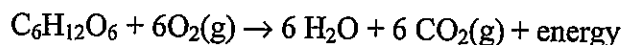


# Cell Respiration

Cell 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. It is known that peas undergo cell respiration during germination. Do peas undergo cell respiration before germination? The results of this experiment will verify that germinating peas do respire. Using your collected data, you will be able to answer the question concerning respiration and non-germinating peas.

Using the CO<sub>2</sub> Gas Sensor, you will monitor the carbon dioxide produced by peas during cell respiration. Both germinating and non-germinating peas will be tested. Additionally, cell respiration of germinating peas at two different temperatures will be tested.

## OBJECTIVES

In this experiment, you will

- Use a CO<sub>2</sub> Gas Sensor to measure concentrations of carbon dioxide.
- Study the effect of temperature on cell respiration.
- Determine whether germinated and non-germinated peas respire.
- Compare the rates of cell respiration in germinated and non-germinated peas.

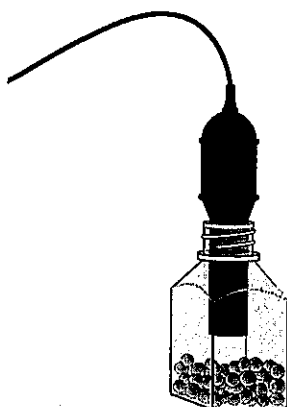


Figure 1

## MATERIALS

computer  
Vernier computer interface  
LoggerPro  
Vernier CO<sub>2</sub> Gas Sensor  
250 mL respiration chamber

25 germinating peas  
25 non-germinating peas  
ice cubes  
thermometer  
two 100 mL beakers

## PROCEDURE

1. If your sensor has a switch, set it to the Low (0–10,000 ppm) setting. Connect the CO<sub>2</sub> Gas Sensor to Channel 1 of the Vernier computer interface.
2. Prepare the computer for data collection by opening the “11B Cell Resp” file in the *Biology with Vernier* folder.
3. Obtain 25 germinating peas and blot them dry between two pieces of paper towel. Use the thermometer to measure the room temperature. Record the temperature in Table 1.
4. Place the germinating peas into the respiration chamber.
5. Place the shaft of the CO<sub>2</sub> Gas Sensor in the opening of the respiration chamber.
6. Wait one minute, then begin measuring carbon dioxide concentration by clicking . Data will be collected for 5 minutes.
7. Remove the CO<sub>2</sub> Gas Sensor from the respiration chamber. Place the peas in a 100 mL beaker filled with cold water and an ice cube. The cold water will prepare the peas for part II of the experiment.
8. Use a notebook or notepad to fan air across the openings in the probe shaft of the CO<sub>2</sub> Gas Sensor for 1 minute.
9. Fill the respiration chamber with water and then empty it. Thoroughly dry the inside of the respiration chamber with a paper towel.
10. Determine the rate of respiration:
  - a. Move the mouse pointer to the point where the data values begin to increase. Hold down the left mouse button. Drag the mouse pointer to the end of the data and release the mouse button.
  - b. Click 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 for germinating peas at room temperature in Table 2.
  - d. Close the linear regression floating box.
11. Move your data to a stored run. To do this, choose Store Latest Run from the Experiment menu.
12. Obtain 25 non-germinating peas and place them in the respiration chamber
13. Repeat Steps 5–11 for the non-germinating peas.

### Part II Germinating peas, cool temperatures

14. Remove the peas from the cold water and blot them dry between two paper towels.
15. Repeat Steps 5–11 to collect data with the cold germinating peas.

16. To print a graph showing all three data runs:
  - a. Label all three curves by choosing Text Annotation from the Insert menu, and typing "Room Temp Germinated" (or "Room Temp Non-germinated", or "Cold Germinated") in the edit box. Then drag each box to a position near its respective curve. Adjust the position of the arrowhead.
  - b. Print a copy of the graph, with all three data sets and the regression lines displayed. Enter your name(s) and the number of copies of the graph you want.

## DATA

Table 1	
Condition	Temperature (°C)
room	

Table 2	
Peas	Rate of Respiration (ppm/min)
Germinating, room temperature	
Non-germinating, room temperature	
Germinating, cool temperature	

## QUESTIONS

1. Do you have evidence that cell respiration occurred in peas? Explain.
2. What is the effect of germination on the rate of cell respiration in peas?
3. What is the effect of temperature on the rate of cell respiration in peas?
4. Why do germinating peas undergo cell respiration?

## EXTENSIONS

1. Compare the respiration rate among various types of seeds.
2. Compare the respiration rate among seeds that have germinated for different time periods, such as 1, 3, and 5 days.
3. Compare the respiration rates of various small animal types, such as insects or earthworms.