Giclée Prepress

The Art of Giclée

Theory and Practice of Giclée Printing

SECTION ONE

The Study of Light

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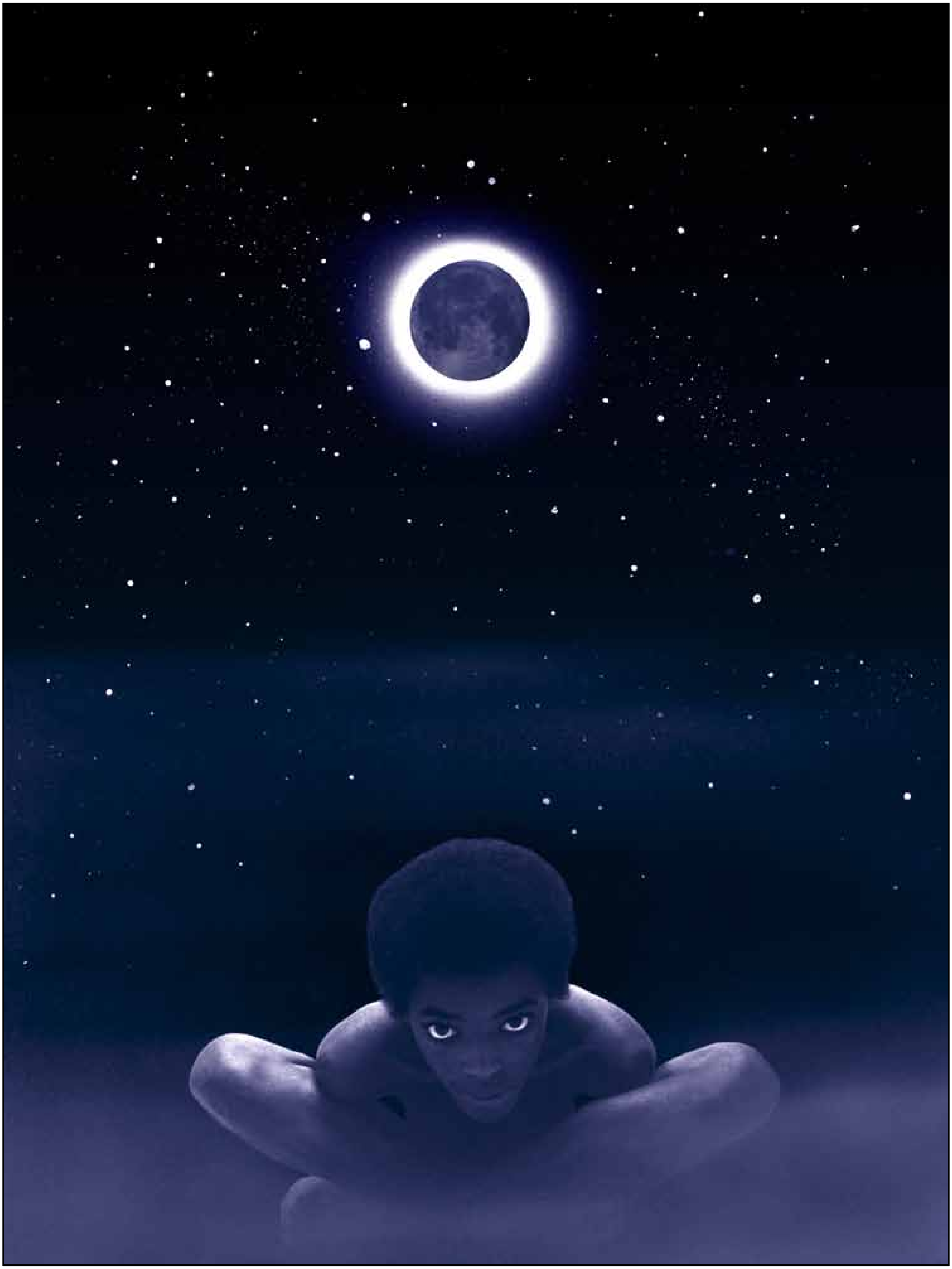

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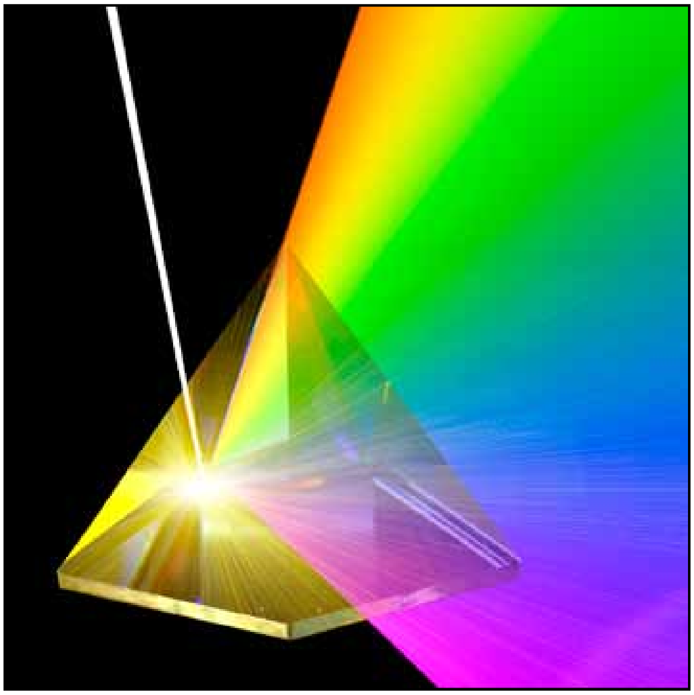
SECTION ONE

The Study of Light

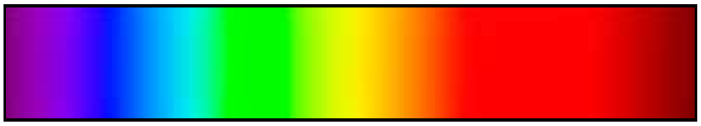
Without Light There Is… Darkness

Deep in the ocean where there is no light, jelly fish and other creatures make light in mysterious ways. Everything we see is because light illuminates it. We have no sensors for darkness (or do we?).



All colors exist in light. When all the colors are combined, the result is white light. To get one color, all the other colors must be taken away.

The light we see is part of a larger spectrum of energy. If we put the visible spectrum in the middle, blue is on one side and red is on the other with green in the middle. The blues extend way out into ultraviolet then x-rays and beyond to spectrums as yet unmeasurable. The reds reach past infrared becoming radio and television signals. But its all the same, really. Your TV can dial in spectrum parts you can't see, and vice versa.



At the TV store you can see the problems of color clearly. Every display will be a slightly different color. Which is right? Why are they different?

One might think, "if they can put a man on the moon why can't they get the color right?" That is a good question and also the subject of this book.

Getting color right is what giclée prepress is all about. It is what any prepress is about, to say nothing of the color problems of the film and broadcast industries. There is a reason why the Coca-Cola logo appears the same shade of red right the way round the world, and that is called color management.

You manage color when you pick color swatches at the paint store. The color looks different outside than it does inside, but it's a start.

Color and light are interlocked. The study of one must intertwine with the understanding of the other. Managing one is pointless without managing the other. Indoor films for indoors, outdoors films for outdoors; that's color management, too.

Today's color management systems and practices are sophisticated and obviously work quite well as can be noted just by looking around. It's easy to see when things are less than perfect.

