

PSYCH 260

Vision

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2021-11-11 07:52:58

Traveling at Warp 1

<https://vimeo.com/117815404>

Announcements

- Exam 3 Tuesday, 11/16
 - On Canvas, 3:05 PM - 10:00 PM

Today's topics

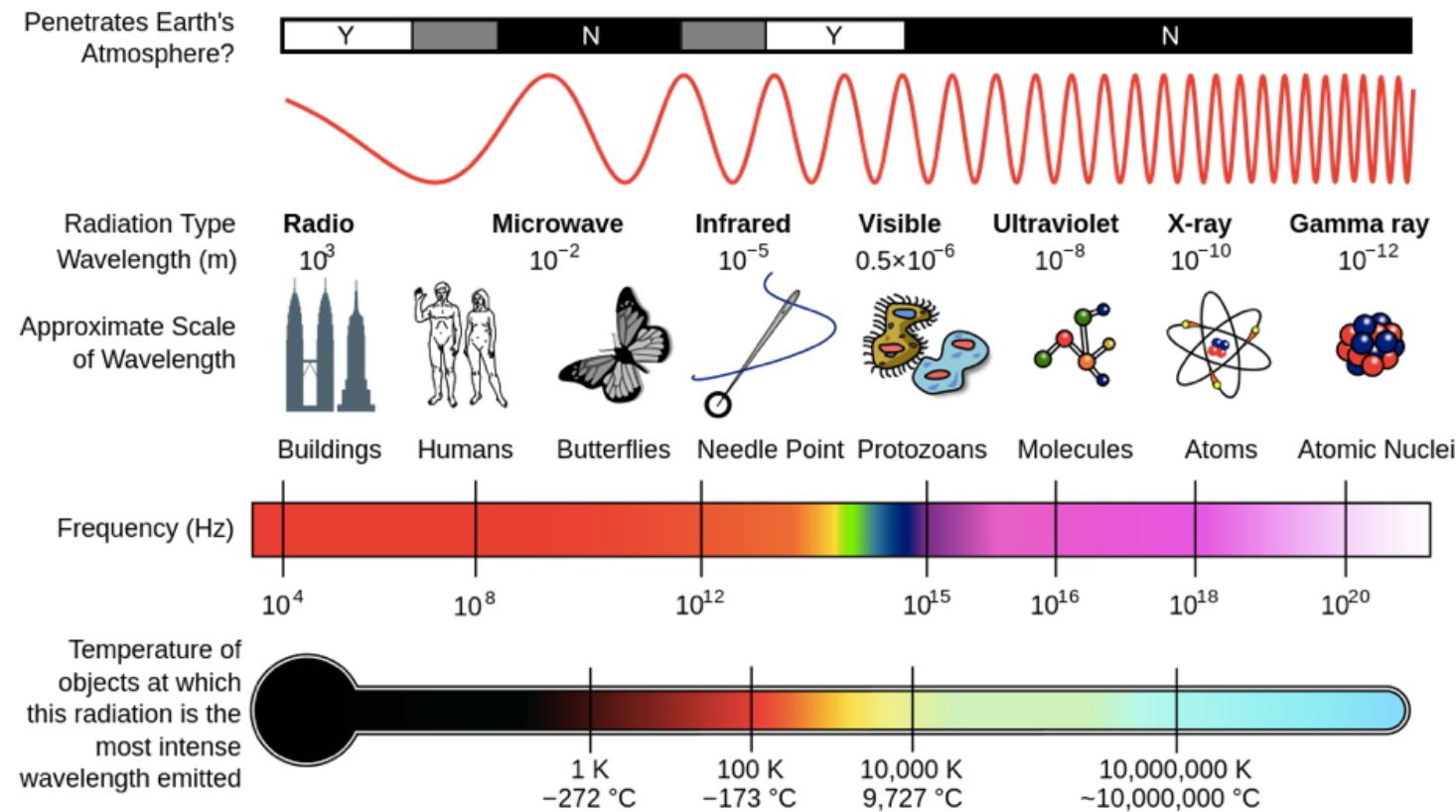
- Wrap-up on action
- Vision
- Exam 3 review

Vision

How vision informs

- What's out there?
 - Shape, form, color
- Where is it?
 - Position, orientation, motion

