Barbara **LONDON** | Jim **STONE**

A Short Course in Photography DIGITAL

Fourth Edition

Fourth Edition

A Short Course in PHOTOGRAPHY

Digital

AN INTRODUCTION TO PHOTOGRAPHIC TECHNIQUE

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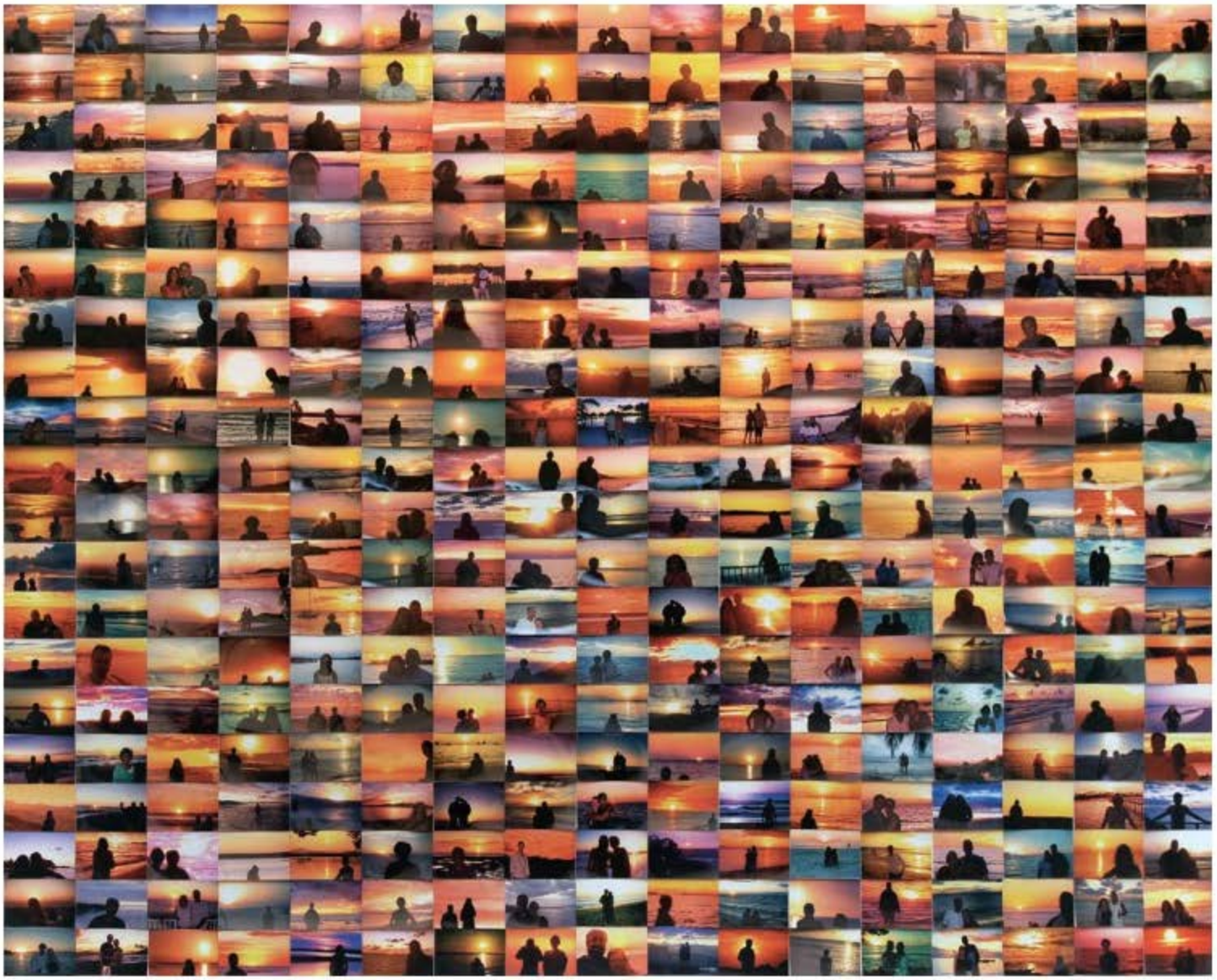

Penelope Umbrico. *Sunset Portraits from 8,462,359 Flickr Sunsets on 12/21/10, 2010.* ***Photography can be your subject, as well as your medium.*** *Umbrico began searching the Web in 2006 for the most-often-photographed subject, finding it to be sunsets (541,795 pictures posted on the popular photo-sharing site Flickr at that time). Umbrico had 4 × 6-inch machine prints made from an "appropriated" selection (this 2010 piece includes only those sunsets with silhouetted figures), and exhibits them in grid form, about 8 feet tall. For a 2011 gallery show, she showed 1,058 4 × 6-inch sunset portraits; by then the total number of sunsets on Flickr had grown to 9,623,557.*

As you make your own photographs, it is worth asking yourself questions. What are the ways you can improve the photographs you are now making? If others have already photographed your subject, how will your pictures be different? If you magnify the meaning your images have for you, will you also increase the impact they have on others? Read on.

Preface

If you don't know anything about photography and would like to learn, or if you want to make better pictures than the ones you are making now, *A Short Course in Photography: Digital* will help you. This book is modeled after the widely used film-and-darkroom edition of *A Short Course in Photography*, but presents the medium in its current, electronic form.

We present here, in depth, the basic techniques of photography:

- How to get a good exposure
- How to adjust the focus, shutter speed, and aperture (the size of the lens opening) to produce the results you want
- How to transfer your pictures to a computer and make sure they are organized and safe from loss
- How to use computer software to make your photographs look their best

Almost all of today's cameras incorporate automatic features, but that doesn't mean that they automatically produce the results you want. This edition of *A Short Course in Photography* devotes special attention to:

- Automatic focus and automatic exposure—what they do and, particularly, how to override them when it is better to adjust the camera manually

Some of the book's highlights include:

- Getting Started. If you are brand new to photography, this section will walk you through the first steps of selecting and installing a memory card, setting the camera's menu options, focusing sharply, adjusting the exposure, and making your first pictures. See pages 4–9.
- Projects. These projects are designed to help develop your technical and expressive skills. See page 136 or 155.
- Making Better Prints. This includes information about how to adjust your photographs with image-editing software (pages 92–111), select ink and paper for them (page 117), print them (page 118), and then display them in a mat and frame (pages 120–127).
- Types of lenses (pages 31–41), cameras (pages 10–13), lighting (pages 134–151), and software for organizing and archiving (pages 131–133).
- History of Photography. The medium has been used for documentation, persuasion, and personal expression since its 19th-century invention. See pages 180–213.

Photography is a subjective undertaking. *A Short Course in Photography* emphasizes your choices in picture making:

- How to look at a scene in the way a camera can record it
- How to select the shutter speed, point of view, and other elements that can make the difference between an ordinary snapshot and an exciting photograph
- Chapter 9, Seeing Like a Camera, explores your choices in selecting and adjusting the image and presents ways to photograph subjects such as people and landscapes.
- An updated Chapter 10, The History of Photography, traces the technical, social, and artistic development of the medium since its inception.

New in this fourth edition are:

- The latest on camera technology and software, integration of workflow applications—including Capture One Pro—at every step, and expanded coverage of a Camera Raw workflow.
- New photographs by great contemporary artists, including Edward Bateman, Ian van Coller, Sam Comen, John Divola, Filip Dujardin, Adam Ekberg, Kate Joyce, David Leventi, Martina Lopez, Christoph Oberschneider, Todd Owyoung, Christian Richter, and Geoffrey Robinson.
- The 1970s explosion of color photography is explained in the History of Photography, Chapter 10.
- Current product and technical information throughout, with updated demonstration and example photographs.

This book is designed to make learning photography as easy as possible:

- Every two facing pages completes a single topic
- Detailed step-by-step instructions clarify each stage of extended procedures
- Boldfaced headings make subtopics easy to spot
- Numerous photographs and drawings illustrate each topic

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Many people gave generously of their time and effort in the production of this book. Feedback from instructors helps confirm the direction of the book and determine the new elements in each edition. The authors are grateful to all those who reviewed previous editions and forwarded comments. At Pearson Education, Roth Wilkofsky provided editorial support. Annemarie Franklin, Steve Martel, and the team at SPi Global supervised the production of the book from manuscript to printer and caught our (extremely few, of course) errors. Amber, Jade, and Skye Stone gave their dad time to finish the book. If you have suggestions, please send them to Photography Editor, Pearson Education, 221 River Street, Hoboken, NJ 07030. They will be sincerely welcomed.

