CHAPTER 1

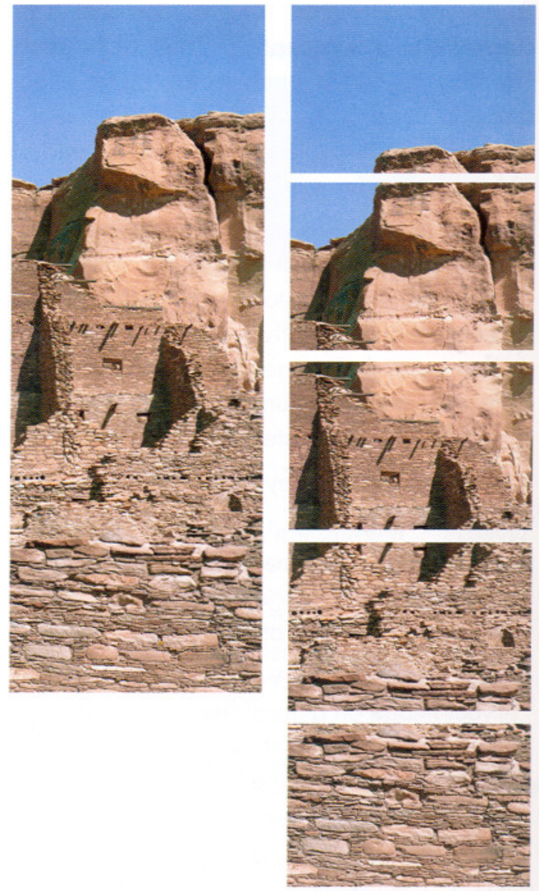
DIGITAL IMAGING

Before digital imaging, the history of photography was one of gradual improvements. The slow evolution of film, cameras, darkroom materials, and printing technologies produced improvements in image quality, ease of use, reliability, and consistency in mass reproduction. Then in the 1980s, digital imaging suddenly began to revolutionize photography. Now, even casual snapshooters can take advantage of digital technology.

There are many advantages to digital imaging. Digitizing an image (converting it to a numerical form that a computer can manipulate) lets you make changes that are often difficult and tedious to do by conventional means. You can dodge, burn, crop, color, combine, and alter photographs in dozens of different ways. Images are stored as electronic data, so a database can store, index, search, and quickly retrieve images. Unlike film and prints, digital images can be duplicated without any loss of quality; a file that has been copied repeatedly can be identical to the original. You can use ordinary telephone lines to send a digital image around the world, in some cases, you can send the image faster than you can carry a print to the office next door. If you want to sell your work or seek clients to hire you, you can place your best images in an online Web gallery.

Some costs accompany all the advantages. There is a time investment in learning how to use the equipment and software. There is also a financial investment: the better the image quality desired, the more that equipment, software, or services (such as a print made at a service center) may cost. However, most users feel the investment is worth the cost because digital imaging lets you record more of what you see and achieve more of what you can imagine.

This chapter introduces some basic concepts in digital imaging. You'll understand how pictures are turned into electronic pixels and how pixels store information about tones and colors. You'll understand the terms that describe technical aspects of images: resolution, dots per inch, pixels per inch, bit depth, and color modes. Technical issues aren't the only important ones; you'll need to know about the ethical and legal issues raised by the computer's ability to copy and alter artwork created by others.



A picture that could not exist without a computer. This photograph of Pre-Columbian ruins in New Mexico's Chaco Canyon National Park was created by combining computer scans from five 35mm photographic negatives. Despite using a telephoto lens, the photographer was able to achieve sharpness everywhere by changing focus as he moved the camera step-by-step from the nearby masonry wall to the distant sandstone cliff. The images were joined and the tones and colors finalized using Adobe® Photoshop® software. At right, the five scans are shown before they were joined.

(Opposite) KATRIN EISMANN Looking East

The first half-century of color photography was a time when the photographic industry worked to create films that recorded the colors of the world with greater and greater accuracy. The second half-century of color imaging may be a time in which the expressive and imaginative use of color is the primary goal of photographic artists.

