“Digital Photography and the Fire Investigator” is brought to you by the International Association of Arson Investigators. This Fire Investigator Distance Learning Project is made available by CFITrainer.net.

The instructor of this program is John Twomey, a Forensic Photographer for the United States Secret Service. John's career in law enforcement photography began in 1992 when he entered the "Forensic Photography Preceptorship Program" at the Dade County Medical Examiner's Department. John taught forensic photography to law enforcement and medical personnel from all over the world at the Dade County Medical Examiner's "International Forensic Photography Workshop." In addition, he was an active member of the Florida Division of the IAI and the South Florida Forensic Association. John taught at the "International Forensic Photography Workshop" on subjects including reflective photography of latent fingerprints, ultraviolet photography of bite marks and blood spatter photography.

John is currently working as lead Forensic Photographer with the United States Secret Service. He has taught crime scene photography to the Secret Service's Uniformed Division Crime Scene Search Unit, agents from the Bureau of Alcohol, Tobacco and Firearms, and has lectured at the National Native American Law Enforcement Association's annual conference.

Let us now welcome Mr. John Twomey . . .

I wanted to speak a little bit about crime scene photography before I moved into the digital realm. The first thing I always ask myself is why am I taking photographs? And of course, you want to document evidence and you want to document things at the scene. What is it usually used for? It's used to refresh your memory in court and supplement your notes. Also, if you take good photographs, you can look back on them later and you can look at things in the photographs and be able to understand them better or show them to other people and be able to see things you may not have seen before. And of course, the ultimate goal of any forensic photographer is the administration of justice.

The first thing I like to do in a photograph is take an identifying photograph, which includes some of the vital information from the scene being date and time, case number, etc. It's usually pretty important to just start off your show with that and then you follow it up with your photographs and you get an idea of what's there, especially if you're doing a lot of photographs, it makes a lot easier. In addition to an identifier, I like to do photographs at the scene of something permanent that tells you where you're at, and that could be a street sign, a house number, anything like that.

Overall, photographs help show the entire scene and they should be done from all sides, and they should try to exclude any extraneous detail. If you're inside at a fire scene or something like that, photograph all four sides of a room so you get a good view of the entire room, and make sure you're shooting wide enough so that you can see all the detail. If you need to take extra photographs, take as many as you need to document the scene properly.

Once you're done taking overall photographs, medium shots of particular areas of interest should be done showing items in relation to other things in the room, and that would be shots such as this. You have a melted light fixture in the middle. You can show it in relation to other things in the room so when you do another photograph closer of it, you know where it is in the scene. I just wanted to talk a little bit about that because I once had a photograph in court that was taken of something, a close up photograph, and I wasn't able to establish where it was in relation to the rest of the scene and the judge actually took that photograph out and disallowed it. So you have to keep that in mind that if you can't identify the photograph, you may run the risk of having it disallowed in court. Once you've done those medium shots, than you can do a close up of the items that you were doing so that you get a good detailed photograph of it, and you may also want to include a ruler in that so that you get an idea of scale.

I always photograph everything in a scene regardless of whether it may be important or not because really when we're arriving on a scene, you don't have a good idea of what's going on, and things may emerge later that become important. And these days, especially if you're using a digital camera, hard drive space is pretty cheap so you can take all you want. Work methodically through a scene, and that also helps with organizing photos later, especially if you're going to court. If you have a methodical approach to how you photograph the scene, you can lay it out for the court and the jury will have a better understanding of what's going on. And also make sure that before you do anything destructive, do all your photographs first.

Especially for arson investigators, I think flash photography is important. If you're photographing in a burned house or anything, you're always going to need that electronic flash, and it also works well in night scenes or outside areas where you're trying to fill in for shadows. Indoors you want to use it unless you're using a tripod, but for the most part, you're going to need to light scenes pretty well using a powerful flash.

This is an example of the backlighting where some cameras, especially newer ones, if they're set on automatic, have problems. The camera's sensor reads the entire scene and if it sees bright lights in some parts of the scene, it may decide to expose for those areas. In this case, the camera did just that, it exposed for the light in the windows while underexposing what we wanted to see, which is the scene. So by adding flash to that or manually overriding a camera and telling it that it has to flash, you then add flash to the scene and balance your lighting so that you can see what you're looking for.

In most cases, your automatic or through the lens metered flashes will work. In some cases, you may be required to compensate, and especially in fire scenes where you have really dark areas that absorb a lot of light, most flashes, especially good ones, have compensation on were you able to add and subtract from the automatic flash. So you may need to add exposure to them to make a better exposure.

Fill flash fills in shadows areas of the photographs so that you can evenly light a scene in outdoor conditions. Here's an example of a burned out car taken in bright sunlight, and while you can see some of the detail, there are areas in the shadows that you really can't see any detail. By adding a flash to this, telling the camera that it needs to fire, you can then balance the light across the entire scene.

Night photography is another area where the flash just doesn't fill enough. The flash maybe can go 10 or 15 feet, but if you're shooting a large scene, it's going to be underlit. It's fine if you're shooting something like this where your detail is right in front of you, but if you're shooting a scene, a very large scene, you're only going to light a short portion of it. By adding multiple flashes or what we call panning the flight, you can add light to the entire scene and be able to see what's going on there. In this case, you see there were probably ten to 12 flashes made using a long exposure on the camera and you're able to light a scene that's extremely dark otherwise.

The other way to light a night scene is without flash using a time exposure, and that's if you've got some other type of lights in the scene that will light it for you. In this case, this photograph is taken from inside a car showing the view that a driver in a vehicular homicide saw when he was traveling down the street. So by taking a time exposure, you're able to see the natural lighting in the scene as well as what the driver may have seen.

What do you need in a camera? Well you need good flashes, you need a lot of lenses, be it zoom lenses, macro lenses, tripods also, cable releases for shooting on a tripod if you need that. All the accessories, including batteries, rulers, film or digital media if you're using a camera, a digital camera, and also, of course, a good camera. High quality optics are pretty important, and multiple lenses also help. If you've got a wide angle, a normal and a telephoto lens, you're in pretty good shape, and also, what's very important, what I've seen from many of the arson investigators that I've talked to is that you need a good macro lens that's capable of focusing one to one which means it can take a life size photograph. Some zoom lenses have a macro built into them. However, it's not quite as good as if you get a true macro lens that's made for close up focusing.

