PRACTICAL POLICE PHOTOGRAPHY

POLICE LINE DO NOT CROSS

BOB McMICKEN
Preface

This is the book that I started to write thirty years ago. Now retired after forty years as a deputy sheriff, private investigator and executive on the security staff of a Fortune 100 company, always with a camera close at hand, I have the time to write the book that I wanted to write way back when.

There are plenty of books on police photography. However, most of them were written either before digital or at a time when digital cameras were underpowered and prohibitively expensive. While this book glosses over some of the more technical aspects of police photography, it covers a multitude of practical details that aren't mentioned in the traditional books.

My early mentors were Captain Grant Ilseng of the Harris County Sheriff’s Department, Bennett Cook of the Burns Detective Agency, Axel Hansen of the Southern Pacific Railroad legal department and Virgil Green of the Foley's (now Macy's) security department.

I received most of my training as a crime scene investigator from Texas A&M Extension Service instructors and pathologists on the staff of the Harris County Medical Examiner's office.

I received valuable advice and assistance from Hayden Baldwin, Larry Barksdale, Robert Cheeseman, Deanna Glaze, Stacey Brownlee, Dr. Patrick Besant-Mathews, George Reis and Dr. Austin Richards, among many others. Naturally, all errors are strictly my own.

This book is dedicated to my beloved wife Diane.

Woodland Park, Colorado
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Chapter 1.1

Introduction

Practical police photography occupies a narrow but useful niche between the kind of photos that anyone might take with a simple snapshot camera and the more sophisticated photographs taken by professional evidence photographers. Practitioners include:

- Police officers in departments that do not have full-time photographers on the payroll.
- Police officers who want to take their own photographs for one reason or another.
- Arson investigators, accident investigators, medical investigators, forensic pathologists, forensic nurses, evidence technicians, training officers, private investigators, game wardens and civilian security personnel.
- In short, just about anyone associated with law enforcement other than full-time, formally trained police photographers.

There might not be much difference between 4 x 6 inch prints of a typical scene taken by a rank amateur with a $100 camera and the same scene photographed by an expert with a $10,000 camera and believe me, it’s no trick at all to spend $10,000 on a camera.
Factor in the difficult lighting conditions common to crime and accident scenes with the need for closeup photographs of trace evidence, throw in a requirement for the kind of large display prints that might be required for courtroom presentation, and the $100 camera will be found wanting while the $10,000 camera is probably overkill.

Practical police photography falls between these extremes. You don't have to be an expert but you do need to know enough to deal with closeup photography and difficult lighting situations. This book concentrates on the intermediate level of skill required by officers and investigators who want to take better pictures than they can get with a snapshot camera.

If you follow the procedures described on the following pages, you should be able to take photos that can be enlarged to at least 12 x 18 and perhaps even 24 x 36 inches using relatively inexpensive equipment, perhaps equipment that you may already have.

**FUD**

FUD stands for *Fear, Uncertainty and Doubt*. This book attempts to remove FUD by explaining the things that an entry level photographer might want to know and by pointing the reader to books and web sites that can be mined for additional information. Knowledge is a great confidence builder.

If you’re satisfied with the results that you can get from a point and shoot, read no further. In good light and fair weather, even a basic point and shoot will deliver good results. It’s only when you challenge yourself to get high quality photographs under conditions ranging from marginal to awful that you need to read this book and/or attend advanced classes taught by competent instructors.

**Analysis Paralysis**

The sheer number of cameras and printers on the market and each manufacturer's desire to differentiate their products from the competition by coining new names for products virtually identical to other, similar, products is a major factor contributing to *Fear, Uncertainty and Doubt*. 
The April 2010 issue of the *Digital Photography Buyer's Guide* lists 273 still cameras, 97 camcorders and 132 printers. The still camera list does not include all of the trendy color options designed to entice fashion-conscious buyers nor does it provide a comprehensive list of the many professional cameras and printers.

Read on. This book will attempt to clarify the confusing terminology foisted upon us by the marketing mavens and identify the relative handful of cameras suitable for police service, whether the user is a first responder, a forensic nurse or a veteran crime scene investigator.

**Objectives**

This book will not teach you to become an expert photographer. That you will have to do for yourself by taking pictures under varied conditions and reviewing them with a critical eye to see what can be improved so you do not continue to make the same mistakes.

Rather, this book will give you a broad brush overview of equipment and techniques, the vocabulary to communicate with instructors and photographers and advice on where to find additional information.

**Practical versus Professional**

A professional photographer is an individual who devotes a substantial portion of his or her time to photographic endeavors, with sufficient training to tackle difficult problems confident of success. A practical, or *occupational*, photographer is an individual who is required to take photographs in conjunction with his or her regular duties, whatever those duties might be.

Once basic skills have been mastered, given sufficient interest, a practical photographer can go on to achieve a professional level of competence by seeking out the training required to master advanced skills.

**For Example**

Some years ago, I saw a photo of a burned-out building taken by a small town fire chief. The photo showed an obvious difference between the
charring that occurred where an accelerant was splashed on the walls compared to normal charring elsewhere in the room.

The normally charred wood had rather large alligator charring and appeared almost silver-gray. The accelerant-soaked wood had a smaller, tighter charring pattern and the color was a deep black, leaving no doubt that the fire was of incendiary origin even without laboratory analysis to confirm the presence of hydrocarbons such as gasoline or lighter fluid.

I recall a photo taken by a small town police officer revealing tire tracks left in the slush of an ice-covered parking lot during the commission of a vehicular homicide. The tracks clearly showed that the assailant had maneuvered his vehicle to run down the victim.

The photo was taken at night using a technique known as *painting with light* because the area was too large to be covered by an ordinary flash unit. If the officer had waited for first light, the ice might have frozen completely, making the tracks less distinct. Once the sun came up, the ice might have melted. It was the kind of photo that had to be taken then and there using the equipment at hand.

During this same period, a physician conducted a post mortem on a woman shot and killed with her husband's deer rifle. The good doctor concluded that the small wound in her back was an entry wound and the large wound in her stomach was an exit wound, indicating a homicide.

Fortunately, the investigating officer took photographs which were subsequently submitted to a forensic pathologist. The pathologist determined that the woman died from a self-inflicted gunshot wound fired at contact range. The large stellated (star-shaped) wound in her stomach was caused by expanding gas leaving the barrel. The smaller wound on her back was just a normal exit wound.

If memory serves correct, the arson photo was shot with a 4 x 5 press camera while the homicide and autopsy photos were taken with manual 35 mm single lens reflex (SLR) cameras, those being the cameras in common use at the time. There was no hocus pocus with alternate light sources or digital trickery because, in those days, alternate light source (ALS) photography was rarely attempted outside of the laboratory and digital imaging did not exist.
Could those photos have been taken with one of today's auto-everything cameras? Yes, but not in the point and shoot mode. The better cameras, film and digital, allow shooting in the manual mode if you know when and how to override the camera's automatic settings.

Photographs have played a role in several Cold Case Files episodes on A&E. In one episode, detectives in Arlington, Texas became suspicious of the husband when a woman disappeared under mysterious circumstances.

When a search for the woman’s body proved fruitless, Arlington detectives and Texas Rangers visited the small town of Copperas Cove where the husband’s first wife reportedly committed suicide via a shotgun blast to the chest some sixteen years previously.

While the original case paperwork was missing, a retired police photographer had a single photograph in his personal collection. The position of the body and the weapon in the old photograph was inconsistent with a self-inflicted wound.

The woman’s body was exhumed and examined by a forensic pathologist who determined that the path of the shotgun pellets combined with the length of the shotgun barrel ruled out suicide. The husband was convicted of a sixteen year old murder because a photographer kept an archival copy of his work.

Copperas Cove, like many towns, is served by a coroner system. In Texas towns too small to be served by a medical examiner, justices of the peace are responsible for determining the cause and manner of death. Very likely, the victim was buried without a detailed post mortem examination because the cause of death was obvious and nobody saw fit to question the husband’s account of the matter.

Had an experienced homicide detective or a competent forensic pathologist examined the original scene and the body, the manner of death would almost certainly have been ruled a homicide from the start, perhaps saving the life of the second wife whose skeletal remains were subsequently discovered in a shallow grave.
One might argue that taking detailed photographs of all homicides and suicides and preserving the camera originals under archival storage conditions is important in departments large and small because you never know when an old case will have to be reevaluated in the light of new information.

More Recently

On May 8, 2009 a former police sergeant was arrested for the murder of his third wife in 2004 following the disappearance of his fourth wife in 2007. The victim was found dead in an empty bathtub. At the time, the death was ruled an accident. The disappearance of the fourth wife resulted in an investigation that included exhuming the third wife to take a second look at the circumstances surrounding her 2004 death.

On June 6, 2009 a veteran Los Angeles Police Department detective was arrested for a murder that occurred on February 24, 1986, reportedly on the basis of new DNA evidence. You don't have to go back years and years to find situations that justify treating any suspicious death as a homicide until proven otherwise. Go ahead. Take pictures. If they aren't needed, nothing is lost but a little time.

Do Your Homework

As a general rule, photographs are admissible if a credible witness can testify that they accurately depict the scene as it appeared when the photographs were taken but the devil is in the details. You need to understand the rules governing admissibility in your jurisdiction and the procedures established by your department.

Why Photography?

Narrative reports provide a broad brush description. Scale drawings are good at locating objects in relation to other objects. Neither diagrams nor reports can accurately convey the overall look and feel of a scene.

Hayden Baldwin, a heavy hitter in forensic circles, summed it up even more succinctly. We take photographs to show others what we have seen.
Size Matters

Houston logged fourteen homicides over a recent weekend and Houston is just one of many jurisdictions in Harris County, Texas. If you think things are tough in Texas, Alaska's Troopers and Canada's Mounties are responsible for policing a sparsely populated area larger than Europe with transportation to many regions limited to bush plane and snowmobile during the winter months. Officers in these jurisdictions are handicapped by sheer distance from major cities where the forensic heavy hitters are to be found.

![Image](image1.png)

Figure 1 - This photo, purporting to be the long-abandoned sheriff's office in Hartsell, Colorado, may be somebody's idea of a joke. Nevertheless, you'll see police stations and sheriff's offices this small and smaller in sparsely populated regions of the American West. If your ideas of law enforcement are based on what you have seen in New York, Chicago or Los Angeles, remember that there are vast regions of the country where you can drive one hundred miles between gas stations without seeing a single cow or a starving buzzard. Many police departments have fewer than twenty-five sworn members.

Required Reading

Read and save the manuals that came with your camera and flash unit. If the camera came to you without a manual, you might be able to download a copy from the manufacturer's web site. If you inherit an older camera, [http://www.forensic-photography.com](http://www.forensic-photography.com) has links to sites that offer both cheat sheets and copies of manuals long out of print.

If you purchase a computer or computer software, be sure to save not only the documentation but all of the installation and utility disks in case you
need to re-install the software or move the application to another computer. Camera or computer, save the receipts and be sure to mail in your warranty registration cards.

**Recommended Reading**

There are a dozen books commonly used in college classrooms and as the basis for certification examinations conducted under the auspices of the Evidence Photographer's International Council (EPIC) and the International Association for Identification (IAI). You'll find a list of these books at http://www.forensic-photography.com > links > books.


**The Internet**

The Internet is a valuable resource. See forensic-photography.com > links > professional associations for links to many sites of interest to police photographers. For product reviews and tutorials of general interest to all photographers, check out:

- http://www.cambridgeincolor.com
- http://www.kenrockwell.com
- http://www.bythom.com
- http://www.luminous-landscape.com
- http://www.imaging-resource.com
- http://www.dpreview.com
- http://www.steves-digicams.com

**Training**

Every community college offers courses on photography. Colleges with forensic science programs are likely to offer courses on evidence photography. The major manufacturers sponsor workshops, as do well-known professional photographers.

The professional associations previously mentioned offer seminars as do some law enforcement agencies. It you want to do advanced work,
formal instruction is essential. In addition, private firms offer classes that can be scheduled in your very own jurisdiction. You'll find a list of training organizations at forensic-photography.com > links > training services.

**Reality Check**

I'd rather be a good investigator than a good photographer. Detective Manuel Fuentes of the Austin, Texas Police Department reports that intruders forced their way into a home where they bound and gagged the residents. The victims reported that a shot was fired but the initial reports made no mention of injuries or a recovered bullet.

Detective Fuentes and associates visited the scene and found bullet fragments lodged beneath a near-invisible hole in the carpet. One of the intruders shot himself in the foot. DNA adhering to the bullet fragments lead to the apprehension of two perpetrators. Apparently, it did not occur to the folks who processed the original scene that, when a shot is fired, the bullet has to go somewhere.

**Handouts**

Go to forensic-photography.com > links > handouts for free articles and PowerPoints plus links to several sites which might be of special interest to readers of this book. These articles will be updated more frequently than the book itself to keep pace with the newest hardware and software, especially cameras and lenses.

**Purchasing On Line**

If you can't find what you want locally, you can order from a long-established mail order house catering to the professional trade:

- http://www.adorama.com
- http://www.bhphotovideo.com

Make sure that you are purchasing items covered by the manufacturer's US warranty. Some dealers market gray market merchandise purchased from overseas distributors. If the product fails, you may have to pay through the nose for repairs.
International Crime Scene Investigator's Association

A number of useful documents can be found at http://www.icsia.org, including the Crime Scene Processing Protocol, the Crime Scene Reminder Card and the Training Checklist.

The ICSIA director, Hayden Baldwin, relies upon the Eagle Crime Scene DVD, Crime Scene Photography by Robinson and Witzke and the FBI's Processing Guide For Developing Latent Prints for his college-level classes. In the detective business, this is what's commonly known as a clue.

Links

Many links in the e-version if this book are hot. If you have the printed version, you'll find most links on the forensic-photography.com links pages.
Chapter 1.2
Forensic Photography

Forensic - Pertaining to matters at issue before a court of law.

Photography - Literally, painting with light.

Forensic Photography - Photographs intended to be used as evidence in a civil or criminal trial.

Forensic photography, also known as police or evidence photography, is a mixed bag. Scenes can be and often are photographed by police officers, crime scene investigators on the police payroll, crime scene investigators on a regional crime lab payroll and medical investigators on the medical examiner's payroll. It depends on the jurisdiction.

Autopsy photos are usually taken by police officers and/or personnel on the medical examiner's payroll, perhaps even the medical examiner (ME) in person. Laboratory photos are taken by specialists in a variety of disciplines, including firearm, fingerprint and questioned document examiners.

Crime scene photography can be easy or difficult depending on the nature of the crime, the level of ambient illumination and the available equipment. Overall views and medium closeups can be taken with a point and shoot (P&S) in good light or within range of the flash.

Technically difficult closeups and low light photos might require professional flash units, heavy duty tripods, single lens reflex cameras and skills beyond the point and shoot level.
Some things are common to many crimes: fingerprints, footprints, tire tracks, tool marks and so forth. Some things are common to a specific offense. Arson investigators are interested in the point of origin, the progress of the fire, containers that may have contained an accelerant, the remains of incendiary devices and of spectators appearing at multiple scenes.

Accident investigators are interested in anything tending to show that one or more of the drivers violated traffic safety laws, weather conditions and road hazards that might have contributed to the accident, points of impact, skid marks, damage to vehicles and fixed objects, etc.

Naturally, injuries to surviving victims and the bodies of deceased persons are of great interest in any investigation.

Some crimes involve multiple offenses. A burglary investigation focuses on the point and manner of entry and the acts that the perpetrator may have committed while in a vacant building.

A home intrusion constitutes forced entry into an occupied dwelling for the purpose of robbing or assaulting the occupants. Arson, rape and murder are often committed following a forced entry. Incendiary fires are often set to conceal evidence of burglary, homicide and insurance fraud to mention only the more obvious possibilities.

Thus, a crime scene investigator needs a comprehensive skill set, of which photography is perhaps the least complicated. You can't become a good crime scene photographer until you master the skills required to process a crime scene.

Almost any specialty that you care to name will have a professional association composed of like-minded individuals with their own training and certification programs.

Two essential skills are developing latent prints and discovering latent bio-stains such as blood and semen. We can't photograph what we can't see. These skills often require formal training and specialized equipment.

Anyone can take overall views of the average crime scene in good light standing on his or her hind legs. The challenge facing a police photographer is not photography per se but taking photographs of acceptable quality under conditions ranging from marginal to awful. You can't put your camera away and go inside to sit by the fire just because it's freezing cold, pouring rain and darker than the inside of a coal bin.
Chapter 1.3
Ethics

Dishonest photographers have been doctoring photographs for nefarious purposes since the process was invented. Civil war photographers improved the composition of their photographs by rearranging bodies and adding somber clouds, as if thousands of dead soldiers weren't dramatic enough. When you see a picture of a celebrity on the cover of a magazine, you can bet the photo was enhanced in some way. Check out:

- http://www.fourandsix.com/photo-tampering-history/
- http://www.gregapodaca.com

The December 8, 2005 episode of CSI: Crime Scene Investigation revolved around a photograph "photoshopped" to merge the picture of a mentally deranged woman into the picture of a neighbor's child. "Photoshopped" is now part of the common lexicon. Given this history of skull-duggery, it's no wonder that attorneys are quick to challenge any photo deemed prejudicial to their client.

As a rule, you can and should adjust brightness, contrast, sharpness and color balance to bring out all of the available detail. If the question comes up, this is easily explained by the fact that photographic images usually have more detail than can be printed without adjustment. In fact, failing to bring out all of the available detail might be considered a form of reverse manipulation by concealing detail visible to the naked eye.

The acid test is that each and every photo must be a true and accurate depiction of the scene as it appeared at the time the picture was taken. The
objective is always to produce a print that accurately depicts what would have been visible to an observer standing where the photographer stood.

Some jurisdictions require taking two sets of photographs, one documenting the scene as it appeared to the first responders and another after scales and markers were added, which might be construed as an alteration even if the scales and markers serve a legitimate purpose.

The best articles on ethics that I can recall reading are "Bad Science" by D.H. Garrison of the Grand Rapids, Michigan Police Department and "Latent Fingerprint Fabrication" by Pat Wertheim of Forensic Investigation Training Seminars.

- http://www.iowaiai.org/bad_science.html
- http://www.iowaiai.org/latent_fingerprint_fabrication.html

Recently, two additional articles have come to my attention written from a defense attorney's perspective. These articles are worth reading because they point out the many ways in which your testimony and "scientific" evidence are subject to challenge.

- http://www.scientific.org/tutorials/articles/kruglick/kruglick.html

The O.J. Simpson case is perhaps the best example of the importance of adherence to established procedure, if only because almost everyone involved with the case with the possible exception of the jailhouse janitor wrote a book of some sort.

According to Evidence Dismissed by Detectives Lange and Vennatter, the list of expert witnesses hired by the defense included Dr. Henry Lee of the Connecticut State Police Forensic Science Laboratory, Dr. Michael Baden, Chief Medical Examiner for the City of New York, forensic toxicologist Dr. Frederic Reiders, Larry Ragle, retired head of the Orange County crime lab and Herbert L. MacDonnell, inventor of the Magna fingerprint brush and one of the first criminologists to investigate the scientific aspects of blood spatter analysis.

While indigent defendants are at the mercy of their court-appointed attorney, a well-heeled defendant smart enough to hire competent counsel will rip you to shreds if you try to play games in the interest of expediency. In some cases, the defense will hire expert consultants simply to keep the prosecution from hiring the same consultants.
Chapter 1.4
Photography Then and Now

Figure 2 - This 1936 article shows a forensic scientist using an 8 x 10 plate camera. Although digital is now the preferred medium for most photographers, large format film cameras are still used by landscape and studio photographers.
Figure 3 - The Speed Graphic was the standard camera for police and press photographers from the mid-30s through the mid-60s. It was eventually discontinued in 1973 following the introduction of the Nikon F2 in 1972.

Figure 4 - The Nikon F introduced in 1959 and the Nikon F2 introduced in 1973 set the standard for today's digital cameras. Photo courtesy Ken Rockwell.
Figure 5 - Many police departments issue compact cameras such as this Panasonic ZS9 (purchased for $129 from amazon.com in 2011) to detectives and patrol officers. In common with most pocket cameras, it has the same controls as a Speed Graphic from 1930 or this Pentax 645 purchased for $2,500 in 1985. The Panasonic is the better snapshot camera. The Pentax is the better landscape camera if you don’t mind paying thirty dollars to have a roll of Fuji Provia processed with a two week turnaround.

Figure 6 - At $1,800 with a 16 - 85 mm lens, the 16 MP Nikon D7000 is suitable for advanced amateurs and entry level professionals. The D7000, along with the Canon D7, are the benchmark cameras for photographers who need something better than a point and shoot without the high cost associated with advanced professional cameras such as the Nikon D4 or the Canon EOS 1DX. I’ve been using a Nikon D70, an earlier version of the D7000, with complete satisfaction since 2005.
At $8,000 with a 24 x 70 mm f/2.8 lens and a premium memory card that can keep up a camera capable of shooting at ten frames per second, the Nikon D4 and the Canon EOS 1DX are today's most advanced cameras for professional photographers who demand and can afford the best. At 16 MP, the D4 will not take significantly better pictures than the D7000 at 1/4th the price. What you're paying for is extreme durability under adverse conditions, the ability to dictate memos associated with each photograph while you're shooting and the best low light performance to be had at any price.

The D4 is admittedly too rich for my blood. Until such time as I win the lottery, I'll continue to use my 6 MP Nikon D70 purchased in 2005 because it is adequate for the intended purpose and works well with my existing lenses and flash equipment.

And therein lies a lesson. Point and shoot cameras are essentially disposable. If you don't like the one you have, you can always buy something better the next time around. SLR cameras are system cameras. Once you invest a substantial sum in lenses and flash units, it's expensive to upgrade to a newer camera requiring superior lenses and even more expensive to change brands.
Chapter 1.5
Jargon

Jargon is the language that specialists use to communicate with other specialists. I've been a photographer of sorts for fifty years but I was baffled when I started hearing the term "chimp." The term derives from the simian "ooh! ooh! ooh!" sounds made when someone views a good photo on a digital camera's LCD display.

Another phrase that had me confused was “expose to the right.” This refers to the histogram displayed on your camera’s LCD. The left side of the histogram represents dark tones, shading to black. The right side represents light tones, shading to white.

Expose to the right means cranking in as much exposure as you can without overexposing, thus blowing the highlights. An underexposed image can often be salvaged in Photoshop. Blown highlights are gone for good.

Glossaries

You'll find good glossaries at:

- http://www.leva.org
- http://www.dpreview.com/learn/?/glossary/

Camera Types

Modern still cameras fall into three categories: pocket cameras, bridge cameras, and SLR cameras. We'll ignore camera phones, which have largely replaced entry level point and shoots. Almost everyone needs a cell
phone in this day and age so there's no reason not to buy one with a built-in camera even if you have other cameras for serious picture-taking.

At one time, digital single lens reflex cameras were identified as D-SLR to distinguish them from film SLR cameras but film cameras are now obsolete for general picture-taking. The abbreviation SLR throughout this book refers to digital single lens reflex cameras.

A pocket point and shoot, usually abbreviated P&S, will give good results if the light is decent or the subject is within range of the built-in flash. The better examples will satisfy the requirements of patrol officers and detectives who are not obliged to shoot under extreme conditions.

Bridge cameras, as the name implies, bridge the gap between pocket and SLR cameras. Typically, a bridge camera will have a non-interchangeable lens with greater coverage than the lens on a pocket camera but they are not as versatile as the larger and more expensive single lens reflex cameras.

Single lens reflex cameras are admittedly large and expensive. The better examples are sophisticated enough to require a longer learning curve than amateur-oriented point and shoot cameras. However, SLR cameras will provide superior picture quality and low light performance they have larger image sensors and more sophisticated internal processing capabilities.

All single lens reflex cameras accept interchangeable lenses and external flash units, adapting the camera to specialized requirements. All single lens reflex cameras offer convenient manual adjustments for situations in which auto-focus and auto-exposure are not appropriate.

**Scene or Shooting Modes**

Cameras both amateur and professional have Auto, Program, Manual, Aperture Preferred and Shutter Preferred shooting modes, abbreviated Auto, P, M, A and S on a Nikon, P, M, Tv and Lv on a Canon control dial. These modes will be explained in a later chapter but, rest assured, if someone sticks a camera in your hands in the morning, you can be out taking pictures that same afternoon even if you're digitally challenged.
Amateur-oriented cameras have various scene modes to help inexperienced photographers cope with difficult lighting situations without delving into the mysteries of shutters speeds, apertures, ISO sensitivity, white balance and so forth. We won't spend much time on scene modes because they serve no purpose if you wish to work beyond the point and shoot level.

**Video Modes**

Most still cameras manufactured in recent years can shoot video. The more advanced cameras have video modes good enough to satisfy the needs of documentary filmmakers.

There are two video modes that you need to be aware of. Standard Definition (SD) is the resolution commonly seen on conventional broadcast television and DVDs. High Definition (HD) is the resolution seen in high definition television broadcasts and on Blue Ray discs.

High definition can be further classified as 720P or 1080P. P stands for Progressive Scan. There is also a 1080I standard, with the I standing for interlaced.

720P is the resolution of most high definition television broadcasts. 1080P is the resolution favored for Blue Ray movies that will be shown on home theater systems with wide screen televisions specifically rated for the 1080P video standard.

Skip Standard Definition cameras. 720P will suffice for projecting on a small conference room screen. You'll want a camera that can record at the higher 1080P level if you intend to display your video on a big screen TV or project it on a large auditorium screen.

**Eschew Obfuscation**

An FBI document refers to "silver halide technology." That's bureaucratic for film. In fact, all color films and some B&W films are based on light sensitive dyes, not microscopic particles of metallic silver. Photo-geeks refer to film as analog technology which it is but what's wrong with the universally understood word film?
The terms image stabilization (IS - Canon) and vibration reduction (VR - Nikon) mean the same thing, as do the terms silent wave and ultrasonic when applied to focusing motors. Manufacturers coin their own terms to differentiate their products from the competition.

A zoom lens with a macro setting is not a macro lens. It's an ordinary lens that will focus closer than other lenses of that type.

Nikon uses the terms aperture preferred and shutter preferred to describe common forms of exposure automation. Canon uses the terms time value and light value to describe the exact functions.

Back when film was king, we spoke of high contrast lighting. Today, the term high dynamic range has replaced high contrast for no good reason that I can see.

While the terms pixels per inch (PPI) and dots per inch (DPI) have different meanings the terms are often used interchangeably without dire consequences. If you’re interested, PPI refers to camera, monitor and scanner resolution while DPI refers to printer resolution.

**Film Industry Terms**

You will run across many terms borrowed from the film industry. Post production, often abbreviated post, refers to the process of getting raw imagery from the camera to the screen or printer.

When photographers speak about going wide, they really mean shooting with a wide angle lens just as going long means shooting with a telephoto lens.

For reasons lost in the annals of antiquity, the chief electrician on a movie set is known as the gaffer. Gaffer’s tape is a sort of zero residue duct tape that movie electricians use to conceal wires.

**Fun with Numbers**

Megapixels (MP), lines pairs per millimeter, dots per inch (DPI) and picoliters per drop are neither the best nor the only way to compare photographic equipment. Instead, look at pictures enlarged to 12 x 18 inches. That’s where the rubber meets the road.
Claims that a scanner will scan a slide in thirty seconds are meaningless. The number that counts is how many slides you can scan in an hour. Five would be a fair average with most desktop scanners.

Digital resolution is based on the number of horizontal pixels, not the total number of pixels. My 6 MP D70 has 2,000 x 3,008 pixels. The 12 MP D300 has 2,848 x 4,288 pixels. Does the D300 have twice the resolution of the D70? It does not. The D300 has 1,280 more horizontal pixels, a theoretical advantage of 43%.

There is a limit to how many pixels your screen or printer can use. Photos viewed on-screen are usually displayed between 72 and 106 pixels per inch (PPI). The average printer supposedly requires 300 PPI to yield a best quality print. Pixels in excess of those required to render a best quality print are thrown away.

I prefer to print 6.7 x 10 inch photos on 8 1/2 x 11 paper, which is what you get from a Nikon D70 at 300 PPI. A 12 MP D300, or even a 24 MP D3X, would not give me better pictures because I already have all the pixels my printer needs for a 6.7 x 10 print.

While a high resolution camera is an advantage if you routinely make large display prints, you might need a good eye, a top-notch printer and an experienced Photoshop operator to see the difference.

**Hearsay Evidence**

Fact: Exposure meters are calibrated for an evenly illuminated scene with a range of light and dark tones that averages out to middle gray.

Conventional Wisdom: Exposure meters are calibrated based on a middle gray scene with the 18% reflectance of a Kodak gray card.

Hearsay: Kodak introduced the 18% gray card at the request of Ansel Adams because Zone 5 in the Zone System is based on 18% reflectance.

Fact: Camera manufacturers calibrate their meters based on standards published by the American National Standards Institute (ANSI) which is based on 12% reflectance, not the 18% of a gray card.

Fact: The difference between a meter calibrated for 12% reflectance and a meter calibrated for 18% reflectance is half a stop.
**SLR Sensors**

SLR image sensors come in two sizes. The full frame sensors found on professional cameras measure 24 x 36 mm. The smaller sensors found on less expensive amateur-oriented cameras measure 16 x 24 mm.

Nikon coined the FX abbreviation to identify cameras using a full frame sensor. DX identifies Nikon cameras with the smaller APS-C sensor. This goes back to the long-defunct Amateur Photo System. APS cameras had several formats, one being known as Classic. Hence, APS-C.

**Pixels**

All pixels, short for picture element, are not created equal. It isn’t the total number of pixels that matters so much as the size and quality of those pixels and the sophistication of the circuitry that converts the light coming through the lens into something that we can use.

The pixels in a twelve megapixel (commonly abbreviated MP) point and shoot are smaller than the pixels in a 12 MP SLR. The smaller pixels gather less light. Under low light conditions, P&S pixels need more amplification to permit shooting at high ISO numbers, resulting in photos of lower quality.

The Nikon D300 and the Nikon D700 are 12 MP cameras. The D300 uses a 16 x 24 mm DX sensor. The otherwise identical D700 uses a 24 x 36 mm FX sensor. Although both are top drawer cameras, the D300 can be cranked up to ISO 6400 while the D700 can be cranked up to ISO 25600, a two stop advantage due to the larger pixels.

**Bull Feathers**

Much of what you may read in photography books and hear in photography classes dates from the days when slow films demanded using a tripod even in full sunlight.

Today, with vibration reduction lenses and cameras that can yield good pictures at ISO 6400 and beyond, you can get away with shooting handheld under conditions that would have been unthinkable a few years ago.
Some folks still think that film is better than digital, which was indisputably true once upon a time. Even today, film might be better for certain technical applications and some photographers prefer the look that they can get from film. For most folks, digital gives better results with less effort.

From time to time, you will hear statements to the effect that photographs document reality. This is another partial truth.

The goal of police photography is to objectively document a scene and the objects of interest within that scene. However, we decide how the scene will be documented in our selection of camera position, focal length, exposure and the manner in which the photos are printed.

These choices will have a bearing on how the photos will be viewed by folks who were not privileged to be there when the pictures were taken. The people looking at your pictures are seeing what you wanted them to see. That’s a snapshot of reality but not quite the whole truth and nothing but the truth.

**More Bull Feathers**

You will hear claims that photos should be printed exactly as taken, without manipulation. Such claims are patently absurd.

Cameras do not have enough dynamic range to capture everything that the human eye can see in high contrast situations. No metering system will yield perfect exposure under any and all lighting conditions. There is no printing process that can reproduce all of the details that a good camera can capture without at least some manipulation.

When film is processed in a wet darkroom, technicians are required to make a series of adjustments to obtain a decent print. When you take your film to a minilab, both the system and the operator will make adjustments. When you do it yourself in Photoshop, you may be obliged to compensate for minor exposure and color balance errors.

It would be more accurate to say that your camera-original photos should be archived exactly as taken, without corrections. Do your adjustments on a copy of the camera-original image file and save the corrected copy under a new file name.
Lens Nomenclature (Full Frame)

The focal length required to achieve a certain angle of view depends on the size of the digital image sensor. While digital image sensors come in a variety of sizes, everyone is familiar with the traditional 35 mm film camera focal lengths. Hence, focal lengths in this book will be reported in the full-frame equivalent with the actual focal length reported only if necessary to identify a particular lens.

