Chapter – 1

Matter in our Surroundings

Physical Nature of Matter

⇒ The matter is defined as the objects which have mass and occupy a certain space. Some of the examples of matter are shown below:

♦ Physical nature of Matter:

⇒ The matter is made up of millions of tiny particles.

⇒ The particle of one type of matter is different from the particle of another type of matter.

Tip: Smell is an abstract concept and not matter. But, smell of any substance is matter as it is gaseous form of a substance which has mass and occupy space

Characteristics of Particles of Matter

⇒ The particles of matter have spaces between them.

For example, the formation of the sugar solution. When we make sugar solution, the particles of one type
of matter get into the spaces between particles of the other. This shows that there is enough space between particles of matter.

⇒ The particles of matter are continuously moving.

For example, mixing of ink in water.

Particles of matter are continuously moving and they possess kinetic energy. As the temperature rises, particles move faster. This means that with an increase in temperature the kinetic energy of the particles also increases.

For example, sugar dissolves faster in hot water than in cold water.

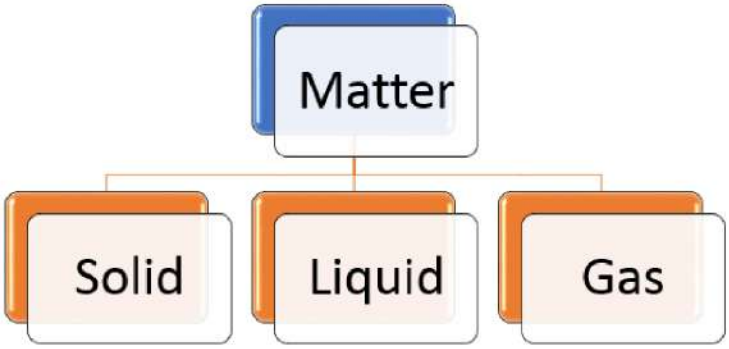
⇒ The particles of matter attract each other.

For example, chalk has a rigid structure.

Question: A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?

Answer: This shows that the particles of water has space between them and have weak intermolecular force of attraction between them.

States of Matter



♦ Solid:

⇒ The particles of solid are very close to each other. They have negligible spaces between them and they vibrate at their place.

⇒ The most important properties of solid are as follow:

(a) The particles of solid have a strong intermolecular force of attraction between them.

(b) The solid has a fixed shape and volume.

(c) The solid cannot take the shape of the container.

(d) The solids have a rigid structure.

(e) The solids are incompressible.

Special case:

1. Sponge has tiny holes which trapes the air. But we compress it, it is actually expelling the air out.

2. Rubber band can change its shape by stretching and can regain after removing force.

3. When you rotate the hourglass, the sand flows like a liquid. When you observe each particle in isolation, you will find that each particle has a fixed shape. So, when a large amount of the sand is poured, it will look like it is flowing.

♦ <u>Liquid:</u>

⇒ The particles of liquids are slightly far from each other.

⇒ So, the forces of attraction between the particles are not so strong and particles can move freely.

⇒ They have little space between them. So, this gives us the most important properties of liquid which are as follow:

(a) The particles of liquid have the intermediate intermolecular force of attraction between them.

(b) The liquid has no fixed shape but a fixed volume.

(c) The liquid can take the shape of the container.

(d) The liquid has no rigid structure.

(e) The liquids are incompressible.

(f) The liquids can flow easily.

Question: Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Find out why.

Answer: The ice is solid, but it has low density than water because of the cage like structure of ice. It has lot of spaces between them, so it floats on water.

♦ Gas:

⇒ The particles of gas are very far from each other. So, the forces of attraction between the particles are weak and particles can move freely in all directions.

⇒ They have a lot of spaces between them. So, this gives us the most important properties of gas which are as follow:

(a) The particles of gas have a weak intermolecular force of attraction between them.

(b) The gas has neither a fixed shape nor a fixed volume.

