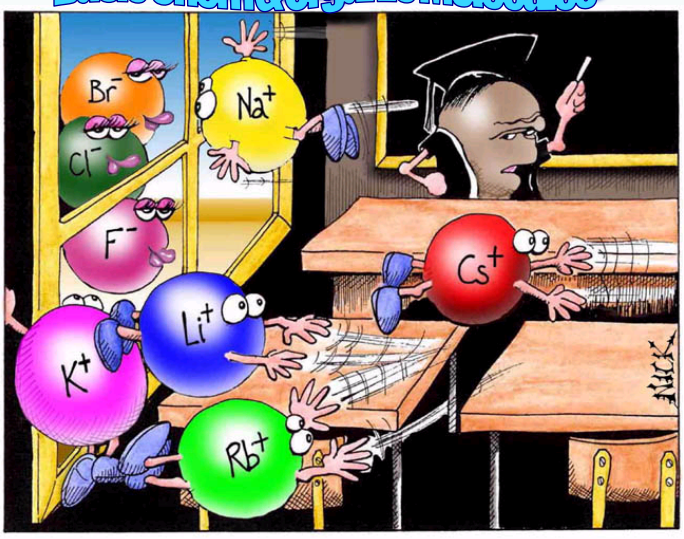
Basic Chem & Organic Molecules



"Perhaps one of you gentlemen would mind telling me just what it is outside the window that you find so attractive..?"

Chemistry of Water

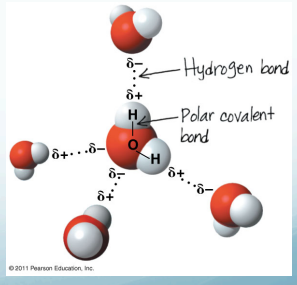
- First cells evolved in water.
  - All living things are 70-90% water
  - water is polar, so hydrogen bond to each other.
  - Water is liquid between 0 and 100 Celsius, critical for life
- Temperature of water rises and falls more slowly than other liquids.
  - Calorie is amount of heat required to raise temperature of one gram of water 1 degree celsius.

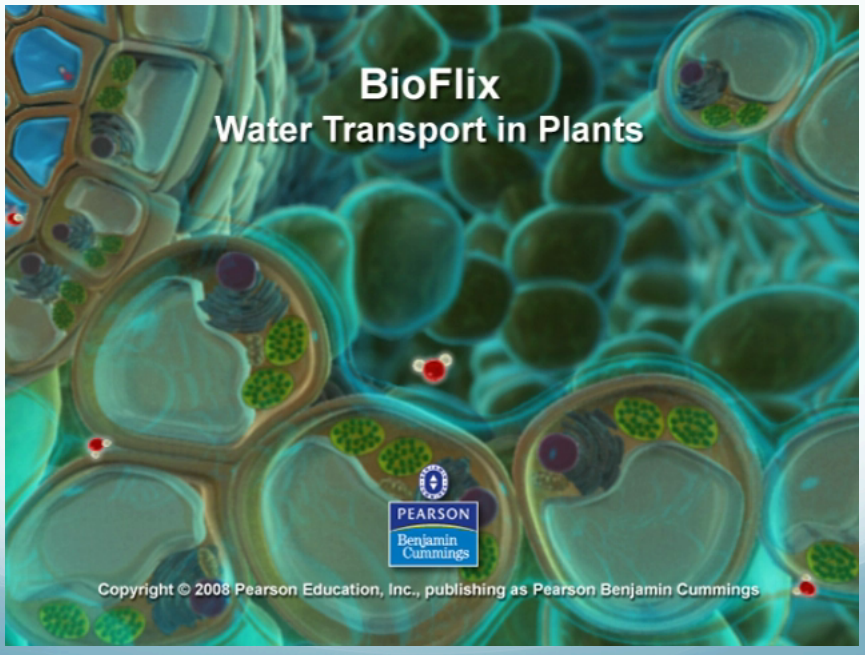
Chemistry of Water

- Water holds heat, protecting organisms from rapid temperature changes and helps maintain normal temperatures.
- Water is the universal solvent.
- Polar molecules attracted to water are **hydrophylic**.
- Nonpolar molecules that cannot attract water are **hydrophobic**.

