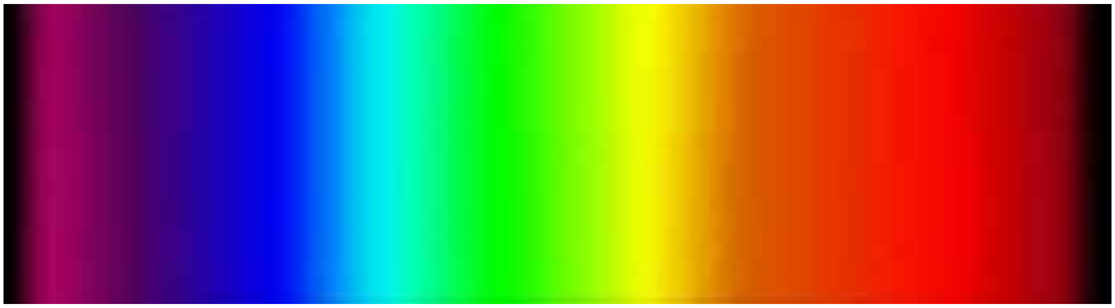


The Spectrum

Light travels in waves of different wavelengths. Light is emitted from sources such as the sun, light bulbs, and fire in many different wavelengths; however the human eye can only detect certain kinds. The eye is capable of sensing light of wavelengths ranging from about 400 to 700 nanometers.

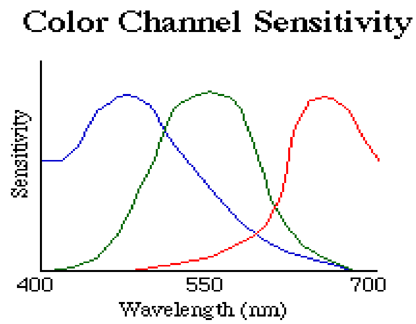
The wavelength of the light determines its color, for example light that has a wavelength of 520 nanometers appears green. Any color that is of a single wavelength (such as 520 nanometers) is called monochromatic. Scientists have displayed all of the monochromatic colors in what is called the visual spectrum and for this reason monochromatic colors are often called spectral colors.

By mixing light of different wavelengths, it is possible to create different colors. Colors formed by mixing different wavelengths of light are called polychromatic colors. The colors we can see because of mixing are shown on something called a Chromaticity Diagram. This shows all of the spectral colors along the edges and the colors formed by mixing them in between. Note that white is in the center of the diagram; white light is actually a mixture of all wavelengths of light.

Color is often classified based on the chromaticity diagram model. The HSL Classification System defines colors in terms of hue, saturation, and lightness. Hue is the closest wavelength of light to the color on the chromaticity diagram. Saturation (also called purity) measures how close the color is to the wavelength on the diagram. A color of a 520nm hue and 100% saturation would be pure 520nm light so would appear green. A color of a 520nm hue and 0% saturation would be in the center of the diagram so would appear white or gray. The final number for color classification is lightness, which measures the intensity of the color. Lightness of 0% would be black because no light would be reflected. Lightness of 100% would be white because all light would be reflected. Lightness between these extremes creates different shades of colors.

Primary Colors

The human eye only has 3 color channels. In other words, our eyes are not able to distinguish the particular wavelengths of light and can only use three different sensors to determine what color an object should appear.

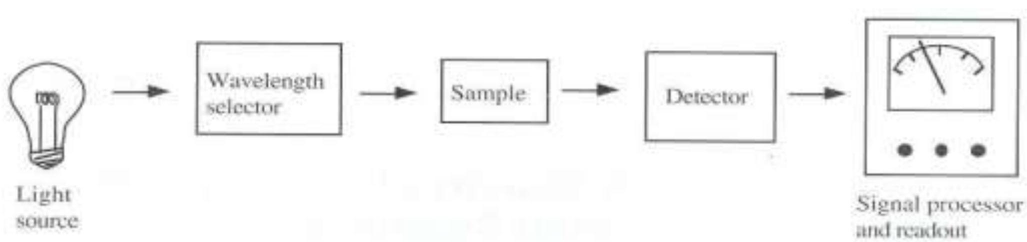


We see the millions of colors around us because of the way that the color channels send signals to the brain. The color channels are called Red, Green, and Blue. Each channel is sensitive to a certain range of light. At 520nm the green channel is very sensitive but the blue channel is only moderately sensitive and the red channel is barely sensitive at all. When 520nm light strikes the eye, a very strong "green" signal, a moderate "blue" signal, and a weak "red" signal are sent to the brain. The brain combines these three signals to determine that the light is 520nm, making the light appear green.

Because red, blue and green are the three colors that the human eye can see, these are called the primary colors of light. Any color visible to humans can be described as a combination of signals from the red, green, and blue, so the RGB Color Classification System was created. This system defines a color in terms of the amount of stimulation it creates in each of the three color channels.

The electromagnetic spectrum is identified by its wavelength. For the visible region, the lengths of the light waves are in the range of billionths of a meter, and, therefore, the wavelengths are expressed as nanometers, nm (1 nm = 1 x 10^{-9} meter).

The instrument used to measure the interaction of light with matter is called a spectrophotometer.



