Density Lab L2

Name ________________________ Date ________________

Lesson Objectives:

At the end of this lesson:

- You will understand that the density of a substance is related to the amount of mass contained in a given volume of that substance.
- You will explain that increasing the density of water involves filling space between molecules.

Introduction:

In this laboratory you will collect data that demonstrates the relationship between the mass of a substance and its volume. First you will prepare a 30% salt solution. You will then determine the mass of three different volumes of water (0% salt) and the same three volumes of your 30% salt solution. After collecting the data, you will plot the volume-mass relationships to determine the density of each solution.

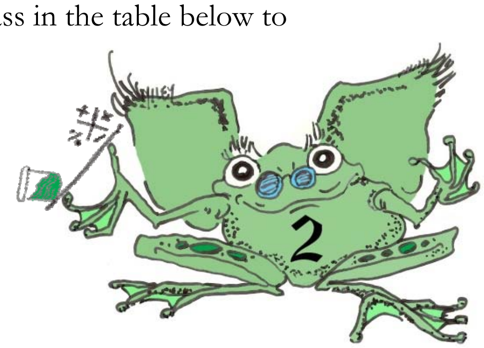
Materials:

- Labels or china markers
- Ruler or straightedge
- Calculators
- 10 ml graduated cylinder or pipette
- 100 ml graduated cylinder
- 2 beakers, each containing 200 ml of water — one beaker labeled 0% salt and the other 30% salt
- Salt (NaCl)
- Balance

Procedure:

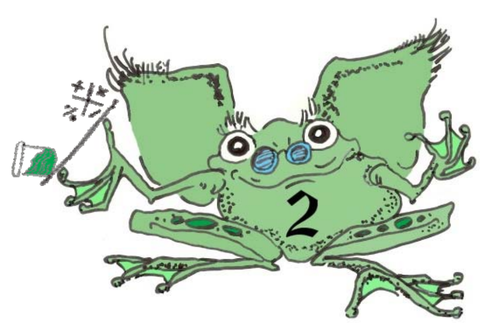
Check off each step as you complete it.

- You have been given two beakers, each containing 200 ml of water. One beaker is labeled 0% salt. Add nothing to this beaker.
- Add 60 g of salt to the beaker marked 30% salt. Stir until the salt is completely dissolved (until no salt crystals can be seen on the bottom of the beaker).
- Place a 100 ml graduated cylinder on the balance and record its mass in the table below to the nearest tenth of a gram (0.1 g).



- Measure 10 ml of the 0% salt solution (water) in a small graduated cylinder (or pipette) and pour this into the 100 ml cylinder. Place the 100 ml cylinder on the balance and record the mass in the table below to the nearest tenth of a gram (0.1 g).
- Measure an additional 10 ml of 0% salt solution (water) in a small graduated cylinder and add this volume to the 100 ml cylinder on the balance and record the mass in the table to the nearest tenth of a gram (0.1 g).
- Measure and add an additional 10 ml of 0% salt solution to the 100 ml graduated cylinder. Measure and record the mass to the nearest tenth of a gram (0.1 g).
- Determine the mass of each volume (10, 20, and 30 ml) of the solution by subtracting the mass of the empty graduated cylinder from the mass of the cylinder with the solution in it.
- Rinse and dry the graduated cylinders and repeat steps 3–7 for the 30% salt solution. Record all of your data.
- Graph the volume (column B) and the mass of solution (column E) data for each solution on the graph on the next page. Be sure to plot the points for the independent variable on the *x*-axis and the dependent on the *y*-axis. Label the axes and assign values for each box. Remember to include the correct units for each axis.

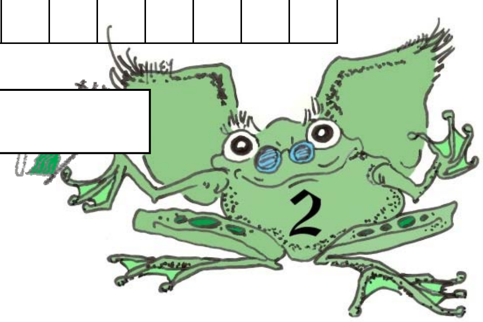
A Solution	B Volume	C Mass cylinder + solution	D Mass of empty cylinder	E Mass of solution (E = C – D)
0% salt (Water)	10			
	20			
	30			
30% salt	10			
	20			
	30			



Key:

0% salt =

30% salt =



Discussion Questions:

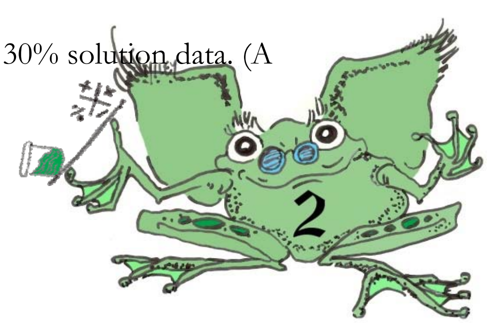
1. Do your data points fit onto a straight line similar to the line you drew to determine the density of water, syrup, and oil in the previous density activity? If not, what do you think happened

2. Calculate the density for each solution (g/ml) by dividing the mass (g) of each 30 ml measured sample by 30 ml. Remember that density equals mass divided by volume. Show your work.

0% Salt	30% Salt

3. If the two salt solutions (0% and 30%) were layered in a beaker in the same way that water, corn syrup, and oil were layered in the previous density activity, which solution would be on top? Explain.

4. Draw a line that is a best-fit line — starting at (0,0) — for the 0% and 30% solution data. (A best-fit line minimizes the amount by which the points miss the line.)



5. If your data depicts straight lines and all of the points lie on the lines, determine the unit rate of change (slope) of the lines. If your data does not fit the line(s), determine the slope of the best-fit line(s) that you drew. *(If you use the best-fit line(s), the ordered pairs to determine slope must be from the best-fit line, not from your data chart.)*

$$\text{Unit Rate of Change} = \frac{\Delta \text{ Mass (g)}}{\Delta \text{ Volume (ml)}} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

Solution	Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Mass (g) Δy	Δ Volume (ml) Δx	Unit Rate of Change (slope) $\Delta y / \Delta x$
0% salt				
30% salt				

6. Compare the calculated density from question 2 with the calculated unit rates of change (slopes). They should be the same or close to the same. Explain why the calculated density is the same as the unit rate of change (slope) of a graphed line.

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7. Using *unit rate of change (slope)* in your explanation, explain why the density of all volumes of your 0% or 30% salt solution (or any other substance or solution) will have the same density.

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