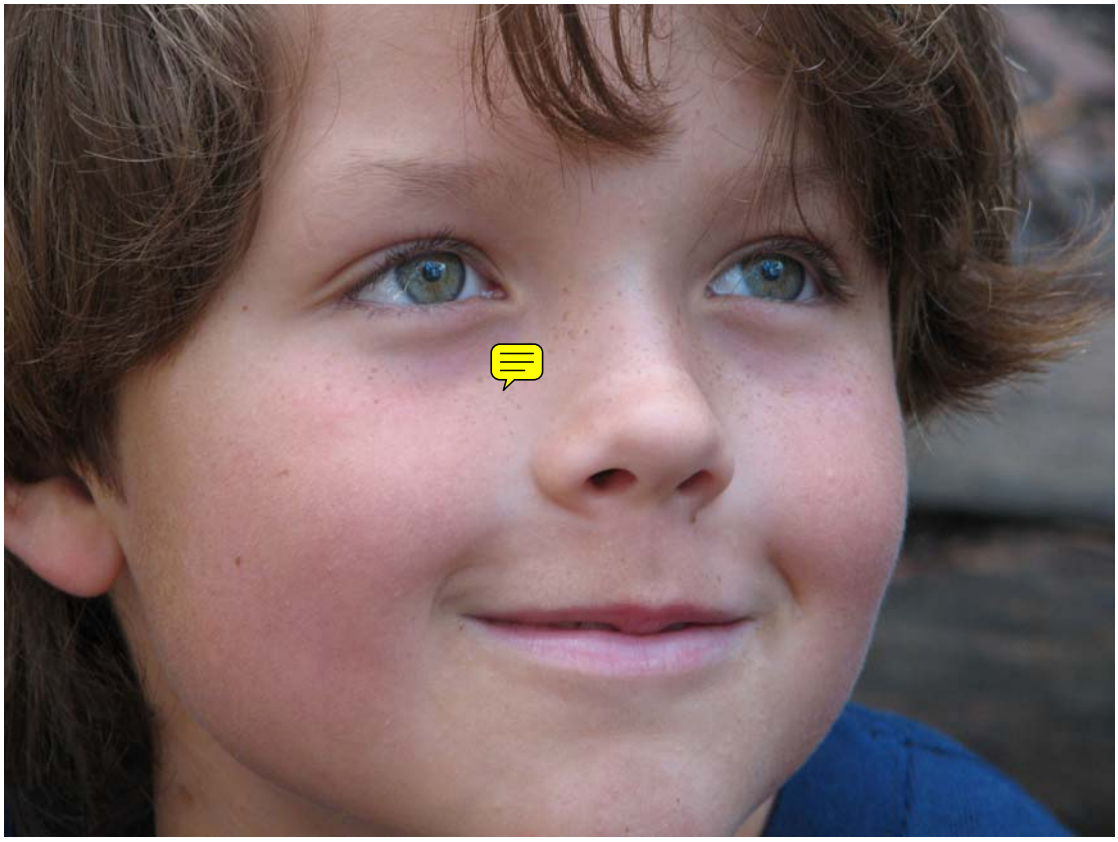
A Short Course in

Using Your Digital Camera

A Guide to Great Photographs

Forth Edition



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Animation

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THE EBOOK EDITION AND MULTIMEDIA

Animation

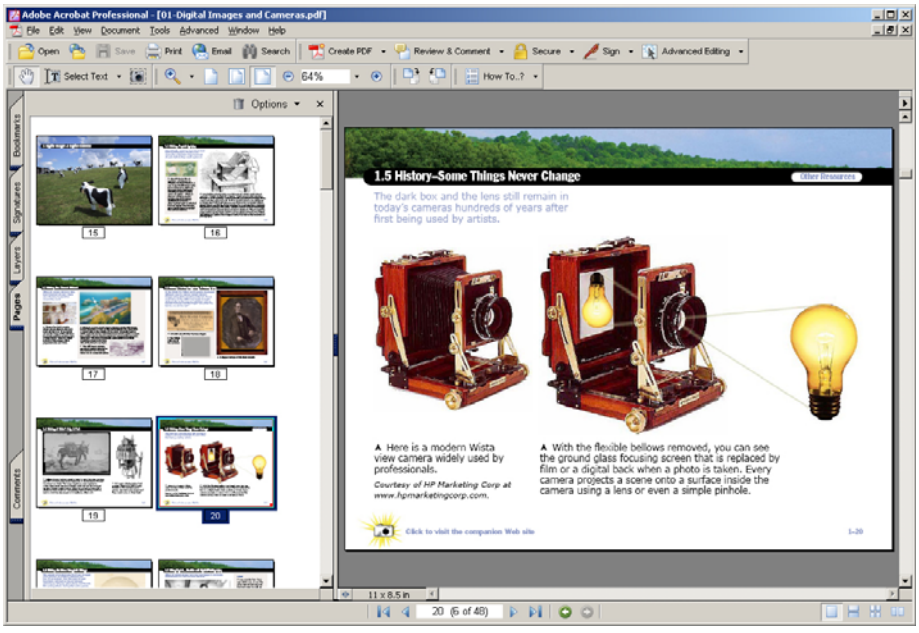
Click to view a PDF document describing how to use this eBook.

The eBook version of this book includes clickable links that display animations and other resources stored on the PhotoCourse.com Web site. To view them you need an Internet connection. These animations and other resources are designed to help you understand the basic concepts of digital photography so it's easier for you to master your camera and its controls. If you have the eBook version, just click any button that looks like the one to the left. The animation that is played is related to the digital photography concept discussed on that page.

The multimedia elements on the eBook version of this book were originally developed for our new book "*Photo Course—An Interactive Multimedia eText*." If you find that they enhance your understanding of digital photography you may want to see more. Click the CD below to learn more about this exciting new 300 page introduction to digital photography.

If you like the printed version of this book, you may want to get a copy of the eBook version or a copy of our new book Photo Course —An Interactive Multimedia eText *with over 300 pages and 90 animations and other resources on digital photography. Click the CD disc to learn more.*

*Adobe's Acrobat Reader displays tabs on the left side of the page. Clicking the "*Bookmarks*" tab displays a table of contents and clicking the "*Pages*" tab displays thumbnails of each page.*



PREFACE

The virtue of the camera is not the power it has to transform the photographer into an artist, but the impulse it gives him to keep on looking—and looking. (Brooks Atkinson, Once Around the Sun).

A great photograph begins when you recognize a great scene or subject. But recognizing a great opportunity isn't enough to capture it; you also have to be prepared. A large part of being prepared involves understanding your camera well enough to capture what you see the way you want to interpret it. Getting you prepared to see and capture great photographs is what this book is all about. It doesn't matter if you are taking pictures for business or pleasure, there's a lot here to help you get better results and more satisfaction from your photography.

To get better, and possibly even great photographs, you need to understand both concepts and procedures; the "whys" and "hows" of photography.

■ Concepts of photography are the underlying principles that apply regardless of the camera you are using. They include such things as how sharpness and exposure affect your images and the way they are perceived by viewers. Understanding concepts answers the "why" kinds of questions you might have about photography.

■ Procedures are those things specific to one kind of camera, and explain step-by-step how you set your camera's controls to capture an image just the way you want to. Understanding procedures gives you the answers to the "how" kinds of questions you might have.

This book is organized around the concepts of digital photography because that's how photographers think. You think about scenes and subjects, highlights and shadows, softness and sharpness, color and tone. Discussions of the procedures you use with some or all cameras are integrated throughout the concepts in places where they apply. This integrated approach lets you first understand the concepts of photography and then see where to look in your camera manual for the specific steps you use in all kinds of photographic situations. There are even places for you to write in notes about how you do it with your own camera.

