OTPO 223: CLINICAL VISUAL OPTICS

WEEK V: ELECTROPHYSIOLOGY OF VISION

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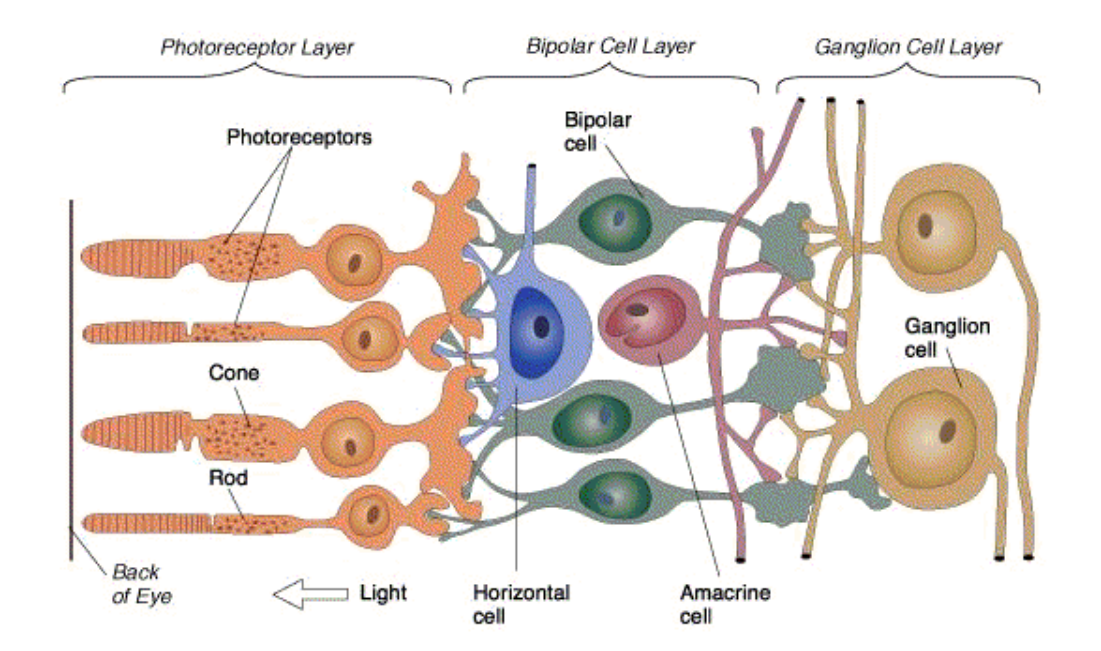
WEEK V: OUTLINE

- Photoreceptors ; morphology and distribution.
- Electrophysiological aspects of vision, how the eye ` sees' ?