Katrin Eismann combined a digital scan of traditional Japanese paper with photographs of a tree, ocean waves, and a mountain scene to create a fantasy landscape. Digital imaging gives photographers the complete freedom in choosing colors that painters have enjoyed for thousands of years. Here, the artificially violet sky behind the tree is crucial to the success of the image. An "accurate" sky (a sky with blues and cyans) would weakly contrast with the muted warm tones of the paper background.

Digital Imaging: An Overview

To understand digital imaging, compare it to conventional photography. Think of the steps you take in conventional photography: exposure, development, and printing.

With digital imaging, however, instead of ordinary exposure and development,

- You *capture* an image by recording it with a digital camera or by using a scanner to read the image into the computer from a conventional negative, slide, or print. In either case, the image is digitized, that is, it is recorded in a numerical form that is usable by the computer.
- You can then *display* the image on the computer monitor.
- Then you can *edit* the image, using software commands to change its color and tones or to combine it with other images.
- You *store* the electronic file that contains your image on a hard disk inside your computer or on a removable hard drive, DVD or CD-ROM disc. Images may also be stored on a nearby computer via a network.
- You can *transmit* it electronically to a distant computer or to a Web server that makes your images available to many visitors.
- You can also *output* it to a printer that reproduces it on paper or film.

EQUIPMENT AND MATERIALS YOU'LL NEED

You don't need to own all, or even any, of these items yourself. Many schools provide access to computers, scanners, printers, and other equipment. Computer service bureaus (often in shops that offer copying and offset printing services) rent time on computers, scan and print images, and generally offer help on how to use their services.

CAPTURE

A digital camera does not use film. It electronically records the image in digital form.

A scanner reads and converts a conventional negative, slide, or print into digital form.

Kodak Photo CD or Picture CD is an easy means of acquiring scanned images. You take your negatives or slides to a photo store, lab, or computer service bureau to have them scanned onto a Photo CD/Photo CD disc, which looks like a music CD. You need a suitable CD-ROM or DVD drive to transfer the pictures from the disc to your computer.

COMPUTING

A Computer drives the monitor, printer, or other devices to which it is attached. The more powerful the computer, the faster it operates.

DISPLAY

A computer monitor displays the image on which you are working and shows various software tools and other options.

EDITING

Image-editing software, such as Adobe Photoshop or Corel PhotoPaint, provides many editing commands that change the colors and tones of the image.

STORAGE AND TRANSMISSION

A hard disk stores image files within the computer. A picture file can occupy a large amount of hard disk space, so generally only a limited number of pictures can be stored.

Removable storage media such as Zip drives, DVDs, or CDs, let you expand your storage and let you transport a file to another location to be shared or printed.

A modem sends files over phone lines and is often used by photojournalists and others who need to transmit pictures in a hurry from a distance. Digital images are also transmitted worldwide on the Internet.

OUTPUT

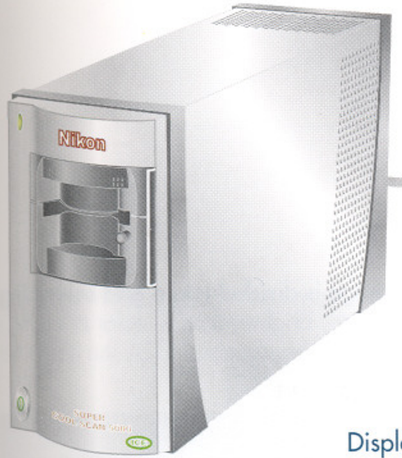
A printer reproduces the image to paper. Print quality varies widely from archival inkjet prints (giclée prints) to less expensive prints that are more like ordinary office photocopies.

A film recorder prints the image onto photographic film as a positive transparency or a negative.

CD or DVD recorder stores the image on a CD or DVD, so other computers can display it.

HTML software places the image onto a Web page that can be viewed over the Internet.

Capture. If you start with conventional negatives, slides, or prints, a scanner can convert the images into the digital form that a computer can use.



capture

Capture. A filmless digital camera can be used instead of a conventional camera and film. A digital camera records an image directly in digital form.

capture

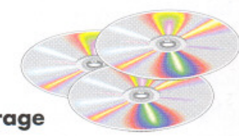
Display. The computer's monitor shows the image as you edit it.

A computer is the core of a digital imaging system. It contains the software that lets you edit an image, then lets you send the image to a printer, modem, or other device to which it is connected.

a computer/storage

Storage. A hard drive stores image files within the computer.

