

COLOR THEORY

QUICK REFERENCE SHEET FOR DESIGNERS

SUBTRACTIVE

CREATED WITH INK;
START WITH WHITE, ADD COLOR.
CMYK



COLOR TYPES

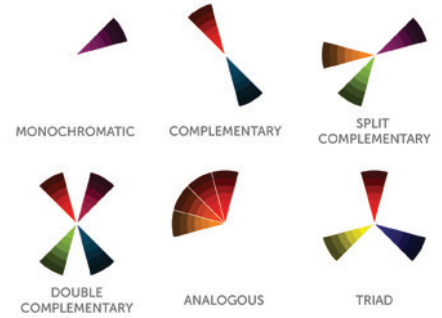


ADDITIVE

CREATED WITH LIGHT;
START WITH BLACK, ADD COLOR.
RGB



COLOR RELATIONSHIPS



MEANINGS



TERMS

CHROMA: How pure a hue is in relation to gray
SATURATION: The degree of purity of a hue
INTENSITY: The brightness or dullness of a hue
LUMINANCE/VALUE: A measure of the amount of light reflected from a hue
SHADE: A hue produced by the addition of black
TINT: A hue produced by the addition of white

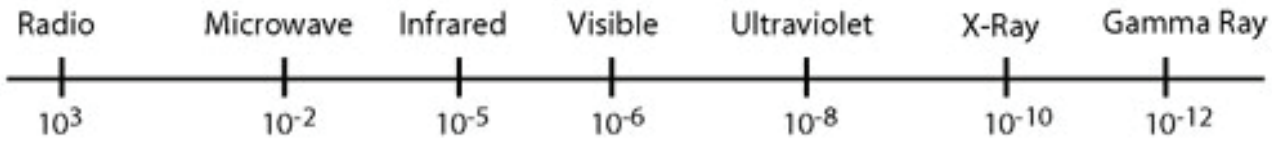
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An Introduction to the History of
Optics and Color Theory:
Newton, Goethe, Chevreul, Munsell, Itten, and Albers, etc.,
etc.,
etc.

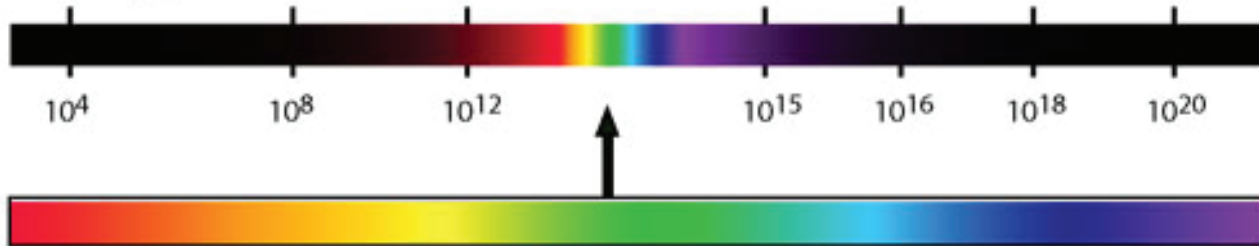
Magnetic Waves

THE ELECTRO MAGNETIC SPECTRUM

Wavelength
(metres)



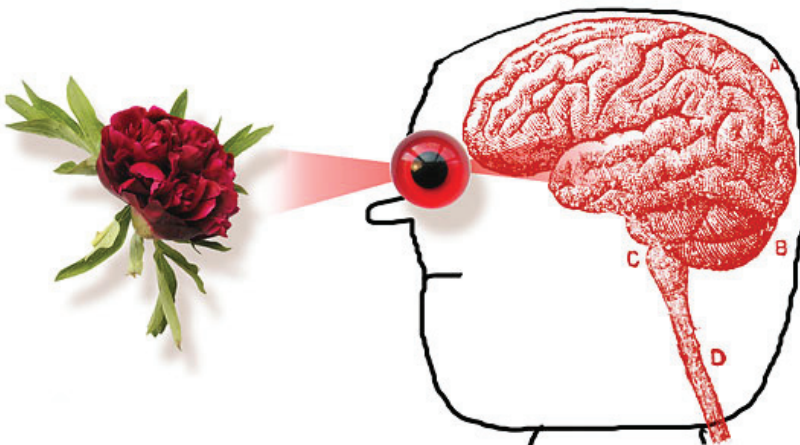
Frequency
(Hz)



The average human eye can detect only a very small portion of this vast range. We know this section as “visible light,” and we can distinguish about ten million variations within it.

When our eyes see the whole range of visible light together, they read as “white.” When some of the wavelengths are missing, they see it as “colored.”

So, when we see “red,” what is happening?



Of our famed rods and cones—the two classes of light-sensing cells with which the retina at the back of each eye is supplied—the rods do the basics of vision, of light versus shadow, through only in gunmetal shades of black, white and grey. The rods sit wider along the retina allowing it to capture periphery vision, although not sharply. The cones, are concentrated in the center of the retina, and capture color and sharper detail, and work best in strong light. Our color vision at night hardly exists because of this.

