TEACHER INFORMATION

Interdependence of Plants and Animals

1. Editable Microsoft Word versions of the student pages and pre-configured TI-Nspire files can be found on the CD that accompanies this book. See *Appendix A* for more information.
2. The Dissolved Oxygen Probe must be calibrated the first day of use. Follow the pre-lab procedure to prepare and calibrate the Dissolved Oxygen Probe. To save time, you may wish to store the calibration values on paper. The students can then skip the pre-lab procedure. They will have the calibration values available for manual entry in case the values stored in the program are lost.
3. In order for the Dissolved Oxygen Probe to warm up and stay polarized, power to the sensor must be continuous. Go! Link or EasyLink, with a computer, and the TI-Nspire Lab Cradle deliver continuous power once the data-collection software is started. However, EasyLink or Go!Link with a handheld will lose power when the TI handheld goes to sleep (APD™). If power to the sensor is disrupted, the sensor must be warmed up for 10 minutes before calibrating or taking readings. To avoid having to warm up the sensor again, students must press a button on the handheld every few minutes to keep it awake.
4. When using a TI-Nspire handheld with an EasyLink or Go!Link interface, we recommend that the handhelds power standby feature be set to 30 minutes. To set this feature, select Settings ►Handheld Setup from the TI-Nspire home screen. Change the Power Standby feature to 30 minutes. You may want to set this back after completing this experiment.
5. As a time-saving measure, instruct the students at the end of class to leave the data-collection program running. This will keep power going to the probes. When the next group of students comes in, they can begin at Step 5 of the procedure. They can skip Steps 1–5 because the initial group of students has completed all of the setup. Have the last group of students for the day shut everything off and put things away.
6. The pond water should be adjusted to pH 7 before class begins. Use 0.1 M NaOH or 0.1 M HCl to adjust the pH. Be sure the elodea are fresh and healthy.
7. Florescent lamps should be used as a source of light. They should be on for the entire 24 hour period, set a few inches from the tubes. If the tubes are water tight, as they should be, test tube racks are not necessary. Students can place them horizontally on a table and the light can be lowered until it is just above the tubes.
8. Wrap the test tubes thoroughly in aluminum foil if they require darkness, or place them in a darkened part of the room. If there are not a sufficient number of test tube racks for these, place the set of four wrapped tubes in a small beaker.
9. Between classes, store the Dissolved Oxygen Probes in a beaker of distilled water. At the end of the day, be sure to empty out the electrode filling solution in the Dissolved Oxygen Probe and rinse the inside of the membrane cap with distilled water.
10. If you have a pH System, but do not have a Dissolved Oxygen Probe, the experiment may be modified to indirectly investigate carbon dioxide levels using only the pH System.

11. When taking dissolved oxygen readings, the students should allow ample time for the readings to stabilize. In some instances this can take 60 seconds.

12. Each student team should use the same set of equipment to make measurements each day.

13. When setting up the Dissolved Oxygen Probe, be sure to remove the blue plastic cap from the end of the probe. The cap is made of a soft plastic material and easily slides off the probe end.

14. Elodea canadensis is a good alternative for those who live in any area to which it is illegal to ship Elodea. Other aquatic plants may work equally well.

ANSWERS TO QUESTIONS

1. Consider the snails.
   a. Snails produce CO_2 when in the light. The pH decreased, meaning the acidity increased. Higher acidity means more CO_2 is dissolved. A snail was the only organism present to produce the CO_2.
   b. Snails consume O_2 when in the light. The DO decreased, so less O_2 is dissolved. A snail was the only organism present to consume the O_2.
   c. Experimental Test Tube: 2. Control Test Tube: 1.
   d. Snails produce CO_2 when in the dark. The pH decreased, so the acidity increased. Higher acidity means more CO_2 is dissolved. A snail was the only organism present to produce the CO_2.
   e. Snails consume O_2 in the dark. The DO decreased, so less O_2 is dissolved. A snail was the only organism present to consume the O_2.
   f. Experimental Test Tube: 6. Control Test Tube: 5.

