# Color: It's all in your head

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# *Let's shed some light on Color . . .*

- When we see color,we are seeing light that has been modified into a new composition of wavelengths by an object. Without light, there is no color, only black.

- In a darkened room, only the rods (nerve cells in our retina) are operational, allowing us to detect variations in brightness even when there isn't enough light to see color.

# *What do we see as light?*

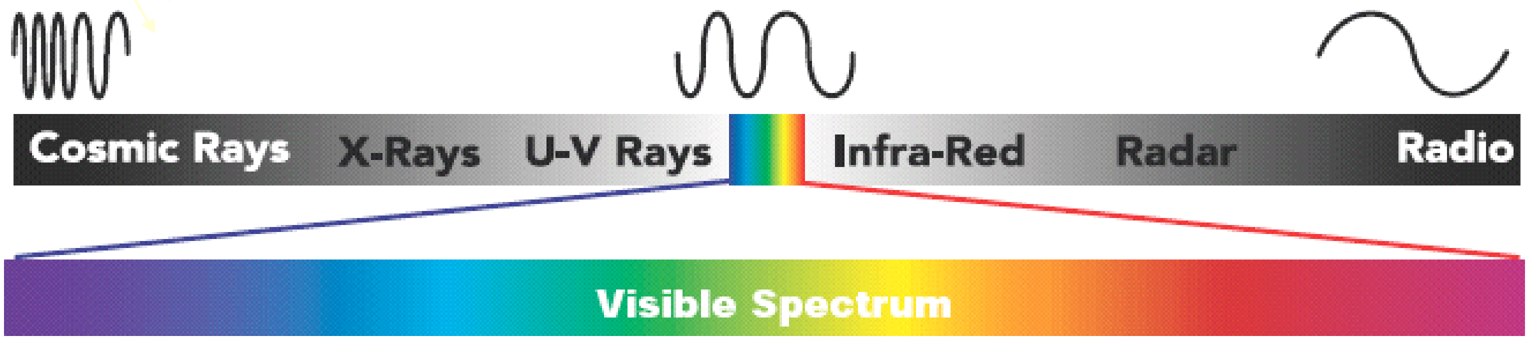
- Light is the visible part of the electromagnetic spectrum. Light can be seen as consisting of waves, each described by its wavelength - the length from wave crest to adjacent wave crest. These wavelengths are measured in nanometers (nm).A nanometer is one-billionth of a millimeter.
- Ultraviolet rays are "beyond" violet and infrared means literally "below red"

# Okay, but what is light then?

- Light is the visible part of the electromagnetic spectrum. The region of the electromagnetic spectrum visible to the human eye ranges from about 400 to 700 nanometers. When our visual system detects a wavelength around 700 nm, we see “red;”when a wavelength around 450-500nm is detected, we see “blues;”a 400 nm wavelength givesus “violet;”and so on.

Short wavelengths=high energy

Long wavelength=low energy



# *The Three Elements of Color*

- Light
- Object
- Viewer

  Without light, there are no wavelengths; without objects there would be only white, unmodified light; and without the viewer there would be no sensory response that would recognize or register the wavelengths as a unique color. Color is a function of perception and highly subjective based on the viewer.

# *In the blink of an eye*

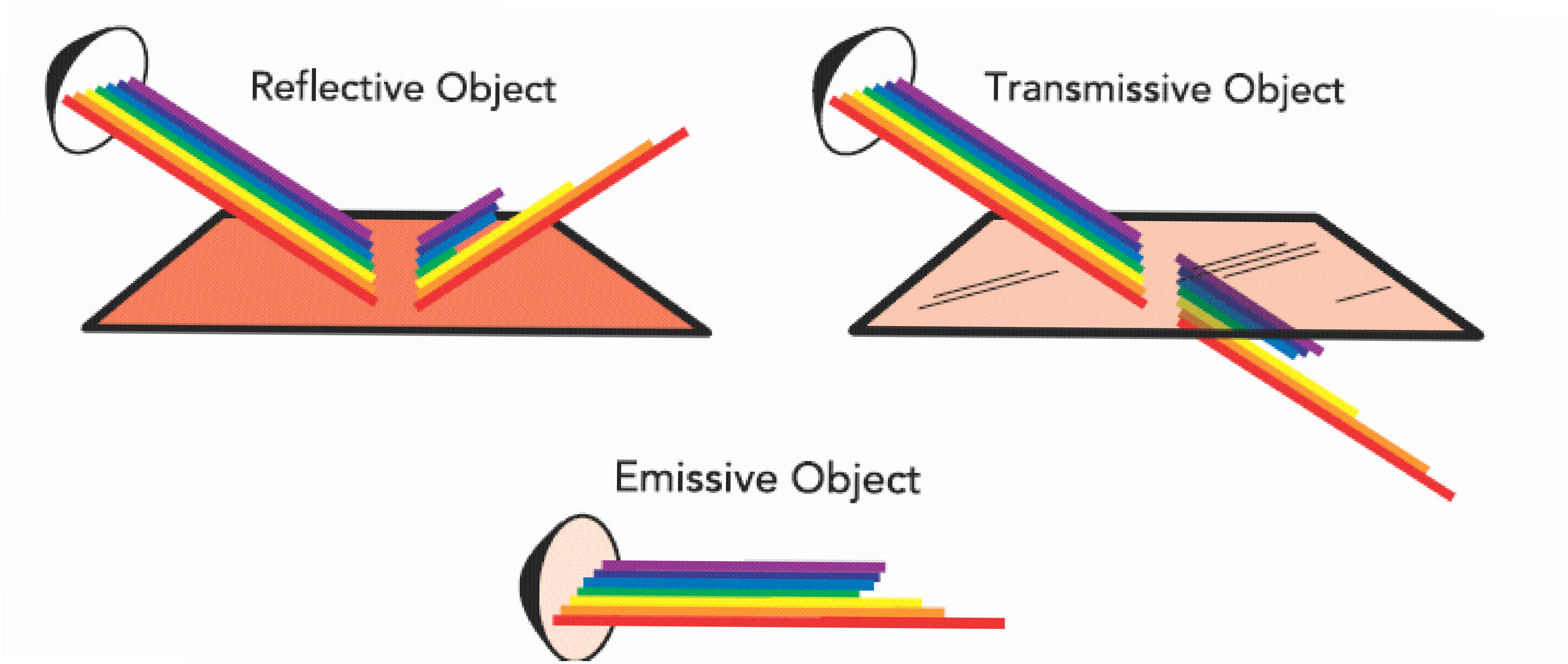
- The cones, photoreceptive nerve cells in your retina break down the visible spectrum down into its most dominant regions of red, green, and blue, then use these colors to calculate color information.

