LIFE SCIENCES 11
CELLULAR RESPIRATION & FERMENTATION

Learning Outcomes

- **I can identify the organelle responsible for cellular respiration and describe its composition.**
- **I can write the chemical equation for cellular respiration.**
- **I can identify where the four different steps of cellular respiration occur and what each step produces.**
- **I can describe the difference between cellular respiration and fermentation in terms of where it occurs and what the final outcome is.**

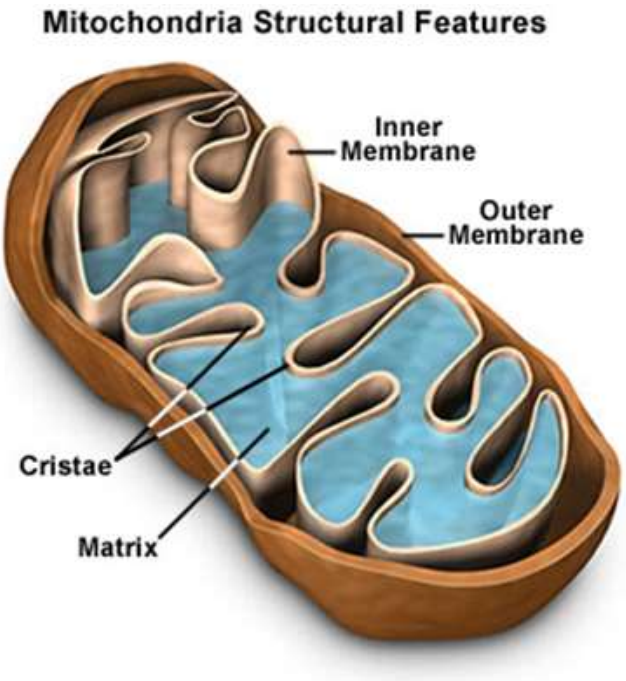
Cellular Respiration

- all plants and animals use the energy stored in glucose to drive the metabolic processes that sustain life
- cellular respiration is the breakdown of glucose using O_2 to produce CO_2, H_2O and energy (in the form of ATP)

$$ADP + P \quad ATP$$

$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$$

- 36 to 38 ATP molecules are produced for every glucose molecule
  - approximately 40% of the energy stored in a glucose molecule; rest is lost to heat

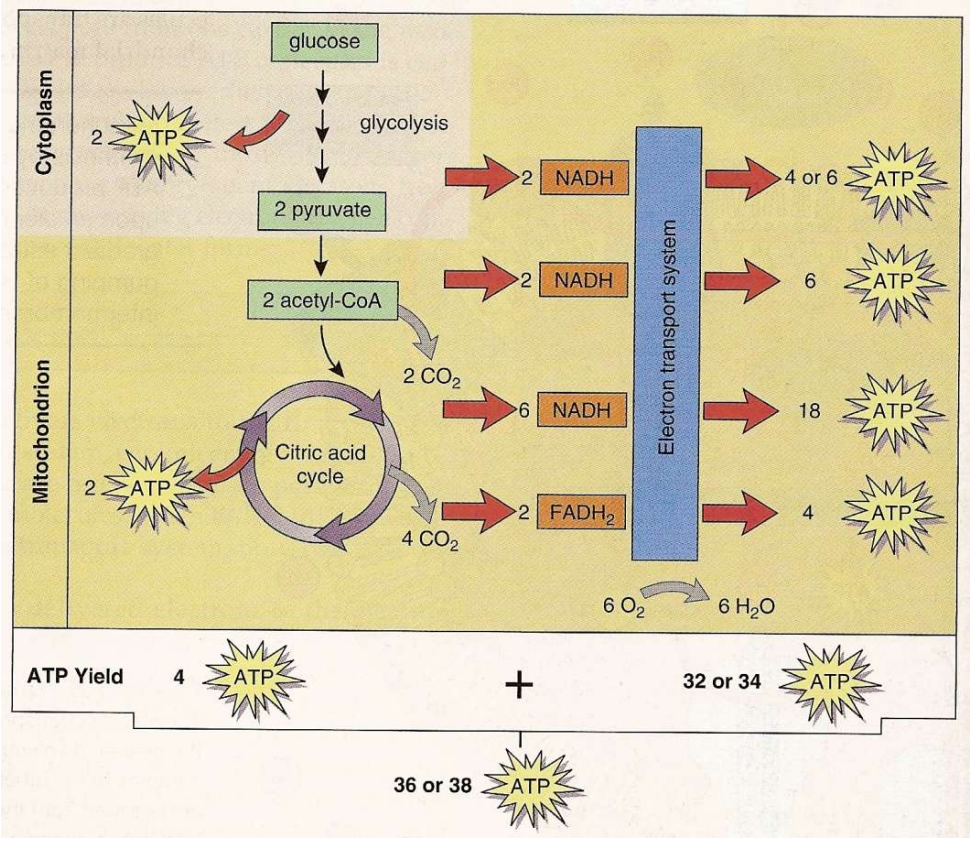


- Phases
  1. Glycolysis
     - breakdown of glucose to two molecules of pyruvate (a 3-C compound) inside the cytoplasm
     - results in the production of 2 ATP molecules and 2 NADH molecules (used in electron transport system)
     - does not require the presence of O_2

