

Getting Started in Digital Photography

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There can be no question that the direction of photography has moved from film to digital, when Kodak has announced that is where their future lies. Indeed, they have said they will end production of black and white printing paper. While some photographers refuse to give up their film cameras and "wet darkroom", most have already switched to digital cameras. Others would like to make the change but have questions. I have been working in digital photography in one form or another since 1993 and would like to try to answer some of those questions with an "FAQ" (Frequently Asks Questions) format. I have not been in my wet darkroom in 2 years and will never go back. My main regret is seeing the value of my non-digital photo equipment drop drastically in value as so many other photographers also make the switch.

What is the attraction? There are many. First is probably the instant feedback of being able to see the image right after taking it. You can tell if the shot was good or not and make adjustments as needed. Second is the greater control you have over the post-camera image. For some people it is being able to do black and white photography at home for the first time. Being able to burn and dodge as in the darkroom, switching from color to BW easily, switching ISO (film speed) frame-to-frame, making dramatic special effects and seeing the result quickly. All these are reasons to switch. Another is convenience in traveling: The problem of carrying film through X-ray scanners is eliminated. The list grows daily.

How many "Mega-Pixels" do I need?

Some people talk about mega-pixels the way others talk about horsepower in their cars the more the better, but there is a similar price to pay. More horsepower means higher gas consumption and that fewer miles traveled the same with more mega-pixels fewer pictures. The number of mega-pixels is one of the determining factors in the resolution of the image, but the resulting larger file, reduces the number of pictures you can store in memory. Just as with horsepower, the question is "how much is enough"? Some people just calculate how many pixels are needed to fit on an 8x10 print, but with the sophisticated image processing programs available today you can do well with fewer pixels. I have found that a 3 mega-pixel camera will produce a good 8x10 and a 5 mega-pixel an 11x14 print. However, more mega-pixels will allow you to crop and use only a portion of an image for a large print. Compact cameras today are available with from 3-7 mega-pixels, while digital SLRs range from 6-16 mega-pixels. NOTE: The picture file format and degree of compression also affects the number of pictures you can store. More about that in Image File Types

There are so many different cameras. How do I know which is the best one for me?

Digital cameras fall into 3 basic groups: Compact, or, Point and Shoot (PS), Prosumer, and Digital Single Lens Reflex (DSLR).

Point and Shoot cameras are the smallest and least expensive type: some are smaller than a pack of cigarettes. They usually have a zoom lens with a range of 3 or 4 to 1, with the wide-angle as low as 28 mm (35 is more common) and the telephoto up to 100 mm, in *35 mm film camera equivalent* (see "DSLR" below for an explanation). Often the ads will talk about "digital zoom" or quote a total zoom range. This is pure advertising hype. The only thing that matters is the *optical zoom* range, which tells the magnification of the lens (3X, 4X). Digital zoom is the result of reducing the resolution of the image by cropping it to the "zoomed" portion of the picture. Total zoom is the product of optical and digital zoom and as such is as meaningless as the digital zoom. The lens may have plastic optics in the less expensive cameras, and even the better lenses would not compare to those on an SLR, but you would be amazed at the quality of image that you could get with them.

The big advantage of a PS camera is the small size and relatively low price. Small size means convenience, which may mean you will carry it with you more and take more pictures. Many PS cameras have the ability to take digital movie clips which can be played back on your computer or sent as attachments to email. Most have a setting to make panoramic photos by taking multiple frames which can be stitched together in the computer. The disadvantages of PS cameras are that except in the high-end ones, the image quality is not as high as for the Prosumer and DSLR cameras, nor is the zoom range is great. Perhaps the biggest complaint is the shutter lag. All PS and Prosumer cameras have a delay between the press of the shutter button and the taking of the picture. In the worst case (low light), this may be 1 or 2 seconds but the better ones can have less than 1 second lag. In good light this is less of a problem. This can be overcome to some degree by pre-focusing (pressing the shutter button half way) if you know the spot where the picture will be, and waiting for the action to come to that spot. The shutter fires almost instantly when you press it the rest of the way. Another disadvantage is that the electronic "noise" (the equivalent of film grain) is much more than in a DSLR at the same ISO setting due to a smaller sensor size.

