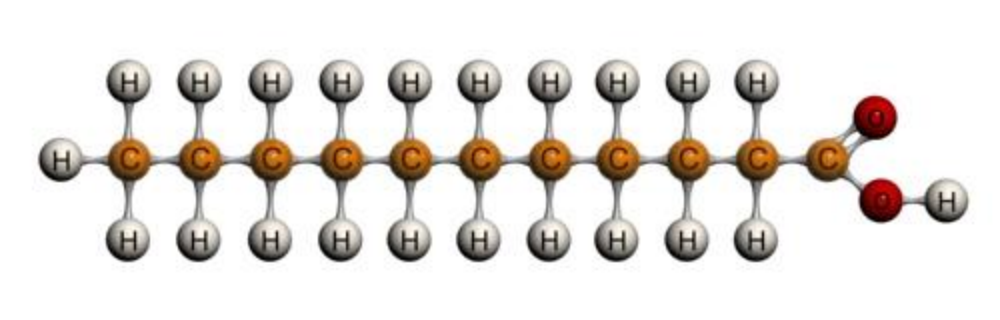
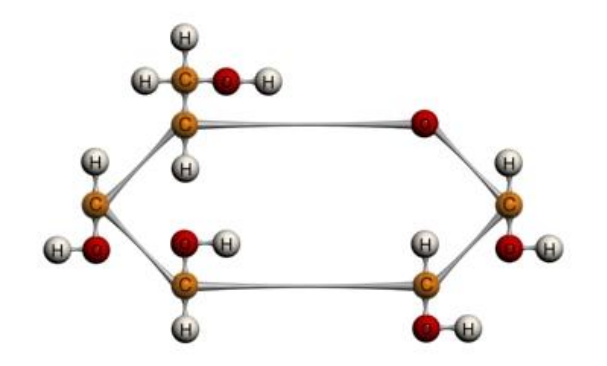
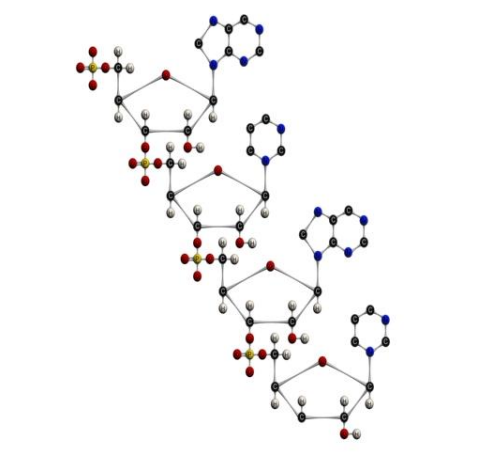
Organic Compounds





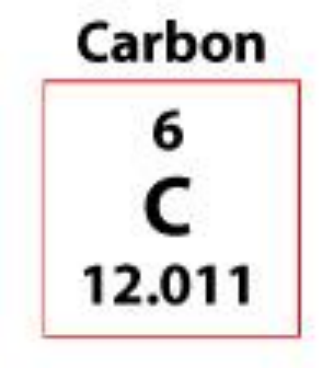


Biology-CP

Mrs. Bradbury

Carbon Chemistry

- The compounds that form the cells and tissues of the body are produced from similar compounds in the foods you eat.

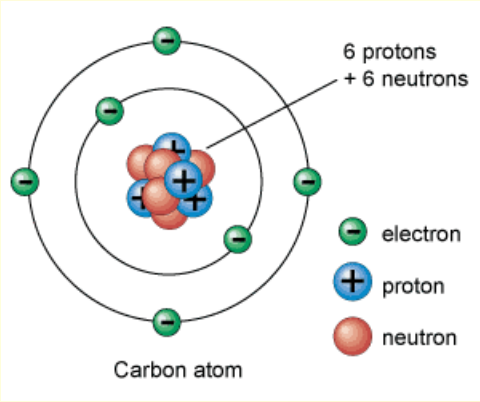


- Common to most foods and organisms is **CARBON.**
  - We are carbon-based life forms

- ***Organic Compound*** – any compound containing the element carbon.
  - Includes sugars, fats, DNA, proteins, etc…

Carbon Chemistry Continued…

- Carbon is the backbone of Organic Compounds



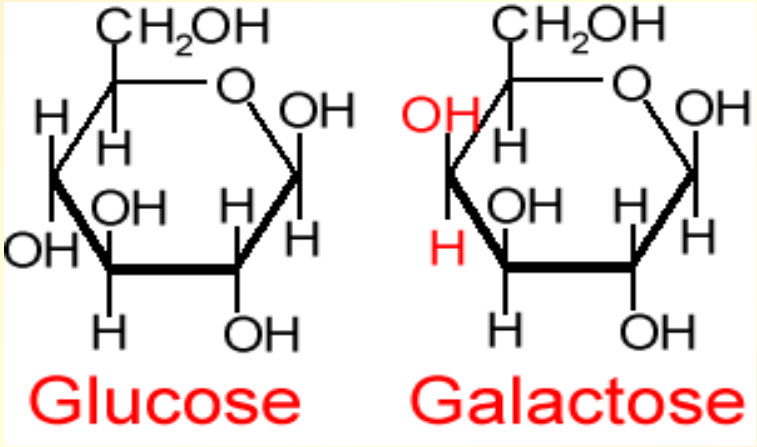
- Carbon has unique characteristics:

