Photosynthesis and Cellular Respiration

by
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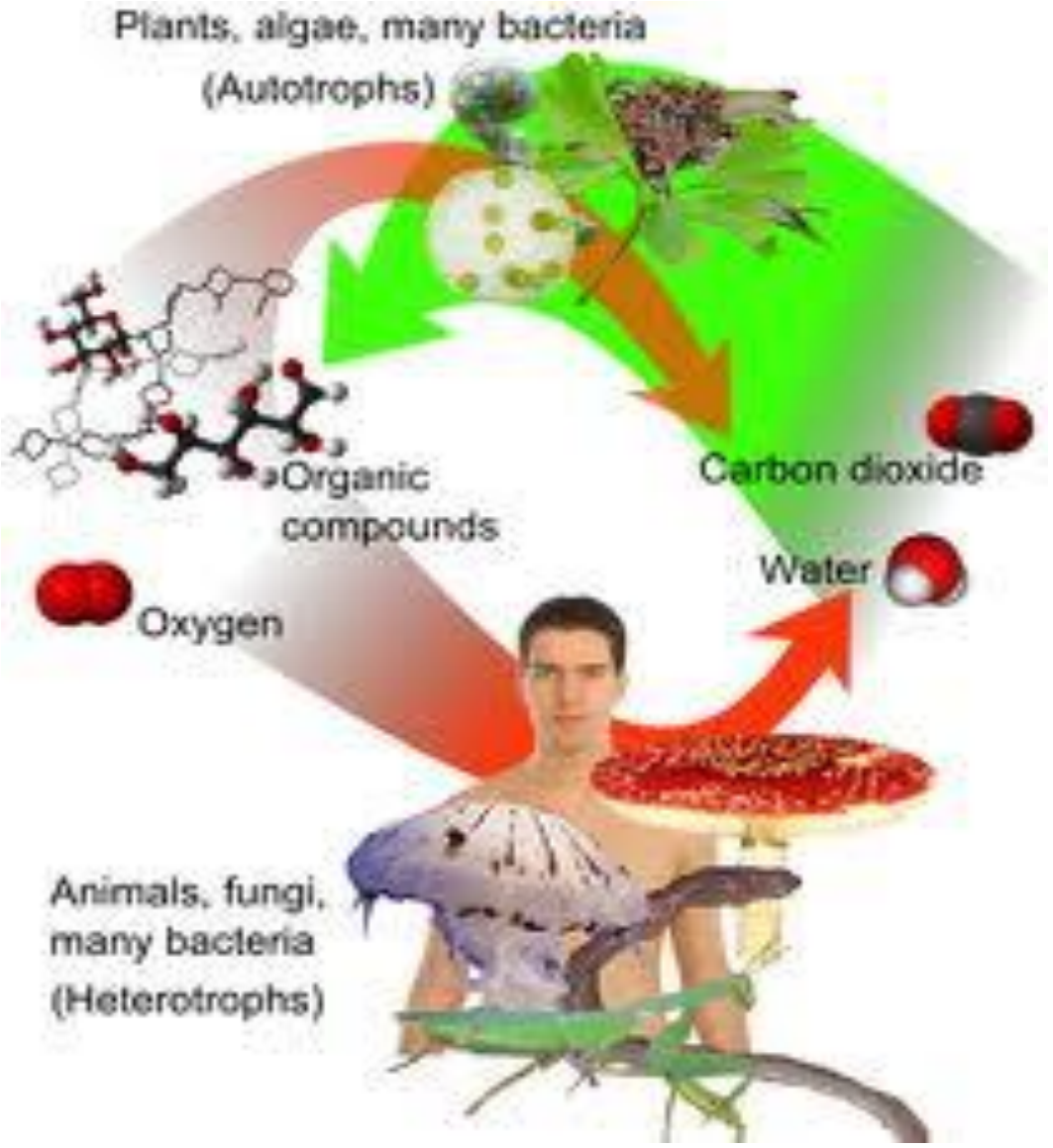
Energy

- All organisms require energy to live.
- Without energy, living organisms would not be able to grow, reproduce, respond to stimuli, or maintain homeostasis.
- Nearly all the energy available on our planet comes either directly or indirectly from the sun.

Autotrophs and Heterotrophs

- Some organisms can harness the sun's energy directly and convert it into food. These organisms are called **Autotrophs**
- There are also some organisms that can use chemicals like to make their own food. These organisms are called **Chemoautotrophs.**
- There are also other organisms that can't make their own food, so they eat other organisms. These organisms are called **Heterotrophs.**