It is up to our cone cells to capture color. As full-spectrum sunlight falls on, say, a red rose, the physical and chemical properties of the flower's petals, allow it to absorb much of the light, save for relatively long, reddish lightwaves, which bounce off the surface and into our greedy eyes. On hitting the retina, those red wavelengths stimulate with greatest fervor the cone cells set to receive them.

In simple terms, coloring can either be chemical or physical.

Within chemical, as said above, the colors appear because they absorb some of the white light, and reflect the rest. So the green is created, because it is absorbing the red and orange wavelengths from the white around it, and reflecting the green.

In a sense, the object is "doing" a color, instead of "being" a color. With a red tomato, the atoms of the object are busy moving in such a way, that when light falls on them they absorb most of the blue and yellow, and reject or reflect the red.



This means, paradoxically, that the "red" tomato is actually one that contains every wavelength except red.

There are physical causes of color, but one which we are all familiar with is the rainbow.



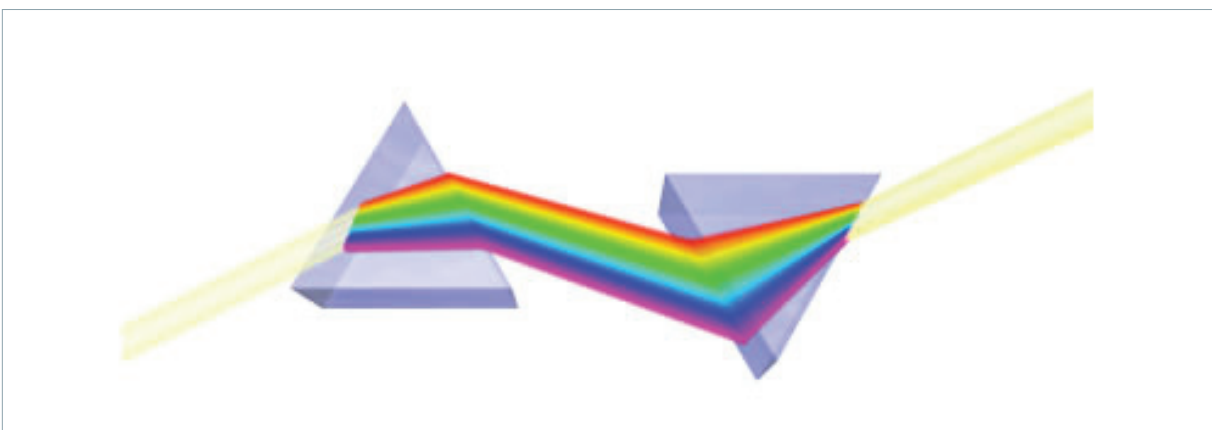
This forms in the sky when light bounces around raindrops and gets divided, or "refracted" into separate wavelengths.



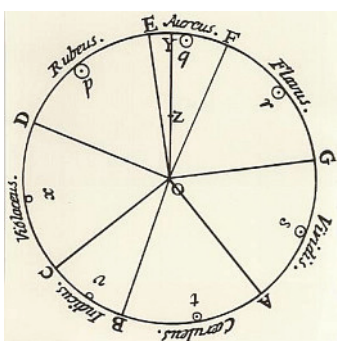
Isaac Newton

The explanation was famously discovered in 1666 by Newton, in a dark room with small prisms made of glass. In a window shutter he drilled a hole, which allowed a thin beam of light to shine in the room. Shining through the prism, he was able to show that light is made up of many colors, each with their own wavelength, red with the shortest, and violet with the longest.

By placing a second prism upside down in front of the first, the rainbow disappeared, and became white light again. This shows that light is made up of every color in the spectrum.



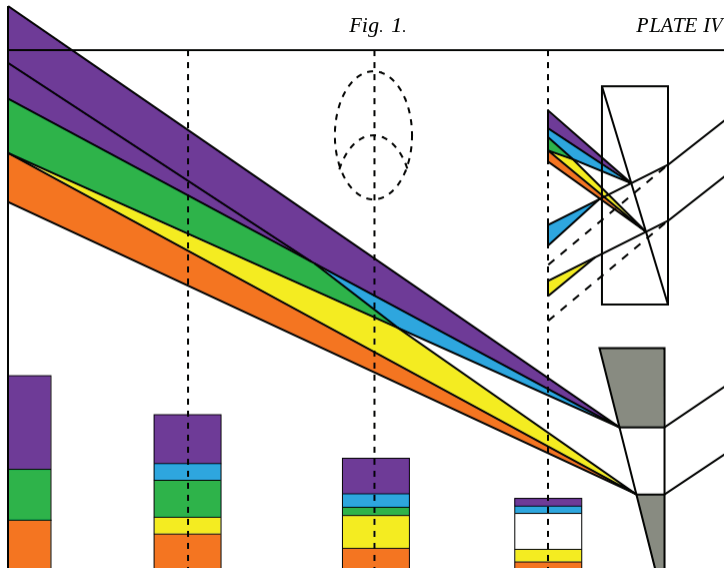
Newton was the first to give a real explanation of how each ray of color bends at a certain fixed angle while passing through the prism.





