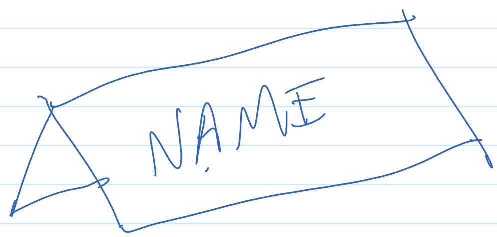
Today:

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

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

Please make a table tent with your name on it



PHOTOGRAPHY FUNDAMENTALS

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

3) LENSES

Minute paper. What are the numbers on your lens? What do they mean?

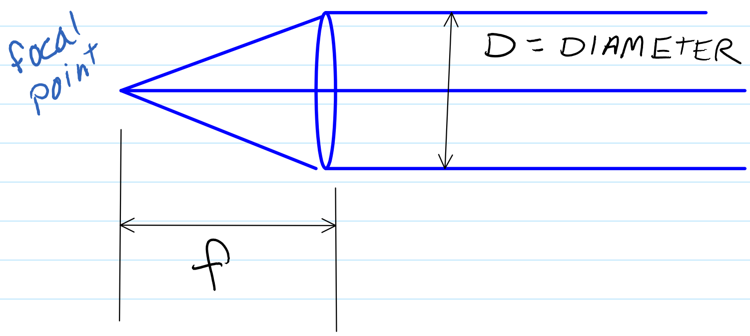
18 - 55 1: 3.5 - 5.6

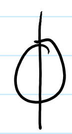
f = focal length aperture f/

f/Diameter
f number

Lenses are defined by FOCAL LENGTH and APERTURE and Diameter

f = focal length = distance from center of lens system to sensor when focused at infinity





Symbol for center of lens
Or sensor location

Ø Symbol for thread diameter

Variable focal length = ZOOM lens.
Now is default. Non-zoom are called 'prime' lenses.

10 years ago, 35 mm film cameras were standard, and the standard lens was 50 mm. f> 50 mm = telephoto long
f < 50 mm = wide angle short

f=18-55
1:3.5
f/D = 3.5 - 5.6

Aperture defined as f/D = f/ = f number = f#
INVERSELY related to diameter.
Nondimensional. More about aperture later.

PHDs have small sensors, so focal lengths and diameters are smaller:
Common values for PHD cameras:
f = 5 - 60 mm, f/ = 4 - 8
28-336 mm equivalent to 35 mm, i.e. same FOV
w = wide T = tight, or telephoto

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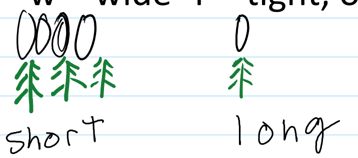
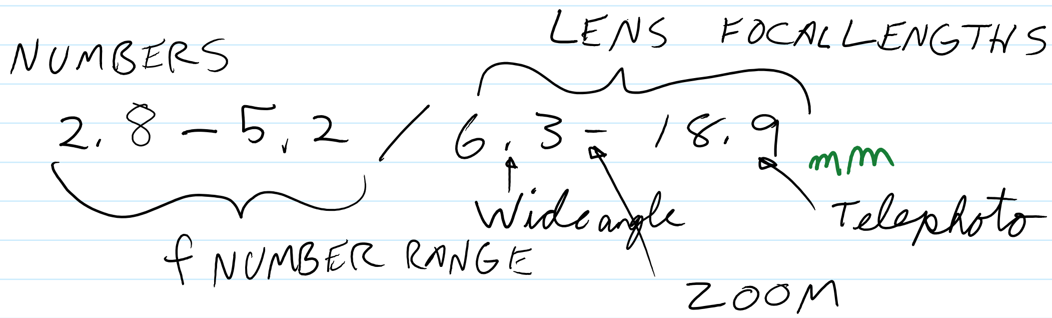


