Is Matter Around Us Pure?

- **Matter:** Anything that occupies space and has mass is treated as a matter.
- **Types of matters:**
    1. **Pure:** The matter which has only single category of particles which has similar chemical properties is called pure substance.
    2. **Mixture:** The physical or chemical combination of more than one type of element is known as a mixture.
- **Types of Mixtures:**
    1. **Homogeneous:** In a mixture where all the particles are uniformly combined then it is said to be a homogeneous mixture. Its particles can't be separated easily. Ex: Sugar and water.
    2. **Heterogeneous:** In a mixture where the particles are not uniformly combined, that is a heterogeneous mixture. Its particles could be separated easily. Ex: Sand and water.
- **Solution:** Solution is a homogeneous mixture of more than single type of particle.
    - **Solvent:** *The component of solution that dissolves other component into it. It is usually present in a large amount in solution.*
    - **Solute:** *The component of solution that is dissolved in the solvent. It is usually present in a small amount in solution.*
- **Properties of Solutions:**
    1. Solution is a homogeneous mixture.
    2. Its particles are smaller than 1nm (10-9 meter) in diameter.
    3. Cannot be seen by naked eyes.
    4. They do not scatter a beam of light passing through the solution.
    5. The solute particles cannot be separated from the mixture by the process of filtration.

- **Concentration of a Solution:** Concentration is a measure of the amount of solute that has been dissolved in a given amount of solvent or the amount of solute dissolved in a given mass or volume of solvent.
    - **Saturated Solution:** When no more amount of solute can be dissolved in a solution, at a given temperature.
    - **Unsaturated Solution:** When more amount of solute can be dissolved in a solution, at a given temperature.
    - **Solubility:** The amount of solute present in a saturated solution, at a given temperature.

Concentration of solution = *Amount of solute / Amount of solution*

Or

Amount of solute/Amount of solvent

- **Ways of expressing Concentration of solution:**
  There are various ways of expressing the concentration of a solution, but here we will learn only two methods:

  1. Mass by mass percentage of a solution:

  $$= \frac{\text{Mass of Solute}}{\text{Mass of Solution}} \times 100$$

  2. Mass by volume percentage of a solution:

  $$= \frac{\text{Mass of Solute}}{\text{Volume of Solution}} \times 100$$

- **Suspension:** It is a heterogeneous mixture in which the solute particles don't get dissolve but remain suspended throughout the bulk of solvent, left floating around freely in the medium. Example: Smoke in air, Dust in water, etc.
- **Properties of Suspension:**
  1. It is a heterogeneous mixture.
  2. Particles can be seen by the naked eyes.

3. It scatters a beam of light passing through it and makes its path visible.
4. The solute particles settle down when a suspension is left undisturbed.
5. A suspension is unstable.
6. They can be separated from the mixture by the process of filtration.

- **Colloidal Solution:** It is a mixture which appears as a homogeneous mixture because of the size of tiny particles but it is actually a heterogeneous mixture.
- **Properties of a Colloidal Solutions:**
  1. A colloid is a heterogeneous mixture.
  2. The size of particles of a colloid is too small to be individually seen by naked eyes.
  3. Colloids are big enough to scatter a beam of light passing through it and make its path visible.
  4. They do not settle down when left undisturbed, that is, a colloid is quite stable.
  5. They cannot be separated from the mixture by the process of filtration.
  6. A special technique of separation known as centrifugation can be used to separate the colloidal particles.
  7. 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.***

- **Separating the Components of a Mixture:** Different methods of separation are used to get individual components from a mixture. Separation makes it possible to study and use the individual components of a mixture.
  - Heterogeneous mixtures can be separated into their respective constituents by simple physical methods like handpicking, sieving, filtration, etc.
  - Sometimes special techniques have to be used for the separation of the components of a mixture.

1. **Evaporation:** The process of separating the volatile (easily evaporated at normal temperatures.) components from its non- volatile solute is called evaporation. Example: ink the mixture of dye in water.
2. **Centrifugation:** The process in which denser particles are forced to the bottom whereas the lighter particles stay on the top when spun rapidly. Example: milk and cream.
3. **Sublimation:** The process of separating the sublime (change directly into vapor when heated,) volatile components from the non-sublime impurity in a mixture. Example: camphor and salt.
4. **Chromatography:** Kroma in Greek means color. This process is used for separation of the solute that dissolves in the same solvent. Example: black ink in a single color.
5. **Distillation**: The process of separating two miscible (forming a homogeneous mixture when added together.) liquids that boil without decomposition and have sufficient difference in their boiling points. Example: mixture of acetone and water.
6. **Fractional Distillation:** The process separating more than 1 miscible liquid by heating up them at their boiling points. There are certain fractional columns in the apparatus to do so. Example: different gases from the air.

7. **Crystallization:** This method is used to purify solids. It separates a pure solid in the form of its crystals from a solution. Example: Copper Sulphate from an impure sample.

- **Physical Changes:**

  The reversible temporary change in which no new substance is formed. Example: melting of wax, etc.

- **Chemical Changes:**

  The irreversible permanent changes in which the new substance is formed. Example: formation of curd from milk, etc.

- **Types of Pure Substances:**

  - **Elements:** Robert Boyle defined an element as a basic form of matter that cannot be broken down into simpler substances by chemical reactions.
  - **Compounds:** The substance composed of two or more elements, chemically combined with one another in a fixed proportion.
  - **Mixture:** Elements or compounds just mix together to form a mixture and no new compound is formed.