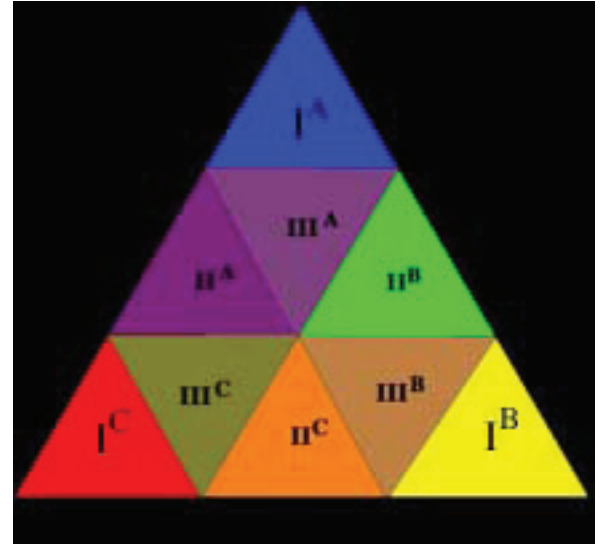
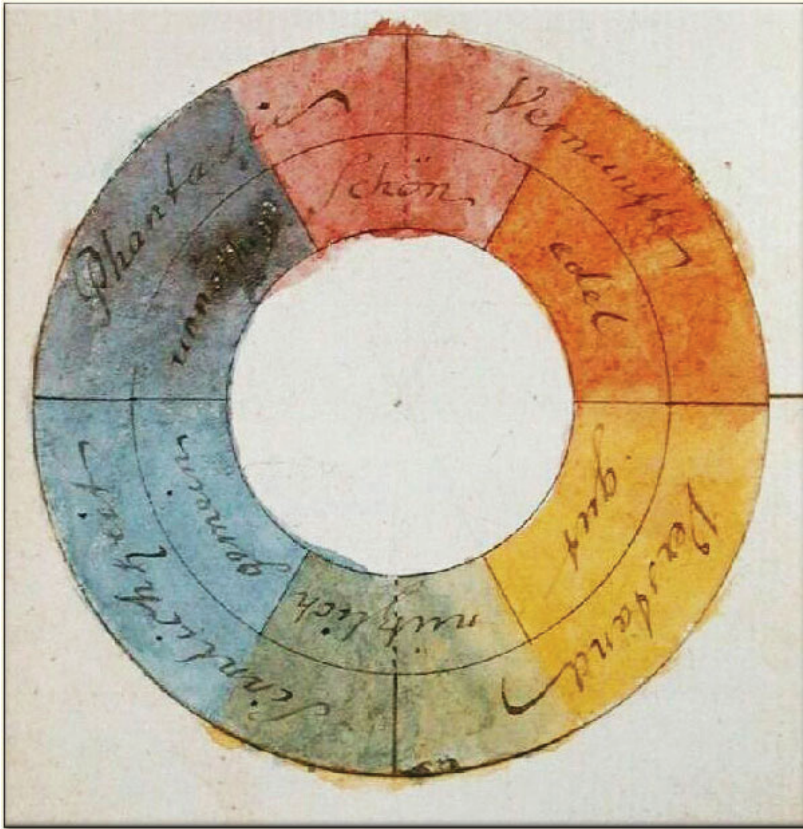
Johann Wolfgang von Goethe

Goethe's works span the fields of poetry, drama, literature, philosophy, and science. Early in his career, however, he wondered whether painting might be his true vocation; late in his life, he expressed the expectation that he would ultimately be remembered above all for his work on color. In 1810, Goethe published his Theory of Colours, which he considered his most important work.

