Name_____

CASE

Activity 4.4.2 Passing Gas

Purpose

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

Plants photosynthesize carbon dioxide and water to produce their food. Conversely, a by-product of photosynthesis is oxygen (O_2), which animals, such as snails, need to breathe. Animals breathe in oxygen and produce carbon dioxide when they exhale. When animals produce carbon dioxide in water, carbonic acid (H_2CO_3) will form. Concentrations of carbonic acid decreases the pH of solutions. When animals increase carbon dioxide concentrations in water, the pH of the water will decrease.

In *Lesson 4.3 Water World*, you monitored the levels of dissolved oxygen (DO) in water. As more oxygen is produced by underwater plants, the concentration of dissolved oxygen in the solution will increase.

How will the production of both carbon dioxide and oxygen by underwater plants and animals compare?

Materials

Per pair of students:

- LabQuest2
- Optical dissolved oxygen (DO) sensor
- pH sensor
- 250ml beaker
- 4 screw top test tubes
- Test tube rack
- Distilled water spray bottle
- Pipet
- Parafilm
- 2 pond snails
- Pond water
- 2 *Elodea* sprigs
- Permanent marking pen

Per student:

- Pencil
- *Agriscience Notebook*

Procedure

You and your partner will 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. The second measurement you will monitor is oxygen.

Part One – Experiment Set up and Initial Measurements

1. Select % using the switch on the DO sensor cable box.
2. Connect the pH sensor and the DO sensor to LabQuest2. Choose **New** from the *File* menu.
3. Obtain and label four test tubes 1 – 4.
4. Place the test tubes in the test tube rack.

5. Fill each tube 2/3 full with pond water.
6. Place one snail in test tubes 2 and 4.
7. Place one sprig of *Elodea* in test tubes 3 and 4. The test tubes should appear similar to those in Figure 1.
8. 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 of *Activity 4.4.2 Student Worksheet*.
9. Repeat Step 8 for each of the other three test tubes.
10. When all the pH readings have been taken, rinse the pH sensor with distilled water and return it to the pH storage bottle.

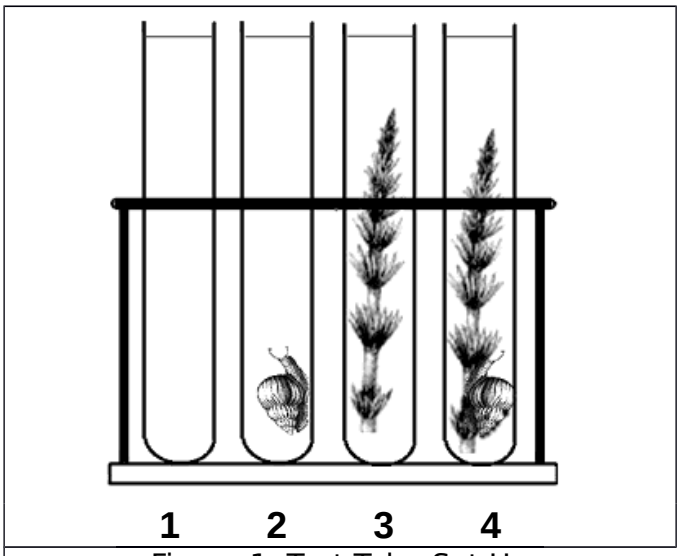

Figure 1. Test Tube Set Up

12. Remove the protective cap from the DO sensor.
13. Place the DO sensor into test tube 1 so the metal dot on the side of the sensor is submerged. **Note:** Do not agitate the water, or oxygen from the atmosphere will mix into the water and cause erroneous readings.
14. When the dissolved oxygen reading stabilizes (~30 seconds), record the value in Table 1.
15. Repeat Steps 12 – 13 for each of the other test tubes.
16. When all the dissolved oxygen readings have been taken, rinse the DO sensor, blot dry and attach the protective cap.
17. 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.
18. Unscrew each cap slightly, so they are barely open.
19. Wrap each tube with parafilm so that they do not leak water. The parafilm may expand to accommodate any pressure build-up in a tube. No oxygen or carbon dioxide should enter or leave a tube.
20. Place test tubes in a well-lit area as directed by your instructor.
21. Predict how the pH and dissolved oxygen will change in each tube. Write a short statement to explain your reasoning in Table 2 on the student worksheet. Be specific about the roles of both the snail and *Elodea*. Be prepared to discuss your reasoning in class on Day 2.

Part Two – Day 2 Observations and Reversal of Organisms

1. Set up the pH sensor and DO sensor as instructed in Steps 1 – 2 of Part One.
22. Repeat Steps 8 – 15 in Part One to take pH and DO readings for each of the test tubes.
23. Record initial results for Day 2 in Table 1.
24. Remove the snail from test tube 2 and the *Elodea* from test tube 3.
25. Place the snail in test tube 3 and the *Elodea* in test tube 2. Note: Try **not** to aerate the water during the transfer. Now the *Elodea* will use the environment established by the snail and the snail will use the environment established by the *Elodea*.

26. Measure the pH and DO of test tubes 1 – 4 again. Record the results for Day 2 reverse results in Table 3. 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.
27. Completely fill the test tubes with pond water and tighten the cap onto each tube, as in Step 16 of Part One. Wrap each slightly opened test tube with parafilm.
28. Predict the pH and the dissolved oxygen % for Day 3 in Table 4 on the student worksheet. Be prepared to discuss your reasoning in class on Day 3.

Part Three – Day 3 Final Observation and Laboratory Equipment Cleanup

1. Set up the pH sensor and DO sensor as before.
2. Take a pH reading and a dissolved oxygen reading from each test tube as before. Record the results in Table 3 for Day 3.
3. Return the snails and *Elodea*, as directed by your instructor. Clean and return the test tubes.
4. Compare your results to your predictions in the conclusion table on the student worksheet.
5. Answer the analysis questions on the student worksheet.

Conclusion

1. What gases are consumed by animals?

Oxygen

1. What gases are consumed by plants?

Carbon Dioxide

2. How are animals and plants dependent upon each other?

Animals need oxygen which is produced by plants and plants need carbon dioxide which is produced by animals.

Name_____

Activity 4.4.2 Student Worksheet

Table 1. ***Initial Results***

Test Tube	pH Day 1	pH Day 2	pH Difference	DO Day 1	DO Day 2	DO Difference
1						
2						
3						
4						

Table 2. ***Initial Results Prediction***

Table 3. ***Reversal Results***

Test Tube	pH Day 2	pH Day 3	pH Difference	DO Day 2	DO Day 3	DO Difference
1						
2						
3						
4						

Table 4. ***Reversal Results Prediction***

Table 5. ***Conclusion***

Analysis Questions

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

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

- 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?

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