Storage/transmission. External storage devices (such as a removable cartridge hard drive or DVD/CD) let you store more image files than can be stored on your computer's internal hard drive. They can also transport an image file to computers and printers at other locations.

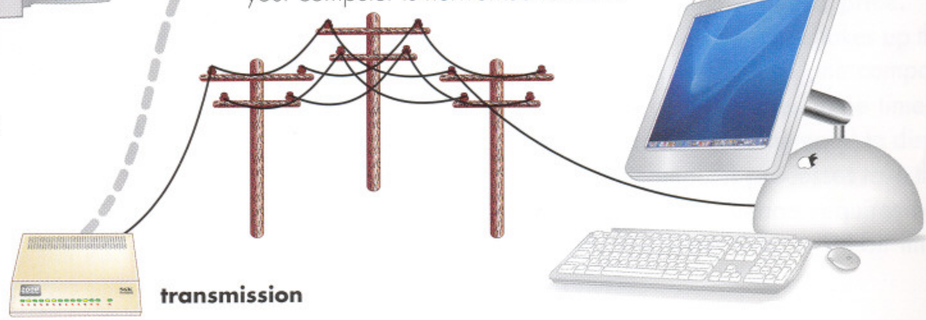


storage

output

Output. When you want to see your image on more than just your computer's monitor, you can print the image on paper or on photographic film (to make a positive transparency or negative), place it on a DVD or CD, or place it on an Internet Web page.

Transmission. You can send an image to a printer, another computer, or other devices, if your computer is networked to them.



transmission

Transmission. A modem can transmit data, including digitized images, over phone lines to another computer or to a Web site's server.

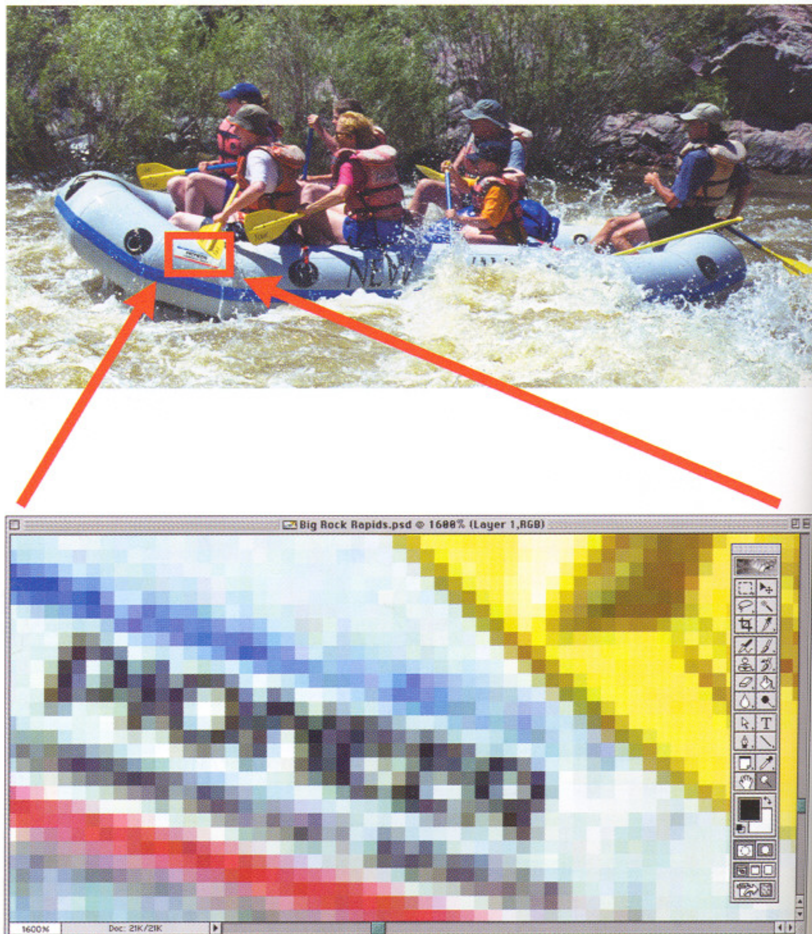
Pictures into Pixels

A picture that you take with film in an ordinary camera is in analog form. Analog means that the image's tones and colors are on a continuously variable (analog) scale, like the volume on a stereo, which changes in smooth gradations from soft to loud. Similarly, the image on a film negative has a smooth, continuous scale of tones, with unbroken gradations from light to dark.