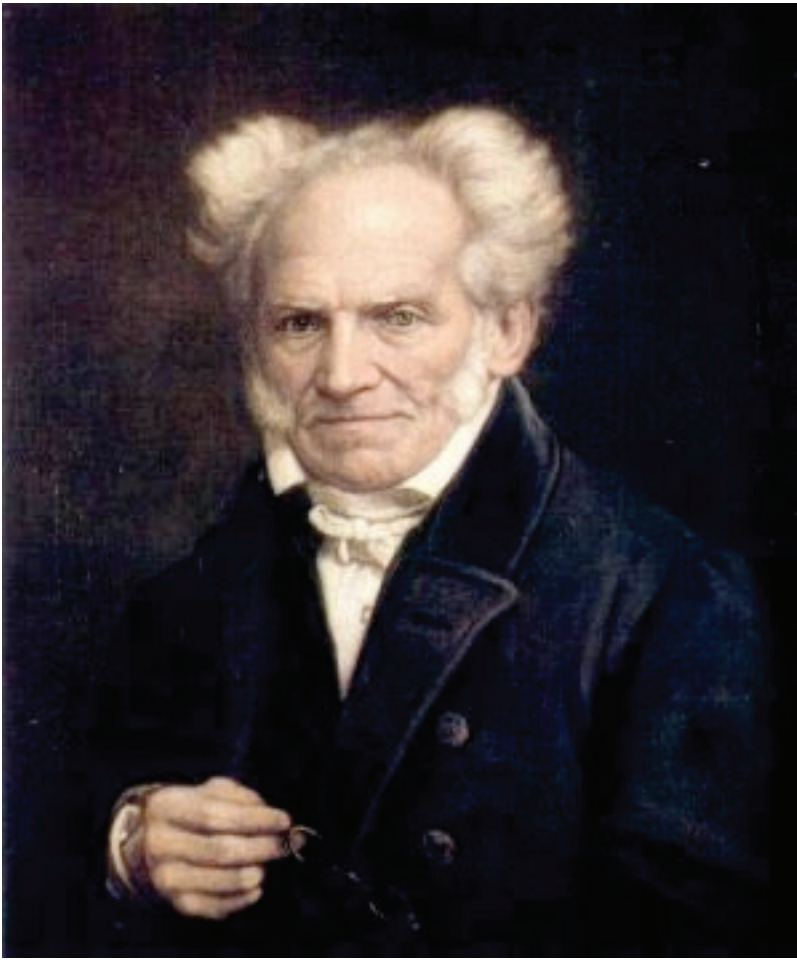


Goethe observed that with a prism, color arises at light-dark edges, and the spectrum occurs where these colored edges overlap. Therefore, light bouncing off of colored objects needed to be considered.

Goethe was vehemently opposed to Newton's analytic treatment of color, engaging instead in compiling a comprehensive description of a wide variety of color phenomena.



Although the accuracy of Goethe's observations are questionable and have since been proven inaccurate, Goethe was, the first to systematically study the physiological effects of color, and his observations on the effect of opposed colors led him to a symmetric arrangement of his color wheel, 'for the colors diametrically opposed to each other... are those which reciprocally evoke each other in the eye.' (Goethe, Theory of Colours, 1810).

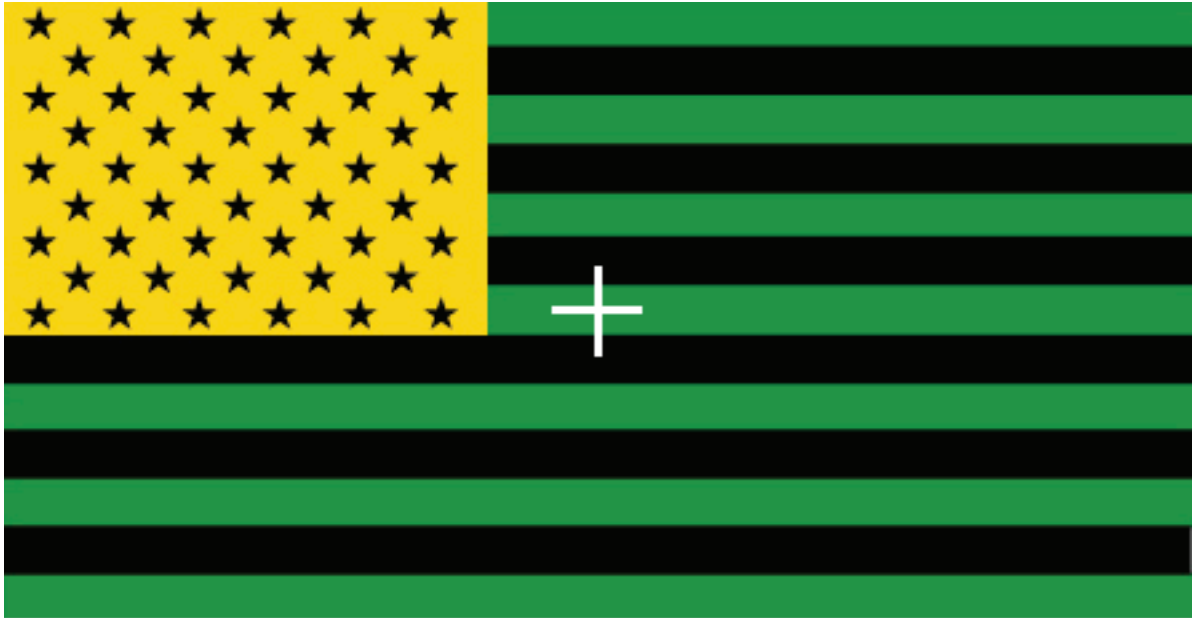


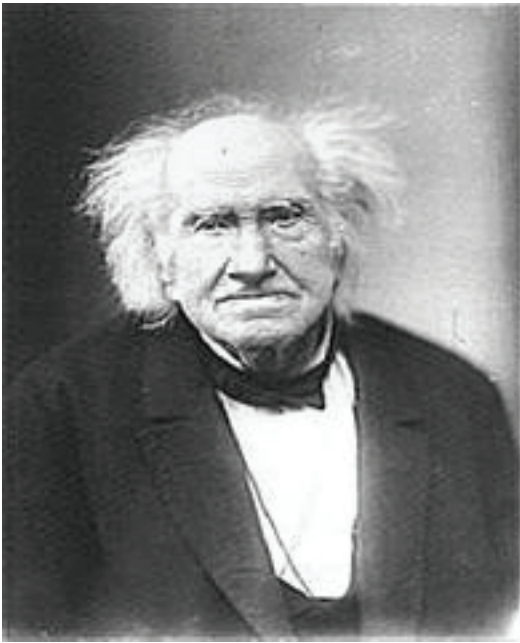
Arthur Schopenhauer

On Vision and Colors, based on Goethe's color theory as expounded in his Theory of Colours of 1810.

