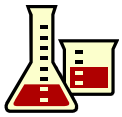
Solutions



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Terms

Solvent
Single substance that does the dissolving substance present in the largest amount

Solute
1 or more substance that is dissolved substance present in the lower amount

Solution
The result of dissolving the solute in a solvent

Solubility
Quantity of a solute that will dissolve at a fixed temperature
Typically expressed a grams solute/per 100 (mL or g)

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Terms

Saturated
Solution contains the maximum amount of solute
A dynamic equilibrium exists

Unsaturated
Solution contains less than the maximum amount of solute

Supersaturated
Solution contains more than the maximum amount of solute
Carefully prepared
Unstable

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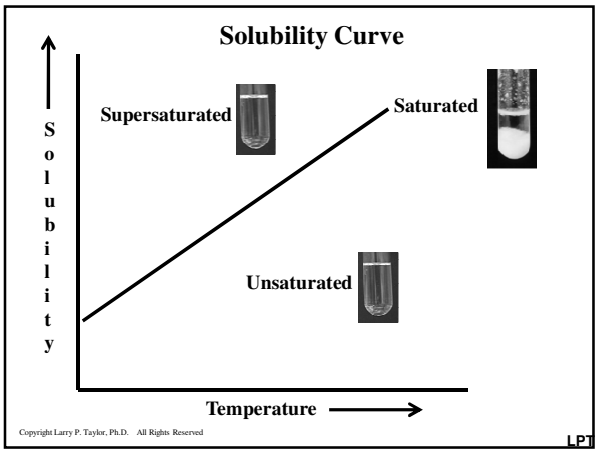
Solubility Curve
Supersaturated
Saturated
Unsaturated
Solubility
Temperature
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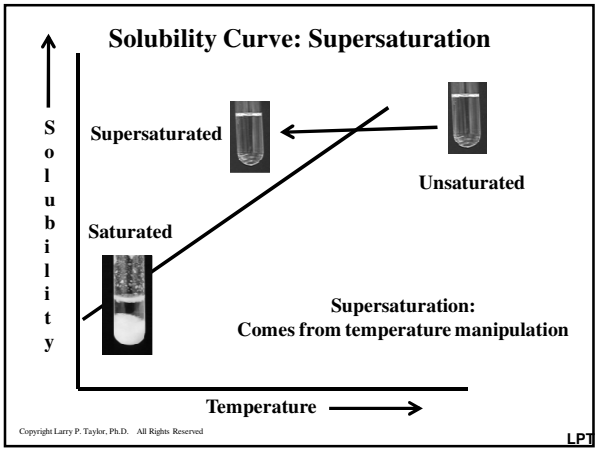
Solubility Curve: Supersaturation
Supersaturated
Unsaturated
Saturated
Supersaturation:
Comes from temperature manipulation
Solubility
Temperature
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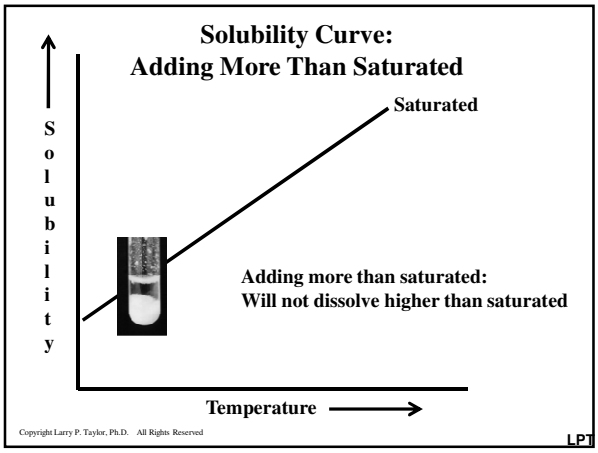
Solubility Curve:
Adding More Than Saturated
Saturated
Adding more than saturated:
Will not dissolve higher than saturated
Solubility
Temperature
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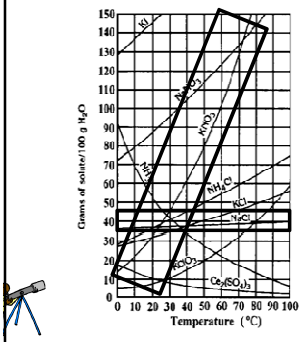
Solubility Curves



Plot of
Solubility vs. Temperature

For each compound (line):

Saturated
On the solubility line

Unsaturated
Below the line

Supersaturated
Above the line

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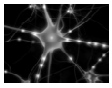
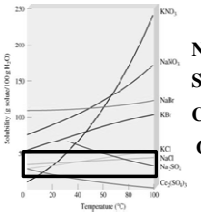
Solubility Curves





NaCl curve is "flat line"
Solubility does not change with temperature
Consider this:
Our nervous system is dependent on Na^+

