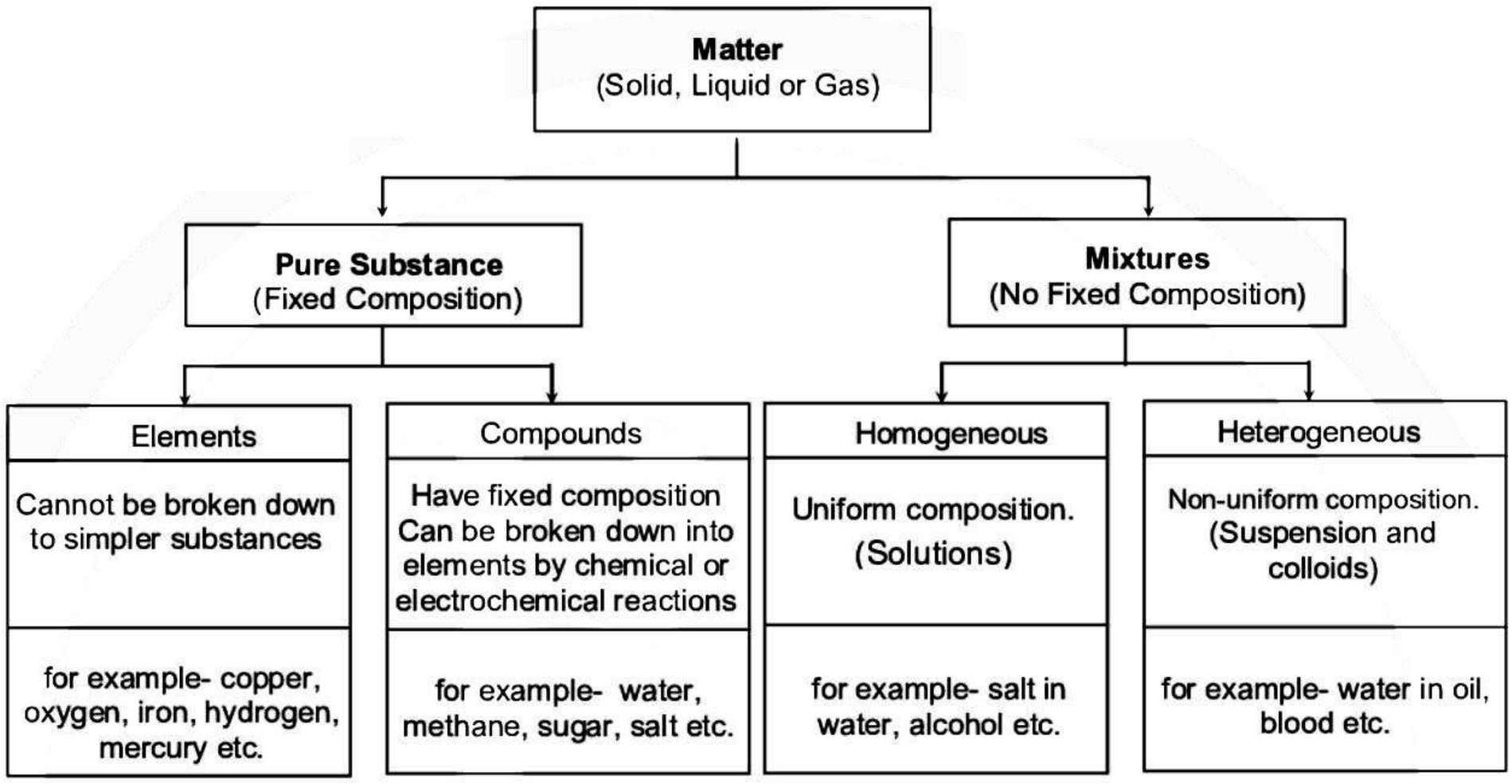
IS MATTER AROUND US PURE

A pure substance consists of particles of only one kind of matter which are similar to one another and which cannot be separated into other kinds of matter by any physical process. Furthermore, a pure substance has a uniform composition throughout. Pure substances are classified into two categories, i.e., elements and compounds.



Element, Compound and Mixture

- An **element** is defined as the simplest form of a pure substance which can neither be broken into nor built from simpler substances by any physical or chemical method. For example, hydrogen, oxygen, mercury, gold, iron, copper, etc.

Elements are further classified into metals, non-metals and metalloids or semi-metals.

(a) **Metals** possess luster. They are malleable and ductile, good conductors of heat and electricity and are sonorous. For example, iron, copper, mercury, sodium, etc.

(b) **Non-metals** are neither malleable nor ductile. They are not lustrous and are non-conductors of heat and electricity. For example, hydrogen, oxygen, bromine, sulphur, phosphorus, etc.

(c) **Metalloids or semi-metals** have properties in between those of metals and non-metals. For example, silicon, germanium, arsenic, antimony and tellurium.

