Aperture, Depth of Field & Background Blur

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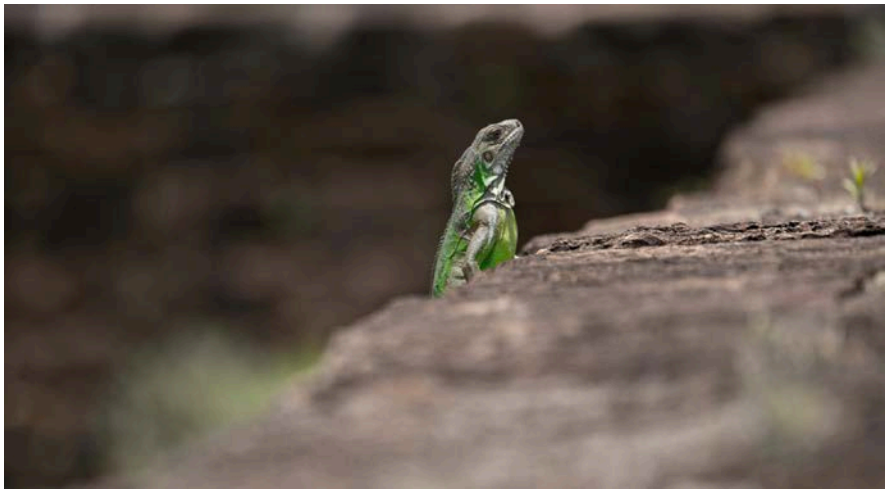
This lesson is going to focus on the photographic concepts of aperture, depth of field and background blur. To achieve a blurry background, use the lowest aperture setting possible. This is a pretty simple concept in itself, but there is so much to understand about how this works and the more you understand, the more you're going to be able to control what you're capturing.



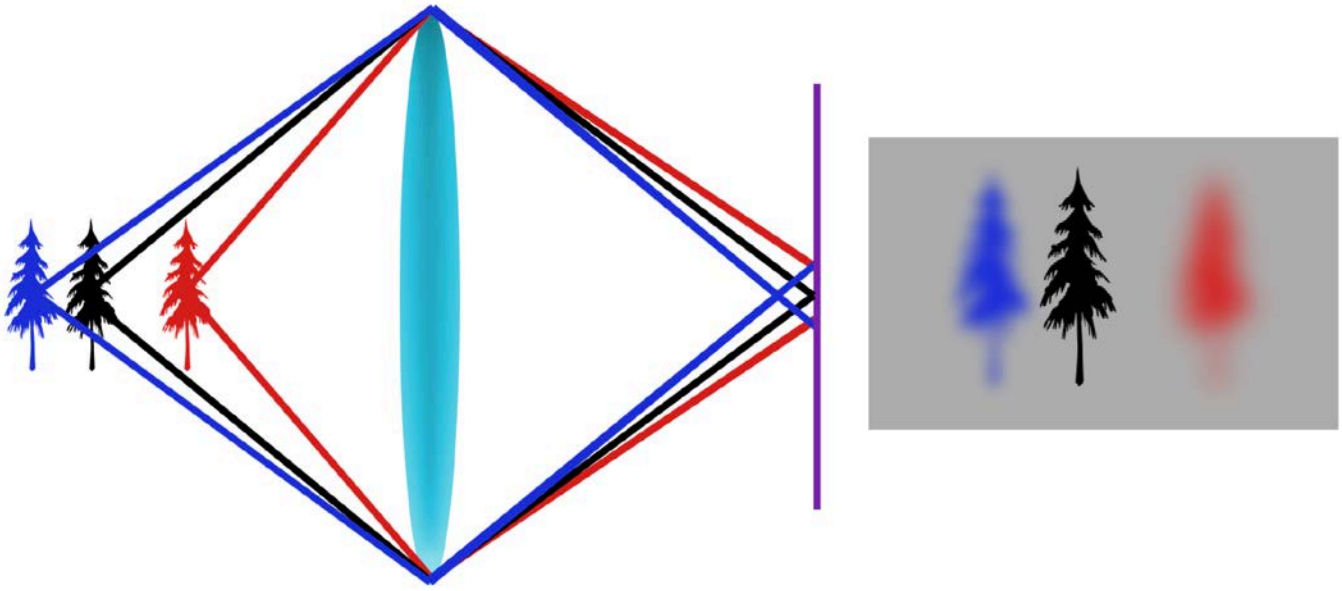
This lesson is going to focus on the knowledge, camera settings and techniques required to achieve a blurry background in your images.

