4 Week Online Photography Course

Exposure: Understanding Light

A Guide to Understanding Light & Exposure

Lesson 1 Course Notes

By
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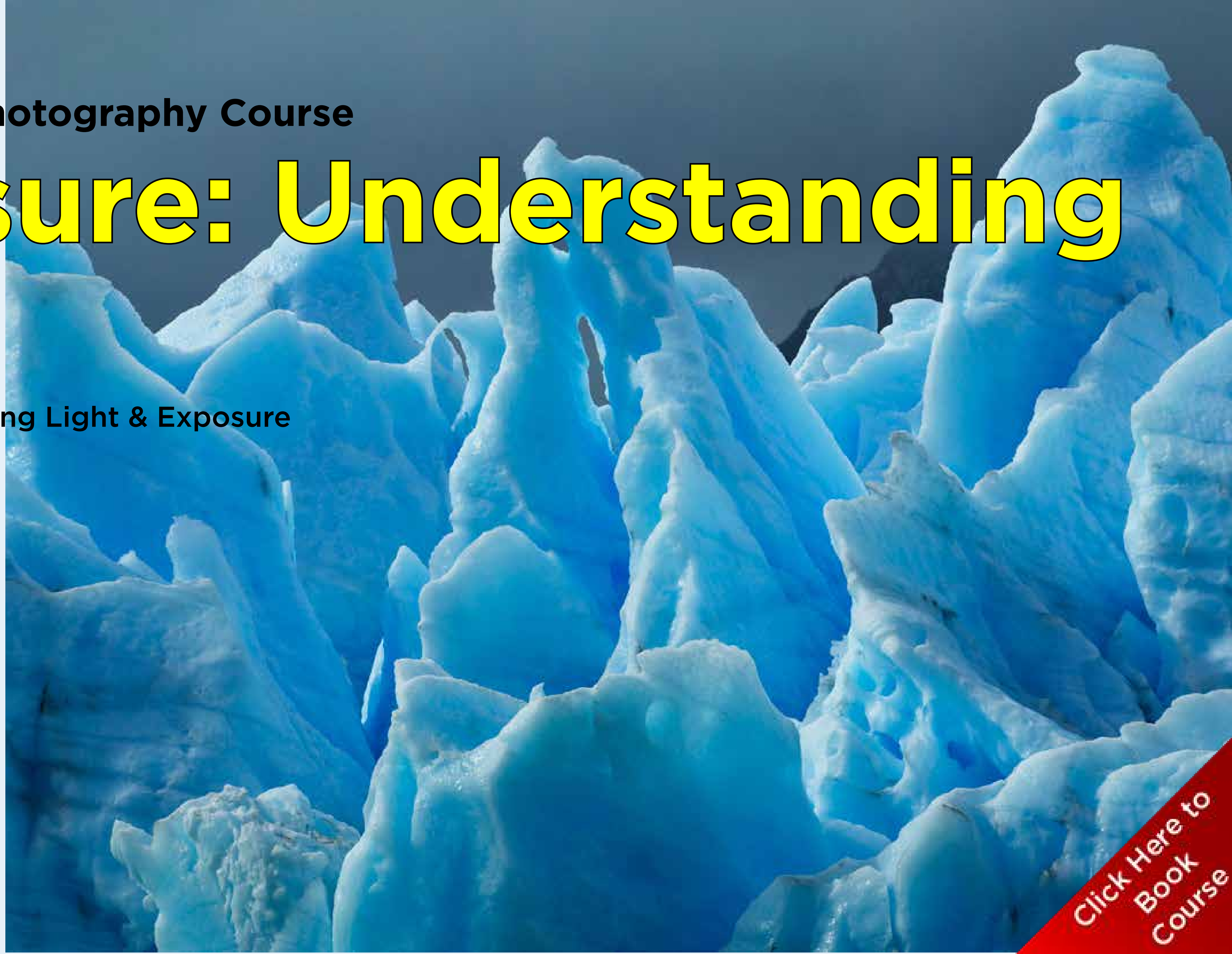

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Introduction

Welcome to this course on Making Use of Light, aimed at describing the crucial role of light in photography, and at showing you how to make the best use of it.

The first 2 lectures in this series are quite technical but please bear with me, as the more exciting copositional and creative stuff come after this.

Any composition will produce a poor image if the lighting is wrong.

Bright or dull, hard or soft, sunlit or cloudy, sunrise or midday; all these give different light qualities that need to be used, in the best way to generate the best images.

In this first lesson, I help you understand what light is, why it acts the way it does, why things don't always come out the way you hope them to, and how the digital camera goes about controlling the colour of light, under a range of lighting conditions.

Nigel Hicks

Course Curriculm

Lesson 1: The Nature of Light

Lesson 1 introduces the very nature of what light is and how it impacts upon the world of photography. Without getting technical, I explain how and why visible light consists of a mixture of different colours, why we see the world around us as having a vast array of colours, and why the nature and indeed colour of the light around us varies with the time of day. I then lead you through the way in which this evolution of the nature and colour of light through the day affects photography in the sense of changes in mood and aesthetics.

Lesson 2: Using Light to Great Effect

Lesson 2 looks at how to make use of light in general photographic situations. The first step will be to review how the camera makes a correct exposure, from light metering to the balance between shutter speed and lens aperture, along with how to understand, assess and control exposure. I then move on to look at the importance of highlights and shadows in an image, and how it is possible to both control and make use of these in creating meaningful, atmospheric images. Linked to this is an understanding of the effects of the sun's height in the sky, coupled with the effects of its angle relative to both the subject and the photographer.

Lesson 3: Light in Photography's - Landscapes and Nature

Lesson 3 shows how to apply the general understanding of light and how to use it to photography of the natural world, whether landscapes or animals and plants. The crucial role of natural light in establishing mood and colour in a natural landscape is emphasized, and then specific techniques to be used in different situations described. These include photography during the 'golden' hours at the start and end of the day, the power of the silhouette, and the use of filters to control exposure in different parts of a scene. Landscapes concludes with a look at how to make use of sunless days, photographing close-up details or shooting in such places as woodlands.

