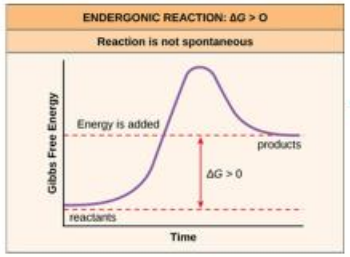
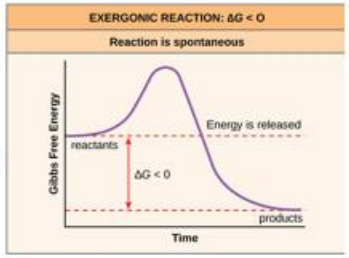
Unit 3:
Cellular Energetics

Endergonic Reaction



- Not spontaneous
- ABSORB energy
- Example: ADP + P_i → ATP

Exergonic Reaction



- Spontaneous
- RELEASE energy
- Example: ATP → ADP + P_i

Gibbs Free Energy & Reactions

What is Gibbs Free Energy?

- Energy available to do work

$$\Delta G = \Delta H - T\Delta S$$

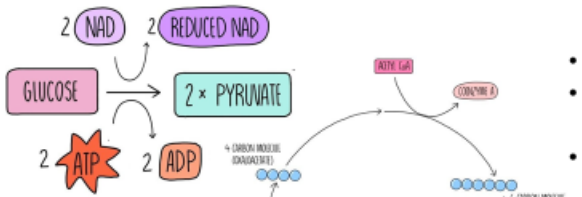
- ΔG: Change in Gibbs Free Energy
- ΔH: Change in Enthalpy
- T: Temperature (K)
- ΔS: Change in Entropy

$$\Delta G = \Delta G_f - \Delta G_i$$

Cellular Respiration

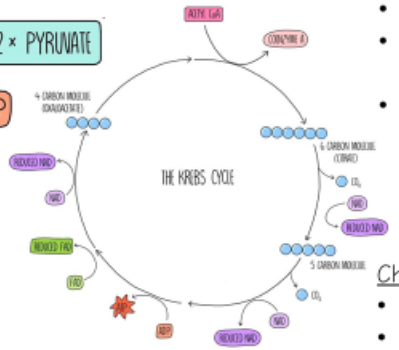
Glycolysis

- Location: Cytosol
- Starting Material:
  - Glucose
- Products:
  - 2 Pyruvate
  - 2 NADH
  - 2 ATP



Krebs Cycle

- Location: Mitochondrial Matrix
- Staring Material:
  - Acetyl CoA
- Products:
  - 2 CO_2
  - 3 NADH
  - 1 $FADH_2$
  - 1 ATP



Oxidative Phosphorylation

- Location: Mitochondrial Cristae
- Starting Material:
  - NADH/$FADH_2$ (electrons)
- Product:
  - ATPs
- Two Parts:

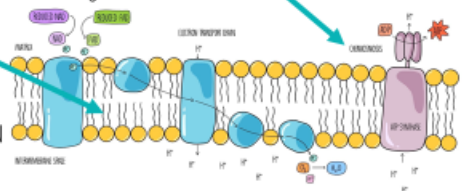
Electron Transport Chain & Chemiosmosis

Chemiosmosis

- ATP Synthase uses proton gradient
- Synthesizes ATP

Electron Transport Chain

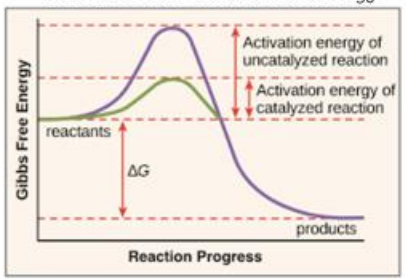
- Protons pumped into IM space
- Generates proton gradient
- Final electron acceptor: OXYGEN



