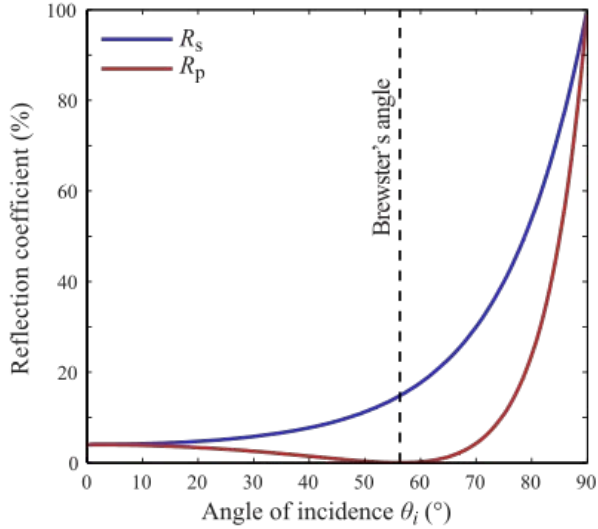


Microscope components and diffraction

- Last class
 - Imaging
 - Absorption
 - Reflection
- This class
 - Components of a microscope
 - Diffraction

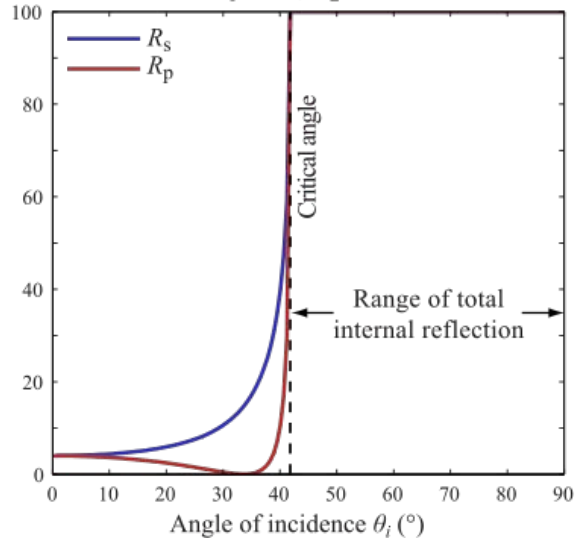
Anti-reflection coatings

$n_1 = 1, n_2 = 1.5$

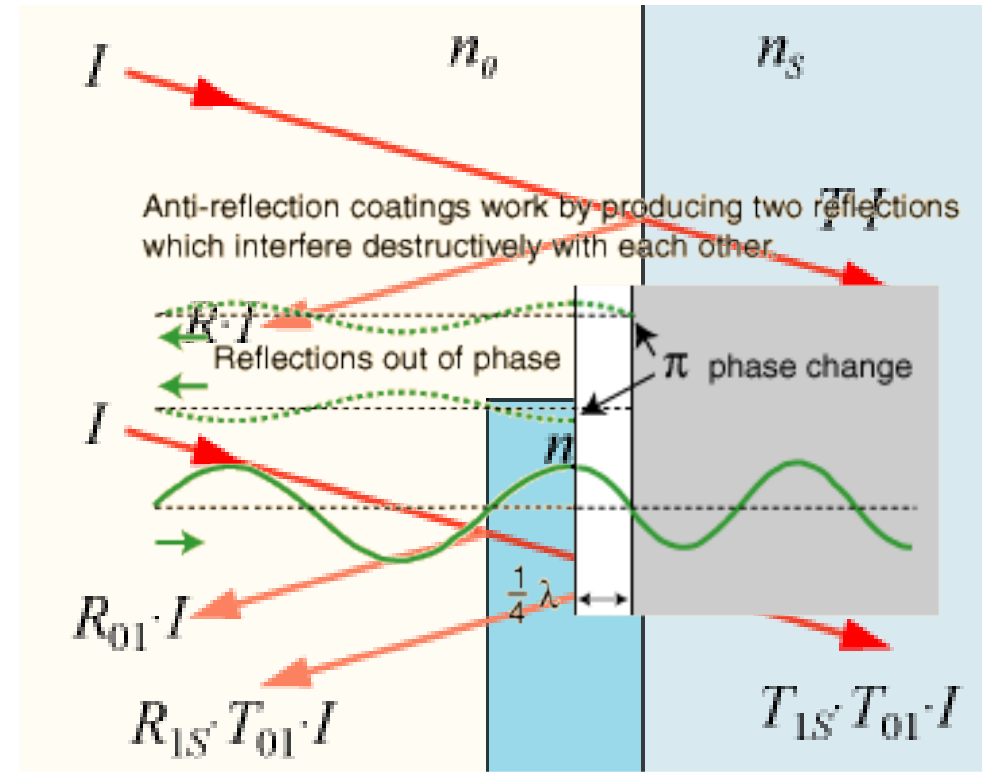


Even at normal incidence, glass reflects ~4% of light

$n_1 = 1.5, n_2 = 1$



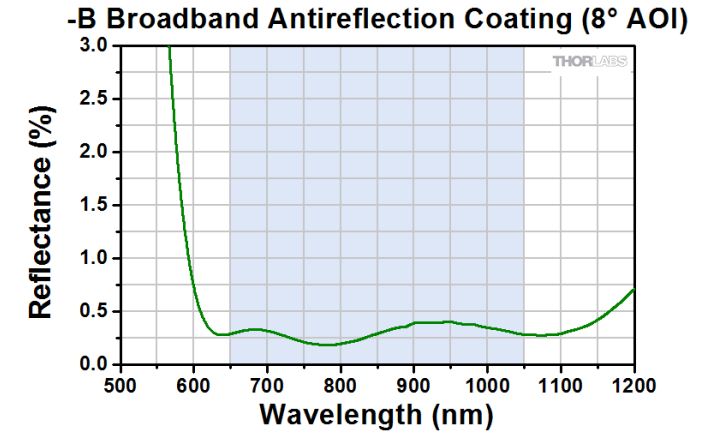
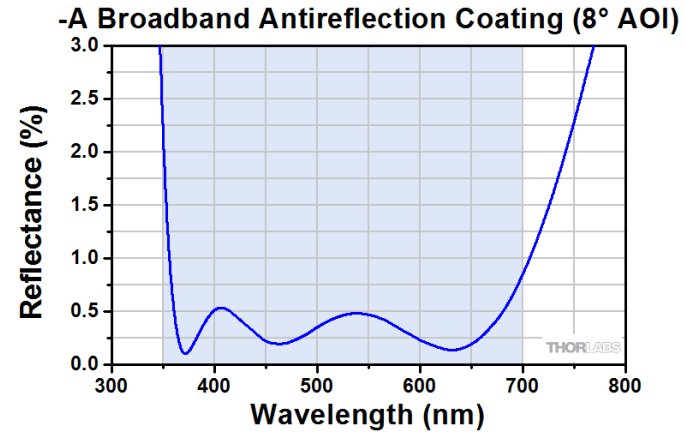
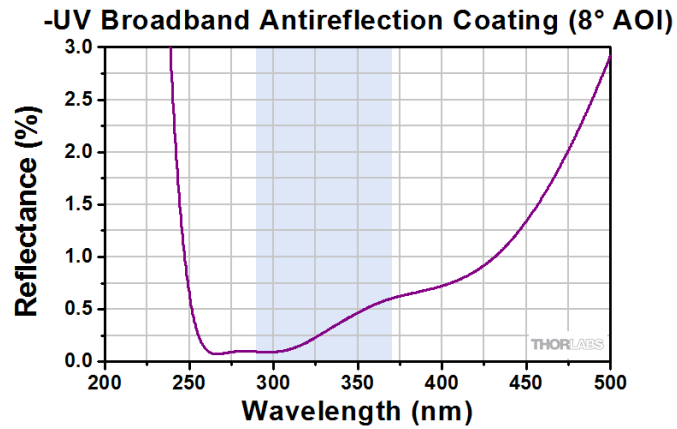
Apply coating with n in between air and glass



$$n_1 = \sqrt{n_0 n_S}$$