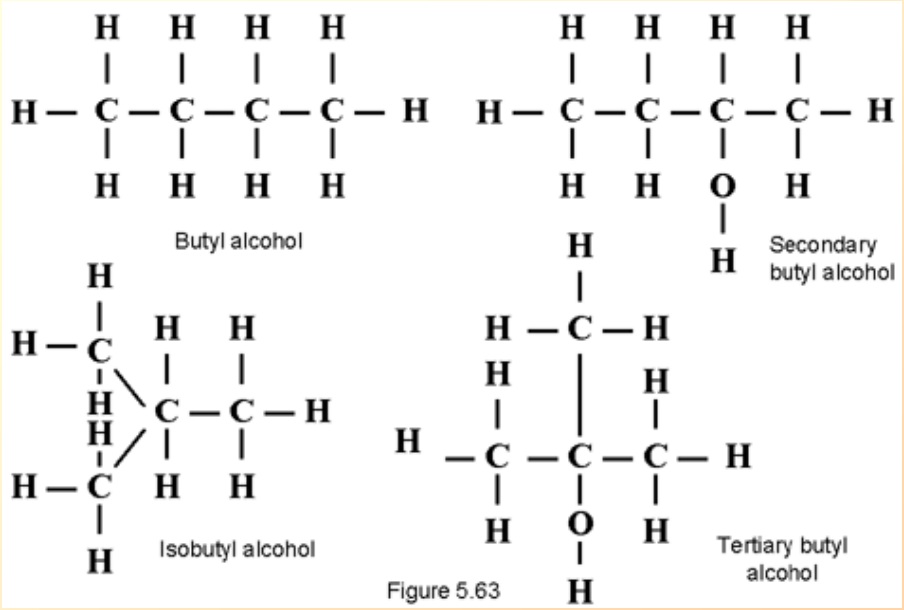
1. Carbon completes its outer shell by sharing 4e- with other atoms
   - To become stable Carbon will form 4 covalent bonds.
   - Can attach to other Carbon atoms to form large carbon skeletons
   - Can form single, double, or triple bonds

Single Bond	Double Bond	Triple Bond
C-C	C=C	C≡C

Role of Carbon Continued…

2. **Carbon will form straight chains, branched chains, or rings of various sizes**
   - Can be any # of carbon atoms and atoms of other elements. (Usually H, N, or O)
   - Results in a large # of Carbon molecules



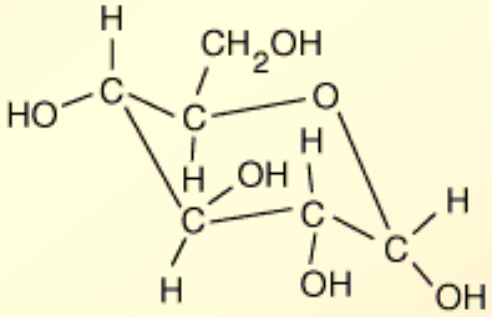


Isomers

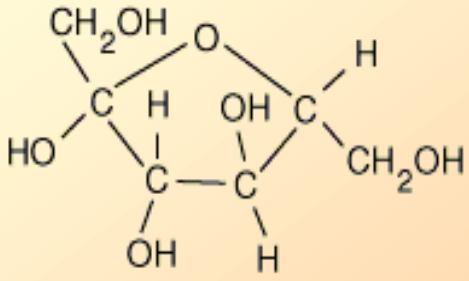
- Carbon compounds with the same formula but different 3-D structures.

- $C_6H_{12}O_6$ is the formula for BOTH **glucose** and **fructose** (simple sugars)

- The atoms are arranged differently in each compound.
- Different shapes give isomers different properties.
- In this case… fructose tastes sweeter!

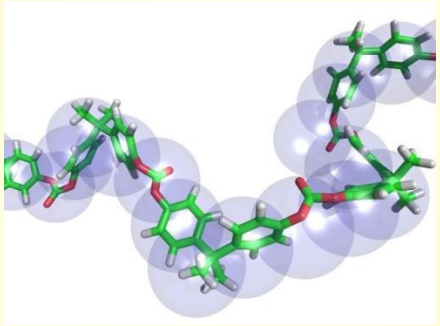


Glucose



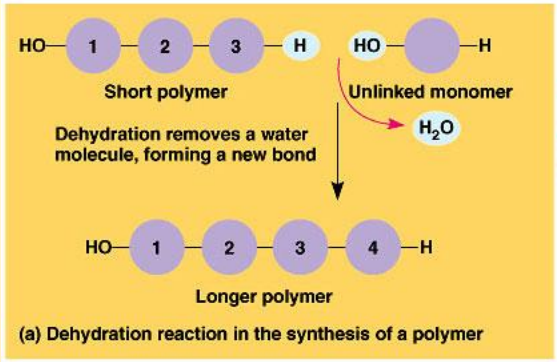
Fructose

Carbon Molecules



- ***Macromolecules*** – long chains of 10ths, 100rds, or 1000ths of carbon atoms.
  - Giant molecules
  - Built by bonding small molecules together to form long chains called ***polymers***.

