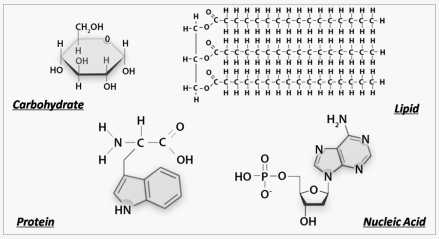
Macromolecules Structure



Carbohydrates

monomer: monosaccharides (linked together into polysaccharides by dehydration synthesis)

functions: energy storage (ex: starch in plants and glycogen in animals) and structural support (ex: cellulose for plan cell walls and chitin for exoskeleton of arthropods and cell walls of fungi)

have a ratio of **CH2O** (1 carbon: 2 Hydrogen: 1 Oxygen)

Proteins

Monomer: amino acids (which are linked by peptide bonds, which are formed by dehydration synthesis between amino and carboxyl groups of adjacent amino acids)

functions: antibodies, movement, membrane receptors

Primary Structure- unique sequence of amino acids

Secondary Structure- folding of the amino acid chain through hydrogen bonds into alpha helices and beta sheets

Tertiary Structure- overall three-dimensional shape of the protein and often minimizes free energy (hydrophobic interactions, disulfide bridges, H-bonds, ionic bonds)

Quaternary Structure- arrangement of polypeptides (only occurs in some) ex: hemoglobin

Denaturation: unfolding of protein structure due to unideal temperature or pH levels

Lipids

Monomer: N/A because lipids aren't polymers since they are assembled from a variety of components (ex: fats, oils, waxes, & steroids) ALL HYDROPHOBIC

Function: energy storage, protection, insulation, phospholipid bilayer

Fats (aka triglycerides): made of a glycerol molecule and 3 fatty acid molecules (fatty acids: nonpolar hydrocarbon chains)

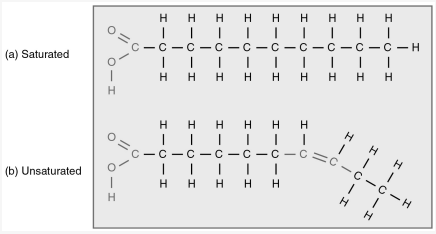
Saturated Fatty Acids: no double bonds between carbons, pack solidly at room temp, max number of hydrogens, commonly produced by animals)

Unsaturated Fatty Acids: have some carbon double bonds which result in kinks, liquid at room temp, commonly produced by plants)

Phospholipids have a hydrophilic (polar) head that includes a phosphate group and 2 hydrophobic fatty acid tails

Steroids have a carbon skeleton of 4 rings that are fused together (ex: cholesterol in animal cell membranes, and estrogen and testosterone)

Saturated vs. Unsaturated Fatty Acids



Nucleic Acids

Monomer: nucleotides

Function: genetic info that codes for amino acid sequences

DNA and **RNA**

Nucleotides are made of **3 parts**: nitrogenous base, pentose (5-carbon) sugar (deoxyribose in DNA and ribose in RNA), and the phosphate group (PO4)

Chemical Reactions

Covalent Bonds	**Nonpolar covalent bonds**: electrons are shared equally	**polar covalent bonds**: one atom has a greater electronegativity --> unequal sharing of electrons
Ionic Bonds	chemical bonds formed by the attraction of oppositely charged ions	ex: table salt
Hydrogen Bonds	weak chemical interactions that form between a partial positively charged hydrogen atom of one molecule and the strong electronegative oxygen or nitrogen of another molecule	ex: hydrogen bonds between water
Van der Waals interactions	very weak, short--lasting connections that are a result of asymmetrical distribution of electrons within a molecule	contribute to the 3d shape of molecules

By **JagritiJha**
cheatography.com/jagritijha/

Published 4th April, 2023.
Last updated 4th April, 2023.

Acids and Bases

pH scale: Measures relative acidity and alkalinity of aqueous solutions (between 0 and 14)

Acids: excess of H+ ions and H+>OH-

Bases: excess of OH- ions and OH->H+

Pure water is **neutral** (pH=7)

Buffers: substances that minimize changes in pH by accepting H+ from a solution when hydrogen molecules are in excess and donate H+ when hydrogen molecules are depleted

Buffers are **essential** in living tissues to minimize pH changes

Carbonic Acid (H2CO3): important buffer in living systems because it moderates pH changes in blood plasma and the ocean

Carbon

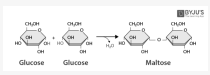
Major elements of life are carbon, hydrogen, oxygen, nitrogen, sulfur, and phosphorus **CHNOPS**

All organic compounds contain **carbon** and *most* contain **hydrogen**

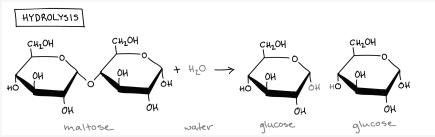
Carbon is unparalleled in its ability to form large, complex, and diverse molecules because it has 4 valence electrons, which means it can form up to 4 covalent bonds (which can be single, double, or triple), and it can form large molecules (which can be chains, ring-shaped, or branched)

Isomers: molecules that have the same molecular formula but differ in atom arrangement, which can result in molecules that are very different in their biological activities (ex: glucose and fructose)

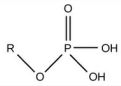
Dehydration Synthesis



Hydrolysis Reaction



Functional Groups

Functional Group	Structure	Properties
Hydroxyl		Polar
Methyl		Nonpolar
Carbonyl		Polar
Carboxyl		Charged, ionizes to release H^+. Since carboxyl groups can release H^+ ions into solution, they are considered acidic.
Amino		Charged, accepts H^+ to form NH_3^+. Since amino groups can remove H^+ from solution, they are considered basic.
Phosphate		Charged, ionizes to release H^+. Since phosphate groups can release H^+ ions into solution, they are considered acidic.
Sulfhydryl		Polar

Properties of Water

Water molecules are **polar**	oxygen region of molecule has a partial negative charge and each hydrogen region has a partial positive positive charge

Properties of Water (cont)

Hydrogen bonds form between water molecules	the slightly negative oxygen atom from one water molecule is attracted to the slightly positive hydrogen end of another molecule	Each water molecule can form up to **4 hydrogen bonds**

Properties of Water (cont)

Hydrogen Bonds are key to each of the following properties of water and what makes water unique	**Cohesion**: Linking of like molecules	**Adhesion**: clinging of one substance to another	**Capillary Action**: movement of water molecules up very thin xylem tubes and their evaporation from stomata in plants; the water molecules cling to each other by *cohesion* and to the walls of the xylem tube by *adhesion*

Properties of Water (cont)

Cohesion is responsible for **surface tension**, which means that water droplets will resist rupture when stress and pressure are added to the system	Water has a **high specific heat**. *Specific Heat* is the amount of heat required to raise or lower the temperature of a substance by 1 degree Celsius. High specific heat makes the temperature of Earth's oceans relatively stable and able to support vast quantities of life	Water is **less dense as a solid than as a liquid**, so ice floats, which keeps larger bodies of water from freezing solid, allowing life to exist in bodies of water	Water is an important **solvent** (*hydrophilic* substances are water soluble and *hydrophobic* substances are nonpolar and don't dissolve in water).