The Role of Light and Pigments on Photosynthesis

CLASS SET – PLEASE RETURN!

Sunlight energy is made up of many wavelengths of energy. When visible light encounters matter it is either reflected or absorbed by matter. What is the relationship between the way in which a plant uses light (absorbs energy) and the colored pigments that the plant contains?

PART A: The Composition of Visible Light

Observe the demonstration using a *defraction gradient* with the light spectrum and answer the interpretation questions below.

DEMONSTRATION PROCEDURE:

- Record the results of the color changes that occur after using different **colored filters**. **RED** **BLUE**
- Record the result of the color changes that occur after **combining colored filters**.
- Record the results of the color changes that occur when using **spinach chlorophyll pigments**.

INTERPRETATION QUESTIONS:

1. List all the colors and their wavelengths (nm) that make up **visible light** in proper order.

2. What colors are being **reflected** for each filter color during the demonstration? (i.e. red & blue)

3. How did **combining all color filters** affect the spectrum created?

4. What colors (wavelengths) of light are being **reflected** when spinach chlorophyll creates a spectrum?

5. What colors (wavelengths) of light are being **absorbed** when spinach chlorophyll creates a spectrum?

6. What colors (wavelengths) of light can spinach pigment use for photosynthesis?

<u>PART B</u>: Paper Chromatography of Spinach Leaf Pigments

Purpose: To explore the types of pigments found in spinach leaves.

Materials:

spinach leaf	chromatography paper	a screw
rubber stopper with hook	test tube & test tube rack	Petroleum ether solvent

Procedure:

1. Obtain a chromatography strip and mark a **pencil line** about 2 cm from the bottom.
2. Attach the paper strip to a the hook on the rubber stopper and position the paper strip so that when inserting it into the test tube, the paper tip is just above the bottom of the tube.
3. Prepare the chromatography paper strip by removing it from the beaker and placing it on your desk.
4. Using the pencil line as a guide, place dry spinach leaf on the paper and press a screw into the center of the pencil line until a dark green "grass stain" dot remains on the paper. **Be careful not to tear the paper.**
5. Allow the chlorophyll "dot" to dry for 1 minute. **Be careful not to tear the paper.**
6. Repeat this process a **15 more times** to ensure enough pigment is on the strip.
7. Add enough solvent to the test tube so that a small amount covers the bottom of the container.
8. Place the paper strip into the test tube so that it's suspended from the hook and stopper.

***It is important that the tip of the paper touches the solvent – DO NOT let the green dot touch the solvent!**

9. Do not move or touch the set up for about 15 minutes, or until it reaches the top of the paper.
10. Remove the paper strip when the solvent has nearly reached the top of the paper.
11. Be sure to attach your dry chromatogram strip to your lab!
12. **<u>Draw and Label</u> with colored pencils** your chromatography paper with the pigments observed. Each color band is a different pigment.

On an ideal chromatogram strip the colors listed from top to bottom are:

Carotene – orange
Xanthophyll – yellow
Chlorophyll *a* – bright green
Chlorophyll *b* – dull or khaki green (**Note: usually the two chlorophylls are close together!**)

INTERPRETATION QUESTIONS:

1. What is the usefulness of chromatography?

2. Is the plant pigment in spinach leaves composed of one or several pigments? What colors of pigment did you find in your separation? Name the pigments found.

3. What does this laboratory activity tell you about why plants appear green?

4. In what organelle (cell part) does one find leaf pigment?

5. How would this lab help you to decide what color windows to use in a greenhouse?
(Hint: remember the demo with spinach chlorophyll from PART A).

6. Many leaves change color in the autumn. How is it possible for this color change to happen? Base your answer on your new knowledge of pigments present in chloroplasts.
(Hint: Chlorophyll *a* and Chlorophyll *b* are easily broken down by the cool autumn temperatures)