Chapter 11 Electric Circuits

What You Will Learn

In this chapter, you will learn how to...

- **identify** electrical quantities and their units, and measure these quantities in an operating circuit
- use analogies to **explain** the concepts of electric current, potential difference, and resistance in a simple circuit
- **draw** circuit diagrams and **explain** the function of each component

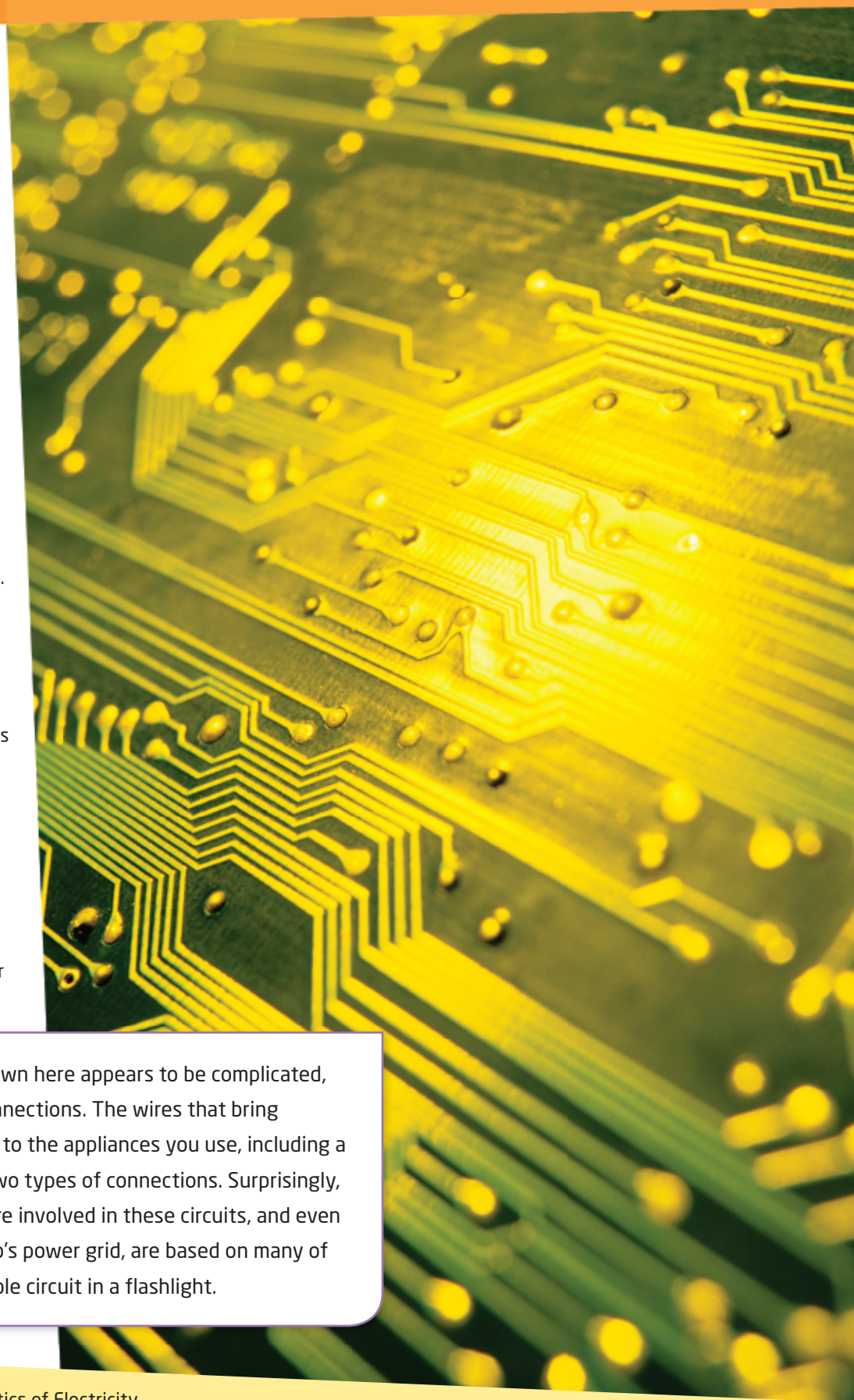
Why It Matters

The electrical technology that is used in common appliances, such as a refrigerator, and portable devices, like a cellphone, depends on controlling the energy that is carried by electrons.

Skills You Will Use

In this chapter, you will learn how to...

