HARVESTING ENERGY

Objectives

1. Define metabolism and differentiate between catabolism and anabolism.
2. Recognize various forms of energy and the Laws of Thermodynamics.
3. Define endergonic, exergonic, oxidation and reduction reactions.
4. Describe how enzymes work.
5. Recognize ATP, its role in metabolism, and two ways it is made.

Outline

A. Metabolism
   1. Laws of Thermodynamics
   2. Enzymes
   3. Adenosine Triphosphate (ATP)
   4. Electron Transport Chain (ETC)
   5. Generation of ATP

A. Metabolism

- Catabolism
    - exergonic
- Anabolism
    - endergonic
- Metabolic Pathway
    - Each step catalyzed by different enzyme

1. Laws of Thermodynamics

- Energy (E)

    - Only true for a closed system

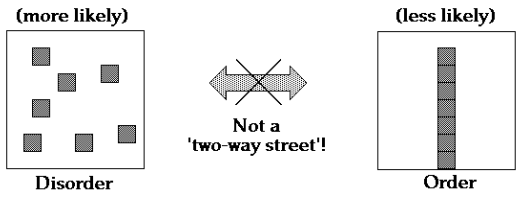
1. Energy cannot be created or destroyed

    - It can only change form

2. In all transformations, some energy cannot do work

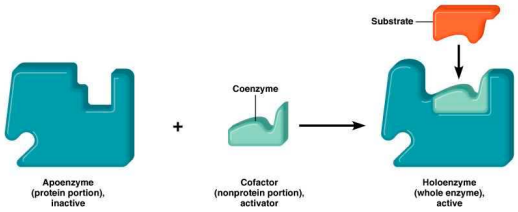
    - Entropy
        - Randomness

    - Energy required to reverse entropy



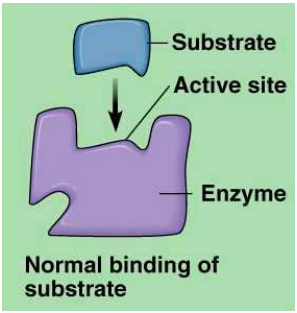
2. Enzymes

- Holoenzyme

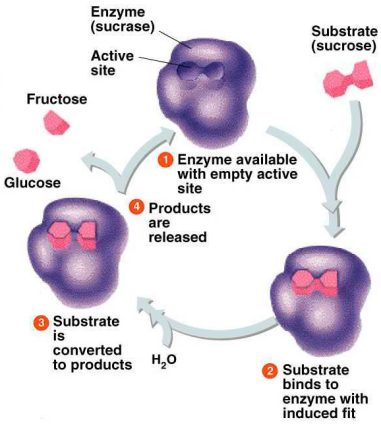


  - Apoenzyme
  - Nonprotein component
    - cofactor
    - coenzyme

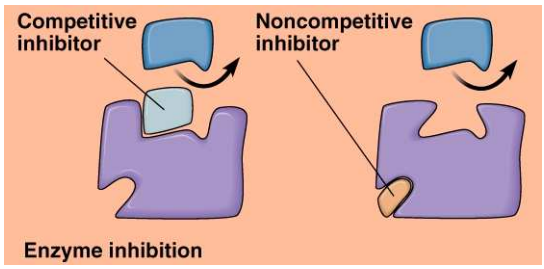
- Active site



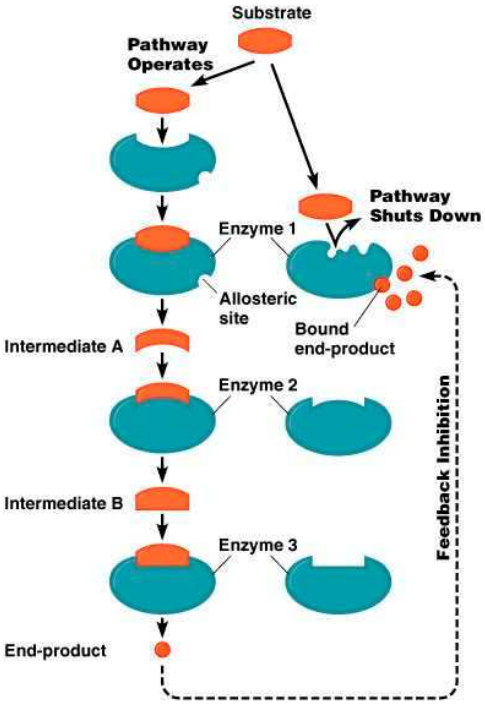
  - Enzyme-substrate complex



- Affected by
  - temperature
  - pH
  - Inhibitors
    - e.g., poisons, medicines

