



We've Got a Floater...

Credits: Elizabeth Gall & Laura Moribe, University of Tennessee Extension

Skill Level

8th grade

Learner Outcomes

Youth will be able to explain the relationship between mass and volume.

Youth will be able to list two ways one can tell the density of an object in comparison to water.

Education Standard(s)

CCSS.ELA-Literacy.SL.8.1.C

CCSS.MATH.Content.8.5

GLE 0807.Inq.5

GLE 0807.9.2

Success Indicator

Form a hypothesis about density of various objects.

Life Skill(s)

Communication

Tags

STEM, science, chemistry, density

Time Needed

30-45 minutes

Materials

- ◆ Water in 2 plastic containers
- ◆ 1 tea light candle
- ◆ 1 empty tea light candle container
- ◆ Clay

Background

Note: Background information is provided here; facilitators do not distribute to the learners. It can be discussed briefly after youth have completed the experience.

The density of a substance is defined as the relationship between the mass and volume of that substance. More specifically, density is an indicator of how packed the atoms of a substance are. If the atoms within a substance are well-organized and well-packed, then that substance is relatively dense. On the other hand, if the atoms of a substance are scattered and loose, then that substance is less dense. In other words, even if two substances are occupying the same volume, the density of each substance will be determined by how compact the atoms are within each substance. One way to observe the density of an object is by placing it in water and seeing whether it floats or sinks.

This activity examines density by looking at two different substances—clay and candle wax. Students will measure similar volumes of the two substances and will compare the two masses to determine which substance is more or less dense relative to water.

Introduction and Opening Questions

What happens to a beach ball when you throw it in the pool at 4-H Camp? What would happen to a bowling ball if you threw it in the pool? What do you think makes the beach ball act differently from the bowling ball?



Experience *(use the Experiential Learning Model and encourage critical thinking and the use of science abilities and skills)*

Activity:

Facilitator Preparation:

Facilitator should prepare both the candle wax and an equal volume of clay. Remove the candle wax from the metal container. Prepare an equal volume of clay by placing it, not packing it, into the metal container. Make sure the clay weighs less than the candle wax.

Weigh the equal volumes of water, candle wax, and clay. Provide the mass amounts to the students to complete the Student Handout.

Demonstration:

Facilitator should show that the candle wax is heavier than the clay but that the candle wax floats and the clay sinks.

- 1) Ask students which substance is heavier. Have one or two students weigh both substances in their hands to determine which is heavier (emphasize that the candle wax is heavier than the clay).
- 2) Ask students to predict whether the clay/candle wax will sink/float (students can write down their prediction on the Student Handout provided in the back).
- 3) While students are writing down their predictions, pour water into a clear plastic container (or large cup) until the container is about half full.
- 4) Proceed with the demonstration by having students observe as you put both the candle wax and clay in the water (the candle wax should float and the clay should sink despite the fact that the candle wax weighs more than the clay).

Discussion:

Facilitator should briefly discuss with the students what they observed during the demonstration. For example, facilitator may ask students why they think the bigger, heavier candle wax floats and the smaller, lighter clay sinks.

Procedure:

- 1) Provide students with the mass of equal volumes of water, candle wax, and clay.
- 2) Explain to students that they will use a graph of mass vs. volume to calculate four unknown densities.
- 3) Prior to having students perform calculations, talk briefly about how density is the relationship between mass and volume and therefore, to calculate density, you must divide an object's mass by its volume.
- 4) Go through the example (Unknown Density 1) on Page 7 to determine the density of an object based on the graph.
- 5) Instruct youth to match the three unknown densities from the graph with the known densities of three objects listed next to the graph.

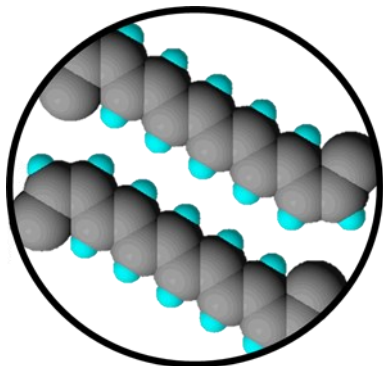


Experience (cont.)

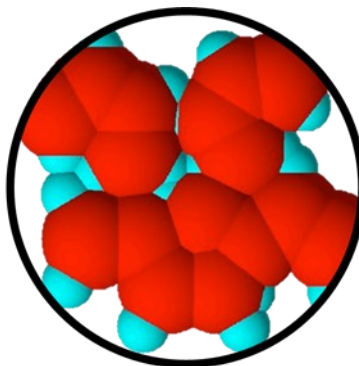
Discussion:

If there is enough time, facilitator can compare the density of each substance on a molecular level to give students a better understanding of the concept of density.

