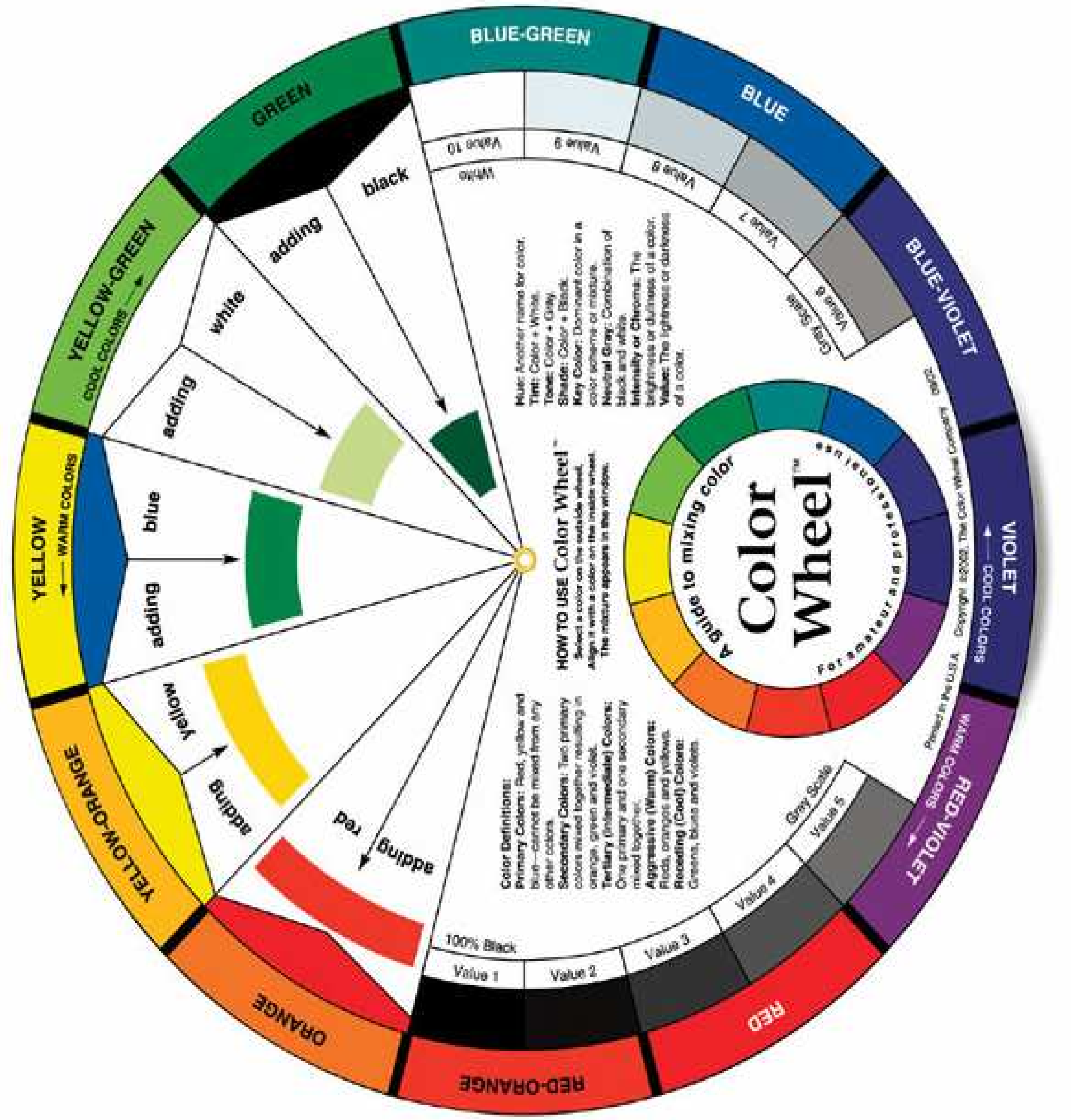
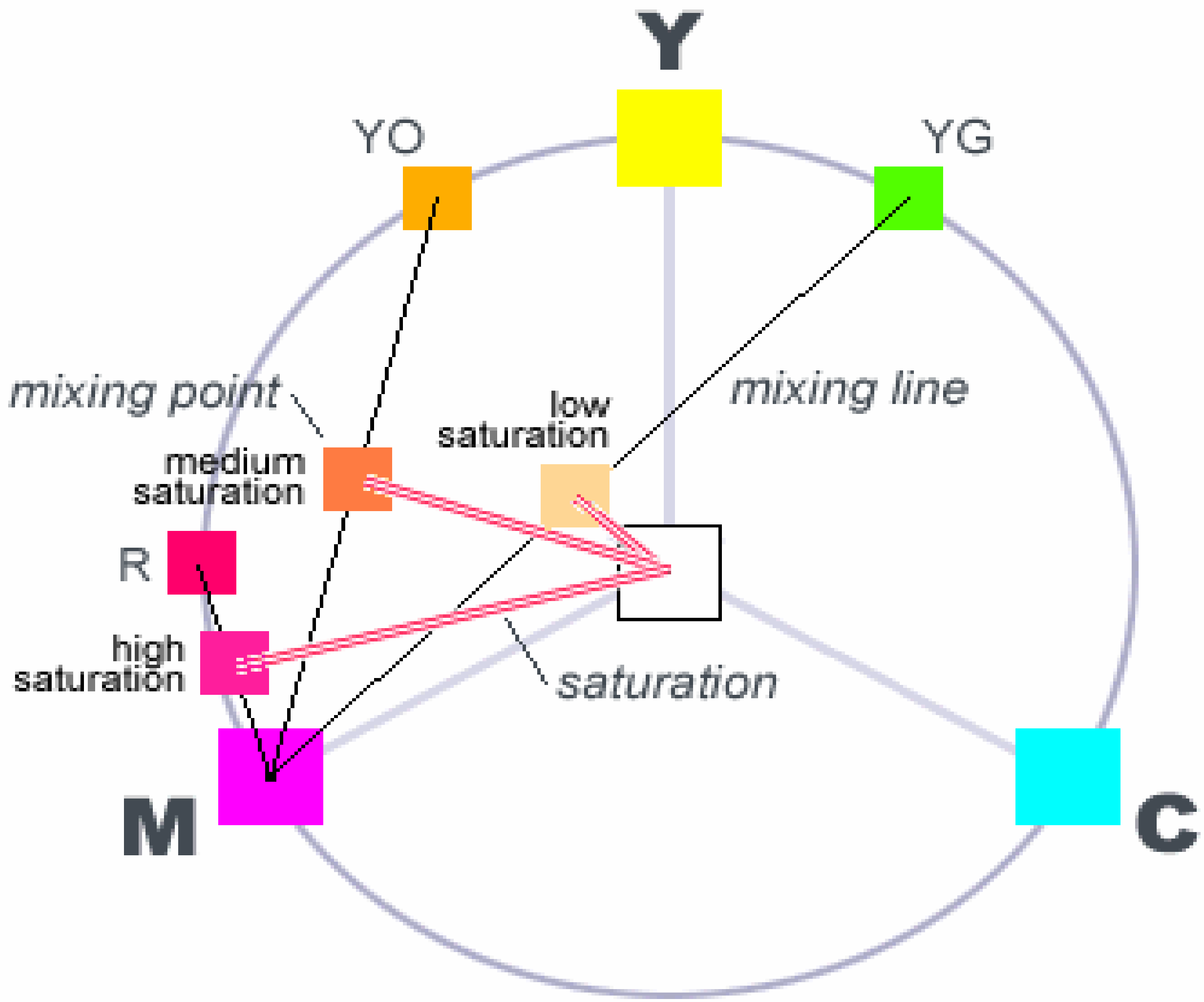
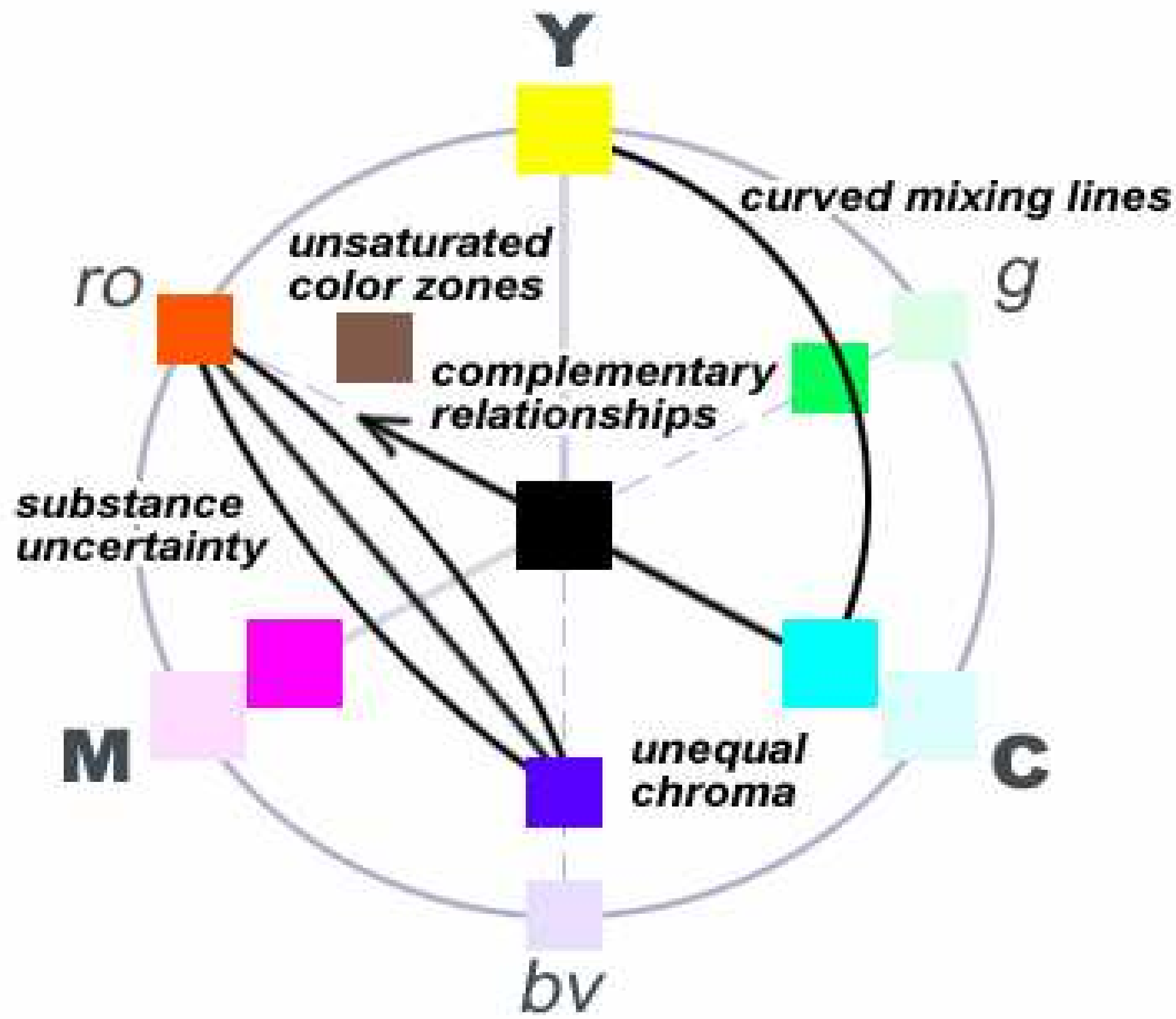
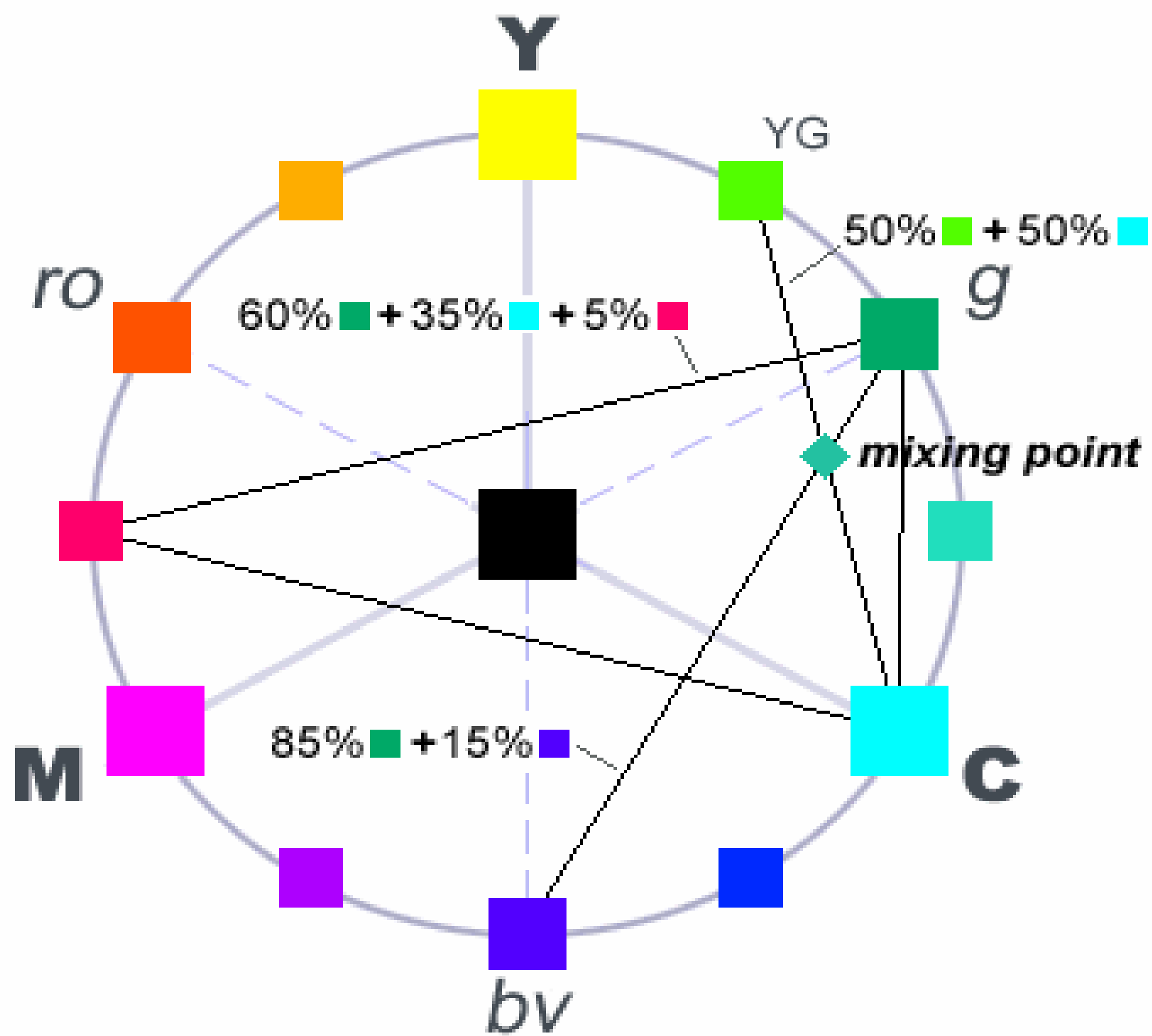


BLUE-GREEN
BLUE
BLUE-VIOLET
VIOLET
COOL COLORS
RED-VIOLET
WARM COLORS
RED
RED-ORANGE
ORANGE
YELLOW-ORANGE
YELLOW
WARM COLORS
YELLOW-GREEN
COOL COLORS
GREEN
adding black
adding white
adding blue
adding yellow
adding red
White
Value 10
Value 9
Value 8
Value 7
Value 6
Gray Scale
Value 5
Value 4
Value 3
Value 2
Value 1
100% Black
Color Wheel
A guide to mixing color
For amateur and professional use
HOW TO USE Color Wheel
Select a color on the outside wheel.
Align it with a color on the inside wheel.
The mixture appears in the window.
Hue: Another name for color.
Tint: Color + White.
Tone: Color + Gray.
Shade: Color + Black.
Color Definitions:
Primary Colors: Red, yellow and blue—cannot be mixed from any other colors.
Secondary Colors: Two primary colors mixed together resulting in orange, green and violet.
Aggressive (Warm) Colors: Reds, oranges and yellows.
Receding (Cool) Colors: Greens, blues and violets.

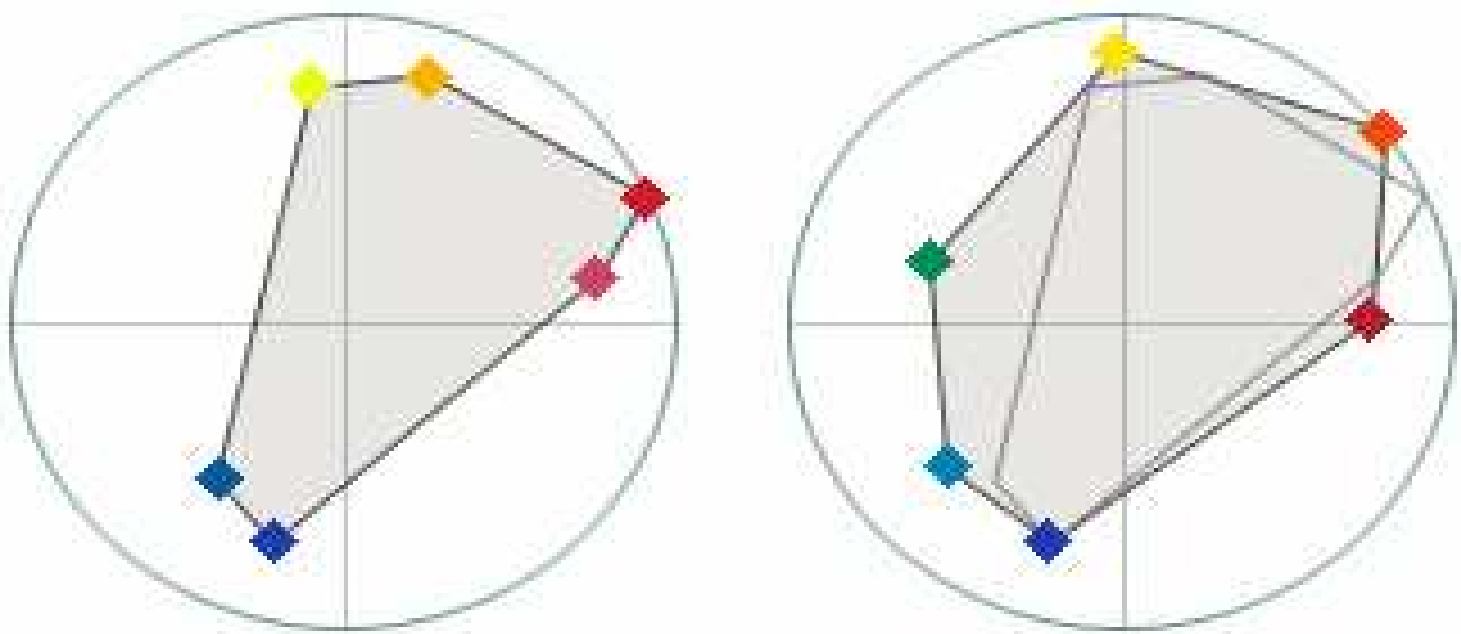

Y
YO
YG
mixing point
medium saturation
low saturation
mixing line
R
high saturation
saturation
M
C



the color mixture problems in a color wheel



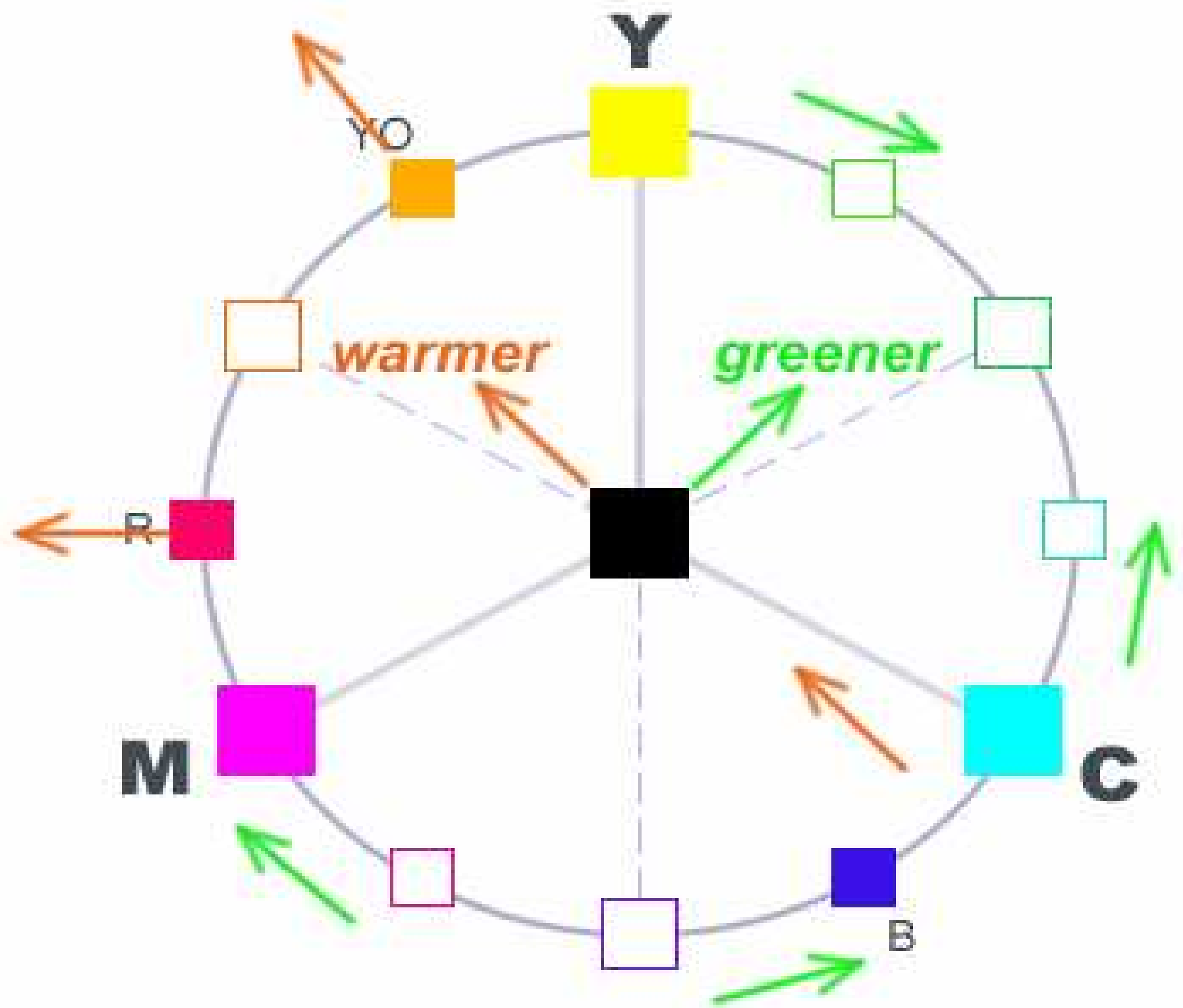
planning color mixtures on a color wheel



