The Eye

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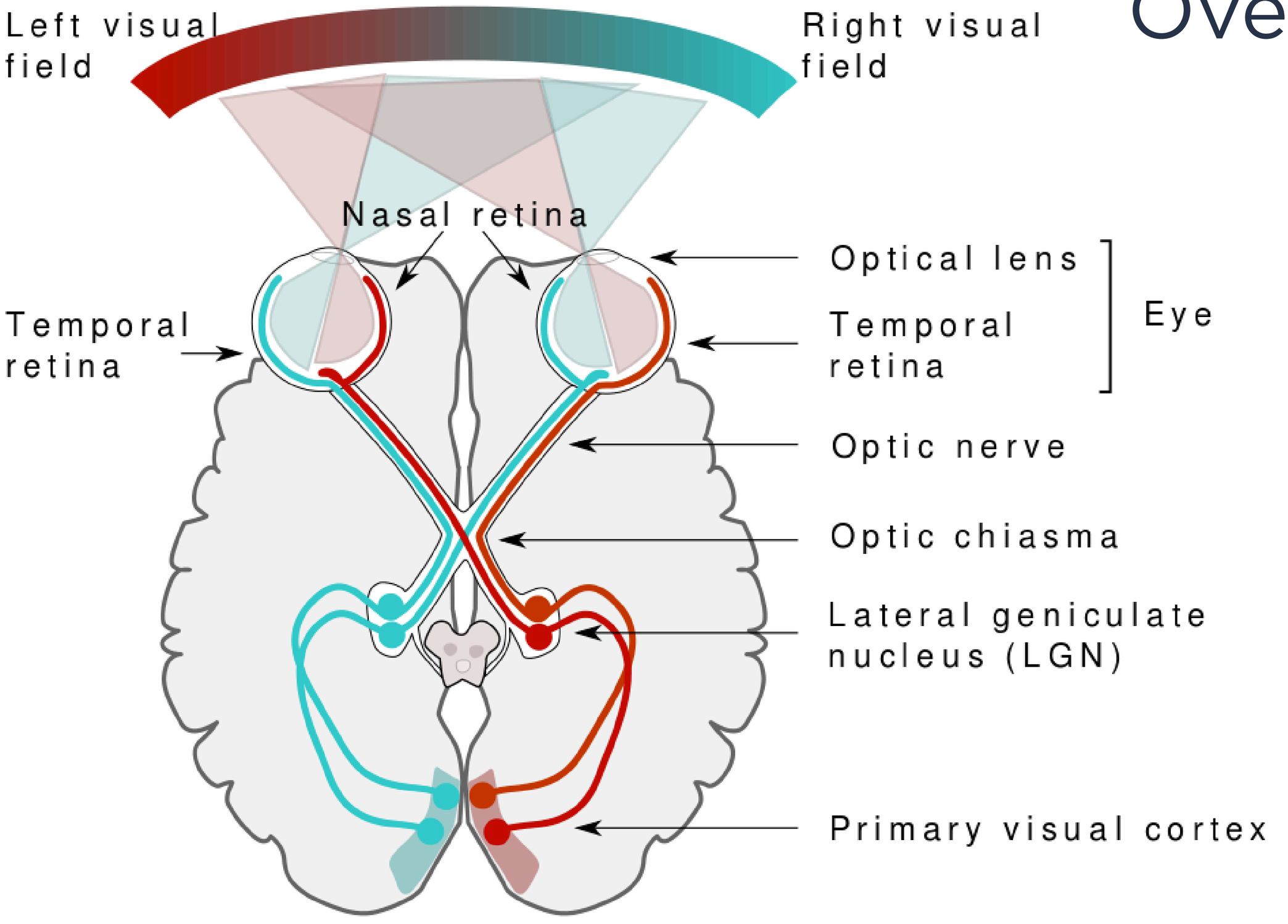
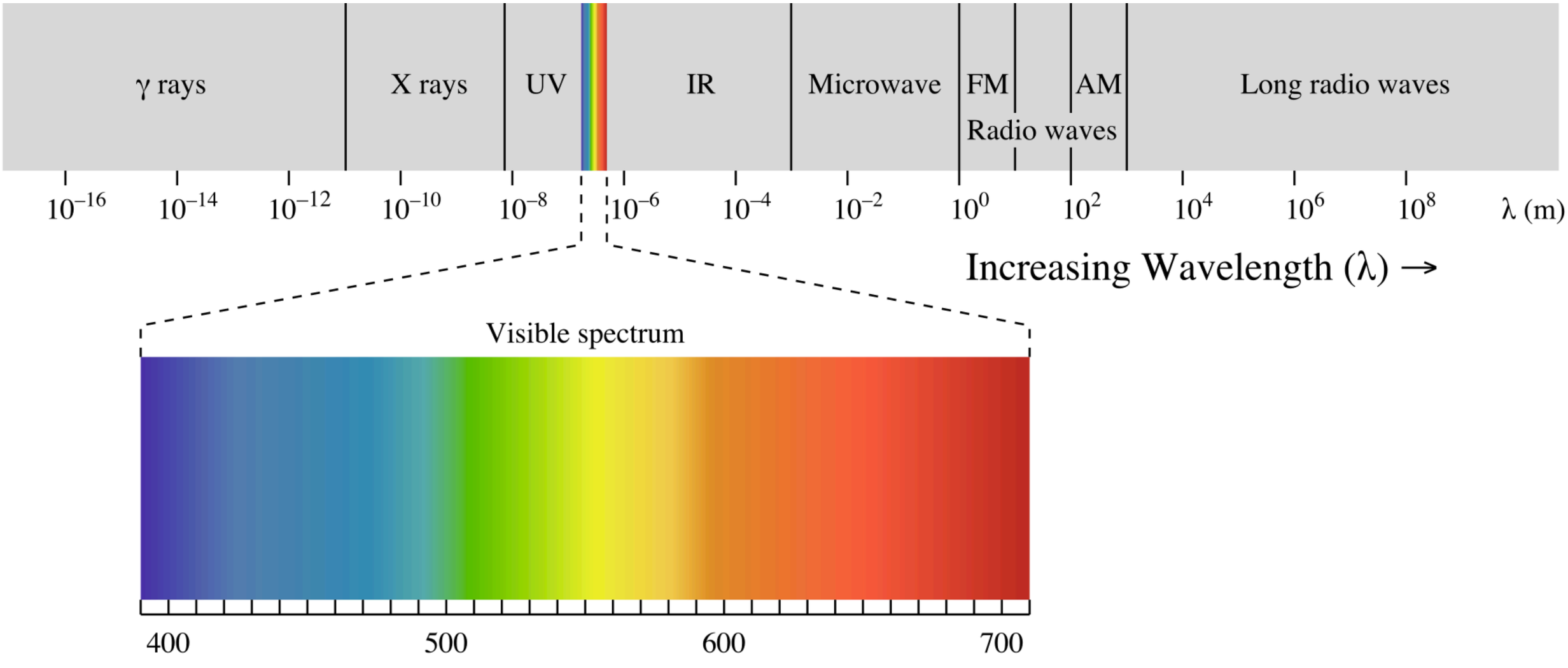
- Describe the eyes and how their properties influence vision.
- Describe the structure of the human retina.
- Understand the structure of the retina, and explain how it influences vision.
- Understand the difference between the two types of photoreceptors in the retina: rods and cones.

