Photosynthesis

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Printed: August 11, 2014

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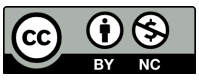


CHAPTER 1

Photosynthesis

Lesson Objectives

- Explain the importance of photosynthesis.
- Write and interpret the chemical equation for photosynthesis.
- Describe what happens during the light reactions and the Calvin Cycle.

Check Your Understanding

- How are plant cells different from animal cells?
- In what organelle does photosynthesis take place?

Vocabulary

- chlorophyll
- photosynthesis
- stomata
- stroma
- thylakoid

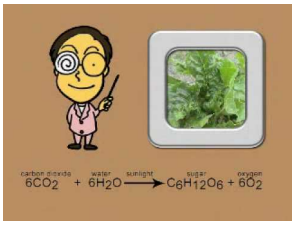
What is Photosynthesis?

If a plant gets hungry, it cannot walk to a local restaurant and buy a slice of pizza. So how does a plant get the food it needs to survive? **Photosynthesis** is the process plants use to make their own "food" from the sun's energy, carbon dioxide and water.

Actually, almost all organisms obtain their energy from photosynthetic organisms. For example, if a bird eats a caterpillar, then the bird gets the energy that the caterpillar gets from the plants it eats. So the bird is indirectly getting energy that began with the "food" formed through photosynthesis. Therefore, the process of photosynthesis is central to sustaining life on Earth.

During photosynthesis, carbon dioxide and water combine with solar energy to create glucose and oxygen. Glucose is a sugar that acts as the "food" source for plants. Oxygen, which is necessary for animal life, is the waste of photosynthesis.

The Photosynthesis Song can be heard at http://www.youtube.com/watch?v=C1_uez5WX1o (1:52).



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The Process of Photosynthesis

Photosynthesis takes place in chloroplasts. Chloroplasts are one of the main differences between plant and animal cells. There are two separate parts of a chloroplast (**Figure** 1.1).

- The inner compartments formed by the flattened sacs, or **thylakoids,** are called the thylakoid space. Energy from sunlight is absorbed by the pigment chlorophyll in the thylakoid membrane.
- The interior space that surrounds the thylakoids is filled with a fluid called **stroma.** This is where carbon dioxide is used to produce glucose.

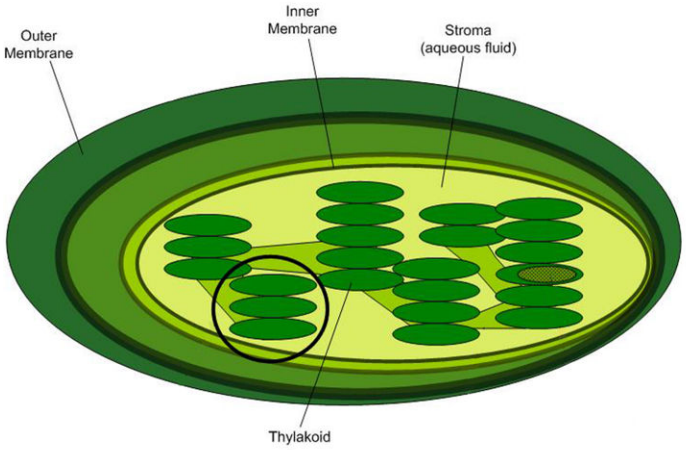


FIGURE 1.1

The chloroplast is the photosynthesis factory of the plant.

The Reactants

What goes into the plant cell? The reactants of photosynthesis are carbon dioxide and water, and the energy from sunlight. This means that carbon dioxide, water, and the sun's energy are necessary for the chemical reactions of photosynthesis.

- **Chlorophyll** is the green pigment in leaves that captures energy from the sun.
- The *veins* in a plant carry water from the roots to the leaves.
- Carbon dioxide enters the leaf from the air through special openings called **stomata** (**Figure** 1.2).

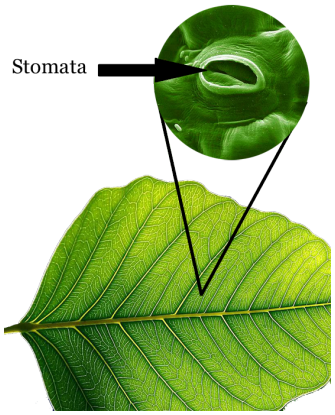


FIGURE 1.2

Stomata are special pores that allow gasses to enter and exit the leaf.

The Products

What is produced by the plant cell? The products of photosynthesis are glucose and oxygen. This means they are produced at the end of photosynthesis.

- Glucose, the food of plants, can be used to store energy for later in the form of carbohydrate molecules.
- Oxygen is a plant waste product. It is released into the atmosphere through the stomata. As you know, animals need oxygen to live. Without photosynthetic organisms like plants, there would not be enough oxygen in the atmosphere for animals to survive.