Electromagnetic (EM) radiation

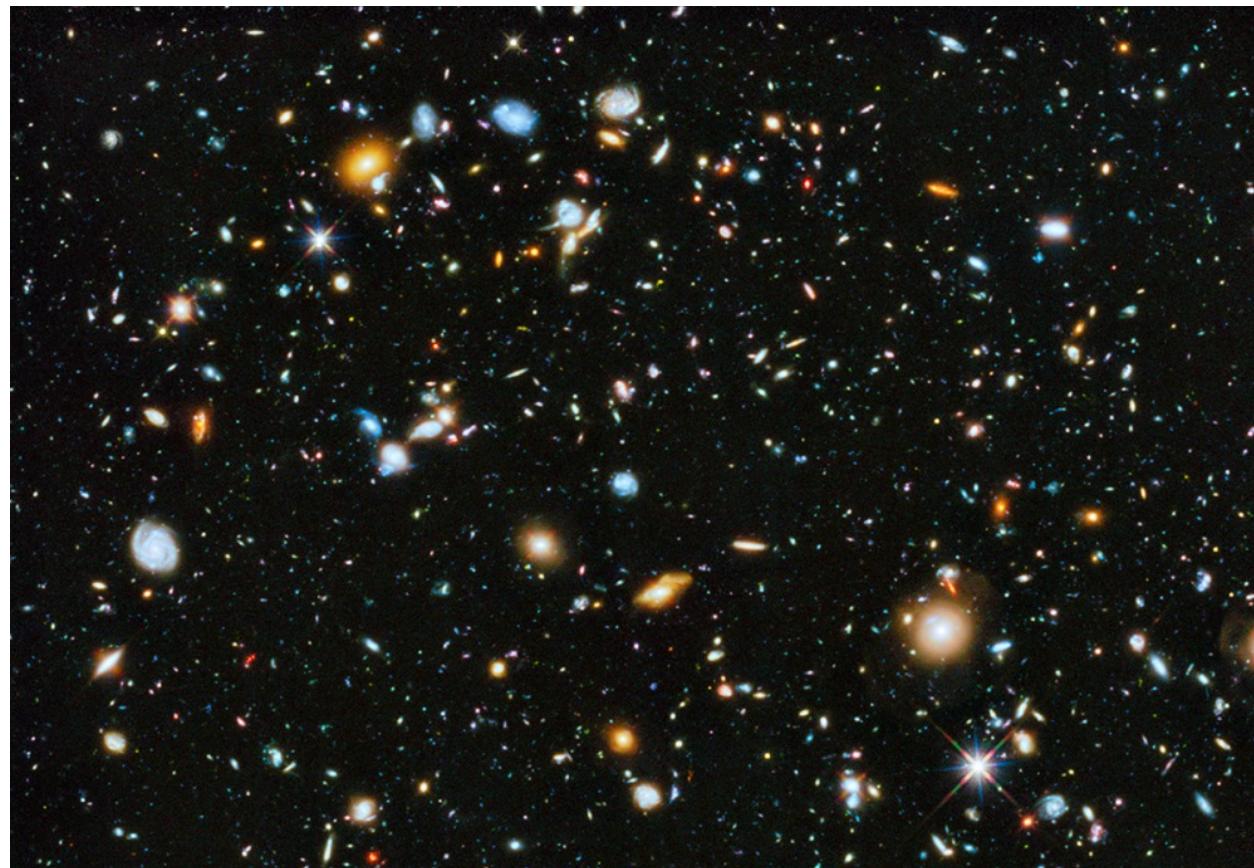


http://en.wikipedia.org/wiki/File:EM_Spectrum_Properties_edit.svg

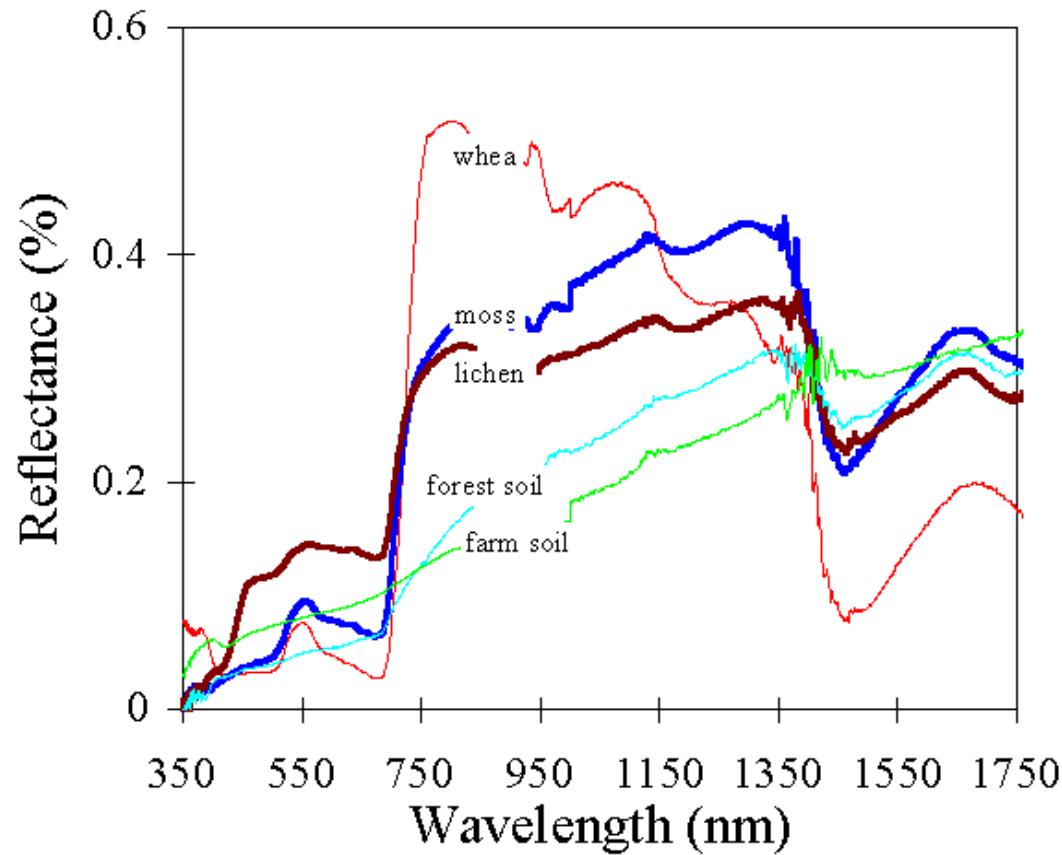
Features of EM radiation

- Wavelength or frequency
- Intensity
- Location/position of source
- Reflects off some materials
- Refracted (bent) moving through other materials

EM radiation provides information across space (and time)