Chemistry of Water

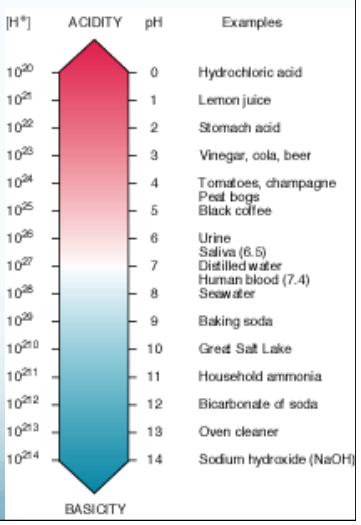
- Water molecules are cohesive and adhesive.
  - **Cohesion** allows water to flow freely without molecules separating, due to hydrogen bonding.
  - **Adhesion** is ability to adhere to polar surfaces; water has positive and negative poles.





Acids and Bases

- Water has a neutral pH.
- Acid molecules dissociate in water, releasing H ions.
- Bases are molecules that take up hydrogen ions or release hydroxide (-OH) ions.
- pH scale indicates acidity or alkalinity of a solution.
- pH ranges from 0 (acidic) to 14 (basic).
- Buffers keep pH steady and livable.

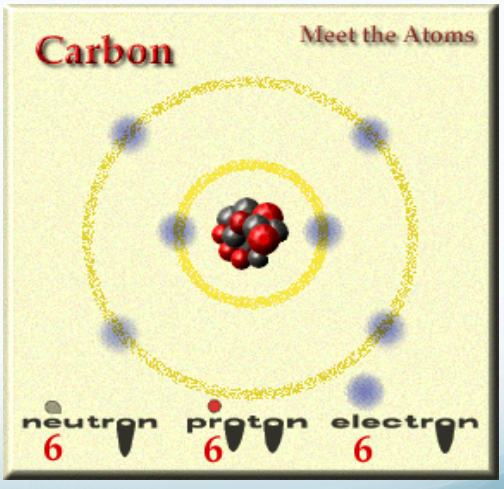


Chapter Four: Organic Molecules

- C,H,N,O are the most common elements in living things and make up 95% of your body weight.
- **Organic Molecules** -Determine the structure and function of living things and have Carbon bonded to other atoms.
- **Inorganic Molecules** -Do not contain carbon and hydrogen together but can play important roles in living things.

The important characteristics of Carbon

- Carbon (C) has four electrons in outer shell; bonds with up to four other atoms.
- The ability of C to bond to itself makes carbon chains and rings possible.



- **Functional groups** - clusters of atoms with characteristic structure and functions.
- **Isomers** -molecules that have identical molecular formulas but differ in arrangement of their atoms.
- *see chart in book!

Functional Groups	Class of Molecules	Formula	Example
Hydroxyl —OH	Alcohols	R—OH	Ethanol
Carbonyl —CHO	Aldehydes		Acetaldehyde
	Ketones		Acetone
Carboxyl —COOH	Carboxylic Acids		Acetic Acid
Amino $-NH_2$	Amines		Methylamine
Phosphate $-OPO_3^{-2}$	Organic Phosphates		3-Phosphoglyceric acid
Sulfhydryl ~~SH	Thiols	R-SH	Mercaptoethanol

