NAME PERIOD DATE

6. RESPIRATION OF GERMINATING SEEDS

Does temperature affect the respiration rate of organisms? How does the respiration of dormant seeds compare to the respiration of germinating seeds?

Objectives

- Explain how photosynthesis and respiration drive the cycling of matter and energy through living things.

Materials and Equipment

- Data collection system
- Carbon dioxide gas sensor with sampling bottle
- Beaker or cup, 250-mL
- Ice, 1 cup
- Zip seal sandwich bag
- Dry seeds, 25 mL
- Soaked seeds (room temperature), 25 mL
- Soaked seeds (chilled), 25 mL

Safety

Follow regular lab safety procedures.

Procedure

Part 1 – Dry, dormant seeds

1. Select Sensor Data in SPARKvue.

2. Connect the carbon dioxide gas sensor to your device.

3. Choose the Graph template.

4. Seal the empty sampling bottle with the carbon dioxide gas sensor. Calibrate the sensor.

5. Collect a large handful of soaked, chilled seeds such as beans or peas. Drain excess water and place the seeds in a zip seal bag. Close the bag and add it to the beaker. Add enough water to cover the seeds and add ice to create an ice water bath. Dry your hands.

6. Place 25 mL of dry, dormant seeds into an empty sampling bottle. Use the 25-mL line on the bottle to measure volume. Seal the bottle with the carbon dioxide gas sensor and set the system on its side as shown in Figure 1.

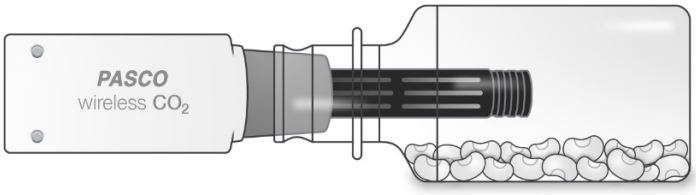


Figure 1: Set the bottle on its side

7. Predict how dormant seeds will affect the amount of carbon dioxide (CO_2) in the bottle compared to an empty bottle. Record and explain your prediction in Table 1.

8. Select Start to begin collecting data. Record the initial CO_2 concentration in Table 2. Do not disturb the system during data collection.

9. Stop collecting data after 3 minutes. Record the final CO_2 concentration and time elapsed in Table 2.

10. Remove the carbon dioxide gas sensor from the sampling bottle.

11. Remove the seeds from the bottle. Dispose of the seeds according to your instructor's directions.

12. Fill the empty bottle with water and the pour the water out to flush excess CO_2 from the bottle.

Part 2 – Germinating seeds (room temperature)

1. Repeat steps 6-12 with soaked, room temperature germinating seeds. Drain the seeds to avoid excess water in the bottle. Do not allow the sensor to get wet.

Part 3 – Chilled germinating seeds

1. Repeat steps 6-12 with germinating seeds from the ice water bath. Remove the seeds from the bag and drain them if needed before adding to the bottle. Do not allow the sensor to get wet.

2. Show all three runs in SPARKvue and scale the display. Sketch your results in Graph 1. Include numbers, labels, and units on the x- and y-axes. Add a key to identify each run.

3. Calculate the change in CO_2 concentration for each run. Use the following equation and enter the result in Table 2.

   Change in CO_2 Concentration = Final CO_2 Concentration - Initial CO_2 Concentration

4. Calculate the rate of CO_2 concentration change for each run. Use the following equation and enter the result in Table 2.

   Rate of CO_2 Concentration Change = Change in CO_2 Concentration ÷ Time

Data Collection

Table 1: Predictions before starting each run

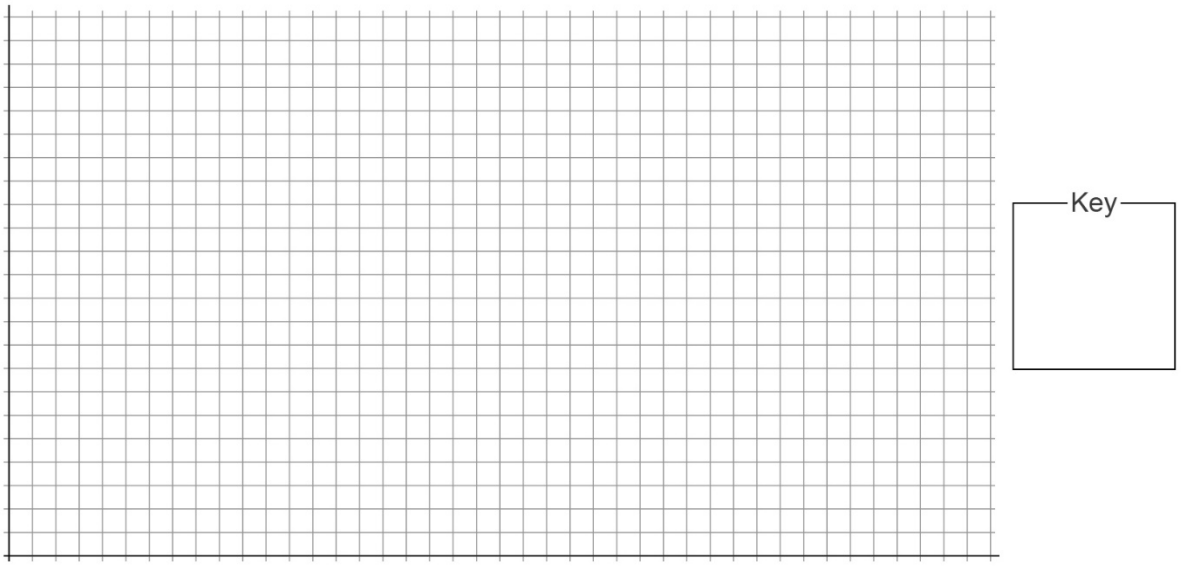
Run	Prediction: How will the amount of carbon dioxide in the bottle change when seeds are added? Explain your prediction.
Dry, dormant seeds	
Room temperature germinating seeds	
Chilled germinating seeds	

