

## CHAPTER 5 Elements, Compounds, and Mixtures

## SECTION

## 2

## Compounds

**BEFORE YOU READ**

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

- What are compounds made of?
- What happens during a chemical reaction?
- Are the properties of compounds like the properties of the elements used to make them?



California Science Standards

8.3.b, 8.5.a, 8.7.c

## What Are Compounds?

Most elements take part in chemical changes fairly easily, so they are rarely found in pure form in nature. Instead, they are found combined with other elements in compounds. A **compound** is a pure substance composed of two or more elements that are chemically combined. The figure below shows some compounds that you might find in your kitchen and what elements make up those compounds. ✓

### Familiar Compounds

Compound	Elements combined
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

A chemical change, or reaction, happens when one or more substances are changed into one or more other substances. During a chemical reaction, new substances form because atoms are rearranged. The properties of a compound can be very different from those of its elements. For example, water is made of hydrogen and oxygen. Both are gases at room temperature. Water is a liquid at room temperature. ✓

In some chemical reactions, two or more elements combine to form a compound. In other chemical reactions, a compound can be separated into elements or simpler compounds. Still other reactions involve changing compounds into other compounds. In all cases, though, different materials exist after the reaction occurs.

**STUDY TIP**

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

**READING CHECK**

**1. Describe** What is a compound?

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**READING CHECK**

**2. Compare** How do the properties of a compound compare with those of its elements?

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**SECTION 2** Compounds *continued*

## What Properties Do Compounds Have?

Just as each element has physical and chemical properties, each compound has characteristic properties. Physical properties of compounds include 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.

### Physical Properties

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

Chemical properties can be used to identify compounds, too. Chemical properties include changes that occur when compounds are exposed to other chemicals or to heat or light. The figure below shows how the chemical properties of three common white solids differ.

### Chemical Properties

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

The properties of a compound differ, not only from those of other compounds, but also 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 results in sodium chloride. Sodium chloride, or table salt, is safe to eat.

## Critical Thinking

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

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## TAKE A LOOK

**4. Identify** What element is part of both of the non-flammable compounds in the table?

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### CALIFORNIA STANDARDS CHECK

**8.5.a** Students know reactant atoms and molecules interact to form products with different chemical properties.

**Word Help:** interact to act upon one another

**5. Identify** Give one property of sodium chloride that is not a property of sodium or chlorine.

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**SECTION 2** Compounds *continued***How Can I Tell Two Compounds Apart?**

You can tell one compound from another because every compound has a unique set of properties. This means that a compound can be identified by measuring or observing some of its properties. These properties are different for different compounds. ✓

Suppose you are given two white powders and told that one is powdered sugar and the other is baking soda. You must identify which is sugar without tasting it. How can you do this? Knowing that baking soda will fizz in an acid like vinegar, but sugar will not, gives you a way to identify the sugar.

You can put each powder into a beaker. Then, add some vinegar to each beaker. The powder that fizzes is the baking soda. ✓

**Do Elements Always Combine in the Same Way to Make Compounds?**

You may have heard that carbon monoxide is a poisonous gas and that plants use carbon dioxide to make oxygen. How are these compounds different? Carbon monoxide has one carbon atom combined with one oxygen atom. Carbon dioxide has one carbon atom combined with two oxygen atoms.

The properties of a compound depend on which elements combine and how much of each element is in the compound. It is similar to making words from letters. The same letters can be combined to make the words “hose” and “shoe,” but the words are different.

**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 forms mercury and oxygen.



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

 **READING CHECK**

**6. Identify** How can a compound be identified?

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 **READING CHECK**

**7. Describe** What chemical property of baking soda can be used to identify it from sugar?

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 **Say It**

**Discuss** The paragraph to the left compares elements to letters of the alphabet. In small groups, discuss other comparisons that can help you better understand how compounds differ from one another.

**TAKE A LOOK**

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

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# Section 2 Review

8.3.b, 8.5.a, 8.7.c 

## SECTION VOCABULARY

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

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

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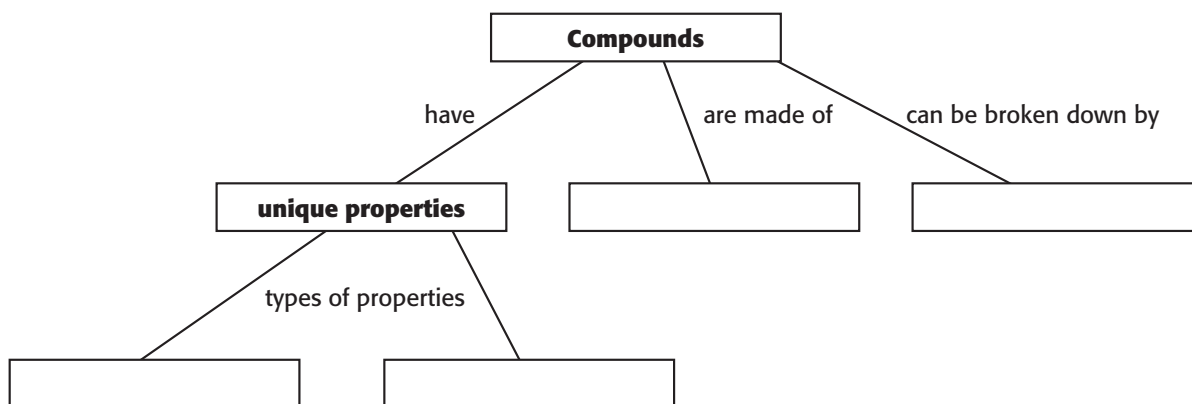


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**2. Organize** Fill in the Knowledge Web below with words from this section.



**3. Draw Conclusions** A plant label made of copper is bright and shiny when it is placed in the garden. 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 has happened to the copper?

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**4. Analyze Ideas** If a piece of pure iron is placed in pure nitrogen, nothing happens. If the iron is exposed to air, it begins to rust. What conclusion can you make about air, based on this observation?

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