SOLUTIONS & SOLUBILITY

VISUAL CHEM CARDS

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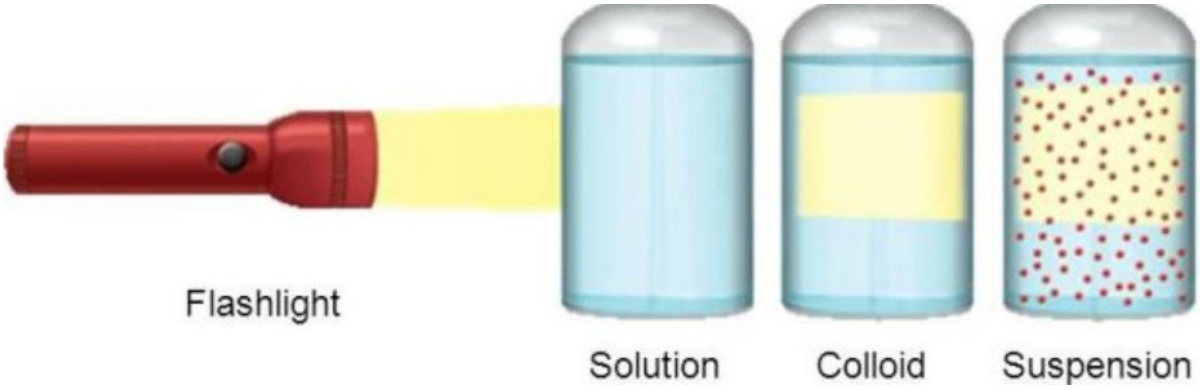
Solutions, Colloids & Suspensions



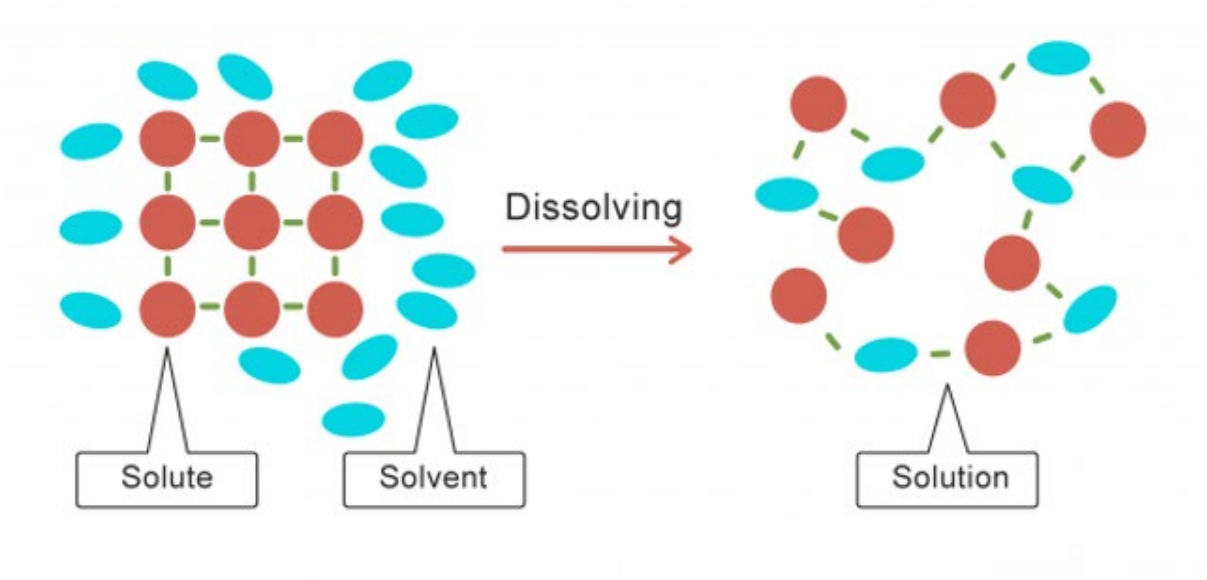
A **solution** is always transparent, light passes through with no scattering from solute particles which are molecule in size. The solution is **homogeneous** and does not settle out. A solution cannot be filtered but can be separated using the process of distillation.

