

Main Topic	Measurement & Analysis
Subtopic	Density
Learning Level	Middle
Technology Level	Low
Activity Type	Student

Description: Observe and explain a discrepant event in which objects float and sink in warm and cold water.

Required Equipment	Density Rods, 100mL Graduated Cylinder (2), Student Thermometer, food coloring, water, rubbing alcohol
Optional Equipment	salt

Educational Objectives

- Observe and explain a discrepant event in which objects float and sink in warm and cold water.

Concept Overview

The Density Rod Set consists of two rods. The aluminum rod sinks in warm water and floats in cool. This is because cool water is more dense than warm, and the aluminum rod is made to be between those two densities.

The PVC rod does the reverse – floats in warm water and sinks in cool. This time, the rod changes more than the water, becoming more dense when it is cool.

Lab Tips

Density Rod (aluminum)

1. Fill a graduated cylinder with warm water (50 or 60°C). To prevent air bubbles that cling to the Density Rod and cause erratic operation, use deaerated water if you can. (Previously boiled water works.) Place the rod in the warm water and observe the results. (It sinks to the bottom and stays there until the water cools.) **Explanation:** As the water cools, it becomes more dense. The water eventually becomes more dense than the rod, and the rod begins to float.
2. Half fill a graduated cylinder with cold water, and carefully pour hot water on top. (You might want to add a drop of food coloring to one half of the water.) Insert the rod and observe the results. (It will sink through the hot water and remain suspended at the boundary between hot and cold water. Note: this process is used to construct density floats that stay at a certain depth of water for ocean research.)
3. Partly fill a graduated cylinder with room temperature water. Insert the rod and observe. (The rod will float.) Carefully add a layer of 90% water and 10% alcohol and observe again. (The rod will remain suspended between the layers.) Stir the two layers together. The rod sinks to the bottom.
4. Challenge students to alter the mixture in Experiment 3 so that the rod will float again. (Adding a little bit of salt will increase the liquid's density, causing the rod to float.)

Reverse Density Rod (PVC)

1. Fill a graduated cylinder with warm water at about 40°C. (Use deaerated water if possible.) At first, the rod will sink, but as the rod warms, it will begin to float. (Watch for bubbles and disperse them if they appear.) The rod will be floating after about 3 minutes. It will float until the water cools. **Explanation:** The density of the rod also changes with temperature. In the case of the PVC rod, the rod changes density more drastically than the water does. When the rod is warm, it is less dense than water, and it floats. When it is cool, it sinks.
2. If you put the warm rod into cold water, the rod will float until the rod cools sufficiently, and then sink.
3. What will happen if the Reverse Density Rod is placed in a layered cylinder, as in #2 above? What if the layers are reversed? (The layers won't stay reversed for long. Colored layers will show that the cooler water moves toward the bottom of the cylinder, since it is less dense.)

Density Rods

Name: _____

Class: _____

Goal:

Describe and explain observations of two different rods that float and sink.

Materials:

Aluminum density rod, PVC density rod, 100mL graduated cylinder (2), thermometer, water, water/alcohol solution

Procedure:

Density Rod (aluminum)

1. Fill a graduated cylinder with warm water (50 or 60°C).
 - a. Place the rod in the warm water and record your observations.

 - b. Fill the cylinder with cold water. Place the rod in the cold water and record your observations. (If you can, instead, leave the warm water setup alone for the rest of the lab so it can cool on its own.) Explain what you observed.

2. Half fill a graduated cylinder with cold water, and carefully pour hot water on top. (You might want to add a drop of food coloring to one half of the water.) Insert the rod and observe the results.

3. Partly fill a graduated cylinder with room temperature water. Insert the rod and observe. _____ Carefully add a layer of 90% water and 10% alcohol and observe again. _____ Stir the two layers together. _____
4. Optional: Alter the mixture in Experiment 3 so that the rod will float again.

Density Rods

Name: _____

Class: _____

Reverse Density Rod (PVC)

5. Fill a graduated cylinder with warm water at about 40°C. Place the PVC rod in the water and observe it for 5 minutes. Record your observations.

6. After 5 minutes, transfer the rod to cold water. Record your observations and explain.

7. What would happen if you placed the PVC rod in a layered cylinder as in #2 above? What would happen if you reversed the layers, putting cold water on top?