Another thing that's pretty handy is a wide aperture lens for shooting in lowlight, and that means that it goes to wide opening to an F stop of about 2.8 or maybe even wider. A powerful electronic flash is pretty important, especially if you're doing arson photography. You can get a little pop up flash on a camera and use it. However, it's just not going to give you the power that you need for big scenes or for scenes that are very dark where a lot of light is going to be absorbed. In addition, some of these other features are bonuses when you go looking for flashes.

A rugged camera is pretty necessary, in my opinion, for anyone doing investigations, especially in dirty, nasty scenes, and if you're anything like me, you beat the heck out of your cameras. I drop them, I bounce them off things and I need a sturdy body that can handle that kind of punishment. And in addition, there are other features such as interchangeable lenses, flashing, different focus options and the ability to focus in lowlight that are very handy for anyone doing crime scene photography.

Some of the considerations that I think are pretty important that people forget a lot is to actually practice with the equipment you're going to go out and shoot a crime scene with. Don't go out and just start shooting a scene when you haven't used the equipment, and especially true if you're just getting into digital photography. Most people who consider themselves photographers feel comfortable with anything. However, if you're switching from film to digital photography, it's quite a different medium and you really do need to practice with the equipment to be comfortable with it. You also need to know all the different features of your equipment and what it can and can't do.

The other things that are pretty important are to make sure your equipment is working properly and that you have the proper film or digital ISO settings for the scene that you're photography. Meaning, are you shooting in lowlight where you're going to need a high ISO or are you shooting in bright sunlight where you might need a lower ISO. Those are some of the considerations to keep in mind.

Well, of course, when you do any kind of this photography, the ultimate goal is to get the photograph submitted into court so that you can get the administration of justice that we talked about earlier. You need to be able to make sure that your photographs accurately depict the scene to be admissible in court, and that means you have good composition, good lighting, good color and accurate focus. And the photos cannot be prejudicial. That means no unnecessary details in there which may inflame a jury.

When presenting, you need to be able to tell certain things about your photographs, such as where they were taken, how they were taken and the orientation. And like I was saying earlier, I once was not able to tell the judge that, and therefore, got a picture thrown out. So you need to keep that in mind when you're taking the pictures and when you're presenting them.

Everyone always asks are digital photos admissible in court, and the answer is in most jurisdictions that I've heard of, yes. I've never heard of any case, and as far as I know, there are no known cases where a photograph was inadmissible solely due to the fact that it was taken with a digital camera. But obviously, you're most important thing to do is check with whoever your prosecuting attorneys are, be it a state, district or assistant U.S. attorney, and ask them whether it's okay.

Included in your reading are a bunch of cases involving digital photography, and I wanted to talk about a couple of them because I think they're pretty important. Ahmen versus the State is one of those cases, and I just pulled out one little quote that basically says what I think is true with digital photography, and that is that there shouldn't really be any difference between admitting a photograph taken with a film camera and a photograph taken with a digital camera. As long as the investigator can go into court and testify as to the accuracy of the photograph, than it should be admitted.

A couple other cases that involve digital photography, State of Washington versus Eric Haden, and Florida versus Raos, where digitally enhanced photographs, digital photographs were subjected to Frye hearings. In both cases, the digitally enhanced photographs went through the Frey hearing and were accepted into trial. In one case, it ended up in a conviction. The other one ended up in an acquittal. However, apparently the acquittal in that case was not due to the fingerprint evidence.

Image authentication I think, and especially will be more important as time progresses because there are a lot of software companies out there pushing this type of thing for digital photography meaning image authentication software or water marking software that allows you to be able to tell whether an image has been changed from the original. There is also another way to authentic images, and that is by setting good procedures in place that you're able to go into court and tell the court that the photograph you took was immediately put on to some type of media, and that it is the same as when you photographed it.

Software out there claims that it can insure that one image is identical to another, and it does that by looking at the file structure and using algorithms to verify whether there have been changes made. My opinion on some of this is that if, like any other software, if you want to defeat the software, you can depending on the time you want to put into it. Is it necessary or will good standard operating procedures suffice?

The original image should always be preserved for the court, and steps should be taken so that you can present that to the court. That means good SOPs, chain of custody procedures and witness testimony, and if you're going to make changes to a digital photograph, either software history or written notes can be used to show the techniques that you used. I'm a member of the Scientific Working Group for Imaging Technology, which addresses a lot of the issues in digital photograph, and one of the things we will be addressing is the image authentication issue so that we can better understand the software that's available and how it works and whether it's actually necessary for law enforcement and investigative photography.

What captures light in a digital camera? It's not film. It's a sensor inside the camera. What it does is it takes that light and it turns it into an electronic signal. Sensors made up of thousands of pixels, and I'm sure everyone's heard about the megapixel cameras, the bigger the better, meaning the more pixels you have, generally the better the image is going to come out. Well how big do you need? That's a question everybody asks me. Do I need a ten megapixel camera, do I need a 12? Well really it depends on what your output is going to be. If you're an investigator doing highly detailed photographs, than, yes, you need a higher megapixel camera. But if you're a first responder on a scene, just snapping photographs to document what's there, you probably don't need as high a megapixel camera. So keep that in mind if you're purchasing cameras for first responders or for investigators.

This is kind of a look at what an image sensor in a camera looks like. The actual image sensor only captures in gray scale, however, they actually paint colored filters on to each pixel separately. So it kind of looks like disarray although slightly different. The sensor captures those images and then the camera software actually makes up the other colors to complete the photograph. When you're looking at cameras, why, if you're an investigator, would you want to buy a low quality digital camera? Well obviously it doesn't cost very much, and that's an important thing. Especially if you're buying a lot of equipment or if you just don't have a very good budget.

But the thing about it looks good on the monitor, I'm sure everybody's said that and then printed out a photograph and it looks pretty bad. So you had to keep that in mind that the resolution on your monitor is a lot lower than printing resolution. So if it looks good on the monitor, it's not necessarily going to look good in print. The nice thing about low quality cameras is they are easy to use. There are not a lot of changes or anything. But if you're a professional doing evidence photography for investigations, you should be using professional equipment.

One of the survey questions out is do you use digital photography, and it looks like the results are pretty mixed. You've got, yes, some used consumer quality point and shoots, yes, let's see, most people use professional cameras or point and shoot cameras. Okay. Not many using high quality professional cameras, and I guess that depends on what your role in the investigation is. Most of the people, we've got 37% using prosumer and 30% using point and shoot cameras. So that's pretty interesting. I, on the other hand, use a professional camera with multiple lenses that I can make changes when I need to.