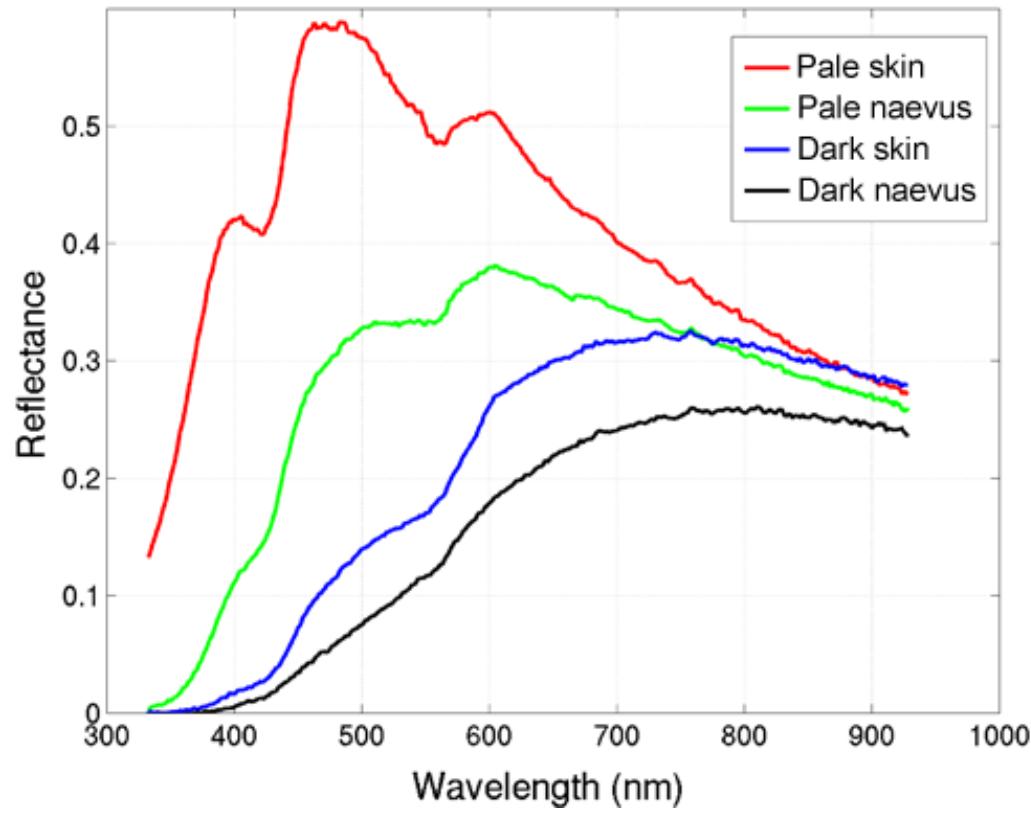


Reflectance spectra differ by surface

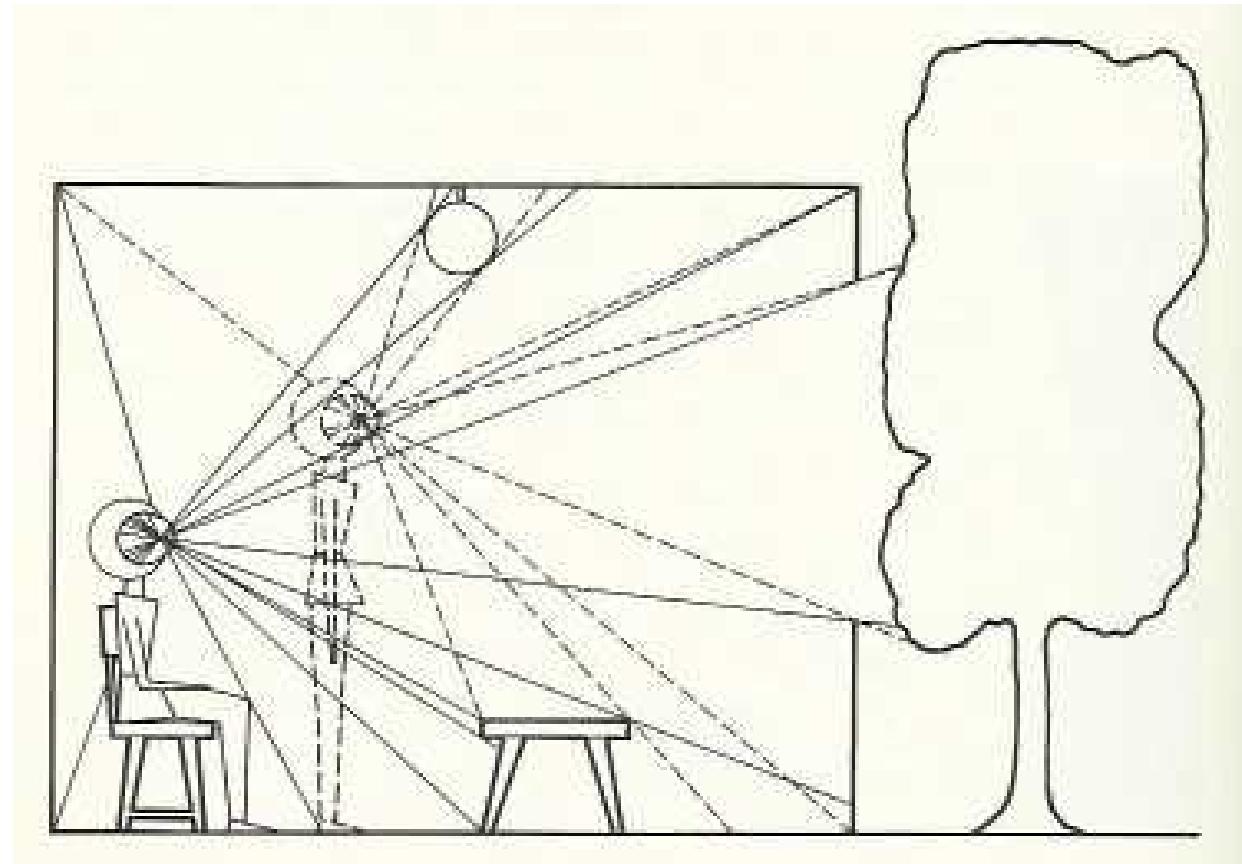


http://www.vgt.vito.be/userguide/book_1/4/42/ie42bd.gif

Reflectance spectra



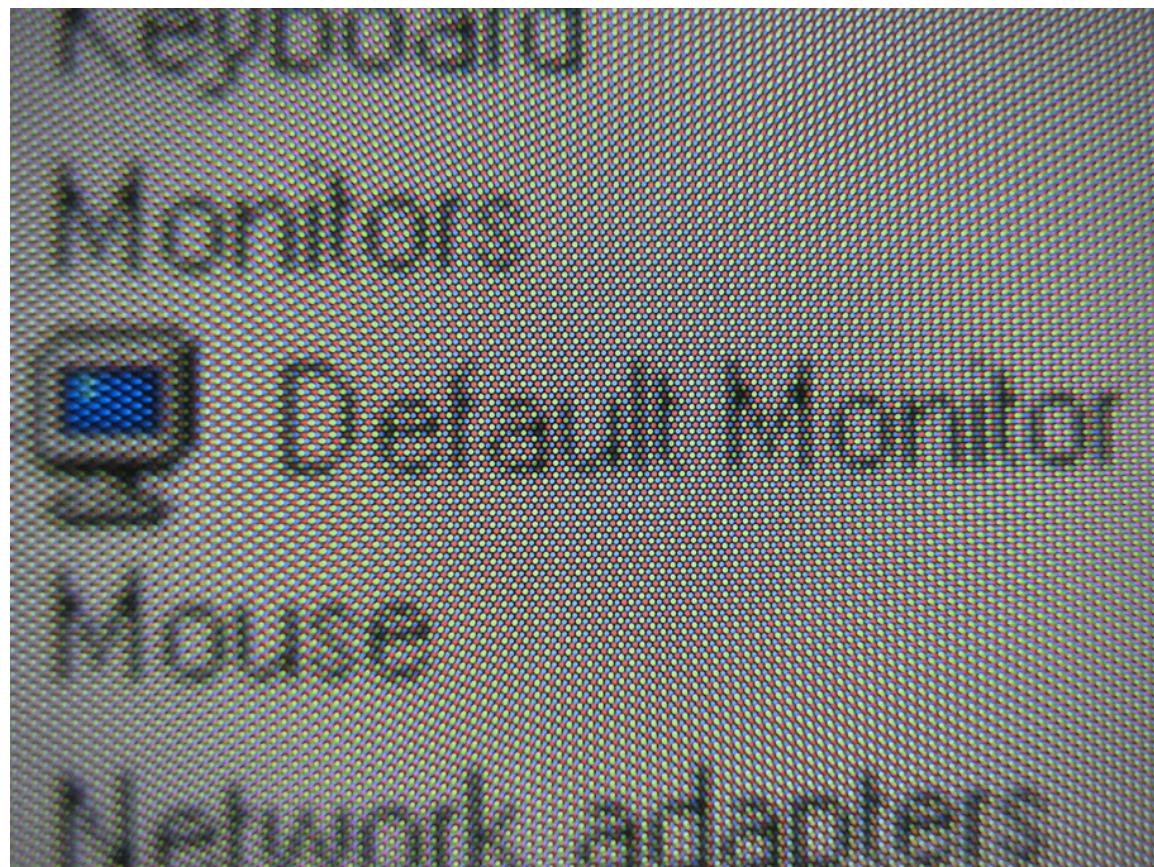
Optic array specifies geometry of environment



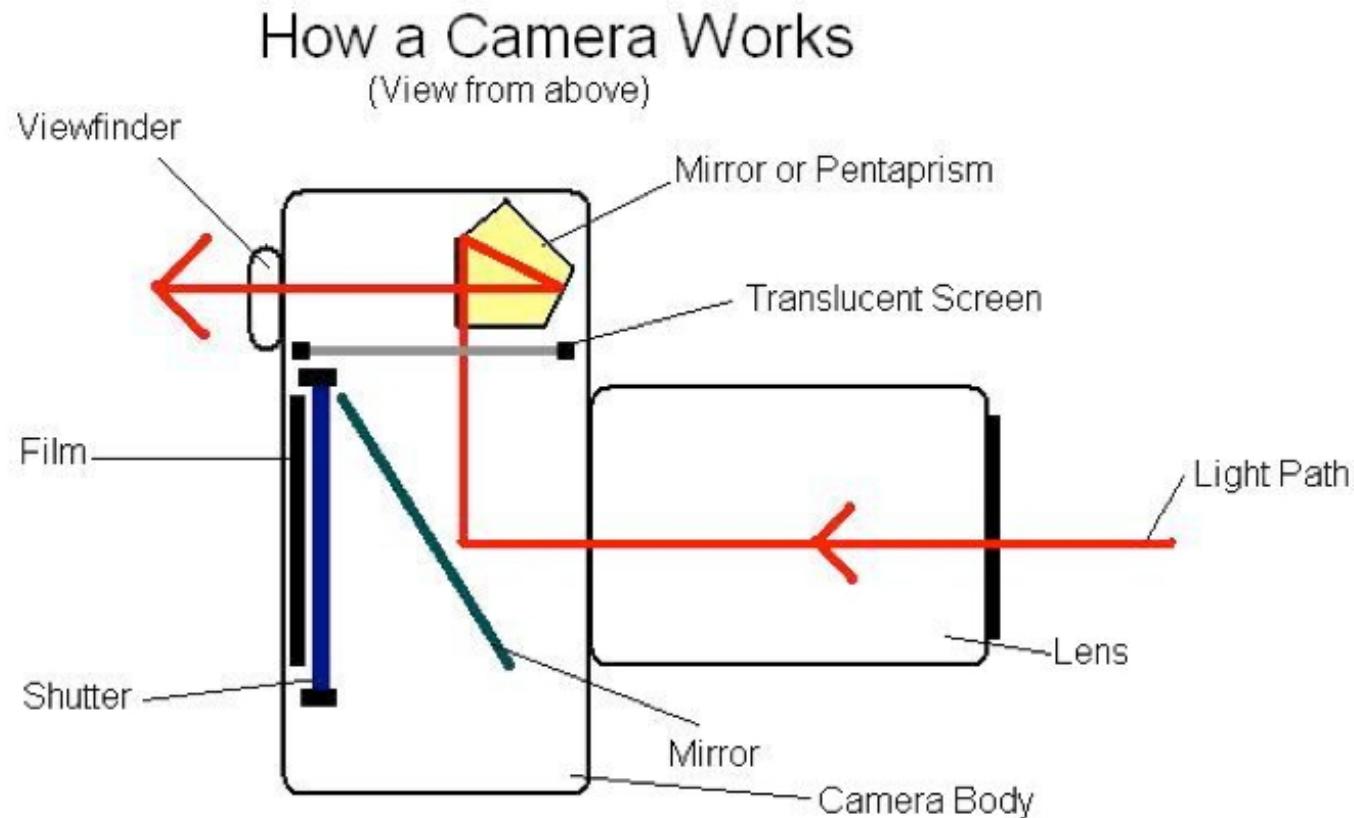
Color == categories of wavelength

- Eyes categorize wavelength into relative intensities within wavelength bands
- RGB ~ **Red, Green, Blue**
 - Long, medium, short wavelengths
- *Color is a neural/psychological construct*

