Name:_____

Density, Buoyancy, and Force Diagrams PhET Lab)

http://phet.colorado.edu/en/simulation/density

Introduction

You've heard that oil floats on water. You also know that ice cubes normally float in a glass of water. Why? What causes some things to float in water (corks, ice, dogs) and some to sink in water (rocks, metal spoons, mobsters)? Density is often described as the amount of mass crammed into a volume, and is illustrated by the formula shown below. The units for density are expressed g/cm^3, g/mL, kg/m^3, and kg/L. In this simulation, we will use kg/L. Water's density is 1.00 kg/L.

Important Formulas: $\rho = m/V$ $\quad \vec{W}_{fluid} = \vec{F}_{Buoyant}$ $\quad \vec{W}_{object} = m\vec{g}$

Procedure: *PhET Simulations → Play With Sims → Physics → Density* Run Now!

- Take a few minutes and familiarize yourself with the simulation before moving on.

Free Body Diagrams for Floating Objects:

- Using the simulator, grab the various blocks, lift them over the water and drop into the water a few times.

The %-Density Ratio *Trick*

- Estimate the percentage of the wood, ice, and Styrofoam block that is under water while those blocks are floating. Remember: the density of water is 1.00 kg/L

% Wood under water	***% Ice under water***	***% Styrofoam under water***
Density of Wood	***Density of Ice***	***Density of Styrofoam***

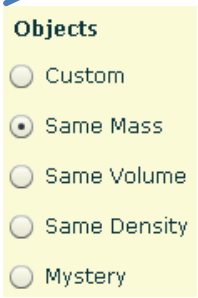
- Compare your estimations to the densities shown on the chart 0.92 kg/L. Place those densities in the chart above.
- ~~Create a formula to show how much of a floating object would be submerged in **any** fluid.~~

Calculating Density

Using the simulation, select the each scenario listed on the right, complete the tables below.

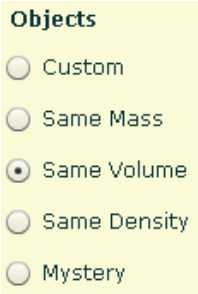
Same Mass

Block	% submerged	Mass, kg	Volume, L	Density, kg/L
Blue		5.00 kg		
Yellow		5.00 kg		
Green		5.00 kg		
Red	*Sunk / 100%*	5.00 kg		



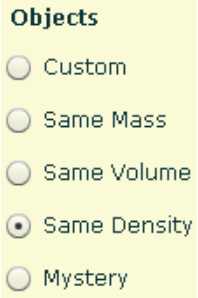
Same Volume

Block	% submerged	Mass, kg	Volume, L	Density, kg/L
Blue				
Yellow				
Green				
Red				



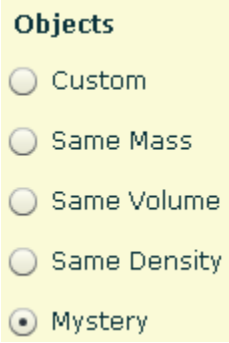
Same Density

Block	% submerged	Mass, kg	Volume, L	Density, kg/L
Blue				
Yellow				
Green				
Red				



Mystery

Block	% submerged	Mass, kg	Volume, L	Density, kg/L
Blue, B				
Yellow, A				
Green, C				
Red, D				
Purple, E				



Open up the **"Show Table"** and identify the mystery blocks:

A = , B = , C = , D = , E =

<u>Conclusion Questions</u>

1. Increasing the size of an object *increases / decreases / doesn't change* the object's density (circle)
2. An object with a density of .67 kg/L would float *1/3 , 1/2 , 2/3* **under** water. (circle)
3. A **floating** object has an upward buoyant force that is *equal to / larger than / less than* the downward weight.
4. An ice cube dropped into a glass of 100% ethanol (density=. 789 kg/L) would *sink / float*.
5. ~~Using the formula you found for the %-density ratio, determine the percentage of a wood block (ρ=.400 kg/L) that would be submerged in ethanol.~~ _____
6. Determine the density of an unknown metal that displaces 4.5 L of water and is found to have a mass of 25.4 kg. _____
7. How much water will a 1.00 kg metal block displace with a density of 7.00 kg/L? _____
8. How much water will a 1.00 kg **plastic** block (ρ= **0.60** kg/L) displace when **floating**? (careful)_____ _____
9. The red block in the "Same Volume" floats in water. The blue block sinks in water. Using your data from the chart above and your knowledge of buoyant forces and weights, what volume of the blue block would float **above** the water line if the blue block was placed on top of the red block in the water? _____