  2. Transition Reaction
     - movement of pyruvate molecules across the mitochondrial membrane
     - oxidation of pyruvate to a 2-C acetyl group attached to coenzyme A (acetyl-CoA)
     - occurs twice per glucose molecule
     - results in the production of 2 CO_2 and 2 NADH molecules

  3. Citric Acid Cycle (Kreb's Cycle)
     - cyclical series of reactions that give off CO_2 and produce 2 ATP molecules
     - 4-C compound attaches to one of the acetyl-CoA molecules to form a 6-C molecule
     - 6-C molecule is oxidized to form a 5-C molecule releasing one molecule of CO_2, then oxidized again to a 4-C compound releasing another molecule of CO_2
     - 4-C compound is recycled to join with another acetyl-CoA molecule
     - results in the production of 4 CO_2, 6 NADH, 2 $FADH_2$ and 2 ATP

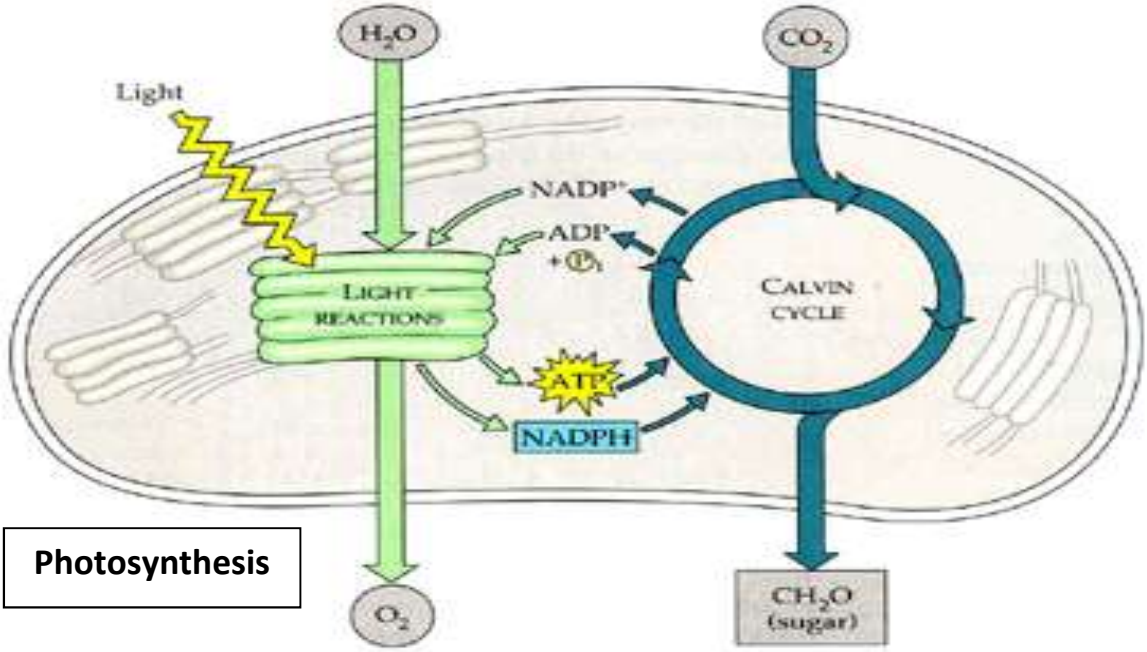
  4. Electron Transport System
     - series of electron carrier molecules that move electrons to O_2 → allows it to combine with H^+ ions to become H_2O
     - occurs on the cristae (folds) within the mitochondria
     - location where the NADH and $FADH_2$ molecules are reduced to NAD^+ and FAD, and then recycled back to the first 3 phases
     - results in the production of 32 – 34 ATP molecules
       - 3 ATP for each NADH
       - 2 ATP for every $FADH_2$



Fermentation

- used to produce ATP, especially in muscle cells, when O_2 is limited (ie: during strenuous exercise)
- similar to glycolysis, but the electrons gained by NAD^+ to form NADH are used to reduce pyruvate to either lactic acid or alcohol
  - lactic acid
    - 3-C molecule produced by animals
  - alcohol
    - 2-C molecule (ethanol) produced by plants
    - also makes one CO_2
- not as efficient → only 2 ATP produced per glucose

PHOTOSYNTHESIS AND CELLULAR RESPIRATION



Photosynthesis