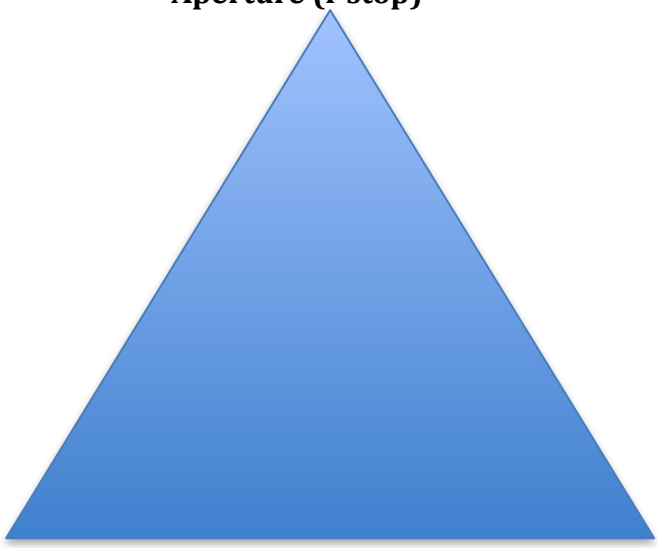
Basics of Exposure

Photography is about recording light so understanding the basics of how to control light are essential. When we see something, our eyes see light in a similar way to how a camera sees it but our brains then interpret it focusing on certain aspects of the scene and ignoring others. We have all seen amazing scenes and photographed them, only to be disappointed by the resulting photo. This is because a camera simply records what is in front of it and reproduces it without any interpretation or emotion. We need to understand light so that we can control our camera to record the important parts of the scene to then present in an image to recreate the feeling we had when viewing the scene.
The basic starting point is the **Exposure Triangle**. This has the three variables that we can control, **Aperture, Shutter Speed** and **ISO**, at each of the corners of the triangle. Varying each of these affects the others and we need to make creative decisions about which takes priority and which compromises to accept.

Aperture (f-stop)



Shutter Speed
(duration of exposure)

ISO
(sensor sensitivity to light)

Each variable controls an aspect of the final image;

<u>Aperture</u> controls Depth of Field (how far apart subjects can be and still be in focus).
In a landscape you may want everything from near to far to be in focus so want a large depth of field. For a portrait you may want you subject sharply focused against a soft out of focus back ground so want a shallow depth of field.
Aperture is measured in **f-stops** which where is can be a little confusing. The aperture is the size of the opening in the lens that allows light in (similar to the size of the pupil in your eye) the size of the aperture is controlled by the diaphragm (similar to the iris in your eye).

The f-stop is the ratio between the diameter of the opening and the focal length of the lens.
The smaller the f-stop number the bigger the aperture and the bigger the f-stop number the smaller the aperture. An F-stop of f4 is a smaller number so bigger aperture than f16.
Small f number = small depth of field = small number of objects in focus
Big f number = big depth of field = big number of objects in focus

In all these photos focus was on the 3rd tree from the left. Notice how as the f-number gets bigger more and more trees come into focus. Look at the leaves on the left, the trunks of the trees and the trees in the distance. In the first image the leaves on the left and distant trees are both quite blurry.


f2.8


f4


f5.6


f8

In this final image the nearest leaves on the left and furthest trees in the distance are all in focus.

This series shot with a macro lens shows that at close focussing distances depth of field is very shallow and the effect of closing down the aperture is more obvious. Notice that as the f number gets larger more objects come into focus and a larger distance on the ruler is sharp. In all the photos the near shoulder of the Frill-necked Lizard 3rd from front was the point of focus.


f 5.6


f 8


f 11


f 16


f 22


f 32

In this final image all the objects are in focus and the entire rule legible

This series also illustrates that approximately 1/3 of the depth of field is in front of the focus point and 2/3 behind it.

<u>Shutter Speed</u> controls movement or blur in an image.
Shutter speed is the amount of time that the shutter is open to allow light to fall on the sensor and is measured in fractions of a second or seconds.
To get a really sharp image we need a high enough shutter speed to eliminate camera shake. A useful rule of thumb is to use a shutter speed of 1/focal length of the lens. So for a 50mm lens 1/50s (1/60 is the closest), for a 200mm lens 1/200s (1/250 is closest).
Vibration reduction/Images stabilisation in a camera of lens can help keep sharp images at lower speeds as long as the subject is not moving.
If there is not enough light for hand holding a tripod or other camera support is useful.
Creatively we may want to use shutter speed to control how a subject looks to convey a sense of movement. A picture of a bird in flight completely frozen by a high shutter speed may not look as nice as one where the tips of the wings are slightly blurred to give an impression of movement.

See how the second image of a motorbike here conveys more of a sense of speed and movement with a slow shutter speed.

