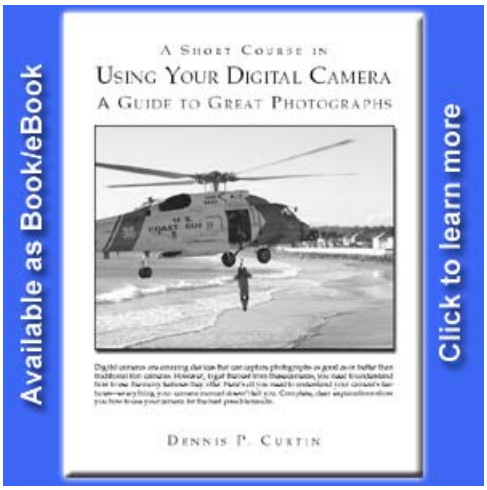
A Short Course in Using Your Digital Camera

5. Understanding Lenses



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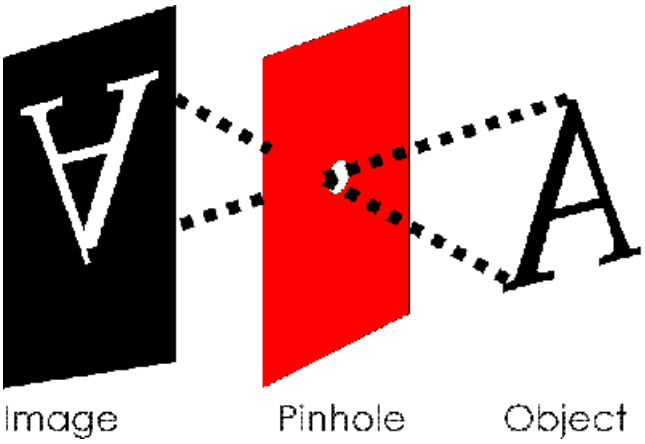
Many digital cameras come with zoom lenses so you can zoom in or out to meet different photographic opportunities. Zoom in on a subject and you can capture distant action at sporting events or in the field. Zoom out and you can capture a wide-angle view of a large group, a roomy interior, or of an expansive landscape. The ability to change your angle of view as you frame your image is one of your most powerful creative controls.

Modern camera lenses are designed on computers, ground to critical tolerances, coated with chemicals to improve light transmission, and then mounted in precision barrels and mounts. These lenses have excellent speed and sharpness, much more so than lenses of just a few years ago. The primary function of a lens is to gather light reflecting from a scene and focus that light as sharply as possible onto the image sensor in the camera. A high-quality lens does this very well, but to get the most out of what it has to offer you should know a few of its characteristics and how they affect your images.

Although your camera is equipped only with a zoom lens, in this chapter we look at the effects it has when used as a normal, wide-angle, and telephoto lens. This approach gives you the background you need to use the lens effectively and creatively.

How a Lens Works

Surprisingly, lenses are not actually needed to take a picture. You can make a camera out of a shoebox with a small hole in one end. Known as a pinhole camera, this primitive device can actually focus an image and record it on film. To make a photograph, the box is loaded in the dark with a light-sensitive film or paper and the pinhole is covered with opaque tape. Peeling the tape back (much like a shutter) to uncover the pinhole (much like a lens aperture) begins the exposure, recovering the pinhole ends it. The exposed film or paper can be removed in a darkroom and the image developed.



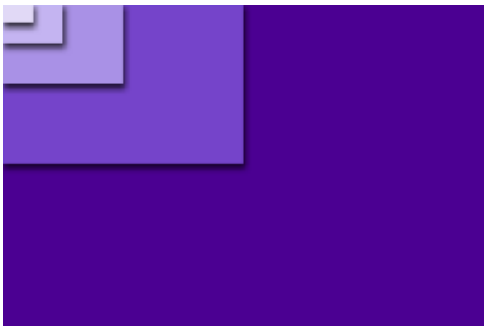
In a pinhole camera, the light waves from the object converge on the pinhole and focus the image upside down on the film.

