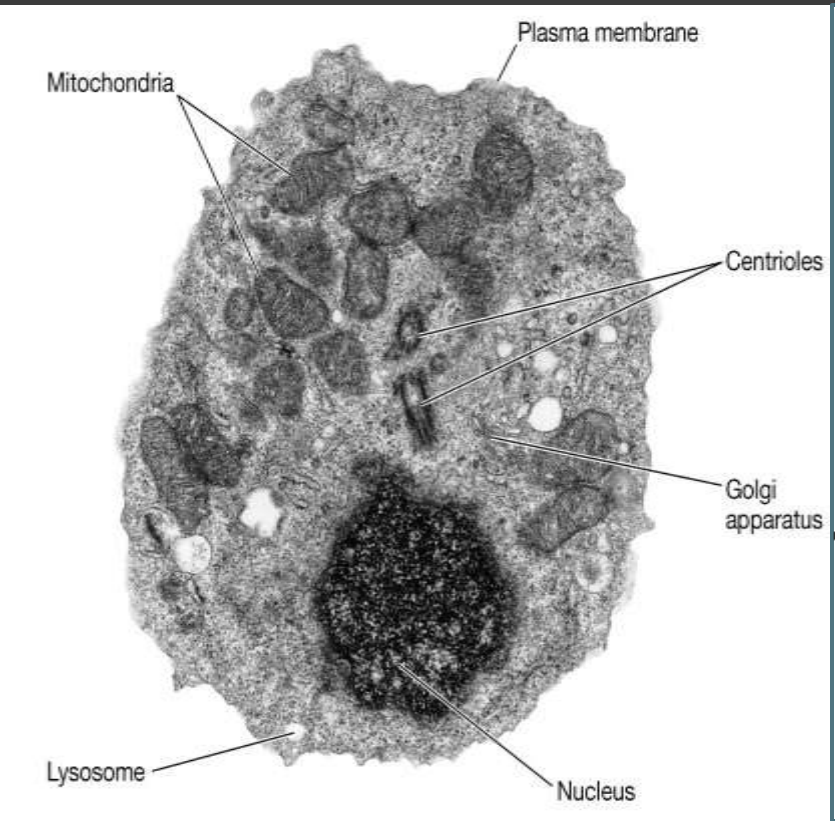
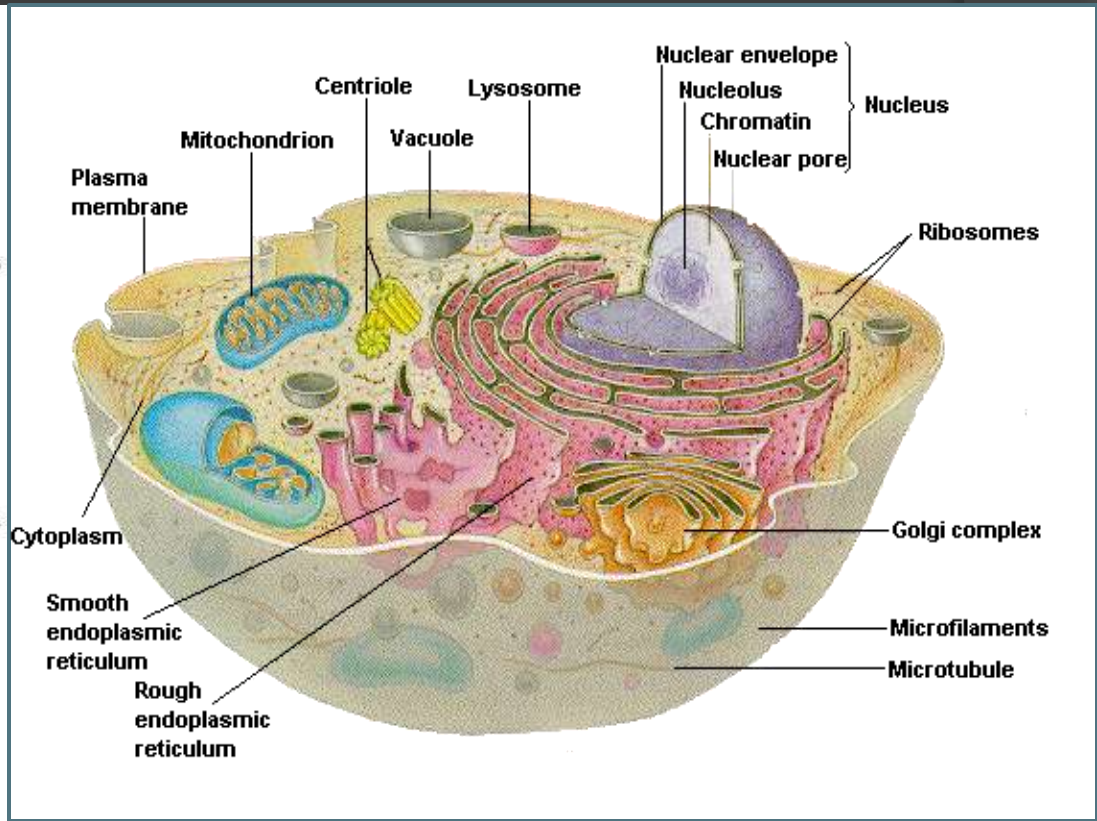
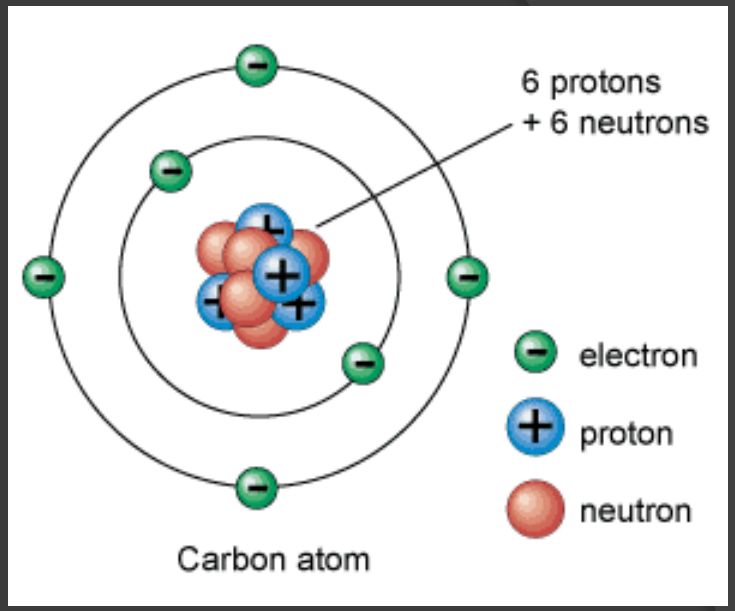
Chemistry of Cells

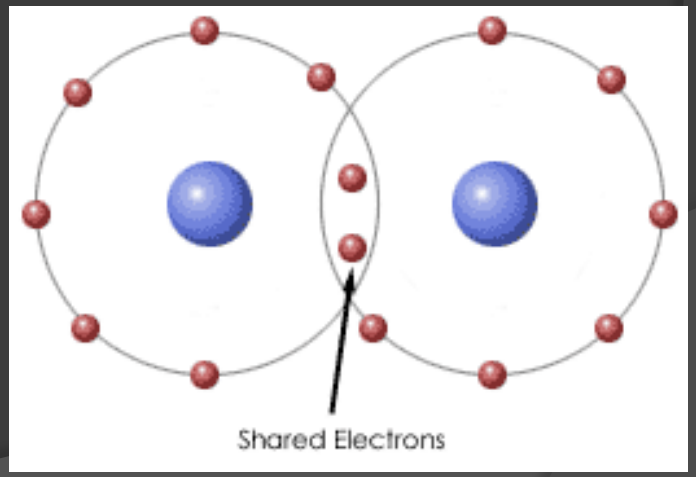




Carbon Compounds

- Most matter in our body that is not made of water is made of organic compounds.
- Organic compounds contain carbon atoms that are covalently bonded to other elements; typically hydrogen, oxygen, and other carbon atoms.
- Remember, Covalent bonds form when two or more atoms share electrons to form a molecule.



