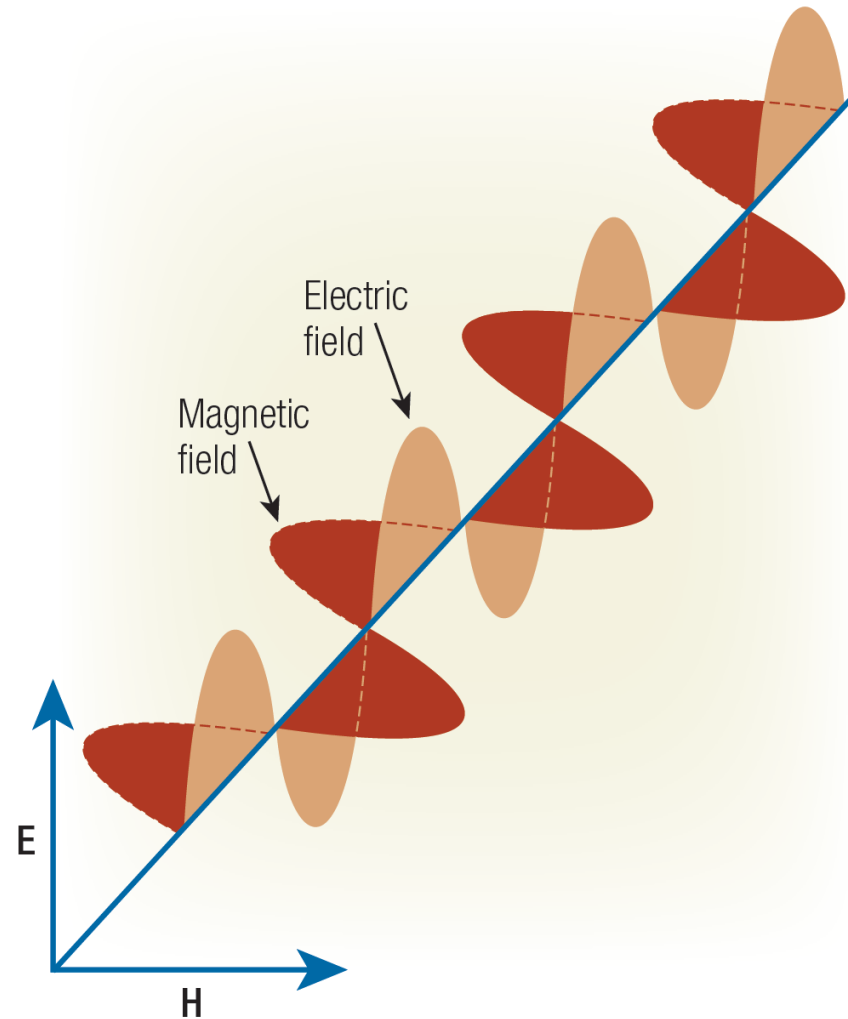


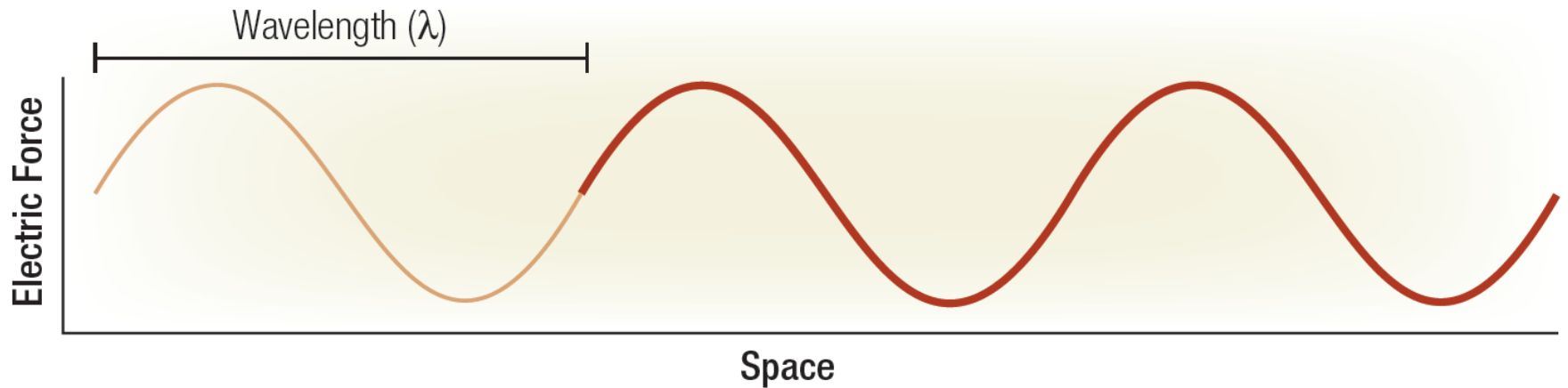
Light, the Eye and Optics

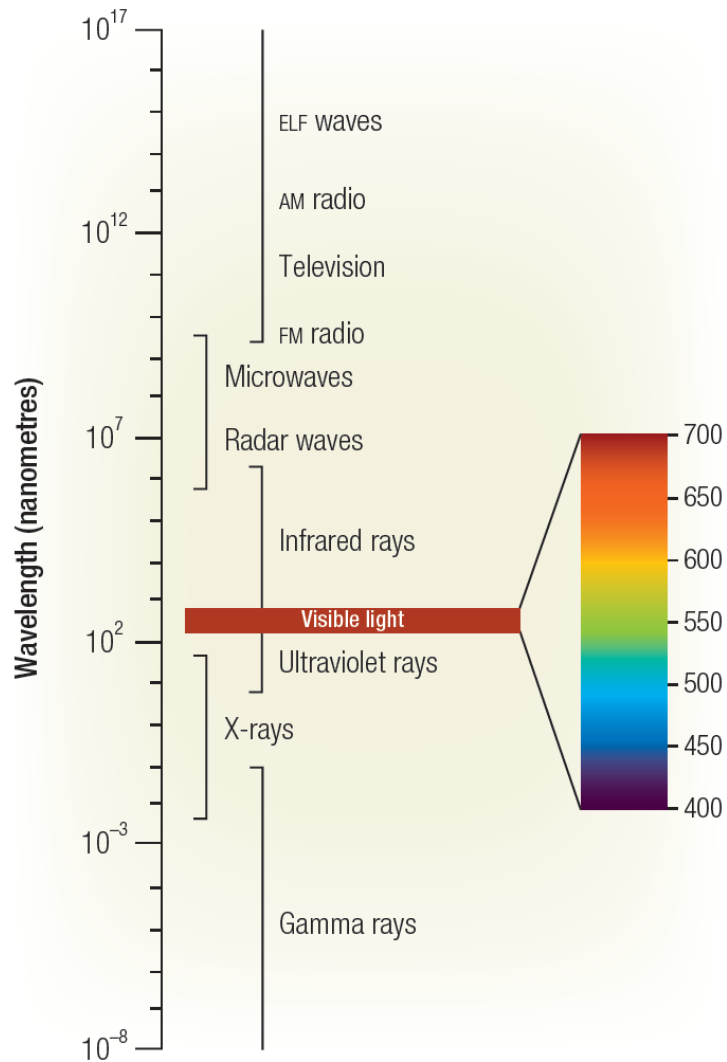
Light

aka Visible Electromagnetic Radiation



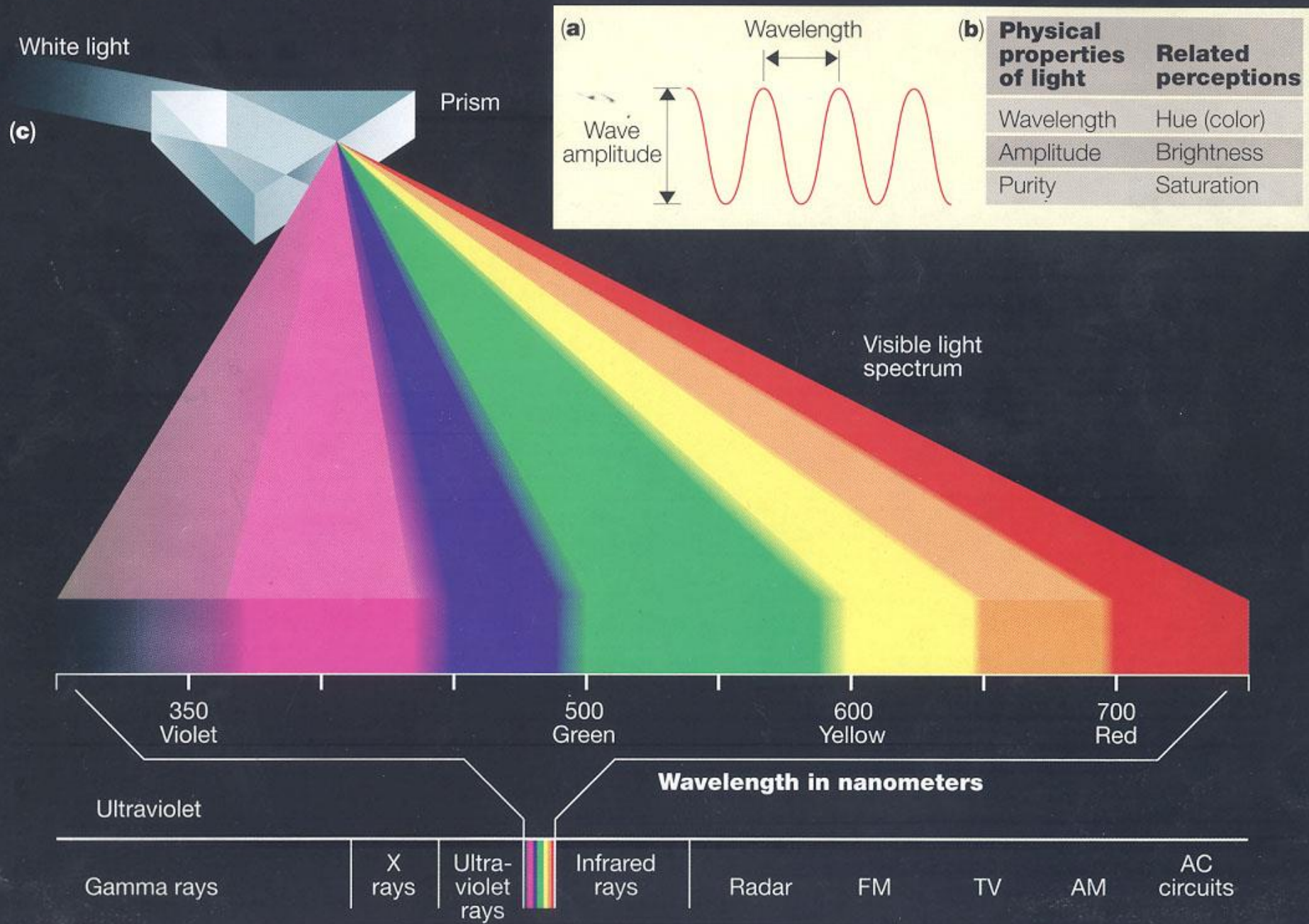
Wavelength $\approx 1/\text{Frequency}$



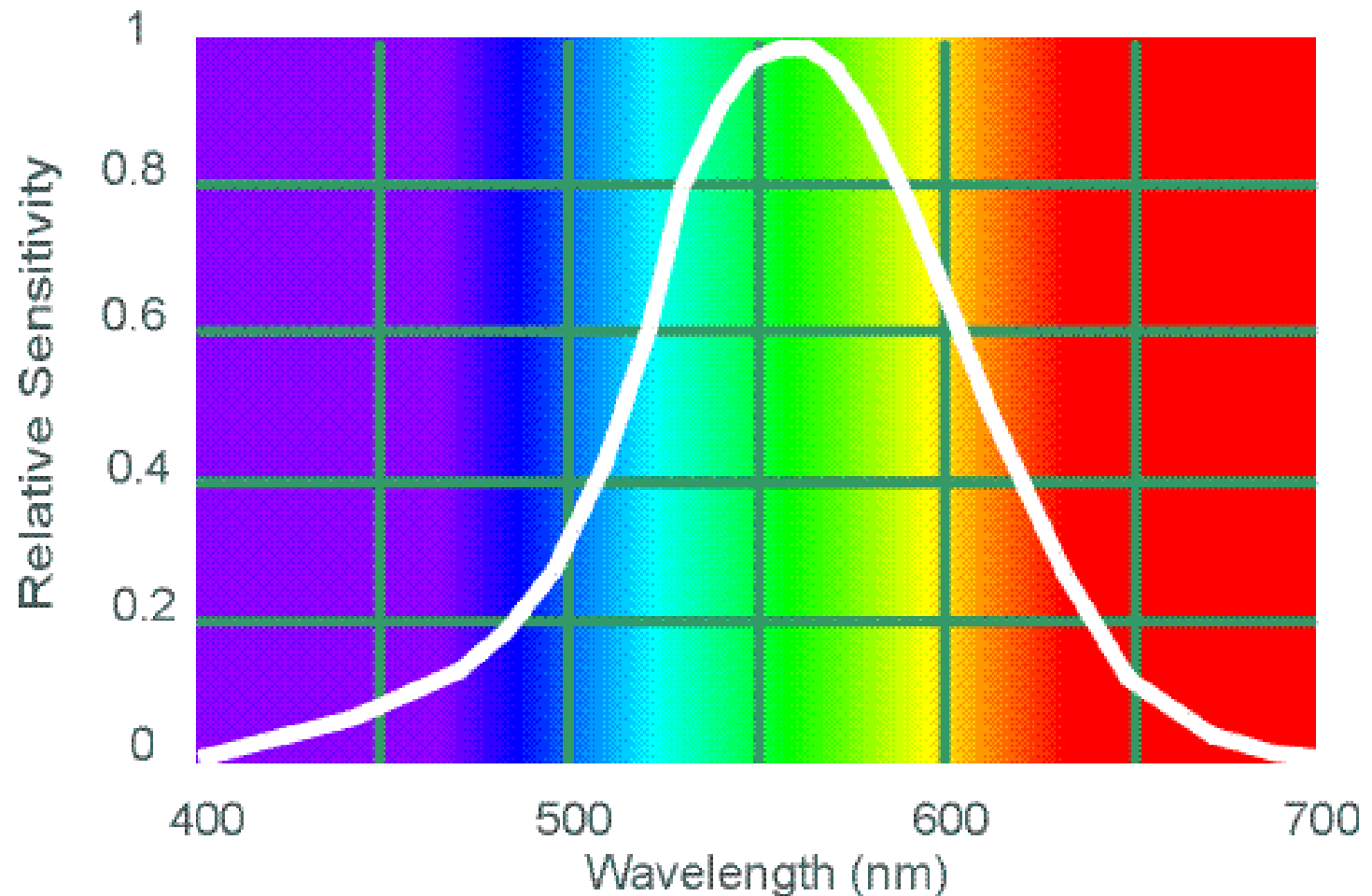


Visible Spectrum: 400-700 nm