- ***Polymers*** – large molecules formed when many tiny molecules ***(monomers)*** bond together.
  - Like a string of pearls
  - Formed through condensation (water loss forms a bond)
  - Broken down through ***hydrolysis*** (adding water to break bonds)
  - Ex: proteins, sugars, fats, and nucleic acids



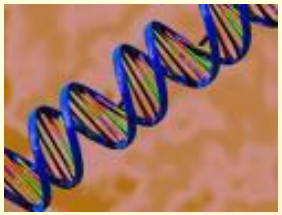
Four Major Organic Molecules

1. Carbohydrates

2. Lipids (Fats and Oils)

3. Proteins

4. Nucleic Acids

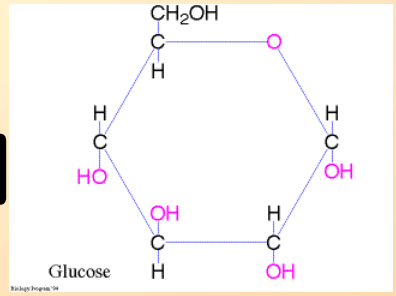


- All are macromolecules and polymers!

Carbohydrates

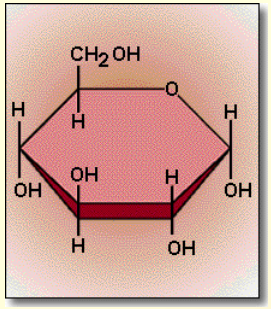
- An organic compound
- Composed of carbon, hydrogen, and oxygen in a ratio of 1-C to 2-H to 1-O
  - Ex: Glucose is $C_6H_{12}O_6$ (1:2:1)

- **Uses:** To store and release energy
- **Sub-Units/Monomers:** Monosaccharid

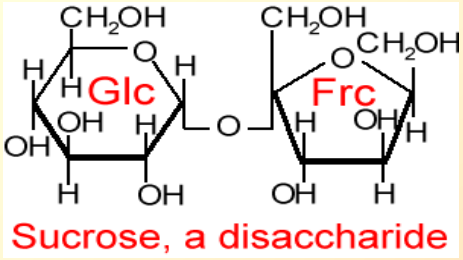


Types of Carbohydrates

1. **Monosaccharides** (1-sugar carb.)
   - Simple sugars that are the building blocks of carbohydrates.
   - Ex: Glucose and Fructose – $C_6H_{12}O_6$

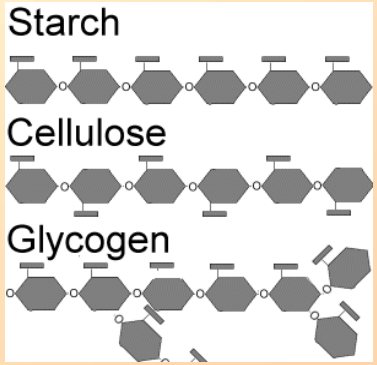


2. **Disaccharides** (2-sugar carb.)
   - Two monosaccharides linked together
   - Link by condensation reaction
   - Ex: Sucrose, Lactose, Maltose (table sugar – $C_{12}H_{22}O_{11}$) = glucose + fructose



Sucrose, a disaccharide

3. **Polysaccharides** (many sugar carb.)
   - Complex carbohydrates
   - Composed of many monosaccharide sub-units
   - Ex: Starch, Glycogen, Cellulose (plant cell walls)



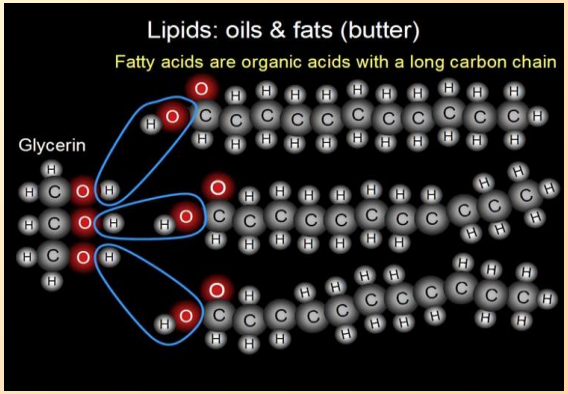
Lipids

- Organic compounds that have a large portion of carbon-hydrogen bonds and less oxygen then carbohydrates
  - Ex: $C_{57}H_{110}O_6$ (Beef Fat)

- **Non-polar molecules** – will not be attracted to water molecules and are insoluble in water

