

Some materials appear homogenous, but are actually a combination of substances. For example, green plants contain a mixture of different pigments. In addition, the black ink in the pens that are used in this experiment is a mixture of different colored materials. In many instances, we can separate these materials by dissolving them in an appropriate liquid and allowing them to move through an absorbent matrix, like paper.

Paper chromatography is used in this experiment to separate the components of black ink. As the solvent is pulled by capillary action up the absorbent paper, it passes through the words written in ink on the paper. The ink is dissolved in a dilute acid-alcohol solution, the solvent, that consists of vinegar (acid), rubbing alcohol, and water, and the ink is separated into the different pigments that are present in the ink.

The concept of polar and non-polar materials and how these groups migrate in a chromatography set-up depends on the polar nature of the solute (ink) and solvent (chromatography solution). In general, more polar materials will hydrogen-bond better to the water causing these materials to move slowly away from water-based solvents and therefore migrate more slowly up the paper. This discussion, however, is probably too advanced in most elementary school classes. It is probably best to explain that the components of the ink that are more soluble in the chromatography solvent will move faster along the paper and thus will appear closer to the top of the paper. Components that are less soluble in the solvent will move slower and appear closer to the bottom of the paper. Changing the composition of the solvent (for example, adding more vinegar or using less alcohol) will change the solubility of the ink components and thus change where these components migrate on the paper.

## **Chromatography to Carnation**

**Lesson Plan:** Science/Art Cross Curriculum      **Grade Level:**

**Created By:** Suzanne Turner      **Time Requirement:** 2 days (science portion)

**Subjects:** Art and Science

**Objectives: Science** - The students will be able to demonstrate through discussion and in writing their understanding of what occurs when water passes through lines drawn with water soluble, colored pens on absorbent paper.

**Art** - Students will create carnations out of the papers used in their chromatography experiment.

### **Definitions/Terms: chro·ma·tog·ra·phy**

Pronunciation: "krO-m&-'tä-gr&-fE

Function: *noun*

Date: 1937

Any of various techniques for the separation of complex mixtures that rely on the differential affinities of substances for a gas or liquid mobile medium and for a stationary adsorbing medium through which they pass, such as paper, gelatin, or magnesia. A process used for separating mixtures by virtue of differences in absorbency.

### **Absorb**

Pronunciation: ab-'sorb, -'zorb

Function: transitive verb

Etymology: Middle French absorber, from Latin absorbere, from ab- + sorbere - to suck up; akin to Lithuanian surbti to sip, Greek rophein to gulp down

Date: 15th century 1 : to take in and make part of an existent whole (toilet paper) 2 a : to suck up or take up (a sponge absorbs water)(plant roots absorb water) b : to take in

### **Separate**

Pronunciation: 'se-p(&-)"r At

Function: verb Inflected Form(s): -rat·ed; -rat·ing

Etymology: Middle English, from Latin separatus, past participle of separare, from se- apart + parare to prepare, procure -- more at SECEDE, PARE Date: 15th century

Transitive senses 1 a : to set or keep apart : DISCONNECT, SEVER b : to make a distinction between : DISCRIMINATE, DISTINGUISH SEGREGATE 2 a : to isolate from a mixture : EXTRACT b : to divide into constituent parts 3 a: to dislocate (as a shoulder) especially in sports intransitive senses b : to become divided or detached : WITHDRAW 4 a : to become isolated from a mixture synonyms SEPARATE, PART, DIVIDE, SEVER, SUNDER, mean to become or cause to become disunited or disjointed. SEPARATE may imply any of several causes such as dispersion. PART implies the separating of things in close union or association. DIVIDE implies separating into pieces or sections by cutting or breaking .

**Materials:**

- \* Toilet paper (two-ply) White. (**NOTE: for Year Round Schools and summer school save the toilet paper rolls and make Firecrackers**)
- \* Water soluble colored pens (e.g. Crayola. For a class of 33 students figure 17 sets of pens with red, green, black, orange, and blue).
- \* Soft plastic scientific eye droppers (Delta Educational Supplies - "<http://delta-ed.com/catsc.htm>)
- \* Plastic cups to hold water (figure 1 for every 2 students)
- \* Paper towels in case of spills.

### Preparation:

- \* As you unroll the toilet paper tear off the square sheets placing them into stacks of 24 squares (12 squares per student). Put stacks into plastic sandwich bags to store. Put out onto tables.
- \* Place plastic cups with water onto table with two eye droppers per cup.
- \* Put out sets of water soluble colored pens (e.g. Crayola).
- \* Prepare an area where the students can turn over their sheets to dry after they have finished with each sheet of paper. (Butcher paper works well as the newsprint does not bleed onto their experiments)

### Procedure:

- \* Have students draw lines in a circular pattern around a center point using the colored pens on all of **their** sheets of toilet paper. Make sure to tell them not to press too hard or they will tear the sheets.
- \* Once they have completed this work they can now begin to place their sheets one at a time over a jar lid or petre dish.
- \* Place two drops of water into the center of the sheet using the eye droppers. As the water is drawn into (absorbs or soaks into) the sheets of paper it will be drawn through the lines made with the colored pen. The lines will start separating as the water is drawn through. The different colors which make up the original color drawn will start to appear at this time. If more water is needed allow them to place one more drop at a time in the center of their dish.
- \* Before the student carries the jar lid or petre dish over with the tissue still on top, have them write in their log what colors appeared as the original one separated..
- \* Have the students carry the jar lid or petre dish over to their assigned area and carefully turn it over, allowing the tissue sheet to lie on the paper to dry. It is very fragile at this point and will tear easily.
- \* Once the toilet paper has dried you can make **Carnations** as an art project.