

ABOUT MATTER

[B&G; Chapter 1]

- Chemistry is the study of matter with respect to its composition, characteristics and the transformations it undergoes.
- What is matter? It is anything that has mass and occupies space.
- Animal, vegetable or mineral; all these are matter; we humans are matter.
- So is the air we breathe and the water we drink.
- So what isn't matter? Energy; such as heat, light and electricity.
- Energy is important though; almost all of the changes that matter can undergo are accompanied by either a gain or loss of energy.

Properties of Matter

- The term "**property**" describes the characteristics of a substance that can be used to distinguish it from another substance.
- **Physical properties** are characteristics that can be observed; colour, taste, size, physical state, boiling point and melting point are all physical properties.
- **Chemical properties** are characteristics which describe how a substance undergoes changes (or not !) to form a different substance; colour change after a reaction occurred would indicate a chemical change.

ELEMENTS

- An **element** is a pure substance that cannot be broken down into a simpler substance by a chemical reaction, or energy such as heat, light or electricity; there are about 100 of these substances.
- While most of the matter you encounter every day is not an element, there are a few common things that are.....

- Any substance that is not an element is a combination of two or more elements; so we say that elements are the fundamental building blocks of all matter.

- Symbols have been assigned to each element, and the elements are charted on what we call the **Periodic Table of the Elements**.

- Most elements are **metals**, some are gases and only two are liquids; the latter are called **non metals**.
- Properties of metals:

- Some important non metals:

THE NATURE OF MATTER

- Imagine cutting up a piece of aluminum foil.....

- Eventually the pieces would have a diameter of 0.00000001 cm (or 10^{-8} cm); and it is not possible to cut them any smaller.
- All these pieces would be identical; both in looks and in the way they behave.....these pieces are called **atoms**.

- The way in which the many atoms that make up a sample of an element are arranged determines the actual type of matter.....

- Take an atom (any atom!!).....the other atoms it touches are called its **nearest neighbors**.
- Metals form a pattern of regular, repeating patterns of atoms.....the pattern extends in at least two directions and usually in all three.
- This repeating pattern may be referred to as an **extended network** of atoms.
- Non metals usually have a more complicated arrangement of their atoms.
- A **crystal** is formed by large numbers of atoms arranged in a regular pattern; most metals form a crystalline structure.
- A less regular structure of atoms does not produce a crystal and is often referred to as an **amorphous** arrangement.

COMPOUNDS

- **Compounds** are pure substances made up of two or more elements.
- They may be broken down into their constituent elements by chemical reaction or the use of some form of energy; they cannot be broken down by physical means.
- A compound has its own unique properties; these will be different from those of the individual elements that make up the compound.
- Compounds have a definite **composition**; or percentages of each element that make up the compound.

EXAMPLES:

- A sample of a pure substance contains only that substance; and all samples of a pure substance will have the same properties (both physical and chemical) under identical conditions.
- Both elements and compounds are pure substances; they are made up of only one element or compound and have a uniform composition.

MIXTURES

- A mixture contains two or more substances; as they have not undergone a chemical reaction, they will retain their own properties.
- Components of a mixture may be separated by a physical process.
- There are two types of mixtures; **homogeneous** and **heterogenous**.
- **Homo** is a prefix that means "the same" or "uniform".
- A homogeneous mixture has uniform properties throughout the mixture; the different components in the mixture cannot be visibly distinguished.
- All parts of a homogeneous mixture are in the same physical state; more commonly known as a **solution**.

- The term is usually applied to liquids, but "solid solutions" also exist.
- Solutions contain a **solute** (something that is dissolved) in a **solvent** (what the solute is dissolved in).
- The dissolved solute particles are small, *individual* particles.

- **Alloys** are homogeneous mixtures of substances that have an *overall* metallic character; they are formed by the addition of one substance to another.
- Two common types of alloys are:
Substitutional; those in which the atoms of the added substance are similar in size to those of the original metal.

Interstitial; those in which the atoms of the added substance are so small that they fit into the spaces between the atoms of the original metal.

- **Hetero** is a prefix that means "different", or "non uniform".
- A heterogeneous mixture contains different parts, which can usually be visibly distinguished; they have a non uniform appearance.
- The different parts of a heterogeneous mixture have different properties.
- The different parts of a heterogeneous mixture may or may not all be in the same physical state.

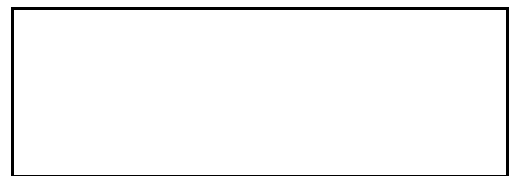

EXAMPLES:

- Many rocks contain different kinds of crystals which can easily be distinguished visually.
- Many liquids appear to be homogeneous, but actually are not.
- Other liquids, such as oil and vinegar salad dressing are very obviously heterogeneous!
- Air that is not clean may contain dust or other solid particles. Sometimes one can see the "smog" in city air; a heterogeneous mixture.
- A heterogeneous mixture of a solid and a liquid is termed a **suspension**; it may be mechanically separated.
- If there is enough liquid, we can shake it up..... wait a moment and the solid will settle to the bottom.
- **Colloids** are mixtures that appear to be uniform.....properly termed **colloidal dispersions**, these are heterogeneous mixtures that represent an intermediate state between solutions and suspensions.
- The particles in a colloidal dispersion are either large molecules or aggregates of smaller molecules; too large to pass through a natural cell membrane.

- These particles are not large enough to settle out of the mixture, but are large enough to scatter a beam of light.
- Colloids can exist in a number of phases; depending on the substance being dispersed and the dispersing medium.....

- Emulsions are colloidal suspensions in which both substances are liquids; often one component is water and the other an oil of some sort.....

CLASSIFICATION OF MATTER



PHYSICAL STATES OF MATTER

- Three states exist for matter: solid, liquid and gas.
- States can be classified as to whether its has a definite or indefinite shape or volume.

SOLID: *Definite Shape, Definite Volume*

- Always takes the same shape and volume, no matter where it is.

LIQUID: *Indefinite Shape, Definite Volume*

- Always takes the shape of the container that it is in, to the extent that it fills the container.

GAS: *Indefinite Shape, Indefinite Volume*

- Always completely fills the container; taking its volume and shape.

- The observed state of matter depends on the temperature and pressure when the observation is made.
- The "natural" state of a particular substance is the one that we commonly observe, but almost all matter can exist in any of the three states if the **conditions** (temperature and pressure) are appropriate.
- **Water** is one of the few substances which we may commonly observe in all three states; solid, liquid and gas.
- It is the temperature at which we observe the water that will determine its physical state.

What is an LCD ?

- The accepted abbreviation for Liquid Crystal Display; this is a form of matter in between the liquid and solid states.
- The particles exist in regular patterns, as in a crystal, but the material sort of flows, like a liquid.
- Light can be either transmitted through the particles or reflected by them, depending on whether or not an electrical current is being applied.....

MOLECULES

- Molecules are particles made up of two or more atoms; they go about their business as intact units.
 - Each unit is a combination of a fixed number of atoms held together in a certain geometric arrangement
 - A **diatomic** molecule consists of only two atoms:
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- Molecules containing more than two atoms are termed **polyatomic**:

- The composition of molecules is indicated by a **Chemical Formula**; a list of each type of atom present in the molecule followed by a subscript denoting the number of that type of atom in the molecule.

EXAMPLES: