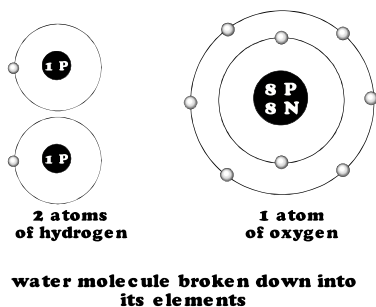


Introduction

You have seen how scientists represent the reactions that create substances. You may have wondered how two substances with **oxygen** in them (like water and sugar) could be so different. In this unit, we will discuss what properties these substances have that make them unique.

Elements

By now we know that matter has mass, volume, and density. We also know that matter can be a solid, liquid, or a gas. We have also learned some of the physical and chemical properties of matter. We experimented to show that chemical changes produce new substances. However, what makes up matter? Think about water. Water can be broken down into **hydrogen** and oxygen. The substances of hydrogen and oxygen cannot be broken down by chemical means. These substances are called **elements**. Elements cannot be broken down by chemical action. All substances are made of elements.



If you look at all the buildings around you, you see that they come in many different shapes and sizes. But there are similarities between the buildings. Think of a pyramid and a castle. Both are made of stone blocks, but the blocks have been arranged in very different ways. By doing this, the builders

made the structure they wanted. You can think of elements as building blocks. On Earth, we have discovered about 120 elements. While some of the elements can only be found in very special labs, these are all the elements that we know exist. Everything is made from these elements.

Some substances are made of only a single element. Aluminum (Al), gold (Au), oxygen (O), and hydrogen (H) are examples of substances with a single element.

13 Al ALUMINUM 27.0	79 Au GOLD 197.0	8 O OXYGEN 16.0	1 H HYDROGEN 1.008
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examples of substances with a single element

Most elements are solid under normal conditions. Few are liquid. The mercury (Hg) used in thermometers is normally liquid.

Many other elements are gases under normal conditions. Oxygen (O) and hydrogen (H) are just two of the elements that are gases at room temperature.

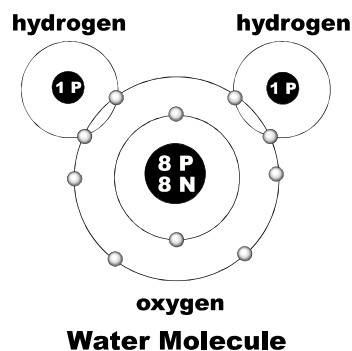
Scientists have a special way of writing the names of elements. They use letters instead of writing the whole word. The letters are called **symbols**. Here are some of the common ones.

Elements	Symbols
Copper	Cu
Aluminum	Al
Iron	Fe
Mercury	Hg
Oxygen	O
Hydrogen	H
Silver	Ag
Gold	Au
Carbon	C

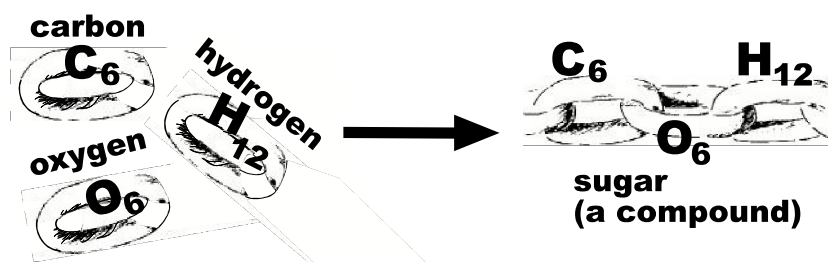
Each of the elements has its own symbol. Each element has at least one property that makes it different from another element.

Compounds

Many substances are made from more than one element. Elements can unite with each other. The elements form new substances that are very difficult to separate. The new substances are called **compounds**. A compound has chemical and physical properties that are uniquely its own. It may look totally different from the elements that formed it. As you have seen, the atoms of two elements, hydrogen (H) and oxygen (O), combine to form water.



Sugar is a compound formed by atoms of carbon (C), hydrogen (H), and oxygen (O).



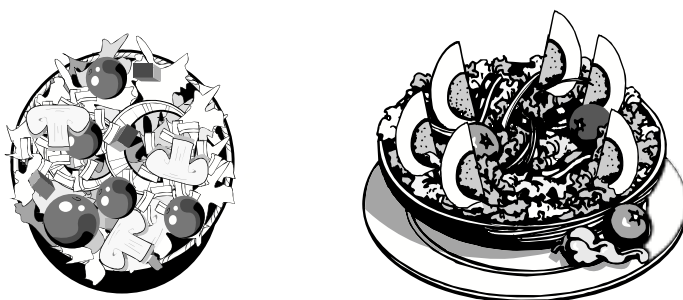
Sugar and water do not look like the elements that formed them. When compounds are formed, the elements always combine in the same proportions. A **formula** tells how elements combine to form compounds. The formula for water is H₂O. Compounds always have formulas.

Mixtures

It is possible to combine two elements or compounds without producing new substances. No chemical change takes place. These substances are called **mixtures**. Mixtures can be separated. Each substance in the mixture keeps its own properties. If you mix iron filings with sand, you could separate them because there has been no chemical reaction. There is no new compound; there is only iron and sand.

If we took hydrogen and combusted it with oxygen, water would be formed. Water does not have the same properties as hydrogen and oxygen because it is a different compound. Water is always made from two hydrogen atoms and one oxygen atom. Water cannot be made any other way because it is not a mixture.

On the other hand, a mixture can be made in many different ways. Air is a mixture. The elements in the air are not always the same. Tossed salad is a mixture too; salads do not always have the same ingredients. Mixtures do not have formulas. They are not formed by chemical changes.



A tossed salad is a mixture too; salads do not always have the same ingredients.

Summary

Now we know that elements are the simplest forms of substance. Gold (Au) is an element. Compounds are formed when a chemical change takes place between two or more elements. Mixtures are formed when two or more substances are put together. No chemical change takes place. The parts of a mixture can easily be separated.