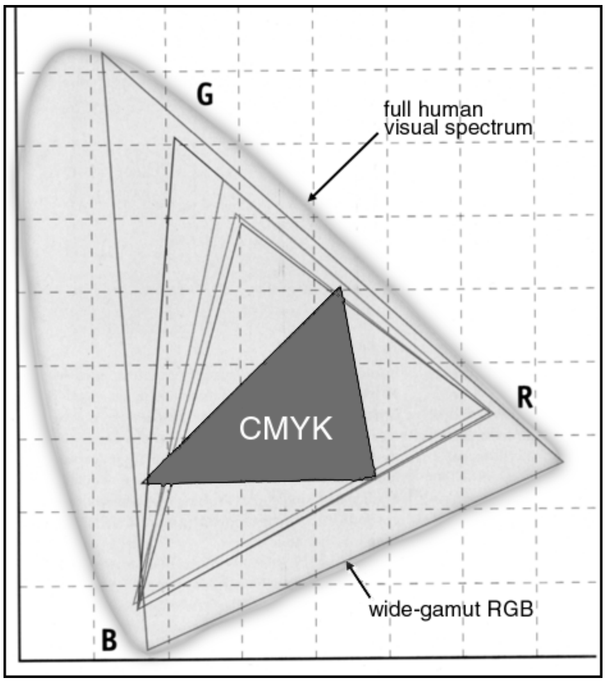
-- About Color & Calibration --

Color fidelity and accuracy can be very hard to control in digital art. Color is complex by its very nature, and digital color can make things even more complicated. The major reason for this is the fact that your monitor device displays colors in a very different way than your printer device. Where monitors (and other projective color displays) use a three-color (**RGB**) additive color mixing system, most printers use a four-color (**CMYK**) subtractive color mixing system; these two models of color mixing are quite different. Generally, this means that in many cases some of the rich, vibrant colors you see on your RGB display may not print as rich or bright on your CMYK printer (see below).



This chart summarizes the ranges of visible color that can be perceived/displayed according to various "devices", including your eyes. The trick is to maintain color accuracy, range and depth between various devices (e.g. from object, to monitor, to print). Note how, compared to the range of human vision, and even to the RGB spaces of various monitor schemes, the CMYK color range or **gamut** of most all kinds of printers is very limited. In the real world of print, this means that true color information is always lost along the way from object to image.

Basic operative rule to keep in mind: "WYSIONWYG" ("what you see is often **not** what you get"). In other words, your eyes have a different color sensitivity than your monitor, which almost always has a much wider color range than your printer output. Colors will often shift in hue, saturation and/or brightness from object through input device (e.g. scanner, camera) and will be shifted further and tonal range will be constricted from monitor to printer. The truth is, even the paper you use in your inkjet printer can lead to dramatic changes in the color range the printer generates!

Your goal: If color accuracy is important to your artwork (e.g. proper fleshtones) or a client's demands (e.g. an Eddie Bauer forest green shirt), you must try to keep color information as consistent as possible from the actual object to monitor and to the final printed output of the object. This is done via calibration (input to monitor to output) and color management systems (e.g. ColorSync on the Mac or other color control software). It also involves knowledge of the various color settings preferences you select in your graphics app, and a knowledge of various color profiles you can attach to files. Some of this can get very complicated and is beyond the scope of this course, but being aware of these issues and knowing what questions to ask service bureaus can help you begin to understand and manage color skillfully.

