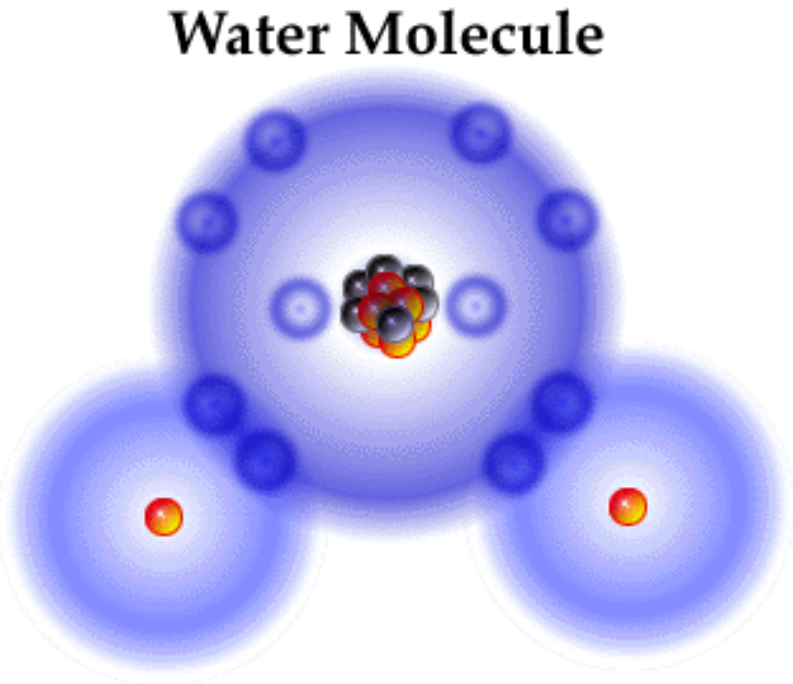
Biochemistry: Water and Organic Compounds

