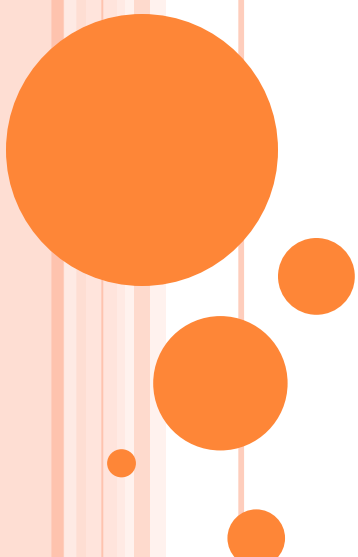


Colloids



Classes of solutions

True Solutions

(Suspensions)

Colloidal Solutions

Suspensions:

- ❑ Heterogeneous mixtures

- ❑ Relatively large particles

e.g. whole blood

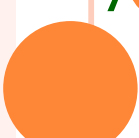
many medicines (Shake well before using)

Colloids:

- ❑ Heterogeneous mixtures (micro)
- ❑ Dispersed particles: 1 to 500-1000 nm

Hydrophilic colloids (eu colloids)

Hydrophobic colloids (aggregation)



Colloids

- ❑ Colloids are mixtures of a solvent and suspended particles.
- ❑ Particles are too small to see but are larger than molecules.
- ❑ Due to their small size they do not settle out of solution.
- ❑ There are several types of colloid:
 - aerosol (gas + liquid or solid, e.g. fog and smoke),
 - foam (liquid + gas, e.g. whipped cream),
 - emulsion (liquid + liquid, e.g. milk),
 - sol (liquid + solid, e.g. paint),
 - solid foam (solid + gas, e.g. marshmallow),
 - solid emulsion (solid + liquid, e.g. butter),
 - solid sol (solid + solid, e.g. pearl, opal).

Types of Colloids

Dispersed Phase	Continuous Phase	Name
Gas	Liquid	Foam
Gas	Solid	Foam
Liquid	Gas	Aerosol
Liquid	Liquid	Emulsion
Liquid	Solid	Gel
Solid	Gas	Aerosol
Solid	Liquid	Sol
Solid	Solid	Solid sol

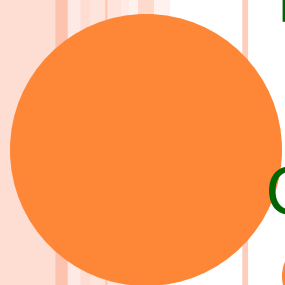
Properties:

Brownian motion

Tyndall Effect (Reflection and light scattering)

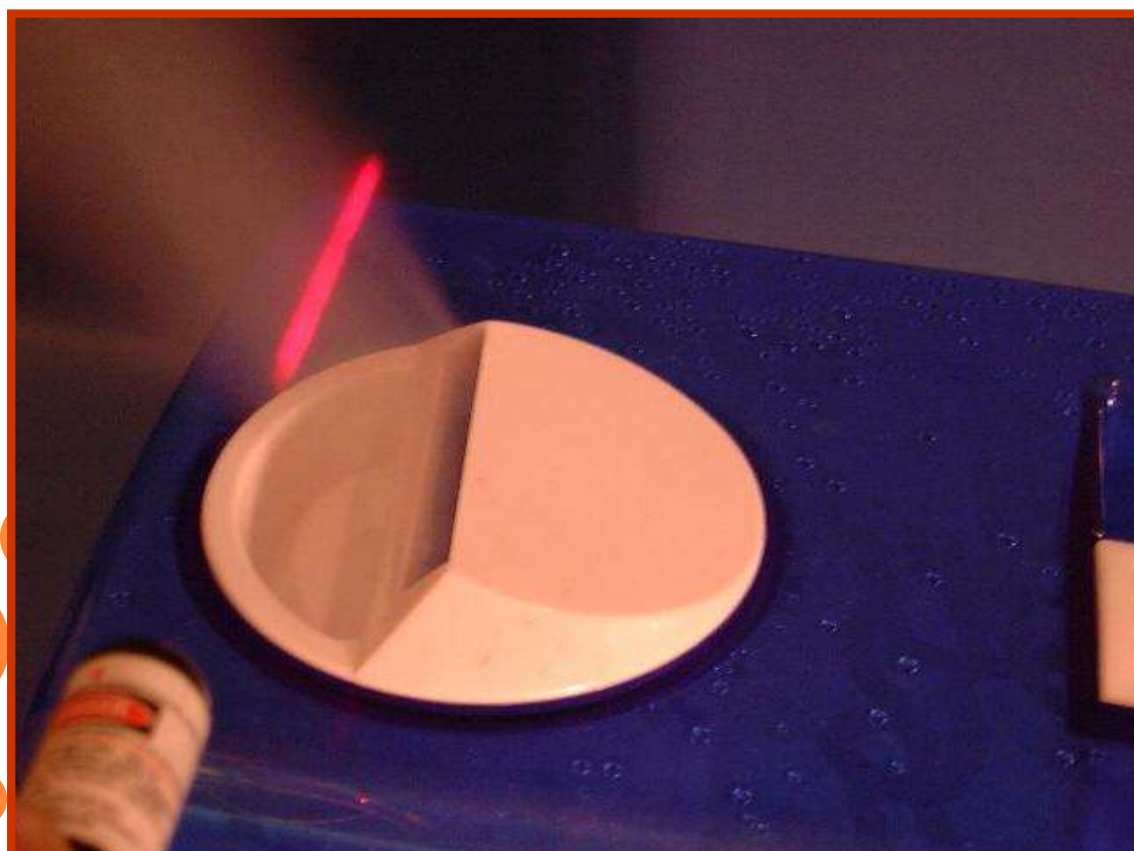
Coagulation $\longleftrightarrow$ peptization

