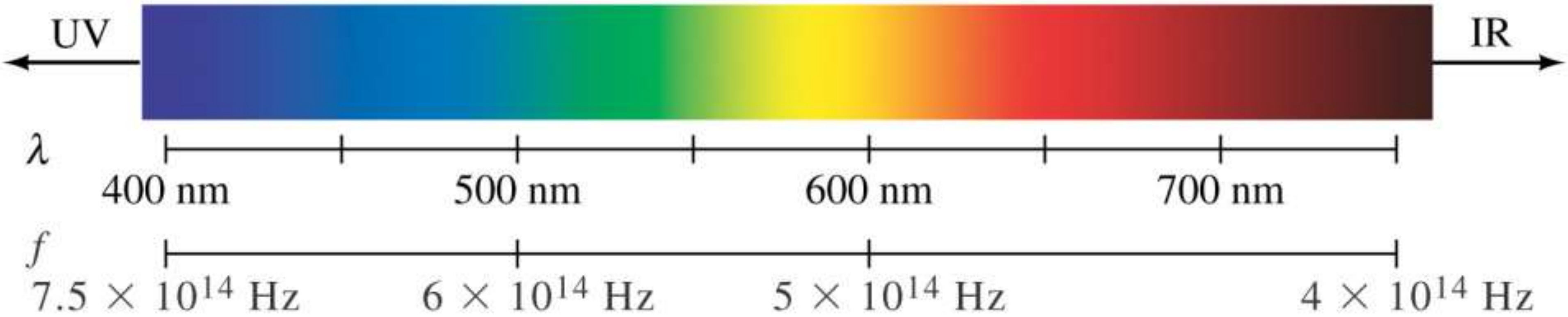
The Visible Spectrum and Dispersion

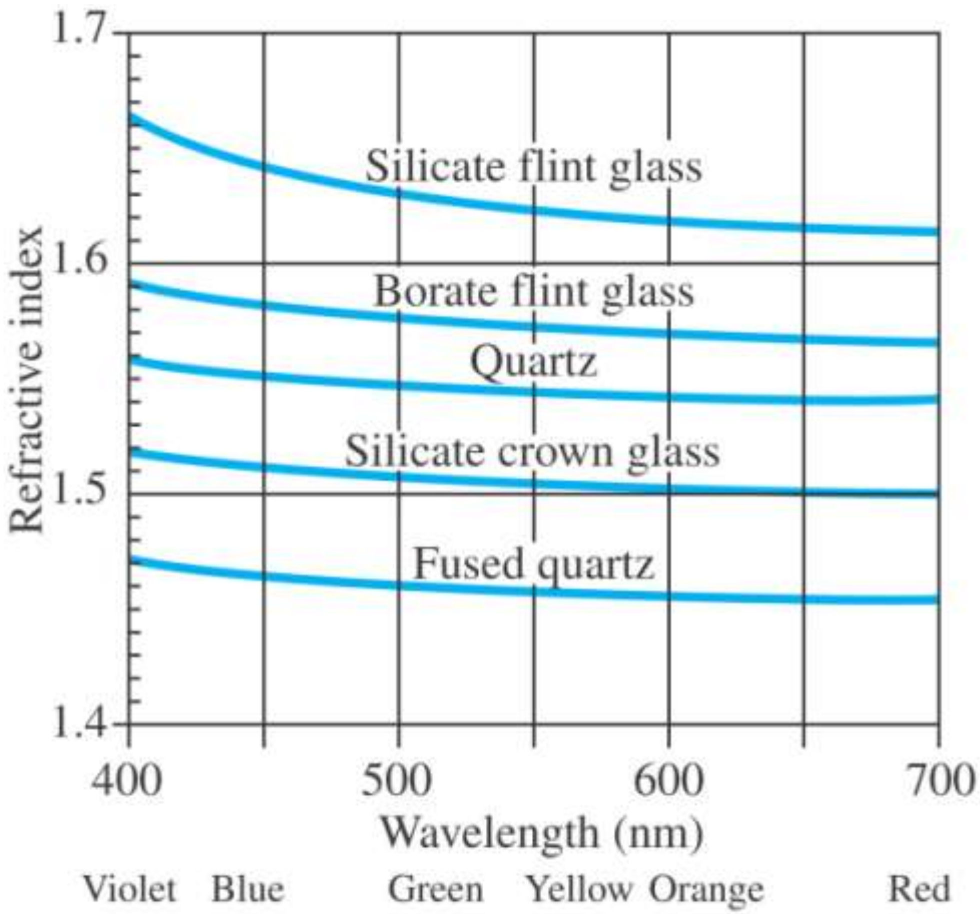
Wavelengths of visible light: 400 nm to 750 nm

