Name _____ Class _____ Date _____

CHAPTER 2 Matter
SECTION 1

Classifying Matter

KEY IDEAS

As you read this section, keep these questions in mind:

- How can matter be classified?
- Why are elements and compounds considered pure substances?
- How are elements and compounds different from mixtures?

What Is Matter?

This book, a pencil, a piece of paper, and even you are made of matter. In fact, anything that you can hold or touch is made of matter. **Matter** is anything that has both mass and volume. *Mass* consists of all the particles that make up an object. *Volume* is how much space the object occupies. ☑

Some things you cannot see are matter. For example, you cannot see air, but because it has both mass and volume, it is matter. Some things you can see, however, are not matter. For example, light is not matter even though you can see it. Why isn't light matter? It does not have mass or volume.

MATTER AND CHEMISTRY

Chemistry is the branch of science that studies matter and its changes. Chemists study the particles that make up matter. They also study what happens to these particles as they interact with one another. Chemists often use the knowledge they gain to develop new products for consumers such as you. Almost everything that you use in daily life involves chemistry. This includes foods, soaps, clothing, and compact discs (CDs).

READING TOOLBOX

Compare After you read this section, make a Venn diagram to show the similarities and differences between elements, compounds, and mixtures.

READING CHECK

1. Identify What two properties does all matter have?

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LOOKING CLOSER

2. Explain What can you see in this picture that is not matter? Explain your answer.

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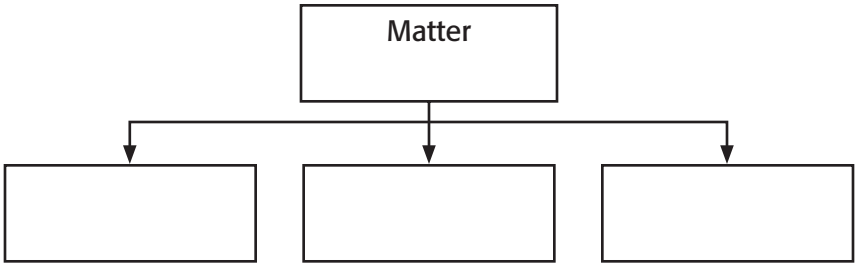
CLASSIFYING MATTER

To *classify* something is to place it into a specific group. All members in the group share certain features. For example, the CDs in a music store are classified into groups such as rock, classical, and jazz. Like CDs, matter is classified into different groups.

Matter can be classified in several ways. One of the most common ways scientists group matter is based on what makes it up. Every sample of matter is either an element, a compound, or a mixture. Gold and oxygen are examples of elements. Water and sugar are examples of compounds. Vinegar and brass are examples of mixtures.

LOOKING CLOSER

3. Complete Fill in the graphic organizer to show the three main groups of matter.



What Is an Element?

Gold and oxygen are classified as elements. An **element** is a substance that cannot be separated or broken down into simpler substances. An element is made of only one kind of atom. An **atom** is the smallest unit of an element that has the chemical properties of that element.

Critical Thinking

4. Identify Relationships How are atoms and molecules related?

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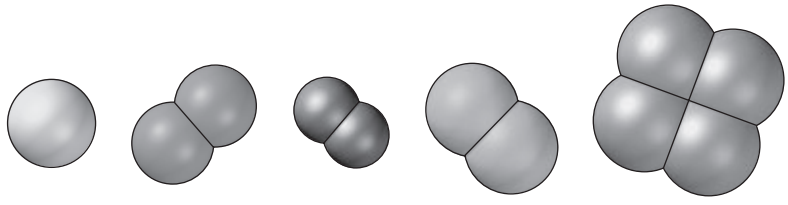
Some elements exist as single atoms. Helium, an element often used to fill balloons, exists as a single atom. Other elements exist as combinations of more than one atom known as molecules. A **molecule** is a combination of two or more atoms that are combined in a definite ratio. For example, a molecule of water has two hydrogen atoms and one oxygen atom. The ratio of hydrogen atoms to oxygen atoms in water is always 2:1.

Each of these molecules is made up of atoms of the same element. Many molecules are made of two or more different elements.



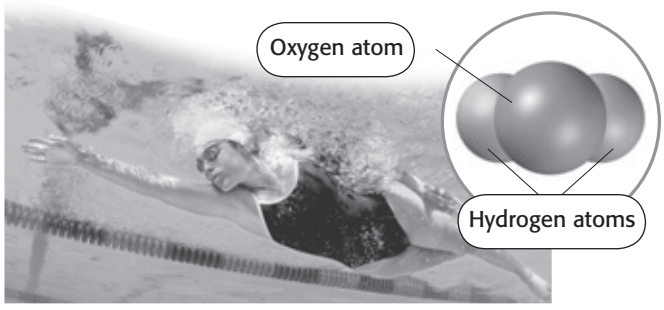
Neon Oxygen Hydrogen Chlorine Phosphorus

ELEMENT SYMBOLS

Each element is represented by a one- or two-letter symbol. The symbol is either a single capital letter or a capital letter and a lowercase letter. For example, the symbol for carbon is C and the symbol for copper is Cu. All the elements and their symbols are listed in the periodic table.

What Is a Compound?

Water and sugar are examples of compounds. A **compound** is a substance made up of atoms of different elements that are chemically combined. When elements combine to form a compound, they always combine in the same ratio. For example, a water molecule is always made of two hydrogen atoms and one oxygen atom.



Water is a compound. Each water molecule is made up of two hydrogen atoms and one oxygen atom.