Jim Stone
Barbara London

ANNIE LEIBOVITZ

Yo Yo Ma, 1998. ***Framing is a basic control*** *you have in making a photograph. The two photographs on this page and opposite are about music. Would you center your subject or use a corner? Do you want action or repose? Black and white or color? Horizontal, vertical, or square? Candid or posed? Viewed from above, below, or straight on? More about framing on pages 154–155.*

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Camera 1

In this chapter you'll learn…

- the basic controls of your camera and what they do.
- the categories of cameras, and their characteristics, so you can choose the right one for your purposes.
- the first steps of getting a camera ready, focusing an image, and adjusting the camera's settings.

Project:
EXPOSE SOME PICTURES

YOU WILL NEED

Camera. We suggest one with adjustable controls.

Output. To evaluate your work, it's good to see exactly what you did. Your digital pictures can be viewed on the camera's small monitor but they are easier to evaluate on a computer screen. Pages 8 and 88 tell you how to download photographs from your camera to a computer. Once they are on a computer, your unedited photographs can also be displayed large with a digital projector or on a wide-screen television so you can easily see small details and imagine what they might look like printed at a large size. If you shoot 35mm film you can take it to the photo lab in a drug store or supermarket chain for overnight processing and printing.

Pencil and notepad or smartphone to keep track of what you do. Optional, but highly recommended for all the projects.

PROCEDURE See pages 4–9 if you are just beginning to photograph. Those pages walk you through the first steps of setting up your camera, focusing an image sharply, adjusting the camera settings so your photographs won't be too light or too dark, and making your first pictures. See pages 10–13 for more about the kinds of cameras.

Have some variety in the scenes when you shoot. For example, photograph subjects near and far, indoors and outside, in the shade and in the sun. Photograph different types of subjects, such as a portrait, a landscape, and an action scene. Page 9 gives some suggestions.

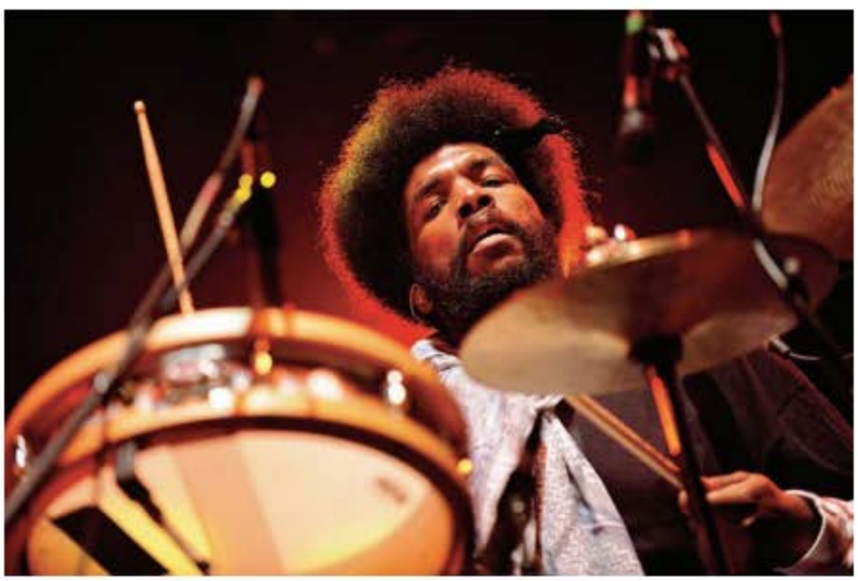
HOW DID YOU DO? Which pictures did you like best? Why? Were some different from what you expected to get? Did some of your camera's operations cause confusion? It helps to read your instruction book all the way through or to ask for help from someone familiar with your camera.

All cameras have four things in common: an image-forming lens; a light-sensitive surface (film or a digital sensor) to record the light that forms an image; a light-tight container (the camera's body) to keep other light out; and two important controls to adjust the amount of picture-making light (the exposure) that reaches the light-sensitive surface.

This chapter describes those light controls and how you can take charge of them, instead of letting them control you. Almost all current cameras are equipped with automatic exposure and automatic focus, and many have automatic flash. If you are interested in making better pictures, however, you should know how your camera makes its decisions, even if the automatic features can't be turned off. If they can, you will want to override your camera's automatic decisions from time to time and make your own choices.

- You may want to blur the motion of a moving subject or freeze its motion sharply. Pages 18–19 show how.
- You may want a scene sharp from foreground to background or the foreground sharp but the background out of focus. See pages 44–45.
- You may want to override your camera's automatic focus mechanism so that only a certain part of a scene is sharp. Page 43 tells when and how to do so.
- You may decide to silhouette a subject against a bright background, or perhaps you want to make sure that you don't end up with a silhouette. See page 72.

Most professional photographers use cameras with automatic features, but they know how their cameras operate manually as well as automatically so they can choose which is best for a particular situation. You will want to do the same because the more you know about how your camera operates, the better you will be able to get the results you want.



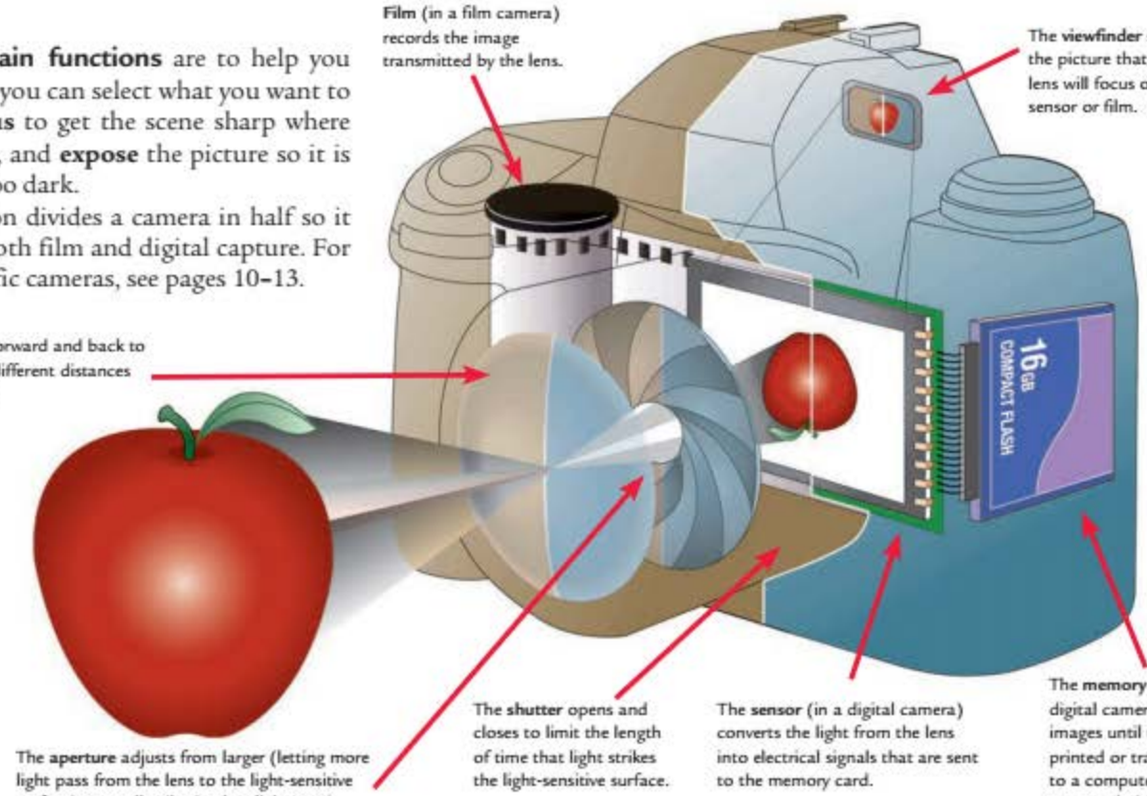
***Todd Owyoung**. Drummer Questlove performing with the Roots, Fox Theater, St. Louis, Missouri, 2008.*

Getting Started

GETTING YOUR CAMERA READY

A camera's main functions are to help you **view** the scene so you can select what you want to photograph, **focus** to get the scene sharp where you want it to be, and **expose** the picture so it is not too light or too dark.

This illustration divides a camera in half so it shows parts for both film and digital capture. For more about specific cameras, see pages 10–13.

