

Photosynthesis in Leaf Disks

Name _____ Group _____ Date _____
Photosynthesis in Leaf Disk

Introduction:

Photosynthesis is a process in which plants convert light energy (sunlight) into usable chemical energy (carbohydrates). Photosynthesis involves two simultaneous processes: the light dependent reactions and the light independent reactions (**Calvin Cycle**). In the light dependent reactions, light energy is captured and converted to high energy ATP and NADPH molecules. In the light independent reactions these high-energy molecules are used to reduce **CO₂** and eventually form carbohydrates such as glucose.

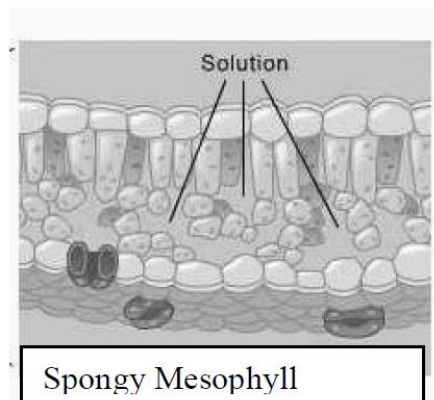
Overall reaction (unbalanced): $\text{CO}_2 + \text{H}_2\text{O} + \text{light energy} \rightarrow \text{Glucose} + \text{O}_2$

In this experiment, the spaces in the spongy mesophyll of leaf disks are filled with water or sodium bicarbonate solution, which causes them to sink in the solution. The leaf disks are then exposed to light and observations are made as the cells undergo photosynthesis.

Objectives:

By the end of this activity you should be able to:

- Describe the reactants and products of photosynthesis and the source of reactants from the environment.
- Explain the relationship of photosynthesis to the observations made during the experiment.
- Identify another variable that might affect photosynthesis and design an experiment that uses leaf disks to test your ideas.
- Create hypotheses about the effects of environmental variables on the rate of photosynthesis.



Materials:

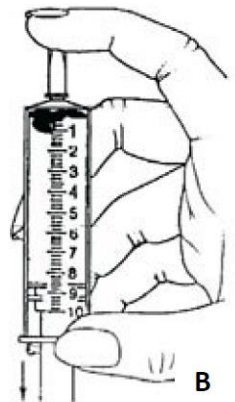
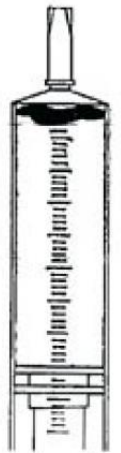
- 1.5 g sodium bicarbonate (baking soda)
- Liquid dish soap
- Eyedropper
- Plastic syringe (10-15 mL)—no needle!
- Plastic spoon or straw (for stirring)
- Leaf material
- Hole punch
- 2 small beakers
- Timer or clock with second hand
- Light source
- Paper towels



Photosynthesis in Leaf Discs

Procedure: Solutions are safe to handle without gloves.

1. Using a one-hole punch, cut 20 leaf disks from young actively growing leaves.
2. Take two beakers (label A and B).
3. In beaker A, take 300 mL distilled water. Use an eyedropper to add about 2 drops of dish detergent and stir gently.
4. In beaker B, prepare 0.2% sodium bicarbonate (NaHCO_3) solution by adding approximately 1.5 g sodium bicarbonate (baking soda) to 300 mL distilled water. Stir until dissolved. Use an eyedropper to add about 2 drops of dish detergent to the solution and stir gently. There should be no bubbles afterward.
5. Take two large clean syringes (no needles). Remove the plungers and place 10 leaf disks in each of syringe bodies. Be sure the leaf disks are near the tips of the syringes as you insert the plungers so as not to damage the disks. **(pic A)**
6. In one of the syringes, draw 5 mL of distilled water from beaker A , and in the other syringe draw 5 mL of sodium bicarbonate solution from beaker B. The leaf disks should be floating in both the syringes at this time.
7. Hold the syringes tip upward and expel the air by depressing the plunger carefully. Stop before solution comes out the tip.
8. Seal the tips of the syringes using the index finger of your left hand and hold tightly. Pull back on the plungers creating a partial vacuum within the syringes. If you have a good seal it should be hard to pull on the plungers and you should see bubbles coming from the edge of the leaf disks. Hold for a count of ten. **(pic B)**
9. 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.
10. Repeat steps 6 and 7 until all the disks sink. Do not overdo these steps!! You have been successful if the disks sink to the bottom. Don't repeat "just to be sure" as it is possible to damage the cells of the leaves.
11. Remove the plungers from the syringes and pour the solutions containing the disks back into their respective beakers (A and B). Make sure they sink to the bottom.
12. Place both the beakers under a light source, approximately 6-8 inches below the light. The lights are best held in a clamp on a ring stand. Begin timing the experiment as soon as the light is turned on. Record your observations on page 4.
13. Notice what is happening to the leaf disks as photosynthesis proceeds. Continue to record your observations in the chart on page 4. After each time check, tap the side of the beaker to make sure the disks are not "sticking" to the container walls.



Photosynthesis in Leaf Disks

Data Table: Number of Leaf Disks Floating

| Time (minutes) | Number of Disks Floating (Beaker A, without CO ₂) | Number of Disks Floating (Beaker B, with CO ₂) |
|----------------|---|--|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |

(After 15 minutes consider the experiment over and that no more disks will rise.)

Lab Analysis and Questions:

1. Use the graphing grid on page 6 and graph the results from the beaker A and beaker B.
2. What is the variable in the experiment?
What problem/question did you answer in this experiment?
3. Why was detergent added to the solution?
Why was sodium bicarbonate (NaHCO₃) added only to the solution in beaker B?

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4. Explain why it was important to not to add sodium bicarbonate (NaHCO_3) to beaker A during the experiment.

5. Describe and explain the relationship between the number of disks floating and time, as shown on the graph.

6. Did any leaf disks float in the Beaker A ? What may explain this result?

7. What process cannot occur in the leaf disks in beaker A?

8. Explain the changes that occurred within the leaf tissue that allowed the leaf disks to rise to the surface in one of the beakers.

9. You will now design and carry out an “Experimental Lab” using a variable that you select. Think about another factor you could test to determine its affect on photosynthesis. Set up a lab notebook page that lists your hypothesis, materials, procedures, data charts and conclusions. Ask your teacher for any extra materials you might need to be sure they are available. Be sure to follow all safety guidelines.

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Question 1 –Graph

In the area below create a **double line graph** to display the results of the experiment. Provide a title, label the X and Y axis, and label each line appropriately or use a color key.

