Today: Admin stuff
 Reports
 Literature searches
 3) Lenses
 4) Exposure

Reports - Due Monday
 Image Assessment form
 Your Image + Report (Reflect)
 Handcopy or separate file OK

• Literature Search
 Ugrades - Web level - Wikipedia
 Minimum Good for optics
 Variable for fluids
 Textbooks
 Web sites
   .gov, .edu
 Good
 .com 
 Variable

Grades - Technical literature
 Peer-reviewed
 Google Scholar = variable
 Database - Inspec = great
 Ref from Wikipedia

3) LENSES
 Defined by
 FOcal LENGTH & Aperture

- 5-60 mm
  - 28-135
  - 10.5
  - 28-200
  - 5.9-25.9 mm

FOCAL LENGTHS

- 3.8 - 4.8
- 1.35 - 3.6
- 1.5 μm

Aperture

Zoom

F/2.8

Focus

45 mm/1.5 μm

http://www.engineeringvillage2.org/
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Focus - Moves System of lenses W.R.T. the sensor

\[ \frac{1}{f} = \frac{1}{O} + \frac{1}{I} \]

SLR - Want to focus close
Spacer - For closeups
- Offset lens from body

CIRCLE of Confusion

Small aperture = Wide DOF

Small aperture = Restricting aperture

Object

DOF = Depth of field
- Acceptably small circle of confusion
- Range of acceptable

Focal Length

\( f \uparrow \) For objects seem closer
Zoom in @ 1:1000

Tight Wide
LONG SHORT

Zoom = Range of focal length \( f \)

Next: Lens Laws

Moves lenses inside system
Small aperture = Wide DOF
Big aperture = Small DOF

Aperture & measured by f-number

\[ f\# = \frac{f}{\text{Diameter of aperture}} \]

Fast lens = large diameter = lots of glass

Ansel Adams: f/64 club

DOF ↑ as f/ ↑ BUT less light

4) EXPOSURE

Total light thru lens \times \text{length of time}

controlled by f/

Aperture, f/

Measured in STOPS

STOP = FACTOR of 2 in AREA

\[ \text{Area} = \pi \frac{D^2}{4} \]

\[ f\# = \frac{5\#}{6} \quad \text{factor of 2 in light} \]

Today: Finish Exposure

Resolution

Clouds

35, 4, 5, 6, 8, 11, 16, 22, 32, 45, 64
1 stop  1/3 stop increments

EV = Exposure Value ~ 1 stop
Given exposure: Shutter \& f/

Game Exposure:

\[
\frac{1}{30} \quad 3.5 \\
\frac{1}{10} \quad 4.0 \\
\frac{1}{5} \quad 5.6
\]

Shutter speed: D.O.F. Lens limits

High shutter - Sharp, No Motion Blur, BUT poor D.O.F.

Long shutter - Lots of light, allows good D.O.F.
Particle tracks
Need Neutral Density filter
Log scale
Time averaged images: BUT Camera Motion need tripod

Av - Aperture priority. You pick, camera chooses shutter.
Tv - Shutter priority

Shutter speed: \( \frac{1}{x} \) seconds

\[
1'' \\
\frac{2}{2}'' = 2 \text{ seconds} \\
\frac{3}{2}'' = \frac{3}{2} \text{ second}
\]

Time - Actuate open, actuate closed
Bull - open as long as actuated

ISO = ASA Names of standards for sensitivity

Slow film Kodacolor 64 Lower sensitivity
100
200
Need indoor shots

800
1600
3200

closer to human eyes

GRAINY
Noise
Digital

Gain