



# Manual Photography Essentials

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Innovation & Research Commons

# How Cameras Work

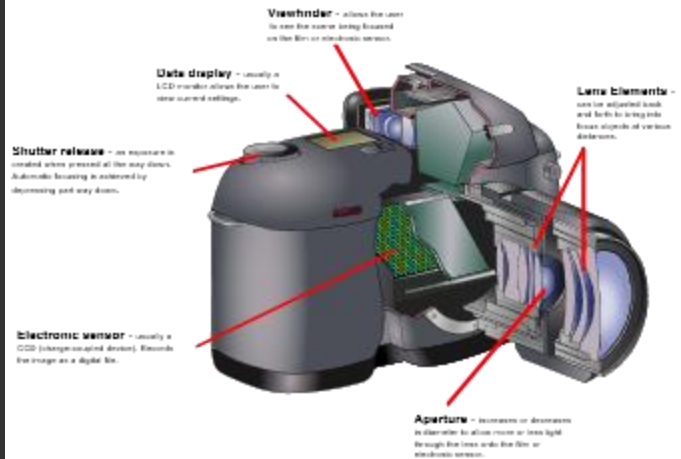


Photo by Jean Francois

All our cameras are Nikon or Canon DSLRs, which stands for **Digital Single Lens Reflex**. Both brands we carry here in the Tech Lending Space use mirrors.

Mirrorless digital cameras exist, like the Panasonic GH4 and GH5, but we only carry mirrored cameras.

## Looking at the Diagram:

DSLR cameras work by the light coming in through lens, bounces off the mirror, up into the focusing prism and reflecting the image into your eye. This allows you to see a general depiction of what your photo will look like. It won't show you how light or dark your image will be, it'll just show you what is being seen through the view finder.

Important Public Service Announcement: Pointing the camera at the sun can damage the sensors, and more importantly, pointing the camera at the sun and looking through the view finder can damage your eye. **So never point the camera up at the sun.**

When you press the shutter to take a picture, the mirror is bouncing the light into the prism drops and exposes the sensor. The sensor collects the light info and turns that into the image.

Mirrorless is similar, but it uses a lower quality digital sensor that the light hits and it puts that into a digital image through the viewfinder. But when you click the shutter, the lower quality sensor drops and you can still take the pic and the sensor is hit with the light.