Learning Goals

Overview

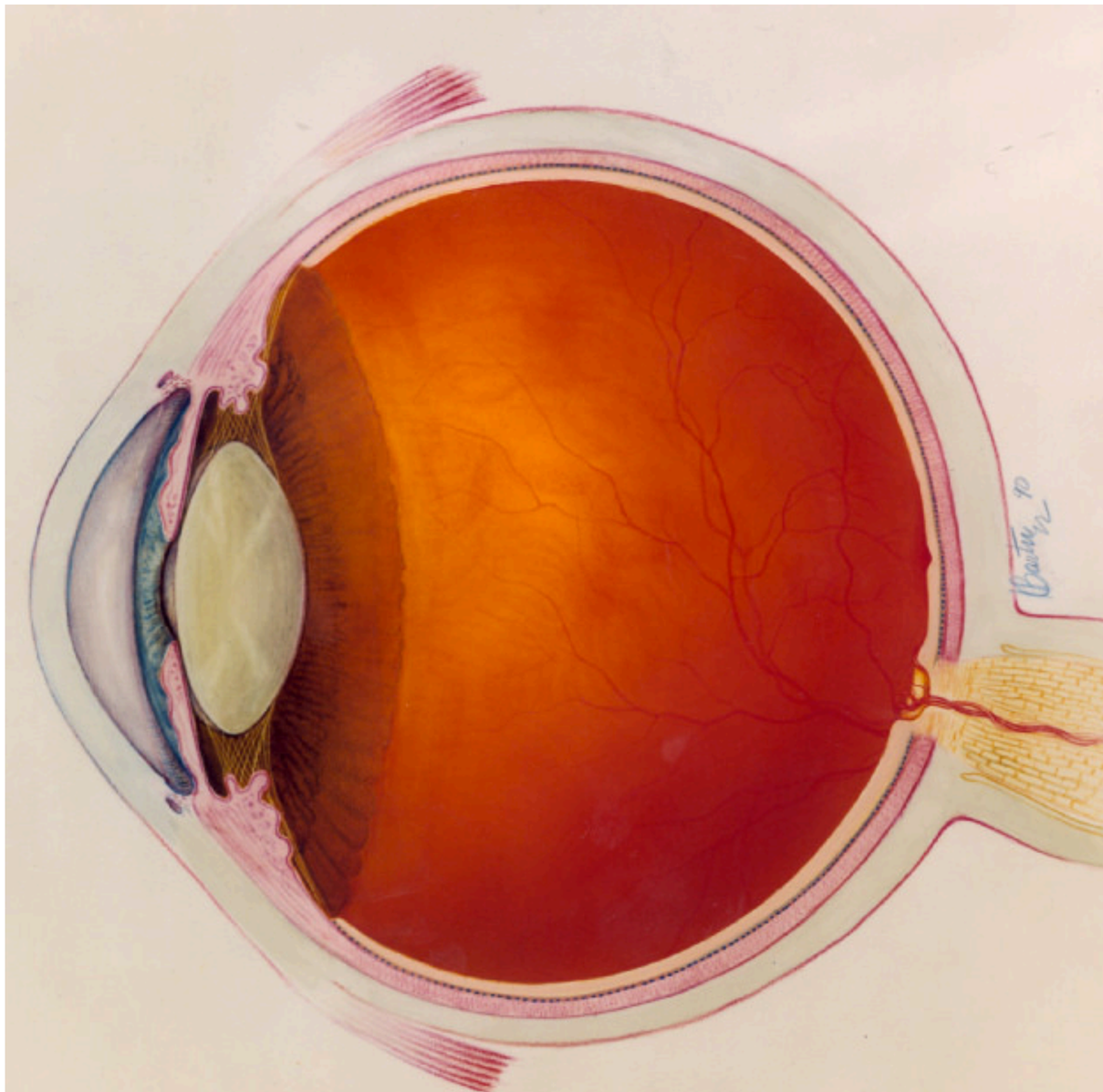

Left visual field
Right visual field
Nasal retina
Temporal retina
Optical lens
Temporal retina
Eye
Optic nerve
Optic chiasma
Lateral geniculate nucleus (LGN)
Primary visual cortex

Visible light is composed of electromagnetic waves with wave-lengths between 400-750 nm.



Visible Spectrum

The eye is a fluid-filled sphere enclosed by 3 layers of tissue:



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1. The outer layer is composed of the sclera and the cornea.

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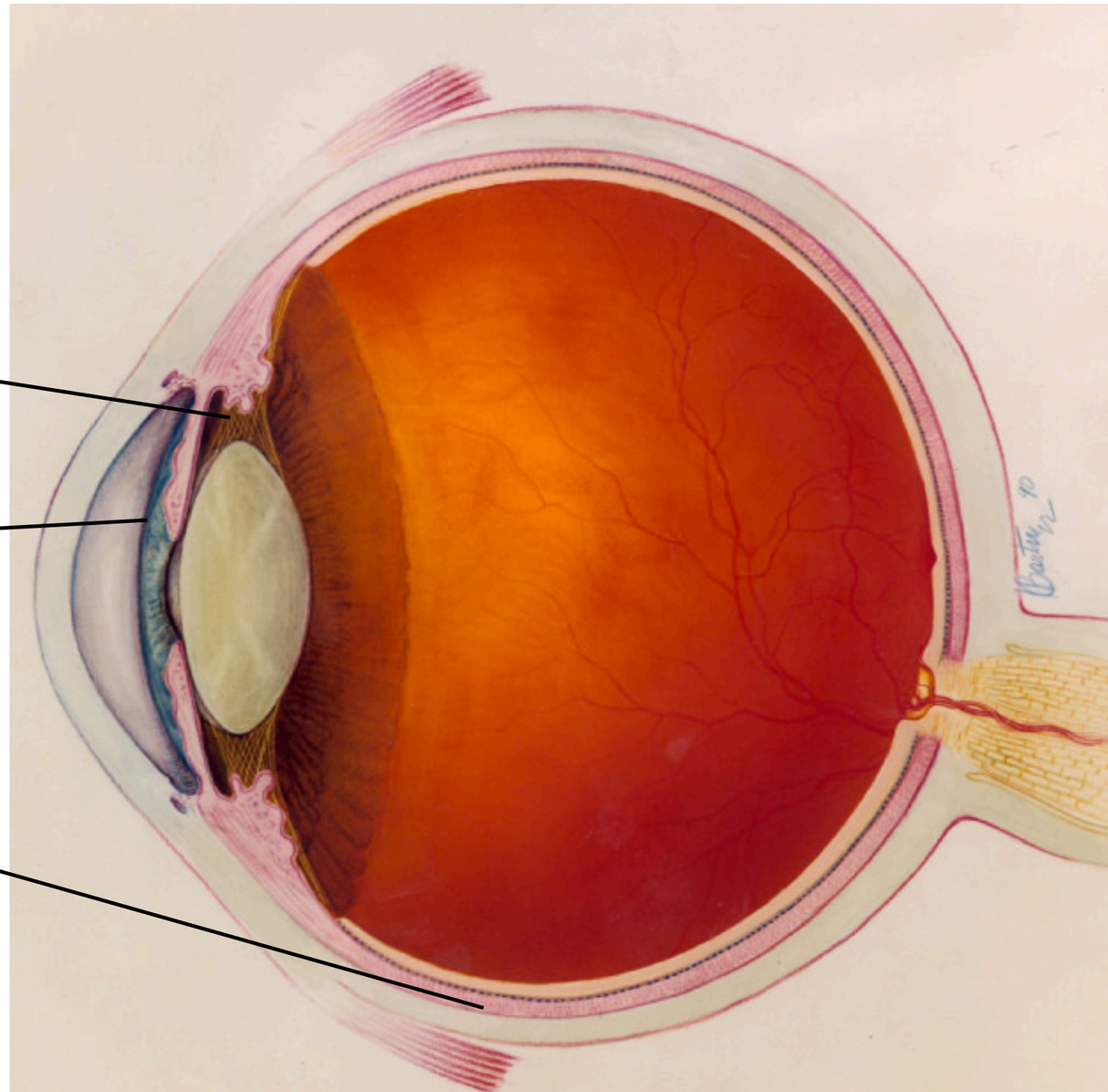
Light is initially focused by the cornea (transparent).

