8.1 How Organisms Obtain Energy

Transformation of Energy

- Energy is the ability to do work.
- Thermodynamics is the study of the flow and transformation of energy in the universe.

8.1 How Organisms Obtain Energy

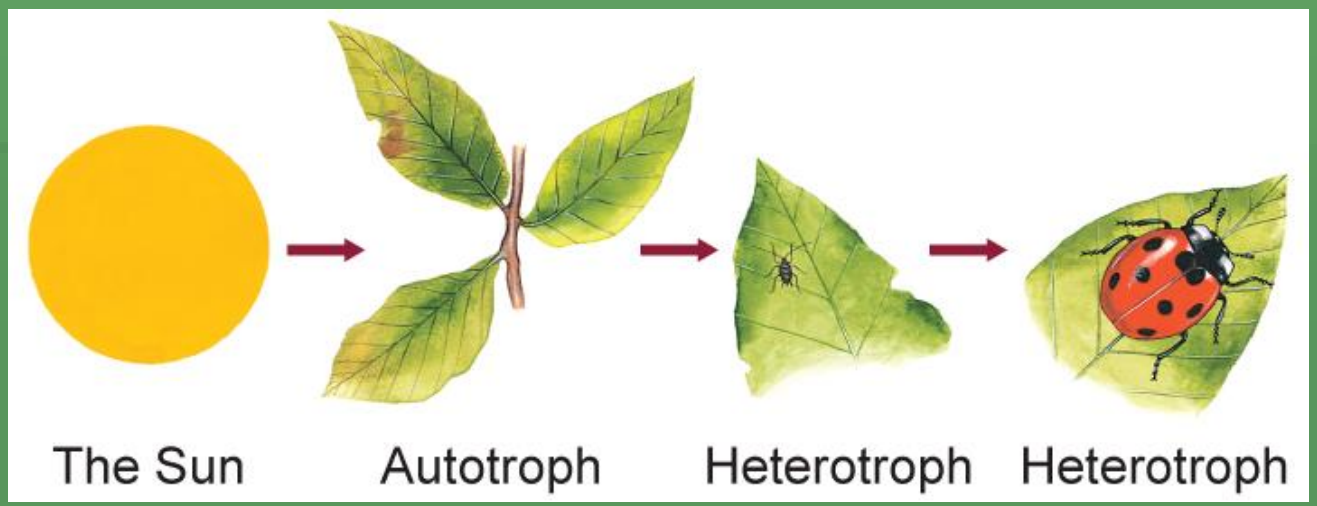
First Law of Thermodynamics

- Energy can be converted from one form to another, but it cannot be created nor destroyed.

8.1 How Organisms Obtain Energy

Autotrophs and Heterotrophs

- Autotrophs are organisms that make their own food.
- Heterotrophs are organisms that need to ingest food to obtain energy.



8.1 How Organisms Obtain Energy

- Metabolism - All of the chemical reactions in a cell

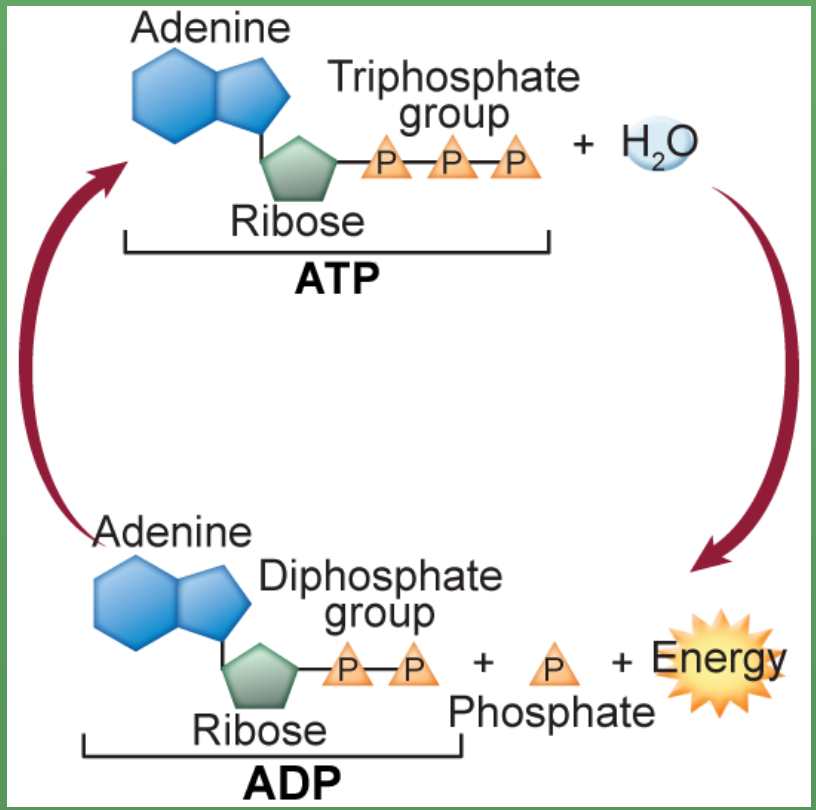
- Photosynthesis—light energy from the Sun is converted to chemical energy for use by the cell (Plants)

