Lab 5: Photosynthesis

Problem: Can evidence of the process of photosynthesis be seen?

Goals

1. To understand the importance of photosynthesis

2. To learn the chemical formula for photosynthesis

3. To understand how the reactants form the products

4. To observe the evidence of the photosynthetic process

Materials and Equipment

150-mL beaker
Three small vials with caps
Tweezers
Bromothymol blue solution (BTB)

Materials Not Included

Distilled water
Three 6 cm (approx 3 inches each) pieces of Elodea (water plant found at pet stores)
Light source
Straw
Aluminum foil
Sharpie® pen

Introduction

The energy that allows our bodies to function ultimately comes from the sun. This may surprise you because we don't directly gain energy from standing out in the sun. The path of the sun's energy to our bodies is a little more roundabout than that. We either eat the plants or eat animals that have eaten plants in order to retrieve the energy from the sun that they contain.

Green plants use the sunlight to produce sugars with the help of a chemical called chlorophyll. The process by which plants trap light energy from the sun and store it in the chemical bonds of a sugar molecule is called photosynthesis. The chemical reaction for this process is:

$$6CO_2 + 6H_2O + Energy\,(light) \rightarrow C_6H_{12}O_6 + 6O_2$$

Notice several things about this chemical equation. There must be carbon dioxide, water, and light in the presence of chlorophyll for a plant to produce sugar (glucose) and release oxygen. During the chemical reaction, hydrogen from the water combines with carbon dioxide from the air to form a simple sugar molecule called glucose. The oxygen left over from the water molecule is released into the air. What makes this process amazing is that humans breathe out, or exhale, carbon dioxide (just what the plant needs for photosynthesis) and plants give off oxygen (just what humans need to breathe).

In this experiment, bromothymol blue solution (BTB) will be used as an indicator for the presence of carbon dioxide. As carbon dioxide is absorbed into in water it forms carbonic acid. When there is no carbon dioxide present, the BTB will show a blue color. As carbon dioxide increases in the water and forms more carbonic acid, the color will change to green and then, with even more carbon dioxide, to yellow. When a plant is put into a jar with BTB and in the presence of all the things necessary for photosynthesis to take place, the level of CO_2 would be high so the solution should be yellow. As photosynthesis takes place, the CO_2 would be used up, making the solution turn towards blue.

Devotional

But without faith it is impossible to please Him: for he that cometh to God must believe that He is, and that He is a rewarder of them that diligently seek Him. Hebrews 11:6

Principle: Faith is essential to life in Jesus Christ.

The process of photosynthesis is essential to life on earth. Without it, plants, which are autotrophs, would not be able to manufacture their own food in the form of sugar. Humans, like so many other organisms, are heterotrophs and cannot produce their own food; their very lives depend on the sugars manufactured by plants through photosynthesis.

Just as photosynthesis is basic to life, so there is a very basic element to the Christian life, without which, no action completed, no sacrifice made, or no act of worship offered will be pleasing and acceptable to God. That crucial element to life in Christ is faith. Hebrews 11:6 tells us that "without faith it is impossible to please God, for whoever would draw near to God must believe that He exists and that He rewards those who seek him." Are you pleasing God by seeking and trusting in Jesus Christ alone?

Procedure

Note: Keep the water plant in the dark so that the photosynthesis process is slowed down until you start the experiment.

1. Place 90 mL of distilled water into a 150-mL beaker. Put twenty-four drops of bromothymol blue into the beaker.

2. Record the color of the solution in the data table in the question section of this lab.

Note: Bromothymol blue turns blue to yellow at almost a neutral (pH 7.0). It is very possible that your water could be either slightly acidic (yellow), neutral (green), or slightly basic (blue). If your water is acidic (yellow) then do procedure 3 for one minute.

3. Use a straw to blow **slowly** into the solution. After the solution turns yellow, continue to blow through the straw for one minute. What substance does the yellow color indicate is now present in the solution? Answer question 2 in the question section of this lab.

4. Use a Sharpie® pen to label the vials #1, #2, #3.

5. In vial #1 and #2 place one 6 cm piece of Elodea plant. You may need to fold the plant to get it all into the vial.

6. Carefully fill each vial with the solution until each is completely full. Cap each vial.

7. Completely cover vial #2 with aluminum foil so that no light can enter. Leave vial #3 with nothing but the solution in it.

8. Place all three vials about two feet from a lamp or place them in sunlight.

9. Leave the plants, undisturbed, through the night. If you using a lamp, the lamp does not need to be on the whole night.

10. In the morning, use tweezers to remove the plant from vials #1 and #2. Hold all three vials up against a white background. Compare the final colors and record them in the data table.

Lab 5

Questions for Photosynthesis

1. What was the color of the BTB solution?

2. What color did the BTB solution turn after blowing into it with a straw?

3. Why was the third vial left with no plant?

4. Fill in the Data Table below:

	Initial Color of the BTB solution in each vial	Final Color after overnight by the lamp	Presence of CO_2 (Y/N)	Evidence of the process of photosynthesis (Y/N)
Vial #1				
Vial #2				
Vial #3				

5. What color was the solution indicating the presence of carbon dioxide?

6. What color was the solution when no carbon dioxide was present?

7. Would less carbon dioxide be present in a vial in which photosynthesis had occurred? Why or why not?

8. What color would the solution be in a vial in which photosynthesis occurred?

9. After sitting overnight, in which, if any, of the vials did the water changed color?

10. If there was a change in color, why do you think it occurred?