10 Photog 3 Focus Aperture Shutters

Monday, October 5, 2020 2:23 PM

Today: Focus, aperture, shutters

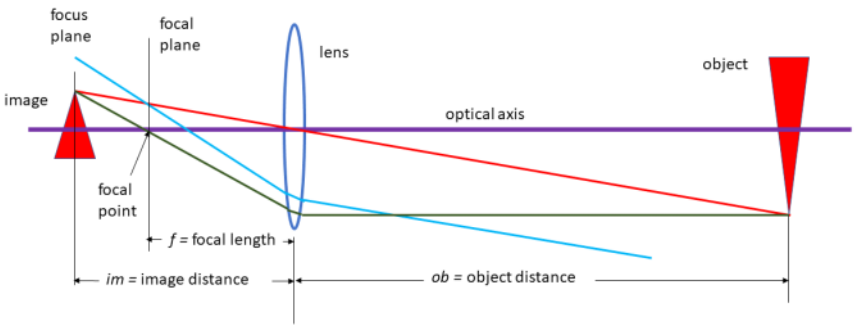
PHOTOGRAPHY FUNDAMENTALS

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

3) LENSES

FOCUS

'In focus' when all collected light from a point on the object shows up at a single point in the image.



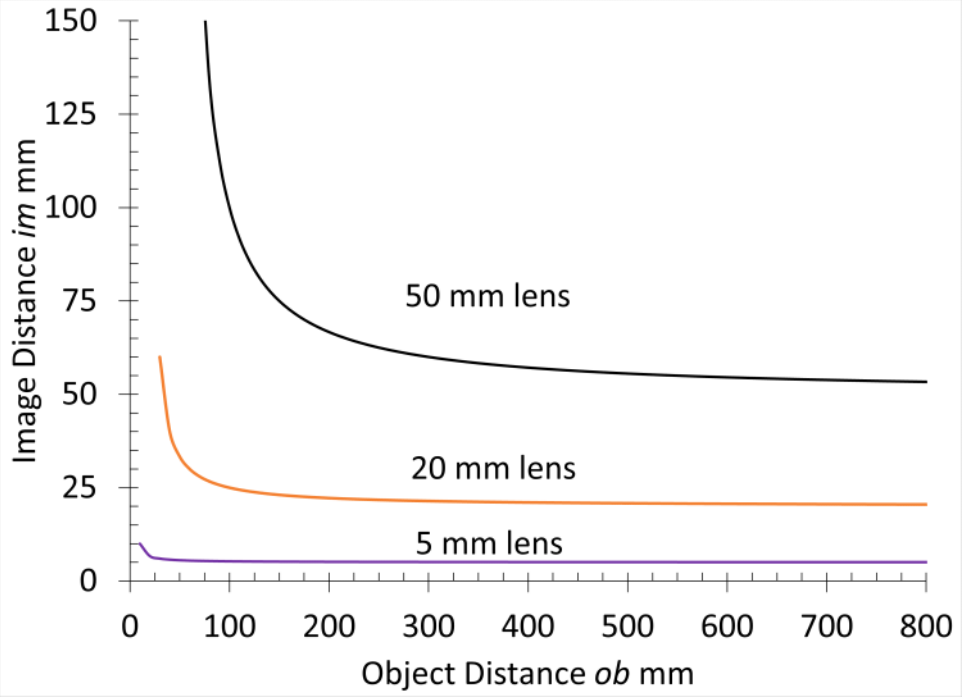
Lens laws:

1) light through center of lens is undeflected
2) light parallel to axis goes through focal point
3) all light entering lens at a given direction ends up at the same point in the focal plane
4) Lens focus (lensmaker's) equation:

$$\frac{1}{f} = \frac{1}{Ob} + \frac{1}{Im}$$

For a set focal length, as an object moves closer, lens must move away from sensor plane to keep focus plane at sensor. Mechanical limit defines closest possible object distance for focus.

TRY THIS NOW
Change the focus distance on your camera. How does the physical length of the lens change?

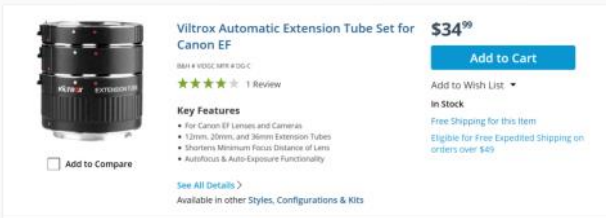


This is why small cameras with small sensors and short focal lengths have better macro capability than larger cameras.
Hardly have to move the lens at all.

$$\frac{1}{f} = \frac{1}{im} + \frac{1}{ob}$$
$$\frac{1}{im} = \frac{1}{f} - \frac{1}{ob}$$
$$\frac{1}{\left(\frac{1}{f} - \frac{1}{ob}\right)} = im$$

