

Lesson A2–6

Understanding Plant Physiology

Unit A. Horticultural Science

Problem Area 2. Plant Anatomy and Physiology

Lesson 6. Understanding Plant Physiology

New Mexico Content Standard:

Pathway Strand: Plant Systems

Standard: II: Address taxonomic or other classifications to explain basic plant anatomy and physiology.

Benchmark: II-A: Examine unique plant properties to identify/describe functional difference in plant structures including roots, stems, flowers, leaves and fruit.

Performance Standard: 4. Explain the processes of photosynthesis and respiration.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Describe the process of photosynthesis.
2. Describe the process of cellular respiration.
3. Explain why photosynthesis and respiration are important to us as human beings.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003.

Schroeder, Charles B., et al. *Introduction to Horticulture*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2000.

List of Equipment, Tools, Supplies, and Facilities

Writing surface

Overhead projector

Transparencies from attached masters

Copies of student lab sheet

A glass and water

Microscope and Elodea (an aquatic weed) from a pet store or a prepared slide of a leaf

Terms. The following terms are presented in this lesson (shown in bold italics):

Cellular respiration

Chlorophyll

Chloroplast

Mitochondria

Photosynthesis

Transpiration

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Bring a drinking glass to class. Either teach briefly or ask students to come up with a simple equation for photosynthesis. Something like “carbon dioxide and water give you sugar and oxygen” should do it. Partially fill the glass with water and ask for an easy carbon dioxide source. When your breath is suggested, breathe out into the container, thus “combining” water and carbon dioxide. Cover the container with your hand and shake vigorously. After anywhere from 5 to 60 seconds of shaking, stop and take a drink. State that the equation must be true because you just tasted the water and it was sweet! This will set off a furious discussion on how this is or is not possible. Stick to your story as long you feel necessary. If you really want to set them off, talk to a student before class and have them play along, first as an unbeliever and then a convert. You may lace another drinking glass with sugar syrup, so that when you fill it up with tap water, it tastes sweet. The object of the deception is to get the students to think of exactly what it takes to produce sugar. Of course it only happens in plants.

Summary of Content and Teaching Strategies

Objective 1: Describe the process of photosynthesis.

Anticipated Problem: How does photosynthesis work?

- I. **Photosynthesis** is the process by which a plant turns the light energy from the sun into chemical energy in the form of sugar. Photosynthesis is a complex series of chemical reactions that happens within the plant cells.
 - A. The plant uses the small molecules of water and carbon dioxide to form the very large, complex glucose molecule. Glucose is a sugar. A by-product of the reaction is oxygen gas.
 - B. The plant uses glucose as a source of energy. Since the plant cannot use the light energy directly, it converts the sunlight into chemical energy held in the chemical bonds of the glucose molecule.
 - C. The chemical reactions which make up photosynthesis take place in a small structure inside the cell called a **chloroplast**. A chloroplast is filled with large amounts of a green pigment called **chlorophyll**. It is chlorophyll which allows photosynthesis to occur.
 - D. Although it is a rather odd statement, it would be accurate to say that plants don't photosynthesize, chloroplast does. Plants just happen to be lucky enough to contain chloroplast in their cells. These little sugar factories simply do their job and feed the plants at the same time.
 - E. Photosynthesis uses a great deal of water to convert the light energy into chemical energy. Some of that water is released at the end of the chemical reactions. That water is released through the stomata of the leaf in a process called transpiration. Transpiration is good for a plant in that it can cool the surface of a leaf by evaporation. It can be dangerous to plants who have a weak root system or have recently been transplanted.

Use the recommended resources to strengthen the students' understanding of the concepts. Put up TM: A2–6A as visual aid to help students understand the chemical equation for photosynthesis. LS: A2–6A will help provide an actual picture to relate what is being learned.

Objective 2: Describe the process of cellular respiration.

Anticipated Problem: How does cellular respiration work?

- II. In many ways, **cellular respiration** is the opposite of photosynthesis. Photosynthesis makes sugar, cellular respiration breaks it down. Photosynthesis stores energy in chemical bonds, cellular respiration releases that energy.
 - A. In cellular respiration, a plant starts with glucose, which is broken down in combination with oxygen gas. Water and carbon dioxide are released, as is all of the energy that was contained in the bonds of the glucose molecule.

- B. Cellular respiration takes place in structures contained within cells called *mitochondria*.
- C. Plants can break down sugar through cellular respiration as can animals, fungi, and many bacteria.

