ACTIVITY 5.1

WHERE DID THE SUGAR GO?

1. Tea bag drawings should show filaments with gaps between them. Drawings of grains of sugar should show some detail and some size, and not be just dots. If students draw just dots, they may be confusing grains of sugar with sugar molecules.

   a. Yes.

   b. No. Students' drawings might indicate relative size of grains and holes.

   c. Yes. You might point out here that molecules are much smaller than grains. Grains of sugar are made of trillions of molecules.

2. You can drape a tea bag over the side of a cup by wetting the top of the bag and pressing it over the edge.

a. Students usually see wavy lines in the water under the tea bag.

b. The water should taste sweet.

c. The reason you cannot see the sugar is that is has broken into molecules--too small to see. (This question, though, will probably elicit some misconceptions from students, like "you can't see it because it has disappeared," or "because it has melted." You can use this question to help students begin to think about the process of dissolving.)

d. Encourage students to write as much as they can and to explain their ideas clearly. Many will not have complete or even scientific explanations, which is OK at this point, since they are just beginning to develop this explanation. It would be a good idea to discuss three or four different student explanations before reading in the text, and point out differences between them.

e. The sugar would spread evenly throughout the water. The molecules of water and of sugar are constantly mixing. The molecules' motion causes the molecules to intermingle evenly throughout the mixture.

(Some students might suggest that the sugar settles on the bottom. They probably do not understand that molecules are <u>always</u> moving, so they constantly move throughout the water.)

Some students think that sugar crystals are actually molecules. Crystals of sugar are cube-shaped because of the rigid array of (trillions of) molecules in solid sugar.

Use Transparency 9 here:

TRANSPARENCY 9: WHAT HAPPENS WHEN SUGAR DISSOLVES IN WATER?

BOTTOM LAYER:

Many students feel that, when sugar dissolves in water, the sugar "disappears" or "melts." Most students will not answer this question in terms of molecules.

OVERLAY:

Students should be challenged to see that just because the sugar is no longer visible does not mean that it is gone forever. On a macroscopic level, the sugar mixes with the water. On the molecular level, water molecules hit the large grains of sugar, knocking off individual molecules. These sugar molecules eventually become evenly dispersed throughout the water. Since we cannot see individual molecules, the sugar seems to have disappeared. We know it is still there, however, because the water tastes sweet.

Remember that the word "substance" is supposed to remind students to ask two questions: What substance is changing? and How is it changing? the word "molecules" is supposed to remind students to write about what is happening to molecules during the change.

It is the molecular part of the explanation that provides a reason and accounts for the change. We want to help students get to the point of explaining the phenomena in this lesson cluster and the following clusters in terms of molecules.

ACTIVITY 5.2

DISSOLVING FAST AND SLOW

TEACHING SUGGESTIONS:

For this activity use Kosher or canning salt because most table salt is sprayed with corn starch (which results in a cloudy mixture).

1. Divide the class into groups. Each group must have 2 cups containing water and salt.

2. Be sure the students understand that they must fill the cups equally.

3. Be sure the students put the same amount of salt in each cup.

4. After the activity is complete, collect materials, clean up and discuss ways students dissolved the salt more rapidly in one cup then in the other.

STUDENT RESPONSES:

1 & 2. Student responses will vary. Some may suggest stirring, or shaking.

3. No, the salt still exists. Taste the liquid which is salty or allow the water to evaporate and salt will remain behind.

4. The student drawing should show water molecules and molecules to represent salt.

5. Stirring moved the water past the grains of salt, and caused more molecules of water to hit the salt grains, so the molecules of salt were broken off from the grains faster.

6. Yes. The magic eyeglasses should show molecules of water, sugar and salt.

7. Place the salt water solution in a pan and allow the water to evaporate. The solid salt will remain in the pan.

LESSON 5.3

COMPLEX SOLUTIONS

PURPOSE:

To help students understand that most common solutions are complex; that is, have several solids dissolved in water.

