Chapter 5 Classifying Chemical Reactions

What You Will Learn

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

- **describe** evidence of chemical reactions
- **identify** reactants and products of four reaction types: synthesis, decomposition, single displacement, and double displacement
- **discuss** chemical reactions associated with key environmental concerns

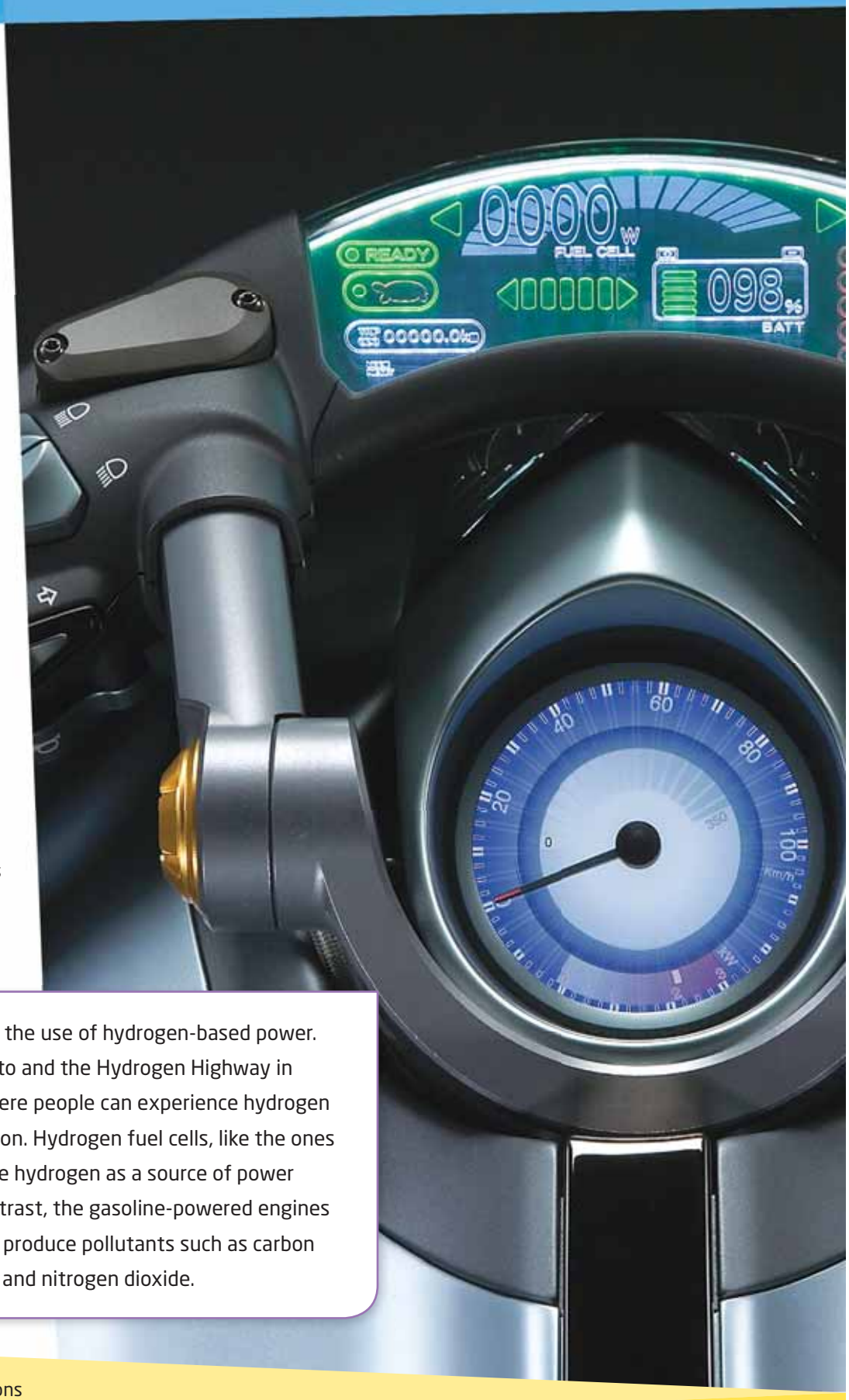
Why It Matters

Reactions provide energy and produce products that you use, but they can also create environmental hazards through toxic by-products. An understanding of chemical reactions is key to minimizing hazards and to developing innovative products for society.