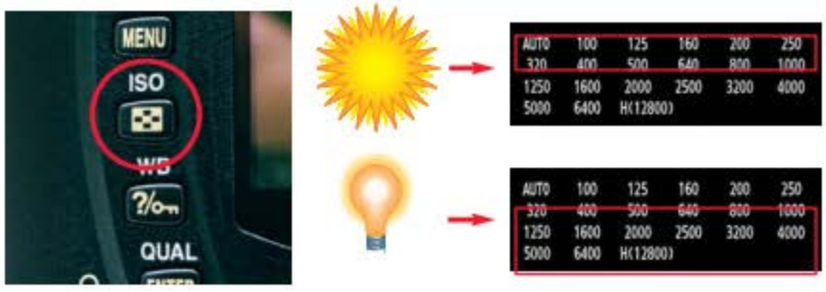


More about camera controls on pages 14–27.

Choose a Memory Card

Digital cameras store pictures on memory cards that vary in capacity and speed. Because there are several types that are not interchangeable, make sure you have one that fits your camera.

Select an ISO



ISO speed (100, 200, 400, and so on) describes a sensor's (or film's) sensitivity to light. The higher the number, the less light it needs for a correct exposure (for a picture that is not too light or too dark). With a digital camera, you may select an ISO setting within that camera's range. You may choose a different ISO for each picture, or you may set your camera to do so automatically. Lower numbers will generally result in higher-quality pictures (see Noise, page 75).

Set an ISO of 50 to 800 for shooting outdoors in sunny conditions. In dimmer light, such as indoors, use an ISO of 800 or higher. Film is made with a fixed ISO; an entire roll must be exposed at that speed. 400 speed film is a good all-purpose choice.

Check the Batteries

Make sure your camera's batteries have a fresh charge. No digital cameras and few film cameras will operate without power. A half-empty symbol will let you know when the battery is low. Carry a fully-charged spare if you can.

Many cameras use proprietary battery packs that must be recharged with the manufacturer's matching charger. Some compact cameras have built-in batteries that limit your shooting while they recharge.

Some cameras use standard batteries that you can buy nearly anywhere. Most conventional sizes are available in money-saving rechargeable versions.

Insert a Memory Card

Insert the memory card only with the camera's power turned off. Then turn on the camera. Make sure you are using the right kind of card for your camera and one with enough capacity. Cards intended for another camera may not operate correctly in yours.

Keep cards protected when they are not in the camera. Memory cards are vulnerable to dust and moisture as well as magnetic fields, heat, and shock. Try not to touch the electrical contacts.

Display the Menu

Open the options menu. Turn the camera on and press the button to display the menu on the camera's monitor.

Review the defaults. In your camera's manual, read through the list of settings that can be changed by the operator. Decide which of them you would like to change from the camera's defaults, the way those options have been set by the factory.

Select a menu item with the control wheel on the camera's back, then use the jog dial (also on the back) to reveal a list of settings or choices for that item.

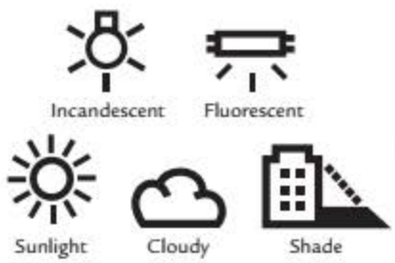
Getting Started

FOCUSING AND SETTING THE EXPOSURE

Set Basic Menu Options

Select the file type and resolution. The menu item may be called "image quality," because visual fidelity is affected by your choice. A lower resolution or compressed file lets you store more pictures on your memory card, but at some loss of quality. Saving pictures in the camera's raw format, at its highest resolution, keeps the quality highest.

Choose an ISO speed. It can be different for each picture. Higher numbers let you shoot in lower light but produce an image with more noise (see page 75).

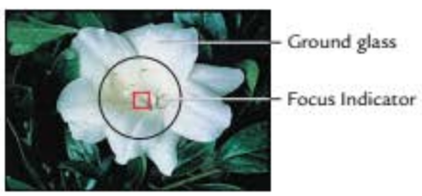


Select the white balance (color temperature) of the dominant light source in which you are shooting, such as incandescent (tungsten) bulbs, sunlight, or outdoor shade. A camera set on automatic makes these adjustments for you. If your camera has a raw format option, it leaves the white balance choice until you edit the file.

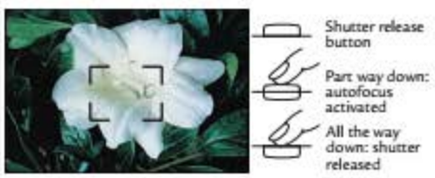
More about ISO speed on page 75.

Focus

Focus on the most important part of your scene to make sure it will be sharp in the photograph. Practice focusing on objects at different distances as you look through the viewfinder so that you become familiar with the way the camera focuses.



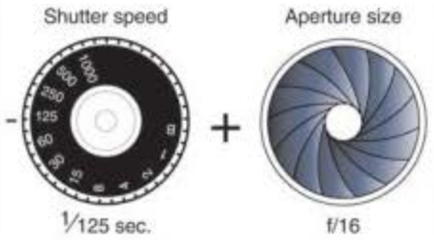
Manual focusing. As you look through the viewfinder, rotate the focusing ring at the front of the lens. The viewfinder of a single-lens reflex camera has a ground-glass screen that shows which parts of the scene are most sharply focused. Some cameras also have a microprism, a small ring at the center of the screen in which an object appears coarsely dotted until it is focused. An advanced or *system* DSLR may offer a choice of focusing screens.

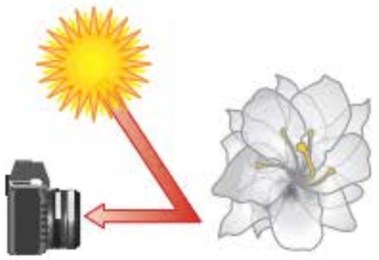


Automatic focusing. Usually this is done by centering the focusing brackets (visible in the middle of the viewfinder) on your subject as you depress the shutter release part way. The camera adjusts the lens for you to bring the bracketed object into focus. Don't push the shutter release all the way down until you are ready to take a picture.

More about focus and when and how to override automatic focus on pages 43.

Set the Exposure





To get a correctly exposed picture, one that is not too light (overexposed) or too dark (underexposed), you—or the camera—must set the shutter speed and the aperture according to the selected ISO sensitivity and how light or dark your subject is. The shutter speed determines the length of time that light strikes the sensor; the aperture size determines how bright the light is that passes through the lens and shutter to the light-sensitive surface.

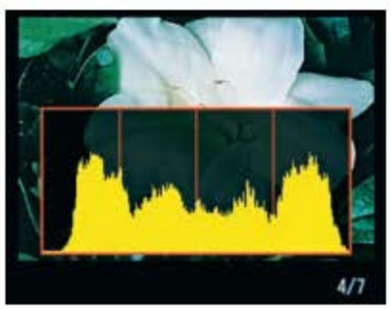
More about shutter speed and aperture on pages 18–27 and about exposure and metering on pages 62–73.

EXPOSURE READOUT

Exposure Readout

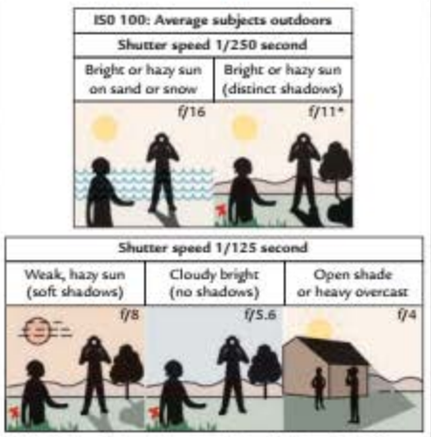
A data panel appears on the body of some cameras, displaying shutter speed and aperture settings (here, 1/250 sec. shutter speed, f/16 aperture), as well as other information.

The shutter speed and aperture settings appear in the viewfinder of some cameras (here, 1/250 sec. shutter speed, f/16 aperture).



A histogram is an accurate representation of exposure that most cameras can display on the monitor after you take each photograph. If your subject is not moving or is otherwise cooperative, make a test exposure of the scene first. Over- or underexposed tests can be deleted. More about histograms on pages 60–61.

Manually Setting the Exposure



*f/5.6 for backlighted close-up subjects. Subject shaded from sun but lighted by a large area of sky.

With manual exposure, you set both the shutter speed and aperture yourself. How do you know which settings to use? At the simplest level you can use a chart like the one above. Decide what kind of light illuminates the scene, and set the aperture (the f-number shown on the chart) and the shutter speed accordingly.

