Chemistry in Life
BIO 42
Human Biology

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Learning Objectives

- Identify the four most common chemicals in living organism
- List the three types of chemical bonds and compare their strengths

Four most predominant/common chemical in living organisms

In every 1,000 atoms in our bodies

- Oxygen - 255
- Carbon - 95
- Hydrogen - 630
- Nitrogen - 15

Other chemicals in our bodies in smaller amount

- Calcium
- Phosphorous
- Sulfur
- Sodium
- Chlorine
- Magnesium
- Iron
- Iodine
- Selinium

Chemistry is all about bonding

- Atoms – building blocks of molecules and chemical compounds
- Molecule – is a chemical unit formed from two or more atoms
- Compound – is a molecule with unlike atoms

Three types of chemical bonds

1. Ionic bond
2. Covalent bond
3. Hydrogen bond

Three types of chemical bonds

1. Ionic bond
   - Strong attraction between positive & negative ions
1. Covalent bond
   - Sharing of electrons either being non-polar or polar
1. Hydrogen bond
   - Weak attractive bond

Three types of chemical bonds

1. Ionic bond
   - Ex. Salt (Many ions in the body including calcium, sodium, potassium, hydrogen and phosphate form ionic bonds
2. Covalent bond
   - Common involve carbon, oxygen, nitrogen and hydrogen
3. Hydrogen bond
   - Water molecules

Six properties of water essential to life

- Liquid in room temperature, at sea level it vaporizes (at or above 100 C)
- Able to dissolve many other substances and therefore a good solvent (Hydrophilic vs. Hydrophobic)
- Both cohesive and adhesive
- High specific heat (temperature buffer)
- Has a high heat of vaporization (540 cal to convert water to vapor)

Six properties of water essential to life

- Ice floats

Acid vs. Base

Acid

- Vinegar
- Battery acid
- Soft drinks
- Beer
- Wine
- Coffee

The lower the pH the more acidic it is

Basic

- Drain-O
- Baking Soda
- Milk of Magnesia
- Ammonia

The higher the pH the more basic it is

Four main categories of organic compounds

I. Carbohydrates
II. Lipids
III. Proteins
IV. Nucleic Acid

Carbohydrates

- Best source of energy of the human body
- Composition (carbon, hydrogen and oxygen)
- 1:2:1 ratio
- Hydrolysis breaks down carbohydrates

Lipids

- Examples are oils, waxes, and fats
- NOT 1:2:1 ratio
- Energy storing

Proteins

- Structural and functional
- Composition (carbon, hydrogen, oxygen, and nitrogen)
- Most abundant in the human body

Nucleic Acids

- Information molecules
- Composition (carbon, hydrogen, oxygen, nitrogen, and phosphorous)
- Store and process organism's hereditary information

ATP

- Adenosine Triphospate – currency of the human body

  - powers cellular activity

Cell Theory

- All living things are composed of cells
- All cells arise from preexisting cells through cell division
- Cells obtain hereditary material, which they pass to daughter cells during cell division
- The chemical composition of all cells is quite similar
- The metabolic processes associated with life occur within the cell

Three basic parts of the cell

1. Plasma Membrane – barrier or cell wall
2. Cytosol – fluid that supports organelles
3. Nucleus – most prominent organelle

Movement across the membrane

Passive

- Filtration
- Diffusion -higher to lower concentration
- Facilitated diffusion – requires a transporter

Active

- Endocytosis
- Exocytosis

Cell signaling mechanism

- Circulating hormones
- Local hormones (paracrine)
- Gap junctions

Four tissue types

- Epithelial tissue
- Connective tissue
- Muscular tissue
- Nervous tissue

Epithelial tissue

- Covers the body and lines all the cavities and composes the glands

Connective tissue

- Connects the structures of the body
- Provides structural support and holding the organs
- Stretchy and strong

Muscular tissue

- Provides movement and heat

Nervous tissue

- Tissue that responds to the environment by detecting, processing and coordinating information

Types of muscular tissue

- Skeletal muscles
- Smooth muscles
- Cardiac muscles

References

- Ireland, K.A. (2011). *Visualizing Human Biology (3rd ed.). Danvers, MA: Wiley & Sons Inc.*