

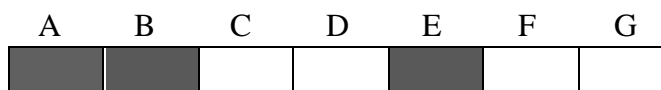
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Density Tubes

Concept: Identifying matter using physical properties of density

National Science Standards:



Background:

Density is a property of all matter. The density of an object is simply a comparison between its mass and its volume (the amount of space it occupies). If two objects have the same volume, the one with the greater mass has the greater density. If two objects have the same mass, the one with the smaller volume will have the greater density. If a substance floats in water, assuming that the substance does not dissolve in or react with water, its density is less than that of water. If the substance sinks, its density is greater than that of water.

Liquids have their own characteristic densities. An instrument used to measure the density (specific gravity) of a liquid is called a hydrometer. Hydrometers follow the Archimedes' principle which states that any object that floats displaces an amount of liquid equal to its own weight. If the density of a liquid is greater, the object floats higher, as it has to displace less liquid to equal its own weight. If the hydrometer floats deeper, it is in a liquid of lower density.

Objectives: Determine the relative densities of water, alcohol, and cooking oil.

Determine where different recycled materials would settle in given liquids.

Apply newly learned information to create a density tube.

Suggested grade levels: 4-6

Estimated time:

- Teacher prep: 30 minutes for each part
- Activity: two 40-minute sessions

Materials needed: (Quantities listed are per group unless otherwise noted. * indicates that the quantity needed is one per student.)

- Part I:
- 3 tubes (Density tubes with covers are centrifuge tubes (rounded bottom) or vials (flat bottom). Plastic tubes or vials are safer than glass and are available from Flinn or American Science Surplus, tel#847-982-0870; 3605 Howard Street, Skokie, IL 60076.)
 - permanent marker

- water
- test tube stand
- clay ball
- cooking oil
- test tube brush
- 3 film canisters with lids
- soap
- metric ruler
- 50 mL graduated cylinder
- pipette
- 1 straw
- rubbing alcohol
- labels
- recycled plastic pellets:
- GOGGLES*
- pencil
- recycled plastic pellets:
 - #1 polyethylene (PE)
 - #2 high density polyethylene (HDPE)
 - #5 polypropylene (PP)

Part II:

- film canister lids*
- 3 beaker
 - hot glue gun
 - 3 pipettes
 - plastic test tubes with screw-on lids*
 - recycled plastic pellets:
 - #1 polyethylene (PE)
 - #2 high density PE (HDPE)
 - #5 polypropylene (PP)
 - alcohol
 - water
 - cooking oil
 - funnel
 - GOGGLES*

Safety/Disposal: Wear safety goggles.

Students will dispose of all liquids by pouring them into a designated disposal container. The teacher will filter this container and liquids may be disposed down the drain if permitted in your community. Plastic pellets should be placed in the garbage.

Procedure:

Part I:

1. Before the activity, the teacher should make the hydrometer and prepare student containers of

the liquids.

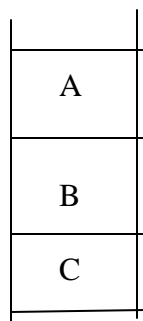
1. A. Using a ruler and a permanent marker, measure and mark 1 cm intervals the length of the straw.
B. Cover one end of the straw with a small ball of clay. Check that the clay will fit inside the test tube without touching the sides.
C. Fill 3 film canisters 3/4 full of liquid, one canister for each liquid.
2. Direct the students to fill the first test tube with 20 mL of alcohol from the film canister. This test tube should be labeled “alcohol.”
3. Instruct the students to place the hydrometer (the straw with the clay ball on the end) in the test tube and read the scale from the bottom up. They should record data on the data sheet.
INSTRUCT THE STUDENTS NOT TO EMPTY THE TEST TUBE.
4. Have them repeat the above procedure using 20 mL of water and 20 mL of oil. Tell the students to label the tubes “water” and “oil.” Again, have them record on the data sheet.
5. Next, the students should place 1/4 tsp. of PE (#1) plastic pellets in film canister lid and drop 3-4 pellets in each test tube. They should push pellets down with a pencil to remove air bubbles. Instruct the students to observe where pellets settled within each liquid and record on the data sheet.
6. Have the students repeat number 3 of the procedure using HDPE (#2) and PP (#5) plastic pellets.

Part II

1. Before the activity, the teacher should prepare the test tubes and student containers of the liquids.
 - A. Use a hot glue gun to glue test tube bottoms onto film canister lids to stabilize the test tubes.
 - B. Fill 3 beakers, one of each of the three liquids. Prepare one set per group.
2. Based on experiment results from Part I and concepts learned in the “Recyclable Plastics” activity, select two liquids to use in the density tube. (Note: Alcohol and water will mix together.)
3. Direct the students to use a funnel to fill the test tube 1/2 full of the first liquid. Add the second liquid leaving some room at the top. Students may choose to add food coloring to one of the liquids.
4. Instruct the students to add a few plastic pellets (10-12) into the tube. Any combination of pellets can be used. Tell them to use some pellets that you know will float in the middle between the two liquids.
5. Tell the students to add more of one of the liquids so that it is filled to the top of the tube and place cap on tightly. (Note: Tubes work best with no air in them.)
6. Next, they should turn test upside down and observe what happens.

Wrap-up:

- Expected results: In Part I, the relative densities from highest to lowest are: water, cooking oil, alcohol. PE (#1) will sink to the bottom of all three test tubes. HDPE (#2) will float in water and in alcohol and oil. PP (#5) will float in all three.
- Follow up questions:
 1. Look at the diagram below. Label which letters would be alcohol, water, and cooking oil.



A _____

B _____

C _____

2. In the water, where did HDPE settle? Is this material more or less dense than water?
3. In the alcohol, where did HDPE settle? Is this material more or less dense than alcohol?
4. In the cooking oil, where did HDPE settle? Is this material more or less dense than the cooking oil?
5. In your density tube, which liquid was most dense? How do you know?

Extensions:

- Have students layer all the liquids in the test tube from most dense to least dense based on experimentation.
- Use a variety of other liquids such as corn syrup, liquid soap, salt water, glycerin, milk, vinegar, maple syrup, honey, and sugar water. Baby oil is not recommended.
- Use recycled particles that are numbered 3, 4, 6, and 7.
- Have students make hydrometers.
- Make a density column using five different liquids.
- Add some glitter to the density tubes.

Resources:

This activity is based on a presentation at the MATR Institute by Sandra Van Natta, a middle school teacher in Cincinnati, Ohio.

Hands on Physical Science Activities by Marvin Tolman. Parker Publishing Co., 1995.

Chemistry is Fun by Mickey and Jerry Sarquis, Institute for Chemistry Education, University of Colorado, 1990.

Hands On Plastic: A Scientific Investigation Kit from The American Plastics Council and NMLSTA.