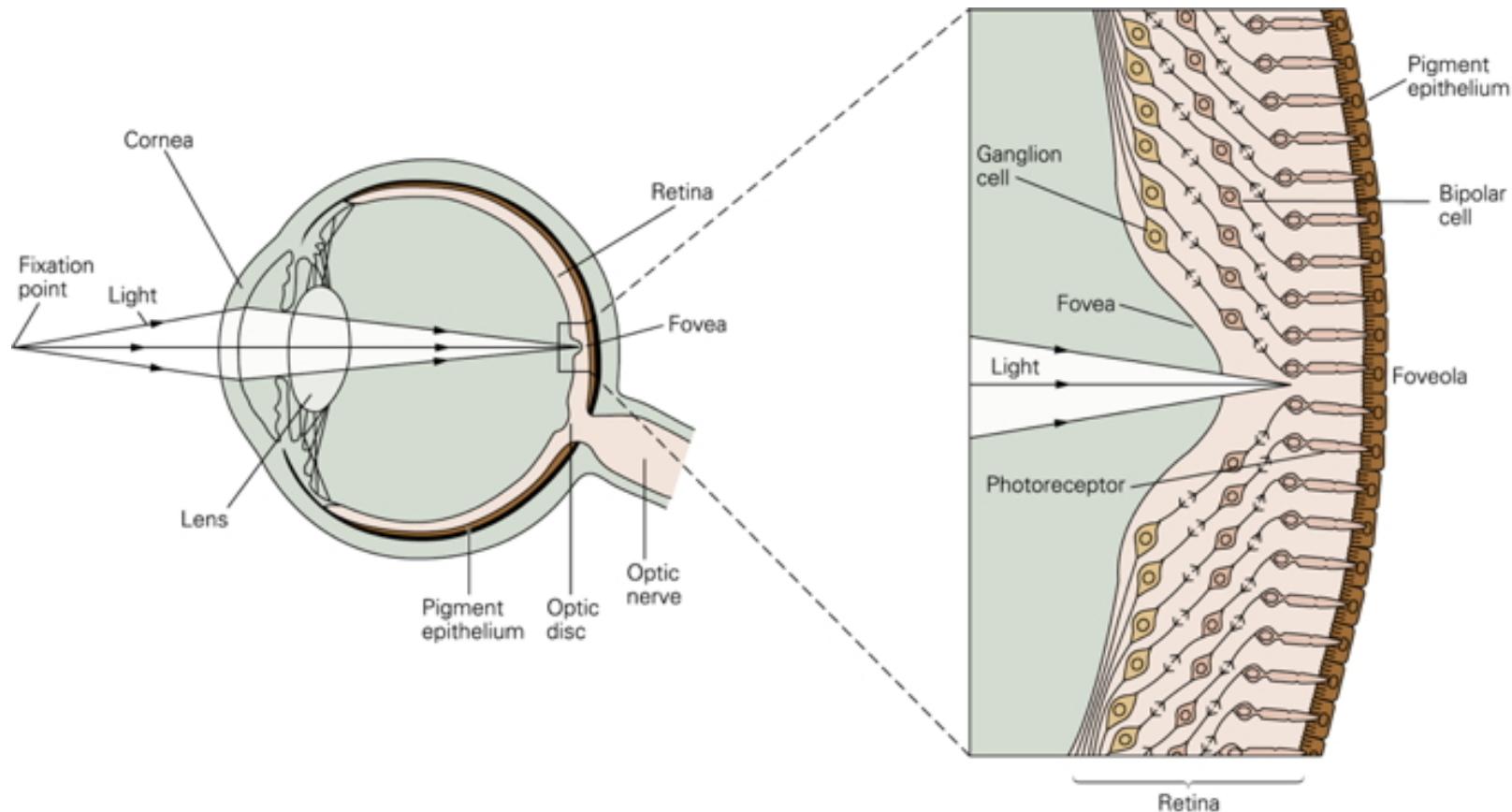
RGB monitors



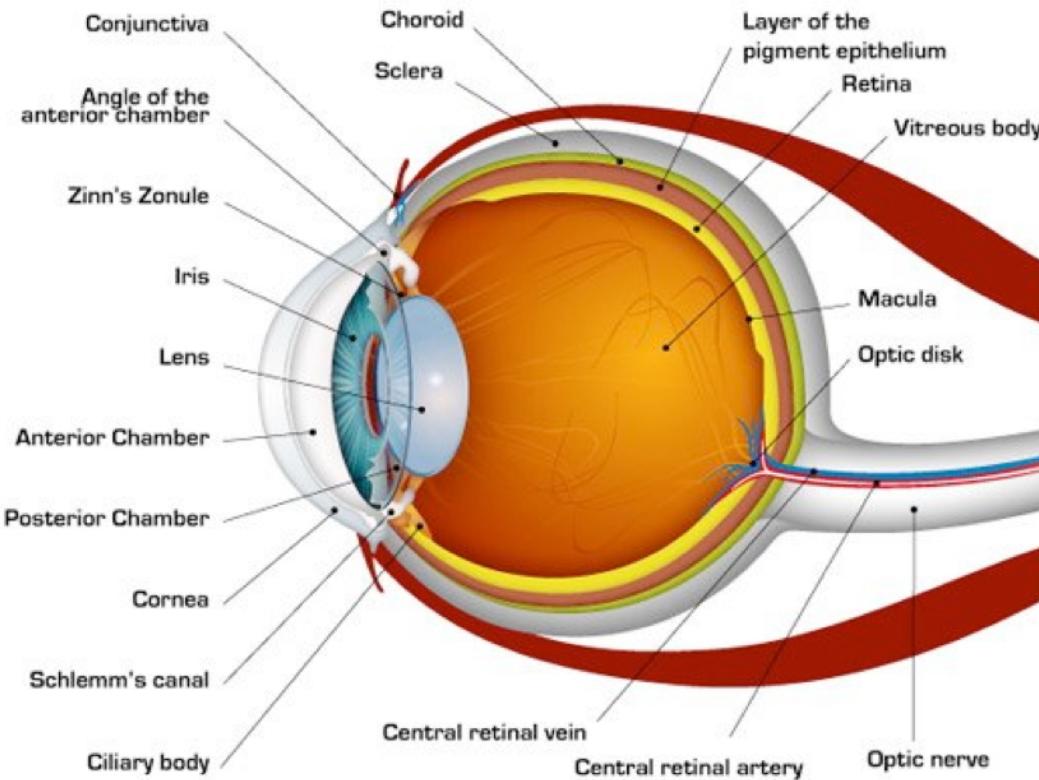
How a camera works



The biological camera



The biological camera



Parts of the eye

- *Cornea* - refraction (2/3 of total)
- *Pupil* - light intensity; diameter regulated by the *Iris*.
- *Lens* - refraction (remaining 1/3; variable focus)

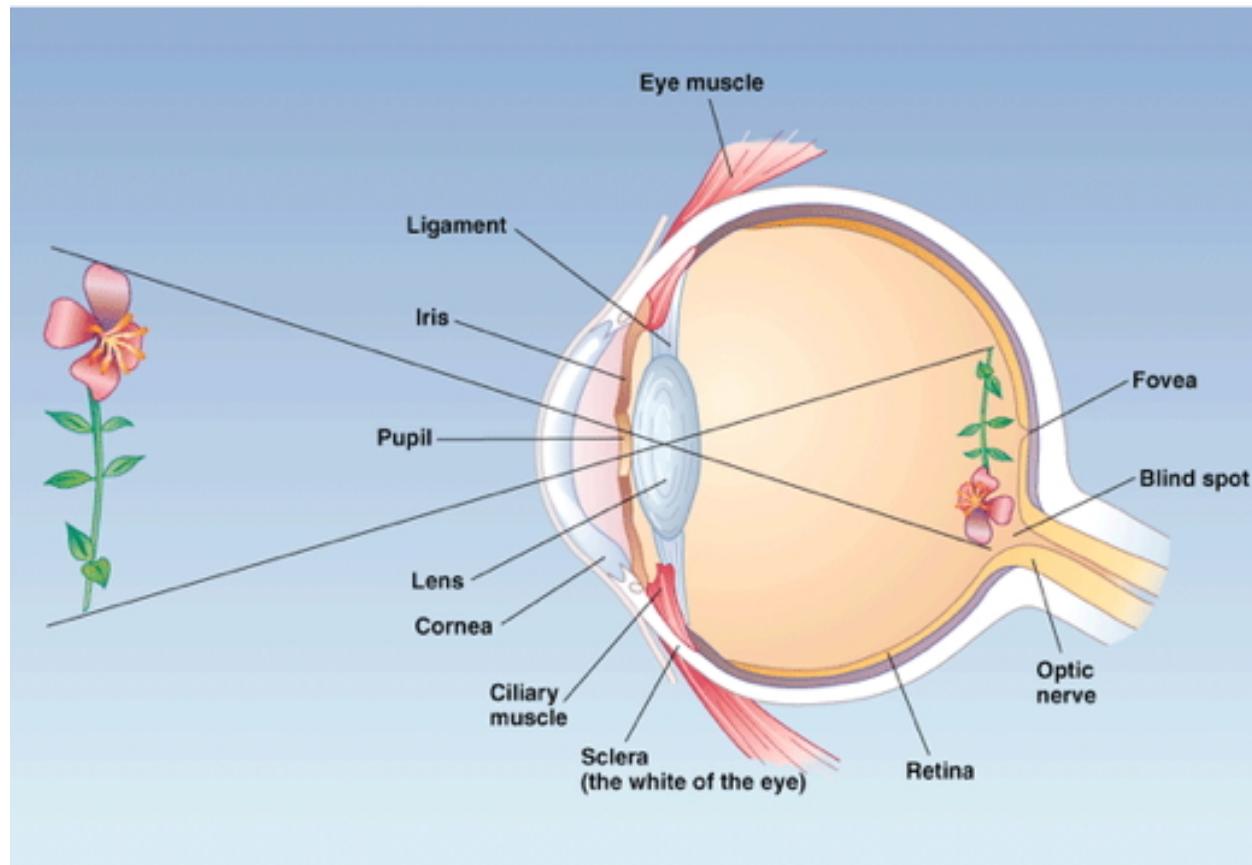
Parts of the eye

- *Retina* - light detection
 - ~ skin or organ of Corti
- *Pigment epithelium* - regenerate photopigment
- *Muscles* - move eye, reshape lens, change pupil diameter

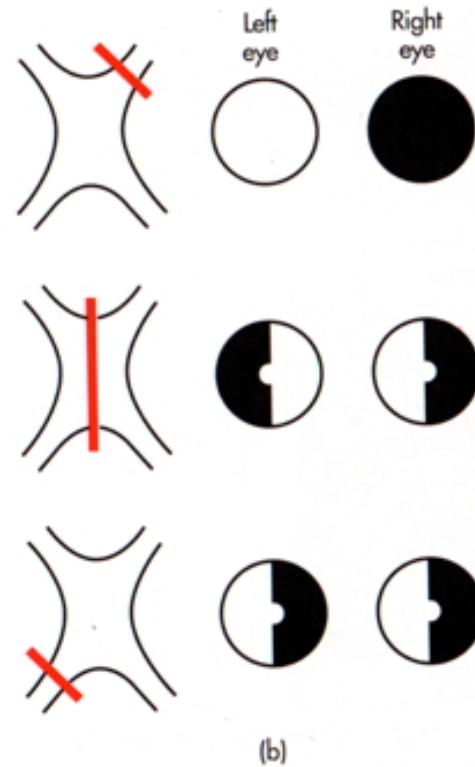
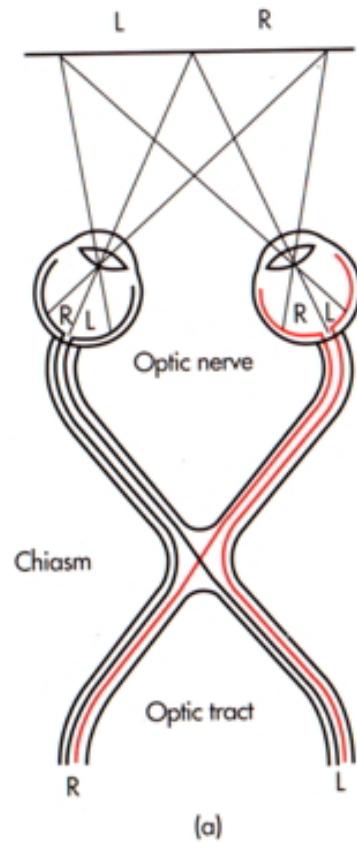
Eye forms image on retina