Lesson 4: Light in Photography's -People and Architecture

Lesson 4 concludes the course by leading the student through ways to use light to photograph the human environment, namely people and their buildings. I look first at building exteriors, showing how to photograph both entire buildings and close details using light skills borrowed from landscape photography. This moves on to consider the photography of interiors, using both natural and a variety of manmade light sources to light up the internal space, generating images that range from the fashionably 'clean' or minimalist typical for many public spaces, to cosy and homely for the domestic scene.

Exposure: Understanding Light: The Nature of Light

What actually is light? The whole cosmos is enveloped in electromagnetic radiation, waves of energy, the great majority of which is invisible, though detectable with the right equipment. ER, as it's often abbreviated to, ranges from very high energy, high frequency cosmic rays at one end of the spectrum through gamma and x-rays to very low energy, low frequency radio waves at the other end.

As we all know, some of this ER can be both dangerous and highly useful, whether X-rays in medicine or radio waves in telecommunications. In the middle of this vast electromagnetic spectrum sits visible light, that small segment of the ER spectrum that our eyes can see.

Other well known forms of electromagnetic radiation include ultraviolet light, which sits just outside our vision at the high energy violet end of the visible spectrum, and infrared lying just outside our vision at the opposite, low energy red end.

The principal colours we recognize in the spectrum are red, orange, yellow, green, blue, indigo and violet. Each colour has a slightly different energy level, but much of the time all colours are present around us in varying balances. When there is an even mixture we have white light, which is roughly what we have during the middle of the day.

We've all seen a rainbow, and this is one of nature's best ways of showing how white light is made up of a mixture of different light colours. When rays of sunlight pass through water droplets suspended in the air, whether rain or spray, the water bends those rays.

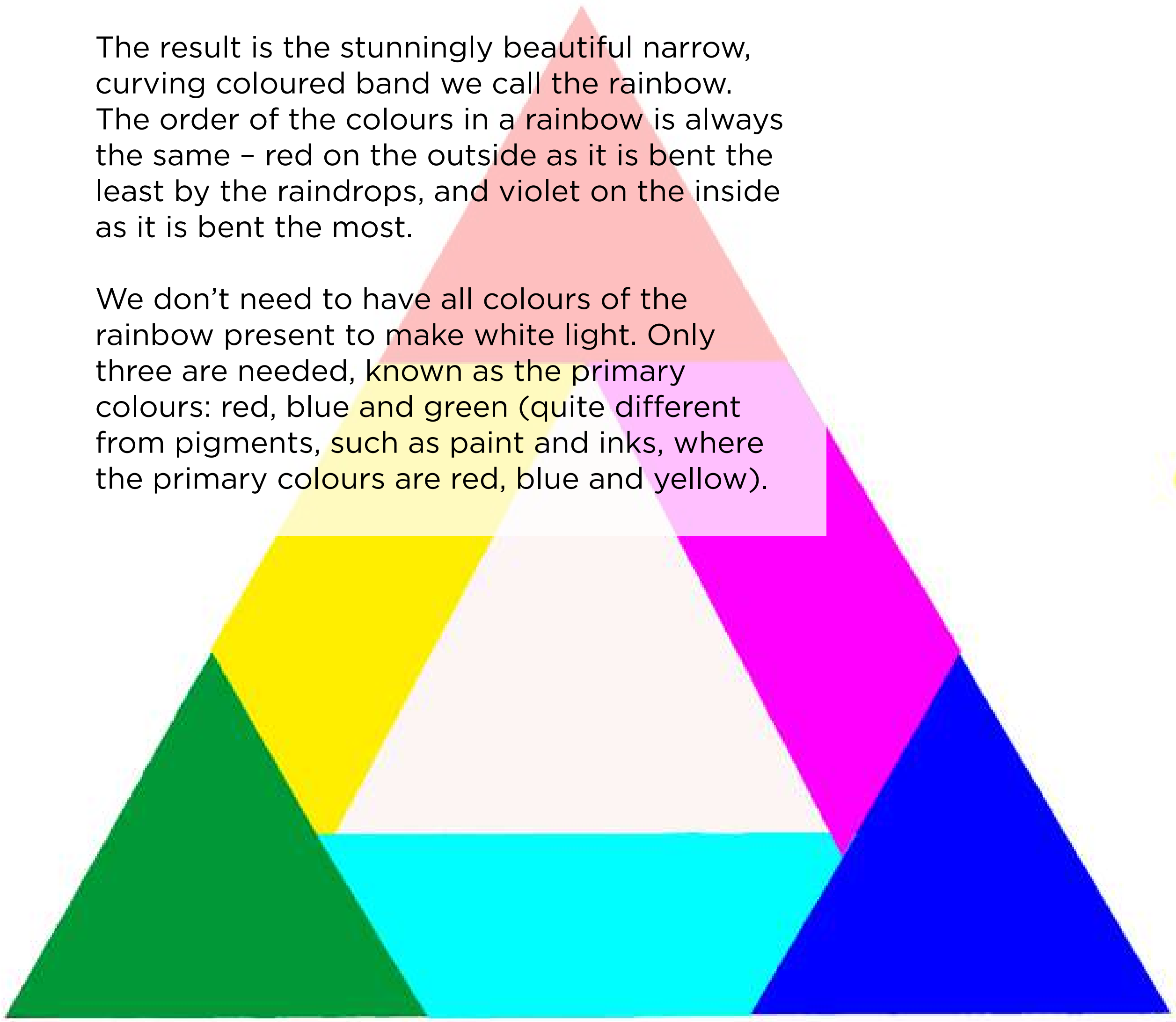
Primary and Complementary Colours

Each colour is bent by a slightly different amount, breaking the sun's white light up into its component colours. We can only see this when our vision is directly in line with the direction of the light – ie with the sun right behind us.