UNIQUE PROPERTIES

The properties of a compound are different from the properties of the elements that make up the compound. For example, both hydrogen and oxygen are gases at room temperature. However, hydrogen and oxygen combine chemically to form the compound water, which is liquid at room temperature.

CHEMICAL FORMULAS

A *chemical formula* shows how many atoms of each element are in a unit of a substance. The number of atoms of each element appears as a *subscript* after the symbol. For example, a molecule of O_2 has two oxygen atoms.

Numbers placed in front of a chemical formula show how many molecules of a substance that you have. One molecule of table sugar is written as $C_{12}H_{22}O_{11.}$ Therefore, three molecules of sugar are written as $3C_{12}H_{22}O_{11}$.

Critical Thinking

5. Explain A particular molecule has two hydrogen atoms and two oxygen atoms. How do you know that this is not a molecule of water?

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Math Skills

6. Calculate How many total atoms are in three molecules of table sugar?

_____

LOOKING CLOSER

7. Label Use the periodic table in the back of the book to label the elements in a molecule of indigo.

Indigo is a dye that was once used to make jeans blue. Four different elements make up a molecule of this compound.

What Are Pure Substances?

All elements and compounds are considered pure substances. In chemistry, a **pure substance** is matter that has a fixed composition and definite properties. Consider a pot of water. The water will boil at 100 °C, no matter how much water is in the pot. ☑

When boiling water to cook pasta, some people add salt. Like water, salt is a compound and therefore a pure substance. However, when salt and water are mixed, the combination is no longer a pure substance. Instead, the combination of salt and water is classified as a third type of matter called a mixture.

READING CHECK

8. Identify What two kinds of matter are pure substances?

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What Is a Mixture?

A **mixture** is a combination of two or more pure substances that are not chemically combined. The chart below shows how mixtures differ from elements and compounds. ☑

READING CHECK

9. Explain How are mixtures and pure substances related?

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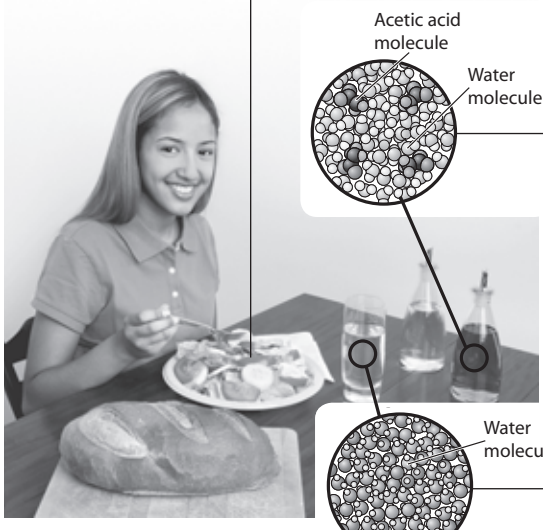
Pure substance (element or compound)	Mixture
Has a fixed composition	Does not have a fixed composition
Properties of components change when their elements combine	Components keep their original properties when combined
Components cannot be separated physically	Components can be separated physically

HETEROGENEOUS AND HOMOGENEOUS

Mixtures can be classified into two main groups. These groups are based on how well the components of the mixture are *distributed*, or spread out.

A tossed salad is an example of a *heterogeneous mixture*. The substances in a heterogeneous mixture are not distributed, or spread, evenly throughout the mixture. Different parts of the mixture may not be the same. Some parts of the salad, for example, may have more tomatoes or carrots than other parts of the salad.



The vinegar used on a salad is a *homogeneous mixture*. The components of a homogeneous mixture are distributed evenly. This means that every part of the mixture is the same. In vinegar, molecules of acetic acid are spread evenly among the molecules of water

Water is a *pure substance*. It has a fixed composition and definite properties.

LOOKING CLOSER

10. Compare How do homogeneous and heterogeneous mixtures differ?

MISCIBLE AND IMMISCIBLE

Gasoline is a homogeneous mixture made up of many different liquids. The liquids in gasoline are *miscible*, which means that they can be mixed and will stay mixed.

If you shake up a mixture of oil and water, they will not mix well. The oil will rise to the top of the container and the water will stay at the bottom. Oil and water are *immiscible*, which means they do not mix or will not stay mixed.

Critical Thinking

11. Apply Concepts Generally, you must stir a can of paint before you use it. Is paint miscible or immiscible? Explain your answer.

MAKING MIXTURES

A mixture can be made up of solids, liquids, or gases. It can even be made up of all three. For example, a carbonated drink is a homogeneous mixture made up of water, sugar, flavorings, and carbon dioxide gas. Some other examples of mixtures are shown below.

Example	A mixture of...
Air	gases
Sand	solids
Gasoline	liquids
Fog	gases and liquid
Seawater	solids, liquids, and gases

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Section 1 Review

SECTION VOCABULARY

atom the smallest unit of an element that maintains the chemical properties of that element

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

element a substance that cannot be separated or broken down into simpler substances by chemical means; all atoms of an element have the same atomic number

matter anything that has mass and takes up space

mixture a combination of two or more substances that are not chemically combined

molecule a group of atoms that are held together by chemical forces; a molecule is the smallest unit of matter that can exist by itself and retain all of a substance's chemical properties

pure substance a sample of matter, either a single element or a single compound, that has definite chemical and physical properties

1. **Explain** Why is Co an element, but CO a compound? (Hint: Use the periodic table in the back of the book to help you.)

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2. **Compare** How are compounds and mixtures alike? How are they different?

_____

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3. **Complete** Fill in the concept map below to show the relationship between the following: compound, element, matter, mixture, pure substance.