- A 50 mm lens is considered “normal.”
- A 35 mm lens can be either a short normal or a moderate wide angle depending on who you ask.
- Focal lengths between 24 and 28 mm are considered standard wide angles. Fourteen to 21 mm lenses are considered ultra-wide. Anything shorter than 14 mm will probably be a spherical fisheye lens covering an 180° circle.
- Focal lengths between 85 and 135 mm are commonly known as portrait lenses. Lenses in the 150 to 400 mm range are standard telephotos if the maximum aperture is f/4 or f/5.6.
- Ultra-fast lenses such as the 200 mm f/2, the 300 and 400 mm f/2.8s and the 500 and 600 mm f/4s are considered exotics and priced accordingly.
- A zoom lens has a variable focal length which is both a convenience because you can carry fewer lenses and an aid to composition when you can’t get close enough or back off far enough. Only the best zooms are as good as a good prime.
- A prime lens has only the one focal length marked on the lens barrel. They are usually but not always optically superior to zooms.

The Normal Lens Myth

A so-called normal lens has a focal length equal to the diagonal of the negative or image sensor because this supposedly replicates the angle of view as seen by the human eye but this is, at best, only a partial truth.
The diagonal of a 24 x 36 mm negative or a full frame sensor is 43 mm. At one time, Nikon marketed a 58 mm lens as a "normal." Some photographers, myself included, used a 35 mm lens as their normal focal length.

Hayden Baldwin explains that when 35 mm cameras first came out back in the Sixties, camera manufacturers promoted the idea that the normal, distortion-free, focal length was 50 mm. This was thought to be as close to what the human eye could see as the technology of the day allowed. Defense attorneys argued that any photo not taken with a 50 mm lens was too distorted to be used in court.

Then, people started buying point and shoot film cameras such as the Konica Hexar with 35 mm and later 28 mm lenses. As jurors became more familiar with what wide angle photos looked like, distortion was no longer an issue. Now, we routinely use zoom lenses that start at 24 mm on the wide end. I became partial to the 24 mm focal length because I routinely worked in tight pump, valve and electrical equipment rooms where even a 28 mm was not wide enough.

The diagonal of a 4 x 5 negative is 163 mm, yet many press cameras were sold with a 127 mm Kodak Ektar, clearly of the wide angle persuasion. Press cameras, usually one of the 4 x 5 Graphic models, were in common use by police photographers from the 1930s through the 1960s. Thus, before 35 mm camera manufacturers started promoting the 50 mm focal length, the vast majority of police photographs were taken with a wide angle lens.

**Aspect Ratio**

Aspect ratio is the ratio between the length and the width of a film negative, a digital image sensor, a sheet of photographic paper, a photographic print or the screen of a monitor or television set.

This is important because photographic papers and picture frames tend to follow the old 4 x 5 standard dating to the days of old-fashioned press and plate cameras while digital image sensors are often provide the user with a choice of aspect ratios.
The standard for single lens reflex cameras is 2:3 for still photos, a format introduced by Leica in 1913. Generally, you can choose between 420 x 640, 720 x 1280 or 1080 x 1920 pixels for video.

Nikon's professional cameras offer the standard video with various frame rates plus a choice of the 2:3 or the 4:5 aspect ratio for still photographs. The 4:5 option allows accurate composition for photographers who wish to offer their clients 8 x 10, 11 x 14 or 16 x 20 prints.

A compact camera might offer you the choice of a 2:3 or a 3:4 aspect ratio for still pictures and the same 420 x 640, 720 x 1280 and 1080 x 1920 options for video. 3:4 is the native aspect ratio for compact cameras.

420 x 640, 720 x 1280 and 1080 x 1920 correspond to the current 9:16 standard for wide screen monitors and televisions. The 1080 x 1920 pixel option (known as 1080P on a HD television) provides the highest resolution.

An older camcorder might offer a 480 x 640 option, corresponding to the old VGA (video graphics adapter) standard for obsolete CRT monitors and television sets.

The only paper and frame sizes corresponding to the 2:3 aspect ratio are 4 x 6, 6 x 9, 11 x 17 and 13 x 19. Paper sizes corresponding to the 4:5 aspect ratio are 4 x 5, 8 x 10, 11 x 14 and 16 x 20.

**Katzeye Optics (http://www.katzeyeoptics.com)**

If you don't want to blow $8,000 on a Nikon D4 just to have the option of selecting the 4:5 aspect ratio to compose an occasional 16 x 20 print, Katzeye Optics will install a new viewfinder screen with 4:5 guide lines in your existing Canon or Nikon SLR for a mere two hundred bucks, with the advantage of superior performance using manual focus lenses.
Chapter 1.6
Legal Considerations

You will miss 100% of the shots that you fail to take.

Adversarial System

A smart attorney never asks a question unless he knows the answer. Of course, there are some fairly dumb attorneys but that's another story.

The prosecutor is an advocate for the victim, asking questions in a manner calculated to convince the jury that the defendant did the dirty deed and was caught fair and square.

The defense attorney is an advocate for the accused. It's his job to ask questions calculated to create an element of doubt, often by suggesting that the arrest was based on incompetence, stupidity, malfeasance and chicanery. The defense is entitled to a list of prosecution witnesses and copies of their notes and any photos that they might have taken.

Police officers, crime scene investigators, evidence technicians and medical personnel are supposed to be impartial witnesses without any interest in the proceedings beyond relating what they have seen and what has been related to them by credible individuals with first-hand knowledge.

Horrible miscarriages of justice have occurred when police and prosecutors ignore exculpatory evidence or rely on questionable identifications in their efforts to convict an individual, often for reasons that defy rational
explanation. It is thus important to record the usual who, what, when, where, why and how without editorializing. And so it is with photographs.

Do not mix scenes on one memory card. Do not photograph things that are irrelevant to the investigation, such as an inappropriate photo of a victim or a colleague caught in an awkward position.

Shoot the entire scene, not just the shots that support your theory of the crime. The defense will invariably ignore the good and challenge the bad so try to avoid taking bad photographs.

Be prepared to answer any question in an objective, professional manner that will make sense to a jury composed largely of working class individuals who don't know the first thing about photography other than what they might have seen on television.

**Prejudicial and Inflammatory**

A judge will exclude photos likely to upset jurors. Dr. Besant-Matthews has hundreds of slides retrieved from morgue garbage cans so disgusting that they could not possibly be used in court.

My favorite was the head of a murder victim minus the top of his skull to expose the brain. The top of the skull was placed haphazardly near the head. The autopsy table was drenched in blood and littered with blood-soaked paper towels, a blood-smeared Stryker saw and assorted surgical implements. Bram Stoker would have loved it.

**Irrelevant and Immaterial**

Doctor B's catalog of photographic ineptitude included photos of a gurney near the body of the victim who, being deceased, was not going anywhere and was no longer in need of medical attention. The gurney was not part of the original scene and contributed nothing to the jury's understanding of the circumstances surrounding the victim's death.

**Best Evidence**

A prosecutor will try to present the best available evidence. In some cases, this will be eye witness testimony. In other cases, this might be testimony supported by photos and visual aids. Photos that cannot be admitted because the photographer failed to do his job properly are worthless, regardless of their technical merit.
Fair and Accurate

A photograph should be a fair and accurate representation of the scene as it appeared to the person taking the photograph and others who were present at the time.

Well, make that somewhat fair and reasonably accurate. We all know that a photo is a two-dimensional representation of a three-dimensional scene.

Separation in Time from Event

If no photos were taken at the time of an event, lawyers may dispatch photographers to get what they can. Their photos might be a fair and accurate representation at the time the photos were taken, but the original scene may have looked altogether different.

The light might be different. Objects present at the time of the event may be long gone. New objects may have taken their place. Old buildings may have been repaired or demolished. New buildings may have been erected. Trees in full bloom during the summer months may shed their leaves during the winter months.

Investigators who specialize in reconstructing crime and accident scenes take pains to interview witnesses, study the available reports, collect old photographs, verify weather conditions, determine the height of the sun and the phase of the moon, etc.

Nothing to Show

Some photos are taken to show that there is nothing to show. This might include photos taken upon admission to a jail or hospital to show that the subject arrived in good condition, photos taken at an accident scene to show that there were no skid marks and so forth.

Cause, Mechanism and Manner of Death

A coroner or medical examiner (ME) is responsible for determining the cause, mechanism and manner of death. These are concepts that might not be clearly understood by laymen, or even by physicians who do not have the post-doctoral training required to qualify as a forensic pathologist.
The cause of death is the event or agency that ultimately caused the deceased to depart from this vale of tears. Heart failure is not a cause of death. Eventually, we will all die from heart failure brought about from some other condition that is the proximate cause.

A gunshot wound to the chest might be the cause. The mechanism is how the bullet brought about the victim's demise. It could be through loss of blood, damage to internal organs, infection, etc.

The manner of death can be classified as natural, accidental, murder, suicide or undetermined. A gunshot death might be classified as undetermined until subsequent investigation shows that it was inflicted accidentally or during the course of a homicide or suicide.

**Post Mortem Interval**

It's good to know how the deceased came to be deceased. It's just as important to know when the victim met his end. Obviously, establishing an approximate time of death will aid in identifying persons who had an opportunity while excluding those who did not.

Less obviously, who predeceased whom can determine who inherits a substantial sum of money and who ends up selling pencils on a street corner.

**Chain of Custody**

The chain of custody is a system that accounts for each piece of evidence to include photographs from the time they are taken or collected until they are presented in court.

This chain is typically maintained by a series of signatures as the evidence passes from hand to hand until it reaches a designated custodian.

This should be spelled out in standard operating procedures known to every member of the department and the prosecutor's office.

**Standard Operating Procedure (SOP)**

Every department needs a set of protocols that cover every aspect of the photographic process from the time a photo is taken until it is delivered to a custodian for processing and archiving and, ultimately, to investigators, prosecutors and attorneys.
The fact that you followed your department's written SOP is your first line of defense if your photos should be challenged in court. Let whoever wrote the SOP explain it, should an explanation be called for.

**Accidental Association**

Accidental association describes something that may have found its way into a crime scene before it became a crime scene. Unfortunately, there is no way to tell whether something is relevant or irrelevant during the initial stages of an investigation. Shoot everything.

**Digital Hearsay**

Suppose Felony Frank tells Nefarious Nelly when and how he committed a certain crime, said crime being against the peace and dignity of the state. Further suppose that Nelly tells her friend Sally the Snitch who repeats Nelly's remarks to Officer McGruff.

Can McGruff arrest Frank and secure a conviction on the basis of second hand information receive from Sally? No. Nelly is the only person who can testify to Frank's admission because she and only she has first hand knowledge.

And so it goes if you are fortunate enough to find a camera, a camcorder, a CD or a hard drive that might contain incriminating photographs. The person who found the device must bag and tag for submission to a properly equipped lab, taking care to maintain the chain of custody.

A technician will take steps to preserve any digital files resident on the device before processing the device for prints. In all probability, it will be necessary to subject the memory card or hard drive to a forensic examination to glean all of the evidence recorded therein to include files that someone might have tried to erase. It is often possible to recover deleted files even from recently reformatted disks and memory cards.

If incriminating evidence is found, the person who found the device will have to testify to the manner in which it was found and the laboratory technicians will have to testify to their findings. Think child pornography. Think serial killers who videotape themselves in the process of murdering their victims so they can relive the moment.
Warrants, the Photographer and the Exclusionary Rule

The Fourth Amendment states that "The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized."

Probable cause can be defined as a legally sufficient reason but, as usual, the devil is in the details and those details can vary from jurisdiction to jurisdiction.

Sounds simple in concept but it can be anything but simple in practice and there is something called the exclusionary rule just to keep everybody honest. What is the Exclusionary Rule? In simple terms, evidence collected illegally cannot be used in court and this applies to photographs as well as fingerprints, firearms and the like.

The solution is simple. If in doubt, get either a warrant or a legally valid consent to search before processing your crime scene. This should be baked into your department's standard operating procedure and pounded into the head of every officer from the time he enters the academy until the day he retires.

See http://www.interfire.org/res_file/srchseiz.asp. This describes how well-intentioned and presumably competent people went astray, to the detriment of their cases. If there is a chance that your department's procedures have loopholes that might allow an eager beaver to create similar problems, submit your procedures to the district attorney's office for review.

The Expert Witness

Do not allow yourself to be qualified as an expert unless you possess genuine expertise based on training and experience and have the fortitude required to stand up under rigorous cross-examination.

While an individual qualified as an expert witness can offer opinion testimony, the defense can hire their own experts to challenge your expertise. If the defendant's pockets are deep enough and the stakes are high enough, the defense can always find someone with impressive credentials to offer a contrary opinion, notwithstanding facts that should be obvious to anyone with an IQ above room temperature.
It is not unusual for the defense to hire all of the big guns in a certain specialty simply to keep the prosecution from hiring those same big guns, leaving only little guns with less impressive credentials available to the prosecution.

**Persistent Evidence**

An article at [http://expertpages.com/news/photographic_evidence.htm](http://expertpages.com/news/photographic_evidence.htm) suggests that photographs are persistent evidence available to jurors from the moment the photos are admitted into evidence until twelve men good and true reach their final verdict.

Oral testimony, on the other hand, is likely to go in one ear and out the other if the witness is somewhat less than eloquent. Furthermore, critical testimony can be drowned in an ocean of drivel if a trial drags on for weeks and weeks.

Cops who speak in the stilted jargon of the trade, as in exit the vehicle, do themselves no favors when speaking to ordinary citizen-jurors who merely get out of the car.

**Police Training**

Police officers in departments large and small go through a minimum curriculum known as POST for Police Officer Standards Training. While the details differ from state to state, POST training covers an overview of the law, patrol procedures, first aid, marksmanship, pursuit driving and a host of other things that a rookie will need to know before he or she is turned over to a field training officer.

Large departments, naturally, have their own internal training programs because a big city police officer is expected to know things of limited interest to his or her small town counterpart. Many rural and suburban police officers are expected to receive POST training at their own expense in local community colleges before applying for a job.

Consider marksmanship. A firearm is a simple mechanism with a few controls, most of which are intuitively obvious. Before pinning on the badge, a recruit is expected to demonstrate his or her proficiency with the standard sidearm and, perhaps an off duty sidearm, the patrol shotgun and the patrol rifle.
In years past, it was assumed that police applicants had some familiarity with firearms. Now, the average rookie has never handled a gun before entering a marksmanship class and may require intensive training to ensure that he is not a danger to himself and the public.

And how is this training delivered? Once the classroom work is out of the way, an officer's training involves sending rounds downrange and verifying the minimum percentage of those rounds actually hit the target.

Alas, there are no state-mandated training requirements for police photographers. Much of the training that is available is limited to lecture and PowerPoint presentations. Only the more progressive schools assign field problems that must be completed by the student for a grade.

Even this laudable effort is handicapped because students are often required to provide their own camera. A student with a $200 point and shoot is going to be at a serious disadvantage compared to the student with a $2,000 SLR, a $1,100 macro lens, a $500 flash unit and a $400 tripod.

Thus, unless a newly minted police photographer is fortunate enough to work for a department with a well-established training program, he or she may be obliged to master the fundamentals through diligent self-study. It isn't all that difficult. That's the way most police photographers were trained in the old days and, all too often, even today.

As a matter of interest, all the legendary photographers of yesteryear such as Matthew Brady, Ansel Adams, Edward Steichen, Alfred Eisenstaedt and Margaret Bourke-White were self-taught, as were many of the Pulitzer-winning photographers during the heyday of Life and Look.
Chapter 1.7
Picture Quality

Don't blame the camera if you can't produce a good 20 x 30 inch print.

There are no absolutes in photography. While some things are generally true most of the time, nothing is universally true all of the time. Confronted with the same scene, two photographers of equal skill are likely to put their own spin on things because:

- Cameras and lenses of the same make and model are not necessarily identical.
- ISO numbers can vary with lighting conditions and processing.
- Some photographers adjust their camera to complement their printer. Since there are dozens of printers, there are any number of possible adjustments.
- Under difficult lighting conditions, I like to spot meter in the manual mode while another photographer might bracket.

Does it matter? Not in the least, as long as you understand your equipment and know how to get the most out of it.

How do you know if you’re getting the most out of your equipment? It’s easy. Look at the pictures. Have your best pictures enlarged to 12 x 18 inches with a minimum of manipulation in Photoshop. Can’t get a decent 12 x 18 print? In the detective business, we call that a clue.
You’ll get the most out of 12 x 18 inch prints when your digital image files are printed on a photo-quality inkjet using the printer manufacturer’s ink and 13 x 19 inch premium glossy paper. If you send your digital image files to a lab, there’s a chance that their automated processing equipment will compensate for some of your exposure and color balance errors.

If your pictures are consistently overexposed, underexposed or not quite as sharp as they should be, you need to find out why and fix the problem. It could be something as simple as shooting handheld when you should be using a tripod.

Exposure can be judged by studying the histogram on the camera's LCD display. Once you learn to read it correctly, a histogram will tell you how close you came to getting the proper exposure.

With practice, you can tell quite a bit by looking at your pictures on a good monitor using the Actual Pixels option. However, prosecutors and jurors are going to be looking at prints so you’ll want to verify your technique by looking at prints as large as those that would be used in court, perhaps 20 x 30 or even 24 x 36.

Adequate for the intended purpose is a good standard to shoot for. Photographer Peter iNova suggests the MCT standard. If Mom Can’t Tell, the difference might not be worth worrying about.

Figure 8 - One of the things that you pay for when you buy an advanced camera such as this Nikon D7000 is a large LCD display giving you access to all of your shooting and setup information, plus a thumbnail of each exposure with the option of displaying a histogram. Buttons and switches give you on the fly access to settings that must be accessed through the menu on compact cameras.
Chapter 1.8
Understanding Digital

Digital cameras record an image by assigning a numerical value ranging from 0 to 255 to adjacent red, green and blue picture elements, aka pixels. These red, green and blue pixels are combined to create the colors that we see on our computer screens and in our digital prints.

How many colors? Sixteen million to be exact: 256 x 256 x 256 = 16,772,216. All of these colors can be described in terms of their red, green and blue values, usually written as RGB(128,128,128) which happens to be middle gray.

Download Visual Color Picker from http://www.snapfiles.com. Place the eyedropper over any spot on a photo displayed on your monitor and you will get an RGB readout of the colors associated with the pixels at that particular spot. Move the eyedropper and watch how the RGB values change.

Film cameras record an analog image on grains of metallic silver or color-sensitive dyes. With the demise of optical enlargers, the resulting negative is scanned into a digital image file. The process is the same whether the scanning takes place on minilab equipment or an $80,000 drum scanner.

Once converted to digital, the process of printing a scanned photo is the same as printing a camera-original digital photo. You cannot buy a printer that is not based on digital technology.

In a conventional wet darkroom, negatives had to be printed on the appropriate grade of paper for a length of time determined by trial and error. More often than not, certain areas of the photo had to be given more or less exposure, a process known as dodging and burning.
The same thing happens on a computer in photo-editing software except the adjustments are made by mathematically manipulating the numerical values associated with each pixel. Manipulating numbers, after all, is what computers do best. This mathematical hocus pocus is invisible to the operator. The results are visible on the screen as adjustments are being made.

Picture a little too light or dark? Move the Levels slider and the computer adjusts the value of the appropriate pixels. Picture a little too blue? Move the Blue slider and the computer adjusts the value of the blue pixels. When the picture looks right, print and save the file.

Unfortunately, TV cop shows to the contrary, you can’t pull information out of a digital photograph that wasn’t there to start with. However, photos that were properly focused and exposed to start with will often reveal details absent in haphazard snapshots.

Figure 9 - The Dodge Ram badge is clearly visible in this crop from a 20 x 30 enlargement because we have enough pixels to work with. No amount of Photoshop legerdemain will reveal crisp detail in the Cummins Diesel logo because we don’t have enough pixels.
Chapter 1.9
Processing

In small departments, officer might process their own digital photographs. In larger departments, an officer might be issued several memory cards and, after shooting a scene, enclose the used card in a properly labeled evidence envelope that must be turned into the Photo Lab in exchange for a new card.

Digital has all but put film manufacturers and film processing labs out of business. Digital offers immediate gratification and a computer-literate user can process and print his own digital image files with minimal effort.

An inexpensive laptop with FastStone, free to home and student users from http://www.faststone.org, will suffice for students and occasional users.

You'll find an overview of the setup required to process and print anywhere from 50 to 500 a day in at forensix-photography.com > links > handouts > digital_imaging.pdf.

Cold Case Considerations

Photos processed in a conventional wet darkroom or on modern minilab equipment can be expected to last fifty years under archival conditions, meaning in a temperature- and humidity-controlled environment protected from the sun, ozone, UV-rich fluorescents and the acid left over from the manufacturing process found in most papers and plastics.

Until recently, the same could not be said for photos printed on inkjet printers. The dyes used in inks made right up until the last few years, and still used in low end printers, were not stable enough to produce a print that
you could expect to last more than two or three years. Prints made with some third party inks and off-brand papers will fade in a matter of weeks.

Now, prints made on Epson, Canon and Hewlett-Packard printers using pigment-based inks can be expected to last fifty years or more if you use the manufacturer’s ink and best quality paper. All bets are off if you try to economize with third party inks and budget paper.

Wilhelm Imaging Research is the authority on photo longevity. Check http://www.wilhelm-research.com for their ratings on any printer that you might want to purchase. Long after you retire, your diligence will be appreciated by cold case detectives now running around in rompers.

If you’re responsible for your department’s photo archives, you might want to take a look at how your pre-digital slides and negatives are stored and take action as required to ensure that they will be easy to find and in pristine condition in thirty years.

Dr. Patrick Besant-Matthews relates that twenty-six years passed between the time he posted a victim and the time that he was called upon to testify. One of his colleagues had to produce photos thirty-six years after a homicide because new technology allowed the police to identify a suspect. Visit the following sites for additional information:

- http://www.pixmonix.com
- http://www.loc.gov/film/storage.html
Chapter 2.1
The Right Tool for the Job

With so many cameras on the market and new cameras coming out to replace old standbys at regular intervals, purchasing a camera can be confusing for an individual and a challenge for the administrator responsible for equipping an entire department.

Students spending their hard-earned cash to purchase a camera good enough to complete a basic photography course have relatively modest requirements. Full time crime scene investigators have more stringent requirements. One size does not fit all. However, it's simple to break the problem down into bite-size chunks.

- Any camera that you can buy today, including the newest camera phones, will have at six megapixels.
- Six megapixels is sufficient to make prints of the largest size commonly required for courtroom presentation.
- Twelve megapixels is adequate for all but the most demanding applications.
- Sixteen megapixels will suffice if you're shooting National Geographic cover stories.
- Twenty-four megapixels will suffice when prestigious law firms are litigating multi-million dollar differences of opinion in civil court.
• Any camera with a lens covering the 24 to 120 mm focal lengths found on a film camera and focusing down to fifteen inches or so will suffice for crime scene photography.

• The built-in flash on compact cameras typically has a range limited to ten or fifteen feet.

• $500 flash units for SLR cameras have a range of fifty or sixty feet, one hundred feet or more for the $1,000 handle-mounts.

• At night, you may need an SLR and a substantial tripod to cover outdoor scenes too large to be photographed with flash.

• SLR cameras are expensive. You won't get your money's worth unless you invest in good lenses, sturdy tripods, external flash units, heavy duty cases, premium memory cards and so forth.

• SLRs are system cameras. Go with a system that includes all of the accessories that you expect to need both now and in the future.

• You'll want a camera durable enough to survive life on the street, which includes exposure to inclement weather.

If you need to shoot large outdoor scenes at night, you will eventually want an SLR. If you expect to do the kind of advanced photography commonly confronting state agencies and big city crime scene investigators, you will probably need an SLR.

Camera enthusiasts waste an inordinate amount of time worrying about technical specifications. Camera companies cater to these non-photographers by publishing often-meaningless specifications.

Consider pixels. It isn't the number of pixels that count but the size and quality of those pixels and the power of the processor that convert photons into image files. Size matters.

<table>
<thead>
<tr>
<th>Camera Type</th>
<th>Typical Sensor Size</th>
<th>Sensor Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pocket and Bridge</td>
<td>6 x 8 mm</td>
<td>48 mm²</td>
</tr>
<tr>
<td>EVIL/Micro 4/3rds</td>
<td>13 x 17 mm</td>
<td>221 mm²</td>
</tr>
<tr>
<td>APS-C SLR</td>
<td>16 x 24 mm</td>
<td>384 mm²</td>
</tr>
<tr>
<td>Full Frame SLR</td>
<td>24 x 36 mm</td>
<td>864 mm²</td>
</tr>
<tr>
<td>645 Medium Format</td>
<td>42 x 56 mm</td>
<td>2,352 mm²</td>
</tr>
</tbody>
</table>
Thus, your 12 MP bridge camera is never going to deliver the picture quality and low light performance of a 12 MP Nikon D300 using an APS-C sensor and the D300 can't match the picture quality and low light performance of a 12 MP Nikon D700 using a full frame sensor.

ISO values are another specification subject to misinterpretation. A camera will always produce its best pictures at the default ISO value. As you increase the ISO, the camera's internal computer has to work harder to process the image, with a consequent decrease in picture quality.

Most cameras will do a good job one or two stops over the default ISO value, which might take you to ISO 400 in a compact camera and ISO 1000 for an older SLR. The newer and more expensive SLRs will give you good results at values as high as ISO 6400. Generally, a camera's highest ISO option should be reserved for emergencies such as surveillance.

Many bridge cameras (otherwise known as super-zooms) have focal lengths the equivalent of 500 to 840 mm on a film camera. Does this mean that you can shoot at those focal lengths with impunity? Not hardly.

Even with image stabilization, you'll have a hard time getting an acceptable percentage of handheld shots at focal lengths greater than 200 or 300 mm, and then only in good light.

Many compact cameras have the same controls found on SLR cameras. However, an SLR camera will give you faster and more convenient access to those controls if you know how to use them.

Buy a compact camera and be happy if you expect to shoot mostly in the point and shoot mode. Buy an SLR if you're aggravated by the limitations of a compact camera.

I have a very nice pocket camera, useful for snapshots and situations where it is desirable to remain unobtrusive. I usually drop it in a pocket when I leave the house, even for a quick trip to the store.

Like all cameras, the LCD can be hard to see on a sunny day. It's virtually worthless in low light and closeup situations without a tripod that cost three times more than I paid for the camera. Shop carefully. A number of previously purchased pocket cameras did not engender much affection.
I bought my first SLR in 1971. I currently own five SLR cameras. A unique SLR advantage is the ability to focus and compose with an optical viewfinder that accurately frames the scene, even on a sunny day or shooting at night with the aid of a flashlight.

I have yet to find an electronic viewfinder that suits me as well as the optical viewfinder on the least expensive Canon and Nikon SLR cameras. This includes Electronic Viewfinder Interchangeable Lens (EVIL) cameras such as the Panasonic GH2 and the Sony NEX-7 which sell for prices comparable to a mid-range SLR.

We'll ignore camera phones in the pages that follow. They are not endorsed by the Scientific Workgroup on Imaging Technology. Top drawer smart phones are barely on a par with the cheapest P&S.

Although you would be hard-pressed to find a cell phone that does not have a built-in camera, make sure the phone is a model endorsed by your department and compatible with your department's processing procedures.

There are arguments against using a camera phone for evidence photography unless the phone was actually issued by your department and used exclusively on departmental business. An attorney can subpoena your phone and have it examined by a forensic consultant. You might get it back in one piece and then again, you might not.

Do you really want a defense attorney or even a police supervisor reviewing your cellular calling habits, your list of frequently called phone numbers and any personal photographs that you might have taken?
Chapter 2.2
Compact Cameras

You'll find specific camera models listed at forensic-photography.com > links > handouts > cameras_latest.pdf. With new models coming out every month or so, this free handout will be updated at regular intervals.

If your phone has a built-in camera, why buy a compact camera? Good question, but not without answers:

- You need removable media.
- You need a camera that can accept spare batteries.
- You need a camera with an optical zoom lens.
- You need a camera with more and better adjustments.
- You need a camera with better low light performance.
- You need a camera that can be examined by your supervisors and/or a defense consultant without risk of embarrassment.

Before making a decision, visit a store with a good selection to get an idea of what's currently available and see how individual cameras handle in comparison to other cameras of the same general size and type.

A small camera that will fit in your shirt pocket may not be the best choice if you routinely wake up to find your car covered in a foot of snow and need four wheel drive just to get out of the driveway.

Don't worry about pixels. Every compact camera that I've tried within the last five years will take pictures of respectable quality in good light.
Look for a camera made by a reliable manufacturer and backed by a good warranty.

A good compact camera will have an image stabilized lens, an eye-pleasing LCD screen, a macro mode for closeup photography, a high definition video mode and lens with an optical zoom range sufficient to cover the average crime scene. Ignore digital zoom specifications.

**Pocket Super-Zooms**

![Panasonic ZS camera](image)

Figure 10 - The Panasonic ZS series is typical of pocket super-zooms. The author's ZS9 has a 24 - 384 mm zoom lens, wide enough for indoor crime scenes, long enough for unobtrusive daylight surveillance. The built-in flash, limited to ten or fifteen feet outdoors, will light up a fair size living room.

Pocket cameras with an extended zoom range can be handy when you can't get close to your subject for one reason or another. I paid $129 for my ZS9 at amazon.com in 2011. If you watch for sales, you can find a good camera at a very reasonable price.

**Bridge Cameras**

There are any number of compact cameras intended to bridge the gap between cameras that will actually fit in your pocket and the SLR cameras favored by advanced photographers.
These cameras come and go so fast that nobody can keep track of them. Many of the newest models cameras are designed for air travelers who want near-SLR levels of performance without paying excess baggage penalties, a requirement of no interest to police photographers.

Figure 11 - The Canon SX-40 is typical of high end super-zoom bridge cameras with a sensor no larger than you'll find on a good pocket camera and a built-in flash suffering from the same limitations. Nevertheless, these cameras sell in large numbers to people who want something more than a pocket camera without spend more than $500.00.

At the risk of offending fans of various mid-size cameras, I suggest that criminal justice students purchase a good pocket camera to start with and graduate to an SLR if and when they are obliged to work above the point and shoot level. If the bridge camera concept appeals to you, look for a model that has:

- An eye level viewfinder
- A large, articulated LCD display
- A hot shoe
- A high definition video mode
- A sensor larger than the 6 x 8 mm sensor found in pocket cameras.
- A lens covering at least the 24 to 120 mm range on a film camera.
EVIL Cameras

EVIL is short for Electronic Viewfinder Interchangeable Lens. This relatively new class of camera, also known as Micro 4/3rds and ILC for Interchangeable Lens Compact, is intended to bridge the gap between bridge and SLR cameras.

![Image of a Sony NEX-7 camera](image)

**Figure 12 - The Sony NEX-7 is one of the better EVIL cameras with a 24 MP APS-C sensor, an articulated LCD, an eyepiece viewfinder, a hot shoe that will support a small flash and a good video mode. Unfortunately, with an 18 x 55 mm lens, the price is only $150.00 less than you'll pay for a Nikon D7000 with an 18 - 105 mm kit lens.**

EVIL cameras appeal to people who want to travel light. With current luggage restrictions, air travelers who formerly depended on SLR cameras have an understandable desire to downsize.

These are good cameras for travel photography but they're not versatile enough to compete with an SLR such as the Nikon D7000 or a Canon 7D, which are large enough to provide satisfactory results with the $1,000 professional flash units used by news, sport and wedding photographers who must get pictures that others miss if they expect to eat regularly.
Chapter 2.3
Single Lens Reflex Cameras

Do not assume that you need an SLR camera simply because most books on evidence photography were written by people who gained their experience when SLR cameras were the only game in town.

Back in the day, for every CSI using an SLR, a battalion of detectives and patrol officers were using Polaroids, Instamatics and iconic 35 mm rangefinder cameras such as the Konica Hexar and Canon Canonet QL-17.

