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Choosing Digital Camera Lenses

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Lenses may be the most critical component of the camera. The lens on a camera is a series of precision-shaped pieces of glass that, when placed together, can manipulate light and change the appearance of an image.

Some cameras have removable lenses (interchangeable lenses) while other cameras have permanent lenses (fixed lenses). Fixed-lens cameras are limited in their versatility, but are generally much less expensive than a camera body with several potentially expensive lenses. (The cost for interchangeable lenses can range from $1-200 for standard lenses to $10,000 or more for high quality, professional lenses.) In addition, fixed-lens cameras are typically smaller and easier to pack around on sightseeing or recreational trips. Those who wish to become involved in fine art, fashion, portrait, landscape, or wildlife photography, would be wise to become familiar with the various types of lenses serious photographers use.

The following discussion is mostly about interchangeable-lens cameras. However, understanding the concepts will help in understanding fixed-lens cameras as well.

Lens Terms

While the discussion on lenses can become quite technical there are some terms that need to be understood to grasp basic optical concepts—focal length and maximum aperture.

Focal Length

The focal length will determine the view angle of the picture, such as wide angle, normal angle and telescopic view.

Figures 1 & 2. *Figure 1 shows this camera at its minimum focal length of 4.7mm, while Figure 2 shows the110mm maximum focal length.*

Focal length refers to the distance from the optical center of the lens to the image sensor. Thus, a 21mm wide-angle lens will be tighter to the camera body than a 60mm normal-angle lens, which will be tighter to the camera body than a 300mm telephoto lens (see Figures 3 & 4). The numbers themselves

have nothing to do with the quality of the lens, only the use.

Maximum Aperture
Within the lens is a diaphragm that creates an adjustable opening (Figure 3). This opening in the diaphragm is called the aperture. For more information on how the aperture works see the USU Extension fact sheet titled, "Aperture and Digital Photography."

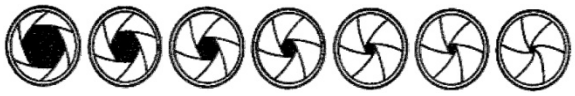

Figure3. This diagram shows the difference in sizes of the aperture settings.

The important thing to remember about aperture is that the smaller *f*-stop number means a larger aperture. A larger aperture lets in more light. Therefore, larger maximum aperture lenses, such as *f*/2.0, are better for low light situations than a smaller maximum aperture, such as *f*/4.0. This is especially true if there is any action in those shots.

Types of Lenses

All lenses fall into the categories of prime lenses or zoom lenses. Prime lenses have a fixed focal length while a zoom lens has an adjustable focal length.

Figure 4. *This photo shows different lenses. From left to right, 50mm prime lens (f/1.4-16), 50mm 2:1 macro lens (f/2.0-22), 8mm fisheye lens (f/3.5-22), 14-42mm zoom lens (maximum aperture f/3.5-5.6), and 50-200mm zoom lens (maximum aperture f/2.8-3.5).*

Prime Lenses
Prime lenses can range anywhere from macro, to wide angle, to telephoto. The point is the focal length will not change. The only way to get a closer or more distant shot of the subject is to change the lens or physically move the camera closer or farther away from the subject.

However, what is lost in versatility will generally be gained in overall quality. All else being equal, a prime lens will produce fewer distortions or aberrations than a zoom lens.

A prime lens will have two numbers to help determine its capabilities—the focal length (such as 50mm) and the aperture range (such as *f*/3.5 – *f*/17).

The types of prime lenses include fisheye, macro, extreme wide angle, wide angle, normal angle, medium telephoto, and telephoto. Figures 5 to 8 were all take from the same location and show the different perspectives offered by different focal lengths.

Figure 5. *Fisheye view. Note how the sides of the structure seem to bow. This lens provides almost an 180^{o} view.*

Figure 6*. 14mm extreme wide-angle view. The sides are straight but the view begins further away from the photographer.*

Figure 7*. 54mm normal-angle view. Not as much of the view inside the greenhouse can be seen.*

Figure 8. *200mm telephoto view This shot is clear through the end of the greenhouse door.*

Fisheye

Fisheye lenses are a special super wide angle lens that intentionally distorts the view. They are used to catch more of the peripheral view than can normally be seen by the human eye.

