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Inside Outside, 2010.

METERING AND EXPOSURE

> UNLIKE ANY OTHER VISUAL IMAGE, A PHOTOGRAPH IS NOT A RENDERING, AN IMITATION OR AN INTERPRETATION OF ITS SUBJECT, BUT ACTUALLY A TRACE OF IT. NO PAINTING OR DRAWING, HOWEVER NATURALIST, BELONGS TO ITS SUBJECT IN THE WAY THAT A PHOTOGRAPH DOES. —JOHN BERGER

To beginning photographers in my college courses and workshops I say, "In order to make successful photographs, you first have to understand basic technical aspects of exposure." And they reply, "Why should I do that when my camera figures out exposure for me? All I have to do is use Program mode!"

The answer is simple. *The technical aspects of exposure are intrinsic to the appearance and meaning of your images.* Using your camera's Program or Auto mode relinquishes your creative control, which you want to retain so you can make meaningful photographs.

Although learning the technical aspects of exposure seems intimidating at first, I've created a guide that's straightforward and easy to use. Armed with this knowledge, you'll make successful images while you enjoy a more rewarding photographic practice.

As you proceed, be sure to have your camera with you, set to Full Manual mode, and have your camera manual handy to help you identify and manipulate the various exposure controls as you learn them. Once you've completed the chapter you'll know how to read a light meter, and you'll be able to use your camera's technical controls to make good exposures. Let's get started.

WHAT IS EXPOSURE?

Photography literally means "light writing." Through exposure to light, we transcribe an image of the world directly onto light-sensitive media. In photography, the word "exposure" has dual meanings. First it refers to the amount of light that strikes and alters the photographic media, and then it refers to the resulting *density* (the overall lightness or darkness) of the image. There are four factors working together to determine exposure. After just a little study and practice, using them becomes second nature.

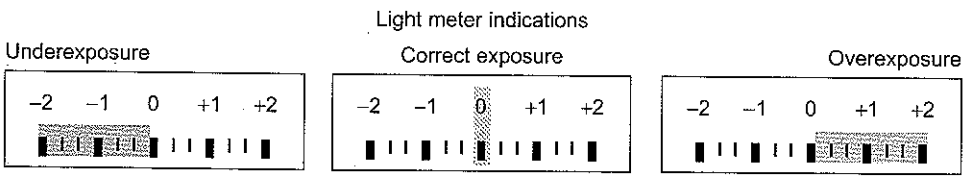
Four Determinants of Exposure

1. Amount of light in the scene
2. ISO (defines the photographic media's *sensitivity to light*)
3. Aperture (controls the *intensity* of light striking the media)
4. Shutter speed (controls the *duration of time* the media is exposed to light)

First, take some time to locate your camera's exposure determinants and familiarize yourself with how to manipulate them. Once you've done that, you'll have to understand one important term that relates to all of them in order to use them well—"stops." In photography, *a "stop" refers to the relative change in exposure to light caused by altering any of the four determinants.* Stops are specific and predictable, which makes calculating exposure much easier. Any 1-stop change in one direction will double the exposure to light; moving in the other direction will cut the exposure in half. Adding exposure will brighten the image, while subtracting exposure will darken it. Although cameras usually allow you to make finer exposure changes—{1/2} or {1/3} stop—while you learn it's easier to keep it simple and use the whole numbers for practice. As you proceed, I highly recommend memorizing the "whole stop" numeric designations that will be discussed.

The Amount of Light in the Scene

The amount of light in the scene is the first determinant of exposure. Light is either *ambient*—light already existing in the scene—or it's added using flash or strobe. Ambient light, also called available light, includes sunlight, moonlight, indoor lighting (such as tungsten, fluorescent, halogen, etc.), firelight, candlelight, and so on. Although flash and strobe



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In-camera light meters indicate the degree to which a given combination of exposure determinants renders good exposure, underexposure, or overexposure. Camera meters may look different, but they all work the same way. Underexposure renders a darker image, overexposure renders a lighter one, and good exposure is "just right."

equipment offer added control over photographic lighting, learning exposure control is far easier using ambient light. Once you really understand exposure, you can advance to using artificial light, whose principles are built upon those of ambient light exposure.

To determine how much light is in the scene, you'll use your camera's *reflected-light meter.* This tool "reads" the amount of ambient light reflected toward you from the scene to determine how much is needed based on the ISO (the next exposure determinant). Based on these two factors, the meter then recommends an aperture and shutter speed combination to render good exposure density.

Meters indicate degrees of exposure from underexposure (too little light), to proper exposure, to overexposure (too much light). When you look inside your camera's viewfinder at the meter's exposure indicator, notice that it responds when you change your aperture or shutter speed, or when you point your camera toward lighter and darker areas of a scene. This is your meter at work. There's no need to try controlling it just yet; as we move further into exposure you'll learn how to use it to get the exposure you need. You'll also learn to recognize those situations when your meter might be fooled, and to correct for that as well.

ISO (Also Known as Film or Sensor Speed)

Although you don't always control the amount of light in the scene, you do control the other three exposure determinants, starting with the ISO. As you already know, photographs are made using materials that are *sensitive to light.* The ISO identifies just how sensitive to light a particular medium is.

When using traditional film, you normally choose the ISO corresponding with the film's sensitivity and maintain that setting throughout the entire roll. With digital media, you can change the ISO at will, depending on your lighting requirements.

ISO	Lighting Requirements	Visual Qualities
50	Extremely slow response to light Good for still life and flash/strobe work Requires long shutter speeds or wide apertures	Film: Very fine grain Digital: Very low noise Both: Excellent fine detail
100	Slow response to light Great for bright light and still-life work *Two times faster than 50 ISO* *Half the speed of 200 ISO*	Film: Very fine grain Digital: Very low noise Both: Very fine detail
200	Medium-slow response to light	Film: Medium-fine grain Digital: Low noise Both: Very good, fine detail
400	Medium-fast response to light General-purpose; good in fluctuating light *Two times faster than 200 ISO* *Half the speed of 800 ISO*	Film: Medium grain Digital: Barely perceptible noise Both: Good fine detail
800	Fast response to light Good for stop-motion and fast-moving subjects	Film: Larger grain Digital: Some apparent noise Both: Less fine detail
1600	Very fast response to light *Four times faster than 400 ISO* *Two times faster than 800 ISO*	Film: Very large, coarse grain Digital: Visible noise Both: Very little fine detail
3200	Extremely fast response to light *Two times faster than 1600 ISO*	Film: Extreme, large, coarse grain Digital: Distractingly visible noise Both: Little to no fine detail

The ISO chart outlines the "whole stop" ISOs, describes the speed at which they respond to light, and explains the visual qualities of each. These numbers are pretty straightforward because they make mathematical sense: ISO 100 responds to light twice as fast as ISO 50; ISO 200 responds to light twice as fast as ISO 100, and so on. Although there are ISO's available in between whole-stops, if you memorize these you'll always know where you stand in terms of light-gathering ability.

