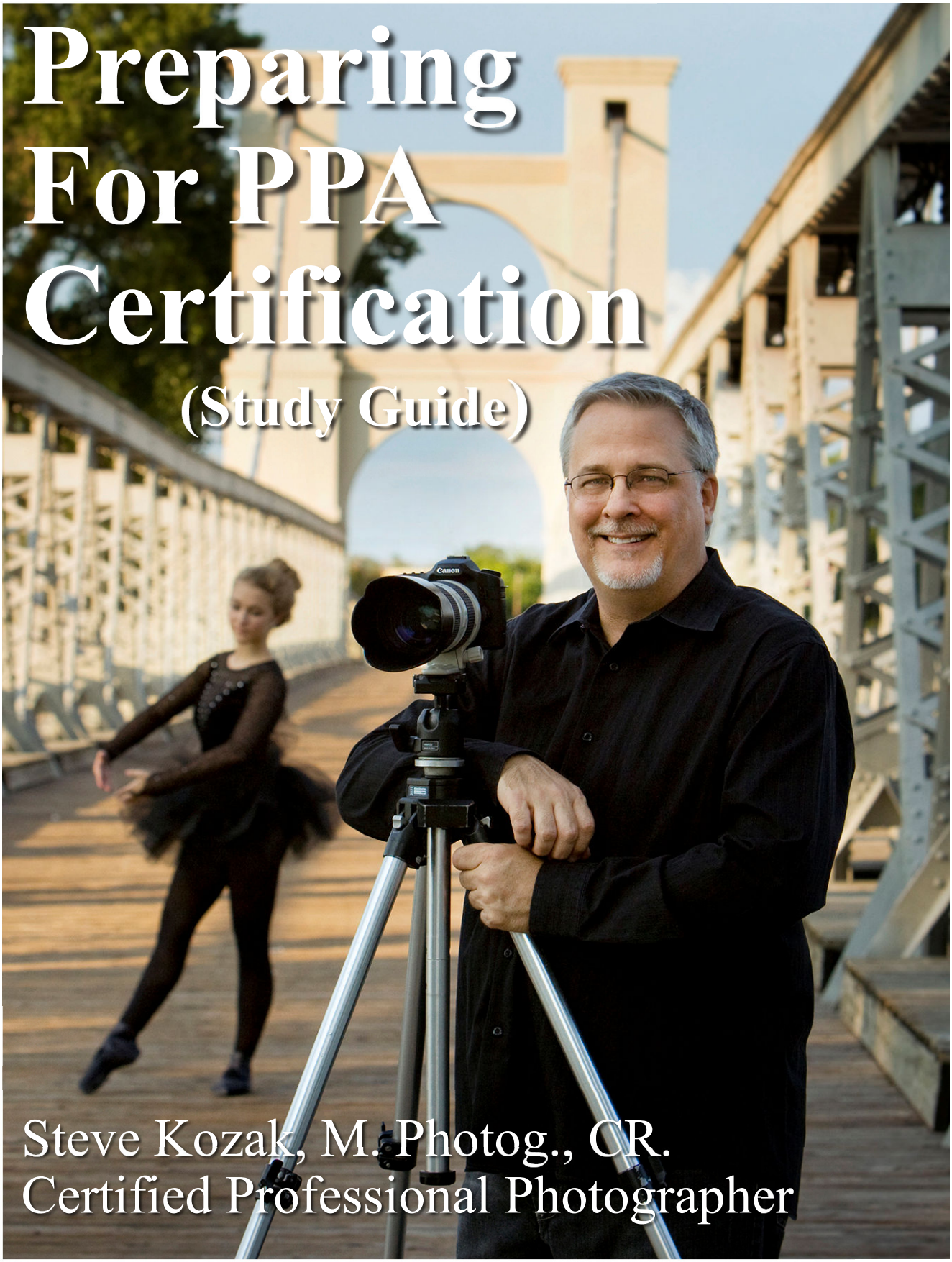
CPP Study Guide
by Steve Kozak

Preparing For PPA Certification

(Study Guide)



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Certified Professional Photographer

Cover Photograph by Marlo Collins

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About this study guide...
First of all, I want to congratulate you on your decision to consider PPA Certification. The time spent in studying the material and preparing for the Technical Image Evaluation will strengthen your skills as a photographer and boost your confidence.

I also want to thank you for your investment in this study guide! We will cover a lot of ground in the pages that follow and I hope that you take the time to really learn the material and put it into practice rather than just memorizing it for the exam.

The book is laid out according to the CPP Test Specifications provided by PPA. The specifications cover both the art and the science of photography, as well as the finishing, delivery and preservation of completed images. The information presented in this guide will provide you with a foundation on which you can build a strong base of knowledge as you move forward with your career. If it any point you don't understand something, **ask!** Feel free to email me if you have questions. My address is steve@stevekozak.com.

About your success...
I want you to **enjoy** this process! I also want you to be **successful** when you take the exam and submit your images. I have found that the real secret to success with this process lies with you putting what you learn into practice immediately.

About the instructor...
Steve Kozak is an active member of the Texas Professional Photographers Association (TPPA) and the Professional Photographers of America(PPA). Steve has earned the "Master of Photography" and the "Craftsman" degrees from PPA, and is a PPA "Certified Professional Photographer". He has also been awarded the "Full Fellowship Degree" from TPPA.

Steve's work has been accepted into numerous exhibitions representing PPA, including a prestigious exhibit by Kodak and Walt Disney World held at that EPCOT in Orlando, Florida. In addition, his work has been selected for the "Permanent Loan Collection" that travels the world to promote PPA! National recognition of his work also include: Numerous Distinguished Print Awards, The **"Masterpiece Award"** from Fuji USA, The "Trophy Print" Award for best folio, and numerous "Merit" prints from PPA.

His work has appeared in Bride & Groom, Southern Bride, and Life magazines. He has written for Professional Photographer and The Texas Professional Photographer magazines. He teaches at the Texas School of Professional Photography and Imaging USA and continues to travel across the country to speak to professional photography associations.

Visit Steve's web site at: www.SteveKozak.com

CAMERA, LENSES AND ATTACHMENTS (12%)

Items relating to this category will include digital cameras as well as the various lenses, menu settings and attachments that might be utilized.

A. Select the appropriate camera for subject matter and output requirements. (3 items)

1. Knowledge of the types and specifications of digital cameras appropriate for photographic assignments (file size, sensor size, sensor type,DSLR, mirrorless)

B. Select the appropriate lens based upon size and distance of subject matter as well desired perspective. (5 items)

1. Knowledge of the types of lenses and their impact in terms of different effects
2. Knowledge of the limits of lenses (i.e., angle of view)
3. Knowledge of how to control distortions created by height, distance, and angle of camera relative to subjects
4. Knowledge of the effects of depth of field based on f-stops
5. Knowledge of hyperfocal distance
6. Knowledge of how the size of the image sensor influences the magnification of the lens

C. Use camera, camera menu settings, and camera supports to create a quality image. (3 items)

1. Knowledge of camera controls and settings
2. Knowledge of the effects of extreme temperatures or humidity upon operation of equipment
3. Knowledge of appropriate use of camera supports (tripods, monopods)
4. Knowledge of methods used to set white balance
   - White balance target (gray card)
   - Calibration disc
   - Color temperature
5. Knowledge of the impact on file size and format (TIFF, JPEG, RAW, etc) on final image

D. Select and use the appropriate lens attachment (1 item)

1. Knowledge of lens modifiers (hoods, polarizing filters, UV filters, neutral density, extension tubes, etc.)

EXPOSURE AND METERS (18%)

Items measuring this set of specifications will include (1) how to meter for the correct exposure; and (2) the relationship between shutter speed and f-stop.

A. Employ a light meter properly to achieve desired exposures. (6 items)

1. Knowledge of proper use of incident, reflective or spot meters
2. Knowledge of the conditions under which meters should be used
3. Knowledge of how to interpret light meter readings

B. Set f/stops and shutter speed based upon exposure and desired effects. (8 items)

1. Knowledge of relationship between shutter speed, f-stop and ISO to produce the desired result
    - f-stop for depth of field,
    - shutter speed for stop action,
    - dragging shutter,
    - control of noise or grain
2. Knowledge of equivalent exposures
3. Knowledge of exposure compensation relative to lighting situations (light absorption and reflection values, skin tones)

C. Verify proper exposure. (4 items)

1. Knowledge of how to use a gray card to achieve exposure value
2. Knowledge of how to read and interpret a histogram

LIGHTING (28%)

This portion of the examination will measure (1) how to best light the subject; (2) possible types of lighting (Studio, Ambient, Flash, Daylight); (3) lighting design; and (4) lighting equipment.

A. Evaluate the lighting options to determine the tools necessary to complete the assignment. (4 items)

1. Knowledge of various light sources and light equipment to created desired effects (electronic flash/strobe, continuous, natural/ambient)
2. Knowledge of how to use remote triggering (infrared, photosensitive, or radio)

B. Determine the lighting ratio. (3 items)

1. Knowledge of establishing desired lighting ratios

C. Understand light modifiers (light blockers, black reflectors, gels, spots, flags, etc.) and their uses. (3 items)

1. Knowledge of use of modification devices to achieve desired effects (gels, reflectors, umbrellas, soft boxes, parabolics, etc.)
2. Knowledge of additive and subtractive light

D. Determine the type of lighting pattern to be used with the given subject(s). (4 items)

1. Knowledge of soft, hard and diffused light sources for producing desired effects
2. Knowledge of desired light pattern effects (broad, short) that can be obtained on different subjects and/or background
3. Knowledge of directing and combining lights (corrective lighting) with different subjects to create desired effects and complement them

E. Determine the appropriate lighting usage (main, fill, etc.) for subject(s). (6 items)

1. Knowledge and placement of main/key, fill, background, accent lights to achieve desired effects (control shadows, create depth, enhance subject matter)
2. Knowledge of techniques for controlling/utilizing light (natural light, window, outdoor, studio, mixed, incandescent, florescent, LED)
3. Knowledge of backlighting for producing desired effects
4. Knowledge of lighting products (reflective, transparent, translucent, opaque)
5. Knowledge of using flash fill techniques (indoor and outdoor; Sunny 16 rule, basic daylight exposure)
6. Knowledge of on-camera and off-camera flash techniques (TTL, high speed sync, and manual)

F. Understand the theory of light. (6 items)

1. Knowledge of the light spectrum, color temperature and color balance
2. Knowledge of the properties of reflectance (angle of reflectance equals angle of incidence, influence on color, etc.)
3. Knowledge of the properties of light (fall-off, size of light source, depth of light, inverse square law, distance to subject, etc.)

G. Select the appropriate filter/gel for color correction of the light source. (1 item)

1. Knowledge of filters and gels used for color correction

H. Use lighting techniques as composition and design elements (1 item)

1. Knowledge of how to coordinate composition and lighting to create the desired effect
2. Knowledge of the use of gels, grids to alter the relationship among subjects or products.

Test Specifications

COMPOSITION AND DESIGN (19%)

Items relating to this area will focus on the following topics: (1) Subject placement within image area; (2) Special effects, including props; (3) location; (4) clothing; (5) color harmony/color wheel; and (6) coordination of background and subject.

A. Determine the best color relationship to complement subject(s) to achieve the desired effects. (4 items)

1. Knowledge of color harmony, interactions, and effects in order to coordinate subjects with backgrounds and enhance the final image
    - Tonal values and hues
    - Contrast
    - Saturation of color
    - Effect of patterns
2. Knowledge of the color wheel
    - Primary
    - Secondary
    - Tertiary
3. Facets of color:
    - Warm.
    - Cool,
    - Bright,
    - Light,
    - Dark
    - Recede (cool/dark) versus Project (warm/light)

B. Analyze the natural environment to complement subject(s) to achieve the desired effects. (4 items)

1. Knowledge of how to adapt to the environment (understand the environment to achieve a photographic advantage)
    - Color harmony
    - Patterns
    - Subject placement
    - Direction of lighting
    - Distractions
    - Balance

C. Frame or crop the picture within the camera's viewfinder. (2 items)

1. Knowledge of cropping pictures to create desired effects
2. Knowledge of aspect ratios

D. Use angle of view to produce the desired effect (mood, power, size, strength, etc). (6 items)

1. Knowledge of perspective effects and how to achieve these effects (perspective, camera angle, camera position)
2. Knowledge of the elements of composition that create different effects (Rule of thirds, leading lines, positive/negative space, etc)

E. Position subject(s) with selected background, special effects, and props to achieve the desired effect. (3 items)

1. Knowledge of how to compose the elements within a scene to create the desired effect
2. Knowledge of using props as complementary accessories to the subject matter
3. Knowledge of how to achieve what the client desires – scenarios

DIGITAL POST PRODUCTION (13%)

Items measuring this specification will include: (1) color space; (2) file formats and resolution; (3) color management; (4) digital manipulation and (5) storage. Basic knowledge of post-production software will be necessary.

A. Understand the best color space in which to work. (2 items)

1. Knowledge of color spaces (RGB, CMYK, SRGB, Adobe RGB, Pro Photo RGB)
2. Knowledge of color space for printing and reproduction

B. Select appropriate file format. (2 items)

1. Knowledge of file formats (TIFF, DNG, JPEG, EPS, PSD, PNG, GIF, RAW, etc)
2. Knowledge of PPI versus DPI

C. Create/employ a color management system. (3 items)

1. Knowledge of monitor calibration and viewing characteristics
2. Knowledge of color/ICC profiles

D. Select appropriate file management and archival systems. (2 items)

1. Knowledge of back-up/archive media
2. Knowledge computer operations (RAM, storage, SSD)

E. Manipulate digital images (4 items)

1. Knowledge of available techniques to manipulate digital images (exposure, color correction/balance, adjusting levels, details, dodge & burn, etc.)
2. Knowledge of cause and effect in the manipulation of digital images

IMAGE CAPTURE, AND OUTPUT (10%)

Items included in this section will measure knowledge of image capture and output options.

A. Select the appropriate format for final job requirements. (4 items)

1. Knowledge of file size relative to enlarging capabilities
2. Knowledge of appropriate selection of capture file format (JPEG, RAW)

B. Identify and correct problems in images. (2 items)

1. Knowledge of possible problems in image capture (white balance, dust spot on chip, flash synchronization, etc.)
2. Knowledge of how to correct problems in image capture (white balance, moiré, noise reduction, lens flare, sharpening, chromatic aberration, etc.)

C. Output/Print image to desired medium. (4 items)

1. Knowledge of file sizes relative to final output
2. Knowledge of the necessary instructions (use of cropping guides, monochrome vs color preference, etc) to provide the lab
3. Knowledge of the different output devices relative to the reproduction requirements (scanning, printer, web, printing press)
4. Knowledge of resolution required for output (ink jet, photo lab, Dye sublimation printers, and web, etc.)
6. Knowledge of archival processes for printed images

CAMERA, LENSES AND ATTACHMENTS (12%)

Items relating to this category will include digital and film cameras as well as the various lenses, menu settings and attachments that might be utilized on either type of camera.

A. Select the appropriate camera for subject matter and output requirements. (3 items)
1. Knowledge of the types and specifications of digital cameras appropriate for photographic assignments (file size, sensor size, sensor type, DSLR, mirrorless)

Digital Camera Selection and Sensor Size

Selecting the appropriate camera for an assignment is based on how the finished image will be used and the size of the digital sensor that will be required to produce an appropriate file size for that assignment.

Sensor Size & Quality

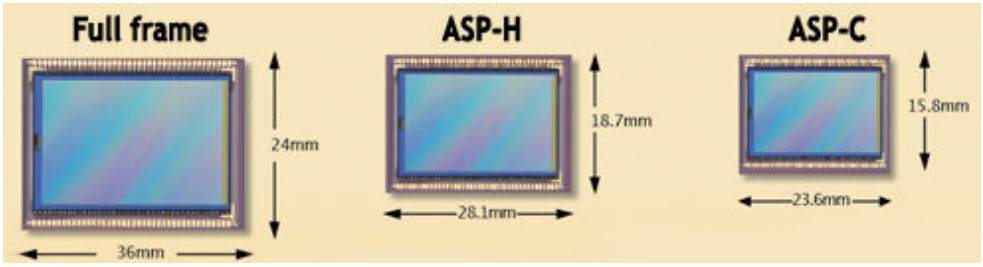
The sensor records image data. Because of the relationship of image quality and resolution with the file size produced from the various sensors used to capture images, the photographer should have an understanding of which cameras are appropriate for certain photographic assignments.

The larger the finished image is to be presented, the larger the native file size should be to render those images with appropriate resolution. Photographers may be called on to create images for everything from websites to images that will be printed very large and over-sized.

Generally, today's digital cameras are manufactured with sensors that can be classified into four size categories: Cropped, Full Frame, Medium Format and Large Format.

Cropped Sensors - These are the smallest of the sensor sizes and include most compact, point and shoot cameras as well as many entry level or "pro-sumer" digital SLR's. These may also be referred to as APS-C or ASP-H sensors.

Web only images and smaller photographic prints and albums are easily handled with the cropped sensor cameras.



Full Frame Sensors - These are the class of digital SLR's that feature a sensor that is same size as the traditional 35mm film frame.

Full frame sensors are well suited for larger wall portraits and 4 color printing for brochures and magazines.

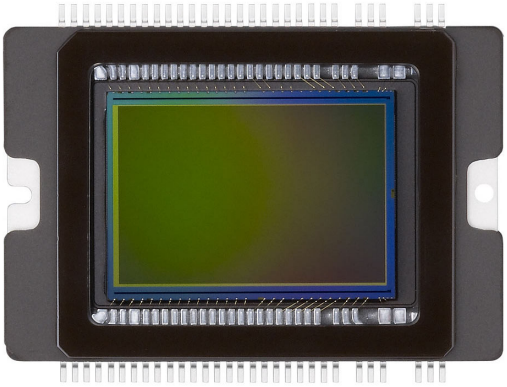
Most wedding and event photography is appropriately captured with a cropped or full frame sensor camera, but a high end portrait or commercial studio that specializes in large wall portraits (40"x50" and larger) or high end commercial printing may require the high resolution created with files from a medium or large format cameras.

Medium Format - These cameras are represented by those cameras which utilize a sensor that is larger than 35 mm, and smaller than 4x5 inches. These sensors are sized according to traditional “medium format” film sizes and include sensors that are 6 cm x 6 cm, 6 cm x 7 cm, and 6 cm x 4.5 cm

These cameras are ideal for high end, large format printing and more demanding 4 color printing jobs of commercial images for trade shows, posters and billboards.

Large Format - These cameras capture images with film or a digital sensor that are 4 inches by 5 inches or larger. They are used for jobs requiring very large prints or graphics with very fine detail. For example, a commercial client wishing to place 10ft x 20ft images in airports of a line of fine watches may require the detail and sharpness that can only be captured by large format sensors.

Sensor Types



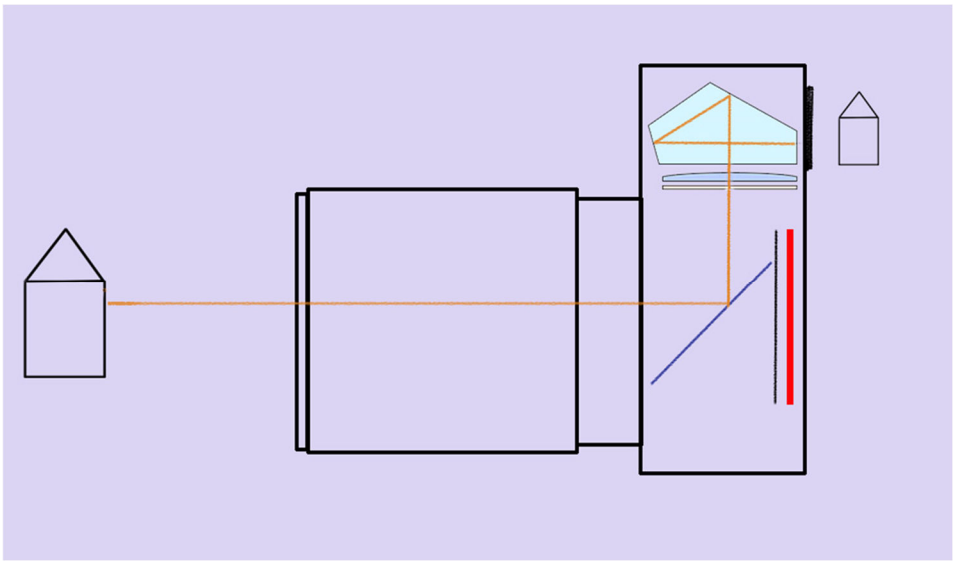
The two most common sensor types in today’s digital cameras are CMOS (complementary metal-oxide semiconductor) and CCD (charge-coupled device) sensors. Both sensors **convert light into electrons**, but they have their own unique characteristics.

- CMOS sensors may be more susceptible to noise.
- The light sensitivity of a CMOS chip tends to be lower.
- CMOS traditionally consumes little power.
- CCD sensors create high-quality, low-noise images.
- CCDs tend to consume a lot of power—as much as 100 times more power than an equivalent CMOS sensor.

CMOS sensors are used in most of today’s full frame and cropped frame digital cameras. Traditionally, they are of lower quality, lower resolution and lower sensitivity than CCD’s, however, technical advances have improved them greatly. They are generally used to help keep the costs of the camera down and they have great battery life.

CCD sensors tend to be used in higher end medium format and large format cameras and video cameras that focus on high-quality images with lots of pixels and excellent light sensitivity.

DSLR



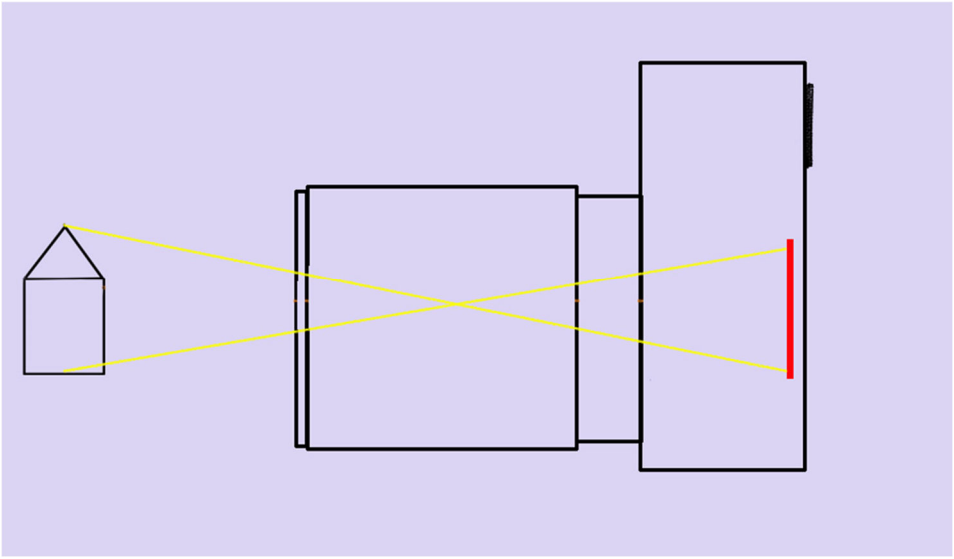
The Digital Single Lens Reflex cameras are modeled after the generation of 35mm film cameras.

With this design, light passes through the lens and onto a mirror which reflects the image up onto a prism and then through the eye-piece.

Because the mirror is located in front of the sensor (or film), it must flip up and get out of the way during an exposure.

This movement creates a degree of noise as well as vibration as the mirror goes up and back down.

Mirrorless Cameras



With a mirrorless camera, the light passes through the lens directly onto the camera sensor which provides a live preview image directly to the rear screen or an electric viewfinder.

This allows you to see the image exactly as the camera “sees” the image and how it will be recorded. Check your manual to see how to activate this feature.

Mirrorless cameras eliminate the bulk and weight of a DSLR by replacing the mirror and optical viewfinder. Without the mechanical movement of a mirror, they are is also quieter than a DSLR..

File Size

Digital images are made up of tiny points known as “pixels”. The word “pixels” comes from combining the words "**PIC**ture **EL**ement." The number of pixels in a digital image is a product of the camera’s sensor. Larger sensors create more pixels and therefore, higher “resolution” images. The higher the resolution, the more detail can be reproduced within the image.

Resolution

Suppose you were asked to draw a picture of a face using only dots. If you were only allowed 1000 dots, your picture would not have a lot of detail—especially in highly defined areas such as the eyes. If, instead, you were able to use 1,000,000 dots, your drawing would have much more detail and be better defined. The difference is that having 999,000 more dots gives your image much more resolution.

The resolution of any digital image is defined by the number of pixels per inch. Since digital images are made up of these tiny points (pixels), images with a higher pixel count per inch provide more detail than images with less pixels per inch.

A “megapixel” is one million pixels. A camera that generates a 16 megapixel file will have a higher resolution than a camera that generates a 4 megapixel file because it has 12,000,000 more pixels to use in rendering the image.

Let’s take a look at a few generalities of file sizes:

- Higher megapixel files will produce higher quality images than lower megapixel files.
- Smaller images do not require very large files to produce acceptable quality.
- Images for the web do not require large file sizes.
- Larger file sizes can produce larger images with less decline in quality.
- Larger images benefit from larger file sizes.
- Images that will be printed by a 4-color press generally benefit from larger file sizes.

Bit

A “bit” is a single unit of digital information which can be represented as either a “0” or a “1”. So in effect, one bit can generate two values. (0 or 1)

With two “bits” (2x2), four distinct values can be generated: (0-0, 0-1, 1-0 or 1-1).

Byte

A “byte” consists of 8 “bits”. Eight bits 2^8 (2x2x2x2x2x2x2x2) creates 256 values, so in the realm of digital imaging, 8 bits can generate 256 tonal values. Sixteen bits generates 65,536 tonal values.

Bit Depth

Bit Depth (bits per pixel) is the precision to which a pixel can specify color. For example, a sensor that records at 8 bit values for Red, 8 bits for Green and 8 bits for Blue (RGB) means there are 256 possible values for each of the Red, Green and Blue channels. When you multiply that out, (256x256x256) the sensor is capable of creating 16,777,216 color values at 8 bit depth. A camera that records three colors at 8 bits each, generates a 24 bit image.

JPGs render color at 8 bits per color. This means when you use your camera in JPG mode, your camera processes the file with 16.7 million colors.

In RAW format, DSLR cameras usually capture in 12 or 14 bits for each color. This dramatically increases the number of colors (billions) that the camera can capture. A camera capturing a 12 bit RAW file captures 68.7 **billion** colors - far out preforming the JPG capture. RAW capture provides the photographer much more latitude for color adjustments compared to JPG capture.

Increasing the bit depth also increases the size of the digital file. Resolution and bit depth determine the total file size.

Dynamic Range

One of the considerations in selecting a camera is the dynamic range of the sensor. The dynamic range represents the camera’s ability to record the darkest values and the lightest values of a scene, with detail. The wider the dynamic range, the more distinct the separation of the various darkest and lightest values there will be.

The dynamic range is the ratio between the lightest (highest) and darkest (lowest) values. (lightest values/darkest values)

When it comes to the perception of these values, camera sensors, computer monitors, printers, photographic prints and even our eyes have their own unique dynamic range.

When the dynamic range of a scene exceeds the recordable dynamic range of the camera sensor, detail may be lost in the shadows or highlights. Overexposure will cause a loss of highlight detail and underexposure will cause a loss of detail in the shadows. That is why proper exposure is so important.

B. Select the appropriate lens based upon size and distance of subject matter as well as desired perspective. (5 items)

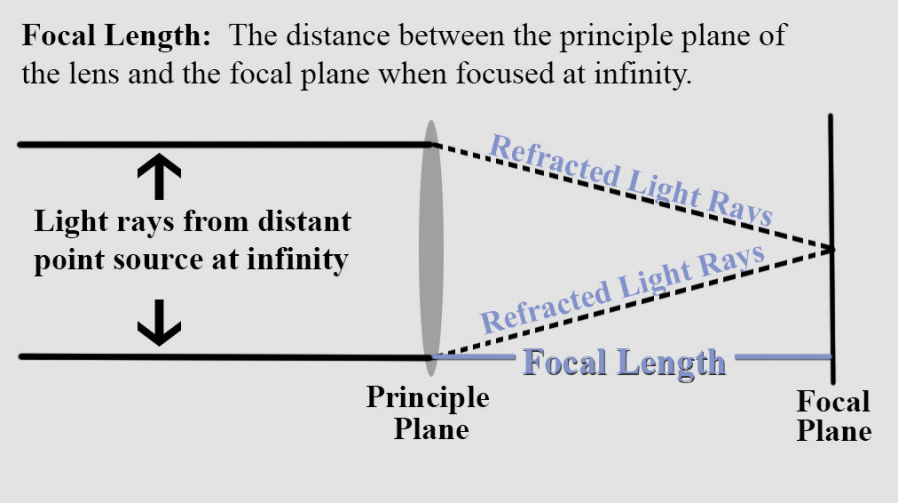
1. Knowledge of the types of lenses and their impact in terms of different effects

Lens Selection

We really begin to realize the creative potential of photography when we understand the wide array of lens options that are available and how lens selection impacts the way an image is recorded.

Focal Length

Focal length is defined as the distance between the principle plane of the lens to the focal plane (sensor plane) when focused at infinity.



The illustration right represents a simple lens and parallel light rays captured from an infinitely distant point. When the light rays pass through the principle plane, they are refracted and redirected. The plane at which these rays intersect is the point where the light rays are focused to a single point, or “focal point”.

Our cameras use complex lenses instead of simple lenses, but the idea is the same. The light passes through a number of lens elements and is refracted to the sensor plane (focal point) where the light is recorded. The distance between the principle plane and the focal plane (when focused at infinity) is the focal length. The focal length of lenses used with DSLRs are usually expressed in millimeters (mm) because the diagonal measurement of the sensor is also measured in millimeters.

Prime or "fixed" lenses have a single focal length. Common prime lenses include: 28mm, 50mm, 85mm, 135mm, 200mm and 500mm. The advantages of prime lenses is they tend to be sharper and often have larger aperture openings than zoom lenses.

Normal Lens

The term, "normal" lens refers to a lens that records a scene with a field of view that is similar to the way the eyes see a scene. There is little or no magnification or expansion of the image.

The focal length of the normal lens is approximately the same millimeters as the diagonal measurement of the sensor in millimeters.

In the chart at right, notice how the "normal lens focal length" is approximately the same as the "sensor diagonal" of each of the sensor (film) formats.

Film format	Sensor diagonal	Normal lens focal length
APS C	30.1 mm	28 mm
APS H	33.5 mm	35 mm
135, 35mm	43.3 mm	50 mm
120/220, 6 × 4.5 (645)	71.8 mm	75 mm
120/220, 6 × 6	79.2 mm	80 mm
120/220, 6 × 7	88.1 mm	90 mm
120/220, 6 × 9	101.0 mm	105 mm
120/220, 6 × 12	125.0 mm	120 mm
large format 4 × 5	150.2 mm	150 mm
large format 5 × 7	208.0 mm	210 mm
large format 8 × 10	312.5 mm	300 mm

With a DSLR camera, the **"full frame"** sensor is the size of the traditional 35mm film frame. **Cropped** sensors such as the APS-C and the APS-H are smaller than a full frame sensor.

On a full frame sensor (35mm), the 50mm lens is considered to be a "normal" lens. On an APS-C cropped sensor camera, the 28mm is a "normal" lens. (Any focal length close to the diagonal size is considered "normal", so a 45mm lens on a full frame sensor would also be considered "normal".)

Wide-angle lenses

Any lens with a focal length smaller than the normal lens for that particular format is considered to be "wide-angle". This type of lens records a "wider expanse" than the normal lens. For cameras with full frame sensors, common wide-angle lenses include 35mm, 28mm, 24mm, 14mm. These "expand" the view as recorded by a normal lens.

Wide-angle lenses are the perfect choice for photographing indoors where space is limited, or for photographing larger groups and is a great choice for landscape and scenic photography.

In general, a wide-angle lens has a tendency to distort horizontal and vertical lines, especially on the "wider" wide-angles. For example, straight lines may appear to "bend" a bit with a wide angle lens.

Wide-angle lenses inherently have a large depth of field, so backgrounds and foregrounds almost always appear sharp when focused even a few feet out.

Wide-angle lenses can be used to exaggerate the difference in size or distance between a subject and elements in the foreground or background. Objects closer to the camera will appear larger than objects in the background which appear smaller and further away.

Generally, avoid using wide-angle lenses for close-up photographs of people. Distortions of facial features created by from using this lens can be very unflattering.

Telephoto Lenses

Lenses larger than the normal lens are considered to be telephoto lens as they begin to magnify the image compared to what is seen with the naked eye. Common telephotos are 85mm, 135mm, 200mm and 500mm. A 100mm lens magnifies the image size by about twice

the size compared to a 50mm lens. The image at 200mm is magnified about 4 times larger than the same image if taken at 50mm.

Telephoto lenses visually bring objects that are far away, closer. This is the ideal lens for wildlife, sporting events, and other situations where you cannot get very close to the subject.

Telephoto lenses can be used to “compress” objects in the foreground and the background with the subject, making them appear closer together than they really are. (see page 23)

They are also an excellent choice for “people” photography. Telephoto lenses have a shallower depth of field than a normal or a wide-angle lens. This helps the photographer eliminate background distractions when taking portraits. The larger the focal length the shallower the depth of field.

The larger the focal length, the more difficult it is to hold the camera steady. This is because larger focal lengths not only increase the magnification of the image, they also increase the magnification of movement. A sturdy tripod is invaluable, especially in low light.

Tips:

- *To hand-hold a telephoto lens, you should use a shutter speed at least equal to the focal length of the lens. For example, a 100mm lens will require a shutter speed of 1/125 to hand-hold with reasonable sharpness. A 200mm lens requires 1/250 to hand-hold. (see page 51)*
- *Use higher ISO’s to achieve faster shutter speeds when hand holding.*

Zoom lenses

Zoom lenses cover a range of focal lengths. They combine a minimum and a maximum focal length and provide all of the focal lengths in between.

The advantages of zoom lens include the fact that you have a range of focal lengths in one lens. This also gives you the ability to crop in the camera. The photographer can easily tighten the crop around a subject or compose the image with more space around the subject with out having to step forward or backward.

Zoom lenses may not be quite as sharp as “fixed” lenses and may not provide very large maximum lens openings, making them less effective in low light.

The largest aperture value of a zoom may be **“fixed”** which keeps the exposure consistent throughout the zoom. However, many less expensive zooms have a **“variable aperture”** which changes the aperture automatically when the lens is set to the largest aperture and the lens is zoomed to larger focal lengths. For example, a 3.5-5.6 variable aperture 70-200mm lens will provide the photographer with a F-stop of F3.5 when the lens is at 70mm. When zoomed to 200mm, the F-stop changes to 5.6 as its largest lens opening. This can be very dis-concerting when using the camera in manual and the camera resets the F-stop during the zoom.

Macro Lenses

Macro lenses focus at very close distances to bring out fine details in photographs of very small objects. Macro lenses achieve larger than life size magnification with minimal distortion.

Teleconverters
Teleconverters double or triple the focal length of a lens. With a 2x converter, a 50mm lens becomes a 100mm. A 70-210mm becomes a 140-420mm lens. With a 3x converter, a 50mm becomes a 150mm. The converter mounts to the camera just like the lens and then the lens mounts to the converter.

A 2X converters reduces your effective f-stop by two stops. A 3X converter reduces the effective f-stop by three stops. They also tend to reduce the contrast and sharpness of your images.

2. Knowledge of the limits of lenses (i.e., angle of view)

Angle of View

The focal length (mm) of the lens determines the "angle of view" - or how much of a scene is recorded. (field of view)

Take a look at the illustration at right. Remember, a normal focal length records a scene about the same way our eyes see the scene.

As the **focal length decreases**, the principle plane moves closer to the focal plane and the **angle of view increases**.

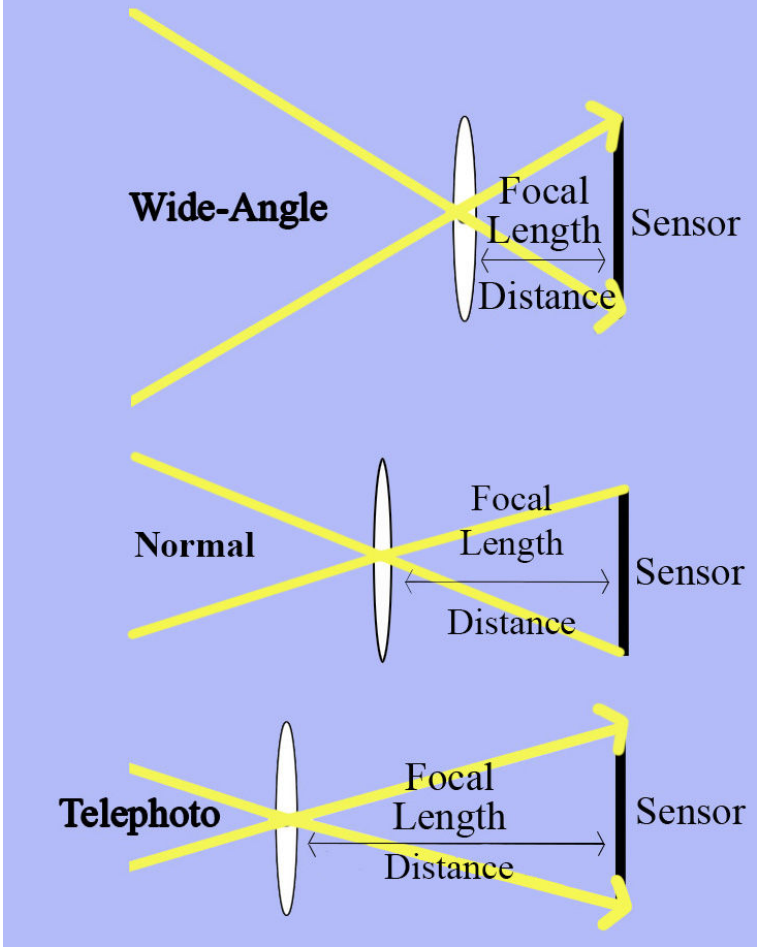
As the **focal length increases**, the principle plane moves further from the focal plane and the **angle of view decreases**.

If you need a little help understanding this concept, try this little exercise:

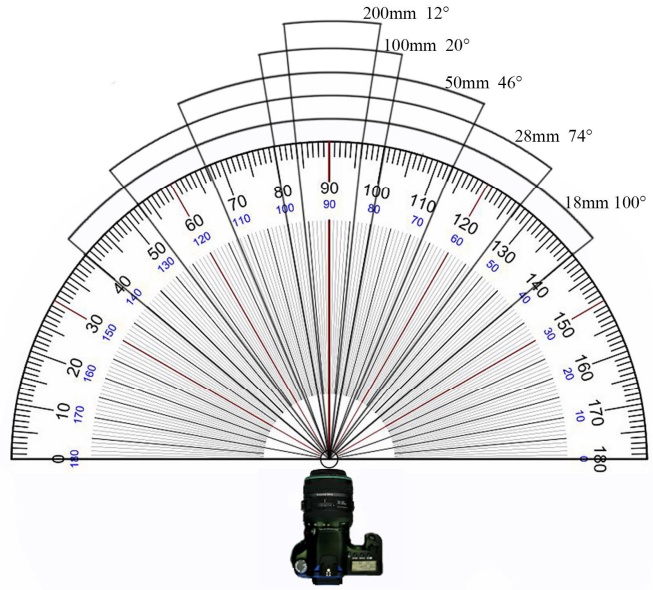
- *Make a circle with your thumb and index finger and hold it out about 6 inches from your eye. Your fingers represent the principle plane. Now, look through the circle of your fingers with the other eye closed and pretend this is the angle of view of a normal lens.*
- *Now, move the circle one inch from your eye. Notice you now have a **wider angle** of view.*
- *Now move the circle away at your arms length. Notice how you now have a **narrow angle** of view.*

(Keep in mind, this is not a perfect analogy - but maybe it helps you to understand the relationship of focal length and angle of view.)