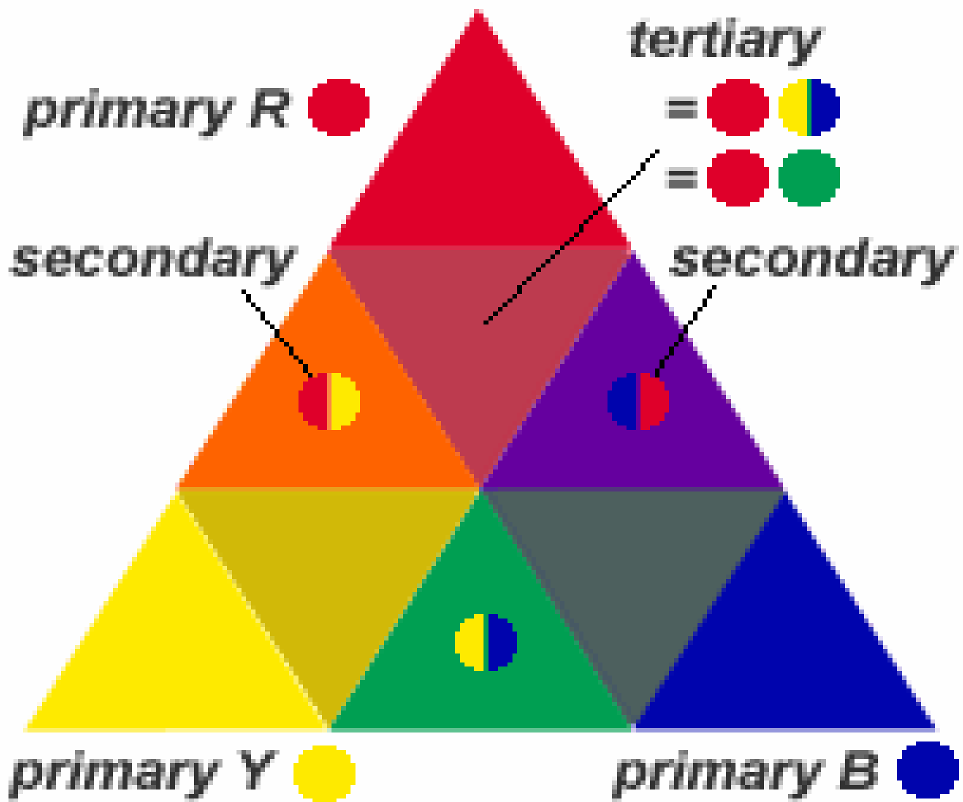
comparing the gamut of two palettes

split primary palette (left) and secondary palette (right) on CIECAM $a_C b_C$ plane

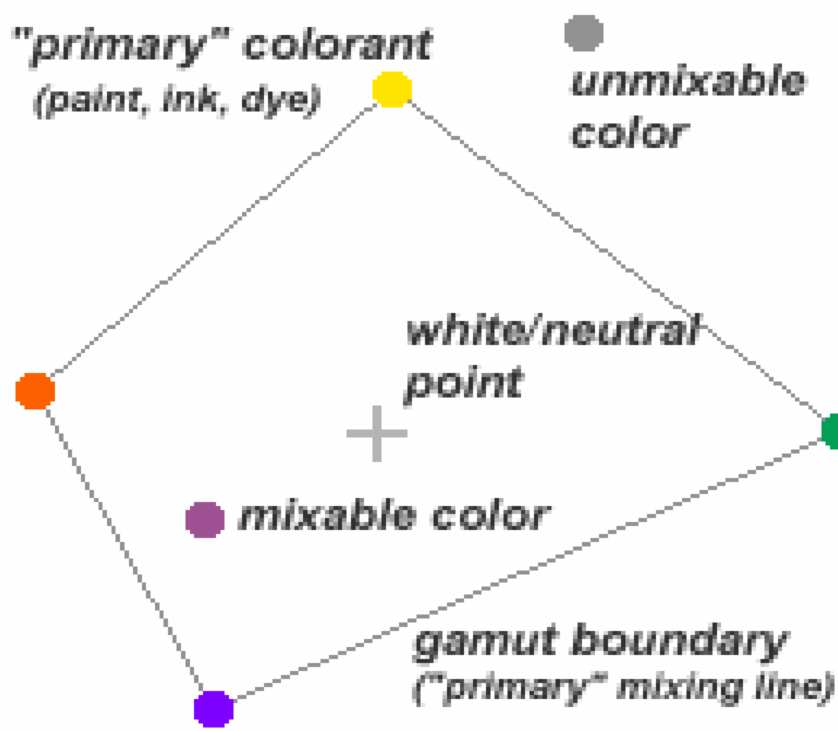
primary and secondary paint mixtures
most saturated hue mixtures using three primary paints (left) or six secondary paints (right)



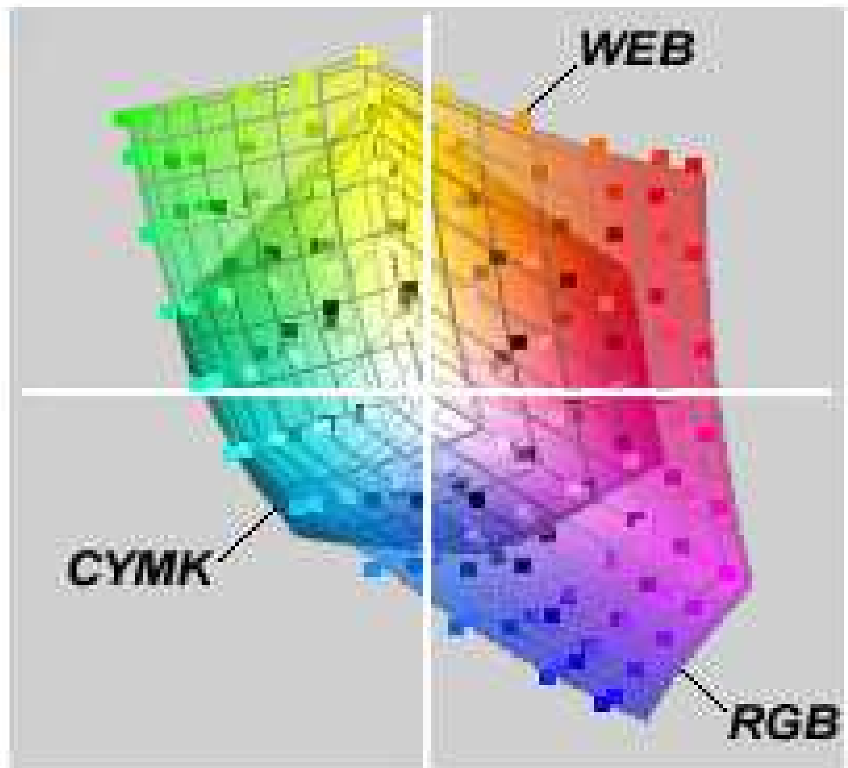
unequally spaced colors and the implied illuminant



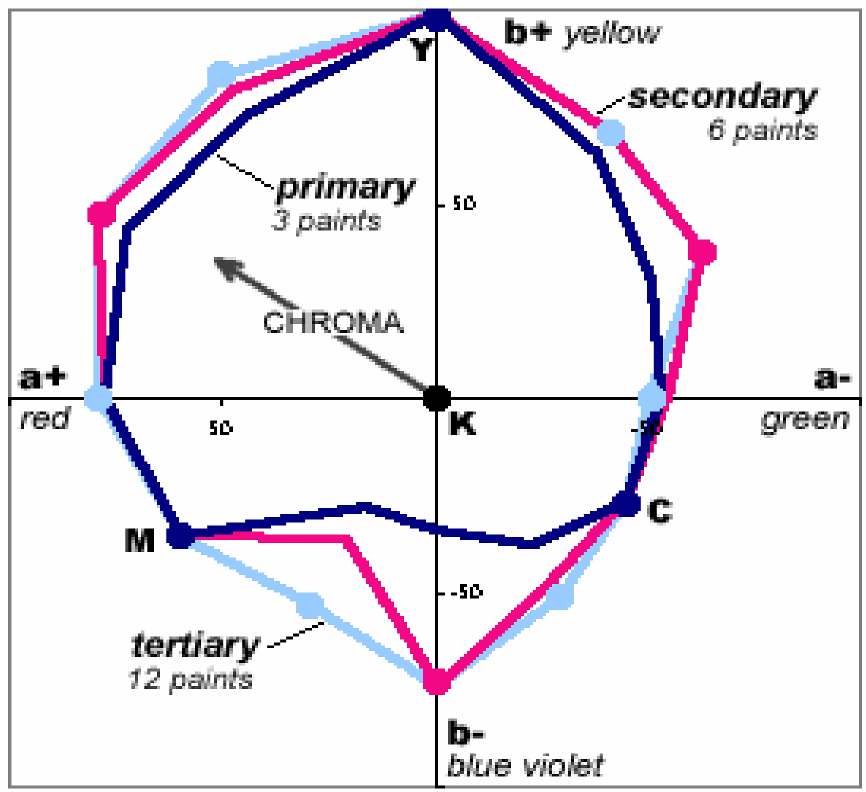
the alternative color theory
definitions of a tertiary color



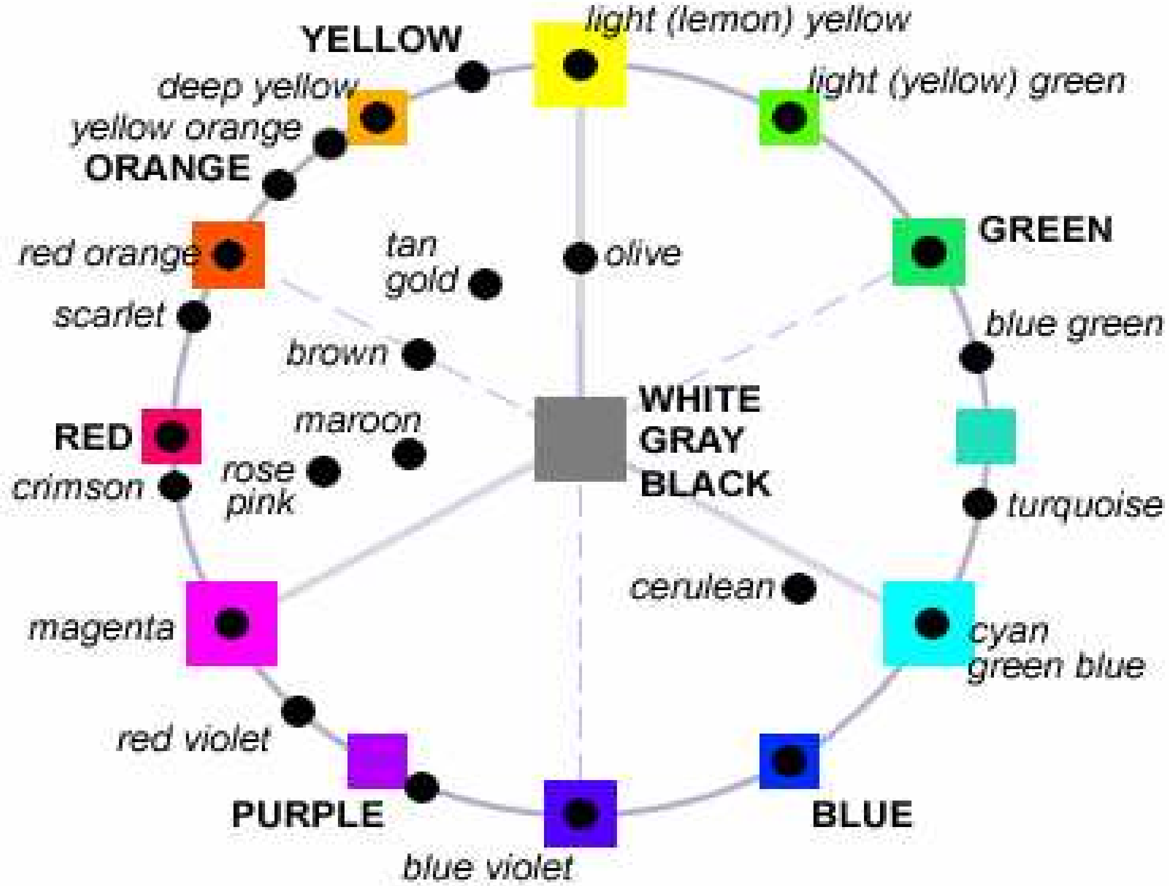
a gamut showing the
chroma limits but not the
lightness range



a CIELAB comparison in three dimensions of the RGB, CYMK and "web safe" gamuts

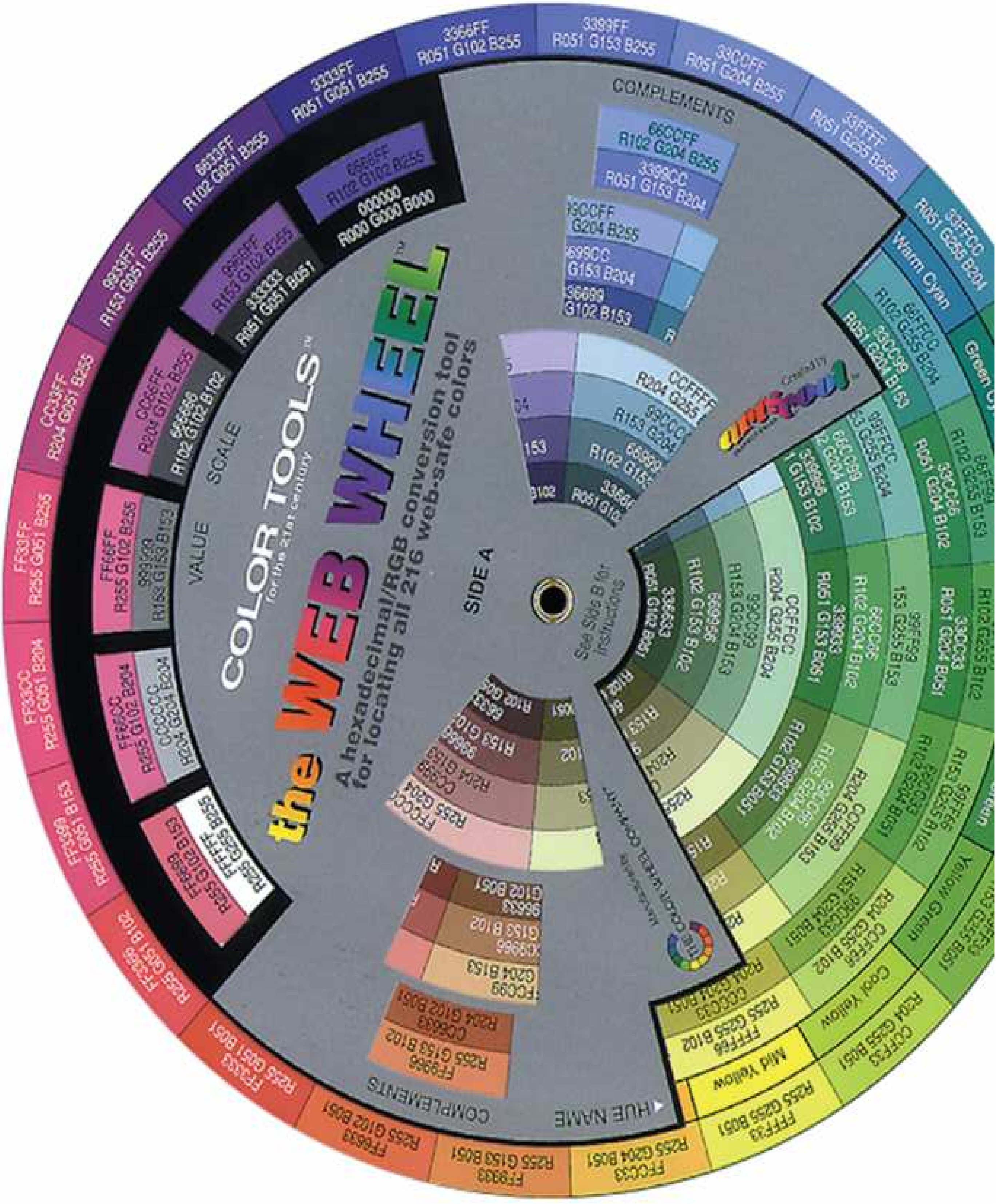


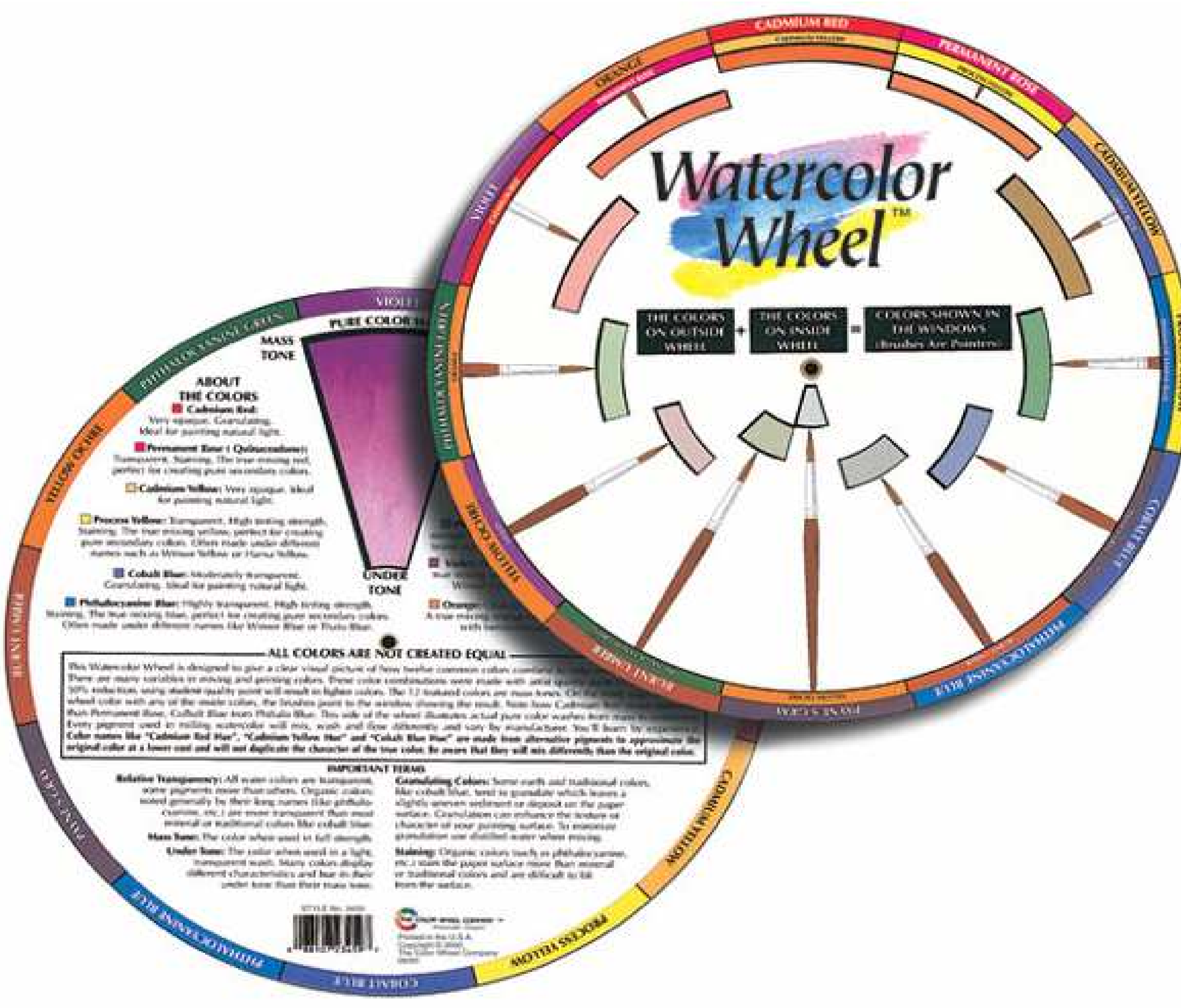
the gamut or maximum chroma of tertiary colors

