How Do Cameras Work?

Photography is one of the most important inventions in history; and has transformed how we conceive the world. The basic technology that makes all of this possible is fairly simple. A still film camera is made of three basic elements: an optical element (the lens), a chemical element (the film) and a mechanical element (the camera body itself). The trick to photography is calibrating and combining these elements in such a way that you can master the affects you wish to achieve.

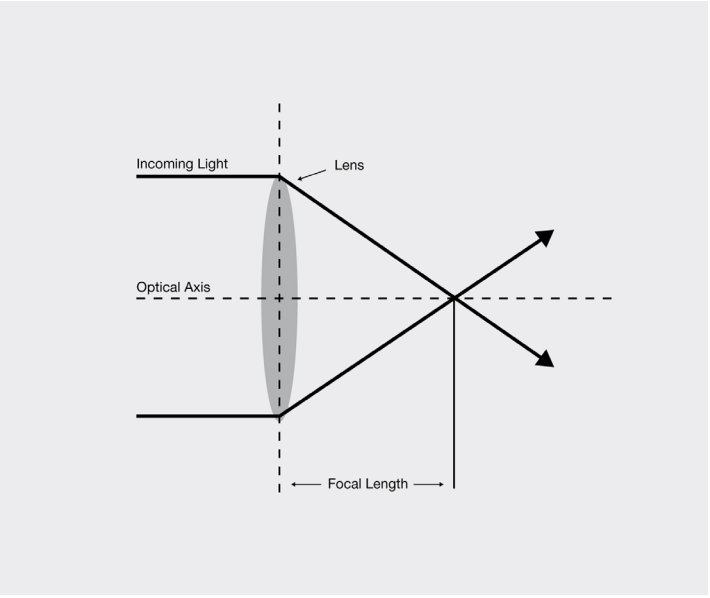
Cameras really started to change the world with the introduction of the “Brownie” camera in 1900. With the Brownie, photography was no longer just for professional photographers; the average family could now own a camera. Snapshots, spontaneous, and un-posed images started to record everyday life. This miniature camera was inexpensive and easy to use, and versions of the Brownie were still being sold into the 1960s. Nowadays, digital cameras have increasingly become the preferred choice for professionals and amateurs due to their speed, portable scale, ease of use and the savings made from not needing to develop film.

Every camera is essentially a lightproof box, with some method of letting in just a small amount of light at just the right time. Once the light is in the box, it forms an image (like in the camera obscura), causes a chemical reaction on photographic film (like in the Brownie camera), or energizes a photocell (like in a digital camera).

Light and Lenses
The word photography comes from the Greek, which actually means writing or drawing with light. Light travels in straight lines and outwards in all directions from any light source, whether a candle, a light bulb or the sun. When light strikes an object it is reflected back and we are then able to see it.

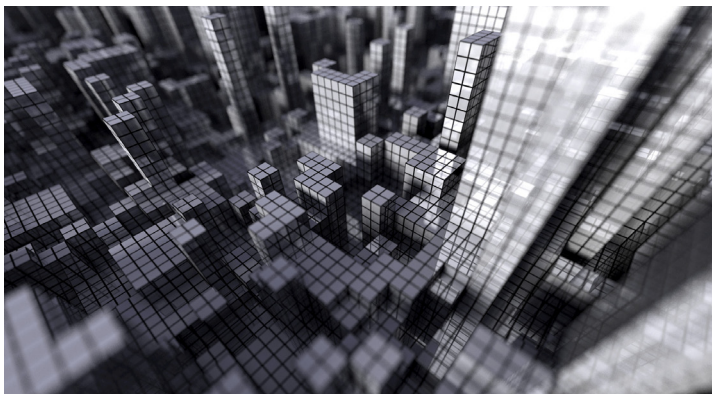
The speed of light is constant but when light rays reach a lens they slow down, bend and become refracted. The camera lens receives rays of light from every point of the subject in front of it. It refracts them so that they collectively converge creating an upside down, back-to-front image.

Focal Length
Focal length refers to the extent to which the lens bends the light. Very simply, it is the distance from the lens to the film, when focused on a subject at infinity. The distance from the lens at which a sharp and precise image can be formed is called the focal plane. To focus on something closer than infinity, the lens is moved farther away from the film. This is why most lenses get longer when you turn the focusing ring.



