

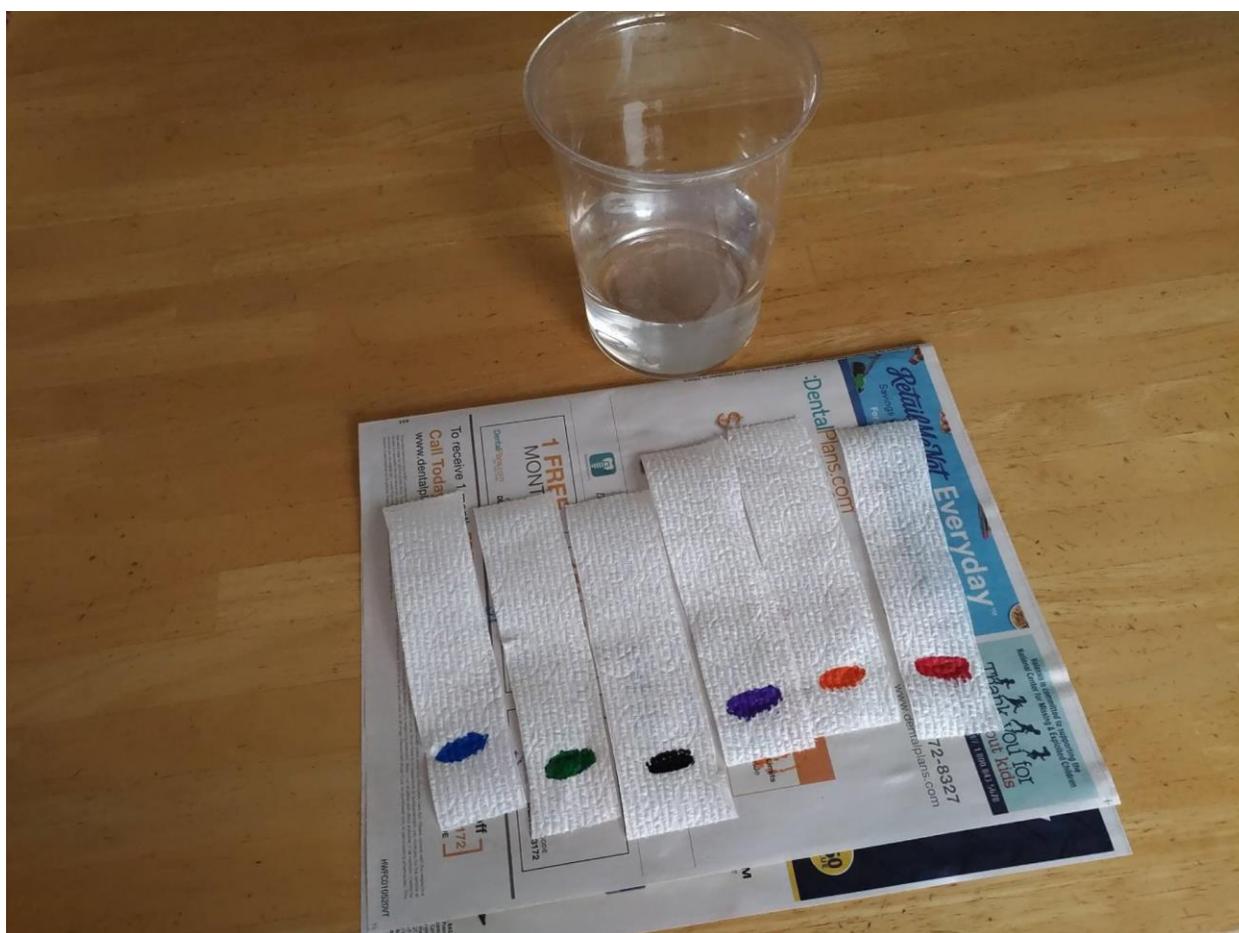
## Chromatography--Unmixing mixtures

By Linda Butler

Lots of things are made up of mixtures. Take some simple things like flour, sugar, butter, an egg, and chocolate chips, mix them together and bake them and you have—cookies! There are lots of mixtures in our world. Garden soil is a mixture of dirt—inorganic things like ground up rocks and minerals, and organic things like leaves and roots. The markers you draw with have ink that's made up of mixtures of colors, or pigments. Pigments can be found naturally in plants or minerals, or they can be made chemically.

