

AP Biology Notes: Biological Molecules

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Four Things to Know about Biological Molecules:

1. Organic compounds are molecules that contain carbon. All living matter is made up of nitrogen, carbon, hydrogen, oxygen, phosphorus, and sulfur (N'CHOPS).
2. Living systems require free energy and matter from the environment to grow, reproduce, and maintain homeostasis. Organisms survive by coupling chemical reactions that increase entropy with those that decrease entropy.
3. The water molecule's polar nature leads to surface tension (enabling capillary action) and makes it an effective solvent. It expands rather than contracts when it freezes. These properties make water essential to life on Earth.
4. The four most common types of biological molecules are carbohydrates, lipids, proteins, and nucleic acids. Carbs, proteins, and nucleic acids include polymers composed of simpler monomer subunits, which give the molecules their distinctive properties: monosaccharides make up disaccharides and polysaccharides, amino acids make up mono peptides and polypeptides, and nucleotides make up RNA and DNA. Lipids are not technically polymers, but some of them are composed of smaller molecules: triglycerides (fats and oils) contain glycerol and three fatty acids, while phospholipids contain glycerol, two fatty acids, and a modified phosphate group.

Key Topics: Biological Molecules

Remember that the AP Biology exam tests you on the depth of your knowledge, not just your ability to recall facts. While we have provided brief definitions here, you will need to know these terms in even more depth for the AP Biology exam.

Matter and Energy

- **Oxygen:** A nonmetallic element essential in animal and plant respiration
- **Organic molecules:** Most molecules that contain carbon (C); note that there are exceptions (e.g., carbon dioxide is not considered organic)

The Importance of Water

- **Nutrients:** Vitamins or minerals essential for growth and metabolism in an organism
- **Minerals:** Naturally occurring inorganic elements essential in the nutrition of organisms
- **Membrane:** Thin structure connecting or separating structures or regions of an organism
- **Hydrophobic:** Repelling water, “water fearing”
- **Hydrophilic:** Having an affinity for water, “water loving”

Biological Monomers and Polymers

- **Polymer:** A large molecule that is composed of many similar molecular units (e.g., starch)
- **Monomer:** A basic molecule that can covalently bond to other monomers to form long chains called polymers
- **Carbohydrate:** An organic compound to which hydrogen and oxygen are attached; the hydrogen and oxygen are in a 2:1 ratio; examples include sugars, starches, and cellulose
- **Monosaccharide:** A simple sugar; typically, a five- or six-carbon sugar (e.g., ribose or glucose)
- **Polysaccharide:** A carbohydrate that is composed of many monosaccharide units joined together, such as glycogen, starch, and cellulose
- **Lipid:** An organic compound that contains hydrocarbons and includes fats, oils, waxes, and steroids
- **Fats:** Solid, semi-solid, or liquid organic compounds composed of glycerol, fatty acids, and organic groups
- **Adipose:** Fatty tissue, fat-storing tissue, or fat within cells
- **Phospholipids:** Phosphorus-containing lipids composed of two fatty acids and a phosphate group modified with simple organic molecules
- **Plasma membrane:** The cell membrane
- **Protein:** An organic compound that is composed of many amino acids; contains C, H, O, and N
- **Lactase:** An enzyme that breaks down the sugar lactose
- **Lipase:** An enzyme that catalyzes the hydrolysis of lipids
- **Pepsin:** An enzyme that breaks down proteins into smaller peptides

- **Protein Synthesis:** The creation of proteins, coded for by nucleic acids
- **Deoxyribose:** A five-carbon sugar that has one oxygen atom less than ribose; a component of DNA (deoxyribonucleic acid)
- **Ribose:** A pentose sugar that occurs in nucleotides, nucleic acids, and riboflavin
- **Nitrogenous base:** The five purine and pyrimidine bases found in nucleic acid—adenine, thymine (in DNA only), cytosine, guanine, and uracil (in RNA only)
- **Adenine:** A purine nitrogenous base that pairs with thymine in DNA and uracil in RNA
- **Guanine:** A purine nitrogenous base that is a component of nucleotides and nucleic acids; it links up with cytosine in DNA
- **Thymine:** A pyrimidine nitrogenous base in nucleic acids and nucleotides; pairs with adenine in DNA
- **Cytosine:** A pyrimidine nitrogenous base that is present in nucleotides and nucleic acids; it is paired with guanine
- **Uracil:** A pyrimidine nitrogenous base found in RNA (but not in DNA); pairs with adenine
- **DNA:** Deoxyribonucleic acid; found in the cell nucleus, its basic unit is the nucleotide; contains coded genetic information; can replicate on the basis of heredity
- **RNA:** An abbreviation of ribonucleic acid, a nucleic acid in which the sugar is ribose; a product of DNA transcription that serves to control certain cell activities; acts as a template for protein translation; types include mRNA (messenger), tRNA (transfer), and rRNA (ribosomal)