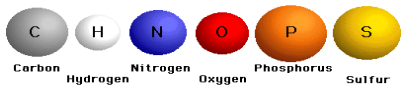
4 Molecules of Life
Carbohydrates, Lipids, Proteins, Nucleic Acids *(later)*

All Living things are made of "BIO-MOLECULES" have 6 basic elements:



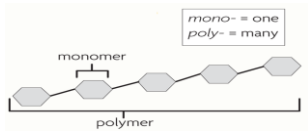
CHNOPS

All Bio-molecules are made of smaller, simpler molecules, put together in specific order. The order determines what kind of molecule it will be

***** Think Lego**

Monomers are the individual subunits.

Polymers are made of many monomers.



Energy comes from digestion of biomolecules

Energy from biomolecules comes from the breaking of bonds between the C, H, O.

The more bonds the more energy stored
The amount of energy = Caloric Value
(ATP PER GRAM)

Proteins, carbohydrates, and fats/lipids all have different structures and # of bonds = different caloric values

Digestion breaks down food to usable biomolecules

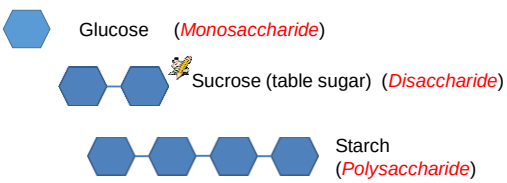
CARBOHYDRATES

Carbohydrates **are important as an energy source for all organisms and as a structural molecule in many organisms.**

Functions

- **Primary source of fuel for cellular respiration.**
- **Store energy for short periods of time.—*Don't eat carbs before bed***
- **Carbon, Hydrogen, Oxygen in them, when they are broken down are recycled and used to make other organic molecules such as amino acids used to make proteins**
- **Used to provide structure for plants (*Cellulose—Cell Wall*)**
- **Provide fiber for animal digestion.**

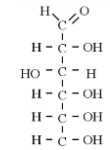
- **Simple sugars (*monosaccharaides-Basic unit*) IE: glucose.**
- **Simple sugar + simple sugar = complex sugar (di or polysaccharides), for IE: starch or cellulose (poly).**
- **If more than needed, convert to fats for storage**



Lipids

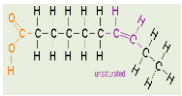
- **2 component molecules (Monomers)**
  glycerols* and *fatty acids
- **Because of more bonds and the structure/shape of the molecules, *fats contain more energy* than carbohydrates**
- **(ATP per gram) **Highest Caloric value****

Lipids have more energy than carbs because they have more chemical bonds and bonds hold energy



Carbohydrate

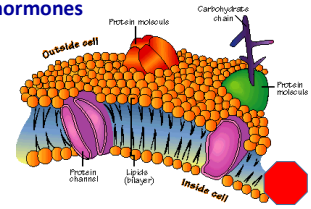
Lipids have about 2x as many bonds in their molecules as carbs



Lipid

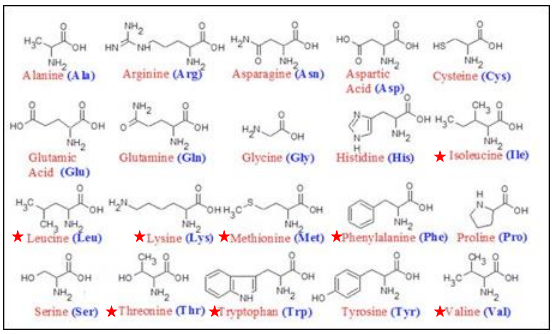
Function of Lipids

1. **Important when carbohydrates are scarce – long term energy storage**
2. **Cushion vital organs**
3. **Insulation of body**
4. ***Component of cell membrane***
5. **Some vitamins and hormones**



Amino Acids—What makes up proteins

- **Amino acids are the building blocks or monomers for proteins**
- **Pass through cell membrane**
- **Used as raw materials to make proteins**
- **Amino acids are molecules made of C,O,H,N,S**
- **There are *20* amino acids -- 12 made by body, 8 must be gotten from outside (beans, meat, nuts)**



★ 8 amino acids we need to get via food source

Proteins

- **Chains of *amino acids***
- **Can be broken down for energy, by being converted to carbohydrates 1st (only when no carbs or lipids avail)**
- **Contains same amount of energy as carbohydrates (ATP per gram)**
- **Proteins (and amino acids) are not broken down for energy until the body is out of carbs and lipids to breakdown**
  - **Muscles have mainly protein that is why fat is lost before muscle tissue when dieting**

Functions of Proteins

Structural - Keratin in hair and nails

Transport – hemoglobin transports oxygen

Hormone – coordinate body activities

Contractile – muscle proteins

Enzymatic – digestive enzymes accelerate speed of chemical reactions

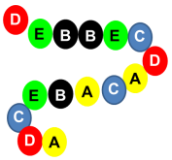
Proteins and Amino Acids

Individual Amino Acids

Monomers

Protein (*amino acids attached together*)

