Lab: Photosynthesis Lab

Learning Goals: ***(1 point)***

1. Students will be able to diagram the parts of the chloroplast and know how each part is involved in photosynthesis.
2. Students will be able to name the pigments involved in photosynthesis.
3. Students will be able to describe the function of the stoma in the process of photosynthesis.

Part I: Where, What How Photosynthesis

1. **Draw** the chloroplast structure from the photosynthesis chapter of the textbook. **Label** each of the parts of the chloroplast. *(3 points – excellent, standard, poor)*
2. Write the chemical equation for photosynthesis including the proper coefficients and then describe the formula in words in a paragraph below it. Paragraph must consist of at least 5 sentences. *(4 points – 2 for equation & 2 for paragraph)*

Part II: How many pigments are in a plant using Chromatography?
Procedure:

1. Take chromatography paper and cut so it will fit in vial with cap closed and touch bottom. Do not touch the center of the paper with your fingers; it will cause error in your results.
2. Draw two faint lines with your **pencil**. One 2 cm from the bottom of the paper and the other 4 cm above that line (6cm from the bottom). Label your vial with masking tape and lab group number.
3. Put the leaf on top of the paper. Roll the coin over the leaf, over your 2cm line. This should transfer some of the plant material onto the paper. Move the leaf and roll the coin again. Do this multiple times to create a dark green line of pigment at the 2cm line.
4. Place 5 ml of acetone in the vial. This is your solvent. *Do not let the pigment touch the solvent.* **Pour the acetone in the fume hood only!** Acetone is flammable, please use with caution.
5. Create the data table that is found below in your lab book. Place the paper in the vial and put the cap on the vial. Start the timer.

Pigment Color	Distance Pigment Migrated (cm)	R_f Value	Pigment Name

6. Record your **qualitative data** as the process is happening. Make sure to describe what you are observing using descriptive words. *(2 points – present & good; present & poor)*
7. When the liquid reaches the 4cm line, or 15 minutes, whichever comes first, take the paper out of the acetone and put it on a paper towel to dry.

8. Draw four horizontal pencil lines. Draw one line indicating how far the solvent travelled. Measure and record this distance as distance solvent migrated. Draw the remaining lines at the furthest locations from the 2cm line for each pigment (you should see 3 pigment bands) and draw three lines. Measure and record the distance each pigment migrated and the distance the solvent migrated in cm. Make sure to record measurements as specifically as possible. All distances should be measured in cm using the 2cm line as 0cm.
9. Draw the chromatography paper in lab book using color. One team member may attach the groups' paper into their lab book.
10. Use the equation below to calculate R_f values and record on table.

$$R_f = \frac{\text{distance pigment migrated (band of color)}}{\text{Distance solvent migrated (clear liquid)}}$$

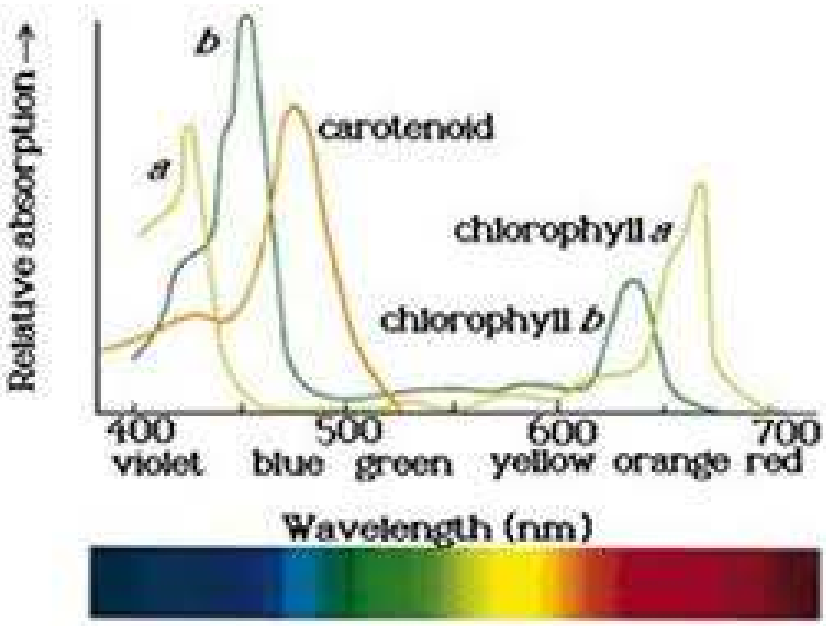
11. Address the following in your lab book.
    a. How can you tell that there are three different pigments?
    b. Which band traveled the furthest distance in on the paper? *(1 point)*
    c. Why do you think the pigment traveled the furthest distance on the paper?
    d. Graph calculated R_f values for each pigment. *(3 points – excellent, standard, poor)*
12. Using reference data below, identify the name of each of the three pigments observed and add Pigment Name to data table. *(3 points – accuracy)*

