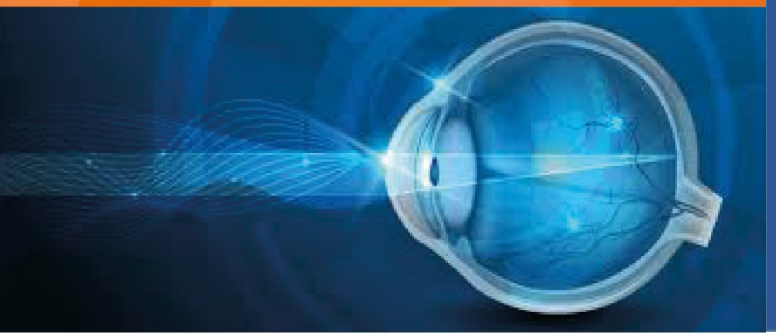
Eye Anatomy & Function



Dr Jie Zhang PhD
Senior Research Fellow

Associate Professor Bruce Hadden
LLD, FRACS, FRANZCO

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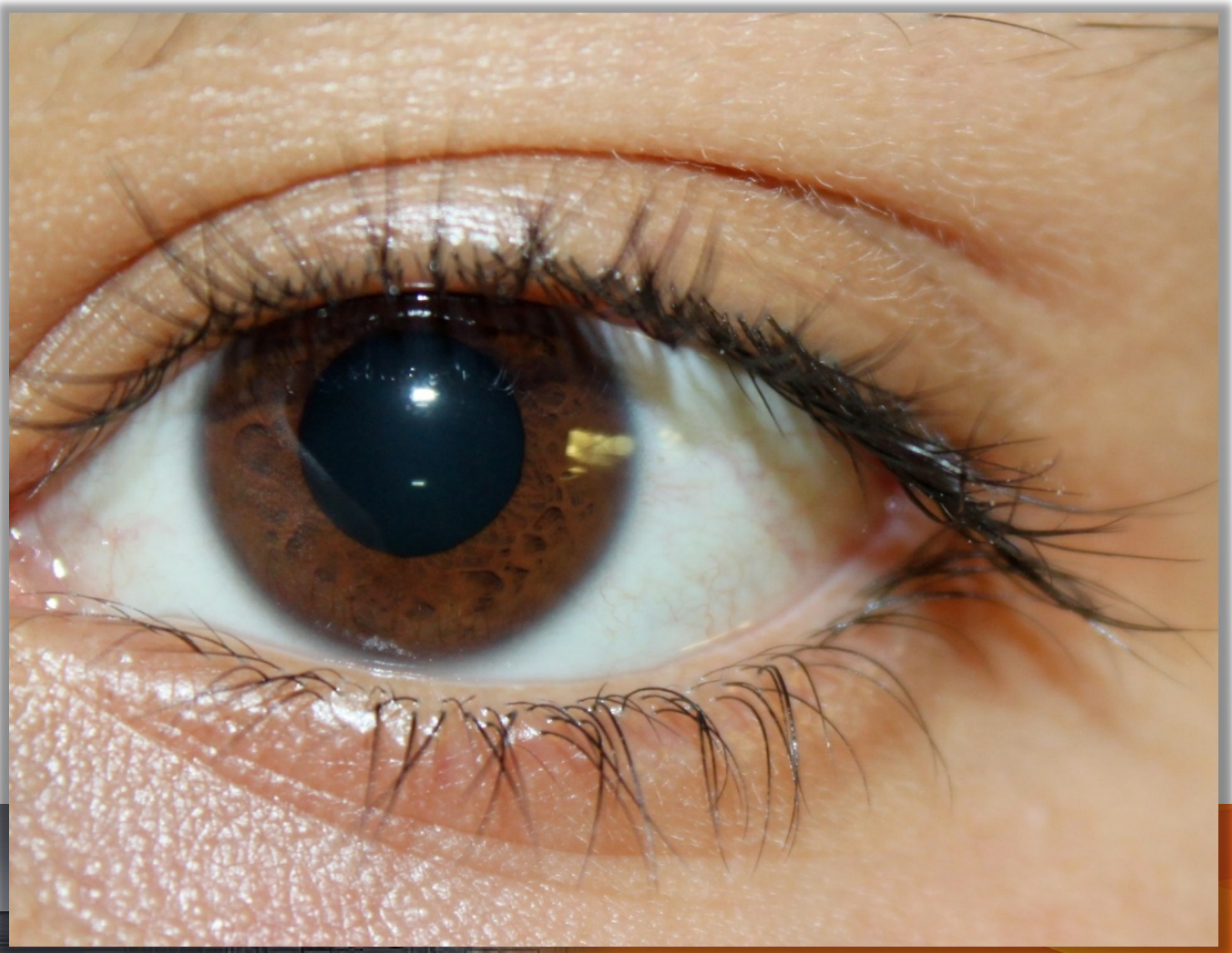
External ocular appearance



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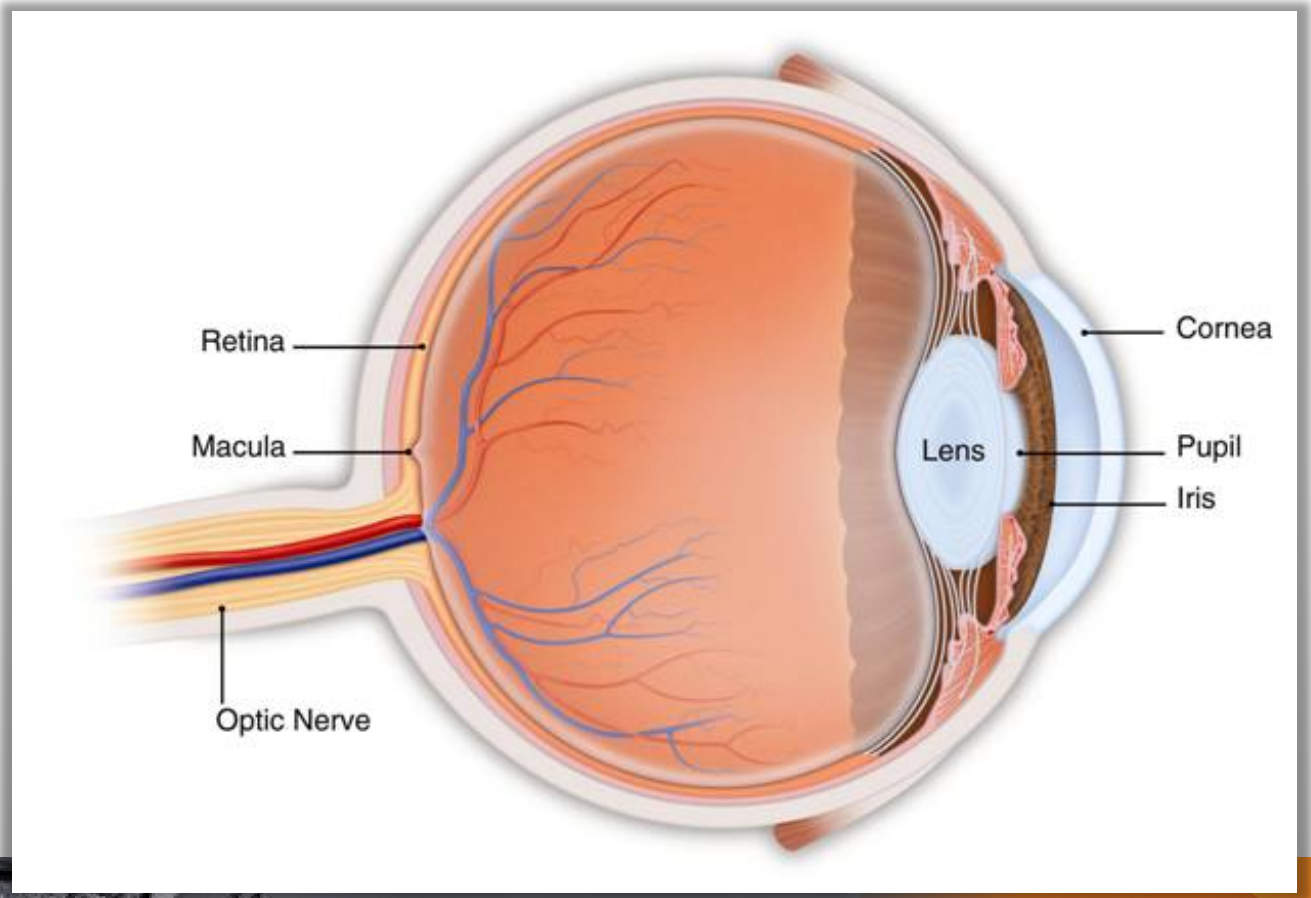
Key Eye Functions



- Transmits and refracts light from the front to the back of the eye
  - *Transparent light path*
  - *Includes structures that bend light (refract)*
- Converts light energy into action potentials transmitted to brain

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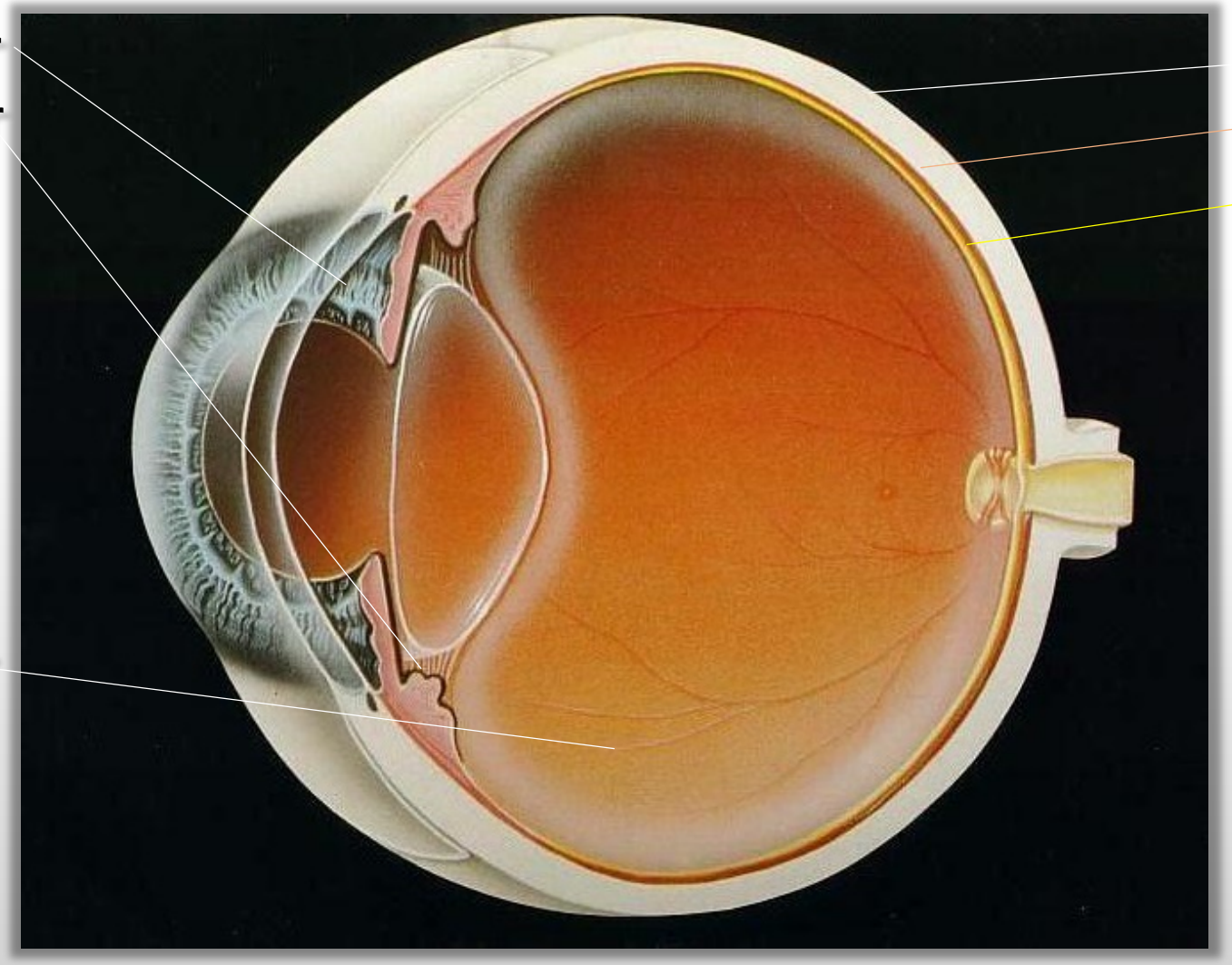
Layers and chambers of the eye

Anterior Chamber
Posterior Chamber



Fibrous Tunic
Vascular Tunic
Nervous Tunic

Vitreous Chamber

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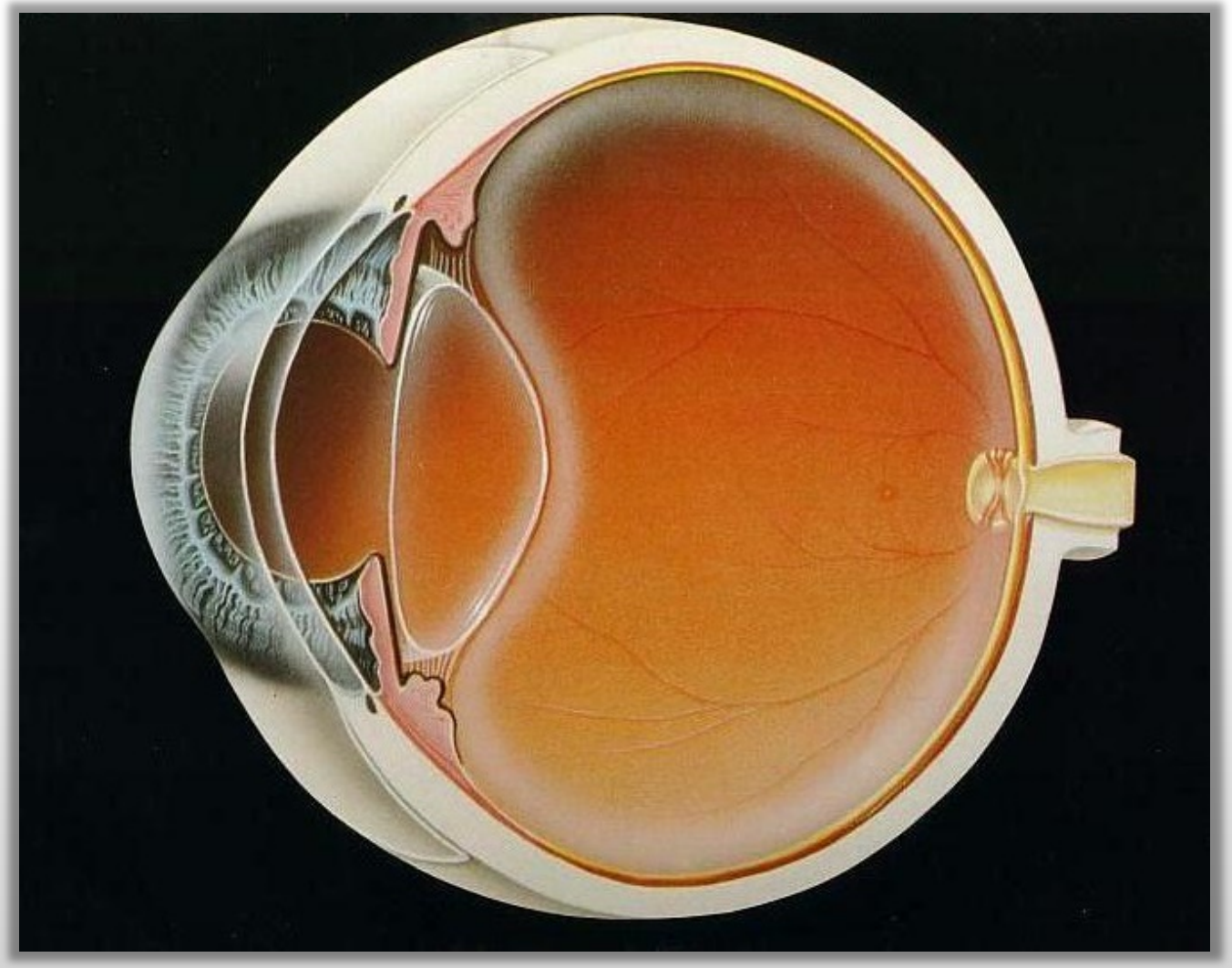
Defining ocular segments

Anterior segment: Structures in front of vitreous: Cornea, iris, ciliary body, and lens



Posterior segment:

Vitreous, retina, choroid, optic nerve

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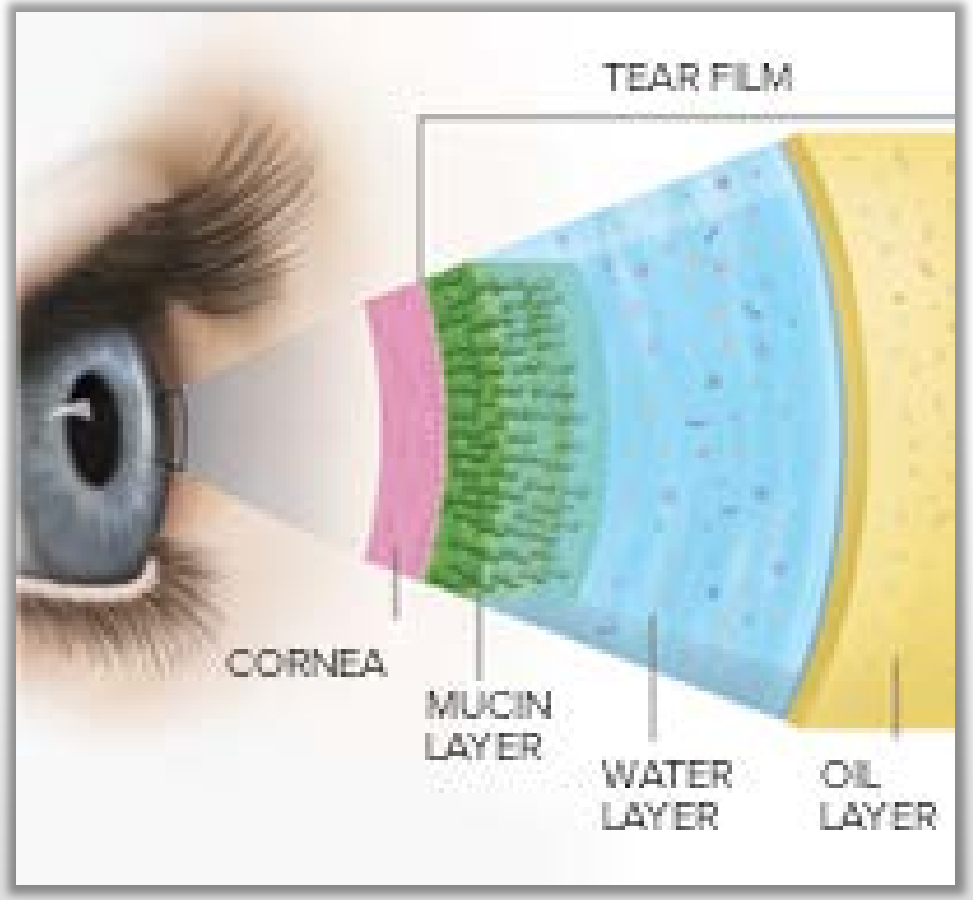
Tear film layers and functions

- **Oil layer:**
  - Meibomian glands
    - Prevents evaporation
- **Water layer:**
  - Lacrimal glands
    - Lubricates
    - Allows blinking
    - Washes away debris
    - Forms smooth surface
- **Mucin layer:**
  - Goblet cells of conjunctiva
    - Attaches tear film to eye
    - Spreads water evenly



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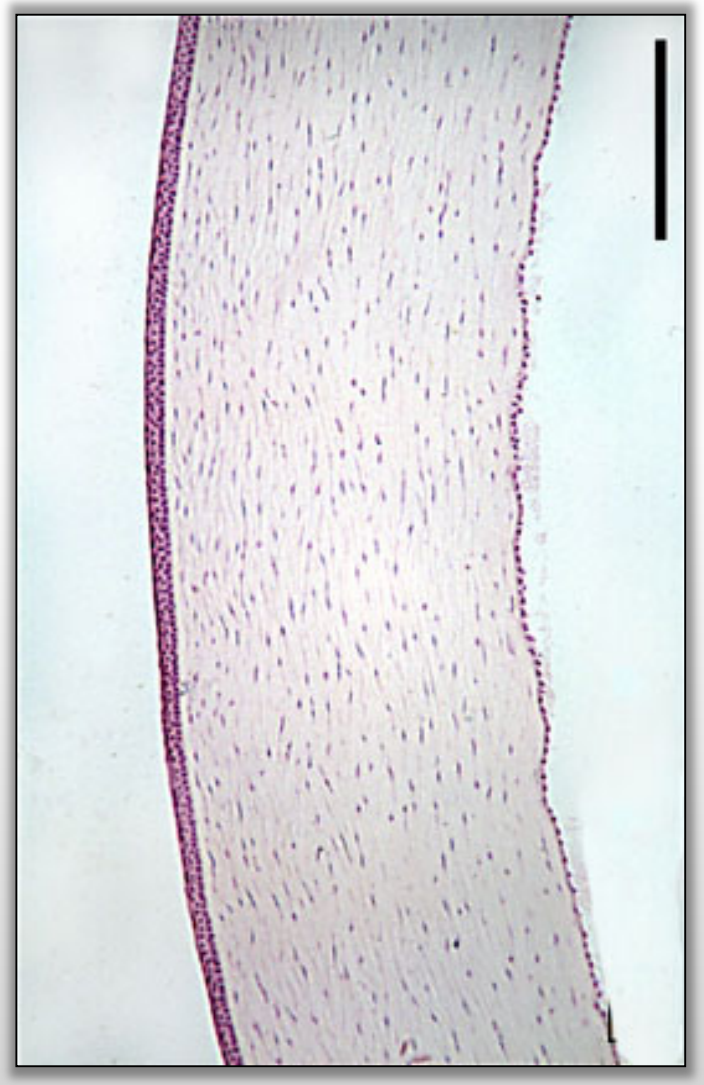
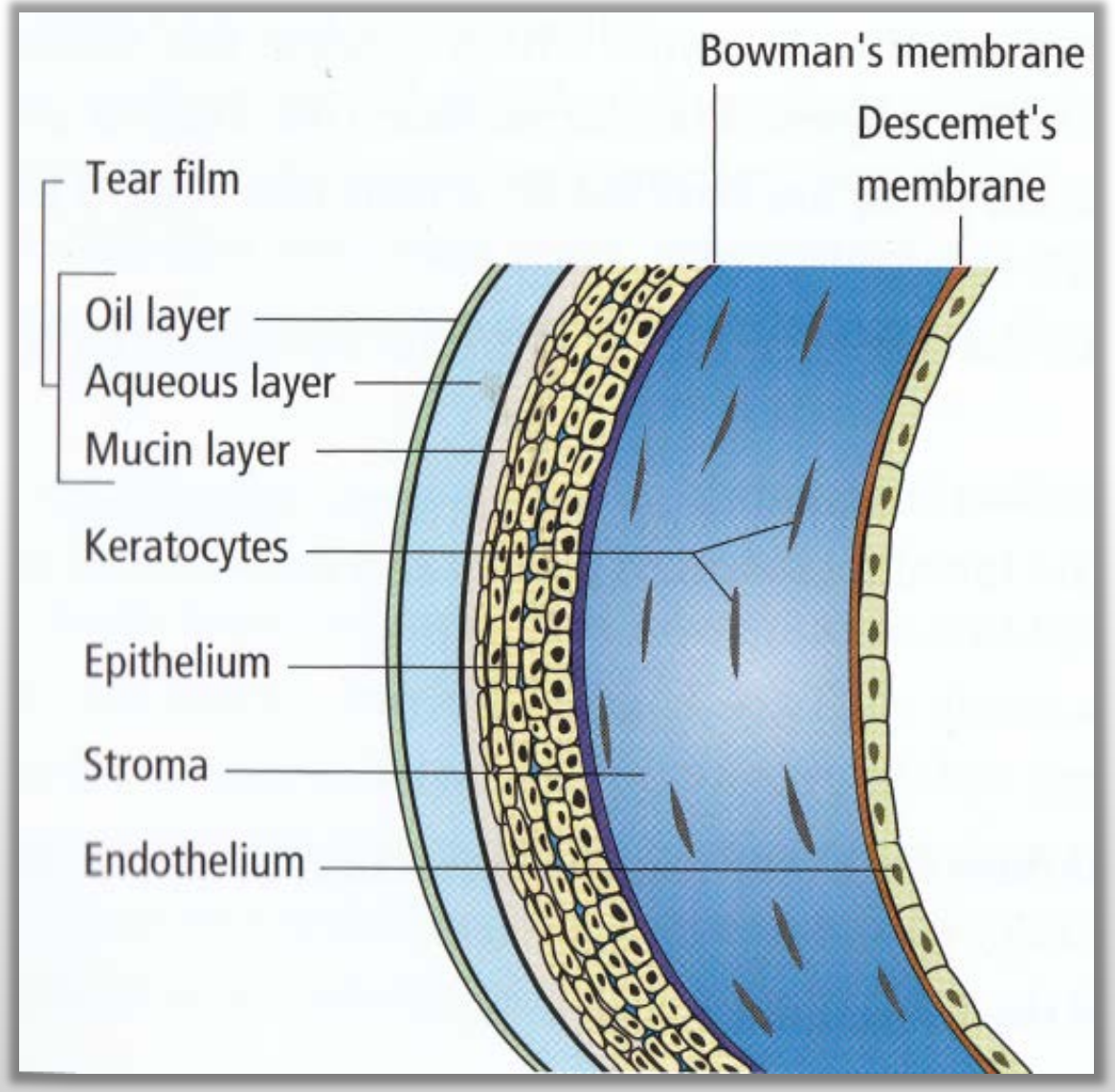
Cornea functions



- **Transmits light, transparent**
  - Collagen and matrix
    - Aligned
    - Spacing
    - Relative dehydration is maintained by endothelial cells
  - No blood vessels
- **Refracts light +40-44 dioptres**
  - Curvature
  - Has different refractive index from air

Corneal anatomy



Epithelium:

Barrier to fluid loss and pathogen penetration

Stroma:

Collagen, ECM, keratocytes

Endothelium:

Maintains relative dehydration

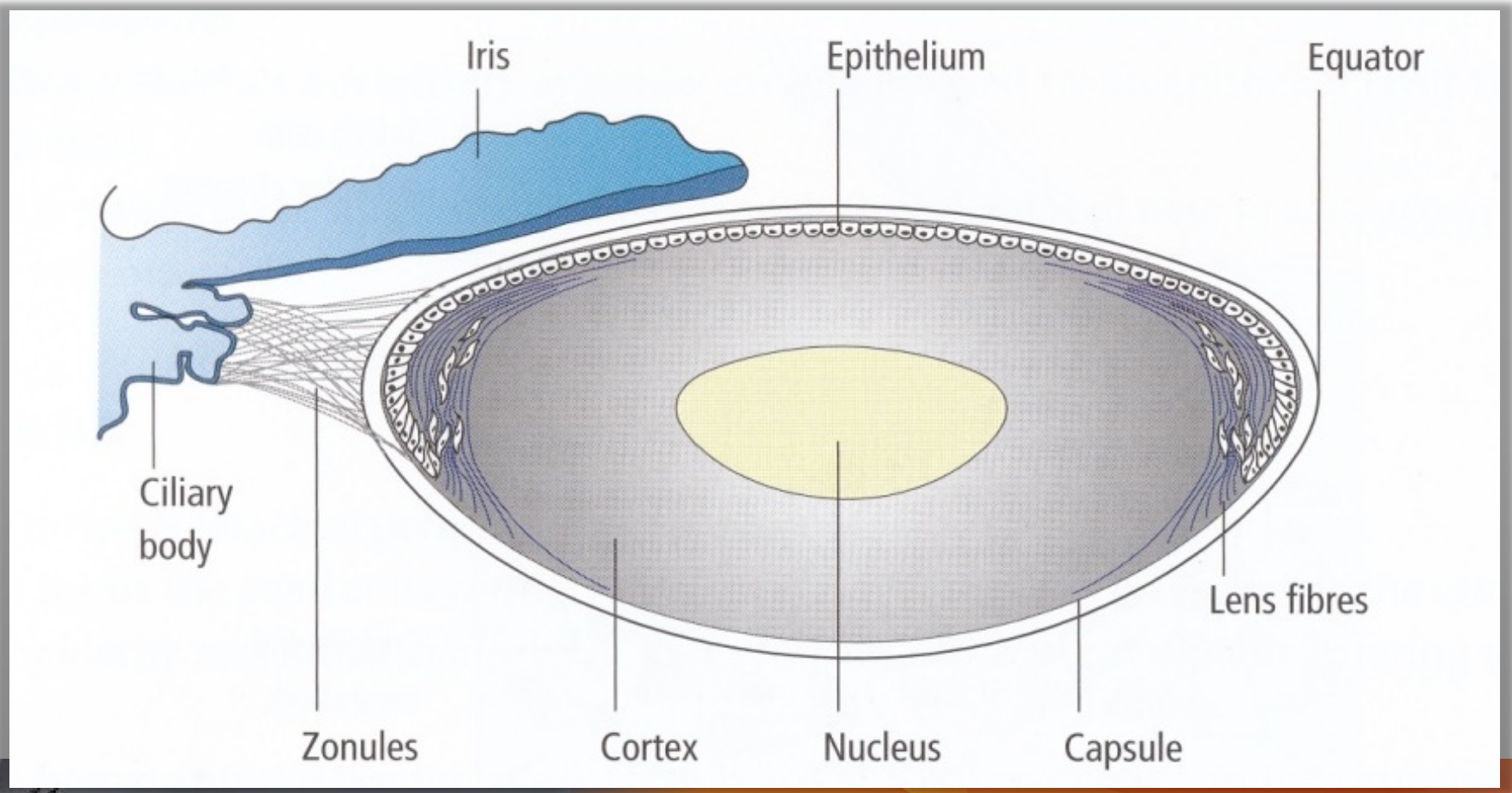
Dense innervation:

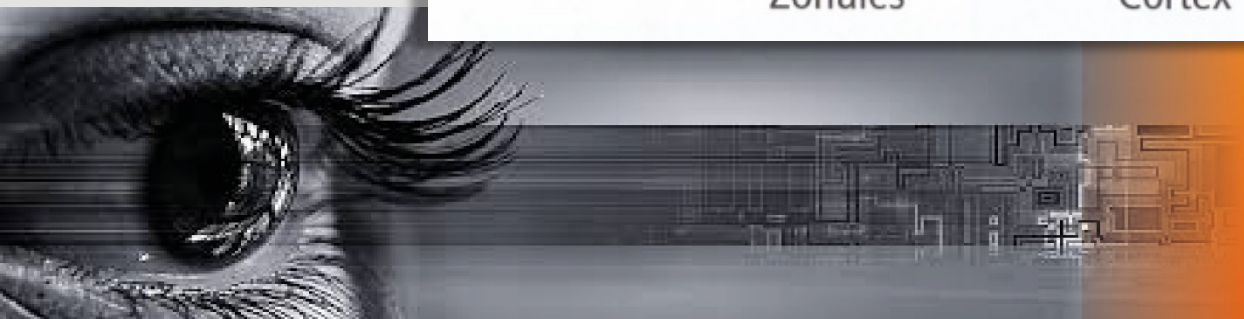
Most sensitive organ in the body
Immune privilege
Rapid tearing reflex

The cornea:

Transmits light
Refracts lights
Protects ocular interior

Structure of the crystalline lens





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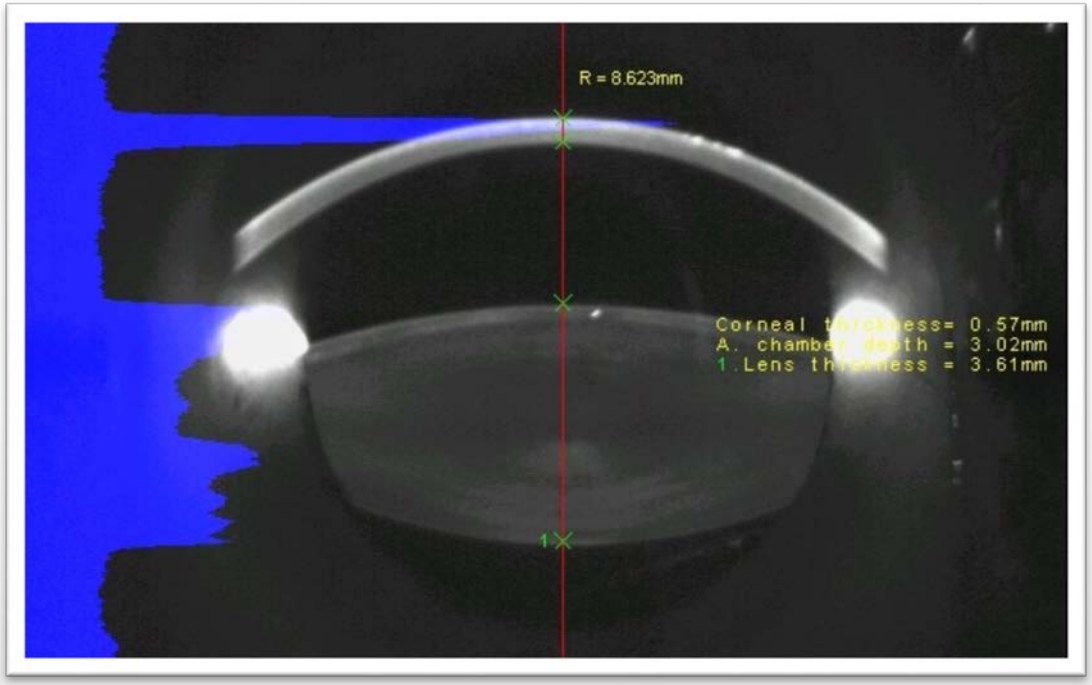
Crystalline Lens: Structure and function

- Composed of α, β, and γ crystallins (water soluble proteins)
- Transmission of light
- Refraction of light. +17 dioptres
- Variable refraction of light - accommodation