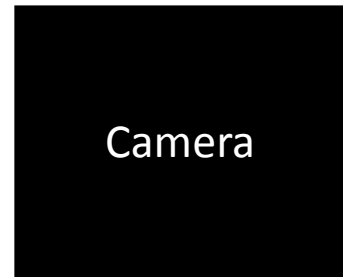
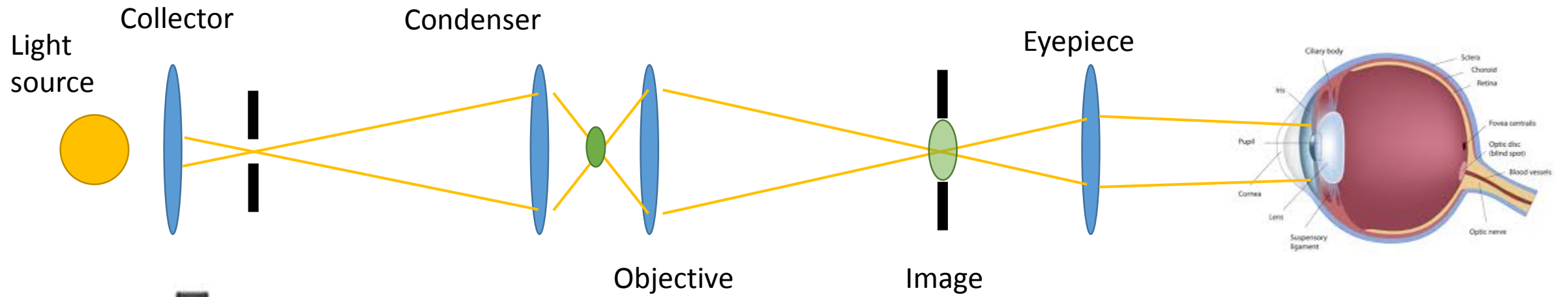
One coat of proper index takes reflection 4% -> 2%
Set thickness = $\lambda/4$

Real world anti-reflective coatings



Microscope components

Parts of a microscope



Objectives are the most expensive, therefore most important component

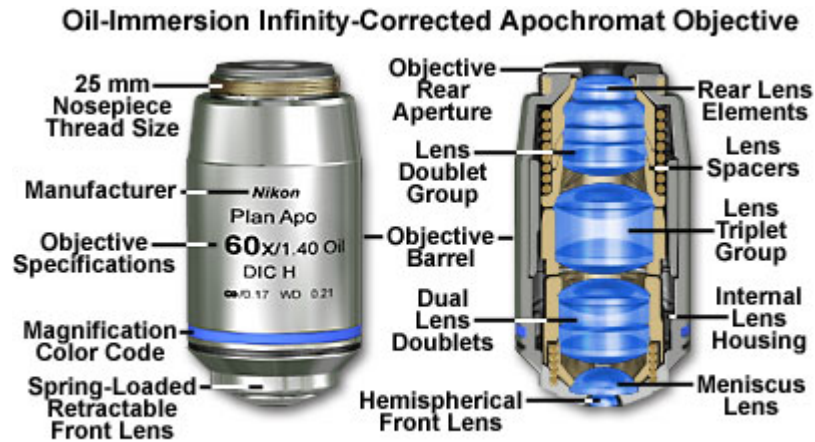


Figure 1

Primary image forming optic
 Set resolution limits downstream
 Required to be small

Metrics for objectives:

- Numerical Aperture
- Magnification
- Field number
- Immersion medium
- Aberration correction
- Working distance
- Depth of focus
- Transmission