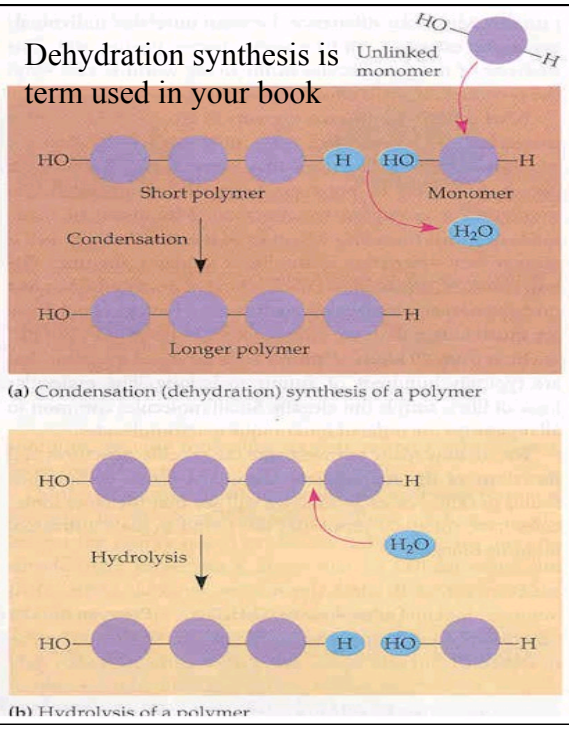
Making Biological Molecules

- **Monomers**- subunits of polymers.
- **Polymers**-large macromolecules composed of three to millions of monomer subunits.
- Polymers build by different bonding of monomers. The joining and breaking of these bonds is referred to as dehydration synthesis and hydrolysis (explained next slide).
- Enzymes carry out these 2 processes.

Dehydration synthesis- a water is removed (dehydration) and a bond is made (synthesis).

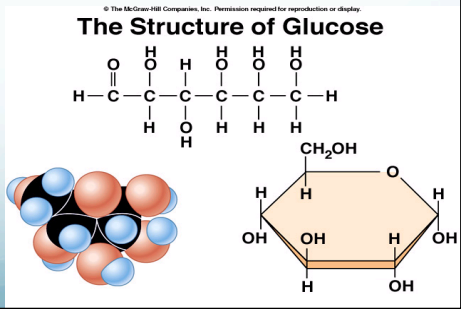
Hydrolysis reactions- break down polymers in reverse of dehydration; a hydroxyl(-OH) group from water attaches to one monomer and hydrogen (-H) attaches to the other.

Dehydration synthesis is term used in your book



Carbohydrates (simple)

- **Monosaccharides**-simple sugars with a carbon backbone (three to seven carbon atoms).
- Ex: Glucose, Ribose and Deoxyribose
- **Disaccharides**-two monosaccharides joined by condensation.
  - Sucrose
    Glucose + fructose
- **Function:** Provide Energy
- **Bonds:** Glycosidic Bonds



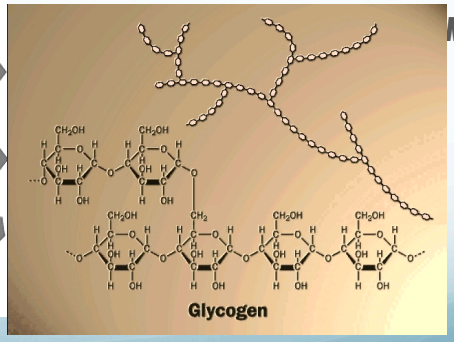
Complex Carbohydrates – chains of sugars

- **Polysaccharides**-chains of glucose molecules or modified glucose molecules
- Examples: chitin- in fungi & shellfish
  - **Starch**-a straight chain of glucose molecules with few side branches.

Starch

Cellulose

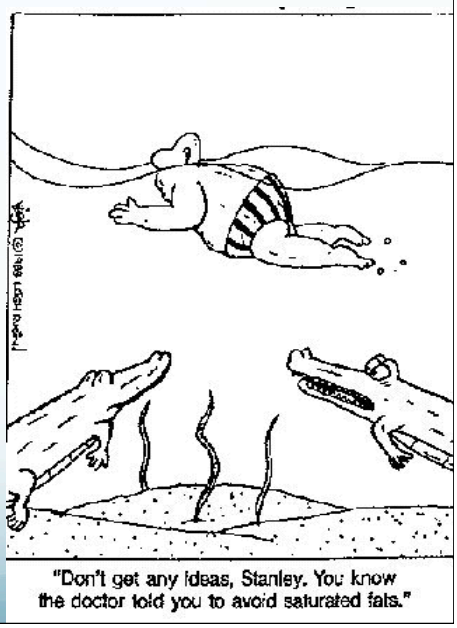
Glycogen



with

Chapter Five: Lipids

- Lipids include fats, oils, waxes, phospholipids, and steroids.
- Many are insoluble in water because they lack polar groups.
- Lipids are **not** a polymer



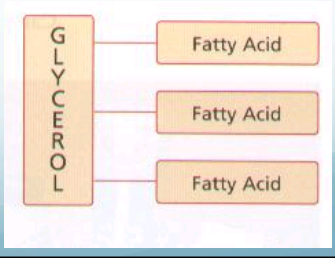
Lipids

- **Sub Units:**

Glycerol-a water-soluble compound with three hydroxyl groups.

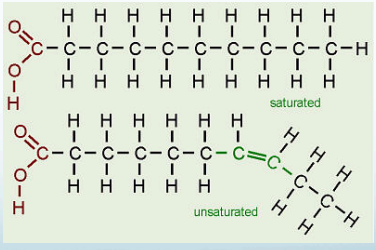
Fatty acid -a long hydrocarbon chain with a carboxyl (acid) group at one end

- Because the carboxyl group is a polar group, fatty acids are soluble in water.
- **FUNCTIONS:**



Lipids

- **Saturated fatty acids** -no double bonds between their carbon atoms (each carbon is SATURATED with hydrogens).
- **Unsaturated fatty acids** -double bonds in the carbon chain where there are less than two hydrogens per carbon atom.



Examples of Lipids

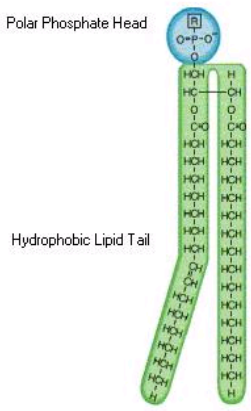
- **Triglycerides**-glycerol joined to three fatty acids by condensation synthesis.
- **Fats** -triglycerides containing saturated fatty acids.
- **Oils**-triglycerides with unsaturated fatty acids

Lipid examples cont'

- **Waxes**-a long-chain fatty acid bonded to a long-chain alcohol.
- They are solid at room temperature.
- Waxes form a protective covering that retards water loss in plants, maintain animal skin and fur

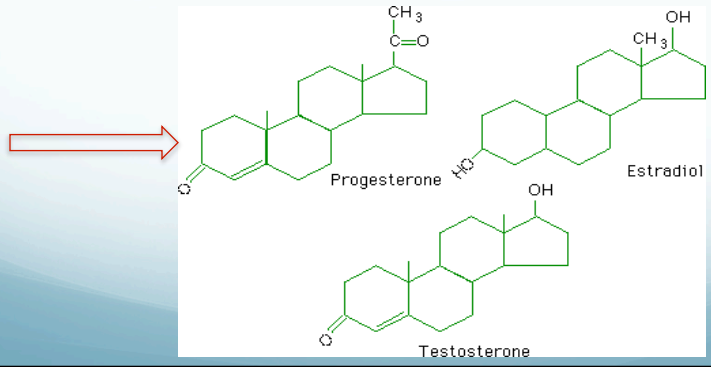
Lipid examples cont'

- **Phospholipids**- similar to fats except one fatty acid is replaced by a phosphate group or a group with both phosphate and nitrogen.
- Phosphate group= polar head.
- Hydrocarbon chains = nonpolar tails.
- Phospholipids can arrange themselves in a double layer, the phospholipid bilayer, which makes up the plasma membrane.