Today's point and shoots fill the niche formerly filled by these classic cameras with three major differences. Those cameras:

- Had a fixed focal length lens, typically a moderate wide angle.
- Adjusted ISO by loading film with the desired characteristics.
- Did not have a long list of dubious options.

If you prefer the more responsive handling and superior viewfinders commonly found on an SLR, indulge yourself. You can use it in the point and shoot mode just as you would a bridge camera with the advantage of better low light performance and the option of mounting a high output flash.

If you're an aggressive shopper, you'll typically pay $500 or $600 for a low end SLR versus $400 or $500 for a mid-range bridge camera. The bridge camera will give you more telephoto reach but the kit lens found on an entry level SLR will cover the average crime scene adequately. Do not spend serious money on an advanced SLR camera unless:
You need to work at the advanced CSI level typically required by state agencies and the larger metropolitan police departments.

You want to pursue one of the IAI certification programs requiring an advanced camera and the skills associated therewith.

You're prepared to spend $300 on a tripod, $500 on a flash, $3,000 on lenses, a couple of hundred dollars on incidentals and $150 on a weather-resistant case before buying the camera itself.

If you can't answer even one of the above questions affirmatively, use whatever the department issues and make the best of it.

SLR cameras are not hard to use if you confine yourself to the same auto-everything modes found on compact cameras. However, you won't realize the advantages that an advanced SLR camera system can offer unless you're willing to master the camera's manual focus and exposure controls.

If you're in the market for an SLR, I suggest limiting your search to Canon and Nikon. The Canon and Nikon systems are more complete and more widely distributed than others. Which might be better for a given application is a largely a matter of personal preference.

Cameras manufactured by Olympus, Pentax, Panasonic and Sony will take pictures every bit as good as those taken by Canon and Nikon cameras in the same price range. However, if you need a certain lens or a particular accessory on short notice, Canon and Nikon are your best bets.

**Entry Level Cameras**

The Nikon D5100 and the Canon Digital Rebel T3I may not have all of the bells and whistles found on more advanced cameras but they do have articulated LCD displays, great for closeup work and unusually high or low camera angles such as might be found in the morgue if you are ever called upon to photograph autopsy proceedings.

Unfortunately, most of my Nikon lenses were purchased between 1978 and 1998. They will only work with mid-range and high end cameras such as the Nikon D7000, the D3, the D4 and the D700. Otherwise, I wouldn't hesitate to buy a D5100 to replace my D70.
Recommended SLR Cameras (AS-C Sensors)

Perhaps the best SLR cameras for police photographers with requirements that cannot be satisfied with a point and shoot are the high end amateur and low end professional cameras commonly known as prosumer models. Prosumer is a contraction of professional and consumer. At this writing, the cameras that I recommend include:

- The Nikon D300s and D7000
- The Canon 7D and 60D

![Figure 13 - Although priced as a high end amateur camera, the Nikon D7000 has a rugged magnesium body and the kind of weather-sealing formerly found only on substantially more expensive professional cameras.](image)

Professional SLR Cameras (Full Frame Sensors)

Full frame SLR cameras come in two distinct flavors. On the one hand, we have cameras with 20+ pixels from Nikon, Canon and Sony intended for landscape, portrait and studio work at moderate ISO values. On the other, we have new state of the art cameras such as the 16 MP Nikon D4 and the 18 MP Canon EOS 1DX designed for news and sports photography.
While you can never have too many pixels if you're shooting landscapes for a living, Nikon still makes their 12 MP Nikon D700 and D3S cameras, at least until the supply of D800 and D4 models catches up with demand. Twelve megapixels will suffice for all but the most demanding assignments. Sixteen megapixels is more than a careful photographer really needs but the extra pixels are nice to have if you can find a D4 in stock.

Lenses

I have good news and bad news. The good news is that you'll very likely replace an SLR camera every three to five years while a good lens will outlast several cameras. The bad news is that you will very likely spend more on your lenses than you paid for your camera.

Go to http://www.forensic-photography.com/handouts.html and check out Lenses.pdf for a list of specific camera and lens combinations based on the current Canon and Nikon catalogs.

Smart Money

Why use a Nikon D70 purchased in 2005 when the Nikon D7000 introduced in 2010 is clearly the better camera and D800 introduced in 2012 is in a class by itself?

The D70 is paid for. It's adequate for the intended purpose. I can make 12 x 18 inch prints that look good at arm's length and 20 x 30 prints that look good from across the room. I have a Panasonic pocket camera for snapshots and a Pentax 645 that satisfies my urge to shoot an occasional landscape.

If I were compelled by necessity to replace my D70, I'd probably opt for a D700 because it will work with my existing Nikon lenses and I would enjoy the image quality and low light performance that you can only get from a full frame sensor.

Whether I'd enjoy a D700 enough to pay a $1,000 premium over the D7000 is a question that would depend more on my bank account than the technical merits of the two cameras. Bucks up, I'd go with the D700. Otherwise, I'd cheerfully settle for the D7000.
Chapter 2.4
SLR Accessories

A first responder can very likely get by with a pocket point and shoot and a few memory cards. A full-time crime scene investigator likely to be confronted with more complex scenes, higher expectations and a broader range of responsibilities will need more, and more expensive, equipment.

Shoe-Mount Flash Units

Most cameras include a popup flash good for ten or fifteen feet but you'll need a shoe-mount flash for most outdoor and many indoor scenes. I recommend buying the camera manufacturer's high end flash because you'll need all the light that you can get to cover a large scene.

You will also want a flash extension cord because the ability to use your flash off camera is essential for closeup work. I recommend the Nikon SC29 with an on-camera focusing light or the similar Canon Off Camera Shoe Cord 2.

Figure 14 - A Nikon SB-800 flash on a D300 SLR. The built-in flash on this or any other camera will rarely reach out more than fifteen feet or twenty feet. A high end shoe mount from Canon or Nikon will give you fifty feet or more outdoors, perhaps one hundred feet if you crank up the ISO.
Professional Flash - Metz (http://www.metz.de/en)

Figure 15 - The Metz 76 MZ-5 is a powerful handle-mount flash with three times the power of the best shoe mount. If you routinely photograph large outdoor scenes at night, the $1,000 price tag might be money well spent.

Tripods

Figure 16 - A sturdy tripod with an articulated center column such as the Manfrotto 055XPROB or the Giottos shown here is indispensible for closeup and low light work. You can expect to pay $300 or more for a decent tripod.
Standard Accessories

The things that you need to get started in addition to a camera, lenses, a flash, a flash extension cord, and a tripod and a cable release are a camera bag, a supply of memory cards, a lens hood (if you didn't get one with your lens), spare batteries and a few odds and ends.

You can expect to pay anywhere from $75 to $300 for a good camera bag. I suggest the all-weather Lowepro AW200 because it holds just about everything that I'm willing to carry.

Everyone needs a lens cleaning kit. If your kit came with a packet of tissues, throw them away and purchase micro-fiber cleaning cloths which are less likely to scratch delicate lens coatings. You'll also need a sensor cleaning kit, even if your camera has a self-cleaning mode.

Get memory cards recommended by the camera manufacturer and large enough to shoot an entire scene. Carry as many cards as you need to avoid running out. The Lexar and SanDisk brands are preferred. Use a fresh memory card for each scene and format the card in your camera every time you install a fresh card.

If you’re a frequent traveler, you’ll want a bag or case large enough to accommodate your battery charger in addition to your other goodies plus, perhaps, a spare camera and your laptop.

Hard Cases

Soft-side camera bags are great if you want something to sling over your shoulder while still giving your gear a reasonable amount of protection. If you need something that can take a beating, you'll want a hard case such as those manufactured by Pelican at http://www.pelican.com.

Batteries

Cameras and flash units eat batteries. AA Duracells and Energizers can be purchased anywhere. Walmart and Home Depot carry AA lithium batteries for cold weather operations.
Buying AA batteries can get expensive if you're shooting every day. The solution? Rechargeables. Use rechargeables when you can and replaceables when you must. Stick with brand name batteries and chargers such as Panasonic and Sanyo.

**Spares and Loaners**

I have yet to meet a pro who carried just one camera. The spare might be an older model but it’s there in case the primary camera fails. I’ve never needed a spare but I’m not willing to tempt fate by leaving it at home.

Keep an old point and shoot or a surplus film camera on hand as a loaner. If someone wants to borrow your brand new digital SLR, point the offender towards the nearest camera store. Presumably, anyone qualified to use a digital SLR will already have a digital SLR.

**Gray Card**

Everyone needs a gray card, available at any camera store worthy of the name. The traditional application is taking a spot reading from a surface of known reflectance. Another option is using the white side of a gray card to set a custom white balance. The third and perhaps the most useful trick is to include a gray card in the scene. This will allow a Photoshop operator to set the proper color balance during post production.
Chapter 2.5
Scales and Markers

Scales and markers are an essential part of every police photographer's kit. Download the Oregon Rule catalog from http://www.orcforensics.com to get an overview of what's available.

Bear in mind that a first responder will have rather basic requirements while an investigator routinely processing felony crime scenes will have more demanding requirements.

We all know that markers are used to tie specific items found at the scene to evidence tags, diagrams and so forth. To this I would add:

- Carry enough markers to identify every item in the scene with a unique marker, preferably all of the same type and numbered consecutively without duplicates.

- Use markers in numerical sequence. If a marker is lost, order a replacement before using that set at another scene.

- Scales should be in proportion to the subject. Do not use an ABFO scale for footprints. Do not use a framing square for bite marks.

Defense attorneys love to find a weak link in your testimony. If your markers go from 17 to 19 without an 18, a shrewd attorney could easily ignore the markers that are there and hammer you on the missing marker.

If you say "I forgot," he'll ask what else you might have forgotten. If you say, "I lost it," he'll ask what else you might have lost. If you say, "I
used what they gave me," he will suggest that your department might be less than meticulous about other aspects of the evidence collection process. Don't open that door.

Figure 18 - A properly positioned scale can help a Photoshop operator correct a form of distortion known as keystoning and make a life-size print in which one inch on the scale equals one inch on the print.

Figure 17 - If you're shooting a shiny object such as a gun or a knife, use off-camera flash or shoot at a slight angle to control reflections. Steel rules are less likely to get bent in your camera case. Plastic rules may help to control reflections.
Chapter 2.6  
Adequate for the Intended Purpose?

Obviously, a camera should be adequate for the intended purpose. There are no universal standards that will cover everyone from a rookie patrolman to a senior crime scene investigator. However, there are standards which, while by no means universal, will give you a place to start.

- Guidelines established by the Scientific Workgroup on Imaging Technology can be found at http://www.theiai.org/guidelines/swgit/index.php.
- The Fingerprint Sourcebook prepared by the Scientific Workgroup on Friction Ridge Analysis, Study and Technology can be found at http://www.nij.gov/pubs-sum/225320.htm.
- Guidelines established by the Scientific Workgroup on Firearms and Toolmarks can be found at http://www.swggun.org.
- Guidelines established by the Scientific Workgroup on Shoe Print and Tire Track Evidence can be found at http://www.swgtread.org.

SWGIT Section 3 suggests that specification sheets may be used as a guide, but in most cases it will be necessary to test equipment under operational conditions.

This might mean shooting outdoors at night in lousy weather with awful to non-existent ambient lighting. You won't learn much about a camera's flash, auto-focus and auto-exposure systems at high noon on the police parking lot.
A good tripod eliminates human error and makes it possible to take better low light, fingerprint, footprint, tire track and tool mark photos than you can expect to take shooting handheld. A tripod with an articulated center column is helpful when photographing evidence at found in awkward places and at inconvenient angles. If you're doing comparative testing, anything less than a Manfrotto 055XPROB can skew your results. While other tripods are every bit as sturdy, Manfrotto tripods widely distributed.

There are perhaps two hundred cameras ranging in price from $75 to $500 that might serve the needs of a first responder. For best results, wait for daylight or get close and use flash. This is exactly what point and shoot cameras are designed to do so you can expect good results without undue effort.

SWGIT, SWGFAST, SWGTREAD, the IAI and advanced texts recommend a adjustable single lens reflex camera for crime scene investigators and evidence technicians. For our purposes, a crime scene investigator is an officer responsible for processing and documenting traffic fatalities and felony crime scenes such as rape, murder, manslaughter, arson and crimes against property resulting in significant monetary loss.

A CSI does more than take pictures. He or she develops and lifts latent prints, casts tool marks, footprints and tire tracks, searches for invisible blood and semen stains, diagrams buildings inside and out, collects trace evidence and so forth ad infinitum.

Figure 19 - There's more to crime scene investigation than taking a few pictures while trying not to get blood on your shoes. It requires advanced training, specialized equipment and often a specialized vehicle. See the list originally published by the Department of Justice on page 67.
Chapter 3.1
Building a Kit

You will notice an emphasis on digital single lens reflex cameras in this and in the following chapters because:

1. Many compact cameras have the same Auto, Program, Shutter Preferred, Aperture Preferred and Manual modes found on SLR cameras.
2. Just to be different, Canon uses the terms Time Value and Light Value instead of Shutter Preferred and Aperture Preferred.
3. Many cameras have a manual focus option.
4. Many cameras will let you adjust ISO and White Balance.
5. Many cameras have a video mode of some sort.

We emphasize the SLR camera because this is the camera that, more often than not, will be used by full time crime scene investigators working for a well-funded department.

- A criminal justice student taking a basic evidence photography course using a personally owned camera might be obliged to work in one of the more advanced modes to satisfy course requirements.
- A first responder using a department-issued camera might be required to work in one of the more advanced modes to simply to get the job done.

Thus, if you know how an experienced SLR user might approach a given problem, you can figure out how to apply the same approach using a
pocket or bridge camera even if you're forced to use dig deep into the menu structure instead of using the buttons and dials commonly found on an SLR.

![Pocket Camera Case](image)

**Figure 20 -** A pocket camera user can get by nicely with a case just large enough to protect the camera when not in use. This particular case has a convenient belt slot.

Someone with a high end bridge camera or an entry level SLR might want a case large enough to accommodate the camera, an external flash, spare batteries for the camera and the flash, and perhaps a cable release and an off-camera flash cord. This will require both a larger case and, given the cost of the contents, good dust- and weather-sealing.

If you're using a department-issued SLR, it is reasonable to suppose that the department will issue a well-padded case large enough to accommodate the camera and all of the required accessories, plus a substantial tripod.

If you're spending your own money, and many police photographers do exactly that either by choice or necessity, you can bet that the first case you buy will be too small. You're need for lenses and accessories will grow as you gain experience and start taking on more demanding assignments.

Thus, if you buy an advanced SLR such as a Nikon D7000 or a Canon 7D, you will more than likely acquire or eventually wish to acquire:
- Camera body with a general purpose zoom
- A telephoto lens for long range work
- A macro lens for closeup and fingerprint work
- A fast prime lens for low light work
- UV filters to protect your most used lenses
- An external flash
- A cable release and an off camera flash cord
- Spare batteries for camera and flash
- A substantial tripod with an articulated center column
- Lens and sensor cleaning supplies
- Spare memory cards
- Scales and markers
- Cheat sheets for camera and flash from http://www.photobert.com
- An 18% gray card for taking substitute light readings
- A flashlight adjustable for both spot and flood

Figure 21 - The author's kit with four lenses, a cable release, an off-camera flash cord, an incident light meter, a gray card, a ring light, a lens cleaning kit, several scales and a flashlight. An LED Lenser tactical flashlight has replaced the Pelican flashlight shown. This kit was originally put together in the mid-90s for a Nikon F4. Aside from replacing manual focus with auto-focus lenses and a Gossen Luna Pro with a Sekonic L358, this kit is virtually identical to a kit built around a Nikon FE in 1978 and an even older kit built around a Canon FTb in 1971.
Figure 22 - An adjustable flashlight such as this Coleman or one of the LED Lenser tactical lights belongs in every photographer's kit. The spot mode is useful for focusing under low light conditions. The flood mode can be used for closeup photography. An LED Lenser flashlight has replaced this light in my kit simply because the Lenser has a little more reach in tactical situations.

Figure 23 - This shot of a manual focus Nikon lens was made with the Coleman light pictured above mounted on one tripod with the camera on a second tripod. Exposure 1.3 seconds at f/22, ISO 200.
Other Stuff (That You May or May Not Need)

Photography does not exist in a vacuum. It's just one of many skills. Here's an annotated and abridged list courtesy Forensic Magazine and the DOJ of what a well-equipped CSI might have in his or her car or truck.

**Essential Items:**

- Bindle paper (*commonly used to package trace evidence*).
- Biohazard bags.
- Bodily fluid collection kit (*various kits for blood, semen, DNA, etc.*).
- Camera (*SLR with standard, macro and telephoto lenses*).
- Memory cards, spare batteries, remote flash, tripod and remote cord.
- Evidence seals/tape.
- Flashlight(s) with extra batteries (pocket, tactical, forensic, Q-Beam).
- Footwear casting materials (*dental stone has replaced plaster of Paris*).
- Graph paper and pencils, small ruler or straight edge.
- Latent print kit (*from $20 to $2,500*).
- Measuring devices (*tape measures, laser measures and surveyor's wheel*).
- Multifunction utility tool (*the Leatherman Wave is a good choice*).
- Notebook.
- Paper bags (*small enough for hands, large enough to bag bloodstained bedding*).
- Permanent markers (*Marks-A-Lot or Sharpie*).
- Personal protective equipment (*gloves, rubber boots, goggles, Tyvec overalls*).
- Placards (*presumably, they're talking about numbered markers*).
- Plastic resealable bags (*that's bureaucrat for Ziploc*).
- Scales for photography (*about $50 for a good assortment from Oregon Rule*).
- Spray paint, chalk, etc.
- Syringe/knife tubes (*aka evidence tubes, also cardboard gun boxes*).
- Tweezers (*steel for splinters, disposable plastic for evidence*).
- Fingerprint and tool mark casting material.
- *First aid kit with Betadine and sterile eye wash - crime scenes can be hazardous.*

**Optional items:**

- Audio recorder (*check out the Sony PCM-10, good for voice and video audio*).
- Biohazard labels.
- Bloodstain pattern examination kit (*blood spatter kit plus Hemoscein or Luminol*).
- Backup camera (*compatible with primary camera's lenses and flash unit*).
- Chemical enhancement supplies (*this could mean anything - lab chemistry?*).
- Cutting instruments (*knives, box cutter, scalpel, scissors*).
- Directional marker/compass (*magnetic compass plus compass rose*).
- Distilled water (*for mixing chemicals and irrigating injuries*).
- Entomology (insect) collection kit.
- Evidence collection containers (from Tupperware to body bags).
- Evidence identifiers.
- Extension cords (heavy duty outdoor three wire grounded).
- Fingerprint ink pad and cards for elimination prints.
- Flags (presumably wire surveyor flags).
- Forensic light source (from $50 to $50,000).
- Generator (Forest Service approved, full wave rectified).
- Gunshot residue kit (for testing a suspected shooter's hands in the field).
- High-intensity lights (preferably on stable eight foot stands).
- Labels.
- Laser trajectory kit (includes lasers, trajectory rods, angle finder, etc).
- Magnifying glass (also a jeweler's loupe).
- Maps.
- Marker stickers such as numbers, letters, arrows, scales.
- Metal detector (small for bullets in walls - large for cartridge cases in tall grass).
- Mirror (for looking over, under and behind things that can't be moved).
- Nail clippers for collecting debris under fingernails.
- Phone list with important numbers.
- Pocket knife (redundant if you have a Leatherman tool).
- Presumptive blood test supplies (ditto drugs commonly found at crime scenes).
- Privacy screens (excellent for annoying reporters and TV cameramen).
- Protrusion rod set (same as trajectory rod).
- Rakes (and perhaps a shovel, presumably for clearing wooded dump sites).
- Razor blades or knife with blades that can be broken off after each use.
- Reflective vest (flares were also listed in the original DOJ document).
- Refrigeration or cooling unit (to preserve perishable evidence).
- Respirators with filters (verify NIOSH approval for anticipated hazards).
- Roll of string (useful for tying things and plotting trajectories).
- Rubber bands.
- Screen sifters (evidence recovery in sand, gravel, graves, etc.).
- Sexual assault evidence collection kit (not the same as a hospital rape kit).
- Shoe print lifting equipment (presumably the mean an electrostatic lifter kit).
- Snow wax (for casting shoe prints and tire tracks in snow).
- Tarps to protect evidence from the weather.
- Templates (scene and human) (available in a kit from forensic supply houses).
- Thermometer.
- Tool kit (something always needs fixing, assembly or dismantling).
- Traffic cones.
- Waterless hand wash with germicide (and perhaps some paper towels).
- Little Giant folding ladder for overhead shots and attic access.
- Pelican 9440 battery powered LED Area Light (One is good. Two is better.)
Chapter 3.2
Let There Be Light

Daylight aside, flash is the most convenient form of light because it's always available, either built into your camera or stashed in your kit. However, there are other forms of light that you should be aware of.

Students in particular are obliged to look for field-expedient sources of light to demonstrate a certain skill without buying the latest and greatest of everything. Police administrators who want to outfit officers using a point and shoot camera have a similar problem.

Figure 24 - A clip-on light from the hardware store will solve many lighting problems for the student on a budget. Use a 50 watt spot for closeups, a 100 watt flood for area views and outdoor scenes.
Figure 25 - A Q-Beam that can be adjusted from spot to flood will do as well as off-camera flash for photographing fingerprints, footprints, tire track and tool marks. It can be used in lieu of flash of painting large outdoor scenes at night.

Figure 26 - The Coleman flashlight mentioned in a previous chapter was modified by attaching a tripod adapter with J-B Weld. The average flashlight is not powerful enough to permit handheld photography.
Some classes may require students to demonstrate proficiency with forensic lighting. A forensic light source (also known as an alternate light source, usually abbreviated ALS) can do four things:

- Use invisible ultraviolet light to cause the target to photograph darker than the background, requiring a bandpass filter.
- Use invisible infrared light to cause the target to photograph darker than the background, requiring a bandpass filter and an IR-modified camera.
- Use invisible ultraviolet light to cause the target to fluoresce in a visible portion of the spectrum, requiring a contrast-enhancing barrier filter.
- Use visible light of a certain wavelength to cause the target to fluoresce in a visible portion of the spectrum, requiring a contrast-enhancing barrier filter.

Fortunately, a light producing relatively modest power in the 450 - 460 nm wavelength will suffice for the things that a typical student might be called upon to do. With a 450 nm light, a pair of contrast enhancing goggles and a Tiffen 15 deep yellow filter, you can see and photograph:

![Figure 27 - It is common practice to shoot video at felony crime scenes. Now that virtually all cameras have a video mode, it is no longer necessary to carry both a still camera and a camcorder. However, you may need a video light such as this Manfrotto model light that mounts on your camera's hot shoe.](image-url)
- Dried semen, saliva and vaginal fluid
- Latent prints developed with fluorescent fingerprint powder
- Latent bloodstains processed with Hemascein or Luminol
- Bone and tooth fragments, gunshot residue, etcetera

Figure 28 - This particular kit from xenopuselectronix.com includes a 450 nm flashlight and a pair of goggles in a fitted case for $125 plus S&H. Based on an aluminum tactical flashlight, it should be economical enough for a student and rugged enough to survive life in the trunk of a stiffly spring patrol car.
Chapter 3.3
Camera Setup

Life was simple when we cooled off by opening another window and warmed ourselves by throwing another log on the fire. Cameras came with manual focus lenses and foolproof rangefinders. The placement of the shutter release and exposure controls was standardized. The only decision to make required deciding which film to use.

Digital changed all of that. While the better digital cameras have certain features in common, the placement and manner of setting these features varies from camera to camera and some of the factory default settings may not be what we want when taking evidence photos.

Many cameras have a menu option that will let you reset everything to the factory defaults, handy when you inherit a camera from another user. A few cameras, notably the Nikon D7000 and the Canon 7D, have user programmable settings that will let you return to your own preferred defaults.

Whether you buy a new camera or inherit an older camera, read the manual. If your camera came without a manual, you can download one from the manufacturer’s web site or one of the Internet services specializing in older camera manuals. The following settings will get you started:

**Shooting Mode**

The better cameras have five shooting modes, Auto, Program, Shutter Preferred, Aperture Preferred and Manual, usually abbreviated PSAM. Some cameras indicate Auto with a symbol. Canon uses Tv and Lv (Time Value and Light Value) instead of S for Shutter Preferred and A for Aperture
Preferred. Do not expect to find consistent nomenclature every time you pick up an unfamiliar camera.

Cameras intended for the consumer market invariably have scene modes of one kind or another, sometimes represented by a symbol on the mode dial and sometimes buried within the menu structure.

SLR cameras can be used in the Auto mode but this defeats the purpose of buying an SLR. SLR users will get better results learning to shoot in the Program, Shutter Preferred, Aperture Preferred and Manual modes as dictated by lighting conditions and the nature of the scene.

- In the Program mode, the camera sets the shutter speed and aperture while you set ISO and white balance independently.
- In the Shutter Preferred mode, you set the shutter speed, ISO and white balance while the camera sets the aperture.
- In the Aperture Preferred mode, you set the aperture, ISO and white balance while the camera sets the shutter speed.
- In the Manual mode, you set everything to suit yourself.

Scene modes may be advantageous for pocket and bridge camera users. Since there are no universal standards for scene modes, what works
on one camera might fail on another. An experienced SLR will usually obtain superior results using the PSAM adjustments described above.

**Metering Modes**

The better cameras give you a choice of Matrix (Nikon) or Evaluative (Canon), Center-Weighted and Spot Metering. Matrix and Evaluative mean exactly the same thing. Other manufacturers may have their own terminology. Select Matrix as your default. Center weighted and spot work well with flash or when you're shooting a backlighted subject or working under high contrast conditions.

**Shutter Mode**

These days, you may be forced to choose between single frame, slow speed continuous, high speed continuous and video, to name but a few possibilities. For evidence photography, take one picture at a time in the single frame mode.

**Focus Mode**

Snapshot cameras should be left in the auto-focus mode. Common SLR options include Single Frame Auto-Focus, Continuous Auto-Focus and Manual. Set Single Frame Auto-Focus and select the center focusing sensor as your defaults. This will give you predictable results for static scenes.

Continuous auto-focus uses all of the available focus sensors to track a subject in motion when you're shooting with the shutter in the continuous mode. Often, Manual works best for low light and closeup photography.

Turn off all gimmick options such as red-eye reduction, face detection, blink detection, closest subject, etcetera. These modes can cause the camera to focus on something other than the object of primary interest. Face detection obviously work well at parties.

Some cameras will let you select between focus priority and shutter priority. In the focus priority mode, the camera will not take a picture if the auto-focus system has not locked in on the central subject. In the shutter-priority mode, the shutter will fire whether or not the picture is in focus.
Select focus priority for crime scene work and learn to use your camera's focus confirmation indicator and focus and exposure lock controls, the nature of which will vary from camera to camera.

**Vibration Reduction**

Vibration reduction, under one name or another, is standard on most cameras. On a snapshot camera, this can be turned on or off somewhere in the menu system. On an SLR, look for a VR switch on the lens barrel near the manual focus switch.

Leave VR on if you're shooting hand-held. Some persnickety SLR shooters recommend turning VR off unless you're shooting under low light conditions dictating a slow shutter speed. Other SLR users leave VR on unless shooting off a tripod. Follow the advice in your camera manual.

**ISO**

Most cameras give you a choice between selecting Auto ISO or a manual ISO value. In addition, the better cameras will let you define the parameters that the camera will use when automatically adjusting the ISO.

I prefer to leave bridge and pocket cameras in the factory default auto ISO mode. On those that I've used, this seems to give acceptable results.

On SLR cameras, I prefer to leave the camera set to the default ISO value for daylight and indoor flash pictures, switching to a higher ISO for low light and outdoor flash situations. Other photographers are content to leave their SLR cameras in auto-ISO, specifying a minimum shutter speed and a maximum ISO value.

**White Balance**

Point and shoots can be left in the auto WB mode, resorting to flash under tungsten and fluorescent light. SLR cameras can safely be left in the auto WB mode shooting in daylight and with flash, switching to the incandescent or fluorescent modes under tungsten or fluorescent lights.
**Picture Quality**

Most cameras give you a choice between the RAW, TIF and JPEG file formats. Ignore RAW and TIF for the time being. To start with, set your camera to shoot Large/Fine JPEGs so you can properly evaluate your photos without getting lost in advanced Photoshop techniques.

For production work, you can adjust your picture quality to correspond to the largest size prints that you expect to need on a regular basis. For all but the most demanding purposes, anything over nine or ten megapixels at the normal quality setting merely loads up your memory cards and slows down your computer.

You can also adjust various settings controlling color, brightness, noise reduction, sharpness and color space. Use the factory defaults until experience suggests modifying these settings.

<table>
<thead>
<tr>
<th>JPEG Image Size</th>
<th>Fine</th>
<th>Normal</th>
<th>Basic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large - 16.1 MP</td>
<td>7.8 MB</td>
<td>3.9 MB</td>
<td>2.0 MB</td>
</tr>
<tr>
<td>Medium - 9.0 MP</td>
<td>3.9 MB</td>
<td>2.2 MB</td>
<td>1.1 MB</td>
</tr>
<tr>
<td>Small - 4.0 MP</td>
<td>2.0 MB</td>
<td>1.0 MB</td>
<td>0.5 MB</td>
</tr>
</tbody>
</table>

This table reflects the file size in megabytes (MP) versus JPEG image size in megapixels (MP) at the fine, normal and basic quality settings. These quality settings govern the degree of JPEG compression and hence the amount of color information available in a photo. From the Nikon D7000 manual.

Advanced photographers with good Photoshop skills almost invariably shoot in RAW. For purposes of comparison, a RAW file with lossless compression is 19.4 MB versus 7.8 MB for a Large/Fine JPEG. On this camera, a Medium JPEG at the Normal quality setting will suffice for 6.7 x 10 inch prints at 300 DPI on 8.5 x 11 paper. Shoot Large/Fine JPEGs if you can reasonably anticipate the need for prints larger than 6.7 x 10 inches.

With high capacity memory card and multi-terabyte hard drive prices at an all-time low, I'd be inclined to shoot Large/Fine JPEGs for everything, even if my computer runs a little slower when loading and saving files.
Exposure Compensation

The better cameras have an exposure compensation button that will let you make adjustments on the fly if the LCD display and histogram indicate that a particular photo is too light or too dark. Leave this set to zero, the default, unless your pictures are consistently too light or too dark.

Some manufacturers set their exposure meters to yield brighter pictures at the risk of overexposing under high contrast conditions while others are more conservative to avoid blowing out the highlights, resulting in pictures that may appear somewhat bland to the casual observer. Moderate underexposure can be corrected in Photoshop. Blown highlights are gone for good.

Memory Card Slots

High end cameras have two memory card slots. You can program one as primary, the other as either not used or secondary. You can mirror the primary to the secondary for backup. You can record JPEGs to the primary and RAW to the secondary. You can record still pictures to the primary and video to the secondary.

File Management

Some cameras will let you reset the camera-assigned file number to zero every time you format the memory card or let the numbers increment all the way to 9999 before they roll over to 0001. The second option is preferred to avoid cluttering your hard drive with files of the same name.

Nikon SLR cameras, and perhaps others as well, will let you change the file prefix from DSC to three letters of your choosing, perhaps your initials. You can also set the camera to record your name and badge number in the space reserved for copyright information.

Flash Management

SLR cameras will let you set a variety of options to govern both the built-in popup flash and any external flash units which might be mounted.
The key settings, usually the defaults, are front curtain sync on and redeye reduction off at 1/60th of a second. Using an in-camera option for redeye reduction usually causes more problems than it solves.

Modern flash units are as complicated as modern camera. Study the manual that came with your flash unit. Make sure that you are studying the sections of the manual that pertain to your camera. Some flash units will work with a variety of cameras but not necessarily in a manner consistent with your camera.

**Date and Time**

Set the date and time when you get a new camera. Check it periodically thereafter, preferably every time you roll up on a new crime scene. Digital image files include an EXIF file reflecting the date and time. Questions will be asked if the date and time recorded in your digital image files fails to correspond with the date and time reflected in other documents pertaining to the case in question.

**EXIF Files**

EXIF stands for Exchangeable Image File Format. This information, including the date and time, is embedded in every digital photograph. This EXIF file was exported as a text file using BreezeBrowser Pro.