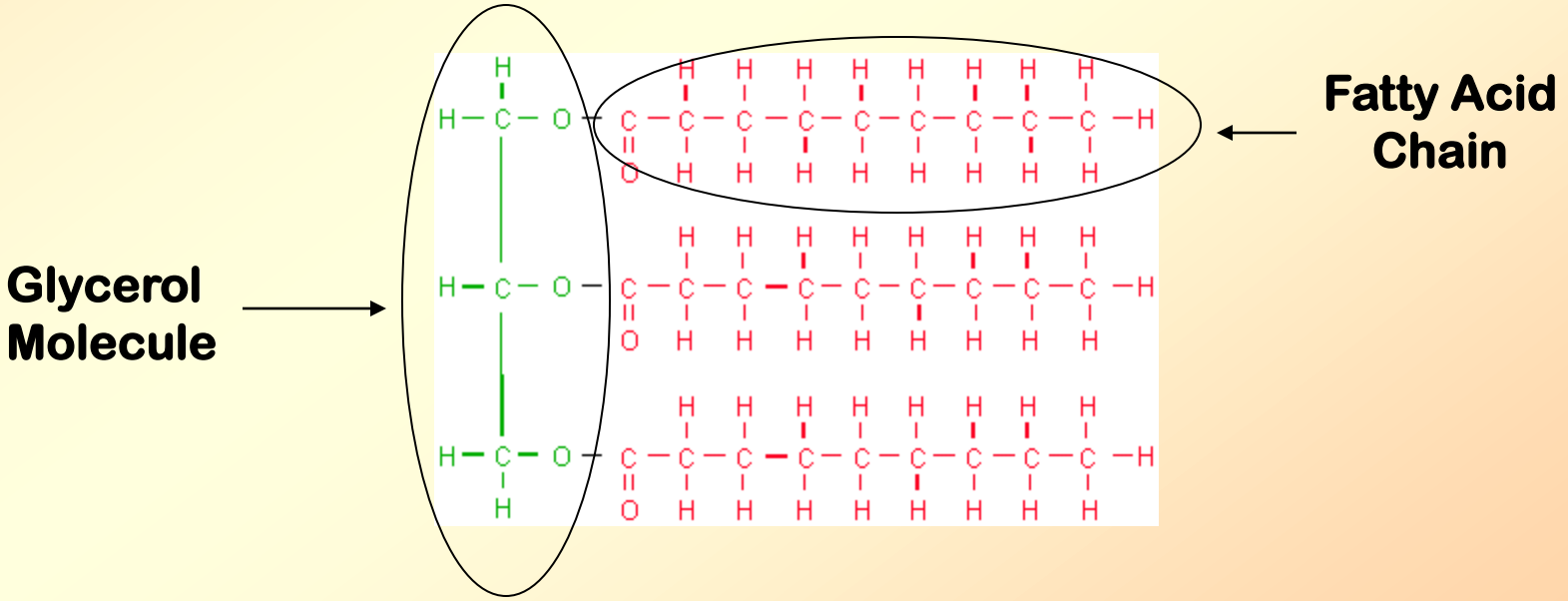
- **Uses:**
  - 1. Long term energy storage
  - 2. Insulation
  - 3. Protective coating – major component of cell membranes.

- **Sub-Units/Monomers:**
  - fatty acid chains and glycerol



General Structure of a Lipid

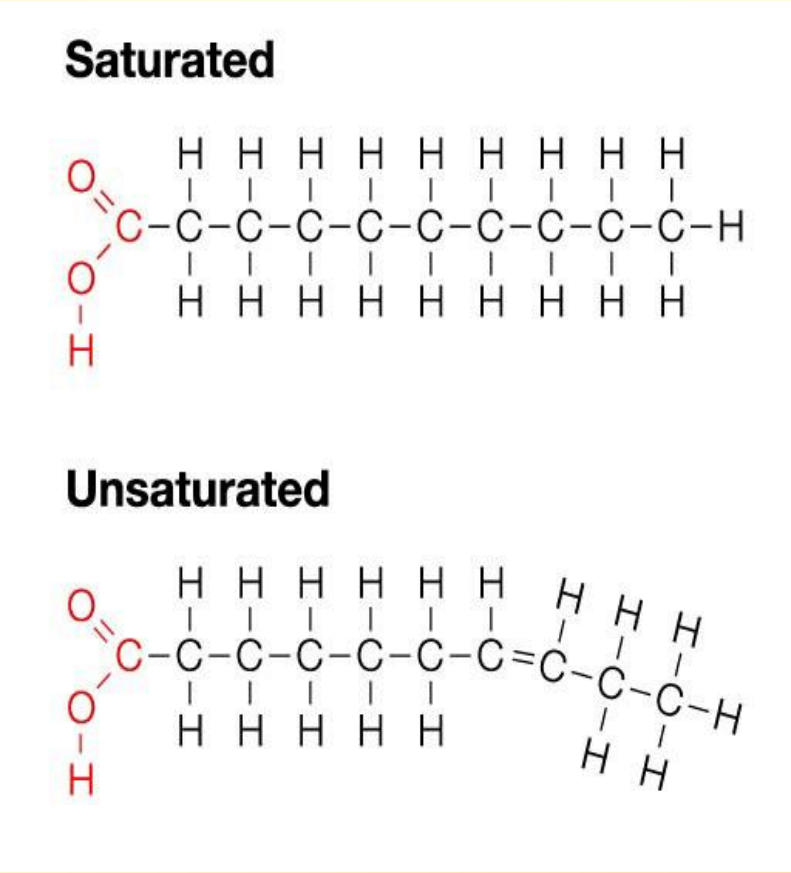
- Fat consists largely of ***triglycerides***
- **Triglycerides**
  - A glycerol molecule joined with 3 fatty acid chains. (Long chains of carbon and hydrogen – stores lots of energy)
  - Form by condensation reactions



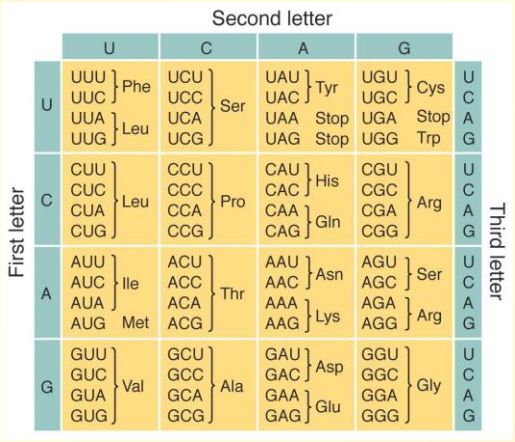
Types of Lipids

1. **Saturated Fats** – fatty acid chains of carbon with only single bonds
   - Generally solid at room temperature
   - Ex: Butter and steak fat

2. **Unsaturated Fats** – fatty acid chains of carbon with double bonds
   - Generally liquid at room temperature (oils)
   - Ex: peanut oil, corn oil, olive oil, etc…



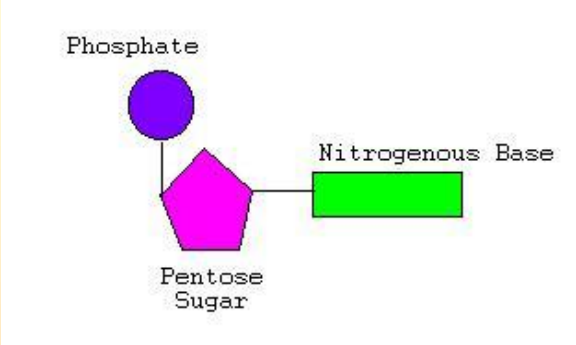
Nucleic Acids



- **A complex organic compounds that stores information in cells in the form of a code…… the genetic code.**

- **Uses:** to store genetic information and make proteins.