There is a wide range of features in this type of camera. The simpler models are designed for someone who uses the camera in the fully automatic mode. The more expensive ones have more features and allow creative exposure control with aperture or time priority modes, or complete manual exposure. Prices range from as low as \$100 for fixed lens, minimum featured cameras, to \$400-500 for top of the line models. There are too many models to keep track of and new ones appear almost daily. Consult a good photography site such as listed below for recommendations and reviews.

Prosumer cameras are larger in size than PS cameras, but not as big as DSLRs. Typically they have a sensor with 5-8 mega-pixels. The larger size allows them to have a wider range zoom lens, of better quality. Some have as much as a 12X zoom, ranging from 35 mm to over 400 mm in 35 mm film equivalent. The lenses on these cameras, which are not removable, are of better quality than on most PS cameras, but not as good as those available for DSLRs. They usually have automatic and creative control exposure modes and less noise than PS models. These cameras are meant for the person who wants

much of the capabilities of a DSLR but not the weight, cost and inconvenience of buying, carrying and changing the additional lenses. However, at higher ISO ("film speed") they do have more noise than a DSLR, and similar shutter lag to the PS cameras, which DSLRs do not exhibit. They are a step between the PS and DSLR in size, cost and capability. Many of the Prosumer cameras have image stabilization built in to reduce the effect of shake on the high magnification lenses. This can be a very useful feature when trying to hand hold a 400 mm equivalent lens.

The Prosumer camera would be a good choice for someone going on a trip where there will be a need for a wide range zoom or long telephoto lens, but for whom a DSLR is not an option because of price or weight. There are fewer cameras in this category than PS. Prices are in the \$400-800 range. Examples are the Canon Powershot Pro-1 and Powershot S2-IS, Nikon Coolpix 8400 and 8800, Panasonic DMC-FZ20, Minolta Dimage Z5, Olympus C-8080, Sony DSC-F828.

The DSLR is the highest class of digital camera, with all the features of film SLR cameras and more. DSLRs come with a variety of sensor sizes ranging from full frame (FF) 35 mm size to 60% 35 mm size. The Nikon and Canon professional models are FF but most of the Canon DSLRs have what is called a 1.6 crop factor while the Nikons have a 1.5 crop factor. This is the result of 35 mm FF film lenses producing an image designed for a 35 mm film frame, which is larger than the sensor, with some of the image falling off the edges. The result is similar to increasing the focal length of the lens by the crop factor. Thus a 100 mm lens on a DSLR will produce an image with the magnification of a 160 mm lens on a film SLR. For someone taking telephoto pictures this may be a plus, but it is undesirable for wide angle pictures. A 20 mm lens on a DSLR produces an image like a 30-32 mm lens on a film camera; not good. As a result there have been a number of new lenses with minimum focal lengths 10-12 mm which take advantage of the fact that the usable image size is smaller in a DSLR, to satisfy the need for a wider angle lens for digital SLRs.

DSLRs do not have some of the features found on PS or Prosumer cameras. They do not have a movie or a panoramic mode. They do not allow use of the LCD screen to view the picture prior to its being taken, as in the PS or Prosumer cameras. On the plus side, DSLRs show no more shutter lag than film cameras. Noise in a DSLR is much better than in a PS or Prosumer camera due to their larger sensors. In the Canon 10D and 20D the ISO can be set as high as 3200. Little noise is seen up to 800 ISO. While in a PS camera, ISO of 400 is maximum and anything 200 or over is very grainy. DSLRs give the photographer more control than the other types of cameras. You can set the depth of field by adjusting the aperture and preview the result in some cameras. They also offer more flexibility in flash exposure, allowing adjustment of the flash intensity in relative to ambient light. In short, they offer the same features found in film SLRs and more.

Prices run from \$800 up. The lowest price range DSLRs include the Canon Digital Rebel XT and Nikon D50, both of which are excellent cameras. The next level sells for \$1200-1400 and includes the Canon 20D and the Nikon D70. These more expensive models are more durable (and heavier) and can take more pictures in burst mode as well as having

other features not available in the lower models. Above these are the professional cameras starting at \$5000.

