THE BASICS OF PHOTOGRAPHY

GETTING THE EXPOSURE RIGHT.

That means, the picture is neither too dark nor too light!
In the old days of film cameras, it was how much light is allowed to reach the light sensitive film. In digital cameras, the ‘sensor’ replaces the film but the principle is just the same – you have to control how much light hits the sensor.

What controls exposure?
There are three things which control exposure:
1. The aperture
2. The shutter speed
3. The setting of the ISO

More about these in a moment.

If you select ‘Full auto’ on the camera dial, all of these settings will be selected automatically – you don’t need to worry about anything as the inbuilt meter in the camera will measure the light and set things accordingly.

So why do you need to understand about apertures, shutters and ISO settings?
Well, each of those things enables you to be more creative and get the picture just as you like it.
So let’s look at each of these things, one at a time, and understand what they do.

1) THE APERTURE
Inside the lens, is a mechanism that opens to allow light to pass through the lens into the camera (and onto the sensor). The amount or size of the opening varies and is referred to as an ‘f’ number, for example f2, f2.8, f4 etc.
The range of apertures is shown below:

f1.4, f2, f2.8, f4, f5.6 f8, f11, f16, f22, f32

It is not important to understand what these numbers mean but what can be seen from the pictures below, is that the smaller the f number, the bigger the opening and the more light allowed in.
The other important thing to understand about f numbers is that each step in the f number scale, lets half as much light in. So for example, f2 lets in twice as much light in, as f2.8. Similarly, f22 allows only half as much light in, as f16.

So why is it important to understand about apertures? Why would you want to control the aperture rather than leave it up to the camera to select it in automatic mode?

Well the aperture opening determines the ‘depth of field’ in a photograph. Now you’re thinking, what the hell is depth of field, I’d got enough to think about with apertures, shutter speeds and ISO.

It’s really quite easy to understand. When you focus on a subject, a certain distance, both in front of the subject and behind the subject is also in focus. This area is called the depth of field.

So, by controlling the aperture, you can determine how much of the picture is in focus and use it to be creative.

For example, if you were taking a picture of a landscape, you would want the depth of field to be as big as possible, so from close foreground to distant background is in focus.

On the other hand, if you were taking a portrait of someone in a crowd, you might want to have a very shallow depth of filed so your subject is isolated from everyone else around them.

The thing to remember is that the smaller the f number, the shallower the depth of field.

**Small f number = big opening = shallow depth of field = less of the picture in focus**

**Large f number = small opening = greater depth of field = more of the picture in focus**

To demonstrate these principles, look at the pictures below and on the next page.

On the picture below, look at how the leading rider is in focus and the following riders are out of focus. This is because a large aperture setting of f3.5 created a very shallow depth of field.
Both pictures were taken with the same lens, from the same position and with the same ISO selected. On the picture above, the aperture was set to f2.8 and below, the aperture was set to f22. The top picture isolates the subject against an out of focus background because it has a shallow depth of field whereas the one below has a greater depth of field, with the background, whilst not entirely in focus, far more in focus than the top picture.
2) THE SHUTTER SPEED

So now you understand about apertures, let’s look at the second thing which controls exposure – shutter speed.

We’ve already learned that the size of aperture lets varying amounts of light into the camera, depending on what we set it to.

Inside the camera is a shutter, which is a bit like a curtain and opens, usually for a split second and then closes. The sensor in the camera is exposed to the scene it sees through the lens and the detail is captured and saved as a picture on the card in the camera.

The time the shutter is open is called the shutter speed and is normally stated in fractions of a second:

\[
\frac{1}{4} \quad \frac{1}{8} \quad \frac{1}{15} \quad \frac{1}{30} \quad \frac{1}{60} \quad \frac{1}{125} \quad \frac{1}{250} \quad \frac{1}{500} \quad \frac{1}{1000} \quad \frac{1}{2000} \quad \frac{1}{4000}
\]

The range shown above is by no means the limit of possible shutter speeds, as they can be several seconds long (or even hours!) and they can be incredibly fast, say \( \frac{1}{10000} \). But the range shown above is more normal. It’s also worth noting that on the camera, they will be shown as 4, 8, 15, 30, 60 etc, rather than as fractions. If you go down to really slow shutter speeds of seconds rather than fractions of seconds, the camera shows them as 1”, 2”, 3”.