Enzymes

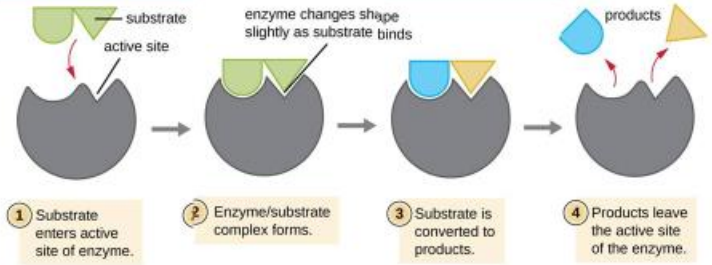
Functions

- Biological catalyst
- Speeds up chemical reactions
- Reduces the activation energy



Important Notes:

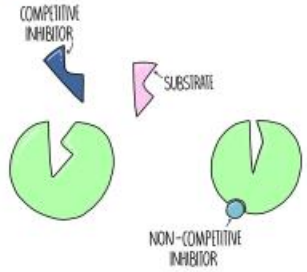
- Enzymes are PROTEINS
- Are NOT consumed by the reaction
- Have no effect on the change in Gibbs Free Energy



Inhibitors

Competitive:
- Binds to active site

Noncompetitive:
- Binds to allosteric site



Denaturation

Environmental Temperatures
pH
(outside of optimal range)
Salinity

Photosynthesis

Light Reactions

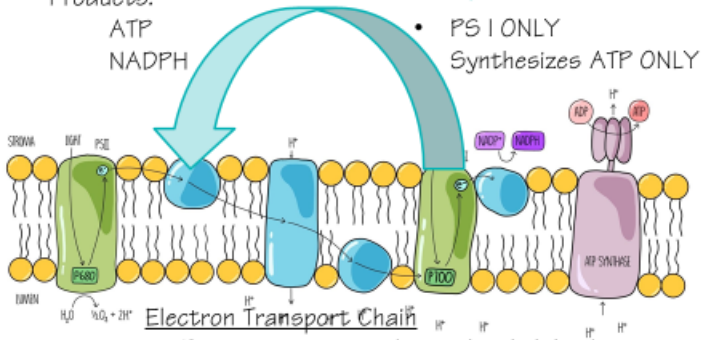
- Location: Thylakoid Membrane
- Starting Material:
  - Water (electrons)
  - Photons (energy)
- Products:
  - ATP
  - NADPH

Linear Electron Flow

- PS I & PS II
- Synthesizes ATP & NADPH

Cyclic Electron Flow

- PS I ONLY
- Synthesizes ATP ONLY

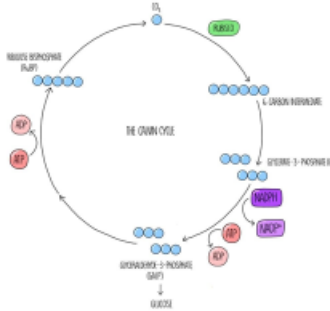


Electron Transport Chain

- Protons are pumped into the thylakoid space

Calvin Cycle

- Location: Stroma
- Starting Material:
  - 3 CO_2
  - 9 ATP
  - 6 NADPH
- Products:
  - G3P



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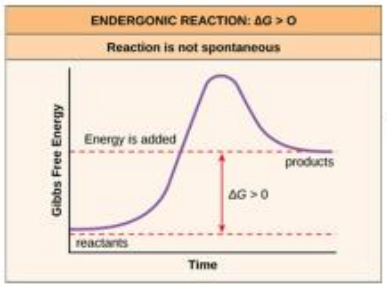

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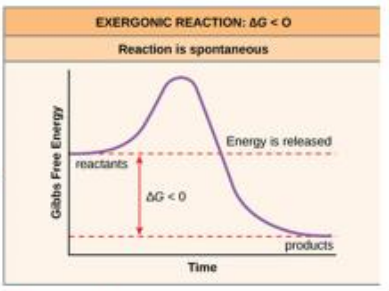

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Gibbs Free Energy & Reactions

Temperature (K)

Change in Gibbs Free Energy — $\Delta G = \Delta H - T\Delta S$ — Change in Entropy

