Color of Light Theory

Complimentary except for EdTA members, from:

High School Theatre Lighting Rep Plot; a step-by-step guide
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COLOR

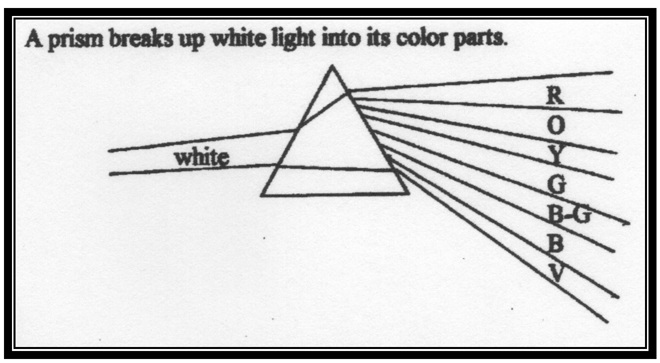
Color is used extensively in theatre lighting. Even a "white" light that you see probably has a color filter on it. In the theatre these color filters are called gels. Some gels are so subtle, that they even have names like "No Color Blue".

Color is used to depict mood, location, time of day, and so on. Rudimentary examples include blue or lavender for nighttime, green for a forest, or amber for a sunset. Warm colors are usually associated with comedy and cool colors with tragedy. Color can also be used to enhance people's skin tones. Some notorious actresses are renown for demanding a certain gel color in the lights to enhance their skin tone.

The color our eyes see is the product of the color of light and the color of every object and person on the stage. Let's look at why this is.

WHITE LIGHT

"White" light is made up of many colors, usually considered to be seven or eight colors: red, orange, yellow, green, blue-green, blue, indigo, violet.



When you see "white" light it is rarely pure white; meaning, an exact mix of all of the colors. All white light has a "color temperature", based on the temperature of a "black burning body", which affects what color "white" it is. A "cooler" "bluer" light has a higher color temperature. A "warmer" "amber" light has a lower color temperature. Think about a fire pit. The hottest ambers in the middle that have been burning a long time are a very cold bluish white in color, while the (relatively) colder edges of the outer flames are very warm and amber in color.

COLORED LIGHT

Given colors can also have a variety of hidden colors. For example, there are a lot of pink gels that are very similar to look at, but some tend to the yellow and some tend to the blue. Take for instance Rosco® gels numbers 33 through 37.

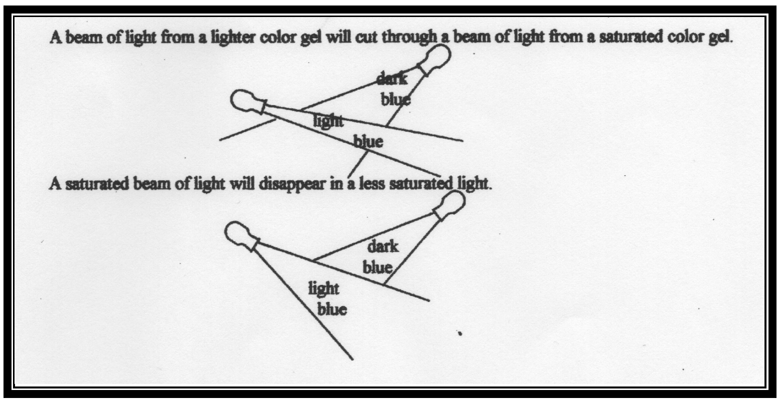
R33	No Color Pink	A warm tan tint.
R34	Flesh Pink	Has a hidden orange, can look peachy.
R35	Light Pink	More yellow than R33, makes greens pop out.
R36	Medium Pink	Orangey, more saturated than R34.
R37	Pale Rose Pink	A more saturated blue-ish pink.

Similarly, a blue gel can tend to the red or to the green. A blue gel with a bit of red in it might be good for suggesting a warm summer night, while a blue gel with a bit of green tint to it might be good for a tragic or scary scene, or a cold winter night. A blue gel with a slight red tint to it will make skin tones more appealing than one with a green tint. There is really no such thing as a pure color gel. Even green gels can have a bit of red in them. Try this with a Rosco 91 gel, called "Primary Green". Fold the gel into four and hold it up to an incandescent light source. What color do you see?

