Today:

- Lenses
  - Lens laws
  - Typical lenses
  - Focal lengths
  - Aperture, depth of field

JH Bring to class:
Closeup lenses
extension tubes
Iris
View camera

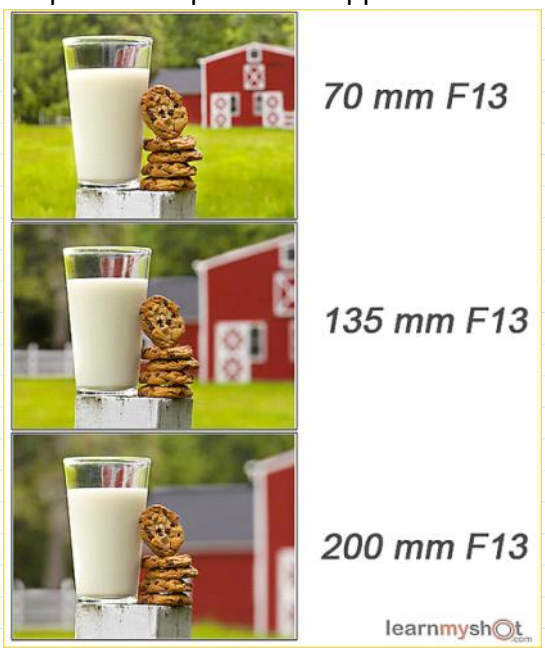
PHOTOGRAPHY FUNDAMENTALS

1) Framing
2) Camera
3) Lenses
4) Exposure Control
5) Resolution

3) LENSES

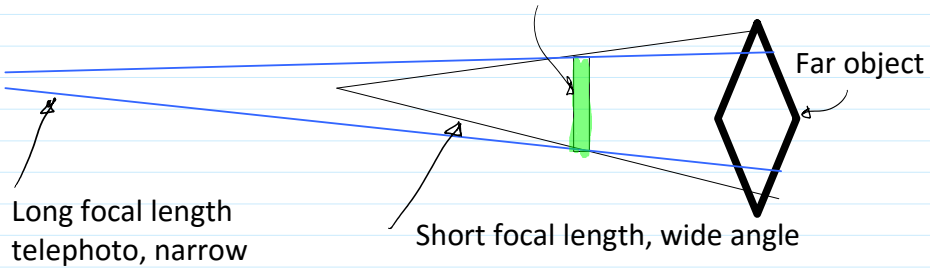
Impact of focal length on framing:

As f increases (longer lens), field of view narrows
'Telephoto compression' happens too



http://www.learnmyshot.com/Telephoto-Lens-Perspective-Compression-and-the-Angle-of-View

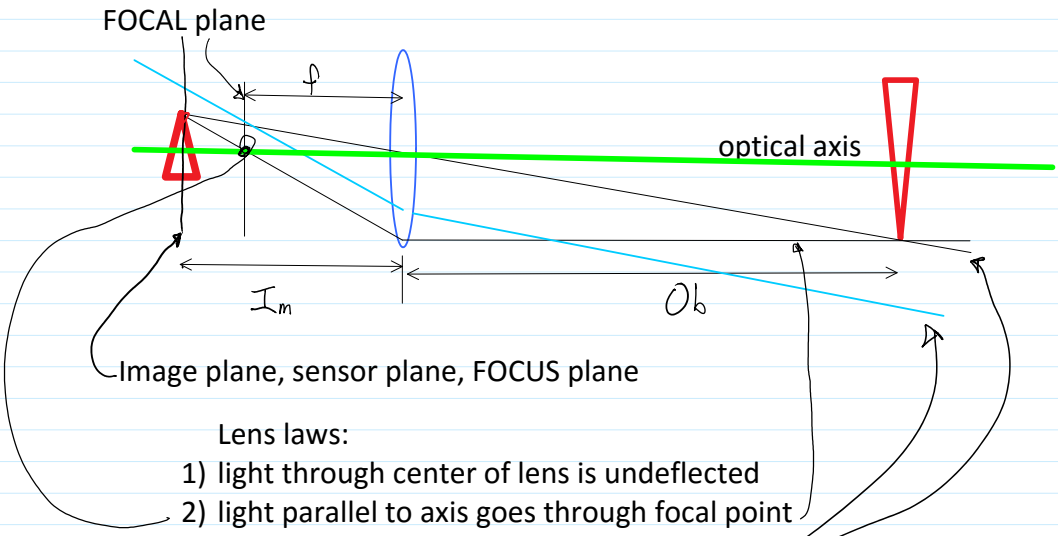
https://www.youtube.com/watch?v=4yyFKNfRq_M