From the ISO chart you see that the slower the light-gathering abilities of the media (film or sensor), the more exposure to light is required to record adequate image density. The primary advantage to slow ISOs such as 50 or 100 is their very fine image detail and clarity; however, it's difficult to impossible to freeze moving subjects or achieve adequate exposure in low lighting conditions. Slow ISOs are best for still life, flash photography, tripod work, or if you intend to blur the contents of the frame.

A medium ISO speed such as 400 has sort of best-of-both-worlds light sensitivity. It offers very good image detail and clarity, it's fast enough to shoot in most lighting situations, and most movement can be frozen by choosing appropriate aperture/shutter combinations (which we'll learn about in the next section). It's best to choose your own ISO settings rather than allow your camera to automatically select one for you.

ISO settings also affect the visual appearance of the image due to film grain and digital noise. The higher the ISO, the more grain or noise. Traditional media's light sensitivity increases as ISO increases because it literally has more light-sensitive material (usually silver) in it. For this reason, the material particles (grain) become larger and more visible as the image is enlarged.

Digital noise is similar to film grain, but the media works a bit differently. Digital sensors capture light according to an optimal ISO setting where image quality is its highest. Setting your digital camera's ISO slower or faster than the sensor's optimal setting amplifies an electronic signal created by exposure to light. The image clarity is therefore reduced and noise increased; the farther away you are from the optimal setting, the worse it gets. It's similar to turning music up above your speakers' optimal level; the volume gets louder but the sound quality gets worse. Refer to your camera's manual for its optimal ISO and stay as close to it as possible, given the lighting conditions. The disadvantage to digital noise it that, unlike film grain which can have a visually pleasing random distribution, digital noise rarely has a pleasant appearance. However, the advantage is that you're not necessarily stuck with it. Many high-end digital cameras have little apparent noise even up to 800 ISO, and your camera's software, Adobe Lightroom and Photoshop, and some excellent third-party plug-ins offer noise reduction capabilities that work very well to minimize or eliminate noise even up to 3200 ISO.

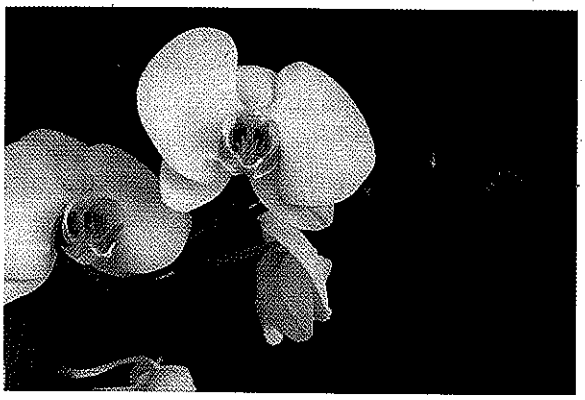


IMAGE © ANGELA FARIS BELT, 2007.
Film grain and digital nose are similar in that they reduce detail and clarity in the image. The two images following are enlargements of the frame above shot at 100 ISO and 3200 ISO.

100 ISO: Increased clarity and detail

3200 ISO: Decreased clarity and detail

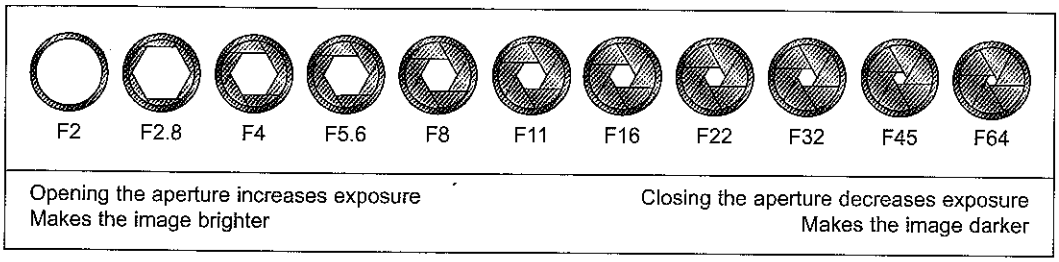
These are the common, whole-stop ISO numbers. Like the whole aperture and shutter speed numbers, each 1-stop change (from one number to the next) either doubles the media's sensitivity to light or reduces it by half. Slower ISO's need more exposure to light than faster ISO's to achieve proper exposure and image density.

50 100 200 400 800 1600 3200

Apertures/F-Stops

The second determinant of exposure, the aperture, is commonly called an *f*-stop. It is the size of the opening through which light enters the camera. Normally located in the lens, the aperture controls the intensity of the light that will strike the photographic media for a given length of time (which is controlled by the shutter). The common, whole aperture numbers are as follows:

f/2, *f*/2.8, *f*/4, *f*/5.6, *f*/8, *f*/11, *f*/16, *f*/22, *f*/32, *f*/45, *f*/64



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From left *f*/2 to right *f*/64: Illustrating an aperture closing, or "stopping down" inside a lens. As aperture numbers increase, their size becomes smaller. So larger numbers are referred to as smaller apertures. As apertures become smaller, less light strikes the media, reducing the exposure. Also, as apertures become smaller, depth of field increases throughout the image. This will be covered in depth in Chapter 4.

Note that while *f*/2 is a small number it is a large aperture and lets in the most light; while *f*/64 is a large number it is a small aperture and lets in little light. I know it sounds backward. Knowing how the numeric designations came to be doesn't matter; remembering their interrelationship does. *Each whole aperture number lets in exactly half or two times the amount of light let in by the whole number directly before or after it.* For example:

- *f*/2.8 lets in half the light of *f*/2 and two times more light than *f*/4.
- *f*/5.6 lets in half the light of *f*/4 and two times more than *f*/8.
- *f*/16 lets in half the light of *f*/11 and two times more than *f*/22.

Knowing these relationships and memorizing the whole aperture numbers make exposure calculation much easier and enriches your photographic practice. Although most lenses don't offer the entire aperture range (some may offer *f*/4 to *f*/22 only, others from *f*/2.8 to *f*/16 only), they do allow you to set the aperture in between full stops for finer control.

