Oliver - Biomolecules Notes
FALL SEMESTER 2023

INSTRUCTOR:

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Vocabulary / Key Terms/ Concepts	Biomolecules
activation energy *adhesion* *amino acids* *carbohydrates* *catalyst*	**Student Expectations:** The student is expected to: • ***Distinguish between carbohydrates, lipids, proteins, and nucleic acids by structure*** ☐ Compare and Contrast ***Monomers*** / ***Polymers*** ☐ ***Dehydration synthesis*** / ***Hydrolysis*** in molecule formation ☐ ***Carbohydrates*** contain carbon, hydrogen, and oxygen; usually in a 1:2:1 ratio (example: glucose $C_6H_{12}O_6$) ☐ ***Lipids*** contain mostly carbon and hydrogen ☐ ***Proteins*** contain nitrogen, as well as carbon, hydrogen, and oxygen. They are polymers of molecules called amino acids that have an amino group ($-NH_2$) on one end and a carboxyl group (-COOH) on the other ☐ ***Nucleic acid***s contain hydrogen, oxygen, nitrogen, carbon, and phosphorus. They are assembled from individual monomers known as nucleotides which consist of a 5-carbon sugar, a phosphate group, and a nitrogenous base

cohesion *dehydration synthesis* *enzymes* *hydrolysis* *lipids* *macromolecules* *mixture* *monomers* *monosaccharide* *nucleic acids* *nucleotides*	• ***Identify the function of carbohydrates, lipids, proteins, and nucleic acids*** ☐ ***Carbohydrates***: source of energy; are used as structural materials in organisms ☐ ***Fats or lipids***: nonpolar molecules that store energy and are an important part of cell membranes ➔ ***Phospholipids***: make up the cell membrane / regulate transport. ***Hydrophilic*** heads, ***hydrophobic*** tails ➔ ***Triglycerides***: glycerol with three fatty acids. ***Saturated*** vs ***Unsaturated*** ☐ **Proteins**: chains of ***amino acids***; the sequence of amino acids determines a protein's shape and specific function ➔ Some control the rate of reactions and regulate cell processes ➔ Some are used to form bones and muscles ➔ Some transport substances into and out of the cells ➔ Some help fight disease ➔ ***Enzymes***: raise reaction rate, lower activation energy ☐ **Nucleic acid**: store and transmit hereditary information ➔ ***DNA*** = Deoxyribonucleic Acid ➔ ***RNA*** = Ribonucleic Acid - make proteins • ***Describe energy changes in a chemical reaction*** • ***Identify activation energy as the energy needed to get a reaction started*** • ***Interpret energy-absorbing reaction and energy-releasing reaction graphs*** • ***Identify that enzymes are proteins that act as biological catalysts. They speed up chemical reactions that occur in cells*** • ***Understand that enzymes lower the activation energy needed to get a reaction going*** • ***Explain how enzymes provide a place where reactants can be brought together to react. The reactants are called substrates.*** • ***Understand the factors that can affect enzyme activity*** ☐ pH ☐ temperature • ***Know roles of enzymes include:*** ☐ Regulating chemical pathways ☐ Making materials that cells need