Table 2: Carbon dioxide (CO_2) concentration data for each run

Run	Initial CO_2 Concentration (ppm)	Final CO_2 Concentration (ppm)	Time (s)	Change[1] in CO_2 Concentration (ppm)	Rate of CO_2 Concentration Change (ppm/s)
Dry, dormant seeds					
Room temperature germinating seeds					
Chilled germinating seeds					

[1] The sensor is accurate to ±40 ppm. Changes that occur within this range are insignificant.

Graph 1: Carbon dioxide produced from dormant seeds and germinating seeds

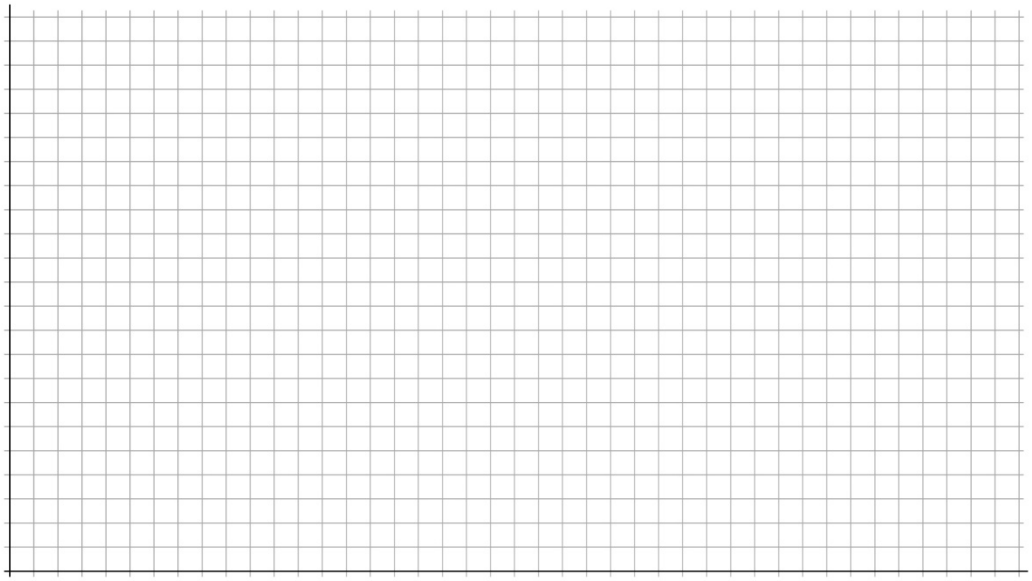


Questions and Analysis

1. The rate of CO_2 production is equivalent to the seed respiration rate. How does the respiration rate for germinating seeds compare with the respiration rate of dry, dormant seeds? Support your answer by discussing the visual difference between these seeds and their energy requirements measured by CO_2 production.

2. How does the rate of CO_2 production for cold germinating seeds compare with the rate of CO_2 production for the room-temperature germinating seeds? Support you answer with data and with a discussion of how temperature affects enzymes used for respiration.

3. On Day 1 of a 3-day experiment, 50 dry seeds are placed in a sampling bottle and a small amount of water is added to the bottle. A carbon dioxide gas sensor is used to seal the bottle and record carbon dioxide levels once every hour for three days. Predict what will happen to the carbon dioxide level over the 3 days and sketch a graph to show your prediction. Explain your graph.



4. Explain how your graph relates to the flow of energy and matter through living things.

5. The pH level of soils can vary significantly. Some soils are acidic, some are neutral, and some are alkaline (basic). Describe an experiment you could carry out to test whether water pH affects the rate of carbon dioxide production of germinating seeds. Identify dependent, independent, and control variables, required materials, procedure, and a data analysis plan. Write your proposal on a separate paper and attach it (or fill out an Experiment Design Plan if supplied by your instructor).