Republic of Iraq Ministry of Higher Education &Scientific Research
Al-Maaref University
Dentistry Department

solubility and solution colloidal system

Lec(5)
First stage
By
Qusay Abdulsattar

- Fluids in living system are complex mixtures of colloids, ions and molecules. The behavior of these fluids in the body is vital of life.
- Solutions are homogeneous mixtures of two or more components.
- Solute = a substance dissolved in a solvent to form a solution; usually the smaller portion.
- Solvent = The dissolving medium of a solution; usually the greater portion.

Solubility: The amount of solute that dissolved in a given quantity of solvent to form the saturated solution.

The solubility of a solute in a particular solvent depends on a number of factors:

- Kind of solute
- Kind of solvent
- The temperature of the solvent
- The pressure above the solvent

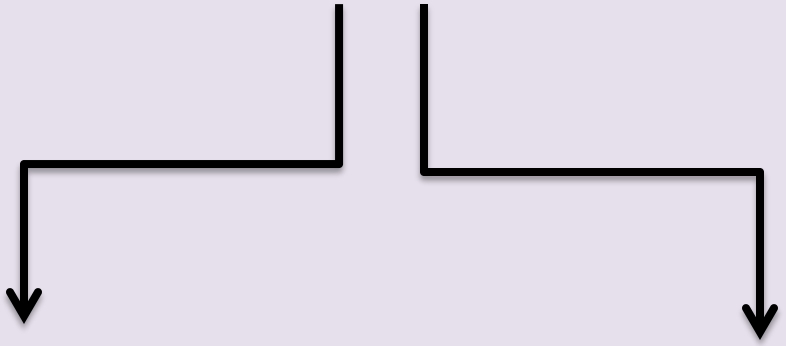
- Some substances, (like water and alcohol), can be mixed together and create a homogenous phase in any proportion.
- Sometimes there is no limit to the amount of one substance that dissolve in another. This is particularly true for solution of a liquid in liquid.

1-Completely miscible: pair of liquids that are infinitely soluble in each other. (for example alcohol with water)

2-Partially miscible: other liquids are only slightly soluble in each other.

3-Immiscible: liquid that are insoluble in each other, for example (Gasoline immiscible water).

Solutions



Heterogeneous

Heterogeneous: mixture are those which are not homogeneous .