Dialysis



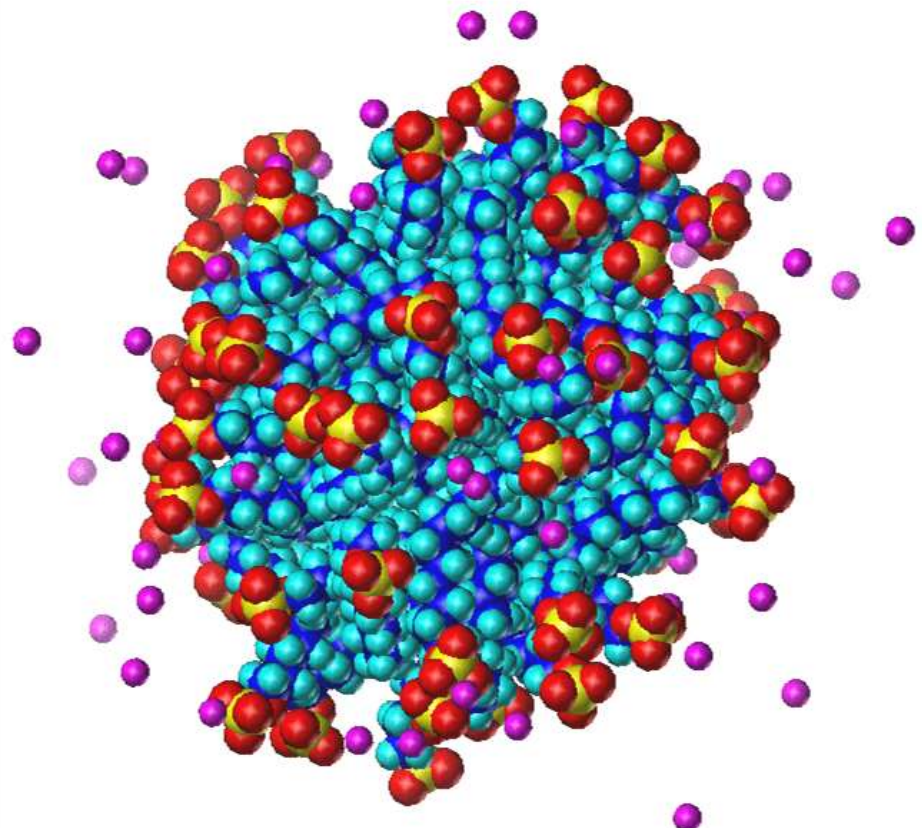
Tyndall Effect

- ❑ Tyndall effect: ability of a Colloid to scatter light.
- ❑ The beam of light can be seen through the colloid.



