

BOTANY, PLANT PHYSIOLOGY AND PLANT GROWTH

Lesson 7: PLANT PHYSIOLOGY

I. LESSON DESCRIPTION

Students study a reading assignment, and then collaborate as a team to create an effective diagram on photosynthesis or respiration. *Estimated time requirement for this lesson is 28 minutes.*

Curriculum Standards: Minnesota Academic Standards in Science, Minnesota Department of Education, 5-24-10, Grades 9-12:

- 9.4.1.2.4 “Explain the function and importance of cell organelles for prokaryotic and/or eukaryotic cells as related to the basic cell processes of respiration, photosynthesis, protein synthesis and cell reproduction.”

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards, National Council for Agricultural Education, 2009:

- Natural Resource Systems (NRS):
 - NRS.01.02.01.a. Describe morphological characteristics used to identify trees and other woody plants.
 - Plant Systems (PS):
 - PS.01.03.01.a. Explain the basic process of photosynthesis and its importance to life on Earth.
 - PS.01.03.01.b. Explain requirements necessary for photosynthesis to occur and identify the products and byproducts of photosynthesis.
 - PS.01.03.02.a. Explain cellular respiration and its importance to plant life.
- PS.01.03.02.b. Explain factors that affect cellular respiration and identify the products and byproducts of cellular respiration.

Basic physiological processes give insight to the structure of plant parts.

Student Learning Objectives: After completing this class, students will be able to explain and to diagram the basic plant processes:

- (1) photosynthesis, or production of food
- (2) respiration, or consumption of food, and
- (3) transpiration, or water movement through the plant.

Instructional Methods: Reading Assignment, Cooperative Learning Activity.

II. LESSON PLAN

Introduction

Legend:

Text in normal face - Represents teacher's words.

Text in italic face - Represents suggestions for the teacher.

Interest Approach:

- A textbook on botany says “Each year more than 150 billion metric tons of sugar are produced worldwide by the photosynthetic process. The importance of photosynthesis, however, extends far beyond the sheer weight of this product. Without this flow of energy from the sun ... the pace of life on this planet would swiftly diminish and then ... would virtually cease altogether.” (*From Biology of Plants, 4th edition, Chapter 7 on Photosynthesis*)
- Now that you’ve mastered the anatomy of a plant, you can better understand its physiology.

Relevancy:

- In this lesson we’ll learn three basic plant processes.

Learning Objectives:

- After attending this class, you will be able to explain the processes of :
 - (1) Photosynthesis, or production of food
 - (2) Its reverse process called respiration, or consumption of food, and
 - (3) Transpiration, or water movement through the plant.
- Now let’s move into a study session on these processes.

Instructional Methods

Reading Assignment: 10 minutes estimated

- Distribute to each student a copy of the reading assignment, 07_PlantPhysiology_Reading.doc.*
- Please study this handout. You’ll have 10 minutes.

Cooperative Learning Activity: 15 minutes estimated

- Divide the class into several teams of about 6 students each.*
- To help reinforce the lesson that you studied, make a rough sketch of a plant showing roots, stem, and just two or three leaves. Then refer to the two equations in your reading assignment and add the words used in the equations, to complete your team’s diagram of the process. Half of the class can illustrate photosynthesis, while the other half illustrates respiration. You can use the plain English words rather than the chemical symbols. Use plenty of arrows to show the movement.
- Then discuss their diagrams.*

Conclusion

- As you understand how a plant produces food in photosynthesis, and consumes food in respiration, and moves water in transpiration, you can more easily grasp how a plant develops in relation to environmental factors, plant nutrition, and soils.
- Consider how simple these three processes are, in comparison with the extremely complex systems in the human body - the circulatory system and digestive system.
- In the next lesson, we'll learn how various environmental factors affect the three basic processes we discussed.

OPTIONAL ACTIVITIES

- Guide a class discussion on the question, "How will plants react in a small well-insulated greenhouse receiving no outside air for weeks?" The reaction will be photosynthesis will slow or stop since carbon dioxide will be depleted. Nursery personnel can use dry ice or a carbon dioxide generator to remedy the shortage.
- If you have access to a microscope, examine some cross-sections of leaves to see if you can identify the stoma and chloroplasts.
- Study turgor pressure in two small potted plants. Waxleaf begonias are good since their tissue is succulent. Keep one pot thoroughly moist and let the other go without water for several days until much of the soil is dry. When the dry plant becomes limp, use thumb and forefinger to compare the succulent leaf of the watered plant, with the pliable leaf of the dry plant. Lead a discussion with the students on the impact of letting a plant go limp between waterings – since the plant encounters water stress, photosynthesis cannot proceed, and the plant will not develop.
- Study transpiration in terms of the mineral transport from the soil to the plant parts. Place a white flower, such as a carnation, in a vase with food coloring. In a few hours the dye will rise to the tips of the flower petals.

RESOURCES

Books:

- *Biology of Plants*, Seventh Edition (December 17, 2004), by Peter H. Raven, Ray F. Evert, Susan E. Eichhorn, Publisher: W. H. Freeman; Hardcover: 944 pages. ISBN: 0716710072
- Comprehensive book on botany.