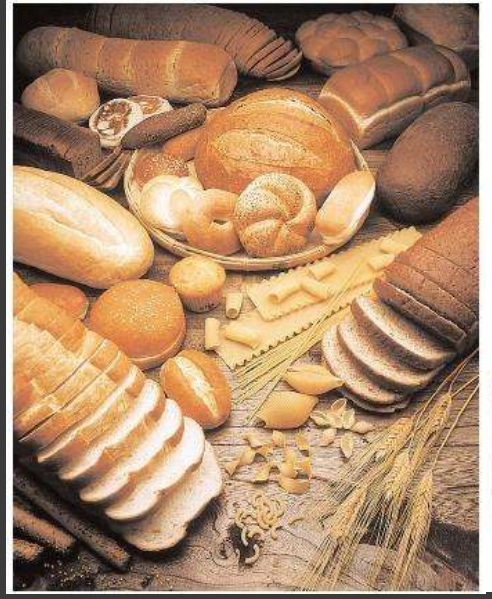


Covalent bond

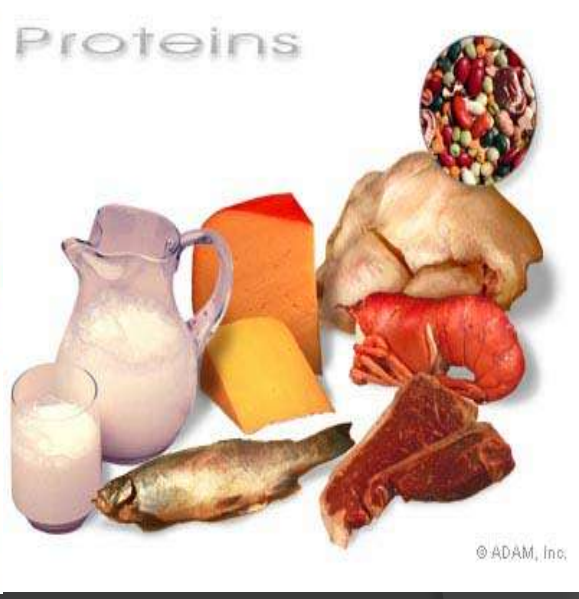
Carbon Compounds

- Four principal classes of organic compounds are found in living things.

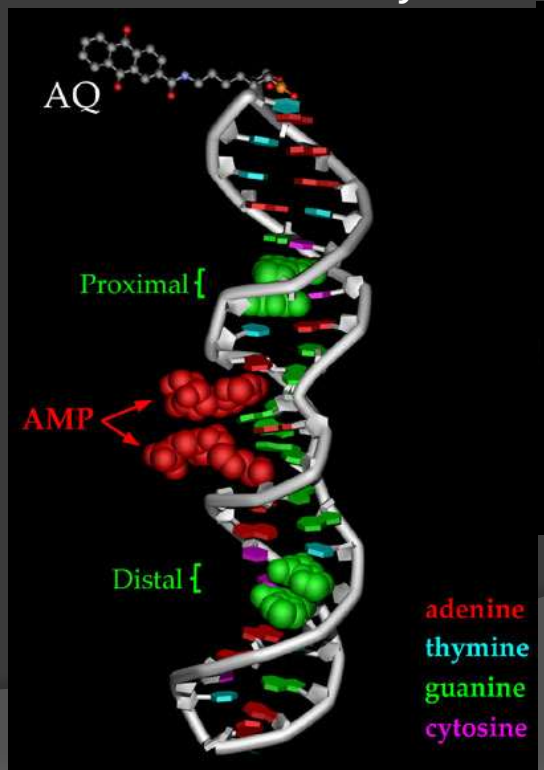
1. Carbohydrates
2. Lipids
3. Proteins
4. Nucleic acids



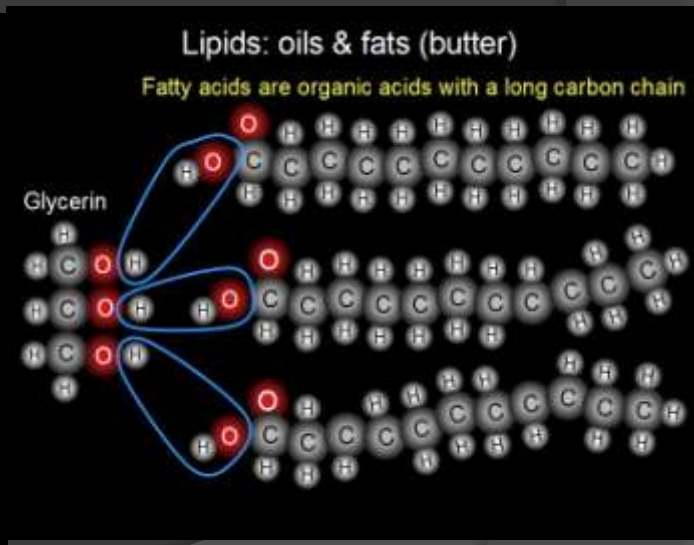
carbohydrates



proteins



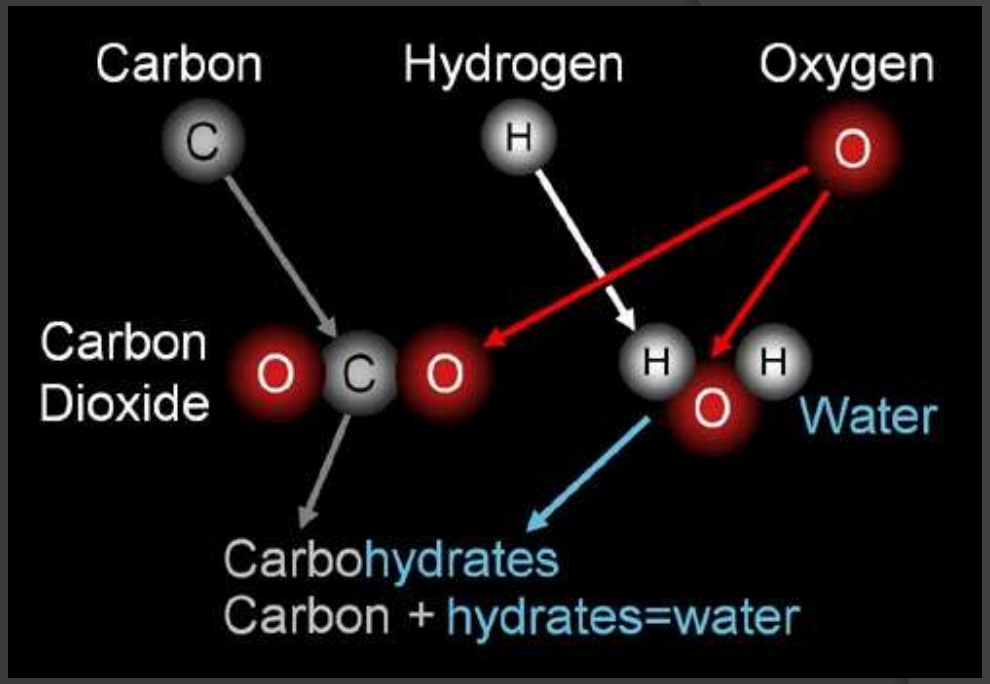
Nucleic acids



Lipids

Carbohydrates

- Carbohydrates are organic compounds made of carbon, hydrogen, and oxygen atoms.

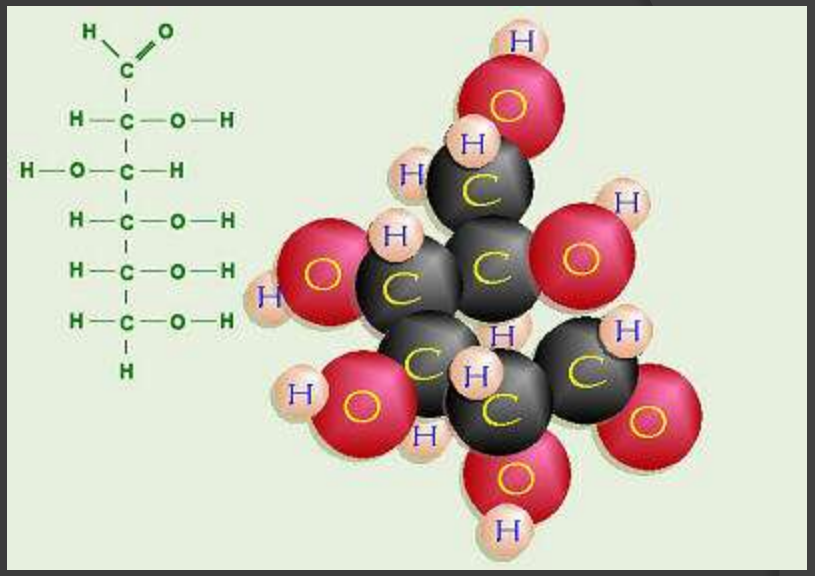


- Carbohydrates are a key source of energy and are found in most foods; especially fruits, vegetables, and grains.

Foods containing carbohydrates

Carbohydrates

- The building blocks of carbohydrates are single sugars called monosaccharides.

