SECTION 2

READING WARM-UP

Terms to Learn

compound

What You'll Do

- Describe the properties of compounds.
- Identify the differences between an element and a compound.
- Give examples of common compounds.

Compounds

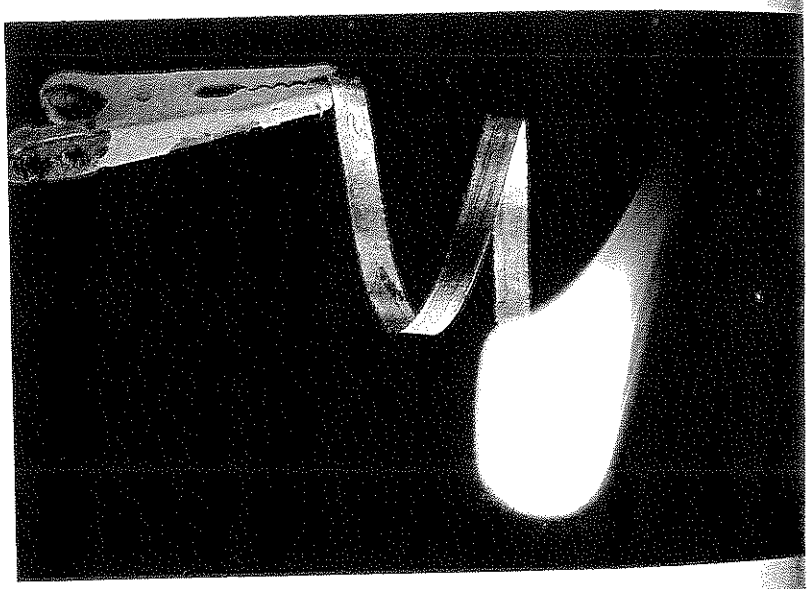
Most elements take part in chemical changes fairly easily, so few elements are found alone in nature. Instead, most elements are found combined with other elements as compounds.

A **compound** is a pure substance composed of two or more elements that are chemically combined. In a compound, a particle is formed when atoms of two or more elements join together. In order for elements to combine, they must *react*, or undergo a chemical change, with one another. In **Figure 6**, you see magnesium reacting with oxygen to form a compound called magnesium oxide. The compound is a new pure substance that is different from the elements that reacted to form it. Most substances you encounter every day are compounds. The table at left lists some familiar examples.

Familiar Compounds

- **table salt**— sodium and chlorine
- **water**— hydrogen and oxygen
- **sugar**— carbon, hydrogen, and oxygen
- **carbon dioxide**— carbon and oxygen
- **baking soda**— sodium, hydrogen, carbon, and oxygen

Figure 6 *As magnesium burns, it reacts with oxygen and forms the compound magnesium oxide.*



Elements Combine in a Definite Ratio to Form a Compound

Compounds are not random combinations of elements. When a compound forms, the elements join in a specific ratio according to their masses. For example, the ratio of the mass of hydrogen to the mass of oxygen in water is always the same—1 g of hydrogen to 8 g of oxygen. This mass ratio can be written as 1:8 or as the fraction 1/8. Every sample of water has the 1:8 mass ratio of hydrogen to oxygen. If a sample of a compound has a different mass ratio of hydrogen to oxygen, the compound cannot be water.

very Compound Has a nique Set of Properties

ch compound has a unique set of properties that allows you distinguish it from other compounds. Like elements, each mpound has its own physical properties, such as boiling nt, melting point, density, and color. Compounds can also identified by their different chemical properties. Some com-unds, such as the calcium carbonate found in chalk, react th acid. Others, such as hydrogen peroxide, react when posed to light. You can see how chemical properties can be d to identify compounds in the QuickLab at right.

A compound has different properties from the elements t form it. Did you know that ordinary table salt is a com-und made from two very dangerous elements? Table salt—dium chloride—consists of sodium (which reacts violently th water) and chlorine (which is poisonous). Together, how-r, these elements form a harmless compound with unique perties. Take a look at **Figure 7.** Because a compound has ferent properties from the elements that react to form it, m chloride is safe to eat and dissolves (without explod-in water.

7 Table salt is formed when the nts sodium and chlorine join. The ties of salt are different from the ties of sodium and chlorine.

dium is a soft, silvery ite metal that reacts lently with water.

Chlorine is a poisonous, greenish yellow gas.

Sodium chloride, or table salt, is a white solid that dissolves easily in water and is safe to eat.

QuickLab

Compound Confusion

1. Measure 4 g (1 tsp) of **compound A,** and place it in a **clear plastic cup.**
2. Measure 4 g (1 tsp) of **compound B,** and place it in a **second clear plastic cup.**
3. Observe the color and texture of each compound. Record your observations.
4. Add 5 mL (1 tsp) of **vinegar** to each cup. Record your observations.
5. Baking soda reacts with vinegar, while powdered sugar does not. Which of these compounds is compound A, and which is compound B?

Self-Check

Do the properties of pure water from a glacier and from a desert oasis differ? *(See page 168 to check your answer.)*

Compounds Can Be Broken Down into Simpler Substances

Some compounds can be broken down into elements through chemical changes. Look at **Figure 8.** When the compound mercury(II) oxide is heated, it breaks down into the elements mercury and oxygen. Likewise, if an electric current is passed through melted table salt, the elements sodium and chlorine are produced.