The Eye

The eye is a fluid-filled sphere enclosed by 3 layers of tissue:

2. The middle layer includes the iris, the ciliary body, and the choroid.



The Eye

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Ciliary body

The ciliary body encircles the lens. It contains a musculature that adjusts the refractive power of the lens.

The Eye

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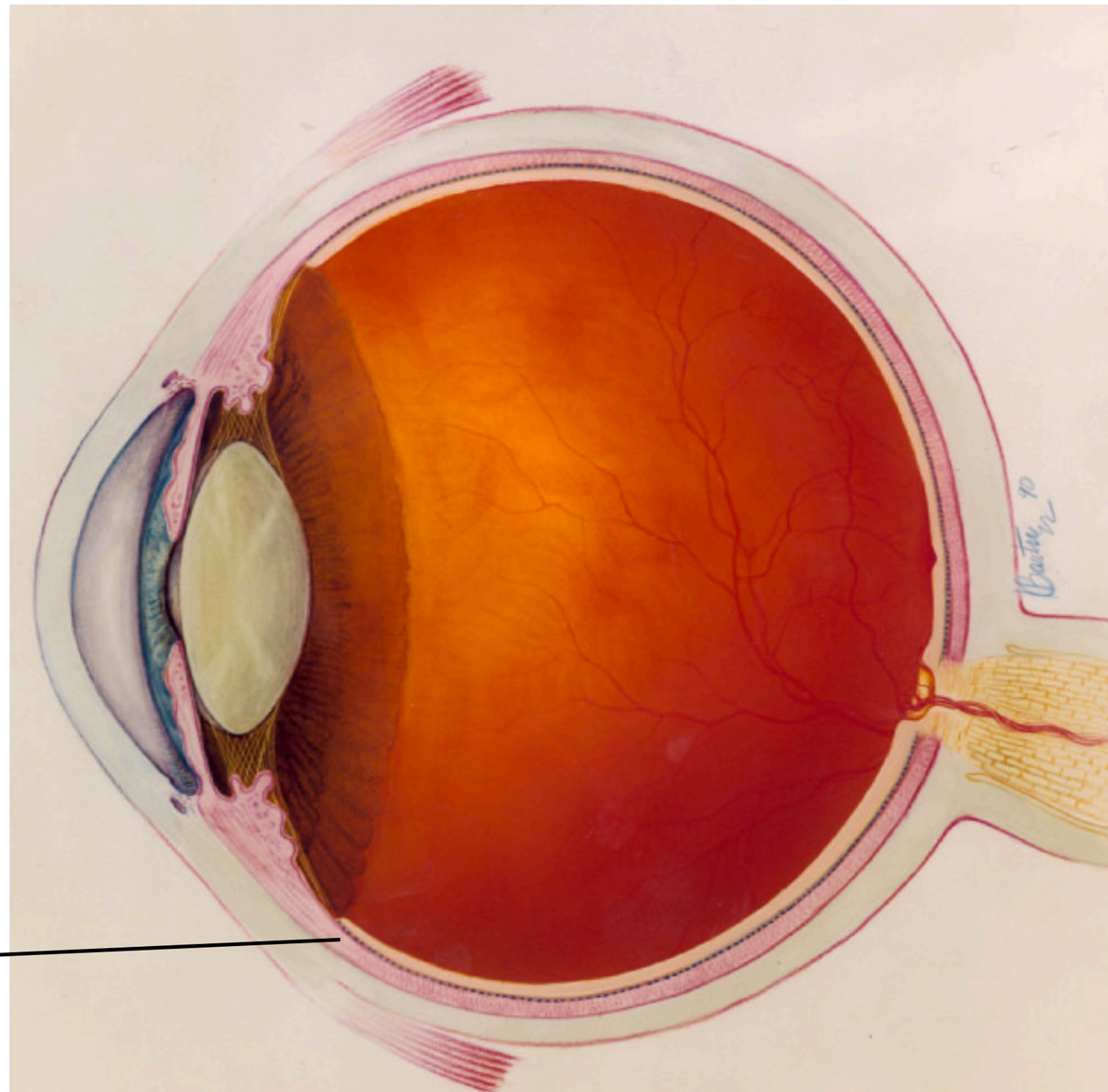
The choroid is a capillary bed. It supplies oxygenation and metabolic sustenance to the cells in the retina, including the photoreceptors.

