

Biol 1441

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Chapter 5: The Structure and Function of Macromolecules

I. The Synthesis and Breakdown of Polymers

Dehydration or **condensation** reaction: a chemical reaction in which two molecules covalently bond to each other with the removal of a water molecule.

Hydrolysis: a chemical process that lyses, or splits, molecules by the addition of water.

Q: How many molecules of water are needed to completely hydrolyze a polymer that is 5 monomers long? *Answer*: 4

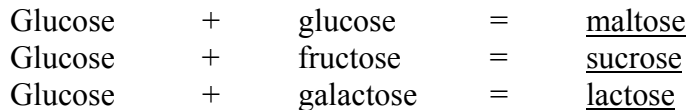
II. Carbohydrates

Monosaccharides - monos: single, sacchar: sugar

Aldose - aldehyde sugar: ribose (pentose sugar), glucose, galactose (hexose sugar)

Ketose - ketone sugar: fructose (hexose sugar)

Disaccharide: a double sugar, consisting of two monosaccharides joined by dehydration synthesis.



Glycosidic linkage: covalent bond formed between two monosaccharides by a dehydration reaction.

Polysaccharide: a polymer of up to over a thousand monosaccharides joined by glycosidic linkages.

Starch: a storage polysaccharide in plants consisting entirely of glucose.

Glycogen: an extensively branched glucose storage polysaccharide found in the liver and muscle of animals.

Cellulose: is a major component of the tough walls that enclose plant cells.

Chitin: a structural polysaccharide of an amino sugar found in many fungi and in the exoskeletons of all arthropods.

Q: A dehydration reaction joins two glucose molecules to form maltose. The formula for glucose is $C_6H_{12}O_6$. What is the formula for maltose? *Answer*: $C_{12}H_{22}O_{11}$.

III. Lipid:

Fats (triacylglycerol): is constructed from two kinds of smaller molecules: glycerol and fatty acids.

Saturated fatty acid: all carbons in the hydrocarbon tail are connected by single bonds, and maximize the number of hydrogen atoms attached to the carbon skeleton.

Unsaturated fatty acid: possessing one or more double bonds between the carbons in the hydrocarbon tail. Such bonding reduces the number of hydrogen atoms attached to the carbon skeleton.

Phospholipid: is a constituent of the inner bilayer of biological membranes, having a polar(hydrophilic) head and a nonpolar (hydrophobic) tail.

Steroid: characterized by a carbon skeleton consisting of four rings with various functional groups attached.

Cholesterol: is a common component of animal cell membranes and is also the precursor from which other steroids are synthesized. Many hormones, including vertebrate sex hormones, are steroids produced from cholesterol

Q: Why are human sex hormones considered to be lipids?

IV. Proteins

Enzymes/ catalyst: a chemical agent that changes the rate of a reaction without being consumed by the reaction.

Polypeptide: a polymer (chain) of many amino acids linked together by peptide linkages.

**Be able to distinguish peptide linkage and glycosidic linkage.*

Protein: consists of one or more polypeptides folded and coiled into specific conformations.

Protein Conformation and Function

Primary:

Secondary: alpha helix and beta sheet.

Tertiary:

Quaternary:

Denaturation: when protein loses its native conformation, thereby becoming biologically inactive, occurs under extreme conditions of pH, salt concentration, and temperature.

V. Nucleic acids

Nucleic acid: a polymer (polynucleotide) consisting of many nucleotide monomers; serves as a blueprint for proteins and, through the actions of proteins, for all cellular activities. The two types are DNA and RNA.

- **DNA** (*deoxyribonucleic acid*): a double-stranded, helical nucleic acid molecule capable of replicating and determining the inherited structure of a cell's proteins.
- **RNA** (*ribonucleic acid*): single-stranded, a type of nucleic acid consisting of nucleotide monomers with a ribose sugar and the nitrogenous bases adenine (A), cytosine (C), guanine (G), and uracil (U); usually single-stranded.

The flow of genetic information: **DNA** → **mRNA** → **protein**

Q: In a DNA double helix, a region along one DNA strand has this sequence of nitrogenous bases: 5'-TAGCAATGCT-3'. List the base sequence along the other strand of the molecule, clearly indicating the 5' and 3' ends of this strand.

Answer: 3'-ATCGTTACGT-5'