2 What Makes Up Matter?

LESSON GOALS

You will learn
- what atoms and elements are.
- what molecules and compounds are.
- what mixtures and solutions are.

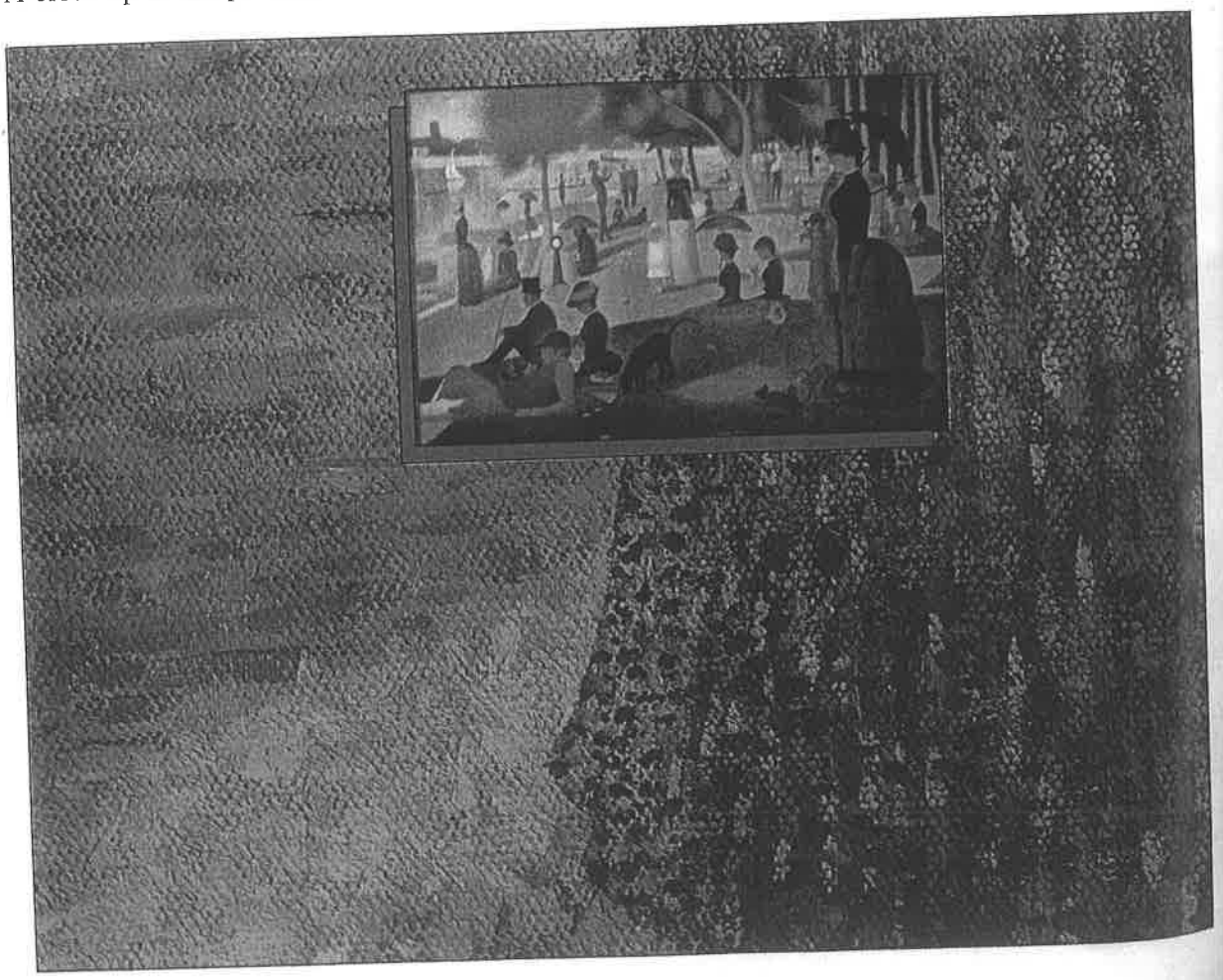
Look at the people in the painting below. Now look at the other painting below. This picture is a close-up of a small part of the first painting. The artist painted tiny dots to make the painting. When you look at the painting from a distance, you see the whole picture. Like the painting, all matter is made up of smaller and smaller bits. However, you cannot see the small bits of matter.

atom (at′əm), the smallest whole bit of an element.