Homogeneous

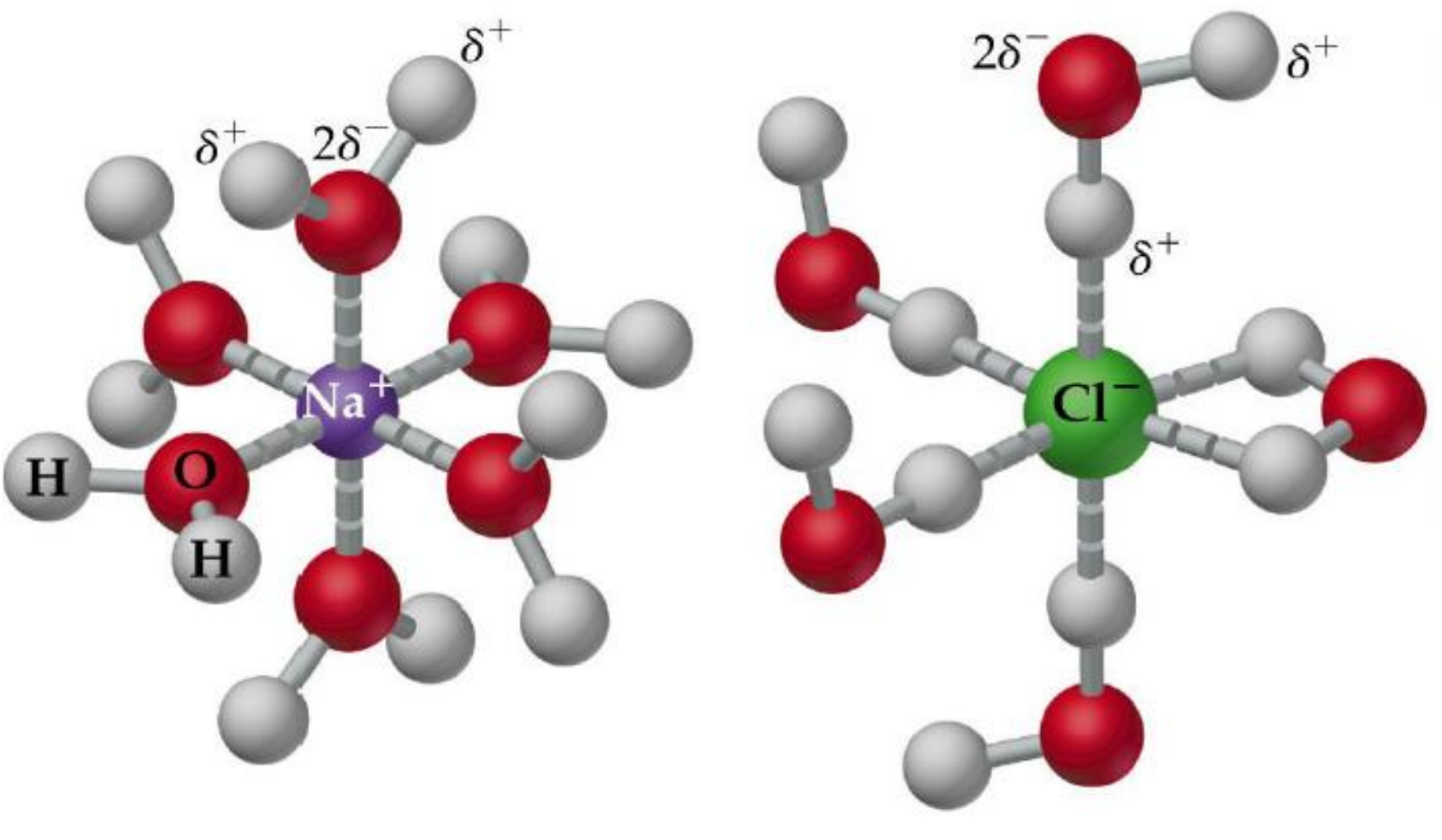
Homogeneous: mixtures are those in which the smallest samples are everywhere identical in composition and properties.