To get more effective, interesting, and creative photographs, you only need to understand how and when to use a few simple features on your camera such as focus, exposure controls, and flash. If you've previously avoided understanding these features and the profound impact they can have on your images, you'll be pleased to know that you can learn them on a weekend. You can then spend the rest of your life marveling at how the infinite variety of combinations they provide make it possible to convey your own personal view of the world. You'll be ready to keep everything in a scene sharp for maximum detail or to blur it all for an impressionistic portrayal. You'll be able to get dramatic close-ups, freeze fast action, create wonderful panoramas, and capture the beauty and wonder of rainbows, sunsets, fireworks, and nighttime scenes.

As you explore your camera, be sure to have fun. There are no "rules" or "best" way to make a picture. Great photographs come from using what you know to experiment and try new approaches. Digital cameras make this especially easy because there are no film costs or delays. Every experiment is free and you see the results immediately so you can learn step by step.

PHOTOGRAPHY ON-LINE

The contents of this book are constantly updated, enhanced, and expanded on-line. To learn more about digital photography, visit our ShortCourses Web site at www.shortcourses.com.

Contents

List of Animations

Chapter 1
Camera Controls & Creativity

CONTENTS

Serious digital cameras give you creative control over your images. They do so by allowing you to control the light and motion in photographs as well as what's sharp and what isn't. Although most consumer digital cameras are fully automatic, some allow you to make minor adjustments that affect your images. Many cameras, including high-end point and shoots and digital SLRs, offer a wide range of controls. However, regardless of what controls your camera has, the same basic principles are at work "under the hood." Your automatic exposure and focusing systems are having a profound effect on your images. However, even with your camera on automatic mode, you can indirectly control, or at least take advantage of the effects these systems have on your images.

In this chapter, we'll first explore how you use the camera in various automatic modes and see what effect each of the settings has on your images. In the chapters that follow, we'll explore in greater depth how you take control of these settings, and others, to get the effects that you want.

TAKING PHOTOS IN AUTOMATIC MODE

HOW TO: SELECTING AUTOMATIC MODE

Look in your camera manual for a section on selecting *auto* or *automatic exposure mode*:

_____
_____

HOW TO: TURNING THE MONITOR ON AND OFF

Look in your camera manual for a section on *LCD monitor*:

_____
_____
_____
_____

All digital cameras have an automatic mode that sets focus and exposure for you. All you have to do is frame the image and push the shutter button. You'll find that this auto mode of operation is great in the vast majority of situations because it lets you focus on the subject and not on the camera. Here's a brief guide to using auto mode on almost any camera.

■ **Getting ready**. Turn the camera on and set it to automatic mode—usually spelled out or indicated by a camera icon. To conserve your batteries, turn off the monitor and compose your image through the optical viewfinder if your camera has one. (Digital SLR cameras don't let you compose the image on the monitor and some point and shoots don't have optical viewfinders.) If the camera has a lens cap, be sure to remove it.

■ **Framing the image**. The viewfinder or monitor shows you the scene you are going to capture. To zoom the lens to frame your image, press the zoom-out button or lever to widen the angle of view and the zoom-in button or lever to enlarge subjects. If using an SLR, you zoom by turning a ring on the lens. If the image in the viewfinder is fuzzy, see if the camera has a diopter adjustment you can use to sharpen it.

■ **Autofocus**. Cameras have one or more focus zones or areas, each of which is often indicated in the viewfinder with cross hairs, boxes or brackets. The part of the scene that you cover with one of these focus zones will be the sharpest part of the photo. Many cameras will focus on the center of the scene but others will focus on the closest part of the scene covered by any of the focus zones. How close you can focus depends on the camera and lens.

■ **Autoexposure**. The camera's exposure system measures light reflecting from the scene and uses these readings to set the best possible exposure.

■ **Autoflash**. If the light is too dim, the autoexposure system will fire the camera's built-in flash to illuminate the scene. If the flash is going to fire, a flash lamp usually glows when you press the shutter button halfway down.

■ **Automatic white balance**. Because the color in a photograph is affected by the color of the light illuminating the scene, a camera automatically adjusts white balance so white objects in a scene are white in the photo and other colors are free of a color cast.

READY OR NOT

On many cameras you can tell if the camera is ready to take a photo by pressing the shutter button halfway down. When you do so, lamps in or next to the viewfinder may glow to indicate when focus is set and the flash is ready to fire.

HOW TO: TAKING A PICTURE IN AUTOMATIC MODE

1. Turn the camera on and set it to automatic mode. Be sure to remove the lens cap.
2. Compose the image in the viewfinder or on the monitor, making sure the subject that you want sharpest is covered by the focus area used to set focus. If unsure, center it in the viewfinder.
3. Press the shutter button halfway down so the camera can set focus and exposure. When the camera has done so, a lamp may glow or the camera may beep.
4. Press the shutter button all the way down to take the picture. When you do so, the camera may beep. The camera then saves the new image onto the camera's memory card.
5. When done, turn the camera off.

GOOD THINGS TO KNOW

TV ANYONE?

Most digital cameras come with a cable so you can connect it to a TV and share your photos with others.

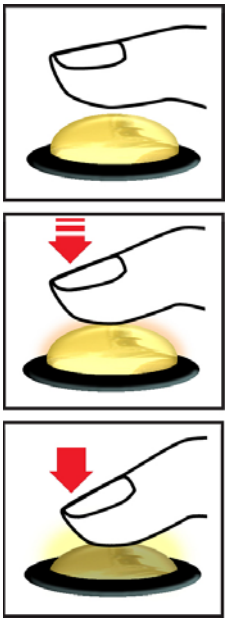
When you first start taking photos, it sometimes seems that there is too much to learn all at once. Here are some things you may want to know right off.

- **The first time you use the camera**, or if the batteries have been removed or dead for an extended period, you should enter the date and time. The date and time will help you organize, locate, and identify your images later.
- **Always check camera settings** on the control panel and in the viewfinder. Notice how many pictures you can take at the current settings and the status of the battery charge. Also, learn what the icons mean because it's not at all unusual to change a setting, then forget you have done so.

Animation

Click to see a PDF poster of typical digital camera icons.

- **If an image is being stored when you turn the camera off**, the image will be completely stored before the camera powers down.
- **Most shutter buttons have two stages**. When you press it halfway down, the camera sets focus and exposure. When you press it all the way down, you take the picture. To capture action shots, hold the button halfway down while focused on the scene. When you then press the button the rest of the way, the camera shoots immediately because focus and exposure have already been calculated. On some cameras you can also press the shutter button all the way down in one action, but there will be a delay before the photo is taken and it may be out of focus.

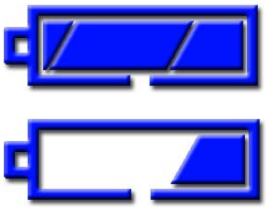


Most shutter buttons have two stages.