Shorter wavelengths are ultraviolet; longer are infrared

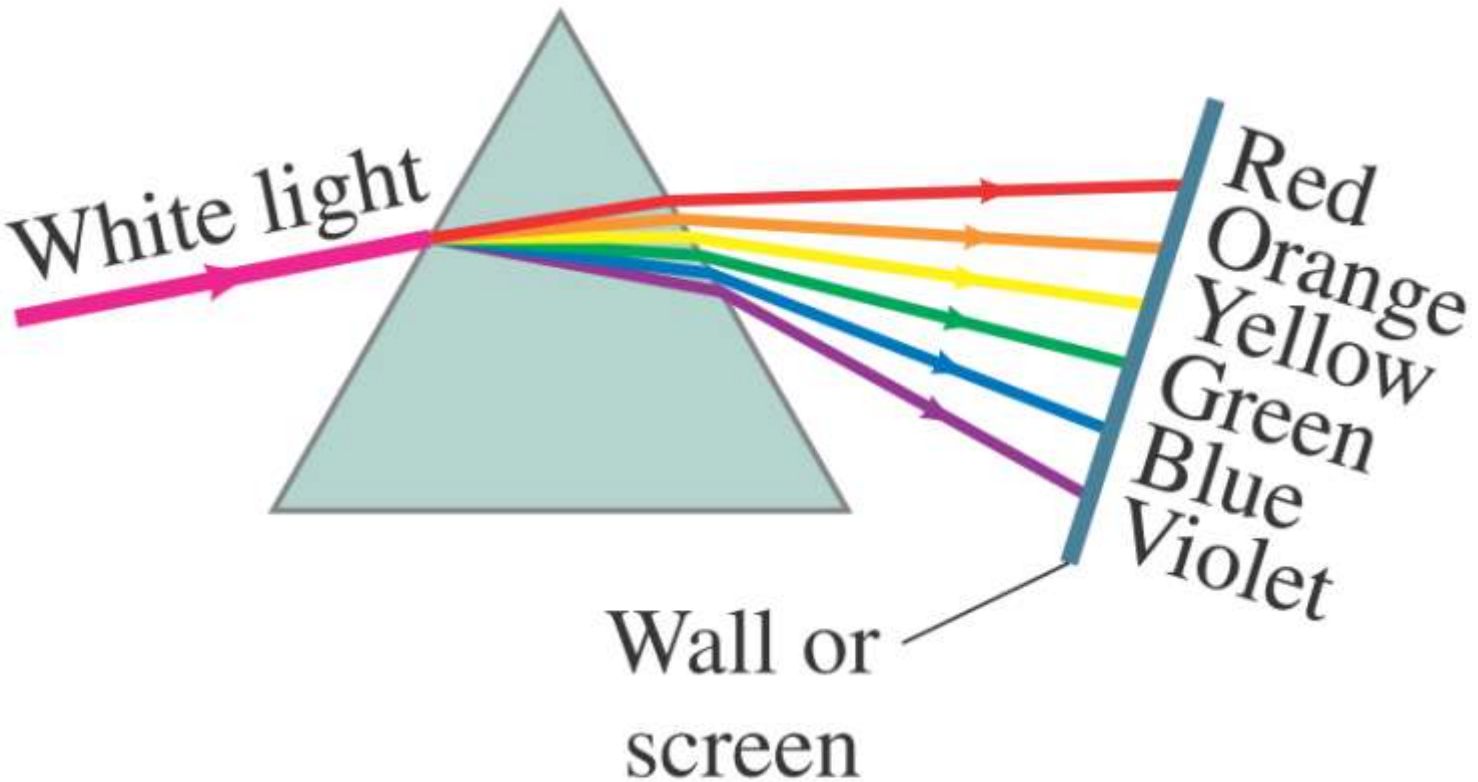


The Visible Spectrum and Dispersion

The index of refraction of a material varies somewhat with the wavelength of the light.



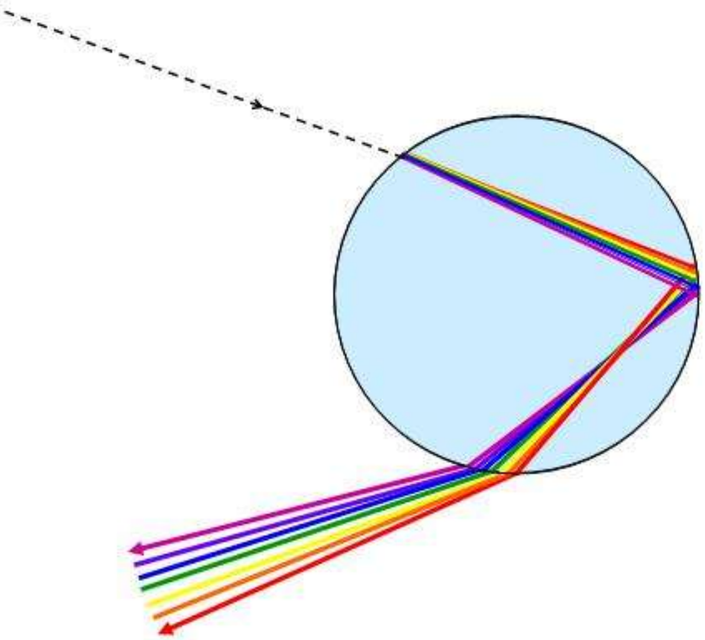
This variation in refractive index is why a prism will split visible light into a rainbow of colors.

