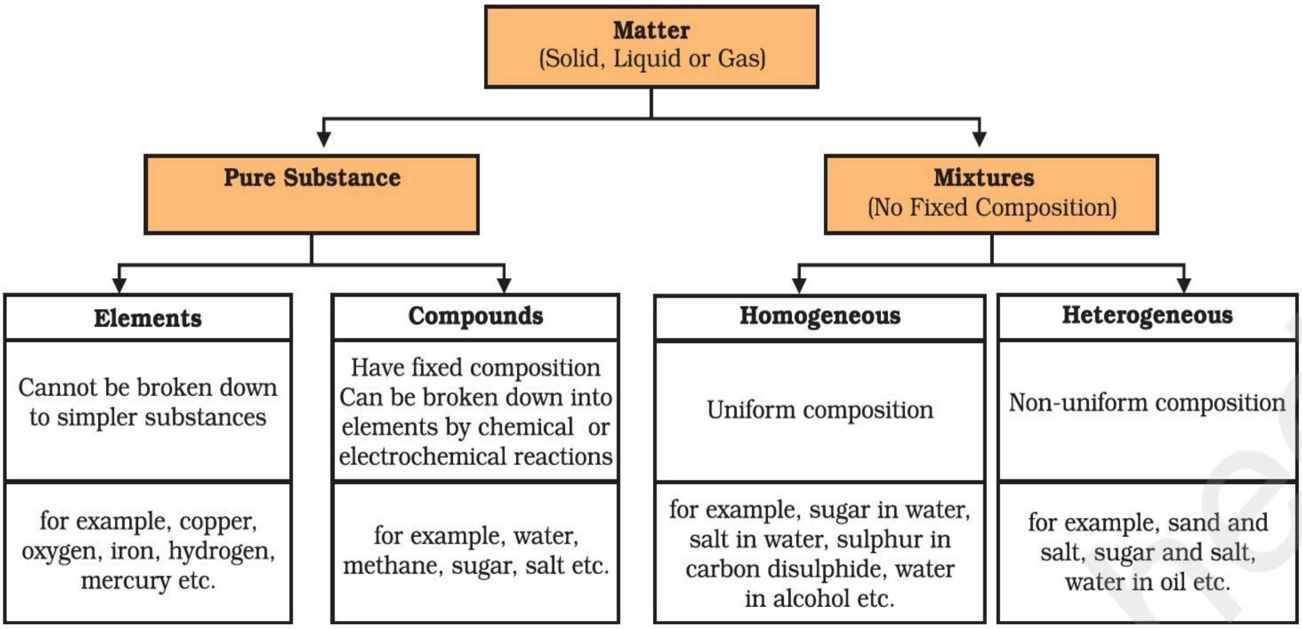
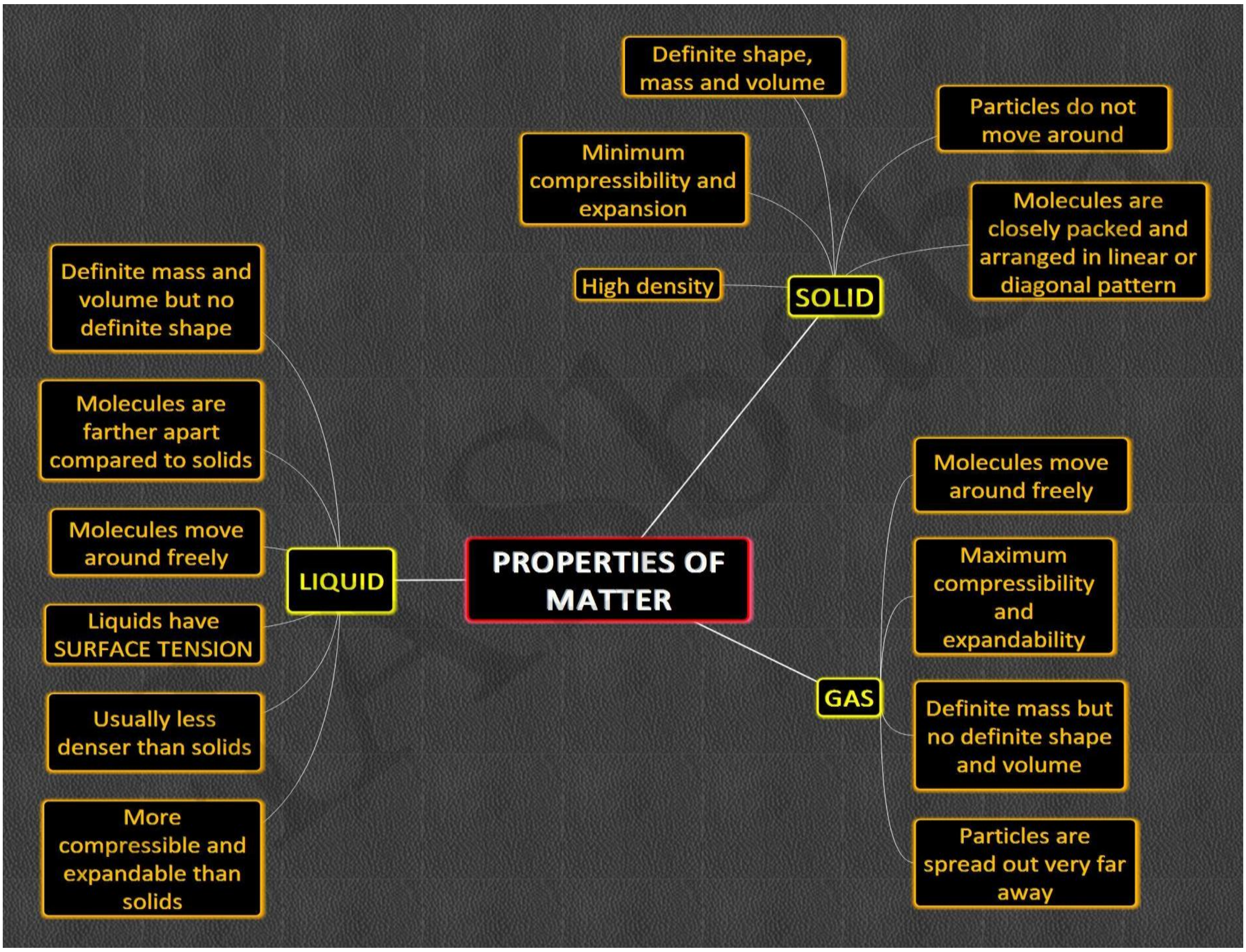
MATTER