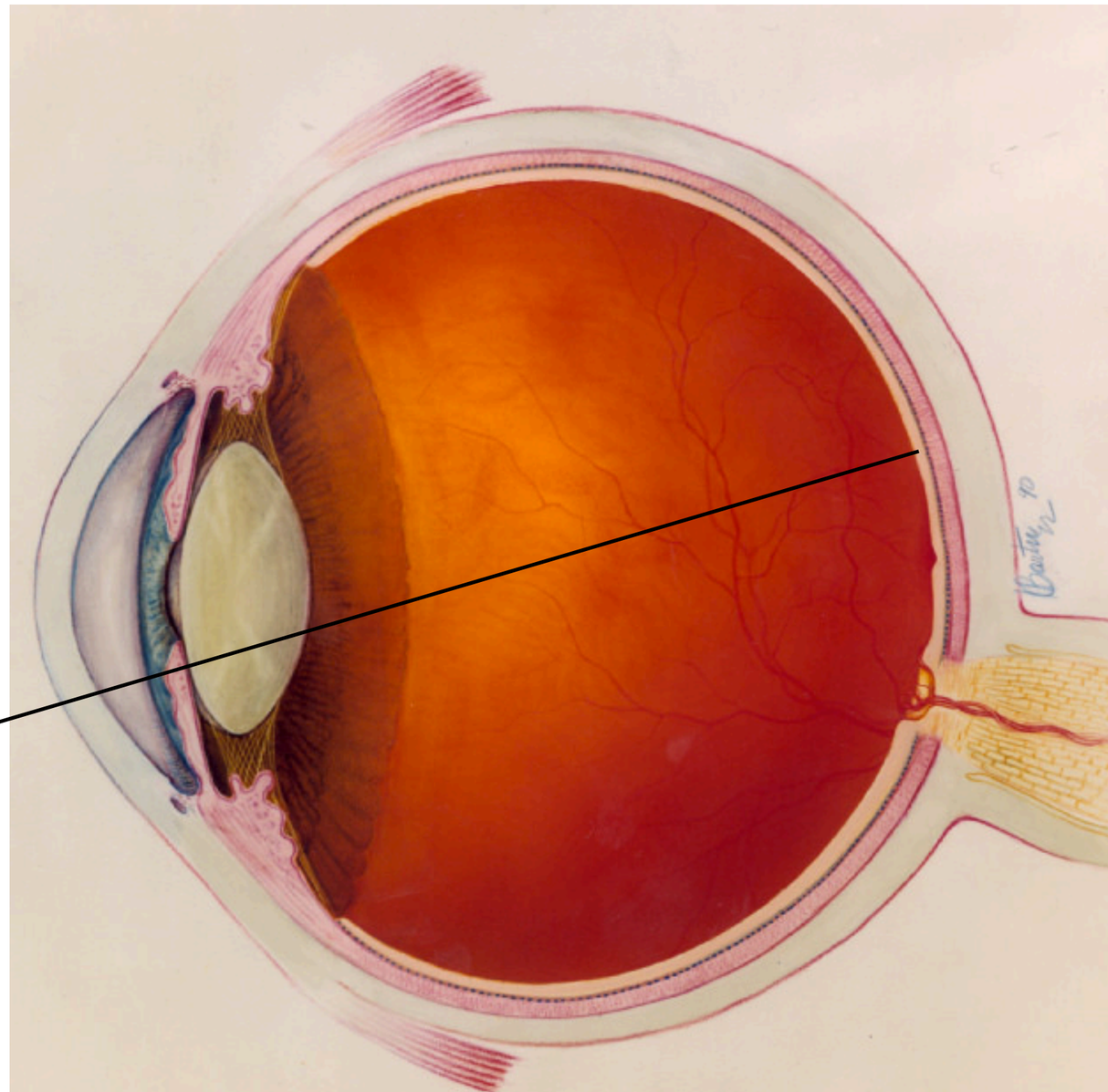


The Eye

The eye is a fluid-filled sphere enclosed by 3 layers of tissue:

3. The inner layer is the retina.

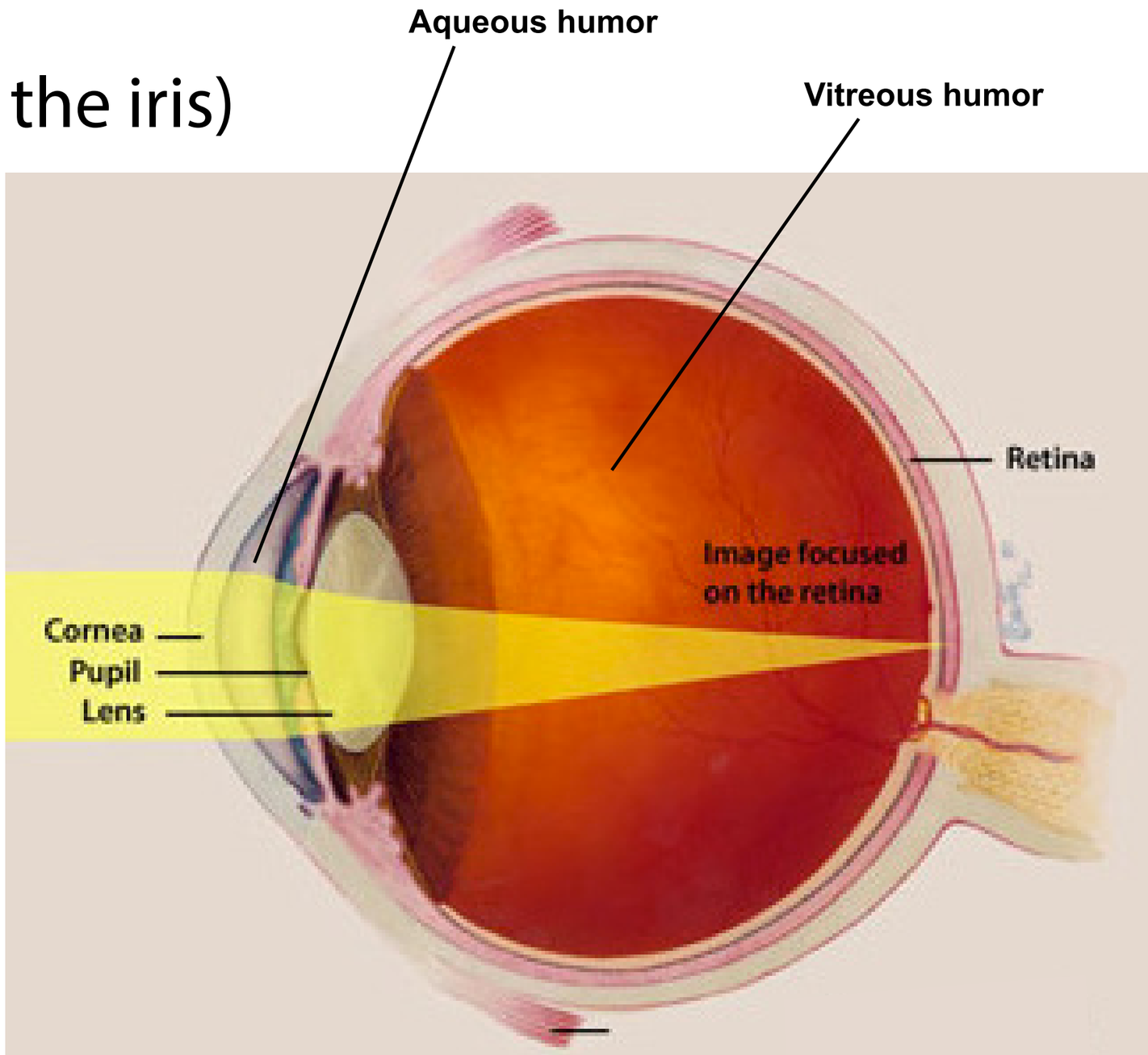
The retina contains the photore-ceptors.