When Color Management Fails

A recent episode reminded me that even with advanced color management systems, communication fails when people get involved.

On the other end of my phone was a client commenting on a color test strip for a giclée on canvas. We found ourselves at odds trying to make our color interpretations understandable to each other. The discussion revolved around the orange sky tones in a sunset picture. The client wanted the orange tones to be '30% less intense'… but, what does that mean?

Without a face-to-face meeting using test-strips and color swatches the discussion was challenging. Emailing a file wouldn't help because no RGB display can show CMYK color accurately enough to judge the dynamic tone range of a giclée print.

Pantone® *color system is one way to solve problems with communications about printed colors. There are similar systems, Each provides swatch books for matching colors and communicating descriptions.*

Using a color matching system is how the Coke logo always appears the same red wherever it is shown around the world. Users of the logo can reference the PMS number (Pantone Matching System) specified by Coca-Cola.

Pantone's system extends into digital media and the company's products include the tools needed to profile computer monitors and other digital imaging devices.

The Study of Color

Computers have the same problem people do when it comes to color. Just as I was asking my client, "what do you mean, 30% less intense?" a giclée printing machine might query a computer about the same thing.

The International Color Consortium (ICC) was established in 1993 to create order out of chaos in the digital imaging world. The ICC created a color identification system like Pantone's.

Pantone's system grew out of traditional printing, using CMYK colors. The ICC's system is based on RGB color and displays that emit rather than reflect light. (Note that Pantone caught up with digital imaging and now their color system extends into both RGB and CMYK colors.)

ICC color numbers can be discovered by using the Eyedropper tool in PhotoShop to sample any color. Notice that the sampled color becomes the Foreground Color shown on the Tool Bar.

Click on either color in the Tool Bar and the Color Picker dialogue box opens. There you can see the components of the Foreground and Background Colors as well as their codified ICC identification numbers.

While in Color Picker, notice that the color is defined four different ways: RGB, CMYK, LAB and CIE. Of the four, only RGB and CMYK are commonly used, although it is said that LAB is the most accurate way of measuring color, scientifically speaking.

Each of the four color measurement methods is geared for a different segment of the imaging market. RGB color is derived from emitted light. CMYK color derives from reflected light. Each of these has a different color gamut, or range of colors that it can produce. LAB and CIE are more scientific in that they don't care whether the light is emitted or reflected.

Color measurement ranges from technical to sublime. The science of color is all about measurement, control and repeatability. The art of color is about involves emotions and sentiments that elude measurement or precise control. Science is universal. Art is personal. Science requires *a posteriori* evidence. Art is happy with the *a priori* kind.

The giclée prepress artist is more like a sorcerer… part scientist, part artist. To get the job done right, the prepress artist must understand color, what it is, where it comes from, and how to control it.

Scientific Color

The color of light is scientifically and technically measured in various ways to establish standards required by different trades, crafts and professions.

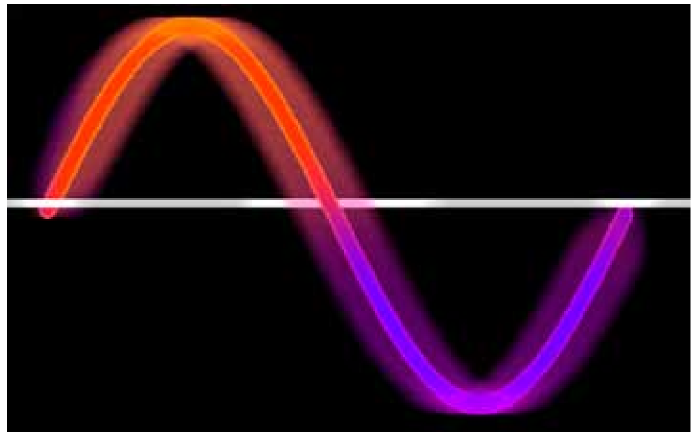
But what exactly are they measuring? What is light?

Light is energy. It is produced when chemicals interact. Burning produces light as fuel and oxygen interact. Phosphorescent jellyfish and fireflies produce "cold" light by interacting chemicals in their flesh.

Light is emitted from a source and reflects off the objects around it, making them visible. When no light is present thngs cannot be seen.

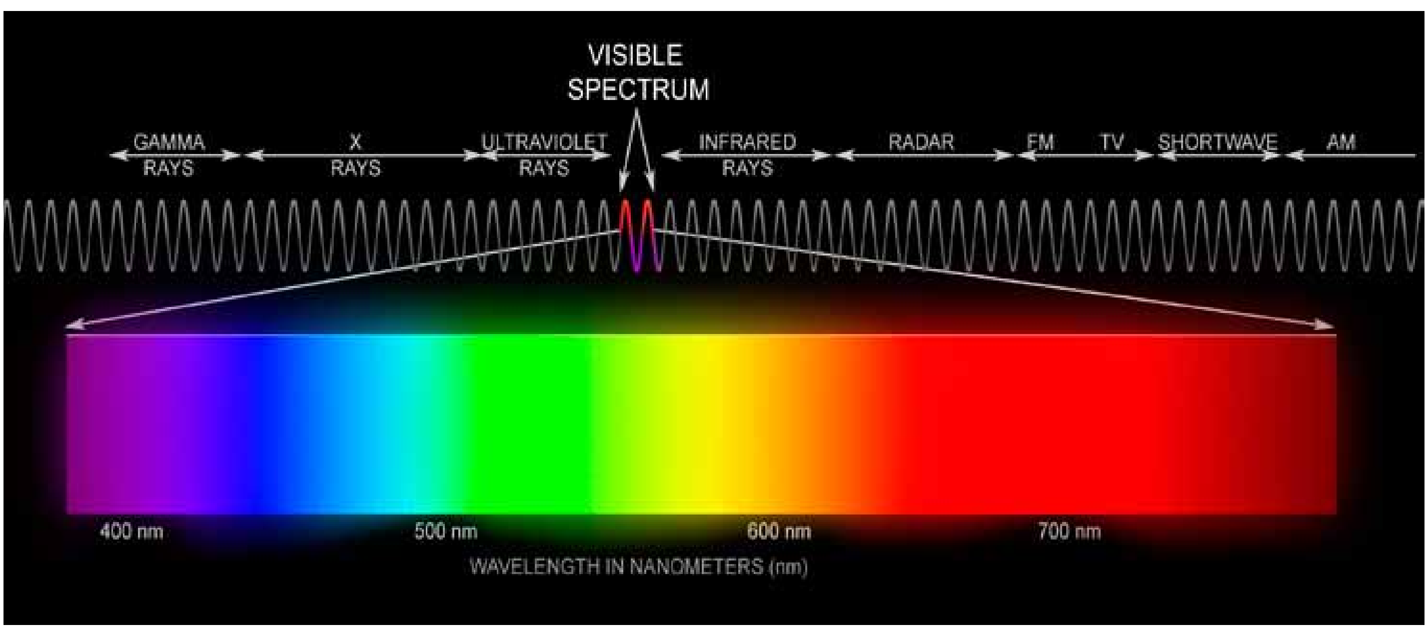
Light that is emitted is called "source light". It has more colors than reflected light. The object that the emitted light falls on absorbs some of the emitted light, and reflects back what is left. A leaf looks green because it absorbs away the red and blue from the source light.

Light is emitted from sources as waves that behave as both rays and particles. Light waves are depicted as a sine waves.



