

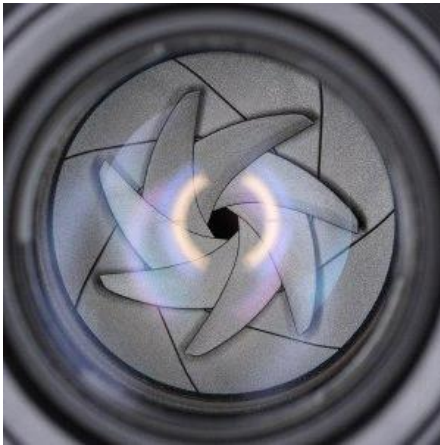
Today: Focus, aperture, shutters

- Friday: Team First Critique

PHOTOGRAPHY FUNDAMENTALS

- 1) Framing/workflow
- 2) Camera
- 3) Lenses
 - Typical lenses
 - Focal lengths
 - Focus and Lens laws
 - Aperture, depth of field
- 4) Exposure Control
- 5) Resolution

Focus, Aperture and DOF



Overlapping leaflets form an iris with a variable diameter opening, here from a Canon EF-M 32mm F1.4 STM lens. [D-Kuru, CC BY-SA 4.0 via Wikimedia Common](#)

From <https://www.flowvis.org/Flow%20Vis%20Guide/overview-4-photography-c-lenses-aperture-and-dof/>

Aperture spec = F number, F#, f/, f-stop = f/D = focal length/ optical hole diameter

Inverse of hole diameter

The larger the hole, the smaller the f/

Range is usually f/1.4 to f/22

What is yours? How does it change with zoom?

On consumer cameras, f/ will change with zoom.

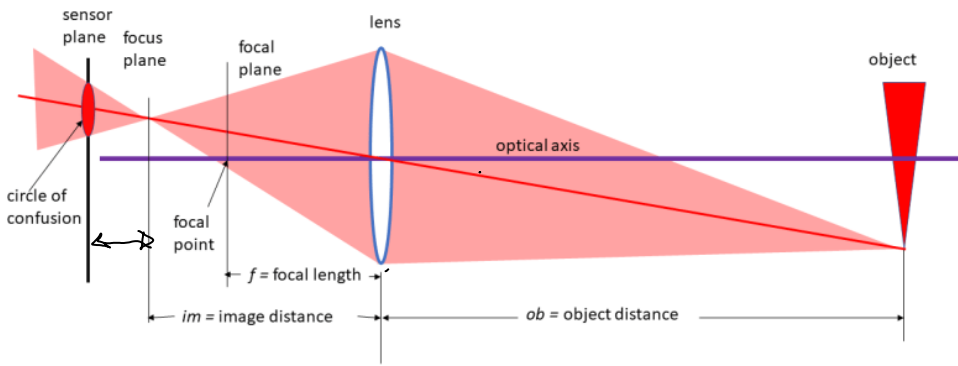
Not so for professional lenses.

DSLR 3.5-22
1.8

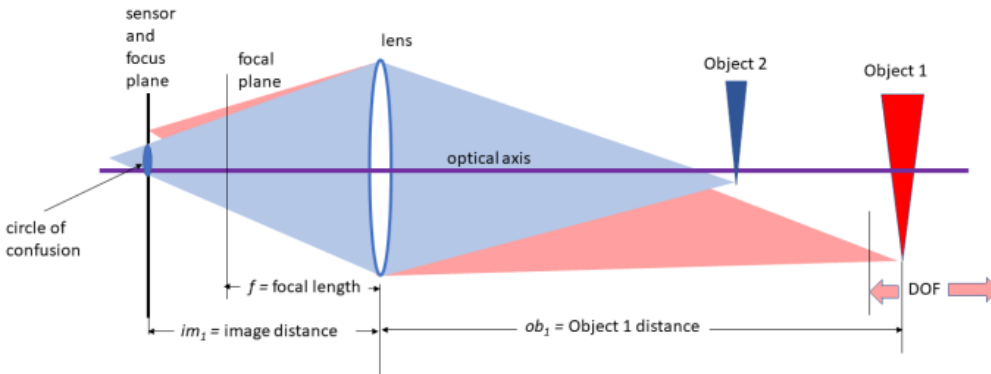
2 main effects: on depth of field, and exposure

DOF = depth of field = range of object distances with 'acceptable' focus.

