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1 Basic Theory

Understanding the basics of color is important, if you are to get the best out of Photoshop.

8 Bitmaps and Vectors

10 Pixels and Resolution

11 RGB and CMYK Color Models

13 Color Management

Bitmaps and Vectors

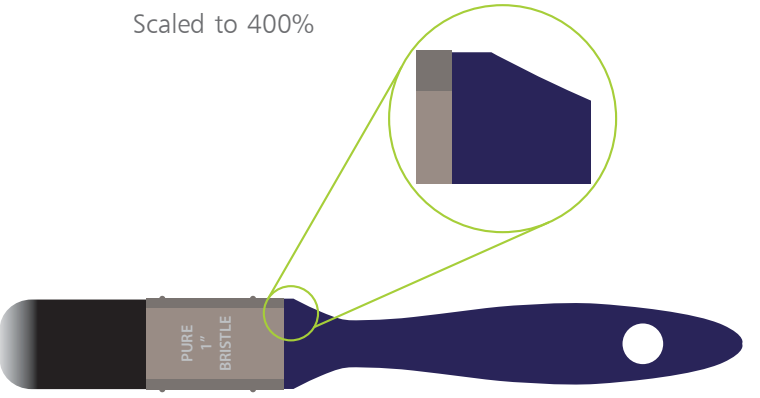
Photoshop is an image-editing application, with a wealth of tools and commands for working on digital images or bitmaps. There are utilities for retouching, color correcting, compositing, and more. There are also over 100 functional and creative filters, which can be applied to entire images, selected areas, or specific layers.

A bitmap image consists of a rectangular grid, or raster, of pixels – very much like a mosaic in concept. When you edit a bitmap, you are editing the color values of individual pixels, or groups of pixels.

Image-editing applications differ fundamentally from vector-based applications, such as Adobe Illustrator. In these applications, you work with objects that can be moved, scaled, transformed, stacked, and deleted, as individual or grouped objects, but each exists as a complete, separate object all the time.

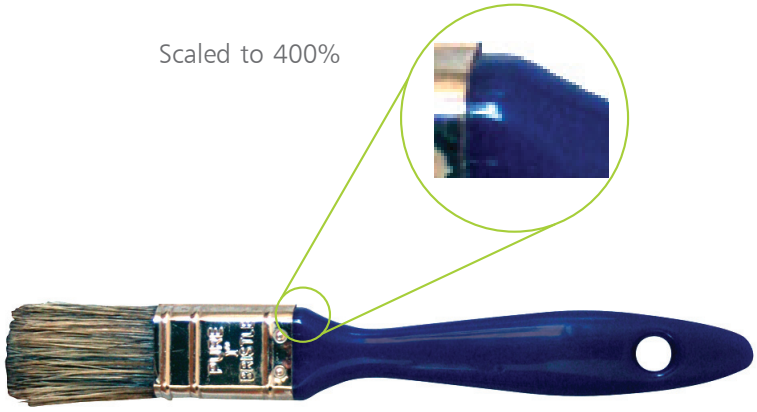
These applications are called vector drawing packages, as each object is defined by a mathematical formula. Because of this, they are resolution-independent – you can scale vector drawings up or down (either in the originating application or in a page layout application, such as QuarkXPress or Adobe InDesign) and they will still print smoothly and crisply.

You should always try to scan an image at, or slightly larger than, the size at which you intend to use it. This means you will avoid having to increase the size of the image.



Vector drawing at actual size

In contrast, bitmaps are created at a set resolution – a fixed number of pixels per inch. If you scan an image at a specific resolution, then double its size, you are effectively halving its resolution (unless you add more pixels). You are likely to end up with a blocky, jagged image, as you have increased the size of the individual pixels that make up the bitmap image.



300ppi bitmap at actual size

Bitmaps and bit-depth

An important factor for when the digital data of an image is captured, typically using a digital camera or by scanning, is its bit-depth. Bit-depth refers to the amount of digital storage space used to record information about the color of a pixel. The more bits you use, the more color information you can store to describe the color of a pixel – but the larger the file size you end up with.

To output realistic images using PostScript technology, an image should be able to represent 256 gray levels. A 24-bit scan is sufficient for recording 256 gray levels for each of the Red, Green and Blue channels (8-bits for each channel), resulting in a possible combination of over 16 million colors.