Atoms and Elements

An **atom** is the smallest whole bit of each kind of matter. Atoms are much too small to see. A toy balloon the size of your head would hold many billions of atoms of the gases found in air.

A close-up of the painting



Most of the matter you see around you is made up of many different kinds of atoms. However, some matter is made up of only one kind of atom. You might have used the substance in the picture. This foil is made from aluminum. Aluminum is an **element**—matter that is made of only one kind of atom. Aluminum is made of atoms of aluminum.

Scientists know of 109 different elements. The pipe in the picture is made from the element copper. Gold, mercury, silver, and carbon are other elements in the objects below. Oxygen is an element that you need from the air you breathe. Your body is made of atoms of many different elements. Atoms of the element calcium make bones and teeth strong.

SCIENCE IN YOUR LIFE

Look at the black tip of your pencil. It is made of a soft material that is a form of the element carbon. Your pencil point is very small, but it contains billions of carbon atoms.

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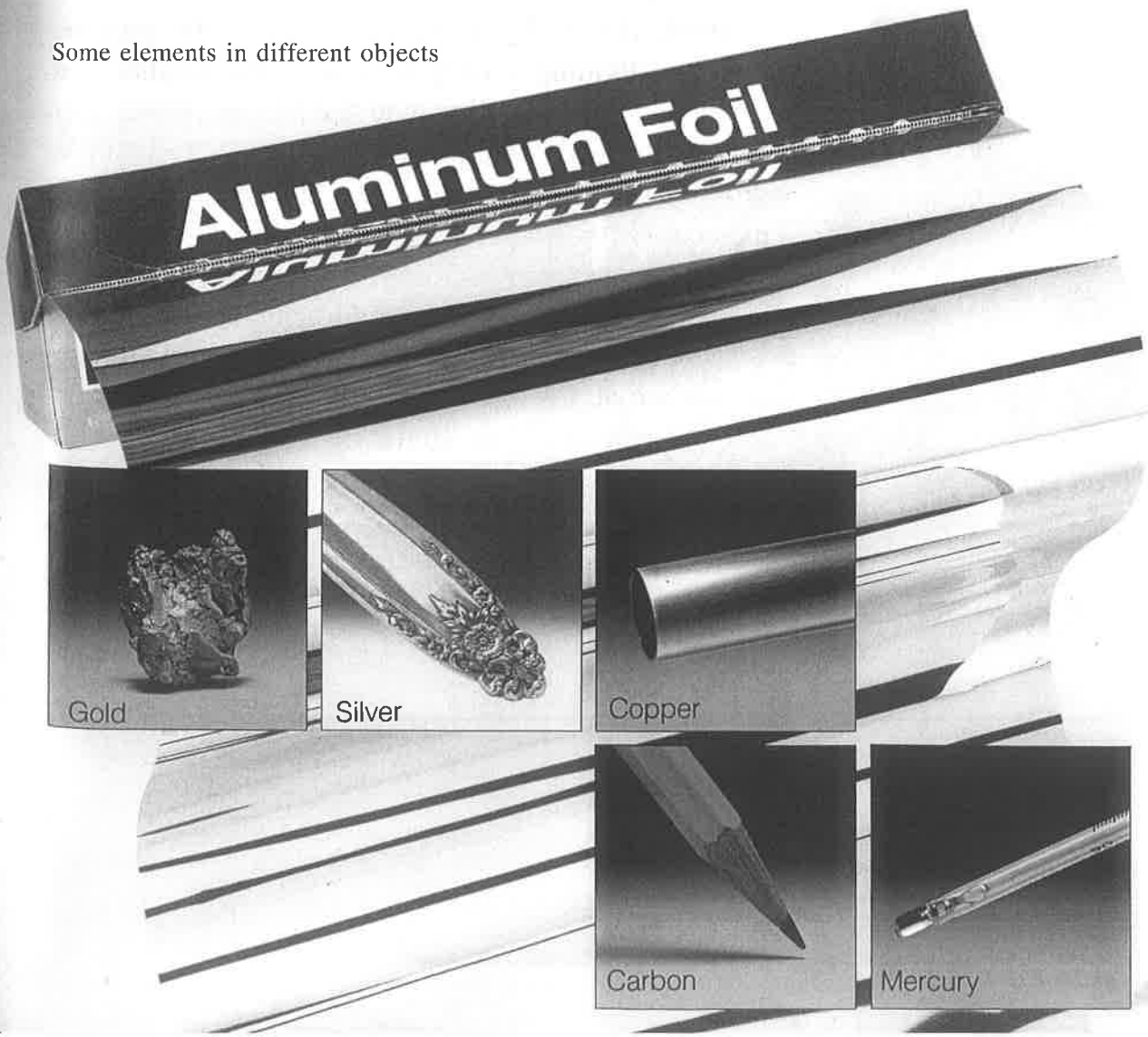
element (el′ə mənt), matter that has only one kind of atom.