Lipid examples cont'

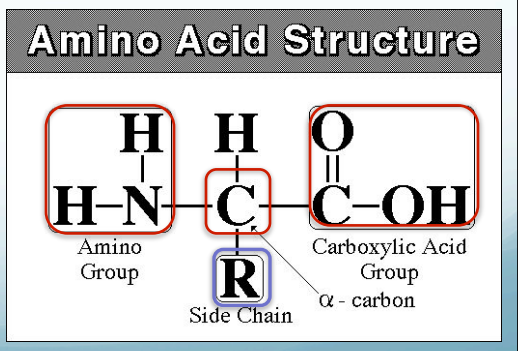
- **Steroids**-differ from fats; they have a backbone of four fused carbon rings
- The function of steroids differs due primarily to the different functional groups that are attached.



Proteins

- **Protein Functions:**
  - support, enzymes, transport, defense, hormones, and motion.
- **Momomer- Amino Acids make up proteins.**
- **Amino Acids all contain a central carbon, carboxyl group (-COOH) and an amino group (-NH), and an R group.**
- **There are 20 different Amino Acids commonly found in cells .**

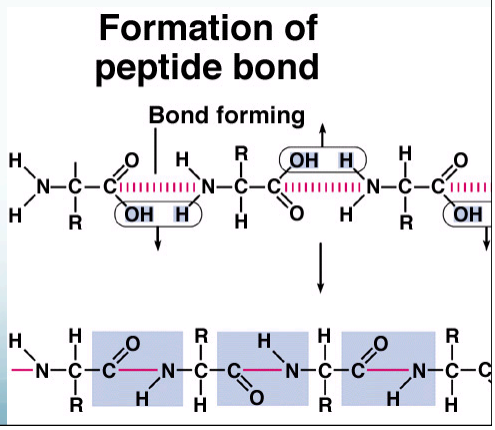
-Properties of a.a. are determined by R group



- **Bonds between amino acids = Peptide bond -a covalent bond between amino acids.**
- **Atoms of a peptide bond share electrons unevenly.**
- **Peptide-two or more amino acids bonded together.**

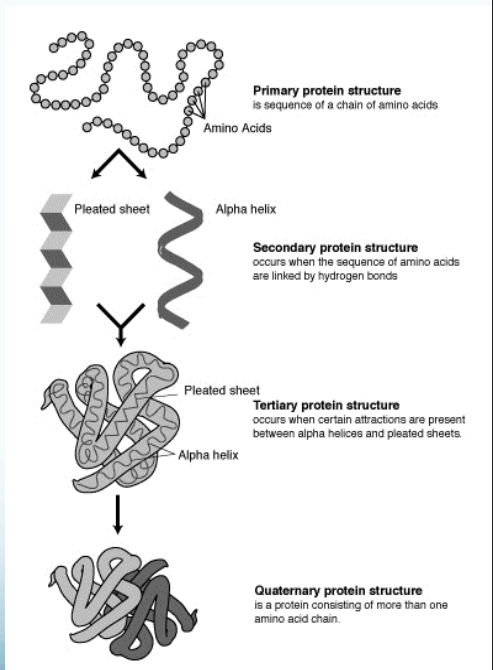
- **Polypeptides- chains of many amino acids joined by peptide bonds.**

•(synonym for PROTEIN)



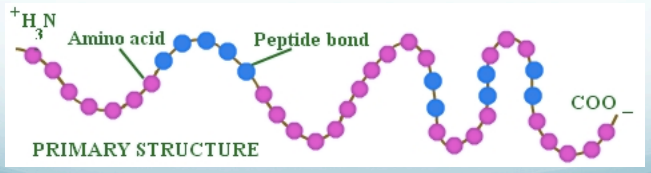
Proteins

- The shape of a protein determines it's function in an organism.
- Levels of protein structure
  - Primary
  - Secondary
  - Tertiary
  - Quaternary



Protein Structure

- **Primary Structure** -the sequence of amino acids joined by peptide bonds.
- Since amino acids differ by R group, proteins differ by a particular sequence of the R groups.



