

DETECTIVE NOTES

Case File: 11



Chromatography

Key Questions:

- What is chromatography?
- How can chromatography help police solve crimes?

Desired Outcomes:

- Students understand how chromatography works and how it connects with analyzing handwriting samples.

Activities and Timelines (32 minutes)

Introduction 10 minutes

What is Chromatography?

Main Activities 20 minutes

Chromatography Experiment

Conclusion 2 minutes

Review

Resources

- Resource 11-1: Take-Home Chromatography & Craft

Extension Activity

- Take Home Activity

Introduction

10 minutes

- **Ask** students how they think forensic scientists determine if the ink used to write a letter or note at a crime scene is a match to the ink of a pen found in possession of a suspect?
- **Explain:** Paper chromatography is a technique used to separate and identify substances that are coloured, like ink from a marker or pen. The separation of the components can create a unique pattern, allowing for comparison between a known sample with unknown samples.
- **Explain:** Chromatography uses two phases to separate components: a stationary phase and a mobile phase. The mobile phase carries the components being separated through the stationary phase. We will talk more about these phases when we do an activity.
- **Discuss:** Imagine all the different cases where a note could be left at a crime scene and chromatography could be useful. Many writing instruments and the ink within them can be unique to an individual. Can you think of any kinds of crimes where a criminal might use a pen or leave a note? (Examples may include: a ransom note, forging a check, leaving a threatening note, etc).
- **Instruct:** Ask the students to look at their writing instruments and notice how each person in the class most likely has a different one. A different type of writing instrument, different brand, different ink or graphite types, etc.



- **Materials:**

- ▷ Tall, clear cups (one for each colour you test)
- ▷ White coffee filter
- ▷ Water-soluble markers
- ▷ Pencils (one for each marker)
- ▷ Tape

- **Teacher Prep:**

- ▷ Cut coffee filters into strips (1"x6")
- ▷ Collect water-soluble coloured markers from different brands, choosing the same colour (brown or black work best).
- ▷ Using one of those markers, write a simple sentence on a piece of paper.
- ▷ Draw pencil line on coffee strips
- ▷ Draw marker line on strips
- ▷ Fill cups with water
- ▷ Complete all of the steps for the marker that was actually used to write the note before completing this lesson



Teacher's note: In advance:

- ▷ Collect a set of water-soluble coloured markers from different brands **that are all the same colour** (black, brown, or red are suggested colours). On a blank piece of paper write a simple sentence using one of the markers. Label the markers by number, depending on how many you have.
 - ▷ Draw a pencil line across the width of each coffee filter strip, approximately one inch from the end of the strip.
 - ▷ Using a pencil, write the number of the marker you will use on the top end of the strip.
 - ▷ Put a pencil across the mouth of one cup and place a strip in the cup so the bottom of the strip is about 1/2" from the bottom of the cup
 - ▷ Tape the strip to the pencil. Repeat with the other pencils, strips, and cups.
 - ▷ **Ensure** that you follow all of the steps for the demonstration below with the marker that you used to write the note, so the students can use it to compare to the other samples!
 - ▷ Watch this video if you would like to see a short demo before doing it in class: <https://www.youtube.com/watch?v=kqIKHO29zOk>
- **Say:** Using paper chromatography, we are going to test some markers. I have a sentence here that was written using one of these markers and it will be up to you to help me discover which marker wrote the sentence!
 - **Show and Explain:** I have already prepared some coffee filters strips by taping them to pencils. We are going to test each marker (display them by number), to see if we can match one to this sample, which was created using the marker that wrote the note! (Show the completed colour-separated coffee filter).
 - **Demonstrate:**
 - ▷ Choose one of the markers and draw a thick line above the middle section of the pencil line. Repeat for remaining markers and strips.



Teacher's note: marker lines should not touch the sides of the coffee filter strips

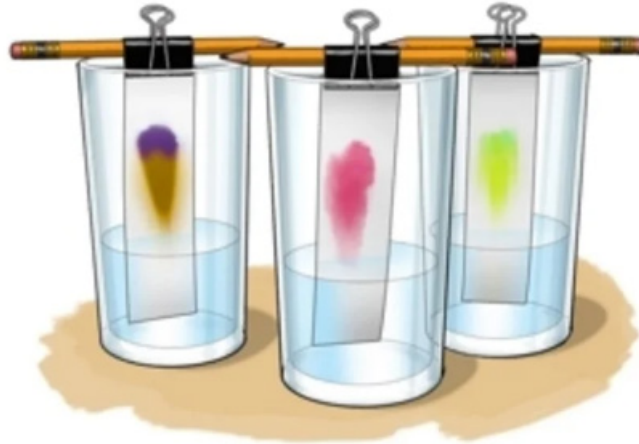
- ▷ Hold a strip on the outside of one of the glasses and slowly pour a small amount of water into the cup, until the level just reaches the bottom of the paper strip. Repeat with remaining glasses.



