Introduction to DSLR Photography

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The technical, left-side-of-the-brain stuff

Shutter speed
Apertures
Exposure
Bracketing

Depth of field
ISO and Noise
Focal length
Lenses

Most of the topics discussed here mainly apply to digital single-lens reflex (DSLR) cameras that offer a wide range of creative settings. Settings on some point-and-shoot digital cameras also can be adjusted. The concepts of shutter speed, apertures and depth of field apply to all cameras, but it may not be possible to make adjustments on some cameras, as the camera's computer chips and sensors manage these settings "internally."

Note #1: The diagrams on pages 2 and 5 were shamelessly "borrowed" from the Internet. The remainder of the words and charts are my own creation.

Note #2. I hurriedly updated this handout for digital photography and may have missed a few things from the older "film" version. Please send me an email if you see something out of place: clives@shaw.ca

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Shutter Speed

The shutter speed is the length of time the shutter is open. A camera's shutter performs the same function as a shutter in front of a window—it keeps the light out. When the shutter is opened, light enters and is recorded as "computer language" on the sensor and immediately "written" to the memory card. (It's more complex than this and I don't understand it all. The captured data are changed by the camera's software if shooting in jpeg. Other changes may be made of shooting in certain modes.)

The longer the shutter is open the more light enters. On some cameras, shutter speeds range from 1/8000th to 30 seconds. Normal working ranges for outdoor photography range from about 1/30th to 1/500th of a second—depending. Many cameras also have a B" setting, which allows the shutter to be opened indefinitely. When set at "B," the shutter remains open as long as the shutter button is pressed.

Fast shutter speeds are used to "stop" motion and can be used to reduce the amount of "blur" resulting from camera shake. Sometimes slow shutter speeds are desirable to create a "special" effect. Slow shutter speeds may be required in low light conditions. (At slow shutter speeds a tripod–or other stabilizing technique–is needed to prevent unwanted blur.)

Digital cameras typically have information/function screens that show shutter speeds as fraction, such as 1/60 second. However, inside a DSL's viewer, the shutter speeds are displayed as:

1000…500…250…125…60…30…15…8…4…2...1

These represent 1/1000th … 1/500th … 1/250th second down to ½ and 1 second. Most (all) DSLR cameras allow speeds to be set at half of third intervals in between these common designations. For example: 1/125…***1/200***…1/250.

Typical Shutter Speed Uses	
Speeds (fractions of seconds)	***Use ranges***
> 1 sec, 1/2 to 1/15	For use in low-light conditions such as close-up photography in dark areas, like a forest. Also for night photography, fireworks and streets scenes. A tripod must be used.
1/30	Possible to shoot without a tripod with some lenses.
1/60 to 1/125	Common shutter speeds for outdoor photography under cloudy to sunny skies. These moderate speeds, combined with a small aperture (*f*8 to *f*16), result in large depths of field on sunny days.
1/250	Also common in outdoor photography. A person walking fast or jogging will be essentially stopped at this speed. This is about the lowest speed for hand holding a moderate telephoto lens—from 200 to 300-mm focal length. (See note.)
1/500	This shutter speed will freeze a car or runner. This is the minimum shutter speed for hand holding a 400 or 500-mm telephoto lens. This is borderline speed for (say) flying birds.
1/1000 +	This speed will freeze a racing car, however, because of speed the photographer will have to "pan" the racing object and a tripod is not possible. Wing tips of flying birds start to become crisp at this speed, but 1/2,000 is better yet.

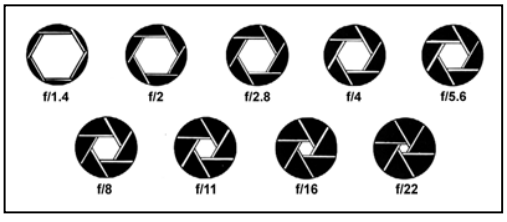
Note: For sharp pictures a tripod is highly recommended for telephoto lenses. Internal anti-shake systems and vibration reduction lenses allow us to shoot at slower speeds and still maintain sharpness. I use a monopod or tripod for the vast majority of telephoto shots—other than flying birds.

Each change from one speed to the next results in a doubling or halving of the amount of light passing through the shutter and hitting the sensor. For example, a shutter speed of 1/60th second allows in twice as much light to pass as 1/125th second. Or conversely, 1/60th second allows half as much light to pass as 1/30th second. Shutter speeds are intimately connected to aperture size. To obtain proper exposures, as shutter speed is changed, the aperture must also be changed to compensate for the amount of light hitting the sensor. (See below.)