Angle of View: As the focal length decreases, the angle of view increases. As the focal length increases, the angle of view decreases.



Your Vision Is In The Lens You Use!
So much of capturing your vision for any given image is in selecting the right lens. It is helpful to understand how lens selection impacts depth of field and how to change perspective as it relates to your subject.



WHAT YOU SEE AND WHAT YOU GET
We have already seen that the focal length (mm) of the lens determines the "angle of view" - or how much you see in the image.

The illustration at right shows a 50mm lens on a full frame sensor camera captures a 46° view of a scene. A 100mm lens narrows the angle of view to 20°. A 200mm lens captures a 12° view of a scene when used on a full frame sensor.

These images below illustrate the angle of view of focal lengths of at 35, 80, 120 and 200mm. While it is obvious that the bride and groom appear closer at longer focal lengths, look at the images again and note the changes in the angle of view.

Perspective
In the book, **Photography (10th Edition)** by London, Stone and Upton, **"Perspective"** is defined as, "The apparent distance, size and depth of objects within a two-dimensional image." I tend to think of it as the relationships of the foreground and background to the subject.

The fact is, perspective is determined the moment you select a place to stand to take a photograph. The various lenses that you may use at that same camera position captures the scene with a specific angle of view, but they do not change the perspective of the relationship of the subject with the distance, size and depth of the background that you are photographing.

Even when using a zoom lens and zooming through the various focal lengths from wide-angle to telephoto does not change perspective...unless you MOVE!

It is the camera position that determines perspective. Take a look at the images below.

The image on the left was taken at 35mm and the image on the right with a 70mm. I did not move, I simply zoomed the lens.

The image at right is the SAME IMAGE as the image taken at 35mm above. I simply cropped it to the same crop as the 70mm image. Notice, the perspective did not change!

Changing focal lengths without changing camera position does not change camera perspective or even the relationship of subject to background. It only changes the angle of view.

Zoom With Your Feet
To change perspective means to change camera position. Moving higher, lower, closer and further all change perspective.

It is often said that telephoto lenses "compress" the background and wide-angle lenses create distance in the background. As we saw on the previous page, that was not the case. If you photograph a subject with a normal, wide-angle and telephoto focal length and do not change distance, the perspective is the same in all three. However, if you take an image with a normal lens, then compose the subject with the exact crop by moving closer and using a wide-angle lens, there will be a noticeable difference in the relationship of the subject to the background. The background will appear smaller and further away.

If you then compose the subject in the same crop by backing up and using a telephoto lens, the background will appear much larger and closer (compressed) to the subject. (see page 23)

In the workshop images at right, we can see the change in perspective from changing camera position. The top image was created with a 28mm lens. Notice the size of the brick column behind the first group of three. Also note the relationship of the size of the foliage in the background with the over-hanging tree branch.

In the bottom image, I kept the same crop, but I backed up several yards and used a 60mm focal length. Notice how much larger and closer that brick column is now compared to the previous image. Then take a look at how much larger the bushes and trees are in the background as they relate to that over-hanging branch. Now we see that zooming with the feet changes perspective.

Using Compression

We have just seen that moving further from the subject and using a telephoto creates compression - or elements in the foreground and background appearing closer in relation to the subject. The longer the focal length, the greater the compression and the closer the subject appears to be to the background.

This is especially helpful when you are dealing with a large background element which is important to the scene. By working farther away from the background and working with a telephoto lens, the photographer is able to scale a very large background to an appropriate size as it relates to the subject.

For example, in the image at right, I was able to scale the size of the lighthouse as it relates to the family by moving the family further away from the lighthouse and using long focal length (telephoto).

How much different would this image have been if I had posed the family at the base of the lighthouse and taken the image with a wide-angle lens?

Wide angle lenses tend to create distance between elements in the background and foreground in relation to the subject.

The image on the left was taken at 35mm. Depth is created between the building and the bride and the building appears further away.

On the image at right, I backed up and zoomed to 70mm. Compression makes the building look closer to the bride than it really is.

Controlling the angle of view allows the photographer to use the best parts of a given scene.

GET RID OF DISTRACTIONS
The wider the lens, the more is included in your images. I prefer to control what is included in my images through lens selection.

The image below shows a nice background, but I hate seeing the bright sky in the upper corners. Since the eye goes to the brightest area of a dark image, the bright sky pulls the eye away from the subject.

The image on the right allows me to take the best part of that scene and include only the area that best suits my composition.

3. Knowledge of how to control distortions created by height, distance, and angle of camera relative to subjects

Controlling Distortion

There are different types of distortion caused by different lenses. Some distortions are actually useful to the photographer and can be used to help convey the story the photographer wishes to tell.

Other types of distortion can be a nuisance and the photographer will need to know various ways to eliminate or minimize the distortion caused by specific lenses.

Convergence
Tilting the camera upwards to photograph a tall building tends to exaggerate the building as wider at the bottom and narrower at the top. This effect is known as “convergence” or “keystone”. This effect is exaggerated with a wide-angle lens. This problem is not a distortion caused by the lens, it is actually a distortion of perspective.

To minimize this effect, the photographer must control the camera perspective and keep the film plane (sensor) parallel to the building. This requires creating enough distance from the building to capture the entire building from top to bottom without tilting the camera upwards.

In the image at right, the subject's location in relation to the building and the fountain made it impossible to capture the entire building without the camera tilting upwards. The result is the convergence of the lines of the building at the top.

This problem can also be remedied with view cameras or **tilt -shift lenses** that can control perspective. A **tilt-shift lens**. on a DSLR can be **shifted** upwards while leaving the camera, and therefore the sensor plane, parallel with the subject. This can also be done easily on traditional view cameras as they also have the ability to "tilt" and "swing" while keeping the film plane parallel to the subject.

Another way to control this "distortion" is in an image editor such as Photoshop.

Camera Angle
To minimize subject distortion, the position of the camera is relative to the subject height.

For a full-length pose, the camera should be placed near the level of the subject's waist and the lens should be level with the ground.

For standing poses cropped to a 2/3 length, position the camera near the level of the subject's chest and with the lens level to the ground.

For head and shoulders poses, position the camera slightly above the subject's chest level and with the lens level to the ground.

4. Knowledge of the effects of depth of field based on f-stops

Depth of Field

Depth of field is defined as “the area in a photograph that will be in acceptable focus.” Simply put, depth of field determines the relative sharpness or lack of sharpness in the background (and the foreground) in relation to the subject.

Depth of field is a measurable distance. Approximately one-third of the total distance extends forward towards the camera at the point of focus and two-thirds extends behind the point of focus. For example, with a subject focused at 10 feet with a 9ft depth of field, the photographer can anticipate relative sharpness between 7 to 16 feet. (3ft in front, 6ft in back)

Shallow Depth of Field

A shallow DOF means that the background and the foreground will appear more out of focus.

The image at right was taken at F2.8 and has a shallow depth of field. Notice how the background is quite out of focus.

This technique allows the photographer to place the emphasis on the subject without distractions from the background.

Large Depth of Field

With a large DOF, the background and the foreground appears sharper or more in focus.

The image at right was taken at F16 and has a much larger depth of field. A larger depth of field is useful in when elements in the background are used as part of the overall composition.

There are three things that control depth of field:

- F-stops
- Camera-to-subject distance
- Focal length of the lens

Controlling the depth of field allows the photographer to "soften" or “sharpen” the background to the degree that is desired for the specific image. A shallow depth of field helps to put emphasis on the subject and may help to eliminate unwanted distractions.

F-Stops

The f-stops not only control the amount of light that reaches the sensor, but they also control depth of field.

The larger the lens opening, the shallower the DOF
The smaller the lens opening, the greater the depth of field.

Camera-to-Subject Distance

The camera-to-subject distance has a pronounced impact on depth of field.

The closer the camera is to the subject, the shallower the DOF.
The further the camera is to the subject, the greater the DOF.

Focal Length

There are inherent tendencies in lens selection to depth of field.

The longer the focal length of the lens, the shallower the DOF.
The shorter the focal length of the lens, the greater the DOF.

Calculating Depth of Field

This task was much simpler in the days when lenses had a depth of field scale etched into the barrel of the lens. With many of today’s modern zoom lenses used on so many cameras of varying sensor sizes, the depth of field scale has virtually vanished.

There are a number of online DOF calculators (http://www.dofmaster.com/doftable.html) and some printed charts available which are camera specific, but the easiest way to calculate DOF these days is with a helpful smart phone app. (I use **Depth of Field Calculator BY Essence Computing.)**

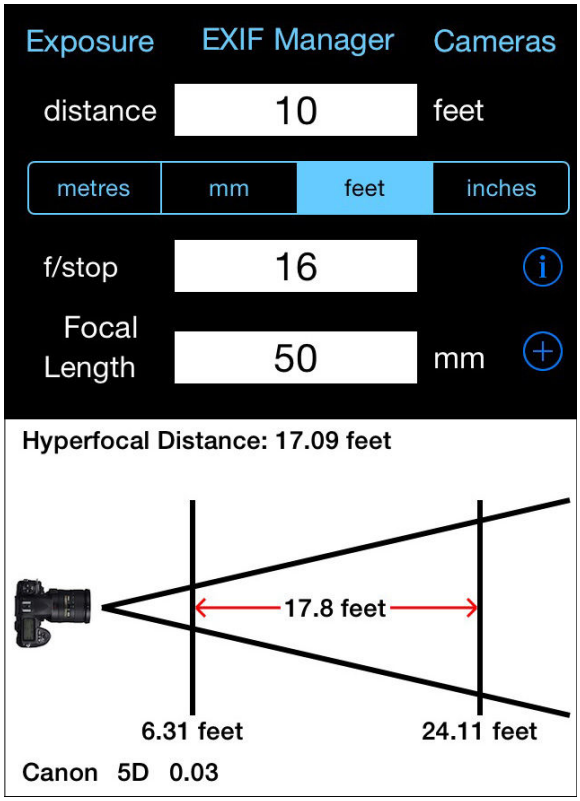
5. Knowledge of hyperfocal distance

Hyperfocal Distance

To maximize the sharpness of the background, photographers will sometimes manipulate the point of focus in order to take the focus of the background to infinity. By definition, hyperfocal distance is the closest distance of focus in which a lens will keep objects at infinity acceptably sharp. The hyperfocal distance provides the photographer with a point of focus to achieve the largest possible depth of field by keeping infinity within the furthest range of a given f-stop.

Again, the task of determining this distance was much simpler in the days when lenses had a depth of field scale. Hyperfocal distance varies with each focal length, f-stop and sensor size, so it is much easier to use my **Depth of Field Calculator BY Essence Computing** app.

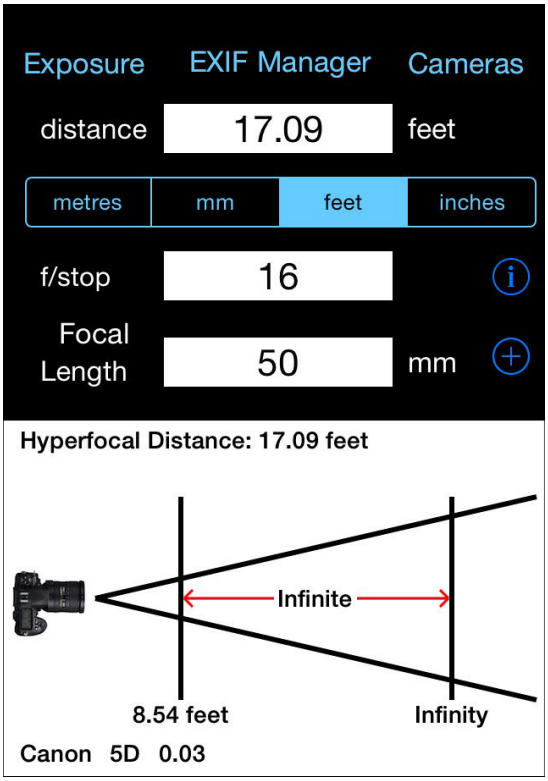
The idea is to increase the depth of field by actually focusing past the subject while ensuring that the subject remains in the area in front of the point of focus and still appears sharp.



For example, with an image exposed with a 50mm lens at F16 using a full frame sensor, the subject at 10ft has a depth of field of 17.8ft. (left)

The result shown on the chart indicates a total depth of field of 17.8ft and the elements which are between 6.3ft and 24.1ft would be in acceptable focus. It also reveals the hyperfocal distance to be 17.09ft.

Knowing that the subject is at 10ft, I can use the app to input the resulting hyperfocal distance of 17.09 and see the change in depth of field. (right)



Now we can see that the nearest point of acceptable focus is at 8.54ft, and the background focus has increased from 24.11ft to infinity. That is an infinite gain in depth of field! I can also see that my subject at 10ft is still within the range of acceptable focus.

This technique is quite popular among landscape photographers, but it also has applications for all types of photography.

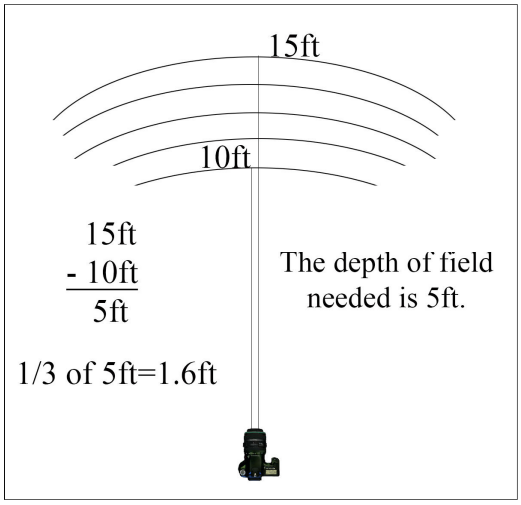
CPP Study Guide
by Steve Kozak

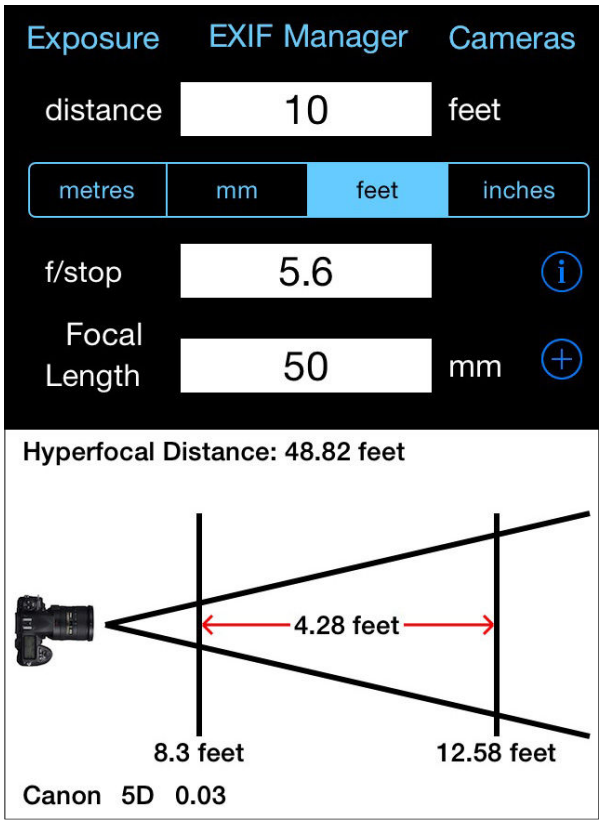
For example, let's look at photographing a choir that is arranged in 5 rows using a full frame sensor and a 50mm lens at F5.6

The front row is 10ft from the camera and the back row is 15ft from the camera.

If you calculate the difference in the distance between the two rows, you get 5ft. We are looking for a DOF of at least 5 feet to keep the front and back rows sharp.

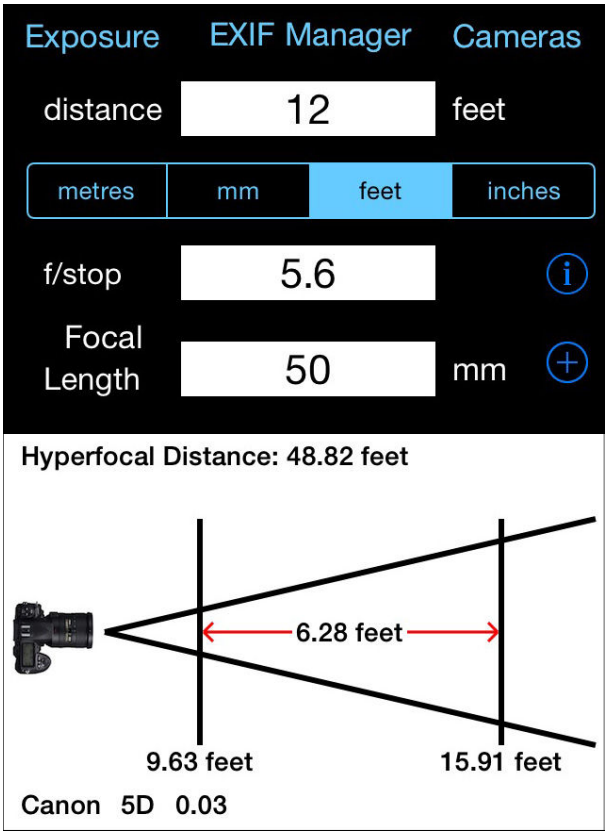
We know 1/3 of the DOF comes forward and 2/3's goes backward, so a depth of field of 5ft has 1.6ft in front and 3.4ft in back.





Using the DOF app at left, we can see that F5.6 focused on a subject at 10ft only provides 4.28ft of DOF and only 2.58ft of that is going behind the first row. The result would be that the back two rows will not be sharp.

Using hyperfocal techniques, we can change the point of focus to 12ft and the first row of the choir at 10ft is within range (9.63ft) and the back row at 15ft is within range (15.91ft). (right)



Cameras, Lenses and Attachments

6. Knowledge of how size of the image sensor influences the magnification of the lens

Digital Sensors - Size Matters!

A lens throws a circular image onto the film/ sensor plane. That circle has to cover the film or sensor from corner to corner.

DSLR cameras are generally offered with “full frame” or “cropped frame” sensors. A full frame sensor will yield an image in the same aspect it would have been recorded on a piece of 35mm film.

Increasing the net focal length of a telephoto lens is sort of cool for telephoto images, but it is sad when you no longer have a wide angle lens at 28mm. The 28mm lens on a cropped sensor with a 1.6 multiplication factor has a similar angle of view as a 45mm lens on a camera with a full frame sensor. For a camera with a cropped sensor, you may consider a wide angle lens designed for cropped sensors. It throws a smaller image circle which renders a wide angle image on the smaller sensor. But beware, these lenses will not move with you to a camera with a full frame sensor as the circle is too small to cover the sensor corner to corner.

A cropped sensor is smaller than a full frame and only records a a portion of the image that would be captured on a full frame sensor.

This has the effect of recording the image with more of a telephoto effect when using the same lens.

A multiplication factor is used to express this telephoto effect. For example, a multiplication factor of 1.6 means a 200mm lens on a camera with a cropped sensor will have the angle of view of a 320mm lens.

C. Use camera, camera menu settings, and camera supports to create a quality image. (3 items)

1. Knowledge of camera controls and settings

Camera Controls

ISO (Also see pg. 47)

The ISO setting controls the sensor's sensitivity to light. The ISO setting also calibrates the camera meter so that it measures the light correctly for the ISO speed.

A recent trend in DSLR's has been the addition of "Auto ISO". Use of this setting basically puts the camera into an automatic mode—even if the camera is set to Manual Mode.

Exposure Modes

Manual (M)
Manual mode is for photographers who want complete control over the F-stop and shutter speed selections. The photographer will determine the exposure by selecting the F-stop and shutter speed and ISO settings based on the desired image capture. In this mode, the camera has no say in determining the final exposure as long as the ISO is set to any setting other than "Auto ISO".

Program (P)
In program, the decision of f-stop and shutter speed selections are totally selected by the camera. The photographer may choose the ISO setting, but the camera makes all other exposure choices.

Aperture Priority (A) (Av)
In this mode, the photographer selects the aperture and the ISO setting, but the corresponding shutter speed is selected by the camera.

Shutter Speed Priority (Tv) (S)
In this mode, the photographer selects the shutter speed and the ISO and the camera selects the corresponding f-stop.

Creative Modes
These so-called "creative modes" are simply glorified program settings that have some specific tendencies in which f-stops or shutter speeds are chosen by the camera based on the creative mode selected. For example, a "runner" icon indicates that the camera will always select the fastest shutter speed in an effort to control motion.

These modes are generally fun for consumers who might choose to use them, but probably have very little value to an educated photographer.

White Balance

This control on the camera is used to correct the color casts that come with photographing in various types of lighting conditions. This control uses a series of several icons to represent various lighting sources and the photographer can simply choose the icon that matches the light source being used.

There are also “custom” white balance options which can be used in tandem with other tools to set the white balance of a given scene.

Some cameras also offer a “K”, or “Kelvin” setting that allows the photographer to be even more selective in how the white balance is controlled. Use of the “K” setting requires the photographer to access the menu to manually choose the Kelvin temperature setting desired.

Focus

While many photographers use the shutter button to activate the camera’s auto focus features, most cameras provide an option to use a button on the back of the camera to activate the focus.

Some photographers elect to use the back-focus feature exclusively and have elected to disable the shutter button from activating the focus. Once the camera is focused with the back button, there is no need to re-focus as long as the camera to subject distance does not change. This allows the photographer to fire rapidly for fleeting expressions and opportunities which might be missed if each image had to be focused.

Deactivation of the shutter button for focus is found in the “Custom Function” section of the menu.

Mirror Lock-up

This control locks the mirror “up” so that it does not move during an exposure. This is helpful for long exposures where vibration of the moving mirror can cause the image to be less sharp.

Menus

There are any number of settings and custom function features within the menu settings. Some of these settings allow a more personalized experience for a photographer’s preferences while some of the other settings impact how an image is recorded.

Quality

This menu function controls the file type (s) and size that will be used to record images. These may include: RAW, JPG Small, JPG Medium, JPG Large, TIF and RAW+JPG options.

Format

This menu function is the preferred method to prepare a memory card for use after all of the previous images have been safely copied and backed up onto your computer.

2. Knowledge of the effects of extreme temperatures or humidity upon operation of equipment

Use of the Camera in Extreme Temperatures and Humidity

While most of us may never take on an arctic expedition, there are still many times our gear is exposed to sub-freezing temps and other weather extremes. Knowing just a few things about these environments will help you survive with your camera in tact.

Cold Temps

The effect on freezing temperatures on your camera are probably minimal. Certainly check your owner's manual or visit a few websites that offer insight into using your camera in extremely cold environments. (http://www.picturecorrect.com/tips/camera-equipment-tips-in-low-temperatures).

One issue you are likely to encounter with cold temps is reduced battery life. Prepare by having extra batteries on hand and keep the batteries charged that you are not using. I also try to keep my spare batteries warm by keeping them in clothing inside my coat. The website, PictureCorrect.com also recommends turning off the shot preview as well as minimizing the half-press pre-focus.

One of the biggest problems for camera use in extreme weather conditions is condensation forming inside the lens, on the sensor and inside the camera body. Condensation can be a problem when you go from cold temperatures to warm temperatures. If you have been in the cold for some time, going indoors and exposing the camera to warm temperatures may cause condensation to form. Give the camera time to warm up and allow the condensation to evaporate before taking it back out so that the condensation does not freeze once it is exposed to the cold.

Warm Temps

You don't have to be in freezing temperatures to experience condensation, either! I once did a beach wedding where I was photographing the bride and her bridesmaids in the air-conditioned villa. As soon as we stepped outside into the warm and humid coastal air, my lens, mirror and sensor hopelessly fogged up and stayed that way for almost 45 minutes. This would have been a disaster had I not prepared for this by keeping another camera and lens outside which was acclimated to the warm temperature and high humidity.

To avoid this situation, try to warm the gear up gradually and not send it immediately into the hot, humid air after it has been indoors or in a car with strong AC.

3. Knowledge of appropriate use of camera supports (tripods, monopods)

Camera Supports
Support of the camera during the exposure is an important consideration, especially at slower shutter speeds or when using longer focal length lenses. There are a number of tools a photographer might consider when additional camera support is desired.

Tripod
The tripod is likely the first choice when it comes to providing camera support and stability. Typically, a professional-grade tripod is nothing more than a base with three legs and an adjustable column for critical height adjustments. With most professional tripods, the actual mechanism that attaches the camera to the legs of the tripod is sold separately. This gives the photographer an array of choices for camera mounting to fit almost every shooting style.

Tripod selection begins with the consideration of the amount of weight the tripod will bear and the weight of the camera, lens and other gear that will be mounted to it. Lightweight tripods seem convenient at first because they are not so heavy to carry around, however, you probably don't want to trade that *convenience* for the tripod's **stability** once the camera is mounted. A heavy camera and lens on a lightweight tripod is a recipe for disaster when the rig becomes top-heavy. Bottom line, match the tripod to your gear's weight.

Tripods are available in a number of alloys and composite materials that make them lighter and more durable. Outdoor photographers who do a lot of hiking may prefer a carbon fiber tripod for its lighter weight and its ruggedness in the wild.

If I am in the studio or in a high traffic area, I just like a heavy tripod for its stability and the fact that it is almost impossible to knock over when accidentally kicked.

A tripod is so much more than just a camera support. I like the freedom that comes with using a tripod. It allows me the flexibility of being able to address the client eye to eye and not having to be hidden behind the camera during the session. I am also free to walk over to the subject and make quick adjustments to hair and clothing. I also like composing my image and then knowing that the composition will remain consistent and that lines within the composition stay straight.

Tripod Heads

There are all sorts of “heads” available for mounting a camera to a tripod. Some heads are designed for shooting video while others are geared towards still cameras. Like tripods, the choice you make should be based partly on knowing it is rated for the weight of the gear that will be placed on it.

I also prefer a head that offers a “quick release” plate which allows for quick removal of the camera for hand-held use and easy return to the tripod when finished.

Monopod

A monopod is another form of camera support utilizing a single post (leg) to take the weight of the camera off the photographer’s hands and arms during the exposure. While providing a great deal of additional stability, it is still not as stable as a tripod. It will also require some sort of head attached to it to allow for vertical compositions if your lenses do not have a tripod mount collar.

Image Stabilization or Vibration Reduction

Some camera systems and some lenses offer Image Stabilization (IS) or Vibration Reduction (VR) options. These systems help to provide a sharper image when using slower shutter speeds where the image might appear blurry if the camera was hand-held and IS or VR was not used. This is a helpful option although it does add considerably to the cost of the lens.

Also, these IS and VR features must be turned off when using the camera on a tripod or other camera support as in these cases, they will actually cause the image to record as blurry.

4. Knowledge of methods used to set white balance
   - White balance target (gray card)
   - Calibration disc (e.g., expo disc)
   - Color temperature

White Balance
We discussed earlier the settings for white balance. Here we will look at some of the methods for determining white balance.

White Balance Target
The most common target is a simple 18% gray card or panel which is photographed under the same lighting conditions as the subject. Set the f-stop and shutter speed to move the camera meter to the center while pointed at the gray card. Take the image then simply view the histogram to ensure the result is a single line near the center of the graph. If it is, then activate the camera's "Custom White Balance" settings and the camera now will be set for color correction under that particular light source. (Image at right shows Digital Target by Photovision.)

Calibration Target
The **x-rite ColorChecker Passport** handles color correction of RAW images in post production - not in the camera. It uses a variety of color swatches that are photographed in the same lighting conditions as the subject. Once the target is photographed, it can be opened with software that is programmed to read the known value of each of those swatches and automatically adjusts each of the subsequent images from those same lighting conditions.

Calibration Disc
A calibration disc works similarly to the white balance target in setting a custom white balance.

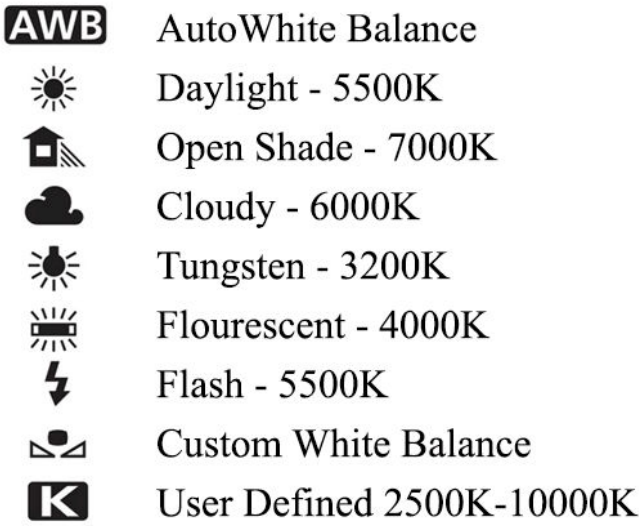
The difference is that the disc is mounted onto the lens and photographers must place themselves in such a way (usually at the subject position) that the light that is falling on the subject is now falling on the disc. Then activate your camera's custom white balance settings. (Image at right shows ExpoDisc 2.0 by ExpoImaging.)

Color Temperature
Cameras that offer a “K” or Kelvin setting allow the photographer to set the white balance manually by selecting the desired color temperature setting based on the Kelvin color temperature scale.

This scale places a numerical value on color which can be measured with a sophisticated color temperature meter for highly accurate settings which may be required for high-end commercial applications and images.

Since color is so subjective to the human eye, and since most photographic situations do not require extremely accurate color reproduction, a little knowledge of the Kelvin scale can prove very valuable to the photographer who does not wish to or need to spend the money on a color temperature meter.

The icons below represent a single color temperature value within the range of Kelvin values for that particular light source.



The chart below provides a range of possible color temperatures from a variety of common light sources. By tweaking the color temp in the camera menu to the light source, the photographer is able to render accurate color. The “K” settings provide almost 80 choices for accurate white balance where use of the icons provide only 6.

Color Temperature	Light Source
1000-2000 K	Candlelight
2800-3400 K	Tungsten Bulb (Incandescent)
3000-4000 K	Sunrise/Sunset (clear sky)
4000-5000 K	Fluorescent Lamps
5000-5500 K	Electronic Flash
5000-6500 K	Daylight with Clear Sky (sun overhead)
6500-8000 K	Moderately Overcast Sky
9000-10000 K	Shade or Heavily Overcast Sky

5. Knowledge of the impact on file size and format (TIFF, JPEG, RAW, etc) on final image

File Size and File Formats
The type and size of the file that is created when the shutter is pressed is controlled by "Quality" settings inside the camera's menu. The choices that are made here have a profound impact on the quality and size of the finished image that can be produced from that file.

RAW
Simply put, a RAW file contains unprocessed data captured by the sensor. This data includes image metadata as well as pixel data. The key here is that a RAW file is not an image file...it is a data file that contains information gathered by the sensor. It is akin to a traditional negative in that all of the image data is contained within the file.

RAW files must be converted or "processed" into image files. Part of the processing includes adjustments to exposure, white balance, tonal ranges, noise reduction and sharpening and more. This conversion takes place in any number of software environments used to make adjustments to the files and then convert them into final image files such as JPG's, Tiffs and more.

The adjustments to RAW files do not actually make any changes to the RAW files themselves. These adjustments are logged and stored in a companion file or "sidecar" file that is created and linked to the RAW file when it edited. These files provide the "instructions" that have been generated for the changes that are to be applied to the RAW file when it is accessed.

Because there are no changes to the RAW file, it is considered a LOSSLESS file in that there is no data loss when the file is accessed and then saved. While the file remains untouched, endless changes can be made to the sidecar files as the photographer chooses countless options for finishing the image. As each interpretation is completed, a new image file can be generated.

Capturing your images in RAW format provides you with the entire amount of data that your camera is capable of recording. In other words, a 16 MP camera will provide you with 100% of the data it recorded as there is none of the internal processing and no compression that takes place when shooting in JPG mode. During JPG compression, almost 75% of the image data is discarded for the convenience of "saving space".

Preserving this full range of digital data provides for a wider range of image corrections for exposure, white balance, contrast, saturation, sharpening and more.

JPG
A JPG or JPEG file is a compressed image file. It can be processed and created inside the camera as a part of the image capture process or created in post production inside any number of image editing softwares.

JPGs that are processed in the camera undergo a series of adjustments to contrast, sharpness and color space and more. These settings are applied universally to each image captured according to the camera settings. (RAW processing allows these adjustments to be made individually to each file based on the photographer's desires for that image.)

A JPG is a LOSSY file. Because JPGs are compressed, much of the original data for the image is discarded and lost when the file is compressed into a smaller size. The result is that processing the JPG file does not provide as much latitude for subsequent adjustments in post image editing. JPGs are prone to image artifacts (digital noise) because of the compression.

JPGs do not allow for preservation of individual layers and must be flattened upon saving.

JPGs are often the file type that is used for uploading images to a lab for printing. The compressed file is small enough to upload and download over the internet while still having enough data to create printed images. They are also commonly used as the file type for websites.

RAW + JPG
Many cameras offer a RAW + JPG capture which creates both file types at the time of exposure. This can be helpful in cases where quick access to the image file (JPG) is required but more detailed processing and image preservation (RAW) is desired in the long run.

Using this combination does increase the amount of storage space utilized on the camera's digital storage media.

TIFF
A TIFF file can be Lossy or lossless, compressed or uncompressed. It is frequently used for graphics and photographs as it can preserve layers upon saving for later editing and does not suffer from image artifacts if not compressed when saved. TIFF files are often provided for high quality 4-color printing.

PSD
A PSD file is a Photoshop Document file. It is an uncompressed, lossless file used primarily for image editing as they can be saved to preserve all layers and other image editing features. This is helpful when reopening the file as it retains the editing which can be continued at any time.

DNG
The Digital Negative is a universal format which retains all metadata within the file instead of separate sidecar files. Since RAW formats change frequently, the DNG format is constant and will remain constant and will be accessible for the long term.

D. Select and use the appropriate lens attachment (1 item)
1. Knowledge of lens modifiers (hoods, polarizing filters, UV filters, neutral density, extension tubes, etc.)

Lens Modifiers

Lens Hood
A lens hood or lens shade is used at the end of the lens to reduce the possibility of stray light striking the front of the lens. Using a hood helps eliminate unwanted lens flare.

Polarizer
A polarizer is a popular filter because it has several benefits to the photographers. A polarizer may be linear or circular. A circular polarizer is the better choice for lenses which utilize the auto-focus features of a DSLR.

A polarizer is something of a screen that is built on a mount so that it can be rotated to provide a greater or lesser effect as it is turned.

Use of the polarizer can provide increased color saturation and contrast. This is great for landscape and scenic images, but most of this can be handled in post production as well.

A polarizer can also reduce reflections or glare on water and glass and other non-metallic reflective surfaces. A polarizer is often used when photographing other pictures or documents to help cut down the glare.

A polarizer can also be used to darken a blue sky when it can be used with the sun at 90° to the photographer's left or right.

Filters
Filters are used for all sorts or purposes from lens protection to color correction and from image enhancements to creative interpretations. Filters may screw directly onto the lens or mount onto a filter holder which is attached to the lens. In our discussion, we are going to look at a few of the most common filter types and what they provide.

Lens Protection
Two common filters that are used primarily for protecting the front of the lens from dirt, fingerprints and scratches are the Skylight (1A) filter and the UV Haze filter. Both the 1A and the UV Haze filter's absorb ultraviolet rays, eliminating some degree of distant haze in a scene while also providing some layer of protection for the lens.

Placing inexpensive filters on the front of the lens may indeed have a negative impact on image quality as filters are not designed with the precision of a high end lens.

FLD or FLW
These filters are used to correct the color cast of two common fluorescent light sources. An FL-D Fluorescent filter is used when you wish to correct for the greenish tone that appears when shooting daylight film under general purpose fluorescent lighting.

80A or 80B
These dark blue filters are used to balance tungsten lighting to daylight. This removes the yellowish cast that is present when the image is captured unfiltered. The 80A is for lights with a color temperature of 3200K and the 80B is for 3400K photo flood lights.

Neutral Density
A neutral density filter reduces the amount of light that reaches the sensor. It adds no color or effects other than the ability to reduce the shutter speed to create longer exposures or larger lens openings under bright light conditions. ND filters come in values of 1, 2, 4, and 8 stop values and more. They can be combined to reduce the overall exposure as desired. For example, you could combine a 1 and 2 stop ND filter to net a 3 stop reduction in the exposure.

A common use for a ND filter occurs in landscape photography where the photographer wishes to record moving water at a long exposure to "soften" the water. For example, if a scene measures F22 @ 1/8 at 100 ISO, the photographer has likely maxed out the f-stop and ISO options. By adding a 4 stop ND filter, the shutter speed can be reduced from 1/8 of a second to 2 seconds. (1/8, 1/4, 1/2, 1 second, 2 seconds)

Variable Neutral Density
There are also variable Neutral Density Filters. This is a single filter that can be rotated to increase or decrease the density to the desired amount.

Graduated Neutral Density
ND filters may also be "graduated" where the top of the filter provides the neutral density which gradually decreases toward the middle or the bottom of the filter. This is great for photographers trying to capture a scene that is not as well lit as the sky above the scene. The ND has the effect of darkening the bright sky to bring the exposure down closer to the landscape.

Extension Tubes
These are similar to bellows in that they are used to create distance between the lens and the sensor to allow for close up photography. They come in assorted sizes which can be used individually or stacked together to lengthen the distance.

EXPOSURE AND METERS (18%)

Items measuring this set of specifications will include (1) how to meter for the correct exposure; and (2) the relationship between shutter speed and f-stop.

A. Employ a light meter properly to achieve desired exposures. (6 items)
   1. Knowledge of proper use of incident, reflective or spot meters
   2. Knowledge of the conditions under which meters should be used
   3. Knowledge of how to interpret light meter readings

Light Meters

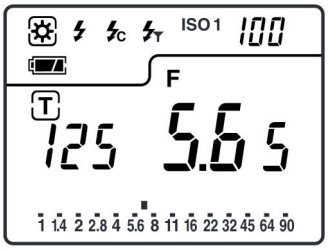
When it comes to measuring the amount of light, there are two types of meters a photographer will use: an "incident" meter or a "reflective" meter. While both meters do measure light, they go about it in completely different ways.

The one thing the meters do have in common is the fact that both of them are calibrated to render a tonal value of "Middle Gray" also known as 18% Gray. (Note: There are some who suggest the value is actually 12% gray, but conventional acceptance of the standard is 18% gray which is what we will accept for the purposes of the CPP test.)

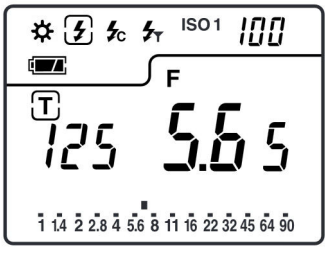
Think of this gray value as the mid point between black and white.

Measuring Ambient Light

Light meters require a bit of input from the user in order to render an acceptable result. First, set the meter into "ambient" mode. Next, input the ISO that you will be using on your camera during the exposures. Once that is set, you then have the option to select a preferred f-stop or a preferred shutter speed. Once have made your choice, the meter will provide you with the corresponding shutter speed if you chose the f-stop, or the corresponding f-stop if you chose the shutter speed.



