Photosynthesis Activity
FYE 2022

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Objectives: After this activity, students will be able to:

- Define key words associated with photosynthesis
- Collect data on spinach leaf disks under different colored lights
- Conduct a simple experiment investigating the effect of light on photosynthesis
- Graph data showing class results
- Hypothesize how light affects photosynthesis
- Explain results in a written paragraph

Introduction:

Photosynthesis is essential for life on Earth because this process harvests energy from the sun to make food in the form of simple sugars that are used by most living organisms. To grow, reproduce, and just stay alive, organisms need **energy**. Living things need energy for every activity. If the energy supply runs out, activity stops, and life ends

All plants can use **sunlight** as their energy source for **photosynthesis**. Wherever it is warm, wet, and bright enough, photosynthetic organisms absorb light energy, and use that energy to convert **carbon dioxide** to a simple sugar called **glucose**. Plants also release **oxygen** as a byproduct of photosynthesis. Water enters plants through the roots. Carbon dioxide enters the plants through tiny pores on the surface of the leaf called **stomata.** Oxygen and water exits the leaves through the stomata. The reaction for photosynthesis looks like this:

$$\underset{\text{Carbon dioxide}}{6\,CO_2} + \underset{\text{Water}}{6\,H_2O} \xrightarrow{\text{light}} \underset{\text{Oxygen}}{6\,O_2} + \underset{\text{Sugar}}{\text{Glucose } (C_6H_{12}O_6)}$$

Sunlight contains light of many colors, or wavelengths, all of which we can see in the colors of a rainbow. Substances that absorb light are called **pigments**, and the most important of these pigments in green plants is **chlorophyll**, which gives them their green color.

Each group will need the following materials:

- 10 spinach leaves
- Lamps with different colored lights
- 1 hole puncher
- Beaker filled with 50 mL way with 1% Baking Soda ($NaHCO_3$) solution in water
- 1, 10 mL syringes
- 1 petri dish top filled with a little bit of water
- Tin foil
- Timer (phone is ok)

Procedure:

1. Use a paper hole puncher to cut 10 leaf disks from 10 healthy leaves. Try to cut the leaf disks between major veins.

2. Fill your bealer with 50 mL 1.0 % baking soda solution. *This solution will be the source of CO_2 for the leaf during photosynthesis. When baking soda ($NaHCO_3$) is added to water the following happens:* $\boldsymbol{NaHCO_3 + H_2O \rightarrow Na^+ + H_2O + CO_2}$

3. Place the disks into the 10 mL syringe and make sure that they settle to the bottom of the syringe. Move the plunger all the way to the bottom of the syringe in order to remove the excess air.

4. With the syringe, suck up approximately 5 mL of bicarbonate solution from the beaker. Push the plunger upward in order to remove all of the air at the tip of the syringe. The leaves will be floating in the solution at the top of the syringe because they are full of air.

5. In order to remove the air from the leaves, you will need to create a "vacuum", meaning there is no air in the syringe. Place your thumb over the tip of the syringe while you pull the plunger. Shake the syringe while you are doing this in order to keep the leaves in the water. Now, push the plunger upward while keeping your thumb over the syringe tip. If you have successfully removed all of the air out of the leaf disks, you will see them settle to the bottom of the syringe. They are now ready to be used in the experiment. NOTE: This step may need to be repeated several times before the leaf disks begin to settle. Be persistent! Your instructor can show you how to do this if you don't understand.

6. Leaf disks can be transferred to the beaker filled with 1.0% bicarbonate solution. They should settle to the bottom of the beaker.

7. Cover your beaker with sunken leaf disks with tin foil until you are ready to begin.

8. Place the beaker with the submerged leaf disks under the lamp(s). Your group will put your disks under a specific light color desginated by your instructor. Place the petri dish with a little water on top of the plastic cup. This is your heat trapper and will prevent the lamps from cooking your spinach!

9. Write your hypothesis down on the next page about what you think is going to happen with the different colored lights. For example: I hypothesize that leaf disks exposed to x color will float more quickly to the surface than y color. OR, I hypothesize that different colored lights will not affect the amount of leaf disks floating after each minute.
   Your hypothesis is never WRONG….either your data support it or they don't!

10. Remove the foil. Each minute for the next 15 minutes, count how many leaf disks are floating in the beaker. Graph your data in the table found on the next page. The faster the rate of photosynthesis, the sooner the disks will float.