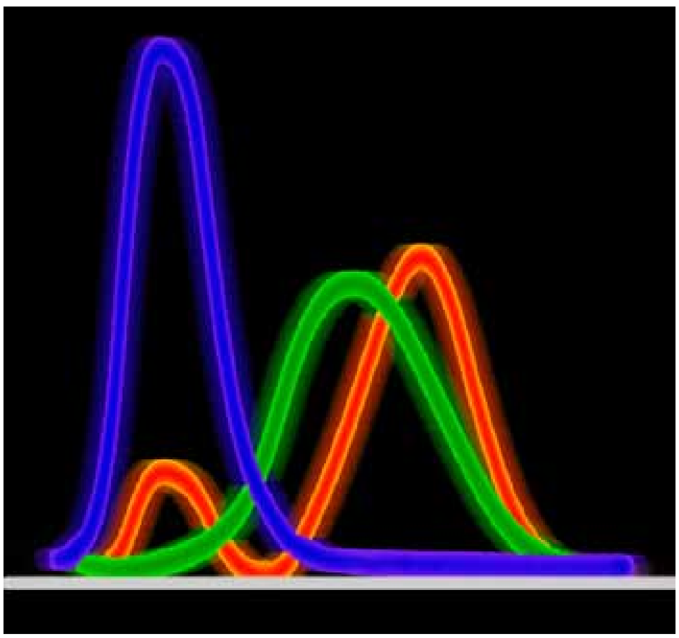
Sine waves cycle up and down, over and under an imaginary center line. The number of complete cycles in a given time or space is referred to as the frequency of the wave. Frequency is a way of defining the distance between the peaks (or valleys) and is also referred to as the length of the wave, or "wavelength". The unit of measurement is a nanometer, which is one billionth of as meter.

If we measure the colors in the rainbow, the nanometer numbers are lower at the blue end than they are on the red end. That is because blue light has longer wavelengths, red light shorter ones. Other colors fall somewhere in between.



Light waves extend far beyond the visible spectrum. Blue extends into ultraviolet light and eventually X-rays and gamma rays. Red light extends out into infrared, then microwaves, radio & television waves and beyond. We can't see this energy but we know it is there from instruments that can detect it. Using nanometer wavelength designations, visible and invisible light energy can be measured and described.

The longer the wavelength of light, the more 'power' it has. By power I mean 'inherent energy'. In the world of sound we know that base-end sounds go farther and penetrate deeper than treble sounds… which is why you can hear the thump-thump of your neighbor's stereo right through the walls.



Blue light has more energy than either red or green, and red has more than green. The relative amounts compared to one another look like this when plotted graphically. Any device that measures light by averaging will be fooled by pure colors because their strengths are so different when compared to one another.

The practical implications of this are that it is impossible to correctly expose all three primary components of light in a single camera exposure, unless the camera has algorithms to make the compensations necessary to even out the curves.

If you took a picture of a red balloon together with a green one and a blue one, if the blue one is correctly exposed, the red and green ones will be too dark. If the green one is correctly exposed, the red and blue will be too light.

This phenomenon extends throughout every step of the photomechanical reproduction process (including audiovisual) and the giclée prepress artist should be aware of that, look for it and make the necessary compensations if necessary.
But back to the scientific study of light…

In the study of the perception of color, one of the first mathematically defined color spaces was the CIE 1931 XYZ color space, created by the International Commission on Illumination (CIE) in 1931.

The CIE defined color by associating measurements with the way the human eye physically perceives color.

Tristimulus Values

The human eye has two kind of photo receptors. Cone cells see colors in the daytime and rod cells activate after dark but see a limited color range.

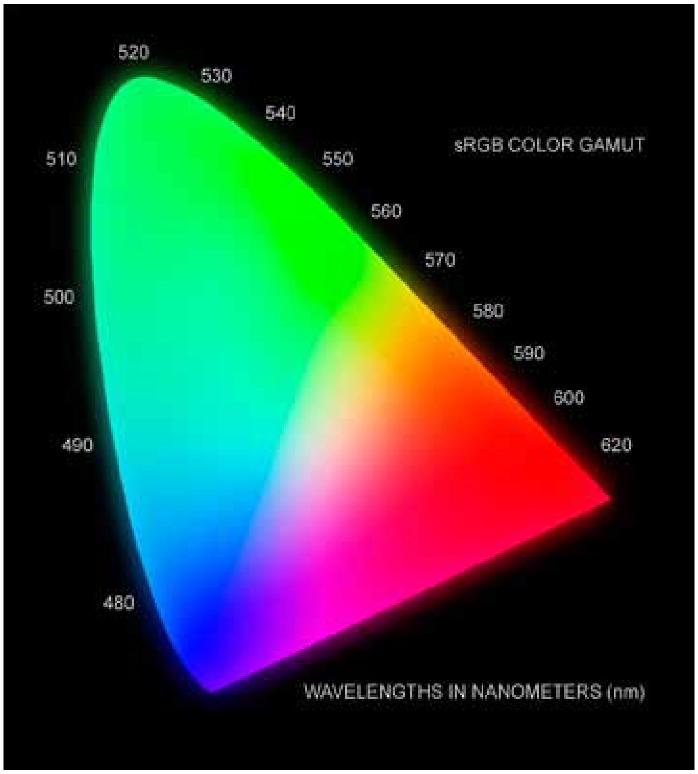
Cone cells are of three types. Each type sees one of the three primary colors of emitted source light: Some cone cells see reddish wavelengths of 420–440 nanometers (nm); the second type sees greenish middle wavelengths from 530–540 nm; and the third type sees blue wavelengths from 560–580 nm.

CIE descriptions of color sensations in the eye use parameters that are based on those three levels of eye sensitivity. The three parameters are called the tristimulus values of a color. The tristimulus values are roughly red, green and blue, hence the term "RGB". They are the amounts of the three primary colors -- red green and blue -- needed to create that color.

Color Spaces

Any specific method for associating tristimulus values with each color is called a color space. In other words, the space defines the range of colors available… the dynamic tone range.

Note that in the CIE color space the X,Y,Z values are not pure red, green, blue colors as they are in an RGB color space. Rather, they may be thought of as 'derived' from the red, green, blue colors. That is because pure primaries cannot create as many other colors as can slight mixtures that although close to being RGB are not pure.



This diagram of the sRGB color space displays the colors that can be produced by a computer monitor or television set. The outer curved boundary shows wavelengths in nanometers.

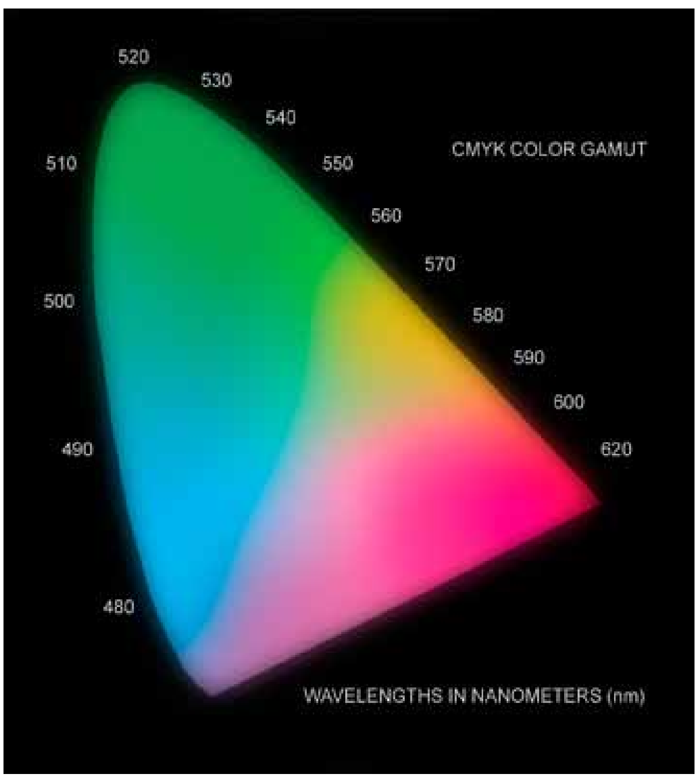
Compared to the sRGB color gamut for monitors and televisions the chart for pigment colors looks dull and lackluster. Pigment colors are less saturated than emitted-light colors because they are reflected instead of being emitted. Objects absorb parts of RGB source light and reflect back what's left, hence the name "subtractive' color.