- **If the viewfinder appears blurry**, see if the camera has an diopter adjustment that makes it sharper.
- **To take pictures**, hold the camera in your right hand and support the camera or lens with your left. Don't block the flash, autofocus port, or lens.
- **As you take photos**, they are first stored in the camera's internal memory called a "buffer." When the buffer is full you'll have to wait until one or more of the images has been transferred to the memory card before taking any more pictures.
- **Don't open the battery or memory card access covers** while an image is being saved. Doing so can not only damage the image being saved, it can also damage the card.
- **Some cameras will briefly display the image** you just took as it is being saved. Usually you can turn this feature on or off.
- **You can usually adjust the brightness of the monitor**. Make it brighter in bright light and dimmer in dim light.
- **Many cameras have a tripod socket** so you can attach it to a tripod when you want sharper pictures.
- **Take as many shots of a given scene as you can think of;** changing positions, distances, and angles. You may be surprised later at what works and what doesn't.
- **When done shooting**, turn the camera off.

Most cameras store images on a removable memory card that slides into a slot on the camera. Courtesy of Kodak.

WHEN THINGS GO WRONG



Icons on the camera's control panel or monitor indicate the status of the batteries. The icons, many of which look like these, show when the battery is fully charged (left) and getting low (right).

If anything can go wrong, it will. Here are some of the things you might encounter.

- **If the camera seem to be turned off**, it may just have entered sleep mode. If you don't use any controls for a specified time, the camera enters this mode to reduce battery drain. To wake it up, press the shutter button halfway down, or turn the camera off and back on. After an hour or so of inactivity, some cameras shut off completely. You can often change the time it takes before the camera enters sleep mode or turns off completely.
- **If you can't turn on the camera**, the batteries are dead or have been removed or a memory card hasn't been inserted.
- **If your batteries drain quickly**, stop using the monitor to take and review pictures. If it's cold, keep the batteries or camera under your coat.
- **When you turn the camera on**, a battery shaped icon on the control panel indicates when the batteries are fully charged, getting low, or run down empty and should be replaced immediately.
- **When you turn on the camera**, an error message will be displayed if there is a problem with the memory card.
- **If you can't take a picture**, it may be because the memory card is full. To free up room for new pictures, move the images to a computer and erase the memory card, delete some you don't need, or switch to a smaller image size.
- **Some cameras have a delay** between your pressing the shutter button and the shutter opening. This can cause you to miss fleeting expressions.
- **To control which part of the scene the camera focuses on**, read your user guide so you understand how focus works in various exposure modes.
- **If the focus lamp blinks** when you press the shutter button halfway down, the camera may be having trouble focusing.
- **If the flash lamp blinks** when you press the shutter button halfway down, the flash is charging. Release the shutter button for a few seconds and try again.
- **If flash photos are too dark**, you are probably too far from the subject. Most built-in flash units are good only up to about ten feet. They don't have the power to illuminate subjects much father than that.
- **If photos are too light when using flash**, you may want to reduce the flash power (page 121).
- **If your pictures are blurred**, you may not be holding the camera steady as you smoothly press the shutter. Most blurry photos are caused by jabbing the shutter button. You may also be too close to the subject or the subject may be moving too fast.
- **Never take pictures of the sun or other bright light sources**. Doing so can injure your eye or the camera's image sensor.
- **If your pictures are not at all the way you expect**, it may be because the camera remembered a change you made in the settings and continues to use that changed setting. Some cameras remember changes even when you turn a camera off and back on. See if your camera has a procedure that resets all settings to their factory defaults.

When deleting files or formatting memory cards, think before you do so. It's easy to loose files.

TYPES OF DIGITAL CAMERAS

This old Kodak ad slogan now applies to the entire field of digital photography. With kiosks everywhere, it's easy to shoot and then just print the images you want.

When it comes time to choose a new digital camera, there is quite a range of types to choose among. You are usually trading off size versus flexibility. Pocket sized cameras usually don't have all of the features of larger cameras, but they are much more convenient. The best news is that despite their great differences, most cameras will capture very good image quality, especially when used to create snapshot-sized prints.

Point and shoot cameras usually have fewer controls than other digital cameras but many are also small, bordering on tiny. With a camera that fits into your pocket, you're more likely to have it when you need it.

Camera phone quality is improving rapidly with 8 megapixel models already available in some parts of the world. In time these cameras may present real competition to point and shoot cameras.

The fastest selling point and shoot digital cameras are those built into camera phones. The problem with these cameras is that their image quality is improving very slowly and doesn't yet match that of dedicated cameras.

One-time-use cameras take surprisingly good pictures and some even have a monitor on which you can review your results.

Digital photography has already matured to the point where there are one-time-use point and shoot versions.

Fixed lens cameras often have great zoom lenses and capture large images.

Pentax makes underwater cameras including the Optio WPi.

High-end fixed lens cameras usually have a zoom lens and many of the exposure and focus controls found on SLR cameras.

Single-lens reflex cameras (SLRs) are the most flexible and often the most expensive cameras.

SLR cameras from major companies have more lenses than you'll ever need.

One of the most popular camera types among professionals and serious amateurs is the single-lens reflex, better known as an SLR. These cameras are expensive but have certain advantages over other camera types:

- You can change lenses.
- You see the scene through the lens so what you see is what you get. (Fixed lens camera with electronic viewfinders differ from SLRs in that they don't use a movable mirror to bounce light into the viewfinder.)
- You can select from a large variety of accessories, including powerful flash units.

DIRTY SECRET

- Removing the lens from an SLR lets dust enter the camera and settle on the sensor. This dust creates dark spots in your images. You can remove the dust yourself but it's risky (page 123).

UNDERSTANDING IMAGE SIZE AND QUALITY

Animation

Click to see how pixels are printed using dots of colored ink.

Digital photographs are actually mosaics of millions of tiny squares called *picture elements*—or just *pixels*. Like the impressionists who painted wonderful scenes with small dabs of paint, your computer and printer can use these tiny pixels to display or print photographs. To do so, the computer divides the screen or printed page into a grid of pixels. It then uses the values stored in the digital photograph to specify the brightness and color of each pixel in this grid—a form of painting by number.

A digital image that looks sharp and has smooth transitions in tones (top) is actually made up of millions of individual square pixels (bottom). Each pixel is a solid, uniform color.

TIP

■ A few camera companies, even some that are otherwise respectable, try to deceive you into thinking their cameras have higher resolution than they really do. They use software to inflate the size of a captured image and then use this inflated size in advertising claims about the camera. This way each captured pixel can suddenly become four, and voila' a 2 megapixel image suddenly and magically becomes 8.

NUMBER OF PIXELS

The quality of a digital image depends in part on the number of pixels used to create the image (sometimes referred to as *resolution*). At a given size, more pixels add detail and sharpen edges. However, there are always size limits. When you enlarge any digital image enough, the pixels begin to show—an effect called *pixelization*. This is not unlike traditional silver-based prints where grain begins to show when prints are enlarged past a certain point.

Animation

Click to see how some cameras inflate their pixel counts.

The term "resolution" has two meanings in photography. Originally it referred to the ability of a camera system to resolve pairs of fine lines such as those found on a test chart. In this usage it's an indicator of sharpness, not image size. With the introduction of digital cameras the term began being used to indicate the number of pixels a camera could capture.

When a digital image is displayed or printed at the correct size for the number of pixels it contains, it looks like a normal photograph. When enlarged too much (as is the eye here), its square pixels begin to show.

Animation

Click here to explore the original meaning of "resolution".

Animation

Click to see the effects of pixelization as an image is enlarged.

Animation

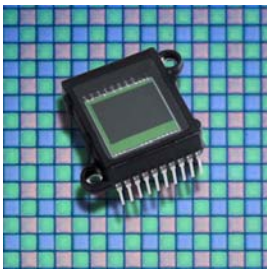
Click for an Excel worksheet that converts pixels into print sizes.