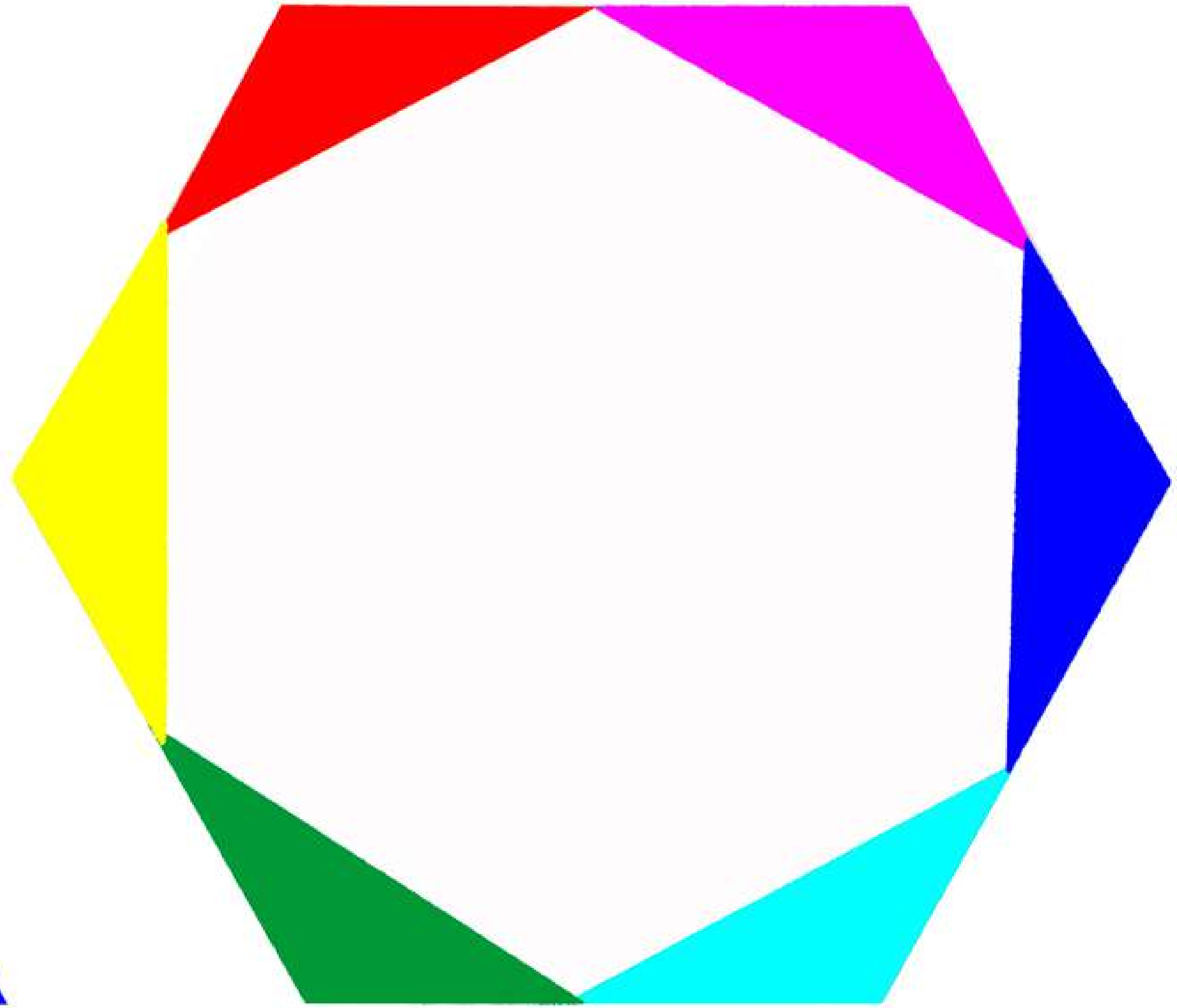
The result is the stunningly beautiful narrow, curving coloured band we call the rainbow. The order of the colours in a rainbow is always the same – red on the outside as it is bent the least by the raindrops, and violet on the inside as it is bent the most.

We don't need to have all colours of the rainbow present to make white light. Only three are needed, known as the primary colours: red, blue and green (quite different from pigments, such as paint and inks, where the primary colours are red, blue and yellow).

The Colour Triangle



The Colour Hexagon



All the other colours can be created by different blends of the three primary colours. This is often represented diagrammatically by the colour triangle, with each primary at one of the triangle's apices, the primaries blending to make the other colours along the triangle's sides.

Each primary has a complementary, or opposite colour: magenta for green, yellow for blue, and turquoise (also called cyan) for red. The presence of any of these complementary colours reduces the effect of their respective primary. Their relationships can be represented in the colour triangle, each

complementary sitting at the midpoint of each side, opposite each relevant primary. Alternatively, all six colours can be shown in a colour hexagon, with each occupying an apex. A knowledge of this is critical in photography using film, as filters often have to be fitted to the camera lens to correct for colour imbalances in the light.

With digital photography, however, the camera is usually set up to do this automatically with the photographer barely having to think about it. It is still useful to have an understanding of it, however, as doing so makes it easier to understand how to use the camera's white balance settings (which are covered below).

Furthermore, a knowledge of primary and complementary colours is still crucial in two areas: studio lighting, and in-computer image manipulation, both areas where you are likely to want to fine tune colour balances.

Everything in the world absorbs or reflects light of different colours to varying degrees, whether that light is coming directly or indirectly from the sun, or from an artificial light source.

When we look at any object and see its colour, that colour is the light that has not been absorbed by the object, but which instead has been bounced back, or – if the object is transparent – has been transmitted through it. A white shirt, for example, absorbs no light and so bounces every colour off it, making us perceive the shirt as white.

A black object, on the other hand, absorbs all light, bouncing nothing back and so appearing black. Vegetation absorbs all light colours reasonably well except green, which is bounced back for us to see, while a red dress reflects red light.

A pane of glass will normally allow all light colours to pass through, thus appearing completely clear. Coloured glass, on the other hand, contains material that will absorb all colours except the one(s) whose colour you want to see.

Red glass, for example, absorbs all light except red, which can still pass through, enabling us to see the glass as red. This is true whether the glass is a huge window or a tiny lens filter.

As already mentioned, light of different colours has different energy levels – blue and violet towards one end of the visible spectrum have a much higher energy than orange or red at the other end. This affects how much they're absorbed or reflected by the objects all around us, ranging from dust suspended in the air to entire buildings, in that blue light is often readily bounced around, while red is more usually absorbed.

