IS MATTER AROUND US PURE

- **All the matter around us is not pure. The matter around us is of two types : pure substances and mixtures.**

- **Pure Substances : Elements and Compounds**

- **A pure substance is one which is made up of only one kind of particles.**

- **All the elements and compounds are pure substances because they contain only one kind of particles.**

- **All the elements like hydrogen, oxygen, nitrogen,chlorine, bromine, iodine, carbon, sulphur, iron, copper, silver, gold, mercury and silicon, are pure substances.**

- **all the compounds such as water (including ice and steam), carbon dioxide, sodium chloride, sugar, copper sulphate, alum (aluminium potassium sulphate), calcium oxide, sodium hydroxide, hydrochloric acid, sulphuric acid, nitric acid, potassium permanganate, camphor, naphthalene and sand b (silicon dioxide), are pure substances.**

Impure Substances : Mixtures

- **A mixture is one which contains two or more different kinds of particles (atoms or molecules).**

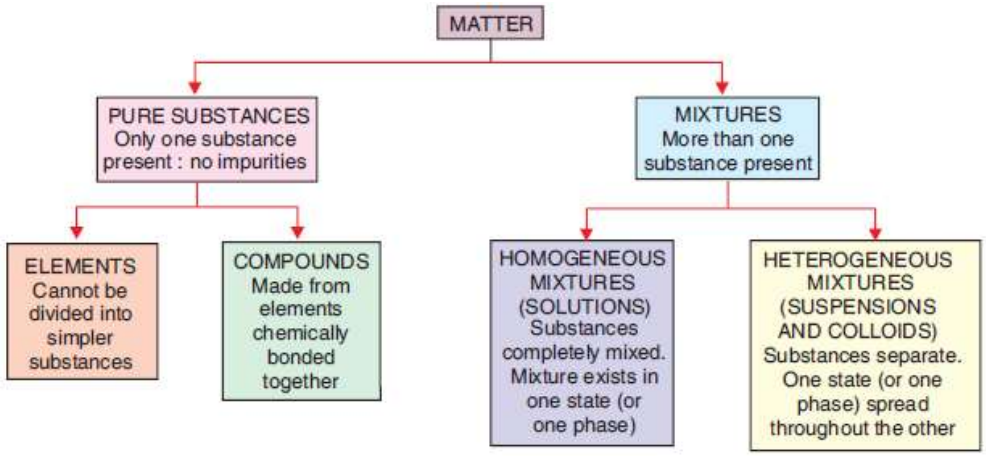
- **a mixture contains two or more pure substances mixed together. For example, salt solution is a mixture of two pure substances : salt and water.**

- **Some of the examples of the mixtures are : salt solution, sugar solution, milk, sea-water, air, sugarcane juice, soft drinks, *sharbat*, jaggery (*gud*), rocks, minerals, petroleum, LPG, biogas, tap water, tea, coffee, paint, wood, soil and bricks.**

- **Most of the matter around us exists as mixtures of two or more pure substances.**

- **All the matter can be divided into three general classes : elements, compounds and mixtures.**

FLOW CHART OF THE MATTER



- **ELEMENTS**

- **An element is a substance which cannot be split up into two or more simpler substances by the usual chemical methods of applying heat, light or electric energy.**
- **An element cannot be split up into two (or more) simpler substances because it is made of only one kind of atoms.**
- **An element is a substance which is made of only one kind of atoms. Elements can be solids, liquids or gases.**
- **Every substance in this world is made up of one or more of these elements.**
- **Every substance in this world is made up of one or more of these elements.**
- **only two elements (mercury and bromine) are liquids at the room temperature.**
- **Just as 26 letters of the 'English alphabet' combine in various different ways to make a very large number of words, in the same way, a few elements combine together in various different ways to make an extremely large number of materials and objects.**

Metals, Non-Metals and Metalloids

all the elements can be divided into three groups :

1. Metals,

- **A metal is an element that is malleable and ductile, and conducts electricity.**

Properties of Metals

1. Metals are Malleable. This means that metals can be beaten into thin sheets with a hammer (without breaking).
Aluminium foils are used for packing food items like biscuits, chocolates, medicines, cigarettes, etc.

2. Metals are Ductile. This means that metals can be drawn (or stretched) into thin wires. All the metals are not equally ductile.
Gold and silver are among the best ductile metals.

3. Metals are Good Conductors of Heat and Electricity. This means that metals allow heat and electricity to pass through them easily.
Silver metal is the best conductor of heat.
Silver metal is the best conductor of electricity.

4. Metals are Lustrous (or Shiny), and can be Polished.
For example, gold, silver and copper are shiny metals and they can be polished.