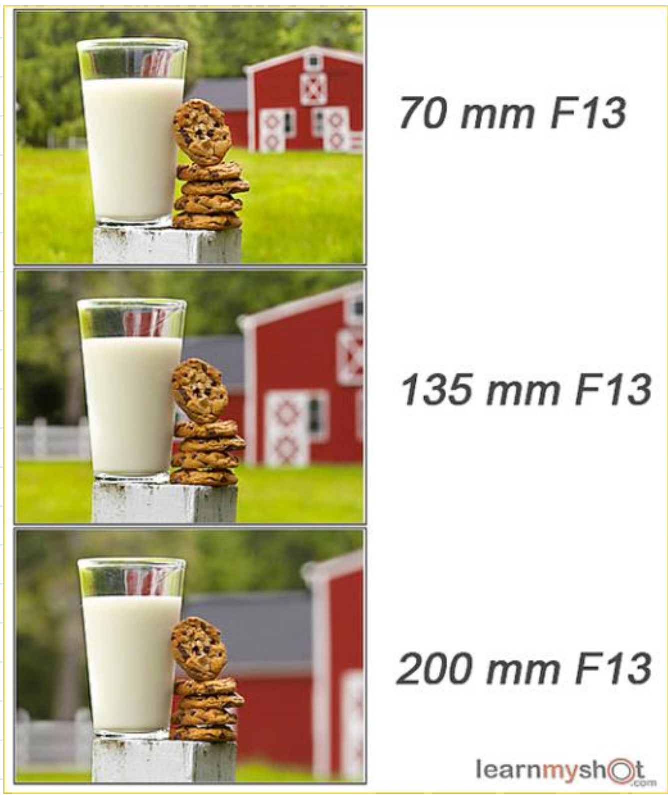
For DSLR, bigger sensors, up to 'full frame' 35 mm

f = 18- 60 mm, f/ 1.8 - 22

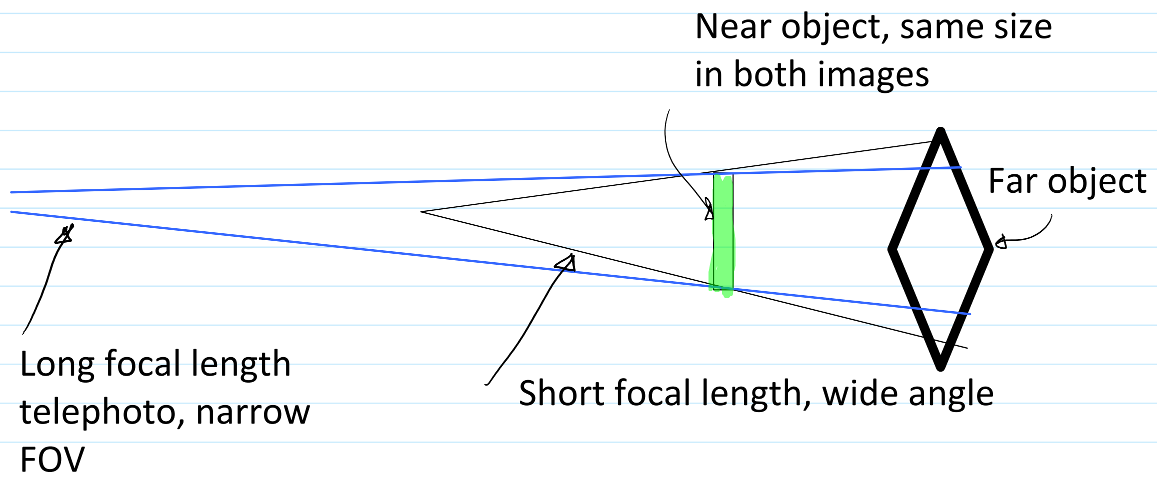


Impact of focal length on framing:

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



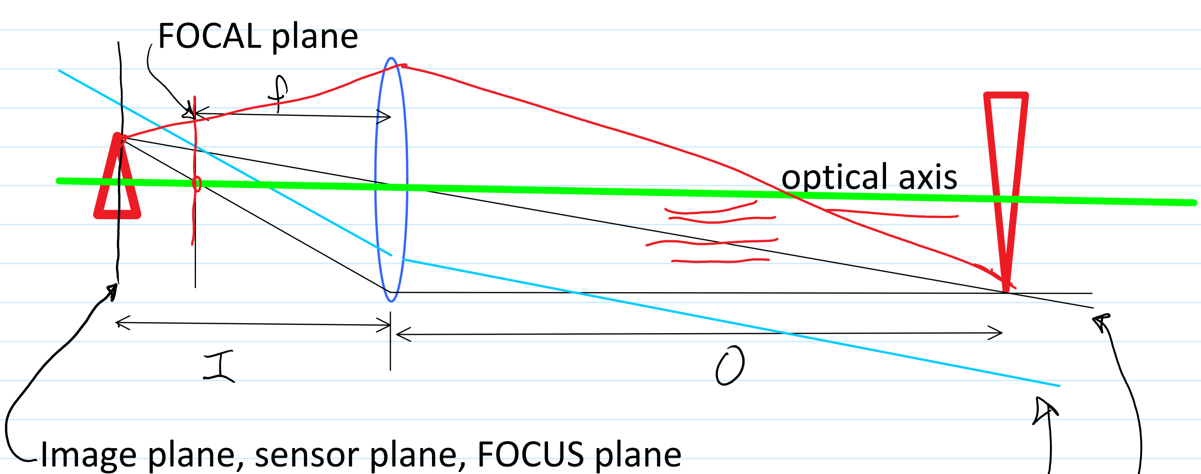
https://www.youtube.com/watch?v=4yyFKNfRq_M