MORPHOLOGY OF THE RETINA

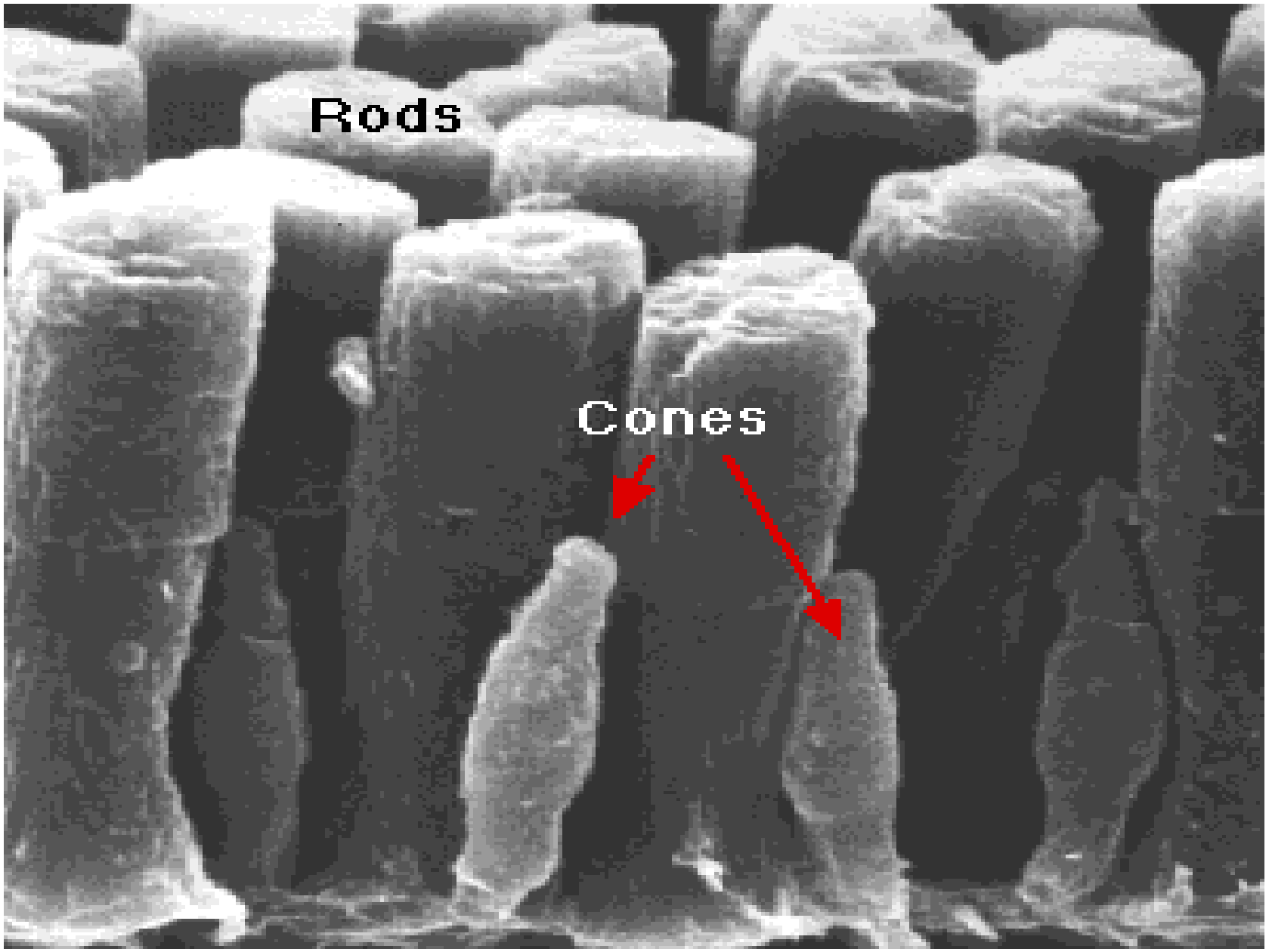
- Back of retina, pigment epithelium (Choroid)

