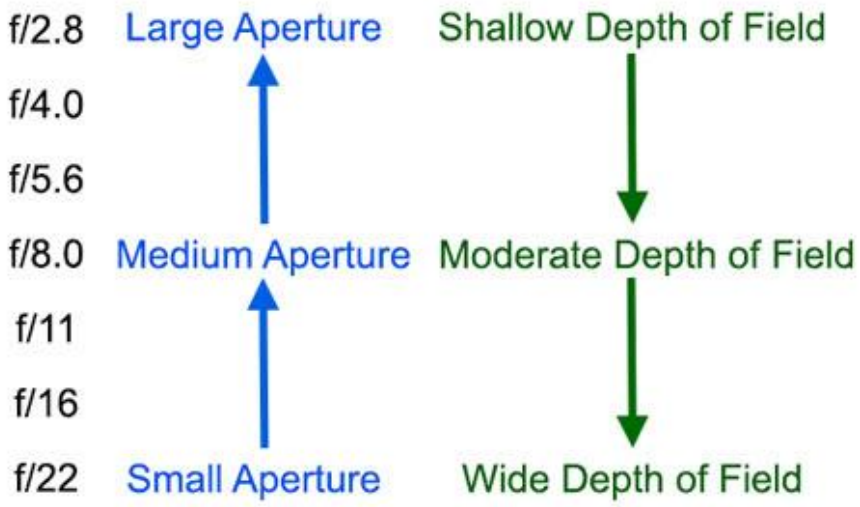
Day 5: Master Depth of Field (the Aperture)

- **Measurement:** The aperture is the size of the opening in the lens that allows light into the camera. The measurement is actually a ratio of the focal length to the diameter of the lens opening. The measurement is always an f/number like numbers below.
- **Range:** The range of aperture openings varies from lens to lens. Lenses with extremely wide apertures are referred to as "fast" and they cost a lot of money. A pretty typical range of values is between f/4.0 and f/22, which is a range of 5 stops of light.
- **Trade-Off:** Using a large aperture lets a lot of light into the camera, but it results in something called a shallow depth of field. This is where, while your focus point is sharp, things in your picture get blurry pretty fast as they move away from that point. On the other hand, a smaller aperture gets you a deep depth of field so everything is sharp, but it greatly restricts the amount of light allowed into the camera.

f/2.8	f/4.0	f/5.6	f/8.0	f/11	f/16	f/22

The aperture numbers are confusing. Moving up and down a stop of light (which you will recall is a doubling of light) does not double or halve the numbers. You are better off just memorizing these numbers, but remember that your camera will probably change in 1/3 stop increments.

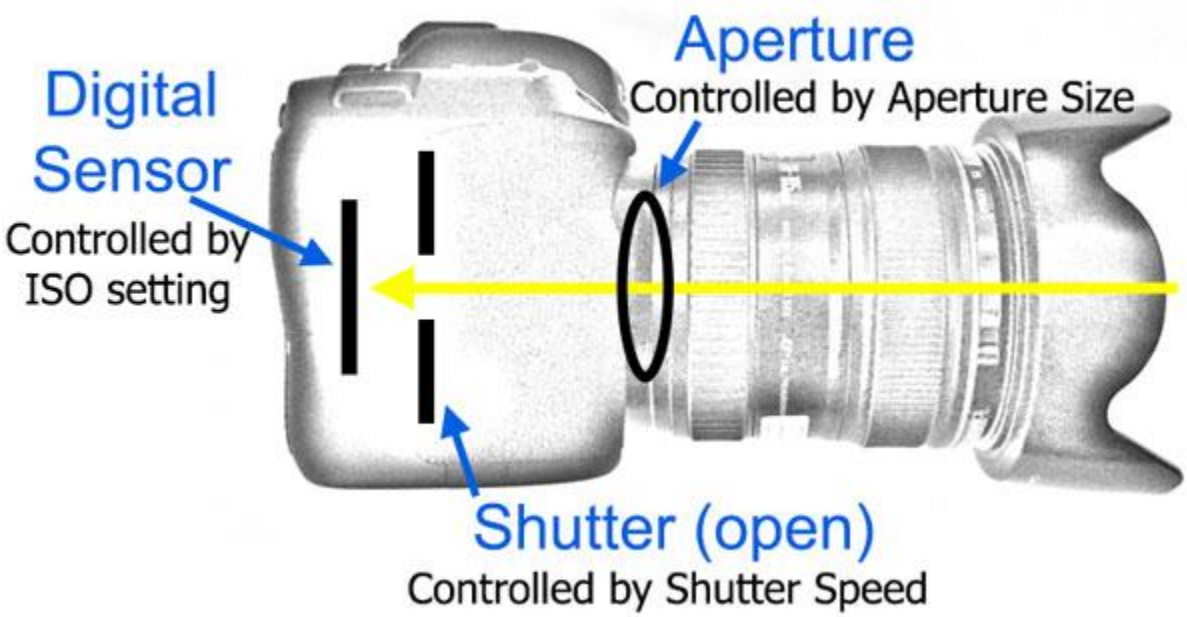


Practical application:

- Portraits: use a large aperture (small f/number), which gets you a shallow depth of field.
- Landscapes: use a small aperture (large f/number), which gets you a deep depth of field.
- When you don't care - "f/8 and forget it!"

Additional Commentary

In today's lesson, we are going to learn how the aperture works and the effects it has on your photography. Recall that this is the second of our three exposure controls:



As you saw when we talked about ISO, these exposure controls tend to involve trade-offs. With ISO you had a trade-off between a higher exposure value (caused by the greater sensitivity of the digital sensor to light) and the creation of digital noise in your picture. With the aperture, there will be a trade-off as well. This time it will be between the higher exposure value and something called “depth of field.” But whereas digital noise is pretty much always a bad thing, a limited depth of field isn't necessary bad. It is more of a creative choice.

We'll get into depth of field in a second. First let's talk about the aperture itself.

How the Aperture Works

The aperture is the opening in the lens that allows light from the lens into the camera. The opening is adjustable. You can make the aperture larger, which allows a lot of light into the camera, or smaller, which lets in less light into the camera. This will have effects, which we'll get into in a second. Here is what the aperture looks like when opened up to different sizes:

Aperture Measurements

The way aperture is measured is screwy and won't make any sense to you at first. The measurement always starts start with an f/ and then has a number. You will hear people saying they were shooting at f/8 or f/22 and that means what aperture they were using.

What do the numbers mean? First, I'm going to tell you the actual definition, but then I'm going to ask that you forget about it and just think about it from a practical point of view. Technically, the way an aperture size is defined is the ratio of the focal length to the diameter of the lens opening. That's the definition, and you can forget about that except for one thing: since the measurement is a ratio and the denominator (bottom number of the ratio) is the size of the opening, that means that the smaller the f/number, the larger the aperture.

This measurement gives new photographers fits. You would think that a large number like f/22 would mean that you have large aperture, right? Wrong. The large number means that the focal length is large relative to the size of the opening. A small f/number means that the focal length number is small relative to the size of the opening. So larger f/numbers mean larger apertures.

Example of how aperture setting might appear on an LCD display

It might make more sense if we start talking about the actual range of apertures available to you. There are lenses that have apertures as large as f/1.4 or even f/1.2, but those are usually very expensive prime lenses. This is referred to as "fast glass" presumably because the large amount of light being allowed into the camera lets you work fast. On the other side of the scale, things are fairly uniform. The smallest aperture settings on most lenses is f/22.

The range of apertures depends on the specific lens. Here is a chart showing common aperture values for your lens:

f/2.8	f/4.0	f/5.6	f/8.0	f/11	f/16	f/22

The numbers you see are in 1-stop increments. Recall when we talked about ISO that a stop is a doubling of light. When you doubled the ISO, the numbers made sense. You went from 100, to 200, to 400 and so on. The numbers were easy to understand since a doubling of light meant a doubling of the number.

Because of the way apertures are measured, the number doesn't double when you double the amount of light being let into the camera. Therefore, you will just need to spend some time getting familiar with these numbers. Spend some time looking at the values on the chart. Keep in mind, however, that your camera may be set to measure changes in 1/3 stop increments, which means you will likely be presented with values in between the numbers I have shown you here.

The Trade-Off with Aperture

Why wouldn't you just always make the aperture bigger to let in as much light as possible? That would make sense, wouldn't it? You could always just put the aperture on its largest setting. You

would get the maximum amount of light into your camera. You could use a fast shutter speed. You would never have to worry about aperture ever again.

But I've already talked about aperture values having a trade-off, so you know there is going to be a consequence of using larger apertures. That consequence is that is results in a shallow depth of field. Depth of field refers to how much of the picture is sharp or in focus, and how much of it is blurry. When the depth of field is shallow, only a small part of your picture will be in focus. We'll talk more about depth of field in just a second (and a shallow depth of field isn't necessarily a bad thing), but for now I just want you to understand the trade-off involved.

