Post-Lab Conclusions:

1. **Review:** How are the gram, the cm^3, and the milliliter all related?

   The milliliter and the cm3 are always equal.
   And 1 milliliter of water has a mass of 1 gram.

2. How does heating up a substance affect its density?

   Heating a substance causes the molecules to vibrate and expand. This increase in volume results in a lower density.

3. How does cooling down a substance affect its density?

   Cooling a substance has the opposite effect: the volume shrinks slightly, so the substance becomes more dense.

   (One notable exception to this rule is ice, which crystalizes when it freezes and ends up becoming less dense.)

4. How do you think adding impurities generally affects the density of a substance?

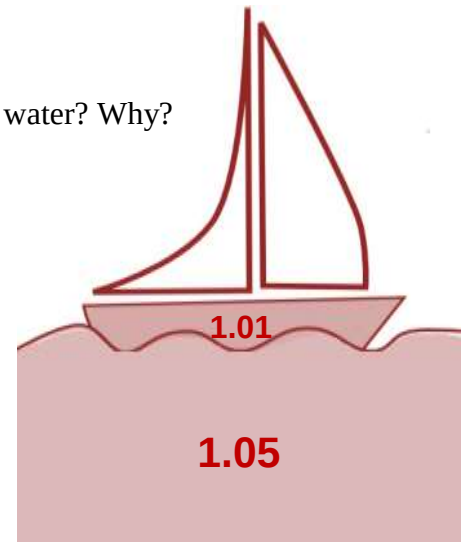
   Adding impurities (if the impurities are heavy) will generally increase the density of a substance. Salt water, for example, is more dense than fresh water because the salt adds mass without changing the water's volume.

5. Imagine you were involved in a shipwreck, and you had to build a life-raft out of either warm metal, cold metal, warm wood, or cold wood. Which would you choose and why?

   Metal is very dense, so you can rule those two choices out. And warm wood would be slightly less dense than cold wood, so it would float a bit better.

6. Do you think your life-raft would float better in salt water or fresh water? Why?

   It would actually float better in salt water. Salt water has a density of about 1.05 g/ml. So even if the boat was overloaded, and had a density of 1.01 g/ml, it would sink in a pond but still float in the ocean.



7. Explain how "hot air balloons" are able to fly, even though they are not filled with helium, or hydrogen, or any other exotic gases.

Hot air balloons are filled with (surprise!) hot air. When the air is heated, it expands and becomes less dense. This less-dense air will actually float in normal air, just like a buoy floats in the ocean. The only problem is getting back down!

8. Imagine you had a football filled with compressed air and you took it outside into the cold. What would happen to the football's density? And therefore, what would happen to the pressure inside of the football?

If a football is inflated indoors (let's say to a pressure of 12.5 PSI) and then brought outside into the cold, the molecules will condense. This causes the volume of the football to shrink, thereby increasing the density and lowering the air pressure inside the football.

9. Use your knowledge of the Metric System, mass, volume, and density to fill out the missing sections in the table below…

Object	Volume	Mass	Density	Sink or Float? *(in water)*
Mr. A	73,706 cm^3	72,600 g	**0.98 g/ml**	**Float**
Pencil	7.71 cm^3	5.4 g	**0.70 g/ml**	**Float**
Saturn	82,713 $\times 10^{25}$ ml	56,829 $\times 10^{25}$ g	**0.69 g/ml**	**Float**
Jupiter	143,128 $\times 10^{25}$ ml	189,808 $\times 10^{25}$ g	**1.33 g/ml**	**Sink**
A Black Hole	0.2475 $\times 10^{25}$ ml	9.9×10^{38} g	400,000,000,000,000 g/ml	**Sink**
Hot Air Balloon	11,930,000,000 ml	1940 kg	**0.00016 g/ml**	**Float**
Can of Coke	355 ml	362 g	**1.02 g/ml**	**Sink**
Can of Diet Coke	355 ml	351 g	**0.99 g/ml**	**Float**
The Human Brain	**1,400 ml**	1,400 g	**1.00 g/ml**	Right in Between *(so that the brain does not float/sink inside the skull)*