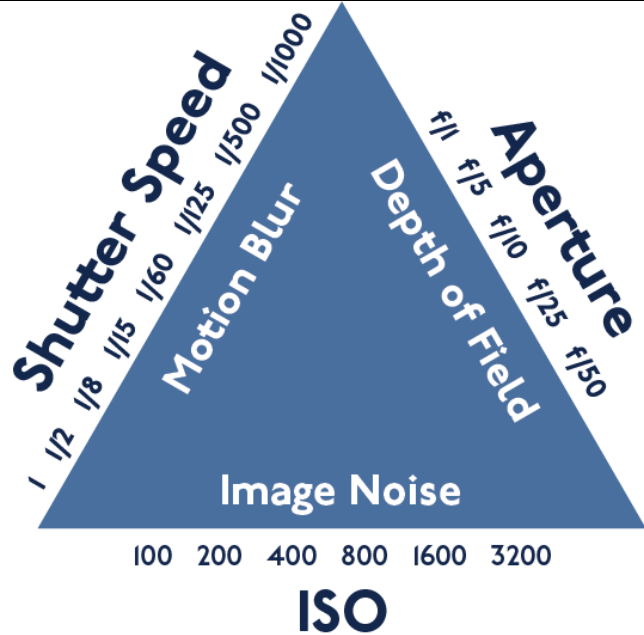
## The Sensor



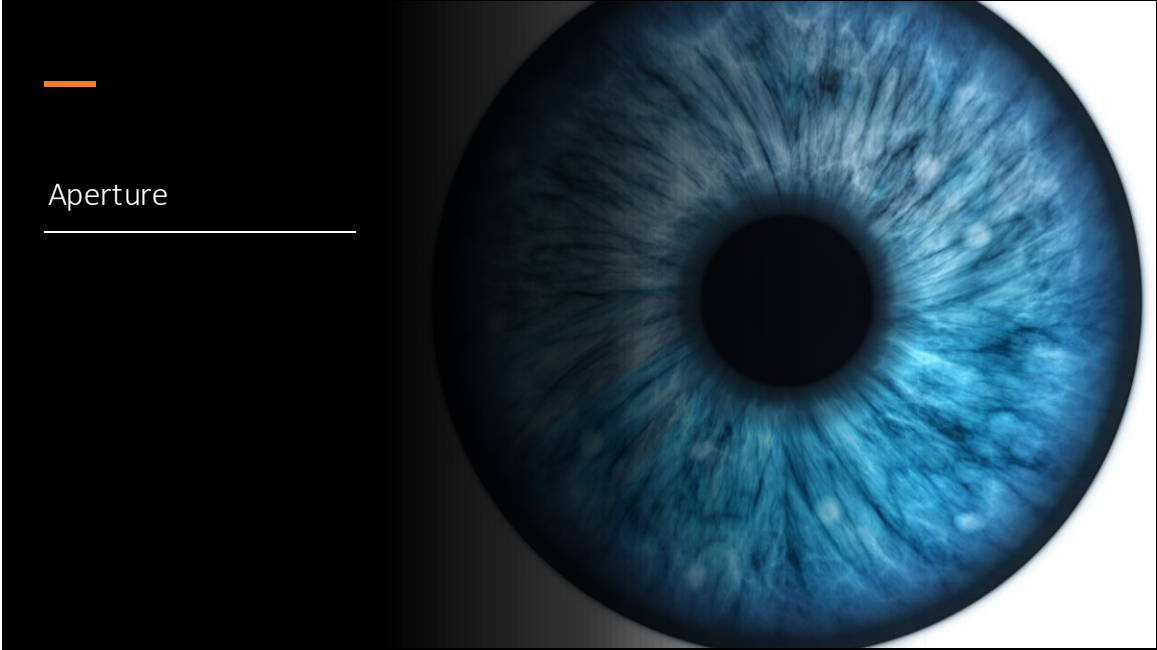
This is what the sensor looks like. When you open up our DSLRs you will see a mirror, behind the mirror is the sensor, and the sensor acts like a sponge that absorbs light. It creates an image from the light that's absorbed. This is the part that makes the camera expensive. The rest of the housing is relatively cheap, but sensor technology can get very expensive.

Camera cost is driven by the quality of the sensor. The higher quality and larger sensors will give you higher quality images, especially in low light conditions.

## The Photographic Triangle



There are three main sides of the photographic Triangle. All three need to be balanced to produce an image that's clear and not too blown out or too dark. The three sides of the triangle are, Shutter Speed, Aperture, and ISO. **ISO** refers to the sensitivity of your camera's sensor (or film, in traditional cameras) to light. It's one of the three pillars of exposure, along with **aperture** and **shutter speed**. Different image stylings come from choosing different setting options—like motion blur is determined by shutter speed, and depth of field is determined by aperture.

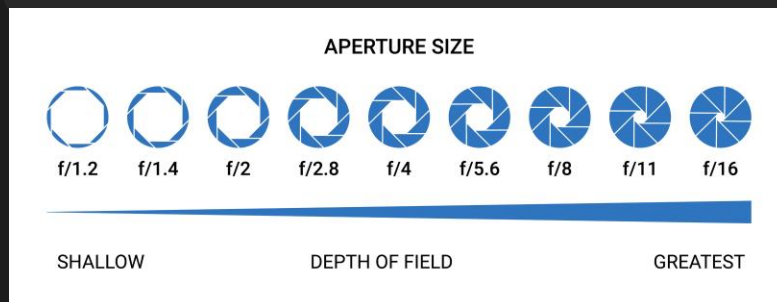


## Aperture

Aperture is the first side of the photographic triangle that we'll talk about today. Aperture is the size of the opening that lets in the light.

# Aperture

- Aperture is the opening that controls the amount of light let into the sensor.
- Measured in f-stops, written out as  $f/2$ ,  $f/3.5$ , and  $f/16$ 
  - F-stops are written as fractions so the larger the number the smaller the aperture/opening
- Aperture affects depth of field. The larger the aperture opening, the shallower the depth of field. The smaller the aperture opening, the deeper the depth of field.



Aperture is measured in f stops. Written out as fractions – the smaller the number the larger the opening.  $F/1.2$  is larger than  $F/16$

Aperture affects the depth of field. The larger the opening, the shallower the depth of field. The larger the opening the less in focus most of the image will be. You can take a picture with a nice, blurred background if you use a wider aperture. However, for portraiture you don't want too wide of an aperture and have that depth of field too narrow, because you can encounter the problem where someone's nose is in focus, but the rest of their face isn't.

