Definitions of Terms

Resolution: Refers to the sharpness and clarity of an image, measured in terms of ppi and dpi.

PPI: (*pixels per inch)* Measurement used for images displayed on screen

DPI: (*dots per inch*) Measurement used in printing images.

Pixel: A word invented from "picture element" - the basic unit of programmable color on a computer display or in a computer image.
- from http://searchsmb.techtarget.com

Megapixel: A megapixel (that is, a million pixels) is a unit of image sensing capacity in a digital camera. In general, the more megapixels in a camera, the better the resolution when printing an image in a given size.
- from http://searchsmb.techtarget.com

Lossy: A term meaning "with losses," used to describe image file formats that discard data due to compression.

Lossless: A term used to describe an image file format that retains all the data from the initial image file.

RGB: (*Red, Green, Blue*) The color model for display devices (monitors, digital projectors, etc.) Each displayed color is determined by a combination of RGB.

CMYK: (*Cyan, Magenta, Yellow, and Black*) The color model for printing. If you are printing something in color, be sure you have saved it in CMYK.

Bit-mapped (or Raster) images: Images that have data that describe the color of each pixel. Larger display sizes equal larger file sizes in this type of image. Bitmapped images cannot be rescaled without resulting in "pixilation", or loss of definition in the details. JPEG and GIF images are examples of bitmapped images.

Vector images: Vector images have data that describe lines and curves. These images can be enlarged and still maintain their smooth edges (not pixilated like bitmap images). Artists and designers will often work with vector images, and then "rasterize" the finalized version for distribution and display. Adobe Illustrator files (.ai) and CorelDraw files (.cdr) are examples of vector images.

Proprietary: Denotes ownership and non-disclosure of details regarding format or programming code. In the context of this tutorial, proprietary refers to file formats that require a certain software application to read/open that file. For example, .psd is the proprietary file format for Adobe Photoshop files.

Open Source: Denotes a more accessible way to share, improve and distribute resources, requiring that licensing not be specific to a particular product. See http://www.opensource.org for more info.

Explanation of File Formats

It is also helpful to understand the common image file formats of digital images, how these file formats differ, and what their recommended use is. TIFF (.tif), JPG (.jpg, .jpeg), GIF (.gif) and PNG (.png) are file formats (and their respective file extensions) that you are likely to encounter. Other image file formats are used to a lesser extent; these formats are often proprietary, such as Photoshop .psd files.

TIFF — A lossless file format that can be compressed. This format is widely supported across operating systems. **TIFF is the best file format for archiving high quality images.**

JPG or JPEG — The JPG file format was specifically created for photographs, and can contain millions of colors. JPGs are automatically compressed (you can choose the level of compression to match your desired image quality), resulting in a relatively small file size while still retaining quality. **For this reason, JPGs are ideal for email and Web use.** JPGs are lossy, discarding information each time that they are compressed.

GIF — The **lossless and compressed file format that is preferred for graphics,** because it keeps edges and lines sharp. GIFs are limited to 256 or fewer colors, and are not recommended for photographs, but rather for images with flat fields of color, such as clip art. GIFs can be static or animated.

PNG — **Portable Network Graphics format, an open source substitute for GIFs.** PNGs provide a higher lossless compression rate than GIFs, and help to reduce cross-platform differences in image display quality, among other technical advantages. PNG provides a useful format for the storage of images during intermediate stages of editing. See http://www.libpng.org/pub/png/ for more info.

All of the formats detailed above are readable in both Windows and Mac OS operating systems, and are supported by most image viewing and editing applications.

Production of Digital Images

Digital images can be produced in a number of ways, the most common of which are detailed below.

Scanning: You can take pretty much any printed material and scan it to obtain a digital copy of it. Readily available scanners make scanning images on paper, printed photos, slides, and negatives a fairly simple process. Many of these scanners are "plug and play," which means that soon after you unpack and plug your scanner into your computer, you can scan away without much delay.

Flatbed scanners (Figure 1) operate in a way similar to photocopier – you raise the lid, put the image face down on the glass, close the lid, and scan. Some of these flatbed scanners even have feeder trays, to quickly scan multiple pages.

Figure 1
www.epson.com

Figure 2
www.photographic.com

Figure 3
www.canon.com

Photo print, slide, and negative scanners (sometimes these are all combined into one scanner, as in Figure 2) usually have a slot into which you feed the item you want scanned. You can scan these types of materials on a flatbed scanner, but the raising and lowering of the lid often shifts or turns the items slightly, resulting in unexpectedly crooked or off-centered scans. A small piece of tape across your item and the edge of the scanner – NOT the glass – can help to alleviate this problem.

Digital Cameras: Digital cameras (Figure 3) and camera phones are probably the fastest, easiest way to produce digital images. Keep in mind that there is quite a wide range of performance differences among brands, models by the same brand, and between consumer vs. professional grade equipment. What you really need to know is how to navigate through the function menu on your particular piece of equipment. The user manual will be very helpful in explaining what all those weird abbreviations, codes, and acronyms mean!

At this point, I want to point out a few **notable settings** on the digital camera:

1 - All digital cameras have variable settings for image quality, or "resolution." Some cameras have options such as "good," "better," and "best," while others actually have numbered pixel dimensions, such as 640x480 or 1600x1200. What it boils down to is this: the better the quality, or higher the numbers, the bigger the file size for each image, and the less total number of images you can fit on the memory card or disk. So, you have to decide, do you want fewer but higher-resolution pictures, or are you a shutterbug that needs to take 100 shots just to get a few that look good? Your situation and your skill may help determine this decision. Part of this includes your intended use of the pictures once you get them off the camera, which we will discuss in more detail later in this tutorial. If need be, you can purchase a memory card with larger storage capacity to hold more pictures.