~NCERT



Mixtures	Compounds
1. Elements or compounds just mix together to form a mixture and no new compound is formed.	1. Elements react to form new compounds.
2. A mixture has a variable composition.	2. The composition of each new substance is always fixed.
3. A mixture shows the properties of the constituent substances.	3. The new substance has totally different properties.
4. The constituents can be seperated fairly easily by physical methods.	4. The constituents can be separated only by chemical or electrochemical reactions.

~NCERT



LIQUID

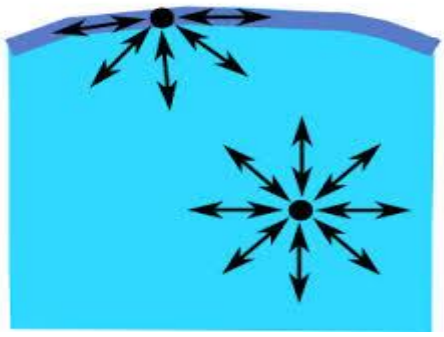
A. **VAPOUR PRESSURE:**

- Pressure of vapour in a closed container
- Changes majorly with temperature
- Has an exponential relationship with temperature
- Increases with increase in temperature
  - Liquids boil at lower temperatures at higher altitudes compared to sea level because of low pressure condition
  - Water boils at lower temperature at high altitudes due to less pressure

  - Pressure cookers are used for cooking to increase the boiling point of water by increasing pressure
  - Liquid does not boil in a closed container

B. **SURFACE TENSION**

- Molecules of a liquid at the surface are in a different arrangement than interior molecules
- Molecules lying on surface experience a net inward force by molecules lying below



- Surface acts as if it is under tension
- Liquids tend to contract to the smallest possible area
- Eg: Spherical shape of drops
- Liquids that wet glass (like water) rise in the capillary put inside the liquid
- Liquids that don't wet glass (like mercury) do not rise in the capillary
  - Their level inside capillary remains below the level in the container

C. **VISCOSITY**

- Internal resistance to flow by liquids
- Friction offered by one part of liquid to another
- High viscosity
  - Liquids flow slowly
- Low viscosity
  - Liquids flow faster
- Increase in temperature
  - Greater kinetic energy
  - Decrease in viscosity
- During fever, the viscosity of blood decreases which increases blood circulation.

- Glasses of Old buildings: Thicker below-- Glass is highly viscous liquid

MELTING POINT

- The constant temperature at which a solid changes into a liquid on absorbing heat
- Process of melting is called fusion
- It is a characteristic property of a solid
- At the melting point, solid and liquid states exist in equilibrium
- Measure of the strength of intermolecular forces
- High melting point
    - Strong cohesive forces
- Low melting point
    - Weak cohesive forces

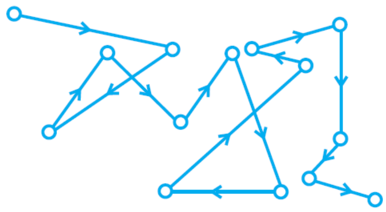
FREEZING POINT

- The constant temperature at which liquid changes into solid by giving out heat energy
- Numerically, Melting point = Freezing point

