Part I

Preparation and Concepts for Serious Image Editing

Serious image editing requires serious preparation. Problems in your images that you can ignore when you are just starting out become far more important as you gain experience editing. What you don't want to do when you work on images is spend hours correcting something that would have taken moments to fix at the time of capture. So your first task in working with any image should be to always take the time to capture the best image information that you can. Get the best capture as a photo or scan, instead of one you will just plan to fix later. The better the information you start with, the more likely you'll have what you need to make the best result.

Capturing the best information and getting the best results require understanding the images themselves and how image information is retained and displayed. Before getting into image editing, there are some concepts that must be clear. Understanding these concepts and setting up images correctly can help you bring the right information into Photoshop Elements, optimize image processing, and develop an approach to the processing itself. This part of the book lays the groundwork you'll need for stepping into more advanced concepts.

Chapter 1

Essentials of Images and Image Editing

There are really only a few types of change that can be made in an image, and they revolve around altering content. You choose the tools to use and then work with tone and color to change the composition. That's it. If your process covers tool selection, color correction, and composition changes, you are doing what you should for every image.

Following a process and understanding the possibilities gives you a solid foundation to work from. Although the actual changes for each image may be very different, you can use the same set of tools and the same editing process just about every time. The purpose of this chapter is to outline the process and concepts for you. With this foundation, you can then jump into making your images better.

The Image Editing Process

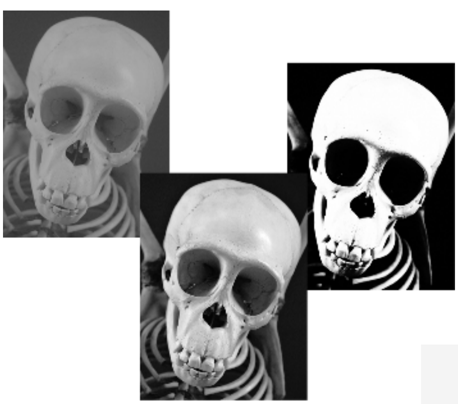
The Tools You'll Need

Basic Concepts of Tone, Contrast, and Color

Understanding and Using Color Management

Resolution

Knowing Your Equipment and Images



The Image Editing Process

When you go on a vacation, it is a good idea to make a checklist to help you remember everything you have to do before you go and everything you want to bring along. When approaching image correction, a checklist can help ensure that you've covered all the essentials. The list should cover everything you will have to do to an image, and you'll want to do the steps in a particular order until you develop your own preferences and methods.

The process that follows is one that I have developed over many years of working with digital images, and it covers all the steps you will need to take in correcting images. For some images you'll skip a step, and for others you might spend hours indulging one step or another. During the process of correction, you will generally want to work from global changes down to smaller and more specific changes.

The steps come in three parts:

Preparation Be sure your system and program setup are correct and that you know what you want to do with the image.

Correction Take specific steps to achieve your goals in correcting the image.

Purposing Finalize the image to target it to specific output.

Image Correction Checklist

Each set of steps in the image editing process is outlined in the following checklist. Consider this checklist your plan for editing images. It is the roadmap that all of the technique covered in the following chapters falls into.

Preparation

1. Be sure that your monitor is calibrated and that you have set up your preferences and tested your output. Doing so ensures your best chance of getting the results you intend. (See "Understanding and Using Color Management," later in this chapter.)
2. Store the original image file safely and work with a copy to do all of your image editing. If any step goes awry, you will want to be able to return to the original image to start over, or you may want to repurpose the original in the future.
3. Consider resolution and color. Have in mind a target range for the resolution and a color mode for the final image. You may work at different resolutions and in different color modes throughout, but knowing what you need from the outset can help you work smarter, with fewer color conversions (which you generally want to try to

avoid). See "Types of Color" and "What Image Resolution to Use," later in this chapter.

4. Evaluate the image. This analysis can include looking at color and tone, determining the image type (high-key, low-key, high contrast), evaluating the extent of work to be done, and considering the composition. The result of the evaluation should be a short list of things you want to improve or change. See "Evaluating Image Tones" in Chapter 3.

Correction

5. Make general color and tonal corrections. Be sure to make a good general correction at this point, but don't spend a lot of time getting it exact. A good general correction will point out some flaws that may otherwise lurk in the image until later in the process. While it isn't bad to double back during the process, it can unnecessarily increase the amount of time you spend on images. See "Redistributing Tone with Levels" and "Snapping and Fading Contrast with Curves" in Chapter 3 and "Levels Correction for Color" and "Curves Correction for Color" in Chapter 4.
6. Make general damage corrections, such as eliminating dust from scans, fixing cracks and holes in scanned images, and reducing digital noise. See "Doing Minor Cleanup First" in Chapter 3 and "Minor Cleanup for Color Images" in Chapter 4.
7. Make more involved color correction. This means do more intensive tonal and color adjustments, but not spot adjustments (using selection or masking). Those corrections will come later. See "Snapping and Fading Contrast with Curves" in Chapter 3 and "Curves Correction for Color" in Chapter 4.
8. Crop and size the image so that you are working with only the image area you really need. See "Cropping as a Tool for Composition" in Chapter 6.
9. Make major specific compositional changes and corrections, including replacing parts of the image with replacement parts you have created. This is the final compositional change. See Chapters 6 and 7.
10. Make targeted color and tonal corrections to selected parts of the image. You'll revisit techniques from Chapters 1 through 7 to select and mask changes to specific areas of an image. Chapter 5 might hold the most to mine in this step.
11. Make final fine-tuning adjustments to sharpening, contrast, and brightness.
12. Save the layered RGB version of the image. Be sure to give the file a new name, so you do not save over the original.

Purposing

13. Simplify the image as appropriate. This step may include flattening the image or merging layers, altering the color mode, or removing extraneous image information.

Don't delete or merge shape layers that may be important to your output.

14. Make final color and tonal adjustments to optimize the image for output and use. This step can include such changes as setting white and black points and making device-specific color changes. See suggestions in Chapter 9, "Options for Printing."
15. Save the image in output file format.
16. Package the image for output and use.

This checklist may seem long, but each step will often not be very involved. Some steps you will do naturally, and some take just a moment. Practicing correction by following the steps in the list can ensure that you make all adjustments and corrections that you intend to in achieving your goals for the image. The tools to use in each of these steps are reviewed in the next section. While this provides a solid process, using the process correctly depends on how well you understand your images. The sections that follow the checklist provide the fundamentals you need to use the process.

The Tools You'll Need

In each step of the image editing process, you can use a small subset of the tools and commands in Elements to accomplish your goals. Having a list of these tools helps you know what tools to concentrate on and master, while leaving other tools safely behind. Concentrating on the smaller tool set will help streamline your image processing and keep you on target during the editing process.

The tool set listed in Table 1.1 is based on the steps described in the preceding section. Most of these tools are standard tools you already have in Photoshop Elements; others are add-ins you will find on this book's companion CD. These "Hidden Power tools" can simplify processes or add new functionality to Photoshop Elements. See the "Hidden Power Tools" section of the book's introduction for instructions on how to load and access these tools.

You may occasionally reach outside this suggested tool set for a special purpose, but this listing offers a general guideline to simplifying the tools needed to get excellent and consistent results. The choices are based not on which tool is easiest to use, but on which will provide the best results.

Table 1.1
Tool Set

PROCESS STEP	TOOL	USE THIS TOOL TO DO WHAT?	LOCATION
1 : Calibrate the monitor.	Adobe Gamma (PC) or Display Calibrator Assistant (Mac)	Do free, easy monitor calibration and ICC profile generation in one process.	Adobe Gamma is on your computer's Control Panel or the Photoshop Elements CD. Display Calibrator Assistant can be found in the Displays System Preferences by clicking the Calibrate button under the Color tab.
2: Store the original image.	Save As	Save your image with a specific name and location.	File → Save As
3: Specify resolution and color settings.	New	Set the color, size, and resolution to use for new images.	File → New
	Image Size	Change the size and resolution of an open image.	Image → Resize → Image Size
	Mode	Change the image color mode of an open image.	Image → Mode
	Scanner or digital camera	Use equipment settings to adjust image color and resolution at capture.	
4: Evaluate the image.	Eyedropper	Sample to check color and tone values in specific image areas.	Eyedropper tool in the toolbox
	Info palette	Display sampled readouts.	Window → Info
	Histograms	View a chart and statistics showing tonal mapping of the image.	Image → Histograms
	Levels	View image histograms as part of the Levels dialog box display.	Enhance → Adjust Brightness/Contrast → Levels
5: Make general color and tonal corrections.	Levels	Use simple sliders to adjust tonal dynamic range.	Enhance → Adjust Brightness/Contrast → Levels
	Reduce Color Noise	Reduce color noise associated with digital capture.	Hidden Power Tools under Effects on the Styles and Effects palette, in the PowerTools1 category
	Basic Color Correction	Adjust tonal levels and balance color as a process.	Hidden Power Tools under Effects on the Styles and Effects palette, in the PowerTools1 category
6: Make general damage corrections.	Clone Stamp	Make brush-style corrections via sampling of other image areas.	Clone Stamp tool in the toolbox
	Healing Brush	Make smart brush-style corrections via sampling of other image areas.	Healing Brush in the toolbox
	Masking	Customize selections by using masking.	Hidden Power Tools under Effects on the Styles and Effects palette, in the PowerTools1 category

