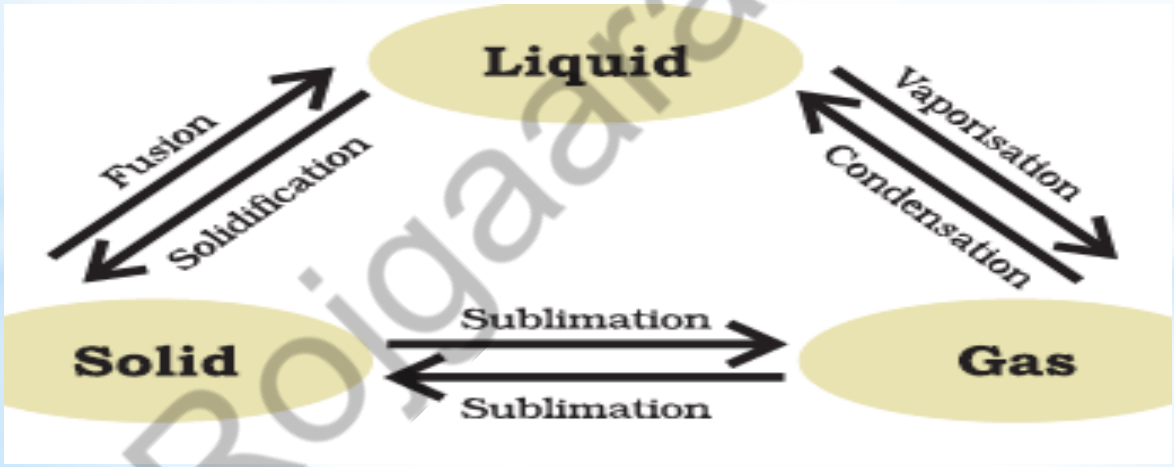
Chemistry: *Chemistry is the branch of science concerned with the composition, properties, characteristics and reactions of substances along with energy.*

Chemistry is divided into various branches–

- **Inorganic Chemistry** is associated with the properties of compounds of the chemical elements contained in minerals.
- **Organic Chemistry** is concerned with the compounds of carbon and hydrogen or their derivatives.
- **Biochemistry** is concerned with the carbon compounds found in living organisms.
- **Electrochemistry** deals with the study of relation between electricity and chemical change. Geochemistry is mainly associated with the chemical composition of rocks and minerals and ores obtained from them.

STATES OF MATTER

- Anything that occupies space and has mass or weight is called Matter.
- Matter undergoes changes which may be either chemical changes or physical changes.
- All matters exist in one of the three physical forms or states: solid, liquid and gas.
- The three states of matter are inter convertible.



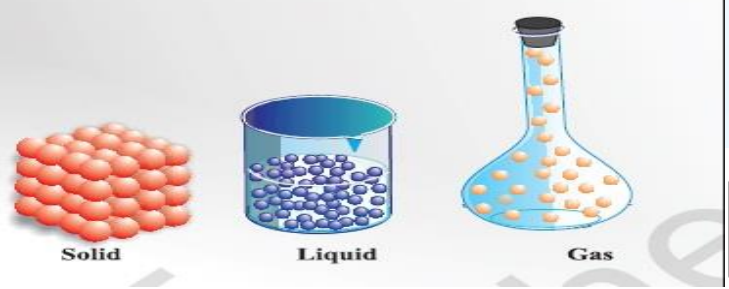
KINETIC THEORY OF MATTER

- All forms of matter is composed of small particles (molecules, atoms, ions).
- The particles are in continuous, never-ending motion (Brownian motion).
- The higher the temperature, the faster is the motion, as thermal energy is converted into kinetic energy.
- The particles attract one another with a force (intermolecular force) which decreases with the increasing distance between them.

CHARACTERISTICS OF MATTER

- In a solid, the particles are packed closely together, so, inter-particle attractive force is very high.
- Inter-particle force is weak in liquids, so they are able to flow and occupy shape of container.
- Inter-particle force is negligible in gases. So their particles are able to wander about more freely than those of liquids or solids.
- Their free random motion is called Brownian motion.

CLASSIFICATION OF MATTER



Matter
(Solid, Liquid or Gas)

Physical classification
Chemical Classification

Pure Substance

Mixtures
(No Fixed Composition)

Elements	Compounds	Homogeneous	Heterogeneous
Cannot be broken down to simpler substances	Have fixed composition Can be broken down into elements by chemical or electrochemical reactions	Uniform composition	Non-uniform composition
for example, copper, oxygen, iron, hydrogen, mercury etc.	for example, water, methane, sugar, salt etc.	for example, sugar in water, salt in water, sulphur in carbon disulphide, water in alcohol etc.	for example, sand and salt, sugar and salt, water in oil etc.

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

ELEMENTS

- An element is a pure substance that is composed of only one kind of atoms.
- An element cannot be composed from or decomposed into simpler substance by a physical or chemical change. Examples: Aluminium (Al), Hydrogen (H), Iron (Fe) etc.