The Eye

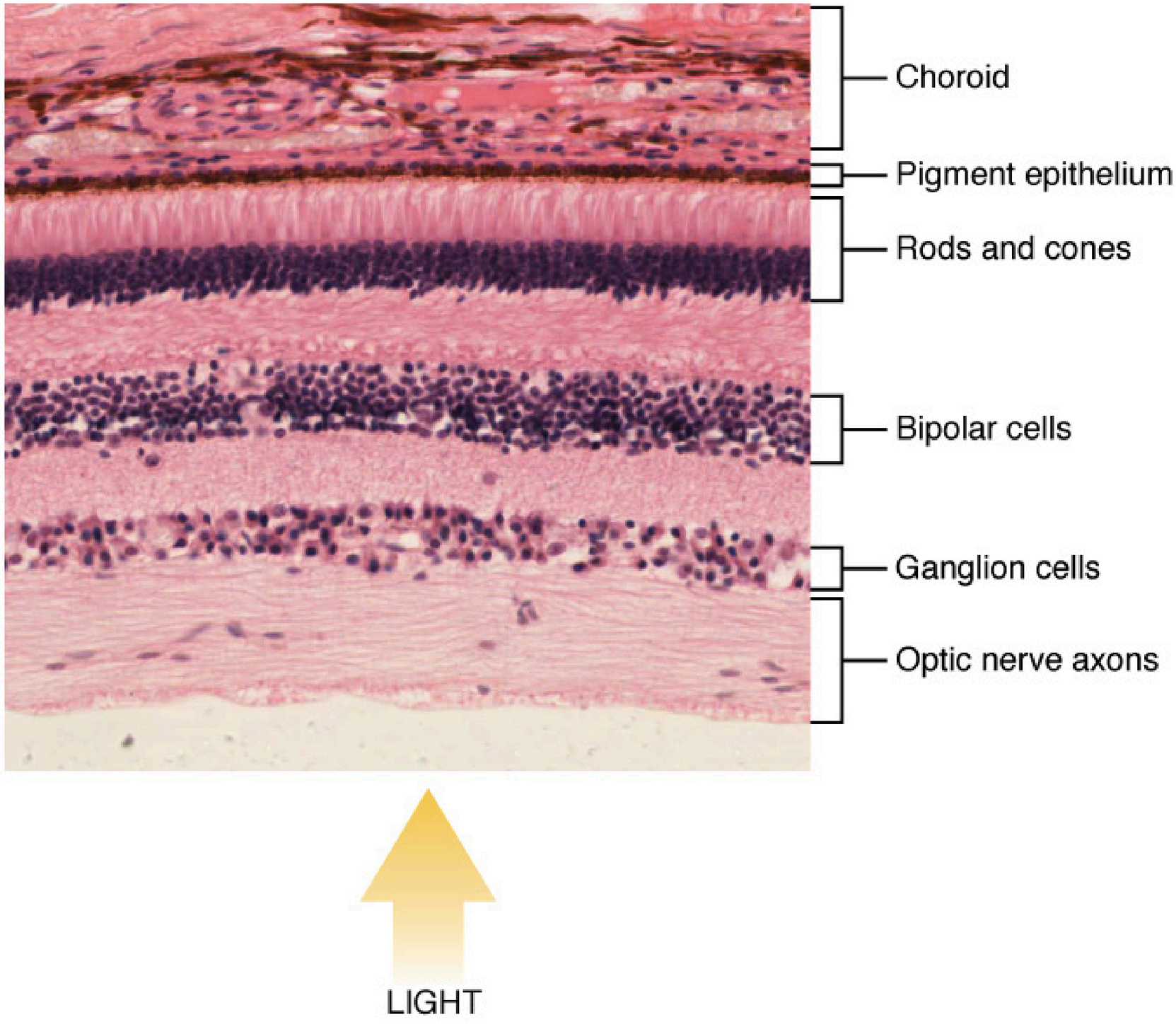
En route to the retina, light successively travels through:

1. The cornea
2. The aqueous humor
3. The pupil (i.e., the hole in the iris)
4. The lens
5. The vitreous humor

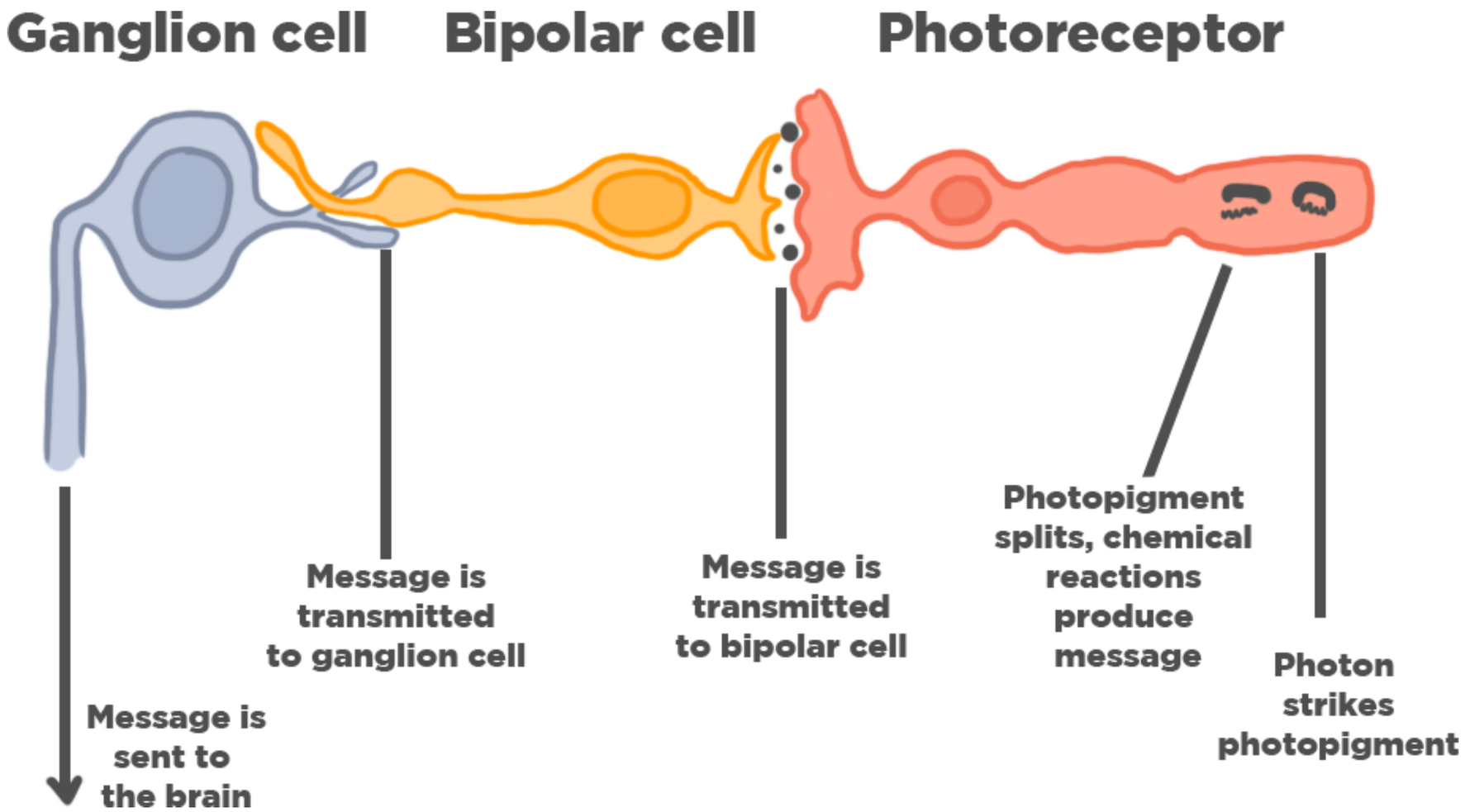


The Eye

The retina is made up of several relatively transparent layers that contain 130 million photoreceptor cells. Those photoreceptors convert light energy into neural activity.