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

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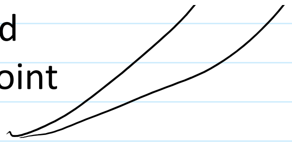
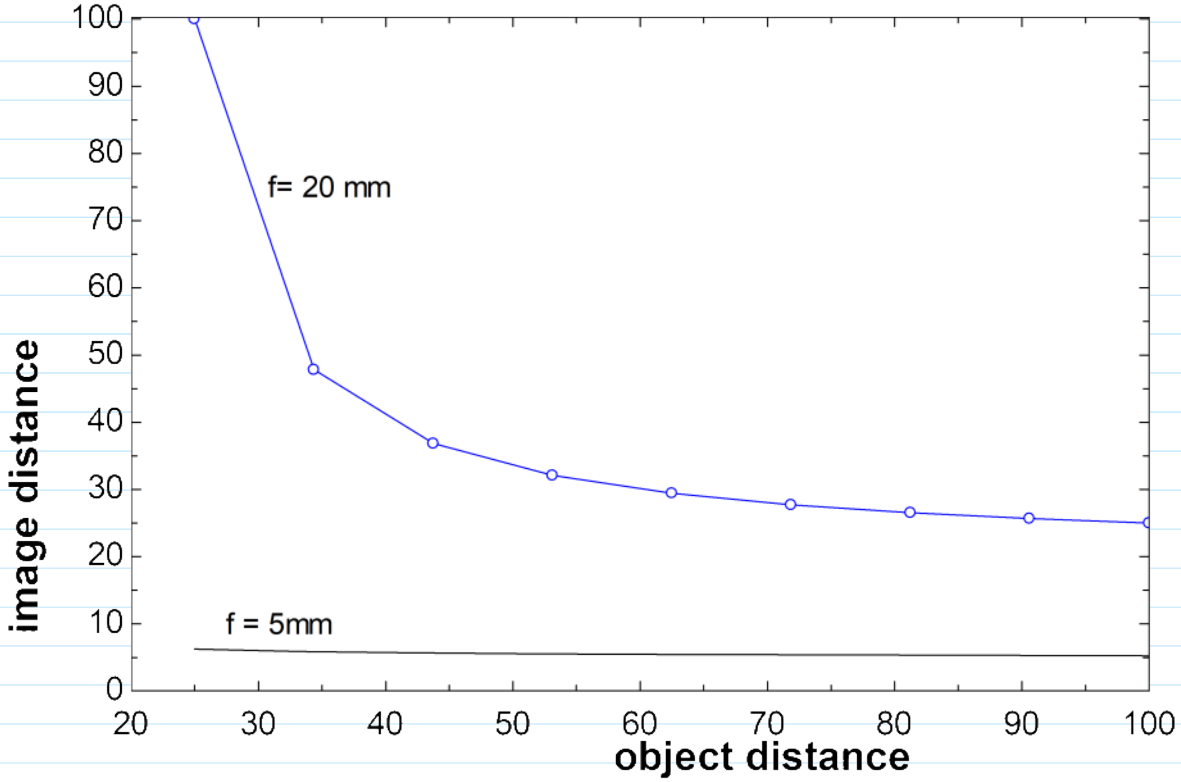
2) light parallel to axis goes through focal point
3) all light entering lens at a given direction ends up at the same point in the focal plane



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

As object moves closer, lens moves away from sensor plane to keep focus plane at sensor. Mechanical limit defines closest possible focus distance.



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

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

<u>"Reverse macro" adapters</u> 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 often lack threads. Just hold it 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

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

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.

Homework Exercise: Can you get the most magnification by zooming out and moving close, or by zooming in and moving back? At which extreme can you focus closest?

zooming out and moving close

Cell	PHD	DLSR

by zooming in and moving back?

Cell	PHD	DLSR