

How to Take Better Pictures

With today's automatic cameras almost anyone can produce a sharp, well-exposed image. What will set you apart from other photographers is how well you compose your images. The tips below will help you create eye-catching compositions—and transform your photos from mere snapshots into works of art.

Follow the Rule of Thirds



Divide the image into three sections

Placing your subject off-center creates an interesting, dynamic image. Imagine your photograph divided into three horizontal and vertical sections. To compose a well-balanced, off-center shot, place your subject near the intersections of the imaginary grid lines. This is called the rule of thirds.



Use the rule of thirds to create dynamic portraits



Emphasize a dramatic sky by placing the horizon along the lower grid line



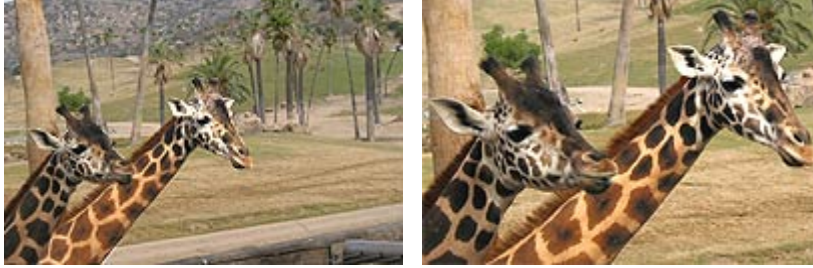
With a moving subject, use the rule of thirds to leave space for the subject to travel into



Busy shots feel more orderly when you apply the rule of thirds.

Get Close

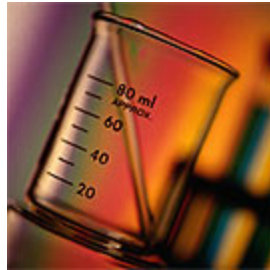
Your subject is interesting, so get close to it. Don't let your pictures suffer from the "Grandma at the Grand Canyon" syndrome, with a tiny subject and lots of boring, irrelevant space.



Get close to your subject

Try Unusual Angles

Be bold! Try turning your camera to 45 degrees before snapping a picture. Or instead of snapping it from eye level, kneel down or lie on the ground to get a more interesting shot.



Take a picture from an unusual angle

Frame Your Subject

Try framing your picture with foreground objects to add depth to the image.



Frame your subject in the scene

Pay Attention to Lines

Curves, straight lines, and diagonals add energy and movement to your compositions. Let roads and rivers draw the viewer into the image or lead the viewer's eye in a specific direction. Watch for natural geometric patterns and place yourself at an interesting angle to them.



Let roads and rivers lead the viewer into the picture



Look for patterns of lines



Diagonals are dynamic, and curves are sensual

Don't let lines unintentionally throw your photo off balance. When you shoot the horizon or a building, keep the straight lines level—unless you're shooting at a dramatic, intentional angle.



Keep the horizon level

Avoid Cluttered Backgrounds

Don't let a cluttered background overwhelm or obscure your subject. Move around, or lie down, to get a clear shot at your subject without the distractions.



A cluttered background can obscure your main subject



Reposition your subject or yourself

Avoid Mergers

As you position yourself to avoid a cluttered background, also look out for trees, lamp posts, and other background objects which might merge with your subject in unfortunate ways.



Don't let a tree grow out of your subject's head



Reposition your subject or yourself to avoid mergers

Look for Interesting Reflections and Shadows

Reflections and shadows lend a touch of artistry to an otherwise plain picture. They can provide meaningful contrasts (such as an old building reflected in a modern high rise) or depth (such as the shadow of trees along a wooded path).



Shadows and reflections add depth and artistry

Understanding Resolution

When you work with bitmap images like digital photographs, you work with pixels. A pixel (short for "picture element") is the smallest unit in a computer image or display. Every image on your computer is made up of a colored grid of pixels.

Your digital camera records pixels, your scanner converts physical images into pixels, your photo editing software manipulates pixels, your computer monitor displays pixels, and your printer paints pixels onto paper. In the digital world, "inches" don't exist, only pixels do.

