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 700nm, we see "red;"when awavelength around 450-500nm is detected,we see "blues;"a 400nm wavelength givesus "violet;"and so on.

Short wavelengths=high energy   Long wavelength=low energy

Cosmic Rays   X-Rays   U-V Rays   Infra-Red   Radar   Radio

Visible Spectrum
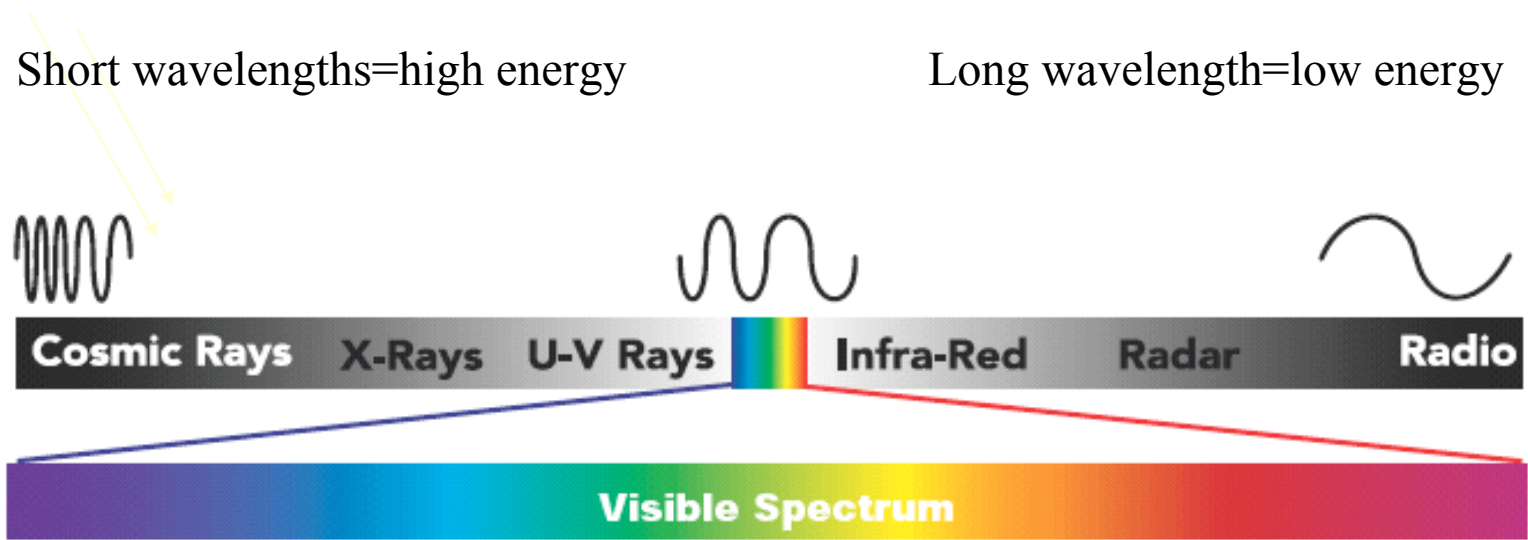
The Three Elements of Color

- 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.