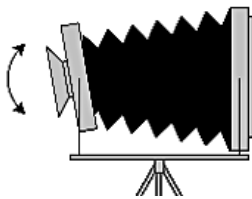
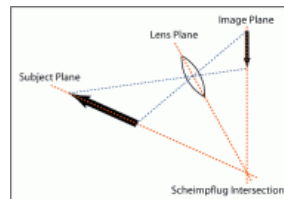
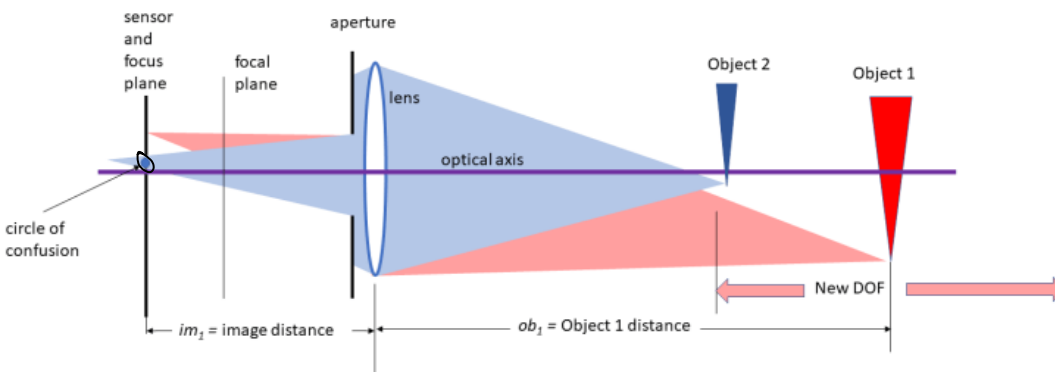
In focus: Sensor plane is at focus plane. What if that is *not* true? Maybe the object is not the perfect distance away?



Now put Object 1 in focus, and Object 2 too close to the camera



Now **stop down** the aperture. What happens to the circle of confusion?



View camera with tilt
[Cdheald, CC BY-SA 3.0 via Wikimedia Commons.](#)

Tilting a lens tilts the object plane. [Fil Hunter, Public domain, via Wikimedia Commons.](#)

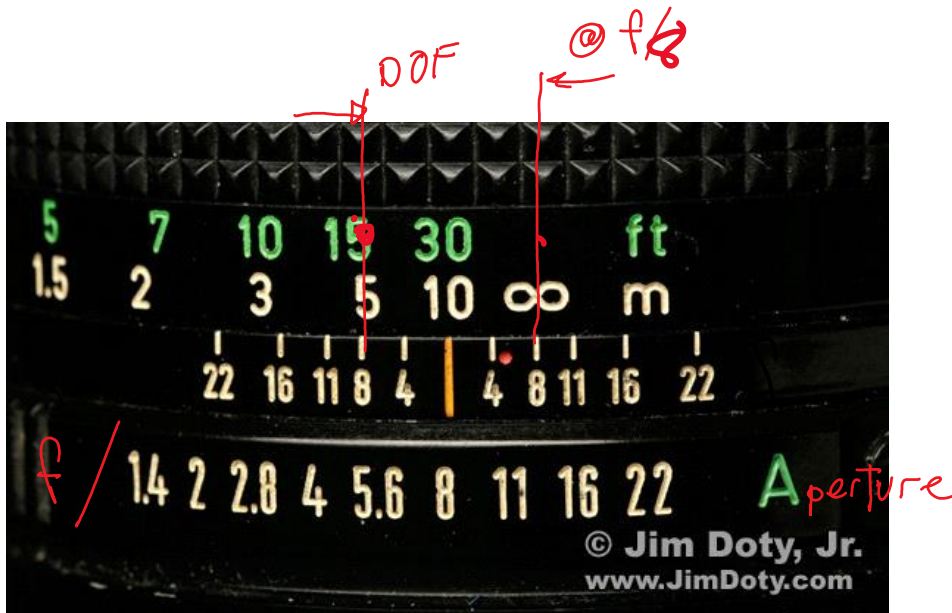
Scheimpflug principle

A LensBaby does this for DSLRs, but are \$\$\$. Includes a simple lens. \$200 to \$2000

Sometimes out-of-focus areas are desirable.
 Bokeh = the aesthetic quality of blur in an image

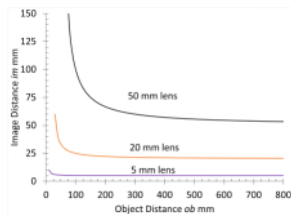


Droplets of oil on the surface of water reflect a glittery backdrop. [Kelsey DeGeorge, Get Wet, Spring 2014.](https://www.gettyimages.com/detail/stock-photo/Droplets-of-oil-on-the-surface-of-water-reflect-a-glittery-backdrop-117718711)



http://jimdoty.com/learn/exp101/exp_big3/exp_big3.html

Only old manual lenses have this guide now.



More DOF behind best focus because of nonlinear lens equation.
 Focusing is done with aperture wide open. Some cameras allow a preview with lens stopped down for DOF preview.

