Tutorial 3: Chemical Versus Physical Changes and Classifying Matter

Goals:

- ✓ To be able to classify matter correctly.
- ✓ To be able to differentiate between chemical and physical changes.

Matter

- Anything that has mass and occupies space.
- Chemistry is the study of matter and the changes that matter undergoes.

Examples of chemical changes:

- Milk spoils due to a chemical reaction that converts lactose to lactic acid.
- Iron rusts due to a chemical reaction with oxygen that forms iron (III) oxide (rust).

States of Matter:

- Solid: has a fixed volume and fixed shape; solids are held together in a rigid, organized structure; solids are incompressible.
- Liquid: has a fixed volume, but no fixed shape; liquids take on the shape of the portion of the container that they occupy; liquids are incompressible.
- Gas: also known as vapor; has no fixed volume and no fixed shape; gases conform to the volume and shape of their entire container; gases can be compressed and expanded.

Classifying Matter

Matter is either a **pure substance** or a **mixture** of pure substances.

1) **Pure substance:** matter that has a fixed composition and distinct properties; can be an **element** or a **compound**.
   - **a)** **Elements** are substances that cannot be broken down into simpler substances by chemical methods. They are the building blocks for all matter.
     - (i) An **atom** is the smallest piece of an element that can exist and still retain the properties of that element. Atoms are composed of subatomic particles (protons, neutrons and electrons).
   - b) **Compounds** are pure substances that can be broken down into simpler substances by chemical means (chemical reaction). They can be broken down into the elements which make they up. Compounds are still pure substances as they have a fixed composition.
     - **(i) Molecular compounds**: composed of molecules which are small uncharged units. Molecular compounds are typically composed of nonmetals only. Water (H_2O) is a molecular compound.
     - **(ii) Ionic Compounds:** composed of positively and negatively charged particles called ions. Typically formed from metals and nonmetals. Sodium chloride (NaCl) is an ionic compound

2) **Mixture:** A mixture is matter that contains two or more substances (either elements and/or compounds) mixed together. Mixtures can be **homogeneous or heterogeneous**.
   - **a) Homogeneous mixtures:** Uniform throughout (same phase and composition), and will have the same properties throughout. Homogenized milk is an example of a homogeneous mixture.
   - **b) Heterogeneous mixtures:** Not uniform throughout (may contain different phases), and will have varying composition throughout. Iced tea is an example of a heterogeneous mixture.

Chemical and Physical Changes

Physical Change: A change that does not alter the chemical identity of the substance undergoing the change.

NOTE: All changes in state are physical changes!

Examples of Physical Change:

- Shattering a ceramic plate
- Melting an ice cube
- Boiling water

Chemical Change: A change in which a substance is turned into a different chemical substance (or substances). Chemical changes are shown through chemical equations.

Examples of Chemical Change:

- Rusting of iron: $4Fe\ (s) + 3O_2\ (g) \rightarrow 2Fe_2O_3\ (s)$
- Burning of propane gas: $C_3H_8\ (g) + 5O_2\ (g) \rightarrow 3CO_2\ (g) + 4H_2O\ (g)$