Once the reading has been taken, you can quickly scroll through all of the "equivalent" exposures to see all of the combinations of f-stops and shutter speeds that can be used under those particular lighting conditions.



Measuring Flash

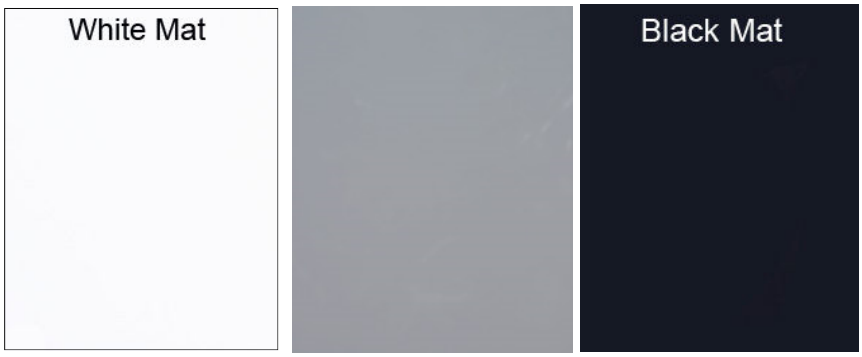
To set up a meter with both ambient light and flash capabilities, be sure to set the meter into "Flash" mode. This is usually indicated by a lightning bolt icon. Some meters also provide modes for connecting the meter to the flash by a cord (lighting bolt w/C) and possibly a mode for firing a flash wirelessly through a built-in or optional transmitter. (lighting bolt w/T)

Input the desired ISO and select a shutter speed. Most of the time, 1/125 is used, but there are situations where a faster speed may be selected to avoid any bright ambient light to influence the meter's reading. Once activated, the meter will provide an f-stop read out.

Reflective Meter
A reflective meter measures the light reflecting from the subject or scene. Allow that to sink in for a moment. A reflective meter does **NOT** measure the amount of light that is lighting the subject...it only measures the amount of light **REFLECTING** from the subject.

For example, if we set up a light to illuminate a white poster board and we use a reflective meter to measure the light, we will get a VERY different meter reading if we were to use a black poster board and the exact same light! Imagine...two different exposures with no change in the light. "Why?", you ask, it is because we are measuring the light REFLECTING off the two poster boards with our REFLECTIVE meter...and white reflects MORE light than black.

If we were to actually take individual photos of the two poster boards using the exposures provided by the reflective meter, we might also be shocked at the result, which is: BOTH images look identical...GRAY. Not white. Not black. 18% GRAY!



Why does this happen? It is because the meter is designed to average the reflected light reaching the meter and provide an "average" of all those tones that will render an 18% gray result.

To add to this explanation, consider this: **the meter inside your camera is a reflective meter!**
This meter "drives" ALL of the exposure decisions that are made by the camera while in Program, Aperture Priority, Shutter Speed Priority and Auto ISO modes.

When you point your camera towards a scene, the meter has no idea if it is looking at trees, grass, the sky, a bride, the sun or the moon. It only knows that there is light reflecting from all sorts of sources throughout the entire scene and its ONLY job is to find the average of all those dark sources, bright sources and all those mid tone values...and give you the average.

So, when you point the camera toward a white card, it does not know if it is white or black, but it does know its job is to deliver...GRAY. When you point the camera towards a black card, again, it does not know if it is white or black, but it does know to deliver...GRAY! That is why a black card and a white card BOTH turn out gray using a reflective meter.

This is about the time we learn that a reflective meter requires a high degree of interpretation. If you are photographing a bride in her white dress on a sandy beach in the middle of the day, chances are your camera meter is turning your bride gray. You, the photographer, have to figure out how to interpret what that meter is doing to you.

You may also elect to use a hand-held reflective meter, but the way it interprets the result is the same as your camera meter.

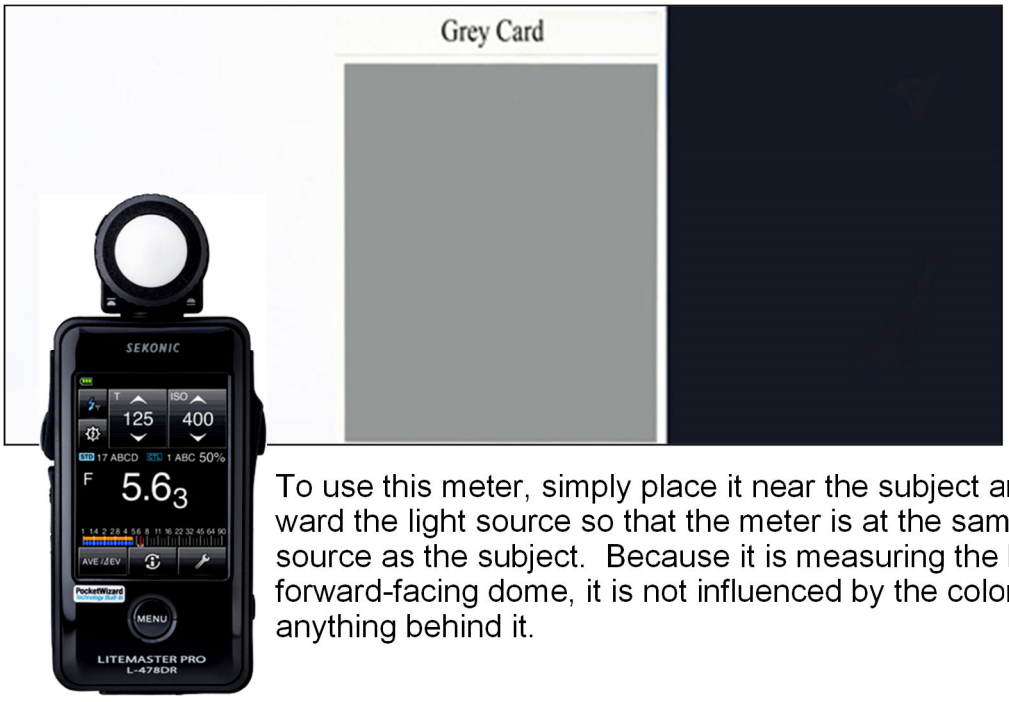
Spot Meters
Some photographers figure out early on that the camera meter averages the entire scene which causes all sorts of problems, so they turn to a spot meter to overcome this problem. A spot meter drastically narrows down the area it will read to render the exposure result. Some spot meters will narrow the coverage to a 1° view. A spot meter may be a hand-held meter, but most DSLRs allow for changing the in-camera meter to work like a spot meter.

While all of this seems like a good idea, you have to remember...IT IS STILL A REFLECTIVE METER. If you point the spot meter to white, you will get gray. If you point it to black, you still get gray. The best hope is to find an area in the scene that reflects an 18% gray value. This is not easy unless you have a lot of experience "interpreting" the reflective value of objects...OR, if you have a "GRAY CARD".

By introducing an 18% gray card into the scene and placing it in such a way that it is in the same lighting as your main subject that you are trying to expose, you can now take your spot meter reading from the gray card and you will have a "perfect" exposure for that subject in that lighting. In doing this, white will be white, black will be black and all other tonal values will fall into place.

You can also use a Gray Card in the same way to do a custom white balance.

Incident Meter
Where a reflective meter measures the light reflecting **FROM** the subject, an incident meter measures the amount of ambient light falling **ON** the subject. That is an important distinction, because now we have a meter that does not care what is behind it, it only cares about the light that is falling on the dome or disc of the meter when providing a result.



To use this meter, simply place it near the subject and point the dome toward the light source so that the meter is at the same distance from the light source as the subject. Because it is measuring the light falling on the forward-facing dome, it is not influenced by the color or the tonal values of anything behind it.

The result that is provided by the incident meter is still an 18% result, but it is the result of the measurement of the ambient (constant) light and not the reflected light. Setting your camera to this reading will render all the tonal values accurately. As a matter of fact, the reading from the incident meter measuring the light falling on the subject will be exactly the same as the reading from the reflective meter measuring a gray card in that same light.

In addition to measuring ambient light, many incident meters are also capable of measuring studio flash or portable strobes.

Which Meter Should You Use?
Reflective - In camera, this meter produces average results. Its usefulness is really dependent on your ability to interpret the scene.

Spot - Particularly useful for landscape and wildlife photography where up-close metering with an incident meter is impractical or impossible. Meter readings with a spot meter can be done at long distances because of its narrow angle of view.

Incident - Ideal for portraits where the light can be measured at the subject position. Also ideal for studio lighting with hot lights or strobe lights. A must for measuring any flash exposure.

Interpreting Light Meter Readings

As we have already seen, interpreting the light meter readings is a must for reflective meters and spot meters. There is also some degree of interpretation that must be done with an incident meter as well. While the incident meter does measure the light falling on the subject, that reading does not necessarily provide you with any exposure information from the shadows that may be present in the scene.

Interpreting Light and Shadow
For most photographers, the primary concern is in the exposure of the main light that illuminates the subject. That part we have covered...all you do is point the meter towards the light. But, what if you want to know the exposure value of the shadows? Most techniques simply involve taking a 2nd reading of the shadow side and then comparing the result with the first reading.

If the difference between the two readings is not acceptable and too far apart, the photographer may elect to add some supplemental lighting or “fill” light to raise the value of the shadow side thus bringing the two values closer together. This difference (Light Ratio) is a personal preference for each photographer.

Interpreting the Read-out of the Meter

The meter itself may also require some degree of interpretation of the reading. Many meters can be programmed to take measurements within 1/10 of a stop. This provides the photographer with very accurate readings, but these 1/10th cannot be overlooked. If your meter is set to measure in 1/10ths, you have to interpret the 1/10 reading for your final exposure!

For example: The read out on the meter at left is F5.6_3 at 1/125. That means the f-stop is F5.6 and 3 tenths. While our cameras don't provide f-stops in 1/10 increments, it does have the capability of setting it in 1/3 or 1/2 stop increments.

If we carry out this exposure, we may actually select F6.3 if our camera is set up in 1/3 stop increments or we may choose to "round up" to F6.7 (sometimes called, "F5.6 and a half") if our camera is in 1/2 stop increments.

These are decisions you want to be familiar with as you look at your meter readings paying close attention to that 1/10 reading. If you are not careful, you may glance at F8.0_9 and carelessly use F8 when, in fact, the reading is a mere 1/10 of a stop from being F11.

B. Set f-stops and shutter speed based upon exposure and desired effects. (8 items)

1. Knowledge of relationship between shutter speed, f-stop and ISO to produce the desired result
   - f-stop for depth of field,
   - shutter speed for stop action,
   - dragging shutter,
   - control of noise or grain

ISO

The ISO number is a way of rating a sensor's (or film's) sensitivity to light.

The higher the ISO number, the more light sensitive the sensor is.
The smaller the ISO number, the less light sensitive the sensor is.

In other words:
The higher ISOs such as 400 and 800 and higher, are quite light-sensitive and are capable of recording images in low-light situations such as indoors with no flash or even outside at night.

The lower ISOs such as 100 and 200 require more light, so they are often used outside during daylight or indoors with a flash.

ISOs have the same relationships to each other as do f-stops and shutter speeds.

200 ISO is twice as sensitive as 100 ISO.
400 ISO is twice as sensitive as 200 ISO.

It is really important to use the right ISO for the lighting conditions under which you are working. The higher the ISO, the less sharp the image will be and the more likely digital noise will occur in your images. This will be more apparent as you begin to enlarge your images. These imperfections may appear as pixilation (jagged edges), graininess or digital “noise”.

Changing the ISO setting on the camera recalibrates the in-camera meter to reflect the exposure values at the given ISO.

The ISO setting is the basis on which all exposures are calculated. Think of the ISO as one side of an “exposure triangle” which includes f-stops as the second side and shutter speeds as the third side. (see page 56)

All exposures which are expressed with an f-stop and a shutter speed must also include an ISO to be relevant.

F-stops

The f-stop, or “aperture” is the control in the lens that “opens up” or “stops down” the diaphragm inside as a way to control the amount of light that reaches the film or sensor. The f-stops are:

1.4 2 2.8 4 5.6 8 11 16 22 32 ...

The f-stops on your lenses may not be numbered exactly the same as these, but they will be close. These are considered to be “whole stops”. You can set up to your camera to also show “half stops” or “1/3 stops” between each of these whole stops.

You really should commit the listed f-stops, in order, to memory! Memorize the numbers as listed rather than those on your lens. We will learn to interpret the numbers on your lenses, later. When it comes to f-stops:

The smaller the F number, the larger the lens opening.
The larger the F number, the smaller the lens opening.

A large lens opening such as F2.8 will let more light reach the sensor than a small lens opening such as F22. As a matter of fact, there is a relationship between each of the f-stops:

Any time you move your lens from one F# to the next smaller F#,
the amount of light that reaches the film **DOUBLES.**

EXAMPLE:

F5.6 allows twice as much light to reach the sensor as F8.
F4 allows twice as much light to reach the sensor as F5.6.

This pattern is the same throughout the F#’s.
On the other hand:

Moving the lens from F5.6 to F8 reduces the amount of light reaching the sensor by half!
Moving the lens from F4 to F5.6 reduces the amount of light reaching the sensor by half!
And this pattern continues.

So in summary:

1.4 - 2 - 2.8 - 4 - 5.6 - 8 - 11 - 16 - 22 - 32...
Larger Openings <----------> Smaller Openings
More Light Reaches the Film <----------> Less Light Reaches the Film
Move One F-stop, Light Doubles <----------> Move One F-stop, Light is cut in half

Changing the lens opening from one f-stop to the next will either double the amount of light that reaches the film or cut it in half, depending on which way you move it.

Exposure and Meters

Shutter Speeds

The shutter speed controls the amount of light that reaches the sensor by determining how long the shutter remains open. Memorize these shutter speeds:

...1sec. - 1/2 - 1/4 - 1/8 - 1/15 - 1/30 - 1/60 - 1/125 - 1/250 - 1/500 - 1/1000 - 1/2000...

Notice that shutter speeds continue in both directions. Also note that we go from 1 second to 1/2 second. Your camera will not show these speeds in fraction form. When you look at your shutter speed dial and it says 500, it means that it is 1/500th of a second!

(Now comes the tricky part!)
The smaller the shutter speed number (1/1000), the faster the shutter.
The larger the shutter speed number (1/2), the slower the shutter.

A fast shutter speed allows **less** light to reach the sensor than a slow shutter speed. **More** light reaches the sensor during 1/2 second than 1/1000th of a second.

Shutter speeds have the same relationships to each other as the f-stops do in that when you move from one shutter speed to the next, you either **double** the amount of light that reaches the sensor or you **cut it in half.**

EXAMPLE:
Move from 1/250 to 1/125 and the amount of light reaching the sensor doubles.
Move from 1/30 to 1/15 and the amount of light reaching the sensor doubles.
The pattern continues.

ON THE OTHER HAND:
Move from 1/30 to 1/60 and the amount of light reaching the sensor is cut in half.
Move from 1/500 to 1/1000 and the amount of light reaching the sensor is cut in half.
The pattern continues.

So in Summary:

...1sec. - 1/2 - 1/4 - 1/8 - 1/15 - 1/30 - 1/60 - 1/125 - 1/250 - 1/500 - 1/1000 - 1/2000...
Slower Speeds <----------> Faster Speeds
More Light Reaches Film <----------> Less Light Reaches Film
Moving Objects may Blur <----------> Moving Objects Appear Sharp

Changing the shutter speed from one to the next will either double the amount of light that reaches the sensor or cut it in half, depending on which way you move it.

Controlling Motion

The shutter speeds not only control the amount of light that reaches the sensor, but they also control the apparent movement of objects in motion during the exposure.

Objects that are moving during the exposure will appear almost stationary at fast shutter speeds, and may record as a blur during longer shutter speeds.

Fast Shutter Speed

This image was recorded at F2.8 @ 1/250.

Notice how the fast shutter speed arrested the movement of her hair.

Slow Shutter Speed

This image was recorded at F8 @ 1/30.

Notice how the slow shutter speed recorded the movement of her hair and her arm.

Controlling Motion

The shutter speeds not only control the amount of light that reaches the sensor, but they also control the apparent movement of objects in motion during the exposure.

Objects that are moving during the exposure will appear almost stationary at fast shutter speeds, and may record as a blur during longer shutter speeds.

By the way, shutter speeds help control movement of the camera by the photographer. We all have a tendency to shake when we hold the camera. For a picture to be truly sharp, the camera needs to be kept very still during the exposure.

When hand-holding the camera, use shutter speeds that are no slower than the focal length of the lens you are using. It is recommended that you use shutter speeds with a value that is at least 1/focal length - or faster when your hand-holding the camera. For example, use 1/250 if you have a 200mm lens on the camera or 1/125 with a 100mm lens. Generally speaking, it is best not to allow the shutter speed to fall below 1/60 when hand-holding any lens.

Slow Shutter Speed

This image at left was recorded with a 100mm lens at F16 @ 1/8 with the camera hand-held. Notice how the slow shutter speed recorded the movement the camera in my hands.

Fast Shutter Speed

This image at right was recorded with a 100mm lens at F4 @ 1/125 with the camera hand-held. Using a shutter speed that is at least equal to the focal length of the lens (100mm < 125) allows me to hand-hold the camera and record a sharp image.

Using speeds slower than the focal length of your lens may require a tripod, monopod or some other camera support.

Vibration Reduction or **Image Stabilization** features on a lens will also help keep images sharp at slower speeds. But beware, the vibration reduction or image stabilization feature of your lens must be turned off when these lenses are used with the camera on a tripod.,

Flash Sync

In order to use a portable flash, we need to know the correct "flash sync" of the camera. This is the fastest shutter speed that can be used and still coordinate the timing of the flash with the shutter in the camera. The sync speed is determined by the manufacturer and model of the camera being used. Generally it is 1/125 or 1/200, but it may vary from camera to camera. Certain shutters sync at all speeds. Be sure to check your camera manual to determine your camera's sync.

We will discuss this in more detail in a later section.

Panning

This technique can be used to record a moving subject with a degree of motion blur by using a slow shutter speed. This works best for subjects that are moving across the field of view. Simply follow the path of the moving subject with the camera as it passes across the field of view, keeping the subject within the viewfinder.

When done well, the result creates a surprisingly sharp subject with a strong horizontal blur pattern of the background. This creates a sense of movement and speed.

Shutter speeds for panning are dependent on the speed of the object, the focal length of the lens and the camera to subject distance. Try using speeds near 1/15 to start and adjust from there for the desired effect.

2. Knowledge of equivalent exposures

Exposure

The basics of photography begin with correctly exposing the sensor by finding the right combination of f-stop and shutter speed at a given ISO. Exposure can be expressed in this formula:

Exposure = INTENSITY @ TIME
or, E = IT
"Intensity" is the f-stop and "Time" is the shutter speed.

We can plug-in some numbers just to see what happens: **E = F8 @ 1/125**
(F8 and 1/125 are variables that I selected entirely at random for this example.)

"E" will represent the amount of light that reaches the sensor. If you remember any algebra, because there is an = in the equation, I can change my variables, so long as I keep the final result "E" consistent.

In my sample, I stated E = F8 @1/125. If for some reason I wanted to change the F8 to F5.6, I could as long as I keep the amount of light that reaches the sensor equal!

If I move from F8 to F5.6, I am making the lens open up to let twice the amount of light reach the sensor. In order to remain equal, I have to cut the light in half by moving the shutter speed to the next faster speed.

E = F8 @ 125
and
E = F5.6 @ 250

F5.6 @ 1/250 is an equivalent exposure to F8 @ 1/125 because in both cases, the exact amount of light reaches the sensor. As a matter of fact, there can be many equivalent exposures:

F22 @ 1/15
F16 @ 1/30
F11 @ 1/60
F8 @ 1/125
F5.6 @ 1/250
F4 @ 1/500
F2.8 @ 1/1000

Each of the above exposures yield the exact amount of light onto the sensor.

This process is the same no matter which f-stop and shutter speed combination you choose to start out with. The hard part about exposure is figuring out which f-stop and shutter speed to start with in the first place. (We will cover this in-depth later.)

The ability to work through the equivalent exposures to select a desirable f-stop or shutter speed is what gives the photographer the power to "create images" rather than simply "take pictures" as we will soon see.

Depth of Field and Exposure
If you refer to the information on Page 27, you will be reminded that f-stops not only control the amount of light that reaches the film, but they also control depth of field.

The larger the lens opening, the shallower the DOF.
The smaller the lens opening, the greater the depth of field.

Since larger lens openings provide a shallower the DOF, the photographer may wish to select an exposure that utilizes a large lens opening to create an image where the background is de-emphasized creating stronger attention on the subject.

Using the examples on the previous page, we came up with a list of equivalent exposures:

F22 @ 1/15
F16 @ 1/30
F11 @ 1/60
F8 @ 1/125
F5.6 @ 1/250
F4 @ 1/500
F2.8 @ 1/1000

Of these choices, F2.8 at 1/1000 will provide and image with the shallowest DOF.

The image at right was taken with a 200mm lens at F2.8 to minimize the DOF and make the background quite out of focus.

If the priority is to record the background as sharp, the best choice is F22 at 1/15.

The image at left was done with a 200mm lens at F16 to ensure the entire bridge is rendered as relatively sharp.

Again, camera-to-subject distance and the focal length of the lens has a huge impact on how depth of field is recorded, but when it comes to determining exposure, select the appropriate f-stop to further accentuate your desire for background and foreground sharpness or lack of sharpness.

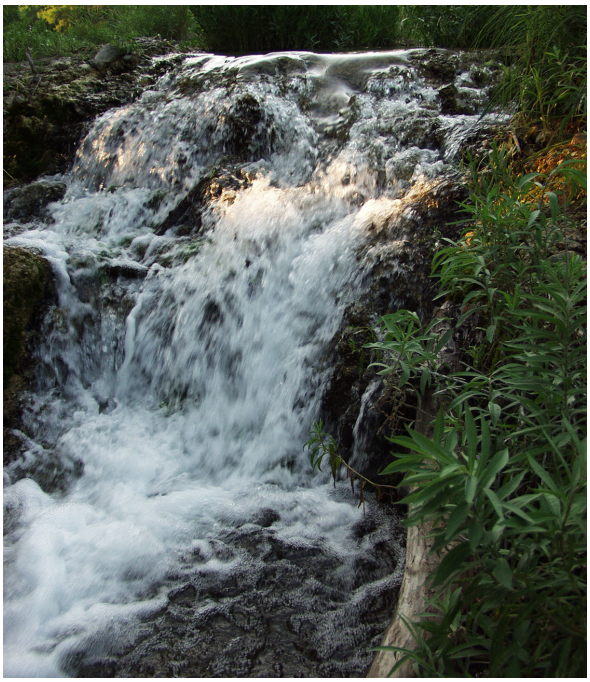
Exposure and Meters

Motion and Exposure
We have already seen that shutter speeds not only control the amount of light that reaches the film, but they also control motion.

Since faster speeds tend to arrest motion, the photographer may wish to select an exposure that utilizes a faster speed to create an image that records a moving subject with a high degree of sharpness. The tendency to "freeze" a moving subject is dependent on how fast the subject is moving, how close you are to the subject and the focal length of the lens. The ability to arrest the movement of a moving subject increases as the shutter speed increases.

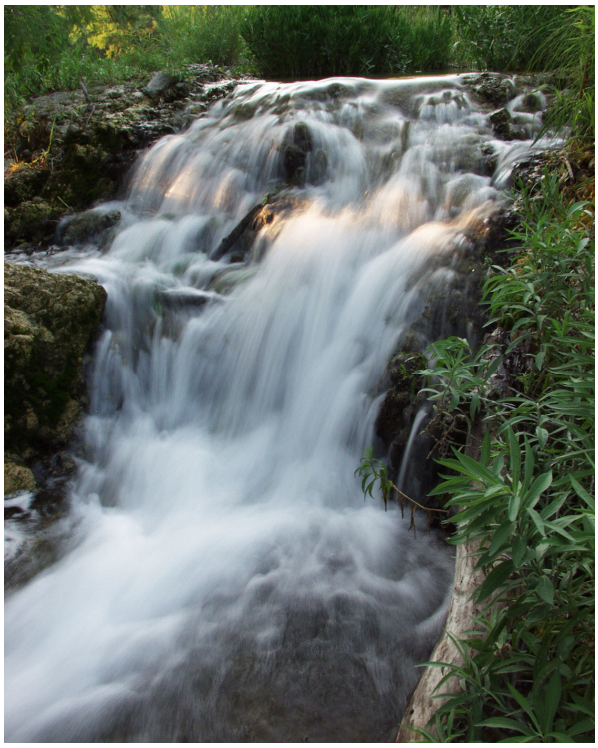
Using the examples on the previous pages, we came up with a list of equivalent exposures:

F22 @ 1/15
F16 @ 1/30
F11 @ 1/60
F8 @ 1/125
F5.6 @ 1/250
F4 @ 1/500
F2.8 @ 1/1000



Of these choices, F2.8 at 1/1000 will provide the best chances of "freezing" a moving subject.

If the priority is to record the movement in the scene, the best choice is F22 at 1/15.



The image above was taken at F2 @ 1/125 with a 15mm lens. The shutter speed was fast enough to capture individual drops of water coming over the falls.

The image at left was done with a the same lens using F11@1/4. The slow shutter speed has a huge impact on how the movement of the water is recorded. The choice is a matter of taste.

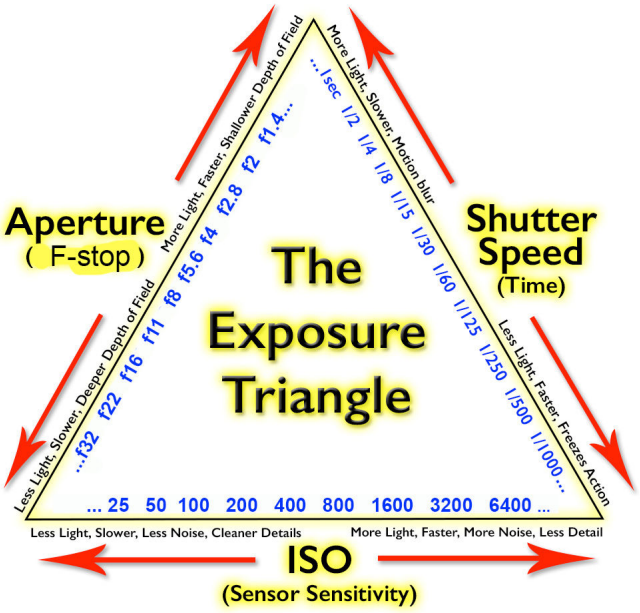
ISO and Exposure
We have already seen where "whole" ISO numbers (100, 200, 400, 800, 1600, 3200…) represent "one stop" of exposure as you move from one to the next. Moving from one ISO to the next higher ISO number represents a one stop increase in exposure, Moving from one ISO to the next smaller ISO number represents a one stop decrease in exposure.

Exposure is established at a specified ISO. For example, F8 @ 1/125 is not relevant without also specifying an ISO. Since ISOs, f-stops and shutter speeds combine to determine the amount of light that will reach the sensor, these settings are often referred to as the "triangle of exposure". Since all three are directly related to exposure, changes to one of these settings will impact one of the other two.

For example,
At 100 ISO: F8 @ 1/125

If we change the ISO to 200, we are **increasing the exposure on the sensor by one stop** as the sensor is now twice as sensitive. To compensate for the change to ISO, we can either move the f-stop or the shutter speed to keep the exposure equivalent.

100 ISO: **F8** @ 1/125 ≡ 200 ISO: **F11** @ 1/125
or
100 ISO: F8 @ **1/125** ≡ 200 ISO: F8 @ **1/250**



There may be occasions when you will want to increase the ISO to use faster shutter speeds.

For example, you are photographing a sporting event late in the day with an F2.8 lens. The meter reading indicates an exposure of F2.8 at 1/125 at 100 ISO. You would prefer to use 1/500 to capture the movement of the players in action.

The difference between F2.8 @ **1/125** and F2.8 at **1/500** is **two stops**. (1/125, 1/250, 1/500)
Changing the ISO from **100** to **400** increased the exposure by **two stops**. (100, 200, 400)
So, F2.8 @ 1/125 at 100 ISO ≡ F2.8 @ 1/500 at 400 ISO.

There may be occasions when you will want to increase the ISO to use available f-stops.
For example, you are photographing a family late in the day with a 100mm, F4 lens. You know that you must use a shutter speed of 1/125 because you are hand-holding the lens. The meter reading indicates an exposure of F2 at 1/125 at 100 ISO. You need F4.

The difference between **F2** @ 1/125 and **F4** at 1/125 is **two stops**. (F2, F2.8, F4)
Changing the ISO from **100** to **400** increased the exposure by **two stops**. (100, 200, 400)
So, F2 @ 1/125 at 100 ISO ≡ F4 @ 1/125 at 400 ISO.

Bracketing

Bracketed exposures may ensure proper exposure when you find yourself in difficult lighting situations. Bracketing is simply the taking a photograph using several different exposures. First, do your best to determine the correct exposure and take the photograph using that f-stop and shutter speed combination. Then, shoot a second image using the same f-stop but at one speed faster than the original one. You may also shoot a third image at one speed slower than the original.

For example: If you determine the exposure is F8 @ 125, then shoot at that exposure and then also shoot F8 @ 60 and F8 @ 250. This will yield three different exposures and then you can evaluate which image you prefer.

You may also bracket by keeping the shutter speed constant and changing only the f-stop.

For example: If you determine the exposure is F8 @ 125, then shoot at that exposure and then also shoot F5.6 @ 125 and F11 @ 125.

Some cameras have a menu setting which allows for Automatic Exposure Bracketing (AEB). Check the manual for your camera for specific instructions.

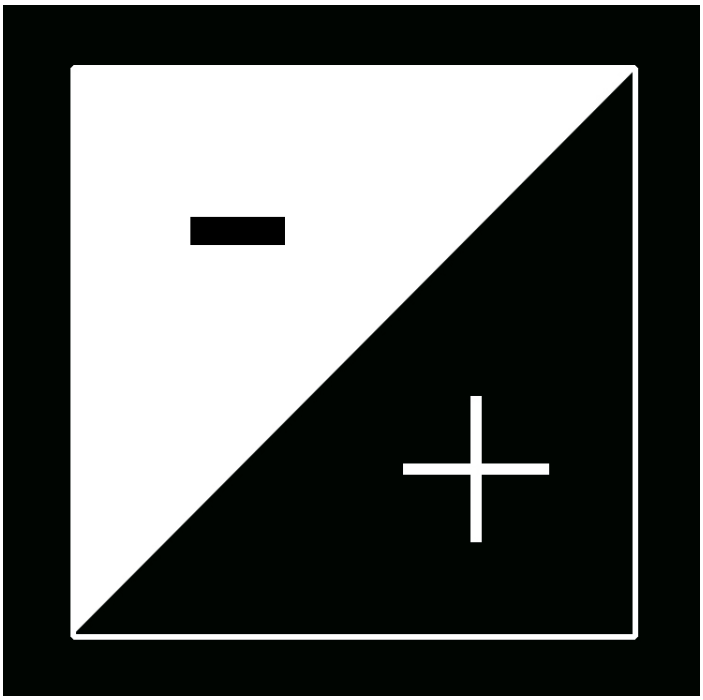
3. Knowledge of exposure compensation relative to lighting situations (light absorption and reflection values, skin tones)

Exposure Compensation

Shooting the camera in “manual” mode is the ultimate exposure compensation. When exposure readings are taken with an incident light meter, there is no need for exposure compensation because the reading is an accurate reading.

Exposure compensation may very well be required for cameras which are used in Program, Aperture Priority or Shutter Speed Priority modes. Again, this is because the camera “averages” the exposure of the entire scene.

Most cameras have the ability to allow the user to override the camera’s choice of exposure and reduce or increase the exposure settings by up to two or three stops and in 1/2 or 1/3 stop increments.



Exposure compensation using “-1” or “-2” reduces the average exposure by one and two stops respectively. Settings such as “+1” and “+2” increase the exposure by one or two stops. The image at left shows my camera with “-.3” (1/3 stop) exposure reduction.

Check your manual to find out how to set the exposure compensation function on your camera.

It is helpful to recognize situations which may cause the camera readings to be over or under exposed.

Overexposure
Overexposure of a subject happens when the overall tones of the scene are dark and the subject is lit. Stage presentations with dark backgrounds or spotlighted performers against a dark background are great examples.

The camera sees mostly dark values so it averages the exposure of the darkness which lightens the dark, but lightens the subject as well washing out all of the detail in the subject. Setting the camera’s exposure compensation to “-2” tells the camera to use an exposure that is two stops less than the average exposure. Hopefully, this will be enough to keep the subject closer to the actual value of the lighting on the subject.

In the image above the dark sky and water and the dimly lit hotel caused the camera to over expose the brightly lit water features.

Setting exposure compensation to a –1.3 gave me a much better exposure on the fountain and allowed me to record the water with detail. (left)

Underexposure
Typical situations which create underexposure on the subject occur when the background is lighter than the subject. A subject in a scene with a lot of sky or a subject indoors with a lot of windows revealing outdoor exposures are good examples.

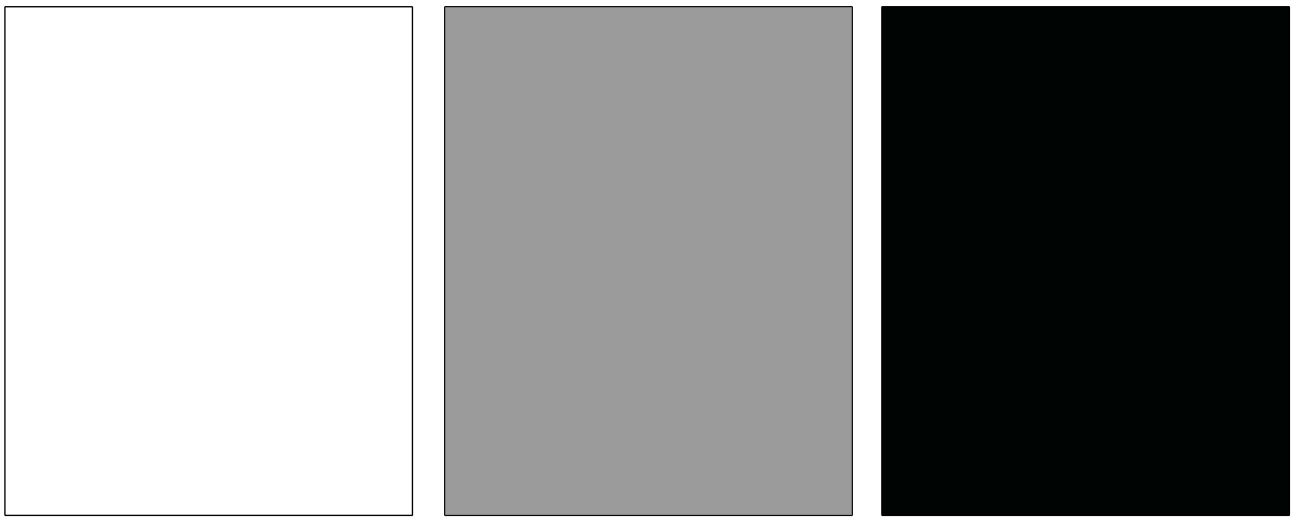
The camera will read the bright light and average the exposure which causes the subject to be dark. Setting the exposure compensation to +1 or +2 may be just enough to render a properly exposed subject. Keep in mind, the background may wash out or be somewhat overexposed, but the subject will be closer to the proper exposure.

In the image above, the couple appeared dark with the camera basing the exposure on the bright sky. The truth is, the image works as a silhouette. I did not want to capture the entire ceremony in silhouette, so I added two stops exposure compensation to be able to record detail in the couple. Of course, the background and sky washed out, but their expressions were important and needed to be captured.

In many ways, over and under exposure are relative terms. It really all depends on your vision, your taste and delivering what the client wants.

C. Verify proper exposure. (4 items)

1. Knowledge of how to use a gray card to achieve exposure value



White Card Gray Card Black Card

18% Gray Card
An 18% gray card or target is a calibrated measurement tool that reflects 18 percent of the light that reaches it. Light reflected from a gray card is measured with a reflective meter to provide an accurate exposure.

By introducing an 18% gray card into a scene in such a way that it is placed in the same lighting as your main subject, you can now take a meter reading from your camera meter or any reflective meter and you will have a "perfect" exposure for that subject in that lighting. Setting your camera to this reading will render all of the tonal values accurately. As a matter of fact, the reading from the reflective meter measuring the gray card will be the same reading you would get from an incident meter measuring the same light falling on the subject. (review pages 43-45)

The Zone System
While not listed in the test specifications, the Zone System is widely recognized for classifying exposure values of specific tones from black to white. On the 10-point scale of the Zone System, pure black is placed in Zone 1. Pure white is in Zone 10.

The 18% gray value is a widely recognized as "middle gray". It is the midpoint between black and white. It is also the middle value of the Zone System at Zone 5.

As we are about to see, it also appears as the center value on your camera's histogram.

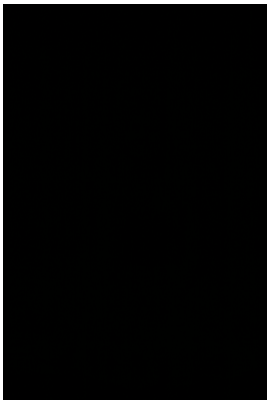
2. Knowledge of how to read and interpret a histogram

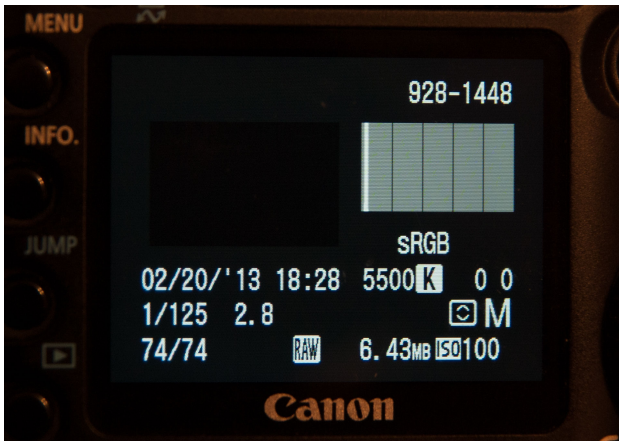
Histograms

Histograms are a graphic representation of the 256 tonal values of the pixels within the image. The horizontal graph represents the pixel's numerical value from "0" (black) on the left to "255" (white) on the right.

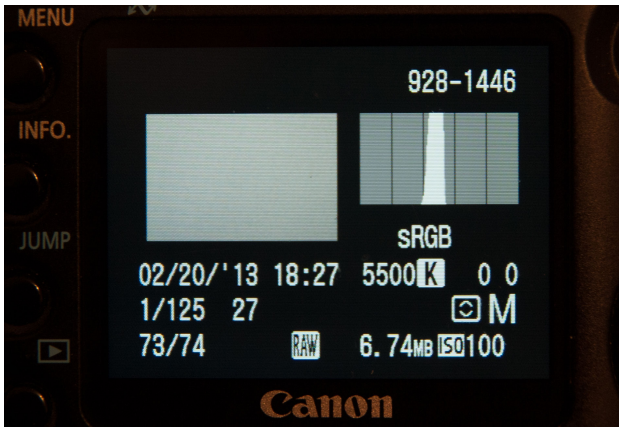
The graph represents an approximate 5 stop range. The blacks appear on the left side of the graph while the whites or highlights appear on the right side of the graph.

