

Chemistry of Life

elements- single substances that can not be broken down into simpler substances

atom- smallest particle of an element that still has all of the properties of that element

Atoms and How They Work

1. Atom: Smallest piece of matter

- All matter is made of atoms.
- Atoms are too small to be seen with a light microscope.
- Atoms make elements. Atoms of one element have different properties than atoms of another element.

A. Atoms Contain:

1. Nucleus: Center of atom with neutrons and protons

a. **Protons:** Positively charged and have mass(not gained or lost)

b. **Neutrons:** No charge(neutral) and have same mass as proton.

2. Electron cloud: outer perimeter of atom contains electrons.

a. **electron:** negatively charged and mass too small..considered zero.

b. **Energy Levels((orbitals)):** moves outward from nucleus

1. First level...max 2 electrons

2. Second Level...max 8 electrons

3. Third level...max 18 electrons

4. Fourth energy level...max 32 electrons

(Electrons can be gained or lost which will give an atom a positive charge or negative charge)

B. Bohrs Model:

C. Periodic Table: Demetri Mendeleev created the periodic table by organizing elements by increasing atomic mass. **Current model based on Mosely's increasing atomic mass.**

- There are more than 100 elements
- Few elements are found in their pure form
- Useful model for classifying elements

1. **Groups:** Vertical Columns. Elements are placed with similar properties.

- a. **Noble Gases** are found in group 18. They are the most stable of elements. Their outer most ring is full/complete.
- b. **Metals**: to the left of the staircase. Ex
- c. **Non-Metals**: to right of the staircase. Ex
- d. **Metaloids**; are found with in the staircase

2. **Periods**: Horizontal rows. Increase by number of one proton and one electron.

Identify an element in group 3 period 5 _____

- 3. **Atomic Symbol**: letter or letters representing element. Ex.
- 4. **Atomic Number**: Number of protons
- 5. **Atomic mass**: Larger number of the two numbers
- 6. **Calculating Neutron Number**: Subtract proton number from atomic mass.
- 7. **All elements in the same group of the periodic table behave in a similar manner**

d. **Isotopes**: different mass numbers for the same element based on different neutron numbers. Ex.

1. Identified by super script ex.

Parts of an Atom

Element	Atomic #	Atomic Mass	Proton #	Electron #	Neutron #	Atomic Symbol

E. **Compound**: two or more elements combine to form a new substance.

- When atoms join together to form compounds this can also be one molecule. Ex.
- Atoms when combined can form regular geometric patterns. Ex.

F. **Bonds**: Bonds are formed so elements find stability = formation of compound.

- 1. **Covalent**: Electrons are shared
 - a. **Polar**: electrons stay with one atom longer than another atom = unequal sharing ex. H₂O
 - b. **Non-Polar**: Atoms share electrons for same amount of time = equal sharing.
- 2. **Ionic**: Electron are gained or lost by atoms. Atom will have **positive** or **negative** charge = **ion**. Ex. NaCl
 - Atom with a charge can also be identified with a **super script**. Ex.

When bonds break energy is released in the form of heat.

1. Endothermic reaction: is when energy is absorbed during the reaction. Identified by lower temperature of the product.

2. Exothermic Reaction: is when energy is released during the reaction. Ex. Oxidation/Rust. Burning wood or any fossil fuel for electricity.

G. Mixture:

1. Homogeneous: when two substances blend and can't see differences.

- a. **Solution:** mixture that is evenly mixed. Can not see difference physically
- b. **Colloid:** substance that has particles that are permanently suspended. All dairy products and fog are considered colloids

- Colloids scatter light this is called the **Tyndall Effect**. Ex.

2. Heterogeneous: can see different substances mixed together ex. Chocolate chip cookie.

- a. **Suspension:** mixture that usually needs to be stirred before it can be drank. Ex ..pulp in orange juice

symbol- letter or letters representing an element

compound- the chemical combination of two or more elements

molecule- smallest part of a compound which still has all of the properties of that compound

****** The cell is a complex chemical factory containing some of the same elements found in the nonliving environment.

Carbon, hydrogen, oxygen, and nitrogen are present in the greatest percentages (96%).

****** Organisms consist of both organic and inorganic compounds.

2 TYPES OF COMPOUNDS

1. **organic**--always contain carbon--especially in C-C and C-H bonds--associated with living things and their products

ex. carbohydrates, lipids, proteins, and nucleic acids

2. **inorganic**- usually lack carbon--when carbon is present it is usually combined with oxygen

ex. carbon dioxide, inorganic acids, salts, water, and bases

Chemical bonds hold the atoms in a molecule together.

** In general, the more chemical bonds a molecule has the more energy it contains.

Formula- shows the composition of a compound

TYPES OF COMPOUND FORMULAE

1. **Structural Formula**--indicates the kinds of atoms in a molecule, their proportions, and how the atoms are arranged or held together

2. **Molecular formula**--indicates the actual nos. and kinds of atoms in a molecule --does NOT indicate structural setup

3. **Empirical Formula**--shows the symbols of the elements in a compound followed by small subscript numbers showing the ratio of atoms in the compound

Acids: substances which ionize into positively charged hydrogen ions in a water solution (H⁺ ions)

ex. $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$

-- Acids turns blue litmus paper red and usually taste sour.

Bases: ionize into negatively charged hydroxide ions in a water solution (OH⁻)

ex. $\text{KOH} \rightarrow \text{K}^+ + \text{OH}^-$

--- Bases turns red litmus paper blue.

-- Bases usually feel slippery to touch and taste bitter.

Neutralization Rxns. -- important in living things

Acid + Base \rightarrow Salt + Water

ex. $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{HOH}$

(This is how stomach antacids work.)

pH scale: measures degree of substance alkalinity or acidity alkaline = base

****** Most body fluids have a neutral pH (6-8)

Major Types of Reactions in Living Things

1. **Dehydration Synthesis:** chemical combination of two small molecules to make another larger molecule with water being driven off

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2. **Hydrolysis:** (enzymatic hydrolysis) (digestion) -- addition of water to a larger molecule to form two or more smaller molecules -- opposite of dehydration synthesis

Additional notes....

Chemical equations:

Chemical equations are balanced because the law of conservation of mass (mass is never gained or destroyed just transferred)

Ex. $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

Mixture vs Solution:

Mixture: combination of chemical that keep their individual properties (characteristics)

- Can see difference in each part physically
- Do not dissolve
- Are unevenly mixed
- Can be separated physically (ex. Use of magnet or change in state (evaporation))

Solution: when one or more substances are evenly mixed.

- The body contains solution they must stay with-in specific range of concentrated amounts.

Ex. Glucagon and insulin levels in blood.