BOILING POINT

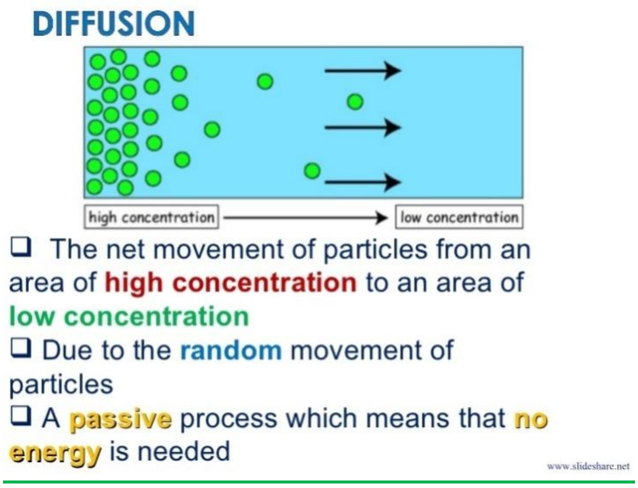
- The constant temperature at which liquid changes into gas by absorbing heat energy
- The process is called boiling or vaporisation
- Indication of the strength of intermolecular forces
- Volatile liquids
    - Boil at low temperatures
    - Weak intermolecular forces
    - Like petrol, alcohol, acetone, etc.
- Depends on pressure of atmosphere
- Varies directly with pressure
    - Water boils at lower temperatures at higher altitudes

BROWNIAN MOTION



- Zigzag or irregular motion of particles suspended in liquid
- Observed in all types of colloidal solutions
- Collision between molecules of dispersion medium and dispersed phase
- Opposes gravity
    - Does not let particles settle down

DIFFUSION



- Movement of molecules from region of higher concentration to lower concentration
- It does not need any membrane
- Movement of solute as well as solvent
- Experienced in gases, liquids and solids
- It cannot be stopped or reversed
- Example:
    - Fragrance of a perfume spreading inside a room
    - Diffusion of tea pigments in water

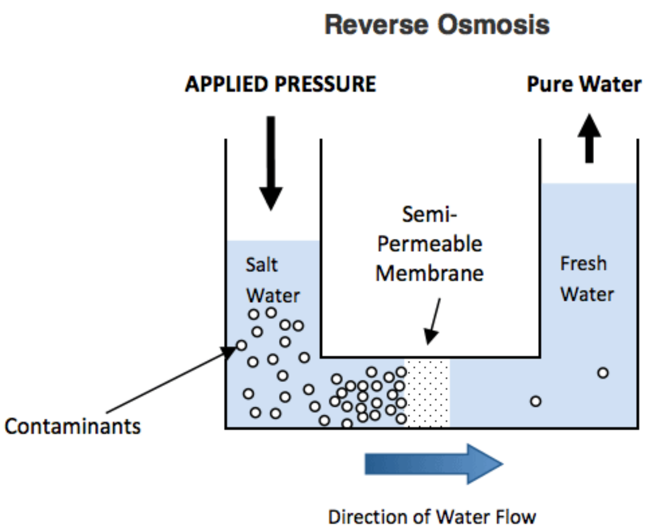
- If two metal pieces are tied together for years, they will diffuse into one another

OSMOSIS

- Flow of solvents from less concentration to higher concentration
- Requires a semi-permeable membrane
- Only flow of solvent
- Experienced only in liquid medium
- It can be stopped or reversed
- Example:
    - Absorption of water from the soil by plants
    - Raw mangoes shrink into pickle when placed in high concentration solution
    - Withered flowers are revived in fresh water

REVERSE OSMOSIS

- Osmosis occurs without the application of energy
    - Flow of solvents from lower concentration to higher concentration of solute
- Reverse osmosis requires application of energy
- Semi permeable membrane between the two solutions of different concentrations
- Allows the passage of water molecules but not the majority of dissolved salts, organics, bacteria and pyrogens



- Applied pressure shall be greater that the naturally occurring osmotic pressure

- Used for desalination, recycling, wastewater treatment (water filters, RO), and can even produce energy

DIALYSIS

- Removal of dissolved substances from a colloid by means of diffusion
- Particles (solute) of a true solution can pass through a membrane
    - This property used for diffusion
- Apparatus used is dialyser
- Colloidal solution with impurities is stored in a container of suitable membrane
- It is suspended in distilled water
- The impurities diffuse into water
- Pure colloidal solution left behind
- Process can be made faster by application of electric field
- This process is widely used in dialysis of blood
    - Membrane allows excess ions and wastes to pass through
    - Colloid sized particles like haemoglobin are left behind
    - Blood is purified