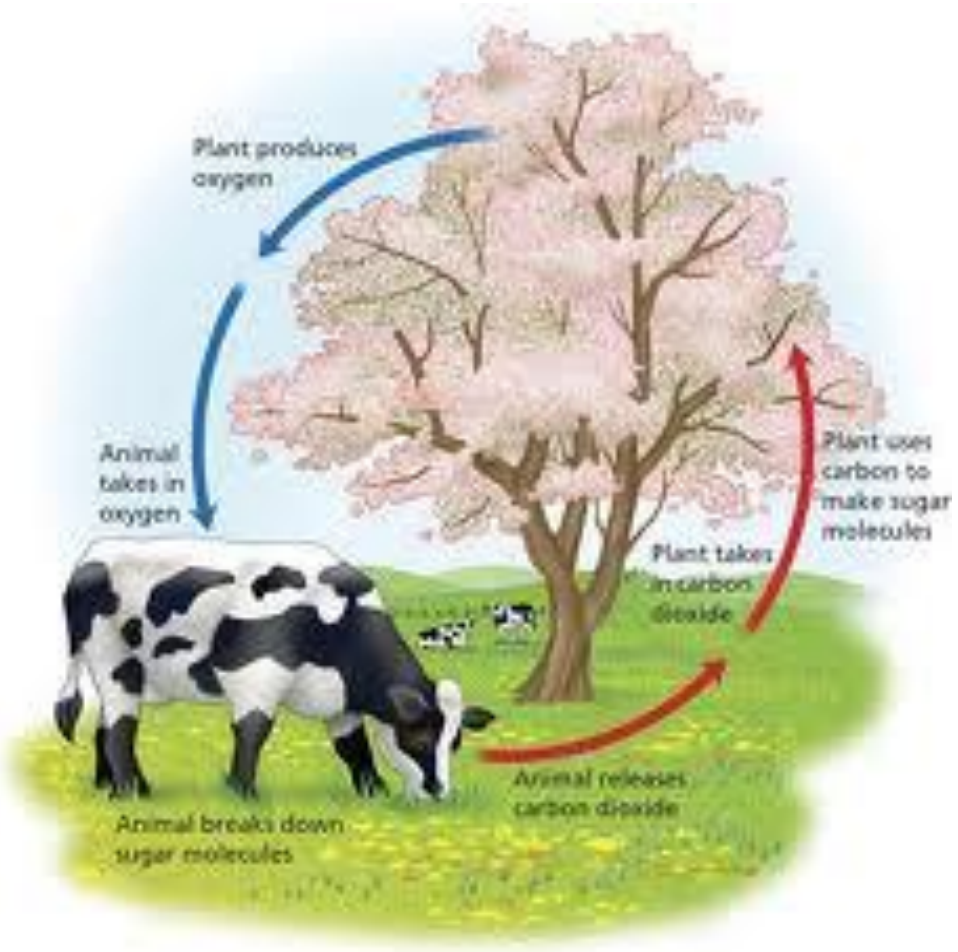
Autotrophs and Heterotrophs

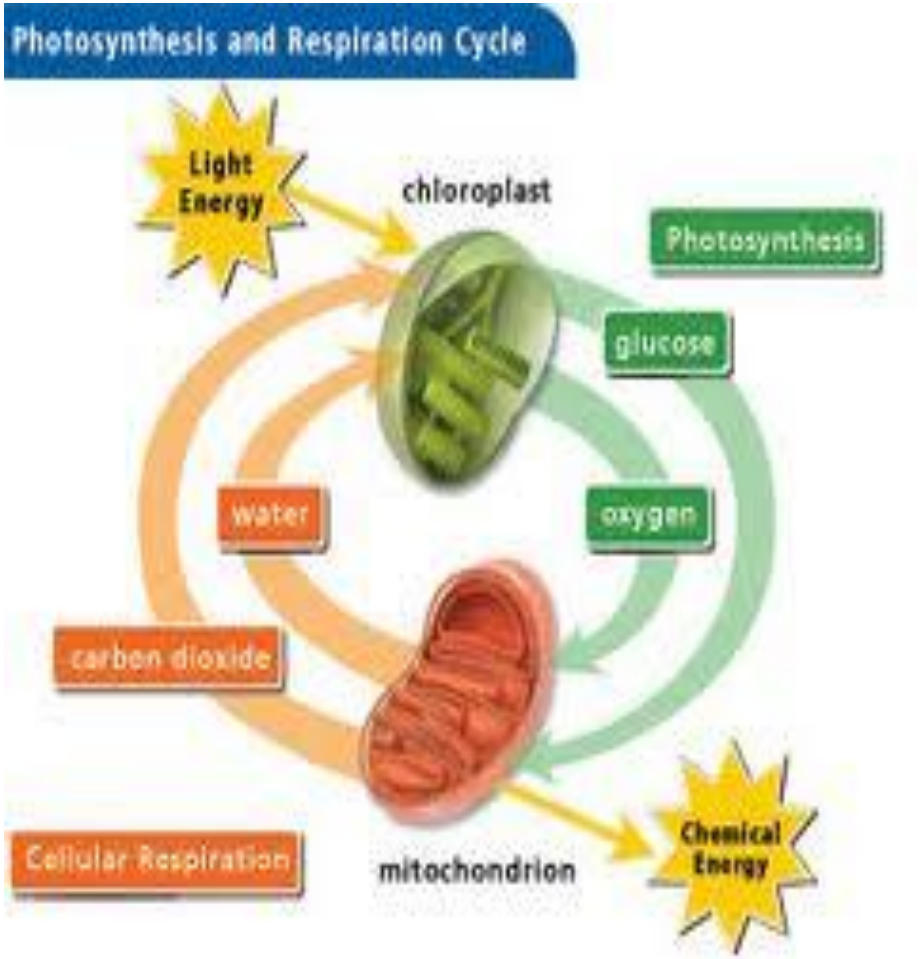


Metabolism

- **Metabolism** can be defined as the sum of all the chemical reactions in the body's cells.
- **Anabolic reactions** are metabolic reactions that build larger molecules from smaller ones.
- **Catabolic reactions** are metabolic reactions that break down large molecules into smaller ones.
- **Photosynthesis** is an anabolic reaction that uses energy from the sun to make glucose (sugar).
- **Cellular respiration** is a catabolic reaction that breaks down glucose to release energy.