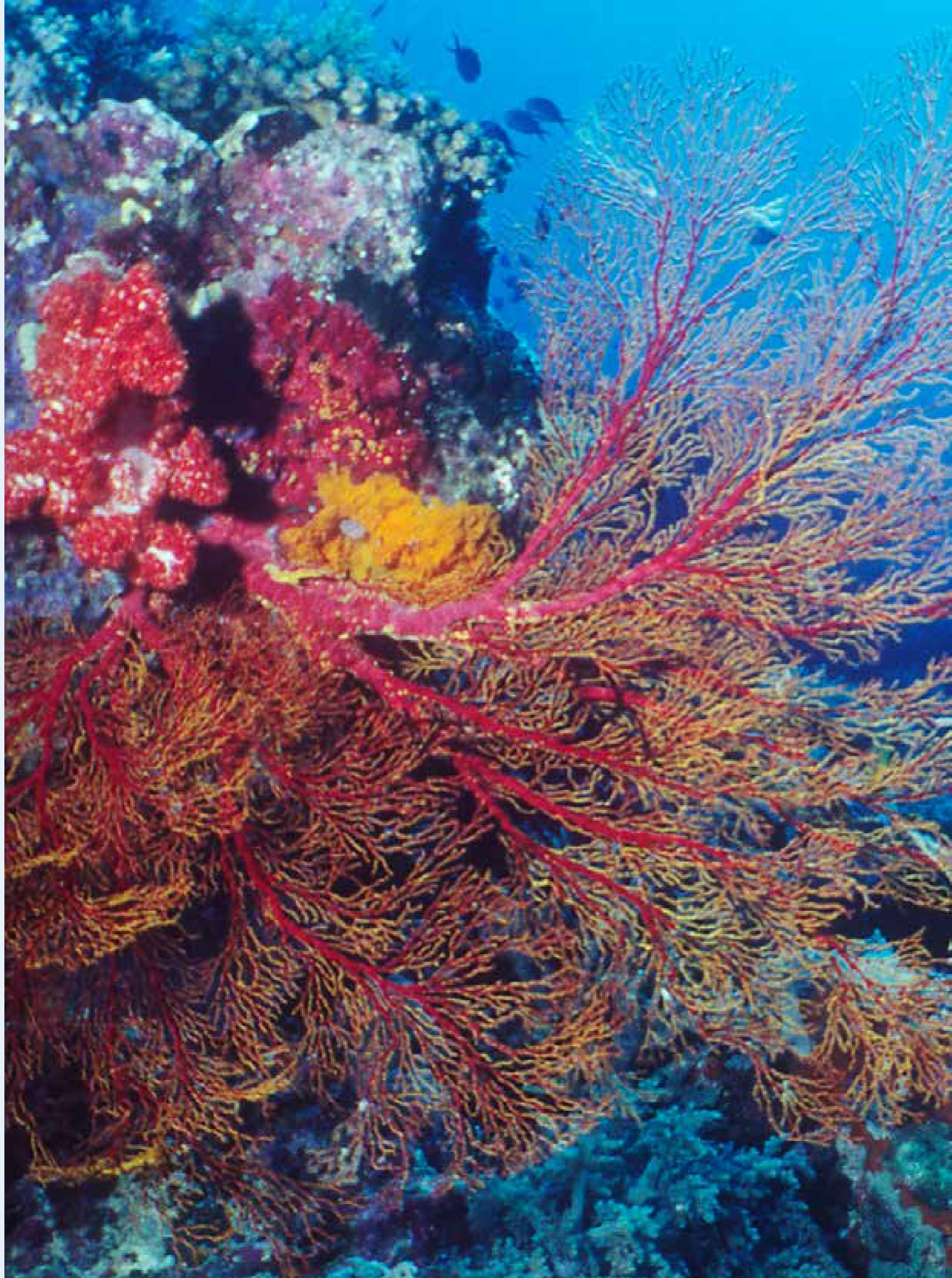
This is probably why the natural world appears largely blue and/or green – these are the main colours towards the high energy end of the spectrum, and are the colours most likely to be reflected off objects rather than absorbed.

This is why a clear daytime sky is blue: it is filled with blue light being bounced around in the atmosphere on its way from the sun to us – it reaches us eventually (which is why we can see it), but via a very roundabout route. Light reaching us directly from the sun appears white as it contains all the visible light colours (which is why during the day the sun, and the sky immediately around it, usually appear white).

Under water, once you're more than a couple of metres below the surface, everything appears blue. This is because all light at the red end of the spectrum is quickly absorbed by the water, and all that remains is blue or blue-green light.

For this reason, underwater photographers always have to use flashguns – it's not so much due to the lack of light but the need to correct the submarine colour imbalance by shining some white light onto the subject.

As I've already said, white light is created by an even mixture of the colours of the visible spectrum, notably of the three primary colours. This is the kind of light we experience in the middle of the day in clear weather.

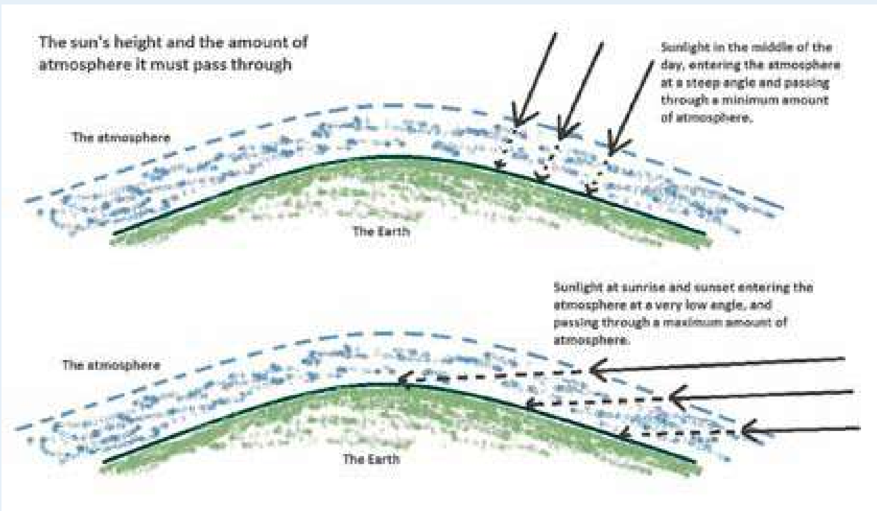


At other times of the day and in other weather conditions the colour balance can be rather different. This is especially noticeable at sunrise and sunset, times when of course the sun is very low in the sky.

