Livingston Camera Club – Photography Basics

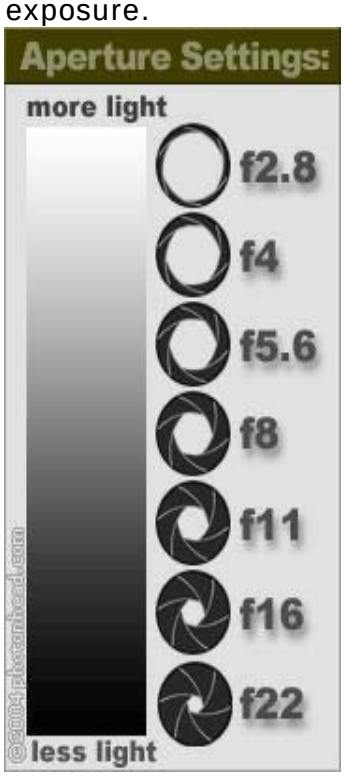
Light

The word "photography" essentially means "writing with light" so light is probably one of the most important considerations when it comes to taking a photograph or making an exposure.

The first element under your control is the ISO (International Standards Organisation) or, on some older cameras, it may be marked as ASA (American Standards Association). ISO is now the more commonly used system, though the range of speeds noted using the two systems is identical. ISO is a measure of the film speed or its sensitivity to light – the higher the number, the faster the film, and the greater its sensitivity to light.

With a film camera, the film speed is set for the entire roll of film so, if you choose a slow film – say ISO 50 or 100 and the day becomes very dull, you'd better hope you've packed your tripod! With a digital camera, however, the ISO – in this case the sensitivity of the camera's sensor* – can be changed before each exposure so, if you're struggling for light, you can simply increase the ISO until you're able to take the shot as you'd like. With some Digital Single Lens Reflex Cameras (DSLR's) you can choose an ISO of up to 6400. The higher the ISO the more digital "noise" (grain) is likely and so are best avoided if possible.

Whether yours is a film or digital camera, light enters via the lens so it is the amount of light allowed to enter and the length of time it is allowed to fall on the film or sensor that makes the exposure.



The amount of light entering the camera is controlled by the **aperture** of the lens – the variable opening that, depending on the individual lens, may be as big as f/2 or as small as f/45. Aperture is always measured in f/ stops and, for those of you who *really* need to know these things, the f/ stop numbers are apparently the square roots of the number in the 2 times table – 1, 2, 4, 8, 16, 32 and so on. The apertures are rounded to no more than one decimal place so we have, for example, f/2, f/2.8, f/4, f/5.6, f/8, f/11, f/16 with each of these settings representing a halving in open area of the aperture of the previous setting. That means that, although it may not seem obvious, an aperture of f/2.8 lets in half the amount of light allowed in by aperture f/2.

The images to the left show some apertures and how much light is able to pass through at the various settings. As you can see, there is a considerable difference between f/2.8 and f/22. This also demonstrates the feeling most people have that the f/ stop scale goes "the wrong way" but, as you can clearly see, the smaller the number, the bigger the hole and, if you can grasp that, you're half way there!!

Shutter Speed is the other part of the light equation and is used to control the length of time the light entering your camera can reach the senor and, whilst it has an obvious practical function for making sure your exposures are neither too dark to see anything nor so burnt out as to be of no use, shutter speed can have creative uses, too.

Shutter speed also determines whether there will blurring of any motion within your shot. A slow shutter speed can be used to get the "milky" effect in a waterfall shot, whilst a fast shutter speed would be used to "freeze" the motion of the water, often allowing individual water droplets to be visible.

**the "sensor" on a digital camera is more properly referred to as a charge coupled device or CCD but "sensor" probably means more to most people so that's what we'll call it!*

The most commonly used analogy to explain the relationship between aperture and shutter speed is to think of your sensor as a cup being filled with water from a tap. How the cup is filled depends on how much you turn on the tap (how big or small an aperture you choose) and how long the tap is left running (the shutter speed). There are a couple of other factors to bear in mind – the size of the cup which is the ISO, and the water pressure or the intensity of the light being reflected from the subject as a dark object being photographed on an overcast day won't reflect as much light as a light object on a bright, sunny day.

