

Chapter 1 - Matter and Measurement

Section 1 – Study of Matter

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Introduction - Chemistry

- What is chemistry? Chemistry is the study of matter.
- What is matter? Matter is anything that has mass and occupies space i.e. has volume.
- History of Chemistry:
 - The science itself was called alchemy but eventually became chemistry.
 - Chemistry is as old as the world, iron age, bronze age etc. Medicine started from chemistry, painting, fire etc. all is chemistry.
 - As the subject grew chemistry branched out to Organic, Inorganic and Physical to begin with and eventually into Analytical, Biochemistry etc.
 - There are now many chemical industries dealing with medicine, food, paint, polymers, energy and many more.

This chemistry course will cover the fundamentals of chemistry such as measurement, structure of atoms, writing chemical equations and carrying out basic calculations using those equations.

Scientific Method

All scientists follow what is called the scientific method. This is process that ensures that the science, experiment and verification is good enough to publish work or carry it on to a bigger scale.

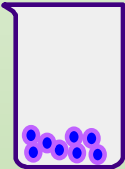
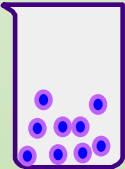
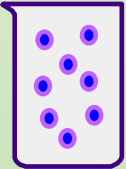
- **Observation** – Key to knowing what to study. If one does not have good observation, then one does not know what is happening around them.
- **Hypothesis** – Thinking of an idea that proposes what is happening and how to get results.
- **Experimentation** – This involves designing and carrying out experiments to prove your hypothesis. This generally takes the most time. Experiments should be duplicated and verified by peers to make sure they are authentic and replicable by all.
- **Theory** – This is done when hypothesis is proven by experimentation. Theory then will be valid in similar hypothesis.
- **Law** – When the theory stands the test of time, it becomes a law.

Theory and Laws can be challenged and changed in light of new information; however, one must do experimentation to confirm new theory.

Matter

Again, chemistry is the study of matter, which is anything that has weight and volume.

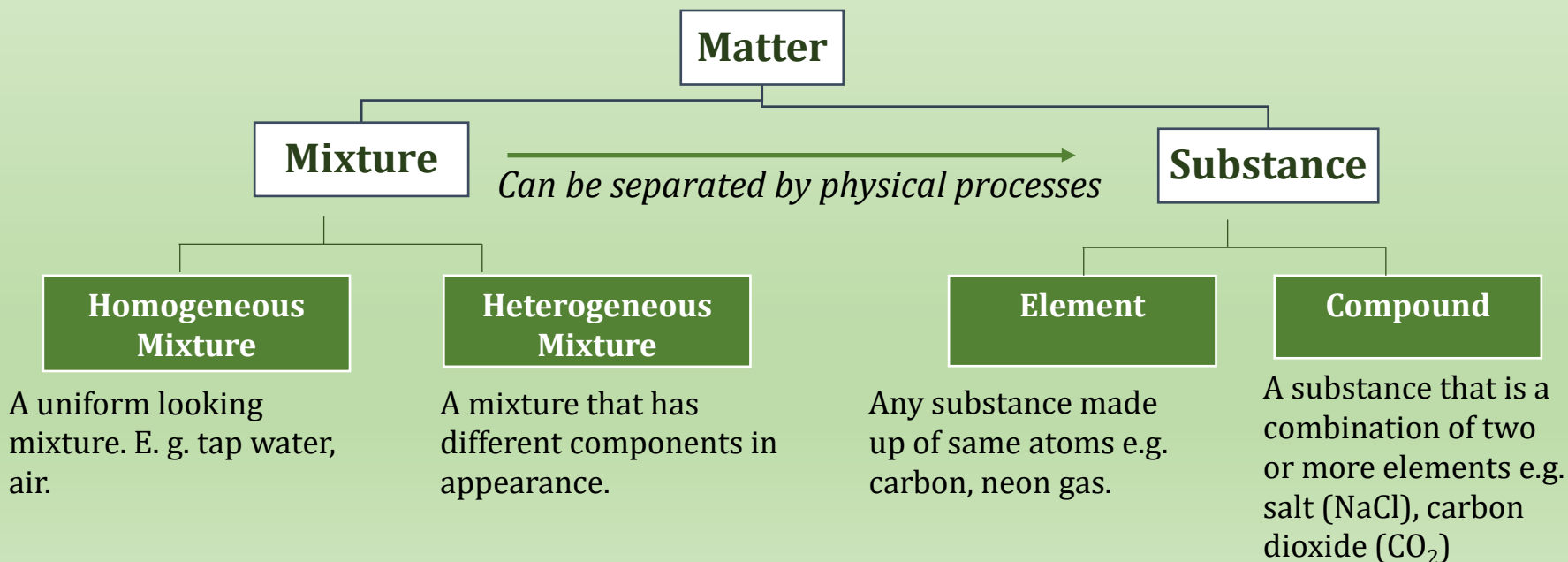
Matter can be classified in three phases as shown below in the table.

