Photosynthesis Lab

This will be a two part lab. Part I will involve a given protocol that all groups will follow. Part II will allow your group to modify the protocol in part I to test another variable.

Background:

Overall reaction of photosynthesis:

Light Energy + Chlorophyll + $6(CO_2)$ + $6(H_2O)$ -----> $C_6H_{12}O_6$ + $6(O_2)$

Light Dependent Reaction:

12 H_2O + 12 $NADP^+$ + 18 ADP + 18 P_i + light and chlorophyll ------→ 6 O_2 + 12 NADPH + 18 ATP

Light Independent Reaction:

12 NADPH + 18 ATP + 6 CO_2 -------→ $C_6H_{12}O_6$ (glucose) + 12 $NADP^+$ + 18 ADP + 18 Pi + 6 H_2O

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. Since cellular respiration is taking place at the same time, consuming oxygen, the rate that the disks rise is an indirect measurement of the net rate of photosynthesis.

Materials for Part I:

- A fresh spinach leaf
- Syringe
- Marker
- Bicarbonate/detergent solution
- Single hole punch
- Clock or watch
- Table lamp

Procedure Part I:

- Cut 10 or more uniform leaf disks for each trial.
- Infiltrate the leaf disks with sodium bicarbonate solution.
  Remove the piston or plunger and place the leaf disks into the syringe barrel. Replace the plunger being careful not to crush the leaf disks. Push on the plunger until only a small volume of air and leaf disk remain in the barrel (< 10%).
- Pull a small volume of sodium bicarbonate solution into the syringe. Tap the syringe to suspend the leaf disks in the solution.
- Holding a finger over the syringe-opening, draw back on the plunger to create a vacuum. Hold this vacuum for about 10 seconds. While holding the vacuum, swirl the leaf disks to suspend them in the solution. Let off the vacuum. Be careful, the syringe may spray!!! The bicarbonate solution will infiltrate the air spaces in the leaf causing the disks to sink. You will probably have to repeat this procedure 2-3 times in order to get the disks to sink. If you have difficulty getting your disks to sink after about 3 evacuations, it is usually because there is not enough soap in the solution. Add a few more drops of soap.
- Pour the disks and solution into a clear plastic cup. Add bicarbonate solution to a depth of about 3 centimeters. Use the same depth for each trial. Shallower depths work just as well.

- For a control infiltrate leaf disks with a solution of only water with a drop of soap--no bicarbonate.
  Place under the light source and start the timer. At the end of each minute, record the number of floating disks. Then swirl the disks to dislodge any that are stuck against the sides of the cups. Continue until all of the disks are floating.

Data Part I:
For each minute for a total of15 minutes, record the # floating leaf discs

Data Analysis Part I:
Graph data. Include a label of axis, consistent scale, use graph paper, interpret graph

Conclusion Part I:
1- Why does the length of time to float act as an indicator for photosynthetic rate?

2- What exactly is responsible for the formation of Oxygen during photosynthesis?

3- Offer a thorough metabolic explanation for why the disks would not float if in a solution with no Carbon Dioxide.

4- Was the class data similar to your group data? Explain.

5- How might different rates of photosynthesis in different light intensities affect ecosystems? Offer examples to justify your answer.

6- Using your previous knowledge of photosynthesis and the results from today's exercises, explain the role, origin, or fate of each of the following:

- Oxygen Gas
- Carbon Dioxide
- Water
- Chlorophyll a
- Accessory Pigments
- Glucose

Photosynthesis Lab Part II

Problem, Materials, Procedure, Data, Data Analysis, Conclusion

Select one of the following to test the effect on photosynthesis:

- Color of light
- Light intensity
- Concentration of sodium bicarbonate solution