National Aeronautics and
Space Administration

# Christa's Lost Lessons

## Leaf Chromatography

Grade: 5-8

For more of Christa's lessons and accompanying videos filmed in orbit, visit www.challenger.org/christa.

www.nasa.gov

# Leaf Chromatography

## Background Guide

Grade Level:
**5th-8th**

Suggested Time:
**55-60 minutes**

**Standards:**

- 3-PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
- RI.3.3: Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.
- W.3.9: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
- 4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

## Background

- **Chlorophyll:** A green pigment, present in all green plants, responsible for the absorption of light to provide energy for photosynthesis.
- **Photosynthesis:** The process by which green plants use sunlight to synthesize foods from carbon dioxide and water.
- **Chromatography:** The separation of a mixture into its individual components.
- **Capillary Action:** When a liquid, like water, moves upward to the cohesive and adhesive properties of the liquid.most successful rain-bow.

## Materials

- Green, deciduous tree leaves - avoid waxy or dry leaves; leaves that are fresh, large, moist, and soft will work best.
- Acetone or nail polish remover.
- Measuring utensils - a graduated cylinder is preferred.
- A small, clear jar.
- A utensil to grind the leaves into a pulp/ mush (a knife or other type of grinder).
- A paper towel or chromatography paper.

## Objective

- Following this activity, students will be able to:
  - show how chromatography is involved in the coloration of plant life.
  - apply concepts of chromatography and capillary action to new procedures and experiments in a classroom setting.

## Essential Questions

- How does chromatography apply to plant life?
- How does chromatography play a role in leaves changing color in the fall?

## Teacher Preparation

This lesson is designed to accompany the chromatography video. NASA astronaut Ricky Arnold explains this experiment in the video and there is video footage of this exercise being performed.

In each jar your class uses, you will need about 20 mL of acetone or nail polish remover and about three leaves worth of pulp. If you are using a larger jar, you may need to use more acetone or nail polish remover.

If possible, the teacher should grind the leaves ahead of time to eliminate the risk of injury. The leaves nead to be finely ground and it can be difficult to for students to handle knives in a fine and delicate manner.

At this point, the experiment is ready to be conducted by students in groups or as a class presentation by the teacher. See the "Explain" section below for instructions on how to conduct the experiment.

# PROCEDURE

### ENGAGE (5 min)

Materials needed: Pre-collected leaves

**Opening Introduction:**

- Show students the leaves that you have collected. **Discussion question:** Why do you think the leaves are green in color?
- Have students recall their knowledge of chromatography. Do you think that green is the only color present in leaves?
- When do you see leaves change color?
- Explain that by using acetone/nail polish remover, you are going to break down the chlorophyll in the leaves and make fall colors.

## EXPLORE (10 min)

Materials needed: Attached lab worksheets, pen or pencil

**Initial Predictions:**

- Allow students to make observations about and sketch the original leaves (color, texture, shape, etc.).
- Students should make predictions about what colors they will see after they add the acetone or nail polish remover to the pulp and use **chromatography** techniques to break down the **chlorophyll**.

## EXPLAIN (30 min)

Materials needed: Small, clear jars; acetone; graduated cylinder; leaves; paper towel or chromatography paper; spoon; knife; tape; pen or pencil

## CONDUCTING THE EXPERIMENT

1. If not already prepared, grind the leaves into a pulp using a knife or other utensil.

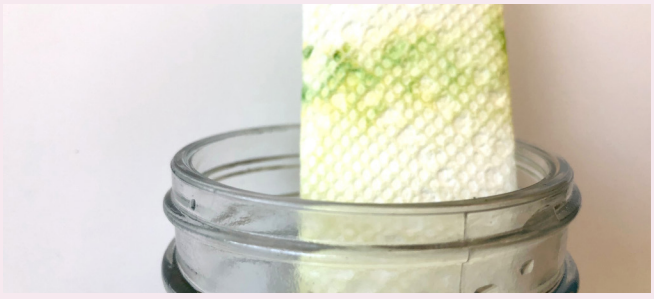

2. Scoop the leaves into a jar using a spoon or another utensil.

3. Using the graduated cylinder or another type of measuring utensil, add 20 mL (or more for a larger jar) of acetone or nail polish remover to the jar. Stir the leaves slightly.