(c) The gas can take the shape of the container.

(d) The gas has no rigid structure.

(e) The gas is compressible.

(f) The gases can flow easily.

	SOLID	LIQUID	GAS
Intermolecular force of attraction	Strong	intermediate	Weak
Fixed shape	✓	✗	✗
Fixed volume	✓	✓	✗
Take the shape of the container	✗	✓	✓
Rigidity	✓	✗	✗
Compressible	✗	✗	✓
Fluidity	✗	✓	✓

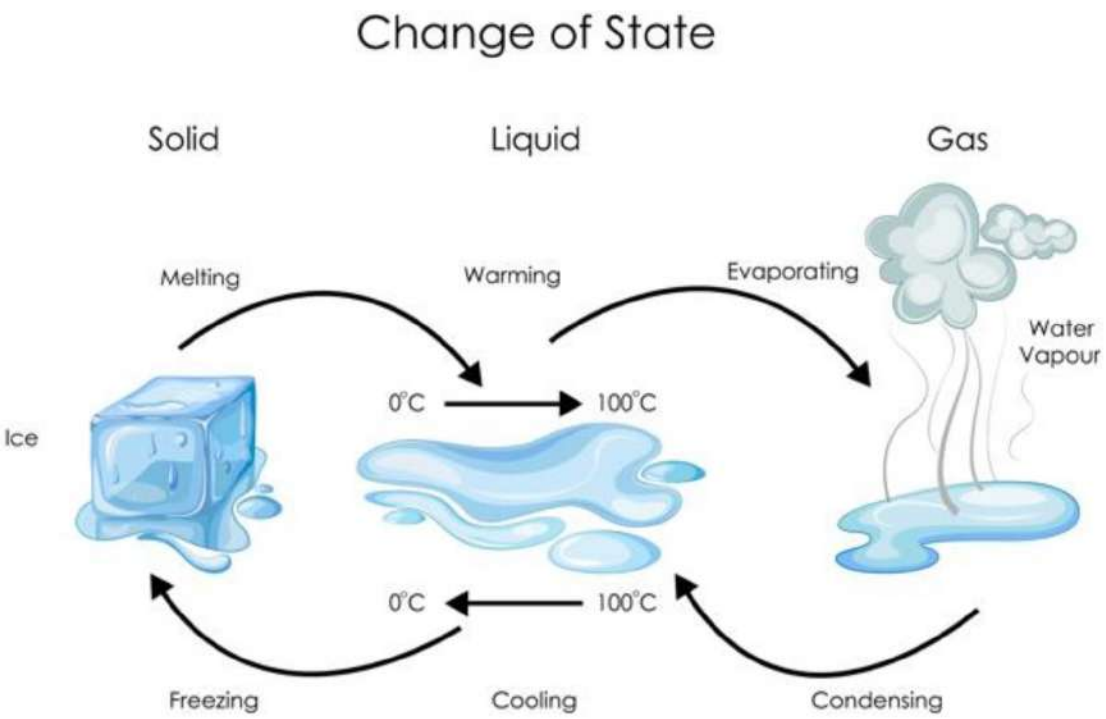
Diffusion

- The process of intermixing of particles of two different types of matter is called diffusion.
- The order for the rate of diffusion in different states of matter:
  GAS > LIQUID > SOLID
- The rate of diffusion increases with an increase in temperature.
- This is because when you increase the temperature, the kinetic energy of the particles increases and they mix into others quickly.

Question: Arrange the following substances in increasing order of forces of attraction between the particles— water, sugar, oxygen.

Solution: The forces of attraction is strong in solid and weak in gas. Sugar is solid, water is liquid and oxygen is gas. So, the order of forces of attraction between the particles is:
Oxygen < Water < Sugar

Can Matter change its State?



There are three states of matter and these states of matter can interconvert into each other.

