Worksheet: Buoyancy

Name: _____ Group name: _____

In this lab you will study buoyancy. A convenient unit for the density is g/cm³. Note that 1 kg/L = 1 g/cm³. The density of water is about 1 g/cm³.

1. Use the tools provided to determine the density of the objects listed. Fill in the table below, but leave the last column blank for now.

Object	Mass	Volume	Density	Fraction below surface (e.g 0.15)
Brass Cube				
Aluminum Cube				
Wood Cube				
Wood Cylinder				
Teflon Cylinder				
Copper penny				

   - Predict which of the above materials will float in water:

   - Archimedes' Principle states that the buoyant force on an object is equal but opposite to the weight of the fluid it has displaced, i.e. $F_b = \rho_{\text{water}} V_{\text{immersed}} g$, where V_{immersed} is the volume of the immersed part of the object. For a floating object this buoyant force is equal but opposite its weight so $F_g = \rho_{\text{object}} V_{\text{object}} g$. Write and expression for the fraction of the object below the surface for a floating object:

$$f = \frac{V_{\text{immersed}}}{V_{\text{object}}} = \_\_\_\_\_$$

     Use this to fill in the last column of the table.

   - Test your predictions: observe which of the objects float, and which fraction of the object is below the surface.

2. The density of the human body is about 0.98 g/cm^3. This less than the density of water, so why do we need to move to stay afloat?

3. Place the deeper part of the petri dish in the water and carefull load the teflon cylinder onto the "boat." Note the level of the water in the container with a mark on the piece of tape. Remove the cylinder and drop it into the water.

   Does the water level **rise** or **fall** (circle one)? Explain why this happened.

4. Carefully lower a paper clip onto the surface of the water so that it's suspended. (You can use the bent fork.)

   - Paper clips are made of stainless steel with a density of 7.9 g/cm^3. How can the clip still float?

   - How can you confirm your answer experimentally? Do it!

5. Use Archimedes' trick to determine the density of the metal sculpture. Weigh the object to determine its mass, then determine the volume from how much water it displaces when you immerse it.

   - $\rho =$ _____ _____
   - Based on the density you obtained, which metal is the sculpture made of?

   - At this point, you are allowed to exclaim "Eureka!" (but please don't run around naked)