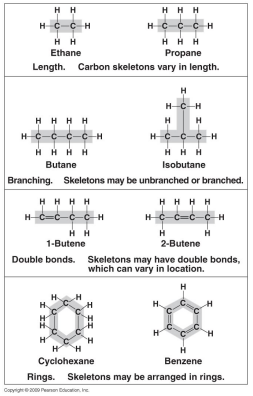
Biology – Chapter 2b
Biochemistry

Honors Biology – Chapter 3
The Molecules of Cells

Ridgefield Memorial High School



Carbon molecules are the building blocks for most important biological chemicals.

TABLE 3.2 FUNCTIONAL GROUPS OF ORGANIC COMPOUNDS

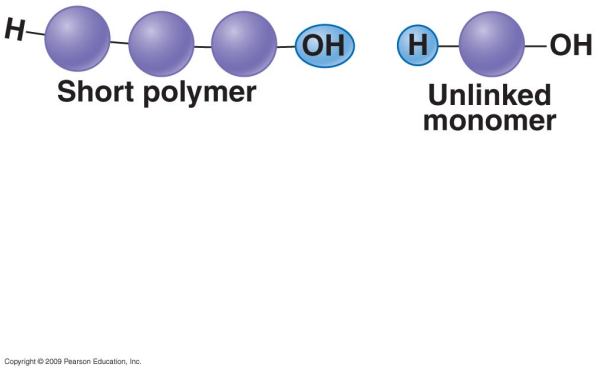
Functional Group	Examples
Hydroxyl group —OH	Alcohol
Carbonyl group C=O	Aldehyde; Ketone
Carboxyl group —COOH	Carboxylic acid; Ionized

These are some of the functional groups found on organic (biological) chemicals.

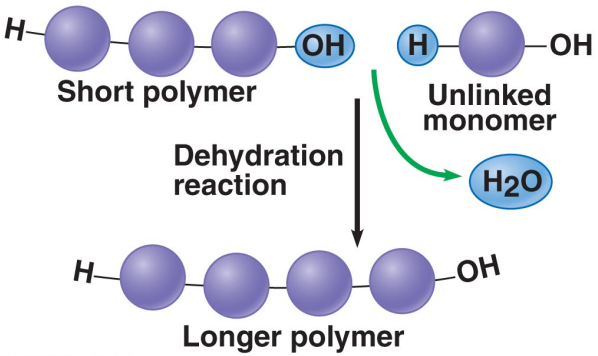
TABLE 3.2 FUNCTIONAL GROUPS OF ORGANIC COMPOUNDS

Functional Group	Examples
Amino group —NH_2	Amine; Ionized
Phosphate group —OPO_3^{2-}	Organic phosphate (ATP)
Methyl group —CH_3	Methylated compound

These are some of the functional groups found on organic (biological) chemicals.



Large molecules are built using dehydration synthesis reactions.
A water molecule is produced (released).



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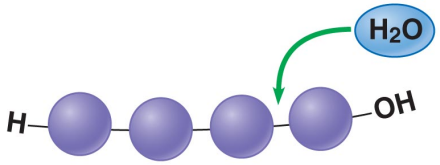
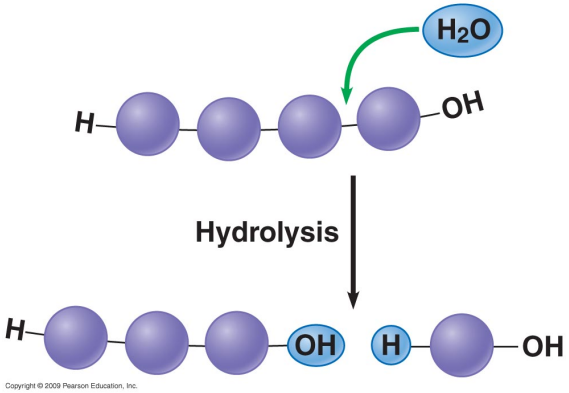


Large molecules are broken down using hydrolysis reactions.
A water molecule is split (used up).



