CHAPTER 7

Teaching Suggestions

Science and Mathematics Lab

(Course 2, Lesson 1-8)

Density and Buoyancy

OVERVIEW

This activity provides students with the opportunity to combine measurements of mass (g) and volume (cm^3) into a single measurement of density $\left(\frac{g}{cm^3}\right)$, a fraction that is usually expressed as a decimal. Students will be required to compare decimals in order to draw conclusions about buoyancy.

RECOMMENDED TIME

1 class period

MATERIALS

- balance scale
- beakers (250 mL and 1,500 mL)
- egg
- graduated cylinder (100 mL)
- measuring tray
- salt
- spoon
- stirring rod
- water (room temperature)

PREPARATION

You may want to have some students bring in eggs and salt.

TEACHING THE LAB

1. Have students work in groups of three. Each group member should work with the balance scale and beakers to take measurements for some of the data.
2. Students may need to be shown how to measure the volume of the egg using water displacement. Pour water into the large beaker and record the level. Place several eggs in the water and record the change in the water level. The amount of water displaced is equal to the volume of the eggs. Because beakers are not very accurate, it is better to measure several eggs at once and calculate the average. This will provide an approximate volume for an egg.

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Density and Buoyancy (continued)

3. Demonstrate how to add the fresh water to the salt water without mixing the two. Pour water from a graduated cylinder into a beaker using a stirring rod. Place the rod against the side of the beaker and gently pour the water on the rod. The water should flow down the rod to the side of the beaker. This will help prevent mixing.

4. Remind students that when weighing 100 milliliters of water they must subtract the weight of the container from the overall weight. It is best to weigh the container first and then add an additional 100 milliliters of water.

Answers and Conclusions

1. Answers may vary with the accuracy of the measurements. The density of an object is determined by dividing its mass by its volume, $D = \frac{m}{V}$. The density of fresh water is approximately 1, of salt water approximately 1.1, and of an egg approximately 1.1.

2. Sample answer: The egg sank below the fresh water but floated in the salt water.

3. The density of the egg is greater than the density of fresh water and about the same density as the salt water.

4. The egg sank to the bottom.

5. Sample answer: Buoyancy increases as the density of the liquid increases.

6. A person is less dense than the water.

7. It is easier to float in seawater because it is denser than fresh water.

8. $\frac{35}{1{,}000}$, 3.5%

9. The density of the helium is less than the density of the air, so the balloon floats.

CHAPTER 7

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Density and Buoyancy

INTRODUCTION

The density of something is defined as the mass, m, per unit volume, V. To calculate the density, ρ (Greek letter rho), you divide the mass by the volume $\left(\rho = \frac{m}{V}\right)$. Buoyancy also involves mass and volume. An object will float in a liquid because of the buoyant force acting on it. The buoyant force is the upward push of a liquid against an object. When the mass of the liquid displaced by the object is equal to the mass of the object, the object floats.

OBJECTIVES

In this lab, you will:

- determine the densities of fresh water, salt water, and an egg.
- understand the relationship between density and buoyancy.

MATERIALS

- balance scale
- beakers (250 mL and 1,500 mL)
- egg
- graduated cylinder (100 mL)
- measuring tray
- salt
- spoon
- stirring rod
- water (room temperature)

PROCEDURE

1. Weigh 125 grams of salt into the measuring tray on the balance scale.
2. Pour a liter of water into the 1,500-mL beaker. Add the salt to the water and stir until the salt dissolves.
3. Find the mass of 100 mL of the salt water. Record it in the Data Table. Pour the salt water back into the beaker.
4. Find the mass of 100 mL of fresh water at room temperature. Record it in the table.
5. Find the mass of the egg. Record it in the table.
6. Find the volume of the egg. Record it in the table. In the metric system, 1 mL = 1 cm^3.

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Density and Buoyancy (continued)

7. Slip the egg into the beaker of salt water using the spoon. Observe and record its position on a sheet of paper. Remove the egg.
8. If the egg sinks to the bottom, add another 25 grams of salt to the salt water and repeat Steps 3 and 7.
9. Carefully pour 250 mL of fresh water on top of the salt water. Pour the water down the side of the beaker using the stirring rod. *Do not mix.*
10. Slip the egg into the beaker using the spoon. Observe and record its position on a sheet of paper.
11. Stir the solution, and observe what happens to the egg.

DATA AND OBSERVATIONS

Substance	Mass (g)	Volume (cm^3)	Density (g/cm^3)
Salt Water		100 cm^3	
Fresh Water		100 cm^3	
Egg			

Questions and Conclusions

1. What are the densities of the fresh water, salt water, and the egg? Show the densities as fractions and as decimals. Record the densities as fractions and decimals in the table.
2. What happened to the egg when you added it to the fresh water? the salt water?
3. How would you compare the density of the egg to that of fresh water and salt water?
4. What happened to the egg after you mixed the salt water and fresh water together?
5. What is the relationship between density and buoyancy?
6. Explain, in terms of density, why a person is able to float in water.
7. Is it easier for a person to float in seawater or in fresh water?
8. In every 1,000 grams of actual seawater, there are 35 grams of salt. What fraction of seawater is salt? What percent of seawater is salt?
9. Explain how a balloon inflated with helium floats in air.