Modern Biology

Chapter 3

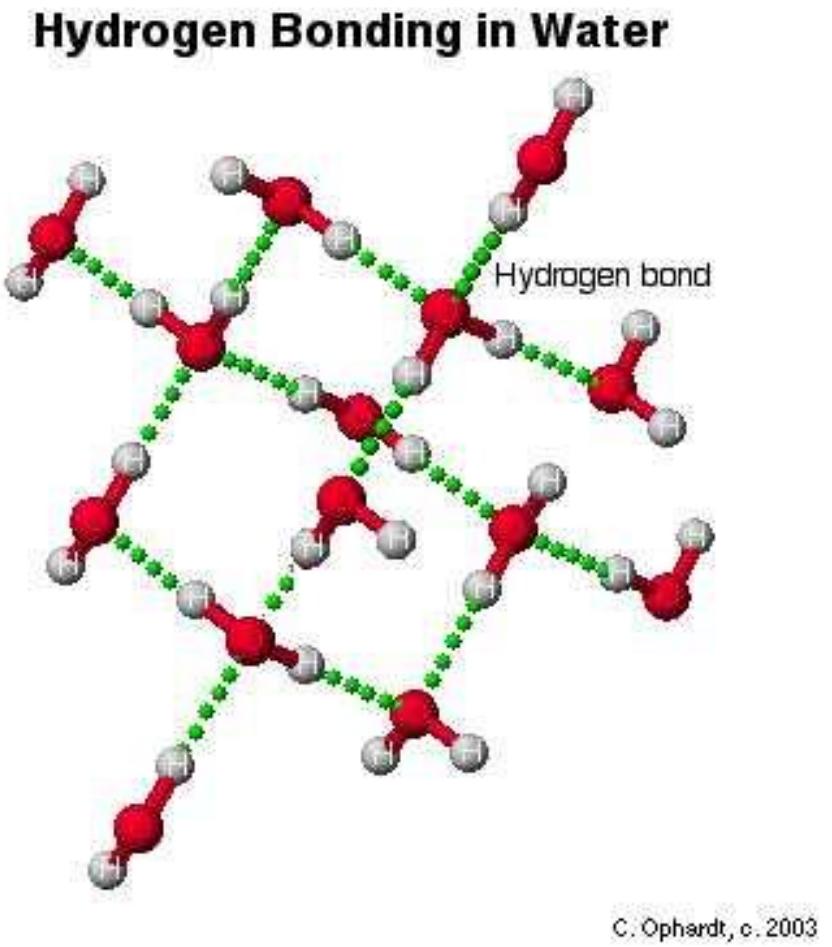
Water



- Formed by covalent bonds (atoms share electrons)
  - Atoms don't share equally→water is POLAR
    - Oxygen end is slightly negative (O is electron hog)
    - Hydrogen ends are slightly positive
    - POLARITY is why water is a good solvent
      - Dissolves lots of different compounds

Hydrogen Bonding in Water

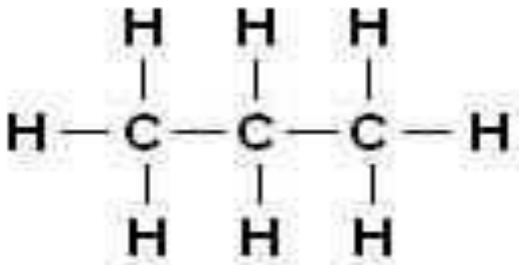
- Polarity causes water to be attracted to each other
- H-bond: attraction that holds water molecules together
- Responsible for cohesion (sticking together) that produces surface tension
  - Cohesion and adhesion (attraction between unlike substances) responsible for capillarity (water moves up through stems)
- Water has to gain/lose lots of energy to change temp.
  - This energy initially goes into breaking H-bonds
  - This is why a pot of water on the stove isn't hot right away



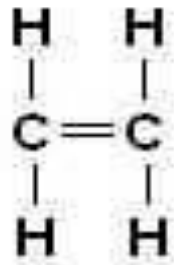
Carbon Compounds

- Organic compounds
  - Contain carbon atoms covalently bonded to each other and to other elements (H, O, N, usually)
- Carbon has 4 electrons in its outer E-level
  - Needs 8 to be stable…shares it's electrons with other atoms
- Able to form straight chains, branched chains, or rings

Examples of Carbon bonds

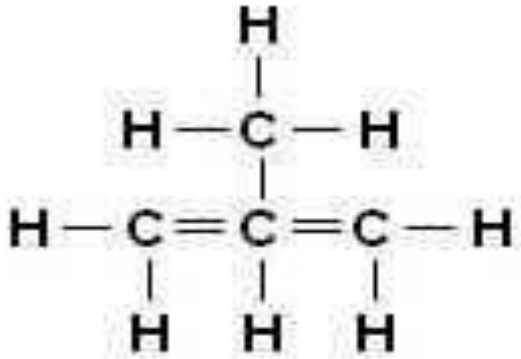


Propane



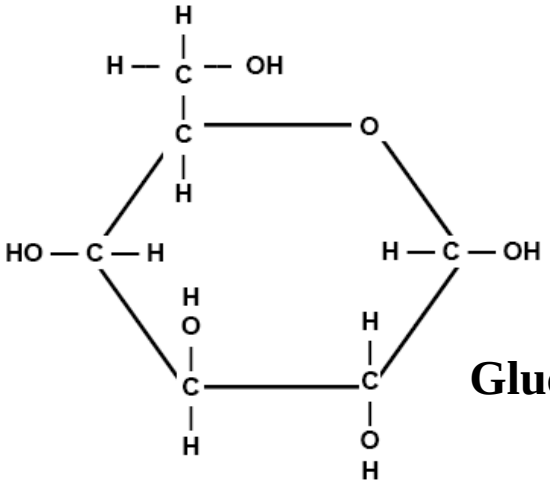
Ethylene

(plant hormone-ripens fruit)