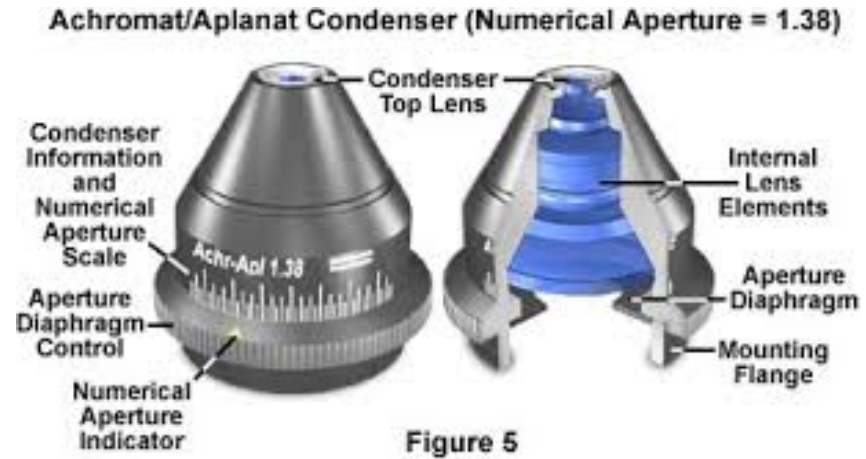
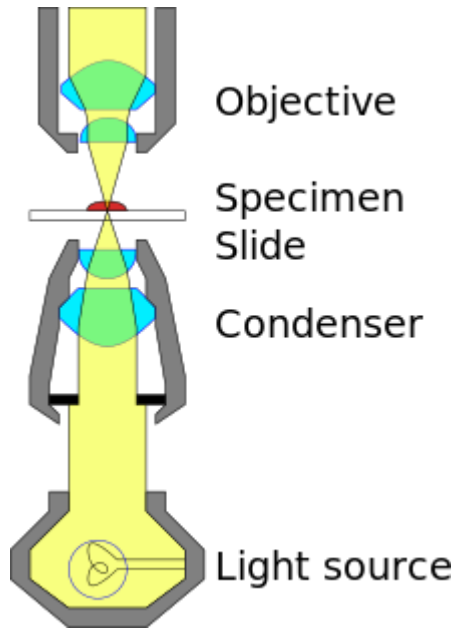
All of these things will contribute to image quality



Objective	CFI S Fluor 20Xremove
Image	
Type	Super Fluor
Primary Technique	Brightfield
Price	\$\$\$\$
Immersion	Air
Magnification	20X
Numerical Aperture	0.75
Working Distance	1
Cover Glass Thickness	0.17

Condensers

Concentrate light into a cone that can be adjusted with an iris



Condenser Aperture Size and Image Quality

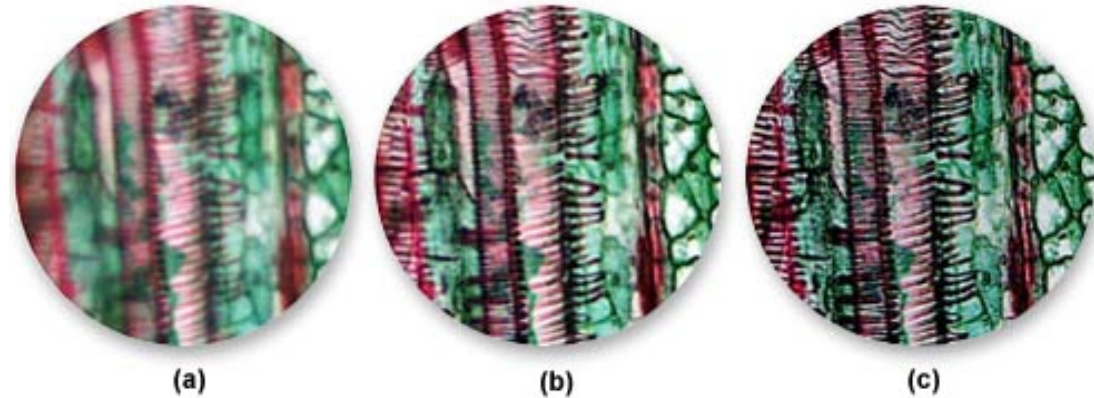


Figure 4

Brighter, higher resolution

Dimmer, higher contrast

Eye pieces

- Typically come in 10-20x
- Don't believe that things can get to 1200x magnification, high mag, just blurry