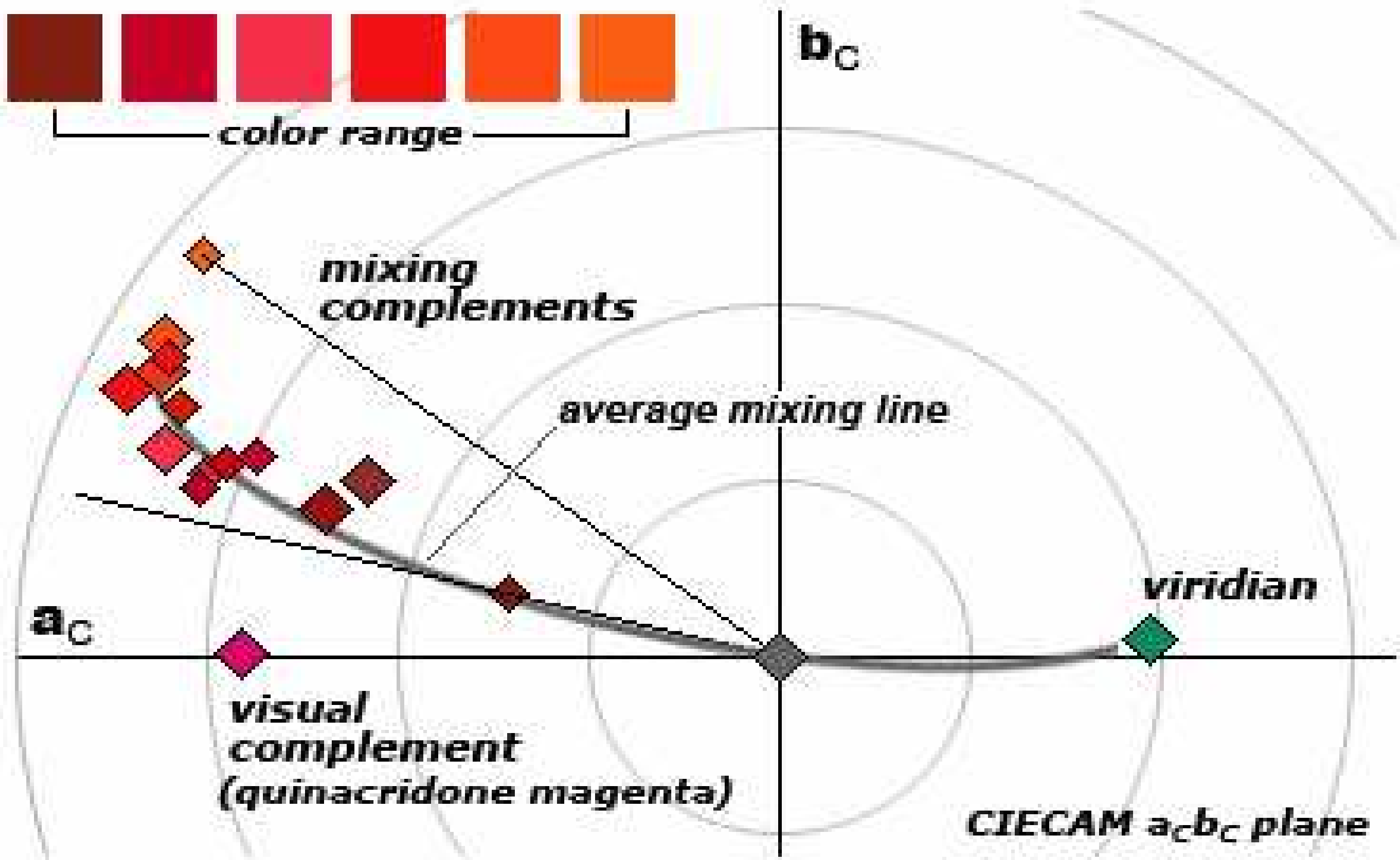


standard hue names around the hue circle

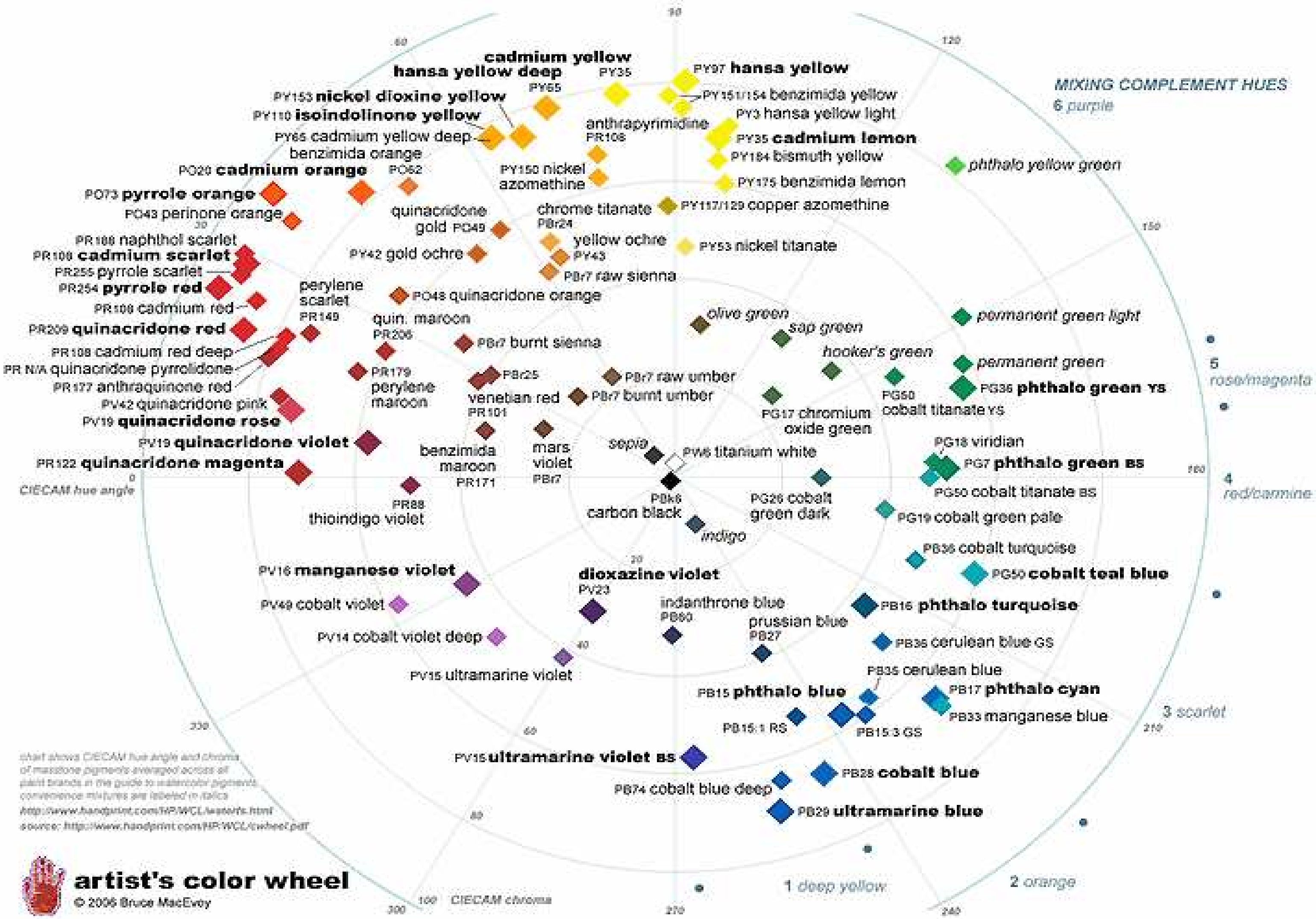
BLUE CYAN
CYAN
BLUE
VIOLET
GREEN CYAN
GREEN
cmy primary mixing wheel
MAGENTA
RED MAGENTA
RED
ORANGE
YELLOW
YELLOW GREEN
COMPLEMENT
Side A
Pure colors
Tones


COLOR TOOLS
for the 21st century
the WEB WHEEL
A hexadecimal/RGB conversion tool for locating all 216 web-safe colors
SIDE A
See Side B for instructions
VALUE
SCALE
COMPLEMENTS
HUE NAME
3333FF R051 G051 B255
3366FF R051 G102 B255
3399FF R051 G153 B255
33CCFF R051 G204 B255
33FFFF R051 G255 B255
33FFCC R051 G255 B204
6633FF R102 G051 B255
9933FF R153 G051 B255
CC33FF R204 G051 B255
FF33FF R255 G051 B255
FF33CC R255 G051 B204
FF3399 R255 G051 B153
FF3366 R255 G051 B102
FF3333 R255 G051 B051
FF6633 R255 G102 B051
FF9933 R255 G153 B051
FFCC33 R255 G204 B051
FFFF33 R255 G255 B051
CCFF33 R204 G255 B051
66CCFF R102 G204 B255
3399CC R051 G153 B204
000000 R000 G000 B000
333333 R051 G051 B051
666666 R102 G102 B102
999999 R153 G153 B153
CCCCCC R204 G204 B204
FFFFFF R255 G255 B255
Warm Cyan
Green Cyan
Yellow Green
Cool Yellow
Mid Yellow

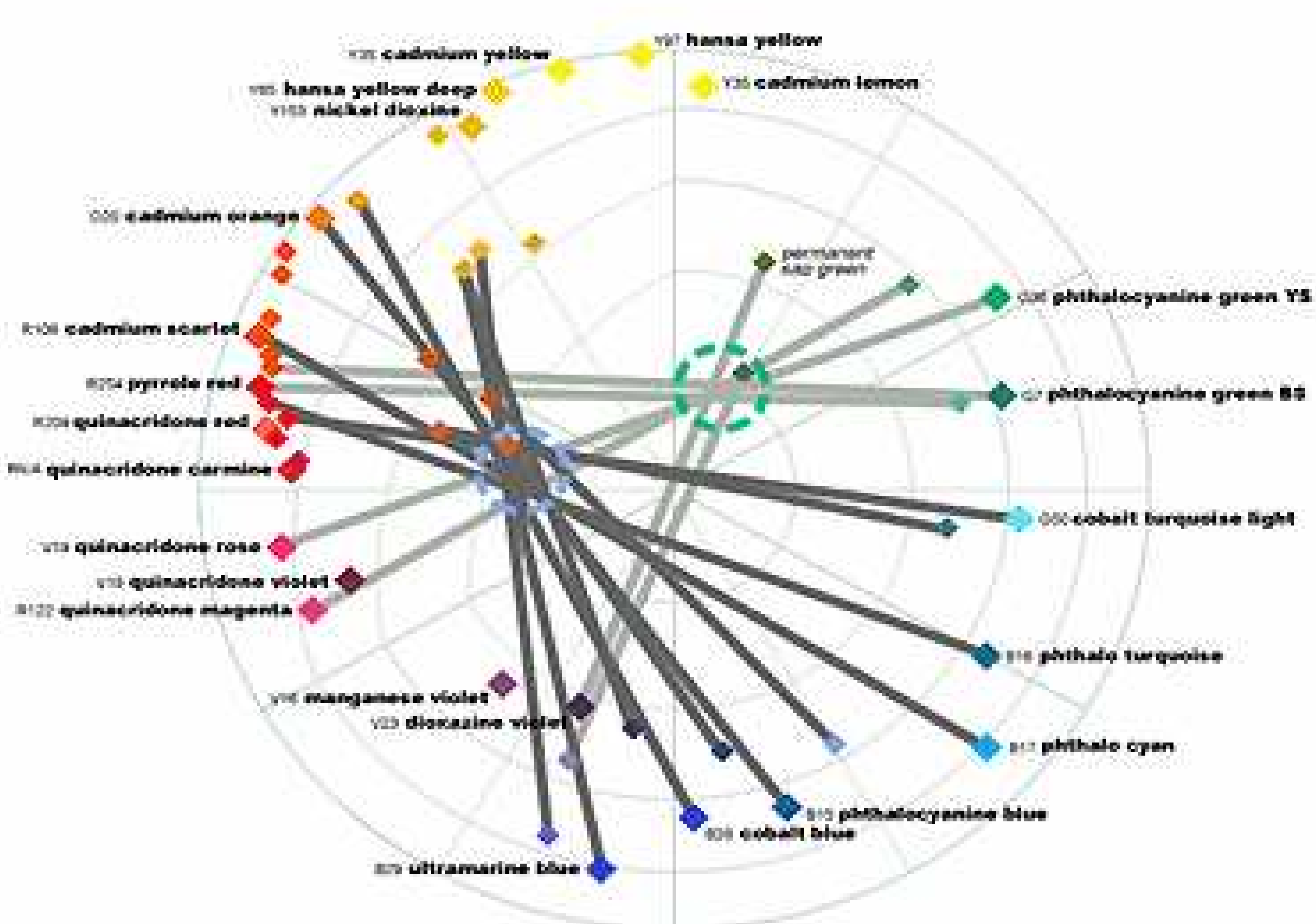

Watercolor Wheel™
THE COLORS ON OUTSIDE WHEEL + THE COLORS ON INSIDE WHEEL = COLORS SHOWN IN THE WINDOWS (Brushes Are Pointers)
CADMIUM RED
PERMANENT ROSE
CADMIUM YELLOW
PROCESS YELLOW
COBALT BLUE
PHTHALOCYANINE BLUE
PAYNE'S GRAY
BURNT UMBER
YELLOW OCHRE
PHTHALOCYANINE GREEN
VIOLET
ORANGE
PURE COLORS
MASS TONE
UNDER TONE
ABOUT THE COLORS
ALL COLORS ARE NOT CREATED EQUAL
IMPORTANT TERMS



visual & mixing complements of viridian



Download the high quality PDF version



mixing lines between blue and green pigments and their mixing complementary "warm" pigments

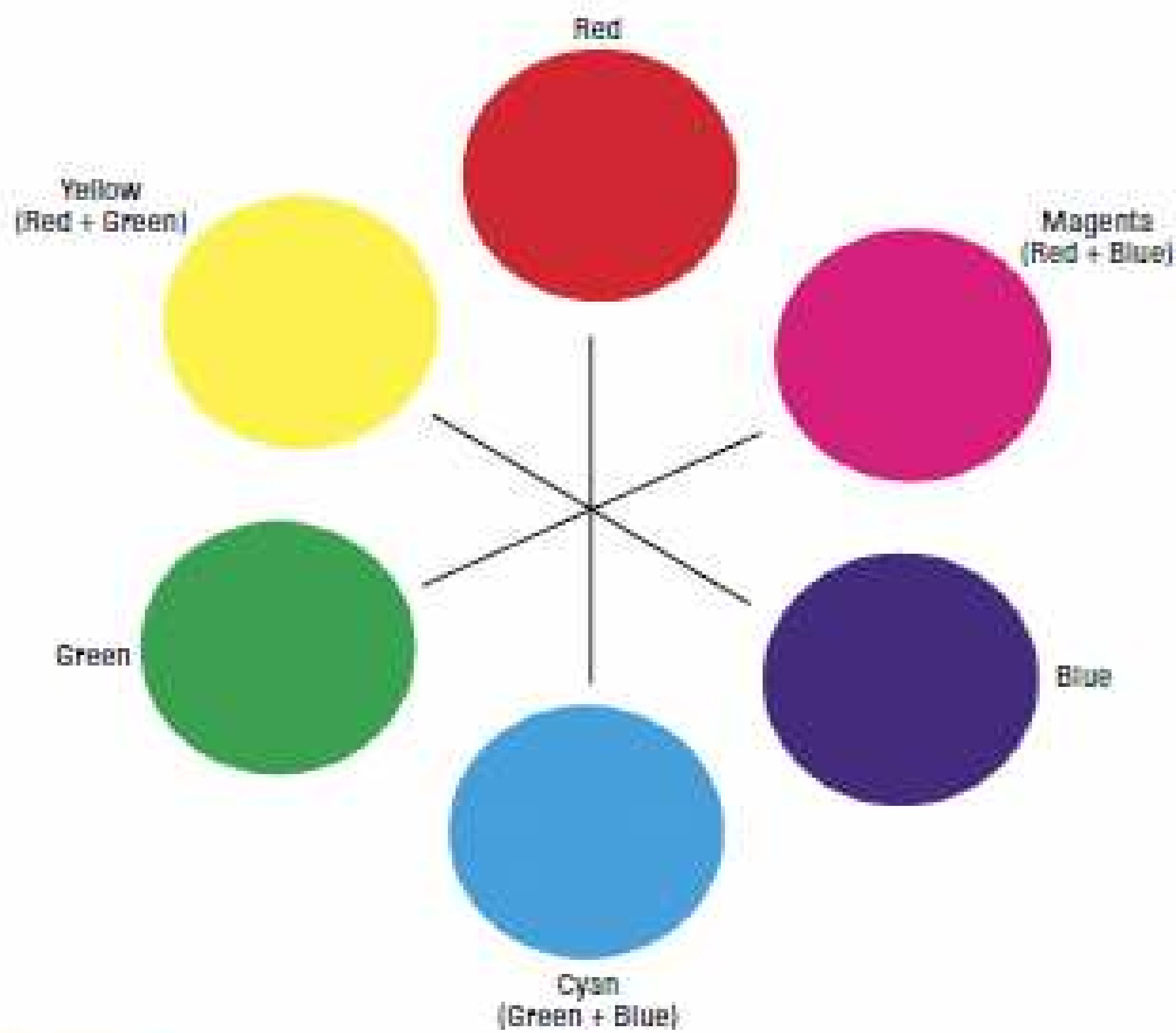
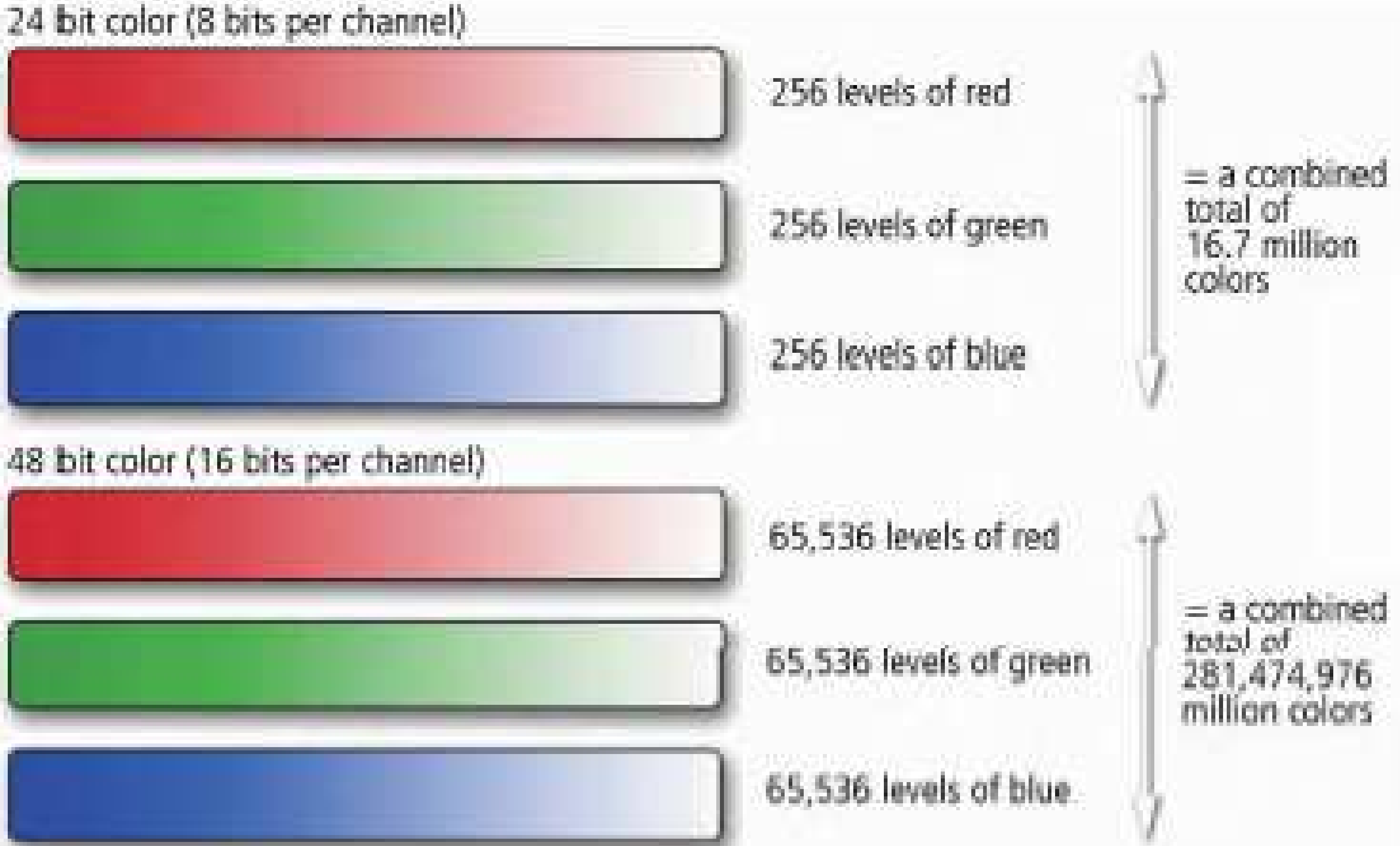
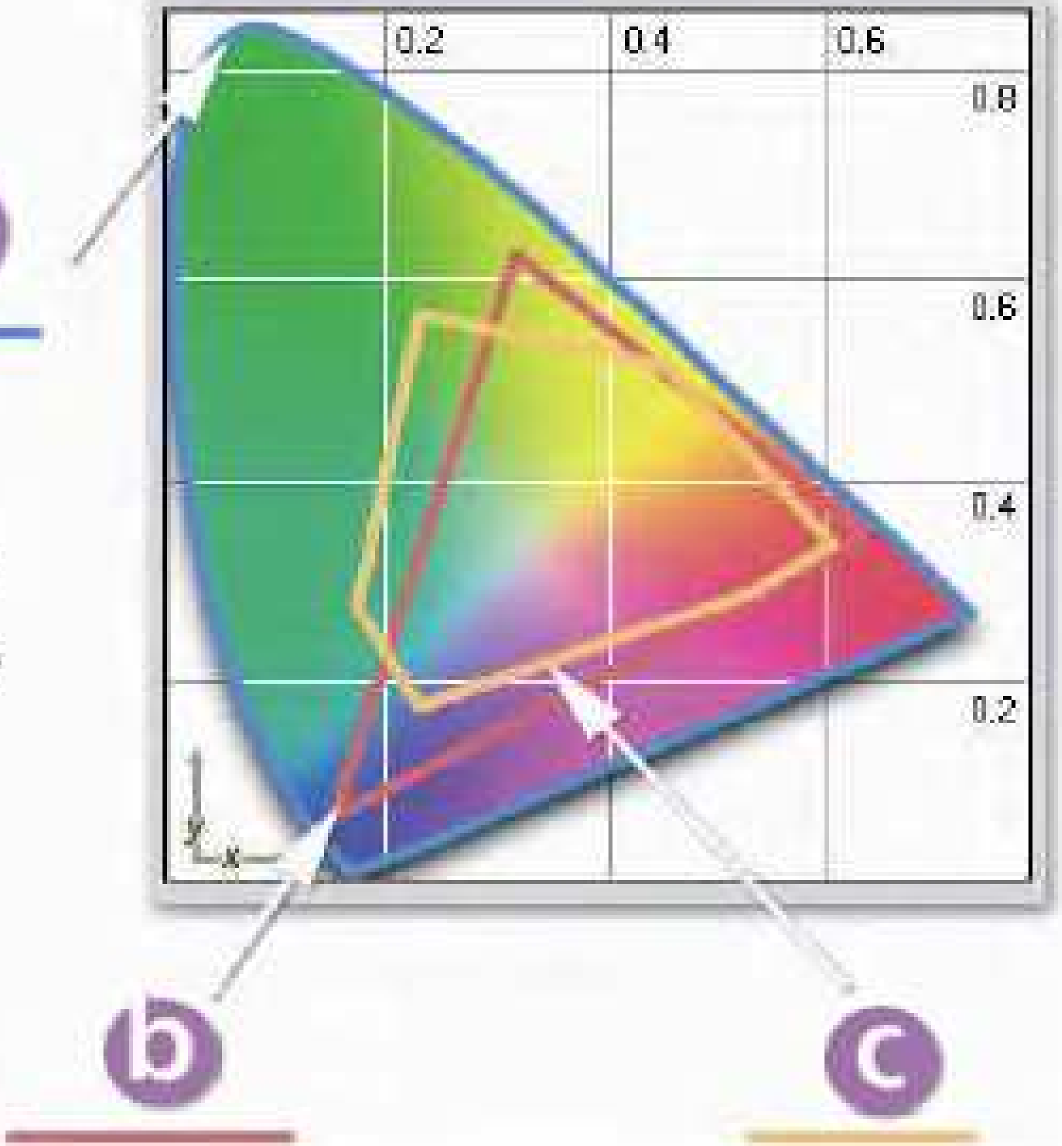