Light is bent when it passes between substances having different densities. You can see this if you look at an object that is both in and out of water; for example a spoon in a glass half full of water looks bent at the point where it enters the water. Obviously, the spoon isn't bent; the light reflecting from the spoon is, as it passes from the dense water to the less dense air. The same effect occurs when light passes from the air through a piece of glass. If the glass is curved correctly, as it is in a camera lens, it can bend the light in such a way that an image of the scene in front of the lens is focused behind it.

Refraction bends light when it passes between substances of different densities.

The focal length of any lens is the distance between the optical center of the lens and the point at which it focuses an image. When you use a magnifying glass to focus the light from the sun onto a piece of paper, the area illuminated by the beam will become larger or smaller as you change the distance between the magnifying glass and paper. At the point where the bright circle of light is smallest (and where it might set the paper on fire), the simple lens that constitutes the magnifying glass is in focus. The distance between the magnifying glass and the paper is the lens' focal length.

Lens focal lengths are based on the physical characteristics of the lens so they are absolute values. However, a given focal length lens may be a wide angle lens on one camera and a telephoto lens on another. This is because descriptions such as "wide-angle" or "normal" depend on the size of the film or image sensor being used. As these get smaller, a given focal length lens magnifies more. There are currently a number of differently sized image sensors used in digital cameras. For that reason, different focal lengths are needed to give the same image coverage on different cameras. Because of the confusion this causes, most digital camera companies give the actual focal length of their lenses and then an equivalent focal length were the lenses to be adapted to a 35mm camera. For example, a camera may list its lens as 7.5mm (equivalent to 50mm on 35mm camera). Because digital equivalents vary widely, we often use the more familiar 35mm focal lengths in this book.



In the upper left corner are shown some image sensor sizes. The larger rectangle is the size of a frame of 35mm film.

Zoom Lenses

A zoom lens lets you choose any focal length within the range the lens is designed for. When you change focal lengths by zooming the lens, two important effects are immediately obvious in the lens' angle of view and its magnifying power.

Angle of view refers to how much of a scene the lens covers. Zoomed out, you have a wide-angle of view that captures a wide expanse of a scene. As you zoom in, the field of view narrows and you can isolate small portions of the scene without moving closer to the subject.

Magnification is related to the lens' angle of view. Since zooming out includes a wide sweep of the scene, all of the objects in the scene are reduced to fit into the image. Zooming in gives a much narrower angle of view, so objects in a scene appear larger.

Zoom lenses on digital cameras work much like those on camcorders. There are two buttons or a movable lever. Pressing one zooms in, increasing the focal length and narrowing the angle of view. Pressing the other zooms out, decreasing the focal length and widening the angle of view.

One of the best things about zoom lenses is the speed with which you can react to photo opportunities. Here, the key action in the scene on the left is lost in the large frame. By zooming in, this key action was isolated (right).

How To: Zooming the Lens

To use a zoom lens you press a lever or zoom-out button to widen the angle of view and a lever or zoom-in button to enlarge subjects. The viewfinder zooms along with the optical zoom lens although it doesn't always show the entire picture area.

Normal Zoom

A "normal lens" for a 35mm camera usually refers to a lens with a 50mm focal length. On a digital camera, an equivalent lens will have a much smaller focal length because image sensors are much smaller than 35 mm film. When you zoom your lens and look at the image on the LCD monitor, the scene looks about the same as it does to the unaided eye. Looking at the LCD monitor with the lens zoomed all the way out makes everything appear closer than it actually is. With it zoomed out to a wide-angle, everything looks farther away.

A normal-focal-length (50mm) lens isn't necessarily the one photographers normally to use. Many photographers prefer the wider angle of view and greater depth of field provided by a slightly shorter focal length.

Changing Apertures

A lens' maximum aperture is determined by dividing the actual diameter of the aperture opening into the focal length of the lens. That's why the aperture might change from f/2.6 when zoomed out to f/4 when zoomed all the way in on a subject.

See for Yourself

A lens is called normal because it captures a scene just as the human eye does. This seems to violate common sense, because the eye's angle of view is much wider than any normal lens. However, you can demonstrate for yourself why a specific focal length is normal for your camera. If you are a passenger in a car, try zooming the lens as you watch the traffic ahead on the LCD monitor. The longer focal lengths make distant cars appear right on top of you; in reaction you might even try to put on your brakes and then discover the cars are nowhere near as close as you thought. With shorter focal lengths, cars look far ahead, even when relatively close. A normal focal-length makes the cars appear in the same distance relationship as you perceive them ordinarily.