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PROCESS STEP	TOOL	USE THIS TOOL TO DO WHAT?	LOCATION
	Copy	Copy the selected image area to the clipboard.	Edit → Copy
	Paste	Paste a copied area from the clipboard into a new layer.	Edit → Paste
7: Make advanced color corrections.	Luminosity and Color, RGB, and RGBL separations	Split images into component colors and tone (channels) to simplify and target adjustments.	Hidden Power Tools under Effects on the Styles and Effects palette, in the Power-Separations category
	Curves	Make custom multirange adjustments to tone, contrast, and color by using one of the most powerful correction tools.	Hidden Power Tools under Effects on the Styles and Effects palette, in the Power-Tools1 category
	Hue/Saturation	Adjust color by using slider controls to alter hue, increase/decrease saturation, and affect general lightness and darkness.	Layer → New Adjustment Layer → Hue Saturation
	Color Balance	Adjust color by balancing the influence of color opposites.	Hidden Power Tools under Effects on the Styles and Effects palette, in the Power-Tools1 category
8: Crop and size the image.	Crop	Change the image size by cropping out or adding extra canvas area.	Crop tool in the toolbox
	Image Size	Change the physical dimension and/or number of pixels in an image.	Image → Resize → Image Size
9: Make specific compositional changes.	Marquee and Polygonal Lasso	Select regular and irregularly shaped image objects.	Polygonal Lasso tool in the toolbox
	Masking	Customize the visibility of layered image parts and control the intensity of selections.	Hidden Power Tools under Effects on the Styles and Effects palette, in the Power-Tools1 category
	Copy	Copy a selected image area to the clipboard.	Edit → Copy
	Paste	Paste a copied area from the clipboard into a new layer.	Edit → Paste
	Transform	Reshape an isolated object.	Image → Transform
	Guides	Place nonprinting edges for alignment.	Hidden Power Tools under Effects on the Styles and Effects palette, in the Power-Tools2 category
	Add Noise	Roughen up tones that are unnaturally smooth.	Filter → Noise → Add Noise

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PROCESS STEP	TOOL	USE THIS TOOL TO DO WHAT?	LOCATION
	Gaussian Blur	Smooth out tones that are unnaturally rough.	Filter → Blur → Gaussian Blur
10: Make targeted color and tonal corrections.	History Brush	Paint in adjustments from filtered results (for example, to target Dodge and Burn).	Hidden Power Tools under Effects on the Styles and Effects palette, in the PowerTools1 category
	Gradient Map	Influence specific tones and colors by using gradients.	Layer → New Adjustment Layer → Gradient Map
	Masking	Customize the visibility of layered image parts and control intensity of selections.	Hidden Power Tools under Effects on the Styles and Effects palette, in the PowerTools1 category
	Blend Mask	Influence specific tones and colors by using tone and color measurement.	Hidden Power Tools under Effects on the Styles and Effects palette, in the PowerTools1 category
11: Make final fine-tuning adjustments.	Unsharp Masking	Work with both local and fine contrast in the image to improve edge definition and contrast in color and tone.	Filter → Sharpen → Unsharp Mask
12: Save the image.	Save As	Save with a new filename.	File → Save As
13: Simplify as appropriate.	Merge	Remove extra layers and image content when there are no vector layers to preserve.	Layers → Merge Linked, Layers → Merge Visible, Layers → Merge Down
	Flatten	Remove extra layers and image content when there are no vector layers to preserve.	Layers → Flatten Image
	Text To Shape	Globalize type handling by converting type to vector layers.	Hidden Power Tools under Effects on the Styles and Effects palette, in the PowerTools2 category
14: Optimize the image for final output and use.	Mode	Convert to final color space.	Image → Mode
	Levels	Make final adjustments to tone.	Enhance → Adjust Brightness/Contrast → Levels
	Blend Mask	Adjust white point.	Hidden Power Tools under Effects on the Styles and Effects palette, in the PowerTools1 category

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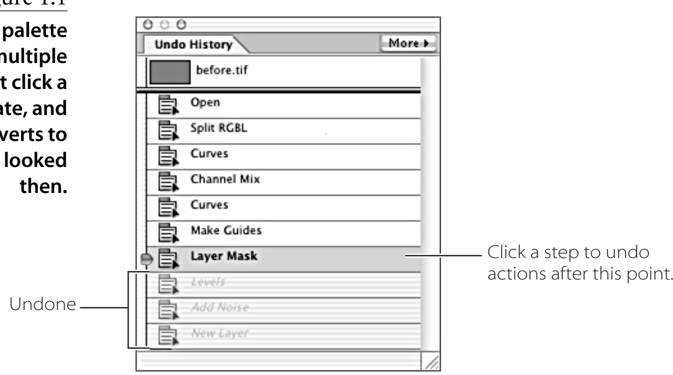
PROCESS STEP	TOOL	USE THIS TOOL TO DO WHAT?	LOCATION
	Separations (CMYK and Duotone)	Create separations for print ready files.	Hidden Power Tools under Effects on the Styles and Effects palette, in the Power Separations category
15: Save in output file format.	Save As	Save with a new filename.	File → Save As
	Save For Web	Save Web images with limited color and transparency.	File → Save For Web
	DCS Templates	Use custom files to allow unsupported color modes (CMYK and spot color).	Hidden Power Tools folder included on the book's CD
16. Package the image for output and use.	Permanent and/or temporary storage devices	Assemble the image parts and organize the content to complete purposing and storage.	

The tools mentioned here will all be explored in this book as part of the exercises in making image corrections. This listing cuts out many tools, most of which provide redundant (and sometimes inferior) means of completing tasks. If you use these tools to follow the methods described in the book, you will find that other tools are seldom necessary. Several other minor tools will sneak in at points during the exercises; while they are not specifically mentioned, they are mostly related to or substitutes for tools covered in the categories in the list.

One tool that does not fit into any particular step, but is very useful, is the History palette, shown in Figure 1.1. When doing serious correction and experimentation, it should become a good friend. For example, when you have taken several steps that have not accomplished what you hoped, a single click on the History palette can step you back to an earlier point in the development of the image so you don't have to start all over again. This lets you undo multiple steps at once, or compare before and after changes at a click. It's a real time-saver and a helpful tool.

Figure 1.1

The History palette acts like a multiple Undo. Just click a previous state, and the image reverts to the way it looked then.



Basic Concepts of Tone, Contrast, and Color

Without light, there would be no images. Light is what shapes the subject of images. It strikes an object that you are photographing, reflects back through the camera lens, and creates the color and tone captured in the exposure for the image. Light shapes the object, because shadows and highlights reveal object contour. The subtle interplay of tones, contrast, and color gives shape to objects and defines the subject of an image.

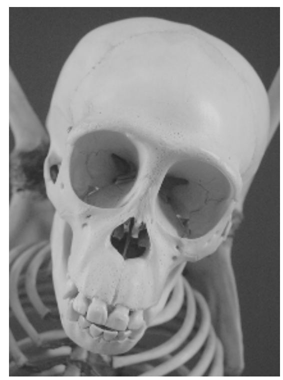
Tonal range is the difference between the lightest and darkest image areas. The greater the difference is between the lightest and darkest areas of an image, the greater the tonal range. The way light and dark tones play against one another is *contrast.* The more stark the difference is between light and dark image areas, the greater the contrast. If tonal range and contrast are not balanced correctly, an image will appear too light, too dark, too flat, or too harsh and contrasty, as illustrated in Figure 1.2.

Figure 1.2

One image can look many different ways, but the best way usually uses full range and flattering contrast.

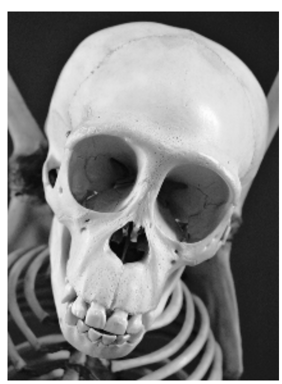
Too light

Too dark



Too flat

Too harsh



Balanced

Creating a dynamic image starts with making the most of the tonal range that exists in the image. Contrast (or lack of contrast) between tones within that range helps define image character. Not every image will naturally have high contrast and a broad tonal range. Some images may be naturally high-key (light, usually with moderate to low contrast), low-key (dark, usually with moderate to low contrast), or simply low contrast. Usually, the goal of correction is to maintain the natural character, or *key,* of an image while adjusting tone and contrast to enhance and improve dynamics. If there are 255 possible grays for your image, and you use only 100 of those, the image is really only 40 percent as dynamic as it might be. If you adjust the tonal range, the image can become more visually dynamic; if you adjust with care, you won't lose the natural quality of the image.

Both tone and contrast work in almost the same way in color and black-and-white images: you want to make the most of and expand tonal range and dynamics while maintaining image character. The difference is, when you extend the tonal range in a black-and-white image, you get more potential grays; when you make similar adjustments in color images, you get more potential colors.

Color as Tone

Color is a pretty simple thing to manage if you're picking out clothes, drapes, or upholstery. In those cases it is already mixed and applied for you. If you don't have experience with color mixing, it isn't until the first time you actually try to correct the color of an image that the complexity of color comes alive. If you've never had any training in art and color theory, understanding how color works can be a little confusing. Add to that the existence of different *color modes* (theoretical ways of defining color), and color becomes still more complex. Even more confusion can grow from the fact that color is stored in your digital images as grayscale. Because color can be split into simple grayscale components, it is important to understand how grayscale (tone and contrast) can also define color. However complex, you have to understand color and how it works in digital images to apply it and achieve the results you want.

For the most part, images that you will work with in color will be in RGB mode. *RGB* stands for red, green, and blue. It is an additive light-based color theory: different combinations and intensities of red, green, and blue lights make up the set of available colors. As the red, green, or blue lights are made brighter and applied with more intensity, the resulting color gets brighter, and colors mix in these varying intensities to form other colors. Full intensity of red, green, and blue results in white; lack of red, green, and blue results in black. It is a theory that works great with projection, such as on your monitor and some projection TVs. Breaking images into their component RGB colors is how your monitor displays color.

Each color you see in an image is made up of these three colors in different combinations. Each of the three colors has 256 intensities in 8-bit images (Elements does have 16-bit capability, which is discussed more later in this chapter and in the "Bit Depth" section of the appendix). The grayscale representations of the intensity of the red, green, and blue are stored as grayscale information in your image files. Light coming into a camera or sensed by a scanner is actually broken into these three components to be stored. Later the information is reassembled, allowing your computer to reproduce full-color images from the RGB.