Focusing in Camera (1:01)

Focusing in your camera is similar to shining light through a magnifying glass. The closer you bring the magnifying glass to a subject, the more concentrated the light will become. When the magnifying glass is far from the subject, the light will appear as a larger circle. The same is true when you have a point of detail on something you want to photograph and it's a little bit out of focus. It appears as a blurry circle. Since that detail is not in isolation, there will be all sorts of specks of detail. If they're all rendered as blurry circles, the whole area will look blurry.

Aperture Determines Depth of Field (2:15)

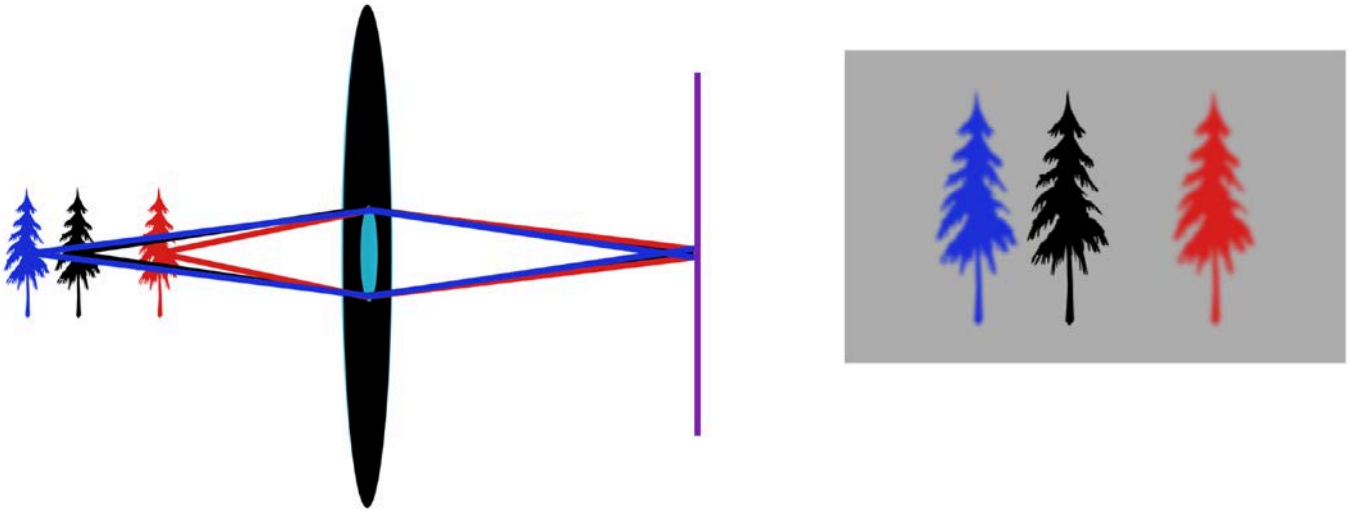
Let's look at how the aperture setting in your camera affects depth of field and perceived sharpness. When you have a light source, the sun for example, it will emit light in all directions. When you place your lens in front of that light source, it will affect the light that's being emitted by focusing the light to a single point. If the light source is a tiny speck, then the focus point will be a tiny speck as well. If that's where we place the camera's sensor, we will have an in-focus rendering of the subject. Now this speck doesn't need to be a light source. It can be a speck of detail on a subject (a tree for example). The light will fall on the speck of detail, bounce off of it, and go into the camera lens so that the speck on the subject can become focused on the camera sensor. If there are any objects in front of or behind the object being focused on, they will be slightly blurry because the reflected light will not hit the sensor as a focused point. There is only one distance that is truly in focus. Points closer or farther are rendered as blurry.



Here, we have a lens with the subject (the black tree) on the left and the camera sensor on the right. The black tree is the focus point, and you can see that the light is reflected to a single point on the camera sensor (the light on the right). Anything closer or farther from the lens will reflect onto the sensor as a larger circle and will therefore be out of focus.

Now let's take the same scenario but add an aperture, which is an opening that can get smaller and larger. Now, we can make the opening smaller, allowing less light to move through the lens. All of the rays of light hitting the outer edges of the lens will be discarded because they can't fit through that opening. Now, the light reflected off of an object that's behind or in front of the subject will hit the sensor in a smaller circle and will therefore render the object as less blurry.