The pixel size of a digital photograph is specified in one of two ways—by its dimensions in pixels or by the total number of pixels it contains. For example, the same image can be said to have 4368 × 2912 pixels (where "×" is pronounced "by" as in "4368 by 2912"), or to contain 12.7 million pixels or megapixels (4368 multiplied by 2912).

Image sizes are expressed as dimensions in pixels (4368 × 2912) or by the total number of pixels (12.7 megapixels).

TIP

■ Good prints can be made using 200 pixels per inch. Using this as a guide you can calculate that a 2000 x 1600 pixel image (just over 3 megapixels) will make a good 10 x 8 inch print.



An image sensor sits against a background enlargement of its square pixels, each capable of capturing one pixel in the final image. Courtesy of IBM.

Animation

Click to see how all cameras are just dark boxes.

Animation

Click to see where the name "charge-coupled device" comes from.

HOW AN IMAGE IS CAPTURED

Digital cameras are very much like earlier cameras. Beginning with the very first camera all have been basically black boxes with a lens, an aperture, and a shutter. The big difference between traditional film cameras and digital cameras is how they capture the image. Instead of film, digital cameras use a solid-state device called an *image sensor*. In some digital cameras the image sensor is a *charge-coupled device* (CCD), while in others it's a *CMOS sensor*. Both types can give very good results. On the surface of these fingernail-sized silicon chips are millions of photosensitive diodes, each of which captures a single pixel in the photograph to be.

When you take a picture the shutter opens briefly and each pixel on the image sensor records the brightness of the light that falls on it by accumulating an electrical charge. The more light that hits a pixel, the higher the charge it records. Pixels capturing light from highlights in the scene will have high charges. Those capturing light from shadows will have low charges.

After the shutter closes to end the exposure, the charge from each pixel is measured and converted into a digital number. This series of numbers is then used to reconstruct the image by setting the color and brightness of matching pixels on the screen or printed page.

IT'S ALL BLACK AND WHITE AFTER ALL

It may be surprising, but pixels on an image sensor only capture brightness, not color. They record the *gray scale*—a series of tones ranging from pure white to pure black. How the camera creates a color image from the brightness recorded by each pixel is an interesting story with its roots in the distant past.

The gray scale, seen best in black and white photos, contains a range of tones from pure black to pure white.

When photography was first invented in the 1840s, it could only record black and white images. The search for color was a long and arduous process, and a lot of hand coloring went on in the interim (causing one photographer to comment "so you have to know how to paint after all!"). One major breakthrough was James Clerk Maxwell's 1860 discovery that color photographs could be created using black and white film and red, blue, and green filters. He had the photographer Thomas Sutton photograph a tartan ribbon three times,

HOW TO: SELECTING A QUALITY MODE

Look in your camera manual for a section on *image quality*, *image size*, *compression*, *JPEG*, *TIFF*, or *RAW*.

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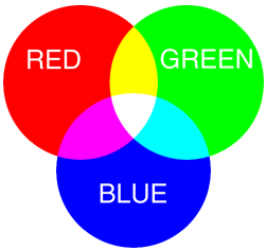


RGB uses just three basic colors to create full color images.

each time with a different color filter over the lens. The three black and white images were then projected onto a screen with three different projectors, each equipped with the same color filter used to take the image being projected. When brought into alignment, the three images formed a full-color photograph. Over a century later, image sensors work much the same way.

Colors in a photographic image are usually based on the three primary colors red, green, and blue (RGB). This is called the *additive color system* because when the three colors are combined in equal amounts, they form white. This RGB system is used whenever light is projected to form colors as it is on the display monitor (or in your eye). Another color system uses cyan, magenta, yellow and black (CMYK) to create colors. This system is used in a few sensors and almost all printers since it's the color system used with reflected light.

Since daylight is made up of red, green, and blue light; placing red, green, and blue filters over individual pixels on the image sensor can create color images just as they did for Maxwell in 1860. Using a process called *interpolation*, the camera computes the actual color of each pixel by combining the color it captured directly through its own filter with the other two colors captured by the pixels around it. How well it does this is affected in part by the image format, size, and compression you select.

Animation

Click to explore how red, green and blue can create full color images.

Animation

Click to explore how cyan, magenta and yellow can also create full color images.

Animation

Click to explore how more pixels give sharper images.

Animation

Click to see the effects of compression.

Animation

Click to explore the differences between JPEG and RAW formats.

IMAGE FORMATS

One of the most important choices you'll make when shooting photos is what format to use—JPEG or RAW.

■ *JPEG* is the default format used by almost every digital camera ever made. Named after its developer, the Joint Photographic Experts Group (and pronounced "jay-peg") this format lets you specify both image size and compression. The smallest size is best for the Web and e-mail (although it will usually have to be reduced) and the largest for prints.

The JPEG format compresses images to make their files smaller, but many cameras let you specify how much they are compressed. This is a useful feature because there is a trade-off between compression and image quality. Less compression gives you better images so you can make larger prints, but you can't store as many images. Because you can squeeze more smaller or more compressed images onto a storage device, there may be times when you'll want to switch to the smaller size and sacrifice quality for quantity.

■ *RAW* images are often better than JPEG images because they are not processed in the camera, but on your more powerful desktop computer. These RAW files contain every bit of the captured data, unlike JPEGs which are always processed in the camera with some data being discarded. RAW files can be viewed, edited, and converted to other formats using most photo-editing software or programs included on a CD that comes with the camera. Some cameras let you capture RAW images by themselves or with a companion JPEG image that gives you an identical high quality RAW file and a smaller, more easily distributable JPEG image. When you use this feature, both the RAW and JPEG files have the same names but different extensions. The RAW format is discussed in more detail on page 62.

When you select an image format, size, and compression, you're not only affecting image quality but also how many images can be stored on your memory card. Sometimes when there is no storage space left, you can switch to a smaller size and higher compression to squeeze a few more images onto the card.

STORAGE CAPACITY

The number of new images you can store at the current settings is usually displayed on the camera's monitor or control panel.

EXPOSURE CONTROLS—THE SHUTTER AND APERTURE

Animation

Click to explore how exposure determines how light or dark an image is.

One of the most important aspects of photography is getting the exposure right because it determines how light or dark an image is and what mood it conveys. The two most important exposure controls are the shutter speed and aperture because both affect the total amount of light reaching the image sensor. However, they do more than just control the exposure. As you'll see shortly they are also the most creative controls you have.

- The *shutter* opens to begin an exposure and closes to end it. The shutter speed setting determines how long the shutter opens to expose the image sensor.
- The *aperture* is the hole through which light enters the camera. The size of the hole can be changed to control the brightness of the light that reaches the image sensor.

If you strip away all of the modern technology and look at the earliest cameras, you will find the same controls in much simpler, and perhaps easier to understand, versions.

In the early days of photography, a plate called a waterhouse stop, *was inserted into a slot in the lens. The size of the stop's hole acted just like the iris apertures used today. A lens cap was removed and then replaced to begin and end the exposure—a primitive version of a shutter. This vintage camera is surrounded by waterhouse stops (apertures) and a lens cap (the shutter) leans against it.*

Photo by Ake Borgstrom at www.photographica.nu.

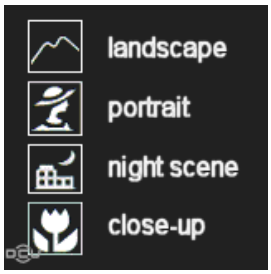
Less light makes an image darker (left) and more light makes it lighter (right).

CHOOSING EXPOSURE MODES

Animation

Click to explore the various exposure modes on many cameras.

