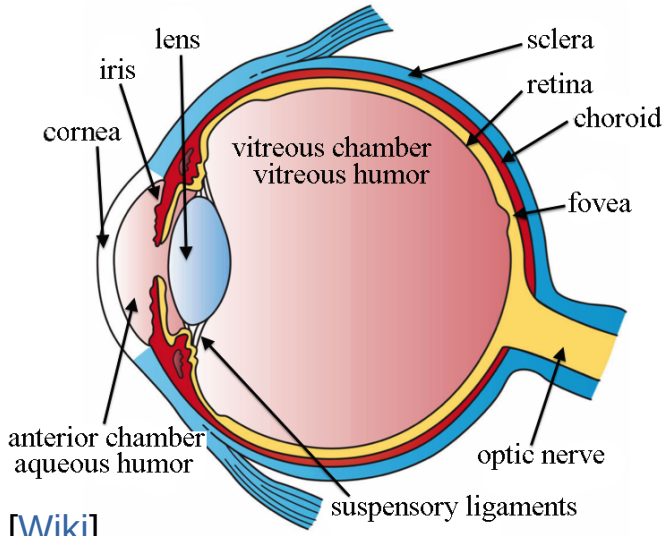
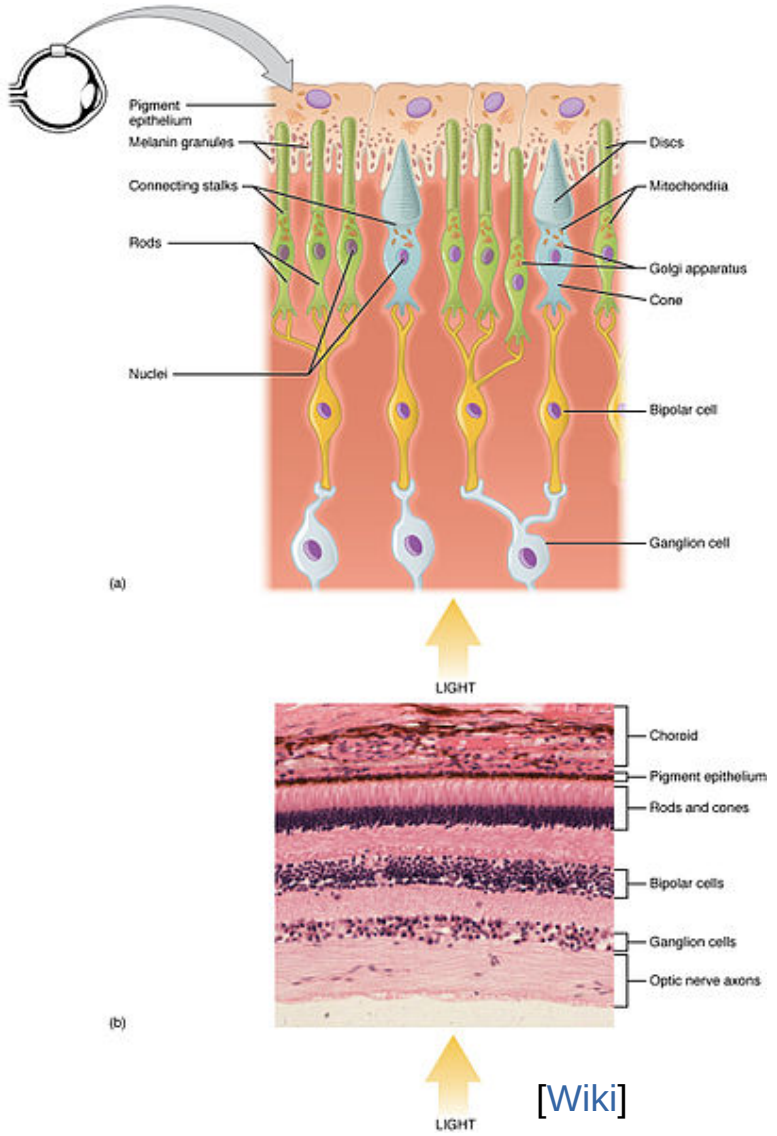
Human Eye



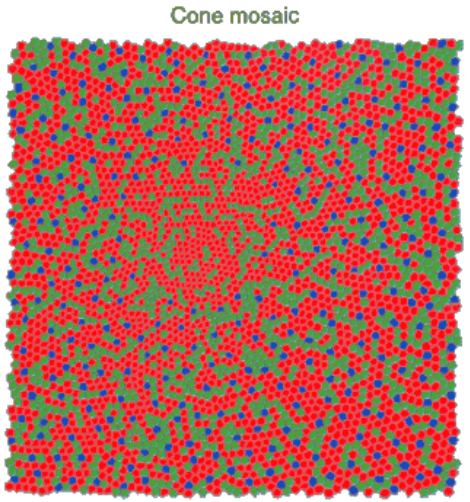
[Wiki]

Focal length f' = 23mm

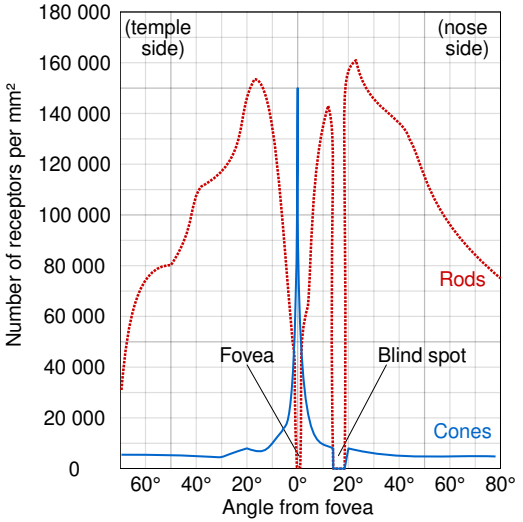


[Wiki]

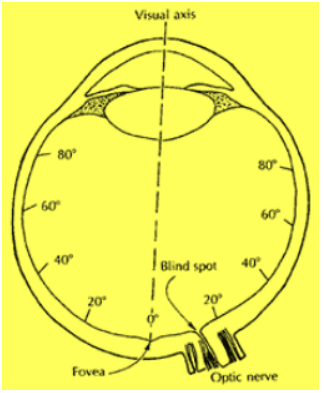
Human Eye



~ 1° foveal region
[cis.rit demo course]



[Wiki]

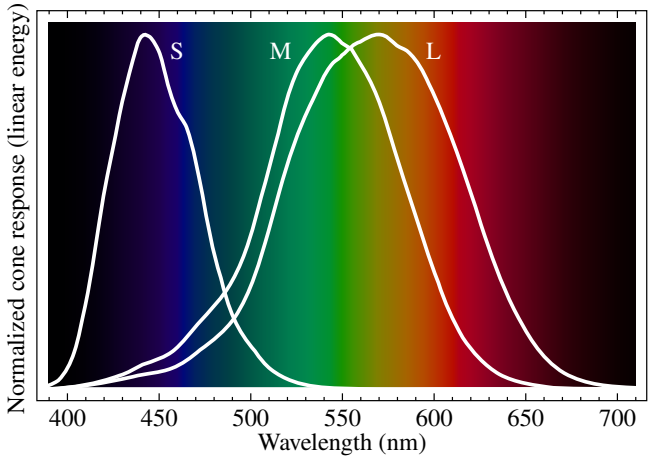


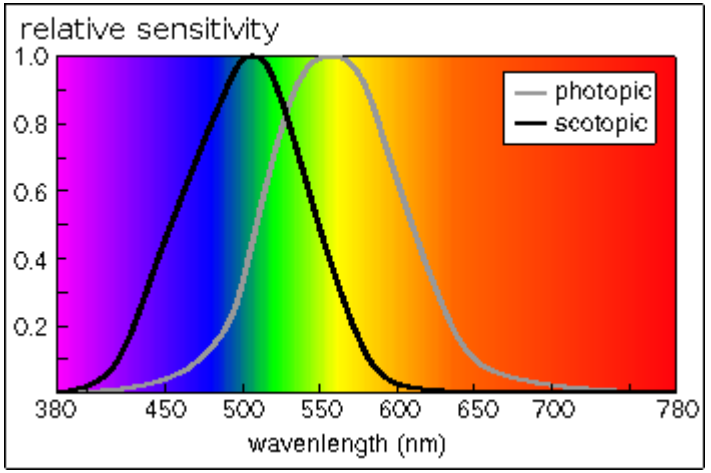
[cis.rit demo course]