Photosynthesis and Cellular Respiration

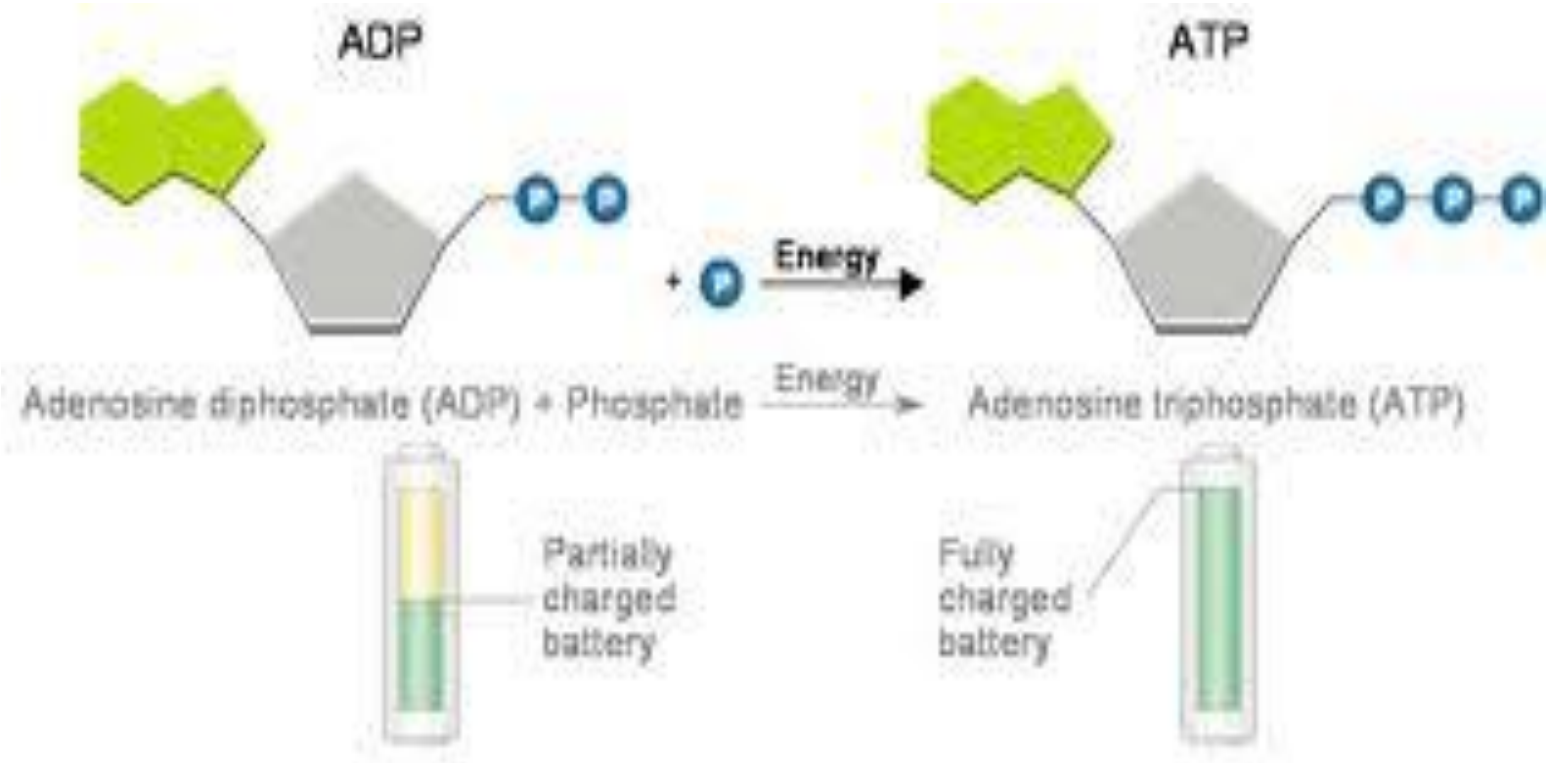




Adenosine Triphosphate (ATP)

- Even though living organisms require glucose for energy, glucose does not directly supply energy.
- In order to obtain energy, first a cells mitochondria must break down glucose in order to obtain **ATP**.
- ATP (Adenosine Triphosphate) is the most important energy molecule used by living organisms.
- When ATP loses a phosphate, it releases energy and becomes adenosine diphosphate (ADP).

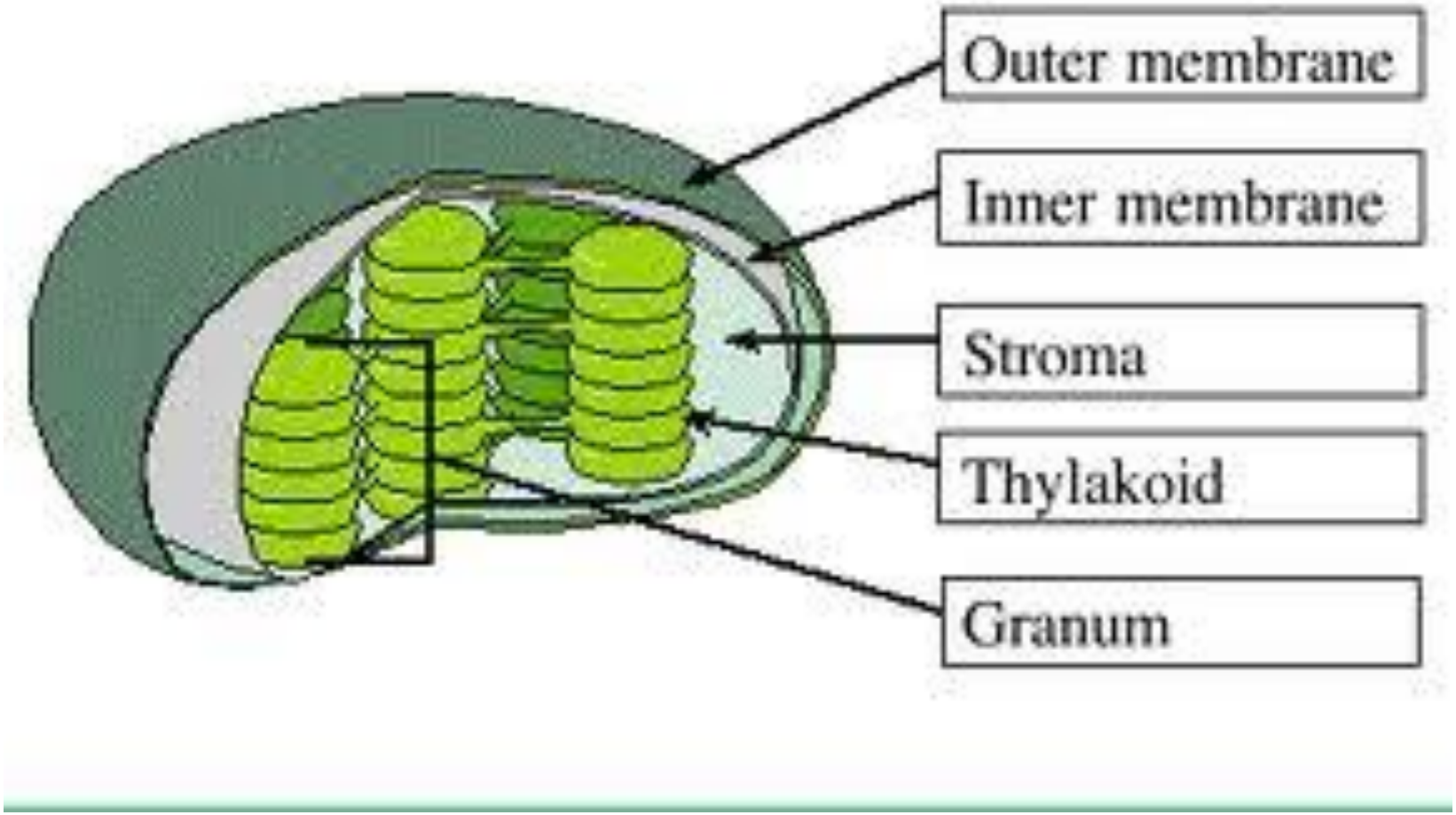
Adenosine Triphosphate (ATP)