When it comes to the measurement of apertures and the trade-off involved, just keep in mind the following:

- **Large apertures have smaller f-numbers like f/4 and f/5.6.** Again, these apertures will allow more light into the camera, but will create a *shallow* depth of field.
- **Smaller apertures use larger f-numbers like f/16 and f/22.** These are the apertures that allow less light into the camera, but create a *deeper* depth of field.
- **Medium apertures are, as you might expect, in the middle, and use f-numbers like f/8.** There is an old saying of "f/8 and forget it" if you don't want to get too worked up about the size of the aperture and the impact on depth of field.

Depth of Field

The best way to explain depth of field is by talking about its effects in pictures you are already familiar with. You are no doubt familiar with portraits in which the person's face is in focus, but the background is very blurry and out of focus. That is referred to as a *shallow* depth of field. It is created when you use a larger aperture. The person or thing you set your focus on will be sharp, but the background will be blurred.

Conversely, you have probably seen landscape photos where everything from front to back of the picture appears sharp and in focus. That effect is created by using a small aperture setting. When you use a smaller aperture, the falloff towards out-of-focus is much slower. That means that everything in your picture will be sharp.

Take a look at these pictures of a chess board shot using different size apertures. Pay attention to how sharp or fuzzy the King is for each of the different aperture settings:

Large Aperture
f/2.8

Shallow
Depth of Field

Medium Aperture
f/8

Moderate
Depth of Field

Small Aperture
f/22

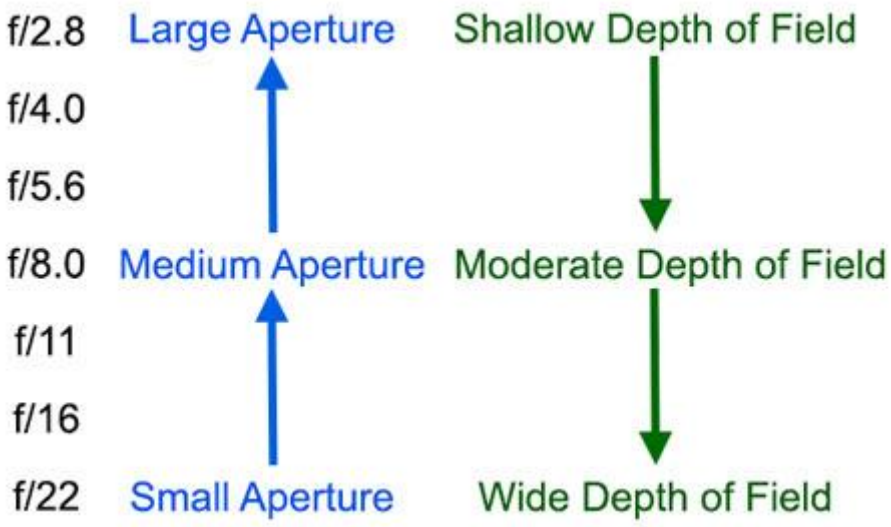
Deep
Depth of Field

Do you see how the smaller aperture (with the larger f/number) results in the King being sharper? By the time you get to f/22 the King is almost in focus. Conversely, when you look at the King in the picture shot at f/2.8, the King is extremely blurry.

Now let's take a look at an example that is perhaps more practical. This is an outdoor shot of some flowers in the foreground and a coastline in the distance.

Notice how the background of the picture on the left - shot with a wide aperture of f/5.6 is blurry, while it is relatively sharp in the picture on the right shot at f/16?

Here is a chart showing you the relationship between the measurement value, the size of the aperture, and the resulting depth of field in your pictures:



I'm not going to sugar-coat it though. If this is new to you, this is just going to be confusing to you for a little while. Keep practicing with it. This is perhaps the hardest thing you will have to learn. In time it will become instinctive and you won't have to think about it anymore.

Other Factors in Controlling Depth of Field

So far I've been talking about depth of field as if the aperture size is the only thing that affects it. There are, however, a few other factors, and I wanted to mention them as well. Here are the other factors:

- **Focal length:** Long focal lengths (i.e., when you are more zoomed in on something) make it easier to get a shallow depth of field. In fact, when you are shooting wide angle it can actually be difficult to create a shallow depth of field. This is bad if you are trying to achieve that blur, but nice in that you don't need to use a small aperture to get a nice sharp background. A lot of landscapes are shot with wide angle lenses so this can be very helpful.
- **Subject to background distance:** The more distance you put between your subject and the background, the more the background will be blurred. This makes sense, doesn't it? When you talk about depth of field, you are talking about how fast things fall to out of focus. If you put more distance between things, there is more room to fall out of focus. Conversely, having things close together in your picture will make the depth of field appear deeper.
- **Subject to camera distance:** The closer you are to your subject the shallower your depth of field will appear. This is because your focus is set close to you. Similar to our last factor, now there is more distance to the background and thus more room for things to fall out of focus.

