Photographers don’t just take photographs - they make them!
**Digital Single Lens Reflex Camera**

The basic operation of a DSLR is as follows: for viewing purposes, the mirror reflects the light coming through the lens upwards at an approximately 90 degree angle. It is then reflected by the pentaprism to the photographer's eye. During exposure (when the photograph is taken), the mirror swings upward, and a shutter opens, allowing the lens to project light through the aperture onto the film / sensor.

**Cross-section view of DSLR system**

1 - 4-element lens + aperture  
2 - Reflex mirror  
3 - Focal-plane shutter  
4 - **Sensor** / film  
5 - Matte focusing screen  
6 - Condenser lens  
7 - Pentaprism  
8 - Eyepiece

Photography is the Art of Recording Light

In order to record light successfully you need to know how to control your camera settings manually. Understanding photography exposure allows you to give correct instructions to your camera about:

- Film / Sensor Speed
- Aperture
- Shutter Speed
- Light Metering

Your camera is just a tool - you are the artist.
# Basic DSLR Camera Operation

<table>
<thead>
<tr>
<th>The constant</th>
<th>ISO setting</th>
<th>= sensitivity of film / sensor to light</th>
</tr>
</thead>
<tbody>
<tr>
<td>The variables</td>
<td>Aperture</td>
<td>= adjustable opening in lens</td>
</tr>
<tr>
<td></td>
<td>Shutter Speed</td>
<td>= duration of exposure</td>
</tr>
</tbody>
</table>

The aperture controls **volume of light**

= the **science** of photography

The aperture controls **depth of field / focus**

= the **art** of photography

The shutter controls **duration of exposure**

= the **science** of photography

The shutter controls **appearance of motion**

= the **art** of photography
Aperture + Shutter Speed = Exposure

Aperture + Shutter Speed = Pictorial Outcome

Camera: Mamiya RB 6x7 + 65mm wide angle lens*

Exposure
Scene: strong directional sunlight from behind the photographer
Film ISO: 100
Aperture Priority: f/22
Camera mounted on tripod

Pictorial Outcomes
Medium format negative: detail retained when enlarged
100 ISO: broad tonal range
f/22: broad depth of field; precise edge definition
No camera shake
*distortion of space

Clive Stone, mid 1980's
Film / Sensor ISO

ISO rating

sensitivity to light doubles each stop

50 100 200 400 800 1600 3200 6400

sensitivity to light halves each stop

the science: sensitivity of film/sensor to light

Slow
more light required
fine grain
(DSLR) less noise
more tonal detail
precise edge definition

Fast
less light required
coarse grain
(DSLR) more noise
less tonal detail - high contrast
looser edge definition

the art: pictorial outcome
Shutter Speed

Duration of exposure halves each stop

30” 15” 8” 4” 2” 1” 2 4 8 15 30 60 125 250 500 1000 2000

Duration of exposure doubles each stop

Slow shutter speed = longer exposure to light

The science: sensitivity of film/sensor to light

Fast shutter speed = shorter exposure to light

Motion appears blurred *

The art: pictorial outcome

Motion appears frozen*

* relative to speed of motion being photographed
Aperture

- Large aperture
  - Larger volume of light
  - Narrow depth of field
  - The art: pictorial outcome

- Small aperture
  - Smaller volume of light
  - Wide depth of field
  - The science: sensitivity of film/sensor to light

Aperture size halves each stop

Aperture size doubles each stop
The f/stop number is the ratio between the diameter of the aperture in the lens and the focal length of the lens. The focal length is generally measured in millimeters.

On a standard 50mm SLR lens with an aperture diameter of 25mm, the f/stop number is $2 = f/2$. 

The f/stop number is defined as the ratio of the focal length of the lens to the diameter of the lens, which can be expressed as:

$$\text{f/stop} = \frac{\text{focal length of the lens}}{\text{diameter of the lens}}$$

Images not to scale
On the same 50mm lens with an aperture diameter of 12.5mm, the f/stop number is 4 = f/4

and with an aperture diameter of 6.25mm, the f/stop number is 8 = f/8

http://en.wikipedia.org/wiki/F-number
Exposure Combinations

“Correct” exposure can be selected by using various combinations of film / sensor speed, shutter speed, and aperture setting.

