Name:	Class:	Date:

11 Compounds and Mixtures

6.1-C2, 6.1-C3

Getting the Idea

Key Words
pure substance
compound
molecule
chemical formula
mixture
density
solubility
evaporate
boiling point

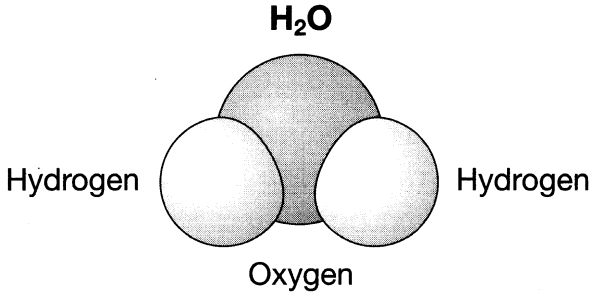
As you have learned, there are more than 100 known elements, with different properties. But most substances are not made up of just one element. Elements combine in different ways to form many other substances.

Compounds

You have learned that an element is made up of only one type of atom. Elements are pure substances. A **pure substance** is matter that has the same chemical composition throughout and cannot be separated into its parts by physical means. Elements form compounds. A **compound** is a pure substance that forms when two or more elements join chemically in a fixed proportion.

Just as an element is made up of one kind of atom, a compound is made up of one kind of molecule. A **molecule** is a group of two or more atoms held together by very strong chemical bonds. These bonds form between atoms that share or transfer electrons. A molecule is the smallest unit of a compound that has all the properties of that compound.

A molecule can be made up of more than one atom of the same element. For example, two atoms of oxygen join to form a molecule of oxygen gas (O_2). A molecule can also be made up of two or more different elements. A water molecule is made up of two hydrogen atoms and one oxygen atom. The illustration below models a water molecule.



Molecules are identified by chemical formulas. A **chemical formula** is a group of chemical symbols and numbers that shows the kinds and numbers of atoms in a molecule. The formula for a water molecule is H_2O. H is the chemical symbol for hydrogen. O is the chemical symbol for oxygen. The small number 2 is called a *subscript*. It shows that the molecule contains two atoms of hydrogen. The O has no subscript. That means that the molecule contains only one atom of oxygen.

Molecules and compounds have different properties from those of the elements that form them. For example, water is a liquid at room temperature, while hydrogen and oxygen are gases. Water does not burn, but hydrogen does. Table salt is a compound made up of sodium and chlorine. Sodium (Na) is a soft metal that explodes when combined with water. Chlorine (Cl) is a poisonous gas. When these elements combine to form sodium chloride (NaCl), they form the edible, white solid you know as table salt.

Mixtures

Elements can combine in different ways to form either compounds or mixtures. A **mixture** is a combination of two or more substances that are not joined chemically. Mixtures are not pure substances.

The substances that form a mixture are not bonded together. Because they do not combine chemically, the parts of a mixture keep their own identities and properties. For example, if you mix salt and sugar, the salt will still be salt, and the sugar will still be sugar. Some crystals will taste salty, and some will taste sweet.

You may have eaten a mixture for breakfast. Cereal is an example of a mixture because cereal is a blend of many distinct substances. A bowl of cereal may contain bran flakes, corn flakes, nuts, fruits, and milk. Air is a mixture of gases. Ocean water is another mixture. It is made up mostly of two compounds—water and salt—as well as small amounts of other substances.

Separating Mixtures

Unlike compounds, the parts of mixtures can be separated by physical means. The different substances in a mixture have different physical properties that can be used to separate them. Some of these properties are particle size, density, solubility, boiling point, and attraction to a magnet.

Separating Mixtures by Particle Size

Suppose you wanted to sort a handful of rocks, pebbles, sand, and other soil particles. You could pick out the pebbles by hand. Then you could use a sifter to separate the sand from smaller soil particles.

Separating Mixtures by Density

The **density** of a substance is its mass per unit of volume. Mass is the amount of matter in a substance. Volume is the amount of space a substance occupies. You can think of density as the amount of matter that fits in a given space.

On your dinner table, you may have seen a mixture separate by density. Oil-and-vinegar salad dressing usually separates into two layers. The denser vinegar settles to the bottom, while the less-dense oil floats on top. You can use this method to separate other mixtures of liquids with different densities.

Separating Mixtures by Solubility

Solubility is the ability of one substance to dissolve in another given substance. Suppose you wanted to separate a mixture of salt and sand. Salt dissolves in water. Sand does not. You could mix the salt and sand with water and pour the mixture through a filter paper. The water and dissolved salt would go through, leaving the sand in the filter paper. Then you could let the water **evaporate**, or change from a liquid to a gas. The salt would be left.

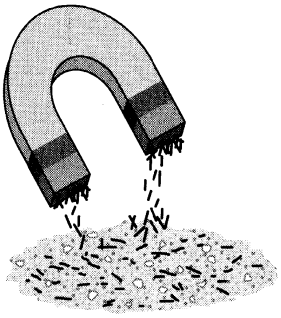
Separating Mixtures by Boiling Point

Boiling point is the temperature at which bubbles of gas form throughout a liquid and start rising to the surface. Different substances have different boiling points. If you heat a mixture of liquids, the liquid with the lowest boiling point will evaporate first. The liquid with the second lowest boiling point will evaporate next, and so on. With special equipment, you can collect the different gases and cool them until they become liquids again. You can also separate a liquid from a solid by boiling.

Did You Know?

Iron is added to some cereals. If you crush the cereal into a powder, you can use a magnet to separate particles that contain iron.

Separating Mixtures by Magnetic Properties Some substances are attracted to a magnet, and others are not. You can use these differences to separate some mixtures. For example, you can use a magnet to separate a mixture of sand and iron filings. As shown in the diagram below, the magnet will attract only the iron filings.



Iron fillings are attracted to a magnet, but sand is not.

DISCUSSION QUESTION

How are compounds and mixtures similar and different?