In the same way steps in aperture settings allow twice as much or half as much light in, shutter speeds are exactly the same. So, for example, a shutter speed of 250 allows half as much light to hit the sensor as 125 and twice as much as 500.

You may hear these steps referred to as ‘stops’. So a shutter setting of say, 30 is one stop from 60 and similarly in the other direction, one stop from 15.

So, the same question as with apertures – why would you want to control the shutter speed rather than leave it up to the camera to select it in automatic mode?

Shutter speed controls the ‘movement’ in a picture and there are two reasons why you need to think about this.

Firstly, you have to try and hold the camera steady when you take a picture, otherwise your picture may be blurred. This is often referred to as ‘camera shake’, where the whole picture is blurred because the shutter speed wasn’t fast enough to counter slight movement the instant you took the photograph. It is generally accepted that a shutter speed of 60 or faster will avoid camera shake. Whilst this is a general rule, the longer the lens, the more susceptible you are to camera shake and the faster the shutter speed should be to avoid it. So for example, if you have a 200mm lens on the camera, it is wise to have a faster shutter speed of say 200. The alternative to setting a relatively fast shutter speed, is to mount the camera onto a tripod to keep it steady.

Secondly, you need to think about whether the subject itself is moving. If you are taking a portrait for example, there is no need to have a fast shutter speed. On the other hand, if you are taking a picture of a Formula 1 car, you may need a shutter speed of maybe 2000 to avoid it being a blur.

Now look at the pictures on the next page to understand this in practice.
The picture above was taken at ¼ sec and clearly shows camera shake due to the fact that the camera could not be held steady with such a slow shutter speed.

Now look at the two pictures below. Figure 6 (left) was taken at 1/500 sec (500) and the dog is perfectly sharp, whereas Figure 7 (right) at the much slower speed of 1/60 (60) is blurred. Notice that the grass in the foreground is sharp, indicating that it isn’t camera shake, but the dog is blurred, because she was moving and the shutter wasn’t fast enough to freeze her.
Now if we look at the two pictures on this page, the horses are moving much faster than the dog and it is very likely that a shutter speed of 500 would still not be fast enough to freeze the action.

To counter the possibility of a blurred picture, a much faster shutter speed of 1250 was selected, making sure not only the riders were sharp but also the horses legs and hooves which are the part of the subject where there is most movement.

So a faster shutter speed is normally selected to freeze movement and capture fast action, though there may be times when you either want to be more creative or you may want to retain some movement in the subject, so the picture is not too ‘static’. We’ll look at examples of this later.
Two more examples of shutter speeds. Figure 10 (above) was shot with a shutter speed of 1/1250 sec and the water droplets are clearly visible. Figure 11 (below) however, the water is a blur as a result of selecting a 1/2 second shutter speed.
THE ISO SETTING

The final factor that controls exposure is the ISO setting. The first thing to say is that you don’t need understand what the acronym ISO stands for.

In the ‘old days’ before digital cameras, a roll of film was loaded to the camera. The rolls of film could be bought in various ISO speeds. The range was normally 50 ISO, 100 ISO, 200 ISO and 400 ISO. Having loaded the film, every picture on the roll had to be taken at the same ISO speed.

These days, with digital cameras, the ISO range is vast and typically:

100, 200, 400, 800, 1600, 3200, 6400.

On high end digital cameras, the range extends to:

12800, 25600, 51200, 102400.

Not only has the ISO range dramatically increased, with digital cameras, unlike with a roll of film, every picture can be taken at differing ISO settings if required.

So what does it all mean?

The ISO number refers to how sensitive the sensor (or film in the old days), reacts to light. So in bright, sunny conditions, an ISO setting of 100 or 200 would be sufficient. If the weather was not so good and it was a cloudy, dark day, then maybe 400 or 800 ISO would be required. And if you were taking pictures in the evening (without a flash) or under floodlights at a sporting event for example, then much faster ISO settings would be required, in the range of 1600 to 6400.

As with steps in Apertures and Shutter Speeds, steps in ISO settings react twice as fast or half as fast as each other. So for example, ISO 400 will react twice as fast to light as ISO 200, but half as much as ISO 800.