Consumer cameras, which a lot of you are using, I'm sure you know that they're a little bit cheaper, they have smaller CCDs, although now you can get them with larger sensors. So most of them now are in the six to seven megapixel range, maybe even higher. However, they do have some drawbacks, they have poor CCD quality, meaning that the sensor in it is not very good. They usually have lower quality optics, so the pictures aren't quite as sharp. They're usually slow writing to the memory cards, and I'm sure everyone's felt this when they take a photograph, and it takes maybe three seconds for it to actually take the picture so that the consumer cameras usually are a little bit slower than a prosumer or professional camera. And of course, they don't really have a lot of features. You can't make a lot of changes as far as shooting in manual settings or adding flashes, that type of thing.

Prosumer cameras, as they're called, they're kind of the middle of the road. They have a better sensor size, they usually have better optics, they're a little bit quicker, they have lots of extra features, and one of the things that I really like about most of these cameras is you're able to shoot in an uncompressed format, meaning, well, we'll get into it later. But they are usually a little bit more expensive.

Professional cameras are your top of the line digital cameras. They have large CCDs, they have the ability to change lenses and the ability to use any kind of lens that the manufacturer provides, which is pretty nice. They're usually pretty quick taking the pictures and writing to memory. You're able to use external flashes on them as opposed to just using the built in flash on the camera, and they usually have pretty durable bodies. However, the drawback, and I'm sure everyone knows this, is they are pretty expensive. However, the prices are coming down on a lot of the good professional digital cameras, so don't be deterred by price.

Lenses, when you're photographing with a digital camera, especially one that's a professional, the sensor inside that camera is actually smaller than the size of 35 millimeter film, so it changes the effective focal length of the lens. When you're using your removal lens, you actually lose distance. So if you're shooting with a 200 millimeter lens, it will become a 300 or a 50 millimeter lens will become a 75 millimeter. So keep that in mind why you buy a camera and when you buy lenses. You may notice that like a wide angle lens of, for instance, a 36 millimeter, which is a standard wide angle lens on a film camera actually becomes a normal lens on a digital camera. So you have less of a field of view when you're taking the photograph. So if you're out on a scene and you're using a digital camera with a wide angle lens, you may need to get an actual wider angle in order to capture more of the scene. So that's something to keep in mind when you're buying your cameras and when you're looking at the lenses that you have in stock.

Some of the important accessories when you're using a digital cameras are batteries. Obviously, you carry a lot of batteries out on a scene because you don't want to run out, and people forget, when you're looking at the monitor on a digital camera, the more you look at that monitor, the more batteries you're going to burn, and they burn through pretty quickly. You also want lots of media, especially when you're buying these higher megapixel cameras. The more megapixels you have, the more drive stick space you're going to be eating up. So you're going to have to go out and buy some large compact flash cards or SD cards or whatever cards your camera takes.

In addition to the camera itself, you also have to keep in mind the things that you're going to need when you come to the office to process and download your photos. You're going to need a good computer with lots of memory, multiple disk drives, lots of ports for plugging in devices such as the camera or adapters for the media cards, you're going to need card readers that can do multiple types of cards, a pretty large hard drive if you're going to be storing images on your computer itself and a CD or DVD writer in order to save those images.

I wanted to talk a little bit about printing because when we look at digital photographs, like I said earlier, you look at them on the screen, they look pretty good, but when you print them out sometimes the quality isn't quite there, and that's because screen resolution is a lot lower than printing resolution. Some of the common printers I'm sure most people have in their offices are ink jet printers because they're cheap, they're easy to get. Unfortunately, the ink media is a little expensive for them, but they're kind of slow. Dye sublimation printers are a little bit higher quality than ink jets. However, they're also a little more expensive, but they print at a higher resolution. Then when you get into quite a bit more expensive, you have laser printers and photo quality printers that actually print and go through a photographic chemistry.

Print resolution. Ink jet printers can print pretty much at every resolution, but if you were to print them at like a screen resolution which is 72 pixels per inch, they wouldn't look quite as good as if you boost up their resolution to a 15 or 300 where most other printers such as the dye sub or photo quality printer will print around 300 pixels per inch so the quality on the image is a little bit better and you get better detail. Here's just a little chart that shows some of the different resolutions you would need for printing at certain resolutions within interpolating or up sampling the photograph. And that means without creating information in that image to make it larger.

I'm sure everybody's seen grain on a film camera. When you shoot at higher ISO's you get those little, it looks like sand grains on your images. Anyone who's done that with a digital camera and seen that same type of grain, it's called digital noise, and it's a collection of electrons at the pixel sites, and it's caused usually by lowlight or underexposed photographs, long exposure times, sometimes heat and especially high ISO settings. So if your camera gives you the ability to change high ISO's, you want to stay to a lower ISO photograph.

Working with the Secret Service, we get to do a lot of the larger events that go on that involve protection related things. So I went out to the Olympics and this is one of the photographs that I took at the Olympic Village. It was taken at night, and it's not a bad photograph, but it shows a good example of digital noise. If you zoom into the darker areas, you can see all the little sand like grains in the darker areas of the photograph. And that's digital noise caused by the ISO setting on the camera in the lowlight shooting at night.

So what do you want to do to combat digital noise? You want to shoot in low ISO settings if possible, meaning, if you're shooting in daylight, try shooting at 100 to 200 ISO, and if you're shooting at night, you can go to 400 and maybe 800, however, you don't want to go too much higher than 800 depending on the camera you have. Some cameras are better at reducing noise, some have a real problem with it. Also, if you're shooting timed exposures at night, you want to try to keep that exposure to a minimum amount of time, as low as you can go. There is noise reduction software available out there. So you keep that in mind, but you want to use that as a last resort.

The most common file formats that are out there for photography and digital stuff, and I'll include video on there, is JPEG, MPEG, TIF, and TIF actually has a compressed version called TIF LZW, BIT MAP or RAW, which is the native formats built into some newer digital cameras. I talked a little bit about image compression. Compression actually makes an image smaller by eliminating some of the information in it so that it can be saved on a hard disk at a lower resolution or use up less space on the hard disk. However, if you compress an image too much, you're going to lose image quality.