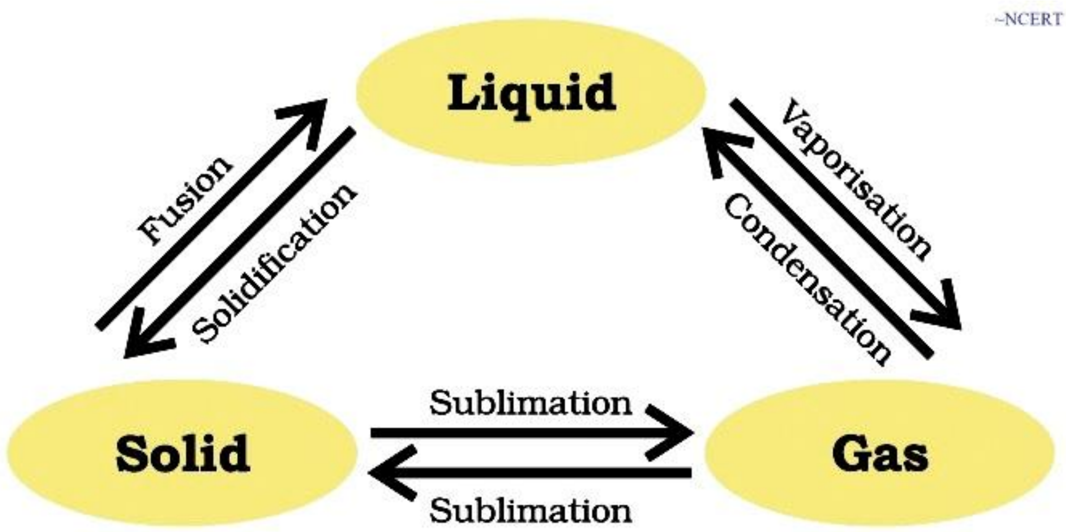
LATENT HEAT OF FUSION

- Even after melting starts, the temperature inside the beaker filled with ice does not increase
    - Heat received by beaker is used up in overcoming the force of attraction
- It increases only after ice melts completely
- Thus the heat energy absorbed by ice without increasing temperature is hidden (latent)
- This is latent heat
- The amount of heat required to change 1kg of ice into water without increase in temperature

LATENT HEAT OF VAPORISATION

- Amount of heat (in KJ) required to change 1kg of liquid into vapours at atmospheric pressure without changing the temperature
- Steam causes severe burn compared to water at same temperature
  - Steam has absorbed extra energy (Latent heat of Vaporisation)

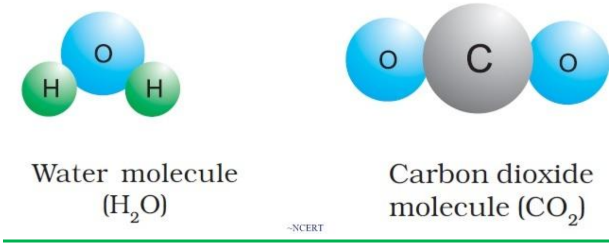
INTERCONVERSION OF STATES OF MATTER



SUBLIMATION

- Some solid substances on heating, directly change into gaseous state, without passing through liquid state
- Some substances in gaseous state, directly change into solid state on cooling
- Solid obtained on cooling is called sublimate
- Gaseous form of the solid is called sublime
- Examples:
  - Naphthalene balls/moth balls, dry ice, Iodine, etc
  - Solid room fresheners
  - Dry sublimation printers (not messy like ink printers)

Name the technique to separate
(i) butter from curd: Centrifugation
(ii) salt from sea-water: Evaporation
(iii) camphor from salt: Sublimation



DRY ICE

- Frozen carbon dioxide
- Useful for freezing
- Sublimates into gas, hence called dry ice
- Causes serious burns if touched without gloves
- 1kg dry ice releases 500 litres of CO_2
- Storage rooms shall be sufficiently aired before entering them (anesthetising nature of CO_2)

RATE OF EVAPORATION

Rate of evaporation increases with:

- Increase in surface area
    - Clothes are spread out for drying
- Increase in temperature
    - More particles gain energy to evaporate
    - Clothes dry faster in summers
- Decrease in humidity
    - Air cannot hold more than a specific amount of water vapour
    - When humidity is less, more water vapour can evaporate
    - Sweat from our body evaporates faster in less humid conditions
- Increase in wind speed
    - Particles of water vapour move away
    - Decreasing humidity
    - Increased evaporation
    - Clothes dry faster on a windy day

Why are we able to sip hot tea or milk faster from a saucer rather than a cup?
Answer: We are able to sip tea, milk faster from a saucer because it has larger surface area than the cup. In larger surface area rate of evaporation is faster due to which tea or milk cools rapidly.

PLASMA

- Fourth state of matter
- All matter is vaporised at extremely high temperatures
- It is a kind of fluid
- Hot gases of sun, stars, gases in space between stars
- Electric arcs, fluorescent lights, neon signs
    - Places where electric current is passed through a gas filled tube
- Super energetic and super excited particles

BOSE-EINSTEIN CONDENSATE

- Professor SatyendraNath Bose did some study in 1920
- Based on his study, Einstein predicted a fifth state in 1925
- Carl E. Weiman in 1995 chilled gas atoms of extremely low density to the lowest temperature achieved
- Created fifth state matter
- Called Bose-Einstein Condensate