Ideally, when you work on images in Photoshop, you will do so using a monitor capable of displaying over 16 million colors. This ensures that you can see all the color detail in the image. Although you can work on images using only thousands of colors, for best results, especially where color reproduction is important, you need to work with as many colors as possible.

Don't forget

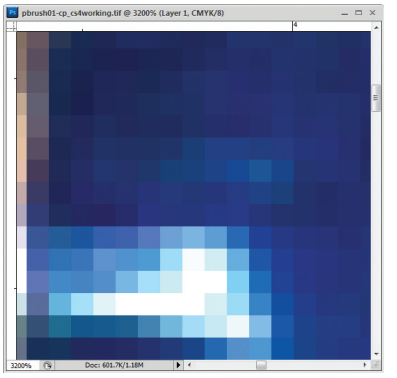
More, rather than less, color information is usually desirable, as this means the image can represent more shades of color. Finer transitions between colors, and greater density of color, leads to a more realistic image.

Hot tip

Photoshop can handle images that use 16 or 32-bits per channel, which originate from high-end digital cameras, scanners and microscopes. 16/32-bit per channel images contain a far greater range of colors than 8-bit per channel images. The disadvantage of working with such images is that their file sizes are also dramatically larger. The bit depth per channel of an image appears in the title bar of the image window:

Pixels and Resolution

Pixels



A pixel is the smallest element in a bitmap image captured by a digital camera or scanner. Pixel is short for "picture element". Zoom in on an image in Photoshop, and you will start to see the individual pixels – the fundamental building blocks – that make up the image. When working in Photoshop, you are editing pixels, changing their color, shade, and brightness.

Resolution

A key factor, when working on bitmap images, is resolution. This is measured in pixels per inch (ppi).

Pixels can vary in size. If you have an image with a resolution of 100 ppi, each pixel would be 1/100th of an inch square. In an image with a resolution of 300 ppi, each pixel would be 1/300th of an inch square – giving a much finer, less blocky, result.

When working on images that will eventually be printed on a printing press, you need to work on high-resolution images. These are images whose resolution is twice the halftone screen frequency (measured in lines per inch – lpi) that will be used for final output – that is when you output to film or directly to plate.

For example, for a final output screen frequency of 150 lpi – a typical screen frequency used for glossy magazines – you need to capture your image at a resolution of 300 ppi.

Resolutions of double the screen frequency are important for images with fine lines, repeating patterns, or textures. You can achieve acceptable results, especially when printing at screen frequencies greater than 133 lpi, by using resolutions of 1½ times the final screen frequency.

To work with images for positional purposes only, as long as you can get accurate enough on-screen results and laser proofs, you can work with much lower resolutions.

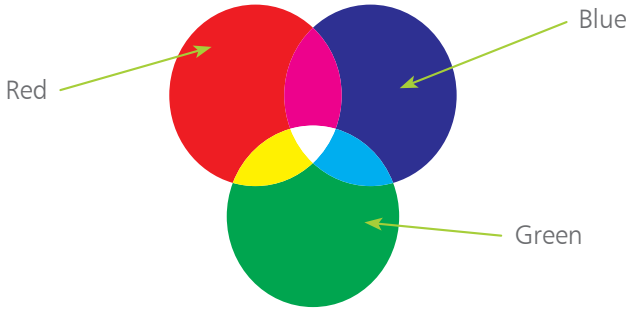
Hot tip

Images intended for multimedia presentations, or the World Wide Web, need only be 72 ppi, which is effectively the screen resolution.

RGB and CMYK Color Models

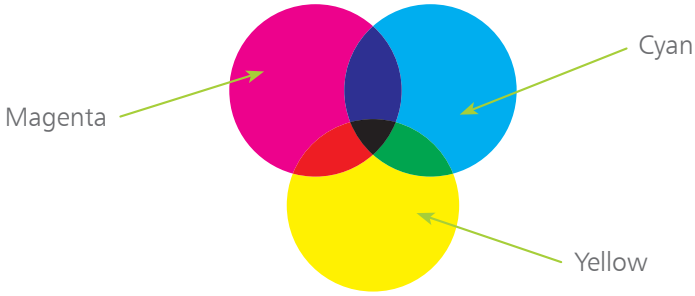
You need to be aware of two color models, as you start working with Adobe Photoshop. These are the RGB (Red, Green, Blue) and CMYK (Cyan, Magenta, Yellow and blacK) color models.

