

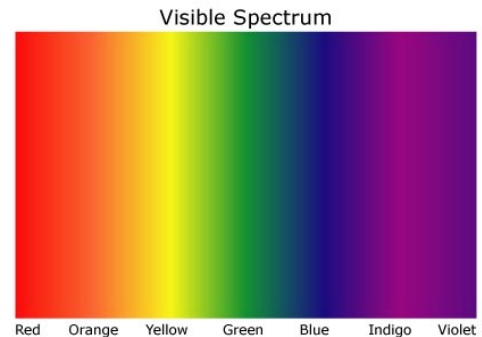
Color Addition Lesson Notes

Learning Outcomes

- Why do we see color?
- How can we reduce the complicated world of color into a few simple and understandable principles?

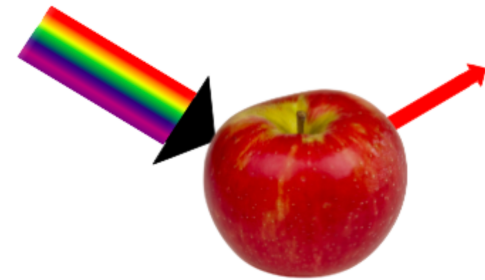
Where Does Color Come From?

- Color is the result of varying wavelengths of light reaching our eye. Each color is representative of a unique wavelength of light.
- The full spectrum of visible light is referred to as **ROYGBIV**.



The Red Apple

- The color an object appears is determined by what color(s) the object **reflects** to our eyes.
- An apple appears red under sunlight because the apple **absorbs** all the colors but red from the white light (interpreted as ROYGBIV) that is **incident** upon it.



Color Math

$$\text{ROYGBIV} - \text{OYGBIV} = \text{R}$$

Incident-Absorbed-Reflected Model

The color an object appears depends on the colors that are incident, absorbed, and reflected by the object.

Incident light = light colors that land on the object.

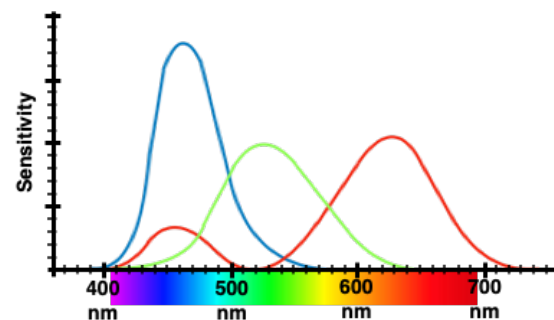
Absorbed light = light colors that are absorbed, subtracted, or taken away by the object.

Reflected light = light colors that are bounced the object to the eye.

The Eye's Response to Light

Our eyes contain three different **cones** (light receptors) that are sensitive to a range of wavelengths.

Because of their peak sensitivity, we refer to them as the **red cone**, the **green cone**, and the **blue cone**.



How Does Color Vision Work?

When light from objects reach our eyes, the red, green, and blue cones gather the information about intensity and send it to the brain.

The brain interprets this collection of information and translates it into words associated with color - "red", "maroon", "lavender", etc.

What Color Involves

Physics: wavelengths of light

Physiology: the eye, signals to the brain

Psychology: language

Where Do All the Colors Come From?

By combining **primary colors of light** together, other colors can be produced.

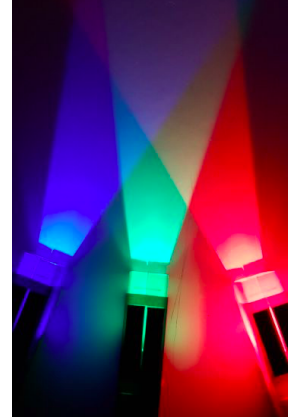
When combined in equal intensity:

Red + Blue \Rightarrow Magenta

Green + Blue \Rightarrow Cyan

Red + Green \Rightarrow Yellow

The millions or billions of colors of light can be produced by combining red, green, and blue light in equal and unequal intensities. All screens are based on this principle.



Color Wheel and Color Addition Equations

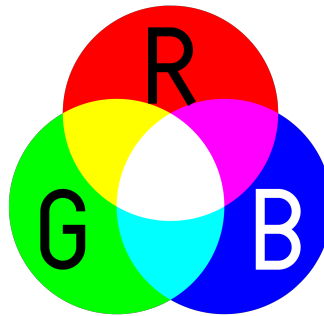
Primary colors of light combine in equal intensities to produce **secondary colors of light**.

Color Addition Rules

Red + Green \Rightarrow Yellow

Red + Blue \Rightarrow Magenta

Green + Blue \Rightarrow Cyan



The Math of Color

$$R + G = Y$$

$$R + B = M$$

$$G + B = C$$

$$R + G + B = \text{White}$$

Complementary Colors of Light

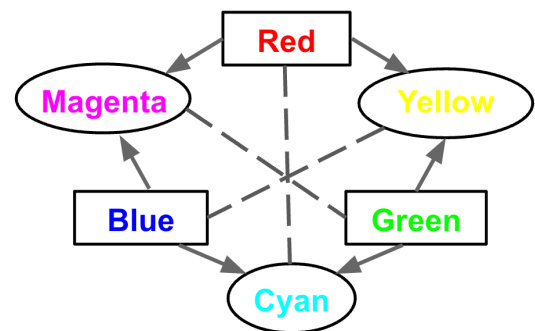
By definition, **complementary colors of light** are two light colors that combine to produce white light.

The complementary color pairs are:

Red and Cyan

Blue and Yellow

Green and Magenta



White vs. Black

White is the **presence of all the colors** of ROYGBIV (or at least of RGB).

Objects that appear white are reflecting all the light of ROYGBIV to our eyes. They absorb no light and reflect all the light.

VS.

Black is the **absence of all the colors** of ROYGBIV (or at least of RGB).

Objects that appear black are not reflecting any of the ROYGBIV light to our eyes. They absorb all the light and reflect no light.