Good lighting conditions = Low ISO speeds = 100 ISO or 200 ISO

Overcast or cloudy conditions = Medium ISO speeds = 400 ISO or 800 ISO

Poor light or floodlight conditions = Fast ISO speeds = 1600 ISO to 6400 ISO

You may now be asking the question ‘why don’t I just set the ISO at 6400 anyway?’, thinking that will cover all possibilities. Well there are two reasons why you wouldn’t want to do that.

The first reason is that the higher the ISO, the price you pay is in the quality of the picture. In the old days of film, high ISO rated films produced prints which were ‘grainy’. The equivalent of grain in digital pictures is ‘noise’.

Now, don’t run away with the idea that pictures taken at high ISO settings will be terrible, fit only for the bin or ‘delete’ key on your PC, because with modern cameras, ‘noise’ is acceptable, particularly if the file is printed to a relatively small size of say 15cm x 10cm or even bigger. But print the picture to 50cm x 40cm say, and the noise will be more noticeable.

Look at the pictures on the next page to understand this point in practical terms.
These two pictures, printed to a size of around 15cm x 10cm are both perfectly acceptable. However, look at the enlarged insets of the petals and we see the effect of high ISO settings. Figure 12 (above) was taken at 400 ISO, whilst Figure 13 (below) was taken at 8000 ISO. The digital ‘noise’ is very noticeable in the one below, particularly in dark areas of the picture, like the dark brown colour in the petals.
So digital noise and the effect on picture quality is the first reason why you wouldn’t want to set a very high ISO speed as the norm.

The second reason is more of a practical one. The higher the ISO, the larger the file and the more memory it takes up on your card. It not only takes more memory but it takes longer to process within the camera and this in turn can restrict the rate at which you are able to shoot. So a camera with capability to shoot at 10 frames a second would shoot at something less than that with a high ISO setting.

So the thing to do, is set the ISO as low as possible, taking into consideration what shutter and aperture settings you want for the type of picture you are taking.

**RECAP**

So before we go any further, let’s just recap what we’ve learned.

So you hopefully now understand the three different things on your camera which you are able to set to control exposure – Aperture, Shutter Speed and ISO.

You should also understand how one controls the depth of field (the Aperture), the second controls movement in the picture (Shutter Speed) and the third (ISO) the ‘noise’ the picture displays.

On the next page, we’ll have a look at how we set things on the camera and then we’ll explore how, when we change one of the three variables, it affects the other two.
CAMERA SETTINGS

So, how do we select apertures, shutters and ISO settings on the camera. The camera will have either a dial on the top, as in Figure 14 below, or it will have a digital display. This dial (or digital display) gives you the opportunity to select the camera ‘mode’.

FULLY AUTOMATIC ( }

‘Fully Automatic’ is the mode where the camera will select the settings for you. It is shown as a green rectangle on the dial. Set it to this and you should get a correctly exposed picture in most circumstances.

But you have no control over what the picture will look like. If it’s set on this setting and you take a picture of a fast moving subject, it will probably be blurred. Or if you take a scenic view, the depth of field may be quite shallow and the foreground and background out of focus.

The exposure should be correct but you may well be disappointed with the picture.

To counter this, camera manufacturers created other modes, such as ‘Sports’ mode, ‘Portrait’ mode and ‘Scene’ mode.

These modes add some intelligence to the automatic mode. So for example, if you set it to Sports mode (shown by a symbol of someone running), it assumes the subject is moving quite quickly and therefore selects a fast shutter speed.

Conversely, if you select Portrait mode (shown as a face symbol), it assumes you want a shallow depth of field and sets the camera accordingly.

Finally, if you set Scene mode, it assumes you want a great depth of field and will select a small (high f number) to achieve this.

So this is an improvement on the fully automatic setting but you are still in the hands of your camera thinking it knows what type of picture you really want.

As you now understand the effect of shutter speed and apertures, you can choose one of the next two modes and be in control of your picture taking.

SHUTTER PRIORITY (Tv)

So take it off the fully automatic mode and set it to ‘Tv’ mode (sometimes shown as ‘T’). ‘Tv’ stands for Time Value and this allows you to select which shutter speed you want to take the picture at. Let’s assume you want to take a picture of your dog and the dog is moving. A slow shutter speed will lead to the dog being blurred, so select 1/500 to freeze the dog’s movement. When you point the camera at the dog, with the ISO set to say 400, the camera automatically sets the aperture value. Let’s say, given the lighting conditions, it selects an aperture of f5.6. We are now using the camera in semi-automatic mode, where you are setting the ISO and selecting the shutter speed, leaving the camera to automatically set the aperture in order to give the correct exposure.