Protein Structure

- **Secondary Structure**- the particular shape of a polypeptide.
  - **Alpha helix**-covalently bonded by disulfide linkages between two cysteine amino acids.
  - **Beta sheet**-these pleated polypeptides turn back upon themselves.

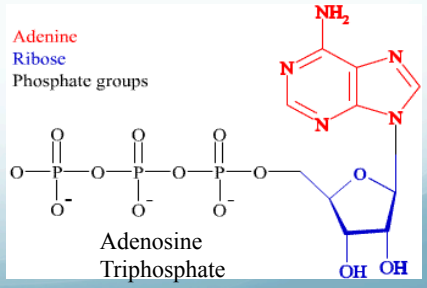
  *remember hydrogen bonding and disulfide bonds
- **Tertiary Structure**-proteins of the secondary structure are folded.

Protein Structure

- **Quaternary structure**- two or more polypeptides combine.
- Most enzymes have quaternary structure.
- **Denaturation** = the changing of the polypeptides shape,
  - can occur due to temperature and pH changes.
- Once a protein loses its normal shape, it cannot perform its usual function.

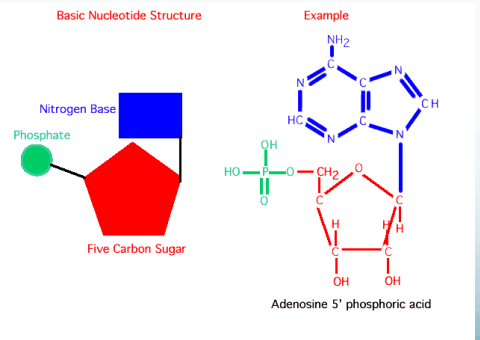
Nucleic Acids

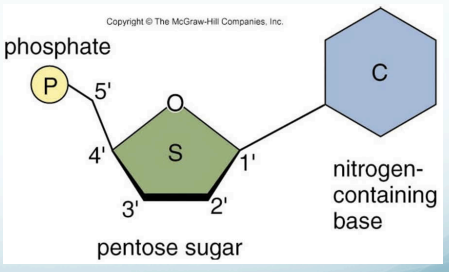
- Nucleic Acid Functions: Store and transmit
  - Examples: Coenzymes, ATP, DNA, and RNA.
- Momomer = Nucleotides
- Coenzymes-molecules which facilitate enzymatic reactions.



Nucleic Acids

- Parts of a nucleotide:
- Nitrogen Base
- Pentose Sugar- Ribose or deoxyribose
- Phosphate group

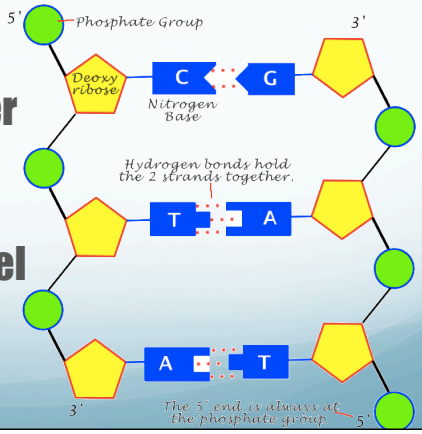




Directionality of DNA

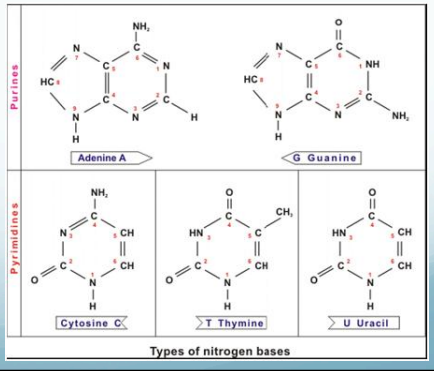
- The Polymer is bound together creating a sugar and phosphate backbone.
- Each strand of DNA is created in one direction
- Sides are held together by hydrogen bonds
- Strands run antiparallel

3' -5'



Nucleic Acids

- **Complementary base pairing**- two strands of DNA are held together by hydrogen bonds between purine and pyrimidine bases.
- The number of purine bases always equals the number of pyrimidine bases.