Solid	Liquid	Gas
		
Particles are packed	Particles are closer	Particles are far apart
Particles are static	Particles are in motion but slower than gas	Particles are always in motion
Solids can be molded into shapes	Liquids take the shape of the container	Gases take the shape of the container

Classification of Matter

Matter, whether it is gas, liquid or solid, can further be classified into **mixture** and **substance**. Mixture and substances are also further classified into two types of mixtures: **homogenous** and **heterogenous**. Substances can exist by themselves or in combination with another element.

Mixtures can be separated into substances by physical means (separation science) e.g., filtration, distillation etc. Separation science and is a huge field of chemistry as almost everything in the world exists as a mixture. Compounds can be separated into elements by only chemical means, which is generally what mining metals is all about.



Solved Problem: Classifying matter

Which of the following can be classified as matter:

- a) iron b) human mind c) exhaust fumes d) blue light e) kindness

matter

not matter

matter

matter

not matter

Solved Problem: Classifying mixtures

Classify the following as hetero or homogeneous mixture:

- a) Helium gas in a balloon. **HOMOGENEOUS**
b) A cup of water from the beach. **HETEROGENEOUS**
c) Table salt. **HOMOGENEOUS**
d) Milk. **HETEROGENEOUS**

Properties of Matter

Physical Property

Studying the matter without changing its chemical identity.

Examples: color, boiling point, heat conductivity.

Chemical Property

Studying how chemicals will change on reaction with other chemicals.

Examples: Reaction with water, oxygen.

Changes in Matter

Physical Change

A change that does not change the chemical itself. It is reversible.

Examples: boiling, melting.

Chemical Change

A change where something new is formed. Can be reversible but only by another chemical change.

Examples: boiling an egg, burning a candle.

Solved Problem: Identifying physical and chemical properties

Which of the following can be classified as chemical or physical properties:

- a) Ability of natural gas to burn. **CHEMICAL**
- b) Diamond is hard. **PHYSICAL**
- c) Sulfur is yellow. **PHYSICAL**
- d) Sugar can dissolve in water. **PHYSICAL**

Solved Problem: Determining chemical and physical change

Which of the following can be classified as a physical or chemical change:

- a) Mining iron from iron ore (iron oxide). **CHEMICAL**
- b) Wool being spun into yarn. **PHYSICAL**
- c) Boiling an egg. **CHEMICAL**
- d) Silkworm making silk. **CHEMICAL**

Measuring and Properties of Data

Data can be collected in two different ways.

- **Quantitative:** data collected using *numbers*, e.g, weight, density, volume.
- **Qualitative:** data collected using *physical properties*, e.g., color, gas formation, solid formation.

Properties can also be classified as extensive or intensive depending on what data and what is being observed. This helps scientists to be able to predict if data collection will change or not in a future experiment.

- **Extensive property:** depends on amount of matter – e.g., size, mass, volume.
- **Intensive property:** does not depend on amount – e.g., temperature, density, color.

Solved Problem: Classifying qualitative and quantitative data

Which of the following can be classified as qualitative or quantitative data:

- | | |
|--|--------------|
| a) Separating socks by their color. | QUALITATIVE |
| b) Measuring the temperature of evaporating alcohol. | QUANTITATIVE |
| c) Adding ingredients in cake. | QUANTITATIVE |
| d) Sprinkling salt on fries. | QUALITATIVE |

Solved Problem: Classifying extensive and intensive properties

Which of the following can be classified as extensive or intensive properties:

- | | |
|--|-----------|
| a) Adding water to concentrated juice. | EXTENSIVE |
| b) Measuring the temperature of evaporating alcohol. | INTENSIVE |
| c) Rainbow appearing in the sky. | INTENSIVE |
| d) Mixing sugar in coffee. | EXTENSIVE |

Key Words/Concepts

- Scientific Method
- Matter
- Hetero and homogeneous mixtures
- Phases of matter: solid, liquid and gases
- Chemical and physical properties
- Chemical and physical change
- Intensive and extensive properties
- Qualitative and quantitative analysis