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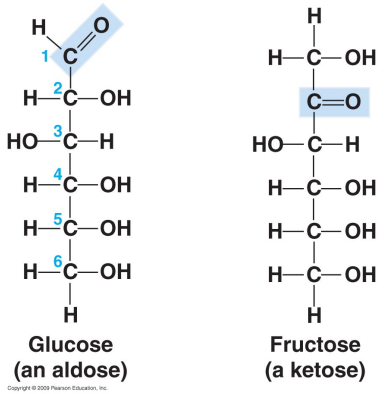
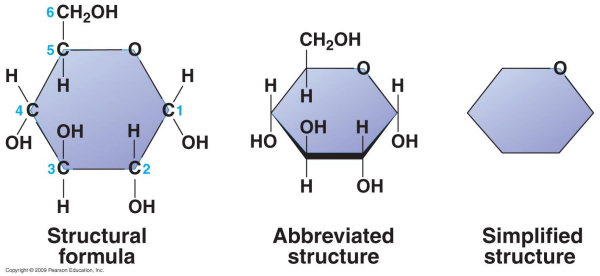
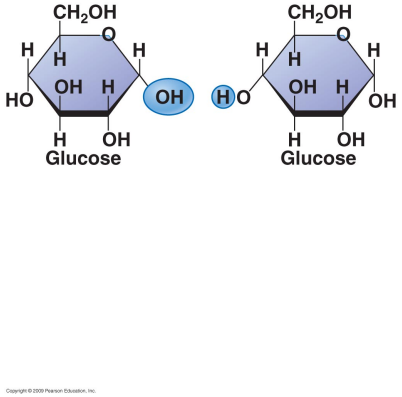


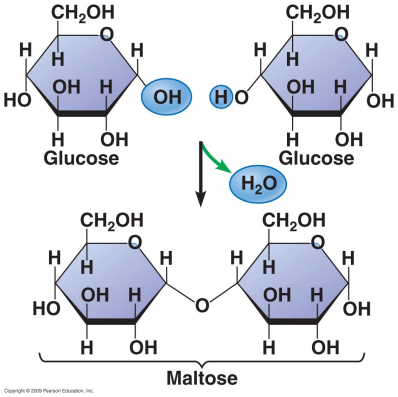
Glucose (blood sugar) and fructose (fruit sugar) are both monosaccharides.



These are 3 different ways to draw the same glucose molecule.



A dehydration synthesis reaction combines 2 monosaccharides into 1 disaccharide.



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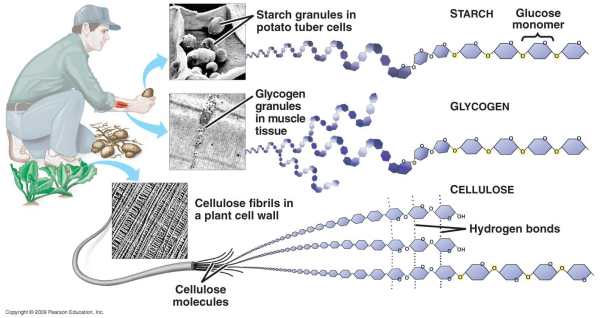
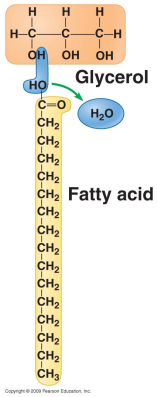
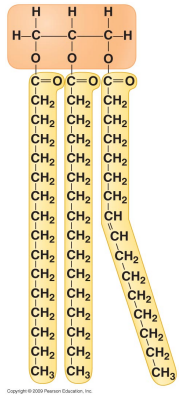


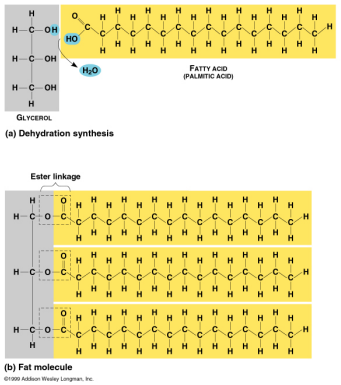
Starch, glycogen, and cellulose are all types of polysaccharides.
Note the structural differences between starch/glycogen and cellulose.