Figure 1-1: This simple color wheel shows red, green, and blue hues.



8 bit versus 16 bit *Digital photographs captured in 16 bit per channel mode contain a greater number of colors than those captured with 8 bits.*

Color and digital devices >> The devices used to capture, process and output color pictures all respond to color in a different way. Each piece of hardware is only capable of working with a subset of all possible hues. This range of colors is called the device's color gamut. (a) Camera gamut. (b) Screen gamut. (c) Printer gamut.
Graph images generated in ICCToolbox, courtesy of www.icctools.com.



Color gamut >> The difference between the gamuts of different devices can lead to photographers not being able to match what they see on screen with printer output.
(a) All visible colors.
(b) Screen colors.
(c) Printable colors.
Graph generated in ICCToolbox, courtesy of www.icctools.com.

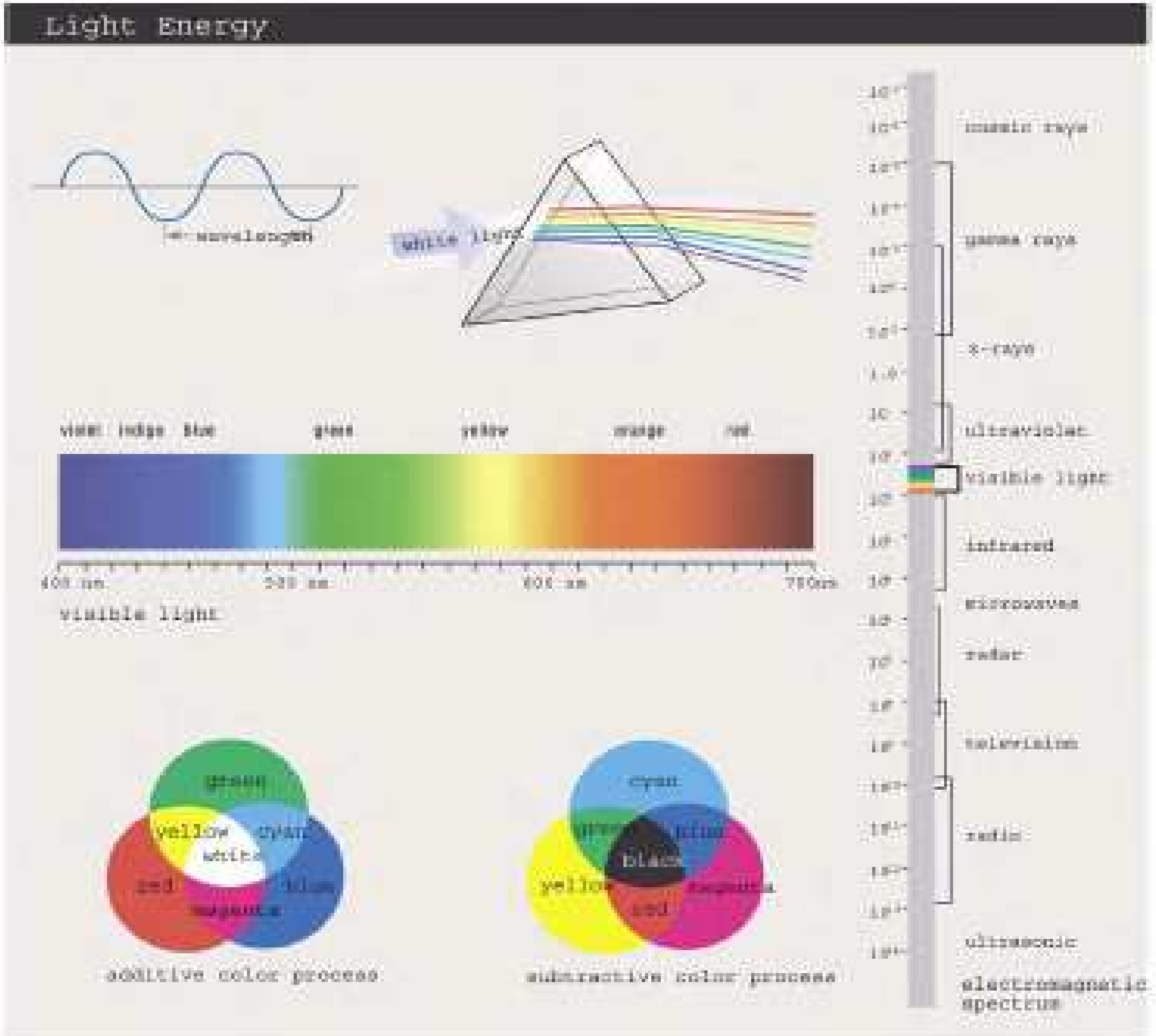
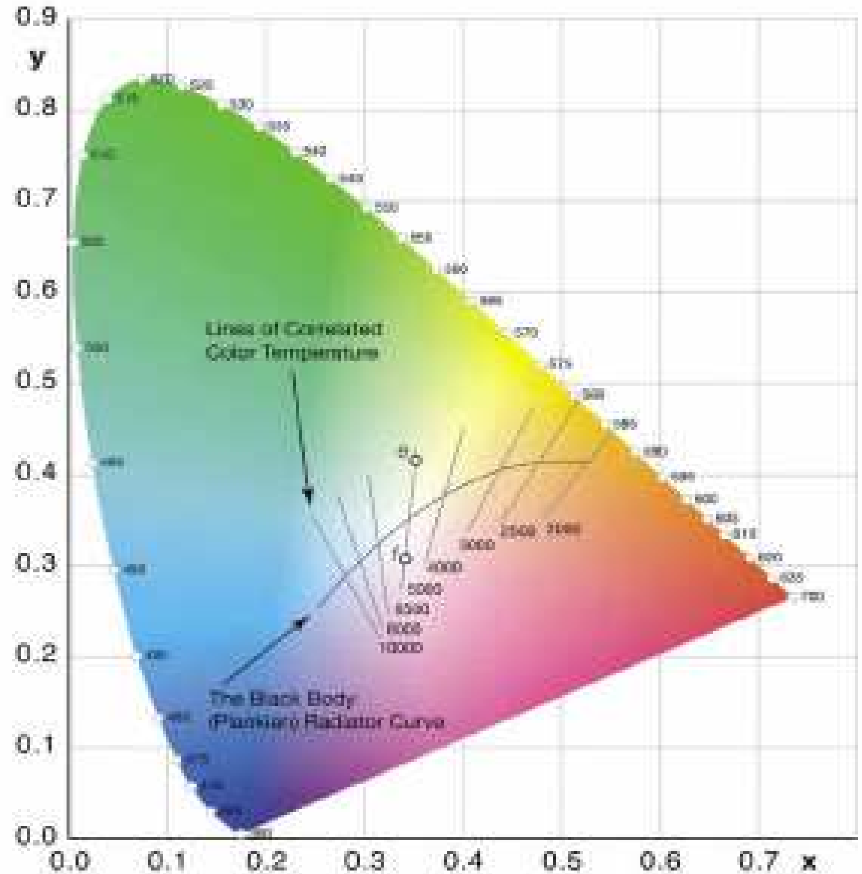
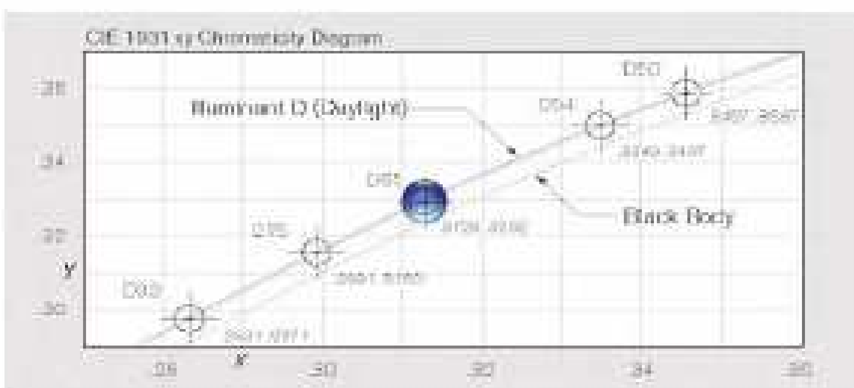


Fig. 1-5 Light is a form of electromagnetic radiation. After being passed through a prism the visible light spectrum can be seen from violet (400 nm) to red (700 nm). This illustration also shows how both additive and subtractive primaries can produce white or black as well as many other colors. (Illustration Courtesy of GretagMacbeth)



A

Fig. 1-6A The lines of correlated color temperature and their relationship to the blackbody curve are seen in this illustration. The lines of CCT run roughly perpendicular to the blackbody from green/yellow to orange/violet. Take note that all the colors along a line of CCT can be labeled with the same color temperature. The colors marked "e" and "f" in the diagram may both be described as 5000 K. (Illustration by Karl Lang)



B

Fig. 1-6B This screen capture from the Sony Artisan display software illustrates a close-up of the blackbody curve and above it, what is known as the daylight curve. Here the standard illuminants are plotted. The spectra of the D illuminants can be converted to xy and plotted on the CIE Chromaticity diagram as this daylight curve.

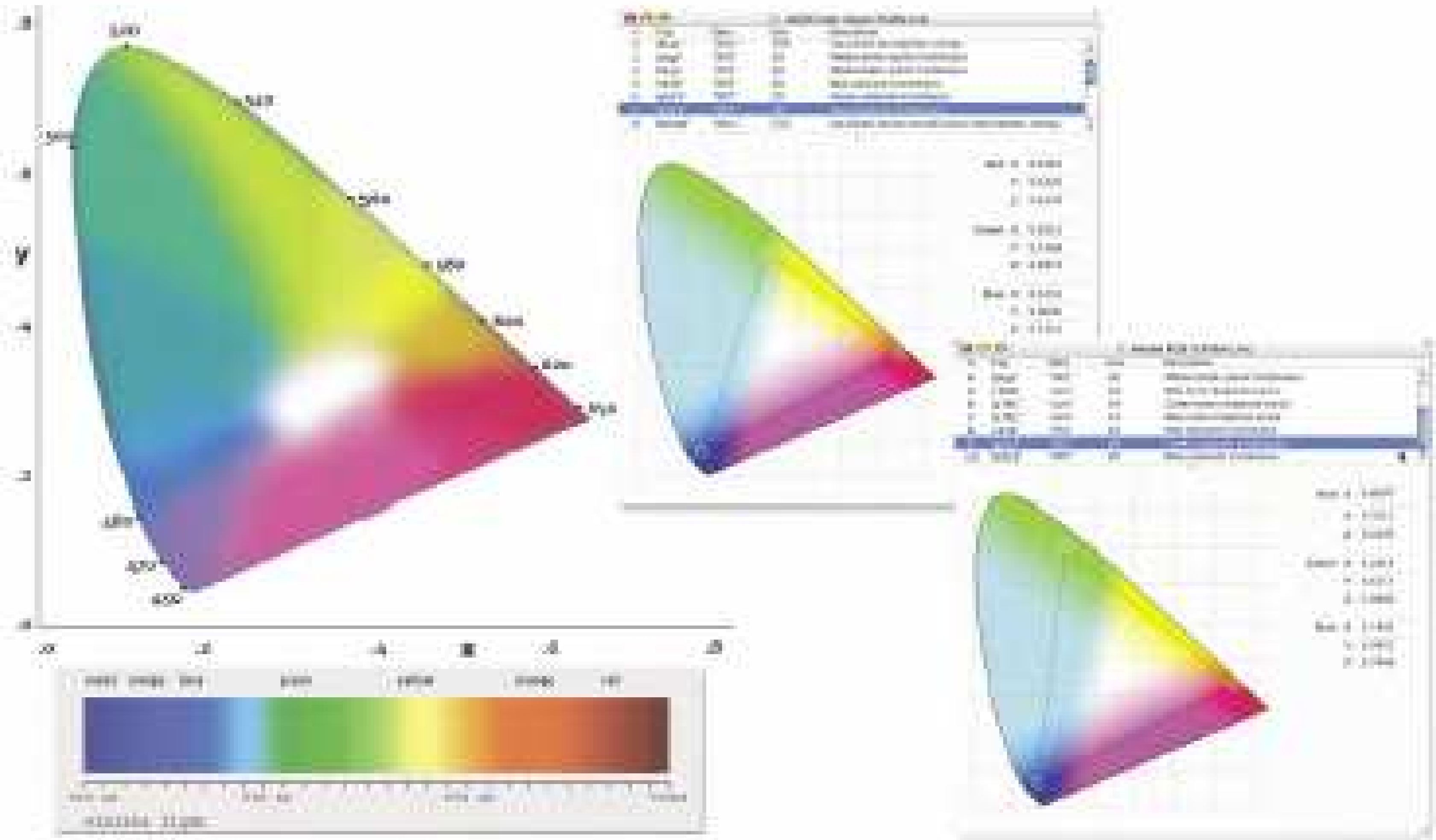


Fig. 1.7 The good old CIE Chromaticity Diagram seen here is a staple for color geeks everywhere. This horseshoe-shaped diagram represents the gamut of human vision. The pure visible wavelengths from 380 nm to 700 nm can be seen around the edge of the diagram. The two CIE Chromaticity Diagrams to the right show the gamut plots of sRGB and Adobe RGB (1998). Notice the triangles that form the boundaries of the color space for sRGB (top) and Adobe RGB (1998) are different. The greenest green in Adobe RGB (1998) is much more saturated than the greenest green in sRGB.

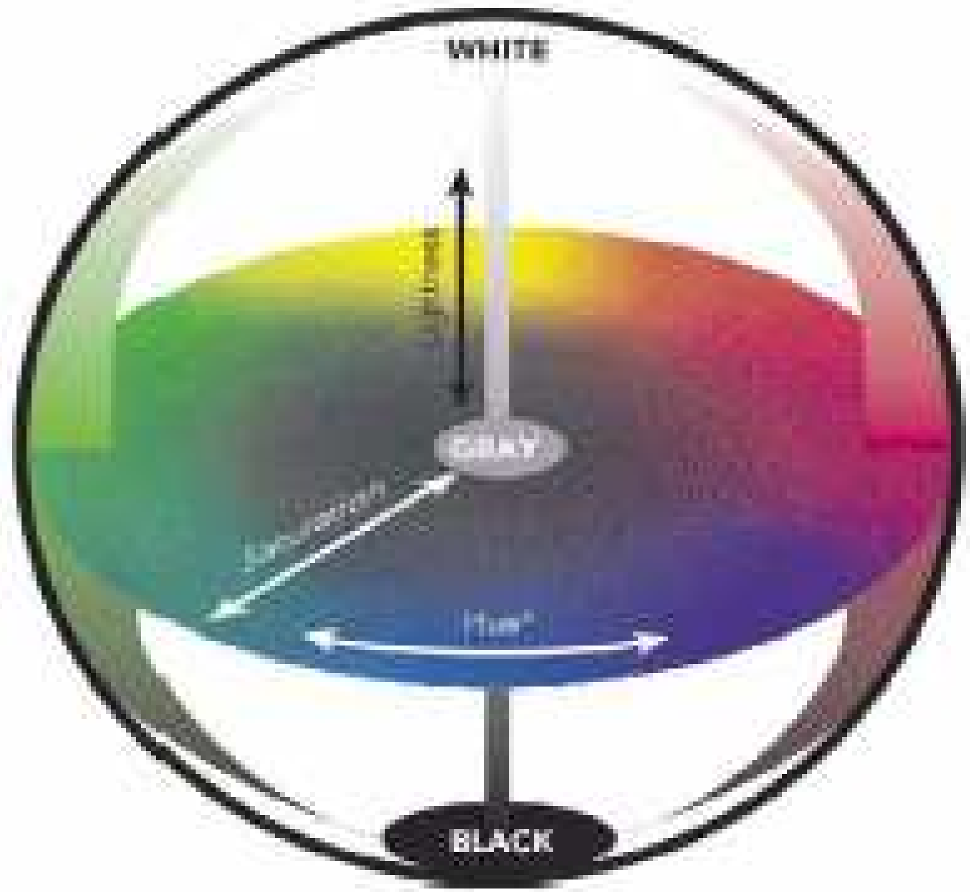


Fig. 1-8 It is somewhat difficult to show a three-dimensional color sphere on a flat page, yet this illustration courtesy of X-Rite does a great job of showing how hue, saturation, and lightness are plotted in such a space. In this globe, white to black is plotted vertically running through the center of the sphere. Saturation runs from the center of the sphere outward with gray in the center of the sphere and full saturation running the equator. Hue (color) runs 360 degrees around the equator.

