# Respiration of Germinating Seeds

Driving Question

Why do seeds have optimal temperature ranges in order to germinate?

Materials and Equipment

|  |  |
| --- | --- |
| * Beaker, 1000-mL | * Pea or dry bean seeds (30 per class): |
| * CO2 sensor | * black, navy, white, or pinto |
| * Sampling bottle (included with sensor) | * Ice, cubed or crushed |
| * Water |  |

Background

In California alone seeds generate $2.9 billons in gross sales worldwide so to say that seeds are important to our state’s economy is an understatement. In order to produce high quality seed crops we must provide them with ample sun, water and nutrients so that the seeds themselves have enough stored resources to germinate and thrive until they can photosynthesize. Many enzymes in cells are affected by temperature. All enzymes have an optimal temperature at which they function best. In this activity, you will investigate whether dry seeds or germinating seeds have the higher rate of cellular respiration, and you will then determine whether temperature affects the rate of respiration.

Procedure

1. Connect to the CO2 sensor.

2. Open the Respiration of Germinating Seeds lab file.

3. Calibrate the CO2 sensor

4. Put 10 dry, dormant seeds into the sampling bottle. Put the end of the CO2 gas sensor into the sampling bottle. Firmly plug the end of the sampling bottle with the rubber stopper.

5. Start data recording. Adjust the scale of the graph to show all data. After 10 minutes, stop data recording.

6. Name the data run, "dry dormant seeds". Record the starting data in Table 1 under the “Initial CO2 Concentration (ppm)” Colum and “Dry dormant seeds” row. Record the ending data under the “Final CO2 Concentration (ppm)” Colum and “Dry dormant seeds” row.

7. Place the 10 germinating seeds that have been soaking overnight in room-temperature water into the sampling bottle. Put the end of the CO2 gas sensor into the sampling bottle. Firmly plug the end of the sampling bottle with the rubber stopper.

8. Start data recording. Adjust the scale of the graph to show all data. After 10 minutes, stop data recording.

9. Name the data run, " Room-temperature germinating seeds ". Record the starting data in Table 1 under the “Initial CO2 Concentration (ppm)” Colum and “Room-temperature germinating seeds” row. Record the ending data under the “Final CO2 Concentration (ppm)” Colum and “Room-temperature germinating seeds” row.

10. Place about 400 mL of cubed or crushed ice into the 1000-mL beaker. Add about 400 mL of water into the 1000-mL beaker.

11. Place the 10 germinating seeds that have been soaking in ice water into the sampling bottle. Put the end of the CO2 gas sensor into the sampling bottle. Firmly plug the end of the sampling bottle with the rubber stopper.

12. Hold the neck of the sampling bottle such that most of it is in the beaker with the ice water.

13. Start data recording. Adjust the scale of the graph to show all data. After 10 minutes, stop data recording.

14. Name the data run, "Cold germinating seeds ". Record the starting data in Table 1 under the “Initial CO2 Concentration (ppm)” Colum and “Cold germinating seeds” row. Record the ending data under the “Final CO2 Concentration (ppm)” Colum and “Cold germinating seeds” row.

Table 1: Data table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Run | Initial CO2 Concentration (ppm) | Final CO2 Concentration (ppm) | Time  (s) | Rate of CO2 Production (ppm/s) |
| Dry dormant seeds |  |  |  |  |
| Room-temperature germinating seeds |  |  |  |  |
| Cold germinating seeds |  |  |  |  |

Analysis & Questions

1. How does the rate of CO2 production for germinating seeds compare with the rate of CO2 production for the dry, dormant seeds?
2. How does the rate of CO2 production for cold, germinating seeds compare with the rate of CO2 production for the room-temperature, germinating seeds?
3. What other factors might affect the rate of production of CO2 gas by the germinating seeds?
4. What is the chemical equation for cellular respiration? Where does cellular respiration occur in the cell?
5. Judging from this expression, what gaseous molecule would you expect to be produced during cellular respiration?
6. Explain why plants need to perform cellular respiration, even though they are photosynthetic organisms.