$R_f = 0.89$ ---- Carotene
$R_f = 0.51$ ---- Chlorophyll a
$R_f = 0.44$ ---- Chlorophyll b

13. In a paragraph, discuss differences & similarities between observed data and the reference data. Include any possible sources of error, how they may have impacted the data and how the errors will be removed in future experiments. *(3 points – excellent, standard, poor)*

Part III: What are Pigments?

1. Defend the following statement: The sun is the primary energy source for all living things. *(3 points – excellent, standard, poor)*
2. The graph below shows the color of visible light that chlorophyll a, chlorophyll b, and carotenoid pigments absorb. Where a curve has a peak, much of the light at that wavelength is absorbed. Where a curve has a trough (a dip) much of the light at that wavelength is reflected or transmitted. When you look at a color, the color you see is actually being reflected or transmitted. Substances that absorb visible light are called pigments. Draw and fill in the data table below the graph. *(3 points)*



Pigment Name	Primary Colors Absorbed	Primary Color(s) Reflected/Transmitted
Chlorophyll a		
Chlorophyll b		
Carotenoids		

3. Describe the significance of the leaf's ability to absorb a wide spectrum of visible light via the different pigments in your lab book. *(3 points – excellent, standard, poor)*

Part IV: Investigating Stomata

1. Focus Question: How do you think gases are exchanged between a plant and its surrounding environment?
2. Draw a cross section of a leaf and label all parts. *(3 points – excellent, standard, poor)*
3. Follow the procedures below to investigate stomata. Include headings with underlines. *(5 points – excellent, above standard, standard, below standard, poor)*
    a. Problem: What are stomata?
    b. Prediction: Write a prediction about stomata. (size, location, placement)
    c. Expected Results: Using an image or a graph, depict what you expect from the prediction stated.
    d. Methods: Write out the procedures followed to observe stomata under the microscope. DO NOT include a list of materials but rather incorporate them into the procedure to follow.
    e. Data: Collect data from this investigation (make measurements, draw image, etc.)

f. Explanation of Observations: In a paragraph, incorporate research about stomata with findings from investigation to describe the role the stomata plays in plant processes and diagram the parts that make up the stomata.

Part V: Factors Influencing Photosynthesis

1. Focus Question: What factors do you think influence the rate at which photosynthesis takes place?
2. Follow the procedures below to investigate factors that influence photosynthesis. Include headings with underlines. *(5 points – excellent, above standard, standard, below standard, poor)*
    a. Problem: What factors influence photosynthesis?
    b. Independent Variable: identify what factor being tested and what variable will be used to simulate this factor.
    c. Dependent Variable: identify what data is being measured and recorded. Make sure to indicate what units are being used in measurements.
    d. Controlled Variables: identify what components of the experiment are being held the same between the experimental and control setup.
    e. Hypothesis: Write an appropriate hypothesis including what variable is being changed, what impact it will have, and why it is thought to have that impact.
    f. Expected Results: Using an image or a graph, depict what you expect from the hypothesis stated.
    g. Methods: Write out the procedures followed to observe the impact this factor has on photosynthesis. DO NOT include a list of materials but rather incorporate them into the procedure to follow.
    h. Data: Record data from this investigation
    i. Explanation of Observations: In a paragraph, incorporate research about the factor that was tested with findings from investigation to describe the role the factor tested plays in plant processes.
3. Follow-up Analysis Questions: Answer the following in complete sentences in the lab book.
    a. Predict the impact of Light Intensity, Carbon Dioxide Availability, and Temperature on the rate of photosynthesis by drawing one graph with three lines. *(3 points – general accuracy)*
    b. Discuss similarities and differences between class data and what is expected for the two factors tested in this lab. Make sure to address any errors that may have impacted data collection or any ways to improve the experiment. *(3 points – excellent, standard, poor)*