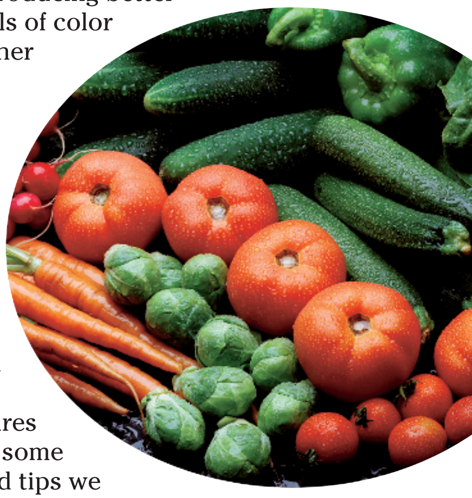
1

Understanding Color

In This Chapter

- Getting the essentials of managing color
- Speaking the language of color
- Mixing three hues into millions of colors
- Choosing the right color mode for your image
- Switching between color modes

In order to manage and correct color photos, you need to understand a few things about how your digital camera, your computer, and your printer handle color. The tools you use to create your photos capture and display color in a consistent manner. Although not the most exciting aspect of correcting an image for proper color viewing, the basics of color and how your devices deal with color is an essential ingredient to producing better color photos. In this chapter, we cover some essentials of color that you need to know as you work through all the other chapters in this book.



Understanding Calibration Basics

Throughout this book, we talk about working in a good color-management workflow. Developing such a workflow begins with the essentials — setting up your work environment, getting your monitor in shape, and using your color desktop printer properly.

In this book, we talk about some sophisticated measures to help you best view, edit, and print color images. In some cases, you may think that some recommendations and tips we offer are a bit more than you want to do when you edit your own pictures. If you're not ready to change your work environment, you need to make some decisions about what you can realistically do to prepare your environment and your computer as best you can to effectively edit photos.

One thing to keep in mind is that the more preparation steps you cut out of your color-management workflow, the farther you move away from accurate color reproduction. Therefore, you may decide to eliminate some things that we consider critical to preparing your work environment; but realize that you can't expect to achieve the most accurate color in your photos.

We tried to write this book in such a way that you don't need to read it cover to cover, but even so, you do need to work through some essentials in order to dive into Elements' Standard Edit mode and begin editing your pictures. You can't avoid these essentials — you need to address them before you begin image editing. To prepare your work environment and set up your computer for good color management, you need to do some preliminary tasks:

- **Controlled lighting:** One of the most commonly overlooked areas related to good color-viewing conditions is carefully setting up your viewing environment. If you work on a super professional color monitor, have your monitor tweaked with a $5,000 color calibrator, and use the most sophisticated color profiles, you're only halfway to managing color. If light coming through your window and from your overhead light fixtures results in a colorcast on your monitor, you're not working in an optimum viewing environment. The first consideration you need to make is controlling the lighting of your workplace. We cover setting up lighting in Chapter 2.
- **Monitor calibration:** You've heard it all before, and we repeat it here — you need to be certain your viewing device reflects the best possible brightness and gray balance that you can get. On the low end, you can purchase some inexpensive calibration equipment; on the high end, you can purchase some very sophisticated calibration tools. At some point, you need to use a device to get your monitor to display the best it can, in terms of brightness and gray balance, as we explain in Chapter 3.
- **Color profiles:** You may have heard the term color profiles before. A *color profile* is a small computer file that contains all the settings that give you the best color capture, view, and/or print. If you don't use color profiles, your reproduction efforts are like taking a shot in the dark.

  Color profiles are created through the process of calibration. Therefore, you need to first get familiar with some of the steps used for calibration: Color profiles are ultimately created from your calibration adjustments. In many cases, you acquire color profiles with your hardware equipment — especially color printers. You need to know when and how to create a color profile and how to use color profiles supplied by hardware developers. We cover color profiles more in Chapter 3.

There you have it. Your first steps in color correction involve controlling lighting, calibrating your monitor, and having all the color profiles you need for editing images and outputting them either for Web hosting or printing. After you have these essentials in place, you can begin the task of color correction.

Getting to Know the Language of Color

Color terms and definitions can be very confusing, but for this book, we use the same terms and concepts that Adobe Photoshop Elements uses and avoid all the fancy scientific stuff you really don't need to know to edit your images.

Color is defined by just three terms: hue, saturation, and brightness. In order to make the concept of correcting color much easier to understand later in the book, we also give you the definition of a complementary color, which means the exact opposite (on the color wheel) of the color you're looking at.