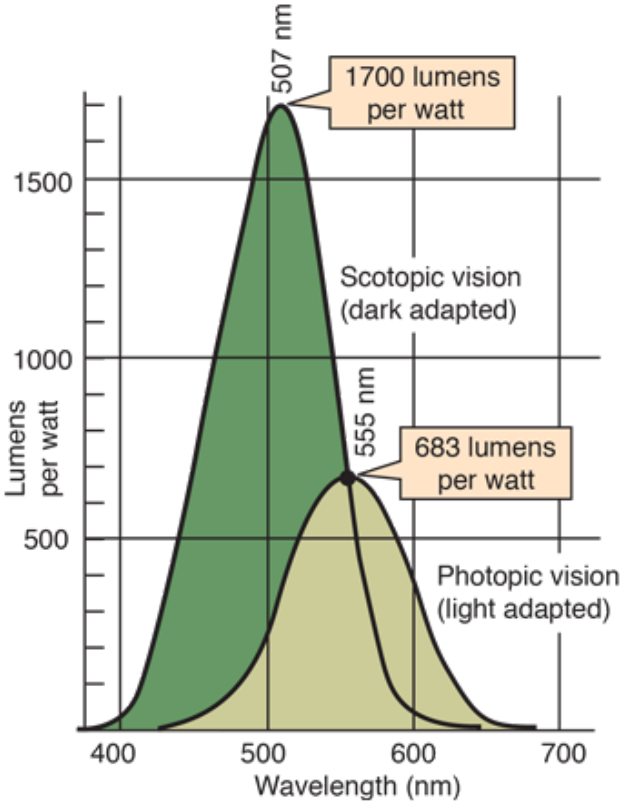
„the total photoreceptor count showed a considerable interindividual variability ranging in the present study from 38742000 to 80650000 rods and 2235495 to 4284437 cones“ [Jonas et.al. 1992]

Color

Color is the perception of the relative stimulation of human retina cone cells by light in the visible range.



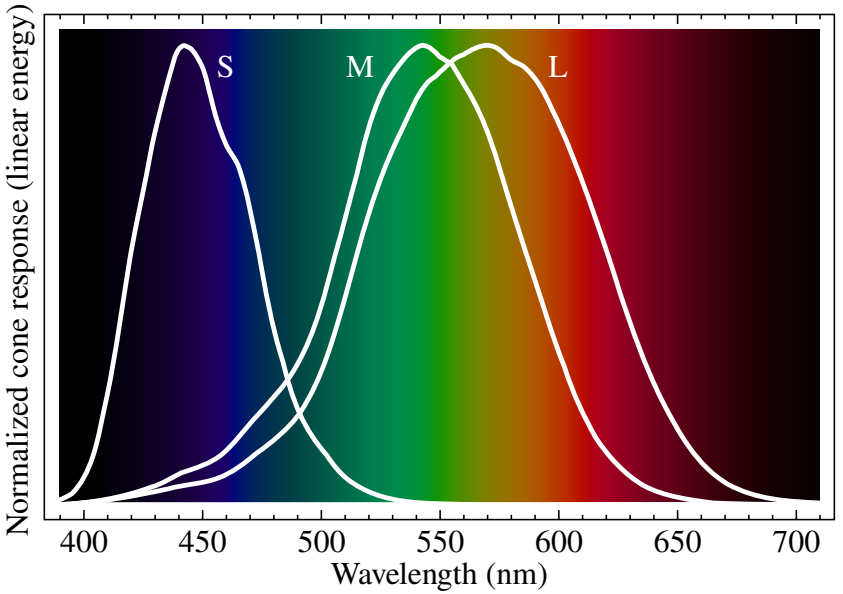




10° Standard Observer

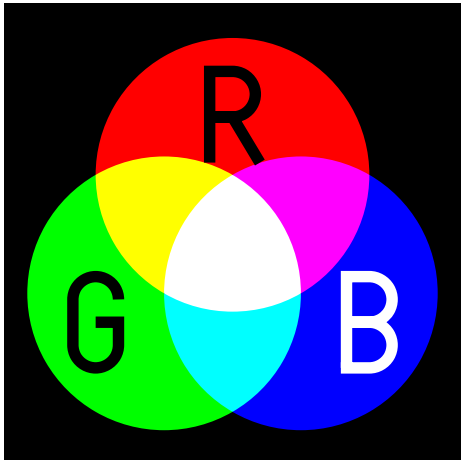
LMS Color Space

The sensitivities of the three types of receptor cells (long, middle, short) to light of different wavelength defines the additive **LMS color space**.