polar

polymers

polysaccharides

proteins

saturated

solute

solution

solvent

substrates

suspension

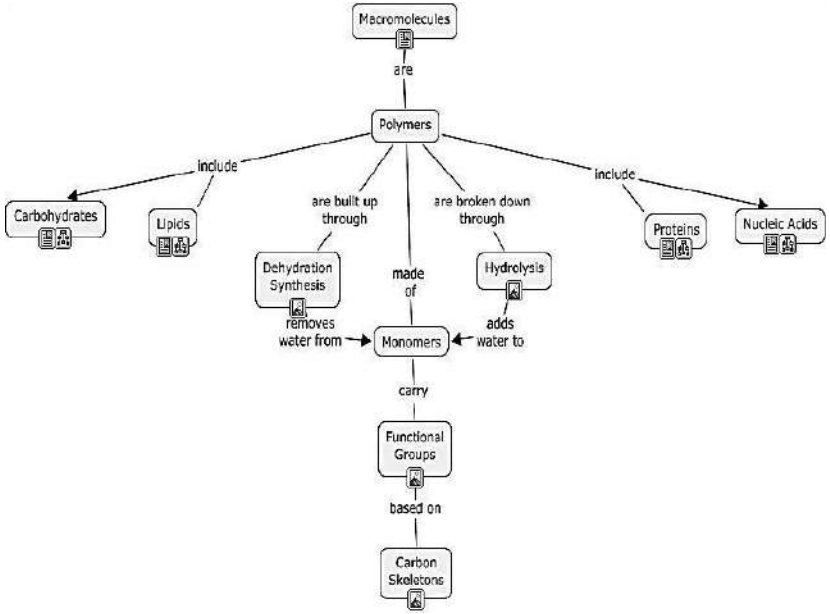
unsaturated

- ☐ Releasing energy
- ☐ Transferring information

_____

Characteristics -

- Large organic molecules.
- Also called _____ .
- Made up of smaller "building blocks" called _____ .
- **Biological Macromolecules** are:
  1. **_____**
  2. **_____**
  3. **_____**
  4. **_____**

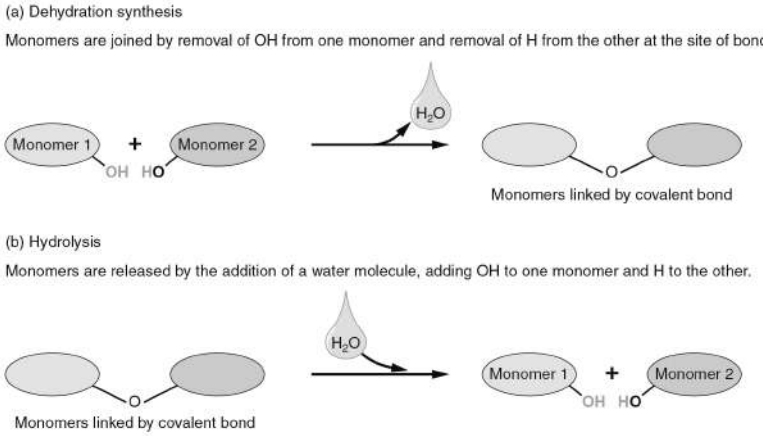


(DNA and RNA)

_____ Synthesis & _____ –

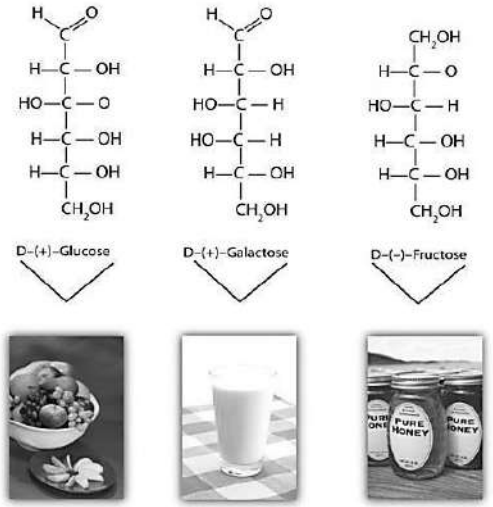
- Cells **connect** _____ to make _____ by a process called condensation or _____ (removing a molecule of water).

- Cells _____ **down macromolecules** into _____ by a process called ***hydrolysis*** (adding a molecule of water)



_____

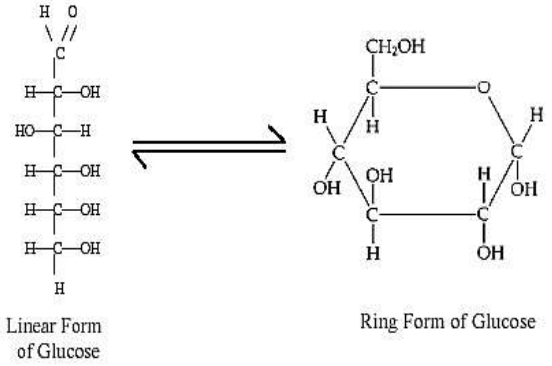
- _____ can range in size from small sugar molecules to large strands of sugar molecules bonded together. A biochemical test to indicate the presence of sugar – _____ ***solution*** (indicator) – turns green, yellow, orange, or red when heated.