The picture is converted to a digital form, called a bitmap image or raster image. The image is sampled at a series of locations, with each sample recorded as a single, solid-toned **pixel** (short for picture element). The pixels that make up the image are arranged in a grid of rows and columns, like the squares on a sheet of graph paper. In the finished image, the pixels are so small that you don't see them individually; instead, you see a smooth gradation of tones. You can see pixels if you enlarge an image on your computer (see illustrations, this page).

The original analog image is converted into digital form by assigning each pixel a set of numbers to designate its position, brightness, and color. Once the image is digitized, you can use editing software, like Adobe® Photoshop®, to select and change any group of pixels in order to change color, to lighten or darken, and so on. The computer does this by changing the numbers assigned to each pixel.

To put an image into digital form, the image is divided into a grid containing many tiny spots called pixels. The location, brightness, and color of each pixel are recorded as a series of numbers that are then saved by the computer for later use.



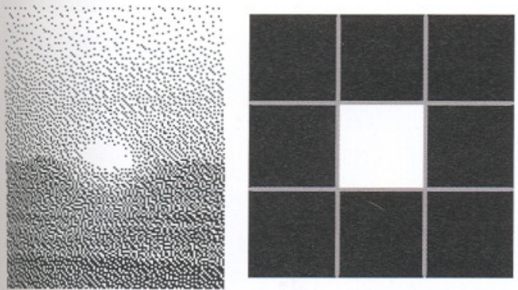
To see pixels on your computer's monitor, select a part of the image and enlarge it. If you are using Adobe Photoshop, for example, you can take the following steps:

- Open a picture file.
- Select the Zoom tool (shown in the toolbox at right as a magnifying glass) by clicking on it.
- Place the magnifying glass on the image. Click repeatedly on the image to zoom the image to greater degrees of enlargement.
- To reverse the zooming and return the image to the original size, click repeatedly on the image while holding down the keyboard's Option or Alt key.

Each square is a pixel. Notice that each contains a solid tone; the color or brightness varies from pixel to pixel, but never within a pixel.

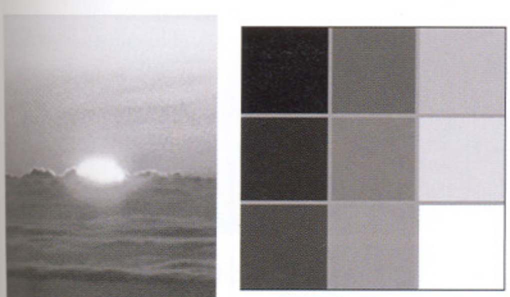
Bit Depth

The greater the bit depth, the more colors and tones in a picture.



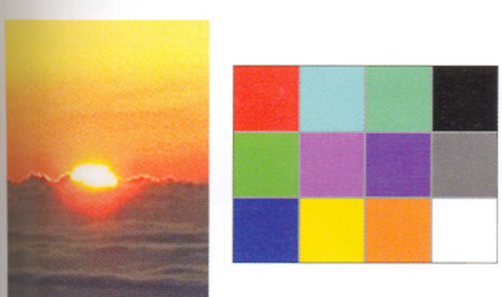
0	0	0
0	1	0
0	0	0

One bit per pixel produces two tones, black and white. Left, the image can have only two tones, black and white. Center, an extreme enlargement of nine of the pixels. Right, how the computer represents the pixels with numbers.



0	95	191
31	127	223
63	159	255

An 8-bit pixel has 256 black, white, and gray tones available. Left, this is enough for an excellent black-and-white rendition. Center, an enlargement of nine pixels. Right, the same tones are represented by numbers: 0 is black, 31 to 223 are various shades of gray, and 255 is white. An 8-bit pixel can also produce any of 256 colors, enough for a limited color rendition.



255 0 0	0 255 255	73 230 165	0 0 0
0 255 0	255 0 255	140 63 184	127 127 127
0 0 255	255 255 0	255 153 51	255 255 255

A 24-bit pixel can be any of more than 16 million colors. Left, it can produce an image comparable to a conventional color film photograph. Center, an enlargement of 12 pixels. Right, here the colors are produced by mixing the primary colors (red, green, and blue). Each of the three colors has eight of the pixel's 24 bits, or 256 possible tones. Note that 255 indicates the maximum amount of a color; 0 indicates none of the color is present.