The key to successfully editing, scanning, and printing images lies in understanding how pixels transform into inches and vice versa. **Resolution** is the interpreter between the physical world of inches and the digital world of pixels. When you scan an image, the scanner translates inches into pixels using resolution. When you print an image, the printer translates pixels into inches using resolution. So what's resolution? Unfortunately, the word is used in different ways in different contexts. "Camera resolution" usually means something slightly different from "image resolution", and "printer resolution" is something else yet again.

We'll try to establish some consistent terminology and make it all clear in the short tutorial below.



Resolution allows you to transform pixels into inches and vice versa

The Two Faces of Resolution

Before we go over specific types of resolution, let's cover the two basic ways the term resolution is used. In some contexts, resolution refers to the *pixel count* of an image. An image with lots of pixels is often called a "high resolution" image. But in other contexts, resolution refers to the *density* of pixels in a given linear area such as an inch. This "density" is expressed as ppi (pixels per inch) or dpi (dots per inch) and this density number is embedded invisibly in a bitmap image, as an instruction to output devices, such as a printers. For clarity, we will refer to the first type of resolution as **pixel count resolution** and the second as **embedded resolution**.

What is the difference between pixel count resolution and embedded resolution?

Embedded resolution tells your printer how far apart to spread the pixels in a printed image. It determines how "fine grained" the printed image will look.

It is completely independent of the pixel count of the image. A high-pixel-count image can have a low embedded resolution or vice versa. Embedded resolution is inversely proportional to the size of the printed image. Given the same pixel count, a high embedded resolution will result in a smaller printed image (the pixels are packed together more tightly), and a low embedded resolution will result in a larger image (the pixels are more spread out).

Embedded resolution, however, does not affect the size (in bytes) of your image or its appearance on a computer screen. Those properties are determined solely by the pixel count. The byte-size of the image file is directly proportional to the pixel count, as is its size on your computer screen, which simply displays all the pixels in the image in a fixed one-to-one grid.

What is the difference between ppi and dpi?

The term ppi (pixels per inch) originated in the world of computers, and dpi (dots per inch) in the world of printing, but today they are often used interchangeably.

What is my camera's resolution?

A camera's resolution is usually defined as the number of megapixels (or millions of pixels) that it can capture in a single photo. This is obviously a *pixel-count* resolution. Most digital cameras capture images on a CCD (charge coupled device) sensor. The camera's resolution is calculated by multiplying the number of pixels along the length and width of the sensor. Contemporary cameras typically capture between one million and six million pixels per image.

A two-megapixel camera, operating at maximum resolution, will create an image that has about two million pixels. However, most cameras offer at least three different pixel-count settings for taking pictures with varying degrees of quality. At lower settings, the camera reduces the number of pixels to create a smaller image that requires fewer bytes to store in memory.

Which resolution setting should I choose when I take a picture?

It depends on what you want to do with the picture. Do you want to e-mail it to friends, post it on a Web site, make it your computer's wallpaper, print it as a 4" x 6" photograph, or create a poster-sized print? For images that will be viewed on a computer monitor (such as those you send by e-mail or post to the Web), a low pixel-count setting is perfectly adequate. Since most people view images on monitors that display only 800 x 600 pixels, a low pixel-count image, such as a 600 x 400 photograph, will fill up most of their screen without running off the edges. A low pixel-count setting will also reduce the file size of the image and reduce time it takes others to download or display your image.

Printers, however, can print at much higher resolution than a typical computer screen. Images that you intend to print should be captured at a higher pixel-count setting.

- For a 2" x 3" print, the image dimensions should be 400 x 600 pixels minimum

- For a 4" x 6" print, the image dimensions should be 800 x 600 pixels minimum
- For a 5" x 7" print, the image dimensions should be 1000 x 1400 pixels minimum
- For an 8" x 10" print, the image dimensions should be 1600 x 2000 pixels minimum

You can learn more about printing and resolution by reading [this section](#). If you don't know what you want to do with your image the moment you take a picture, to be safe, it's a good idea to set your camera to the highest resolution setting. You can always reduce the pixel-count of your image later for e-mailing or web publishing.