Thankfully, modern cameras tend to have very good metering systems that mostly get this calculation right but they can still be fooled so you need to know how to correct it. It's also best to know how to fully control light so you can use it creatively, too. There is a reciprocal relationship between shutter speed and aperture so, if you increase one, you should decrease the other and vice versa. For example, if an exposure setting of 1/125 sec at f/8 is correct, 1/60 sec at f/11 and 1/500 sec at f/4 would also be correct.

Below is a series of five shots taken for the Open College of the Arts course, The Art of Photography, to show the effect of slowing the shutter speed whilst photographing a moving object. As you can see from the data below each shot, as the shutter speed was slowed, the aperture had to be increased, otherwise the shots would have had too much light and would have "burned out".

These shots were all taken using a tripod, at a focal length of 25mm (i.e. using a zoom lens set at 25mm from the sensor), and at an ISO of 200.

Print 4/1 – f/4.0, 1/400 sec exposure

This print shows my subject still sufficiently in focus, but that he was in motion as the photo was taken is becoming more obvious.

Print 4/2 - f/9.0, 1/160 sec exposure

This print shows more clearly the motion of the subject, especially against the static background. There is slightly more blurring, particularly of the runner's extremities.

Print 4/3 - f/13.0, 1/40 sec exposure

Here the motion is even more pronounced, with only the runner's foot on the ground showing any level of focus.

Print 4/4 - f/18.0, 1/25 sec exposure

There's not a great deal of difference between this image at 1/25 sec exposure and the previous one at 1/40th and, again, only the leading foot is in focus.

Print 4/5 - f/29.0, 1/10 sec exposure

Here, at the slowest exposure taken in this sequence, the runner is just a blur, with none of him in focus at all and, indeed, he is hardly recognisable as a person. A slower exposure still would have resulted in an even more abstract splash of colour with the background staying the same.

Obviously, I should have had my subject wear a red jersey!!

If you can, try a similar experiment for yourselves, using different shutter speeds and apertures to see the differences that can be made. Try shooting the light trails from cars at night and find out what's the best combination of shutter speed and aperture to get the most effective shot – just be sure to set up somewhere you'll be safe from the traffic and won't be blocking a path for other pedestrians as you don't want to be run over by a car, or have some pedestrian fall over you!

Depth of Field is the next aspect of your exposures that will be affected by your choice of aperture. Many beginners try to get everything in every shot in focus but that's not always possible and is rarely desirable in any kind of creative shot. Depth of Field or DoF is defined as the "zone of acceptable sharpness extending in front of and behind the plane of the subject that is exactly focussed by the lens".

In practice, that means that the main subject of your exposure is expected to be sharply in focus but the areas in front of and behind it may not necessarily be just as sharp, depending on your set up. The bigger your aperture (the smaller the f/ stop number) the less will be in focus so someone shooting a studio shot of a single flower head might choose f/3.5 so the centre and the petals of the flower head would be sharply focussed but the background would be suitably diffused so as not to be a distraction. Someone photographing an entire valley however would want as small an aperture as possible (the bigger the f/ stop number) to get as much in focus as they could, so they might choose f/32. That would mean that very little light was entering the camera, so a fairly slow shutter speed may be needed on all but the brightest of days and they'd therefore be most likely to rely on a tripod to avoid camera shake.

The second factor influencing DoF is the focal length of the lens being used. A landscape photographer would typically use a wide angle lens – for example, the Sigma 10 – 20mm. A lens like this will allow you to keep everything sharp from just a couple of metres in front of the camera to the horizon. A long telephoto lens, however – for example, the Tamron 70 – 300mm – depth of field can be limited to just a few inches in front of and behind the point of focus.

