MATTER

- Matter is made up of small particles
- The matter around us exists in three states— solid, liquid and gas.
- The forces of attraction between the particles are maximum in solids, intermediate in liquids and minimum in gases
- The spaces in between the constituent particles and kinetic energy of the particles are minimum in the case of solids, intermediate in liquids and maximum in gases
- Particles of matter are continuously moving, that is, they possess what we call the kinetic energy. As the temperature rises, particles move faster. So, we can say that with increase in temperature the kinetic energy of the particles also increases
- The states of matter are inter-convertible. The state of matter can be changed by changing temperature or pressure.

DIFFUSION

- The mixing of a substance with another substance due to the motion of its particles is called diffusion. It is one of the properties of material. The diffusion of one substance to another substance goes on until a uniform mixture is formed. Diffusion takes place in gases, liquids and solids. **Diffusion** increases on increasing the temperature of the diffusing substance.

STATES OF MATTER

- Matter around us exists in three different states– solid, liquid and gas. These states of matter arise due to the variation in the characteristics of the particles of matter

1. THE SOLID STATE

- Solid have a definite shape, distinct boundaries and fixed volumes, that is, have negligible compressibility. Solids have a tendency to maintain their shape when subjected to outside force. Solids may break under force but it is difficult to change their shape, so they are rigid.

2. THE LIQUID STATE

- Liquids have no fixed shape but have a fixed volume. They take up the shape of the container in which they are kept. Liquids flow and change shape, so they are not rigid but can be called fluid

- The rate of diffusion of liquids is higher than that of solids
- Particles move freely and have greater space between each other as compared to particles in the solid state

3. THE GASEOUSSTATE

- Gases are highly compressible as compared to solids and liquids
- Gases have lower density than other states of matters
- The liquefied petroleum gas (LPG) cylinder that we get in our home for cooking or the oxygen supplied to hospitals in cylinders is compressed gas
- The oxygen supplied to hospitals in cylinders is compressed gas.
- Compressed natural gas (CNG) is used as fuel these days in vehicles.
- The rate of diffusion of gas is higher than that of solids and liquids
- We come to know of what is being cooked in the kitchen without even entering there, the smell of hot cooked food reaches us in seconds because rate of diffusion of gas is higher than that of solids and liquids.

MATTERS CHANGE ITS STATE?

Water can exist in three states of matter–

• Solid, as ice,

• Liquid, as the familiar water, and

• Gas, as water vapour.

1. EFFECT OF CHANGE OF TEMPARATURE

Increasing the temperature of solids, the kinetic energy of the particles increases.Due to the increase in kinetic energy, the particles start vibrating with greater speed. The energy supplied by heat overcomes the forces of attraction between the particles. The particles leave their fixed positions and start moving more freely. A stage is reached when the solid melts and is converted to a liquid. The minimum temperature at which a solid melts to become a liquid at the atmospheric pressure is called its **melting point**

- The melting point of ice is 273.15 K

The melting point of a solid is an indication of the strength of the force of attraction between its particles.

The process of melting, that is, change of solid state into liquid state is also known as **fusion**.

Supply heat energy to water, particles start moving even faster. At a certain temperature, a point is reached when the particles have enough energy to break free from the forces of attraction of each other. At this temperature the liquid starts changing into gas. The temperature at which a liquid starts boiling at the atmospheric pressure is known as its boiling point