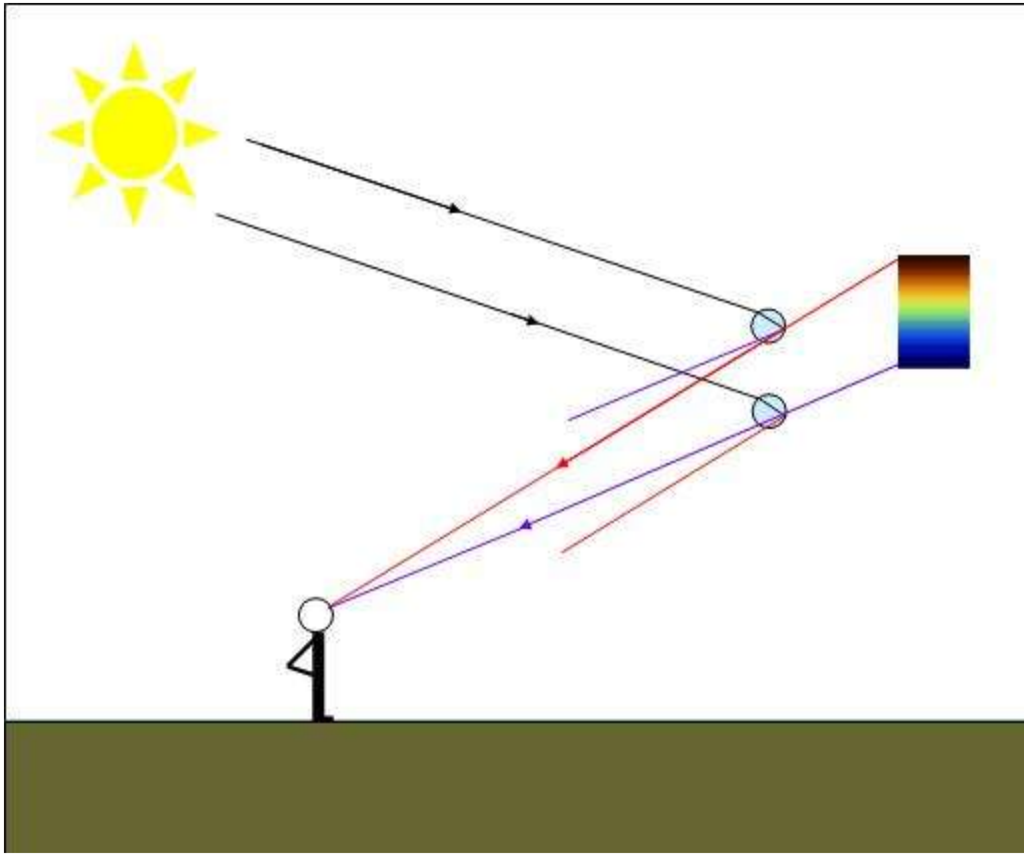


Prism

[Time for a Gizmo!]

Actual rainbows are created by dispersion in tiny drops of water.





Double Rainbow at Fenway

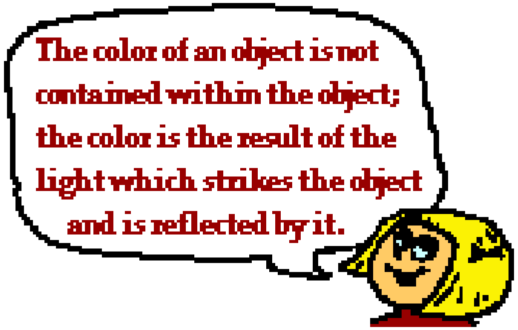
Sometimes you can see a second rainbow, when two reflections of light within the drop occur. The intensity of this secondary rainbow is much lower than that of the main one and the colors are reversed.

Circle Rainbows

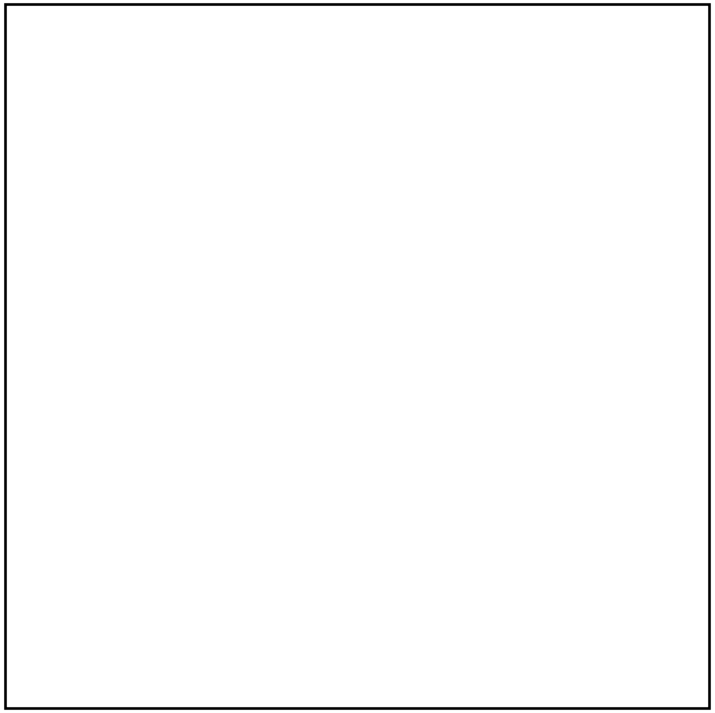
Color by Reflection

The color of the objects which we see are largely due to the way those objects interact with light and ultimately reflect or transmit it to our eyes.

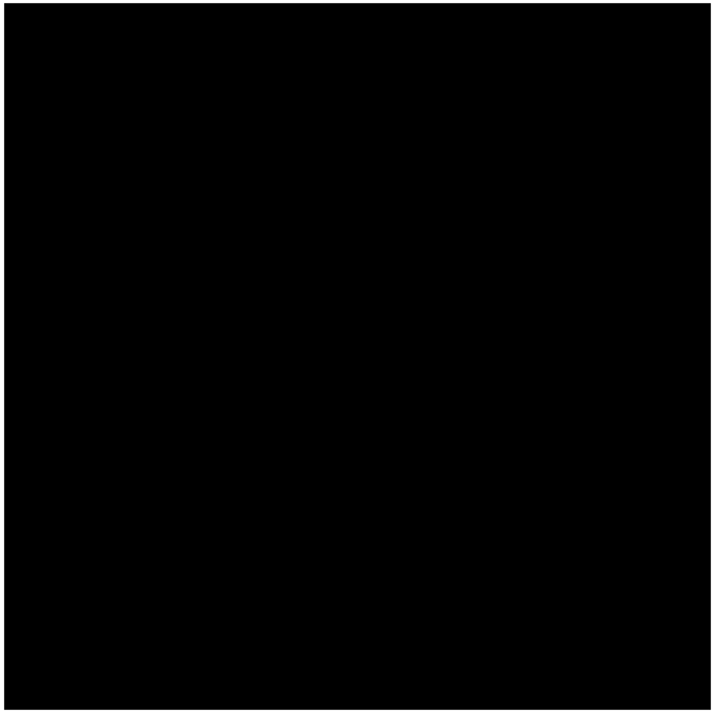
The color of an object is not actually within the object itself; rather, the color is in the light which shines upon it that ultimately becomes reflected or transmitted to our eyes.