Cornea 2/3rd and lens 1/3rd refracting power

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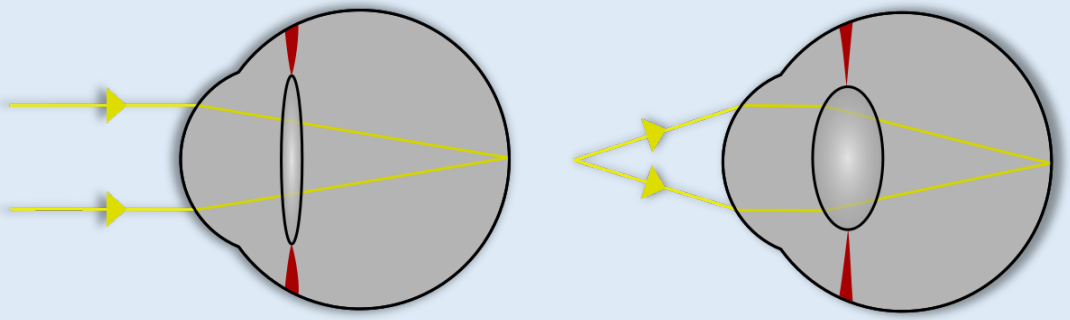
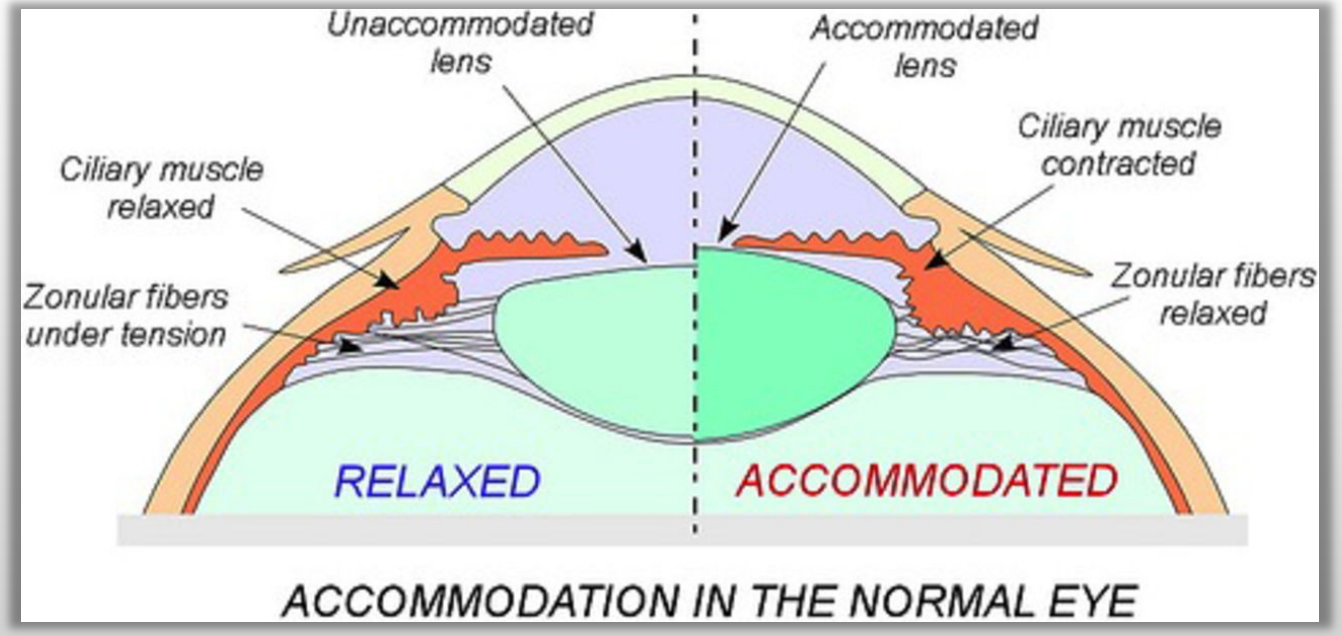
Accommodation

Far objects:
Ciliary muscle relaxed
(↑ diameter)
Zonules tight
Lens flatter i.e.
distance



Near objects:
Ciliary muscle contracts
(↓ diameter)
Zonules relaxed
Lens increases in convexity
'accommodation' i.e. near



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Accommodation video

- https://www.youtube.com/watch?v=p_xLO7yxgOk&list=WL&index=3&t=0s
- Search for accommodation reflex on youtube

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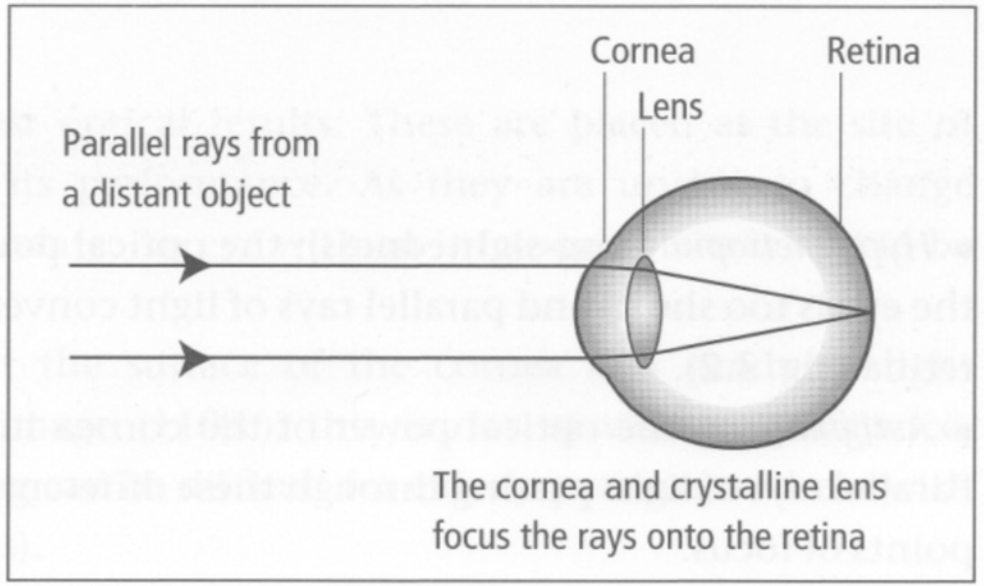
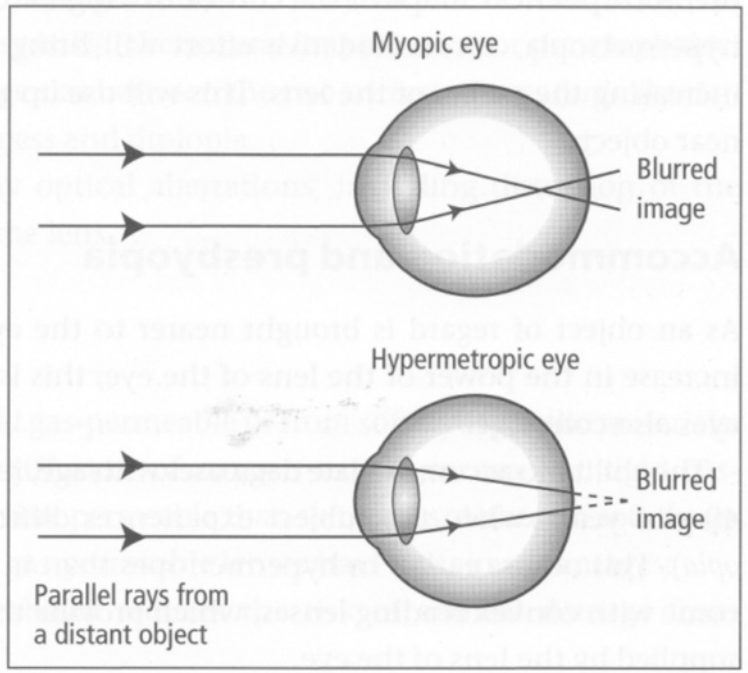
Emmetropia, Myopia & Hypermetropia

Emmetropia: cornea/lens/eye length “normal”



Myopic eye = long, hyperopic eye = short



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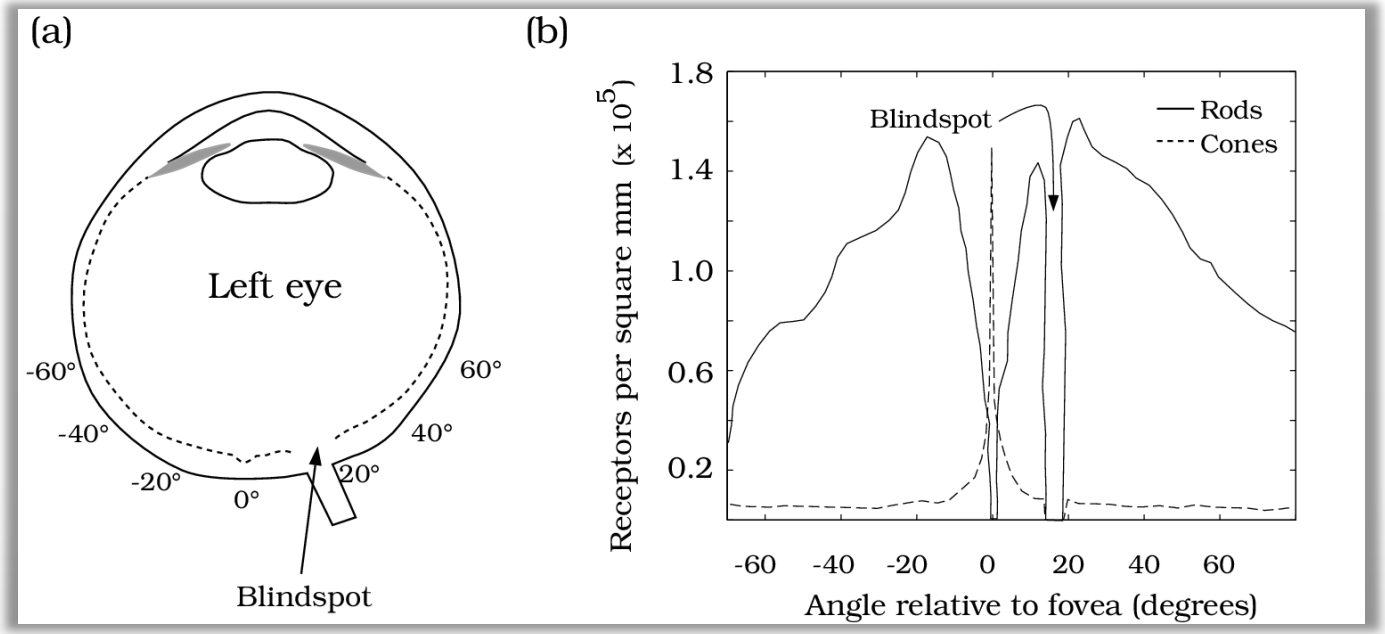
Retinal Function



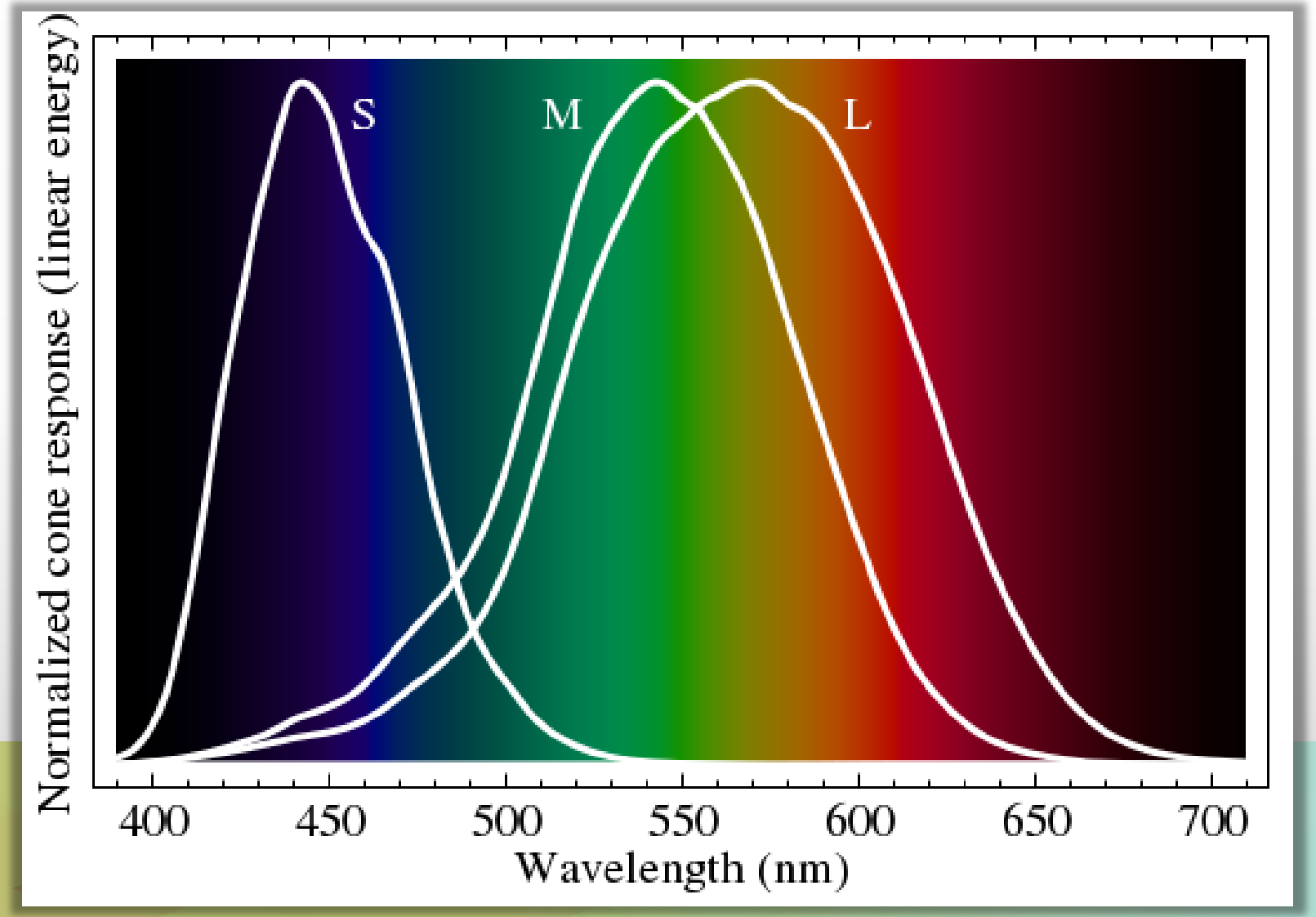
- Photoreceptors: conversion of light into action potentials
  - Cones. 6 million. High threshold to light. High acuity. Light adapted (photopic) vision. Colour vision- 3 types of cones: blue, green, red.
  - Rods. 120 million. Low threshold to light. Sensitive to movement. Dark adapted (scotopic) vision. No colour. Low resolution.
  - Synapse with bipolar cells → Retinal ganglion cells → Axons form the optic nerve. 1 million fibres.

Spectral sensitivity ranges (nm)

S (Blue 2%) 400-500nm

M (Green 32%) 450-630nm

L (Red 64%) 500-700nm



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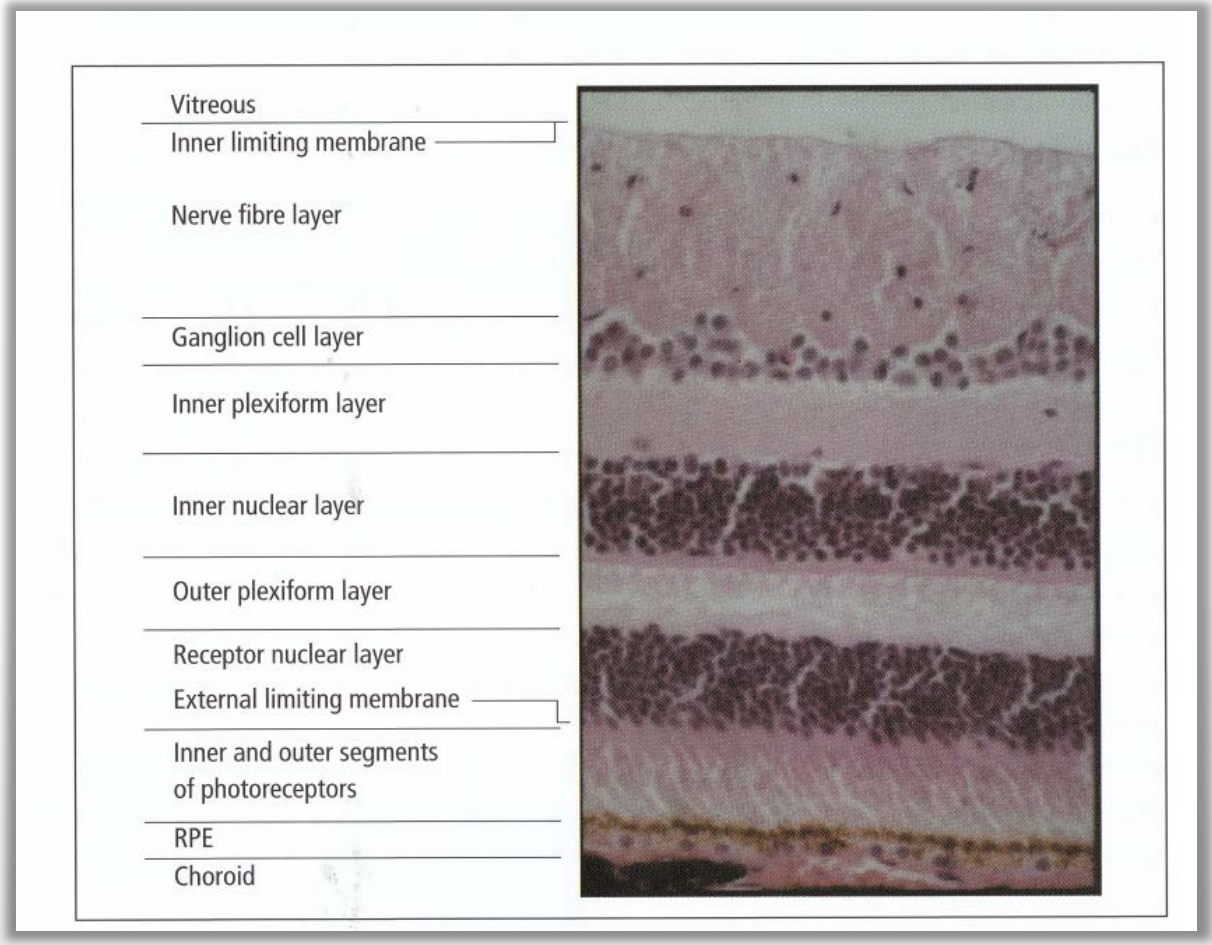

