Introduction to Physics and Mass/Volume

<u>Required Equipment</u>:

- Balance
- Ruler
- Golf ball
- Ping pong ball
- Beaker
- Irregularly-shaped object (pencil, eraser, etc.)

<u>Pre-Lab Lecture Key Points</u>:

➔ *Physics* = the science of energy and motion

➔ Talk a little bit about physics and how we're essentially trying to understand the world around us

➔ *Mass* = the amount of "stuff" in an object ("stuff is difficult to define at this level but it's basically the number of atoms)

➔ *Volume* = the amount of space that an object takes up

➔ Make sure students really understand the difference between mass, volume, and the fact that they are completely independent

➔ Demonstrate volumetric calculations for two or three objects, including a sphere (suggested: cube = length^3 and sphere = 4/3*pi*radius^3)

➔ For simplicity, the lab assumes that the golf and ping pong balls are solid spheres and not spherical shells

➔ Don't provide students with the definition of density now but be prepared to ask them if they are familiar with it or if they can potentially come up with a formula for it

<u>Student Lab Procedure</u>:

1. Using a ruler, measure the radius of the golf ball in centimeters (cm) and record it on your worksheet.

2. Compute the volume of the golf ball using the formula provided in the pre-lab.

3. Repeat steps 1 and 2 for the ping pong ball.

4. Using the balance, measure the mass of the golf ball in grams (g) and record it on your worksheet. You may have to use something circular to keep the ball from rolling off.

5. Repeat step 4 for the ping pong ball.

*Stop here to tell the students to note that even though the balls have roughly the same volume, they have different masses (i.e. they take up the same amount of space but contain different amounts of "stuff")

*Time permitting, ask the students if they are familiar with the concept of density; if not give them the formula and ask them to compute it

6. Fill a beaker with roughly 200 mL of water.

7. Take the golf ball and place it entirely in the water.

8. Now look at the level of the water. It's higher than 200 mL! Record the new value on your worksheet.

9. Subtract 200 mL from the new value to get the volume of the golf ball.

*Stop here to show students that this volume should roughly match the volume they got by using a ruler

*Stop here to ask students if they have any ideas on how to calculate the volume of an irregularly-shaped object such as an eraser

10. Repeat steps 7-9 for an irregularly-shaped object such as an eraser or key.

11. The new water value you record will be the volume of this object!

Wrap-Up:

➔ One last time, ask students the difference between mass, volume, and density

➔ If you're feeling adventurous, begin to talk about weight, which is not equal to an object's mass but the force exerted on it by gravity

➔ Recall the classic example that a person's mass will be the same on Earth and Mars but his/her weight will not because the gravitational constant (g) is different (weight = mass*g)

➔ Time permitting, you can also ask about and/or begin to mention error sources such as the lines on the ruler or the level of water in the beaker; this is a pretty important aspect of experiments and should be introduced at some point