- Cellular respiration—organic molecules are broken down to release energy for use by the cell (Animals + Plants)

8.1 How Organisms Obtain Energy

ATP: The Unit of Cellular Energy

- ATP = Energy



8.2 Photosynthesis

Overview of Photosynthesis

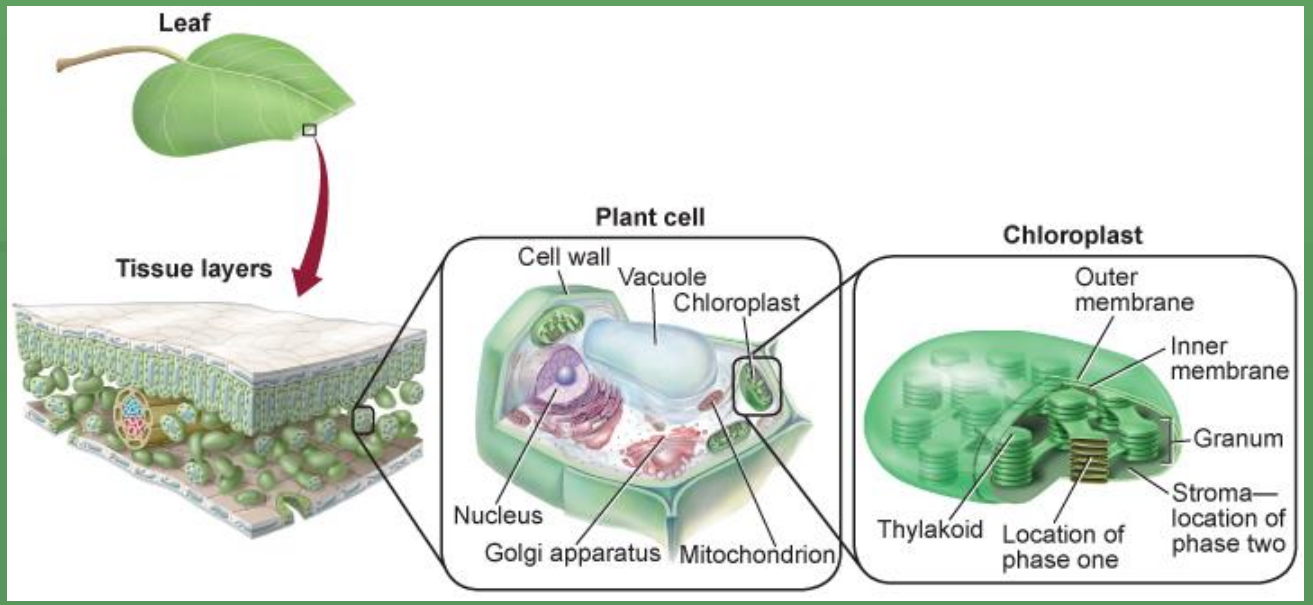
- Photosynthesis occurs in two phases.
  - Light-dependent reactions
  - Light-independent reactions

$$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$$

8.2 Photosynthesis

Phase One: Light Dependent Reactions

- The absorption of light is the first step in photosynthesis.
- Chloroplasts capture light energy.



