Aperture, Shutter Speed, ISO, and Depth of Field

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Aperture and shutter speed Aperture, also called f-stop, is a measure of the size of the opening in the lens that allows light to pass through to the sensor. The lower the number, the wider the opening. It is important to be able to control the aperture setting because it affects the shutter speed necessary for a good exposure and the depth of field. In general, the wider the aperture, the faster the shutter speed and the lower the depth of field.

Apertures are described in terms of "stops". Many zoom lenses today can open up to about f4; the next full stop is f5.6, then f8, f11, f16, f22 –in between these full stops are a myriad of intermediate stops. Some lenses can open up as far as 2.8, 1.8, or even 1.2. Lenses with a low number are called "bright lenses" or "fast lenses" because they allow more light to pass through and so have more potential to shoot at faster shutter speeds. Fast lenses are typically larger, weigh more, and cost a lot more than slower lenses.

Aperture and shutter speed have an exponential relationship to each other. For each "stop" increase, say from f5.6 to f8, there is an approximate halving of the necessary shutter speed. For example, if a good exposure at f5.6 requires 1/60th of a second, the same exposure at f8 would require 1/30th, and the same exposure at f11 would require 1/15th of a second.

Lenses usually produce the sharpest results when photos are shot about 3 stops down from their maximum aperture. This sharpness results because the light passes through the sharpest part of the lens. Stopping the lens down further, however, forces the light rays to bend and so decreases overall sharpness –although it increases depth of field.

ISO ISO describes the sensitivity of the sensor to light: a higher ISO is more sensitive, which allows a faster shutter speed or smaller aperture (higher f-stop). ISO ratings also bear a mathematical relation to aperture and shutter speed, as a 2x increase in ISO allows a 2x increase in shutter speed or a one-stop increase in f-stop. For example, at ISO 100, the correct exposure for a given photo might be 1/60th of a second at f8; at ISO 200, the correct exposure could be 1/125 of a second at f8 or 1/60th of a second at f11; at ISO 400, the correct exposure could be 1/250th of a second at f8, 1/125th at f11, or 1/60th at f16.

Clearly a higher ISO offers advantages as far as shutter speed and aperture. The drawback, however, is that the overall image quality degrades with higher ISO. For most purposes, however, the image degradation is relatively minimal until the very high ISOs, such as ISO 800 or 1600. And it's better to have too high an ISO than a blurry image because the shutter speed was too slow! In general, shutter speeds should be at least the inverse of the focal length on the lens. For example, an image shot at 60 mm should be at 1/60th of a second.

Depth of Field.

Depth of field decribes how much of the image is in focus. A photo in which features are in focus from say 5 feet to 50 feet has a greater depth of field than one in which features are in focus from 20 to 50 feet. In general, the smaller the aperture (greater the f-stop) and smaller the focal length on the lens (eg., 28 mm as opposed to 50 mm), the greater the depth of field.

Depth of field is one reason why photographers often use tripods. A tripod allows a slow shutter speed, which allows a small aperture (high f-stop), which allows a large depth of field. A large depth of field can be useful for landscape images, where a sharp foreground leads the viewer's eye into the background. However, keep in mind that most good photos have strong subjects—and a large depth of field can cause the image to look cluttered. A small depth of field, however, can help the subject stand out because all the extraneous material goes out-of-focus.