5.11G: Oxygenic Photosynthesis

Oxygenic photosynthesis, provides energy to organism and allows for carbon fixation, all the while producing oxygen as a byproduct.

Learning Objectives

• Describe oxygenic photosynthesis

Key Points

• Plants, algae and cyanobacteria release oxygen during photosynthesis.
• Photosynthesis is also needed for carbon fixation.
• While different organisms may have differences during oxygenic photosynthesis, they all follow the general equation of, carbon dioxide + water + light energy → carbohydrate + oxygen.

Key Terms

• cyanobacteria: Cyanobacteria, also known as blue-green bacteria, blue-green algae, and Cyanophyta, is a phylum of bacteria that obtain their energy through photosynthesis.
• oxygenic: of, relating to, containing or producing oxygen

In plants, algae and cyanobacteria, photosynthesis releases oxygen. This is called oxygenic photosynthesis. Although there are some differences between oxygenic photosynthesis in plants, algae, and cyanobacteria, the overall process is quite similar in these organisms. Photosynthesis is not only needed by photosynthetic organism for energy but also for
Carbon dioxide is converted into sugars in a process called carbon fixation. Carbon fixation is a redox reaction, so photosynthesis needs to supply both a source of energy to drive this process, and the electrons needed to convert carbon dioxide into a carbohydrate, which is a reduction reaction. In general outline, photosynthesis is the opposite of cellular respiration, where glucose and other compounds are oxidized to produce carbon dioxide, water, and release chemical energy. However, the two processes take place through a different sequence of chemical reactions and in different cellular compartments. The general equation for photosynthesis is therefore:

$$2n \text{CO}_2 + 2n \text{DH}_2 + \text{photons} \rightarrow 2(\text{CH}_2\text{O})n + 2n \text{DO}$$

Carbon dioxide + electron donor + light energy → carbohydrate + oxidized electron donor.

In oxygenic photosynthesis water is the electron donor and, since its hydrolysis releases oxygen, the equation for this process is:

$$2n \text{CO}_2 + 4n \text{H}_2\text{O} + \text{photons} \rightarrow 2(\text{CH}_2\text{O})n + 2n \text{O}_2 + 2n \text{H}_2\text{O}$$

carbonate dioxide + water + light energy → carbohydrate + oxygen + water

Often 2n water molecules are cancelled on both sides, yielding:
\[ 2n \text{CO}_2 + 2n \text{H}_2\text{O} + \text{photons} \rightarrow 2(\text{CH}_2\text{O})n + 2n \text{O}_2 \]

carbon dioxide + water + light energy \rightarrow carbohydrate + oxygen

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