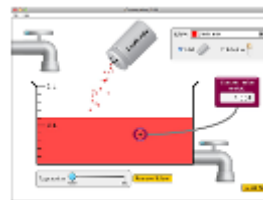


Concentration and Molarity PhET-Chemistry Labs



Introduction: Everyone likes candy. Have you ever wondered how that candy is produced? How do they get all that delicious sugar into those tiny packages? Could you make hard candy like those you can buy? It's easier than you think. Web searching for "rock candy" will yield a number of delicious recipes you can try at home.



Concentration

Some handy vocabulary for you to define:

Solute _____ Solvent _____

Moles _____

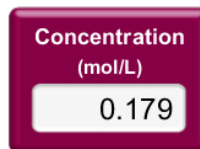
Molarity _____

Saturated (not fats) _____



Unsaturated (not fats) _____

Supersaturated _____

Procedure: PhET → Play with the Sims → Chemistry → Concentration Run Now!



Part 1: Dissolution and Saturation

Take some time to play and familiarize yourself with the simulation. Click on everything. Move all the sliders. Notice what happens to the concentration as solid solute  is added and when evaporation occurs. 

How does the concentration change as solid solute is added? _____

How does the concentration change as additional water is added? _____

How does the concentration change as evaporation occurs? _____

How do you know when a solution is **saturated**? _____

When a solution *is* saturated, and additional solid solute is added, what happens? _____

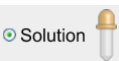
Why do you think this is? _____

How does adding this additional solute change the concentration of this saturated solution? _____

How does evaporation change the concentration of a saturated solution? _____



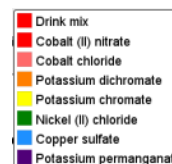
Part 2: Concentrated Solutions



Adding a concentrated solution... describe a way to determine the concentration of the solution in the spigot. Write your plan here: _____

Using your plan...how might you get that concentrated solution to become saturated? _____

Does your plan work for all the other solutions too? _____ Why? / Why Not? _____



$$\text{Molarity (M)} = \frac{\text{amount of solute (mol)}}{\text{volume of solution (L)}}$$

Part 3: Molarity ...PhET→Play with the Sims → Chemistry → Molarity Run Now!

Molarity is moles per Liter, that is, how many moles of solute (entire salt) is dissolved per Liter of solution.

First, determine the **saturation concentration** of each of the solutions, that is, how concentrated can you get each solution before the solution is saturated. If you can't determine the concentration using the simulation "Molarity", try using the simulation "Concentration" (You will use this information again in **Part 5**, if your instructor requires it)



Molarity

■ Cobalt (II) nitrate	Saturation concentration	■ Potassium chromate	Saturation concentration
■ Cobalt chloride		■ Nickel (II) chloride	
■ Potassium dichromate		■ Copper sulfate	
■ Gold (III) chloride		■ Potassium permanganate	

Part 4: Calculating Molarity Using the simulation and the formula for Molarity above, complete the table below.

Moles of Compound (mol)	Liters of Solution (L)	Molarity of Solution (M)	Moles of Compound (mol)	Liters of Solution (L)	Molarity of Solution (M)
.53	.79			.78	.59
.86	.34		.88		1.8
1.0	.20		3.5	8.4	
.67	.67			6.4	8.5

Part 5: (Extension Exercise) Total Ion Concentration (this will be important for Equilibrium, Kinetics, and Acid-Base)

Just as an entire solution has a concentration, so does each individual ion. For instance, since there are three ions when a Calcium Chloride CaCl₂ molecule dissolves into solution, a 3.0 M solution of CaCl₂ is 3.0 M with respect to Ca²⁺ ions and 6.0 M with respect to Cl⁻ ions, for an overall ion concentration (solubility) of 9.0 M (3.0 M + 6.0 M).

Using what you know about inorganic nomenclature and common ions, complete the table below

Compound	Saturated Concentration (from Part 3)	Cation Molarity	Anion Molarity	Total Ion Solubility
Co(NO ₃) ₂				
CoCl ₂				
K ₂ Cr ₂ O ₇				
AuCl ₃				
K ₂ CrO ₄				
NiCl ₂				
CuSO ₄				
KMnO ₄				

Conclusion Questions and Calculations, Concentration and Molarity Post-Lab Exercises

(please staple to your lab page)

The Sims: Google: "Phet" PhET → Play with the Sims → Chemistry → "Concentration" or "Molarity"

1. Adding pure water to a saturated solution (with no solids) would cause the concentration of that solution to *increase / decrease / remain the same*. (circle)
2. Adding pure water to a saturated solution (with some solids) would cause the concentration of that solution to initially *increase / decrease / remain the same*. (circle)
3. Adding a solid salt to a saturated solution causes the concentration of that solution to *increase / decrease / remain the same*.
4. Evaporation acting on an unsaturated solution causes the solution's concentration to *increase / decrease / remain the same*.
5. Evaporation acting on a saturated solution causes the solution's concentration to *increase / decrease / remain the same*.
6. Using your notes, your text, or the internet discover what happens to the saturation concentration when a solution's temperature is increased. What happens as a solution is heated? _____
7. Why does this happen? (hint...think about the molecules) _____
8. Can you dissolve .35 moles of Potassium Permanganate (KMnO_4) into 500 mL of water? _____ Why? / Why not? (please show work)
9. Can 1750 mL of water dissolve 4.6 moles of Copper Sulfate CuSO_4 ? _____ Why? / Why not? (please show work)
10. What is the solution concentration formed from 3.6 moles NaCl dissolved into 1.3 L of water? (please show work)
11. What is the solution concentration formed from 2.1 moles BaCl_2 dissolved into 1.9 L of water? (please show work)
12. How many moles of solute are present in .75 L of a .89 M (molar) solution? (please show work)
13. How many moles of solute are present in 1.4 L of a 1.9 M (molar) solution? (please show work)
14. What volume of water would be required to dissolve .46 moles of solute to produce a .22 M solution? (please show work)