# COLOR THEORY

*"Only those who love color are admitted to its beauty and immanent presence.
It affords utility to all, but unveils its deeper mysteries only to its devotees."*

**— Johannes Itten**

## Course Summary

In 1704, Isaac Newton published *Opticks*, outlining his studies on light and color. Splitting light with a prism, he identified the spectrum of visible colors, which he identified as Red, Orange, Yellow, Green, Blue, Indigo, and Violet (ROYGBIV). In the centuries since, numerous artists and scientists, including Goethe, Van Gogh, and Kandinsky, have expanded upon Newton's color theory or developed their own theories. We'll examine and test several of these theories and models of color.

## The science of color

- Color does not exist separate from our perception. If an object appears red then all light except red is absorbed and red is reflected.
- When individuals view the same color, they do not see the same color. **Color is subjective.**
- Our eyes have two types of photoreceptors.

    **Rods** are sensitive to levels of light and assist vision in low levels of light.
    **Cones** perceive **co**lor. There are three types, referred to as: Blue (perceive short wavelengths, i.e., blues/violets); Green (perceive medium wavelengths, i.e., greens/yellows; and Red (perceive long wavelengths, i.e., red, oranges, and yellows).

- Shinobu Ishihara developed color blindness tests in 1917. There are three different types of color blindness:

    **Monochromatism** (complete color blindness, only see black, white, and shades of gray),

    **Dichromatism** (only two of three types of cones function) ,

    **Anomalous trichromatism** (three types of cones present but one type's light sensitivity is altered creating a reduced color spectrum).

    Dichromatism and anomalous trichromatism can be distinguished even further by three types of malfunctioning cones: tritanopia (blue deficiency), deuteranopia (green deficiency), and protanopia (red deficiency).

- Light affects our perception of color, including direct vs. indirect sunlight. Different types of bults, for example, incandescent vs. fluorescent vs. LED (light-emitting diode) project warm or cool or neutral (daylight) light. Professionals use light booths with strictly measured light output (e.g., 5000 Kelvin in print industry) to view color as accurately and consistently as possible.
- Different chemicals in materials reflect different colors. Designers and manufacturers use this knowledge so that different materials appear alike.

## Some important individuals in the history of color theories and systems

**Isaac Newton** split light with a prism and identified seven colors (red, orange, yellow, green, blue, indigo, and violet or ROYGBIV) in part to match the seven main tones in the musical scale. However, there is no defining line between adjacent colors. Over time, others dropped indigo as it is perceived as blue or violet. Otherwise, the remaining colors (ROYGBV) remain essential to color theories today.

**Johann Wolfgang Von Goethe** developed the concept of colors having a correct proportion to each other.

**Johannes Itten** identified seven contrasts of colors which affect our perception of the colors and of compositions using one or more of the contrasts. Itten also developed a method of teaching and studying color.

**Philipp Otto Runge** conceived of the color sphere in 1807.

**Wassily Kandinsky** posited that basic shapes are connected to the primary colors, specifically, triangles are yellow, squares are red, and circles are blue.

**Josef Albers** emphasized that color deceives. His teaching required practice with color, emphasizing the effects colors have in their interactions with one another. He headed the Department of Design at Yale and is considered to be one of the most influential teachers of visual art in the twentieth century.

**Albert Henry Munsell** developed the Munsell Color Theory (approximately 1898) and the Munsell Color System, which is based on a three-dimension model made up of three attributes: hue (color), value (lightness/darkness), and chroma (saturation or brilliance). He created devices to measure the attributes of color and developed standards for measuring and viewing color.

# Language of color

## Color models

**CMYK**: Cyan Magenta Yellow Black
**RGB**: Red Green Blue
**HSB**: Hue Saturation Brightness
 Alternates:
**HSV**: Hue Saturation Value (We'll focus on this model)
**HSL**: Hue Saturation Lightness
**Lab**: L: Lightness a: Red/Green value b: Blue/Yellow value

## Additive vs. subtractive mixing

**RGB is Additive**: lights (as in live theater), screens, TVs, and LEDs
 Superimposes RGB (Red, Green, Blue) light rays. All three added together make white light.
 16.7 million color possibilities.
**CMYK is Subtractive**: paint, ink, dyes, print
 Produced by reflected light. CMYK (Cyan, Magenta, Yellow, Black) inks printed on white paper
 absorb or subtract red, green, and blue portions of the spectrum.
 16 thousand color possibilities.