# *Imitating the Eye. . .*

- Scanners, monitors and RGB printers also use red, green, and blue light to create a wide range of colors.
- RGB is known as the additive color space because taken together in even proportions, they produce white light. Unfortunately, monitors differ from one another in their displays so we need to manage color better from monitor to monitor.

# Objects Modify the LightWaves, Altering the Colors we Perceive

- Paper , Photographic Prints- Reflective objects
- Slide & Transparencies-Transmissive
- Emissive- Computer Monitors, Lightbulbs

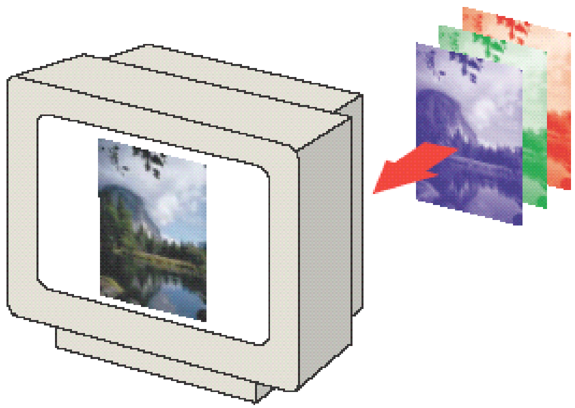

Reflective Object
Transmissive Object
Emissive Object

# But we are also printing on paper. . .

- When we print, we are using the subtractive primaries, CMY. The inks or toners act as filters absorbing light being reflecting from the paper. If the inks (toners, etc.) were pure, black would be the result of full ink coverage. They aren't, so we add black to the CMY for printing.
- In our field, we are always moving from RGB to CMYK and we need a way to manage this process effectively to ensure we achieve the results we want.