Which Camera To Choose?

That, of course, is up to you. The pros and cons of the 3 types are described above. Pick the one that suits you best. I have both a PS and a DSLR and I often take both with me. As for a specific model my best advice is to ask people who have the various cameras and get their opinion, better yet, try one in a store. A very good resource is the web site: **DPRReview** . They have in-depth detailed reviews of many cameras (mostly DSLRs and Prosumer) including head-to-head comparisons, and readers reviews of all types. Other good review and forum sites are Steve's Digicams and luminous-landscape .

If you are choosing a DSLR then I suggest you stay with the lens system you use for your present film SLR. Both Canon and Nikon are very good. They each have DSLRs over a range of prices. If these are still out of your price range then perhaps a used previous model bought on eBay or from a member of a local camera club would be a good choice. These are often available for about half of the street price of the newer model.

Image File Types

The image detected by the sensor in a digital camera must be stored in memory. It can be stored in several ways. In the case of minimum processing the image is compressed in a "lossless" way. That is, when it is restored to its original form (uncompressed) it is exactly like the original. If, on the other hand it is desired to store more images, more compression is required. There is a standardized mathematical procedure (algorithm) which is used to give various degrees of compression, but with the introduction of "artifacts" into the reconstructed image. This algorithm is called JPEG or JPG (pronounced jay-peg) compression. The artifacts may appear as ripples around hard edges in adjacent areas of sky, and as small boxes in open areas. It is usually hard to see these for low levels (high quality) compression, but they more apparent at higher compression and large print size. JPG is referred to as "lossy" compression. At minimum compression, JPG can easily make an 11 x 14 inch print from a 6 Mega-pixel camera, but higher compression will produce visible artifacts.

In addition to choosing degrees of JPG compression you usually are offered a choice of resolution for the image. Thus an array of 2000 by 3000 pixels may be stored in a number of sub-resolutions, such as 1000 x 1500 or 500 x 750 (example sizes only). This is done so that you can store the most images possible, depending on your output needs. So, if you are only going to print 4x5" pictures rather than 8X10's, you can use one of the smaller file resolutions. You are allowed these choices through the menu on your camera's LCD screen. You can also mix them at will.

The uncompressed or lossless file types are TIF (pronounced "tiff") and RAW, meaning relatively unprocessed. Most DSLRs, Prosumer and some high-end PS cameras offer RAW. A few offer TIF but all cameras allow JPG. A RAW file contains the least processed data and provides the highest depth of color information. JPG images are

stored with 8-bit (256 levels) per color data but RAW are usually at least 12-bit data (4096 levels). However, RAW images require more processing when you get them into a photo editing program, and take more room to store. Typically a RAW file will be 2 to 3 times larger than the least compression JPG. TIF files follow a standard format but are also usually 8-bit data, however, they do not suffer from the artifacts found in JPG images. Canon and Nikon and other manufacturers each have proprietary RAW formats, but many photo editing programs can read and process them. Adobe has recently proposed and published their own format called DNG for Digital Negative. It has not yet been widely accepted.

Internal Image Storage

Most cameras have some internal memory to buffer bursts of images until they can be transferred to a removable memory card. There are a variety of memory card formats. The most common and least expensive is Compact Flash or CF. Others are Memory Stick (used only by Sony), Secure Digital (SD), the newer and smaller XD, and Micro-drives, which are miniature hard drives that fit as CF-II cards. Some cameras use multiple types. Memory cards range in size from 16 Mega-Bytes (MB) to 4 Giga-Bytes (GB). Prices have fallen significantly in the last year. Today it is possible to get a 1 GB CF card for just over \$55. Memory Sticks may cost twice this. If you shoot low compression JPG then a 6 Mega-pixel camera may give 300 to 500 images on a 1 GB card. The difference depends on the camera and the ISO (higher ISO gives more noise which results in less compression). Some people do not like to "put all their eggs in 1 basket" and prefer several smaller cards (256 or 512 MB) so if one fails or is misplaced or accidentally erased, all is not lost.