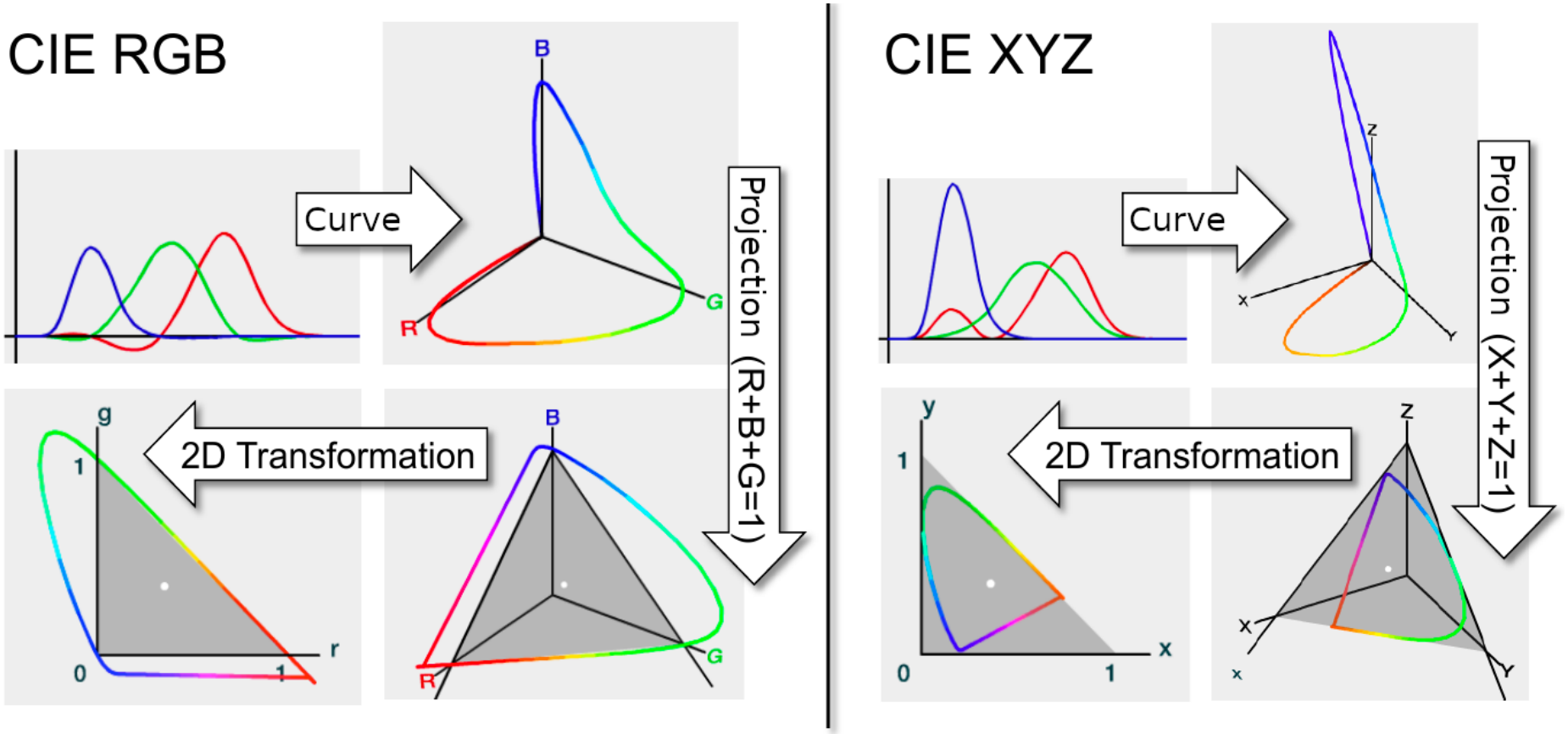


RGB Color Space

The **RGB color space** is an additive color space with respect to three primary colors with peaks at 700 nm (red), 546.1 nm (green) and 435.8 nm (blue), not directly related to human vision.