The initial basis for Schopenhauer's color theory comes from Goethe's chapter on physiological colors, which discusses three principal pairs of contrasting colors: red/green, orange/blue, and yellow/violet.

Schopenhauer agreed with Goethe's claim that the eye tends toward a sum total that consists of a color plus its spectrum or afterimage. Schopenhauer arranged the colors so that the sum of any color and its complementary afterimage always equals unity. The complete activity of the retina produces white. When the activity of the retina is divided, the part of the retinal activity that is inactive and not stimulated into color can be seen as the ghostly complementary afterimage, which he and Goethe call a (physiological) spectrum.



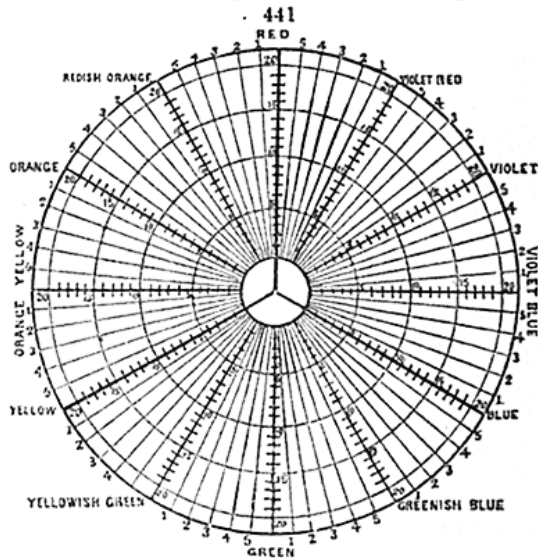


Michel Eugène Chevreul

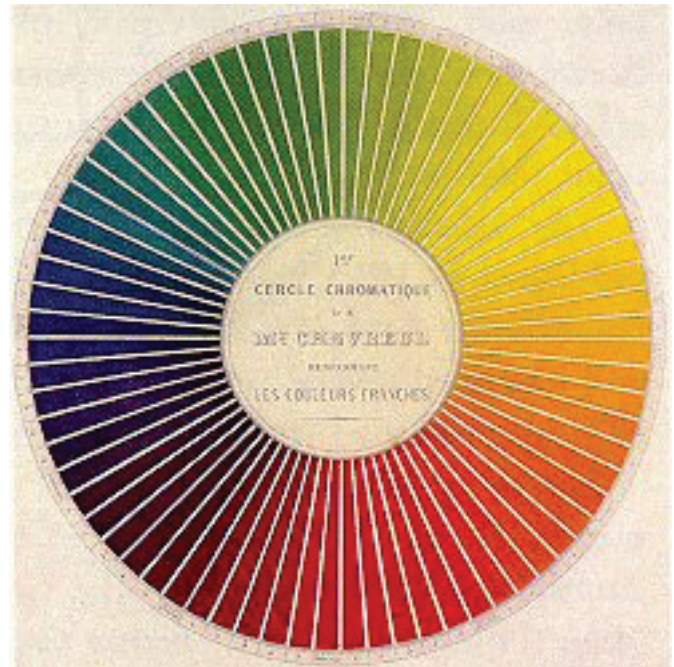
Chevreul, a French chemist whose work with fatty acids led to early applications in the fields of art and science.

After being named director of the dye works at the Gobelins Manufactory in Paris, he received many complaints about the dyes being used there. In particular, the blacks appeared different when used next to blues. He determined that the yarn's perceived color was influenced by other surrounding yarns. This led to a concept known as *simultaneous contrast*.

800. Chevreul's classification of colors, and chromatic diagram.—The chromatic diagram, of Chevreul, fig. 441, greatly

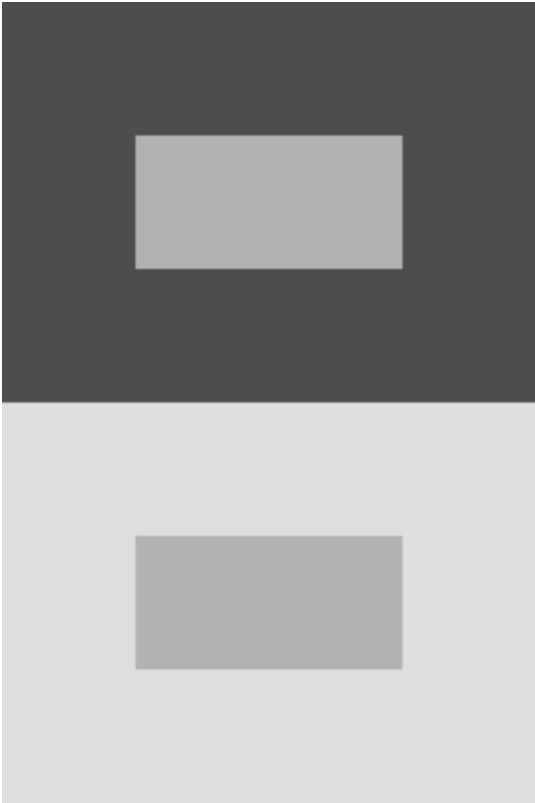


facilitates the study of complementary colors, and the modifications produced by their mutual proximity.