Another parameter of these cards is the read and write speed. Cards are usually described by their "X" factor and are available from 1X to 80X. Kingston says their 50X cards read and write at about 8 MB/sec. Less expensive cards have a lower X factor. Older cameras are fine with a 4X card but newer ones with faster processors will benefit from a 10X and higher card. When reading the card into your computer, the speed difference will be noticeable.

While the cameras are designed to be connected to the computer by a USB cable to read out the stored images, it is a better idea to read the memory card by means of a card reader: why waste your battery. There are single format card readers and multiple (7 in 1, etc) format models that will work with any card. These are available as USB 1.1 and USB 2.0 interface devices, with USB 2.0 being 40 times faster. Name brand single format memory card readers may cost \$15-20 while generic multi-format models are about the same price. When you connect your PC to either the camera or the card reader, the memory card will appear as an additional hard drive on your computer. You can then transfer files to or from the card in the same way as a hard drive. On a Windows PC go to the START icon on your bottom task bar and click on MY COMPUTER. A list of all hard drives will appear. You can click on the new drive and find all your images. I normally copy them to a new folder which I make in MY PICTURES. Note that you can

also do the inverse process and copy files to a memory card to transport them to a store for printing. Storing and cataloging images is a whole topic in itself.

Do not reformat the card using the computer. Do it in the camera to be sure the formatted card is compatible with the camera file system.

External (Out of Camera) Image Storage

It is usually most convenient to transfer your images from the memory card to the computer hard drive, however, if you take a lot of pictures eventually your hard drive will fill up. Many people find they are taking many more pictures with their digital camera than they did with film. While the theory is that you can erase unwanted images while you are shooting, it is not always practical to do this. The time may not be opportune or, the image on the LCD screen may not be big enough to evaluate. How can you keep the hard drive in your computer from filling up? (1) Cull the images soon after uploading them. (2) Install a second large hard drive just for images. This may cost less for the drive but unless you install it yourself the labor may be prohibitive. (3) Buy an external USB hard drive for your computer. An easy installation, usually you just plug it in and it is recognized. (4) Burn the images onto CDs or DVDs. This works but is best suited to storing the originals rather than images you work on repeatedly.

All these work, but what if you are traveling? What are your choices then? You can take a laptop computer with you and still do 1,3 and 4 of the above, and have the advantage of also editing the pictures on the road. Sometimes that isn't practical. What do you do with the laptop while you are shooting? Will it be safe in your hotel room? There are a number of alternatives. These are called PSDs (Portable Storage Devices) and are designed specifically for storing images from memory cards. (1) The "Image Tank" type device. This is a small (1" x 4" x 6") battery/AC powered unit which uses a microprocessor to transfer the data from the memory card onto a small built-in hard drive of 20-60 GB capacity. It has a small alpha-numeric screen to show menus and status. These run \$200-300. Some examples are The Image Tank G2 and The Super-Digibin 2. (2) The next step up is a similar device but with a small (3.5") built-in viewing screen to look at the images. These have 20-80 GB storage capability and cost \$400-500. Examples are the Epson P2000 and the Nixvue Vista and units made by Flash Trax. (3) There are CD and DVD burning PSDs also. These battery powered devices take a memory card directly into them and burn the data onto the disk. The operating system allowed bridging disks in the case of CDs, and both CD and DVD versions accept multiple memory card dumps per disk. Cost is about \$200-250 for the CD version and \$300-350 for the DVD version. An example is the Delkin Burnaway portable CD Burner and DVD burner.

Another advantage of the Epson, Nixvue and CD/DVD burners is that they can output to a TV for viewing on a large screen. All of these PSDs can be used to read the files from the storage medium to a PC via a USB cable and conversely, you can write from a PC back to the PSD. As with the card reader described above, they appear as an external hard drive and can be read or written to in the same way.