# Depth of Field



70mm - f/2.8

70mm - f/4

70mm - f/6.3

70mm - f/10

Here are examples of depth of field. All of these were taken with the same lens and the only difference is the aperture opening. You can see with the wider aperture, the background is blurry, and once you get to the smaller opening everything is in focus.



## Shutter Speed

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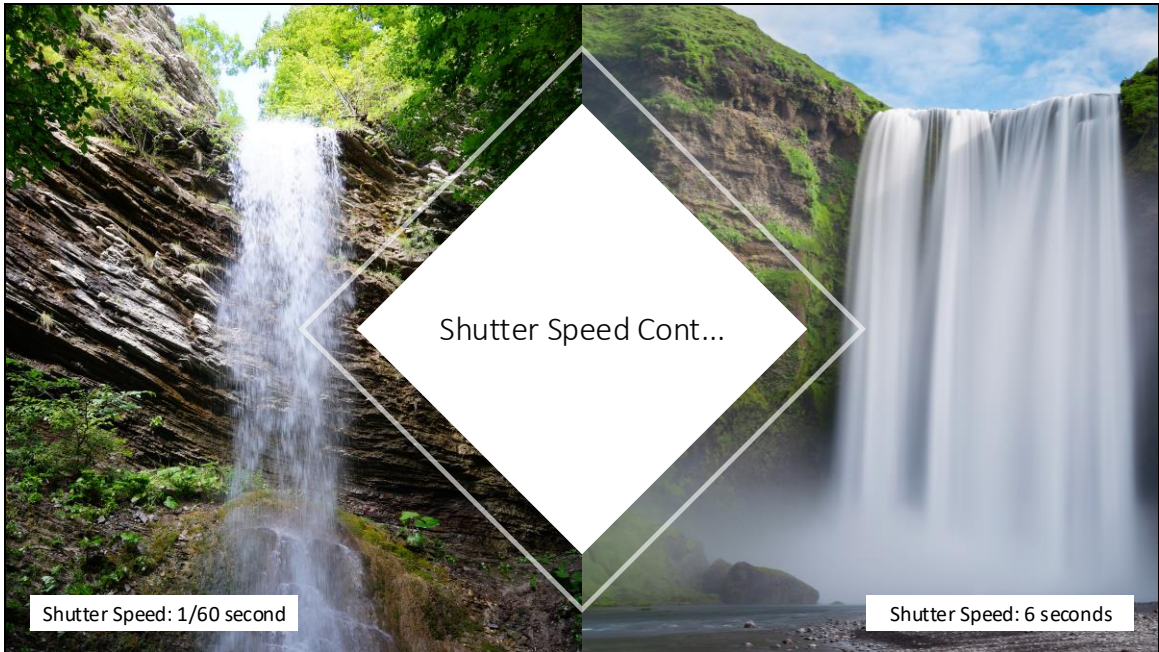
Aperture is the size of the door opening, shutter speed is the how long the door is open for.

# Shutter Speed

- Is the length of time that the shutter is open, exposing the sensor to light.
- Mostly measured in fractions of a second up to full seconds of measurements.
- Longer shutter speeds or "slow" shutter speeds increase the amount of light hitting the sensor.
  - Slow shutter speeds also create motion blur.
- Short shutter speeds are good for action shots like sporting events.
- Anything below 1/90 should be braced on a tripod

It's mostly measured in fractions of a second, up to full second measurements. The slower the shutter speed, the more light hits the sensor. The longer the shutter speed, the brighter your image will be. Short shutter speeds are good for action shots at sporting events or pets running around the house, because if the shutter speed is too long and something is moving, you can get what is called Motion Blur.

Anything below 1/90 or 1/60 of a second, you should be bracing on a tripod when you take your images. Because you can pick up some slight hand movement from just shifting.



Sometimes you can use a slow shutter speed to get a cool effect. The two waterfalls are using a fairly slow shutter speed of 1/60th of a second, but if you bump the shutter speed up to a full 6 seconds, you can make the texture of the waterfall look like silky fabric.