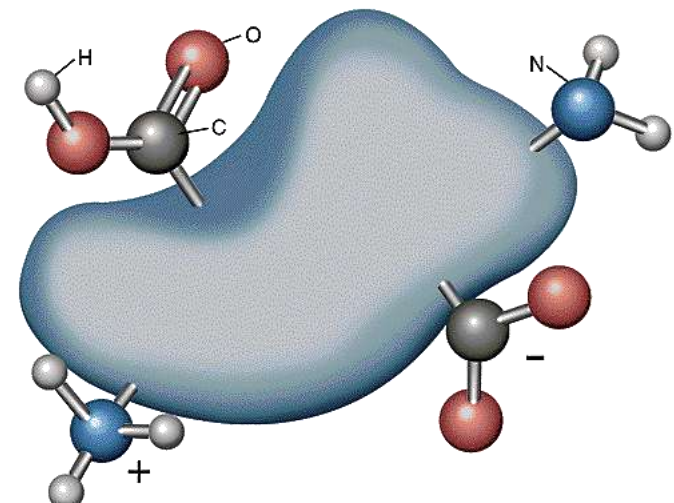
Removal of Colloidal Particles

- ❑ Colloid particles are too small to be separated by physical means (e.g. filtration).
- ❑ Colloid particles are coagulated (enlarged) until they can be removed by filtration.
- ❑ Methods of coagulation:
 - ❑ heating (colloid particles move and are attracted to each other when they collide);
 - ❑ adding an electrolyte (neutralize the surface charges on the colloid particles).
- ❑ Dialysis: using a semipermeable membranes separate ions from colloidal particles.



Hydrophilic & Hydrophobic Colloids

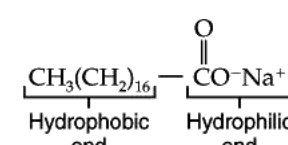
- Focus on colloids in water.
- "Water loving" colloids: hydrophilic.
- "Water hating" colloids: hydrophobic.
- Molecules arrange themselves so that hydrophobic portions are oriented towards each other.
- If a large hydrophobic macromolecule (giant molecule) needs to exist in water (e.g. in a cell), hydrophobic molecules embed themselves into the macromolecule leaving the hydrophilic ends to interact with water.



