Stage 3 Correcting Color Problems

Before starting to color-correct an image, you need to understand how different colors interact with each other. Remember from Project 3: two main color models — RGB and CMYK — are used to output digital images. (Other models such as L*a*b and HSB have their own purposes in color conversion and correction, but they are not typically output models.)

Although the RGB and CMYK models handle color in different ways, these two color models are definitely linked. RGB colors are directly inverse (opposite) to CMY colors, referring to the position of each color on a color wheel. The relationship between primary colors is the basis for all color correction.

Referencing a basic color wheel helps you understand how RGB colors relate to CMY colors. If you center an equilateral triangle over the color wheel, the points of the triangle touch either the RGB primaries or the CMY primaries. Adding together two points of the triangle results in the color between the two points. Red and blue combine to form magenta, yellow and cyan combine to form green, and so on.

Opposite colors on the color wheel are called **color complements**. Using subtractive color theory, a color's complement absorbs or subtracts that color from visible white light. As an example, cyan is opposite red on the color wheel; cyan absorbs red light and reflects green and blue. Because you know green and blue light combine to create cyan, you can begin to understand how the two theories are related.

How does all this apply to color correction?

If you want to add a specific color to an image, you have three options: add the color, add equal parts of its constituent colors, or remove some of its complement. For example, to add red to an image, you can add red, add yellow and magenta, or remove cyan. Conversely, this means that to remove a color from an image, you can remove the color itself, remove equal parts of its constituents, or add its complement. To remove cyan from an image, for example, you can remove cyan, remove blue and green, or add red.

Make sure you understand the relationships between complementary colors:

- To add red, add yellow and magenta or remove cyan.
- To add blue, add cyan and magenta or remove yellow.
- To add green, add cyan and yellow or remove magenta.
- To remove cyan, remove blue and green or add red.
- To remove yellow, remove green and red or add blue.
- To remove magenta, remove blue and red or add green.

Note:

While it might seem easiest to simply add or subtract the color in question, a better result might be achieved by adding one color and subtracting another. For example, if an image needs less blue, simply removing cyan can cause reds to appear pink or cyan to appear green. Adding magenta and yellow to balance the existing cyan creates a better result than simply removing cyan.

Note:

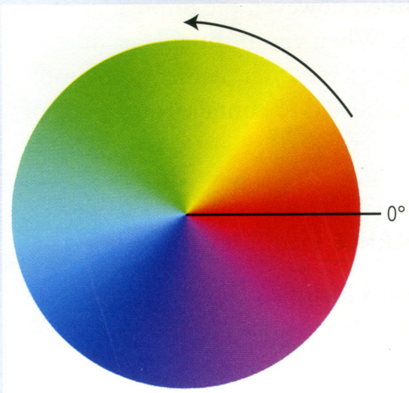
An important point to remember is that any color correction requires compromise. If you add or remove a color to correct a certain area, you also affect other areas of the image.

Understanding Color Terms

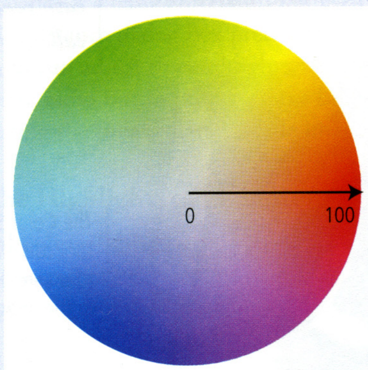
Many vague and technical-sounding terms are mentioned when discussing color. Is hue the same as color? The same as value? As tone? What's the difference between lightness and brightness? What is chroma? And where does saturation fit in?

This problem has resulted in several attempts to normalize color communication. A number of systems have been developed to define color according to specific criteria, including Hue, Saturation, and Brightness (HSB); Hue, Saturation, and Lightness (HSL); Hue, Saturation, and Value (HSV); and Lightness, Chroma, and Hue (LCH). Each of these models or systems plots color on a three-dimensional diagram, based on the elements of human color perception — hue, colorfulness, and brightness.

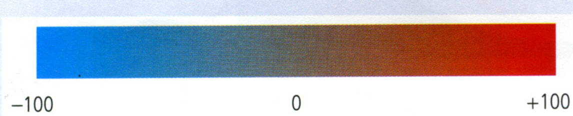
Hue is what most people think of as color — red, purple, and so on. Hue is defined according to a color's position on a color wheel (called **hue angle**), beginning from red at 0° and traveling counterclockwise around the wheel.



Saturation (also called "intensity") refers to the color's difference from neutral gray; highly saturated colors are more vivid than those with low saturation. Saturation is plotted from the center of the color wheel. Color at the center is neutral gray and has a saturation value of 0; color at the edge of the wheel has a saturation value of 100 and is the most intense value of the corresponding hue.



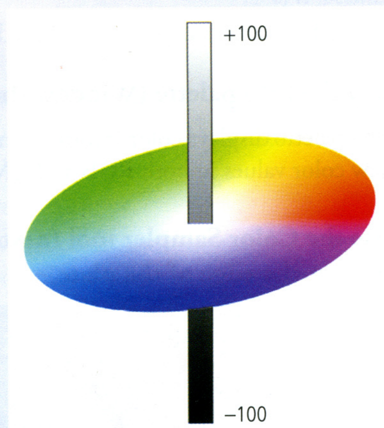
If you bisect the color wheel with a straight line, the line makes up a saturation axis for two complementary colors. A color is dulled by the introduction of its complement. Red, for example, is neutralized by the addition of cyan (blue and green). Near the center of the axis, the result is neutral gray.



Chroma is similar to saturation, but chroma factors in a reference white. In any viewing situation, colors appear less vivid when the light source dims. The process of chromatic adaptation, however, allows the human visual system to adjust to changes in light and still differentiate colors according to the relative saturation.

Brightness is the amount of light that is reflected off an object. As an element of color reproduction, brightness is typically judged by comparing the color to the lightest nearby object (such as an unprinted area of white paper).

Lightness is the amount of white or black added to the pure color. Lightness (also called "luminance" or "value") is the relative brightness based purely on the black-white value of a color. A lightness of 0 means there is no addition of white or black. Lightness of +100 is pure white; lightness of –100 is pure black.



All hues are affected equally by changes in lightness: