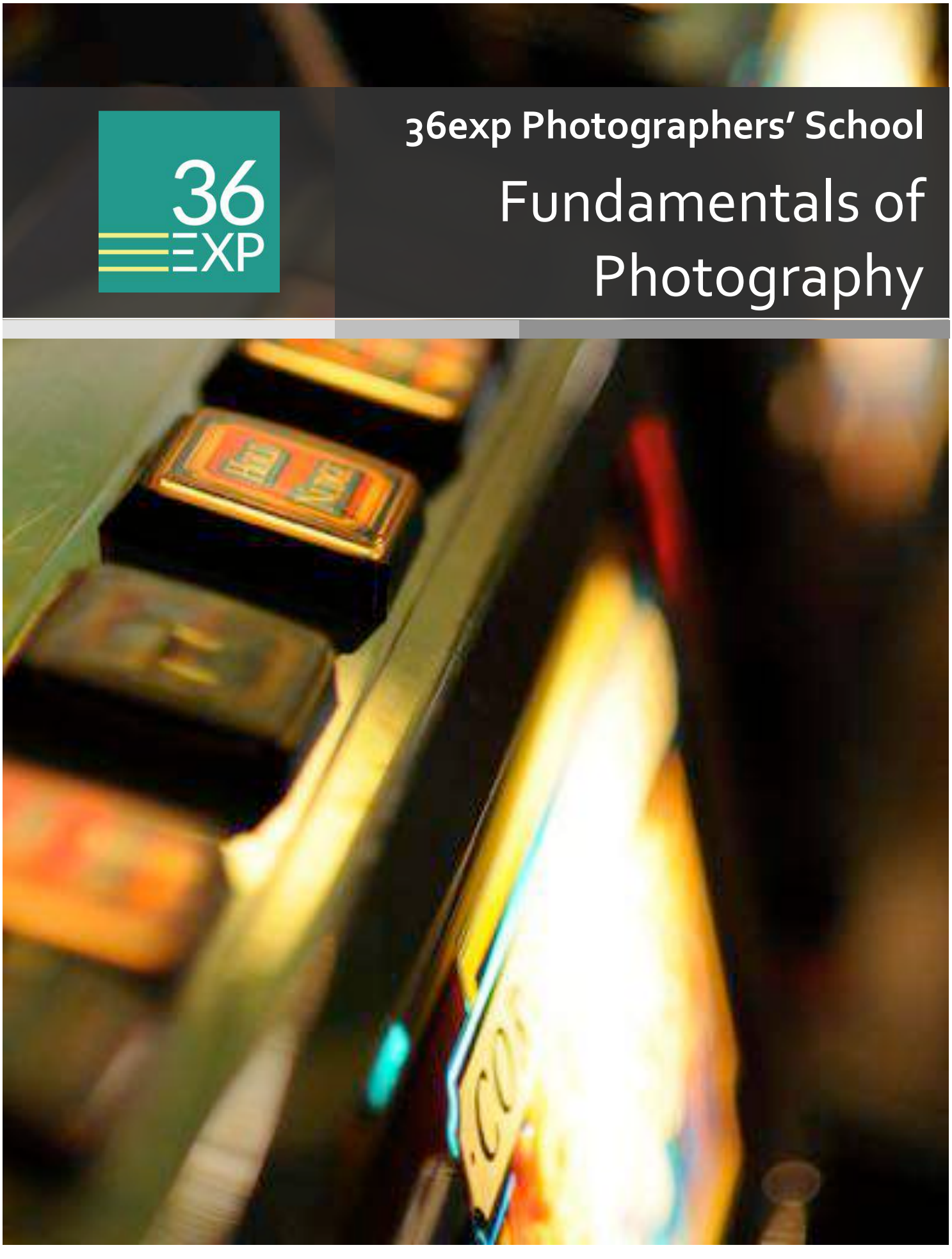
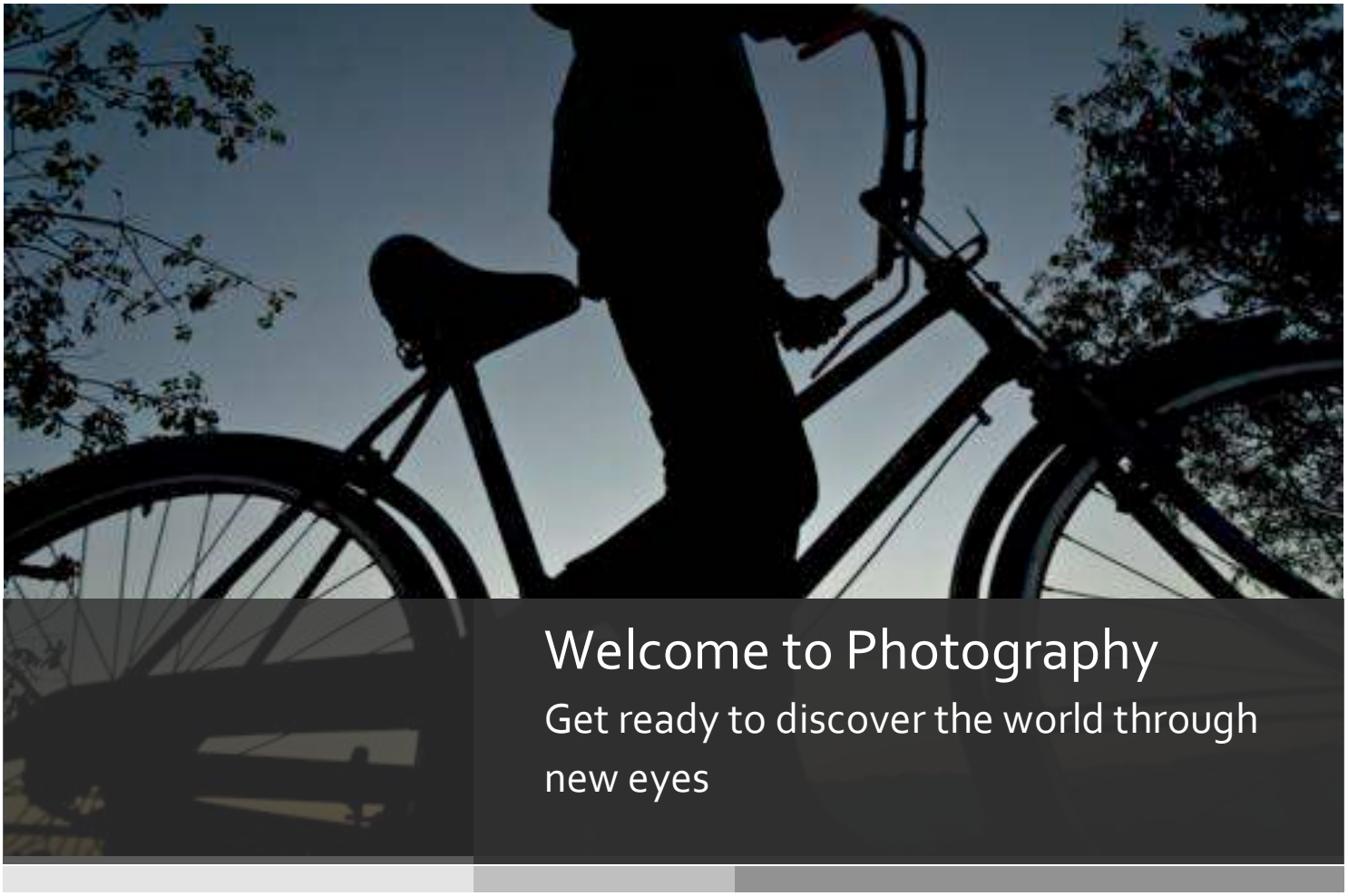


36exp Photographers' School

Fundamentals of Photography



Welcome to Photography

Get ready to discover the world through new eyes

Congratulations on deciding to understand your camera better. Now discover how to take great photos.

Our Fundamentals of Photography guide is intended to help you understand the fundamental principles of photography and to ensure that you have enough knowledge to take control of your camera so you can start taking some really amazing photos.

Photography is a unique blend of creative input and technical understanding which may seem overwhelming at first. By reading this guide you will discover the functions you need to know about on your camera, and find our how to use them to take great photos.

This guide will help you understand everything form how your camera and sensor works to how to take a great looking photo.

Along the way we'll demystify exposure, shutter speed, aperture and ISO and we'll show you how to take shots with a narrow depth of field, plus how to take photos showing movement.

Every camera is different and we've tried to show you how to access any setting you need on your camera.

Hopefully this guide is just the start of your photography journey.