Metals are characterised by:

- **Metallic Lustre** Good thermal and electrical conductivity
- **Ductility** (can be drawn into wires) e.g. copper, gold.
- **Malleability** (can be beaten into sheets) e.g.–Iron, Aluminium
- **Gold** is most ductile and malleable hence used in making ornaments.

Non-metals are characterised by absence of above properties. e.g. Oxygen, Chlorine etc.

Metalloids are elements which exhibit properties midway between those of metals and non-metals, e.g., Arsenic, Antimony.

Exceptions

- Except Mercury, all metals are solid at ordinary temperatures.
- Except Bromine, all non-metals are gases or solids under ordinary conditions.

Percentage of different elements in human body. Oxygen – 65%, Carbon – 18%, Hydrogen – 10%, Nitrogen – 3%, others – 4%

COMPOUNDS

Compound is a pure substance that is composed of two or more elements chemically combined in definite and constant proportions. e.g. water (H_2O), Sodium Chloride ($NaCl$) etc.

Silicon dioxide (SiO_2) is the most commonly found compound on the earth crust in lithosphere while oxygen is the most commonly found element on earth.

Atomicity - The total number of different elements present in a molecule of compound is called its atomicity such as its 2 for $NaCl$ and 7 for H_2SO_4.

Mixture

- A mixture contains more than one substance (element and/or compound) mixed in any proportion.
- A mixture is matter composed of two or more substances (elements, compounds or both) in variable proportions in which each of its components still exhibit its own characteristics properties

Mixtures can be **heterogeneous** i.e. non uniform, or **homogeneous**, i.e. the same throughout. [3]

Homogeneous mixtures have the same composition throughout the sample e.g. salt solution.

Heterogeneous mixture consists of two or more parts which have different compositions. e.g. mixture of iron and sulphur.

Separation of a pure substance: A substance known for its specific properties such as boiling point, melting point, density, refractive index, etc is called a pure substance.

From a given mixture, a pure substance can be separated depending upon the property of the substance or of the present impurity.

- There are different methods known and adopted to separate a pure substance from a given mixture such as **filtration, crystallization, sedimentation followed by decantation, distillation** provided that the difference between the two liquids is minimum of 25°C, fractional distillation, **chromatography, sublimation, centrifugation, etc. of these processes:** [3] **evaporation and crystalization** is used to obtain salt from sea water.

Mixtures are three types - solution, colloid and suspension.

Property	True Solution	Colloid	Suspension
1. Solute size	Less than 1nm	Between 1nm to 1000 mm	Greater than 1000 mm
2. Solute visibility	Invisible	Visible only under ultra microscope	Visible with naked eyes
3. Filtration	Pass through filter paper and parchment membrane	Possible through filter paper but not parchment membrane	Impossible through both filter paper and parchment membrane
4. Tyndall effect	No	Yes, with scatter-ing of light	Only occasionally otherwise not.

Solution

- A solution is a homogeneous mixture of two or more substances.
- The major component of a solution is called the solvent, and the minor, the solute.
- The true solutions are always homogenous and the size of solute particles is less than 10–7 cm.
- In a true solution, the solute particles cannot be distinguished from the solvent molecules even by using a microscope.

Colloids

- Colloids are heterogeneous mixtures in which the particle size is too small to be seen with the naked eye.
- Colloids is big enough to scatter light.
- Colloids are useful in industry and daily life.
- The particles are called the dispersed phase and the medium in which they are distributed is called the dispersion medium.

- A colloid is a kind of solution in which the size of solute particles is bigger than that of a **true solution** but smaller than those of a **suspension**.
- **Milk, Blood, Ink, Soap solution, Gum, Jelly** are example of colloidal solutions.
- The size of the solute particles in a colloidal solution is between **10–7 cm and 10–5 cm.**
- Solute particles can be separated using **ultra filter paper** only.

	Dispersed phase	Dispersion medium	Example
1.	Solid	Solid	Solid sol., minerals and rocks, gems
2.	Solid	Liquid	Sol, gold sol., sulphur sol.
3.	Solid	Gas	Aerosol, smoke
4.	Liquid	Liquid	Emulsion, milk
5.	Liquid	Solid	Gel, cheese, jellies
6.	Liquid	Gas	Liquid aerosol, cloud
7.	Gas	Liquid	Foam, froth in air
8.	Gas	Solid	Solid foam, pumic stone

Suspension

A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughoutthe bulk of the medium. Particles of a suspension are visible to the naked eye.

- 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.
- When the particles settle down, the suspension breaks and it does not scatter light any more.

Property	True Solution	Colloid	Suspension
1. Solute size	Less than 1nm	Between 1nm to 1000 mm	Greater than 1000 mm
2. Solute visibility	Invisible	Visible only under ultra microscope	Visible with naked eyes
3. Filtration	Pass through filter paper and parchment membrane	Possible through filter paper but not parchment membrane	Impossible through both filter paper and parchment membrane
4. Tyndall effect	No	Yes, with scattering of light	Only occasionally otherwise not.