# ISO

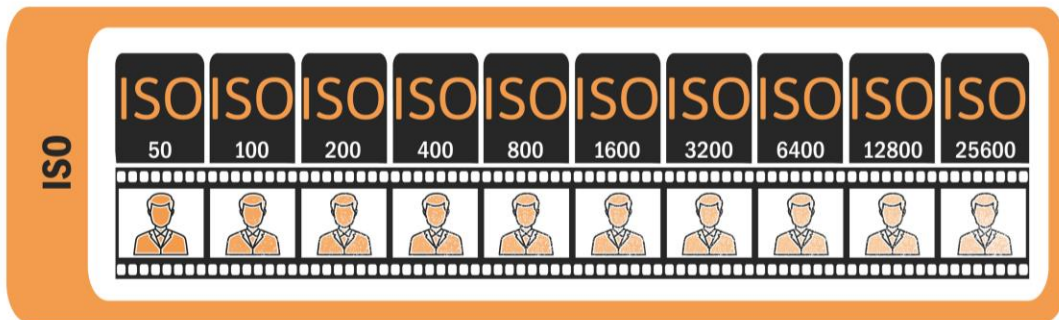


Photo courtesy of maincapture.com

ISO It's how absorbent your film (in non-digital cameras) or the sensor in digital cameras is to light. So in the days of using physical film, the first thing you'd have to do is adjust the ISO setting to match the film.

## Low ISO (e.g., 100 or 200):

Sensor is **less sensitive** to light.

Ideal for bright conditions (like daylight).

Produces **cleaner images** with minimal noise.

## High ISO (e.g., 1600, 3200, or higher):

Sensor is **more sensitive** to light.

Useful in low-light situations (indoor, night photography).

Increases the risk of **digital noise** (grainy look).

**Practical tip:** Start with the lowest ISO possible for your lighting conditions to maintain image quality, and only increase ISO when you can't get enough light through aperture or shutter speed adjustments.

On a **digital SLR (DSLR) camera**, ISO works similarly to traditional film, but instead of changing film sensitivity, you adjust the camera sensor's sensitivity electronically.

Here's how it works in practice:

### 1. ISO Setting on a DSLR

You can manually set ISO in your camera's menu or use **Auto ISO**, which lets the

camera adjust ISO based on lighting.

Common ISO ranges: **100–6400** (some cameras go much higher).

## **2. Interaction with Exposure Triangle**

**Low ISO (100–200):** Best for bright daylight; gives sharp, clean images.

**High ISO (1600+):** Used in low light (indoor, night scenes); increases brightness but adds **noise** (grain).

## **3. Why It Matters**

Raising ISO lets you shoot in darker conditions **without a tripod or flash**, but at the cost of image quality.

Lower ISO gives the best quality but requires more light or slower shutter speeds.

## **4. Practical DSLR Workflow**

**Outdoor daylight:** ISO 100–200.

**Indoor without flash:** ISO 800–1600.

**Night photography:** ISO 1600–3200 (or higher if your camera handles noise well).

## **For Film cameras: ISO = Film Speed**

Each roll of film has a fixed ISO rating (e.g., ISO 100, 400, 800).

This number indicates the film's sensitivity to light:

**ISO 100:** Low sensitivity → great for bright daylight, very fine grain.

**ISO 400:** Medium sensitivity → versatile for indoor/outdoor.

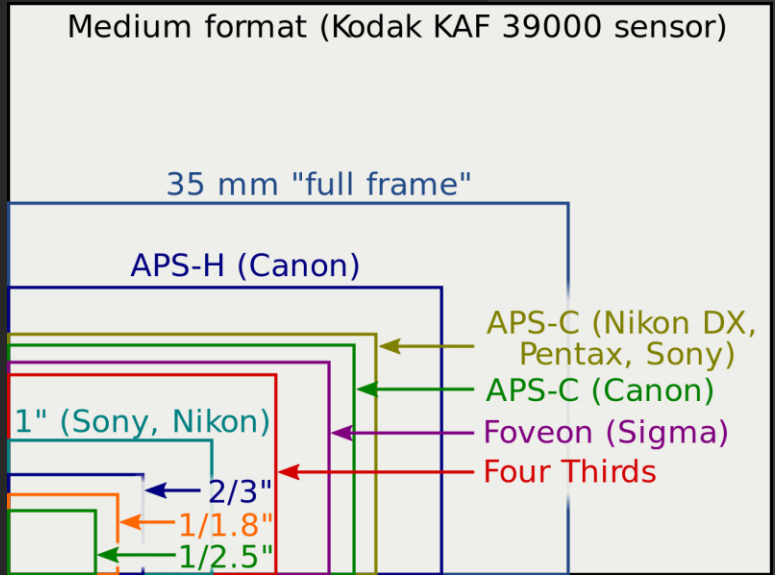
**ISO 800+:** High sensitivity → good for low light, but more noticeable grain.