Photographers often need to change shutter speeds (say, to stop motion), and therefore the aperture must also be adjusted in order to get the correct exposure. One cannot be changed without changing the other—unless ISO is also changed. (On older cameras shutter speeds and apertures [***f***-stops] were adjusted manually. On newer cameras you can change either speed or aperture to suit the needs of the picture and the camera automatically adjusts the other setting.)

Aperture or f-stop number

The aperture is a "donut hole" in a mechanical structure in the camera lens or camera body that regulates the amount of light which passes to the sensor—at any given shutter speed. A large hole (low *f*-stop number) lets in more light than a small hole (high *f*-stop number).



Technically, the *f* number (*f*-stop) is the ratio between the diameter of the aperture and the focal length of the lens. All this really means is that for any given f-stop, the actual diameter of the aperture (in

millimetres) is larger for a telephoto lens than for a wide angle or "normal" lens. This presents some engineering issues, and "fast" [wide aperture] telephoto lenses get incredibly expensive. *This already is "too much information"—my eyes are glazing over—and we won't worry about the "lens physics" details here.* ☺

The standard *f*-stop numbers are:

1.4 … 2 … 2.8 … 4 … 5.6 … 8 … 11 … 16 … 22

Some expensive lenses will show more numbers at one or both ends of the scale. The largest theoretical aperture is *f*1, although I am not sure if such a lens is physically possible to build. Some large-format cameras have pinhole apertures at *f*45.

Changing the f-stop by one setting either doubles or halves the amount of light striking the sensor. (This is a key concept to grasp and also true of shutter speeds.) An aperture setting of *f*11 lets in one half as much light as *f*8. The setting of *f*5.6 lets in twice as much light as *f*8.

Exposure reciprocity *— this is a simple concept with a scary name* ☺

This technical term simply means: ***for any given light condition, a wide range of shutter speeds and aperture openings (f-stops) will result in correct exposure***. If your camera's meter reading indicated that f 5.6 and 1/60th second was the correct exposure, all of the combinations below would give the same exposure if the light was always the same:

f	*f/22*	*f/16*	*f/11*	*f/8*	*f/5.6*	*f/4*	*f/2.8*	*f/2.0*
Speed	**1/4**	**1/8**	**1/15**	**1/30**	**1/60**	**1/125**	**1/250**	**1/500**

From this chart, you can see why "fast" lenses (with large apertures) are desirable for wildlife and sports photography. Be aware, that this is only one example of exposures. Naturally, other light levels would mean that at (say) f5.6 the shutter speed could be 1/20 second or 1/500 second — almost an infinite range.

So what?

Why should a photographer care about changing shutter speeds and messing with apertures? Simply, because some photo opportunities may require fast or slow shutter speeds. And some may require wide or narrow apertures. Briefly, shutter speeds must be at minimum levels to avoid camera shake or "stop" action—unless you specifically wanted blur. Wide apertures reduce depth of field and small apertures widen depth of field. On cameras that will allow these changes, like DSLRs, this interchange of shutter speeds and aperture sizes is useful for improving picture quality and image impact.

Exposure compensation

The high-quality light meters in today's digital cameras are excellent and you may never need to tell your camera to overexpose or underexpose a scene. But they can be fooled. Most subjects have a "normal tonality"— somewhere between black and white—and reflect an average of about 18 percent of the light hitting them. (Camera light meters read reflected light.) This is fine for the vast majority of subjects we photograph as most things we photograph have "average brightness."

As good as these light meters are they cannot know everything. The meters are programmed to assume that we photograph objects of "normal tonality" — you, me, the kids in the back yard. The meter tries to force the camera to make the image "normal." And here's where it gets tricky. If you take a picture of a gray object of average reflectance, the camera does it right and tries to

make the picture "normal tone." But if you photograph a white sheet of paper, guess what happens? It assumes the object has average reflectance and tries to make it "normal tone" and the white paper turns out dark. Conversely, if you take a picture of a black object the camera again assumes it is "normal tone" and over exposes it–makes it too light. The image is washed out or over exposed.

Fortunately many cameras (not all point and shoot cameras) allow you to over or under expose the picture from the reading selected by the camera's meter. Also fortunately, with digital cameras we get instance feedback and can compensate immediately.

Here are some general guidelines to adjust exposures. (Refer to you camera's instruction manual about adjusting exposures.)

