



DENSITY

Teacher Notes



FOURTH GRADE BACKGROUND

- Fourth graders can perform multiplication, but they are just learning division
- The students probably haven't talked about density
- Their only experience with density was a third grade exercise called "Float or Sink"

PREVIOUS LESSON REVIEW

- What did you learn last month about volume?
- How do we measure the volume of a cube? How do we measure the volume of a liquid?
- Review "displaced volume" to calculate the volume of an object.

INTRODUCTION

An important property of matter is density. Density can be thought of as the amount of matter that is stuffed into a fixed space or, more technically, as the mass of matter divided by its volume. For example, an empty desk is less dense than the same desk filled with books and pencils. The desks occupy the same amount of space (volume), but the full desk has more material (mass). When discussing density with the students, the following ideas need to be made apparent.

- If you pack more mass into the same volume, it's denser
- If you pack the same mass into a smaller volume, it's denser
- If an object has more mass, that doesn't necessarily mean it's denser

One way to introduce the topic of density is to revisit states of matter with a demonstration. We have three containers of equal volume: each filled with a solid, liquid, or gas. A solid has the greatest number of particles in the container, a liquid has an intermediate number of particles, and a gas has the fewest number of particles in the same container. Other demonstrations to clarify the concept of density are to compare a table tennis ball and a golf ball. The tennis ball and golf ball are the same shape; however, the table tennis ball is less dense because it is hollow and the core of a golf ball is solid. To explore the topic of relative density, the students can compare objects' densities by placing them in a cup of water. Objects that are denser than water will sink to the bottom of the cup, while those less dense will float at the top.

DISCUSSION THOUGHTS

Why do things sometimes float on water? Why does a balloon float when filled with helium but not with air?

VOCABULARY

- **Density:** The amount of matter "stuffed into a fixed space"
- **States of Matter:** The three states of matter are solids (fixed shape and volume), liquids (fixed volume and shaped by the container), and gases (filling the container)

ACTIVITIES

- **Liquid Density Demonstration**
 - Pour some corn syrup into a graduated cylinder. Next, pour the dyed water gently into the cylinder by flowing it down the side (the water can mix with the syrup if poured too vigorously). Finally, pour some vegetable oil into the graduated cylinder. The liquids will separate into red, blue, and clear layers based upon their densities. The oil is least dense and floats on the top and the corn syrup is most dense and sinks to the bottom.
 - Objective: Show that liquids with different densities will separate based upon their densities
 - Materials:
 - Corn syrup dyed with red food coloring
 - Vegetable oil
 - Water dyed with blue food coloring

- Graduated Cylinder
- **Sink or Float**
 - Students are paired up and given a cup of water and a bag of assorted items. Before putting the objects in the cup, the students should make a hypothesis about whether the object will float or sink and explain why they made each hypothesis. Objects should then be dropped gently into the cup and observations should be recorded on the worksheet. If students were stranded on an island in Lake Ontario (fresh water), which objects could they use to make a boat?
 - Objective: Determining the relative densities of objects compared to water
 - Materials:
 - 15 plastic cups half filled with water
 - 15 object bags (ping pong ball, paper clip, foam, wood, cork, marble, crayon, and penny)
 - 30 Density Experiment Worksheets
- **Denser Water**
 - As a demo, fill a small plastic cup 3/4 of the way with salt. Ask the students to formulate a hypothesis about what the salt will do to the water and the objects (will it change the density of the water?). Salt water is denser than pure water (there is more mass per volume). Add salt to the water and stir; discuss the results. Now have students determine the relative densities of the red and green cylinders. The green cylinder floats in pure and salted water. The red cylinder sinks in pure water but floats in salted (add more salt if the red cylinder doesn't float). Rinse the cylinders with clean water before placing back into the kit. If students were stranded on an island in the Atlantic Ocean (salt water), which objects could they use to make a boat?
 - Objective: Experiment with density by comparing the densities of objects in pure and salt water
 - Materials:
 - 1 plastic cup filled halfway with water
 - 1 carton of salt and spoon
 - 1 set of cylinders (red and green)
- **Aluminum Challenge**
 - Give each student a 2-inch square piece of aluminum foil and a cup of water. Tell the class to make the aluminum foil sink to the bottom of the cup. Some students will crumple the foil into a ball, but this will not solve the problem because air will be trapped inside. To make the foil sink, it must be folded up to remove all of the air between the layers.
 - Objective: Experiment with the concept of density by increasing the mass per volume of Al
 - Materials:
 - 30 aluminum foil squares (2-inch)
 - 30 plastic cups filled halfway with water

CONCLUDING THOUGHT

Does the mass of an object tell you whether or not an object will sink or float? What about volume (do bigger objects sink compared with smaller ones)? Are heavier objects always denser?