- Pure means that all the constituent particles of that substance are the same in their chemical nature. A pure substance consists of a single type of particles.
- Mixtures are constituted by more than one kind of pure form of matter, known as a substance.
- A substance (element, compound) cannot be separated into other kinds of matter by any physical process.
- Depending upon the nature of the components that form a mixture, we can have different types of mixtures.
- Copper sulphate + Water : **Solution**
- Chalk powder or wheat flour + Water : **Suspension**
- Few drops of milk or ink + Water : **Colloidal solution**
- A solution is a homogeneous mixture of two or more substances. Eg: Lemonade, soda water
- In a solution there is homogeneity at the particle level. Particles of solute are evenly distributed in the solution.
- ***Alloys*:** Alloys are homogeneous mixtures of metals 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
- 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.
- A solution of iodine in alcohol known as 'tincture of iodine', has iodine (solid) as the solute and alcohol (liquid) as the solvent.
- Aerated drinks like soda water are gas in liquid solutions. These contain carbon dioxide (gas) as solute and water (liquid) as solvent.
- Air is a mixture of gas in gas. Air is a homogeneous mixture of a number of gases. Its two main constituents are: oxygen (21%) and nitrogen (78%). The other gases are present in very small quantities.
- **Properties of a solution**

- A solution is a homogeneous mixture.
- 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.

- Depending upon the amount of solute present in a solution, it can be called a dilute, concentrated or a saturated solution. Dilute and concentrated are comparative terms.
- At any particular temperature, a solution that has dissolved as much solute as it is capable of dissolving, is said to be a saturated solution. In other words, when no more solute can be dissolved in a solution at a given temperature, it is called a saturated solution.

- The amount of the solute present in the saturated solution at this temperature is called its solubility.
- If the amount of solute contained in a solution is less than the saturation level, it is called an unsaturated solution.
- The concentration of a solution is the amount of solute present in a given amount (mass or volume) of solution, or the amount of solute dissolved in a given mass or volume of solvent.
- *Concentration of solution = Amount of solute / Amount of solution*
- A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium. Particles of a suspension are visible to the naked eye.

Properties of a Suspension

- Suspension is a heterogeneous mixture.
- The particles of a suspension can be seen by the naked eye.
- The particles of a suspension scatter a beam of light passing through it and make its path visible.
- The solute particles settle down when a suspension is left undisturbed, that is, a suspension is unstable. They can be separated from the mixture by the process of filtration.
- The particles of a **colloid** are uniformly spread throughout the solution. Due to the relatively smaller size of particles, as compared to that of a suspension, the mixture appears to be homogeneous. But actually, a colloidal solution is a heterogeneous mixture, for eg milk.
- Because of the small size of colloidal particles, we cannot see them with naked eyes. But, these particles can easily scatter a beam of visible light.
- This scattering of a beam of light is called the **Tyndall effect** after the name of the scientist who discovered this effect.
- 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.
- *Solution of copper sulphate does not show Tyndall effect, (b) mixture of water and milk shows Tyndall effect.*
- Tyndall effect can be observed when sunlight passes through the canopy of a dense forest. In the forest, mist contains tiny droplets of water, which act as particles of colloid dispersed in air.

Properties of a colloid

- 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.
- They do not settle down when left undisturbed, that is, a colloid is quite stable.
- They cannot be separated from the mixture by the process of filtration. But, a special technique of separation known as centrifugation , can be used to separate the colloidal particles.

- The components of a colloidal solution are the dispersed phase and the dispersion medium. The solute-like component or the dispersed particles in a colloid form the dispersed phase, and the component in which the dispersed phase is suspended is known as the dispersing medium.