Subject	***Exposure compensation***
White sand or snow ***See note***	+2 *f*-stops. *If your camera has manual settings, the shutter speed can be slowed down two units. (Say, from 1/250 to 1/60) Or, the aperture opened two units. (Say, from f11 to f5.6)*
Other bright objects like yellow fall leaves	+½ to +1½
People, foliage, grass, most scenes, your chesterfield	No compensation
Dark tree foliage such as evergreens	- 1
Black bear, black lab or black Angus face	- 1½ to -2

Note*: This can be confusing. Overexposure is needed when the main area to be photographed is sand, snow or other white subjects. But, if your subject (say a person) is standing on snow in bright sunshine, and if you are taking a picture of the person's head and body, and there is little or no snow in the actual picture, then you may, in fact, have to underexpose the image. Here's why. In addition to the normal bright sunshine the subject is receiving extra light reflected from the snow–and the camera's metering system may not compensate enough. When in doubt, bracket. See below.*

Bracketing

For most photographs, you can rely on your camera's exposure system. However, there are times when you may not be certain such as in bright, back-lighted sunshine. Sometimes these pictures are critical and perhaps you will never have the same opportunity again.

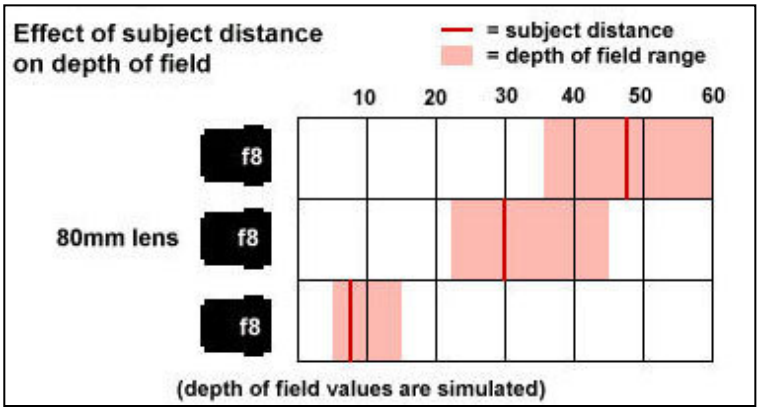
When you are not confident in the camera's settings, then you may want to "bracket," that is, take several pictures at different exposures. In difficult circumstances, bracketing is a good way to help ensure a good exposure. Usually bracketed exposures of one or two stops above and below the metered exposure are sufficient. (This means adjusting the shutter speed one faster or one slower, OR changing the aperture by one *f*-stop wider and one narrower than the meter suggestion.)

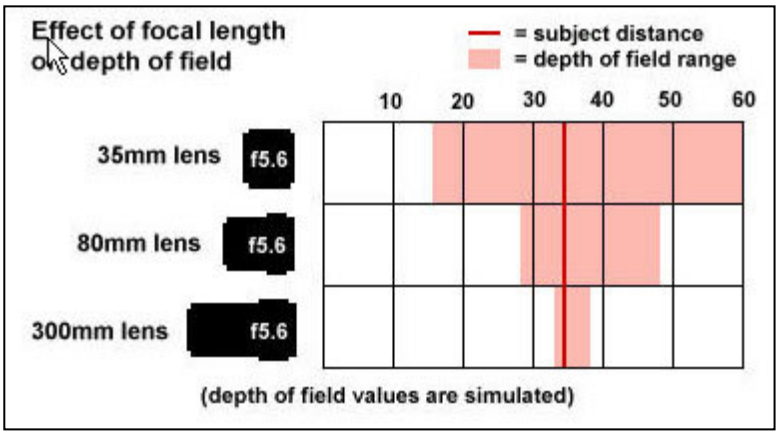
Depth of Field

The depth of field is the range in front and behind (of where the lens is focused) that ***is also in focus***. The range of depth of field (DOF) varies with focal length, aperture size and distance from the camera to the focus point. See diagrams.

Sometimes it is desirable to limit the DOF and a wide aperture (low *f*-stop number) is used. (And shutter speed is therefore increased.) However, some subjects require a deep DOF and the

aperture must be narrowed (to say, *f*16). The shutter speed may then become too slow and a tripod must be used. (Wind can affect depth of field. If photographing a field of wild flowers it may be desirable to select a smaller aperture such as *f*16. However the resulting shutter speed may be 1/60th second or slower. The DOF is therefore compromised—or you can select a higher ISO. If the flowers are waving in the wind they will not be sharp when photographed at this speed.