Stay awake because the following sections are really important.

Hue

Hue is the term used to name the actual color you're looking at. Your eyes perceive only three pure colors, but those three colors mix in your brain to give you all the colors you actually see.

The human eye has special receptors called *cones.* Cones come in three different kinds, each sensitive to a narrow portion of the light spectrum humans can see. One cone type responds to short wavelength light and sees blue. One cone type responds to middle wavelength light and sees green. The last cone type responds to the longest wavelengths and sees red. Our eyes' three-color cone design is why your monitor can show you millions of colors, even though it projects light in just three pure hues: red, green, and blue. These colors are known as the *additive model.*

Photoshop Elements works with color by mixing (adding) red, green, and blue. You need to identify these hues in the same way that Photoshop Elements does. Take a look at the color wheel in Figure 1-1.

Figure 1-1 shows a standard, simplified color wheel. The colors are as close to the real monitor hues as we can show you in this book because of ink limitations.

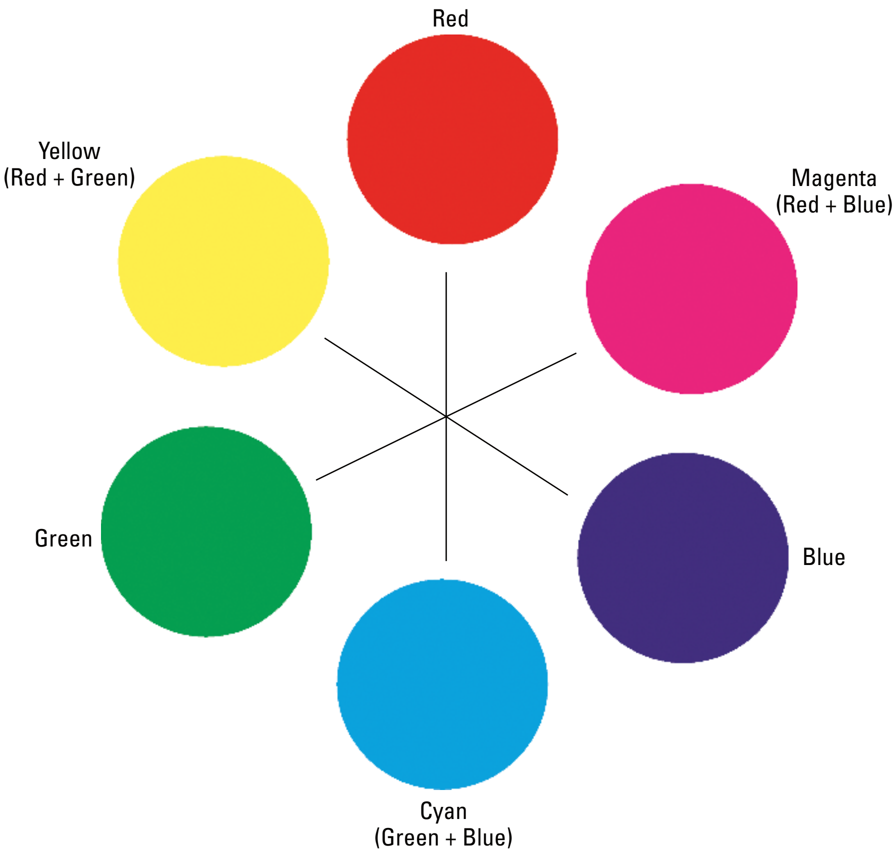


Figure 1-1: This simple color wheel shows red, green, and blue hues.

The first thing you might question is the yellow patch, made from green plus red. Keep in mind that you're mixing light, not paint. Mix equal parts of red and green light, and you get yellow. No, we're not making this up! Your eyes see yellow when something you're looking at emits equal parts of green and red light.

Still doubt us? Well, paint a yellow patch on your monitor in an Elements file, then zoom in and look very closely at the monitor. The only colors you see are little, glowing pixels of green and red. It's counter-intuitive, but green and red light make yellow.

The next color that might confuse you is blue. It looks purple, you say? You also might think that the cyan patch should really be called blue. Remember, you're mixing light, not paint.

Your kindergarten teacher is probably to blame for the confusion. Back when you mixed paints in those long-ago classes, she showed you that blue and yellow mixed together made green, and you probably had a pot of paint called purple that looked like the blue patch on our color wheel.

