Summary

THE BIG IDEA **Any path along which electrons can flow is a circuit.**

35.1 A Battery and a Bulb

In a flashlight, when the switch is turned on to complete an electric circuit, the mobile conduction electrons already in the wires and the filament begin to drift through the circuit.

- There must be a complete path, or **circuit,** for a bulb in a simple circuit to light.
- In a simple circuit, electrons flow from the negative part of a battery through a wire or foil to the side (or bottom) of a bulb, through a filament inside the bulb, and out the bottom (or side) and through the other piece of wire or foil to the positive part of the battery. The current then passes through the interior of the battery to complete the circuit.

35.2 Electric Circuits

For a continuous flow of electrons, there must be a complete circuit with no gaps.

- A gap is usually provided by an electric switch that can be opened or closed to either cut off or allow electron flow.
- When connected **in series,** the devices in a circuit form a single pathway for electron flow between the terminals of the battery, generator, or wall socket. When connected **in parallel,** the devices form branches, each of which is a separate path for the flow of electrons.

35.3 Series Circuits

If one device fails in a series circuit, current in the whole circuit ceases and none of the devices will work.

- In a **series circuit,** devices are arranged so that charge flows through each in turn.
- The current passing through each device in a series circuit is the same.
- In a series circuit, the total resistance to current is the sum of the individual resistances along the circuit path.
- The current in a series circuit is numerically equal to the voltage supplied by the source divided by the total resistance. This is Ohm's law. Ohm's law also applies separately to each device.
- The *voltage drop*, or potential difference, across each device connected in series depends directly on its resistance. The total voltage across a series circuit divides among the individual devices.

35.4 Parallel Circuits

In a parallel circuit, each device operates independent of the other devices. A break in any one path does not interrupt the flow of charge in the other paths.

- In a **parallel circuit,** each electric device is connected to the same two points of the circuit. The voltage is therefore the same across each device connected in parallel.
- The total current in a parallel circuit divides among the branches. Ohm's law applies separately to each branch.
- The overall resistance of a parallel circuit is less than the resistance of any one of its branches.

35.5 Schematic Diagrams

In a schematic diagram, resistance is shown by a zigzag line, and ideal resistance-free wires are shown with solid straight lines. A battery is represented with a set of short and long parallel lines.

- Electric circuits are frequently described by simple diagrams, called **schematic diagrams,** using special symbols to represent certain circuit elements.

35.6 Combining Resistors in a Compound Circuit

The equivalent resistance of resistors connected in series is the sum of their values. The equivalent resistance for a pair of equal resistors in parallel is half the value of either resistor.

- The *equivalent resistance* of a circuit with several resistors is the value of a single resistor that would comprise the same load to the battery or power source.
- The equivalent resistance for a pair of 1-ohm resistors in series is 2 ohms.
- The equivalent resistance for a pair of 1-ohm resistors in parallel is 0.5 ohm.

35.7 Parallel Circuits and Overloading

To prevent overloading in circuits, fuses or circuit breakers are connected in series along the supply line.

- Electric current is usually fed into a home by wires called lines, which supply 110–120 V. This voltage is applied to devices that are connected in parallel by plugs to these lines.
- As more devices are connected to the lines, more pathways are provided for current. The combined resistance of the circuit is thereby lowered, and a greater amount of current occurs in the lines. Lines that carry more than a safe amount of current are said to be *overloaded*.
- When insulation that separates the wires in a circuit wears away and allows the wires to touch, the path of the circuit is shortened. This is called a short circuit, and it can draw a dangerously large current.