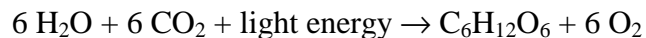


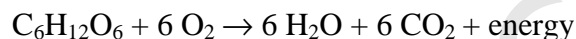
# Photosynthesis and Respiration

Plants make sugar, storing the energy of the sun into chemical energy, by the process of photosynthesis. When they require energy, they can tap the stored energy in sugar by a process called cellular respiration.

The process of photosynthesis involves the use of light energy to convert carbon dioxide and water into sugar, oxygen, and other organic compounds. This process is often summarized by the following reaction:



Cellular respiration refers to the process of converting the chemical energy of organic molecules into a form immediately usable by organisms. Glucose may be oxidized completely if sufficient oxygen is available by the following equation:



All organisms, including plants and animals, oxidize glucose for energy. Often, this energy is used to convert ADP and phosphate into ATP.

## OBJECTIVES

In this experiment, you will

- Use an O<sub>2</sub> Gas Sensor to measure the amount of oxygen gas consumed or produced by a plant during respiration and photosynthesis.
- Determine the rate of respiration and photosynthesis of a plant.

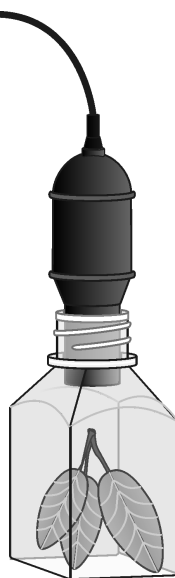






Figure 1

## MATERIALS

computer	250 mL respiration chamber
Vernier computer interface	plant leaves
Logger Pro	500 mL tissue culture flask
Vernier O <sub>2</sub> Gas Sensor	lamp
aluminum foil	forceps

## PROCEDURE

1. Connect the O<sub>2</sub> Gas Sensor to the Vernier interface.
2. Prepare the computer for data collection by opening the file “31A Photosyn-Resp (O<sub>2</sub>)” from the *Biology with Vernier* folder of *LoggerPro*.
3. Obtain several leaves from the resource table and blot them dry, if damp, between two pieces of paper towel.
4. Place the leaves into the respiration chamber, using forceps if necessary. Wrap the respiration chamber in aluminum foil so that no light reaches the leaves.
5. Place the O<sub>2</sub> Gas Sensor into the bottle as shown in Figure 1. Gently push the sensor down into the bottle until it stops. The sensor is designed to seal the bottle without the need for unnecessary force. Wait 3 minutes before proceeding to Step 6.
6. Click  to begin data collection. Data will be collected for 10 minutes.
7. When data collection has finished, determine the rate of respiration:
  - a. Move the mouse pointer to the point where the data values begin to decrease. Hold down the left mouse button. Drag the pointer to the point where the data ceases to decline and release the mouse button.
  - b. Click on the Linear Fit button, , to perform a linear regression. A floating box will appear with the formula for a best fit line.
  - c. Record the slope of the line,  $m$ , as the rate of respiration in Table 1.
  - d. Close the linear regression floating box.
8. Move your data to a stored run. To do this, choose Store Latest Run from the Experiment menu.
9. Remove the aluminum foil from around the respiration chamber.
10. Fill the tissue culture flask with water (not the respiration chamber) and place it between the lamp and the respiration chamber. The flask will act as a heat shield to protect the plant.
11. Turn the lamp on. Place the lamp as close to the leaves as reasonable. Do not let the lamp touch the tissue culture flask. Note the time. The lamp should be on for 3 minutes prior to beginning data collection.
12. After the three-minute time period is up, click  to begin data collection. Data will be collected for 10 minutes.

13. When data collection has finished, determine the rate of photosynthesis:
  - a. Move the mouse pointer to the point where the data values begin to increase. Hold down the left mouse button. Drag the pointer to the point where the data ceases to rise and release the mouse button.
  - b. Click on the Linear Fit button, , to perform a linear regression. Choose “Latest: Oxygen Gas” and a floating box will appear with the formula for a best fit line.
  - c. Record the slope of the line,  $m$ , as the rate of photosynthesis in Table 1.
  - d. Close the linear regression floating box.
14. Print a graph showing your photosynthesis and respiration data.
  - a. Label each curve by choosing Text Annotation from the Insert menu. Enter “Photosynthesis” in the edit box. Repeat to create an annotation for the “Respiration” data. Drag each box to a position near its respective curve. Adjust the position of the arrow heads.
  - b. Print a copy of the graph, with both data sets displayed. Enter your name(s) and the number of copies of the graph you want.
15. Remove the plant leaves from the respiration chamber, using forceps if necessary. Clean and dry the respiration chamber.

## DATA

Table 1	
Leaves	Rate of photosynthesis/respiration (ppt/min)
In the Dark	
In Light	

## QUESTIONS

1. Was either of the rate values a positive number? If so, what is the biological significance of this?
2. Was either of the rate values negative? If so, what is the biological significance of this?
3. Do you have evidence that cellular respiration occurred in leaves? Explain.
4. Do you have evidence that photosynthesis occurred in leaves? Explain.
5. List five factors that might influence the rate of oxygen production or consumption in leaves. Explain how you think each will affect the rate?

## EXTENSIONS

1. Design and perform an experiment to test one of the factors that might influence the rate of oxygen production or consumption in Question 5.
2. Compare the rates of photosynthesis and respiration among various types of plants.

# Vernier Lab Safety Instructions Disclaimer

**THIS IS AN EVALUATION COPY OF THE VERNIER STUDENT LAB.**

**This copy does not include:**

- **Safety information**
- **Essential instructor background information**
- **Directions for preparing solutions**
- **Important tips for successfully doing these labs**

The complete *Biology with Vernier* lab manual includes 31 labs and essential teacher information. The full lab book is available for purchase at:

<http://www.vernier.com/cmat/bwv.html>



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