Mixing paints to get different colors uses subtractive primaries. The subtractive primaries are cyan, magenta, and yellow. Your teacher probably called them blue, red, and yellow. It made naming the paints a lot easier, but it wasn't really correct.

Equally mixing the red, green, and blue primaries create cyan, magenta, and yellow on your monitor, as shown on the color wheel in Figure 1-1. Just remember that you need the basic hues of red, green, and blue to make a full range of hues (or colors) on the computer.

Colors exactly opposite of each other on the wheel are called *complementary colors.* Mix the complementary colors together on the monitor in equal parts, and you get a shade of gray, light gray, or white. The complementary colors cancel each other out. We talk more about this concept of colors canceling each other out in Chapter 8, where we show you how to correct the color on a bad image file.

Saturation

The term *saturation* defines the purity of a hue. Saturation is pretty easy to understand if you look at a few examples, such as the ones shown in Figure 1-2. The green patch in Example A is a highly saturated hue. In Example B, the patch is the same hue but less saturated. In Example C, the patch is desaturated more than B. Finally, in Example D, you see the same hue completely desaturated and therefore devoid of color.

Saturation defines the vividness of the hue in question. Think of a desaturated color as one with white, gray, or black mixed in. Gray represents a fully desaturated tone — no color at all.

Brightness

Brightness means what it says: It's the term used for how light or dark is the hue in question. Keep in mind that a hue can be bright without being saturated. Here's an example: The three cyan patches in Figure 1-3 are equal in saturation, but they vary in brightness.

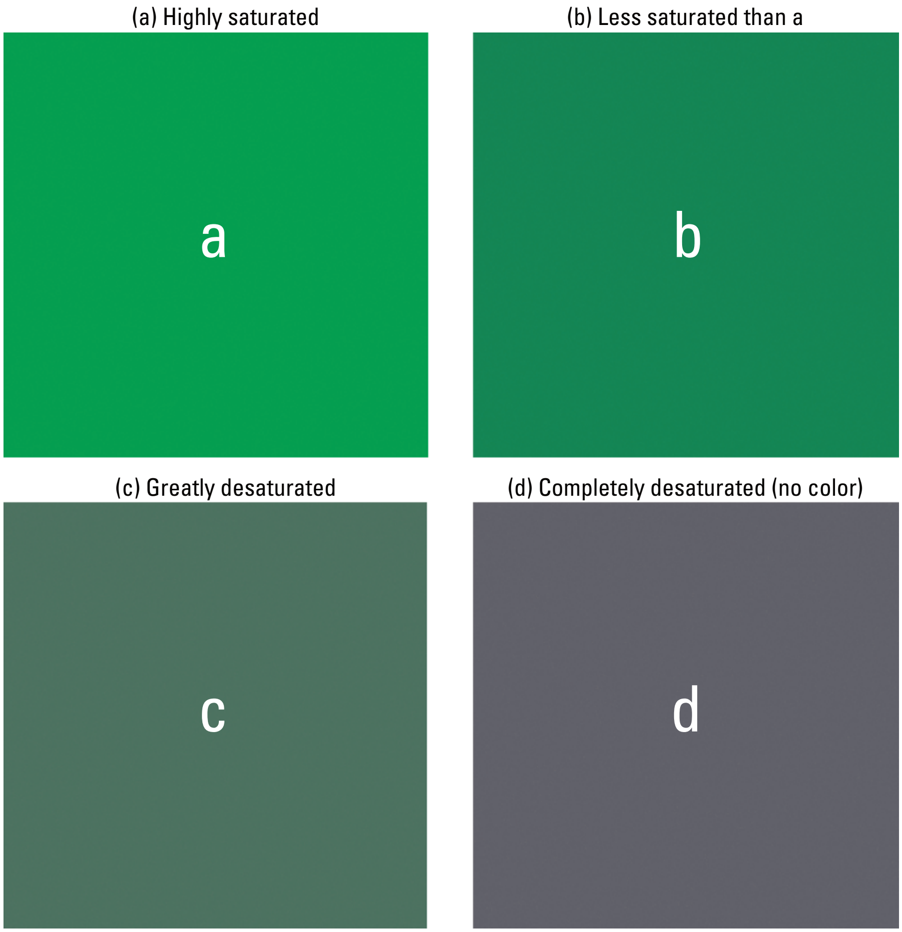


Figure 1-2: A green patch shown at different levels of saturation.