In the images at right, the photograph of the black card produces a histogram where the values are all located to the left side of the graph near the "0" values. The graph indicates that there are no other pixels in the image with any other tonal values. (Zone 1)

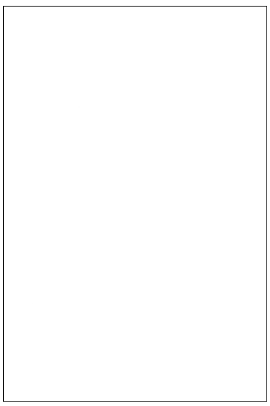


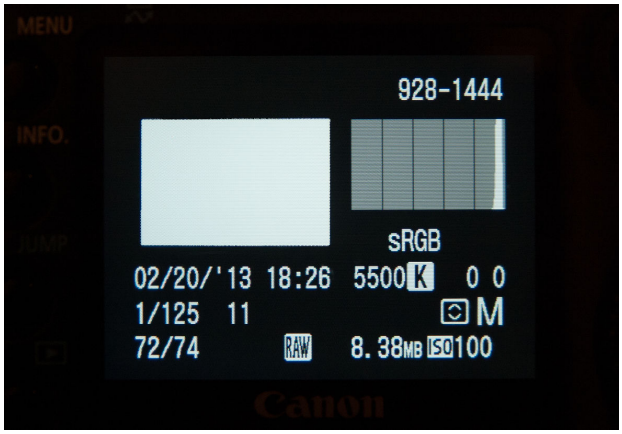


The images at right of the gray card show all of the pixel values in the image to be near the middle gray tonal values. This makes sense because I photographed a gray card for this exposure. (Zone 5)



Finally, in the images at right, I photographed a white card and as expected, the histogram shows all of the pixel values to be properly placed near the "255" values which represent white. (Zone 10)





LIGHTING (28%)

This portion of the examination will measure (1) how to best light the subject; (2) possible types of lighting (Studio, Ambient, Flash, Daylight); (3) lighting design; and (4) lighting equipment.

A. Evaluate the lighting options to determine the tools necessary to complete the assignment. (4 items)

1. Knowledge of various light sources and light equipment to create desired effects

Seeing Light

Where an artist uses paint to put a vision on canvas, a photographer uses light. This is why it is important to begin to not only "see" light and recognize its many qualities, it is also important to understand its nature and how to control it.

Photographers should learn to recognize light and understand its source and how that light is being introduced into a scene. For example, natural light outdoors comes from the sun, however, a subject who is placed in shade is still illuminated. So where does that illumination come from? Some will say "The sun!", but the photographer who "sees" light might recognize that the lighting is coming from sunlight reflecting off of a nearby building. Of course, there would be no lighting without the sun, but in this example, the second photographer has a better grasp on the nature of light.

The "seeing" photographer also probably recognizes instantly that the reflected light from the building produces a softer quality of light than direct sunlight and perhaps has a warm color shift because of the brick exterior of the building. As a matter of fact, this photographer most likely sought this location out for these very qualities.

Natural Light Sources

Common natural light sources include: direct sunlight, open sky, indirect sunlight, reflected sunlight, filtered sunlight, overcast lighting and more. (Some might like to add "moonlight" to this list, but I place the moon in the list as "reflected sunlight".) Fire might also be considered a natural light source.

Artificial Light Sources

Artificial light is anything other than sunlight. This includes all environmental lighting such as lamps, street lights, household and commercial lighting, decorative and more.

Also included in this group are the wide varieties of photographic lighting products that are available to photographers including portable strobe, studio flash, hot lights, cool lights, LED, spot lights and more.

Portable Strobe

Portable strobes are light weight and well-suited for use outdoors and on location. Usually, these are battery operated making them very well suited for outdoor use.

They can be used on camera or off-camera with remote triggering, and can be used with umbrellas, softboxes or any number of light modifiers available for use with portable strobes.

Studio Flash

Studio flash provides a great deal of creative control and convenience for photographers who choose to work in a studio environment. They can also be portable enough for location use or even outdoors with some models able to use optional battery packs.

Studio flash gives the photographer control over the main and fill lights with added control of possible hair lighting and background lighting. Creative lighting is also possible with the use of a wide range of lighting modifiers.

Studio flash can also provide a great deal of power output when needed.

Hot Lights

Hot Lights are another source of studio or location lighting options which provide a continuous light source utilizing either tungsten lamps (left) or quartz (below) light bulbs. These provide strong illumination, but are usually not as strong as studio strobes.

The advantages include being able to “see” the light as it is being used. They also closely match the warm color temperature of typical lighting fixtures such as lamps and dropdown lighting found in many interior scenes. These are often used with video applications. They may also be used with any number of lighting modifiers or color correction gels.

One disadvantage is that, as the name implies, they do generate a lot of heat.

Cool Lights
Cool lights also provide a continuous light but do so through the use of fluorescent, compact fluorescent (left) or LED bulbs. (below) They compare to the output of hot lights without generating heat. They are available in a range of color temperatures and can be filtered to match the color temperature of other light sources.

They may be used with an assortment of lighting modifiers or as parabolic light sources.

The advantage of these lights is the fact that they are a constant light source which allows the photographer to “see” the light as it is being used.

They are also popular with photographers who photograph infants because they are not disturbed by the burst of light that occurs with traditional studio flash.

Compact fluorescent bulbs in a parabolic reflector

LED lights in a panel

2. Knowledge of how to use remote triggering (infrared, photosensitive, or radio)

Remote Triggering

A photographer working in a studio environment or who wishes to introduce artificial strobe lighting to an outdoor setting will probably prefer the convenience of remote triggering the strobe as opposed to being tethered to the light source by a cord. There are three types of remote triggers to consider: infrared, photosensitive and radio.

Infrared Triggers

These triggers work with an infrared light ray from a source or "trigger" unit striking an infrared receiver on the remote unit. They are usually found built in to higher end portable strobes.

The use of infrared triggers come with some degree of inconveniences. For example, while usually reliable, infrared triggers require "**line of sight**" so that the two units are able to "see" each other. They also usually have a limited distance that the master and receiver can be separated for effective use. They may also be impacted greatly by the amount of existing light in the environment. For example, they may be less efficient outdoors in bright light.

Photosensitive Triggers

These triggers work on the basis of a flash with a remote sensor "seeing" another flash. A remote sensor causes the 2nd flash to fire in sync with the trigger flash with no perceivable delay. While not requiring a direct line of sight that is necessary with infrared triggers, the remote still must be situated to detect the sudden burst of flash from the trigger unit.

These are sometimes built into studio lighting units or as external devices that can be used with existing flash units.

Photosensitive triggers also suffer some degree of accuracy in bright light environments.

Perhaps the biggest detriment to the use of photosensitive triggers is from other photographers! These triggers are susceptible to firing indiscriminately in environments where other people with cameras are also using a flash. Repeated firing of the remote unit unintentionally leads to faster draining of the flashes resources and is just plain annoying.

Radio Triggers

These reliable triggers use radio waves to communicate with each other. The transmitter connected to the camera sends a radio signal to a receiver mounted to the remote flash to fire it. These allow for use at increased distances and do not require a line of sight.

Radio triggers can be purchased as a set including a transmitter and a receiver. It is common to be able to purchase additional receivers so that multiple lights can be fired with a single transmitter. Some units serve as a dual unit that can be set to "transmit" or "receive". Radio remote triggers are also useful in firing the camera during long exposures in order to reduce vibrations that may affect sharpness.

Because radio triggers work on unique frequencies, many brands offer multiple channel options for firing different sets of lights. I once taught a class at the Texas School of Professional Photography that had several classes going on in the same eight-story building. The first few moments of class were chaos in that every instructor's transmitter was firing all of the lights in the other classrooms—even those on different floors! After all, you can pick up the same radio station on every floor, so too were the radio signals of our transmitters penetrating the walls and floors from several levels. This situation was quickly resolved when each instructor was assigned his or her own channel. Thank goodness for multi-channel units!

In addition to buying external radio triggers, many higher end studio lights have radio receivers built into the unit. Because most radio triggers are proprietary, a studio light with a built in radio trigger may come with its own transmitter or require a specific brand of transmitter to fire that unit.

Another common use of a radio transmitter is that the receiver can be set up to fire the camera remotely. Just take a close look at the backboard of a college or pro basketball game and see the multitude of cameras that are mounted to them. These cameras are being fired remotely by the photographer sitting on the sidelines or in the stands with a radio transmitter. There can be so many cameras on the backboard because they all have been assigned a unique channel.

These remote triggers come in very handy as well under situations where it might be inconvenient or even dangerous to be near the camera or the flash. Wildlife photographers will often use an unmanned camera left in the animals environment and safely fire the camera remotely from a safe distance.

Some meters also offer a built-in transmitter or the option of adding a transmitter module to the meter. This is very convenient because the flash can be triggered simply by activating the meter.

B. Determine the lighting ratio. (3 items)

1. Knowledge of establishing desired lighting ratios

Photographers, even those of us who teach photography and teach these CPP prep courses, often disagree on the process of establishing light ratios. Before I was selected as an "Approved" CPP prep class instructor, I served on the Certification Commission who oversaw the process of writing the questions and researching the answers that are used on the test.

Even among those of us who served on the commission had different views on the topic of lighting ratios. The particular commission I served with did an outstanding job of clarifying the questions and the principles of lighting ratios. Those of us who teach the courses also met to bring clarity on how lighting ratios should be taught.

I am not saying "my way is the right way", nor is it the "only way", but I will promise you that if you understand the information you are about to be presented, and if you ignore all others who try to explain light ratios, you will likely be very satisfied with your results from taking the test.

Getting Started
The study of light ratios begins with the fundamental photographic idea of an f-stop (or a shutter speed). An f-stop represents a quantity of light that reaches the sensor based on a given shutter speed at a given ISO.

If we go back and review the basics of f-stops, we know that moving from one f-stop to the next larger lens opening (whole stop) allows **twice** the amount of light to reach the sensor.

For example, moving from F16 to F11 doubles the amount of light reaching the sensor.

Conversely, moving from one lens opening to the next smaller lens opening (whole stop) cuts down the amount of light reaching the sensor by **half**.

So, moving from F11 to F16 reduces the amount of light reaching the sensor by half.

It is important to recognize that the increase or decrease of exposure through the f-stops (and shutter speeds) is exponential - not linear. So lets take a look at how this is carried out over a number of f-stops:

Starting at F16, moving to F11 doubles (2X) the amount of light reaching the sensor.

F16 to F11 = 2X the light

Moving from F11 to F8 doubles the amount of light again! So F8 allows 4X the amount of light to reach the sensor than F16 allows.

F16 to F11 = 2X the light
F16 to F8 = 4X the light

(If you had $1 and I doubled it for you, you would have $2, If I doubled it again, you would have $4.)

Moving from F8 to F5.6 doubles the amount of light again! So F5.6 allows 8X the amount of light to reach the sensor than F16 allows.

(If I doubled your previous $4, you would now have $8.)

Moving from F5.6 to F4 doubles the amount of light again! So F4 allows 16X the amount of light to reach the sensor than F16 allows.

(If I doubled your $8, you would now have $16.)

By now, you probably see the trend and that moving from F16 to F 2.8 allows 32X the amount of light that F16 allows.

With whole stops, F1.4, F2, F2.8, F4, F5.6, F8, F11, F16, F22, F32 and beyond, whichever f-stop you begin with, the following is true:

Opening the lens by / Increases the light reaching the sensor

1 stop = 2X
2 stops = 4X
3 stops = 8X
4 stops = 16X
5 stops = 32X
6 stops = 64X
7 stops = 128X
8 stops = 256X

The converse of all of this is:

Closing the lens by / Decreases the light reaching the sensor

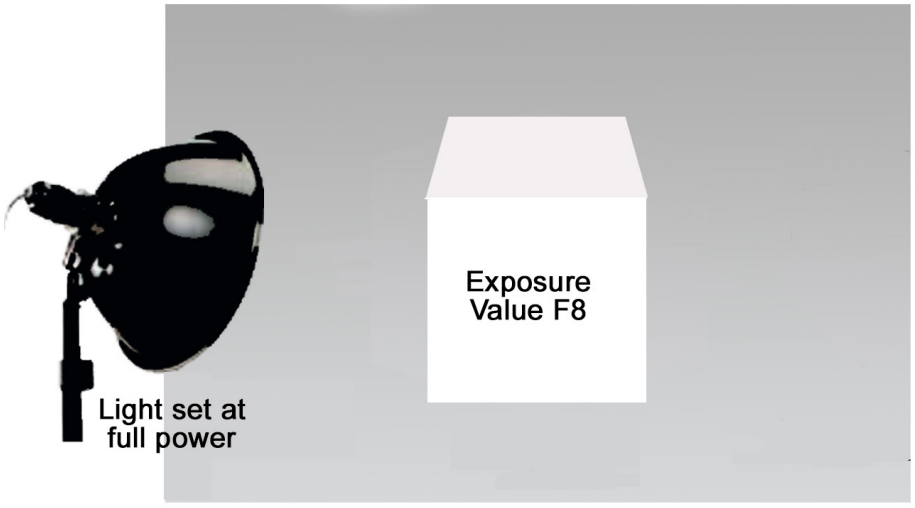
1 stop = 1/2X
2 stops = 1/4X
3 stops = 1/8X
4 stops = 1/16X
5 stops = 1/32X
6 stops = 1/64X
7 stops = 1/128X
8 stops = 1/256X

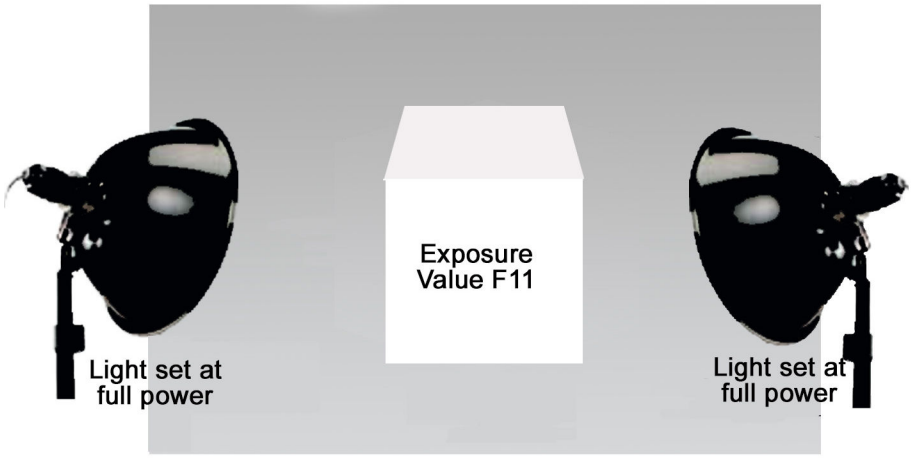
Keep in mind, in the above examples, the amount of light given off by the light source is not changing—only the amount of light passing through the diaphragm of the lens and reaching the sensor is changing. Think of it as opening or closing the blinds in a window to allow more or less light into a room. The light outside is not changing, only the amount of light allowed into the room (sensor) is changing.

Lighting

The Cumulative Property of Light

Imagine a white box that is turned so that the camera could only see a single side of the box. If I set up one light powered at F8 to illuminate the single, visible panel, my exposure will simply be F8. (see right)





If I added a second, identical light which is also set to F8, I have doubled the amount of light on that panel and increased the amount of light on that panel by 2X. (see left)

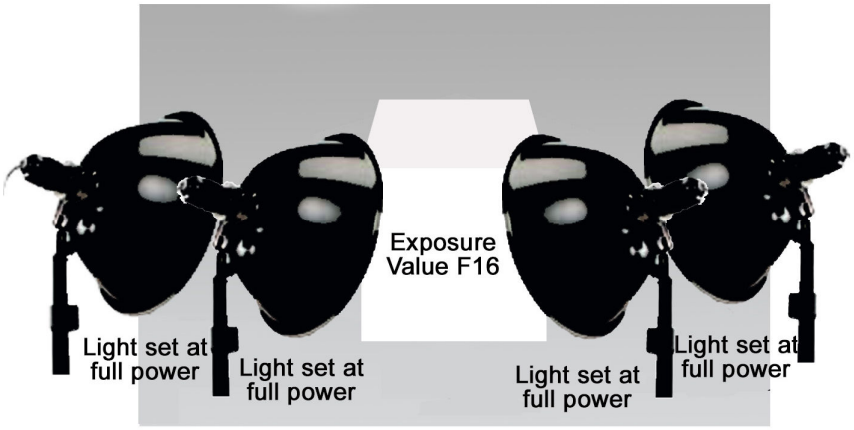
To properly expose this panel, I now need to use F11.

This example demonstrates the cumulative property of light.

If I want to photograph that panel at F16, I now have to double the amount of lights used to illuminate the panel to 4. (see right)

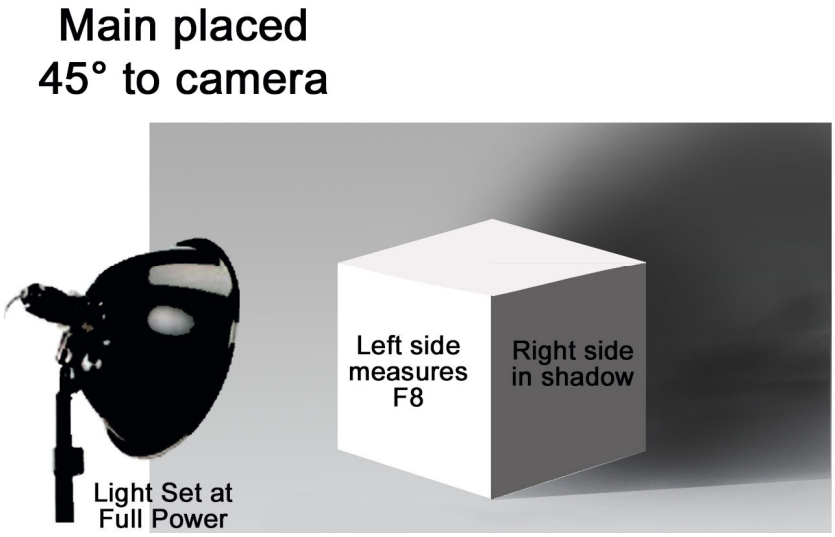
If I wanted to use F22, I would have to double the amount of lights on the panel to 8, and so on.

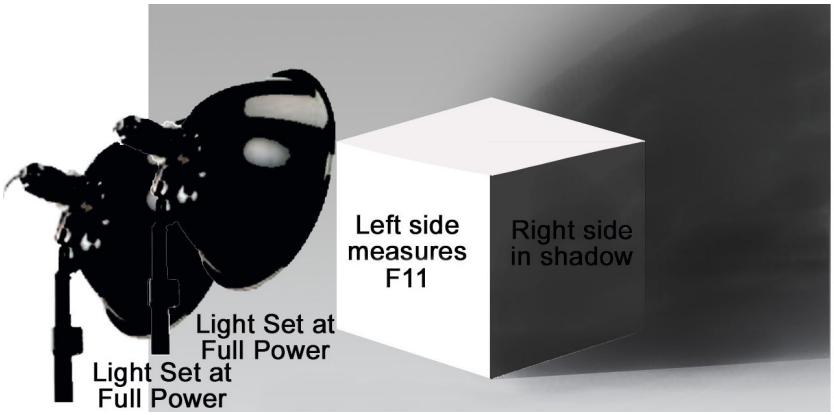
The amount of light on a subject increases as additional light is introduced.



Contrast
Now, let's rotate that white box 45° so that the camera now sees two sides of the box; one side to the left and one side to the right.

If I add one light to the left side, in such a way that the right side does not receive any direct illumination from the light, obviously, the lighted side will be considerably brighter than the non-lighted side. The difference between the illuminated side and the shadow side is known as, "contrast".



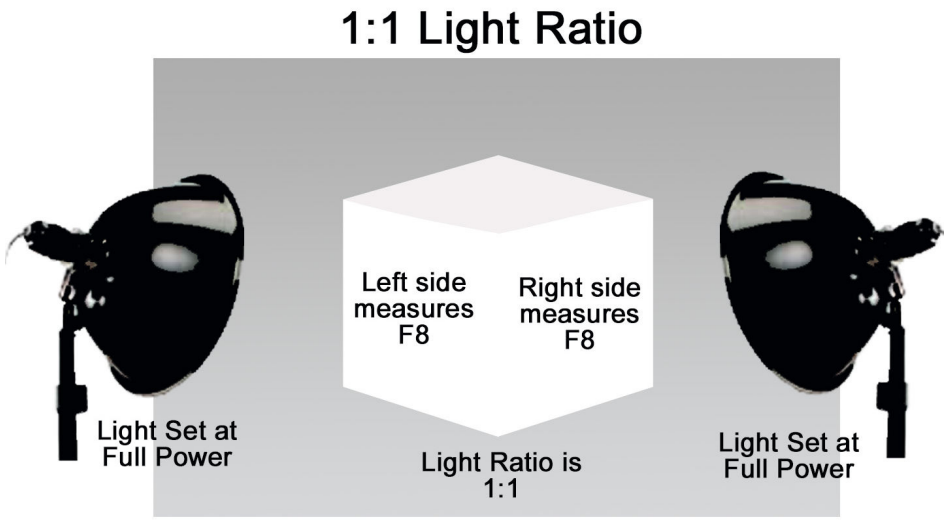


If I add a 2nd light to the left side, the illuminated side gets even brighter and the shadow side appears much darker. This would represent an increase in contrast between the highlight side and the shadow side. The more light we add to the lighted side, the more the contrast is increased.

When it comes to portraiture, or lighting any other three-dimensional subject, the photographer must consider the contrast between the highlights and the shadows and determine when that contrast range is acceptable or desirable for the overall appearance of the subject.

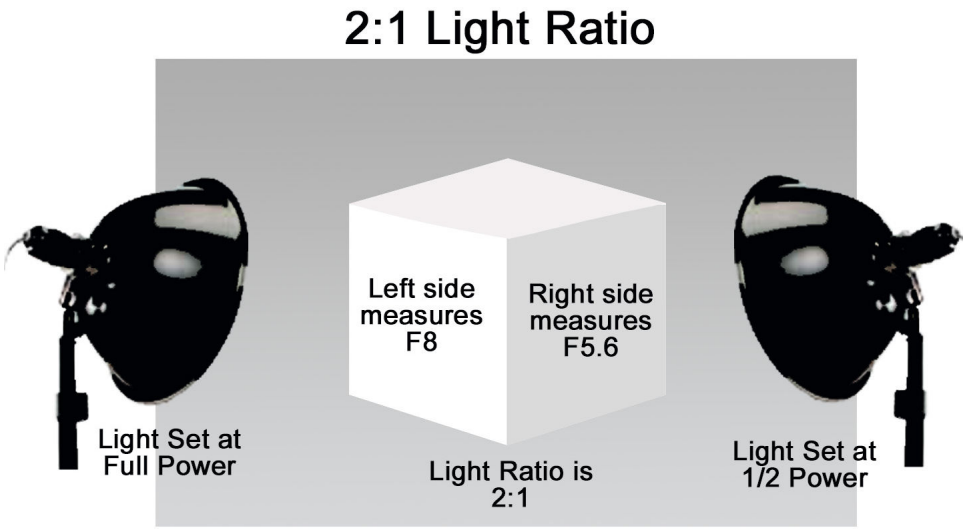
For many lighting situations, the contrast is controlled by the photographer using one light as a "main" light to initially illuminate the subject and a 2nd light or reflector which is introduced to "brighten" the shadows created by the main light. This 2nd light is known as a "fill" light because it "fills" the shadows with additional illumination.

Contrast and Light Ratios
With our box example, we could place the main light to illuminate the left side and place our 2nd light so that it only illuminates the right side. If both lights are set identically to the same power, then the ratio of the lights are set at 1:1 (equal power) and the result of the light on the box is also 1:1 since there are equal amounts of light on both sides. (see right)



When lighting is set in this manner, there is not really a "fill" light. Both are acting like "main" lights. Lights that are placed a 45° on both sides of the camera at equal power are said to be in a "butterfly" position. Each light should be measured separately to make sure they are set to equal output. Let's say we measure each light at F8. The overall exposure in this set up would be F8 as the lights are independently illuminating the two distinct sides of the box.

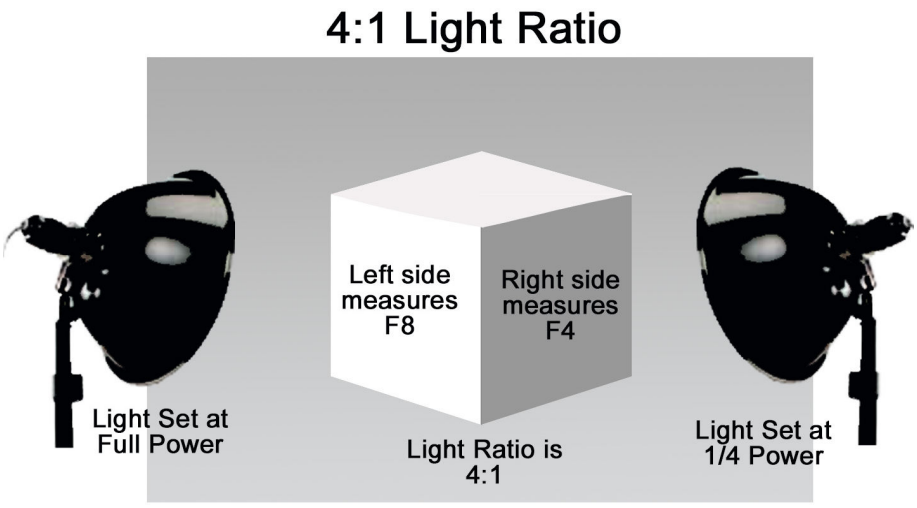
This is a common light pattern that produces a "flat" light result because there is no contrast between the highlight and shadows because there are basically no shadows to begin with.



If I decrease the power of the right light by one stop (from F8 to F5.6) , the left light(F8) is now twice as bright as the right light (F5.6). Remember, twice the amount of light represents one stop, so now my lights are set at 2:1 and the result on the box is also 2:1.

The light at full power on the left acts as the "main" light and would place the right side of the box in shadow, but because there is the light on the right side, it "fills" in the shadow created by the main and reduces the contrast.

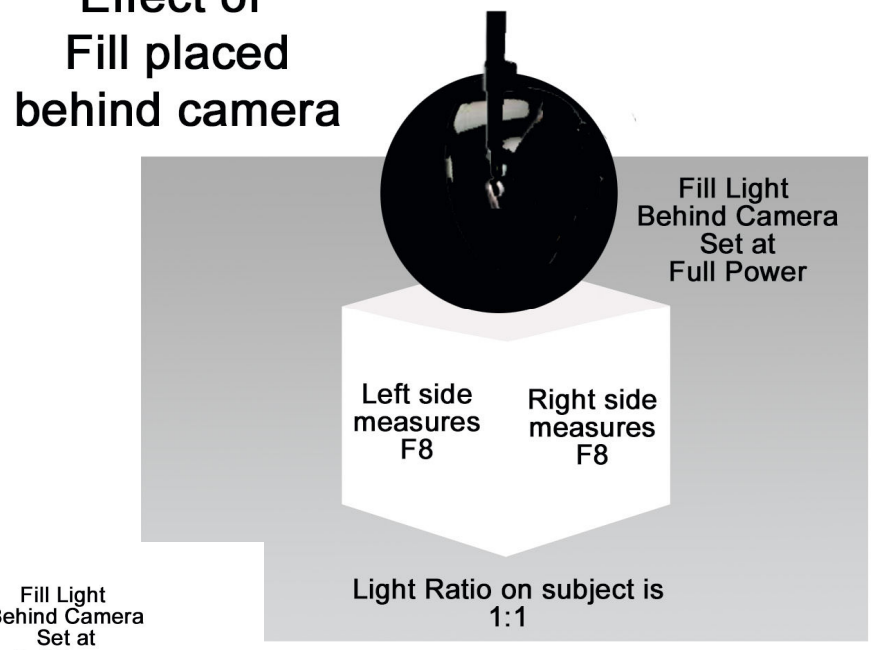
If I decrease the power of the right light by two stops (from F8 to F4), the left light(F8) is now four times as bright as the right light(F4). Remember, 4X the amount of light represents two stops, so now my lights are set at 4:1 and the result on the box is also 4:1. The contrast has increased compared to the 2:1 setting.

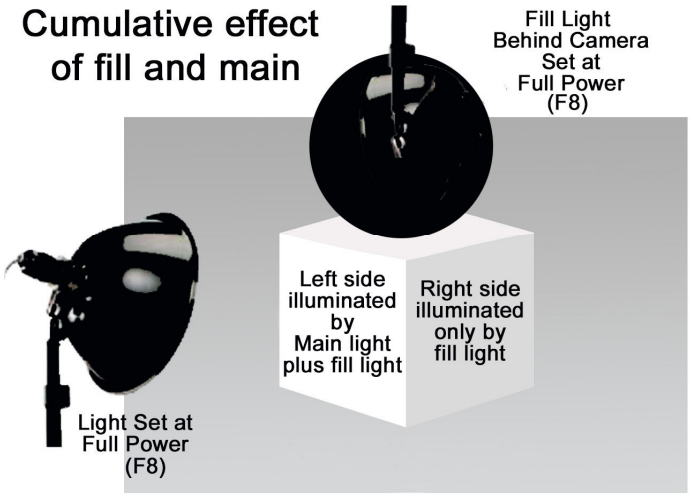


Keep in mind, that the placement of the two lights in the previous examples are in such a manner that neither one adds any light to the opposing side.

Layered Lighting
Something very interesting happens when we move one of the lights behind the camera so that it is allowed to add light to BOTH sides of the box.

Both sides of the box receive equal illumination with the light in this position. Notice in the example at right, each side measures F8 from the single light source placed behind the camera.



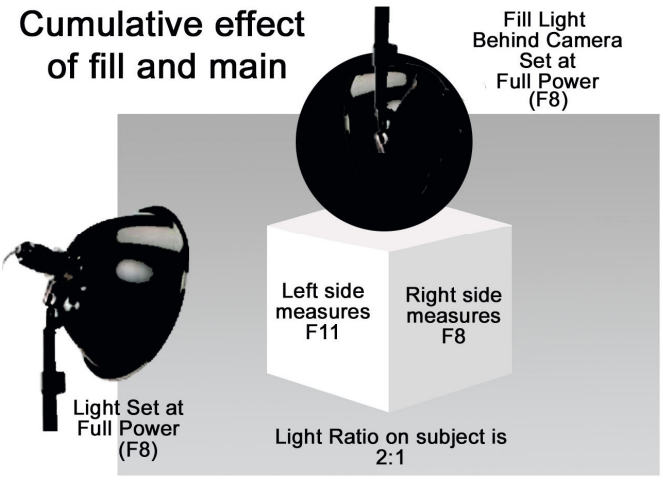


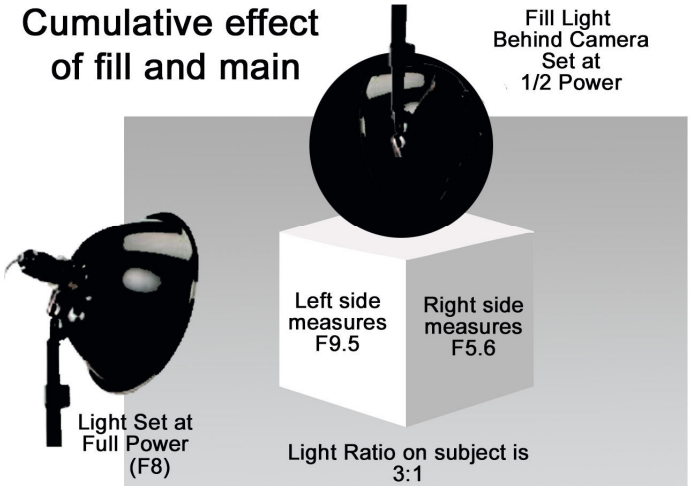
Adding a main light on the left only provides light to the left side, but the fill behind the camera adds light to the shadow side AND the highlight side.

We have already learned that lighting is **cumulative**, so when we add light to the highlight side we have to account for the fact that the overall exposure on the highlight side has **increased**!

For example, if the main measures F8 and the fill behind the camera also measures F8, then the left side of the box receives the net effect of two lights, 2X as much (cumulative) and the right side only receives the effect of one light. (see right)

Since both lights measure F8, the left side of the box would measure F11 cumulatively and the right side would measure F8 for a 2:1 ratio on the box - even though the lights are at equal power (1:1).





If we power down the fill by one stop to F5.6, then the highlight side accumulates all of the light from the main (F8) plus 1/2 stop of additional light from the fill for a cumulative total of F9.5 (F8.5 on the light meter set to measure in 1/10 stops).

The shadow side of the box only gets the lighting from the fill light (F5.6) set at 1/2 power of the main. So the difference is that the left side is 3X brighter than the right. F9.5 compared to F5.6 or 3:1. Remember, the ratio at the subject is 3:1 even though the lights are set at a 2:1 ratio.

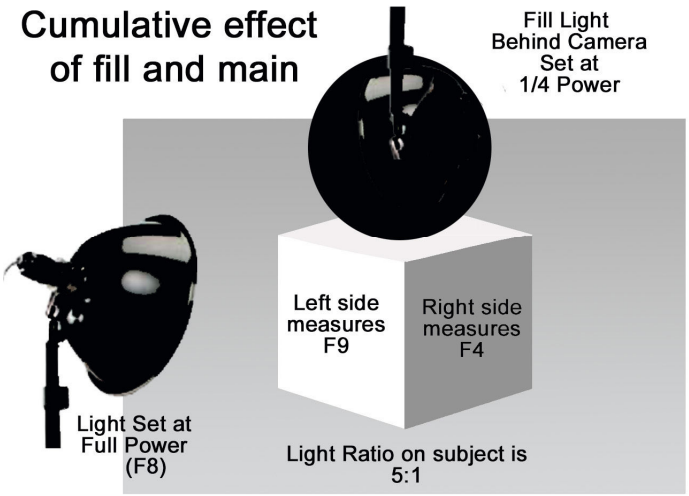
The exposure is based on the overall reading of both lights on the highlight side which would be F9.5 and that is how you would set the camera.

In a 3:1 ratio, the highlight side will always measure 1 ½ stops brighter than the fill.

You will need to recognize the f-stops (half stop increments) that exist between the whole stops.

If we power down the fill by two stops to F4, the highlight side accumulates all of the light from the main (F8) plus 1/4 stop of additional light from the fill (4x + 1/4) for a cumulative total of F9 (F8.3 on the light meter set to measure in 1/10 stops).

The shadow side of the box only gets the lighting from the fill light (F4) set at 1/4 power of the main. So the difference is that the left side is 5X brighter than the right. F9 compared to F4 or a 5:1 ratio. Remember, the ratio at the subject is 5:1 even though the lights are set at a 4:1 ratio.



In a 5:1 ratio, the highlight side will always measure 2 1/3 stops brighter than the fill.

Again, you will need to recognize the f-stops (1/3 stop increments) that exist between the whole stops.

If all of this discussion on cumulative properties of light (or layered lighting) seems terribly confusing, allow me this simplified comparison to see if it helps:

Scenario #1

I have two piggy banks.
I named them Main and Fill.
If I put $1 in the Main Bank,
Then, I put $1 more (1X) in the Main Bank and $1 (1X) in the Fill
2:1 ratio.

Scenario #2

I put $1 in the Main bank.
Then, I put $0.50 (1/2X) in the Main bank and $0.50 (1/2X) in the Fill bank
I have $1.50 in the Main and $0.50 in the Fill
3:1 ratio

Scenario #3

If I put $1 in the Main bank,
Then, I put $0.25 (1/4X) in the Main bank and $0.25 (1/4X) in the Fill bank
I have $1.25 in the Main and $0.25 in the Fill
5:1 ratio

There are no trick questions on the CPP test. In preparing to take the CPP test, the questions will always indicate the placement of the main and the fill. You should be able to recognize when the placement of the fill creates a layered lighting situation. The questions will basically address either the result of the ratio of the lights on the subject, OR, how the lights should be set to achieve that result.

One More Thing
Light gathered by the sensor is also cumulative. The longer the sensor is exposed to light, the more light is recorded by the sensor. This is why long exposures (30 - 60 seconds) of a landscape illuminated by a full moon will actually render the night scene to appear almost as broad daylight. The sensor just keeps gathering light until the shutter is closed, or it gathers so much light that it completely over exposed the scene and yields no detail.

C. Understand light modifiers (light blockers, black reflectors, gels, spots, flags, etc.) and their uses. (3 items)

1. Knowledge of use of modification devices to achieve desired effects (gels, reflectors, umbrellas, soft boxes, foil, parabolics, etc)

Lighting Modifiers

Parabolics

Parabolic reflectors are designed to increase the efficiency of the light by focusing the light forward. This is accomplished by the "bowl" shape which works to keep the light beaming forward. The directional beam of light can be very harsh creating very **distinct shadows** which "sculpts" the subject to bring out detail and texture.

For portrait images, the lights are usually **feathered** to skim the edges of the light on the subject to create a softer and more flattering light on the subjects.

The parabolic shape is also used in other lighting modifiers such as parabolic umbrellas.

Umbrellas: . Great for portraits as they provide uniform diffused light. They are available in a variety of sizes and materials. The larger the umbrella, the softer the light it can produce.

Some umbrellas are made specifically to "shoot through", meaning the light source is directed toward the subject and passes through the umbrella. With most umbrellas, the light is turned away from the subject and bounced into the interior of the umbrella, so the reflected light bounces back to illuminate the subject.

Umbrella

Select white, silver or gold, depending on the warmth of light you want to direct onto your subject.

A white satin umbrella provides a high degree of soft lighting with little contrast.

A silver umbrella will create a more specular light with more contrast than the white umbrella.

A gold umbrella is also quite specular and produces a higher degree of contrast. It is often used to "warm" skin tones or to closely match the quality and color of sunlight.

CPP Study Guide
by Steve Kozak

Softbox: Available in different sizes to help control the contrast of the light. Smaller softboxes produce higher contrast light while the larger softboxes provide a softer light. Usually used in conjunction with a reflector. The image below shows a small softbox fitted over a portable strobe.


Softbox

Strip Light: A narrow softbox—great as a hair light or as a main light. (see above)

Scrim: Translucent diffusion panels are placed in front of a light source to soften the light. (see left)

Snoot: When attached to a light source, snoots restrict the spread of light to a concentrated area. They produce a "spotlight" effect. Some have a focusing capability to allow you to control the spread of the light.


Snoot

Barn Doors: These attach to your strobes to control light coverage. They usually have 2 or 4 hinged flaps that move independently and adjust how wide or narrow an area the light covers. (see left)

Grids: Also known as, "egg crates", grids are used to control stray light by keeping the direction of light focused forward. The softbox at right is fitted with grids.

Louvers: Blinds attached to a softbox that open and close to help control the volume of light and the direction of the light coming out of the softbox.

Lighting Accessory Gear

Gobo/Flag: Gobo comes from the words "go between". Gobos are usually black cards or “flags” that are placed in front of the light source to block unwanted light. They are usually used to keep light from hitting a particular spot on the subject or to keep stray light off the background. (left)

Reflectors: Reflectors come in many shapes and sizes and are made from numerous materials. They are used to reflect or bounce light back into shadow areas to help illuminate details.

White reflectors provide a soft, diffused light quality where silver reflectors tend to be more specular.

Gold reflectors reflect “warm” light onto the subject.