Notice that the recommended shutter speed on the chart is 1/250 sec. or 1/125 sec. These relatively fast shutter speeds make it easier for you to get a sharp picture when hand holding the camera (when it is not on a tripod). At slow shutter speeds, such as 1/30 sec. or slower, the shutter is open long enough for the picture to be blurred if you move the camera slightly during the exposure.

You can use a camera's built-in meter for manual exposure. Point the camera at the most important part of the scene and activate the meter. The viewfinder will show whether the exposure is correct. If it isn't, change the shutter speed and/or aperture until it is. Here, plus numbers signal overexposure, minus means underexposure. Lining up the red arrow with the dot in the center indicates the exposure is right.

To prevent blur caused by the camera moving during the exposure (if the camera is not on a tripod), select a shutter speed of at least 1/60 sec. A shutter speed of 1/125 sec. is safer.

Automatically Setting the Exposure

With automatic exposure, the camera sets the shutter speed or aperture, or both, for you.

With programmed (fully automatic) exposure, each time you press the shutter release button, the camera automatically meters the light, then sets both shutter speed and aperture.

With shutter-priority automatic exposure, you set the shutter speed and the camera sets the aperture. To prevent blur from camera motion if you are hand holding the camera, select a shutter speed of 1/60 sec. or faster.

With aperture-priority automatic exposure, you set the aperture and the camera sets the shutter speed. To keep the picture sharp when you hand hold the camera, check that the shutter speed is 1/60 sec. or faster. If it is not, set the aperture to a larger opening (a smaller f-number).

More about how to override automatic exposure on page 66.

Getting Started

EXPOSING IMAGES

Hold the Camera Steady

For horizontal photographs (sometimes called *"landscape"* mode), keep your arms against your body to steady the camera. Use your right hand to hold the camera and your right forefinger to press the shutter release. Use your left hand to help support the camera or to focus or make other camera adjustments.

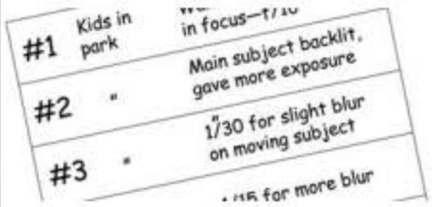
For vertical photographs (*"portrait"* mode), support the camera from below in either your right or left hand. Keep that elbow against your body to steady the camera.

A tripod steadies the camera for you and lets you use slow shutter speeds for night scenes or other situations when the light is dim. Make sure to use a cable release, remote trigger, or self-timer with it.

Expose Some Images

Make an exposure. Recheck the focus and composition just before exposure. When you are ready to take a picture, stabilize your camera and yourself and gently press the shutter release all the way down. Most cameras prefocus automatically when you press the shutter button halfway down. If your subject cooperates, try several different exposures of the same scene, perhaps from different angles.

An LCD monitor shows exact framing and lets you check to see that the picture is not too light or too dark after you take it. Most digital cameras will also let you zoom in the monitor display on a small part of the saved picture to check precise focus.



You'll learn faster if you keep a record as you are shooting. Digital cameras automatically save camera and exposure information—like the aperture, shutter speed, and ISO—and store it with each picture. But it helps to note your reasons for those choices: the way a subject was moving, for example, or the direction and quality of light. This will let you identify the paths to your successful images and help you make great pictures more often.

Download the Pictures

Transfer your pictures to another storage device, usually a computer's hard drive, at the end of a day's shooting or whenever you want to review them in detail. This transfer is called *downloading*. You can remove the memory card and plug it into a card reader, as shown above, or connect the camera and computer directly with a cable, below. Some cameras can transfer images wirelessly.

Download your pictures directly to a computer if it's convenient. If you are shooting on location you can transfer them to a portable hard drive or other device made for reading cards. Don't erase the memory card until you are sure all your images are secure and, if possible, duplicated in at least two places.

You can delete unwanted images from the card using the camera, but—unless you are running out of room on the card during a shoot—it is safer to save that editing step until after all your images have been downloaded.

WHAT WILL YOU PHOTOGRAPH?

Bob Simons

Where do you start? One place to start is by looking around through the viewfinder. A subject often looks different isolated in a viewfinder than it does when you see it surrounded by other objects. What interests you about this scene? What is it that you want to make into a photograph?

Get closer (usually). Often people photograph from too far away. What part of the scene attracted you? Do you want to see the whole deck, the whole back yard, or are you more interested in the person cooking? Do you want the whole wall of a building, or was it only the graffiti on it that caught your attention?

Kyle Bajakian

Try a different angle. Instead of always shooting from normal eye-level height, try getting up high and looking down on your subject or kneeling and looking up.

Look at the background (and the foreground). How does your subject relate to its surroundings? Do you want the subject centered or off to one side to show more of the setting? Is there a distraction (like bright sunlight or a sign directly behind someone's head) that you could avoid by changing position? Take a look.

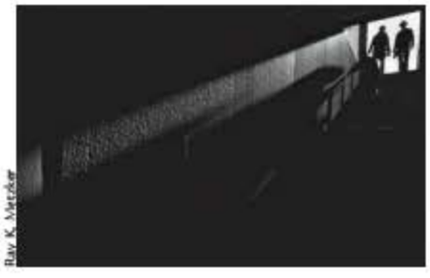
More about backgrounds and the image frame on pages 154–157.

Karl Baden

Check the lighting. At first, you are more likely to get a good exposure if you photograph a more or less evenly lit scene, not one where the subject is against a very light background, such as a bright sky.

More about lighting on pages 134–151.

Karl Baden



Ray K. Metzker

Don't be afraid to experiment, too. Include a bright light source or bright sky in the picture (just don't stare directly at the sun through the viewfinder). In the resulting photograph, darker parts of the scene may appear completely black, or the subject itself may be silhouetted against a brighter background.

Types of Cameras

FILM CAMERAS

What kind of camera is best for you? For occasional snapshots of family and friends, an inexpensive, completely automatic, nonadjustable camera that you just point and shoot will probably be satisfactory. But if you have become interested enough in photography to take a class or buy a book, you will want an adjustable camera because it will give you greater creative control. If you buy a camera with automatic features, make sure it is one that allows you to manually override them when you want to make exposure and focus choices yourself.

Film camera designs evolved as tools for specific tasks, and followed the slow evolution of film (see Chapter 10, pages 184–186). Here are the major styles, which are useful to know about because many elements of these designs have been incorporated into their digital counterparts.

Single-lens reflex cameras (SLRs) show you a scene directly through the lens, so you can preview what will be recorded. You can see exactly what the lens is focused on; with some cameras, you can check the depth of field (how much of the scene from foreground to background will be sharp). Through-the-lens viewing is a definite advantage with telephoto lenses, for close-ups, or for any work when you want a precise view of a scene.

Very early SLRs used large glass plates or film sheets but since the 1950s almost all were made to accept 35mm film. A few models aimed at (and priced for) professional photographers used larger roll film. Recent SLRs incorporate automatic exposure, automatic focus, and automatic flash but allow manual control. Many different interchangeable lenses for SLRs are available.

Digital SLRs (DSLRs) resemble their 35mm film ancestors. Some SLR cameras made for 2¼-inch-wide roll film (called medium-format) may be used with accessory digital capture backs. Digital-only models, also called medium-format, are also available.

SLRs have long been very popular with professionals, such as photojournalists or fashion photographers, or with anyone who wants to move beyond making snapshots.

Single-lens Reflex Camera

Rangefinder cameras are viewfinder film cameras. This means they have a peephole, or window, separate from the lens, through which you view the scene. Inexpensive "point-and-shoot" viewfinder cameras simply show the approximate framing through the window. A rangefinder camera is more complex, with a visual focusing system that you use as you look through the viewfinder window. The window shows a split image when an object is not in focus. As you rotate the focusing ring, the split image comes together when the object is focused sharply. Rangefinder cameras let you focus precisely, even in dim light, but you cannot visually assess the depth of field because all parts of the scene, even the split image, look equally sharp in the viewfinder.

Rangefinder Film Camera

Because the viewfinder is in a different position from the lens that exposes the film, you do not see exactly what the lens sees. This difference between the viewfinder image and the lens image is called *parallax* error, and is greater for objects that are closer to the camera. Better rangefinder cameras correct for parallax error and have interchangeable lenses, although usually not in as many focal lengths as are avail-

able for SLRs. Most use 35mm film; ones called medium format are for wider roll film, few are digital. Rangefinder cameras are fast, reliable, quiet in operation, and relatively small.