Figure 1-3: These three cyan color patches vary in brightness values, from least bright on the left to brightest on the right.

We repeat these color concepts a great deal in this book as we work our way through color management. Editing a file to change overall color, brightness, and contrast often affects the hue, saturation, and brightness of the colors in your file. Understanding how to define those changes can make the rest of the book far easier to understand.

Color space

Throughout this book, we continually refer to the term *color space. Color space* is a way to numerically describe color on computers. Color space is also often referred to as a *color model.* RGB (Red, Green, and Blue) is a color space. CMYK (Cyan, Magenta, Yellow, and blacK) is a different color space. HSB (Hue, Saturation, and Brightness) is a color space that describes color as we define it in the preceding sections.

For most purposes, because Elements is limited in the number of color spaces that you can view, we pretty much stick with the RGB color space throughout this book.

Color gamut

Another term you find frequently used in this book is color gamut. *Color gamut* is simply the entire range of color within a given color space. We might use a phrase such as "outside the color gamut," which simply means that a particular color isn't contained within the range of color for a particular color space. As a result, you can't see the color on your monitor, and you can't print the color on your printer.

You might have a color visible on your monitor because it fits within the monitor color gamut, but the color may not print on your color desktop printer. The color isn't within the printer's color gamut.

Clipping

Quite often, we talk about colors or tones being *clipped,* which means that the value is cut off. A color that's clipped, for example, won't print. When Elements prints a photo that has some color clipped, the print shows you the closest color to the clipped value. Beyond that value, the clipped colors aren't printed.

Clipping also relates to image tones (or grays). If we say that a very light or dark tone is clipped, for example, the print appears with some whites and blacks lost. This loss of tone results in a loss of detail in highlights (whites) and shadows (blacks).

Suppose you took a picture in which the foreground subject is in the sun. In the background, your eyes see a beautiful range of shaded trees. When you print your photo, the leaves on the trees aren't completely visible. They look dark and don't have much detail. The dark tones were clipped (cut off) from the image.

Mixing Colors

Your computer monitor is capable of displaying a total of 16.7 million distinct and individual colors. The monitor is capable of showing you all these colors by mixing the primary hues of red, green, and blue together. Understanding how your monitor mixes the colors ultimately helps you understand how to edit your pictures for color correction.

Imagine a diaphragm similar to your camera's diaphragm. You can turn the f-stop ring to open or close the diaphragm. As you open the diaphragm, you let more light pass through the lens. If you could close a diaphragm all the way on a lens, you would block all light from passing through the lens.

When your monitor displays a color, it allows certain amounts of light to pass through the RGB color phosphors in a similar fashion to a camera lens. The monitor can control the amount of light that passes through the phosphors in 256 individual steps. It's like having a ring on your camera lens with 256 separate adjustments.

In computer terms, 0 (zero) is a number; therefore, the 256 value is really measured from 0 (zero) to 255. If you assign 255 to the red hue and 0 (zero) to the green and blue hues, you see a fully saturated red color on your monitor. To test this theory, follow these steps:

1. **Open any file in Standard Edit mode.**
2. **Double-click the mouse cursor on the Foreground color swatch in the Tools palette.**

   The Color Picker dialog box opens.
3. **Set the color to a fully saturated Red.**

   Type **255** in the R text box in the Color Picker. Type **0** (zero) in the G and B text boxes, as shown in Figure 1-4. These numbers mean that you open the diaphragm all the way for the Red channel and close it all the way for the Green and Blue channels. The result is a fully saturated red color. (For more on channels, see the section "Understanding channels," later in this chapter.)

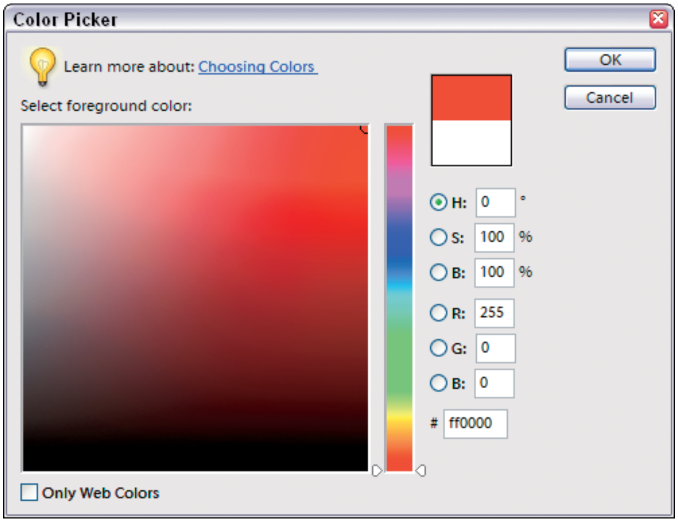


Figure 1-4: The Color Picker identifies a fully saturated red color.