What resolution should I use to scan an image?

As with taking a digital photo, your intended use for the image determines your best scanning resolution. For example, a 4" by 6" photograph scanned at 300 ppi will have large pixel dimensions and will appear large on a computer screen, while the same photograph scanned at 72 ppi will have fewer pixels and will appear much smaller on a screen.

Scanning resolution is expressed in terms of dpi or ppi, which you will recognize from our earlier discussion of *embedded resolution*. The scanning resolution not only determines how many pixels will be captured, it also gets embedded into the image as an invisible piece of information for future output devices. To calculate the pixel dimensions of a scanned photograph, multiply the scanning resolution by the dimension in inches: Resolution x Inches = Pixels. Using this formula you can calculate the pixel dimensions, for example, of a 4" x 6" photograph scanned in using 300 ppi:

300 pixels/inch x 4 inches = 1200 pixels
 300 pixels/inch x 6 inches = 1800 pixels

So your 4" x 6" photograph will be displayed as 1200 x 1800 pixels on your monitor. Unless you have very large monitor, the image will spill over the edges.

Of course, you could later resize the scanned photograph in FotoFinish, or you could rescan it using a lower resolution (ppi) setting. To calculate the resolution you should use to scan a photo, first decide how big you want your image to appear on your monitor (Pixels / Inches = Resolution). For example, if you want your 4" by 6" photograph to appear as 400 x 600 pixels on the monitor, then you would scan it in at 100 ppi. If you want to create a 100 x 150 pixel thumbnail, you would scan in your 4 inch x 6 inch photograph at 25 ppi.

Keep in mind that as you increase your scanning resolution you create larger files that might be inappropriately large for e-mailing or web publishing. Below are a list of some possible resolution and image size combinations:

Original Image	Scan	Pixel Count	BMP File Size
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	Resolution		
4" x 6"	72 ppi	288 x 432	364 KB
4" x 6"	100 ppi	400 x 600	703 KB
4" x 6"	150 ppi	600 x 900	1.54 MB
4" x 6"	200 ppi	800 x 1200	2.74 MB
4" x 6"	300 ppi	1200 x 1800	6.17 MB

What embedded resolution should I use to create a new image?

The appropriate embedded resolution depends on how you want to use the image. If you want to print your image, you should create it with a high embedded resolution (200 to 300 ppi).

When you create graphics for the screen, embedded resolution does not matter. Simply pick the pixel dimensions of your image and don't worry about embedded resolution. Most people use 72 ppi for creating web graphics but this is just an arbitrary embedded resolution that has become a standard. You don't need to use 72 ppi to create a web graphic. Since monitors display images based on pixel dimension, embedded image resolution will not affect how large or small an image looks on the screen. A 300 by 199 pixel image set to 72 ppi and a 300 by 199 pixel image set to 300 ppi will look the same on the same screen. As discussed above, the embedded resolution (ppi or dpi) of an image only affects the image when printed.



Image info: 300x199, 72 ppi, file size: 20 KB



Image info: 300x199, 300 ppi, file size: 20 KB

As you can see from this example, the embedded resolution does not affect

the screen appearance or the file size of the image.

What embedded resolution should I use to print an image?

To understand how embedded resolution affects the printed dimensions of an image, take a sample photograph and choose the **Scale** command in the **Image** menu in FotoFinish. As you increase the resolution, the printed dimensions of the image go down. As you decrease resolution, the printed dimensions go up. The printed dimensions change because FotoFinish spreads or condenses the fixed number of pixels in your image to achieve the specified resolution. To create a higher resolution, the pixels are condensed to a smaller area, and vice versa.

The chart below illustrates how embedded resolution affects the printed dimensions of an image:

Pixel Dimensions	Image Resolution	Printed size
640 x 480	72 ppi	8.89" x 6.67"
	300 ppi	2.13" x 1.60"
800 x 600	72 ppi	11.11" x 8.33"
	300 ppi	2.67" x 2.00"
1024 x 768	72 ppi	14.22" x 10.67"
	300 ppi	3.41" x 2.56"
1280 x 960	72 ppi	17.78" x 13.33"
	300 ppi	4.27" x 3.20"
1600 x 1200	72 ppi	22.22" x 16.67"
	300 ppi	5.33" x 4.00"
2400 x 1600	72 ppi	33.33" x 22.22"
	300 ppi	8.00" x 5.33"

Given the same number of pixels, a higher embedded resolution shrinks the final printed output.

