Burying Beetle Respiration

Note: This laboratory exercise is adapted from the *Biology with Vernier* lab manual, Experiment 23B, *Effect of Temperature on Cold Blooded Organisms.* It is intended for use with the Vernier sensors and interfaces.

Introduction

In their study of *Nicrophorus investigator* populations across elevations, Smith et al. (2000) discovered two interesting patterns: 1) lower elevation sites supported larger populations; 2) higher elevation sites supported bigger individuals. The authors attributed these differences to a change in burying beetle reproductive strategies in response to a range of available carcass sizes. At higher elevation sites, brood size (number of larvae) remained constant but bigger larvae emerged from bigger carcasses. At lower elevation sites, larvae size remained constant but brood size increased on bigger carcasses. Smith et al. (2000) posit several different explanations for these patterns, and ultimately land on the following conclusion: "The change in temperature with elevation is clearly an important component linking the physiology of growth and development to behaviour and population dynamics, though it likely interacts with competition and resource density." We need to learn more about the link between temperature and the physiology of growth and development in burying beetles.

Smith, R.J., Hines, A., Richmond, S., Merrick, M., Drew, A., and Fargo, R. 2000. Altitudinal variation in body size and population density of *Nicrophorus investigator* (Coleoptera: Silphidae). *Environmental Entomology* 29(2): 290-298.

Learning Goal

Measure and describe the effect of temperature on the metabolism of burying beetles.

Materials

2 labeled respiration chambers (clear plastic 250 mL bottles)
2 Vernier CO_2 Gas Sensors
2 LabQuest interfaces
2 laboratory water baths
Distilled water
1 electronic balance
markers and labels
6 adult burying beetles (3 per respiration chamber)

Procedure

1. Fill the water baths with distilled water. Set one to 20 °C, and the other to 30 °C.
2. Use the respiration chambers, burying beetles, and electronic balance to complete the table below: *2 pts*

Respiration chamber label	1	2
Mass of respiration chamber (g)		
Mass of respiration chamber + 3 burying beetles (g)		
Mass of 3 burying beetles (g)		

3. Turn on the LabQuest interfaces and plug a CO_2 sensor into each one. The switch on the side of the CO_2 sensors should be set on low. Make sure that the sensors are recognized on the interface and that CO_2 readings appear in units of parts per million (ppm). **The mode of data collection should be time based, the rate set at 1 samples/s, and the duration for 600.0 s.** Allow a minute or two for the readings to stabilize. Insert a sensor into each respiration chamber, creating a seal and a closed system.
4. Place chamber 1 in the water bath at 20 °C, and chamber 2 in the water bath at 30 °C. It will be necessary to hold the chambers to keep them partly submerged in the water, *but do not get the sensors wet*. Allow 90 seconds for the water baths to warm the air in the chambers, and then select the *Run* button (green play button in the bottom left corner) on the LabQuest interfaces to start measuring CO_2 concentrations.
5. For ectothermic burying beetles, body temperature is set by the temperature of the environment. **What do you predict will happen to the respiration rate of burying beetles as ambient temperature increases? Explain why.** *2 pts*
6. The LabQuest will stop collecting data after 10 minutes. Use the graphing tool on the LabQuest interface to measure the slope of each line in units of ppm/sec. To do this, select *Analyze* from the menu at the top, and *Curve Fit*. Choose a *Linear* fit equation.
7. Complete the table below: *4 pts*

Chamber	Temperature (°C)	Slope (ppm/sec)	Respiration rate (ppm/min/g)
1	20		
2	30		

8. *How do burying beetle populations change along an elevation gradient?*
Based on the results of the experiment, propose a **hypothesis**, or a possible answer to the question above. *2 pts*