

Name: \_\_\_\_\_

## Activity 4.3.2 Passing Gas

### Purpose

You know that animals rely on plants for food, but did you know that plants and animals rely on each other for life sustaining gases in the air?

Plants photosynthesize to produce their food. For photosynthesis to occur, plants need carbon dioxide. Animals produce carbon dioxide when they exhale. Conversely, a by-product of photosynthesis is oxygen and animals need oxygen to breathe. Test the production of carbon dioxide and oxygen by plants and animals in this experiment.

### Materials

#### Per pair of students:

- LabQuest2
- Dissolved oxygen sensor
- pH sensor
- 300 ml Beaker
- 4 screw top test tubes
- Test tube rack
- Distilled water spray bottle
- Pipette
- Parafilm
- 2 pond snails
- Pond water
- 2 Elodea sprigs
- Permanent marker pen

#### Per student:

- Pencil
- *Agriscience Notebook*

### Procedure

You and your partner will create a control and three test variables to determine the interdependence of plants and animals. The variables will involve water plants called *Elodea* and pond snails.

For this investigation, you will detect the presence of carbon dioxide by measuring the pH of each sample. Carbon dioxide dissolved in water creates carbonic acid ( $H_2CO_3$ ) and concentrations of this substance will decrease the pH of solutions. Therefore, if more carbon dioxide is released from the organisms, the pH will decrease.

The second measurement you will monitor is oxygen. In *Lesson 3.5 Water World*, you monitored the levels of dissolved oxygen in water. The same concept is used for this activity. As more oxygen is produced by plants, the concentration of dissolved oxygen in the solution will increase.

The following procedures will direct you through this experiment.

## Part One – Using LabQuest2 and Sensors

**Important:** Prior to each use, the dissolved oxygen sensor must warm up for a period of 10 minutes as described below. If the sensor is not warmed up properly, inaccurate readings will result. Perform the following steps to prepare the dissolved oxygen sensor.

1. Connect the pH sensor and the dissolved oxygen sensor to LabQuest2. Choose New from the File menu.
2. It is necessary to warm up the dissolved oxygen sensor for 5–10 minutes before taking readings. With the sensor still in the distilled water beaker, wait 5–10 minutes while the sensor warms up. The sensor must stay connected at all times to keep it warm. **NOTE:** If disconnected for a period longer than 5 minutes, it will be necessary to repeat this step.
3. While you are waiting for the DO sensor to warm, continue Part Two Steps 1–8.

## Part Two – Experiment Set up and Initial Measurements

1. Obtain and label four test tubes 1–4.
2. Place the test tubes in the test tube rack.
3. Fill each tube 2/3 full with pond water.
4. Place one snail in test tubes 2 and 4.
5. Place one sprig of *Elodea* in test tubes 3 and 4. The test tubes should appear similar to those in Figure 1.
6. Remove the pH sensor from the storage bottle. Rinse the sensor thoroughly with distilled water. Place the pH sensor into test tube 1 and gently swirl to allow water to move past the tip of the sensor. When the reading stabilizes, record the pH value in Table 1.
7. Repeat Step 6 for each of the other three test tubes.
8. When all of the pH readings have been taken, rinse the pH sensor with distilled water and return it to the pH storage bottle.
9. Place the dissolved oxygen sensor into test tube 1 so that it is submerged half the depth of the water. Gently and continuously move the sensor up and down a distance of about 1 cm in the tube. This allows water to move past the tip of the sensor. **Note:** Do not agitate the water, or oxygen from the atmosphere will mix into the water and cause erroneous readings.
10. When the dissolved oxygen reading stabilizes (~30 seconds), record the value in Table 1.
11. Repeat Steps 9-10 for each of the other test tubes.
12. When all of the dissolved oxygen readings have been taken, rinse the dissolved oxygen sensor and return it to the distilled water beaker.
13. Completely fill each test tube with pond water and tighten the cap onto the tube. Do not allow any air bubbles to remain in any of the test tubes. Unscrew each cap slightly, so that they are just barely open. Wrap each tube with Parafilm so that they do not leak water. The Parafilm will expand, if necessary, to accommodate any pressure build-up in a tube. No oxygen or carbon dioxide should enter or leave a

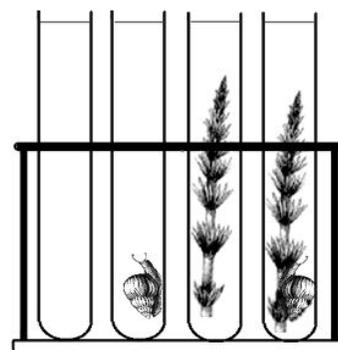


Figure 1. Test Tube Set-up

tube.

- Place test tubes in a well-lit area as directed by your instructor.
- Predict how the pH and dissolved oxygen will change in each tube. Write a short statement that explains your reasoning. Be specific about the roles of both the snail and *Elodea*. Be prepared to discuss your reasoning in class on Day 2.

Prediction:

### Part Three – Day 2 Observations and Reversal of Organisms

- Set up the pH sensor and dissolved oxygen sensor as instructed in Part One.
- Repeat Steps 6–12 in Part Two to take pH and DO readings for each of the test tubes.
- Now the *Elodea* will use the environment established by the snail and the snail will use the environment established by the *Elodea*. Remove the snail from test tube 2 and the *Elodea* from test tube 3. Place the snail in test tube 3 and the *Elodea* in test tube 2. **Note:** Try not to aerate the water during the transfer.
- Measure the pH and DO of test tubes 1–3 again. Record the results in Table 2. These values should be similar to those measured before the transfer. If not, the water may have been mixed too vigorously with the atmospheric air. However, these results give you a baseline to compare results for Day 3.
- Completely fill the test tubes with pond water and tighten the cap onto each tube, as in Step 13 of Part Two. Wrap each slightly opened test tube with Parafilm.

### Part Four – Day 3 Final Observation and Laboratory Equipment Cleanup

- Set up the pH sensor and dissolved oxygen sensor as before.
- Take a pH reading and a DO reading from each test tube as before. Record the results in Table 2 for Day 3.
- Return the snails and *Elodea*, as directed by your instructor. Clean and return the test tubes.

**Table 1 Initial Results**

Test Tube	pH Day 1	pH Day 2	pH Difference	DO Day 1	DO Day 2	DO Difference
1	8.06	7.60	0.46	9.2	2.1	7.1
2	8.11	6.77	1.34	9.1	1.0	8.1
3	8.03	6.85	1.18	8.2	4.0	4.2

4	8.22	6.73	1.49	7.2	1.6	5.6
---	------	------	------	-----	-----	-----

Table 2 Reversal Results						
Test Tube	pH Day 2	pH Day 3	pH Difference	DO Day 2	DO Day 3	DO Difference
1	7.60			2.1		
2	6.50			2.0		
3	6.74			3.8		
4	6.73			1.6		

## Conclusion

- Based on your results, describe how carbon dioxide and oxygen levels change in the presence of the snail.

It will have less oxygen in the water for the snails

- Based on your results, describe how carbon dioxide and oxygen levels change in the presence of *Elodea*.

It will just gain more oxygen that is taken from the snail and the water

- How did exchanging the snail and *Elodea* in test tubes 2 and 3 on Day 2 affect carbon dioxide and oxygen levels in those test tubes?

The plant is going to put more oxygen into the tube the snail was in and had taken out of the water.

- Summarize the relationship between snails and plants in a pond.

They work with each other because for all the oxygen the snails take out and the carbon dioxide they put in the plant takes it out and re-puts oxygen in