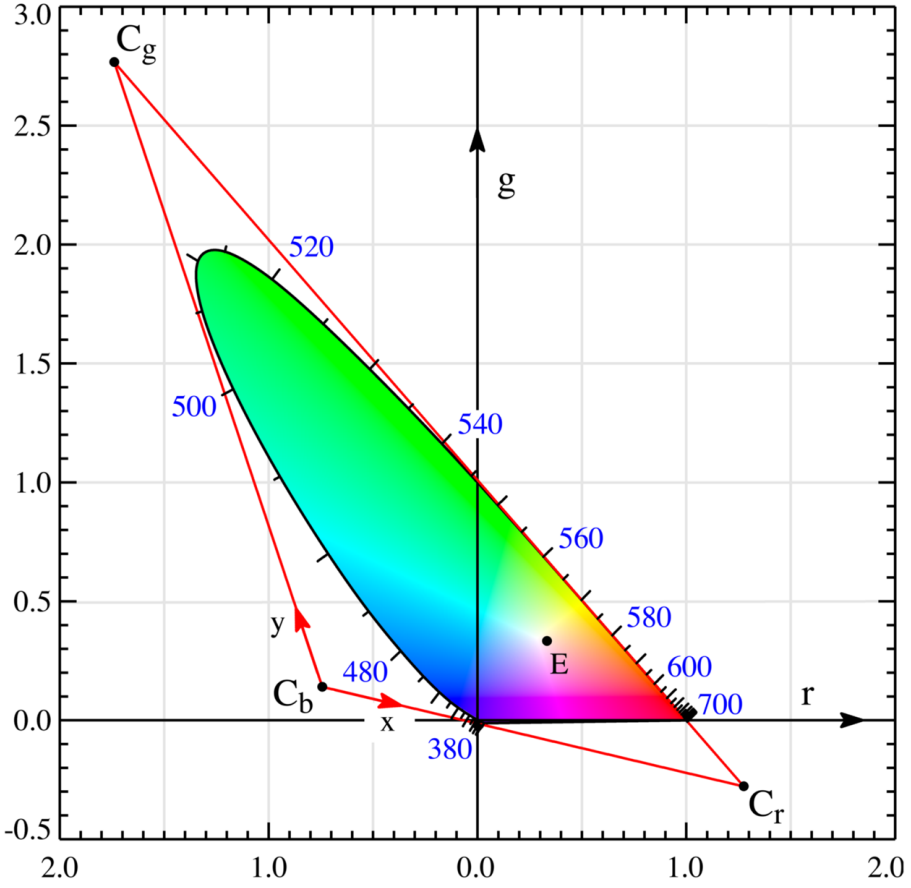


XYZ Color Space



Screenshots from Applet: http://graphics.stanford.edu/courses/cs178/applets/threedgamut.html