- Image inverted (up/down)
- Image reversed (left/right)
- Point-to-point map (*retinotopic*)
- Binocular and monocular zones

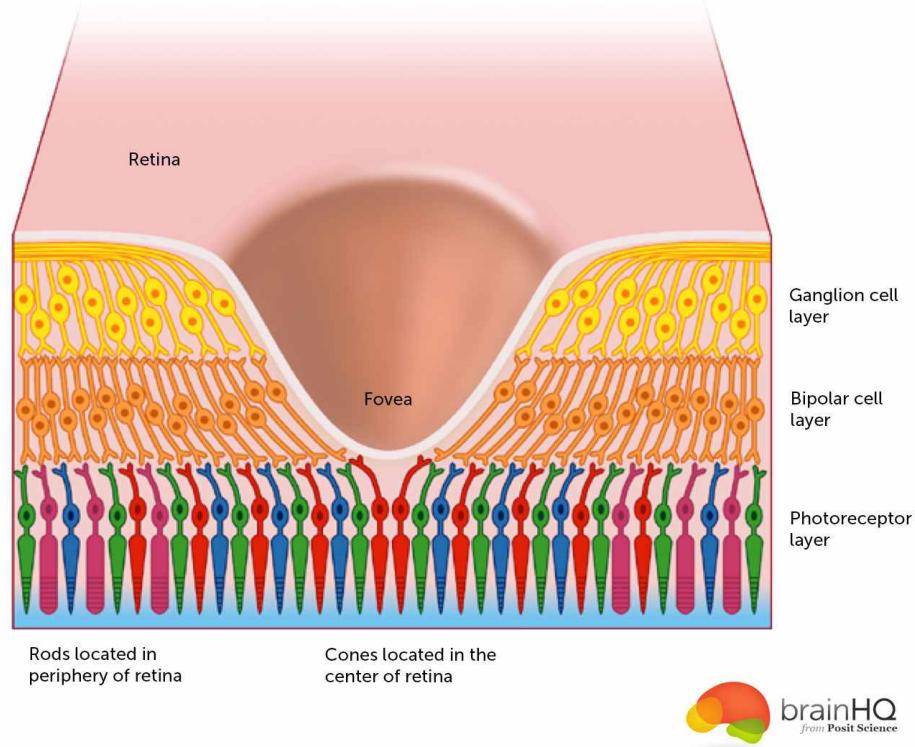
Retinal image



Eyes views overlap



The *fovea*

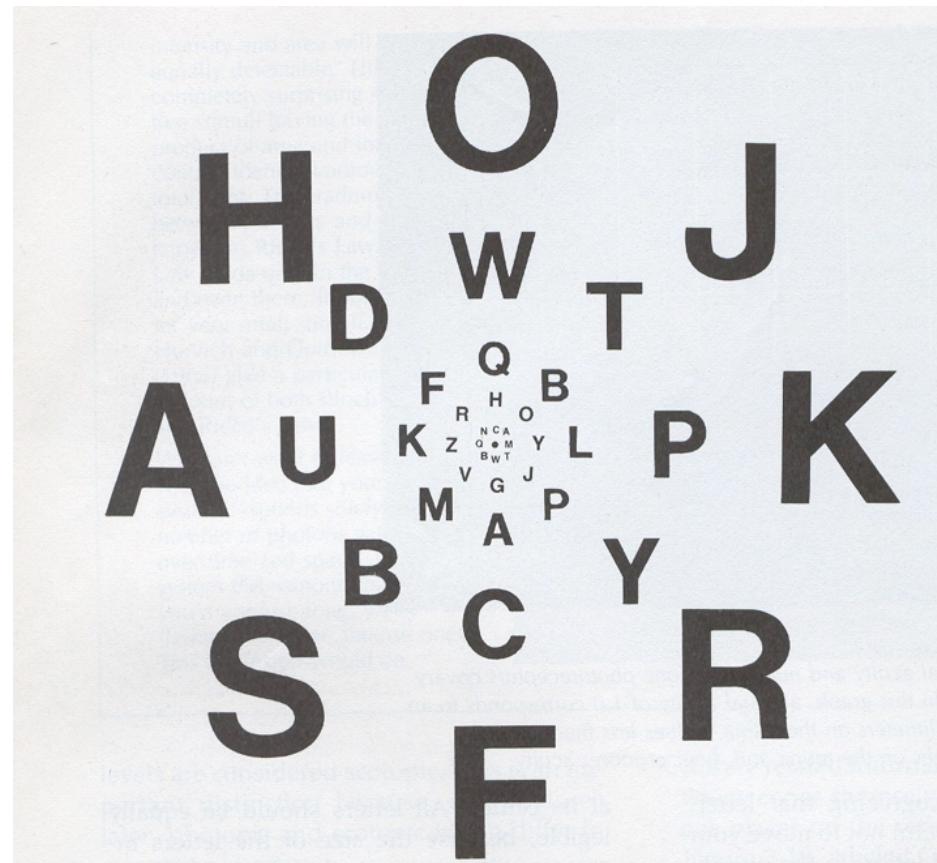


<http://www.brainhq.com/sites/default/files/fovea.jpg>

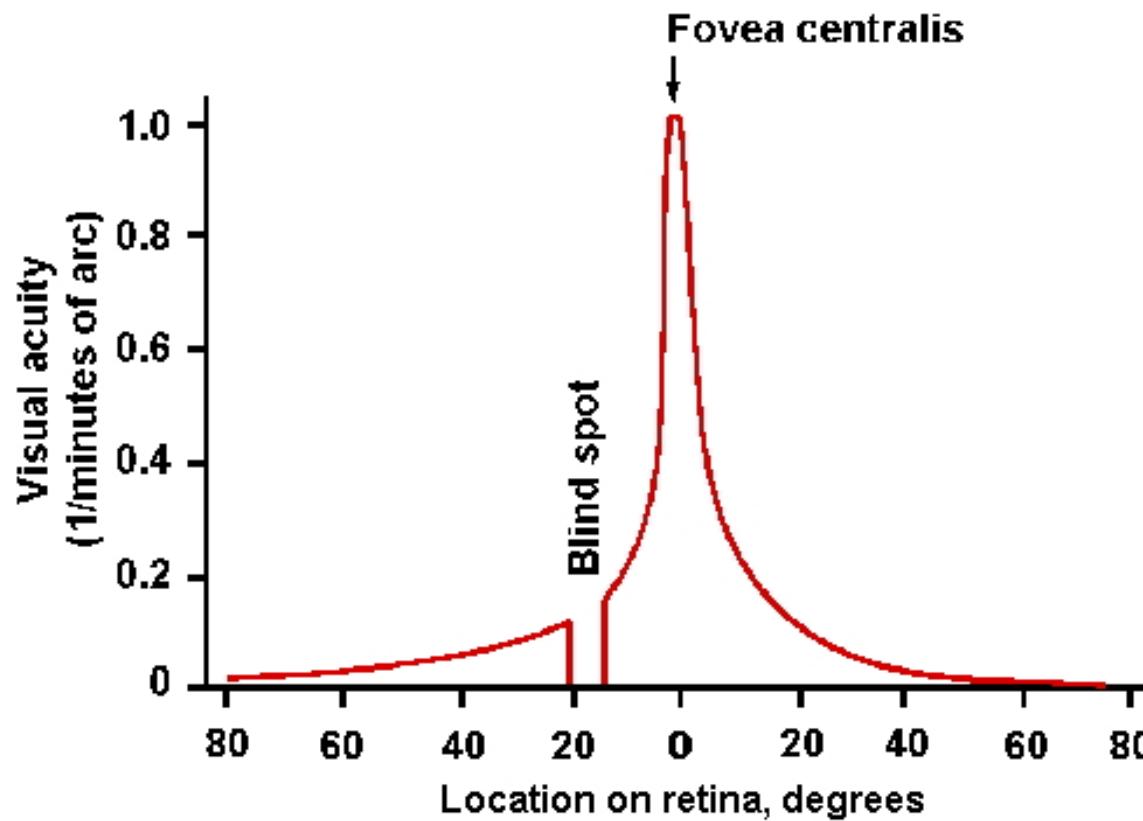
The fovea

- Central 1-2 deg of visual field
 - ~ thumbnail @ arm's length
- Aligned with visual axis; center of gaze
- *Retinal ganglion cells* pushed aside
- Highest *acuity* vision == best for details