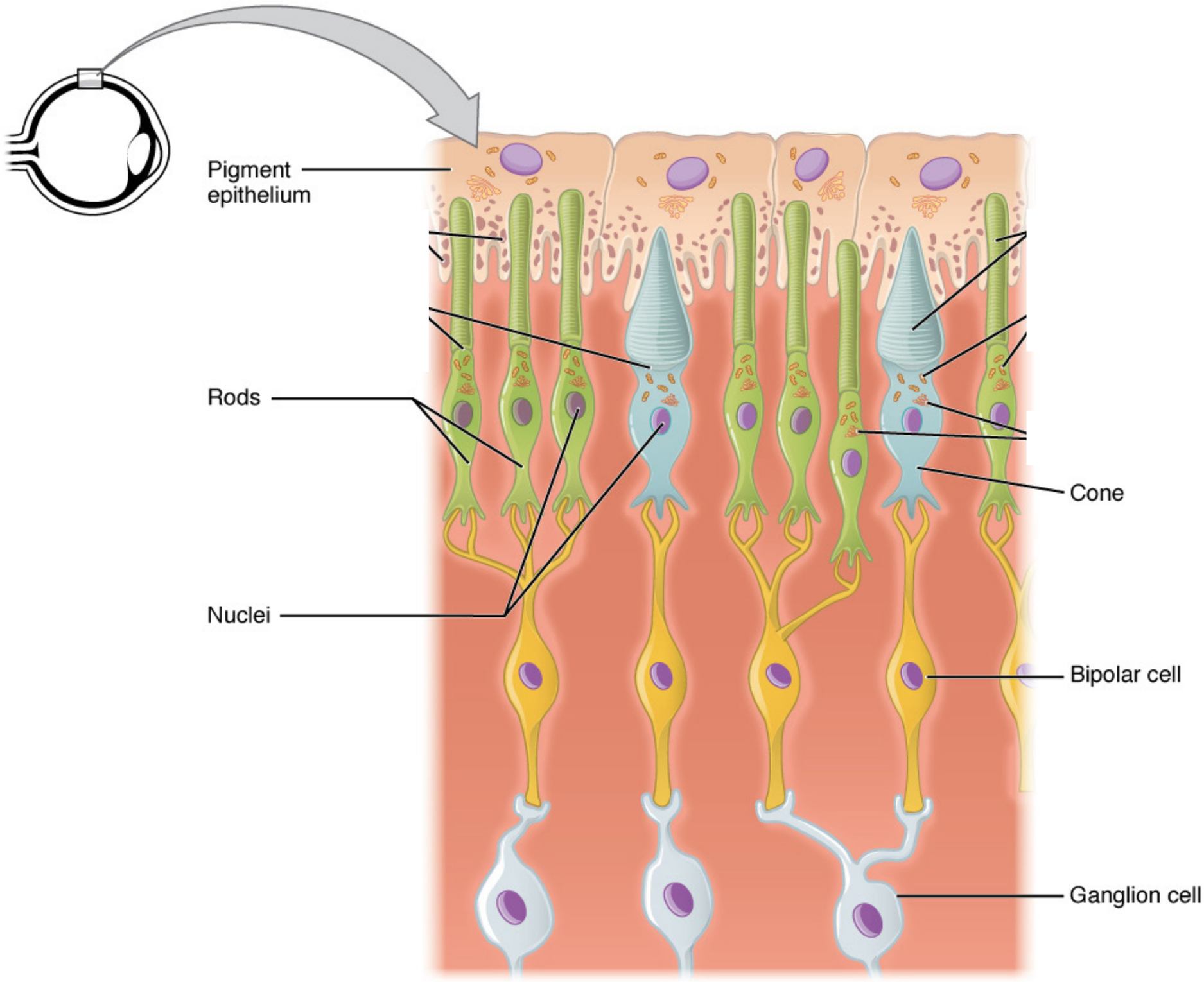


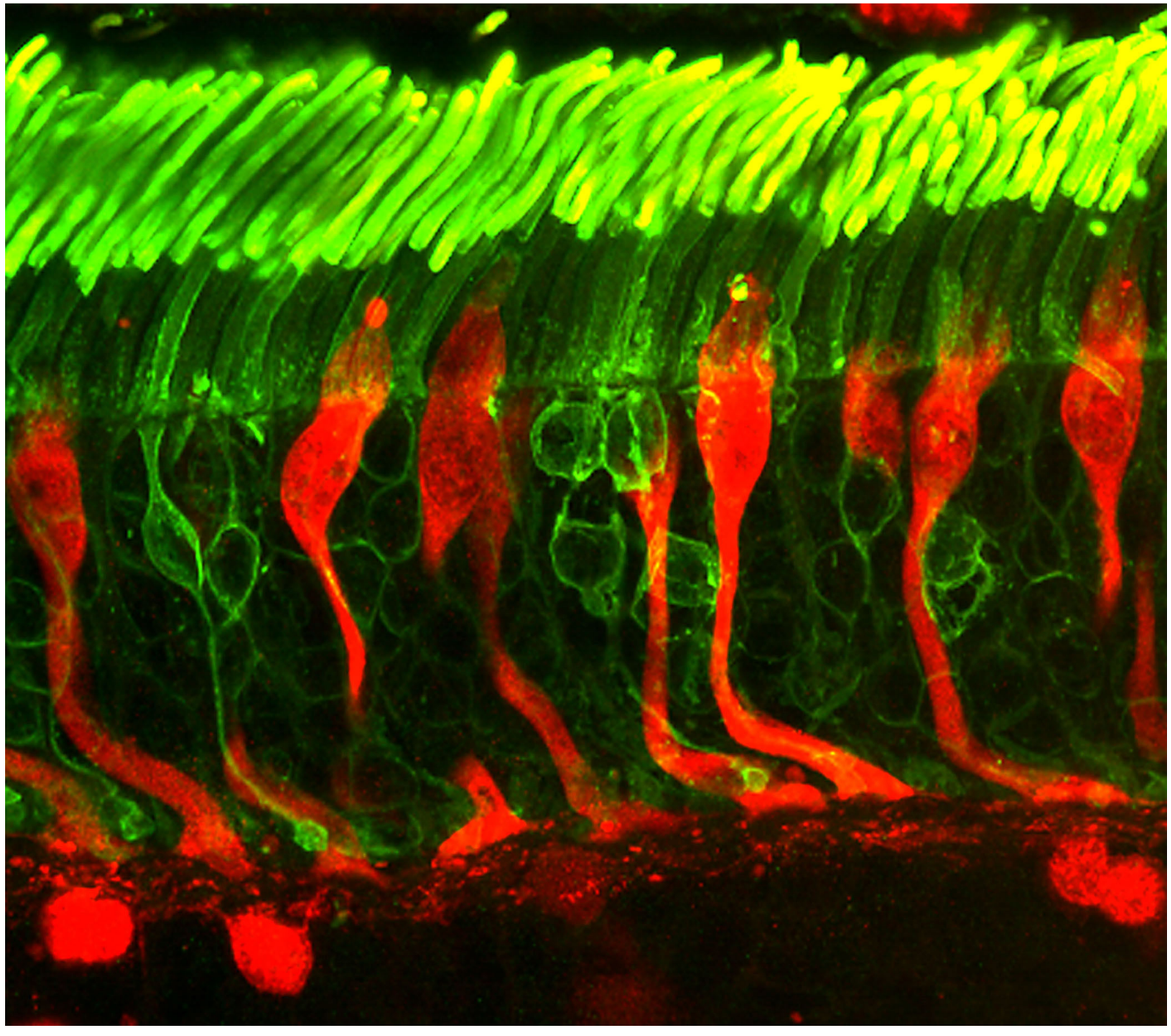
Retina


Ganglion cell
Bipolar cell
Photoreceptor
Message is sent to the brain
Message is transmitted to ganglion cell
Message is transmitted to bipolar cell
Photopigment splits, chemical reactions produce message
Photon strikes photopigment