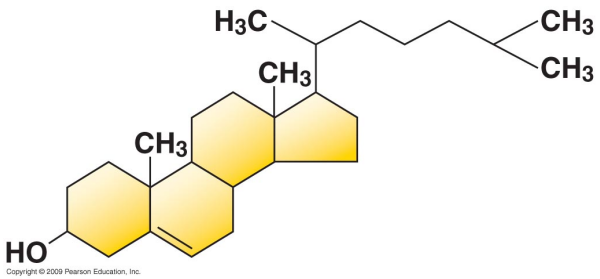
It takes 3 dehydration synthesis reactions...



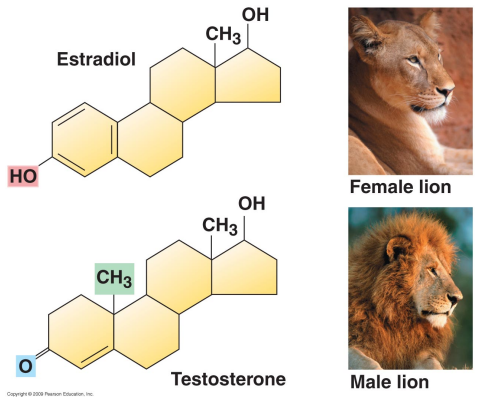
...to produce one triglyceride molecule.



A triglyceride is made up of 1 glycerol molecule and 3 fatty acids.
A triglyceride is highly non-polar (hydrophobic).

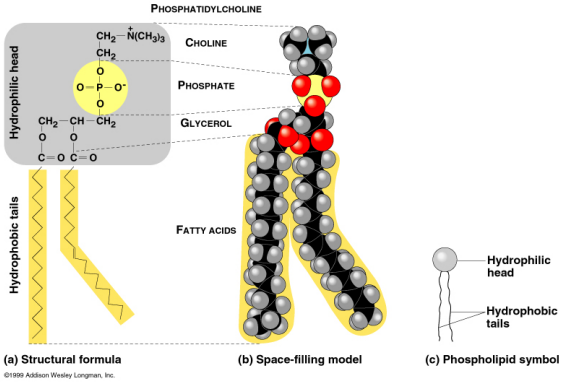


Cholesterol is highly non-polar (hydrophobic).
Cholesterol is a type of steroid, which the body uses...

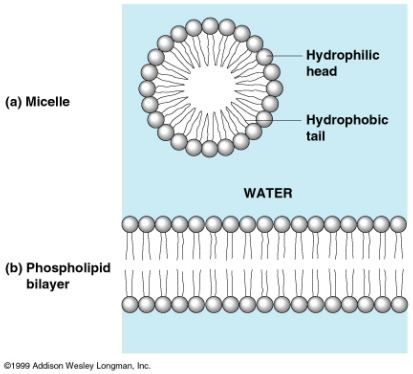


...to make the sex hormones estrogen and testosterone.

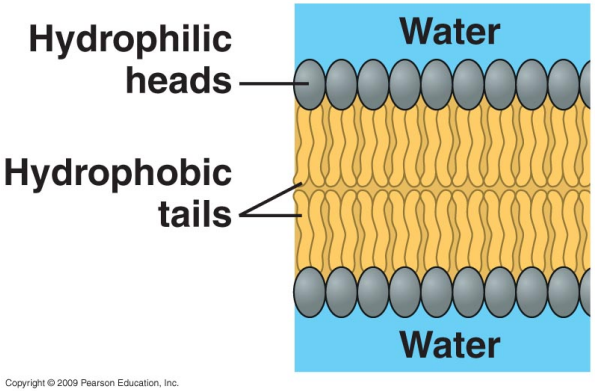
Anabolic steroids (testosterone) builds muscle but causes the testes to shrivel up.



A phospholipid contains 1 polar head (phosphate group) and 2 non-polar tails (fatty acids).



Phospholipids are the most important chemical found on the cell membrane because they form a bilayer.