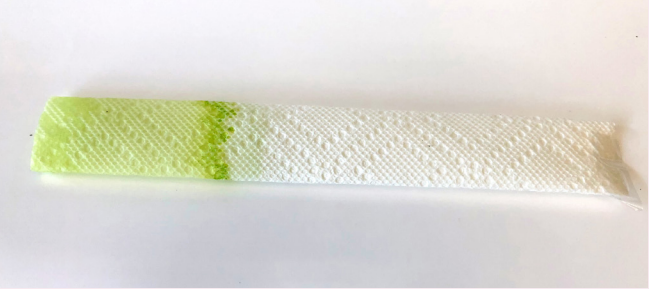
4. If using a paper towel, fold it into a long, thin strip. If using chromatography paper, no rolling needs to be done.

5. Put the tip of the paper towel or chromatography paper into the mixture. You can either hold it or push the jar against a wall and tape the paper towl or chromatography paper to the wall while keeping one end in the mixture.

6. Allow the paper towel/chromatography paper to soak. Record your observations. Let it soak until the yellowish color starts to appear on the paper. This takes about 15-20 minutes.



7. Remove the paper towel from the mixture. What do you notice? Where do you see evidence of chromatography? Record your observations.



## ELABORATE (5 min)

Materials needed: None

**Defining Terms and Explaining:**

- **Chlorophyll**: A green pigment, present in all green plants, responsible for the absorption of light to provide energy for photosynthesis.
- **Photosynthesis**: The process by which green plants use sunlight to synthesize foods from carbon dioxide and water.
- **Chromatography**: The separation of a mixture into its individual components.
- **Capillary Action**: When a liquid, like water, moves upward due to the cohesive and adhesive properties of the liquid. This is essential to plant life because this is how they uptake water from their roots and transfer it to the rest of the plant. This is also how the acetone mixture traveled up the paper towel.

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### EVALUATE (5 min)

Materials needed: Worksheets attached below.

**Record Observations:**

- Students should have recorded their observations throughout the experiment. Worksheets below are provided for this purpose.
- What did the acetone do to the leaves?
- What is chlorophyll?
- Why do leaves lose their color in the fall?
- Where did you see evidence of chromatography?
- Where did you see capillary action in the experiment?
- Why is caplilary action important to plant life?

## Extension and Enrichment

Students can test different types of leaves. Will evergreen needles work the same way? What about leaves from a flower?

You can also test this with leaves that have already turned color. Will you still see the effects of chromatography?

**Additional Resources:** Printable worksheets included.

# LEAF CHROMATOGRAPHY

## INTRODUCTION

Now that you have learned what chromatography is, you are going to explore its role in plant life. This experiment will show you how we can use chromatography to see fall colors. Why do you think leaves change colors in the fall? Let's find out!

## MATERIALS

- Small, clean jars.
- Acetone or nail polish remover
- Graduated Cylinder
- Leaves
- Paper towel or chromatography paper
- Spoon
- Knife
- Tape
- Pen or pencil

## DIRECTIONS

1. If not already prepared, grind the leaves into a pulp using a knife or other utensil.


2. Scoop the leaves into a jar using a spoon or another utensil.

3. Using the graduated cylinder or other type of measuring utensil, add 20mL (or more if using a larger jar) of acetone or nail polish remover to the jar. Stir leaves gently.

# LEAF CHROMATOGRAPHY

4. If using a paper towel, fold it into a long, thin strip. If using chromatography paper, no rolling needs to be done.

**Making predictions:**
What do you think will happen to the paper towel when you dip it in the mixture? Write down your predictions.

_____

_____

_____

5. Put the tip of the paper towl or chromatography paper into the mixture. You can either hold it or push the jar against a wall and tape the paper towel or chromatography paper to the wall while keeping the end in the mixture.

6. Allow the paper towel/chromatography paper to soak for about 15-20 minutes. Record your observations.

| Observation # | Description/Sketch |
|---|---|
| 1 | |
| 2 | |
| 3 | |

# LEAF CHROMATOGRAPHY

## CONCLUSION

Remove the paper towel from the mixture. Where do you see evidence of chromatography?

Explain why you were able to see fall colors on the paper towel when you mixed acetone and the leaves together.

Do you think this experiment would work the same with other types of plants like a rose? Would you get the same results? Why or why not?

If this experiment were conducted in space, how would it work differently? Would the set up look the same? Would the astronauts get the same results? Where would they get the leaves? Below, explain how you would set up this experiment in space.

Draw a diagram of what your experiment would look like in space

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