File: DSC_1623.JPG
File size: 3,030KB
Image counter: 2050
Camera Model: NIKON D70s
Firmware: Version 2.10
**Date/Time:** 2011:08:08 14:09:51
Shutter speed: 1/125 sec
Aperture: 5.6
Exposure mode: Program
Flash: Off
Metering mode: Multi-segment
ISO: 200
Lens: 18-70mm f/3.5-4.5
Focal length: 70mm
Focal length: 105mm (in 35mm film)
AF mode: AF-S
Image size: 3008 x 2000
Rotation: none
Image quality: FINE
White balance: AUTO
Color mode: MODE1a
Color space: sRGB
Saturation: Normal
Sharpness: AUTO
Contrast: AUTO

When you edit a digital photo, the name of the program used to perform the edit appears in the space normally associated with the camera's firmware version. Defense attorney know this, or they should.

Some of the more professional cameras will let you insert a brief comment such as your name and badge number in an EXIF file every time you take a picture.

Additional information can be embedded in a digital image as part of the IPTC/XMP file. This option is commonly used by professional photographers to record copyright and caption information. Some of the newer photo-editing programs allow a photographer to sort his or her photographs according to key words assigned when a picture is downloaded.

You will run into the IPTC/XMP abbreviation if you work with any of browsers and editors suitable for professional work such as Photoshop, Lightroom and FastStone. IPTC stands for International Press Telecommunications Council. XMP (Extensible Metadata Platform) is a new version developed by Adobe Systems.
Chapter 3.4
Shoot Like a Pro

All cameras have an Auto mode, a lifesaver for folks who don't know anything about photography and have neither the time nor the inclination to learn. Even if you're a complete duffer, the Auto mode will give you usable, often excellent, pictures outdoors during the daylight hours and indoors or at night when the subject is within range of your flash.

In the Auto mode, the camera sets everything including ISO and White Balance. This may be an advantage for first responders and detectives with limited training.

However, many police departments are requiring detectives and first responders to take pictures that were formerly taken by full time crime scene investigators. Many schools that offer evidence photography courses expect their students to demonstrate skills beyond the point and shoot level.

A police department that expects officers to take pictures that require something more than a basic point and shoot should take care to select a camera that is suitable for the intended purpose, based on comprehensive testing by experienced photographers and typical users.

Cameras with similar specifications that are outwardly similar in appearance can have significant differences in performance, particularly under low light conditions, when shooting with flash and when the user is obliged to take extreme closeups.

With so many cameras on the market, with heavily promoted new models being introduced at frequent intervals, we can only generalize.
When SLR-like performance is required, we can safely exclude camera phones and the cheapest pocket cameras. Experienced photographers buy pocket cameras and camera phones in large numbers to use when it isn't worth carrying the full kit, often using them in the point and shoot mode in situations conducive to handheld photography at default settings.

We'll limit this discussions to the Nikon D7000 which can serve as a benchmark. You will be obliged to study your manual to find out what features are available on your camera and how they may be enabled or disabled. Purchase a case large enough to accommodate your camera manual. Even professionals forget how to access a seldom-used feature.

Any camera worthy of serious consideration will give you the option of shooting in all of the standard focus and exposure modes. By and large, experienced photographers tend to:

- Shoot in the program mode using auto-ISO, auto-WB and auto-focus most of the time.
- This can fairly be termed the thinking man's auto-everything mode.
- Shoot in the shutter preferred mode with manual ISO when photographing an action event to control subject and camera motion.
- Shoot in the aperture preferred mode using manual ISO when taking flash pictures under less than ideal conditions to ensure adequate depth of field.
- Shoot manual focus, exposure, ISO and white balance for extreme closeups and under extreme low light conditions.
- Daylight, flash and certain LED lights work well when white balance is set to Auto or Daylight.
- Tungsten and fluorescent lights call for manual white balance adjustments.

Study your camera manual for specific advice on achieving accurate auto-focus. This can vary from camera to camera. However, most cameras activate the auto-focus system by partially depressing the shutter release with a focus confirmation light visible in the viewfinder.
Chapter 3.5
Camera Handling

Whether you're using a P&S or an SLR, you need to be able to adjust the settings as required by current conditions. You need to be able to mount and dismount lenses and flash units. You need to be able to change batteries and memory cards. You need to be able to erect a tripod without poking yourself in the eye. These things can be done at night under blizzard conditions but they do take practice.

The Basics

Leave your camera set for your preferred defaults. Usually, this will include turning on auto-ISO, auto-exposure, auto-focus and auto-white balance in the Program mode. This will give you a high percentage of usable shots if you have to start shooting as soon as your feet hit the ground.

When circumstances allow a more contemplative approach, you may need to override the defaults to obtain high quality photos that will print with a minimum of tinkering in Photoshop. Thus, you need to be able to adjust focus, exposure, ISO and white balance on the fly, even in the dark.

This is obviously an area where an advanced SLR has it all over the average point and shoot. A good SLR will let you make all of the commonly used adjustments without taking the down from eye level. Nevertheless, the better point and shoots have a logical menu structure that will let you make the any needed adjustments without undue aggravation.
Use a neck strap to avoid dropping the camera and to leave your hands free when you're not taking pictures. Consider a photographer's vest if you need to carry extra lenses, a flash unit, spare batteries or whatever.

Format your memory cards in the camera in which they will be used. Use a card large enough to photograph any scene that you can reasonably expect to encounter. Use a fresh card for each scene and carry enough cards to photograph several scenes. This will help keep photographic evidence for the current case separate from other cases and make it easier for lab personnel to match photos to the correct case number.

Keep your unused cards in a dust- and moisture-resistant case. Develop a safe method for keeping used cards separate from unused cards. Unless your department specifies a different procedure, keep used cards in a sealed evidence envelope marked with the case number along with the date, time and your name and badge number.

**Holding the Camera**

![Figure 30 - Experienced photographers cradle SLR cameras and the larger bridge cameras in the palm of their left hand and support the lens with the fingers of their left hand. The right hand grips the camera body while the right index finger controls the shutter release. A gentle but firm grip is sufficient, with enough backward pressure against your nose and brow to provide additional support, rather like a rifleman's cheek weld.](image)

With practice, you can manipulate the shooting controls without taking the camera from your eye. Having a viewfinder that displays important settings and logically placed buttons to control these settings are among the things that distinguish a pro camera, letting you work quickly and efficiently.
The Shutter Release

Shooting with a manual camera, you twiddle with all of the dials before pressing the shutter release button. The shutter release does one thing and one thing only - release the shutter.

On electronic cameras, which includes all digitals, the camera will turn itself off after a period of inactivity to conserve battery power. Tapping the shutter release will wake the camera up so you can start taking pictures.

Once the camera is awake, partially depressing the shutter release will activate the metering and auto-focus systems.

- If you set the auto-focus system so that only the central focus indicator is active, you can aim the camera at the center of interest which may not be in the center of the scene.
- If you set focus priority as the default, the camera will not let you take a picture until you receive focus confirmation.

If you're shooting an SLR with a good lens in good light, the auto-focus confirmation dot in the viewfinder will come on almost instantly so you can fully depress the shutter to take the picture.

In marginal light, the auto-focus mechanism might have to hunt before the confirmation dot comes on. A focus assist lamp built into the camera or the flash is a big help, if not blocked by your hand or a big lens.

Focus confirmation methods vary on compact cameras which are typically held at arm's length. On some models, you'll hear a beep and/or the focus frame or frames will blink. If you're using one of the so-called social cameras with face recognition, you may see a blinking frame around every face in a group picture. Once you have focus confirmation, recompose if necessary and fully depress the shutter release to take the picture.

Focus Assist Lights

I discovered an interesting fact while playing with my Fuji S4000 bridge camera. If you can see the red focus assist lamp projected on the subject, the camera will focus quickly and accurately even on objects thirty
or forty feet away and the picture will be properly exposed. If you cannot see the focus assist light on an object even ten feet away due to low reflectance, the odds are that neither focus nor exposure will be accurate.

This is also true of my Nikon SLR with an SB800 flash unit. I don't guarantee that this is true of all cameras. It isn't mentioned in any of the manuals but it can easily be verified by experimentation.

**Shutter Speed**

Conventional wisdom holds that it is always safe to shoot at a shutter speed in fractions of a second equal to or greater than the reciprocal of the focal length in millimeters. In other words, if you're using a 28 mm lens, you should shoot at a shutter speed of 1/30th of a second or faster.

Folks with good hands and image stabilization can usually get away with shooting at slower shutter speeds. The loss in sharpness may not be obvious in a 4 x 6 print but it will very likely show up like a wart on the end of your nose in a 12 x 18 print. Vibration reduction it is not a cure-all.

If conditions dictate shooting at a shutter speed below 1/60th of a second even with VR, consider using a higher ISO, flash or a tripod.

**Conventional Wisdom Is Often Wrong**

The notion that it is always safe to shoot at a shutter speed equal to or greater than the reciprocal of the focal length is true but only up to a point. Those points are:

- Level ground
- No wind to speak of
- Nobody joggling your elbow
- No action demanding a higher shutter speed
- No hard partying the night before

If you’re shooting from a boat in rough seas, on the top rung of a rickety ladder or hunkered down behind the oleander bushes, you may need to shoot at a much higher shutter speed than would otherwise be the case.
The newer ultra-high resolution cameras with twenty or more megapixels demand shooting at higher shutter speeds than would otherwise be the case because camera shake and subject motion that would be invisible at twelve megapixels in an 11 x 14 print can become objectionable in a high resolution camera if you're making prints 12 x 18 or larger.

What's the point of buying a high resolution camera such as the Nikon D800 or the Canon 5D Mark III if you don't intend to make oversize prints on a regular basis. Even a sixteen megapixel camera will quickly reveal shortcomings in your technique if you print of paper larger than 8.5 x 11.

Practical Example

Figure 31 - The photo on the left was shot handheld at 1/30th of a second using a sharp 60 mm macro lens at twenty feet. The photo on the right was shot off a sturdy tripod. Both photos were cropped from a 20 x 30 enlargement.

Aperture

The lens aperture controls depth of field and, to a lesser extent, sharpness. A typical SLR lens offers apertures from f/3.5 to f/22. A fast prime will take you from f/1.4 to f/16. A macro lens will typically stop down to f/32, ensuring great depth of field. Pocket and bridge cameras typically offer apertures from f/2.8 to f/8, which can severely limit depth of field when you're shooting a three dimensional object at close range.
A photographer with an SLR may elect to shoot in the aperture preferred mode to ensure adequate depth of field, using flash or bumping up the ISO to keep the shutter speed high enough to prevent blurred images.

By and large, most SLR lenses are at their best one or two stops down from wide open and start to lose a little sharpness due to a phenomenon known as diffraction. For landscape work where depth of field is not a major concern, I like to shoot at f/5.6 or f/8 regardless of whether I'm shooting a digital SLR or a medium format film camera.

**Tripod Handling**

If the wind is blowing, keep one hand on your tripod to keep it from blowing over. Maybe your camera will survive the fall and maybe it won’t. Setting up a tripod for the first time can be a trying experience. The legs seem to go everywhere but where you want them.

Holding a collapsed leg in one hand, use the other hand to extend the leg full length and lock down the adjustments. Rotate one third of a turn and repeat for the other two legs. When all three legs are extended, you should end up holding one leg in each hand with the third leg extended away from you. Set the third leg on the ground and step back while separating the two legs that you're holding.

Loosen the collar so you can raise and rotate the center column as required. Lock down the center column, mount the camera and connect your cable release. Compose. Lock down the vertical and horizontal adjustments and you're in business.

Try to avoid raising the center column. Sometimes you need the extra height but you may pay a penalty in sharpness at the longer focal lengths and slower shutter speeds. Your money will be well spent if you purchase a tripod that will let you shoot at eye level without raising the center column.

Most tripods have multiple detents so you can spread the legs to bring the camera closer to ground level. Some tripods have a center column that can be inverted so you can take perpendicular shots. Practice using your tripod's features so you can employ them as required.
Setting up a tripod with all legs extended equally works fine for landscapes and so forth. When you need to position your camera just so for closeup photography, you may find yourself with one leg on the floor and two legs resting on a kitchen counter or the hood of a car.

**Transporting**

If possible, keep your kit in the passenger compartment where it will get the benefit of heating and air conditioning. Don't leave a camera in the car if you won't be using it for a few days or if the car will be parked all day under the hot summer sun or in sub-zero cold.

If you travel by air, use a kit small enough to fit in the overhead compartment or pack everything in a Pelican case, yellow preferred, using two TSA-approved padlocks. Insure for full replacement value. If your kit grows legs, a yellow case might be easier to spot than a black case.

While memory cards are immune to airport x-ray machines, they are not immune to magnets. Pros generally download their image files to a laptop and backup the hard drive to a CD. Better yet, burn two CDs. Keep one in your custody to preserve the chain of and mail the other back to the office for insurance against the risk of loss in transit.

**Temperature Extremes**

LCD displays are likely to stop working if the camera is exposed to triple digit or sub-zero temperatures for any length of time. Once the temperature falls to within a comfortable range, your LCD should start working normally.

Your camera can fog up when stepping out of an air-conditioned car on a humid day or entering a warm house on a cold day.

The solution? Set the camera on the front seat, turn off the air and open a window before you reach the scene on a warm summer day. If you'll be shooting indoors during the winter months, place the camera on the front seat and crank up the heater.
Either way, you want to give condensation a chance to form and dry before you arrive at the scene. Leaving the camera in a well-insulated case will delay the drying process.

Static electricity is prevalent when the humidity is low. Be careful walking across a wool carpet. A static discharge in the camera body can damage delicate internal circuitry.

Cold weather is hard on batteries. Carry spares in an inside pocket. If you live in an area of extreme cold, look for a camera that uses cold-tolerant lithium batteries. Some cameras can run on AA lithiums if you purchase an optional power pack.

Rechargeable batteries lose their charge over time, and that charge is lost faster in cold weather. Carrying a spare may not buy you much if the weather is really cold and you neglect to keep your spares charged. Bring your kit in at night and charge the batteries more often than usual.

Opinions differ on the best strategy for dealing with cold. Some folks recommend keeping the camera inside your jacket. Others contend that the humid air inside your jacket will condense when you take the camera out. If you live where sub-zero temperatures are the rule, check with local photographers to see how they cope.

**Rain, Slush, Sleet and Snow**

Rain and snow are invariably problems when you have to work outdoors in bad weather. The solution? Buy a Kata Rain Cover, available from camera stores catering to the professional trade. If you neglected to purchase a Rain Cover, improvise something from a plastic garbage bag.

A lens hood can shield the front element and provide an anchor for your Rain Cover. A clear filter will allow you to wipe water from the lens with a dry hanky without scratching the lens itself. An assistant holding an umbrella can provide extra protection if the rain is coming down in sheets.
Maintenance

Cameras built to professional standards do not wear out. They are damaged by accident, abuse and neglect or they are retired in favor of new cameras better suited to current requirements. One million exposures in the hands of a professional are not unheard of.

The less expensive cameras commonly purchased by individual police officers and police purchasing agents will typically last three years, more or less, depending on how heavily they are used and whether they are assigned to a well-trained and well-motivated individual or passed from uncaring hand to uncaring hand at every shift change.

If your camera goes on the fritz, your best bet is to send it to a factory-authorized warranty repair station. Try Camera Repair Service at http://www.criscam.com if you have an older camera.

A camera is a precision instrument. Drop it and it is likely to get bent. Get it wet and delicate circuits are likely to corrode. Setting it aside for any length of time without removing the batteries is an invitation to corrosion. The first rules of preventive maintenance are:
• Use a neck strap to prevent dropping the camera.
• Use lens caps to protect lenses that are not being used.
• Use clear filters and lens hoods to protect lenses that are being used.
• Use a Kata Rain Cover in wet weather.
• Remove the batteries from cameras that won’t be used for any length of time.
• Transport your equipment in well-padded cases designed to resist dust and moisture.

Many lenses are ruined by inept cleaning. Dust can be blown away with a rubber syringe or whisked off with a lens brush. Smudges can be moistened with a little breath and gently wiped away with a microfiber lens cloth. Greasy smudges may require lens cleaning fluid.

Do not use window cleaner or field-expedient cleaning aids such as a dirty shirttail. If you must use a dirty shirttail, pray that you’re using it on a $50 filter and not a $1,500 lens.

The outside of your camera can be cleaned with a lint-free tee shirt and a can of Dust-Off. Do not use Dust-Off on the lens or the camera’s innards. The propellant can damage delicate mirror and shutter mechanisms.

If you have a problem with dust in your camera, the ideal cleaning tool is a blower somewhat larger than an ear syringe. Giottos makes one that looks like a rocket. If that doesn’t work, try one of the small, dust-free vacuums used by computer technicians.

Opinions differ on the need to clean SLR image sensors. Some photographers never clean their sensors. Others using the exact same camera may be obliged to clean their sensor every few days if they are working in a dusty environment.

Go to http://www.cleaningdigitalcameras.com if your sensor needs cleaning. This site has instructions and links to sites that can provide the necessary supplies.
Chapter 4.1
Light

Photography is literally painting with light and light can be emitted, transmitted, reflected, absorbed, fluoresce or luminesce. It would therefore behoove a photographer to know something about light. For our purposes, it is enough to know that light has four more or less obvious qualities. These qualities are intensity, direction, color and contrast.

The light falling on a scene is known as incident light. The light reflected by a scene is known as reflected light. The intensity of the incident light reflected back into the camera lens is the main factor in determining exposure.

Photograph a black and white patrol car on a sunny day, with light and dark tones averaging out to middle gray.

- With the sun behind us, the car is frontally lit, receiving maximum light from the sun and reflecting maximum light back into the lens.
- With the sun to our right or left, the car is side-lit. Sidelighting reflects less light and the shadows are more pronounced.
- Stand facing the sun and the car is backlit. Backlighting places the near side of the car in its own shadow, illuminated only by light from the open sky.
- Photograph the same car on an overcast day. The light comes from all directions so all sides receive an equal amount of light.
Photographers think of light and exposure in terms of stops, or f-stops. Each stop is twice the value of the next lower stop and half the value of the next higher stop. This applies to the ISO rating of the film, to the aperture that allows light to pass through the lens to reach the image sensor and to the shutter speed which controls the duration the shutter is open.

ISO ratings specifying the sensitivity of the sensor at a given setting are reasonably consistent from manufacturer to manufacturer. Shutters are mechanical devices but, by and large, you can take your shutter speeds (measured in fractions of a second) for granted.

Aperture is nothing more than the ratio between the focal length and the diameter of the iris. F/2 represents a 25 mm aperture on a 50 mm lens.

**Relevant Facts:**

- Common ISO ratings run from ISO 100 to ISO 6400, with lower ISO ratings implying higher picture quality while higher ISO ratings suggest greater sensitivity to light when getting the picture is more important than the quality of the picture.

- Common shutter speeds run from thirty seconds to 1/4000th of a second, with the slower shutter speeds admitting more light to the image sensor while faster shutter speeds are required to freeze subject motion and reduce the effect of camera motion.

- Common apertures run from f/1.4 to f/22, with the smaller f-numbers indicating larger apertures which admit the greatest amount of light while reducing the depth of field.

- All of these numbers have intermediate divisions broken down by one-half or one-third stop values. You need to know the range of available settings are for any camera that you happen to be using.

**Rules to Remember**

You need to remember several important rules. The first is the law of *reciprocity* which states that, if the metered exposure happens to be 1/60th of
a second at f/11, 1/30th of a second at f/16 or 1/125th of a second at f/8 will provide the same exposure.

- 1/30th of a second is one stop more than 1/60th of a second while f/16 is one stop less than f/11.

- 1/125th of a second is one stop less than 1/60th of a second while f/8 is one stop more than f/11.

The second is the Sunny 16 rule that states that a shutter speed in fractions of a second equal to the ISO rating of the film at an aperture of f/16 will give you the correct exposure of a frontally lit subject on a sunny day.

Shooting at ISO 400, you would expose a frontally lit subject for 1/500th of a second at f/16. On most cameras, 1/500th is the marked shutter speed closest to 1/400th of a second. Open up one stop for sidelighting, two stops for backlighting, three stops for open shade and four stops on an overcast day.

This gives you a handle on how photographers use the word "stop" when describing film speed, shutter speed and lens aperture. These values are so closely related that you can't speak of one without thinking of the other two.

Contrast describes the brightness range of a scene, or the difference between the lightest and darkest areas containing important detail, sometimes referred to as textured white and textured black.

On a sunny day, the white roof of a black and white patrol car would represent the brightest area because it receives the greatest amount of light and it is also a reflective surface. The shadow under the car would represent the darkest areas, with the tires being only slightly lighter than the shadows.

This would be considered a high contrast scene on a sunny day. On an overcast day, it would be considered a low contrast scene because the light reflected from the roof of the car would not be as intense and the shadows under the car would not be as dark.
This hypothetical underpass accident presents focus and exposure problems because, when you compose the picture to include both cars the camera is pointed between the two cars. The metering and focusing systems are "seeing" not the objects of interest but something in the background, perhaps the supporting columns or a retaining wall. You can have a similar situation when photographing two bodies on the floor, one to the right and one to the left, while the camera is pointed at a chair on the far wall.

Going back to our hypothetical patrol car, we now come face to face with another law, namely the law stating that the angle of incidence is equal to the angle of reflection.

If the angle of sunlight hitting the windshield is equal to the angle between the windshield and the camera, you'll pick up a reflection known as a specular highlight just as you would if you took a flash picture standing in front of a mirror.
The solution? Change position so that the angle of incidence is no longer equal to the angle of reflection, eliminating the undesirable reflection.

If we photograph our hypothetical patrol car at night using flash, we come face to face with the inverse square law which states that the intensity of light from a point source varies inversely with the square of distance. If we photograph our car from a distance of thirty feet, the foreground in front of the car will be overexposed while the background behind the car will be underexposed.

This is of no great consequence if all we want is a photo of the car itself. It is a matter of considerable consequence if we're trying to photograph an auto-pedestrian accident with impact debris in the foreground, the body of the victim in the middle ground and the vehicle in the background.

We now have to balance our flash exposure in a way that preserves detail in the foreground, the middle ground and the background, not easily done when the light falls off four stops every time we double the distance.

Light also has color, usually expressed in degree Kelvin. The midday sun and the light from a flash unit are approximately 5500K. The color temperature in open shade can run from 7000K to 20000K, giving your photos a bluish cast without correction. This corrections is applied via your camera's white balance control, which can be either manual or automatic.

Move indoors and the light from an ordinary light bulb will be somewhere between 2500 and 3500 degrees Kelvin, imparting a yellowish cast to your pictures. Fluorescent, mercury vapor and sodium vapor lights can vary all over the ballpark.

A scene illuminated by light from several sources, each with a different color temperature, can be a real bear. Shooting with ambient light, you can only correct for the predominant light source.

While color casts can be removed during the editing process, it's better to get it right in the first place. Photographers who depend on a Photoshop operator to correct their mistakes are merely demonstrating their ineptitude.
Often, the path of least resistance is to shoot flash at a shutter speed high enough to minimize the effect of ambient light (which requires shooting in the Manual or Shutter Preferred modes). Shooting digital, you can set a custom white balance using either a Kodak gray card or an ExpoDisc available from http://www.expodisc.com.

Some subjects are more critical than others. You want accurate colors during a homicide investigation because the color of stains, discolorations, bruising and lividity can be diagnostic to a pathologist.

**Photo-Friendly Lamps**

If you're taking pictures in a lab setting and don't want to use flash, or if you need to evaluate color prints in your digital darkroom, you'll want full spectrum lamps with a color temperature approximating daylight. You can purchase full spectrum daylight balanced compact fluorescents in Walmart, camera stores, hobby shops and industrial lighting supply houses.

Read the label or consult the manufacturer's web site. If it doesn't say *continuous spectrum* and indicate a color temperature between 5000K and 6500K, keep looking.

**Quantifying Color By Wavelength**

The color of light can be quantified either by the color temperature in degrees Kelvin, usually abbreviated K, or by the wavelength in nanometers, usually abbreviated nm.

<table>
<thead>
<tr>
<th>Color</th>
<th>Wikipedia</th>
<th>Source B</th>
<th>About.com</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultraviolet</td>
<td>&lt;100 - 380</td>
<td>&lt;100 - 400</td>
<td>&lt;100 - 380</td>
</tr>
<tr>
<td>Violet</td>
<td>380 - 450</td>
<td>400 - 450</td>
<td>380 - 435</td>
</tr>
<tr>
<td>Blue</td>
<td>450 - 475</td>
<td>450 - 475</td>
<td>435 - 500</td>
</tr>
<tr>
<td>Cyan</td>
<td>475 - 495</td>
<td>475 - 495</td>
<td>500 - 520</td>
</tr>
<tr>
<td>Green</td>
<td>495 - 570</td>
<td>495 - 570</td>
<td>520 - 565</td>
</tr>
<tr>
<td>Yellow</td>
<td>570 - 590</td>
<td>570 - 590</td>
<td>565 - 590</td>
</tr>
<tr>
<td>Orange</td>
<td>590 - 620</td>
<td>590 - 620</td>
<td>590 - 625</td>
</tr>
<tr>
<td>Red</td>
<td>620 - 750</td>
<td>620 - 750</td>
<td>625 - 740</td>
</tr>
<tr>
<td>Infrared</td>
<td>750 - &gt;1400</td>
<td>750 - &gt;1400</td>
<td>740 - &gt;1400</td>
</tr>
</tbody>
</table>
There is no universal agreement on exactly which wavelengths equate precisely to a certain color. Google "color spectrum" and you will probably find several color charts, no two of which are in perfect agreement. Look at college-level physics texts and you will find still more color charts.

Source B and the chart extracted from Wikipedia are identical except that Source B indicates that the visible spectrum starts at 400 nanometers rather than the 380 nanometers suggested by Wikipedia and About.Com.

This color bar, also borrowed from Wikipedia, tells a simple story. Colors are not cast in stone. The line between colors are not etched with a sharp chisel. We all perceive colors differently and the transition from one color to another is gradual.

Thus, the wavelengths that you see in color charts should be viewed as useful approximations. What we can agree on is that the visible spectrum starts at a wavelength between 380 and 400 nanometers in a color commonly perceived as violet and continues to a wavelength between 700 and 750 nanometers in a color commonly perceived a red.

In our chart, I've shown the lower end of the UV band as being less than 100 nanometers and the high end of the IR band as being greater than 1,400 nanometers. Eventually, ultraviolet light becomes x-rays and gamma rays while infrared eventually becomes microwaves and radio waves.

The International Standards Organization (ISO) has proposed the following definitions for ultraviolet light:

- Ultraviolet A  400 - 315 nanometers  (aka near UV)
- Ultraviolet B  315 - 280 nanometers  (aka middle UV)
- Ultraviolet C  280 - 100 nanometers  (aka far UV)
The International Commission on Illumination (ICE) has recommended the following definitions for infrared light.

- Infrared A 700 - 1400 nanometers
- Infrared B 1400 - 3000 nanometers
- Infrared C 3000 nanometers - 1 millimeter

Ultraviolet light has applications in medicine, industrial testing, curing plastics and sterilizing everything from scalpels to municipal water supplies.

The more powerful lights in the UV-A range can be somewhat hazardous while all lights in the UV-B and UV-C ranges are distinctly hazardous and best reserved for specialists who know what they're doing.

Fortunately, we're concerned with light in the range of 365 to 850 nanometers. These are the wavelengths covered by standard forensic lights and capable of being photographed with readily available lenses and filters using standard or inexpensively modified cameras.

**Quantifying Light by Color Temperature**

You need to understand color temperature because the color temperature of the light falling on a scene determines how your camera will record the colors in the scene. Any deviation from 5500K will cause a color shift unless we compensate by adjusting the white balance.

<table>
<thead>
<tr>
<th>Color Temperature in Degrees Kelvin</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Candle</td>
<td>1000K</td>
</tr>
<tr>
<td>Sunrise</td>
<td>2000K</td>
</tr>
<tr>
<td>Common Tungsten Light Bulbs</td>
<td>2700K</td>
</tr>
<tr>
<td>Type B Photofloods</td>
<td>3200K</td>
</tr>
<tr>
<td>Fluorescents</td>
<td>2700K - 4100K</td>
</tr>
<tr>
<td>Sunny Day - Electronic Flash</td>
<td>5500K</td>
</tr>
<tr>
<td>Bright Sunshine Clear Sky</td>
<td>6000K</td>
</tr>
<tr>
<td>Continuous Spectrum CF Lamps</td>
<td>6500K</td>
</tr>
<tr>
<td>Overcast Sky</td>
<td>7500K</td>
</tr>
<tr>
<td>Open Shade Clear Day</td>
<td>9000K</td>
</tr>
<tr>
<td>Heavy Overcast</td>
<td>10000K</td>
</tr>
</tbody>
</table>
Quantifying Intensity

Photographers think of light intensity in terms of f-stops. You will also run into the terms light value and exposure value but these terms can be ignored for our purposes. Scientists think of light in terms of foot-candles, candela, lumens, lux, joules and watt-seconds, all terms that you might encounter in a physics class or a camera specification sheet.

Naturally, a video camera rated to provide full video at one lux is better for a night surveillance than a similar camera rated at ten lux. Also naturally, a high end electronic projector putting out 5,000 lumens will work better in a large room than a low end projector rated a 1,200 lumens.

The Quality of Light

The light from a point source such as the sun is crisp, throwing sharp shadows. The light in open shade or on a cloudy day is diffuse, throwing soft, indistinct shadows. You can prove this to yourself by looking at the shadow of a finger on the palm of your hand in sunlight and in open shade.

Figure 33 - The picture on the left was taken in full sunlight. The picture on the right was taken in open shade. Note the absence of a shadow.
Figure 34 - This picture was taken with sun almost directly overhead.

Figure 35 - This is a four minute time exposure taken by the light of a full moon and a sixty watt porch light fifty yards away. Clearly, the quality and intensity of the light falling on a scene will affect the color, quality and clarity of a photograph.
Latitude refers to the number of stops that an exposure can be off and still yield an acceptable print. The average print can record a brightness range of five stops between textured black and textured white. Values below textured black will print as flat black. Values above textured white will print as pure white.

You might be able to print detail over a brightness range of six or seven stops if the process can be fine-tuned by a skilled operator.

There are differences between prints made in a wet darkroom, prints made on automatic minilab equipment, dye sublimation prints and inkjet prints. There are subtle differences between glossy and matte paper. There are significant differences between the $100 inkjets designed for snapshot photographers and the $10,000 inkjets designed for professionals.

For our purposes, assume that a brightness range of five stops is all that you're likely to see. Anything over five stops is a bonus.

A good camera might be able to capture a range of eight or nine stops, only five of which will appear in the print without adjustment in Photoshop. While digital has no latitude for overexposure, you can often recover the detail in underexposed shadow areas.

Fortunately, most scenes are average so you can blaze away confident that all of your pictures will turn out. The trick is being able to recognize scenes that are not average, either because the brightness range is greater than five stops or because the balance between light and dark tones does not average out to middle gray.
Figure 36 - Eleven Mile Canyon a few miles west of Woodland Park, CO. I've never owned a camera that failed to properly expose an outdoor scene with a full range of light and dark tones during the daylight hours. There are trout in these waters and in the nearby reservoir. This photo was taken with an SLR but it could just as well have been taken with a good pocket camera.
Chapter 4.3
Exposure Basics

Why discuss exposure when an automatic camera will give you a perfect picture nine times out of ten? Because, sometimes, the one shot that you really need is the one that you can't get by letting the camera do your thinking for you.

Know Your Camera

Some cameras are conservatively calibrated, yielding camera-original image files that may appear somewhat dark in the interest of preserving highlight detail in high contrast scenes. This is of no consequence because you can always pump up the shadows in Photoshop but you can't salvage blown highlights.

Other cameras are more likely to yield an image that requires no tweaking in moderate contrast situations with the concurrent risk of blowing out the highlights in high contrast situations. This too is of no consequence. If you prefer the conservative approach, you can always dial in a little exposure compensation.

Know Your Scene

You're the photographer. You should know what is relevant and what is irrelevant. Cameras are calibrated to satisfy the needs of photographers concerned with the overall scene, not just critical elements within the scene.