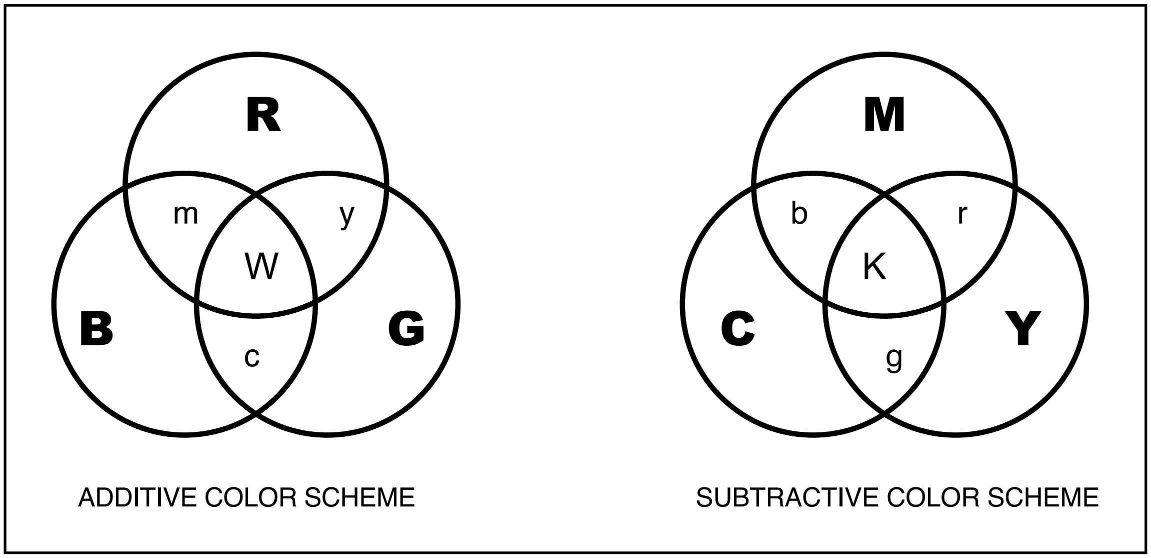
Some basic considerations:

- Even if you don't print your image, different computer platforms, monitors, and software can display color quite variably (even on the same computer!!!). Monitors can vary in terms of their contrast, brightness, color saturation, color temperature, and their color accurace. It's very important to realize this when considering web design color layout, because you can never control how your images may appear on other peoples' monitors!
- The RGB monitor color gamut is generally much wider than what can be obtained with traditional CMYK printing inks. This applies to commercial printing of digital files, but even your home color inkjet printer prints in CMYK, so expect some color changes from monitor to paper. **Calibration** and **color management** can help minimize variation. The very least you should do is calibrate your color monitor for the conditions you work under and try to keep your working conditions constant (e.g. room lighting, monitor brightness, contrast, and background color) between sessions. Macs have very good built-in monitor calibration and color management capabilities; PC's can be more of a problem. Adobe products have good color engines that coordinate and manage input and output.
- Color can range from 2 (black & white) to hundreds of millions or more. This is called **bit depth**, usually expressed as an exponent of 2 (binary). For example, a bit depth of 8 would represent 2^8 or 256 colors or steps of gray. Most color work is done in 24 bit (256 steps of red, green, and blue or 16,777,216 total colors), but some can be done in 24 bit color for extreme high-end work (not usually necessary for most of us). Often, for web design, lower bit depths (e.g. 8 bit) are used to reduce the color palette and file size.
- Try to learn about the various color setting preferences and color profles in your graphics apps and input/output devices and how to use them to set up conditions for producing files for various destinations (e.g. commercial printers, inkjet printers, the Internet, etc). This can be confusing, but is worth the effort.
- Ignorance can sometimes be bliss. When in doubt, stay in RGB and do not convert a file to CMYK or set-up a file in CMYK without knowing the specific details that a commercial printer uses. Often, the service bureau will convert your files themselves
- The default sRGB colorspace that Photoshop uses may not be the best choice for high-end printing but is OK for web artwork and generic print art. Consider using a higher-gamut colorspace, like AdobeRGB for more precise color representation in print. But it may not, in turn, be the most reliable for designing artwork that will only be displayed on the Internet, where sRGB would better simulate an "average " user's color monitor

Some concepts and definitions:

additive (RGB) and subtractive (CMYK) or process color
bit depth
calibration
color management (e.g. ColorSync)
color space
color temperature (^{o}K; warm/cool)
device profiles
gamma (monitor contrast; Mac vs Wintel)
gamut

hue
indexed color (for .GIF images)
lightness, luminance, or brightness
profile (embedding or tagging files)
saturation or chroma
value
web-safe browser palette (216 colors)
working space



e.g. 255 **R** + 255 **B** + 255 **G** = **W**hite 100% **C** + 100% **M** + 100% **Y** = Blac**K**

-- when 2 additive primaries overlap, a subtractive primary is produced; where all 3 overlap, white is produced. This would be like shining R,G,and B spotlights on a performer onstage.
-- when two subtractive primaries overlap, an additive primary is produced; where all 3 overlap, black is produced. Like mixing R,G, and B paints on paper (you would get brown-black mud)

Note that there are other working schemes and theories put forth for color mixing and matching. The two above are common for describing color in terms of devices such as monitors and printers.