- 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
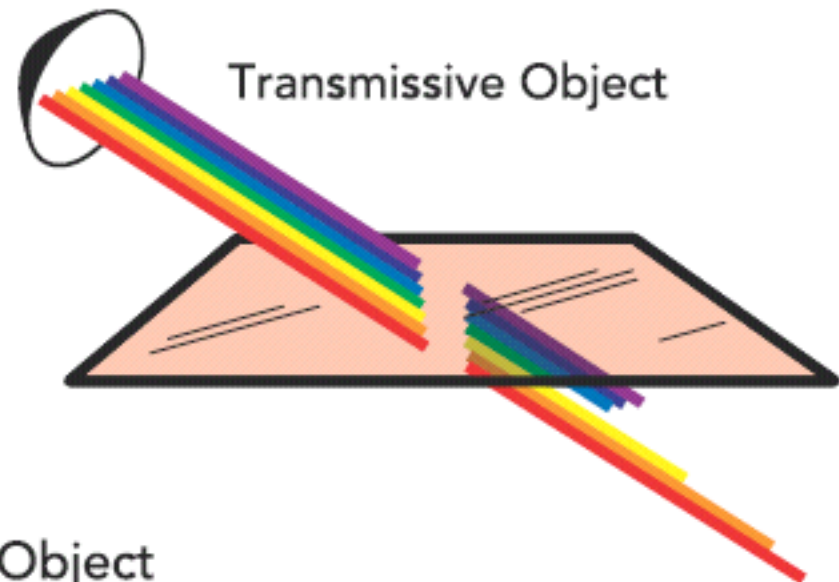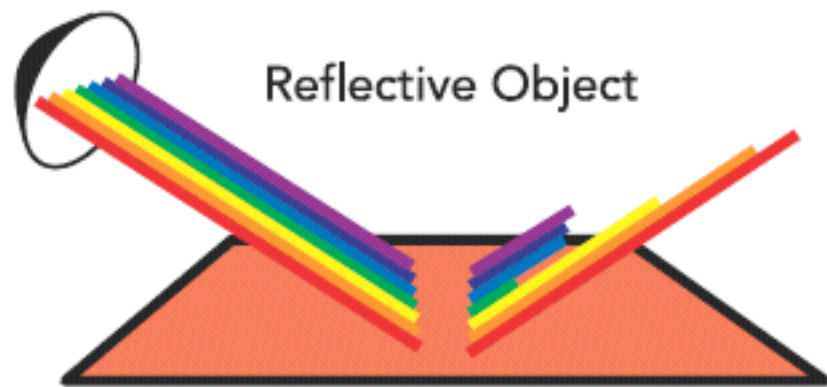
But we are also printing on paper. . .

- 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 the graphic arts, 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.
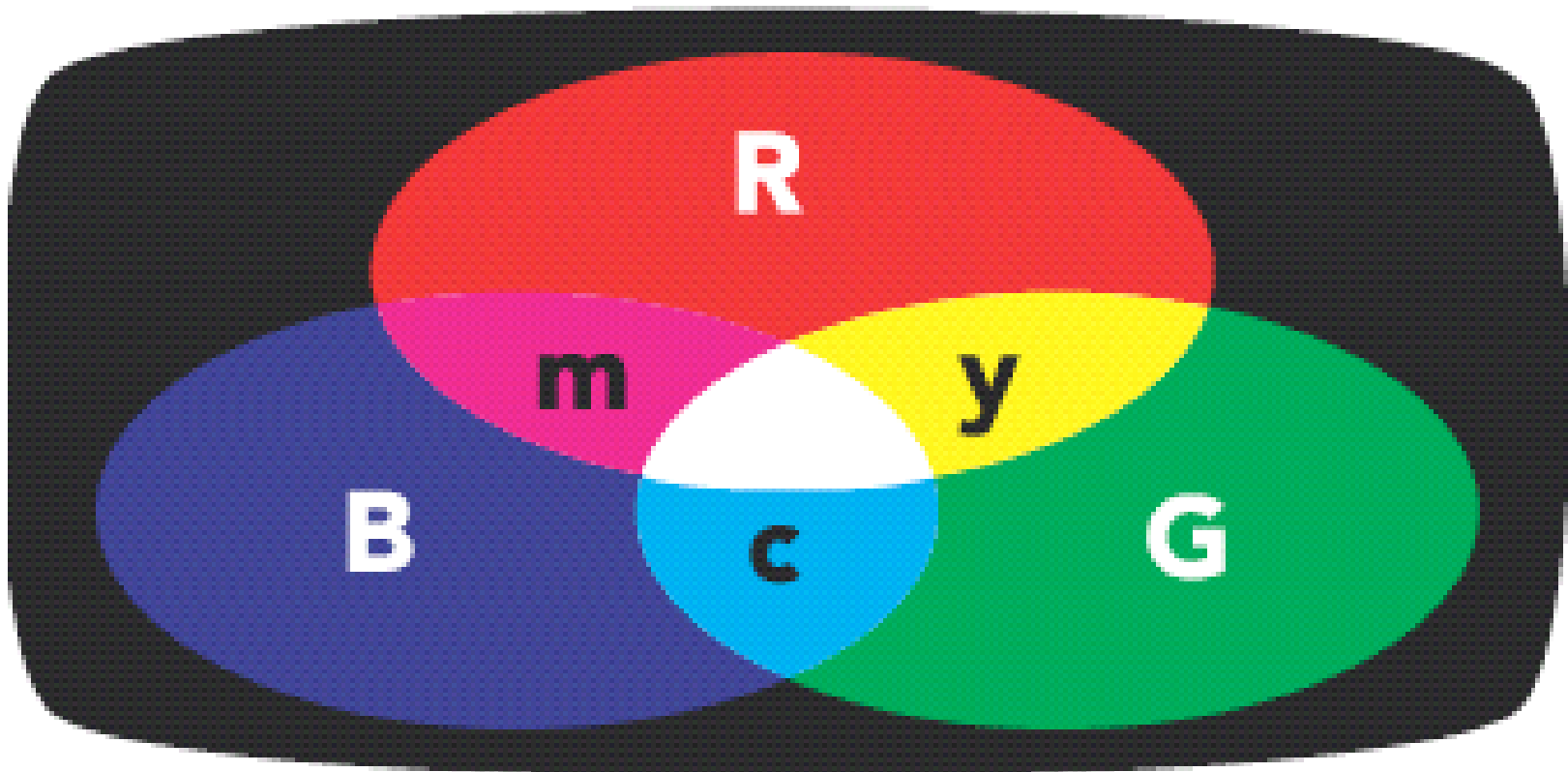
RGB Separations
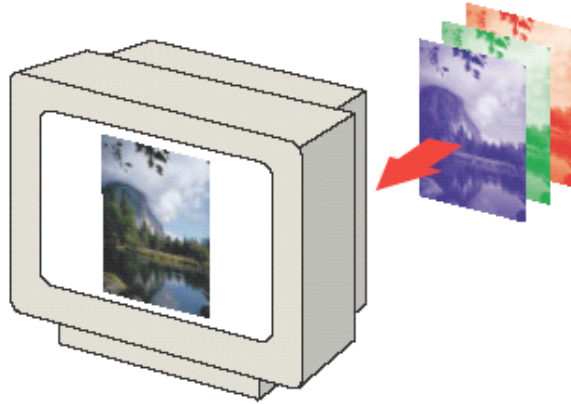
CMYK Separations