Light, the Physical Stimulus for Vision

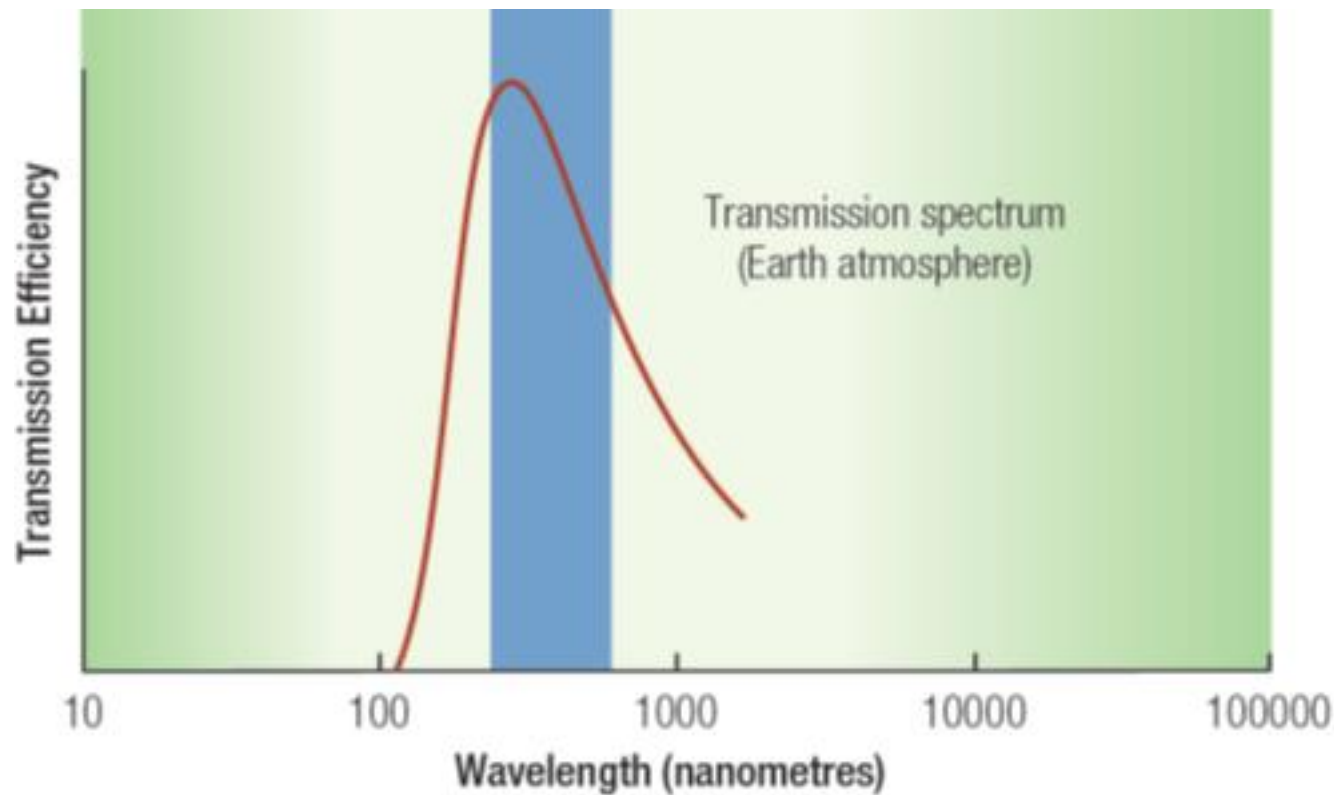


Visibility as a Function of WaveLength (V_λ) (Light Adapted Eye)



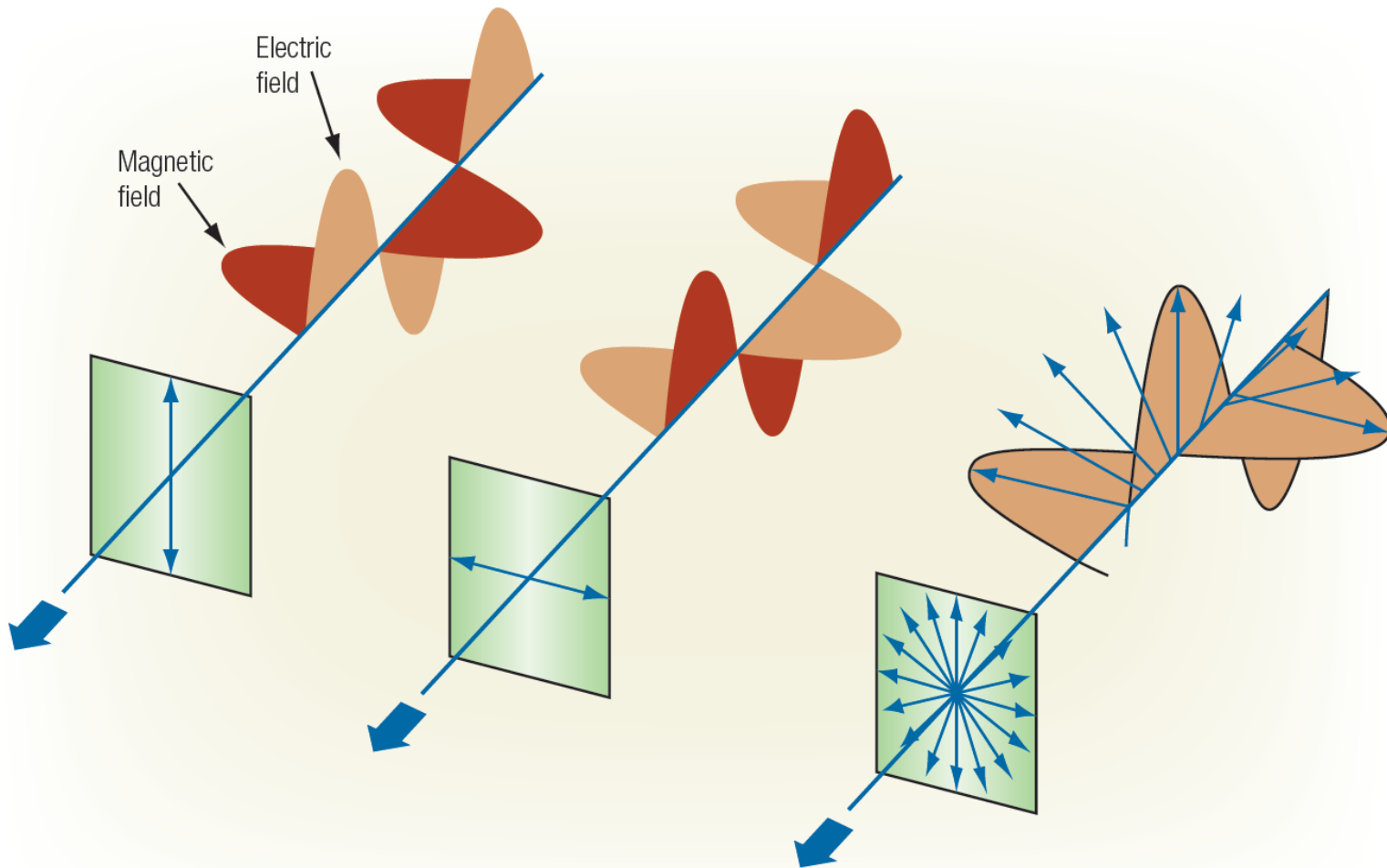
Why 400-700 nm?

Visible Spectrum (400-700 nm) versus Nature of Sunlight



Polarization

(Orientation of Electric Field)



Light Facts