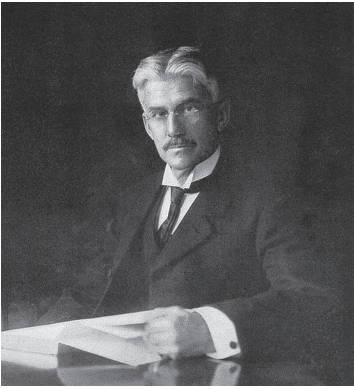


Simultaneous contrast refers to the manner in which the colors of two different objects affect each other. The effect is more noticeable when shared between objects of complementary color.

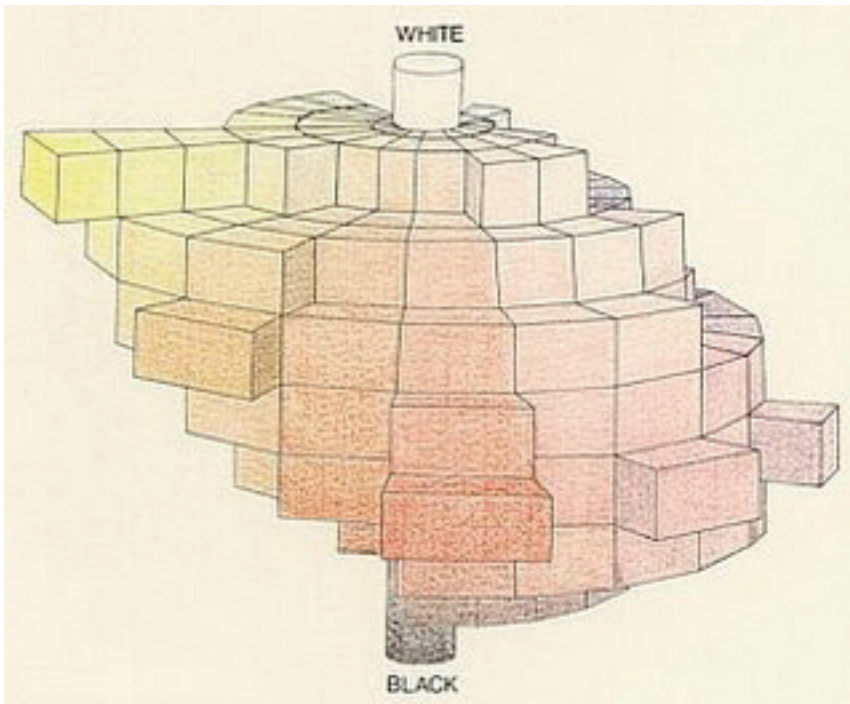
In the image here, the two inner rectangles are exactly the same shade of grey, but the upper one appears to be a lighter grey than the lower one due to the background provided by the outer rectangles.



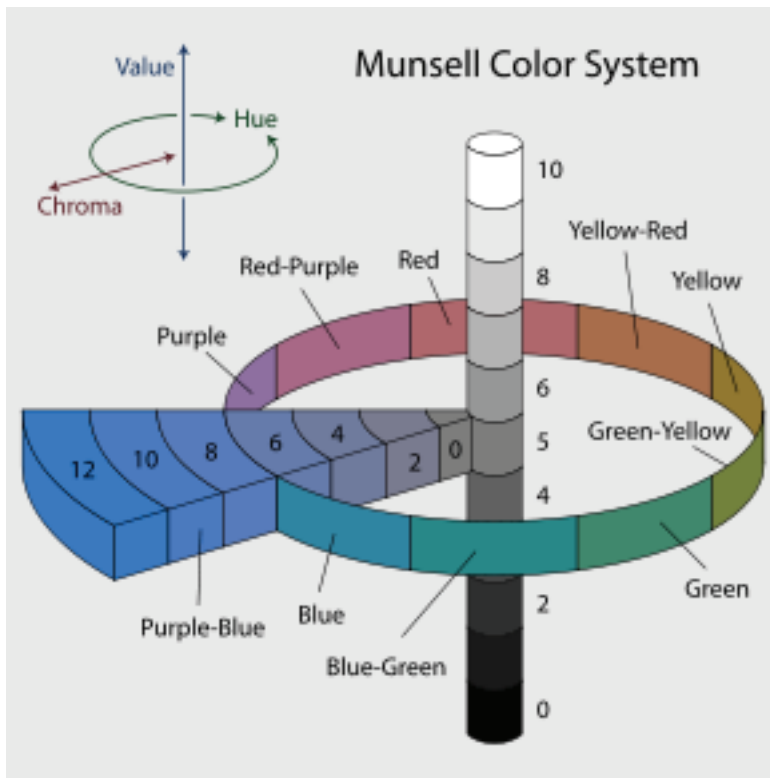
Therefore relativity and context play a huge part in the colors that we see. They do not stand alone.