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

Source: NCERT

- Heterogeneous mixtures can be separated into their respective constituents by simple physical methods like handpicking, sieving, filtration
- **HOW CAN WE OBTAIN COLOURED COMPONENT (DYE) FROM BLUE/ BLACK INK?** we can separate the volatile component (solvent) from its non-volatile solute by the method of evaporation
- **HOW CAN WE SEPARATE CREAM FROM MILK?** Sometimes the solid particles in a liquid are very small and pass through a filter paper. For such particles the filtration technique cannot be used for separation. Such mixtures are separated by centrifugation.
- **The principle of centrifugation is that the denser particles are forced to the bottom and the lighter particles stay at the top when spun rapidly.**
- **HOW CAN WE SEPARATE A MIXTURE OF SALT AND AMMONIUM CHLORIDE?** To separate mixtures that contain a sublimable volatile component from a non-sublimable impurity , the **sublimation process** is used.
- Sublime material eg,ammonium chloride, camphor, naphthalene and anthracene .
- **HOW CAN WE SEPARATE A MIXTURE OF TWO IMMISCIBLE LIQUIDS?(** by using separating Funnel) The principle is that immiscible liquids separate out in layers depending on their densities.
- **IS THE DYE IN BLACK INK A SINGLE COLOUR?** (*using Chromatography)* The ink that we use has water as the solvent and the dye is soluble in it. As the water rises on the filter paper it takes along with it the dye particles. A dye is a mixture of two or more colours.
- The coloured component that is more soluble in water, rises faster and in this way the colours get separated.

Applications of Chromatography: To separate

- colours in a dye

- pigments from natural colours
- drugs from blood.

- **HOW CAN WE SEPARATE A MIXTURE OF TWO MISCIBLE LIQUIDS?** This method is called distillation. It is used for the separation of components of a mixture containing two miscible liquids that boil without decomposition and have sufficient difference in their boiling points.
- To separate a mixture of two or more miscible liquids for which the difference in boiling points is less than 25 K, fractional distillation process is used. For the separation of different gases from air, different factions from petroleum products etc
- To separate oxygen gas from air, all the other gases present in the air had to be separated out. The air is compressed by increasing the pressure and is then cooled by decreasing the temperature to get liquid air. This liquid air is allowed to warm-up slowly in a fractional distillation column, where gases get separated at different heights depending upon their boiling points.
- **HOW CAN WE OBTAIN PURE COPPER SULPHATE FROM AN IMPURE SAMPLE?** The crystallisation method is used to purify solids.
- Crystallisation is a process that separates a pure solid in the form of its crystals from a solution.
- Crystallisation technique is better than simple evaporation technique as –

- some solids decompose or some, like sugar, may get charred on heating to dryness.
- some impurities may remain dissolved in the solution even after filtration. On evaporation these contaminate the solid.

Applications

- Purification of salt that we get from sea water.
- Separation of crystals of alum (*phitkari*) from impure samples.

- **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.
- Metals usually show some or all of the following properties:

- They have a lustre (shine).
- They have silvery-grey or golden-yellow colour.
- They conduct heat and electricity.
- They are ductile (can be drawn into wires).
- They are malleable (can be hammered into thin sheets).
- They are sonorous (make a ringing sound when hit).

- Examples of metals are gold, silver, copper, iron, sodium, potassium etc. Mercury is the only metal that is liquid at room temperature.
- Non-metals usually show some or all of the following properties:

- They display a variety of colours.
- They are poor conductors of heat and electricity.
- They are not lustrous, sonorous or malleable.

- Examples of non-metals are hydrogen, oxygen, iodine, carbon (coal, coke), bromine, chlorine etc.
- Some elements have intermediate properties between those of metals and non-metals, they are called metalloids; examples are boron, silicon, germanium etc.
- **COMPOUNDS:** A compound is a substance composed of two or more elements, chemically combined with one another in a fixed proportion.
- Properties of a compound are different from its constituent elements, whereas a mixture shows the properties of its constituting elements or compounds.
- Pure substances can be elements or compounds. An element is a form of matter that cannot be broken down by chemical reactions into simpler substances. A compound is a substance composed of two or more different types of elements, chemically combined in a fixed proportion.