It gets complicated when there are several areas of interest and the ambient illumination is not even enough to capture everything you want to
record in a single exposure. You can waste a lot of time and energy learning to recognize these problems by trial and error.

The better way is to walk typical scenes with your camera set in the spot metering mode. Or, better yet, use an incident meter. If the intensity of the light falling on areas of interest within a scene differs by more than one or two stops, you might be in trouble.

**Incident Light Meters**

Used correctly, the meter built into your camera is accurate enough for all ordinary purposes. However, an incident meter such as the Sekonic L358 is both a valuable training aid and a useful way to check cameras and flash units to make sure they're within factory specs.

**Middle Gray**

We see the world in terms of color as well as light and shadow. Exposure meters see the world in shades of gray.

Exposure meters are calibrated on the assumption that the average reflectance of typical scenes will average out to middle gray. For years, instructors taught us that middle gray was the 18% reflectance found in a Kodak gray card.

We now know that exposure meters are calibrated in accordance with ANSI standards, variously reported as 12% to 14% reflectance. The difference is only half a stop. The instructions accompanying Kodak gray cards specify opening up half a stop to compensate.

**Kodak 18% Gray Card**

Every photographer should have a gray card in his kit. The white side can be used to set a custom color balance. The gray side can be placed in the scene to give your Photoshop operator a color reference of known value. A gray card can also be used to take a substitute meter reading when an incident meter is not available.
How Exposure Meters Work

Your camera's exposure meter reads the intensity of light reflected from the scene and comes up with a preliminary exposure value based on the oft-unwarranted assumption that the reflectance of all important elements in the scene will average out to middle gray. The meter then determines the range of suitable exposure values based on the ISO preset.

In the program mode, a computer in the camera comes up with an exposure based on rules coded into a memory chip. These rules take focal length and distance into account, just as you would using a handheld meter or an older camera with a match needle meter.

In the Auto mode, or in the program mode with ISO set to Auto, the camera's computer will crank up the ISO within predetermined limits to ensure an optimum combination of shutter speed and aperture.

Metering Patterns

Modern cameras give you a choice of metering patterns. Matrix patterns read the entire scene and try to compensate for areas that are significantly brighter or darker than the scene as a whole. Center-weighted patterns read the entire scene but concentrate sensitivity in the center of the viewfinder. In the spot mode, the meter reads a small portion of the scene indicated by a circle in the viewfinder.

Matrix serves most purposes nicely. Unfortunately, the camera isn't smart enough to figure out which portions of the scene are most important. You, the photographer, have to be smart enough to decide whether matrix metering will properly expose the area of interest without regard for areas devoid of relevant detail.

Used with discretion, spot metering will give you better results in difficult lighting situations. Center-weighted metering might be your best bet when shooting with flash, particularly when there is a lot of foreground and background of no great relevance to the subject.
Shooting Modes

The Auto and Program modes will give you a supposedly optimum combination of shutter speed and aperture. Most of the time, this works well. You can always tweak your settings or switch to one of the other modes if you want a faster shutter speed to freeze motion or a smaller aperture to increase depth of field.

- Use Auto or Program most of the time but check the shutter speed and lens aperture in the viewfinder to make sure that the shutter speed is fast enough to minimize camera shake and the aperture is small enough to give you adequate depth of field.

- Use Shutter Preferred when you want to shoot at a particular shutter speed to freeze motion regardless of depth of field.

- Use Aperture Preferred when you want to shoot at a given aperture to capture sufficient depth of field regardless of the possibility of camera shake and subject motion at slow shutter speeds.

- Use Manual when you want maximum control over both the shutter speed and lens aperture.

Amateur cameras have scene modes that are supposed to bias Auto exposure values for closeups, portraits, landscapes and so forth. These are a handy crutch for snapshot photographers but, if you're going to work at the professional level, you need to be smarter than your camera.

Don't be afraid to crank up the ISO if you can't come up with a satisfactory combination of shutter speed and lens aperture under low light conditions. Don't be bashful about using a tripod and/or flash when you can't depend on getting the shot that you want handheld.

Exposure Compensation

There are several ways to compensate for an invalid meter reading.

- Check the histogram and dial in exposure compensation as needed.
• Take a meter reading from an important part of the scene and lock in the reading before shooting, always assuming that the metered area is close to middle gray.

• Use spot or center-weighted metering to eliminate errors likely to result when an irrelevant part of the scene is either significantly brighter or significantly darker than the area of interest.

• When there are multiple areas of interest, switch to manual and average a series of spot readings.

**Bracketing**

Bracketing is both a crutch for the inept and a parachute for the expert. You will eventually run into a situation where you can't trust your meter and you can't afford to miss the shot.

The solution? Bracket your exposures two full stops over and two full stops under the metered exposure. Many cameras have a bracket button that can be programmed to bracket more or less automatically.

**High Contrast Composites**

How do you handle situations where you have a brightness range of ten or twelve stops?

Use the manual mode. Set the aperture to an f-stop sufficient to ensure adequate depth of field. Take careful meter readings from the lightest of highlights, a representative mid-tone and the darkest of shadows. Record the shutter speeds. Place your camera on a substantial tripod. Use a cable release.

Focus and compose as usual. Use the predetermined aperture to avoid changing the depth of field between shots. Take one exposure at each of the calculated shutter speeds from minimum to maximum. Avoid moving the camera. Each exposure must be in perfect registration with the other exposures.
You should end up with three exposures identical except for the shutter speed. An experienced Photoshop operator can combine these photos into a composite image file with a brightness range of five stops, rather than the original ten or twelve, using the Merge HDR tool.

Some cameras can create high contrast composites in-camera, an advantage for photographers without Photoshop skills. As usual, the terminology will vary from manufacturer to manufacturer to satisfy marketing requirements.

**Time Exposures**

Most cameras will let you take exposures up to thirty seconds long. Some cameras have a time or bulb setting that will let you take exposures as long as you like by means of a cable release. Naturally, you'll need a sturdy tripod. If your camera has a mirror lock, use it to avoid mirror-induced vibrations.

Professional cameras have a viewfinder screen to keep extraneous light from entering through the viewfinder, thus affecting your exposures. No viewfinder screen? Place a handkerchief over the viewfinder.

A one or two second exposure at ISO 400 will capture many night scenes with excellent results. If the light is too low to obtain an accurate meter reading, check your histogram and shoot until you obtain a satisfactory result even if exposures stretch out to several minutes.

Some of the better SLR cameras will let you shoot as high as ISO 6400 with good results. The noise common to high ISO photos may not be objectionable. If it is, it can be removed in Photoshop.

If you find the Photoshop noise removal tools wanting, invest in one of the third party plug-ins such as Noise Ninja or Neat Image.
Chapter 4.4

 Thumbnails, Histograms and the Blinkies

 Thumbnails

 Thumbnails give you an opportunity to review the shots that you've just taken. If you're not happy with what you see, keep shooting until you get it right. Using thumbnails often and wisely is the key to getting the best results out of a digital camera.

 Having problems seeing your LCD in sunlight? Worried about damage to the LCD? Buy a hood from http://www.hoodmanusa.com that will fold flat against the back of your camera when not in use.

 The Blinkies

 Some cameras will indicate clipped highlights in the viewfinder when you take a meter reading and in the thumbnail when you review the shot. These clipped highlights are generally indicated by a blinking effect, easier to see than to describe.

 If an important element in the scene falls within the area indicated by the blinkies, you're overexposed. Dial in minus exposure compensation in half stop increments until the blinkies disappear. The blinkies will always indicate specular highlights even if the photo as a whole is properly exposed.
Histograms

Digital cameras give you the option of displaying a histogram that graphs the range of light and dark tones. The values to the left of center represent dark tones. The values to the right of center represent light tones.

If your light tones are blocked up against the right side of the histogram, you've overexposed. These clipped highlights cannot be restored in photo-editing software.

If your dark tones are blocked up against the left side of the histogram, you're underexposed. You can probably recover some of the missing dark tones in a competent editing program but you'll get better prints if your photos are properly exposed to start with.

Of course, a snowscape will include mostly light tones while the sodden ruin of a burned out building will include mostly dark tones. You need to interpret histograms according to the values found within the scene.

The histograms that you can see in your editor and in the camera's LCD display show both an overall exposure value and individual values for the red, green and blue channels.

You can expect a color shift if the histogram shows that one of your color channels is clipped, indicating that that color is overexposed even though the scene as a whole is properly exposed.
Chapter 4.5
Grain, Noise and Distortion

Our eyes provide us with depth perception and the ability to adapt from bright sunlight to dim starlight. Even in sunlight, we can perceive detail in all but the deepest of shadows. Our eyes adapt to changes in the color of light so that red is red whether viewed outdoors in the sunshine or indoors under tungsten light.

A camera, on the other hand, captures a two-dimensional representation of a three-dimensional scene. The field of view depends on the focal length of the lens.

A digital sensor can capture only a narrow range of tones from textured black to textured white. Shadow detail below the sensor's exposure range will print as pure black devoid of detail. Highlight detail above the sensor's exposure range while print as pure white.

Shooting under tungsten or fluorescent lights without dialing in the correct white balance will give your pictures a yellowish or greenish cast. This can best be described as color distortion.

Our eyes expect to see converging horizontal lines such as railroad tracks disappearing to a point in the distance. This looks normal because we've been seeing converging horizontal lines since the Romans started building straight roads two thousand years ago.

Stand too close and tilt the camera back to photograph a tall building and you'll see converging vertical lines. A photo of a building with acutely converging vertical lines looks distorted even though a person standing
where the photographer stood and tilting his head back would see the same thing. Although a form of perspective distortion, this effect is commonly known as keystoning.

While we can see close to 180° including our peripheral vision, we can only focus on a fairly narrow area at any one time, perhaps less than 5°. We can't see everything around us in sharp focus without moving our eyes, and perhaps even our heads.

The camera, on the other hand, takes in everything within its field of view. A wide angle lens takes in more than we're used to seeing while a telephoto lens takes in less.

Wide angle lenses make distant objects appear farther away than they really are. This is known as wide angle distortion. Telephoto lenses make distant objects appear closer than they really are. This is known as telephoto distortion.

Together, these effects are known as perspective distortion. This is an over-simplification but sufficient for our purposes.

- Color distortion can be corrected by adjusting the white balance on a digital camera.

- Converging vertical lines can be corrected either by taking the picture from a greater distance where the degree of convergence is not so acute or by correcting the image in Photoshop.

- Distortion generally can be cured by avoiding exaggerated camera angles, using a "normal" focal length and viewing prints at the correct viewing distance.

Pincushion and barrel distortion, jointly known as rectilinear distortion, are commonly seen at the edge of the frame when photographing parallel lines, especially with the cheaper zoom lenses. Pincushion distortion describes parallel lines that appear to be pinched while barrel distortion describes parallel lines that are bowed out.
Neither pincushion nor barrel distortion are obvious when photographing a three-dimensional object centered in the viewfinder. Both forms of distortion can be corrected in Photoshop.

Vignetting is another form of distortion easily corrected in Photoshop. Some lenses at the wider apertures are brighter in the center than they are at the edges. This makes the edges appear dark when photographing an evenly illuminated object such as a brick wall.

Vignetting usually disappears once the lens is stopped down one or two stops. Vignetting may not be visible when photographing a scene with an important central subject and an irrelevant background.

There is another form of color distortion known as lateral chromatic aberration, aka color fringing. Color fringing, normally visible only in the largest prints, comes about when the lens does not focus all colors in the same plane. This is common with inexpensive zooms which is another reason to stick with lenses of mid-range or better quality. Mild cases of color fringing can be corrected in Photoshop.

It is enough to know that these phenomena do exist and that they can be corrected or explained. Some of the more esoteric forms of distortion are of interest only to photographers making large display prints intended to hang in art galleries. The worst forms of distortion can be avoided by steering clear of cheap and/or off-brand lenses.
Diffraction

Diffraction is a form of distortion typified by reduced sharpness and lower contrast commonly encountered in large format photography when small apertures such as f/32 or f/45 are required to get reasonable depth of field. Generally, shooting with a full frame digital camera, you can ignore the effect of diffraction at apertures of f/11 and larger.

Image Format versus Print Size

The aspect ratio of a 24 x 36 mm full frame sensor or a 16 x 24 mm APS-C sensor is 2:3. The aspect ratio of an 8 x 10 print is 4:5. If you make an 8 x 10 print from a digital image file, you're going to crop the image as shown in the photo on page 182. Failing to match the aspect ratio of your prints to the aspect ratio of your camera deprives the user of whatever information might be contained in the margins.

Digital Noise

Digital sensors are analog devices that generate weak electrical signals when exposed to light. A processor amplifies these signals and converts them from analog to digital, with the digital image being recorded on the memory card. Lower ISO settings require the least amplification, resulting in higher image quality. As the ISO setting is increased, the additional amplification results in noise, just as cranking up the volume on a radio can over-drive the speakers.

Digital Noise Reduction Technology

Modern cameras have a noise reduction setting buried in their menu. High end editing programs like Photoshop have a digital noise reduction filter. There are stand-alone digital noise reduction programs, of which Noise Ninja and Neat Image are perhaps the best known.

None of these programs actually remove noise. Rather, they blur fine detail, concealing the noise. Since cameras vary widely in image quality at the higher ISO settings and some noise reduction programs are more efficient than others, and some photos are adequate for the intended purpose
even with a generous dose of digital noise, this is something that you’ll need to decide for yourself.

**Converging Lines**

We expect to see converging horizontal lines. Some folks are bothered by converging verticals caused by pointing the camera skyward but you would see what the photographer saw if you were standing where he stood when he took the picture.

![Figure 37](image)

*Figure 37 - The mine car on the left is shown as shoot from a low camera angle, revealing converging verticals. The photo on the right was adjusted to eliminate converging verticals Photoshop, a thirty second job. Gripple Creek, Colorado.*

![Figure 38](image)

*Figure 38 - We expect to see converging horizontal lines in a highway running straight to the horizon. US 24 west of Hartsell, Colorado.*
Flare

Flare, also known as ghosting, is caused by a strong light source within the scene or a strong light source such as the sun outside of the field of view striking the lens at an oblique angle. You've seen flare when the sun hits your windshield at just the right angle.

Besides providing mechanical protection, a lens hood will protect your photos from extraneous light striking the lens at an oblique angle.

Perspective Distortion

Perspective varies with distance, not focal length. Focal length controls the size, or magnification, of the image. You can prove this to yourself by closing one eye and looking at objects near and far through an empty slide mount.

Figure 39 - The photo on the left shows moderate wide angle distortion because it was taken with a 24 mm lens from a distance of twenty feet to eliminate a distracting foreground. The photo on the right was taken from across the road with a 50 mm lens, providing a more natural perspective. Nikon FE circa 1978.
Chapter 4.6
Focus

Manual cameras with split image rangefinders were very accurate with prime lenses f/2.8 or faster. Optical rangefinders have been replaced by electronic rangefinders, usually represented by a dot in the viewfinder, and today's zoom lenses are usually f/3.5 or slower.

The latest professional cameras have the ability to fine-tune the auto-focus system to work with lenses that might be a little off due to manufacturing tolerances, a matter of scant consequence to snapshot photographers.

Zoom lenses with variable maximum apertures ranging from f/3.5 to f/5.6 are neither as fast nor as accurate as professional lenses with a constant maximum aperture of f/2.8 or faster. In low light, it may take two or three seconds to focus. Some auto-focus systems will not work at all with a lens slower than f/5.6.

If you routinely have focus problems while working under low light conditions, use an external flash with an IR focus assist light. You can also upgrade to a faster lens. Professional zooms are expensive but a fast prime in your most commonly used focal length should be relatively inexpensive.

Although some cameras have built-in auto-focus assist lights, their range is limited to fifteen or twenty feet compared to a flash with focus assist. Even with an external flash, you may need to focus manually while someone holds a flashlight.

When a lens is focused on infinity, all objects from the infinity symbol marked on the lens barrel to the horizon will be in sharp focus. When
the lens is focused at a distance less than infinity, which varies with the focal length of the lens, the depth of field varies with both the focal length and the aperture.

For any given focal length and aperture at distances less than infinity, only a portion of the scene will be in sharp focus. This is known as depth of field, also called depth of focus. Depth of field falls off gradually in front of and behind the plane of best focus.

There can be only one plane of best focus. Focus falls off before and after the plane of best focus. The falloff may be minimal depending on focal length and aperture but it is there.

The notion that focus falls off one-third of the distance in front of the plane of best focus and two-thirds of the distance behind the plane of best focus is a convenient rule of thumb but it isn’t cast in stone.

The depth of field scale found on the barrel of most prime lenses is merely a guide and not a very accurate guide at that. Zooms do not have a depth of field scale because the depth of field changes with every change in focal length.

A depth of field preview button, if you have one, only works in good light at the larger apertures. In dim light or stopped down to the smaller apertures, the viewfinder is too dark to judge focus accurately. In most cases, you will be obliged to depend on experience.

Short focal lengths have greater depth of field than long focal lengths. Small apertures have greater depth of field than large apertures. In fact, a 28 mm lens stopped down to f/16 has near-infinite depth of field.

Compact cameras and DX reflex cameras require shorter focal lengths than their FX counterparts due to their smaller sensors, so short that you can just about disregard depth of field at one of the wide angle setting. Depth of field can be very limited, perhaps a scant inch or so, if you're using a telephoto lens and shooting wide open at close range.

If the subject of greatest importance is in the center of the scene and the foreground and background are not particularly significant, let the camera auto-focus on the subject with confidence. When all parts of the scene
including the foreground and background are of equal importance, use the smallest aperture that you can get away with even at the expense of using a tripod when you'd rather shoot handheld.

**Auto-Focus**

Modern cameras have anywhere from five to fifty auto-focus sensors. This serves two purposes when all sensors are active.

- If you're shooting an action event in the sequence mode and the subject moves out of the area covered by the central sensor, the camera will automatically hand off the focusing chores to another sensor.

- If you're shooting a static scene in the single frame mode with an off-center subject, you can use the jog wheel on the back of the camera to select the appropriate sensor.

If you have your camera set to use the central focus sensor in the single frame mode, partially depress the shutter release to activate the auto-focus mechanism, and wait for the focus confirmation indicator before taking the picture.

Or, switch to manual focus when the center of interest is not covered by the central focus sensor or if the subject does not have enough contrast to satisfy auto-focus requirements, common in closeup and fingerprint work.

**Hyperfocal Distance**

Hyperfocal distance is the distance at which everything from the near foreground to the horizon will be in focus when the lens is stopped down to shooting aperture. This is a moot point if you're using a modern camera with a zoom lens but, like the Zone System and other terms in common usage pre-digital, you'll still see the occasional reference.

**Auto-Focus Problems**

Perhaps the most common auto-focus problem is shooting through foliage, fencing and so forth. You're eyes focus on the object of interest,
ignoring the intervening obstruction. The camera focuses on the obstruction, leaving the subject out of focus. The solution? Focus manually.

Figure 40 - This picture taken in the Cheyenne Mountain Zoo was manually focused on kitty's nose. As you would expect, auto-focus invariably tried to focus on the cage bars.

Don't hesitate to use manual focus when auto-focus isn't getting the job done to your satisfaction. Turn off gimmick focus modes like face detection that aren't contributing to the job at hand. Always wait for the focus confirmation light before fully depressing the shutter release button.

I still use manual focus lenses purchased more than thirty years ago because they tend to be somewhat sharper and more precise than all but the very best professional zoom lenses. You can new Nikon and Zeiss manual focus lenses from Adorama and B&H Photo-Video.

Focusing screens in today's digital SLR cameras are optimized for auto-focus lenses with a maximum aperture of f/2.8 or slower, resulting in a dark viewfinder image under marginal lighting conditions. Katzeye Optics can install a new focusing screen in most SLR cameras optimized for stationary subjects and manual focus prime lenses f/2.8 or faster.
Chapter 4.7
Color

Black and white conveys shape and texture in shades of gray. A good B&W print can be richly detailed. Sharpness and the ability to make high contrast prints make B&W the medium of choice for technical work.

For routine crime scene photography, color is preferable. Color provides information that you can't get from black and white.

What if the defense objects to color on the grounds that Technicolor blood and gore might prejudice the jury? No problem. A color photo can be converted to B&W but a B&W photo cannot be converted to color.

Color is important in homicide investigations. The color of ante mortem bruises, post mortem lividity and similar discolorations are clues that will help the pathologist determine the cause and manner of death.

Ideally, any person found dead under suspicious circumstances will be examined by a forensic pathologist. In rural areas where homicides are rare and forensic pathologists few and far between, the initial examination might be conducted by a justice of the peace, a mortician, a physician without the years of training required for certification as a forensic pathologist.

Photos taken at the scene are part of the overall picture. If the pathologist can't respond in person or dispatch an investigator, he has to depend on photographs to tell him the condition of the body at the time it was discovered and the circumstances surrounding the discovery.

If the original post mortem is questioned, a second pathologist, deprived of an opportunity to view the body in person, will want to see photographs taken at the scene and during the original post mortem.
Even if you normally photograph nothing more critical than an occasional fender bender, adjust your camera on the assumption that accurate colors are more important than pretty colors.

Pretty colors? Photographers who routinely shoot landscape and travel photographs invariably go for bright, bold colors. Many cameras destined for the snapshot trade come pre-configured to deliver pretty colors.

You never know when you're going to be called upon to shoot a homicide or photograph an assault victim. The idea is to use one camera setting for everything so you don't get tripped up by something that doesn't behave as expected when the chips are down.

You can go into your camera's menu and adjust sharpness and color saturation to suit yourself. The exact settings will vary from camera to camera so it pays to read the manual. The defaults on my Nikon D70 produce accurate skin tones so I have no need to modify the factory settings.

Take people pictures and, if the skin tones are off, make adjustments as required until you can capture accurate skin tones regardless of the subject's complexion or ethnicity. If skin tones are rendered accurately, other colors should fall into place.

When maximum color fidelity is important, use flash for medium and closeup shots of homicide victims. Flash is consistent from shot to shot and it's the best match for shots taken in direct sunlight.

**Mixed Light Sources**

Even professionals have trouble when the light comes from two sources, such as ordinary household lamps at 2700K combined with afternoon sunlight streaming through a window at 5500K. You can't pull the blinds without disturbing the scene. Using flash to override the tungsten light might overexpose the sunlight. Etcetera.

Coming up with an exposure that will capture the entire scene will be tough enough without trying to come up with a way to ensure accurate color
reproduction in both parts of the scene. Motion picture crews need truckloads of equipment to solve problems of this nature.

Painted walls are another problem. Light, whether from flash, household lamps or sunlight, will be reflected by the walls, picking up their color and influencing the color of other objects within the room.

This might not be a big deal when shooting overall views. It can become a big deal shooting closeups of the body and bloodstains at a homicide scene.

The solution? Get as close as possible. Angle your camera and flash unit to avoid multiple light sources and reflections from off-colored walls. Take a test shot in shooting light with a gray card in the scene to provide a color reference target. With a color reference to go by, a Photoshop operator can dial in the corrections required to yield accurate colors when the pictures are printed.

**Color Perception**

Like 10% percent of the population, I’m somewhat color blind. Knowing that I do not perceive colors accurately, I compensate by shooting flash or setting a custom white balance in questionable lighting situations.

Even people who are not clinically color blind perceive colors differently. Obviously, you want technicians with good color perception to process your photos so they can dial in accurate color corrections during the printing process.

**Evaluating Color Prints**

Some monitors will render colors accurately out of the box, but a monitor's ability to render colors accurately can shift as components age. As with cameras, some monitors ship from the factory programmed to deliver the vibrant but not always accurate colors preferred by the folks shooting vacation snapshots. You will also find printers that do not render prints that match the image displayed on your screen.
To make matters even more interesting, you cannot properly evaluate prints in light that does not approximate the color of daylight, requiring lamps producing continuous spectrum light in the range of 5500K to 6500K. Providing good lighting for print evaluation requires nothing more than purchasing lamps designed to render colors accurately.

This rules out incandescent lamps, ceiling fixtures with lamps of unknown value and so forth. Desk lamps with continuous spectrum bulbs in the 5500K to 6500K range will suffice for casual use.

Visit http://www.solux.net for an overview of lighting systems specifically designed to render colors accurately in museums, art galleries and digital darkrooms.

If your monitor is off, you'll need a color calibration tool such as the Spyder 3 Pro from http://www.datacolor.com. Once your monitor is calibrated, you should be able to obtain satisfactory results using the ink and paper specified by the printer manufacturer.

Professional photographers who live and die by the quality of the colors in their exhibition prints often profile their printers to provide an exact match for the colors displayed on a calibrated monitor.

The entire process from calibrating your monitor to profiling your printer and constructing a properly designed viewing station is known as color management. A good Photoshop operator will be familiar with these terms and know how to set up a system built around professional monitors and printers.

Readers of this book don't need to know all there is to know about color management but you do need to be able recognize prints that do not accurately represent the colors visible in the scene when photos were taken. Tools are readily available tools to calibrate monitors and printers.
Chapter 4.8
White Balance

Digital cameras default to automatic white balance, which is another way of saying that the camera compensates for ambient light sources that are either more or less than the standard 5500K. Sometimes this works. Sometimes it doesn't. Some cameras are better than others. None are infallible.

Experienced photographers often set their own white balance. Typical options include sunlight, tungsten, fluorescent, flash, cloudy and open shade. Cameras like the Nikon D7000 and the Canon 7D will let you set white balance to the actual Kelvin temperature, an advantage in difficult lighting situations.

Your colors will be off if you fail to set a correct white balance. Unless you had the forethought to include a gray card in the scene to provide a color reference of known value, it may be impossible to render the image correctly in the final print.

I'm told that recent Nikon cameras are calibrated to yield an accurate automatic white balance in daylight when the color temperature falls between 4200K and 7500K.

None of the usual presets are likely to work perfectly in a situation involving mixed light sources. If in doubt, set a custom white balance using the white side of a Kodak gray card or an ExpoDisc available from Expo Imaging. Expodisc tutorials for many cameras are available on the Support Menu at http://www.expoimaging.net.
Check http://www.outbackphoto.com/workflow/wf_65/essay.html for instructions on correcting color casts in Photoshop when you include a gray card in your initial test shots.

Or, if the object of interest is within range of your flash and your flash has enough oomph to predominate over the ambient light, just set your white balance to flash and shoot flash.

What you do not want to do is trust to luck if you're forced to shoot under an uncertain light source such as mercury vapor, sodium vapor or metal halide which can vary all over the ballpark. Fluorescent can be iffy because you've got a near-infinite number of fluorescent tubes with no way to tell what's what in the fixture.

Figure 41 - The photo at left was shot in direct sunlight with automatic white balance. The Crayons look good and the 18% gray card in the foreground is middle gray, just as it should be. The picture on the right was illuminated by a 2700K tungsten lamp using the same camera settings. The gray card is not gray and the Crayons do not look anything like their actual colors.
Chapter 4.9
Filters

Filters are rarely needed for general picture-taking because digital cameras will let you adjust for the prevailing light source via the white balance control.

Filters subtract unwanted light which has the dual effect of eliminating undesirable colors which is good and reducing exposure, which is bad. Losing one or two stops to a filter might force you to use a tripod when you could otherwise shoot handheld.

Cameras with through-the-lens metering systems automatically correct for a reduction in exposure caused by using a filter. If you're using a hand meter, you will have to reduce the metered exposure by the manufacturer's published filter factor to compensate.

There are several kinds of filters. The ones that we're interested in are protective UV filters, barrier and bandpass filters for infrared and ultraviolet work, and contrast filters for fingerprints and questioned documents.

The terms barrier and contrast depend on how a filter is used. A filter used to enhance weak ultraviolet fluorescence is a barrier filter. The same filter used to improve contrast in conventional photography is a contrast filter. The Hoya and Tiffen brands are widely distributed in the US while the Schott and Schneider brands are readily available in Europe.

I recommend using a Hoya Super HMC UV or a Hoya Pro1 Digital UV filter to protect lenses used under wet, dusty or dirty conditions. Hoya filters use homogenous glass and have durable coatings which may be advantageous on filters subject to heavy use. Otherwise, clear filters can
actually degrade image quality by interposing an extra layer of glass between you and your subject.

A multi-coated circular polarizer can be used to control reflections from non-metallic surfaces such as water, glass and paper.

The contrast filters formerly use in B&W photography still have applications in fingerprint, questioned document and UV/IR work. Contrast filters lighten their own and similar colors while darkening colors that are their opposite on an artist's color wheel, available at any art supply house or by mail from http://www.colorwheelco.com.

Fingerprint examiner Esther Neate suggests that red, green, blue and yellow plus UV and polarizing will satisfy most purposes. Other sources mention deep yellow and orange. Filters are available from Adorama and B&H if you can't find what you want locally.

Tiffen does not specify whether their contrast filters are coated or uncoated. Hoya filters are available with and without UV coatings. If you're working with ultraviolet, uncoated filters might be advantageous but I've used Tiffen filters for years without a problem.

<table>
<thead>
<tr>
<th>Tiffen</th>
<th>Hoya</th>
<th>Darkens</th>
<th>Barrier Filter For</th>
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</thead>
<tbody>
<tr>
<td>No. 8 - Yellow</td>
<td>K2 - Yellow</td>
<td>Violet</td>
<td></td>
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<tr>
<td>No. 11 - Green</td>
<td>X1 - Green</td>
<td>Red</td>
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<tr>
<td>No. 15 - Deep Yellow</td>
<td>Blue - Violet</td>
<td>395 - 470 nm</td>
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<tr>
<td>No. 16 - Orange</td>
<td>G - Orange</td>
<td>Blue</td>
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<tr>
<td>No. 25 - Red</td>
<td>25A - Red</td>
<td>Blue - Green</td>
<td>495 - 570 nm</td>
</tr>
<tr>
<td>No. 47 - Blue</td>
<td>Yellow</td>
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</tbody>
</table>

This table, vastly over-simplified, is based on an artist's color wheel and the Kodak Digital Photoguide. Visit http://www.neateimaging.com. Ms. Neate provides convincing proof that filters and forensic lighting should be part of every serious evidence photographer's tool kit.

My everyday cameras receive some fairly rough treatment so I routinely use protective filters. I do not use protective filters on my macro lenses or the lenses used for landscape photography. These lenses are gently used and are rarely exposed to rain, snow, grit and grime.
Chapter 4.10
Composition

Photographers with artistic pretensions follow all sorts of rules to make their photographs interesting. Photographers with real talent ignore these rules to make their pictures stand out from the crowd. In either case, the center of interest is rarely in the center of the frame.

The opposite is true in police photography. The center of interest should always be in the center of the frame. The obvious exception is a scene containing multiple objects of interest. In this case, the scene itself is the center of interest rather than any one specific object within the scene.

Most texts on police photography advise shooting overall views to fix objects within the scene in relation to other objects, medium closeups to provide details that can't be seen in overall views and closeups to capture details that can't be seen in medium closeups. That's the way it was done when we were shooting 4 x 5 press cameras. That's the way it's done today.

Professional viewfinders take in 100% of the image area. Amateur viewfinders take in somewhere between 90% and 95% of the image area. The optical viewfinders on point and shoots vary, with 80% being typical.

If you're printing on an inkjet printer, a full frame print will give you the entire image area. If you're printing full bleed (the technical term for borderless) on a minilab system, the machine will trim the edges.

Compose accordingly. If you ask the lab to print photos with a 2:3 aspect ratio on 8 x 10 paper without specifying "print full frame," you'll lose a little vertically and quite a bit horizontally.
Amateurs invariably stand too far from their subject or use a wide angle when they should be using a normal or telephoto setting, either because they don’t know any better or because they’re afraid of missing something. As a result, they lose detail that could safely be captured if they framed a little tighter.

Professionals, depending on their creative intent, often fill the viewfinder with their subject to capture maximum detail and eliminate a distracting background. As a result, the subject can't be seen in context which might be good from an artistic point of view, bad from our point of view.

The solution? Compose your pictures tight but not too tight. You want to capture as much detail as possible while including enough background so that the context is obvious, taking into account your camera's framing and printing characteristics.