At these times, the light coming from the sun towards us is shining almost parallel to the Earth's surface, grazing along the surface and so passing through a very large amount of the atmosphere – far more than in the middle of the day when the sunlight hits our atmosphere much closer to 90 degrees and so comes down through the minimum amount of atmosphere.

As a result, at sunrise and sunset almost all the blue light is bounced by the atmosphere back into space and virtually the only light that reaches us directly from the sun is red light. A large proportion of this red light is absorbed as it passes through the atmosphere, but enough reaches us for the sun to be visible as a red ball, along with some red light in the sky or bouncing off nearby clouds.

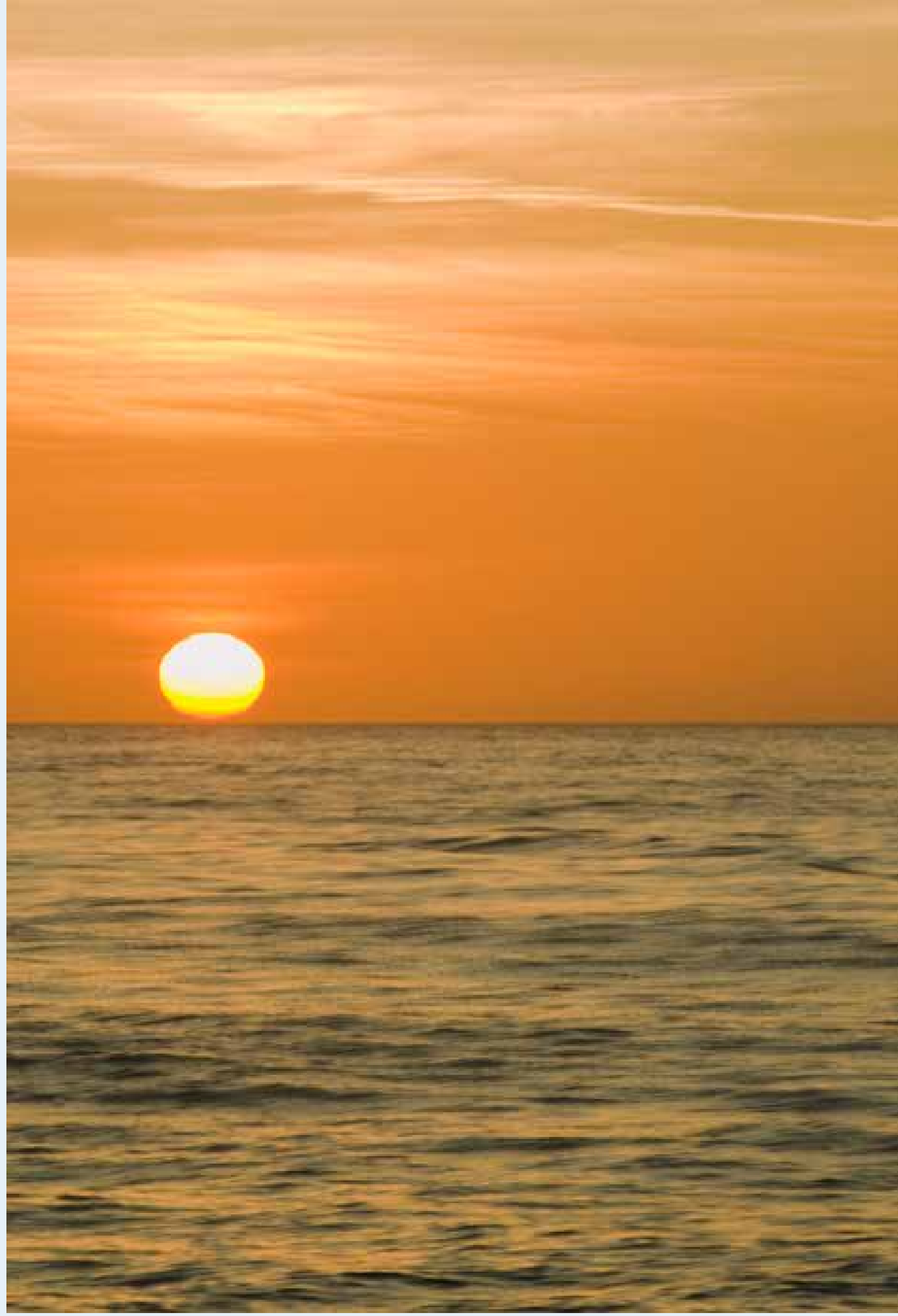
The fact that we can see the sun as a red ball rather than a blinding fiery light - as it is in the middle of the day - indicates just how much of its output is either absorbed (red light) or bounced away (blue and green light) by the atmosphere. The more junk there is drifting around in the atmosphere, whether dust, water vapour or pollutants, the more light is absorbed or bounced away and the dimmer the sun's red ball becomes.



At dawn and dusk, when the sun is below the horizon (in other words, shortly before sunrise and shortly after sunset), no light reaches us directly from the sun. At this time the only light present is blue light reaching us very indirectly as it bounces its way through the atmosphere and eventually down to ground level.

The result is the blue/violet lighting typical of twilight. Any red present in the sky at this stage is due to sunlight shining from below our horizon 'up' into the sky immediately above the horizon, and then being bent just enough by atmospheric water vapour or dust for it to reach us, such as when it bounces off the bottom of high-level clouds.

What all this means for photography is that images shot during the first and last hour or two of the day will often be filled with a 'warming' rich red colour, something that is very moody and pleasing to the eye. Hence, much of our best photography – particularly landscapes – is taken at this time of day.