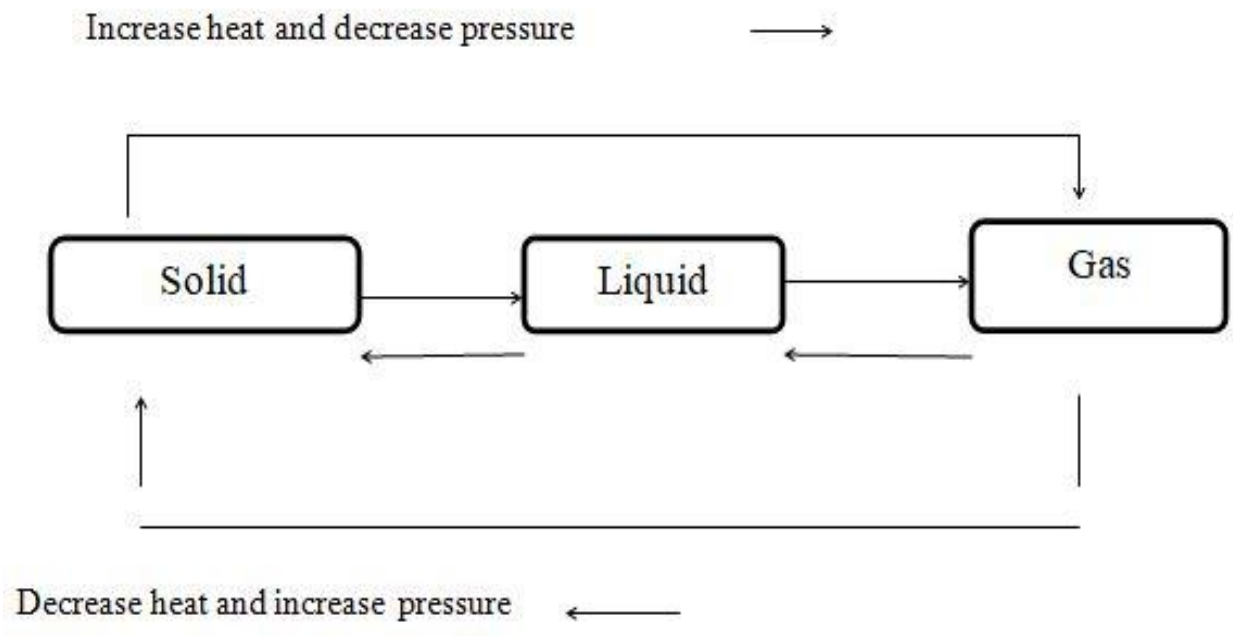
- State of matter can be changed into another state by changing the **temperature**

LATENT HEAT

The heat energy required to convert a solid into a liquid or vapour, or a liquid into a vapour, without change of temperature known as latent heat

2. EFFECT OF CHANGE OF PRESSURE

- Increasing or decreasing the pressure can change the state of matter
- Pressure and temperature determine the state of a substance, whether it will be solid, liquid or gas
- Gases can be liquefied by applying pressure and lowering temperature and liquid also convert to solid by applying the pressure and lowering the temperature



- Atmosphere (atm) is a unit of measuring pressure exerted by a gas
- The unit of pressure is Pascal (1 atmosphere = 1.01 * 10^5 Pa)

Solid carbon dioxide

- It is stored under high pressure.
- Solid CO2 gets converted directly to gaseous state on decrease of pressure to 1 atmosphere* without coming into liquid state. This is the reason that solid carbon dioxide is also known as dry ice

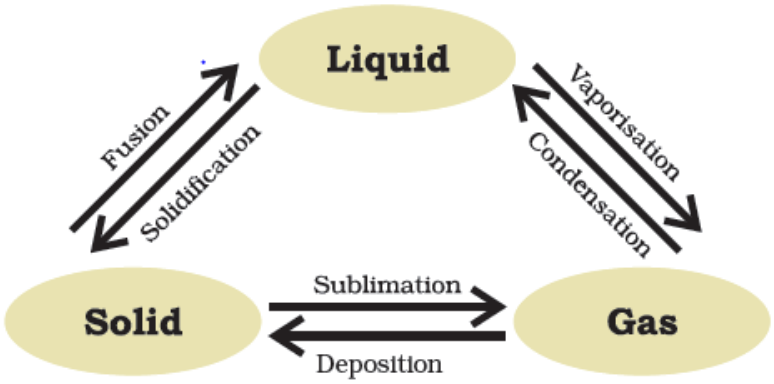
Sublimation & Deposition

A change of state directly from solid to gas without changing into liquid state is called sublimation and the direct change of gas to solid without changing into liquid is called deposition.