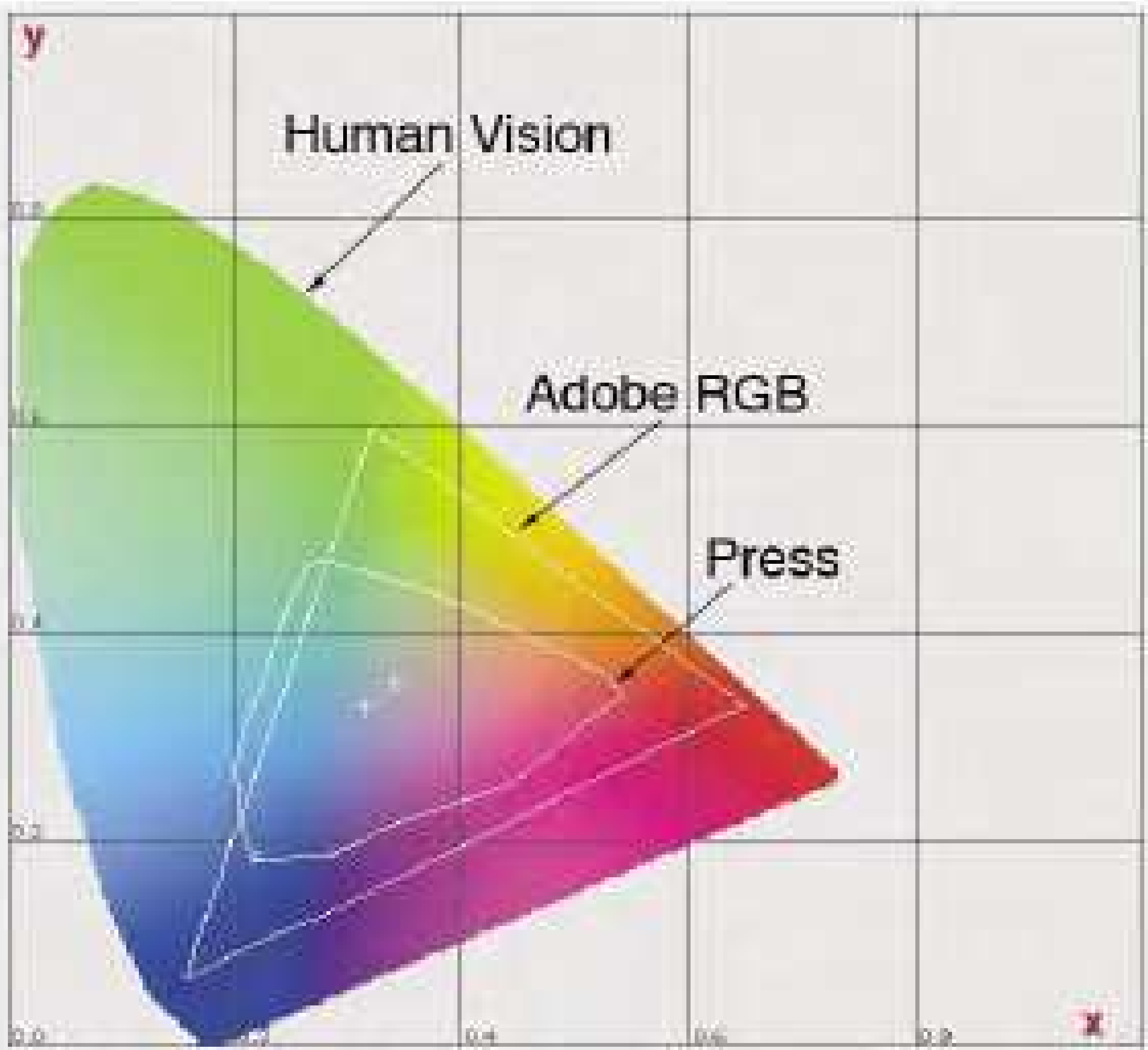


Fig. 1-9 This CIE chromaticity diagram shows the gamut of two color spaces: Adobe RGB (1998) and a typical printing press. The entire diagram indicates the color gamut visible to the human eye.

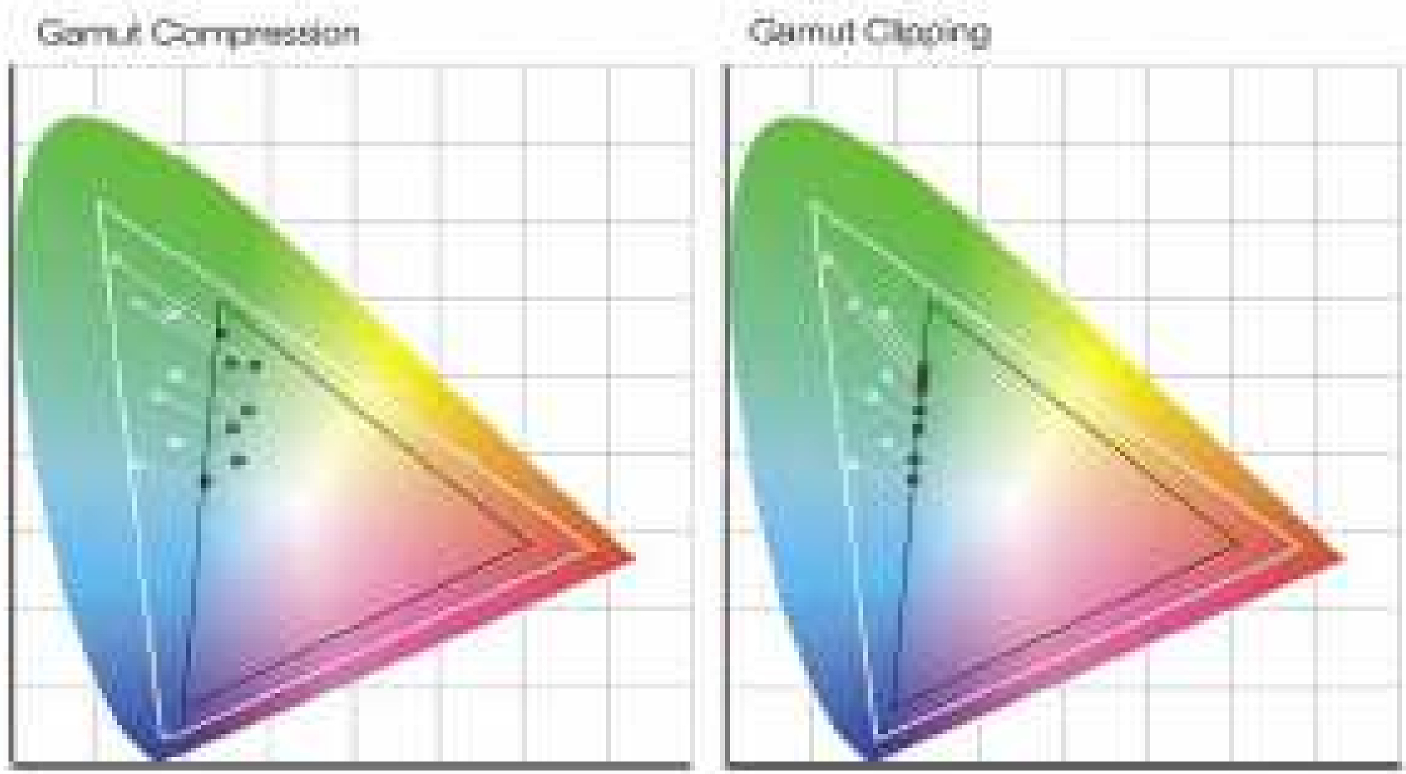
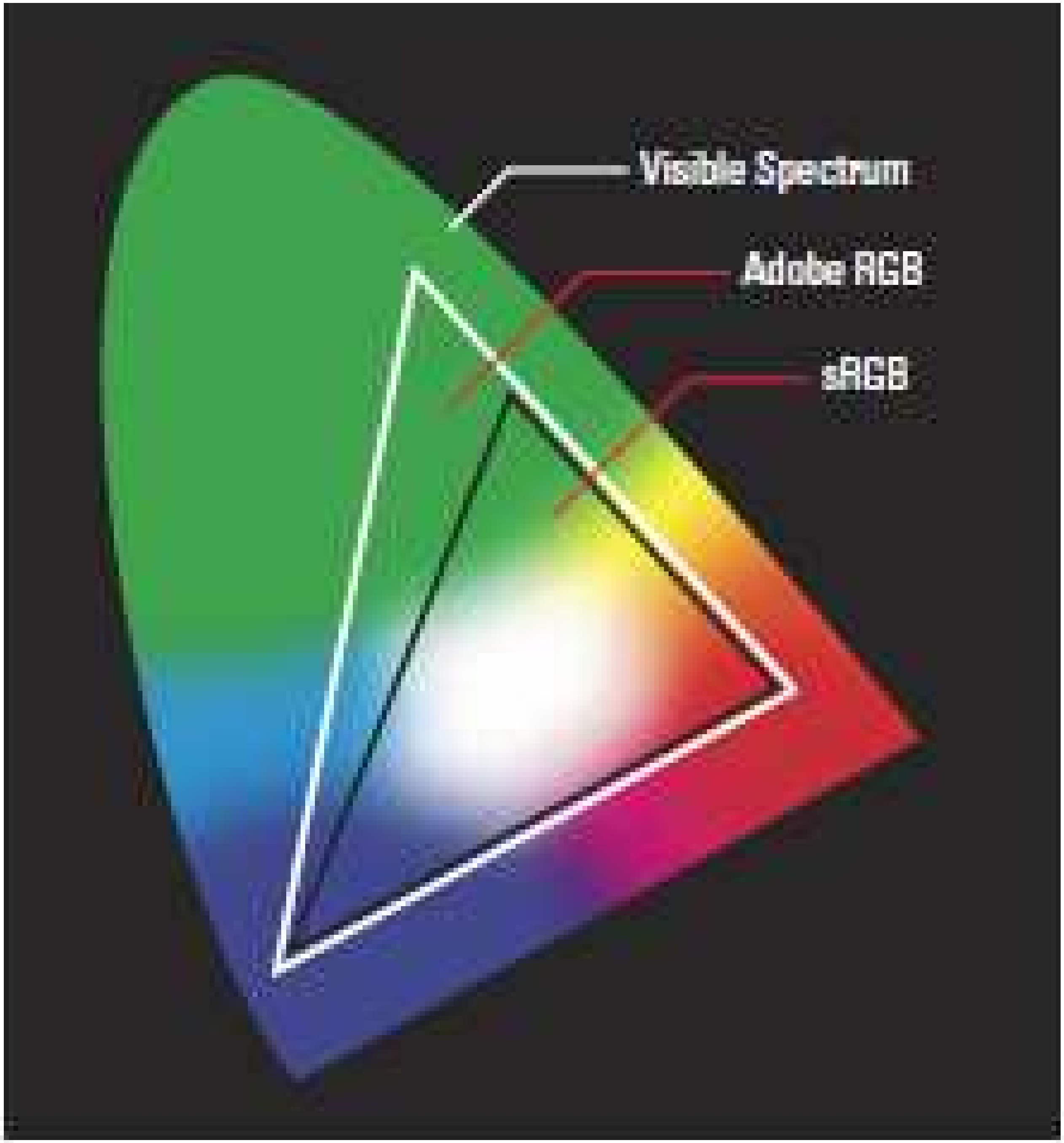


Fig. 1-11 This illustration shows the primary differences in gamut compression and gamut clipping using rendering intents. (Illustration by Karl Lang)



Visible Spectrum
Adobe RGB
sRGB

sRGB

This color space is an attempt at defining a RGB standard promoted by HP and Microsoft. sRGB was intended for low-end devices such as consumer digital cameras, scanners, and printers, as well as viewing images on the Internet. sRGB was derived from HDTV standards and as such, very detailed specifications of phosphors, gamma, and viewing conditions define sRGB. It is questionable how many displays actually produce these exacting specifications, at least without calibration. sRGB has the most limited color gamut of Photoshop-installed RGB working spaces, however sRGB does use a 2.2 gamma encoding.

Unless you wish to deal with only low-end output devices or output images on the Internet, sRGB is not the best RGB working space for professionals. This is due to sRGB missing a good deal of RGB gamut needed for more sophisticated output needs including print work. If you have to send an RGB document to an unsophisticated client who will view the document on a PC outside of an ICC-aware application, sRGB is a good option. sRGB is also a good color space to save images intended for the World Wide Web since the vast majority of such users are working on uncalibrated displays on a PC and as yet, so few Web browsers are ICC savvy. See the sidebar, "The sRGB Debate."

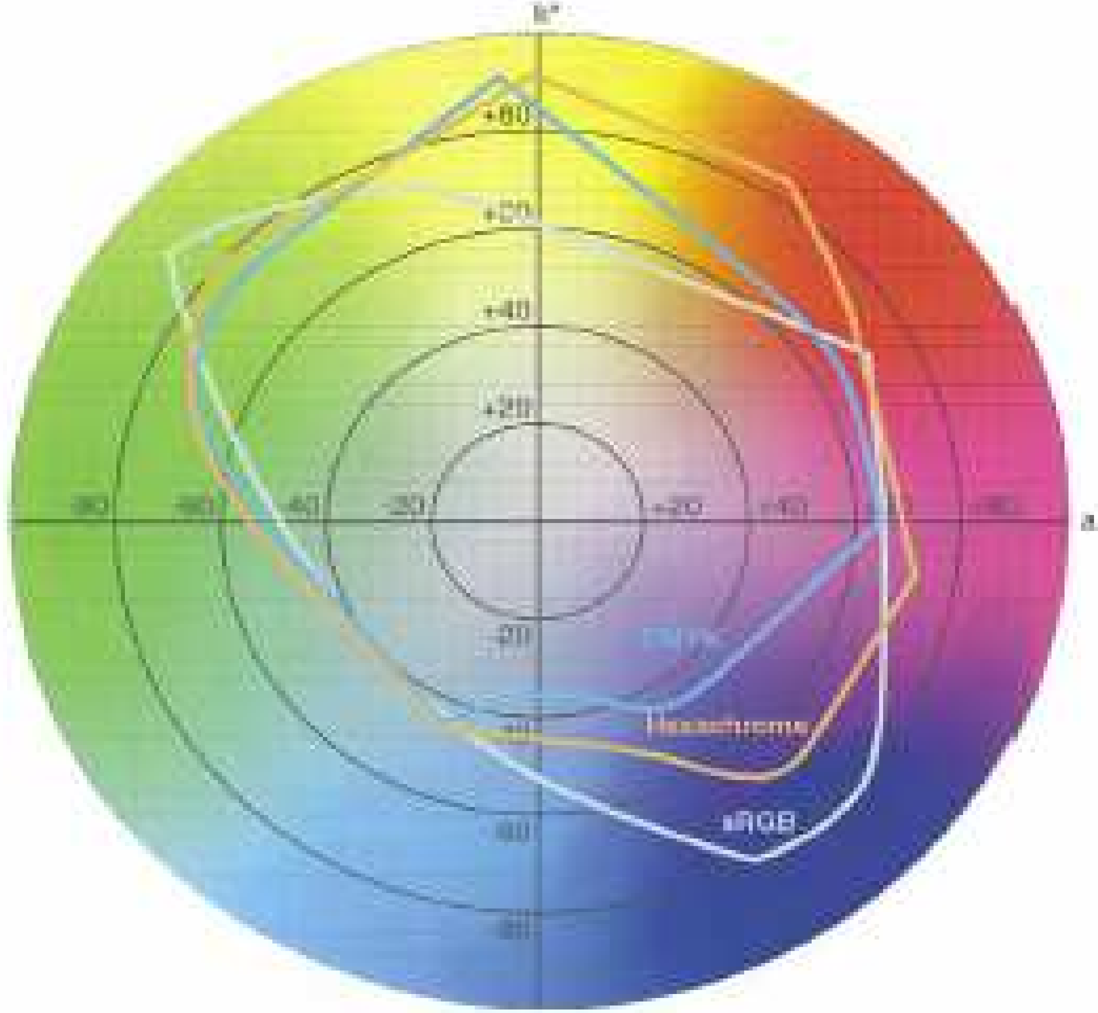


Fig. 7-12 The extended gamut of Hexachrome is seen in this 2D map courtesy of Pantone. The orange outline is the gamut of Hexachrome, which is significantly larger than the darker blue outline of conventional four-color CMYK. Notice how the addition of orange and green inks extend the gamut in those colors.

Figure 4-5: The RGB color model is based on red, green, and blue light.

Figure 4-6: The print color model is based on cyan, magenta, and yellow ink.

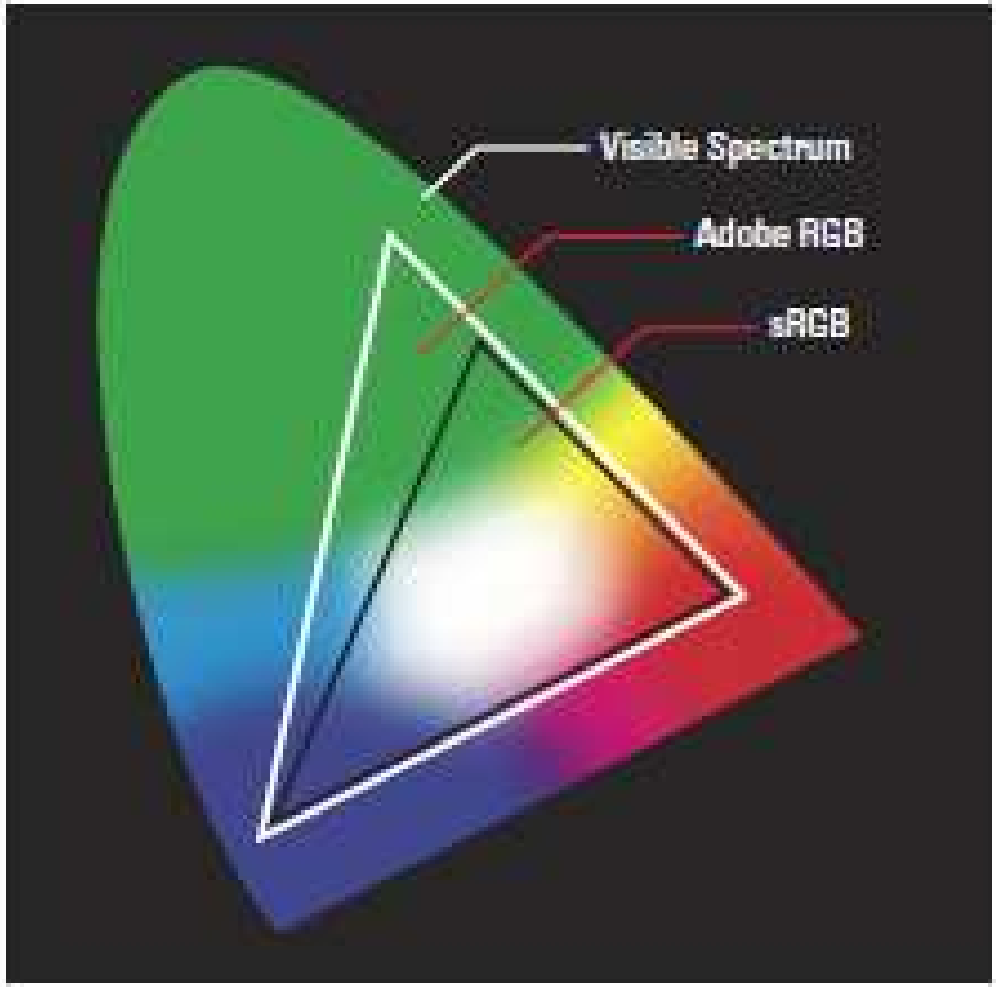
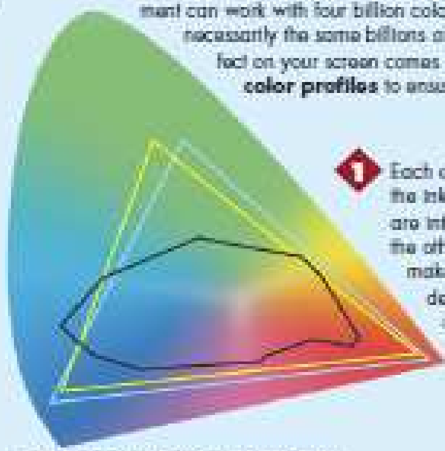


Figure 4-7: The Adobe RGB spectrum includes more colors than sRGB.

