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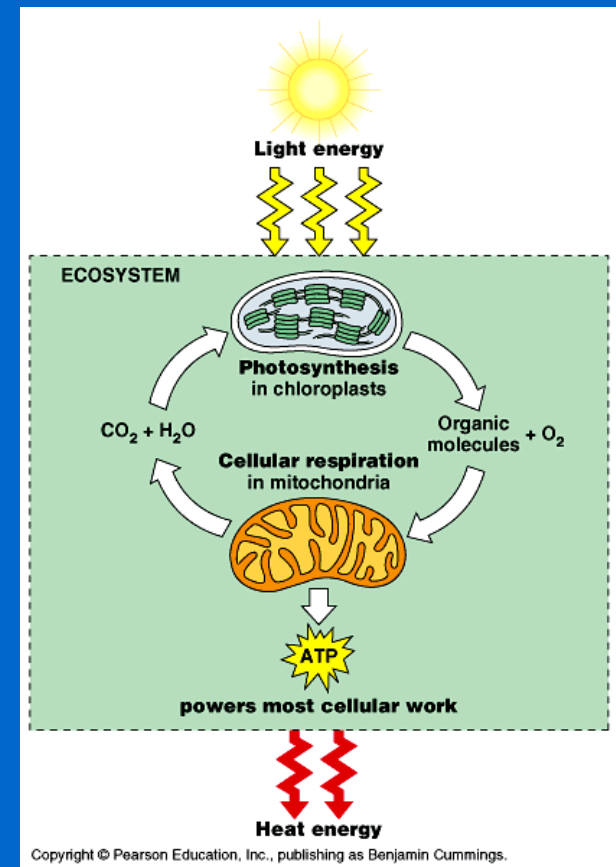
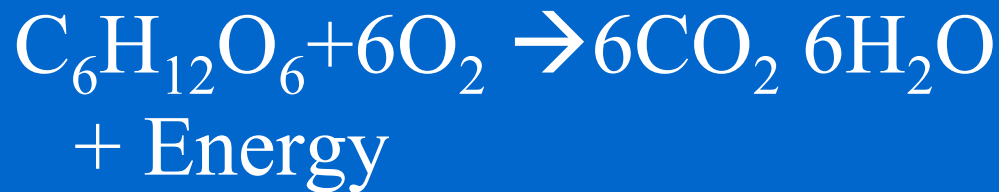
Cellular Respiration