One way to think of apertures and shutter speeds is to use the analogy of a tap for the aperture and a timer for the shutter speed.

When you open a tap all the way, water pours out and a container is filled in a very short time.

When you open a tap just a little, water trickles out and so it takes a much longer time to fill the same container.

No matter which combination of volume (flow of water) and duration (length of time the tap is on) you choose, the bucket will be filled the same amount.
Likewise, the film or sensor in a camera can be exposed the same amount by various aperture and shutter speed combinations.

For example, the exposure combinations below allow the same volume of light to enter the camera. However, the pictorial outcomes are quite different.

<table>
<thead>
<tr>
<th>Aperture size increases</th>
<th>Shutter speed lengthens</th>
</tr>
</thead>
<tbody>
<tr>
<td>f/2 @ 1/1000</td>
<td></td>
</tr>
<tr>
<td>f/2.8 @ 1/500</td>
<td></td>
</tr>
<tr>
<td>f/4 @ 1/250</td>
<td></td>
</tr>
<tr>
<td>f/5.6 @ 1/125</td>
<td></td>
</tr>
<tr>
<td>f/8 @ 1/60</td>
<td></td>
</tr>
<tr>
<td>f/11 @ 1/30</td>
<td></td>
</tr>
<tr>
<td>f/16 @ 1/15</td>
<td></td>
</tr>
<tr>
<td>f/22 @ 1/8</td>
<td></td>
</tr>
</tbody>
</table>

**Pictorial Outcomes**

*Depth of field is shallow and there is little possibility of subject or camera blur.*

*Depth of field increases slightly and the possibility of subject or camera blur increases.*

*Depth of field increases even more as does the possibility of subject or camera blur.*
Using the **Aperture** and **Shutter** Together

**Aperture Priority** - manually select the aperture first, then use light meter to select the shutter speed

**Aperture Priority Mode** - manually select the aperture, and the camera automatically selects shutter speed

**Shutter Speed Priority** - manually select the shutter speed first, then the light meter to select the aperture

**Shutter Speed Priority Mode** - manually select the aperture, and the camera automatically selects shutter speed

The photographer prioritises the zone of sharp focusing, that is, the depth of field.

The photographer prioritises the appearance of motion, whether it is blurred or frozen.
Through the Lens (TTL) Light Meter

The TTL meter is a reflective meter as it measures the light bouncing off the subject and into the camera lens.

DSLR cameras provide limited area metering including centre-weighted and spot metering options.

The light meter is calibrated to “read for” average light reflectance (18%). This equates to [ ] in black and white photography, hence the need to overexpose in bright lighting conditions and underexpose in dark lighting conditions.

This drawing shows how the exposure meter system of a DSX1000 works, the red lines describing the electric circuit. There is one light sensitive sensor for spot metering in the mirror, and two sensors (only one shown) for the area metering behind the prism.
Using the Light Meter in Manual Mode

Set ISO rating → Select either Shutter Speed Priority or Aperture Priority

Shutter Speed Priority
- Set shutter speed
- Use the light meter* to assist you in selecting the “correct” corresponding aperture (f/stop)

Aperture Priority
- Set the aperture
- Use the light meter* to assist you in selecting the “correct” corresponding shutter speed coordinate

Compose your shot and focus the lens

Press the shutter release button to make the shot

*Learn about light metering: http://www.moosepeterson.com/techtips/flash.html
A “correct” exposure will be obtained on a sunny day using ISO 100, an aperture of f/16 and a shutter speed of 1/125 (the closest equivalent) of a second.

\[ f/16 \times 1/125 \]

No light meter?? Don’t worry … use the **Rule of f/16**

At an aperture of f/16 on a sunny day, a suitable shutter speed will be \( 1 / \text{the film speed} \). For example if you are using ISO 200, your shutter speed will be \( 1/250 \) (the closest equivalent).

\[ f/16 \times 1/250 \]