Speed of Light 186,000 miles/s; 300 Million m/s
(psychologically instantaneous)

Energy in light is wavelength dependent
 $E = h * \text{frequency} = h * 1/\text{wavelength}$
(shorter wavelengths have greater energy)

Psychological light measurement units:

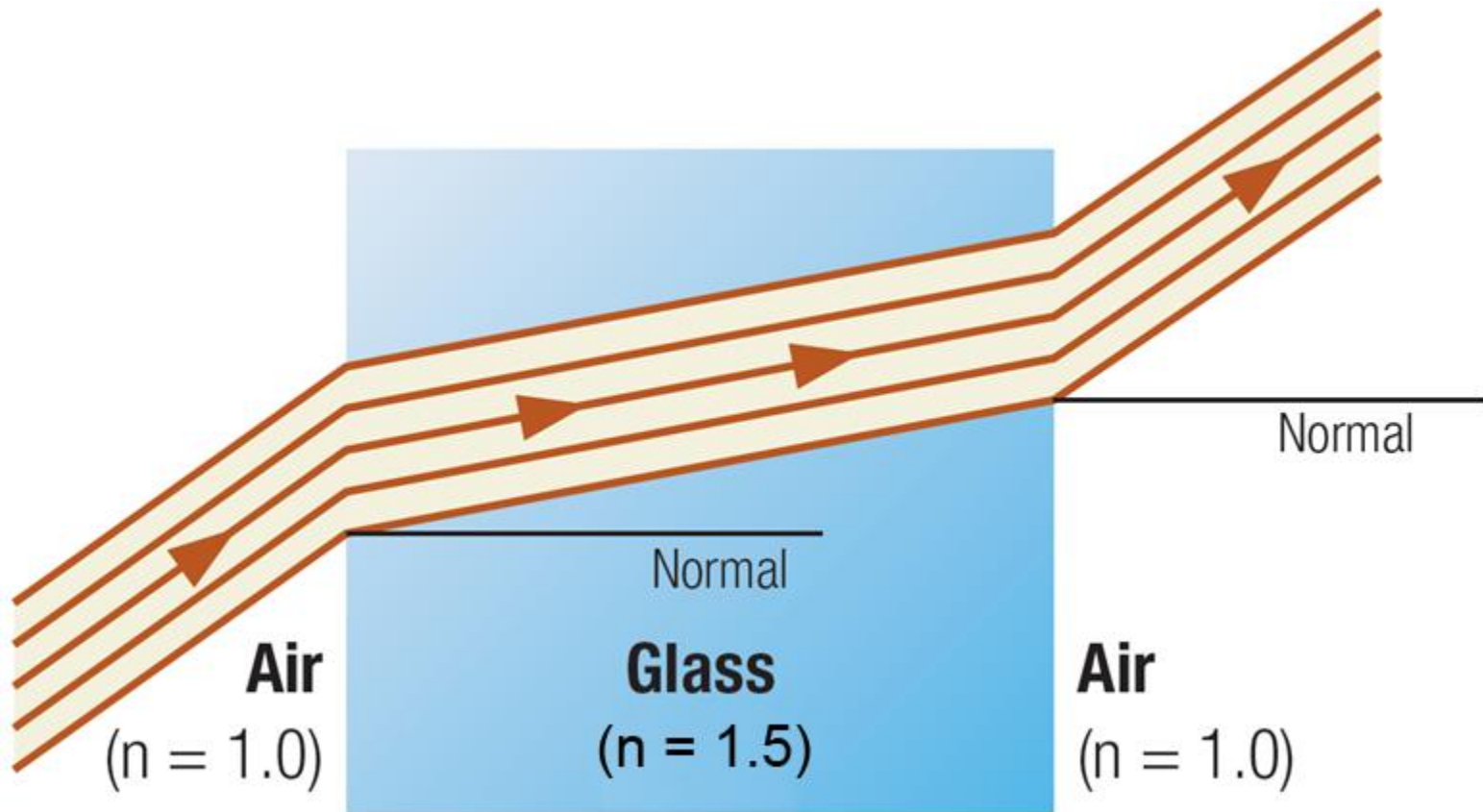
LUMEN Total light “flux” emitted by a source
(WATTS x Visibility Function)