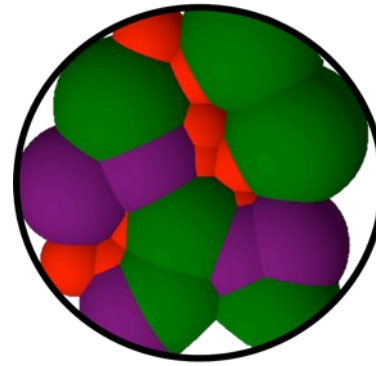
- 1) Have each group (or a couple of groups) verbally share their results with the class.
- 2) Briefly discuss the molecular structure of each substance so students can understand why clay is more dense than water and why water is more dense than candle wax.



Candle wax is made out of carbon and hydrogen atoms connected in long chains – these atoms are relatively light and the long chains keep the structure of candle wax from getting too incredibly packed.



Water is made out of oxygen and hydrogen atoms – oxygen atoms are smaller and heavier than carbon atoms making water heavier and making the structure tighter as the smaller oxygen atoms can be packed more efficiently than the long chains in candle wax.



Clay is made out of oxygen, silicon, and aluminum atoms – the silicon and aluminum atoms are much heavier than the carbon, oxygen, and hydrogen atoms found in wax and water making clay a very heavy molecule. The oxygen atoms also bond with the silicon and aluminum atoms to make a very packed structure with relatively heavy molecules.



Talk It Over...

Share...

- 1) Which substance did you observe sink and which substance did you observe float in water?
- 2) Which substance was most dense? Which substance was least dense?
- 3) How did you feel working in a group during this activity?

Process...

- 1) What physical qualities can you compare to find out whether a substance is more or less dense than water?
- 2) After having completed this activity, can you explain why a beach ball floats and a bowling ball sinks?
- 3) What is an advantage of working with others?

Generalize...

- 1) When you jump in a pool or river, do you float or do you sink?
- 2) Are you more or less dense than water?
- 3) Can you think of another situation where you have had to work with other individuals to accomplish a goal?

Apply...

- 1) If you wanted to float on water to relax or to rescue someone, what kind of substances would you use?
- 2) Can you think of another situation where density of a substance is important?

Term and Concept Discovery

Density — the mass of a specific volume of a substance

Mass — the quantity of matter in a sample

Volume — the space a sample occupies



Appendix

Standards:

CCSS.ELA-Literacy.SL.8.1.C – Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.

CCSS.MATH.Content.8.5—Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

GLE 0807.Inq.5 – Communicate scientific understanding using descriptions, explanations, and models.

GLE 0807.9.2 – Explain that matter has properties that are determined by the structure and arrangement of its atoms.

Resources:

Adapted from: American Chemical Society – “Density: Sink and Float for Solids”

Density: Sink and Float for Solids. (2015). Retrieved from: <http://www.middleschoolchemistry.com/lessonplans/chapter3/lesson4>

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Student Handout

Name _____

Use the space below to write down your initial prediction: which substance do you think will float and which do you think will sink – the candle wax or the piece of clay?

Which weighs more, candle wax or an equal volume of water?

Substance	Volume	Mass (circle one)	Density (circle one)
Candle wax	same	heavier/lighter	greater/lower
Water	same	heavier/lighter	greater/lower

Which weighs more, clay or an equal volume of water?

Substance	Volume	Mass (circle one)	Density (circle one)
Clay	same	heavier/lighter	greater/lower
Water	same	heavier/lighter	greater/lower



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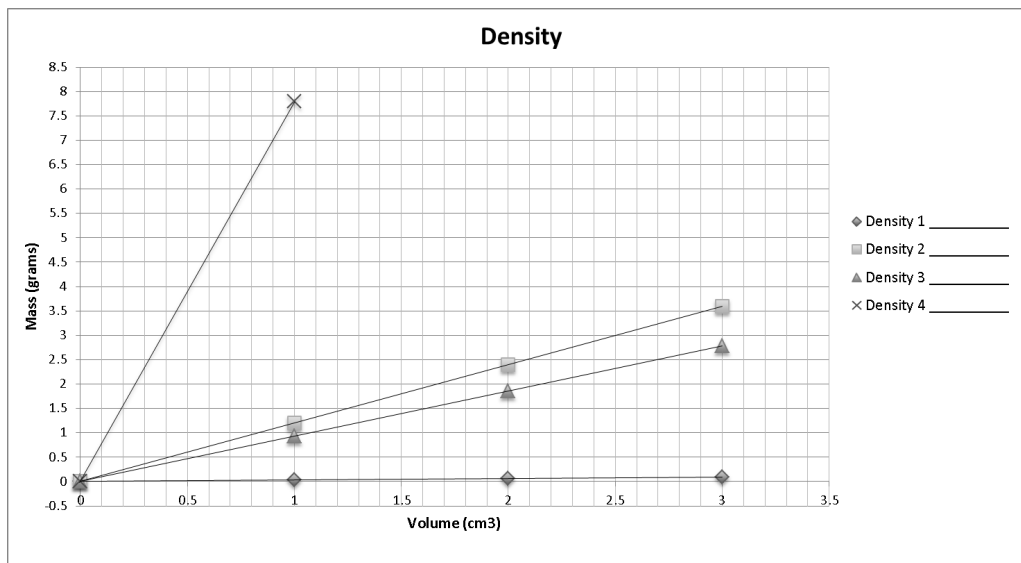
Student Handout