Acuity varies across the retina



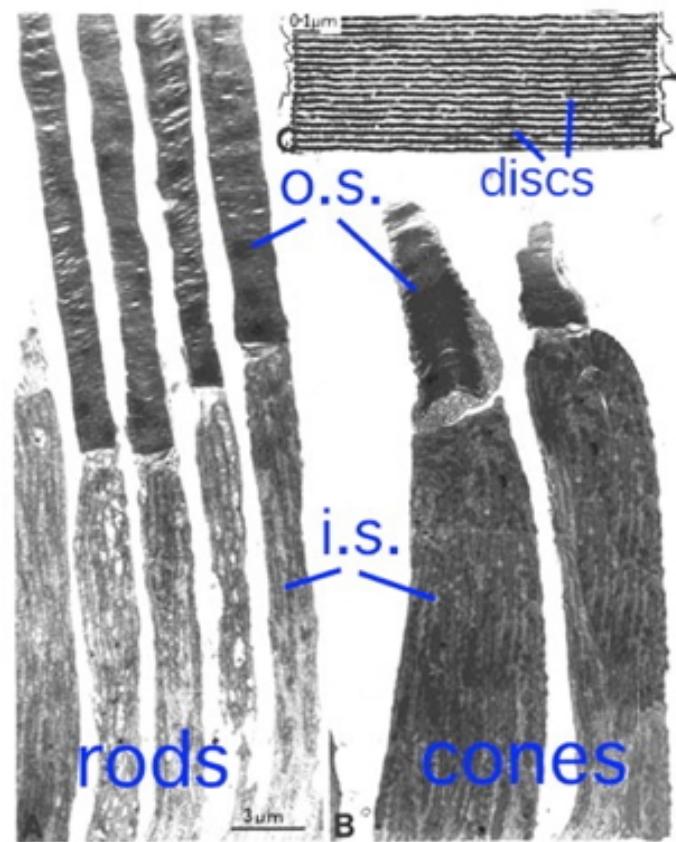
Acuity varies across the retina



http://michaeldmann.net/pix_7/blndspot.gif

What part of the skin is like the fovea?

Photoreceptors detect light



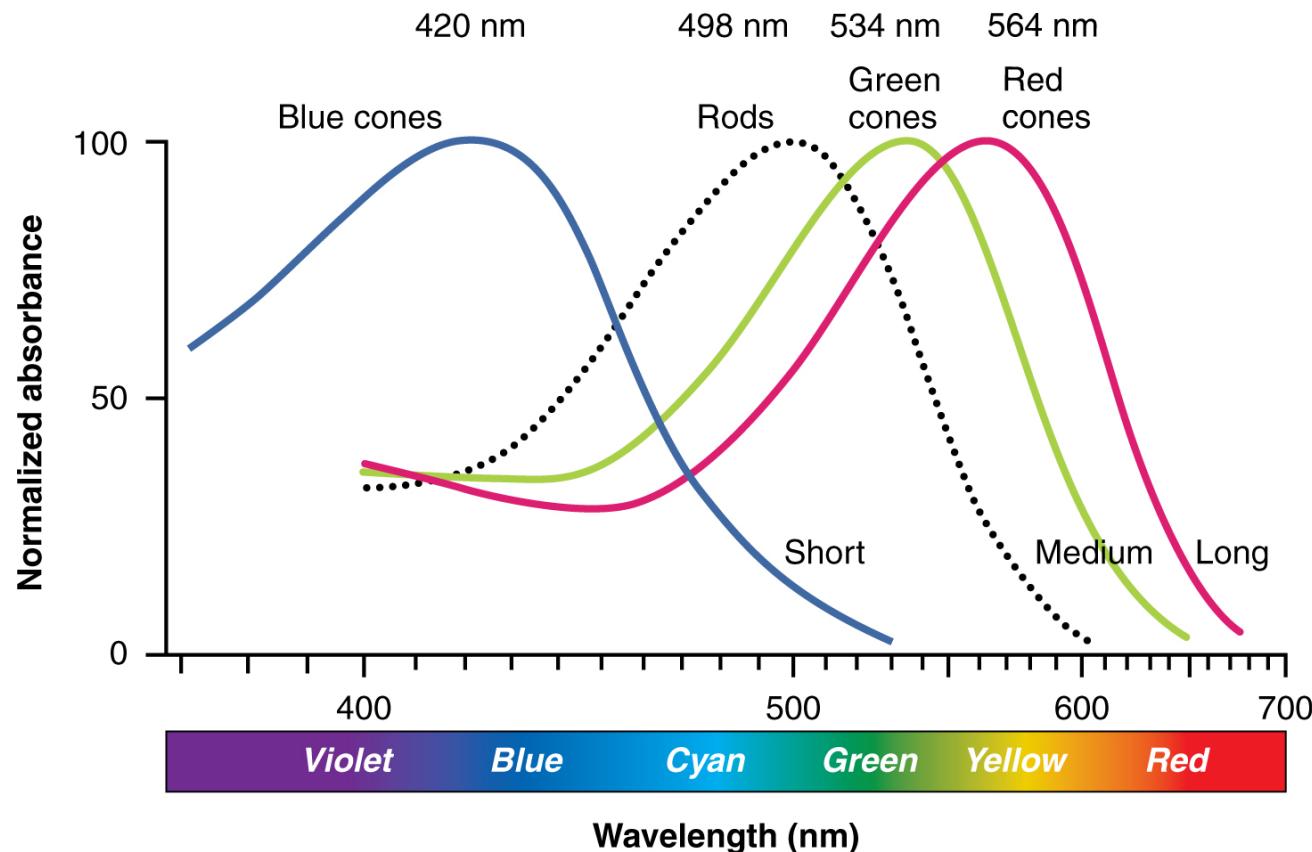
Photoreceptors detect light

- *Rods*
 - ~120 M/eye
 - Mostly in periphery
 - Active in low light conditions
 - One wavelength range

Photoreceptors detect light

- *Cones*
 - ~5 M/eye
 - Mostly in center
 - 3 wavelength ranges

Photoreceptors “specialize” in particular wavelengths



Anatomy & Physiology, Connexions Web site. <http://cnx.org/content/col11496/1.6/>, Jun 19, 2013.

How photoreceptors work

- Outer segment
 - Membrane disks
 - *Photopigments*
 - Sense light, trigger chemical cascade
- Inner segment
 - Synaptic terminal
- Light *hyperpolarizes* photoreceptor!
 - The *dark current*

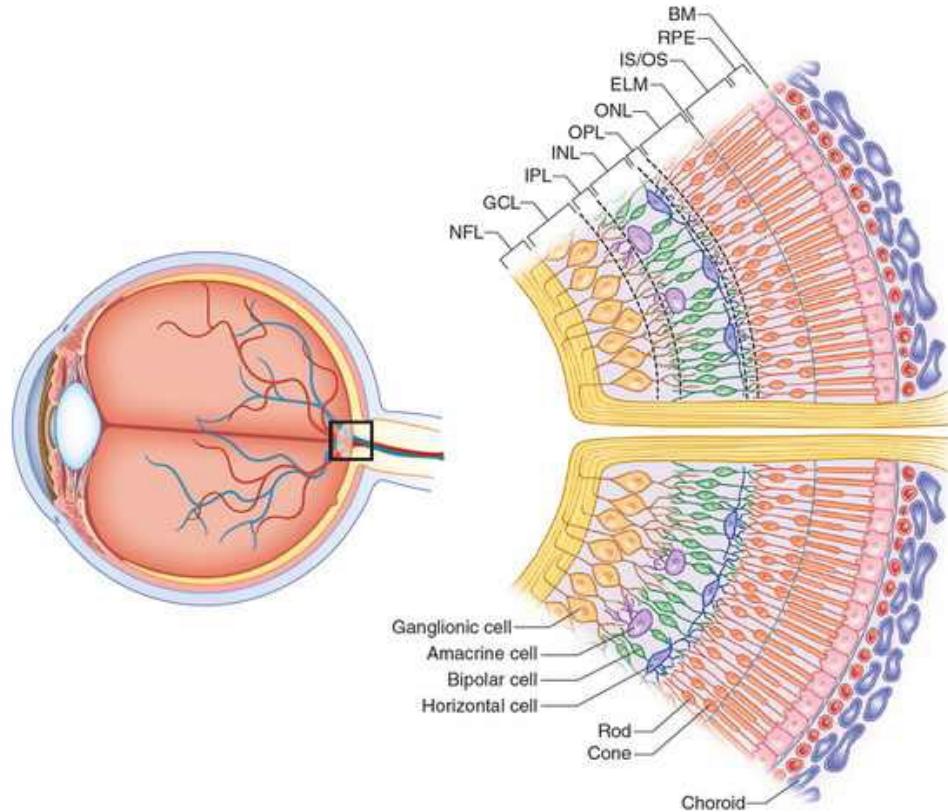
Retina

- Physiologically *backwards*
 - How?
- Anatomically *inside-out*
 - How?