LUX Illumination (Light distribution falling on a surface)
(lumens/m²)

LUMINANCE Light from reflective surface as captured by the eye
(lumens/sr/m²) **candela/m²** (nit)

Refraction of Light

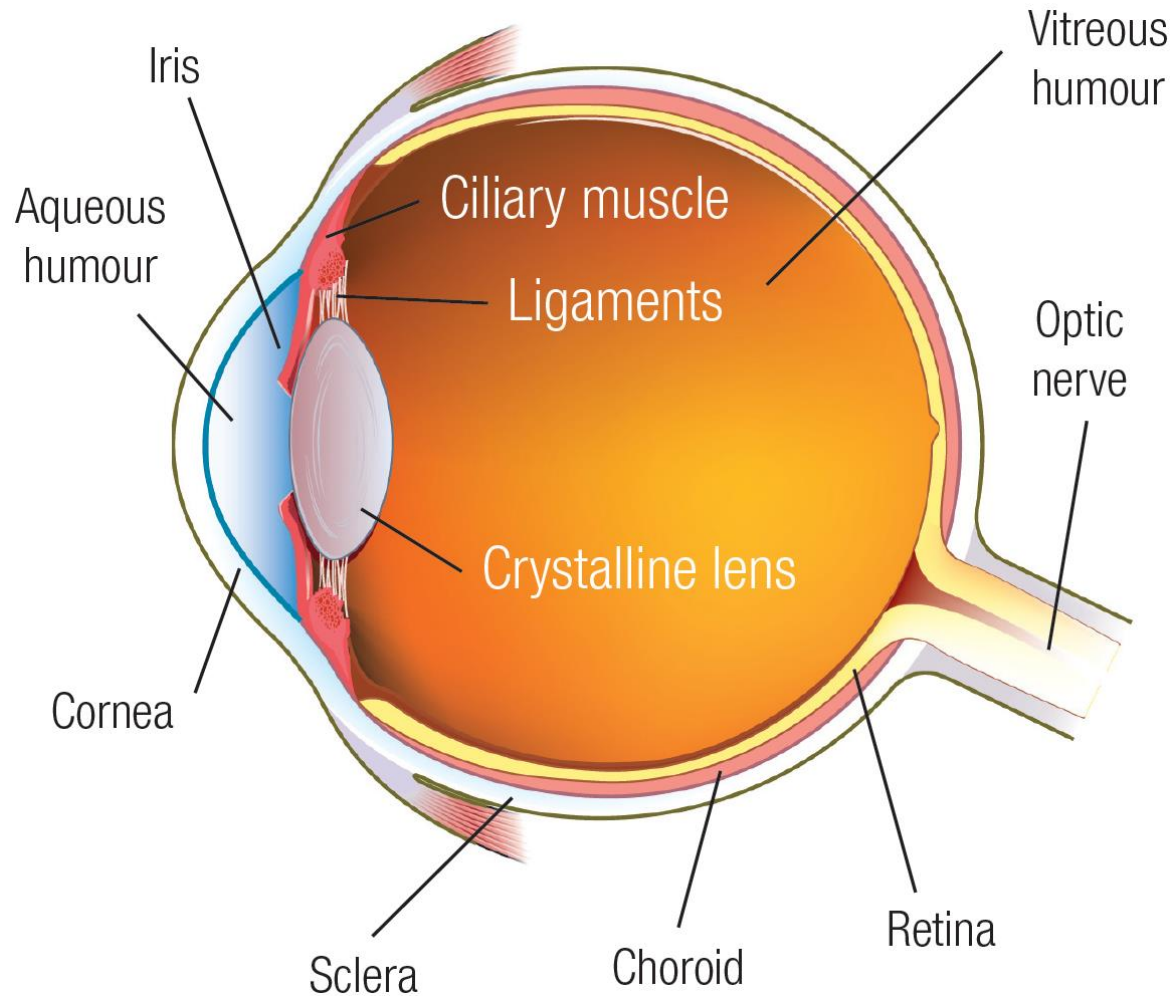
Bend toward normal entering dense medium.
Bend away from normal leaving dense medium.



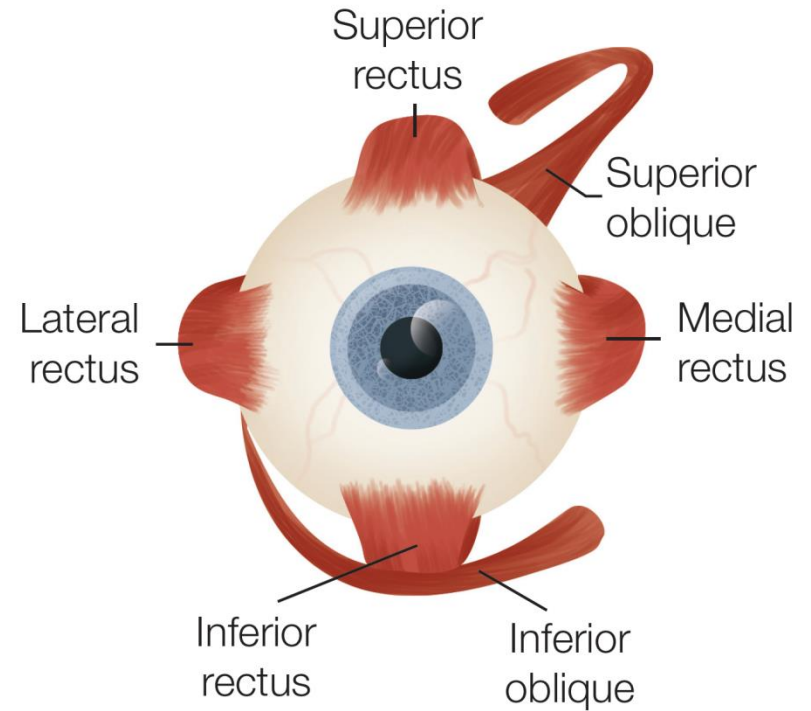
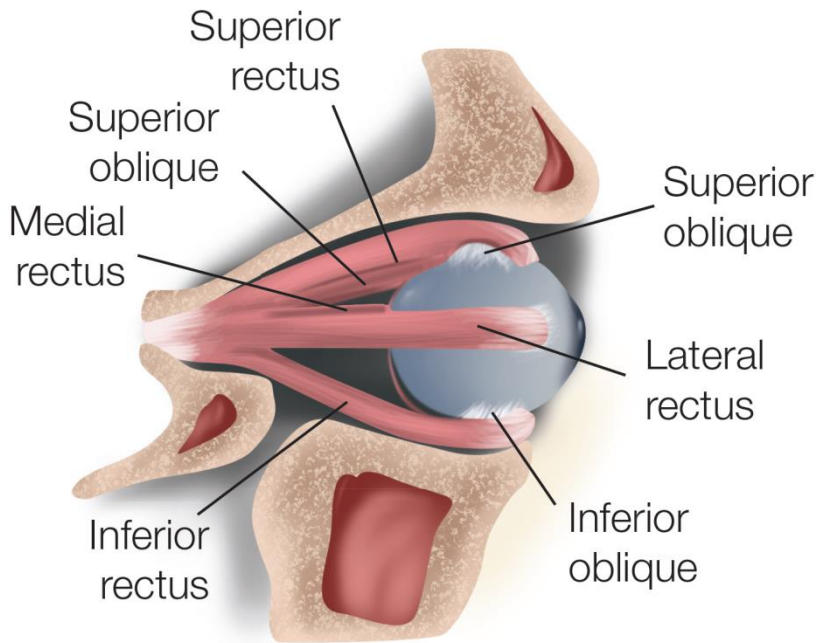
Snell's Law: $\sin \theta_1 / \sin \theta_2 = n_2 / n_1$ $n_1 \sin \theta_1 = n_2 \sin \theta_2$