As mentioned above for dawn and dusk, when we don't receive direct sunlight one of the main sources of our light is indirect, light that has been bounced around in the atmosphere on its way from the sun to us.

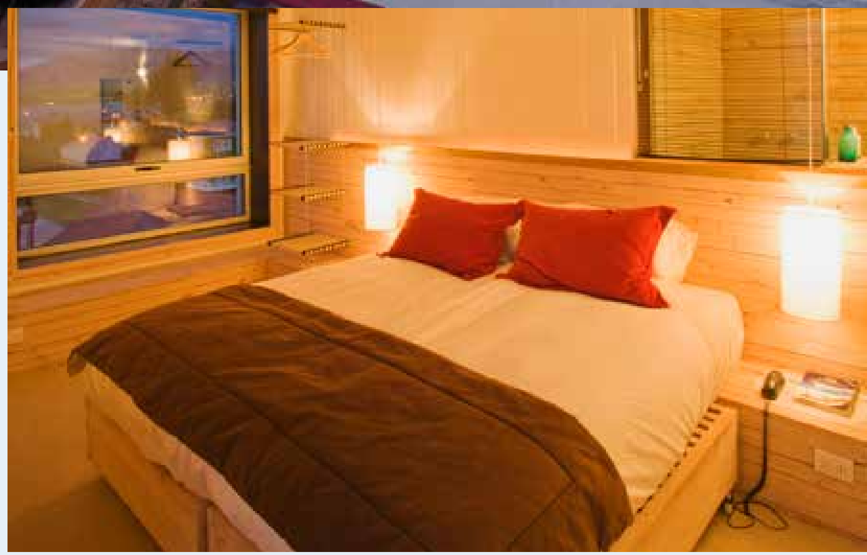
This inevitably is rich in blue. Not only does this happen when the sun is below the horizon, but also – though to a much lesser extent – when it is high in the sky but unable to shine on us directly, either due to cloud cover or haze, or because we are in a shaded area.

Thus, on both a cloudy day and in sunny weather but in the shadows – such as the shade of a tree – the light will tend to be not truly white but rather rich in blue, something that usually makes images look less attactive, unless corrected (which will be covered below).

It is a rather similar scenario indoors. Inevitably, any natural light illuminating an indoor environment is almost certainly going to be rather indirect, unless the sun is at such an angle that it is able to shine straight in through a window and light up most, if not all, the interior space.

The usual situation, however, is that natural light reaching into a room has been bent and bounced around a few times on its way from the sun, and as a result is rather rich in blue. This may not be immediately apparent to the eye, but it certainly is to the camera, and if not corrected will often generate rather disappointingly 'cold' and lifeless images.

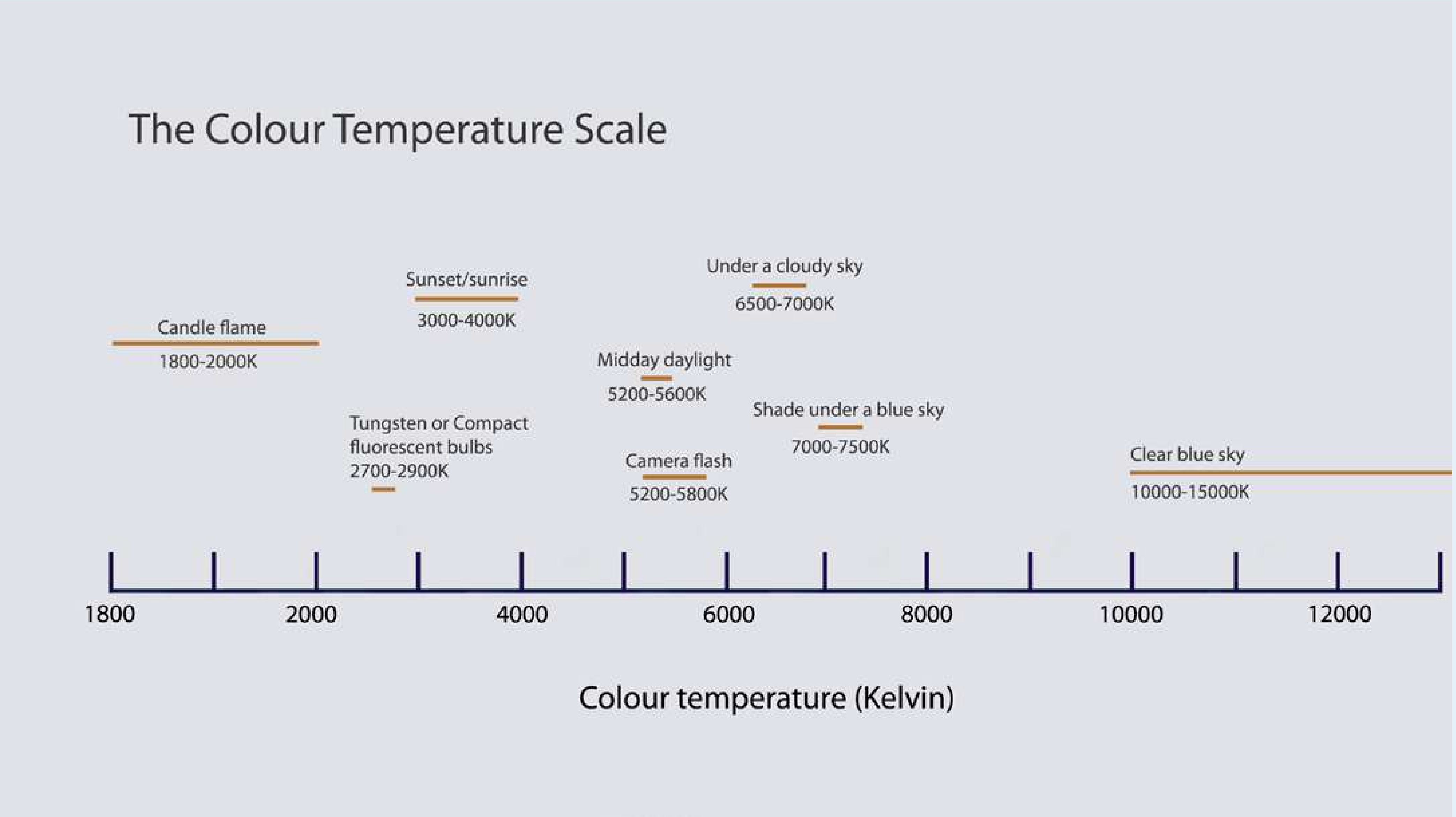
When it comes to artificial lighting, these days we have quite a plethora of different types, including tungsten (or incandescent), halogen, fluorescent, compact fluorescent (usually known simply as energy-efficient bulbs) and light-emitting diode (LED). The light they emit has different colour properties from daylight, and they all differ from each other, making for a rather complex and confusing scene.