Skills You Will Use

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

- **identify** the evidence of a chemical reaction
- **develop** an activity series for metals
- **investigate** synthesis, decomposition, and displacement reactions



Canada is a leader in exploring the use of hydrogen-based power. The Hydrogen Village in Toronto and the Hydrogen Highway in British Columbia are places where people can experience hydrogen and fuel cell technology in action. Hydrogen fuel cells, like the ones that power this motorcycle, use hydrogen as a source of power and produce only water. In contrast, the gasoline-powered engines that are commonly used today produce pollutants such as carbon monoxide, nitrogen monoxide, and nitrogen dioxide.

Activity 5-1

Foiled Again!

As you know, mass is conserved during a reaction. In this activity, you will observe that some substances appear and others disappear. What is happening to the atoms and ions in the reaction between aluminum and a solution of copper ions and chloride ions?

Aluminum can undergo a reaction with aqueous copper(II) chloride.

Safety Precautions

- Wear safety goggles and a lab apron.
- The materials can become quite hot. Avoid touching the hot liquid or glass. Use a thermal glove.

Materials

- 50 mL of copper(II) chloride solution
- two 250 mL beakers
- aluminum foil
- water
- paper towel
- spoon or other hard object

Procedure

1. Read the procedure, and then create a table to record your observations. Give your table a title.
2. Your teacher will give you about 50 mL of copper(II) chloride solution in a beaker. Crumple a piece of aluminum foil into a ball. Record your observations of the starting materials in your table.
3. Place the foil ball in the solution.
4. When the reaction stops, record your observations of the materials as you allow everything to cool for a minute or so. Pour all the warm liquid into the second beaker, being careful to keep the solids in the first beaker. Rinse the residue out of the first beaker twice with cold water, and pour the rinse water into the second beaker. Dispose of the liquid as directed by your teacher.
5. Pour the residue onto a paper towel, and press out the remaining water. Examine the residue. Press a hard metal object onto the residue, and smear the residue along the paper. Record your observations.

Questions

1. What happened to the colour of the solution? Propose an explanation.
2. What happened to the aluminum? Propose an explanation.

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 560.

Organizing Your Learning

Identifying Cause and Effect

To identify cause-and-effect relationships when you are reading, look for words or phrases that are signals. For example, the phrase *was the result of* signals a cause-and-effect relationship. Other signal words and phrases include

- **Cause X** affects/produces/results in/causes **Effect Y**.
- ... **Cause X**. As a result,/Therefore,/Consequently, **Effect Y**.
- **Effect Y** is a result of/is due to/occurs because of **Cause X**.

Use the Strategy

Read the section titled "Treating Car Exhaust" on page 200. Note three words or phrases that signal cause-and-effect relationships. Write short sentences like those above. Include the signals, and use your own words to fill in the causes and effects.

Reading Effectively

Monitoring Comprehension

As you read, stop periodically to check your comprehension. Place a small sticky note beside each chunk of text. Put a ✓ on the sticky note if you understand what you have just read, and put an ✗ if you do not. For each chunk of text that you *do* understand, restate the main idea. For each chunk of text that you *do not* understand, follow the steps below.

- Reread the chunk of text. Try to identify the part that is confusing you.
- If a word or term is confusing you, check the margin, the Glossary, or a dictionary for a definition.
- If a concept is confusing you, examine the visuals on the page to see if they can help you understand the concept.
- If a formula or definition is confusing you, look for examples in the text that might help you understand.

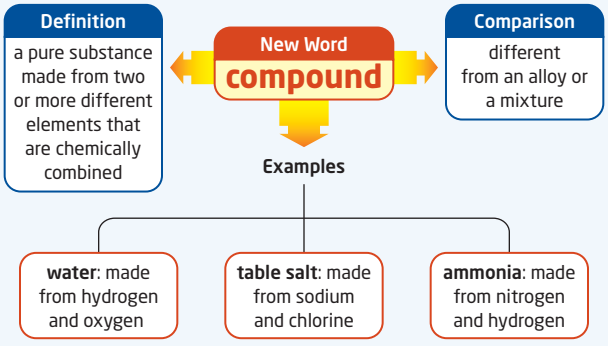
Use the Strategy

Read the material on the next page. Follow the strategy above to check your comprehension.

Word Study

Creating a Word Map

A **word map** like this one can help you grasp the meaning of a new word or concept.



Use the Strategy

As you read this chapter, create a word map for the word *precipitate*. Compare your word map with a partner's word map. If your partner has any information that helps you understand the word better, add this information to your word map.