A **colloid** is intermediate between a **solution and a suspension**. While a suspension will separate out a colloid will not. Colloids can be distinguished from solutions using the Tyndall effect. Light passing through a colloidal dispersion, will be reflected by the larger particles and the light beam will be visible.

A **suspension** is cloudy and **heterogeneous**. The particles are larger than 10,000 Angstroms which allows them to be filtered. If a suspension is allowed to stand the particles will separate out.

Solutions

Factors Affecting Solubility



	Solid & Liquid Solutes	Gas solutes
Temperature	Solubility increases with temperature.	Solubility of gases decreases with temperature
Pressure	For majority of solid and liquid solutes, pressure does not affect solubility.	Solubility increases with pressure.
Molecular Size	Solubility decreases with increasing molecular size	Solubility decreases with increasing molecular size

In most cases solutes dissolve in solvents that have a similar polarity.

"Like dissolves like"

Non-polar solutes do not dissolve in polar solvents and the other way around.

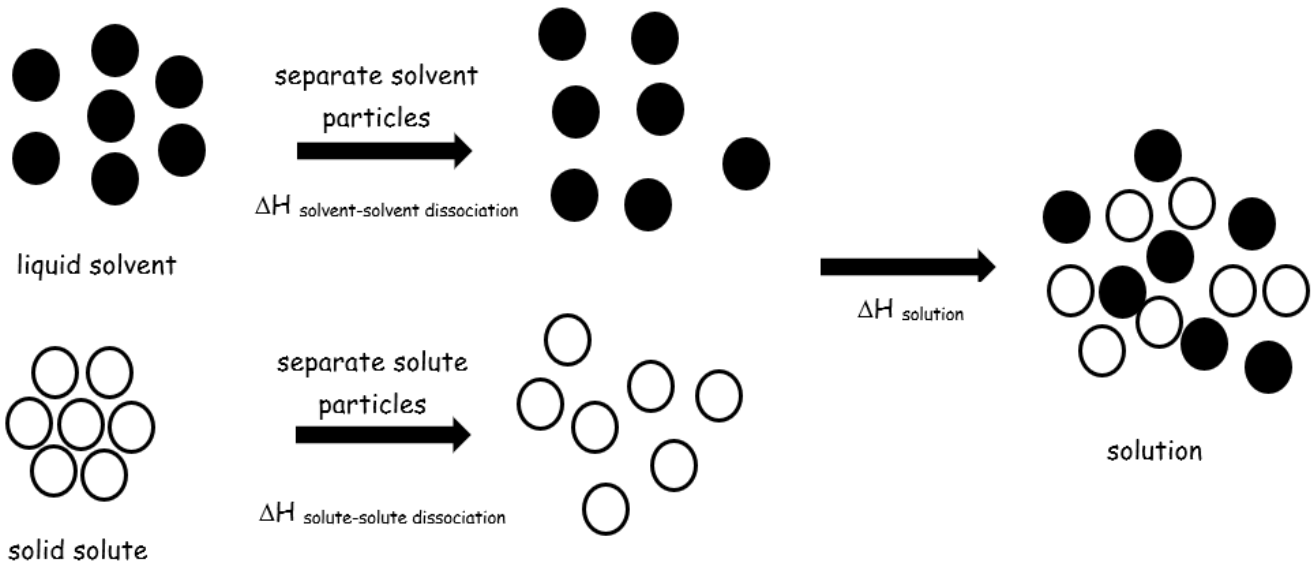
Solubility

Solution: A homogeneous mixture of substances.

Solvent: The substance in a solution present in the greatest amount.

Solute: the substance in a solution present in the least amount.