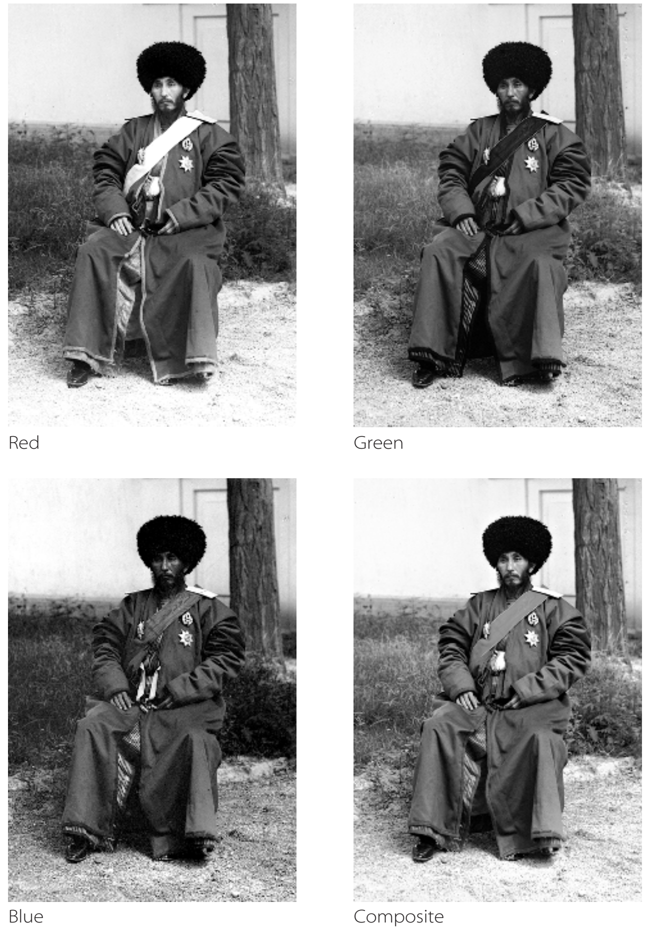


Figure 1.3

This image by Prokudin-Gorskii, titled *Man in Uniform, Seated on Chair, Outside*, was taken around 1910 by separating color into grayscale RGB plates. Scans of the glass plates can be composited to achieve a full-color result (as shown in this book's color section).

This theory and practice have been around for quite a while. One of the earliest photographers to create color images did it in Russia in the early 1900s, before there was color film. Sergei Mikhailovich Prokudin-Gorskii (1863–1944) made glass plates three at a time when he took pictures with a specially designed camera, filtering for the red, green, and blue components of light to record the strength (tone) of each component on what was essentially grayscale film. The plates would record the captured light as grayscale, and then using a special projector, Prokudin-Gorskii would project the images simultaneously with red, green, and blue filters to reproduce the color images on a screen. Figure 1.3 shows one of Prokudin-Gorskii's images; a composited version of this image is also presented in this book's color section. (These plates are from the collection at the U.S. Library of Congress, which can be accessed at `http://lcweb2.loc.gov/pp/prokquery.html`.)

Inside each of your color images are the primary source colors: red, green, and blue. These source colors are stored as grayscale representations and mappings of the intensity of red, green, and blue light in every pixel in your image. When you work on color images, the changes that you make affect all three of the source colors at the same time. The grayscale color components can be separated out of your images and retrieved for use in adjusting your image dynamics, tone, contrast, and color.

Photoshop has a palette called Channels, which is not included with Elements. The Channels palette, like the Layers palette, enables you to edit color components and manipulate them separately (in RGB as well as other color modes). This can be a great tool in making complex color corrections. Even though there is no formal Channels palette, this book shows you how to access and alter channel information easily, just as if you had a Channels palette working for you. The channels are referred to as *components*.

Breaking down color information into color components may not always be to your advantage when making corrections, but it can often be helpful when trying to isolate damage and perform advanced color correction. The ability to make separations into image components is a key concept of this book. If you understand how to make component separations and how these separations combine to create your images, it opens a world of possibility for improving images.

As Prokudin-Gorskii did in creating his "color" images, we can re-create representation of color as grayscale by filtering digital images. When the color components are separate, they can be adjusted one at a time, simplifying the way you work with color. This can help when correcting color-specific defects, in simplifying an approach to images and corrections, in developing a better understanding of what happens when you apply a tool to color images, and in doing the most complex color alterations and corrections. Let's look a little more at color types and color management.

Types of Color

Color in your images can be measured in several ways. Photoshop Elements uses color modes, which as I said earlier are really just different ways of depicting color and tone. The following are the four modes you can use:

- RGB
- Indexed Color
- Grayscale
- Bitmap

Later in this section and elsewhere in the book I'll talk about other color modes, including LAB, CMYK, RGBL and Duotone. These are not technically working color modes in Elements, but you can achieve these separations and save the separations to files using Elements.

Image color mode and file type are two very different things. Knowing which color modes appear in which file types (and which file types to use with a certain color mode) is often essential for correctly purposing your images.

For the most part, people using Photoshop Elements will be working with 8-bit color images in RGB mode. This mode offers the broadest flexibility for tool use, and is the mode most images are in when captured or created. As I have said, RGB refers to the type of color storage; in this case information is stored as red, green, and blue components. *8-bit* refers to the exactitude of the color representation, or the number of variations that can be stored per pixel in a color component. There are 16 million potential colors in 8-bit RGB, based on 256 possible tonal variations in each of the three color components ($256 \times 256 \times 256 = 16,777,216$ possible variations). That's one big box of Crayolas! In fact, it is the largest color set of any of the color modes you will be working with in Elements, except when using 16-bit RGB. A larger number of possible colors in your image allows finer distinction between colors and helps changes that you make to images blend more evenly.

16-bit is perceived to be an advantage over 8-bit: with 35,184,372,088,832 potential colors, images can theoretically have better integrity, and changes are less apt to damage image information. When working with 16-bit images, however, some important tools and functions are not available for image correction—most notable of these is layers. Other drawbacks to 16-bit include greatly increased file size, greater computer horsepower needed to process the images, and the lack of ability to use output from a 16-bit file (at present, information must be converted to 8-bit for print processing and display).

> Regardless of what you read elsewhere, 8-bit files can be returned to 16-bit in Elements. This will not magically restore 16-bit information that may have been lost or unavailable, but it will enable you to restore the advantage of 16-bit editing to 8-bit images. See the "16-Bit Images" sidebar later in this section.

Generally, you will work in 8-bit RGB for the best access to tools and the most predictable behavior of images. When the image is complete (that is, all changes you are going to make have been made), then you can consider converting the RGB image to other modes as required for your final purpose. You can save RGB files in many formats, but you will probably most often use TIFF (print), Photoshop (archive), JPEG (Web), and PDF (portability).

Indexed Color is a much more limited color mode than RGB and is almost always associated with GIF Web images. This color set has a maximum of 256 colors. The colors are created as a table by using *hex values*: six-character codes that represent specific colors (see the Hex Code Chart on the Hidden Power CD). The colors cannot be mixed, and must be one or another of the colors in the table. The goal of limiting colors, especially in the case of Web images, is to simplify files and make them smaller. In the case of Web images, this helps transfer them more quickly.

Even without any experience in converting to Indexed Color from RGB, it may be obvious that converting all of your 16 million potential colors from an 8-bit RGB into a measly set of 256 colors for Indexed Color may not always produce the best results. In converting to Indexed Color from RGB, almost all of your original color will have to change. Of course, the results can be disastrous when imposed on a full-color image. However, there are color tricks (such as dithering) that can make Indexed Color's color sets appear larger than they really are. Because color is applied rather than mixed, Indexed Color is a difficult color mode to work in. Moving to this color mode will almost always be a last-step conversion, and almost always will be done in converting images for display on the Web (when JPEG is not used). They are almost always saved in GIF format.

Grayscale (Figure 1.4) is also limited, but to no color at all. This "color" mode has 256 levels of gray tones (in 8-bit mode) that make up all you see in standard black-and-white images, or when working with individual color channels (such as color components extracted from RGB images). Generally you should convert images to grayscale when you are printing images without color, so that you can get the best depiction of tone (without depending on the color device to convert color for you). Taking the color out of an image can be simple, but it can also be considered an art, because what looks good in color may not look good at all in a straight conversion to black-and-white (though we will look at various ways to improve your results). Grayscale images are most often used in black-and-white print jobs.

Bitmap images are like grayscale, but are more strictly formed in black or white—using no grays. Pixels are either white (off) or black (on), as illustrated in Figure 1.5. For the most part, bitmap images are used with line art (pen-and-ink-type line drawings). Bitmap will probably be the least used color mode of those available. You will probably save Bitmap mode images in TIFF or BMP formats. High-resolution bitmap images are sometimes used for line art and other special purposes for print, such as creating dithered drop-shadows for use in layout.

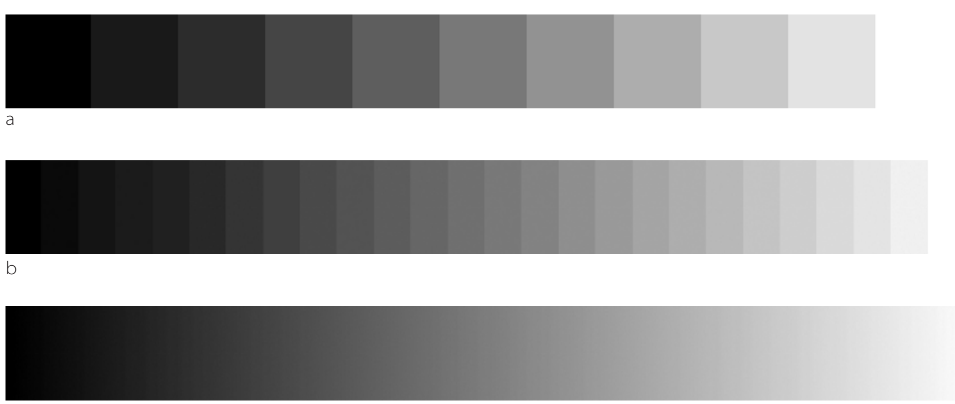


Figure 1.4
Grayscale gradients showing black-to-white gradients in (a) 10 steps (10 percent darker in each), (b) 25 steps (10 levels darker in each) and (c) 255 steps (every level of gray).