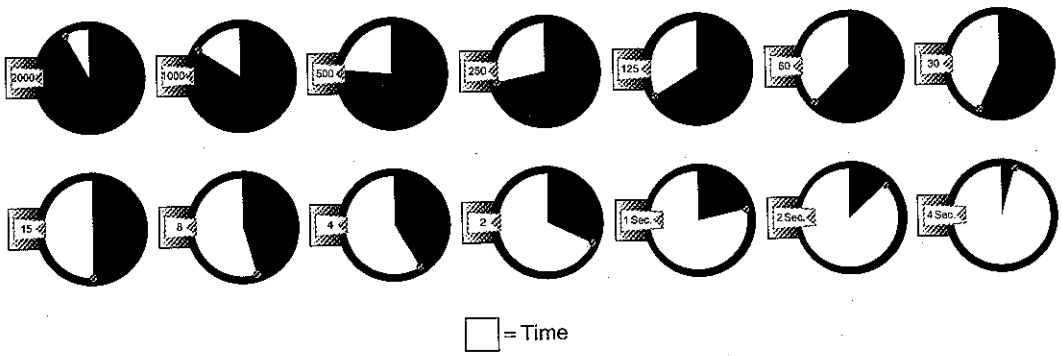
Learn how to change your camera's apertures, and determine whether it allows you to make {1/2} stop or {1/3} stop changes in between whole aperture numbers. Try to determine what your meter is telling you when you change apertures; for instance, your meter should indicate that as you close the aperture you are reducing the exposure to light, and as you open the aperture you are increasing exposure to light.

Zoom Lenses and Variable Maximum Apertures

With zoom lenses, the maximum aperture (smallest number) may vary depending on the zoom range. For instance, a 28–70 mm, *f*/4–5.6 zoom lens has more light-gathering ability at 28 mm (where the aperture will open to *f*/4) than it will at 70 mm (where it will only open to *f*/5.6). This makes the lens lighter weight, smaller diameter, and less expensive; however, lenses with very wide zoom ranges have reduced image quality. When buying lenses, look for a prime lens (non-zooming), or short zoom ranges for best quality, and look for the largest maximum aperture you can afford to give you more exposure control and creative flexibility.

Shutter Speeds

The third determinant of exposure that you control in-camera is the shutter speed. Normally located in the camera body just in front of the media, the shutter controls the duration of time the media is exposed to light. When you depress the shutter-release mechanism, a curtain within the camera



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From top left 1/2000 of a second to bottom right 4 seconds: Illustrating the shutter speed slowing down in 1-stop increments. As the shutter speed slows down, light strikes the media for a longer time, which increases exposure. The faster the shutter speed, the better your chances of freezing motion in the image; the slower the shutter speed, the more likely you are to blur it. This is covered in depth in Chapter 5.

opens, allowing light coming through the aperture to strike the media for a specific amount of time. The aperture and shutter speed are used to balance the intensity of light and the duration of exposure to it. The relationship between the whole shutter speeds is just like the relationship between whole apertures, that is, any 1-stop change will either double or cut in half the amount of exposure to light. This comes in very handy when you're trying to determine proper exposure.

The common, whole-stop shutter speeds are as follows:

1/8000, 1/4000, 1/2000, 1/1000, 1/500, 1/250, 1/125, 1/60, 1/30, 1/15, 1/8, 1/4, 1/2, 1 sec. 2″ 4″ 8″ ...

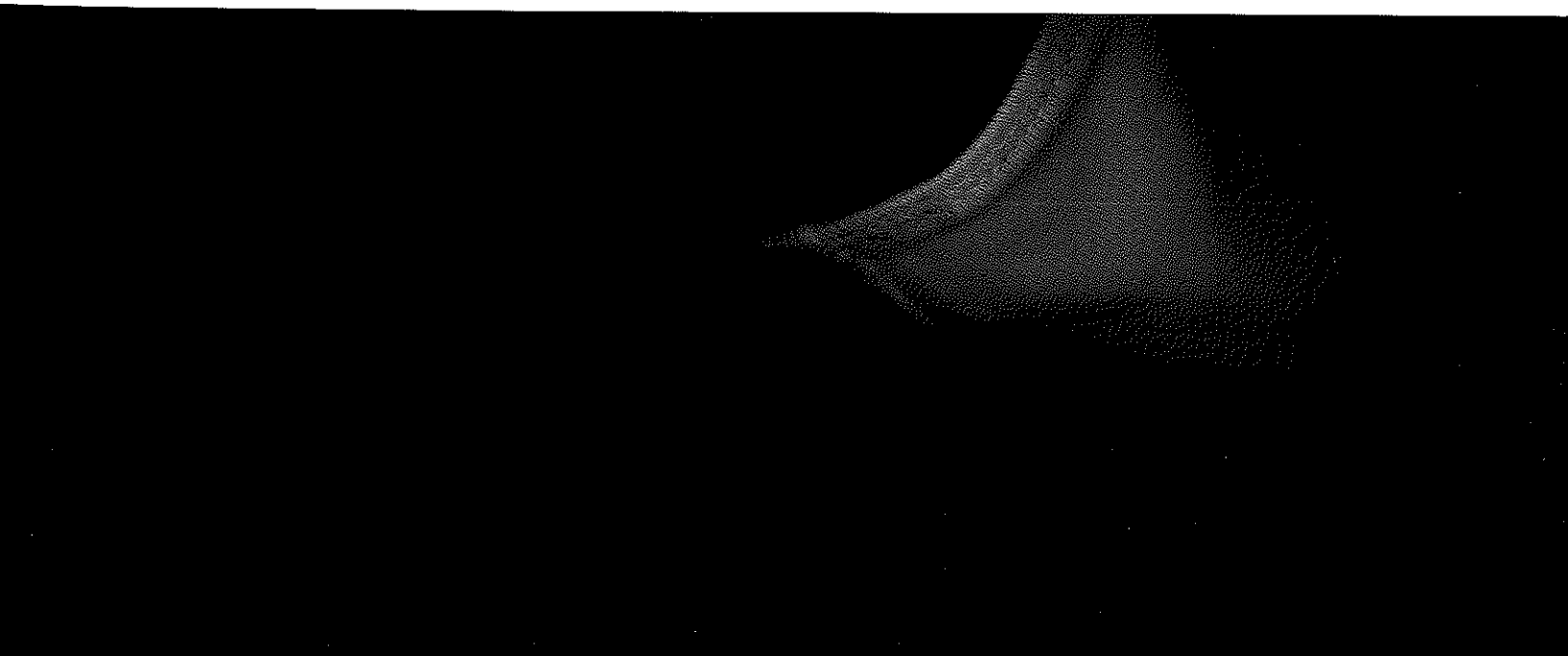
On nearly all shutter speed indicators, the number "2" refers to one half of a second, the number "30" one thirtieth of a second, the number "1000" one one-thousandth of a second, and so on. In photographic terms, 1/30 is considered a slow shutter speed (too slow to avoid a blurry photograph unless you're really steady, have image stabilization lenses, or use a tripod). Average shutter speeds range from 1/60 to 1/500 of a second, depending on the lighting situation. Because the shutter speed determines the duration of time that light is allowed to strike the media, it makes sense that slower shutter speeds add exposure whereas faster shutter speeds reduce exposure.

