

# FOCUSED CAMERA™

## ISO LESSON

If you have not completed the [lessons on Aperture and Shutter Speed](#), you should complete those before working on ISO. Aperture, we learned, controls light, but also affects depth of field and can be used for creative effect to get a blurry background behind the subject. Shutter speed, also controls the amount of light and we learned how it can be used for artistic effect with slower speeds to create motion blur or at higher speeds to freeze motion. ISO is the third way to control the amount of light with your camera. Together these three aspects make the Exposure Triangle. We will put all three together later, for now we will focus on ISO.

ISO is a measurement of sensitivity to light. Since the 1970s a consistent standard was used to label film so that you would always know how your film would act when used in the appropriate setting for that film. For example, ISO 100 was for bright sunny outdoors. If you wanted to change your location, by going inside for instance where it is darker, you would need to load a new roll of film (or make adjustments to your camera settings). Today, digital cameras can change ISO by pressing a button, but it still refers to light sensitivity. ISO tells us how sensitive our camera sensor will be to the light.

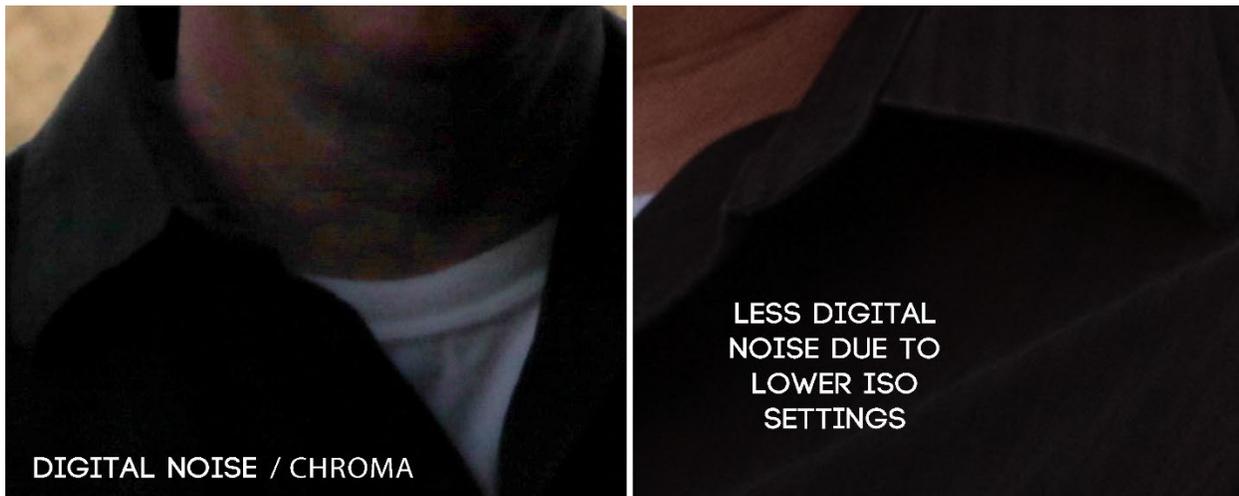
At ISO 100, which is for bright well-lit conditions, we already have lots of light so we do not need the sensor to be sensitive and take in more light. At ISO 1600, which would be for poorly lit conditions, we do want the sensor to be more sensitive to then gather more light.

Unlike aperture and shutter speed, which can be used various ways for creative effect, ISO has a big downside. The higher the ISO goes, the more “grain” you will see in your image. The “grain” in digital photos is digital noise from the electronic current in the sensor (and is similar the “grain” found in old film prints). For more information about ISO, its origins, and the science behind “grain” [see our blog post](#). Technology is ever-improving and cameras today can handle higher ISO than ever before, but much of this depends on the quality of the sensor (a reason why some cameras cost so much more) and the sensor size. These will determine the point at which image quality deteriorates.

Take a look at these sample images (cropped and enlarged). On the left, using a higher ISO, you see a lot of “grain” or noise. This noise can add unwanted pixels of color (chroma noise) into an image as well as affect pixel brightness (luminance noise).

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On the right, using a lower ISO, you should see there is much less noise in the image. Noise is easier to spot in darker or shadowed areas of your images.



So now you know, you don't want to turn the ISO way up unless you absolutely have to. The higher your ISO, the more degraded your image quality will be.

To change your ISO settings you may need to consult your camera manual. If you need to [download a manual for your camera click here](#).

The only cameras that I am currently aware of that have an ISO Priority shooting mode (actually called Sv or Sensitivity Priority) are some Pentax cameras. For the rest of us, check to see if your camera has Auto ISO settings. If it does, then once you set this, for most shooting modes the camera will automatically select the lowest possible ISO (it may not work on all modes on all camera brands). You may also be able to change settings to create a maximum ISO limit. All of these settings will be explained in your camera manual and you should look to see when Auto ISO or ISO limits work and if there are any times that they will not work.

In addition to Auto ISO, you should learn how to go into your settings to make manual adjustments to ISO. And don't worry, you cannot mess up your camera. If you ever have an issue where you have made a setting or adjustment and cannot "undo" it on your own, there is a reset function in your camera menu that puts everything back into default (the way it was when you first opened the box). To manually adjust ISO, most cameras have an ISO button. Press this and then usually there is a dial to change the ISO. For today's hands-on activity, you will need to know how to manually change ISO. Refer to your camera manual before you proceed.

We are going to test the different ISO settings and then view the images at 100% so you can inspect the "grain" and details of the images.

