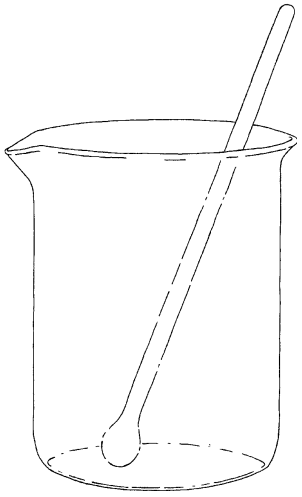
Activity 2.2

How Much Can It Take?

When something is dissolved in water, that material is held in the spaces between the water molecules. As a result, the volume of the water does not change!

Equipment/Materials

five cups of water
clear plastic or glass cups or beakers
table salt
granulated sugar
baking soda
cocoa (not chocolate drink mix)
cooking oil
plastic spoons
Student Record Sheet 2.2: "How Much Can It Take?"



Time Required: 20 minutes plus setup and cleanup time

Procedure:

1. Label each cup (1 to 5 or by naming the material being tested) and measure equal amounts of water into each cup.
2. Using a measuring spoon or a plastic spoon and leveling the sugar on each spoonful, add sugar to Cup 1 while stirring constantly until the sugar no longer dissolves. Note: If the water seems cloudy, the material has not yet dissolved completely. Continue stirring until each spoonful is completely dissolved (the water is clear) or the sugar remains on the bottom of the cup. Record the number of spoonfuls of sugar added until the water could not dissolve any more sugar.
3. Have each participant estimate the amount of each of the other materials that will dissolve in water and record those estimates on his or her record sheet. You may wish to state that an estimate or guess is known as a hypothesis. (They will probably hypothesize that the other materials will behave like the sugar, and the water will dissolve similar amounts. This is a null hypothesis; it states that there is no difference between the solubility of sugar and the solubility of the other materials.)
4. Use the same technique used in step 2 above, and repeat the procedure with table salt in Cup 2, adding 1 spoonful at a time until the salt no longer dissolves. Record the number of spoonfuls of salt dissolved in the water along with any other observations made during the test.
5. Repeat this procedure with baking soda in Cup 3.
6. Repeat the procedure with cocoa in Cup 4.
7. Repeat the procedure with cooking oil in Cup 5.
8. Have the participants compare the results with their hypotheses recorded on their record sheets. Ask them to discuss the differences they observed and to discuss some possible reasons for those differences.
9. Lead them to conclude that the sugar and salt are very soluble in water, baking soda is moderately soluble, cocoa is slightly soluble and cooking oil is essentially nonsoluble. Use the instructor information and other background material.
10. Challenge participants to think. Ask if the solubility would change if the water were heated to boiling or chilled. Based on their own experiences, they should be able to predict that water will hold more solute as its temperature increases (e.g. cocoa dissolves much more readily in hot water than in cold water).

Instructor Information: At room temperature, a cup of water should dissolve approximately 5 to 7 teaspoons of sugar or table salt. Baking soda is less soluble. Real cocoa dissolves poorly in water at room temperature. Watch for cocoa to drop out of suspension to form a siltlike layer on the bottom of the container. Cooking oil may form a

temporary suspension of tiny globules (like those seen in vinegar and oil salad dressings when shaken) if it is stirred vigorously, but the oil should form its own layer on top of the water very quickly. Cooking oil is a fat with hydrophobic molecules that are much more attracted to each other than to water molecules. Because oil is lighter than water, it forms a separate layer on the surface of the water. Cocoa contains small amounts of cocoa butter, a fat found in the cocoa bean. As a result, it is slightly hydrophobic, although it is slightly soluble in water at room temperature. To make cocoa, water or milk is heated to get the chocolate into solution. Moderately soluble sodium bicarbonate (baking soda) dissolves more slowly and to lower concentrations than do the very soluble table salt and sugar. The structure of these two solutes makes them very hydrophilic.

Pure water does not exist in nature. It dissolves gases from the air almost as quickly as it condenses from a gas itself, and its ability to dissolve many other substances results in most natural water being a solution of the atmosphere, soils and vegetation in its watershed. Dissolved minerals in water give it its “taste,” and its solvent nature is very important to life on earth. Discuss some of the ways that water as a solvent is useful to us, from the ability to brew tea to the action of carrying nutrients to the cells in our bodies.

Record Sheet 2.2

How Much Can It Take?

? Do you know when a solvent is the solution?

Name: _____

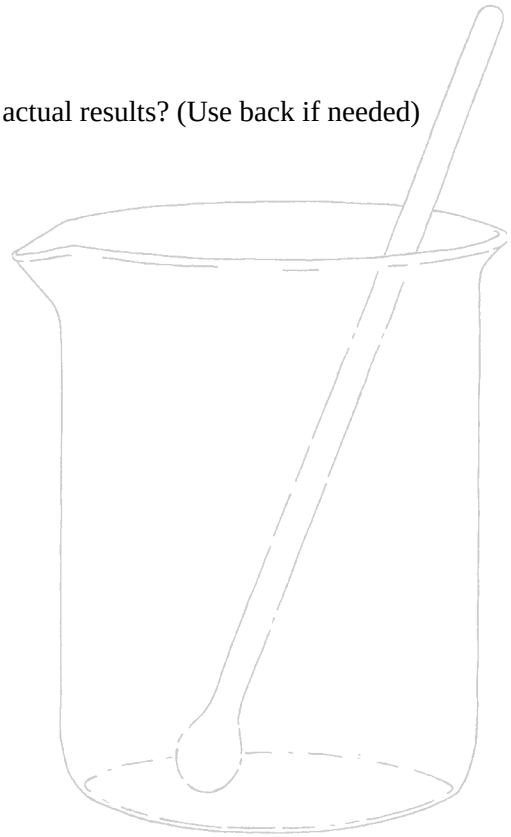
1. How many spoonfuls of sugar dissolved in Cup 1?_____
2. When no more sugar will dissolve in the water the solution is _____.
3. Before testing the other materials, predict if each one will dissolve more, the same, or less than the sugar did in water. Circle your prediction.

table salt	more	less	same
baking soda	more	less	same
cocoa	more	less	same
cooking oil	more	less	same

4. Repeat the experiment for Cups 2, 3, 4, 5. Record the number of spoonfuls dissolved and your observations below:

	Amount Dissolved (spoonfuls)	Observations
Cup 2 - table salt		
Cup 3 - baking soda		
Cup 4 - cocoa		
Cup 5 - cooking oil		

5. How did your predictions compare to the actual results? (Use back if needed)



Answer: *When your problem is how to clean up any water soluble material, water is the solvent, the solution to the problem!*