Detailed article on DOF: <http://www.largeformatphotography.info/articles/DoFinDepth.pdf>

4. EXPOSURE

For a given light intensity, exposure = Total photons hitting the sensor: (aperture area) X (time shutter is open)

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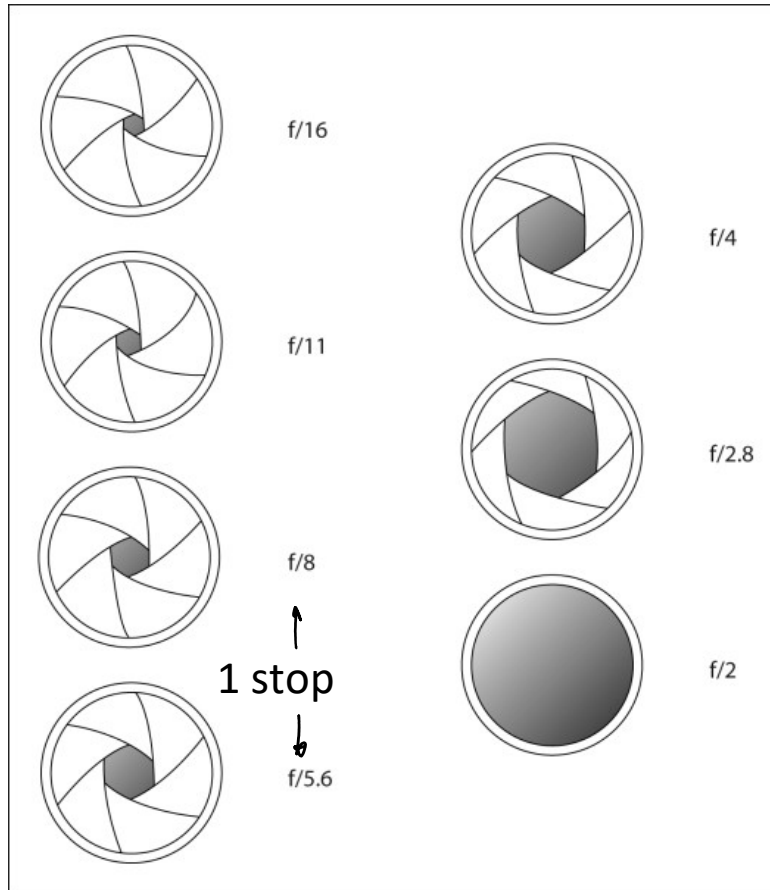
Aperture

$$f/ = \frac{f}{D} = \frac{\text{focal length}}{\text{aperture diameter}}$$

Aperture has impact on exposure too, how much light total hits the sensor.

- Exposure units: **1 stop = 1 EV Exposure Value = factor of 2 in area, or total light.**
Camera adjustments in 1/3 or 1/2 stop steps

Stop used to be a metal plate with hole punched in it. It stopped light.



Aperture (iris) mechanism made from overlapping pivoting leaves.

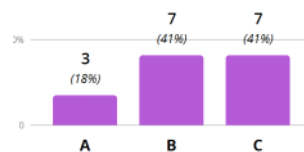
http://media.wiley.com/assets/1007/41/0-7645-9802-3_0213.jpg

F-stop series, 1 stop increments: 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32, 45, 64

WRITE THIS DOWN, we'll use in a few minutes

Have you read the manual for your camera?

- A) Yes, pretty thoroughly
- B) Skimmed it
- C) Nope



Shutter Speed

Shutter speeds: 30 = 1/30th of a second etc.

5 = 1/5th of a second

30" = 30 seconds

T = time, click to open shutter and again to close

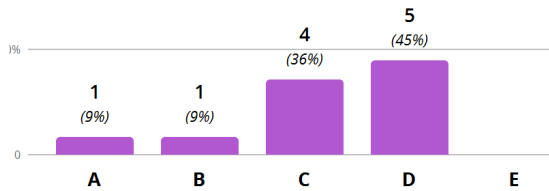
B = bulb, shutter stays open as long as button is pressed (or bulb is squeezed)

In groups:

Check your camera shutter speed options. What is the range?

Make a looong time exposure

- A) T
- B) B
- C) Neither
- D) both



Proper exposure = middle value on an average pixel

There are many automatic exposure programs, but this is a basic starting point. More on this later.

Shorten the shutter time by half plus open the aperture 1 stop = same exposure

Or

Shorten the shutter time by half plus *increase sensor sensitivity* by 2x = same *effective* exposure

Same image brightness
 f/5.6, 1/100 sec, ISO 200
 f/8, 1/100 sec, ISO 400
 f/4, 1/200 sec, ISO 400

OK, many combinations lead to the same overall brightness. How to choose?

In groups, what are the side effects of each choice?

Side Effects	If you want your photo		Side Effects
	Darker	Brighter	
	Aperture f/8 f/5.6 f/4 f/2.8 f/2.0 f/1.4		
	Shutter Speed Fast Medium Slow 1/1000 sec 1/250 sec 1/30 sec		
	ISO Sensitivity Low gain High gain ISO 100 ISO 6400		