Eye pieces look at an image formed in the microscope

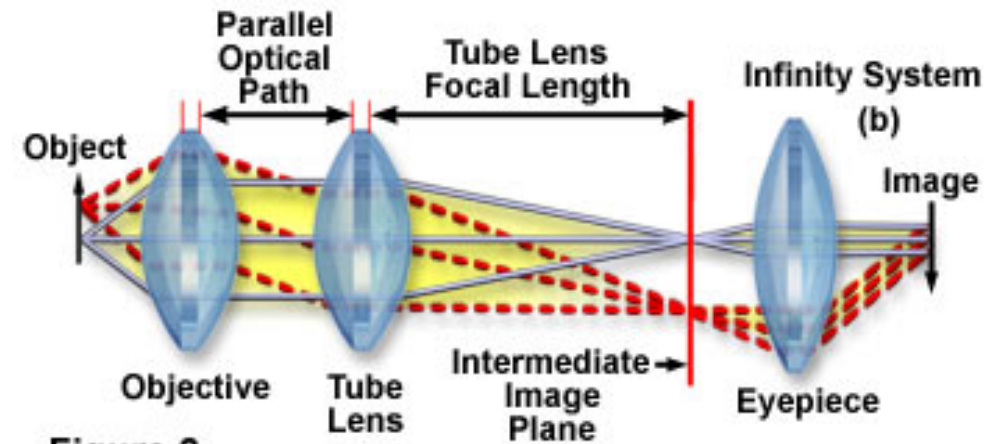


Figure 2

Aberration-Free 10x Eyepiece With Diopter Adjustment

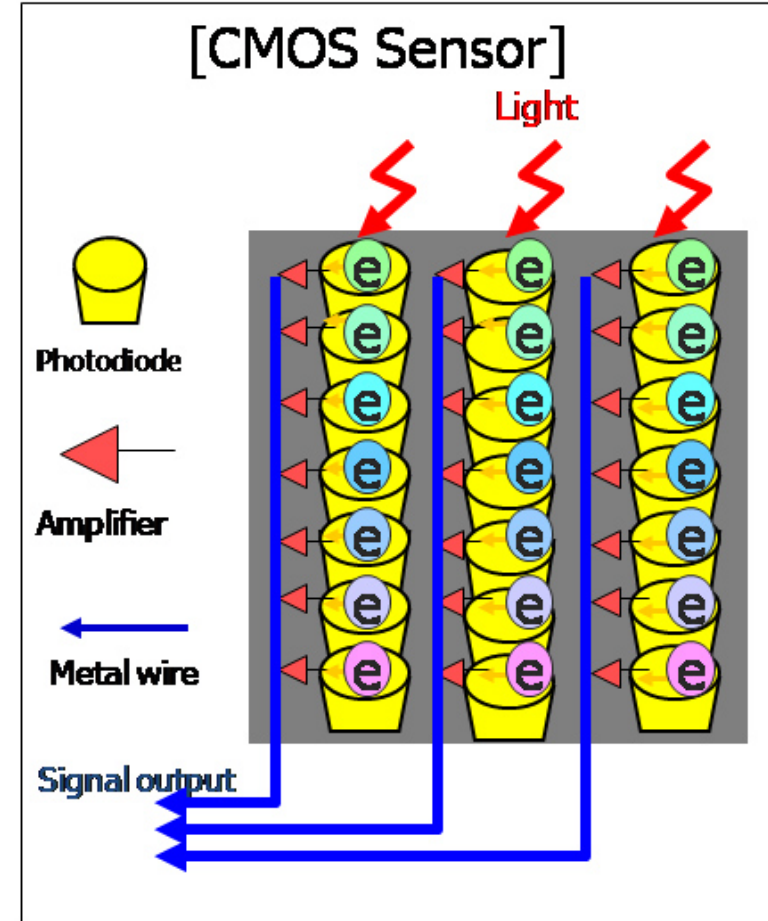
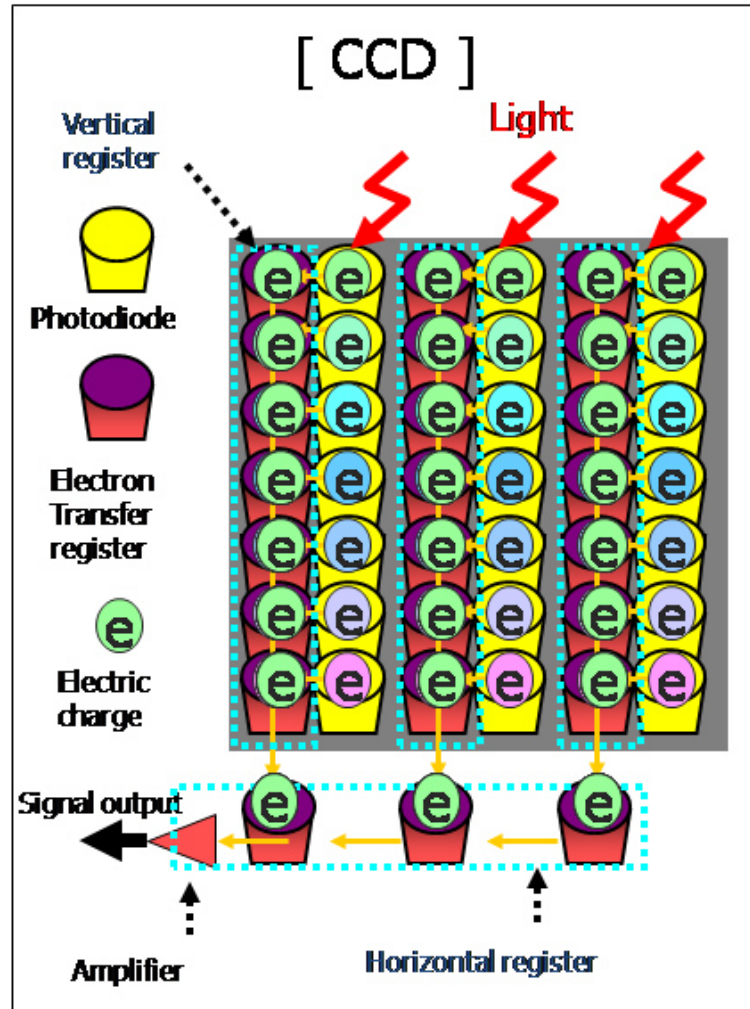


Figure 1

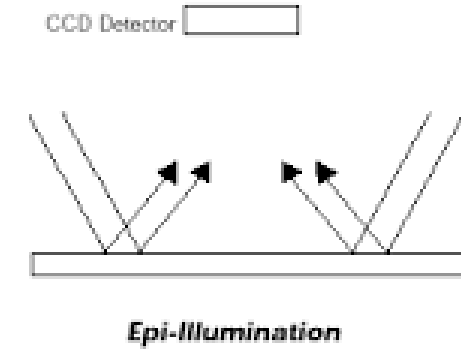
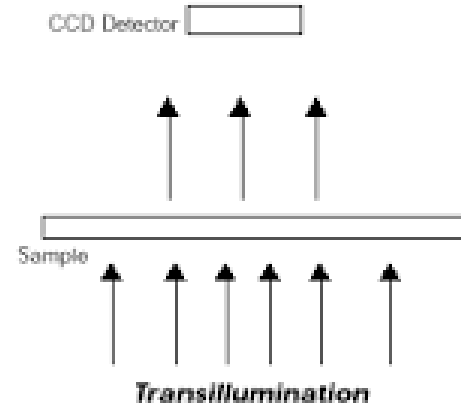
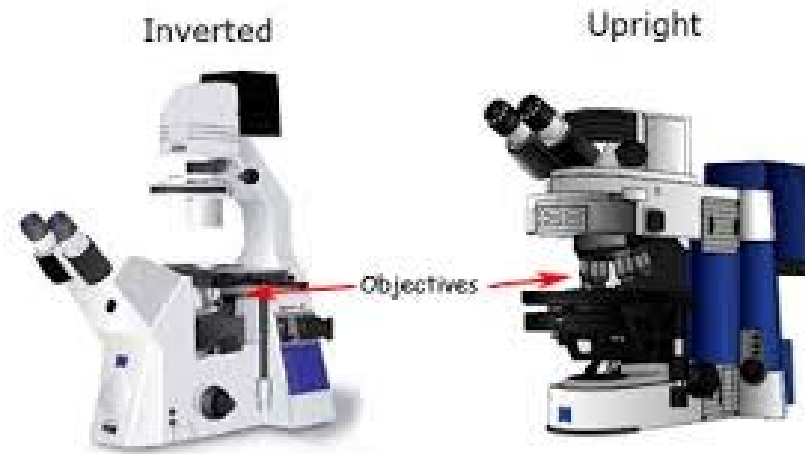
More money gets you slightly better eyepieces

