9.35 Lecture on

Optics and the Eye

The electromagnetic spectrum

- Light is one kind of electromagnetic energy.
- We can see 400-700 nm (somewhat arbitrary cut-offs).
- Longer is infrared, shorter is ultraviolet.
- Some animals can see IR or UV.

Properties of a sinusoidal wave

- Amplitude, wavelength (or frequency), phase.
- Wavelength determines perceived color of light
- Newton: "the waves are not coloured"

Light travels in straight lines

(let’s pretend)

- Geometric optics: light rays, straight lines.
- Emission, transmission, absorption, reflection, refraction

Pinhole camera

(cf. camera obscura)

1 pinhole: sharp but dim

(1 pinhole is not enough)

2 pinholes: brighter but double image

Improved camera

- Use prisms to align images

A lens: a continuum of prisms
with a continuum of pinholes
The human eye

Eye vs. Camera:
• Lens/focus
• Aperture
• Shutter speed
• Film/CCD
• Film speed
• Color vs. B&W
• etc...

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Blindspot demo

Draw on a piece of blank paper
Close left eye; fixate “x” with right eye
Move paper near and far until circle vanishes

Poke yourself in the eye, please.
(wait for instructions)

• Observe the flickering light.
• Why does it look like light?
  (Mueller’s law of specific nerve energies)
• Where is it located in visual space?

Focus: cornea plus lens

Cornea does most of the refraction, but it’s fixed.
Lens needs to change shape to adjust focus.

Near and farsightedness

Corrected vision does NOT mean 20/20 vision.

Correction is expressed in diopters

Diopter = 1/(focal length)

A 1 diopter lens brings a point at infinity to focus at 1 meter.
A 2 diopter lens brings it to focus at .5 meter.
A -2 diopter lens brings it to focus at -.5 meters.

Diopters are cool because they add.
Correction (glasses or contacts) is expressed in diopters.
Example: Ted’s correction is about -5.5 (myopic).

Corrected vision does NOT mean 20/20 vision.
The compound eye

(Image removed due to copyright considerations.)

Rods and Cones

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Other problems...

Different focal length on different axes: astigmatism.

Why does the world look blurry under water? How do goggles help?

The retina

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