This means that an out-of-focus area doesn't always look blurry in your pictures because the circle it reflects onto the lens is not large enough to make it look blurry. When it's small enough, your eye can't tell the difference between the tiny circles and a truly sharp speck of detail.



Here, we have added an aperture to the lens so that less light can hit the sensor. With the light more focused like this, the objects that are in front of and behind the focus point (the tree) will be reflected as smaller circles on the sensor and will therefore be less blurry.

The Circle of Confusion Looking at the previous two diagrams, there is a concept that you should be aware of and it's known as the circle of confusion. Your eyes and brain put together can often times confuse a blurry circle for a sharp speck of detail. There is a limit to how big of a circle can be tolerated before it's going to start to look blurry.

To simplify these concepts, depth of field is the near-to-far distance range where objects look acceptably sharp. (They're within the circle of confusion.)

Depth of Field Preview (13:42)

The lower the numeric aperture setting, the wider the aperture will be. When you use the lens' lowest aperture setting, it's commonly referred to as shooting "wide open." It's important to know, however, that the viewfinder of a DSLR is always "wide open" (and therefore bright). It closes down when you press the shutter. Use the Depth of Field Preview button to preview the depth of field your aperture setting will produce.

- Set the focus at 1/3 of the way into your desired depth of field area.
- If the viewfinder has less depth of field than desired, set the f-stop to something other than "wide open."
- Concentrate on the nearest area that should be sharp, then toggle the depth of field preview on and off multiple times to determine of the area is sharp (the viewfinder will get dark).
- Repeat for the farthest area that should be sharp.
- Adjust the aperture (and focus point) until the desired depth of field is achieved.

Mirrorless cameras work a little differently. When you look through the viewfinder on a mirrorless camera, you're not seeing an optical view. You're instead looking at a video screen. Because of this, mirrorless cameras can show the depth of field preview without darkening the viewfinder. In fact, there is usually a setting on the camera where you can leave the preview turned on. With this turned on, you can change the aperture on your camera and see a live preview of the depth of field you're going to get. Just be aware that keeping this setting on will slow down your auto focus.

Camera Modes and Depth of Field: Choosing a Mode (20:57)

The camera mode you shoot in will determine how much control you have over the aperture setting.

Green Zone: Can see the aperture setting, but can't change it because the camera has complete control. Blurry backgrounds are only achieved by chance.

Program: Defaults to the camera choosing the aperture, but you can "shift the program" to specify a certain aperture. Returns to automatic the moment the camera times out or is power cycled. In this mode, you need to pay constant attention to consistently achieve blurry backgrounds.

Aperture Priority: You choose the aperture while the camera adjusts the shutter speed to achieve consistent exposure. This mode gives you consistent control of the background blur.

The camera mode you choose will determine how much control you'll have over the aperture setting.

Manual Mode: You choose both the aperture and shutter speed, which requires constant adjustment as the brightness of the scene changes. This mode gives you consistent control of background blur, but requires constant attention to achieve proper exposure.

The F-stop Setting (23:42)

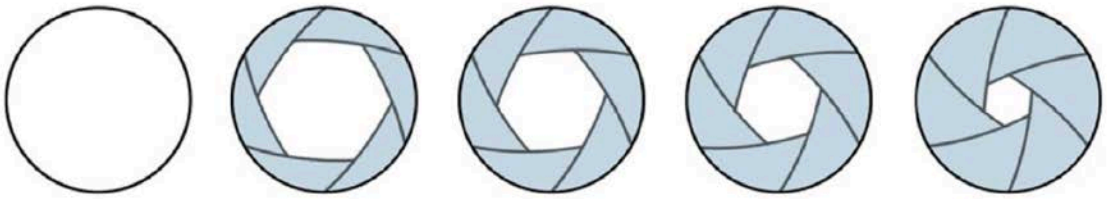
The F-stop setting determines how much light will hit the sensor, not how large the aperture will be. The f-stop setting on your camera determines how much light goes through the lens by making the aperture larger or smaller.

