Activity: Decomposition

Objective

Investigate the decomposition activity in different substrate samples by measuring the carbon dioxide output and temperature change.

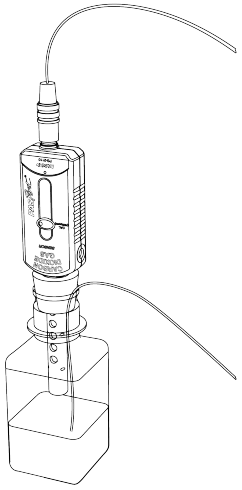
Materials and Equipment

- Data collection system
- Fast response temperature sensor
- Carbon dioxide gas sensor
- Sensor extension cable
- Sample bottle, 250-mL
- Substrate samples (3 to 5) with different composition and amounts of organic debris, 100 mL

Safety

- Wash your hands with soap and water after handling organic specimens.

Procedure – Measuring decomposition



***NOTE**: Record all work, including tables, data, diagrams, and answers, into your notebook.*

☐ 1. Start a new experiment on the data collection system, ⁽¹.²⁾ connect the carbon dioxide gas sensor to the data collection system using the extension cable, ⁽².¹⁾ and set the units to measure *parts per million* (ppm). ⁽⁵.³⁾

☐ 2. Calibrate the carbon dioxide gas sensor. ⁽³.¹⁾

☐ 3. Connect the fast response temperature sensor to your data collection system ⁽².²⁾ and set the units to measure degrees Celsius. ⁽⁵.³⁾

☐ 4. Measure and record the room temperature in your notebook.

☐ 5. Copy Table 1 into your notebook and record your qualitative observations of the substrate sample.

☐ 6. Estimate the percentage of the sample that is made up of organic material (such as leaves, twigs, and plant matter) and record the percentage in Table 1.

☐ 7. Place 100 mL of the substrate into the 250-mL sample bottle; pack it gently to get an accurate volume.

☐ 8. Place the fast response temperature sensor into the bottle and make sure the tip of the sensor is covered with the substrate sample.

☐ 9. Insert the carbon dioxide gas sensor, display both temperature and CO_2 concentration on the *y*-axis of the graph with time on the *x*-axis, ⁽⁷.¹.¹⁰⁾ and collect data for 10 minutes. ⁽⁶.²⁾

☐ 10. Find the maximum temperature reached and calculate the difference between the maximum temperature and room temperature. Record your results in Table 1.

☐ 11. When data collection is completed, remove the substrate and thoroughly rinse out the sample bottle, or exchange your sample bottle for a different substrate sample tested by another group.

☐ 12. Repeat the procedure for your remaining substrate samples.

Procedure – Data Analysis

Table 1: Rate of carbon dioxide production in different types of substrate

#	Substrate Description	Volume of Air (L)	ΔT (°C)	Organic Debris (%)	Rate of CO_2 Production or Consumption per 100 mL of Substrate	
					(ppm/hr)	(µmol/hr)
Ex.	Fine grain topsoil, light brown in color with little visible organic material, very low moisture content.	0.200	1.3	~15%	450	3.67
1						
2	RECORD DATA AND ANSWERS IN YOUR NOTEBOOK.					
3						
4						

***NOTE**: The volume of air in the sample bottle is 200 mL (300 mL total volume – 100 mL substrate).*

☐ 13. Apply a linear fit to your data to determine the carbon dioxide production or consumption rate. Record the slope in *ppm per hour* in Table 1. (9.5)

☐ 14. Convert *ppm carbon dioxide per hour* to *micromoles per hour* to standardize your data (as described in the Dimensional Analysis activity).

☐ 15. Compare your standardized data to the standardized data of other groups in your class. How do your results compare to theirs? Propose an explanation for any differences.

Questions

***NOTE**: Record all work, including calculations and answers, into your notebook.*

1. What effect, if any, did the sediment particle size have on the rate of decomposition? What effect did the amount of organic material have on the rate of decomposition?
2. How does the temperature data correlate to the carbon dioxide production rates? What does this indicate?
3. Which horizon in the soil profile shown to the right would you expect to have the highest rate of decomposition? Explain your answer.
4. Complete the questions in the Challenge: Biosphere handout for this activity.