The camera, sensor and resolution

Intro to Exposure & F-Stops

Aperture, Shutter Speed and ISO

Controlling exposure

Metering

Auto Exposure Modes

Exposure compensation

AF modes

Depth of Field

Motion

Auto ISO

White Balance

Metering modes

Histogram

Exposure Lock

Intro to Manual mode

Image Quality

Composition

Light

Part 1

The Camera, Sensor and Resolution

How Your DSLR Camera Works

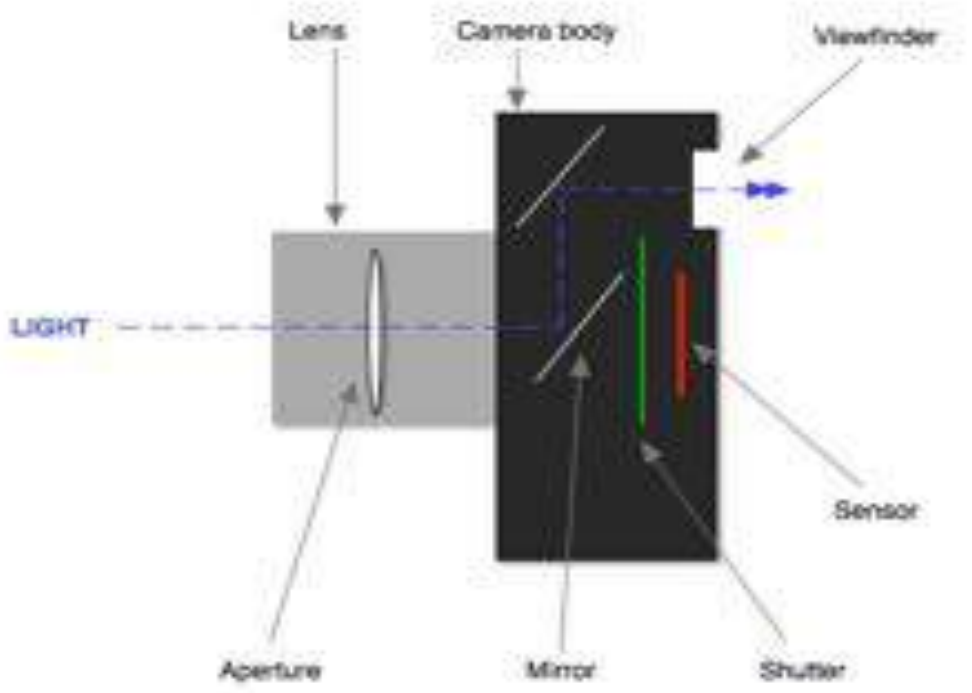
Cameras are designed to capture light and form images.

Inside your camera is some highly sophisticated and capable technology designed to help you create those images. The technology differs between manufacturers and models, but all DSLR cameras operate in a similar way. They all need a lens to focus light, and they all have a sensor to capture the light and form an image.

Inside your camera's body is a sensor on which the image is formed when it is exposed to light. Normally the sensor is not exposed to any light because it has a shutter in front of it blocking the light. When you look into your camera's viewfinder, you are actually seeing the view through the camera's lens. Two mirrors bounce light, which enters through the lens, out through the viewfinder.

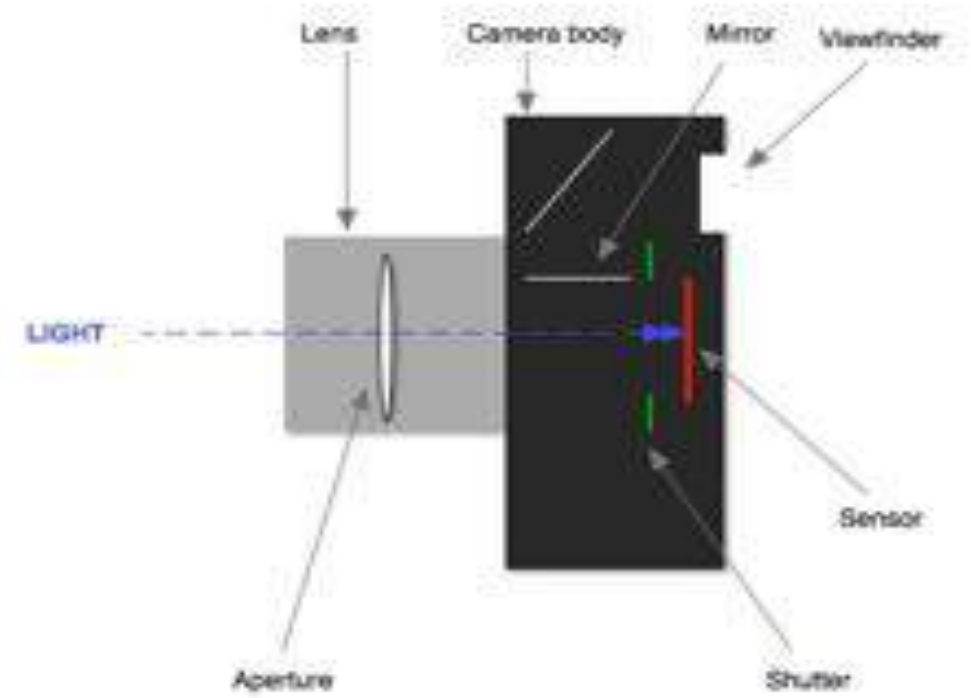
Lenses focus light onto the sensor. All lenses contain an opening called the aperture. The aperture can be made large or small, more on that later.

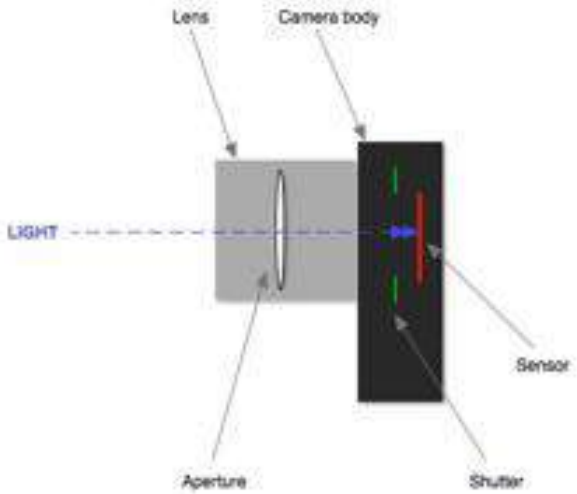
Here's a simplified diagram of a DSLR camera in its resting state, i.e. when you are not pressing the shutter button.



How Your DSLR Camera Works

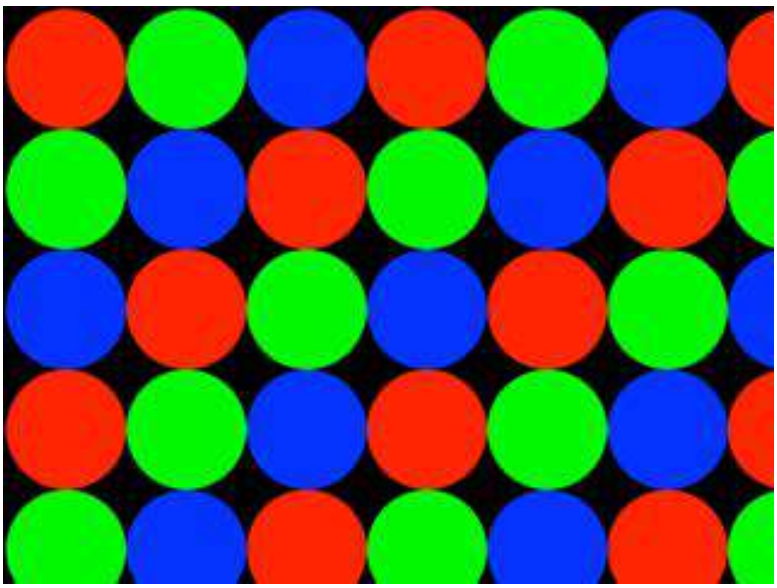
This diagram shows what happens when you press the shutter button to take a photo. Two things happen: the mirror lifts up and the shutter opens which enables light to hit the sensor and form an image.





Compact cameras don’t have the mirror mechanism, which is why they are smaller. The image you see when you look in the viewfinder or check the back of the camera is formed electronically.

The Image Sensor



A camera sensor is made up of millions of light collecting pixels. Each pixel captures a tiny dot of light.
If your camera has 18 megapixels, this means it has 18,000,000 of these light collecting pixels on its sensor.

Sensors come in different sizes. Generally bigger sensors mean better image quality. Most entry level DSLRs have what is known as an APS-C sized sensor. Professional DSLRs have a sensor that is referred to as full frame and is the same size as an old 35mm film frame. Compact cameras have smaller sensors, and phones have even smaller sensors.

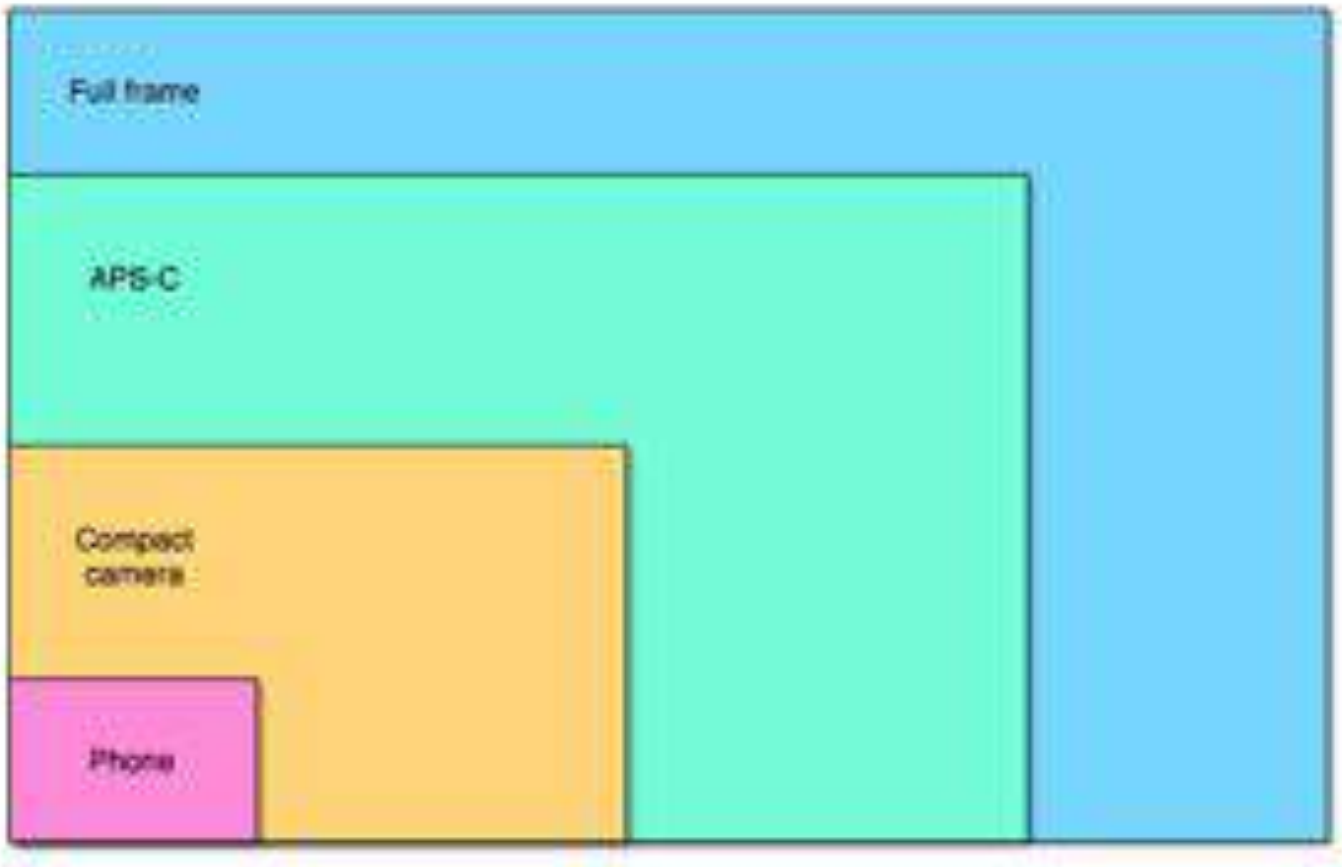


Image Sensor & Resolution

Because a camera sensor has millions of pixels it is able to capture lots of detail and colour

However, if a camera's sensor only created a few hundred pixels, the photos it produced would be made up of individual blocks.

You can see a similar effect to this if you zoom into a photo on your camera's screen because you are enlarging a small part of the photo and just looking at a few pixels.

Try It Yourself

How many pixels does your camera have?

How big is your sensor?

If you zoom into a photo a lot on your camera screen what do you see?

Exposure

Exposure is a fundamental element of photography; it refers to the exposure of your camera's sensor to light. Good exposure is one of the most important things to get right when taking a photo.

Correct exposure usually means that the sensor has received the correct amount of light to create a photo that looks similar to the scene as viewed with the naked eye.
Over-exposure usually refers to an image that is brighter than the actual scene, and under-exposure usually means the image is darker than the actual scene.

Here are three images of the same scene, each has a different exposure; because in each photo the camera's sensor has received a different amount of light.

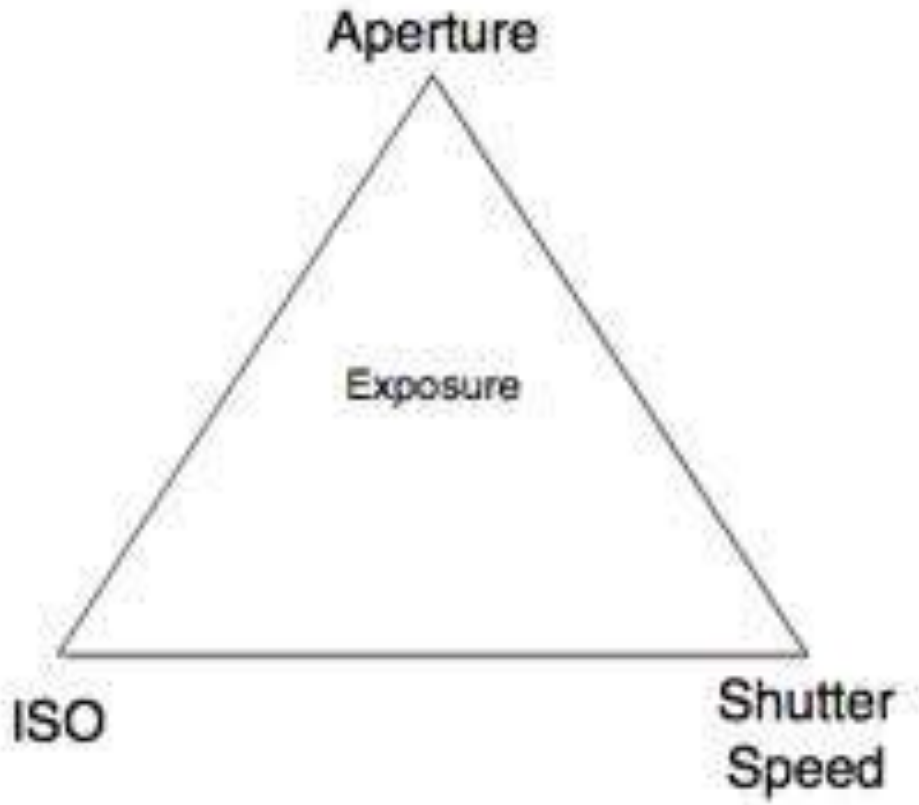
Overall, this photo is over-exposed. It is lighter than the scene appears to the eye. We have lost the detail in the clouds. However, we can see the detail in the darker part of the photo, and if this had been intentional we would say that the photographer had exposed for the shadows.

This photo is correctly exposed, on average. We lose some detail in the darker areas but most of the mid tone areas such as the sky and the tower appear as they do to the naked eye.

In general terms this photo is under-exposed. Most of it appears darker that the actual scene. We can see detail in the clouds though, which are the brightest park of the photo (the highlights), so we could also say that the photographer had exposed for the highlights in this case.

Different exposures of the same scene can result in very different looking photos.

Exposure



Two things – shutter speed and aperture; control the amount of light that hits your sensor.

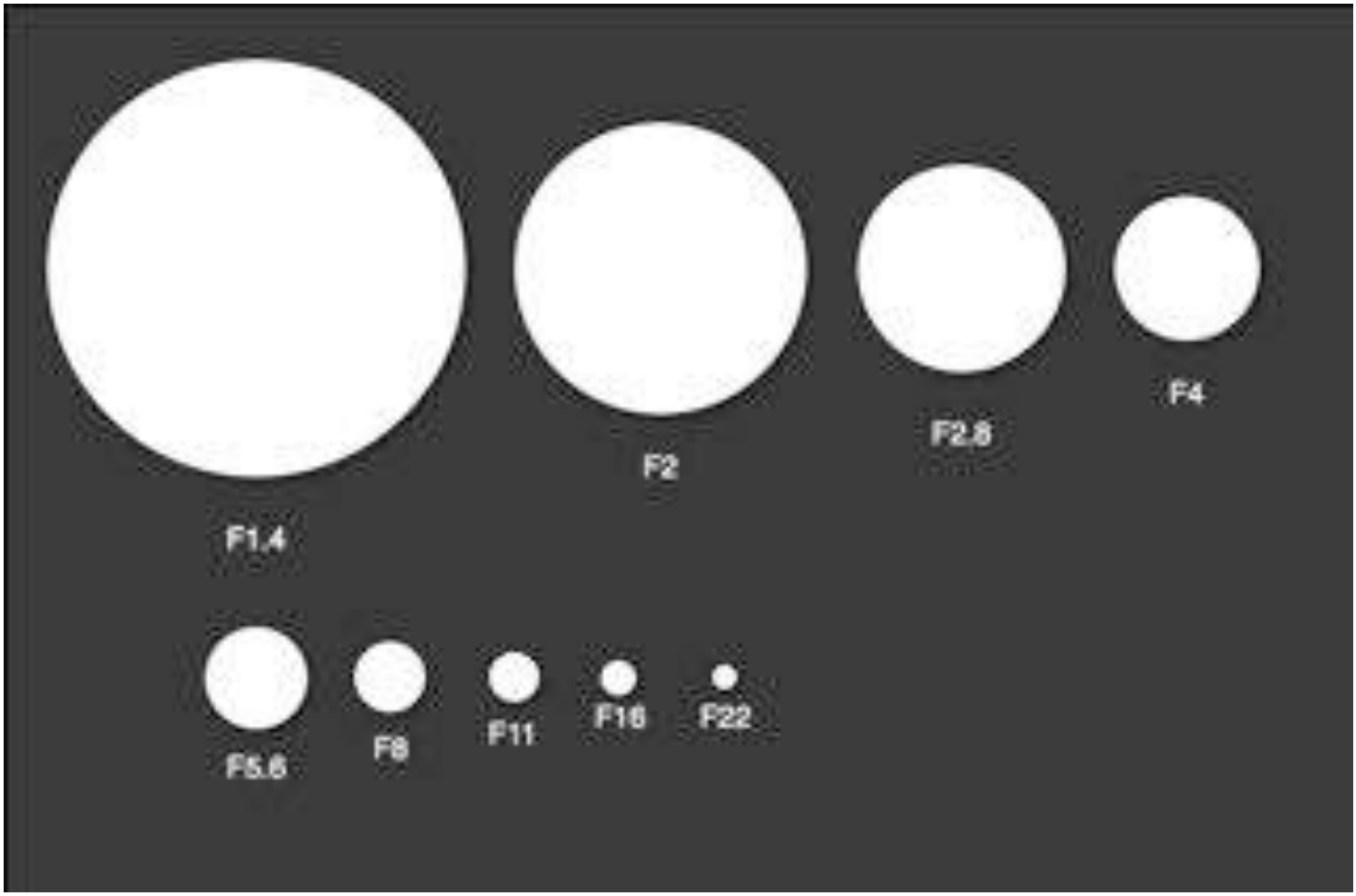
Shutter speed refers to the length of time, in seconds or fractions of a second, that the shutter is open for when you press the shutter button. The longer the shutter is open for, the more light hits the sensor.

Aperture refers to an opening in your lens. The size of this opening can be changed. If it is smaller it allows less light to hit the sensor, if it is larger it allows more light to hit the sensor.

ISO is a setting that alters the sensor's sensitivity to light. A higher ISO number makes your sensor more sensitive to light and it therefore requires less light to make a brighter image, lower ISO numbers need more light to create an image.

A common term in photography is F-stops. One F-stop means a halving or doubling of the amount of light entering the camera. Two F-stops means doubling and doubling again i.e. times 4.

Aperture & Exposure

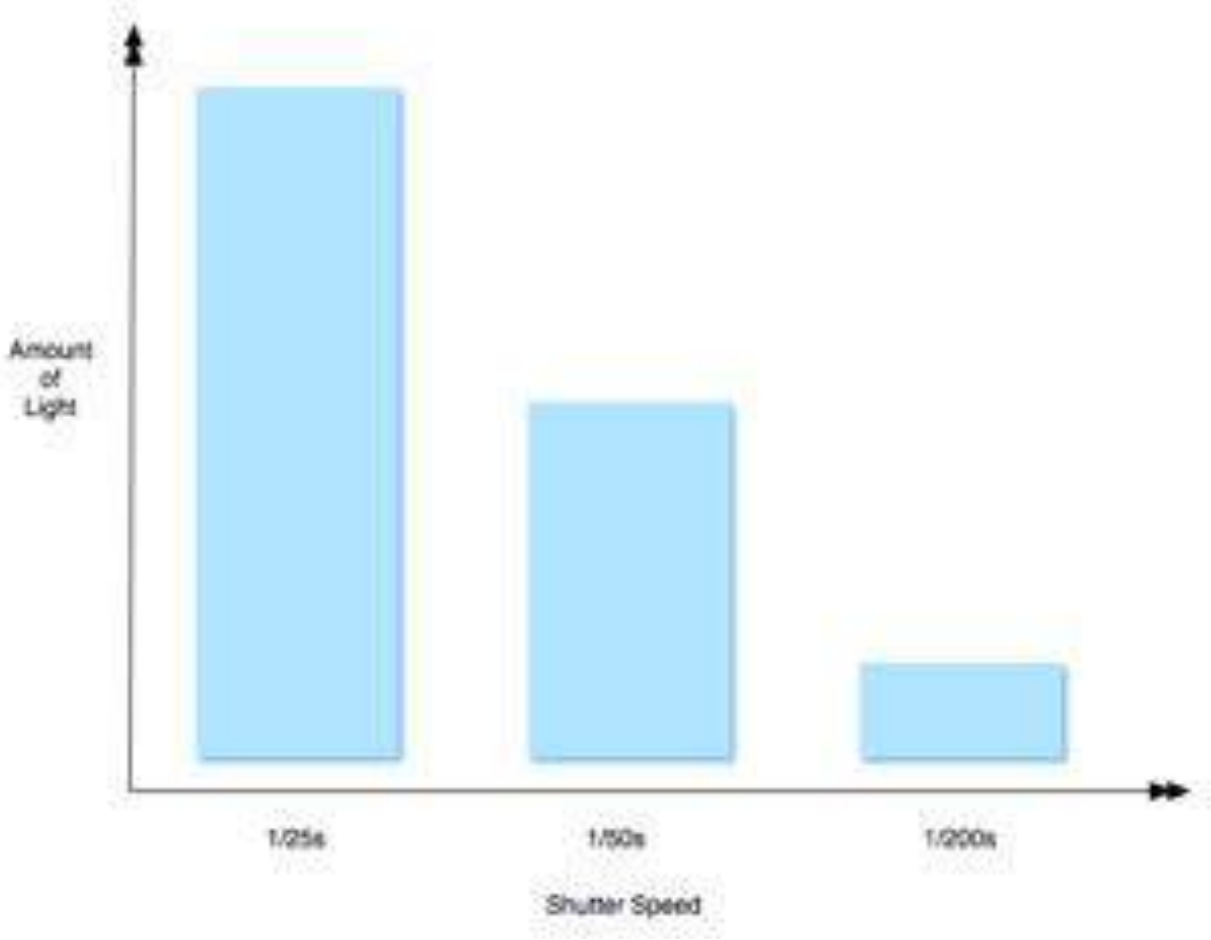


Aperture is basically a hole in your lens. You can control how big or small this hole is. If the aperture is larger it allows more light to reach the sensor, and if it is small it allows less light to hit the sensor.

Aperture is referred to by F-numbers. Smaller F-numbers mean a larger aperture. Usually the lens that comes with your camera has a maximum aperture of around 3.5.

The diagram above shows the relative size of different apertures. Each of the circles above shows what is known as a full F-stop. Each F-stop is twice as large or small as the one next to it and therefore allows twice or half as much light to hit the sensor.