F STOPS

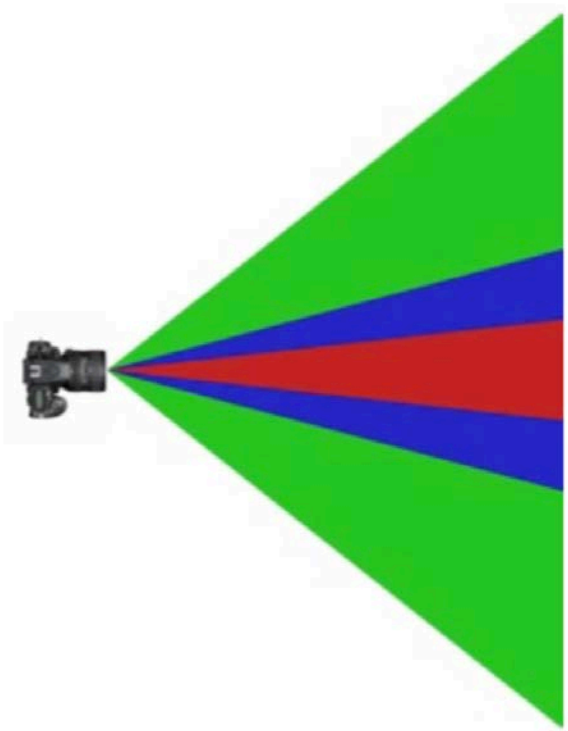
.7 1.0 1.4 2 2.8 4 5.6 8 11 16 22

Each jump either doubles or halves the exposure needed

THE APERTURE



At left, the aperture is wide open (the lowest f-stop available). As you close down the aperture, less light enters the lens.



Zooming captures less light, so a larger aperture is needed in order to maintain exposure.

When you zoom your lens, the aperture size also changes, even though the f-stop isn't changing. In order to give the same amount of light all the time, the aperture needs to be changed. When you have a wide angle lens, you can see a wide amount of space in the scene. All of the light falling on that wide space is going into the lens to produce a photograph. If you zoom your lens to a narrower scene, you now only seeing a fraction of the light that you were previously seeing, so the aperture on the camera needs to open up to compensate. A setting of f/2.8 on a wide angle lens produces a much smaller aperture than f/2.8 on a telephoto lens.

ƒ/ : The Aperture is More than a Number (26:56)

To understand the ideas above, you must understand why there is an ƒ in front of the 2.8.

ƒ/4 is a fraction!

Aperture size = Focal Length ÷ F-stop

Therefore, a 100mm lens at F/4 = 25mm aperture

Wide vs. Telephoto at ƒ/2.8 means:

17mm ÷ 2.8 = 6mm aperture

200mm ÷ 2.8 = 71.4mm aperture

The 200mm lens at 2.8 has a dramatically larger aperture opening than the 17mm lens at 2.8. This means that long lenses are going to make it much easier to get a soft/blurry background. A blurry background is quite hard to achieve with a really wide angle lens.

A "fast" lens doesn't always mean a wide aperture Fast glass is how some people refer to lenses that have an aperture setting that can go really low. Fast lenses are usually much more expensive than ordinary ones. The lowest setting the aperture can go will be printed somewhere on the front of the lens. Know that a "fast" lens doesn't always mean a wide aperture. Here are some examples of different lenses and what their aperture size is when shooting "wide open."

- Nokton 25mm f/0.95 = 23.75mm aperture
- Nikon 50mm f/1.4 = 35.7mm aperture
- Canon 50mm f/1.2 = 41.66mm aperture
- Canon 85mm f/1.2 = 70.8mm aperture
- Canon 200mm f/1.8 = 111mm aperture
- Canon 300mm f/1.8 = 166.6mm aperture

Infinity ∞ (35:43)

It's infinitely more difficult to achieve a blurry background with a wide angle lens and this is due to ∞. This is the symbol for infinity. Most lenses have a focus scale on the side. You can focus the lens, and this scale will tell you exactly how far away it ended up focusing on something. Looking at the focus scale, it's going to show farther and farther distances until it can't go any farther. When it gets to that point, the ∞ symbol will appear. If you focus at infinity, then anything beyond that point will also be sharp.

It can be useful to think about where the infinity point shows up on a wide angle lens, a mid-range lens and a telephoto lens because they're really different.

On my 100-400mm lens, the infinity point is somewhere around 100 feet away. This means that if I focus on something 100 feet away or farther, it will be impossible to get anything beyond that point to be blurry.

On my mid-range lens, the infinity point is around 15 feet away. If I focus on something 15 feet away (or farther), then anything beyond that point will be in focus.

On my really wide fisheye zoom lens, the infinity point is around 3.5 feet. This means that if my subject is 3.5 feet or farther away, everything behind it will be in focus. You can see how this can make it very difficult to achieve blurry backgrounds with wide angle lenses.

Lens Crop Factor (41:05)

When a camera has a sensor that is not full frame, it means that it is smaller than the size of 35mm film and it therefore has a crop factor.