http://en.wikipedia.org/wiki/Snell's_law

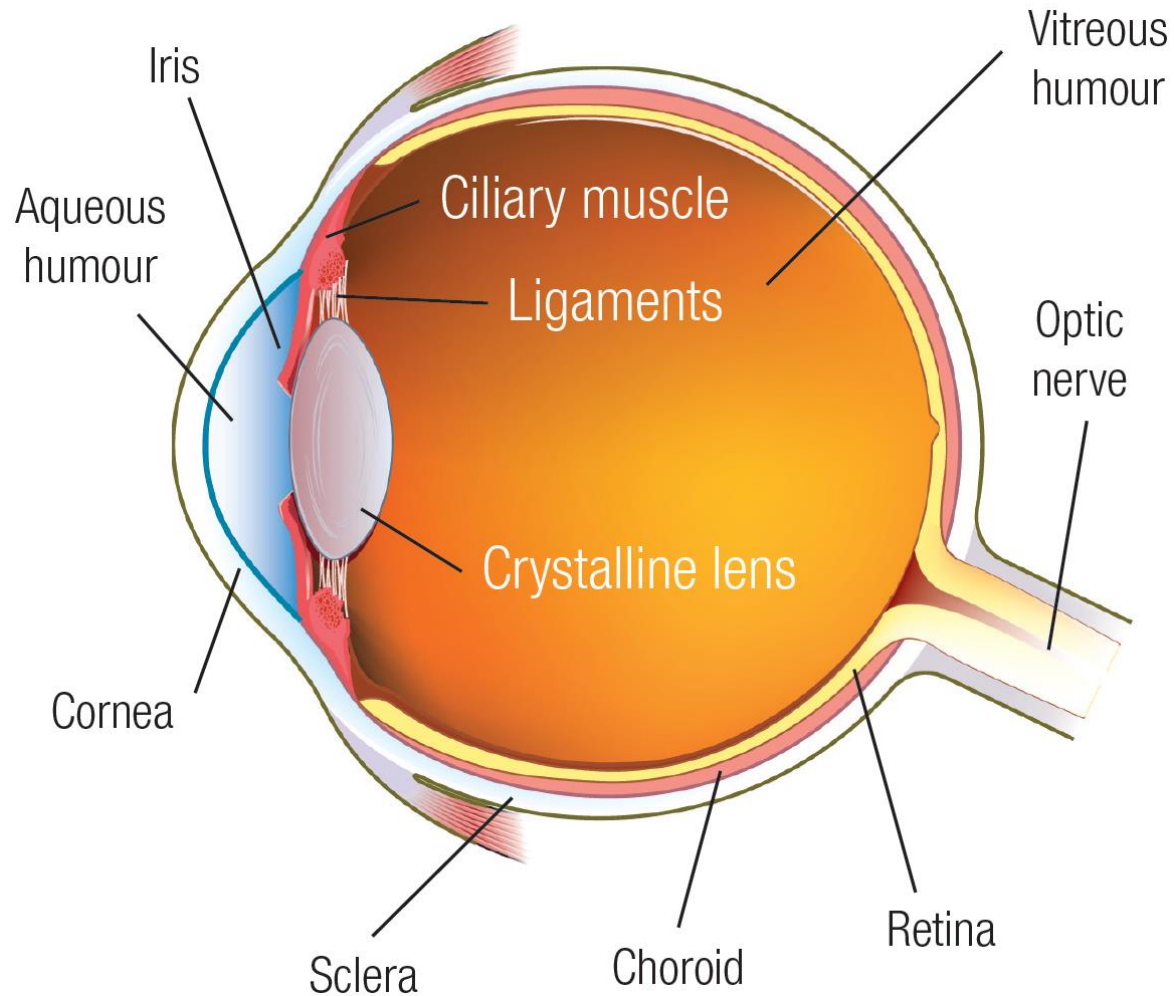
The Human Eye



Six Extraocular Muscles



The Human Eye



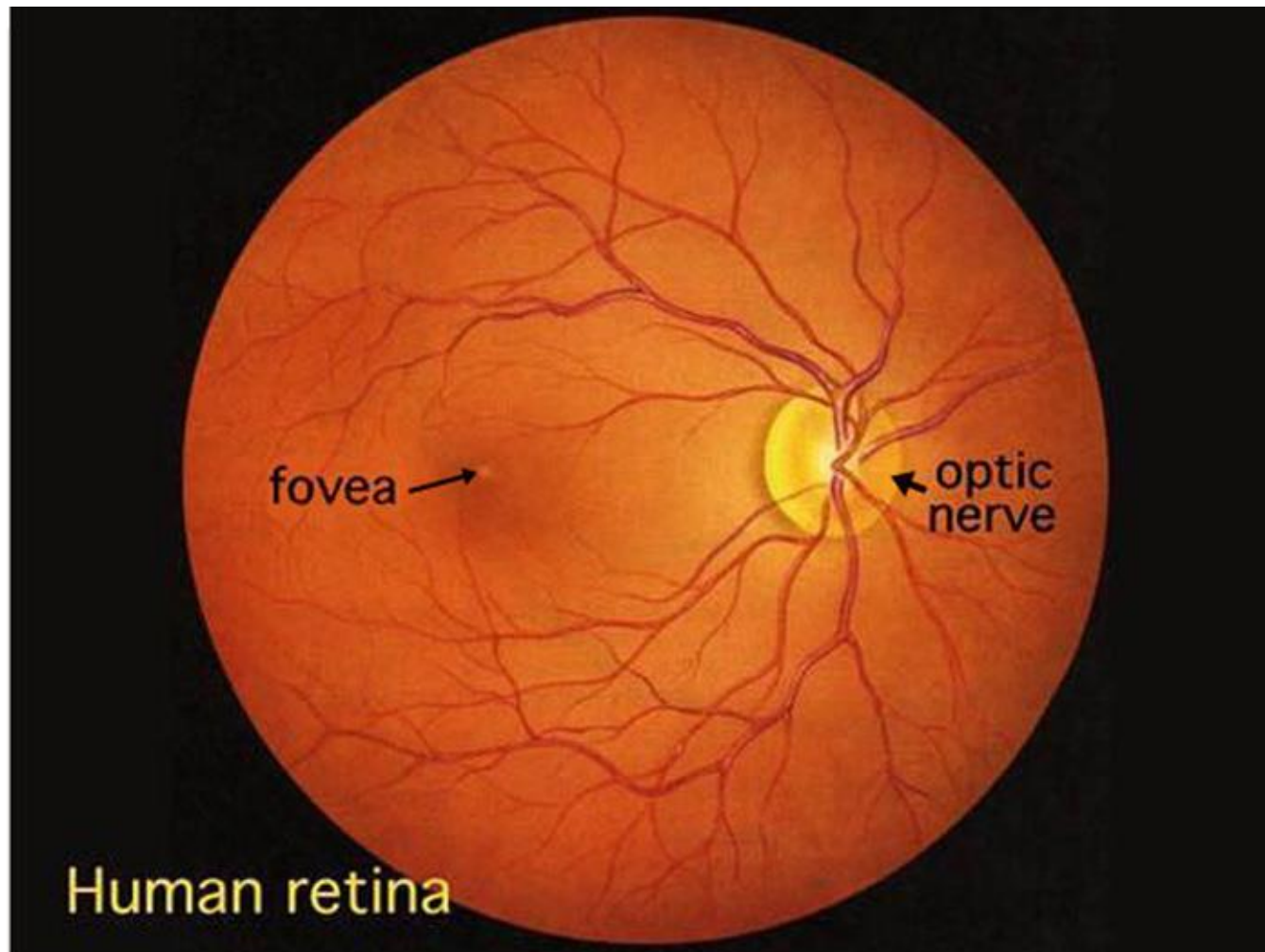
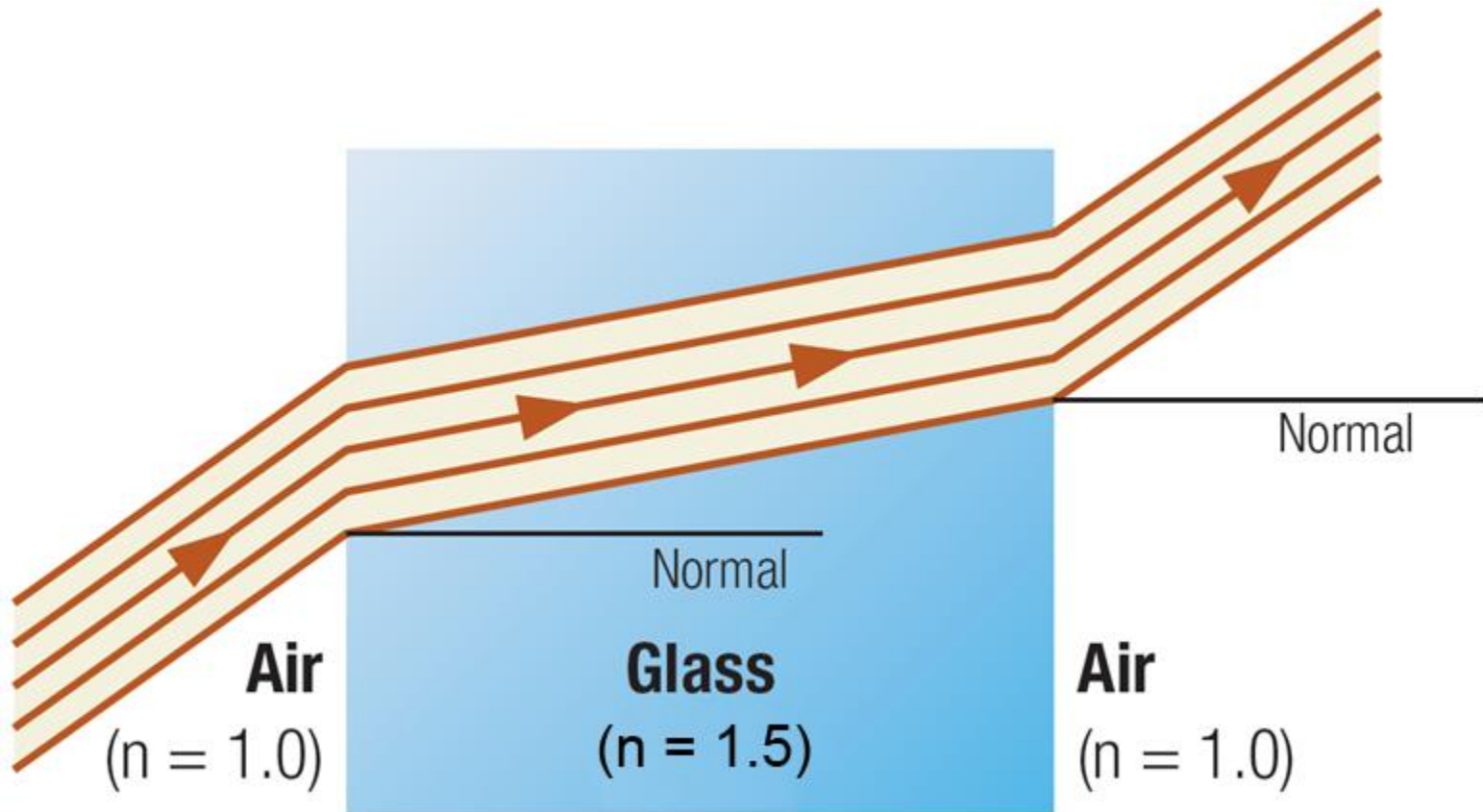