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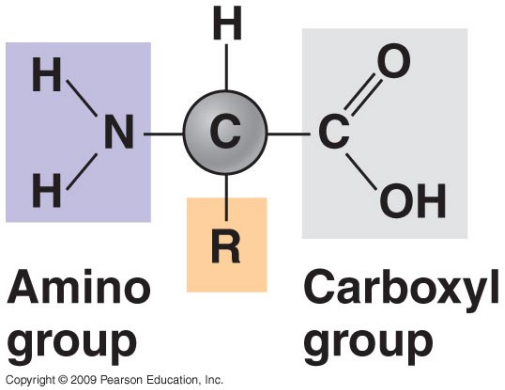
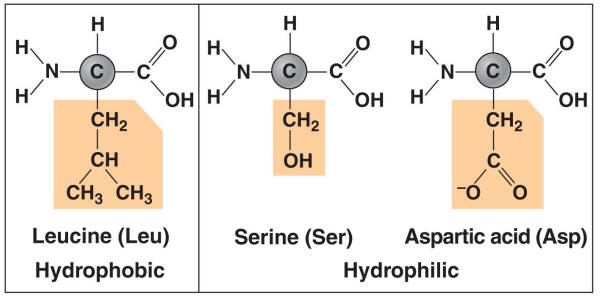
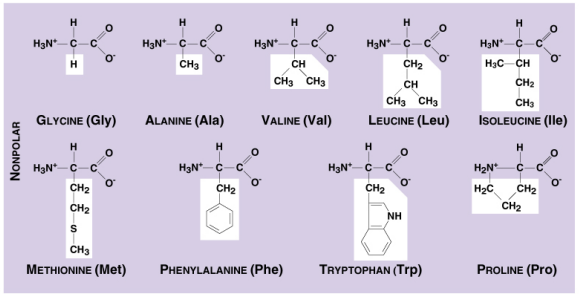


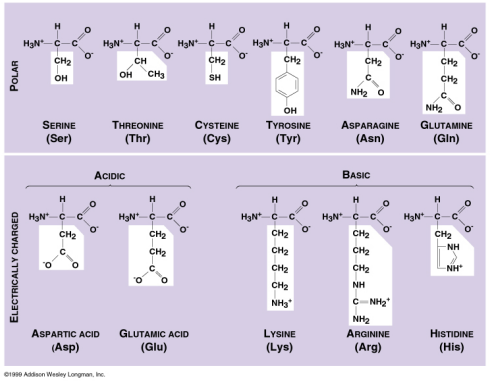
This is the basic structure of an amino acid.
The 20 different amino acids differ in the composition of their R groups.



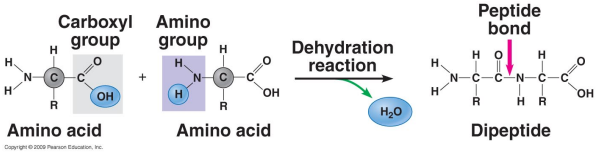
Some amino acids are polar like water (hydrophilic) and others are non-polar like oil (hydrophobic).



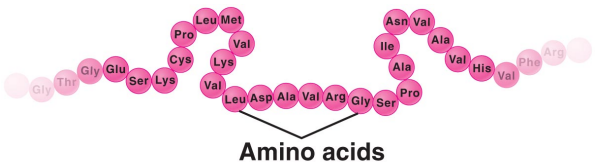
These are the structures of the 9 non-polar amino acids.



These are the structures of the 11 polar amino acids.

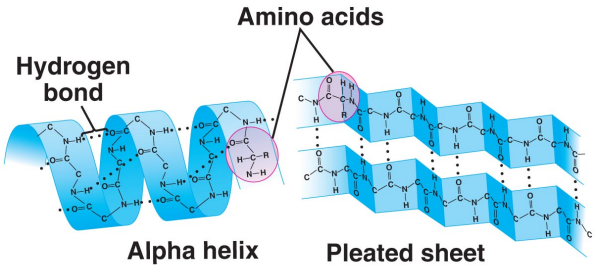


Amino acids can be combined by dehydration synthesis reactions.
Two amino acids form a dipeptide.



Primary structure

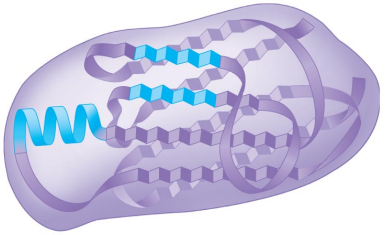
The primary structure of a protein is its amino acid sequence.