2. Consider the Elodea.
   a. Elodea consume CO_2 when in the light. The pH increased, so the acidity decreased. Lower acidity means less CO_2 is dissolved. Elodea was the only organism present to consume the CO_2.
   b. Elodea produce O_2 when in the light. The DO increased, so more O_2 is dissolved. Elodea were the only organism present to make the O_2.
   c. Experimental Test Tube: 3. Control Test Tube: 1.
   d. Elodea produce CO_2 in the dark. The pH decreased, so the acidity increased. Higher acidity means more CO_2 is dissolved. Elodea were the only organism present to produce the CO_2.
   e. Elodea consume O_2 in the dark. The DO decreased, so less O_2 is dissolved. Elodea was the only organism present to consume the O_2.
   f. Experimental Test Tube: 7. Control Test Tube: 5.

3. Consider the elodea placed in the snail's water on days 2–3.
   a. Elodea consumes the CO_2 that snails release when in the light. CO_2 increased when a snail was alone in the pond water, yet it decreased when elodea replaced the snail. Some of the CO_2 used by the plant must have come from the snail. The increase in pH was greater for elodea in Tube 2 of Table 2 than in Tube 3, Table 1, so more CO_2 was consumed from water the snail was in.

b. Elodea produces O_2 when in the light, as above. The DO increased, so more O_2 is dissolved.
c. Experimental Test Tube: 2. Control Test Tube: 1.
d. The pH change in Test Tube 6 from Day 2 to Day 3 was negative. This indicates that the plant did not remove the CO_2; rather, it was added as the plant respired. Elodea did not consume CO_2 in the dark, and did not use the CO_2 from the snail.
e. Elodea consumed O_2 when in the dark. The DO decreased, so the plant respired when in the dark.
f. Experimental Test Tube: 6. Control Test Tube: 5.

4. Consider the snail placed in the elodea's water on days 2–3.
   a. The snail did release CO_2 in the light, as during Day 1 – Day 2. The pH decreased, so the acidity increased. Higher acidity means more CO_2 is dissolved.
   b. Snails consume O_2 that elodea produce in the light. 2b (above) shows that plants make O_2 in the light. The DO change in Test Tube 3 from Day 2 to Day 3 was negative. This indicated that the snail removed the O_2 made by elodea.
   c. Experimental Test Tube: 3. Control Test Tube: 1.
   d. The snail did release CO_2 in the dark, as the pH decreased.
   e. The snail did consume O_2 while in the dark, as the DO decreased.
   f. Experimental Test Tube: 7. Control Test Tube: 5.

5. Here is a summary of the relationship between snails and plants in a pond:
   - Snails can produce CO_2 in both light and dark conditions.
   - Elodea produce CO_2 in the dark, but consume CO_2 when illuminated with light.
   - In the light, elodea can use the CO_2 that snails produce.
   - In the dark, elodea cannot use the CO_2 that snails produce.

   - Snails can consume O_2 in both light and dark conditions.
   - Elodea produce O_2 in the light, but consume O_2 when in the dark.
   - In the light, snails can use the O_2 elodea produce.
   - In the dark, elodea do not produce O_2, so snails cannot use it.

6. Answers may vary. The answer depends upon the rate of photosynthesis vs. the rate of respiration in Test Tube 4.
   - If the rate of respiration by the snail and plant was greater than the rate of photosynthesis, 3a and 3b might be answered differently. The pH would remain low and the amount of DO would also be low.
   - If the rate of respiration by the snail and plant was less than the rate of photosynthesis, 4a and 4b might be answered differently. The pH difference would be higher, indicating a removal of CO_2. The amount of dissolved oxygen would also be high. This might mask the respiration by both plant and animal.

7. Answers may vary.