Reflected-light pigment colors are referred to as subtractive colors because taking away primary light colors creates them.

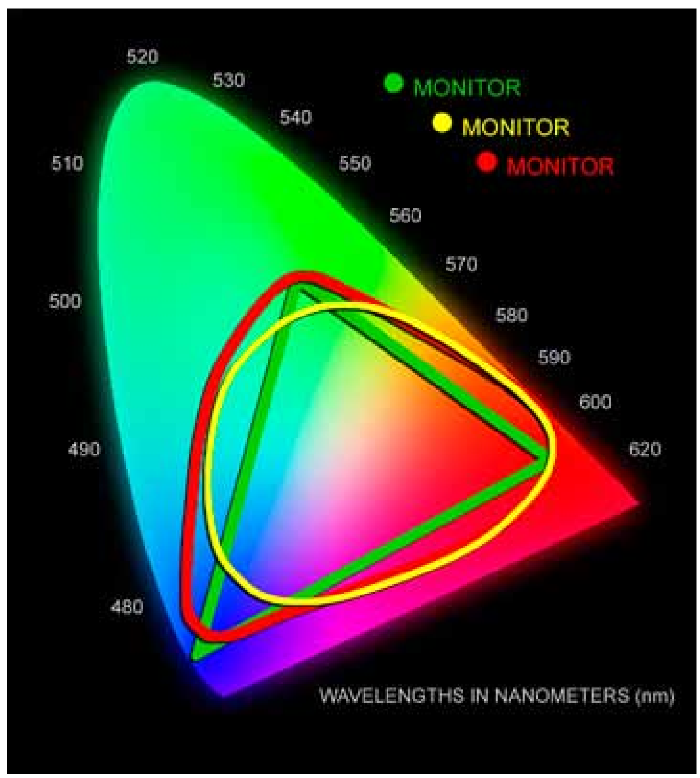
Primary light colors are called additive because adding one primary to another makes secondary colors.

When pure primary RGB colors are mixed together they create the secondary colors of magenta, cyan and yellow (CMY). These secondary colors are also the colors of the printing inks used in the four-color printing process.

The best way to see the color differences between the CMYK and RGB color spaces is to look at a color gamut comparison chart.



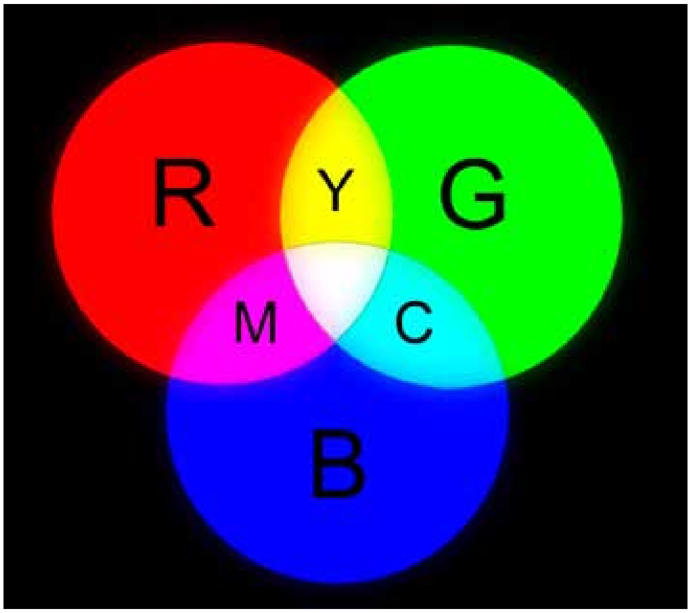
This diagram of the CMYK color space displays the colors that can be produced by 4-color process printing inks. Notice how different this gamut is compared to sRGB. Many sRGB colors cannot be reproduced using CMYK inks.



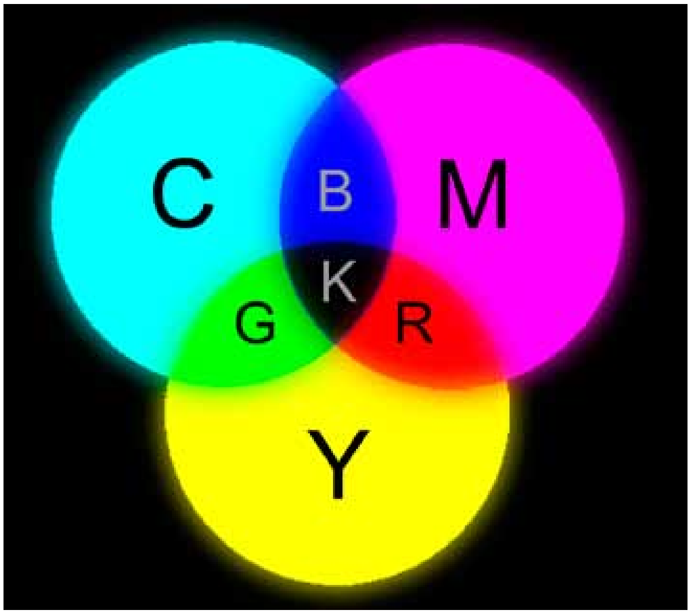
This chart shows the visible color spectrum and within it plots of CMYK, Monitor, and Pantone color gamuts. You can see that some of the Monitor color space is "outside" the CMYK space. All three gamuts show only portions of the visible light spectrum.

Additive Versus Subtractive Color

Transmitted light is called "additive" because if all three primary colors are mixed together the result is white (or gray).



Mixing combinations of the three primary light colors of Red, Green and Blue produces the secondary pigment colors of Magenta, Cyan and Yellow. Primary light colors equally blended result in white.



Mixing combinations of the secondary pigment colors of Cyan, Magenta and Yellow produces the primary light colors of Red, Green and Blue. Secondary pigment colors equally blended result in black (K).

Photography, film and video all record and display colors using RGB primary colors. Artworks and printed works use CMYK secondary colors.

Note that although cyan magenta and yellow can theoretically produce black in our less-then-perfect world the result is actuality dirty dark gray, so "K" (black) is used to achieve true black in printed material and artwork.

Subtractive color is so called because we see what is left after the object has subtracted by absorption all *other* colors. A red balloon absorbs green and blue light. A green leaf absorbs blue and red. A yellow banana absorbs some of the red and green light and just about all of the blue.

The Brightness Factor

Another way to measure color is to divide it into two parts: brightness and chromaticity. For example, the color white is a bright color, while the color gray is considered to be a less bright version of that same white. In other words, the chromaticity of white and gray are the same while their brightness differs.