The bit depth, or number of bits each pixel contains, determines the colors and tones in an image. Computers record information in binary form, using combinations of the digits 1 and 0 (zero) to form large numbers. A bit is the smallest unit of information, which consists of either a 1 or a 0. A pixel may contain as little as one bit, which is either a 1 or a 0, or it may contain 24 bits or even 48 bits.

The greater the bit depth, the smoother the gradation from one pixel to another, because each pixel will be able to render a greater selection of possible colors and tones. A picture composed of 1-bit pixels (consisting of either a 1 or a 0) will have only black or white pixels (see illustration this page, top).

An 8-bit pixel is composed of eight bits in a row. There are 256 ways to arrange eight 0s or 1s, starting with 00000000 (zero) and ending with 11111111 (255), so an 8-bit pixel can be any of 256 colors. But 256 colors are not enough for a good color reproduction. However, 8 bits will produce a very good black-and-white pixel showing any of 256 different black, gray, and white tones (see illustration this page, center).

To depict a picture with realistic colors and tonality, 24-bit pixels are needed. A pixel containing 24 bits can represent any one of over 16 million colors (see illustration this page, bottom). A 48-bit pixel can represent any of 280 trillion colors.

Increasing the bit depth has a price. An image composed of 24-bit pixels takes up three times as much disk storage as one composed of 8-bit pixels. It also requires three times as much RAM (random-access memory) to display the picture, and computer processes take three times as long. A 48-bit image requires twice the computer resources than a 24-bit image requires.

Picture "Size"

Ppi, dpi, and other image measurements

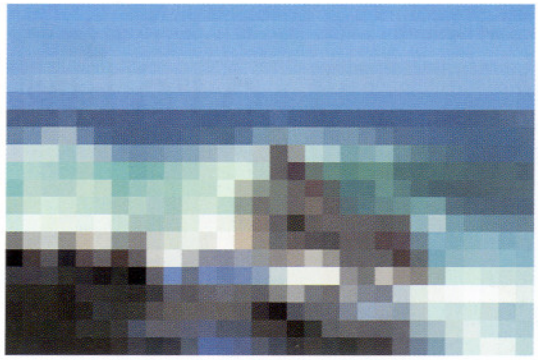
How big is your picture? You must know how pixel data is measured when you prepare to scan an image, print it, or perform other operations. See also Bit Depth, page 5.

Physical size is a familiar place to start. It is the width and height of the image measured usually in inches or sometimes in other units, like centimeters. For example, the physical size 8 inches wide by 10 inches high.

Pixel dimensions are the number of pixels along the height and width of an image. The number of these pixels is determined by the settings of your scanner or digital camera at the time the image is digitized. For example, a scanned 8 × 10-inch print might have pixel dimensions of 2,400 pixels wide, 3,000 pixels high, or simply 2,400 × 3,000. Generally, the more pixels you have, the better the quality of the image (see illustrations this page).

Pixels per inch (ppi) or resolution (the apparent sharpness of an image) is calculated when an image is printed or is displayed on a monitor. Assuming that the number of pixels remains constant, the pixels per inch—and the resolution—will change as the size of the printed or displayed image increases or decreases. For example, as you increase your print size, the same total number of pixels spread out to fill a bigger space. Each pixel has to increase in size, which *decreases* the resolution, and makes the image appear less sharp than a smaller print of the same image (see illustrations opposite).

Dots per inch (dpi) is used for several measures–which results in confusion. DPI is used as a measure of printer resolution. It is the number of dots of ink (per inch) produced by a printer as it prints an image. In general, the more dots per inch, the clearer and more detailed the image. Dots per inch also describes the maximum number of pixels per inch that a mon-



An image with very few pixels. A 35mm slide (1.5 inches × 1 inch) scanned at only 20 samples per inch (20 dpi) results in an image of 30 × 20 pixels. Notice how the image has very little resolution (detail). The image's file size would be only 1,800 bytes because there are only 600 pixels, and each pixel uses 3 bytes (24 bits). The calculation is 30 × 20 pixels × 3 bytes per pixel = 1,800 bytes.

