

## QUESTION SET 2.1

### ARE OTHER SUBSTANCES MADE OF MOLECULES?

1. Encourage students to add many other substances to this list.

SOLID	LIQUID	GAS
Steel	Alcohol	Helium
Sugar	Milk	Carbon dioxide

2. Students may need to be encouraged to use their imagination in drawing pictures of molecules of alcohol and oxygen. Accept any reasonable shapes, but the arrangement of molecules should be similar to any liquid, solid, and gas. (The actual shapes of alcohol and oxygen molecules are shown on pages 14 and 23 of the science book.)

Alcohol liquid: alcohol molecules are constantly moving, sliding and bumping past each other.

Ice (solid water): molecules locked in rigid array, vibrate in their places.

Oxygen gas: Oxygen molecules far apart, bouncing around freely in space.

You may want to use a student analogy to illustrate the arrangement and movement of molecules in solids, liquids, and gases.

Solids: Students are in their seats in a classroom. They are moving but they stay in their seats--a rigid pattern.

Liquids: Students are doing a laboratory experiment moving past each other, but staying in their classroom.

Gases: Students are changing classes, moving freely and far apart.

3. Both water and water vapor have the same kind of molecules--water molecules. They are different in that water is a liquid and water vapor is a gas. The molecules of water vapor move freely and are very far apart compared to liquid water.

(Students may wonder whether the molecules of water vapor move faster than the molecules of liquid water. They do, only if the water vapor is hotter than the liquid water. Molecules of a gas at room temperature, like oxygen or water vapor in the air, move at about the same speed as molecules of liquid water at room temperature.)

4. Water vapor and oxygen are both gases and they are both substances made of molecules. They are different because they have different kinds of molecules.

5. Ice and water have the same kind of molecules--water molecules. Glass molecules and the water molecules in ice are different. Therefore ice could not change into glass.
6. Light is not a solid, liquid, or gas, and it is not matter. Only matter is made of molecules. Light is a form of energy.

## ACTIVITY 2.2

### MAKING MIXTURES

#### TEACHING SUGGESTIONS:

Because each group of students will prepare six mixtures, you may want to place directions on the chalkboard and assign specific tasks to each group member. This activity works best when small amounts of each mixture is used. For best results, there should be no more than one inch of the mixture in the bottom of each tumbler.

Emphasize that we can see substances but not molecules.

#### STUDENT RESPONSES:

1. 5cc salt and 25cc pepper: Yes  
5cc salt and 5cc sugar: Responses will vary (differences in crystal shapes are visible with a magnifying glass).  
Pepper water: Yes  
5cc sugar and 150 ml water: No (assuming sugar is dissolved).  
5 ml syrup and 150 ml water: No
2. You could tell the difference between pure substances and mixtures if you could see molecules with a magnifier. But you cannot see molecules with a magnifier.
3. A pure substance is made up of only one kind of molecule. A mixture is made up of two or more different kinds of molecules mixed together.
4. The sugar grains break up into individual molecules.

The molecules of both the sugar and water are constantly moving. They intermingle so that the molecules of sugar spread throughout the water.

(Some students think that the sugar disappears and does not exist any longer. One way to tell that the sugar still exists is to taste the water. More on dissolving in Lesson Cluster 5.)

5. The sugar molecules are intermingled throughout the water molecules.

Use Transparency 3 here:

### TRANSPARENCY 3: WHAT WOULD OCEAN WATER LOOK LIKE?

#### **BOTTOM LAYER:**

Often students make distinctions between mixtures and pure substances based on observable properties only; they believe that if something looks clear, then it is a pure substance. Thus, they will say that ocean water is pure because it looks clear. This would imply that ocean water has only one kind of molecule, even though most students will not answer in terms of molecules.

#### **OVERLAY:**

Ocean water, even though it looks clear, has several different kinds of molecules, thus making it a mixture and not a pure substance. Emphasize this difference to your students. Although ocean water is a mixture of a number of different substances, only salt is shown in this transparency, as it is the most familiar to students.

## QUESTION SET 2.3

### MOLECULES IN STATES OF MATTER

#### TEACHING SUGGESTIONS:

After the students have complete this question set, you might want to use the transparency "How are molecules arranged and how do they move?" or the poster to discuss the students' answers.

#### STUDENT RESPONSES:

1. You may have to encourage some students to use their imagination in making up shapes for molecules for substances that they do not know.
  - a. Students' choices will vary.
  - b. Any shapes are OK, as long as different substances have differently shaped molecules.
  - c. Arrangements and motions should be similar to those previously described for molecules of solids, liquids, and gases.
  - d. Arrows should show vibration for the molecules of the solid, movement through space for the molecules of the liquid and gas.

2. Your friend was wrong because a speck of dust is huge compared to a molecule. A speck of dust is made of millions of billions of molecules itself. A molecule is so tiny you cannot see it even with a microscope.
3. Yes! Ocean water is a mixture of salt and water, and many other substances.

Students' drawings should show at least water molecules and salt molecules mixed together. They may represent salt molecules any way they want.

(There are really no salt "molecules" in ocean water, though. Salt crystals are made of equal numbers of sodium and chlorine atoms, alternatively arranged in a rigid array. The chemical name of salt is sodium chloride, and its chemical formula is NaCl (Na stands for sodium). When salt crystals dissolve in water, the sodium and chlorine atoms move about separately. They are called "ions," because one has a positive electric charge and the other has a negative electric charge.)