Note that the chromaticity diagram cannot specify colors of objects or printing inks, since the chromaticity observed while looking at an object depends on the color of the light source as well. As you have probably experienced, a given color will photograph differently when lit by different kinds of light, or at different times of day.

RGB and CMYK achieve 'brightness' two completely different ways. White in the RGB world is created by equal parts of pure red, green and blue. The brighter each of those three is (i.e. more energy emitted by the source light) the brighter in resulting image.

CMYK achieves brightness by revealing or hiding the substrate media. The white you see in a watercolor painting or in a printed image is the color of the paper itself… there is no white ink. Lighter shades of colors have less pigment, revealing more paper.

The different types of paper used in printing have different levels of brightness as well as different colors and these qualities have impact on how an image appears when printed on them.

The surface of a paper also has characteristics that affect the perceived tonal range. Of greatest impact is the reflectivity. Papers range from very glossy to dead matte. More gloss means more blacks. More matte means less black. Surface textures are a matter of taste, some like glossy but I prefer smooth satin and matte. The more pronounced the texture, the more reflectivity you get especially on the raised textural patterns.

A good example is gloss-varnished canvas giclées. At certain angles it is hard to see the picture through the canvas texture surface reflections. However the glossy varnish extends the dynamic tone range of the giclée because the blacks get darker.

The wider tone range revealed by gloss finishes can be clearly seen in this comparison of Epson Glossy Paper and Matte Canvas. Matte finishes make "scatter light" which lightens dark tones, killing contrast.

Gloss finishes beef up dark tones and contrast by revealing finer differences between dark tones. Scandinavian bakers give their Danishes and pastries a gloss coat of clear gelatin to add depth to their colors.

As useful as all these measurements and definitions can be, they are mostly theoretical… they don't solve day to day problems like the constantly changing color of daylight.

Kelvin Temperature

As the sun arcs across the sky from horizon to horizon the color of its light changes from reddish at sunrise to bluish at noon and back to reddish at sunset. This phenomenon was recorded and measured by Lord Kelvin (William Thomson) in the 1800's.

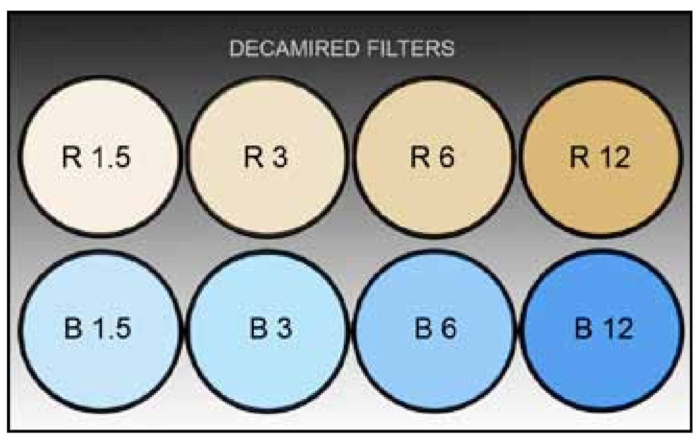
According to the Kelvin scale of color measurement, daylight is 5500 degrees… that's the color of daylight as measured at high noon on the equator. *Only on the equator at high noon* will daylight be 5500 degrees but that doesn't matter because all measurements do is provide bases for analysis and comparison, and a way to describe them to others understandably and with precision.

Other familiar Kelvin temperatures are incandescent lights 3200 - 3400 degrees; sunrise & sunset 4000 degrees; candlelight 2700-2900 degrees. As you get higher and the air thins the light gets bluer. The light in a spot shaded from direct sunlight is bluer as well, as is the light on a cloudy day. In an airplane the sky's light temperatures could get as high as 20,000 degrees K.

To accurately photograph an object's color under different lighting conditions photographers adjust light color to one of the three standard temperatures required by different film types.

Film is made for three different light colors. Daylight film is balanced for 5500 degrees. Tungsten films come in two types for either 3400 degree light (Type A) or 3200 degrees (Type B).

Examples of tungsten lights are old-fashioned filament-type light bulbs, photoflood lamps, and quartz lights. All tungsten lights burn redder as they age, making it nearly impossible to get 100% accuracy. Note: the term "tungsten" derives from the name of the metal used to make the glowing filaments of the original light bulbs.



Decamired (MIRED) filters solve the problem of matching the light color to the film's requirements. Bluish tones correct light that is reddish and vice versa. European KR & KB filters are based on MIRED values.

Decamired filters solve the problem of matching the light color to the film's requirements. Bluish tones correct light that is reddish, and vice versa.

The term mired comes from MIcro REciprocal Degree. The micro reciprocal degree value, or mired value, of any light source is the reciprocal of its temperature multiplied by 1,000,000. Some examples:

"Normal" Daylight = 5500°K. The reciprocal (1/5500) equals .00018181. Multiply that value by 1,000,000 and we have a mired value of 180 (we can round it to the nearest 10 and dispense with decimal places).

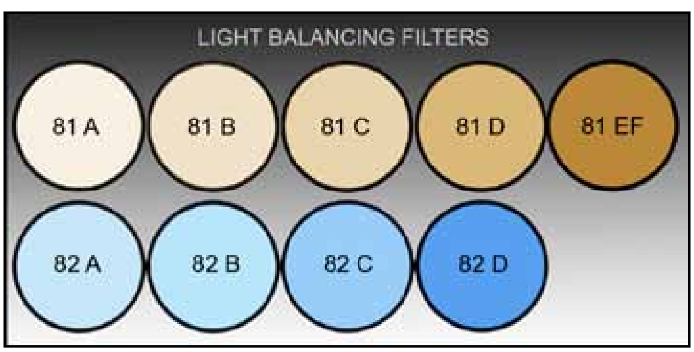
"DYS" Quartz lamp = 3200°K. The reciprocal (1/3200) equals 0.0003125. Multiplied by 1,000,000 equals a mired value of 310.

In open shade (a scene lit not by direct light, but by blue sky) or hazy conditions, the color temperature can be much higher (bluer) than 5500°K. If we were in the cockpit of an airliner flying at 35,000 feet the light temperature would be up to 20000°K with a mired value of 50.

The Decamired value is the mired value divided by 10. "Normal" daylight has a DM value of 31, the quartz lamp has a DM value of 18, and open shade has a DM value of 5.

Decamired or DM filters are unique in that they will have a predictable effect by imparting a mired shift of their value, regardless of the light source temperature.

Light Balancing Filters



Photographers also use the 81 and 85 series of Light Balancing (LB) filters for the same purpose as Decamired filters.

Besides their usefulness to bring light color into line with a film's requirements, these filters can also be used creatively to warm-up sunsets with more saturated reds and yellows, or to add coldness to a winter scene with a touch of pastel blue.

These filters don't just throw on a cast of color if they are used when a scene is originated. A cast of color is when an equal amount is applied to all other colors. If you look through pink glasses it is not the same as altering the source light with the same color. If you make the source light as pink as the glasses the effect will be different.

Different objects absorb different amounts of the three component colors of emitted light (RGB) resulting in a dynamic change in the tone range we see.

A color cast makes equal changes to all colors. Dynamic changes are unequal among colors, depending on the amount of the color absorbed by object.

Color Correction of Tints

Light balancing and Decamired filtration controls warm and cool tones by modulating two of the primary light colors, red and blue. Green is considered to be a tint, as are colors that "contaminate" the source light.

Photographers use colored reflectors to tint reflected light. The tinted light blends with the source light to make a hybrid, tinted mixture. Such tints are controlled with Color Correction filters.