In general, the light they emit has a lower energy than daylight, and if no correction is applied images shot under their light will appear with an unpleasant colour cast – orange if shot under tungsten lighting, green if shot under standard fluorescent lighting, for example. Halogen, LED and 'daylight' fluorescent lighting appear to have colour properties closest to daylight, and can give images with reasonable colour accuracy without much correction.

The final artificial light source is flash. While the artificial light sources described above are used as ambient lighting – meaning that they provide continuous relatively low level light – flash of course produces instantaneous bursts of light (ranging from about 1/500 to 1/1000 second) that vary from high to low intensity.

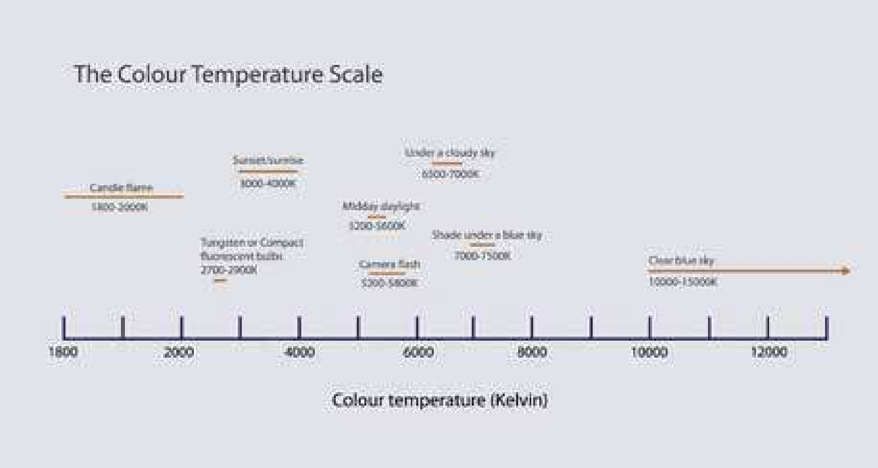
The great thing about flash is that its colour closely matches that of daylight (though sometimes it can be a bit too blue), making it popular among photographers as a highly portable artificial sun, one that can be highly controlled given the right kinds of flash equipment. How to use it will be described later.



It becomes a lot easier to understand and keep track of the relative energy levels and colours of the different artificial light sources and of natural light at different times of day and under different weather conditions if you use a scale on which they can all be rated and compared.

This is where the colour temperature scale comes in, so named for technical reasons that I won't go into here. Suffice to say, the scale's gradations are called 'Kelvin' (usually abbreviated to simply 'K'), after the Scottish scientist who came up with it.

On this scale 'standard' daylight such as you might have at about midday in bright weather has a colour temperature of 5200-5500K, while a clear blue sky would rate at about 11,000-13,000K, and sunset about 3000-4000K.



The various artificial light sources range around the lower end of this scale, tungsten lighting typically coming in at about 2700-3000K and white fluorescent tubes at about 4500K.

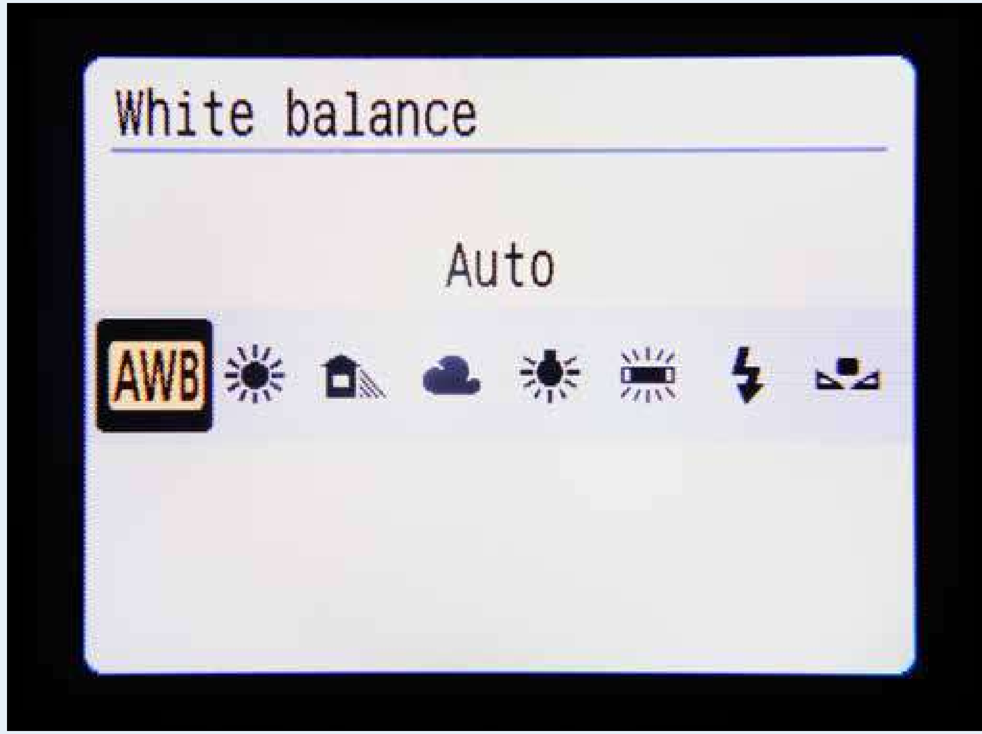
It is not essential to know about the technical aspects of the colour temperature scale or even to remember all these numbers – though memorizing 5500K would be a very good start – but it is a good idea to have an understanding of the rankings as it does help in using the digital camera's white balance mechanism, the system used to ensure that colours are rendered accurately regardless of the colour temperature of the light source.