Can we go on to the survey about image formats? This is a photograph taken of a fingerprint shot at either uncompressed or a very compressed setting. It looks fine at this setting, and if you zoom in closer, you can see that there's quite a bit of detail there. If you go onto the next photograph, at this size, it's kind of hard to tell, but this graph was compressed quite a bit. So it takes up extremely less space than the uncompressed or lower compressed photo, and if you zoom in, you can see that when you compress it a lot, you really lose a lot of detail. You can't really see any detail in this. So if you're doing photographs that require detail, you have to be careful.

Looking at our survey, pretty much what I expected. Most people use JPEG settings. A) because it's convenient, B) because it saves you a lot of hard drive space. We do have a few people using RAW, which is pretty interesting. The RAW settings on a lot of the digital cameras are kind of nice because they lose less space than a TIF file, which is a totally uncompressed setting. The RAW is uncompressed, however, it takes up less space on the media card and gives you some greater abilities.

JPEG's, if you're going to use them, which clearly a lot of people are, try and make sure that you use them on the lowest compression setting and the highest resolution. I think that's pretty self-explanatory. If you've got a good quality digital camera, you want to use it to the best of its ability. The nice thing about it is it does allow you to shoot a lot of photographs on a card and save them onto a disk without using multiple disks. There will be a light loss of image quality. One thing that I want to mention about JPEGs also is if you're doing work on them after the fact when you go back to your office, try not to resave them multiple times as a JPEG. The more you save it as a JPEG, each time you will lose a little bit more quality on it.

TIF is what I would prefer to use, although I must concede that sometimes it's difficult to use it, especially if you're using a large megapixel camera. A six megapixel camera shot in TIF mold will yield an 18 megabyte file. So you really chew up a lot of space if you're doing a lot of photographs. However, it does have the highest quality and there's no image degradation from compression issues. RAW is a nice format for some of the cameras. It takes up less space than TIF, but more than a JPEG. However, you do need proprietary software from a manufacturer. It usually has to be converted into a TIF or a JPEG for printing or distributing to other people. So that's the little drawback about RAW.

Some of the things to consider when you're taking photos is you really do need a hard drive in your computer if you're going to be storing and working on a lot of images. You need lots of memory cards. It seems like I keep buying memory cards and I keep needing more. The nice thing is the prices are coming down. You can get one gigabyte cards for relatively cheap now. So you can get one, two, I think they're up to eight gigabyte cards. I don't know how most people are archiving theirs, but I would guess they're probably using CDs or DVDs. So keep a lot of those on hand for backing up files. And if you're shooting in a large agency or shooting a lot, you may need to look like a ray device or some type of server that gives you huge storage options and also secure backups.

Now I wanted to talk a little bit about enhancement because we've seen some of these issues come up recently with enhancing digital photographs, and whether by enhancing it you're actually changing the image or not, and this is I think probably the biggest issue when it comes to digital photography is, yes, it's easy to enhance an image, but also you have to remember you're going to have to testify as to the integrity of the image. So when you enhance a digital image, are you improving image quality or are you actually altering the image? And that's up for debate. You can make changes to something, but if you go too far, yes, you may be altering detail in that image.

If you are doing any kind of major enhancements, you should always do it on a copy rather than using the original image. So you maintain your image and then you make a copy that you then make the changes on. That way if there are any questions later on, you can show the original image and the enhanced image and compare or contrast them. And if you're using advanced techniques, you may want to document them or using software that will record the history that you use or by taking written notes.

There is software available that will save your edited history so that you can save that as a attachment to the file itself so that you can look at exactly what you did to a photograph later on. One of the other things that most people forget about, but you really should take some training if you're going to be doing any kind of enhancement or manipulation to images so that, A) you know what you're doing with the software, and B) if you go to testify in court, you're more comfortable talking about that software. I see, based on our survey, that most people will save the image on write only media prior to making any changes, and that's pretty good. So the other ones may want to consider first burning it to a CD or some other type of media and then making a copy so that you can keep that original image.

This is a little example of some basic image enhancement techniques. There are a lot of other techniques out there that are pretty more advanced, and the more advanced you get, obviously the more training you're going to need. In addition, you want to document those things. However, these image enhancements here are pretty standard to photography and have been for quite a long time. So if you're doing these, printing an image, you probably don't need to be making a duplicate. If you're just making a slight brightness or contrast adjustments or resizing or cropping part of the image, than you're probably pretty good as far as if you do it from an original and make slight changes, you don't need to save those images.

I wanted to talk a little bit about some of these changes. Contrast in brightness adjustments. If everyone can see, in the slide they're a little bit small, but in the middle of the photographs are a little box where you can change the lightness or darkness or the contrast of an image and you can see the little histogram in there. By moving back and forth in the histogram, you change the lightness or the darkness of that image, and that usually is done to improve image quality. So in the slide on the left the image is kind of dark, and what I did was just, there's a little slider in the middle, I grabbed it and dragged it over and made the image lighter. And that's okay, all you're doing is making it brighter so you can see the details a little better.

Dodging and burning is another one that's been kind of controversial, and that's where you actually selectively brighten or darken certain areas of the photograph. On the left hand side is the original again, and on the right hand side, you can see in the middle I've actually brightened up certain areas of the scene to make them lighter. And that's also okay as long as you're not drastically altering the image. Certain little dodging and burning to areas that may be dark or too bright is all right to do.

Resizing is actually changing the pixel count of an image, either up sampling, which is adding pixels, so you can make a picture larger, or down sampling, which is throwing away pixels to make an image smaller. You have to be careful when you're making images larger because if you go too large, and I'm sure everybody's done this, where they've blown a picture up so large that it looks very pixelized and loses image detail. And if you print stuff, most of the printing software will automatically resize it for you. So just make sure that when you do that you don't go up too large. Cropping is also something that you can do which is just cutting out parts of the photograph. As long as you still have the original with the full image on there, than you're in good shape if you want to print a cropped image.

Whiteness and color balancing are also things that have traditionally been done for a long time, and that just is simply making the picture accurately reflect what you've seen either by balancing the color or by changing the white balance a little bit to make the color accurate to what you saw. For the most part when you're printing, on a lot of cameras, the photos don't come out very sharp so basic sharpening of an image is also something you can do to make a higher quality print. You just have to be careful sometimes if you over sharpen an image. Here's an example of an over sharpened image. On the left hand side is the original image, and on the right hand side, I way over sharpened it so you can actually see a halo on the edge between the light and the dark areas, and that's what sharpening does. It increases the contrast between dark and light areas to make it appear sharper to your eye. So you have to be very careful about sharpening and over sharpening an image. You will then tend to lose image quality where what you originally were trying to do is gain image quality.

