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# PLANT RESPIRATION AND PHOTOSYNTHESIS

## Driving Question

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

## Materials and Equipment

- CO<sub>2</sub> 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 CO<sub>2</sub> is produced during cellular respiration, an increasing CO<sub>2</sub> 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 CO<sub>2</sub> production (respiration) and consumption (photosynthesis) depends on many factors but it is easy to determine the dominant process with a CO<sub>2</sub> sensor.

## Procedure

1. Connect to the CO<sub>2</sub> sensor.
2. Open the AGR 07 Plant Respiration and Photosynthesis.spk lab file.
  - If the file is not available create a graph display showing CO<sub>2</sub> 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 CO<sub>2</sub> sensor. Refer to your user manual in the product box or go to either the product page's document tab or product videos at Pasco.com to view calibration methods.
5. Place the CO<sub>2</sub> gas sensor into the sampling bottle so that the rubber stopper plugs the end of the bottle.
- ❓ 6. What do you think will happen to the CO<sub>2</sub> level in the bottle while the plant is in the light? Explain your answer.
7. 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.
8. Begin data collection and continue for 10 minutes.
9. 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 CO<sub>2</sub> level in the bottle while the plant is in the dark? Explain your answer.

11. Using the analysis tools, determine the initial, final, and change ( $\Delta$ ) in  $\text{CO}_2$  levels for each trial. Record your data summary in Table 1 on the next page.

Table 1: The change in the  $\text{CO}_2$  level inside the mini-terrarium in darkness and in light

Light Condition	Initial $\text{CO}_2$ Level	Final $\text{CO}_2$ Level	Change in $\text{CO}_2$
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  $\text{CO}_2$  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  $\text{CO}_2$  level will rise when compared to its initial  $\text{CO}_2$  level."
6. Answer the driving question, "Do plants perform cellular respiration, in addition to performing photosynthesis?"