Super Science Connections: Is Black Really Black?

How many ways can we make the color black?

This activity is intended for children entering grades K-4 in the next school year. To carry it out safely there must be a responsible older person to prepare materials, read directions aloud, and supervise the activity. This could be a parent, guardian, or older sibling. The supervisor should do the preparation steps and consult the science background information on the last page before leading children through the activity.

Materials

- One set of food coloring (red, yellow, green, and blue) *
- One clear container, such as a plastic cup (plastic is preferred because glass can shatter)
- Water
- Crayons or pencils to record data on a copy of page 3.

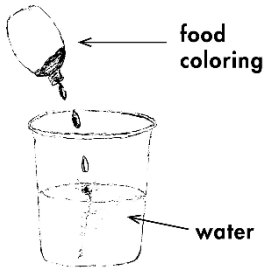
* *Food coloring can stain clothing and some surfaces! Depending on the age of the participants, supervisors may want to handle the food coloring themselves.*

Preparation

- Before beginning, make several copies of the worksheet on page 3.
- Use a crayon or marker to color each of the color words at the bottom of the worksheet with the appropriate color. (This will allow non-readers to record their data.)
- Tell participants the goal is to make water black by adding drops of different food colors.

This activity is courtesy of ICE, the Institute for Chemical Education at UW-Madison's Chemistry Department. It is adapted for use at home from Is Black Really Black? in the Super Science Connections Section 1: Color and Light activities offered by ICE at this link: http://ice.chem.wisc.edu/SSC/.

Directions



1. Add water until the container is one-third full.
2. Discuss with participants which colors and how many drops of each color they plan to add to the container.
3. Add food coloring drop by drop and remember to count the number of drops used from each color!
4. Use a crayon or pencil to record data on the chart on page 3. Starting at the bottom, color in one box for each drop of each color. What combination of colors makes the color black?
5. Empty the cup, add fresh water, and try again to make the water black. Is it possible to make black using a different combination of colors? Be sure to count and record the number of drops used from each color!
6. Repeat the experiment several times. Try to figure out the smallest number of drops of food coloring that will make black. Try making the same final color by adding individual colors different ways. For example, add one drop of each color before adding two drops of any color; or, add all drops of a single color followed by all drops of each other color. Record and compare observations.

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How we made the color black

Number of drops	Green	Blue	Red	Yellow
8				
7				
6				
5				
4				
3				
2				
1				

Names of the Scientists _____

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Science Background

White light, such as sunlight, consists of all colors of the rainbow: **r**ed, **o**range, **y**ellow, **g**reen, **b**lue, **i**ndigo, and **v**iolet (r o y g b i v or Roy G Biv). When light passes through water, the water does not absorb any of these colors because water is transparent. This activity involves adding food colors that absorb some of the light that would otherwise pass through the water. For example, yellow food color absorbs all colors of white light except yellow, so the yellow light passes through and we see yellow. The yellow dye absorbs no yellow, a little orange and a little green (neighboring colors in Roy G Biv), and every bit of each other color (blue, indigo, violet).

Red, yellow, and blue are primary colors. Primary means that you can mix these colors to get any color you want; for example, mixing the red and yellow food colorings gives orange. This is because all colors except red, yellow, and orange (the color between red and yellow in Roy G Biv) are completely absorbed by one or both food dyes. Orange passes through the mixture most strongly. Adding enough different colors absorbs all light and produces the color black, but in this activity, children will learn that black can be made by several different combinations.

Reflecting light from an object is similar. When light hits an object, the light can be absorbed (taken in) or reflected (bounced back). If the object reflects all the light, the object looks white, like printer paper. The paper reflects all the light back to our eyes and does not take in (absorb) any of the light. If something on the white paper absorbs all the light, it looks black, like the color of the print you are reading in this activity. To make black print, an inkjet printer sprays all colors onto the white paper. Printing a lot of black pages will use lots of ink!

Humans can see all colors of the rainbow. So can some other primates, and some birds, fish, reptiles, and insects. But many animals, including dogs, cats, and mice, lack the ability to differentiate colors as well as humans can. A dog looking at a rainbow sees something that looks mostly gray, with a little blue and yellow.

Mathematics Connection

The data collected in this activity are recorded in the form of a *bar graph*; that is, the more drops are added for a given color, the higher the bar for that color. The graph has the number of drops of each color for its vertical axis and the colors for its horizontal axis.

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