How do I calculate what resolution I need to print a 4"x6" image?

With FotoFinish you can easily print a 4"x6" photo using the standard photo size templates. If you use the Photo Wizard, you don't need to know anything about resolution to print your image. Simply pick a template and print.

However, if you want more control over print quality and size, you can use the simple resolution formula to calculate the embedded resolution you need for any given output.

For example, let's imagine a 2 megapixel camera that creates a 1600 by 1200 pixel image. You can print this image at any number of different sizes by specifying different embedded resolutions. Take the length of the image in pixels and divide it by your target length in inches. The resulting number is the embedded resolution in ppi (or dpi):

1600 pixels / 11 inches = 145 ppi
 1600 pixels / 10 inches = 160 ppi
 1600 pixels / 9 inches = 177 ppi
 1600 pixels / 8 inches = 200 ppi
 1600 pixels / 6 inches = 266 ppi
 1600 pixels / 4 inches = 400 ppi
 1600 pixels / 2 inches = 800 ppi

As your desired printing area decreases, your resolution increases. As a general rule, you can get a good, photo-quality print at 200 ppi or above. However, photo quality is in the eye of the beholder. You'll probably need to experiment to find the resolution that looks acceptable on your printer.

Why does my image look blocky and blurry when printed?

If you choose to print a small image at a large size, the pixels in your image are stretched to fill the requested print area. In effect, FotoFinish has to reduce the image's embedded resolution. Your eye perceives this as a blocky, blurry, or "[pixelated](#)" effect.

Why does my image look different on my monitor from when I print it?

One of the hardest things to understand about desktop publishing is that the size of the image on your screen does not accurately reflect the size of your image when you print it. An image that fills your entire screen might only be a small thumbnail when printed (although this would be an extreme case).

When your image's embedded resolution is higher than the monitor's display resolution, the image appears larger on the screen than when printed. Luckily, FotoFinish allows you to see a preview of how your printed image will look. Just set the **View** menu to **View at Output Size**. Your image will be displayed on-screen as it would be printed if you chose to print it at 100% of its actual size.

What is my monitor's resolution?

Monitor resolution refers to the number of pixels or dots displayed in a given unit length of the monitor. Your monitor's resolution will depend on the size of your monitor (15 inches, 17 inches, etc.) as well as its screen area setting (1024 x 768, 800 x 600, etc.). Below is a list of monitor resolutions for some common monitor and screen area settings.

Monitor size	Actual screen size (horizontal)	Resolution at 800 x 600	Resolution at 1024 x 768	Resolution at 1280 x 1024
15"	11.04"	72 dpi	93 dpi	116 dpi
17"	12.8"	62 dpi	80 dpi	100 dpi
19"	14.4"	55 dpi	71 dpi	89 dpi
21"	16"	50 dpi	64 dpi	80 dpi

What is printer resolution and do I need to worry about it?

Printer resolution is the number of ink dots printed on an inch of paper measured in dpi (dots per inch). Most of today's printers have a resolution of 300 or 600 dpi. In most cases, the printer's resolution will not affect how you size and scale images. If you pick a template in FotoFinish or print your image at its actual size in inches, printer resolution will never effect the size of your printed image.

If you want to control the quality of your printed image for a professional result such as an image destined for publication in a newspaper or magazine, you can calculate the optimal resolution for your image based on a printer's LPI (lines per inch).

For most printers there is an optimum image resolution, beyond which increasing the embedded resolution of the image (ppi) makes no discernible effect on the output quality. Each printer can only print so many lines per inch (LPI). LPI measures the number of halftone dots a printer can create in an inch of paper. Halftone dots are how a printer simulates continuous shades of colors while only using four colors: cyan, magenta, yellow, and black (some photo-quality printers also add light cyan and light magenta). Every individual pixel in your image will be represented by a random pattern of these smaller, various-sized printer dots. This process is also called screening or halftoning.