Now some of the techniques that should be avoided when working on forensic images are selective adjustments of certain areas in addition to spotting, erasing, rubber stamping, cloning, anything that actually deletes parts of the image, and this is I think where the big debate about digital photography started from is the ease with which you can take something out of a photograph or add something in. This is the selective adjustment I was talking about where you actually select part of the photograph and just lighten that area up. It's slightly different than dodging and burning. So you can do it, but you should avoid it if at all possible and just use a dodge and burn technique. Obviously, the spotting, erasing, rubber stamping, you should never do that when you're working on a forensic image. Everybody see what I did on this one? Left to right? I took the fingers out of there. So that's something that should always be avoided is altering, this is what you would call altering an image as opposed to enhancing an image.

What software do you use? I get asked that a lot and unfortunately, I can't really recommend specific companies, but some of the things you want to look at are a good image editing and printing software, and the most expensive solution, and I know there are some pretty expensive image editing softwares out there that a lot of people use, but there are other options which are less expensive that will do everything you need, and so you need to look closely at what your needs are. If you're only doing basic image adjustments such as the contrast, color, that type of thing, than you don't need the most expensive software out there. So keep that in mind when you're buying software, and you also have to keep in mind that when you buy that software, you have to continue to buy upgrades and stuff like that so the cost is not just the initial cost.

If you're going to be burning to CD or DVD, you need software for that, whether it's built into your computer when you buy it or when you buy your burner later on. One of the other things that I think is really important for anybody using a digital camera is data recovery software, and that allows you to retrieve deleted images from a storage media, and I don't know about you guys, but I've done the mistake of deleting images repeatedly from a card when I actually needed them or had forgotten to download them or deleted one by accident off a computer and then went back to a card. So there is recovery software that will allow you, as long as you haven't photographed back over the card again, to recover deleted images from the media. So go out there and buy that if you can, and they're actually quite cheap. So it's something to keep in mind.

Digital asset management software is also pretty important, especially as you shoot more and more digital photographs. It allows you to archive the images so that you can store them in a logical sequence, be able to view them and organize them on your computer or other devices. There's also the other softwares that come with the cameras, the printers, and then there's specialized softer that will do noise reduction or sharpening or some of the other special techniques that I talked about earlier.

Some of the pros to digital photography. I think everyone has kind of learned, you can view your images immediately and sometimes people actually forget about that, but you really should take advantage of it, if you have a digital camera, is viewing those images so that you make sure you've got exactly what you need. You don't have to process or send out your photos to a lab, so your expenses down the road are a lot cheaper. You don't have to pay a lab to process or do it in house. Another nice thing about a digital camera is you don't have to keep changing film for different lighting conditions. The cameras will see any lighting conditions. You can change for shooting in fluorescent lights or you can change for shooting in daylight immediately. You can also digitally send those files over the net or email them or do anything you need to do to them as long as it's secure. And the ability to make corrections and enhancements is a big bonus to the digital photograph. In the long run, you really do save money if you move to digital photography. You have to look at the long run and what your agency can do. Yes, there is a large up front cost, but you will save money over time.

Some of the cons are the expensive up front costs. Getting the camera and the lenses and computers and things like that, cards. It does add up if you buy them all at once. Yes, we talked a few minutes ago about people like me who have a tendency to accidentally delete images. That is a danger to digital photography, but as long as you have a good recovery software and you know that you need to recover something, it's not as much of an issue as it once was.

The thing about digital cameras, and it's kind of changing now, but the cameras are pretty expensive for the quality you get. To get the best quality, you have to spend a lot of money, and if you use a low end camera, you don't necessarily get the best quality as you would with a 35 millimeter camera. You can buy a pretty low end 35 millimeter film camera and still get the same quality. Printing digital images sometimes can be slow, especially if you're on a ink jet printer. If you move to something like a photo printer, the speed is the same as it is with film.

One of the things that is unknown about digital photographs is what are we going to do for the long term archiving of these images. Right now, if you put them on a CD or DVD, it's unknown how long those can actually last. It's been said that CDs and DVDs will last quite a while, maybe ten, 15 years under ideal conditions, but they do degrade in ultraviolet light or humidity will degrade a CD or DV a lot quicker. One of the other things that we did as a simple solution to save the CDs a little bit more is they make CD writable pens that are using inking that won't dissolve through the layers on the CD. So go out there an buy one of those if you're using Sharpies or something to write on your CDs or DVDs, it may damage them down the road. And also, sticky labels have been said to damage the CDs or DVDs.

The other thing about software and hardware with digital photography is that everything is changing so quickly that things may become obsolete. If you were to archive a CD and come back in ten years, we may be using different file formats or different operating systems that won't be able to read that stuff. So keep that all in mind when you're making the transition or when you're archiving your items.

I wanted to look at the survey, and it talks about written SOPs. We've got about three to one that don't have SOPs, and that's pretty interesting. So the large majority of you do not have written standard operating procedures, and you may want to consider writing something down so that you've got procedures in place that you can show to the court that tell them this is how we do things, it's standard each time and you will, I think, serve yourself better if you do go into court.

Some of the other things you have to consider when you're doing your operating procedures is handling the digital images. They should be protected and archived as you would film, meaning you save them and you also need to make sure that you're backing up your images. The one thing about digital photography is that CDs or DVDs may fail on you, so you want to make sure you have some type of back up. And also, those major crimes that are where you have to keep an image forever, you have to make plans for backing that up down the road.

Also make sure that the guys that are out there using the equipment are trained. I know it's hard sometimes to get training. You kind of get a camera dropped in your lap and you're expected to walk out the next day and start photographing a scene, but you want to make sure you get as much training in the equipment as you can, read manuals, practice with it so that when you go out you're prepared and your equipment is ready to go for you. You also want to make sure that if you're shooting with cameras or you're back printing that everything is calibrated and maintained so that things are consistent and image quality is as good as it can be.

I'm going to say this, and judging by the response on who uses different formats, I prefer if you're shooting for forensic work to shoot in an uncompressed format, but I do also understand that the compressed format is the choice for most people. So if you use a compressed format, just make sure you use the lowest compression possible and don't repeatedly save that compressed image. The other thing I would say is you're working and doing any kind of comparison work, that you may want to shoot those in an uncompressed format. Any examiner who is doing detailed work on something would probably want an uncompressed format for their comparisons.