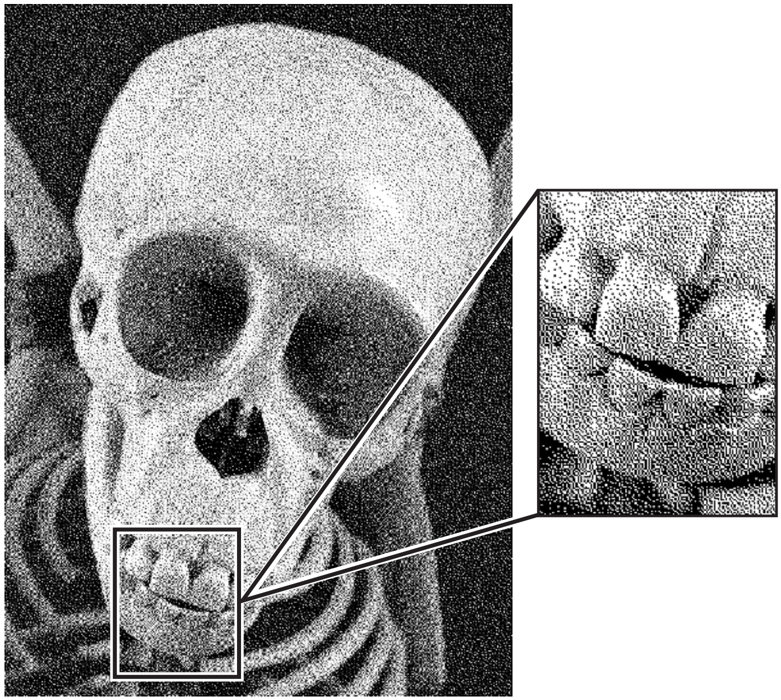


Figure 1.5
The magnification of a portion of the original bitmap image reveals the bitmap patterning.

These BMP bitmap images are different from the color bitmaps used in screen shots and other images as a common file format on Windows computers.

CMYK color (depicting images with cyan, magenta, yellow, and black) is a common printing color scheme that is not really available to Elements users as a color mode. It is how color is most often depicted in print. While you will not work in a CMYK color mode in Elements, you will usually print with CMYK color. The theory is similar to RGB in that a limited set of colors are used as inks to create the visible color set. At the same time, CMYK is perceptually the opposite of RGB. While RGB is based on additive color (the more light or color you add, the brighter it gets), CMYK is subtractive (the more ink/color you add, the darker it gets, because the light striking the color is absorbed). Figure 1.6 shows how two ink halftones combine for a darker result.

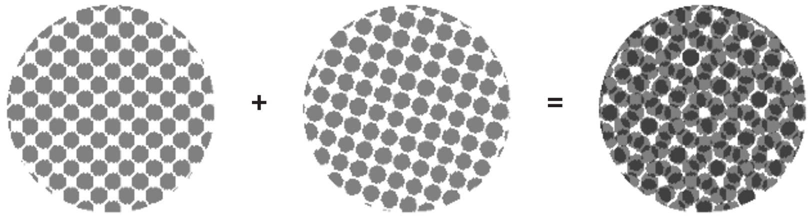


Figure 1.6
Samples of black (45°, left image) and cyan (108°, middle image) halftone dots as grayscale. When the halftone dots are printed over one another (right), colors combine to absorb more light.

Conversion from RGB to CMYK is often disappointing, because CMYK can portray fewer colors even though there is one more color in the set. The easiest way to understand this is to consider efficiency. While light is pretty much 100 percent efficient when projected, the absorption of light by ink pigments is not. Because pigments do not provide perfect light absorption, the color they reflect is not perfect in conversion. Black is added to the CMY color set as an attempt to increase the efficiency of absorption. As an additive, it produces only redundant color (color that should have been reproducible in a 100 percent efficient CMY pigment set). As a result of the inefficiency, the CMYK color set suffers, and results in less dynamic color and tone than RGB.

There is a supposition that you cannot work with CMYK images in Elements because it is not a supported color mode, but this is not entirely true. Although the program is not set up to handle CMYK directly, an indirect approach can enable you to make custom CMYK separations and usable CMYK images that can help you improve printed output. The file format used with CMYK is often TIFF, PDF, or Photoshop EPS. Regretfully, none of these will work directly. However, later in the book I will show you how you can essentially hijack another file format (DCS: Desktop Color Separation) that will allow saving and manipulating files as CMYK.

16-BIT IMAGES

Some users wonder—and even worry—about using 16-bit mode for image editing. 16-bit images offer more color detail: whereas 8-bit can reproduce "only" 16 million colors per pixel, 16-bit can reproduce more than 35 trillion (based on Photoshop's color handling). While this difference between 16-bit and 8-bit may be significant for archival purposes, for most cases in the real world, it should not make a noticeable difference in your images. You might see the difference if you are making extreme changes to an image or trying to rescue image detail from shadows and highlights. However, most output devices can't handle the additional image information in 16-bit images, and it is questionable whether technology will meet the 16-bit challenge in the near future, or if human perception can really distinguish between the results.

Photoshop Elements supports some 16-bit color adjustment as of version 3. Previously it would convert 16-bit images to 8-bit when opening. The only real gain you have for 16-bit images is in importing original 16-bit information or temporarily extending the usable color space for your images while you work on them. If you have a camera or scanner that creates 16-bit images, be sure, as suggested, to store copies of original images before converting to 8-bit.

When possible, working in 16-bit rather than 8-bit can provide an advantage for grayscale images, arguably more so than color. The measly 256 colors in the single grayscale component can more easily run out of image room and variation than the 16 million variations per pixel in 8-bit color. While you can't apply all tools in 16-bit (Elements does not, for example, support layers with 16-bit images), you can make some corrections using 16-bit, and you can switch back to 16-bit after making 8-bit modifications (using Hidden Power techniques).

To temporarily switch to 8-bit, do the following:

1. Have a 16-bit image open.
2. Duplicate the image (File → Duplicate).
3. Put your new filename in the As field. For this example, use **`Temp 8-Bit`**. Click OK.
4. Change the mode of the `Temp 8-Bit` image to 8-bit (Image → Mode → Convert To 8-Bits/Channel).
5. Make any corrections you want involving layers, and so forth, that you can't do in 16-bit mode.
6. Make a selection of the entire image using Select All (Command/Ctrl+A), Copy (Command/Ctrl+C). Then activate the original 16-bit image and Paste (Command/Ctrl+V).

When you paste, the image information you have been manipulating in 8-bit will convert to 16-bit. There are, of course, some limitations to the effectiveness of this conversion, but you can return to 16-bit mode and save the manipulation as a 16-bit file.

You can also convert files that were originally 8-bit images to 16-bit:

1. Have a flattened 8-bit image open. Check the Height and Width in pixels by using Image Size (Image → Resize → Image Size) and note the values.
2. Make a selection of the entire image using Select All and Copy.
3. Open the `Hidden 16.psd` image on the Hidden Power CD.
4. Resize the image (using Image Size again) to the Height and Width determined in step 1. Accept the changes by clicking OK.
5. Paste.

This will paste the 8-bit information into the 16-bit file, converting it during the process. Changes that you make while in 16-bit mode will reflect the advantages of 16-bit files. You can now fluidly move from 8-bit to 16-bit files in Elements.

See the appendix for more information on 16-bit images.

Understanding and Using Color Management

A buzz phrase in image correction is *color management.* If you are not familiar with this term, or if you have heard of it but don't know quite what it is, this section covers most of what you need to know. Although it is something you should take seriously, color management does not have to be as complex or mysterious as it tends to be. This brief discussion will help you become familiar with it, poke it with a stick, and see that it is dangerous if completely ignored. We'll look at your options, get set up, and get on with the main course of editing images with confidence as you pass color management by with a better understanding and a knowing grin.

Color management is supposed to be a means of helping you get better color consistently. That sounds good, and it is usually the reason why people think it is something they can't do without. By using color management, the goal is to have a better chance of your images looking the same from a variety of outputs (print and display). Color management uses profiles that describe how your display handles color to help translate what you see to other devices and how those devices handle color (via a common color palette and profiles of those other devices). The profile from your monitor or working color space can be embedded (saved) with your image file to act as the color interpreter for other devices (monitors and printers).

> This section deals only with Elements Color Management options. For more information on using printer profiles, see the "Printing with a Profile" section in Chapter 9.

Every device has its own profile, which acts as the interpreter on its end, so the devices can speak the same color language and adjust for differences. The key to full color management is that every device has to have a profile to be able to interpret other profiles, so the translation will work reliably. The embedded profile will affect images behind the scenes, both to help represent color correctly on-screen and to serve as a translator to other devices. In theory, that results in a better image. All this automatic translation sounds very appealing, like I'm serving the chocolate cake first.

This is all nice in theory, but the sad fact is, it doesn't necessarily work in practice. There are a lot of points in image processing where detours or errors can occur. Your profile can get dropped, changed, or ignored, or it can just plain be wrong. Profiling can occur where you don't expect it, and other profiles can be wrong, causing information in your image to be misinterpreted. Any of these can cause unexpected results.

First, you are responsible for building yourself a color profile—unless you use a generic one (not recommended). You have to set up the profile correctly, and there is no guarantee that you will (even if you follow instructions) because the process involves your assessment of color by eye (if you don't use a profiling device), and that may not be entirely accurate. Second, every step between saving your image and sending it to the printer has to both respect the color management and process it correctly. This is where the chocolate cake turns to mud pie.