Sodium stearate

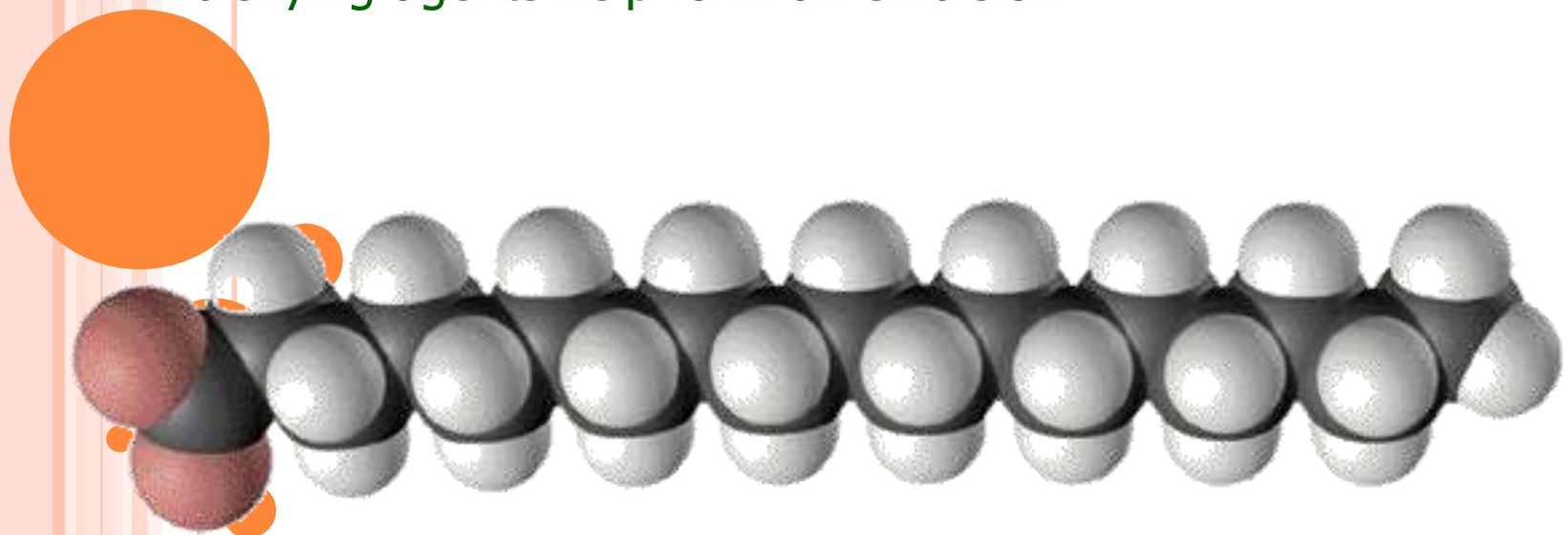


Na⁺



Hydrophilic and Hydrophobic Colloids

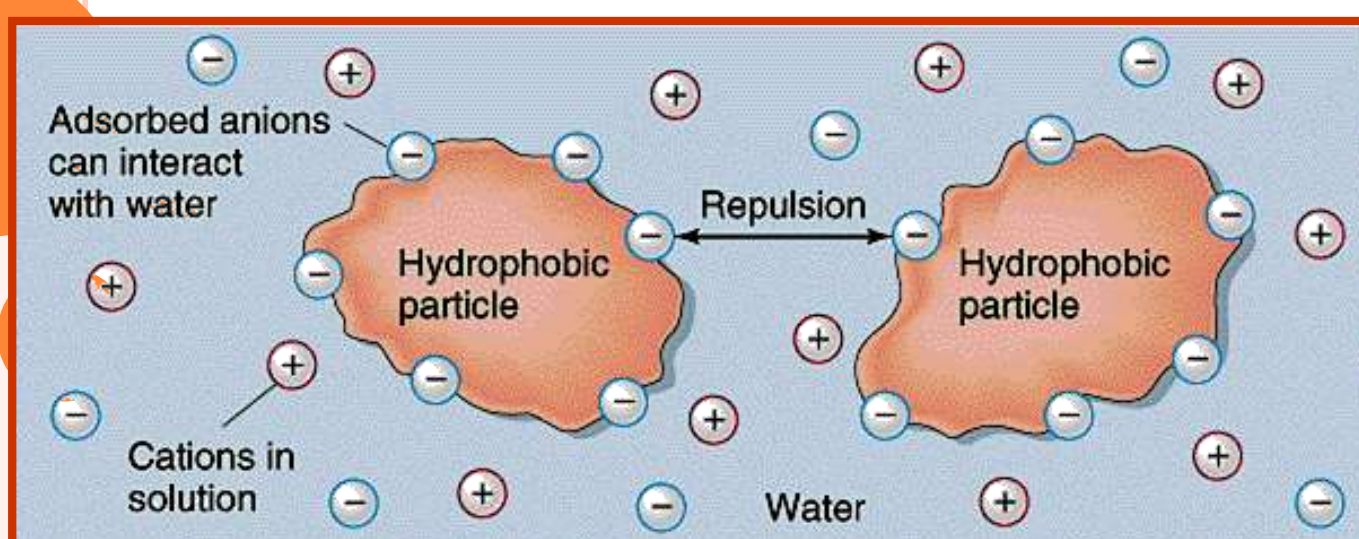
- ❑ Most dirt stains on people and clothing are oil-based. Soaps are molecules with long hydrophobic tails and hydrophilic heads that remove dirt by stabilizing the colloid in water.
- ❑ Bile excretes substances like sodium stearate that forms an emulsion with fats in our small intestine.
- ❑ Emulsifying agents help form an emulsion.



Sodium stearate

Hydrophilic and Hydrophobic Colloids

- ❑ Sodium stearate has a long hydrophobic tail ($\text{CH}_3(\text{CH}_2)_{16}-$) and a small hydrophilic head ($-\text{CO}_2-\text{Na}^+$).
- ❑ The hydrophobic tail can be absorbed into the oil drop, leaving the hydrophilic head on the surface.
- ❑ The hydrophilic heads then interact with the water and the oil drop is stabilized in water.



Particle Sizes Become Larger

Solutions	Colloidal Dispersions	Suspensions
All particles are on the order of atoms, ions, or small molecules (0.1-1 nm)	Particles of at least one component are large clusters of atoms, ions, or small molecules, or are very large ions or molecules (1-1000 nm)	Particles of at least one component may be individually seen with a low-power microscope (over 1000 nm)
Most stable to gravity	Less stable to gravity	Unstable to gravity
Most homogeneous	Also homogeneous, but borderline	Homogeneous only if well stirred

Solutions	Colloidal Dispersions	Suspensions
Transparent (but often colored)	Often translucent or opaque, but may be transparent	Often opaque but, may appear translucent
No Tyndall effect	Tyndall effect	Not applicable (suspensions cannot be transparent)
No Brownian movement	Brownian movement	Particles separate unless system is stirred
Cannot be separated by filtration	Cannot be separated by filtration	Can be separated by filtration

Homogeneous ——— to ——— Heterogeneous —>