Macro

A macro lens is specialized to magnify close up shots beyond the normal close up lens. The focal length of a macro lens will typically be 50mm or less. But instead of providing a wide-angle view, the elements inside the lens are designed to magnify the subject with an aspect ratio of at least 1:1. Some may even have a ratio of 2:1, which would provide twice the magnification of a 1:1 ratio.

The macro mode on a digital camera allows a camera to shoot much closer to the subject. There are buttons or switches on a camera for pre-programmed settings that usually are best for close-up photography. A flower is usually the macro symbol (Figure 9) and a mountain indicates settings for infinity or long-range shots.

Figure 9. *The macro mode setting that allows the camera to produce close-up shots.*

While many zoom lenses tout macro capabilities, most of them don't have a higher ratio than 1:2. So in reality, they are merely a close-up lens, not a macro lens.

A close-up lens can be modified with an extension tube or magnification filters. These modifications will help a normal lens behave more like a macro lens.

Extreme wide angle

A lens with a focal length of less than 21 mm is an extreme wide angle lens and is frequently used for architecture photos.

Wide angle

A lens with a focal length between 21mm – 35mm is considered a wide-angle lens. It is best used for broad, landscape type pictures.

Normal angle

The normal angle range lens will have a focal length between 35mm – 70mm. It most closely approximates the view angle of the human eye. This range is good for general, everyday type use.

Medium telephoto

A medium range telephoto lens will be between 70 – 135 mm. This range allows the photographer to get tight pictures on the subject without getting too close with the camera—great for portrait photography. It allows the subject to be a little more comfortable in the photo shoot.

Telephoto

A telephoto lens from 135 – 300 mm is good for wildlife and sports shooting. The photographer can stand back and allow the natural action to take place.

Zoom Lenses

In the case of a zoom lens there will be two numbers reflecting the minimum and maximum distance between the lens and the image sensor. For example a 35-70mm lens will range from 35 to 70 millimeters from the image sensor.

In addition, on most zoom lenses the maximum aperture will decrease as the lens zooms in on a subject. Thus the maximum aperture may actually be a range, such as *f*/2.8 – *f*/3.5, depending on the zoom position of the lens.

The zoom feature of fixed-lens cameras allows the photographer to zoom in (or magnify) a distant object. It also allows one to zoom out (or widen) for a broad landscape view. Thus, the camera can be adjusted from a telephoto (magnified) view to a wide-angle view.

Fixed-lens cameras typically have two types of zoom, optical zoom and digital zoom. Optical zoom is the physical extension of the lens that brings the object in "closer." Digital zoom is when the camera "crops" the photo beyond physical capabilities of the lens. With the digital zoom the picture would become pixilated if the camera didn't interpolate (guess) what the picture should look like. Digital zoom does not yield high quality results but may be adequate when it is otherwise impossible to get closer to the subject.

For beginning photographers a good quality, middle range zoom lens should be adequate. Once a photographer discovers the type of photos he or she enjoys taking, then more specialized lenses can be purchased.

Summary

Digital cameras may have fixed lenses or interchangeable lenses. Lenses may also be prime or zoom lenses. Prime lenses have a fixed focal length while zoom lenses have an adjustable focal length.

The focal length and the maximum aperture help determine the capabilities of a lens, but are not necessarily indicators of lens quality. The focal length helps determine a lens's view angle while the maximum aperture indicates the amount of light that is allowed back to the image sensor.

References

Busch, D.D. 2008. *Mastering Digital SLR Photography*, Thomson Course Technology Boston, MA.

Understanding Lenses. Cambridge in Colour. http://www.cambridgeincolour.com/tutorials/camera-lenses.htm

Peterson, B. 2004. Understanding Exposure Revised Edition. Amphoto Books. New York, NY.

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