Types of solutions

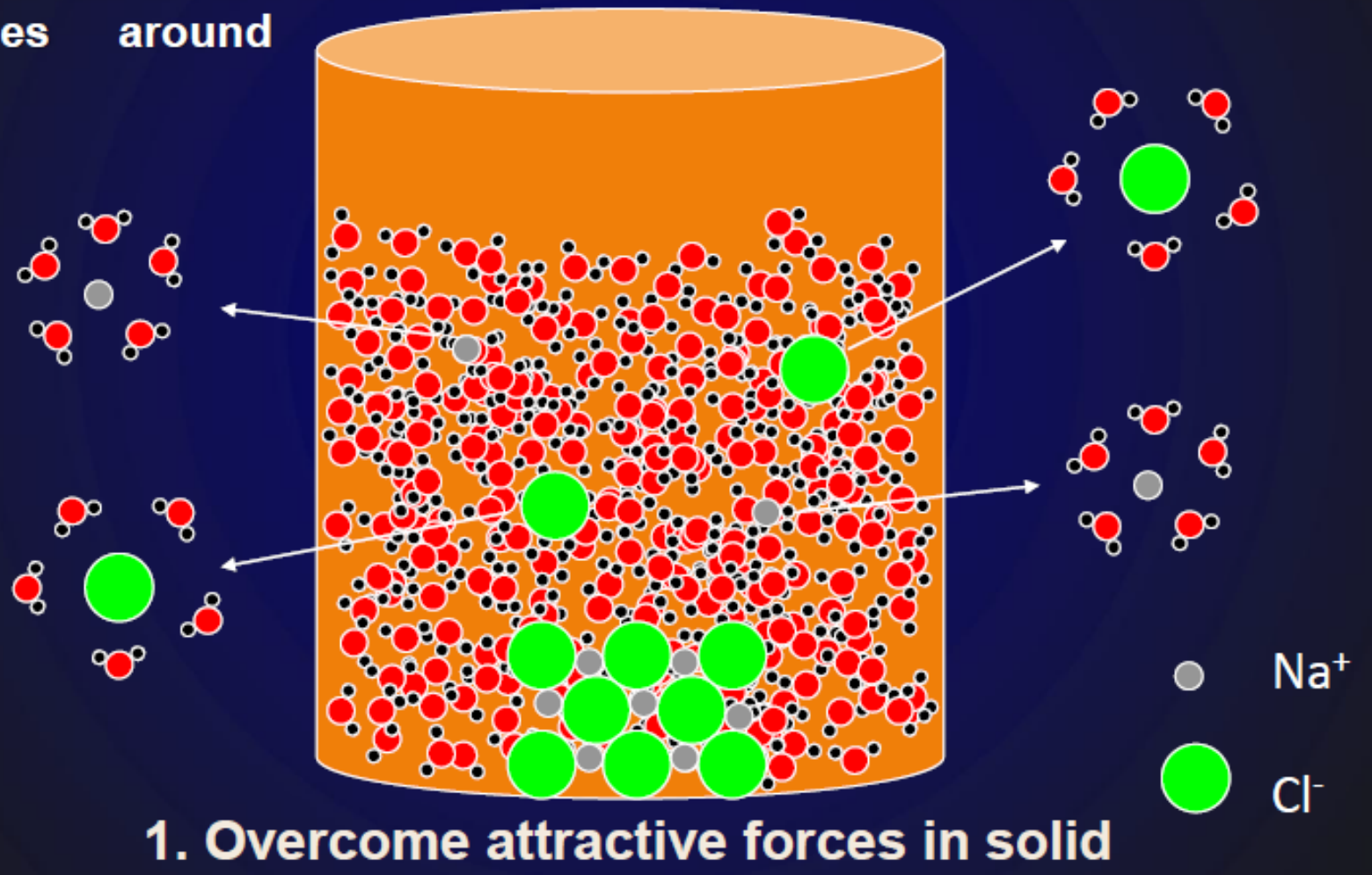
There are five main types of solutions as shown in the table below:

State of Solution	Original State of Solute	State of Solvent	Examples
Gas	Gas	Gas	Air, natural gas;
Liquid	Liquid	Liquid	alcoholic beverages, antifreeze
Liquid	Solid	Liquid	seawater, sugar solution, etc.
	Gas	Liquid	carbonated (soda) water
Solid	Solid	Solid	metal alloy, e.g., steel, brass, bronze, etc;

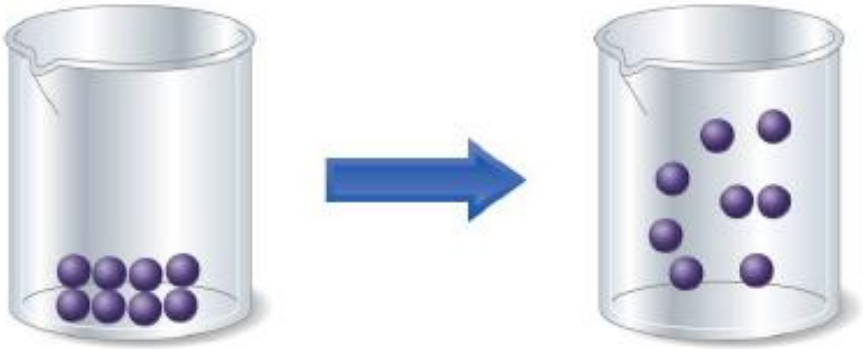
The solution process hydration or solvation