An image with many pixels. The same slide was scanned at 300 samples per inch (300 dpi), which creates an image of 135,000 pixels (450 × 300). Notice the image has much more resolution than the 20 dpi image. The image's file size would be 405,000 bytes (approximately 400 kilobytes). The calculation is 450 × 300 pixels × 3 bytes per pixel = 405,000 bytes.

PROJECT

Resolution, File Size, and Sharpness

What you need A 4 × 6 or 5 × 7 photograph with sharp details and a scanner.

Procedure Scan the picture twice, once at 50 samples per inch (50 dpi) and once at 200 samples per inch (200 dpi). Save both files. Note the two file sizes. Examine the two images side-by-side on the monitor. To help you compare them at equal size, zoom the 50 dpi image to 400%, but view the 200 dpi image at 100%.

How did you do? You should have found that the image scanned at 200 dpi has a file size about 16 times larger than that of the 50 dpi image. The image scanned at 200 dpi should look significantly sharper than the 50 dpi image. The reason that the 200 dpi image is sharper than the 50 dpi image is that it has 16 times more pixels.

Print size affects resolution. If the number of pixels remains constant, increasing the size decreases the resolution. Here, the same image file was printed at three different sizes. As the image increases in physical size, the size of each pixel also increases, making the image appear less sharp.

Note that, in the largest print, the pixels have become so large that they are individually visible. This is similar to what happens when you make a very large darkroom print from a small negative (for example, a 20 × 24 print from a portion of a 35mm negative). The grain in the film is magnified so much that it becomes visible in the print.

FILE SIZE

File size measures the amount of disk space or RAM occupied by an image, usually listed as the number of bytes the file contains.

bit	The smallest unit of digital information
byte	8 bits
kilobyte (KB)	1,000 bytes
megabyte (MB)	1,000,000 bytes
gigabyte (GB)	1,000,000,000 bytes

(The numbers are rounded off. A binary kilobyte, for example, actually contains 1,024 bytes.)

itor or LCD panel can display without blurring the pixels together.

However, the term dots per inch is also improperly used to describe a scanner setting—the number of times per inch a scanner "samples" an image to convert it to a grid of pixels. This should preferably be called ***samples per inch***.

File size measures the amount of disk space occupied by an image (see table this page). It is affected by pixel dimensions and bit depth, plus other factors such as file format and how much the image is compressed for storage (see page 29 for file formats).

Usually, when the file size is bigger the picture quality is better, but unfortunately you can get too much of a good thing. As the file size increases, the computer has to process and store more data about the picture. If the file is very large, this can cause problems by greatly increasing the time the computer takes to execute each command or by greatly increasing the amount of computer storage space needed. Trade-offs may have to be made between the quality desired and the file size that can be conveniently handled by your computer.

How you set up a file depends on the final output you want. For example, to calculate the number of dots per inch for a scan, you must determine how big you want the final print to be. At a school, your instructor can tell you how to specify the pixels per inch and other file characteristics when you are setting up an image file. If you are using a service bureau to scan or print your pictures, ask them how they suggest you set up the file. Also, see your image-editing software manual. This book will provide more information on how to set up and adjust your image files.

Modes and Color Spaces

HOW COMPUTERS WORK WITH COLOR

Computers create colors in several ways. When you scan an image or capture it with a digital camera, a set of numbers is created to represent the colors of each pixel. However, there is no standard way to assign numbers. Instead, there are many systems for numbering colors, including some systems that were devised before the age of computers. Scientists call these systems **color spaces**. A color space numerically describes all the colors that can be created by a device such as a camera or a printer. You do not need to understand the details of color spaces, but you need to be aware that color spaces differ because some contain more colors than others—making it impossible to exactly translate colors from one color space to another. For example, your scanner and camera use color spaces that contain more colors than your printer's color space, so you must make adjustments to your images in order to get good prints.

Use RGB color for capture and display. Scanners and digital cameras use the RGB color space. In RGB, each pixel is given a separate number for each of the three primary colors (red, green, and blue). (To see an RGB pixel, see the illustration at the bottom of page 5.) Scanners and cameras have red, green, and blue colored filters placed over the sensors that measure the light intensity. Thus scanners and cameras are like color film, where each of the three light-sensitive layers is sensitive to only one RGB color. RGB mode is usually 24-bit RGB; each color is assigned eight of the 24 bits. Some cameras and scanners may use 16 or more bits per color to achieve better quality. Adobe Photoshop software can edit 48-bit RGB images, where each color is assigned 16 of the 48 bits.