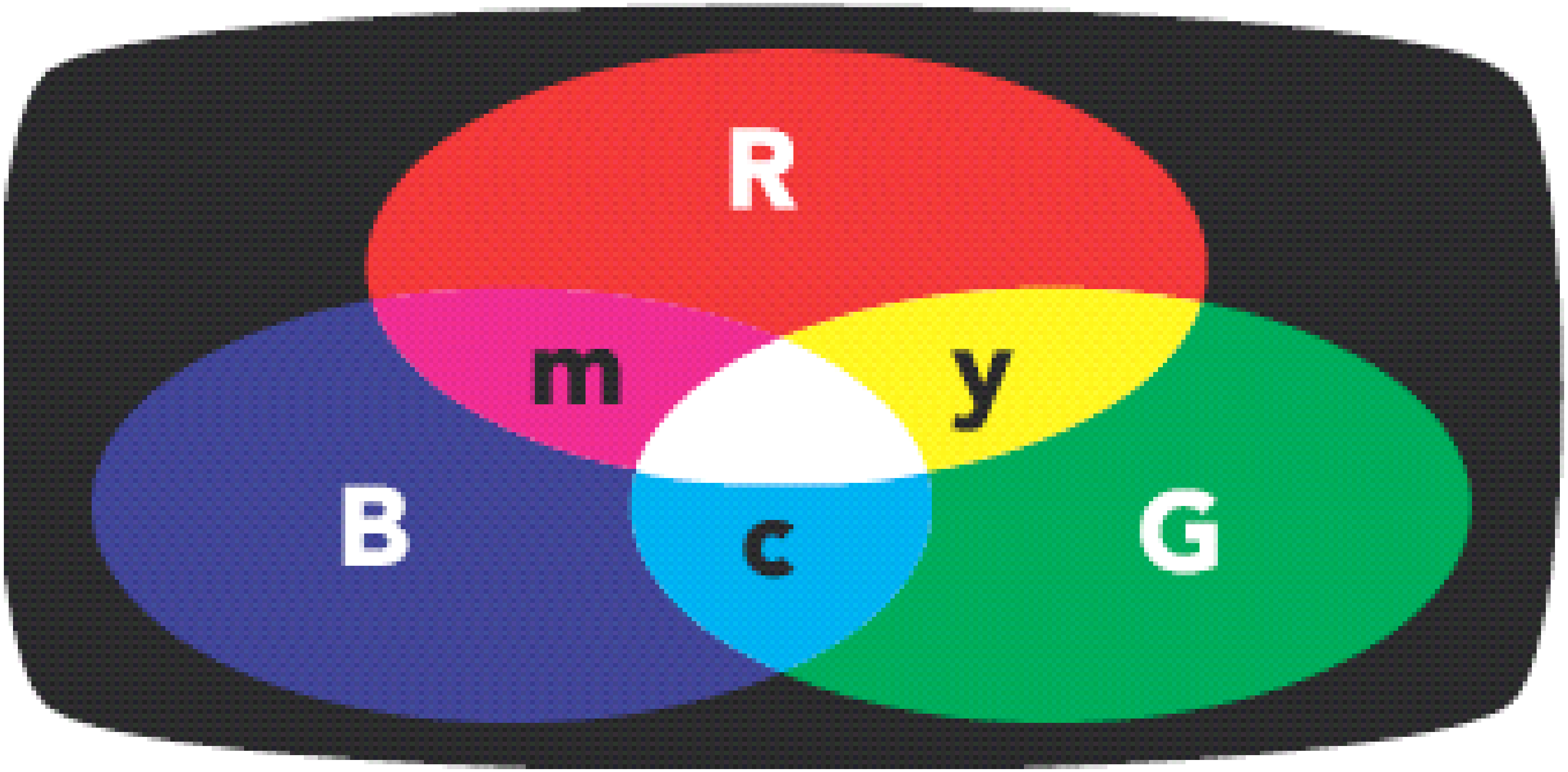
# RGB Separations

# CMYK Separations



RGB separations of projected image

CMYK separations of printed image



R
m
y
B
c
G

# *Connecting the spaces . . .*

- RGB
- CMY

Write this two acronyms like this and you can easily remember how the two spaces interact. Yellow subtracts blue (short wavelengths), magenta absorbs green (medium wavelengths), and cyan absorbs red (long wavelengths).

But, RGB and CMYK are device dependent

# *Because Color is Highly Subjective. . .*

- We can’t actually measure color because color happens in the observer’s mind.
- What we could/can do is measure instead the light that enters the observer’s eye . We also can use devices (such as densitometers, colorimeters and spectrophotometers) to measure light reflected from objects

# *Metamerism*

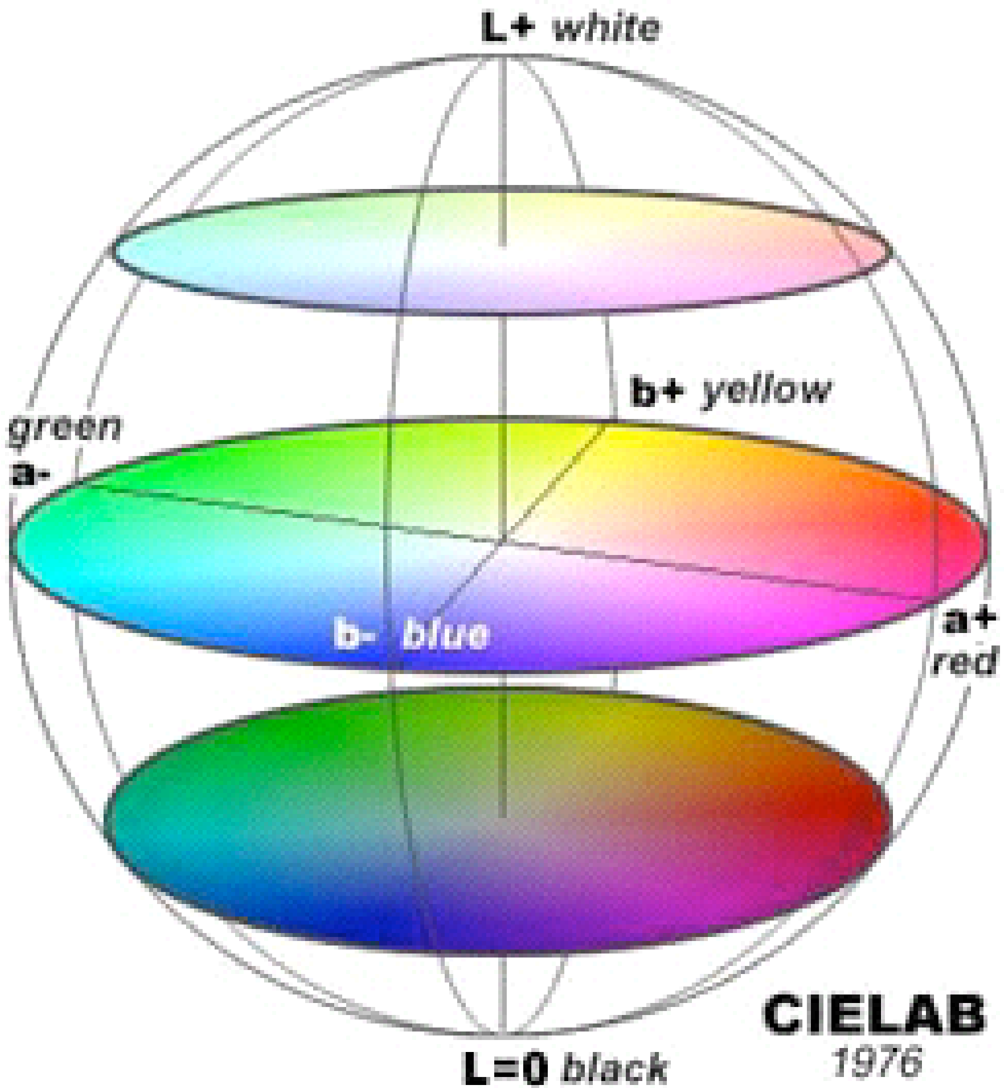
- Metamerism-when two color samples are perceived to be identical under some, but not all, lighting conditions. So, a catalog picture that you view under florescent light looks different when you bring in home and view in under your home lighting conditions.
- Surrounding Colors affect color perception, just as light sources do.

# *Color Management is NOT New*

- In the Graphic Communications Industry, we have always attempted to manage color communication using standard viewing conditions to communicate color --should view proofs under 5000 Kelvin light source/gray walls, minimal ambient lighting & hoods on monitors. But fewer people and devices were involved.
- However, with the elimination of film and the ever increasing number of input (scanners, digital cameras), display devices (monitors, projectors) and output devices (digital presses, inkjet printers, offset presses, gravure presses), it becomes more critical to understand and manage color effectively to avoid disappointing results.

