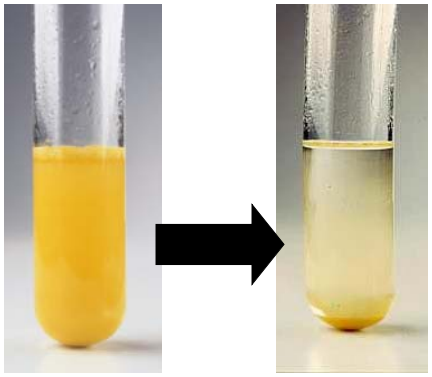
Solution Chemistry

- Solutions are homogeneous mixtures of two or more pure substances.
- In a solution, the solute is dissolved the solvent.

State of Solution	State of Solvent	State of Solute	Example
Gas	Gas	Gas	Air
Liquid	Liquid	Gas	Oxygen in water
Liquid	Liquid	Liquid	Alcohol in water
Liquid	Liquid	Solid	Salt in water
Solid	Solid	Gas	Hydrogen in palladium
Solid	Solid	Liquid	Mercury in silver
Solid	Solid	Solid	Silver in gold

Suspensions

- If the particles in a solvent are so large that they settle out unless the mixture is constantly stirred or agitated, the mixture is called a **suspension**.



Before stirring (very cloudy)

After stirring (clearer but some solid settled on bottom)

Colloids

- Means “glue” in Greek
- A **colloid** is a mixture that contains solid particles that are small enough to remain suspended due to the motion of molecules
  - Examples:
    Paint - solid dispersed in liquid
    Milk – liquid dispersed in liquid
    Shaving cream – gas dispersed in liquid
    Smoke – solid dispersed in gas

- Many colloids look similar to solutions because their particles cannot be seen.
- The ***Tyndall effect*** can be used to distinguish between a solution and a colloid.
- The ***Tyndall effect*** occurs when light is scattered by colloidal particles dispersed in a medium.
  - example: a headlight beam is visible from the side on a foggy night

Factors Affecting the Rate of Dissolution

1. Surface area of the solute is increased
2. Stirring or shaking
3. Higher temperatures

- **Remember**, dissolution is a physical change—you can get back the original solute by evaporating the solvent.
- If you can't, the substance didn't dissolve, it reacted.

Types of Solutions

- **Saturated solution:** contains ***the maximum*** amount of dissolved solute (undissolved solid remains in the flask)
- **Unsaturated solution:** contains ***less*** than the maximum amount of solute for a given temperature (no solid remains in flask)
- **Supersaturated solution**: solvent holds ***more*** solute than is normally possible at that temperature.

Supersaturated Solutions

These solutions are unstable.

Crystallization can often be stimulated by adding a “seed crystal” or scratching the side of the flask.

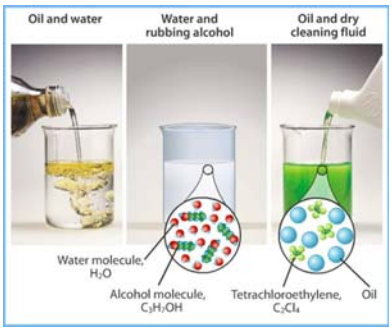
Solubility

- **Solubility**: the amount of substance required to form a saturated solution with a specific amount of solvent at a given temperature
  example: The solubility of sugar is 204 g per 100 g of water at 20°C

- Scientists often use **“Like dissolves like”** as a rough but useful rule for predicting whether one substance will dissolve in another.

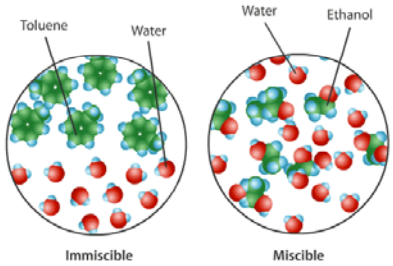
  - Polar substances tend to dissolve in polar solvents.

  - Nonpolar substances tend to dissolve in nonpolar solvents.



Liquid Solutes and Solvents

- Oil and water do not mix because oil is nonpolar whereas water is polar.
- Liquids that are not soluble in each other are **immiscible**.
- Liquids that dissolve freely in one another in any proportion are **miscible**.



Effects of pressure on solubility

• The solubility of **liquids** and **solids** does not change with pressure.

• The solubility of a **gas** in a liquid is directly proportional to its pressure. (Increasing pressure above a solution forces more gas to dissolve.) Known as **Henry's Law**

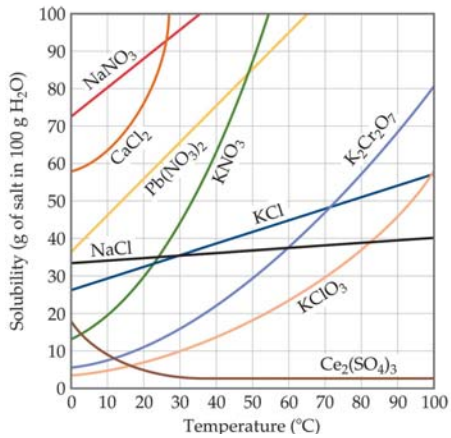
At **lower** pressure, **less** gas is dissolved in the liquid

As pressure **increases**, **more** gas dissolves in the liquid

The rapid escape of a gas from a liquid in which it is dissolved is known as **effervescence.**

Effects of Temperature on Solubility

- Increasing the temperature usually increases solubility of solids in liquids



Effects of Temperature on Solubility

- However the opposite is true for gases. Increasing the temperature usually decreases gas solubility
  - Carbonated soft drinks are more "bubbly" if stored in the refrigerator.
  - Warm lakes have less O_2 dissolved in them than cool lakes.