Color Correction Filters are shades of primary and secondary colors, RGB and CMY. They range from pure colors to pastels measured on a 100-point scale. CC100Y is pure yellow, CC05Y is a pale shade.

To eliminate a tint of one color, its opposite is used. For a tint equal to CC10Y the correction is CC10B. The opposite of 30M is 30G, and so on.

It is not uncommon for a tint to involve two colors, requiring a filter pack that includes several CC filters.

Digital Light Balancing

Decamired filters solve the problem of matching the light color to the film's requirements. Bluish tones correct light that is reddish, and vice versa.

Today's digital camera can balance light without the need of external filters, thanks to algorithms that present the captured visual data in a way that looks correct. Artist and viewer determine what is "correct".

More expensive digital cameras offer the opportunity to set the Kelvin temperature. Less expensive cameras have presets with names like "Indoor," or "Cloudy", or "Night" and the like.

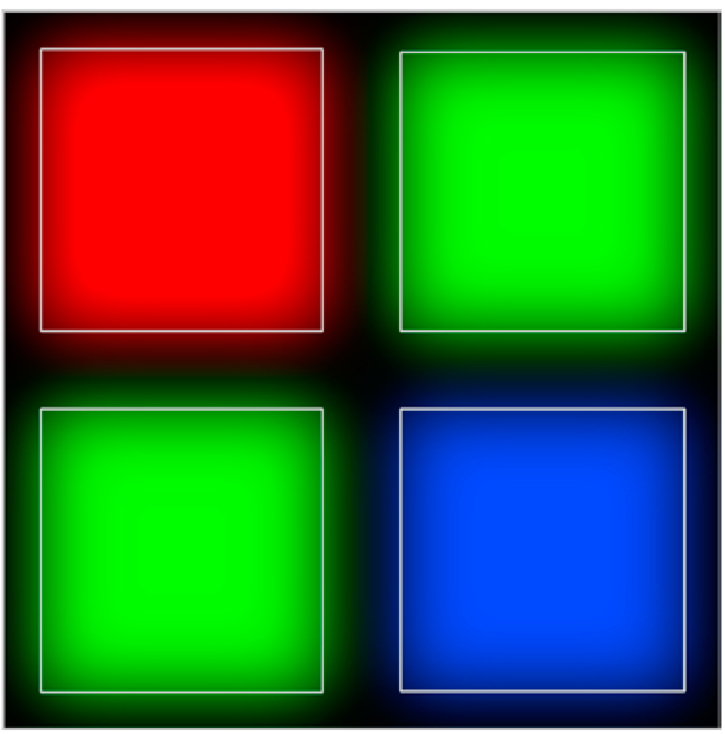
The presets assume an average light temperature for those conditions and apply the necessary MIRED or light balancing filtration electronically using algorithms.

How Cameras and Scanners Make Digital Pictures

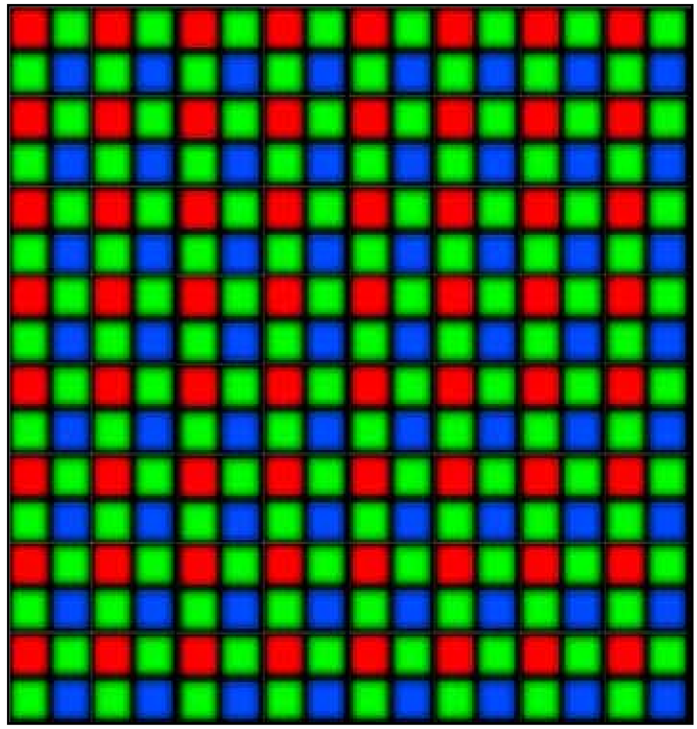
Algorithms are how digital cameras and scanners make pictures out of data. First an image is "captured" and the data recorded. Then algorithms process the data to produce images.

CCD (charge coupled device) and CMOS (complementary metal oxide semiconductor) image sensors capture the image.

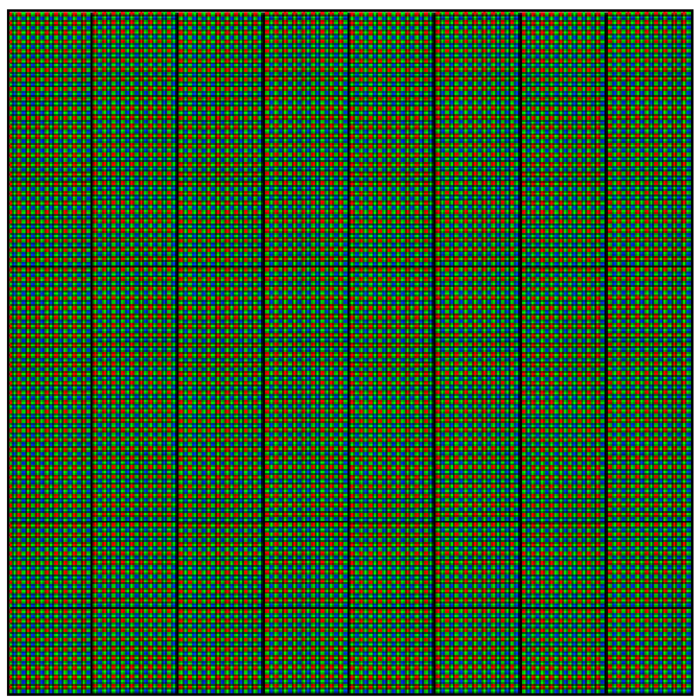
Each does the same job, converting light (photons) into an electrical signal (electrons). Actually, they convert the light into three signals, once each for Red, Green and Blue.



Single-pixel CCDs have one sensor each for Red, Green, and Blue light. An extra green sensor is sometimes included because the green component of ight has less energy compared to red and blue. Each sensor outputs an electrical signal with a strength proportional to the amount of light focused on the pixel by the lens.

