

Plant Pigments

Pre-Lab Discussion

Photosynthesis begins when light is absorbed by pigments in the plant cell. One technique for separating and identifying these pigments is paper chromatography. In paper chromatography, solvent moves up the paper carrying with it dissolved substances—in this case plant pigments. The pigments are carried along at different rates because they are not equally soluble in the solvent and are attracted in different degrees to the paper.

Many green leaves contain pigment colors that are not seen until autumn because they are hidden by the chlorophyll. A few plants have leaves that are red, orange, or yellow all year long.

In this investigation, you will use paper chromatography to determine what differences exist in the plant pigments of various colors of leaves. You will also determine which leaves or which parts of leaves contain the chlorophyll necessary to carry out photosynthesis.

Problem

What plant pigments can be found in different colored leaves?

Materials (per group)

- 2 pieces of filter paper
- 2 150-mL beakers
- 2 glass plates (covers for beakers)
- Coin
- 70% isopropyl alcohol (rubbing alcohol)
- Fresh spinach leaf
- Red leaf such as a *Coleus* leaf
- Scissors
- Stapler
- Metric ruler
- Pencil

Safety

Put on a laboratory apron if one is available. Put on safety goggles. Handle all glassware carefully. Alcohol is flammable. Do not expose it to heat or flames. Do this laboratory investigation in a well-ventilated room. Be careful when handling sharp instruments. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

Procedure

1. Make two filter-paper rectangles that are each approximately 12 cm by 7 cm. Using a pencil, draw a base line 1.5 cm from the bottom of the long side of each rectangle. See Figure 1.

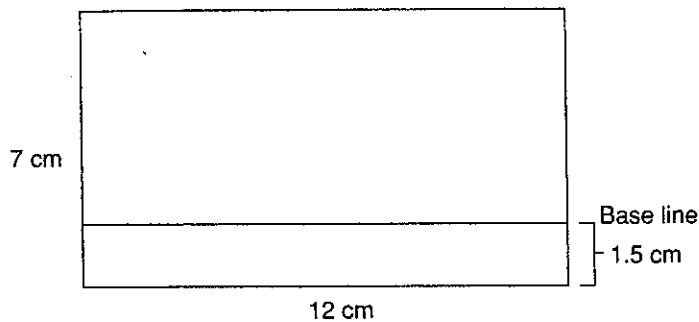


Figure 1

2. Place a spinach leaf over the pencil line on one of the rectangles. Roll the coin over the leaf so that a horizontal green line is transferred to the pencil line. Repeat this step with the red leaf and the second filter-paper rectangle. See Figure 2.

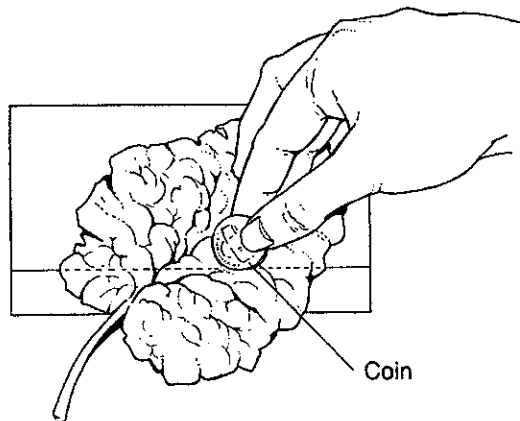


Figure 2

3. Add just enough isopropyl alcohol to each of the two beakers to cover the bottom. Do not add more than 1 cm to ensure that the pigment line will not be submerged when the paper is lowered into the beaker. **CAUTION: Avoid inhaling the alcohol.**
4. Make a cylinder of each piece of filter paper by stapling it end to end. Lower each paper cylinder into a beaker containing alcohol. See Figure 3. The solvent will begin to move up the paper and cause the pigments to move as well.

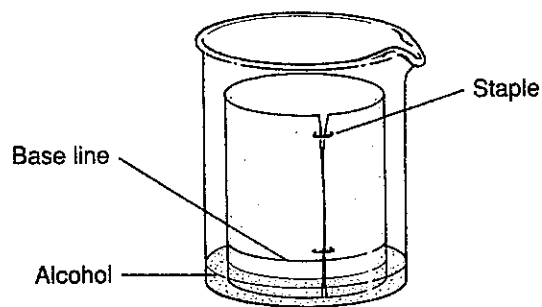


Figure 3

5. Cover each beaker with a glass plate. Do not disturb the beakers for approximately 15 minutes, or until the solvent is about 1 cm from the top of the paper.
6. When the solvent is about 1 cm from the top of the paper, remove the paper and mark the farthest point of the solvent's progress (front line) with your pencil before this line evaporates.
7. Allow the filter-paper cylinders to dry, and then make a sketch of the chromatogram. Some possible colors and the pigments they represent are: faint yellow—carotenes; yellow—xanthophyll; bright green—chlorophyll *a*; yellow-green—chlorophyll *b*; red—anthocyanin

Observations

Data Table

	Line	Color Observed	Probable Pigment
S p i n a c h	1 (base line)		
	2		
	3		
	4		
	5 (front line)		
R e d L e a f	1 (base line)		
	2		
	3		
	4		
	5 (front line)		

Analysis and Conclusions

1. How many pigments were separated in each type of leaf? _____

2. How did the pigments in the spinach leaf compare with the pigments in the red leaf?

3. Which of these leaves can carry on photosynthesis? Explain your answer.

Critical Thinking and Application

1. Photosynthesis requires the green pigment chlorophyll. Explain how a Japanese maple tree, having only red leaves, can carry on photosynthesis. _____

2. Many trees have leaves that are green in the summer and red, yellow, or orange in autumn. Where were these colors during the summer? How can they suddenly appear in autumn?

3. In addition to separating plant pigments, what are some other possible applications for paper chromatography? _____

Going Further

Perform a similar experiment to compare the light pink portion of the *Coleus* leaf to the dark purple portion, or to compare leaves from plants grown in the dark to leaves from plants grown in the light.