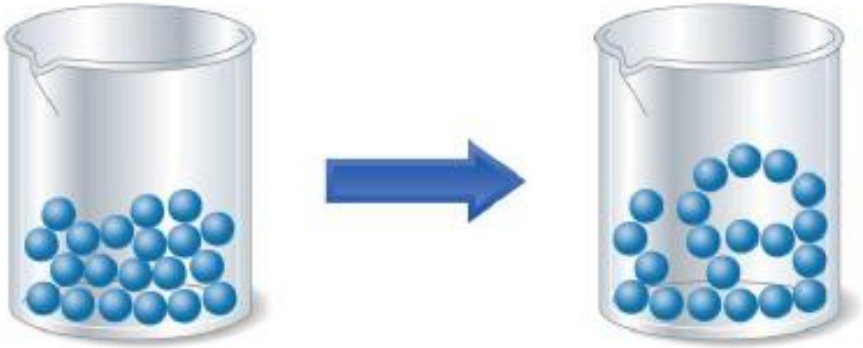
Dissolving process in water



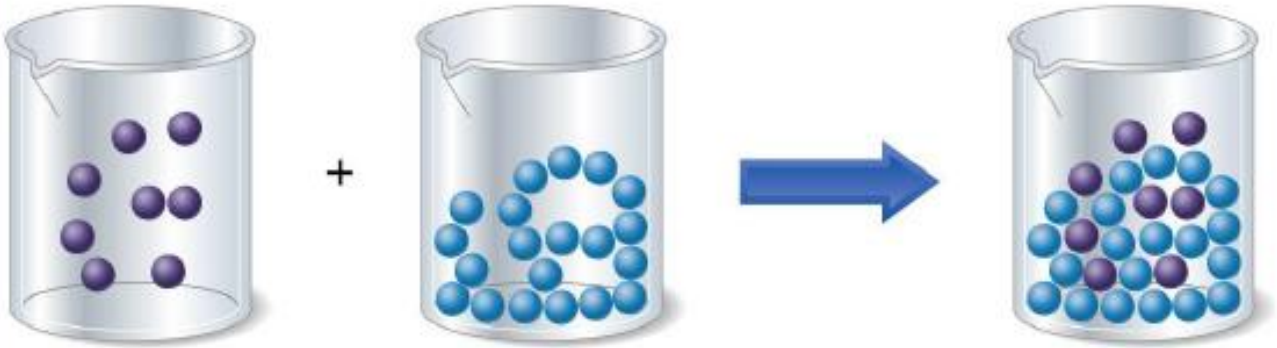
Three Steps of Solution Formation



ΔH_1: Separation of solute molecules



ΔH_2: Separation of solvent molecules



ΔH_3: Formation of solute-solvent interactions

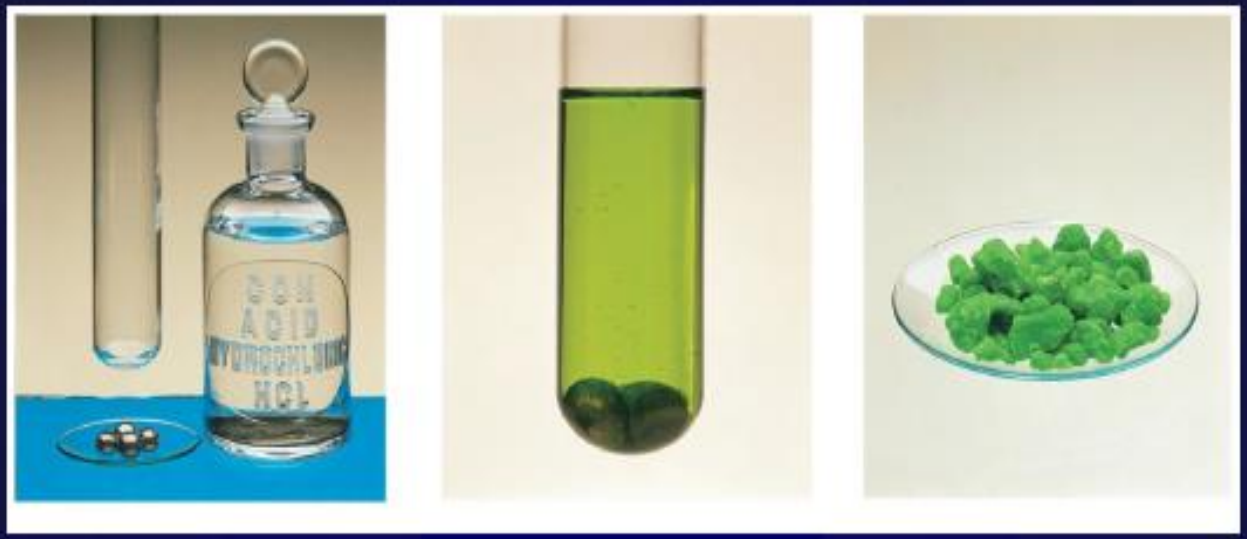
Factors Affecting Solubility

- Intermolecular Forces
- Pressure