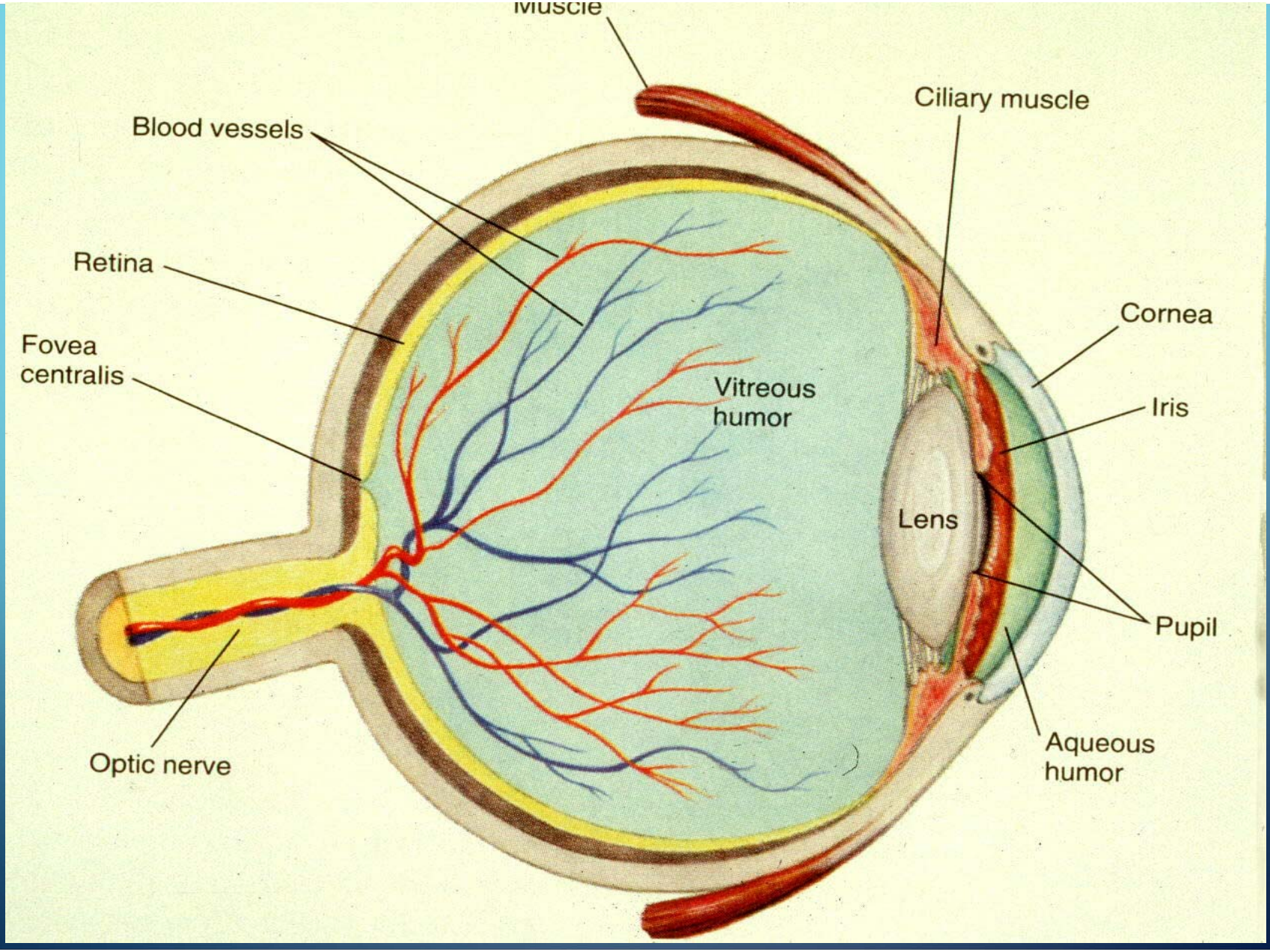


Light path

RODS AND CONES

- As we have seen in past lectures, that rods and cones are the structures within the retina that are responsible for receiving light. They are called photoreceptors.
- Light enters the eye, gets focused by the lenses to the retina in order to reach the photoreceptors.
- Since light is an ` energy' and each colour of the light carriers different amount of energy. Light –with its different colours- interacts with the photoreceptors, inducing chemical reactions, then electrical signal that stimulates the nerves.

