**Unit 5: The Properties and Structure of matter**

**Matter**

Any object that has ***mass*** and the ***ability to occupy space*** or simply the volume of the object.

**States of matter**

Matter can be in one of 3 states:

* **Solid –** a state in which particles are tightly packed together, these particles have a fixed volume and shape. The particles are held together by strong intermolecular forces and arranged in a regular and orderly manner.
* **Liquid –** Within a liquid state particles are still quite close together but they are free to move around each other and are still held together by intermolecular forces.
* **Gas –** particles have no fixed shape or volume, they move around freely and rapidly. They almost have no forces holding them together, thus they have very little interaction.

**Molecular differences between states of matter**

* **Solid –** particles have a shape and volume. Solids cannot be compressed as they are already tightly packed. Particles are arranged in a fixed and ordered pattern.
* **Liquid –** particles don’t have a shape but they have volume. Liquids cannot be compressed, even though the particles are not as close to each other as in a solid state, the intermolecular forces are still strong enough to resist external pressure and maintain their volume.
* **Gas –** particles do not have shape or volume. They can spread out and fill the shape or container they are in. Gases can be compressed for 3 reasons, there is not a lot of spaces between the particles, the particles move freely and bounce of each other because their intermolecular force is very weak and cannot resist external pressure. So when pressure is applied to the particles they are forced close together.

**Classification scheme of matter**

**Mixtures**

A mixture consist of two or more components that are **NOT** chemically combined can be separated by physical means depending properties of the components. There are **two** types of mixtures.

**Homogeneous mixtures**

A mixture from which the two elements are evenly distributed and their composition is uniform throughout.

Example:

* **Saltwater -** The mixture of salt and water in which the salt particles are evenly distributed throughout the water.

**Heterogeneous mixture**

The components in the mixture are not evenly distributed and their composition varies and differs between each other.

Example:

* **Soil –** soil is a mixture of different-sized particles, organic matter and sometimes rocks or minerals, as you can see these components varies and differs from one another. Making the mixture heterogeneous.

**Compound**

A compound is a substance consisting of two or more elements which are ***chemically*** bounded together, often in a fixed ratio.

Examples:

* **Water (H20) –** water is a substance made up of the elements hydrogen and oxygen that are chemically bound together in a fixed ratio.

**Elements**

An element is a substance that cannot be broken down into simpler substances by chemical means e.g. **Oxygen (O)**

**Difference between a physical and chemical change**

**Physical change**

Is when the ***form or state*** of an object is changed however its chemical composition remains ***unchanged***. Some of the properties of an object that can changed are shape, size, texture and state of matter.

For example:

**Melting of frozen water *–*** affects the state of matter, however the chemical properties are still unchanged e.g. hydrogen and oxygen a still in the melted water.

**Chemical change**

Affects the ***composition*** of the object producing ***new*** substances. Some properties that can change are reactivity, acidity, combustibility, toxicity and basicity.

For example:

**Burning wood –** produces new substances such as carbon dioxide and water, which are completely different from what substance we has initially thus it’s a chemical change.

**Techniques for separating mixtures**

* **Filtration –** this technique separates insoluble solids from liquids or gases. Using a filter paper you can trap solids and allow the liquids and gases to pass through the filter into another container.
* **Magnetization –** Use a magnet to separate a magnetic substance from a non-magnetic substance. For example, the iron sticks to the magnet and not the sand.
* **Simple distillation –** separates components in a mixture which have significantly different boiling points. The mixture is heated, and the component with the lowest boiling point will evaporate first, leaving the component with the higher boiling point behind.
* **Fraction distillation –** a more precise technique that separates components in a mixture which have very close boiling points (less than 30-40 degrees Celsius).
* **Chromatography –** used to separate mixtures based on the ***two*** ***stationary*** and ***mobile*** phase. In the ***stationary phase***, the process gives the two components a ***surface*** for them to ***interact***, in which various ***characteristics (e.g. chemical properties, varying degrees of polarity, etc.)*** are present to ***assist*** them in the separation process. In the ***mobile phase carries*** the two components ***along***, allows them to separate based on their ***affinities*** for the stationary and mobile phase.

**Useful definitions**

* **Extensive property –** characteristic of a substance that ***depends*** on the ***amount of matter*** present.
* **Intensive property –** characteristic of a substance which ***depends*** on the ***qualities or attributes*** of its matter ***rather*** than the ***amount of matter***.
* **Solvent –** a substance which ***has*** the ability to **d*issolve*** ***other*** substances.
* **Solute –** a substance that ***dissolves*** ***into*** another substance.