

Fabric Chromatography

Have you ever washed a red and white shirt and had the red dye run onto the white? Sometimes this bleeding of colors can have a positive outcome. Try this exploration to create some intentional bleeding and even some chromatography.

Materials

- squares of old white sheets, white T-shirt material, or muslin large enough to fit over the mouth of the container
- several different colored permanent markers (such as El Marko, PaperMate M15) including at least one of green, purple, or black
- wide-mouthed container such as a margarine tub or coffee can
- large rubber band that will stretch around the circumference of the container
- rubbing alcohol (70% isopropyl alcohol)
- dropper
- (optional) all-white or white-background T-shirt, previously washed

Exploration

Step 1 Stretch a piece of cloth over the open end of the container and loop a rubber band around the sides to secure the material. Near the center of the cloth, create a circle (about the circumference of a quarter) of different colored dots. (See Figure 1.) Record the color and position of each dot.

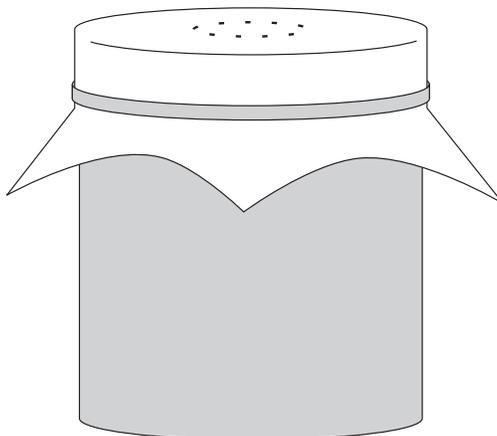


Figure 1: After stretching the fabric over the can and securing it with a rubber band, mark a circle of different colored dots on top.

Step 2 While the dots are still wet, drip several drops of water in the center of the circle of dots so that the water travels out radially to the dots. What happens? Repeat with a second piece of cloth, this time with the dots dry, and record what happens. Explain any differences.

Step 3 Allow the cloth to dry almost completely, or set up a third piece of cloth as you did in Step 1. Drip rubbing alcohol in the center of the circle of dots so that the liquid travels out radially to the dots. Let the fabric dry out between additions of the rubbing alcohol. How does this affect the pattern and/or separation? Explain any differences between the observations with water and with rubbing alcohol.

Step 4 (Optional)

- (a) On another piece of cloth, dot several colors over one spot and drip rubbing alcohol onto the spot. What did you observe?
- (b) You can also apply this technique to line drawings. Try it and see the results.
- (c) Select your favorite color and pattern and use this technique to decorate a T-shirt.

Care of your T-shirt:

To preserve the colors on your T-shirt, first soak it in cold salt water to set the dyes. Subsequently, hand launder the T-shirt in mild detergent in cold water. (You may wash it with regular laundry in the machine without harming other washables, but its colors will fade much more rapidly.)

Challenge

What is the difference between bleeding and chromatography, and what factor is most likely to determine which one occurs?

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Concepts

mixtures and their separation, solubility, chromatography

Expected Student Responses to Exploration

Step 1 Indicated color pattern of dots.

Step 2 (a) When the dots are wet, bleeding occurs.

(b) When the dots are fully dry, nothing happens to the dots.

(c) The inks themselves are not soluble in water. When the ink is wet, the solvent that is still present is somewhat soluble and acts as a co-solvent in dissolving the ink.

Step 3 (a) Depending on the choice of pens and colors, some of the dots will only bleed, while others will separate into different colors. Typically, green will separate into yellow and blue, black into several different colors (depending on the manufacturer), and purple into pink, yellow, and blue.

(b) The inks from the permanent markers do not dissolve in water (a polar solvent) but do dissolve in rubbing alcohol (a less polar solvent). The movement of the colored dots on the cloth depends on the relative attraction of the ink for the solvent (the mobile phase) and the cloth (the stationary phase).

Expected Student Answer to Challenge

Both involve movement of color on a material such as fabric. In bleeding the different components of the pigment are not separated as they are in chromatography.

Acknowledgment

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