Use the recommended resources to strengthen the students' understanding of the concepts. Put up TM: A2–6A to display the chemical equation for cellular respiration.

Objective 3: Explain why photosynthesis and respiration are important to us as human beings.

Anticipated Problem: How are photosynthesis and respiration important to us as human beings.

- III. Photosynthesis and cellular respiration are two of the most important chemical reactions to human beings.
 - A. All of our food and nutrition comes either directly or indirectly from photosynthesis. We eat a combination of plants and things that ate plants.
 - B. All of our heat and electricity comes either directly or indirectly from by-products of photosynthesis in plants.
 - C. All of the oxygen that we breathe comes from the photosynthesis reactions.
 - D. *Transpiration* is the release of water from leaves as part of photosynthesis. It puts thousands of tons of water into the air, cooling our environment and encouraging rainfall.

Use the recommended resources to strengthen the students' understanding of the concepts. Put up TM: A2–6A as visual aid to the students. Discuss with the students what might happen were photosynthesis to stop. How long would life as we know it go on? How long could we survive?

Review/Summary. Ask students to write a paragraph comparing and contrasting photosynthesis and cellular respiration. It will become clear how much review needs to be done. Review or revisit problem areas.

Application. Use LS: A2–6A in conjunction with teaching the objectives.

Evaluation. Evaluation should be based on student comprehension of the learning objectives. This can be determined using the attached sample written test.

Answers to Sample Test:

Part One: Matching

1. b 2. a 3. c

Part Two: Completion

photosynthesis
cellular respiration

Part Three: Short Answer

1.
 - A. performed by plants only
 - B. needs light energy
 - C. occurs in chloroplasts
 - D. stores energy
2.
 - A. performed by both plants and animals
 - B. occurs in mitochondria
 - C. releases energy
 - D. occurs in the presence of oxygen gas

Test

Lesson A2–6: Understanding Plant Physiology

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- a. Chlorophyll
- b. Chloroplasts
- c. Transpiration

- _____ 1. Small green structures in the plant cell which hold pigment.
- _____ 2. Green pigment found in plants which is responsible for photosynthesis.
- _____ 3. The release of water from the leaves which is part of the process of photosynthesis.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

- 1. The process by which a plant converts water and carbon dioxide into sugar and oxygen is called _____.
- 2. The process by which both plants and animals convert sugar back into water and carbon dioxide is called _____.

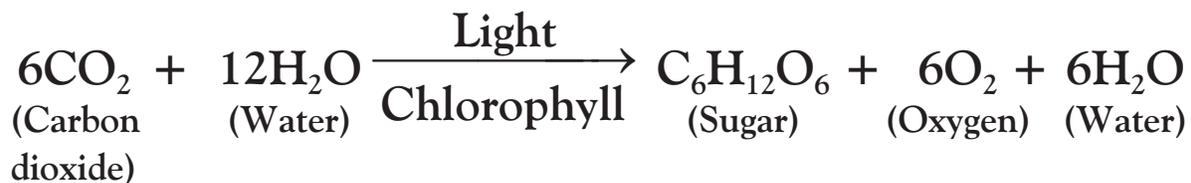
Part Three: Short Answer

Instructions. Provide information to answer the following questions.

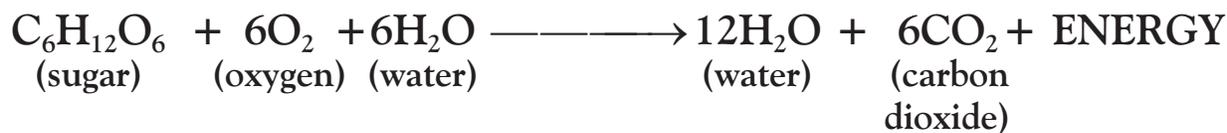
- 1. List four characteristics of photosynthesis.

- 2. List four characteristics of cellular respiration.

PHOTOSYNTHETIC EQUATION



EQUATION FOR CELLULAR RESPIRATION



Lab Sheet

1. Mount an Elodea leaf on a microscope slide. Look at the Elodea leaf under the microscope. The nice thing about Elodea is that it is only two cells thick making it very transparent. Look for the small chloroplasts located at the cell wall. If the sample is actively growing, you will see the chloroplasts rotate. Draw a picture of the cell and label the following:

Chloroplasts

Cell wall

Cytoplasm

2. What color is the cell? What color are the chloroplasts? Why
3. Why are the chloroplasts rotating in the cell?