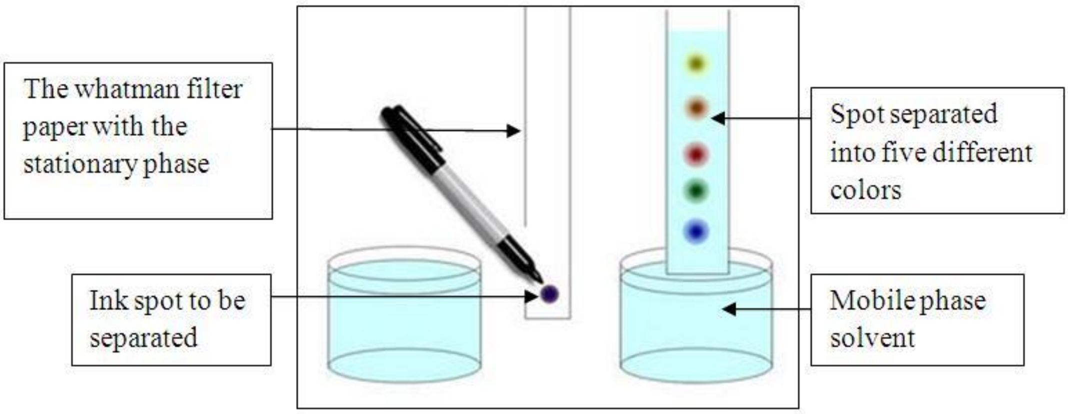
CRYSTALLISATION

- Crystals of a pure substance are obtained from its solution
- Hot and concentrated solution is cooled slowly
- Crystals are formed
- Separated by filtration
- PRINCIPLE: Difference in solubility of the compound and the impurity
- Crystals are dried in air or in oven
- Choice of proper solvent is crucial to crystallisation
- Example: Crystallisation of sugar from a mixture of sugar and common salt
    - Put the mixture in hot ethanol

- Sugar dissolves, salt does not
- Water not chosen as solvent to avoid dissolution of salt as well
- Filter salt out
- Concentration and slow cooling of the remaining solution
- Crystallisation of sugar, impurities if any, will be left out

CHROMATOGRAPHY

- Separating components of a mixture
- PRINCIPLE: Differential movement of different components
- Mixture dissolved in a fluid- Mobile Phase
- Mobile phase moves and separates into components on the stationary phase