# *CIE color model- LAB*

- CIE (The international Commission on Illumination) conducted many experiments since the 1920s and developed a model, LAB, in 1976 that allows  us to numerically represent the color that people with normal color vision see in different lighting conditions. In the graphic arts, D50 and D65 are the standard illuminants that are most important.
- The CIE’s work forms the basis of color management systems --it is device independent.


L+ white
b+ yellow
green
a-
b- blue
a+
red
L=0 black
CIELAB
1976

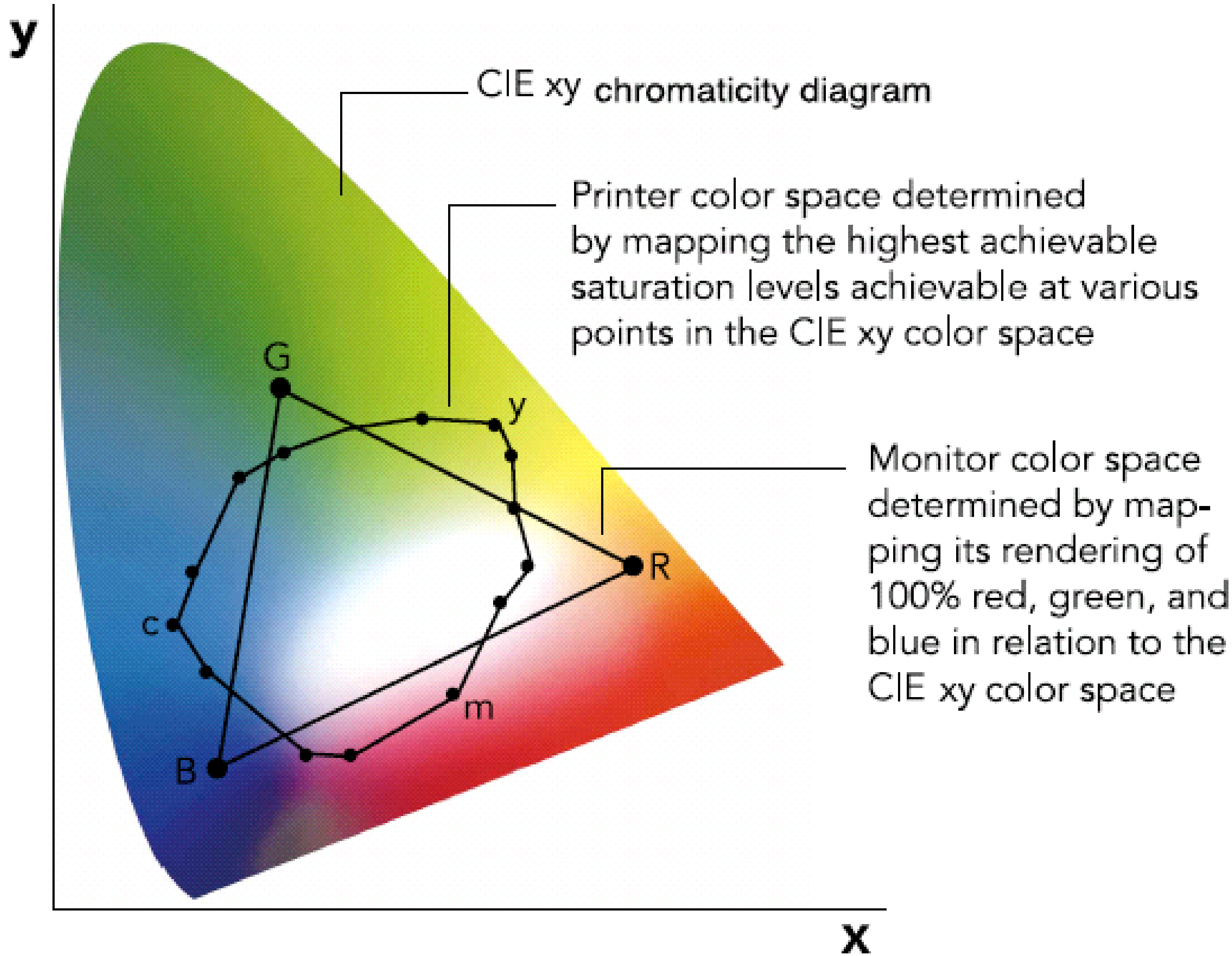
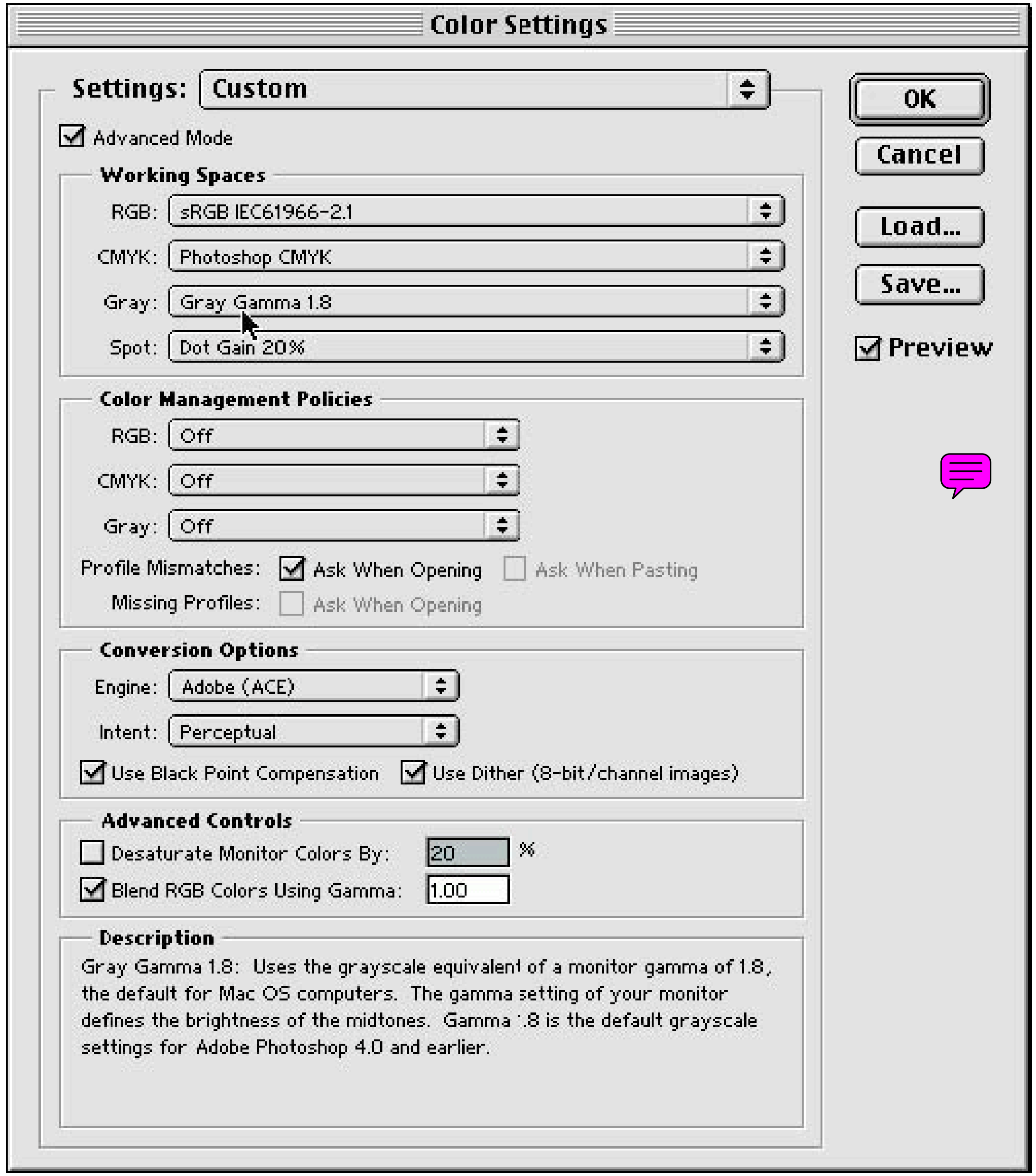
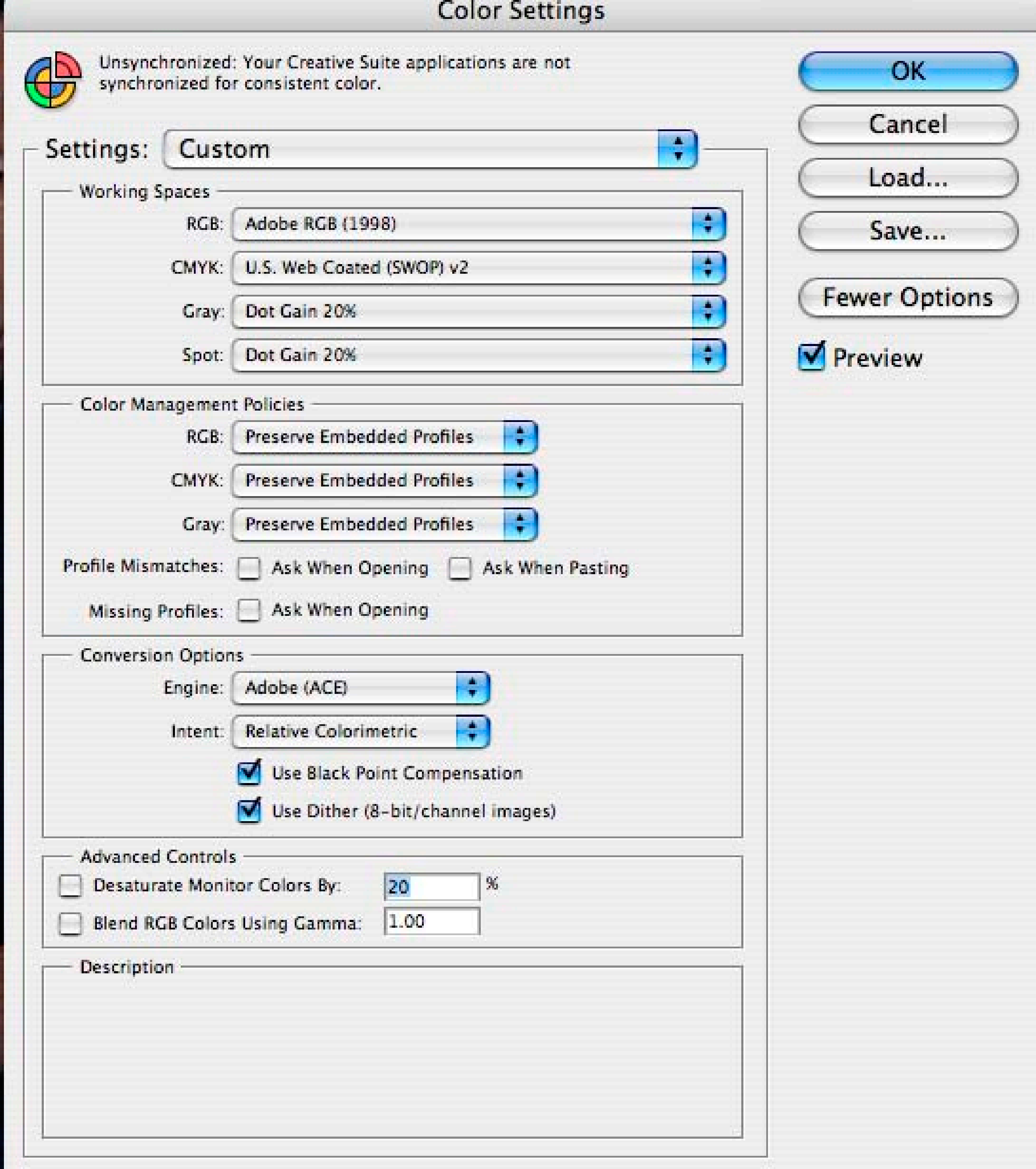
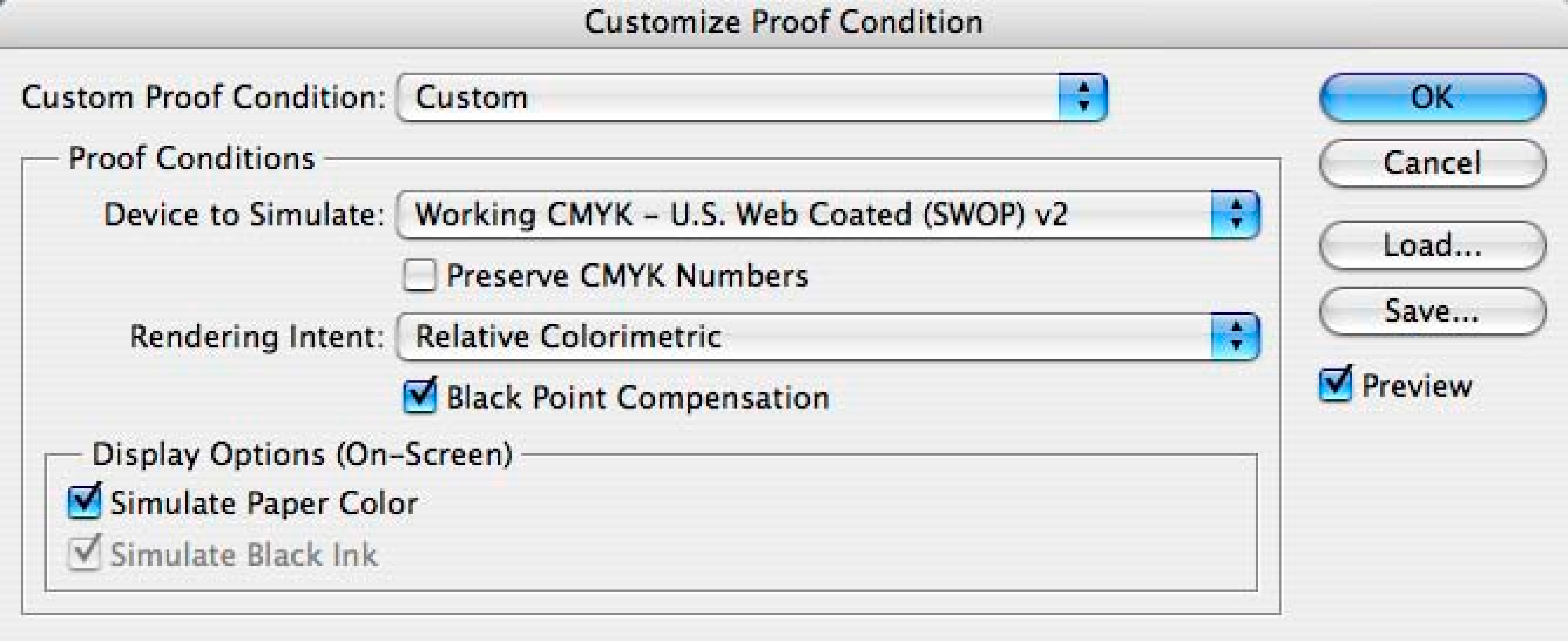
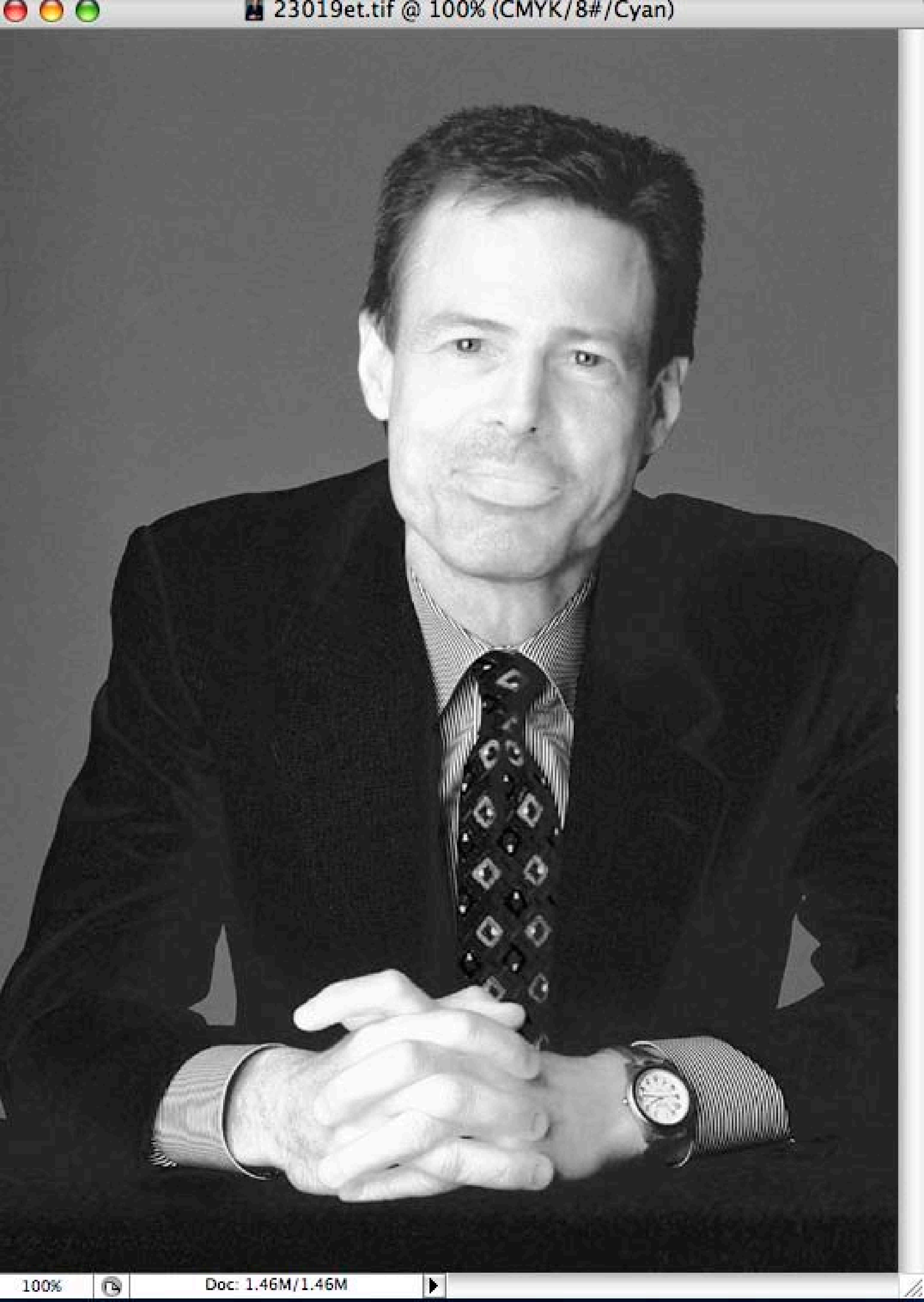