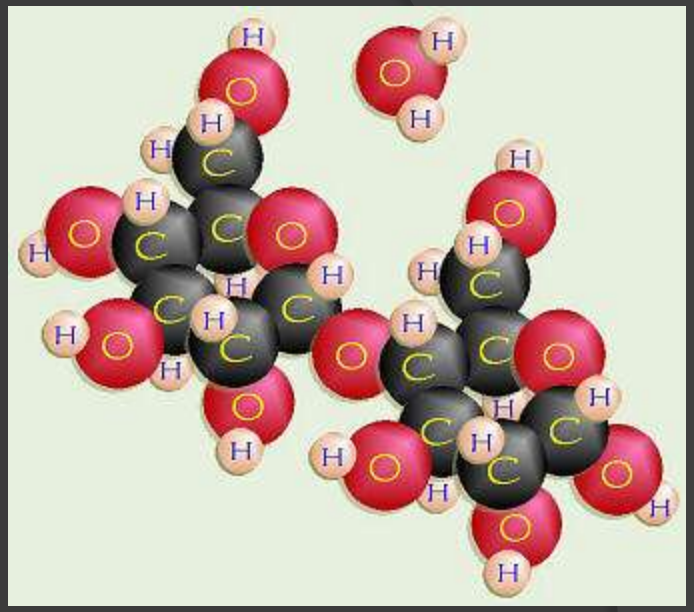


glucose

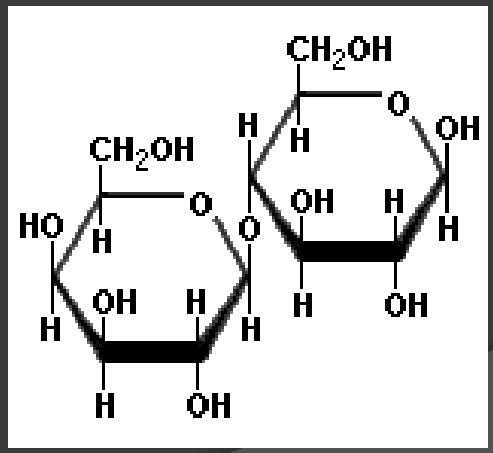
- Single sugars such as glucose and fructose are a major source of energy in cells.

Carbohydrates

- Disaccharides are double sugars formed when two monosaccharides are joined.

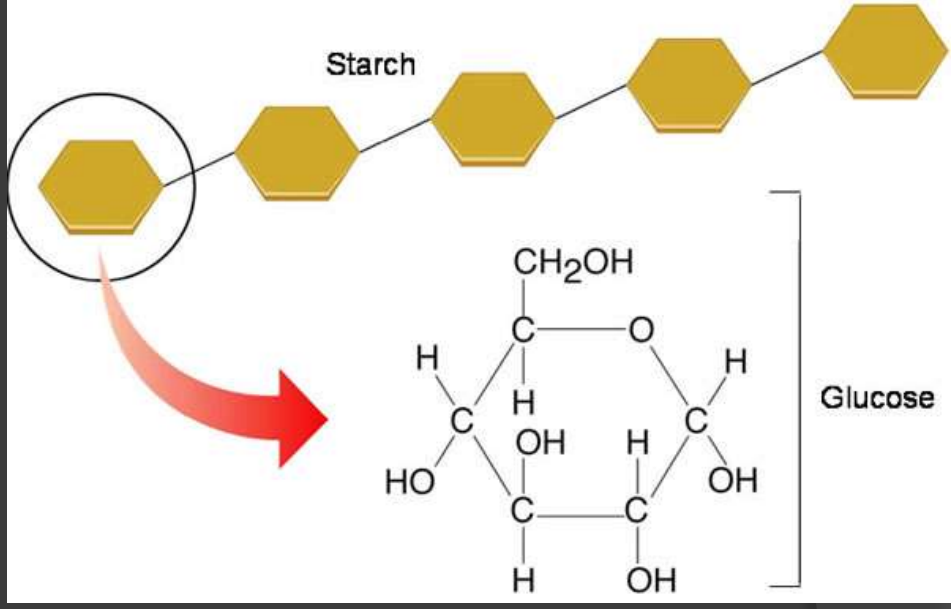


- Sucrose, a common table sugar, is formed when glucose and fructose are joined.

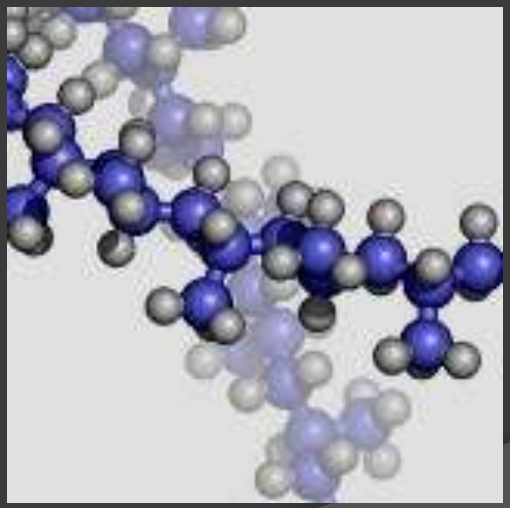


Carbohydrates

- Polysaccharides, such as starch, are chains of three or more monosaccharides.



- A polysaccharides is an example of a macromolecule, a large molecule made of many smaller molecules.

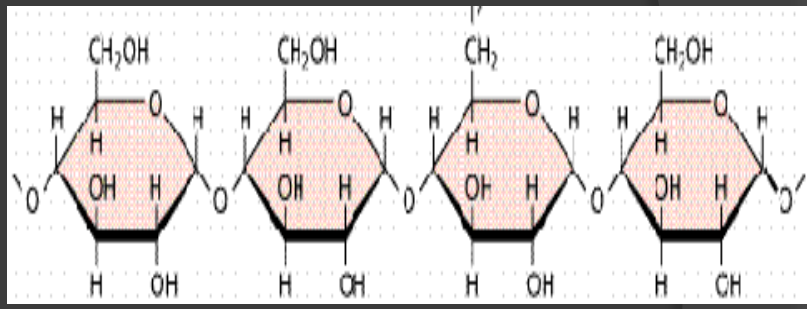


Carbohydrates

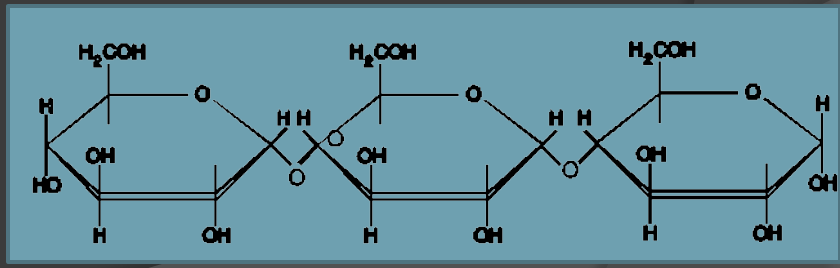
- In organisms, some polysaccharides function as storehouses of the energy contained in sugars

- Two polysaccharides that store energy in this way are starch, which is made of plants, and glycogen, which is made from animals.

- Both starch and glycogen are made of hundreds of linked glucose molecules.