One of the other things you want to keep in mind, and some people don't do this, but may want to consider is to copy the originals on to a read only media such as a CDR or a DVD as soon as possible. That way you've got the original image in a state that it can't be altered quickly so that you don't make changes to it accidentally or delete it accidentally. And you always want to save the images in their native file format. If you shot it as a JPEG, you don't to convert it to a TIF and save it as that. Just save it as a JPEG and save that original and then you can make changes later on if you need to, but always make sure you have the original saved in its original format. And if possible, most cameras these days will record data to the image file such as the date and the time and sometimes even a serial number or something for the camera. So use that if you can, it's a good backup for saying I shot this at that date at that time. If your camera can corroborate that by showing you the data in the file, than that's good, but you also have to make sure that you have the correct date and time. Sometimes if the battery dies or something, the time will reset, so keep that in mind when you're using that stuff.

When you bring the images back and you're in your office working on them, be specific in a standard operating procedure about what techniques are okay to use and what are not. That way anybody using the equipment can't say, oh I thought I could remove those fingers from the image. Nobody told me I couldn't. Be specific and say contrast and brightness adjustments are okay, but rubber stamping images is not. So that's pretty important. And also be specific about what should be documented in notes or not. Do you need to document everything? No, I don't think so, but do you need to document major changes? Probably.

You want to save the original work on a copy. I've said it probably four or five times, but it's pretty important. You always want to keep that original, and that way if you go into court, there's no questions about, you know, did you make an alteration that actually changed this image or did you just make an enhancement that made it look better for printing. So always keep that original on hand so that you can show it to the court if you need to. Back up those images to some other type of media because you never know if a hard drive crashes or a CD doesn't work. That's pretty important.

How can digital photographs benefit you at a crime scene? Well you can always make sure you have the photograph. Sometimes you may be in difficult lighting situations or really dark areas. If you take a look on that screen and make sure you've got that photograph, than you're ready to go. You can make color balance and ISO changes easily on a digital camera without changing film or cameras. On some cards, you can shoot five or six hundred shots at a time without changing film. So that's a nice bonus. Also, you can view those images immediately, you can transmit them somewhere if you need to and you can shoot lots of photographs without incurring adding processing or printing costs, and that's kind of nice. So the more you shoot the better.

Some of the considerations that I've noticed over time of shooting this, and this is one of the things I've said, you kind of need to get comfortable with digital photography as opposed to just shooting film if you're just making a change, but digital chips have a sensitivity similar to slide film meaning sometimes there's less latitude and a picture can easily be over or under exposed. So you may need to take a couple of different shots to get a better exposure of something. It is better sometimes to be under exposed than over exposed. I'm sure everybody's probably noticed this. If you take a photo and it's kind of over exposed with a digital photograph and there's areas of just bright light, you can't get any detail back in those areas because once that image is white, if there's any white there, it's going to stay white. On the other hand, if you're way under exposed and you try and brighten something up, you're going to introduce noise into that photograph. So those are some of the considerations. If you think you're under or over exposed by too much, feel free to take a couple extra pictures because all you're doing is adding more space on your drive.

For those of you using a camera that has interchangeable lenses, some of those cameras, if you take the lens off you can actually get dust into the camera housing when you are taking lenses off. It will get into the camera housing and actually get on to the chip or the filter that covers the chip, the image sensor, and if that happens, you end up with black spots on your images, and it's pretty difficult sometimes to clean them without damaging or scratching the chip. So keep that in mind if you are changing lenses, especially at fire scenes where you've got a lot of dust floating around that you want to either not change the lenses or go somewhere safe and change them. The other thing that I do a lot is if I'm changing lenses and I'm in a dusty area, I hold the camera down so that the lens opening is facing downward. That way, it's more difficult that the dust will fall in if the camera is facing downward. They make the blower brushes that you can use to clean out the inside of a camera, and they also make swabs and other things to clean the chips because if you damage that chip, you've pretty much destroyed the camera.

All right, now we're going to move on to questions. I've got a slide down here. Thanks for asking that question. Actually, that was something I wanted to address and had forgotten. There are, in the reading list, a couple of different examples of how to write SOPs. I think the English version is an actual SOP and it's extremely detailed. It's excellent, but may be a little too detailed for a lot of detail. The Swiggett guide to writing an SOP is very general, and that's kind of the downside. It's hard to tell people exactly what to put in an SOP. I get this question a lot. What should I have in an SOP? I'm not in the practice of telling people how to run their shop. So I tell them some of the things, and I've gone over some of them in the slides and you can look back on them.

Some of the things that you need to consider are the enhancement techniques you're using, how you go about photographing how your camera is set, how you download your images, how you make changes to your images. Do you burn them to a CD or do you just leave them on your hard drive and back them up at regular intervals. Those are some of the considerations. That is an open question. That's kind of why the Swiggett guidelines are very generic because they're speaking to a wide audience. You're talking to people who are doing it on their own or maybe a single person, a small agency up to large federal agencies. So everybody's going to do things a little bit differently. But as long as you write one that you're comfortable with that has specific procedures for making sure your images are saved, are in the same format and there are not alterations made to them, that nobody else can make changes to them and that you're able to get them into court and be able to tell the court that this is an accurate representation of what you saw at the scene, those are what you need to consider when you're writing an SOP.

I'll start with Mr. Sheldon asked what do you mean by perpendicular to the scale? That means if you're photographing with a scale, you want to shoot directly on to the scale because if you shoot it at an angle to the scale, it will be distorted in the photograph. So if you need to reproduce it at the same size later on, say you need the exact size to print in court, if you haven't shot directly straight on to the scale, reproducing it at the exact size will be difficult. So always try and shoot directly at the scale.

Mr. American says how do you paint with light or add multiple flashes? I could talk about that for quite a while, but I've actually done courses on that that take a while, but quickly I'll just go over that. You need to open your camera up and make one long exposure with your camera and then take either a flash or some other lighting device and manually fire multiple flashes in your scene, and that's the quick answer to that. Unfortunately, I can't make a long answer out of it.