Below are some common lpi outputs from different printers:

Printer or Output	LPI
Black and white laser printer, 300 dpi	53 - 60 lpi
Black and white laser printer, 600 dpi	60 - 106 lpi
Newspaper	65 - 100 lpi
Book (uncoated paper)	120 - 133 lpi
Book (coated paper)	133 - 150 lpi
Color Magazine	150 - 175 lpi
Art Book and Magazine	175 - 250 lpi
Dye Sublimation Printer	206 - 400 lpi
Photo-quality Inkjet Printer, 360 dpi	150 lpi
Photo-quality Inkjet Printer, 720 dpi	250-300 lpi
Photo-quality Inkjet Printer, 1440 dpi	250-300 lpi

Source: [Agfanet](#)

To obtain a quality print, your image resolution should be slightly higher than the printer's given LPI. To calculate this ideal resolution, multiply the LPI by about 1.5 to obtain the ideal pixel per inch (ppi) figure for your image. For example, given a 360 dpi photo-quality inkjet printer with a 150 lpi, you can get a photo-quality print if your image has 150×1.5 or 225 ppi. If you don't know your printer's lpi, the best way to find your optimal print resolution is to experiment. Print a test image at various resolutions to find out what your

minimum ppi is for a photo-quality print. A good test image is a close up picture of a newspaper or a photo that has some angled straight edges in it.

What is Actual Pixel Size and When would I Choose It?

In the foregoing discussion, a printer's resolution (both dpi and LPI) only affected your printed image quality not size. There is one exception. If you choose **Actual Pixel Size** in FotoFinish's **Print** dialog then printing at 100% of pixel size means the printer will print one dot for every pixel in your image. The size of the printed image will be determined by the printer's resolution in dpi. For example, if your printer has a 600 dpi resolution a 1200 by 1600 image will be printed to a 2" (1200/600) by 2.66" (1600/600) area. Choose FotoFinish's **Actual Pixel Size** option if you want to print the best quality image your printer can create.

Congratulations! You now know more about resolution than you ever wanted to know. We realize it's a complex and confusing subject, so feel free to bookmark this page and refer back here any time you need a refresher course.

Glossary of Common Digital Photography Terms

Anti-Aliasing Smooths out hard edges in a drawing by blending colors. This is especially apparent when applied to text.

Anti-Aliased
Not Anti-Aliased

Aperture Refers to the camera's adjustable opening (also known as a diaphragm or iris) that allows light to reach the camera's sensor (or film). The size of the aperture is measured using an *f-number* also called the *f-stop* (F8, f/8, etc). The smaller

the f-number, the larger the camera's opening. The size of the aperture directly affects [depth of field](#) and [shutter speed](#).



Large aperture
Small f-stop (F2)
Shallow depth of field



Small aperture
Large f-stop (F8)
Greater depth of field

A low f-stop like F2 requires a higher shutter speed, which creates a shallow

depth of field. A higher f-stop like F16 requires a slower shutter speed, which allows for a greater depth of field. Lenses usually have a minimum and maximum aperture. A lens with a large maximum aperture (or a low f-stop like F2) is often called a fast lens.

Artifact Unwanted distortions in an image caused by [lossy image compression](#).



Artifacts like the ones on the left are typical of compressed JPEGs. The visibility of the artifacts depends on the level of compression used.

Bit The smallest unit of computer memory, short for *binary digit*. A bit has two states: zero (off) and one (on). Eight bits create a byte. Therefore, a byte can represent any one of 256 states (2 to the 8th power).

Bit Depth or Color Depth The number of colors (or shades of gray) available in the image. Each pixel in an image is created by mixing the values for red, green, and blue. Currently, consumer-level graphics cards limit each color to one byte (or 8 bits) of memory. Consequently, the maximum color depth an image can have is 24 bits (3 x 8 bits for each color). These 24 bits allow for 2^{24} (or 256 x 256 x 256) colors creating the rich 16.7 million color display you are used to. You can manually reduce this color depth for any individual photograph in an image editing software like FotoFinish. Reducing the bit depth reduces the number of colors displayed in the image.

