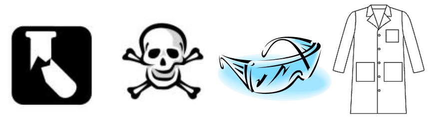
Photosynthesis Lab - Elodea and Bromothymol Blue; SB3 a,b



Green plants use sunlight to make glucose. To do so, the plant must use carbon dioxide and water in a process called photosynthesis. The glucose made by plants is used by plants and animals as a source of energy. To release the energy contained in the bonds of glucose, the glucose must be converted to ATP. The process by which ATP is made from glucose is called cellular respiration. Respiration also produces waste products including carbon dioxide and water, which are the same substances that served as raw materials for photosynthesis. In water, carbon dioxide dissolves to form a weak acid. As a result, an acid-base indicator such as bromothymol blue (btb) can be used to indicate the presence of carbon dioxide. In this lab, you will use bromothymol blue as an indicator to show how much CO_2 is left in test tubes containing plants exposed to light. Elodea is a freshwater aquatic plant native to the United States. Commonly known as the waterweed, elodea is an important component of aquatic ecosystems. A small piece of elodea will be introduced to a solution containing bromothymol blue and CO_2. The purpose of this lab is to determine the effects of elodea on CO_2 levels and to observe evidence of cellular respiration and photosynthesis.

Part 1: Elodea and Bromothymol Blue:

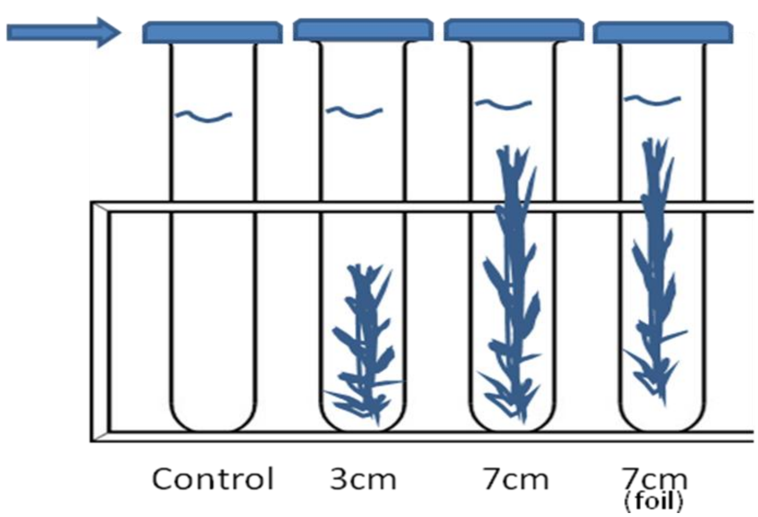
1. Label four test tubes: "control," "3 cm elodea" and "7 cm elodea." and "7 cm dark". Fill all four test tubes about 3/4 full of CO_2 induced bromothymol blue (btb) solution. Using a ruler and scissors obtain the designated length of elodea and add them to the corresponding test tubes. Gently push each Elodea down into the solution with a glass stirring rod. The Elodea must be fully submerged. Note that the control test tube should not have any Elodea.

2. Obtain the pH for the four test tubes using a LabQuest2 Digital Probe. Remember to thoroughly rinse and shake the probes after each use and to return them to "homeostasis".

3. Fully seal the top of the test tube marked "control" with masking tape. Next, wrap the "4 cm dark" test tube completely with aluminum foil. The entire test tube must be wrapped to ensure light does not enter.

4. Place all test tubes in a rack and be sure to note your group's location since we will need to share test tube racks

5. View the colors of the test tubes after a 24 hour period of time and obtain pH measurements. Observe the color differences after 48 hours. Record your observations in the data table.



Results: Color description for each test tube.

Sample	Control	3 cm Elodea	7 cm Elodea	7 cm Dark
Color (24 hours)				
Color (48 hours)				
pH (initial)				
pH (24 hours)	NA			
pH (48 hours)				

Hypothesis: Record your detailed hypotheses for each tube under the data table.

1. Describe the relationship between the size of the plant and the difference in C02 levels as indicated by the reactivity and color of the bromothymol blue solution?

2. Carefully examine the mitochondrion and chloroplast models located at station 7. Compare and contrast the structure and function of a mitochondrion with that of a chloroplast.