Shutter Speed & Exposure

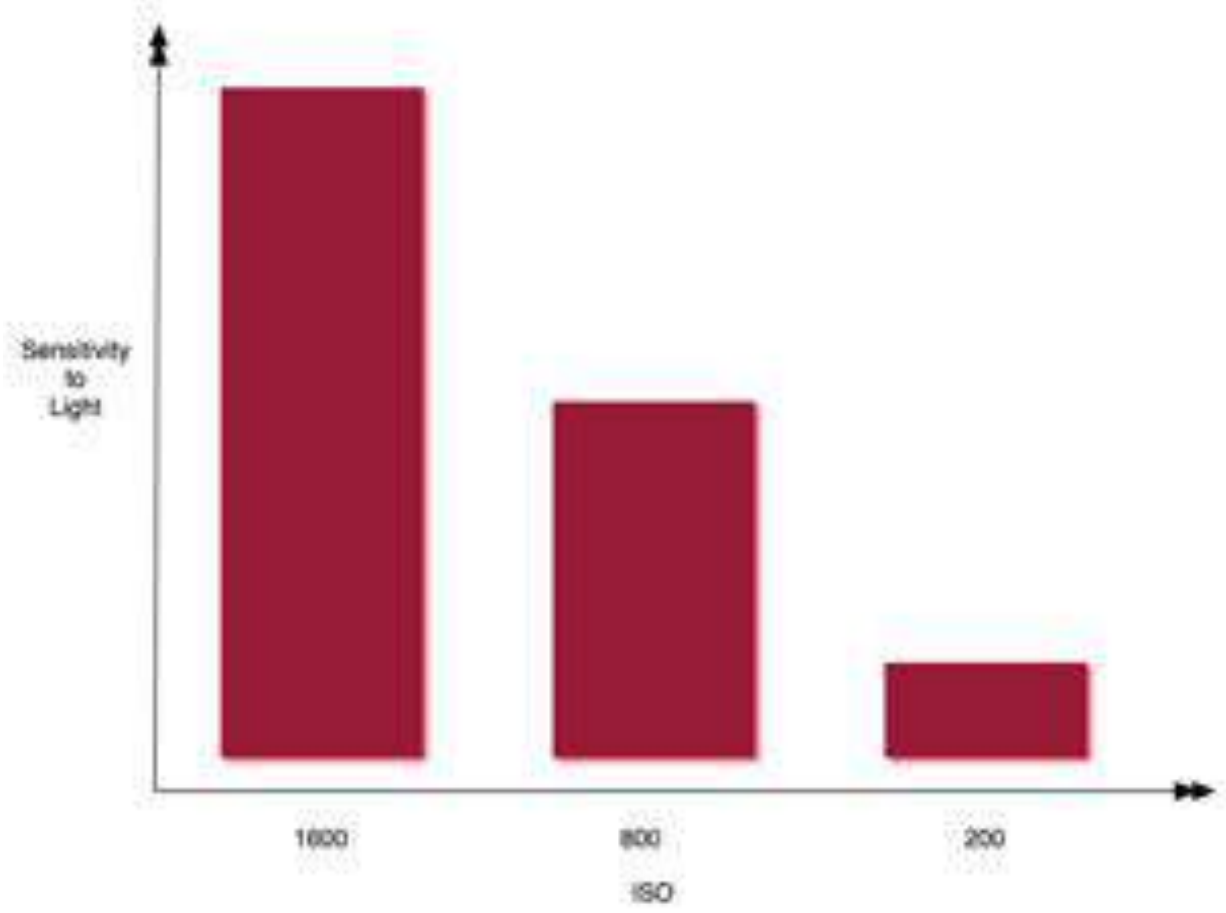


When you press your camera's shutter button, the shutter opens for a pre-determined amount of time called the shutter speed. Shutter speed is expressed in seconds or fractions of a second. Most entry level cameras have a maximum shutter speed of 30 seconds and a minimum of 1/4000 of a second.

A longer shutter speed allows more light to hit the sensor and makes the image brighter. By doubling or halving the shutter speed you can double or halve the amount of light that hits the sensor.

Doubling the shutter speed e.g. from 1/100s to 1/200s would mean you reduce the exposure by 1 F-stop. Doubling it again i.e. to 1/400s reduces the exposure by 2 f-stops from 1/110s.

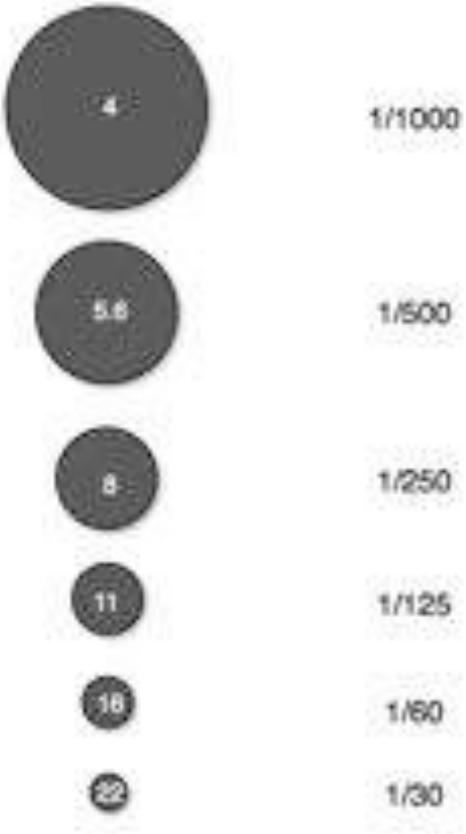
ISO & Exposure



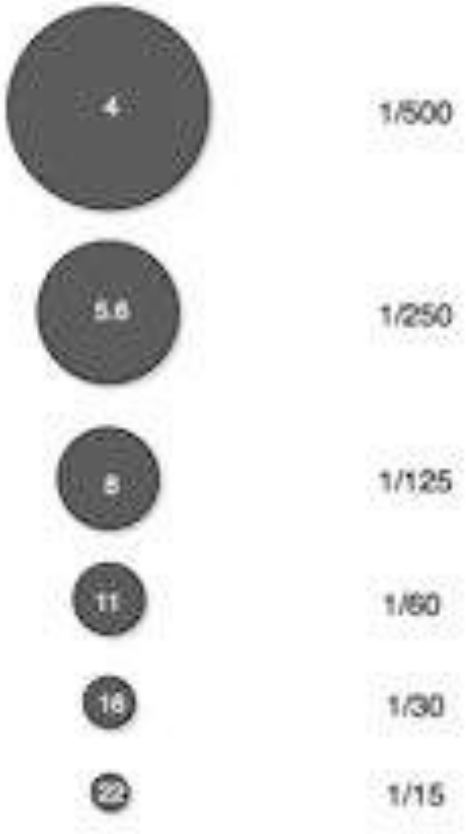
ISO is the sensitivity of the sensor to light, the lowest setting is usually ISO100, and it goes up into the thousands. Doubling the ISO doubles your sensor's sensitivity to light so it required half as much light to create the same exposure.
Lower ISO settings give the best quality images, whereas very high ISO settings result in slightly lower quality images due to noise (grain) and some colour degradation.
Because less light is needed, using higher ISO settings allow you to use faster shutter speeds, which can be useful when you don't have much light and want to avoid camera shake that is caused by using a shutter speed that is too slow.

The Relationship Between Aperture, Shutter Speed & ISO

Aperture, shutter speed and ISO combine to control how bright or dark the image is (the exposure). Using different combinations can achieve the same exposure. A larger aperture allows more light to hit the sensor and therefore the shutter speed can be increased to compensate. Theses examples explain in more detail.



Each of the setting combinations above would achieve the same exposure. If we achieve a correct exposure at F8 using a shutter speed of 1/250s we know that by doubling the size of the aperture to f5.6 will allow twice as much light to hit the sensor and therefore we only need our shutter to be open for half the amount of time; so f8 and 1/250s gives the same exposure as f5.6 and 1/500s and so on.

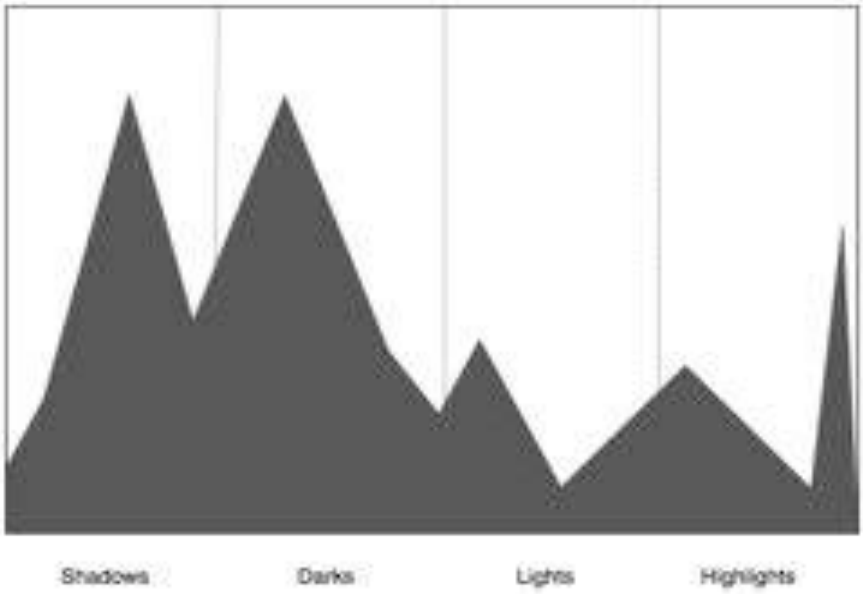


If the exposure combinations on the left were created using an ISO of 200, then these shutter speed and aperture combinations above would be the result of changing the ISO to 100. As you can see the shutter speed in each case has been made twice as long (1/500s vs 1/1000s at f4). This is because ISO100 is half as sensitive to light compared to ISO200 and we therefore need twice as much light to hit the sensor, which can be achieved by using a shutter speed that is twice as long or by doubling the size of the aperture.

How Your Camera Reads Light & Uses Aperture, Shutter Speed & ISO

Your camera has an inbuilt light meter to read the amount of light in a scene. Depending on which mode your camera is in it will use this light meter and then either choose the aperture, ISO and shutter speed combination that will achieve a correct exposure, or it will give you an indication of the settings to use.

Your camera's light meter 'sees' only tones; it then selects a combination of aperture, shutter speed and ISO that would achieve a mid tone. If a subject is dark e.g. a black wall, you cameras meter 'thinks' it is a dark scene and it will expose the scene to make it a mid grey.

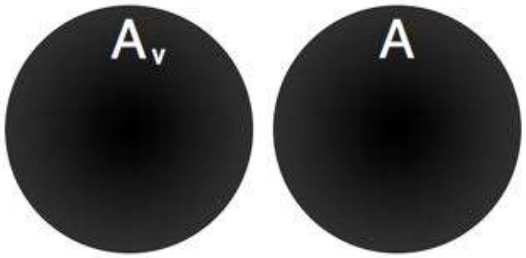


This is a histogram; it is a graphical representation of the tones in an image split into shadows, darks, lights and highlights. You can display this when you review your images and it gives you idea of the amount of light and dark areas in an image.