Take some time to learn how to change your camera's shutter speeds, and determine whether it allows you to make {1/2}-stop or {1/3}-stop changes in between whole shutter speed numbers. Try to determine what your meter is telling you when you change shutter speeds; for instance, your meter should indicate that as you speed up the shutter you are lessening the exposure to light, and as you slow down the shutter you are increasing exposure to light. Work with your camera's aperture and shutter speed settings together under bright lighting conditions to manipulate exposure so you see how to move the meter indicator to proper exposure.

Camera Shake: Avoid Blurry Pictures at Slower Shutter Speeds

Camera shake refers to creating a blurry picture from using too slow a shutter speed while handholding the camera. Beyond using a tripod, you can still avoid it. Here's the basic rule: *Always use a shutter speed that is the numerical equivalent or faster in relation to the focal length of the lens, and never go slower than 1/60.* It's best to err on the side of too fast a shutter speed if you don't want blurry pictures. For example:

- If you're using a 100 mm lens, use a shutter speed of at least 1/125.
- If you're using a 200 mm lens, use a shutter speed of at least 1/250.
- With any focal length of 50 mm or shorter (say, 16 mm) you should still use a shutter speed of at least 1/60 to avoid camera shake.
- If you use a tripod in conjunction with a cable release or the camera's onboard timer, you can use just about as slow a shutter speed as necessary as long as the subject isn't moving.



Types of Shutters

There are two basic types of shutter mechanisms: leaf and focal plane (also called curtain) shutters. Leaf shutters are located within the camera's lens and are most commonly found in medium- and large-format cameras. Focal-plane shutters are located inside the camera body, just in front of the film or sensor plane, and are most common in SLR cameras. The two kinds of shutters have several different attributes that are significant when using flash or strobe. Focal plane shutters are limited to the flash synch speed or slower in order to expose the entire picture plane, because this is the fastest speed at which the entire image area is open to light simultaneously. You can find the flash synch speed for your particular camera in your camera's manual, and it's usually 1/60 to 1/250 of a second. Leaf shutters, on the other hand, can be used with a flash or strobe at any speed, because the aperture opens from the center outward, a significant advantage for studio and commercial photographers. However, because of this functionality, leaf shutters also have a slower minimum shutter speed than do focal plane shutters. That is, while focal plane shutters commonly expose as fast as 1/4000 of a second, leaf shutters are about 1/500 of a second at their fastest. Most all photographers using this text are using focal plane shutters, so you won't need to worry about the differences here.

UNDERSTANDING YOUR LIGHT METER

If you're working with in-camera meters, it's helpful to understand how they work. In-camera through-the-lens (TTL) meters are a type of *reflected-light meter;* they read *reflectance value,* or how much light is reflected off the surface of the subject. Your camera's light meter is a tool, a guide to help you determine what the proper exposure will be for a particular scene under a particular quantity of light. Once you understand how your light meter works, it becomes an indispensable tool.

For a light meter to guide you properly, it first needs one vital piece of information: the ISO sensitivity setting. Based on this information, the light meter "reads" the amount of light reflected from within its field of view and determines how much of that light it needs to properly expose the media. Your meter assumes every scene is an average scene, containing a range of tones from black to white, so when interpreting its exposure recommendation, there is one characteristic you can always count on: *Your light meter averages any light that it reads to middle gray (also known as 18% gray).* It doesn't matter whether it's really an *average scene*, a *high-key scene* (a predominantly light-toned scene, for instance, a white dog in a snow drift), or a *low-key scene* (a predominantly dark-toned scene, say, a black cat on a dark stone path). Your meter will average the light reflected from within its field of view and give you an exposure

recommendation to render the scene middle gray. Although it might seem odd, this fact is actually a benefit to you.

High-key and low-key scenes consist of tones that "fool" your reflective meter. A high-key scene is up to two stops (four times) brighter than an average scene, and a low-key scene is up to two stops darker than an average scene. The result of exposing at the meter reading in these cases is called *subject failure;* that is, *the reflectance value of the subject fails to produce a middle-gray reading* and the density of the image is wrong. Your meter will recommend exposures that will render even high-key and low-key scenes gray. Of course, you don't always want the scenes you shoot to look gray (i.e., you want the white dog in the snow drift to look white, not gray; and the black cat on the stone path you want to be a predominantly dark to black scene, also not gray). In these situations you have to override your meter's recommendation, adding up to two stops of exposure to high-key scenes to brighten them, and subtracting up to two stops for low-key scenes to darken them. Because your meter does the averaging whether you want it to or not, there are a couple of simple rules you can follow so that your photographs render the tones you want. Read on.