5. Metals are Generally Hard (except sodium and potassium which are soft metals). Most of the metals are hard.

6. Metals are Usually Strong. They Have High Tensile Strength. This means that metals can hold large weights without breaking.

7. Metals are Solids at the Room Temperature (except mercury which is a liquid metal).

8. Metals Generally Have High Melting Points and Boiling Points.
sodium and potassium metals have low melting points (of less than 100°C).

9. Metals Have High Densities.

10. Metals are Sonorous. This means that metals make a ringing sound when we strike them.

11. Metals Usually Have a Silver or Grey Colour (except copper and gold). Copper has a reddishbrown colour whereas gold has a yellow colour.

2. Non-metals,

- **A non-metal is an element that is neither malleable nor ductile, and does not conduct electricity.**

Properties of Non-Metals

1. Non-Metals are Not Malleable. Non-Metals are Brittle. This means that non-metals cannot be beaten into thin sheets with a hammer.
Brittleness is a characteristic property of solid non-metals.

2. Non-Metals are Not Ductile. This means that non-metals cannot be drawn into wires.

3. Non-Metals are Bad Conductors of Heat and Electricity.
diamond is a non-metal which is a good conductor of heat.
graphite is a non-metal which is a good conductor of electricity.

4. Non-Metals are Not Lustrous (Not Shiny). They are Dull in Appearance.
Iodine is a nonmetal having lustrous appearance.

5. Non-Metals are Generally Soft (except diamond which is extremely hard non-metal).

6. Non-Metals are Not Strong. They Have Low Tensile Strength.

7. Non-Metals may be Solid, Liquid or Gases at the Room Temperature.

8. Non-Metals Have Comparatively Low Melting Points and Boiling Points
Only one non-metal graphite has a very high melting point (of 3700°C).

9. Non-Metals Have Low Densities. One non-metal iodine has, however, high density.

10. Non-Metals are Not Sonorous. This means that solid non-metals do not make a ringing sound when we strike them.

11. Non-Metals Have Many Different Colours.

3. Metalloids

The elements which show some properties of metals and some other properties of non-metals are called metalloids.
The important examples of metalloids are : Boron (B), Silicon (Si), and Germanium (Ge).

MIXTURES

- **A mixture is a substance which consists of two or more elements or compounds not chemically combined together. For example, air is a mixture of gases like oxygen, nitrogen, argon, carbon dioxide and water vapour, etc.**

- **All the solutions are mixtures.**

- **the various substances present in a mixture are known as ''constituents of the mixture'' or ''components of the mixture''.**

Types of Mixtures

1. Homogeneous mixtures

- **Those mixtures in which the substances are completely mixed together and are indistinguishable from one another, are called homogeneous mixtures.**

- **All the homogeneous mixtures are called solutions. Some of the examples of homogeneous mixtures (or solutions) are : Sugar solution, Salt solution, Copper sulphate solution, Seawater.**

2. Heterogeneous mixtures.

- **Those mixtures in which the substances remain separate and one substance is spread throughout the other substance as small particles, droplets or bubbles, are called heterogeneous mixtures.**

- **A mixture containing two (or more) immiscible liquids is also a heterogeneous mixture. For example, a mixture of petrol and water is a heterogeneous mixture.**

Most of the mixtures are heterogeneous, only solutions and alloys are homogeneous mixtures.

COMPOUNDS

- **A compound is a substance made up of two or more elements chemically combined in a fixed proportion by mass. For example, water (H_2O) is a compound made up of two elements, hydrogen and oxygen, chemically combined in a fixed proportion of 1 : 8 by mass (Atomic masses : H = 1 u, O= 16 u, so H_2 : O = 2 u : 16 u or 1 : 8).**

- **Compounds can be further divided into three classes : acids, bases and salts, on the basis of their properties.**

DIFFERENCE BETWEEN MIXTURE AND COMPOUND

Mixtures	*Compounds*
1. A mixture can be separated into its constituents by the physical processes (like filtration, evaporation, sublimation, distillation, solvents, magnet, etc.).	1. A compound cannot be separated into its constituents by physical processes (It can only be separated into its constituents by chemical processes).
2. A mixture shows the properties of its constituents.	2. The properties of a compound are entirely different from those of its constituents.
3. Energy (in the form of heat, light, etc.) is usually neither given out nor absorbed in the preparation of a mixture.	3. Energy (in the form of heat, light, etc.) is usually given out or absorbed during the preparation of a compound.
4. The composition of a mixture is variable, the constituents can be present in any proportion by mass. A mixture does not have a definite formula.	4. The composition of a compound is fixed, the constituents are present in fixed proportion by mass. A compound has a definite formula.
5. A mixture does not have a fixed melting point, boiling point, etc.	5. A compound has a fixed melting point, boiling point, etc.