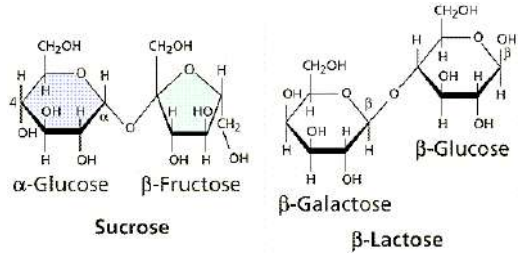


- Elements Used to Form:
  1. _____
  2. _____
  3. _____
- Examples:

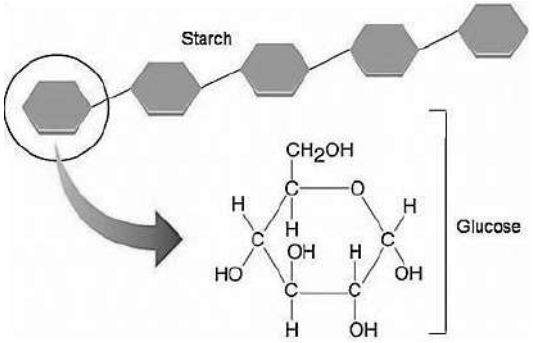
1. _____

- Called **Simple Sugars** ***(monomer)***.
- Include: **Glucose**, **Fructose** & **Galactose**.
- They have the same chemical formula, $C_6H_{12}O_6$, but have different structures.
- These three sugars are structural isomers:
  - _____ is found in sports drinks.
  - _____ is called "milk sugar"
  - _____ is found in fruits.





- If the compound name ends in **– ose** means it is a sugar.
- In aqueous (watery) solutions, Monosaccharides ***form ring structures***.
- They are the main fuel that cells use for work.



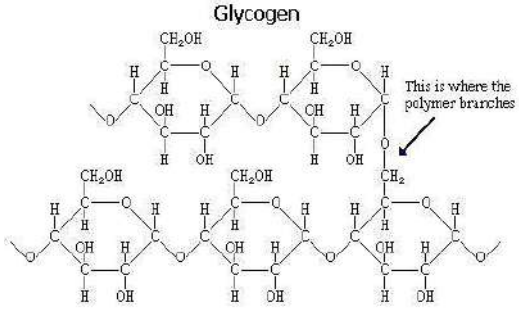
2. _____

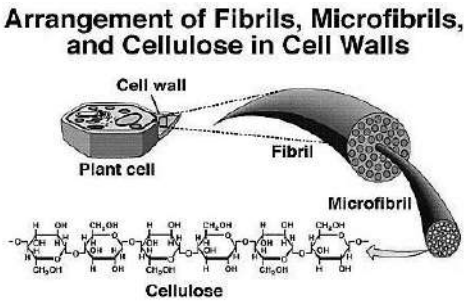
- A ***disaccharide*** is made of **two** sugar molecules joined together.
- They are joined in the dehydration *process*.

- There is a glycosidic bond between the two sugars.

3. _____

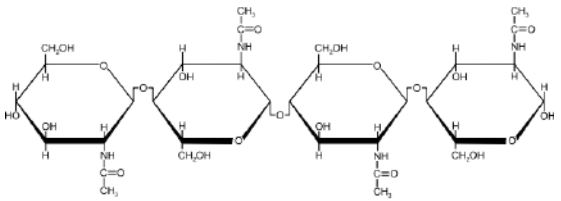
- **Complex** carbohydrates
- Composed of **many** sugar monomers linked together.
- _____ of **monosaccharide** chains.
- Three types of polysaccharides are: **starch**, **glycogen**, and **cellulose**.
  - _____ **–** in ***iodine*** (indicator) turns dark blue or black
    - Starch is an example of a polysaccharide in plants.
    - Plant cells store starch for energy.
    - Potatoes and grains are major sources of starch in the human diet.
  - _____
    - Animals store excess sugar in the form of glycogen.
    - Glycogen is similar in structure to starch because both are made of glucose monomers.
      - _____
    - Cellulose is the most abundant organic compound on Earth.
    - It is the structural component of plants.
    - It forms cable-like fibrils in the tough walls that enclose plants.
    - Many animals cannot digest cellulose.
    - It is also known as dietary fiber.





