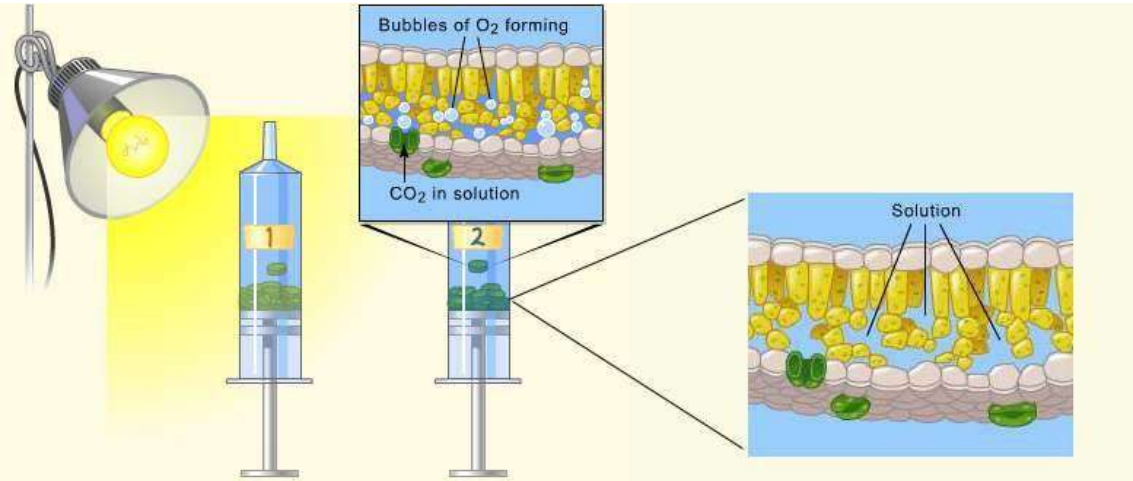
Light Dependent Reaction Photosynthesis Lab

Introduction

Is light important for photosynthesis? Photosynthesis is the process by which plants take carbon dioxide from the atmosphere, add water, and use the energy of sunlight to produce sugar. Photosynthesis occurs in the chloroplast, an organelle in plant cells that contains the molecule chlorophyll. Chlorophyll absorbs the energy of sunlight. That light energy is converted to chemical energy through the steps of photosynthesis.

The reactions of photosynthesis can be divided into two major types: light-dependent reactions and light-independent reactions. The light-dependent reactions convert energy from the sun into a form that the chloroplast can then use to make sugar from carbon dioxide, in the process producing oxygen as a waste product. The light-independent reactions use that energy to make glucose from carbon dioxide and water.

Leaf disks float, normally. When the air spaces are infiltrated with solution the overall density of the leaf disk increases and the disk sinks. The infiltration solution includes a small amount of sodium bicarbonate. Bicarbonate ion serves as the carbon source for photosynthesis. As photosynthesis proceeds oxygen is released into the interior of the leaf which changes the buoyancy causing the disks to rise. The light depended reaction of photosynthesis also uses water in conjunction with two photosystems (PII / PI) to create ATP and NADPH using H+'s and e-'s. The hypothesis is that plant disks will form oxygen as a by-product and thus float when they are exposed to CO_2 , water and light during the photosynthesis process.



Method

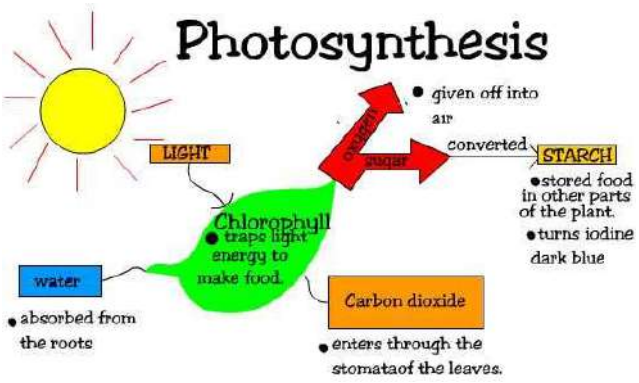
Apparatus:

per Class / Stock Table

Fresh Bok Choy
Sodium Bicarbonate *(baking soda)*
Liquid Soap (Dawn) ; w/ Beaker and Eye Dropper(s)
Clean Drinking Water (not distilled)
Electronic Scale and Boat

per Group / Partners

400 mL beaker
18oz Clear (not opaque) Solo Cup
18oz Black Solo Cup
Plastic Syringe (ie. 10+ cc) – no needle
Plastic Straw
Needle Probe
Stirring Rod
Light Assemble (60+ watts)
Timer (clock)
White Notecard
Calculator
Resources



Procedure: **$6\ CO_2 + 12\ H_20 \rightarrow LIGHT \rightarrow C_6H_{12}O_6 + 6\ 0_2 + 6\ H_20$**

Setup:

1. Gather all necessary materials in order to conduct the lab.

2. Prepare 300 mL of bicarbonate solution:

   - The bicarbonate will serve as an alternate dissolved source of carbon dioxide, which is introduced in the Calvin cycle to help provide carbon for glucose, for photosynthesis.

   - Using your 400 mL beaker, prepare .7% solution by measuring 2 g of sodium bi-carbonate ($NaHCO_3$) into 300 mL of clean drinking water and stir until dissolved.

   - Add 4 "drops" of liquid soap to your $NaHCO_3$ solution and stir gently. The soap will wet the hydrophobic surface of the leaf allowing the solution to be drawn into the leaf.

3. Obtain a leaf and place it on your thumb. Avoiding major veins and using a plastic straw drill and press out 20 uniform leaf disks by pressing the leaf against the bottom of a finger or thumb which will cushion the process. The leaf disks should have accumulated in the straw.

   - Remove the piston or plunger and carefully place the leaf disks into the syringe barrel near but not in the tip; note, you may have to gently blow them out of the straw or use a needle probe to carefully place them into the syringe.

   - Replace the plunger being careful not to crush the leaf disks.

4. Infiltrate the leaf disks by removing the air in the leaf and replacing the air with the sodium bicarbonate / soap solution:

   - Pull on the plunger to draw in a small volume of sodium bicarbonate solution enough to suspend the leaf disks (~$1/4^{th}$ of the syringe full).

- Tap the syringe to suspend the leaf disks in the solution; they should be floating.

- Hold syringe upward and slowly push on the plunger until no air remains in the barrel or nozzle; stop before any solution comes out. Leaf disks should be floating in the syringe.

- Holding a finger over the syringe opening, draw back on the plunger "gently" until you feel a slight press on your finger in order to create a vacuum for ~10 seconds. Very small bubbles may be coming off the leaves if you are doing this correctly. (see pic.)

- Let off the vacuum (remove your finger) and swirl the barrel with the leaf disks around to see if they will sink toward the plunger of the syringe because of air space infiltration.

Note: You may have to repeat the vacuum creating steps 2-4 times in order to get the disks to sink. Do not repeat too often because you could cause damage to the leaf. If most of the disks sank just do not count those that are still floating in the next step. If necessary, use the needle probe to gentle push any disks out of the nozzle.

5. Remove the plunger over your clear plastic cup and allow all the solution and disks to fall into your cup. Add the rest of your bicarbonate solution from your beaker to your plastic cup.