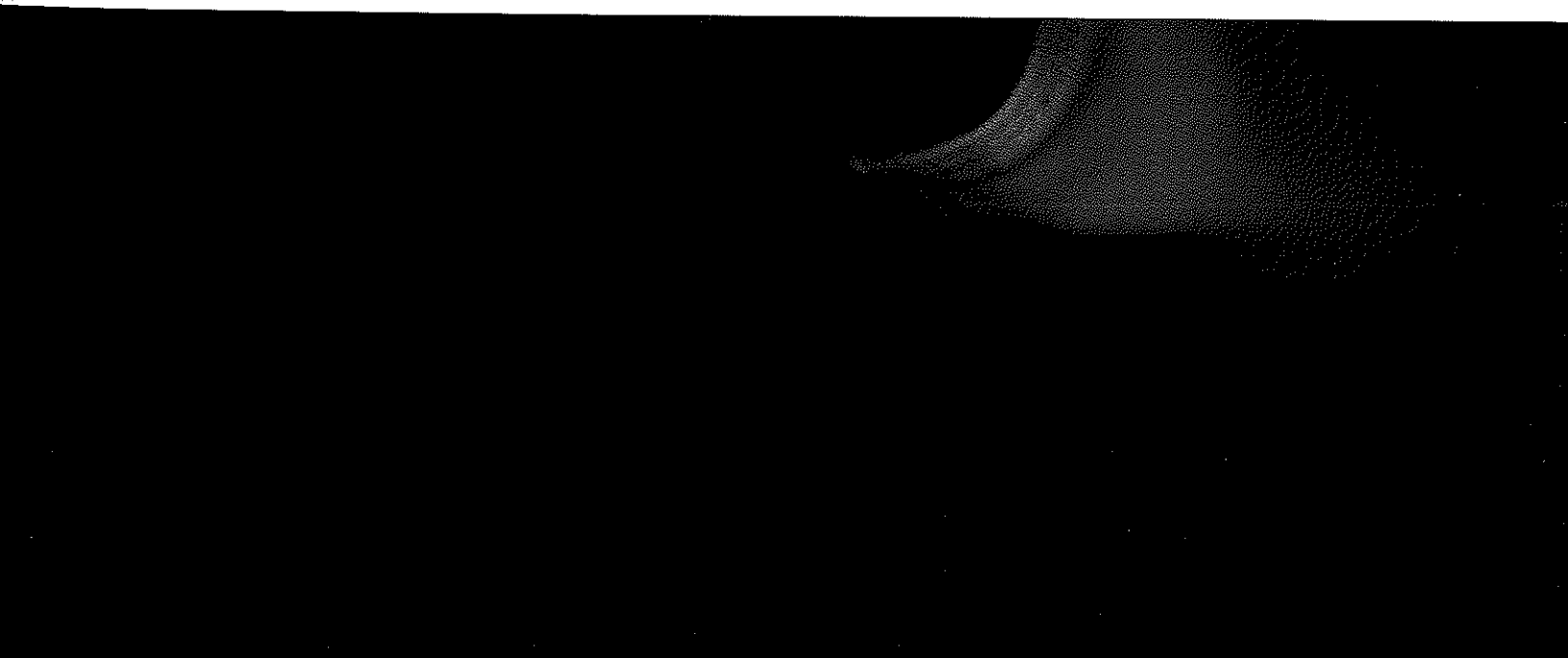
PUTTING IT ALL TOGETHER

At this point you have a good idea about how ISOs, apertures, and shutter speeds work, and how to manipulate them. You'll notice that as you change these settings your camera meter indicates how close you are to exposing for the correct density. There are essentially three ways to expose photographic media:

1. Normal exposure (N) means the exposure is correct; an average-tone scene should contain all tones with proper density and detail.
2. Overexposure (+) means the medium will receive more light than is needed to average to middle-gray, and so will become increasingly lighter.
3. Underexposure (–) means the medium will receive less light than is needed to average to middle-gray, and so will be increasingly darker.

Your goal is to expose properly *based on the tonal range of the scene,* and because the exposure relationship between whole shutter speeds and whole apertures is the same, any number of *equivalent exposures* exist for a single scene.

What this means is that if an exposure of *f*/8 at 1/125 is correct, then an exposure of *f*/4 at 1/500 will also be correct, as will an exposure of *f*/32 at 1/8. In other words, if you close the aperture to let in one stop less light, and you slow down the shutter speed to let in one stop more light, then the resulting exposure densities will be the same. There are reasons to choose one exposure combination over others, and the chapters on apertures and shutter speeds cover this in depth. The following example of water moving over a rock will help to demonstrate.



Your initial meter reading has the right exposure, but a noncommittal image in terms of the rushing water as it relates visually to the still leaves. You want either blurred or frozen motion to choose from.	So you decide to blur the water using a slower shutter speed. You change your ISO to the slowest, and your aperture to the smallest, so that your shutter speed can be longer, creating the most blur you can get from your camera.	Finally you decide to freeze the motion of the water as best you can. So you change your ISO to the fastest, and your aperture to the largest, so that your shutter speed can be shorter, causing the water to be frozen in time.

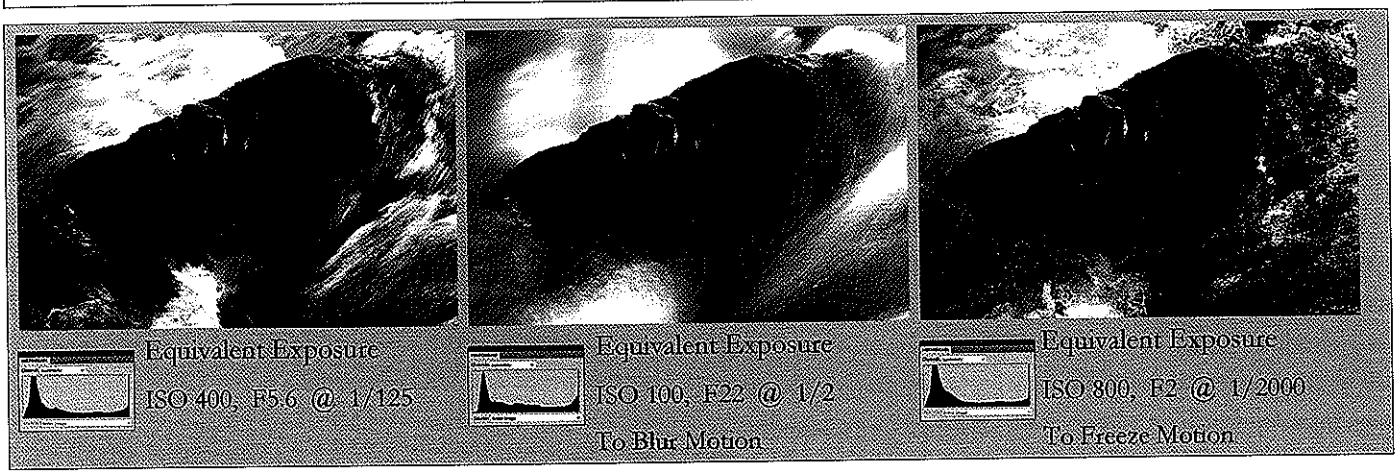


IMAGE © ANGELA FARIS BELT.

These images were made with equivalent exposures; each has the same amount of tonal density. Any number of ISO-aperture-shutter combinations will provide equivalent exposures, but they will produce different visual effects, which are clear to see here. How to control these effects is covered at length in the chapters on apertures and shutter speeds.

Bracketing to Ensure Proper Exposure

Even with advanced metering systems, to ensure that you record an accurate exposure, *bracketing* may sometimes be in order. *Bracketing means making several different exposures of the same scene.* In a way, this is the opposite of equivalent exposures; you bracket to capture a range of exposure densities so you have several to edit from later. To bracket, make an exposure at the camera's recommended meter reading,

then make a second exposure at {1/2} to 1 stop over the meter reading (for a lighter image), and then make a third exposure at {1/2} to 1 stop under the meter reading (for a darker image). This technique is often used to find the right exposure for high-key and low-key scenes (which is demonstrated in the next section) and to cover your bases if you're not sure of the proper exposure.

Evaluating Exposure with Digital Cameras

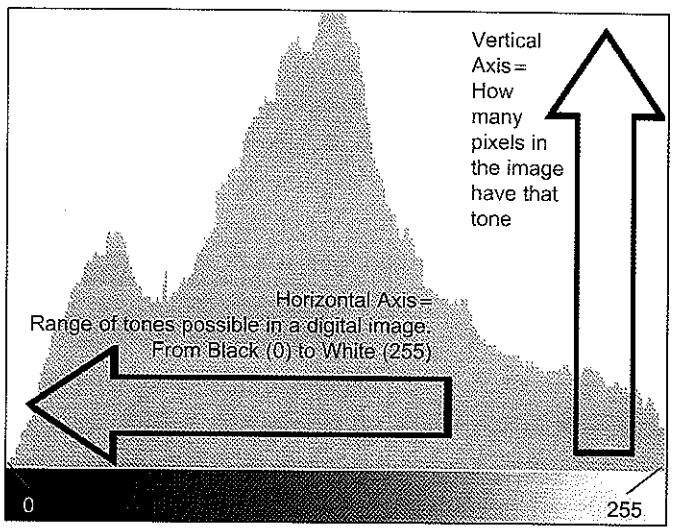
The very best advice: never, never, ever—never ever—trust your LCD monitor. Always refer to your histogram (explained in the following section) to judge your exposure.