ADVANCE PREPARATION:

Teachers may want to have little cups or bottles of various complex solutions in the room for students to view.

MATERIALS LIST:

Select 3 or 4 items such as:

soda	syrup	liquid dish detergent
mouthwash	kool-aid	hair color dye
catsup	clear shampoo	dish water
honey	apple juice	

Transparency 3: What would ocean water look like?

TEACHING SUGGESTIONS:

Have students collect labels from different complex solutions they may find at home. Discuss why these items are complex solutions. Note: Some items you find in your kitchen or bathroom are not complex solutions, i.e., ammonia (without soap or detergent), bleach (without soap or detergent), hydrogen peroxide, and alcohol. Each of these solutions contains only water and one other compound.

Remember that the word "substance" is supposed to remind students to ask two questions: What substance is changing? and How is it changing? The word "molecules" is supposed to remind students to write about what is happening to molecules during the change.

It is the molecular part of the explanation that provides a reason and accounts for the change. We want to help students get to the point of explaining the phenomena in this lesson cluster and the following clusters in terms of molecules.

Use Transparency 3 here: See Teacher's Guide Lesson 2.2 for a description of Transparency 3.

SUGGESTIONS FOR ADDITIONAL ACTIVITIES:

1. Crystal growing

An interesting way to extend this lesson cluster is to have students grow two or more different types of crystals. The first step in growing crystals is to prepare a saturated solution. This can be done by dissolving as much of the solid as possible in a hot water solution. Pour this solution in a jar, and cover the jar with cheese cloth to prevent dust from getting into the solution. Allow the solution to cool overnight and crystals should form on the bottom of the jar. Pour the liquid from the crystals into a second jar, take one of the nicest crystals, tie it one a piece of thread, and suspend it in the solution of the second jar. Allow it to stand as the crystals grow.

If crystals start forming on the bottom or sides of the jar, repeat the procedure just described by pouring the solution into a clean jar and again suspending a seed crystal on a piece of thread.

There are a number of salts that make interesting crystals. Some are: alum, Rochelle salt, photographer's hypo or sodium thiosulfate, and cupric sulfate. Alum is aluminum sulfate and Rochelle salt is potassium sodium tartarate.

Growing crystals is tedious and requires a lot of patience. Perhaps you would want to start growing crystals several weeks before you intend to use them.

Crystals and Crystal Growing, by Alan Holden and Phylis Singer, is a good reference source. It is in the Science Study Series, published by Anchor Books, Doubleday & Co., Inc.

2. Finding complex solutions

Students bring in solutions from stores and study the labels. (Remember that only clear liquids are true solutions.)

LESSON 5.3

CLUSTER REVIEW

TEACHING SUGGESTIONS:

1. After each child has answered the questions, you may want to write several different answers to each question on the board and compare students' responses.

STUDENT RESPONSES:

1. Students should draw the water molecules in the way they have been drawn previously. The other molecules may be made up by the students: You may want to suggest different shapes for each molecule.

2. Both friends are wrong.

   This question is to help the students contrast dissolving with disappearing and melting. Students should be able to explain what dissolving is; they should show that the sugar still exists.

   (You may want to point out that the sugar has not melted because the sugar or water has not been heated. Hot water is not hot enough to melt sugar either, although sugar dissolves faster in hot water--See Lesson 6.1.)

3. Do not allow the students to just copy what they had written earlier. The explanation should mention both substances (water and salt), and water and salt molecules.

4. You might ask each student to write three statements in their activity book.

Write all student responses on the board. (Even if a response is incorrect). Now have the students group the responses, and discuss any they feel are not correct.

Student responses might include these important points from the lesson cluster:

1. All matter is made of molecules.
2. Molecules can move from one place to another.
3. Grains can break apart into molecules.
4. I can see evidence of molecules moving from one place to another.
5. I can make something dissolve faster by stirring it.
6. When sugar or salt dissolve in H_2O the molecules break away and join with the water.
7. A molecule of sugar in a grain or a molecule of sugar in water is the same.