The Chemical Basis of Life

Chemistry in Living Systems

Some things you may (or may not) remember! => with a partner, write down what you know about the following terms:

- biochemistry
- element
- compound
- organic compound
- mixture
- isotope
- chemical bonds
- intramolecular
- intermolecular

only about 92 naturally occurring elements serve as the building blocks of matter
only six are the chemical foundation for our great diversity of life
carbon, hydrogen, nitrogen, oxygen, phosphorus, sulfur
all atoms of the same element have the same number of protons, but the number of neutrons can vary => isotopes
radioisotopes are unstable isotopes that are useful diagnostic tools in medicine

Chemistry in Living Systems

Interactions of Molecules

- most biological studies do not consider individual elements, but rather molecules
- many of the molecules of life are organic molecules (meaning they are carbon-based)
biochemistry is the "bridge" between biology and chemistry
biochemists are concerned with understanding the properties and interactions of biologically important molecules

Interactions within Molecules

- Intramolecular forces
  - occurring between atoms within a molecule
  - bonds within molecules are covalent bonds (formed when valence electrons are shared between two atoms)
  - some atoms attract electrons more strongly than others (referred to as electronegativity)
  - the unequal sharing of electrons results in a polar covalent bond (one atom has a partial positive, the other a partial negative)
  - molecules with polar bonds are called polar molecules

Interactions Between Molecules

- Intermolecular forces describe forces between molecules
  - much weaker than intramolecular forces
  - determine how molecules interact and thus play a large role in biological systems
  - two types of intermolecular interactions are particularly important for biological systems:
    - Hydrogen bonding
    - Hydrophobic interactions
Hydrogen Bonding

- A hydrogen bond occurs between an atom with a partial negative charge and a hydrogen atom with a partial positive charge.
- Although a H-bond is much weaker than a covalent bond, many H-bonds together can be very strong.

Hydrophobic Interactions

- Non-polar molecules do not form H-bonds.
- When non-polar molecules interact with polar molecules, they form 'clumps' rather than mix (think oil in water).
- Non-polar molecules are hydrophobic (water-fearing).
- This hydrophobic effect plays a large role in how cell membranes form.
- Polar molecules are hydrophilic (water-loving).

Ions in Biological Systems

- When an atom or group of atoms gains or loses an electron it becomes an ion.
- Ions are an important part of living systems.
- H+ ions are critical in cellular respiration.
- Na+ ions are important in neural transmission.

Functional Groups

- A functional group is an atom or a group of atoms attached to a molecule which gives the molecule particular chemical and physical properties.

Your task

1. Use page 14 in your textbook to fill in the worksheet on functional groups.

Structures and Shapes of Molecules

- A molecular formula shows the number of each type of atom in a compound.
- A structural formula shows how the different atoms in a molecule are bonded together.
3-dimensional Shape

- molecules are not flat, they take up space in three dimensions → this 3-D shape influences behaviour and function

Practice

- In class, discuss pg 13 #1-5
- For independent work, do pg 17 #1, 2, 4, 5, 6, 13