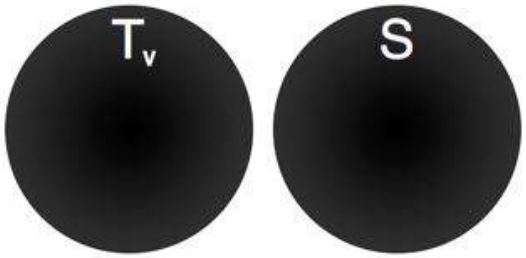
Exposure Modes

You can take varying degrees of control over how your camera chooses the settings to achieve a correct exposure. The exposure mode is selected using the dial on the top of your camera.

In Auto mode your camera choose the setting for you to expose the scene correctly. You don't get any input into the settings used.



Aperture Priority mode - Av (Canon) or A (Nikon) – lets you select the aperture and the camera chooses the appropriate shutter speed to expose the scene correctly.



Shutter Priority mode - Tv (Canon) or S (Nikon) – lets you select the shutter speed and the camera chooses the appropriate aperture to expose the scene correctly.

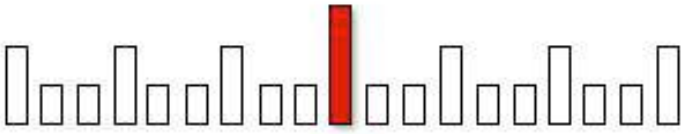
Program mode enables you to select either the shutter speed or the aperture, and the camera chooses the corresponding aperture or shutter speed.

In Manual mode you choose both the aperture and the shutter speed.

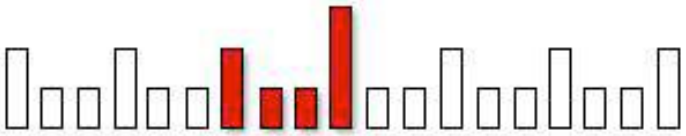
Manual Mode – Exposure Meter

In Manual Mode, although your camera doesn't change any setting for you it does give you a guide as to how much light there is in the scene. When you are using manual mode and you look through the viewfinder a scale like this is shown:

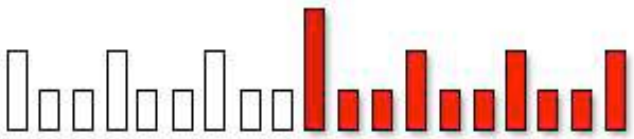
This scale is a representation of the amount of light the camera is sensing. When the large mark in the middle is illuminated this indicates a correct exposure. The medium sized marks to the left and right indicate stops of under or over exposure.



An exposure scale that looks like this represents correct exposure.



This represents a scene that would be one stop underexposed.

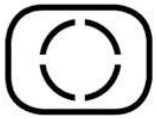


This represents a scene that would be more than 3 stops overexposed if taken at the current manual settings

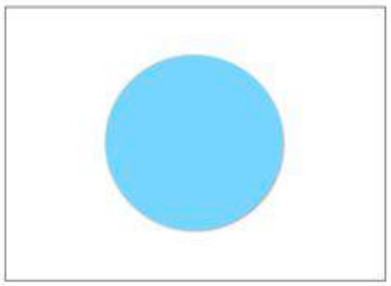
Remember that in Manual mode the camera is not going to make any changes to the settings, but it is giving you an indication of the exposure using this scale.
You can then adjust the aperture, ISO or shutter speed to change the exposure.

Metering Modes & Exposure Lock

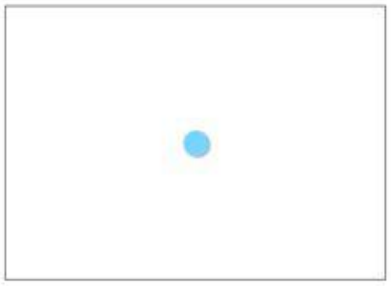
You can select which part of the scene your camera looks at to measure the amount of light it receives. To change the metering mode look for a symbol or a button like the one on the right. The main metering modes are:



Matrix or Average Metering. In this mode the camera looks at the whole scene and chooses an exposure that will have a much of the scene as possible correctly exposed. This works well for scenes that are evenly lit, but it won't work so well for high contrast scenes.



Centre Weighted. In this mode, the camera Prioritises the centre portion of the scene and Ensures that part of the frame is correctly exposed. This is useful when your subject occupies the middle of your photo.

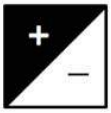


Spot Metering (and Partial Metering). In this mode the camera reads the light from a small spot in the centre of the frame. This is useful in high contrast scenes when you want to correctly expose a specific area of the photo.

Exposure Lock (AE-L on Nikon and usually the star button for Canon) can be used to great effect in conjunction with spot metering. It allows you to lock the exposure on a certain point, and then you can recompose the photo while maintaining the locked exposure.

Exposure Compensation – Over Exposure To Brighten Shadows

If you find that you'd like to brighten or darken the way a photo looks this can easily be achieved using exposure compensation. Pressing a button that looks like the one on the right accesses this.



Exposure compensation is useful particularly when using matrix metering mode.
If you encounter a scene which is strongly backlit, and the background is much brighter than your subject, e.g. on a sunny beach with your friend in shadow, you will often find that the background is well exposed but your subject is too dark. This is because the camera's matrix metering is basing the exposure on the majority of the scene, which is very bright.

Your photo may look something like the one, with your subject silhouetted against the perfectly exposed background.

You can overcome this by setting exposure compensation to +2 which we did for the photo. This has the effect of brightening the overall exposure by 2 stops (4x brighter) and it means that the dark areas become well exposed and the bright areas are now over exposed. Because we care more about the dark areas in this example, that's a good thing.

Achieving an exposure that prioritises the dark areas of the photo is called exposing for the shadows.

Exposure Compensation – Under Exposure To Darken Highlights

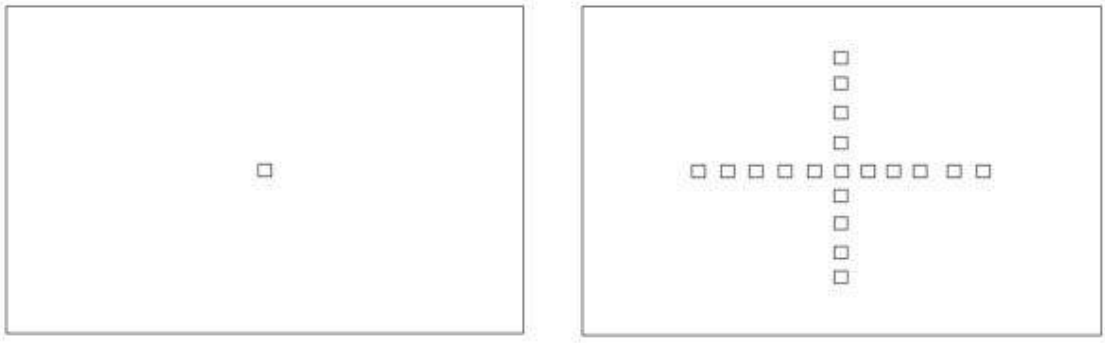
No exposure compensation vs minus 2 exposure compensation

You can use the minus side of exposure compensation to make bright areas look better in your photo. This works well in bars and rooms that have atmospheric lights.
Matrix metering makes the dark area brighter and also causes the bright areas to become very bright. By selected -2 in exposure compensation you can make the dark area go very dark, which is fine in this example, and ensure the bright areas are well exposed which works well when you want to emphasis atmosphere.

Achieving an exposure that prioritises the light areas of the photo is called exposing for the highlights.

Autofocus Modes

Most cameras enable you to either select one single point of focus or choose to allow the camera to pick the point of focus.



By using auto area focus mode the camera will make the decision as to what should be in focus. By selecting single point autofocus you choose the exact point in the photo that will be in focus.

Additionally you can choose single shot auto focus or focus tracking. Single shot (AF-S) focus can be locked by you. Continuous focus (AF-C or AI Servo) will attempt to track a moving subject and adjust focus as the subject moves.

In single shot (AF-S) focus mode you can lock focus by half pressing the shutter button, you will hear a beep and see a green focus confirmation dot in the viewfinder when you achieve this. You then fully press the shutter to take the photo. This is useful when you want to choose the focus point. If you are using single point autofocus you can place the focus point on your chosen subject, lock focus by half pressing the shutter button, and then you can recompose the photo to have your subject in focus but on the edge of the frame. The subject will stay in focus while you hold the shutter button, and the image will only be taken when you fully press the shutter. Single point and single shot (AF-S) autofocus modes make a good combination when you want to be in control of what is in focus when shooting static objects.

In AI Servo (AF-C) autofocus mode, when you half press the shutter button, instead of locking focus, the camera will try to maintain focus on the subject even if it moves. This is a useful mode combined with auto area, if you are taking photos of subjects that are moving around a lot because you have a better chance of having your subject in focus even if they move closer or further from the camera.