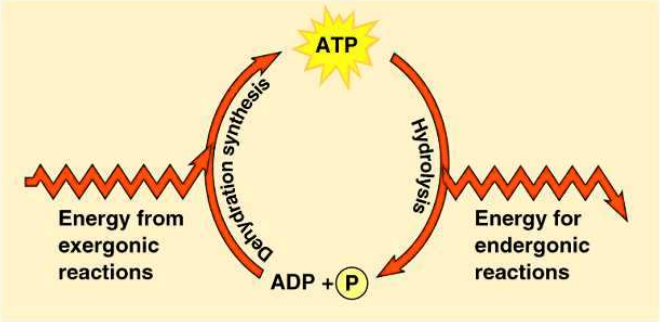


    - Competitive
    - Noncompetitive
  - Feedback inhibition



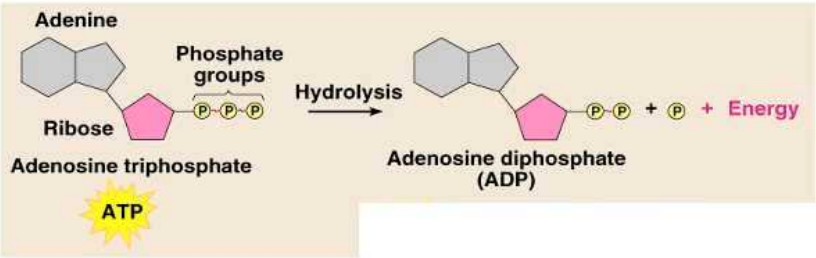
3. Adenosine Triphosphate (ATP)

- Transports energy
    - Couples endergonic-exergonic reactions



- E released when 2nd or 3rd Ⓟ released

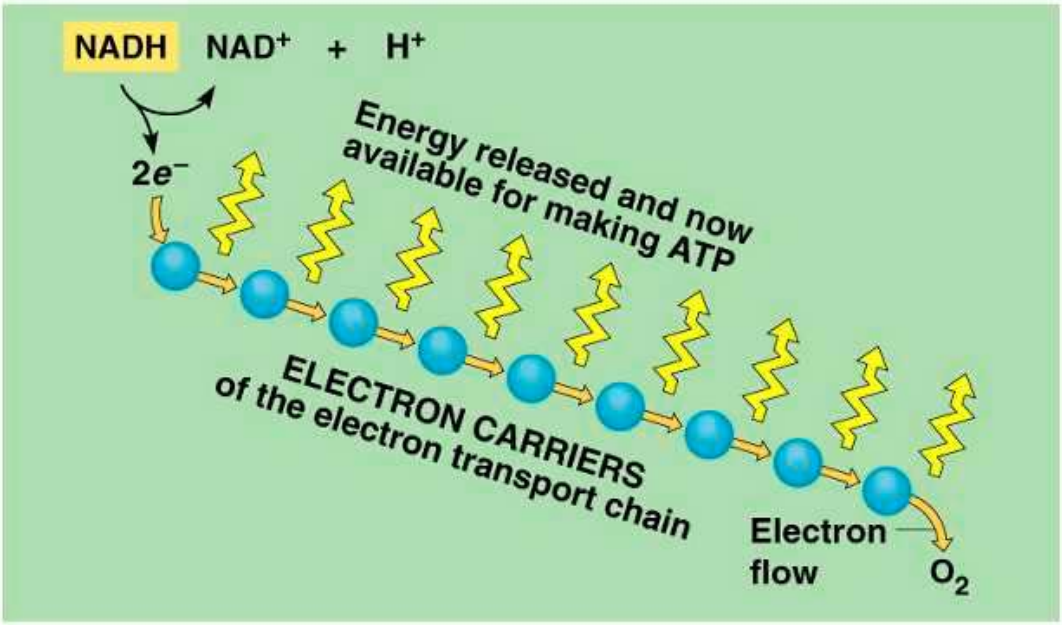
- E expended to add 2nd or 3rd Ⓟ
    - Phosphorylation



- Involved in many E transformations

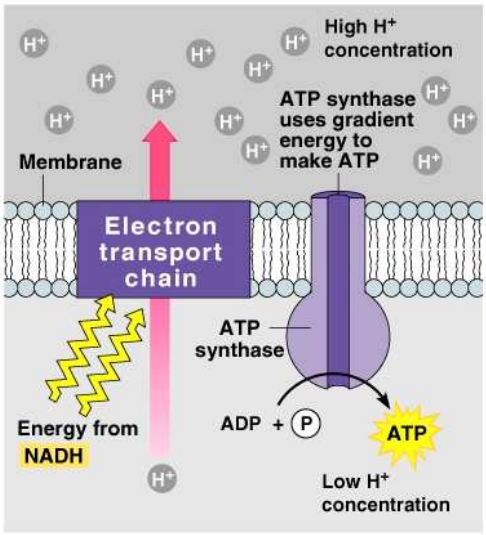
4. Electron Transport Chain (ETC)

- String of electron carriers
    - Embedded in a membrane
    - Pass electrons from one to another
        - Series of oxidations-reductions
    - Energy released with each transfer
- Main energy producer in eukaryotic cell



5. Generation of ATP

- Chemiosmosis



- Uses energy from H^+ gradient

- Redox reactions pump H^+ out of cell

    - Occurs in ETC

    - $[H^+]$ high outside, low inside

- $[H^+]$ carries potential energy

- H^+ diffuses across membrane

    - ATP Synthase

        - Couples diffusion with phosphorylation

- Types
  - oxidative phosphorylation

  - photophosphorylation

- Substrate-level phosphorylation (SLP)