

Unit C: Plant Physiology

Lesson 1: Understanding Plant Physiology

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.

Recommended Teaching Time: 2 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed with use of this lesson plan
- <http://photoscience.la.asu.edu/photosyn/education/learn.html>
- <http://www.shaunbryer.com/webquest.html>
- grapevine.net.au/.../science/photosynthesis.html

List of Equipment, Tools, Supplies, and Facilities

Writing surface
PowerPoint Projector
PowerPoint slides
Transparency Masters
Copies of Student Lab Sheet
Geranium Plants (same size, shape and color)
2 gallon plastic bags with twist to close
250ml Beakers
500ml Beaker
Hot Plate
Pair of Plastic Tongues
Petri Dishes
91% Isopropyl Alcohol
Alka-Seltzer or something comparable
Soda Lime
Potassium Iodide
Cardboard
Water

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slide #2):

- 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.

You need to get three plants. Ask the students what they think will happen when you place the plant into a dark room or cupboard. Explain to them that you will water it as often as the other plants. After they share their ideas, ask what they think is going to happen when you place a plant into a partitioned box. Have the student's share their ideas. The last plant will be kept in natural light. What do the students think will happen? After discussion let the students know you are going to come back to these plants in about a week to make observations.

Based on their predictions you can get a feel of how much they know about photosynthesis. You might have to mention the word while they are making their predictions. Allow the discussion to flow into the objectives of the lesson.

**** Use this activity to lead into the importance of photosynthesis.**

Summary of Content and Teaching Strategies

Objective 1: Describe the process of photosynthesis.

(PowerPoint Slide #3)

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.

(PowerPoint Slide #4)

- 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.

(PowerPoint Slide #5)

- 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

(PowerPoint Slide #6)

- 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.

****TM: C1-1 or PowerPoint Slide #7 can be used as a visual aid to help students understand the chemical equation for photosynthesis. LS: C1-1 will help provide an actual picture to relate what is being learned. Write each part of the chemical equation on index cards. Have each student draw an index card. When you say "GO" have the students arrange themselves in the correct order to form the photosynthesis equation. (Keep these index cards because you will be able to use them for the respiration equation.)**

Objective 2: Describe the process of cellular respiration.

(Power Point Slide #8)

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.

****TM: C1-1 or PowerPoint Slide # 9 can be used to display the chemical equation for cellular respiration. Use the index cards again. Pass them out to each student. Have them get into the correct order to form the cellular respiration equation. Ask if they notice anything between the two equations. Hopefully they will see that they are exactly opposite of each other. This will help in memorizing the equation.**

****PowerPoint Slide #10 shows a comparison between photosynthesis and respiration.**

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

(PowerPoint Slide # 11)

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 TM: C1-1 again 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. There are also review questions on PowerPoint Slide # 12 that can be used.

Application: Use LS: C1-1 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

1. photosynthesis
2. 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

Sample Test

Name _____

Test

Lesson C1-1: 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 _____.

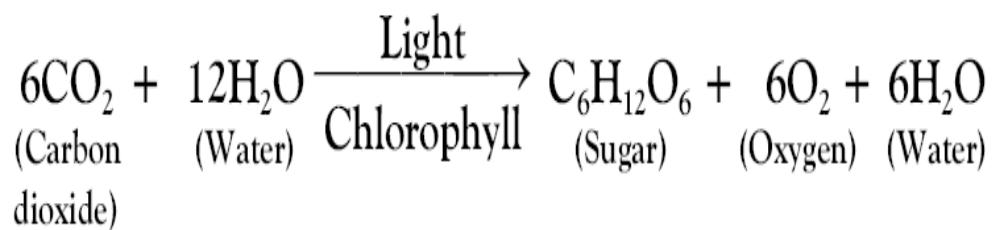
Part Three: Short Answer

Instructions. Provide information to answer the following questions.

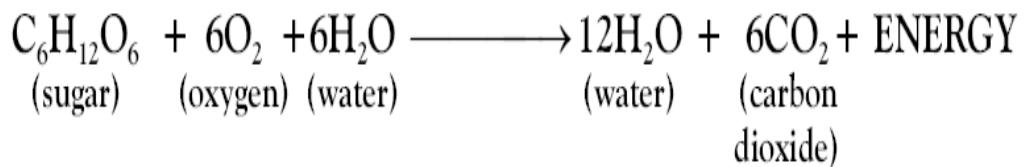
- 1. List four characteristics of photosynthesis.

- 2. List four characteristics of cellular respiration.

PHOTOSYNTHETIC EQUATION



EQUATION FOR CELLULAR RESPIRATION



Lab Sheet

Purpose:

To measure the amount of starch left in a leaf of a geranium plant under the following conditions; carbon dioxide increased, decreased and neither increased or decreased.

To prove increased starch increases the process of photosynthesis in the green plant.

Materials Needed:

- 3 Geranium Plants (same size, shape and color)
- 3 2 gallon plastic bags with twist to close
- 2 250ml Beakers
- 1 500ml Beaker
- 1 Hot Plate
- 1 Pair of Plastic Tongues
- 4 Petri Dishes
- 1 1pt. 91% Isopropyl Alcohol
- 1 Package of Alka-Seltzer
- 1 50mL of Soda Lime
- 1 Bottle of Potassium Iodide
- 3 Pieces of Cardboard
- 1 Pitcher of Water

Procedure:

1. Mark plants A, B and C.
2. Put cardboard pieces at the bottom of each bag.
3. Put plant A in one bag with one 250mL beaker half filled with water. Place Alka- Seltzer in water, twist close.
4. Put plant B in one bag. Put 50mL of Soda Lime in a Petri dish and place in bag with plant B, twist close.
5. Put plant C in one bag. Twist close. (This is the "control" plant.)
6. Find a sunny place in your classroom to place all three plants. (The plants must have same amount of sunlight and water.) The plants are to set for one day.
7. After one day, remove plants from bags. Break off one leaf from each plant put in Petri dishes marked A, B, and C.
8. Half fill the 500mL beaker with water.

9. Fill the 250mL beaker with alcohol.
10. Place beaker with alcohol into beaker with water, on to the hot plate.
11. Take leaves one at a time and put in beaker with hot alcohol. Leave in for ten minutes.
12. Remove leaf with plastic tongues.
13. Place leaf on paper towel to dry, then place in Petri dish.
14. Place several drops of potassium iodide on each leaf.
15. Observe color change of the three leaves. (the darker the color (purple) the more starch.
The lighter the color, the less starch)

Discussion

1. What were the results of plant A, with Alka-Seltzer? Was the carbon dioxide increased, decreased, or remained the same?
2. What were the results of plant B, with the soda lime? Was the carbon dioxide increased, decreased, or remained the same?
3. What were the results of plant C, the "control" plant? Was the carbon dioxide increased, decreased, or remained the same?