- Chapter 5-3



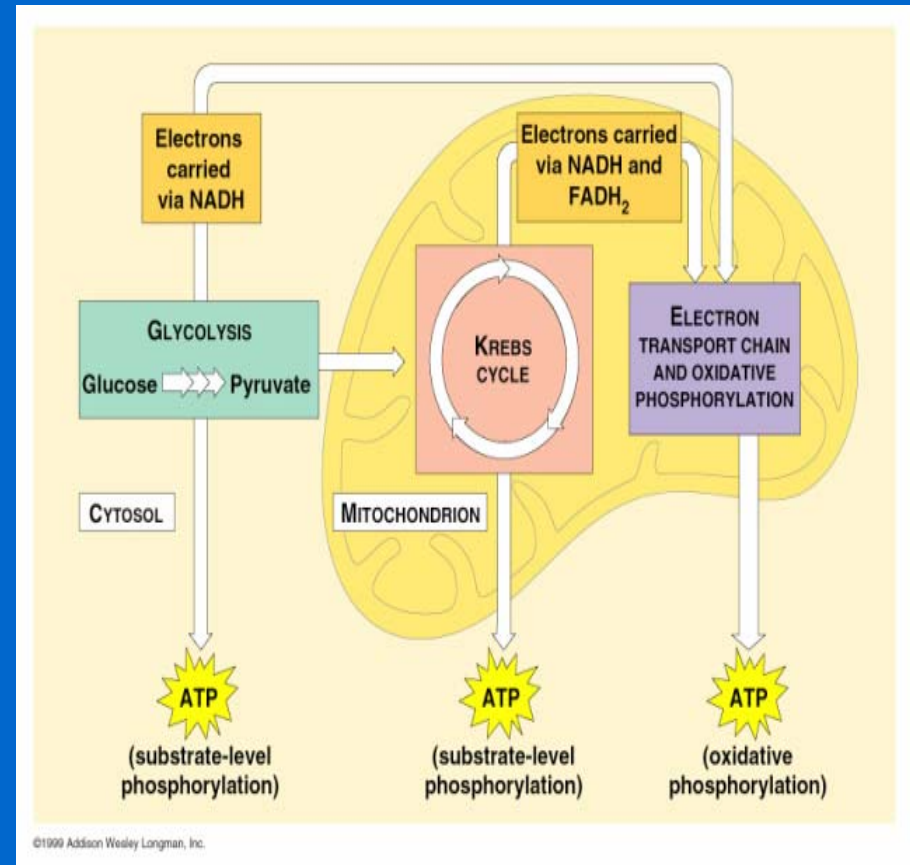
Principles of Energy Harvest

- Catabolic pathway
 - Fermentation
 - Cellular Respiration



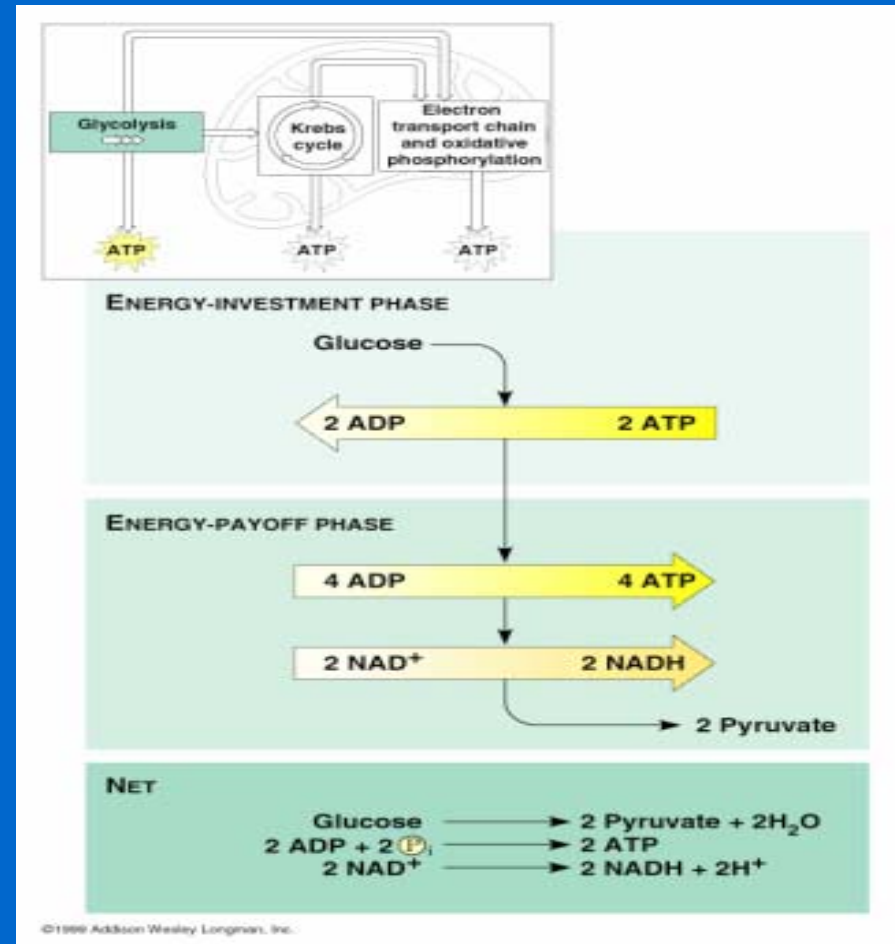
Cellular respiration

- Glycolysis: cytosol; degrades glucose into pyruvate
- Kreb's Cycle: mitochondrial matrix; pyruvate into carbon dioxide
- Electron Transport Chain: inner membrane of mitochondria; electrons passed to oxygen



