

A scenic photograph of a rocky riverbank. The foreground and middle ground are filled with numerous grey, angular rocks of various sizes. The water is clear, revealing a bed of smooth, dark stones and patches of green algae. Sunlight reflects off the water's surface, creating a shimmering effect. A semi-transparent text box is overlaid on the left side of the image.

Photography

1. Focusing the Camera
2. Exposure Time and Aperture
3. Depth of Field
4. The ISO numbers

1. Focusing the Camera

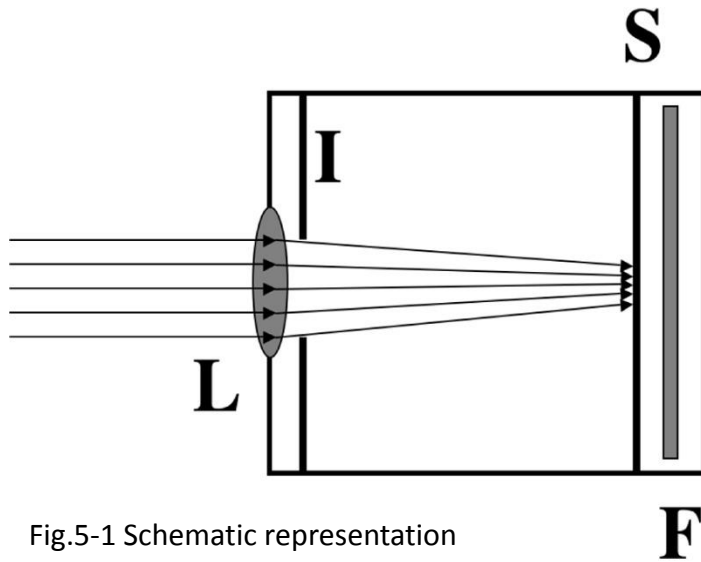
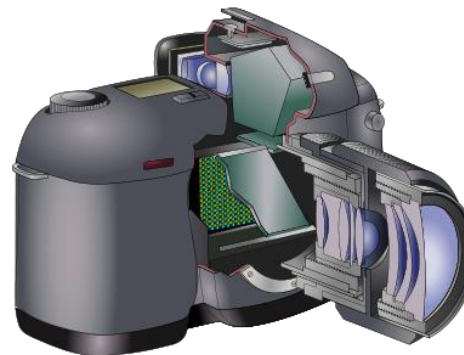


Fig.5-1 Schematic representation

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- The lens (L) focuses the image on the detector;
- The iris aperture I – a.k.a. f-stop;
- Shutter S opens for a short time;
- F – the detector (CCD or film)

When the object is far away,
the image in the focal plane: $i=f$



Daguerreotype camera from 1839,
in the Westlicht Photography
Museum in Vienna, Austria. [Public domain](#)



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A schematic of a DSLR camera

ISO

Sensitivity (film speed)
vs. Noise (grain)



Proper Exposure

Motion blur
vs. Sharp

Shutter Speed

Deep focus vs. shallow
focus (Depth of Field)

Aperture

2. Shutter speed

1 1/2 1/4 1/8 1/15 1/30 1/60 1/125 1/250.....

← I increases by factors of 2

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Effects of long and
short exposure
time.





Aperture / Entrance pupil

Each single step in f-number changes the amount of light by factor of 2. It also changes the depth of field.





Model - Canon PowerShot SX540 HS
 Shutter speed: 1/10 seconds
 f number: 3.40
 ISO: 1600

The f-number is the focal length of the lens divided by the aperture diameter:

$$f / = \frac{f \text{ (mm)}}{\text{Diameter}}$$

$$f/4 = 50\text{mm}/4 = 12.5 \text{ mm}$$



Aperture



[Read more](#)

