Mass vs. Density

A Physical Science Demonstration

Introduction

Two candle pieces, one large and one small, are placed in clear, colorless liquids. One candle sinks, the other floats. What causes the difference? Is it their mass? Is it their density? Maybe not all colorless liquids are identical!

Concepts

- Mass vs. density
- Observation
- Intensive vs. extensive properties
- Hypothesis

Materials

Candle, paraffin wax
Ethyl alcohol, CH_3CH_2OH, 400 mL
Water, H_2O, 400 mL
Watch glass (to fit beaker), 2
Beaker, 600-mL, 2
Knife
Tongs

Safety Precautions

Ethyl alcohol is toxic by ingestion and inhalation and a skin irritant. It is also flammable and a dangerous fire risk. Use in a well-ventilated area and keep all sparks and flames away from it. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

1. Label two 600-mL beakers 1 and 2 and place them on the demonstration table.
2. Before students come into the classroom, add about 400 mL of ethyl alcohol to beaker #1. Cover the beaker with a watch glass to reduce evaporation and to prevent the vapor (odor) from diffusing around the room.

Procedure

1. To beaker #2, add about 400 mL (or slightly less) tap water. Let the students see you filling this beaker. Cover the beaker with a watch glass.
2. *(Optional)* Observe the liquid levels in the two beakers. Add a little extra water to beaker #2 and then, observing that the two liquids are still not level, pour a little water from the second beaker back into the first. Cover both beakers with a watch glass.
3. Cut a paraffin wax plumber's candle into two pieces, one about twice as long as the other. Observe that the two candle pieces are not equal.
4. Place the larger candle piece into beaker #1 (ethyl alcohol). The candle sinks.
5. Place the smaller candle piece into beaker #2 (water). The candle floats.
6. Invite discussion. Why does one candle float and the other sink? Ask the students to predict what will happen if the two candle pieces are switched.
7. Use tongs to remove the candle pieces from their respective beakers.
8. Place the larger candle into beaker #2 (water). The candle floats.
9. Place the smaller candle into beaker #1 (ethyl alcohol). The candle sinks.
10. Invite questions, hypotheses, and explanations.
11. If students ask whether the two liquids are the same, ask them how they would determine this. Let one student smell (by wafting the vapors only!) the ethyl alcohol to determine that the two liquids are not the same.

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Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Candles may be reused or disposed of according to Flinn Suggested Disposal Method #26a. Ethyl alcohol may be reused or disposed of according to Flinn Suggested Disposal Method #26b..

Tips

- This demonstration will work with either anhydrous ethyl alcohol or 95% ethyl alcohol.
- Make the most of the discrepant events observed in this demonstration. Remember that students often learn best when they have the opportunity to confront their own misconceptions—you want students to guess the "wrong" answer first!
- Remind students of the difference between an observation and an interpretation (or inference). Students may have observed that the two liquids were both clear and colorless. Some students interpreted this (incorrectly) to mean that the two liquids were identical.
- Determine the density of the two liquids by massing 100 mL of each liquid.

Discussion

Whether a solid object sinks or floats when immersed in a liquid depends only on the relative densities of the solid and liquid and is independent of both the mass and shape of the solid and the volume of the liquid. Density, the ratio of mass per unit volume, is an *intensive* physical property—it does not depend on the amount of material. Density is therefore a unique and characteristic physical property that can be used to help identify a substance.

The three substances used in this demonstration and their approximate room temperature densities are as follows: ethyl alcohol, 0.79 g/mL; a paraffin wax candle, about 0.90 g/mL; and water, 1.00 g/mL. The candle is therefore more dense than ethyl alcohol (the candle sinks) and less dense than water (it floats).

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
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 and properties of matter

Reference

This activity was adapted from Flinn ChemTopic™ Labs; Vol. 1 Introduction to Chemistry; Cesa, I., Editor; Flinn Scientific: Batavia, IL (2002).

Materials for *Mass vs. Density—Chemical Demonstration* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP6253	Flinn ChemTopic™ Labs, Vol. 1, Introduction to Chemistry
E0009	Ethyl Alcohol, 500 mL
C0192	Plumber's Candles, White, Pkg/4
GP1025	Beaker, 400-mL
GP8008	Watch Glass, Pyrex®

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