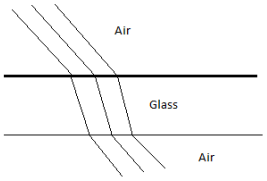
The Science of Photography

By James Demro 2013

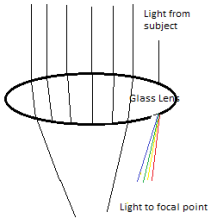
To start off talking about photography we need to discuss light and how it works. Light is a electromagnetic particle. That means it has an electronic component and a magnetic component and acts as though it has mass. Since light or photons have a maximum speed limit the only way they have to change their energy they carry is by the wave length. The shorter the wave length the more the energy and the longer the wave length the less energy it carries. Normally we consider light as photons that are visible. Some consider it to include a much wider spectrum including infrared and ultraviolet. Photons can go from an nearly infinite wavelength to microscopic in wavelength. The longer wavelengths are like infrared that is not in our or birds range of vision to visible; red to a yellow to a green to a blue and violet then to ultraviolet that is not visible to most people. In some birds the longer wavelength (near violet) photons are in their range of vision including pigeons. These differences in energy levels has an effect on photography. There are two major ways it is involved in photography. One is what is called the temperature of the light and the other is effects of refraction on the different wavelength (also called frequencies)

The temperature of light is the color of the light as approximated by the figure to the right. The numbers are the temperature in degrees Kelvin. The Kelvin scale is taken from absolute zero and uses the same delineations as the Celsius scale. So the freezing point of water would be 273 degrees Kelvin or 0 degrees Celsius of 32 degrees Fahrenheit. It is the photons given off by what is called a black body radiator. Other words a light source that doesn't produce light by means like fluorescents, transmission, led lights, etc. The sun is a black body radiator and is the temperature of about 5778 degrees Kelvin. So when taking photos in the sun light there will be much more blue light than a light source like incandescent light bulbs witch in more in the red range. Most digital cameras have some built in programs to try and adjust for the different color light source. With conventional film you have to buy film for the color temperature of the light source. If you look at a 35 mm film box you will find the temperature of the light the film is designed for. I am sure you all have seen indoor photos made with outdoor film. The photos all look red. Digital cameras won't always get it right so it is important to use proper light source if you can.

An incandescent bulb will be a cooler or more red light source than a fluorescent bulb light source or more blue light source. If you look at the box the light bulbs comes in they will normally give the light temperature. Then you need to go to your camera's manual and see what setting works with what temperature. This seems complicated, but if you go to your camera manual they might explain what light source to use on what setting. This is all important if you want photos with accurate color.

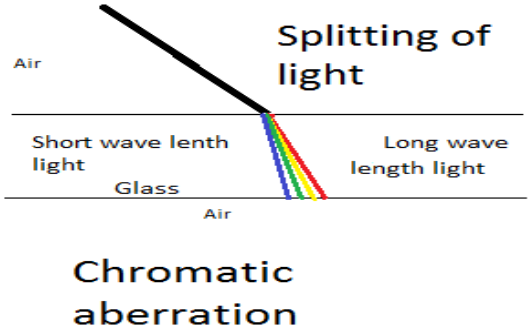


Next is the energy the light has and how refraction affects the different wave lengths. Refraction is the bending of the photons or light beam as it goes from a more dense to a less dense material or vice versa such as going through a glass pane. This is the reason when you look into a pool of water the location of an object in not always where it appears. This is how lenses work. Except for having flat surfaces the surfaces are curved. This changes the amount of bend in different locations allowing the lens to focus the light.



The figure to the immediate right shows the bending of light in what is called a positive lens. Positive lenses focus the light to a point. If not for a thing called chromatic aberration this all that would be needed for a camera lens. Chromatic aberration is the differential amounts different wave length light bends in a lens. Red light has a longer wave length and is bent less because of it. This is how a prism

a camera they use different curvature lenses and different materials to try and correct for chromatic aberration. They never can make a perfect lens, but they can get very close. And of course to get that better lens there is a lot more engineering and manufacturing involved so the cost goes up rather quickly for better quality lenses. It is not just the quality of the grind on the lens you are paying for. This is all part of find the right camera for your use. You have to decide on how precise you want your photos.

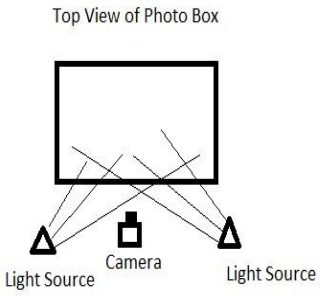


Chromatic aberration

The next most important aspect of making photos of pigeons where the light source is coming from. If the light is from a single direction it will give what is called harsh lighting. Sometimes you may want to have harsh lighting for certain effects. To get the softer lighting you need to get light in from more than one direction. The softest light I can think of is like a ring flash would give you. I feel this gives a very flat looking photo. It is also hard to get a feel for depth.

This is a ring flash that is made for a conventional 35mm camera. The part to the left in the photo mounts on top of the camera in the normal flash mounting. The ring to the right in the photo mounts over the lens so that light hits the object being photographed evenly lighted. A normal flash on a 35mm camera or even a digital camera flash is close to a point source of light and will normally give harsh lighting if there is no other light source available. If you set a photo studio to make photos of your birds you should probably consider a number of light sources and at different intensities to get the best of all worlds.

Building a photo studio you will want to have the light sources behind the camera lens. This way the camera doesn't pick up the light and flooding out the photo. You can also change the angle of the light sources for different affects. The last major point to consider is the intensity of the light and a thing called depth of field. In a conventional camera the lens normally has what is called the F stop. This is an aperture diameter in the lens. The smaller the aperture the deeper the focus or depth of field will be. This lets in less light so to get the right exposure you need more intense light source. In a conventional film camera with F stop settings you have to trade off shutter speed, F stop and light source intensity to get the photo you want.



In the cheap digital camera that most of us take to shows there is a set F stop in most of them. The only perimeter the camera can change is shutter speed and color temperature. So the depth of focus is always the same. In higher ends digital cameras especially if they have exchangeable lens and a manual setting you can get more depth of the focus.

There is a lot more involved some call the art of photography that I am not going to cover that stuff like camera angle.