Computer monitors are also RGB devices. A monitor's screen creates color when its red, green, and blue phosphors glow after being struck by the tube's electron beams.

ALIDA FISH Walking with Pygmalion #8

Alida Fish has created a series of images that make us reflect on Americans obsession with "the perfect body." She blended photographs of the bodie of ordinary Americans into photographs of statues from classical antiquity. B substituting realism for perfection in these classic sculptures, the composite im ages surprise us and upset our expectations about classical art. The images remind us that our fascination with bodily perfection has it origins among the Greek and Roman founders of Western civilization more than 2,000 years ago.

To achieve the effects in this image, Fish scanned the two images in Grayscale mode, which gives 256 levels of gray from black to white but no colors. She blended the images using Photoshop (see Layers, page 66). By making the top layer solid in some places and semi-transparent or wholly tra parent in other places, she made the two images blend seamlessly.

The finished digital image was printed onto black-and-white film (see fil recorders, page 107) and printed in an ordinary darkroom. To achieve the color effects, Fish permitted colored stains to form while the image was deve oping. She achieved the stains by prolonging the development time. Stainin was increased by removing the print from the developer and spraying it wit variety of unusual photographic chemicals. The result is a one-of-a-kind print.

Note: the developing procedures used by the artist may produce harmful gasses. An exhaust system is necessary to protect the heath of the darkroom worker.

RGB cannot create photographs on paper, however, because intermediate colors like cyan, magenta, and yellow cannot be created by mixing RGB inks. When red and green phosphors mix on a computer monitor, yellow is the result. This is because RGB is an additive color space (see page 94) where color mixtures are created when light of the three primary colors is added to a dark background (for example. like a blank monitor screen). However, when red and green inks mix on paper, the result is black. This is because ink on paper is a subtractive color space: the background (paper) is white, and inks subtract colors from white. Red ink subtracts green and blue, while green ink subtracts red and blue. Working together, they subtract red, green, and blue. The paper is black because no light is reflected.

Use CMYK color for prints on paper. Since a subtractive system of colors (see page 94) must be used in printing, the CMYK color space is used. CMYK represents the three subtractive primary colors (cyan, magenta, and yellow) plus black, whose function is explained in the following paragraph. Unlike RGB inks, cyan, magenta, and yellow inks can create intermediate colors. For example, yellow ink plus magenta ink creates red. The yellow ink subtracts blue while the magenta ink subtracts green. Both inks reflect red, so only red appears on the paper.

Why is black ink used? Black (the K in CMYK) is necessary because the CMY inks used in printing are not color perfect. When all three are mixed together, they create brown instead of black. Black ink is added to improve black and near-black tones. Adding a fourth color makes CMYK a 32-bit color because each of the four colors uses 8 bits.

The color space of a computer image is called its mode. Imaging software calls a color space like CMYK a mode. In Adobe Photoshop, modes are accessed with the Image > Modes command. When a new mode is selected, the current image is converted from its original mode into the selected mode. There are several modes besides RGB and CMYK. **Grayscale** mode is often used in black-and-white photography; it's a colorless mode, measuring only brightness. It creates eight-bit images that have 256 levels of gray. **Indexed color** is a mode used to create color images that use only 256 colors (8-bits) or less. It is of limited use for most photographic images, but is ideal for creating graphics for the Internet.

There are possible conflicts between RGB and CMYK modes. When an RGB image is printed on paper, problems in conversion may occur because the way the image looks on an RGB monitor rarely matches the print created with CMYK inks. Photographers usually edit images in RGB mode because most home, school, and small-business printers, such as inkjets and color laser printers, do a fairly good job of translating RGB colors into CMYK colors. However, when preparing images for printing presses, photographers usually prefer working in the software's CMYK mode. When CMYK mode is selected, the software reduces the range of colors that the monitor can display in order to mimic the colors that the inks can produce. The problem of getting the print to match the monitor will be discussed in Chapter 5.