Advanced Metering Systems

Many contemporary metering systems are good at guessing the tonal range of a scene. Those that are provide a much more accurate meter reading than older analog meters. For instance, I own a camera whose meter is accurate to within {1/2} stop of the correct reading even in high-key and low-key situations, so if I add or subtract the usual two stops I will have gone too far. To guarantee proper exposure, you'll want to practice in various tonal range scenes to determine how your camera's meter responds.

DIGITAL MEDIA HISTOGRAMS DEMYSTIFIED

Histograms provide a graphic representation of how the image's tones are distributed throughout the tonal range possible to capture. They are the only accurate way to decide if your exposure is correct.



A histogram's horizontal axis shows the tones possible to capture in the image. These tones range from black (0) to white (255). The vertical axis "stacks" the number of pixels within each of these tones you have captured.

A histogram's horizontal axis shows the tones possible to capture in the image. These tones range from black (0) to white (255). The vertical axis tells you how many pixels within each of these tones you have captured. Histograms aren't right or wrong—they just are. They are a reflection of the tones in the scene as they will be rendered in the image. Average scenes, accurately exposed, will have an average distribution of pixels throughout the tonal range (left to right). High-key scenes will have the majority of their pixels to the

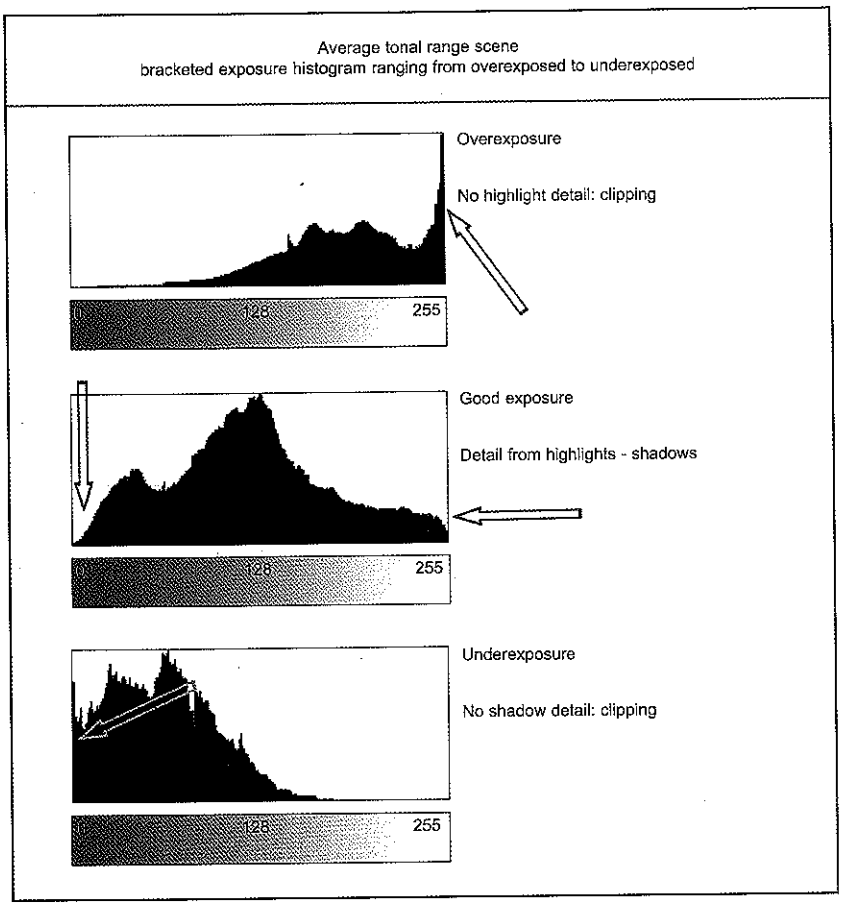


ILLUSTRATION © ANGELA FARIS BELT.

Average-tone scenes will have a relatively even distribution of pixels throughout the histogram from left (black) to right (white). Clipping occurs when the image is underexposed or overexposed, and the histogram indicates this by stacking pixels against its sides. A histogram with too many pixels to the right indicates that another exposure to less light is required. A histogram with too many pixels to the left indicates that another exposure to more light is required.

right side of the histogram, and low-key scenes will have the majority of pixels to the left side of the histogram.

Clipping

If your histogram presses against the top of the chart, there is no need to worry; you simply have more pixels in these tones throughout the image. If your histogram presses up against the left or right sides of the chart, then the image is missing some shadow or highlight detail. If there are only a few pixels stacked vertically against either side of the chart, then there are only a few pixels too dark or too bright to record detail. If there are a lot of pixels pushed against the sides of the chart, then a lot of the image is either too light or too dark to record detail and will be rendered as either solid white or solid black.

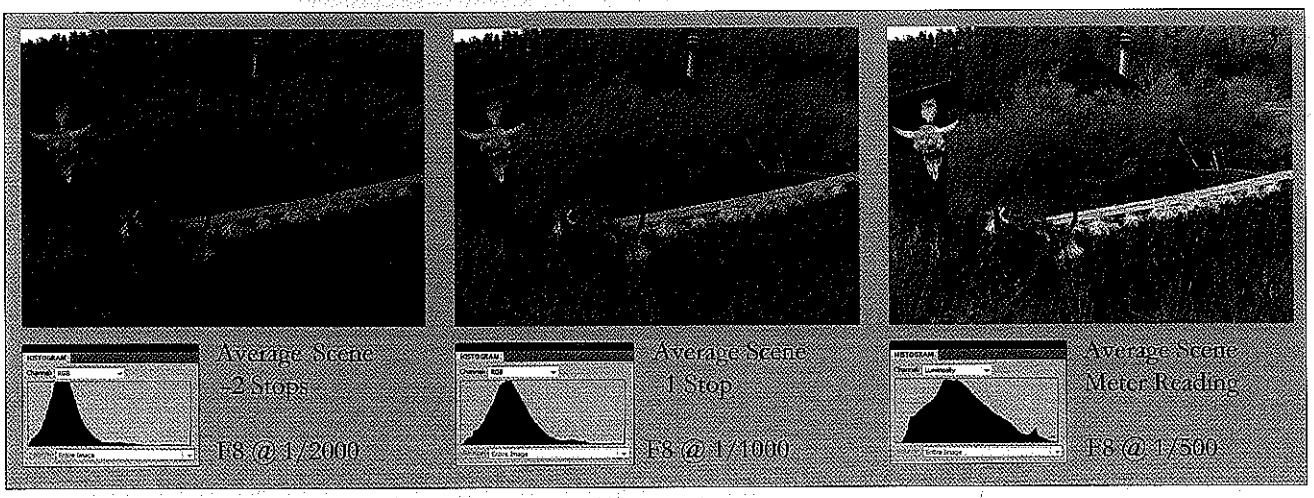
THREE TONAL RANGES: EXPOSURE AND HISTOGRAMS EXPLAINED

Average Scenes

As exposure decreases, the image becomes darker; as exposure increases, the image becomes lighter.