Black reflectors are used to add lighting contrast on a subject through a subtractive light technique in which the reflector is used to “block” light or to reflect “black” into the shadows.

The image at left was taken with the ambient light present in the scene and without any supplemental lighting.

In the image at labove you can see the placement of my gold reflector to add additional light to the subject.

The final image (above right) is improved with the reflector providing better lighting on her face and by elevating the exposure for the shadows.

Gels: Filter sheets are used over light sources to change colors of backgrounds or change the color temperature of the light source. There are also gels to help diffuse light.

Gels are often used to create color in the background. Color choices are selected to create mood, create contrast or to create a desired color scheme. In the image at left, I selected the gel to tie together the color of her hair and her shirt.

This gel kit (right) is used to adapt the color output of a portable strobe. The assortment of filters allows for color correction as well as creativity in introducing color into a scene.

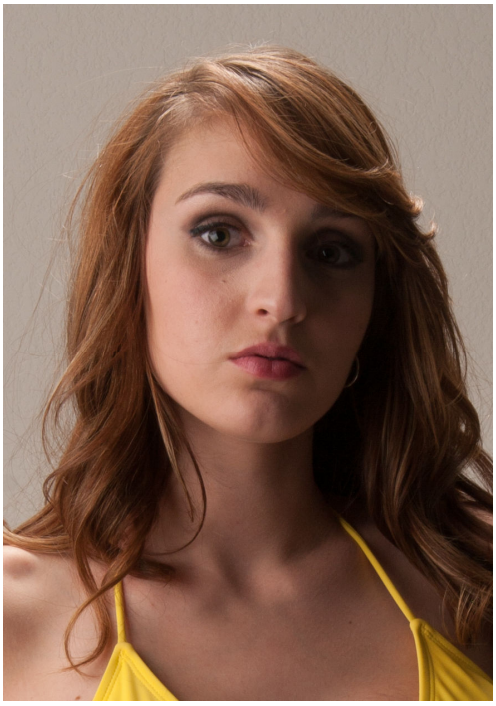
2. Knowledge of additive and subtractive light

Using Additive and Subtractive Light

Additive Light

Using light to sculpt the subject requires a degree of directional light that skims and rakes across the subject to create form, shape and texture. This will be true when working with natural light or artificial lighting. In either case, the efforts of the photographer to create a directional light pattern also creates shadows. In that the photographer is responsible for creating or directing the light onto the subject, so too is the photographer responsible for handling the shadows that are created. In some cases, the shadows may be too strong or too deep that additional (additive) light will be required to provide some degree of illumination of the shadow area.

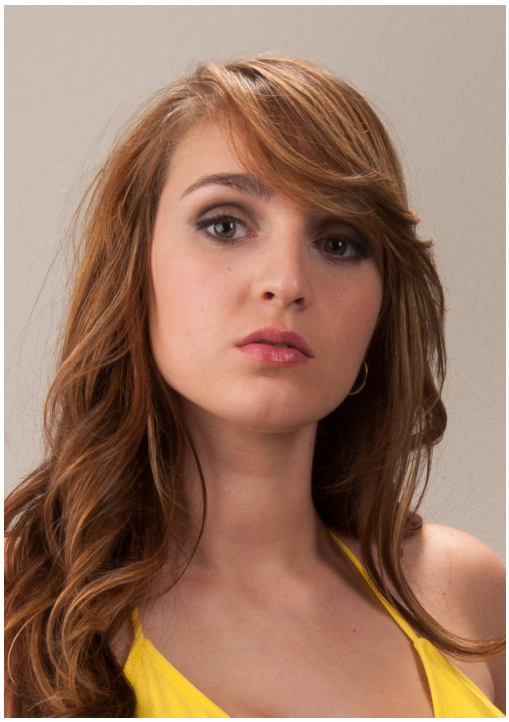
In the studio environment, this task is usually handled by a “fill” light. Where the main light is used to create the directional pattern of light on the subject, the fill lights job is to take care of the shadows. The illumination of the shadows by the fill light determines the lighting ratio of light on the subject. (see pages 72-76)



In the test image at left, only the main light is used. I was setting up to do a swimsuit image for her portfolio, so I placed the main light to camera left so that the light would rake across the body to bring out the curves and shape of her body. This test image shows the deep shadows that were created from the main light.

I need the shadows because raking light brings out texture and detail, but I did not want the shadows to be that strong.

Adding a fill light behind the camera now adds light to the shadow side. I am going to control the shadows by adjusting the intensity of the fill light.



In the test image at right, I decided the fill was a bit too strong making the over all lighting appear too flat. Flat lighting would not bring out the curves and contours of her body, so I elected to power down the fill light one more stop.

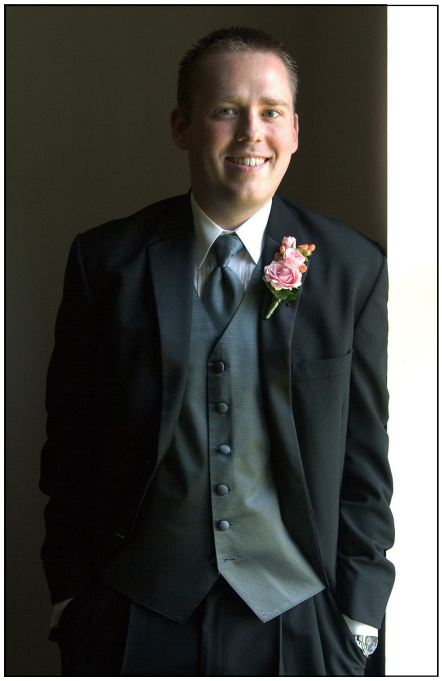
The final result gave me a nice lighting pattern with form and shape but with good detail in the shadow areas.

Control of the shadows can also be handled with any number of reflector types in the studio or with natural light. In some lighting scenarios, the main light may be provided by light bounced off of a reflector and the ambient light may be used as the fill.

In the image at left, I created a dramatic lighting pattern that also created very deep shadows.

In the image at right, I added a gold reflector to lightly fill in the shadows.

The degree to which the shadows are filled is strictly a matter of taste. By feathering the reflector, I could increase or decrease the intensity of the reflector fill. I ultimately selected a pose in which the amount of fill was even less than shown here because I liked the dramatic look.



The image at left was taken with natural window light. I felt like the lighting had too much contrast as the shadows were particularly deep.

In the image at right, I used an additive lighting technique by bouncing a bit of light from my portable strobe off of the wall and ceiling to my left.

This raised the illumination of the shadows just enough to provide detail and a nice balance to the lighting pattern.

Subtractive Light
In some cases, a photographer will need to keep light from reaching the subject in order to create a more desirable or a more directional lighting pattern. In using a subtractive lighting technique, the photographer will block unwanted light or reduce the amount of incoming light in order to achieve the desired result.

In the image at right, There is so much overhead light, that I am not getting a good directional lighting pattern. The light from above is causing deep shadows in the eyes and strong highlights on her cheeks, forehead and the top of her dress and flowers.

I could have elected to use an additive lighting technique and introduced a bit of flash onto the subject to create a directional lighting pattern and eliminate the dark circles in her eyes.

Instead, I chose to use a simple **subtractive lighting** technique. By using a nearby covered walkway as a canopy to block the overhead light, I was able to redirect the direction of light to the side providing me a wonderful directional lighting pattern.

The canopy allows the side lighting to rake across the body providing texture and detail in her dress and flowers. It also provides nice illumination to the eyes and face.

The architecture of the church provided me with a canopy to block the overhead light, but this could also be done in some instances with a large black reflector or scrim.

In the image at right, I used a similar subtractive lighting technique to eliminate the contrast of the harsh, direct sunlight seen in the background. Creating this canopy also helped create a bit more of a directional lighting pattern on the flower. I also added a second mat board to simplify the background.

In the studio set up below, I am using a flag to eliminate some of the light from striking the background.

The result of the same set up is shown here. The image on the left is lit entirely by the main light. Not only is it illuminating the subject, it is also illuminating the background.

By using a subtractive technique, I place my flag in between the main light and the background to keep the light off the background. I feathered the flag in such a way that I even blocked some of the light on the subject's right side to darken her hair and her arm.

D. Determine the type of lighting to be used with the given subject(s). (4 items)

1. Knowledge of soft, hard and diffused light sources for producing desired effects

Regardless of the type of light that is being used to illuminate a subject or a scene, a photographer must consider both the **quantity** of light and the **quality** of light.

Quantity of Light
Exposure of an image is based on the quantity of light that is present on the subject and within the scene whether the lighting is from a natural light source or lighting that has been introduced into the scene or a combination of both. The quantity of light is measurable with a light meter and by recognizing known values following the “Sunny 16” rule. (See page 105)

Photographers generally create exposures based on the lighting that illuminates the subject. Using this measurement as the basis for the exposure, the photographer will then evaluate the entire scene to determine other important considerations such as:

- the best angle to use
- how other light present in the scene might impact the image
- the exposure values of the shadows
- the intensity of the lighting in the background
- the impact of including the sky in the image
- and more

These observations determine whether or not the photographer might wish to:

- introduce additional supplemental lighting
- find ways to block unwanted light
- find ways to redirect the light
- introduce an artificial main source of light
- scrap the selected scene entirely

While most images base the exposure by the lighting on the subject, this is not always the case. Photographers may elect to create images to interpret a scene based on exposure values of other elements in the image. An example of this would be placing the subject in silhouette and basing the exposure on the light values of the sky and not the subject.

While proper exposure is a science, it is also an art and open to a lot of interpretation by the photographer.

Quality of Light
In evaluating the light from natural or artificial light sources, the photographer also considers the quality of light. This includes the characteristics of hard light (specular, high contrast) vs soft light (diffused), but also the inherent color of the light.

The image at right is an example of hard lighting from direct sun. The sharply defined shadows are the result of a hard light source.

The smaller the light source relative to the subject, the harder the light it will produce.

Of course, the sun is really quite large, but relative to the subject, it is a tiny orb in the sky.

When clouds move in and cover the sun, the sunlight is diffused, or spread out by the clouds, which turns the hard light from the sun into a large light source, which produces a soft, diffused lighting.

An overcast sky sort of acts like a huge softbox to diffuse the harsh light of the sun.

The soft light is a low-contrast light source that does not produce the distinctive shadows of a hard light.

In the image at left, there is little evidence of shadow on the ground. What shadow there is, has a very diffused edge.

Generally, the most flattering lighting for portraiture is a soft, diffused lighting.

When it comes to outdoor portraits, open shade provides the best opportunity for soft, diffused lighting. Just because the lighting is soft, we still may need to employ additional techniques to control the light.

The image above was created using open shade in the family's back yard.

Photographers considering a studio space may prefer a space with a north facing window since it does not have to deal with direct sunlight coming through it.

A north facing window is a great source of soft, diffused lighting throughout the entire day.

Lighting Design

Hard Light Sources

Hard light is described as harsh lighting from a small light source (relative to the subject) which produces strong and distinct shadows. Because hard lighting creates strong contrasts between highlights and shadows, it is often use to emphasize texture and form. Often times, hard lighting is considered to be unflattering for portrait subjects, but it may be appropriately used to create drama or emphasis on facial features.

Hard light sources are generally hard because they are small. Hard light sources include portable flash, parabolic reflectors and bare studio lighting sources. The sun is also a hard light source. Even though the sun is very large, its distance from the earth makes it appear small. This is important to understand because it is not just the size of the light source being small that makes the lighting hard - it is also the distance of the light source from the subject that will determine the light quality. Even a softbox can be a hard light source if it is used too far away from the subject.

Soft Light Sources

Soft, or diffused light sources are generally soft because they are larger in size and often used at close distances to the subject. An umbrella or a softbox, for example, alters the output of a hard studio light or flash by enlarging the size of the light source as the light bounces off of the reflective surface or shoots through an opaque fabric.

The closer the light source is to the subject, the softer it becomes. The further away the light source is from the subject, the harder it becomes.

Softer light is generally considered to be more flattering to portrait subjects because it tends to hide wrinkles and blemishes. The larger the source, the softer the light.

It is also often used in landscape photography because it has considerably less contrast than hard lighting. Less contrast means the tonal values will be more even and controlled. Commercial photographers will also use soft light to control or eliminate distracting shadows which might take away from the product.

Generally, a fill light will be a large light source so that it will work to reduce the shadows of the main light without creating additional shadows of its own.

Flat Lighting
Lighting that strikes the subject from the front or that does not rake across the subject to bring out texture and detail is said to be “flat”. An overcast day is a good example of “flat” lighting. Even though an overcast day is soft lighting, the over all effect of it is to be flat because it is not directional.

Hard light can also be flat if it strikes the subject from the front and does not rake. For example, an on-camera flash creates flat lighting. A subject that faces directly toward the sun will also appear flatly lit if the sun is behind the camera.

Flat lighting is not always bad. It is commonly used in product photography as well as fashion photography.

A light tent (right) is used to create very flat and shadowless lighting for product photography. For fashion photography, flat lighting diminishes the features of the model to focus more attention on the clothing or other product.

Flat lighting may also be a flattering choice for older clients and those with strong cases of facial blemished because of its tendency to hide wrinkles and skin imperfections.

When photographing large groups, flat lighting may be the safest choice to avoid the possibility of creating uncontrolled shadows across the group. On the image at right, I used two lights - one on each side of the camera at 45° at equal power to create a flat lighting pattern. This helped to reduce the unsightly shadows of the raised arms throughout the image.

2. Knowledge of desired light pattern effects (broad, short) to be obtained on different subjects and/or background

Lighting Patterns
If we see the face as having two sides divided down the center of the nose, a face turned towards the camera shows both sides equally. But turn the face to one side or the other, the camera will see more of one side and less of the other.

In the images below with the face divided at the nose, notice that the camera sees more of the right side of the face. The wider side is referred to as the **"broad"** side and the narrow side is called the **"short"** side.

Broad Lighting

The lighting pattern is named for the side it illuminates first. In the image at left, with the placement of the main light to the right of the camera. The model's head is turned to the left, but the light first strikes the side that shows more of her face. This pattern is referred to as **"broad lighting"**.

You can also image that if we were able to see her ears, we would see her ear on the right, but not on the left. The light first strikes the side of her face (broad side) that is turned toward the camera where we could see her ear.

Short Lighting

In the image at right, the main light was moved to the left side of the camera. Now the main light first strikes the model's narrow side of her face, or the side that is turned away from the camera. This lighting pattern is called, **"short lighting"**.

Lighting

3. Knowledge of directing and combining lights (corrective lighting) with different subjects to create desired effects and complement them

Creating A Broad Light Pattern
Again, we want to consider that the subject is making a deliberate turn of the head so they are not looking directly into the camera, but not so far that the nose breaks the plain of the back cheek.

I generally try to turn the head enough to show only one ear. Placing the light so that it is on the same side as the visible ear will produce a **Broad Light Pattern**.

Placing the main light on the same side of the face that is turned away from the camera will produce a **Short Light Pattern**.

Broad Lighting vs. Short Lighting
Broad lighting tends to make a face “fuller” and “rounder” and the appearance of added “weight” on the subject.

Short lighting tends to slenderize a rounded face and tends to be the most flattering lighting pattern on most subjects.

My memory device is, “No woman wants to be a broad!” Since no one has ever come into my studio as asked me to make them appear “fuller and rounder”, I make a point to do short lighting on most of my subjects.

E. Determine the appropriate lighting usage (main, fill, etc) for subject(s). (6 items)

1. Knowledge and placement of main/key, fill, background, accent lights to achieve desired effects (control shadows, create depth, enhance subject matter)

Main light
The choice of type and size of main light to be used is almost always a product of the venue the photographer is working in, what the photographer has on hand and the final result the photographer wishes to achieve. From hard light to soft, from flat light to directional, from studio lighting to natural sunlight, there are many decisions that go into the lighting tools that will be used and the placement of those tools to obtain a desired effect and to overcome obstacles.

The main light is almost always the first consideration. If you are working outdoors or on location with natural light, the environment may very well dictate the placement of the subject within that environment to achieve the desired lighting pattern. When it is not possible to place the subject, the photographer must be able to create the desired lighting in a wide variety of scenarios. This may include using additive or subtractive lighting techniques—maybe both. No matter what the situation is, the main light begins the lighting process.

Whether the main light is an artificial source or a natural light source, its first job is still to illuminate the subject. It is used to create highlights and shadows in a lighting style and pattern that is desired.

The placement of the main light should be high enough that the catchlights appear at the ten o'clock or two o'clock position in the eyes.

Catchlight: The points of light created by the light source that appears in the subject's eyes. The catchlights traditionally should be at either the ten o'clock or two o'clock position.

Lighting

E. Determine the appropriate lighting usage (main, fill, etc) for subject(s). (6 items)

1. Knowledge and placement of main/key, fill, background, accent lights to achieve desired effects (control shadows, create depth, enhance subject matter)

Main light
When appropriate, it may even be used to create flat lighting.

In both of the images below, flat lighting was used because both subjects faces are in very different places. Directional lighting from either side of the camera would likely result in unwanted shadows or lighting that came from below the face of the reclining subjects. The safest choice was to create a flat lighting environment.

In the outdoor image above, I simply selected an area where the sun reflected off of a building behind me to create flat lighting on the couple.

In the studio image above, I used a large softbox above and behind the camera to create a flat lighting pattern on the couple.

Key: Refers to the overall colors or tones of an image.

High Key: Refers to an image that is created using mostly light tones and bright backgrounds.

Low Key: Refers to an image that is created using mostly dark tones and dark backgrounds.

High Key **Low Key**

Lighting

If texture and detail are important, then directional lighting is a must and the subject should be placed in such a way that the light rakes across the subject to bring out form and shape.

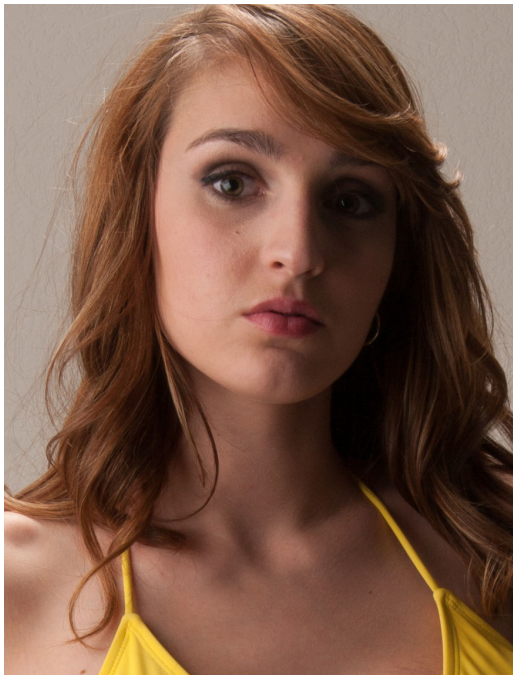
Lighting patterns are the same whether created with natural light or artificial light.

Both of these images feature a very similar look to the directional light even though one was done with natural light and the other with artificial lighting.

The images below and right both use lighting to create a split lighting pattern. The image below used natural window light and the image at right was with studio flash from a large softbox.

High overhead lighting patterns often produce unwanted highlights and dark eyes. By turning the face upward toward the light and selecting an appropriate pose, even troublesome lighting can turn into something usable indoors or in the studio.

Fill Light: The fill light is used to control contrast. By increasing the power of the fill you reduce the contrast in the photo. By decreasing the amount of light from the fill, you will increase contrast. The purpose of the fill light is to add just enough light to soften the shadows created by the main light.

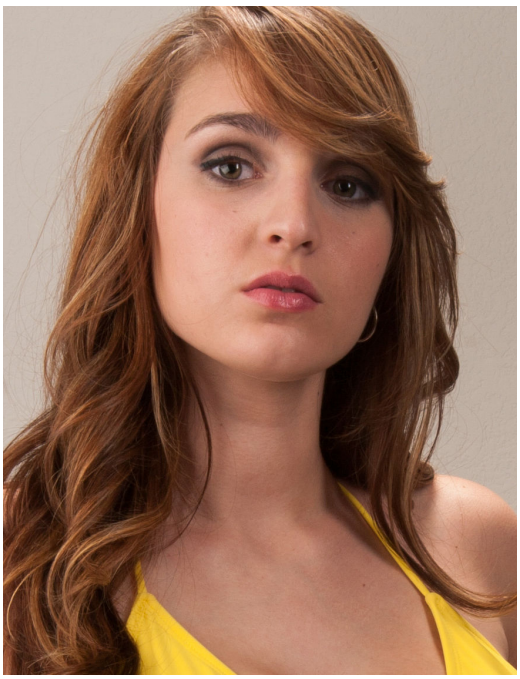


The image above shows the lighting of the main light with no fill.

Traditionally, the fill light is placed directly behind the camera.

This helps to keep the fill from creating a 2nd, unnatural shadow on the highlight side of the face.

Sometimes, the fill may be placed on the shadow side at about 45° from the camera.



The image above shows the same lighting as the image at left but with an added fill light.

Hair Light: The hair light illuminates the subject's hair providing separation from the background. This is especially important when photographing a subject with dark hair against a dark background. It is usually placed above and slightly behind the head. This light should only illuminate the hair and should not spill onto the subject's face.

Rimlight: The bright, outer glow of light coming from the back side is call a rim light.

This is a great technique for creating a fashion look for your female subjects with longer hair. (left)

The light is placed behind the head with the light directed to the back of the head.

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Background Light: Lights can be used to illuminate the background, gaining more depth or separation in your image. This light is usually placed behind the subject and towards the background to create a desirable pattern.

In the image at left, the subject's hair blends into the very dark background and creates no separation between the two.

In the image at right, a background light was placed behind the subject and pointed toward the seamless paper background. This gives a nice gradation to the background and provides good separation between it and her hair.

The image at left was taken with natural window light in a darkened hallway.

In the image at right, I simply turned on the recessed lighting fixtures which provided enough lighting on the wall to create separation and give the image a sense of depth.

Accent/Kicker Light: This specialty light defines and sculpts the subject by adding a strong highlight on the subject to add interest, create from or separation.

Notice how the image on the right utilizes a kicker light to bring out the subject's jaw line which helps to define the shape of her face.

Kicker lights can be created with just about any size light source. They are often times created by using a strip light or softbox placed behind the subject at about 45° and pointing back towards the subject.

A softbox keeps the kicker from becoming so specular and spreads the kicker over a larger area.

Care must be taken to not get flare in the lens since the lights are facing the camera.

Kicker lights are not just for the studio, the pattern can also be created with natural lighting in certain conditions.

In the image at right, I positioned the couple with the natural, ambient light coming in from the back right.

I then added a hint of fill flash to illuminate the couple from the front.

The ambient light served to provide a very nice hair light on her and an accent light on the left of his face and a nice separation light on his right shoulder.

2. Knowledge of techniques for controlling/utilizing light (natural light, window, outdoor, studio, mixed, incandescent, florescent, LED)

Controlling Natural Light
Natural light is somewhat unpredictable from day to day. Changes to natural lighting conditions occur with full sun, overcast skies and heavy cloud cover. Each lighting condition changes the photographer's approach in how subject will be lit.

With portrait photography, full sun is a hard light source and generally not well suited.

The image at right was taken at midday with the sun high overhead. The mix of highlights and shadows on the faces makes for lighting that is harsh and uneven.

The image may have benefited from a strong fill flash to raise the illumination of the shadows.

Photographers may need to seek out opportunities to work in open shade or create opportunities for diffused directional light.

The arsenal of gear used by photographers to control the light include, scrims, translucent panels, gobos, reflectors, umbrellas, softboxes, parabolic reflectors, snoots, barn doors, honeycomb grids and more.

Translucent panels may be utilized to the modify hard sunlight and turn it into a larger and softer quality of light.

Subtractive lighting tools may be used to block direct sunlight and create directional light that is better suited.

Window light is at it best when there is no direct sunlight coming through the window and the lighting is soft. This could mean working on the side of the building opposite the sun, or north facing windows that do not get direct sun.

Window light may be modified with translucent fabrics to cover the window when direct sun comes in through the window.

Window light may also benefit from reflector fill if the contrast of the lighting is unacceptable.

Overcast skies and heavy cloud cover tend to create very flat lighting. Subtractive lighting methods may be employed to create directional patterns and eliminate high, overhead lighting.

The angle of the sun when it is low in the sky during early morning and near sunset tends to bring out the textures of landscapes and architecture. The lower angle allows the lighting to skim across the ground and on surfaces that will appear flat lit once the sun comes up.

The Golden Hour
The period of time around sunrise and up to one hour after sunrise, and about thirty minutes before sunset is known as the “golden hour” or “magic hour”.

The sun’s lighting appears softer and warmer during these times making these popular times for capturing images.

Mixing Light Sources
Inevitably, a photographer is going to be in a position where lighting of various types and color will come into play. For example, you may find yourself having to mix artificial light sources with natural light sources or even mixing various types of artificial light.

The image right was a screenshot of a local official who was doing a press conference. It is one of the worst examples of mixed lighting I have seen. The warmer ambient light overhead is clashing with the blue light emitting from his monitor in front. This situation would have benefitted greatly from an added light source in front to overcome the effects of mixed lighting.

The keys to the solution of using mixed lighting sources is:

A. To overpower the ambient light with supplemental lighting, or
B. Determine the color temperature of each of the light sources and then using color corrective gels to bring the color temperatures in line.

It is helpful to have an assortment of color correction filters for the various light sources you might encounter.

Example 1
A typical scenario might include photographing at a church wedding. Many of the images that are created at a wedding take place in the sanctuary where the primary lighting is a tungsten light source which illuminates the congregation and, perhaps, even stronger tungsten lighting to cover the alter area. The color values of these areas could easily range between 2800K—3400K.

If you photograph the wedding party at the alter with a flash, you are now mixing a daylight balanced flash at 5500K with the 3000K lighting at the alter. Setting the camera's white balance to "flash" or "daylight" will provide a proper color for the wedding party. The color values in the church will shift to "orange".

Setting the white balance to "Tungsten" while using the flash will make the color of the church look good, but the color of the people lit by the flash will go awry.

The solution:

Add an orange, color correcting gel to the flash which changes the "daylight" color balance of the flash to an equivalent "tungsten" value and **set the camera white balance to "Tungsten" (roughly 3200K)**.

CTO (color to Orange) filters will be available at various shades to fine tune the desired tungsten temperature setting.

Example 2
Photographing indoors with hot lights that have a color temperature of 3200K. The scene includes light coming into a large window that brings 5500K daylight into the room. If you set the camera white balance to daylight, the supplemental hot lighting turns orange. If you set the camera white balance to 3200K, then the color of the incoming window light shifts.

Solution 1: Use blue (CTB - Color to Blue) color correction gels over the supplemental hot lighting which changes the white balance to daylight and set the camera white balance to 5500K.

Solution 2:
You could use the hot lights without a gel, but cover the entire window with a CTO color correction gel which changes the white balance of the window light to tungsten and set the camera white balance to 3200K.

Either solution will work.

In situations where filtering the light is not practical, RAW capture will provide you with the opportunity to make corrections to the color in stages which can be combined to create the final image with proper color. It may be best to consider the primary light source on the subject when selecting the white balance, then use RAW corrections on the rest of scene.

3. Knowledge of backlighting for producing desired effects

Backlighting
Backlighting is a situations where the background is brighter than the subject. Recognizing a backlighting situation allows the photographer to make plans on how to handle the exposure.

In cases of strong backlighting, the background may completely "blow out" losing most if not all of the detail in the background when the camera exposure is set for the subject. To correct this issue, the photographer will need to add supplemental lighting onto the subject to raise the illumination on the subject to get the exposure value closer to the background exposure value.

The image at far left is an example of strong backlighting. The bride standing in the shade of the gazebo appears very dark compared to the F16 exposure of the background.

In the image at left, I attempted to lighten the image in Photoshop to simulate what happens to the background if I had used the exposure for the bride in the shade. The background would simply blow out.

The task at hand would be to raise the illumination of the bride to an exposure that is closer the that of the background.

The solutions:
This would be commonly done with using a fill flash technique.

Expose for the background and match the output of the flash to the exposure of the background.

It could also possibly be done with a reflector that adds illumination to the subject.

Constant lights such as LED lights may also provide enough illumination onto the subject to bring the exposure values in line with a bright background.

Lighting

It may be possible that the backlit background might have at least some portion that is better suited for the exposure. In this example, it may be as simple as selecting a telephoto lens that will isolate the best part of the background for bringing the exposure values closer together.

Other techniques may include trying to reduce the overall exposure of the background by blocking some or all of the light with a gobo or a scrim.

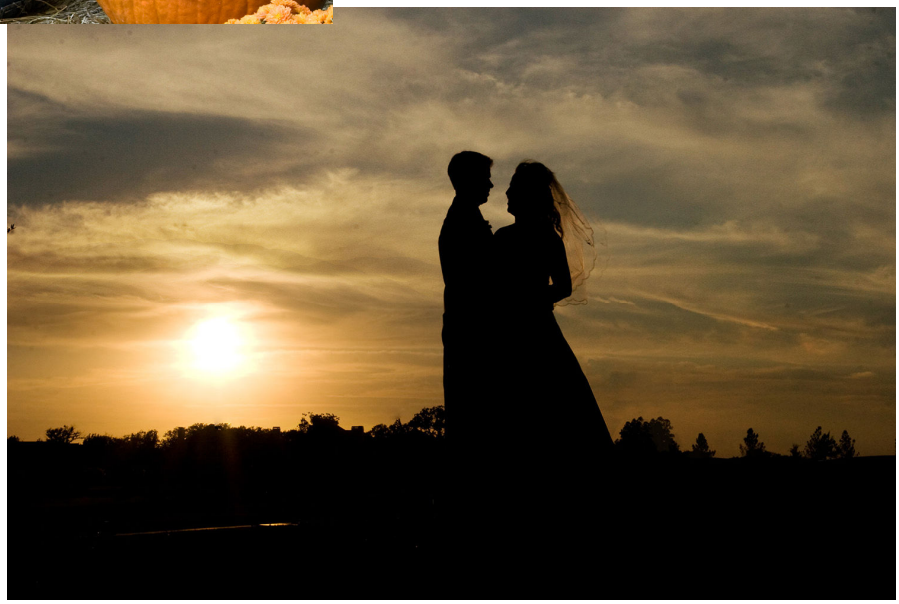
Some backlighting issues may be solved by using several images at separate exposures then working them in an image editing software to create a final acceptable image.

There could even be a strong case for allowing the background to simply blow out. If the background is terrible or if it adds to the desired effect to render the background as over exposed, then blowing it out may be a suitable creative decision.

Backlighting as a Rim Light
In cases where the backlighting is also striking the back of the subject, it may be possible to create a rim light pattern on the subject's hair. This is a wonderful technique when done properly. It is especially helpful if you are able to isolate the subject against the darker parts of the background - another bonus of having a telephoto lens on hand.

Creating Silhouettes
In other backlighting scenarios, it may be best to use the backlighting to create a strong silhouette.

To create a silhouette, measure the brightest part of the background and use that setting on the camera. Try to isolate the subject against the brightest part of the scene.



4. Knowledge of lighting products (reflective, transparent, translucent, opaque)

Product Lighting
There are several situations that may arise in product photography. Items that you encounter may range from jewelry to glassware as well as items that are translucent such as bottles of wine and items that are opaque. Each of these requires a different approach to how they are lit.

While it is impossible to cover every aspect of product photography here, we can take a look at some general approaches to come away with great images.

While I don't consider myself to be a product photographer, I have encountered many of the same situations that commercial photographers deal with in my wedding photography.

Reflective Surfaces
Products with highly reflective surfaces require very large light sources. The key to photographing reflective surfaces is to remember, you are photographing **reflections**. For example, with a product that is photographed with a softbox, you may very well be photographing the **reflection of the softbox** on the product's surface. Using a softbox at close range may allow you to see only the "white" of the box without having to see the box, stands, camera and other unwanted distractions in the items' reflection.

In the natural light image of this wedding cake at left, there was no direct reflection of light on the metallic surface of the letters on top of the cake. As a result, the brushed silver finish does is not even apparent.

In the image at right, I used a bounce flash technique and just a bit of a lower camera angle so that the letters would reflect some of the light from the flash as it hit the ceiling. The result is that the reflection of light on the letters allow us to see the true color and the metallic finish of the letters.

Softboxes, reflectors and light tents are very useful in this type of product photography. Reflectors may include simple white, gray or even black pieces of foam core which can be used to bounce reflections onto the objects' surface. Even with a light tent, black cards can be used to create black reflections which may help to better define the object.

Transparent Products
Transparent products such as glassware also benefit from large light sources and backlighting. Glassware can often times be presented through simply lighting the background and allowing the background to show through the object.

In the image at left, I lit this arrangement with natural window light which was several feet away. The pinpoint, specular highlights do little to define the shape of the globe. Basically, you see the windows in the reflection of the glass.

In the image at right, the bride asked me to photograph this bottle which was shared between her and her sisters. I used bounce flash to be able to create a large light source (the light from the flash striking the ceiling) which would give the bottle larger and diffused highlights. Photographing the bottle with direct flash would have just cause a lot of glare from the flash reflecting off the bottle.

With the image at right, I simply chose to photograph this candle in the church window using only the backlighting of the window. This kept me from dealing with any annoying reflections in the glass that would have occurred if I had used my flash.

In a studio environment, dimension and shape may be accentuated by the use of pieces of white and black foam core to reflect on the objects surface. For example, take another look at the image of the window lit arrangement above. There is a hint of a dark outline along the contour of the globe. This was simply a reflection of the darkened room in the glass. Had this been a studio image, I could have brought in black foam core and placed it in such a way that it reflected in the class to give the globe a stronger definition of shape.

In the image at right, the white highlights on the edges help define the shape of the globe. These are reflections of the window sill in the glass, but this could also be accomplished with white foam core in the studio.

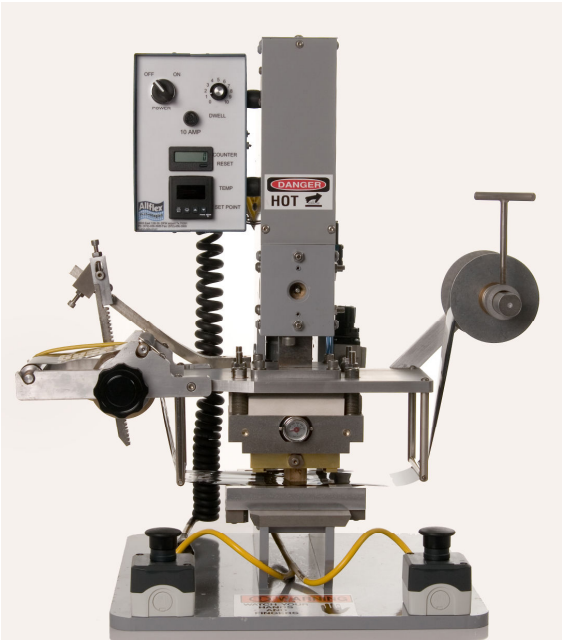
Translucent Products
Translucent products also benefit from large light sources and well placed reflectors. Backlighting is often employed to help define the value of the translucency of the object and provide definition to shape and form as needed.

This frosted mug at right was nicely lit with a large window behind the table. The backlighting really shows off the translucence of the mug and the beer.

Opaque Items
The list of opaque items one might encounter is huge! The task is to define the shape, texture and details of the product as well as its color.

Soft lighting is frequently used in product photography in order to showcase the product without unwanted shadows.

In the studio, a large softbox or translucent scrim is often used to light product with soft, even light which is virtually free from shadows. In the image above, I used a 4x6 softbox to show off these corrugated bins. (The client sells the bins, not the product in them.) I positioned the box above and slightly to the left so that I could create just enough shadow and highlight on the bins to give them a sense of depth.



With the image at right, I used a large umbrella to the left to skim the light just across the front of this machine. The soft shadows of the skimming light provide depth and a bit of three dimensionality to the device.

I also used a large sheet of white foam core to the right as a reflector to bounce back some of the light so that the lighting was still pretty even.

5. Knowledge of using flash fill techniques (indoor and outdoor; Sunny 16 rule, basic daylight exposure)

The "Sunny 16" Rule

Every situation that you encounter has a measurable amount of light to work with, and with the help of a meter, we could measure the exact amount of light for that situation. For now, however, we're simply going to learn to estimate the amount of light without the help of the meter.

When working under daylight conditions only, there is a formula that makes calculating the exposure quite easy. We are looking for a starting exposure and this chart makes it simple to memorize. The formula is call the **"Sunny 16 Rule"** and looks like this:

Lighting Pattern / Starting Exposure
Sunny / F16 @ 1/ISO
Partly Cloudy / F11 @ 1/ISO
Overcast / F8 @ 1/ISO
Heavy Overcast / F5.6 @ 1/ISO

For each of the lighting patterns, the f-stop is given. The shutter speed will be determined by the ISO that is being used.

For example, if it's a **sunny day,** and you are using **100 ISO,** the starting exposure would be **F16 at 1/125.**
(1/125 is the closest shutter speed to 100 ISO.)

If you are using 400 ISO, the closest shutter speed will be 1/500, so your starting exposure would be F16 at 1/500.

Once you have determined the starting exposure, then you can go through the equivalent exposure process we learned earlier, to determine the equivalent exposure you might wish to use, depending on the effect you want. (see page 53)

Example 1
On a "heavy overcast" day using 400 ISO. The exposure would be F5.6 @ 1/500.

You might like an increased DOF, so try
F8 @ 1/250
or
F11 @ 1/125
or
F16 @ 1/60

All of these exposures will work, but F16 will give you the most DOF. You can even go to F22 at 1/30, but remember 1/30 may be too slow to hand-hold the camera without noticeable camera shake.

Example 2
This time we find ourselves on a sunny day with 100 ISO. The starting exposure will be F16 at 125. We want to "freeze" kids who are riding bicycles so they appear sharp. Try:

F11 @ 1/250
F8 @ 1/500
or
F5.6 @ 1/1000.

F5.6 at 1/1000 will be the sharpest of the choices. Yes, there will be a shallower DOF, but what is the priority here?

Flash Fill and "The Sunny 16 Rule"
While it may not be ideal to photograph a subject in full sun, sometimes, there is no choice. The hard lighting of full sun creates strong shadows which may be objectionable. In these situations, a portable flash may be used to help fill some of the harsh shadows.

We will look at using flash in detail in the following pages, but lets get a quick understanding of what can be done in using flash with the "Sunny 16" rule.

Let's take an example of a bride and groom exiting the church after the ceremony. With an afternoon wedding, they will be making their exit outside in full sun. Photographing at F16 at 1/125 with 100 ISO follows the "Sunny 16" rule. The problem is going to be the hard shadows that occur because of the sun. Using the flash as a "fill" will help raise the illumination of the shadows.

Balancing the fill light to the main light creates "flat" lighting. So, the goal here is to introduce the flash at an output that is less than F16. Typically, **setting the flash to fire one stop less** than F16 will provide enough illumination in the shadows to provide detail and to offset some of the unwanted shadows.

Remember, you can't get rid of all of the shadows or the lighting appears flat and unnatural. Setting the flash too low will likely result in not seeing any evidence of it at all as the exposure from the sun is so strong.

In the image at right, I photographed the bride in groom just outside the chapel at F16. Knowing they would be in and out of direct sunlight, I set my flash to fire one stop less at F11. The flash fills her face and his back nicely, although the fill is somewhat obvious.

Setting the flash to fire one stop less than the ambient light outdoors is a pretty good formula to follow.