Illustration Source: X-RITE Color Guide


Color Settings
Settings: Custom
Advanced Mode
Working Spaces
RGB: sRGB IEC61966-2.1
CMYK: Photoshop CMYK
Gray: Gray Gamma 1.8
Spot: Dot Gain 20%
Color Management Policies
RGB: Off
CMYK: Off
Gray: Off
Profile Mismatches: Ask When Opening Ask When Pasting
Missing Profiles: Ask When Opening
Conversion Options
Engine: Adobe (ACE)
Intent: Perceptual
Use Black Point Compensation
Use Dither (8-bit/channel images)
Advanced Controls
Desaturate Monitor Colors By: 20 %
Blend RGB Colors Using Gamma: 1.00
Description
Gray Gamma 1.8: Uses the grayscale equivalent of a monitor gamma of 1.8, the default for Mac OS computers. The gamma setting of your monitor defines the brightness of the midtones. Gamma 1.8 is the default grayscale settings for Adobe Photoshop 4.0 and earlier.
OK
Cancel
Load...
Save...
Preview


Color Settings
Unsynchronized: Your Creative Suite applications are not synchronized for consistent color.
OK
Cancel
Load...
Save...
Fewer Options
Preview
Settings: Custom
Working Spaces
RGB: Adobe RGB (1998)
CMYK: U.S. Web Coated (SWOP) v2
Gray: Dot Gain 20%
Spot: Dot Gain 20%
Color Management Policies
RGB: Preserve Embedded Profiles
CMYK: Preserve Embedded Profiles
Gray: Preserve Embedded Profiles
Profile Mismatches: Ask When Opening
Ask When Pasting
Missing Profiles: Ask When Opening
Conversion Options
Engine: Adobe (ACE)
Intent: Relative Colorimetric
Use Black Point Compensation
Use Dither (8-bit/channel images)
Advanced Controls
Desaturate Monitor Colors By: 20 %
Blend RGB Colors Using Gamma: 1.00
Description


Customize Proof Condition
Custom Proof Condition: Custom
OK
Cancel
Load...
Save...
Preview
Proof Conditions
Device to Simulate: Working CMYK – U.S. Web Coated (SWOP) v2
Preserve CMYK Numbers
Rendering Intent: Relative Colorimetric
Black Point Compensation
Display Options (On-Screen)
Simulate Paper Color
Simulate Black Ink


23019et.tif @ 100% (CMYK/8#/Cyan)
100%
Doc: 1.46M/1.46M


ColorEdge CE240W
Profile My Display
Verify Display Type
Place ColorMunki on Display
Create Profile
Before and After Comparison
A series of color patches will now be read to determine the gamut and color response of your display.
Place ColorMunki into its soft case and mount it to your display.
Click here for video instructions
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Hue
Value
Chroma

Color Schemes are a organized way of putting colors together for specific effects… in your graphic designs, in fashion, and in interior design…..

**monochromatic, complementary, analogous, warm,cool.**

# *Monochromatic*

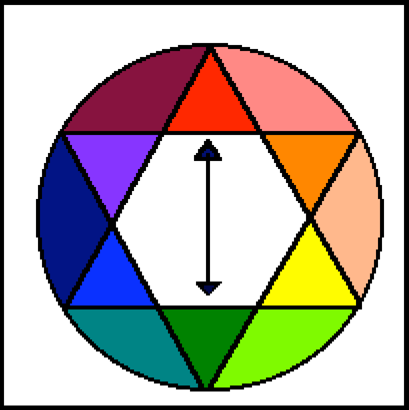
Mono” means “one”, “chroma” means “color”… this type of color scheme has only one color and its values. The following slide shows a painting done in a monochromatic color scheme.

This non-objective painting has a **monochromatic** color scheme - blue and the values (tints and shades) of blue.

