Photosynthesis Labs

In this activity you will select a plant and conduct multiple experiments to uncover the ideal conditions for your plants growth.

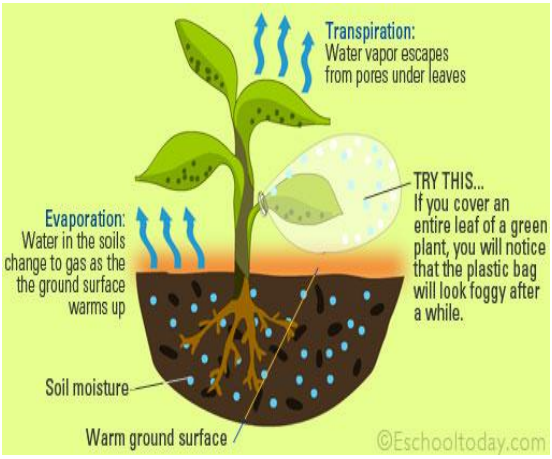
Research questions: What factors influence the rate of photosynthesis of plant _____ and what are the ideal conditions for growing plant_____?

You will test multiple variables using the following techniques:

-Lab 1: Transpiration
-Lab 2: Spectrometry
-Lab 3: Paper Chromatography
-Lab 4: Photosynthesis rate leaf disk float tests.

At the end of your investigations you will write a CER that answers the research question

LAB 1: Transpiration



Transpiration:

What is transpiration?

Transpiration is the process by which moisture is carried through plants from roots to small pores on the underside of leaves, where it changes to vapor and is released to the atmosphere. Transpiration is essentially evaporation of water from plant leaves. Transpiration also includes a process called guttation, which is the loss of water in liquid form from the uninjured leaf or stem of the plant, principally through water stomata.

Studies have revealed that about 10 percent of the moisture found in the atmosphere is released by plants through transpiration. The remaining 90 percent is mainly supplied by evaporation from oceans, seas, and other bodies of water (lakes, rivers, streams).

In this lab you will test and calculate the transpiration rate of your chosen plant

Procedure:

Within your group:

- - Obtain a tube and write your name on it.
- -- Measure fixed volume of water in centrifuge tube
- - Add food coloring to your water (~5 drops / 25 mL)
- - Choose your plant / vegetable.

-Record the volume and mass of the water in the tube. 1 ml = 1 g of water

-Estimate the surface area of your plants leaves

-cover your tube with saran wrap, leave your plant under a lamp, and wait one day for results

Results

Initial Water _____ g H_2O Final Water _____ g H_2O

Total Leaf Surface area_____ dm^2 Calculated transpiration rate _____ g H_2O / (dm^2 * hr)

Analysis (finish experiment first)

1.What is plant transpiration?

2. Why do plants transpire? What is exchanged with the environment?

3. What might affect the transpiration rate of plants?

4. Why would different plants potentially have different transpiration rates

5. What environmental factors could influence the rate of plant transpiration?

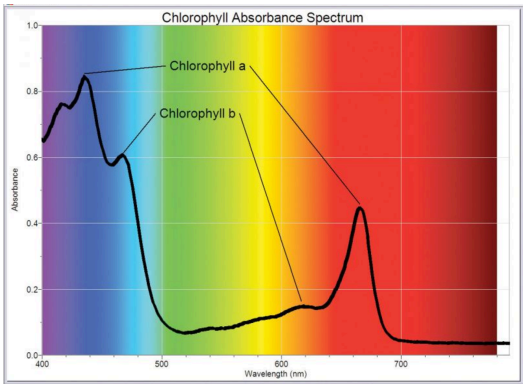
6. Describe the relationship between surface area and transpiration

7. Identify potential sources of error in this lab

LAB 2: Spectrometry

Absorbance Spectra

Absorption spectroscopy refers to spectroscopic techniques that measure the absorption of radiation, as a function of frequency or wavelength, due to its interaction with a sample. The sample absorbs energy, i.e., photons, from the radiating field. The intensity of the absorption varies as a function of frequency, and this variation is the absorption spectrum. Absorption spectroscopy is performed across the electromagnetic spectrum.



In this lab you will use a spectrometer to generate a absorbance spectrum for your plant. This will inform you which frequencies (colors) of light your plants leaves absorb and reflect.

Procedure:

-obtain a ziplock back, cuvette, and isopropyl alcohol
-place a few leaves in a back with isopropyl alcohol. Crush the leaves until the solution is the same color as the plants leaves
-pour the solution into the cuvette
-Place your cuvette into the spectrometer.
-push the play button to record. Take a picture of the spectra you generate or email a copy of the file to yourself.
-paste the absorbance spectra below and use it to answer the analysis questions.

Paste a copy of your absorbance spectra below!

Analysis

1.What is an absorbance spectra? How is it useful to scientists?