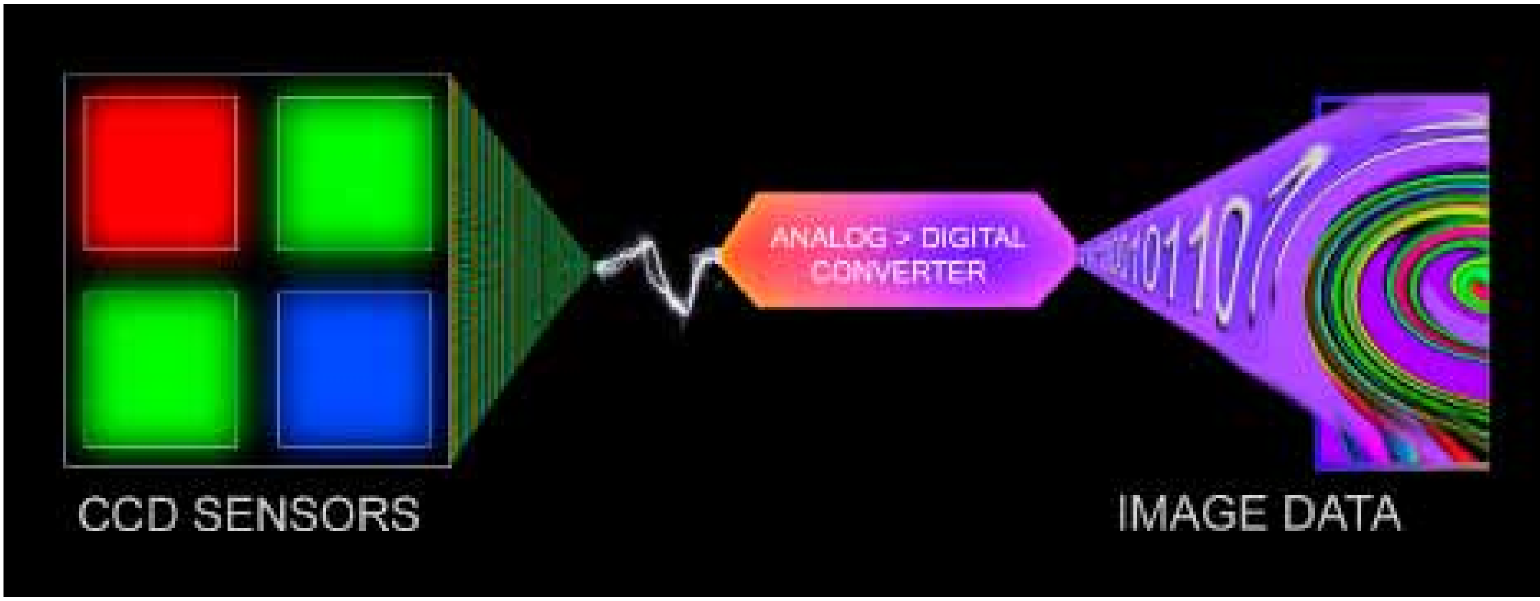


The pixel sensors are arranged on a grid, like a checkerboard. Each square represents a single pixel. This grid is 8 X 8 totalling 64 pixels.



This grid is 64 X 64 totalling 4,096 pixels. It would take 244 like the one above to equal just one "megapixel", which is 1,000,000 pixels. That's 4,000,000 distinct electrical signals (at least).

The next step is the job of a digital-to-ananlogue converter. Each sensor's individual signal is encoded into binary code. The code is then processed by algorithms, stored as a digital data file and finally reconverted back to an analog signal for display.



The main differences between CCD and CMOS light sensing devices is that a CCD sensor sends it's data off-chip to be processed by another, whereas a CMOS does more on-chip processing. Each has advantages and disadvantages.

Feature	*CCD*	*CMOS*
Signal out of pixel	*Electron packet*	*Voltage*
Signal out of chip	*Voltage (analog)*	*Bits (digital)*
Signal out of camera	*Bits (digital)*	*Bits (digital)*
Fill factor	*High*	*Moderate*
Amplifier mismatch	*N/A*	*Moderate*
System Noise	*Low*	*Moderate*
System Complexity	*High*	*Low*
Sensor Complexity	*Low*	*High*
Camera components	*Sensor + multiple*	*Sensor + lens*
	support chips	*possible, but*
additional		
	+ lens	*support chips*
common		
Relative R&D cost	*Lower*	*Higher*
Relative system cost	*Depends on application*	*Depends on application*

Performance	*CCD*	*CMOS*
Responsivity	*Moderate Slightly better*	
Dynamic Range	*High*	*Moderate*
Uniformity	*High*	*Low to Moderate*
Uniform Shuttering	*Fast, common*	*Poor*
Uniformity	*High*	*Low to Moderate*
Speed	*Moderate to High*	*Higher*
Windowing	*Limited*	*Extensive*
Anti-blooming	*High to none*	*High*
Biasing and Clocking	*Multiple, higher voltage*	*Single, low-voltage*

*www.dalsa.com/corp/markets/CCD_vs_CMOS.aspx

There are two different technologies for capturing images digitally. Both types of imagers convert the photons in light to electrons which are collected to generate an electric voltage.

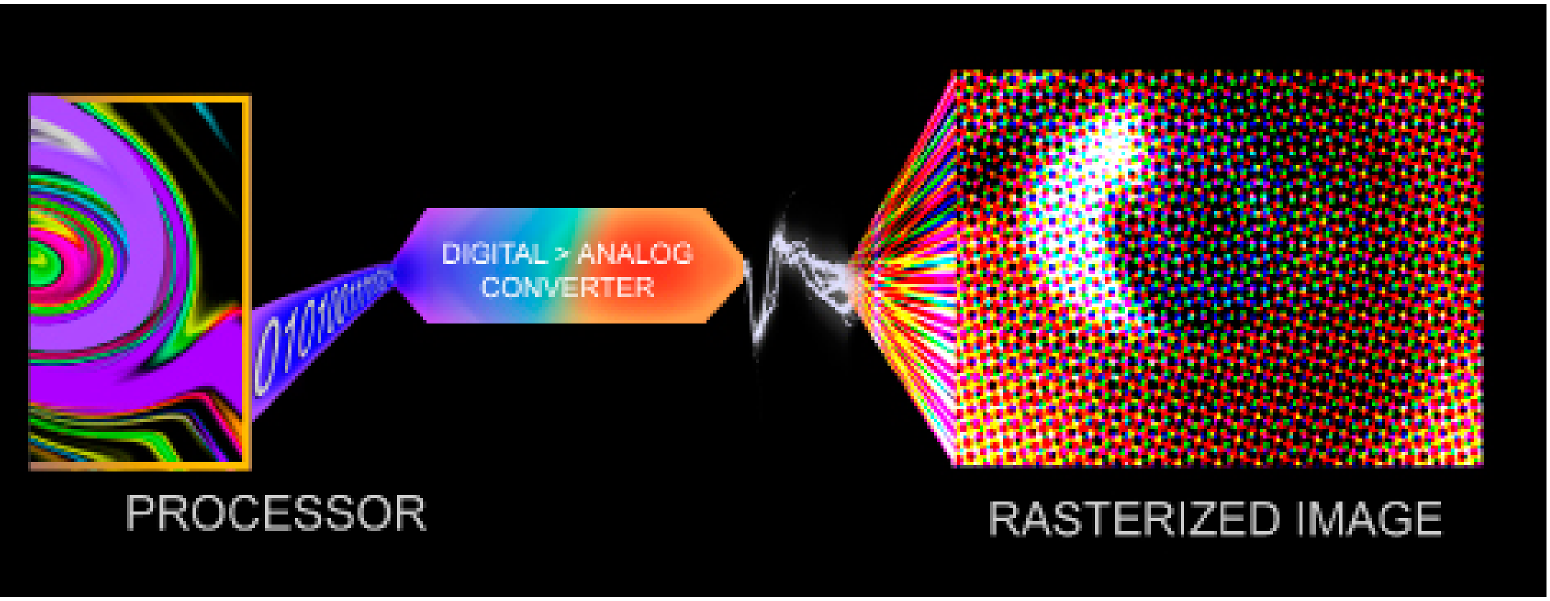
More light equals more voltage. Each pixel on the grid is a sensor that has three parts, one for each of the RGB primary colors. Each sensor catches its part of the light focused on it by the lens.