Retina

- Physiologically *backwards*
 - Dark current (more NT released in dark)
- Anatomically *inside-out*
 - Photoreceptors at back of eye

Retinal layers

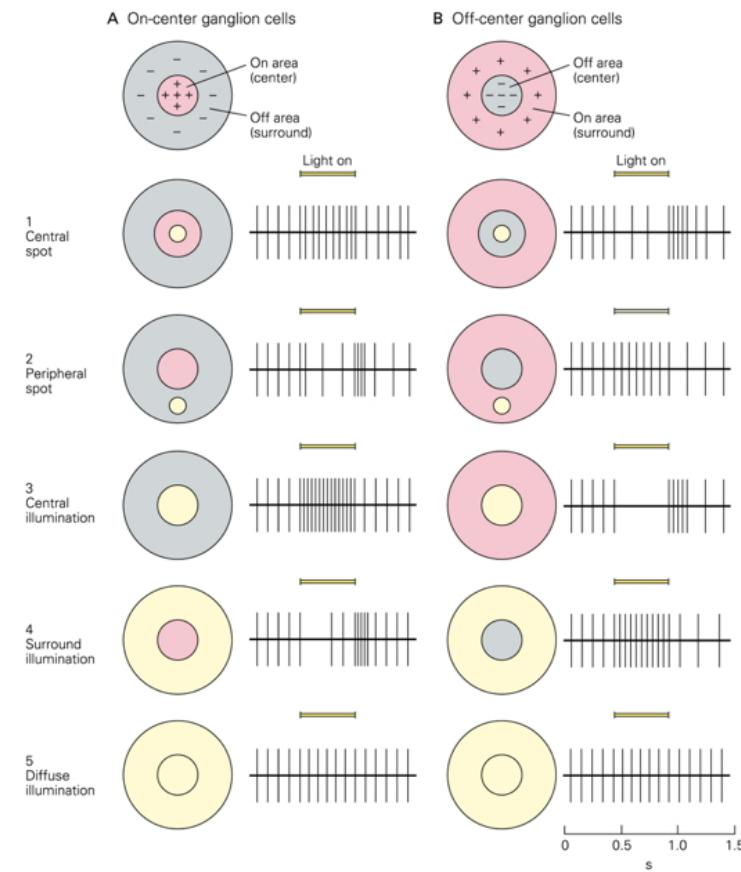


<http://www.retinareference.com/anatomy/>

Retinal layers

- Bipolar cells
 - Horizontal cells
- Retinal ganglion cells
 - Amacrine cells

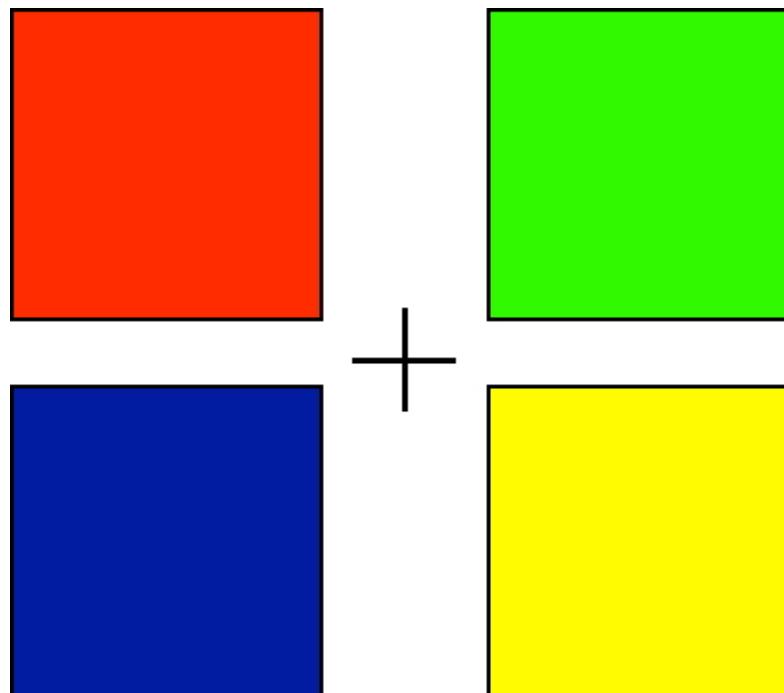
Center-surround receptive fields



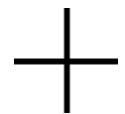
Center-surround receptive fields

- Center region
 - Excites (or inhibits)
- Surround region
 - Does the opposite
- Bipolar cells & Retinal Ganglion cells ->
- Most activated by “donuts” of light/dark
 - Local contrast (light/dark differences)

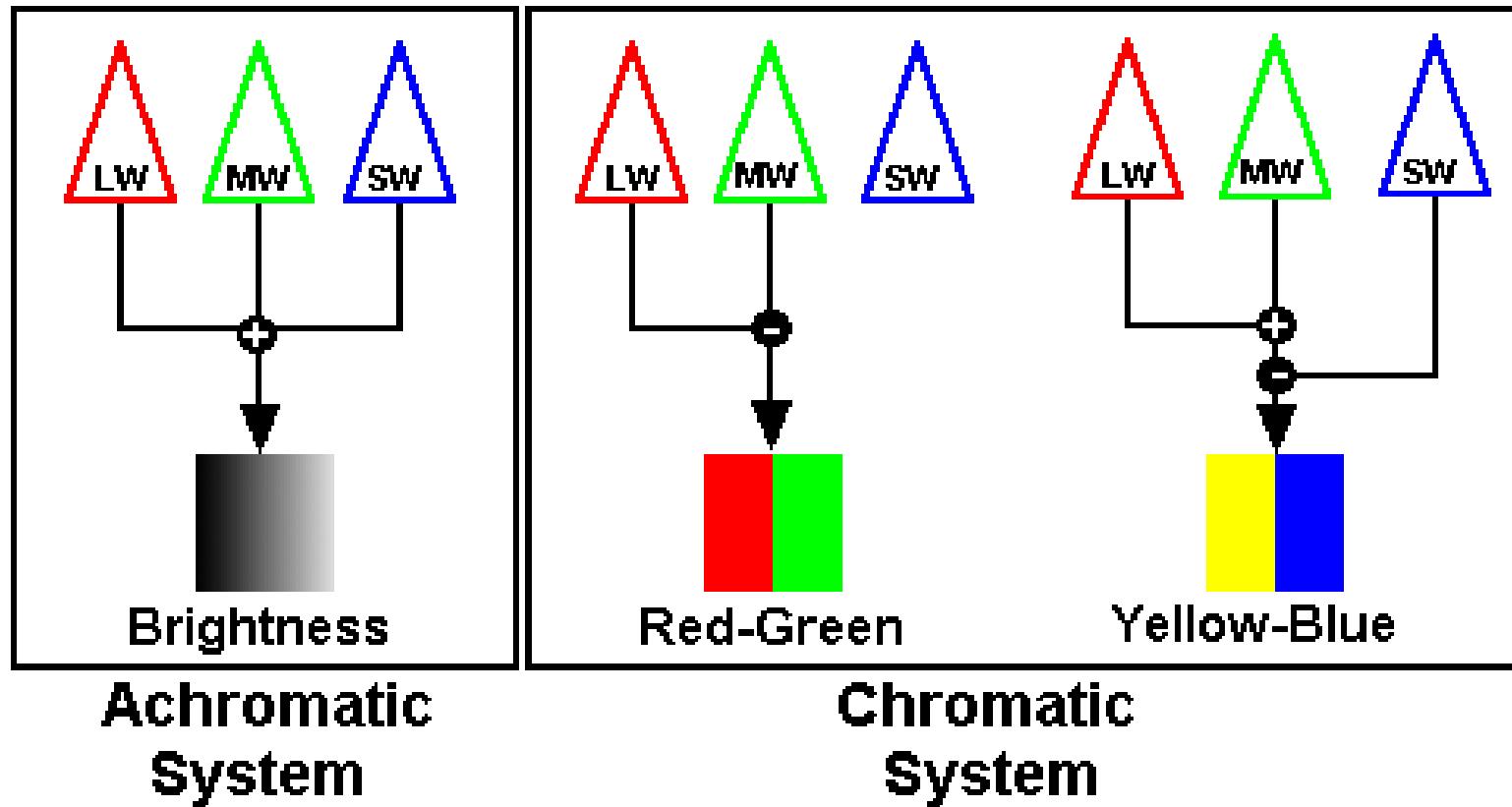
What's a reddish-green look like?



What's a reddish-green look like?



