

Lesson Name: Density and Buoyancy
Lesson Type: Exploration / Project
Authors: Leconte Elementary Team Sp'11
Last Updated: 4/7/11

Materials:

- Water
- Cooking Oil
- Syrup
- water bottle
- 3 2L soda bottles with the tops cut off
- several Easter eggs
- small weights (small marbles or rocks)
- aluminum foil

Agenda

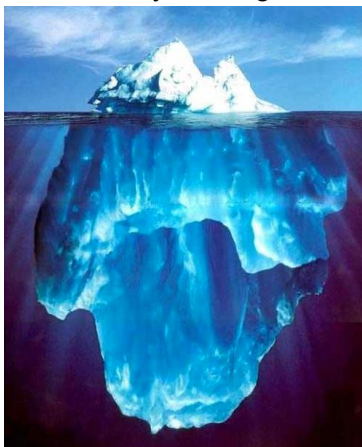
- Introduction to the concept of density/real world examples (10 min)
- Demonstration using several liquids (5 min)
- Easter egg experiment (25 min)
- Concluding thoughts/evaluation (5 min)

Introduction

Begin by asking the students what they know about density and discuss the equation for density and it's meaning with them.

$$D = m/V$$

Discuss how submarines submerge and reemerge with the students.
Discuss why icebergs float.



Demonstration

To demonstrate different densities in liquids mix cooking oil, water, and syrup in a water bottle and show them how the three different liquids with different densities separate. Ask them to determine the order of density of the liquids.

Activities:

Build a “submarine” that:

Goal A: floats on top of the water

Goal B: floats at the layer in between the syrup and water

Goal C (hardest): float in the middle of the water layer

1. Design the “submarine” by filling the plastic Easter egg shell with different “cargo” (weights).
2. Repeat until goal is met. Record how many weights were used to achieve goal.
3. Repeat for the rest of the goals.

Changing Density by Changing Volume

1. show the students an aluminum foil cube in water and observe whether or not it floats water
2. crumple up the aluminum foil cube into a compact ball and observe whether it floats in water
3. Discuss the following with the students
 - Why did the aluminum foil sink when crumpled up?
 - Did the density of the aluminum foil change?
 - How did the density of the aluminum foil change?

Closing Discussion:

Ask the students to rank the different materials used in class by density on the board.

How can you change density?

What did you do to the egg to change it's density?

How did the density of the foil change?

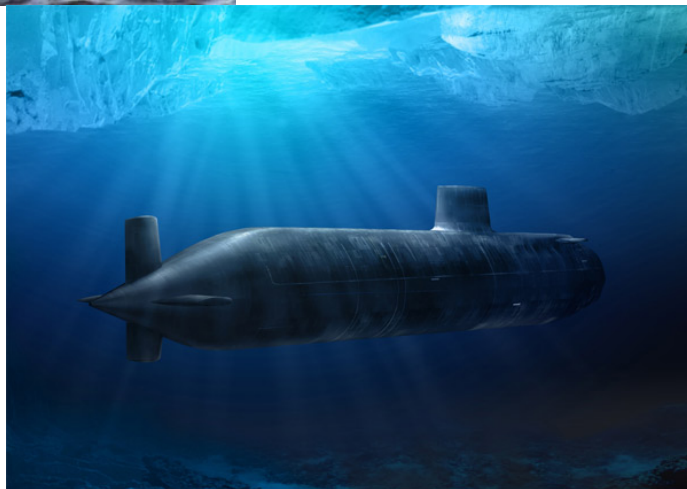
Background for Mentors:

Mass density (ρ) is defined as mass per unit volume: $\rho = m / V$

The separation of the different liquids is due to differences in intermolecular interactions, primarily the difference between polar and non-polar compounds. Water having 2 polar O-H bonds is a high polar molecule that make water a polar protic molecule. This means that the oxygen atom has a slight negative charge due to its greater attractive forces on the electrons and the hydrogen atom has a slight positive charge due to its lessor attractive forces on the electrons. Cooking oil on the other hand has large non-polar hydrocarbon chains and therefore has no slight charges as water does. Because of these differences in the presence of charge these two substances do not mix because the molecules of one do not readily replace the

molecules of the other. This is because the interactions between the respective molecules are different.

Submarines use the property of density to submerge and reemerge from water. They submerge by filling their tanks with water and thus becoming more dense. They reemerge by pumping compressed air into the water tanks, forcing the water out, and becoming less dense. This causes the buoyant force to propel them to the surface.



Worksheet:

Alternative to Worksheet: Rank the densities of different materials used in this activity on the board with the class.

Sources:

<http://science.howstuffworks.com/transport/engines-equipment/submarine1.htm>

<http://www.elmhurst.edu/~chm/vchembook/120Adensity.html>

<http://blog.vadaenergy.com/wp-content/uploads/2009/05/nuclear-submarine.jpg>

<http://www.toptenz.net/wp-content/uploads/2009/08/8-ssn-astute-submarine.jpg>