



Topic 4: Metabolism

SCI141




Objectives

- Describe enzymes and their actions.
- Describe the processes of Photosynthesis & Respiration.

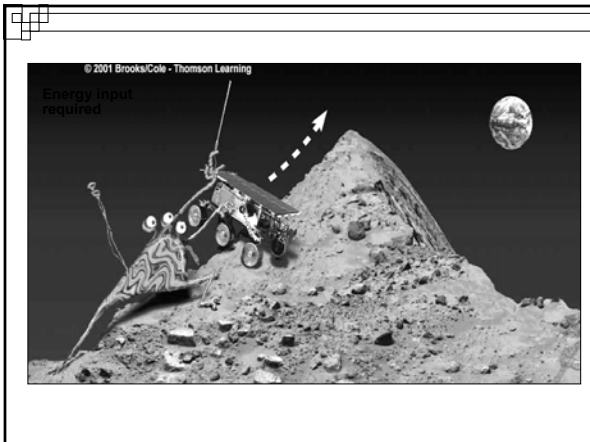

$$2\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + 2\text{O}_2$$

↑
Enzyme speeds up reaction



Enzymes

- Enzymes decrease activation energy
 - The amount of energy required to move a reaction forward
 - Reaction becomes more favorable



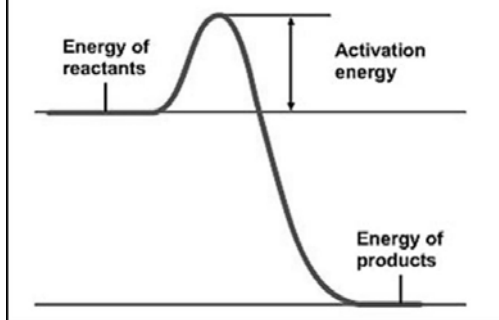
Four Features of Enzymes

- 1) Enzymes do not make anything happen that could not happen on its own. They just make it happen much faster.
- 2) Reactions do not alter or use up enzyme molecules.

Four Features of Enzymes

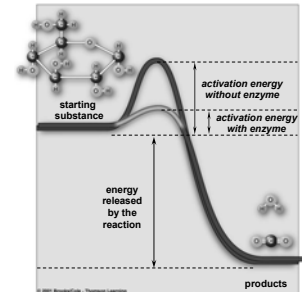
- 3) The same enzyme usually works for both the forward and reverse reactions.
- 4) Each type of enzyme recognizes and binds to only certain substrates.

Without Enzyme



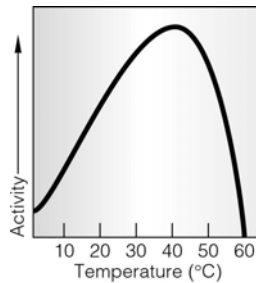
Activation Energy

- For a reaction to occur, an energy barrier must be surmounted
- Enzymes make the energy barrier smaller

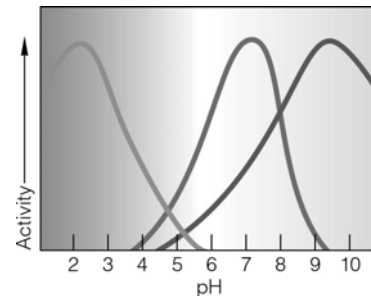


Effect of Temperature

- Small increase in temperature increases molecular collisions, reaction rates
- High temperatures disrupt bonds and destroy the shape of active site



Effect of pH

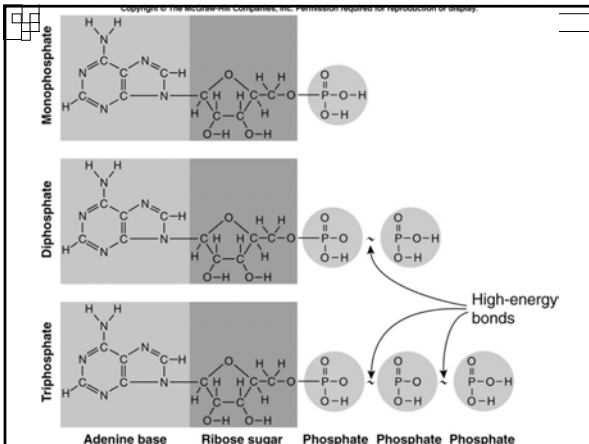


Enzymes

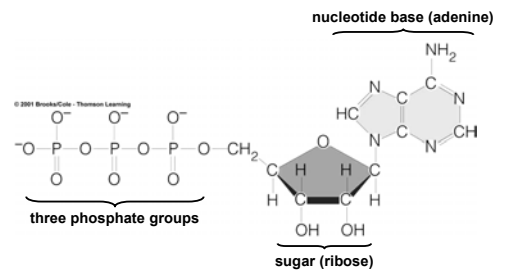
- Enzymes make metabolism much more efficient for organisms.