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## The Assignment – Part 1:

1. Using fully automatic mode take a photo in a darker room or a shaded area around you – a dark corner of a room away from the windows, the leaves on the ground under the shade of a big shrub, or at dusk. Be sure to focus. Note the ISO chosen by the camera. ISO should be 1600 (or higher). If it is not, find an even darker location.
2. Still using fully automatic mode, go to a slightly more lit area and take a photo. Note the ISO chosen by the camera. Be sure to focus. Take a few shots until you get one with an ISO of about 400.
3. Still using fully automatic mode, go to a brightly lit, very sunny area and take a photo. Be sure to focus. Take a few shots until you get one with an ISO of about 100.

For this series of photos it does not matter what the subject is. For consistency, choose an object (dark colors are better) to place in all of your shots and focus on that; something like a coffee mug or teddy bear. Do not change the zoom and keep your distance to your focus point about the same.

Now take your final three images and upload them onto your computer. View the images at 100% (or zoom in to look closely). You should clearly be able to see more grain and color noise in your images shot at ISO 1600 and 400 and much less in your image shot at ISO 100.

Here are my images. You can see the image taken with the highest ISO (left) has the worst image quality. The image taken at ISO 100 (right) has the best image quality.



ISO 3200  
IMAGE DETAILS ARE  
HIDDEN BY "GRAIN"  
OR NOISE

NOISE IS VERY  
NOTICEABLE IN  
ALL AREAS OF  
THE IMAGE

ISO 400  
SOME IMAGE  
QUALITY IS LOST

NOISE LEVEL "OKAY"  
UNTIL IMAGE IS  
ENLARGED; NOISE  
MORE NOTICEABLE IN  
DARKER AREAS

ISO 100  
IMAGE DETAILS ARE  
PRESERVED

NO NOTICEABLE  
NOISE EVEN WHEN  
ENLARGED; DARK AREAS  
SHOW DETAILS LIKE  
FUZZ & LINT

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## The Assignment – Part 2:

1. Go to a poorly lit, but not dark area. Take a photo with the camera in Auto mode. Check the camera settings. If the ISO was not at least 800, try a slightly darker location. Write down the settings the camera used once you get a photo with an ISO of around 800.
2. Switch your camera to Aperture priority mode and set the aperture to match your initial settings.
3. Set the ISO to 100 or 200.
4. Take the photo again. What settings did the camera select or change? Shutter speed!



Notice that the overall exposure of my images (and yours too) is the same both times. On the left, the camera selected all of the settings in Auto Mode. By choosing a darker location it had to select a higher ISO of 800. On the right, I used Aperture Priority mode and selected the same aperture, to keep that factor constant. I changed the ISO to 100. The only factor remaining, which is controlled by the camera, is the shutter speed. The camera has to compensate for the change I made to ISO.

By changing the ISO from 800 to 100, we have reduced light sensitivity by 3 stops. A stop is halving or doubling of light. When we change ISO from 800 to 400 we have reduced light sensitivity in half (1 stop). Then from 400 to 200 and from 200 to 100 we have reduced light sensitivity by two more stops, for a total of 3 stops. Since aperture is constant (f/4 both times), the camera knows the shutter speed must adjust and slow down by 3 stops to balance our exposure. Slowing down the shutter means it opens and closes more slowly therefore letting in more light. Our initial shutter speed was 1/30<sup>th</sup> of a second in Auto Mode. Changing the shutter speed to 1/15<sup>th</sup>, then 1/8<sup>th</sup>, and finally 1/4<sup>th</sup> increases the light by 3 stops. If this is confusing, you might need to go back and review the lessons on aperture and shutter speeds (and [download our Exposure Triangle “Sliders”](#) cheat sheet).

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## The Assignment – Part 3:

1. Set your camera to Shutter Priority and set the shutter speed to  $1/2000^{\text{th}}$
2. Set the ISO to 100 and take a photo in the same poorly lit area.
3. The resulting photo should be very dark, possibly all black. The camera will choose the aperture (most likely this will be your max aperture). It is possible your camera may not even let you take a photo at all. If this happens, move someplace with a bit more light. Here is my image using Shutter Priority,  $1/2000^{\text{th}}$  of a second, ISO 100, f/4 (black).
5. The dark photo is underexposed. I could fix this by changing to a slower shutter speed to let in more light, but let's say things were moving very fast, like kids running indoors during a party. I need to freeze motion. My only option might be to let more light in with ISO instead. So, set your ISO to 400 and take a shot.
6. Turn the ISO to 800, take a shot, then 1600, etc. Keep doubling the ISO and taking photos until you reach your maximum ISO or your image looks like it has the correct exposure. Your camera may not be able to get correct exposure even at the highest ISO. On the right is my image using Shutter Priority,  $1/2000^{\text{th}}$  of a second, ISO 6400, f/4.



Thankfully, to freeze motion, you will rarely need to go with a shutter speed faster than  $1/250^{\text{th}}$  or  $1/500^{\text{th}}$  of a second (not  $1/2000^{\text{th}}$  like we are using for this test). So if maxing the ISO does not work to correct an exposure issue, I could adjust the shutter speed as well.

### What is the takeaway?

Whenever possible use lower ISO. Leaving your ISO on Auto ISO or setting a maximum ISO can help, but there are times when you will have to use a higher ISO than you might like. The example above simulates one such time – when you need a fast shutter speed, but are working in dark conditions. At a certain point your aperture on your lens will max out (can't get any more open) and the only way to get the light you need may be to increase ISO. This happens often in museums, historic homes, indoor sporting events, indoor parties, night shoots, etc. If you can bring in additional lighting, open a curtain, move toward a window, or move to a brighter location, you can keep your ISO lower, but there will be times when these are not options. When faced with a choice of getting the shot or not, always take the shot even if the ISO has to be high.