Macro Photography: Techniques for close focus

Extension tubes (for DSLR) allow lens to move further out and focus closer.



https://www.bhphotovideo.com/c/search?Ntt=Canon%20Extension%20Tube&N=0&InitialSearch=yes&ap=Y&gclid=CjwKCAjwn9v7BRBgEiwAbq1Ey4UGoJ7JL17VJ8nuohuDReoMd_oQrovcpFcIEQC8WZVny-elgAgaiRoC11AQAvD_BwE

Check that electronic capability for autofocus and auto exposure are there; wiring goes through tubes

"Reverse macro" adapters let you turn the lens around, or put a reversed lens at the end of your normal lens. $15.
Caution, interior lens element is now exposed, easily scratched.

'Close up' lenses allow close focus by changing system f . Long f lens, threads on to the outer end of main lens (threads standard, but need to match diameters). Lower quality, though. Each additional lens element can lose 10% of light, introduce aberrations.
PHD cameras and cell phones often lack threads. You can just hold a close up lens out in front, or mount to cardboard tube. Check focus often.
Inexpensive, $6 for set of 4. Available for camera phones too.

Spec'd in 'diopters' = 1/f in meters. Typically +1, +2, +4 $\frac{1}{f_T} = \frac{1}{f_1} + \frac{1}{f_2}$

Macro Homework Exercise:

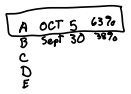
1. Can you get the most magnification by zooming out and moving close, or by zooming in and moving back?
2. At which extreme can you focus closest? What is the minimum distance? What is the FOV there?
3. Make an image of a 25¢ coin. At what lens settings do you get the greatest magnification, where the coin is as large as possible in the image and still sharply in

focus?

4. Make the same image with three f/stops: max, min and low medium. (Try to keep overall exposure and ISO the same, and use tripod or keep shutter time short.) Inspect the three images closely for focus, depth of field and overall sharpness. What happened?

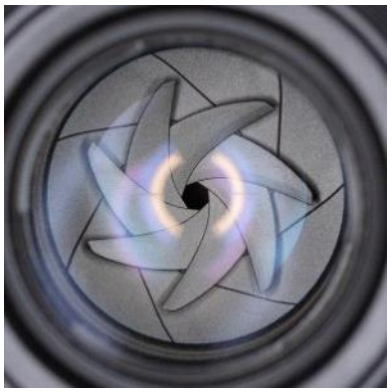
Enter your data in this spreadsheet:
https://docs.google.com/spreadsheets/d/1WeUigolyQ80W2QfFvzXmn9omN4Yx621oaquPcuttUVY/edit?usp=sharing

When should this be due?



Example: iPhone 8 and Canon 90D

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

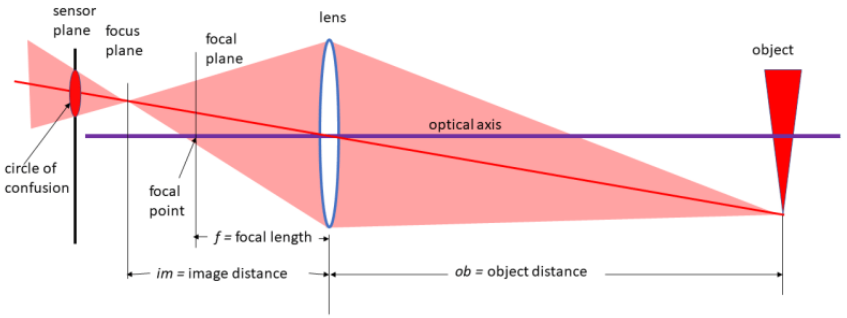
From <https://www.flowvis.org/Flow%20Vis%20Guide/overview-4-photography-c-lenses-aperture-and-dof/>

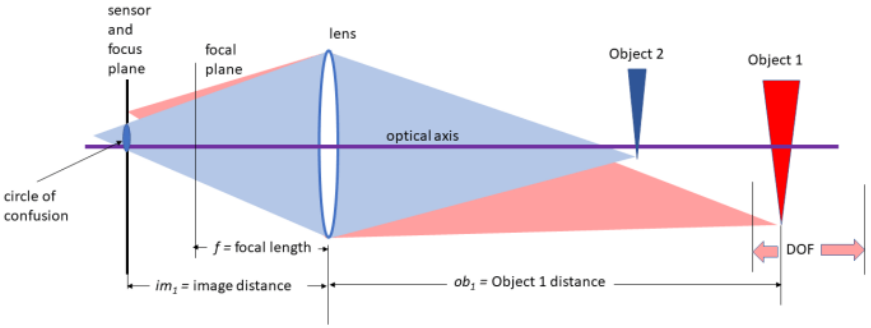
Aperture spec; F number, f/, f-stop = f/D = focal length/ diameter
Inverse of hole diameter
The larger the hole, the smaller the f/
Range is usually f/1.4 to f/22