Twin-lens Reflex Camera

Twin-lens reflex cameras (TLRs), except for a couple novelty "retro" digital versions, are all film cameras. New ones are made by a few companies, but secondhand models are widely available. They cannot easily be adapted to digital capture. Each camera has two lenses: one for viewing the scene and another just below it that exposes the film.

A large film format (2¼ inches square) is the TLR's advantage. Its disadvantages are parallax error and a viewfinder image that is reversed left to right. Some now-discontinued TLRs had interchangeable lenses; adjustments on all models are completely manual.

View cameras have a lens in the front, a ground-glass viewing screen in the back, and a flexible, accordion-like bellows in between. The camera's most valuable feature is its adjustability: the camera's parts can be moved freely in relation to each other, which lets you alter perspective and sharpness to suit each scene. You can change lenses and even the camera's back; for example, you can attach a back to use self-developing film or one to record a digital image.

Each film exposure is made on a separate sheet, so you can make one shot in color and the next in black and white, or develop each sheet differently. Film size is large—4 × 5 inches and larger—for crisp and sharp detail even in a big print.

Using a view camera can be a more considered process because they are slow to use compared to smaller hand-held cameras. They are large and heavy and must be mounted on a tripod. The image on the viewing screen is upside down, and it is usually so dim that you have to put a focusing cloth over your head and the screen to see the image clearly. When you want complete control of an image, such as for architectural or product photography or for personal work, the view camera's advantages outweigh what some might see as inconveniences.

View Camera

Some cameras are made to fill a specialized need.

Panoramic cameras make a long, narrow photograph that can be effective, for example, with landscapes. Some of these cameras crop out part of the normal image rectangle to make a panoramic shape. Others use a wider-than-normal section of roll film; some may rotate the lens from side to side during the exposure.

Digital panoramas can be made during editing by stitching several individual frames together, either from digital capture or from scanned film, so special-purpose panoramic cameras are no longer common. Some digital cameras can display a segment of the previous frame on the side of the monitor to help align the next shot for more seamless reassembly later. Other cameras (and smart phones) have a "sweep" mode that can capture a panoramic image with one press of the button when moved across a scene.

Stereo or *3-D cameras* take two pictures at the same time through two side-by-side lenses. The resulting pair of images, a *stereograph,* gives the illusion of three dimensions when seen in a stereo viewer.

Underwater cameras are not only for use underwater but for any situation in which a camera is likely to get wet. Some cameras are water resistant, rather than usable underwater. Specially-made underwater housings are available for professional use or larger camera models.

Types of Cameras

DIGITAL CAMERAS

Digital camera designs are continually evolving and the array of available models can be overwhelming. With so many options, you can usually choose a camera based on the combination of features you need, but you may have to compromise. To get the most out of this book (and your photography) choose a camera that offers you the option to control focus and exposure manually.

Compact Camera

Size is often the first consideration in choosing a camera. Your camera shouldn't be so large or so small that it gets in the way of your photography.

Digital single-lens reflex (DSLR) cameras are the most versatile choice but they are big enough that you'll probably carry one only when you are meaning to use it. Professional models can be relatively heavy, but taking even the smallest and lightest SLR out for a walk requires a shoulder strap or camera bag. Using one in public suggests to others that you are not a casual snapshooter, that you are photographing seriously.

Compact cameras are mostly designed for amateur photographers but vary considerably in quality. The smaller the camera, the more likely its features will be limited. Some compacts are good enough to be used by professionals when they don't want to carry a larger camera; some are made to be used a few times and then set aside. Most compact digital cameras are a bit too large and heavy for your pocket, but fit well in a small shoulder bag along with your phone and sunglasses.

Subcompact digital cameras can be carried in a pocket so you are ready to make pictures anywhere, any time.

Compact Action Camera

With image quality and features that compare poorly to larger cameras, the market for subcompacts is giving way to smart phones.

Lens. Do you need interchangeable lenses? One common characteristic of a camera made for serious photographers is that a wide assortment of lenses can be attached. An arsenal of specialized lenses can be expensive to acquire and cumbersome to carry. A fixed lens may be all you need, especially if it is a zoom that covers the range you'd expect to use (see pages 32–33).

Viewing system. The purpose of a camera's viewing system is to let you frame and preview, as accurately as possible, the photograph you are about to capture.

A *single-lens reflex camera* projects the image-forming light directly from your lens onto a mirror and then to your eye through a pentaprism (see page 17) so you see what the lens sees. Because the viewfinder is held to your eye, it is relatively easy to follow action. But the mirror must swing out of the way for the moment of exposure, so you don't actually see the exact image you have captured. And the mirror's motion can cause unwanted vibration that causes slight blurring.

Mirrorless cameras most often have a small monitor or LCD screen on the back of the camera that displays what the lens is seeing, transmitted directly from the image sensor. This image, called *live view*, is used for framing and focusing, and is replaced momentarily with a view of each captured image immediately after being taken.

Medium-format Digital SLR

The monitor on some cameras is articulated, or tiltable, for viewing from unusual angles, such as overhead or waist level.

Mirrorless cameras may have an *electronic viewfinder*, or EVF. This viewfinder is a smaller version of the LCD monitor that is located inside the camera. It can be seen when holding the camera to your eye rather than at arm's length. SLR-style mirrorless cameras have a characteristic pentaprism; other cameras resemble rangefinder film cameras with the EVF visible through a peephole located in a corner of the camera's back.

An EVF display can be made lighter and darker to compensate for the brightness of a scene or for setting different apertures (page 22). Some cameras can show in the viewfinder an outline of the areas of best focus, sometimes called *focus peaking,* or fill the frame with a very small section of the scene to allow more precise visual focusing.

Resolution. The maximum number of pixels a camera's sensor can capture is called its resolution. A camera, for example, may be 12, 16, or 24 megapixels (MP). An image file captured by almost any current digital camera can make a satisfactory letter-size (8½ × 11) print. Generally, to keep the same image quality, the larger the print, the higher the resolution needed (see page 55). If you aren't planning to make large prints, you probably don't need the highest megapixel count.

Mirrorless EVF Camera

Sensor size also affects image quality. A 12MP sensor can be physically large or small. If it is small, to have the same number of individual light-sensing elements as a large 12MP sensor, the elements must also be smaller and more tightly packed. The larger and less crowded these elements are on the sensor, the higher the quality of the image (see noise, page 75). Most subcompact cameras and all cell phones have very small sensors and, therefore, produce images of somewhat lower quality.

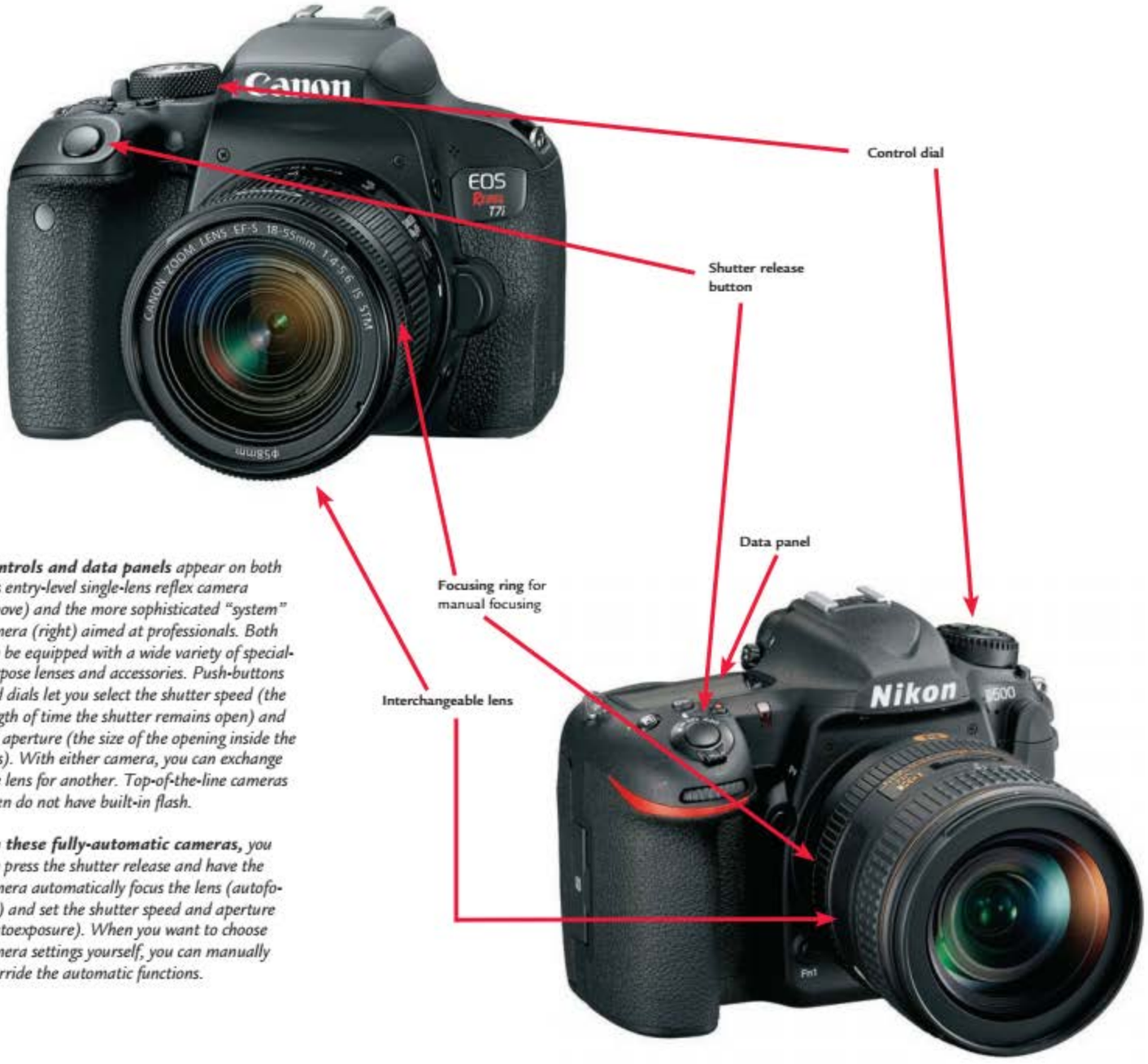
A sensor the same size as a 35mm film frame is called *full frame*. Larger sensors are made for medium-format digital cameras, priced for well-paid professional photographers. Some common sensor sizes smaller than full frame are (in descending order of size) APS-C, Four-Thirds, 2/3", 1/1.8" (see the chart on page 45).