SATURATED LIGHT

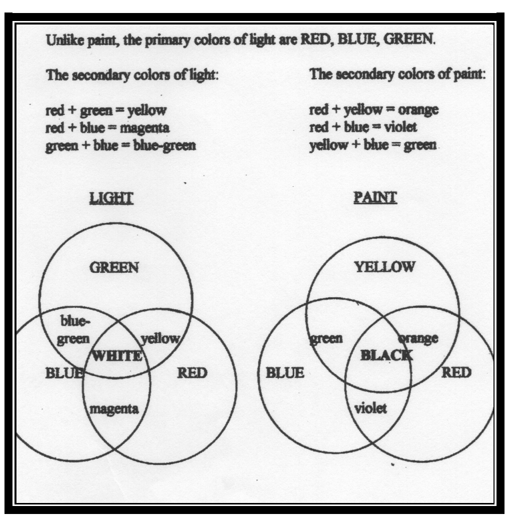
You can think of saturation as how "deep" or "dark" a color is. A hot magenta pink gel is more saturated than a pastel baby pink gel. Gels transmit (let through) different amounts of light depending on their saturation. Gels with less pigment transmit more light than do gels that are saturated in pigment. Think back to your school chemistry class. A solution of water and salt is saturated once no more salt will dissolve into the water, making it look murky and hard to see through. A less saturated solution is easier to see through.

When lighting a night scene for example, use a dark blue. However, if you only used a dark blue it would be difficult for the audience to see your actors. So some other less saturated light would have to be added, probably from another direction. Saturated and less saturated gels can be used in combination to create effects, as the less saturated light will "cut through" the more saturated light.



COLOR MIXING

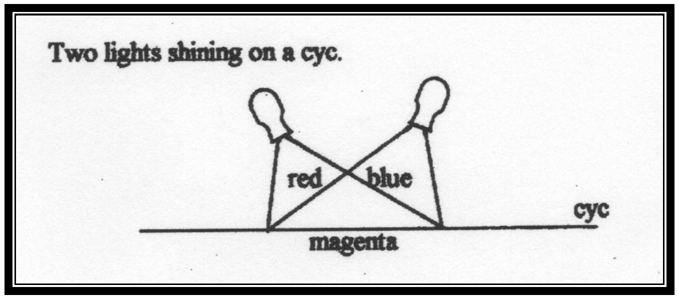
Unlike paint, the primary colors of light are: RED GREEN BLUE



The colors of light can be combined, just as the colors of paint can be combined, to make countless colors. There are two ways to combine colors in light: additive mixing and subtractive mixing.

ADDITIVE COLOR MIXING

You use additive color mixing when colored lights coming from two or more instruments are combined. This is most noticed when lighting a cyc (the white drape at the back of a stage).

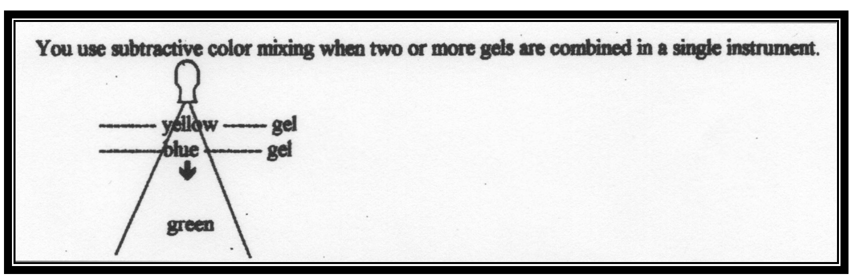


Blue and red will make a magenta/purple/lavender color, while blue and green will make blue-green/teal. Red and green make – can you guess? – yellow. If beams of pure red, blue and green are mixed together the result will appear to be "white" light. Similarly, each primary color mixed with its opposite secondary color will also appear to be "white" light.

SUBTRACTIVE COLOR MIXING

Subtractive mixing is something you won't find in paint, only in light. You use subtractive mixing when two or more gels are placed in a single instrument.

For instance, suppose you place a yellow gel and a blue gel in a light. The color of the beam of light would be green.