Evaporation

Evaporation is a surface phenomenon. Particles from the surface gain enough energy to overcome the forces of attraction present in the liquid and change into the vapour state.

Rate of evaporation depends upon the surface area exposed to the atmosphere, the temperature, the humidity and the wind speed.



Some measurable quantities and their units

Quantity	Unit
Temperature	Kelvin
Length	Metre
Mass	Kilogram
Weight	Newton
Volume	Cubic Metre
Density	kilogram per cubic metre
Pressure	Pascal

Now scientists are talking of five states of matter: Solid, Liquid, Gas, Plasma and BoseEinstein Condensate.

- **Plasma**: The state consists of super energetic and super excited particles. These particles are in the form of ionised gases. The fluorescent tube and neon sign bulbs consist of plasma. Inside a neon sign bulb there is neon gas and inside a fluorescent tube there is helium gas or some other gas. The gas gets ionised, that is, gets charged when electrical energy flows through it. This charging up creates a plasma glowing inside the tube or bulb. The plasma glows with a special colour depending on the nature of gas. The Sun and the stars glow because of the presence of plasma in them. The plasma is created in stars because of very high temperature.
- **Bose-Einstein Condensate**: In 1920, Indian physicist Satyendra Nath Bose had done some calculations for a fifth state of matter. Building on his calculations, Albert Einstein predicted a new state of matter – the Bose-Einstein Condensate (BEC). In 2001, Eric A. Cornell, Wolfgang Ketterle and Carl E. Wieman of USA received the Nobel prize in physics for achieving "Bose-Einstein condensation". The BEC is formed by cooling a gas of extremely low density, about one-hundred-thousandth the density of normal air, to super low temperatures.

IS MATTER AROUND US PURE

- Depending upon the chemical composition, matter is classified into elements, compounds and mixtures
- A mixture contains more than one substance mixed in any proportion
- Air is a mixture of nitrogen, oxygen, carbon dioxide, water vapour and other gases. Soil is a mixture of clay, sand and various salts. Milk, ice cream, rock salt, tea, smoke, wood, sea water, blood, tooth paste and paint are some other examples of mixtures. Alloys are mixtures of metals.
- Mixtures can be separated into pure substances using appropriate separation techniques

TYPES OF MIXTURES

1. Homogeneous mixture
2. Heterogeneous mixture

Homogeneous mixture

1. A mixture in which the components cannot be seen separately is called a homogeneous mixture.
2. It has a uniform composition and every part of the mixture has the same properties
3. Tap water, milk, air, ice cream, sugar syrup, ink, steel, bronze and salt solutions are homogeneous mixtures

Heterogeneous mixture

1. A mixture in which the components can be seen separately is called a heterogeneous mixture.
2. It does not have a uniform composition and properties.
3. Soil, a mixture of iodine and common salt, a mixture of sugar and sand, a mixture of oil and water, a mixture of sulphur and iron filings and a mixture of milk and cereals are heterogeneous mixture.

SOLUTIONS

- A solution is a homogeneous mixture of two or more substances. You come across various types of solutions in your daily life. Lemonade, soda water etc.

Aerated drinks like soda water etc., are gas in liquid solutions. These contain carbon dioxide (gas) as solute and water (liquid) as solvent.

- We can also have solid solutions (alloys) and gaseous solutions (air)
- The particles of a solution are smaller than 1 nm (10-9 metre) in diameter. So, they cannot be seen by naked eyes
- Because of very small particle size, they do not scatter a beam of light passing through the solution. So, the path of light is not visible in a solution
- The solute particles cannot be separated from the mixture by the process of filtration. The solute particles do not settle down when left undisturbed, that is, a solution is stable.
- A solution has a solvent and a solute as its components. The component of the solution that dissolves the other component in it (usually the component present in larger amount) is called the solvent. The component of the solution that is dissolved in the solvent (usually present in lesser quantity) is called the solute.
- The concentration of a solution is the amount of solute present per unit volume or per unit mass of the solution.

