

# Photosynthesis and Respiration

## Lesson 6: Photosynthesis and Respiration

### Basic Plant Processes

There are five basic processes that plants depend on for growth. In order to grow plants properly, it is important to understand how these processes affect plant growth. These processes include: photosynthesis, respiration, water absorption, translocation, and transpiration.

### Movement of Nutrients and Water

The movement of water and nutrients in a plant involves three processes: transpiration, translocation, and absorption.

Transpiration is the loss of water by evaporation through the leaf surface. Although it occurs primarily through the leaf surface, it also occurs from the stems and petals. Transpiration occurs when the plant's stomata open to take in carbon dioxide, needed for photosynthesis. Transpiration is greatly influenced by environmental factors such as light, temperature, humidity, and wind. As more water is lost to transpiration, more water must be absorbed by the plant.

Translocation is the movement of water and organic compounds within the plant. The vascular system consists of canals of xylem and phloem tissues through which translocation occurs. Water and dissolved minerals are primarily translocated upward from the roots through the xylem tissues. This is due to tension in the xylem tissue caused by the continuous water column. This tension, produced by transpiration, is transmitted to the absorbing cells in the roots, triggering them to absorb more water. Organic compounds (sugars and starches) are translocated through the phloem tissues from areas of high concentration to areas of low concentration. Primarily it is from the leaves to the rest of the plant, including the root system.

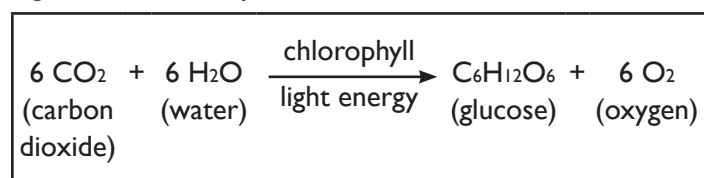
Water and dissolved minerals are absorbed by plant root hairs. Absorption of water and dissolved minerals from the soil into plant root cells is by the process of osmosis. Osmosis is a type of diffusion. Diffusion is the movement of molecules from an area of higher concentration to an area of lower concentration. Osmosis is the diffusion of water through a differentially permeable membrane. For example, the membrane surrounding plant cells will allow some

molecules and materials—depending on their chemical properties and size—to pass through easily and quickly. Other materials are allowed to pass through very slowly. Still other materials are blocked from entering.

### Plant Food Production – Photosynthesis

Photosynthesis is the process through which green plants convert carbon dioxide and water in the presence of light into simple sugar (food). The formula is illustrated in Figure 6.1.

Figure 6.1 – Photosynthesis Formula



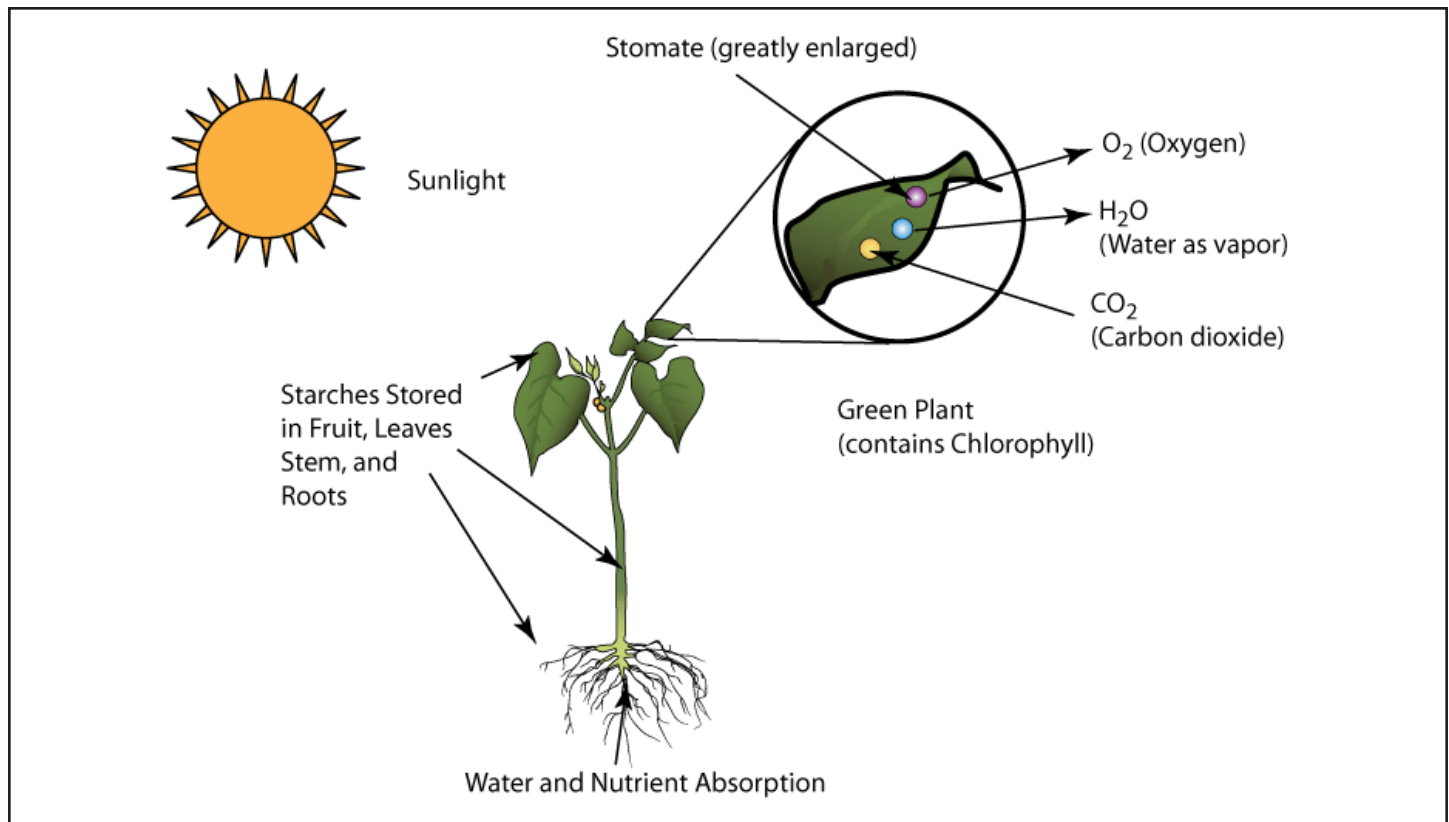
Carbon dioxide enters the plant through stomata, primarily located on leaves. Water is absorbed through root hairs and moves to the leaves through the xylem tissues. Light strikes the chlorophyll, which is present in the cells of the leaf and stem. Light energy is absorbed, enabling a chemical reaction to take place between carbon dioxide and the hydrogen in water. Glucose, the most common carbohydrate and a simple sugar, is produced and transported by the phloem tissues to other parts of the plant. Oxygen is released as a by-product through the stomata. Water vapor is also released when the stomata open. See Figure 6.2.

Plants produce their own food through the process of photosynthesis. Plants use photosynthetically manufactured food for energy to perform the various processes necessary for plant growth. Plants also store food in the form of carbohydrates to be used by the plant when needed.

Respiration involves the breakdown of glucose. This process releases energy for plant growth, absorption, translocation, and many other processes occurring within the plant. Glucose molecules are combined and stored in the form of complex starch molecules in plant cells. Nearly all respiration occurs in the presence of oxygen (aerobic respiration). However, some cellular respiration may occur

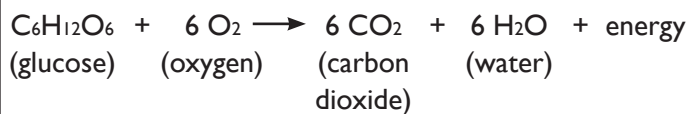
# Plant Science

Figure 6.2 – Photosynthesis Process



for a short time without oxygen (anaerobic respiration). The formula for aerobic respiration is illustrated in Figure 6.3.

Figure 6.3 – Respiration Formula



Respiration enables the plant cell to release energy, which is used in energy-requiring chemical reactions within the cell. In addition, respiration releases carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) into the atmosphere. Respiration is a continuous process occurring throughout the day, for as long as the plant lives.

Figure 6.4 compares photosynthesis and respiration. Note that photosynthesis changes light energy from the sun into

chemical energy. The chemical energy is stored in the form of glucose molecules. Respiration reverses the process by changing the chemical energy from the breakdown of glucose molecules into other forms of energy needed by plants.

## Air Quality

The role of plants in improving air quality is vital. All forms of life need oxygen to survive. Plants produce oxygen as a by-product of photosynthesis. Excessive emissions from automobiles and industry damage plant life and lessen the production of oxygen by plants. Pollutants entering the atmosphere, the soil, and the water interrupt some plant processes. For plants to continue to grow and produce oxygen, humans need to keep the environment clean.

## Summary

Five processes affect plant quality and longevity. Through the process of photosynthesis, a green plant manufactures its own food (simple sugar or glucose). The process

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Figure 6.4 – Photosynthesis vs. Respiration

	PHOTOSYNTHESIS	RESPIRATION
Energy relationships (stored or released)	Stored	Released
Raw Materials	CO <sub>2</sub> and H <sub>2</sub> O	Glucose and O <sub>2</sub>
Function	To convert sun energy into chemical energy	To release energy from glucose for cellular metabolism
End products	O <sub>2</sub> and glucose	CO <sub>2</sub> , H <sub>2</sub> O, and energy

of respiration breaks down glucose to release energy needed within plant cells. Water and dissolved mineral nutrients enter roots through the process of absorption. Translocation is the movement of water, dissolved minerals, glucose, and other organic compounds within the plant. Transpiration is the process of water loss from the plant primarily through stomata located on leaves. Plants play a vital role in improving air quality through the production of oxygen.

## Credits

Walton, P.D. *Principles and Practices of Plant Science*. NJ: Prentice-Hall, 1988.

Wells, J.A., and J. Anderson. *Greenhouse Operation and Management*. University of Missouri-Columbia: Instructional Materials Laboratory, 1990.