TRY THIS NOW

FOCUS

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

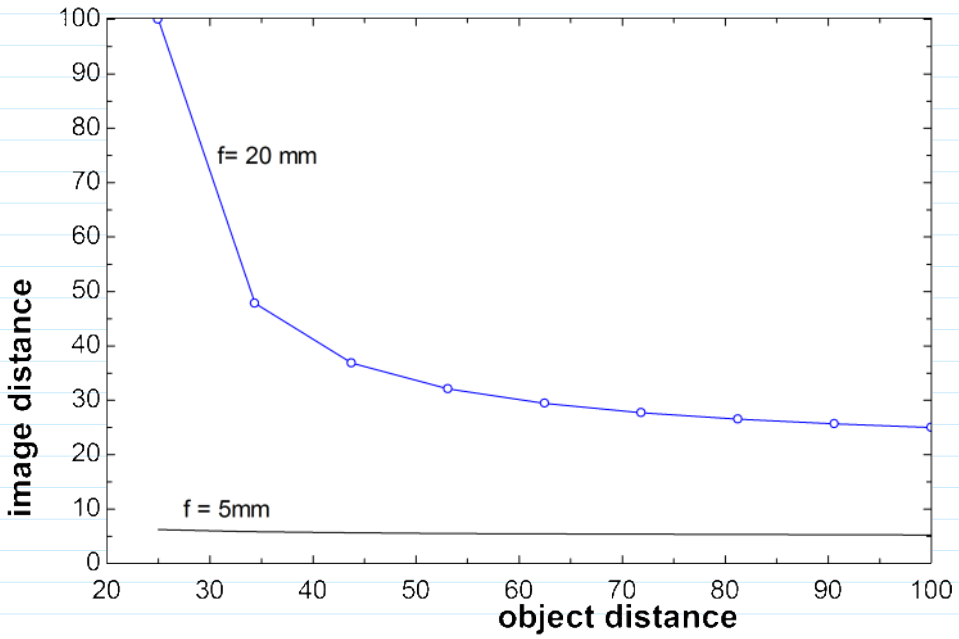


Lens laws:

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

$$\frac{1}{f} = \frac{1}{O_b} + \frac{1}{I_m}$$

As object moves closer, lens must move away from sensor plane to maintain focus. Mechanical limit defines near focus distance.
For a given object distance, as the lens becomes shorter, the image distance (flange standoff?) also gets smaller: hence smaller cameras do well for macros



This is why small cameras have better macro capability than larger cameras.

<file://C:\Users\hertzber\Documents\01CLASSES\FlowVis\Content\objectimagedistances.EES>

Extension tubes (for DSLR) allow lens to move further out and focus closer. $75 set of 3

"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 reducing 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 often lack threads. Just hold it out in front, or mount to cardboard tube. Check focus often.
Inexpensive, $6 for set of 4

Spec'd in 'diopters' = 1/f in meters. Typically +1, +2, +4

$$\frac{1}{f_{TOTAL}} = \frac{1}{f_1} + \frac{1}{f_2}$$

PHD cameras often have 'macro mode' = Flower Button.
Does yours?

For DLSRs, prime and zoom 'macro' lenses are available.
Expect high price, hope for quality.

Exercise: Can you get the most magnification by A) zooming out and

moving close, or B) by zooming in and moving back? At which extreme can you focus closest?

zooming out and moving close

Cell	PHD	DLSR
3	2	

by zooming in and moving back?

