# Using Paper Chromatography to Identify Dyes in Candy (Skittles, M&Ms)

**Objective:** The components of a dye will be identified using paper chromatography and comparison to known food dyes.

**Materials:**
A set of food coloring reference dyes
Candy: Skittles or M&Ms or similar
Cellulose Chromatography Paper
0.10% wt/v solution of NaCl in $H_2O$
50/50 water/ethanol solution
capillary tubes open at both ends

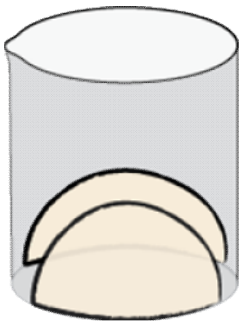
**Theory:**

**Chromatography** is a method of separation based on differences in chemical and physical properties of substances. There are many types of chromatography but they all have three components: something which needs to be separated (analyzed), a **stationary phase** and a **mobile phase**. The substance that needs to be separated has components that will interact differently with the stationary and mobile phase and therefore will travel at different rates carried by the mobile phase. There also has to be some method for detecting the components in the mixture e.g. visual detection of color or a developing solution for colorless substances.

In paper chromatography the paper (cellulose) is the stationary phase and a dilute saline solution (0.10% wt/v aqueous solution of NaCl) is the mobile phase. The dyes on the pieces of candy are dissolved in the 50/50 water/ethanol to form a solution that may be analyzed.

**Procedure:**

1. Prepare a **developing chamber**. We will use a 400 mL beaker covered with a large watch glass and about 20mL of our saline solution. For the mobile phase to be able to move up the stationary phase (the paper) the atmosphere of the developing chamber needs to be saturated with our solution. It is important to keep the cover on the chamber. Also soaking a couple of half circles of filter paper in the saline solution and placing them on the sides of the chamber aids in keeping the chamber atmosphere saturated.

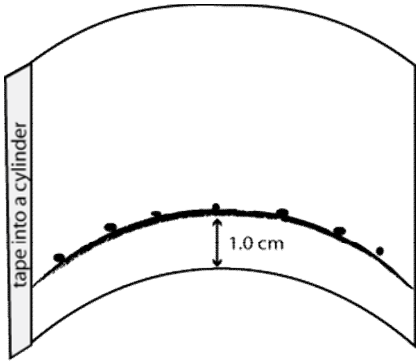


2. Prepare micropipettes to use to apply our dyes to our chromatography paper. Micropipettes may be made from capillary tubes. Hold the tube over a Bunsen burner flame for a few moments and then draw it out in the middle. Two micropipettes can then be formed from this stretched out tube.

3. Prepare solutions for analysis. We have our known dyes and our unknown dye mixtures to prepare. Place several candies of the same color in a small beaker and add 3 mL of the 50/50 water/ethanol mixture to dissolve the dye. Do this for four different colors. For the known substances follow the instructions given to you as these depend on the kind of standards that are available.

4. Prepare the chromatogram. Draw a line with **pencil** about 1.5 cm from the edge of your paper. Think of this at the starting line in a race up the paper. The reason why it is so important to use pencil is that pens have ink with dyes that will travel up the paper and confuse the analysis. Mark places along the line about every 2 cm to indicate where you will apply the different solutions. Record the order you use when applying solutions to the paper. Use a different micropipette for every solution that you use. Dip the micropipette into the solution and spot it onto the paper - not just once but very rapidly many times. **This keeps the spot small and concentrated.**

5. Tape the chromatogram into a cylinder so it will stand up and place it in the chamber being careful not to touch the sides of the chamber. It is very important that the level of the developing solution is **below** the starting line so the applied solutions are not immediately washed into the mobile phase reservoir. Allow your chromatogram to develop.

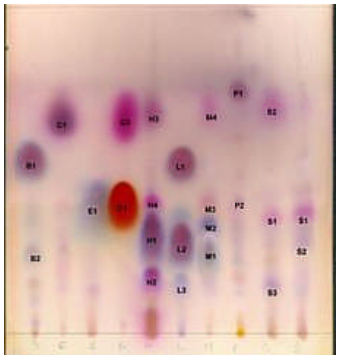



6. When the mobile phase has risen to within 1 cm of the top of the paper remove the chromatogram and immediately mark the **solvent front** with a pencil. You may not be able to see it once the paper dries.

7. Draw ellipses around each spot of color. Allow your chromatogram to dry for about five minutes. Observe your chromatogram with a UV lamp for additional information about the dyes.

**CAUTION: Never look into a UV lamp. It can damage your eyes.**

8. Create data charts and determine the $R_f^*$ for each spot on your chromatogram. Draw conclusions about the dyes in the candy samples by making comparisons to reference dyes.



* The **retardation factor ($R_f$)** is the distance the spot moves divided by the distance the solvent front moves. This is why it is very important to draw a line at the solvent front when you remove your chromatogram from the developing chamber.

This image from Wikipedia shows a typical paper chromatogram. Notice that the spots vary in size and shape. To determine how far a spot has traveled measure from the center of the spot to the starting line.