Although profiling was planned to function behind the scenes and stay with your image, you can't be sure that the results you get are based on the choices you have made to embed your monitor profile in the image—unless you manage each step of the process. You also can't be sure that you really want the process to respect your profile (for example, if it is not correct). Embedding a profile doesn't work consistently because it can't be enforced: even if you embed a profile, some device or person along the way can drop your settings. There are devices that don't recognize color management settings; there are services that don't use them in processing. If your results depend on the color management, and the wrong color profile is embedded or the profile is missing, you are just as likely—or more likely—to get a bad result than you are without embedding color profiles.

Your only chance for guaranteed success using embedded color profiles is to make a study of how the profiles work, and become intimately knowledgeable about the output types and processes you use. Reading your printer manual is not necessarily intimate knowledge; it goes somewhat deeper than that.

Even with this additional effort, using color management and embedding profiles requires testing. Funny thing is, you have another choice: *not* embedding profiles. Not embedding profiles can have pitfalls and also requires testing. It does, however, remove the potential added complexity of using embedded profiles. In the long run, if you set up your system correctly by calibrating your monitor and creating a monitor profile (an ICC profile that describes your monitor) , not embedding profiles can often lead to more predictable results. You should not entirely dismiss color management, and you should create a monitor profile—even if you are not embedding profiles in your images. This helps calibrate your monitor and adjust the view of your screen. Embedding profiles in your images, on the other hand, is like an extra half-step in a staircase that can just as likely trip you up as ease your progress up the stairs—depending on how much you are paying attention. My experience is that you are more likely to trip over that half-step and swear at it than praise it.

None of this is to say that you can't embed profiles with success! You can, and if you do currently, don't change what you do. My perspective on using or not using profiles is a lot like my perspective on images: don't change what works, change what doesn't. If you currently use embedded profiles and everything works fine, stay with them. If you don't use profiles with success, don't use profiles, or you have never looked at them, or you don't understand what they are and how to use them, practice color management with the following fast, safe, and effective system:

1. Calibrate your monitor and create a monitor profile (I'll show you how to do this in a moment).
2. Don't embed profiles.

To be reasonably successful with color management, the Photoshop Elements user needs to calibrate, create a monitor profile (which Elements uses for image viewing), and choose how to handle profiles by making a selection in Color Settings. Even if you choose No Color Management, you are still using color management—you just choose not to embed profiles in your images. Calibrating your monitor and creating the monitor's color profile helps ensure that you see a best representation of the images on your display. This best representation should show what your image will look like on most other displays—and, for the most part, what it will look like in print. The next few sections present in a little more depth what you should expect to see on your monitor, how to calibrate, and what to do to build an ICC profile for your monitor.

What You See Should Be What You Get

One problem with trusting your visual sense is that it assumes that what you see on-screen is the right thing. Regrettably, that is not probable without calibration. All monitors are different, and the settings for display and color will affect what you see. If you haven't calibrated, colors on your screen might look different from colors on someone else's—and worse, they might not match or even come close to the color that gets printed.

If you are looking at a screen that is shifted green and you depend on the color to be accurate, a good correction will tone down the greens to make the image look right on-screen. This will cause output of any kind to be shifted toward reds (the opposite of green). Calibration will help compensate for shifts by flattening the response of your screen.

The goal of calibration is simple: you want to be able to trust what you see on your monitor, within reason. If you can trust what you see, you can mostly use your visual sense to correct your images.

I say *mostly* because even if you've calibrated your monitor, you have merely adjusted it for best performance. You are going to get the most out of your monitor, but the monitor itself may have some limitations—and there are inherent limitations in printing, so it is likely that there will be some differences between what you see on-screen and the result in print. Although you probably won't reach perfection, calibrating your monitor gives you a far better chance of at least coming close. With some selective checking, you should be able to feel confident in what you'll get as a result.

Calibrating Your Monitor and Building an ICC Profile

In this section you'll look at how to calibrate your monitor and create a monitor profile. Creating the profile helps your system adjust previews so images on-screen appear accurately. Before you begin, you should know several things about the response and performance of your monitor, including the manufacturer-suggested color temperature, gamma, and phosphor settings. These settings should be available from the manufacturer (call tech support and ask for an engineer if necessary).

What you use for calibration may vary. In the past, Adobe provided Adobe Gamma for monitor calibration for Mac and Windows users. It is no longer provided for the Mac because the Display Calibrator Assistant is a standard utility on OS X and above. WiziWYG is another free utility from Praxisoft for Mac and Windows, available from their website (`www.praxisoft.com`).

In the following steps, I describe the sequence (and show the screens) of Adobe Gamma for Windows; alongside these, I include some matching screens for Display Calibrator Assistant for Mac OS X(the order will be slightly different). Each of these utilities is similar in respect to what they do, and any will work for purposes of calibration and creating the profile. For the most part, you can simply start them up and read the directions as they appear on-screen. If you are lucky enough to have a calibration device (such as the Spyder by ColorVision), use that for calibrating your monitor instead of the following procedure; calibration by hardware calibration devices will be more accurate than calibration by eye.

Color temperature reflects the monitor display color for the *white point,* which really measures the color of white on your monitor. It is usually 6500, 7500, or 9300 degrees on the Kelvin scale. The higher the number, the more blue (or cool) there is in the white; the lower the number, the more red (or warm) there is. It is an inherent characteristic of your display and can subtly affect the appearance of color on-screen.

Gamma is a measure of tonal response, often a number between 1 and 3 with two decimal places. *Phosphors* are a set of six numbers with *x* and *y* coordinates for red, green, and blue; these numbers can have up to three decimal places. These settings vary between monitor brands and models, so don't make assumptions about them or copy someone else's. Find the settings in your manual or contact the manufacturer (via the website or technical support—again asking for an engineer if necessary).

> Monitor manufacturers don't always put monitor specs for phosphors, white point, and gamma in the manuals. You'll likely have to seek it out. When you obtain the information, write it down. I usually write the settings right on the cover of the monitor manual for easy reference.

Your monitor should be in an area that will minimize glare, and lighting (except where noted during the calibration) should be as you will have it when you are most frequently using the computer and monitor. Lighting should generally be subdued and indirect if possible. Changes in lighting will require recalibrating the monitor. The monitor can be calibrated to different light conditions, but it is easier to maintain a consistent room lighting than to add it as a variable in color corrections. Extremely bright or overly dark rooms might cause some problems with calibrations and monitor viewing. Optimally, room lighting should be bright enough that you can read and view materials that are not on the screen, yet not so bright that it causes glare or washes out the display. After creating your profile, be sure the lighting where you work remains the same as when you calibrated the monitor.

Before you begin, you should also locate the monitor's brightness, contrast, and color controls. If your monitor has an option to reset to factory settings, do it now. If there is no reset option, use the monitor controls to normalize the screen by eye. Grays should look flat gray rather than a little warm or cool. After resetting or adjusting color, leave these controls alone and do not change them after calibration. Now you are ready to start calibration.

> Calibration will be slightly different in every operating system and OS version, though the options in various dialog boxes will be similar.

1. Turn on your monitor and system, and let the monitor warm up for at least 30 minutes.
2. If you haven't done it yet, read the owner's manual for the monitor to see if it provides suggestions for calibration.
3. Open Adobe Gamma by double-clicking the icon in the `Control Panel` folder. You should see the screen illustrated in Figure 1.7. If Adobe Gamma is not in the `Control Panel` folder, find it on the Photoshop Elements CD.

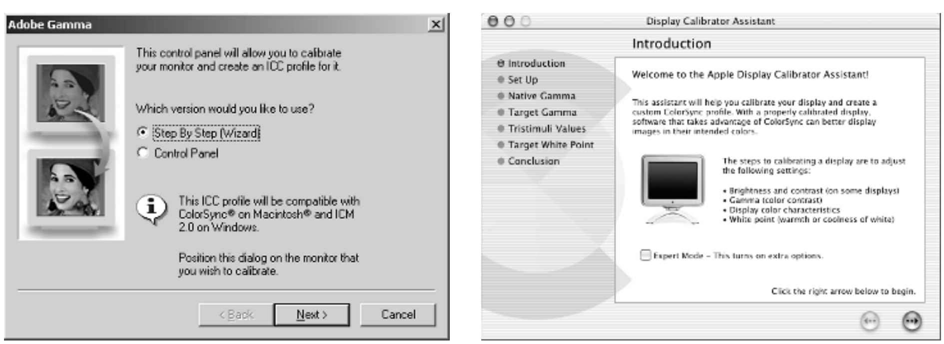


Figure 1.7 **The initial Adobe Gamma and Display Calibrator Assistant screens**

4. Click Step By Step. This will lead you through the process of calibrating and creating an ICC profile for your monitor. Click the Next button.
5. In the Description field, type a name for the profile you will be creating (Figure 1.8). You can enter a lot of information here, but it's best to keep it short. I find it handy to name the monitor and add the date, so the profiles are easy to identify. If you use output white point settings (step 12), you may also want to include this value in the name. Click the Next button.

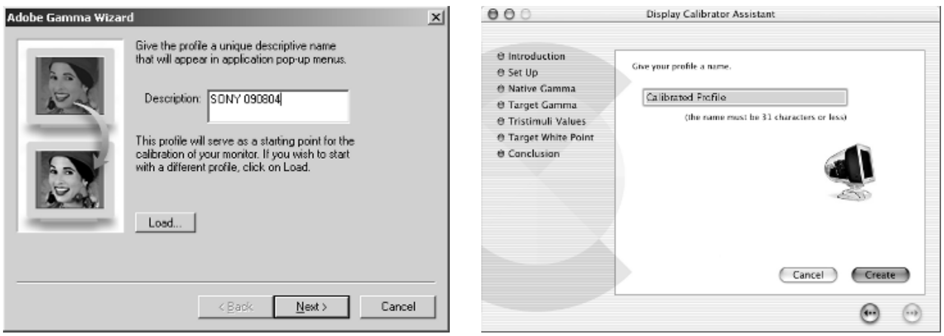


Figure 1.8
Type the profile name in the Description field. (The opportunity to name the calibration comes last in Display Calibrator Assistant sequence.)