If Na^+ solubility changed with temperature,
Our nervous systems would alter with temperature

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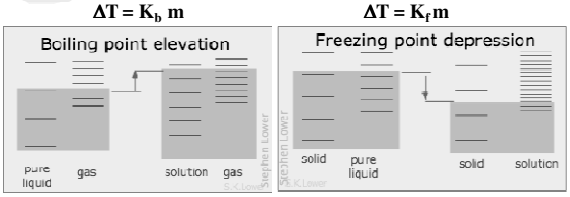
$\Delta T = K_f m$

Solutions Alter Physical Properties Dependent on Concentration of Solute

$\Delta T = K_b\ m$ $\Delta T = K_f\ m$



Adding salt to water:
Raises Boiling Point
Raises Cooking Temperature
(but not enough to be significant)

Adding salt to water:
Lowers Freezing Point
Keeps water on sidewalks liquid

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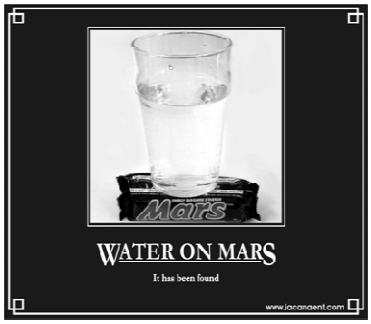

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Solutions Lab

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Online Lab

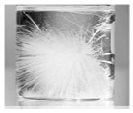
Purpose

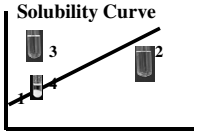
Observe the solubility- temperature relationship

Isolate 1.00 gram of NaCl by evaporation

Procedure

Instructor Demo of sodium acetate super-saturation





1 = Solid visible ➔ Solution is saturated

2 = After heating: All solid dissolved ➔ Solution unsaturated

3 = After slowly cooling: No solid visible ➔Supersaturated

4 = After Seeding: Solid visible ➔ Saturated

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Sodium Acetate Demo Photos

			
Ambient	**~ 100 ºC**	**After Cooling**	**After Seeding**
White Solid Clear Liquid	**No Solid Clear Liquid**	**No Solid Clear Liquid**	**White Solid Clear Liquid**

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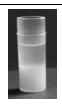
Solubility of NaCl & KNO_3

NaCl

		
Ambient	**~ 100 ºC**	**After Cooling**

KNO_3

		
Ambient	**~ 100 ºC**	**After Cooling**

Large or Small
Increase or Decrease in solubility
Less visible "stuff" ➔ greater the solubility

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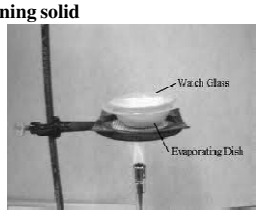
Isolate 1.00 g of NaCl From 2 M Solution

Calculate volume needed (See calculation slide)
Pour 2 M solution into evaporating dish
Cover with watch glass (limits spattering)
Remove water by heating with a Bunsen Burner
Weigh remaining solid



Hand On Set Up

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Volume of 2 M NaCl Solution Needed to Isolate 1.000 g NaCl

Determine Molecular Mass of NaCl

Na = 22.99

Cl = 35.45

58.44 g / mole

Dimensional analysis to solve for volume

$$1.000\ g\ NaCl \times \frac{1\ mole\ NaCl}{58.44\ g} \times \frac{1000\ mL}{2.000\ mol} = 8.560\ mL$$

The M means Moles per Liter or Moles per 1000 mL

Whenever you see M (Molarity), think moles / Liter or moles / 1000 mL

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Calculations

Mass of NaCl Solution:

Mass of evaporating dish , watch glass and NaCl Solution:

- Mass of evaporating dish and watch glass:

Mass of liquid:

Mass of NaCl Isolated:

Mass of evaporating dish , watch glass and NaCl Solid:

- Mass of evaporating dish and watch glass:

Mass of solid:

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Concentrations

% by Mass

$$\%\ (by\ mass) = \frac{grams\ \ solute}{grams\ solution} \times 100$$

Molarity

$$Molarity\ (M) = \frac{moles\ solute}{Liters\ solution}$$

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Yields

% Yield = $\frac{\text{Actual (Obtained in Experiment)}}{\text{Theoretical (Calculated Yield based on Stoichiometry)}}$ x 100

% Error = $\frac{\text{Actual Yield (g) - Theoretical Yield (g)}}{\text{Theoretical Yield (g)}}$ x 100

% Error should be small and negative

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Conclusion

Describe the solubility of NaCl when the temperature changes
Delete incorrect term
Compare the solubility change for KNO_3 to the NaCl

Describe % yield
Describe % error

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Let's Boldly Go Explore Today's Lab

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