Another demonstration is to take two photographs of greatly different size and tape them to a wall. Look at them one at a time on the LCD monitor with the lens zoomed to a normal focal-length a little above it's widest angle of 28mm. Move close enough so each fills the LCD monitor. You'll discover you are at the correct distance for viewing the prints. With a longer focal-length you would feel too far away, and with a shorter one too close.

It's hard to look at a photo and tell what focal-length lens was used to take it. However, objects in an image taken with a normal lens look normal in their spatial relationships.

Wide-Angle Zoom

Zooming out gives you a wide-angle of view that lets you capture a wide expanse of a scene. This wide angle of view is ideal for use in tight spaces, such as when photographing landscapes and in small rooms where you can't position the camera a great distance from the subject.

If you don't get too close to your subjects, wide angle zoom is good for indoor portraits where including the setting is important.

A lens zoomed to a wide-angle also has great depth of field. This great depth of field makes short lenses good for street or action photographs. When out to capture quickly unfolding scenes, keep the lens zoomed out to a wide angle so you'll have maximum depth of field when you respond quickly to a photo opportunity.

Zooming out increases depth of field and widens the angle of coverage making it ideal for interior shots. The great depth of field also makes focusing less critical so you can capture those fleeting moments you might otherwise miss.

Short lenses also let you focus very close to your subject, and the effect this can have on the perspective in your images can be dramatic. Objects very close to the camera loom much larger than those farther in the background. This distortion in the apparent size of objects can deliberately give emphasis and when carried to an extreme, give an unrealistic appearance to a scene.

In addition to zooming your lens all of the way out for wide-angle coverage, some cameras have wide-angle lens adapters that widen it even more.

Shooting down on these two girls makes their heads look much larger than they really are since they are much closer to the camera and its wide-angle lens.

Telephoto Zoom

A lens zoomed in on a subject acts somewhat like a telescope: It magnifies the image of your subject. This is especially useful when you can't get close to your subject—or don't want to. Zooming in like this is ideal for wildlife, portrait, and candid photography, whenever getting close to a subject might disturb it.

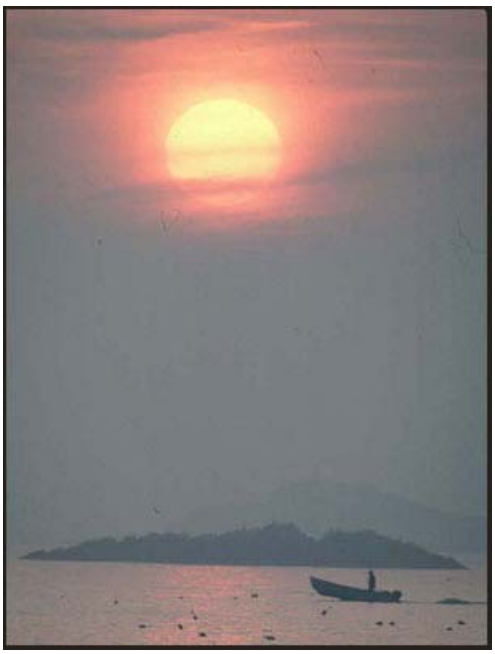
When you zoom in on a subject, depth of field gets shallower so you must focus carefully. Also, zooming in visually compresses space, making objects in the scene appear closer together than they actually are.

The primary drawback of zooming in is that it gives you a smaller maximum aperture. This smaller maximum aperture may require a longer shutter speed and since a long lens magnifies movement, just as it magnifies the subject, you may have to use a tripod instead of hand-holding the camera.

Zooming in makes distant objects appear compressed. Here a long lens has been used to "compress" a street scene at the foot of the Rocky Mountains in Colorado.

For a telephoto view, you can zoom the lens all the way in. For even more magnification, some cameras have optional lens converters that give you even longer focal lengths.

When the lineup of cement trucks (upper right) is shot head-on with a long lens (lower left) they appear much closer together then they really are. This is actually due to the distance from the subject, not the focal length of the lens, but the effect is easy to get with a long lens.



A long lens makes the sun look larger in relation to foreground objects.