Cell	PHD	DLSR
10	1	12

Different from last year: More Magnification with

Wide, focus close

Cellphone	PhD	DSLR
II	IIII	IIII
	I	

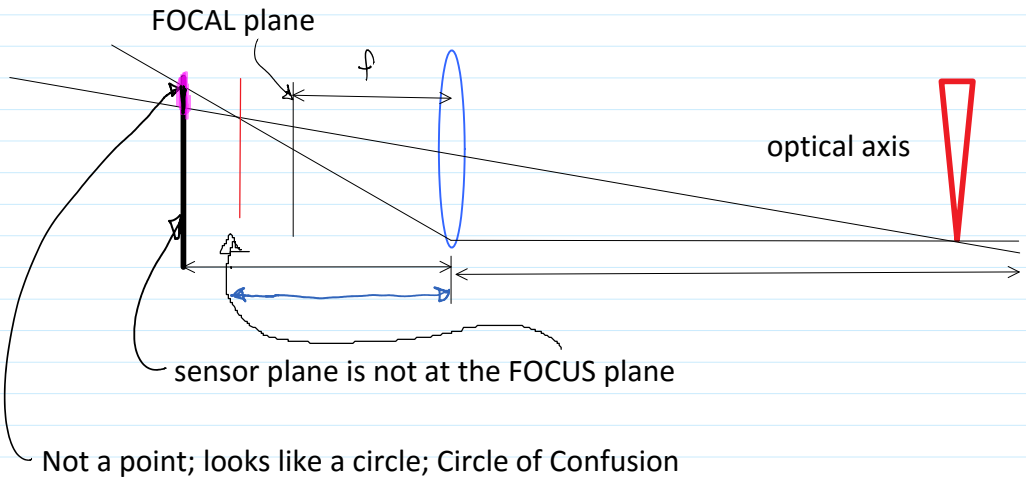
Tight, far focus

Cell	PhD	DSLR
		III

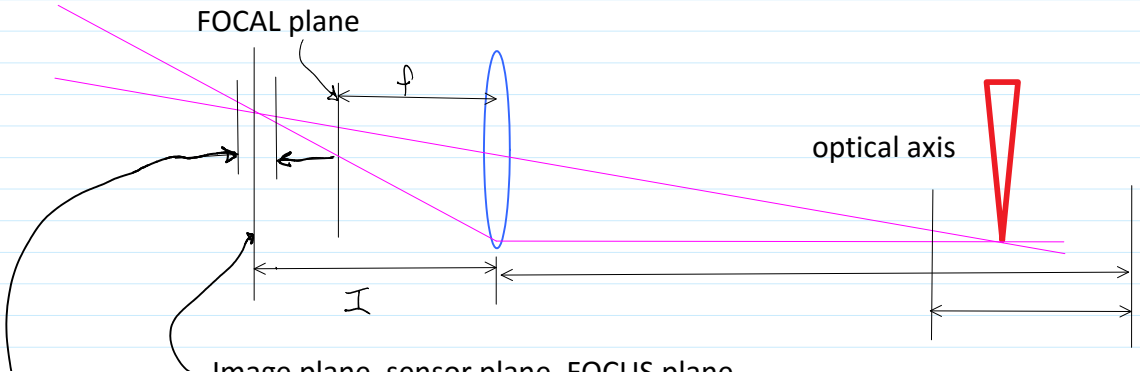
Close focus distance

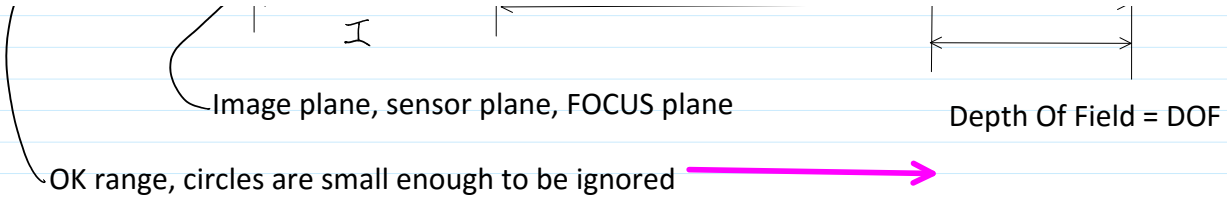
3-4 | 2" 1½" | 4-5" 2-3" | 5-6"