Color by Reflection

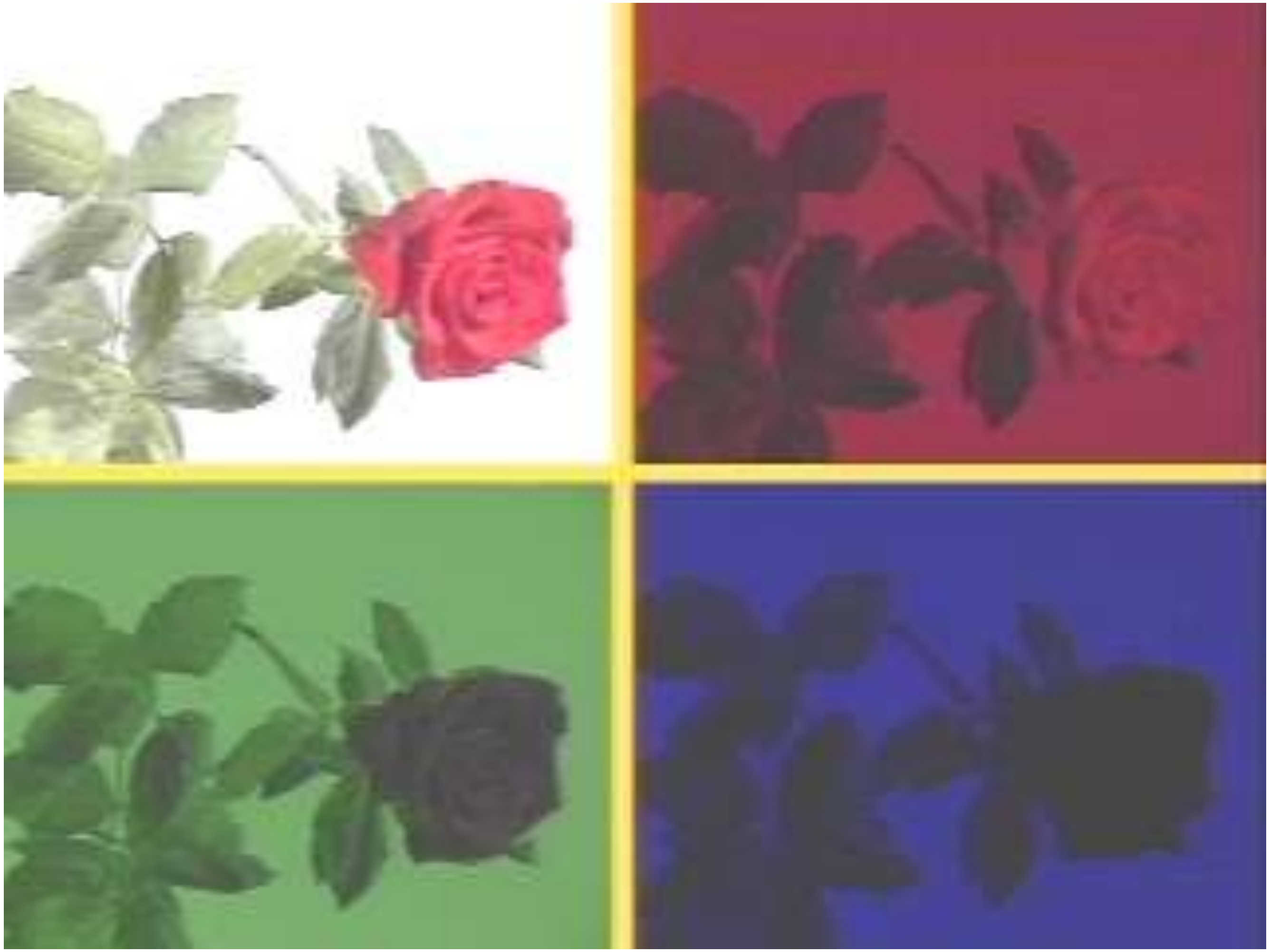


The white square reflects all colors of light



The black square absorbs all colors of light

Color by Reflection



The red rose with green leaves appears different colors depending on which color light is shined upon them.

Color by Reflection

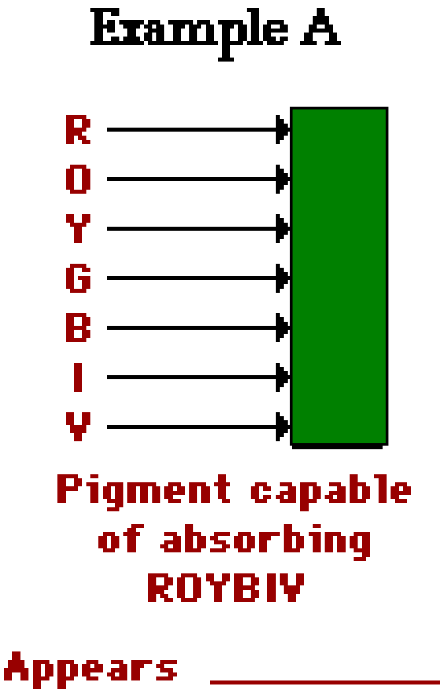
Color by Reflection

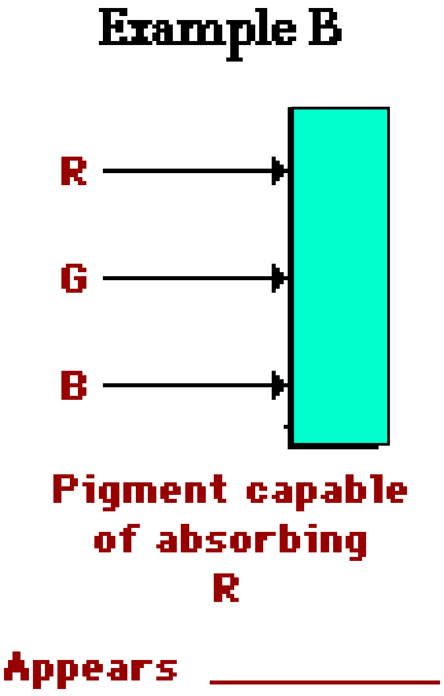
Color by Reflection

Color by Reflection

Color by Transmission

Transparent materials are materials which allow one or more of the frequencies of visible light to be transmitted through them; whatever color(s) is/are not transmitted by such objects, are typically absorbed by them.



