MATTER

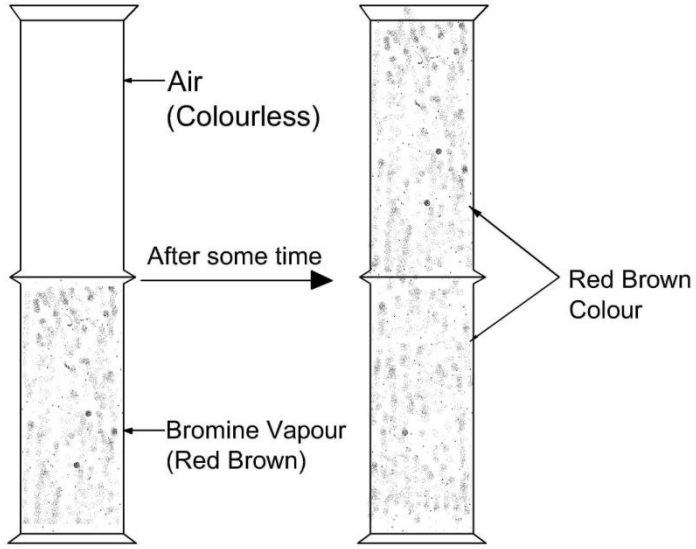
- Anything that occupies space and has mass and offer resistance is called matter.
- Example: air, water, rock, oil etc
- Matter is made of particles: Everything is made up of tiny pieces or particles (the particles which make a matter are atoms or molecules)

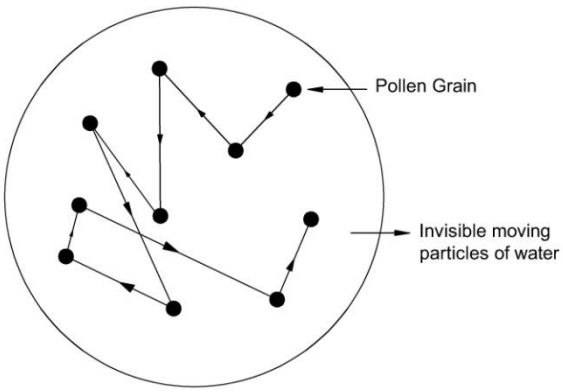
SUBSTANCE

- A substance is a kind of matter that cannot be separated into other kinds of matter by any physical process.
- Example: sugar dissolved in water can be separated from water by simple evaporating the water, here sugar is a substance.

EVIDENCES FOR PARTICLES IN MATTER

1. **Dissolving a solid in a liquid:** potassium permanganate crystals and water are made up of tiny particles. The particles of potassium permanganate are purple whereas the particles of water are colorless. When they are mixed particles separate from one another and purple colored particles spread throughout water making the whole water purple. So we can conclude they are moving or they are in motion.
   - **Movement of different particles among each other (on their own) so that they become mixed uniformly, is called diffusion**





2. **Mixing of two gases:** the mixing of bromine vapour into air can be explained by taking that both are made up of tiny moving particles.
3. **Movement of pollen grains in water:** The pollen grains move on the surface of water because they are constantly being hit by the fast moving particles of water.
   - **The zig zag movement of the small particles suspended in a liquid (or gas) is called Brownian motion.**

CHARACTERISTICS OF PARTICLES OF MATTER

1. Particles of matter are very-very small.
2. The particles of matter have spaces between them.
3. Particles of matter are constantly moving.
4. The particles of matter attract each other.
5. The particles of motion increases with rise in temperature.

NOTE:
- Rigid: unbending/inflexible, example: stone
- Fluid: which can flow, example: water

CLASSIFICATION OF MATTER

On the basis of physical state matter can be classified into three groups.

1. Solid: example – sugar, sand, wood, iron etc
2. Liquid: example – water, milk, oil, alcohol etc
3. Gas: example – air, oxygen, hydrogen, carbon di oxide etc

PROPERTIES OF SOLIDS

1. Solids have a fixed shape and fixed volume.
2. Solids cannot be compressed.
3. Solids have high densities.

NOTE
- Density = mass / volume
- Density is measured in Kg/m^3 or $gram/cm^3$

4. Solids do not fill their container completely.
5. Solids do not flow.
6. Particles of solids have negligible kinetic energy.
7. Solids do not have the property of diffusion or negligible diffusion.

PROPERTIES OF LIQUIDS

1. Liquids have a fixed volume.
2. They have no fixed shape: Liquids take the shape of vessels in which they are placed.
3. Liquids cannot be compressed much.
4. Liquids have moderate to high densities. They are usually less dense than solids.
5. Liquids do not fill their container completely.
6. Liquid generally flow easily.
7. The kinetic energy of the particles in a liquid state is more than that in the solid state.
8. Particles in the liquid state can easily diffuse and this rate of diffusion increases with the rise in temperature.

PROPERTIES OF GASES

1. Gases have neither a fixed shape nor a fixed volume: Gases acquire the shape and volume of the vessel in which they are kept.
2. Gases can be compressed easily (into a small volume).
3. Gases have very low density.(they are very-very light)
4. Gases flow easily.
5. Gases exert pressure. (Since particles in a gas have high kinetic energy they strike the walls of container with a force as a result they exert pressure).
6. Gases diffuse very rapidly.

