# Color

It is common knowledge today that white light is a mixture of the colors of the rainbow. In this section we will explore various features of color and color mixing.

1. First examine the spectrum of white light using a prism. Because different colors bend different amounts in glass, a prism will separate the colors of which white light is composed. Look at the white light source through the prism and see if you can identify the various colors of the rainbow. Describe below what you see.

2. A diffraction grating will also separate colors, using a different property of light (namely, interference). Take one of the gratings and look through it at the white light. You should see the same spectrum…in fact, you should see several repetitions of it, called the first and second "order" spectra. Describe below your observations.

   Now look at some of the other light sources in the room and describe your observations. There should be some LED's and of course the fluorescent lights. Describe your observations. In what way are the light sources in this group different from the white light?

3. We see ordinary objects because light reflects off of them. If all colors of light reflect off an object, then it will look white….assuming we look at it in white light! If we shine red light on white paper, then of course it will appear red. A green object appears green in sunlight because primarily green reflects from the object, not other colors. The other colors are absorbed by the object. So if we shine red light on a green object, it should appear dark, even black. Notice how colors look different in sunshine than in indoor lighting, and fluorescent

lighting makes objects look different than incandescent lighting does. Is color an intrinsic property of an object, or does it depend on the color of light under which it is observed?

4. If white light can be separated into the various colors, then recombining the colors ought to reproduce white light. We find that the full spectrum can be approximated by the three main color bands red, green, and blue. These are the ‘additive” primaries. If they are added together, they produce white light. If just two of them are combined, we get new colors, cyan, magenta, and yellow. Use the small light box as a source of red, green, and blue light. Use a lens to bring the colors together and observe the effect of adding just two colors at a time. You can also do this with colored cellophane (red, green, blue) placed over lamps.

   Can you produce cyan, magenta, and yellow? How?

   With all three lights on, you should get white light where they overlap. Do you?

5. The three colors cyan, magenta, and yellow are called the subtractive primaries. These are the primary colors used in mixing pigments. Pigments gain their color be selective reflection: cyan absorbs red and reflects blue and green, which combined yield cyan. We say that a cyan pigment has subtracted out the red.

   What color does magenta subtract out?

   What color is subtracted by a yellow pigment?

   What colors are subtracted when magenta and yellow paints are mixed, and what color is left over?

6. There are many different ways for an object to produce color. Tell (in a word or two) how each of the following gets its color:

Blue sky

Red sunsets

Soap bubbles

Red hot charcoal

Blue hot flame

Yellow sodium lights

A red shirt

Green glass

Prisms

Interesting websites with pictures and explanations of various atmospheric optical phenomena can be found here:

http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/opt/home.rxml

or here:

http://nsidc.org/arcticmet/basics/phenomena/aurora_borealis.html

or here: I think this is the best:

http://www.atoptics.co.uk/