- **Sub-Units/Monomers:**
  - Nucleotides
  - Consists of 3 parts: a sugar, phosphate, and a nitrogen base.



Types of Nucleic Acids

1. **DNA**
   - deoxyribonucleic acid
   - Master copy of an organisms information code.
   - Passed on every time a cell divides

2. **RNA**
   - ribonucleic acid
   - Forms a copy of DNA for use in making proteins (protein synthesis)

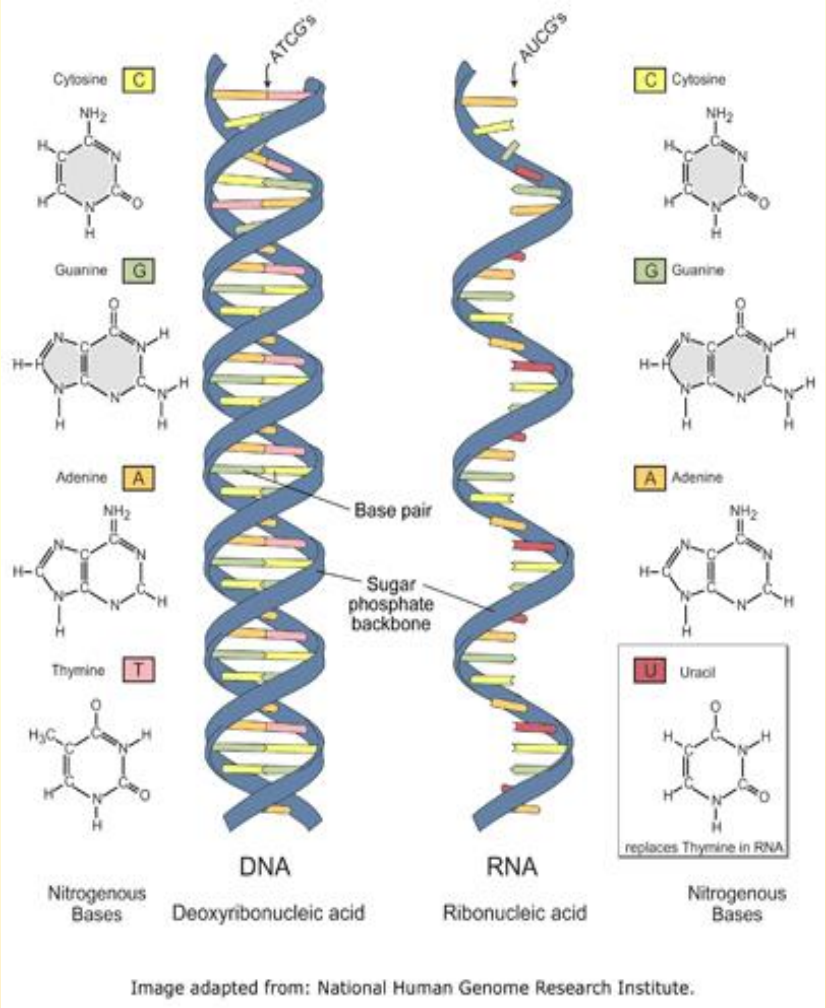
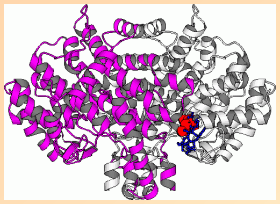
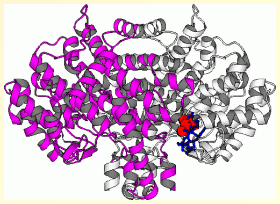


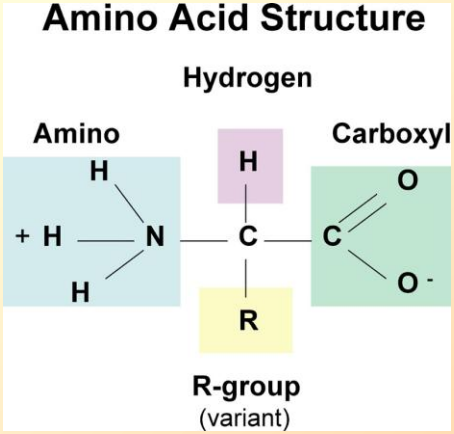
Image adapted from: National Human Genome Research Institute.