Figure 42 - The shaded areas identify the areas that will be cropped if order a picture taken with a 3:2 aspect ratio to be printed on 8 x 10 paper without specifying "full frame."

Always check your LCD display to make sure you have not inadvertently cut off your subject's hand at the edge of the frame or photographed a person with a tree sprouting from the top of his or her head.
Chapter 4.11
Color Illustrations

PDI Test Target

The sixteen megapixel test photo (next page) can be downloaded from http://www.webstir.com/color_management/PDITestImage.htm. This photo is commonly used to verify that monitors and printers are properly calibrated. Every photographer should have a copy of the PDI target on his or her hard drive. You can burn a copy to a CD and take it to an outside lab to see if their work is up to par, even on prints as large as 24 x 36.

Due to limitations in the printing process, do not expect the photos shown on the following pages to reflect the colors that you would see displayed on a calibrated monitor or printed on a well-profiled printer.

Printers go to great lengths using commercial printing processes and special coated papers to reproduce the colors that you see in magazines such as the National Geographic and in big budget advertising photos.

Alas, printing of that quality would drive the price of a book up beyond the reach of the average student or a police officer purchasing a book out of his own slender paycheck. That's why most photos are rendered in grayscale and color photos are grouped together to reduce printing costs.
Nancy Chen's Latin Lovely

Even though composed of nothing more than little square pixels associated with the colors red, green and blue, each identified by a number between 0 and 256, good photographs can provoke an emotional response.

A grayscale rendition, while still a recognizable likeness, lacks much of the emotional impact found in the color version. Without color, we can't even guess at the colors in the dancer's costume, depriving us of information that was available in the original.
Color Balance

Figure 44 - The photo on the left was taken with an off-camera Nikon SB-800 flash and an SC-29 off-camera flash cord. The photo on the right was taken with an on-camera Digi-Slave 3200 ring light. Nikon D70. Auto white balance.

The photo on the left is accurate. The photo on the right is too blue but it shows detail not evident in the left hand photo, perhaps because of a variation in color temperature or the light striking the skin at a different angle. Photos taken with a 395 nm forensic light with a Tiffen 15 filter and an LED Lenser tactical light in the flood mode had their own stories to tell.

Photos taken to show how bruises and other injuries develop over time must be taken using the same camera settings, the same lighting setup and in the same environment as the original photos to be of any value. Otherwise, you'll be recording differences in color balance rather than the progress of bruising and subsequent healing.
This picture is a crop representing the tip of a yellow flower shown in the screen capture of an image being analyzed in Visual Color Picker. The colors that we see in a photograph are nothing more than little square red, green and blue pixels numbered from 0 to 256 that, when combined in a photographic image, yield sixteen million colors.
Figure 45 - The top photo is a snapshot taken by Mrs. McMicken standing on the side of the road with her five megapixel purse camera, smaller than a pack of cigarettes. The bottom photo is a crop for a 20 x 30 inch enlargement. Pocket cameras have many limitations but, when the light is good, picture quality is not one of them. Her present purse camera is a fourteen megapixel Panasonic ZS-5 pocket super-zoom, acquired for the extra telephoto reach.
Chapter 5.1
Evidence Photography Basics

Sgt. Larry Barksdale of the Lincoln, NE, police department reminded me that an attorney is not only entitled to copies of your camera-original image files, he or she can subpoena the camera used to take those pictures.

If you're shooting with a personally owned camera, an attorney can subpoena your camera and turn it along with any photos, even personal photos or photos pertaining to an unrelated case, that happen to be on the memory card over to a forensic consultant for examination. You might get it back on one piece and then again, you might not.

Think about the consequences if your personally owned smart phone along with your speed dial numbers, calling history and personal photographs falls into the hands of a defense attorney looking for the slightest hint of impropriety that can be used to attack your credibility.

Your equipment is subject to departmental regulations. Thus, if you buy a camera because the city does not issue a camera or the city-issued camera has perceived shortcomings, you might be opening a can of worms unless department policy allows officers to use their personal cameras.

Fifty years ago, it was common for police departments to specify a medium frame revolver, Colt or Smith and Wesson, with a four inch barrel and adjustable sights chambered for either the .38 Special or the .357 Magnum cartridge, using only department-issued, factory-loaded ammunition. I still have several .357 Magnum revolvers purchased in the mid-Sixties that satisfy this requirement. They're as good as a Glock for the first six rounds.
The purpose of this specification was to preclude officers reporting for duty with guns and ammunition that failed to pass the sniff test and to ensure that everyone could be supplied with safe, reliable ammo from departmental inventory in the event of an emergency.

A camera specification for patrol officers might require a camera purchased from a reliable manufacturer such as Canon, Nikon, Panasonic or Sony with an optical zoom lens covering the equivalent of 28 to 105 mm that is small enough to fit in the pocket of the uniform trousers and capable of capturing large/fine JPEGs with a resolution of at least ten but less than twenty megapixels using only department-issued SDHC memory cards.

This ensures that an officer can put the camera in a pocket to leave his or her hands free (essential on domestic disturbance calls for obvious reasons), that the memory cards can be processed by the police photo lab, and that the pictures will be of sufficient quality if the subject is in good light or within range of the built-in flash.

I'm oversimplifying. A department might issue a pocket camera to patrol officers and a full SLR kit complete with an external flash, an off-camera flash cord, a tripod and suitable lenses to investigators working major cases under adverse lighting conditions, perhaps with something in between for supervisors and detectives.

Unfortunately, some resource-strapped departments issue point and shoot cameras in the expectation that officers so-equipped will be able to photograph complex scenes without camera-specific training.

Camera-specific? Between them, Canon, Nikon, Sony and Panasonic manufacture more than one hundred point and shoot models ranging in price from less than one hundred to more than five hundred dollars, no two of which are exactly alike. They all have one thing in common: a flash with an outdoor range limited to ten or fifteen feet.

Purchasing an expensive bridge camera or an entry level SLR with a hot shoe doesn't buy you anything extra in the way of low light performance unless you also purchase an external flash, an off camera flash cord and a tripod. Together, the cost of these accessories might be three or four times what you paid for the camera.
The advice to test under operational conditions cannot be repeated too often. I've taken good low light and closeup photos with a pocket camera. However, doing so consistently required using the same $400 tripod, $500 copy stand and 300 watt photo-floods that I use with an SLR.

If your department expects nothing more than daylight snapshots and close range flash pictures, you should be able to get by with a careful reading of the camera manual. Canon, Nikon, Panasonic, Sony, Olympus and Ricoh camera manuals can found on line.

If your department expects you to use a point and shoot to photograph the kind of evidence formerly photographed by experienced crime scene investigators with an SLR camera, you will almost certainly need task-specific training using the department-issued camera. There are simply too many compact cameras on the market to say with any certainty what a particular model can and cannot do.

Intermediate and advanced SLR cameras from Canon and Nikon are more predictable because those in the same price range have many features in common.

Presumably, officers responsible for investigating major accidents and felony crime scenes have received more training than first responders and are thus competent to use an advanced SLR camera and the accessories associated therewith. When you add up the cost of the training and materials required to collect fingerprint, shoe print, tool mark, blood spatter, sexual assault and DNA evidence, to name only the more obvious examples, the cost of an SLR camera and accessories is not disproportionate.

You can buy a virtually indestructible six inch stainless steel ruler at Walmart for three dollars. A set of scales in sizes ranging from two inches to one hundred feet will set you back upwards of fifty dollars. A set of one hundred evidence markers will set you back more than two hundred dollars.

Why would you want to carry one hundred evidence markets? A high capacity 9 mm magazine holds at least fifteen rounds. An AK47 magazine holds thirty rounds. You can easily find fifty or more empty cartridge cases at the scene of a pitched battle between rival gangs.
Regardless of your specific responsibilities as spelled out in your departments procedures, you can safely assume:

- That you will be obliged to shoot every scene twice, once before again after scales and markers have been placed in the scene.
- Objects of interest from bodies to buildings should be photographed from at least four and perhaps eight points of the compass.

Figure 46 - At least one photograph of weapons, blood stains, bullet holes, cartridge cases, footprints, fingerprints, tool marks and so forth should be taken with the scale parallel to the long axis of the object and the back of the camera perpendicular to the surface on which the object was found.
Chapter 5.2
Low Light and Flash Photography

A good many photos will be taken with flash, either indoors at any time or outdoors at night. Less obviously, flash can be used to fill in the shadows, improve contrast and correct color balance even when there is enough light to shoot without flash.

Modern flash units have a number of shooting modes, the most common of which are auto and auto with automatic fill. Modes such as slow sync, rear curtain sync and manual can safely be disregarded.

Flash units come with instructions every bit as dense as the instructions that come with modern cameras. Learn how to lock in the flash exposure when the center of interest is not in the center of the scene and how to set flash exposure compensation independent of the camera exposure.

Selecting a Flash Unit

If the small flash built into your camera doesn't have enough power, buy the most powerful flash offered by the camera manufacturer. Consider the Metz 76-MZ5 or a Quantum Q-Flash for large scenes indoors and out. A shoe-mount may not have enough oomph to cover large outdoor scenes.

How Automatic Flash Works

Digital flash units fire a series of almost invisible preflashes to determine the proper exposure before the main flash fires. This works fine most
of the time. However, people with fast reflexes can respond to the preflash, giving you a blink when you expected a smile.

Do not shoot until the ready light comes on. Since the ready light on most flash units comes on at 80% power, wait an extra five seconds to be sure that you're shooting at full power.

![Image of a damaged car and a parking lot after a fire]

Figure 47 - These photos reveal the limitations of a point and shoot camera using the built-in flash following a fire in a parking garage that destroyed fourteen automobiles. I would not expect better results using the popup flash built into an SLR. Situations like this call for an SLR with a $500 shoe mount or a $1,000 handle mount.

**Metering Modes**

Matrix metering reads the entire scene, including the foreground and background. Shooting flash, you might have better luck using center-weighted metering, or even spot metering if the object of interest occupies a small portion of the scene.

**Flash Sync Speed**

All cameras have a flash sync speed representing the maximum shutter speed that can be used with flash. Typically, this is 1/250th of a second. Shoot in the shutter preferred mode at the highest flash sync speed supported by your camera and the flash exposure will predominate over ambient light. This is handy in a mixed lighting situation when you want to eliminate an undesirable color cast.
Flash Coverage

If you’re using a zoom lens, the flash unit will adjust the area of coverage from wide angle to telephoto by moving the flash tube within the reflector assembly. If you zoom out to wide angle, you’ll get more coverage but less range. Zoom in, you’ll get more range but less coverage.

Nikon flash units will let you manually adjust the angle of coverage when using the flash off camera, as when painting with light. This will let you put the light where you want it and gauge the proper distance between flashes by popping test shots before going for the money shot.

Flash Range

Check the manual to determine the maximum range of your flash unit at various focal lengths and ISO values. Obviously, you’ll get more range at the higher ISO values. With an f/2.8 lens and ISO cranked to the max, you might be able to reach out to one hundred feet at the price of an overexposed foreground. Real world results are usually somewhat less.

Close range overexposure problems are easily solved by using the little plastic diffusion dome that came with your flash, or even a piece of white paper taped in front of the flash loop fashion. Some flash units have pullout wide angle diffusers that work like a charm.

Bounce Flash

Normally, you would shoot with the flash unit pointed straight ahead but the better flash units can be rotated down for closeups or angled to bounce the light off a convenient wall or the ceiling. This works well if the walls and ceiling are painted a reflective white. The results can be unpredictable if the ceiling is neither white nor reflective.

Auto-focus Using Flash

Many cameras have a built-in focusing light. The range is seldom more than fifteen or twenty feet. Cameras with an infrared focusing light and external flash units that project an infrared grid generally have more
range and provide more accurate focus than focus-assist systems using white light. With an infrared focus assist, you can generally count on getting accurate auto-focus if you can see the focus-assist grid pattern reflected from the target. If not, switch to manual and use a flashlight.

**Normal Flash**

Normal flash pictures, for want of a better term, are the kind of flash pictures taken at routine crime scenes. Observe the caveats that apply to non-flash photography. Automatic flash works well when the scene contains a mixture of light and dark tones averaging out to middle gray and the object of interest is in the center of the scene.

If the subject is off center, meter and focus on the object of interest and lock in the readings. Then recompose and shoot in the usual manner. Verify that the exposure lock method used for ambient light photography applies to flash photography.

If you've got a body in the snow or something of that nature, check your histogram and if the exposure seems a little off, consider switching to center-weighted or spot metering before taking another picture.

**Fill Flash**

Modern flash units are smart enough to be used outdoors in daylight to fill in harsh shadows and illuminate backlighted subjects more or less automatically.

If you want to get fancy, buy a copy of *Flash... The Most Available Light* from LumiQuest. It explains how to use multiple flash setups and bias the exposure in favor of either the flash unit or ambient light, depending on the effect that you want to achieve.

**Multiple Flash Units**

High end SLR cameras have the ability to control remote flash units. This makes it possible to cover a large area in a single exposure if you happen to have several compatible flash units and light stands on hand.
Manual Flash

Automatic flash is so reliable that manual flash is rarely used. Manual flash exposures are calculated by using a guide number. Set the camera to the flash sync speed, divide the guide number for the ISO that you're using by the distance in feet, and the answer is your shooting aperture. Read your camera and flash manuals for details.

Red Eye Reduction

Shooting with a flash mounted close to the lens, common with point and shoots and popup flash units, light reflected off blood vessels at the back of the eye will cause a phenomenon known as red eye.

Leave red eye reduction off. Red eye reduction works by firing a series of preflashes before the actual exposure. In theory, this will cause the subject's pupils to contract, eliminating reflections from the aforesaid blood vessels. In practice, it makes people blink.

The better solution is to use a shoe-mount flash. If your shoe-mount isn't tall enough to completely eliminate red eye, use a Pocket Bouncer. Photoshop may be your only option if you're using a point and shoot.

Off-Camera Flash

If you'll recall, the angle of incidence is equal to the angle of reflection. Often, the only way to eliminate reflections from a shiny surface is to move the flash off-camera. Closeup photography frequently requires grazing light to bring out detail. Off-camera flash is the answer.

Nikon makes two off-camera flash cords. One includes an on-camera focus assist light, the other does not. I recommend the SC-29 unit with an on-camera focus assist light.

Dedicated flash extension cords preserve all of the automation features built into your flash unit, letting you position the flash two or three feet away from the camera to eliminate reflections and provide a source of grazing light, also known as oblique or cross lighting.
Painting with Light

No matter how powerful your flash, photographing a large outdoor scene might call for a technique known as painting with light. Set the camera on a sturdy tripod. Focus and compose using an aperture sufficient to provide adequate depth of field. Lock the shutter open using the time or bulb setting. With an assistant holding a hat in front of the lens between pops, fire off a series of overlapping flashes sufficient to cover the scene.

You'll be using the flash in the manual mode and firing by means of the test button. Adjust the flash angle to the widest setting consistent with the reach needed to cover the areas of interest. You can adjust flash output to match your shooting aperture by firing each flash from a distance calculated by to provide the proper exposure in the center of the scene.

If you start at the far end of the scene, you might not show up as anything more than a faint ghost image if you stray into the picture area.

Figure 48 - Use the test button to visualize your flash coverage. This technique requires practice but it's virtually the only way to capture a long skid mark on a dark and dismal stretch of highway. Photo courtesy Detective Robert Kramer.
**Time Exposures**

Painting with light is a useful skill but it doesn't hurt to have more than one trick up your sleeve. You will find that many parking lots, downtown streets and industrial areas have enough ambient illumination to permit making time exposures.

 Obviously, you'll want to use a sturdy tripod and a cable release. Less obviously, you'll want to use mirror lockup if your camera offers this feature. If you do not have a good noise reduction (NR) program such as Neat Image or Noise Ninja, you may want to turn on in-camera NR.

 Many cameras have exposure meters that will give you accurate readings in low light. As with painting with light, you'll want to use an ISO number that will give you noise-free results and an aperture sufficient to capture the required depth of field.

  If your meter isn't up to the job, start shooting at ten seconds and use your histogram to dial in shorter or longer exposures until you're satisfied with the result. I carry an incident light meter because it is more sensitive that my in-camera meter. Exposure times as long as thirty minutes are not unheard. Five minute exposures are common.

  Don't overlook a Q-Beam as an alternative to shooting long time exposures. Lock the shutter open and paint the scene with the Q-Beam instead of your flash.

**Brown Spots**

You may need help from someone with a flashlight to focus in low light. Problems arise when you fail to turn the flashlight off before taking the picture. The camera, naturally, is set for flash and expects the light to be in the 5500K range. Flashlights with a tungsten bulb put out light in the 2500K range. The result is a brown spot.

 I've replaced all of my older flashlights with LED lights with a 6,500K color temperature. Some are powerful enough to serve as a tactical light as well as a focusing aid. In a pinch, an LED flashlight with an adjustable beam such as an LED Lenser works quite well for closeup photography.
Overexposed Foreground

You're almost sure to see overexposed foregrounds when using flash to photograph large outdoor scenes. The solution? Tilt your flash up a bit to direct the output away from the foreground and towards the middle ground.

Night Shots

Figure 49 - These photos were taken by Hayden Baldwin's students using Nikon D80 cameras. The first shot was taken with flash. The second is a time exposure. All it takes is a little patience and a sturdy tripod.
Figure 50 - The top photo was taken with a Nikon D70 SLR and a $400 tripod. This shot took less than a minute including the time required to erect the tripod. The bottom photo was taken with a $129 Panasonic ZS-9 using the same $400 tripod. It took several minutes of trial and error experimentation to coax a usable picture out of the pocket camera.
Figure 51 - The top photo is the first of fifty taken on a warm summer day. The bottom photo was taken standing in the same spot in the middle of a winter storm with temperatures in the single digits. Nikon D70 with SB-800 flash at ISO 1000.
Chapter 5.3
Closeup Photography

For our purposes, closeup photography can be defined as any photo of a small object that you can't be sure of getting with the desired degree of detail using the equipment and technique used to shoot overall views and medium closeups.

Any decent camera will do a good job on an object measuring 10 x 15 inches at a distance of two or three feet. Point and shoots are pretty much a trial and error proposition. Someone using a point and shoot is not likely to have the tripod and external flash with an off-camera flash cord likely to be found in an SLR photographer's kit. Nevertheless, you can do good work with a point and shoot once you understand your camera's limitations.

Photographing a small object at a 1:1 reproduction ratio is easy in the lab where you have access to macro lenses, copy stands and specialized lighting. Photographing that same object at a crime scene can be a real challenge.

At a 1:1 reproduction ratio, an object 10 mm tall will be recorded as a 10 mm image. At a 1:2 reproduction ratio, the same 10 mm object will be recorded as a 5 mm image.

Degree of Difficulty

In some cases, it may be sufficient to establish a small object in the scene before it is lifted, cast or bagged and tagged. While you certainly want the best picture that you can take under the circumstances, the picture itself is merely supporting evidence.
In other cases, it may be impossible to lift or cast a fingerprint or footprint. Thus, you need photos good enough to be used for identification purposes. While usually falling within the scope of a formally trained crime scene investigator's responsibilities, photographs of this nature are not impossible if you have the right equipment and a little patience.

The secret to taking good closeups is get close. Often, this will mean getting down on your hands and knees or using a telephoto lens to fill the viewfinder. The less a photo has to be enlarged, the better.

Suitable Lenses

Most lenses run out of steam at reproduction ratios around 1:10. Some zooms will take you down as low as 1:2 but the quality may not be good enough for critical work. If you're shooting an SLR, your best bet is a true macro lens. I suggest a 105 mm macro for full frame cameras and a 60 mm macro for cameras with the smaller DX sensor, equal to 90 mm on a full frame camera.

Perspective

Closeup photographs should be taken with the camera perpendicular to the subject. In other words, if you're shooting an object on the ground, the back of the camera should be parallel with the ground. Shooting with the
camera canted introduces perspective distortion, rendering the photo less than ideal for evidence purposes.

A level available from photo supply houses can be slipped into the hot shoe to ensure that your camera is level horizontally and vertically.

Use L-shaped scales with the long edge parallel with the long edge of the subject and accurately lined up along the bottom of the frame. This will demonstrate that the camera was perpendicular if that is indeed the case or it will help your Photoshop operator dial in the correction required to obtain a distortion-free print.

Take your closeups from a comfortable working distance using a focal length long enough to fill the frame with the object of interest. In some cases, this will require using a moderate telephoto. I recommend zooms that will go to at least 105 mm or the digital equivalent on the long end.

Use a moderate telephoto for head and shoulders identification photos. We don't look at people with our nose in close proximity to the subject's nose. If you can't see both ears clearly in a full face photo, you're too close.

**Steadiness**

You can probably get away shooting handheld at reproduction ratios down to 1:10 if you're using flash. Otherwise, use a tripod and a cable release. At shutter speeds below 1/30th of a second, you'll want to lock up the mirror if your camera has this option. Mirror slap can degrade image quality at high reproduction ratios.

For closeup work, use a tripod with a rotating center column that can position the camera perpendicular to a horizontal surface at some distance from the tripod's central axis. Besides the tripod itself, you'll need a ball head strong enough to support a heavy camera pointed straight down.

**Focus**

You'll generally want to shoot at an aperture no larger than f/11 for closeups, which offers a good combination of sharpness and depth of field with most lenses. Of course, you may need to shoot at a smaller aperture
when photographing a three-dimensional object or an object that can only be photographed at an oblique angle.

If you can't trust auto-focus on your particular camera, either shoot a series of shots in the hope that one will turn out or do what the pros do - use an SLR with a macro lens and focus manually. Determine the proper distance by trial and error and focus or set the desired reproduction ratio if you’re using a macro lens. Then, move the pre-focused camera back and forth until the target is in sharp focus before releasing the shutter.

![Image](image.png)

**Figure 53 - Depth of field at high reproduction ratios is slight. This is a .44 caliber Remington SJHP expanded to 3/4th of an inch. Even at f/32, only the near edge of the bullet is in sharp focus.**

If you're photographing a footprint or tire track in snow or soft earth, focus on the sole or tread pattern where the detail is to be found, not on a scale placed beside the print.

Shooting off a copy stand, you can set the desired reproduction ratio and bring the subject into focus by cranking the counter-balanced head up and down. Accomplishing the same feat in the field requires adjusting your tripod’s center column in near-microscopic increments without letting the camera fall. A focusing rail makes the job easier.
Focusing Problems

Your camera’s auto-focus system needs a subject with clearly defined detail to focus accurately. Closeup subjects like bloodstains, fingerprints and tire tracks may not have the kind of crisp detail required for accurate auto-focus. You may need to focus manually, easy with an SLR but dubious with the typical point and shoot.

Exposure – Flash

You may not have much luck using a high-powered flash unit straight on at distances under two or three feet. The solution? Use off-camera flash, your handy-dandy Pocket Bouncer or the little white diffusion dome that came with your flash. I've had good luck using the wide angle diffuser on my Nikon SB-800 flash both on and off-camera.

If your camera did not come with a diffusion dome, you can order one from http://www.stofen.com for about twenty bucks.

If you're shooting a more or less middle gray, non-reflective subject, you can depend on the camera's auto-exposure system. If the subject is appreciably lighter or darker than middle gray, check your histogram and dial in exposure compensation as required.

Heavy duty flash units like the Metz may be too powerful for use at close range. Even if you use one of these big guns for your overall shots, you may be obliged to switch to a shoe-mount with an off-camera extension cord for close work.

Exposure – Continuous Light Source

Some objects such as footprints and tire tracks may require oblique or grazing light to bring out the requisite degree of detail. With today's SLR cameras and an off-camera flash cord, off-camera flash is easy.

If you don't have a flash that will give you accurate off-camera flash exposures, use any light source you can find from a desk lamp to a Q-Beam.
Direction

Various sources list the preferred angle for photographing footprints and tire tracks from a low of 15° to a high of 45°. Splitting the difference at 30° might work some of the time but not all of the time. It depends on the depth of the impression. The shallower the impression, the lower your flash will need to be to capture the requisite degree of detail.

If you can't shoot with a continuous light source, have an assistant with a flashlight illuminate the subject from various angles, distances and directions while you look through the viewfinder. When you find the precise angle and direction that reveals the greatest detail, that's where you want to position the light that you will actually use to take the picture.

Quality

The light from electronic flash, photofloods and video lamps can be quite harsh, causing reflections from shiny surfaces. The solution?

- Vary the angle to eliminate reflections.
- Use a polarizing filter on non-metallic surfaces.
- Use your trusty LumiQuest Pocket Bouncer.
- Bounce the light off any convenient surface that is more or less white, using a second reflector as needed to control contrast.
- Drape a tent from translucent material such as a tracing paper over the object and direct your light at the tent, creating a diffuse light source.
- You can buy commercial tents from http://www.tabletopstudio.com, where you'll find a number of excellent tutorials.

Photographing a fingerprint on the inside of a window can be problematical during the daylight hours. The solution? A car blanket or a yard or two of black velvet. Tape the blanket to the outside of the window to block backlighting and photograph the print in the usual manner, taking care to avoid reflections from the glass surface.
Shooting Handheld

We've all seen pictures of a crime scene investigator shooting handheld closeups of fingerprints and the like. The pros use a tripod.

Steadiness may not be a problem with flash because flash units control exposure by reducing the duration of the flash, not the intensity. At close range, your flash exposure may be fast enough to make camera shake a non-issue.

Pressing the shutter the instant the subject is in sharp focus can be a problem if you're holding the camera in one hand, the flash unit in the other and your depth of field is no more than one millimeter. Unless you're 100% confident of your ability to get the shot handheld, use a tripod!

Flatbed Scanners

Some flatbed scanners can scan three-dimensional objects in addition to slides, negatives, photographs and documents. You might want to try scanning fingerprint lifts, drug paraphernalia and so forth. The scanned images can be edited in Photoshop and printed on any printer.

While slides and negatives scanned on a flatbed cannot equal those scanned on a professional film scanner, you can buy a good flatbed scanner such as the Epson V700 for $600.

Copy Stands

A good copy stand and lighting setup can save time and aggravation if you need to photograph documents and small articles of evidence in an office or lab setting. Cheap copy stands are no bargain. I suggest the Kaiser RS1 base with a Kaiser RT-1 camera bracket as a reliable benchmark.

You can expect to pay $1,000 or more for a good copy stand and lighting setup. Both Adorama and B&H Photo Video stock the complete Kaiser line.
Controlling Reflections

Figure 54 - The photo on the left was taken with an on-camera ring light. You'll get the same result photographing shiny objects with on-camera flash, especially the flash built into the average compact camera. The picture on the right was taken with a Nikon D70, an SB-800 flash and an SC-29 off-camera flash cord.

Figure 55 - Coffee cans make good test subjects when you need a three-dimensional target to check depth of field. The photo on the left was taken with on-camera flash. The photo on the right was taken with off-camera flash. Aperture-preferred automation at f/11. Nikon D70, SB800 flash and an SC-29 off-camera flash cord.

If you're obliged to use a point and shoot camera or an entry level SLR with only the built-in flash, remember that the angle of incidence is equal to the angle of reflection. You can always shoot at an oblique angle to eliminate detail-robbing reflections at the expense of introducing perspective distortion in the form of keystoning.

There are no free lunches. However, objectionable perspective distortion can often be corrected by judicious manipulation in Photoshop which will doubtless have to be documented if the picture is used in court.
Random Samples

Figure 56 - A diffusion dome standard with Nikon flash units and available for virtually every flash unit ever made including some of the more popular handle mounts from stofen.com is an invaluable aid for controlling closeup reflections.

Figure 57 - Serial numbers are a firearm examiner's stock in trade. Nikon D70, 60 mm macro, Kasier copy stand, 6500K daylight lamps in 10" reflectors.
Figure 58 - The photo on the left was taken with a 2700K spot and a 18% gray card. The photo on the right was cropped from a 20 x 30 enlargement. Nikon D70, 60 mm macro lens, Kaiser copy stand. Tungsten white balance. The D70 is a 6 MP camera. Do not underestimated the importance of good lenses and substantial support for your camera.

Figure 59 - Depth of field as always a problem in closeup photography when shooting at an oblique angle. The markings on the syringe are one centimeter apart. The photo on the right was taken at f/3.8 (wide open at this distance). The photo on the left was taken at f/22.
Handy Gadgets

Figure 60 - The Joby Gorillapod Focus with a mini-ball head and a Manfrotto Magic Arm are virtually indispensible if you do a lot of critical closeup work in the field. You can't always depend on a standard tripod to position your camera exactly where you want it. I routinely use my Gorillapod to position my LED Lenser flashlight in clamp adapted from a weapon's light of uncertain origin purchased at a gun show.

Figure 61 - This setup is cheap and portable anywhere you have AC power.
Ring Lights

Ring lights provide axial lighting, essential for some types of closeup work. I've used a Digi-Slave 3200 from srelectronics.com for years with complete satisfaction. The Digi-Slave uses LEDs to provide a continuous daylight-balanced light source. It works like gangbusters using a tripod or copy stand. The output is marginal for handheld photography.

The Metz 15 MS-1 ring light is a viable option if your camera manufacturer does not offer a quality ring light. Metz is the premier European manufacturer of flash units and their flash units are compatible with all currently manufactured cameras, along with many older cameras.
Chapter 5.4
Photomacrography and Photomicrography

Conventional closeup photography with a macro lens will take you down to a 1:1 reproduction ratio, generally suitable for fingerprints, tool marks, serial numbers, questioned documents and so forth. In most cases, this is all that a police photographer will have to deal with at a crime scene.

Things are a little different when we move into the lab where the photographer, or more commonly an evidence technician or a forensic scientist, might be required to photograph hair, fiber and trace evidence.

While various authorities differ on nomenclature, for our purposes photomacrography involves the reproduction ratios between 1:1 requiring nothing more than a standard macro lens and photomicrography requiring a microscope in lieu of a camera lens. Firearms examiners routinely use a comparison microscope to match recovered bullets to the suspect weapon.

Photomacrography and photomicrography are not rocket science but they do require more and better equipment than the average crime scene investigator will carry in his or her vehicle, and perhaps more knowledge of the photographic process, especially with regard to lighting and exposure.

In a perfect world, macro and micro photography would be the exclusive province of forensic scientists wearing white lab coats but the world is far from a perfect place. Recently, Sergeant Larry Barksdale of the Lincoln, Nebraska, police department was confronted with the need to photograph a human hair in connection with a pending homicide trial.
Forty years ago, Sergeant Barksdale would have done the same thing that I or any other photographer would have done under similar circumstances. We would have stopped in at our friendly neighborhood camera store and purchased the lavishly illustrated Kodak guides to macro and micro photography, each selling for four or five dollars.

Sadly, well-stocked neighborhood camera stores are now a rarity and those wonderful Kodak guides that many of us depended upon are long out of print. Furthermore, Canon and Nikon have discontinued much of the specialized equipment found in older catalogs.

However, all is not lost due in large part to the Internet. Besides the many scientists who depend on macro and micro photography, thousands of skilled amateurs pursue these specialties for artistic reasons. Google photomicrography and photomacrography and you’ll find pictures of surprising beauty along with plenty of technical information.

Figure 63 - Sgt. Barksdale purchased this stereo microscope on line for $350.
Figure 64 - This is the .45 cartridge case shown on the computer screen on the previous page taken through the microscope eyepiece with a Canon S95 point and shoot camera. You can't argue with success. This photo cropped to fit the page has enough resolution to be enlarged to 20 x 30 inches, enough for any court exhibit.
Figure 65 - This photo of a human hair was taken with Sgt. Barksdale’s polarizing microscope, purchased on line for $565.
Chapter 5.5
Forensic Lighting Hardware

Forensic lighting, including but not limited to ultraviolet and infrared light, is used to make invisible evidence visible and once that evidence becomes visible, we can photograph it. Forensic lighting is easier to demonstrate than describe, provided you have the right hardware. What, exactly, can you do with forensic lighting? Among other things, you can:

- Detect latent blood, urine, saliva, semen and vaginal stains.
- Detect bruises no longer visible to the naked eye.
- Detect fraudulent alterations to questioned documents.
- Detect latent prints dusted with fluorescent powder.
- Detect gunshot residue.
- Detect illegal drug residue.
- Detect accelerants at the scene of an incendiary fire.
- See through bloodstains to reveal whatever they might conceal.