This smaller palette of indexed colors requires less memory to store than a regular 24-bit, or True Color, photograph. However, by reducing color depth, you also open the door to [color banding](#) and [dithering](#).

Bitmap image

Images created or captured as a grid of colored dots called [pixels](#). Because a bitmap image - also known as a raster image - contains a finite number of pixels, the way a bitmap image looks is affected by its resolution. If you scale a bitmap image, it will lose detail and quality. See also [vector image](#).

Blooming

A distortion caused by an overflow of charge from one image sensor pixel to another. Blooming typically occurs with heavily backlit subjects such as leaves shot against the sky.

Blur

A lack of sharpness in the image caused by [resampling](#), a missed focus, or by camera or subject movement during a slow [shutter speed](#).

Bracketing

Taking two or three extra shots of the same subject with different exposure settings to ensure a perfect exposure.

Brightness

Describes how light or dark we perceive a color to be. The higher the brightness value, the closer the color will be to white. The brightness of a color is the same as its [value](#).

Burn

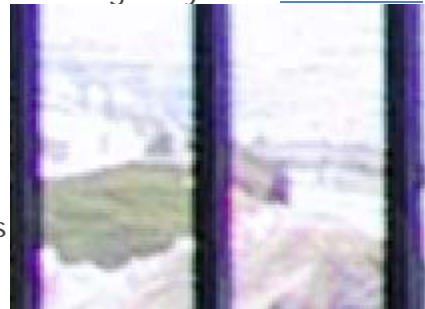
To darken a small area of the picture in an image editing software or a darkroom.

Chroma

Refers to the purity of color. The less gray, white, or black a color has in it, the more pure and vivid it will appear.

Chromatic Aberration

Purple fringing that occurs along the edges of backlit subjects such as plants, people, and buildings. Chromatic aberrations occur when the camera lens can't focus the different wavelengths of light onto the same spot on the image.



Notice the purple light along the edges of the bars on the picture to the right.

CMYK

A [color model](#) based on four *process colors*: Cyan, Magenta, Yellow, and Black. The colors are mixed to create a full-color image on a printer. The printing press prints an image in four separate layers starting with yellow, then cyan, magenta, and black. The CMYK color model is different from the [RGB](#) model used on your computer display and digital cameras. Unlike a computer screen which emits light, ink absorbs it and the color our eyes perceive is the color that is reflected from the paper. Because the process involves absorbed instead of emitted light, CMYK is a subtractive color model (you start with white



light and create colors by absorbing certain wavelengths of that light). Cyan absorbs the red component of white light, magenta absorbs green, and yellow absorbs blue. As you mix cyan, magenta, and yellow together, you will eventually get black.

Color or White Balance

Refers to the relative intensity of colors in your image. Without correction, a picture taken at sunset can seem too yellow or orange and a picture taken under fluorescent lights might seem too green. Some cameras come with built in automatic white balance correction. You can also adjust the color balance in an image editing software. The colors are divided into three pairs: Cyan and Red; Magenta and Green; and Yellow and Blue. As you increase the amount of one color, you also automatically reduce its inverse.

Color Banding

The appearance of visible bands of colors that replace subtle gradations in order to accommodate a reduced palette.



The original image



Colorbanding caused by reducing the image to only 8 colors

Color Model

A system of classifying individual colors. [CMYK](#) is the color model used in printing. [RGB](#) is the color model used in TV sets and computer monitors. HSL, HSB, HSV, and LCH are color models that describe how we perceive color.

Compression

Storing image data in a way that results in a reduction in file size. Compressing data is especially important when you want to publish images to the web or e-mail. [GIFs](#), [JPEGs](#), and [PNGs](#) are all common compressed file formats. Compression can be lossy or lossless. Lossless compression doesn't lose any image data. [GIFs](#) and [PNGs](#) are lossless file formats (although GIFs lose color depth). Lossy compression results in the loss of image data every time the image is saved. [JPEG](#) is a lossy file format.