Mr. Bates asks, what, in your opinion, is the best digital camera for this type of photography or what camera do you prefer? That's kind of a tough one. Actually, any of the major manufacturers make excellent cameras, and I really don't see any downside to any of them. So I'm not going to necessarily recommend a specific camera, but they are all pretty good. The next question also is do you have a recommendation for a digital camera? Canon Revelex T or other is, yeah, any of the Canon, Nikon, Olympus, Sony, Fuji, are all excellent manufacturers and they all make good cameras.

What kind of focus options do you look for? The main focus options that I look for are does it allow you to focus manually. Almost every camera will focus automatically. But are you able to focus manually, especially if you're focusing in macro situations where you're very close up to something, I like to have the ability to focus the camera manually so that I know I'm getting a good photograph.

Mr. Belancia also asks what kind of situations would you practice shooting to familiarize yourself with new equipment? Pretty much everything. I'll shoot around the office, I'll take it home, shoot my wife and my cat, and I'll go out and shoot sports. Anything, as long as it gets you using the camera and playing with the different features. So shoot some in daylight, maybe shoot some in darker night time situations, go out and shoot in difficult bright light or I've gone out and shot in the snow, which is really difficult to shoot in. Any time you do that and you see the results, you learn the more about how your camera works.

Doesn't zoom distort the distance to an object Mr. Sheldon asks. Yes, it does. If you're shooting with multiple lenses, including wide angles or zooms, wide angles and zooms will distort distances and wide angles especially have a tendency to distort even the view in an image. For overall photographs and things like that, I don't see a problem with using a wide angle lens to just show the scene. However, if you're doing any kind of photography where it involves distances or your taking the medium shots of particular objects, than you should use something close to a normal lens, which in film photography would be about 55 millimeter and may be a little different on some of the digital cameras.

What kind of devices and techniques do you use to orient the photo? I pretty much, most of the time will just do a photograph that shows part of the scene. Like if I do a wide angle of a room, I can see certain things in it. As long as I have a wide angle of the room and then I can do a medium shot that shows, say, an item sitting on a table, than I can do the close up of the item itself. As long as I have the sequence of photos that shows the wide angle, the medium and the close up, than I should be able to orient it that way. I don't use any kind of markers in the scene unless I'm marking multiple items of evidence in a scene if that's kind of what you're asking.

One lawyer I heard tried to get digital images excluded because transferring the image from the media to hard drive constituted, I'm not sure, interpolation maybe was what you're saying? The spelling I couldn't quite read. I haven't heard that, but from everything, there's always going to be, if you're transferring from one image or from one system to another, software issues, but for the most part, when you transfer a file, my understanding is that you're transferring the image itself and there should be no changes made to it in the transfer, though I may be wrong on that.

What chain of custody do you recommend for images, media, printing, and what this chain needs for originals? Well, again, it depends on what your chain of custody is for the photographs. If you had a chain of custody for film photography where the film was shot at the scene, it was handed of to the photographer in the lab, and the photographer printed it, gave the prints to the investigator and then filed the negatives in a file in a lab, you should do something similar to that with digital. You take the photographs at the scene, you bring the card back to your computer and you immediately download it to a secure media via a hard drive or CD or DVD, the photographs are printed, the photographs are given to the investigator and the original digital images are archived into either a case jacket or some other area. That really depends on what your chain of custody on photographs is.

I've worked in a police department where the chain of custody was the negatives were kept in a file locked in the photography section or the crime scene section of the police department. So that's simple enough to do with CDs. You do the same thing essentially. Then here we usually distribute them out to the investigators, and they take care of the chain of custody of the images after that. So it all depends on what your department or agency has done in the past, and you just kind of keep it similar so that you can track exactly where those images have been. There is software out there also, if you keep it on a server or something like that, it will record who has access to it. You can keep access to certain people, etc. so that you can keep an exact idea of who's viewed it, who's printed it, etc.

The next question, what is the minimum megapixel rating you would use for forensics? That's kind of another open ended question. I'd go with the best you can get, the highest you can get for the money. So now you're looking at seven, eight, nine, that's pretty reasonable for the most part. You can, out of an eight megapixel digital camera, get an excellent 8 x 10 photograph, you can even get an excellent 16 x 20 if you wanted to blow something up for court. So I think you don't have to go out and get a 22 megapixel camera that costs $20,000 to take good forensic photographs, but get the best you can for the money you've got.

What kind of test targets and performance standards do you recommend for testing adequate image quality? Well that depends on what you mean by adequate image quality. Everybody has a different opinion of that. That's kind of an open ended question. I'll say what I would do is just make sure that your camera is in good condition and up to standards. When you get a camera from a manufacturer, it's usually set for certain color, etc. What you want to do is on the viewing side you can make sure that your monitor is calibrated for color and make sure that your printers are calibrated so that you get accurate color from printing from your monitor to your printer so that things are consistent, and there is software out there and hardware that will allow you to calibrate your monitor so that what you see on your monitor is consistent every time, and you can then print the same kind of color.

Is it best to use the standard functions on a digital camera or to choose the functions as you shoot? Well that depends on your comfort level with the camera. I prefer to shoot a lot of my stuff in manual settings because it gives you more control. One of the things with some of the digital cameras out now is if you shoot, he actually asks portrait versus manual functions, and this was one of the things I was telling somebody else about the digital cameras, some of them, when they're set for portrait settings or close up settings, they actually control more than just exposure in the camera, they control your depth of field, they control the sharpening, in camera sharpening, because each camera actually does some type of sharpening in the camera. So if you set it on a portrait mode, they use less sharpening than they would if you were doing like a close up mode on the digital because normally when you shoot a portrait you want it a little softer so that people's wrinkles don't look as bad or whatever. So you have to be aware of that. If you use the manual functions on a digital camera, than the sharpening will be set to whatever you have it set at or whatever the camera's default is, and in addition, color balance and those types of things. So it gives you more control over the entire camera.

Consumers are becoming more demanding and the price is dropping on some of the more sophisticated features, how can we test to make sure the camera performs adequately? Well I'd say take some photos really. The best way to test a camera is go in, you know, either call the manufacturer and tell them you'd like to sample their camera. That's what we do before we do before we buy any of the cameras, is we'll have them come in and we'll take a look at the cameras. Or go into a camera shop and say I'd like to test these cameras, I'm preparing to buy them, because if you look at samples from different cameras, you can see the differences in image sharpness and color balance, in how it reacts to light, whether it has difficulty with bright light situations or reflective lighting or things like that. So test them out. I think that's the best way to determine what's a good camera.