Some elements in different objects



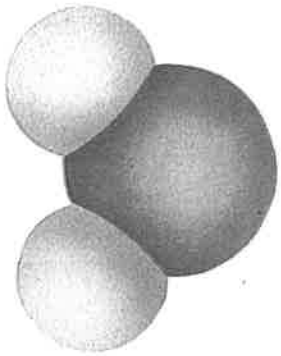
Molecules and Compounds

compound (kom′pound), a substance formed when atoms of two or more different elements join together.

molecule (mol′ə kyül), two or more atoms held together in a special way.

You could not live without water. Yet water is not one of the 109 elements. Water is made up of two elements—hydrogen and oxygen. Water is a **compound.** A compound is a new substance that forms when atoms of two or more different elements join together. Most kinds of matter on the earth are compounds.

You know that the smallest whole bit of an element is an atom. The smallest bit of the compound water that has the same properties as water is a molecule. A **molecule** is two or more atoms joined together. For example, two atoms of oxygen join together to form an oxygen molecule.

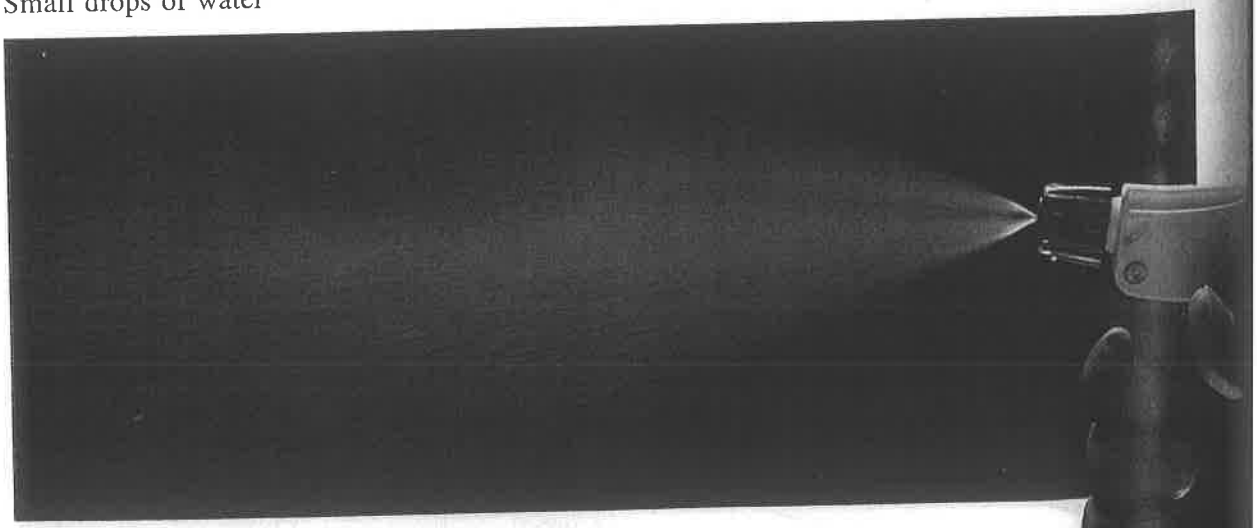


A water molecule

Think about the drops of water in the picture. Imagine dividing a drop of water into smaller and smaller drops. Finally, you could not make any smaller drops that would still be water. The smallest drop of water with the properties of water is a molecule of water.

Every water molecule is the same. Each water molecule is made up of two hydrogen atoms and one oxygen atom. Pretend the two blue circles in the picture are atoms of hydrogen. The gray circle is an atom of oxygen. Two atoms of hydrogen join with one atom of oxygen to form a molecule of water.