Other compounds undergo chemical changes to form simpler compounds. These compounds can be broken down into elements through additional chemical changes. For example, carbonic acid is a compound that helps to give carbonated beverages their "fizz," as shown in **Figure 9.** The carbon dioxide and water that are formed can be further broken down into the elements carbon, oxygen, and hydrogen through additional chemical changes.

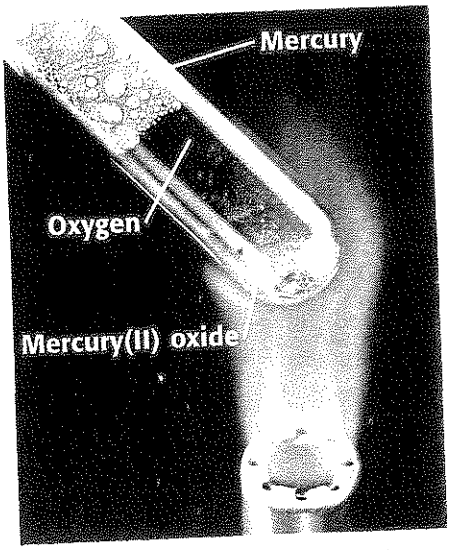


Figure 8 *Heating mercury(II) oxide causes a chemical change that separates it into the elements mercury and oxygen.*

Figure 9 *Opening a carbonated drink can be messy as carbonic acid breaks down into two simpler compounds—carbon dioxide and water.*

Physics CONNECTION

The process of using electric current to break compounds into simpler compounds and elements is known as electrolysis. Electrolysis can be used to separate water into hydrogen and oxygen. The elements aluminum and copper and the compound hydrogen peroxide are important industrial products obtained through electrolysis.

Compounds Cannot Be Broken Down by Physical Change

The only way to break down a compound is through a chemical change. If you pour water through a filter, the water molecules pass through the filter unchanged. Filtration is a physical change, so it cannot be used to break down a compound. Likewise, a compound cannot be broken down by being ground into a powder or by any other physical process.

Compounds in Your World

You are always surrounded by compounds. Compounds make up the food you eat, the school supplies you use, the clothes you wear—even you!

Compounds in Nature Proteins are compounds found in all living things. The element nitrogen is needed to make proteins. Figure 10 shows how some plants get the nitrogen they need. Other plants use nitrogen compounds that are in the soil. Animals get the nitrogen they need by eating plants or by eating animals that have eaten plants. As an animal digests food, the proteins in the food are broken down into smaller compounds that the animal's cells can use.

Another compound that plays an important role in life is carbon dioxide. You exhale carbon dioxide that was made in your body. Plants take in carbon dioxide and use it to make other compounds, including sugar.

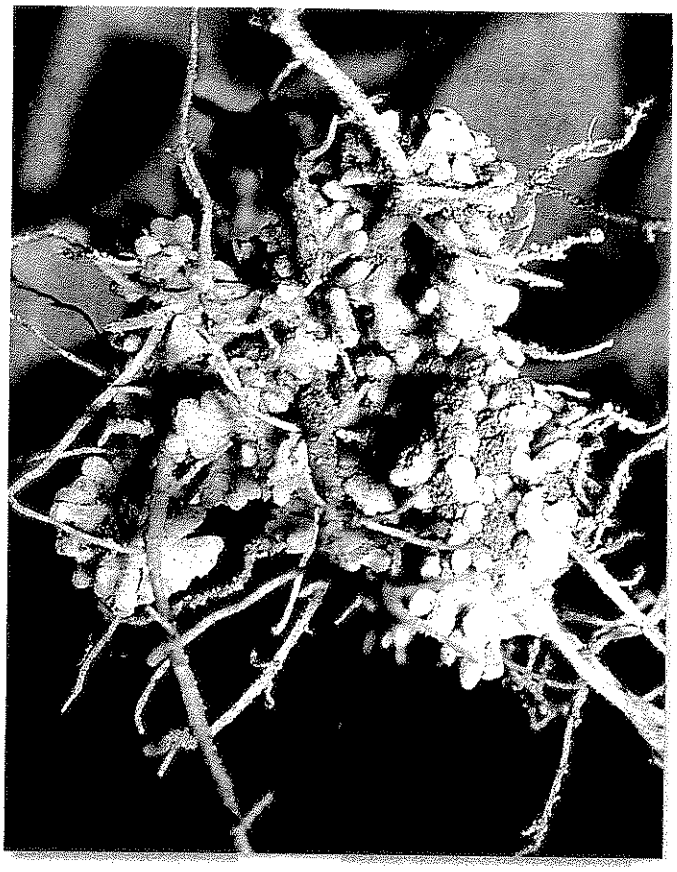


Figure 10 *The bumps on the roots of this pea plant are home to bacteria that form compounds from atmospheric nitrogen. The pea plant makes proteins from these compounds.*

Compounds in Industry The element nitrogen is combined with the element hydrogen to form a compound called ammonia. Ammonia is manufactured for use in fertilizers. Plants can use ammonia as a source of nitrogen for their proteins. Other manufactured compounds are used in medicines, food preservatives, and synthetic fabrics.

The compounds found in nature are usually not the raw materials needed by industry. Often, these compounds must be broken down to provide elements used as raw material. For example, the element aluminum, used in cans, airplanes, and building materials, is not found alone in nature. It is produced by breaking down the compound aluminum oxide.

SECTION REVIEW

1. What is a compound?
2. What type of change is needed to break down a compound?
3. **Analyzing Ideas** A jar contains samples of the elements carbon and oxygen. Does the jar contain a compound? Explain.

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