

Who stole all the Oxygen?

Question: How are photosynthesis and respiration alike and different?
How can calculator based learning units (CBLs) be used to collect data?

Kentucky Core Content:

SC-H-3.1.5 Plant cells contain chloroplasts, the site of photosynthesis. Plants and many microorganisms (e.g., Euglena) use solar energy to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment. This process of photosynthesis provides a vital link between the Sun and energy needs of living systems.

SC-H-3.5.4 Living organisms have the capacity to produce populations of infinite size. However, behaviors, environments, and resources influence the size of populations. Models (e.g., mathematical, physical, conceptual) can be used to make predictions about changes in the size or rate of growth of a population.

SC-H-3.6.1 Living systems require a continuous input of energy to maintain their chemical and physical organization since the universal tendency is toward more disorganized states. The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy stored in the bonds between the atoms can be used as sources of energy for life processes.

Scientific Inquiry 2.1 (Use of technology)

Objectives: Students will be able to:

1. Explain the similarities and differences in photosynthesis and respiration; and to show the differences between them.
2. Discuss how real life situations, fish, plants, and sunlight will affect dissolved oxygen, and how we can manage appropriately to maintain a healthy level of oxygen in our system.
3. Interpret a graph or graph data from an experiment.
4. Use graphing calculators and calculator-based learning units to collect data.

Materials:

4 Six gallon aquarium systems (or jars)
Plastic wrap – to seal tanks
Elodea (aquatic plant)
Minnnows or feeder goldfish
Temperature probes
Dissolved oxygen probes
CBL units from TI (one for every pair of students)
CBL overhead
Overheads (below)
DOhandout.doc (attached)

Procedure/time:

This experiment will take one full class period (50 minutes) and about 15 minutes of the following day to complete the follow up questions. See Teachers sheet for exact procedure.

Assessment:

Assessment takes place immediately as students learn to use the CBL units. The students' progress can be followed by watching to see if they have arrived at the correct screens on their CBLs and if they are collecting data correctly. Assessment of prior knowledge of photosynthesis and respiration is conducted during the guided discussion explained on the teacher's sheet. The students' grasp of the information is assessed during the experiment by allowing them to develop hypothesis about what will happen in each tank and explain why they believe it will happen. More analysis is conducted the following day through the analysis questions.

Who stole all the oxygen? Teacher's sheet

1. Introduction to CBLs
 - a. Load Datamate prior to class
 - b. Discuss use and graphing abilities
 - c. Discuss probes
 - d. Set-up
 - i. Turn on CBL
 - ii. Press Apps
 - iii. Select Datamate
 - iv. Hit Enter
 - v. Add temperature sensor
 - vi. Sensor should read on top right of screen
 - e. Temperature experiment for CBL practice
 - i. Press one for setup
 1. press 2 for time graph
 2. press 2 for change times
 3. enter number and interval of data points
 - a. data every two seconds for 1 minute
 4. press 1 = ok
 5. press 1 = ok
 - ii. press 2 to start
 - iii. grip end of probe to heat up
 - iv. Double beep means it is done
 - v. Graph shown
 - vi. Press enter to return to home
 - vii. Do a few more times with the challenge of who can get the gauge the hottest
2. Discuss photosynthesis and respiration
 - a. What is different between plants and animals
 - b. How do plants make food?
 - c. $6 \text{ H}_2\text{O} + 6 \text{ CO}_2 + \text{sunlight} = \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2$ (Attached overhead can be used.)
 - d. How do animals make energy?
 - e. $\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 = 6 \text{ H}_2\text{O} + 6 \text{ CO}_2 + \text{energy (ATP)}$ (Attached overhead can be used.)
3. Set up experiment
 - a. Set up 4 tanks before class
 - i. Tank 1 – fish only
 - ii. Tank 2 – Elodea only
 - iii. Tank 3 – Elodea and fish
 - iv. Tank 4 – Nothing (control)
 - b. One DO probe for each tank
 - c. Attach DO probe where temperature was
 - d. Change time settings as before
 - i. Every 30 seconds, 20 times
 - e. get back to main screen and start experiment
4. Hypothesis for each tank
 - a. We will seal each tank for 10 minutes
 - b. What will happen to our oxygen? Why?
 - c. Have students work together in small groups to develop a hypothesis

5. Analyze
 - a. Look at graph of each tank at end of 10 minutes
 - b. Discuss what happened
6. Make hypothesis for 2 hour experiment
 - a. Have students work together in small groups to develop a hypothesis
 - b. Share hypotheses.
7. Run 2 hour experiment yourself after class – save graphs in CBLs
8. Following day
 - a. Discuss graphs and results
 - b. Have students answer the following questions.
 - i. Was your hypothesis correct
 - ii. What factors in each aquarium affect the amount of dissolved oxygen in the water?
 - iii. What effect do plants have on dissolved oxygen?
 - iv. What effect do animals have on dissolved oxygen?
 - v. How are photosynthesis and respiration alike?
 - vi. How are photosynthesis and respiration different?
 - vii. A landowner has a pond on her land that she using for fishing, but she notices that there is a lot of plant life on the surface. She decides she needs to get rid of all the plants so the pond is clean for the fish. Would you advise her to do that? Why or why not?

Photosynthesis



Respiration



Hypothesis

Tank 1 : Water Only

Tank 2: Fish

Tank 3: Plants

Tank 4: Plants and Fish