6. Knowledge of on-camera and off-camera flash techniques (TTL, high speed sync, manual)

The Basics of Flash Photography

The power output of a portable flash varies from brand to brand and with different models. The versatility of a portable flash is a product of having plenty of power to start with and the ability to power the flash down when necessary.

The output of the flash is key because this determines the f-stop ranges you will be able to use for exposures with the flash.

Flashes can be used at a constant output (manual) or with a variable output (TTL).

A flash meter will help determine the exposure by providing you with the f-stop. Unlike non-flash photography, we do not really have a choice of shutter speeds. The shutter speed will be dictated by the camera's sync speed.

Flash Sync

In order to use a portable flash, we need to know the correct "flash sync" of the camera. This is the fastest shutter speed that can be used and still coordinate the timing of the flash with the shutter in the camera. The sync speed is determined by the manufacturer and model of the camera being used. Generally it is 1/125 or 1/200, but it may vary from camera to camera. Certain shutters sync at all speeds. Be sure to check your camera manual to determine your camera's sync.

Out of Sync

Failure to use the correct flash sync may result in a portion - if not most of your photographs to be black. This occurs when the flash fires and the curtain mechanism or camera shutter has not had time to get fully opened. The flash fires and the curtain blocks a portion of the sensor so nothing is recorded in that area. This creates the black area on the photograph!

6. Knowledge of on-camera and off-camera flash techniques (TTL, high speed sync, manual)

TTL
TTL mode is where the light passes "**through the lens**" and is measured at the sensor.

When using your flash in TTL mode, the camera and flash work together to determine the output of the flash. This occurs as the camera is taking a measurement of the ambient light reaching the sensor.

With this information, the flash adjusts the amount of light it will provide based upon the meter reading, in an attempt to balanced the flash output to the ambient exposure.

In TTL mode, the camera ultimately determines the flash output giving the photographer the flexibility to work without too much regard for exposure variations.

The downside is that the photographer never really knows how much flash is being delivered during any given exposure. Many different factors such as composition, zooming and color variations will impact the flash output.

Manual
For photographers who want full control and consistent output of the flash, then Manual Mode is the best option.

In this mode, the flash delivers a consistent measurement of light regardless of the ambient exposure, crop, zoom or environmental elements.

High Speed Sync
This setting allows the photographer to take images outside the limitations of the camera's sync speed (usually 1/200).

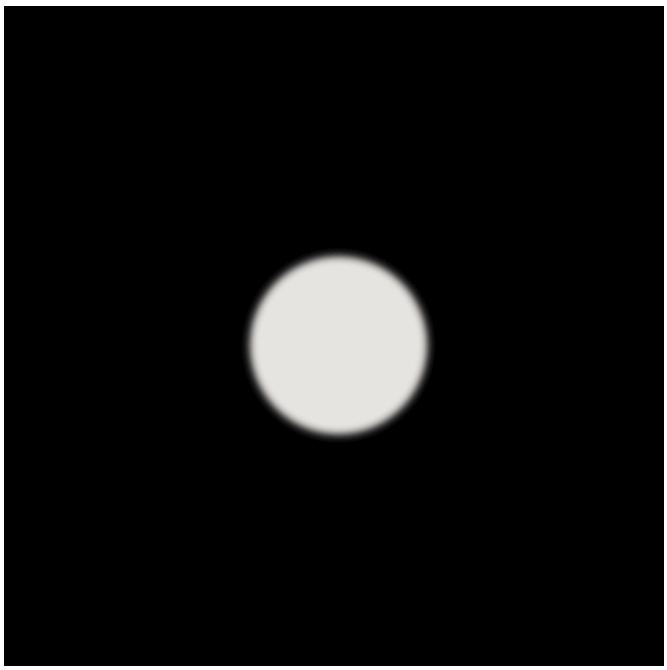
A typical situation might include a bright background and a subject that is considerably less illuminated. In this situation, if we expose for the background, the subject would be too dark. Conversely, if we expose for the subject, the background would be too bright.

With High Speed Sync, the camera is set to properly expose the background using shutter speeds faster than 1/200. In this mode, the flash will fire several bursts in coordination with the movement of the curtains that open and close during the exposure.

The result is that the ambient light is recorded as usual, but the flash is recorded in different sections on the sensor as it fires multiple times during the exposure.

Because the flash has to make multiple bursts during a very fast exposure, it fires at a reduced output each time it fires, This usually means the flash can't be too far from the subject for it to be effective.

Preparing the Flash for use in Manual
In an effort to make flash photography as automated as possible, many flashes have controls that alter the output of the flash based on tracking the focal length of the lens in use. Many flashes have "zoom" heads that move in and out to focus or spread the output of the flash to coincide with the position of the lens. This process causes the flash output to increase as the light is focused at longer focal lengths and decrease at wider focal lengths as the light is spread.



The image at left illustrates how the flash will use the zoom head to focus the light into a smaller angle of coverage when zoomed in with a long telephoto lens.

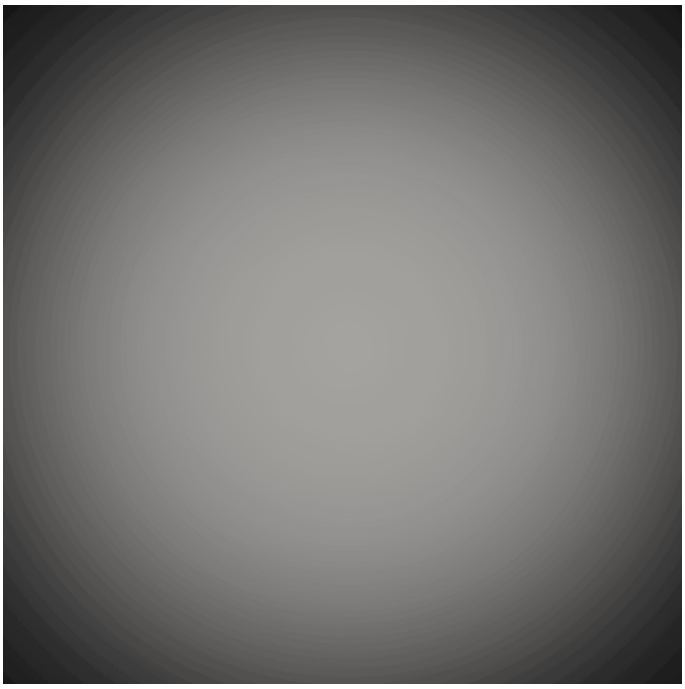
The longer the lens, the more concentrated the light becomes and the less area it covers. The other notable characteristic is that the light becomes brighter.

You can see the same effect with one of the focusable flash lights.

In the image at right, this illustration represents the flash coverage when the lens is zoomed out towards the wider angles. The wider the angle of the lens, the wider the angle of coverage will be emitting from the flash.

The light has to spread so that there is enough flash coverage for the lens that is being used.

The output of the flash is less when at wide angle than at telephoto settings.



Lighting

(Please Note)
In real world use of a manual flash, the photographer must take into account the fact that the output changes with flashes that have an automatic zoom.

Guide No. (GNo.) (ISO 100, in meters/feet)

Normal Flash (Full Output) and Quick Flash (GNo.)

Flash Coverage (mm)	14	24	28	35	50	70	80	105
Normal Flash (Full output)	15/ 49.2	28/ 91.9	30/ 98.4	36/ 118.1	42/ 137.8	50/ 164	53/ 173.9	58/ 190.3
Quick Flash	Same as 1/2 to 1/6 manual flash output							

*In the flash specs at right, each "flash coverage" angle changes the net output of the flash making it almost impossible to use manual flash exposures unless the zoom tracking is turned, "**Off**"!*

My Method for Manual Flash
To use my flash in manual mode, I had to turn the zoom head tracking off. The problem is, you can't just turn it to "off". You have to set the zoom to a "Manual Zoom" (M Zoom) setting and select the position of the zoom head on the flash that you wish to use.

Guide No. (GNo.) (ISO 100, in meters/feet)

Normal Flash (Full Output) and Quick Flash (GNo.)

Flash Coverage (mm)	14	24	28	35	50	70	80	105
Normal Flash (Full output)	15/ 49.2	28/ 91.9	30/ 98.4	36/ 118.1	42/ 137.8	50/ 164	53/ 173.9	58/ 190.3
Quick Flash	Same as 1/2 to 1/6 manual flash output							

Using the chart for my flash at right, I selected the 35mm position because the flash provided an ample angle of coverage for most of my flash needs. I tested my flash with my 28mm lens and there was very little fall-off of the flash.

I made a point to recognize I would have to reset the zoom head when I use my 17mm lens because the lens will capture an area that is wider than my flash covers.

The various "M Zoom" settings also change the output of the flash. It is important to have the flash fire at a consistent power for manual flash to be predictable. By setting the flash to "M Zoom" at 35mm, the flash no longer tracks my lens, and it has a consistent output allowing me to easily find the appropriate f-stop.

For the CPP test, you will NOT be tasked with making these determinations or calculations. You will NOT have to know how to deal with various zoom head positions and their impact on flash exposures.

It is important to note that we **do not use "equivalent exposures"** in flash photography. If you wish to use a different F-stop, you will have to **change the output of the flash**.

Lowering the Output of a Portable Flash
Many portable flashes have the ability to “power down” the output of the flash—sort of like a dimmer switch. Some flashes can be powered down in one stop intervals while others can be adjusted by 1/3 stop intervals.

Unfortunately, most flashes do not use simple terminology such as “one stop less” or “two stops less”. Instead, they use the ratio values for the output of light. For example, a flash that is set to “1/1” power is at “full power” output. If the flash is set to 1/2 power, the output of the flash is reduced by one-half which is one stop. (review the fundamental relationships of f-stops on pages 70—71)

Here are the ratio settings for powering down a portable strobe:

1/1 = Full Power output of the flash
1/2 power reduces the output by 1 stop
1/4 power reduces the output by 2 stops
1/8 power reduces the output by 3 stops
1/16 power reduces the output by 4 stops
1/32 power reduces the output by 5 stops
1/64 power reduces the output by 6 stops
1/128 power reduces the output by 7 stops

Advanced Flash Techniques

Fill Flash As A Main Light

When your subject is being photographed against a bright background, try using fill flash to add light to your subject. This helps to bring the exposure on the subject closer to the exposure of the background. This keeps the background from being too bright and washed out or your subject from being too dark and underexposed.

To use fill flash with a manual flash, read the meter for the ambient light of the background using the correct sync speed. For example, your camera syncs at 1/125, then meter the ambient light of the background at 1/125 to find the correct F-stop. Then prepare the flash output to correspond to that F-stop.

Remember, you can determine the output of the flash by altering how close or how far you place the flash from the subject. The closer the flash is to the subject, the higher the exposure value. The further the flash is from the subject, the lower the exposure value.

The background is F16 at 1/125 (above)

(right) Setting up the flash at 7 feet yields an output of F16 from the flash when metered at full power. This balances the exposure of the couple with the exposure of the background.

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by Steve Kozak

Not only can we determine the output of the flash by changing the flash to subject distance, we can also determine the output of the flash by powering it down.

Example 2:
The background reads F5.6 at 1/125. The flash is set up in a softbox and the meter reading of the flash is F11 at 5 feet. How do we get the flash exposure output to be F5.6 to match the background exposure without having to move the flash?

Simply **reduce the power** output of the flash to **1/4** power to reduce the flash output to **F5.6**.

Reducing the output to **1/4** power **reduces** the output by **two stops**.

Why not move the softbox back instead?

Because moving the light source back makes the relative size of the light source **smaller** and therefore, **harder.**

Example 3

The background measures F4 at 1/125 at 100 ISO.

.

The flash set to full power meters F11.

What power reduction would you use to get the flash to fire at F4?

The output setting is 1/8 reducing the output by 3 stops.

Dragging the Shutter
You can take flash photographs at shutter speeds that are slower than the flash sync. For example, if your shutter syncs at 1/125, you can also use 1/60, 1/30, 1/15, 1/8 and so on. This is called dragging the shutter. Dragging the shutter allows you to record some of the ambient light along with the flash exposure.

To do this, figure your F-stop for the flash exposure. Then, read the ambient light with a meter to determine the corresponding shutter speed at that setting for the flash. Set camera to the corresponding shutter speed.

In the image at left, my flash exposure was F5.6@1/125. This left the church very dark.

To "drag the shutter":
I measured the background of the church at F5.6 and the meter measured F5.6@1/4.

In the image on the right, my settings on the camera were: **F5.6@1/4** to match the ambient light of the church.

The results provided proper exposure of the couple with detail in the background.

Getting the Flash Off of the Camera
There are several compelling reasons to get the portable flash off of the camera. One of the main reasons is the fact that on-camera flash is harsh and flat. It is harsh because the size of the light source is quite small. It is flat because the light is always from the front since it is on the camera axis.

Getting the flash off of the camera allows the photographer to work with the flash in any number of unique lighting modifiers made for portable flashes and even with umbrellas and softboxes. These tools all help turn that tiny little light source of the flash into a much larger light source by bouncing it or shooting it through lighting modifiers creating much larger light sources.

The image at left is done with only the ambient light from the windows.

In the image at right, my flash is off-camera placed to the left of the bride. This provides me with a very controlled directional light pattern creating depth and detail.

The second compelling reason to get the flash off of the camera is to be able to place it to achieve desirable directional lighting patterns. Additional flashes may also be used to add fill, hair, background, kicker lights and more.

A third great reason for getting the flash off of the camera is that you are no longer bound to having to use exposures based on camera-to-subject distance. When the flash is mounted on a stand and placed in position to light the subject - it does not move. The photographer is free to move about without having to change exposures as happens when the flash is mounted onto the camera.

To get the flash off of the camera, a light stands with an adapter made for mounting with the flash's shoe will be required. You will also need some system for remote triggering the flashes or a very bothersome cable will need to be used between your camera and flash.

F. Understand the theory of light. (6 items)
1. Knowledge of the light spectrum, color temperature and color balance

Quality of Light
In the process of evaluating the light from natural and artificial light sources, the photographer also considers the quality of light. This includes the characteristics of hard light (specular) and soft light (diffused) but also the inherent color value of the light.

The Color of Light
The electromagnetic radiation spectrum includes a very small section that is visible to the human eye. This is known as the "visible light spectrum". Visible light has varying wavelengths which determine how we see its color.

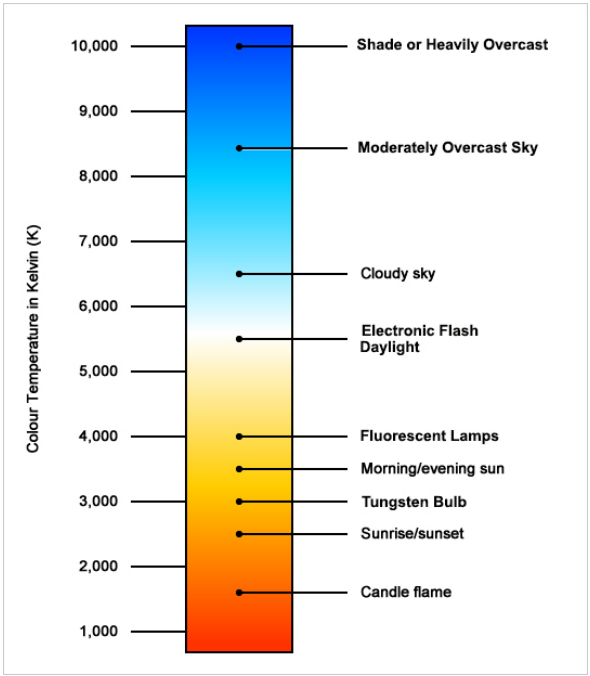
White light contains all of these wavelengths. Passing white light through a prism separates the light waves across the visible spectrum - simply put, a rainbow of color.

If you remember any one thing from 7th grade science class, it may very will be Roy G. Biv. This mnemonic device helps us remember the order in which these light rays manifest themselves when white light is passed through the prism: Red, Orange, Yellow, Green, Blue, Indigo and Violet.

Color temperatures describe the color values throughout the visible spectrum with a numeric value based on the Kelvin Color Temperature Scale. Simply put, color has a numerical value than can be expressed in "degrees Kelvin" or K°.

White Light
Take another look at Roy G. Biv. If you think about the initials of old Roy, you get R.G.B. (Red, Green, Blue). This is sort of helpful to us to remember that our cameras reproduce colors by adding values of red, green and blue.

If we think about it this way, white light is like the basis for natural color we perceive in daytime sunlight. Daylight is "White Light". We generally accept that it is measured as 5500 K°. On a camera's white balance settings, daylight is represented by the "Sun" icon.



The perception of color is the result of light reflecting off of a surface. Under “white light” conditions (5500 K°), color is what we know it to be; a “white” sheet of paper is “white”.

So, what happens when we view color under conditions other than “white light”?

Color Shifts
Understand that every source of light has its own color. These color values range from the very warm tones at 1000K (candlelight) upwards to the very cool tones at 10000K (shade).

Because the perception of color is the result of light reflecting off a surface (or a subject) and because every source of light has its own color, photographers have to be aware of how a light’s color value in K° will impact the recorded color values of a scene.

Remember, 5500K represents daylight (white light). If we have a light source that is measured at 2800K, it is a much “warmer” color of light. In this case, “white” is no longer “white”...it is more orange or yellow. The thing is, our brains trick us. Our brains know that a white sheet of paper is white, so we “see” it as white under almost all lighting conditions. We are simply programmed to see the colors as we know them. We are also fooled by surrounding colors.

A camera, however, does not have a brain to trick it. It simply records the color value of the reflected light coming from the scene. So, when we look at a photograph of a white sheet of paper that has been photographed under a 2800K light source and the camera’s white balance icon set the “the sun”, the paper appears orange or yellow.

For that sheet of paper to appear “white” in the photograph, the photographer would have to recognize that the light source was 2800K and move the white balance setting from the “sun” to the “light bulb” icon which represents “warm” tungsten light A camera that offers a Kelvin option could be set to the “K” setting and then dialed to 2800 in the camera’s white balance menu.

Photographers must deal with color shifts from all artificial light sources and from changes of the sun’s position in the sky or its blockage during cloudy conditions. Remember, color temperatures may range from 1000 to 10000. A camera that offers the Kelvin option for white balance usually covers from 2200K to 10000K in 100° increments. If you add all those up, the Kelvin options provide the photographer with 79 distinctive white balance options.

The white balance icons represent only one of these 79 values for each icon. Since there are only 6 icons that represent a single setting, the camera can only get you “in the ballpark” using these icons. The K setting clearly offers the opportunity for much more accuracy.

What is “Accurate” Color?
The art of photography is subjective. So is color. There are certainly plenty of reasons to record accurate color of any given scene or subject. Accurate color is often a priority for commercial photography. It could also be a priority for a bride who is wearing an off-white dress and desires her images to reflect this subtle hint of warmth to her dress.

There are times, however, when the photographer may wish to impose deliberate shifts to "accurate" color. A photographer may prefer slightly warmer skin tones for example. Perhaps a photographer would prefer slightly "bluer" tones in a snow scene to represent that it is "cold" or overly red tones of a summer scene to emphasize "hot"? These deliberate shifts in color are part of a photographer's prerogative when it comes to capturing images.

2. Knowledge of the properties of reflectance (angle of reflectance equals angle of incidence, influence on color, etc.)

Properties of Light

Properties of light include a look into some of the physics of light.

Angle of Incidence

If you throw a rubber ball straight into a wall, you can predict that the ball is going to come right back at you. If you throw that same ball into the wall at a 45° angle, you are going to have to go and chase is as it will bounce off the wall in the opposite direction and at the exact angle you threw it. What you just learned is that, the angle of incidence equals the angle of reflectance. Light travels in the same course that ball does.

If you photograph a mirror straight on with a flash on the camera, you are going to see the resulting burst of flash in that mirror because the light bounces straight back to you just like the ball. However, if you take a few steps to the side and photograph that same mirror with the same flash, the reflection of the flash comes off the mirror at the opposite direction and at the same angle.

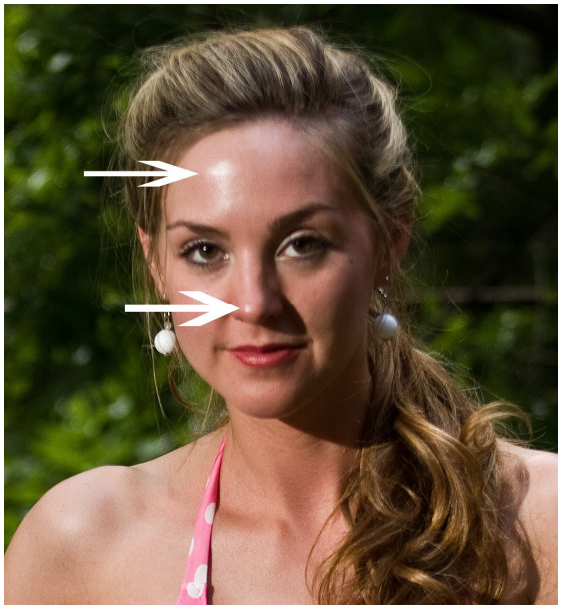
This principle recognizes the path that light travels relative to a "normal". For photographers, "normal' is the line created between the camera position and the subject. If you are behind the camera, facing your subject, and the main light is exactly behind you, the angle of incidence is 0°. Move the light so that it is at 45°, the angle of incidence is now 45° and the angle of reflectance is also 45°.

Light bounced off of a highly reflective surface returns the light more efficiently than dull or matte surfaces. Glossy surfaces reflect more light than rough surfaces.

Lighting that is reflected or bounced off of a surface will also take on the color of that surface.

3. Knowledge of the properties of light (fall-off, size of light source, depth of light, inverse square law, distance to subject, etc.)

Size of the Light
The size of the light source relative to the subject determines its relative hardness or softness. It also impacts the size and intensity of highlights and the hardness or softness of the shadows.



Smaller light sources tend to create specular highlights and harder transitions between highlight and shadow.

Larger light sources tend to create diffused highlights and softer transitions between highlight and shadow. The small portable flash created strong specular highlights on her forehead and down the bridge of her nose and a small highlight at the tip of her nose. (left) The transition of the highlight and shadow on her nose and cheek is very abrupt.

The image at right was done in the studio with a soft-box.

The large light source created a diffused highlight on her forehead and nose and a much more gradual transition of highlight and shadows on her nose and cheek.

The Inverse Square Law
This law of physics states that "the intensity of the light on a subject is inversely proportional to the square of the distance of the subject from the light source."

In simple terms, it tells us that at any given distance if we double that distance, we lose two stops of light.
For example, a light that measures F11 at 10 feet, will measure F5.6 at 20 feet.
(The math looks like this: The distance is doubled (2X). The inverse of 2 is 1/2. $1/2^2=1/4$)
The output of the light at ten feet was F11, at twenty feet, it is now 1/4 (two stops) the intensity that it was at 10 feet..

Conversely, if we take any given distance and then cut it in half, we gain two stops of light. For example, if the light measures F11 at ten feet, it will measure F22 at five feet. (a two stop gain)
(The math looks like this: Distance is cut in half. (1/2X) The inverse of 1/2 is 2. $2^2 = 4$) Now, at five feet, the light is 4X brighter (two stops) than it was at ten feet.

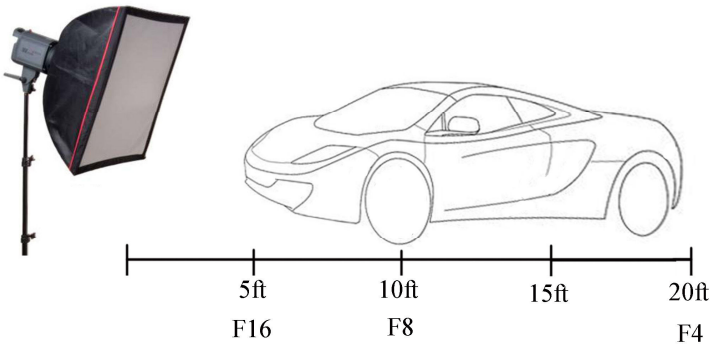
This is true for any exposure at any given distance.

Depth of Light

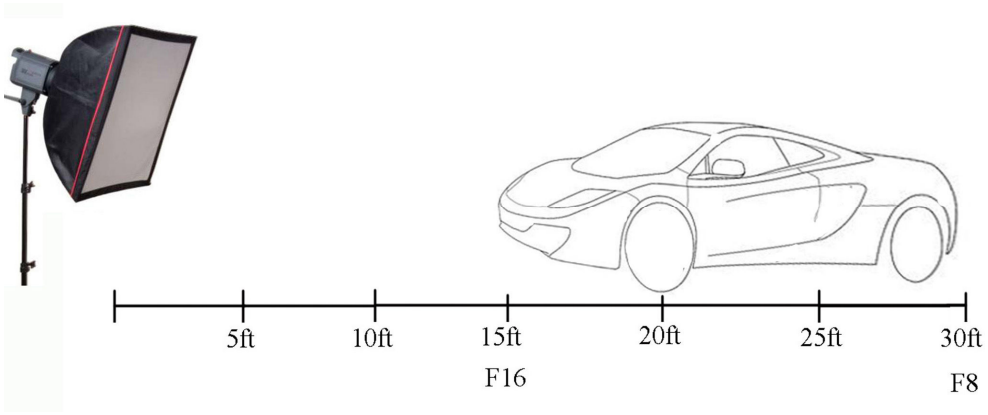
One of the takeaways from the "inverse square law" is that light falls off more rapidly at close distances than it does at further distances. The "depth of light" describes the consistency of the exposure from the point of the subject and the rate in which it falls off.

This comes into play when a photographer is trying to light a subject or subjects and control how quickly the light falls off. For example, assume you are photographing a car from the front bumper to the rear. The car is 15 feet long. A large soft box is placed 5 feet from the front of the car.

If the light at the front bumper measures F16, then the light falls off to F8 near the windshield and measures F4 at the rear of the car. The light falls off rapidly (4 stops) because the light source is rather close to the front subject.



If the light is moved back to 15 feet from the front bumper, and is powered up to read F16 at the front of the car, the rear of the car is only two stops less than the front of the car.



Now, consider lighting a subject from the front near the camera perspective. The same effect happens as the light falls off in the background. The further the light is from the subject, the slower it is to fall off. The closer the light is to the subject, the quicker it falls off. This effect is seen in the images below.

Lighting

G. Select the appropriate filter/gel for color correction of the light source. (1 item)
1. Knowledge of filters and gels used for color correction

Color Correction
While DSLR's have built-in white balance controls, color correction filters still have a place in modern photography. For our discussion, we will look at a couple of the most common CC filters.

FLD or FLW
These filters are used to correct the color cast of two common fluorescent light sources. The FLD is used for "daylight" balanced fluorescent tubes and the FLW is for "warm" light balanced fluorescent tubes. Both filters help reduce the overtones that are often present with fluorescent lighting.

80A or 80B
These dark blue filters are used to balance tungsten lighting to daylight. This removes the yellowish cast that is present when the image is captured unfiltered. The 80A is for lights with a color temperature of 3200K and the 80B is for 3400K photo flood lights.

81A, 81B and 81C
These filters are in a class of "warming" filters which may be used to offset bluish overtones often present with overcast lighting or portable flash.

CTO (color to Orange)
These filters change the "daylight" color balance to an equivalent "tungsten" value.

CTO (color to Orange) filters will be available at various shades to hone in on the desired tungsten temperature setting.

These may be used in a mixed lighting situation such as using a portable flash (daylight) inside a church that is lit with tungsten light.

The filter would be applied to the flash so that the color of the flash is closer to the tungsten lighting in the church. The photographer would then set the camera to roughly 3200K.

This helps to reduce the unsightly appearance that mixed lighting sources can produce.

CTB (color to Blue)
These filters change a warm "tungsten" color balance to an approximate "daylight" value.

This filter may be used In a situation with mixed lighting sources that include incandescent (tungsten) or "hot" lights with daylight (such at window lighting).

The use of the filter to cover the tungsten light sources will convert the color temperature of the warm lights (2700K—3400K) closer to a daylight (5500K) value. The photographer would then set the camera to "Daylight" (5500K).

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H. Use lighting techniques as composition and design elements (1 item)
   1. Knowledge of how to coordinate composition and lighting to create the desired effect

Composition and Lighting
Lighting can be used as a compositional tool to bring attention to the subject. The eye tends to go to the brightest part of a dark image and the darkest part of a light image.

The lighting choice in the image at left provides strength to the composition by leading the viewer directly to the couple.

In the image at right, the model wore a colorful blouse which would normally be a "busy" choice. I used one of my studio umbrellas as a background element to provide a stark contrast to the black in the background. The blacks and the whites in the background complement the blacks and whites in her blouse. The blues in her blouse provide a nice contrast to the warm tonal values of her skin and hair.

Lighting control is the key to using light as a compositional element. In the image at left, I used a snoot on the main light to illuminate the director without illuminating the rest of the theater seats. The controlled lighting on him sets him apart in the foreground and balances him nicely with the lighting on the stage.

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2. Knowledge of the use of gels, grids to alter the relationship among subjects or products.

Gels and Grids
The use of a gel changes the color of the light. By placing the gel on the background light, I changed the color of the background. The purple gel places the background in the same color family as the subject's shirt. This helps to place emphasis onto the subject and the warm tones of her face.

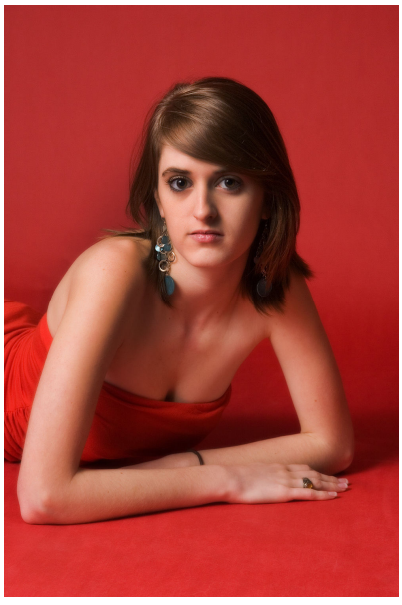
In the image below, I used two gels on separate lights on either side and overlapped them to create a blend of colors in the center. I liked the contrast of cool to warm colors in the background which bring out the contrast of the cool colors of her sweater and her warm tones of her skin and hair.

Light from the main or fill will dilute the color created by the gel so care must be taken to keep stray light off the background.

Gels used on a white background tend to be less intense and more pastel. (left)

Gels used on a black background tend to be more vivid and rich in color. (below left)

The most intense colors come from using a gel of the same color as the background. In the center image below, the red color comes from using red seamless paper with no additional background lighting. The image below right uses a red gel to illuminate the red paper.



2. Knowledge of the use of gels, grids to alter the relationship among subjects or products.

Gels and Grids
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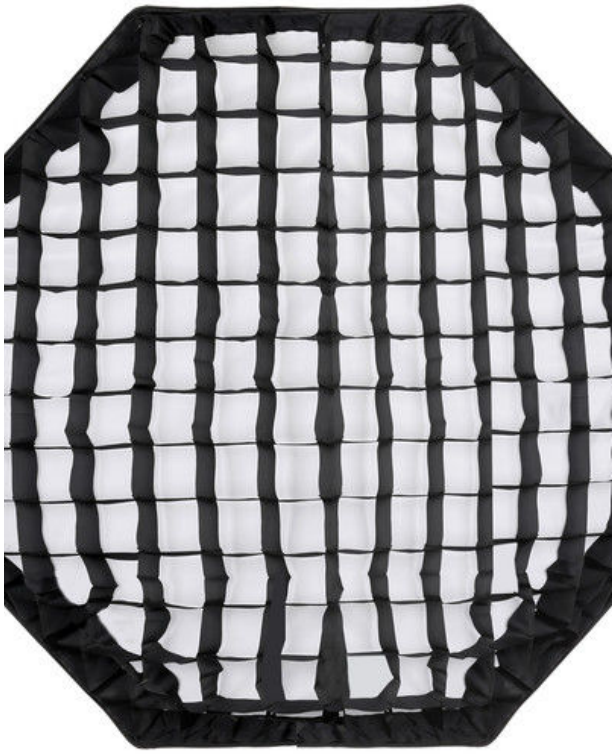
In the image at right, the softbox is fitted with an optional grid which helps direct the light where it Is wanted and reduces unwanted light that might spill onto the background or other areas.



In the image at left, I used a softbox with a grid to keep the light off the background and directed towards the subject. By controlling the lighting by keeping it off the background, I was able to place the emphasis onto the subject.

Lighting

COMPOSITION AND DESIGN (19%)

Items relating to this area will focus on the following topics: (1) Subject placement within image area; (2) Special effects, including props; (3) location; (4) clothing; (5) color harmony/color wheel; and (7) coordination of background and subject.

A. Determine the best color relationship to complement subject(s) to achieve the desired effects. (4 items)

1. Knowledge of color harmony, interactions, and effects in order to coordinate subjects with backgrounds and enhance the final image
   - Tonal values and hues
   - Contrast
   - Saturation of color
   - Effect of patterns

Tonal Values and Hues

Hues are made up of the twelve colors named on the color wheel. In a reflective light environment (RGB), they include the three primary colors (red, green, blue), the three secondary colors (cyan, magenta, yellow) and the six tertiary colors (orange, chartreuse, spring green, azure, violet, rose).

Tints are created by adding white to any hue on the color wheel.
Shades are created by adding black to any hue on the color wheel.
Tones are created by adding both black and white to any hue on the color wheel.

Color Harmony

Harmony in any form represents a pleasing blend of values to create an enjoyable environment. From a visual standpoint, color harmony might be defined as the pleasing arrangement of color utilized throughout an image. This will include a pleasant blend of colors that appear in the foreground, middle ground, background, subject matter, subject clothing and props.

From a planning or execution standpoint, the photographer will select background and accent colors based on the subject and the clothing selections of the subject. However, the reverse may also be true in that often a location is selected and the photographer will select the appropriate clothing for the subjects to wear in that environment. The key here is, good planning. Rarely would all of these elements come together on their own without a bit of preparation on the part of the photographer and the subject.

"Seeing" in a Reflective Light Environment
The degree to which we see color and record color is very different. Our eyes work with our brains to do some degree of mental color correction. This is why we see a sheet of paper as "white" even when viewed under a tungsten light source, for example. But take a photograph of that sheet of paper with your camera set to "daylight" and that white sheet of paper is definitely yellow or orange and there is nothing your brain can do to tell you it is otherwise.

Photographers should learn to "see" the abstract realm of the color of reflected light and recognize its impact on the color that will be recorded, and more importantly, how to correct it.

It is also good for photographers to see the abstract realm of color as it pertains to selecting colors to be included in an image and those colors that should be excluded from an image.

Tonal Values
Key: Refers to the overall colors or tones of an image.

High Key: Refers to an image that is created using mostly light tones and bright backgrounds.

Low Key: Refers to an image that is created using mostly dark tones and dark backgrounds.

High Key

Low Key

Composition

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Contrast
In composition, the term “contrast” can be used to describe a number of things. At its root definition, it is the illustration of the differences that exist between two or more elements. It addresses the very distinctive and opposite features between them. The usual pairings include good and evil, hard and soft and black and white. With these three examples, we have one pairing that represents ideals (good and evil), one that represents the physical (hard and soft) and one that represents the visual (black and white. There are many more pairings we could list, but let’s just get the basic concept.

With photographic compositions, the photographer will often include various contrast representations in telling the visual story. Heck, there may be not better way to explain what something IS than to clearly illustrate what it is NOT!

The above image utilizes several possible contrast themes: “young and old”, “beauty and the beast” and “warm and cool”.

Contrast in ideals are a universal theme: Beauty and The Beast, Sweet and Sultry, Life and Death. Whatever your theme may be, contrasts are a great way to tell your story.

Photographers may use **physical contrasts** in a photographic composition to help set the subject apart and provide strong subject emphasis. Contrasting textures is a great way to make a statement. This is why photographers may elect to photograph a beautiful, soft-skin model against a very rough textured exterior. The contrast of the rough texture of the background will contrast the smooth texture of the model’s skin which will set the model apart.

There may be an occasion to place a subject in a small corner of a very large environment to contrast the power and domination of the world over the powerless or “insignificant” subject. (David and Goliath).

The image at left contrasts the darker tonal values of the background with the bright white of her dress. It also contrasts the sense of beauty of the model with the rather utilitarian simplicity of the this alley. The disconnect between the fashion and the alley bring attention to the model.

Then, there are those **visual contrasts** that deal with color and tonal values. A model in a "little black dress" will easily stand out against the stark white of a high key background.

The warm tones of the sun reflecting in the windows and the light from the beacon of the lighthouse provide a nice contrast to the cool colors of the evening sky.

The goal is to use these contrasts to tell your visual story and to make sure that contrasts don't serve as a distraction or a nuisance in creating your composition.

Saturation of Color
The saturation of color is the relative brightness of the color. From a compositional standpoint, backgrounds with subdued color saturation may be perfect for presenting a subject wearing highly saturated fabrics because the subject will stand out.

Conversely, a subject could be overwhelmed by backgrounds and colors that are highly saturated because they tend to be "busy" and attract attention away from the subject.

Photographers will use many tools and techniques to alter the saturation of color in a scene in order to design an image within a given environment.

Composition

Saturation of Color

Color saturation is relative to the amount of light reflecting from a given color in relation to the subject and the overall exposure. There may be occasions to work in a location where a highly saturated background can be subdued by blocking light reaching the background or by raising the illumination of the subject relative to the background (fill flash, for example).

Saturation of Color

There may also be situations where a photographer will add light to a scene to bring out the color saturation of a specific area, or even use gel filters on supplemental lighting to increase the color saturation of a scene.

Composition

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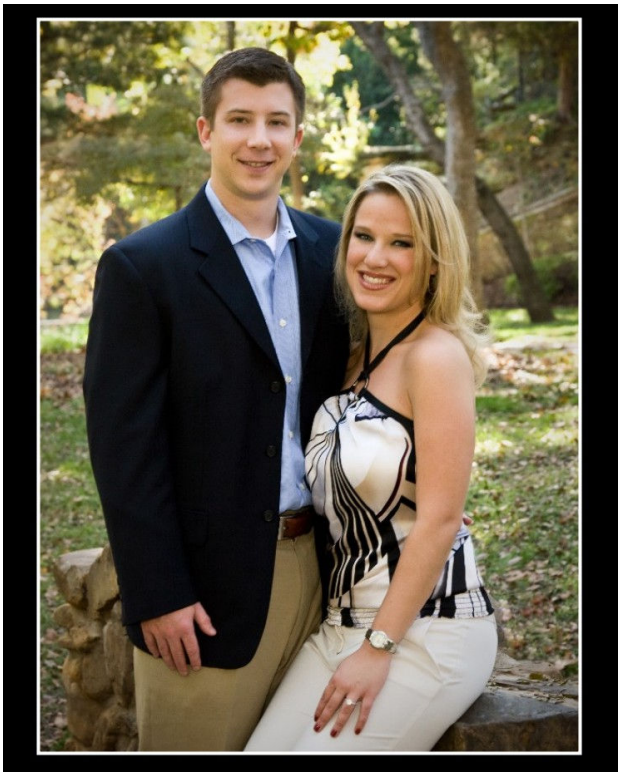
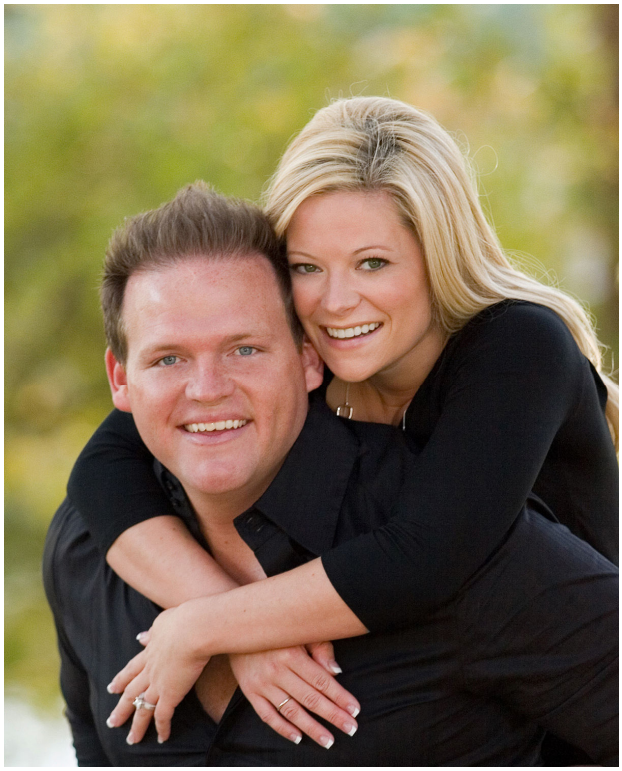
Effect of Patterns
Patterns in a composition can work for or against the photographer. Patterns in a scene can create visual interest and movement creating an opportunity to place a subject into the scene at precise points to take advantage of the leading lines or repetitive patterns.