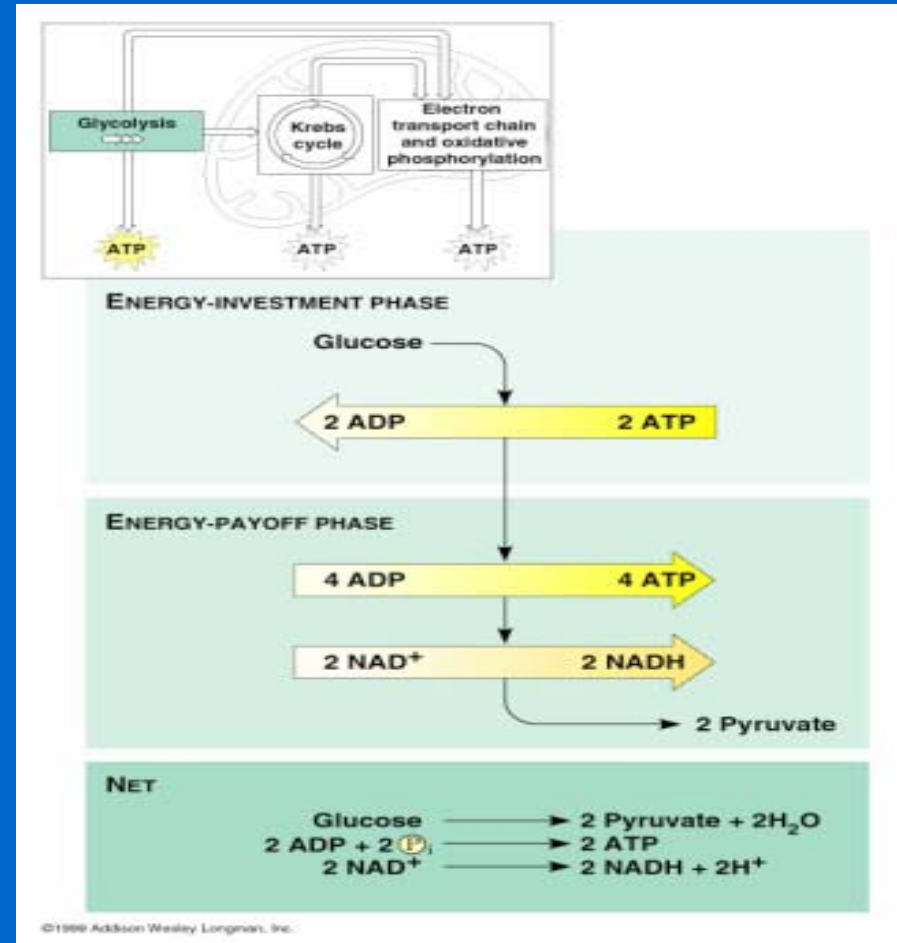
Glycolysis

- 1 Glucose \rightarrow 2 pyruvate molecules
- Energy investment phase: cell uses ATP to start the reaction
 - 2 ATP
- Energy payoff phase: energy is produced
 - 4 ATP and 2 NADH



