Vision

BIOPHYSICS 1 - LECTURE
2018 - NOV - 20

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Refractive power of the eye

Diopters

Cornea

Aqueous humour

Vitreous humour

Lens

Air

Total dioptrer

\approx 60
Image formation

\[ D_\infty = 60 \text{ m}^{-1} = \frac{1}{f} \quad \rightarrow \quad f = \frac{1}{D_\infty} = \frac{1}{60} = 0.017 \text{ m} = 1.7 \text{ cm} \]

\[ \frac{1}{p} + \frac{1}{q} = \frac{1}{f} = D \]

- \( p = \infty \)  
  \[ \frac{1}{p} + \frac{1}{q} = D_\infty \]
- \( p = 1 \text{ m} \)  
  \[ \frac{1}{p} + \frac{1}{f} = D_\infty + 1 \]

\( \triangleright \) dioptric of the eye changes
Accommodation

- **Looking at far objects**
  - Iris and ciliary fibers are taut.
  - Maximum focal length.
  - Flat lens.

- **Looking at close objects**
  - Ciliary muscles are contracted.
  - Ciliary fibers are loosened.
  - Lens becomes more rounded, focal length shorter.
  - Round lens.
Color sensitivity

max at 555 nm
Resolving power

image falling on receptors

what we see

\[ l' = \frac{1}{60} \text{ deg} \]

\[ l' = \pm 5 \mu m \]

\[ l' = \pm 2 \mu m \]
Structure of receptor cells

Outer segment
- disks
- rhodopsin

Inner segment
- mitochondria
- nucleus

Synaptic end
- Rod

Outer segment
- Cone

Inner segment
- Synaptic end
Isomerization of retinal

M-cis \hspace{1cm} \xrightarrow{\text{ }} \hspace{1cm} \text{all-trans}
**dark**

\[ \text{Na}^+ \quad \text{GMP} \uparrow \]

\[ \text{Na}^+ \quad \text{K}^+ \]

\[ \text{Glutamate} \]

\[ -40 \text{ mV} \]

**light**

\[ \text{Na}^+ \quad \text{GMP} \downarrow \]

\[ \text{Na}^+ \quad \text{K}^+ \]

\[ \text{Glutamate} \]

\[ -70 \text{ mV} \]
Color vision - spectral sensitivity of the 3 cone types
Colors are mixed in the brain using additive color mixing.
LCD displays also use additive color mixing.