Proteins



- Large organic compounds composed of carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur.
- Essential to all living things.
- **Uses:**
  - 1. make up cell membranes (with lipids)
  - 2. build structures (like muscles)
  - 3. carry out metabolic processes (enzymes carry out chemical reactions)
  - 4. Defensive of the body

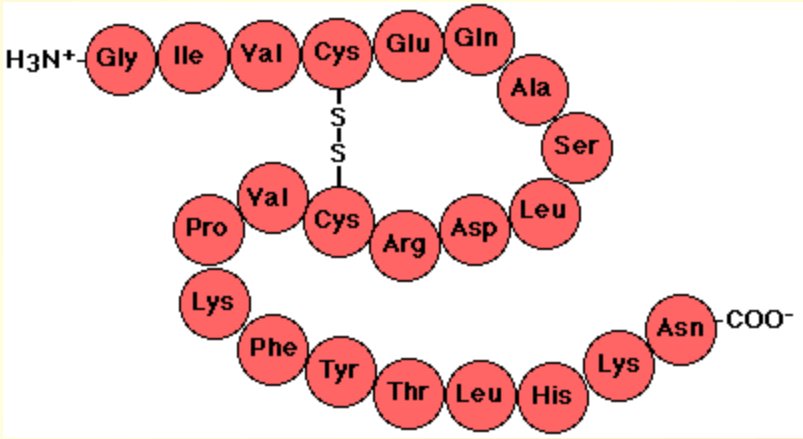


- **Sub-Units/Monomers:** amino acids

- There are 1000ths of different proteins each with a unique shape and function. (Catalase, Lactase, Amylase, hemoglobin, actin, etc…)

Proteins Continued…

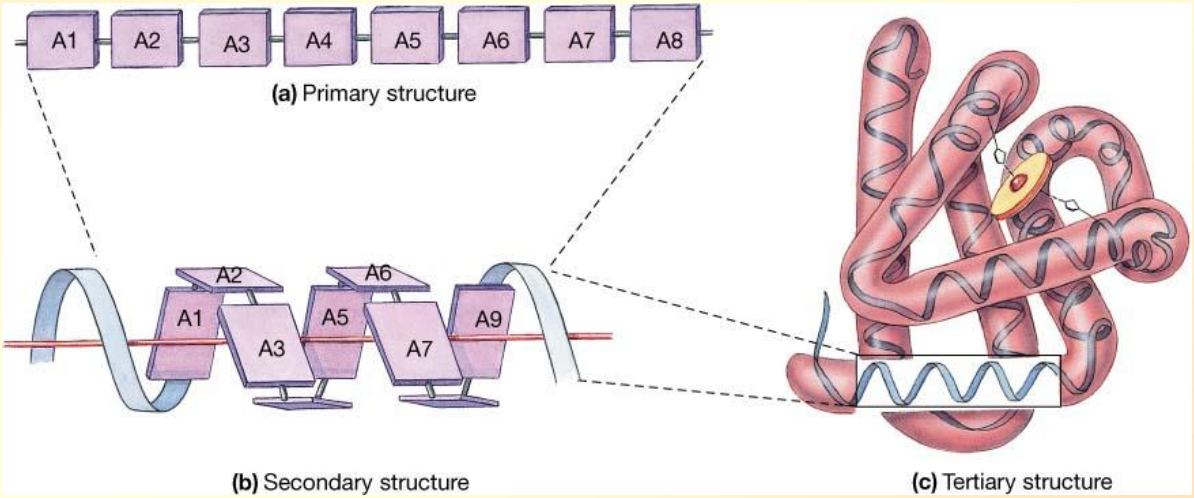
- Twenty common amino acids
- Amino acids link together by ***condensation reactions*** to form covalent bonds
  - called **peptide bonds.**
- Can be combined in any order any number of times to make a large variety of proteins.

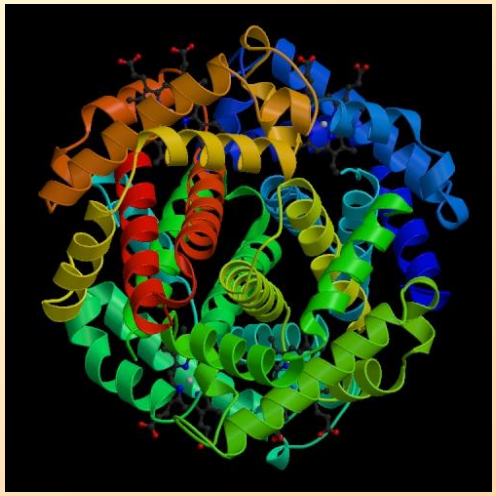


- The order of amino acids determines the protein type.
- Even a slight change in amino acid order can affect the proteins function
  - Ex: A change in 1 amino acid causes Sickle Cell-Anemia

Protein Shape

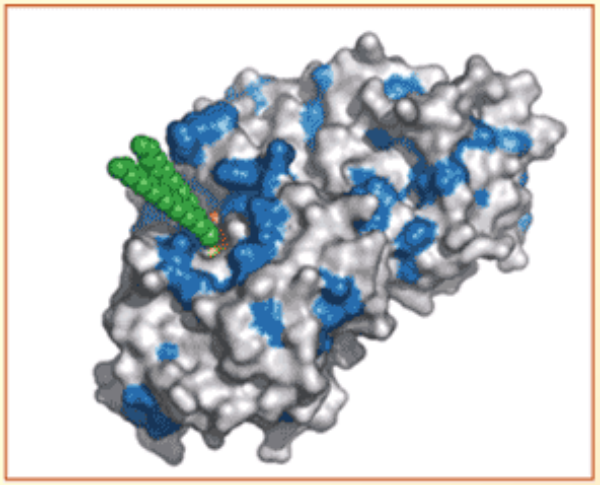
- Once the amino acid chain is formed the protein is twisted, folded, and coiled into a unique shape.
- Proteins MUST have the correct shape in order to function.
- Anything that changes the protein shape will affect the function of the protein
  - A misshapen protein is said to be ***denatured***
  - Usually caused by a change in environmental conditions… such as pH or temperature changes