Catch 22

Some of these processes require the use of chemical reagents such as Luminol or Hemascein along with special filters and light sources of a specific wavelength. Most if not all take place in a dark room. Exposures tend to be on the long side, requiring a sturdy tripod or copy stand.

Much of the published information is either contradictory or devoid of technical content. It is a known fact that some petroleum distillates can be
detected using ultraviolet light. However, various sources suggest wavelengths between 252 and 520 nanometers, usually abbreviated nm. One source suggests that certain flammable liquids cannot not be detected at all while another claims that accelerants can found even in minute quantities.

Australian investigator Tony Cafe at http://www.tcforensic.com.au and Dr. J.G. Rankin, a professor of forensic chemistry at Marshall University in Huntington, WV, caution that many items found after a fire can produce false positives, rendering UV photographs supposedly depicting pour patterns useless unless supported by laboratory findings from carefully obtained and mapped samples.

One supplier tested their lights on common accelerants poured on a cloth and allowed to dry. They omitted the obvious step of burning their test swatches to simulate what might be found after a fire. Consequently, their recommendations are somewhat suspect.

It is also a known fact that ultraviolet light can be used to detect latent bruising and enhance visible contusions. However, I have yet to read an article pointing out that the age and ethnicity of the victim can impact the validity of commonly recommended techniques.

If you think that forensic lighting might be a useful addition to your skill set, seek training from an instructor with demonstrated expertise in your area of interest.

The Glock Syndrome

Prior to 1985, nobody had heard of Anton Glock and his funny little plastic pistol. Today, Glocks account for sixty percent of the pistols carried by American law enforcement. Glocks are perceived as being safe, simple, accurate and reliable. Glocks are also somewhat lighter than comparable models from other makers and thus less of a burden on the wearer's belt.

There are no forensic lighting products held in equal esteem. A number of companies make forensic lights, each accompanied by a self-serving list of claims.
What is UV and IR?

The visible spectrum ranges from approximately 400 to roughly 700 nm. The following tables were obtained from several sources. One source, not reprinted here, combined the Blue and the Green columns, omitting Cyan altogether. Other sources peg the ultraviolet range at 100 to 400 nm rather than 100 to 380 nm as shown here in compliance with a standard proposed by the International Standards Association.

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Wavelengths shorter than ultraviolet eventually become x-rays while wavelengths longer than infrared eventually become radio waves. For our purposes, it is sufficient to know that the native sensitivity of the sensor in your digital camera is something like 315 to 1,100 nm.

Modern cameras are designed to take color photographs using visible light in the range of 400 to 700 nm. An internal filter is placed ahead of the sensor to filter out most of the undesirable UV and IR light.

Modern lenses are coated to further reduce ultraviolet rays from the sun, a powerful source of UV. Many photographers place a UV filter ahead of the lens to protect their expensive glass from grit, grime, dings and scratches.

Still, it is possible to take UV and IR photographs with most cameras in part because some cameras still have useful sensitivity in invisible portions of the spectrum and in part because some techniques use invisible light to excite fluorescence or luminescence in visible portions of the spectrum which can be photographed by conventional means.
Fluorescence? Luminescence? Incandescence is light emitted from a heat source, such as a light bulb. Luminescence is cold light emitted by an external source of energy. Fluorescence is luminescence emitted by an external source of ultraviolet energy. You will find these terms used interchangeably and often incorrectly.

What you need to know is that a technique that uses ultraviolet light to cause the target to fluoresce in a visible portion of the spectrum can be usually be photographed with whatever camera you happen to have on hand, as long as the lens is threaded to accept the required barrier filter.

In reflected infrared photography, you're photographing with light that is invisible to the naked eye and perhaps to the sensor in your digital camera. The solution? Get rid of the camera's internal filter.

**Infrared Cameras**

There are, to be sure, any number of specialized cameras. However, for routine work, almost any camera will suffice for UV photography.

You will need a camera modified for sensitivity above 700 nanometers for IR photography. Why? Because of the aforementioned internal filter designed to block most of the UV and IR, the better to provide accurate color rendition with visible light.

While Fuji no longer makes a UV/IR camera, outfits such as Life Pixel (http://www.lifepixel.com) can modify existing cameras by replacing the factory filter. Life Pixel reports that their UV/IR Plus Visible conversion will give results identical to the discontinued Fuji cameras as long as you're willing to sacrifice an older camera or void the warranty on a new camera.

If you intend to convert a camera, I suggest using a relatively new SLR with Live View and good high ISO performance. You might want to consider Nikon because manual focus Nikon lenses have fewer elements and simpler coatings, thus passing more of the available light.

Old Nikon lenses are plentiful and inexpensive. Some manual focus lenses are still available new. They'll work on all current Nikons D7000 or better in the manual focus and exposure modes.
Lenses

When you have a camera converted to IR, a competent shop can recalibrate the auto-focus system for the lens that you want to use. This might be the kit lens that came with the camera, a macro lens for fingerprint work or a fast prime lens to provide a brighter viewfinder image.

It is also worth identifying your preferred lens because you'll need filters. You can follow the path of least resistance and purchase 77 mm filters plus step-down rings to adapt 77 mm filters to your lens or lenses. However, a 77 mm filter for a large zoom lens might cost three times as much as a 52 mm filter designed to fit a manual focus lens.

Some folks think that special lenses are required for UV photography. Not true. This story goes back to the film era when Nikon made their long-discontinued 105 mm UV Nikkor with a special glass that transmitted UV better than standard optical glass.

Today, according to Dr. Austin Richards of Oculus Photonics, standard lenses will pass UV down to 350 nm, which is sufficient for all but the most specialized applications. However, for those special applications, Jenoptik (http://www.jenoptik-inc.com/coastalopt-standard-lenses.html) has UV lenses for Nikon cameras that will take you down to 250 nm.

Goggles

Goggles are indispensable for increasing contrast while working with ultraviolet. The colors most commonly recommended, and often supplied with ultraviolet illuminators, are yellow, orange and red. I have a pair of deep yellow goggles from http://www.rcforensics.com that work well from 460 down to 395 nm.

You will want protective UV goggles for everyone in the room if you are working with one of the more powerful UV illuminators, particularly at the lower wavelengths.
Filters Defined

In ultraviolet fluorescence photography, a barrier filter blocks reflected excitation light, passing on the fluorescence that we want to photograph. In reflected ultraviolet and reflected infrared photography, a bandpass filter passes light in the specified range of wavelengths, rejecting all others.

Ultraviolet Filters

Filters are a story unto themselves. Filters come in a variety of sizes but you may not find every size at every dealer. To make matters even more interesting, the Kodak Wratten filters mentioned in older texts are hard to find and available only as 3 x 3 and 4 x 4 inch square gels which must be slotted into an adapter in front of the lens.

Conventional B&W film was not especially sensitive to infrared. Thus, the fact that a UV bandpass filter such as the Peca 900 designed to duplicate the Wratten 18A had an infrared leak was of no great consequence. When these filters were used with digital cameras, some users found that their ultraviolet images were actually infrared.

Dr. Richards reports that the Baader Venus filter available from http://www.alpineastro.com is an effective bandpass filter in the 325 to 390 nm range without leaks in the IR portion of the spectrum. The Venus filter is so named because astronomers use it to photograph the planet Venus.

For work in the 395 to 460 nm range, Robert Cheeseman recommends a Tiffen 15 deep yellow barrier filter. I bought one. It works.

The Red 25 filter is specific to light in the 495 to 570 nm portion of the spectrum. UV emitters with peak output in the 520 to 560 nm range are used by fingerprint examiners working with rhodamine and DFO and crime scene investigators using fluorescent powders.

Infrared Bandpass Filters

The discontinued Kodak Wratten 87 filter is commonly recommended for infrared work in the 850 nm portion of the spectrum, which seems to be
the forensic sweet spot. The Peca 904, the Hoya 72R and the Tiffen 87 are supposedly equivalent. A 25 Red filter can also be useful for infrared work.

**Peca Filters**

Peca filters, available from http://www.ir-uv.com, cover many of the more useful Wratten filter values and they are reportedly built to a higher standard than other filters. Peca is the only manufacturer to publish spectral response curves for their filters. You can look at the spectral response curve for the Peca 900 filter and see the "bump" in the IR portion of the spectrum.

**The Color Wheel**

Keeping track of which goggles and filters will work with a given light source can be confusing. An artist's color wheel is the easiest way to identify workable filters and goggles. Simply use a filter or a pair of goggles with a color complimentary to the color of your light source.

I work with Purple 395 and Blue 460 nm lights. Yellow is complementary to violet, which is close enough to purple for government work. Orange is complimentary to blue. Thus, the Tiffen 15 barrier filter which is actually a yellow-orange and the deep yellow goggles purchased from RC Forensics work well in practice and are consistent with color theory.

**Forensic Lights Generally**

You can spend anywhere from $50 to $50,000 for a forensic light. The more expensive lights give you a choice of wavelength, handy because no single wavelength will satisfy all requirements. Some cover both the UV and the IR ends of the spectrum.

The larger laboratory instruments can only charitably be described as portable, and then only if you have a reliable source of clean full-wave rectified AC power. Half-wave rectified construction generators intended to power lights and saws can fry electronic equipment.
If Wishes Were Horses...

Paupers would have a Foster and Freeman DSC4 fingerprint examination system in their forensic laboratory. Foster and Freeman at http://www.fosterfreeman.com does an excellent job of describing the DSC4 system in their well-illustrated brochure, better than I can do in the space herein allocated. A perusal of the Foster and Freeman site is nothing if not educational. Many of their products, some with six figure price tags, cannot be found anywhere else.

In a nutshell, the DCS4 system consists of a Nikon D700 camera, a 105 mm macro lens, a Kaiser copy stand with an illuminated base, a light source and filters that covers all of the wavelengths commonly need for fingerprint examinations with and without chemical enhancement, a shroud to allow working in room light, and a computer designed to facilitate comparisons between a latent print and the suspect's ten card.

Laboratory Forensic Lights

ry. At prices in the $20,000 range, these units are not especially portable and perhaps too expensive to be hauled around in the back of a truck.

**Portable Forensic Lights**

A number of companies make portable forensic lights suitable for crime scene investigations. Read the specifications. Make sure that you can return a unit that doesn't live up to expectations. Prices vary from less than one hundred to more than five thousand dollars. Lights come in single- and multi-wavelength persuasion. The Spex Handscope available in several versions from crimescop.com is perhaps the most popular multi-wavelength portable light.

See [http://www.forensic-photography.com/link_lights.html](http://www.forensic-photography.com/link_lights.html) for links to vendors and [http://www.forensic-photography.com/link_handouts.html](http://www.forensic-photography.com/link_handouts.html) for articles of interest to criminal justice students, including Flashlights.pdf.
Figure 67 - If cost is no object, consider Ladino’s TrAc Finder kit from Ladino’s US distributor, Arrowhead Forensics. You get a powerful searchlight, four forensic filters and three contrast-enhancing filers in a sturdy carrying case. You can select spot and flood reflectors to suit the light to your specific application.
Chapter 5.6
Forensic Lighting Techniques

Ultraviolet and infrared photography can require some rather expensive equipment with limited utility unless you're a full time crime scene investigator or a forensic scientist working in the laboratory.

You can practice conventional photography around the house or even at the zoo. Mastering UV and IR skills is somewhat more difficult.

Ideally, an instructor teaching an advanced class will have the requisite skills and access to the necessary cameras, lenses, filters and light sources. A camera with Live View connected to a big screen television will let students see what the camera sees in real time.

A homicide investigator tells me that she seldom tries to use forensic lighting at a crime scene because it is more efficient to transmit the evidence to the lab. Laboratory personnel have experience with some of the more esoteric techniques and access to equipment that is not readily available to investigators in the field.

Nevertheless, a police photographer should know that forensic lighting techniques can be used to detect and photograph evidence that would otherwise be invisible and have a clear idea of how to go about it, even if the technique has no immediate relevance to the officer's present duties.

As in medicine, the first rule is do no harm. Unless you know what you're doing, use non-destructive techniques that will not invalidate subsequent investigations. By and large, photography is non-destructive but the ultraviolet used in certain fingerprint and bloodstain detection techniques will kill DNA.
The techniques described in this chapter were derived from *Police Photography* 5th edition by Larry Miller and *Advanced Crime Scene Photography* by Christopher Duncan plus numerous papers and PowerPoints found on the Internet.

- Reflected UV Imaging For Forensic Applications - Dr. Austin Richards
- Domestic Violence Photography - Lt. James Pex
- Reflected UV to Document Bruising of Children - Det. Patrick Cochran
- How To Improve Prosecution of Strangling Cases - Strack and McClane
- Infrared Photography - Michael J. Brooks
- Forensic Lighting Techniques - Robert Cheeseman (PPT)
- Ultraviolet Light ... Detection of Ignitable Liquids - Sarah Kunkel (PPT)
- Hemascein - Larry Barksdale (PPT)
- FF Light Sources (UK).PDF - Foster and Freeman
- Forensic Decision Guide - Foxfury

I have taken the liberty of combining material from the various sources and adapting the results to reflect digital imaging procedures. This is not gospel. These are merely things that I think a forensic science student or an entry level police photographer might find useful.

**Technical Tidbits**

The wavelengths stated in filter and forensic light specifications reflects the peak value. Spectral response is typically a bell curve, with values falling off more or less gradually on either side of the peak. Thus, you don't necessarily have to nail a recommended value on the money.

If precise values are of critical importance, test your lens, filter or light source using a spectrophotometer which can be found in many crime labs and most college chemistry labs.

With few exceptions, UV and IR photography requires subdued light if not total darkness. Do not expect stellar results trying to photograph an outdoor scene at high noon on the 4th of July. If you need to process a car, have it towed to the police garage.
If you're photographing an indoor scene during the daylight hours, cover the windows. Go outside and try to find a ladder tall enough to reach the windows. Heavy duty plastic garbage bags and duct tape work well.

If you suspect that an accelerant was used to start a suspicious fire and you want to document the pour pattern, you may have to come back at night. Once you pull off the scene, you might have to obtain a new search warrant before returning.

False positives, things that show up that are not evidence and should not be confused with evidence, include a long list of things found in any household, including all products that include "magic brighteners."

Finally, many forensic lights bearing the UV label actually put out light in the visible portion of the spectrum. They are said to be "UV lights" because that particular wavelength will cause certain materials to fluoresce. Now that you know, don't worry about it. They're UV for our purposes.

Persevere

It is possible to develop latent prints on the body of a deceased person by superglue fuming. It has been done successfully but the failures outnumber the successes. However, five universities with forensic science programs operate body farms. No doubt the hit rate will improve as more students graduate from these programs.

A detective tells me that she has made numerous attempts to enhance faded tattoos in the morgue without success but she intends to keep trying. Depending on the condition of the body, tattoos might be the only way for relatives to identify a person who does not have prints on file. Of necessity, murder investigations start with attempting to identify the victim.

I did a presentation for arson investigators in 2009. The question most frequently asked and the one question that I couldn't answer at the time was how to use UV to photograph a fire scene. The literature was singularly uninformative but several manufacturers now provide useful advice.

Don't give up on a procedure just because it fails upon occasion. Alternate light source photography, ALS for short, is used to photograph
evidence which cannot be seen with the naked eye. You don't know for sure that the evidence is present until you find it, a hit or miss proposition.

However, if the ambient light is dim to non-existent, you can often find fluorescent evidence with nothing more than a good 450 - 470 nm flashlight and a pair of yellow goggles.

**Flavors**

ALS comes in four flavors: reflected ultraviolet, ultraviolet fluorescence, reflected infrared and infrared luminescence, also called infrared fluorescence. For our purposes, reflected UV and reflected IR can be considered together, as can UV and IR fluorescence.

UV fluorescence photography is easy to understand and demonstrate because we use invisible UV to cause an invisible substance to emit light (fluoresce) in a visible portion of the spectrum. The fluorescence is typically rather weak and cannot always be seen or photographed without contrast-enhancing goggles and barrier filters.

The filters and goggles suppress unwanted light so we can see and photograph the fluorescent light emitted by the evidence that we're looking for, plus any other fluorescent material (false positives) in the field of view.

Certain materials absorb and/or reflect ALS light at different frequencies from what they absorb and reflect under visible light. In this case, both our light source and our reflected light are invisible, requiring suitable cameras, lenses and bandpass filters to record the image.

What you can't see using UV fluorescence might show up in a reflected UV or IR photographs. A good examples is gunshot residue (GSR) concealed under a blood stain. Dried blood might be opaque in visible light but transparent to infrared.

When the time comes to pick a forensic light, Larry Dow with Foster and Freeman suggests that brighter is always better.
Ultraviolet Fluorescence Demonstrated

Take half a teaspoon of powdered Tide detergent. Tide is loaded with optical brighteners, easy to see, easy to photograph and safe to handle. Dissolve in a cup of warm water. Pour some on a clean white handkerchief. Let dry overnight. Ultraviolet fluorescence only works on dried stains.

Place your camera on a tripod. Take one photograph in white light without a filter. Record the exposure. Place a Tiffen 15 filter on your camera and, wearing a pair of yellow goggles, turn off the room lights. Illuminate your Tide-stained hankie with a forensic light rated between 450 and 470 nm. An inexpensive student light will do.

Your camera's auto-focus and auto-exposure system may or may not work. If not, use manual focus and use your white light exposure as a starting point to determine your UV exposure. Use the histogram to dial in exposure compensation as required. Experiment until you find the right angle and distance at which to hold your light.

Nocturnal Housekeeping Patrol

After lights out, go through a house or student dorm using yellow goggles and the brightest 460 nm light that you can find. Don't overlook kitchens, bedrooms, bathrooms and dirty clothes hampers. You might find interesting things in a motel room.
Among the things that you're likely to see are dried urine, dried semen, dried saliva and perhaps even dried skin oils or hand lotion leaving visible friction ridges on a smooth surface. You might see nail clippings on bedroom floors and glowing trails of rodent urine around kitchen walls. The brighter your light the more you're going to see.

The is ultraviolet fluorescence at work. The next step, of course, would be to photograph your discoveries. You will inevitably find areas that do not provide a level surface for your tripod. You might need to shoot at a small aperture to provide adequate depth of field. Expect exposures ranging from several seconds to a minute or more.

**Biological Stains at Crime Scenes**

Dried urine, semen, saliva and vaginal fluid are among the biological stains commonly found at crime scenes. They will all fluoresce under ultraviolet light in the 450 - 470 nm portion of the spectrum. They can all be viewed through a pair of yellow goggles and photographed with a digital camera using a Tiffen 15 filter.

**Latent Blood Stains**

![Figure 69 - These photos courtesy Robert Cheeseman show a door mat stained with dilute dried blood. The stains are invisible in white light and under a 475 nm forensic light. They show up clearly using a 475 nm forensic light and a Tiffen 15 barrier filter following an application of Hemascein, available from abacusdiagnostics.com.](image)
Fingerprints

If possible, check smooth surfaces for latent prints using deep yellow goggles and a light in the 450 - 470 nm range in subdued light before dusting. Occasionally, the natural oils on a person's skin or in hand lotion with fluorescent ingredients will give you prints that you can work with.

More commonly, fingerprint technicians working with objects having a complex, multi-colored design will use a fluorescent fingerprint powder. Most powders will fluoresce under UV at 450 - 470 nm. The a Tiffen 15 filter will suppress the background, making the print stand out. Once photographed, the print can be lifted in the usual manner.

The Forensic Source at http://www.forensicsssource.com lists the specific wavelengths required to give best results with their fluorescent powders. Of the lights that a CSI might carry, their recommendations range from 365 to 590 nm. Would that other vendors were as helpful.

Laboratory technicians routinely use agents such as rhodamine and DFO to develop latent prints which will fluoresce under green light in the 520 - 570 nm range, requiring a Red 25 barrier filter and red goggles.

Reflected Infrared

Reflected infrared requires a camera modified for UV/IR Plus Visible, a Peca 904 bandpass filter and an 850 nm forensic light, along with Live View and a lens with good performance on the infrared end of the spectrum.

You may find that electronic flash is more useful than a continuous light source. A Quantum flash with the Q-Flash 80 reflector has more power than other options.

If you're not ready to spend $4,500 on a 60 mm Jenoptik lens suitable for both UV and IR photography, I suggest an inexpensive 50 mm f/1.8 prime lens or a manual focus macro with an infrared focusing mark.

Reflected IR depends on the fact that substances that do not fluoresce when exposed to infrared light will often absorb infrared, turning black in a
photograph. A few substances, dried blood in particular, are transparent to infrared making it easier to photograph whatever might be under the blood.

You cannot see reflected infrared, unless the reflection happens to be on the border between infrared and visible light.

I cannot think of too many applications for infrared photography that you might want to try at a crime scene. If the evidence is portable and time constraints allow, it might be more efficient to transport the evidence to the lab or the morgue.

If you have the tools for reflected IR photography, what can you do with it? Blood is transparent to infrared. Powder stippling and gunshot residue may be opaque to infrared. Thus, you may be able to photograph powder stippling and GSR through dried bloodstains on patterned fabric that refuses to cooperate with other methods.

Injuries both ante-mortem and post-mortem which cannot be clearly seen and photographed using white light or reflected ultraviolet may yield their secrets to reflected infrared. Without a Jenoptik lens, you'll have to first focus without a filter using white light and transfer the setting to the IR focusing mark before installing the filter.

You will not find IR focusing marks on a zoom lens. You will need to use a prime lens. I suggest a manual focus prime.

**Contusion Enhancement**

See http://www.forensic-photography.com/contusion.pdf for an article on contusion enhancement


I elected to treat contusion enhancement as a sidebar topic because it is somewhat controversial, somewhat complicated, not easily demonstrated in the classroom and in general seems to be an endeavor best left to forensic pathologists and forensic orthodontists with the credentials to be qualified as an expert witness able to offer opinion testimony if a case goes to court.
If you have an interest in using forensic lighting to document injuries that cannot be seen under white light, get in touch with the special victims unit of a police department or a prosecutor's office that is using forensic lighting to successfully prosecute domestic violence cases.

**Arson Scene**

Even in the absence of evidence such as gasoline cans, accelerants can be detected by chemical sniffers and arson dogs. Sometimes pour patterns are clearly visible, especially when the scene is viewed with a powerful light from various angles to reveal differences in the charring pattern.

Like contusion enhancement, using UV to detect accelerant pour patterns is not easily demonstrated in the classroom and requires equipment that may not available to the average crime scene investigator. For an overview, see http://www.forensic-photography.com/arson.pdf.

**General Guidelines**

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This table was prepared based on recommendations published by various manufacturers but results are not guaranteed by this author or the vendors. You must test under operational conditions to make sure that a forensic light is both durable and adequate for the intended purpose.
Buy a light or lights consistent with the intended use and the anticipated conditions of use. You don't need a mega-light to see fluorescent fingerprint powder in a dark room because you know where you dusted.

You may need a powerful light for general crime scene search, documenting incendiary pour patterns or processing a large area with Luminol or Hemascein, especially if you have limited control over the ambient lighting.

Lights plural? Some manufacturers only make lights in a single wavelength. You may need to buy a light for every wavelength that you think you might need which can get expensive in a hurry.
Chapter 5.7
Fingerprint Photography

Fingerprints are:

- Hard to find using conventional dusting techniques.
- Commonly found on surfaces that are not camera-friendly.
- Often found on the back of gear shift levers, on the bottom of door knobs, above eye level on doors and windows, et cetera.

The prudent practitioner will:

- Adhere to the practices recommended by SWGFAST and IAI.
- Transfer portable items to a laboratory for processing by experts using specialized chemicals and equipment.
- Use a kit that includes standard, fluorescent and magnetic powders, plus a varied assortment of lifting and casting materials.
- Include a 2" fingerprint scale parallel to the long axis of each print.
- Use the latest lifting and casting techniques in addition to photography to preserve prints found at the scene.
- Use fluorescent powders with forensic lights in the 450 and 530 nm wavelengths with appropriate goggles and barrier filters.
- Use an SLR camera with a macro lens, a tripod, a cable release, an external flash, an off-camera flash cord and a Joby Gorillapod to steady the camera when there is no room to erect a standard tripod.
- A Gorillapod can be used on vertical and horizontal surfaces.
Remember:

- The capture area of a 12 MP camera is 2.5 x 4.3 inches at 1,000 pixels per inch, enough for a thumbprint and a two inch scale.
- Even with a macro lens, you may find that vibration reduction and auto-focus are unreliable at high reproduction ratios.
- Depending on the subject, auto-exposure may or may not produce consistent results.
- Reflections can be troublesome shooting with on-camera flash.
- Most photographers depend on manual focus, manual exposure and off-camera flash for difficult closeup targets.
- Many crime scene prints will be low contrast partials on rough or multi-colored surfaces, difficult even under ideal conditions.
- Take exclusion prints from people with legitimate access.

But Wait, There's More

Fingerprint photography is challenging because you've got to find the print and render it visible before you can photograph it. Processing a felony crime scene, which includes finding and preserving latent prints, is a job that requires specialized training.

Once a fingerprint is found, photographed and lifted, the digital image (whether a photograph or a scanned lift), must be resized to 1:1, converted to gray scale and tweaked to enhance contrast. Only then can the print be submitted to an examiner. This requires good Photoshop skills in addition to good investigative and photographic skills.

Overview

Fingerprints come in four flavors: patent, latent, plastic and dust impressions. A patent print is visible to the naked eye. Latent prints must be developed by dusting, fuming, chemical treatment or illumination with an alternate light source. Plastic prints are embossed in a surface such as blood, visible to the eye but difficult to lift. You may or may not be able to lift a
dust impression but there are electrostatic lifters that will make the job easier. Embossed prints are often cast with a silicone casting agent.

There is nothing inherently difficult about taking photographs intended to establish a fingerprint on an object before lifting. Most any camera will suffice. Taking photographs good enough for submission to AFIS) or to an IAI-certified examiner for identification purposes takes training and experience.

The standard for fingerprint photography is 1,000 pixels per inch or higher. Five hundred pixels per inch will suffice for palm prints. See http://www.theiai.org/guidelines/swgfast/index.php and look for the article on Friction Ridge Digital Imaging Guidelines.

Palm prints reportedly account for 20% of all prints collected at crime scenes. A 12 megapixel camera will give you a 5 x 8.5 inch capture area at 500 pixels per inch, adequate for a large palm print with a six inch scale.

Once you have a print to work with, lighting becomes the problem, especially on shiny surfaces. I spent thirty minutes trying to photograph a print on a nickel plated .357 Magnum before hitting on exactly the right angle. While firearms are generally submitted to a lab for examination, there is no shortage of shiny objects that cannot be transported to a lab.

If you want to hone your fingerprint skills, start by rolling an inked print onto a ten card. If you do not have access to a proper print-rolling setup, order a thumbprint pad from http://www.inklessprints.com.

The objective is to become familiar with the technique required to photograph prints using the equipment that you already have or can reasonably afford and find the right combination of flash angle and exposure compensation. This won't teach you anything about developing latent prints but it will teach you something about photographing them.

**Tripod Management**

Once you've found a latent print and rendered it visible, the big trick is not photographing the print but positioning the camera perpendicular to the
surface on which the print was found at whatever distance is required to record a 1,000 pixel per inch capture area.

This is simple if the print is on a vertical or horizontal surface, not too high and not too low, with no obstructions that will limit your ability to place the tripod where you want it. Otherwise, it can be quite difficult if the print is on a surface that precludes a conventional tripod setup.

The job is easier if you have a tripod with an adjustable center column, a good ball head and a focusing rail to adjust focus without changing the reproduction ratio. An articulated LCD will let you see what you're doing at awkward angles. Shooting handheld is a last resort.

**Reference Fingerprint Pad**

If you want to experiment with photographing dusted prints without making an unholy mess searching for latents, buy a $6 reference fingerprint pad from Armor Forensics. This pad is “inked” with a substance that duplicates the oils found in “real” latent prints.

**Hayden Baldwin’s Two Bits**

![Quarter](image)

Figure 70 - Hayden Baldwin points out that a thumbprint is almost the exact size of a quarter. If you can’t successfully photograph a quarter, you can’t expect to successfully photograph a fingerprint.
Guidelines for collecting footprint and tire track evidence can be found at http://www.swgtread.org. The Scientific Work Group for Shoe Print and Tire Tread Evidence recommends an adjustable SLR camera and a substantial tripod with provision for off-camera flash.

Unless your tripod has a head such as the Manfrotto 405 with integral spirit levels, an accessory spirit level that will fit in the camera's hot shoe is essential to ensure that the back of the camera is parallel with the ground.

Many tripods will let you invert the center column but this is cumbersome. A tripod with an articulated center column such as the Manfrotto 055XPROB is more convenient.

Footprints can be found indoors and out, either as an impression in snow or soft ground or as a dust residue on a smooth surface. Tire tracks are usually but not invariably found as impressions in snow or soft ground.

Impression evidence should be photographed with and without scales prior to casting. Footprints found in the form of dust should be photographed with and without scales prior to lifting, preferably with an electrostatic lifter.

The 6 x 12 inch scale commonly used for footprints is known as the Bureau scale. For tire tracks, use a scale long enough to lay parallel to the
circumference of the largest tire that you can expect to encounter, something in excess of twelve feet for a commercial truck tire.

Figure 71 - Evident Crime Scene Products has a nice mini-tutorial on their dental casting stone products. If you need to hone your skills, look for an equestrian arena. Arena sand is often trucked in at considerable expense and holds footprints and tire tracks remarkably well.
Chapter 5.9
Tool Marks

Tool marks are a form of impression evidence that can be used to link tools found in the perpetrator's possession to impressions left at the scene of the crime.

Tool marks are commonly left by hammers, chisels, screwdrivers, crowbars and bolt cutters. Tool marks are commonly found on door frames, window jams, chains and padlocks.

As with other forms of impression evidence, tool marks on structures too large to be transported to the lab are best preserved by casting once the evidence has been carefully photographed using the same equipment and techniques used for photographing plastic fingerprints.

You'll need a tripod and source of cross lighting to bring out fine detail. While off-camera flash is commonly used for cross lighting, there is no reason why a Q-Beam, a flashlight, a desk lamp or a clip-on light from the hardware store won't work.

Obviously, tool mark evidence such as chains and padlocks found at the scene should be carefully packaged and transported to a properly equipped laboratory for processing. There is no reason to process easily transported items in the field.

Also obviously, tool mark impressions left on door frames and window jams will require careful placement of your lights, cameras and tripods.
to bring out maximum detail. You can buy paper scales with an adhesive backs or use a regular scale with double-sided tape on a vertical surface.

Figure 72 - Students can practice of a well-worn strike plate. This example is the best of dive shots using a Panasonic ZS9 with on-camera flash. The camera was tilted slightly to eliminate reflections. The bottom screw is slightly out of focus, a fact that went unnoticed until the JPEG was opened in Photoshop.

Figure 73 - Left: Test strike on soft pine using a framing hammer. Right: The face of the hammer showing embedded drywall from a DIY project. Panasonic ZS9 using a 300 watt photoflood for cross-lighting.
Chapter 5.10
Identification Photographs

A reliable guideline for identification photos and mug shots can be found at the http://www.fiswg.org/documents.html. The specific document that you want is Section 5 - Capture and Equipment Assessment for Face Recognition Systems.

While the Facial Identification Scientific Working Group is largely concerned with automated facial recognition systems, facial recognition photos are starting to show up in criminal data bases along with DNA and fingerprints. FISWG standards are similar to the standard for passport photos.

As you might imagine, camera phones, non-adjustable cameras and on-camera flash are not recommended. The focal length should be a moderate telephoto in the 85 to 135 mm range on a full frame camera, long enough to provide a lifelike perspective when taking head and shoulders photos.

At the professional level, people photography is often flash photography. It doesn't matter whether you're photographing a pretty girl or a decomposed corpse.

- Direct sunlight is harsh, introducing strong shadows and uncomfortable squints.
- Open shade is better but it adds a bluish tint to skin tones.
• High wattage photofloods can be unpleasantly warm for both the subject and the photographer.

• An ideal mugging setup is two studio strobes placed at 45° to the subject's position and triggered by a low power on-camera flash.

• If desired, a third strobe can be positioned to illuminate the background behind the subject.