How Color Calibration Works

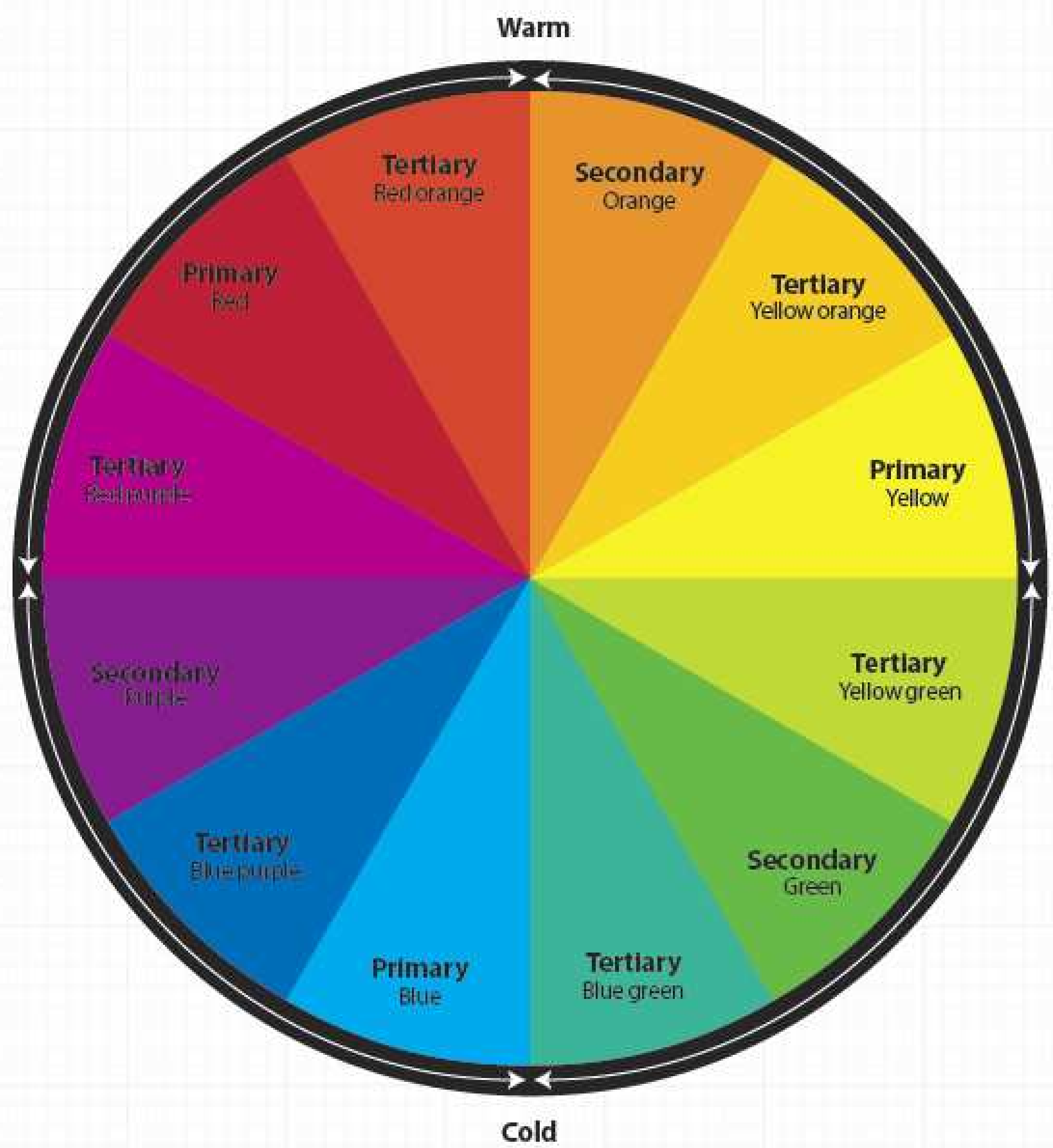
It might be true that a rose is a rose is a rose. But a red rose is not a red rose is not a red rose. Although there are only seven basic colors in the spectrum, there are so many shades and tones that the number of colors the human eye perceives quickly jumps into the quadrillions. Needless to say, at least a few million of them are some variation of red. The trouble is that none of the hardware used in digital photography—cameras, scanners, LCD screens, CRT monitors, printers, and projectors—can capture or display all those colors. At best, most equipment can work with four billion colors. The problem is that the billions of colors your monitor can display are not necessarily the same billions of colors your printer can produce. That's why a photograph that looks dead-on perfect on your screen comes out of your printer murky and off-color. It's the job of **color calibration** and **color profiles** to ensure a red from your scanner is a red on your monitor is a red on a print.



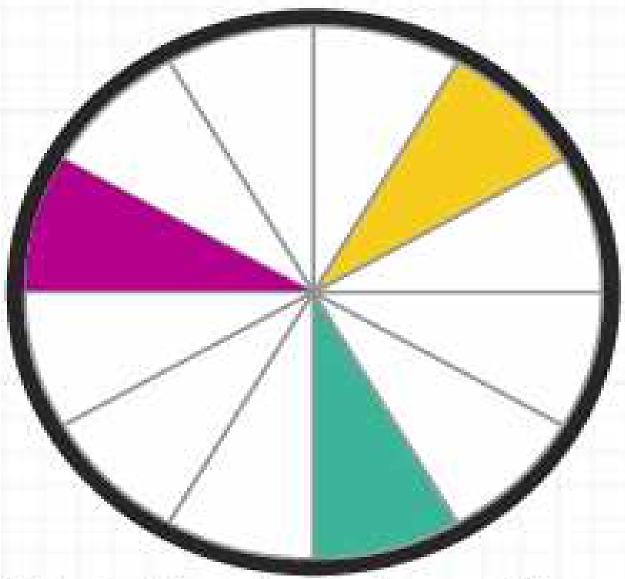
1 Each device that produces or measures color has its own **color space** based on the inks, dyes, pigments, phosphors, lights, filters, and other colored materials that are intrinsic to how the device handles color. None of these color spaces match the others' precisely, not even two identical monitors of the same model and maker. Over time a device's color space might not even match itself. Phosphors decay, inks fade, and even the changing temperature of the day can alter the color space of some hardware.

2 As a result, colors can change unpredictably as a graphic works its way through the production process. The solution is to **calibrate** all the graphics hardware so their results are consistent.

3 Because the human eye and perception are notoriously unreliable, most color calibration systems use a **colorimeter**, a device that measures the intensity and color of light. The colorimeter is placed on a computer screen while accompanying software displays specific shades of gray, blue, red, and green. (It can be used with TVs and other color sources, as well.)

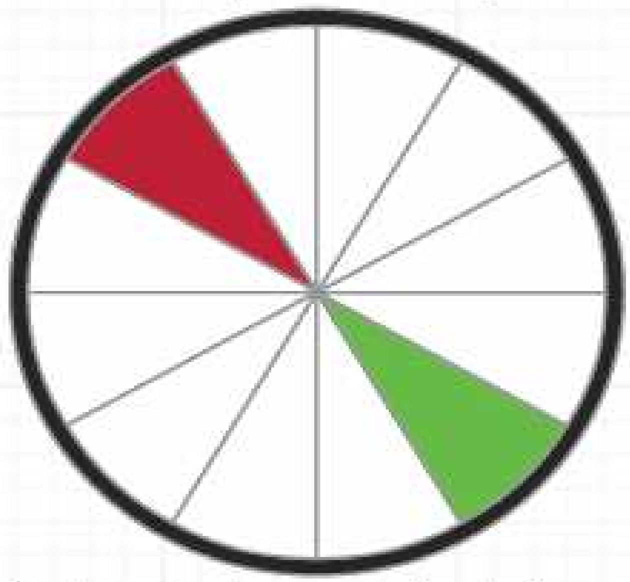

Warm
Tertiary
Red orange
Secondary
Orange
Primary
Red
Tertiary
Yellow orange
Tertiary
Red purple
Primary
Yellow
Secondary
Purple
Tertiary
Yellow green
Tertiary
Blue purple
Secondary
Green
Primary
Blue
Tertiary
Blue green
Cold

Triads



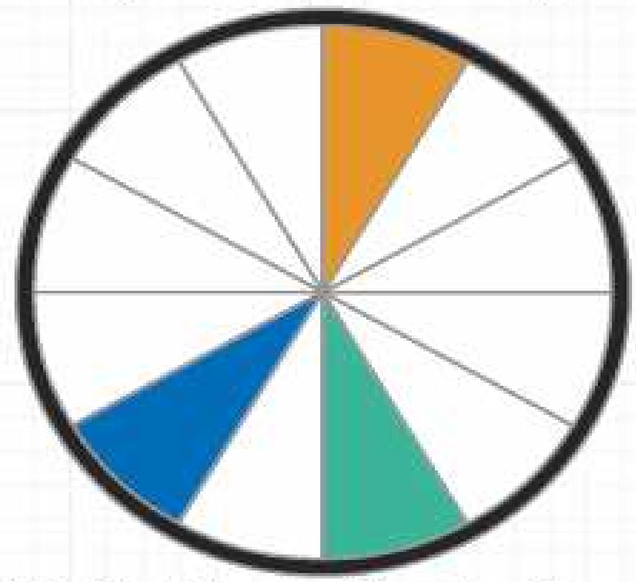
Triads refer to three colours that have equal distance between each other on the colour wheel. They contrast with one another and give a powerful effect.

Complementary



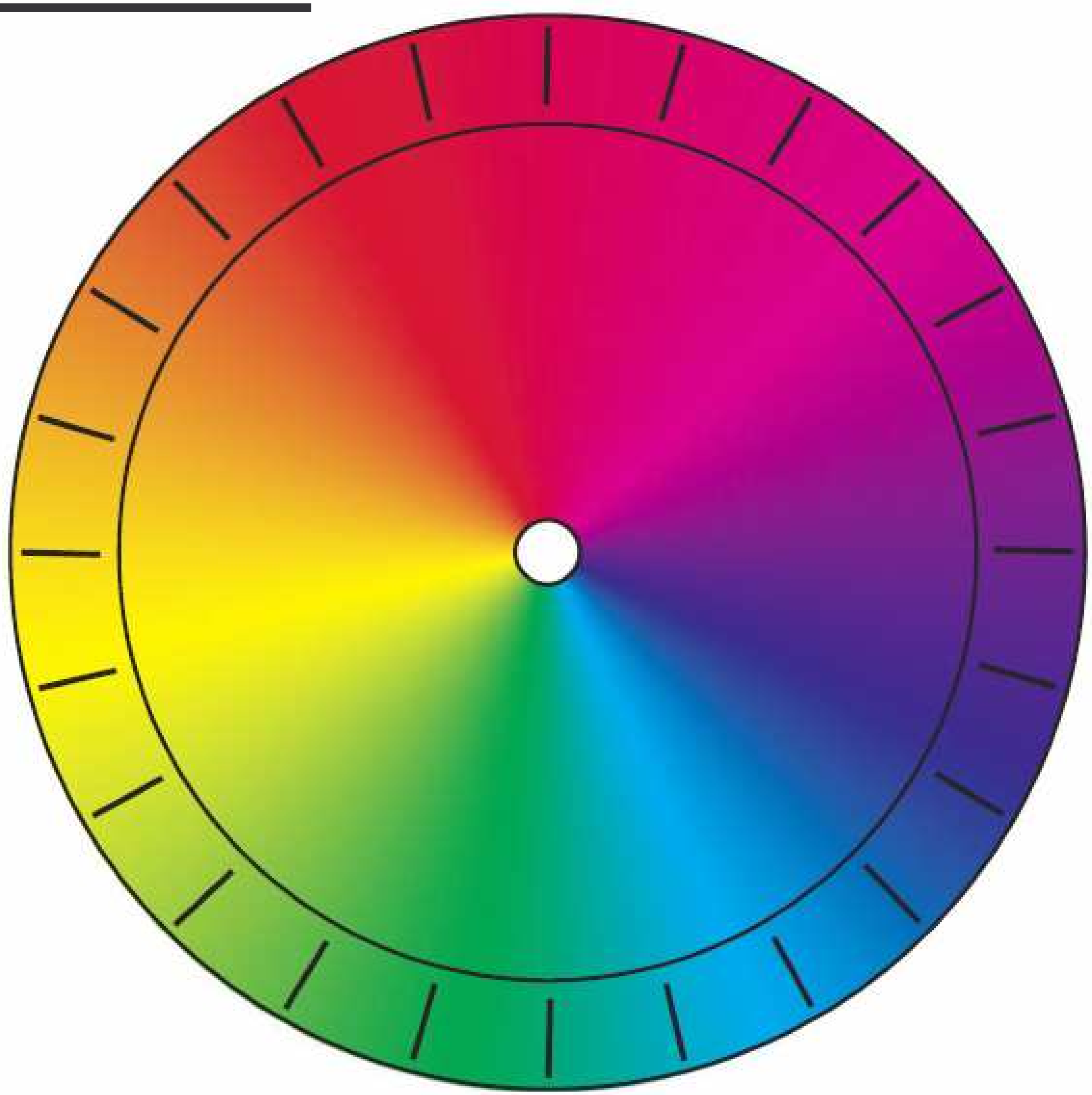
Complementary colours are opposite each other on the colour wheel and give vibrant results when used together. You can also use them to fix colour casts.

Split Complementary

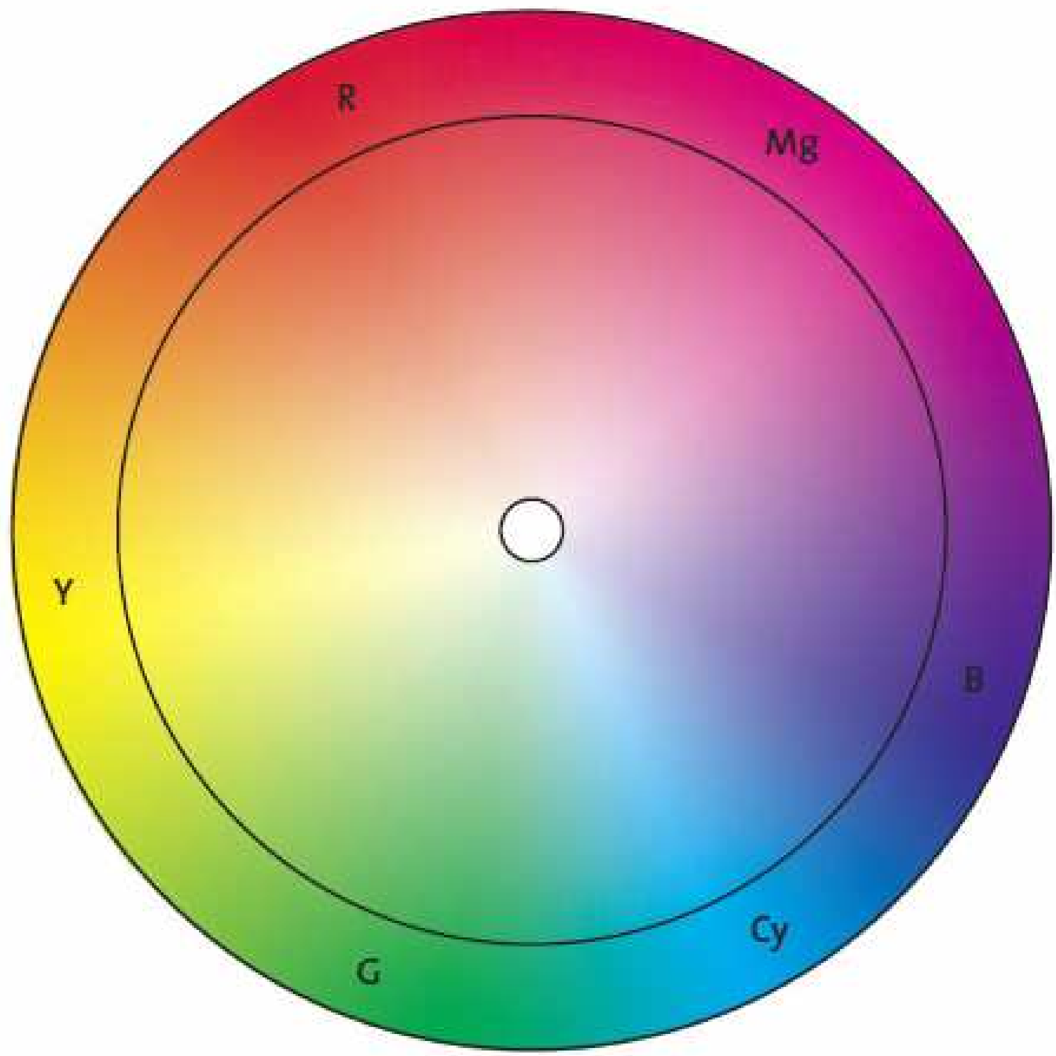


This relationship is made up of three colours. The principal colour and then two colours next to the complementary colour of the principal.

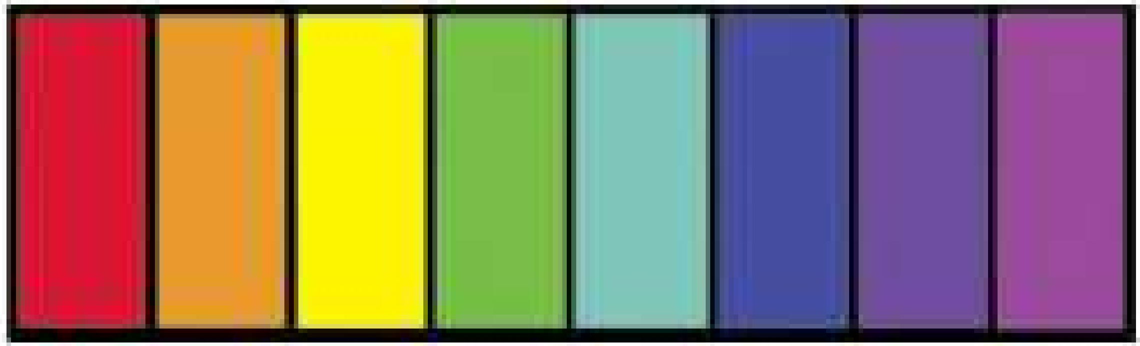
Hue Colour Wheel



Saturation Colour Wheel



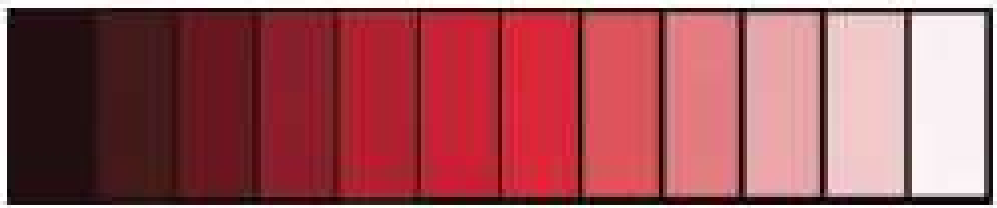
Hue



The eight hues are shown here. Hue is the position of a color on the color wheel: red, orange, yellow, green, cyan, blue, violet (or purple), and magenta. That's it. There are only eight hues. Pink, brown, turquoise, and beige are not hues. Using the hue name is a good way to begin to describe a color. Stop signs are red, a lemon is yellow, and grass is green. Although this lacks subtlety, describing exact colors using words is impossible.

Brightness

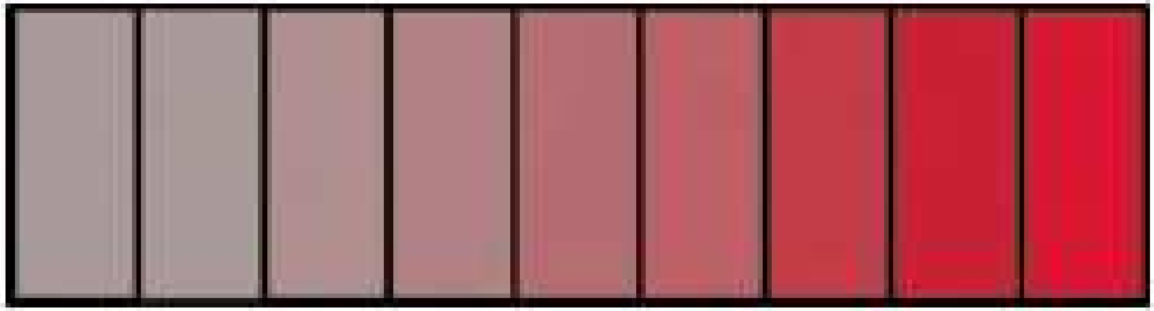
Brightness (sometimes called value) is the addition of white or black to the hue. Brightness is the position of a color in relation to the gray scale.