Image Editing Software

Now that you've taken a digital picture and stored it on your computer, what can you do with it? Very few images are perfect as they come out of the camera. They can all benefit from a little tweaking whether it's increasing contrast or saturation to perk up the image, or cropping it to simplify the composition, or burning or dodging (darkening and lightening) portions of the image to bring them into a better range for printing. This is done using an image editing program. My experience is with Adobe Photoshop and Photoshop Elements on a PC (not a Mac), but there are a number of other programs that do very much the same thing. The advantage of the Photoshop series is that they are the most common program and you are more likely to find others who can help you with problems. There are also many books available on this software. The latest version of Photoshop is called CS2, which lists for about \$900 and sells for about \$600. Upgrades to owners of recent prior versions run about \$150. That's pretty expensive. Truthfully, you will find almost all you need to work on photographic image editing in Photoshop Elements for a lot less money. The latest version, Elements 3, lists at \$100 and sells for \$50-80. Unless you are a graphics professional, you would probably be fully satisfied with Photoshop Elements. I cannot even begin to explain how to use this software here. There are books 3-inches thick for that.

Printing Your Images

After you have worked on your images in a photo editing program you will want to save it and print it. You can do this on a printer at home or take the image to a photo finisher for printing. Costco and most large drug store chain stores have the capability to accept images on memory cards or CDs. There is usually a read-in device which you use to select the images to be printed, the number of copies and the size of the prints for each image. Prices are reasonable. Costco charges \$0.19 for a 4 x 6 print, \$2 for an 8 x10, and \$3 for an 11 x 14. You may have hundreds of images on your memory card but only want to print a few. While you can spend the time selecting which to print from the thumbnail images on the screen in the store, I prefer to transfer only the images to be printed to a blank memory card or burn them on a CD. To transfer them to a memory card, connect your card reader with the memory card in it to the PC using the USB cable. From your photo-editing program, open the pictures you want printed and save them to the hard drive representing the memory card. If you prefer, you can copy the files to a CD and burn them using your CD burning software.

Another interesting way to print and share your images is to use one of the on-line image handling services. Examples are [Snapfish](#) , [Shutterfly](#) and [Ofoto](#), now owned by Kodak. With these services you "upload" your images to their server. It is a simple process clearly explained on their web site. They provide an address at which you, or anyone you direct to that address via an email, can see the images. Once someone has established an account with the service, they can select any pictures they would like to have printed and will be charged only for the ones printed, which the service will mail to them. The cost is reasonable, running from 12-20 cents for a 4x6 print. This is a good way to share photos with friends and relatives or have prints made for you.

Alternatively you can print the pictures at home. Epson, Canon and HP each make very good photo printers. Be sure to use a good photographic quality paper recommended by your printer manufacturer. These are available in 4x6 and 8x10 sizes for standard width printers, and up 13 x 19 inches on wide carriage models. In the past, prints would fade in a few months from exposure to the sun and ozone in the air, but using the best papers and the recommended inks they now last from a few years to tens of years. Epson even makes some printers that use pigment based inks (as opposed to dye based inks) for prints that will last for 100-200 years.

In any case you must be sure that the monitor you use is reasonably calibrated, that is, what you see on the monitor must be the same as the finished print. This is not a trivial problem. How do you distinguish between a color tint or difference in brightness being due to the monitor or the printer? Photoshop (but not Elements) comes with a utility called Adobe Gamma, which will let you make a reasonable calibration. To find Adobe Gamma on your computer go to the START button on the bottom task bar and click on SEARCH. Then enter ADOBE GAMMA where it says FILES AND FOLDERS. This will find Adobe Gamma if it exists on your PC. You can buy a device to do the calibration for about \$100, or borrow one from a friend. I have never used one but have been very satisfied with the Adobe Gamma method. If neither is available then you must make a print and adjust your monitor to get the color, brightness and contrast to look the same as the print using trial and error. Not a good answer, but the best I can offer.

Scanners

There are 2 types of scanners for home use: Film scanners and flatbed scanners. Flatbed scanners are the most common type. A variation on the flatbed is the "all-in-one" scanner-printer-FAX which combines all 3 functions, however the scanners and printers in these units are not usually of the same quality as dedicated units made specifically for photography.