If you've got twenty dollars to spare, purchase a copy of *Flash... The Most Available Light* from LumiQuest. This booklet describes techniques commonly used by professionals to improve the quality of their people pictures. The same techniques can be used by police photographers to improve their identification photos.

You may want to use manual focus for identification photos. Focus on an eye from the front, an ear from the side. If you're setting up a mugging station, make test prints on your usual printer to verify that you're capturing fine detail and accurate colors.
Chapter 5.11

Surveillance Photography

Surveillance photography requires endless patience, an iron bladder, good binoculars, a large Thermos, plenty of Rolaids and lots of Windex. If you have to shoot through a window, start by cleaning the glass inside and out. A voice-activated recorder can be a real help when you can't take notes.

Video cameras are ideal for surveillance. While the image quality can't compare to an SLR with fast professional lenses, it may be good enough for identification purposes. The better camcorders have long lenses, image stabilization, good low light capability and an eyelevel viewfinder.

A professional SLR is the camera of choice when you need photographs clear enough to identify an unknown individual at a distance under low light conditions. The $6,000 Nikon D4 is fantastic because it can be cranked to ISO 204,800. A $2,500 image stabilized 70 - 200 mm f/2.8 lens is good out to fifty yards. Beyond fifty yards, you'll need the same lenses required by sport photographers at prices ranging from $4,000 to $10,000.

DX cameras such as the Nikon D7000 and or the Canon 7D will suffice under all but the most extreme conditions but most folks purchase consumer lenses such as a 70 - 300 in the $500 price range to go with these cameras. These lenses will not suffice for low light work.

Even if you have a $1,500 camcorder or a $5,000 SLR, you'll still want a super-zoom pocket camera. In good light, these cameras are invaluable when you need to take a fast shot without alerting a wary subject. A
Nikon D4 with a 70 - 200 mm f/2.8 lens has many positive attributes but inconspicuous is not among them.

Figure 74 - This is a fifty yard grab shot taken with a Panasonic ZS9 at full zoom. The crop from a 20 x 30 enlargement shows plenty of detail. Not bad for a $129 pocket camera. In years past, I paid thousands of dollars for cameras that fell far short of today's pocket super-zooms.
Chapter 5.12  
The Scene

Once upon a time, Judge Colt adjudicated more cases than Judge Kodak. Crime scene investigation procedures haven't changed much in the last fifty years. Today's crime scene investigators have superior methods for analyzing evidence but you've still got to collect the evidence and do it right the first time because you won't get a second chance.

Wait for a warrant if a warrant is required. Evidence including photographs collected without a warrant may not be admissible.

Photography is just one of the many steps involved with processing a scene. In jurisdictions without a crime scene unit, the photographic and evidence collection chores might be performed by detectives and patrol officers in addition to their regular duties.

Crime Scene Processing

If your own training as a crime scene investigator is somewhat sketchy, keep an eye on local colleges with a forensic science program, your regional IAI site and professional associations related to your primary area of interest to see what training opportunities are available in your area.

There is no such thing as a one-size-fits-all crime scene checklist. While every scene is different, most scenes have certain things in common, such as forced entry into a residence or place of business and unlawful acts
ranging from theft to homicide followed by an exit from the premises and departure from the area.

In some departments, investigators will take their own photographs. In others, photographers attached to the crime scene unit will handle the photographic chores under the supervision of the lead investigator.

Unless you're working under the direct supervision of an experienced investigator, you cannot properly photograph a crime scene if you have not been trained to process a crime scene, and not just any crime scene. You have to know how to process the specific scene in question.

**Overview**

Assume that you've been assigned to photograph a crime scene. Start by talking to the first responders and lead detectives. Walk the scene to determine what equipment will be needed. If you're confronted with a large outdoor scene on a dark and stormy night armed with nothing more than a pocket point and shoot, you may have to call for reinforcements.

Assuming that you have the proper equipment and know the photos that you will need to take, start with overall views of the exterior of the building from every quarter plus the surrounding area, to include the street in front of the building looking in both directions and a shot of the entrance showing the street number and/or signs identifying the business name.

Take care to avoid damaging footprints and tire tracks until they can be photographed and cast. Photograph signs of entry and egress, to include tool marks and broken glass. Use a tripod or flash as required.

Moving indoors, take overall views of each room from at least four points of the compass, followed by medium closeups of important elements within the scene before moving in for detailed closeups. Having a lens that will cover the range from wide angle to telephoto will speed up the process.

Boxing the compass describes the process of photographing a scene or an object within the scene from various angles. A four-point box would include photos taken from the NE, SE, SW and NW points of the compass. An eight-point box would include photos take from N, NE, E and so forth.
Room interiors might best be photographed from each corner and again with the camera perpendicular to each wall to show relationships between doors, windows and objects within the room.

Many photos will be required to document a room in which a homicide occurred, including:

- The body itself, from every angle including overhead.
- Blood spatter on the floor, walls and ceiling.
- Weapons, to include any object that could be used as a weapon.
- Signs of a struggle.
- Bullet holes and empty cartridge cases.
- Projection rods and lasers showing the trajectory of each bullet.
- Fingerprints, shoe prints, tool marks and dust impressions.
- Trace evidence down to the last hair and fiber.

This is only the first round of photos. Another series of photos will be taken after scales and markers are placed in the scene along with any photos required to support the crime scene diagram and the evidence collection process. You can't just shoot and scoot.

In the event of a recent sexual assault, you will have to test for still-wet semen and vaginal fluid using one of the many kits marketed for this purpose.

If enough time has passed to allow semen and vaginal fluid to dry thoroughly, the room will have to be processed in subdued light if not total darkness with a 460 nm forensic light and yellow goggles.

If there is some suspicion that a body may have been removed and that the perpetrator attempted to cover his tracks by trying to eradicate all traces of visible blood, the floor and perhaps even the walls must be processed with Hemascein, Luminol or Blue Star and examined in subdued light in conjunction with a 460 nm forensic light and yellow goggles.

Should traces of latent blood, semen or vaginal fluid be found, they must be photographed in place before the clothing, bedding or carpet are
collected for transport to a properly equipped lab. Ultraviolet fluorescence is presumptive. Conclusive testing will have to await laboratory findings.

Views from four oblique angles will often suffice for automobiles at least in part because everyone knows what a car looks like. The more complex the subject, the more views you will want to take to be certain of capturing all of the relevant details in both overall views and closeups.

If you learn that something was moved, photograph the scene just as you found it. Let the person who altered the scene explain it.

**Witness Reconstructions**

An attorney is only doing his job when he challenges what a given witness could see. Therefore, it makes sense to photograph the scene from the witness's vantage point and eye level.

I'm six-eight. My step-daughter five zip. There is a two foot difference in our view of the world. Put the moose in the cab of a White Freight-liner and the munchkin behind the wheel of a Ferrari Berlinetta and the difference might be five or six feet.

Take witness reconstruction photos with a "normal" focal length to avoid exaggerating or compressing the perspective. If one or more parties were in a vehicle, be it an automobile or a locomotive, take photos sitting behind the wheel of a similar vehicle.

**Lighting Reconstructions**

Answering the question of what a witness could or could not see becomes even more difficult at night. The common sense solution? Same as above, except at night under lighting conditions closely approximating the lighting conditions at the time of the offense.

Use a digital camera and a sturdy tripod. Take a series of exposures at the default ISO and an intermediate aperture to ensure maximum sharpness. Focus carefully. Review each shot and adjust the shutter speed as required. Stop when the detail visible in the LCD display is a good match for the detail visible with the naked eye. Print the photo to match the thumbnail.
Aerial Views

Overall views of a large and confusing scene are best shot from the air, if you happen to have a helicopter handy. Failing a helicopter, a cherry picker borrowed from the public works department or an aerial ladder truck borrowed from the fire department may suffice.

Use an ISO number high enough to allow shooting at 1/1000th of a second with focal lengths up to 105 mm, 1/2000th of a second with focal lengths up to 200 mm. You can get away with shooting a pro lens wide open at f/2.8. Amateur lenses may be a little soft wide open so you might want to stop down.

The ideal lens for aerial photography is a 70 - 200 f/2.8 constant aperture zoom. If you have a lens with vibration reduction, try it with VR on and off. VR lenses are designed for shooting handheld, generating low frequency vibrations. The higher frequencies encountered in an aircraft might drive the VR system crazy.

Leave the lens in the auto-focus mode. The infinity position on a zoom lens will vary with the focal length, which in turn will vary with altitude as you try to frame the shot.

Ask the pilot to fly as low and as slow as safety will allow and make a pylon turn clockwise around the area of interest. A clockwise pylon turn banks the aircraft with the passenger side towards the area of interest, maintaining a more or less constant distance and altitude.

Camcorders

While still photography is the preferred method for preserving photographic evidence, some departments document both the scene and the evidence collection process with a camcorder (or a still camera with a video mode). Read "Shooting for Justice" from http://www.leva.org.

Unless you're an optimist, do not leave the microphone open throughout a camcorder session to avoid picking up off-camera commentary not meant for public consumption.
Indoor Scenes

![Image of an indoor scene](image)

*Figure 75 - This photo of a model home living room was taken with a Panasonic ZS9 pocket camera using the built-in flash. The reflective walls, floor and ceiling effectively doubled the range of the camera's built-in flash to thirty feet or so.*

## Outdoor Scenes

The first photo on page 152 is the first of fifty taken on a warm summer day. The second photo was taken at night from the same position during a winter storm. At a guess, would have required seventy or eighty flash pictures and a dozen or more time exposures to provide the same coverage.

I used a Nikon D70 with an SB-800 flash for the night shots. I wouldn't have tried with a point and shoot. Perhaps it can be done but not by me.

These photos illustrate general concepts. There were no fingerprints, footprints, tire tracks, tool marks or empty cartridge cases to be documented. No attempt was made to photograph the 10,000 square foot interior.
Figure 77 - Always get at least one shot of the nearest street sign.

Figure 76 - Always get shots showing a building, a scene, a vehicle or whatever the subject might be in relation to its surroundings. This shot shows a Walgreens drug store, an Ent credit union office and the Safeway parking lot with Pikes Peak in the background.
Figure 78 - A telephoto shot from across the highway, showing the entire frontage.

Figure 79 - A panorama assembled from five wide angle shots taken with a Panasonic pocket camera standing 50' in front of the front door. Photoshop CS5.

Figure 80 - A ten second time exposure of the Safeway gas station across the highway, that being the nearest stationary vantage point from which a potential witness could see the front of the building during the height of a storm. Nikon D70. Tripod. Had to wait for a lull in the traffic to get a photo without headlight streaks.
Chapter 5.13
The Knife and Gun Club

There are five liters of blood in a typical human body. Following a crime of violence, much of this blood can be found in pools surrounding the body, in drops marking the path taken by the victim or the perpetrator after the blow was struck, and in high velocity spatter on the walls and ceiling.

Blood pattern analysis is a recognized specialty among the forensic science disciplines. The International Association of Blood Pattern Analysts publishes a list of training opportunities and an informative journal which can be found at http://www.iabpa.org.

Interested readers are referred to standard texts such as Blood as Evidence by Matisoff and Barksdale and Advanced Crime Scene Photography by Duncan.

For our purposes, it is sufficient to know that blood must be photographed with the camera perpendicular to the surface on which the stain was found and these photographs must be properly scaled and free from detail-destroying reflections.

Oregon Rule makes an L-shaped folding rule in 48 x 48 inches and 7'8" x 7'8" sizes. Evident Crime Scene Products offers a set of four 48" Super Sticks that can be assembled in several ways. You'll need products such as these to scale blood spatter on walls above baseboard level.
Figure 81 - Our simulated blood spatter target was made by squirting fabric paint on a sheet of white Foam Core. Left: A useless snapshot taken from waist level. Right, the photo was centered vertically and horizontally using a drywall square, that being the largest scale that I had on hand. Panasonic ZS9 on a Joby Gorillapod.

If you look closely, you'll see the ZS9 exhibits significant barrel distortion. Off-camera flash would be required to eliminate the hot spot in the center of the frame. Getting the camera centered required finding the vertical and horizontal centers of the target and turning on the viewfinder grid.

Many cameras have a grid that can be displayed in the viewfinder but the option is often buried deep within the menu structure.
Chapter 5.14
Vehicles

The exterior of any vehicle from a bicycle to a locomotive can be photographed during the daylight hours using whatever camera you might have on hand. Night shots and vehicle interiors usually require flash.

Vehicle interiors can be challenging when bloodstains, bullet holes and fingerprints are involved. If you have an SLR with an external flash, try using a diffusion dome and tilting your flash at a 45° angle to control reflections. Don't overlook the trunk, the glove compartment, the ash trays, the floorboards and whatever might be concealed under the seats, under the floor mats and behind the visors.
Figure 83 - This badly underexposed photo was taken with a Panasonic ZS9 at ISO 1600. This is about as good as it gets with a pocket camera. Focus was point and pray.

Figure 84 - Nikon D70 with SB-800 flash at ISO 400, manual focus on the front tire using a Streamlight Polytac. Working outdoor scenes at night for an employer with deep pockets, I'd want a Nikon D4 with a 24 - 70 lens and a Metz 76 flash.
Chapter 5.15
The Victim

The body of the victim and the injuries thereto are evidence. The body of a homicide victim is easy to photograph because you can take your time. Photographing an emotionally distressed assault victim requires compassion and understanding in addition to photographic skills. Battered children and female assault victims should be photographed:

- By a female officer or a forensic nurse.
- Before the injuries have been treated, after the injuries have been treated, and once bruises have had time to develop.
- Without removing any clothing not actually required to reveal the extent of his or her injuries.
- After all required releases have been signed and witnessed.
- If possible, bite marks should be photographed by a forensic odontologist qualified to compare the bite marks to a suspect's dentition.

If you photograph an assault victim over a period of several days to demonstrate how bruises have developed, use the same camera, the same lens, the same settings, the same light source and, if possible, the same room to ensure that you're recording changes in the victim's condition and not the environment.
If an assault victim refuses medical treatment, take the best pictures that you can get at the scene. Even if the victim declines to testify, the photos can show the severity of his or her injuries.

In some jurisdictions, the police own the scene but the medical examiner owns the body. Generally, the medical examiner's office will dispatch an investigator to process the body and arrange for transport.

In jurisdictions under the coroner system, a local MD, a justice of the peace or even a mortician might be called to the scene to ascertain that the victim is indeed dead and pronounce the time of death.

Whatever the system, you need to know the procedures established to ensure a harmonious working relationship with the coroner or medical examiner. For the sake of simplicity, we'll assume that one photographer will follow the body from the scene to the morgue.

Shooting overall views and medium closeups of a body does not require anything special in the way of photographic technique. Shooting closeups of trauma, identifying marks or scars, gunshot residue and so forth might require a macro lens and/or off-camera flash.

If you use a shoe-mount flash for closeups, a diffusion dome or a Pocket Bouncer will give you more even illumination than direct flash. An off-camera flash cord is useful for this kind of work. Do the best you can with what you've got if you're using a point and shoot. There are four additional pieces of equipment that you might want to consider:

- A monopod with an articulated head to take overhead shots of an open grave or a body in a bathtub. (Use the self-timer.)

- A camera with an articulated LCD if you occasionally need to take horizontal shots at ground level.

- A Little Giant folding ladder. Little Giant ladders can be configured in a manner that will allow you to get closer than you can with a standard step ladder.
A Honda EU generator with suitable flood lights. Honda EU generators are campground-quiet, have effective spark arrestors and produce a regulated sine wave output that will not harm electronic equipment.

**General Procedures**

If homicide investigations are not covered in your department's crime scene protocol and there are no homicide detectives on site to provide guidance and instruction:

- Take overall views of the body from eight points of the compass, or as many points as the position of the body will allow.

- Take medium closeups and closeups including full-face and profile views and the hands and feet before they are bagged.

- Photograph visible trauma and discolorations, including defense cuts and hesitation marks.

- Photograph any weapons found in the area.

- Photograph articles of jewelry and apparel that might aid in identification or be lost in the process of transporting the body.

- Photograph the rope or ligature paying particular attention to knots in hanging and strangulation cases.

- Ligatures should be removed by the pathologist at the morgue.

- Ropes should never be untied. They should be cut twelve inches above the knot, leaving the knot in place for removal by the pathologist.

- This applies to any tape, rope or cords that might have been used to restrain the victim.

- The type of knot and the manner in which it was tied are important and should be photographed before being disturbed.
• Photograph all insects and insect larvae found on or near the body. Collect specimens. A forensic entomologist can determine the time of death based on the life cycle of various insects.

• Photograph knives, arrows, spears or splinters protruding from the body to show the direction of penetration. Try to avoid dislodging or disturbing the knife. Leave it in place for the pathologist.

• Photograph the removal of the body, to include the ground under the body and areas of the body that could not be photographed before it was moved.

• Photograph the process of exhuming a body from a grave, and any evidence found during the removal process.

• Take accurately scaled photographs of bloodstains and blood spatter.

• Take unscaled photos before placing scales and markers in the scene. Otherwise, the defense attorney will object that placing scales and markers somehow disturbed the scene and concealed valuable evidence that would undoubtedly exonerate said attorney's client.

• Once the body has been outlined and removed from the scene, repeat the entire process. The defense may object to photos of a mutilated body. Removing the body allows photographs of the scene to be introduced with the body represented by an outline.
Chapter 5.16
Post Mortem

*Just about everything in or on a body is wet, moist, curved or shiny. This inevitably creates problems with reflections and depth of field.*

*Dr. Patrick Besant-Matthews*

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In jurisdictions too small to warrant a medical examiner, an elected coroner, a justice of the peace, the county sheriff or a local mortician might be responsible for determining the cause and manner of death.
To be sure, some coroners will arrange to have a forensic pathologist conduct post mortems but many autopsies are performed by physicians without formal training in forensic pathology. In fact, some post mortems consist of nothing more than a superficial examination when there is no reason to question the cause and manner of death.

Assume that a citizen has been shot to death within the jurisdiction of your department and that you have been assigned to photograph the autopsy. Further assume that the circumstances do not rule out the possibility of murder, accident or suicide and that the autopsy will be conducted by a physician who has never treated a gunshot wound or posted a murder victim.

Thus, there is a chance that the gunshot was not the actual cause of death or that factors that would be apparent to a forensic pathologist might be overlooked. Should the original autopsy findings be questioned, there is a chance that your photographs might shed additional light on the subject.

The following procedure will suffice in the absence of a forensic pathologist or a homicide investigator qualified by training and experience to supervise the photographer. Confronted with an unfamiliar situation, it is always better to over-shoot than under-shoot.

- A complete series from every angle as the body is being removed from the body bag, paying attention to items that might have fallen from the body such as a spent bullet.
- A complete series before the body is disrobed, to include all articles of clothing and jewelry that might aid in identification.
- A complete series after the body is disrobed and before it is cleaned, paying special attention to anything adhering to the body that might be washed away during the cleaning process.
- A complete series after the body has been washed, to include closeups of injuries, discolorations, scars, powder burns, etcetera
- Full-face and profile closeups.
- Overhead views front and back. Use a ladder. If there is no ladder in the morgue, check with housekeeping. Every building is likely to have a ladder, if only to change light bulbs. Alternatively, use a camera with an articulated LCD to aid in composing overhead shots.
- Detailed closeups of any additional injuries noticed by the pathologist during the preliminary examination.

- Closeups of knifes, ropes and ligatures before and after removal, and the injuries visible thereafter.

- Photographs from several angles of any probes that might be inserted in a wound to trace the path of the bullet.

- Additional photographs as directed by the pathologist during the course of the autopsy.

- Photos of the victim's clothes before and after they have been allowed to air-dry showing all rents, tears, bullet holes, powder burns and blood stains.

- Photographs of the victim’s personal effects, to include jewelry, watches and so forth.

Figure 86 - This photo of a .45 caliber bullet hole in a 1/8th inch linoleum test panel (available in art supply shops and commonly used for calligraphy) clearly shows powder stippling. SIG P220 with 230 grain Remington Golden Saber fired at six inches.
Powder stippling, when present on the victim's skin or clothing, provides an indication of the distance at which the shot was fired. This can be determined with some degree of precision when it is possible to obtain the weapon in question and ammunition identical to the ammunition used in the actual shooting.

Remington, for example, makes six 230 grain .45 ACP factory loads and it would be a mistake to assume that they're all loaded with the same powder charge. I've chronographed a number of .45 ACP factory loads and found that velocities can vary from 800 to 980 fps from the 4.4" barrel of a SIG P220.

The Remington Golden Saber 230 grain factory load clocked 880 fps from my gun, almost identical to the claimed velocity of 875 fps from a factory test barrel. Depending on the gun and load, some lots of ammunition can vary several hundred feet per second more from the advertised velocity determined in a factory test barrel.

While ultraviolet and infrared photography may be of scant interest to investigators with limited training and an even more limited equipment budget, they are of considerable value to forensic scientists and police photographers with the right equipment and know-how.

In the morgue, ultraviolet and infrared can be used to detect ante-mortem bruising and faded tattoos. Infrared can reveal GSR that can't be seen under white light and penetrate dried blood, revealing everything from laundry marks to powder stippling on the victim's clothing.

This chapter assumes that one person has photographed the entire proceedings from crime scene to morgue. In the real world, you would very likely find both police investigators and medical investigators from the Medical Examiner's office at the scene, technicians assisting the pathologist in the morgue, and evidence technicians in the police crime lab examining the victim's clothing after they have been allowed to dry.

A firearms examiner might get into the act if it becomes necessary to fire test shots and/or verify that bullets recovered from the victim's body were fired from a weapon recovered at the scene or from a suspect.
Chapter 6.1
The Digital Darkroom

An occasional user can get by with a laptop computer, an inexpensive printer and a freeware editor such as Faststone. I use and recommend:

- FastStone from faststone.org, free to home and student users, $34.95 for business and government users, is a fast and efficient editor and file manager if you're shooting mostly JPEGs.

- Photoshop, $699.00 from adobe.com, is a powerful editor with limited file management tools for RAW and JPEG. (Educational discounts available.)

- CSIpix, $299.00 from csipix.com, can compare two scaled photos by side by side with a minimum of fuss. This is a must-have program for fingerprint examiners, firearms and tool mark examiners, etcetera. Download the trial version and see for yourself.

In addition, look at Photo Evidence Pro and Mug Shot Pro from digitalcop.com. These programs provide the comprehensive audit tools missing in general purpose programs such as FastStone and Photoshop.

Advanced users will need Photoshop to do the heavy lifting even if they use a program such as FastStone or Photo Evidence Pro to handle basic editing and file management chores. I have Photoshop CS2, CS5 and CS6 on my computer. They all support the techniques described in Photoshop CS3 for Forensic Professionals by George Reis, a must-have book in any police photographer's library.
I have FastStone set up to call Photoshop and CSIpix from the Edit With External option on FastStone's File, giving me what I consider the best general purpose digital darkroom tools to be had at any price. FastStone's editing tools are similar to those in Photoshop while offering batch processing and printing options absent in Photoshop.

A technician supporting several busy crime scene investigators needs serious horsepower given the large files produced by today's high resolution cameras. I suggest a tower workstation from Dell or Hewlett Packard backed by an on-site service plan with a quad core processor, the 64 bit version of Windows 7 Professional, 8 GB of RAM, a 1 TB hard drive, at least six USB 3.0 ports and a good 24" monitor. I'm using a 24" Samsung. Cost no object, I'd go with a graphics monitor from Eizo or LaCie rated at 1920 x 1200 pixels to get more accurate color and a 16:10 aspect ratio.

You need fast printers if you are required to produce from fifty to five hundred prints a day, plus an occasional courtroom exhibit large enough to be displayed on an easel and still be clearly seen from the jury box.

- Consider a wide carriage inkjet from Epson, Canon or Hewlett Packard for prints ranging in size from 8.5 x 11 to 24 x 36 inches.
- Consider a dye sublimation printer from HiTi at hiti.com or DNP at dnpphoto.com if you need prints from 4 x 6 inches to 8 x 12 inches.
- A good inkjet can print thirty 8.5 x 11 prints an hour with occasional operator intervention.
- A good dye sublimation printer can produce three hundred 4 x 6 prints an hour with minimal operator intervention.

There is more to police photography than taking pictures. There are administrative issues that can't be ignored if the pictures are to be of any value when the case goes to trial or, as often happens, comes up on appeal long after the original technician has departed, leaving you to sort out the mess that he or she left behind.

Never erase or format a memory card until you have made and verified all required backups. This can be an automated overnight process if you're backing up to external hard drives and/or a network file server. See forensic-photography.com > links > handouts > digital_imaging.pdf.
Chapter 6.2
Court Exhibits

Some photos escape challenge because the defense doesn't know what questions to ask. However, you can only take so many shortcuts before a smart lawyer hangs you out to dry.

Lawyers litigating multi-million-dollar differences of opinion on behalf of corporate clients spend substantial sums preparing exhibits that will clarify issues for the jury, often contracting the work to firms that do nothing else.

Photo-quality printers from Canon, Epson and Hewlett-Packard can make beautiful prints up to 12 x 18 for the thirteen inch models, 16 x 24 for the seventeen inch models and 24 x 36 for the twenty-four inch models. Professionals buy these printers in large numbers.

The size of a court exhibit will be dictated by the layout of the courtroom, the nature of the evidence, the preference of the witness, the opinion of the prosecutor and the decree of the judge. Anything smaller than 12 x 18 will be hard to see beyond ten or fifteen feet. At a greater distance, 20 x 30 might be preferable.

Avoid portable electronic projectors. PowerPoints have to be projected in a dark room to be viewed correctly, and then only from a narrow angle behind the screen. Visit the courtroom ahead of time if you expect to use existing audio-video equipment. Some courts have AV equipment that came over on the ark.
Absent an opportunity to conduct a preliminary reconnaissance, I'd be inclined to mount display prints with acetate overlays on stiff backer boards and use an easel. Prints can be displayed in room light without risk of unexpected electrical problems.

A prosecutor of my acquaintance contends that people go to sleep when you turn off the lights to present projected images while everyone is ignoring the witness on the stand if you pass out 4 x 6 inch prints. Large display prints solve these problems.

These are problems for the prosecutor as long as you, the photographer, have provided digital photographs of sufficient quality to be enlarged to whatever size and displayed in whatever manner might be required.

**Digital File Transfer**

You’re in East Gotham. You’ve got photos that need to be delivered to West Gotham, perhaps to the prosecutor, perhaps to a defense attorney, perhaps to another police agency. What are your options?

Forget e-mail, snail mail and sneakernet unless you're required to deliver physical prints. At least four companies offer services that will let you send large files to anyone with e-mail and a fast Internet connection:

- CuteSendIt from http://www.globalscape.com
- YouSendIt from http://www.yousendit.com
- Pando from http://www.pando.com
- MailBigFile from http://www.mailbigfile.com

The message is delivered to the addressee with a link to your attachments on the vendor’s secure File Transfer Protocol (FTP) server. You can send all manner of documents to include photos at full resolution.

If you're worried about security, create an encrypted zip file using 7Zip or PK Secure. Send the key required to unlock the encrypted file by a route not likely to be intercepted, such as via voice telephone to the intended recipient.
Chapter 6.3
State of the Art

There is no secret sauce beyond knowing the limitations of your equipment and understanding the basics of exposure, focus and composition.

Photographers of today are confronted with an astonishing array of cameras that overlap in price and functionality as manufacturers compete to fill every conceivable niche. New models come and go so fast that no store can stock them all.

Arbitrarily, we can lump compact cameras and camera phones in the snapshot category, limited by modest low light performance and the fifteen foot range of their built-in flash. I include high end bridge cameras and entry level SLR cameras in the snapshot category because the people who buy these cameras are seldom inclined to purchase the lenses, tripods and flash units required to use them to their full potential.

By whatever name and at whatever price, snapshot cameras satisfy three user groups.

1. Students taking evidence photography courses who can't afford to spend thousands of dollars on an SLR camera system.
2. Patrol officers and detectives who need to document their observations without being burdened with excessive cost and complexity.
3. Crime scene investigators who need a handy pocket camera to carry when it isn't worth being encumbered by the full kit.
Do not underestimate the importance of snapshots and snapshot cameras. Forty years ago, for every crime scene investigator with a Nikon F2, there were hundreds of cops with Instamatics and Polaroids, often purchased out of their own pocket.

APS-C cameras such as the Nikon D7000 and the Canon 7D and full frame news and sport cameras such as the Nikon D4 and Canon EOS 1DX have 16 - 18 MP sensors. This is all you need for a National Geographic cover, a two page spread in Sports Illustrated or a 24 x 36 inch court exhibit.

Any of these cameras should prove durable enough to survive life on the street. They are heavy enough to balance a Metz flash. They have the adjustments required to work with a forensic light source. With the right lenses, these cameras will suffice for everything from fingerprints to video.

IMHO, everyone needs a good pocket camera. I like the super-zoom models because I'm a surveillance photographer at heart but there are smaller cameras that might be a better fit in your pocket that will take pictures just as good, if you don't need extreme telephoto reach.

Like it or not, if you are routinely confronted with scenes that require something more than you can get from a compact point and shoot, you or your department will find yourselves in the market for an SLR and all of the accessories associated therewith, starting with a good tripod, an external flash, an off-camera flash cord and a macro lens.

If your SLR goes on the fritz, not likely but always possible, you can put your pocket camera on a tripod to get shots that you couldn't get using the pocket camera's built-in flash. Professionals who take pictures for a living buy their SLR cameras in pairs but a good pocket camera can serve as spare for an SLR if you know how to use it.

My Panasonic pocket camera will let me take sixty second exposures in the manual mode. With my $129 camera on a $400 tripod, I can fire three or four full-power flashes with a $500 Nikon SB-800, painting a large scene. It's an emergency procedure but less expensive than buying a second $1,500 camera just to have a spare on hand.
Chapter 6.4
Logical Progression

You may believe that worrying about manual focus and manual exposure is a waste of time when today's point and shoot cameras have excellent auto-focus and auto-exposure systems. This could be true up to a point, depending on your career objectives and the needs of your department. Factors that could influence your thinking include:

- Situations demanding a high output flash.
- Situations demanding a sturdy tripod.
- Situations demanding barrier and bandpass filters.
- Situations demanding a lens with an IR focusing mark.
- Situations where the auto modes just flat don't work.
- Supervisors and prosecutors demanding better picture quality.

The progression from a point and shoot to an SLR might go something like this:

1. You start out with a pocket camera and that's all you really want or need.
2. You find yourself carrying a small tote that includes a tape measure, scales, graph paper and several jars of fingerprint powder.
3. You need a larger tote to accommodate conventional, magnetic and fluorescent powders, plus applicators for each.
4. The fluorescent fingerprint powder requires a forensic light source which in turn requires an SLR lens threaded to accept barrier filters.
5. You replace your patrol car with a small truck because you need to carry a hundred pounds of dental stone for casting shoe prints and tire tracks.
6. Wham, bam, alakazam! You need an SLR camera and advanced photographic skills because you are now a full time crime scene investigator. You have replaced your small truck with a large truck packed with just about everything on the Department of Justice list reprinted on pages 67.

Figure 87 - Photos courtesy Farber Specialty Vehicles for the Indianapolis - Marion County Forensic Services Agency and SVI Trucks for the Colorado Bureau of Investigation. Note that both units are equipped with roof-mounted light towers and awnings to allow working in inclement weather.
Bob McMicken worked as a deputy sheriff and private investigator before joining a Fortune 100 company’s corporate security staff in 1967, retiring as Security Systems Manager in 2006.

During his long career, he used a variety of cameras from Minox to a Crown Graphic, switching over to 35 mm single lens reflex cameras in 1971 and transitioning to digital in 2005. He has conducted investigations for the Harris County Texas Grand Jury and the Bureau of Alcohol, Tobacco, Firearms and Explosives in addition to many internal theft and fraud investigations.

His specialty is photographic surveillance augmented by photographing fire, burglary, accident and structural failure scenes over a six state region, working in both wet and digital darkrooms. In addition to photography and internal investigations, his responsibilities included designing, installing, monitoring and trouble-shooting fire alarm, burglar alarm, close circuit television, two way radio and computer systems.

He lives with his wife Diane in the Colorado mountain community of Woodland Park ten miles north of Pikes Peak.

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