How Photosynthesis Works

- **Energy + $6CO_2$ + $6H_2O$ → $C_6H_{12}O_6$ + $6O_2$**
- Photosynthesis takes place in chloroplasts.
- Inside the chloroplasts are flat sac-like structures called **Thylakoids.**
- Thylakoids are arranged in stacks of other thylakoids called **Grana.**
- The **light-dependent reactions** occur in the Grana. (Photosystems I and II).

Inside a Chloroplast

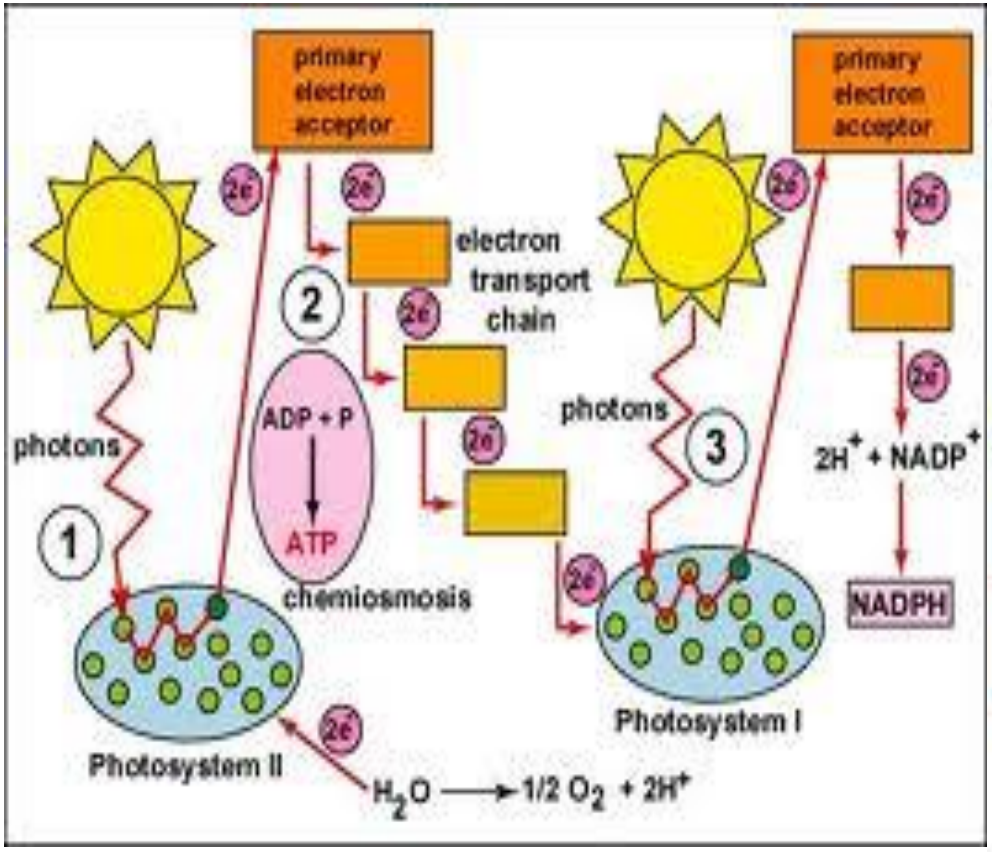


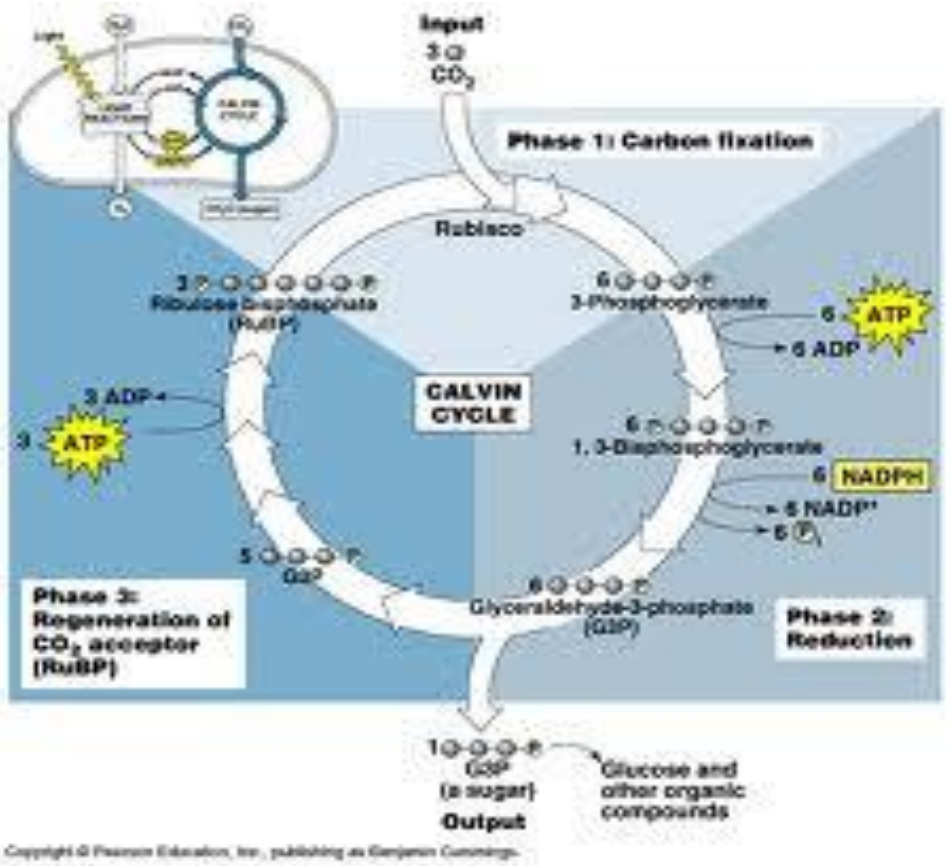
How Photosynthesis Works

- The second part of photosynthesis takes place outside the grana in the fluid-filled space around the grana called **stroma.**
- Light-independent reactions (the **Calvin Cycle**) take place in the stroma.