Understanding grays

The number of distinct settings you have for color mixing are commonly called *levels of gray*. Because the computer monitor doesn't have a diaphragm, you need some method for controlling the amount of light that passes through any one of the three RGB phosphors.

Try to visualize a large plate of glass. If you paint the glass solid black and place a light behind the black glass, zero light passes through it. If you then paint a glass plate 50 percent gray, some light passes through the glass. As you reduce the level of gray to smaller percentages, more light passes through the glass, resulting in more saturated color.

Hence, in Photoshop Elements terms, you have 256 levels of gray that permit you to increase or decrease the saturation on the three individual hues. Remember when we said that your computer monitor can display 16.7 million distinct colors? We got this number by multiplying the maximum number of grays for each hue together (256 × 256 × 256 = 16.7 million). This number really means that you have 16.7 million combinations of levels of gray with which you can create colors.

Understanding channels

In Photoshop Elements terms, the three hues your monitor displays (red, green, and blue) are called *channels.* You can easily see the three channels by opening an RGB color image in Standard Edit mode and opening the Levels dialog box. Select Enhance➪Adjust Lighting➪Levels or simply press Ctrl+L (⌘+L for Macs). When the Levels dialog box opens, click the RGB menu (the down-pointing arrow), and you see the three channels, as shown in Figure 1-5.

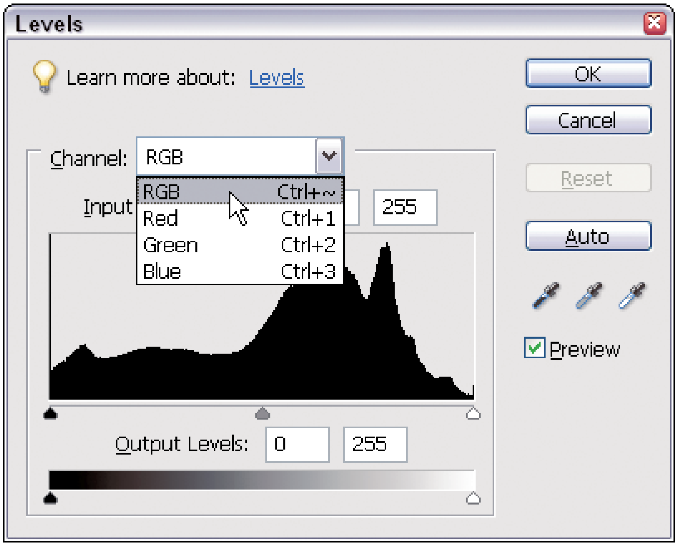


Figure 1-5: In the Levels dialog box, you can access the three RGB channels.

We commonly refer to the RGB channel as the *composite channel* because it's a mix of the different gray levels in all three channels. If you make an adjustment to this channel, all three RGB channels are adjusted together. However, you can also individually make adjustments to the Red, Green, and Blue channels.

When we refer to making adjustments to either the composite channel or the individual channels, we're really talking about painting that imaginary glass darker or lighter to allow more or less light to pass through, resulting in more or less saturated color.

As you work through the chapters in this book, we continually reference tone levels (represented by the 256 levels of gray) and channels. A slight edit to the tone levels in either the composite channel or any one of the individual channels can greatly affect image brightness and color.

Why are there 256 levels?

This 256 number comes up a lot when talking about image modes. What makes it so special?

Reproducing tone on paper or a monitor requires a minimum of about 200 tone levels to give smooth results without *banding* (or making sharp transitions between) the tones in smooth gradient image areas. Some images can get along with far fewer levels of tone, such as highly textured images or those that don't really contain any smooth tones.

Two hundred tone levels is a kind of minimum benchmark for good results. So why 256 levels and not exactly 200? It has to do with the way computers calculate. Computers use binary math, and 8-bit encoding allows exactly 256 tone levels. Seven-bit would result in just 128 tone levels. So, 8-bit mode became the minimum standard for full tonal range image files.