Cameras – two flavors

- CCD vs CMOS



Inverted vs upright



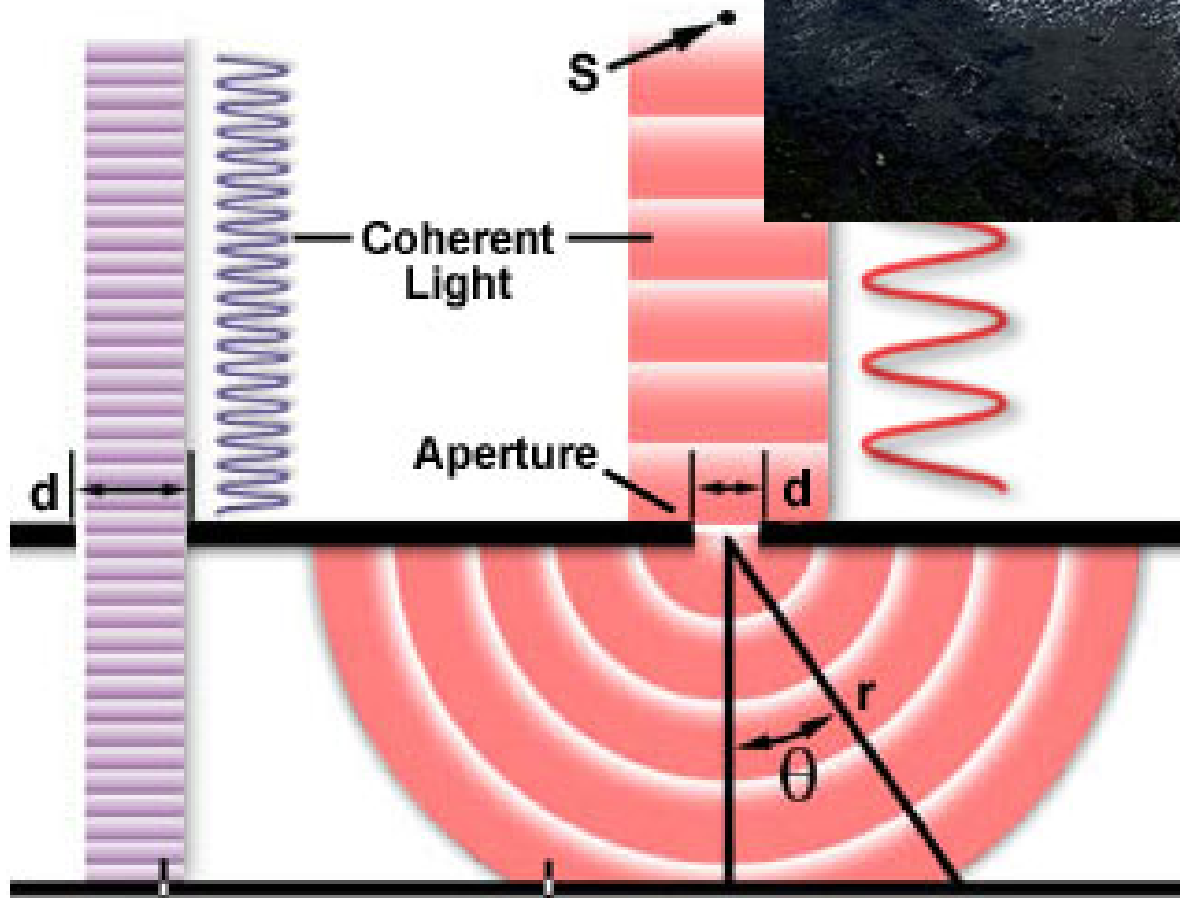
Trans vs epi illumination

Diffraction – Yet another property of waves

Diffraction