2-methylpropane

(used in refrigeration and petrochemical industry)



Glucose

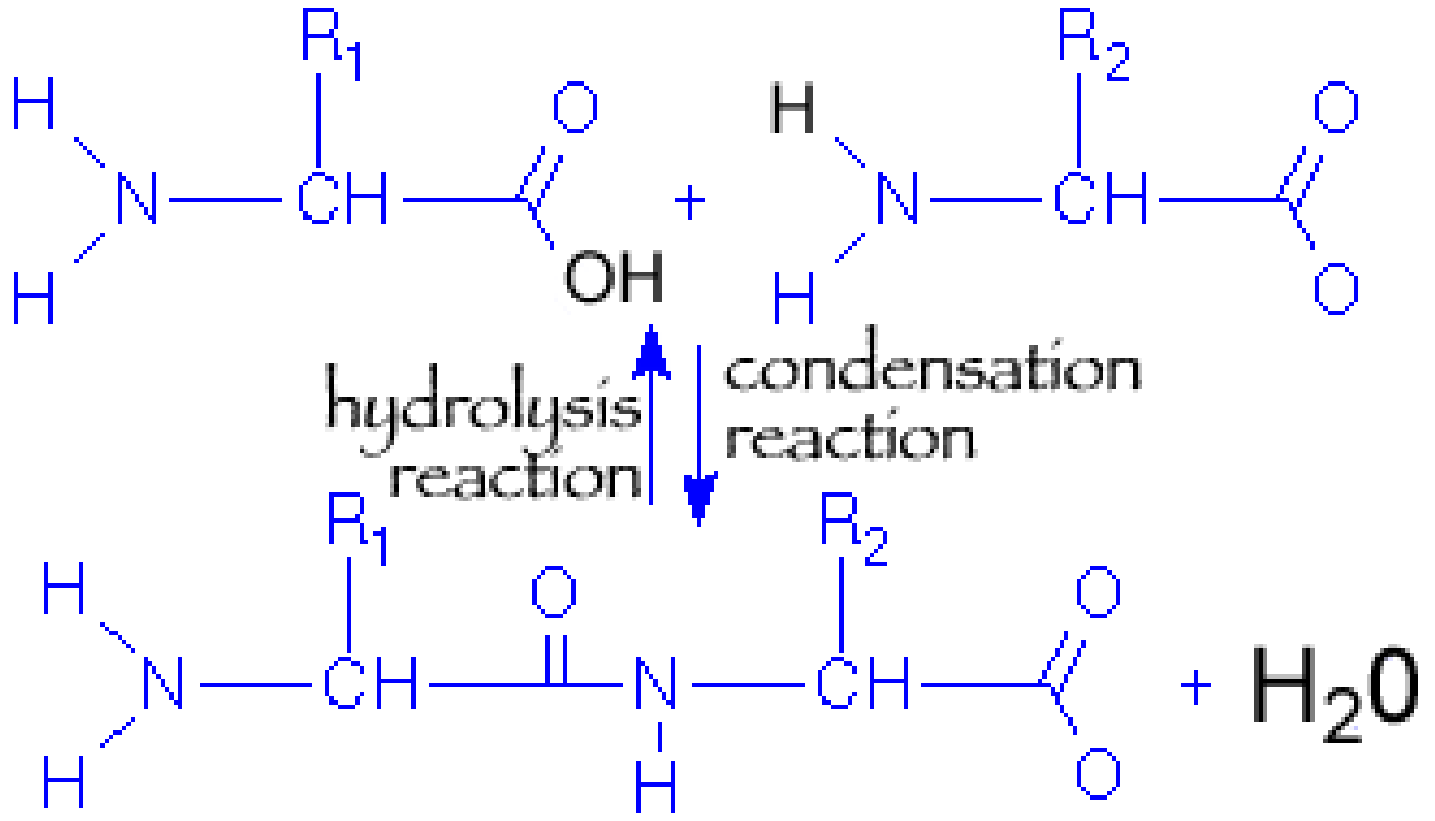
Functional Groups

- Cluster of atoms that influence the properties of the molecule they are attached to.
  - Ex: -OH (hydroxl group)
    - Alcohols contain hydroxyl groups
    - Makes alcohols polar
      - Allows them to dissolve in water, have H-bonds like water