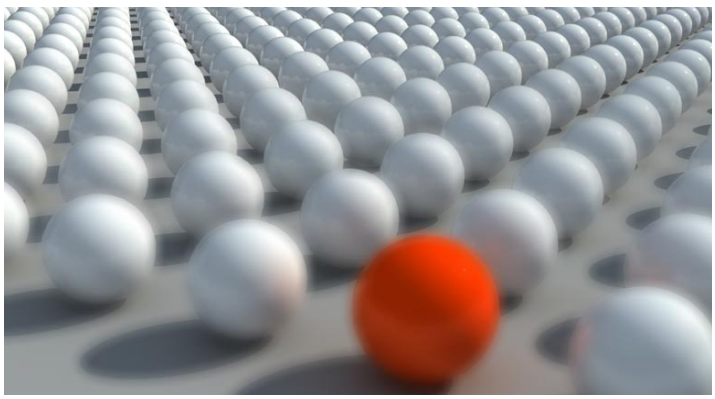
Depth of Field
Controlling depth of field allows all of, or varying parts of the photograph to be in focus. Depth of field is controlled by the focal length of the lens, the aperture and the focal distance between the lens and the subject. As the aperture on the lens is reduced, the depth of field increases, allowing more of the picture to be sharply in focus.

For example, F2.8 gives less depth of field. F2.8 means that the aperture of the lens is letting in a lot of light. If the aperture is set to F22 the aperture is not letting in very much light. This affects your depth of field in the following way:

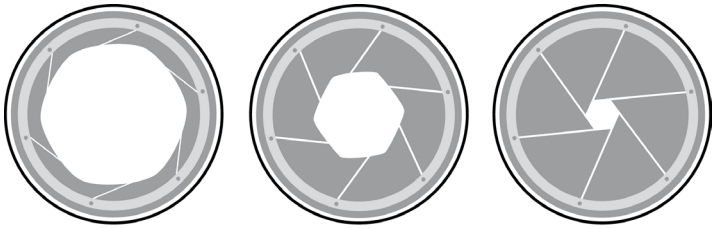


F22 lets in a small amount of light, this means that when you take a photograph your point of focus will be sharp as will the rest of the image regardless if you have only focused on one thing. This is because your depth of field is large when your aperture is letting in a small amount of light.

F2.8 lets in a large amount of light, this will result in your point of focus being sharp but the rest of the image will be out of focus.



The Shutter and the Aperture
The camera uses two devices to regulate the amount of light reaching the film, which is how you control the exposure. These are the shutter and the aperture.



Large Aperture
$f/2$

Medium Aperture
$f/8$

Small Aperture
$f/22$

The Shutter
The shutter covers and uncovers the hole in front of the camera (like an eyelid winking) controlling the length of TIME light is let in to the camera. A fast shutter speed that exposes the film for only a very short time is needed in bright light. A slow shutter speed is needed in dull conditions when there is not a lot of light to allow more time for the light to expose the film.

The shutter also affects the amount of blur and movement within a photograph of a moving object. The longer the shutter stays open the more movement is recorded.

The Aperture
The aperture also controls the amount of light falling onto the film. The aperture can be controlled to expand (open) to let in more light during dull days and to contract (close) to let in less light on bright days. Apertures can start at F1.4 and go up to F64 however F22 is more common. Although you would think that the smaller the F-stop the less light it would allow and the smaller the aperture would be it is in fact the opposite. F1.8 (big aperture) allows in a lot of light where as F22 (small aperture) lets in a little amount of light.

Adjusting the aperture
The different sizes of the aperture are measured in F numbers or F-stops and are usually arranged in a sequence where each number lets in half as much light as the previous number or F-stop. The smaller the F -stop number the bigger the aperture.
The RAW file format

Camera Metering and Exposure
A photograph's exposure determines how light or dark an image will appear when it's been captured by your camera. Believe it or not, this is determined by just three camera settings: aperture, ISO and shutter speed (the "exposure triangle"). Mastering their use is an essential part of developing an intuition for photography.

Metering is the brains behind how your camera determines the shutter speed and aperture, based on lighting conditions and ISO speed. Most cameras employ a basic metering system that allows the photographer to adjust shutter speed and aperture until a needle or array of LED lights in the viewfinder indicated correct exposure. Some cameras allow for unassisted setting of one of these functions once the photographer has set the other. This is called 'shutter speed priority' or 'aperture priority'.

Excessive reliance on automatic exposure readings can lead to incorrect exposures. Conditions such a strong back or side light, or contrast that are extreme can mislead an automatic metering system.

For example: When photographing a subject in front of a white wall, note how much of the frame is taken up by the white wall. This will affect the exposure. If the photography should be exposed for the subject and not the white wall, be sure to take a reading of the subject. This may mean moving closer to the subject to take a reading and then moving back to the original position to exposure the negative.

The RAW File Format
The RAW file format is digital photography's equivalent of a negative in film photography: it contains untouched, "raw" pixel information straight from the digital camera's sensor. The RAW file format has yet to undergo demosaicing, and so it contains just one red, green, or blue value at each pixel location. Digital cameras normally "develop" this RAW file by converting it into a full color JPEG or TIFF image file, and then store the converted file in your memory card. Digital cameras have to make several interpretive decisions when they develop a RAW file, and so the RAW file format offers you more control over how the final JPEG or TIFF image is generated.