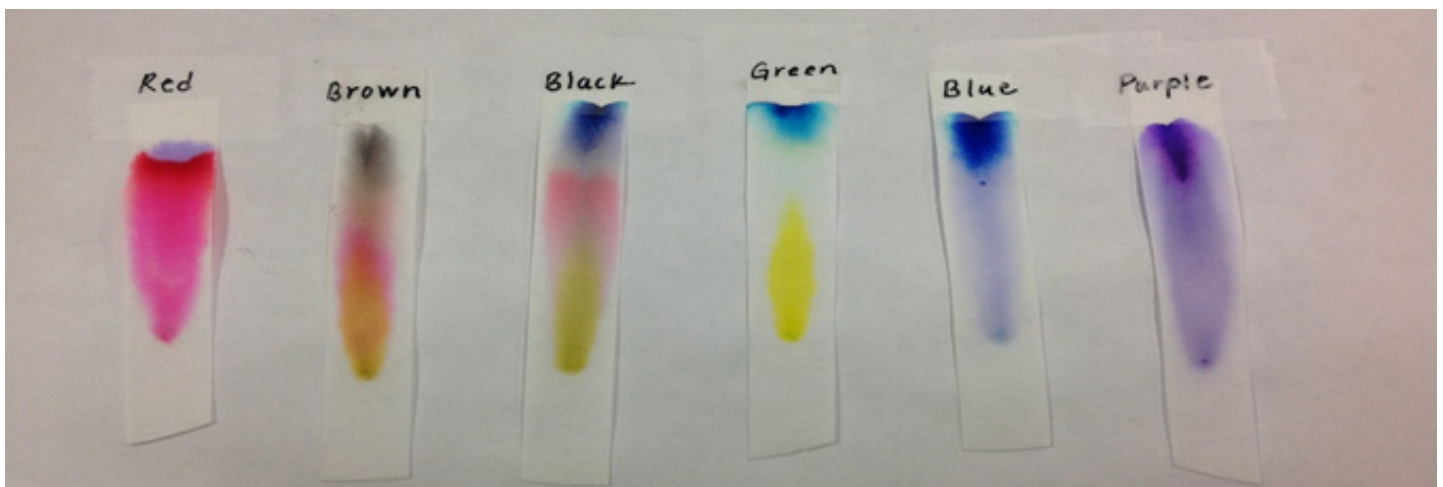
- **Ask and demonstrate:** How do you predict each marker will separate? Will some markers separate into more than one colour? Do you have a guess right now of which marker wrote the note? Why do you think so?
 - ▷ I'm going to place each strip into a cup, and we will watch what happens. This can take a few minutes!



Teacher's note: Important! Remove the pencils and strips from the water when the water level is two cm from the top of the strip.



- ▷ Once the strips are removed, hold them up and discuss the students' observations.
- While the ink elutes up the coffee filter, **Ask and discuss:**
- What phase do you think the water acts as?
 - ▷ **Answer:** The water acts as the mobile phase. Mobile = moving. As the water travels up the coffee filter, it carries or moves the marker ink with it.
- If the water is the mobile phase, what phase are the coffee filter strips?
 - ▷ **Answer:** The coffee filter strips are the stationary phase, meaning they do not move.
- Which sample matches the original sample? Can we now deduce which marker wrote the note?
- **Explain:** The different coloured components in the ink elute, or move up, the paper at different rates based on the strength of their molecular attraction to the paper versus the water, and the size of their molecules.



Conclusion

2 minutes

- **Discuss:** All the different possibilities of chromatography as it relates to police investigation, for example: notes left by suspects, graffiti and paint related property damage, forgery, fraud, etc.
- **Explain:** Even though chromatography is not a very common form of evidence and its usage is very much dependent on the crime committed, the implementation of chromatography in an investigation can still provide useful information and lead to a suspect's arrest.

Optional Extension Activity

30 minutes



Teacher's note: Please see Resources 11-1 for a take home experiment and craft that the students can do. This craft is like the "Main Activity" demonstration but allows students to take the colourful coffee filters and turn them into butterfly art. They can also simply do the chromatography experiment at home, without doing the art activity.

- **Open:** Resources 11-1 to explain the activity.



Teacher's note: You can also print off a copy of Resources 11-1 to take home to help guide them during the craft, or send it to students digitally.

Curriculum Links

Science: Evidence and Investigation

General Learner Expectations:

- 6-8: Apply observation and inference skills to recognize and interpret patterns and to distinguish a specific pattern from a group of similar patterns.
- 6-9: Apply knowledge of the properties and interactions of materials to the investigation and identification of a material sample.

Specific Learner Expectations:

- SLE 3: Recognize that evidence found at the scene of an activity may have unique characteristics that allow an investigator to make inferences about the participants and the nature of the activity and give examples of how specific evidence may be used.
- SLE 4: Investigate evidence and link it to a possible source: e.g by: Analysing the ink from different pens, using paper chromatography.

