BEFORE, you learned
- Matter is made of tiny particles called atoms
- Atoms combine to form molecules

NOW, you will learn
- How pure matter and mixed matter are different
- How atoms and elements are related
- How atoms form compounds

KEY CONCEPT
Matter combines to form different substances.

Matter can be pure or mixed.

Matter can be pure, or it can be two or more substances mixed together. Most of the substances you see around you are mixed, although you can’t always tell that by looking at them. For example, the air you breathe is a combination of several substances. Wood, paper, steel, and lemonade are all mixed substances.

You might think that the water that you drink from a bottle or from the tap is a pure substance. However, drinking water has minerals dissolved in it and chemicals added to it that you cannot see. Often the difference between pure and mixed substances is apparent only on the atomic or molecular level.

A pure substance has only one type of component. For example, pure water contains only water molecules. Pure silver contains only silver atoms. Coins and jewelry that look like silver are often made of silver in combination with other metals.
If you could look at the atoms in a bar of pure gold, you would find only gold atoms. If you looked at the atoms in a container of pure water, you would find water molecules, which are a combination of hydrogen and oxygen atoms. Does the presence of two types of atoms mean that water is not really a pure substance after all?

A substance is considered pure if it contains only a single type of atom, such as gold, or a single combination of atoms that are bonded together, such as a water molecule. Because the hydrogen and oxygen atoms are bonded together as molecules, water that has nothing else in it is considered a pure substance.

**Elements**

One type of pure substance is an element. An **element** is a substance that contains only a single type of atom. The number of atoms is not important as long as all the atoms are of the same type. You cannot separate an element into other substances.

You are probably familiar with many elements, such as silver, oxygen, hydrogen, helium, and aluminum. There are as many elements as there are types of atoms—more than 100. You can see the orderly arrangement of atoms in the element gold, on the left below.

Why is an element considered to be a pure substance?

---

**REMINDER**

A molecule consists of two or more atoms that are bonded together.

**Element: Gold**

The atoms in gold are all the same type of atom. Therefore, gold is an element.

**Compound: Dry Ice**

Dry ice is frozen carbon dioxide, a compound. Each molecule is made of one carbon atom and two oxygen atoms.
**Compounds**

A compound is a substance that consists of two or more different types of atoms bonded together. A large variety of substances can be made by combining different types of atoms to make different compounds. Some types of compounds are made of molecules, such as water and carbon dioxide, shown on page 62. Other compounds are made of atoms that are bonded together in a different way. Table salt is an example.

A compound can have very different properties from the individual elements that make up that compound. Pure table salt is a common compound that is a combination of sodium and chlorine. Although table salt is safe to eat, the individual elements that go into making it—sodium and chlorine—are poisonous.

**CHECK YOUR READING**

What is the relationship between atoms and a compound?

**Mixtures**

Most of the matter around you is a mixture of different substances. Seawater, for instance, contains water, salt, and other minerals mixed together. Your blood is a mixture of blood cells and plasma. Plasma is also a mixture, made up of water, sugar, fat, protein, salts, and minerals.

A mixture is a combination of different substances that remain the same individual substances and can be separated by physical means. For example, if you mix apples, oranges, and bananas to make a fruit salad, you do not change the different fruits into a new kind of fruit. Mixtures do not always contain the same amount of the various substances. For example, depending on how the salad is made, the amount of each type of fruit it contains will vary.

**APPLY**

In what ways can a city population be considered a mixture?
Comparing Mixtures and Compounds

Although mixtures and compounds may seem similar, they are very different. Consider how mixtures and compounds compare with each other.

- The substances in mixtures remain the same substances. Compounds are new substances formed by atoms that bond together.
- Mixtures can be separated by physical means. Compounds can be separated only by breaking the bonds between atoms.
- The proportions of different substances in a mixture can vary throughout the mixture or from mixture to mixture. The proportions of different substances in a compound are fixed because the type and number of atoms that make up a basic unit of the compound are always the same.

How is a mixture different from a compound?
Parts of mixtures can be the same or different throughout.

It is obvious that something is a mixture when you can see the different substances in it. For example, if you scoop up a handful of soil, you might see that it contains dirt, small rocks, leaves, and even insects. You can separate the soil into its different parts.

Exactly what you see depends on what part of the soil you scoop up. One handful of soil might have more pebbles or insects in it than another handful would. There are many mixtures, such as soil, that have different properties in different areas of the mixture. Such a mixture is called a heterogeneous (HEHT-uhr-uh-JEE-nee-uhs) mixture.

In some types of mixtures, however, you cannot see the individual substances. For example, if you mix sugar into a cup of water and stir it well, the sugar seems to disappear. You can tell that the sugar is still there because the water tastes sweet, but you cannot see the sugar or easily separate it out again.

When substances are evenly spread throughout a mixture, you cannot tell one part of the mixture from another part. For instance, one drop of sugar water will be almost exactly like any other drop. Such a mixture is called a homogeneous (HOH-muh-JEE-nee-uhs) mixture. Homogenized milk is processed so that it becomes a homogeneous mixture of water and milk fat. Milk that has not been homogenized will separate—most of the milk fat will float to the top as cream while leaving the rest of the milk low in fat.

**KEY CONCEPTS**

1. What is the difference between pure and mixed matter?
2. How are atoms and elements related?
3. How are compounds different from mixtures?
4. Infer What can you infer about the size of sugar particles that are dissolved in a mixture of sugar and water?
5. Infer Why is it easier to remove the ice cubes from cold lemonade than it is to remove the sugar?
6. Apply A unit of sulfuric acid is a molecule of 2 atoms of hydrogen, 1 atom of sulfur, and 4 atoms of oxygen. How many of each type of atom are there in 2 molecules of sulfuric acid?