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LAB 9: MEASURING THE RATE OF PHOTOSYNTHESIS

IN THIS LAB, YOU WILL MEASURE THE RATE OF PHOTOSYNTHESIS BY OBSERVING THE PRODUCTION OF O₂ GAS, WHICH IS ONE OF TWO PRODUCTS OF PHOTOSYNTHESIS (THE OTHER IS GLUCOSE). YOU WILL OBSERVE THE PRODUCTION OF O₂ GAS BY ITS ABILITY TO LIFT A SUNKEN LEAF DISC.

MATERIALS:

MATERIALS TO BE PICKED UP:	ON YOUR LAB TRAY:	NEED TO BE REPLACED IF LOW:
Spinach leaves (about 4)	Plastic syringe Two small cups 100mL graduated cylinder (to measure water) Large beaker (to fill with water) Small beaker filled with baking soda Small plastic spoon to scoop baking soda Small plastic cup (to <u>measure</u> baking powder) Hole punch to cut leaf discs Stirring stick Timer (phones are okay) Light source (window sill or under lamp)	Paper towel Baking powder Detergent (soap) solution (in pipette dropper)

PROCEDURE:

PREPARE EXPERIMENT CUPS:

1. Collect the small plastic cups. Labeled as follows:
 - A. WITH CO₂ (experimental group)
 - B. WITHOUT CO₂ (control group)
2. **One pair of students should make the following mixtures.** Use the black stirring stick to mix the solution completely. Mix slowly so detergent solution does not start to create bubbles.
 - A. In the cup labeled WITH CO₂ mix in the following:
 - 1)100mL of room temperature water
 - 2)2 drops of detergent solution
 - 3)**0.5g** of sodium bicarbonate (baking soda)
 - B. In the cup labeled WITHOUT CO₂ mix in the following:
 - 1)100mL of room temperature water
 - 2)2 drops of detergent solution

PREPARE LEAF DISCS (REMOVE AIR):

3. **The other pair of students should prepare the spinach leaves.** Collect approximately 4 spinach leaves (if you need more, get another; if you only use 3, return the one without holes in it!)
 - A. Pat dry the leaves with the paper towel.
 - B. Using the hole punch carefully punch out 30 discs total.
 - C. While one student is punch out discs, the other student can collect the discs using the forceps and make TWO piles of 15 discs.
4. Using the forceps, collect 15 of the leaf discs. As you collect them, be careful not to bruise them. It is recommended that you use the forceps to carefully pick them up by their edges.
5. Remove the plunger from the empty syringe and put the 15 leaf discs in the syringe. Use the forceps to push any discs that are stuck to the side down toward the top of the syringe.

6. Put the plunger back into the syringe and push it down until it is just above the pile of leaf discs without crushing them.
7. Put the tip of the syringe in the WITHOUT CO₂ cup and suck up about 20mL of solution.
8. Hold the tip of the syringe up and push out any air bubbles (some water may squirt out, and that's okay). Put your thumb over the tip of the syringe and pull down on the plunger to create a vacuum in the syringe. Gently shake the syringe while you do this to ensure the leaf discs stay in the solution. Carefully release the plunger as it pushes back up into the syringe. WITH YOUR THUMB STILL ON THE TIP OF THE SYRINGE, push the plunger into the syringe forcing the solution into the leaf discs. The leaf discs should begin to drop to the bottom of the solution. Gently shake the syringe to coax the discs to drop. If some do not drop, repeat this step again. NOTE: only do this two or three times or you may damage the leaves to the point where they won't photosynthesize!
9. Carefully start to pull the plunger out over the cup labeled WITHOUT CO₂ and dump the contents including the leaf discs into the cup.
10. QUICKLY cover the cup with the dark piece of fabric to prevent the leaf discs from being exposed to light, which will cause the photosynthesis reaction to take place.
11. Repeat steps 4-8 with the second set of 15 leaf discs and using the solution labeled WITH CO₂. Be sure to QUICKLY cover this cup as well until you are ready to start the reaction.

PREPARE FOR REACTION:

12. Before you start the reaction, peak into your cups trying not to allow the leaf discs to be exposed to light. Use your forceps, pull out any discs that are already floating or are hovering in the middle (the air inside them may not have been fully evacuated). Use your forceps to also spread out any of the discs that may be piled on top of each other.
13. Prepare a timer. You will be checking the number of discs that have risen every minute.
14. When you are prepared, move your cups to either the windowsill (if it is sunny enough during your class period) or under the lights. As you move your cups, be careful not to jostle the discs too much.
15. Start the timer once both cups are exposed to light (be sure that cups are receiving approximately the same light exposure and that they are approximately the same distance away from the lamps if using them).
16. After one minute, count the number of discs that have floated to the surface of each cup. Note this number in your data table.
17. After another minute (minute two), count the total number of discs floating again, and note this in your data table.
18. Repeat this until you have reached ten minutes and do your final count of discs.
(Note: you will be counting the TOTAL that are floating each time. Example: if after one minute 1 has risen, put 1 in your table; after two minutes 2 more have risen, so now there are 3 total and you will put 3 in your data table.)

CLEANUP PROCEDURE:

1. Dump cups with solutions and discs down the drain. Be sure that ALL your leaf discs go down the drain and not the sides of the sink!
2. Rinse the cups, the stirring stick, the syringe, and plunger.
3. Throw away the paper towel and spinach leaf remnants.
4. Check to make sure that the next class period has enough baking soda and detergent solution.
5. Replace the paper towel on your lab tray with a new one.
6. Check all lab tray items are organized and clean, and put the lab tray back on the side counter.