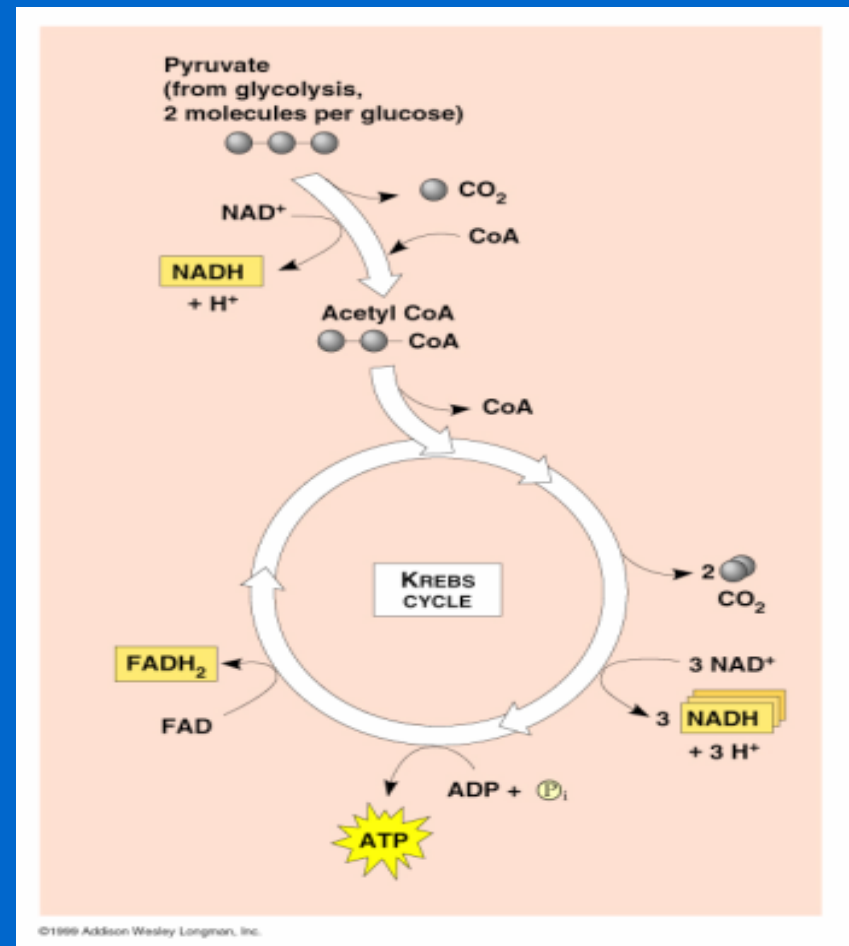
Glycolysis

- Net energy yield per glucose molecule:
 - 2 ATP plus 2 NADH
 - no CO_2 is released
 - occurs aerobically or anaerobically



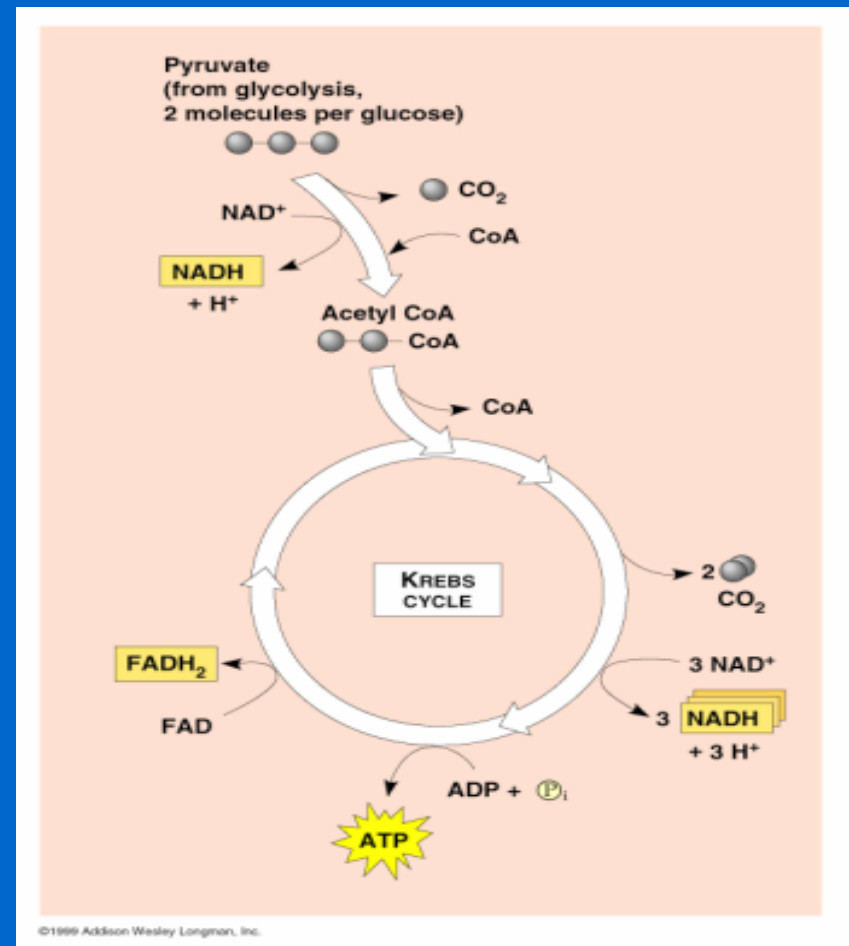
Kreb's Cycle

- If molecular oxygen is present.....
- Each pyruvate is converted into acetyl CoA (begin w/ 2)
 - CO_2 is released
 - $\text{NAD}^+ \rightarrow \text{NADH}$
 - $\text{FAD} \rightarrow \text{FADH}_2$
- From this point, each turn 2 C atoms enter (pyruvate) and 2 exit (carbon dioxide)