A scanner is a device which moves an array of photo-detectors and a coupled lighting array along a document or film frame. In a film scanner the detector array may contain as many as 8000 individual cells arranged in a line about 1 inch wide, which is moved in increments as small as 1/10,000 of an inch. Flatbed scanners may have as many as 3200 cells per inch, and move with a similar precision. The scanning range in a flatbed may be as much as 8.5 inches wide by 11 inches long. In a film scanner the light array is positioned on one side of the film with the detector array on the other, so that the image in the transparency is observed. Flatbed scanners have the light and detector on the same side, reading the reflection off the front surface of the document or photo. Some flatbed scanners had the capability to read transparencies also, by positioning a second light array in the cover so that the light shines through the film. These do not have as high a resolution and may not offer the same scan quality for film as dedicated film scanners, but might be satisfactory for occasional use.

The important parameters in scanners are the "dpi" and scan depth. DPI represents **D**ots-

Per-Inch and is a measure of the physical linear resolution of the scan. A higher dpi is the equivalent of more "mega-pixels". Note that at 300 dpi, an 8x10 will be the equivalent of 2400x3000 pixels or 7.2 mega-pixels. Scan depth is a measure of the number of levels the light information can be resolved. Most cameras store images with 8-bits per color (256 levels) in JPG but some use 12-bit (4096 levels) data in RAW format. Scanners almost all produce 12 to 16-bit (65536 levels) data. Film scanners are available with resolution from 3000 to 8000 dpi. Many offer useful special features which will reduce or eliminate dust and scratches, restore faded colors and reduce film grain. Nikon calls these ICE for Image Correction and Enhancement. Canon and Minolta offer similar capabilities but may use different names.

The Computer

Last but not least in importance is the computer which will be used to enhance or change the digital images. Forgetting the almost religious war between PCs and Macs, there are certain aspects of any computer that are important to digital photography. Primary is the screen with which you view the images. Get the largest size screen that is practical in terms of available space on your work area and cost. Even though you can magnify the image almost without end, it is useful to have viewing space to put the various menus, pallets and toolboxes that are part of the image processing software. Today there are many excellent LCD (flat panel) screens available at prices competitive with CRT (tube based) monitors. These LCDs now offer comparable high resolution and contrast range to the CRTs, however, some there have been some reports that calibrating them to the printer output may be more difficult than for a CRT. I have no first hand knowledge of LCDs. I suggest you talk to someone who uses one for photo-editing.

In the last few years the rate of increase of speed of the CPU, the brains of the computer, has not been as rapid as in the past. There is likely to be another noticeable increase in the next few years when 64-bit processors, operating systems and software become more available, but to wait for that or pay for it may not be cost effective. Processor speed may vary by less than a factor of 2 between the fastest and slowest computer. (Note: I am referring to Intel Pentium IV processors, not Celeron processors, which are slower, or AMD processors, which may be faster.) A bigger payback can be had by increasing the amount of RAM (Random Access Memory), the memory used by the computer in doing its calculations, in the computer. Modern operating systems demand a lot of RAM. Where 128 MB was sufficient in the past, 512 MB is acceptable today. Photoshop is a notoriously memory hungry program, particularly if you work with the large files made by 6-8 Mega-pixel cameras. When your computer has used all the RAM available it begins doing its computations using the hard drive which slows it down by perhaps a factor of 100 or more. On a few occasions I have run out of RAM even with 1 GB installed. Be sure your computer can accept 1 GB or more and have at least that amount in your machine.

The hard drive is where you will store not only your programs, but also your original images and those you have processed. Prices for hard drives today are low and most machines come with at least a 60-80 GB unit, some with as large as 300 GB. It may not

cost much to upgrade if you are buying a new machine, or add a second drive to an older machine. If you are handy you can install a second drive yourself. That is the cheapest way. If not, have a computer store do it. Alternatively you can easily add a USB or Firewire connected external drive, but it may be twice the price of the internal one. To install an external drive just plug it into your USB port and turn it on (for Windows XP)!

You should also have a CD or DVD burner, either internal or USB external model. This will allow for more permanent storage of original or fully processed images without tying up your hard drive. It also provides a cheap means of transporting images. CDs hold up to 700 MB of data while single layer DVDs hold 4.7 GB. A DVD burner will also burn CDs. The price increment for a DVD burner over a CD burner is not large. Today double layer DVD burners are available but at higher prices. The advantage is that they can store 9.4 GB of data, but it isn't often that much is required, and, the disks are much more expensive than CDs or single layer DVDs.