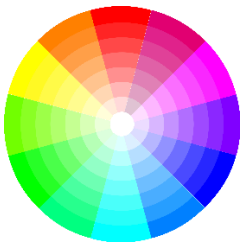
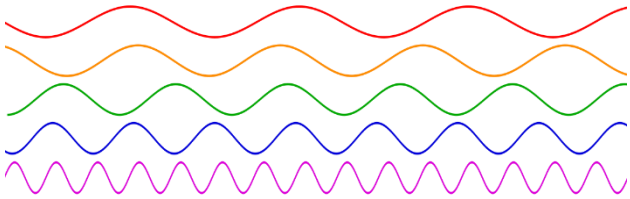
MOVING COLORS – CHROMATOGRAPHY

Do you have a favorite color? Blue is nice. Yellow is pretty, too. Maybe you enjoy drawing or coloring with crayons, also called colors. But what is **color**, really?

To see **color,** you need light. Light comes to Earth from the sun in waves, a cycling motion like waves in the ocean. We see those waves as the colors of the rainbow. Each color has a different wavelength. Violet (dark purple) has the shortest wavelength, and red has the longest. When all of those waves are seen together, we see that as white light.





One way of examining different colors is to separate out the individual colors from a mixture, like the white light created when all wavelengths are seen together. A scientific process called **chromatography** can do just that.

Chromatography is a tool used by **chemists** (scientists who study **chemistry**, a branch of science that studies matter and how it changes) and **biochemists** (scientists who study the chemistry of living things) for separating different parts from a mixture and onto absorbent material.

Chromatography means "color writing" (from the Greek words *chroma* and *graphe*), and it's useful for everything from identifying biological materials to finding clues at crime scenes. The process depends on the speed, or **rate,** at which different substances move through a **media,** or a specific chemical substance.

There are many different kinds of chromatography, but we will explore only one kind, **paper chromatography.** This is used for separating and identifying mixtures that have color.

Have you ever noticed what happens when a paper that is printed with ink gets wet? Sometimes you will see odd lines of different colors move across the paper. This is an example of

chromatography. The ink is dissolved in the water, or some other liquid, and moves across the surface of a solid, the paper. Colors separate out during that process.

Explained scientifically, there is a mixture in one **state of matter**, like a gas or liquid, moving over something else in another **state of matter**, a **liquid or a solid**. The moving substance (ink in this case), is the **mobile phase**. The paper, in this example, does not move. It is called the **stationary phase.** The movement of the **mobile phase** separates the substance into its parts on the **stationary phase**.

This can be complicated to think and talk about, but it is easy to see it in action and fun to watch!

ACTIVITY: Paper Chromatography

- White coffee filters
- Paper plates
- Pencil
- Non-permanent marking pens
- Cups of water, one for each color of marker you will test
- Pipe cleaners (optional)
- Scissors (needed only if you choose to cut newspaper or cardboard)
- Newspaper, a piece of cardboard, or paper plate that you don't need
- Clothespin or clip, to help hold the filter to the top rim of the glass so it doesn't drop into the water

1. Choose a marker. Hint: brown or black is a good choice for the first one.
2. Put a coffee filter on a waterproof surface that is lined with paper, a paper plate or cardboard.
3. Draw a thick circle near the center of the coffee filter leaving enough room in the middle to write the name of the color that you used with a pencil. A good place to make your circle is on the center smooth surface right before the pleats begin.

4. Fold the filter in half, and then in half again. When you open it, this will form a cone.

5. Put a little water in the bottom of a glass.
6. Separate the cone so it balances on the glass with the tip of the cone just touching the water. DO NOT LET THE CIRCLE THAT YOU DREW WITH THE MARKER TOUCH THE WATER, JUST THE TIP THAT IS NOT COLORED. A clothespin or clip can help hold it in place.

7. Let it sit in the water and watch what happens.

8. When the water reaches the outside edge of the filter, place it on a piece of newspaper or cardboard to dry.

9. Once dry, observe the results.

What did you see?

Did the colors run?

Did they separate into different colors? What colors? How many?

Which colors are at the top (they ran quickly)? Which are at the bottom (they ran slowly)?

Which colors are a mixture of other colors?

Which colors are just a different **hue** of one color?

A variety of colored **molecules** make up ink or paint. Some colors, such as orange and green, are made by blending other colors (primary colors) together. Our eyes may see a single color, but it may be a mixture of different colored molecules that make that color. In this experiment, you were able to see the different colors making up some of your markers. You may have seen many artistic colors using markers and coffee filters. In scientific chromatography, the bands of color would likely be narrower and more exact.

OPTIONAL: butterfly craft using the colorful filters

Take a dry filter and squish it up, right in the middle.

Wrap a piece of pipe cleaner around the middle and shape the ends to look like antennae.

Use some string to hang your "butterfly" and admire!

ADDITIONAL RESOURCES

Websites

https://library.si.edu/exhibition/color-in-a-new-light/science

https://kids.alma.cl/the-electromagnetic-spectrum/

https://www.sciencelearn.org.nz/resources/47-colours-of-light

Videos

Chromatography: https://www.youtube.com/watch?v=PvHvx7k7UPU

Science Behind Chromatography: https://www.youtube.com/watch?v=RS9nPo-cfWo

Khan Academy, Color Science
https://www.khanacademy.org/computing/pixar/color/color-101/v/color-science-1

Books available from the Washoe County Library System

Experiments with colors by Salvatore Tocci

Color chaos! by Lynn Rowe Reed

Dazzling science projects with light and color by Robert Gardner