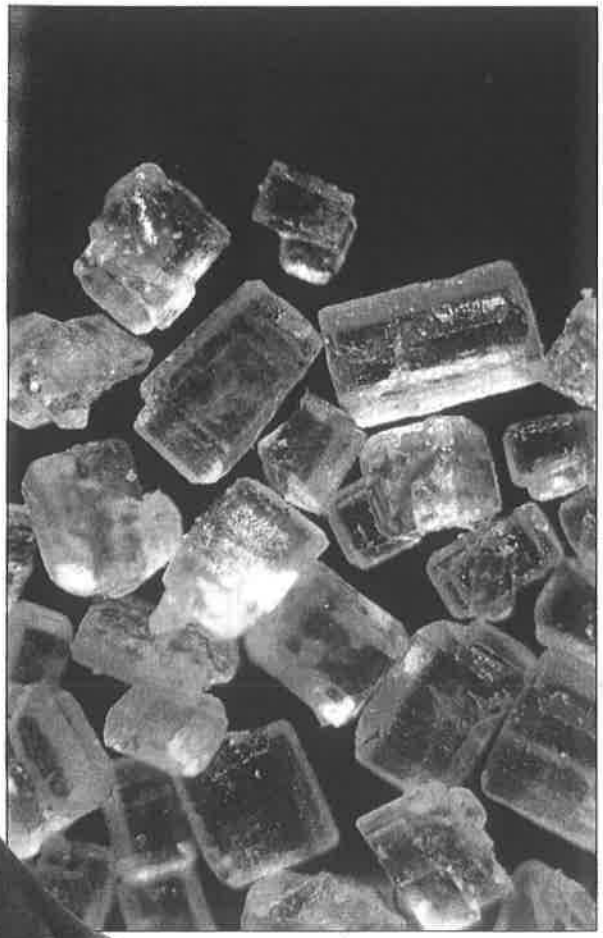
Small drops of water



Some kinds of molecules have only two atoms. A molecule of carbon monoxide always has one atom of carbon and one atom of oxygen. Other molecules have thousands of atoms.

The properties of a compound are usually very different from the properties of the elements in it. How would you describe the sugar in the picture? Every molecule of this compound has twelve atoms of carbon, twenty-two atoms of hydrogen, and eleven atoms of oxygen. However, carbon is often a black solid like the form of carbon below. Carbon has no taste. Hydrogen and oxygen are both gases. Neither gas has a color, an odor, or a taste. When atoms of carbon, hydrogen, and oxygen are joined in a certain way, they make a white solid that tastes sweet.

Magnified sugar crystals



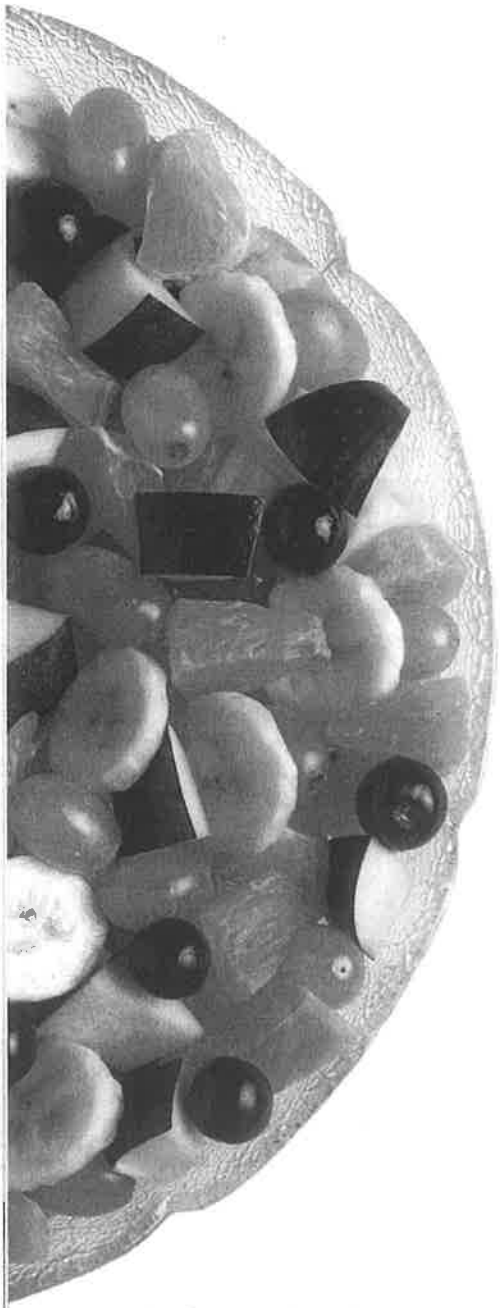
Pieces of carbon

Combining Matter into Mixtures and Solutions

mixture (miks′chər), two or more substances that are placed together but can be easily separated.