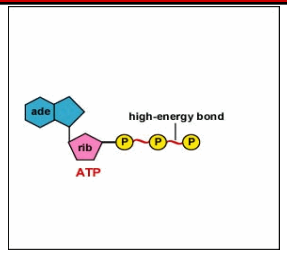
Carbon Molecules

- Monomers
  - Small and simple; single building block
- Polymers
  - Made of repeated, linked monomers
- Macromolecule
  - Made of linked polymers
- Condensation Rxn
  - Links monomers together
  - AKA dehydration synthesis
  - Forms water
- Hydrolysis Rxn
  - Uses water to break polymers apart

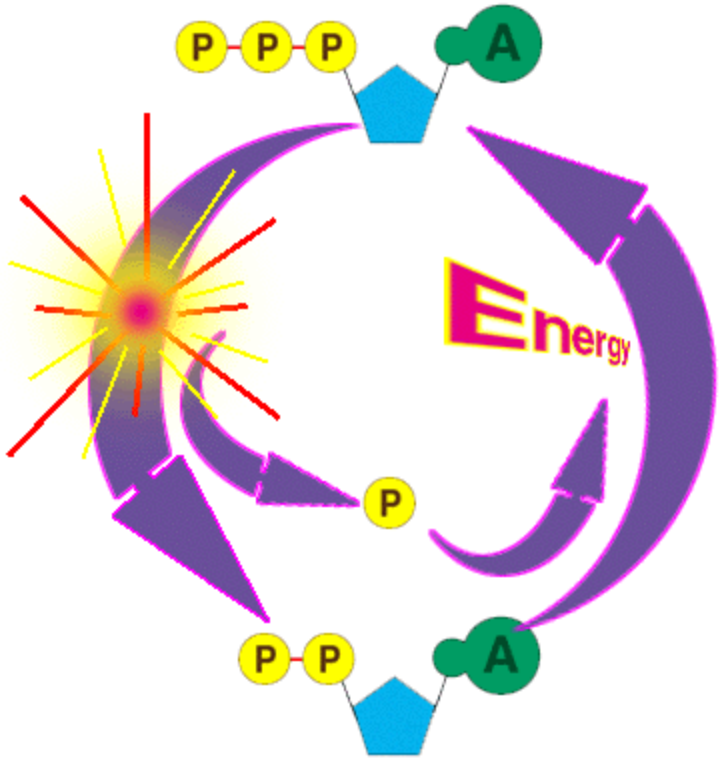
Condensation/Hydrolysis



ATP

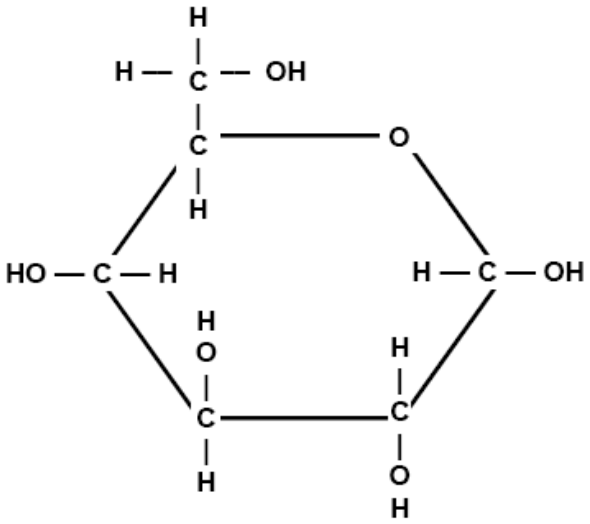


- Adenosine Triphosphate
  - Energy molecule used by the body
  - Broken down into ADP (releases P)
  - ADP + P → ATP
  - Continuous Cycle