Adding white to a red hue creates a bright red (called pink). Adding black to a red hue produces dark red (called maroon or burgundy).

At noon, the sky is bright or light blue. At twilight, the sky is dark blue. Words can describe color only in a general way.

Saturation

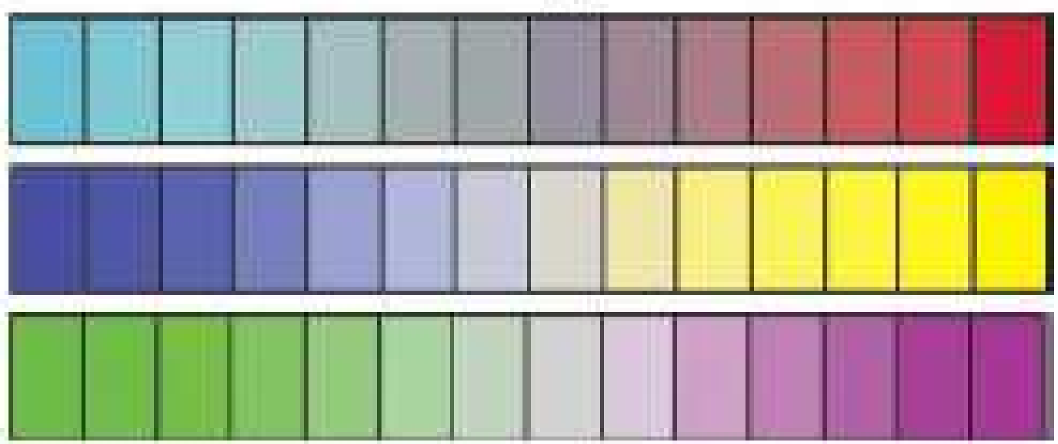


The third term used to describe a color is saturation (sometimes called chroma or intensity) and its opposite, desaturation. Saturation refers to the purity of a hue. For example, fully saturated means the hue is extremely vivid. A saturated red is a red that hasn't been contaminated by any other hue. It's 100% red.

Desaturation involves a saturated hue and its complementary color. Complementary colors are opposite one another on the color wheel.

Desaturation involves a saturated hue and its complementary color. Complementary colors are opposite one another on the color wheel.

As an example, begin with the hue of red. Like all the colors on the wheel, this red is the purest, most vivid, saturated color possible. If a small amount of cyan (red's complementary color) is added to the red hue, the red begins to change. It begins to turn gray. This is called desaturation. The more cyan that is added, the grayer the red will become. When equal amounts of cyan and red are mixed together, there will be no trace of either hue; only gray will remain. Any color will desaturate (or turn gray) by adding its complementary color. When a hue is extremely pure or vivid, it is saturated. The grayer the color becomes the more desaturated it appears.