Retina

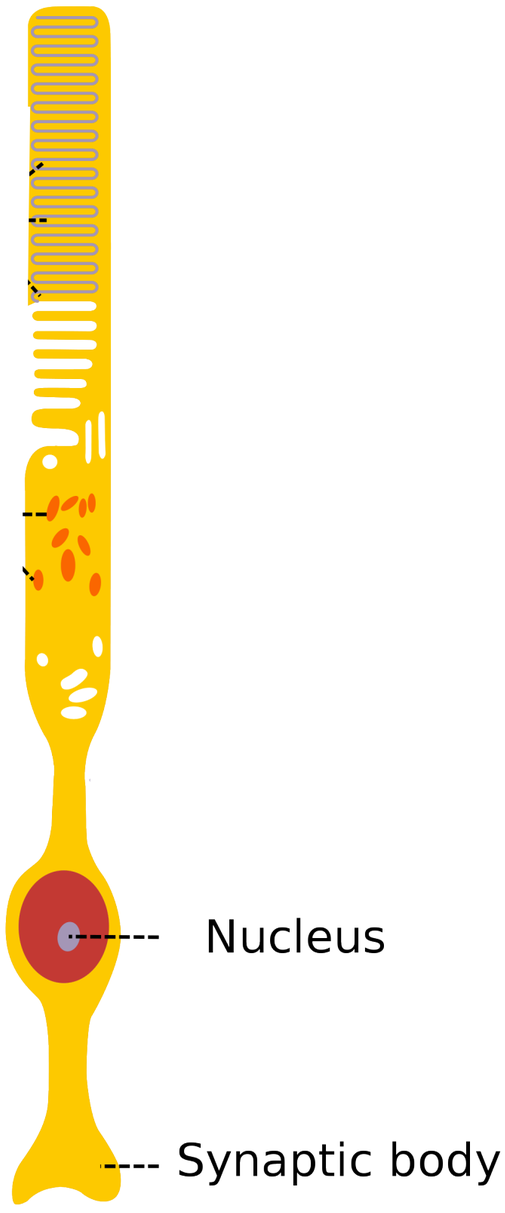
Retina


Pigment epithelium
Rods
Nuclei
Cone
Bipolar cell
Ganglion cell



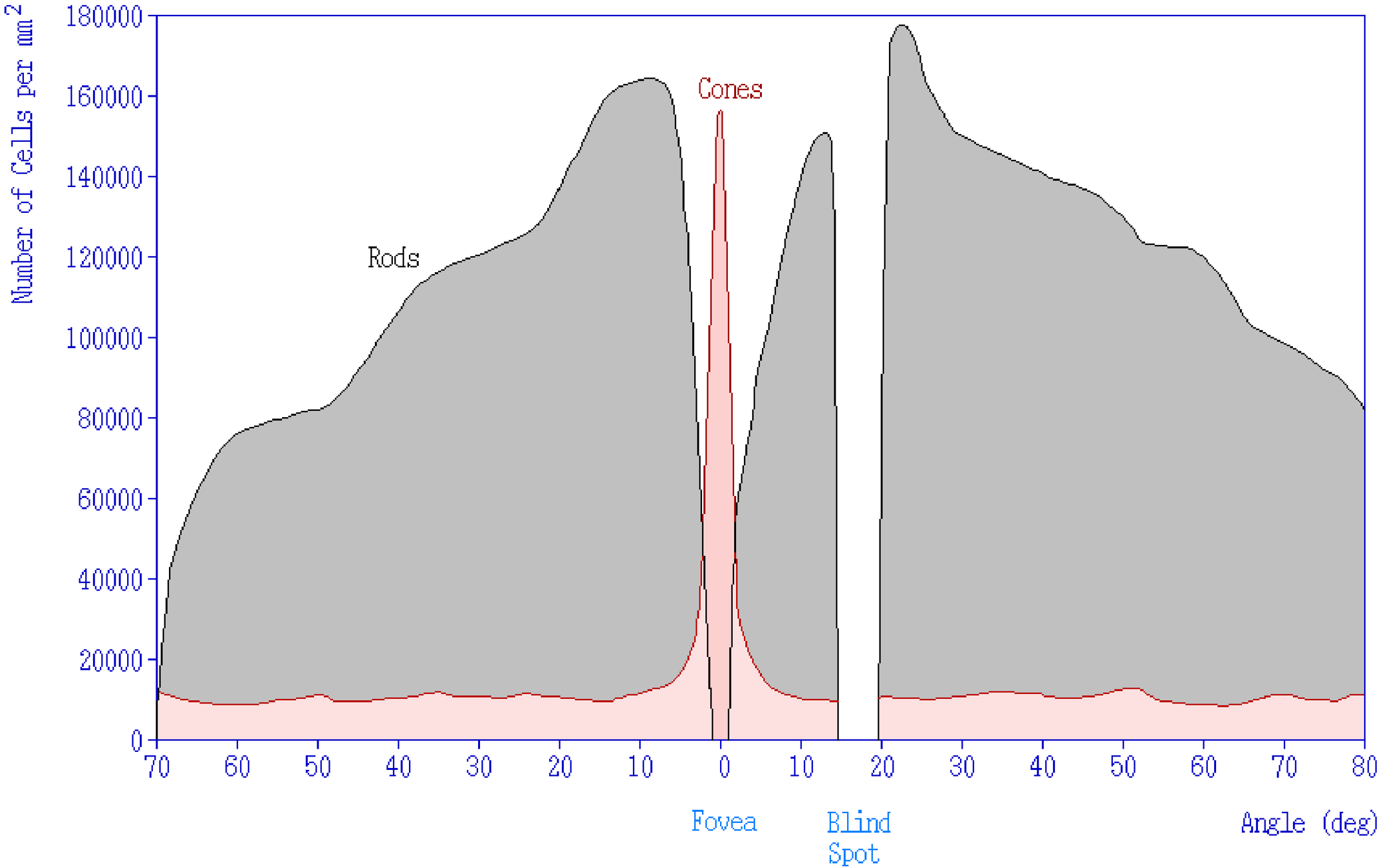
Photoreceptors: Rods & Cones

Rods are long, thin, cylindrical cells that are highly sensitive to light.



Cones are shorter, thicker more tapered cells that are less sensitive to light.

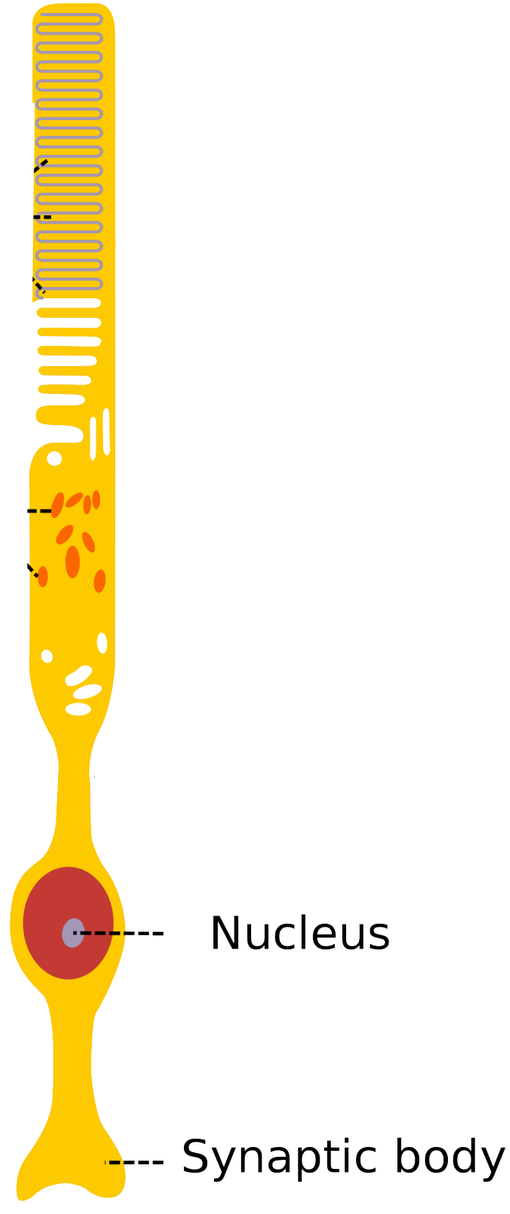
Photoreceptors: Rods & Cones



Photoreceptors: Rods & Cones

How we see in the dark: Rods

- Rods are very sensitive to light but are not differentially sensitive to wavelength.
- Located everywhere in the retina except in the fovea.
- They allow us to see at night without strong light--and they are why colour perception is bad at night.
- We have ~120 million rods.