8.2 Photosynthesis

Electron Transport

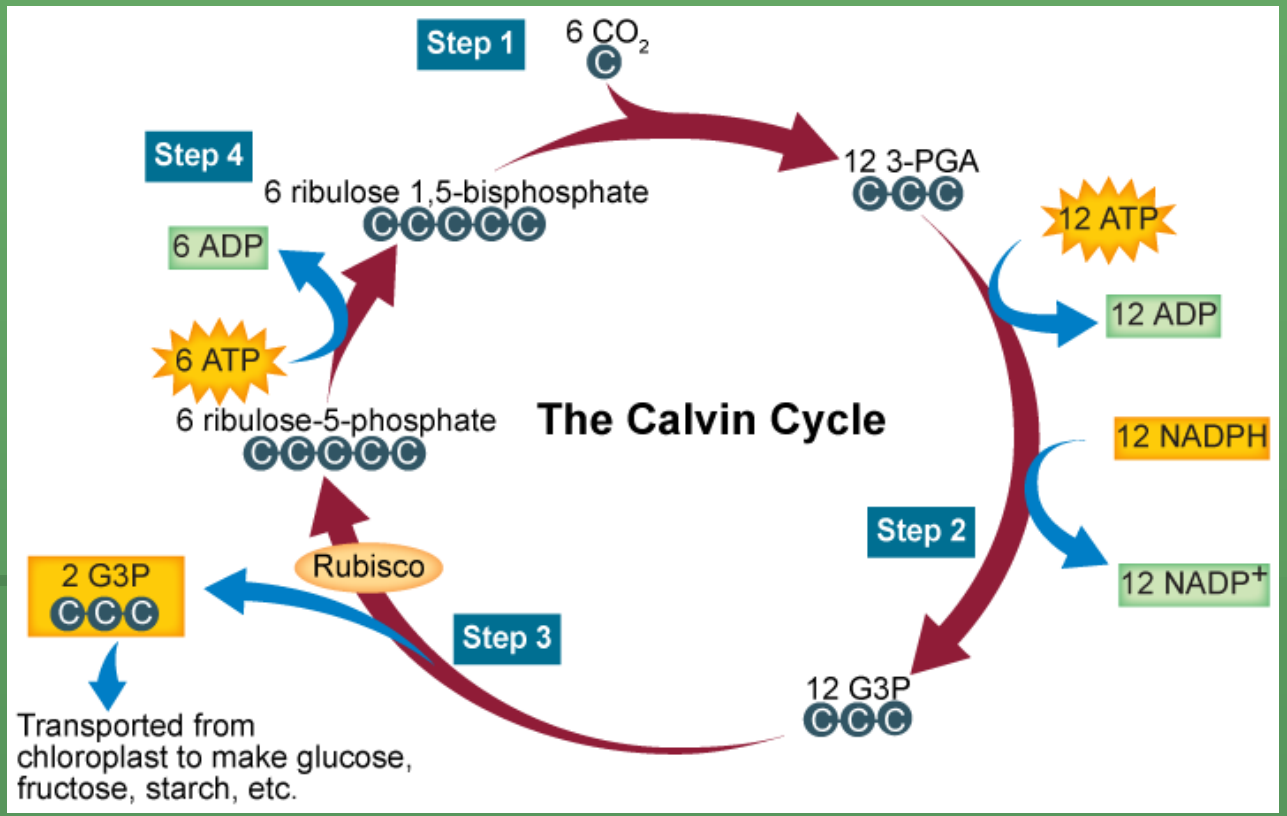
- Light energy causes a water molecule to split, releasing electrons into the electron transport system, H^+ into the thylakoid and releases O_2 as a waste product.

- The electrons and H^+ are used to make ATP and NADPH (energy carriers).

8.2 Photosynthesis

Phase Two: Light Independent, also called the Calvin Cycle

- In the Calvin cycle, energy is stored in organic molecules such as glucose.



- The ATP and NADPH from the Light Dependent Reactions are used to produce sugars from CO_2. It takes 6 CO_2 molecules to produce one sugar molecule.
- The energy is now stored in glucose.

