

Chapter 2: The Chemistry of Life

I. The Nature of Matter (2.1)

A. Properties of Matter

1. Physical properties of Matter (anything that has mass & volume)
 - a. mass: quantity of matter in an object (measurement)
 - *weight: mass x force of gravity (mass doesn't change)
 - b. volume: the amount of space matter takes up
 - *liquid volume (ml or L) graduated cylinder
 - *solid volume (cm^3) $1\text{ml}=1\text{cm}^3$ (L x W x H)
 - c. color, shape, texture, taste and hardness
 - d. physical properties can be observed and measured without changing the identity of the matter (tearing, phase changes)
2. Chemical Properties (describe a substance's ability to change into another new substance through a chemical change)
 - a. chemical reactions are used to change one or more substances into new substances
 - b. look for color change, bubbles, precipitate etc.)

B. Phases of Matter

1. solid: particles of a solid move slightly
 - a. definite shape and volume
2. liquid: particles of a liquid move quickly
 - a. no definite shape, definite volume
3. gas: gas particles move the fastest
 - a. no definite shape or volume
 - *must add energy(heat) to move from one phase to another
 - * phase changes are physical changes

II. Composition of Matter

A. The Atom

1. The basic unit of matter
2. the smallest part of an element

B. Atomic Structure

1. nucleus: the center of the atom
 - contains protons and neutrons
2. energy levels (electron cloud): surrounds nucleus
 - holds the electrons

C. Subatomic particles

1. proton: positive charge, determines atomic number, found in the nucleus
2. neutron: no charge, determines atomic mass (with protons), determines isotopes, in nucleus
3. electron: negative charge, found outside nucleus (energy levels), determines chemical (bonding) properties of the atom.

D. Atomic Number and (Atomic) Mass Number

1. Atomic Number: the number of PROTONS in the nucleus
the identification of the atom
2. Atomic Mass Number: total mass of the atom
protons + neutrons

E. Chemical Elements

1. elements: pure substances that cannot be broken down into simpler substances
 - a. made up of only one type of atom
 - b. periodic table of elements: 92 naturally occurring
 - c. elements are uncharged (electrically neutral, $p^+ = e^-$)
 - d. Chemical Symbol: shorthand way to write an element name

2. Isotopes: atoms of the same element that have different mass numbers

- a. atoms of the same element always have the same # of p^+
- b. isotopes form when atoms of the same element have different numbers of NEUTRONS
- c. example C^{12} and C^{14}

3. Radioactive Isotopes (Radioisotopes)

- a. have an unstable nucleus that will decay (breakdown) and release particles (p^+ or n), energy, or both.
- b. used in medicine
 - *diagnosing disease, treatments for cancer

4. Chemical Compounds

- a. when two or more elements/atoms join chemically to produce a new substance. (chemical reactions)
- b. chemical formula: shorthand way to write the name of a compound
ex. H_2O , CH_4 , CO_2 , CO
shows # and type of atoms in the compound
- c. structural formula: shows how atoms in compound are connected
ex. $H-O-H$, $O=C=O$

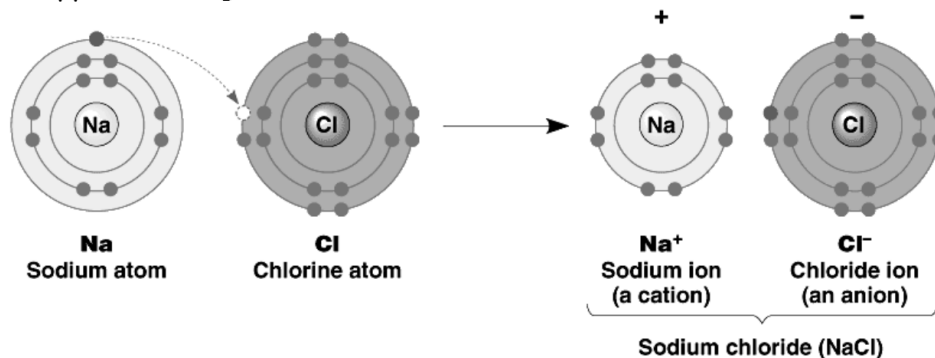
III. Interactions of Matter

A. Chemical Bonding

1. Chemical bonds are the forces that hold atoms together in compounds
2. Chemical bonds form by following certain rules-determined by e-
3. Energy Levels:
 - a. all atoms have a specific # of energy levels to hold the e-'s
 - b. 1st energy level: next to nucleus holds 2 e-'s
 - c. 2nd energy level: holds 8 e-'s
 - d. 3+ energy levels can hold up to 18 but will be happy and stable with 8 e-'s
4. Valence level: the atom's outermost (last) energy level
 - a. atoms are unstable if valence level is not filled: <2(1st) or <8(2+)
 - b. atoms become very stable when valence level is filled
 - c. atoms fill their valence level by chemically bonding with other atoms
5. Atoms will become stable by losing, gaining or sharing valence e-'s (e-'s in outer level)
 - a. Atoms with 1, 2, or 3 valence e-'s : Electron Donors (give away e-'s)
 - b. Atoms with 5, 6, or 7 valence e-'s: Electron Acceptors (take e-'s)
 - c. Atoms with 4 valence e-'s will try to share e-'s with a variety of other atoms

B. Types of Chemical Bonds

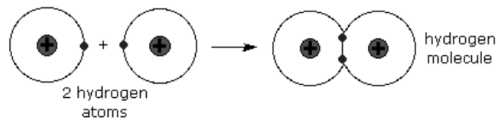
1. Ionic Bonds: chemical bonds that form from a transfer of e-'s from one atom to another, a bond between ions.
 - a. ions: charged atoms that form when an atom gains or loses e-'s
cation: positive
anion: negative
 - b. opposite charges attract (Ionic Bond)



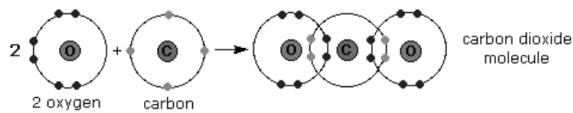
2. Covalent Bonds: a chemical bond formed by the sharing of valence e^- 's between atoms in order to fill their valence level

a. covalent bonds can be single, double or triple.

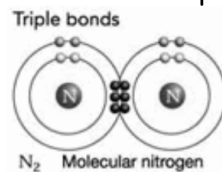
b. single bonds: atoms will share one pair of electrons



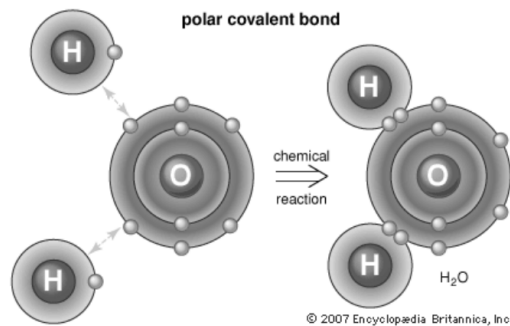
c. double bonds: atoms will share two pairs of electrons



d. triple bonds: atoms will share three pairs of electrons



e. polar covalent bond: an unequal sharing of electrons causes a charge difference across the molecule. ex water



f. non-polar covalent bond: an equal sharing of e^- 's, no charge on molecule

g. molecule: smallest part of a covalent compound