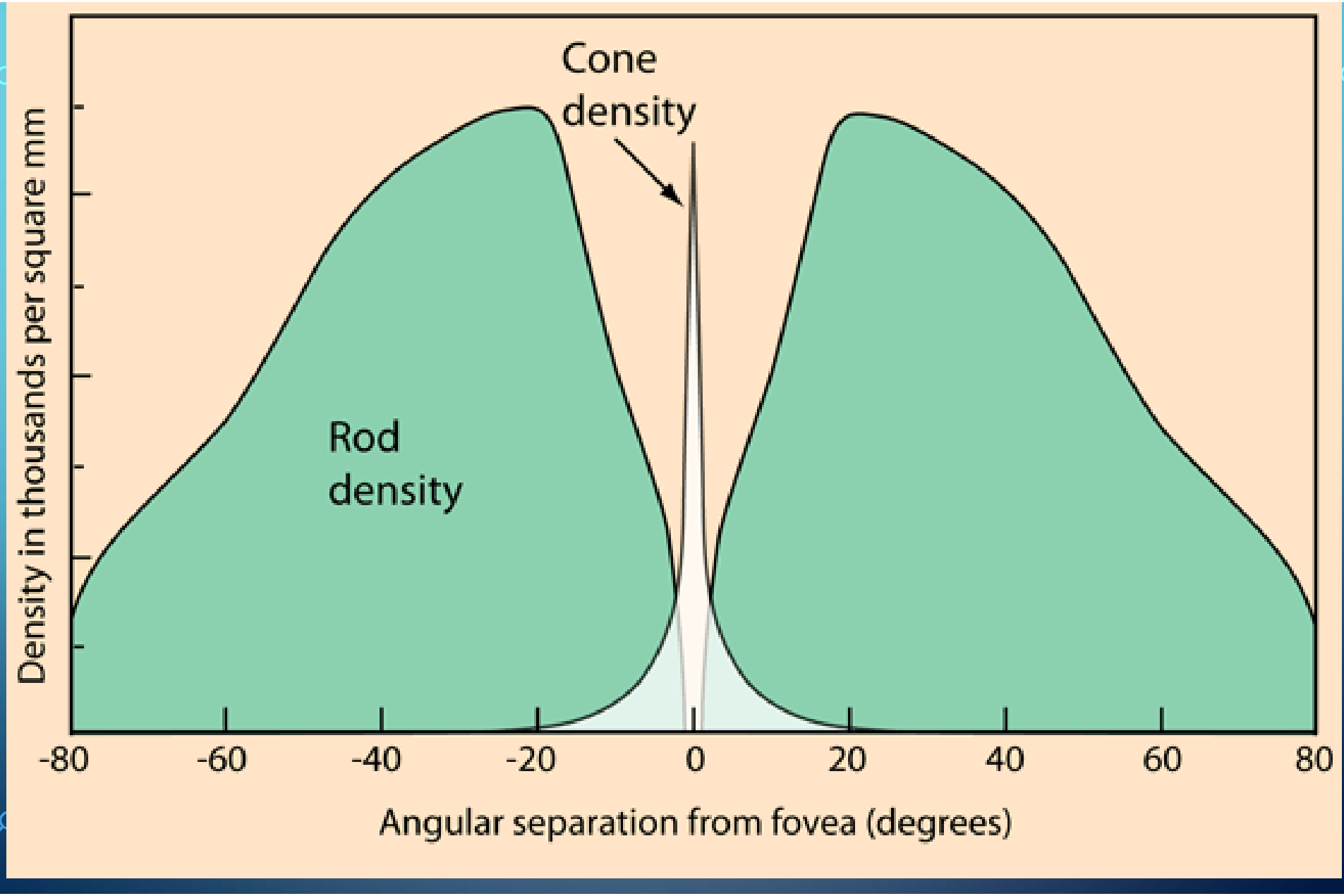

Rods
Cones


Muscle
Ciliary muscle
Blood vessels
Retina
Cornea
Fovea centralis
Vitreous humor
Iris
Lens
Pupil
Optic nerve
Aqueous humor