- _____

- **Chitin** is made of **glucose** subunits linked together in a chain.
- Partly derived from non-sugars (nitrogen).
- Composes _____ of **insects**, lobsters, and shrimp.
- The cell walls of fungi are also made from **chitin**.
- Chitin fibers are also used for **dissolving** _____ .



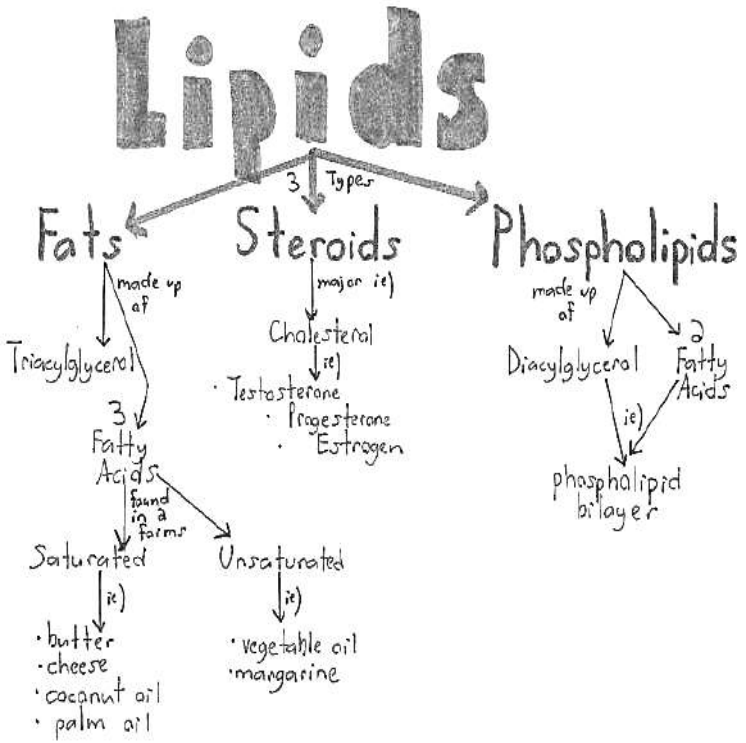
_____

Characteristics

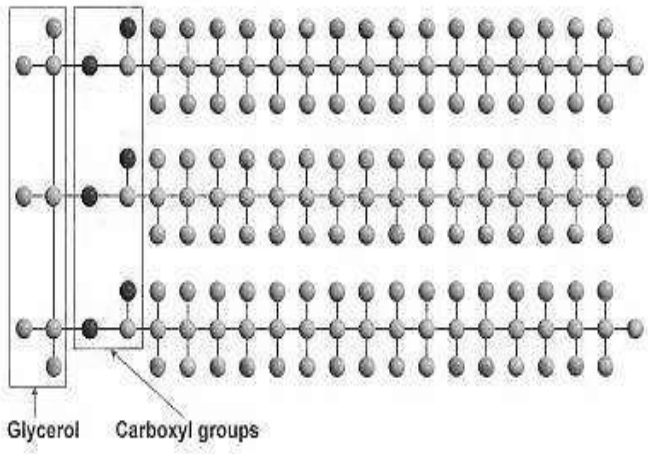
- **Lipids** are _____ –"water fearing".
- Do **not mix** with water.
- Includes **fats**, **waxes**, **steroids**, **oils, hormones,** & _____ .
- **Stores** the most **energy**.
- Composed of: **C, H, & O**

Six functions of lipids:

- **Long term energy** _____



- **Protection** against heat loss (**insulation**)
- **Protection** against water **loss**
- **Protection** against physical **shock**
- Chemical messengers
  (_____)
- Major component of
  _____
  (phospholipids)