The photons in the light are converted into electrons and the collected electrons add up to a voltage, and the device holds that electrical charge. Thus, the pixel is either on or off.

If a pixel is on each of its three RGB sensors will have some or no measurable charge. The contribution of each sensor is what is recorded into RAW camera files after a series of algorithms has processed and "packaged" the information from the CCD or CMOS device.

RAW is an apt name for an image file at this stage because that is exactly what the data is… "raw". Something has to be done with it to make it into a picture that we can see. That is the job of additional algorithms.

An algorithm can be defined as a sequence of steps to get from one place to another. If you are familiar with Actions in PhotoShop algorithms are easy to understand. Actions record what you do so that you can perform the same series of steps over and over again at the touch of a button.



Actions are very handy. Suppose that your camera was set incorrectly when you took a series of pictures. Each of them would share the same fault. Actions allow you to record the correction for one and then apply it to all. That's what your camera does by virtue of algorithms.

Consider that the camera knows not what it shoots. There is no night and day for a camera. There is only light. For the pixel there is no picture, no recognizable scene.

Being a pixel on a CCD or CMOS is like being a sewer worker. Your view of the sky is the tiny spot of it seen through the manhole cover. Think about that… what would you know about the sky? Not much more than the color of the dot you see, possibly more blue, more reddish, or more gray. And so it goes for each pixel on the matrix that forms the grid of dots we call pixels.

It is we who recognize a blue sky as fair weather and a red sky as the beginning or end of the day. We also have our own ideas about what is a really good day or an extra special sunset. We remember bad ones too.

What the camera delivers is judged against what we know and we decide whether the picture is good or bad, right or wrong, too this or too that.

Algorithms determine how the "raw" data is stored and interpreted… they make the picture. The quality of the picture depends on the quality of the algorithms as much as the CCD or CMOS sensors.

All digital imaging is based on algorithms. All algorithms are sequences of steps to process data and convert it from one thing to another.

PhotoShop is all about algorithms. Every tool you use and every action you take is an algorithm. The newer the version of PhotoShop, the more algorithms there are… and the more "automated" the program becomes.

Depending on your needs, automation can be your friend or your enemy. To over simplify, its like having an automatic transmission compared to a standard shift. Each is good for a particular driving style. You wouldn't want an automatic in a rally race, nor would you want a stick shift in big-city traffic jams. PhotoShop® tools can be like that.

As for myself, I prefer as little automation as possible. I have high quality digital cameras all set to manual. In PhotoShop the number of tools I use can be counted on two hands... maybe only one. Manual manipulation of images is something I am comfortable with after years and years working with traditional photography and graphic design procedures.

When I discovered PhotoShop it was 1995 and I used Version 3 to begin with. Things were very elemental then because there were only a few tools. Since then digital imaging has matured and there are many more tools making possible much more control. But it is like making bread. You can make it from scratch (as I prefer to do) or buy it frozen and oven-ready.

Back to color…

The goal of the ICC back in 1993 was to standardize color definitions and nomenclature. The group developed standard device profile format used to characterize color devices. The result is what we now call color management.

Color management begins by profiling your monitor. An ICC color profile is a file that describes a device's color space… the variety of colors it is capable of working with. ICC profiles can be created for three types of devices: a display device (monitor or TV or video projection, for example), an input device (scanners and digital cameras), or an output device (printer).

ICC profiles can be either generic or custom. Manufacturers of devices provide generic profiles which are averages among a group of the same product. They do not describe each individual device's actual color space because that varies slightly from device to device, as well as by the working conditions. However, generic profiles are generally OK and they are what I use for the most part.

Custom profiles are made using color measuring instruments like a spectrophotometer or colorimeter, and software specific to the instrument. The instrument measures how your device displays or outputs a series of known colors and then calculates the deviancies. That information becomes the profile for that device. In that way different devices can understand each other's color space and gamut.

Colorvision (Pantone) "spyder" colorimeter attached to CRT monitor and sampling green light output. By measuring how the monitor displays colors it knows, the colorimeter software can calculate how far off your monitor is and make the necessary profile calibrations.

There are a variety of third party packages for profiling monitors. I use the original Color Vision "spyder" and software, which became a Pantone product. It has served me well over the years. Other packages allow you to profile the output of your printer(s) and the input of your scanner(s).

PhotoShop and other ICC-aware programs use the profiles for color accuracy throughout the workflow. The result is colors that look more accurate when printed or displayed on a variety of devices.

PhotoShop also uses profiles to better convert image files from RGB color space (monitors) to CMYK (for printed output), to display images from photo CDs more accurately, and to "understand" the colors input from scanners and digital cameras.

Monitor profiles also facilitate soft proofing which simulates the look of printed colors on the monitor screen. To use soft proofing in PhotoShop use View / Proof Colors and then set-up the view with the profile of the printer and media to which you will be outputting the image.

You can also create a profile for your monitor using Adobe Gamma for Windows machines and Color Synch or Display Calibrator Assistant in Mac machines. However, those are more rudimentary calibrations.

The Art of Color

How color is perceived is as much a black art as it is science. Advertisers know that certain colors are more persuasive. Package designers know that certain colors command more attention. Sign makers have their favorites, too.

Do colors evoke feelings because of our upbringing or do we carry genetic predisposition?…no matter. The giclée prepress artist is not concerned about what colors do to emotions so much as what they do to each other. How to maximize the dynamic tone range of a picture and match it to the requirements of the giclée printing machine and media, that's what prepress is all about.

Like the study of color itself, the giclée prepress artist's role has a scientific side and an artistic one. As the last step in the production cycle of an image, there are as many creative decisions to be made as there are technical judgements.

Like the algorithms used to execute instructions and make changes, giclée prepress is a sequence of adjustments to adapt an image to the capabilities of the output device.

If an output device can show 1000 colors, there's no point in delivering a file with 2000 colors. You might think, the more the merrier… and you would be wrong. In this case, giving the device 2000 pixels causes it to interpolate your file and reduce your 2000-color gamut to its own palette of 1000 color tones. That may or may not be a good thing. For myself, I prefer to choose which colors to keep and which to dispatch.

Besides technical adjustments like that, the giclée prepress artist's most important job is to interpret the image file's RGB image on a monitor and be able to see it as a giclée. To do that requires an understanding of how printed CMYK colors differ from emitted RGB colors. That is the single most difficult thing to do and it is a skill that is fine-tuned with experience.

Although I teach prepress techniques to artists and photographers at seminars in my studio, they and I realize that the artist's job is to get the image to look right on a profiled RGB monitor. Then, let a competent prepress artist adapt the file to the capabilities of the giclée 'press' being used to print it. The prepress artist is or should be more experienced with how the printed output will look, how his or her printing machine interprets and displays colors. Making the leap off the monitor screen and onto paper or canvas is the single biggest challenge to makers of giclée prints.

The interpretation process itself can be divided into technical and artistic components. Begin the session by asking the artist to tell you what they think is right and wrong about their work as it is seen on the monitor. Then examine the image technically. Are the highlights blown out? Are the shadows clogged up? Is it borderline too dark or light? Is there a cross? Almost every image you print will require adjustments in these basic areas, even before you begin tone-range extension work and color interpretation.

The workflow for a typical prepress session is discussed in the next section.