- Light-dependent and independent reactions are complex chemical reactions.

Overview of Light-Independant and Dependant Reactions

- Light-dependant reactions – photosystems I and II
- Light-independant reactions – The Calvin Cycle

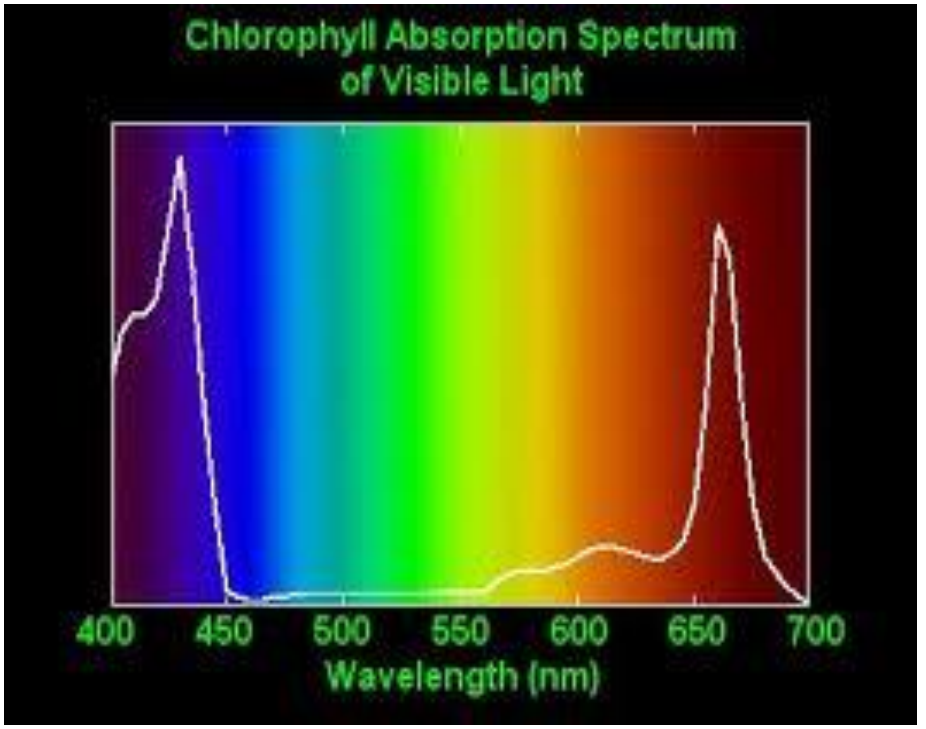




What role do pigments play in Photosynthesis?

- **Pigments** are substances that absorb light.
- There are a variety of pigments found in thylakoids that absorb light.
- The most abundant and important pigments in plants are called **chlorophylls.**
- Most chlorophylls absorb light most strongly in the violet-blue region of the visible spectrum and reflect light in the green region of the visible spectrum.
- This is why plants appear green to our eyes.

Chlorophylls

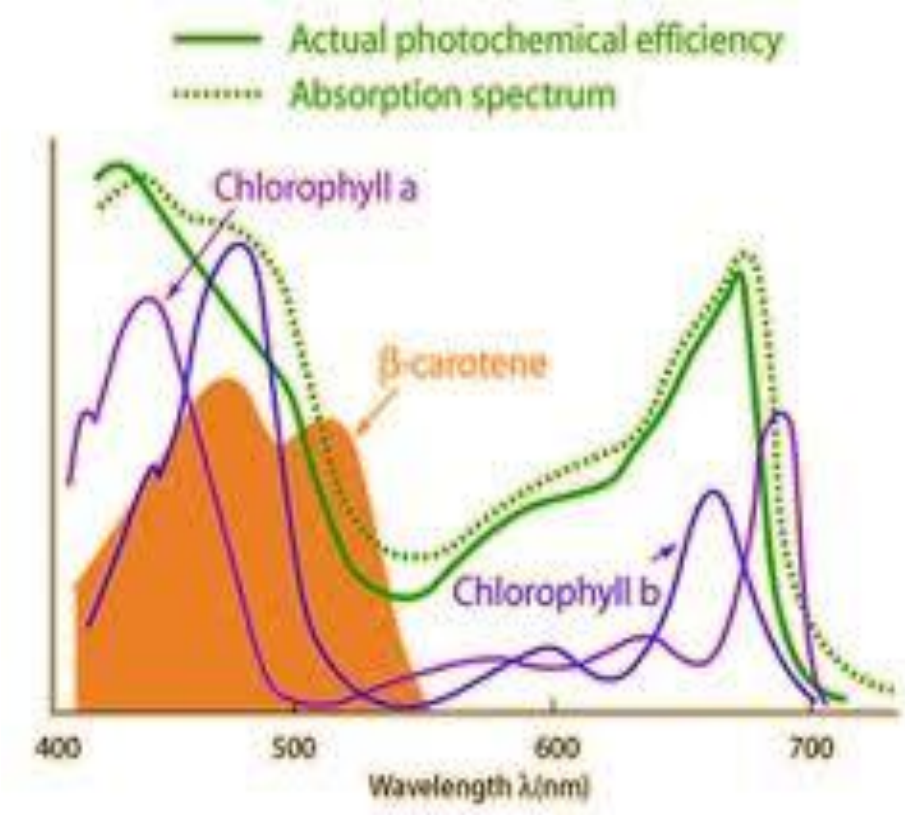


Are there any other pigments?

- There are also other pigments in plants called **accessory pigments.**
- Accessory pigments allow plants to capture even more light from the visible spectrum.
- One type of accessory pigment is called a **carotenoid**. Carotenoids absorb more light in the blue and green regions and reflect light in the yellow, orange and red regions of the visible spectrum.
- Carrots and sweet potatoes are high in carotenoids.
- In autumn you can see these accessory pigments in the falling leaves of trees.

Accessory Pigments and Autumn Colors

- Beta-carotene is one of the main accessory pigments found in plants.



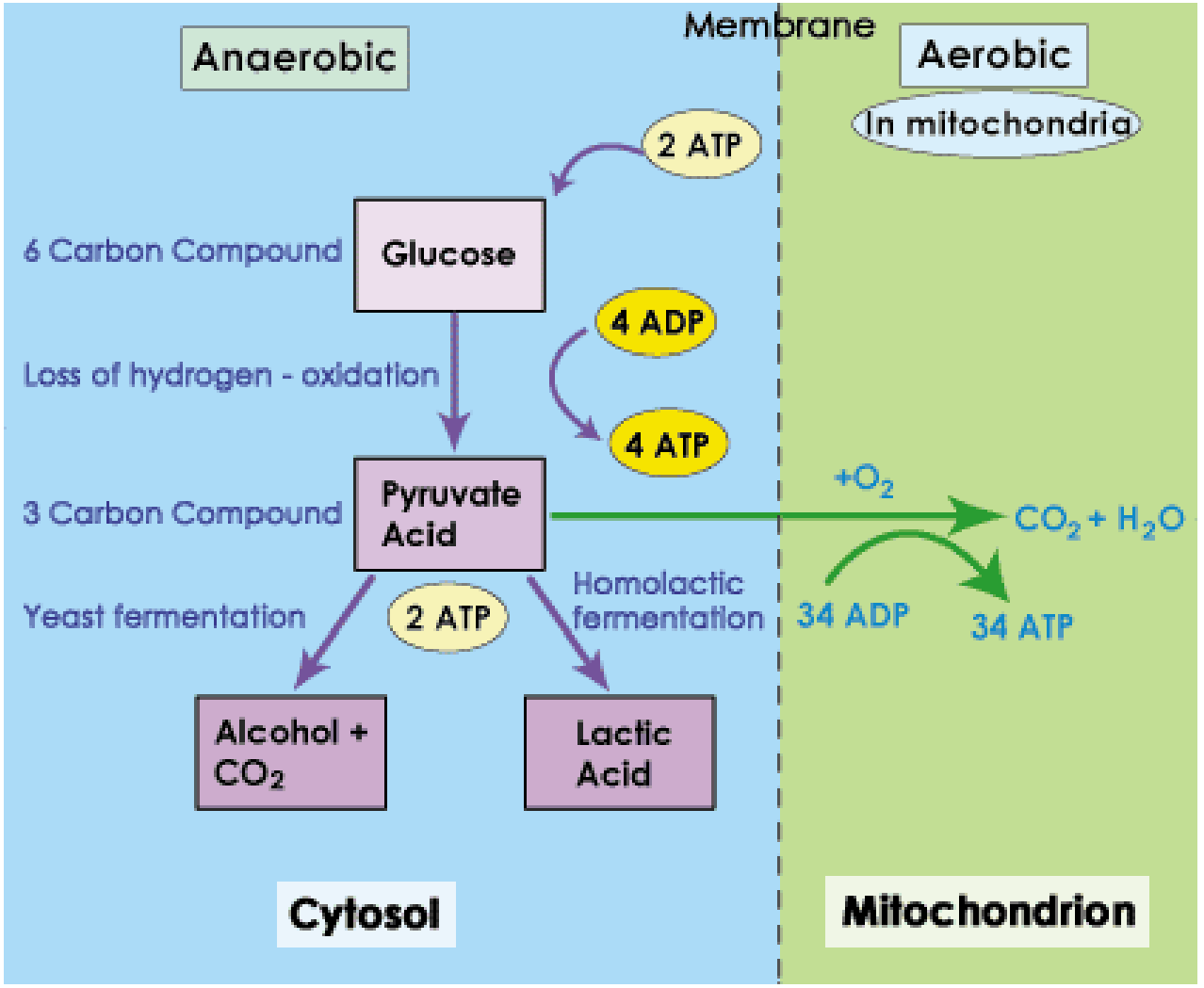
How Cellular Respirations Works

- **$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + Energy$**
- **Cellular Respiration** is really just the reverse of photosynthesis.
- And it occurs in all organisms, both autotrophs and heterotrophs.
- It is how glucose (sugar) gets broken down into usable energy (ATP).