When To Use Aperture Priority – Depth Of Field Control

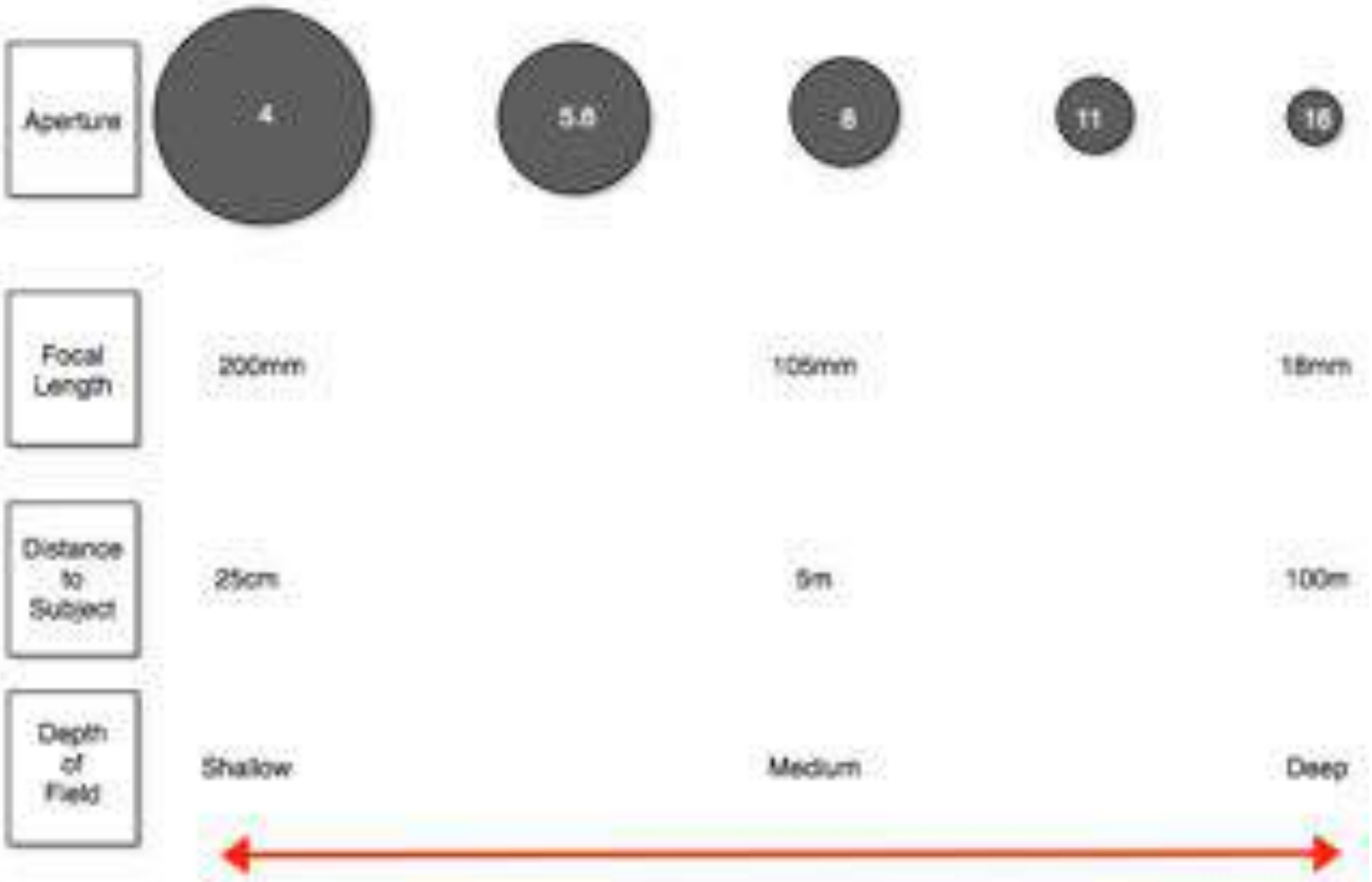
By using Aperture Priority mode you chose the aperture and the camera selects the correct shutter speed to achieve a good exposure.

In addition to influencing exposure, aperture also has a huge impact on depth of field (the amount of an image that in focus). Selecting a large aperture (small F number) will enable you to achieve a shallow depth of field. By using a small aperture (large F number) you will get a wide depth of field.

Focal length and distance to subject also play an important part in depth of field.

To achieve the shallowest possible depth of field you should combine a long focal length (e.g. 55mm or even 200mm) with a large aperture and get relatively close to your subject with the background far away.

This diagram summarises the influence of aperture, focal length and distance on depth of field:



Depth Of Field

In this photo, a very shallow depth of field was achieved by using an aperture of F1.8, an 85mm lens and by being close to the point of focus, plus shooting across the machine to create distance between the buttons.
Foreground and background are out of focus.

Large depth of field achieved by using F11, a 24mm lens and by being further away from the subject.
Foreground and background are in focus.

When To Use Shutter Priority – To Freeze Or Blur Motion

In Shutter Priority mode you choose the shutter speed and the camera selects the correct aperture to achieve the right exposure. Taking control of shutter speed yourself enables you to control how much motion blurt appears in your photo.

Using a slow shutter speed (1/40s in this example) allows you to show motion blur. This is a good way of illustrating movement.

Using a fast shutter speed (1/4000s in this example) will freeze any motion, which is good if you want to show detail in moving objects.

Camera Shake

Camera shake occurs when you use a shutter speed that is too slow for you to hold your camera steady for the duration of the shutter being open. This results in a blurry photo. As a rule of thumb, never use a shutter speed which is less than the focal length that your lens is set at e.g. use at least 1/100s if your lens is set to 100mm, or 1/25s if your lens is set to 25mm.

ISO & Auto ISO

In Aperture Priority, Shutter Priority, Programme and Manual modes you can set the ISO yourself. Using a lower ISO gives you the highest quality images, whereas using a very high ISO setting results in some loss of image quality mainly due to noise. The image to the right was taken at ISO3200 and shows colour speckles in areas, which is noise. Always try to use the lowest possible ISO setting that lets you use a fast enough shutter speed to get a sharp (not shaky) shot.

Auto ISO is an incredibly useful setting, especially in Aperture Priority mode. By selecting auto ISO you let your camera choose to raise the ISO instead of decreasing the shutter speed to achieve a correct exposure.
For example, in Aperture Priority mode you may select a small aperture that requires a slow shutter speed to achieve a good exposure if you have also manually selected a low ISO. However, if you have selected Auto ISO, the camera will automatically raise the ISO instead of lowering the shutter speed, and will prevent you from taking a photo that shows camera shake.

White Balance (WB)

The same photo with different white balance settings.

The colour of light from various sources is different, and the human brain can work this out. We see the light from the sun and from fluorescent bulbs as white, however the light from fluorescent tubes actually has a green tinge; your brain automatically corrects for this.
Your camera sees light exactly as it is so it has different white balance settings for use in different lighting conditions. This includes daylight, flash, cloudy, fluorescent, shade and more. You should ensure the white balance setting of your camera matches the type of light you are in. Luckily your camera also has an Auto White Balance setting (Auto WB). This setting is remarkably good at working out the correct white balance in most situations, but if you find that the colours in your photo don't match what you are looking it could be due to an incorrect white balance being used.

Composition – Rule Of Thirds

Mastering the technical aspects of your camera is one thing. Taking a great looking photo is another. Fortunately a little knowledge of composition will get you a long way towards taking more interesting photos.

One simple and hugely effective composition principle is the **Rule of Thirds**. Images that are divided into thirds are nicer to look at than photos which are divided into halves or quarters.

The rule of thirds means dividing your frame into thirds, both horizontally and vertically, like this:

This can be applied to photos taken in both landscape and portrait orientation.

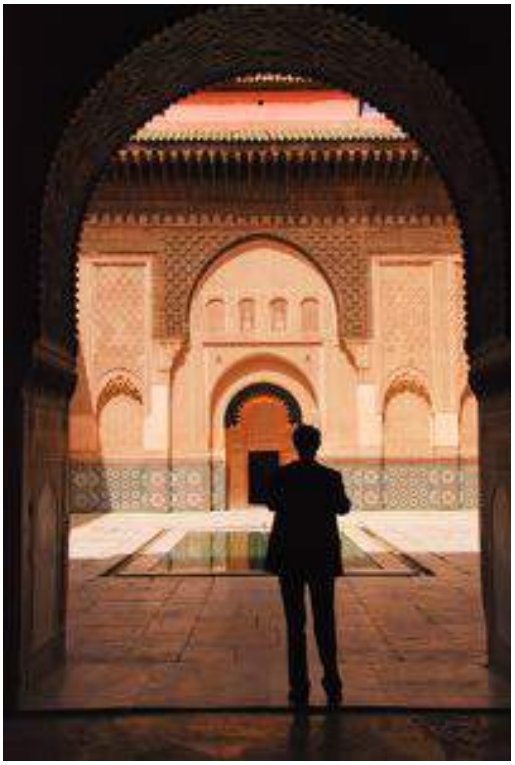
You don't have to have three thirds, dividing the frame into a top third and a bottom two thirds also works really well.