6. Using the monitor controls, set the contrast all the way up and then adjust brightness until the smaller gray box in the center is dark enough that it is just barely discernable from the larger black box surrounding it (see Figure 1.9). If you notice the white frame beginning to darken at any point, stop darkening the screen. If necessary, adjust the brightness setting to lighten the screen a bit until the frame is bright white again. As you fine-tune this adjustment, it may help to squint or use your peripheral vision to get the center square as dark as possible without losing the brightness of the white frame. When you are satisfied with the adjustments, click the Next button.

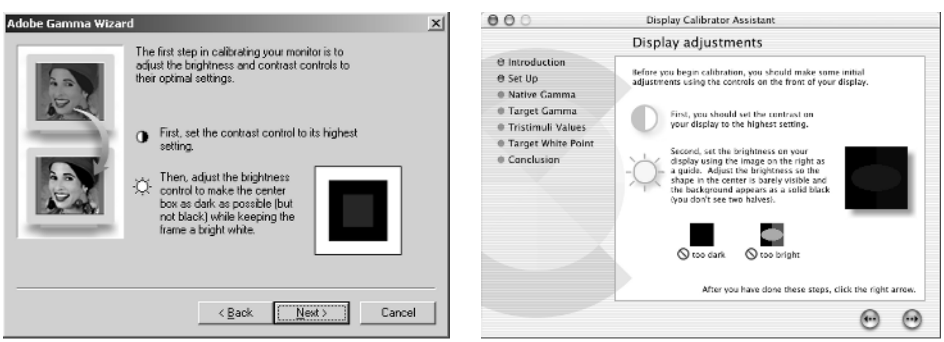


Figure 1.9
Concentric squares in Adobe Gamma, or a square and oval in Display Calibrator Assistant, help you adjust the screen contrast by observation while making adjustments to the physical monitor settings.

7. On the screen that appears, select Custom to open the Custom Phosphors screen shown in Figure 1.10.

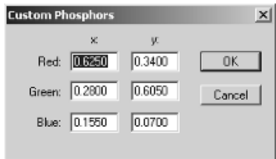


Figure 1.10
Phosphor values describe the monitor's response to color. (Display Calibrator Assistant does not allow custom value entries.)

8. Type the six values obtained from the manufacturer of your monitor in the appropriate fields. You don't have to know what each number means, but you do have to place each one correctly. Click the OK button to close the Custom Phosphors screen and accept the changes. This returns you to the Adobe Gamma Assistant dialog box.

9. Click the Next button. The screen that appears (Figure 1.11) enables you to adjust gamma. Select the View Single Gamma Only check box. Using the slider, adjust the appearance of the outer square (the alternating lines of black and white) so that it matches the tone of the 50 percent black center. Adjust the appearance by squinting at the screen (to blur the box slightly in your vision) while moving the slider. The goal is for the entire square to seem to have a uniform tone.

If you change monitors, you will obviously have to build a new profile. Other less-obvious reasons to build a new profile are monitor aging and changes in response due to use, replacing your system hard drive, and changing room lighting (or computer placement).

10. In the Gamma field, type the Gamma value you got from the manufacturer. You will be able to enter a two-decimal value, but Adobe Gamma will round the value off when you save the entry.

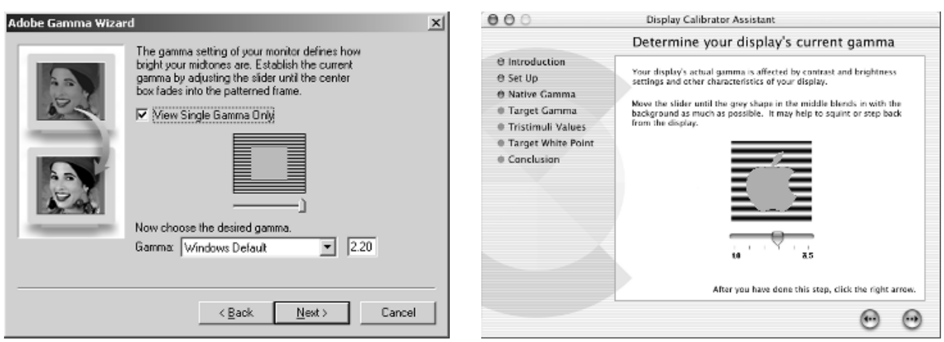


Figure 1.11
Sliders help you visually adjust for the monitor gamma.

11. Click the Next button. The screen that appears (shown in Figure 1.12) allows adjustment of the monitor's white point. Set the monitor's white point by choosing the value in the drop-down list that corresponds with the number you got from the manufacturer. (If you do not know what value to choose, see the following note.)

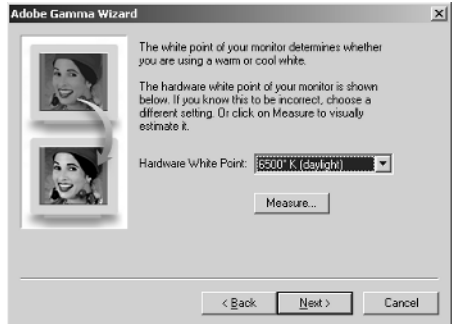


Figure 1.12

White point is a measure of the "color" of the brightest parts of your monitor, measured in degrees Kelvin.

> A second option on this screen enables you to measure the white point. To do this, dim (or turn off) the lighting in your work area and click the Measure button. A set of three gray squares will appear on a black background. Click the square that seems most flatly gray and repeat until the test closes.

12. Click the Next button. The screen that appears (Figure 1.13) will enable you to select a white point for output. This selection should be based on the color temperature of the intended output media. If you are unsure, or you are creating images for the Web, use the Same As Hardware setting.
13. Click the Next button. The next screen (Figure 1.14) enables you to compare calibration before and after the adjustments you made in the previous steps. Click to toggle the Before and After buttons several times, comparing the appearance of your screen as you toggle back and forth. Specifically, note the grays in the dialog box and see whether the color appears more neutral before or after adjustment. The more neutral (lacking any color, and looking flat gray), the better the calibration.

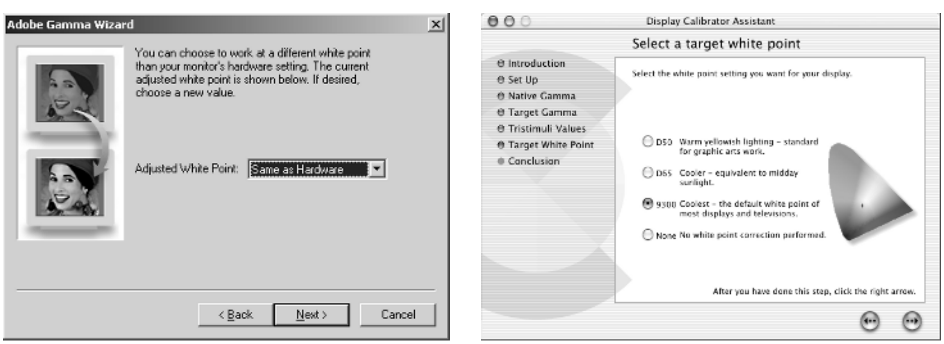


Figure 1.13

Output white point differs from monitor white point. This setting should reflect the color temperature of your output. This may be another monitor, paper, or a projection screen.

14. If the before and after results are noticeably different, run through the process again (steps 3 to 13).
15. Click the Finish button to accept the changes.

> I never calibrate one time and sit back satisfied—even when using a calibration device. I run through the process a few times to be sure I have the best calibration.

What you have just done is calibrated your monitor and created an ICC profile for it. The calibration helps you to be sure the image information you see on-screen is reasonably accurate. The ICC profile is a description of how color appears on your system. This information is used for previews, and can be used if you embed profiles in your images to help describe color in your image to other ICC-aware devices.

Although Adobe Gamma is an adequate tool for visual calibration, calibration devices (see the example in Figure 1.15) can measure more accurately than your eye, and will probably measure a greater number of gray levels and create more accurate profiling. The devices take measurements directly from your screen and create a profile based on those measurements. Using such a device can ensure that your monitor is calibrated properly, and it may actually save some time during calibrations.

Color Preferences

Most Preferences settings in Photoshop Elements are just a matter of personal preference, and they can be changed at any time as you see fit. However, the one group of settings that you will be required to make a choice about and stick to is Color Settings. This is where you can define how Elements handles images with profiles that you open, what color space you want to work in, and whether profiles get embedded in your images by default. The choice you make can be important to your results, and will certainly affect how you work with images. If you are not sure about what to select, or if you are unfamiliar with some of the terminology just used, that's OK. Your options and explanation of terms are covered here.

Before we dive in: how much of this do you really need to know? Probably not that much if you use the techniques suggested in this book. The following explanation attempts to clarify why certain suggestions are made.

Figure 1.14
Compare the Before and After settings by toggling the radio buttons.

Figure 1.15
The ColorVision Spyder device attached to a monitor

Understanding Color Space

The *color space* is a defined color set—a mapping of what colors are possible for your image. Some spaces are said to be *larger* than others, and this isn't technically accurate. All 8-bit RGB images have the same number of potential colors. On the other hand, different RGB color spaces are mapped to cover a wider or smaller *range* of potential colors—not *bigger* color spaces with more colors, just broader spaces that cover a greater range. Because different RGB color spaces map to different color sets, all RGB is not the same, though it is born of the same theory.

The difference between one color space and the next is the range or set of colors that the color space covers. In other words, the numbers in two files defined by different color spaces can be exactly the same, as numbers, yet the display or print result would end up different because the numbers in those files represent different colors (however slight the difference). What you really need to focus on here is what the mappings intend to cover. You can know the name of the color space, but that may not tell you a lot about what you are working with. Two common workspaces applicable to Photoshop Elements are sRGB and Adobe RGB.

Each RGB file has the same number of potential colors—no matter what color space you choose to use.