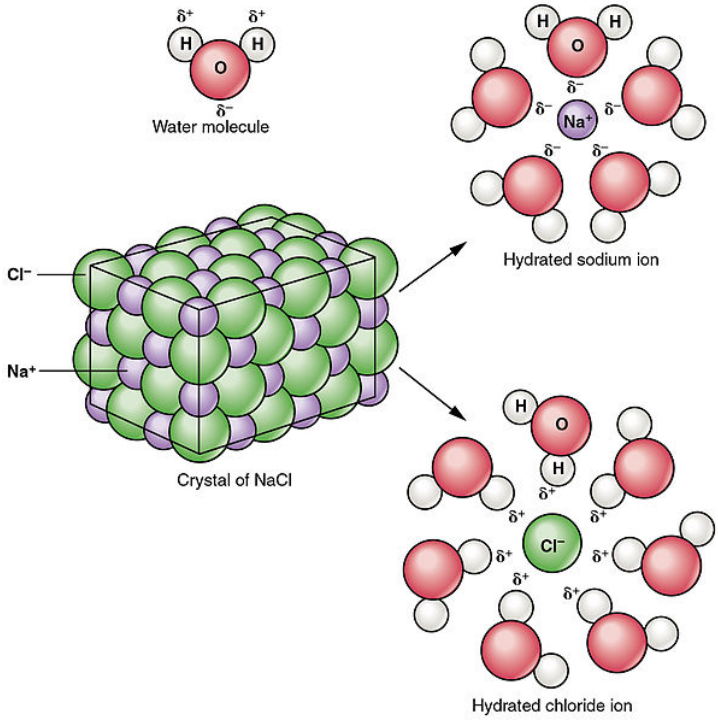
Solubility: the property of a solid, liquid or gaseous chemical substance called **solute** to dissolve in a solid, liquid or gaseous **solvent**.



Solubility

Dissolution of Sodium Chloride

$$NaCl_{(s)} \longrightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)}$$



$[Na(H_2O)_6]^+ = Na^+_{(aq)}$

Hydrated (solvated) sodium ion

$[Cl(H_2O)_6]^- = Cl^-_{(aq)}$

Hydrated chloride ion

NaCl dissolves because the energy released when the ions interact with water overcomes the energy required to break ionic bonds in the solid and the energy required to separate the water molecules so that the ions can be “inserted” into solution.

$$\Delta H_{solution} = \Delta H_{NaCl\ lattice\ dissociation} + \Delta H_{water\ H\text{-}bond\ breaking} + \Delta H_{hydration}$$

bond breaking | bond breaking | bond formation

(endothermic) (exothermic)

If $\Delta H_{hydration} > \Delta H_{lattice\ dissociation} + \Delta H_{water\ H\text{-}bond\ breaking}$ the salt will dissolve.

Solubility of Salts

Soluble	Insoluble
Salts of Group 1 elements (Li^+, Na^+, K^+, Rb^+, Cs^+) and ammonium (NH_4^+) are all soluble.	Oxides (O^{2-}) are usually insoluble. Exceptions include Na_2O, K_2O, SrO, and BaO, which are soluble, and CaO, which is slightly soluble.
All Nitrates (NO_3^-), chlorates (ClO_3^-), perchlorates (ClO_4^-), and acetates ($C_2H_3O_2^-$) are soluble.	Hydroxide salts generally insoluble. Exceptions include Group I hydroxides that are soluble. Some Group 2 (Ca, Sr, and Ba) hydroxides are slightly soluble.
Chlorides (Cl^-), bromides (Br^-), and iodides (I^-) are soluble except for those of Ag^+, Pb^{2+}, and Hg_2^{2+}.	The sulfides of all metals except barium, calcium, magnesium, sodium, potassium, and ammonium are insoluble in water. Note CaS, MgS and BaS are sparingly soluble
All sulfates are soluble except Sr^{2+} and Ba^{2+}. Those of Ca^{2+}, Ag^+ and Pb^{2+} are slightly soluble.	

Solubility Curves

A solubility curve is a data based graph comparing the amount of solute that will dissolve in a given amount of solvent at various temperatures.

The most typical solubility curves are graphed based solid and gaseous solutes dissolved in 100 grams of water.