The final factor affecting DoF is the focussed distance. The closer you are to the subject being photographed, the less depth of field you'll have to work with. If you are using a prime lens – i.e. one with a fixed focal length, e.g. the Canon 100mm macro – the only way to change what you have in focus in your shot is to physically move the camera and lens closer to or further away from your subject.

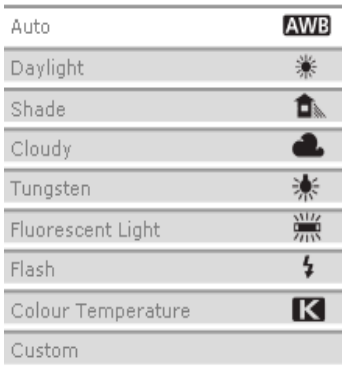
All DSLR's have settings on the Mode Dial that allow for more or less control over the aperture and shutter speed. There may be times when, if you camera is capable, you'll want to leave it in Auto and let the camera make all the decisions for you. That's fine but a camera will just record what it sees, with no creativity involved. If you want to be more involved in the picture taking process, you'll need to investigate some of the other settings. All manufacturers have their own names for the manual input side of things – Canon calls these this the Creative Zone Modes:

P (Program AE): Similar to Auto, Programmed Auto-Exposure the camera chooses both aperture and shutter speed.
Tv (Shutter-priority AE): (Tv stands for Time value) In this setting, you choose the shutter speed and the camera chooses the appropriate aperture based on the available light – this is good for photographing moving subjects where you want to "stop" the motion.
Av (Aperture-priority AE): Here, you choose the aperture and the camera sets the shutter speed. This is often used where you want to control the DoF.
M (Manual): Exactly what it says on the tin – you have full control over all settings. This can be a scary mode but is probably the best to learn from, especially in digital where that learning is "free"!

White Balance is often overlooked in the set up of a camera before a shoot but it can have a huge impact on the appearance of an exposure so it's important to set it correctly according to the shooting conditions. It determines how your camera "sees" white but, as the colour temperature of light (measured in *kelvins*) changes throughout the day, your camera might need some help getting this right.

Temperature	Typical Sources
1000K	Candles, oil lamps
2000K	Very early sunrise, low effect tungsten lamps
2500K	Household light bulbs
3000K	Studio lights, photo floods, projector lamp
4000K	Clear flashbulbs, fluorescent daylight tube
5000K	Typical daylight; electronic flash
5500K	The sun at noon
6000K	Bright sunshine with clear sky
7000K	Slightly overcast sky
8000K	Hazy sky
9000K	Open shade on clear day
10,000K	Heavily overcast sky
11,000K	Sunless blue skies
20,000+K	Open shade high altitude on a really clear day

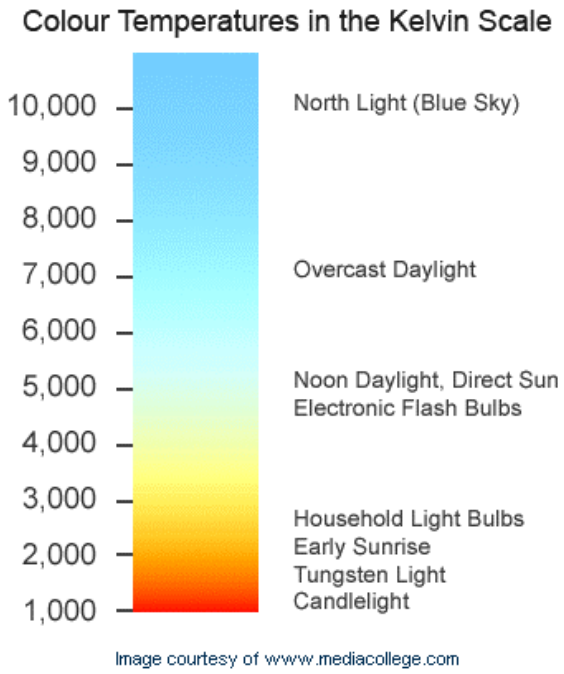
The table above (from http://www.aeimages.com/learn/color-correction.html) shows a range of light temperatures but knowing where on the Kelvin scale the light from a particular source falls won't really help the average photographer. So, most DSLR's have a range of white balance settings to cover most shooting conditions, allowing you to choose the most appropriate for what you're doing. The following are taken from the Canon website where it explains a little more about the effect of white balance: http://www.canon.co.uk/For_Home/Product_Finder/Cameras/Digital_SLR/Technologies_Features/White_Balance.asp



