

Study Photosynthesis with the Floating Leaf Disk Assay

Name: _____

Date: _____

Student worksheet

1. Pre-Experiment

In the space below, write what you think plants need to survive.

2. Experiment - Leaf Disk Assay Procedure

The leaf disk assay is a procedure that allows you to investigate photosynthesis. Photosynthesis is a process that plants carry out to make energy for themselves in order to live and grow. The steps of the leaf disk assay procedure are listed below.

- a. Label your five cups as follows:
 - With baking soda
 - Without baking soda
 - With baking soda, light
 - With baking soda, no light
 - Without baking soda, light
- b. To the "with baking soda" cup, add 300 mL water, 1/8 teaspoon of baking soda and 1 drop of liquid dish soap. Gently stir the solution until everything has dissolved. Try not to create too many bubbles.
- c. To the "without baking soda" cup, add 300 mL water and 1 drop of liquid dish soap. Gently stir the solution until everything has dissolved. Try not to create too many bubbles.
- d. Punch out 30 leaf disks from the spinach or ivy leaves using the hole puncher or a straw. Avoid cutting through major leaf veins.
- e. Remove the plunger of the syringe and place 10 leaf disks into the syringe barrel.
- f. Place the plunger back into the syringe and push it down until only a small volume of air

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is left in the syringe. Be careful not to crush the leaf disks.

- g. Suck up a small volume of the baking soda solution into the syringe with the leaf disks.
- h. Carefully push out all the air from the syringe.
- i. Close the opening of the syringe with a finger and draw back on the plunger to create a vacuum. Hold the vacuum for 10-15 seconds and swirl the leaf disks to suspend them in the solution.
- j. Release the plunger and remove your finger from the syringe opening to release the vacuum.
- k. Repeat applying a vacuum until all the leaf disks have sunk to the bottom of the solution.
- l. Remove the plunger from the syringe and pour all 10 leaf disks with the solution into the cup labeled "with baking soda, light." Fill the cup with baking soda solution up to a depth of about 3 cm and cover the cup with aluminum foil so no light can get in the top. You want to keep these leaf disks in the dark until all your other cups are ready.
- m. Repeat steps e.-l. with the second 10 leaf disks and the baking soda solution. Pour the 10 leaves into the cup labeled "with baking soda, no light" and fill the cup with baking soda solution up to a depth of about 3 cm. For this cup, cover the top *and* sides of the cup with aluminum foil to prevent any light from getting into the cup. These leaf disks should be in the dark during the whole experiment.
- n. Repeat steps e.-l. one more time with the last 10 leaf disks. This time, though, use the water-soap solution (the solution without the baking soda) to fill the syringe. Pour the 10 leaves into the cup labeled "without baking soda, light" and fill the cup with the dish soap solution (without baking soda) up to a depth of about 3 cm.
- o. Remove the aluminum foil from the "with baking soda, light" cup. Place the "with baking soda, light" and "without baking soda, light" cups under the light source. Make sure the light shines straight onto the cups from above.
- p. Keep the "with baking soda, no light" cup covered with aluminum foil.
- q. Start a timer. At the end of each minute, record the number of floating disks in the table provided in the "Record and Analyze Your Data" section below. Briefly swirl the cup to prevent the leaf disks from getting stuck to the bottom or sides of the cup.

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- r. Observe closely what happens to the leaf disks in all three cups. Focus on how the surface of the leaf disks changes. Write your observations down in the section "Record and Analyze Your Data."
- s. Continue the experiment until all the leaf disks are floating in one of the cups.

3. Record and Analyze Your Data

- a. Write your observations during the floating leaf disk assay below.
- b. Record your results in the data table below.