Diffraction of Coherent Light



Intensity Distribution

Figure 3

Light Intensity Distribution

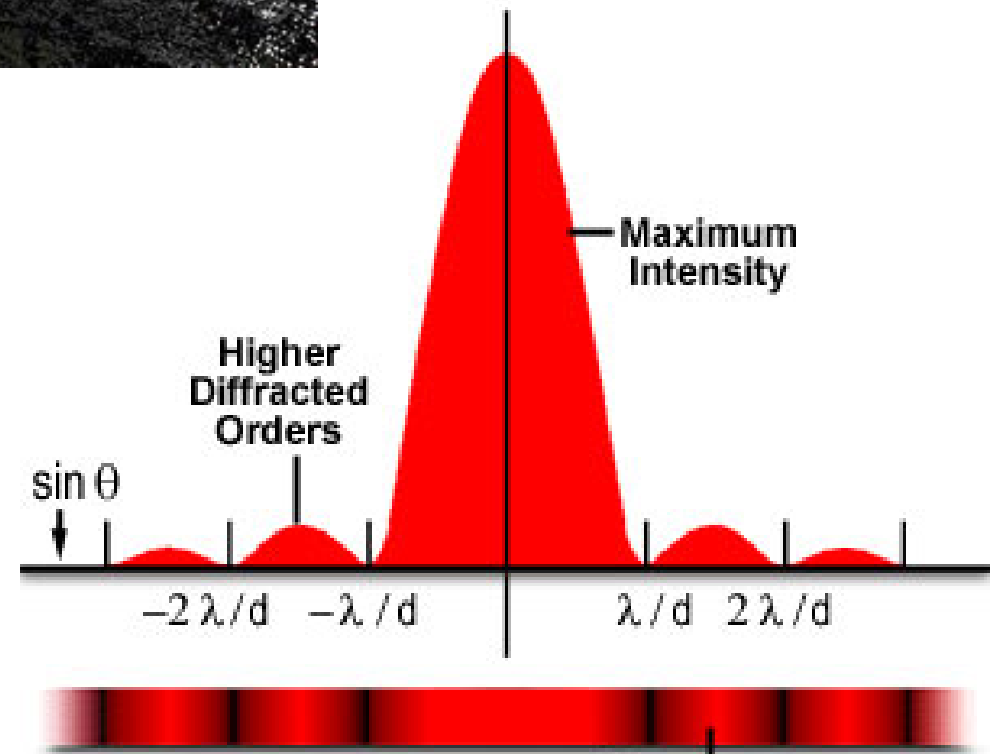
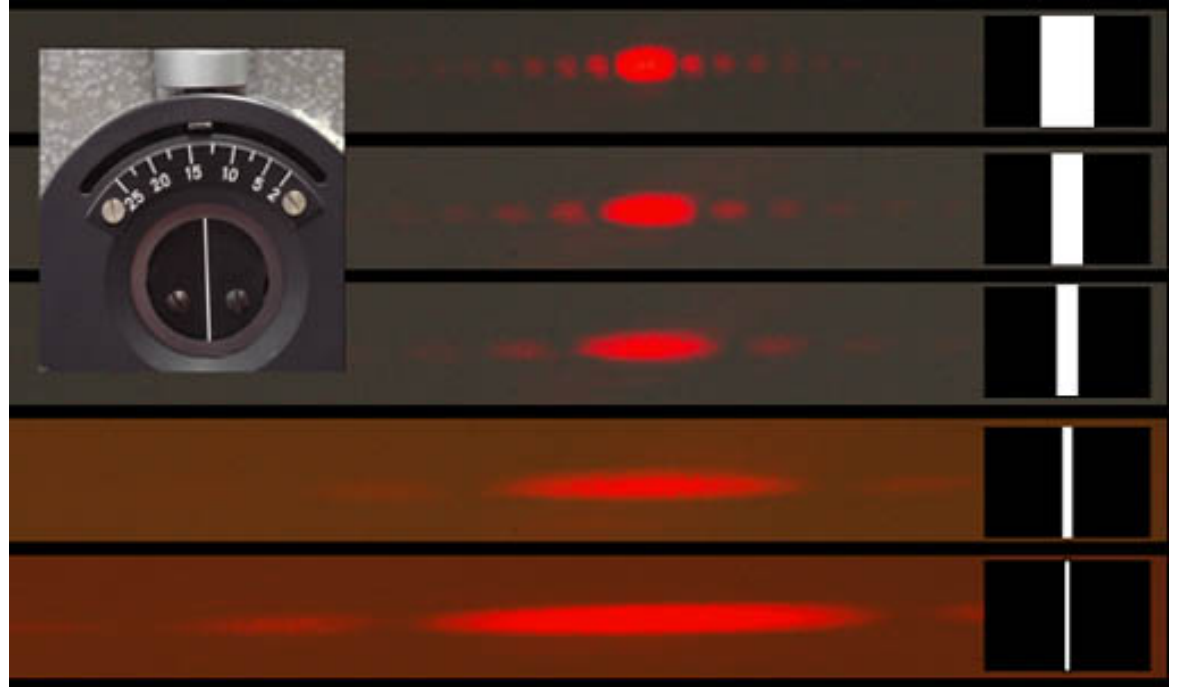
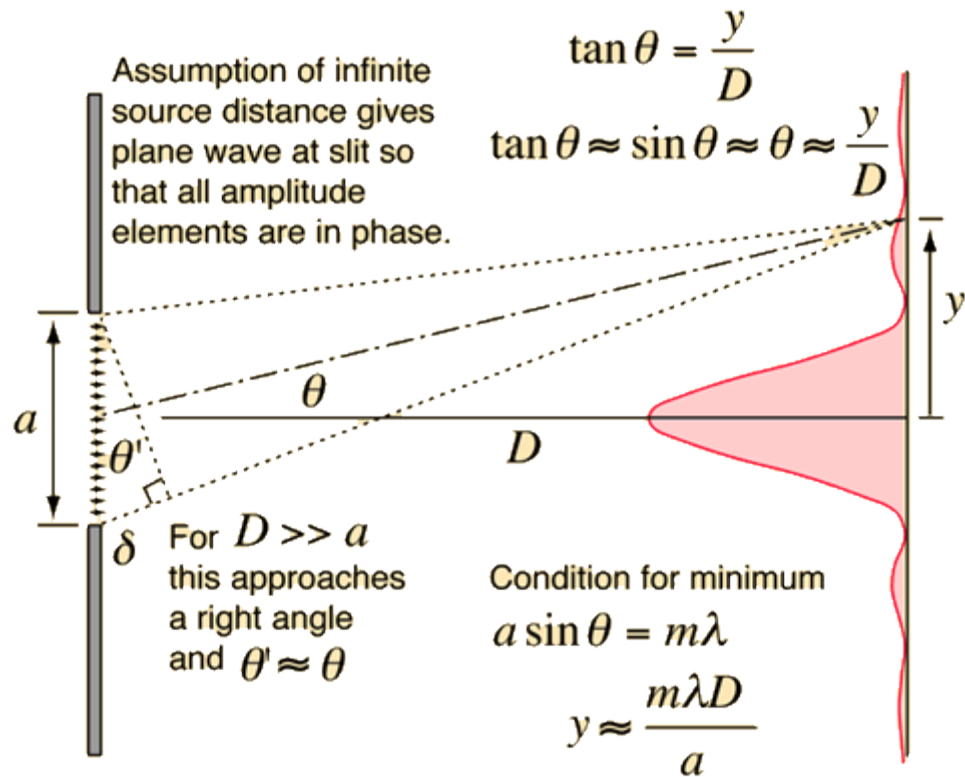