Block diagram of spectrophotometer components

This device is designed to split visible light into its component colors (i.e. different wavelengths) and then allow light of a selected wavelength region to pass through a sample of the material being studied. An electronic detector measures the amount of light that has been transmitted or absorbed by the sample at each wavelength. All spectrophotometers have essentially the same major components but with varying degrees of sophistication. These essential components are (1) a light source, (2) a device to isolate or resolve particular wavelengths of light, (3) a sample holder, (4) a detector, and (5) a meter or other device to display the measured transmittance or absorbance of light. *Figure 2.1* shows a simple block diagram of spectrophotometer components. Spectrophotometers are available for most regions of the electromagnetic spectrum. Spectrophotometers for the visible region of the spectrum were developed first and are still the most common. In these instruments, the light source is an ordinary incandescent light bulb; the wavelength selector consists of a diffraction grating and some lenses; a liquid sample is placed in a test-tube like container (called a *cuvette*); and the detector is a phototube that converts light intensity into an electrical signal.

The meter on the instrument will display either Absorbance (A) or percent transmittance (%T). Transmittance is the more understandable quantity because this is defined as the amount of light that passes through a sample of known thickness (the "path length") divided by the light that passes through a blank of equal thickness, and multiplied by 100 % transmittance (% T) = transmittance by sample transmittance by blank x 100%. The result is a spectrum, a curved line that shows how a particular solution transmits light in the visible region of the electromagnetic spectrum.

However, many newer spectrophotometers display a different property, Absorbance, A, instead of % T. In a general way, absorbance is the inverse of transmittance. Thus, for example, if a sample transmits all of the light at a certain wavelength, then the absorbance of light by the sample at that wave-length must be zero; conversely, if the transmittance is low, this means the absorbance is high. The mathematical relationship is slightly more complicated: Absorbance is defined as 2 minus the logarithm of the % transmittance, or A = 2 - *log* %T. The particular utility of absorbance is that it is directly proportional to the concentration of the colored or absorbing material; i.e., A = abc where "a" = is a constant at a specific wavelength, "b" is the path length or the diameter of the cuvette, and "c" = the concentration of the colored material.

About Atlas

For more than 90 years, Atlas has pioneered innovations in the way companies test the durability of their products. From our first instrument in 1915 - the Solar Determinator - which simulated the fading effect the sun has on fabric, to today's comprehensive network of weathering testing instruments and services, our focus has remained the same:

Providing our customers with sophisticated technology and advanced testing solutions to determine how long their products will last. As a result, they can reach their ultimate goals: a quality product, a competitive edge, a faster time to market.

Atlas is headquartered in Chicago, Illinois and with its European headquarters in Linsengericht, Germany. Atlas has two design and manufacturing sites worldwide for the internationally accepted Weather-Ometer® and Xenotest® line of test instruments: Chicago, Illinois and Linsengericht, Germany.

With the combined resources of Atlas Material Testing Technology our clients can have expert assistance in all areas related to natural and laboratory weathering and material testing solutions. We work together to provide our clients with a test program that will supply the data needed to make informed material performance decisions.

Atlas' history started in 1918 with Light-fastness testing instruments for the textile industry. Today, we still help guide the critical decisions in design, manufacturing and purchasing of textiles and garments by helping detect the materials and processes that cause fading by light.

Light-fastness, or colorfastness to light, is the resistance of materials to fading due to exposure to sunlight or an artificial light source. The most recent tests performed by us for you was our test numbers FA19361 and FA19855 using test method AATCC 16E.

The parameters for AATCC 16E are:
Filters: Borosilicate Inner;
Soda Lime Outer Irradiance Level: 1.10 W/m^2 @ 420 nm Continuous Light
Black Panel Temperature: 63 +/- 3°C
Chamber Temperature: 43 +/- 2°C
Relative Humidity: 30 +/- 5%

Tests were run in a Ci4000 Xenon Weather-Ometer(R).

The following is a link to our page for our current version of the unit:
http://www.atlas-mts.com/shop/product?cID=001001001&ID=3&atk=92418057

American Association of
Textile Chemists and Colorists
The International Association for Textile Professionals

AATCC Test Method 16-2004
Colorfastness to Light

Developed in 1964 by AATCC Committee RA50

1. Purpose and Scope

1.1 This test method provides the general principles and procedures which are currently in use for determining the colorfastness to light of textile materials. The test options described are applicable to textile materials of all kinds and for colorants, finishes and treatments applied to textile materials.
Test Options included are:
1-Enclosed Carbon-Arc Lamp, Continuous Light
2-Enclosed Carbon-Arc Lamp, Alternate Light and Dark
3-Xenon-Arc Lamp, Continuous Light, Black Panel Option
4-Xenon-Arc Lamp, Alternate Light and Dark
5-Xenon-Arc Lamp, Continuous Light, Black Standard Option
6-Daylight Behind Glass

1.2 The use of these test options does not imply, expressly or otherwise, an accelerated test for a specific application. The relationship between any light-fastness test and the actual exposure in use must be determined and agreed upon by the contractual parties.

2. Principle

2.1 Samples of the textile material to be tested and the agreed upon comparison standard(s) are exposed simultaneously to a light source under specified conditions. The colorfastness to light of the specimen is evaluated by comparison of the color change of the exposed portion to the masked control portion of the test specimen or unexposed original material, using the AATCC Gray Scale for Color Change or by instrumental color measurement. Light-fastness classification is accomplished by evaluation versus a simultaneously exposed series of AATCC Blue Wool Light-fastness Standards.

http://www.aatcc.org