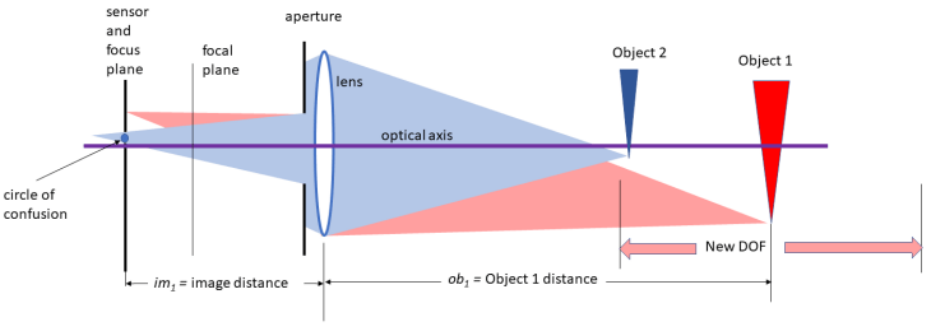
What is yours? How does it change with zoom?
On consumer cameras, f/ will change with zoom.
Not so for professional lenses.

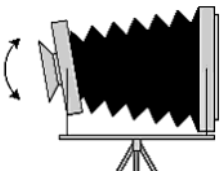
2 main effects: on depth of field, and exposure

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

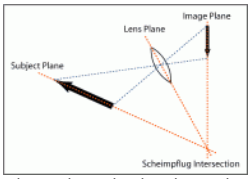








View camera with tilt
. Cdheald, CC BY-SA 3.0 via Wikimedia Commons.

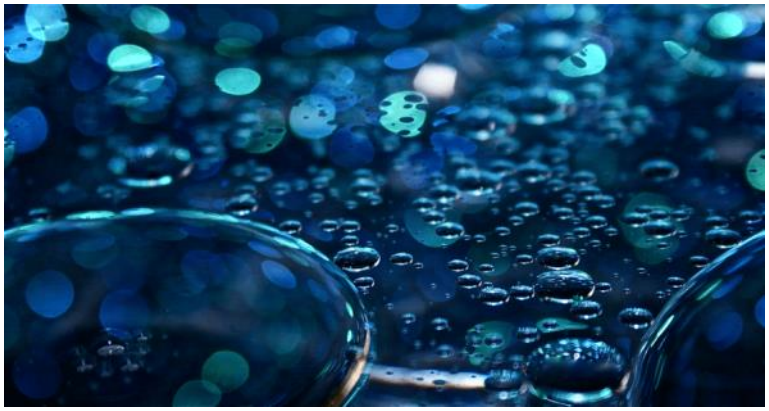


Tilting a lens tilts the object plane. Fil Hunter, Public domain, via Wikimedia Commons.

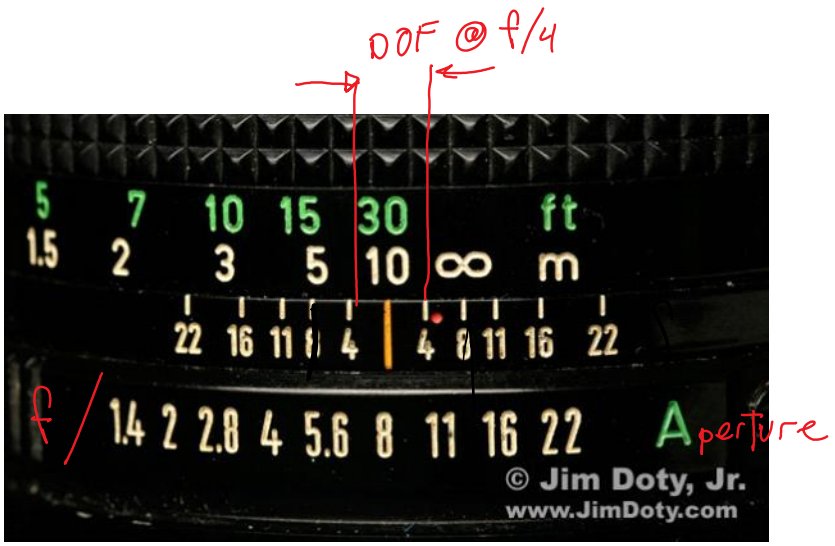
lens baby

Scheimpflug principle

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.



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

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