Solutions Investigation – Beer's Law **Name ___Jen Krug_________**
"Moles, Mass, and Molarity" **Block # ____________________**

Chocolate milk is an example of a solution in which a ***solute*** (chocolate syrup) is dissolved in a ***solvent*** (milk). If you like a lot of chocolate syrup in your milk, then you prefer ***concentrated*** chocolate milk. If you prefer only a little bit of chocolate syrup in your milk, then you like ***dilute*** chocolate milk. How can we relate this idea to chemistry? We would not use terms such as "dilute" and "concentrated" to describe chocolate milk. We'd probably say we like it chocolatey or not too chocolatey. When we are dealing with matter that is really small, we need to describe quantities with different terms. In this lab you will see how the mole can be used to describe solution concentrations.

For example, the molarity, *M*, of a solution is the number of moles of solute in one liter of solution. To determine the molarity of a solution, the following equation can be used:

$$\text{Molarity} = \frac{\text{moles solute}}{\text{1 L of solution}}$$

OR

$$M = \frac{\text{mol}}{\text{L}}$$

In conjunction with the molecular mass of a solute, this equation is used to determine the number of grams of solute needed to prepare a given volume of a solution with a specific concentration.

Investigation Part 1: View the video, taking notes on the essential terms and concepts.

https://drive.google.com/file/d/1Yd39jT4ug0ljSddINAb9S5daqi61sjHl/view

Investigation Part 2: Use the simulation to explore solution concentration.

Set up:

1. Go to https://phet.colorado.edu/sims/html/beers-law-lab/latest/beers-law-lab_en.html
2. Select concentration.
3. Copy this data table on your paper and fill in as you work through the simulation.

Solid	Color of solution after solid is added	Number of 'shakes' of container	Volume of solution	Reported Molarity	Calculated mass of solute in solution (grams)
NaCl	colorless	1	0.5 L	0.180 M	0.5 L x 0.180 M = .09 mol .09 mol x 58 g/mol = 5.22 g NaCl
$CuSO_4$	**blue**	**3**	**0.5 L**	**1.020 M**	0.5 L x 1.020 M = 0.51 mol 0.51 mol x 159.6 g/mol = **81.396 g CuSO4**
$Co(NO_3)_2$	**Dark pink**	**10**	**0.5 L**	**2.520 M**	0.5 L x 2.520 M = 1.26 mol 1.26 mol x 182.943 g/mol = **230.5 g $Co(NO_3)_2$**
K_2CrO_4	**Yellow**	**5**	**0.5 L**	**1.420 M**	0.5 L x 1.420 M = 0.71 mol 0.71 mol x 194.1896 g/mol = **137.9 g K_2CrO_4**
KmnO4	**Dark Purple**	**2**	**0.5 L**	**0.480 M**	0.5 L x 0.480 M = 0.24 mol 0.24 mol x 158.034 g/mol = **37.9 g $KMnO_4$**

Data Collection:

1. Choose sodium chloride from the drop down menu at the top right. Move the container up and down with your track pad to 'shake' some sodium chloride into the water.
2. Drag the purple magnifier onto the water to read the concentration of the solution.
3. Calculate the number of grams of sodium chloride in the solution. (Note the volume of the solution is shown on the left side of the container.)
4. Change the solid to copper(II) sulfate in the drop down menu.

5. Repeat steps 3-5 for copper(II) sulfate and 3 other solids of your choice.
6. Choose one of the solids that produced a colored solution. Adjust either the volume of the solution or the amount of solute. What happens to the color of the solution when these adjustments are made?