# *Complementary*

Complementary colors provide a high contrast to one another- the reds and greens of holiday cards are one example.

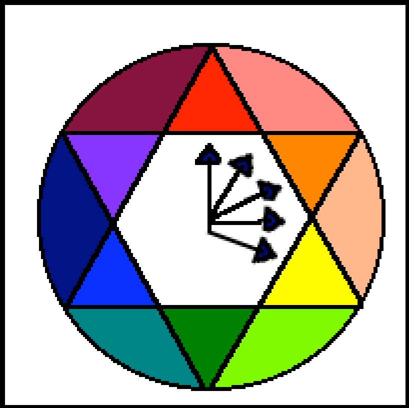
Note that they are opposites on the color wheel.



This painting has **complementary** colors and their values - blues and oranges.

# *Analogous Colors*

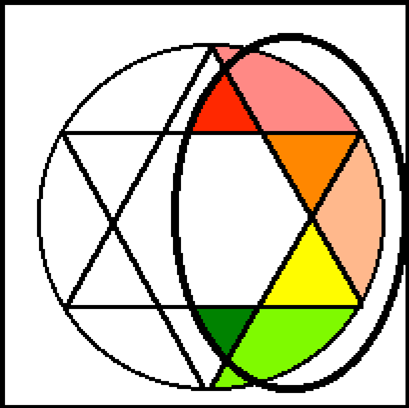
Analagous color schemes offer very little contrast, a more calming effect and are close to one another on the color wheel. Blue-greens, etc.

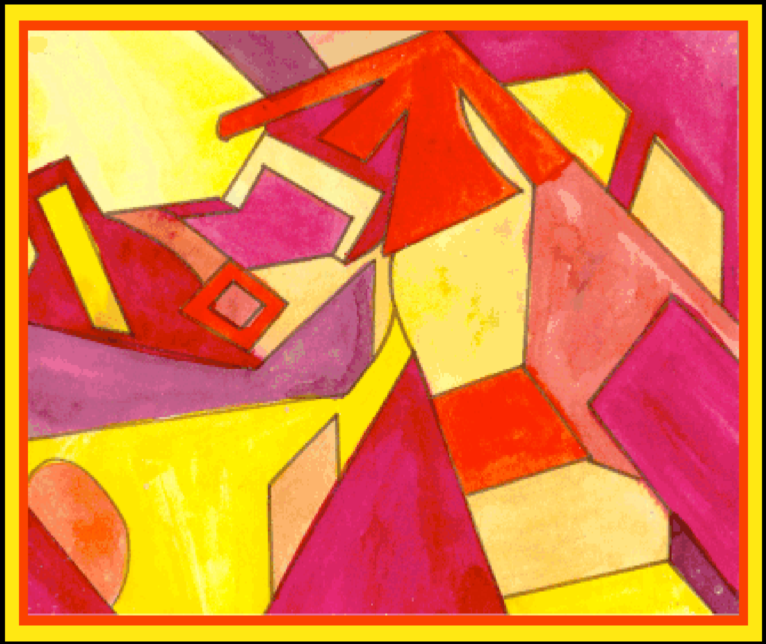


**Analogous** colors are illustrated here: yellow, yellow-green, green and blue-green.

# *Warm*

Warm colors are found on the right side of the color wheel. They are colors found in fire and the sun. Warm colors make objects look closer in a painting or drawing.

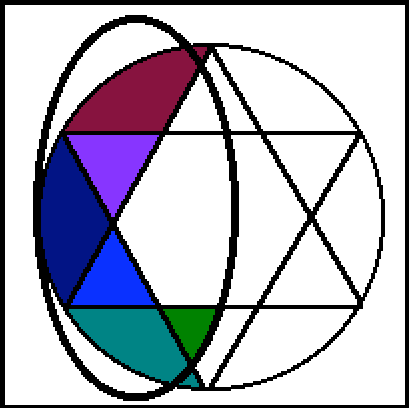


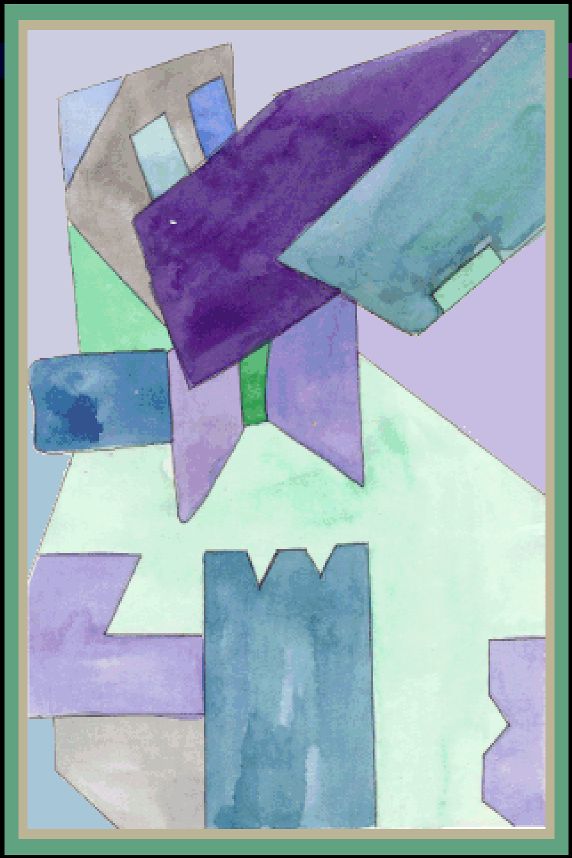


This is an illustration of the use of **warm** colors - reds, oranges and yellows.

# *Cool*

Cool colors are found on the left side of the color wheel. They are the colors found in snow and ice and tend to recede in a composition.





Note the **cool** color scheme in this painting (greens, purples and blues).