  Logger Pro  31

Photosynthesis and Respiration

(O2 Gas Sensor)

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:

6 H2O + 6 CO2 + light energy → C6H12O6 + 6 O2

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 reaction:

C6H12O6 + 6 O2 → 6 H2O + 6 CO2 + energy

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

Objectives

* Use an O2 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.

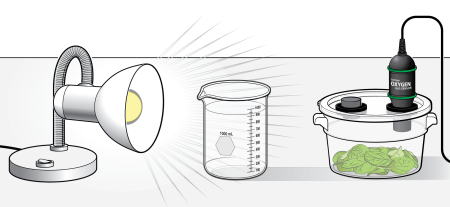


Figure 1

MATERIALS

computer

Vernier computer interface

Logger Pro

O2 Gas Sensor

BioChamber 2000

600 mL beaker

aluminum foil

#6 rubber stopper

spinach leaves

goggles

PROCEDURE

1. Wrap the BioChamber with aluminum foil so that no light will reach the leaves.
   1. Wrap the outside of the chamber with foil.
   2. Cover the lid with foil, poking the holes open to insert the sensor and the rubber stopper.
2. Cover the bottom of the chamber with a one centimeter layer of fresh, turgid spinach leaves.
3. Connect the O2 Gas Sensor to the Vernier computer interface.
4. Prepare the computer for data collection by opening the file “31A Photosyn-Resp (O2)” from the Biology with Vernier folder of Logger Pro.
5. Secure the lid on the chamber. Insert the O2 Gas Sensor into one of the holes and the rubber stopper into the other.
6. Wait 5 minutes for the sensor to equilibrate, then click to begin the 15-minute data collection period.



1. When data collection is complete, determine the rate of respiration/photosynthesis.
   1. Autoscale the data by clicking Autoscale, , on the toolbar.



* 1. Move the cursor to the point where the data values begin to decrease. Hold down the left mouse button and drag the cursor to select the region of decreasing oxygen gas concentration.
  2. Click Linear Fit, , to perform a linear regression.



* 1. Record the slope of the line, m, as the rate of respiration/photosynthesis in Table 1.
  2. Close the linear regression box.

1. Store your data by choosing Store Latest Run from the Experiment menu.
2. Make a heat sink by filling a 600 mL beaker with water.
3. Set up the lamp and heat sink as shown in Figure 1. Important: Do not turn the lamp on until instructed to do so.
4. Remove the aluminum foil from the respiration chamber.
5. Turn on the lamp.
6. Repeat Steps 6–7 to collect and analyze data for photosynthesis.
7. Clean and dry the chamber.

DATA

|  |  |
| --- | --- |
| Table 1 | |
| Leaves | Rate of respiration/photosynthesis (ppt/min) |
| In the dark |  |
| In the light |  |

Questions

1. Were either of the rate values a positive number? If so, what is the biological significance of this?
2. Were either of the rate values a negative number? 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.