RGB is important, because it mirrors the way the human eye perceives color. It is the model used by scanners and digital cameras to capture color information in digital format, and it is the way that your computer monitor describes color.



Red, green and blue are referred to as the "additive primaries". You can add varying proportions of the three colors, to produce millions of different colors – but still a more limited range (or "gamut") than in nature, due to the limitations of the monitor. If you add 100% of red, green and blue light together, you get white. You produce the "secondary" colors when you add red and blue to get magenta; green and blue to get cyan; red and green to get yellow.

The CMYK color model is referred to as the "subtractive" color model. It is important because this is the color model used by printing presses. If you subtract all cyan, magenta and yellow when printing, you end up with a complete absence of color – white.



Hot tip

On the printing press, cyan, magenta, yellow and black combine to simulate a huge variety of colors. Printers add black because, in theory, if you combine 100% each of cyan, magenta and yellow, you produce black, in reality, because of impurities in the dyes, you only get a muddy brown.

...cont'd

Color gamuts

Color gamut refers to the range of colors a specific device is capable of producing. There are millions of colors the eye can discern in the visible spectrum. Scanners, monitors, and printing presses cannot reproduce every color in the visible spectrum – the range of colors they are capable of producing is their gamut.

From the desktop publishing point of view, the process of capturing digital color information, viewing and manipulating this on-screen, and then finally printing the image using colored inks, is complicated, because the gamut of a color monitor is different to the gamut of CMYK and PANTONE inks. There are colors (especially vibrant yellows and deep blues) that can be displayed on a monitor, but cannot be printed using traditional CMYK inks.

Typically, you will work in RGB mode if the image is intended for use on the World Wide Web or in a multimedia presentation. You can work in CMYK or RGB mode if the image is intended for print, but you must remember to convert to CMYK mode before saving/exporting in EPS or TIFF file format, in order to use the image in a page layout application. Adobe InDesign can import CMYK or RGB images in native Photoshop (.PSD) file format.

Beware

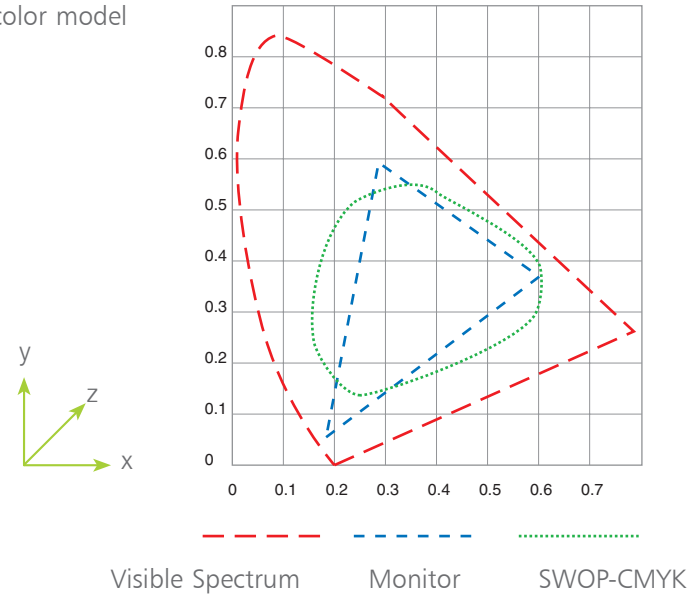
When you convert from RGB to CMYK mode, Photoshop converts out-of-gamut colors (in this case, colors that can be seen on screen, but not printed) into their nearest printable equivalent.

Hot tip

The CIE (Commission Internationale de l'Eclairage) XYZ color model is a model that defines the visible spectrum that can be seen by a "standard" observer.

Colors with the same lightness value fall within an approximately triangular flat plane (the Visible Spectrum area in the diagram opposite). The x axis represents the amount of red in colors, and the y axis indicates the amount of green. The z axis represents the lightness of colors.