Auto should be your default setting
Daylight is for bright days
Shade helps with very contrasty days – bright light and dark shade
Cloudy also does twilight and sunset, making sunsets much warmer
Tungsten is for indoor lighting, e.g. household
Fluorescent lighting, such as in an office building
Flash for when there's not enough ambient lighting and the built-in flash is used
K Allows an exact colour temperature to be set from 2800 – 10000K
Custom lets you save and use your mostly frequently used settings

Setting the wrong white balance can be disastrous as it can leave your exposures with a definite colour cast – for example, using the Tungsten setting under Fluorescent light can mean that people in your shot take on a bluish tinge – not very flattering!

As you'll see from the following chart, cloudy daylight is slightly warmer (therefore bluer) than cloud free daylight (Noon Daylight or Direct Sun on the chart). This means that, if you set your white balance to Cloudy under a clear, blue sky, the camera will produce a redder image to compensate for the expected bluer light. Shaded daylight is warmer still so using the Shade setting will result in an even redder image as the camera compensates further for what it expects will be a bluer subject.



Sometimes, it may not be clear exactly what kind of light is falling on your subject, or they may be lit by a combination of lights – a dull room may mean you switch on tungsten lighting, but there is probably still daylight entering via a window. The Auto setting will get it right most of the time and is a good safety net if you're either prone to forgetting this little detail or aren't sure about the lighting.

One of the best things about digital photography is that experimentation is free so you can take several shots, all using different white balance settings and keep just the one you like best, discarding the others with no loss or expense – with film, that's just not an option. When shooting with film, you won't have the ability to set your white balance for each individual shot but the choice of film is vital and filters can be used to compensate for different light sources.

The table below (from http://www.ephotozine.com/article/Guide-to-colour-temperature) gives more information with an explanation at the bottom.

Film	Kelvin	Illumination	Kelvin	Filter	Colour	Exposure
Daylight	5500K	Tungsten House lights	3200K	80A	Dark Blue	1 1/3
Daylight	5500K	Tungsten Photofloods	3400K	80B	Dark Blue	1
Daylight	5500K	Tungsten Clear flash bulbs	3800K	80C	Dark Blue	1
Daylight	5500K	Daylight Shade under blue sky	7500K	81EF	Straw	2/3
Daylight	5500K	Daylight Shade partly cloudy sky	7000K	81D	Straw	1/3
Daylight	5500K	Daylight Shade under daylight	6500K	81C	Straw	1/3
Daylight	5500K	Daylight overcast	6000K	81A	Straw	1/3
Tungsten A	3400K	Daylight	5500K	85	Orange	1
Tungsten B	3200K	Daylight	5500K	85B	Orange	1
Tungsten	3800K	Daylight	5500K	85C	Orange	1
Tungsten B	3200K	Tungsten lights 100W	2900K	82B	Pale blue	1/2
Tungsten B	3200K	Tungsten Photofloods	3400K	81A	Straw	1/2
Tungsten A	3400K	Tungsten lights 100W	2900K	82C	Pale Blue	2/3
Tungsten A	3400K	Tungsten Clear flash bulbs	3800K	81C	Straw	2/3

The table above shows the film you are using in column 1 and the colour it's balanced to is in column 2. Column 3 is the light conditions you are shooting in and column 4 is the colour temperature of the light. Column 5 is the filter necessary to make the photo look natural and column 6 is the filter's colour. The final exposure column shows the exposure increase that's necessary to adjust for the strength of the filter. This is automatically adjusted by the camera's through-the-lens metering.