Do you recommend the use of both 35 millimeter and digital? That depends on what you're photographing. I'm pretty comfortable, for the most part, using a high quality professional digital camera to photograph everything now. Unless it was going to be something where I was looking for extreme detail or comparisons such as fingerprints, unless I had a super high quality digital camera, the things I was thinking about were fingerprints, tire tracks, where you need to get down, or shoe prints, to extreme detail in order to be able to make an identification. However, if you're shooting general scenes where you have to shoot the scene, you still can do good close ups of items. As long as you're not looking for extreme comparison detail, most good digital cameras are able to handle that. So I guess it depends on what you're shooting, what the quality is of the digital camera that you have. If you're not comfortable with the quality of the digital camera, yes, you may want to supplement with 35 millimeter film.

What do you recommend for changing lenses in nasty environments? Go to a less nasty environment. That's the other thing, like I said, turn the camera down so that gravity isn't working against you and the dust isn't falling in. Change the lenses as little as you can. So don't keep going back and forth. If you have a zoom that can handle a lot of the work, try and leave that on, and if you need to, step outside into a clear area to change the lens.

What does ISO mean? ISO is the sensitivity of the digital camera or film to light. So if you ever went out and bought film, you can get it film ranges from 25 to 1,600 ISO. So the lower you go in that number means the less sensitive it is to light. So if you have a 100 ISO film, it's usually used for bright daylight because it has less sensitivity to light, so it doesn't react as much to light. Higher ISO, such as 800 or 1,600 is usually used for very low light or night conditions because it has an extremely high sensitivity to light. So on the digital camera, the chip itself, they use software to boost the gain on the chip in order to change its sensitivity to light. So the chip itself usually will have a native sensitivity to light of 100 or 200 in ISO terms, and then as you boost that up, the camera boosts up gain on the chip to increase its sensitivity to light. So on a digital camera, you have the same numbers and they essentially mean the same thing, but it's done a little bit differently.

Can you comment on ring light versus ring flash? I guess you're talking for close up work mostly. I've used ring lights and they're both good. They make some that are full ring lights and they make some that are a ring flash with like a couple of multiple different flashes on each side of the ring. They're both excellent and it depends on what you're using it for.

Does noise reduction software present a problem in court? Well that's a good question. It could because what noise reduction does, it kind of softens the image up. So if you were printing it, once you've reduced the noise, you might need to sharpen up a little bit more. I think you have to, again, if you're going to do something like that, keep your original image, do your noise reduction and then save the enhanced image so that if there is a question about whether alterations were made or whether it actually changed the image, than you've got your original and your enhanced image that you can show to the court.

I frequently have to rotate my JPEG files to view the photos. Do I lose information in doing so? If you're rotating it and resaving it, yes, you are losing a little bit of information. Some software will allow you to just rotate the thumbnail so that you can view the thumbnail itself and the actual JPEG images and rotate them. So you may want to consider that where you're just looking at the thumbnail meaning the small photo before you enlarge it. So that's one consideration so that you don't have to rotate them and resave them.

When saving photos on CD or DVD, is there a risk of deterioration of the photos over time? The answer to that is no. The photos themselves, that's the nice thing about digital is the photos themselves will remain the same. The CD or DVD may deteriorate, which is actually a very real possibility. Like I was saying earlier, I think some of the CDs or DVDs have been rated at 10 to 15 years. I think DVDs have a little longer rating as far as their usable shelf life. The thing that we try and do is buy a higher quality CD or DVD. They do make some that are made specifically for archival purposes that are supposed to last longer. The other thing you have to keep in mind is the storage conditions. They need to be protected from ultraviolet light and humidity if at all possible and I would also make sure not to store them in paper like a paper sleeve where the paper is touching them. Use the plastic holders, the hard plastic holders and you should be better off as far as life of the CD or DVD.

What about adding text to pictures to point out certain areas of the picture. I have no problem with that as long as you have the original still. That's what I would call a court presentation, and we do that all the time, where you're adding arrows to point out something or adding text and arrows. As long as you have the original photographs that if there are questions, if the defense attorney says what are you hiding behind that? Well here's the original photograph, and here's the one that I added the text and the presentation for court. So not a problem at all.

What do you use for light balance target in the field? Do you use white balance in the field to correct for lighting conditions? I actually carry a little gray card and the camera that I have will allow me to custom balance using a gray card in the field, a gray or a white card. So I carry an 18% gray card and will sometimes use that to balance my camera in the field if I have a difficult lighting situation. The other thing I'll do is test the different, like my camera has probably eight different color balance settings for various lighting conditions, but I will make sure to test each of those for the actual conditions that it's supposed to be used in. Like I found the camera that I use in bright sunlight, I prefer to use the cloudy setting because it gives it a little more warmth. It makes it less blue and more towards the yellowish, reddish side. It gives it a little more life.

Is there anything wrong with deleting pictures on the scene as you review them? And if files will be out of order, will this cause a problem in court? It's our procedure to not delete images on the scene. I know that's one of the advantages of digital photography, but you're correct. When you do that, you leave a gap in your photographs. It's kind of the same as if you were shooting with film. You're not going to go back after the fact and cut out parts of your film and throw it away. Why should you do it with digital images. You can easily explain that one photograph was dark for whatever reason or you hit the shutter by accident. I don't see an issue with saving all the images. So for us, our operating procedure is that we do not delete images.

Any problems using the camera's date and time stamping? I try not to use it if it stamps on the image. You can have a date and time stamp in the metadata of the file so that it's attached to the file, but not actually in the photograph. If you have it in the photograph, you may obscure some kind of detail in the photograph.

Do you have an SOP that we can use for a draft of our SOP? I may have something. I'll have to talk to Mr. Jones about that and be able to get you something. Are there issues with erasing photos that do not turn out good while shooting the scene? I kind of answered that already. I had to refresh this and go back down. So be patient with me for one second. There's only one more.

Is naming the picture by saving the picture from the camera to the PC hard drive considered altering. That's an interesting question, and I would probably say no. What he's probably asking is can you, rather than having repeating names or numbers all the time, can you go back and say name it with the date and something after the fact? I think that's all right as long as you do it and you've got that in your procedures that you're going to do that and then immediately save it to the read only media, I don't see a problem with that. That's it for the questions. Thanks to everybody for listening. I hope you all do well on the test.