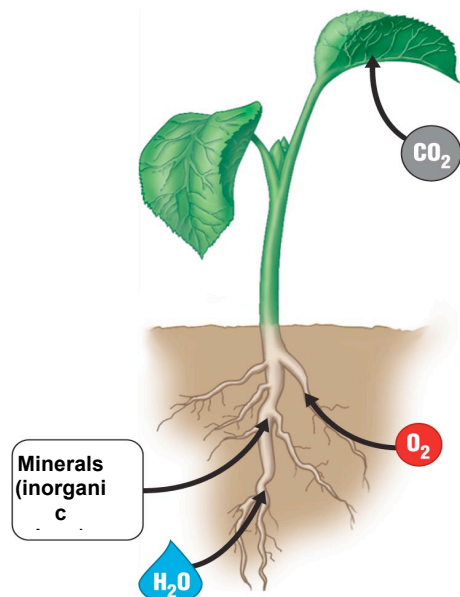


Autotrophic Nutrition

Introduction

To carry out photosynthesis, a plant must obtain **water**, **CO₂** and **sunlight**. Plant organs and tissues are specialized to obtain and transport these materials to the leaves, where photosynthesis occurs.

Water must be absorbed by the roots and carried up the plant stalk. Plants contain vessels that carry material in much the same way as human blood vessels carry blood. **Xylem** vessels carry material *up* the plant stalks from roots to leaves via capillary action of water along the cellulose walls of these once living cells. **Phloem** vessels carry material from the leaves *down* to the roots, with diffusion moving the nutrients from cell to cell within these vessels.



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Photosynthesis occurs in the leaves of the plant in cells that contain chloroplasts. CO₂ is taken in through pores in the underside of the leaf. These **stomata** can open and close depending on the time of day (day vs. night) and the dryness of the air (dry vs. wet). These pores also release the waste products of photosynthesis.

Chloroplasts in the leaves contain pigments that absorb light energy from the sun. These pigments include two forms of chlorophyll, carotenes and xanthophylls. Sunlight contains all the wavelengths of visible light (red, orange, yellow, green, blue and violet), but not all these wavelengths are used in photosynthesis.

O₂ is not required for photosynthesis so why does the diagram above show the plant taking up O₂?

Procedure

I. Roots obtain nutrients

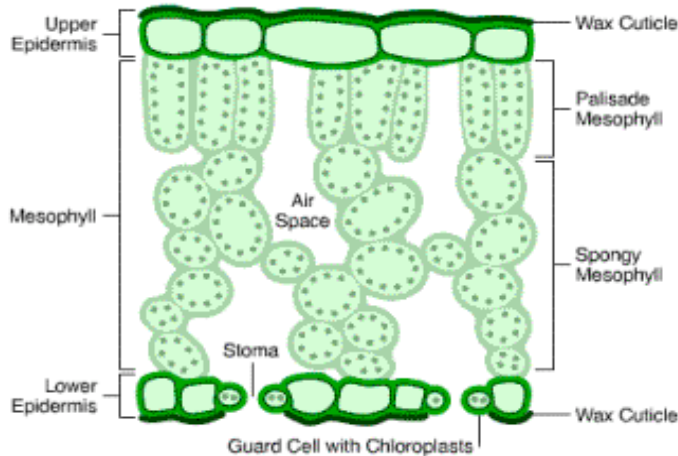
1. Obtain a radish seedling with root.
2. Cut off and discard the radish seedling and make a wet mount with the root tip.
3. Observe and diagram the root tip and root hairs.
4. View at 400x

II. Xylem and phloem carry materials in the plant

1. Obtain a piece of celery (~5 cm long) and place inside a beaker of dye.
2. Allow to sit ~15 min.
3. Start at the end of the celery stalk that was sticking up out of the dye and start slicing very thin slices of celery.
4. Find the place where you can start to see dye inside of the celery stalk.

5. Make a *dry mount* of a very thin slice of celery stalk (no coverslip needed!)
6. View at 40x or 100x and sketch.

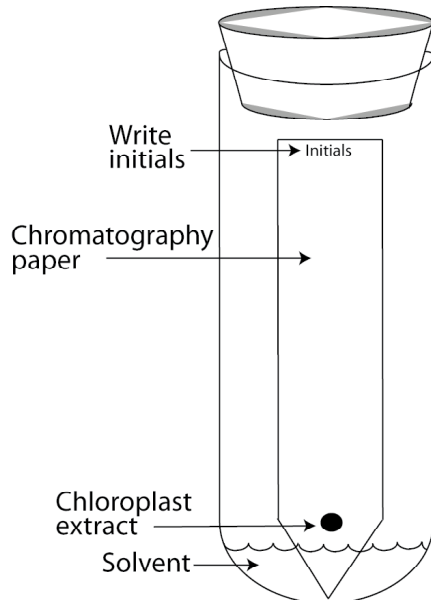
III. Leaves



1. View at 400x and sketch the cross section of *Privet* leaf.
2. Label your sketch.
3. Briefly state the purpose of each part of the leaf.