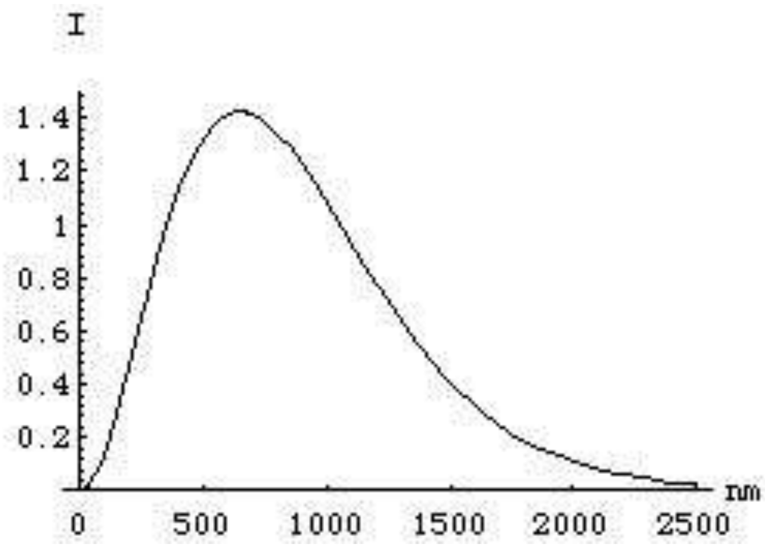


Color by transmission

Time for a Gizmo!

Color by Reflection

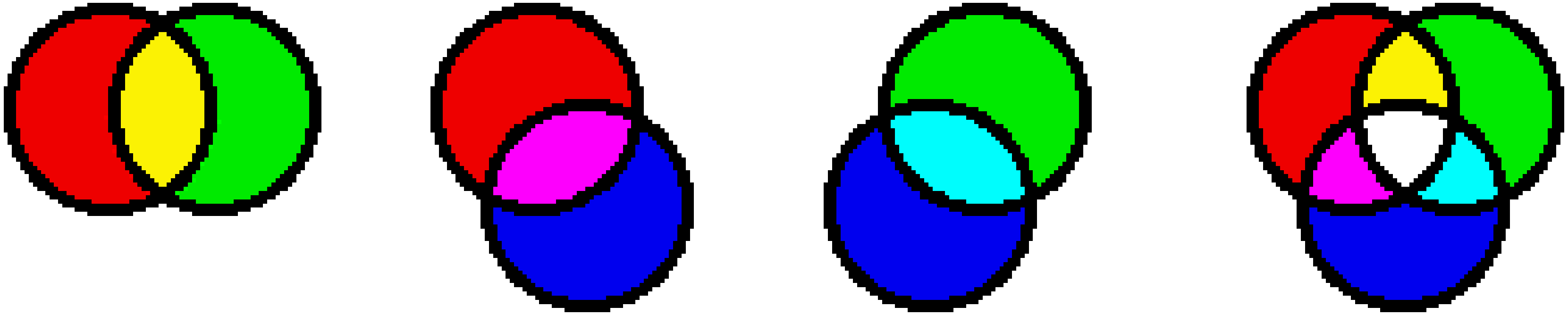
Brightness vs. Color Frequency



560 nm is approximately the brightest visible frequency of light

Mixed Color Light

Any three colors (or frequencies) of light which produce white light when combined with the correct intensity are called **primary colors of light**.
The most common set of primary colors is red (R), green (G) and blue (B).
When red, green and blue light are mixed or added together with the proper intensity, white (W) light is obtained.

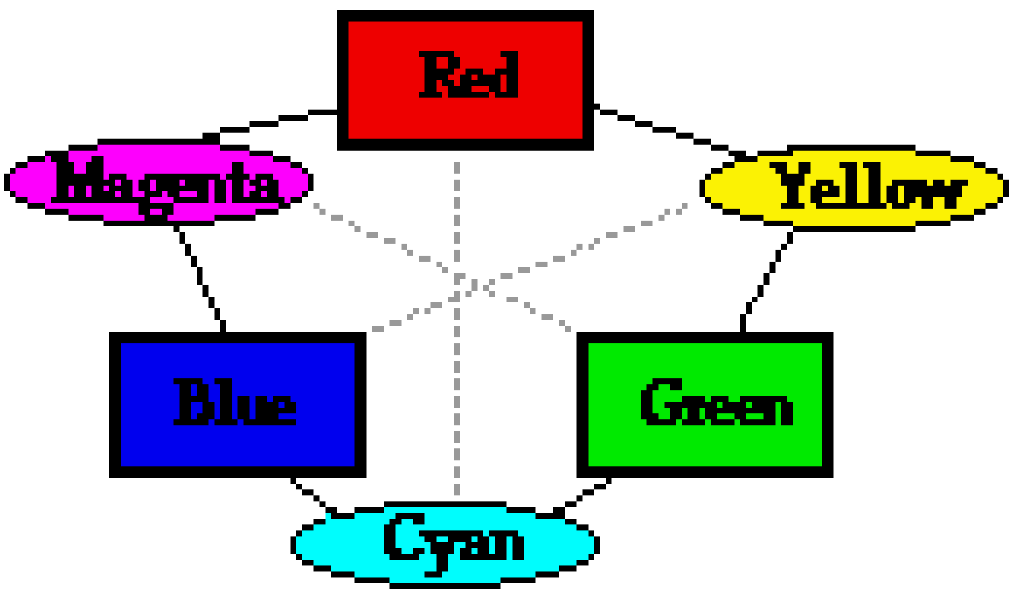


Mixed Color Light

Time for a Gizmo!