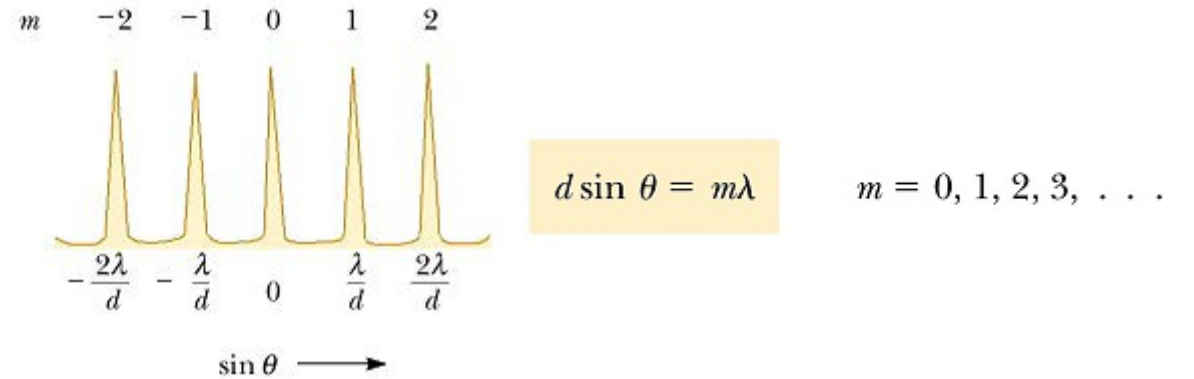
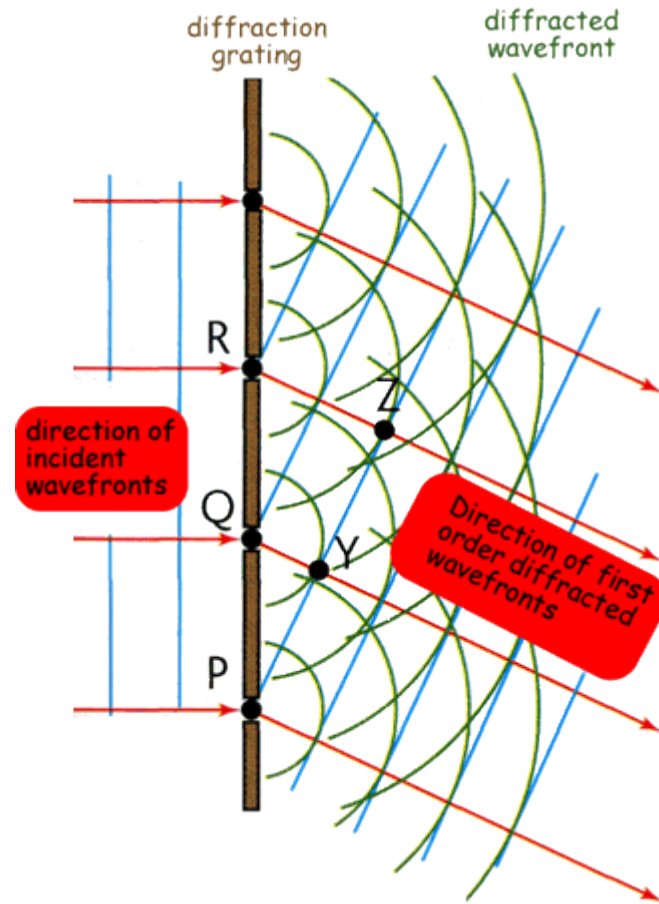
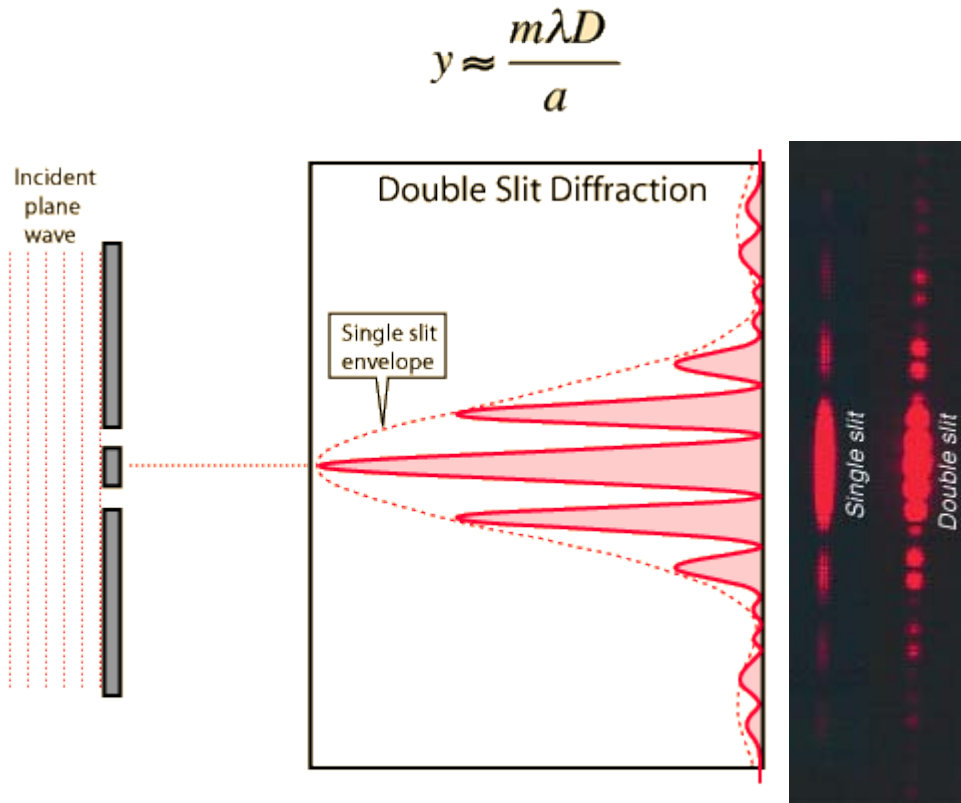
Figure 4