Digital Imaging, Changing Ethics, and the Law

Is it possible? vs. Is it right?

Technology has changed artists' attitudes about the appropriateness of copying, altering, and using other artists' original work. Electronic mass media have created a new culture in which individual images seem like mere raw material. This is an inevitable outcome of the increasing number of images to which we are exposed. By watching television for a single day, an American will see more images than George Washington saw in his entire life. It's as though we have been dropped into an artificial universe.

Often artists create new art out of the changes in the society in which they live. New movements in art have come about as a thoughtful response to this deluge of images. Artists use their own work to explore and comment on the way that visual images have lost their value as unique expressions and become unwanted, throwaway commodities. Inevitably, this requires making realistic or even exact copies of the very images about which they are commenting. Digital imaging has made such copying easy. Some artists have concluded that the image glut has made originality impossible. Their work does not even attempt to include original visual elements; they use copied images as icons to communicate their ideas about the new conditions of art and society. Recycling previous art to create new art is called appropriation.

Appropriation is a hotly debated topic. At one end of the spectrum of appropriation is the ancient and innocent practice of copying art as part of an art education. A painting student might copy a Rembrandt painting in order to learn how to render shadows while a photography student might download dozens of Internet images to use as elements in a collage assignment. At the other end of the spectrum is willful copying for profit. In the middle of the spectrum is a growing gray area created by the ability of digital tools to alter a copied

image beyond recognition—with very little work on the artist's part. Society has not yet formulated and legislated satisfactory standards that apply to digital copying. We are facing the digital future with old, perhaps obsolete, legal standards.

Copyright laws were created shortly after America was founded. Their purpose was to protect the livelihood of creative people whose writings and musical scores were being illegally reprinted by unscrupulous profiteers. Visual arts were eventually included. However, the laws recognized that some kinds of copying are acceptable "fair use," such as quotations in scholarly works or in works of criticism. Some amount of quoting of visual works was also found to be "fair use."

Increasing uncertainties about "fair use" are arising in the digital age. In making decisions

Traditionally, photojour-nalists have been proud that their work is not manipulated. But digi-tal imaging offers pow-erful temptations. Suppose you photo-graph a group of peo-ple. One image from the series is clearly the best, except that one man in the group blinked his eyes. Could you copy his open eyes from another image an paste them over his blinking eyes? Absolutely—if you wor for the man who blinked. But if you are journalist, your employ might consider it grounds for discipline.

Many news publi-cations have adopted policies prohibiting an digital editing that goe beyond traditional dar room practices. Accep able editing is limited cropping, overall colo correction, along with modest amounts of dodging and burning. In 2003, a documen tary photographer's jo nalism award was rescinded when it wa discovered that he ha darkened portions of images so much that i portant elements (inclu ing people in the background) were eff tively hidden. In the same year, a photogr pher was fired from h Los Angeles newspap for compositing two i ages from the Iraq w about fair use, courts in the past considered whether the copying was done for educational and artistic purposes or purely for profit. They weighed the amount of copying and how much income was lost by the originator whose work was copied. Traditionally, artist-copyists had few legal problems because their copying was usually not highly profitable. Further, one-of-a-kind copying is time-consuming and the artist whose work was copied rarely sustained financial losses.

The new environment compels students and teachers to discuss the limits of copying. Digital imaging has made mass copying very easy and encouraged some artists to work exclusively with appropriated images. Digital imaging has also helped reduce the distinctions between commercial art and fine art, while the business of art is bigger than ever before. Thus there are increased opportunities for collisions between the new ethics of artists and the rights of the creators of the appropriated art.

MONICA CHAU Evacuees

Historical images are often the subject of "fair use" appropriation. In a series of images, Monica Chau combined vintage photographs of the forced relocation of Japanese-American citizens during World War II with recent images of the Manzanar, California relocation camp that housed thousands of them. Because little remains of the desert camp but a historical monument and a few decaying buildings, Chau superimposed a 1944 photograph of evacuees onto a photograph she took at the camp site.

Although the 1944 image is still copyrighted, most would agree that her use of the image is acceptable because it falls under the "fair use" doctrine. It is unlikely that she will profit significantly from the images and the images are clearly artistic and have educational purposes. Specifically, she intends to focus attention on a historic moment when America fell short of its ideals and harmed some of its loyal citizens.