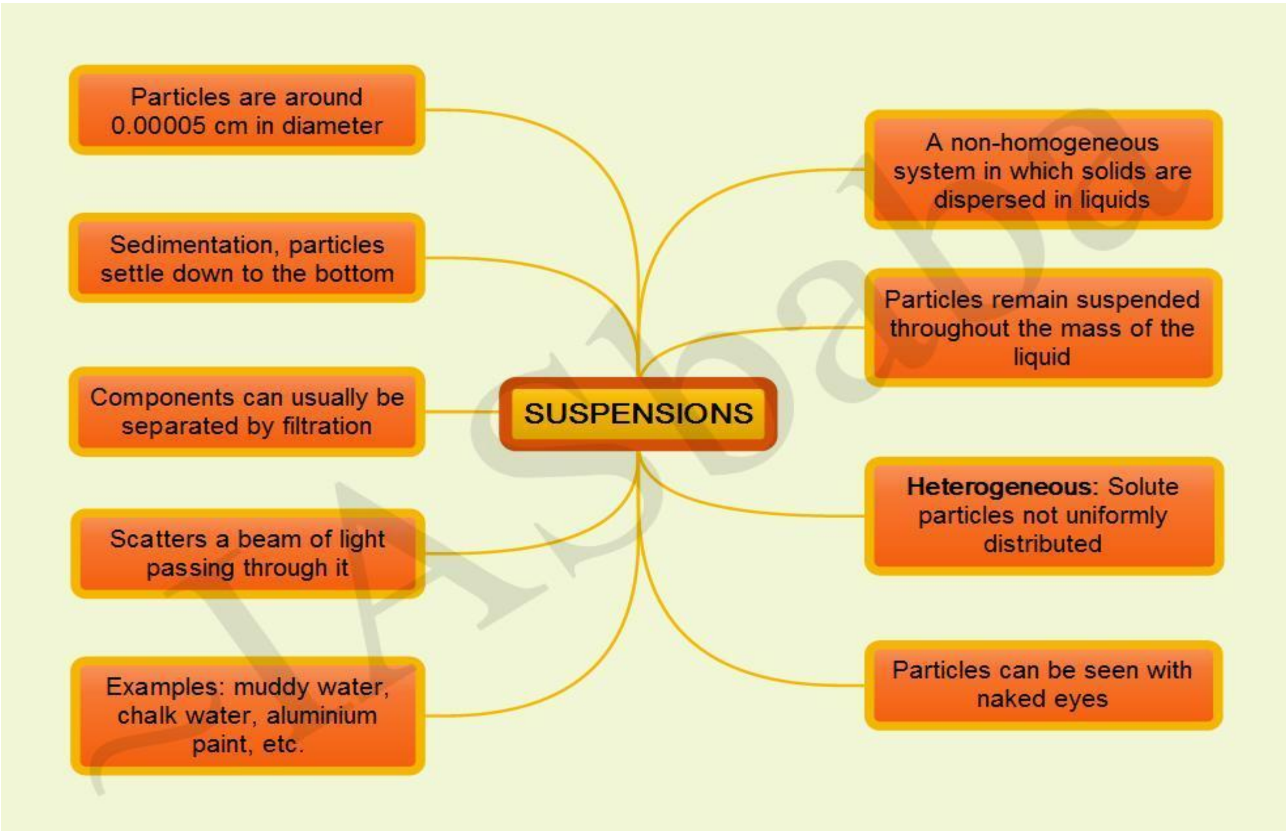
SOLUBILITY AND PRESSURE

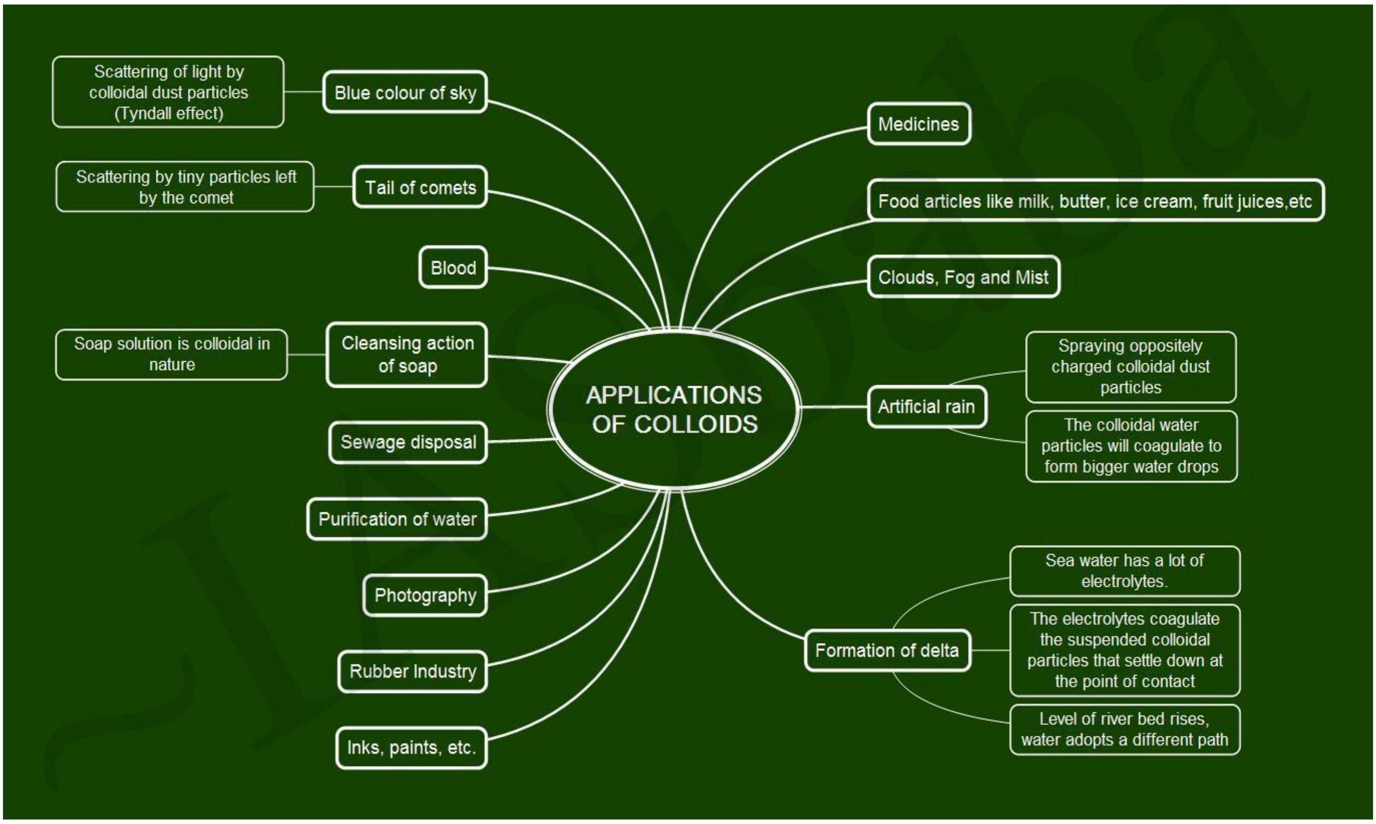
- Dependence of the solubility of solids and liquids on gases is weak
- The solubility of gases depends on pressure
- Solubility of gases increases with increase in pressure
- Solubility of gases decreases with decrease in pressure
- **SCUBA DIVERS:**
  - High pressure underwater
  - Solubility of atmospheric gases in blood increase (Nitrogen)
  - While moving towards surface of water, solubility decreases
  - Dissolved gases released, Nitrogen bubbles formed in blood
  - Blocks capillaries
  - Painful dangerous
  - Medical condition called BENDS

- Tanks used by scuba divers are filledwith air diluted with helium (11.7% helium, 56.2% nitrogen and32.1% oxygen)
- Diver must return to surface slowly

- **HIGH ALTITUDES:**
  - Low pressure
  - Less Oxygen dissolved in blood and tissues
  - Weakness and inability to think clearly
  - Medical condition called Anoxia

- **AERATED DRINKS:**
  - Bottle sealed under high pressure
  - High solubility of CO_2




APPLICATIONS OF COLLOIDS
Blue colour of sky
Scattering of light by colloidal dust particles (Tyndall effect)
Tail of comets
Scattering by tiny particles left by the comet
Blood
Cleansing action of soap
Soap solution is colloidal in nature
Sewage disposal
Purification of water
Photography
Rubber Industry
Inks, paints, etc.
Medicines
Food articles like milk, butter, ice cream, fruit juices,etc
Clouds, Fog and Mist
Artificial rain
Spraying oppositely charged colloidal dust particles
The colloidal water particles will coagulate to form bigger water drops
Formation of delta
Sea water has a lot of electrolytes.
The electrolytes coagulate the suspended colloidal particles that settle down at the point of contact
Level of river bed rises, water adopts a different path