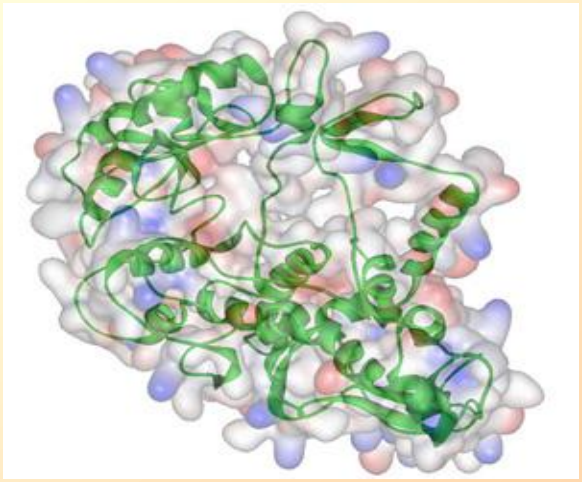




Enzymes

- Proteins found in all living things that speed up chemical reactions.
- Involved in nearly ALL metabolic processes:
  - food digestion
  - synthesis of molecules
  - the storage and release of energy
- Enzymes ***catalyze*** (jump-start) reactions

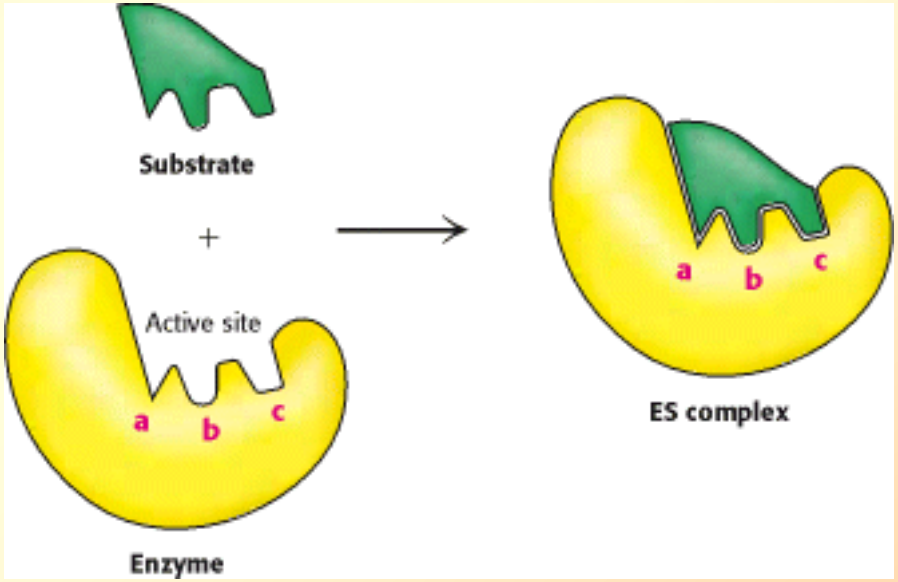




Enzymes and Substrates

- Enzymes are specific for the reactants they work with. (Like a lock and a key)
  - Depends on the enzyme's shape

- The reactant that an enzyme works with is called its ***substrate***
  - Only one type of substrate will fit each enzyme.



- The substrate fits into a region of the enzyme called the ***active site***.

How an Enzyme Works

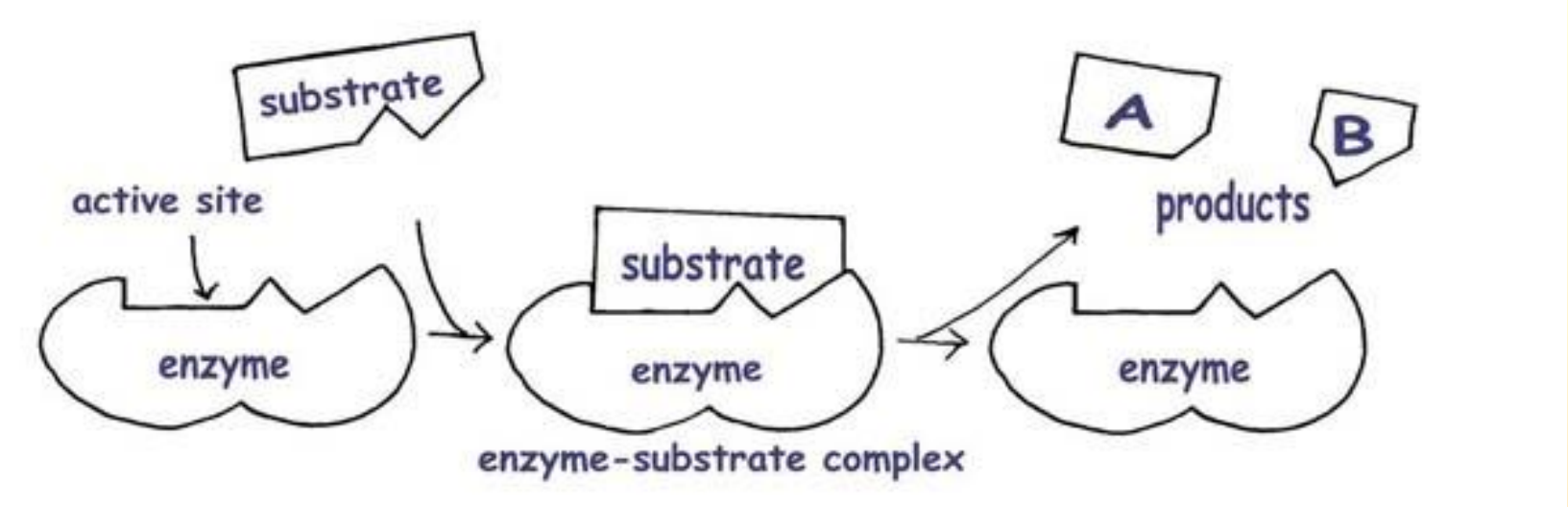
1. The ***substrate*** enters the ***active site*** of the enzyme.