An aeroplane in flight with a frozen propeller is not as dynamic looking as one with a slightly blurred propeller.

The 2 shots of the DC10 show how a little bit of blur of the propellors can make the image look more realistic and closer to what we perceive with our eye.

ISO is the final corner of the triangle and the third variable we can control for exposure. In the days of film this was what was known as “film speed” and represented the sensitivity of the particular film to light.

Low speed film was not very sensitive to light but had fine grain and showed detail well. High speed film was more grainy and showed detail less clearly.

With digital photography each sensor has a “base ISO” at which it performs best (usually ISO 100 or 200 but some go down to 64). This can be adjusted upward to operate in lower light conditions but the **higher** you go the **more noise** you get and the **less dynamic range** (number of levels of brightness the sensor can record). This has improved significantly over time and most modern cameras can operate very well up to ISO 800-1600 and some even up to 3200 or 6400 but you will still get the best image quality at ISO values closest to the base ISO for the sensor.
In these examples you can see that as the ISO increases the range of brightness values in the image drops with less detail in the dark areas and an increase in noise also most noticeable in the dark areas.

These close up crops show the issues more clearly.


ISO 6400


ISO 12800


ISO 64


ISO 6400

We now need to talk about how the three corners of the triangle interact with each other. We have seen that aperture is measured in f-stops and each full stop represents a halving or doubling of the amount of light passing through the lens to the sensor. F4 is twice as bright as f5.6, which is twice as bright as f8.
Shutter speed has stops too. 1/125s allows twice as much light onto the sensor than 1/250s, which allows twice as much light as 1/500s.
If our camera exposure meter tells us that the correct exposure for the set ISO value is 1/250s at f5.6, we have the option of either using that or changing to 1/500s at f4 to achieve a shallower depth of field of 1/125s at f8 to achieve a deeper depth of field.
We aim to keep ISO as low as possible provided it will allow us a fast enough shutter speed to get a sharp image. ISO too, has stops with ISO 100 being half as sensitive as ISO 200 which is half as sensitive as ISO 400 and so on. For example an exposure of 1/30s at f4 for ISO 100 is the equivalent of 1/60s at f4 for ISO 200. If you need to change shutter speed by 1 stop you need to compensate with a stop change in aperture or ISO to maintain correct exposure.

So there we have the **three variables we can control** to adjust exposure, but what is exposure? It is simply allowing the correct amount of light to reach the sensor to record the image we want. The problem is that sensors can only record a certain range of brightness values and these are fewer than we can perceive with our eyes. If too much light falls on the sensor it will record pure white and if not enough falls on we will have no detail visible in the shaded areas. The trick is to get enough light so that the bright areas record detail without “burning out” (clipping) to pure white and the dark areas have enough light that you can record detail there too.

To do this we rely on the exposure meter in the camera. These meters have become very sophisticated and we can often rely on them to get us very close to what we need for most scenes in automatic mode.
Most cameras have a Program (P) where the camera automatically adjusts aperture and shutter speed (and sometimes ISO) to set the exposure but removes creative control from the photographer. Understanding the exposure triangle allows us to choose what settings we want to intentionally show the scene as we want to. Using Aperture priority mode is probably the best way to do this as we can then use the aperture to control the depth of field and shutter speed to achieve what we need.

Histogram

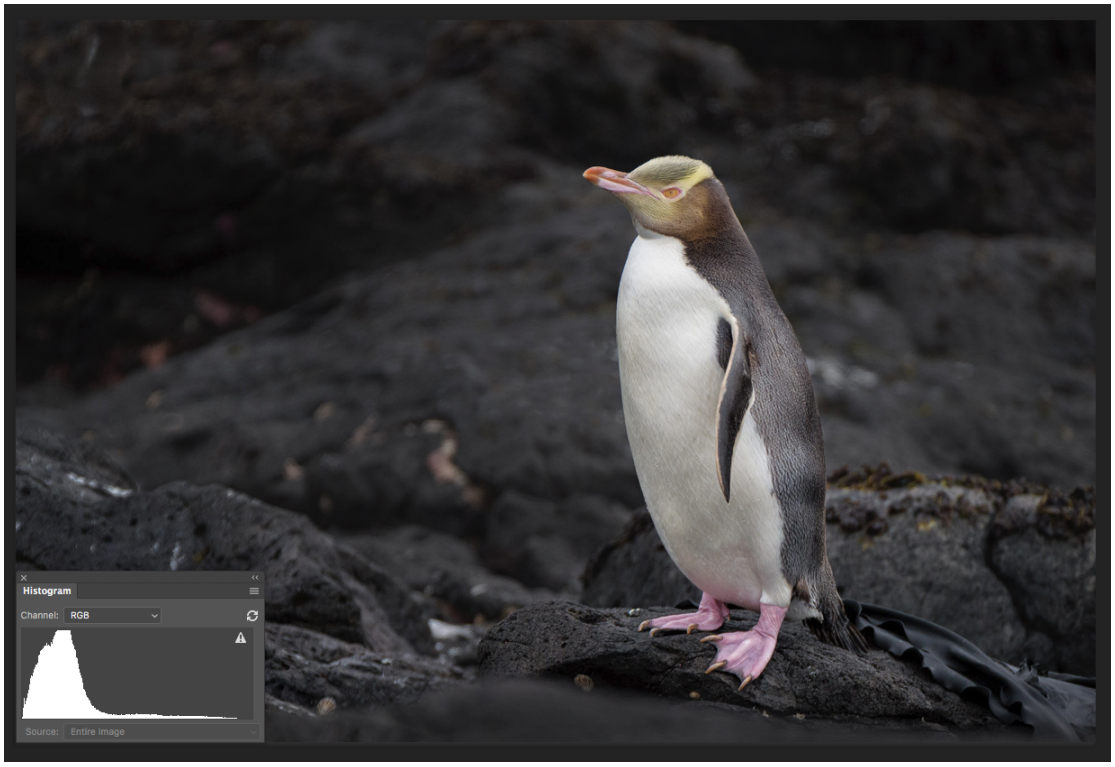
A very useful tool in checking exposure is the histogram. It is simply a graphical representation of the brightness values in the image.
Dark values are on the left and **bright values on the right**.
If the histogram is cut off on the left it indicates some dark areas with no detail recorded (blocked shadows).
If it is cut off on the right it indicates white areas with no details (blown highlights).
A "good" histogram is often described as a Bell Curve but what is good depends on the image.

This is a a nice even toned image with no very bright or dark areas so a Bell Curve type histogram is correct.

This scene has more brighter sky tones and more dark tones in the vegetation so the histogram is flatter with a light peak and small peak of darks but no clipped shadows or highlights.

Another even toned with a fairly smoothly curved histogram.

When we start to work with images that have predominantly dark or light back grounds the histogram can look quite different while still being correct.



In this photo most of the tones are dark and if we had exposed to put a nice curve in the middle of the histogram we would have over-exposed the whites on the penguin and lost detail in part of our main subject.

With an even darker background the histogram is shifted even more to the left

If we are working with a subject with a bright background the histogram shifts to the right.

Here we have an exposure to show detail in the dark feathers of the Adelie which keeping some detail in the snow. The histogram is well to the right but not chopped off.

With this shot we want a nice clean white background so the white tones are pushed right up against the right side of the histogram.

There is no one “correct” histogram. It all depends on the image.
In general you don’t want the histogram cut off on the right or left unless that is what you need for the image you are making.

Expose To The Right (ETTR)

In a digital file half of the recorded information is in the brightest stop so to maximise the information captured in a scene it makes sense to try and get your histogram as close to the right as possible without clipping. This ensures that as much shadow detail is recorded as possible and was especially important in the past but now with sensors with higher dynamic range and much improved RAW processors it is a little less crucial. The downside is risking blowing highlights that cannot be recovered.
Practically, checking your histogram and having “blinkies” turned on for image preview can get you a good exposure without risking blown highlights.
This link explores this a bit further;
https://photographylife.com/exposing-to-the-right-explained.

RAW vs jpg

A RAW file is simply the data captured by the sensor. It is not viewable until processed in a RAW processor. To create an image preview the computer in the camera processes the data into a jpg file using specific white balance, tone curve presets, saturation, sharpening and compression that can be modified to an extent by making some adjustments in your camera setup menu.
A RAW file is a 16 bit file which records at 65 536 brightness levels in each of the 3(RGB) channels. A jpg file is an 8 bit file which only records 256 brightness levels in each channel. As a result creating the jpg throws away a lot of data and creates a smaller file that you can view on a computer and email or print but you lose a lot of control over the image. Most cameras can be set to store either the RAW file or a jpg file or both.
Despite RAW file being much larger it is important to save these if you want to get the most for your images. The RAW file gives you the opportunity to process the image later and make significant changes to colour temperature (white balance), exposure, contrast and saturation. It can be considered the equivalent to the negative from film days which you needed to develop before making a print. Different ways of developing a negative resulted in different image qualities an we are now lucky to be able to process a RAW file in a number of different ways to create a variety of interpretations of a captured scene. We can explore this more in the image processing section.
In summary;
RAW files are much larger, have all the data captured by the sensor so have much more flexibility for editing and maintaining top quality images.
JPG files are smaller, immediately usable but have the camera processing “baked in” so less opportunity for editing.
This link explains more on the benefits of RAW files;
https://luminous-landscape.com/understanding-raw-files-explained/