- **Camera sensor size:** There isn't much you can do about this when you are out shooting, but the size of your camera's digital sensor has an impact on depth of field. Larger sensors make it easier to get a shallow depth of field and create background blur. Conversely, smaller sensors make it easier to preserve a deep depth of field.

I don't want to overstate things: to me these factors pale in comparison to the impact of the size of the aperture. Nevertheless, they are things to keep in mind when you are considering depth of field.

Aperture in the Real World: Portraits

Now let's talk about aperture and depth of field in the context of actual shots you are likely to take. The first context is a portrait (or, really, any picture of a person). In this context, what is important is the person. The background is not important and, in fact, can be a distraction. In this case, how should you set your aperture?

If you said you should set the aperture size to a large setting (i.e., a small f/number) you'd be right. The large aperture leads to a shallow depth of field. Your subject will be sharp but the background will be a little blurry. Something in the neighborhood of f/2.8 - f/5.6 would be good here (depending on the maximum aperture of your lens).

Using large apertures like this makes the exposure process easier. The large aperture lets a lot of light into the camera, so you don't have to worry about using a high ISO (which can lead to digital noise) or a slow shutter speed (which can lead to camera shake and blur).

Aperture in the Real World: Landscapes

Another shot you are likely to take is the landscape shot. Even if you are not a dedicated landscape shooter, sooner or later everyone takes a shot of a beautiful sunset or scenic vista. In this context you usually want everything in your picture to be as sharp as possible. So how should you set your aperture?

If you said you want a small aperture (large f/number), I agree with you. You want everything to be sharp, front to back. The small aperture will lead to a deep depth of field that will keep most or all of your image sharp. Something from f/11 and f/22 would be good.

Keep in mind that doing so is going to seriously restrict the amount of light that is allowed into your camera. The difference between f/4 and f/16 is 4 stops of light, which as you will learn more about shortly) is the difference between a shutter speed of 1/60th of a second (which is usually fine for hand holding your camera) and 1/8th of a second (which is quite slow and can lead to camera shake/blur). This is why landscape photographers are so fond of using tripods.

When Depth of Field Is Not Paramount

Sometimes you really don't care that much about your aperture setting. Or at least it isn't paramount in your mind. What should you do in those settings?

For the most part, anything goes here. If you have a lot of light, you might go with a smaller aperture. On the other hand, if you are in a low-light situation and are worried about having to use too high of an ISO setting or too slow of a shutter speed, you might go with a larger aperture.

There is an old saying in photography that applies in this situation, which is: "f/8 and forget it." When in doubt, f/8 is a good choice.

A Wrinkle: Variable Aperture Lenses

One last thing before we move on. You may have a lens with a maximum aperture that is variable. Many kit lenses that come with cameras have a maximum aperture something like f/3.5 - 5.6. That means that at the wider end of the range of focal lengths, the maximum aperture is f/3.5. However, as you zoom in more and more, the maximum aperture is getting smaller. At the longest focal lengths for the lens (when you have zoomed in all the way) the maximum aperture is only f/5.6.

What is going on here? Is the aperture actually changing size? No, the aperture stays the same size. Remember, however, that the measurement of aperture is actually the ratio between the focal length and the size of the opening. As the focal length gets longer with an aperture that stays the same size, the f/number will increase. Therefore, as you zoom in - and the focal length gets longer - an aperture that stays the same size will have a different measurement. That is what is happening with these lenses.

Day 5 Assignment
A Still Life

Description:

Photograph items around your home using a shallow depth of field. Start in the kitchen. Isolate your subject and blur out the background as much as possible.

Keys to Success:

Start with a wide open aperture to create the shallow depth of field.

Note what else you need to do to capture the shallow depth of field:

How much distance do you need to put between subject and background?

At what point do things in front of the focal point get blurry?

Pay attention to the impact that the wide open aperture has on your other exposure controls.

Upon Completion of this Assignment:

You are now in control of depth of field. You have the ability to blur out a background, which is a pro move. Try it in a portrait sometime. You should be able to apply the converse to create a deep depth of field as well.