

9.35 Lecture on  
Optics and the Eye

The electromagnetic spectrum

(Image removed due to copyright considerations.)

- 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

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- 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)

(Image removed due to copyright considerations.)

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

Pinhole camera  
(cf. camera obscura)

1 pinhole: sharp but dim

(Image removed due to  
copyright considerations.)

2 pinholes: brighter but  
double image

Improved camera

Use prisms to align images

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copyright considerations.)

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

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- 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

(Image removed due to copyright considerations.)

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

## Near and farsightedness

(Images removed due to copyright considerations.)

## Correction is expressed in diopters

Diopter =  $1/(\text{focal length})$

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.

### Other problems...

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Different focal length on different axes: astigmatism.

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

### The compound eye

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### Rods and Cones

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### The retina

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