Test Tube Challenge

Density Inquiry Lab Activities

Introduction

Three colored solutions of different densities are prepared, and then carefully added to a graduated cylinder to demonstrate layering. A spectacular demonstration on density.

Concept

- Density gradient

Materials

Food coloring (red and blue)

Sucrose (table sugar), $C_{12}H_{22}O_{11}$, 60 g

Water, tap

Balance, 1.0-g precision

Beakers, 400-mL, 3

Graduated cylinder, 1000-mL

Stirring rod

Preparation

1. Obtain three 400-mL beakers and add 200 mL of tap water to each beaker.
2. Prepare a 20% sucrose solution by adding 40 grams of table sugar to one of the beakers and stir until sugar has dissolved. Add three drops of red food coloring to this beaker and set aside.
3. Add 20 g of table sugar to a second beaker containing 200 mL of tap water. Stir until sugar has dissolved and set aside.
4. Add three drops of blue food coloring to the third beaker containing only water. Stir to mix food coloring.
5. Carefully pour the 20% sucrose solution into the bottom of the 1000-mL graduated cylinder.
6. Tilt the graduated cylinder to a 30-35° angle. Slowly pour the 10% sucrose solution (colorless) down the side of the cylinder where it will sit on top of there 20% sucrose solution (red). *Caution:* This step must be done very slowly and carefully to ensure the layers do not mix.
7. Repeat step 6 to add the tap water (blue) as the top layer. See Figure 1 for appearance of final product.

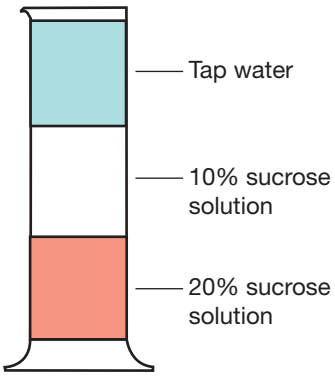

Figure 1.

Procedure

1. Have the prepared cylinder set out in front of the class when the students arrive.
2. Instruct students they will be creating their very own on a smaller scale using a 20 × 150 mm test tube.
3. As this is an inquiry based activity, inform students of the following criteria and leave the remainder of the procedure for them to develop.

   a. The test tube must contain three liquid layers.

   b. They may use tap water, sugar and food coloring. They do not have to have all three in every layer.

   c. There should be no solids in the final test tube.

   d. They are free to use any equipment in the classroom.

Publication No. 91306
061616

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Solutions may be rinsed down the drain according to Flinn Suggested Disposal Method #26b.

Tip

- To save time making the sugar-water solutions, try using one sugar cube or packet for the least dense sugar solution, two packets for the next solution, etc. Add the solutions while students make observations.

Discussion

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Since all the solutions have the same volume, the greater the amount of sugar in the solution, the greater the density.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, structure of atoms, structure and properties of matter, chemical reactions

Acknowledgments

Special thanks to John Hnatow, Jr., Emmaus High School, Emmaus, PA for providing us with the instructions for this activity.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Test Tube Challenge* activity, presented by Jeff Bracken, is available in *Density Inquiry Lab Activities* and in *Jeff Bracken Challenge Labs*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Test Tube Challenge* are available from Flinn Scientific, Inc.

Catalog No.	Description
S0135	Sucrose, Crystal, 2 kg
GP6068	Test Tubes without Rims, 20 × 50 mm

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.