RGB separations of projected image

CMYK separations of printed image

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
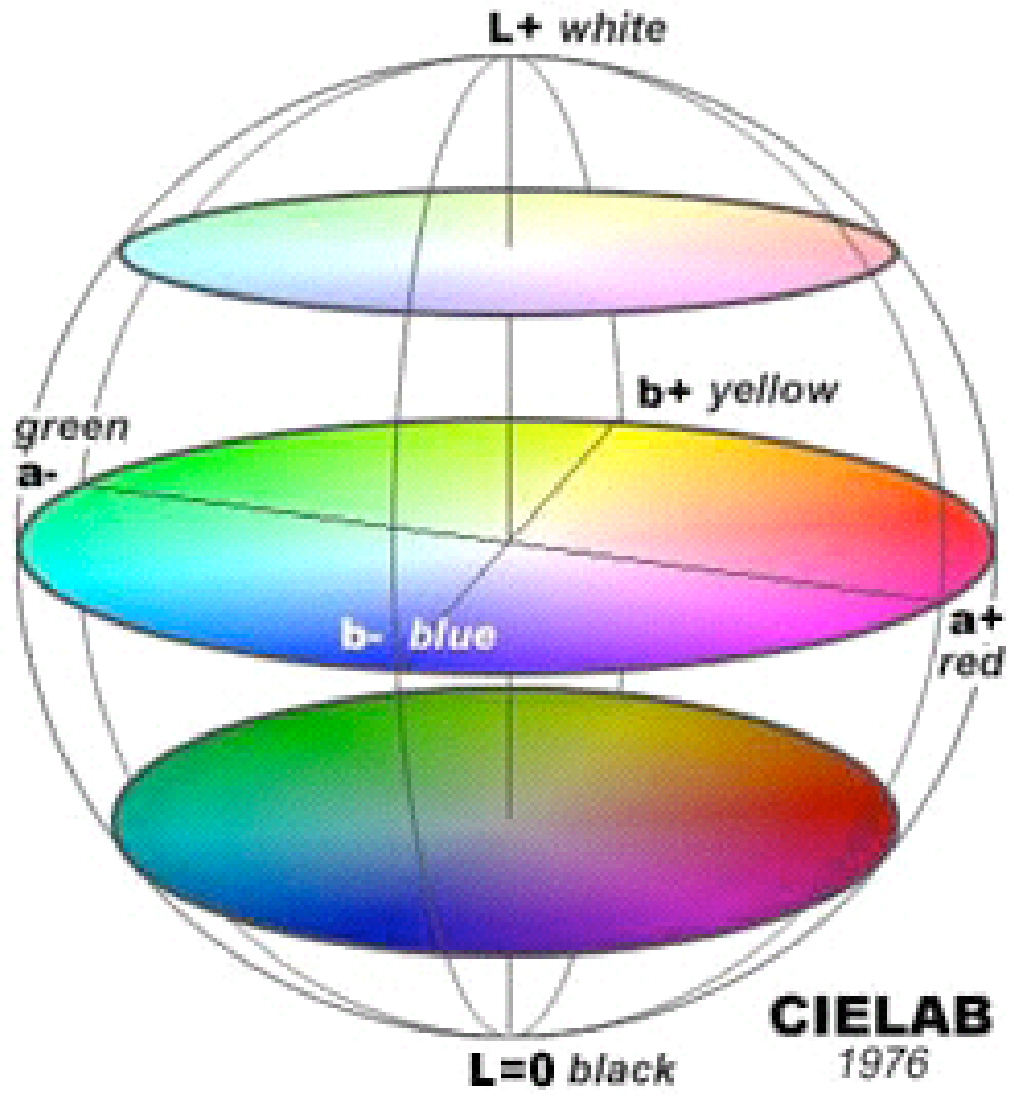
Metamerism