2 – Some digital cameras will let you choose which format you want your images saved in. All cameras will offer .JPG (or .JPEG) format, and some will offer .TIFF format (for high quality, high-resolution images). Additionally, some cameras may have a proprietary format option that only works with the software that came with the camera.

3 – Certain settings on your camera may return to default settings after turning the camera off. This can be especially annoying if you are trying to conserve the battery, but have to navigate through the menus and reset your desired quality or format settings each time you want to take a picture. Again, familiarity with these particular features on your camera will help a lot towards achieving better results.

Photo CDs: You may obtain a collection of digital images from your photo processor, along with your developed prints or slides. Many photo-processing services now provide photo CDs with .jpg images on them. If you are unfamiliar yet curious about the nature of these images, this tutorial should help you figure out what you can and can't do with them, and will give you suggestions for software that can help you manipulate or organize them.

Image Size – Resolution

As mentioned in the definition of terms earlier in this tutorial, resolution refers to the sharpness and clarity of your image. Of course, the sharpness and clarity vary depending on the context of the image. Are you scanning or viewing your image? Are you viewing it on a computer monitor, or are you looking at a printed page?

Scanning: When scanning your images, you are usually prompted to choose what resolution you would like your images scanned at. The intended use or display of your images will help you make this choice.

Printing: Images intended for high-quality printing should be scanned in at no less than 150dpi, preferably 300dpi. Remember, dpi is "dots per inch", and the more dots per inch, the sharper and crisper your images will look on the printed page. Many publishers have minimum resolution requirements for digital image submissions – make sure you know what's required before you start digitizing.

Computer display: Images intended primarily for display on a computer monitor (such as email attachments or images on a Web page) really only need a 72ppi to 96ppi resolution, as that is what computer monitors are capable of displaying. A higher resolution will not make your image appear any better on the screen. In fact, if you don't expect folks to print out your images, these images should be "optimized", which means making them as small and compressed a file as possible (while still retaining the appropriate visual clarity), so that they load quickly, and do not take up too much space on the hard drive.

TIP - if you need to make high resolution, large files available via the Web or computer, create "thumbnail" versions of your images that then link to the larger images. This prevents your viewer from enduring slow loading times for images they are not interested in seeing.

TIP - Optimizing images for computer/Web display involves compression, which throws out some pixel data. You cannot then enlarge the images without encountering pixelation (example on pg. 7).

Resolution Examples (images courtesy of author)

Format: TIFF
DPI: 400
Pixel Dimensions: 2000 x 1193
Print Dimensions: 5" x 3"
File Size: 6.59MB

Ideal for Print Use

Format: JPG
DPI: 72
Pixel Dimensions: 361 x 210
Print Dimensions: 5" x 3"
File Size: 222KB

Ideal for Computer/Web Use

Notice the difference in sharpness & clarity between these two printed images

Resolution Examples

Format: TIFF
DPI: 400
Pixel Dimensions: 2000 x 1193
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File Size: 6.59MB

Enlarged

Format: JPG
DPI: 72
Pixel Dimensions: 361 x 210
Print Dimensions: 5" x 3"
File Size: 222KB

Enlarged

The difference is more pronounced when you try to enlarge the JPG image; the individual pixels become visible.

Image Size – File size

File size is proportional to the pixel dimensions of an image, is partially determined by the file format, and it specifically refers to how much disk space your file occupies, either on the hard drive, CD, or other storage medium. Image files normally range in sizes measured in Kilobytes (KB or K) and Megabytes (MB or M); extremely large files may be measure in Gigabytes (GB). Images for print will have larger file sizes, since higher resolution = more data stored in the file. Images for Web or computer display will have smaller file sizes. As a general rule (and there are appropriate times and places to break it), Web images should fall between 10 and 200K; images with larger file sizes will load more slowly, and generally be too cumbersome for effective computer distribution and display. Saving your images in .JPG or .GIF format will automatically compress and reduce your file sizes significantly, so that you can fit more files onto a disk or attach more to an email message, without exceeding the disk storage or file size limits.

Inserting images into presentations or other documents:
Resizing images on the screen after inserting them into your PowerPoint presentation or Word document does *not* reduce the file size of that image; this only changes the dimensional display size of the image in that document. Presentations and other documents that contain numerous images can become very large in total cumulative file size. In order to keep such presentation and document files at a reasonable size, you should appropriately resize your image files in an image editor before inserting them into your final document.

Best Practices

Start Big: When in doubt about how you might end up using your images, opt for the highest resolution possible. It is always better to start out with the most information possible, and then scale down as necessary. If you start out with low resolution, you cannot get a higher resolution without scanning or taking the picture again with higher resolution settings, and you may not get that chance.

Protect Originals: Keep the original, high-resolution versions of your images (which should be in TIFF format, if possible) in a separate place from your working documents or optimized Web images. Back up your important documents on some kind of external storage medium (CD-Rom or fire wire drive, for example). This will help to ensure that you have something to go back to and work from should something unfortunate happen to the other files.

Name Files Accurately: Develop a file naming convention that will help you accurately identify your files. Names that include descriptive information, version or size information, or intended use information can be helpful when managing large digital image collections.