Albert H. Munsell



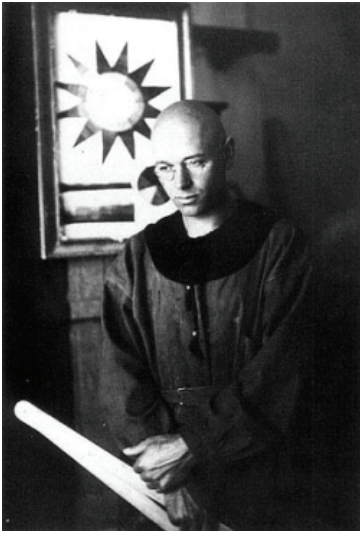
The Munsell color system is a color space that specifies colors based on three color dimensions: hue, value (lightness), and chroma (color purity). It was created by Professor Albert H. Munsell in the first decade of the 20th century and adopted by the USDA as the official color system for soil research in the 1930s.



Several earlier color order systems had placed colors into a three dimensional color solid of one form or another, but Munsell was the first to separate hue (the color), value (lightness and darkness), and chroma (movement towards neutral using the compliment) into perceptually uniform and independent dimensions, and was the first to systematically illustrate the colors in three dimensional space.

For more on the history of color systems, go to:

<http://bibliodyssey.blogspot.com/2006/03/history-of-colour-systems.html>

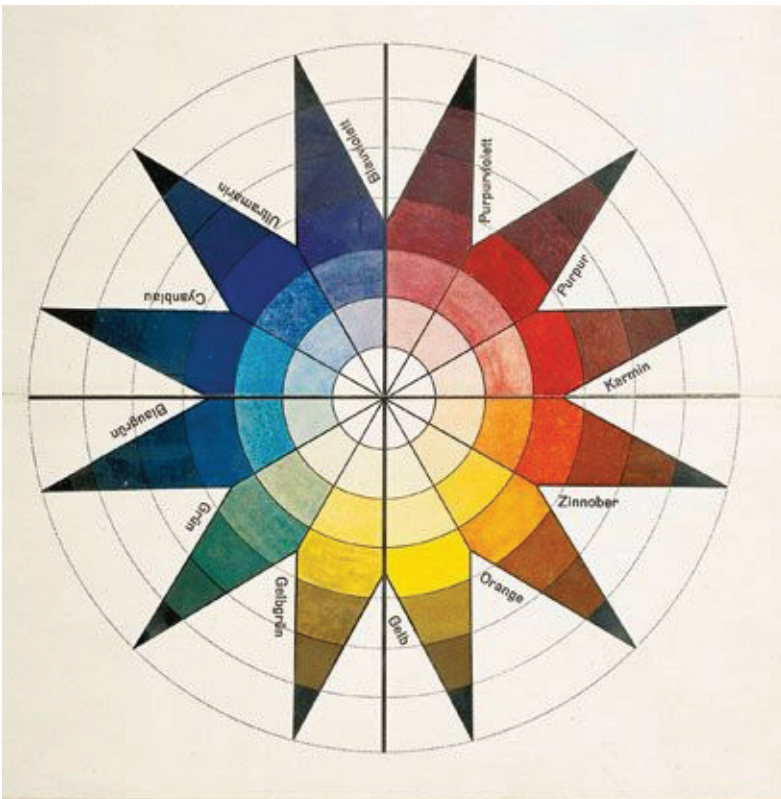


Johannes Itten

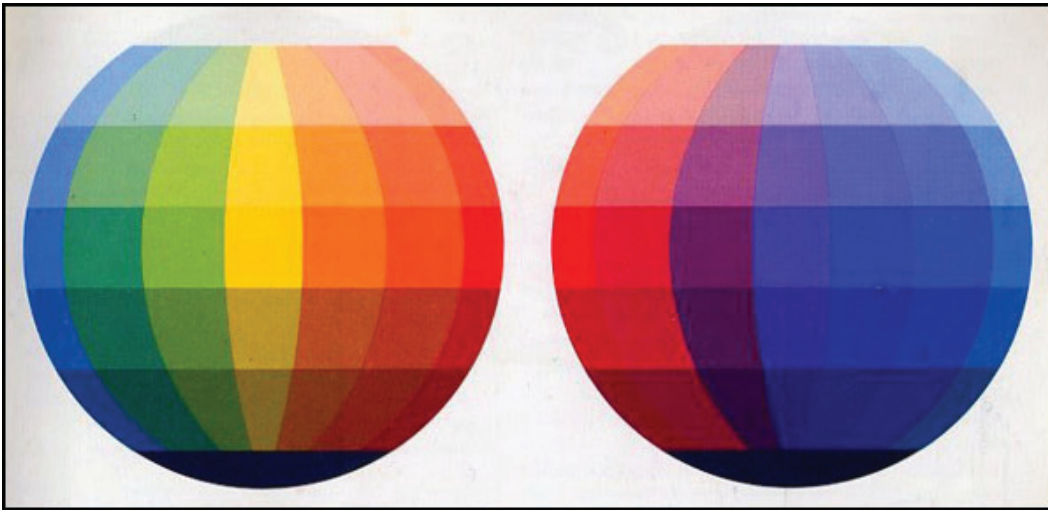
Swiss expressionist painter, designer, teacher, writer and theorist associated with the Bauhaus school.

