

CHROMATOGRAPHY



EXPERIMENT



Have you ever noticed that the leaves of some trees change color in fall? In warmer temperature months, with longer hours of sunlight, plants with green leaves use sunlight to synthesize foods from carbon dioxide and water, a process called photosynthesis. As the temperatures get cooler and the days grow shorter, the chemicals in the green leaves start to break down, as well as the green pigment, exposing the non-green, yellow, orange and red pigments that are also present in the leaves.

Deciduous plants have green leaves that change color and fall off the plant in the fall and regrow in the spring, such as oak and maple trees and mountain laurel and rhododendron shrubs. There are even some conifer trees, those with cones for seeds and needles for leaves, that change needle color, such as larch trees.

Chlorophyll is the green pigment, responsible for photosynthesis. Xanthophylls are the yellow pigments, and carotenes are the orange pigments. These yellow and orange carotenoid pigments are found in carrots, daffodils, and bananas. Anthocyanins are the red pigments that appear in the fall colors and in apples, cranberries, and strawberries. All of these pigments are present in a green leaf.

So, if we separate the different plant pigments in a leaf, then will we see other colors, not just green.

Let's Experiment!

Materials

- 5-10 green leaves
- Scissors
- Glass jar with lid
- Mortar and pestle (or a bowl and spoon)
- Tablespoon
- Isopropyl alcohol (rubbing alcohol)
- White, flat coffee filter cut into a strip
- Pipet, toothpick or eye dropper
- Pencil
- Tape

1 Put on goggles.

2 Use scissors to cut up the leaves into small pieces.

3 Place the pieces into the mortar and grind the pieces with the pestle to release their juices. If you don't have a mortar and pestle place your leaf pieces into a bowl and crush them with the back of a spoon. If needed, add a small amount of alcohol to pulverize the leaves. Do not add water. The liquid produced should be dark green.



Attach the coffee filter strip to the pencil so that it will hang in the jar. The bottom of the strip should touch the bottom of the jar. Remove the strip from the jar.

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5 Add 2 tablespoons of alcohol into the jar.



6 Make a line of the green liquid horizontally across the coffee filter strip about 2 inches up from the bottom.

Hang the coffee filter strip so that the bottom of the strip touches the alcohol. Make sure the line of green liquid is above the alcohol. Cover the jar with a lid. Alcohol can be stinky.

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8 Remove goggles and wash hands.

Wait 1 hour to overnight. Waiting longer will provide better results.

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10 Put on goggles.



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Take the coffee filter strip out of the jar and check it. Different color bands (green, yellow, orange, red) should be evident along the strip.

Remove goggles and wash hands. What colors do you see?

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So What Happened?

Chromatography was the method used to separate the pigments. By passing the leaf liquid through a medium, the coffee filter strip, the different pigments moved through at different rates. This process separated the mixture by color and molecular size, due to different degrees of solubility. When the leaves were crushed, the plant cells were broken open to release their pigment molecules. As the alcohol moved up the strip, it took the molecules with it. The larger molecules were slower and trapped in the fibers of the strip, so they didn't travel as far. The smaller molecules moved more easily through the fibers, so they travelled faster and moved farther up the strip. The different colors or pigments were seen at different locations along the strip.

What Did We Learn?

When the chlorophyll (green pigment) was separated from the leaf, then the xanthophylls (yellow pigments) and carotenes (orange pigments) that were also present, were revealed. We did not see the red pigment in our results. There are many factors affected the results of this experiment, including the type of leaf used. Try repeating the experiment using different leaves and compare the results.