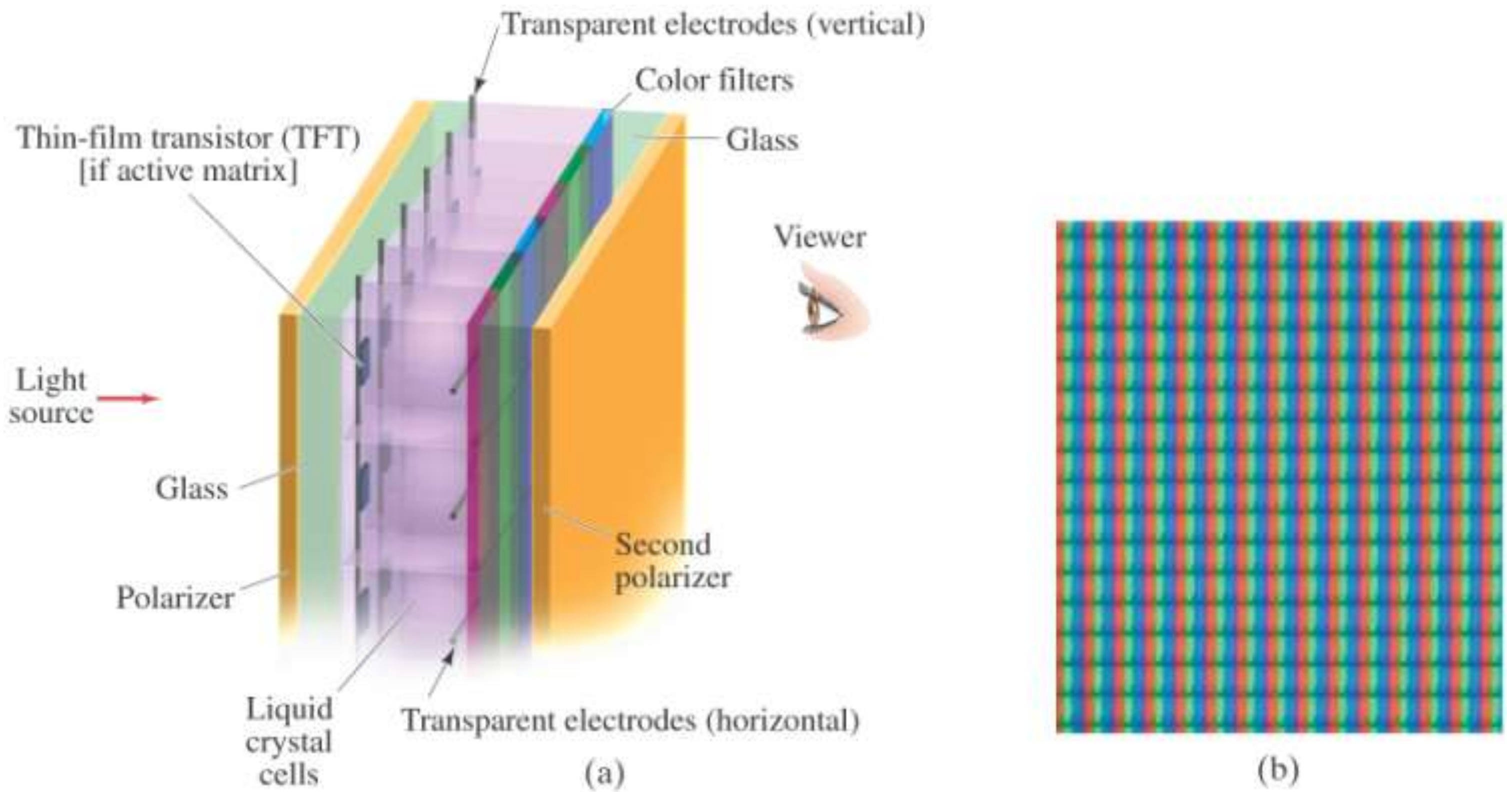
Complimentary Colors of Light

Red and Cyan = White
Green and Magenta = White
Blue and Yellow = White



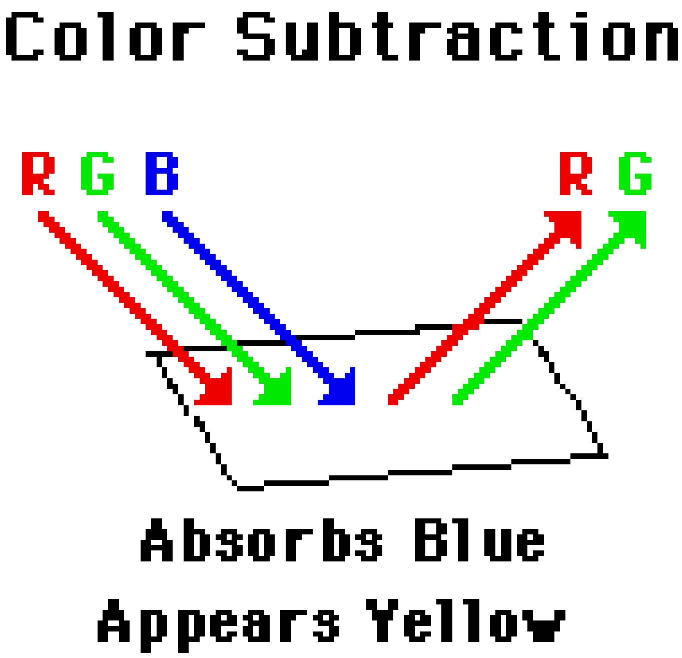
Liquid Crystal Displays (LCD)

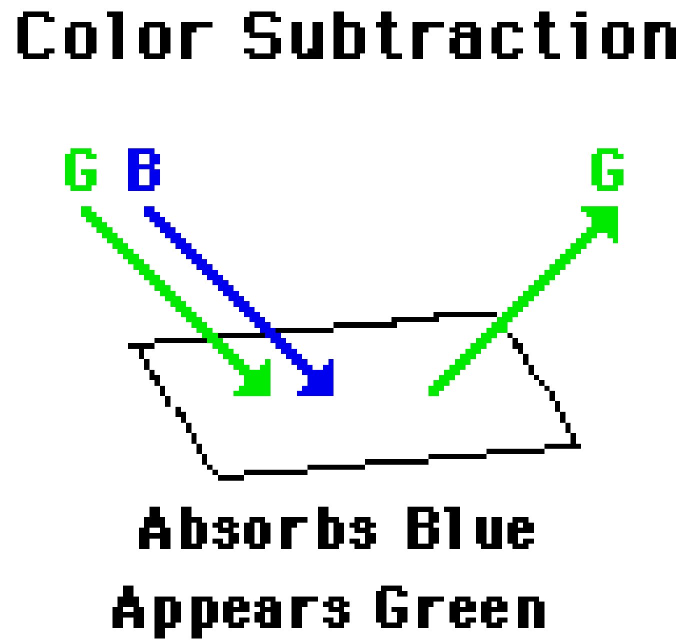
Color LCD displays are more complicated; each pixel has three subpixels to provide the different colors. A source of light is behind the display The pixels must be able to make finer adjustments than just on and off to provide a clear image.