Other features may be a factor in your choice. Most cameras have a built-in flash for use in dim light. A few have built-in Wi-Fi that can transfer image files wirelessly to a computer as you shoot. Some cameras can be remotely controlled with built-in Wi-Fi, Bluetooth, infrared, or radio receivers. Many cameras will capture video at very high quality levels. They have built-in microphones to record sound and many allow external microphones to be connected. To record an active lifestyle, there are action sports cameras (opposite page, top) that are waterproof, shock resistant, and can be helmet or surfboard mounted.

Cell phone cameras now outnumber all other types by a wide margin, and they capture a majority of the photographs made daily, worldwide. Most take only low-resolution images and allow the user no control other than where it points and when it shoots, but the best camera is always the one you have with you.

Basic Camera Controls

Get the pictures you want. Cameras don't quite "see" the way the human eye does, so at first the pictures you get may not be the ones you expected. This book will help you gain control over the picture-making process by showing you how to visualize the scene the camera will capture and how to use the camera's controls to make the picture you have in mind. Digital cameras are shown here. A film camera will have some or all of these same controls.



Controls and data panels *appear on both this entry-level single-lens reflex camera (above) and the more sophisticated "system" camera (right) aimed at professionals. Both can be equipped with a wide variety of special-purpose lenses and accessories. Push-buttons and dials let you select the shutter speed (the length of time the shutter remains open) and the aperture (the size of the opening inside the lens). With either camera, you can exchange one lens for another. Top-of-the-line cameras often do not have built-in flash.*

On these fully-automatic cameras, *you can press the shutter release and have the camera automatically focus the lens (autofocus) and set the shutter speed and aperture (autoexposure). When you want to choose camera settings yourself, you can manually override the automatic functions.*

Focusing. *Through the viewfinder window you see the scene that will be recorded, including the sharpest part of the scene, the part on which the camera is focused. A particular part of a scene can be focused sharply by manually turning the focusing ring on the lens, or you can let an autofocus camera adjust the lens automatically. More about focusing and sharpness appears on pages 42–45.*

Keith Johnson

Shutter-speed control. *Moving objects can be shown crisply sharp, frozen in mid-motion, or blurred either a little bit or a lot. The faster the shutter speed, the sharper the moving object will appear. Turn to pages 18–19 for information about shutter speeds, motion, and blur.*

Aperture control. *Do you want part of the picture sharp and part out of focus or do you want the whole picture sharp from foreground to back-ground? Changing the size of the aperture (the lens opening) is one way to control sharpness. The smaller the aperture, the more of the picture that will be sharp. See pages 22–25.*

Lens focal length. *Your lens's focal length controls the size of objects in a scene and how much of that scene is shown. The longer the focal length, the larger the objects will appear. See pages 32–39 for more about focal length.*

More about Camera Controls

Automatic exposure is a basic feature in almost all cameras. The purpose is to let in a controlled amount of light so that the resulting image is neither too light nor too dark. The camera's built-in meter measures the brightness of the scene and then sets shutter speed, aperture (lens opening), or both in order to let the right amount of light reach the camera's recording sensor (or the film in a film camera). As you become more experienced, you will want to set the exposure manually in certain cases, instead of always relying on the camera. Read more about exposure in Chapter 3, pages 60–73.

You have a choice of exposure modes with many cameras. Read your camera's instruction manual to find out which exposure features your model has and how they work. You may be able to download a replacement manual from the manufacturer's Web site, if you don't have one.

With programmed (fully automatic) exposure, the camera selects both the shutter speed and the aperture based on a program built into the camera by the manufacturer. This automatic operation can be useful in rapidly changing situations because it allows you simply to respond to the subject, focus, and shoot.

In shutter-priority mode, you set the shutter speed and the camera automatically sets the correct aperture. This mode is useful when the motion of subjects is important, as at sporting events, because the shutter speed determines whether moving objects will be sharp or blurred.

In aperture-priority mode, you set the lens opening and the camera automatically sets the shutter speed. This mode is useful when you want to control the depth of field (the sharpness of the image from foreground to background) because the size of the lens opening is a major factor affecting sharpness.

Manual exposure is also a choice with many automatic cameras. You set both the lens opening and shutter speed yourself using, if you wish, the camera's built-in light meter to measure the brightness of the light.

Exposure information *appears in the viewfinder of many cameras. This viewfinder shows the shutter speed (here, 1/250 sec.) and aperture (f/5.6). Displays also show you when the flash is ready to fire and give you warnings of under- or overexposure.*

Some cameras also have a data panel *on the body of the camera that shows the same information—shutter speed and aperture—as well as exposure, autofocus, and ISO modes and the number of exposures remaining on the memory card (here 123).*

INSIDE A DIGITAL SINGLE-LENS REFLEX CAMERA

All cameras have the same basic features:

- A light-tight box to hold the camera parts and a recording sensor or film
- A viewing system that lets you aim the camera accurately
- A lens to form an image and a mechanism to focus it sharply
- A shutter and lens aperture to control the amount of light that reaches the recording surface
- A means to hold a memory card that saves its captured information or to hold and advance film

A. **Body.** The light-tight box that contains the camera's mechanisms and protects the light-sensitive surface (sensor or film) from exposure to light until you are ready to make a photograph.

B. **Lens.** Focuses an image in the viewfinder and on the light-sensitive recording surface.

C. **Lens elements.** The optical glass lens components that produce the image.

D. **Focusing ring.** Turning the ring focuses the image by adjusting the distance of the lens from the recording surface. Some cameras focus automatically.

E. **Diaphragm.** A circle of overlapping leaves inside the lens that adjusts the size of the aperture (lens opening). It opens up to increase (or closes down to decrease) the amount of light reaching the recording surface.

F. **Aperture ring or button.** Setting the ring or turning a command dial (O) determines the size of the diaphragm during exposure.

G. **Mirror.** During viewing, the mirror reflects light from the lens upward onto the viewing screen. During an exposure, the mirror swings out of the way so light can pass straight to the recording surface.

