

Matter-Nature and Behaviour

- Anything that occupies space and has mass is called Matter.
- According to early Indian philosophers, every living and non- living thing is made of five basic elements called the panchtatava- Air, water, earth, sky and fire. Therefore, matter is composed of these five constituents.

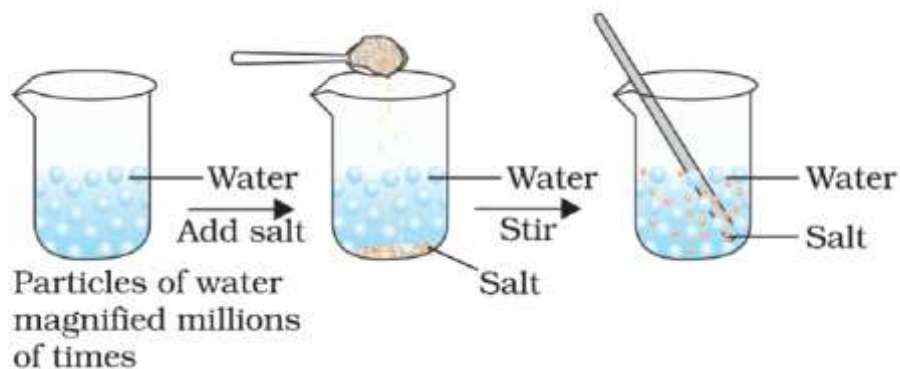
Properties of Matter

- Matter is made up of very small particles called atoms that sum up to form molecules which give rise to matter. The properties of these particles are:
 - The particles of matter are very small in size.
 - These particles have vacant spaces between them.
 - These particles are continuously moving.
 - These particles attract each other.

Experiments that prove properties of matter

Experiment 1

- Take a glass filled with water and mark the level of water in the glass.
- Dissolve some sugar/ Salt with the help of a glass rod.
- Observe the level of the water in the glass remains same.
- This means that matter is made of tiny particles due to which the sugar particles adjusted into the spaces available between the tiny particles of water.



When we dissolve salt in water, the particles of salt get into the spaces between particles of water.

This experiment proves that matter is made of tiny particles and have spaces between them.

Experiment 2

- Lit an incense stick in one corner of a room.
- Observe what happens. The smell can be felt even from a considerable distance. The smell actually diffuses into the air.

This proves that the particles of matter are continuously moving.

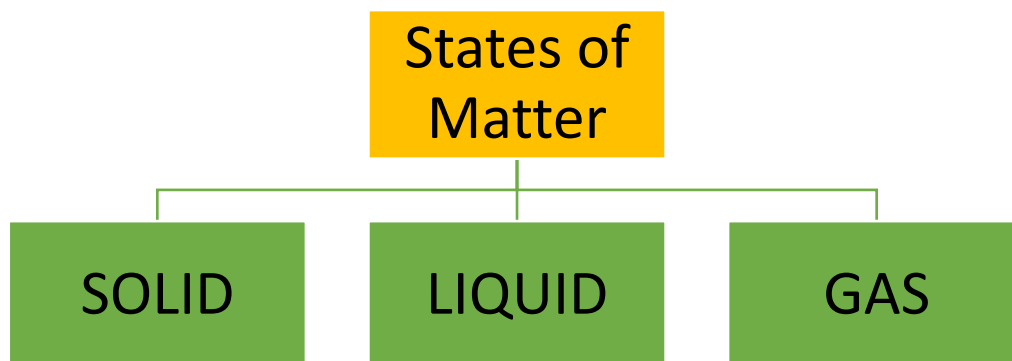
Experiment 3

- Take an iron nail, a rubber band and a piece of chalk.
- Try breaking them by hammering, cutting or stretching.
- All three require different strength of force.

This proves that particles of matter have force acting between them.

States of Matter

Matter can be categorised into three



Solid State

- They have definite shape because of presence of strong intermolecular forces of attraction.
- They have distinct boundaries.
- They have fixed volume.
- The force of attraction is the maximum among the particles in solid. Therefore, they cannot be compressed.
- They possess a fixed shape.
- They are rigid, which means that they break under force but do not change their shape.

Liquid State

- A liquid has no definite shape and takes up the shape of the container in which it is kept.
- Liquids have fixed volumes due to weaker intermolecular forces of attraction as compared to solids.
- They can flow easily because there is space between the particles. That is why they are also called fluids.
- A liquid is compressible due to larger distance between the particles as compared to solids.
- They have lower density.
- A liquid can diffuse into another liquid due to the fact that molecules move faster in a liquid but diffusion is slower as compared to gases.

Gaseous State

- They do not have definite shape and take up the shape of the container.
- They do not possess definite volume due to weakest intermolecular forces.
- They are not rigid.
- They can easily be compressed and put into a small container.
- Since there is lot of space between the particles, different gases can diffuse into each other.
- The particles of gases have least or no force of attraction between them. Therefore, they can freely move in any direction.

