in a circuit. A wire in the center of the fuse melts if too much current passes through it.

A **circuit breaker** is a switch that opens when current in a circuit is too high. The circuit breaker must be reset before the circuit can be used again.

Electrical Safety

Insulation also prevents short circuits.

A three-prong plug can prevent shocks caused by short circuits. If a short circuit develops, the current takes an easier path to ground through the grounding wire.

The transfer of excess charge through a conductor to Earth is called **grounding.**

Electrical Safety

A ground-fault circuit interrupter (GFCI) is an electrical safety outlet. It monitors current flowing to and from an outlet or appliance.

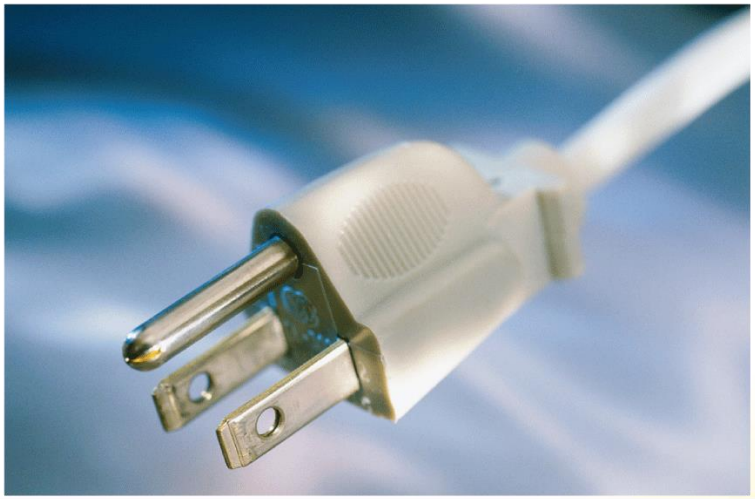
If these two currents are not equal, it means current is escaping.

The GFCI opens the circuit to prevent serious electric shocks.

Electrical Safety

Even a small current in your body can cause a painful shock or injury.

Ground-fault circuit interrupter (GFCI)



Effect of Current on Human Body	
Current Level	**Effect**
1 mA	Slight tingling sensation
5 mA	Slight shock
6–30 mA	Painful shock; loss of muscular control
50–150 mA	Extreme pain; severe muscular contractions. Breathing stops; death is possible.
1000–4300 mA	Nerve damage; heart stops, death is likely.
10,000 mA	Severe burns; heart stops, death is probable.

Assessment Questions

1. A number of light bulbs are connected to an energy source in a series circuit. What will happen to the other bulbs if one of the bulbs burns out?

   a. Nothing will happen.
   b. They will be brighter.
   c. They will be dimmer.
   d. They will turn off.

   ANS: D

Assessment Questions

2. A pair of 15-watt computer speakers are connected to a 12-volt power supply. What is the electric current running through the speakers?

   a. 0.8 A
   b. 1.25 A
   c. 12.5 A
   d. 180 A

   ANS: B

Assessment Questions

3. A ground-fault circuit interrupter is a switch that opens to prevent overheating when the current in a circuit is too high.

True
False

ANS: F, circuit breaker