H. **Viewing screen.** A ground-glass (or similar) surface on which the focused image appears.

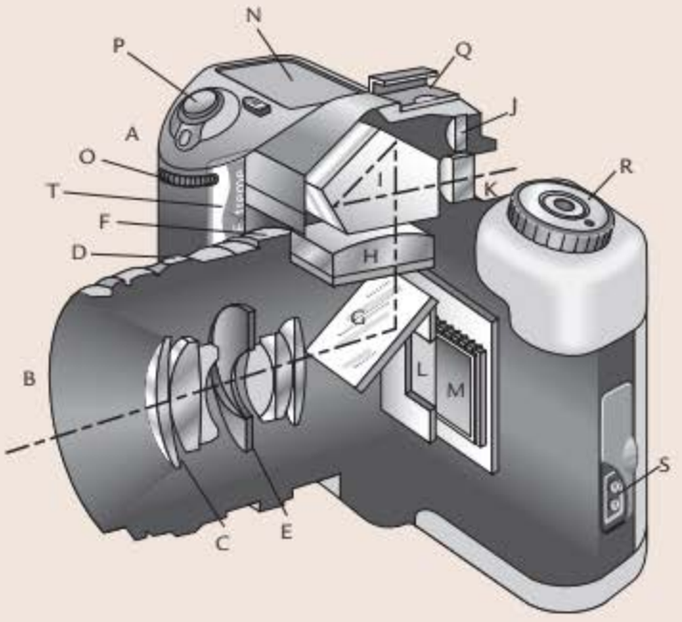
I. **Pentaprism.** A five-sided optical device that reflects the image from the viewing screen into the viewfinder.

J. **Metering cell.** Measures the brightness of the scene being photographed.

K. **Viewfinder eyepiece.** A window through which the image from the pentaprism is visible.

L. **Shutter.** Keeps light from the recording surface until you are ready to take a picture. Pressing the shutter release opens and closes the shutter to let a measured amount of light reach the sensor.

M. **Sensor.** A grid (usually called a CCD or CMOS array or chip) comprising millions of tiny light-sensitive electronic devices (photosites) that record the image. The ISO (or light sensitivity) of the sensor is adjustable, and is set into the camera by a dial or menu setting.



***A simplified look** inside a digital single-lens reflex camera or DSLR (designs vary in different models). The camera takes its name from its single lens (another kind of reflex film camera has two lenses) and from its reflection of light upward for viewing the image.*

N. **Data panel.** A display (most often an LCD screen) for such information as shutter speed, aperture, ISO, exposure and metering modes, and the number of exposures remaining on the memory card.

O. **Command dial.** Selects the shutter speed, the length of time the shutter remains open. On some models, it also sets the mode of automatic exposure operation. In some locations, it is called a thumbwheel or jog dial.

P. **Shutter release.** A button that activates the exposure sequence in which the aperture adjusts, the mirror rises, the shutter opens, light strikes the recording surface, and the shutter closes.

Q. **Hot shoe.** A bracket that attaches a flash unit to the camera and provides an electrical linking that synchronizes camera and flash.

R. **Mode dial.** Sets a manual or one of several automatic exposure modes. On film cameras, a crank to rewind an exposed roll of film may be located here. Most new film cameras rewind automatically.

S. **Cable connections.** Plug in cables that, for example, connect external power or a computer, or control the camera remotely.

T. **Memory card.** Stores image files. May be erased and reused; capacity varies. Can be removed to facilitate transferring files to a computer or other storage device.

Shutter Speed

AFFECTS LIGHT AND MOTION

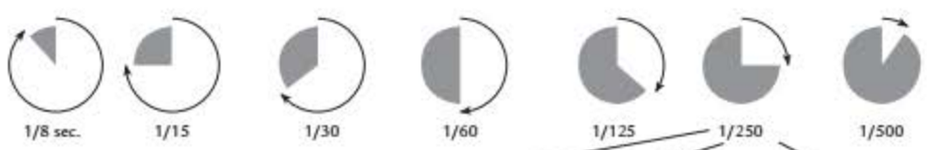
Light and the shutter speed. To make a correct exposure, so that your picture is neither too light nor too dark, you need to control the amount of light that reaches the digital image sensor (or film). The shutter speed (the amount of time the shutter remains open) is one of two controls your camera has over the amount of light. The aperture size (page 22) is the other. In automatic operation, the camera sets the shutter speed, aperture, or both. In manual operation, you choose both settings. The shutter-speed dial (a push button on some cameras) sets the shutter so that it opens for a given fraction of a second after the shutter release has been pressed. The B (or bulb) setting keeps the shutter open as long as the shutter release is held down.

Motion and the shutter speed. In addition to controlling the amount of light that enters the camera, the shutter speed also affects the way that moving objects are shown. A fast shutter speed can freeze motion—1/250 sec. is more than fast enough for most scenes. A very slow shutter speed will record even a slow-moving object with some blur. The important factor is how much the image actually moves across the recording surface. The more of that surface it crosses while the shutter is open, the more the image will be blurred, so the shutter speed needed to freeze motion depends in part on the direction in which the subject is moving in relation to the camera (see opposite page).

The lens focal length and the distance of the subject from the camera also affect the size of the image on the sensor (or film) and thus how much it will blur. A subject will be enlarged if it is photographed with a long-focal-length lens or if it is close to the camera; it has to move only a little before its image crosses enough of the recording surface to be blurred.

Obviously, the speed of the motion is also important: all other things being equal, a darting swallow needs a faster shutter speed than does a hovering hawk. Even a fast-moving subject, however, may have a peak in its movement, when the motion slows just before it reverses. A gymnast at the height of a jump, for instance, or a motorcycle negotiating a sharp curve is moving slower than at other times and so can be sharply photographed at a relatively slow shutter speed.

See the project on motion, page 161.



Shutter speeds appear in the camera's viewfinder (near right), on the shutter-speed dial (center), or as data panel readout (far right). Here, the camera is set to 1/250 sec. Notice that only the bottom number of the fraction is shown on the camera.

***Shutter-speed settings** are in seconds or fractions of a second: 1 sec., 1/2 sec., 1/4, 1/8, 1/15, 1/30, 1/60, 1/125, 1/250, 1/500, 1/1000, and sometimes 1/2000, 1/4000, and 1/8000. Each setting lets in twice as much light as the next faster setting, half as much as the next slower setting: 1/250 sec. lets in twice as much light as 1/500 sec., half as much as 1/125 sec. With many cameras, especially in automatic operation, shutter speeds are "stepless;" the camera can set the shutter to 1/225 sec., 1/200 sec., or whatever speed it calculates will produce a correct exposure.*

Drex Brooks

***A focal-plane shutter** consists of a pair of curtains usually located in the camera body just in front of the sensor. During exposure, the curtains open to form a slit that moves across the light-sensitive surface.*

The size of the slit is adjustable: the wider the slit, the longer the exposure time and the more light that reaches the sensor or film. Focal-plane shutters are found in most single-lens reflex cameras and some rangefinder cameras.

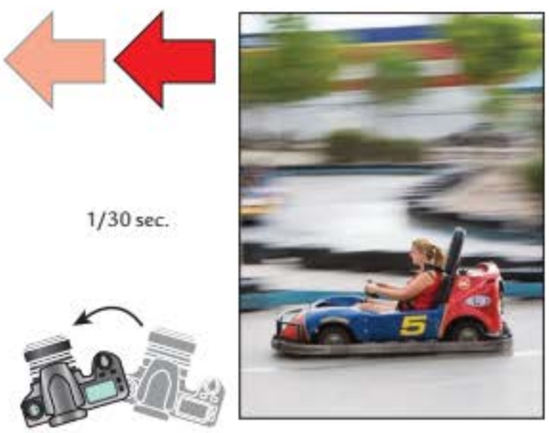
***A leaf shutter** is usually built into the lens instead of the camera body. The shutter consists of overlapping leaves that open during the exposure, then close again.*

The longer the shutter stays open, the more light that reaches the light-sensitive surface. Leaf shutters are found on most compact, point-and-shoot, rangefinder, and twin-lens reflex cameras, view-camera lenses, and some medium-format single-lens reflex cameras.

***Slow shutter speed, subject blurred.** The direction a subject is moving in relation to the camera can affect the sharpness of the picture. At a slow shutter speed, a driver moving from right to left is not sharp.*

***Fast shutter speed, subject sharp.** Photographed at a faster shutter speed, the same driver moving in the same direction is sharp. During the shorter exposure, her image did not cross enough of the recording surface to blur.*

***Slow shutter speed, subject sharp.** Here the driver is sharp even though photographed at the slow shutter speed that recorded blur in the first picture (top left). She was moving directly toward the camera, so her image did not cross enough of the recording surface to blur. The other go-kart, turning to move across the frame, becomes blurred.*



***Panning** with the vehicle is another way to keep it and the driver relatively sharp. During the exposure, the photographer moved the camera in the same direction that the go-kart was moving (a horizontal sweep from right to left). Notice the streaky look of the background, characteristic of a panned shot.*

Blurring to show motion. Freezing motion is one way of representing it, but it is not the only way. In fact, freezing motion sometimes eliminates the feeling of movement altogether so that the subject seems to be at rest. Allowing the subject to blur can be a graphic means of showing that it is moving.