Optical and Digital Zoom Lenses

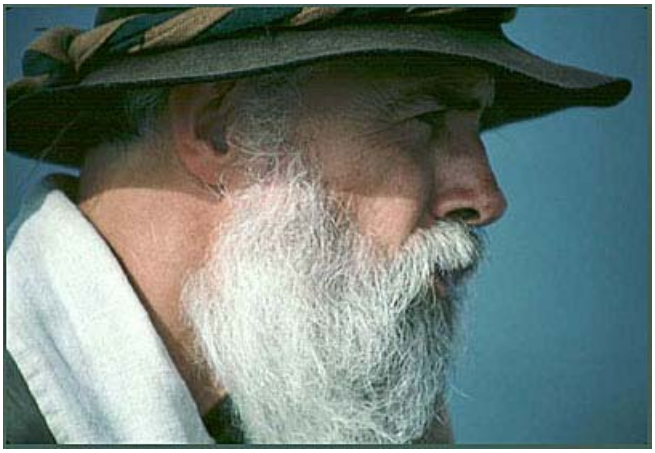
Zoom lenses come in two varieties; optical and digital zooms. An **optical zoom** lens actually changes the amount of the scene falling on the image sensor. Every pixel in the image contains unique data so the final photo is sharp and clear. A **digital zoom** lens uses sleight of hand by taking a part of the normal image falling on the sensor and then enlarging it to fill the sensor. It does this by adding new pixels to the image using interpolation. The interpolated image doesn't have as many unique pixels as one taken with an optical zoom so is inferior. In fact, you don't even need this zoom feature because you can get exactly the same effect just by cropping a normal image in a photo-editing program and then enlarging it.

How To: Using Digital Tele

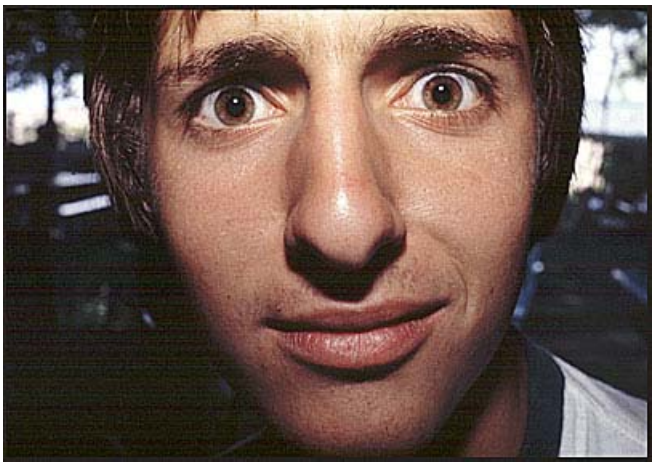
Look in your camera manual for a section on **digital tele** or **digital zoom**.

Portraits with a Zoom Lens

A zoom lens is an excellent portrait lens, especially for head-and-shoulders portraits. When zoomed in you can keep your distance and still fill the viewfinder frame with the subject. Keeping at a distance eliminates the exaggerated perspective caused by working very close to a subject with a shorter focal length lens. It also helps relax your subjects if they get uneasy, as many people do, when a camera comes close.



A long lens lets you get portraits without crowding in on the subject. This let's you capture more natural expressions.



Using a lens zoomed out to a wide angle and close to the subject adds some distortion to the portrait but it still works as an image. Perhaps not as flattering as it might be, the image is probably more interesting to others than to the subject.

Perspective: How a Photograph Shows Depth

A photograph can appear to compress space so that objects appear closer together than you expect. Another photograph of the same scene can seem to expand space so that objects appear farther apart than normal. These apparent distortions in perspective—the appearance of depth in a photograph—are often attributed to the focal length of the lens being used but are actually caused by the distance of the lens from the subject.

The image on the left appears to be more "open" and spacious than the more visually "compressed" one on the right. However, the image on the right is actually contained in the image on the left. It just appears more compressed because the enlarged section includes only those elements farthest from the camera.

Changing camera-to-subject distance does change perspective as shown here. As the camera is moved closer to the foreground subject (bottom), the subject appears to increase in size relative to the background. This changing relationship between the size of objects in the foreground and background creates the difference in perspective.

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