

**Part I—Dissolving in water**

- A. We will determine how much sugar can dissolve in water.

When you are unable to dissolve more sugar into a uniform solution of sugar water, we say the solution is \_\_\_\_\_.

**Step 1:**

1. Start with 5 mL of water in a test tube.
2. Add 1.0 g of sugar. Using your thumb to cover the opening of the test tube, shake for **ONE MINUTE** until the sugar dissolves.
3. Wait another minute before observing. If the sugar settles on the bottom then it has not dissolved.

**RECORD YOUR OBSERVATIONS IN THE DATA TABLE**

4. If the 1.0 g of sugar dissolved, add, 1.0 g more. Shake until dissolved. Record your observations.
5. Continue adding 1.0 g of sugar to your water, shaking for **ONE MINUTE**, and recording observations until the sugar will no longer dissolve.

Volume of water (mL)	TOTAL Mass of sugar (g)	Did the sugar dissolve? Other observations?

6. Pour out your sugar water and begin again, now with **10 mL** of water in the test tube.
7. Using your thumb to cover the opening of the test tube, shake for **ONE MINUTE** until the sugar dissolves.
8. Wait another minute before observing. If the sugar settles on the bottom then it has not dissolved.

**RECORD YOUR OBSERVATIONS IN THE DATA TABLE**

9. If the 1.0 g of sugar dissolved, add, 1.0 g more. Shake for **ONE MINUTE** until the sugar dissolves.
10. Wait another minute before observing. If the sugar settles on the bottom then it has not dissolved.
11. Continue adding 1.0 g of sugar to your water and shaking and recording observations until the sugar will no longer dissolve.

Name: \_\_\_\_\_ Per: \_\_\_\_\_

Volume of water (mL)	TOTAL Mass of sugar (g)	Did the sugar dissolve?

12. Compare the values you obtained with one other group. Who did you share with? \_\_\_\_\_

13. How do you explain the variation in the results if there were any? \_\_\_\_\_

14. Based on your results, and the results of the person you shared with, can you now help Dalilah determine how much sugar can be added to her 8 liters of water? How much should she add?

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15. There is always a limit to how much sugar will dissolve in a particular amount of water. When this limit is reached, the solution is said to be \_\_\_\_\_.

## Step 2: Determining the concentration of solutions

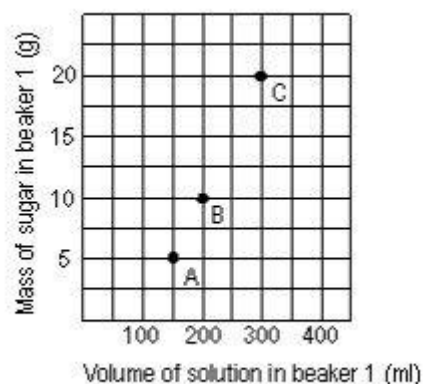
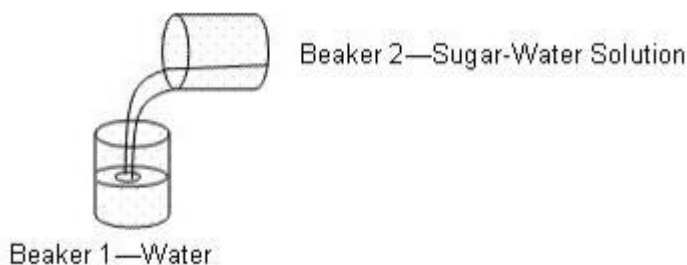
Not all solutions are **saturated**, however there is a way to communicate how concentrated a solution is. For the example in part I, your solution in each step had a particular concentration that was different from the concentration of the previous step.

1. The concentration of each of your sugar-water solutions made in Part I is expressed as the mass of sugar dissolved in each 100 ml of water.
2. Consider the following beaker of 35 grams of sodium chloride (salt) dissolved in 250 ml of water.
  - a. What is the concentration of this solution? (include units) \_\_\_\_\_
  - b. What would be the concentration if 50 ml of the solution was poured off? \_\_\_\_\_
  - c. Using the original beaker, what would be the concentration of the solution if we added 150 ml of water?  
\_\_\_\_\_
  - d. Using the original beaker, what would be the concentration of the solution if we added another 25 grams of salt? \_\_\_\_\_

This lesson is adapted from Physics by Inquiry, L.C. McDermott and the Physics Education Group at the Univ. of Wash. (Wiley, 1996)

Name: \_\_\_\_\_ Per: \_\_\_\_\_

Below is a beaker of plain water and a beaker of a very concentrated solution of sugar and water. In three separate pours, sugar-water solution from beaker 2 is added to the water in beaker 1. A graph of the contents of beaker 1 is shown below for the three pours, A, B, and C.



Using the data from the graph, answer each question and explain how you determined your answer.

- What volume of sugar-water solution was added in the last pour? \_\_\_\_\_
- What was the concentration of the sugar-water solution in beaker 1 after the last pour from beaker 2? \_\_\_\_\_
- What was the concentration of the sugar-water solution originally in beaker 2? \_\_\_\_\_
- How much water was in beaker 1 at the beginning of the experiment? \_\_\_\_\_
- Two students are discussing the idea of concentration with each other. Help the students resolve their disagreement.

**Student 1:** "I have 25 ml of solution in this test tube. It has a concentration of 3.1g/100ml."

**Student 2:** "That doesn't make sense. First you say that you have 25 ml of solution, then you say you have 100ml."

Which student do you think is correct, and why?

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In the problems above, a solid was always mixed into a liquid. In solutions such as these, the solid is typically called the **solute** and the liquid is called the **solvent**. The amount of \_\_\_\_\_ is usually expressed as a mass. The amount of the \_\_\_\_\_ is usually expressed as a volume.