rg chromaticity diagram

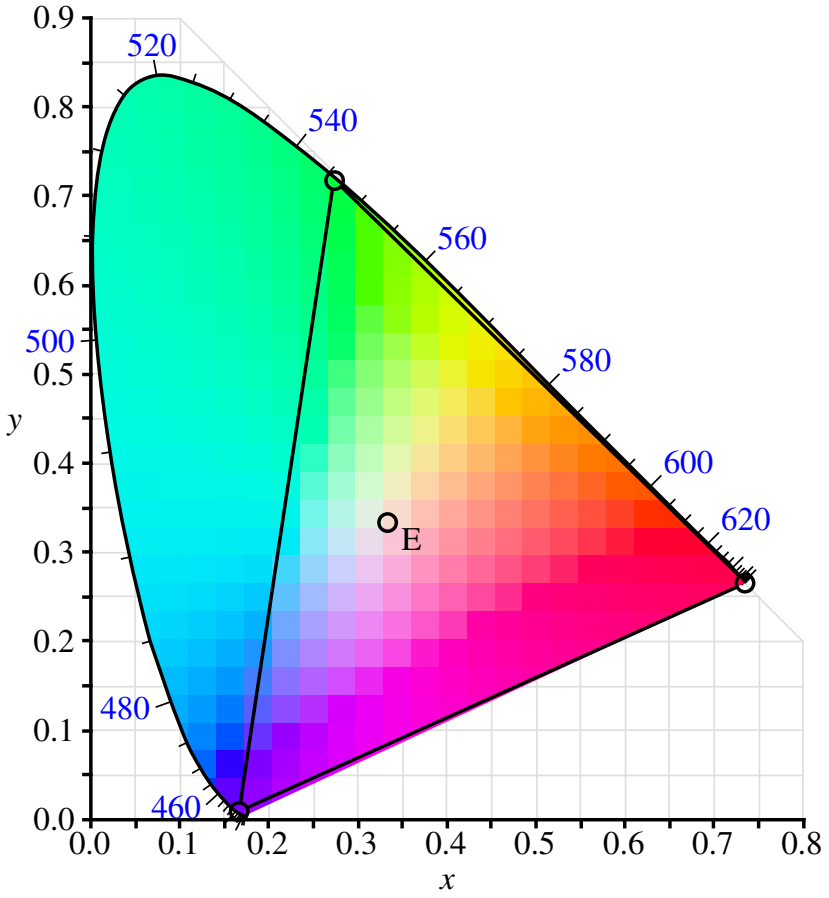


$$r = \frac{R}{R+G+B}$$

$$g = \frac{G}{R+G+B}$$

$$b = \frac{B}{R+G+B} = 1 - r - g$$

xy Chromaticity Diagram

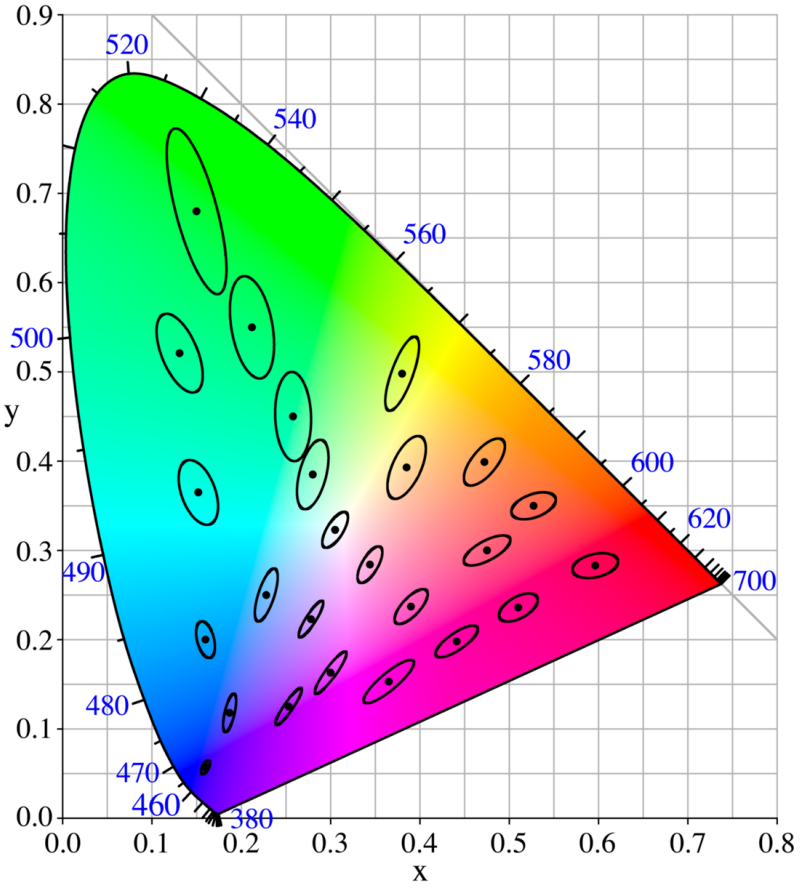


$$x = \frac{X}{X+Y+Z}$$

$$y = \frac{Y}{X+Y+Z}$$

$$z = \frac{Z}{X+Y+Z} = 1-x-y$$

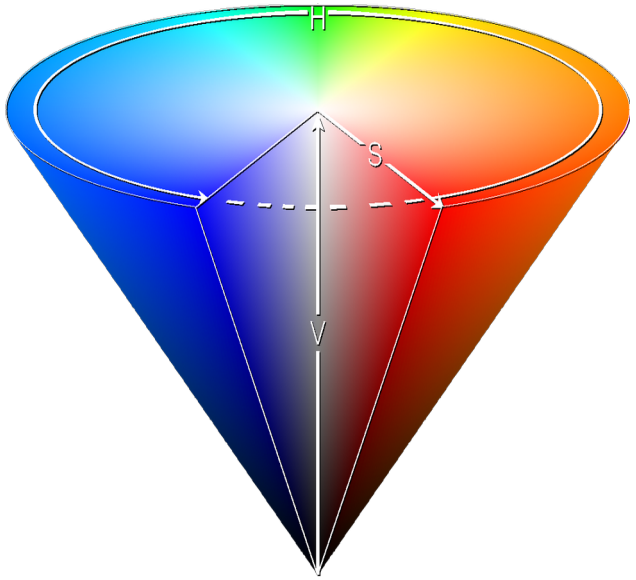
Lab Color Space



HSV color space

HSV (hue, saturation, value) maps RGB values to a conic space such that 0≤V≤1, 0≤S≤1, 0≤H≤360

Hue: Dominant wavelength as perceived by a human (color)
Saturation: Ratio of one color (hue) with gray.
Value: Intensity