You are looking at an "average" scene, one in which there are tones varying from white to black—highlight to shadow—throughout. Your camera meter indicates that an exposure of *f*/5.6 at 1/60 is correct. You could expose at this setting; however, you want more depth of field (that is, you want more in focus from near to far within the scene). You simply move the aperture to a setting that will allow you to have more depth of field, say, *f*/11. But now your meter indicates this setting will underexpose the image by two stops. The remedy is to slow down your shutter speed to compensate for the change in aperture, so the shutter speed for *f*/11 is 1/15. The amount of exposure is exactly the same; the only difference is the configuration: you're letting two stops less light in through the aperture and balancing that with two stops more light via a longer shutter speed, so the density of both images will be consistent. Unlike making equivalent exposures, bracketing makes a range of exposures. See the sample images of the chili peppers drying to help you envision under, proper, and overexposure.

AVERAGE TONAL RANGE SCENE BRACKETED TO UNDEREXPOSE



The saturation of the red chili peppers caught my eye, so I captured this average scene with bracketed exposures to ensure detail throughout the tonal range. *From right:* Normal exposure, −1 stop underexposed, and −2 stops underexposed. The histogram proves that the meter reading provided the best exposure, with only minor clipping in the top left sky. As exposure decreases, the image becomes darker, and the histogram shows more and more pixels beginning to lose detail.

AVERAGE TONAL RANGE SCENE BRACKETED TO OVEREXPOSE

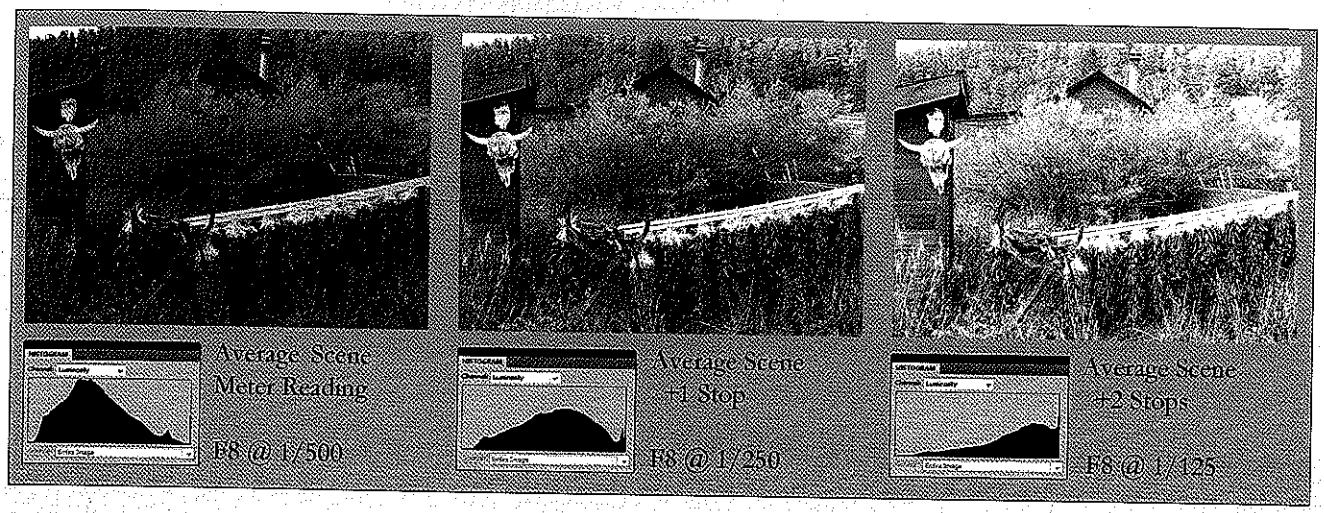


IMAGE © ANGELA FARIS BELT.

As I was there I also captured this average scene with bracketed overexposures. *From left:* Normal exposure, +1 stop overexposed, and +2 stops overexposed. The histogram proves once again that the meter reading provided the best exposure. As exposure increases, the image becomes brighter, and the histogram shows more and more pixels beginning to lose detail.

technical elements of the photographic process—in particular aperture and shutter speed combinations—are the foundation upon which photographic images are made. Use the exercises at the end of this chapter to practice metering and bracketing average, high-key, and low-key scenes to better understand how your camera's meter responds and how to interpret histograms. This will enable you to create images as you conceive them to be.

ADVANCED EXPLANATION OF EXPOSURE

A basic understanding of exposure is usually sufficient to allow you to expose a range of scenes accurately. However, many photographers benefit from understanding exposure in more in-depth terms. If you're one of them, the following section might be for you.

Reflectance Value

Your in-camera meter is reading reflected light in shades of gray; it isn't taking color into account. Certain tones reflect a certain percentage of the light striking them, and this, combined with how apertures and shutter speeds interrelate, is very convenient. In addition to any one-stop change in aperture or shutter speed doubling or cutting in half the