- **The liquid which evaporates completely, leaving no residue, is a pure compound.**

- **The liquid which leaves behind a residue on evaporation, is a solution or mixture.**

- **Alloys are homogeneous mixtures of metals and cannot be separated into their components by physical methods. Example Brass.**

SOLUTIONS, SUSPENSIONS AND COLLOIDS

- **The 'substance which is dissolved' in a liquid to make a solution is called 'solute', and the 'liquid' in which solute is dissolved is known as 'solvent'.**
- **the solute particles are also called 'dispersed particles' and solvents are also known as 'dispersion medium'.**

- **The solutions made by dissolving various solutes in water are called aqueous solutions.**
- **The solutions made by dissolving solutes in organic liquids are called non-aqueous solutions.**

SOLUTIONS

- **A solution is a homogeneous mixture of two (or more substances). Some common examples of solutions are : Salt solution, Sugar solution, Vinegar, Metal alloys (such as Brass) and Air.'**

- **Only soluble substances form true solutions.**

Properties of a Solution

1. A solution is a homogeneous mixture.
2. The size of solute particles in a solution is extremely small. It is less than 1 nm in diameter (1 nanometre = 10^{-9} metre).
3. The particles of a solution cannot be seen even with a microscope.
4. The particles of a solution pass through the filter paper. So, a solution cannot be separated by filtration.
5. The solutions are very stable. The particles of solute present in a solution do not separate out on keeping.
6. A true solution does not scatter light (This is because its particles are very, very small).

Types of Solutions

1. Solution of Solid in a Solid. Metal alloys are the solutions of solids in solids. For example brass.

2. Solution of Solid in a Liquid. This is the most common type of solutions. Sugar solution and salt solution are the solutions of solids in liquids.

3. Solution of Liquid in a Liquid. Vinegar is a solution of acetic acid (ethanoic acid) in water.

4. Solution of Gas in a Liquid. Soda-water is a solution of carbon dioxide gas in water.

5. Solution of Gas in a Gas. Air is a solution of gases like oxygen, argon, carbon dioxide and water vapour, etc.

SUSPENSIONS

- **A suspension is a heterogeneous mixture in which the small particles of a solid are spread throughout a liquid without dissolving in it.**

- **Chalk-water mixture, Muddy water, Milk of Magnesia, Sand particles suspended in water, and Flour in water.**

Properties of a Suspension

1. A suspension is a heterogeneous mixture.
2. The size of solute particles in a suspension is quite large. It is larger than 100 nm in diameter.
3. The particles of a suspension can be seen easily.
4. The particles of a suspension do not pass through a filter paper. So, a suspension can be separated by filtration.
5. The suspensions are unstable. The particles of a suspension settle down after some time.
6. A suspension scatters a beam of light passing through it (because its particles are quite large).

COLLOIDS

- **A colloid is a kind of solution in which the size of solute particles is intermediate between those in true solutions and those in suspensions.**

- **Some of the examples of colloids (or colloidal solutions) are : Soap solution, Starch solution, Milk, Ink, Blood, Jelly and Solutions of synthetic detergents.**

- **In a true solution (like sugar solution), the solute particles are so small that they cannot scatter (or reflect) light rays falling on them.**
- **In a colloidal solution (or colloid), the particles are big enough to scatter light.**
- **The scattering of light by colloidal particles is known as Tyndall effect.**

- **a true solution can be distinguished from a colloidal solution by the fact that a true solution does not scatter a beam of light passing through it but a colloidal solution scatters a beam of light passing through it and renders its path visible.**

- **Colloids are heterogeneous in nature, though they appear to be homogeneous.**

Properties of Colloids

1. A colloid (or colloidal solution) appears to be homogeneous but actually it is heterogeneous.
2. The size of particles in a colloid (or colloidal solution) is bigger than those in a true solution but smaller than those in a suspension. It is between 1 nm and 100 nm in diameter.
3. The particles of most of the colloids (or colloidal solutions) cannot be seen even with a microscope.
4. The particles of a colloid (or colloidal solution) can pass through a filter paper. So, a colloid cannot be separated by filtration.

5. The colloids (or colloidal solutions) are quite stable. The particles of a colloid do not separate out on keeping.
6. A colloid (or colloidal solution) scatters a beam of light passing through it (because its particles are fairly large).