This mode is often referred to as ‘Shutter Priority’ because your priority is to control the movement in the picture, making sure, in this example, the dog is not blurred – you set the shutter speed you want and leave the camera to worry about the aperture.
APERTURE PRIORITY (Av)

Now let’s imagine you are in the Lake District and you come across an amazing scenic view. You want to take a picture and you want to have the near foreground and distant background all in focus. You need to control the aperture to give you maximum ‘depth of field’, which means you need a small lens opening, which in turn means a high ‘f number’ setting. This time, we would select ‘Av’ mode (meaning Aperture Value). Set it to say, f22 to give us a good depth of field and leave the camera to worry about the shutter speed.

MANUAL (M)

It is also possible to set the camera to full manual which enables you to set all three variables - Aperture and Shutter speed as well as the ISO.

So in what circumstances might you want to do this?

You might want to use Manual where the camera might be fooled by the situation. For example, if you was shooting a MotoX rider going over a jump, your instincts would tell you to set it in Shutter Priority mode (Tv) because you want to control, the movement by setting it to perhaps 1/500 second but as he flies into the air, he is set against a bright sky. The camera will meter for the scene it sees, just as you press the shutter release button and the light background fools the camera and leaves the rider as a silhouette against the sky. In these circumstances, you might want to set it manually. Alternatively, you might leave it on Tv and introduce ‘exposure compensation’. But we won’t go into that now – that’s something for later, when you’ve got to grips with the basics.

So my advice is to set the camera in semi-automatic mode, either Tv or Av, depending on what type of picture you are taking and what effect you are trying to achieve. If it’s important you control the depth of field, set Av and if it’s important you control Tv.
TAking Control

Now let’s look at the relationship between aperture, shutter and ISO. In the table below (Figure 15), let’s assume the ISO setting remains constant, set at 400 and you’ve selected Shutter priority mode (‘Tv’) and set it to 1/125. You point your camera at the subject and the camera selects an aperture of f11 to expose the picture perfectly. What the chart shows, is that there are a combination of Shutter and Aperture settings that will give you exactly the same exposure and you are able to choose the combination depending on what type of picture you are taking.

So imagine you are taking a picture of your dog, like in my earlier example. You would set the camera to ‘Tv’ (because you want to control the movement in the picture) and you set it to 1/500. The camera will automatically select the aperture, which in this example would be f5.6.

If however, you were taking a picture of that scenic view in the Lake District and you wanted a good depth of field, you would set it to ‘Av’, select say f22 and the camera would automatically select 1/30 second.

![Figure 15](image)

We do of course have a third variable, the ISO setting. So we can ‘play tunes’ with two of the variables and leave the camera to worry about the third.

![Figure 16](image)  ![Figure 17](image)  ![Figure 18](image)

Look at the three charts above. Let’s assume for a constant lighting source, the correct exposure is achieved with a combination of ISO 800, at 1/250 second and f8 (figure 16).

But you want to set you aperture to f16 for a greater depth of field. You have reduced the amount of light coming through the lens by 2 stops and so assuming you have your camera on aperture priority (because you wanted to control depth of field), your camera will compensate by leaving the shutter open for longer. It will effectively leave the shutter open for 2 more stops to 1/30 second (figure 17)
But because you’ve gone down to a slow shutter speed of 1/30 second, there is a chance you won’t hold it steady enough and you end up with a blurred picture due to camera shake.

So what do you do?

Well if you’ve been following and understanding my ramblings, you will know that you have to increase the ISO setting, so the sensor reacts faster to the light hitting it. By increasing the ISO by 1 stop to 1600, the camera will now shoot at 1/60 second (figure 18)

Note that all three combinations of ISO, Shutter speed and Aperture give exactly the same exposure and this highlights how it is possible to select a combination of settings which enable you to capture the effect you are trying to achieve with your picture.

So now you understand about Shutter speed, Aperture and ISO and you understand the relationship between the three things. If you increase the aperture by one stop for example, you have to decrease the shutter speed or ISO by one stop to compensate and maintain the correct exposure.