From 1919 to 1922, Itten taught at the Bauhaus, developing the innovative “preliminary course” which was to teach students the basics of material characteristics, composition, and color.

He published a book, The Art of Color, which describes these ideas as a furthering of Adolf Hölzel’s color theories (he was a student of Hölzel).

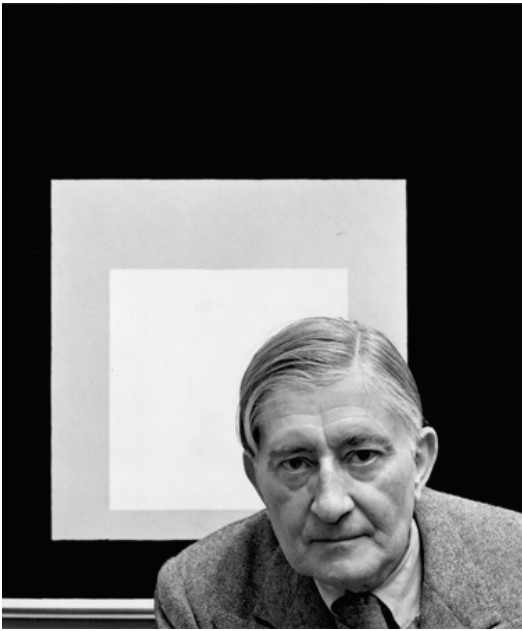


Johannes Itten. Color sphere in 7 light values and 12 tones



Itten's so called "color sphere" went on to include 12 colors.

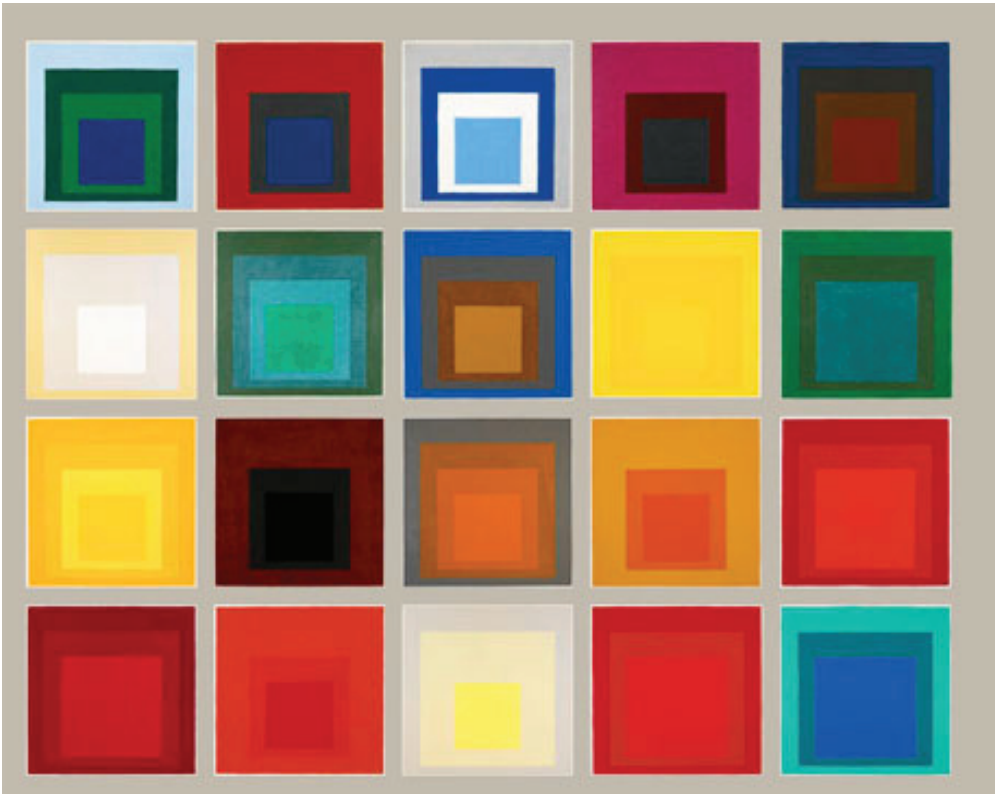




Josef Albers

German-born American artist and educator, Albers studied at the Bauhaus, and then began teaching in the preliminary course of the Department of Design in 1922, and was promoted to Professor in 1925.

With the closure of the Bauhaus under Nazi pressure in 1933, Albers emigrated to the United States and joined the faculty of Black Mountain College, North Carolina, where he ran the painting program until 1949. At Black Mountain his students included Robert Rauschenberg, Cy Twombly, Ray Johnson and Susan Weil. In 1950 Albers left Black Mountain to head the Department of Design at Yale University.



He favored a very disciplined approach to composition. Most famous of all are the hundreds of paintings and prints that make up the series *Homage to the Square*. In this rigorous series, begun in 1949, Albers explored chromatic interactions with flat colored squares arranged concentrically.

Albers published Interaction of Color in 1963, based off of his famous color course, based on direct perception, and not using theories of color systems, such as those mentioned above.

