Producing Oxygen from Photosynthesis - Leaf Disk Investigation

Background

The chemical reactions of photosynthesis require an input of carbon dioxide and water to produce glucose and oxygen. The source of carbon dioxide in this investigation comes from baking soda (sodium bicarbonate) that is dissolved in water.

Like carbon dioxide, oxygen is a colorless, odorless gas which is impossible to observe directly. In this investigation, you will use changes in density as an indirect method to observe the production of oxygen from photosynthesis.

Procedure

Step of the Procedure	Purpose for the Step
1. Label one plastic cup "water" and the other "CO_2 Solution". Add 30 ml of the appropriate solution to each cup.	The water serves as the control. If no CO_2 is present, photosynthesis should not occur, and no oxygen will be produced.
2. Using a hole punch, cut 20 leaf disks from spinach leaves, avoiding large veins.	Using the hole punch makes all the leaf disks the same size. This eliminates leaf size as a variable.
3. Remove the plunger from the syringe labeled H_2O. Place 10 leaf disks into the body of the syringe. Be sure the leaf disks are near the tip of the syringe as you re-insert the plunger. Push in the plunger until only a small volume of air and leaf disks remain in the syringe. 4. Insert the tip of the syringe into the H_2O solution and draw 15 mL into the syringe. The leaf disks should be floating. 5. Hold the syringe tip upward and expel the air by depressing the plunger carefully. Stop before solution comes out the tip. 6. 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. With a good seal it is hard to pull the plunger and you should see bubbles coming from the edge of the leaf disks. Hold this vacuum for 10 seconds and gently swirl the leaf disks to suspend them in solution.	Before creating a vacuum, air is present between the cells of the leaf. The presence of air makes the leaf disk less dense than the solution, so they float. The vacuum removes the air present between the cells of the leaf.
7. To release the vacuum, 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. 8. Repeat steps 6 and 7 until all the disks sink. 9. Remove the plunger from the syringe and pour the solution containing the disks into the appropriate cup. The leaf disks should sink to the bottom.	When the vacuum is released, the solution will fill the spaces that were previously filled with air. The leaf disks sink because they are more dense than the solution.
10. Repeat steps 3-9 with the CO_2 solution and the syringe labeled CO_2.	Both trials are prepared the same to eliminate all variables except the presence/absence of CO_2.
11. Place your cups under the grow lights. Record the number of leaf disks that are floating every 2 minutes for 20 minutes. Gently stir the solution after each observation to make sure no leaf disks are stuck to the bottom of the cup.	As photosynthesis occurs, oxygen is produced. As oxygen is produced, it will accumulate in the spaces between the leaf cells. This will make the leaf disk less dense than the solution and the disk will float.