Station One: Pump up the Volume

At this station, you will find volume by two methods:
Definition: Volume: The amount of space that something occupies

Method One:
Use a ruler to measure the length, width and height of each of the objects.

The formula for volume of rectangular and square objects is $V = \ell \times w \times h$.

1) Record your measurements and calculations in a table like the one below.

Method Two:
Use the method of the overflow can, or just the graduated cylinder to find the volume of the objects using water. However much water the object pushes up is equal to the object's volume.

Make a data table like this:

Object	ℓ(cm)	w(cm)	h(cm)	V(cm^3)	V(mL)
Q					
Y					
Z					

2) Of the two methods that you just tried, which one is easier? Why do you say this?

3) Of the two methods you just tried, which one is the more accurate? Why do you say this?

4) Use some kind of reference material to look up two other volume formulas for objects other than square shaped. Where did you find the formulas?

4) If you were given a rock and told to find its volume, what method would you use, and why?

Station Two: *"Eureka!!!"*

The ancient Greek philosopher/scientist Archimedes was taking a bath and made one of his most famous discoveries. When he hopped into the tub and settled into its cozy water, he noticed a special thing that we take for granted. As his body went in it caused the water to rise. He realized the amount of water that rose was equal in volume to the volume of his body that went underwater. He got so excited over this that he jumped out of the bathtub and ran, naked, down the streets shouting "EUREKA!" To this day, shouting "Eureka" means you just made a neat discovery.

Use Archimedes discovery to find the volume of the objects at this station.

1) Make a data table like this one:

Object	**Volume (mL) by overflow can**

You can figure out the second method of finding the volume of the objects by using the overflow can. Be sure that you are careful and consistent so you do not introduce any errors when using this method.

2) Where could errors occur using the drop can?

3)When you are measuring something, is it better to get your measurement with lots of steps, or through just one step? Discuss how error relates to this.

Station three: "What's the Difference?"

The metric system has some measurements that are purposely similar. This makes it a system that is easier to use than other measurement systems.

At this station there is a cube that has a volume of 1000 mL.

1. Use the ruler to measure out the length, width, and height of the cube, in cm. Make sure you are measuring **from the inside walls of the cube**. Record in a table like below. Use these measurements to calculate the volume of the cube, in cm^3. To do this you multiply the length times the width time the height. (V= l x w x h). Record.
2. Mass the empty cube. Record.
3. Fill the cube with exactly 200 mL of water. Record the mass of the cube and water together.
4. Calculate the mass of just the water in the cube. Record.

Volume (cm^3) Cube	**Mass (g) Empty Cube**	**Mass (g) of Cube & H_2O**	**Mass of H_2O**

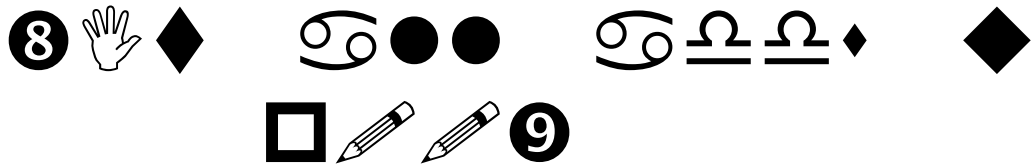
1) What's the difference between 25 mL and 25g of water?

2) Based on the measurements you just made, how many mL's of water are there in 200 cm^3? How many grams of water is this?

3) For each piece of equipment listed below, describe the steps you would take to ensure that you are using it with precision.

A) Graduated cylinder
B) TBB
C) **Ruler**

Station Four:



At this station, you are to use the small graduated cylinder to CAREFULLY measure out certain amounts of water. Each measurement is a different amount. Take turns with people in your group. Each time you measure out the amount instructed, pour all of it into the big plastic graduated cylinder. When done, read and record the volume in the plastic graduated cylinder.

DO NOT just add up all of the numbers and call it the answer… Do what the directions say to do first! (I have my reasons…) **ALSO**… be sure you are reading the grads correctly. Hint: **MENISCUS!!**

Measurement #	Volume (mL)
1	23
2	67
3	107
4	37
5	56
	TOTAL Measured VOLUME:_____ **TOTAL Added VOLUME:_____**

1) Write a short paragraph that describes what you did at this station, what you observed happen as a result, and what the lesson is to be learned from doing this station. Also: What is the meaning to the title of this station?

Station Five: "**LORRAINE** (dramatic pause) you are my **DENSITY**… I mean, **DESTINY**"

At this station you will calculate the density of some objects that are of different sizes, but made of the same material.

"Easy words" Definition: Density is a property of matter. It is a measurement of how much stuff something has packed into it.

The formula for density is: ρ**=m/v** The ρ (the Greek letter rho) stands for density. The **m** stands for mass and **v** stands for volume, and where a slash, **/**, means divide. To calculate density you have to measure an object's mass and its volume.

1) Fill in the table.
You know how to measure mass.
Find the volume of each object by dropping it into a graduated cylinder. How much the volume of the water in the cylinder increases is equal to the volume of that object.

Object	Mass (g)	Volume (mL)	Density (g/mL)
Small			
Medium			
Large			

2) How did the numbers compare that you calculated for density?

3) Why did your numbers turn out the way they did?

4) What effect does size of a type of material have on the density of the material? Why?