One great technique is to create a compositions that contrasts with the patterns. The strong, vertical patterns created by the doorway are a wonderful contrast to the diagonal composition of the bride.

Patterns can also be a distraction - especially in clothing selections. Busy patterns on clothing can take attention away from the face. (bottom left) Best practices would be to try and educate the client about preferred wardrobe choices, but sometimes, clients have other ideas. In these cases, you could try poses that hide some of the busyness of the clothes or finding a background that complements the design. Otherwise, you have to just go with the hand you are dealt. That is why darker, solid color clothing is a good choice.





Composition

2. Knowledge of the color wheel
   - Primary
   - Secondary
   - Tertiary

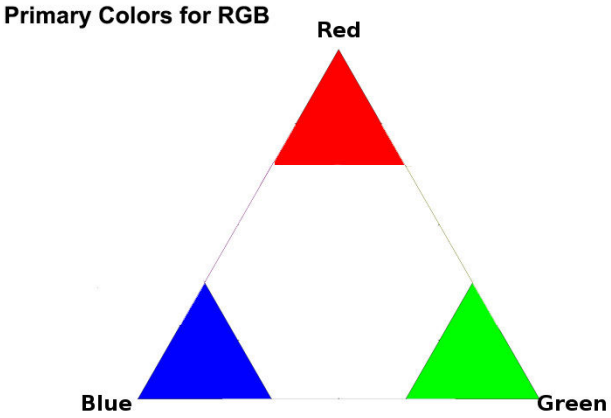
The Color Wheel

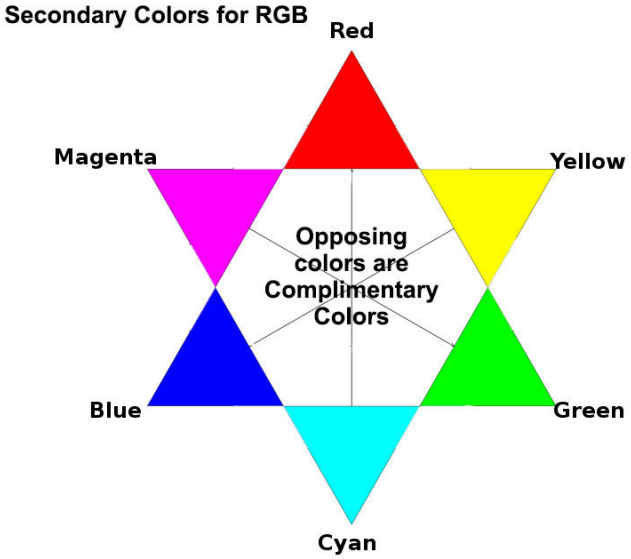
A color wheel is a simple representation of primary and secondary and tertiary colors for any given color space. Don't be confused by the red, blue and yellow color wheel you learned about in elementary school. Photographers mostly concern themselves with the color wheel for the RGB color space because these are the three **additive colors** of white light. After all, we photograph people, places and things that are illuminated by, "light".

The RGB Color Wheel

On the RGB color wheel, Red, Green and Blue are the primary colors. These colors are represented by the numerical value in an RGB color space as follows:

	R	G	B
Red:	255	0	0
Green:	0	255	0
Blue:	0	0	255



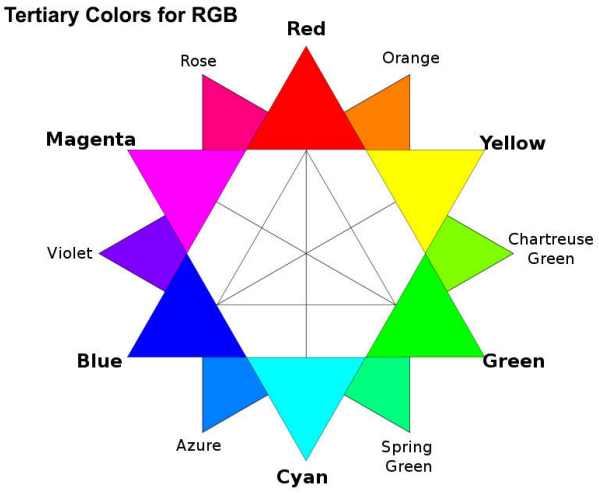


Secondary Colors

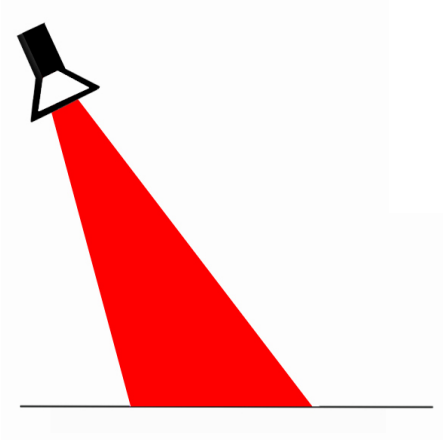
In an RGB color space, the secondary colors are Cyan, Magenta and Yellow. These colors are created when equal amounts of the neighboring colors are blended.

Composition

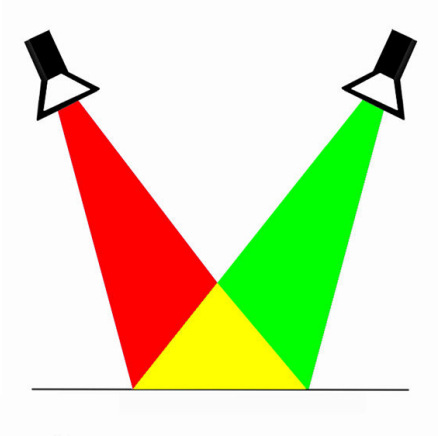
Tertiary color
Tertiary colors are created by mixing either: one primary color with one secondary color, or one primary color with two secondary colors.



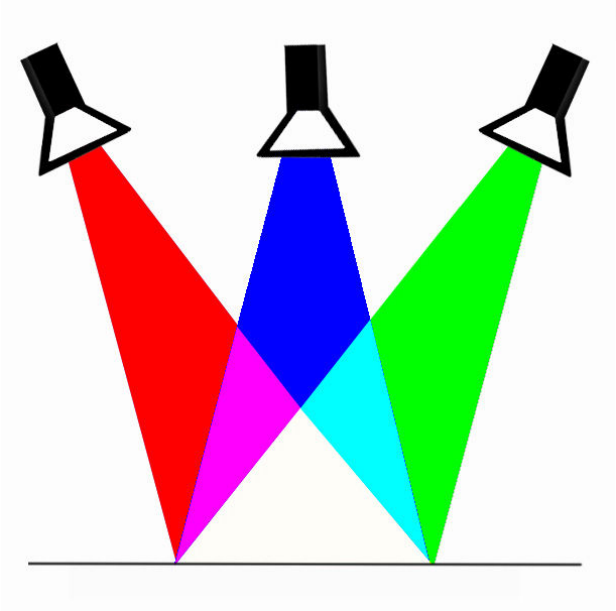
Additive Light
Theatrical lighting is a great place to look at how additive light works. If a stage is lit with a Red spotlight, you can image that everything sort of looks “red”. (right)



But if we add a second spotlight that is green, then the two lights combine to produce a yellow light where the two occupy the same area. (right)



But something very interesting happens when we add a third spotlight to the mix...White Light! (below)



Notice how the area that is occupied by all three colors equally, is white. The eye perceives elements illuminated in this area as having “natural” color - like it would in daylight (5500°) conditions.

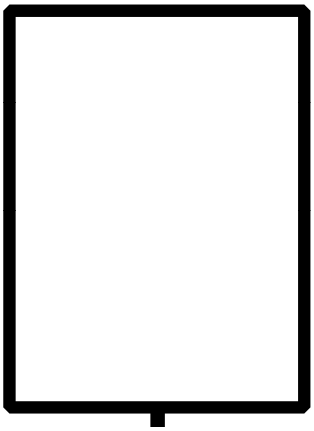
In the area where only two lights overlap, we see the same secondary colors that we saw on the color wheel. Remember these secondary colors are produced when the two colors are blended in equal parts.

Composition

Subtractive Color
We have already seen the additive colors of red, green and blue in an RGB color space. Again, these additive colors are a part of photography in the fact that we deal with light, and the color of light, in a reflective environment. We make corrections to color at the time we capture an image by making adjustments to white balance. We also deal with RGB when we calibrate our monitors which are also made of pixels that emanate RGB color values.

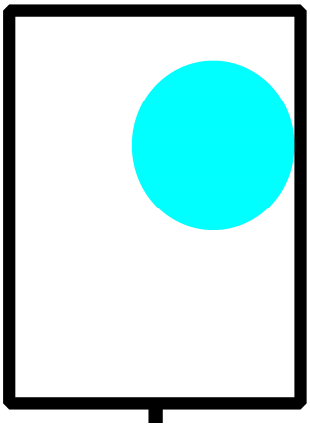
Photographers also deal with **printing images**. Photographic processes that involve applying inks to paper do not achieve color by mixing light - they achieve color through mixing pigments or dyes.

The secondary colors we saw in the RGB color wheel are cyan, magenta and yellow. These are the three **subtractive** colors used to create the primary colors of pigments used in the printing process.

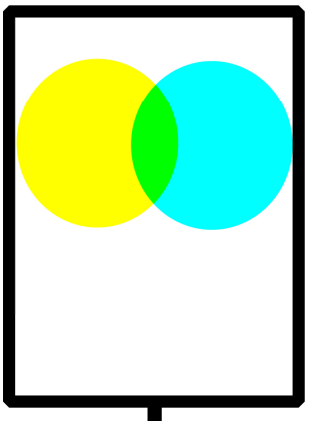


Imagine that the image at left is an illuminated softbox and we are looking at the front of it.

If I place a cyan filter or gel in front of it, the filter absorbs a portion of the white light and we clearly see the filter as cyan. (right)

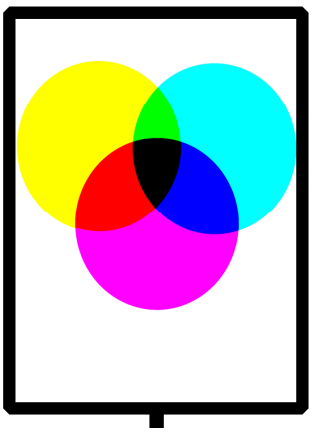


If I add a yellow filter and allow it to overlap with the cyan filter, the two combine to absorb wavelengths leaving us to see green. (bottom left)



If I add a magenta filter and allow it to overlap the other two, we see the filters absorb a variety of wavelengths producing these results:

- Combining yellow and magenta makes red.
- Combining magenta and cyan makes blue.
- Combining cyan, magenta and yellow creates black. (**neutral density)** (right)



When we are adjusting the color for printing or output, we deal with subtractive color. For example, to adjust an image that is too blue, we reduce the amount of blue by adding yellow. Yellow absorbs blue. We are essentially “subtracting” blue when we add yellow.

Composition

3. Facets of Color:
   - Warm
   - Cool
   - Light
   - Dark
   - Recede (cool/dark) vs Project (warm/light)

Facets of Color
There are many facets to color from saturation to color temperature. But in the context of composition, we will look at color to determine the best way to represent the subject and the desired effect of color on the subject.

We already saw where color effects mood and emotions. Here we are going to look at other general facets of color and how they relate to the subject matter.

Warm Colors vs Cool - Warm colors are the hues from red through yellow, browns and tans. Warm colors are said to be "active" because they tend to increase the viewer's attention and stimulate the senses.

Cool colors are considered to be the hues from blue green through blue violet, as well as grays. Cool colors tend to be more "passive" because they tend to have a calming and relaxing effect on the viewer.

Warm colors are said to advance while cool colors tend to recede.

Dark vs Light - Dark colors can be any hue that is mixed heavily with black. Blacks, browns, dark blue, dark green, etc. describes these color values. These colors tend to have a comforting effect on viewers. These color values may be described as "Low Key".

Colors with little to no color values (white) are considered "Light" colors. These colors create more stimulus for the viewer compared to dark colors. Generally considered as "High Key".

The Light colors are said to advance while dark colors tend to recede.

Photographers will use color to emphasize emotions and to add a visual cue to the feeling and the mood of the setting or the subject. There is also much symbolism that comes from color selections.

Simple visual cues for “hot” come from the use of the color red where “cold” is often represented by the color blue.

I boosted the warm colors to prepare this desert scene for printing. It adds to the feeling of being in a hot desert. (left)

The truth is, this image was taken in very early March and there were places with snow on the ground. The image feels very differently when I boost the cool colors. It adds to the feeling of “cold”. (right)

The fact of the matter is, the day was very hazy and the colors were very bland. Knowing the effect of color on mood gave me a couple of options for preparing this otherwise, drab image. (left)

Composition

B. Analyze the natural environment to complement subject(s) to achieve the desired effects. (4 items)

1. Knowledge of how to adapt to the environment (understand the environment to achieve a photographic advantage)
   - Color harmony
   - Patterns
   - Subject placement
   - Direction of lighting
   - Distractions
   - Balance

ORGANIZING WHAT YOU SEE

Photography is about designing and composing an image that is visually pleasing or effective, and recording it technically correct on the sensor. So as a photographer, it helps to have a technical mind as well as an artistic mind.

COMPOSITION - The placement or arrangement of elements within the image. This means the photographer must make decisions about what will be included in the picture as well as what will not. Elements to consider are: Subject, Foreground, Background, Props, and the Center of Interest. Elements of composition are the tools a photographer uses to design the image and tell the story. Rule of Thirds, Balance, Diagonals, Repetition, Pattern, Leading Lines, and Framing are just a few of the tools available.

CENTER OF INTEREST - Every picture starts with a center of interest. It is the focal point of the photographic story. It might be an action, a person, and object, or a location. The center of interest is the reason for the picture.

In the image on the left, we don't know what has the kids' attention. On the right, we can see the book and the image now makes sense. The book is the center of interest.

Color Harmony

Just like in music when individual notes come together to form a pleasing chord, so to do various color schemes and selections work together to form a pleasing and harmonious pallet to the eye.

Grouping of “like” colors such as warm and cool or similar hues such as blues and browns, tend to be harmonious.

The image at right uses warm tones in the color pallet to create color harmony.

In the image below, I added a red gel to the background and the white diagonal elements to create color harmony with her red shirt and white skirt.

Complementary colors (opposite colors on the color wheel) can also produce visual harmony in an image...not because they are similar, but because they are pleasing. The warm lights inside the church create a pleasing harmony with the blue sky.

Pattern
Repeating patterns create strong compositional interest. Repeated patterns in the background can serve to set the subject apart from the background. They can also provide visual movement within an image.

This bridal portrait has strong repeating vertical patterns which contrast with the triangular composition of the bride and her dress.

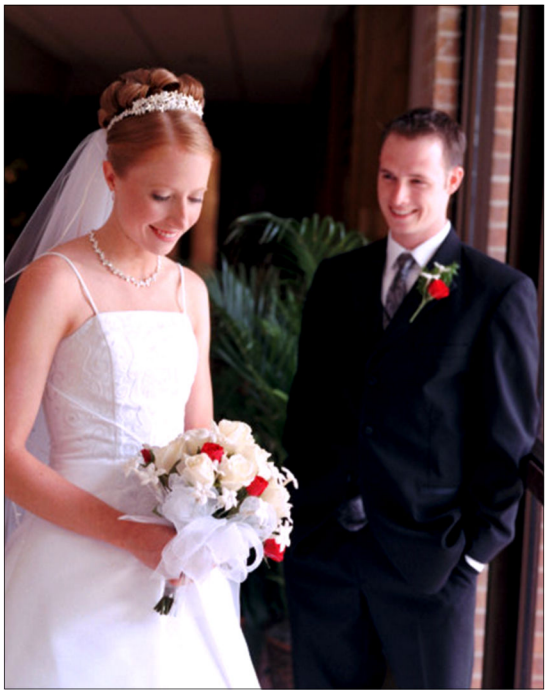
The strong horizontal pattern of the stairs provide a nice way to set off the diagonal and triangular composition of the subject.

The repeating patterns of diagonal lines created by the corrugated tin help set off the vertical orientation of this pose. The diagonal lines act as leading lines which lead the viewer's eye to the subject.

The viewer's eye goes to the face and then tends to follow the contour of front of her body to the hand which leads the eye back to the face. These lines and the subjects' pose help keep the viewer engaged in this image.

Direction of Lighting
Analysis of the environment includes understanding the direction of the lighting. In natural environments, the lighting direction and light quality changes throughout the day. A location that is well suited for photography in the afternoon may be unsuitable during the morning hours.

Make a point to look for directional lighting patterns which allow for raking light to create highlights and shadows which creates texture and detail while also creating desirable lighting patterns on the subject.



In the image at left, the window provides a strong directional light, however, the lighting on the front of the bride's dress is "flat" because it strikes her dress from the front. The result is that much of the detail of the dress is blown out because of the flat lighting on the dress.

With the image at right, the bride's body was turned away from the window so that the directional light would "rake" across the front of the dress. This creates nice texture and detail in her dress. Turning her head back toward the window also created a nice short lighting pattern on her face.

The image at left was taken during morning hours when the sun was behind the building. During afternoon hours this location receives full sun and hard shadows.

There are also dramatic seasonal changes to lighting patterns and light qualities of natural environments due to the natural changes of the position of the sun in the sky during spring, summer, fall and winter seasons. Make a point to note these changes as your work in the same natural environments throughout the year.

Composition

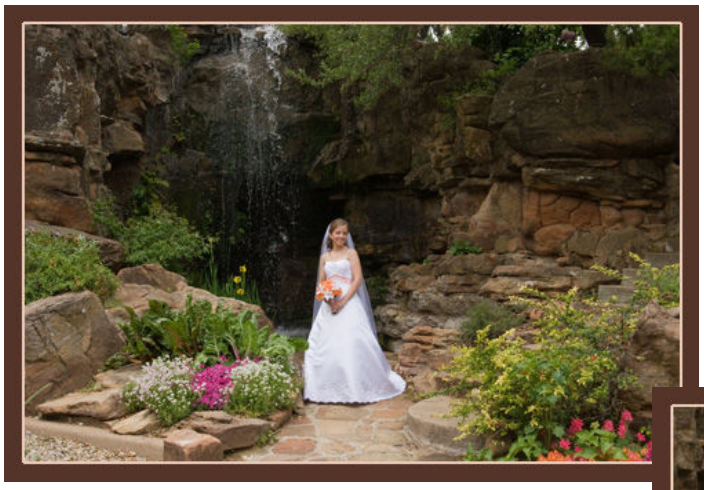
Distractions
Analysis of natural venues includes becoming aware of any distractions that may be present in the location. Distractions may include unwanted highlights and hard shadows, distractions in the background such as people or cars, unsightly power lines, and backgrounds that may be simply too busy.

Many of these distractions can be minimized by using a long telephoto lens and a shallow depth of field. Sometimes, it is as simple as changing camera angles.

In the image at left, I positioned myself in the bed of a pickup truck to get a higher angle on this bride in the wildflowers. The higher camera angle and zooming in slightly allowed me to crop out the distracting horizon line.

The image above taken with a telephoto lens improved the “busyness” of the distractions in the background by reducing the angle of view. (right)

Composition



Perspective

Notice how the 28mm lens on the left gives the image an expanded view and allows the foreground and background to overpower the bride.

By backing up and moving to 120mm, I used compression to create a nice proportion of the bride to the foreground and background elements. (below)

SELECTIVE BACKGROUNDS

I like the design and balance of the bridal portrait below with my 28mm lens, but I REALLY prefer how backing up and using a 70mm lens changes the perspective and allows me to isolate the background to the best part of this scene.

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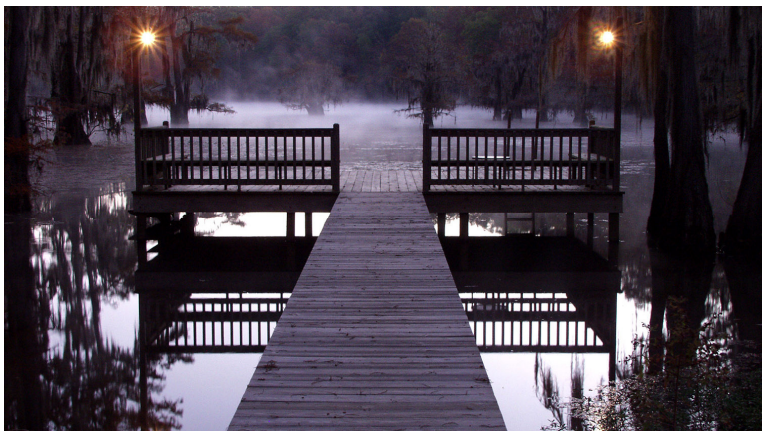
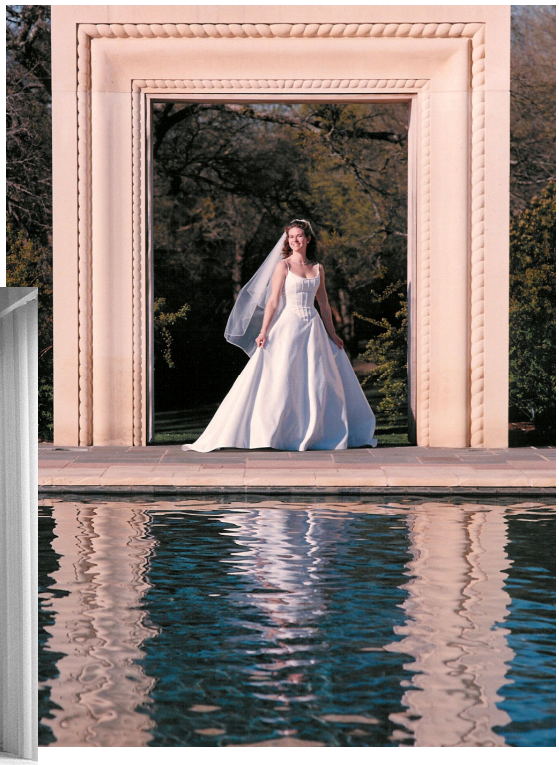
Balance
Balance is created when all of the elements an image are in visual harmony. Balance includes physical balance such as weight and size as well as color balance.

Symmetrical - Images which seem to create even balance left and right or top and bottom are said to have “symmetrical” balance.



The image left, uses strong symmetrical balance as the elements on the left and right are practically even in size and tonal values. Even the illuminated light fixtures add to the balance of this image.



In the image at right, strong symmetry adds to the strength of the composition. Center placement of the subject between the elements of balance keep the viewer’s attention on the bride.

In the image above, symmetry is found in the windows on the left and right. There is also a sense of balance created between the dark values of the fireplace and the dark values of the image on the mantle. The fireplace and the framed image also provide a sense of balance with their shapes.

Symmetry in composition is passive - even if strong, because it does not create tension.

Asymmetrical - Physical balance does not require the elements to be the same size or even symmetrical. “Heavy” objects may be counter-balanced by “lighter”, smaller objects .

This image (left) of The Mittens in Monument Valley illustrate the concept of visual balance. Without the formation on the right, this composition would be heavily weighted on the left and, therefore, out of balance.

Even though the formation on the right is much smaller, it occupies just enough space to provide visual balance to the image.

The birds in flight create a nice asymmetrical balance with the old beach house on the left. Without the birds in this composition, the house weighs “heavy” on the left and the void sky on the right becomes a distraction.

The boys in the foreground are in an asymmetrical balance to their parents in the background. Because they are visually larger in the composition, they are also the primary center of interest and the parents are the secondary center of interest.

Asymmetrical balance is active because it does call the viewer’s attention to the larger element.

Composition

Visual Balance

In the image below left, the tall, thin shrub on the left provides a visual balance to the dark window on the right. The image is thrown out of visual balance when the shrub is removed. (right)

In the image below left, the bridge is not supported visually on the right side and causes an uncomfortable balance problem. Including a base of support for the bridge on the left and right brings visual balance to this image. (right)

C. Frame or crop the picture within the camera's viewfinder. (2 items)
1. Knowledge of cropping pictures to create desired effects

Cropping in the Camera

There is something to be said for "getting it right in the camera". I try to do just that every time I work. But sometimes, it might be better to make some of the cropping decisions at the time you are preparing to order the images instead of when you are taking them. This is because final images may be ordered in a variety of sizes and shapes. If you have cropped too closely in the camera, you may not have as many options for preparing a final image for presentation.

In practice, you may "see" the crop of an image as you are creating it. You may have made some preliminary decisions as the whether the image will be horizontal or vertical. You may have also considered negative space, camera angle and more. The thing is, clients may prefer a 16x20 wall portrait and a 20x30 canvas wrap from the same image. If you have cropped too closely in the camera, then you may be in for a lot of post production editing the make the image fit on both. This problem could be easily solved by cropping a bit looser in-camera. Leaving some space top and bottom and left and right will give you a lot of choices in how you crop an image once you know the size requirements.

Cropping too loosely means that you may be losing some image quality since you are not taking advantage of your sensor size and all of the available pixels. For the most part, this is not a problem with the generous amount of pixels available in many of today's DSLRs. The trick is, crop loosely - but not too loose.

In the image at left, I have cropped very tightly. I like the crop, but if the client wants an 8x10, I have to choose between cutting off her feet or her head. (right)

The yellow line to the bottom crops at 8x10 and the white line to the top crops at 8x10.

I could add a digital mat, but I would rather have a choice!

The full frame image at left is loosely cropped, but it provides me with a number of options in how I present this image. This full frame composition would be ideal for a gallery wrap as it leaves plenty of room on all four sides to provide content for the visual sides of the wrap.

The image below has a nice composition using the rule of thirds and cropping out some of the distractions.

I even like the square composition at left. There is just no way to know what a client is going to want. It is nice to have options.

Cropping Guidelines

- Avoid cropping off hands and feet.
- Avoid cropping at any joint such as elbows, wrists, knees and ankles.

2. Knowledge of aspect ratios

Aspect Ratios
Aspect ratios describe the proportional relationship of the height an width of an image. Aspect ratios are the reasons that the same image cropped to 16x20 will not look the same when that same image is cropped to a 20x30.

For the most part, camera sensors have a 2:3 aspect ratio. Because an image is captured at that ratio, it will need to be printed at that same ratio to avoid cropping out any portion of the image. Prints that are 4x6, 8x12, 16x24 and 20x30 are the same aspect ratio as the image capture by the sensor, so they can be printed with no cropping.

Prints that are 4x5, 8x10, 16x20 24x30 are in the 4:5 aspect ratio. When you try to print at a 4:5 ratio, an image that is captured and cropped to a 2:3 ratio, you will lose a portion of the image. With an 8x10, for example, two inches will be lost off the overall length of the image because the image size would actually need to be an 8x12 (2:3 aspect ratio)...but you only have 10 inches of paper!

Images cropped to 5x7 and 11x14 also lose some of the image's length because the paper is not long enough to contain the entire image.

The image top left shows the entire image file captured at 2:3 aspect ratio. In the final version right, the image was cropped to a 20x24 with a 4:5 ratio. I lost 6 inches of the original file size.

D. Use angle of view to produce the desired effect (mood, power, size, strength, etc). (6 items)

1. Knowledge of perspective effects and how to achieve these effects (perspective, camera angle, camera position)

Perspective
We discussed convergence as it relates to tall buildings, but these same distortions occur when photographing people. Sometimes we use these distortion effects intentionally to help convey the overall feeling of an image.

For example, a lower camera angle will cause a person to look taller. This can be done deliberately to enhance the stature of a subject, perhaps demonstrating "power" or "authority".

Higher camera angles tend to somewhat foreshorten a subject. This may give the impression of dominance over a subject. High camera angles with images of children has something of a belittling effect on the child as the viewer appears to look down on the child.

Higher camera angles can be useful when photographing heavier subjects. Because items which are closer to the lens appear larger, a photographer may choose a pose where the face is somewhat leaned into the camera. Moving the face closer to the lens with the body being a bit further back may help flatter a subject as the weight is moved further away from the lens.

For full length portraits, placing the camera at the subject's waist level or slightly above will usually record the subject without noticeable distortion. For head and shoulders portraits, the camera placement would be at about the chest area or slightly above.

Again, higher camera angles may be used in situations where they may flatter the subject. For example, higher camera angles may hide a double chin, thick neck or even help open up the eyes.

Composition

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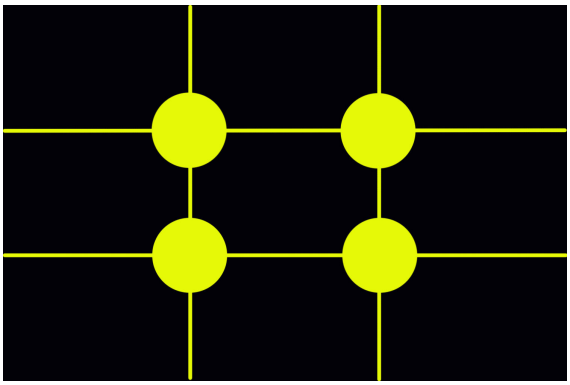
2. Knowledge of the elements of composition that create different effects (Rule of thirds, leading lines, positive/negative space, etc)

RULE OF THIRDS - This rule gives us a suggestion for the placement of the center of interest. Mentally divide the viewfinder into thirds like a tic-tac-toe board, creating nine equal sections. Then place the center of interest on one of the two horizontal or vertical lines.



The intersecting points are also strong positions to use for placement of the center of interest or other elements. One thing to know about this rule is that it is Okay to break it. Very rarely should the subject be place right in the middle of the image, but if it helps to create a strong composition, do it!

The placement of the heads in the upper right intersection give the above image a strong visual composition of the bride and groom.

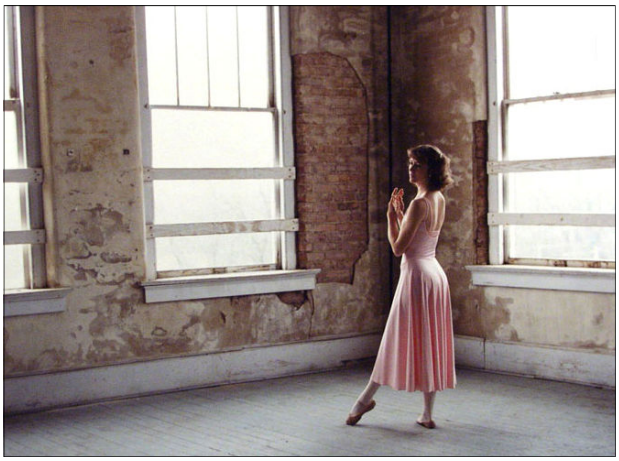
The image at right uses the rule of thirds for the placement of the house and the birds.

Leading Lines
When it comes to arranging elements in a photograph, remember DIAGONAL LINES ARE DYNAMIC.

The eye enters an image from the left (assuming you also read from left to right) and travels a visual path for the composition.

Diagonal **"leading lines"** create movement and are a great way to direct the viewer's eye to the subject.

The diagonal lines created by the window sills and the baseboards all point to the subject and help to hold the viewer's eye on the dancer.



Composition

Positive Space
Positive space is the area that is occupied by the subject.

In dealing with the subject, we have to make compositional decisions on how to best present that subject.

In the image at left, the model is the positive space. All of the rest of the building interior makes up the negative space.

Negative Space
Negative space is the all of the other space that surrounds the subject.

In composition, we use the negative space to "present" the subject. It is as important to the visual success of the image as just about every other aspect of creating the image.

Negative space is a powerful tool to place emphasis on the subject and have the viewer notice the positive space.

Background color, background textures, tonal values, light values and balance of negative space with positive space are just a few of the considerations for selecting the negative space for a given subject.

In the image at right, I selected a high key (light values) negative space to make my subject stand out since it was in stark contrast to the low key (dark values) of her black shirt and her dark hair.

In the image left, I selected a location of contrasting tonal and color values to set my subject apart. The uniform yellow and green hues in the negative space created a nice presentation to set off my model in her dark shirt and dark hair. The brightness of her face is also in harmony with the brightness of the flowers.

Composition

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I really like the color and the texture of the negative space in the image at left. The stark, uniform color does not distract from the subject but seems to add to the mood. I also like the contrast of the rough texture of the brick to the smooth feel of her skin.

In the image at right, there is a nice balance of the positive space with the negative space.

It also utilizes strong vertical lines in the negative space to set off the strong diagonal lines of this dance pose. The black mat "contains" the entire image and helps to focus the attention on the dark tonal values of the dancer.

So how important is the relationship of the negative space to the positive space?

Very! Improper use of negative space may leave the subject feeling very "crowded" with little room to "breathe" or for movement.

In the image at left, the tight crop leaves the feeling that the subject is confined and "boxed" in.

Composition

E. Position subject(s) with selected background, special effects, and props to achieve the desired effect. (3 items)

1. Knowledge of how to compose the elements within a scene to create the desired effect

Elements in an image include foreground, middle ground and background as well as the subject and any props. The placement of the elements should work together to bring attention to the subject and the subject's relationship with the environment.

In the image at right, I used the foliage in the foreground as a framing element to direct the eye to the bride.

In the image at left, I used the leading line of the water and the diagonal lines of the sun's rays to determine the best placement of the bride and groom. Placing them at the intersection of these two lines created a strong point of interest.

E. Position subject(s) with selected background, special effects, and props to achieve the desired effect. (3 items)

1. Knowledge of how to compose the elements within a scene to create the desired effect

It is a good practice to place the subject against a background that is free of distractions, especially around the head and face.

Horizontal lines that intersect the head can create a busy background and unwanted distractions.

In the image below, I raised the camera angle to get rid of a distracting horizon.

Using just the green grass sets the baseball player apart from the background. He asked to have all of his gear in the image, so I placed it in the foreground to create a framing element.

My hope was that it would not be quite as distracting and the eye would go past the gear straight to him. This worked well thanks to the simplified background.

Composition

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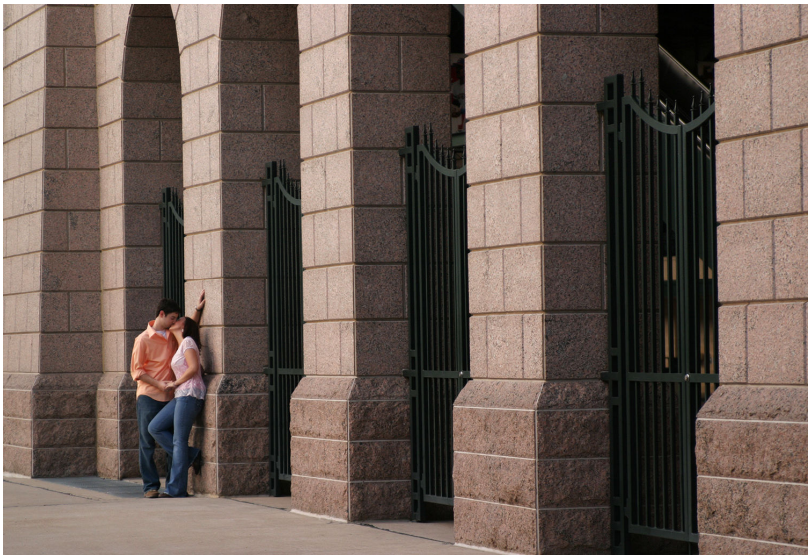
In the image at left, I placed the subject at the darkest part of the background so that she would stand out. I also placed her under a bit of down light which provided very nice separation on her hair.

I also used the large formation on the right to frame her within the composition. The natural formations on the canyon wall all seemed to work together to lead the eye to her.

In the image with the trestle, I placed the subject on one of the repeating lines and near the camera to give her enough scale in the image that I could capture her expression. I like how the lines take you out of the image which represents the idea of her wish to be somewhere else.

In a similar compositional pattern of repeating lines, I chose to place the couple away from the camera. I wanted to give the feeling that the viewer was sort of "peeking" in on them without intruding on them. This gives the image more of a feeling of intimacy.



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2. Knowledge of using props as complementary accessories to the subject matter

Props can be used to help tell the subject's "story" or add a nice touch of interest to an image. Use of props can be appropriate and tasteful if you follow a few guidelines.

Props should add value to the image. Props help the viewer understand more about the subject and who the subject is and how he or she thinks or feels. The image at right lets the viewer know music and his guitar are part of who he is.

Props should complement the image. Props become part of the composition so the placement of the props and the color values of the props should fit into the color scheme of the image. The letter jacket and tennis racquet are within the color scheme of the jacket she is wearing.

The props at left represent this senior's high school years.

All of the props at right were used to create the feel of the little girl's own bedroom. It was actually a den. I just liked the light from this window.

Composition

3. Knowledge of how to achieve what the client desires – scenarios

Clients will often ask for images that portray concepts or capture elements which are personal to them. The key is in understanding their desire and then using tools and techniques to help them get what they want from their images.

Clients may want to place focus on or away from certain physical aspects about themselves. For example, some subjects may want to place emphasis on their long hair or their eye color while others may wish to hide that they are over-weight, too short or have a scar. All of these concerns and many more are part of what is important to address for some clients. Photographers have to learn how to address these concerns behind the camera and in post production.

Height Issues - These can be addressed by raising and lowering the camera angle to achieve the end result. Posing of two people with dramatic differences in height can be handled by seating the taller subject to bring the level of the faces closer together.

Weight Issues - Subjects who are concerned about weight issues can be photographed from slightly higher camera angles and with poses that lean the subject into the camera. Controlled lighting can be used to place lighting on the face while keeping it off of the body since shadows tend to "hide". Poses of two or more can be designed so that heavier subjects may be "blocked" by others.

Balding - Subjects who are concerned about thinning hair or balding can be lit in the studio without using a hair light. Outdoors, subtractive lighting can be employed to block overhead light from the top of the head.

Scars and Blemishes - Clients with concerns about skin imperfections can be photographed with flat lighting to minimize detail of the imperfections. Lighting patterns can be used to place unwanted scars in shadow. Of course, there is always image post production where many of these issues can be concealed or even eliminated.

Not all of the subjects concerns and desires deal with negative issues. Sometimes, they want to feature something positive.

Long Hair - Show off long hair by adding a hair light or kicker lights which will enhance the detail of the hair. Color gels can be used on hair to give it stronger color emphasis.

Body Curves - Directional lighting sculpts the body. For subjects who want to show off their curves in a sensual or romantic mood, use of a large light source allows the light to wrap around the face and the body to create highlight and shadow which define the body. On the other hand, a body builder might want a stronger definition of the muscles so a harder light source may do more to "cut" the detail of a well-defined body.