Screen

Single slit diffraction



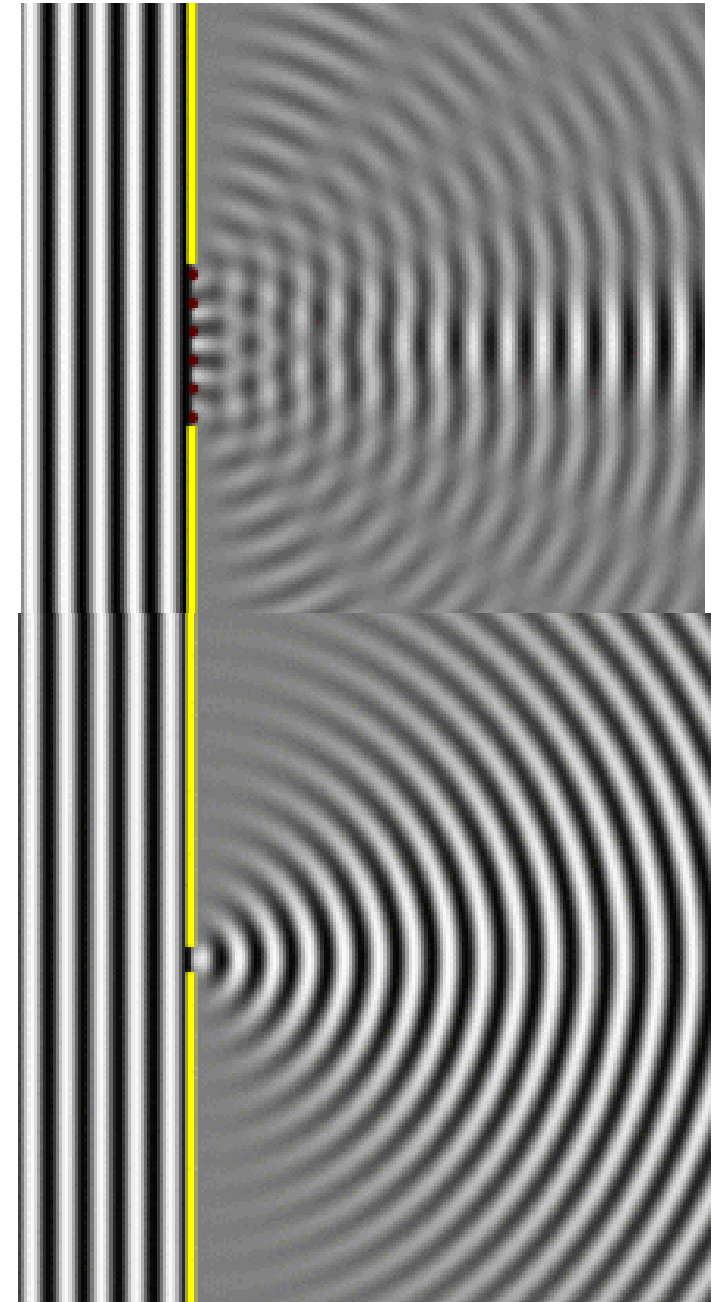
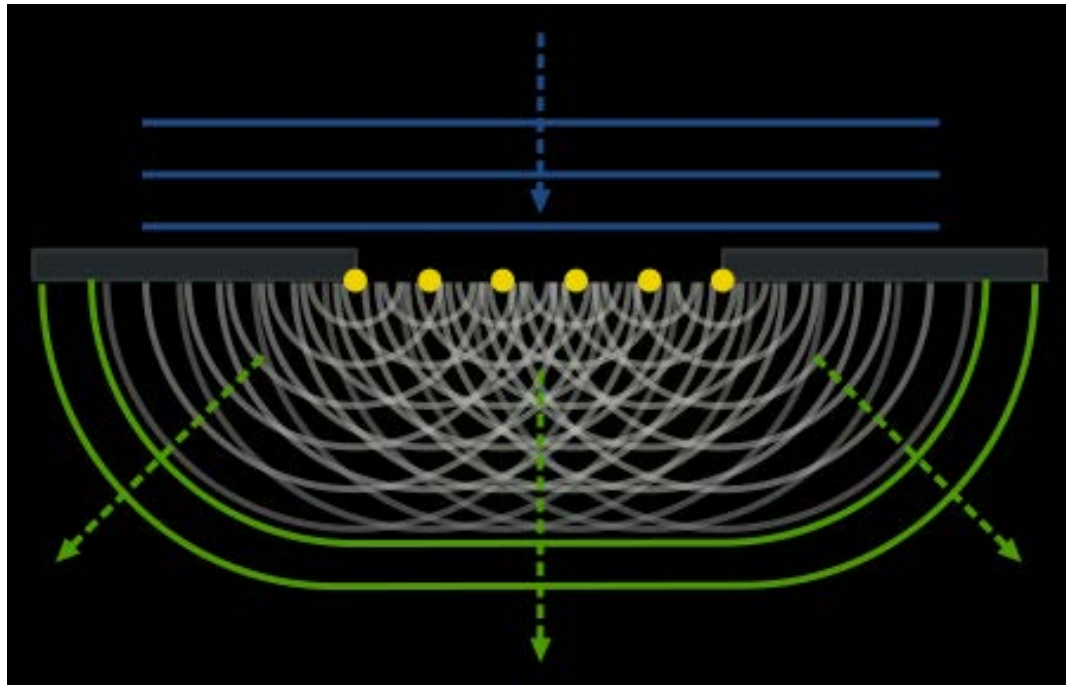
Multi-slit diffraction



Light needs to recombine to form image

Physical basis for diffraction

- Huygen's principle
- A plane wave is made up of interfering spherical waves



On to Matlab...