Base Physical Quantity	Symbol for Quantity	Name of SI Unit	Symbol for SI Unit
Length	l	metre	m
Mass	m	kilogram	kg
Time	t	second	s
Electric current	I	ampere	A
Thermodynamic temperature	T	kelvin	K
Amount of substance	n	mole	mol
Luminous intensity	I_v	candela	cd

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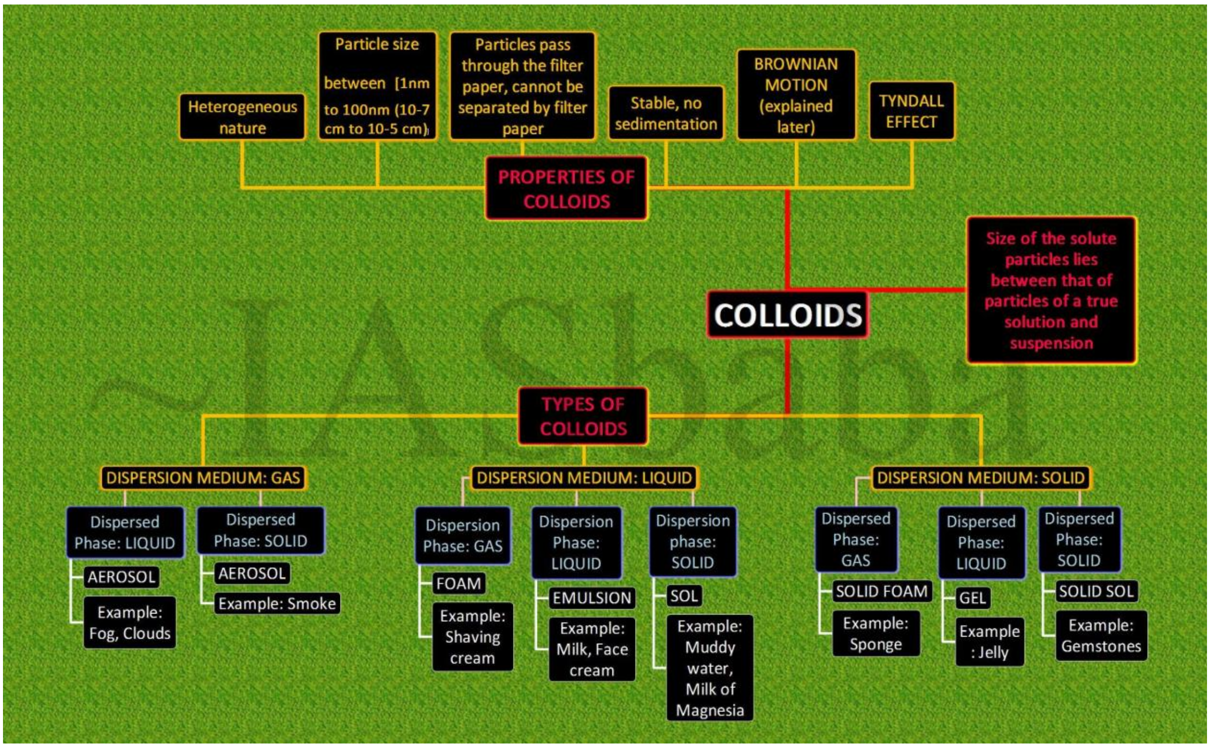
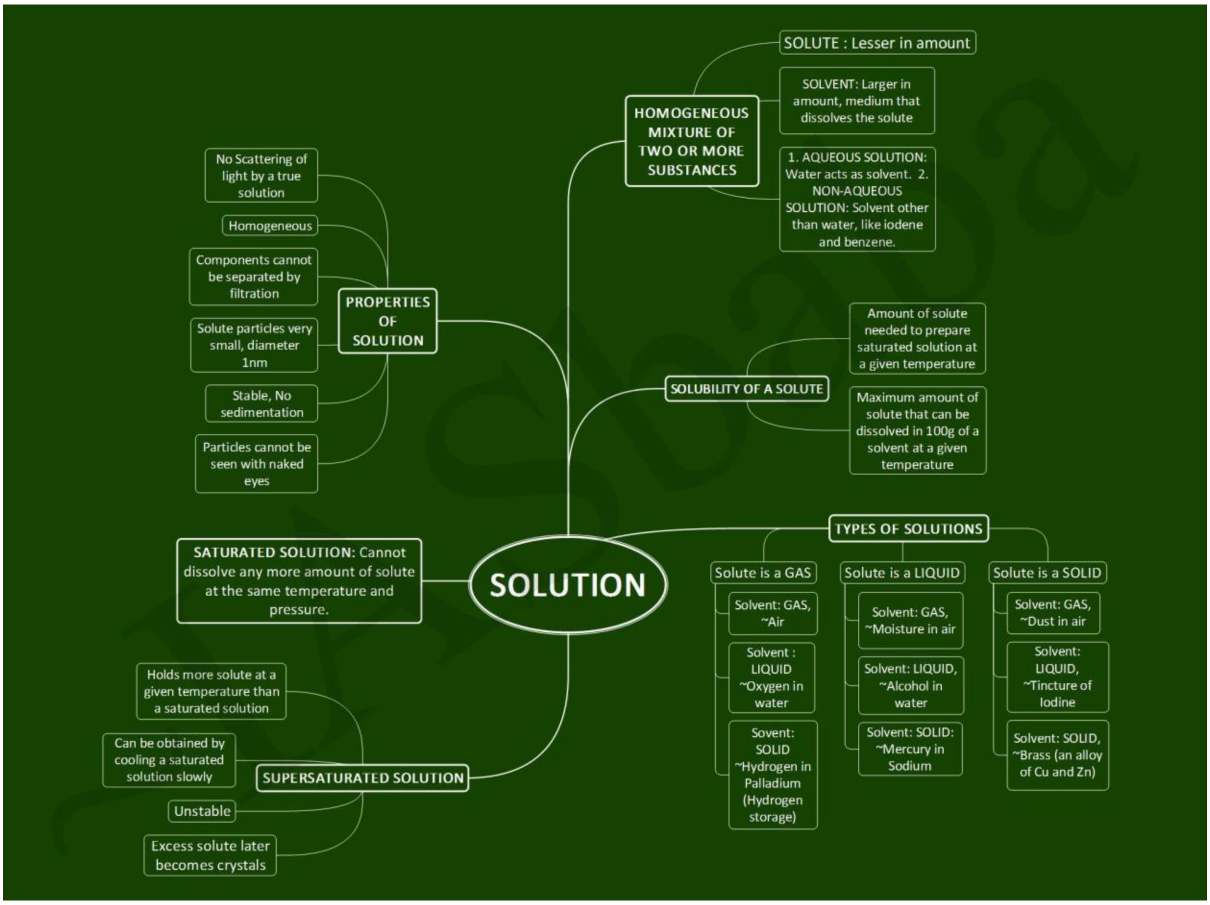
Unit of length	**metre**	The *metre* is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.
Unit of mass	**kilogram**	The *kilogram* is the unit of mass; it is equal to the mass of the international prototype of the kilogram.
Unit of time	**second**	The *second* is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom.
Unit of electric current	**ampere**	The *ampere* is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2 10^{-7} newton per metre of length.
Unit of thermodynamic temperature	**kelvin**	The *kelvin*, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.
Unit of amount of substance	**mole**	1. The *mole* is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12; its symbol is "mol." 2. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.
Unit of luminous intensity	**candela**	The *candela* is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.