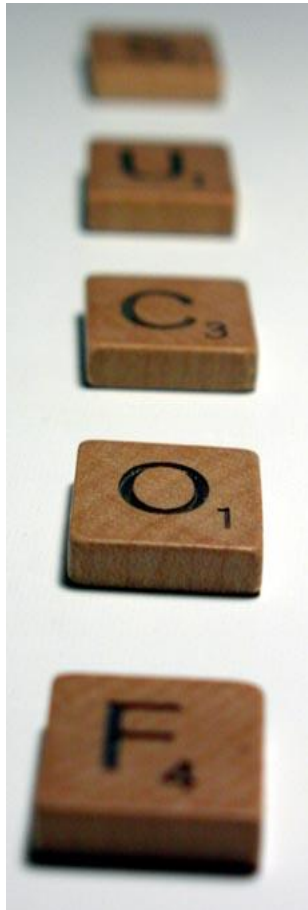


Aperture

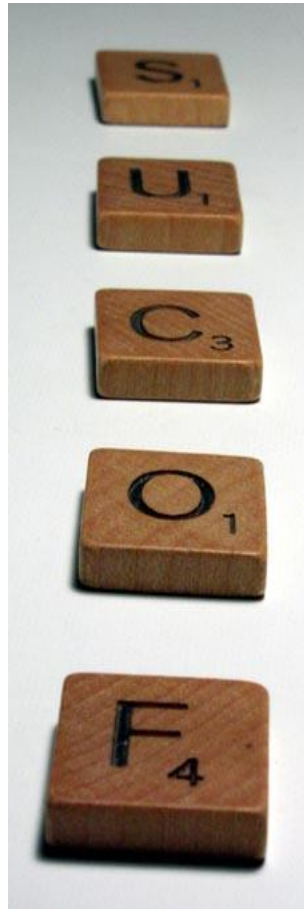


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3. Depth of Field



f/2.8, Focal length:
118.23mm, 1/250
sec



f/10, Focal length:
118.23mm, 1/25 sec



Depth of field
the range of object distances that produce
adequately focused images on film

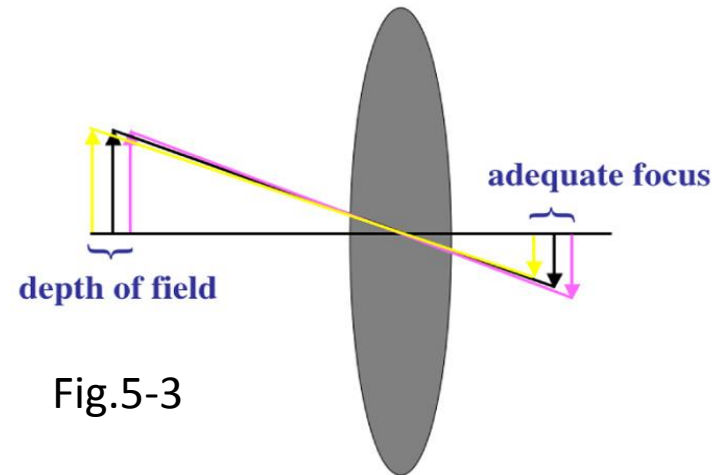
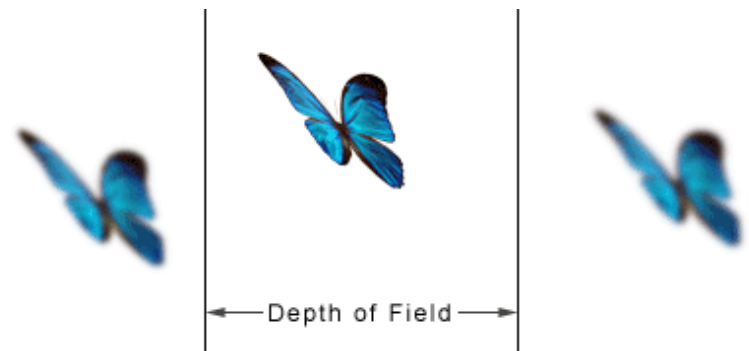
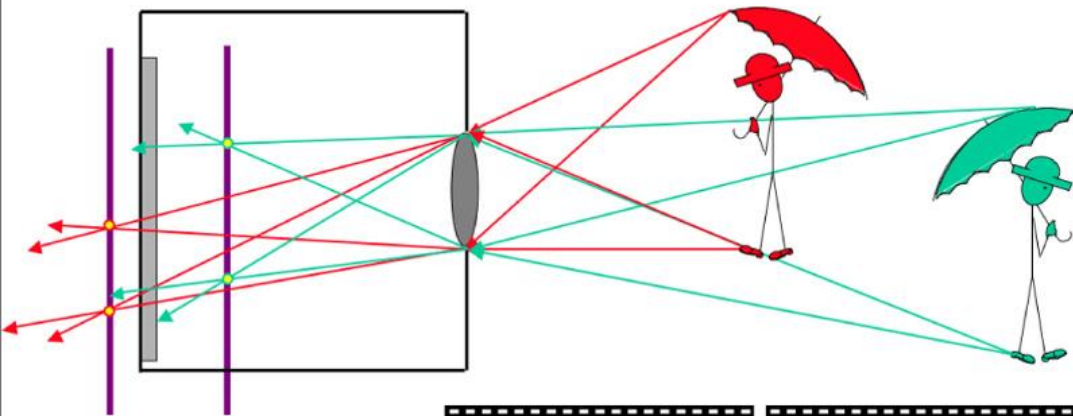


Fig.5-3

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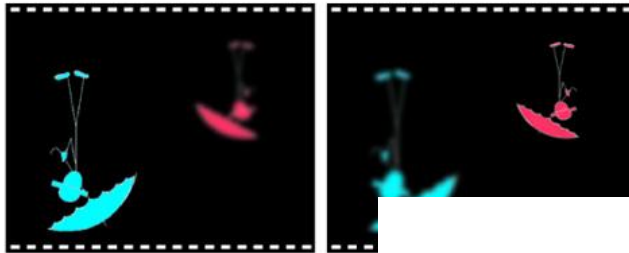