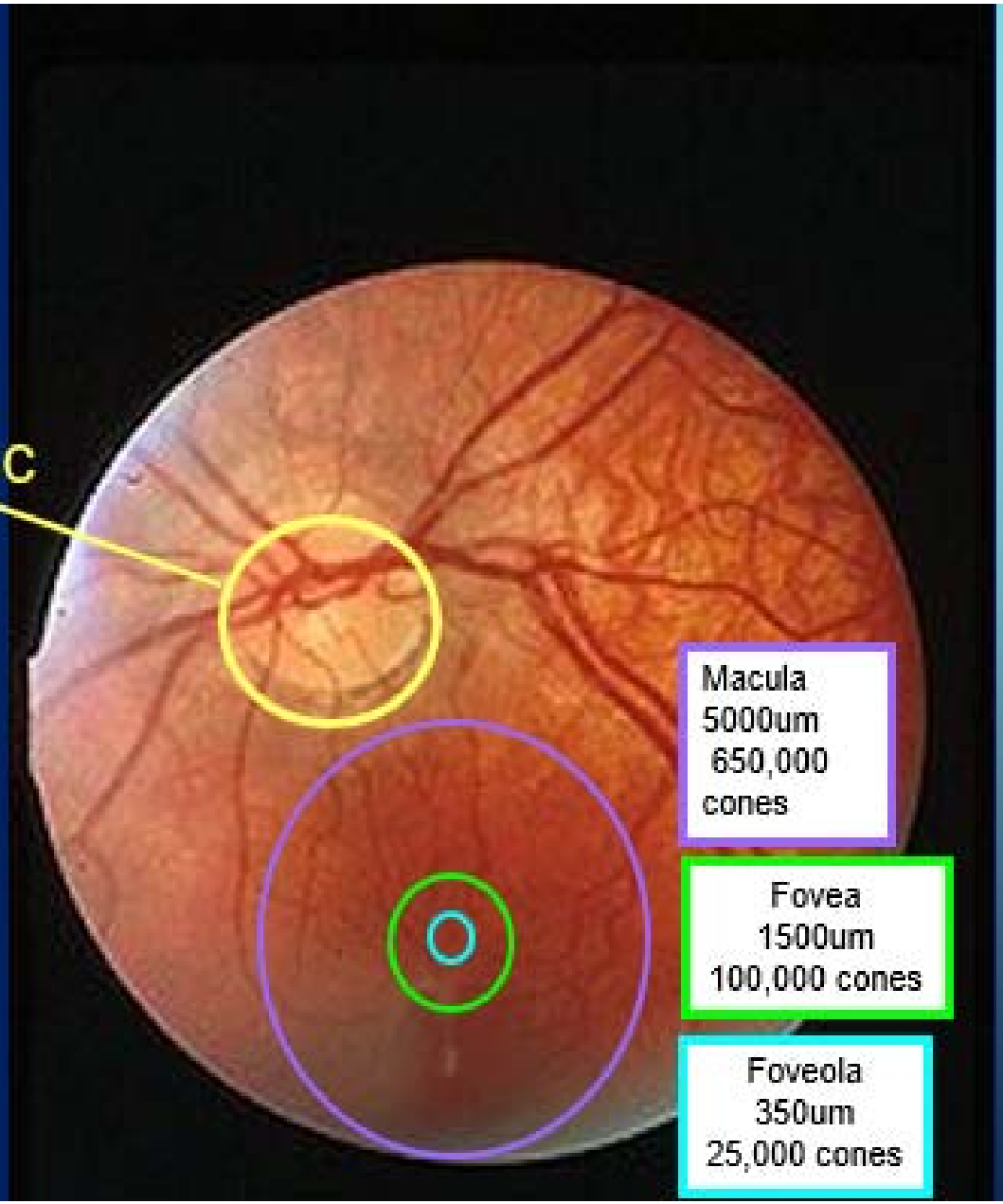
DISTRIBUTION OF PHOTORECEPTORS

- The retina contains two types of photoreceptors, rods and cones. The rods are more numerous, some 120 million, and are more sensitive than the cones. However, they are not sensitive to color. The 6 to 7 million cones provide the eye's color sensitivity and they are much more concentrated in the central yellow spot known as the macula. In the center of that region is the " fovea centralis ", a 0.3 mm diameter rod-free area with very thin, densely packed cones.

- The experimental evidence suggests that among the cones there are three different types of color reception. Response curves for the three types of cones have been determined. Since the perception of color depends on the firing of these three types of nerve cells, it follows that visible color can be mapped in terms of three numbers called tristimulus values. Colour perception has been successfully modeled in terms of tristimulus values and mapped on the CIE chromaticity diagram.


Cone
density
Rod
density
Density in thousands per square mm
-80
-60
-40
-20
0
20
40
60
80
Angular separation from fovea (degrees)

Normal Fundus



PROPERTIES OF PHOTORECEPTORS

- The retina has a total of 100 million rods and 5 million cones

Cones	Rods
Fovea	Periphery
High light levels	Low light levels
Color	Monochromatic
Good acuity	Poor acuity

	Rods	Cones
Light Environment	Dim light - scotopic	Bright light - photopic
Spectral sensitivity	1 pigment	3 pigments
Color discrimination	No	Yes
Absolute sensitivity	High	Low
Speed of response	Slow	Fast
Rate of dark adaptation	Fast	Slow

ELECTROPHYSIOLOGY OF VISION
GENESIS OF ELECTRICAL RESPONSES

RETINAL PHOTORECEPTORS MECHANISM

Light

Absorption by photosensitive substances

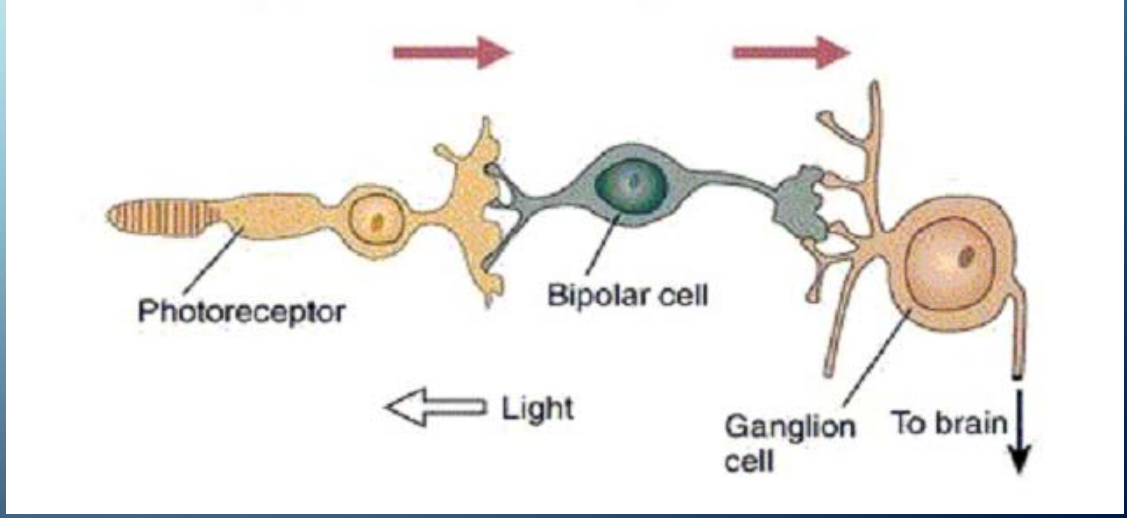
Structural change in photosensitive substances