- 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 Arts 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.
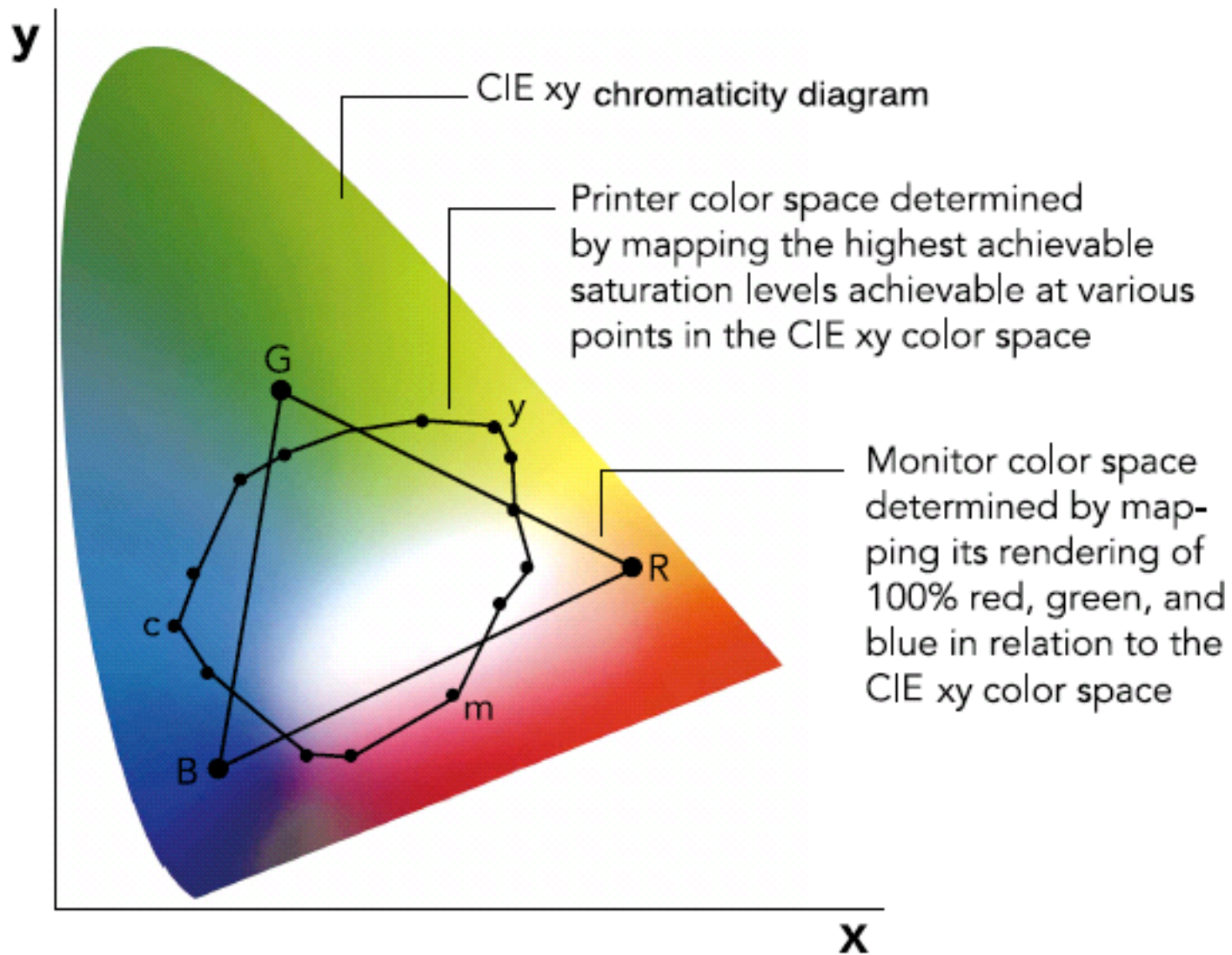
CIE xy chromaticity diagram

Printer color space determined by mapping the highest achievable saturation levels achievable at various points in the CIE xy color space

Monitor color space determined by mapping its rendering of 100% red, green, and blue in relation to the CIE xy color space

Illustration Source: X-RITE Color Guide

Color Settings

Settings: Custom ▼   OK

☑ Advanced Mode   Cancel

Working Spaces

RGB: sRGB IEC61966-2.1 ▼   Load...

CMYK: Photoshop CMYK ▼   Save...

Gray: Gray Gamma 1.8 ▼

Spot: Dot Gain 20% ▼   ☑ Preview

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.

Color Settings

Unsynchronized: Your Creative Suite applications are not synchronized for consistent color.

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

OK

Cancel

Load...

Save...