Station six: **"Use the Right Tool"**

At this station are ways you can measure volume, temperature, distance, and mass.

Measure the mass of the fishing sinker using each triple beam balance and record.

Measure the length **in cm** *(2.54cm = 1in)* of the line to the right using each ruler and record. (the line is right there →)

Measure the temperature of the water using each thermometer and record.

Measure out 44mL of water with a **graduated cylinder**. Pour that water into **another graduated cylinder**. Record the volume. Empty the grad. Now, using the **400mL beaker**, measure 44mL of water. Pour that into a **graduated cylinder**. Record the volume.

1)Record data in the manner shown below:

MASS:
TBB #1_____
TBB #2_____

TEMPERATURE:
Thermometer #1_____
Thermometer #2_____

LENGTH:
Ruler #1_____
Ruler #2_____

VOLUME:
Using Graduated Cylinder_____
Using Beaker_____

2) Identify what was wrong with one of each of the measuring tools you used.

TURN DA PAPER OVER!!!!

more "Use the Right Tool"

3) For each of the above measuring tools, explain what you should do to maintain accurate and precise measurement? Give a specific strategy to use for EACH tool.

4) COPY & FILL IN THE BLANK:

- If you use a graduated cylinder, you can measure ___(unit)___ to the nearest_____ place value.
- If you use a beaker, you can measure ____(unit)____ to the nearest_____ place value.
- If you use a Ruler, you can measure _____(unit)____ to the nearest_____ place value.
- If you use a thermometer, you can measure _____(unit)___ to the nearest_____ place value.

Station Seven: FLOATATION STATION

There are many reasons why things float. One key reason has to do with density.

The density of water is 1 g/mL. Your job at this station is to find the density of three objects. In order to fill in the missing information on the data table, have everyone in the group taking measurements on the different objects at the same time and share your results.

Given the equipment at this station – How can you find the volume of and object that has no real length, width or height???

Object	Mass (g)	Volume (mL *or* cm^3)	Density g/mL	Does it float?
Wood Block				Yes No
Metal Block				Yes No
Foam				Yes No

1) **What can we conclude about the density of objects that float as compared to water's density?**

2) **The density of the planet Saturn is around .8 g/mL. Would Saturn float on water?**

3) **How does the density of a hot-air balloon compare to the air around it?**

4) **Which weighs more--a ton of feathers or a ton of gold? Discuss why this question tricks people when it comes to density….**

Station Eight: "Which is the DENSEST?"

At this station there are three pieces of metal. Discuss with your lab group which one you think is the densest piece of metal. You are allowed to use only direct observation (your five senses) to make this prediction.
"Easy words" Definition: Density is a property of matter. It is a measurement of how much stuff (matter) something has packed into it.

To find the volume at this station, you are to measure the length,width, and the height. Multiply these three numbers to get the volume in cubic centimeters (cm^3).

1.)Record which of the three you think is the densest item.

2)Why do you think it is the densest item?

3) Make a data table like below, and record data.

ITEM	MASS (g)	VOLUME (cm^3)	DENSITY (g/ cm^3)
Heavy Cube			
Light Cube			
Slab			

1) Which item turned out to be the densest item?

2) Was your prediction correct?

3) If something is heavy, does that mean it is very dense? Give an example of something that is very heavy, but not dense.

Station Nine:

Use your VAST webbernet surfing skillzzzz to answer the questions below:

1) What is the difference between qualitative measurement and quantitative measurement? Make up YOUR OWN examples to help explain.

2) What type of measurement do you feel is more important to science? WHY?

3) What are the letters "SI" used to represent?

4) What is a fundamental unit? Give an example.

5) What is a derived unit? Give an example.

7) Compare and contrast "systematic" and "random" errors.

Station X: Not all Plastics are Created Equal!

The Society of the Plastics Industry, Inc., has developed a method for coding plastics by category. The code is a three-sided triangular arrow with a number in the center and letters underneath. The number inside the triangle and the letters below the triangle indicate the resin from which the container is made. Each of these plastics has its own unique **physical properties**, including its own unique **density**.

PETE **HDPE** **V** **LDPE** **PP** **PS** **OTHER**

In lab, you are going to try to figure out what the densities are of five mystery pieces of plastic. You are to use the liquids that are listed below to test the densities of the plastics.

Liquid	Density of the liquid(g/mL)
Alcohol:Water Strong mix (5:1)	≈.90
Alcohol:Water Weak Mix (3:1)	≈.95
Water (Distilled)	≈1.00
Salt Water (10%)	≈1.05

Shape	Results in the liquids (sink or float)				Recycle Code
	Strong alcohol mix (~.90 g/mL)	*Weak alcohol mix (~.95 g/mL)*	*Distilled water (~1.0 g/mL)*	*10% Salt water (~1.05 g/mL)*	
	Sink Float	Sink Float	Sink Float	Sink Float	
	Sink Float	Sink Float	Sink Float	Sink Float	
	Sink Float	Sink Float	Sink Float	Sink Float	
	Sink Float	Sink Float	Sink Float	Sink Float	
	Sink Float	Sink Float	Sink Float	Sink Float	

The chart below shows the five types of plastics that you were given for this lab. Each type is its density range in g/mL.

PP	LDPE	HDPE	PS	PETE

.90-.91	.92-.94	.95-.97	1.05-1.07	1.39+