

PLANT RESPIRATION AND PHOTOSYNTHESIS

Driving Question

Do plants perform cellular respiration, in addition to performing photosynthesis?

Materials and Equipment

- CO₂ sensor with sampling bottle
- Aluminum foil, 1 ft.
- Distilled Water
- Fresh spinach leaves (2), or similar
- Lamp (CFL or LED, 1000 lumens or higher)
- Cotton Ball

Background

Since CO₂ is produced during cellular respiration, an increasing CO₂ concentration inside a mini-terrarium when no light is present is evidence that cellular respiration is occurring. Cellular respiration occurs constantly in plants as in animals, the cells need to be active to sustain life and grow. However, when light and water are available, photosynthesis is possible. The balance between CO₂ production (respiration) and consumption (photosynthesis) depends on many factors but it is easy to determine the dominant process with a CO₂ sensor.

Procedure

1. Connect to the CO₂ sensor.
2. Open the AGR 07 Plant Respiration and Photosynthesis.spk lab file.
 - If the file is not available create a graph display showing CO₂ concentration (ppm) versus time (min).
3. Gently put two leaves of spinach into the sampling bottle. Arrange the stems so that the majority of the leaves face in the same direction and do not overlap significantly. Soak a cotton ball in 5 mL of water and place it into the to the sampling bottle. This will ensure the humidity is near 100% and the leaves stomata will stay open for gas exchange.
4. Calibrate the CO₂ sensor according to the product manual. Place the CO₂ gas sensor into the sampling bottle so that the rubber stopper plugs the end of the bottle.
- ❓ 5. What do you think will happen to the CO₂ level in the bottle while the plant is in the light? Explain your answer.
6. Place the lamp 30-40cm away from the sample bottle so that it is facing the top surface of the leaves and turn it on.
7. Begin data collection and continue for 10 minutes.
8. Stop data collection after 10 minutes has passed and turn the light off. Wrap the bottle in a piece of tinfoil to completely block out the light.
- ❓ 10. What do you think will happen to the CO₂ level in the bottle while the plant is in the dark? Explain your answer.
12. Using the analysis tools, determine the initial, final, and change (Δ) in CO₂ levels for each trial. Record your data summary in Table 1 on the next page.

Table 1: The change in the CO₂ level inside the mini-terrarium in darkness and in light

Light Condition	Initial CO ₂ Level	Final CO ₂ Level	Change in CO ₂
Light			
Darkness			

Analysis & Questions

1. What happens to the level of carbon dioxide gas when the plant is in darkness? Why does this happen?
2. What happens to the level of carbon dioxide gas when the plant is in bright light? Why does this happen?
3. Was there a greater change in the level of carbon dioxide in darkness or light?
4. Which part of the activity shows the effect of cellular respiration on CO₂ levels in the chamber?
5. Write a conclusion for this experiment based on the following hypothesis, "If plant in a closed environment is exposed to light then the CO₂ level will rise when compared to its initial CO₂ level."
6. Answer the driving question, "Do plants perform cellular respiration, in addition to performing photosynthesis?"