Notice the grapes and pieces of orange, banana, and apple in the fruit salad in the picture. The fruits taste good together, but each piece of fruit keeps its own taste. The pieces of fruit can easily be separated. They do not join together to make a new substance.

A **mixture** is two or more substances that are placed—or mixed—together but can be easily separated. Each substance in a mixture keeps its own properties. A mixture can have different amounts of each kind of matter. You can make fruit salad with any kinds of fruit. You also can use any number of pieces of each kind of fruit.



A mixture of fruits

The air you breathe is a mixture of gases. Some of these gases are elements, like oxygen and hydrogen. These elements float freely around each other. Some of the gases in air are compounds, like carbon dioxide and water vapor.

Because air is a mixture, the air in different places has different amounts of these gases. The air over a desert has less water vapor than the air over a warm forest. The air in a city might have more carbon dioxide than the air near a farm.

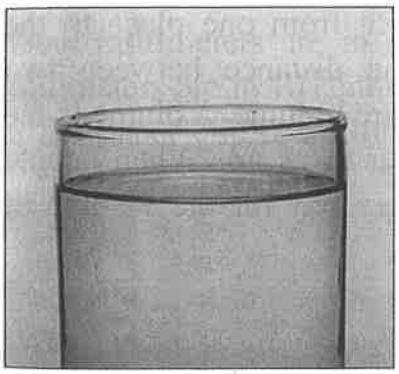
The soil that covers the earth is a mixture of solids. Some of these solids are sand, clay, and pieces of plant matter. Soil in different places has different amounts of these kinds of matter.

A solid and a liquid can also make a mixture. Stirring sand into water makes a mixture of a solid and liquid. Like all mixtures, sand and water are easy to separate. How would you separate a mixture of sand and water?

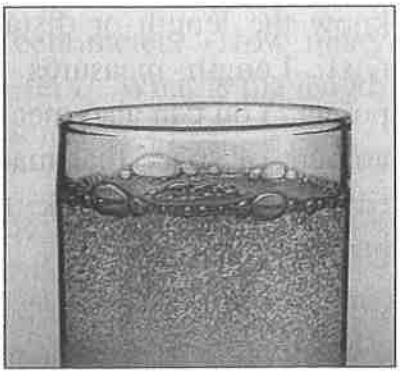
Two liquids can make a mixture. For example, vinegar and oil is a mixture that makes salad dressing. This mixture separates so easily that it is sometimes hard to keep the two liquids mixed. People shake salad dressing made with vinegar and oil just before pouring it to mix the two liquids.

The glasses in the picture hold a special kind of mixture. In the glass on the left, sugar and water are mixed together. Notice that you cannot see the sugar. The molecules of sugar dissolve—or spread evenly in the liquid. One substance spreading evenly throughout another substance forms a **solution.** The substances in a solution can be separated easily. If the water evaporates, the sugar is left in the glass.

Many soft drinks are a solution of sugar and water. Soft drinks also have another kind of solution—a gas dissolved in a liquid. You cannot see the gas carbon dioxide until it starts to separate from the water. You can see this gas as bubbles in the glass on the right.



Sugar dissolved in water



A gas dissolved in water

INVESTIGATE!

Find out if more sugar or more salt dissolves in a certain amount of water. Write a hypothesis and test your hypothesis with an experiment.

solution (sə lü′shən), a mixture in which one substance spreads evenly throughout another substance.

Lesson Review

1. What is an element made of?
2. How is a compound different from an element?
3. How is a solution different from other mixtures?
4. **Challenge!** How are the properties of the compound water different from the properties of the elements in it?

Study on your own, pages 384–385.

PHYSICAL SCIENCE

FIND OUT ON YOUR OWN

Atoms are made of even smaller parts. Look in an encyclopedia to find out what the parts of an atom are. Make a drawing that shows the parts of an atom and name each part.