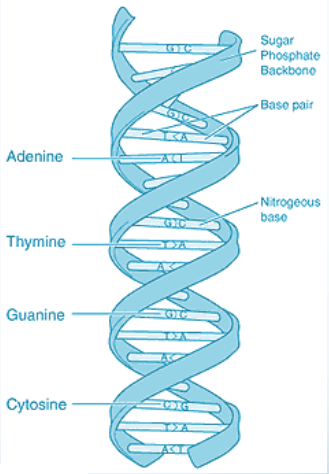


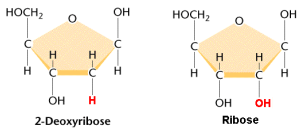
Nucleic Acids

- **ATP (Adenosine Triphosphate)-a nucleotide of adenosine composed of ribose and adenine.**
- **It derives its name from three phosphates attached to the five-carbon portion of the molecule.**
- **ATP is used in cells to supply energy for energy-requiring processes.**

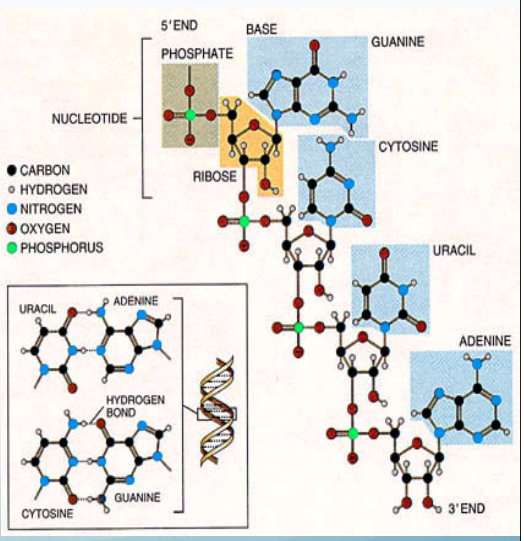
Nucleic Acids

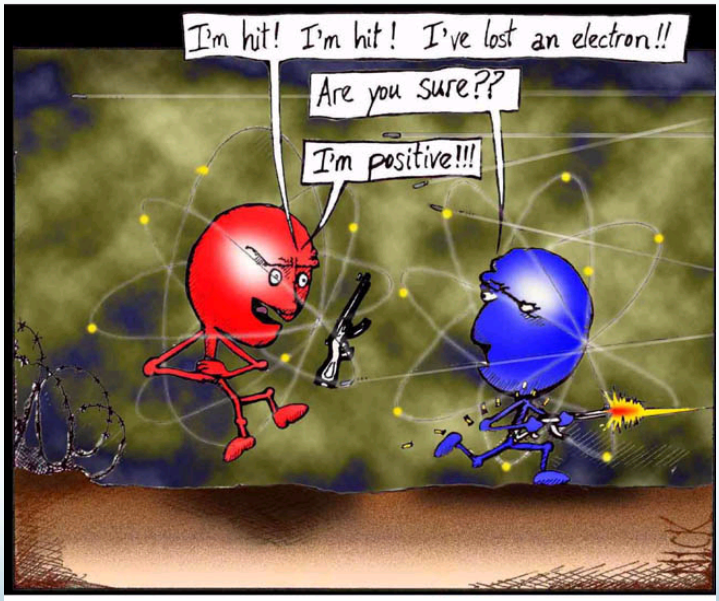
- **Differences between DNA and RNA**
- **DNA:**
  - **Contains deoxyribose sugar**
  - **Contains the base thymine**
  - **Double-stranded with complementary base pairing**
  - **Forms a double helix**





- **Differences between DNA and RNA:**
- **RNA**
  - **Contains Ribose**
  - **Contains the base uracil instead of thymine**
  - **single stranded**
  - **does not form helices**





Another casualty in the War of the Atoms.