(a) Melting or Fusion:

The process in which the substance changes its state from solid to liquid is called Melting or Fusion. The temperature at which the solid starts converting into a liquid at atmospheric pressure is called Melting point. For example, the melting of ice cream.

(b) Vaporization:

The process in which the substance changes its state from liquid to gas is called vaporization. The temperature at which the liquid starts converting into a gas at atmospheric pressure is called the boiling point. For example, the formation of steam.

(c) Freezing or Solidification:

The process in which the substance changes its state from liquid to solid is called solidification or freezing. For example, the formation of ice.

(d) Sublimation:

The process in which the substance changes its state from solid to gas is called sublimation. For example, sublimation of dry ice.

(e) Condensation:

The process in which the substance changes its state from gas to liquid is called condensation. For example, the formation of water droplets on the cold surface.

(f) Deposition:

The process in which the substance changes its state from gas to solid is called deposition. For example, the formation of frost on the leaves.

♦ Effect of temperature:

When the temperature of the matter is increased, the kinetic energy of the particles of matter also increases. Due to the increase in kinetic energy, the particles of matter start vibrating with greater speed and move freely.

When the temperature of the matter is decreased, the kinetic energy of the particles of matter also decreases. Due to the decrease in kinetic energy, the particles of matter start coming closer and developing stronger intermolecular vibration. Hence, the particle restricts their motion

The relation of the Kelvin and Celsius scales is shown below:

$$T(K) = T(°C) + 273.15$$

Concept of Latent Heat

It is the heat required to disrupt the force of attraction between the particles of matter by keeping the temperature constant. The amount of heat energy that is required to change 1 kg of a solid into liquid at atmospheric pressure at its melting point is known as the latent heat of fusion.
For example, Ice has a large latent heat of fusion than water.

The amount of heat energy that is required to change 1 mole of a liquid into a gas at atmospheric pressure at its melting point is known as the latent heat of vaporization.

For example, the steam has high latent heat of vaporization than boiling water.

Question: Why steam cause severe burn than hot water?

Solution: The steam has more heat than water. This heat is called latent heat of vaporization. That is why steam burns more than hot water.

♦ Effect of pressure:

The gases have the most space between their particles and solid have the least. So, solids and liquids are incompressible and have the negligible effect of pressure change on their change in state.

When the pressure of the gas is increased, the kinetic energy of the molecule is decreased and the speed of the molecule also decreased. So, the molecule starts coming close to each other and developing a stronger force of attraction between them.

The most important application of this phenomenon is the formation of LPG and CNG. They are a mixture of hydrocarbons which are filled in a small container at high pressure.

Evaporation

⇒ Evaporation is the process in which the liquid state changes to a gas state when it is heated at any temperature below its boiling point.

⇒ Factors affecting Evaporation:

(a) Surface area:

The rate of evaporation increases with an increase in surface area. For example, the water on the road dries up quickly as compared to water in a pothole.

(b) Temperature:

The increase in temperature will increase the rate of evaporation. For example, wet clothes dry quickly in the hot summer than in winter.

(c) Wind speed:

The increase in wind speed will increase the rate of evaporation. For example, wet hair dries quickly when you blow-dry it.

(d) Humidity:

The increase in humidity will decrease the rate of evaporation. For example, drying your wet clothes on a hot humid day takes a lot of time to dry than on a hot dry day.

Cooling effect:

- The particles of liquid need certain energy.
- So, the particle of liquid take this energy from the surrounding and make the surrounding cooler.
- This is called a cooling effect by evaporation.
- The common application of cooling effect is perspiration. Because of the same reason we wear cotton clothes during summer as cotton absorbs sweat quickly and exposed them to the atmosphere for easy evaporation.

Question: Explain why does a desert cooler cool better on a hot dry day.

Solution: The outer wall of the cooler is sprinkled by water constantly, which evaporate due to hot dry weather. This causes the cooling of air which is inside the cooler. The fan sent these cool air inside the room.