Opponent processing

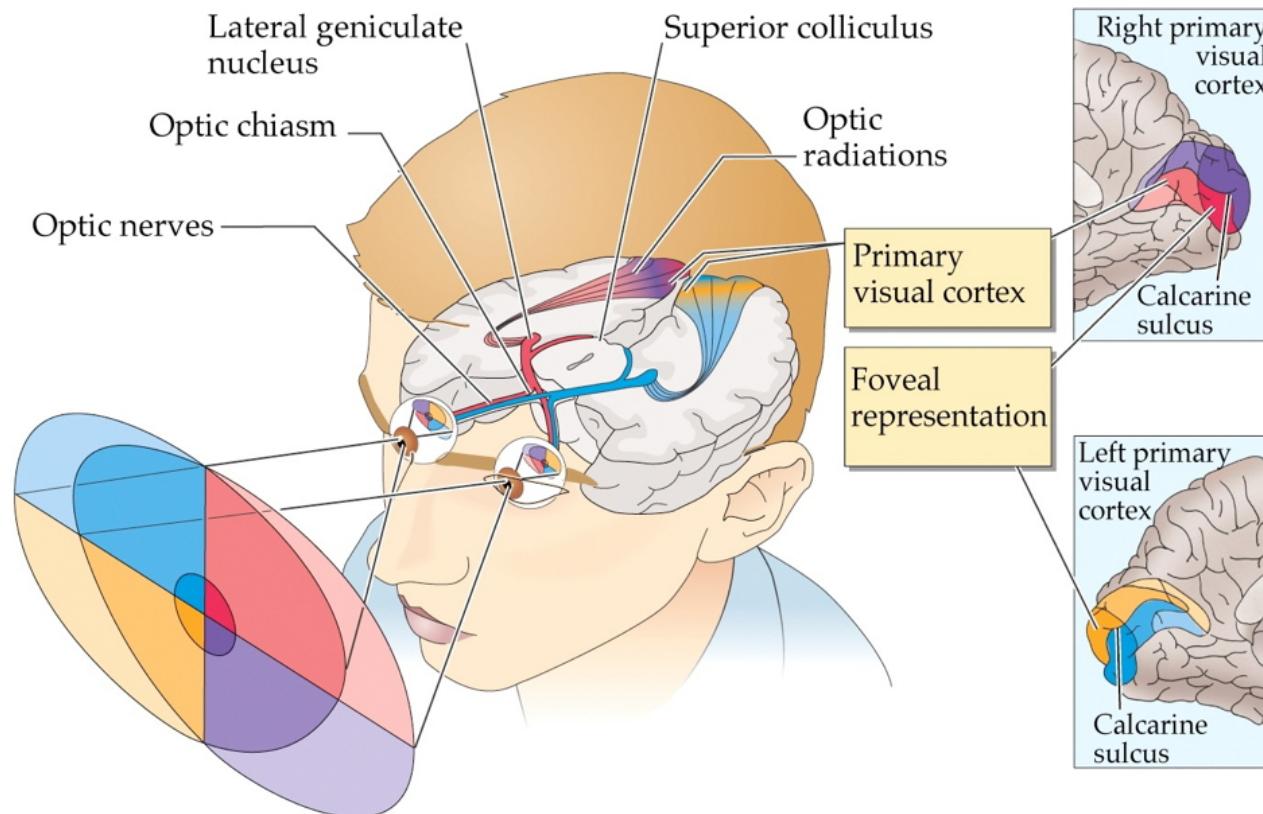


<http://www.visualexpert.com/sbfaqimages/RGBOpponent.gif>

Opponent processing

- Black vs. white (achromatic)
- Long (red) vs. Medium (green) wavelength cones
- (Long + Medium) vs. Short (blue) cones
- Can't really see reddish-green or bluish-yellow

From eye to brain



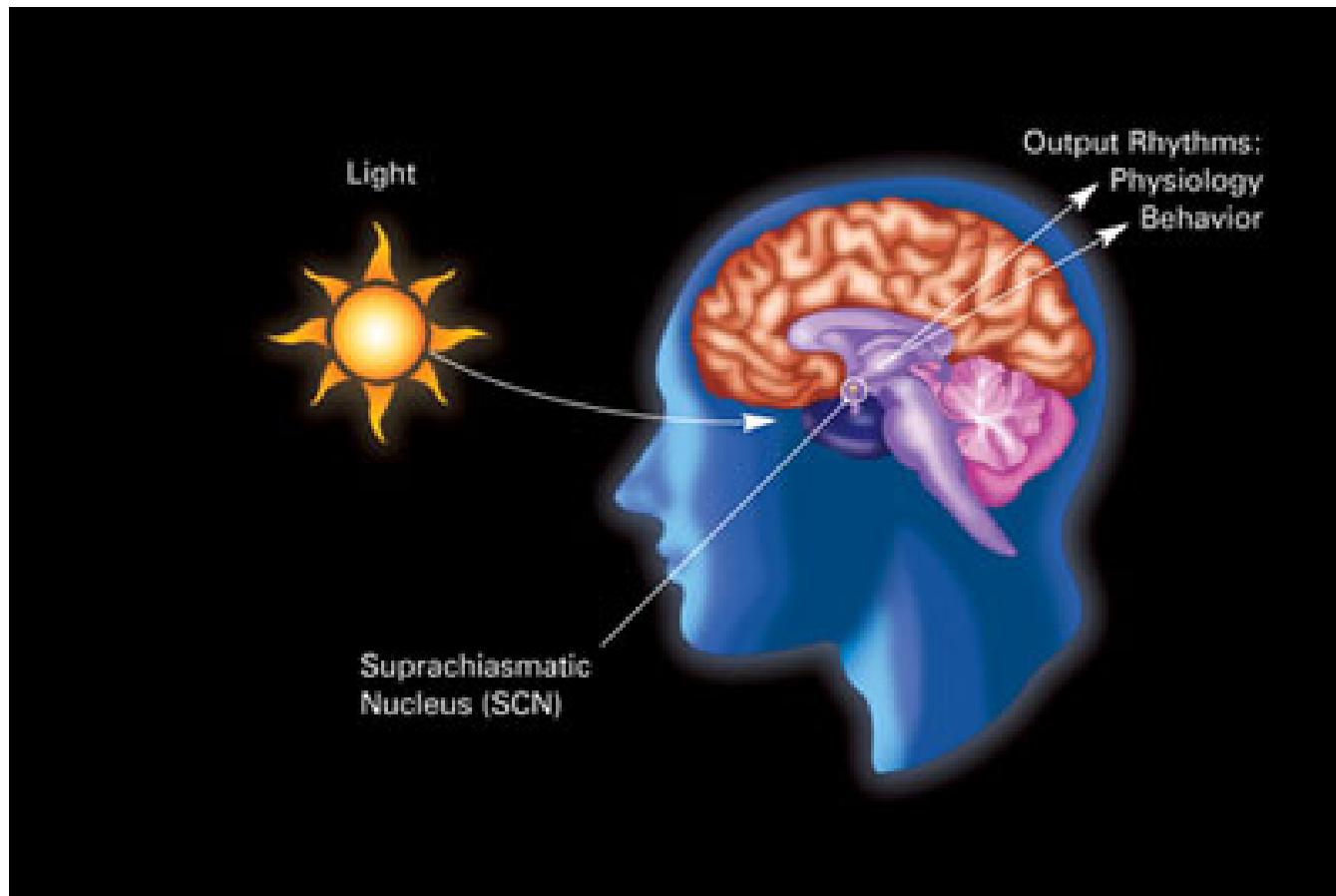
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From eye to brain

- Retinal ganglion cells
- 2nd/II cranial (optic) nerve
 - Optic chiasm

From eye to brain

- Hypothalamus
 - Suprachiasmatic nucleus
 - Regulates circadian (day/night) rhythm via pineal gland



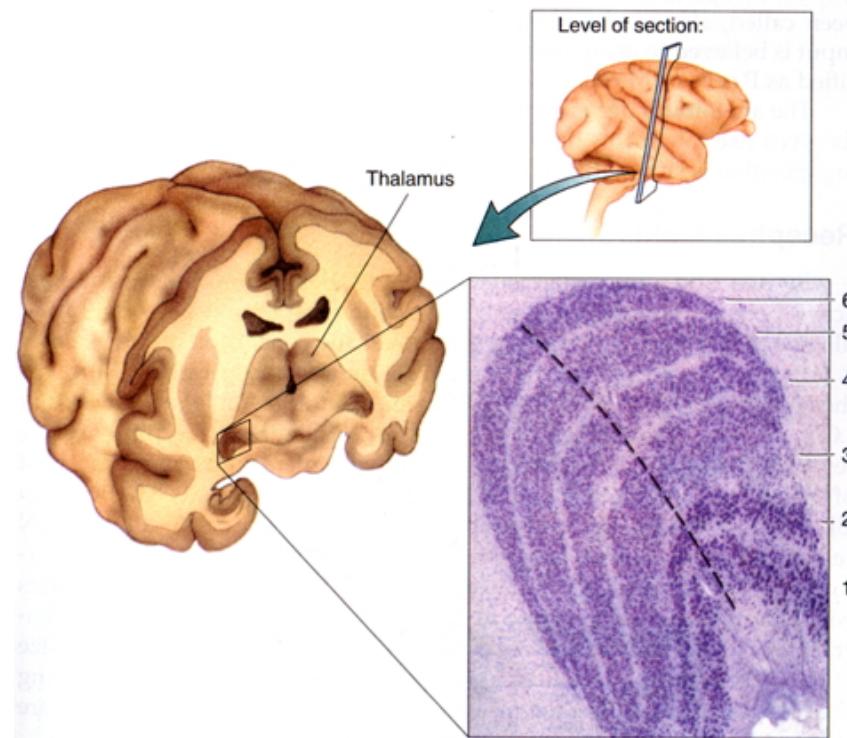
https://en.wikipedia.org/wiki/Retinohypothalamic_tract

From eye to brain

- Superior colliculus & brainstem

Lateral Geniculate Nucleus (LGN) of thalamus

- ~90% of axons from retina



References