Emotion - Clients often wish to capture the emotions they are feeling at a particular time in their life. From love to loss or from success to grief, the use of color, lighting and posing helps to define emotion and provide psychological responses to an image.

Environmental Portraits - Clients often request portraits to be created on location, outdoors or in their home. It is important to select the appropriate environment to compliment the subject. Environmental portraits need to be designed to include the environment as part of the composition. At the same time, care has to be taken so that the location does not overpower the subject.

Lens choice is a key factor in controlling the relative size of the subject to the environment. (see page 23) In some scenarios, a telephoto lenses will compress the environment to help scale the subject with the background but in other scenarios, long focal lengths may be too limiting in revealing enough of a scene.

I used a medium telephoto lens with the image above and backed up far enough to include the mountain tops in the background and use the compression of the lens to make them appear closer to the subject.

Wide angle lenses may be perfect for establishing the scene or they may create too much separation between the subject and the background. It is up to the photographer to determine the best way to include the environment into the composition.

Also consider clothing selections and other props that might help complete the story.

Other Emphasis - Clients may want to celebrate the purchase of a new home, winning an award or a new job. Techniques available to tell these stories are endless. An Academy Award-winning actor might want a portrait with “Oscar” in the background. Adding a hint of additional light on the statue in the background may be just enough to show it off without making the statement too blunt and direct.

“Selective focus” can be used to place emphasis on the ring on a new bride’s hand as she dances the first dance with her husband.

A photographer needs to have a rather large “bag of tricks” at the ready in order to creatively and visually tell the stories their clients want to tell.

Composition

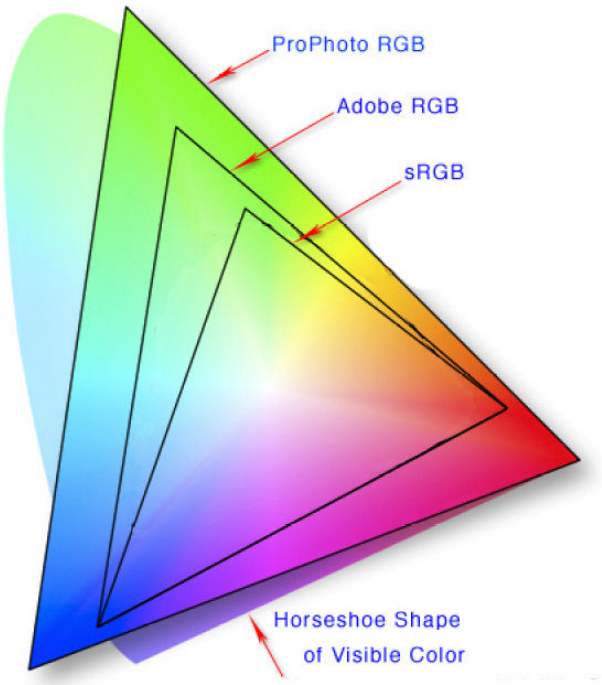
DIGITAL POST PRODUCTION (13%)

Items measuring this specification will include: (1) color space; (2) file formats and resolution; (3) color management; (4) digital manipulation and (5) storage. Basic knowledge of post-production software will be necessary.

A. Understand the best color space in which to work. (2 items)

1. Knowledge of color spaces (RGB, CMYK, SRGB, Adobe RGB, Pro Photo RGB)

Gamut
Gamut is the range of colors that can be seen, captured or reproduced by any device.

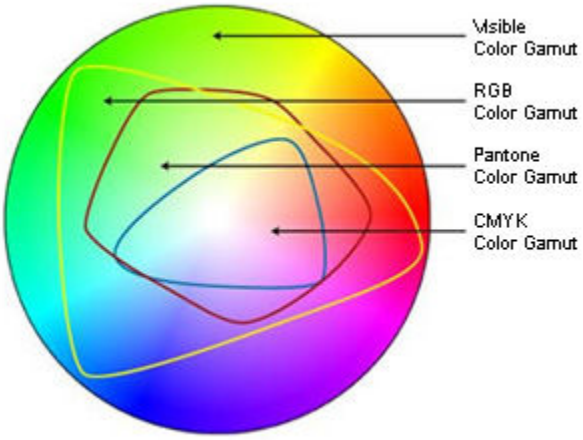


"Color Space" defines the range of color or the color pallet. Digital files, capture devices and output devices use various subsets within the visible color gamut.

RGB
The RGB color model uses additive color mixing of red, green and blue to produce color.

sRGB
"Standard RGB" is the most common color space for capture devices such as digital cameras, video cameras and computer monitors. The sRGB is the smallest of the RGB spaces. It is the primary color space for images viewed on the web.

Adobe RGB 1998
This color space was designed (by Adobe) to expand the gamut of colors achievable on CMYK printers, but by using only RGB primary colors. The Adobe RGB 1998 space is somewhat larger than the sRGB gamut.



Pro Photo RGB
The largest of the RGB color spaces providing the widest range of colors. Many of the colors in this space are not printable by some printers.

CMYK
This "subtractive" color space is used in printing images with inks and dyes onto paper. The process utilizes cyan, magenta, yellow and black to produce its color gamut. Its color space is even smaller than the RGB color spaces.

2. Knowledge of color space for printing and reproduction

Printing and Reproduction
Printing presses and most digital and inkjet printers use the CMYK color space to print an image onto the paper. Because photographers view images in an RGB environment on a computer screen, images will need to be converted to CMYK before the images are printed. This can be done by the photographer, but it may be best to leave this conversion to the printer since they are the most knowledgeable about their own printing process.

When images are printed in a CMYK color space, the conversion from the RGB color space of the file takes place in the printers' ICC profiles. These profiles translate the colors that are seen on the monitor and embedded into the file into a CMYK color space for printing.

B. Select appropriate file format. (2 items)

1. Knowledge of file formats (TIFF, DNG, JPEG, EPS, PSD, PNG, GIF, RAW, etc.)

File Formats
RAW - A lossless file type used for image capture to record data which will be used to create subsequent image files.

DNG - A lossless image format with the purpose of eliminating the proprietary conditions of camera formats used in other RAW formats. DNG provides a universal standard for editing and storing of metadata which is embedded into the file and accessible to all future image editing software editions.

JPG - A lossy file format most commonly used because of its compression. The compression of the file allows for smaller file sizes for storage and for faster transmission of files over the internet. Opening and saving a JPG causes data loss and degradation.

TIFF - A lossless image format used for image capture and image creation and storage. This format can be saved to preserve image layers. It is commonly used in publishing and high end image reproduction.

PSD - A lossless image format for proprietary use with Adobe products. These files are compatible with all of the image editing features found in Adobe software.

PNG - **(**Portable Network Graphics) Designed as an improvement over the GIF File format, the PNG offers a broader color palette than the GIF and is the most used lossless image compression format on the Internet.

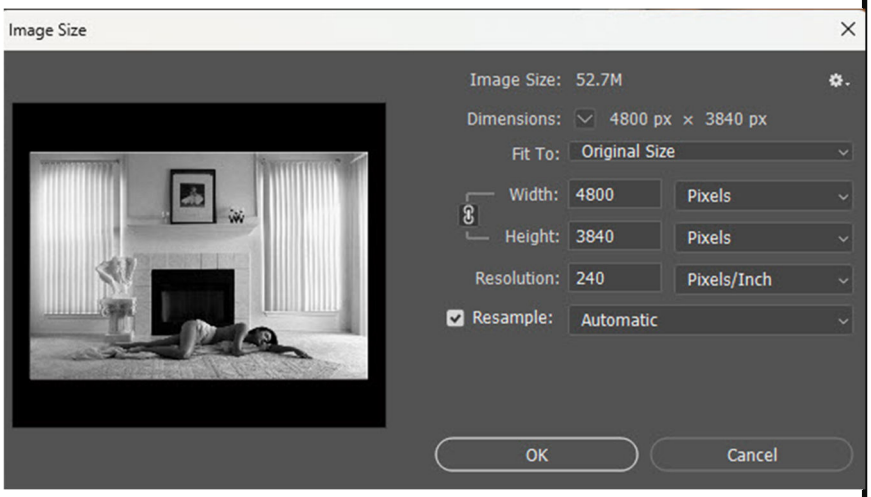
2. Knowledge of PPI versus DPI

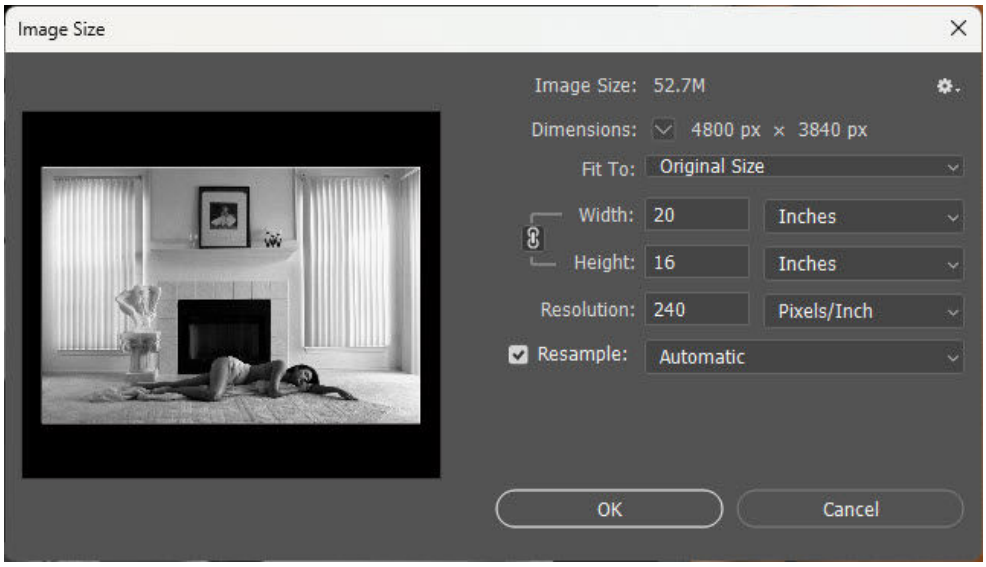
At the time of preparing an image for printing, you will need to consider the output device that you will be printing to. For example, you may be preparing images for the web, or printing on an inkjet printer or a 4-color press or at a photo lab. Each of these will have specific requirements for getting the best results.

PPI vs. DPI
Pixels per Inch (PPI) defines the resolution of a digital file and how it is viewed on a digital display.

PPI refers to the number of pixels contained within one inch of an image on a digital display.

Images with higher pixels per inch provide better detail.





Dots per Inch
Dots per Inch (DPI) defines how many “dots” are used to create the printed image.

The more dots per inch, the higher the resolution and the better the detail.

Where PPI describes the **digital resolution** of a file, DPI describes the **printed resolution** of an image.

C. Create/employ a color management system. (3 items)

1. Knowledge of monitor calibration and viewing characteristics

Calibration is the process of setting up a monitor to ensuring you are seeing an accurate rendition of the colors within your images on your computer screen. This also helps to increase the likelihood that the images you receive from the lab will look like you anticipated.

The principle is that calibrated monitors should all render almost exactly the same appearance of an image across all monitors. Quite simply, you want the lab to see an image on their monitor exactly the same way you see it on your monitor.

Monitor calibration is a two-step process which includes calibration and profiling.

Monitor calibration is done by setting a monitor to a set of standards which have known values for settings such as:

- brightness
- contrast
- white point
- black point
- Gamma - how quickly shades change from black to white
- luminance - the amount of light emitted from the monitor

Profiling
Color Profiling is a process in which your monitor is measured against a standardized set of colors. A hardware profiler runs the monitor through a series of swatches that have a known value and adjusts the screen to predefined standards of color and brightness.

A “Monitor Profile” is created and embedded into the digital file to enable a color-managed software, such as Photoshop and LightRoom, to make suitable translations of color from one device to the next.

Monitor calibration should be done at least monthly to maintain accurate settings.

2. Knowledge of color/ICC profiles

ICC Profiles
In the same way that monitors differ in translating the numerical value of color, so do printers. It is disappointing to see an image that appears beautifully on the computer screen look terrible as it comes off the printer.

An ICC profile is used to standardize the values of color between a monitor using an RGB color space and a scanner or printer using a CMYK color space. The ICC profile makes the translations so that output of the printer closely matches with the color as viewed on the monitor.

D. Select appropriate file management and archival systems. (2 items)

1. Knowledge of back-up/archive media

Archiving Digital Files
Protection of image files is an important consideration. As technology changes, new devices are developed and existing devices improve or seemingly disappear. It is important to keep an eye on emerging technologies and those which are disappearing. The time spent editing and working images is reason enough for you to protect your work. This following are considerations for archiving your valuable files.

Begin by transferring files from your camera storage media onto multiple computer storage devices using multiple storage media types.

Portable External Hard Drive—Very popular for storage of large numbers of files. They are relatively inexpensive and easy to store and retrieve when full. They are somewhat delicate and easily damaged if dropped or mishandled.

External Hard Drives— These larger capacity storage drives feature multiple drives which can be linked together and can be set up in a "Raid Array" in which the data on one drive is mirrored and backed up onto an additional drive for extra security.

External hard drives in a **RAID array** provide an excellent way of storing files. These systems utilize multiple hard drives which store the data on two separate hard drives simultaneously. This process is called, mirroring and provides added security of having data on two drives in the event one of them fails.

The use of a RAID array along with cloud storage provides additional protection in the event of drive failure and allow for easy offsite storage options.

Cloud Storage—Off-site storage cloud servers offer storage of digital files that can be uploaded and accessed through an internet connection. While uploading and file retrieval is not as fast as other storage options, cloud storage adds a layer of safety by storing files in a location separate from hard storage devices which may be susceptible to theft, fire or other damage.

Best Practices for Digital Storage
Redundancy is the best practice for storing valuable digital files. Because of the low cost of digital storage, photographers should utilize a workflow the includes the creation of duplicate files that are stored on two or more media types and stored at two or more locations.

The fact that data storage technology changes and can become obsolete is another reason for using multiple storage devices. Remember floppy disks and Zip drives?

No single method of file storage should be used without an additional back up of those files on other media. This offers a layer of protection of your files in the event one of the storage methods becomes damaged or inaccessible. It is also a good idea to place these backups at a separate location in the event of catastrophic damage to one of the storage venues.

2. Knowledge computer operations (RAM, storage, SSD)

Computer Considerations
Selecting a computer to handle digital workflow is an important decision, especially when image editing software consumes so much of the computer's resources to accomplish tasks quickly and efficiently. There are a few important considerations as you decide on which computer is right for you.

CPU
A computer's CPU is the engine that drives the speed and efficiency of the entire operating system as well as installed software. Modern personal computers and laptops offer options for having a number of available processors in the computer. A computer with a "quad" processor, for example, offers four processors to handle functions and tasks quickly when compared to a single processor.

The speed of the processor is stated in GHz. A 2 GHz processor is faster than a 1.8 GHz.

Processors are also manufactured that will handle certain tasks more efficiently as well. For example, some processors handle gaming applications better than others.

Computer Storage
Computer memory expresses the amount of space available for storage of installed software and saved data files. This space is separate from other memory specifications such as RAM, which is used to actually run active processes.

RAM (Random Access Memory)
Ram refers to the memory allocated for handling temporary processes required to run software applications and calculations. Increased RAM increases the efficiency of processes and tasks.

SSD (Solid State Drive)
The introductions of SSD's has added a new level of speed and protection for files and processes that photographer require for working with images. SSD's can be found in desktop and laptop computers as well as external storage devices.

Benefits include:
- Longer life span over non-SSD media because there is not spinning disk
- Less time required for the computer to boot up
- Files open and processes are faster with SSD drives
- Fast read and write times
- External SSD's are less susceptible to accidental "knocks" and "drops"

E. Manipulate digital images (4 items)

1. Knowledge of available techniques to manipulate digital images (exposure, color correction/balance, adjusting levels, details, dodge & burn, etc.)
2. Knowledge of cause and effect in the manipulation of digital images

Almost every digital image will benefit from some additional techniques to enhance and improve the final image. Some of these techniques apply changes to the pixels in the image file, but do not rearrange the pixels themselves.

Here are a few common techniques for image manipulation that **do not affect pixel position**:

Exposure
Exposure adjustments are made to an image to control the overall “lightness” or “darkness” of the image.

Color Balance
Color corrections using color balance allow for adjustment to individual RGB colors by making selected adjustments to the complementary colors of RGB which are Cyan, Magenta and Yellow. These corrections are made by removing or adding color to create a pleasing result. For example, if an image is too blue, you would remove a degree of blue from the image by adding an appropriate amount of yellow.

Contrast
Contrast adjustments are used to expand or contract the range of tones in the shadow, midtones and highlights.

Dodge & Burn
These tools are used to lighten (dodge) or darken (burn) very specific areas within an image without having to make adjustments to the entire image. Both techniques are frequently used to reduce distractions within the image or to provide additional emphasis to the subject.

These editing tools will **move or replace pixels** within an image file:

Clone Tool
This tool allows for exact duplication of selected pixels from a portion of the image or from a 2nd image (Source) for placement in a selected area (Destination) within the image.

Healing Brush
Similar to the behavior of the clone tool, this brush will “blend” the values of pixels from the source with pixels from the destination.

Using Layers
For added control, edits may be on an adjustment layer. By creating a new layer to perform these techniques, the original layer can be preserved and accessed if needed. Images saved as .tiff and .psd will preserve these layers with no loss of quality. when saved for access at a later time.

Reducing the opacity of an adjustment layer will allow for a more subtle enhancement by blending values from the original layer or other edited layers.

Black and White Conversion
There are a number of ways to convert a color file into black and white. Best practices would be to capture in RAW and make suitable adjustments before saving in the preferred format.

For image files, many photographers elect to keep the image in RGB mode instead of converting to Grayscale. Preserving the RGB channels allows for more precise adjustments to the tonal values.

When making adjustments to each RGB channel individually, adding a color will effectively lighten that color and darken the other two. For example, the green channel will **lighten** green (and adjacent colors on the color wheel) and **darken the reds and blues opposite** to it.

To increase tonal contrast of a specific area, select a channel whose color is on the opposite side of the color wheel to the image's original color.

IMAGE CAPTURE, AND OUTPUT (10%)

Items included in this section will measure of image capture and output options (paper, electronic, web, etc.).

A. Select the appropriate format for final job requirements. (4 items)

1. Knowledge of file size relative to enlarging capabilities

File Size and Enlargement

In the case of image capture, it may be best to begin with the end in mind. The size of the file has a direct impact on the resolution of the image which determines how large that file can be printed and the overall quality of an enlarged image.

For example, images intended solely for use on the web can be produced from a “Low” quality JPG setting on the camera.

Images for publication in a magazine or book will call for a much larger file size than that of an image for the web.

For rather large wall portraits or large press printing, “High” quality JPG or “Tiff” settings are a must.

Photographic Printing

Most photo labs now use printers which use laser technology to expose photographic paper which is then processed in traditional photographic chemistry. These printers produce images with very high resolution. Image files sent to the lab should be of maximum size to produce the highest quality.

Interpolation

Files which are sent to the lab are often not of sufficient resolution to get the most from these high quality printers - especially for larger sized images. Most labs take care of this issue without you even knowing it. They simply run the file through a software which dramatically increases the file size - before the image is actually printed. The software adds pixels and estimates their tonal value based on surrounding pixels. This process is known as, **“Interpolation”.**

Because this interpolation process is so efficient, many labs will request you submit your files at 240-250 PPI to save time in uploading and downloading.

Excessive interpolation has the potential to degrade an image by the introduction of unwanted digital artifacts.

2. Knowledge of appropriate selection of capture file format (JPEG, RAW)

Select Capture File Format
The two file types most commonly available on digital cameras are JPG and RAW.

JPG
JPG capture creates a “lossy” file which loses data when compressed. JPG options usually offer three quality options:

- **Low Quality JPG -** Low resolution files suitable for use in e-mail and website applications
- **Medium Quality JPG -** Medium resolutions files suited to website applications and printing very small prints
- **High Quality JPG -** Larger resolution files intended for printing larger wall photographs and smaller images reproduced in 4-color press processes and magazines.

When using the camera in JPG mode, the image is processed in the camera and then compressed for storage on the capture media. One the image is processed by the camera, almost 75% of the data captured is discarded in the process.

RAW
Produces and uncompressed, unprocessed, lossless data file which can be converted to any number of file formats depending on the final output requirements.

The RAW file requires the photographer to process the image in an image editor. The RAW file provides the widest range of digital data providing much more leeway in editing capabilities and subtleties.

Once the editing is complete, an image file is created in any variety of optional formats.

Because the RAW file is lossless, no data is ever lost in that RAW file.

B. Identify and correct problems in images. (2 items)

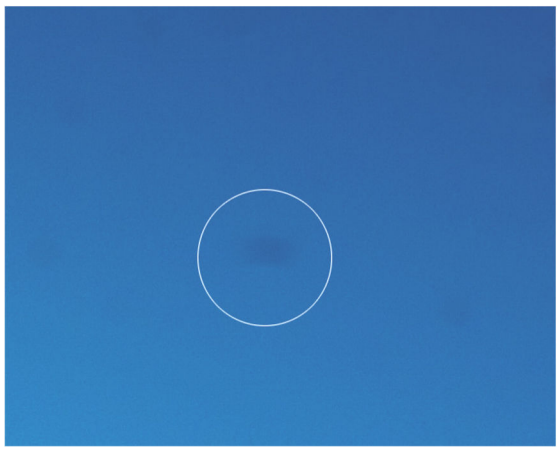
1. Knowledge of possible problems in image capture (white balance, dust spot on chip, flash synchronization)

Diagnosing Problems With Image Capture
Inevitably, problems will occur during image capture. Hopefully, you can spot these problems and quickly correct them during the shoot. Problems that go unnoticed until post-production may be much more difficult to correct and take a great deal of valuable time, or worse, be impossible to correct.

White Balance
Problems with white balance at the time of capture are quickly remedied by selecting the appropriate white balance setting or by use of a color correction filter. Some degree of correction can be done to JPG files during post production. For critical corrections with a wide latitude of adjustment, RAW capture is ideal.

Dust Spots
Airborne dust and other debris may find its way onto a lens and onto the camera's sensor - especially if you remove and replace lenses frequently. The best practice is to turn the camera off when changing lenses.

- On Sensor - Dust on a senor will appear on the image as a small dark and blurry imperfections. Condensation that has formed and dried on a sensor causes visual imperfections on the image. (right) The camera's sensor cleaning option may help with dust, otherwise proper sensor cleaning may be required. (I suggest sending the camera in for cleaning.)
- On Lens - It is a good practice to examine your lenses before using them. A quick visual inspection will possibly save you valuable time correcting the problems during post production. Dust on a lens may have little impact on an image but could manifest itself as minor imperfections in the image.

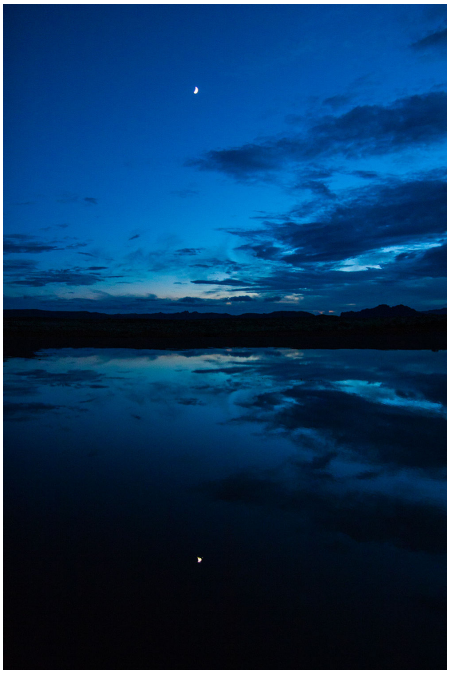


Out of Sync Flash

Failure to use the correct flash sync may result in a portion - if not most of your photographs to be black. This occurs when the flash fires and the curtain mechanism or camera shutter has not had time to get fully opened. The result is that the flash fires and the curtain blocks a portion of the sensor so nothing is recorded in that area. This creates the black area on the photograph! The solution is to not exceed the appropriate "sync" speed as determined by the camera manufacturer for your camera model.

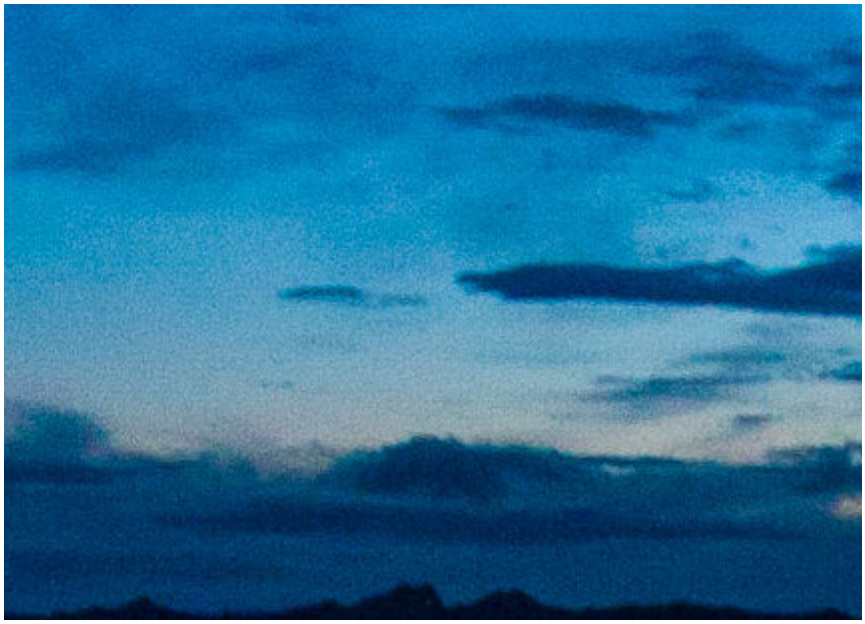
CPP Study Guide
by Steve Kozak

Digital Noise
Digital noise is an objectionable appearance of imperfections within a digital image. The introduction of noise is usually the result of high ISO values or long exposures. Noise patterns in an image appear as random variations of brightness or color. The film equivalent to digital noise is “grain”. Digital images may also manifest noise as “grain”.

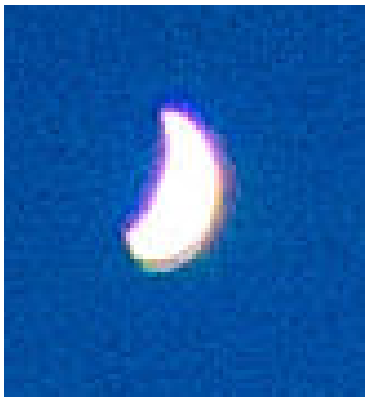


The image at right looks good at a small size, but a closer look reveals a lot of noise from using a high ISO. (below)

While increasing the ISO helps for capturing action in low light, it can also decrease the sharpness of the image and increase the noise. As the ISO increases, so does the noise.



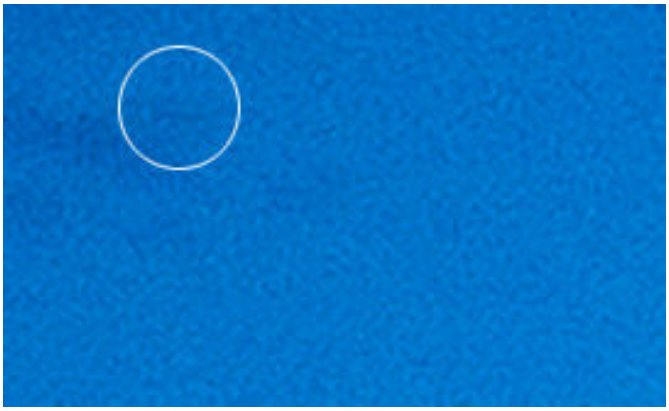
Digital Artifacts
These imperfections may be introduced into a digital image from the sensor, lens optics, jpg compression, digital interpolation or over-sharpening. Digital artifacts manifest themselves in the form of any number of ways including: Moire, jagged edges, chromatic aber
ration, blooming and more.



A closer look at the moon reveals a serious chromatic aberration issue as well as blooming

In the image at right, look for dark lines showing up randomly within the image.

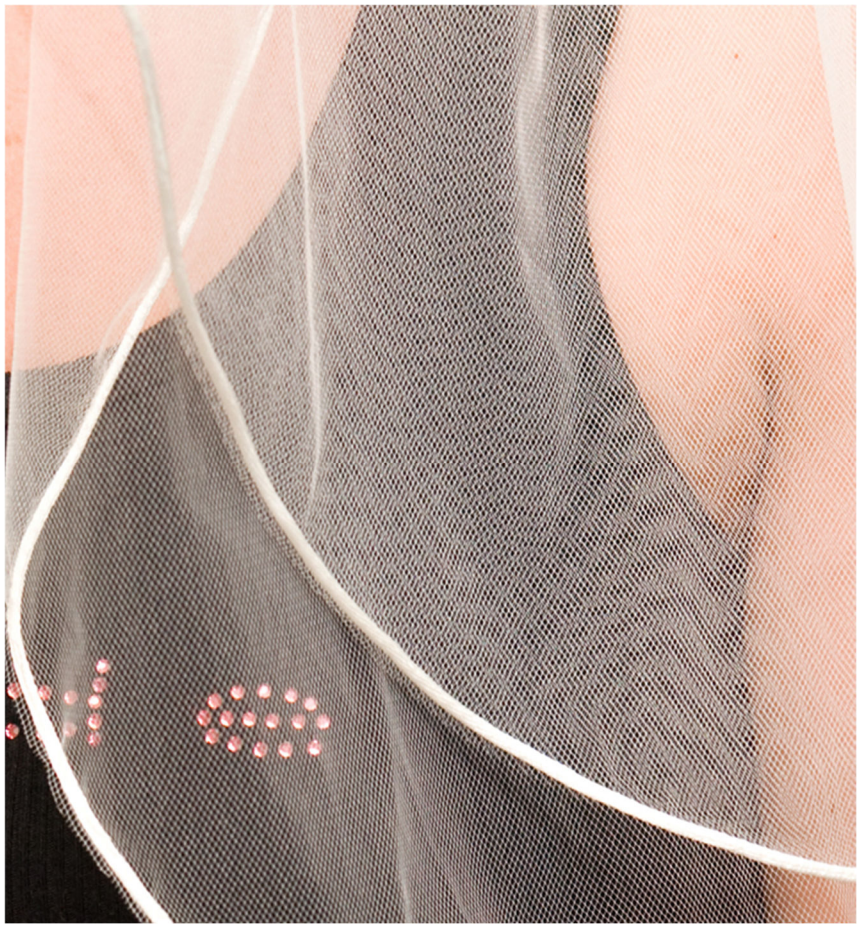
These digital artifacts are the result of using a high ISO and a slow shutter speed.



2. Knowledge of how to correct problems in image capture (white balance, noise reduction, lens flare, sharpening, chromatic aberration, etc.)

Other Problems During Image Capture
Since the CPP test is not product specific, it is difficult to cover this section and not want to share the step by step corrections that one might take in Photoshop to correct these situations. The fact is that I don't think that is the intention of this section of the test specifications. A more general approach to these solutions will be discussed here, while step by step instructions can easily be found online.

White Balance
The best practice is to deal with these issues at capture, but utilizing a RAW workflow will provide the largest latitude for color correction in post production.



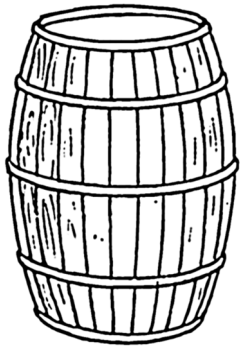
Moiré
This nuisance of unwanted "false" patterns sometimes occurs during capture of clothing or even natural patterns. The "wavy" pattern seen in the bride's veil at right is an example of **Moiré**. This can sometimes be corrected in post production, but can also be avoided with an anti-alias filter at the time of capture.

Noise Reduction
Digital noise is often the result of using high ISO values. The best option is to minimize usage of high ISOs. If noise is becomes an issue there may be noise filter options in your editing software. There are any number of alternate software solutions that will help reduce noise values.

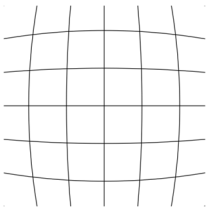
Lens Flare
Unwanted lens flare is best dealt with at the time of capture with a lens hood or simply protecting the lens from unwanted, stray light. Corrections to lens flair are usually done by removing the flare using a selection tool such as the lasso with content-aware fill.

Sharpening
Sharpening an image allows the photographer to improve the look of an image. The key to sharpening is to sharpen an image specifically with the image's final output, size and viewing distance in mind. Careless over-sharpening can result in the degradation of the image and pixelation.

Pixelation
Images that are over-sharpened or that do not have adequate resolution may experience pixelation. The result manifests itself with edges and details appearing indistinct. Closer inspection may reveal jagged, stair-stepped edges that you would expect to be straight and crisp.



Barrel Distortion
With barrel distortion, straight lines bulge out at the center. The apparent effect is that of an image which has been mapped around a sphere (or barrel). In a zoom lens, barrel distortion appears in the middle of the lens's focal length range and is worse at the wide-angle end of the range.



Remedies include use of prime lenses, purchase of higher quality lenses and digital corrections with Photoshop.

Chromatic Aberration
This distortion occurs because the lens design is unable to focus the wavelengths of all the colors to the same convergence point.

Chromatic aberration manifests itself as "fringes" of color along the edges that separate dark and bright values of the image.

The image at right has a great deal of chromatic aberration in edge line where the dark trees touch the bright sky. The enlarged portion of the image really shows the purple fringing.

Corrective measures to reduce chromatic aberration include using smaller lens openings rather than large lens openings. There are also adjustments that can be made to files that are captured in RAW mode and processed through RAW conversion software such as Adobe Camera RAW or LightRoom.

C. Output/Print image to desired medium. (4 items)

1. Knowledge of file sizes relative to final output

Image Size and Final Output
Image output ranges to images for use on the internet to high end printing by 4-color presses. File size and resolution are keys to getting the results you expect.

Web Images
JPG images used online require a minimum file size to display properly and efficiently. Resolutions are set by height and width in pixels. Files that are too large take longer to load.

Inkjet Printing
These image files will need to be somewhat larger than images prepared for online use. The larger the file size, the better the resolution...to a point. Inkjet printers actually print at a higher resolution than the file itself. This is because inkjets can spray hundreds of tiny drops in an inch of space.

Four-color or Press Printing
These services require larger files for high resolution of the printed image. Resolutions for these services are usually 300 PPI and larger.

The bottom line is, strive to prepare images at the highest resolution possible and then size them appropriately for the job. Doing the editing at maximum quality will save you from having to redo the work when the client decides the image you did for their website will look good as a full page ad in a magazine.

For large reproductions, provide the largest file size that can be generated.

Digital Displays
With today's digital displays and large screens, larger file sizes are needed to present high quality images on these larger devices. It is best to know the pixel dimensions of the display in advance so that you can prepare the file at the appropriate resolution.

2. Knowledge of the necessary instructions (use of cropping guides, monochrome vs color preference, etc) to provide the lab

Communication with the lab is critical to ensuring that you get back what you expect from them. You have the ability to do all of the corrections, cropping and color selections yourself and the lab simply serves as the printer. However, lab services include, color correction, custom cropping and even image editing.

Clear written instructions can be provided with the images which indicate your preferences such as:

Color - Do you prefer warm skin tones or cool tones?
Paper Types - Do you want the full tonal range of a glossy paper or do you prefer the lesser contrast of a matte paper?
Mounting - Do you want image mounted onto artboard, foam core or canvas?.

When cropping is critical, do it yourself or provide a guide print showing how you want your images cropped, dodged and burned.

Visit your lab personally if possible and learn what it takes to get your images printed. Learn to speak their vocabulary and develop strong relationships with those who will be printing your work.

3. Knowledge of the different output devices relative to the reproduction requirements (scanning, printer, web, printing press)

The end use of a photograph should be considered as you are preparing your images for image reproduction. For the most part, the image will either by printed by a photographic process, a 4-color process, a inkjet or dye sublimation printer or the image may be used for digital media or the web. Each of these has their own set of parameters that will need to be met for proper reproduction. The two primary parameters you will need to meet are the requirements for **resolution** and the **gamet** (range of colors that can be seen, captured and reproduced) of the desired output.

Continuous Tone
Most of today's professional photo labs use a continuous tone, light jet laser printer which exposes traditional emulsion-based photographic paper that must be processed in a traditional color photographic chemistry. The paper is exposed to three laser lights of Red, Green and Blue which combine to create the color spectrum of the photographic image. Once exposed, it is then soaked through the chemical process and then dried.

A dye-sublimation printer also provides a continuous tone process. The printer lays individual layers of Cyan, Magenta and Yellow dye onto the paper with a thermal print head which transfers each dye layer from a ribbon onto the paper.

Printing with Dots
Inkjet printers create images by spraying various amounts of inks (pigment or dye) onto the paper.

Four-color printing presses create images on paper using tiny dots of various colors created from Cyan, Magenta, Yellow and Black inks.

Digital Presentation
Images that are destined for use on the web or computer monitors. This will include images for websites, e-mail, screen savers, digital displays and presentations (PowerPoint, etc.). Digital signage is common in locations such as airports, malls and fast food locations.

The two primary parameters you will need to meet are the requirements for the color space of the image and the resolution requirements.

4. Knowledge of resolution required for output (ink jet, photo lab, Dye sublimation printers, and web, etc.)

Output Resolution
The two primary parameters you will need to meet are the requirements for the color space of the image and the resolution requirements.

Web Images - Sized by the pixel count for height and pixel width. Usually JPG's in an sRGB color space displayed at 72 PPI.

Inkjet Printing - Usually JPG's in an sRGB color space sized at 200 - 250 PPI for most printers

Photographic Printing - Usually JPG's in an sRGB color space sized at 200 - 300 PPI before interpolation

Four-color or Press Printing - Usually JPG's or TIFF's in a CMYK color space sized at 300 PPI and larger.

5. Knowledge of archival processes for printed images

Archival Care of Prints and Files
It does not take much research on this topic to discover that the information available is very limited and very technical. The foremost authority on the topic may very well be the folks at Wilhelm Imaging Research. www.wilhelm-research.com Their studies on image permanence are vast and in depth.

For our purposes, we are going to look at some generalities of longevity and preservation of printed images.

Protection of Printed Images
Photographers use a number of methods and substrates to print photographic images. The longevity of these images is dependent on many factors in manufacturing including: paper selection, acidity of the paper and mounting materials, ink types, exposure to photographic chemistry and washing in the printing process.

General approaches to improve longevity during production of printed images include:

- Minimizing long exposure to the chemical processing of prints
- Thorough washing after exposure to chemical processing
- Using coated papers for inkjet printing
- Use of printing inks that use pigment instead of dyes
- Printing on archival papers that are acid free

There are also factors effecting the longevity of an image once it is printed. These factors include: exposure to light, humidity, temperature and handling.

General approaches to improve longevity of a image after printing include:

- Minimizing exposure to light (particularly, sunlight and fluorescent lighting)
- Minimizing exposure to humidity (40% or less is recommended)
- Minimizing exposure to heat
- Minimizing exposure to airborne pollutants
- Use of storage boxes and presentation mats that are acid free
- Storage of images in polyethylene, polyester or polypropylene sleeves

Long term storage of images is best with cold storage and low humidity.