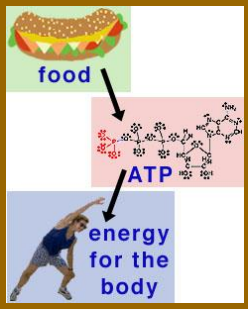
Cellular Metabolism

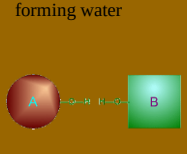


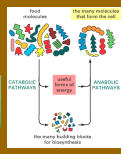
I. Metabolic Reactions

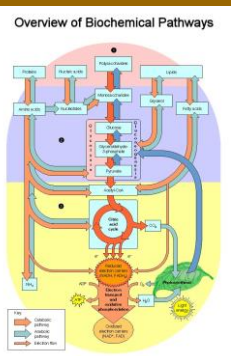
A. Metabolism- Sum of all biochemical pathways

B. **Anabolic** Pathways

1. Consume energy to build complex molecules
2. **Dehydration Synthesis**: Combining two smaller molecules, forming water

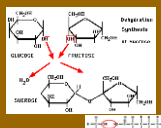


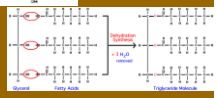


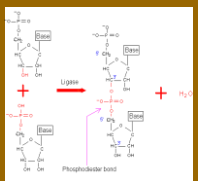


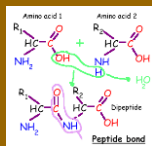
I. Metabolic Reactions

a. . Carbohydrates from monosaccharides
b. Fats(triglycerides) from glycerol and fatty acids
c. Proteins(polypeptides) from amino acids
d. Nucleic acids from nucleotides





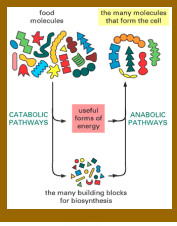


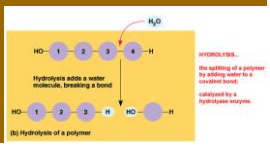


I. Metabolic Reactions

C. Catabolic Pathways

1. Release energy by breaking down complex molecules.
2. **Hydrolysis**: splitting water to break down two portions of a larger molecule.
   a. Monosaccharides from carbohydrates
   b. Glycerol and fatty acids from fats(triglycerides)
   c. Amino acids from protein
   d. Nucleotides from nucleic acids

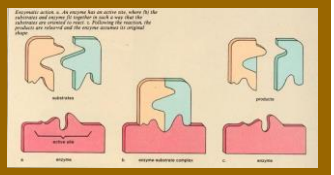




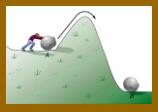
II. Control of Metabolic Reactions

A. **Enzymes**

1. Essential for the functioning of any cell.
2. Act as **catalysts** (Speed up reactions without being used up)
3. Attach to **substrate** molecule and weaken it allowing for a chemical reaction to take place.
4. Enzyme is not altered

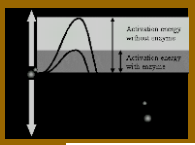


II. Control of Metabolic Reactions

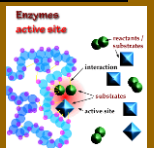


B. Enzymes Lower the Energy of Activation

1. **Energy of activation (E_A)**: energy that must be added to cause molecules to react.
2. Enzymes lower the E_A by forming a complex with their substrate(s) at the **Active site**.

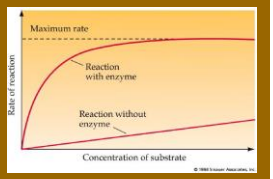


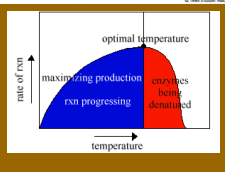
C. Only a small amount of enzyme is needed because enzymes are not used up.



II. Control of Metabolic Reactions

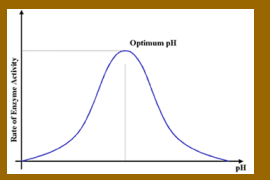
D. Enzyme Speed
1. Enzymatic reactions are rapid
2. Temperature
   a. As temperature rises enzyme activity increases
   b. Due to more molecular collisions
   c. Temperature too high **denatures** enzyme
   d. Optimal for human enzymes is 35º-40ºC





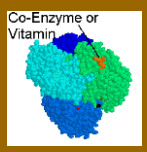
II. Control of Metabolic Reactions

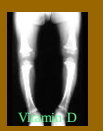
3. pH
   a. Each enzyme has optimal pH
   b. A change in pH can denature the enzyme.
   c. Optimal in humans is pH 6-8
4. Other factors: radiation, electricity, chemicals.

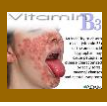


II. Control of Metabolic Reactions

E. Cofactors
1. Molecules that assist enzymes
2. **Inorganic ions**: iron, copper, or zinc.
3. Organic cofactors are **coenzymes** (most are vitamins)
   a. **Vitamins** required in trace amounts
   b. Body cannot synthesize in adequate amounts
   c. Must come from foods
   d. Vitamin deficiency causes lack of enzymatic action.

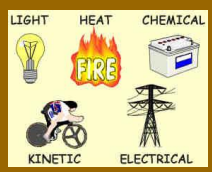


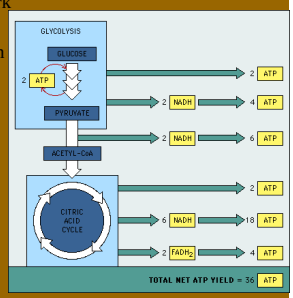




III. Energy for Metabolic Reactions

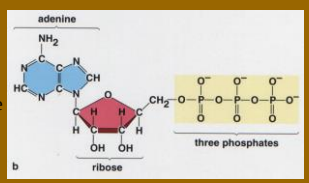
A. Energy is the ability to do work
1. Metabolic processes use chemical energy released when molecular bonds break
2. Glucose **oxidation** during respiration drives metabolism.

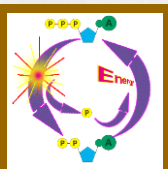




III. Energy for Metabolic Reactions

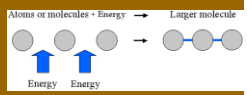
B. **ATP (adenosine triphosphate)**
1. Structure of ATP (a nucleotide)
   a. nitrogen base adenine
   b. sugar ribose
   c. three phosphate groups
2. Energy released when ATP → ADP + P
3. Small amount of ATP is constantly recycled from ADP + P

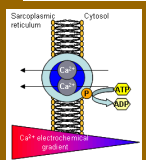




III. Energy for Metabolic Reactions

C. Function of ATP
1. Chemical work: ATP supplies energy to synthesize macromolecules that make up the cell.(polymerization)
2. Transport work: ATP supplies energy needed to pump substances across the plasma membrane.
3. Mechanical work: ATP supplies energy to move muscles, cilia and flagella, chromosomes, etc.





IV. Metabolic Pathways

A. Sequence of enzyme-controlled reactions.
B. Begin with particular reactant, end with a product
C. Have many intermediate steps.