The Chemical Reaction

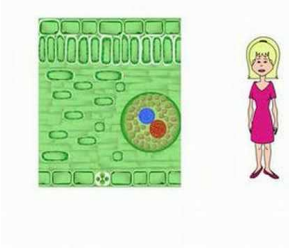
The overall chemical reaction for photosynthesis is 6 molecules of carbon dioxide (CO_2) and 6 molecules of water (H_20), with the addition of solar energy. This produces 1 molecule of glucose ($C_6H_{12}O_6$) and 6 molecules of oxygen (O_2) (**Figure** 1.3). Using chemical symbols the equation is represented as follows:

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

Lesson Summary

- The net reaction for photosynthesis is that carbon dioxide and water, together with energy from the sun, produce glucose and oxygen.

A review of photosynthesis can be viewed at http://www.youtube.com/watch?v=mpPwmvtDjWw (2:41).



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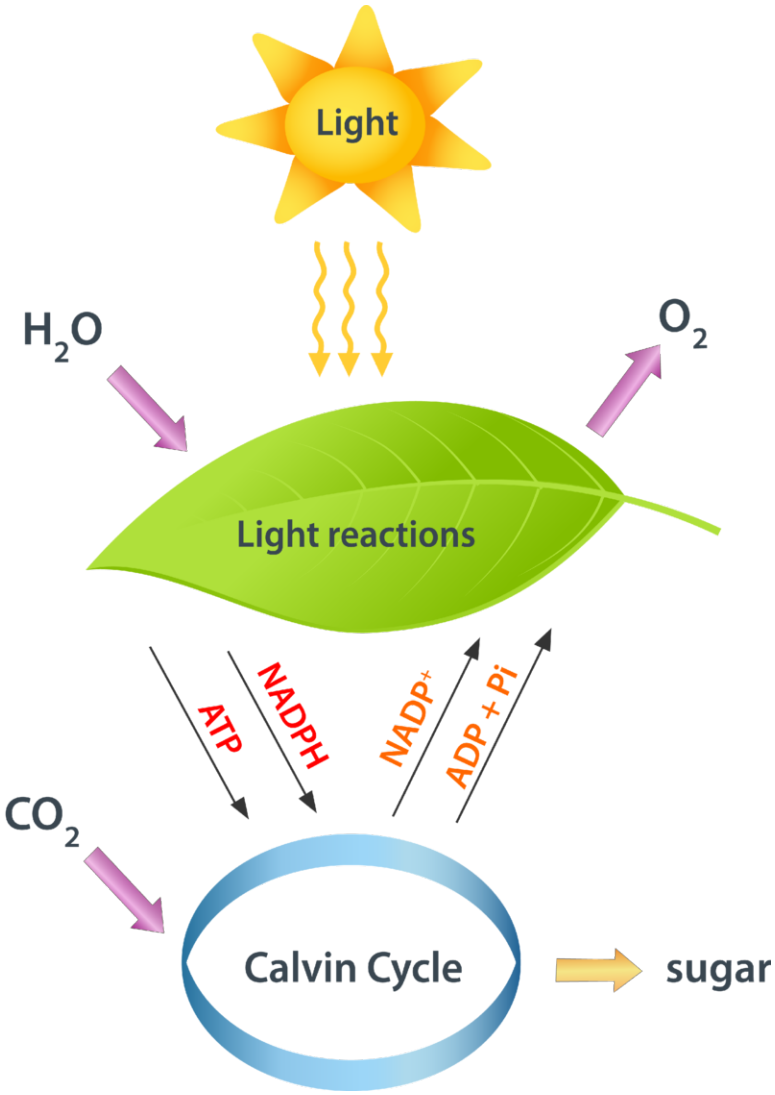

FIGURE 1.3

As is depicted here, the energy from sunlight is needed to start photosynthesis. The initial steps are called the light reactions as they occur only in the presence of light. During these initial reactions, water is used and oxygen is released. The energy from sunlight is converted into a small amount of ATP and an energy carrier called NADPH. Together with carbon dioxide, these are used to make glucose (sugar) through a process called the Calvin Cycle. $NADP^+$ and ADP (and Pi, inorganic phosphate) are regenerated to complete the process.

Review Questions

Recall

1. What are the reactants required for photosynthesis?
2. What are the products of photosynthesis?

Apply Concepts

3. What happens to the glucose produced from photosynthesis?
4. Why is it important to animals that oxygen is released during photosynthesis?
5. Describe the structures of the chloroplast where photosynthesis takes place.

Critical Thinking

6. What would happen if the stomata of a plant leaf were glued shut? Would that plant be able to perform photosynthesis? Why or why not?

Points to Consider

The next lesson is about Cellular Respiration.

- How do you gain energy from the food you eat?
- Which do you think provides more energy- a bowl of pasta or a small piece of candy?
- What "waste" gas do you exhale?

References

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