NOTE
- Lighter gases diffuse faster than the heavier gases.
- Diffusion of gases is not influenced by gravity.

DIFFUSION

- The spreading out and mixing of a substance with another substance due to motion of its particles is called diffusion.
- Diffusion is a property of matter which is based on the motion of its particle.
- Diffusion is fastest in gases and slowest in solids.
- The rate of diffusion increases on, increasing the temperature of diffusing substance. This is because on heating particles gain kinetic energy and move more rapidly.
  Examples:

a. **Diffusion in gases:**
   i. The smell of food being cooked reaches up even from a considerable distance by the process of diffusion.
   ii. The fragrance of burning incense stick spreads all around due to diffusion of its smoke into the air.

b. **Diffusion in liquids:** the spreading of blue colour of copper sulphate into water, on its own is due to the diffusion of copper sulphate particles into the water.

c. **Diffusion in solids:** if we write something on a blackboard and leave it uncleaned for a considerable period of time (say 10 to 15 days), we will find that it becomes quite difficult to clean the board. This is due to the fact that some of the particles of chalk have diffused into the surface of black board.

COMMON UNITS OF TEMPERATURE

There are two common units for measuring temperature.

1. The Celsius scale.
2. The Kelvin scale.

- Temperature on Kelvin scale = Temperature on Celsius scale + 273
- 'Degrees Celsius in short form is written as °C (read as degrees Celsius).
  Melting point of ice is 0° C.
  Boiling point of water is 100° C.
- The S.I. unit of measuring temperature is Kelvin, which is denoted by the symbol K.

NOTE: That the word degree or its sign (°) is not written with the Kelvin scale temperature.
Melting point of ice is 273 K.
Boiling point of water is 373 K.

CHANGE OF STATE OF MATTER

- Physical state of matter can be changed by two ways –
  1. By changing the temperature.
  2. By changing the pressure.

NOTE:
The change in temperature or pressure actually changes the inter particle forces of attraction due to which the inter conversion of states of matter occur.

- **Effect of change of temperature**

1. Solid to liquid change:-
   - The process in which solid changes into liquids on heating is called melting (or fusion).
   - The temperature at which a solid substance melts and changes into a liquid at atmospheric pressure is called melting point of substance.

2. Liquid to gas change:- Boiling (or vaporization)
   - The process in which liquid substance changes into a gas rapidly on heating is called boiling.
   - The temperature, at which liquid boils and changes rapidly into a gas at atmospheric pressure, is called boiling point of the liquid.
3. Gas to liquid change: (Condensation)
   - The process of changing of gas (or vapour) to a liquid by cooling is called condensation.
   - Condensation is reverse of boiling (or vaporization).
4. Liquid to solid change: (Freezing)
   - The process of changing a liquid into a solid by cooling it is called freezing.
   - Freezing is reverse of melting.

LATENT HEAT

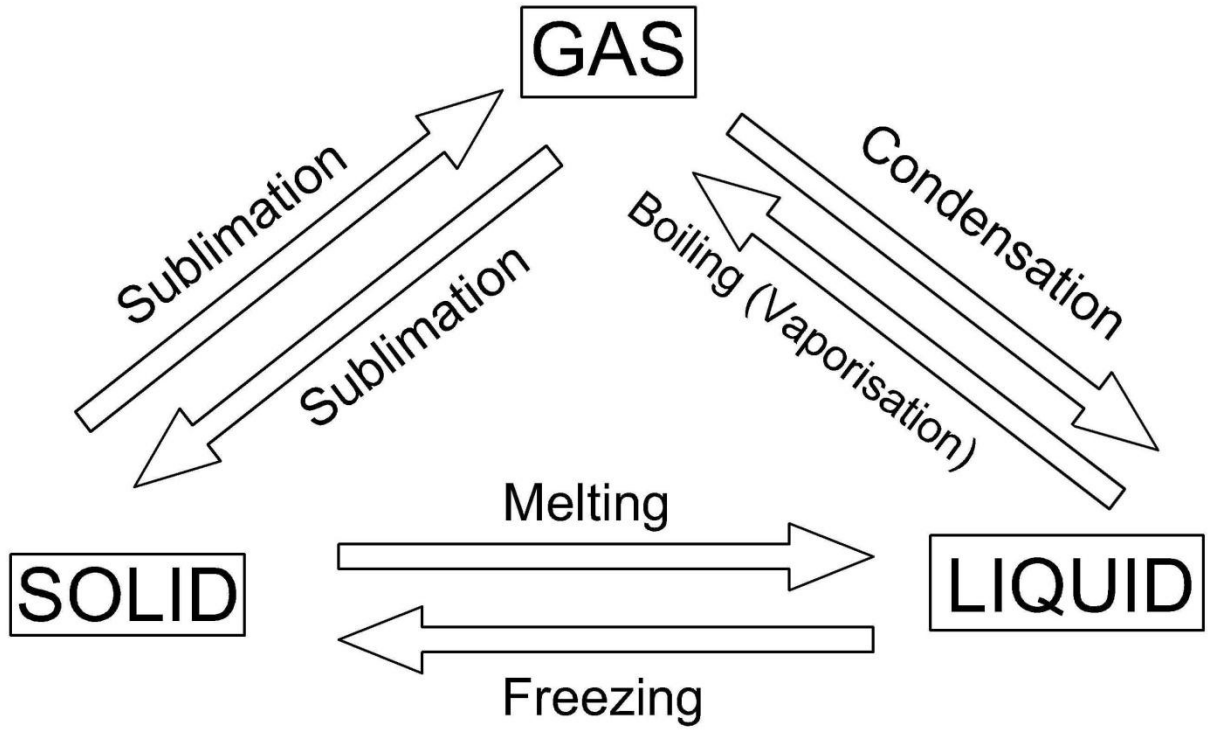
- The heat energy which has to be supplied to change the state of substance is called its **latent heat.**
- Latent means hidden, latent heat doesn't cause a rise in temperature of the substance.
- The latent heat which we supply is used up in overcoming the forces of attraction between the particles of a substance during the change of state.
- Latent heat is of two types:
  - Latent heat of fusion
  - Latent heat of vaporization

