

Living Chemistry

Atoms, Molecules and Compounds

A. Atomic Theory

1. John Dalton - 1805

- a. Every substance is made up of small, indivisible particles called atoms
- b. Molecules are made of atoms that are chemically bonded to one another

B. Elements and Compounds

1. Elements

- a. Substances made of only one kind of atom
- b. Periodic Table represents the known elements and their symbols

(Some symbols don't "make sense" unless you are familiar with their Greek and Latin origins)

2. Compounds

- a. Made up of two or more elements
- b. Biological compounds are made **mostly** of:
carbon hydrogen phosphorus
oxygen nitrogen sulfur
- c. Chemical formulas represent the number of atoms of each element in a compound

C. Structure of Atoms

1. Nucleus

- a. Protons (**positive** charge)
- b. Neutrons (**neutral = no** charge)

2. Electron cloud

- a. **Negatively** charged electrons

3. Atomic number

- a. The number of **protons** in an atom of an element
(In atoms, the #of e⁻ = #of p⁺)

4. Atomic mass

- a. # of protons + # of neutrons
(electrons have charge but no mass)

5. Isotopes

- a. Atoms of the same element that differ in the number of neutrons

Chemical Reactions

A. Chemical bonds

1. Formed sharing or transferring electrons

B. Chemical Reactions

1. The making and breaking of chemical bonds

- a. new molecules are formed

2. Involves changes in energy

- a. exothermic - energy is given off
- b. endothermic - energy is absorbed

3. Activation energy

- a. The energy required to get a reaction going

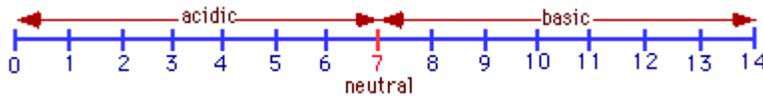
Chemical Bonds

A. Ionic Bonds

1. Attraction between oppositely charged ions
 - a. elements of Group I and Group VII
- B. Covalent Bonds
 1. Bonds in which electrons are shared
 - a. Polar - unequal sharing (Water, ammonia)
 - b. Nonpolar - equal sharing (Fats, oils, methane)
 2. Hydrogen bonds
 - a. Attraction between a slightly positive H and some other slightly negative atom
(1) important in DNA and proteins

Ions and Living cells

- A. Ions
 1. Atoms or groups of atoms with net (+) or (-) charges
- B. pH Scale
 1. A measure of the level of H^+ ions and OH^- ions



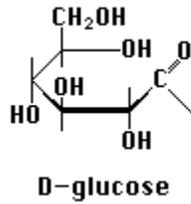
- a. Human blood = 7.4
- b. urine = 6.0
- c. gastric juice = 2.0
- d. distilled water = 7.0
- e. household ammonia = 11.0

Organic Compounds and Life

- A. Definition
 1. Organic compounds consist of carbon, hydrogen and usually oxygen
 - a. Other elements may be present as well
 - b. Not all organic molecules are "natural"
- B. Macromolecules
 1. Large, complex organic molecules
 - a. Carbohydrates
 - b. lipids
 - c. proteins
 - d. nucleic acids

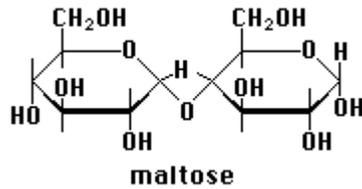
Carbohydrates

- A. Monosaccharides (Single sugars)
 1. Glucose (blood sugar)



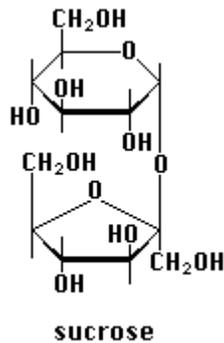
B. Disaccharides (Double sugars)

1. Maltose



glucose + glucose

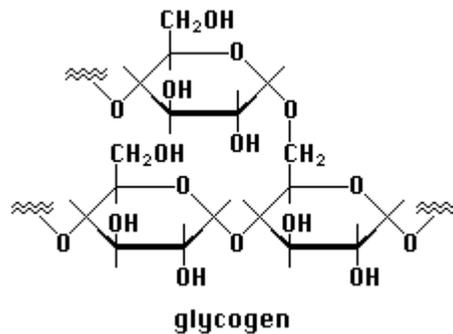
2. Sucrose



glucose + fructose

C. Polysaccharides

1. starch
2. cellulose - wood and cotton fiber
3. glycogen - storage of carbohydrate in liver and muscle



Lipids (Fats and Oils)

A. Structure

1. made of glycerol and fatty acids

a. 3 fatty acids + 1 glycerol = triglyceride

B. Function

1. Storage of energy
2. Formation of cell membranes
 - a. Phospholipids, cholesterol

C. Types of fatty acids

1. saturated fatty acids
 - a. single bonds join carbon atoms
 - b. oils at room temperature
2. unsaturated fatty acids
 - a. some carbons are joined by double bonds
 - b. solids at room temperature

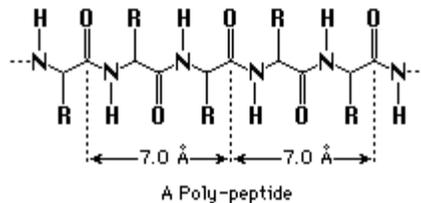
Proteins

A. Functions

1. Immune response (antibodies)
2. Body tissues (skin, hair, muscles)
3. All enzymes are proteins

B. Structure

1. All proteins are made up of amino acids
 - a. amino acids joined by peptide bonds
 - b. 20 different amino acids are found in human protein
2. Polypeptides
 - a. chains of 50 - 3000 amino acids make up proteins
3. Proteins have primary, secondary, and tertiary structure

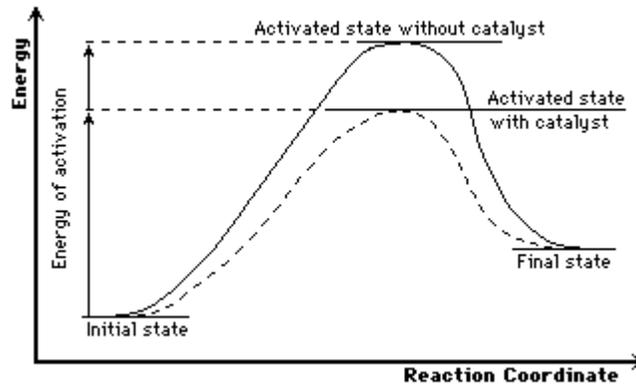


Enzymes and Chemical reactions

A. Function of enzymes

1. Enzymes are biological catalysts

2. Lower the activation energy for chemical reactions



3. All biological reactions are catalyzed by enzymes

Nucleic Acids

A. Structure

1. Nucleic acids are made of building blocks called nucleotides

a. Nucleotides contain:

- (1) phosphate group
- (2) pentose sugar
- (3) nitrogen base

B. RNA

1. Ribonucleic acid

a. Contains the sugar ribose

C. DNA

1. Deoxyribonucleic acid

b. Contains the sugar deoxyribose

The Double Helix

A. Importance

1. Chemical structure of DNA - "GENES"

B. Discovery

1. James Watson and F.H.C. Crick (1953)

RNA

A. Importance

1. Intermediate between proteins and DNA
2. Constitutes the GENES of primitive forms of life