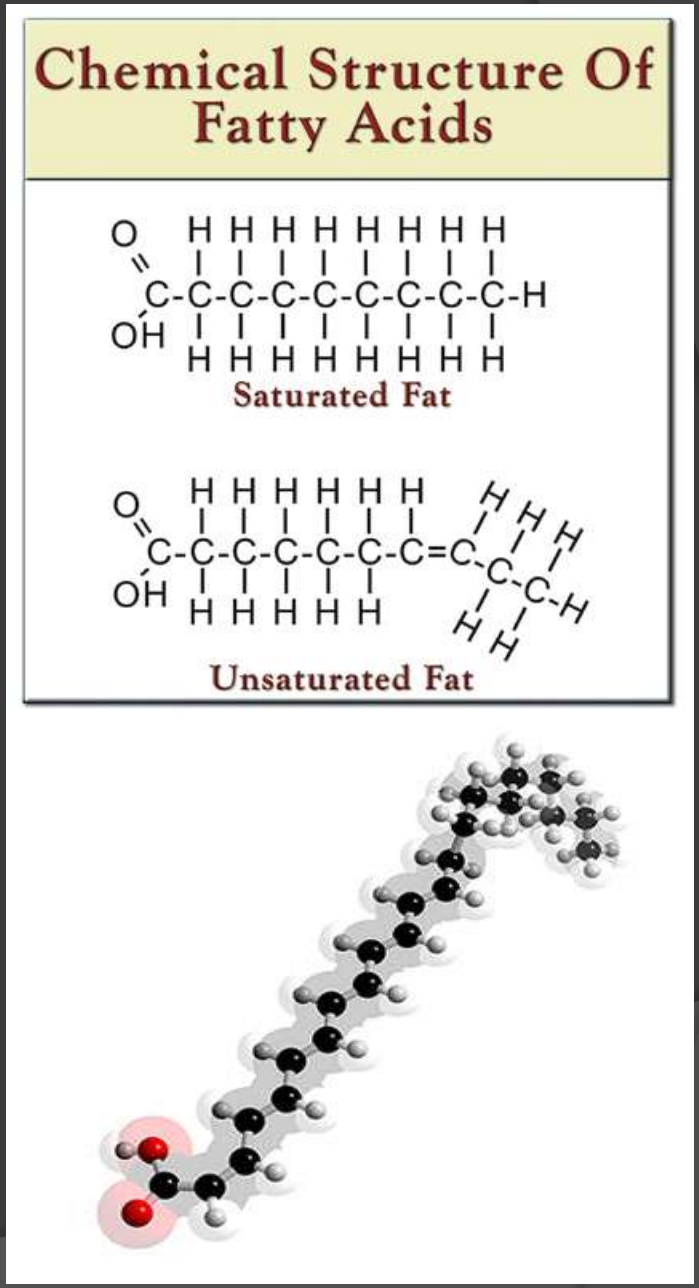
starch



glycogen

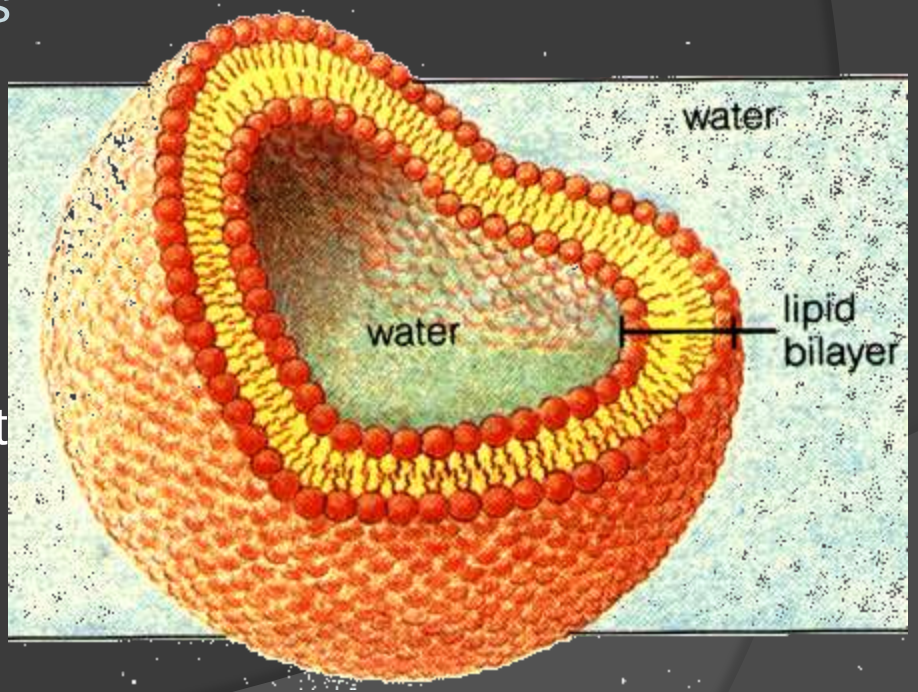
Lipids

- Lipids are nonpolar molecules that are not soluble or mostly insoluble in water. They will not dissolve into water!
- They include fats (both saturated and unsaturated), phospholipids, steroids, and waxes.
- Lipids are an important part of the structure and function of cell membranes.



Lipids

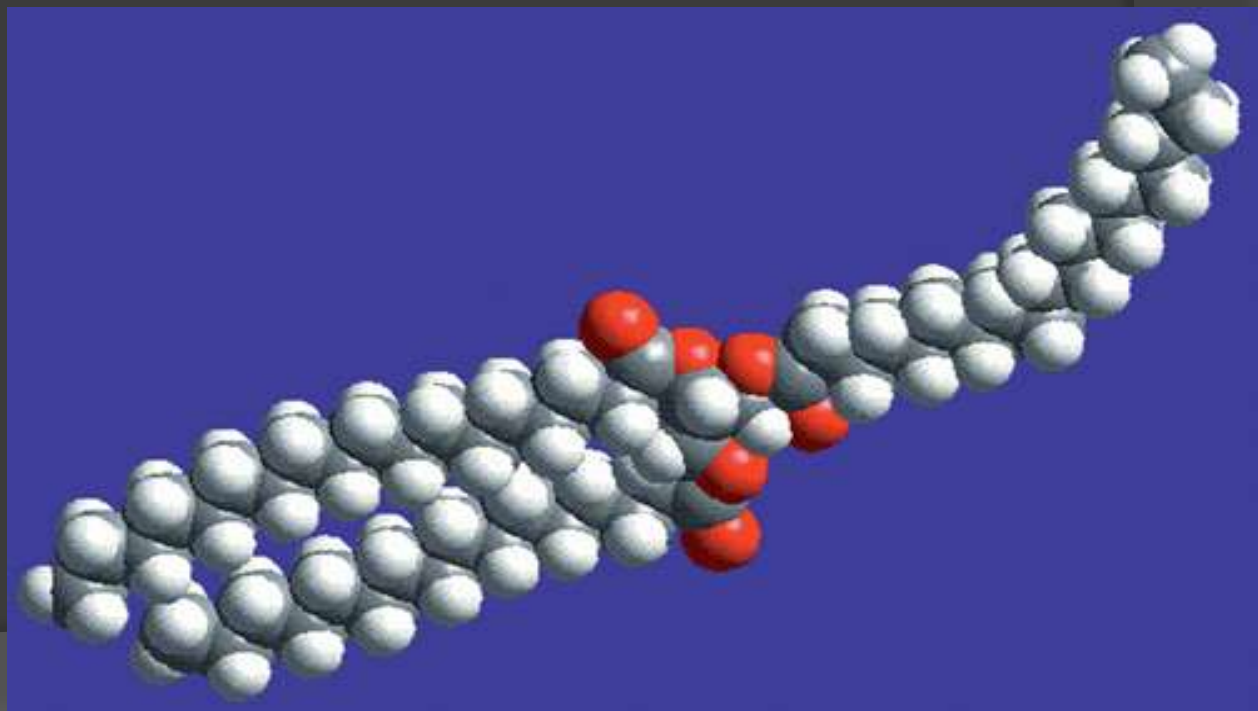
- Phospholipids make up the lipid bilayer of cell membranes.
- Steroids include cholesterol which is found in cell membranes.
- Other lipids include some light-absorbing compounds called pigments, such as the plant pigment chlorophyll.



Lipids

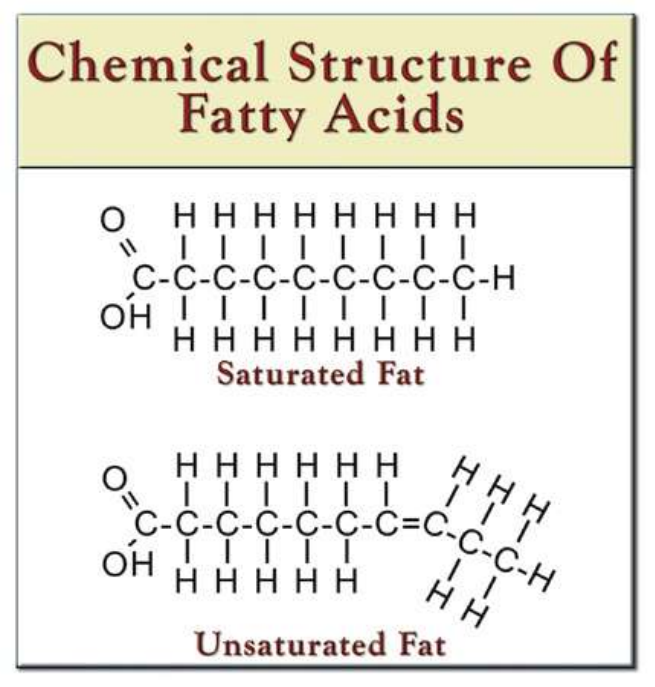
- Fats are lipids that store energy.

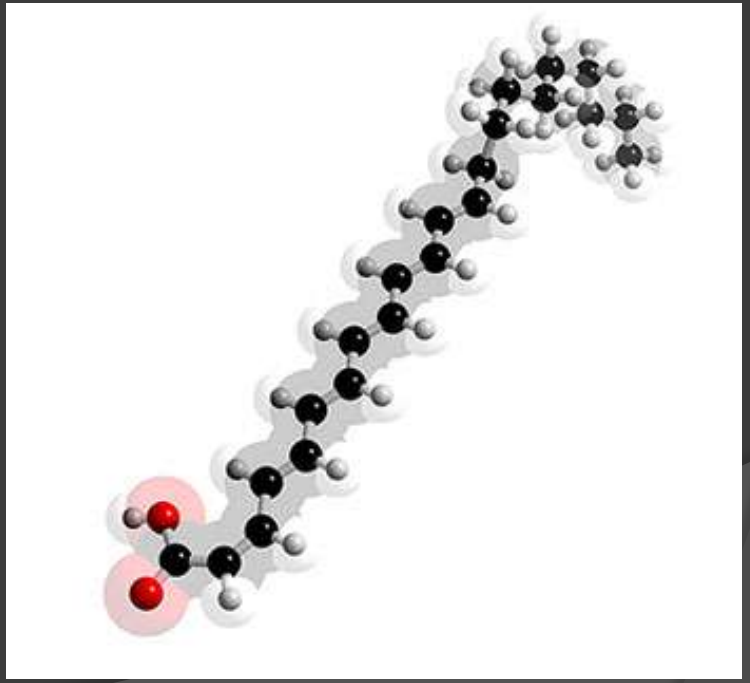
- A typical fat contains three fatty acids that are bonded to a glycerol molecule backbone.



Lipids

- A fatty acid is a long chain of carbon atoms with hydrogen atoms bonded to them.