Contrast

Measures the rate [brightness](#) values change in the image. A high contrast image has a narrow range of relative brightness values. As you increase contrast in an image editing software, the dark colors become darker and the light colors become lighter. For some images, increasing contrast can help bring out details in the image.

Depth of Field

Refers to the distance between the closest and farthest sharp or in-focus portion of a photograph (also called the focal range). A large depth of field means that a large area both in

front and behind your main subject will appear sharp. A shallow depth of field implies that anything other than your main focus point will appear blurred. A smaller f-stop (F2) will create a shallow depth of field. A larger f-stop (F11) will create a greater depth of field.



A picture taken with the camera set to F8



A picture taken with the camera set to F2

- Digital Zoom** A cropping and [interpolation](#) of an image within the camera to get closer to the main subject and mimic a greater zoom without actually gaining any additional image detail. Because it often results in a blurry and [pixelated](#) image, you should avoid using digital zoom.
- Dithering** The process of mixing existing colors to create the illusion of another color that is not available in the given palette. There are two types of dithering: pattern and diffusion. Pattern dithering arranges pixels in a rigid pattern. Diffusion dithering applies a random pattern of pixels that adds a subtle grainy texture to the image.
- Dodge** To lighten a small area of the picture in an image editing software or a darkroom.
- DPI** Short for *dots per inch*, DPI measures the [resolution](#) or density of dots within a given area. Originally DPI was used to describe printing resolution and [PPI](#) referred to the embedded resolution of a digital image, today many people use the two terms interchangeably.
- Exposure** The amount of light that your camera captures while taking a picture. Too much light can create an overexposed image while not enough light can result in an underexposed photograph. An overexposed photograph is lighter than it should be and an underexposed photograph is darker than it should be. Exposure is the result of any combination of [aperture](#) size and [shutter speed](#).
- Flare** A series of bright polygons in the image caused by internal reflections within the camera's lens. Lens flare usually occurs when you shoot directly at a strong light source like the sun or a street lamp.
- Gamut** The range of colors that can be captured or displayed by a device.
- GIF** Stands for Graphics Interchange Format developed by CompuServe-Unisys. It is one of the main graphic formats displayed by web browsers. GIFs store bitmaps in patterns of indexed 8-bit color (256 colors or less) using a special algorithm called Lempel-Ziv-Welch (LZW). Using this

algorithm, gifs compress the raw bitmaps into smaller file sizes. Because of their limited [color depth](#), GIFs are better suited for images made up from solid colors such as logos, icons, and buttons.

Halftone The process (also called screening) by which a printer simulates continuous shades of colors while only using four colors: cyan, magenta, yellow, and black ([CMYK](#)). When printed, individual pixels in an image will be represented by a random pattern of these smaller, various-sized printer dots.

HSB A color model that describes color in terms of [Hue](#), [Saturation](#), and [Brightness](#).

HSL A color model that describes color in terms of [Hue](#), [Saturation](#), and [Lightness](#).

HSV A color model that describes color in terms of [Hue](#), [Saturation](#), and [Value](#).

Hue The distinct characteristics of color that distinguishes blue from red and yellow from green, etc. Technically, hue is the dominant wavelength in the reflected or emitted light.

Interpolation An algorithm used to create pixels based on existing pixel data when you scale an image.

ISO (ASA) speed A measure of a film's sensitivity to light. A 400 speed film is more sensitive to light than a 100 speed film. Consequently, the faster film is better suited for low-light photography. Unfortunately, faster films also create more [noise](#) and reproduce colors less accurately than slower films. Digital cameras either have a preset ISO sensitivity or they allow you to choose from a variety of film speed settings.

Jaggies The stair-like appearance of diagonal lines.



JPEG Stands for Joint Photographic Experts Group. Along with [GIFs](#), the JPEG file format is one of the main graphic formats displayed on the web. JPEGs use a [compression](#) method that sacrifices image information to reduce the file size called [lossy compression](#). This means that every time you save an image as a JPEG, some of the original image data will be lost. JPEGs store images in 24-bit color (GIFs only use 8 bits or less) allowing you to save millions of colors. Consequently, JPEGs are better suited for photographs and images with fine gradations of tone and color.