Classification of Colloids

Technical name of colloid	*Dispersed phase*	*Dispersion medium*	*Examples*
1. Sol	Solid	Liquid	Ink, Soap solution, Starch solution, Most paints
2. Solid sol	Solid	Solid	Coloured gemstones (like Ruby)
3. Aerosol	(*i*) Solid	Gas	Smoke, Automobile exhausts
	(*ii*) Liquid	Gas	Hairspray, Fog, Mist, Clouds
4. Emulsion	Liquid	Liquid	Milk, Butter, Face cream
5. Foam	Gas	Liquid	Fire-extinguisher foam, Soap bubbles, Shaving cream, Beer foam
6. Solid foam	Gas	Solid	Insulating foam, Foam rubber, Sponge, Bread
7. Gel	Solid	Liquid	Jellies, Gelatine, Hair gel
	Continuous network of solid in liquid		

CONCENTRATION OF A SOLUTION

- **The concentration of a solution is the amount of solute present in a given quantity of the solution.**

- **The concentration of a solution is defined as the mass of solute in grams present in 100 grams of the solution.**

$$\text{Mass of solution} = \text{Mass of solute} + \text{Mass of solvent}$$

$$\text{Concentration of solution} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

- **The concentration of a solution is defined as the volume of solute in millilitres present in 100 millilitres of the solution.**

$$\text{Concentration of solution} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$$

SATURATED AND UNSATURATED SOLUTIONS

1. A solution in which more quantity of solute can be dissolved without raising its temperature, is called an unsaturated solution.

2. A solution in which no more solute can be dissolved at that temperature, is called a saturated solution.

Effect of 'Heating' and 'Cooling' on a Saturated Solution

- **if a saturated solution at a particular temperature is heated to a higher temperature, then it becomes unsaturated.**

- **If a saturated solution available at a particular temperature is cooled to a lower temperature, then some of its dissolved solute will separate out in the form of solid crystals.**

SOLUBILITY

- **The maximum amount of a solute which can be dissolved in 100 grams of a solvent at a specified temperature is known as the solubility of that solute in that solvent (at that temperature).**
- **while expressing the solubility of a substance, we have to specify the temperature also.**

Effect of Temperature and Pressure on Solubility

(*i*) The solubility of solids in liquids usually increases on increasing the temperature; and decreases on decreasing the temperature.
(*ii*) The solubility of solids in liquids remains unaffected by the changes in pressure.
(*iii*) The solubility of gases in liquids usually decreases on increasing the temperature; and increases on decreasing the temperature.
(*iv*) The solubility of gases in liquids increases on increasing the pressure; and decreases on decreasing the pressure.

- **Difference between physical change and chemical change**

Physical change	*Chemical change*
1. No new substance is formed in a physical change.	1. A new substance is formed in a chemical change.
2. A physical change is a temporary change.	2. A chemical change is a permanent change.
3. A physical change is easily reversible.	3. A chemical change is usually irreversible.
4. Very little heat (or light) energy is usually absorbed or given out in a physical change.	4. A lot of heat (or light) energy is absorbed or given out in a chemical change.
5. The mass of a substance does not alter in a physical change.	5. The mass of a substance does alter in a chemical change.

SEPARATION OF MIXTURE OF TWO SOLIDS

1. Separation by a Suitable Solvent

A mixture of sugar and sand can be separated by using water as solvent.

- **Sugar is soluble in water whereas sand is insoluble in water. This difference in the solubilities of sugar and sand in water is used to separate them.**
- **A mixture of sulphur and sand can be separated by using carbon disulphide as solvent.**

2. Separation by Sublimation

the changing of a solid directly into vapours on heating, and of vapours into solid on cooling is called sublimation.

- **The process of sublimation is used to separate those substances from a mixture which sublime on heating.**

- **Most of the solid substances do not undergo sublimation.**

- **Ammonium chloride, iodine, camphor, naphthalene and anthracene can be separated from a mixture by sublimation.**

3. Separation by a Magnet

If a mixture contains iron as one of the constituents, it can be separated by using a magnet. For example, a mixture of iron filings.

Separation of Scrap Iron

In factories, scrap iron is separated from the heap of waste materials by using big electromagnets fitted to a crane.

SEPARATION OF MIXTURE OF A SOLID AND A LIQUID

1. Separation by Filtration

Filtration is used for separating insoluble substances from a liquid. A mixture of chalk and water is separated by filtration.

- **A mixture of sand and water can also be separated by filtration.**
- **A heterogeneous mixture of a solid and a liquid can be separated by the process of filtration.**
- **Filtration cannot remove any solid substances which are dissolved in a liquid.**

2. Separation by Centrifugation

Centrifugation is a method for separating the suspended particles of a substance from a liquid in which the mixture is rotated (or spun) at a high speed in a centrifuge.