- Temperature

General Rule: "*Like dissolves Like*"

- Polar solvents tend to dissolve polar or ionic solutes.
- Non-polar solvents tend to dissolve non-polar solutes.

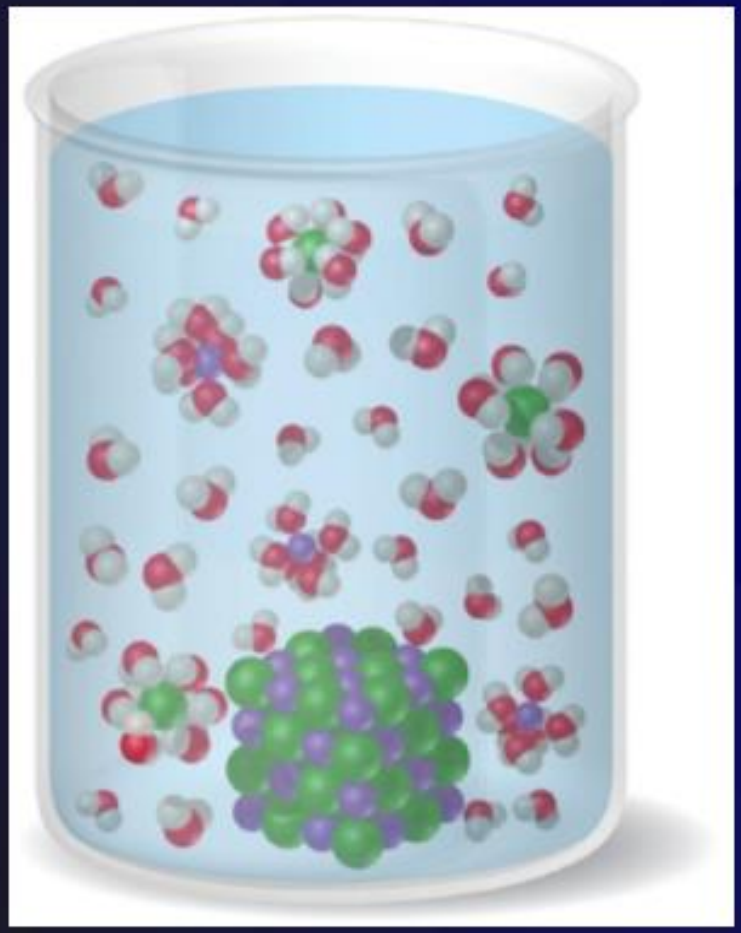
Dissolution vs reaction



$$Ni(s) + HCl(aq) \longrightarrow NiCl_2(aq) + H_2(g) \xrightarrow{dry} NiCl_2(s)$$

- 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.

