Biology Lab: The Effects of Light Intensity on Photosynthesis

Introduction: Photosynthesis is the process by which plants trap the energy found in sunlight and convert it into chemically stored energy. They do this by the “fixing” carbon dioxide into sugar, in the form of glucose. It is this glucose that life on earth depends upon to power the process of life. Without the glucose that plants produce most life on earth would soon run out of available energy and die. In order to carry out photosynthesis, a plant must have light. But, how much light? Some plants need a lot of light. While others seen to thrive in the shade. Does more light lead to more photosynthesis? In this lab, you will examine how the intensity of light affects photosynthesis.

GOGGLES ARE REQUIRED for this lab.

Purpose: To determine how light intensity affects the rate of photosynthesis.

Materials: test tube  sodium bicarbonate solution
forceps or tweezers  light source
600 ml beaker  spoon
stop watch or clock  freshly cut strip of an evergreen (yew)
hand lens (magnifying glass)

Procedure:

1. Working with your partners, completely fill beaker ¾ full with water (400 ml). Mix 1 teaspoon of backing soda into the water. Sodium bicarbonate will provide a source of carbon dioxide.

2. Fill a clean test tube with the sodium bicarbonate solution you just made.

3. Using forceps, place a sprig of evergreen (yew) about halfway down in the test tube. Be sure that the cut end of the sprig points downward in the test tube.

4. Cover the mouth of the test tube with your thumb and turn the test tube upside down. Try not to trap any air bubbles in the test tube.
5. Place the mouth of the test tube under the surface of the sodium bicarbonate solution in the beaker. Remove your thumb from the mouth of the test tube.

![Figure 3](image)

6. Gently lower the test tube inside the beaker so that the test tube leans against the side of the beaker.

![Figure 4](image)

7. Put the beaker in a place where it will receive normal room light. Using a hand lens, count the number of bubbles produced by the sprig in the test tube for 5 minutes. The bubbles are tiny and will form right on the underside of the leaflets of the yew sprig. Record the number in the data table.

![Figure 5](image)

8. Empty the test tube of water and refill it to knock off the bubbles that were just made. Now darken the room (your teacher may elect to do this for you) and count the number of bubbles produced again for 5 minutes. Record the number in the Data Table.

9. Empty the test tube and refill as before in step 8. Turn up the lights in the room (your teacher may elect to do this for you) and sit your test tube with the yew sprig within 15 cm (6 inches) of a bright light. Count the number of bubbles produced in 5 minutes. Record the number in the Data Table.


Mr. Wright’s Biology – SM South (2012)
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**Pre-lab:**

1. What organelle in the plant cell is the site of photosynthesis? _______________________________

2. What pigment found in this organelle absorbs light to power photosynthesis? __________________

3. Write the general formula for photosynthesis.

4. List the reactants of photosynthesis. _______________________________________________

5. Where do plants get the CO$_2$ they use during photosynthesis? ____________________________

6. List the products of photosynthesis? ___________________________________________________

7. Which of these products are released as a gas? __________________________________________

8. If a plant were under water and was photosynthesizing, what gas would be visibly bubbling from the plant? Explain your answer. ____________________________________________

9. What can you tell about photosynthesis if a leaf begins to . . .
   a. produce more gas bubbles?
   b. produce fewer gas bubbles?

10. Identify the . . .
    a. the independent (manipulated variable) variable. _________________________________
    b. the dependent (responding) variable _________________________________
    c. constant variables ______________________________________________________

11. Predict how you think the intensity of light will affect photosynthesis ____________________

**Data:** Record and average the results for the entire class. The first row should be your own groups’ results.

<table>
<thead>
<tr>
<th>Group (list members initials)</th>
<th>Number of Bubbles Produced in 5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Room Light (room lights on)</td>
</tr>
<tr>
<td></td>
<td>Dim Light (room lights off)</td>
</tr>
<tr>
<td></td>
<td>Bright Light (with lamp)</td>
</tr>
<tr>
<td>Average of Groups</td>
<td></td>
</tr>
</tbody>
</table>
Graphical Analysis:
Produce a bar graph comparing the light intensity to the number of bubbles produced.

Analysis and Conclusions:

1. **Observing.** From what part of the yew sprig (stem or leaflets) did the bubbles emerge? ________________

2. **Observing.** When was the greatest number of bubbles produced? ________________________________

3. **Observing.** When was the least number of bubbles produced? ________________________________

4. **Drawing Conclusions.** Describe what affects, if any, light intensity had on the rate of photosynthesis of the yew sprig. ________________________________

5. **Theorizing.** Explain why light intensity had the affects that it did on the rate of photosynthesis. What happened inside the yew sprig (plant leaflets) that caused the yew sprig to react the way it did? ____________________________________________________________

6. **Comparing and Contrasting.** How do your results compare with those of your classmates? Are they similar? Different? ______________________________________________________________________

7. How can you account for any differences in the number of bubbles produced? ________________

8. Can you identify any trends even if the actual numbers differ? ________________________________

9. What was the reason we averaged the data collected by the different groups in the class? ____________

10. List other environmental factors that you could have changed which would have affected the rate of photosynthesis. Explain why you think they would have an effect. ____________________________________________________________