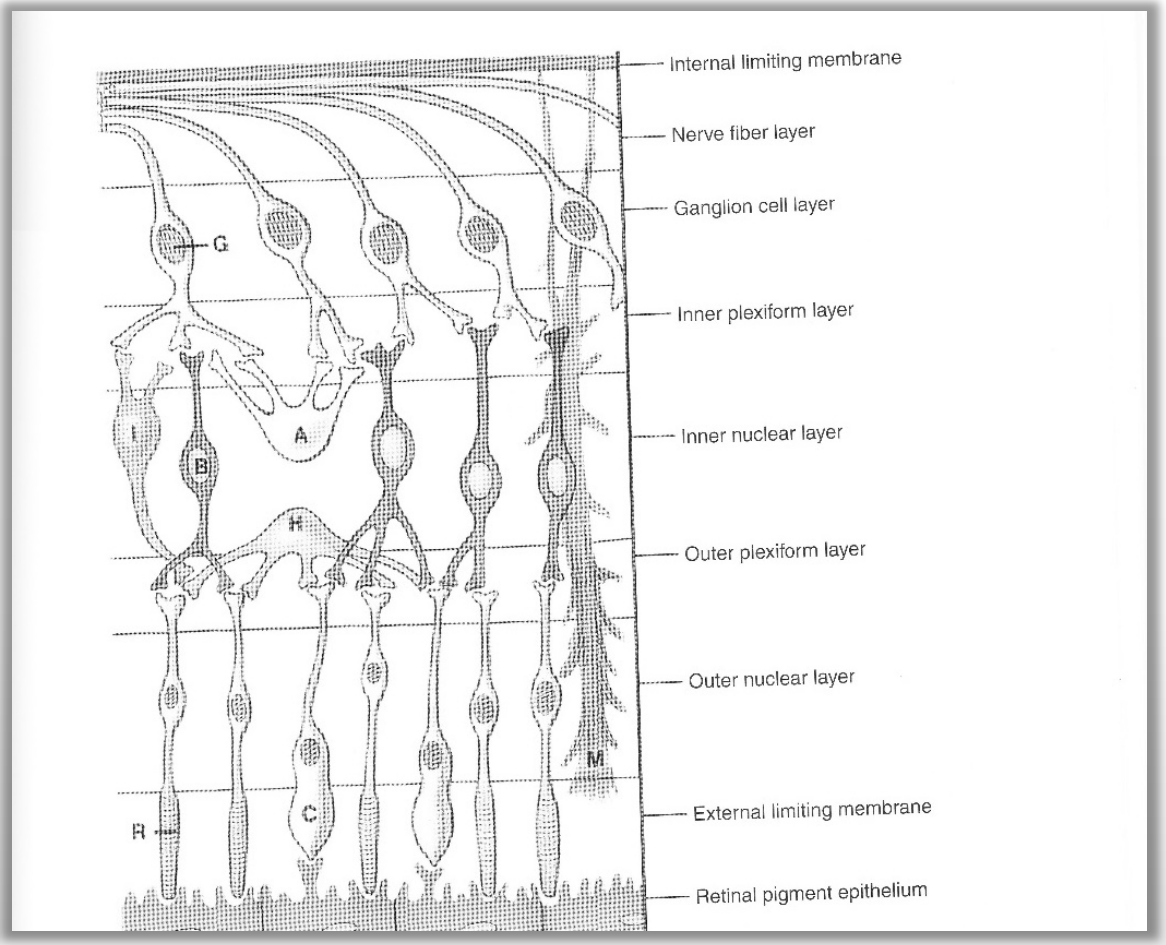

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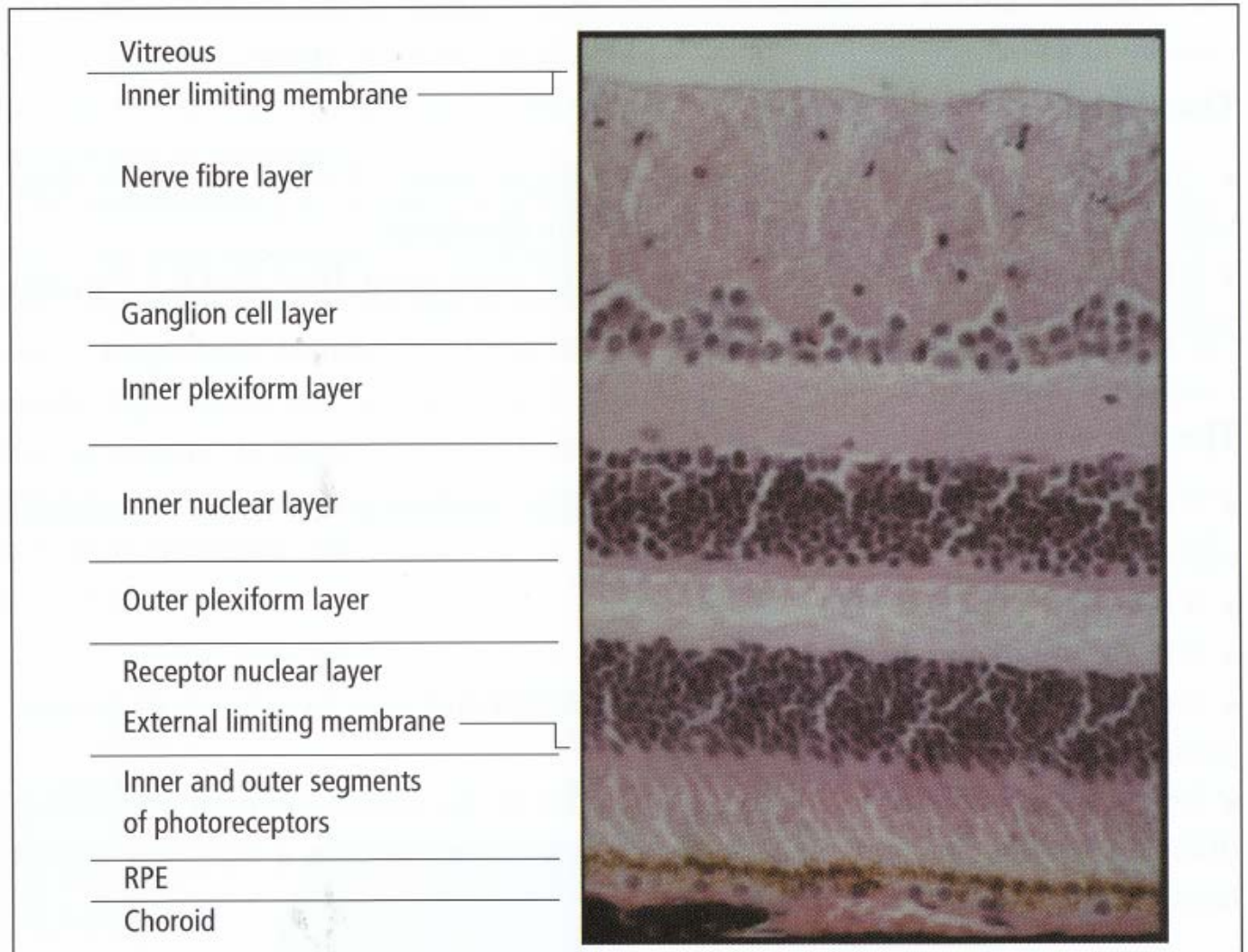
RETINAL MICRO-STRUCTURE



RETINAL MICRO-STRUCTURE

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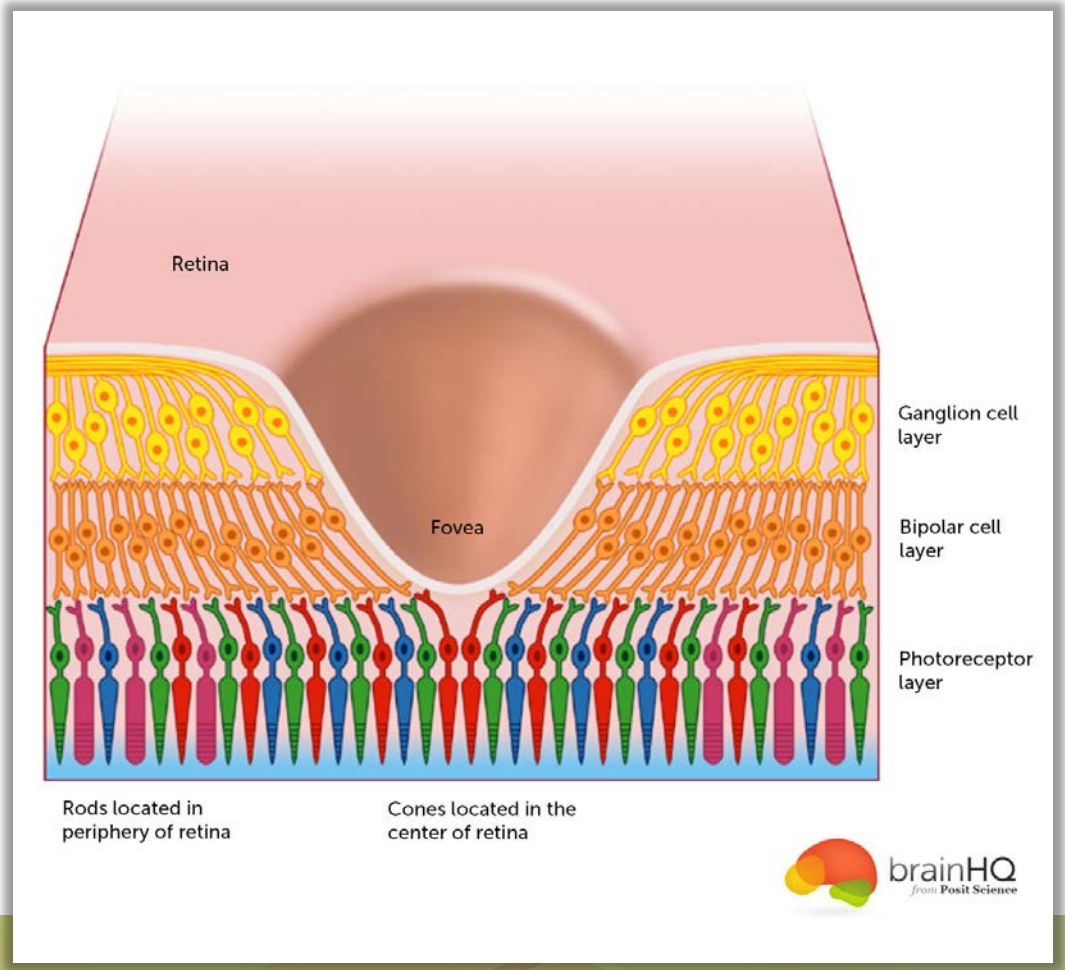
Fovea is within the central macula



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RETINAL MICRO-STRUCTURE

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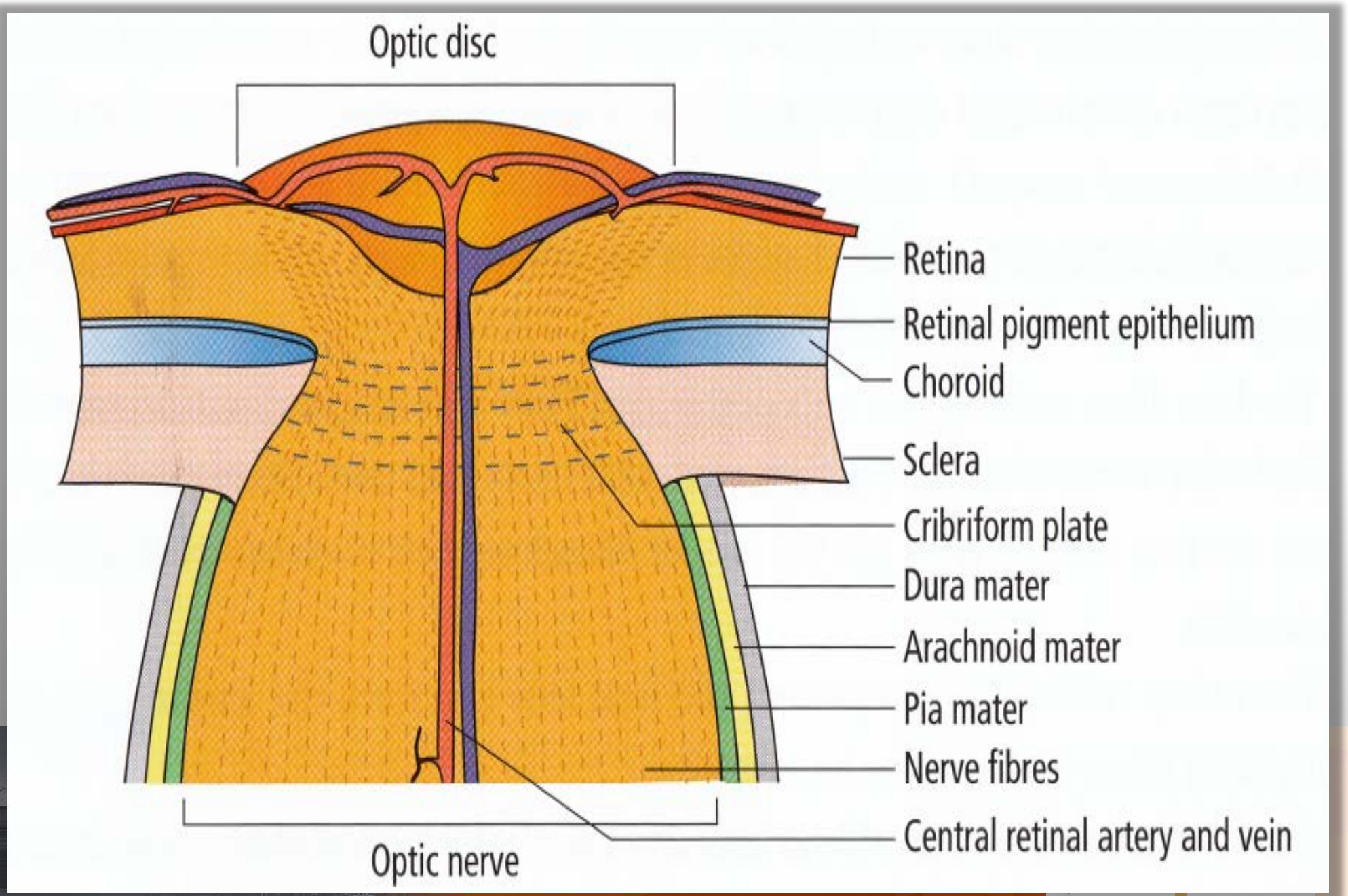
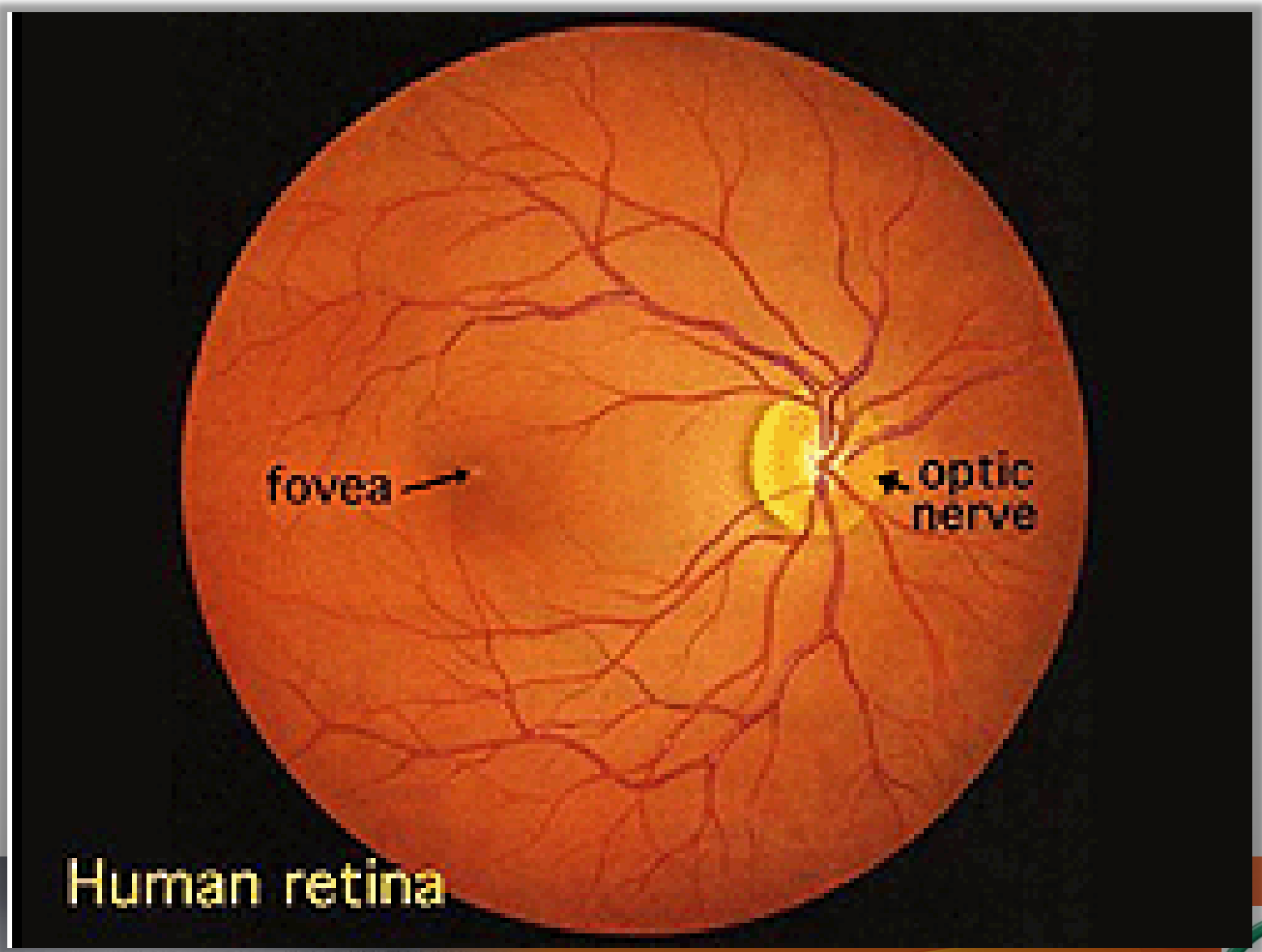