Heterogeneous nature
Particle size between [1nm to 100nm (10-7 cm to 10-5 cm)
Particles pass through the filter paper, cannot be separated by filter paper
Stable, no sedimentation
BROWNIAN MOTION (explained later)
TYNDALL EFFECT
PROPERTIES OF COLLOIDS
COLLOIDS
Size of the solute particles lies between that of particles of a true solution and suspension
TYPES OF COLLOIDS
DISPERSION MEDIUM: GAS
Dispersed Phase: LIQUID
AEROSOL
Example: Fog, Clouds
Dispersed Phase: SOLID
AEROSOL
Example: Smoke
DISPERSION MEDIUM: LIQUID
Dispersion Phase: GAS
FOAM
Example: Shaving cream
Dispersion Phase: LIQUID
EMULSION
Example: Milk, Face cream
Dispersion phase: SOLID
SOL
Example: Muddy water, Milk of Magnesia
DISPERSION MEDIUM: SOLID
Dispersed Phase: GAS
SOLID FOAM
Example: Sponge
Dispersed Phase: LIQUID
GEL
Example : Jelly
Dispersed Phase: SOLID
SOLID SOL
Example: Gemstones


SOLUTION
HOMOGENEOUS MIXTURE OF TWO OR MORE SUBSTANCES
SOLUTE : Lesser in amount
SOLVENT: Larger in amount, medium that dissolves the solute
1. AQUEOUS SOLUTION: Water acts as solvent. 2. NON-AQUEOUS SOLUTION: Solvent other than water, like iodene and benzene.
PROPERTIES OF SOLUTION
No Scattering of light by a true solution
Homogeneous
Components cannot be separated by filtration
Solute particles very small, diameter 1nm
Stable, No sedimentation
Particles cannot be seen with naked eyes
SOLUBILITY OF A SOLUTE
Amount of solute needed to prepare saturated solution at a given temperature
Maximum amount of solute that can be dissolved in 100g of a solvent at a given temperature
SATURATED SOLUTION: Cannot dissolve any more amount of solute at the same temperature and pressure.
SUPERSATURATED SOLUTION
Holds more solute at a given temperature than a saturated solution
Can be obtained by cooling a saturated solution slowly
Unstable
Excess solute later becomes crystals
TYPES OF SOLUTIONS
Solute is a GAS
Solvent: GAS, ~Air
Solvent : LIQUID ~Oxygen in water
Sovent: SOLID ~Hydrogen in Palladium (Hydrogen storage)
Solute is a LIQUID
Solvent: GAS, ~Moisture in air
Solvent: LIQUID, ~Alcohol in water
Solvent: SOLID: ~Mercury in Sodium
Solute is a SOLID
Solvent: GAS, ~Dust in air
Solvent: LIQUID, ~Tincture of Iodine
Solvent: SOLID, ~Brass (an alloy of Cu and Zn)