8.3 Cellular Respiration

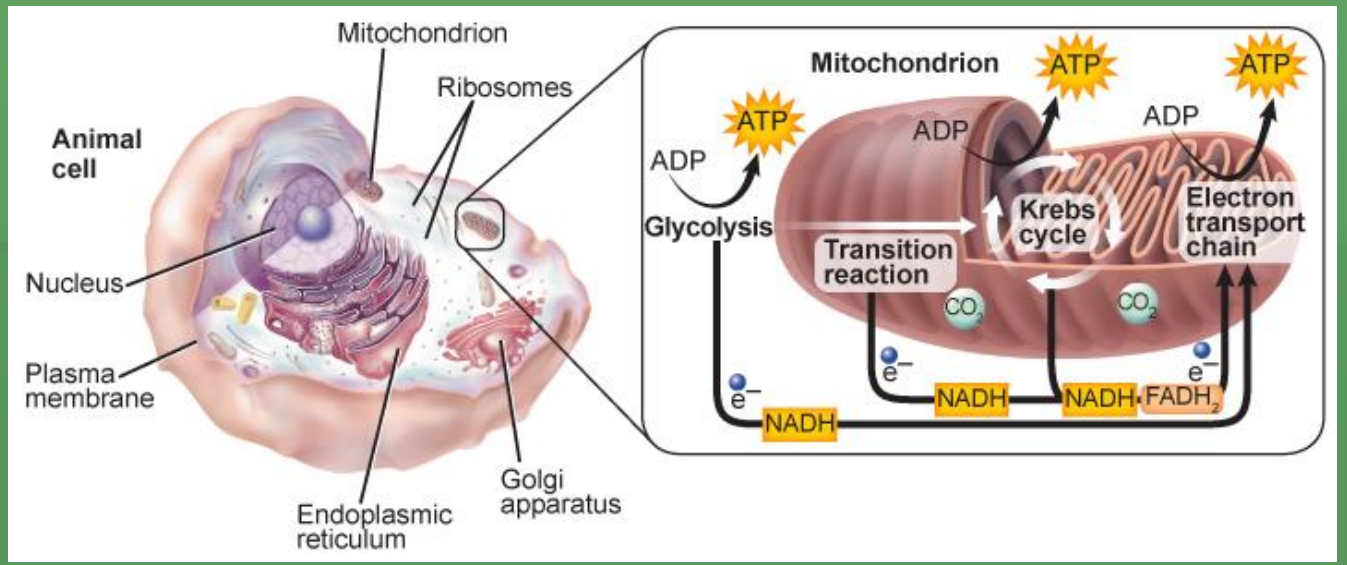
Overview of Cellular Respiration

- Organisms (plants and animals) obtain energy in a process called cellular respiration.
- The equation for cellular respiration is the opposite of the equation for photosynthesis.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

8.3 Cellular Respiration

- Cellular respiration occurs in two main parts.
  - Glycolysis
  - Aerobic respiration - Requires Oxygen



Resources

8.3 Cellular Respiration

Step 1: Glycolysis

- Glucose is broken down into pyruvic acid (or pyruvate) in the cytoplasm through the process of glycolysis.
- This process uses 2 ATP to get started and makes 4, so overall 2 ATP are made.

8.3 Cellular Respiration

Step 2: Krebs Cycle

- Most of the energy from the glucose is still contained in the pyruvic acid.
  - The series of reactions in which pyruvic acid is broken down into carbon dioxide is called the Krebs Cycle.
  - The Krebs Cycle occurs in the mitochondria.
  - The Krebs Cycle produces 2 ATP as well as other energy carrying molecules (NADH and $FADH_2$)

8.3 Cellular Respiration

Step 3: Electron Transport Chain

- Final step in the breakdown of glucose
- Point at which ATP is produced
- Produces 32 ATP
- Cellular Respiration makes 36 ATP total for each glucose molecule.

Use of Oxygen

- Glycolysis does not require oxygen, but the Electron Transport Chain (ETC) does.
- How many ATP were made in glycolysis?
- How many from the ETC?

8.3 Cellular Respiration

Anaerobic Respiration - No Oxygen Required

- When oxygen is not available, the cells cannot complete the full cycle of cellular respiration.
- They perform glycolysis and then a process called fermentation.
- Both these processes are **anaerobic** (don't require energy).

2 Types of Fermentation

- Alcoholic Fermentation – performed by yeast – makes CO_2 and alcohol
- Lactic Acid Fermentation – produces lactic acid – this is what causes your muscles to burn during a sprint