# ISO

- Controls the overall brightness of a photograph
- ISO is a hold over from film photography
- The higher the value the brighter the image will be
- If the value is set too high the image might be grainy
- Measured in increments of 100

The higher the value of ISO, the brighter the image will be. The ISO on our cameras are set automatically. With digital cameras, you shouldn't have to change it. If the ISO is too high, then the image can come out grainy. This is why the higher quality sensors can take better pictures in low light.

## Sensor Size



By Sensor\_sizes\_overlaid.svg: Moxfyred erivative work: Autopil ot (talk) - Sensor\_sizes\_overlaid.svg, CC BY-SA 3.0,

Lens sizes and focal length sizes are all determined by sensor size, and unfortunately there's not really a standard sensor size within the industry.

These are a few different sizes that are available on the market. The I&RC's cameras use the Canon sensors and Nikon DX which are a little bit smaller. Sensor size can mean a higher quality image, but it doesn't always correlate. It's harder to make a high-quality sensor small (Jonah is double checking this) It's more expensive to make sensor technology super small.

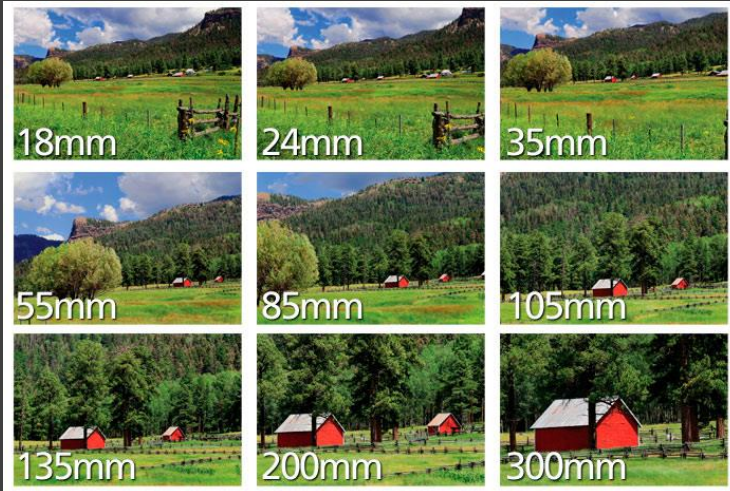
Once other common sensor size is Micro four-thirds. There are several brands that use Micro Four-thirds.

Depending on what brand of camera and sensor size you have that will affect the focal length and lenses that you'll need to use for each task.

## Lens: Focal Length

Type /Use	Ca no n Focal Length	Nikon Focal Length
Ultra Wide	20 mm	13 mm
Wide Angle	24 mm	15 mm
Landscape/ In door Portrait	35 mm	22 mm
"Normal"	50 mm	31 mm
Portrait	85 mm	56 mm
Medium Te lephoto	120mm	80 mm
Te lephoto	200mm+	135mm+

Photo by: Dave Black




This is an example of some photos taken with a Nikon camera. Regardless of what sensor size you have, the smaller the number the wider the angle will be. What's classified as an ultra-wide lens is determined by the brand of camera. For instance, for our Canon cameras, a 20mm lens would be considered ultra-wide, but for the Nikon, it would be a 13mm lens. And for standard general photography and portraits 85 mm is common for Canon cameras, and the equivalent for Nikon would be a 56mm lens.

You may notice when looking at lenses, that some are fixed, meaning they can't zoom, and other are telescopic meaning they can have a range of angles. Typically, a fixed lens will yield a better outcome than telescopic. For instance, a 55-130mm lens set to 85mm won't produce as good of a picture as a fixed 85mm lens. The blurred background and other effects can be enhanced with fixed lenses. Telescopic lenses are great for on-the-go photography – especially if you don't know what you're going to be shooting. Having a wide range of zoom options can be beneficial.

Looking at these images, they are all taken from the same tripod. The only thing that was swapped is the lens. As you can see as you get to a higher level of focal length, it zooms in much more.