If you increase the shutter speed by two stops for example, then you have to decrease the aperture or ISO by two stops to compensate, or, you could decrease the aperture by one stop and the ISO by one stop.

If you are working in semi-automatic mode (either Tv or Av), then the camera compensates for you. So if you are shooting in Tv and you have it set to 1/250, if you change it to 1/500 for example, you are halving the amount of time the light hits the sensor, so the camera will automatically open the aperture by one stop to compensate.

Similarly, if you are working in Av and you have the aperture set to 5.6 and you want to decrease the depth of field and you open the aperture by two stops to 2.8, the camera will automatically adjust the shutter speed by two stops to compensate.

So normally, you don’t have to worry about the ISO. But what if you have the lens wide open at 2.8 and the shutter speed has gone right down to 1/30 because the light is poor? You risk having camera shake at that shutter speed. And what’s more, how do you even know it’s gone down to 1/30 second.

Well, the information is right before your eyes, in the viewfinder. So let’s have a look through the viewfinder and see what the information is telling us.
The picture below (figure 19) shows a typical viewfinder and the information it displays.

Here we have a picture of a squirrel. Let’s have a look at what the display is telling us and try and understand what the numbers and markings mean. The picture below (figure 20) is a slightly larger view of the viewfinder information.

If you have kept up, you will realize the figures on the left and right are the shutter speed and the aperture. But what’s this bit in the middle? Well that is the camera’s light meter and it tells you whether, with that combination of shutter / aperture, your picture is going to be correctly exposed. In the example below, it is. So how do I know that?

Well, when the little pointer at the bottom is in the central position, adjacent to the top pointer, everything is fine. The exposure will be correct.
VIEWFINDER SCENARIOS

Shooting in Av

When shooting in Av, it’s likely the meter will always show correct exposure (that is, the two pointers are always likely to be aligned).

Just think about this for a minute and see if you can understand why that’s the case.

The answer of course, is that whatever the lighting conditions, if you set the aperture, the camera is always going to be able to select a shutter speed to suit – even if that shutter speed is several seconds!

So, you’ve set the camera to shoot in Av mode at f16 and the display is advising you the shutter speed will be 1/15 second. You have a bit of a problem don’t you?

The exposure will be correct, but you will have camera shake. So what do you do?

Well, you have three choices.

1. Open the aperture to something wider than f16. (but if you’ve set it to f16 for depth of field reasons, you have to choose option 2 or 3.
2. Mount the camera on a sturdy tripod
3. Increase the ISO until the shutter speed increase to 1/60 or faster.

So in Av mode, look out for the shutter speed dropping to an unacceptable level and compensate by increasing the ISO (or, if it suits your picture, open up the aperture).

Get the idea?

Let’s try one more scenario in Av mode.

In this example, you’ve set the camera to Av and selected f2.8. The meter is telling you the exposure is fine (pointers aligned) and the shutter speed will be 1/4000.

So, no problem then. Well that’s true but, do you really need a shutter speed of 1/4000? If you don’t, then decrease the ISO by a stop or two and this will result in less digital noise and improved quality of picture.
Shooting in Tv

Now let’s assume you want to control the shutter because you’re shooting a moving subject, so you’ve set it to Tv and selected 1/500 as the shutter speed. The display is showing you that at 1/500 your aperture is f4 but, hold on, the pointers are not aligned. The bottom pointer is to the left, indicating that if you take the picture it is going to be, in this example, 1 stop underexposed. This means it will turn out dark.

So, what do you do? Well, the first thing to realize is that the camera has already tried to open the aperture to it’s widest to achieve a correct exposure but in this case, the lens being used has a maximum aperture of f4. So the only option you have (apart from using a flash gun) is to increase the ISO by 1 stop (from, say 400 to 800ISO). Bingo – correct exposure!

Let’s look at one more Tv scenario to see if you’ve got the hang of it.

This time we’ve selected 500 again and the meter is telling us we’ve got the correct exposure and the aperture will be f11.

Well, there is no problem but, an aperture of f11 is going to give you quite a depth of field. If you’re happy with that, then that’s fine but if you want to restrict the depth a bit, you could either make the shutter faster by a stop or two (to say 1000 or 2000) or drop the ISO by one or two stops (from say 400 to 200 or 100ISO) or of course, a combination of the two (shutter from 500 to 1000 and ISO from 400 to 200).