Alloys: Alloys are mixtures of two or more metals or a metal andanon-metal and cannot be separated into

their components by physical methods. But still, an alloy is considered as a mixture because it shows the properties of its constituents and can have variable composition. For example, brass is a mixture of approximately 30% zinc and 70% copper.

SUSPENSION

- Materials that are insoluble in a solvent and have particles that are visible to naked eyes , form a suspension.

A suspension is a heterogeneous mixture.

- The particles of a suspension scatter a beam of light passing through it and make its path visible.
- The particles of a suspension can be seen by the naked eye.

COLLOIDS

- A colloid is a heterogeneous mixture.
- The size of particles of a colloid is too small to be individually seen by naked eyes.
- Colloids are big enough to scatter a beam of light passing through it and make its path visible.

- Tyndall effect can also be observed when a fine beam of light enters a room through a small hole. This happens due to the scattering of light by the particles of dust and smoke in the air

EXAMPLES OF COLLOIDS

Dispersed phase	**Dispersing Medium**	**Type**	**Example**
Liquid	Gas	**Aerosol**	Fog, clouds, mist
Solid	Gas	**Aerosol**	Smoke, automobile exhaust
Gas	Liquid	**Foam**	Shaving cream
Liquid	Liquid	**Emulsion**	Milk, face cream

Gas	Solid	**Foam**	Foam, rubber, sponge, pumice
Solid	Liquid	**Sol**	Milk of magnesia, mud
Liquid	Solid	**Gel**	Jelly, cheese, butter
Solid	Solid	**Solid Sol**	Coloured gemstone, milky glass

SEPARATING THE COMPONENTS OF A MIXTURE

- Separate the volatile component (solvent) from its non-volatile solute by the method of **evaporation.**

  Applications:

  1. Ink is a mixture of a dye in water

- **Centrifugation** is the process by which fine insoluble solids from a solid- liquid mixture can be separated in a machine called a centrifuge. A centrifuge rotates at a very high speed. On being rotated by centrifugal force, the heavier solid particles move down and the lighter liquid remains at the top.

  Applications:

  1. Used in diagnostic laboratories for blood and urine tests.
  2. Used in dairies and home to separate butter from cream.
  3. Used in washing machines to squeeze out water from wet clothes

- Separation of components of a mixture containing two miscible liquids that boil without decomposition and have sufficient difference in their boiling points this method is called **distillation**

  Applications:

  1. Salt water turned to fresh water using distillation process

- The **crystallization** method is used to purify solids. Crystallisation is a process that separates a pure solid in the form of its crystals from a solution.

  Applications:

  1. Purification of salt that we get from sea water.
  2. Separation of crystals of alum from impure samples.

- Chromatography is a separation technique. It is used to separate different components of a mixture based on their different solubilities in the same solvent

Applications

1. To separate colours in a dye
2. To separate pigments from natural colours
3. To separate drugs from blood.

HOMOGENEOUS & HETEROGENEOUS MIXTURE

Homogeneous mixture	**Heterogeneous mixture**
Consists of single phase	Consists of two or more phases
Has the same uniform appearance and composition	Has different non uniform appearance and composition
Components are unrecognizable	Components are recognizable
Examples: Air, saline solution and bitumen	Example: Sand, oil and water

Types of Pure Substances

On the basis of their chemical composition, substances can be classified either as elements or compounds.

ELEMENTS

- Robert Boyle was the first scientist to use the term element in 1661. Antoine Laurent Lavoisier (1743-94), a French chemist, was the first to establish an experimentally useful definition of an element. He defined an element as a basic form of matter that cannot be broken down into simpler substances by chemical reactions.
- Elements can be normally divided into metals, non-metals and metalloids
- Majority of the elements are solid.
- Eleven elements are in gaseous state at room temperature.

- Two elements are liquid at room temperature–mercury and bromine.
- Elements, gallium and cesium become liquid at a temperature slightly above room temperature (303 K).

COMPOUNDS

- A compound is a substance composed of two or more elements, chemically combined with one another in a fixed proportion.