# White Balance

- Correcting what the camera "sees" as white
- Changes depending on the lighting
- Can be changed while shooting or in post processing



10000 - 15000 K	Clear Sky
6500 - 8000 K	Cloudy and Shade
6000 - 7000 K	Noon Daylight
5500 - 6500 K	Daylight
5000 - 5500 K	Flash
4000 - 5000 K	Fluorescent
3000 - 4000 K	Early Morning and Late Evening
2500 - 3000 K	Tungsten Incandescent
1000 - 2000 K	Candle Flame

White balance is what the camera sees as pure white. This can be thrown off by different colored lights, like fluorescent or in older gymnasiums they have the orange tungsten lights. Auto white balance has gotten much better over the years, but there is a way to manually set this based on what light you're under – or you can take a picture of a white sheet of paper (go through the white balance settings on your camera.) By doing this you're telling your camera, this is white. So, if you're going to be indoors in one location all day, this can be very useful, but if you're switching locations a lot and you don't know what the light is going to be doing, Auto white balance is the best option.

A lot of this is about getting the best image you can when you take the picture. This way you don't have to do as much correction afterwards. To take a good photograph, you need to balance all the elements we've gone over, but the shutter speed, aperture, and ISO are the three main elements that determine how a picture will look. Then on top of that you think about things like depth of field, white balance, etc. those come after the main building blocks of the image, because if an image is too dark, it doesn't matter how beautifully the background is blurred.

## Shooting in RAW

- What are RAW files?
  - RAW files are uncompressed and unprocessed files that contain all the information captured by a camera's sensor.
- Why use RAW?
  - Allow for the highest quality final image.
  - Provide lots of flexibility in editing.
- Why not to use RAW?
  - Larger file sizes.
  - Requires editing.
  - Compatibility issues.



Now we're going to see how well we can read photographic data.



Focal Length: 135 mm  
Aperture: f/2.5  
Shutter Speed: 1/4000 seconds  
ISO: 160

Focal length: 135mm

The zoom on this image is a medium level zoom.

With an Aperture of 2.5

Is this a large or small opening. This is a larger opening because the smaller the number, the larger the opening – meaning a lot of light coming in and hitting the sensor. This might also give it a shallow depth of field.

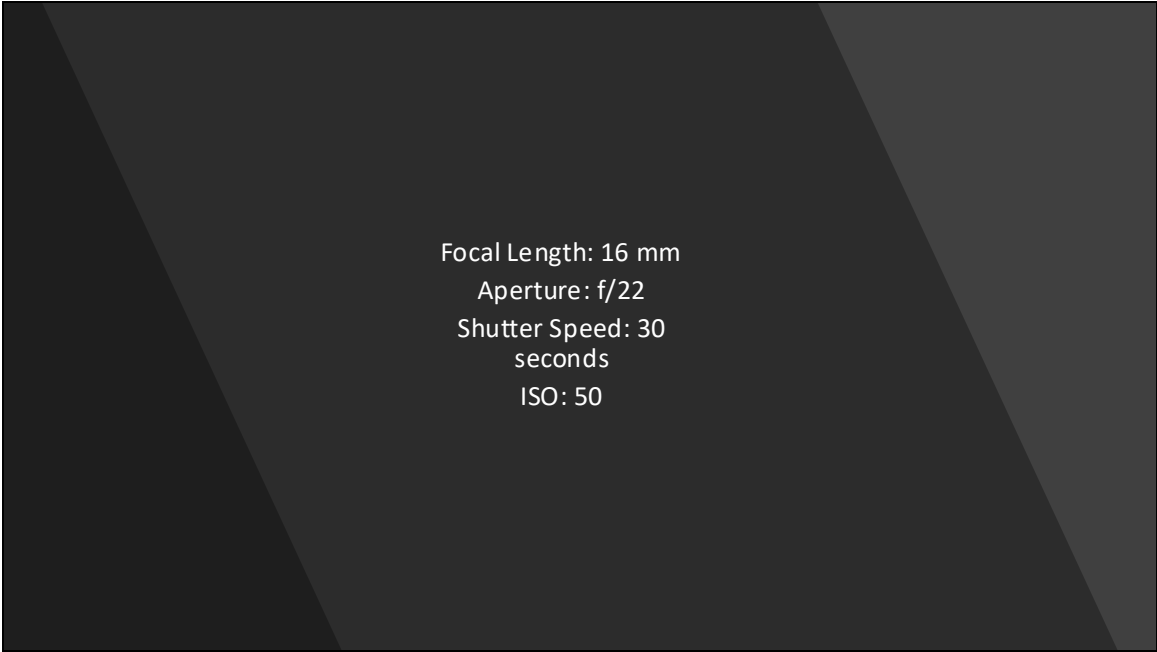
The shutter speed of 1/4000th of a second – is this fast or slower. This is a fast shutter speed, so what are some instances where you'd want a fast shutter speed?