2.Identify which frequencies/colors your plant absorbs

3. Identify which frequencies/colors your plant reflects

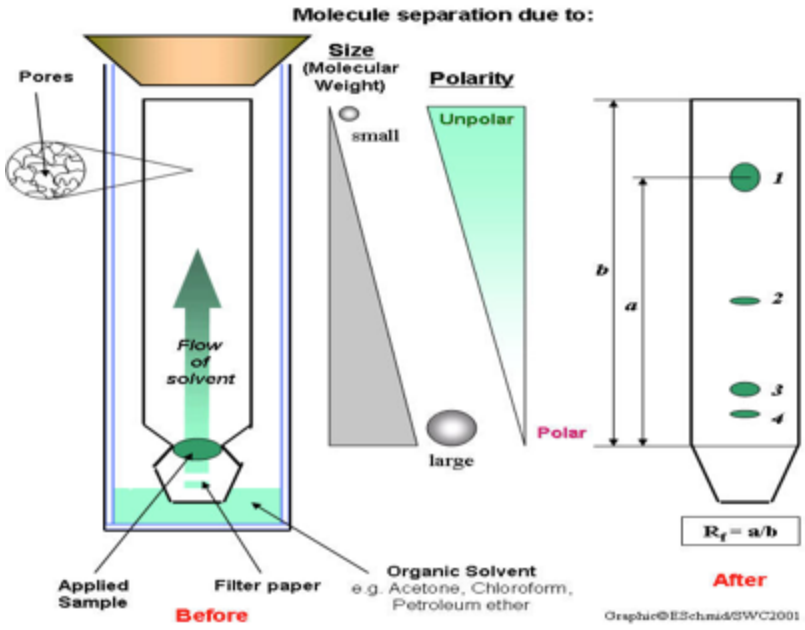
4. Which type(s) of colored lights would be ideal for growing your plant? Why would this be prefered over a traditional white light?

5. How many pigments do you think your plant leaves contain? Explain your answer

6. Why would your plant absorb only specific frequencies? Why not absorb all light frequencies? Consider evolution in your answer

7. How could you experimentally determine which pigments are contained in your leaves?

LAB 3: Paper Chromatography



Chromatography: Paper chromatography is a process that uses special filter paper to separate and identify the different substances in a mixture by weight and polarity. Chromatography means “to write with color.” A sample of a substance is placed in chromatography paper which is placed into a solvent (alcohol), The substances in the mixture dissolve in the alcohol and move up the paper. The heavier substances move up the paper more slowly. The lighter substances move up the paper more quickly. So heavy and light substances get separated from one another on the paper or to put another way, paper chromatography separates pigments by weight and polarity.

Procedure:

1.Obtain 1 strips of chromatography paper, ruler, scissors, pencil, and tape

2. Use a ruler to measure and draw a light pencil line 2-cm above the bottom of each paper strip.

3. **Here is the tricky part! For ONE piece of chromatography paper place the edge of the plant leaf over the pencil line and using the edge of a coin gently press on the leaf to create a single green line over the pencil line. You want this line to be thin and *concentrated* with the pigment from the spinach leaf. Therefore, repeat this edging process carefully about 3-4 times. Be sure not to press too hard or you will poke a hole through the paper.**

4. **Carefully add isopropyl alcohol to the beaker until it reaches a depth of 1-cm in the beaker.**

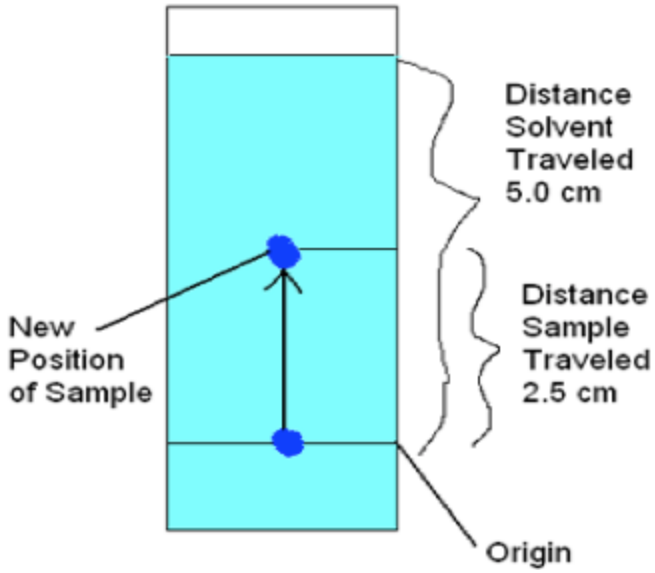
5.. **Lay the pencil across the top of the beaker with the paper strip extending into the alcohol. MAKE SURE THAT THE LEVEL OF THE ALCOHOL IS BELOW THE GREEN LINE ON YOUR PAPER STRIP! IF THE ALCOHOL IS GOING TO COVER THE GREEN LINE, POUR OUT SOME ALCOHOL BEFORE YOU GET THE GREEN LINE WET!**

6. **Observe as the alcohol gets absorbed and travels up the paper by capillary action. This may take up to 20 minutes. Do not touch your experiment during this time.**

7.**Using a ruler and the following formula, measure the Rf values of each pigment. Since the fastest molecules will travel the greatest distance, or to the highest point along the strip, the relative distances can be measured, and the flow rate (migration) of the molecules (Rf) can be calculated by using the following formula:**

Rf = Distance pigment traveled / Distance solvent traveled

Example: Rf = 2.5 cm / 5.0 cm = .5 cm



8. **Take a picture of your completed chromatography results and paste it below**

Analysis: Complete the table below for each pigment your chromatography results detected

Color of pigment	Distance pigment Traveled (cm)	Distance solvent traveled (cm)	Rf value

1. **Describe how paper chromatography is used to isolate and detect pigments in plant leaves**

2. Identify how many pigments your plant leaf has and the color of each.

3. Compare your chromatography results to the absorbance spectra you generated in Lab 2. Do the results of these two experiments agree or disagree? Why or why not?

4. Identify potential sources of error in this lab

5. What applications would paper chromatography have in economic fields such as fashion?

LAB 4: Photosynthesis rate leaf disk float tests

1. **Follow this lab procedure and test as many variables as you can think of. This will help you come up with ideas**
2. **For each trail you run record your results (data, observations, etc) in the evidence portion below. Graphs are encouraged. These trails will be very helpful in writing your final CER**

Evidence:

Research questions: What factors influence the rate of photosynthesis of plant _____ and what are the ideal conditions for growing plant_____?

Claim:

Evidence:

Reasoning: