

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What are compounds?
- What is a chemical reaction?
- How are compounds used in everyday life?

National Science Education Standards
PS 1a, 1c

What Are Compounds?

Look around the classroom. Most of the things you see are not made of just one element. Instead, they are made of elements combined with other elements. A **compound** is a pure substance composed of two or more elements that are joined by chemical bonds. The figure below shows some compounds that you might find in your kitchen and what elements make up the compounds. ✓

Familiar Compounds

Compound	Elements in the compound
Table salt	sodium and chlorine
Water	hydrogen and oxygen
Sugar	hydrogen, carbon, and oxygen
Carbon dioxide	carbon and oxygen
Baking soda	sodium, hydrogen, carbon, and oxygen

RATIO OF ELEMENTS IN A COMPOUND

Elements join in a specific ratio according to their masses to form a compound. For example, in 18 g of water, there are 2 g of hydrogen and 16 g of oxygen. The mass ratio of oxygen to hydrogen is $\frac{2\text{ g}}{16\text{ g}}$ or $\frac{1}{8}$. The mass ratio is written as 1 to 8 or 1:8. Every sample of water has a 1:8 mass ratio of hydrogen to oxygen. What happens if a compound has a different mass ratio of hydrogen to water? The compound cannot be water.

Sometimes the same two elements can join in different ratios. However, two different compounds are formed. For example, carbon and oxygen can join to form carbon monoxide, CO, and can also form carbon dioxide, CO₂. Carbon dioxide forms when there is lots of oxygen present.

STUDY TIP

Asking Questions Read this section silently. In your notebook, write down questions that you have about this section. Discuss your questions in a small group.

READING CHECK

1. Describe What is a compound?

Math Focus

2. Determine A compound has 40 g of calcium and 160 g of bromine. What is the mass ratio of calcium to bromine in the compound?

SECTION 2 Compounds *continued***What Properties Do Compounds Have?**

Compounds, just like elements, have physical and chemical properties. Some physical properties of compounds are melting point, boiling point, density, and color. The table below shows some of the physical properties of three colorless liquids. These properties can be used to tell them apart, even though the three compounds look alike in a container.

Critical Thinking

3. Analyze Data How can you tell from the table that all of the compounds listed are liquids at room temperature?

TAKE A LOOK

4. Identify What element is part of both of the compounds on the table that are not flammable?

READING CHECK

5. Identify How do the properties of a compound compare to the properties of its elements?

Physical Properties

	Melting point (°C)	Boiling point (°C)	Odor	Density (g/mL)
Chloroform	-64	61	strong	1.48
Ethanol	-114	75	mild	0.79
Water	0	100	none	1.00

Chemical properties can also be used to identify compounds. Compounds may change when they are exposed to other chemicals or to heat or light. These are chemical properties. The table below shows how the chemical properties of three common white solids differ.

Chemical Properties

	Reacts with acid	Flammable
Sodium chloride (salt)	no	no
Sucrose (sugar)	no	yes
Sodium bicarbonate (baking soda)	yes	no

The properties of a compound differ from those of its elements. Sodium chloride is made of two very reactive and toxic elements—sodium and chlorine. Sodium is a metal that reacts violently with water and can cause damage if it touches skin. Chlorine is a poisonous gas. The combination of the two elements makes sodium chloride. Sodium chloride, or table salt, is safe to eat. ✓

SECTION 2 Compounds *continued*

How Can Compounds Be Broken Down?

Some compounds can be broken down into their elements by applying heat or using electricity. In the figure below, mercury oxide breaks down to form mercury and oxygen.



When mercury oxide is heated, it undergoes a chemical change in which it separates into the elements mercury and oxygen.

TAKE A LOOK

6. Identify What is used to break down the mercury oxide into mercury and oxygen?

What Are Some Important Compounds?

You are surrounded by compounds. Compounds make up the food you eat, the school supplies you use, and the clothes you wear.

COMPOUNDS IN INDUSTRY

Aluminum is an element used in making cans and airplanes. However, aluminum is not found in nature. Aluminum is produced by breaking down the compound aluminum oxide that is found in nature.

Ammonia is another important compound used in industry. It is used to make fertilizers. Ammonia is made by combining nitrogen and hydrogen.

COMPOUNDS IN NATURE

Proteins are compounds found in all living things. The element nitrogen is needed to make proteins. Plants get the nitrogen they need from the soil. Animals get the nitrogen they need by eating plants or other animals that eat plants. The proteins in food are broken down as an animal digests the food. The simpler compounds formed are used by the animal's cells to make the proteins needed by the animal.

Another compound that is important for life is carbon dioxide. You exhale carbon dioxide that was made in your body. Plants take in carbon dioxide, which is used in photosynthesis. Plants use photosynthesis to make compounds called carbohydrates. These carbohydrates can then be broken down for energy by plants and animals.

STANDARDS CHECK

PS 1c Chemical elements do not break down during normal laboratory reactions involving such treatments as heating, exposure to electric current, or reaction with acids. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances that we encounter.

7. Identify What are two types of compounds found in nature?

Section 2 Review

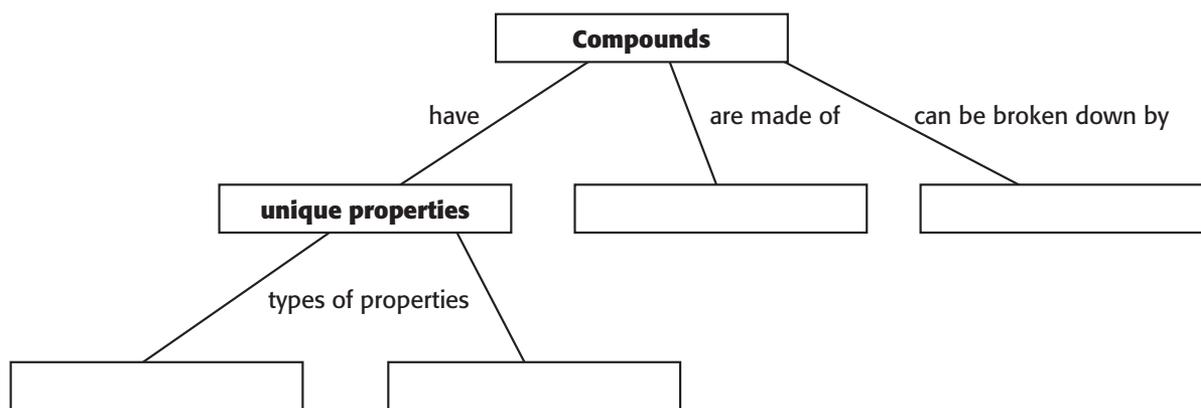
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SECTION VOCABULARY

compound a substance made up of atoms of two or more different elements joined by chemical bonds

1. Explain How do the particles of a compound differ from the particles of an element?

2. Organize Fill in the knowledge web below with words from this section.



3. Draw Conclusions A label for a plant is made of copper. When it is first put in a garden, it is bright and shiny. After a few months, the label has a dull, greenish color. When you rub your finger over the surface, some soft material rubs off. What happened to the copper?

4. Identify What are two types of energy used to break down compounds?

5. Determine A compound has 39 g of potassium and 78 g of selenium. What is the mass ratio of potassium to selenium in the compound?