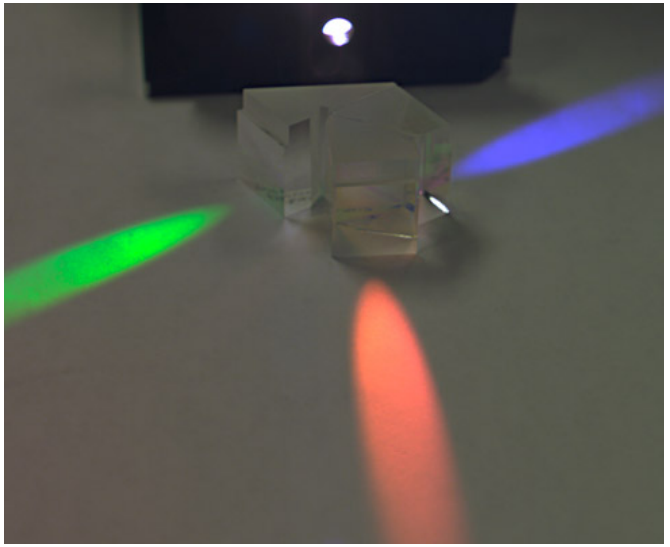
$$V = \max(R, G, B)$$

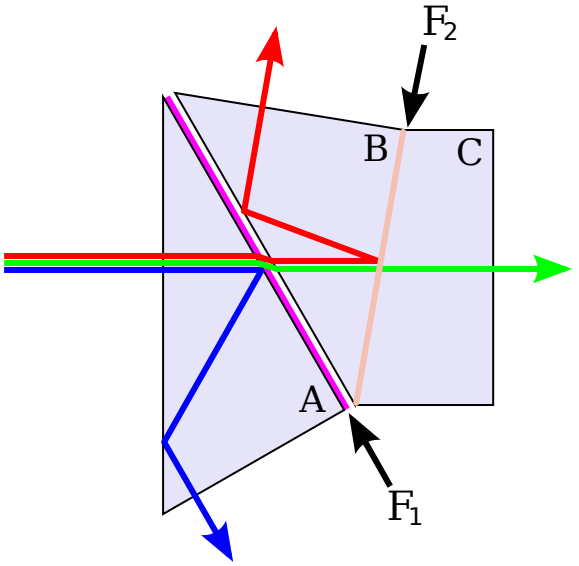
$$S = V - \min(R, G, B), \text{if } V \neq 0, \text{else } S = 0$$

$$H = \begin{cases} 60(G-B)/(V-\min(R,G,B)) & \text{if } V = R \\ 120+60(B-R)/(V-\min(R,G,B)) & \text{if } V = G \\ 240+60(R-G)/(V-\min(R,G,B)) & \text{if } V = B \end{cases}$$