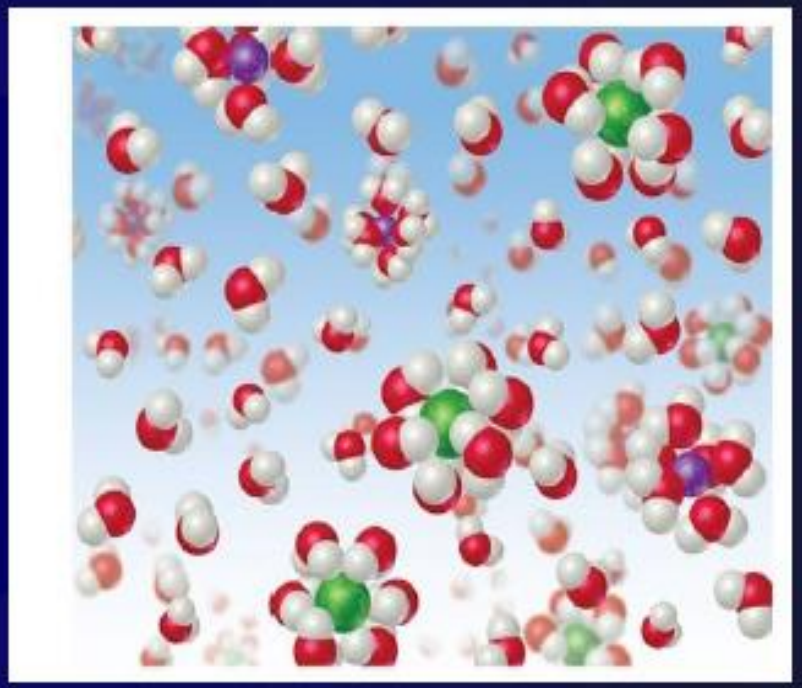
Degree of saturation



- **A saturated solution** is a chemical solution containing the maximum concentration of a solute dissolved in the solvent.
- The additional solute will not dissolve in a saturated solution.
- a soda is a saturated solution of carbon dioxide in water. this is why, when the pressure is released, carbon dioxide gas forms bubbles.

Degree of saturation

- ***Unsaturated solution*** is a solution that contains less than the maximum amount of solute that is capable of being dissolved.
- Solution equilibrium exists when the rate of dissolution equals the rate of recrystallization.
- ***Recrystallization*** is the process of dissolved solute returning to the solid state.



Degree of saturation

- **Supersaturated**

- ***Supersaturated solution*** is a solution that contains more than the maximum amount of solute that is capable of being dissolved at given temperature.
- The recrystallization of the excess dissolved solute in a supersaturated solution can be initiated by the addition of a tiny crystal of solute, called a seed crystal.

- Generally it is useful to know what substances dissolved in water and what factors affected the solubility especially in clinical work in order to specify exactly the amount of solute in solution, the method diverse from substance to other and from solvent to other.

Colloids and Colloidal dispersions

Colloids

Colloid-- A mixture of two phases of matter

emulsions	*aerosols*
smoke	*fog*
foams	*gels*
milk	*clouds*

Gel & Foam

Clouds

Milk

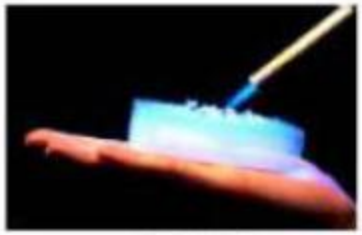
Examples of colloidal systems from daily life

Foams

Milk

Fog, smoke

Detergents



Aerogel

Blood

Paints

Cosmetics

Tyndall Effect

- Colloidal suspensions can scatter rays of light.
- This phenomenon is known as the Tyndall effect.

- **Suspension:** is a heterogeneous mixture of two or more substances. In a suspension, very small pieces of solid are spread through a liquid but do not dissolve. If left, the solid pieces will separate from the liquid and either fall to the bottom or rise to the top. Sand in water is a suspension. Suspensions may separate quickly or stay suspended for a long time, depending on what they contain.

Suspensions

- Have very large particles
- Can be filtered
- Must stir to stay suspended (Examples; Blood platelets, Muddy water).

Properties of solution, colloidal and Suspensions

Solutions	Colloids	Suspensions
• Homogeneous • Particle size: 0.01-1 nm, atoms, ions, or molecules. • Do not separate on standing. • Cannot be separated by filtration • So not scatter light.	• Heterogeneous. • Particle size: 1-1000 nm, dispersed, large molecules or aggregates. • Do not separate on standing. • Cannot be separated by filtration • Scatter light (Tyndall effect).	• Heterogeneous. • Particle size: over 1000 nm, suspended, large particles or aggregates. • Particles settle out • Can be separated by filtration • May either Scatter light or be opaque.