Carbohydrates

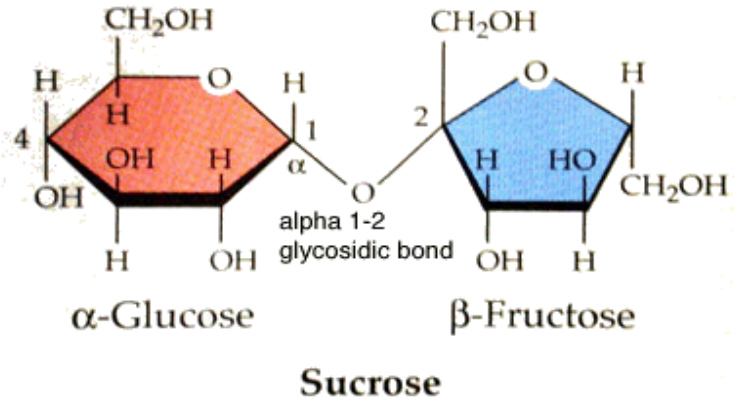
- Made of C, H, O
- Ratio of H to O is 2:1
- Sugars!
- Used for quick energy
  - Monosaccharides
    - Building blocks of all carbs
    - $(CH_2O)_n$ is generic formula
    - Simple sugars
    - Most common are glucose, fructose, galactose
      - Isomers: same formula, different structure



Carbohydrates

- Disaccharides
  - Formed from 2 mono-saccharides
    - Condensation reaction
    - Ex: sucrose

Sucrose has the molecular formula $C_{12}H_{22}O_{11}$



Sucrose

- Polysaccharides
  - Formed from 3+ monosaccharides
    - Condensation reaction
      - Glycogen: storage in animals (used for energy) \
      - Starch: storage in plants
      - Cellulose: in plant cell walls (gives them rigidity, ‘crunch’)

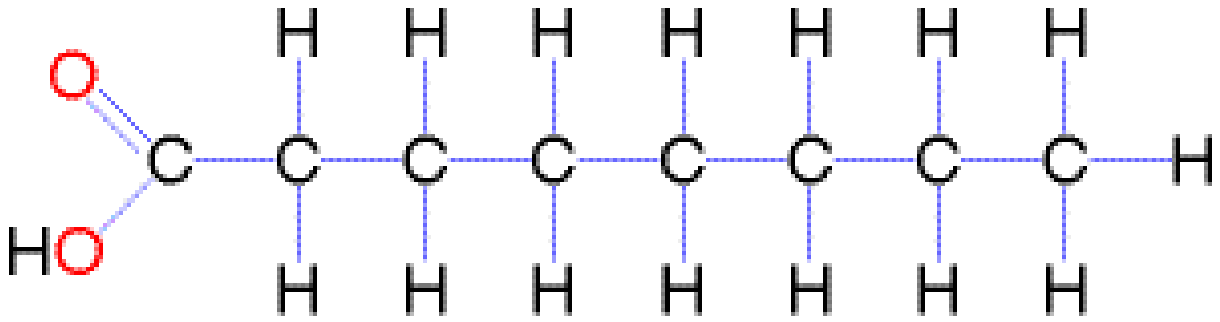
Lipids

- Fats!
- Large, non-polar; do not dissolve in water
- Have more C, H than O
- Responsible for storing energy

