Sink or Swim

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Grade Levels:

Grades 7 through 9

Discipline:

Physical Science - Chemistry

Goal:

Students will identify density as a characteristic property of matter.

Specific Objectives:

Students will define density and explain how to determine the density of an object.

Background:

Sometimes it is useful to know the amount of mass in a given volume of an object.This quantity is known as density. Density is defined as the mass per unit volume of a substance. The following formula shows the relationship between density, mass, and volume:

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

This demonstration shows the differences in the densities of different liquids, and how these differences affect the liquid's physical properties and interaction with other materials.

Materials:

- 2 ice cubes
- 2 250-mL beakers
- 2 400-mL beakers
- salt water solution
- 12-oz. diet soda
- 12-oz. regular soda
- isopropyl alcohol
- 2 eggs
- battery jar or aquarium
- goggles
- food coloring

Management Tips:

1. Add approximately 150 g of salt to 300 mL of water for the salt solution.
2. Use raw eggs. Also, use the same brand of diet and regular soda.
3. The density of water is l.00g/cm^3. Ice is 0.92g/cm^3; sea water is 1.03g/cm^3; alcohol is about 0.79 g/cm^3.
4. This activity can be adapted for use in cooperative learning groups.

Procedure:

1. This demonstration is a very simple way to introduce and interest students in the concept of density. Before the students arrive, prepare the following examples of density differences as seen through buoyancy:

- **a.** Two 250-mL beakers for ice cubes - one with water, one with isopropyl alcohol, or any nontoxic liquid with a density of less than 0.92 g/cm^3.
- **b.** Two 400-mL beakers for eggs - one with 300 mL of water, and one with 300-mL of a concentrated salt solution.
- **c.** An aquarium or battery jar of water for the soda cans (save this for the following activity- "The Choice is Yours: A Density Excursion").

2. Place the ice cubes, eggs, and soda cans in the respective containers when you are ready to perform the demonstration

3. After students make an initial observation, add food coloring to each container to improve visibility.

4. Have students record and discuss their observations and explanations leading to the concept and definition of density.

5. Explain how density is calculated using sample problems.

- **a.** If 96.6 g of gold has a volume of five cubic centimeters, what is the density of gold?
- **b.** If 96.5 g of aluminum has a volume of 35 cubic centimeters, what is the density of aluminum?

6. Have students make some mass and volume measurements of the water and alcohol and calculate their densities.

Questions:

1. Explain why the eggs, ice cubes, and soda cans floated in one liquid but not in the other.

2. Why do you think oil floats on water?

3. Give a stepwise procedure by which you could find the density of any object.

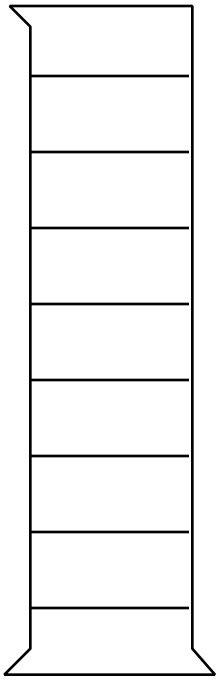
References:

This activity was adapted from an experiment entitled "The Mysterious Sunken Ice Cube" from the book *Chemical Demonstrations*, Vol. 2, 2nd edition, Lee R. Summerlin, Christie L. Borgford, and Julie B. Ealy, American Chemical Society, 1988.

Extended Activities:

1. The "Choice is Yours - a Density Excursion" may be used as a follow up to this activity to further practice calculating the density of matter.
2. Determine the density of salt water.
3. Using the substances and density information given, show where the following substances would be located if they were placed in a graduated cylinder by writing the names of the objects on the lines provided in the figure:

Air 0.001 g/cm^3
corn oil 0.93g/cm^3
corn syrup 1.38g/cm^3
glycerine 1.26g/cm^3
plastic 1.17g/cm^3
rubber 1.34g/cm^3
steel 7.81g/cm^3
water 1.00g/cm^3
wood 0.85g/cm^3



4. Imagine that the squares below are beakers filled with 100 mL of two different liquids, and that the dots inside them are molecules of the different liquids. Draw a circle around the square that contains the most dense liquid.