Fig. 1. Human retina as seen through an ophthalmoscope.

Physiological Optics

Refraction of Light

Bend toward normal entering dense medium.
Bend away from normal leaving dense medium.

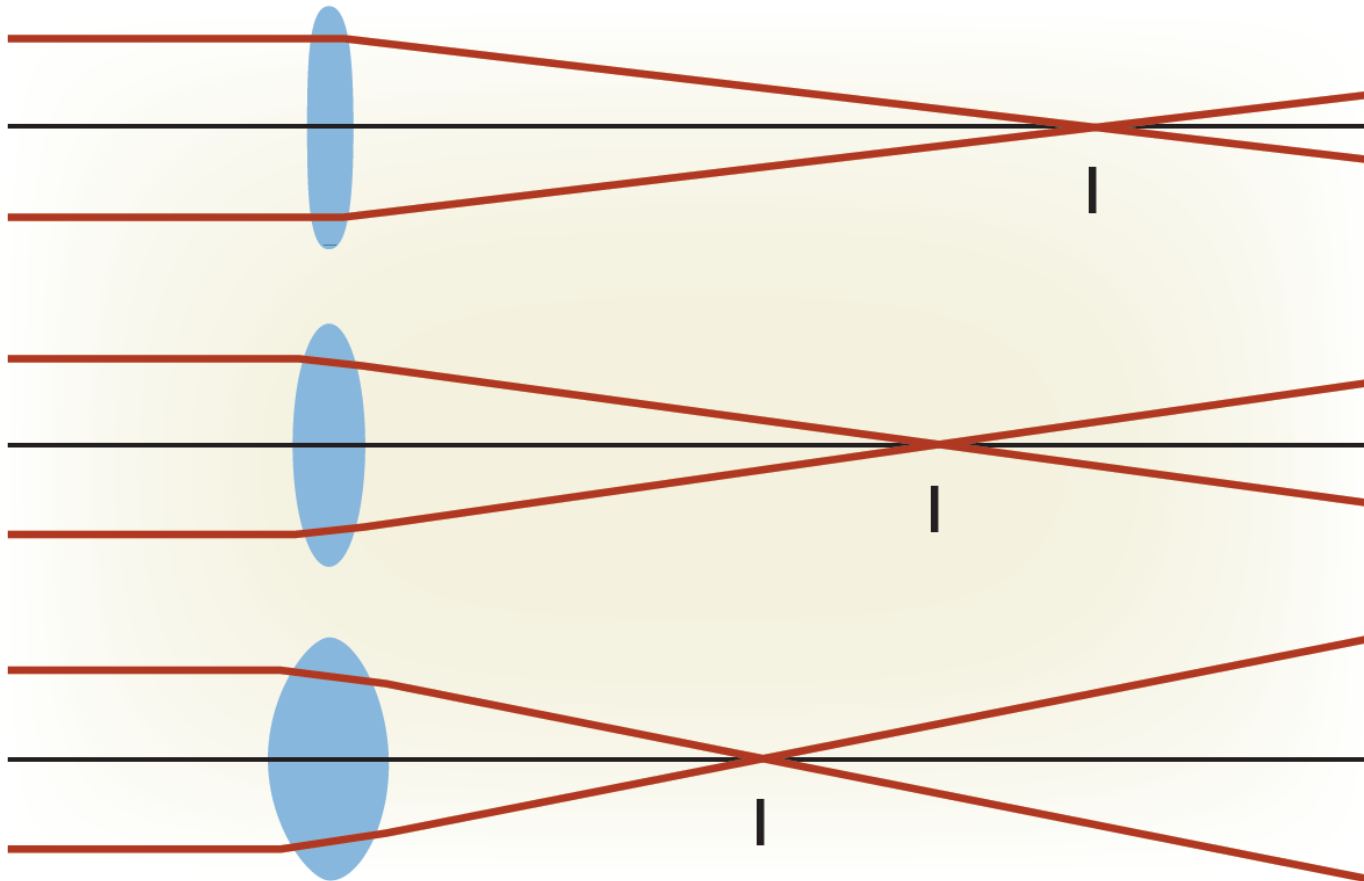


Snell's Law: $\sin \theta_1 / \sin \theta_2 = n_2 / n_1$ $n_1 \sin \theta_1 = n_2 \sin \theta_2$