Effect of change of Temperature

Solid

- As we heat solids, the kinetic energy of the particles of solid increases which decreases the force of attraction between them. As a result, they start vibrating and changing their positions. Slowly due to heat the particles become free and the solid gets converted to a liquid.
- **Melting Point-** The temperature at which solid melts and converts to a liquid at atmospheric pressure is called Melting Point. For example, the melting point of ice is 273.16 Kelvin.

- **Fusion-** The process of melting of a solid into liquid is called Fusion.

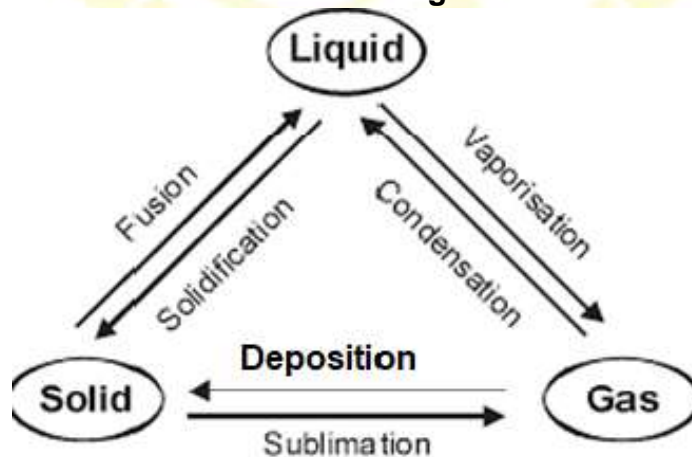
Liquids

- As we heat liquids, the kinetic energy of the particles of liquid increases, the force of attraction among them decreases and they start moving freely. As a result, the particles overcome the forces of attraction completely. This is when the liquid starts changing into gas.
- **Boiling Point** – The temperature at which a liquid starts boiling at the atmospheric pressure is known as its Boiling Point. For example, the B.P. of water is 373 Kelvin.
- **Latent heat of vapourisation-** The amount of heat energy required to change 1 kg of liquid into a gas at atmospheric pressure at its boiling point is known as Latent Heat of Vaporisation.

Effect of change of Pressure

- Pressure creates no effect on solids or liquids because both these states of matter are non-compressible. But if pressure is exerted on a solid it breaks.
- When we compress and decrease the temperature of a gas, the gas changes into a liquid.
- **Dry Ice** – Solid Carbon dioxide is known as Dry Ice. It can directly turn into gas by decreasing the pressure to 1 atmosphere.

Processes involved in change of states of matter



Interconversion of three states of matter

Fusion

The phenomenon of conversion of solid into a liquid is termed as fusion. For instance, melting of ice.

Solidification

The phenomenon of conversion of a liquid into a solid is called solidification. For instance, formation of ice from water.

Condensation

The phenomenon of change of gas to liquid is called condensation. For example, presence of water droplets on surface of glass containing cold water because the water vapour present in air when comes in contact with the cold glass of water it loses its energy and condenses to liquid state. This is seen as water droplets on the surface of glass.

Sublimation

The phenomenon of conversion of a solid directly to gas or gas directly to solid without changing into liquid state is called sublimation. For instance, camphor also called *capoor* when kept for a long time vanishes. This happens due to the sublimation of camphor.

Evaporation

- We already know that particles of matter are never at rest in fact they possess different amount of kinetic energy.
- Due to increase in temperature the particles at the surface of liquid possessing higher kinetic energy are capable to break away from the forces of attraction of other particles present in the surrounding and vaporises. This process of conversion of liquid to vapour at any temperature below its boiling point is termed as evaporation.

Factors affecting Evaporation

- Rate of evaporation increases on increasing the surface area since it is a surface phenomenon.
- Rate of evaporation increases on increasing the temperature because more no. of particles gets enough kinetic energy to convert into vapour phase.
- Rate of evaporation decreases with increase in humidity because air can hold water up to a certain amount only.
- Rate of evaporation increases with increase in the wind speed. That is why clothes dry at a fast rate during windy days.

How does Evaporation cause cooling?

- The process of evaporation uses the energy of the particles. Therefore the particles absorb energy from the surroundings to regain the energy lost during evaporation. This makes surroundings cool.
- For example:
 - Our palm feels cold when we put some acetone on it because the particles gain energy from our palm or surroundings and evaporate.

- People sprinkle water on their roofs or ground on sunny days to cool the area.
- We are able to sip hot coffee or tea faster in a saucer than in a cup.

Why should we wear cotton clothes in summer?

We perspire more in summers. As the sweat evaporates it takes energy from our body surface and keeps our body cool. Cotton being a good absorber helps in absorbing sweat and exposing it to the atmosphere for easy evaporation. Thus, keeping us cool.

Why does water droplets appear on the outer surface of a glass containing ice cold water?

The water vapour present in air, on coming in contact with the cold glass of water, loses energy and gets converted to liquid state, which appears as droplets.