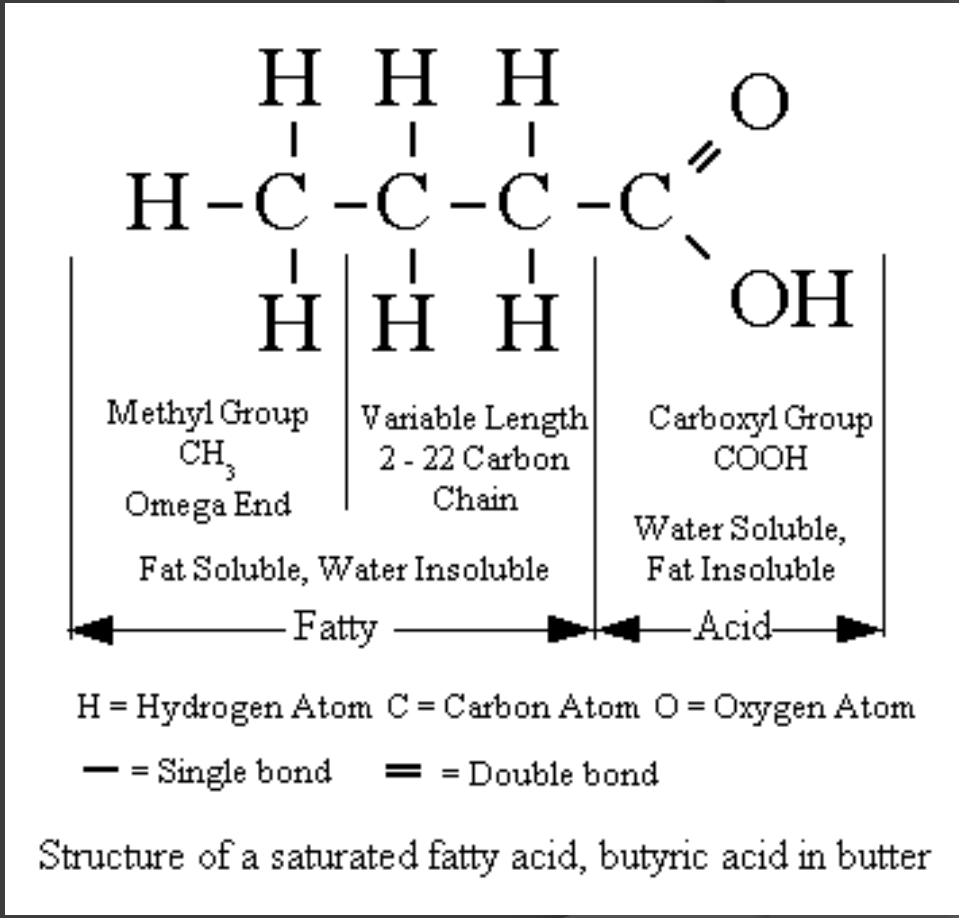




Lipids

- Because bonds between carbon and hydrogen are rich in energy, fats can store a lot of energy.

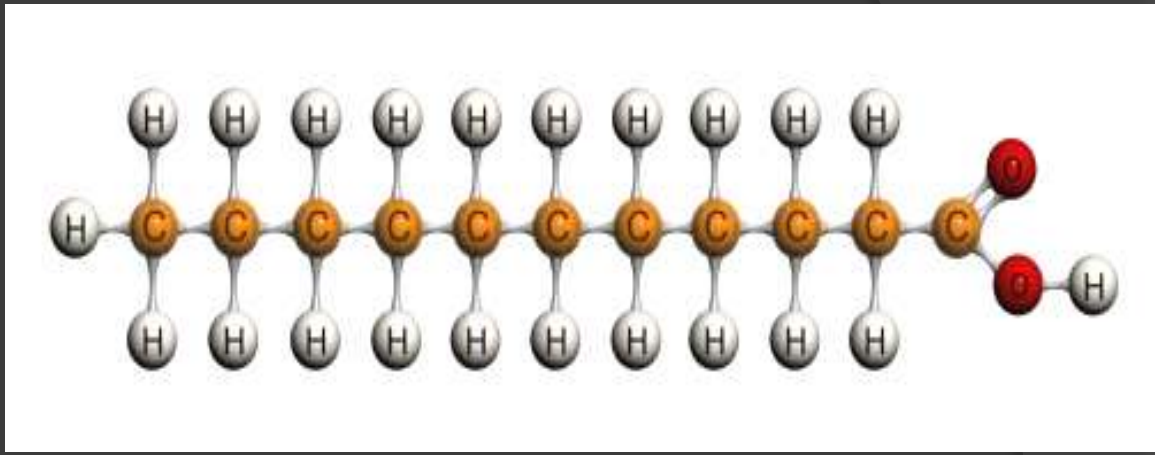
- In a saturated fatty acid, all the carbon atoms in the chain are bonded to two hydrogen atoms.



Structure of a saturated fatty acid, butyric acid in butter

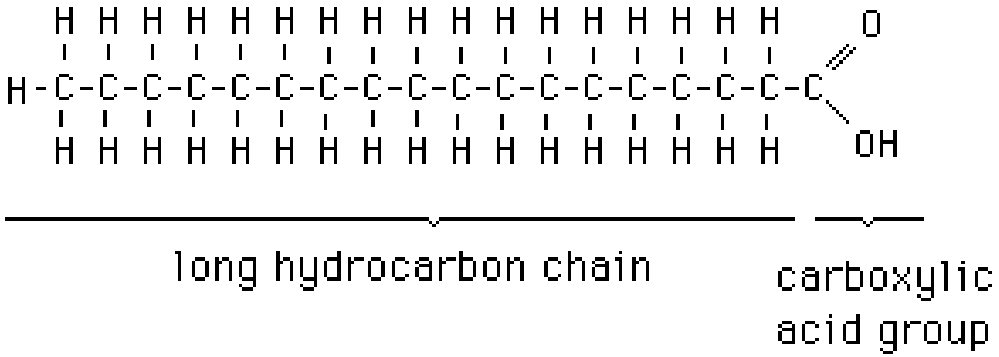
Lipids

- Most animal fats; such as those in butter, lard, and grease from cooked meats, contain primarily saturated fatty acids



Structure saturated fatty acids

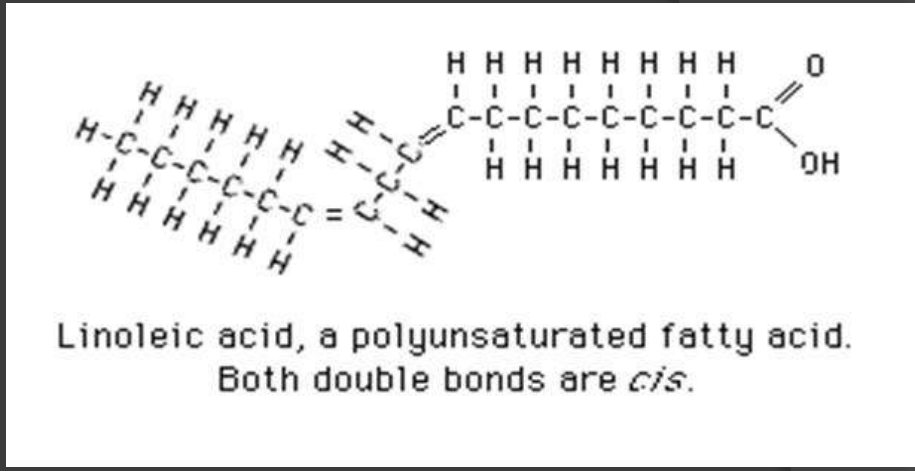
- Saturated fatty acids are generally relatively straight molecules and are generally stay solid at room temperatures.



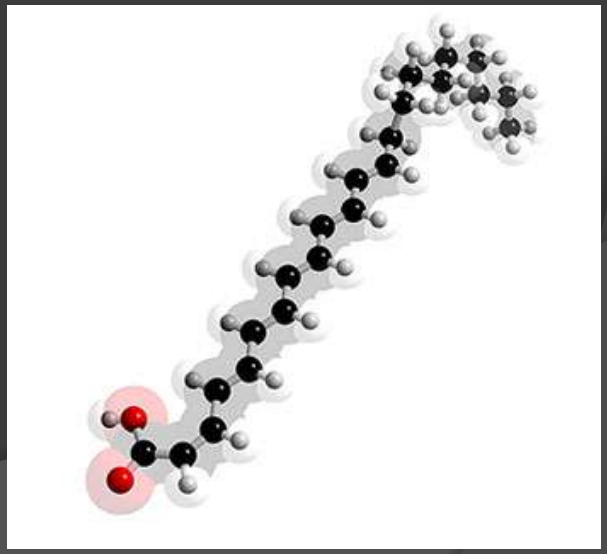
Essential features of a fatty acid

Lipids

- In an “unsaturated fatty acid” some of the carbon atoms are linked by a double covalent bond, each with only one hydrogen atom.

