Adobe℠ Customer Services

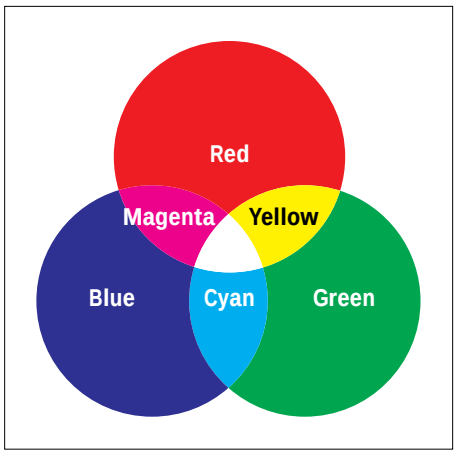
Color Basics

A knowledge of basic color theory is helpful in understanding many of the features and functions of Adobe Photoshop.

ADDITIVE AND SUBTRACTIVE COLORS

White light, such as sunlight, is made up of all the colors in the visible color spectrum. The colors red, green, and blue are known as the *additive primaries*: the three colors of the visible spectrum that combine to create white light. Light-based color reproduction, such as video, film, and monitor displays, relies on use of the three additive primaries.

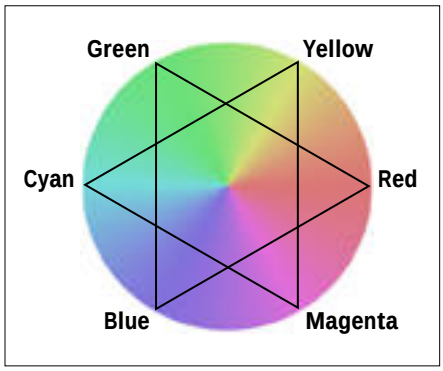
Cyan, magenta, and yellow are known as the *subtractive primaries*, because these colors result when each of the three additive primaries is removed from white light. When printed as inks, the subtractive primaries absorb the red, green, and blue portions of white light in such a way that most of the visible color spectrum can be reproduced on paper. In theory, the subtractive primaries combine to create black. However, due to factors such as impurities in inks, a mix of cyan, magenta, and yellow yields a muddy brown. To compensate for this deficiency, black ink is also used in color printing; the colors cyan, magenta, yellow, and black are known as the *process colors*.



Additive and subtractive colors

For color correction, it helps to visualize additive and subtractive colors using the following simple diagram. This diagram is familiar to color professionals; in essence, it is an abridged version of what is known as the *color circle* or *color wheel*. Each color in the diagram, represented by a point on one of the triangles, is between the two components that make up that color; for example, the color green is composed of the two adjacent colors in the diagram, yellow and cyan. In color correction, add green to an image by increasing cyan and yellow or by decreasing green's complementary color—the color opposite green in the diagram—magenta.

Similarly, remove green in an image either by decreasing cyan and yellow or by increasing the magenta component.



The color wheel

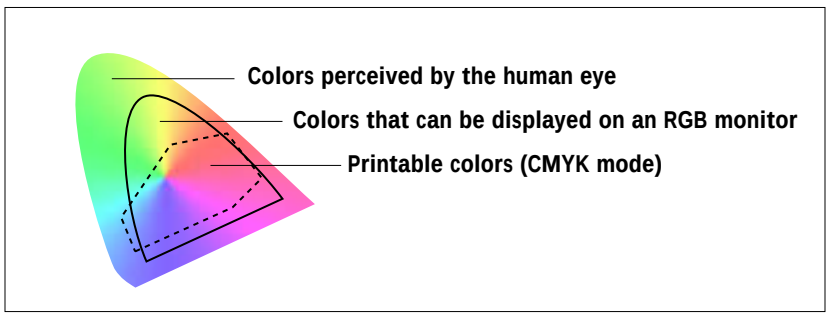
COLOR RANGES, OR "GAMUT"

Color can be viewed in nature, on a monitor, and on paper or film. Which medium is used determines the range of colors, or *gamut*, that can be reproduced. In addition, the gamut may be limited by factors such as the phosphors in the monitor, the dyes on the film, and the ink and paper used in printing.