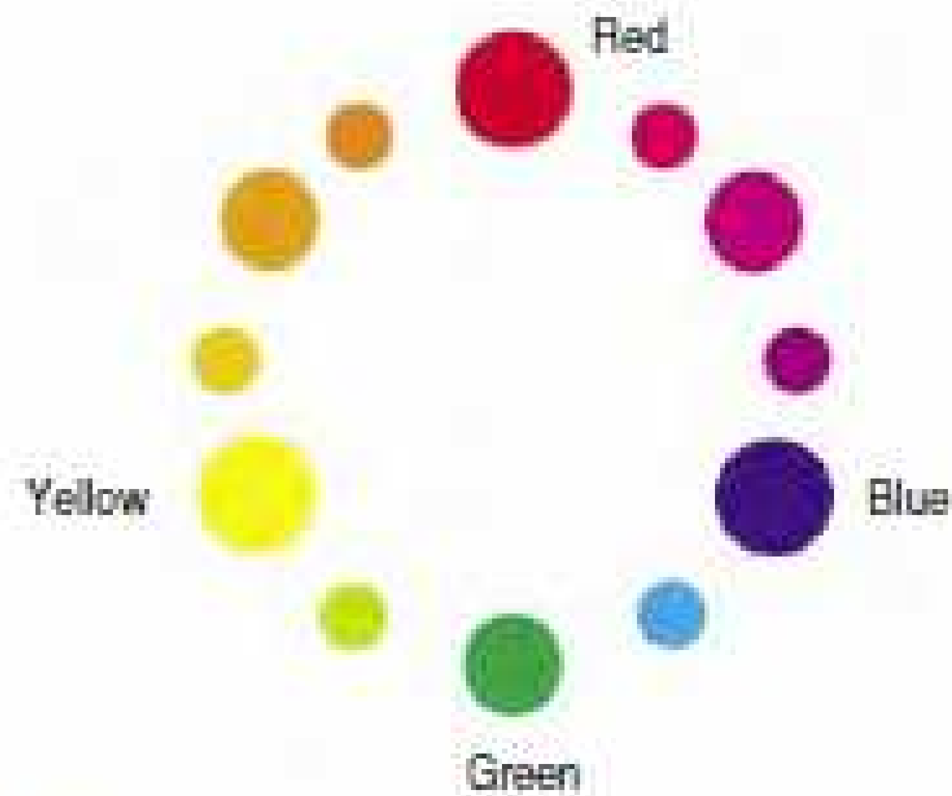


FIGURE 4.2 *Color wheel.*

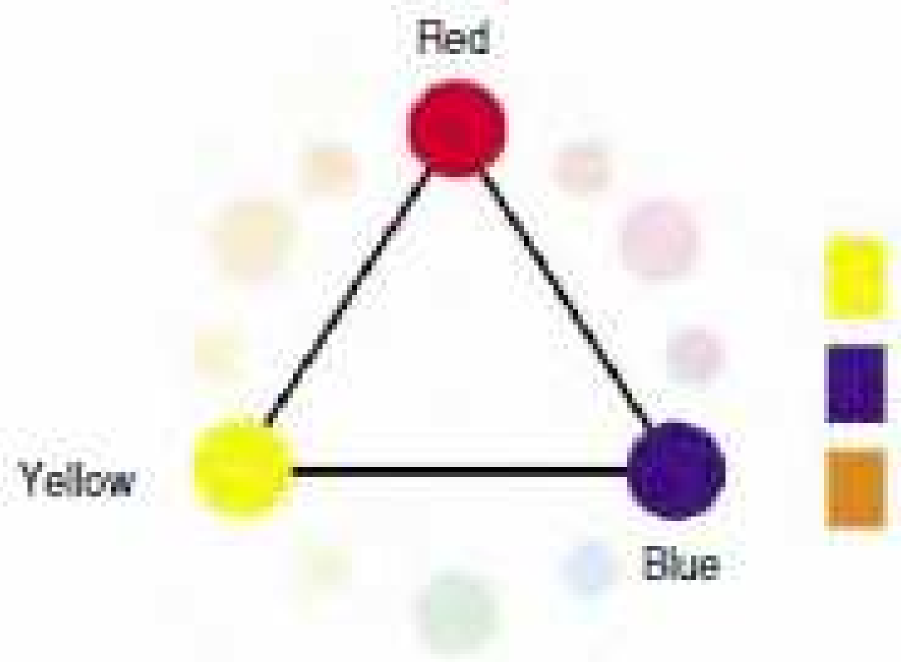


FIGURE 4.3 *Primary colors.*

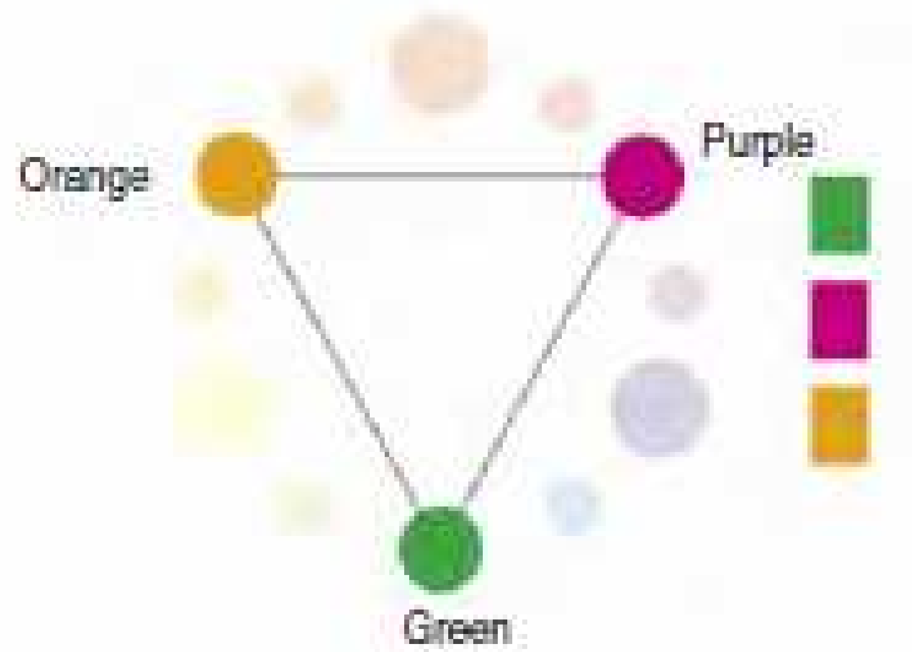


FIGURE 4.4 *Secondary colors.*

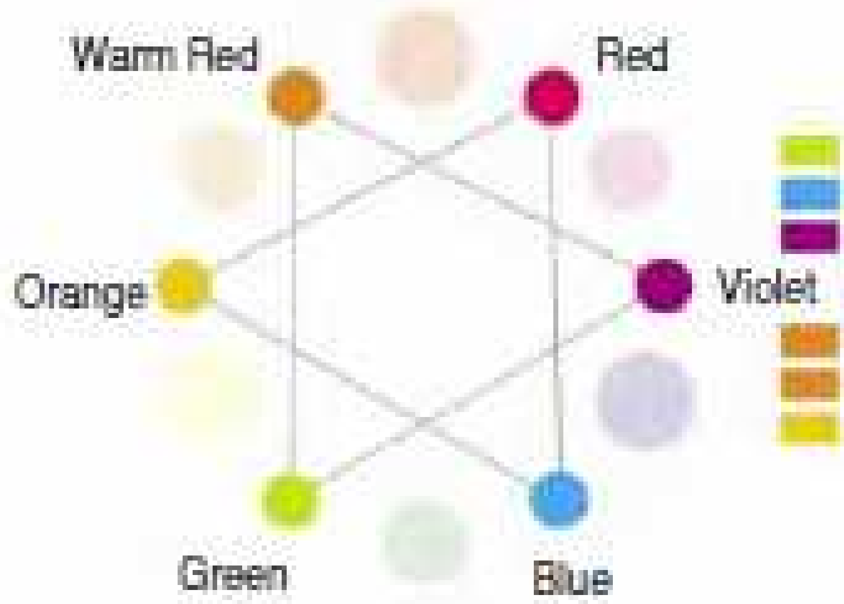


FIGURE 4.5 *Tertiary colors.*

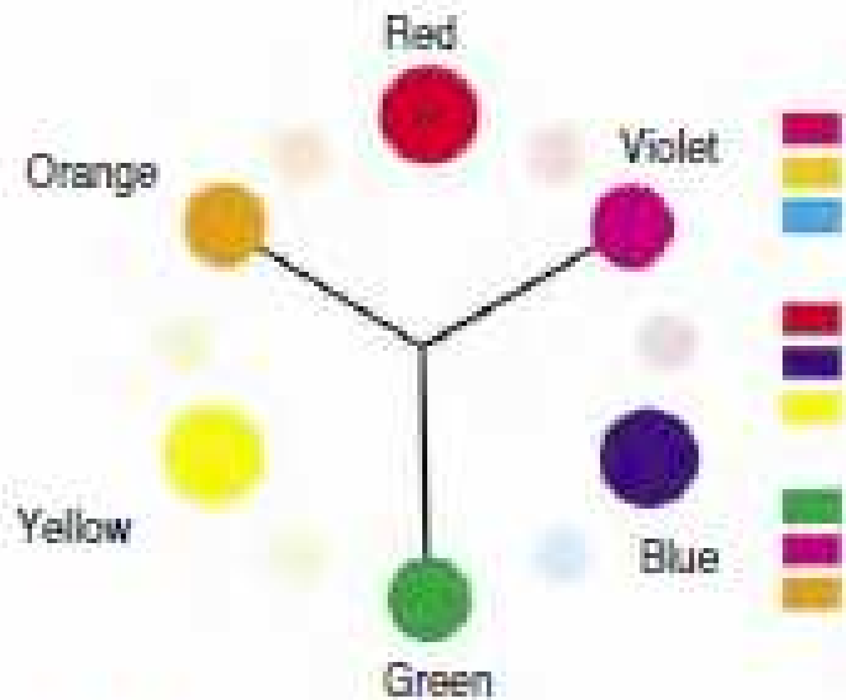


FIGURE 4.6 *Triad colors.*

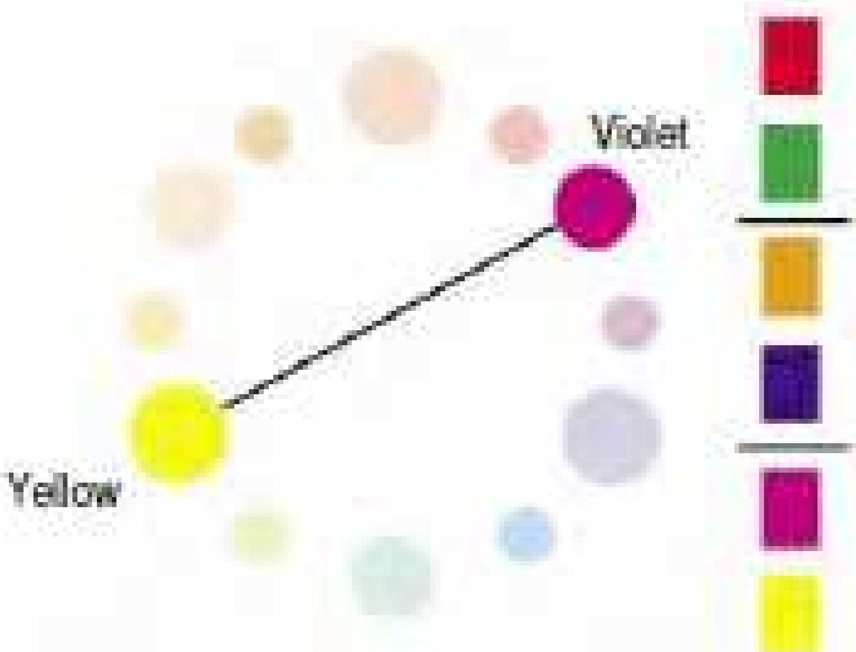


FIGURE 4.7 *Complementary colors.*

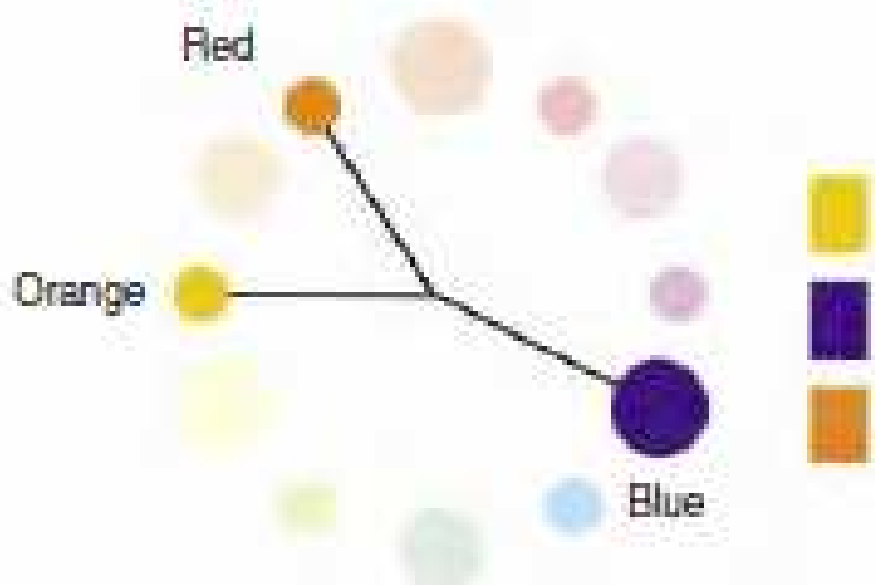


FIGURE 4.8 *Split complementary colors.*

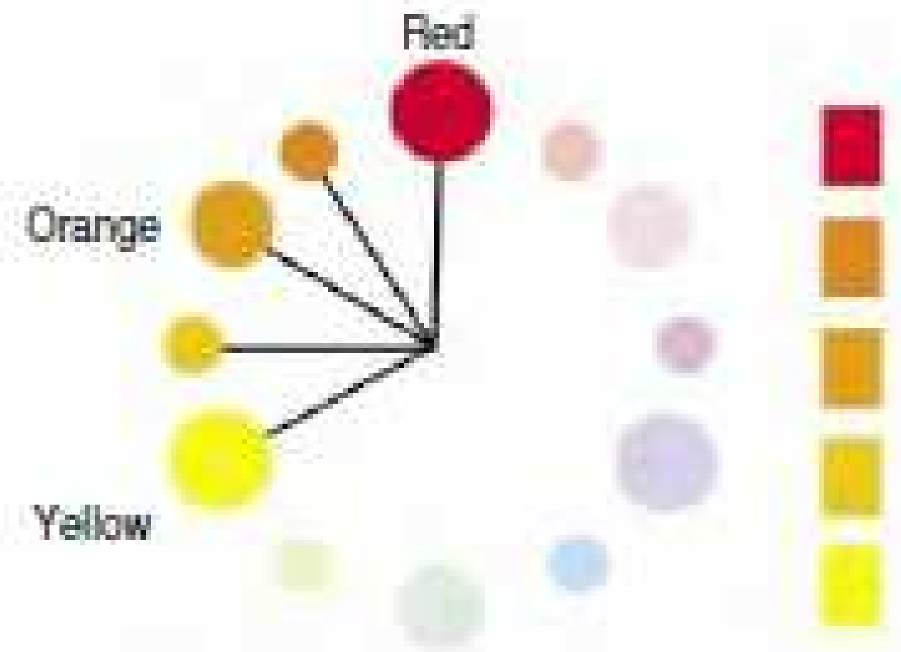


FIGURE 4.9 *Analogous colors.*

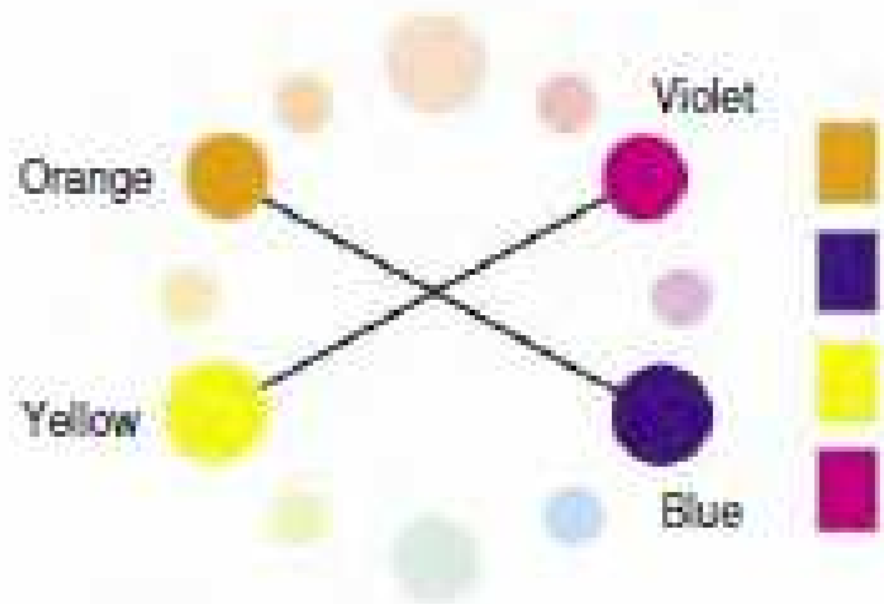


FIGURE 4.10 *Double complement colors.*

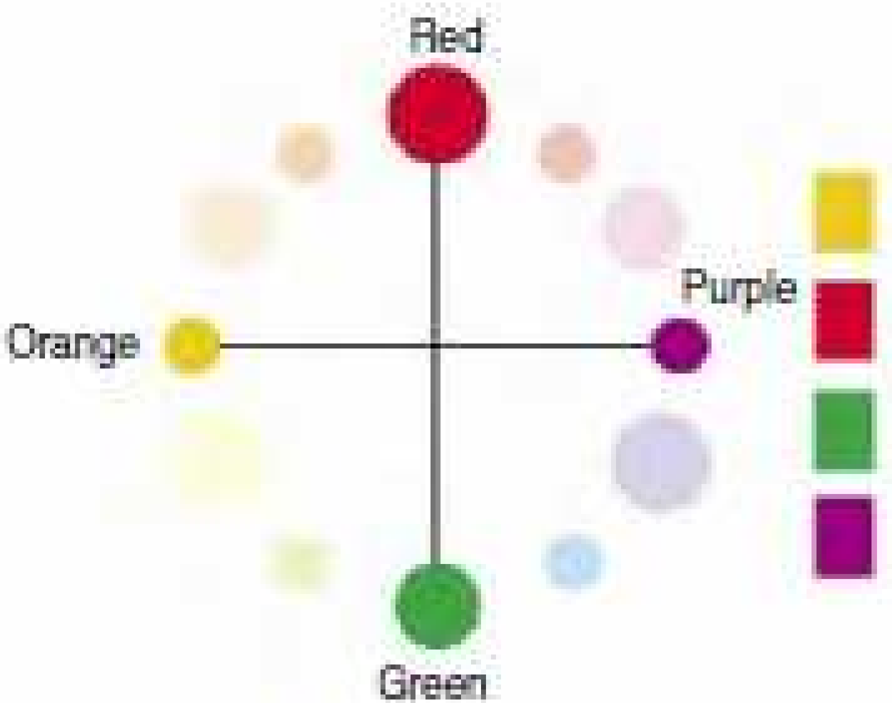


FIGURE 4.11 *Tetrad colors.*

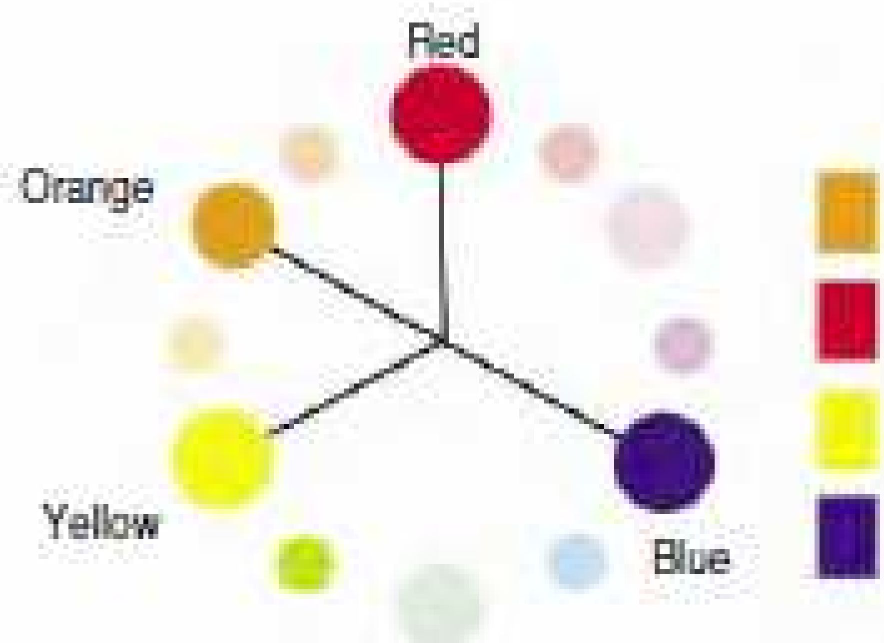


FIGURE 4.12 *Alternate complementary colors.*

Hue

Hue is really the proper name for color. Hue is the property or attribute of color (chroma) as it is perceived and determined by the wavelength of light. Hue can be either reflected or transmitted. Red, blue, and yellow are examples of hues (Figure 4.15).

White, black, and gray, however are called *achromatic colors* because they are devoid of hue. Achromatic color can only be described in terms of intensity and luminance, which are light properties. Objects with hue are called chromatic. It is better to use the word *hue* in place of *color* since the latter term can also mean black, white, or gray, and these are not hues.

FIGURE 4.15 *Hue.*

Note that black, white and gray are not members of HUE!!!

SATURATION

A hue can be pure depending on its mixture with gray. This property is called *saturation*. A saturation scale ranges from gray to the pure color (Figure 4.16).

In other words, saturation is the vividness or dullness of a hue. It is also a perception of a hue's purity. Saturation is, in effect, the perceived intensity of a hue. Saturated colors are perceived to have a no white color component. An example of a saturated color is fire-engine red; the unsaturated version of red is flamingo pink.

COMMISSION INTERNATIONALE DE L'ECLAIRAGE - International Commission on Illumination (CIE) defines saturation as "the colorfulness of an area judged in proportion to its brightness." Yellow is a color that is highly saturated as well as possessing the tendency to be "bright" perceptually.

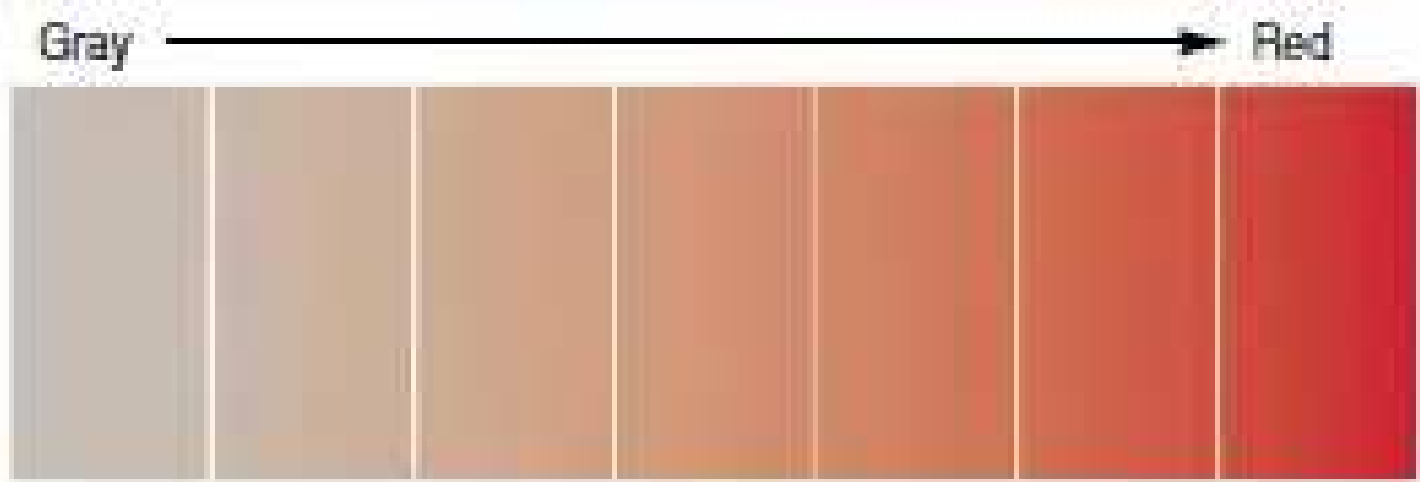


FIGURE 4.16 *Saturation.*

Brightness

Brighness is the apparent intensity of light that ranges from a totally dark black or a luminous white. The word *brighness* is used only to describe self-luminous objects that emit light (Figure 4.17).

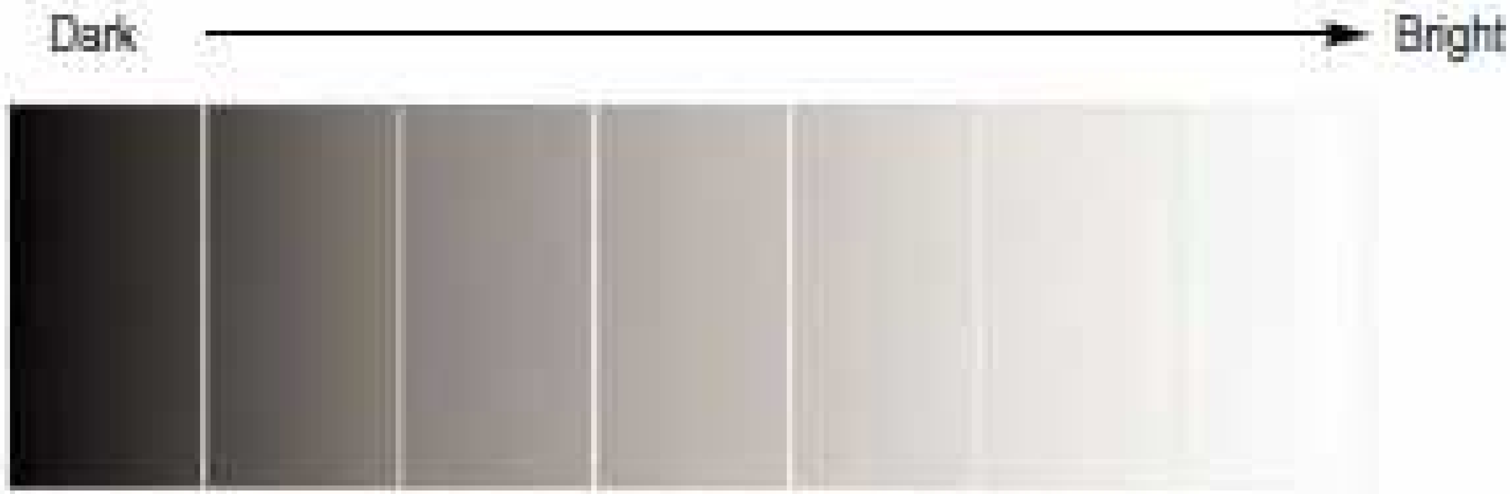


FIGURE 4.17 *Brighness.*

VALUE

Value is the deviation of a hue from white or black. It is an indication of how light or dark an object is. Value really refers to a shade of an object, which is determined by the light reflecting off it (Figure 4.18).

Value can be thought of as the perception of color with the achromatic properties of an object. Value is also called *lightness*; it can be considered the nonlinear response to luminance.

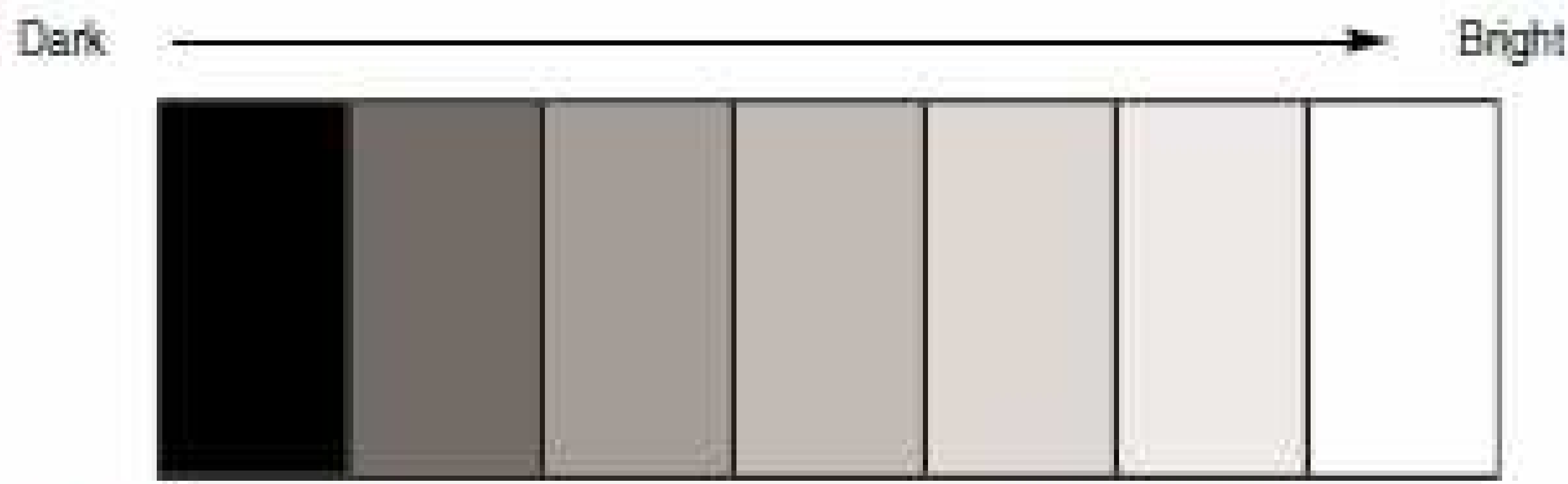


FIGURE 4.18 *Value.*

Tint

Tint primarily results from the addition of white to a pure hue. The consequence of adding white to a pure color is decreased saturation.

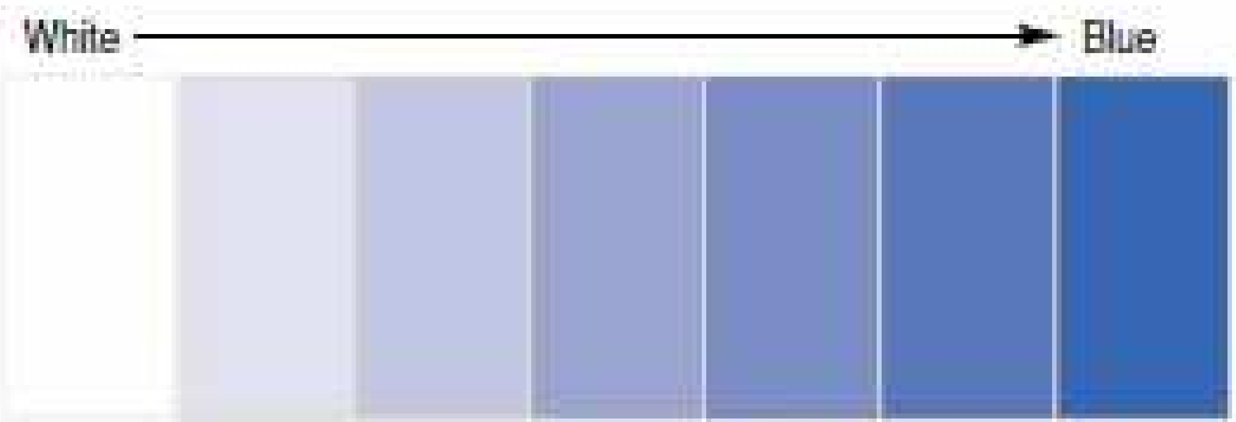


FIGURE 4.18 *Tint.*

Shade

Shade is the opposite of *tint*. A shade is created by the introduction of black to a pure hue. The addition of black decreases the object's lightness.

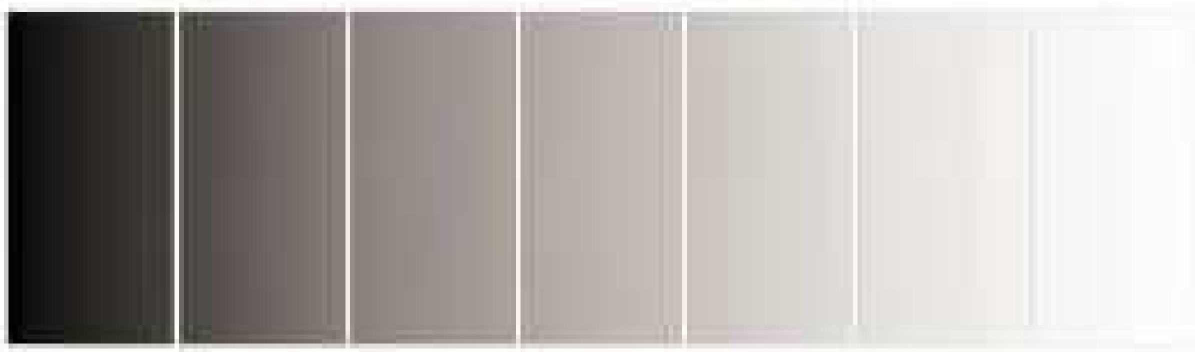


FIGURE 4.20 *Shade*.

Opposite of tint !!

Tone

Tone results from the addition of black and white to a pure color, so tone is really hue plus gray.

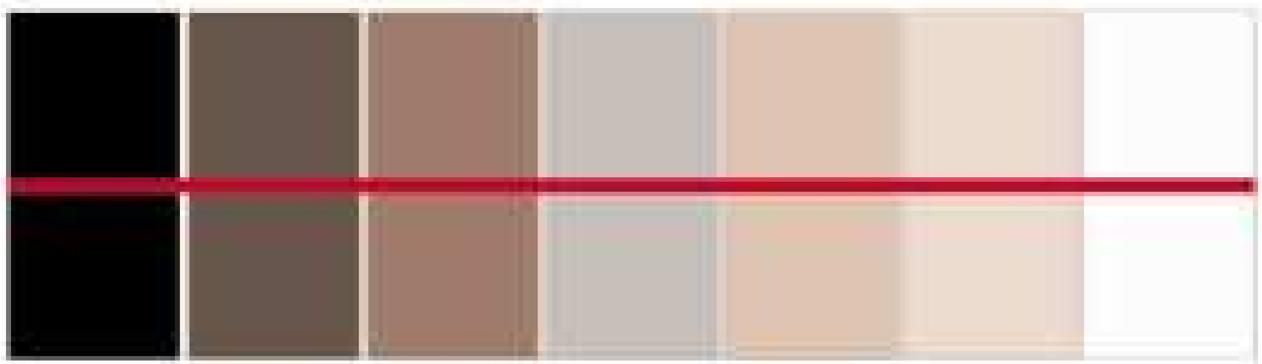
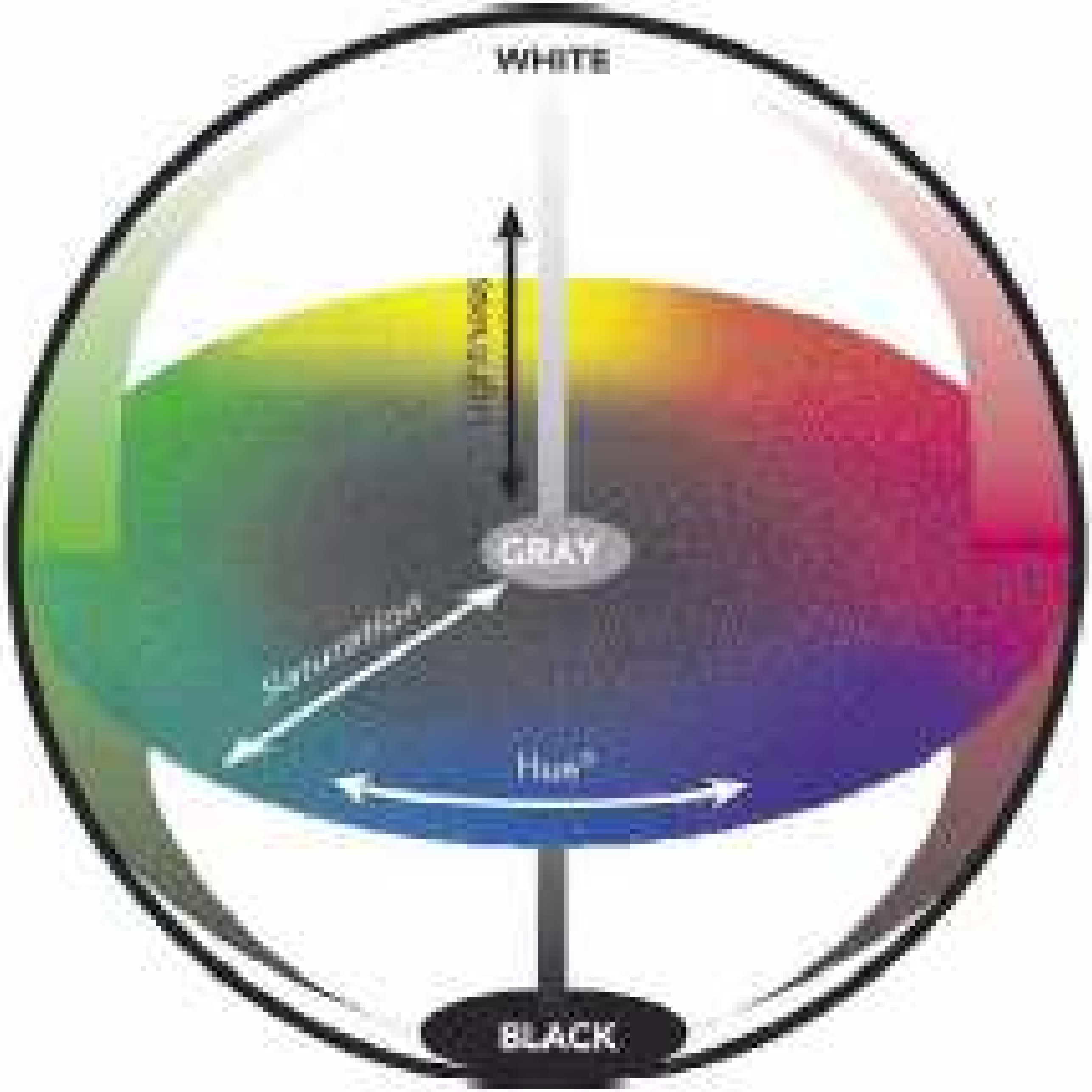


FIGURE 4.21 *Tone.*


WHITE
GRAY
Saturation
Hue
BLACK