Example: Unknown Density 1

Unknown Density 1:

$0.1 \text{ grams} / 3 \text{ cm}^3 = 0.033 \text{ grams/cm}^3 \rightarrow \text{Beach Ball}$

Use the graph below to calculate four unknown densities. Then, match up each unknown density with a known object using the table to the right. Which line corresponds to each object?



Object	Density (g/cm ³)
Candle Wax	0.93
Clay	1.2
Anchor	7.8
Beach Ball	0.032

Use the space below to show your work for each calculation.

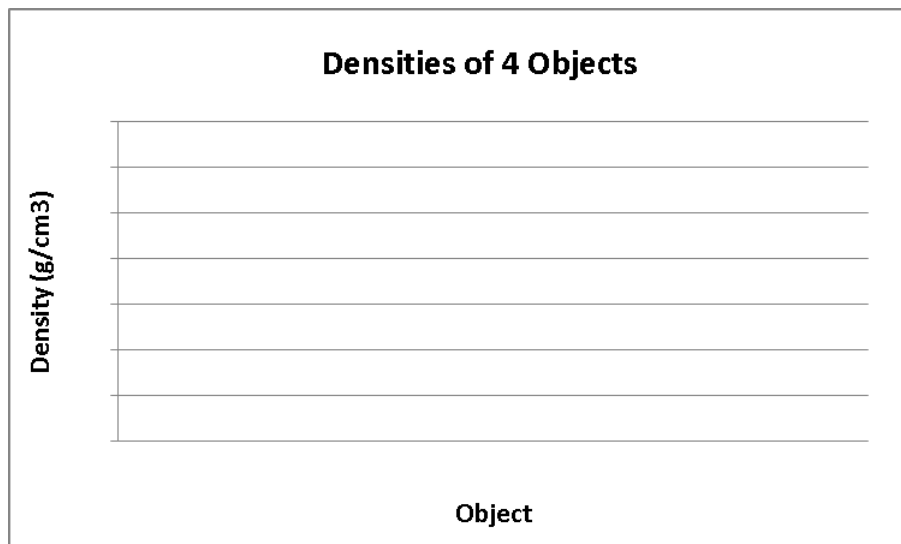


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Student Handout

What is the relationship between mass and volume?

Use the space below to create a bar graph of each object and its corresponding density.





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Answer Sheet

Several possible answers to the math portion of the activity are provided below. Students may use different values for mass and volume but the final density values should all be similar.

Unknown Density 2:

$$3.5 \text{ grams} / 3 \text{ cm}^3 = 1.17 \text{ grams/cm}^3 \rightarrow \text{Clay}$$

$$2 \text{ grams} / 1.7 \text{ cm}^3 = 1.18 \text{ grams/cm}^3 \rightarrow \text{Clay}$$

$$0.5 \text{ grams} / 0.4 \text{ cm}^3 = 1.25 \text{ grams/cm}^3 \rightarrow \text{Clay}$$

Unknown Density 3:

$$1.5 \text{ grams} / 1.6 \text{ cm}^3 = 0.93 \text{ grams/cm}^3 \rightarrow \text{Candle Wax}$$

$$1 \text{ gram} / 1.1 \text{ cm}^3 = 0.91 \text{ grams/cm}^3 \rightarrow \text{Candle Wax}$$

$$2.5 \text{ grams} / 2.8 \text{ cm}^3 = 0.89 \text{ grams/cm}^3 \rightarrow \text{Candle Wax}$$

Unknown Density 4:

$$3.8 \text{ grams} / 0.5 \text{ cm}^3 = 7.6 \text{ grams/cm}^3 \rightarrow \text{Anchor}$$

$$3 \text{ grams} / 0.4 \text{ cm}^3 = 7.5 \text{ grams/cm}^3 \rightarrow \text{Anchor}$$

$$1.5 \text{ grams} / 0.2 \text{ cm}^3 = 7.5 \text{ grams/cm}^3 \rightarrow \text{Anchor}$$