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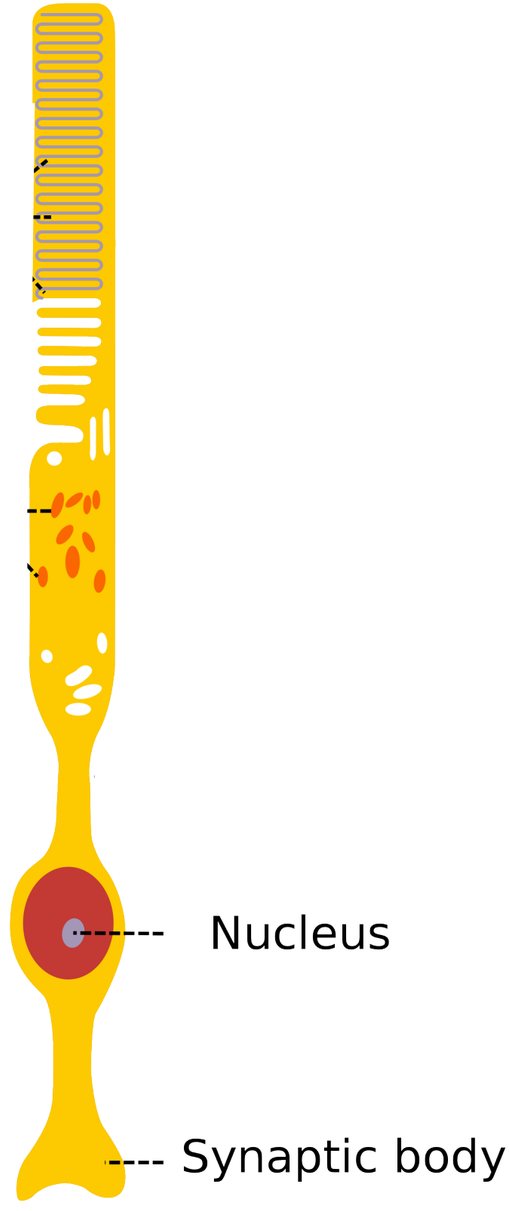
Often, we need to adjust to radical changes of illumination: You step into a dark movie theater after being in the sunlight and you stumble around as if blind. After a few minutes, you can see again. This is dark adaptation: It takes about 20 minutes of darkness for your rods to kick in at full strength.



Photoreceptors: Rods & Cones

How we discriminate wavelength: Cones

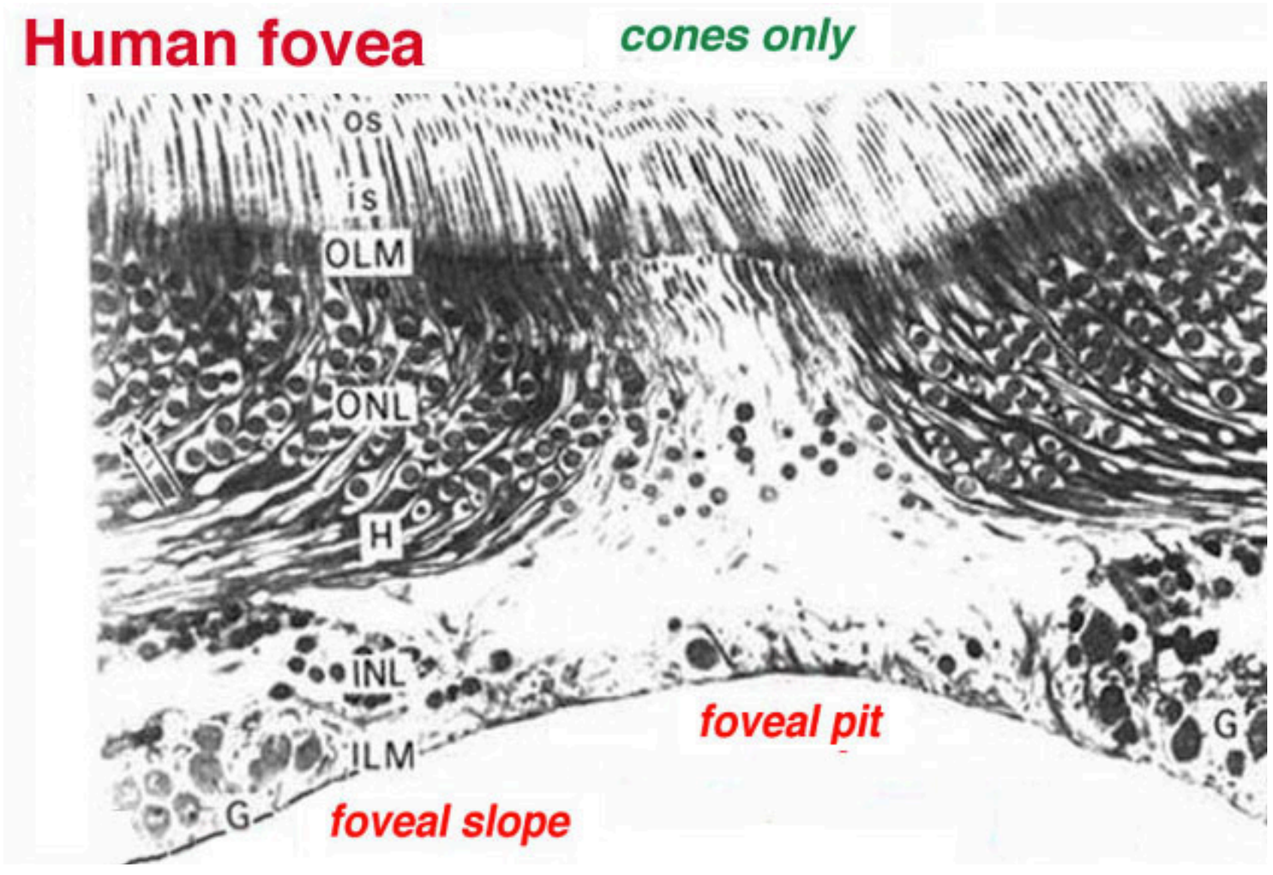
•Cones respond differentially to particular wavelengths of light.
•There are 3 types of cones, each sensitive to different light frequencies.
•Most of our cones are located on the fovea, where visual resolution is sharpest.

We have ~7 million cones in our retina.

Photoreceptors: Rods & Cones

How we discriminate wavelength: Cones

Cones are densely clustered in the center of the fovea: The pinhead-size center of the retina. Unlike the rest of the retina, the fovea contains only cones.



from http://webvision.med.utah.edu/imageswv/hufovea.jpeg

Photoreceptors: Rods & Cones