

CHAPTER 5	Investigation 5.D: Oxygen Consumption and Heat Production in Germinating Seeds	BLM 5.3.1
HANDOUT		
Question: Part 1 —How can you demonstrate quantitatively that germinating seeds consume oxygen? Part 2 —How can you demonstrate that heat is a product of germinating (respiring) seeds?		

Part 1: Oxygen Consumption in Cellular Respiration*

Prediction

Based on the experimental set-up, predict what will happen to indicate that oxygen is being consumed as the seeds respire.

Safety Precautions



If glass tubing is used instead of plastic tubing, handle the tubes very carefully to avoid breakage.

Materials

- large test tube
- ruler
- 1 g of seeds of any kind
- one-hole stopper
- limewater
- pipette
- wad of cotton
- rigid plastic tubing, 20 cm long and bent at right angle
- marker
- liquid detergent
- balance
- paper towels
- spatula
- scotch tape
- support stand and clamp

Procedure

1. Obtain some small plant seeds. If possible, have a different type of seeds from those used by your classmates. Germinate the seeds by spreading them on wet paper towel a day or two before the lab.
2. Start to make a respirometer by inserting the short end of the tube into the hole of the stopper. The long end of the tube should be sticking out at a right angle as shown in the photograph.
3. Draw a line 0.5 cm above the bottom of the test tube with the marker. Add limewater to the tube up to this mark.
4. Moisten a small wad of cotton and place it on top of the limewater. Now place one gram of germinating seeds on top of the moistened cotton.

*Part 1 adapted from *Agri-science Resources for High School Sciences*, P.E.I. Agriculture Sector Council

CHAPTER 5	Investigation 5.D: Oxygen Consumption and Heat Production in Germinating Seeds (cont'd)	BLM 5.3.1
HANDOUT		

5. Tape the ruler to the tubing as shown in the photograph. Use a pipette to add a drop of detergent to the tubing near the end.
6. Carefully insert the stopper and tubing into the test tube to form an airtight seal. Use a support stand and clamps to keep the respirometer apparatus in an upright position.
7. Wait five minutes to allow for the absorption of any carbon dioxide that was in the respirometer when it was assembled. Take an initial reading wherever the drop of detergent is with respect to the ruler. Always take the measurement from the same part of the detergent drop. Record the initial reading in a suitable data table.
8. Take readings every minute for 15 minutes and record them in the data table. Graph your data.

Analysis

1. How did the rate of oxygen consumption in different types of plant seeds compare?

Conclusions

1. Describe what you observed that indicated cellular respiration was occurring in the germinating seeds.
2. Name at least two sources of error that could have affected your observations and data. Explain how significant these sources of error are to the outcome of your investigation.

CHAPTER 5	Investigation 5.D: Oxygen Consumption and Heat Production in Germinating Seeds (cont'd)	BLM 5.3.1
HANDOUT		

Part 2: Heat Production in Cellular Respiration

Hypothesis

State a hypothesis that enables you to obtain quantitative data about the heat given off by germinating seeds.

Prediction

Make a prediction about the outcome of your investigation.

Safety Precautions

The buildup of gases in an enclosed container such as a test tube or flask could cause the container to rupture or shatter. Provide a means for venting gases out of any system you use.

Materials

- germinating seeds (e.g., chickpeas)
- other materials your group decides are needed

Note: Consider using probeware or similar data-logging equipment if it is available.

Experimental Plan

1. With your group, develop a written plan that outlines the procedure you will follow to test your hypothesis. Be sure to consider the following in your procedure:
 - safety
 - controlled variables
 - data collection and recording
2. In the course of your planning, you may wish to consult other investigations you have performed earlier this year (for example, Investigation 2.B in Chapter 2) or in previous science courses. These investigations may provide ideas or procedures that you can adopt or modify.
3. Review your hypothesis and procedure with your teacher before you perform it.

Data and Observations

4. Decide how you will measure the heat given off by germinating seeds.
5. Decide how you will record and display your data to assist you in analyzing and drawing conclusions about your results

CHAPTER 5	Investigation 5.D: Oxygen Consumption and Heat Production in Germinating Seeds (cont'd)	BLM 5.3.1
HANDOUT		

Analysis

1. What variables did you manipulate and control?
2. Compare your results with those obtained by others in the class. Use the differences, if any, to identify possible sources of error in your procedure and/or data collection.

Conclusions

3. Explain why your results either supported or refuted your hypothesis.
4. Predict the results of your investigation if you let it run for a longer period of time, such as several days or a week. Justify your prediction by explaining your reasoning.