Temporal



Nasal

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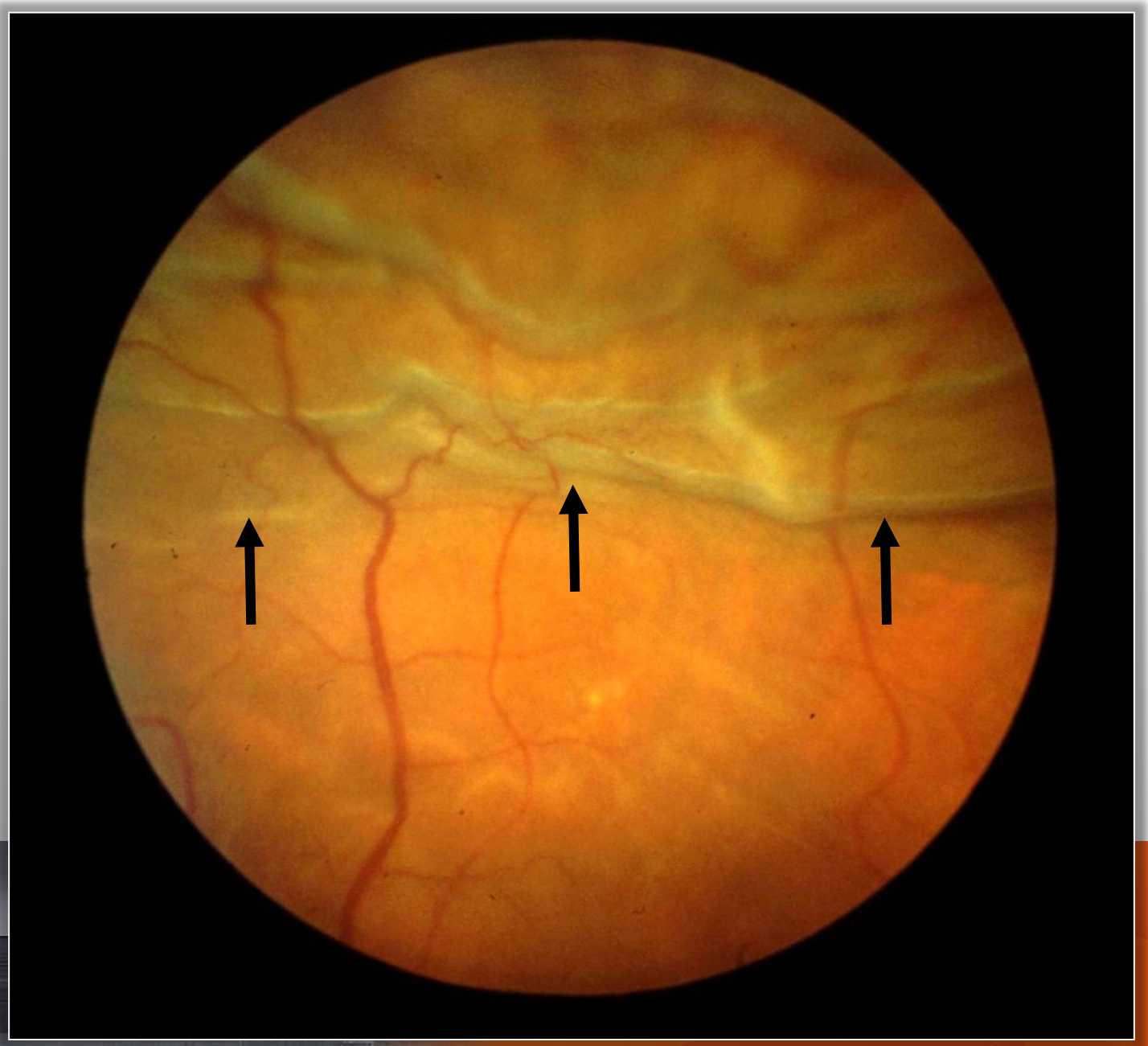
Superior Retinal Detachment



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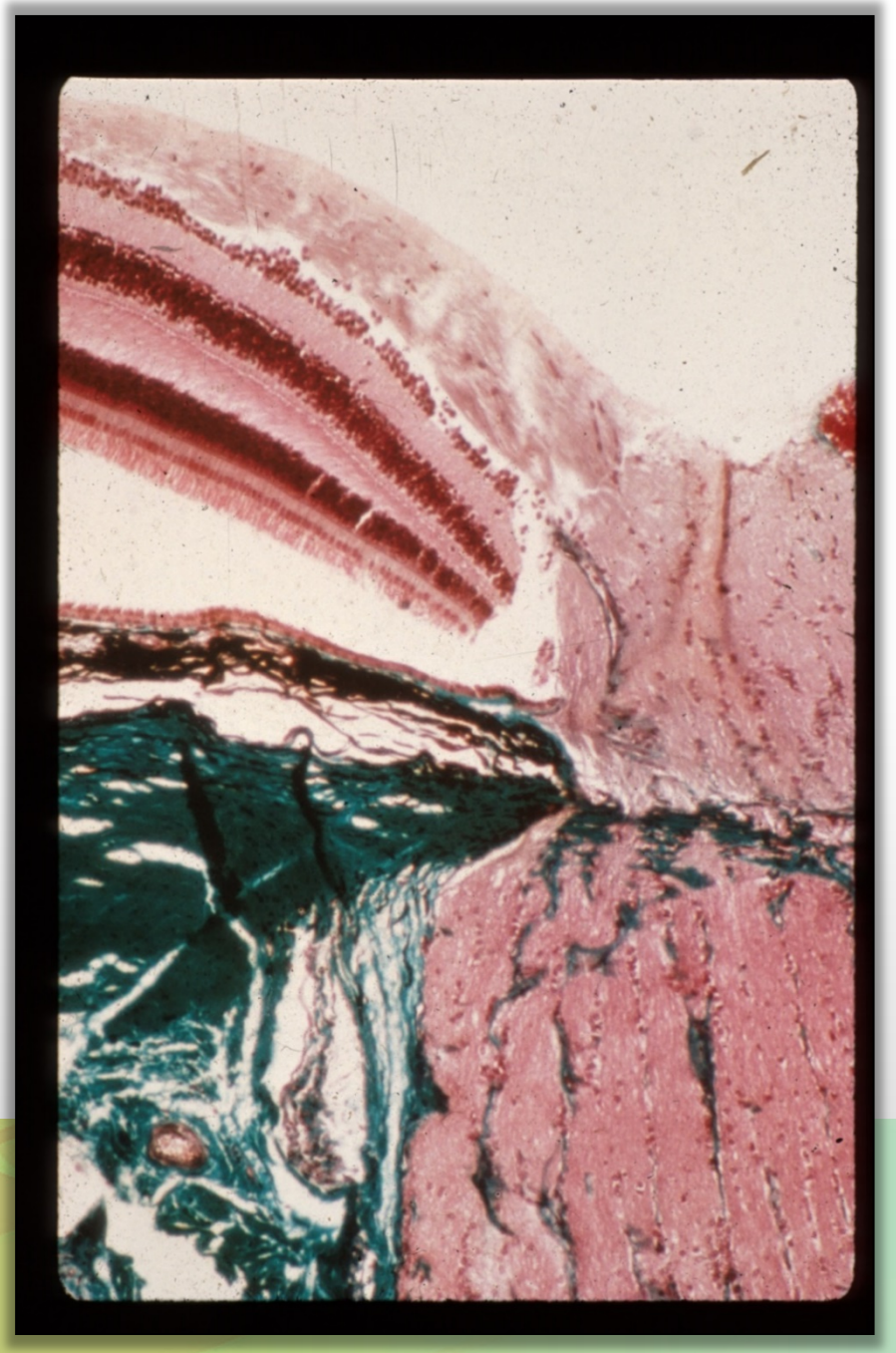
Optic nerve head and adjacent retina

(Masson's trichome)



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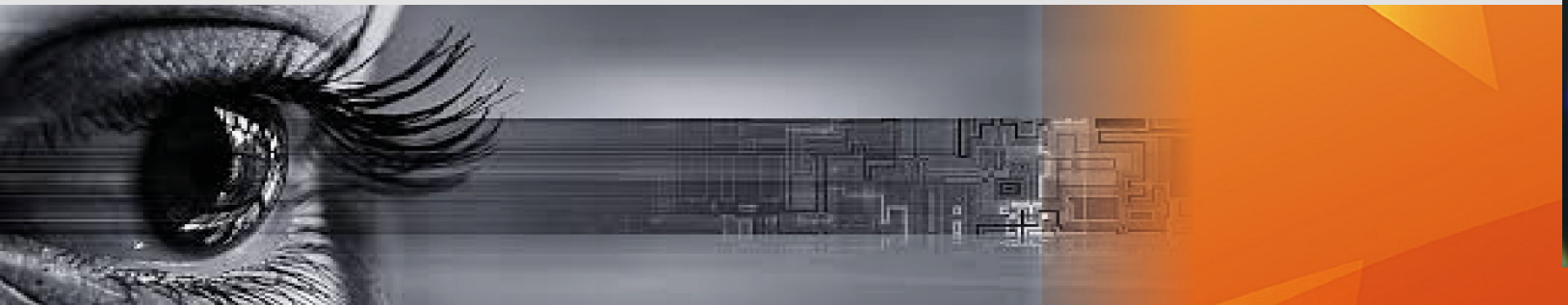
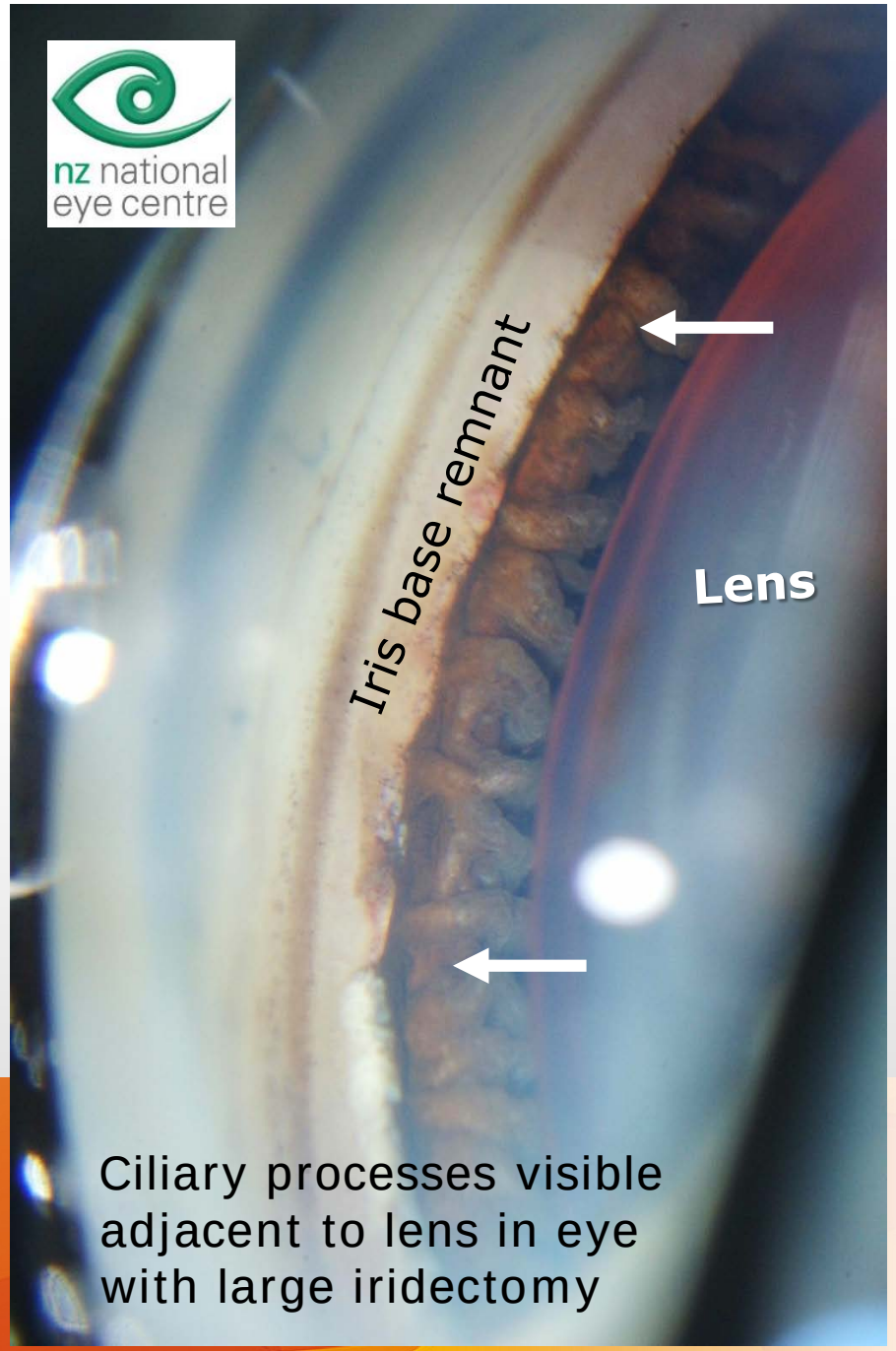
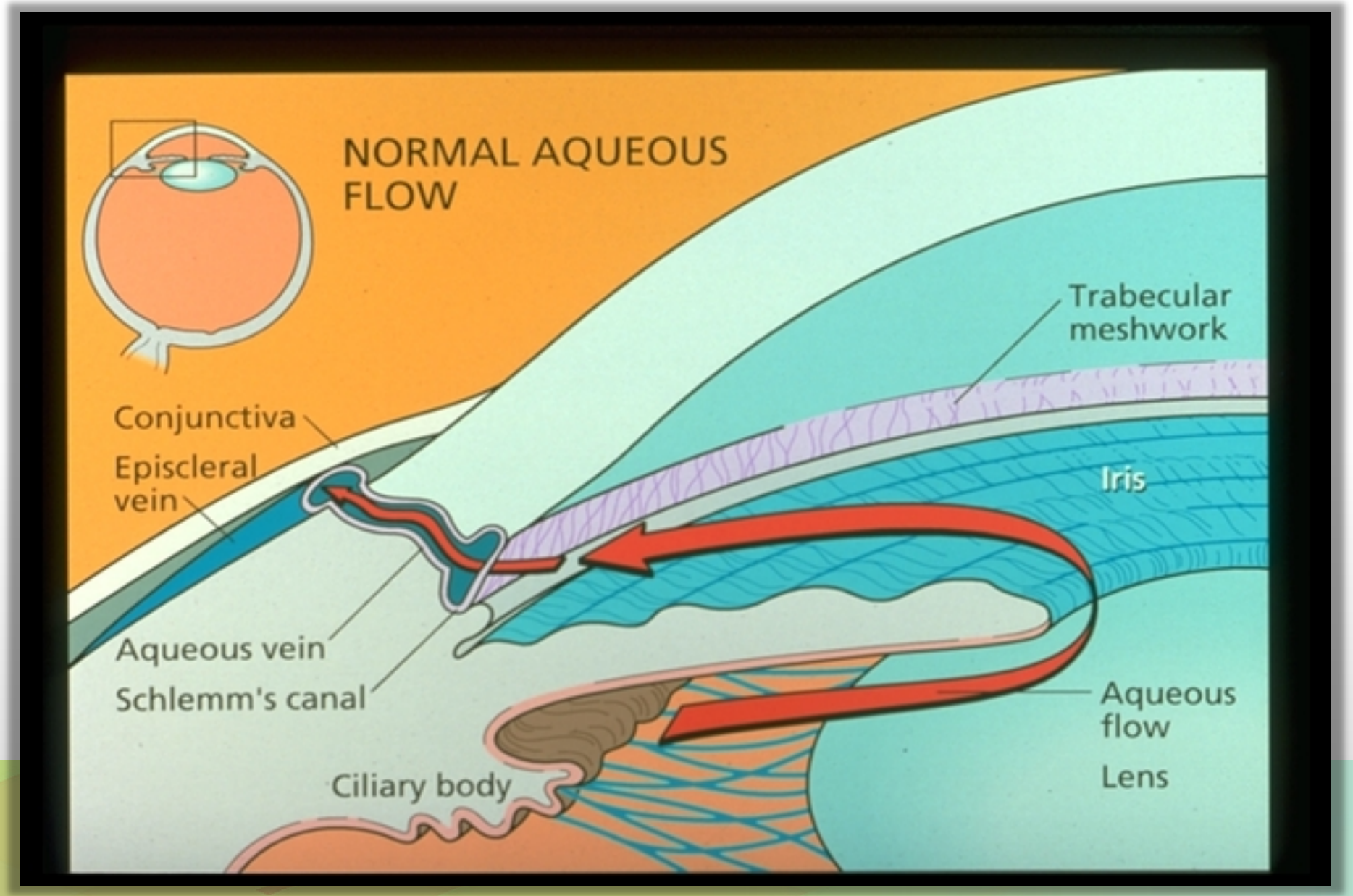
Ciliary Body