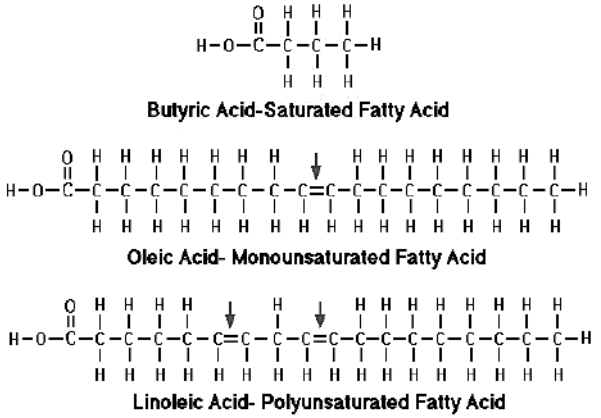


Fatty Acids –

- **Fatty Acids**: a long **chain** of **Hydrogen** and **Carbon** make up lipids. The exception to the monomer/polymer rule is lipids. Lipid base units are not considered monomers. One type of lipid or fat is made up of fatty acids and glycerol molecules in a 3:1 ratio. The bonding of three fatty acids to one glycerol molecule creates a triglyceride

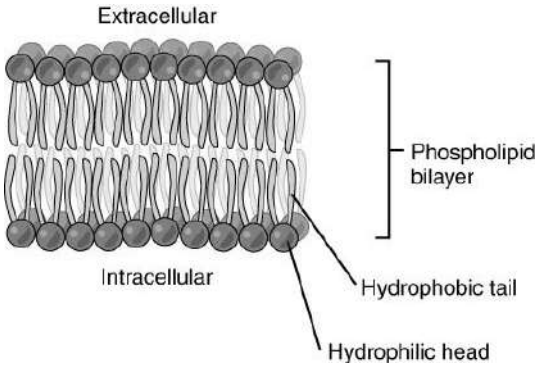
Types of Fatty Acids

1. _____ **Fatty Acid**: if each Carbon is bonded by **single** bonds to other Carbons inside the fatty acid, the fatty acid is said to be saturated.
2. **Mono or** _____ **Fatty Acid**: If a **double** bond is present, then it is said to be mono-saturated or unsaturated.

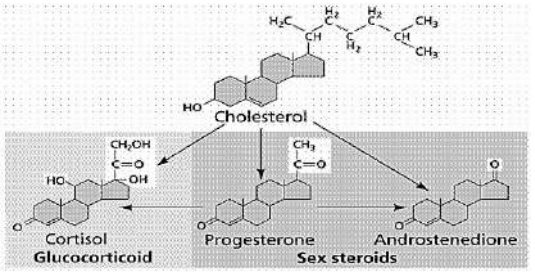


3. _____ **Fatty Acid** - **More than one** double bond

- Most_____ have a high proportion of saturated fatty acids & exist as solids at room temperature (butter, margarine, shortening).
- ***Sudan*** (indicator) can turn a variety of colors in the presence of lipids.
- Most _____ tend to be low in saturated fatty acids & exist as liquids at room temperature (oils).



4. _____ - Cell _____ are made of **lipids** called **phospholipids**.
   - Phospholipids have a _____ that is _____ & **attract** water (_____).
   - Phospholipids also have **2 tails** that are _____ and do **not** attract **water** (_____)



- _____ –
  - The carbon skeleton of steroids is bent to form 4 fused rings.
  - Cholesterol is the “base steroid” from which your body produces other steroids.

_____

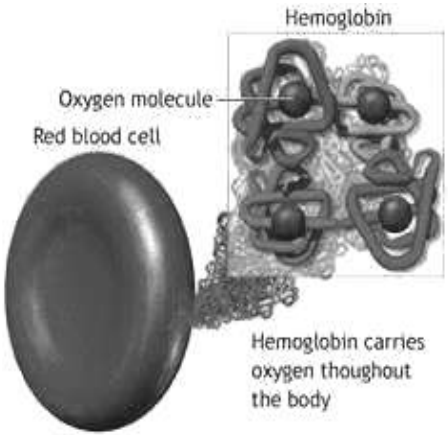
Characteristics

Amino Acid Structure

Hydrogen

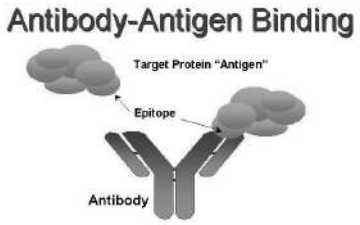
- Composed of
  - o _____
- Monomer
  - o amino acids
    - **20** different (1 mod)
    - Most structural variation