The difference between color spaces is the range of color in their mapping.

sRGB is a "limited" RGB color space in that it assumes some limitations of a common RGB monitor to display all RGB colors. Because of inherent limitations in monitor projection, sRGB is mapped to enable you to record color in your files that most monitors should display correctly. All this really means is that colors are not mapped to the full potential gamut of RGB. The images you make in sRGB color space are more likely to be compatible with what can generally be displayed on other monitors. In other words, it is a generic and friendly color space if you are sharing images for viewing on monitors. This is usually the assumed profile if an image is not tagged (that is, does not have an embedded profile).

Adobe RGB (1998) is a wider-gamut RGB color space than sRGB. It maps to a color set that attempts to better describe colors available on CMYK printers (notably purer cyan). Because it maps a broader range of colors than sRGB, Adobe suggests that it may be a better choice for working with images that are intended for print. The drawback to using Adobe RGB is that you may be manipulating color that you can't see accurately on screen. If color management actually works as designed, however, optimized images for either Adobe RGB or sRGB should appear very nearly the same on monitors or in print.

A third profile you can use for color management in Elements is the custom ICC monitor profile you created for your monitor after calibration. You'll see it as the Embed Color Profile choice in the Save As screen when you are using No Color Management—if you have correctly set up the profile per earlier instructions. This profile attempts to describe the way your monitor handles color. It is used by Elements as a means of attempting to create an accurate preview of colors in conjunction with your working color space.

When you're working with your images and profiles are not embedded, devices using the color file have to make an assumption about the color space. Generally the assumption will be that a generic RGB space was used; that means sRGB rather than Adobe RGB. Therefore, numbers may be interpreted differently than you intend. An Adobe RGB image opened as an sRGB image will desaturate because of the wider gamut numbers being mapped to the smaller gamut color space. The only real choice when using Adobe RGB is to embed the profile (tag the files as Adobe RGB) and ensure, along the route of the image, that the profiles are respected. In other words, using Adobe RGB is a commitment to using embedded profiling and, most likely, full color management.

The Color Settings Dialog Box

The Color Settings dialog box pops up the first time you open Elements, before you do anything. If you have already dismissed this (or want to change preferences after reading this), you can revisit the settings by opening the Color Settings dialog box (Edit → Color Settings), which is shown in Figure 1.16. The three choices seem straightforward enough, but the names really don't tell you what the settings do—and they may be a little deceiving. People might choose Full Color Management simply because that wording seems the most savory choice. Regretfully, that may not be the best choice, and the Help button isn't much help.

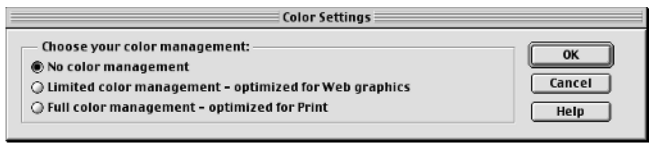


Figure 1.16
Many users may not understand what the options on this dialog box really mean.

Here are descriptions and some important background information for each choice:

No Color Management This choice ignores any existing profile in an image if one is present when you open it. On saving, Photoshop Elements will not embed a profile with your image. The option to embed a profile is available by choosing Save As from the File menu; to embed a profile, you simply select the Embed Color Profile check box. The profile embedded will be based on the ICC profile you created for your monitor.

If you change the Color Settings while an image is open, changing to Limited Color Management will offer the option to embed the sRGB profile if using Save As, but will not embed a profile otherwise. Changing to Full Color Management will save a profile fitting to the current color mode (these options are outlined in the following description for Full Color Management).

Limited Color Management Selecting this option will convert the image to sRGB when it is opened using whatever profile is included. The resulting image will use the sRGB color space. On Save, no profile will be embedded. The option to embed is available using Save As, and the sRGB profile will be embedded if you choose this option.

If you change color management settings while the image is open, changing to No Color Management will allow you the option of saving by manually embedding the monitor profile you created. Changing to Full Color Management will save the image with a profile fitting to the color mode (these options are outlined in the following description for Full Color Management).

Full Color Management This option retains a color profile if it is present in an opened image. On Save, the original profile will be retained with the image. The option to disable embedding the profile can be found in the Save As dialog box. Opening a new image or an image with no existing profile will cause Photoshop Elements to retain the profile with the image based on the color mode. These choices are the same when changing Color Settings while an image is open:

RGB will have the Adobe RGB (1998) profile.

Indexed Color will have the Adobe RGB (1998) profile.

Grayscale will have a Dot Gain 20 percent profile.

Bitmap will have no profile.

Notice that if you want to ignore, convert, retain, or embed a profile , you can do that by manipulating the Color Settings before and after an image is opened. Changing Color Settings in midstream will enforce different rules and create different results. This may be a pain, and it is something you probably won't do very often, but it can come in handy when you get a bad profile or when an opened file does not convert during opening the way you think it should. Attempting to open the image by using different settings might improve the initial result.

It is really a personal decision as to how to manage color. However, the level of complexity and unknowns in working with images seems to rise quite a bit if you choose to embed profiles and use working spaces outside of the more standard sRGB. It is likely that by using optimal techniques for correction (as defined by this book), there should be little difference in your results no matter which color space you use. This is why I suggest using No Color Management and simplifying the workflow. Personally, I work with color management off until I get an image that has a profile embedded. In that case, I might try to open the file by using different Color Settings to see if I get a better-looking conversion. Otherwise, I stick to the things I normally do because I can depend on my normal workflow to get consistent results. I almost never embed a profile unless it is specifically requested.

Resolution

Put as simply as possible, *resolution* is a measure of potential detail in your images. High resolution suggests that there will be intricate detail; low resolution suggests that detail may be compromised. It would seem, if this description holds, that you would always want high resolution if you consider detail important. But that's not always the case. What you really want is the *correct* resolution, and this depends not only on what size you want the result to be but also on what medium you will be using. Output and display can use image resolution in different ways, so the result doesn't depend only on what the resolution of the image is; it depends on how much there is as well as how it is used.

In print, if you don't have enough resolution to meet the needs of the output, images won't look as sharp as they could; if you have too much, file sizes are unnecessarily large and processing will take longer than it needs to—and the results will not improve. On the Web, images without enough resolution will be too small; those with too much will be too large. This rule also carries over into other display-based technologies such as film recorders, which make high-resolution images on film from digital files. You can't just guess how much image information you need; you have to know the amount you really need and work within those parameters. Understanding what resolution is and how it is used is the only way to use it correctly.

While *dpi* is really an output term, it's often used casually as a universal term for resolution (spi, ppi, dpi, and even lpi). The various resolution-related terms can be tricky to use correctly and consistently, but you should know what they mean and use them properly when you mean something specific. To simplify with better accuracy, use *spi* when speaking of capture (scan sampling), *ppi* when discussing digital files, *dpi* when considering output resolution, and *lpi* in the context of halftone dot size.

spi (samples per inch) Capture resolution. The number of scanning and digital capture samples per inch.

ppi (pixels per inch) Digital file resolution. The assigned number of digital pixel elements to be used in printing or display of an image.

dpi (dots per inch) Printer resolution. The number of bitmap dots (smallest printing component) an output can create per inch.

lpi (lines per inch) A measure of halftone dot size. Halftone dots are made of multiple printer dots. The number of rows of halftone dots per inch.

How Image Resolution Is Measured

Image resolution is usually measured in one of several ways: the number of total pixels (image dimension in pixels), the size of the file (number of bytes, kilobytes, or megabytes), or the amount of information per inch (ppi, or pixels per inch). One way of measuring the file size is not necessarily better or worse than another, as long as you can consistently achieve the desired result—without guesswork.

Measuring image resolution in total pixels or file size is not the most intuitive or useful approach for most people working in Elements. Both of these are usually used to measure source image size, such as with scans or images from digital cameras. While the measures tell the quantity of image information in a file, the parameters don't dictate how the information is used. A 2100×1500 image in total pixels could be a 7×5 inch image at 300 ppi, or a 21×15 inch image at 100 ppi—and it can be used that way simultaneously. The number of pixels used in an image measured as total pixels is essentially arbitrary. An image measured with a file size of 12 MB might be about a third larger in RGB than CMYK. In black-and-white (grayscale), a 12 MB image would be much larger still—about four times the area of a 12 MB CMYK image. The lack of a controlling parameter to lock in the size of the image when using total pixels or file size keeps you from knowing exactly what you have and how the image will be applied if you look at file size alone. File size is probably the least-used measure of resolution, and it makes sense only in a workflow where color mode is static (for example, images are either only RGB or only CMYK).

Most Elements users will use ppi as a measure of image resolution because it is the most compatible in comparing to output resolutions. This type of measure tells how much of the image pixel information should be applied per inch. Because printer resolution is most often a finite measure (based on the printer's dpi: how many printer dots can be made per inch), using ppi measurement makes it easy to determine the optimal match between digital image information and what the printer will need to produce the best results.

What Image Resolution to Use

Some people generalize and suggest using 300 ppi as a standard resolution for images going to print. For Web images is it usually accepted that images should be 72 ppi. While these are pretty good as general-purpose guidelines, they don't tell the entire story. 300 ppi may be more than is necessary for all home printers, and may actually be too little for demanding output (such as film recorder output). Because monitor resolutions can vary, your 72 ppi image on a 96 dpi screen would actually be about 75 percent of the intended size. Neither choice is likely to ruin your output, in most cases.

Because output differs, there is no one universal magic formula to figure out what resolution to use. Each output type has a target range (minimum and maximum), based on its capability to process and use image information. Once you know the range you need as a result, you simply use that range as a target when working on an image. Know what your service company or printer manufacturer recommends for output on the devices you use. This may require reading the manuals or giving a call to the service company to find out. The optimal range is the range where the image will perform the best in application; it is possible to get acceptable results by going outside the range depending on how you implement the image and the results that you expect.

Table 1.2 shows the approximate resolutions you will want to use for your images, depending on how you want to use them. An image sent to a device that uses a specified output resolution should have a specific target ppi. The table shows some real-world examples of output resolution and workable ppi ranges. Calculations for the table were based on the formulas shown in the Calculation Used column; square brackets in the calculations indicate the range of values used to determine the lowest and highest resolution acceptable in that media.