- Attachment of zonules (suspensory ligament of lens)
- Accommodation. Ciliary body smooth muscle
- Secretion of aqueous humour: Ciliary epithelium
  - Provides nutrition for the (avascular) cornea and lens
  - Maintains intraocular pressure





Ciliary processes visible adjacent to lens in eye with large iridectomy



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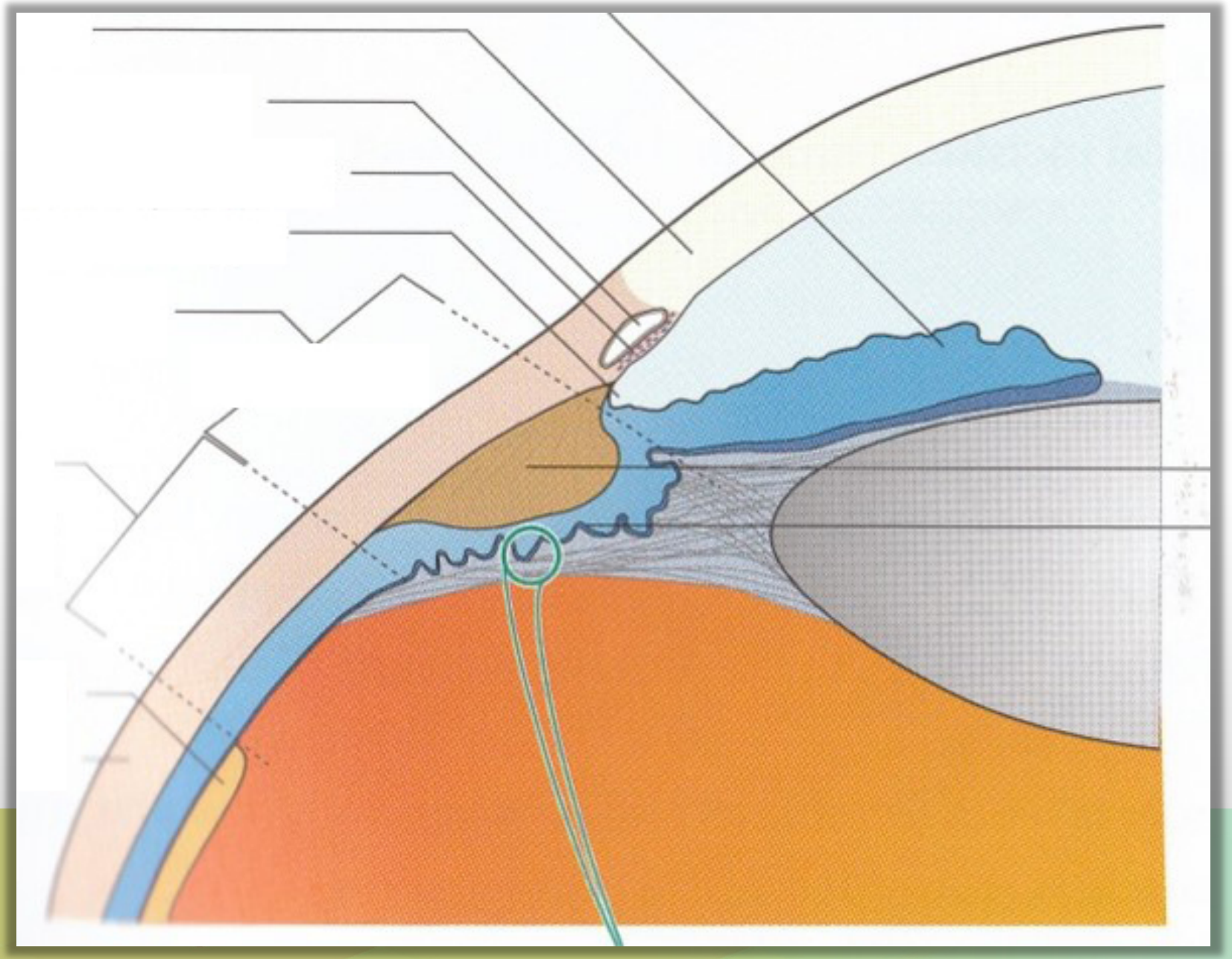
Name these ocular structures



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The Uveal Tract

The eye's vascular and immunological pool

Iris

Variable size of pupil (iris diaphragm) with light level with nearness of fixation

Ciliary Body

Aqueous, accommodation, zonule

Choroid

Nutrition of retina and sclera

The most vascular tissue in the body

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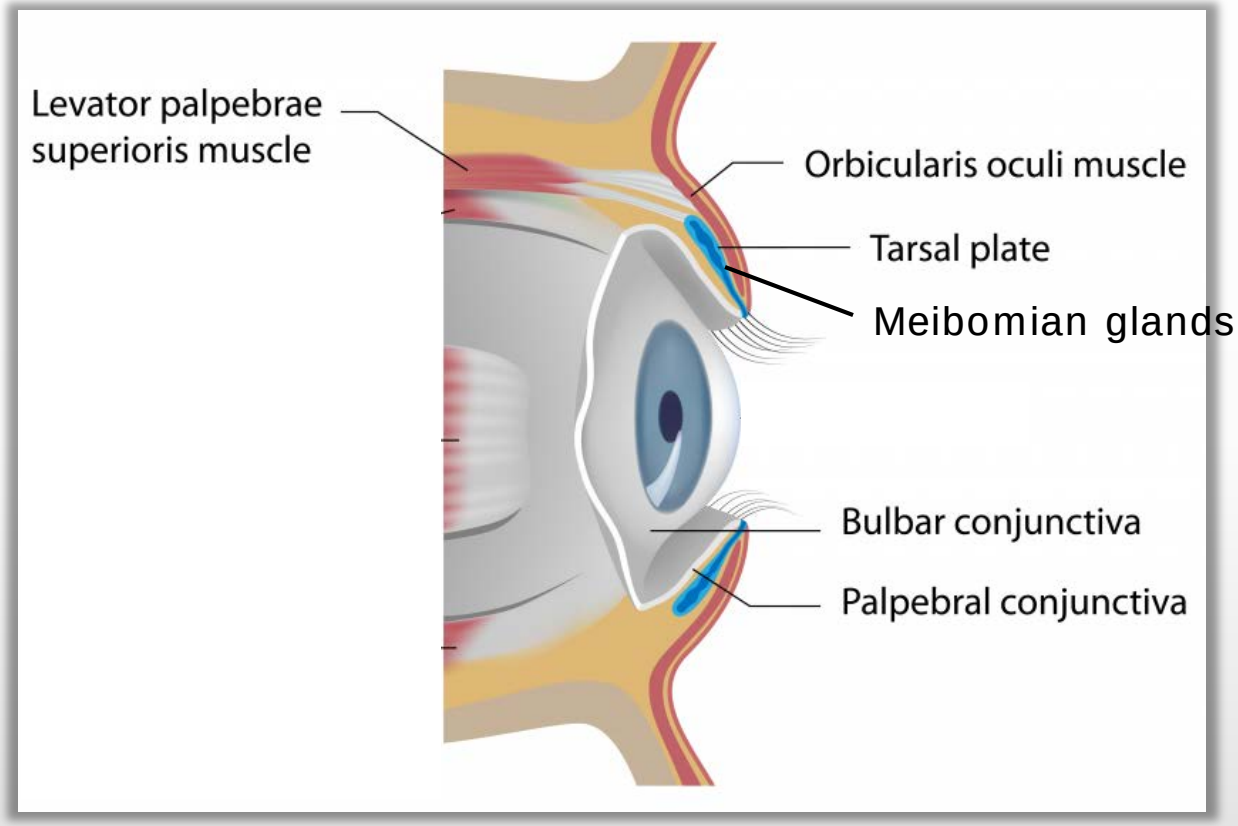
Eyelids and conjunctiva



1. Skin
2. Muscles
3. Tarsal plate - mechanical stability & Meibomian glands – oil layer of tear
4. Conjunctiva

   Attach eyeball to orbit & lids & permits rotation

Functions: Distribute tears, clear debris, cover eyes during sleep & prevent evaporation, protect from foreign bodies via the blink reflex

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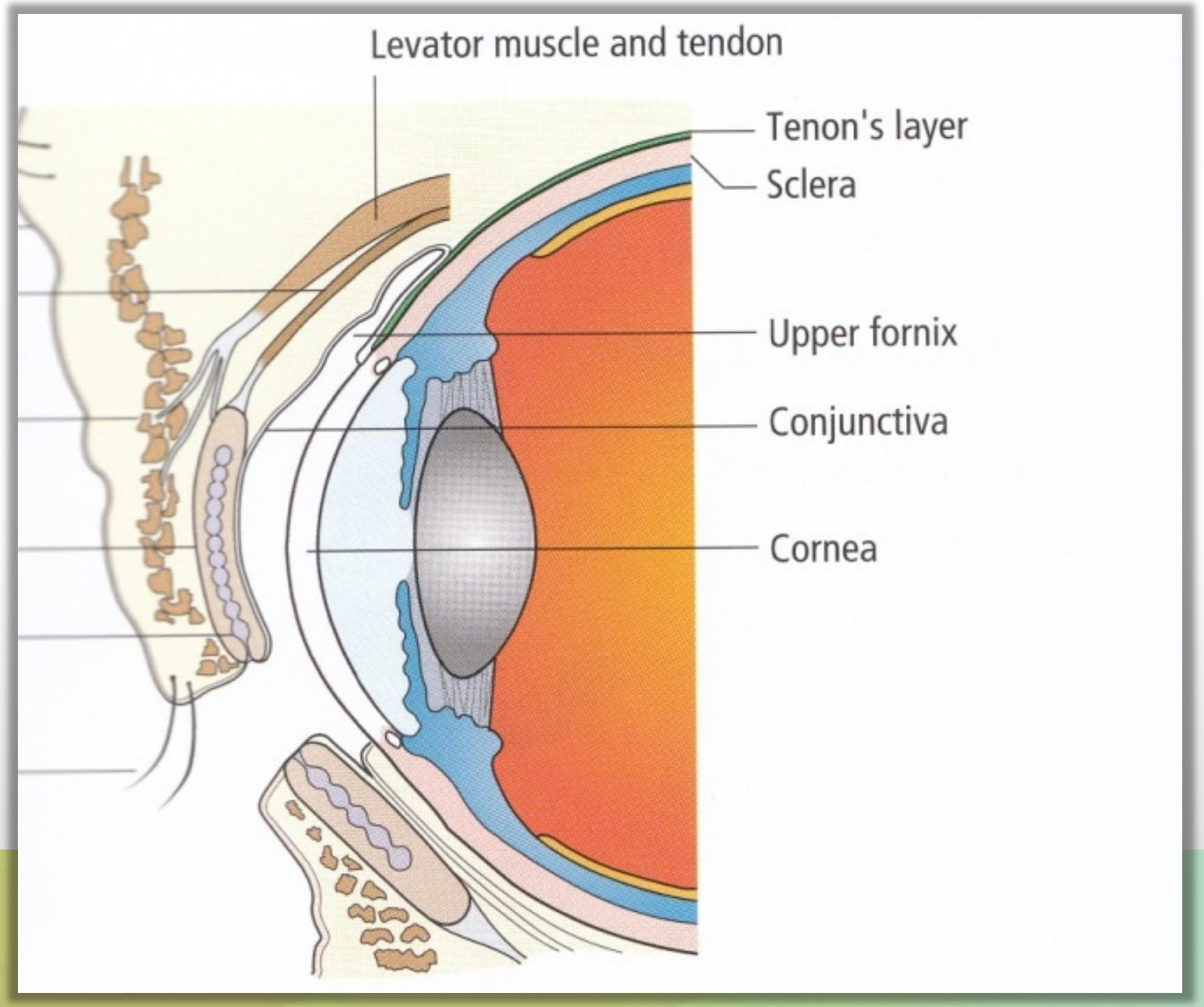
Eyelids and conjunctiva



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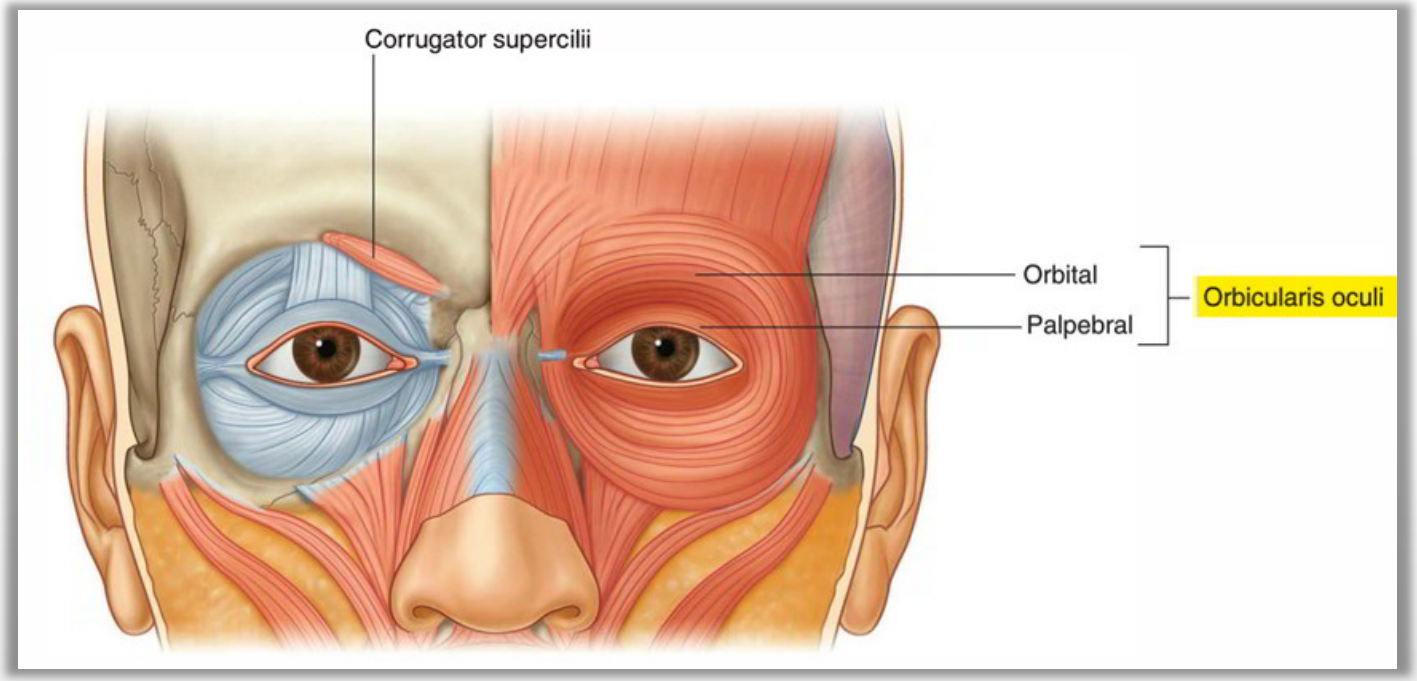
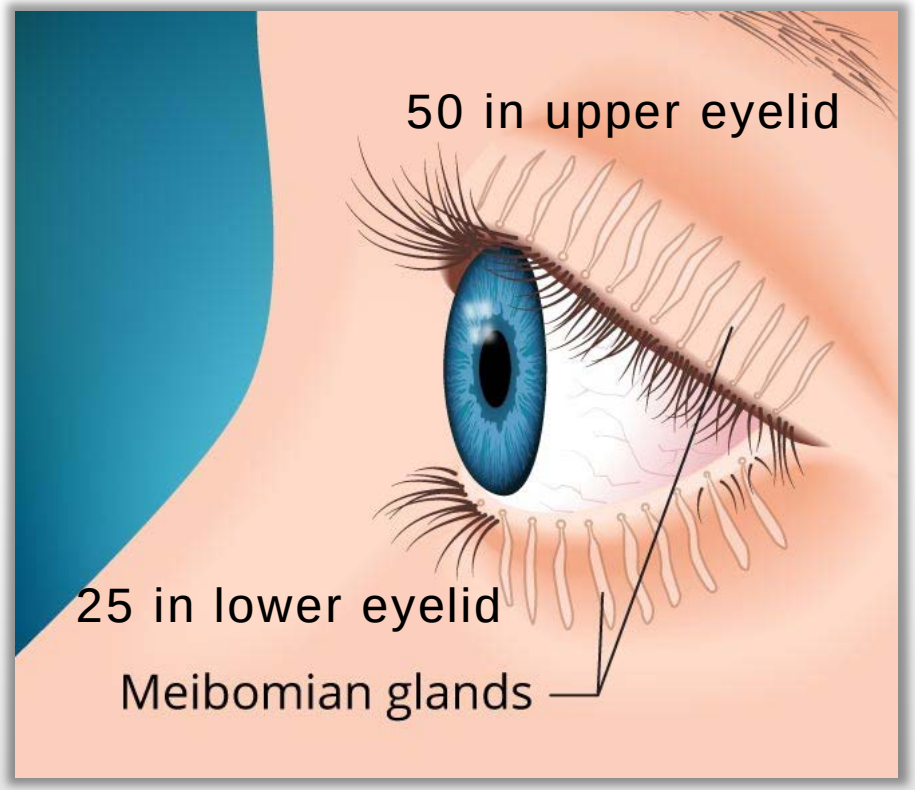
Orbicularis oculi and eyelids