Functions



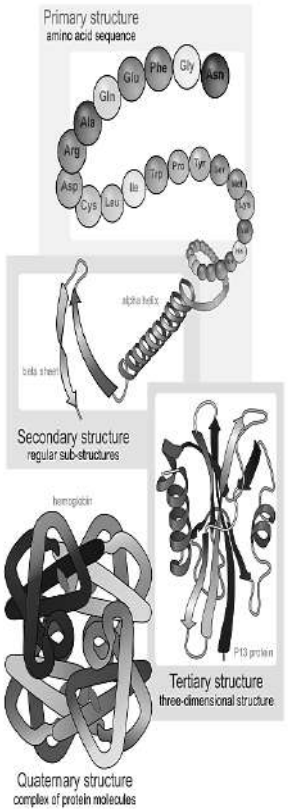
- Essential to Life – _____

  (indicator) turns purple/lavender with protein, pink with amino acid.
- Build **structure**
- _____ :
  - o Makes up _____ tissue
- **Transport**:
  - o Carries oxygen in an organism (_____).
- **Immunity**:
  - Helps fight off foreign invaders
  - _____

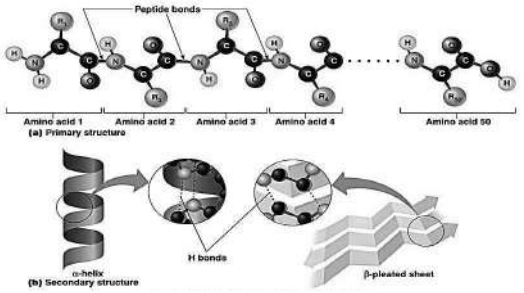


- _____ : (more below)
  - **Speed** up **chemical reactions**
  - amylase and pepsin
- **Energy** source
  - 1 gram = 4 kcal of energy

- _____ : _____
- Covalent bonding links
  - o _____ Bond
- **Four Shapes**

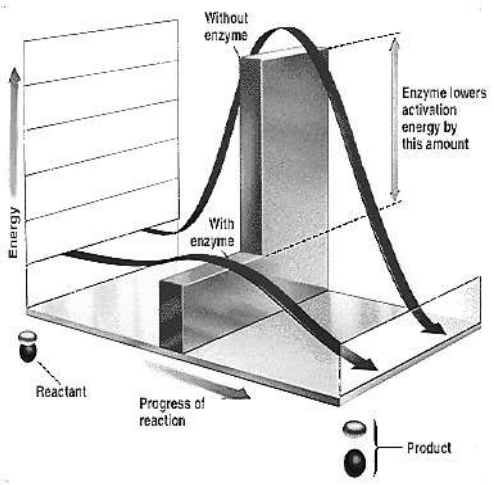


  - o The _____ **structure** is the specific sequence of amino acids in a protein. Called a **polypeptide**.

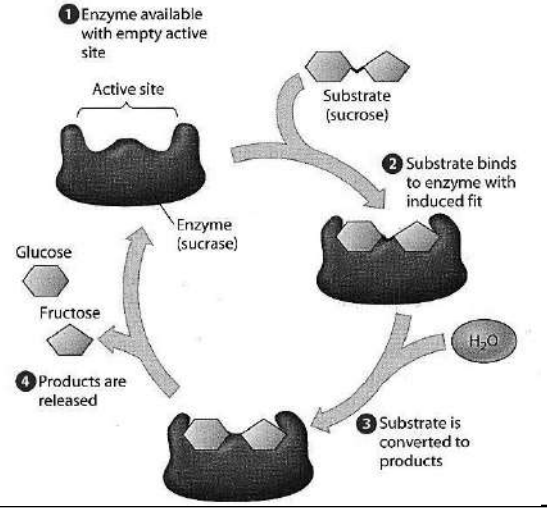


  - o _____ **protein structures** occur when protein chains coil(helix) or fold(pleated)
  - o When protein chains called polypeptides join together, the _____ **structure** forms because R groups interact with each other.
  - o Secondary structures bent and folded into a more complex 3-D arrangement of linked polypeptides
  - o Bonds: H-bonds, ionic, disulfide bridges (S-S)
  - o _____ **Structure**: Composed of 2 or more "subunits".

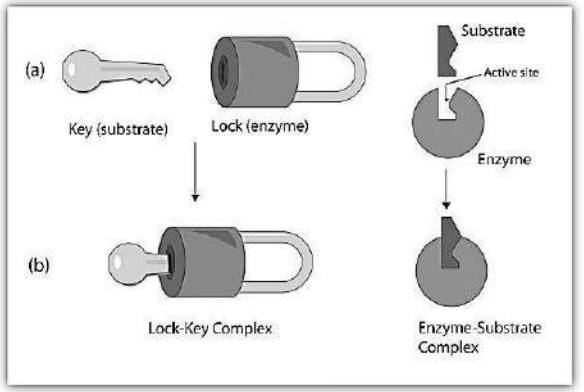
_____ Activity



- **Many proteins act as biological catalysts or enzymes.**
  1. Thousands of different enzymes exist in the body.
  2. Enzymes **control** the **rate** of chemical **reactions** by weakening bonds, thus _____ the amount of **activation** _____ needed for the reaction.
  3. This is accomplished by **binding** to the _____ .
  4. They will then twist or bend the material, lowering the energy needed to split it.
- **The enzyme contains an opening called its _____ (active) site.**
  1. This _____ is specific for the **object** it will hold, called the _____ .
  2. There are just as many **enzymes** as there are **substrates**.
  3. The **enzyme** system is the enzyme and substrate _____ .
- Most are _____ .
- They _____ the activation _____ of a reaction.



- They _____ up the _____
- They are _____ to the _____ .
  - They allow the substrate to fit into the active site like a ball in to a glove, holding it tight. (***Lock and Key Model***)
- They can be reused – _____ **DESTROYED**.



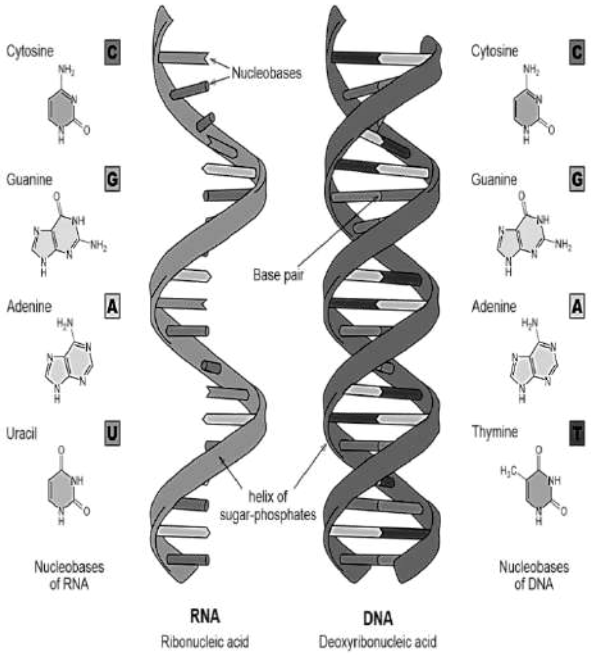
- Some Common Enzymes:

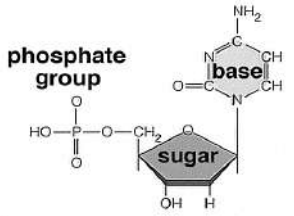
Active Site	Enzyme	Effect on Food
mouth		
stomach		
small intestine (from pancreas)		
small intestine (from pancreas)		
small intestine (from pancreas)		

small intestine		
small intestine		

Nucleic Acids

- **Two types:**
  1. _____ **(DNA-double helix)**
  2. _____ **(RNA-single strand)**
- _____ are composed of long chains of _____ (monomer) linked by dehydration synthesis.
- Composed of the Elements: **C, H, O, N & P**
- _____ include:
  - A _____ group
  - A _____ sugar (5-carbon)
  - A _____ bases:
    - ★ _____ (A)
    - ★ _____ (T) - ***DNA only***
    - ★ _____ (U) - ***RNA only***
    - ★ _____ (C)
    - ★ _____ (G)





Notes Summary	