Fewer Options

☑ Preview

Customize Proof Condition

Custom Proof Condition: Custom

Proof Conditions

Device to Simulate: Working CMYK – U.S. Web Coated (SWOP) v2

☐ Preserve CMYK Numbers

Rendering Intent: Relative Colorimetric

☑ Black Point Compensation

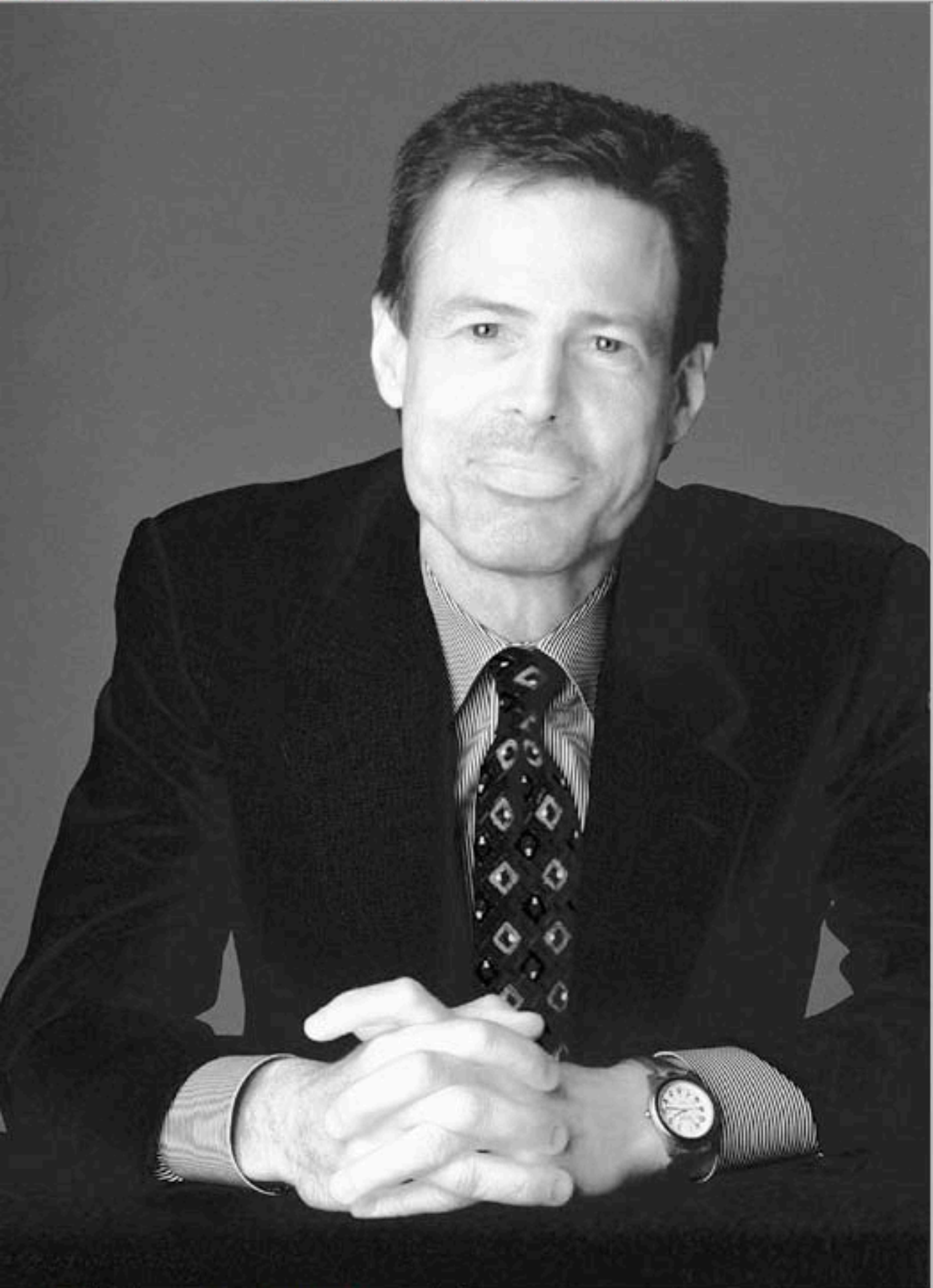### Display Options (On-Screen)

☑ Simulate Paper Color

☑ Simulate Black Ink

OK

Cancel

Load...