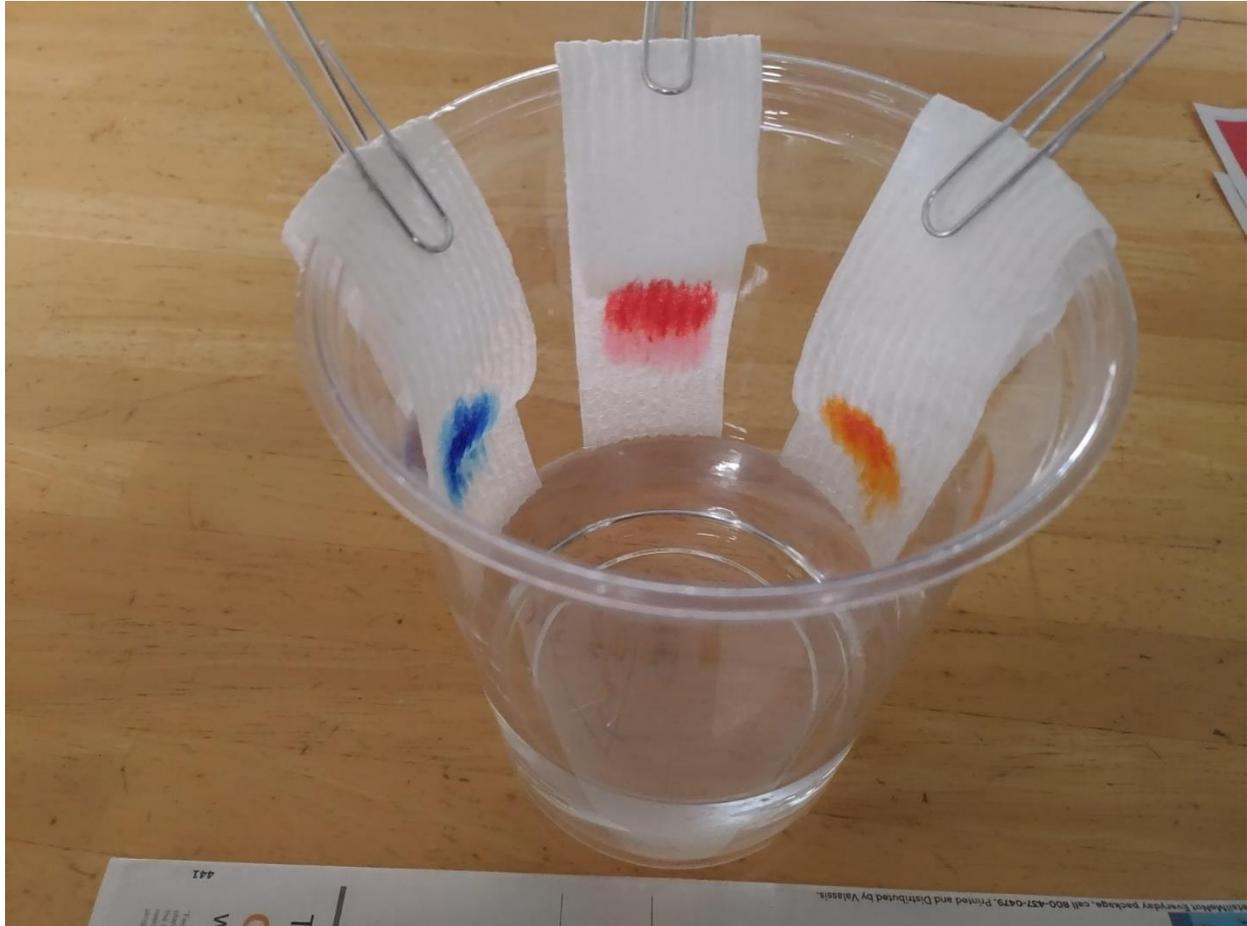
The process of unmixing or separating colors is called chromatography.

To separate the colors of washable markers you'll need markers, paper towel, a container (large yogurt container works great filled about 2" high with water) paper clips, scissors.



Cut the paper towel into strips about  $\frac{3}{4}$ " wide and at least 5" long. Make sure you have some newspaper or another paper under the paper towel strip for the next part—it may bleed through. About a half inch from the bottom draw a thick line of color. Put the bottom edge of your paper towel strip into the water so it's barely touching, and clip it onto the side. You do NOT want the ink to touch the water. Carefully insert and clip 3-4 more pieces of marked paper, being careful they do not touch each other or the ink touch the water.

The water will rise, or “suck up” the paper and bring trails of color with it. This rising motion is called capillary action. Capillary action is the movement of liquid upward or against gravity. Basically, the water molecules are sticky and are able to stick to the paper.



Soon after putting the paper into water the ink marks will dissolve and color streaks will appear. Think of the color streaks as a race. Many inks are made of a mixture of pigments or colors. Some of the pigments move quickly and they will rise the highest. Some move slowly and don't rise as much. After 4-5 minutes your color races will be complete. Unclip them and lay them on a piece of paper to dry.

What do you see? Are some colors relatively pure? Are some colors mixtures of many other colors? Which ink had the most colors? Which colors moved the fastest? Which moved the slowest?



If you wish, carefully try this experiment again with permanent markers. Do these colors act differently? Does the water dissolve the ink? This is one reason that permanent markers do NOT wash out of clothes. Try again with permanent ink markers and dipping them into isopropyl alcohol. Isopropyl alcohol is also a clear liquid; it is a solvent that will dissolve the permanent marker ink, but it moves more slowly along the paper. It may take 10-20 minutes for these inks to separate. How well does the alcohol dissolve those colors?

You can learn more about the science of Chromatography at <https://www.explainthatstuff.com/chromatography.html>

You can learn more about mixing up cookies by talking with your mom or trying a recipe like this one: <https://joyfoodsunshine.com/the-most-amazing-chocolate-chip-cookies/>

If you'd like to do more drawing with your markers, here are some great drawing books: "Draw Real Animals!" (and others) by Lee Hammond, "How to Draw Fairies" and "How to Draw Pirates" (and more) by Mark Bergin, "Drawing with Children" by Mona Brookes.