Modes and how they are designated on the camera vary from model to model. Modes that give you the most control, available only on more advanced cameras, are usually indicated with letters. Those that are fully automatic, often called scene modes, are indicated with icons like those shown here on this Canon mode dial.



On some cameras you select exposure modes using buttons or a menu.

Modern digital cameras have sophisticated ways of controlling the aperture and shutter speed. In fully automatic mode the camera sets them both to produce the best possible exposure. However, there are other exposure modes that are widely used in digital photography. All modes give equally good results in the vast majority of photographic situations. However, when you photograph in specific kinds of situations, each of these exposure modes may have certain advantages. Let's take a look at the modes you can expect to find on some or all digital cameras.

- **Automatic mode** sets the shutter speed and aperture without your intervention. This mode allows you to shoot without paying attention to settings so you can concentrate on composition and focus.

- **Scene modes** have preselected settings for specific situations such as landscapes, portraits, night portraits, sports, and close-up photography.

- **Programmed mode** is just like full auto in that it sets the aperture and shutter speed for you so you can concentrate on composition and action. When in this mode, many cameras have a **flexible program mode** that lets you select from a series of paired aperture and shutter speed combinations that yield the same exposure as that recommended by the camera but which give you control over depth of field and motion.

- **Shutter-priority mode** lets you choose the shutter speed you need to freeze or deliberately blur camera or subject movement and the camera automatically sets the aperture to give you a good exposure. You select this mode when the portrayal of motion is most important. For example, when photographing action scenes, such as those encountered by wildlife photographers, sports photographers, and photojournalists, shutter-priority mode might be best. It lets you be sure your shutter speed is fast enough to freeze the action or slow enough to blur it

- **Aperture-priority mode** lets you select the aperture needed to obtain the depth of field you want and the exposure system automatically sets the shutter speed to give you a good exposure. You select this mode whenever depth of field is most important. To be sure everything is sharp, as in a landscape, select a small aperture. The same holds true for close-up photography where depth of field is a major concern. To throw the background out of focus so it's less distracting in a portrait, select a large aperture.

- **Manual mode** lets you select both the shutter speed and the aperture. You normally use this mode only when the other modes can't give you the results you want. Some cameras have a bulb setting in this mode that lets you capture time exposures such as light trails at night.

HOW TO: CHANGING EXPOSURE MODES

Look in your camera manual for sections on *automatic*, *scene*, or *program mode*, *aperture priority mode*, *shutter priority mode*, *shutter speeds*, and *apertures:*

_____

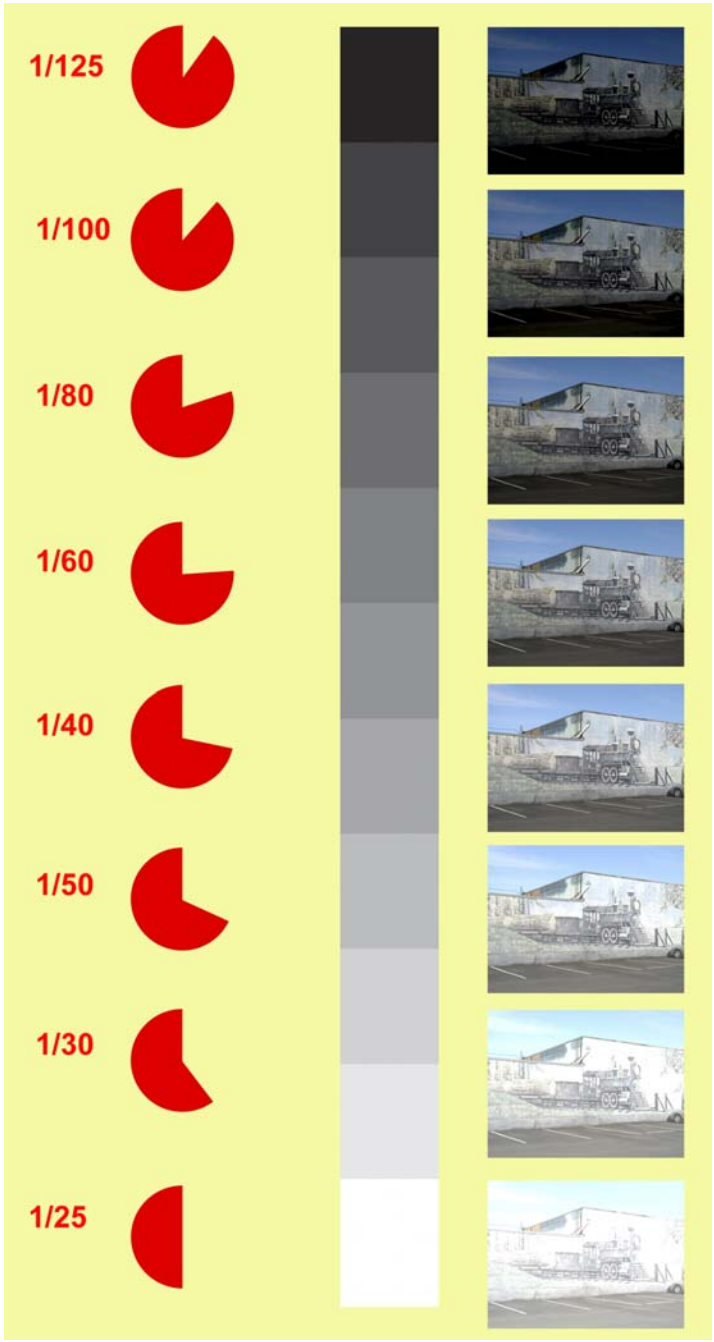
_____

_____

THE SHUTTER CONTROLS LIGHT AND MOTION

The shutter keeps light out of the camera except during an exposure, when it opens to let light strike the image sensor. In respect to just exposure, faster shutter speeds let less strike the image sensor so the image is darker. Slower speeds let in more so it's lighter.

As the shutter speed gets slower, the image gets lighter. The reason you don't usually see this effect in your images is because when you or the camera change the shutter speed, the camera changes the aperture to keep the exposure constant.



Animation

Click to explore the various types of shutters used in digital cameras.

Animation

Click to explore the effect of shutter speed on exposure.

TIP

To get faster shutter speeds increase the ISO. To get slower shutter speeds, use a neutral density filter.

Katie turned a little just as the shutter opened causing unwanted blur in the image.

In addition to controlling exposure, the shutter speed is the most important control you have over how motion is captured in a photograph. The longer the shutter is open, the more a moving subject will be blurred in the picture Also, the longer it's open the more likely you are to cause blur by moving the camera slightly. Although you normally want to avoid blur in your images there are times when you may want to use it creatively.

A fast shutter speed (left) opens and closes the shutter so quickly a moving subject doesn't move very far during the exposure. A slow speed (right) can allow moving objects to move sufficiently to blur their image on the image sensor.

Animation

Click to explore how the shutter speed affects the capture of moving subjects.

Shutter Speeds

1"		
	1"3	1/5
	1"6	
1/2		
	1/2.5	1/3
	1/3	
1/4		
	1/5	1/6
	1/6	
1/8		
	1/10	1/11
	1/13	
1/15		
	1/20	1/20
	1/25	
1/30		
	1/40	1/45
	1/50	
1/60		
	1/80	1/90
	1/100	
1/125		
	1/160	1/180
	1/200	
1/250		
	1/320	1/350
	1/400	
1/500		
	1/320	1/350
	1/400	
1/1000		

Although digital cameras can select any fraction of a second for an exposure, there are a series of settings that have traditionally been used when you set it yourself (which you can't do on many digital cameras). These shutter speed settings are arranged in a sequence so that each setting lets in half as much light as the next slowest setting and twice as much as the next fastest. Some of the traditional shutter speeds are listed to the left from the slowest to the fastest speeds.