The 256 tone levels of 8-bit mode also allow a little headroom for file editing. Image editing always causes some amount of information loss, and as a direct result, an edited 8-bit file always has less than 256 real tone levels remaining. The extra 56 levels allow more editing before any tone banding problems become visible.

Understanding Color Modes

A *color mode* is a fancy term for the method Elements uses to display and print your image. Elements allows you a choice of four different color modes. And although Elements doesn't support the CMYK mode, it can convert a CMYK-mode file to a mode it does support.

RGB

You'll probably use RGB, Elements' standard default mode, 99 percent of the time. This mode uses three channels (Red, Green, and Blue) to describe color and tone. This mode is the most versatile and gives you access to all the editing tools and filters in your Elements application. RGB files allow embedded color profiles (which we talk about in Chapter 4).

Index color

This is an ancient color mode in the computer world. Unlike RGB 24-bit mode, with 16.7 million possible colors, index color allows only 256 colors. This mode was originally created back in the old days as a means to keep color file sizes as small as possible. Computers couldn't display 16.7 million colors back then, so monitors that showed images in only 8-bit mode used index color.

Web pages still use index color today, in the form of GIF-format files that are limited to 256 colors. The Save for Web option in Elements allows you to save files in the GIF format, if you want.

The main advantage to the GIF format is the ability to keep graphic elements clean and sharp on Web pages, unlike JPEG files, which can add distracting visual artifacts to graphics when the JPEG files use high compression settings. But index color doesn't allow the use of color profiles.

Grayscale

You can think of grayscale as the black-and-white image mode, in terms of black-and-white photos. Just a single channel is used to describe image tone without color information. Grayscale has 256 distinct gray levels supported in 8-bit mode and more than 40,000 gray levels in 16-bit mode.

Grayscale mode has advantages if you like to work with classic black-and-white photography. Grayscale files are just one-third the size of an RGB file, so you get much faster computer performance and can store more files on your hard drive.

If you want to tone, paint, or tint a grayscale creation, you must convert to RGB mode to do so.

TECHNICAL STUFF

Grayscale supports embedding special profiles to indicate the display Gamma used and also for dot gain if the file is for traditional press use.

Bitmap

Bitmap is a 1-bit file format. *One bit* means that only two tone values are supported — just white and black with no grays. Bitmap can simulate gray values by using a display we call *dithering,* which places the black and white pixels in a pattern to visually appear as grays.

Elements users should probably see bitmap as more of an image appearance than as a standard file format to use. The main advantage to this mode is the small final file size, compared to grayscale mode. Convert a grayscale file to bitmap, play with the options available for conversion, and you might find a visual style that you like.

CMYK

You can't edit in this mode, but Elements does allow you to open a CMYK color mode file that Elements converts upon opening to RGB mode so that you can work with the image.

CMYK is the color mode used for traditional printing press reproduction of color images. For example, this book was printed from CMYK-mode files.

Printing presses need to use four separate ink plates to reproduce full color images on paper. The press plate colors are cyan, magenta, yellow, and black, so it's called CMYK mode. (Black is abbreviated K because, a long time ago, people were afraid that using B for black might be confused with blue.)

CMYK supports embedded color profiles. (We talk about color profiles in detail in Chapter 4.)

Converting Color Modes

In some situations, you need or want to convert one image mode to another. You may need to convert a grayscale or bitmap file to RGB so you can colorize, paint, or tint the image for output to a color printer. If your file's in bitmap mode, you must convert first to grayscale and then to RGB mode. You can make these conversions by selecting Image➪Mode and then selecting a color mode from choices in the submenu that appears.

In other situations, you may need to convert from RGB mode to index color mode for Web use. Sometimes, you need to make a mode conversion from index color to RGB so you can edit the file for color or tone, before converting it back to index color mode.

Follow these tips when you make image mode conversions for editing:

- To allow full editing capabilities for an index color file, convert the file to RGB mode, edit it, and convert it back to index color mode.
- If you plan to create multiple images for use in index color mode, keep your original files in RGB mode and convert duplicates. You can't recover the information you lose when you convert RGB mode to index color mode.
- You have to convert bitmap mode to grayscale mode in order to edit the tones of the image. You can convert back to bitmap when you finish editing in grayscale mode.

- Grayscale mode has far more editing options than bitmap mode. It's best to keep master files in grayscale mode and convert to bitmap mode as a final step before viewing or printing the file.
- If you want to convert RGB to grayscale, always convert a duplicate file. All the color information is lost when you convert a file to grayscale mode.