Density of Soft Drinks

Density Demonstrations

Introduction

This is a very well-known demonstration that people have been doing for many years. Much educational research indicates that students have great difficulty in distinguishing between the related concepts of mass and volume. This demonstration provides a terrific opportunity to correct misconceptions that many high school students still possess.

Concepts

- Mass
- Volume
- Density

Materials

Nutrasweet®, spoonful
Saturated salt water
Soft drinks, canned*
Sugar samples
Water, tap
Aloha sign
Aquarium, with water
Aquarium, with salt water
Bags, Ziploc®
Double pan balance
Hawaiian lei, optional
Toy airplane, optional

**Diet and Regular Pepsi®, Mt. Dew®, Dr. Pepper®, Sprite®, A & W Rootbeer®, and RC® work well.*

Safety Precautions

This laboratory activity is considered nonhazardous. Follow all standard laboratory safety guidelines.

Procedure

Part A. Freshwater Demonstration

1. Ask students to predict what will happen when each can is dropped into the tap water.
2. Drop each soft drink can into the large tap water aquarium.
3. Students will soon recognize the pattern. The cans containing diet soda float whereas the cans containing regular soda sink.
4. Ask students to name differences between the cans. *Example:* Are they the same size? *Note:* Some students will attribute the sinking and floating to density and Nutrasweet without making the connection to the mass variable in the density equation. Express the importance of the volume being constant.
5. Ask students to predict the relative mass of each can of soda.
6. Place each can on the double pan balance and reveal that the regular soft drink has greater mass.
7. Assuming that the diet and regular soft drinks taste identical, is Nutrasweet more or less sweet than regular sugar? *Note:* Most people have great difficulty accepting that any "chemical" could be sweeter than sucrose.
8. Obtain two Ziploc bags.
9. Fill the first bag with 180 g of sugar and label the bag sugar.
10. Fill the second bag should contain 1 gram of Nutrasweet. Label the bag Nutrasweet. *Note:* If Nutrasweet is not available the bag may be filled with 1 gram of sugar.
11. Display both bags to the students. Explain to students despite the difference in mass, the contents of both bags have the same taste.

Part B. Saltwater Demonstration

1. Ask students if they have ever been to the ocean and what do they notice about the ocean? Eventually students will remember it is easier to float in the ocean.

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2. Tell students its time for a trip to Hawaii! Grab a diet and regular soda. *Optional:* Start the tropical music, place a lei over your head, reach to get a hidden styrofoam airplane, move across the room to reveal a hidden saltwater aquarium. Students will see the "Aloha" sign behind the aquarium.
3. Drop both the diet and regular soda into the saltwater aquarium.
4. Both cans will float in the saltwater solution.

Disposal

The soft drink samples can be used for several years before needing to be replaced. The saturated salt water solution can be collected and stored for future demonstrations.

Discussion

When both kinds of soda (diet and regular) are placed into an aquarium of tap water, the diet floats and the regular sinks. The explanation for this observation is attributed to the relative sweetness of sugar and Nutrasweet. Nutrasweet is approximately 180 times sweeter than sucrose (sugar). This means that if a recipe called for 180 grams of sugar, only 1 gram of Nutrasweet would be needed to provide the identical taste! Nutrasweet Spoonful is a product that claims that 1 teaspoon of it tastes the same as 1 teaspoon of sugar. The vast majority of this product is maltodextrin as a filler! Most people would assume that Nutrasweet Spoonful is pure Nutrasweet.

Most students are already aware that people float better in oceans than in swimming pools, but very few recognize that this is due to density.

Diet Soda Can < 1.0 g/mL (water) < Regular Soda Can < 1.16 g/mL (Salt water)

Extremely "hard" tap water can have a density significantly higher than 1.0 g/mL This can cause even the regular cans to float!

Connecting to the National Standards

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

Unifying Concepts and Processes: Grades K–12
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter

References

Roberts, Royston M. (1989). *Serendipity: Accidental Discoveries in Science.* New York, John Wiley & Sons.

Summerlin, L. R.; Ealy, J. E.; Borgford, C. L.; Ealy, J. B. *Chemical Demonstrations. A Sourcebook for Teachers*, Volume 2, 2nd ed; American Chemical Society, 1988, pp 126–127.

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Density of Soft Drinks* activity, presented by Jeff Bracken, is available in *Density Demonstrations*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Density of Soft Drinks* are available from Flinn Scientific, Inc.

Catalog No.	Description
FB0210	Aquariums, All-Glass®
S0063	Sodium Chloride, 500 g

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