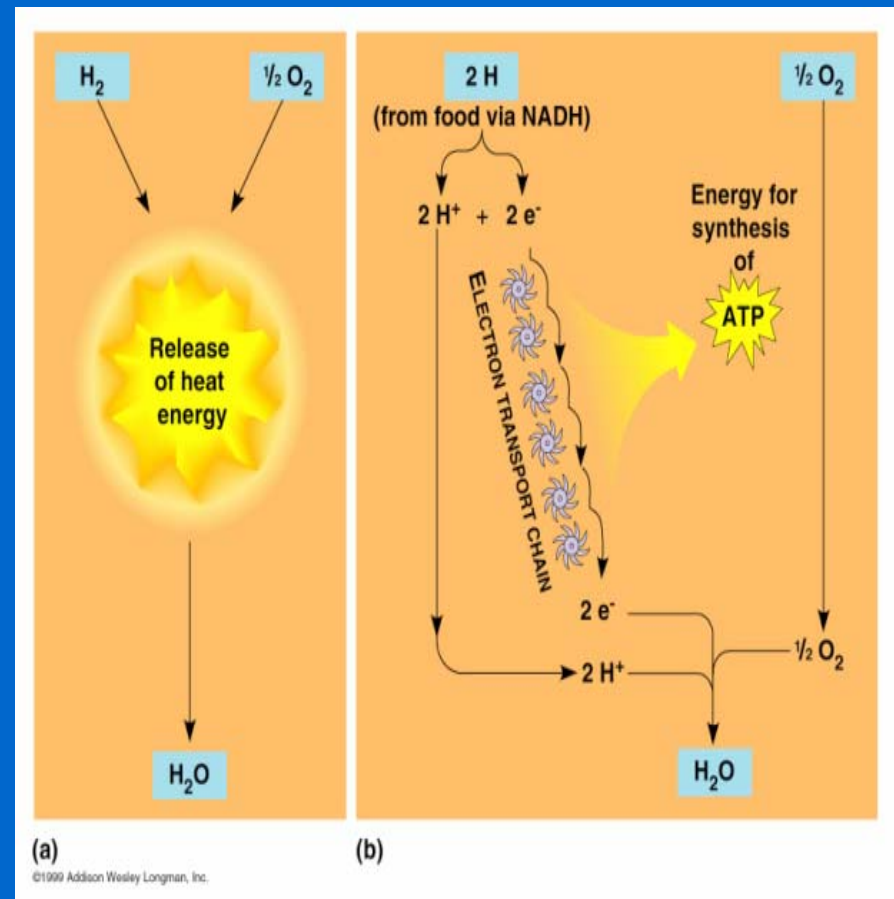
Kreb's Cycle

- For each pyruvate that enters:
 - 3 NAD^+ to NADH
 - 1 FAD^+ to FADH_2
 - 1 ATP molecule