Orbicularis oculi muscle



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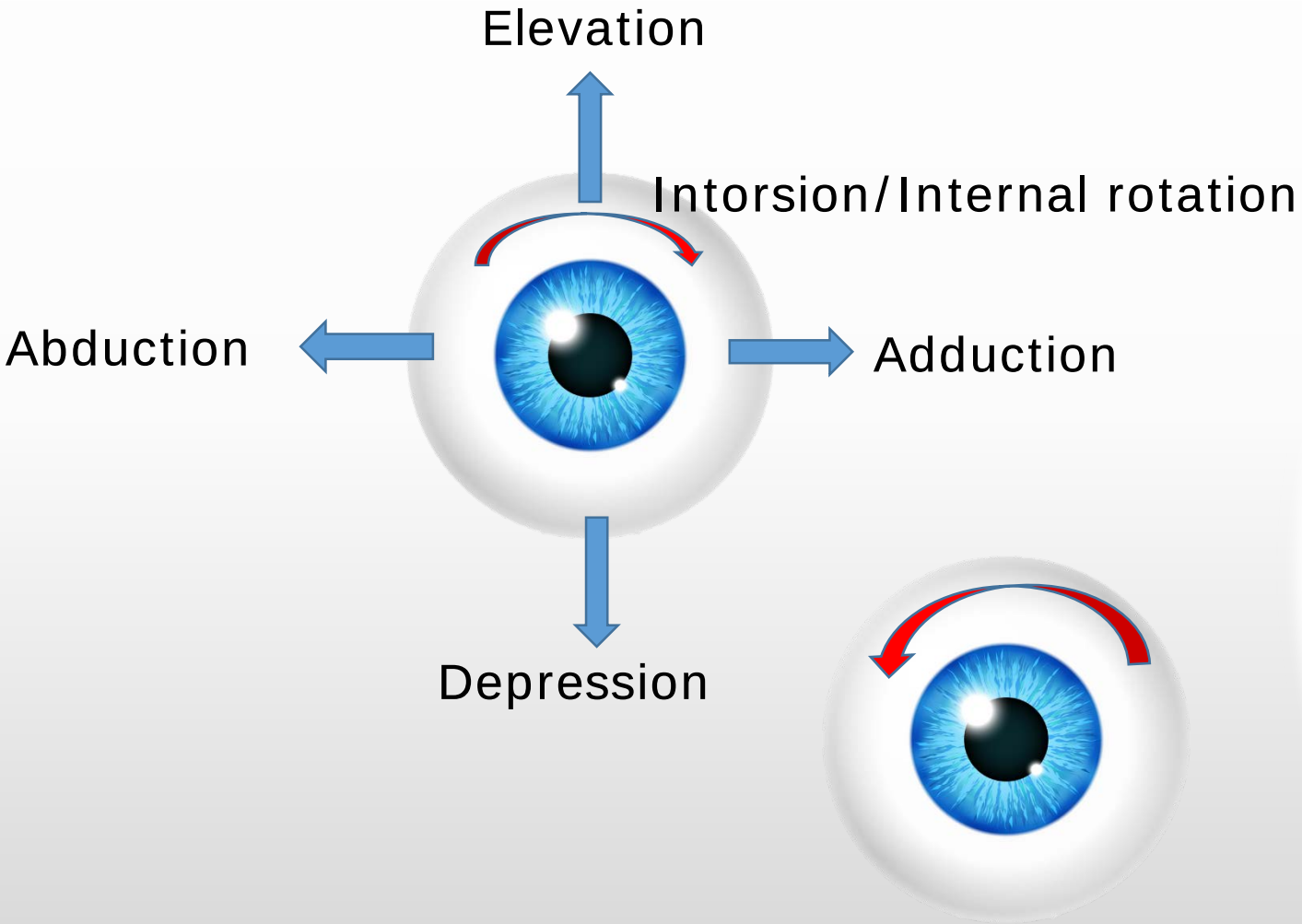
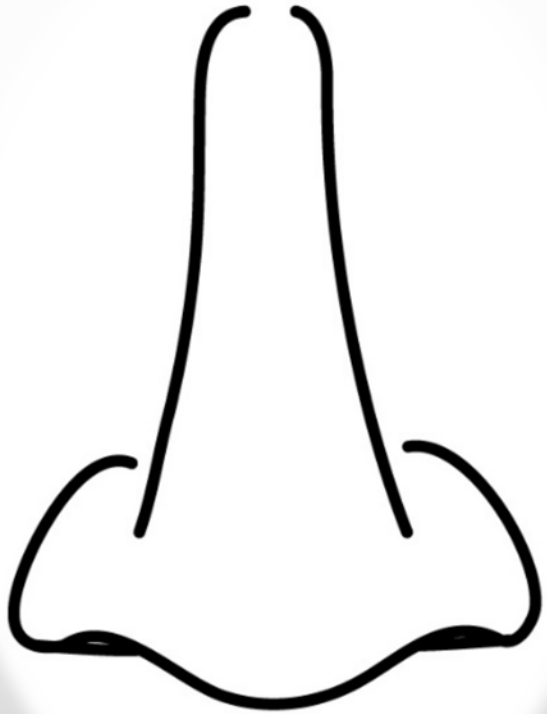
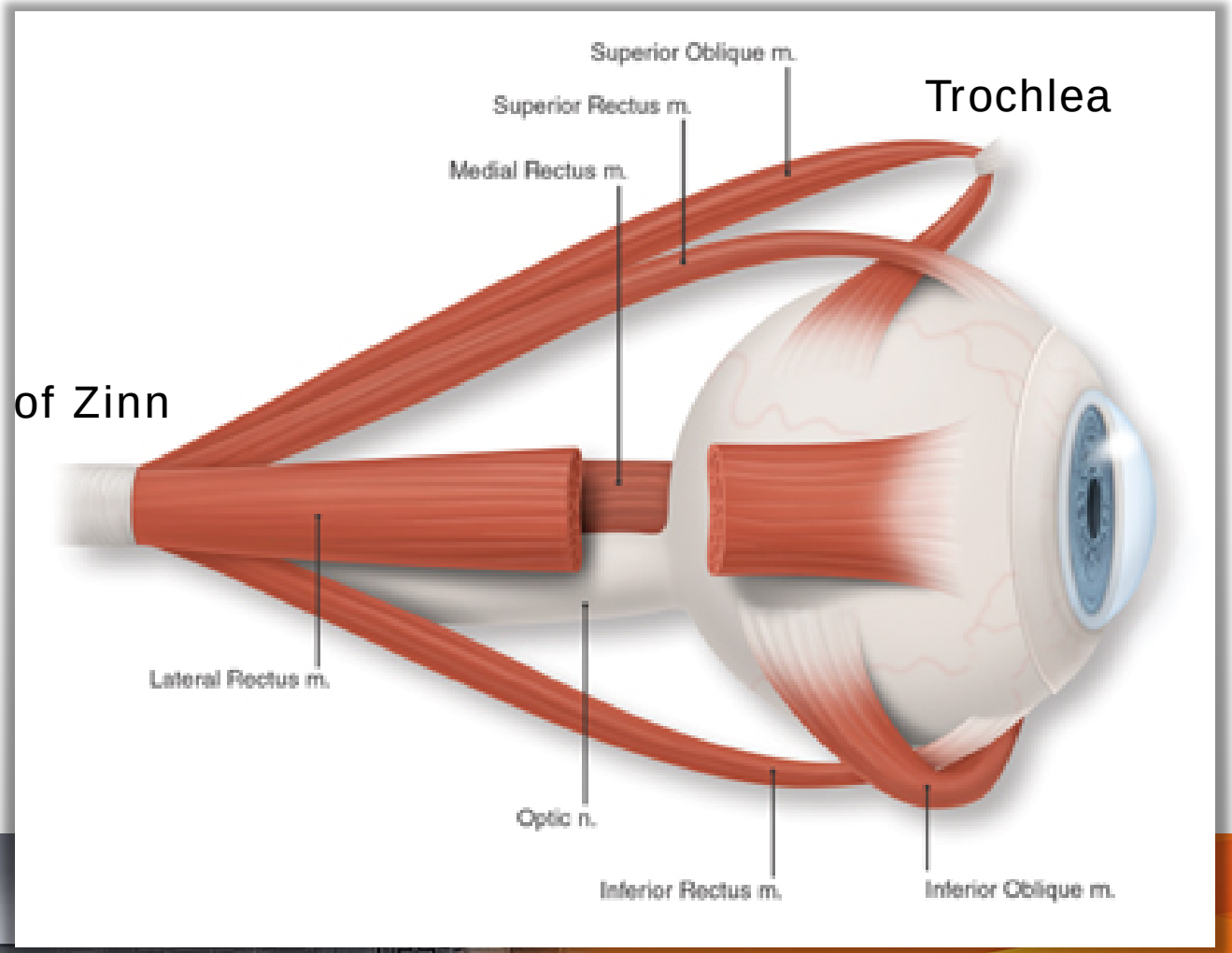
Eye movements





Extra-ocular muscles



Trochlea

Annulus of Zinn

Extra-ocular muscles

- Medial rectus. Adducts.
- Lateral rectus. Abducts.
- Superior rectus. Elevates.
- Inferior rectus. Depresses.
- Superior oblique. Intorts. depresses, abducts.
- Inferior oblique. Extorts. elevates, abducts.

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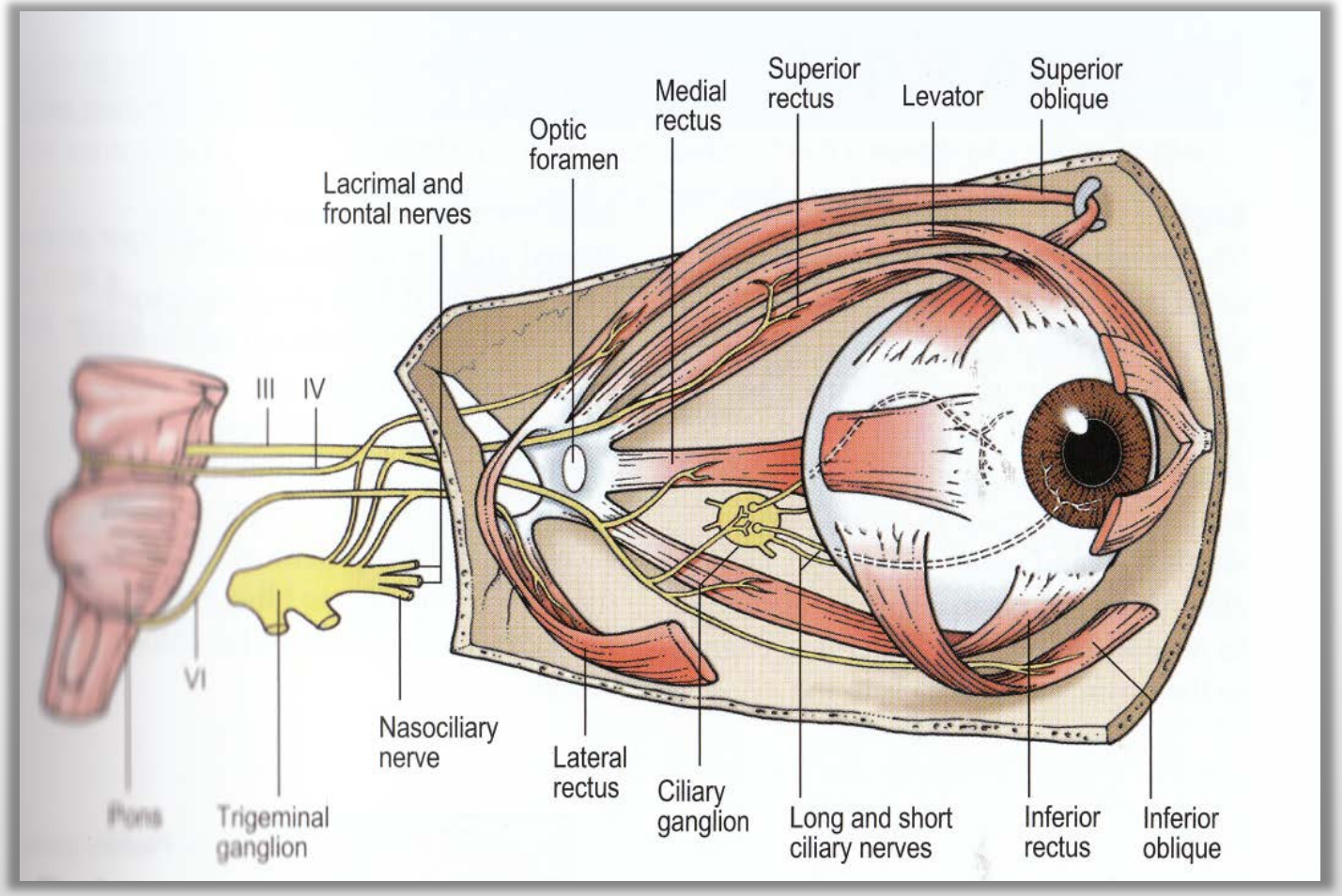
Innervation of extraocular muscles

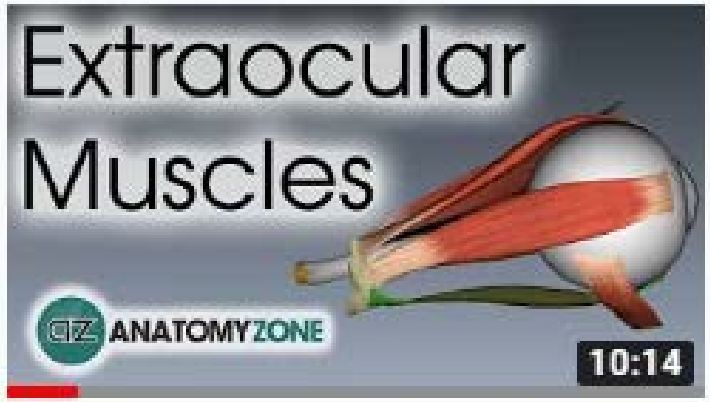


Lateral Rectus Muscle → "Abducts" → Innvervated by Abducens nerve = Cranial nerve 6

Superior Oblique Muscle → Passes through the "trochlea" → Innervated by Trochlear nerve = Cranial nerve 4

The other 4 muscles → Produce "ocular movements" → Innervated by Oculomotor nerve = Cranial nerve 3

Extraocular muscles video



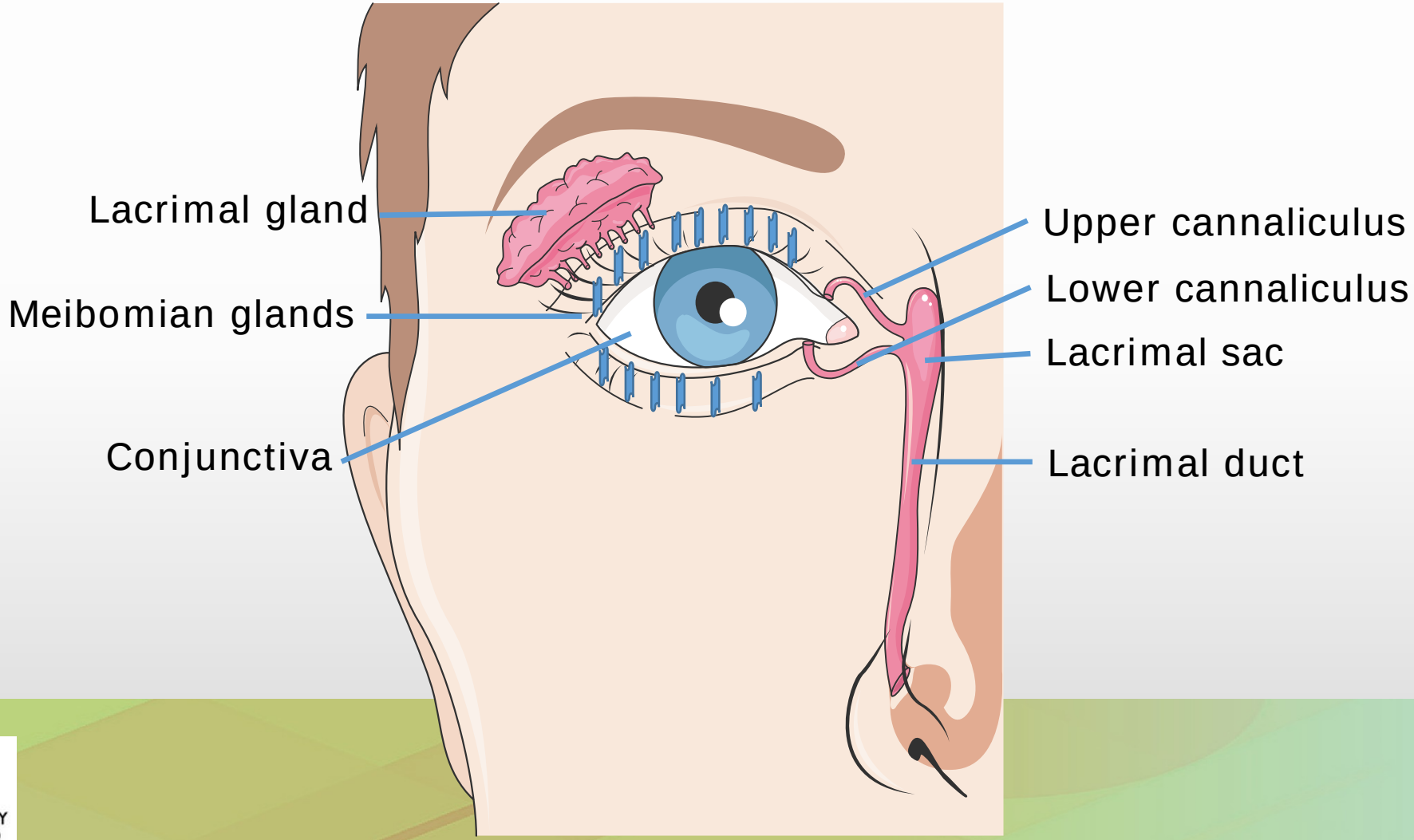
Extraocular Muscles | Eye Anatomy

AnatomyZone 460K views • 3 years ago

Extraocular muscles - second video in eye anatomy series. Check out the 3D app at http://AnatomyLearning.com. More videos ...