So how does metabolism work?

- Organisms all require energy for ...
- Organisms use high energy molecules to accomplish this
 - ATP

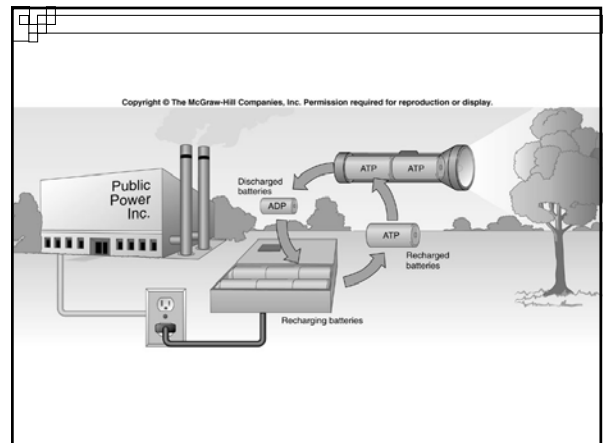


Structure of ATP



ATP → High Energy Molecule

- Phosphate groups are all negatively charged
- By releasing one phosphate group, the molecule is more stable → energy is released
- Hundreds of enzymes can do:
 - $\text{ATP} + \text{ENZ} \rightarrow \text{ADP} + \text{P} + \text{Energy}$



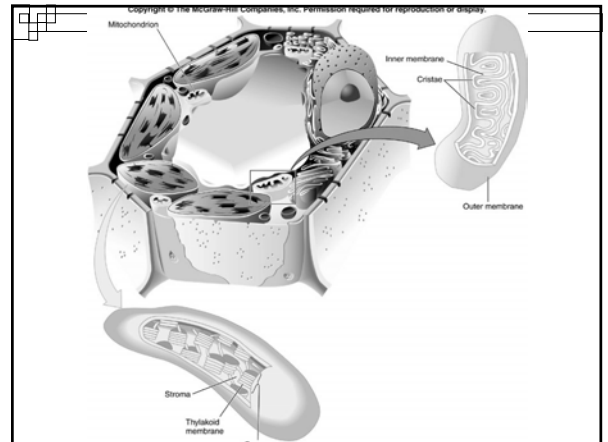
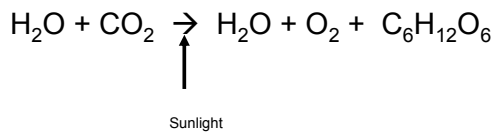
Metabolism

- We need a power plant in order to recharge the ATP
- Ultimate source of energy on earth
 - The sun

Photosynthesis

- Create some sort of stored or potential energy
- Requires pigments that react to sunlight

Photosynthesis



Steps of Photosynthesis

1. **Light Capturing Phase**

Requires pigments (Chlorophyll)

Pigments release excited electrons

Electrons provide energy for next step

Photosynthesis

2. **Light-dependant Phase**

Occurs in the Thylakoid Membrane

H₂O and excited electrons are used to create ATP for the next step

“Byproduct” → O₂

Photosynthesis

3. Light-Independent stage

Takes place in Stroma

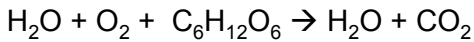
CO₂ is "fixed" into 6 Carbon sugars

Result is glucose → C₆H₁₂O₆

Photosynthesis

- Glucose is stable and can be stored in cells
- Oxygen as a byproduct can be used to release the potential energy stored in glucose

Respiration



And as a result ATP gets charged.

Respiration

- Occurs in Mitochondria
- Many small reactions → 3 steps

Respiration

1. **Glycolysis**

Several enzymes break down glucose into a 3 carbon form → Pyruvate

Without Oxygen, Pyruvate can be broken down into lactic acid → only generates 2 ATP

Respiration

2. **Krebs Cycle**

Uses pyruvate to start releasing electrons

Electrons provide energy for the next step

Byproduct is CO₂

Respiration

3. ETS

Electron and O_2 work to charge up ATP

Net ATP gain is 36 ATP per glucose