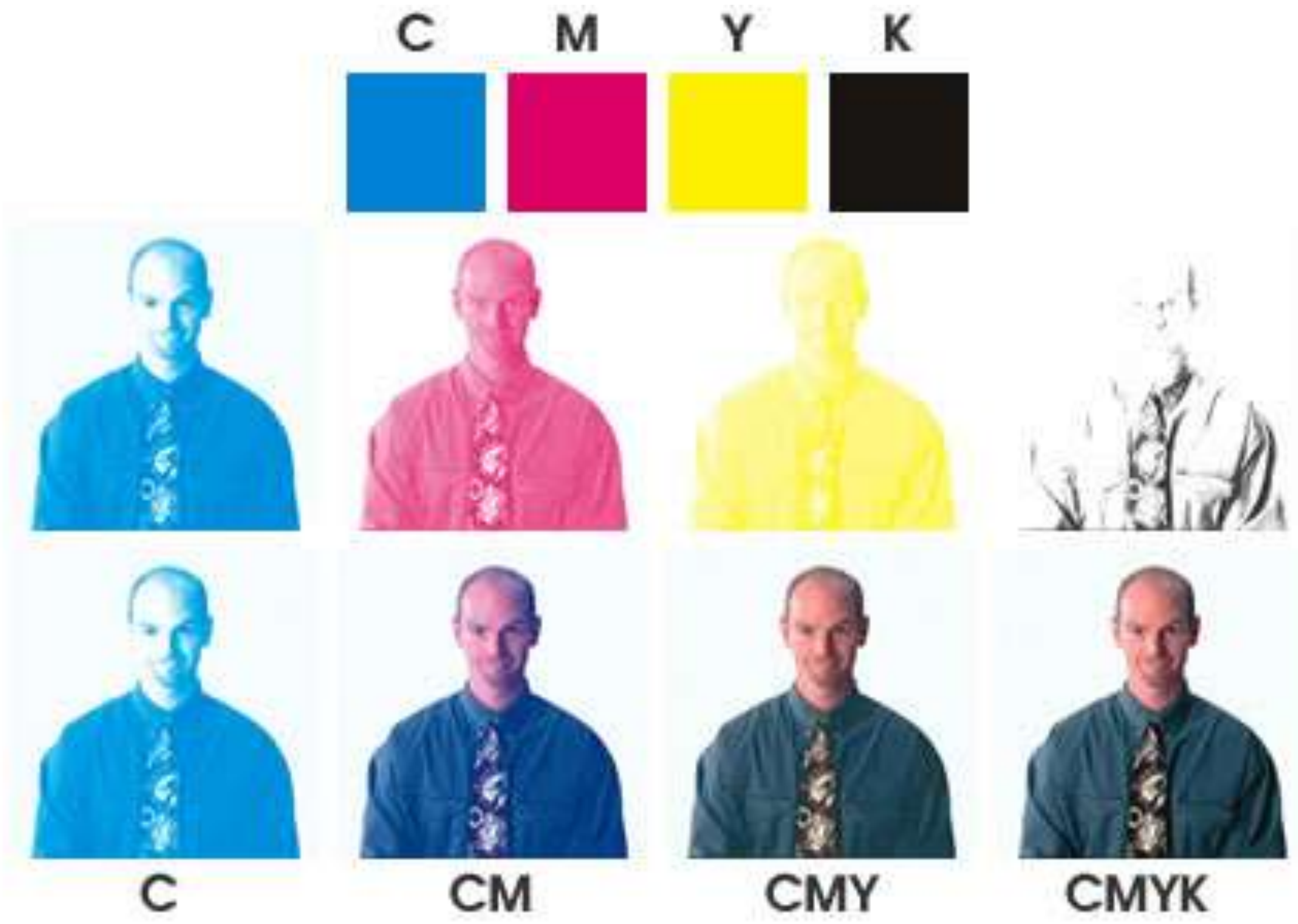
Mixed Color Pigments

The ultimate color appearance of an object is determined by beginning with a single color or mixture of colors and identifying what color or colors of light are subtracted from the original set.