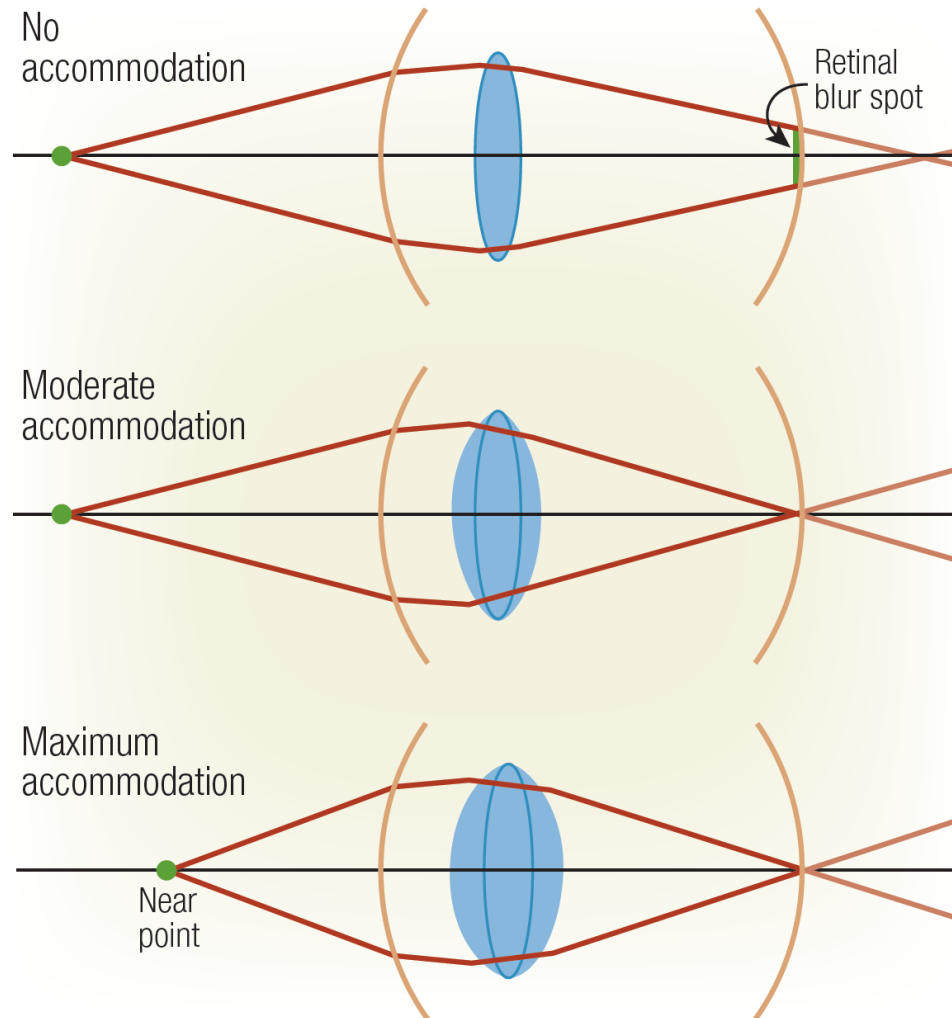
http://en.wikipedia.org/wiki/Snell's_law

Power of Lens

Increases with Curvature



Accommodation of the Lens (Variable Focal Length)



Refractive States of the Eye

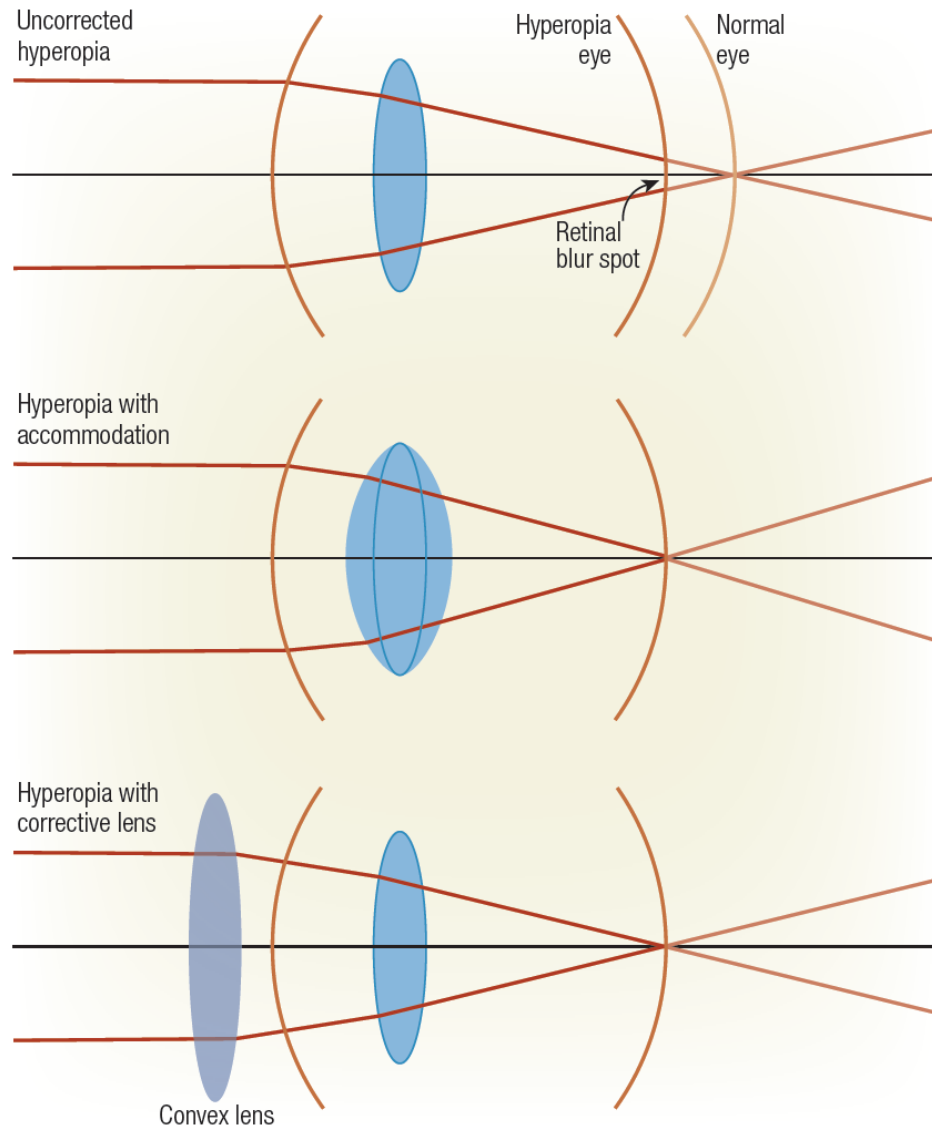
Emmetroia

Hyperopia

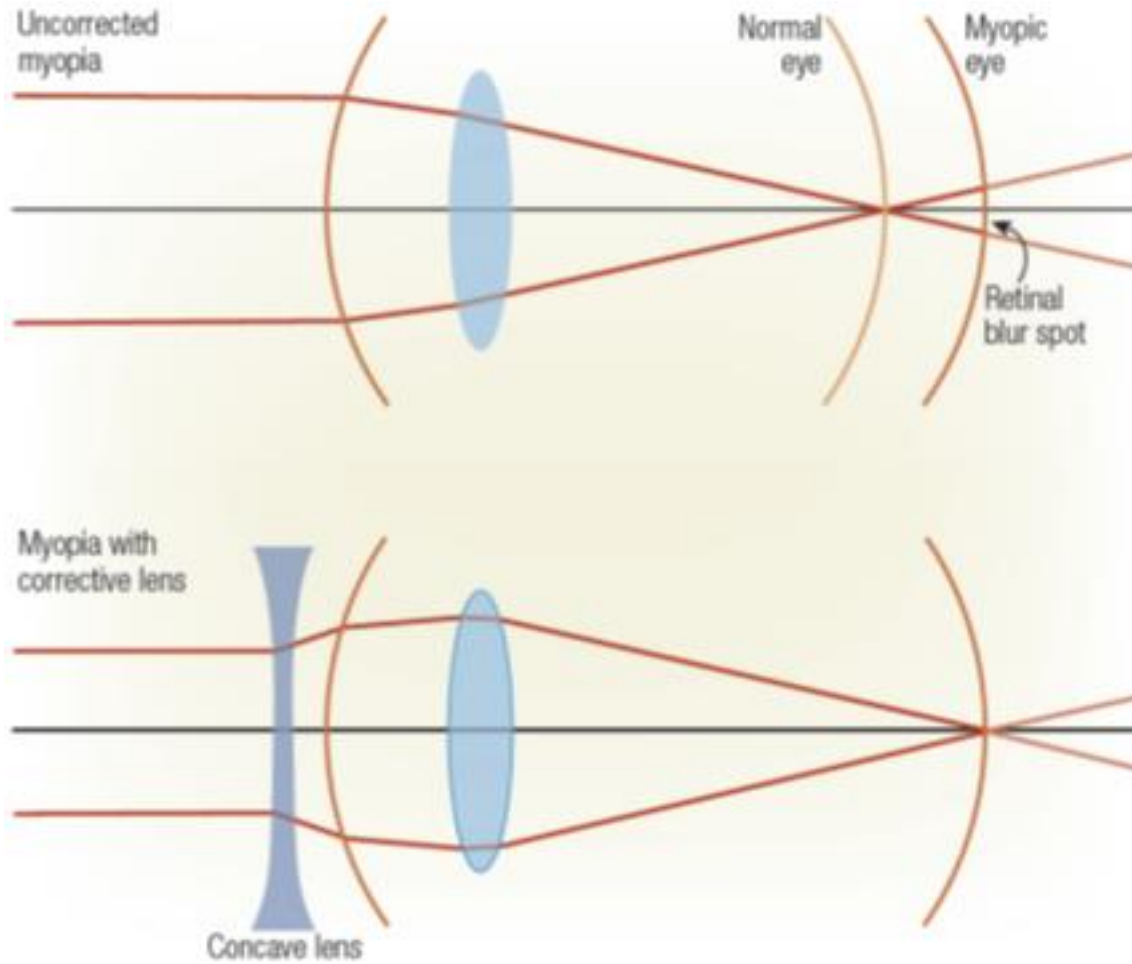
Myopia

(Astigmatism)