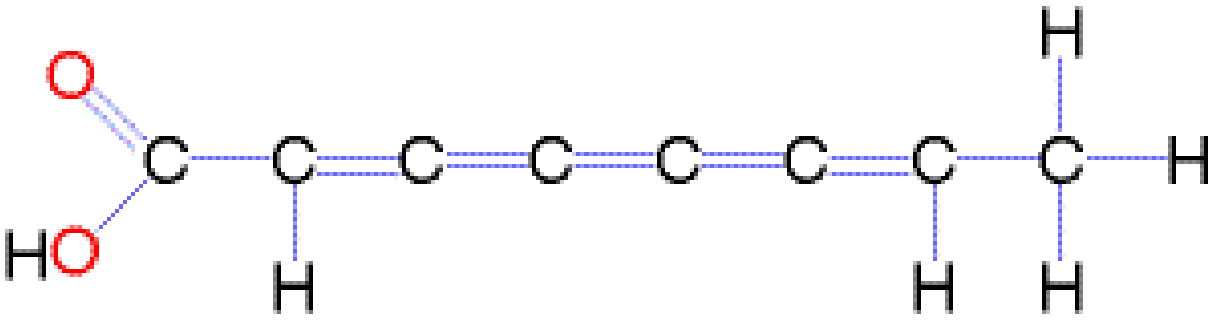
Lipids

- Fatty Acids
  - Building blocks of lipids
  - Straight carbon chain with carboxyl group (COOH) on one end (makes that end polar)
  - Carboxyl end "head" = hydrophilic
    - Water-Loving
  - Carbon chain "tail" = hydrophobic
    - Water-Fearing
  - Can be Saturated or Unsaturated
    - Saturated: all C-C bonds are single bonds (is "full" of H's)
    - Unsaturated: contains some double bonds

Lipids



Saturated



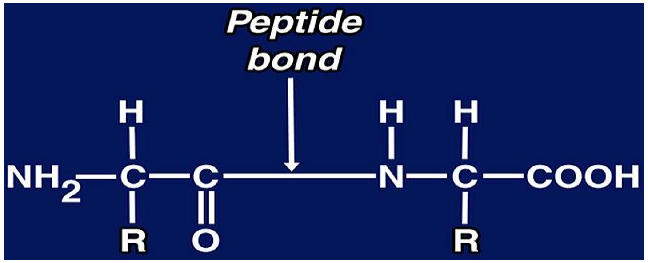
Unsaturated

Lipids

- Triglycerides
  - 3 Fatty Acids attached to 1 Glycerol molecule
    - Saturated: solid at room temp (shortening)
    - Unsaturated: liquid at room temp (oils, found in plant seeds/fruits)
- Phospholipids
  - 2 FA's attached to 1 Glycerol
    - Major component of cell membrane (lipid bilayer)
- Waxes
  - Waterproof
  - Form protective coating on plant leaves
- Steroids
  - 4 fused carbon rings w/ functional groups
  - Hormones
    - Cholesterol
    - Testosterone
    - Etc.