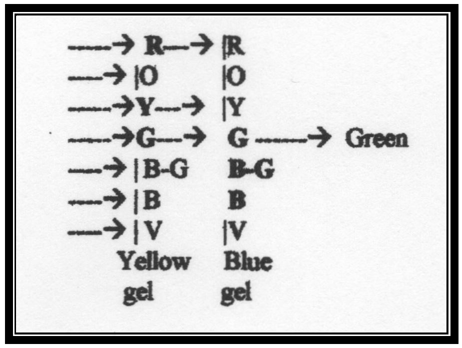


Why is this?

First the full spectrum of light coming from the lamp in the instrument encounters the yellow gel. The yellow gel only lets through the yellow, red and green parts of the spectrum. The other colors of the spectrum are not transmitted, or in other words are "subtracted".

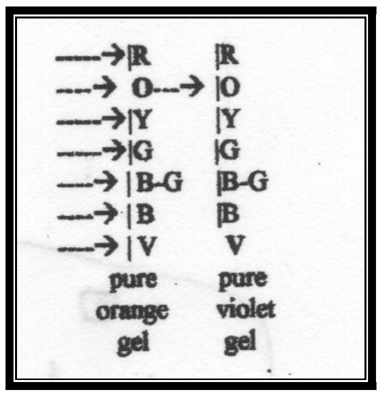
Next the yellow, red and green parts of the spectrum encounter the blue gel. This blue gel only lets through the blue, green and blue-green parts of the spectrum. However there are no blue parts of the spectrum hitting it as the blue was subtracted by the yellow gel. So therefore the only part of the available spectrum to get through is the green.

Another way of looking at this would be:



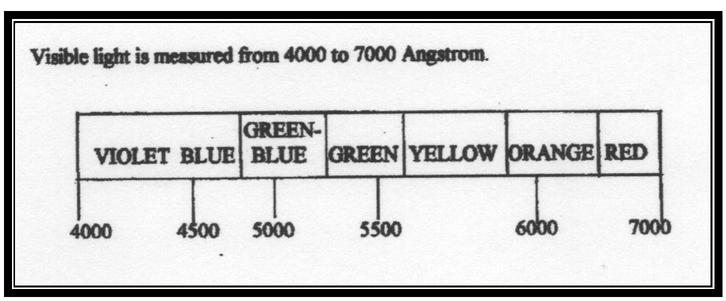
Similarly adding a pure orange gel with a pure violet gel will result in no light being transmitted.

The orange gel would only let through the red, orange and yellow parts of the spectrum. The violet gel will only let through the blue, violet and red parts of the spectrum, but none of those parts of the spectrum are hitting it, so it results in no light getting through.



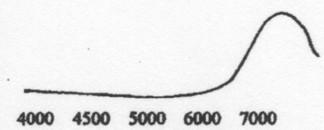
CHOOSING GELS

Most of a Lighting Designer's gel choices will be made by feelings and instinctive reaction to the color, not from scientific data, and not from the instrument readings that film lighting relies on. That said, it's still good to have a basic understanding of the scientific data. Light waves are measured in Angstroms. A violet or blue light wave has a shorter wave length than a red light wave.



Most gel brands have a white card behind each gel in a gel book (essentially a swatch book) with a graph of a color spectrum. This 'at-a-glance' graph lets lighting designers know what colors to expect in a gel. Sometimes just looking at a gel doesn't give the whole picture. The color of any actual gel may not completely reflect the color you get when it's put in front of a stage light. As you saw in the pink gel examples and the R91 example above.

Each gel is rated with this scale. For instance a red gel would look like this (mostly from the red end of the spectrum):



THE COLOR OF AN OBJECT

The color of an object can only be seen because its pigment acts as a reflector of light to the eye. For example, if the whole spectrum of light is being shone on a banana, the banana will only reflect the yellow light from the spectrum, so our eye perceives it as yellow. Similarly, if a blue object is lit with a blue or “white” light it will appear blue. If a pure blue object were lit with a pure red light it would make the object appear “black”, because there is no blue light being applied to the object.

One application for this concept in the theatre would be a dancer in a purple costume, but where the lighting for the piece needs to be lit with an eerie green front wash. A purple costume with only green light shining on it would look a yucky brown. Bringing up a bit of lavender side-light would not ruin the green front wash lighting effect, but would bring out the purples in the costume. This a good example of color and distribution used in combination to create an effect.