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Magazines, artbooks, and other coffeetable books are printed with four-color or full-color printing. The colors are created by using different sizes of CMYK dots.
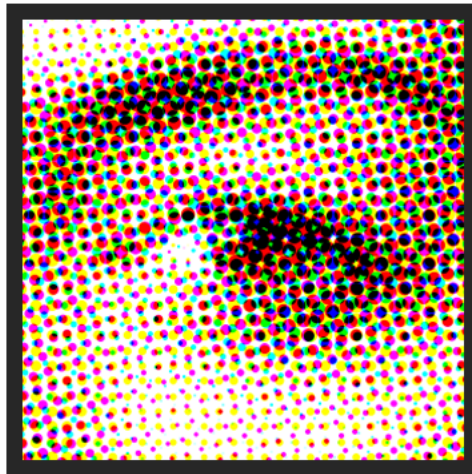


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In the United States, less expensive publications typically use one or two inks. Printers, designers, and clients use the Pantone Matching System (PMS) to define the colors and to match them. Other systems are used in different industries and different countries to ensure that a color is the same from one product to the next.

## Color matching systems and predictions

Color is big business. In many industries—including printing (e.g., advertising and art books), branding (e.g., Coca Cola's "red" or UPS's "brown") and manufacturing (Apple's "green" iPhone or iPad and Gatorade's "blue")—color matching is critical. Think of colors that you automatically identify with companies or products. Each year, Pantone identifies the Color of the Year, which will be used in designs throughout various industries, including print, plastic, fashion, etc.
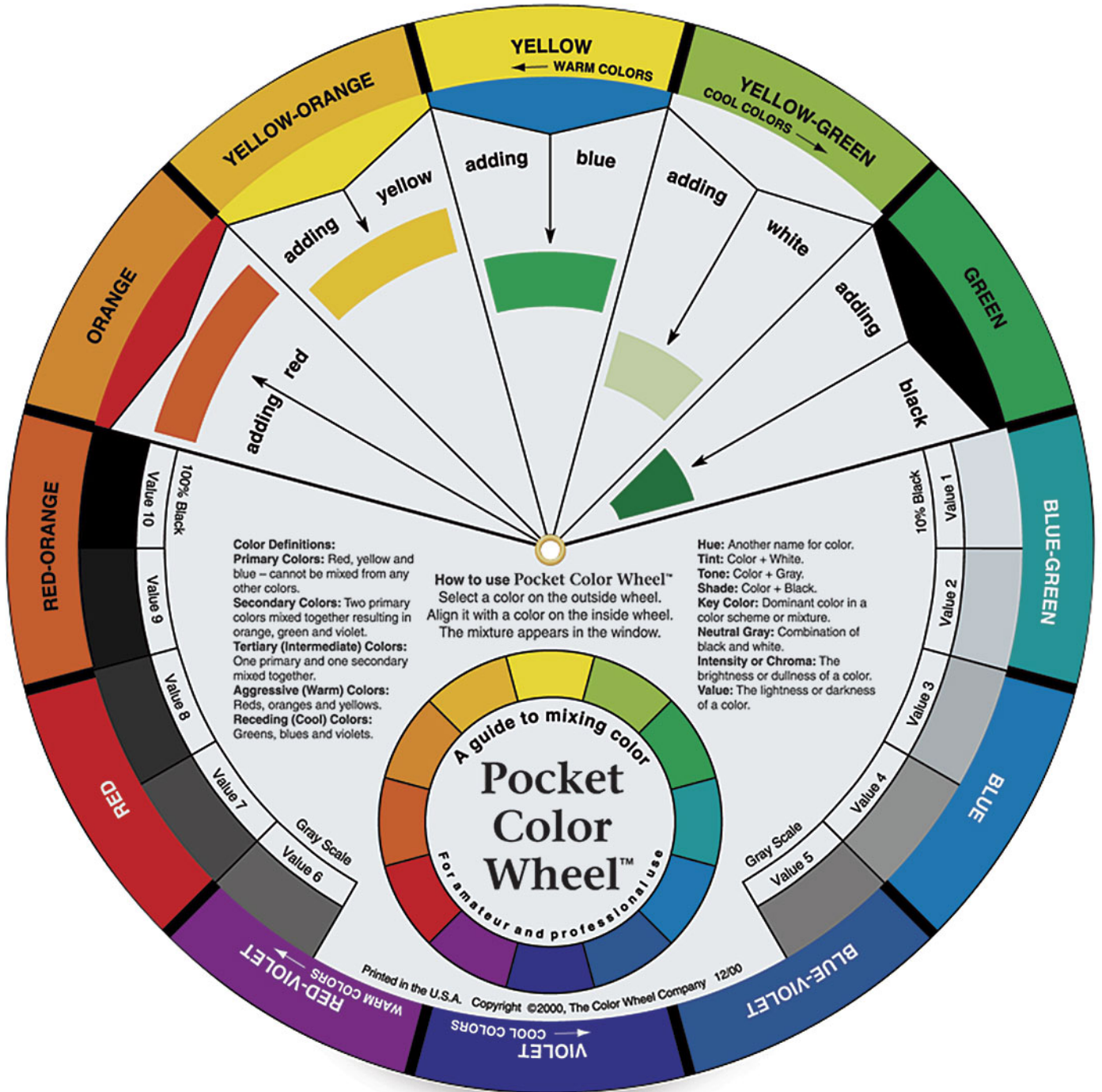
## Describing and classifying color