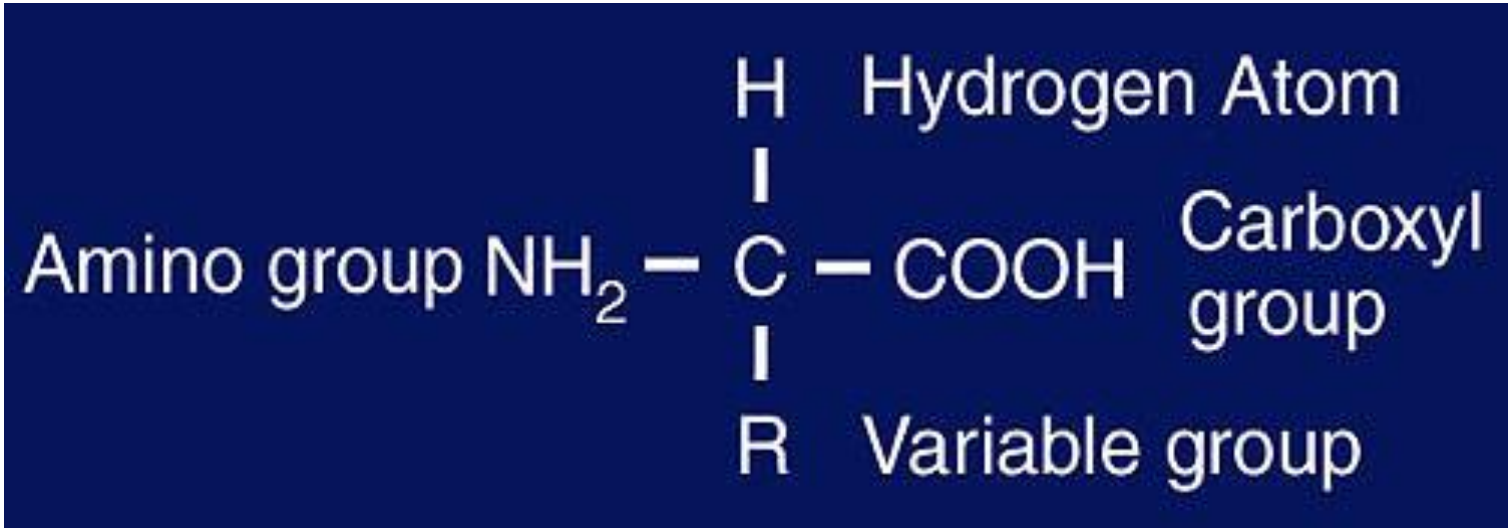
Proteins

- Made of C, H, O, and N
- Building blocks are Amino Acids
  - Amino Acids (20) are almost identical
    - Difference is the R-group (functional group)
- Di-peptide: chain of 2 Amino Acids
- Polypeptide: lots of AA's linked together
- Bond that holds AA's together is peptide bond



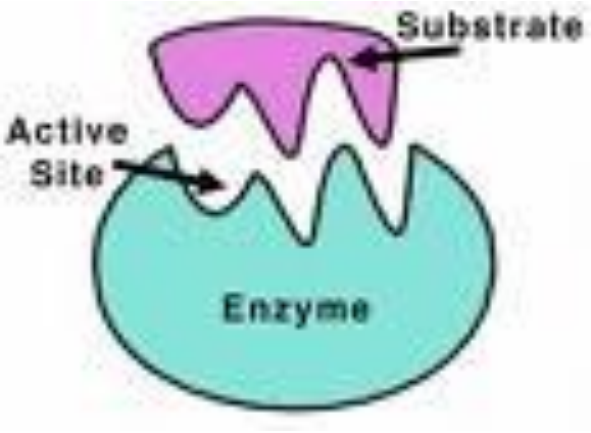
Proteins

- Amino Acid Structure



Enzymes

- Proteins
- Act as catalyst for many reactions that occur in the body
- Substrate: what the enzyme acts on
- Product(s): what is formed from the rxn

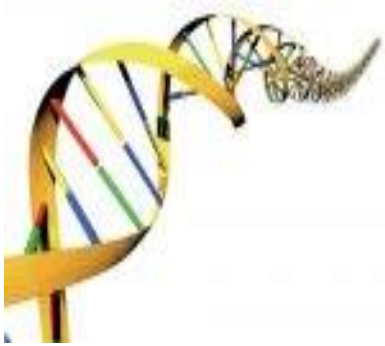


Enzymes

- Are not used up during the reaction
- Are not changed during the reaction
  - Can do the job again and again
- Lock and Key fit
  - Specific shape, must fit perfectly for rxn to occur
- Enzymes can be denatured (destroyed) when:
  - Change in temperature (too high)
  - Change in pH

Nucleic Acids

- Used by cells to store hereditary information
  - DNA
    - Deoxyribonucleic acid
  - RNA
    - Ribonucleic acid



- Made of building blocks called nucleotides
  - 5-carbon sugar
  - Phosphate group
  - Nitrogen base