If you're used to a full frame camera with a lens like a 70-200, and then you use that same lens on a camera with a crop factor of two, you would need to multiply

the millimeter number by a factor of two because the camera is going to crop into the scene by a factor of 2. This means that the 70-200mm lens would really be 140-400.

The crop factor of your lens applies to apertures as well because the focal length is changing.

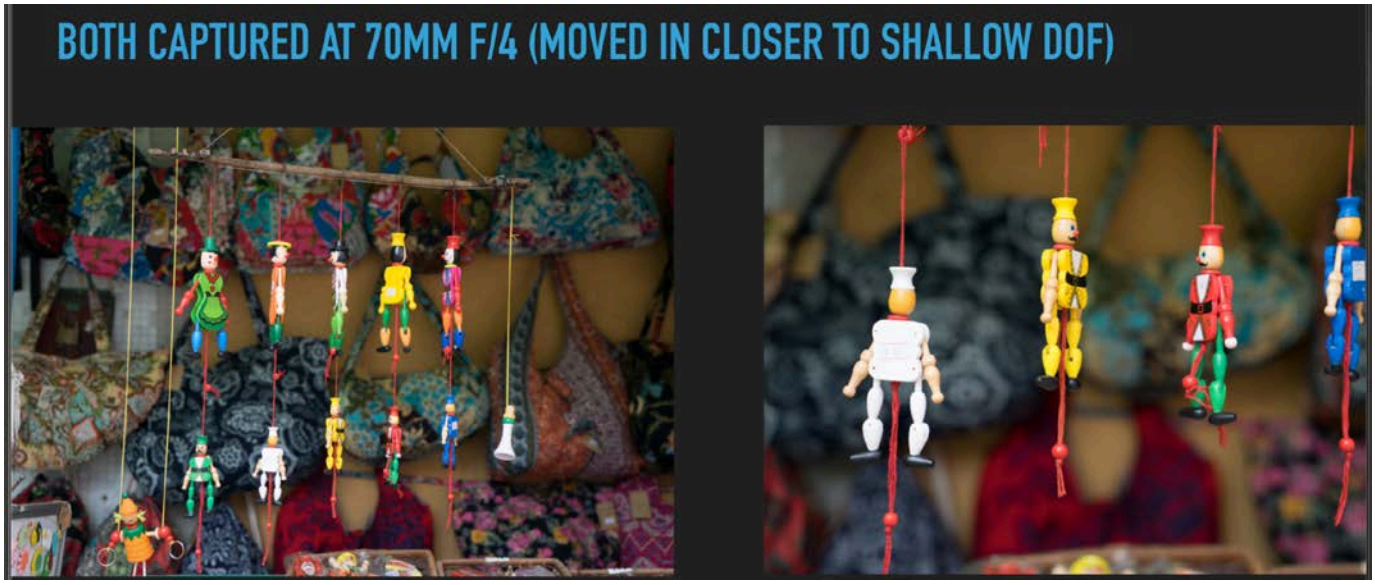
Blurry Background Formula (43:51)

Up until now, we've talked about the various concepts in detail, but in order to get a blurry background, it really comes down to the following:

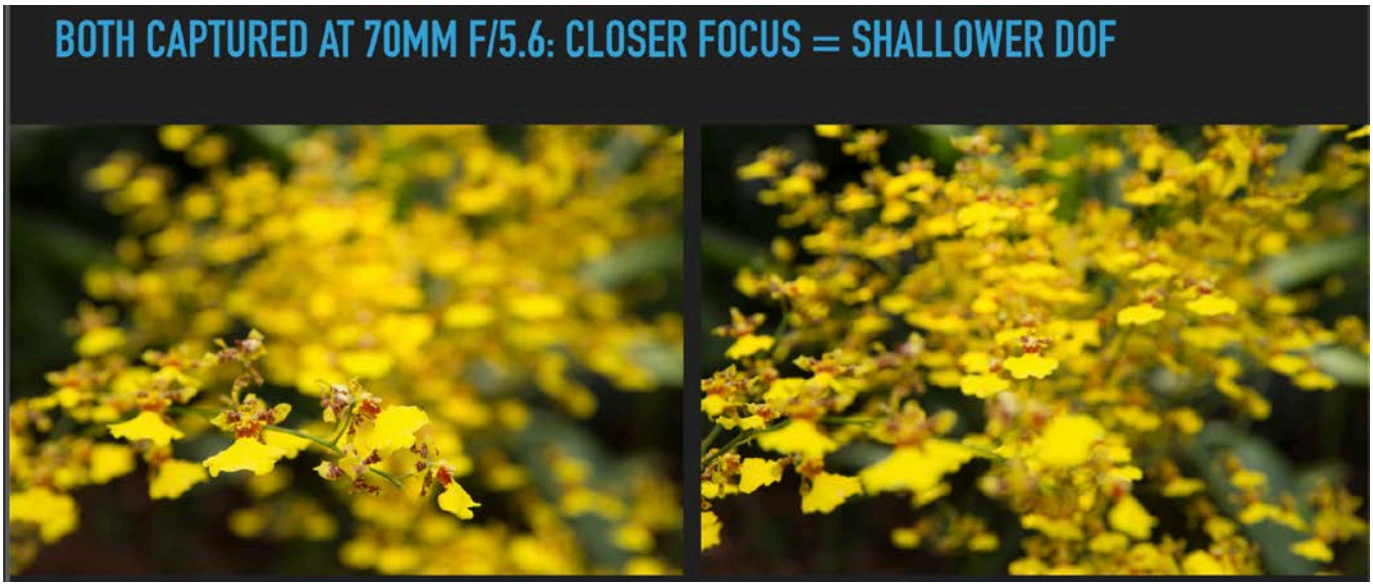
- Use the lowest f-stop available: shoot "wide open."
- Zoom in as much as possible. (A shallow depth of field is impossible at 11mm, but easy at 200mm.)
- Get as close to the subject as possible. (Stitch a panorama if you need a wide view.)
- Position the subject as far from the subject as is practical.

Here, you can see what a difference the f-stop makes. Using an f-stop that is as low as practical will greatly help to achieve a blurry background.

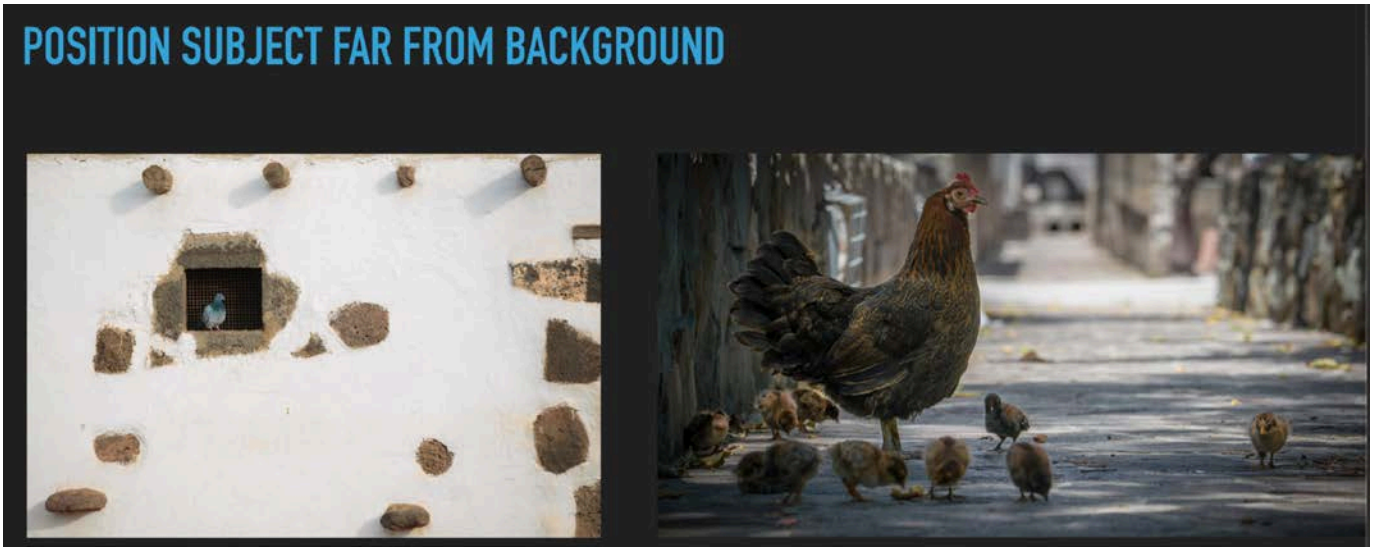
Here, you can see how zooming the lens as far as possible will help to make the background blurry. The image on the right was shot with the lens zoomed as far as possible.