*"If one says 'red' (the name of the color) and there are fifty people listening, it can be expected that there will be fifty reds in their minds. And one can be sure that all these reds will be very different."*

— **Josef Albers**

- **Primary**: red, blue, yellow
  **Secondary**: orange, green, violet
  **Tertiary**: red-orange, yellow-orange, yellow-green, blue-green, blue-violet, red-violet

- **HSV**
  **Hue** (chroma): what people commonly refer to as color, e.g., red, violet
  **Saturation**: how dull or bright
  **Value**: how dark or light, how much black or white a color contains
  When white is added, it is called a **Tint**. When black is added to a color, it is called a **Shade.** (In some systems when gray is added to a color it is called a **Tone**, in others, a Shade.)

## Color wheel



© The Color Wheel Company

## Colors tints, tones, and shades
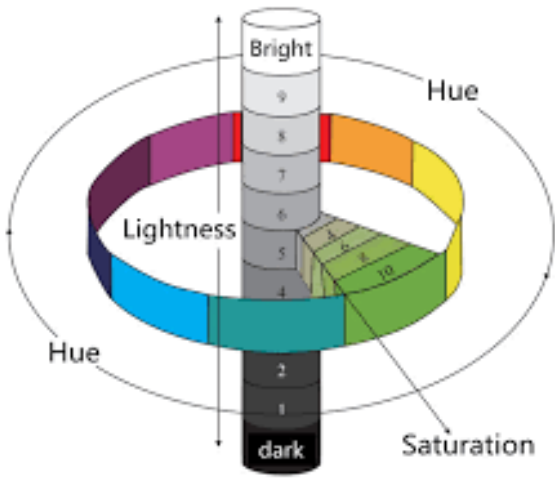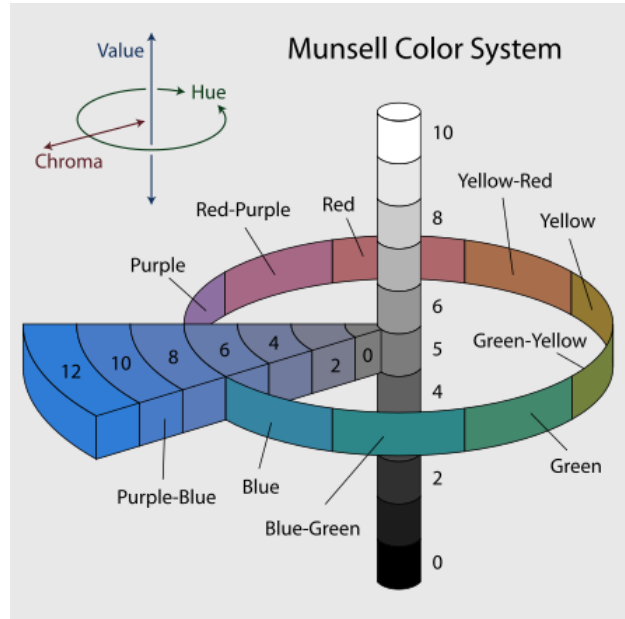


Hues — Pure Colors
Tints — Hue + White
Tones — Hue + Grey
Shades — Hue + Black
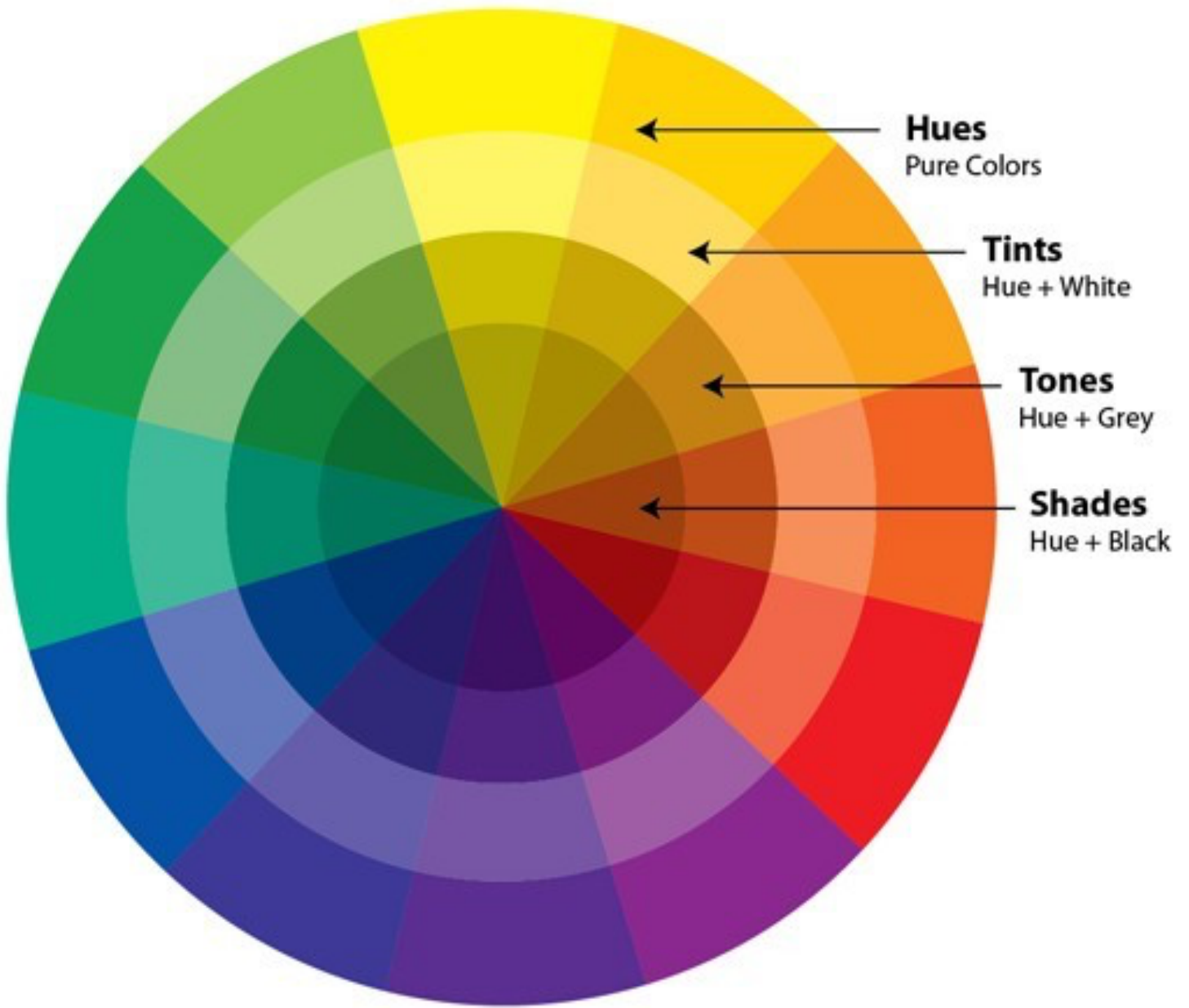
© Beach Painting Contractors