Polymer



Monomers and Polymers

Macromolecule (polymer)	*Monomers*
Carbohydrates (*mono*/disaccharides)	Glucose
Starches (complex carbs)	Carbs
Lipids	Fatty acids and glycerol
Proteins	Amino Acids

Caloric-Energy Values of Organic Molecules

Organic molecules contain different amounts of energy

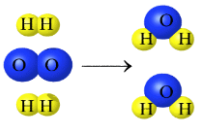
- **Carbs – about 4 calories per gram**
- **Lipids- about 9 cal per gram**
- **Proteins- about 4 cal per gram**

This is why your body stores energy as fats, more energy storage per gram *("more bang for your buck")*

REVIEW OF CHEMISTRY

Reactants **Products**

The **energy** which allows this reaction to take place comes from the movement of the H and O molecules



Think of the arrow symbol as "changes into"

$$2H_2 + O_2 \rightarrow 2H_2O$$

reactants products

Here the internal bonds between the H's and the O's are broken and new ones are formed to make H_2O

Biochemical reactions **allow organisms to grow, develop, reproduce, and adapt.**

The energy required to get a reaction to begin is called the activation energy.

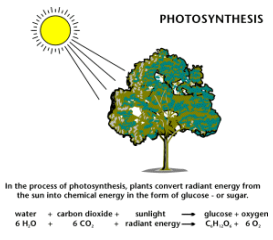
Energy is also released by reactions (this occurs when bonds in reactants break).

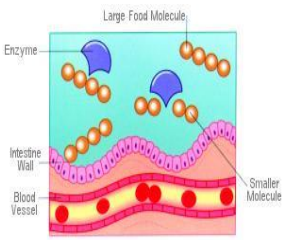
Most reactions give off or produce more energy than they use up.

Bio-Chem. Reactions

EXAMPLES

Photosynthesis & Metabolism





Things that affect Bio-Chem Rxns

Catalyst: changes the rate of a rxn or allows it to happen at lower temps. (**LOWERS ACTIVATION ENERGY Req.**)

Catalyst lower the activation energy

Catalysts are not consumed (destroyed) in the rxn. It can be used over and over.

Enzymes are protein molecules that can act as catalysts in bio-chem rxns.

Things that affect Bio-Chem Rxns

Temperature: affects speed of the rxn as well as if it can happen. Enzymes function with in a specific temperature range

Changes in pH: the acidity of a solution (where rxn takes place) most rxns have a very narrow pH range in which they can take place. Enzymes function with in a specific pH range

Buffers are used to regulate pH in organisms to maintain **homeostasis.**

Enzymes are **denatured, or destroyed** when excess heat or changing pH breaks the **hydrogen bonds** and changing the shape.

Enzymes

Enzymes are very specific:

A certain enzyme can usually only catalyze 1 rxn.

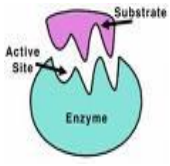
Enzymes are required in most bio-chem rxns. As a result they are necessary for digestion, movement, respiration etc.

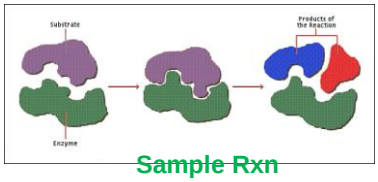
Enzymes also have a very specific range of pH and temperature where they can function

Enzymes

Substrate: same as reactants this word is often used when talking about enzymes.

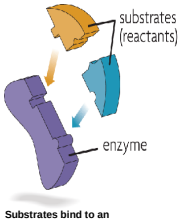
Active Site: the area on the enzyme itself where substrate attaches and rxn takes place





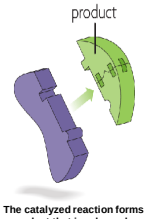
Sample Rxn

Model of How Enzyme Catalyzed RXN Works



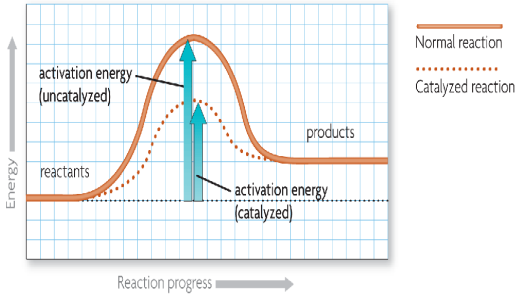
Substrates bind to an enzyme at certain places called active sites.

The enzyme brings substrates together and weakens their bonds.

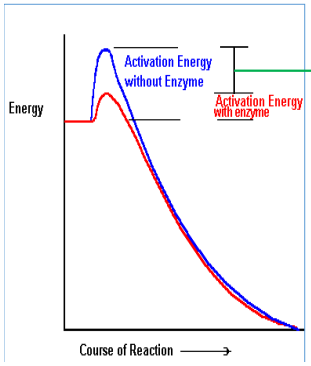


The catalyzed reaction forms a product that is released from the enzyme.

Catalyst



Difference in Activation Energy



As we can see the amount of activation energy required for the reaction to begin is much less w/ the enzyme than w/out.