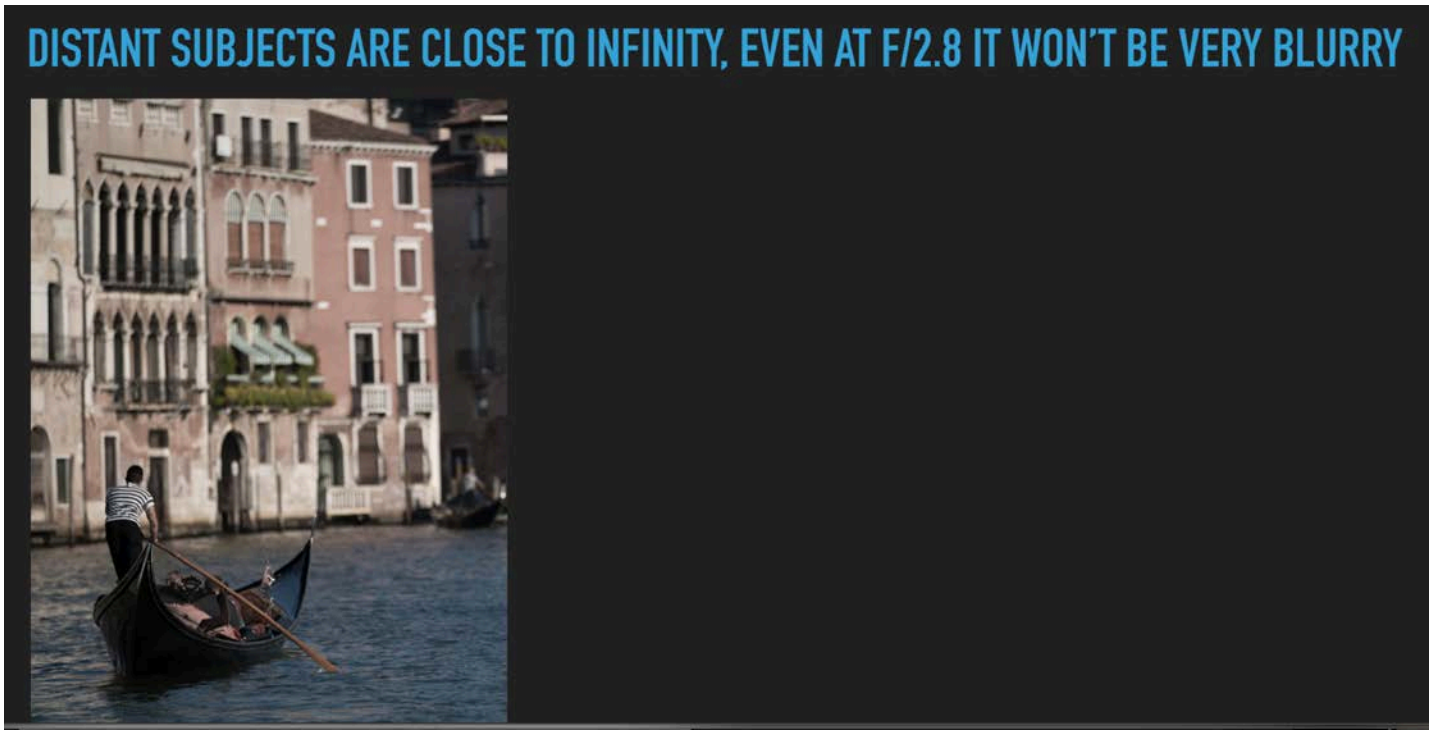
These images illustrate how proximity to the subject can help to make the background soft. In the image on the right, I moved the camera much closer to the subjects.



As you focus on things closer and closer to the camera, it's easier to get the background on things to go soft. In the image on the left, I focused on the flowers closest to the lens. In the image on the right, I focused on the flowers that were farther from the lens.



When the subject is right up against the background, like the image on the left, it will be very difficult to get a blurry background. In the image on the right, the background is far behind the subject and you can see that it was easier to get a blurry background.



When the subject is really far from the camera, it will be difficult to get the background to be blurry, even when shooting at f2.8.

Both of these images were shot at f2.8, but because a wide angle lens was used and the camera was not close to the subjects, the background still appear sharp.

In this image, all measures were taken to ensure a blurry background. I shot at f2.8 using a long lens. I got as close to the subject as possible while making sure the background was far from the subject.