OUT OF FOCUS

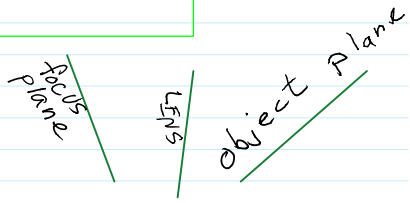


Depth of Field

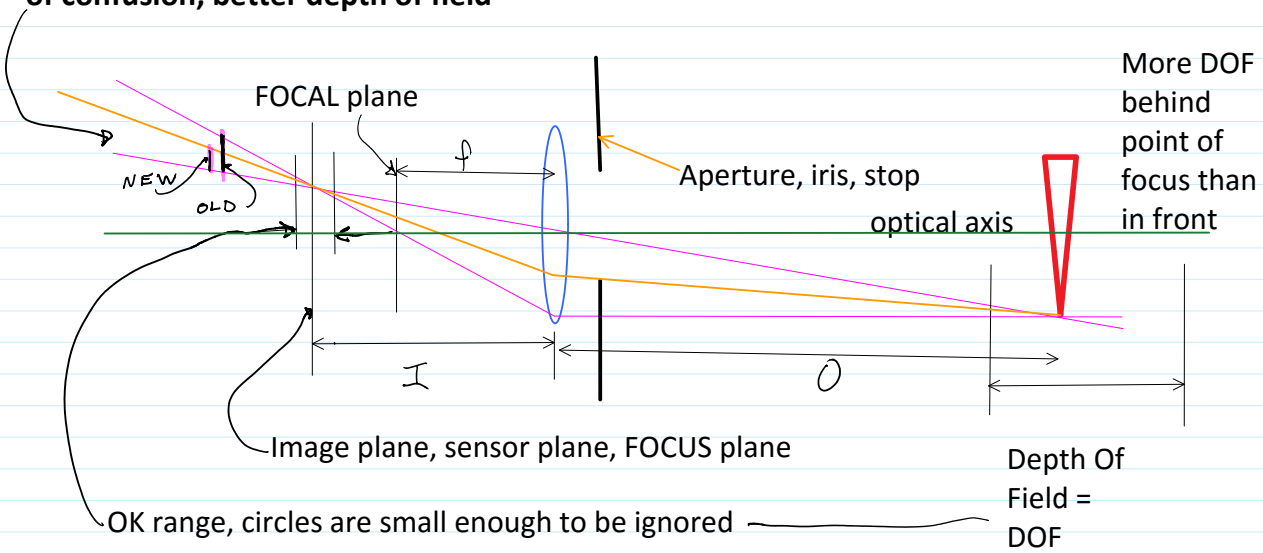


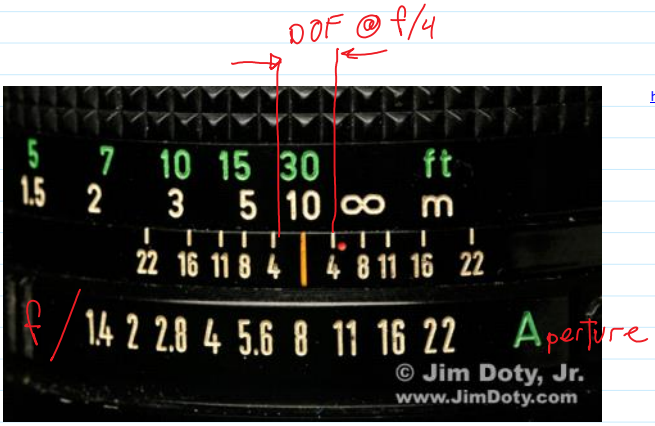


LensBaby: lets you angle the lens axis compared to the camera body axis. Effectively makes the object plane not parallel to the sensor plane
http://lensbaby.com/lenses



Improve DOF by reducing diameter: smaller hole, smaller circles of confusion, better depth of field





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

More DOF behind best focus because of nonlinear lens equation