# Pre-Lab Information

Purpose Design and conduct investigations to examine factors that affect the rate of photosynthesis.

Time Approximately 90 minutes

Question What factors affect the rate of photosynthesis in living leaves?

Summary In this investigation, you will use spinach leaves to observe photosynthesis indirectly. Then, you will design and conduct your own experiment to test a factor that may affect the rate of photosynthesis. Finally, you will analyze your data to draw a conclusion.

# Safety

* Behavior in the lab needs to be purposeful.
* Wear safety goggles when working with substances
* Report all accidents—no matter how big or small—to your teacher.

# Lab Procedure

1. **Gather materials.**

|  |  |
| --- | --- |
| * Baking soda * Timer * 2 plastic syringes * Hole punch * Fresh spinach leaves | * Liquid soap solution (5 mL in 250 mL water) * Water * Light source * 2 clear plastic cups |

1. **Prepare solutions and leaf disks.**
   1. Prepare a solution of baking soda by dissolving 1 g of baking soda in 300 mL of water. There will be carbon dioxide dissolved in this solution from the baking soda. Pour this solution into a cup. Label this cup “With Carbon Dioxide.” Add 1 drop of the liquid soap solution to the cup. The soap allows the solution to enter the leaf disks, getting water and carbon dioxide to the photosynthetic cells.
   2. Add a drop of liquid soap to a cup with 300 mL water. Label this cup “Water Only.”
   3. Use a hole punch to make 20 leaf disks.
2. **Draw out gases from the leaf disks/chads.** 
   1. Remove the plunger from both syringes. Place 10 leaf disks in each syringe.
   2. Put the plunger back in, but do not crush the leaf disks.
   3. Add about 5 mL of solution from your cups to each syringe. One should receive the baking soda solution while the other should receive just water with soap solution. Do this by slowly pulling the plunger back with the syringe immersed in the cup of solution.
   4. You should notice that the leaves are floating. To remove the gas in the spongy mesophyll and make the disks sink, put your thumb over the syringe opening and slowly pull back the plunger. This will create a vacuum that will pull out the gases from the leaf.
   5. Repeat 2–3 times, or until all of your disks sink to the bottom of the syringe.
3. **Conduct your experiment.**
   1. Place your spinach disks in the correct cup. They should sink to the bottom.
   2. Place both cups an equal distance from a light source. Start your timer.
   3. Observe the spinach disks, making note of when each disk floats. Fill out Table A.
   4. Time for a total of 10 minutes.
   5. Calculate the ET50, or time it took 50% of your leaf disks to float.
4. **Design your own experiment.**
   1. Decide on another factor to test, using the materials provided by your teacher.
   2. Write a testable experimental question and a prediction.
   3. Design your control group and experimental group. Explain the setup for each in Table B.
   4. Conduct your experiment, recording your results in Table B.
   5. Complete your lab report and analysis questions.
5. **Clean up your area.** 
   1. Return unused materials and dispose of any trash according to your teacher’s directions.

# Data

Record your data either in your lab notebook or in the space below.

**Table A: Photosynthesis Rates**

|  |  |  |  |
| --- | --- | --- | --- |
| **Baking Soda Solution** | | **Water** | |
| **Time (Minutes)** | **# of Disks Floating** | **Time (Minutes)** | **# of Disks Floating** |
| **0** |  | **0** |  |
| **1** |  | **1** |  |
| **2** |  | **2** |  |
| **3** |  | **3** |  |
| **4** |  | **4** |  |
| **5** |  | **5** |  |
| **6** |  | **6** |  |
| **7** |  | **7** |  |
| **8** |  | **8** |  |
| **9** |  | **9** |  |
| **10** |  | **10** |  |

ET50 for baking soda solution: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ET50 for water: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Table B: Student-Designed Experiment**

**Experimental Question:**

**Prediction:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Describe your experimental group:** | | **Describe your control group:** | |
| **Time (Minutes)** | **# of Disks Floating** | **Time (Minutes)** | **# of Disks Floating** |
| **0** |  | **0** |  |
| **1** |  | **1** |  |
| **2** |  | **2** |  |
| **3** |  | **3** |  |
| **4** |  | **4** |  |
| **5** |  | **5** |  |
| **6** |  | **6** |  |
| **7** |  | **7** |  |
| **8** |  | **8** |  |
| **9** |  | **9** |  |
| **10** |  | **10** |  |

ET50 for experimental group: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ET50 for control group: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Follow-Up Questions

Answer the following questions.

1. Why is it important to make sure carbon dioxide is dissolved in the solution for photosynthesis to occur?
2. Explain why you set up your controlled experiment the way you did. How do you know you had a reliable control group?
3. Based on your data, explain how your factor affected the rate of photosynthesis. Be sure to provide evidence to support your idea. Provide a justification based on what you know about photosynthesis.