Hyperopia



Myopia



Corneal Astigmatism

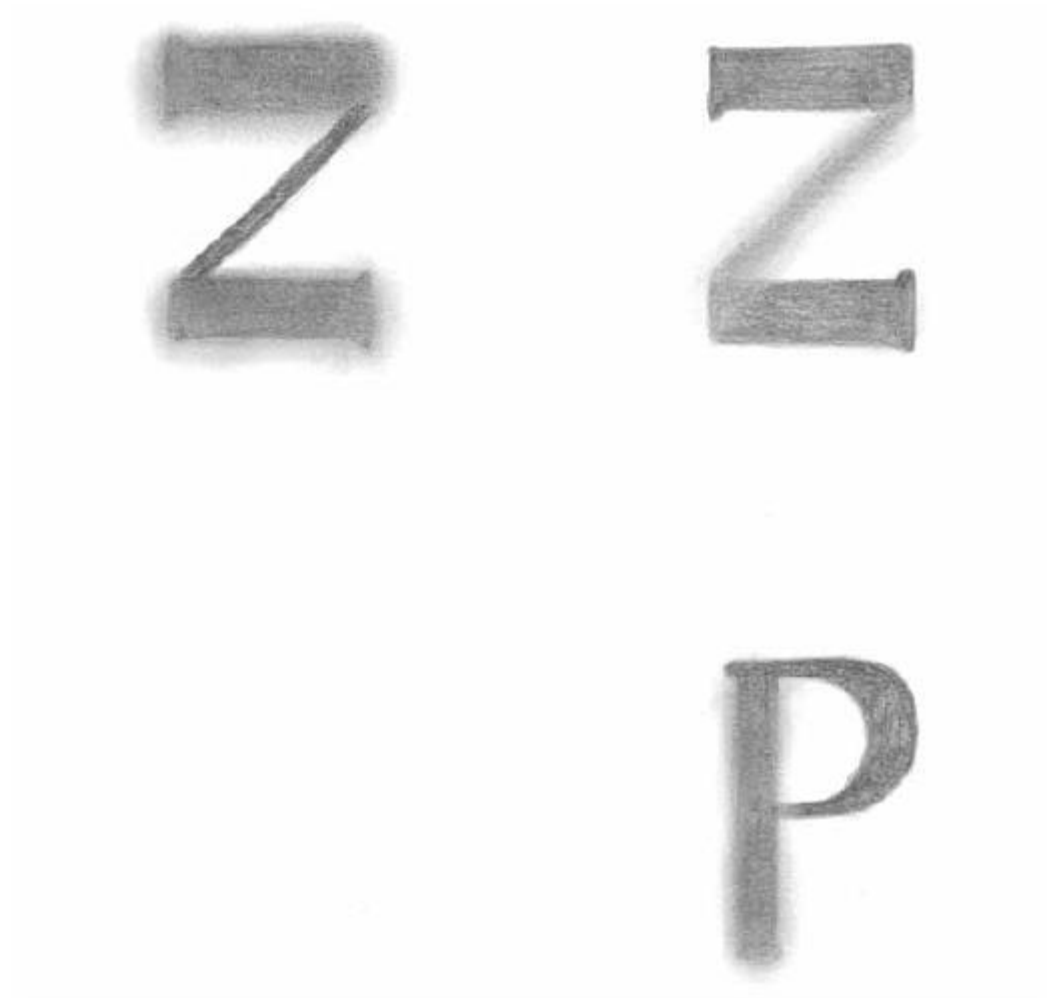


Normal Eye



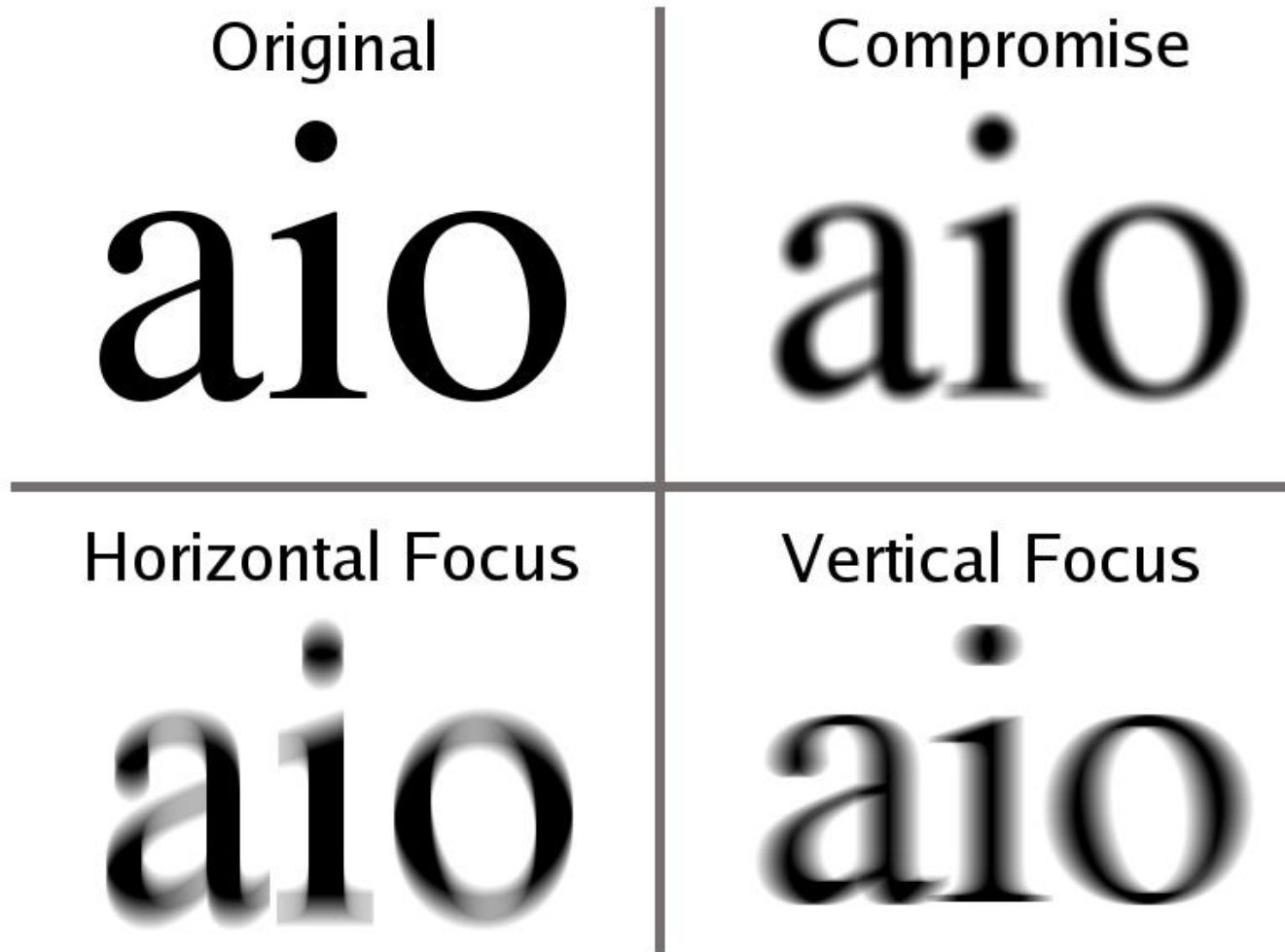
Astigmatic Eye

Simulated Astigmatism



Different angles of astigmatism will affect the appearance of letters.

“Correcting” Astigmatism with Spherical Lenses



End