Measuring Photosynthetic Rate in Spinach Leaf Disks

Background: The chemical equation for photosynthesis is $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$. Light energy from the sun is used to produce food for the plant (glucose) and a waste product (oxygen).

Leaf tissue is riddled with gas-filled intercellular spaces so they float when they are placed in a solution. However, when leaf disks are subjected to a vacuum, the gases are pulled out and the spaces are filled by the liquid. Since fluids are heavier than gas, the leaf disks sink to the bottom. As O_2 is produced by the light-dependent reactions of photosynthesis, it diffuses into the inter-cellular spaces and replaces liquid with gas. When enough O_2 has accumulated, each leaf disk will regain its buoyancy and turn on edge or float to the surface.

Materials:

250 ml flask	spinach leaves	straws
vacuum pump	3 Petri dishes	sodium bicarbonate solution
heat lamp	600 ml beaker	250 ml beaker

Procedure:

1. Label three Petri dishes with your name and fill them 2/3 full of the $NaHCO_3$ solution. Set them aside for now.
2. Get several spinach leaves and cut 60 disks with a straw. (See Figure 8.2). Do not include large veins in the disks.
3. Place the disks in the flask with 150 ml of $NaHCO_3$ solution.
4. Take the flask to the vacuum pump. Turn the pump on for about 1-2 minutes. Release the air and swirl the flask to see if the disks will sink. Be careful not to overaspirate. Remember, the disks will not sink until removed from the vacuum.
5. Pour the contents of the flask into a 250 ml beaker. Discard any disks that are floating. With forceps, gently transfer 15 disks to each Petri dish. Place the lids on the Petri dishes.
6. Place one Petri dish in the designated drawer, put another one on the window sill, and put the third dish under the heat lamps. Make sure to fill the 600 ml beaker with water to act as a heat filter and place on top of the Petri dish.
7. Wait 20 minutes for photosynthesis to occur. After 20 minutes, count the number of disks that are either floating or turned on edge in each Petri dish. Record your data in the data table.
8. Clean up and replace the supplies where they were originally.

Data:

Light	# disks floating	% disks floating	class average
drawer (dark)			
heat lamp			
Window sill (natural)			

Conclusion/Analysis questions:

1. Explain how the experiment measures the occurrence of photosynthesis in spinach with a brief discussion on the process of the light-dependent reaction of photosynthesis.
2. Restate the hypothesis and discuss the results. Was the hypothesis supported or not by the data?
3. Identify the independent and dependent variables.
4. What are some other variables that could affect the rate of photosynthesis?
5. Identify the control group and the test groups.

Reminder: A formal lab report must include the following (in this order): title, problem, hypothesis, materials, procedure, safety, data, and conclusion (essay).