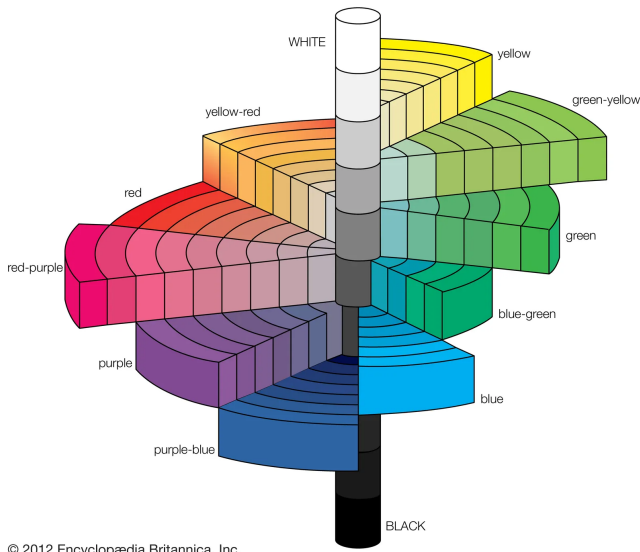## Munsell Color System


© Munsell Color


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## Color wheel complements

**YELLOW**

COMPLEMENTARY

SPLIT-COMPLEMENTARY

**YELLOW-ORANGE**

SPLIT-COMPLEMENTARY

**YELLOW-GREEN**

TRIADIC

**ORANGE**

TRIADIC

**GREEN**

PURE COLOR

PURE COLOR

T I N T — TONE — SHADE

SHADE — TONE — TINT

**Color and Light:** Subdued evening and candlelight create a distortion.

**Mono-chromatic:** Using any shade, tint, or tone of one color.

**Analogous:** Using any colors that are at 90 degree angles on the wheel.

**Achromatic:** A colorless scheme using blacks, whites and grays.

**Color and Light:** Subdued evening and candlelight create a distortion.

**Color and Distance:** Distance causes receding (cool) colors to "black out". Consequently lighter values of color should be employed for greater emphasis.

**Triad:** A contrast of four or more colors on the wheel.

**Tetrad:** A contrast of four or more colors on the wheel.

**Dual:** Using two colors that are two colors apart on the color wheel.

**Triad:** Color scheme that has three colors equally spaced from each other. Example the three primary colors — red, blue and yellow.

**Split Complements:** Choosing one color and using the color on each side of its complement on the color wheel.

**Complementary Harmony:** Combining a shade, tint or tone of one color and crossing over to choose the opposite color. Example blue and orange

COMPLEMENTARY

SPLIT COMPLEMENTARY

TRIAD

TETRAD

TETRAD

**RED**

T I N T — TONE — SHADE

**RED-VIOLET**

12/00

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**How to use the Color Harmony Wheel:**
Turn dial to the key color on the pure color row. Harmonizing color relationships are seen through the windows following the diagram.

**BLUE**

T I N T — TONE — SHADE

**BLUE-VIOLET**

**VIOLET**

KEY COLOR (Pure Color)

ILLUSTRATION OF COLOR RELATIONSHIPS OR HARMONIES

THE COLOR WHEEL COMPANY
Philomath, Oregon
Phone: (541) 929-7526
www.colorwheelco.com

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### Color harmony

There are six types of color harmony.

1. Complementary
2. Split complementary
3. Double or Tetrad complementary
4. Analogous
5. Triadic
6. Monochromatic

### Suggested books

*Interaction of Color*, Josef Albers

*The Elements of Color*, Johannes Itten, Faber Birren

*A Book of Colors: Matching Colors, Combining Colors, Color Designing, Color Decorating,* Compiled by Shigenobu Kobayashi with the assistance of Ronald Sternberg

*Color: A Visual History from Newton to Modern Color Matching Guides,* Alexandra Loske, Smithsonian Books

*Color Design Workbook: A Real World Guide to Using Color in Graphic Design,* Sean Adams with Terry Lee Stone

*Pantone Guide to Communicating with Color*, Leatrice Eiseman

### Suggested websites

https://munsell.com
Site of the Munsell Company, their products, and history

https://www.pantone.com
Site of Pantone, the standard model and products for defining color in the print, fashion, and industrial design industries

https://www.getty.edu/research/exhibitions_events/exhibitions/bauhaus/new_artist/form_color/
About color theory at the Bauhaus (where Albers, Itten, Kandinsky, Klee, and others taught)

paletton.com
Quickly locate various complements of any color

http://colorlisa.com/
Find color palettes from famous paintings

https://www.xrite.com/hue-test
Test your ability to discriminate hues

https://colorhunt.co/
Color palettes selected by designers

http://brandcolors.net/
The specific colors used by various companies, nonprofits, etc.