Capture Panorama for Wide View with Long Lens (56:10)

There are some instances where you'll want a wide view of the scene, but you'll also want the background to be soft. Wide views usually mean wide angle lenses, and we know that it's difficult to achieve blurry backgrounds with wide angle lenses. There is still a way to achieve a blurry background, however, and that is by shooting a panorama. Use a long lens and zoom as much as is required to get the blurry background. Then shoot a panorama of the scene. You'll need to take the extra step of stitching the images together later, but this technique will allow you to get blurry backgrounds of wide scenes.

This panorama was shot using a long lens and a low aperture setting to achieve a blurry background. The individual frames are shown below the stitched panorama.

Lock focus and exposure When shooting panoramas like this, it's very important to use the exposure and focus lock settings on your camera. If the exposure is not consistent across all the pano frames, then parts of the pano will look darker than others. If the focus is not consistent across all frames, you could get an unnatural shift from sharp to blurry in the final result. To get consistent focus, you could set the focus for the first shot and then set your camera to manual focus while you shoot the pano. This way, you know the auto-focus would not take over. Some lenses have a button for focus lock that you could use instead. To lock the exposure, use your camera's auto exposure lock setting, which is sometimes labeled AEL.

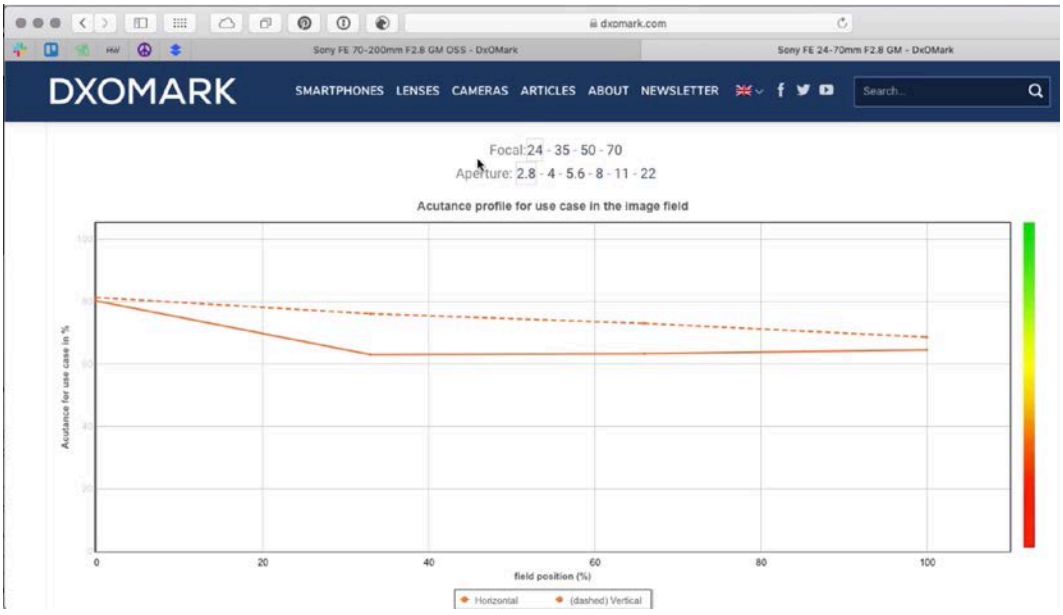
This panorama looks fine when viewed small, but it can't be printed large because there is a spot where the grass abruptly goes from being blurry to being sharp and that's because I had forgotten to lock the focus. :-(

Stop Down for the Sharpest Results (59:37)

Tip: "Wide open" doesn't produce the sharpest results, so only use it when depth of field trumps sharpness.

If you stop down your lens one stop down from wide open, the center of your image will become much sharper. If you stop down your lens two stops from wide open, the corners of your image will start to get much sharper. If the center sharpness and the corner sharpness is more important than getting a blurry background, then consider stopping down one or two stops from wide open.

There is a website that you can use as a resource for finding which f-stops produce the sharpest results on your particular lenses. Visit www.dxomark.com and search for your lens. Then, click the Measurements tab and then choose Sharpness. One of the options here will be called Profiles. Click this option and you'll be presented with a graph. At the top, you can choose a focal length and aperture setting. When you choose a particular combination, the graph will show you how sharp the image will be starting from the center of the frame (the left side of the graph) to the outer edges of the frame (the right side of the graph). The solid line shows the path from the center of the image moving outwards horizontally. The dashed line shows the path from the center of the image moving outwards vertically.



At the website www.dxomark.com, you can look up your lens and find a graph that shows how sharp the image will be at different focal lengths and f-stops.