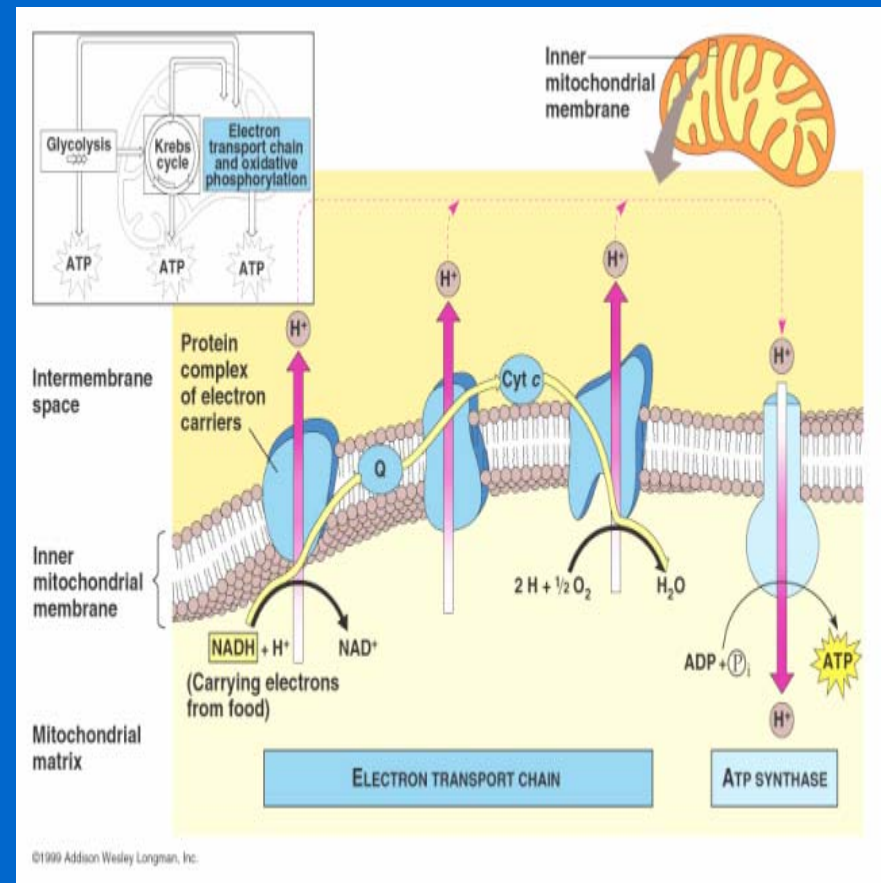
Electron transport chains

- Electron carrier molecules (membrane proteins)
- Shuttles electrons that release energy used to make ATP
- Sequence of reactions that prevents energy release in 1 explosive step
- Electron route:
 - Food \rightarrow NADH \rightarrow electron transport chain \rightarrow oxygen



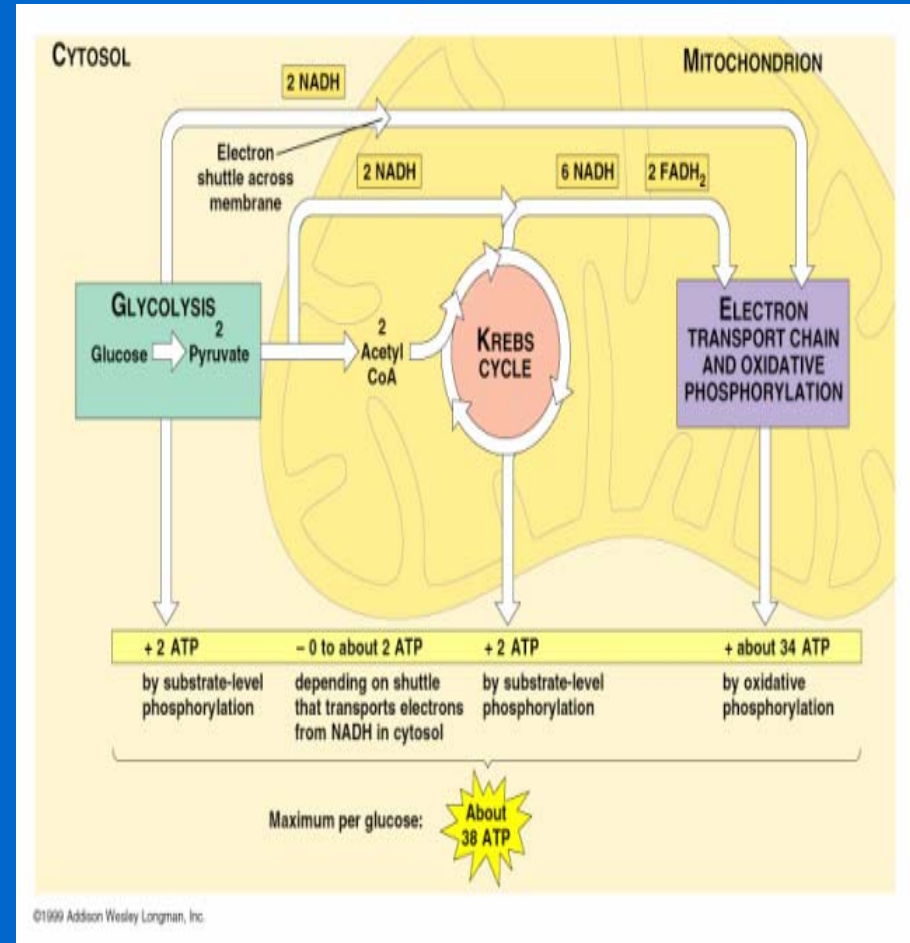
Electron transport chain

- Cytochromes carry electron carrier molecules (NADH & FADH₂) down to oxygen
- Chemiosmosis
- ATP synthase: produces ATP by using the H⁺ gradient pumped into the inner membrane space from the electron transport chain; this enzyme harnesses the flow of H⁺ back into the matrix to phosphorylate ADP to ATP



Review: Cellular Respiration

- Glycolysis: 2 ATP
- Kreb's Cycle: 2 ATP
- Electron transport
2 NADH (glycolysis) = 6ATP
2 NADH (acetyl CoA) = 6ATP
6 NADH (Kreb's) = 18 ATP
2 FADH₂ (Kreb's) = 4 ATP
- 38 TOTAL ATP/glucose



Related metabolic processes

- If oxygen is not present
- Fermentation:
 - Alcohol: pyruvate to ethanol
 - lactic acid: pyruvate to lactate