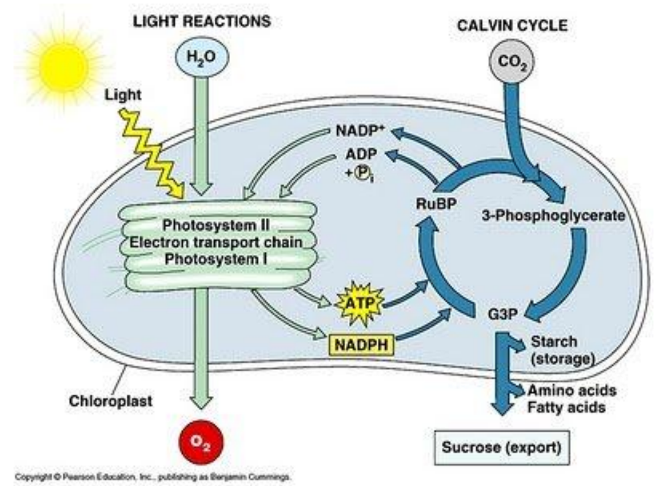
3. Write the chemical equations for both cellular respiration and photosynthesis. Describe how these two processes could be considered "mirror images" of one another.

4. Examine the schematic diagram to the right.

Write a paragraph that explains this process

and differentiates between the light dependent

and light independent cycles.



Consider the following experiment to help you answer the questions below:

You have two sealed boxes. One is clear with a light source shining into it, and the other is completely dark. In each box is placed a healthy, genetically identical plant with no known disorders or diseases. Both plants have access to adequate water and nutrients. At the end of one week, both plants are still alive, but one is clearly doing better than the other.

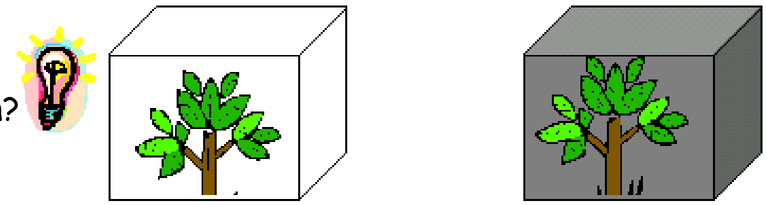
5. What inputs are required for photosynthesis?

6. What inputs are required for cellular respiration?

7. What are the outputs of photosynthesis?

8. What are the outputs of cellular respiration?

9. Why are BOTH plants still alive?



10. Which gasses will increase in each box?

11. Which gasses will decrease in each box?

12. In which box is the Calvin Cycle taking place?

13. What is the independent variable?

14. What is the dependant variable?

15. What are 3 controlled variables?

Part 2: Elodea Structure and Function; SB3b:

1. Obtain an elodea leaf from the main plant, and place it on a clean slide.
2. Place one drop of fresh water onto the leaf, and carefully place the cover slip on top of the leaf.
3. Place the slide under the microscope and observe under low power. You must get the leaf into focus before you can proceed. After the leaf is focused, turn your objective lens to medium power. Use the coarse adjustment again to focus as clearly as you can. NOTE: You may need to move the slide around to find the best portion of the leaf to observe. Under medium power, draw what you see in a circle labeled "Medium Power". You do not need to fill in the entire circle. ONLY USE FINE FOCUS FOR THIS NEXT STEP! Turn the microscope to high power and draw what you see in a second circle for "High Power". Label the chloroplasts (the green objects), the cell wall, and the cell membrane (cell membrane may be hard to see).
4. Count the average number of chloroplasts per cell, and record the number next to your two field of view drawings. DO NOT REMOVE COVER SLIP. Place one to two drops of salt water on the slide, directly next to the cover slip. Obtain a small square of paper towel. Place the paper towel square on the opposite side of the where you placed the drops of salt water. The paper towel needs to be touching the slide and the cover slip. In a few seconds the paper towel should begin to get wet. This means the salt water has not come into contact with the leaf itself. After you have successfully drawn the salt water across the slide, make a sketch for medium and high power again. Be sure to move the slide around and explore multiple parts of the leaf. Again, label the cell wall, cell membrane, and chloroplasts on the "High Power" sketch.

Analysis Questions:

16. SB1d Connection: Salt water contains a **solute** (which is the salt) that attract water molecules from areas of water that have less solutes. Explain what happened, if anything, to the cell wall, cell membrane, and chloroplasts when you added the salt to the slide.

17. Around how many chloroplasts were in one leaf cell? Now estimate around how many leaf cells were in the entire leaf you observed, keeping in mind that the leaf is three cell layers thick. Based on these two estimations, predict how many chloroplasts would be in the picture of the elodea plant that is on the front of this page. SHOW ALL YOUR MATH!

18. Chloroplasts are responsible for harvesting light energy and transferring this energy to a usable form: sugar. Consider your estimation of the number of chloroplasts in the elodea plant. In relative terms, what does your estimation tell you about the amount of energy a single chloroplast can make? (Do you think it makes a lot of energy?) Explain why plants have so many leaves.

19. In your experiment, the cell wall did not change its shape while the cell membrane did (the membrane shrunk). Which of these two structures is responsible for the stability of the plant? Which is responsible for allowing substances to enter or exit the cell? Explain why these two different characteristics are necessary.