Additionally, placing important elements of your photo across the dividing lines works well too.

In the photo on the left you can see that the horizon is placed along the top third line, and also that the boat is where a horizontal and vertical third line cross. This is a great way to use the rule of thirds.

Composition – Frames and Leading Lines

Using **frame**s is another useful compositional technique. Look for frames and arches created by buildings or be more creative by using a structure in the foreground to create a more abstract frame.



Leading lines are lines that take your eye on a path through the photo. Look for anything in a scene that can be used to create a leading line. Curved lines taking your eye to a point or subject in the distance work well.

Composition – Depth & Diagonals

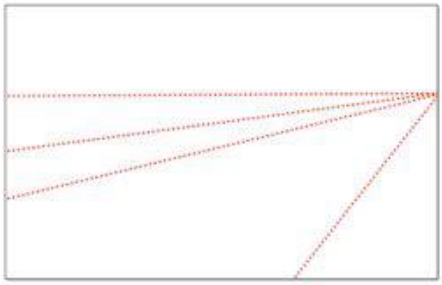
Looking at a photo on a screen or in a print is flat experience. Try to give your photos a sense of **depth** by including foreground, middle ground and background.

Diagonals look more interesting than vertical or horizontal lines, so try to incorporate them when you can.

Composition – Shapes

Having strong **shapes** in your photo gives structure that helps the eye to make sense of the image. Triangles and curves work well in particular.

Triangles can be created from lines in the scene, and the edge of the frame can use used as one of the sides of the triangle. You can see several triangles in this photo.



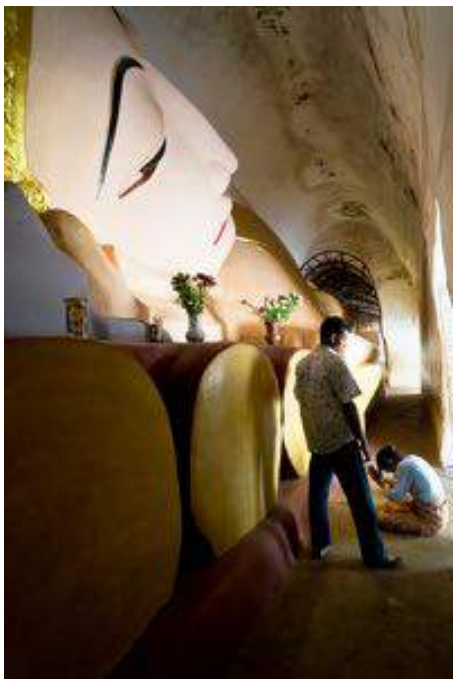
Focal Length & Lens Choice

Zoom lenses have a range of focal length that enable you to get more into your photo or zoom in to make you subject bigger in the frame. The lens on most entry-level cameras has a zoom range of 18mm to 55mm. Focal length is the zoom setting of the lens e.g. 24mm is a focal length.
Shorter focal lengths e.g. 18mm are called wide angle, they allow you to get more into your photo. Longer focal lengths e.g. 200mm are called telephoto. They make subject appear closer. An 18-55mm zoom lens has a focal length that is quite wide to moderate telephoto.

Focal length also impacts the relative size of things in your photo.

The photo on the left was taken using a focal length of 35mm. On an entry-level camera this gives a normal angle of view, which is the same as you see it with the naked eye.

The photo on the right was taken using a wide-angle focal length of 14mm. You can see that the foreground looks large in comparison to the people and the background which look small and further away.



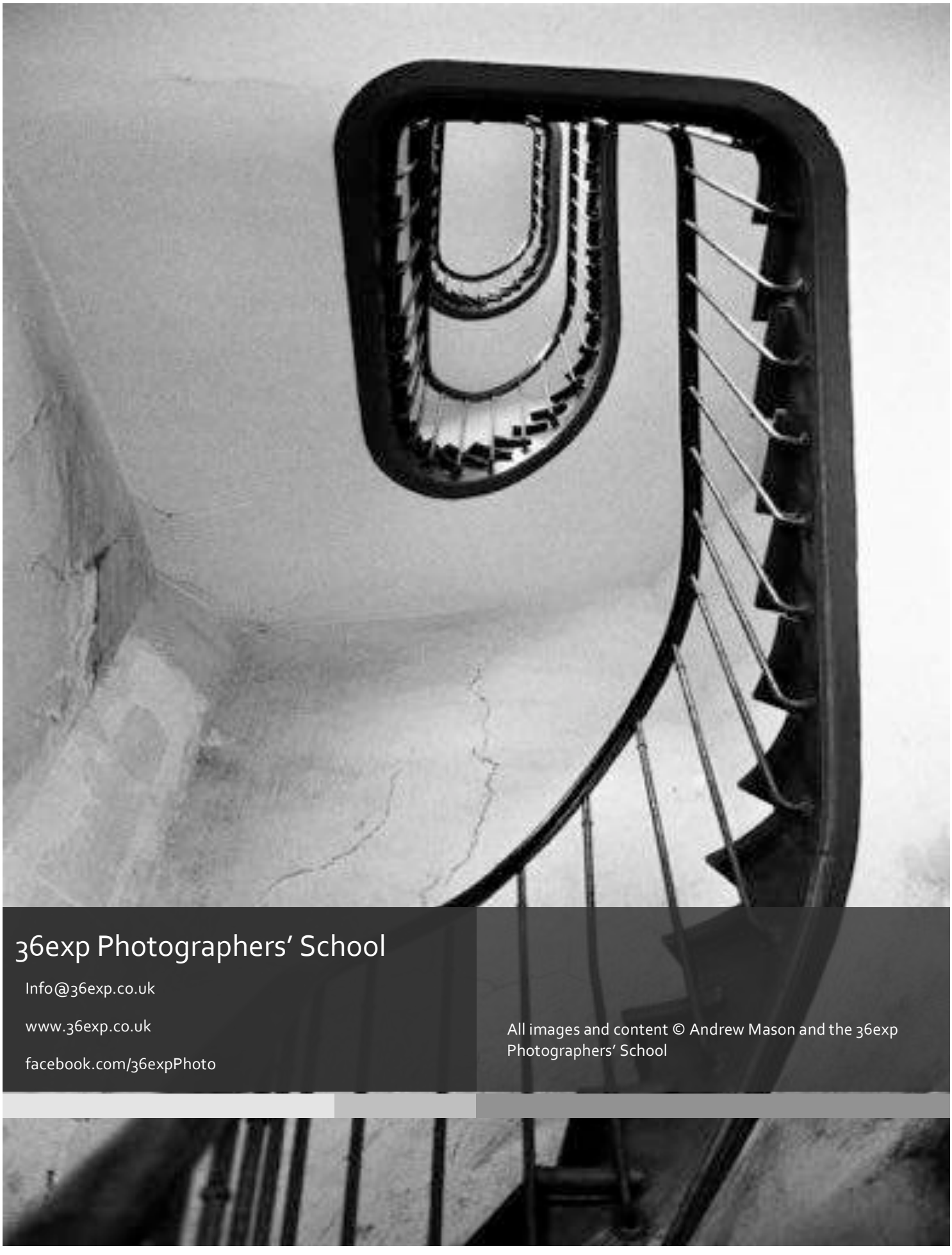
This photo was taken using a 200mm lens, which is a telephoto focal length. The scooter riders look relatively close together and of a similar size, even though they are at different distances from the lens.

Image Quality Settings – JPEG and RAW

By default your camera records images to your memory card as a jpeg. Jpegs are standards file types that can be viewed on all sorts of devices from phones to PCs. They are ready to use straight out of the camera. You can choose the quality of the jpeg and select small, medium or large which alters the dimensions of the jpeg; you can also change the quality of the jpeg to be low quality and high quality; this alters the resolution of the jpeg. Most of the time high quality and large jpegs should be selected. Jpegs are super convenient. They are ready to go straight out of the camera and can be uploaded to Facebook, emailed or printed without the need for any messing around on your computer.
The downside is that, although you can make some small changes to your photos on your computer, the final look of the photo is pretty much fixed by your camera. They don't give you a huge amount of flexibility if you want to correct or edit your photos.

Raw files are basically data. Your camera collects as much data as possible from the scene and shows you a version of it on the back of your camera. Raw files needs to be processed after you take them. Most computers can handle this, but you can't upload a raw file to Facebook for example. Each camera manufacturer has it's own raw format. The advantage of raw files is that they allow much more flexibility for editing. You can, for example, easily change the white balance to anything you want, and you can bring back detail in over exposed or underexposed areas of your image. The downside is that they take up a lot more space on your memory card due to the additional amount of data.

In the example below we have edited the exposure of the photo in Photoshop. In the edited photo on the left you can now see detail in the sand that is not visible in the original photo on the right. If we did the same thing to a jpeg the light areas would have become darker, but we would not have recovered the detail.



36exp Photographers' School

Info@36exp.co.uk

www.36exp.co.uk

facebook.com/36expPhoto