LCH A color model that describes color in terms of [Luminance](#), [Chroma](#), and [Hue](#).

Lightness See [luminance](#).

Lossless compression A type of file [compression](#) that reduces file size without losing image data. [PNGs](#) and [GIFs](#) are common lossless file formats.

Lossy compression	A type of file compression that results in the loss of image data every time the image is saved. JPEG is a lossy file format.
LPI	Stands for <i>lines per inch</i> . LPI measures the frequency of lines a printer can create while halftoning .
Luminance	The lightness or luminance of a color is similar to its value or brightness but the two are not the same thing. In the physical world, luminance is the physically quantifiable intensity of light measured in energy per unit area. On your computer the sun may appear brighter than a tree, but in reality each pixel on the screen is emitting the same amount of energy. Luminance is a way to recreate that light effect on the computer. Colors wash out as luminance increases and colors darken as luminance decreases.
Macro	A one to one or higher magnification of a subject captured on film.
Noise	An unwanted grain pattern in an image often caused by slow shutter speeds and high ISO settings.
Pan	Moving the camera horizontally to capture a subject in motion.
Panorama	A series of images stitched together to create a picture wider than what the camera is normally capable of capturing.
Pixel	Short for a picture element, a pixel is the smallest unit of space in a computer image or display. Every image on your computer is made up of a colored grid of square pixels.
Pixelization	The appearance of recognizable square pixels in an image. Pixelization usually occurs when a bitmap image has been enlarged beyond optimal range for its given number of pixels.
PNG	Stands for Portable Network Graphic. The PNG file format is a great alternative to the GIF format. PNGs compress bitmaps without loss and also support transparency and 24-bit color. You can save a photo-quality image as a PNG without losing image information (like you would with a JPEG) or color (like you would with a GIF).
PPI	Stands for <i>pixels per inch</i> . PPI is a way to measure resolution or the density of pixels within a given area. This measurement allows the software program to tell the printer how large to print a given image.
RGB	An additive color model that starts with black, the absence of light. Computer monitors emit a combination of three colors: red, green, and blue to create a full color display. Unlike the subtractive CMYK model, with all three RGB colors combined, we get white light.
Resample	Changing the pixel dimensions of a bitmap image. When you decrease the number of pixels in the image, you are <i>downsampling</i> , which results in a loss of image data and a blurrier image. Use downsampling to reduce the file size and viewing dimensions of an image for web or e-mail publishing.



When you increase the number of pixels in the image, you are *upsampling*. Upsampling also often results in a blurry, [pixelated](#) image. You should avoid resampling images that are going to be printed.

Resolution	Refers to the total number and density of pixels available in a bitmap image. Read this quick lesson for more detailed information.
Saturation	The intensity of a color with respect to its brightness or value . Given a level of brightness, saturation measures the amount of gray in a color. A color that lacks gray impurities will seem more intense and vivid. Saturation is closely related to chroma .
Sepia	A brownish colored, old-fashioned look to an image often created as a special effect either within a digital camera or in an image editing software.
Shutter Speed	The length of time the image sensor is exposed to light anywhere from a few seconds (8s, 1s, etc.) to fractions of seconds (1/125, 1/500, etc.). You'll need a fast shutter speed to capture action. Slower shutter speeds (speeds below 1/125s) are more likely to create blurring from either camera shake or subject movement. The combination of shutter speed and aperture create a picture's exposure .
TIFF	Stands for Tag Image File Format, a lossless cross-platform (both Windows and Macintosh) bitmap file format.
True Color	A 24-bit color depth. See bit depth for more information.
TWAIN	A standardized interface that allows software to communicate with scanners and digital cameras.
Value	Describes how light or dark a color is. Value can be used interchangeably with the term brightness . A pale yellow color will seem lighter than dark blue. The higher the value of a color, the closer it will be to white and the lower the value the closer the color will be to black.
Vector image	Images created using mathematical statements that define geometric shapes. You can move, resize, and change the color of vector graphics without losing any quality. Unlike bitmaps , vector graphics are not dependent on resolution. You can scale a vector graphic to any size and it won't lose detail or clarity.