2. Enzyme and substrate bond to form the ***enzyme-substrate complex***. In this complex, the enzyme holds the substrate in a position where a chemical reaction can easily occur.

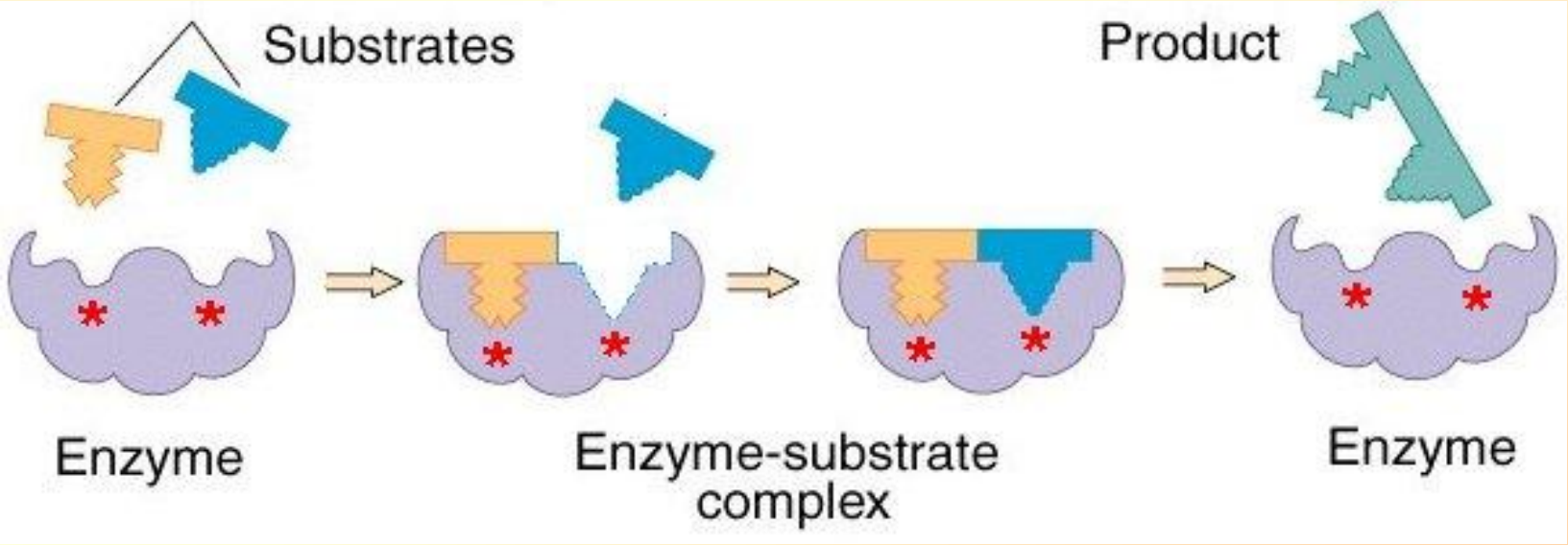
3. After the reaction occurs, the enzyme releases the ***products*** and goes on to repeat the reaction again.

Ex: Enzyme Reactions

Ex: 1

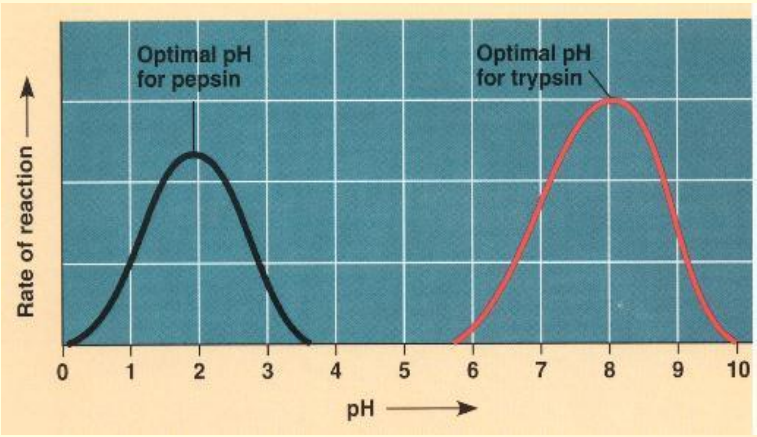


Ex: 2



Factors Affecting Enzymes

1. **Temperature**
   - there is an optimum temperature for enzyme reactions
2. **pH**
   - there is an optimum pH for enzyme reactions



3. **Amount of Enzymes**
   - the more enzymes available the faster the reaction
4. **Amount of Substrate**
   - the more substrate available the faster the reaction

- Changes in temperature or pH may cause enzymes to become "***denatured***"
  - changes enzymes shape and they can no longer bind to the substrate…will render the enzymes functionless