So in Tv mode, you need to pay attention to the pointer and see if it’s indicating your picture will be underexposed (to the left) or overexposed (to the right). Then you have to decide, can you change the shutter speed and still achieve the effect you want, adjust the ISO, or a combination of the two.

Always remember, the correct exposure is achieved by selecting a combination of the three variables - Shutter Speed, Aperture and ISO and shooting in semi-automatic mode (Tv or Av) enables you to be in control and get the effect you are after.

The final pages of this introduction to ‘The Basics of Photography’ is a selection of photographs, showing the shutter, aperture and ISO combinations and the rationale behind the settings.
EXAMPLES OF SHUTTER, APERTURE AND ISO COMBINATIONS

In previous examples, I’ve advised you to set Tv mode when you want to control movement. It’s good advice normally but in these two examples I set the camera to Av mode and selected f3.5 because I wanted to ensure there was a fairly shallow depth of field, making the background free from distractions. I also wanted to make sure the shutter speed would be fast enough to freeze the action, including the water droplets and dust but as it was a nice bright day, I was able to set the ISO to 200 and be confident that with an aperture of 3.5 and an ISO of 200, I would still get a shutter speed of at least 1/1000 or faster.

The lens used for these shots was a 70 – 200 mm f2.8, set at around 100mm.
These two shots were also taken with the camera in Av mode for the same reasons as the previous page. I wanted to make sure the background was out of focus so the players stand out, almost like a 3D picture. They were shot with a 300mm f2.8 lens with the aperture set at f4 and with ISO set to 400, I knew the shutter would be fast enough to freeze the play. Notice the shutter speed of the top picture was 1/1250 second and on the picture below was 1/800. This is because the top scene is lighter, with the player in the centre wearing a blue / white shirt, whereas below, Drogba’s shirt is black, as are the seats in the background and the camera compensated by leaving the shutter open longer in the bottom picture.
These two pictures were taken on the same day, with the camera set to Tv mode, the one above set to 1/500 and the one below to 1/2000. This is an example of where you want to take control of the movement. Setting the shutter too fast, freezes the picture (below) to an extent where the wheels look like they are not turning. The picture below is too static whereas the one above, whilst still generally sharp, retains some movement in the wheels giving an impression of speed. So for speedway racing, I never set a shutter faster than 1/500 and will sometimes go as low as 1/320 to ensure I keep some movement in the picture.
The picture above was taken in Tv mode (because I want to control the movement) and set to 1/400 second. With the 300mm lens wide open at f2.8, it was necessary to set the ISO to 4000. So, I had no choice other than to set a high ISO – I couldn’t go with a slower shutter as the picture may have been blurred and the aperture was wide open, so it had to be a higher ISO. Earlier, I touched on something called ‘exposure compensation’. If you look at the picture below, the subject is under a tree in shadow and the background was in bright sunlight. I set the camera to Av mode at f3.5, with an ISO of 400, which I knew would give me a fast enough shutter speed to freeze the action. But I’m more intelligent than the camera (don’t argue) and I knew the camera would be fooled into thinking the scene was brighter than it was and so I ‘told’ the camera to effectively expose it one stop brighter than the meter would have automatically done. Overriding the camera’s metering system is called ‘Exposure Compensation’ and you are able to set it to over or under expose by up to three stops. Simple! The alternative would have been to use a burst of flash but horses don’t like that much!
So that concludes my tuition on ‘The Basics of Photography’ – I hope you found it useful!

Remember that with digital photography, all the information regarding the pictures is visible to you, embedded in the file:

- Date and time the picture was taken
- Camera it was taken on
- Exposure mode
- Aperture
- Shutter Speed
- ISO
- Focal length of the lens

So use this information to learn, particularly if the picture doesn’t turn out how you hoped it would – study the information and try to understand why.

Finally, take plenty of photographs – unlike in the days of film, it costs you nothing (at least until you start printing).

Some of the pictures I have used in this document required me to have accreditation (like the speedway and the football pictures) but go to grass track races where you have free access from the outside of the track or go to a speedway track where it’s possible to shoot from the spectator areas (like Peterborough). Or shoot football at the local park.

All of the horse pictures (Polo and Cross Country) I took from spectator areas. So go on – have a go!!

Jeff Davies