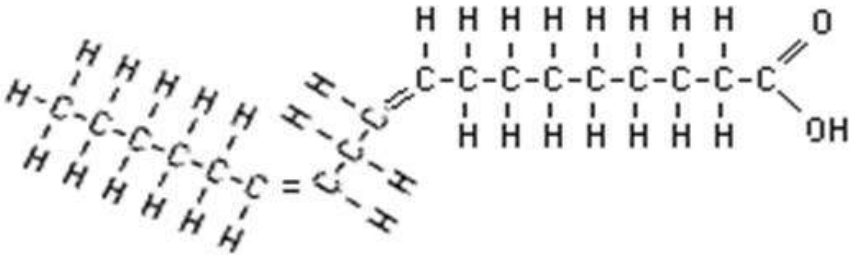


Linoleic acid, a polyunsaturated fatty acid.
Both double bonds are *cis*.



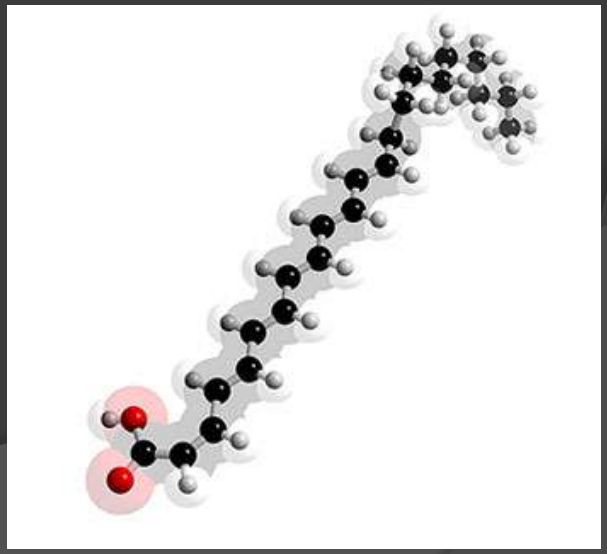
Lipids

- Most plant oils, such as olive oil, and some fish oils contain mainly unsaturated fatty acids that have been saturated artificially by the addition of hydrogen atoms.



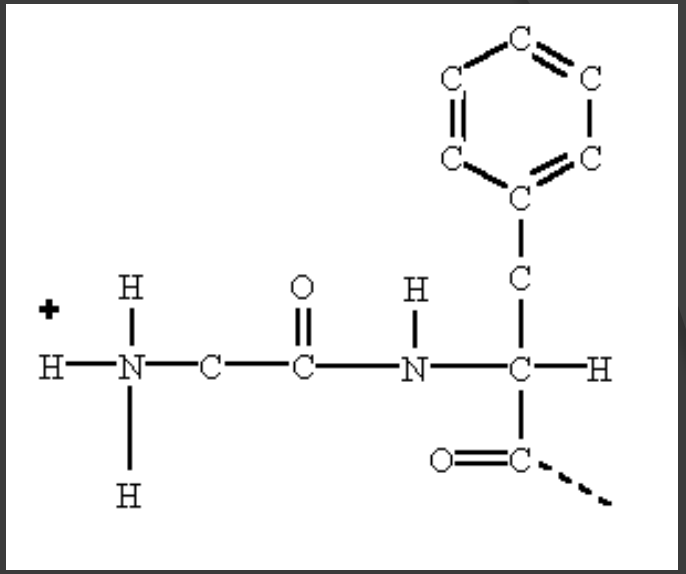
Linoleic acid, a polyunsaturated fatty acid. Both double bonds are *cis*.

- Thus, hydrogenated vegetable oils, such as those in margarine and vegetable shortening, are generally solid at room temperature.

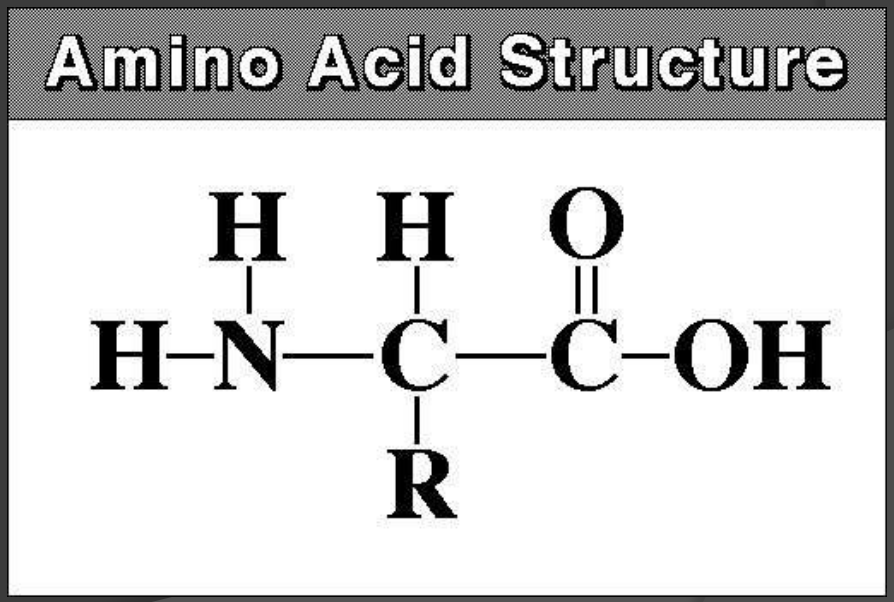


Proteins

- A protein is a large molecule formed by linked smaller molecules called amino acids

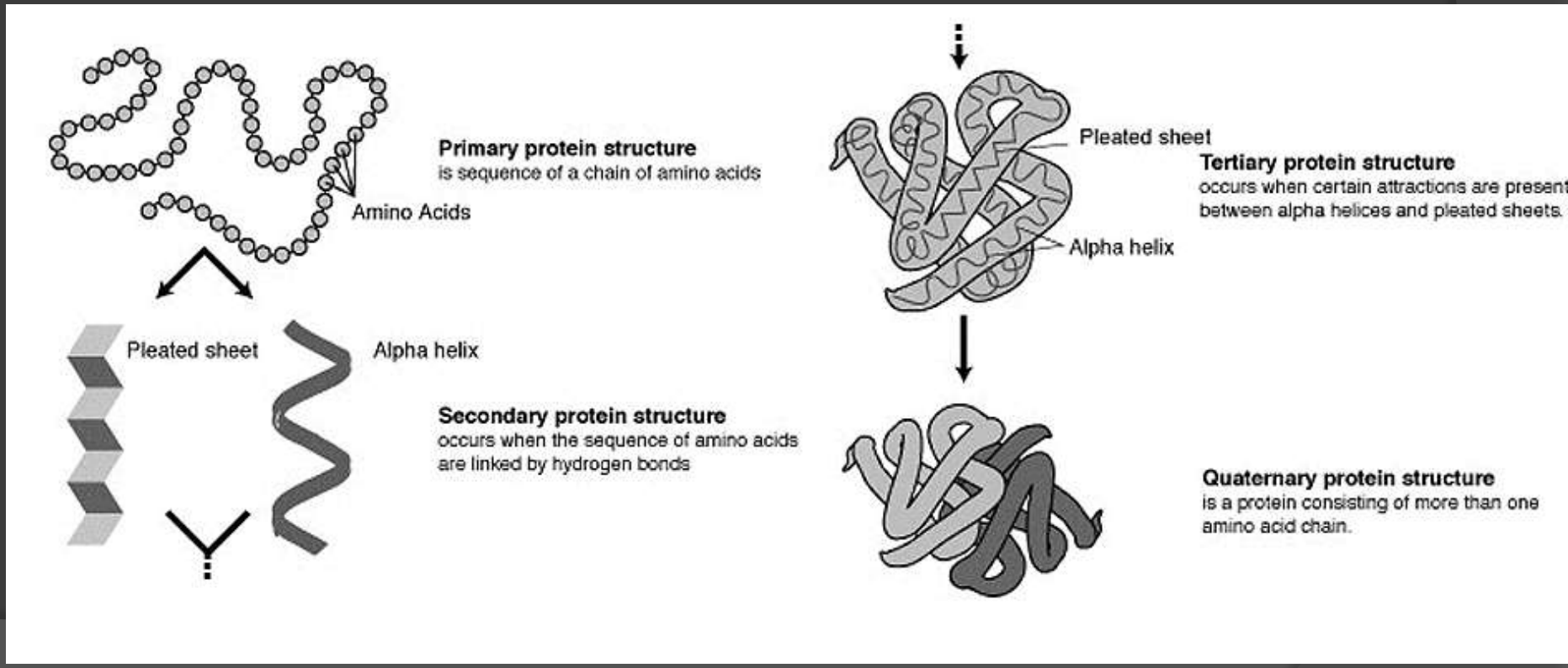


- Amino acids are the building blocks of proteins. 20 different amino acids are found in proteins.