- **describe** the operation, properties, and applications of cells and batteries
- **analyze** how adding a load in series and in parallel affects a circuit
- **investigate** the relations between and **solve** problems about current, potential difference, and resistance in simple circuits
- use circuit diagrams to **design** and **construct** circuits, and measure their electrical properties



Although the circuit board shown here appears to be complicated, it consists of simple circuit connections. The wires that bring electricity into your home and to the appliances you use, including a computer, use no more than two types of connections. Surprisingly, the electrical principles that are involved in these circuits, and even the complex circuits of Ontario's power grid, are based on many of the same concepts as the simple circuit in a flashlight.

Activity 11-1

Shed Light On It

A simple flashlight contains a dry cell to provide electrical energy, an on-off switch, and a light bulb. How are these components connected to operate the flashlight?

Safety Precautions

- If you notice that any wire in the circuit is hot, disconnect the wire from the cell. Inform your teacher.

Materials

- D cell in cell holder
- flashlight bulb in a holder
- switch
- 3 connecting wires
- strip of aluminum foil

Procedure

1. Make sure that the switch is in the open position. Use connecting wires to join the cell, flashlight bulb, and switch.
2. Close the switch. Record the intensity (low, medium, or high) of the bulb.
3. With the switch still closed, unscrew the flashlight bulb from its holder and record what happens to the bulb.
4. Tighten the flashlight bulb into its holder. With the switch closed, remove one of the connecting wires. Record the intensity of the bulb.
5. Use the strip of aluminum foil to replace the connecting wire you removed. Observe the intensity of the bulb, and compare it with its intensity when the wire was used.

Questions

1. Draw a diagram to show the bulb, switch, cell, and connecting wires when the flashlight bulb was glowing.
2. Describe three different ways that you can make a flashlight bulb stop glowing. What do these different ways have in common?
3. How is a strip of aluminum foil similar to a connecting wire?

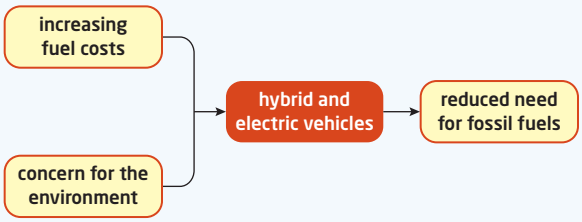
Study Toolkit

These strategies will help you use this textbook to develop your understanding of science concepts and skills.
To find out more about these and other strategies, refer to the Study Toolkit Overview, which begins on page 561.

Organizing Your Learning

Identifying Cause and Effect

Identifying causes and effects can help you understand why things happen. Sometimes, many simultaneous causes lead to an effect, which itself becomes a cause of a second effect. A cause-and-effect map can help you organize such relationships. For example, read the section "Electric and Hybrid Vehicles" on the next page and study the cause-and-effect map below:



Use the Strategy

1. Read the first paragraph of the section titled "Factors That Affect the Resistance of Wires" on page 465.
2. Make a cause-and-effect map showing the relationship between the resistance of two wires made from the same metal, with the same diameter, but with different lengths.

Organizing Your Learning

Comparing and Contrasting

Comparing and contrasting new concepts can help you understand them. Venn diagrams and charts are two ways to organize this information graphically. For example, the chart below shows the differences and similarities between a series circuit and a parallel circuit.

	Differences	Similarities
series circuit	There is *only one* path along which electrons can flow.	Both are closed paths along which electrons that are powered by an energy source can flow.
parallel circuit	There is *more than one* path along which electrons can flow.	

Use the Strategy

1. Create a chart with *resistance* and *load* in the first column.
2. Write the everyday definition for each word in the second column.
3. As you read this chapter, fill in the third column with the scientific definition of each word.

Word Study

Multiple Meanings

Words can have more than one meaning, depending on their context. The chart below shows some words that you may have seen in a non-scientific context. It includes their everyday meanings *and* their scientific meanings, specifically in the context of a unit about electricity.

Use the Strategy

1. Read the text on page 458 titled "Measuring Current and Potential Difference."
2. Make a chart to show the similarities and differences between ammeters and voltmeters.

Word	Everyday Meaning	Scientific Meaning (Physics)
cell	Small room in a prison	A device that converts chemical energy into electrical energy
current	(1) Going on now (2) Water moving in one direction	A flow of electricity
terminal	Building at an airport	Site on a cell that must be connected to other components to form an electric circuit