Color Sensors

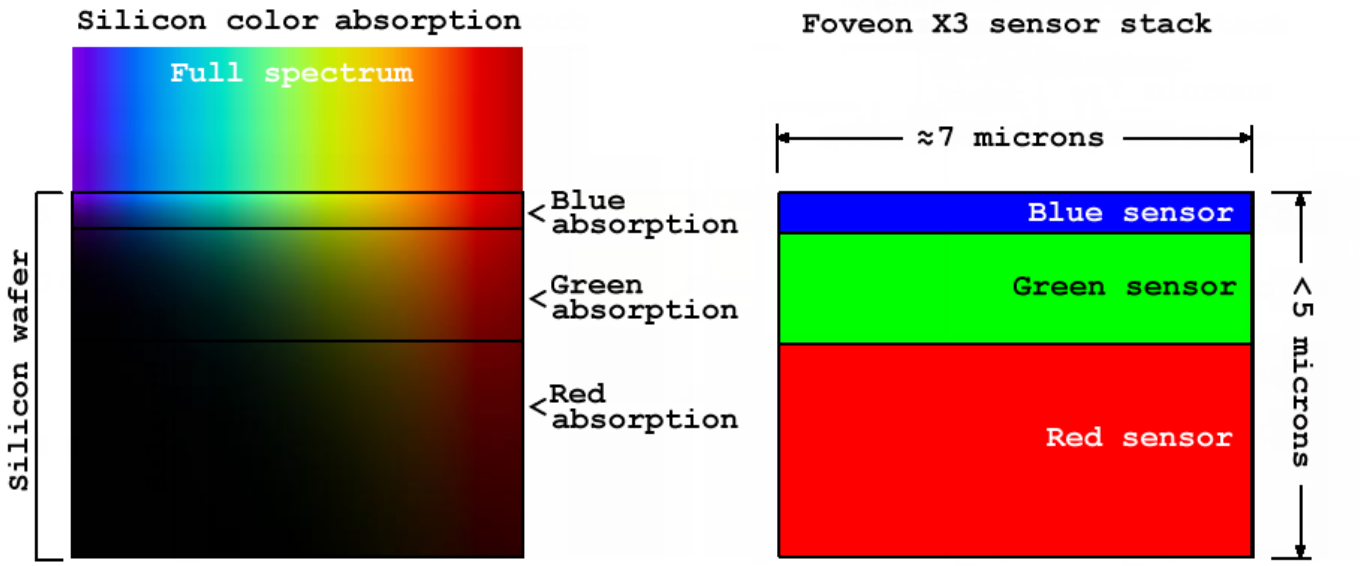
Dichroic filter prism





Color sensors

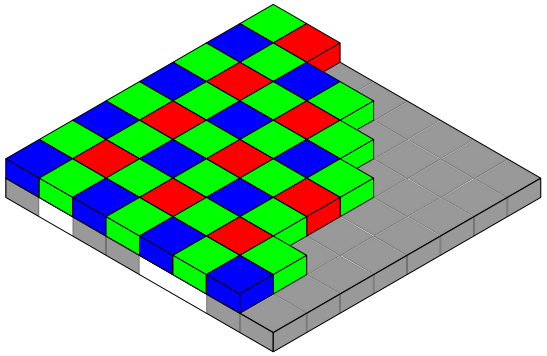
Vertically stacked pixels exploiting wavelength-dependent penetration depth of light

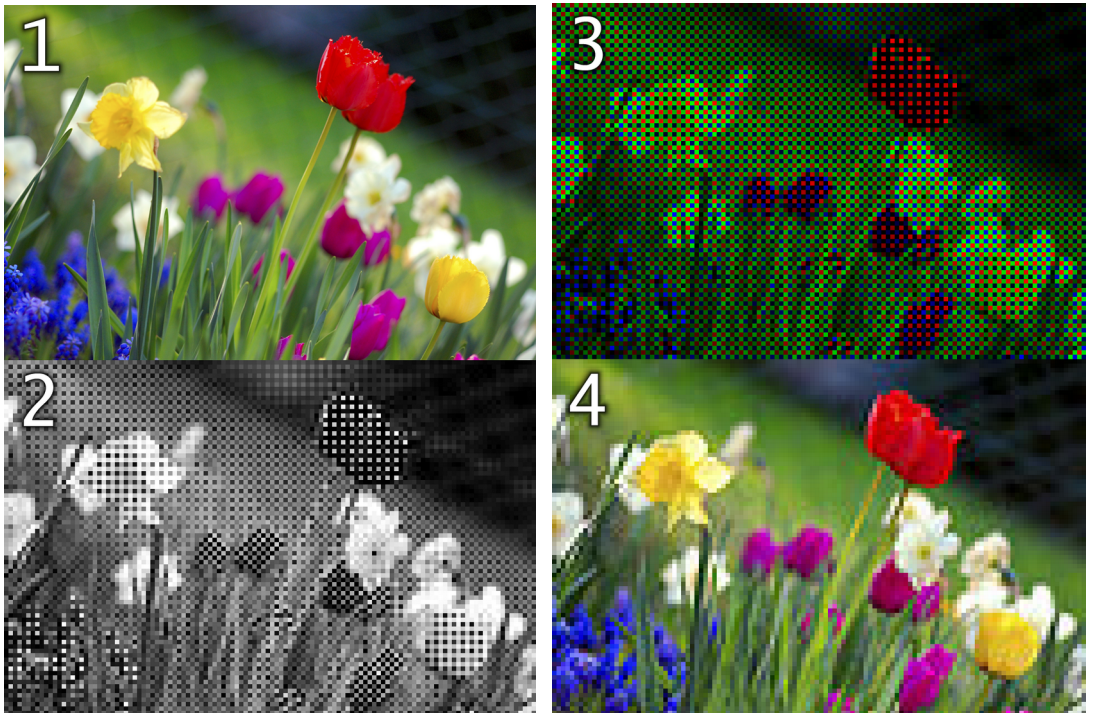


https://en.wikipedia.org/wiki/Foveon_X3_sensor

Color sensors

Bayer Pattern





https://en.wikipedia.org/wiki/Bayer_filter