Four Color Processing



Four Color Processing

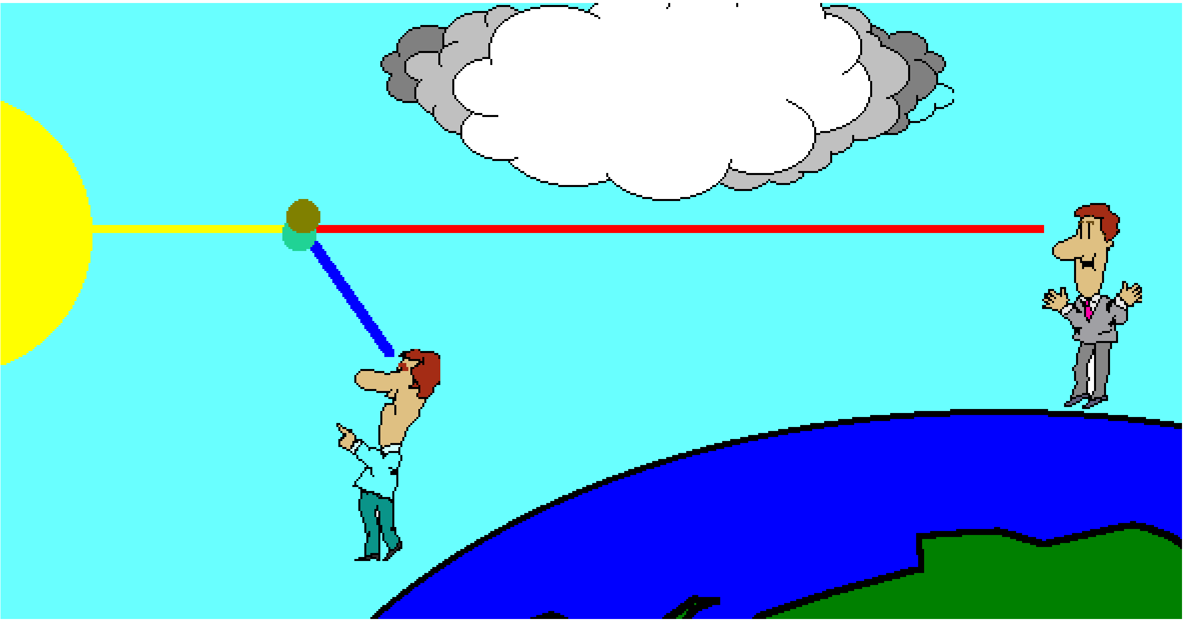
SUBJECT	CYAN	MAGENTA	YELLOW	BLACK
Flesh 18/50/60/8	1/3 of M/Y%	40-50%	40-60%	0-8%
Flesh 12/40/40/0	Note: Magenta & Yellow should run close together or even%.			
Black Flesh	37%	47%	52%	29%
Sky blue	66%	22%	0%	0%
Green Grass	71%	25%	80%	5%
Forest Green	73%	25%	63%	29%
Lemon Yellow	0%	13%	89%	0%
Light Gray	6%	0%	6%	24%
Medium Gray	50%	40%	40%	15%
Steel Gray	27%	19%	23%	4%
Medium Brown	30%	65%	75%	40%
Beige	17%	18%	38%	3%
Gold	26%	33%	70%	13%
Dark Red	21%	100%	92%	13%
Warm Red	0%	91%	76%	0%
Purple	87%	100%	0%	0%
Pink	0%	56%	6%	0%

Blue Skies

As white light (ROYGBIV) from the sun passes through our atmosphere, the high frequencies (BIV) become scattered by atmospheric particles while the lower frequencies (ROY) are most likely to pass through the atmosphere without a significant alteration in their direction.

This scattering of the higher frequencies of light illuminates the skies with light on the BIV end of the visible spectrum.

Blue Skies



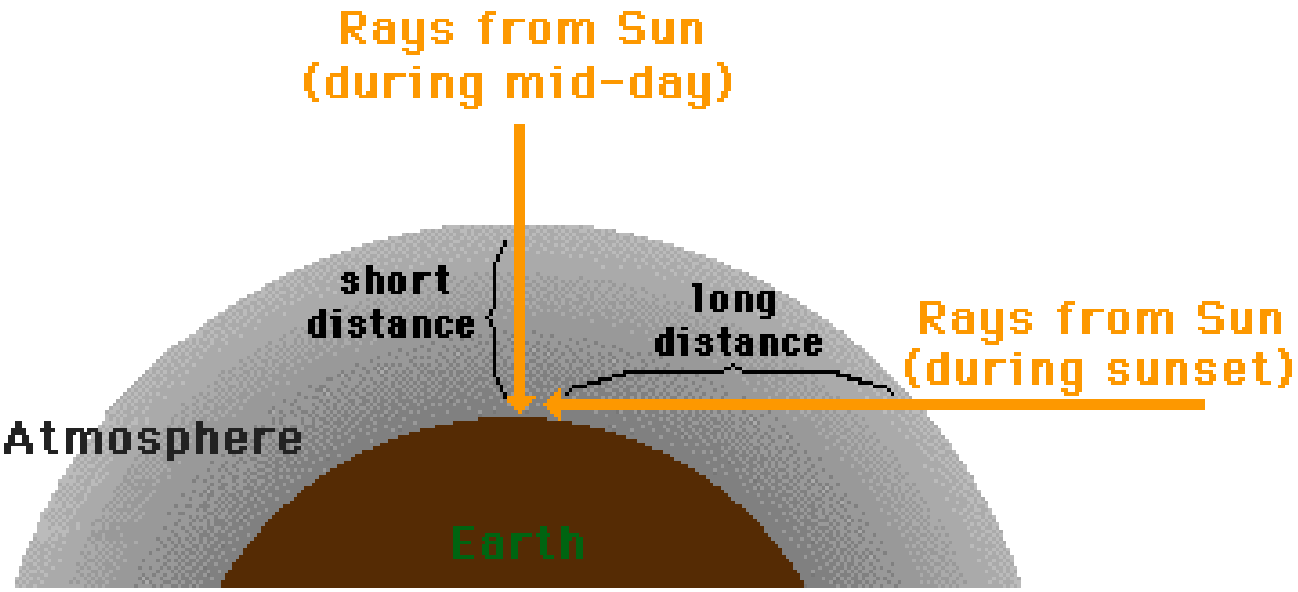
Compared to blue light, violet light is most easily scattered by atmospheric particles; however, our eyes are more sensitive to light with blue frequencies. Thus, we view the skies as being blue in color.

Red Sunsets

The appearance of the sun changes with the time of day. While it may be yellow during midday, it gradually turns color as it approaches sunset. This can be explained by light scattering. As the sun approaches the horizon line, sunlight must traverse a greater distance through our atmosphere

Red Sunsets

As the path which sunlight takes through our atmosphere increases in length, ROYGBIV encounters more and more atmospheric particles. This results in the scattering of greater and greater amounts of yellow light.



Red Sunsets

The effect of a red sunset becomes more pronounced if the atmosphere contains more and more particles. The presence of sulfur aerosols (emitted as an industrial pollutant) in our atmosphere contributes to some magnificent sunsets (and some very serious environmental problems).