Shutter/Aperture Tradeoff
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Shutters and Apertures are two of the most important compositional and exposure tools on the camera. And the relationship between them is crucial to taking control of your camera and designing the images you want to create. *The examples and techniques below will work when you manage your shutter, aperture, and sensitivity (ISO) manually.*

First, let's understand how each works.

Shutter

The shutter is the timing device that controls how long the "window" opens and enables light to pour through the lens onto your focal plane. It determines how long your exposure is.

Standard shutter speeds are designed so that each one is about half or twice as long as the next one, enabling you to double or halve the amount of light with each standard change. Thus, changing the shutter speed one standard setting changes the exposure one stop.

The standard shutter speeds are:

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000

In seconds.

If you move left along this chart, you double the amount of light you let through the shutter with each change. Moving from 1/60 of a second to 1/15 of a second gives you 4 times as much light.

If you move right along this chart, you cut the light by half with each change. Moving from 1/60 of a second to 1/500 of a second gives you 1/8 as much light.

On your camera, the manufacturer is likely to only show the denominator of the fraction. On most cameras, shutter speeds longer than 1 second will be shown with double ticks behind the number like this: 4"

Most of the cameras we use can be set to change either ½ stop or 1/3 stop for every "click" as you turn the control dial. Setting at ½ stop is certainly easier as you are learning. Setting at 1/3 stop gives you finer control over the exposure.

As you move to faster exposures (toward the right end of the scale) (larger denominators) you are better able to stop action. This is great when you are working with motion. It is also very important when working with longer telephoto lenses where the slightest "wiggle" can introduce blur.

As you move to slower exposures (toward the left end of the scale) (smaller denominators and longer than 1 second) you are better able to blur motion. This is important in creating those silky moving water shots and other similar effects.

Aperture

The aperture is the size of opening that the light pours through when it passes through the lens to the focal plane. By enlarging or shrinking this opening, one can influence how much light reaches the focal plane. The aperture is also the key to managing depth of field (or depth of focus).

Apertures are expressed as f-stops. This is a system developed by someone more interested in physics than photography and is based on the relationship of the diameter of the opening to the focal length of the lens. For us, it boils down to a system of numbers we have to learn, but there isn't a great deal of importance for photographers in understanding how each number is figured out.

The standard f-stops are:

f/32	f/22	f/16	f/11	f/8	f/5.6	f/4	f/2.8	f/2	f/1.4

If you move right along this chart, you double the amount of light you let through the aperture with each change. Moving from f/11 to f/8 doubles the amount of light let through the aperture.

If you move left along this chart, you cut the amount of light by half with each change. Moving from f/11 to f/22 yields ¼ as much light passing through the lens.

The aperture controls depth of field. Depth of field is used to describe the distance between the nearest point of sharp focus and the furthest point of sharp focus.

The smaller your aperture (larger f/number) the more depth of field you create. This is helpful when you want something near and far in focus, like a foreground flower and a distant mountain.

The larger your aperture (smaller f/number) the less depth of field you create. This is helpful when you want to blur out unwanted detail around a subject to isolate it from a confusing foreground or background.

The Tradeoff

When you play the shutter speeds and aperture against each other, you can accomplish a lot.

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000
			f/32	f/22	f/16	f/11	f/8	f/5.6	f/4	f/2.8	f/2	f/1.4

Let's say you have a good looking exposure at 1/125 second at f/8. But, that exposure didn't stop the action of a flying bird. You can move to 1/500 of a second at f/4 and have the same amount of light for your exposure, but better ability to stop action.

How did we figure this out? We let in ¼ as much light with the shutter (two stops less) and 4 times as much light as the aperture (two stops more) and ended up with the same amount of light. But, we accomplished our critical goal of reaching the shutter speed we needed.

You can use this tool over and over to get to where you need to be!

For each of the next three examples, we'll assume that the same 1/125 at f/8 was determined to be an acceptable exposure in terms of amount of light.

If you wanted to blur the action, you could slide left along the table until you run out of apertures. Most lenses will let you stop down to f/22 or f/32. That will enable you to slow the shutter to 1/8 or 1/15 of a second.