Phototransduction

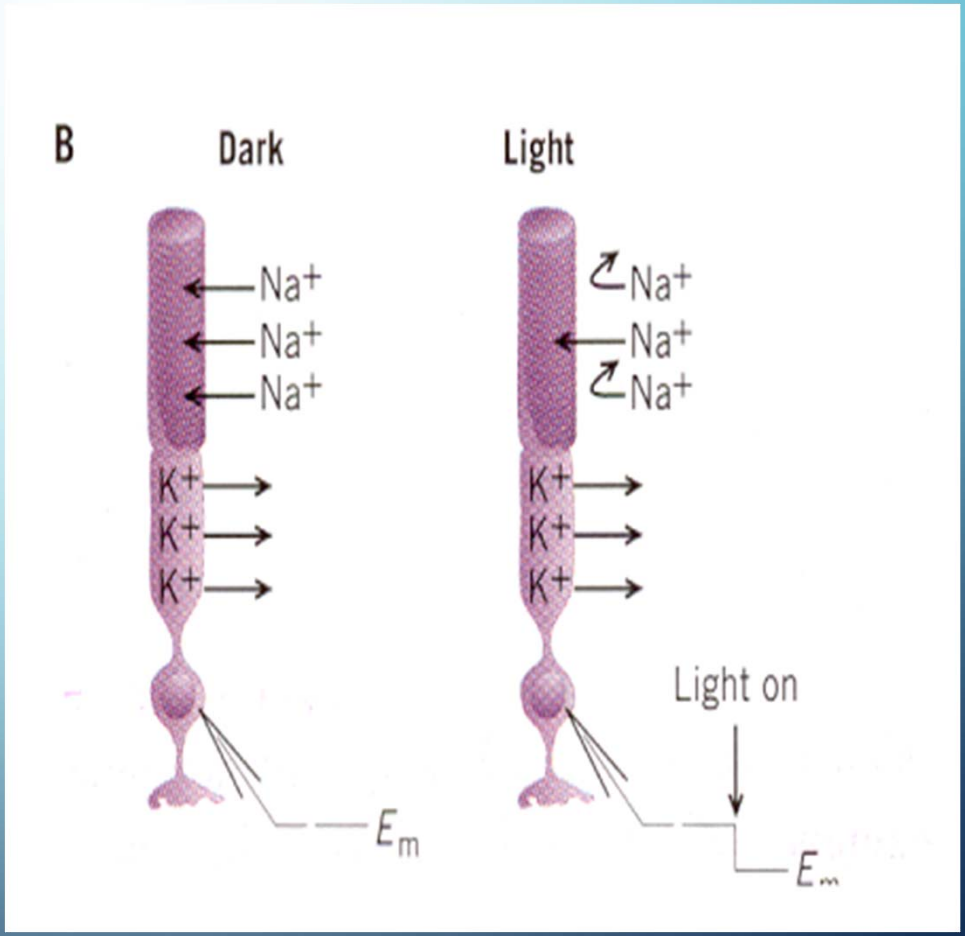
Action potential in the optic nerve

HOW THE EYE SEES?

- Light hits photoreceptors, sends signal to the bipolar cells
- Bipolar cells send signal to ganglion cells
- Ganglion cells send signal to the brain



PHOTORECEPTION



ELECTRIC RECORDING IN RETINAL CELLS:

- Rods & Cones: Hyperpolarization
- Bipolar cells: Hyper- & Depolarization
- Horizental cells: Hyperpolarization
- Amacrine cells: Depolarizing potential
- Ganglion cells:Depolarizing potential

END OF LECTURE V

See you next week ! •