When it comes to photography, the camera has to make sure that it records all the colours in a scene at the right colour temperature. The means by which it does this is called the ‘white balance’, a term that stems from the problem that anything white when seen in good quality daylight could end up looking quite different when viewed under some other lighting condition if no correction is applied.

Applying that correction to keep that white object looking white under a host of other light sources is what the camera’s in-built white balance mechanism achieves. Critically, once the camera has established what should be white and how to correct for any colour imbalance in the light source, then all the other colours in the image naturally fall into place around that white reference point.

To help with this, all digital cameras come with a range of settings that the photographer can select according to the light source being used. These can normally be called (and are generally represented in-camera with corresponding icons for) ‘Sunny daylight’, ‘Cloudy daylight’, ‘Sunny-day shade’, ‘Tungsten’ and ‘Fluorescent’.

Some cameras have several fluorescent settings to allow for use with different types of fluorescent tubes. The final setting common to all cameras is ‘Automatic White Balance’ (usually called simply AWB), which automatically sets what it considers to be the right white balance according to the lighting conditions it detects through its own sensor.



Some cameras also have a dedicated white balance setting for use with flash, recognizing that many flash systems emit light that is a little bluer than normal daylight.

A final setting common to most cameras, especially SLR cameras, is the ‘Custom White Balance’, which enables the photographer to create their own white balance profile for any unique lighting situations, such as when an unusual light source is used, or when lighting is provided by an awkward mixture of light sources, such as daylight and tungsten.

A simple rule of thumb for outdoor photography in daylight is to keep the white balance control set to AWB, as this will quite accurately render most situations at most times of day.

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There are times when the AWB setting could let you down, particularly at or near sunset or sunrise. At these times of day the AWB will tend to detect all that reddish light as being well beyond what it considers normal and so will 'correct' out much of the red or orange glow, leading to rather flat and disappointing images in which you'll wonder what happened to all that beautiful light you thought you were photographing in.

Either correct the problem later in-computer, or while shooting use one of the daylight settings instead of AWB. You will find that the three daylight settings (sunny, cloudy and shade) will boost the reds by different amounts – the shade setting being the most effective (perhaps excessively so!).

When it comes to the levels of blue in an image, generally speaking, it is unusual to want to enhance any such blueness as it creates a 'cold' feeling that is normally rather unattractive – quite the opposite of the 'warm' feeling created by boosting the reds.

However, there are occasions when you might want to boost the blue, generally when you really do want to enhance the feeling of cold.

You can of course, try using exactly the right setting, but remembering to switch from the 'sunny daylight' setting to 'cloudy' and back again every time the sun comes in and out from behind clouds can be quite a challenge, and as a result you will regularly shoot images with the wrong white balance setting. This can be corrected later in-computer, but this is an extra hassle I'm sure we can all do without!

By way of an example of the above, I deliberately shot the same cloud-covered landscape with the 'wrong' white balance, selecting 'sunny daylight' instead of AWB. You can see how the resulting image is rather unnaturally and unattractively blue, giving it a cold feeling.

A specific example of when a blue boost is useful is in photographing glacial ice. Such ice is naturally quite blue, but the AWB mechanism will tend to detect this as 'excess' blue light and so will set the white balance at a high colour temperature (perhaps over 7000K), removing the blueness, and making the ice appear a disappointing grey-white.

To correct this problem and so restore the blueness to the ice, select one of the daytime white balance settings (sunny, cloudy or shade), balancing the image's white at a much lower 5200-6000K, a setting that will restore the ice's blueness.

As with outdoor photography, indoors the AWB will often work well. If natural daylight is the main light source indoors, it is likely to be rich in blue, at a level that is often handled well by either the AWB or the 'cloudy daylight' setting.

The AWB does have some failings indoors, particularly when it comes to low energy tungsten lighting. Such bulbs commonly emit light with a colour

temperature of below 3000K, below the AWB's effective range, resulting in images with a strong orange colour cast.

Selecting the camera's tungsten setting will often provide a more accurate colour rendition, but even this setting is commonly above the colour temperature of domestic tungsten bulbs, and may still produce images a little too orange.

The AWB can be reasonably accurate under fluorescent lighting, but if your camera has several fluorescent white balance settings you should be able to use these and have little difficulty finding one that will give good colour balance for the type of fluorescent lights being used.

If using white or daylight fluorescent tubes you might even get reasonable white balance with the sunny daylight setting – try it and see what happens. If the images come out horribly green you'll know that you'd better use either the AWB or a fluorescent setting. You'll also get an insight into what it is like shooting with film (which is generally balanced to 5500K daylight) under fluorescent lighting!

Shooting under the now widespread energy-efficient compact fluorescent lights can be quite difficult as the colour temperature they emit can be rather varied. Despite being fluorescent lights, many emit light with a colour temperature below 3000K, and so may be most effectively balanced using the camera's tungsten setting.

One of the trickiest situations is when you have a mixture of light sources, such as fluorescent and tungsten or tungsten and daylight. The simplest solution is generally to decide which is the most important light source, and concentrate on balancing the image's white balance to that.

For example, in a room lit by a mixture of daylight and tungsten, the simplest solution (and most aesthetically pleasing, actually) is to set the white balance to daylight and not worry too much about the tungsten.

The tungsten lights themselves and anything lit exclusively by them will look quite orange (much more so than to the eye), but this is often quite attractive and helps lend atmosphere to the interior shot.

You can also use some flash indoors to help boost light levels, fill in shadows and control white balance. How to do this will be covered in more detail in Lesson 4, but from the point of view of white balance control it is useful to mention it here.

You can use it to throw more daylight-balanced light into the scene – useful if you're setting your white balance to daylight – or if the white balance is set to tungsten you can put an orange filter over the flash so the light it throws out mimics the colour of the tungsten.

There is in fact specific filter material available for doing just exactly this, called 85B, something that is quite critical in photography using film.

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