Panning to show motion. Panning the camera—moving it in the same direction as the subject's movement during the exposure—is another way of showing motion (bottom right). The background will be blurred, but the subject will be sharper than it would be if the camera were held steady.

Shutter Speed

USE IT CREATIVELY

John Divola. *D07F12, from the series* Dogs Chasing My Car in the Desert, *Morongo Valley, California, 1997.* ***Creating blur can effectively suggest motion*** *and can often be a better choice than freezing a moving subject. Panning (page 19) is most often accomplished by sweeping the camera across the field of view from a fixed vantage point. Divola held his camera out the window of his moving car; the dog cooperated by matching the speed of the vehicle.*

Make a decision about shutter speed for every shot; don't simply inherit one from your previous exposure or let the camera choose for you. Experiment with arresting motion, like the photographs on the opposite page, and with the possibilities of blur. Try making a long exposure of a moving subject with a motionless camera, as shown on page 160, and by panning, as above. Every photograph you decide to make can capture multiple variations of movement, and each can still be a correct exposure.

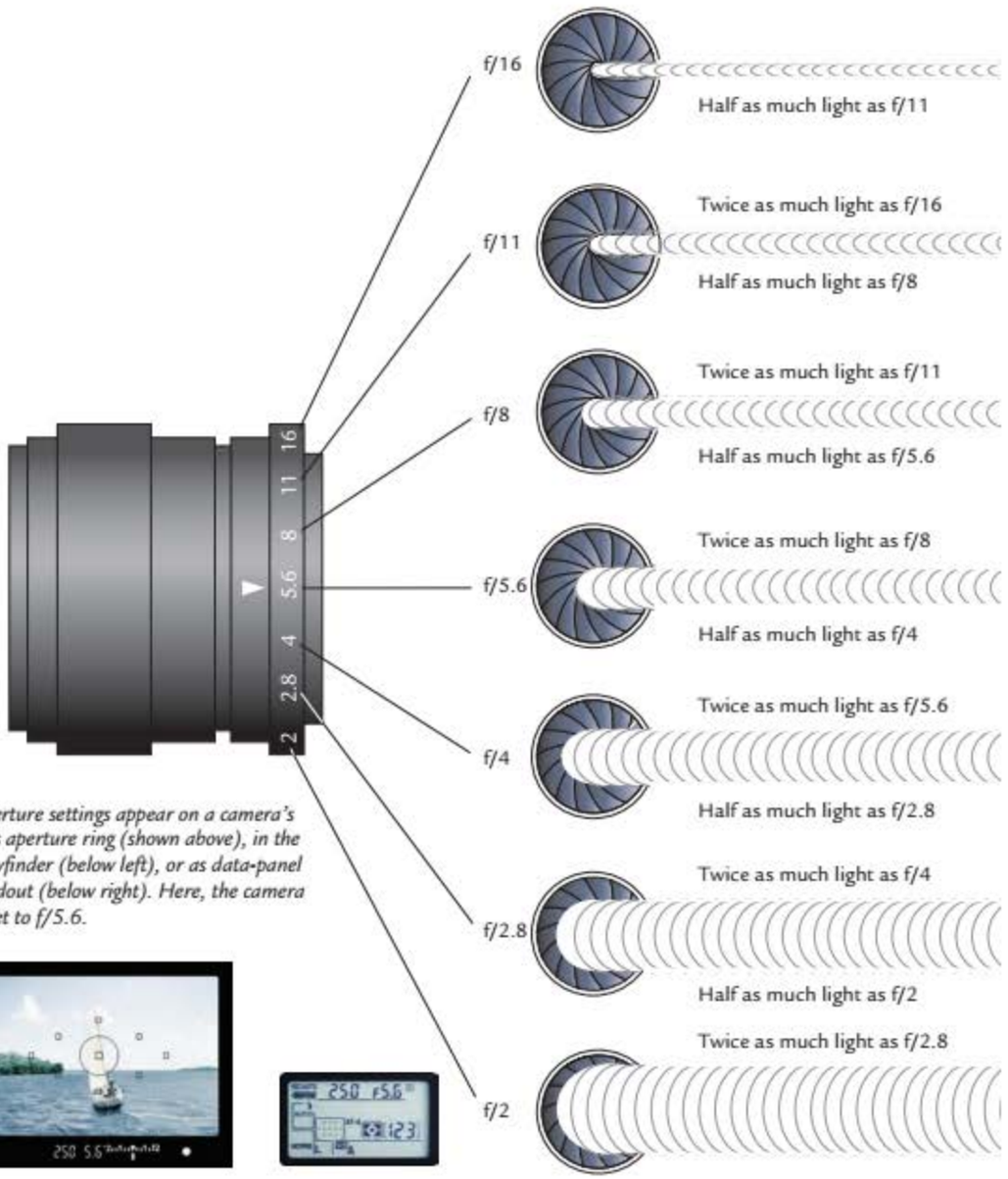
Josef Koudelka. *Spain, 1971.* ***A shutter speed that captures rapid motion also freezes anything slower.*** *The posture and gestures of the participants in this event are held in place for our close inspection.*

Naoya Hatakeyama. *Blast #5416, 1998.* ***The shutter arrests action*** *but it doesn't protect the photographer. For his own safety, making this series of pictures of explosions at a quarry, Hatakeyama used a remote control to trigger the 1/1000-sec. exposures. He relied on advice from the blasting engineer, who understood the "nature" of the rock, to locate his camera to capture the "nature" of violence without damage.*

Aperture

AFFECTS LIGHT AND DEPTH OF FIELD

Light and the aperture. The aperture, or lens opening, is the other control that you can use in addition to shutter speed to adjust the amount of light that reaches the digital image sensor or film. Turning a ring on the outside of the lens (pushing a button on some cameras) changes the size of the *diaphragm*, a ring of overlapping metal leaves inside the lens. (In automatic operation, the camera can do this for you.) Like the iris of your eye, the diaphragm can get larger (open up) to let more light in; it can get smaller (stop down) to decrease the amount of light.



Light and the aperture. *The size of the lens opening—the aperture, or f-stop—controls the amount of light that passes through the lens. Each aperture is one "stop" from the next; that is, each lets in twice as much light as the next smaller opening, half as much light as the next larger opening. Notice that the lower the f-stop number, the wider the lens opening and the more light that is let in. For example, f/8 is a wider opening and lets in more light than f/11, which lets in more light than does f/16, and so on.*

Aperture settings appear on a camera's lens aperture ring (shown above), in the viewfinder (below left), or as data-panel readout (below right). Here, the camera is set to f/5.6.

Aperture settings (f-stops). Aperture settings, from larger lens openings to smaller ones, are f/1, f/1.4, f/2, f/2.8, f/4, f/5.6, f/8, f/11, f/16, f/22, and f/32. Settings beyond f/32 are usually found only on some view-camera lenses.

The lower the f-stop number, the wider the lens opening; each setting lets in twice as much light as the next f-stop number up the scale, half as much light as the next number down the scale. For example, f/11 lets in double the light of f/16, half as much as f/8. Larger openings have smaller numbers because the f/ number is a ratio: the lens focal length divided by the diameter of the lens opening.

Referring to a *stop* (without the "f") is a shorthand way of stating this half-or-double relationship. You can give one stop more (twice as much) exposure by setting the aperture to its next wider opening, one stop less (half as much) exposure by *stopping* (closing) down the aperture to its next smaller opening.

No lens has the entire range of f-stops; most have about seven. A 50mm lens may range from f/2 at its widest opening to f/16 at its smallest, a 200mm lens may range from f/4 to f/22. Most lenses can set intermediate f-stops partway between the whole stops, often in one-third-stop increments. The widest lens setting may be an intermediate stop, for example, f/1.8.

Depth of field and the aperture. The size of the aperture setting also affects how much of the image will be sharp. This is known as the depth of field. As the aperture opening gets smaller, the depth of field increases and more of the scene from near to far appears sharp in the photograph (see photos below and pages 42 and 45). See the depth of field project on page 159.

Small Aperture
More Depth of Field

Depth of field and the aperture. *The smaller the aperture opening, the greater the depth of field. At f/16 (left, top), with the hands and string in the foreground crisply in focus, the face in the background is also sharp. At a much larger aperture, f/1.4 (left, bottom), there is very little depth of field. The face in the background is completely out of focus.*

Large Aperture
Less Depth of Field