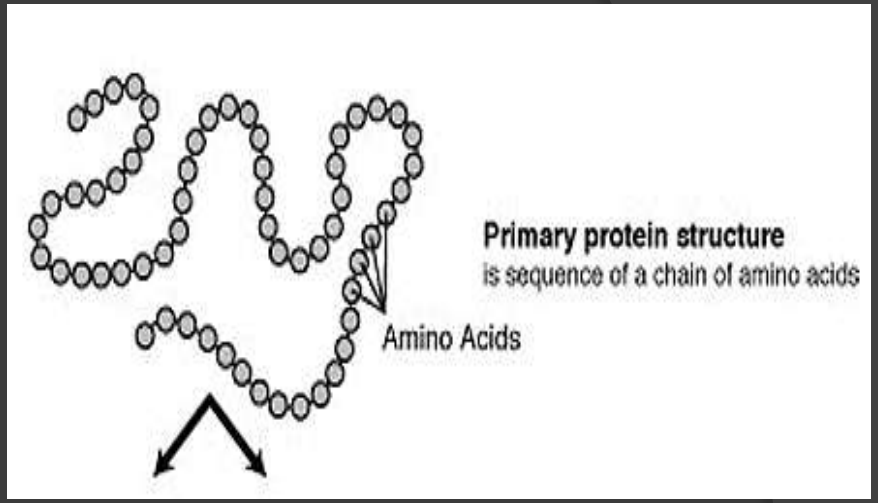
Proteins

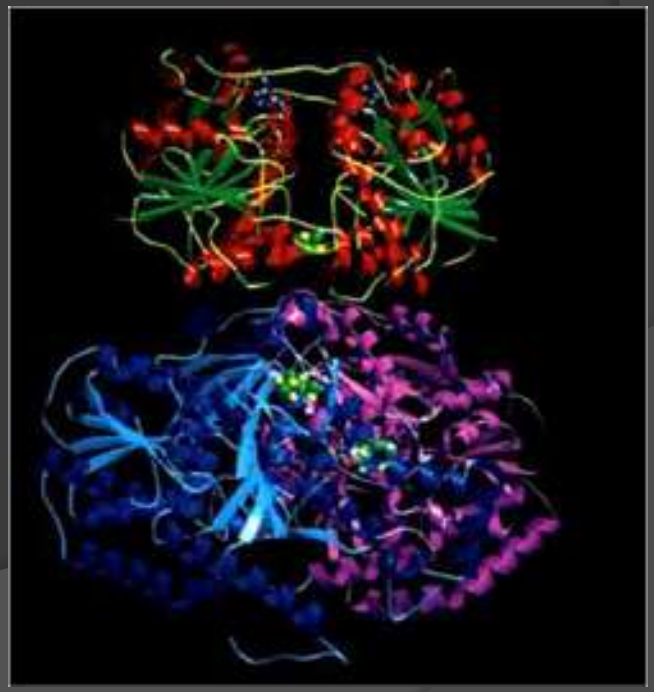
- Proteins fold into compact shapes determined in part by how the protein's amino acids interact with water and one another.



Proteins

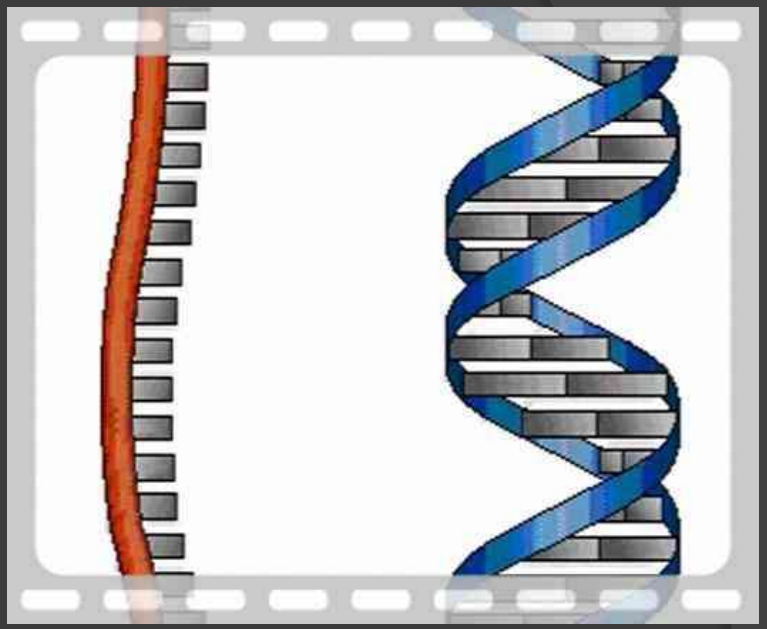
- Proteins have many functions:
  - Some proteins are enzymes and promote chemical reactions.
  - Some proteins have important structural functions.
  - Your hair and muscles contain structural proteins and so do the fibers of a blood clot.
  - Other proteins called antibodies help your body defend against infection.
  - In your blood, a protein called hemoglobin carries oxygen from your lungs to your body tissues.

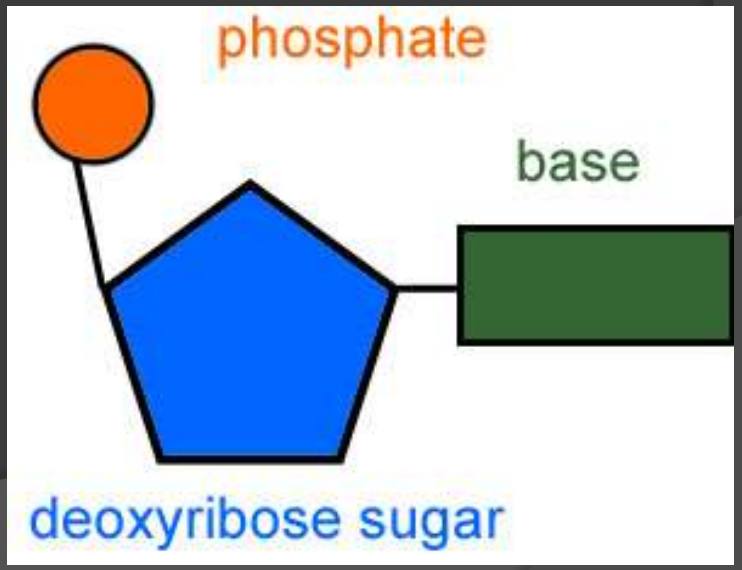




Nucleic Acids

- All of your cells contain nucleic acids.
- A nucleic acid is a long chain of smaller molecules called nucleotides.
- A nucleotide has three parts: a sugar, a base, and a phosphate group.