- The widest variety of colors is in the visible spectrum as viewed in nature. This spectrum contains all colors that the human eye can perceive.

- A subset of these colors can be viewed on a computer or television monitor. These devices reproduce color by emitting red, green, and blue light. Certain colors, such as the color cyan or a very bright yellow, cannot be displayed accurately on a monitor.

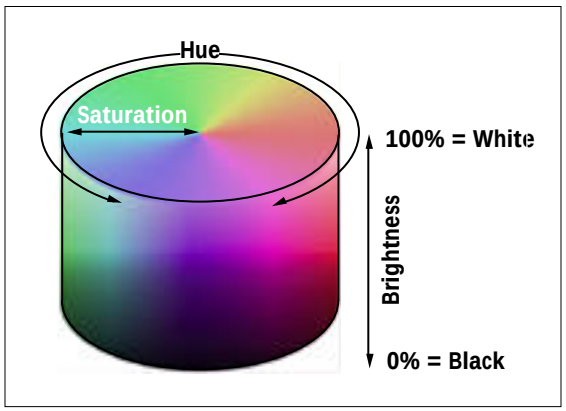
- As shown in the following illustration, the gamut of colors that can be printed using process color inks is primarily a subset of the colors that can be displayed on a monitor. This means that although a monitor can display most printable colors (as in Photoshop's CMYK mode), many colors that can be displayed on a monitor cannot be printed using the four-color process. The "!" icon that appears in the Photoshop color picker and in the Info palette when choosing certain colors indicates colors that are nonprintable, or "out-of-gamut," for process color printing.



Color gamut

HUE, SATURATION, AND BRIGHTNESS

Color is often described in terms of three properties: hue, saturation, and brightness. *Hue* is the name of the color. In Adobe Photoshop, the hue value defines the angle of the color on a color wheel. *Saturation* describes the strength of the hue; this is the property that defines a color as pale or rich. *Brightness*, sometimes called lightness or luminance, describes the lightness or darkness of a color relative to black and white. The Hue, Saturation, and Brightness (HSB) color model is represented in Adobe Photoshop's color picker and Info palette. Other models that can be used to view and edit colors are RGB, CMYK, and Lab.



The HSB color model

VIEWING AND MEASURING COLOR

Many factors influence the perception of color. Lighting conditions, background colors, and the color perception of the viewer are only a few of the variables that can dramatically change how a given color is perceived. For this reason, an accurate and objective measurement of color is essential to high-quality color reproduction. Several instruments measure color with varying degrees of accuracy.

A *spectrophotometer* is the most accurate and sophisticated color measuring instrument. This instrument measures the reflective properties of objects, wavelength by wavelength. Spectrophotometers are expensive instruments that require skilled operators. In color reproduction, they are used primarily by ink manufacturers for quality control.

A *densitometer* measures color density and is used for checking dot gain on output. A densitometer does not measure hue.

A *colorimeter* measures color based on the way the human eye sees color. The basis for colorimetric measurement was established in the early 1930s by the Commission Internationale d'Eclairage (CIE), an international organization that standardized color measurement. The Lab color model used in Adobe Photoshop is a transformation of the original CIE chromaticity diagram and was introduced by the CIE in 1976.

SUGGESTED READING MATERIALS:

- *Color and Its Reproduction*

by Gary G. Field
Published by Graphic Arts Technical Foundation (GATF)
4615 Forbes Avenue
Pittsburgh, PA 15213
412-621-6941

- *The Color Mac Design Production Techniques*

by Marc D. Miller and Randy Zaucha
Published by Hayden
11711 N. College Ave.
Carmel, IN 46032

- *Digital Color Prepress; Volumes 1 & 2*

Published by Agfa Corporation
Marketing Communications
Prepress Education Resources
P.O. Box 7917
Mt. Prospect, IL 60056-7917
800-395-7007