Save...

☑ Preview

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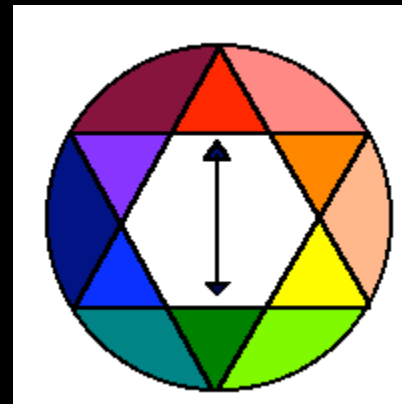
This painting has **complementary** colors and their values - blues and oranges.

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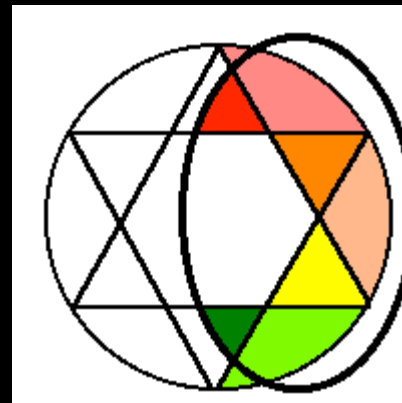
Analogous colors are illustrated here: yellow, yellow-green, green and blue-green.

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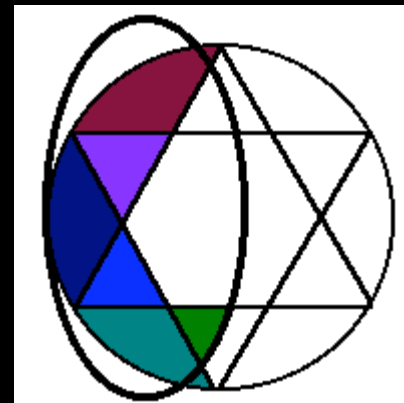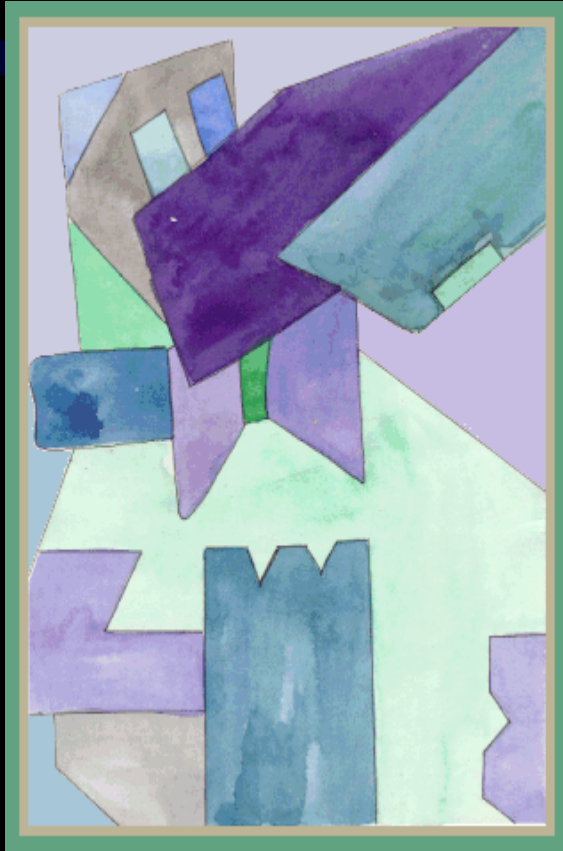
This is an illustration of the use of **warm** colors - reds, oranges and yellows.

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).