- Speeds faster than 1 second are fractions of a second and most cameras display them without the numerator. For example, 1/2 second is displayed as 2.
- Speeds of 1 second or slower are whole seconds and many cameras indicate them with quotation or inch marks (″). For example, 2 seconds is displayed as 2″.

Many high-end digital cameras have added one or two stops between each of the traditional ones. This allows you to adjust exposure in one-half or one-third stop increments for finer exposure control. In the table to the left one-third and one-half stops are shown in red and blue respectively.

HOW TO: SELECTING A SHUTTER SPEED

Look in your camera manual for a section on *shutter priority mode*, or *shutter speeds*.

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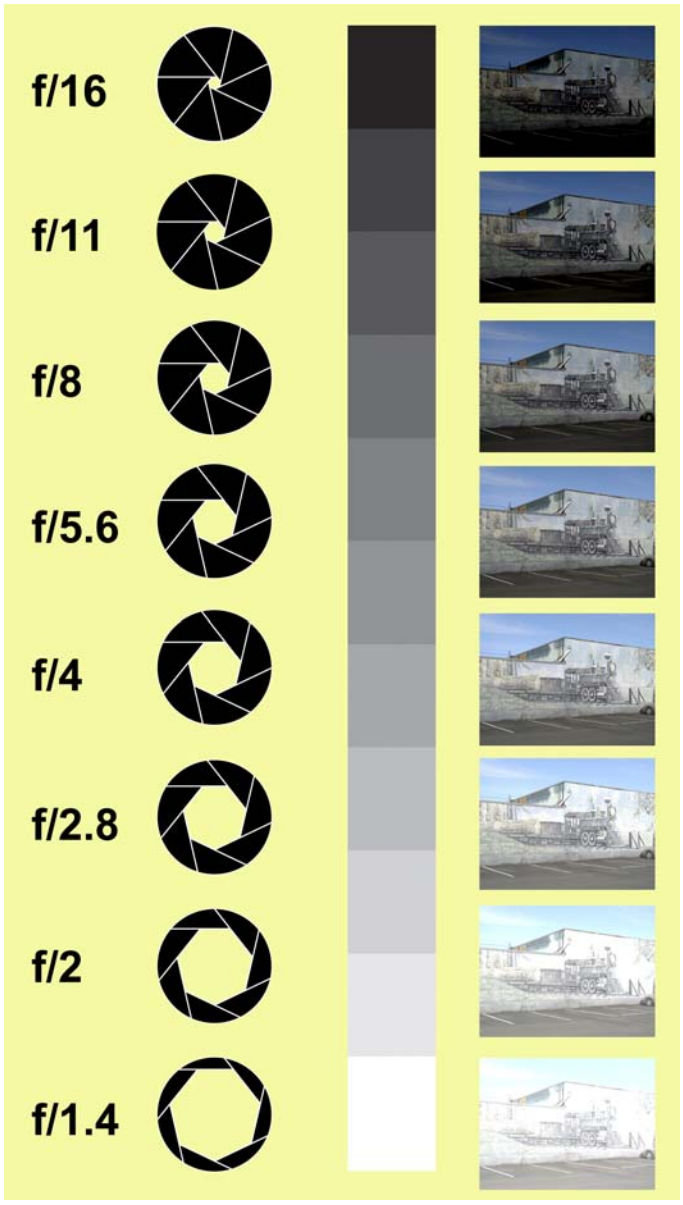
The Aperture Controls Light and Depth of Field

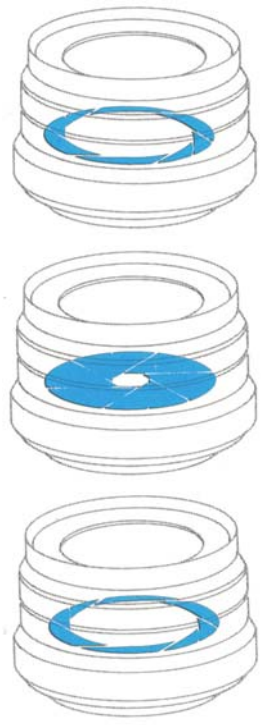
Animation

Click here to explore the standard series of apertures and the aperture's effects on exposure.

The aperture adjusts the size of the opening through which light passes to the image sensor. The aperture can be opened up to let in more light or closed (stopped down) to let in less. In respect to just exposure, smaller apertures let less light strike the image sensor so the image is darker. Larger apertures let in more so it's lighter.

As the aperture number gets smaller (for example, from f/16 to f/11) the aperture opening gets larger and the image gets lighter. The reason you don't usually see this effect in your images is because when you or the camera change the aperture, the camera changes the shutter speed to keep the exposure constant.





In better cameras, the aperture is a series of overlapping leaves located between the glass elements in the lens.

As with the shutter speed, the aperture also affects the sharpness of your picture, but in a different way. Changing the aperture changes the *depth of field*, the depth in a scene from foreground to background that will be sharp in a photograph. Smaller apertures increase depth of field while larger ones decrease it. For some pictures—for example, a landscape—you may want a smaller aperture for maximum depth of field so that everything from near foreground to distant background is sharp. But perhaps in a portrait you will want a larger aperture to decrease the depth of field so that your subject is sharp but the background is soft and out of focus.

A small aperture increases depth of field so foreground and background are sharp (top) and a large aperture decreases depth of field so the background is soft (bottom).

Animation

Click here to explore how the aperture affects depth of field.

TIP

To get smaller apertures increase the ISO. To get larger apertures, use a neutral density filter.

Aperture settings are called *f-stops* and indicate the size of the aperture opening. Each f-stop lets in half as much light as the next larger opening and twice as much light as the next smaller opening. From the largest possible opening to increasingly smaller ones, the f-stops have traditionally been those shown to the left. No lens has the full range of settings; for example, the standard lens on a digital camera will range from about f/2 to about f/16. Notice that as the f-stop number gets larger (f/8 to f/11, for example), the aperture size gets smaller. This may be easier to remember if you think of the f-number as a fraction: 1/11 is less than 1/8, just as the size of the f/11 lens opening is smaller that the size of the f/8 opening. Many high-end digital cameras have added one or two stops between each of the traditional ones. In the table to the left one-third and one-half stops are shown in red and blue respectively.

Apertures

f/1.4		
	f/1.6	f/1.7
	f/1.8	
f/2.0		
	f/2.2	f/2.5
	f/2.6	
f/2.8		
	f/3.2	f/3.4
	f/3.6	
f/4.0		
	f/4.5	f/4.7
	f/5.0	
f/5.6		
	f/ 6.3	f/6.7
	f/ 7.0	
f/ 8.0		
	f/9.0	f/9.5
	f/10	
f/11		
	f/13	f/13
	f/14	
f/16		

How wide you can open the aperture depends on the len's *maximum aperture*—its widest opening. The term "fast lens" usually applies to lenses that can be opened to a wide maximum aperture for the focal length. For example, a lens with a maximum aperture of f/1.8 opens wider, and is faster, than a lens with a maximum aperture of f/2.6. Faster lenses are better when photographing in dim light or photographing fast moving subjects. With most, but not all, zoom lenses the maximum aperture changes as you zoom the lens. It will be larger when zoomed out to a wide angle, and smaller when zoomed in to enlarge a subject.