Sensitivity (ISO) and "Noise"

ISO is a measure of the sensor's sensitivity to light. A high ISO reacts to light in less time than a lower ISO. DSLRs typically have ISO settings that range form 100 to 6400. Like shutter speeds and apertures, the difference between two adjacent ISO numbers is equivalent of one stop. An ISO 100 setting requires twice the exposure as an ISO of 200 —meaning the shutter speed has to be half as fast, or the aperture opened one f-stop, say, from *f*8 to *f*5.6.

The extra speed of high ISOs has a cost. High ISOs result in "noisier" images.

Choose an ISO suited to your camera equipment (lens speed, for example) and the conditions in which you will be taking pictures. Some people (me included) often think of high ISOs as being inferior, but consider this…

It is better to have a sharp, but "noisy" picture than a blurry picture resulting from a shutter speed that is too slow for the light conditions.

Focal length

Focal length is the distance from the center of the lens to the sensor. Usually telephoto lenses (which have long focal lengths) are longer in length. Wide-angle lenses have short focal lengths and are short and stubby. A longer focal length results in a narrow subject area being projected onto the sensor. Therefore, long focal lengths result in larger or magnified subjects.

On a DSLR camera, a lens with a focal length of 35 mm approximates what we see with our eyes. Wide-angle lenses, with short focal lengths, "see" a wider angle than the human eye.

Lenses can be changed on DSLR cameras. Point and shoot cameras have built-in lenses that cannot be changed. Zoom lenses provide a range of focal lengths or magnifications and valuable tools for all photographers. The lens can be adjusted or "zoomed" from one focal length to another—great for picture composition.

See "lens use" chart on the next page.

Please send me an email of you find "errors" in this updated version.

Thanks.

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Lenses		
Type of lens	***Common focal lengths for 35 mm cameras.****	***Comments***
Normal	45 to 55 mm	• "See" close to normal human vision. • Single focal length restricts use for general photography. • Usually "fast," with apertures of *f*2.8, *f*2 and *f*1.8 • Large apertures (compared to tele lenses) allow hand holding in low light because of faster shutter speeds
Wide-angle	28 and 35 mm (Much wider lenses are available.)	• Helpful for taking pictures in places where space is limited such as the front room, a confined space such as a laboratory or holiday trailer. • Great for panoramas and special effects such as photographing a field of wildflowers with mountains in the background.
Telephoto lenses		• Telephoto lenses typically range from 75 mm to 600, however most amateur photographers are well served with lenses to 300 mm. • Moderate telephotos (75 mm to 105 mm) are great for making head-and-shoulder portraits of people. • Longer lenses to 300, 400 or 500 mm are required for many types of wildlife photography. • Longer lenses are great for taking pictures of kids "in the back yard" because you can stay well back and not intrude on their activities. • "Fast" telephotos are very expensive and photographers compromise by getting *f*4 or *f*5.6 lenses and they use higher ISOs such as 400 or 800 • Tripods are a necessity for serious telephoto users.
Zoom lenses	Varies. Some typical zoom ranges include: 28 to 85 mm 24 to 135 mm 18 to 200 mm 28 to 200 mm 100 to 300 mm 75 to 300 mm 28 to 300 mm	• General comments about wide-angle and telephoto lenses apply to zoom lenses with similar focal lengths. • Zoom lenses are a boon to amateur photographers and for this reason must be considered when buying a new camera. • The biggest benefits are in picture composition and versatility. From one position you can take different perspectives of the same subject. • Most DSLR camera packages include a camera body and one lens. Most manufacturers/dealers today include a zoom lens as the "standard" lens. They typically have focal length ranges from about 28 to 85 mm or 18 to 200 mm or so. • Two zoom lenses will provide enough focal-length range for most amateur photographers. For example, 18 to 135 mm and 100 to 300-mm lenses will cover virtually any picture need for most people. • Manufacturers now make "all in one" zoom lenses that have a wide range of focal lengths, from 18 to 300 mm, for example.
** This is the focal length (equivalent) for a 35-mm film camera. DSLRs (except full-frame DSLRs) have sensors smaller than a 35-mm film. Typically, the focal length of a DSLR lens is about 1.5 X that of the lens on a 35-mm film camera. So a 50-mm lens on a 35-mm film camera is about 75 mm on a DSLR with an APS-sized sensor. Got that?*		

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… and again in January 2009
☺ *Clive*