1. **Latent heat of fusion: (Solid-liquid change)**
   - The latent heat of fusion (or melting) of a solid is the quantity of heat in joules required to convert 1Kg of the solid (at its melting point) to liquid, without any change in temperature.
   - The latent heat of fusion of ice is 3.34×10^5 J/Kg.
   - Ice at 0°C is more effective in cooling a substance than water at 0°C.
   - When a liquid freezes to form solid an equal amount of heat is given out.

2. **Latent heat of vaporization: (liquid-gas change)**
   - The latent heat of vaporization of a liquid is the quantity of heat in joules required to convert 1 Kg of liquid (at its boiling point) to vapour or gas, without any change in temperature.
   - The latent heat of vaporization of water is 22.5×10^5 J/Kg.
   - When water changes into steam it absorbs latent heat, but when steam condenses to form water, an equal amount of latent heat is given out.
   - The burns caused by steam are much more severe than those caused by boiling water though both of them are at the same temperature of 100°C. This is due to the fact that steam contains more heat, in the form of latent heat, than boiling water.

SUBLIMATION

- The changing of solid directly into vapour on heating and vapour into solid on cooling is called sublimation.
- The common substances which go under sublimation are ammonium chloride, camphor, iodine, naphthalene, anthracene and solid carbon di oxide (or dry ice).



Note: There is no difference between gas and vapour. The term vapour is used for those gases which exist in the liquid form at room temperature.

- **Effect of change of pressure**
  - Gases can be liquefied by applying pressure (compression) and lowering temperature (cooling).
  - Solid carbon di oxide (dry ice) is stored under high pressure this is because on decreasing the pressure on solid carbon di oxide, it gets converted directly into carbon di oxide.

EVAPORATION

- The process of a liquid changing into vapour or gas even below its boiling point is called evaporation.
- Whatever be the temperature at which evaporation takes place, the latent heat of vaporization must be supplied whenever a liquid changes into vapour or gas.

FACTORS'S EFFECTING EVAPORATION

1. **Temperature:** The rate of evaporation increases on increasing the temperature of liquid.
2. **Surface area of the liquid:** The rate of evaporation increases on increasing the surface area of liquid.
3. **Humidity of air:** (Humidity of air tells us the degree of 'dampness of air')
   - When the humidity of air is low, then the rate of evaporation is high and water evaporates more rapidly.
   - When the humidity of air is high, then the rate of evaporation is low and water evaporates s
4. **Wind speed:** the rate of evaporation of a liquid increases with increasing wind speed.

COOLING CAUSED BY EVAPORATION

- The cooling caused by evaporation is based on the fact that when a liquid evaporates it takes the latent heat of evaporation from 'anything' which it touches. By loosing heat this 'anything' becomes 'cool'.

For example:

1. If we put a little of spirit or petrol at the back of our hands and wave it around, the spirit evaporates and our hands feel very cold.
2. During hot summer days, water is usually kept in an earthen pot (called matka) to keep it cool.
3. At many places, especially in villages, people often sprinkle water on the ground in front of their homes during the hot summer evenings.
4. Perspiration or sweating is our body's method of maintaining a constant temperature.
5. We should wear cotton clothes in hot summer days to keep cool and comfortable.
6. A fan increases the rate of evaporation of sweat from our skin and makes us feel cool and comfortable.

PLASMA AND BOSE-EINSTEIN CONDENSATE:

1. **PLASMA:** Plasma state consists of highly ionized gas in which the particles exist in super energetic and super excited states. Example: Fluorescent tube and neon sign bulbs.

2. **BOSE-EINSTEIN CONDENSATE:** In 1920, an Indian scientist Satyendra Nath Bose gave the concept of fifth state of matter. Bose-Einstein condensate is obtained by super cooling a gas of extremely low density.