

# Chromatographic Analysis

## Summary

This activity shows that paper chromatography can be used to detect forgeries. Students will design and conduct an experiment.

## Time Frame

2 class periods of 45 minutes each

## Group Size

Small Groups

## Life Skills

Thinking & Reasoning

## Materials

Prepared sheet with original and forged signatures (for demonstration); Filter paper for chromatography; Several black pens of different brands (Make sure the pens are easily distinguishable, one from another. Label one pen as TEACHER PEN); Sample note written with one of the black pens; Test tubes or beakers to hold chromatograms; ; M&M's

## Background for Teachers

Using black ink, sign the top of a page and then ask four or five other people to sign your name on the same page. It is important to have the signatures resemble each other as much as possible so that it is difficult to determine the differences. This will help students realize that methods other than a visual comparison are needed to determine which signature is authentic.

Proper instruction on the process of chromatography should be discussed as a preface to the lab.

## Intended Learning Outcomes

Make observations. Identify variables. Plan experiments. Collect and record data. Analyze data and draw warranted inferences. Understand science concepts and principles. Use language of science as a means of thinking and communicating. Report results honestly. Understand the goal of science is to produce knowledge. Recognize the vital role of creativity in science.

## Instructional Procedures

The principal received four notes that had apparently been signed by you, the teacher. One of the notes said some awful things about the principal. The principal is very interested in determining whether or not you wrote the note. Your, the teacher's, job may be on the line. It is very important that you convince the principal which note you wrote and which note you did not.

With the student's level of training, detection of a forgery by hand writing analysis is not really conclusive. Fortunately you (the teacher) use a distinct black pen to which no one else has access. Use chromatography to determine whether or not the note in question was written by you or by someone else. Ask the students to design a way to test whether or not the note is a forgery. The students may work alone or in small groups. Allow students to conduct their experiments. Require them to record their procedures and data. When they complete their experiments, they should analyze their data and draw conclusions. What did they learn? What, if anything, was proven? How could they improve their experiment? Ask each student (or group of students) to report their findings.

What did was their procedure? What were their conclusions?

As a class, discuss the experiments. What worked well? What improvements could be made? Was there one correct way to perform the experiment? How did each group use the methods of science to solve the problem? What role did creativity play in designing the experiments? What, if anything, was proven by the experiment? The following procedure outlines one way to perform the experiment. Do not mandate that your students do the lab this way unless you want to turn the activity from a 'design and conduct an experiment' activity to a cookbook type lab.

Make a chromatogram by cutting strips of chromatography (filter) paper approximately 17 cm long and 1.5 cm wide. Fold the end on the strips to be placed into the water so they are pointed. Place a black dot from each pen on each of the strips about two cm up from the pointed end of the strip. Use a different pen for each strip. Make sure you label each strip or chromatogram with a pencil so that you can tell them apart. Dip the end of the strip into a test tube of water making sure that the water level is below the dot. Do not let the dot go below the water level, or you will have to redo all the steps to this point. Allow the water to soak up the strip and watch what happens to the ink. This may take 20 - 30 minutes. Take the strips out of the test tubes and let them dry. Once dry, relabel your strips and tape them into your lab book. Cut out an individual letter from the mystery note provided and tape it to the filter paper with the ink facing the filter paper. Run the chromatography experiment and tape the chromatogram to your lab book. Compare these results with the results in step 5. Record which pen was used to write the note. Was it the teacher who wrote the note or was it a forgery? What specific evidence enabled you to come to this conclusion?

### Extensions

What are the colors in the candy coating of M&M candies? Challenge your students to design and conduct an experiment that demonstrates what colors are used in M&M candy coating.

This can be done by making four chromatogram strips and using four different coloured M&M's ®. Record, in pencil, the colour of each on a chromatogram strip. Wet the edge of the candy with a very small drop of water and rub its edge on a chromatography strip. Repeat the procedure outlined above, rotating the candy to make a distinct dot on the chromatogram. The dot should be at approximately the same spot as the pen dot was. Repeat the last procedure with the other three candies on the other three chromatogram strips. Run the chromatography experiment and observe the patterns produced on the strips. Attach the strips to the lab book. Below each strip identify the colours used to make the candy coating.

### Assessment Plan

Were the students able to use the methods of science to solve the problem? Was the experimental procedure well designed and logical? Did they test only one variable? Where their conclusions warranted? Were the students able to determine which pen wrote the note?

The student should have made a proper chromatogram and be able to answer to the following questions:

Explain how to construct a chromatogram.

Explain why chromatography can be used to separate and identify different substances that appear to look the same.

Describe how chromatography could be used to solve a crime.

What are some possible sources of error in this lab?

### Authors

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