HOW TO: SELECTING AN APERTURE

Look in your camera manual for a section on *aperture priority* or *apertures:*

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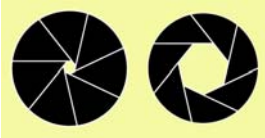
USING SHUTTER SPEED AND APERTURE TOGETHER



In this book and the animations apertures are represented by these realistic icons with a small aperture (left) and a large one (right).

In this book and the animations, shutter speeds are represented by these symbolic icons with a fast shutter speed (left) and a slow one (right). The cut out "pie slice" indicates how far an imaginary second hand would sweep.

When taking photos, one of the first decisions you make with many cameras is which exposure mode to use. As you've seen, your choice determines if you control the aperture or shutter speed. If your camera lets you select them, you can pair a fast shutter speed (to let in light for a short time) with a large aperture (to let in bright light) or a slow shutter speed (long time) with a small aperture (dim light).

Speaking of exposure only, it doesn't make any difference which combination you use. But in other ways, it does make a difference, and it is just this difference that gives you some creative opportunities. Whether you know it or not, you're always balancing camera or subject movement against depth of field because a change in one causes a change in the other. Let's see why.

As you've seen, shutter speeds and apertures each have a standard series of settings called "*stops*."

- With shutter speeds, each stop is a second or more, or a fraction of second indicating how long the shutter is open.
- With apertures they are f/stops indicating the size of the opening through which light enters.

The stops are arranged so that a change of 1 stop lets in half or twice the light of the next setting. A shutter speed of 1/60 second lets in half the light that 1/30 second does, and twice the light of 1/125 second. An aperture of f/8 lets in half the light that f/5.6 does, and twice the light of f/11. If you make the shutter speed 1 stop slower (letting in 1 stop more light), and an aperture 1 full stop smaller (letting in 1 stop less light), the exposure doesn't change. (In all modes other than manual this happens automatically.) However, you increase the depth of field slightly and also the possibility of blur from camera or subject movement.

- For fast-moving subjects you need a fast shutter speed (although the focal length of the lens you are using, the closeness of the subject, and the direction in which it's moving also affect how motion is portrayed). When photographing moving subjects shutter-priority mode is favored because it gives you direct control over the shutter speed.
- For maximum depth of field, with the entire scene sharp from near to far, you need a small aperture (although the focal length of the lens and the distance to the subject also affects depth of field). When photographing landscapes and portraits aperture-priority mode is favored because it gives you direct control over the aperture and depth of field.

On many cameras a quotation mark (") indicates full seconds and a fraction's denominator without a quotation mark indicates fractional seconds. For example, 2" means 2 seconds and 2 means 1/2 second.

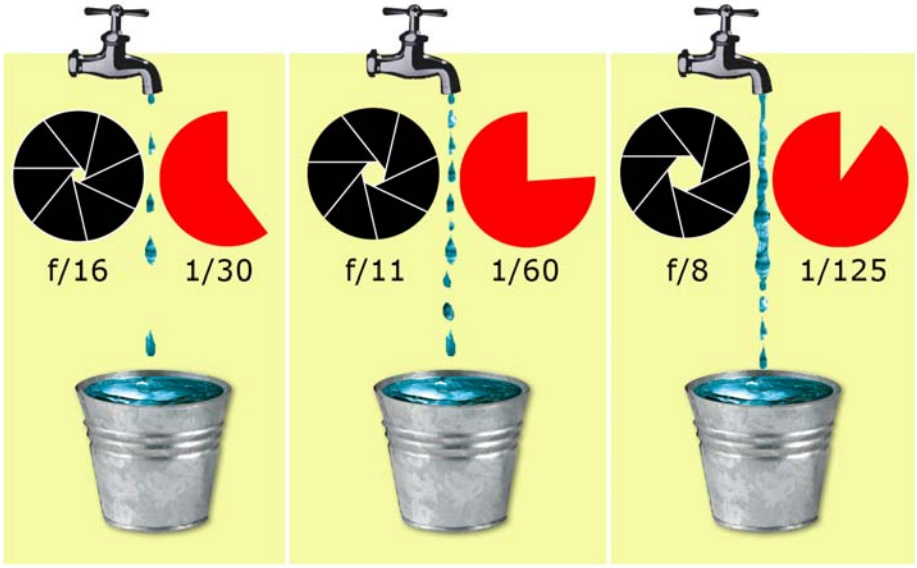
SHUTTER SPEED	READOUT
30 seconds	30"
4 seconds	4"
2 seconds	2"
1/2 second	2
1/4 second	4
1/30 second	30

EXPOSURE—FAUCETS & BUCKETS ANALOGY

One way to think of apertures and shutter speeds is to use the analogy of a faucet for the aperture and a timer for the shutter speed.

- When you open a faucet all the way, water gushes out so you fill a bucket in a very short time. This is the same as pairing a large aperture and fast shutter speed to let in bright light for a short time.
- When you open a faucet just a little, water trickles out and so it takes a much longer time to fill a bucket. This is the same as pairing a small aperture and slow shutter speed to let in dim light for a longer time.

No matter which combination you choose, the bucket is filled the same amount. Likewise, an image in a camera can be exposed the same amount by various aperture and shutter speed combinations while also controlling motion and depth of field.



1. We start with the aperture set to f/16 and the shutter speed to 1/30.

2. When you open the aperture one stop to f/11 the shutter speed has to decrease to 1/60 to keep the exposure the same. This change decreases depth of field slightly and freezes action better.

3. When you open the aperture another stop to f/8 the shutter speed has to decrease another stop to 1/125. This change decreases depth of field even more and freezes action even better.

Animation

Click to explore the relationship between the aperture and shutter speed.

EXPOSURE—SEESAW ANALOGY

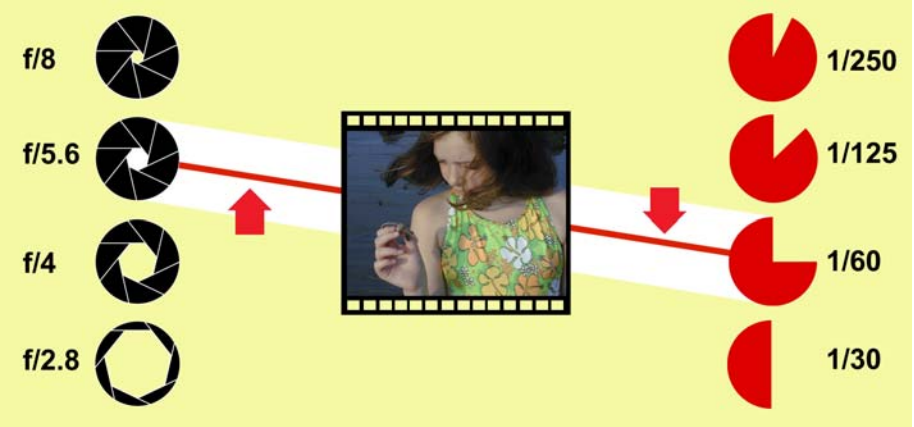
Another way to think of exposure is as a seesaw. As one child rises a given distance, the other falls by the same amount but their average distance from the ground is always the same. In photography, when you or the camera changes the aperture or shutter speed to let in more or less light, you or the camera must also change the other setting in the opposite direction to keep the exposure constant.

The illustrations below show how a change in the aperture setting must be matched by a change in the shutter speed and vice versa. As these offsetting changes are made, the exposure stays constant but depth of field changes slightly and subjects are more or less likely to be frozen.