Time [minutes]	Number of Floating Leaf Disks		
	With baking soda, light	With baking soda, no light	Without baking soda, light
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

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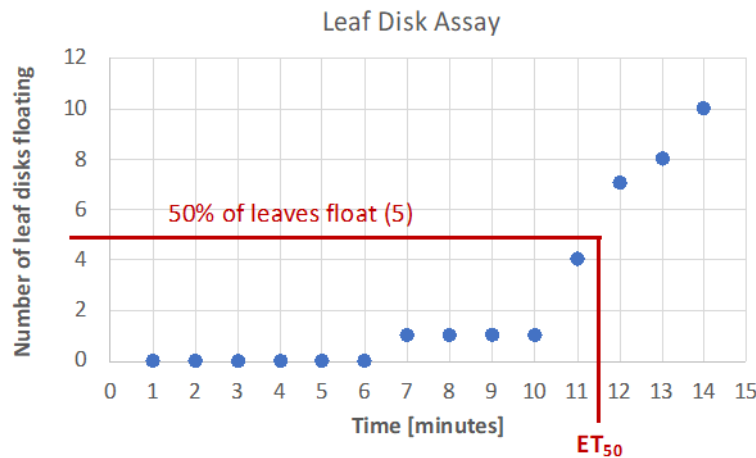
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- c. Based on your observations and results, discuss the following questions within your group.
- ? How did the results differ in each cup? Why do you think they were different?*
 - ? What do your results tell you about what reaction happens during photosynthesis?*
 - ? How could you use the leaf disk assay to measure how quickly plant leaves carry out photosynthesis?*
- d. For the "with baking soda, light" experiment, create a graph that shows how many leaf disks are floating over time. Use "Time (minutes)" as the label for the x-axis and "Number of Floating Leaf Disks" as the label for the y-axis. Also, do not forget to give the graph a clear title.

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- e. Scientists call the time at which 50% of all the leaf disks are floating the Effective Time (ET_{50}). Mark the Effective Time (ET_{50}) on your graph. You can extrapolate it from your data, as shown in the figure below.



- f. Calculate the photosynthesis rate of the experiment $1/ET_{50}$:

4. Post-Experiment

- a. Explain, in your own words, what photosynthesis is.
- b. Write down the equation for photosynthesis below.

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5. Plan and Conduct Your Own Investigation

a. With your group, outline the investigation that you are planning to conduct by answering the questions below.

- What are your independent and dependent variables in your experiments?

- How are you going to change your independent variable?

b. Write down below how you expect your independent variable to affect the rate of photosynthesis.

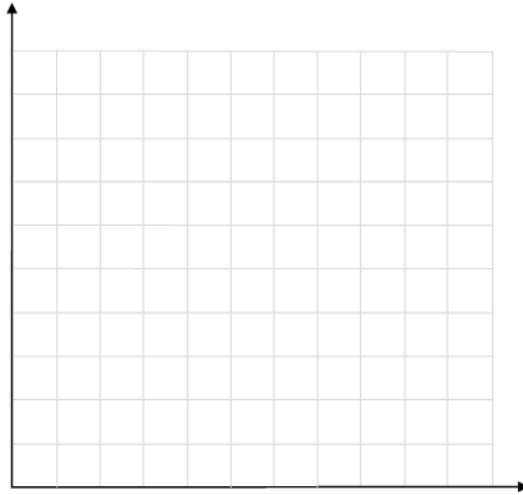
c. Conduct your planned investigation as a group, using the leaf disk assay procedure described in #2 of this worksheet. Record your results in a data table and write down any observations during your experiments. Determine the ET_{50} value and the photosynthesis rate ($1/ET_{50}$) for each experiment.

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- d. Create a graph that shows the effect of your independent variable on the rate of photosynthesis. Plot your independent variable on the x-axis and the photosynthesis rate in minutes⁻¹ on the y-axis. Do not forget to give your graph a clear title.



6. Present Your Results

Prepare a presentation that summarizes your results for the rest of the class. Below you will find some guidance on what to include. Try to keep your presentation under 3 minutes.

Part 1: State the purpose of your investigation (independent and dependent variables) and your hypothesis (how you think your variable affects the rate of photosynthesis).

Part 2: Explain your test procedure: How did you change your independent variable? What did you measure?

Part 3: Summarize your results and observations using graphs or tables. Remember to label the graphs and axes correctly!

Part 4: Write a one-sentence conclusion and a brief explanation of your results.