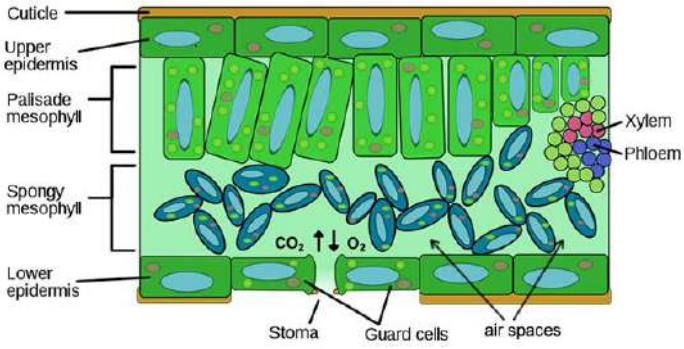
6. Place your cup directly near your light source, on top of a white notecard and start a timer.

7. Count and record the number of disks (see Data/ Result Sheet) that float to the top. Once the last disk "begins" to float, stop your timer – this is your "finished time".

8. Clean, dispose, and dry all necessary materials.

9. Repeat steps 3-8; however, place the translucent plastic cup <u>inside</u> the black cup in order to block the light. The first experiment was a control and that by blocking the light (independent variable), the results of the discs floating or not floating will be the dependent variable. Thus, the second experiment has to be the same setup except for creating a variable.

10. Clean and return all materials. Complete the Data/Result Sheet.



Name: /50

Result Questions: Light Dependent Reaction Photosynthesis Lab

Table: 10 points

	Light	**No/Little Light**
Number of Disks		

Questions: 2 point each

1. Calculate the rate of photosynthesis for each test: Rate of Photosynthesis = $\frac{\text{Number of Disks}}{\text{Finished Time}}$

	Light	**No/Little Light**
Number of Disks per Minute	*(round)*	*(round)*

2. What's the general formula for "photosynthesis" in order to make "glucose"?

3. What gas came from the "splitting of the water" which allowed the disks to float upward?

4. What was the $NaHCO_3$ used for?

5. Water would have been used to provide what two subatomic particles, which are used to make ATP and NADPH via photosystem II and I?

6. Which photosystem(s) was/were used inside the thylakoid membrane for this experiment?

7. If one were to prevent wavelengths of red from coming in contact with the leaf disks; do you feel that there would be a significant change in the number of raised disks?

8. If one were to prevent wavelengths of green from coming in contact with the leaf disks; do you feel that there would be a significant change in the number of raised disks?

9. If one were to prevent wavelengths of violet from coming in contact with the leaf disks; do you feel that there would be a significant change in the number of raised disks?

10. Which photophosphorylation would have been present during the experiment: non-cyclic, cyclic, both, or neither?

Conclusion Paragraph: 10 pts

Write a proper conclusion paragraph by "restating" the problem question and hypothesis below and then answer the remaining questions (see bullets below). You may need to review the beginning of the lab; such as, the background information paragraph. When you are done, you should have "one" indented paragraph summarizing the activity.

Do not include use any personal pronouns: "I, we, our, etc…" in the paragraph
Do not include any proper names "ie Jack or Jill, etc…" in the paragraph
Do not include the word "it" anywhere in the paragraph.
Do not have fragmented sentences in the paragraph.
State the following in your paragraph:

- **What was the problem question?** *(see background paragraph)*
  - ie Start off by writing… The problem question was ….
- **What was the hypothesis?** *(see background paragraph)*
  - ie Start off by writing… The hypothesis was that …
- **Was the hypothesis supported or refuted?** If refuted, tell why?
  - ie Start off by writing… The hypothesis was …
- **What unforeseen event(s) happened during the lab?** (never say none)
  - ie Start off by writing… An unforeseen event was …
- **What improvement(s) could have been made in the activity?** (never say none)
  - ie Start off by writing… An improvement that could be made for this lab would be …
- **State a "springboard question"** (followed by a question mark) *

** A springboard question is a "question" that <u>you make up</u> based on the problem question or this activity. Do not answer this question; but simply state it as the last sentence in your conclusion paragraph with a question mark (?) at the end. The question is meant to "springboard" other thoughts that the reader could investigate having done this lab which is an inventive yet effective way to end a lab activity.)*

Conclusion Paragraph Here: *(write clearly)*