Nucleic Acids

- There are two types of nucleic acids
  - DNA
  - RNA

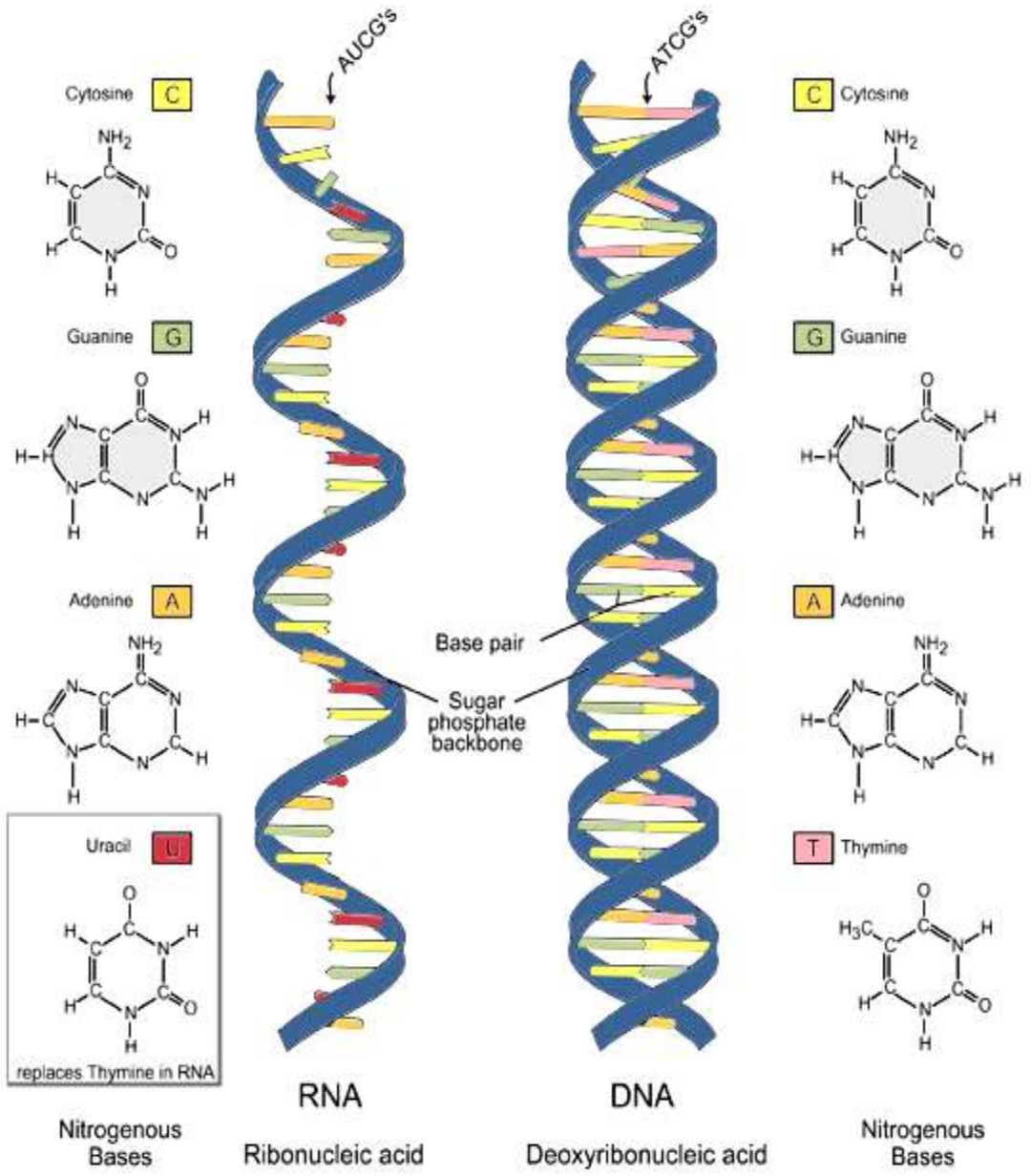
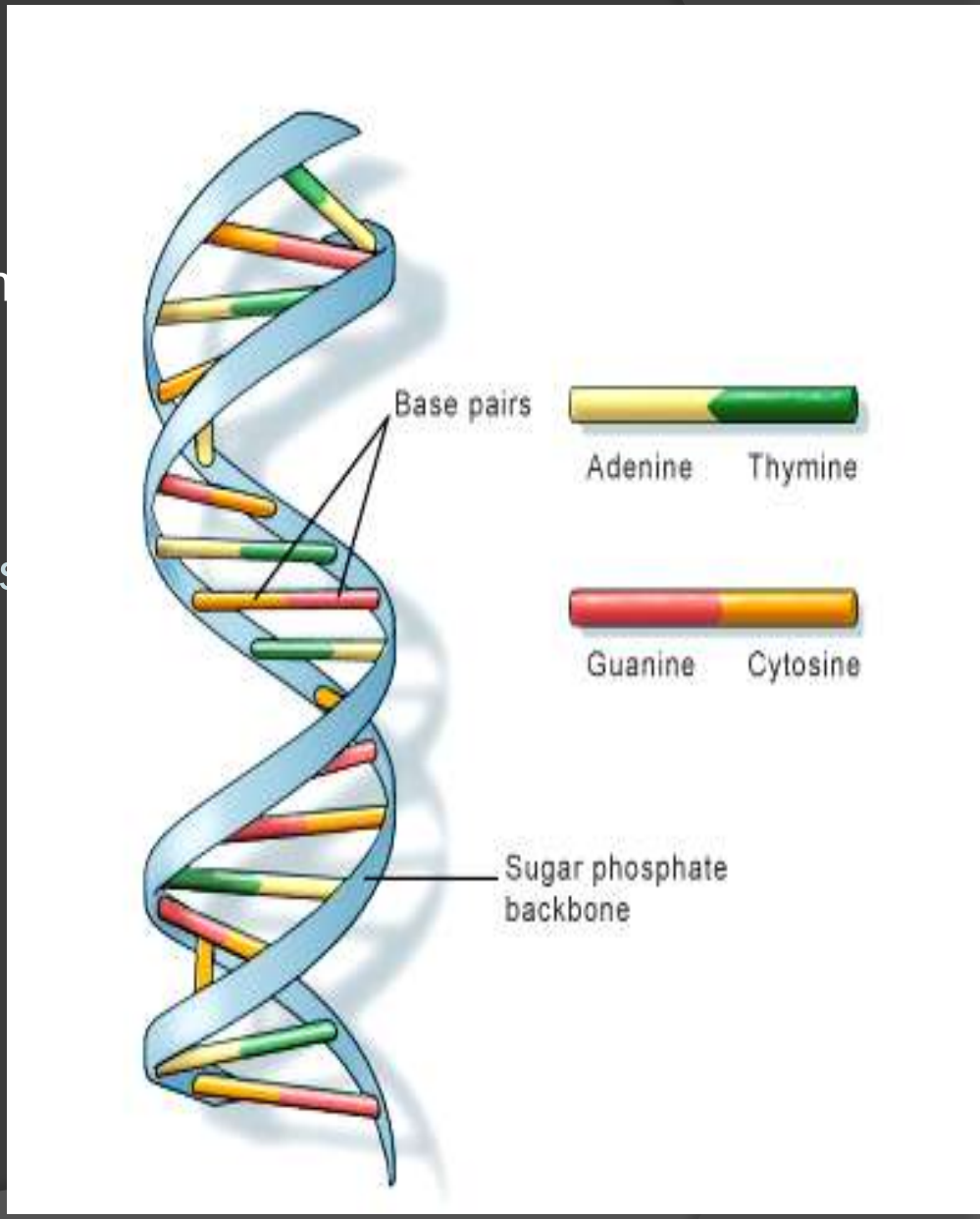


Image adapted from: National Human Genome Research Institute. Talking Glossary of Genetic Terms. Available at: www.genome.gov/Pages/Hyperion//DIR/VIP/Glossary/Illustration/rna.shtml.

DNA

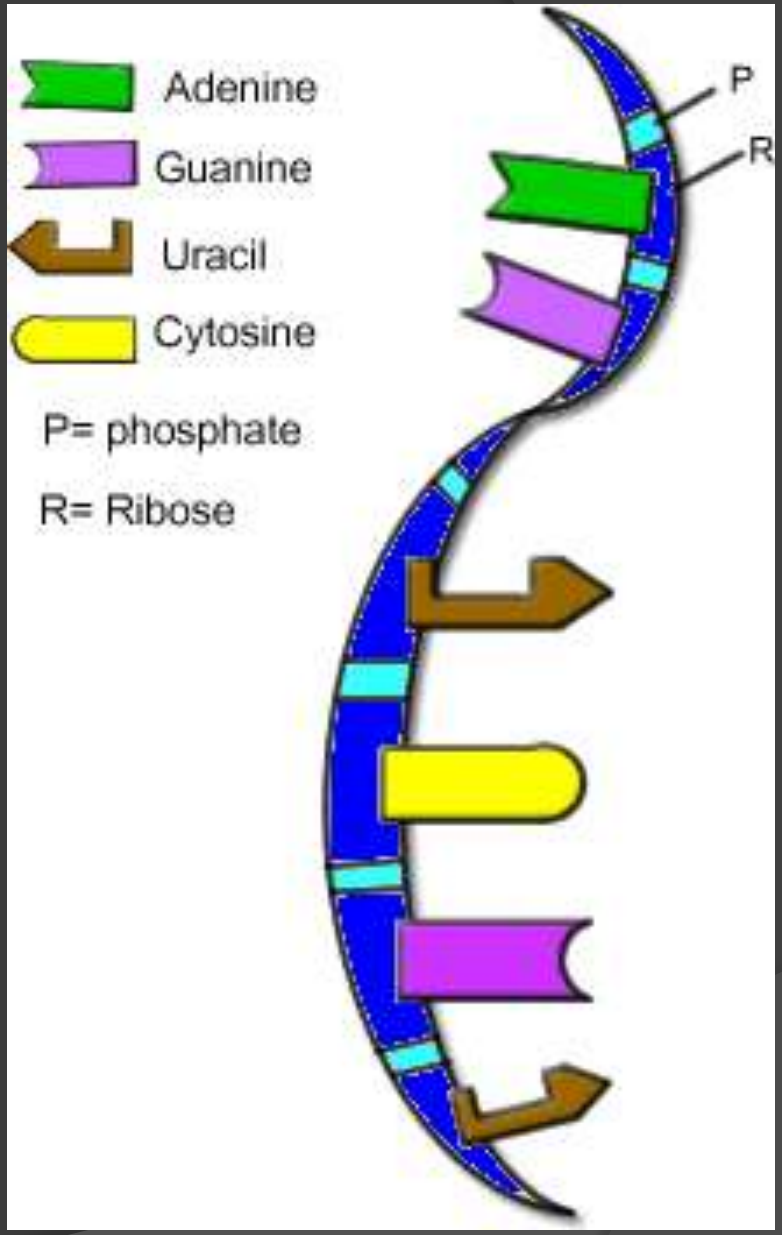
- DNA or deoxyribonucleic acid, consists of two strands of nucleotides that spiral around each other.

- Chromosomes contain long strands of DNA, which stores hereditary information.



RNA

- RNA, or ribonucleic acid, may consist of a single strand of nucleotides or of based pair nucleotides.
- RNA plays many key roles in the manufacture of proteins.
- RNA can also act as an enzyme, promoting the chemical reactions that link amino acids to form proteins.



ATP

- Another important biological molecule is ATP
- ATP, or adenosine triphosphate, is a single nucleotide with two extra energy-storing phosphate groups.
- When food energy is broken down inside cells, some of the energy in the molecules is stored temporarily in ATP.
- Cells need a steady supply of ATP to function.