Table 1.2
Approximate Resolution for Various Media

MEDIA	OUTPUT RESOLUTION	APPROXIMATE IMAGE FILE RESOLUTION	CALCULATION USED
Web	72–96 dpi (monitor)	72–96 ppi	ppi = dpi
Inkjet (stochastic)	720 dpi	180–234 ppi	[1 to 1.3] × (dpi / 4)
Inkjet (stochastic)	1440 dpi	360–468 ppi	[1 to 1.3] × (dpi / 4)
Halftone, low resolution	75–100 lpi	116–200 ppi	[1.55 to 2] × lpi
Halftone, normal	133–150 lpi	233–350 ppi	[1.55 to 2] × lpi
Halftone, high resolution	175–200 lpi	271–400 ppi	[1.55 to 2] × lpi
Line art	600–3000 dpi	600–1342 ppi	$(dpi/600)^{1/2} \times 600$
Film recorder	4K (35mm)	2731×4096 pixels	Total pixels
Film recorder	8K (6×9cm)	5461×8192 pixels	Total pixels

Note that these resolutions are suggested and not absolute. Images will still print and display at other resolutions, but the results may not be predictable or efficient. Actual resolution needs may be somewhat flexible based on circumstances, such as paper and equipment used, original image quality, expected results, and so forth. Be sure to read manufacturer suggestions, and take most of the advice offered by service companies—they should know how to get the best results from their equipment.

Resizing Images

Changing the size of an area that a group of pixels occupies can come in two forms: one causes you to resample an image (using Bicubic, Bilinear, or Nearest Neighbor interpolation), and the other changes the resolution to redistribute pixels over a smaller or larger area:

> **Redistributing** pixels does nothing to actually change the content (mathematics) of the image information that is stored; it just suggests that the content will be applied over a different area.
>
> **Resampling**, on the other hand, actually changes the content of your images, and changes it permanently.

The larger the amount of resizing (the greater the percentage increase or decrease), the more it affects the image content. One of these two things, redistributing or resampling, has to happen each time you either change the size of the whole image (using Image Size, not Canvas Size) or change the size of a selection by stretching or transforming.

When you *upsample* or *downsample* an image or image area and retain the resolution, Photoshop Elements has to interpret and redistribute tonal and color information, either creating (upsampling) or removing (downsampling) pixels. It does this through *interpolation* (adding image information) or *decimation* (removing image information), which are really fancy names for making an educated guess. Resampling an image to make it larger will never fill in information that is not already there, no matter what you do and which plug-in you use. That trick you've seen on TV, where a pixelated image gets clearer and clearer as they zoom in, is reverse engineered. The only thing you can really do to reclaim image detail that you don't already have is reshoot an image or rescan (assuming that the detail is present in what you are scanning). What resampling will do is estimate and average differences between pixels to make a best guess. Details will tend to soften (upsample) or be lost (downsample).

Photoshop Elements has three methods of interpolation (methods of figuring out how to insert new pixels or remove existing ones as you change an image's size), and five interpolation options. Nearest Neighbor, Bilinear, and Bicubic are the methods. Bicubic Smoother and Bicubic Sharper are Bicubic interpolation options that have been added in Elements 3.

Nearest Neighbor When you resize using Nearest Neighbor interpolation, Photoshop Elements picks a representative color from those that already exist in the image. Whether upsampling or downsampling, there is no averaging to create new colors or tones. Nearest Neighbor is useful, for example, for controlled upsampling of screenshots without blurring.

Bilinear Bilinear interpolation behaves much like Bicubic and is supposed to be faster, but I've never clocked them. During the sampling, new tones and colors can be introduced between existing colors that are not in the original image. This can blur sampling of hard edges, but can provide a smooth transition for tones (Nearest Neighbor might provide a blockier, stepped result). One thing about Bilinear upsampling is that it remains more true to simple averaging between neighboring tones and adds fewer new qualities to an image than Bicubic. At times these properties prove to be an advantage in retaining look and feel, and in others they may result in softening. It is useful when you want a straightforward averaging, which may be useful when downsampling images.

Bicubic The resampling process creates new image information by averaging, like Bilinear, but goes one step further to provide a tiny bit of sharpening to the result. This is intended to counteract the blurring result of averaging. It changes a greater number of pixels with the same radius setting as Bilinear, but may generally give a better visible result in most cases than Bilinear. It is the real workhorse for sizing images. Bicubic Sharper is like Bicubic, but with enhanced sharpening; Bicubic Smoother is like Bicubic, but with less sharpening.

While making up information and decimating it sound like bad things, each has its purpose. Usually you should avoid upsampling—especially if the option exists for gaining more detail through a better-targeted source image. However, images can be upsampled with some success, depending on the desired quality—provided the change isn't huge.

Upsampling 10 percent or even 20 percent may not be noticeable if the source image is sharp. Usually you will upsample only to make up small gaps (if necessary) between the resolution you have in an image and what you really need, or to adjust borrowed image components (elements you are compositing from other images).

Downsampling, while certainly damaging and compromising to image content, should be less noticeable in your results. Image information indeed gets averaged or eliminated, but if downsizing is being done for the right reason, any details you lose would have been lost on output or display anyway. Detail loss is inherent in the process of downsizing or outputting images at a smaller size: even if the equipment used could reproduce detail at a smaller size, eventually details will pass the limit of the human eye's ability to discern them.

Multipurpose Images

Making images that you'll use for more than one purpose (for example, print and Web) can cause a little problem. Optimally, you'd like to work with images so that you target the result. Doing so ensures that you retain all of the actual image detail rather than relying on interpolation or decimation and your choice for sampling type to produce the right results. It is a simple fact that an image going to print on a high-resolution printer should have more information than one at the same size used on the Web, or you will not optimize detail.

You have only two solutions in working with dual-purpose images:

- Create two images, each with a specific purpose.
- Create one image and resize.

Either of these choices poses a trade-off. In creating two images, you sacrifice valuable time in repeating processes. It is often self-defeating to work on two images to produce the same results (even using a detailed script) because the difference in size and volume of information in the image will produce different results with the same application of tools. In creating one image and resizing, you have to allow either interpolation of new image information or decimation, which may not be the optimal process. You can't work on small images and resize up, because detail will not be present.

The best way to go about working with multipurpose images is usually to work with them at the highest resolution and then resize them smaller. Working at the higher of two or more resolutions retains the details for the higher-resolution presentations, and decimates detail that will not be reproducible at lower resolutions. Softening or other ill-effects from severe resizing can be countered somewhat by sharpening. (See "(Un)Sharpening and Boosting Contrast" in Chapter 3 for more information on sharpening.)

Knowing Your Equipment and Images

Part of working with images on your computer is learning the nuances of systems and software, and having some idea about what you expect to do with the images. You are responsible for knowing your equipment and the purpose of your images. This section cannot help if you are having trouble with your computer system, but it can tell you what to look for and where to get help. Similarly, it doesn't tell you what exactly to do with images but does present some general guidelines for how to proceed.

Know Your Equipment

Because all computers and systems are not alike, it is impossible to cover every nuance of every system in every situation in one book. There are innumerable digital cameras on the market, a plethora of ways to get the images off the cameras, and hundreds of home printers to print the result to. Software configurations and utilities can cause fresh problems while solving others, and compatibilities can be an issue with both hardware and software.

If you have trouble getting the images off your camera, or have trouble with your printer or computer, the place to find answers is in the user manual for these devices and through technical support from manufacturers.

The following is a short checklist of maintenance tasks you should recognize, understand, and perform for your computer, peripherals, and software.

Scanners (and Analog Film)

- Calibrate your scanner per manufacturer suggestions.
- Maintain a regimen for cleaning the scanner and scanned objects.
- Be sure to use proper connections and connection settings.
- Consider having important images scanned by scanning services, which may have better equipment and resolution than you may have at home (for example, scan negatives and slides to a Kodak Photo CD rather than on a home flatbed scanner).

Digital Cameras

- Choose appropriate settings per manufacturer recommendations, and don't change settings if you don't know what they do.
- Learn about special features and settings by reading the manual.
- Understand image control and exposure.
- Understand how to format camera storage.
- Know how to properly connect a camera to your computer and download images from the camera.

Printers

- Use appropriate paper and inks as suggested by the manufacturer.
- Read maintenance and cleaning suggestions and follow these practices rigorously.
- Don't expect RGB results from a CMYK printer. CMYK is a smaller color space, meaning there are simply fewer colors available.

Computer Software and Hardware

- Maintain a firewall if using an open Internet connection.
- Use virus protection software to minimize problems with infected digital files, especially if you trade a lot of files. Never open a file from an outside source (even a known source) if it has not been scanned for viruses.
- Maintain a schedule of maintenance for data backup, disk error scanning, and associated digital maintenance (such as defragmenting).
- Check manufacturer websites regularly for software updates, bug fixes, and compatibility notices.
- Keep a log of program installations to help locate software conflicts.
- Don't jump to conclusions. Note multiple problems in the operation of your system. If you have problems with more than one program or device, there may be a common link to the real cause.
- Simplify your system whenever possible by detaching chronically unused peripherals and uninstalling unnecessary software.

Know Your Image

Some matters involved in repairing and compositing images are not really judgment calls, and some are. One thing no book or manual can tell you is exactly what you want to do with an image. While I can suggest proven ways of getting good results, learning to evaluate an image's composition and deciding what to do to improve it will be a judgment call. Your judgment will improve over time and with practice.

Don't ever say it is good enough if it isn't good enough. Give up on an image only when it is not worth the effort to improve it. There is almost nothing you can't do with an image if you have the desire. You can also correct the same image from now until doomsday, improving it in increments all the time. Sometimes putting an image aside for a day or two can give you a new perspective: when you come back to it, you may see solutions you hadn't previously considered. Solutions won't always jump out at you, and sometimes you'll have to manufacture them. In trying to stretch your limitations, no matter what you are attempting to do to an image, chances are you will learn from each solution you attempt.

The more you work with images, the easier and quicker the manipulations will become. Now let's push some pixels…