Depth of field



A smaller aperture limits the divergence of the rays, thus producing a larger depth of field.

planes of perfect focus

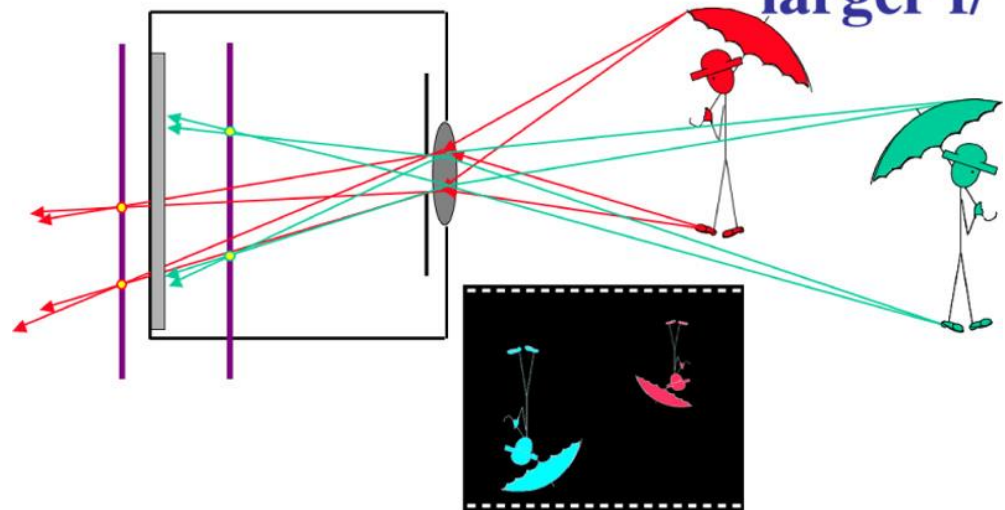


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Depth of field

smaller lens aperture, larger depth of field

larger $f/$



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Q: Which photo is taken with a smaller aperture?



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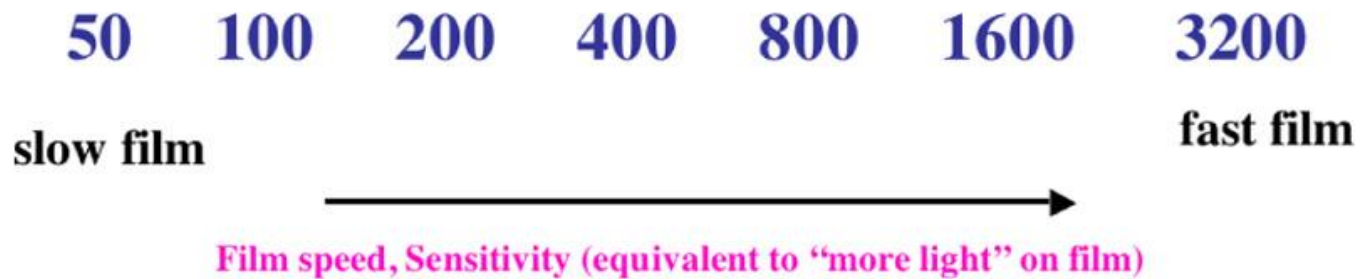


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4. The ISO numbers:

Film speeds (ISO)

they *also* vary by factors of 2



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Film speed: slow & fast

Film sensitivity: low & high

ISO number: small & large
6 ISO 3200 ISO

Photographic Film

- Grains of silver halides: silver bromide (AgBr), chloride (AgCl), iodide (AgI)
- Larger grains, more sensitive (require faster shutter speeds) – faster films
- Fine grains, less sensitive (require slower shutter speeds) – slow film

The collected amount of light depends on shutter speed, aperture and detector sensitivity.

1 1/2 1/4 1/8 1/15 1/30 1/60 1/125 1/250.....

I increases by factors of 2



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f/1 1.4 2 2.8 4 5.6 8 11 16 22 32 45

I increases by factors of 2



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50 100 200 400 800 1600 3200

slow film

fast film



Film speed, Sensitivity (equivalent to “more light” on film)

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The same exposure

ISO 400



ISO 800



ISO 1600



The effect of the ISO setting on the shutter speed

Sensitivity: 64 ISO

Aperture: f3.6

Shutter Speed: 1/8



Sensitivity: 100 ISO

Aperture: f3.6

Shutter Speed: 1/10



Sensitivity: 800 ISO

Aperture: f4.2

Shutter Speed: 1/85



Sensitivity: 1600 ISO

Aperture: f4.2

Shutter Speed: 1/170