1. Here the aperture is f/4 and the shutter speed is 1/125.

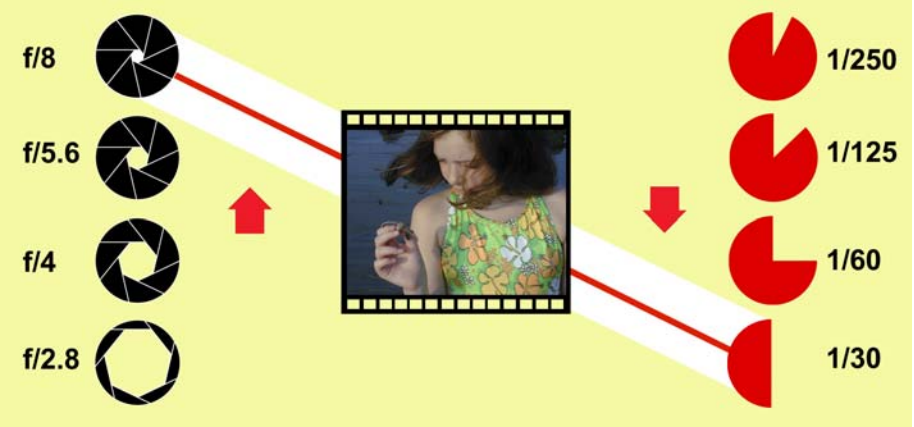
2. If you reduce the aperture one stop to f/5.6 the shutter speed has to decrease one stop to 1/60 to keep the exposure the same.

Depth of field increases slightly and the possibility of subject or camera blur increases.



3. If you reduce the aperture one more stop to f/8 the shutter speed has to decrease one more stop to 1/30 to keep the exposure the same.

Depth of field increases even more as does the possibility of subject or camera blur.

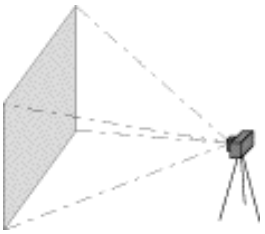


COMPOSING IMAGES

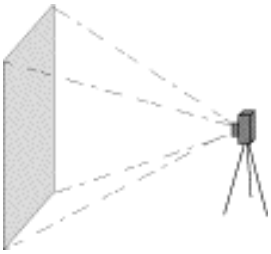
Monitors show you what the view looks like through the lens.

The best monitors are those that swivel and tilt to any angle.

With a swiveling monitor, you can shoot up at things close to the ground such as this newt.



Landscape mode shows the image horizontally.



Portrait mode shows the image vertically.

To help you compose images, digital cameras usually have both a monitor and viewfinder. The primary roles of these two features are quite different, although there is some overlap.

MONITORS

Monitors are small LCD color displays built into most cameras. Their size is specified in inches, and the measurement, like those of TV sets, is based on the diagonal measurement. These screens range between 1.5 and 4 inches and serve a number of useful functions:

- **Menus** are displayed on the monitor so you can change camera settings.
- **Image composition**. On many, but not all cameras, you can compose the image on the screen before you take it. SLR cameras don't let you do this because they use a mirror to bounce the image formed by the lens into the viewfinder. The image sensor only creates the image when the shutter is open.
- **Image review**. You can review an image you've taken so you know it's the way you want it. No more surprises as so often happens when you use a film camera and pick up your traditional prints.
- **Image management**. You can scroll through the images you've taken and create slide shows, delete, rotate, rename, print, protect, copy or otherwise manage them. Many cameras also display thumbnails of a group of images in *index view* so you can quickly locate and select the images you're looking for. Most also let you enlarge the image on the monitor to zoom in on details in your photo—a great way to check sharpness. A few cameras let you view histograms of your image so you can check the tonal range. A few cameras now have touch-sensitive monitors so you can manage your images with a stylus instead of dials and buttons.
- **Direct printing**. You use the monitor to select images for printing when you bypass the computer to print directly from the camera.

On cameras that let you compose the image on the monitor, the displayed image is taken directly from the image sensor, so it is a true TTL (through-the-lens) view. Although you can use the monitor to compose photos, there are times when you may not want to for the following reasons.

- **Battery drain**. Large monitors drain batteries quickly, so it's best to keep them turned off and use the optical viewfinder for taking pictures.
- **Glare**. The image on the monitor can be difficult to read in bright sunlight.
- **Steadiness**. You may have to hold the camera at arm's length, an awkward position that tends to introduce blur into your images through camera shake.

Although you may want to keep the monitor turned off to conserve battery power, there are a few situations in which it becomes indispensable.

- **Close-ups**. When using a camera that isn't an SLR for close-ups, the monitor is a great way to compose and focus the image since it shows the scene exactly the way it will be in the image you'll capture.
- **Odd angles**. When photographing over a crowd, at ground level, or around a corner, a camera with a rotating and swiveling monitor lets you compose the image without holding the camera up to your eye.

Because an optical viewfinder is offset from the lens, what you see through the viewfinder (top) is different from the image you actually capture (bottom).

Electronic viewfinders are small flat-panel displays inside the viewfinder. Courtesy of Zight.

Animation

Click to explore how parallax affects your view of a subject.

A common monitor icon.

Animation

Click to see the light path through an SLR.

In this cutaway view of a Canon SLR you can see the mirror that bounces light up into a prism for the viewfinder. The mirror swings up out of the way when you take a picture. Courtesy of Canon.

VIEWFINDERS

Viewfinders are ideal for following fast action as it unfolds—waiting for the decisive moment. One of their advantages is that they don't draw battery power so your batteries last longer. Viewfinders are coupled to the zoom lens and show the same area covered by the image sensor. There are three kinds of viewfinders and most photographers would consider the SLR viewfinder the best,

- **Optical viewfinders on SLR cameras** show the scene through the lens (TTL) just as 35mm SLRs do. A mirror bounces light coming through the lens into a prism that directs it out of the viewfinder. When you take a picture, the mirror swings up to let light hit the shutter and image sensor. These are true "what you see is what you get" viewfinders because you see exactly what the lens sees.

- **Optical viewfinders on point-and-shoot cameras** show the scene through a separate window that is slightly offset from the view seen by the lens. The offset view isn't a problem except in close-up photography where parallax causes you to see a view that is slightly offset from the one the lens sees so a subject centered in the viewfinder won't be centered in the image.

- **Electronic viewfinders** use a small LCD monitor built into the viewfinder that shows you the same through-the-lens image seen by the image sensor. Because these displays are electronic, menus can be superimposed over the scene so you can change settings without lowering the camera from your eye. This is especially useful on bright days when a monitor is hard to read because of glare. It's also advantageous for people who need reading glasses because the menu can be read without glasses.

Chapter 2
Controlling Sharpness

CONTENTS

One of the first things you notice about a photograph is whether or not it is sharp. Extremely sharp photographs reveal a richness of detail, even more than you would normally notice in the original scene. If the entire image isn't sharp, your eye is immediately drawn to the part that is. If your photos aren't as sharp as you want them to be, you can analyze them to see what went wrong.

■ **Focus**. If none of your image is sharp, or if your main subject is not sharp but other parts of the photograph are, your camera was improperly focused.

■ **Depth of Field**. If your central subject is sharp but the background or foreground is less so, you didn't have enough depth of field.

■ **Camera Movement**. If the image is blurred all over, with no part sharp, the camera moved during the exposure. Some points appear as lines, and edges are blurred.

■ **Subject Movement**. When some of the picture is sharp but a moving subject appears blurred, your shutter speed was too slow.

In this chapter you'll see how to ensure your photos are sharp when you want them to be and how to use blur creatively.