- **A compound** is defined as a pure substance made up of two or more elements chemically combined in a fixed proportion by mass. For example, water, carbon dioxide, lime stone, etc.

- **Mixtures.** A mixture contains two or more substances (elements or compounds),

which are physically mixed in any proportion but not chemically combined. Thus, mixtures have variable composition and hence no definite formula can be assigned to a mixture.

- Properties of compounds are different from those of its constituent elements, whereas a mixture shows the properties of its constituent elements or compounds.

Homogeneous and heterogeneous mixtures

- **Homogeneous and heterogeneous mixtures.** A mixture is said to be homogeneous if its composition is uniform throughout. For example, air (free from suspended impurities), diesel, natural gas, soda-water, etc.

The particles of a homogeneous mixture are so small (< 1 nm or 10^{-9} m or 10^{-7} cm) that they cannot be seen by the naked eye or even under a microscope.

A homogeneous mixture has only one phase.

In contrast, a mixture is said to be heterogeneous if its composition is not uniform throughout. For example, iron filings and powdered sulphur, sand and salt, sand and sugar, kerosene oil and water, etc.

Physical and Chemical Change

- A change in which only the physical properties of a substance change but no new substance is formed is called a **physical change.** The inter-conversion of states of matter (i.e., ice to water or water to steam) is a physical change because these changes occur without any change in composition or the chemical nature of the substance. *These changes are reversible.*

- A **chemical change** brings about changes in the chemical properties of the substance. During a chemical change, the original substances lose their identity to form new substances. A chemical change is also called a chemical reaction. *These changes are irreversible.*

Solution, Solvent and Solute

- A **solution** *is a homogeneous mixture of two or more substances.* The major component of the solution is called the **solvent** and the minor component is called the **solute.** Depending upon whether the solvent is a solid, liquid or a gas, the solutions are classified as solid, liquid and gaseous solutions. Thus, there are in all **nine** types of binary solutions.

The nine types of solutions discussed above are summarized in the following table :

Name of the solution	Solute	Solvent	Examples
Solid solutions 1. Solid in solid	Solid	Solid	Alloys like brass, bronze, German silver, etc.

2. Liquid in solid	Liquid	Solid	Hydrated crystals such as blue vitriol (hydrated copper sulphate).
3. Gas in solid	Gas	Solid	Gases adsorbed over the surface of metals (such as nickel, palladium, platinum, etc.) under pressure.
Liquid solutions			
4. Solid in liquid	Solid	Liquid	Sugar, common salt or other salts dissolved in water.
5. Liquid in liquid	Liquid	Liquid	Mixture of two miscible liquids such as acetone and water, alcohol and water, etc.
6. Gas in liquid	Gas	Liquid	Aerated drinks (here carbon dioxide is dissolved in water under pressure).
Gaseous solutions			
7. Solid in gas	Solid	Gas	Camphor in air or iodine in air.
8. Liquid in gas	Liquid	Gas	Clouds and fog [here, water drops (liquid) are dispersed in gas (air)].
9. Gas in gas	Gas	Gas	Air is a mixture of gases like nitrogen, oxygen, carbon dioxide, inert gases, etc.

- **Alloys** are homogeneous mixtures. They may also be regarded as solid in solid solutions. For example, brass is an alloy of approximately 30% zinc and 70% copper.
- The particles of a true solution are so small (less than 10^{-9} m in diameter) that they **cannot be seen even under a microscope.** They do not **scatter** light.

Saturated, Unsaturated and Supersaturated Solutions

- **Concentration of a solution** is the amount of solute present per unit volume or per unit mass of the solution/solvent.

$$\text{Concentration of solution} = \frac{\text{Amount of solute}}{\text{Amount of solution}}$$

$$\text{Or, Concentration of solution} = \frac{\text{Amount of solute}}{\text{Amount of solvent}}$$

- **Solubility** of a solute in a given solvent at a particular temperature is the amount of the solute in grams that can be dissolved in 100 grams of the solvent at that temperature.
- **Saturated solution.** A solution which contains the maximum amount of the solute dissolved in a given quantity of the solvent at the given temperature and which cannot dissolve any more solute at that temperature is called a saturated solution. In other words, concentration of solute in a saturated solution is the same as the **solubility** of the solute at that temperature.

- **Unsaturated solution.** A solution which can dissolve more solute in it at the given temperature is called the unsaturated solution.

- **Supersaturated solution.** A solution which temporarily contains more solute than the saturation level is called a supersaturated solution. Unlike saturated solution, it is not stable. When it is disturbed either mechanically or by addition of a few crystals of the dissolved solute, precipitation of some additional solute occurs.

Suspension and Colloids

- A **suspension** is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium. The particles of a suspension are big enough (> 100 nm) to be seen by the naked eye. For example, lime-water used for white wash is a suspension of calcium hydroxide in water