Secondary structure

The secondary structure is when the amino acids begin to fold into helices or sheets.

Polypeptide (single subunit of transthyretin)



Tertiary structure

The tertiary structure is when all the folded structures combine into a single 3-dimensional subunit, which may or may not be fully functional.

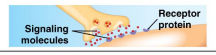
Transthyretin, with four identical polypeptide subunits

Quaternary structure

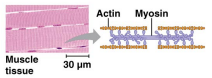
The quaternary structure is the final product, containing all of the necessary subunits. The quaternary structure is functional.

Hormonal proteins
Function: Coordination of an organism's activities
Example: Insulin, a hormone secreted by the pancreas, causes other tissues to take up glucose, thus regulating blood sugar concentration.

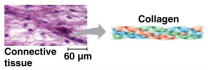
Receptor proteins
Function: Response of cell to chemical stimuli
Example: Receptors built into the membrane of a nerve cell detect signaling molecules released by other nerve cells.



Contractile and motor proteins
Function: Movement
Examples: Motor proteins are responsible for the undulations of cilia and flagella. Actin and myosin proteins are responsible for the contraction of muscles.

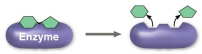


Structural proteins
Function: Support
Examples: Keratin is the protein of hair, horns, feathers, and other skin appendages. Insects and spiders use silk fibers to make their cocoons and webs, respectively. Collagen and elastin proteins provide a fibrous framework in animal connective tissues.

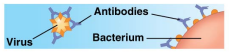


Proteins can be used to make hormones, cell membrane receptors muscle/movement fibers, and structural fibers.

Enzymatic proteins
Function: Selective acceleration of chemical reactions
Example: Digestive enzymes catalyze the hydrolysis of bonds in food molecules.

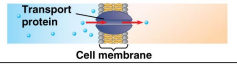


Defensive proteins
Function: Protection against disease
Example: Antibodies inactivate and help destroy viruses and bacteria.

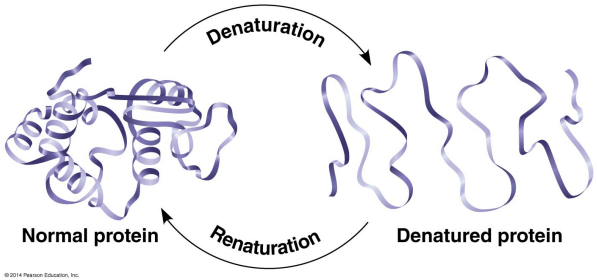


Storage proteins
Function: Storage of amino acids
Examples: Casein, the protein of milk, is the major source of amino acids for baby mammals. Plants have storage proteins in their seeds. Ovalbumin is the protein of egg white, used as an amino acid source for the developing embryo.

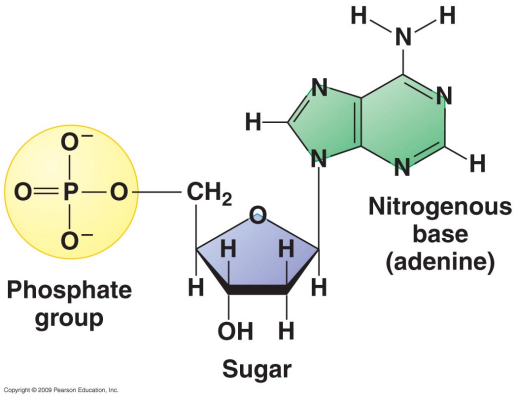
Transport proteins
Function: Transport of substances
Examples: Hemoglobin, the iron-containing protein of vertebrate blood, transports oxygen from the lungs to other parts of the body. Other proteins transport molecules across membranes, as shown here.



Proteins can be used to make enzymes, antibodies, nutritional storage molecules, and transport molecules.



Changes in pH or temperature can cause a protein to denature.
CHANGE THE STRUCTURE → CHANGE THE FUNCTION!



Nucleotides are the building blocks for DNA and RNA.