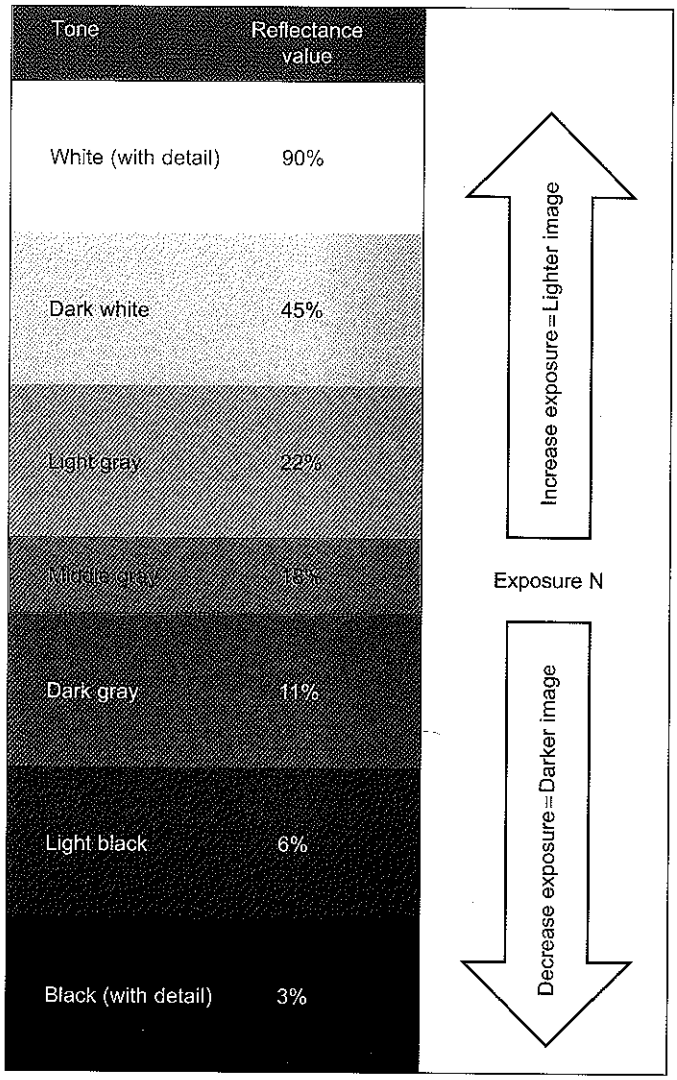


ILLUSTRATION © ANGELA FARIS BELT, 2010.

You should note that this chart is designed to assist you in understanding metering and exposure. Resources pertaining to the *Zone System* might also be of value for photographers wanting more extensive practice in complex exposure control for both film and digital photography.

amount of exposure to light, there are five whole stops between black and white tone, each reflecting double or half the amount of light of its tonal neighbor.

This tonal relationship is a good reference point for calculating accurate exposure in high-key and low-key conditions and to correct exposures that are wrong. Essentially, white tone with detail reflects about 2{1/2} stops more light than middle gray, and black tone with detail reflects about 2{1/2} stops less light than middle gray. This means when you're shooting an average scene, you will usually go with what your meter indicates. When you're shooting a high-key scene, you'll usually want to add exposure (up to +2{1/2} stops) to what the meter indicates so that bright tones are rendered as bright. When you're shooting a low-key scene, you'll usually want to subtract exposure (down to −2{1/2} stops) from what the meter indicates so that dark tones are rendered as dark. Remember, your meter makes exposure recommendations to render any scene as an average one, so when you interpret it and decide to override its recommendation you need to know which way to go.

Stops and Factors

We already know that in photographic terms, a "stop" refers to a relative change in exposure to light that can be made by altering any of the four determinants of exposure. Stops are specific and predictable, and their "whole" numeric designations are a good baseline to memorize, although often you can make finer exposure changes in between stops. Any whole stop exposure change in one direction will double the exposure to light while moving in the other direction will cut the exposure in half.

Figuring exposure beyond a single stop change can be challenging for beginning photographers, but there is a mathematical chart—called the stop-factor chart—that can help. With any whole-stop exposure change, a multiplication factor is applied. The chart is useful in many situations and will be referred to when necessary throughout this book. You will also find reference to it in nearly any studio lighting manual.

A one-stop exposure change = two times or half the amount of light striking the medium. Therefore, changing exposure by more than one stop changes the amount of light by an exponential factor.

Stop	0 stop change	1 stop change	2 stop change	3 stop change	4 stop change	5 stop change	6 stop change
Factor	1× No change	2× or {1/2}	4× or {1/4}	8× or {1/8}	16× or {1/16}	32× or {1/32}	64× or {1/64}

Begin exploring your subject (selecting one is outlined in Chapter 1) using the following exercises to help you master your camera's technical operations and exposure.

This text assumes that you have an understanding of how to process and print your chosen media, and as such does not explain these things for the traditional or digital darkroom. This text centers specifically on controlling visual language through the camera's technical attributes; however, there are plenty of other resources on processing and printing that you can refer to if needed.

For each of the following exercises, choosing a still subject and using a tripod will ensure that each frame's composition stays the same, and makes seeing the comparisons we're after easier. Also, if you are outside under natural light, be sure that clouds are not moving in and out or your exposure readings will change.

1. Equivalent Exposures

Equivalent exposures means making several exposures of the same scene using different aperture and shutter speed combinations and maintaining the same density throughout the images.

Find an average scene representative of your chosen subject, frame it in your viewfinder and focus, and with your camera on a tripod, make the following three exposures:

- An initial exposure at the meter's recommended setting.
- A second exposure opening your aperture one stop to allow in more light while speeding up your shutter speed one stop to let in less light.
- A final exposure opening your aperture another stop to allow in more light while speeding up your shutter speed another stop to let in less light.

When done correctly, your meter should indicate that each exposure is the same as the others, and the density of all three images should be nearly identical.

Find another average scene representative of your chosen subject, frame it in your viewfinder and focus, and with your camera on a tripod, make the following three exposures:

- An initial exposure at the meter's recommended setting.
- A second exposure closing your aperture one stop to allow in less light while slowing down your shutter speed one stop to let in more light.
- A final exposure closing your aperture another stop to allow in less light while slowing down your shutter speed another stop to let in more light.

When done correctly, your meter should indicate that each exposure is the same as the others, and the density of all three images should be nearly identical.

2. Average Scene Bracket

Bracketing a scene means making several different exposures of that scene in order to have the same image with a range of densities.

Find an average scene representative of your chosen subject, frame it in your viewfinder and focus, and with your camera on a tripod, make the following underexposure brackets:

- An initial exposure at the meter's recommended reading.
- A second exposure closing the aperture one stop (do not compensate with the shutter speed). The meter should indicate underexposure, and the image should become darker.
- A third exposure closing the aperture another stop (again not compensating with the shutter speed). The meter should indicate further underexposure, and the image should become even darker.

Without moving the tripod, make the following overexposure brackets:

- An initial exposure at the meter's recommended reading.
- A second exposure opening the aperture one stop (do not compensate with the shutter speed). The meter should indicate overexposure, and the image should become lighter.
- A third exposure opening the aperture another stop (again not compensating with the shutter speed). The meter should indicate overexposure, and the image should become even lighter.

When done correctly, you should have two equivalent exposures at the meter reading and brackets extending two stops over and under the correct exposure, similar to the chili peppers image bracketed earlier in the chapter.

3. High-Key Scene Bracket

High-key scenes are predominantly light in tone; their contents are lighter than average scenes, and as such they might require a degree of overexposure to accurately represent the tones in the scene.

Find a high-key scene representative of your chosen subject, frame it in your viewfinder and focus, and with your camera on a tripod, make the following exposures:

- An initial exposure at the meter's recommended setting.
- A second exposure at +1 stop above the meter's recommended setting by either opening the aperture *or* slowing down the shutter speed by one whole stop.
- A third exposure at +2 stops above the meter's recommended setting by either opening the aperture *or* slowing down the shutter speed by another whole stop.

When done correctly, these scenes should get progressively lighter, and you should be able to determine which exposure is best. Keep in mind that sometimes the best exposure is in between whole stop changes. This exercise will help you to learn how accurately your meter responds to high-key