

Plant-A-Plant Soil Respiration Laboratory Guide

Task

Create a closed system (i.e. a plastic bottle) with different amounts and types of organic matter. Observe how the amount of organic matter affects the release of carbon dioxide from microorganisms during cultivation.

Prepare and Perform Experiment

Materials and Tools (per replicate)

- Six 1-liter plastic bottles with a wide neck, transparent
- Three plastic trays or dishes for soil mixing
- Tap water
- Three 10-15 ml test tubes
- Sodium hydroxide (NaOH)
- Pencil and permanent marker
- Three substrates with different amounts of organic matter: sand, peat, gardening soil

** Note: At least two replicates are recommended for this experiment.

Preparation

- 1) If necessary, calculate the amount of materials needed for more than 1 replicate.
- 2) Wash the bottles thoroughly - do not use any cleansers, since these could influence the growth of plants. Allow the bottles to air-dry. Be sure to choose transparent bottles, since colored plastic will affect the growth of the plants.
- 3) Prepare each substrate in a plastic tray by moistening each with water until damp, but not flooded.
 - a) Sand (almost no organic matter)
 - b) Peat (high amount of organic matter, but difficult to digest by microorganisms)
 - c) Gardening soil (high amount of organic matter, but easy to digest by microorganisms)
- 4) Place the substrates into the bottles (fill to approximately 3-4 cm above the bottle bottom). Prepare 2 bottles for each substrate (one control, one for NaOH).
- 5) Using a laboratory scale, weigh out 2g of NaOH. **Caution: Sodium hydroxide is a strong base – DO NOT touch it with your fingers.** Use a chemical spoon/scoop.
- 6) Place the 2g of NaOH into the 10 ml test-tube.
- 7) Using tweezers, carefully place the test-tube with NaOH into the bottom of each NaOH bottle. Leave the test-tube vertical and prevent the substrate from coming into contact with the NaOH.
- 8) Close the bottles carefully and don't open them during the experiment.

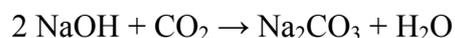
- 9) Try to keep bottles from direct sunlight so that they do not overheat.
- 10) Cultivate the bottles for 10 days and observe what happens to the shape of the bottle.
- 11) Record your visual observation of bottle shape and/or directly measure the bottle volume.

Conclusions

- 1) Revise answers to questions posed at the beginning of the experiment in your science notebook. Does the experimental outcome provide the answers or at least a clue?
- 2) Evaluate validity of your hypotheses. Were they supported or rejected? What was your evidence?
- 3) Did you encounter any issues/difficulties while performing the experiment? What were potential sources of error in the experiment? Are there ways the procedure could be improved?
- 4) Record any remaining questions about the experiment or its outcomes. How would you design an experiment to test one of these questions?
- 5) All scientists, once they have completed their investigation, share their findings with peers in their community. Follow the instructions provided by your teacher to share your work

Why use NaOH?

Carbon dioxide is released from substrates containing organic matter due to microorganism respiration. This causes the air within the bottle to be depleted of oxygen and enriched with carbon dioxide. Inside the bottles with the vial containing sodium hydroxide, the CO₂ is absorbed according to equation:



Therefore the difference in volume between bottles with and without NaOH corresponds to the carbon dioxide released from the substrate.