- **We can separate the clay particles suspended in water very rapidly by the method of centrifugation.**
- **Separation of Cream from Milk**

  The process of centrifugation is used in dairies to separate cream from milk.

3. Separation by Evaporation

Evaporation is used to separate a solid substance that has dissolved in water (or any other liquid).

- **The use of process of evaporation for separating a mixture is based on the fact that liquids vaporise easily whereas solids do not vaporise easily.**
- **The common salt dissolved in water can be separated by the process of evaporation.**

- **The process of evaporation is used on a large scale to obtain common salt from sea-water.**

- **We can separate the 'coloured component of ink' (or 'dye' from ink) by the process of evaporation.**

4. Purification by Crystallisation

The process of cooling a hot, concentrated solution of a substance to obtain crystals is called crystallisation.

- **Common salt is purified by the process of crystallisation.**

5. Separation by Chromatography

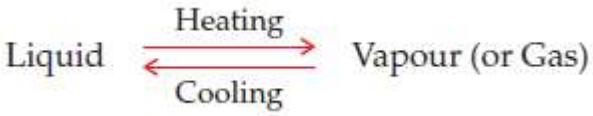
Chromatography is a technique of separating two (or more) dissolved solids which are present in a solution in very small quantities.

- **This separation is based on the fact that though two (or more) substances are soluble in the same solvent (say, water) but their solubilities may be different.**

- **Black ink is a mixture of several coloured substances (or dyes) which can be separated by paper chromatography.**

6. Separation by Distillation

Distillation is the process of heating a liquid to form vapour, and then cooling the vapour to get back liquid.



- **A mixture of common salt and water can be separated completely by the process of distillation.**

SEPARATION OF MIXTURE OF TWO (OR MORE) LIQUIDS

1. Separation by Fractional Distillation

Fractional distillation is the process of separating two (or more) miscible liquids by distillation, the distillate being collected in fractions boiling at different temperatures.

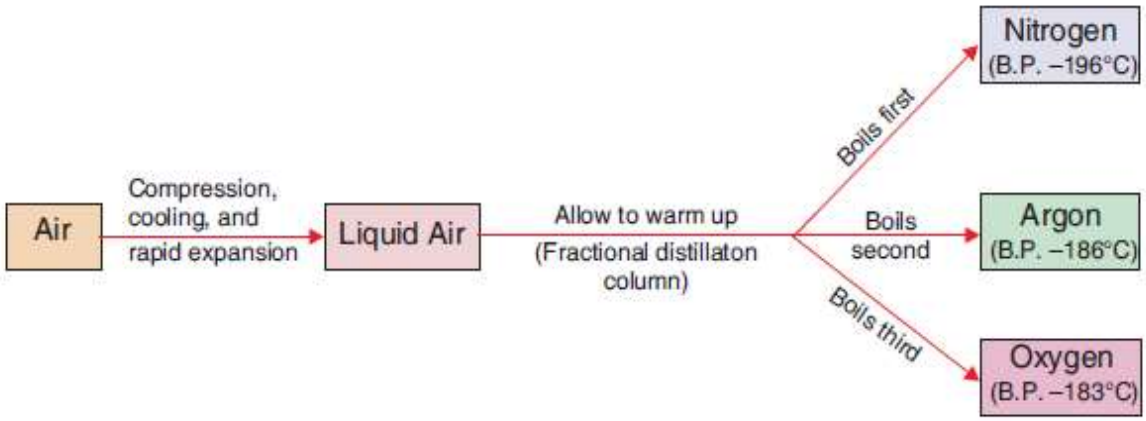
- **To Separate a Mixture of Alcohol and Water**
- **When the temperature at the top of the fractionating column reaches 78°C (which is the boiling point of alcohol), then alcohol vapour passes into the condenser, gets cooled and collects in a beaker kept at the other end of the condenser.**

- **Fractional distillation separates the various liquids according to their boiling points : the more volatile liquid (having lower boiling point) distils over first, and the less volatile liquid (having higher boiling point) distils over later.**

➢ **Separation of the Gases of the Air**

Air is a mixture of gases like nitrogen, oxygen, argon, carbon dioxide, helium, neon, krypton, and xenon, etc.

The various gases of air are separated from one another by the fractional distillation of liquid air. This separation is based on the fact that the different gases of air have different boiling points (when in liquid form).



2. Separation by a Separating Funnel

The separation of two immiscible liquids by a separating funnel depends on the difference in their densities.

➢ **a mixture of water and kerosene can be separated by using a separating funnel.**