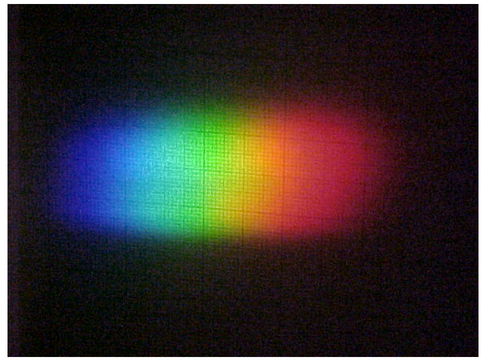
"Looking At Rainbows Through Rose Colored Filters"

This activity shows you what happens when you look at the world through colored filters?



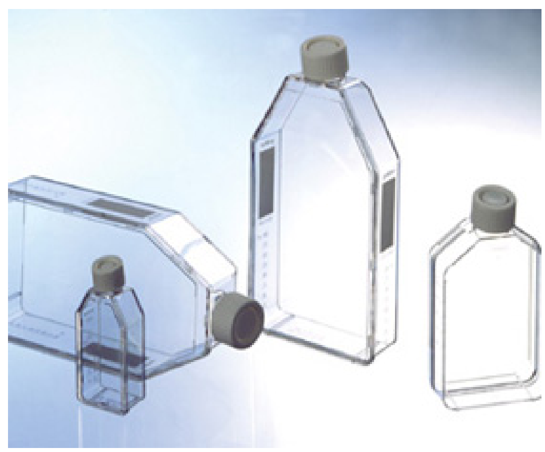
Materials Needed

- biology culture flasks (also called tissue flasks)
- food coloring (red, green, yellow, blue)
- room temperature water
- holographic diffraction grating (6"x 6")
- overhead projector

What To Do

- Fill each of the culture flasks with room temperature water.

- Decide which food coloring pigment you want to use to color the water in each flask. Your choices are yellow or red or blue or green. Place 2-3 tiny drops of food coloring into the clear water. Be careful not to make the water so dark that you can no longer see through it. If that happens, pour out about half the colored water and refill the flask with clear water. This should dilute the food coloring enough to make the colored fluid in the flask transparent. If it is still too dark, then continue to pour out the colored water and add more fresh water.



- If you are working with a group of other people, make sure you have access to a flask colored green, red, blue, and yellow.

- Use the overhead projector and holographic diffraction grating to project a rainbow on the screen (see *Making Rainbows* activity).

- Hold each culture flask up to your eye and look at the rainbow. What happens to the colors of the projected rainbow when you look through the red flask? In particular, make a note of those colors in the rainbow that are visible and those that dim or not visible at all. Repeat for the blue flask, green flask, and yellow flask.

- Repeat the experiment with a new set of culture flasks holding clear water, but this time mix several colors of food coloring together to make new colors. For example, try making water that is colored lavender, pink, orange, peach, or sea foam. What happens to the colors of the rainbow when you look through these flasks? Make a note of those colors in the rainbow that are visible and those that dim or not visible at all.

What's Going On?

White light is actually made up of a rainbow of colors. The white light that exits the projector is broken into a spectrum of colors and spread apart by the diffraction grating. The colors of the rainbow represent different wavelengths of light - from short wavelength blue on one end to long wavelength red on the other. These rainbow colors reflect off the white screen, pass through the colored water in the flask, and enter your eyes. When the wavelengths of light pass through the pigments in the culture flask, molecules that make up the pigment “remove” some colors from the rainbow and allow other colors to pass through. So what you end up seeing is a rainbow with big sections of color missing or dim. The missing colors are the wavelengths that are absorbed by the molecules in the water. The colors you see are wavelengths ignored by the molecules, pass though unabsorbed, and enter your eyes. For red pigment, red wavelengths of light pass right through the water and enter your eyes. For green pigment, green wavelengths pass right through. But what about more complex colors formed when you mixed different drops from different vials of food coloring? Say lavender? Colors missing from the rainbow are the colors that are absorbed by the water. Colors that you still can see are the wavelengths that need to mixed together to make lavender.

So What?
This experiment explains what makes grass green, rose petals pink, and the ink on this page black. When white light strikes an object, molecules of pigment interact with the wavelengths of white light, absorb certain specific wavelengths, and ignore others. The wavelengths that are ignored are the ones that are reflected back to your eyes, get processed by your retina, and interpreted by your brain as a color. If the object absorbs all the colors that strike it, you see black.