Lab: Determining the effect of light on the rate of photosynthesis

Overview:

- Photosynthesis is a process in which plants convert light energy into useable chemical energy in the form of a carbohydrate (glucose). The over-all reaction is shown below:

Photosynthesis reaction:

$H_2O + CO_2 + \text{Light} \rightarrow C_6H_{12}O_6\,(\text{glucose}) + O_2$

- Leaves have a spongy tissue called mesophyll which normally has gases (O_2 and CO_2) in it. Leaves – or disks cut from leaves – normally float in water. This lab will use a vacuum to replace the gases in leaves with water, which will cause the disks to sink in water. If the disks are in a baking soda solution containing dissolved CO_2, as photosynthesis proceeds, H_2O will be replaced by O_2 gas and the leaf disks will once again start to float. So, the rate of photosynthesis can be measured by the rate of rise of the leaf disks.

Materials:

- Baking soda (sodium bicarbonate) solution (water, baking soda, and dilute liquid soap)
- One plastic syringe without a needle
- Spinach leaves
- Hole punch
- 2 plastic cups
- Small box
- Timer
- Lamp

Hypothesis: After carefully reading through the procedure below, write-out your hypothesis for this experiment. Your hypothesis should include a clearly stated prediction about the effect you think light will have on the rate of photosynthesis.

Hypothesis:

_____

_____

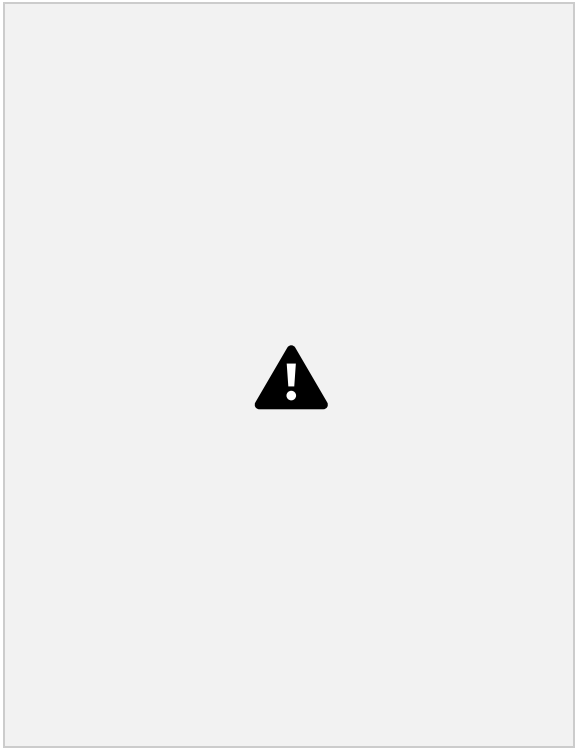
Procedure:

1. Using a one-hole punch, cut 20 leaf disks from spinach leaves (try to avoid leaf veins).
2. Remove the plunger from a large clean syringe (no needle). Place 20 leaf disks into the body of the syringe. Be sure the leaf disks are near the tip of the syringe as you reinsert the plunger so as not to damage the disks.
3. Insert the tip of the syringe into a beaker of baking soda solution draw about 6-7 mL into the syringe. The leaf disks should be floating at this time.
4. Hold the syringe tip upward and expel the air by depressing the plunger carefully. **Stop** before solution comes out the tip.

5. Seal the tip of the syringe using the index finger of your left hand and hold tightly. Pull back on the plunger creating a partial vacuum within the syringe. If you have a good seal it should be hard to pull on the plunger and you should see bubbles coming from the edge of the leaf disks. Hold for a count of ten.
6. Simultaneously, release your index finger and the plunger. Some of the leaf disks should start to sink. Tap the side of the tube or shake gently to break any bubbles on the edges of the disks. Repeat step 5 until all the disks sink.
7. Remove the plunger from the syringe and pour the solution containing the disks into 2 beakers and add the remainder of your solution equally to both beakers. There should be **10 disks per beaker**. Make sure they sink to the bottom.
8. Fill each beaker to the 150mL line with the baking soda solution.
9. Immediately cover ONE of the cups with a small box to block light from the leaf disks. Place the second beaker under a desk lamp, approximately 6-8 inches below the light.
10. Use a stopwatch to begin timing the experiment as soon as the light is turned on. Every minute, for 15 minutes, use the data table below to record the number of floating leaf disks in the light and dark cups. After each time check, tap the side of the cup to make sure the disks are not "sticking" to the cup walls. ***Note:*** *Check the covered beaker quickly to avoid light exposure.*
11. After all your data has been recorded, clean the lab equipment and dispose of solutions in the sink drains.

two people making two sets of 10

Results:



- In the area below, create a **double line graph** to display the results from the light and dark treatments. Remember to provide a title, label the x and y axis, and label each line appropriately or use a color coded key.

Lab Analysis Questions:

1. What problem/question did you answer in this experiment?

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2. Based the data you obtained, explain why your hypothesis was or was not supported.

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3. Describe the relationship between the number of disks floating and time, as shown on your double line graph.

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4. Explain the changes that occurred within the leaf tissue that allowed the leaf disks to rise to the surface.

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5. Explain why it was important to keep one cup covered during the experiment.

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6. What process cannot occur in the dark treatment? _____

7. Based on the equation for photosynthesis, what are the 2 **products** of this process?

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