CIE XYZ color model



Color Management

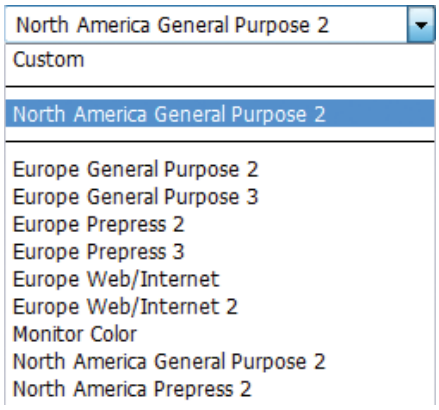
No two devices that represent color, from digital camera to scanner, monitor to printer, will reproduce color in exactly the same way. The aim of a color management system is to ensure, as far as possible, that the colors you see on your screen are as close as possible to the colors you see in the finished work, whether in print or on screen.

Color management settings are available, so that you can choose a color management workflow most suitable for your needs.

Using the Color Settings dialog box, you can define how you manage color in your images as you work in Photoshop.

1. To specify color management settings for your Photoshop working environment, launch Photoshop, then choose Edit>Color Settings (Ctrl/Command+Shift+K).

2. Choose the most appropriate setting for your intended final output, from the Settings pop-up list. For example, if you are using Photoshop for images that will be used in multimedia presentations, or on the World Wide Web, choose Web/Internet or Monitor Color options. If you are working with images that will be color separated then printed using CMYK inks, choose Europe or US Prepress defaults, as appropriate.



3. Only make changes to the default settings when you have gained experience in using Photoshop, and when you have a valid reason for making changes, or if you have consulted with your commercial printer and they have suggested changes to suit your specific output requirements.

Hot tip

If you use Photoshop with other applications in the Creative Suite, such as InDesign and Illustrator, it is recommended that you synchronize color settings across the suite, using Adobe Bridge. In Bridge, choose Edit>Creative Suite Color Settings. Select a Color Settings option, then click Apply. (See pages 36–39 for information on Adobe Bridge.)

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Hot tip

If you feel that you are not achieving good color in printed output, consult your commercial printer about creating custom settings for color management.

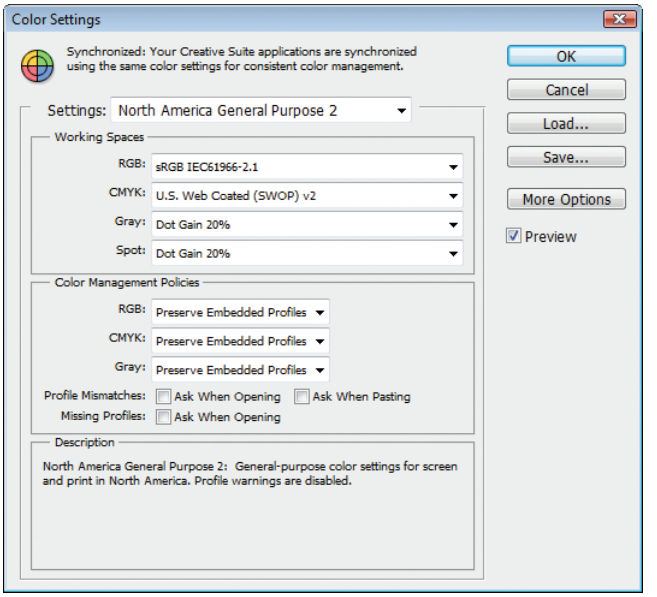
Hot tip

A CMS (Color Management System) is used to translate colors accurately, from one color device to another. It attempts to represent a color consistently, from the color space in which the image was created to the color space used at output, making adjustments so that color displays as consistently as possible across a range of monitors and other devices.

Don't forget

Recalibrate your monitor on a regular basis, as monitor performance can change over time.

4 To get a better understanding of how the settings work in the Color Settings dialog box, roll your cursor over the pop-up lists. The Description area at the bottom of the dialog box updates, with information on how the option affects the image.



5 Click the More Options button to access advanced color management settings. Only change advanced settings if you have a detailed understanding of color management.

Monitor Calibration

To make accurate and consistent judgements about the colors you see on your screen, you must calibrate your monitor. Monitor calibration creates a monitor profile that can be used as part of a color–managed workflow.

Hardware-based color calibration utilities are more accurate than the Adobe Gamma utility, previously available in Photoshop. There is a wide range of third-party monitor calibration suppliers – try doing an online search for "monitor calibration", or look for products such as "i1Display2" from X-Rite, "Spyder2express™" from Datacolor, or "Pantone®huey™" from Pantone.