Cellular Respiration

- There are two types of cellular respiration.
- Cellular respiration that occurs in the presence of oxygen is called **Aerobic respiration** and it occurs in mitochondria.
- Cellular respiration that occurs in the absence of oxygen is called **Anaerobic respiration** and it occurs in a cell's cytoplasm.

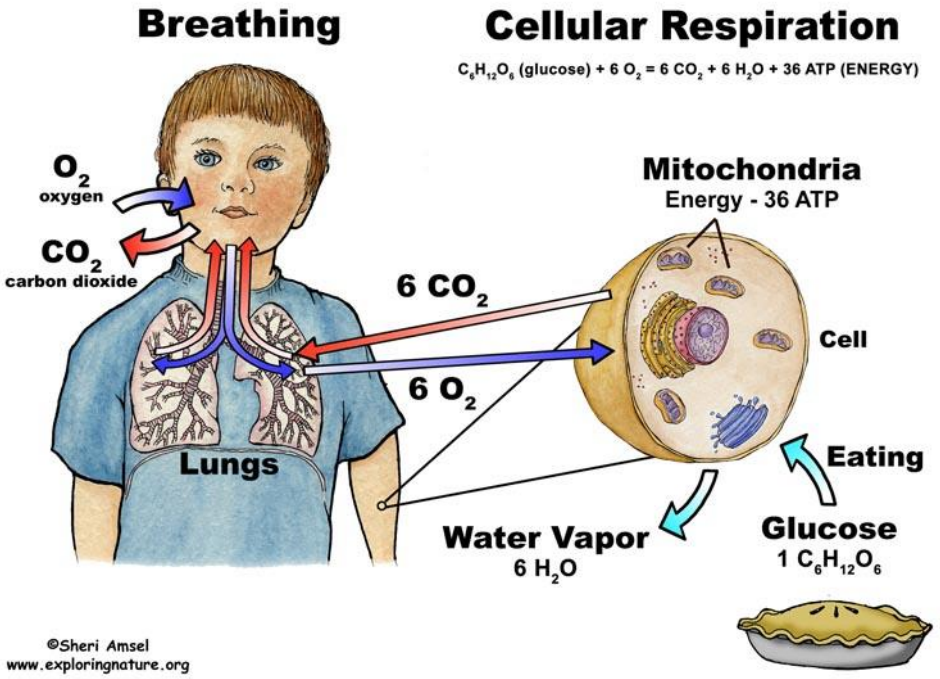
Overview of Cellular Respiration

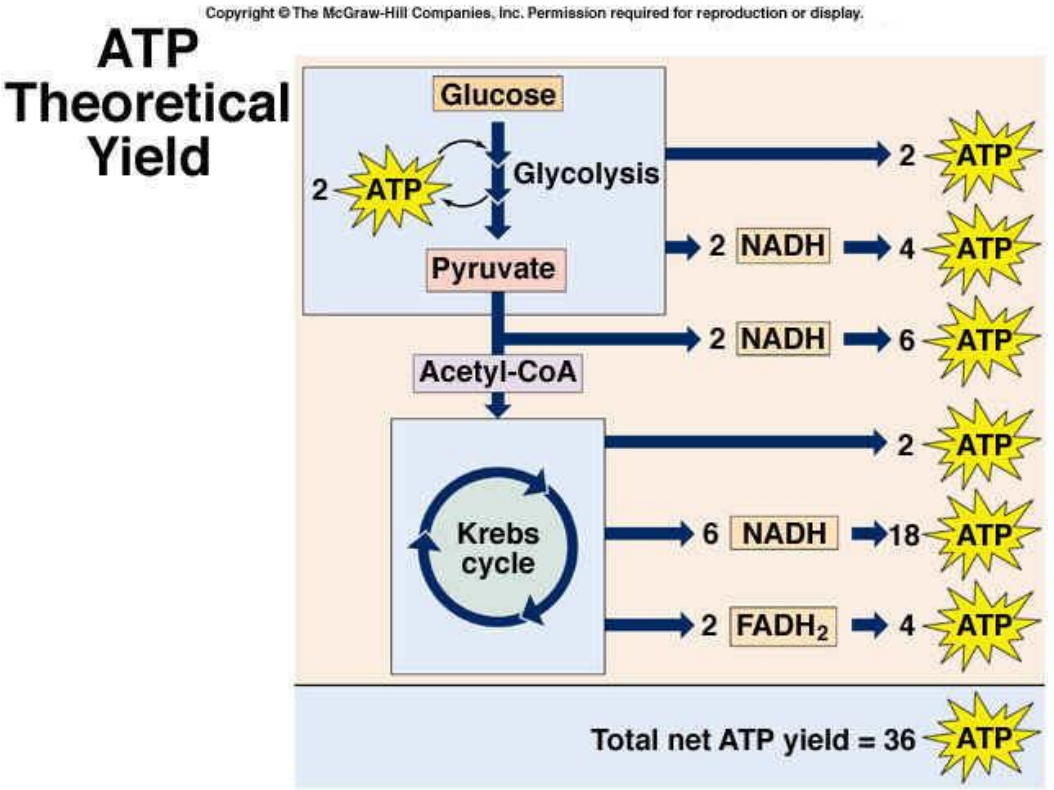


Glycolysis and the Krebs Cycle

- The first part of ALL cellular respiration (both aerobic and anaerobic) is called **Glycolysis.**
- Glycolysis converts glucose into **2 pyruvate** molecules and **2 ATP** molecules.
- Pyruvate must still be broken down to release most of the available energy (ATP) from glucose.
- In aerobic respiration the next step is called the **Krebs cycle**. The Krebs cycle is a series of reactions that yields an additional **34 ATP** molecules from the 2 pyruvate molecules.
- The end result is a total of **36 ATP** molecules.