The ISO is pretty low at 160 and so it shouldn't be too blown with the fast shutter speed and low ISO.

What do you all think this image might look like?



Since this has a wide aperture, both the background and foreground are blurred and only the cat is in focus. Since the cat is running, the short shutter speed ensures the image still looks crisp and clear.



Focal Length: 16 mm  
Aperture: f/22  
Shutter Speed: 30  
seconds  
ISO: 50

Focal Length of 16mm (fairly wide angle)

Aperture of f/22 – pretty narrow opening so not a lot of light is coming through the lens onto the sensor.

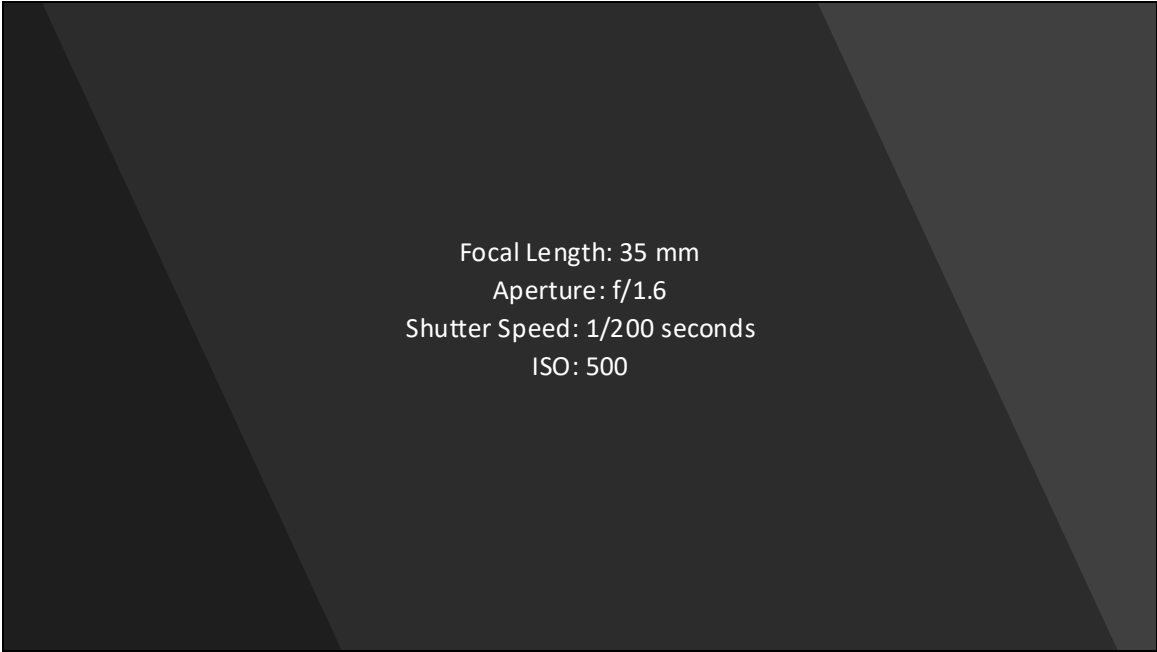
The shutter speed is 30 seconds – which is a very long shutter speed

The ISO is 50 – very low, meaning it's not absorbing a lot of light, but the shutter is open for 30 sec.

What would have 30 seconds of light?



This is an image of traffic at night, with lots of ambient light from the window and cars. The narrow aperture also ensures the cars parked in the background are in focus. Most everything is in focus, unlike the previous image of the cat where only the cat was in focus.



Focal Length: 35 mm  
Aperture: f/1.6  
Shutter Speed: 1/200 seconds  
ISO: 500

Focal length of 35mm – a little wide

Aperture at 1.6 is fairly wide – a lot of light is coming in for a shallow depth of field

Shutter speed of 1/200th second is pretty standard. This is quick enough so you won't get a lot of small movements, but the subject is most likely staying still.

The ISO of 500 is fairly high



This is a wider office shot with a person, but it's not a portrait. The background is blurred a little, but not nearly like the image with the cat. This is a low light, modern office setting/coffee shop, so you must have the higher ISO to compensate for the lower light.