Name _____ **What was your bulb color ? _____**

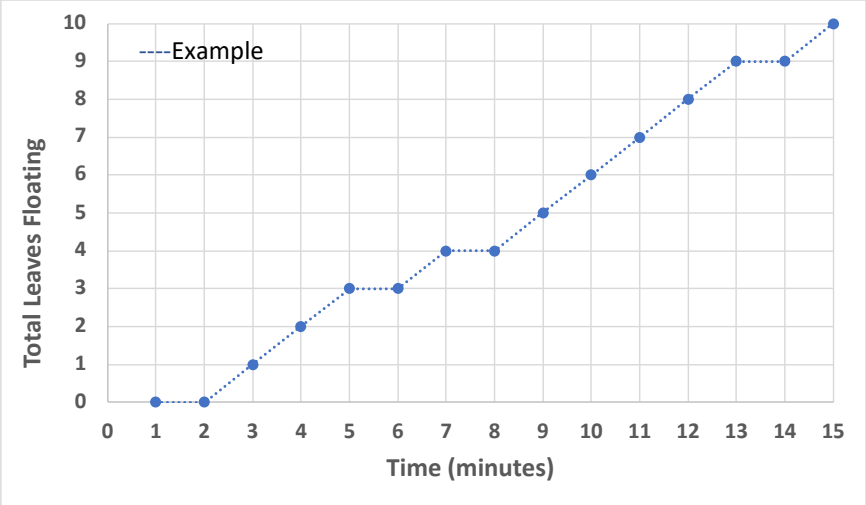
Time (minutes)	**Total Number of Disks Floating**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15 (TOTAL)	

White Light _____
Red Light _____
Green Light _____
Blue Light _____
Yellow Light _____
Other _____

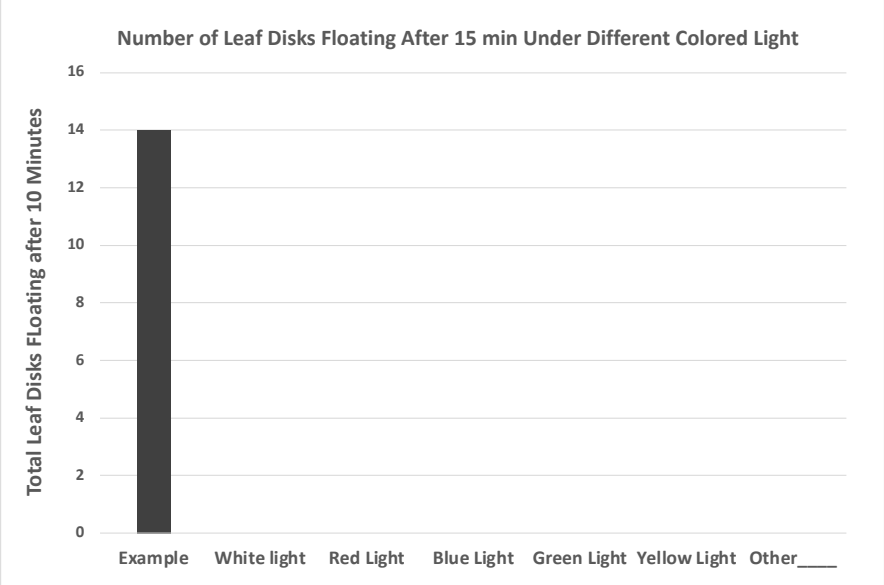
Graph these results in the chart below. An example is given.

1. Write your HYPOTHESIS (prediction) about how different colors of light will affect how many leaf disks are floating in the beakers after 15 minutes.

2. Graph your data on the chart below to determine which color had the highest RATE of photosynthesis. An example is given for you.



3. Get the final number of disks floating after 15 minutes from other groups in the lab. Write the final values below:



4. Look at the graphs above and explain the results. Which color light causes the highest rate of photosynthesis after 15 minutes? Which color light had the most leaves floating after 15 min?

5. Did your data SUPPORT or NEGATE your hypothesis? (Circle one)

6. According to your data, spinach plants are reflecting mostly _____ light, but absorb mostly _____ light.

7. In the book, (page), Anaya's dad says that the reason why the invasive grass is black is because it can photosynthesize using all colors of the spectrum…it absorbs all colors and reflects none (black is the absense of all color). From the data that you collected, is this true for earth plants? Explain below.

8. Speaking of Reflecting… Write or reflect on 3 things that you learned or experienced today in lab. For example, what was something new that you learned? Did you enjoy doing this lab activity? Why or why not?