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000
			f/32	f/22	f/16	f/11	f/8	f/5.6	f/4	f/2.8	f/2	f/1.4

If you want to maximize depth of field (have more distance between your nearest and furthest sharp points of focus) you should also slide to the left on this table. The smaller the aperture (larger the f/number) the more depth of field you create.

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000
			f/32	f/22	f/16	f/11	f/8	f/5.6	f/4	f/2.8	f/2	f/1.4

Sometimes you want to minimize depth of field. You want one sharp point of focus and almost everything else out of focus. This is great for isolating a subject, especially when the background is busy. In this case, you can slide right on the table until you have reached your largest available aperture.

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000
			f/32	f/22	f/16	f/11	f/8	f/5.6	f/4	f/2.8	f/2	f/1.4

Each time we made these moves, we did not impact the brightness of the resulting exposure. We let in an identical amount of light. We did however, control the camera to meet the goals of our composition.

You won't always find that your base exposure starts around 1/125 at f/8.

In bright light, you might find that your starting exposure is more like 1/125 at f/16, resulting in a starting table like this:

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		
					f/32	f/22	f/16	f/11	f/8	f/5.6	f/4	f/2.8	f/2	f/1.4

This obviously makes it easier to stop action and have more depth of field. It also makes it harder to blur waterfalls or minimize your depth of field.

In dim light, you might find that your starting exposure is more like 1/125 @ f/2.8, resulting in a table like this:

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000
f/32	f/22	f/16	f/11	f/8	f/5.6	f/4	f/2.8	f/2	f/1.4			

In dim light, it's harder to stop action or to achieve a great deal of depth of field off a tripod. However, it's very easy to blur action or achieve minimum depth of field.

If you can master these moves, you are really setting yourself up to be in charge of the images you take. If, however, you let the camera decide what exposures to make, you give up the ability to use these valuable tools.

Remember that some shutter speeds may require you to use a tripod, image stabilization or some other method of keeping the camera from moving during the exposure.

Sensitivity

In the digital environment, we get a new tool to use in this tradeoff game: Sensitivity.

In film, we were stuck with the speed of the film we had loaded in the camera. We either had to change film or live with the ISO of the film we had in the camera.

In a digital environment, we have the option of changing the ISO (sensitivity) for each and every exposure, if we want.

There are some cautions. In film, the images got grainier as ISO increased. Similarly, in a digital environment there is a phenomenon called noise (which is really random electronic signals) that amazingly look similar to grain and also increase as ISO increases.

There has been great progress recently. New software noise filters are getting better and better at noise reduction. And new technology in camera and image design are reducing the amount of noise produced.

Also, as ISO increases the dynamic range of the capture decreases. This means that your images look (and indeed are) more contrasty as you raise your ISO!

We recommend using the lowest ISO for most situations.

Sensitivity (ISO) works in stops, like shutters and apertures.

50	100	200	400	800	1600	3200

Moving right on this scale increases the sensitivity 1 stop (double) for each step moved. Moving left on this scale decreases the sensitivity 1 stop (half) for each step moved.

How do you apply sensitivity to the Tradeoff?

First, we leave our sensitivity at our lowest (or “native”) setting unless we need to move it elsewhere.

Sometimes, especially when light is low, the tradeoff isn’t enough to accomplish what you want. Let’s say your base exposure at ISO 100 was 1/60 at f/4 and that f/4 was as low as your lens would go.

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000	ISO
f/32	f/22	f/16	f/11	f/8	f/5.6	f/4							100

But, your subject was monkeys and your lens was long (which might introduce camera motion blur). You are in a pickle to stop the action. By changing your ISO to 800, you change the base exposure by three stops to 1/500 at f/4 which gets you in the ballpark.

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000	ISO
		f/32	f/22	F16	f/11	f/8	f/5.6	f/4					400

In essence, the sensitivity (ISO) move enables you to change the base exposure and essentially slide the shutter and aperture scales alongside each other. It can open up opportunities that simply aren’t available otherwise.

Here is a template and some blanks for you to practice with – or carry into the field to help work out exposures.

1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		
					f/32	f/22	f/16	f/11	f/8	f/5.6	f/4	f/2.8	f/2	f/1.4

Insert your successful trial exposure and then work out your solution!

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		

		1	1/2	1/4	1/8	1/15	1/30	1/60	1/125	1/250	1/500	1/1000	1/2000	1/4000		