Overview of Glycolysis and the Krebs Cycle





Anaerobic Respiration

- In anaerobic respiration, the reactions that occur after glycolysis are called **Fermentation.**
- The reactions of fermentation occurs in a cell's cytoplasm, not in the mitochondria.
- There are two types of fermentation; **Lactic Acid** and **Alcohol Fermentation.**
- Both types of anaerobic respiration produce only a total of only **2 ATP** from Glycolysis.

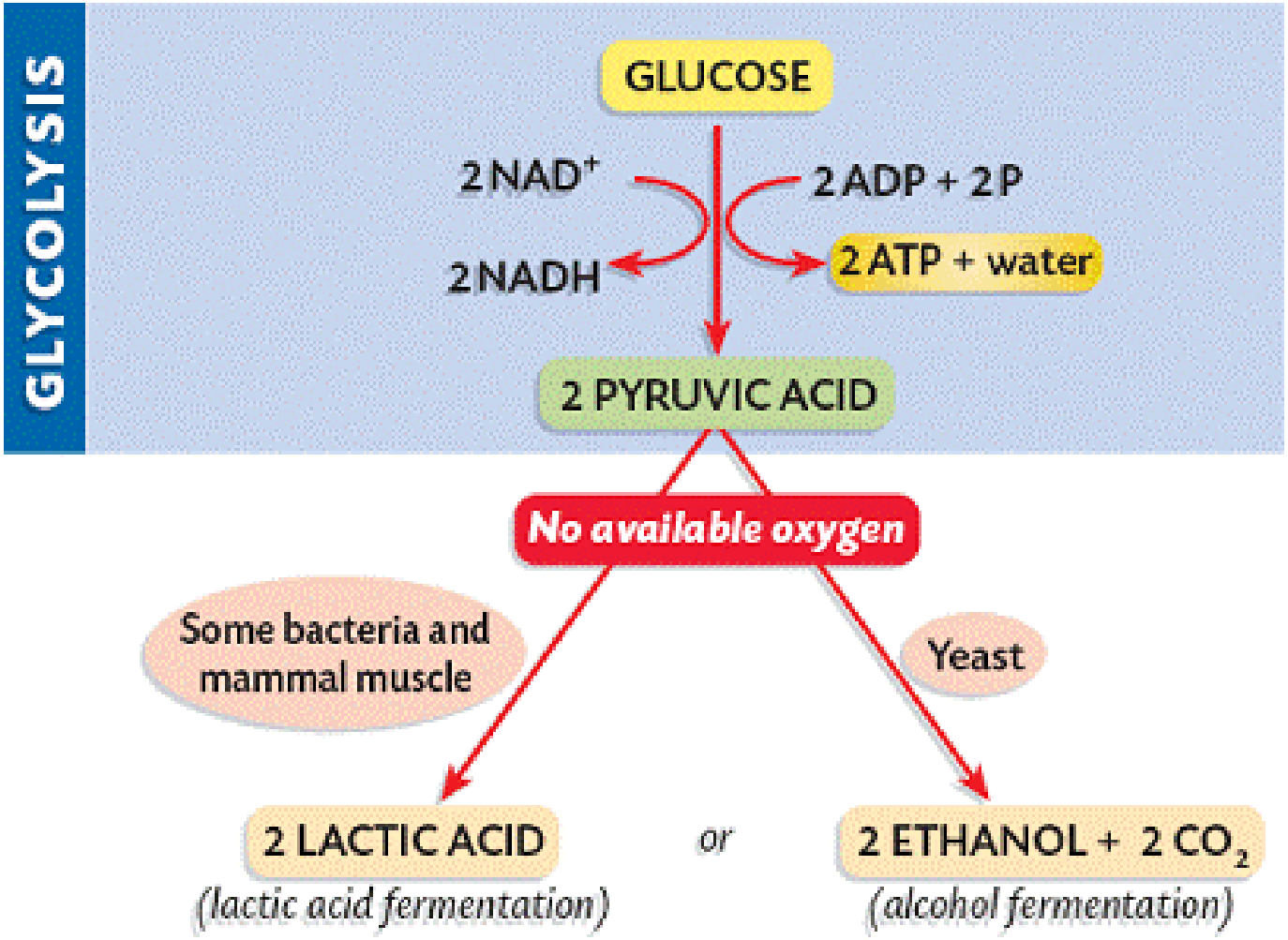
Lactic Acid Fermentation

- In **lactic acid fermentation**, enzymes convert the pyruvate into **lactic acid**.
- Skeletal muscles in the body produce lactic acid during strenuous exercise, such as weight-lifting and long-distance running.
- When lactic acids levels build up, the muscles feel fatigued and sore.
- Lactic acid fermentation also occurs in certain foods that contain microorganisms like yogurt and sour cream.

Alcohol Fermentation

- **Alcohol fermentation** occurs in yeast and certain types of bacteria.
- In this type of fermentation, the pyruvate from glycolysis is converted to **ethyl alcohol (ethanol)** and **carbon dioxide**.
- This is how people convert malt sugars (maltose) into alcoholic beverages by converting sugar into ethyl alcohol.
- This is also how people make bread rise.

Anaerobic Cellular Respiration



Thank You