Change in Enthalpy

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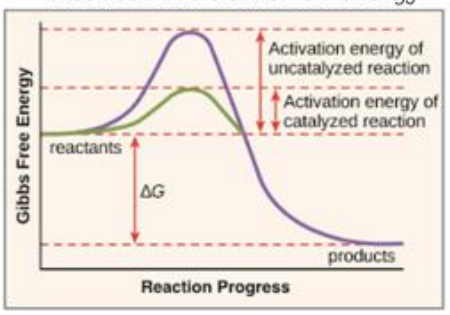

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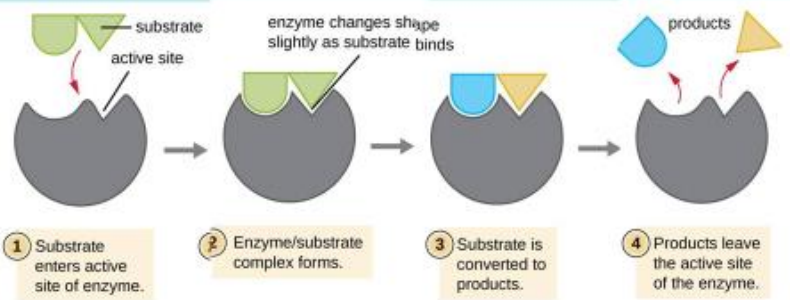

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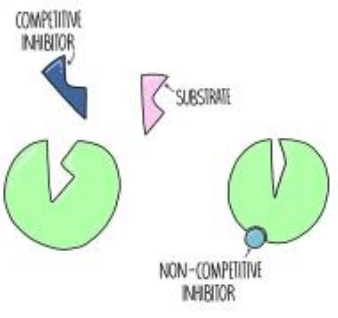

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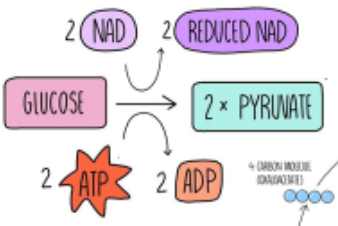

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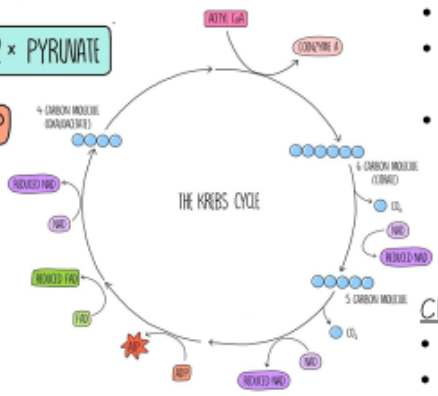

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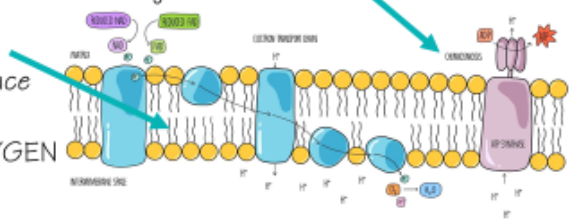

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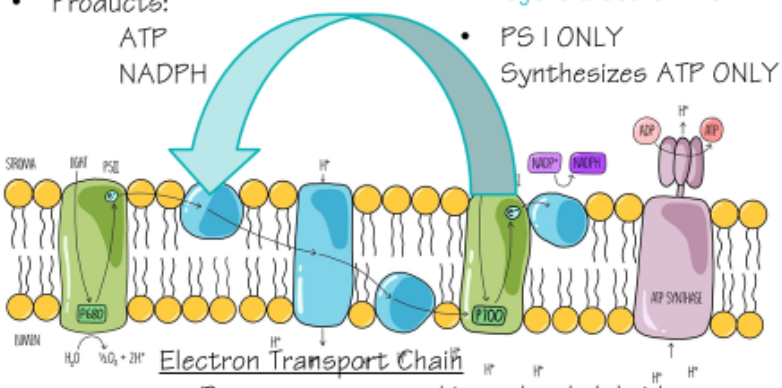

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