IV. Separation of chloroplast pigments by paper chromatography

1. Obtain one strip of chromatography paper per group. *Handle only by the edges - this paper is sensitive to your finger oils!*
2. Write your initials in pencil at the top of the paper



3. Use the capillary pipette to apply 50 drops of chlorophyll extract to paper.
 - a. All drops should be applied to the exact same spot on the paper (~5 cm from the tip.)
 - b. Allow the spot to dry between spots (~30 sec.)
4. Handling paper only on the edges, drop paper strip into the test tube and seal closed with a rubber stopper.
 - a. Test tube should have ~2-3 cm of petroleum ether/ acetone
 - b. ***Petroleum ether/ acetone fumes are toxic – Avoid Breathing Fumes***
5. Paper strip should stand vertically in test tube for ~30 min. Watch your paper strip periodically to see the different pigments present in a chloroplast separate.

V. Absorption of light by chlorophyll.

1. Set up a lamp and spectroscope. You should be able to look through the spectroscope and see a rainbow of colors (red, orange, yellow, green, blue, violet). Each color is a different wavelength of visible light.
2. One group member should look through the spectroscope while another group member holds colored slides in front of the lamp.
3. Look at the colors and determine which wavelengths of light pass through the colored slide and which wavelengths of light are absorbed by the colored slide.
4. Test all the colored slides (green, red, blue and yellow).
5. Each group member should take a turn looking through the spectroscope.
6. Hold a bottle of chloroplast extract in front of the lamp and determine which wavelengths are absorbed and which pass through.
7. The chloroplast extract is dissolved in acetone. Now hold a bottle of acetone in front of the lamp and determine which wavelengths are absorbed and which pass through.
8. Hold a fresh spinach leaf in front of the lamp and determine which wavelengths are absorbed and which pass through.



Be sure to check your instructor's website for extra credit questions and announcements.

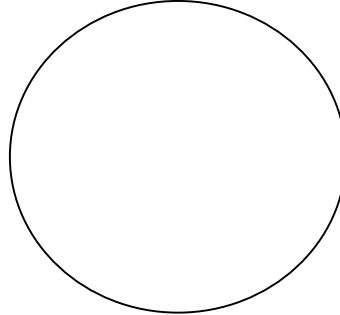
Name _____

Autotrophic Nutrition

Results and Data Analysis

I. Roots obtain nutrients

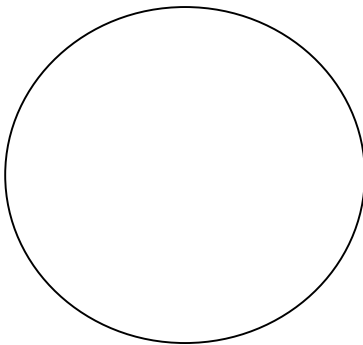
Diagram a few root hairs.



What is the purpose of the root hairs?

II. Xylem and phloem carry materials in a plant

Diagram the cross section of a celery stalk and indicate where dye is localized.



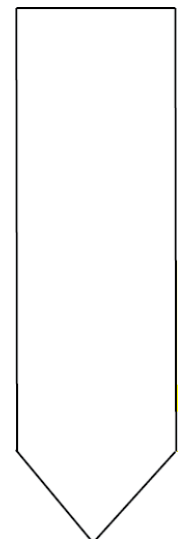
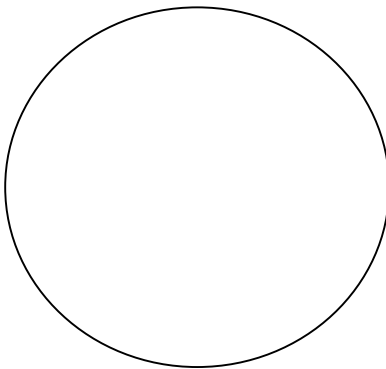
Which type of plant vessel carries the dye up the stem? _____

III. Leaves

Diagram the cross section of *Privet* leaf. Label: **cuticle**, **upper epidermis**, **mesophyll**, **lower epidermis**, **stoma** and give the **function of each**.

Function of:

1. Cuticle
2. Upper epidermis
3. Mesophyll
4. Lower epidermis
5. Stoma



IV. Separation of chloroplast pigments by chromatography

Draw and label your paper chromatography results.

Why are there several different-colored pigments in a chloroplast?

V. Absorption of light by chlorophyll

You have observed which wavelengths are absorbed by and which are transmitted through each colored slide. Use your observations to answer the following questions.

	Colors Transmitted Through	Colors Absorbed
Red slide		
Yellow slide		
Green slide		
Blue slide		
Acetone		
Chlorophyll extract		
Spinach leaf		

1. Violet slides are not available. However, if a violet slide were available, which wavelengths of light would you expect to be *absorbed by* and *transmitted through* it? On what evidence did you base your answer?

2. Given the wavelengths of light that passed through the chloroplast extract and the spinach leaf, what wavelengths of light should be *most effective* in photosynthesis? Provide evidence to support your hypothesis.

3. The bottle of acetone acted as a control. What was the purpose of the acetone control in this experiment?