Search for ‘extraocular muscles eye anatomy’ on youtube
https://www.youtube.com/watch?v=f_rb6FMVHPk&t=7s

Tear production and drainage



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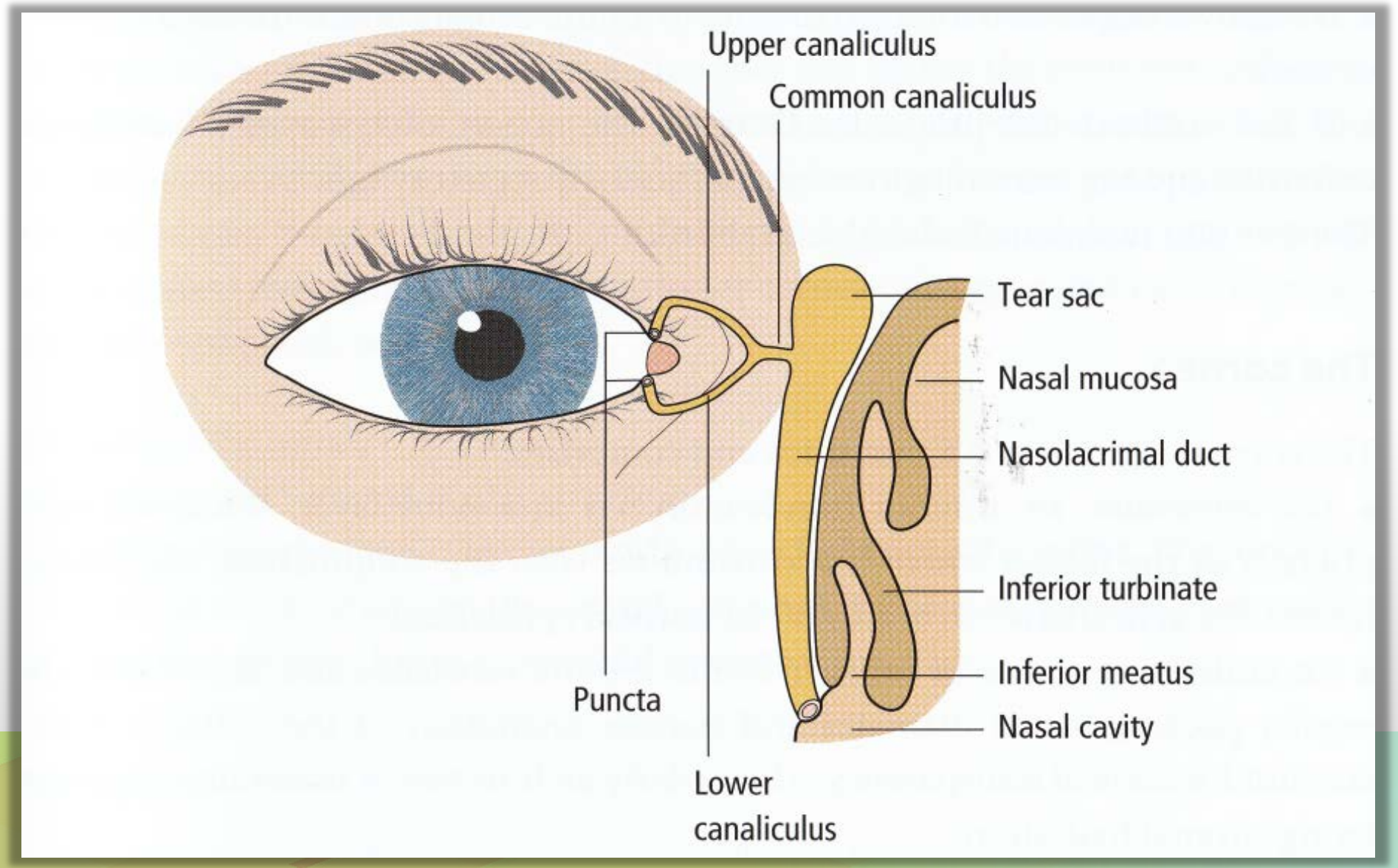

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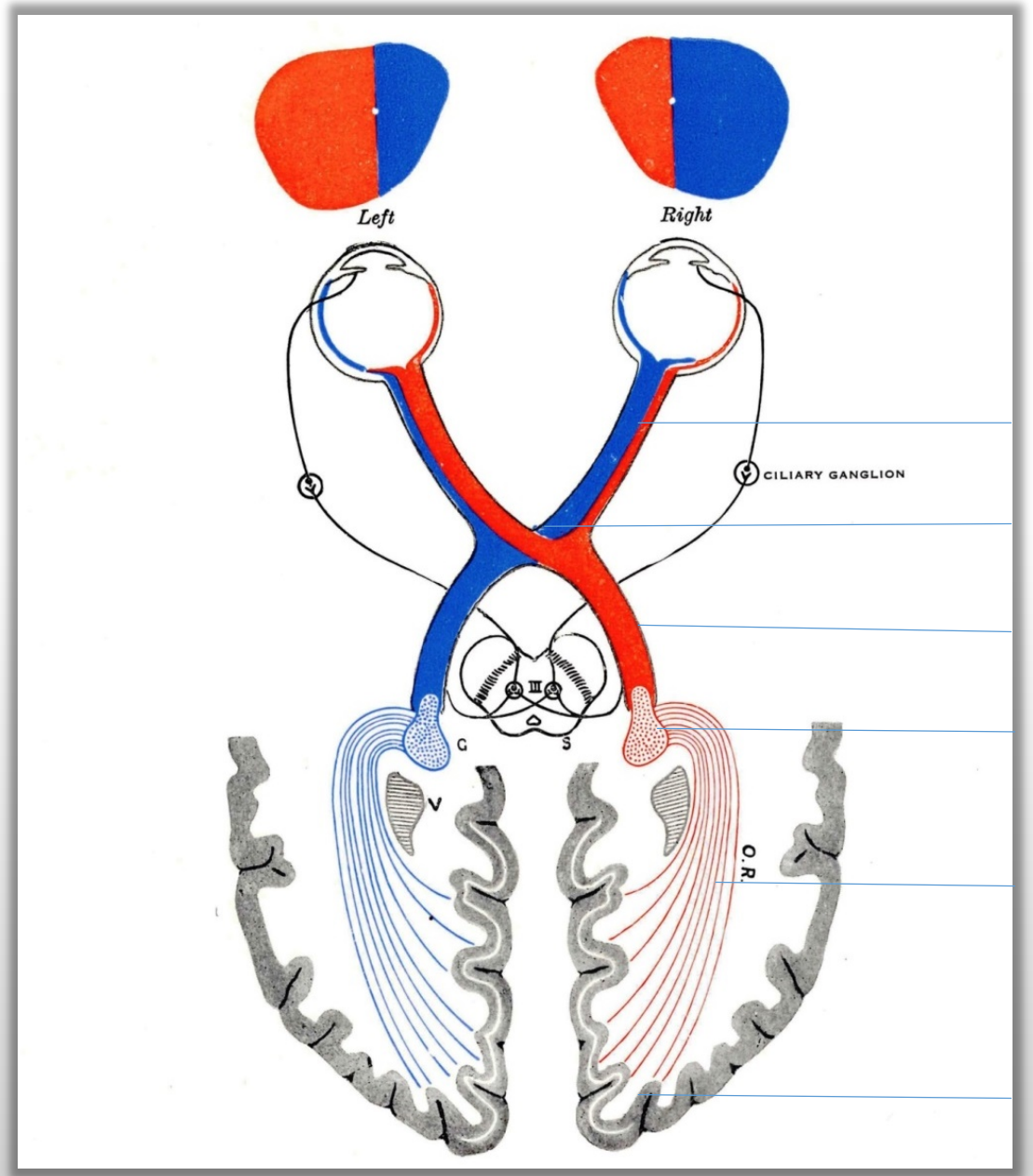
Visual Pathway



Optic nerve

Optic chiasm

Optic tract

Lateral geniculate nucleus

Optic radiation

Primary visual cortex

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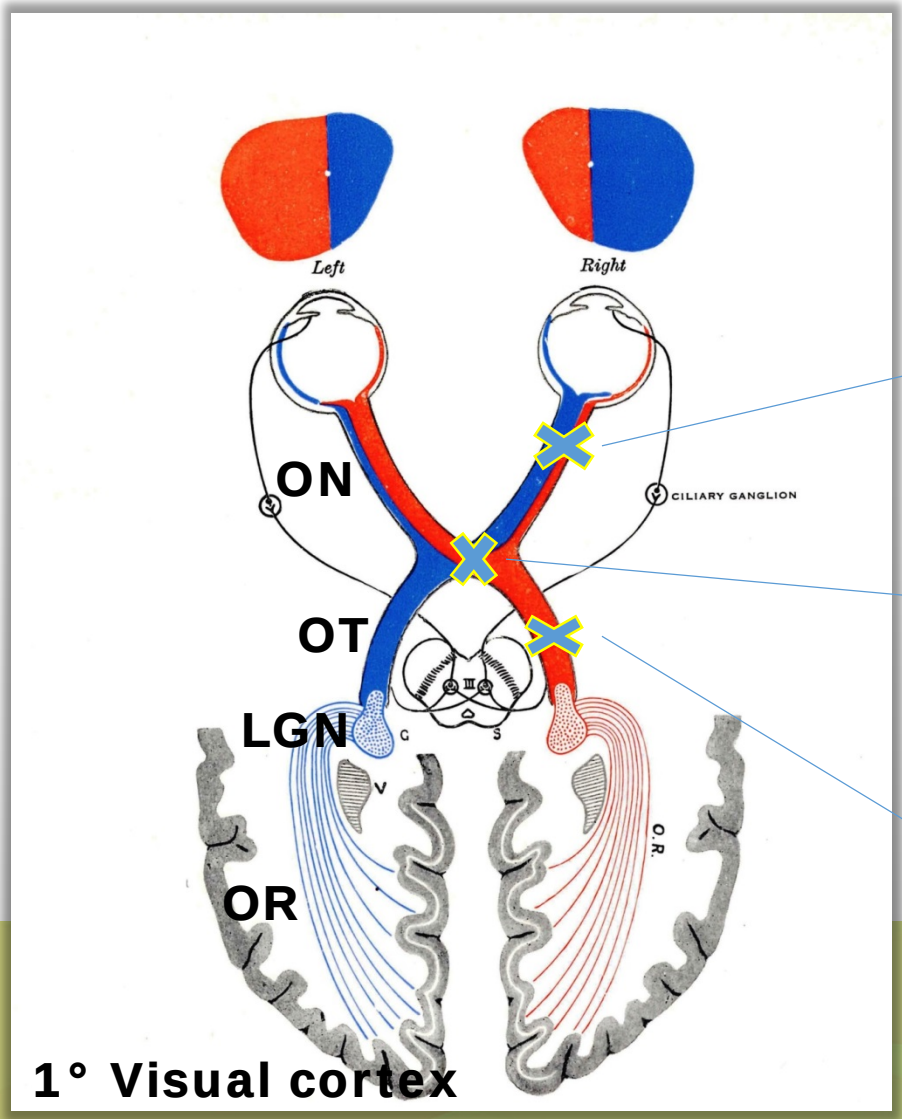
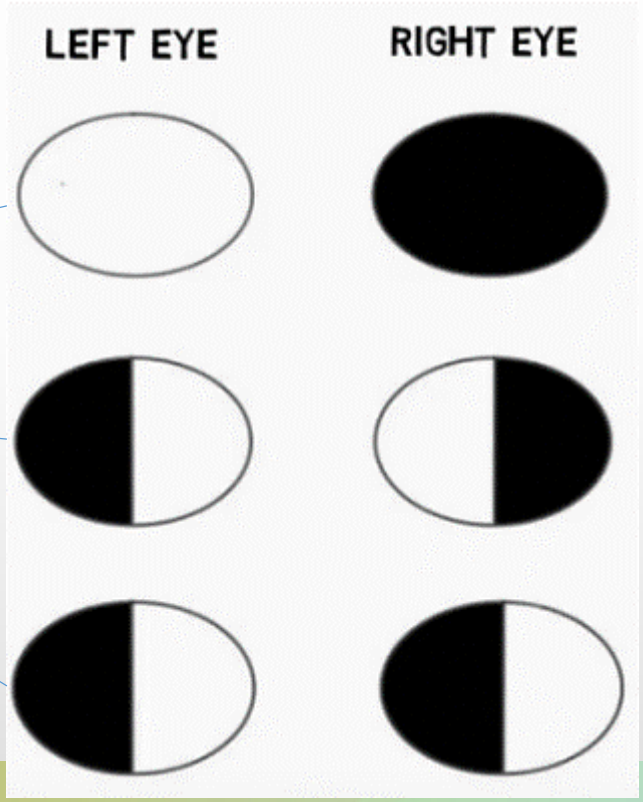
Injuries to Visual Pathway





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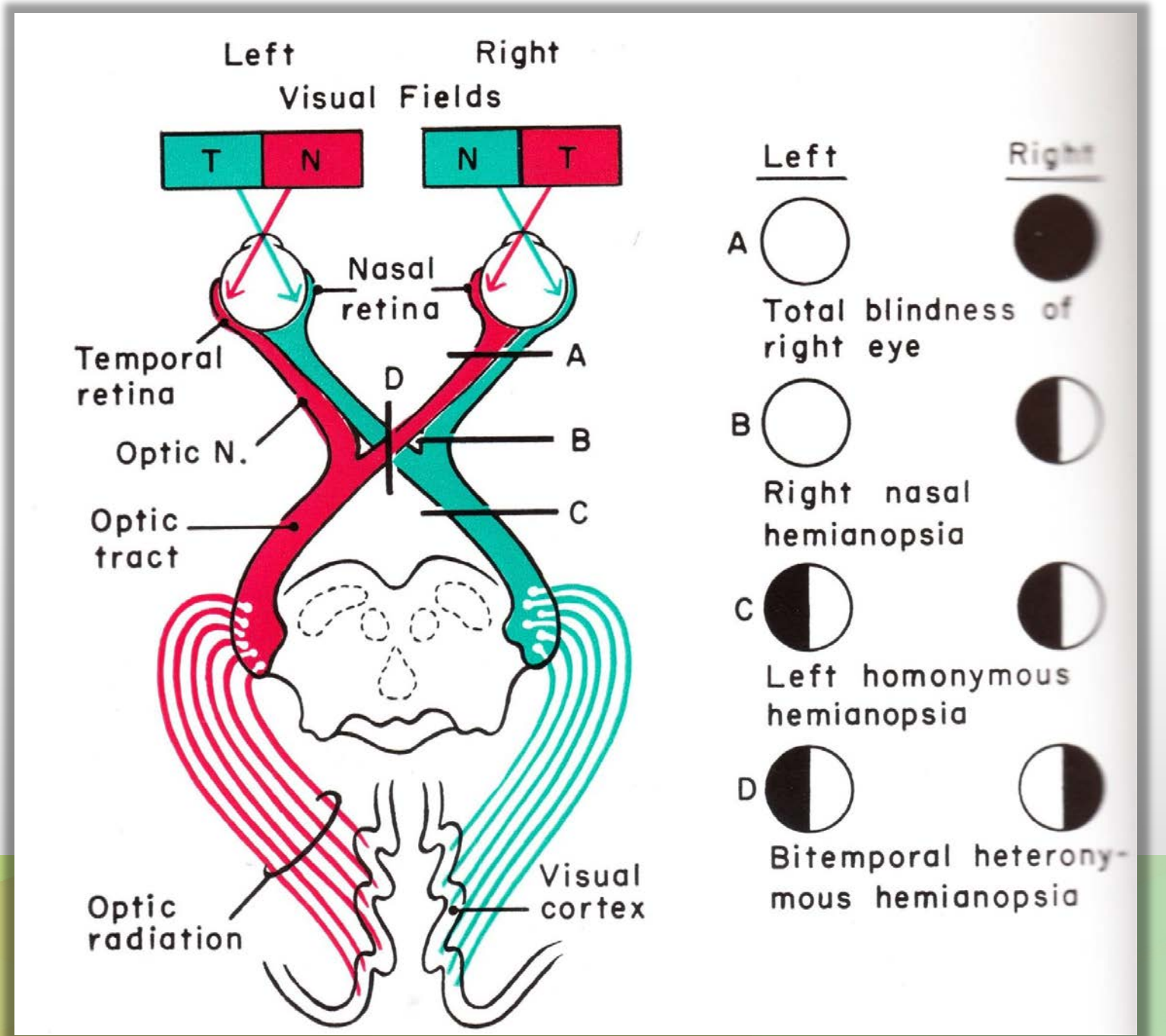

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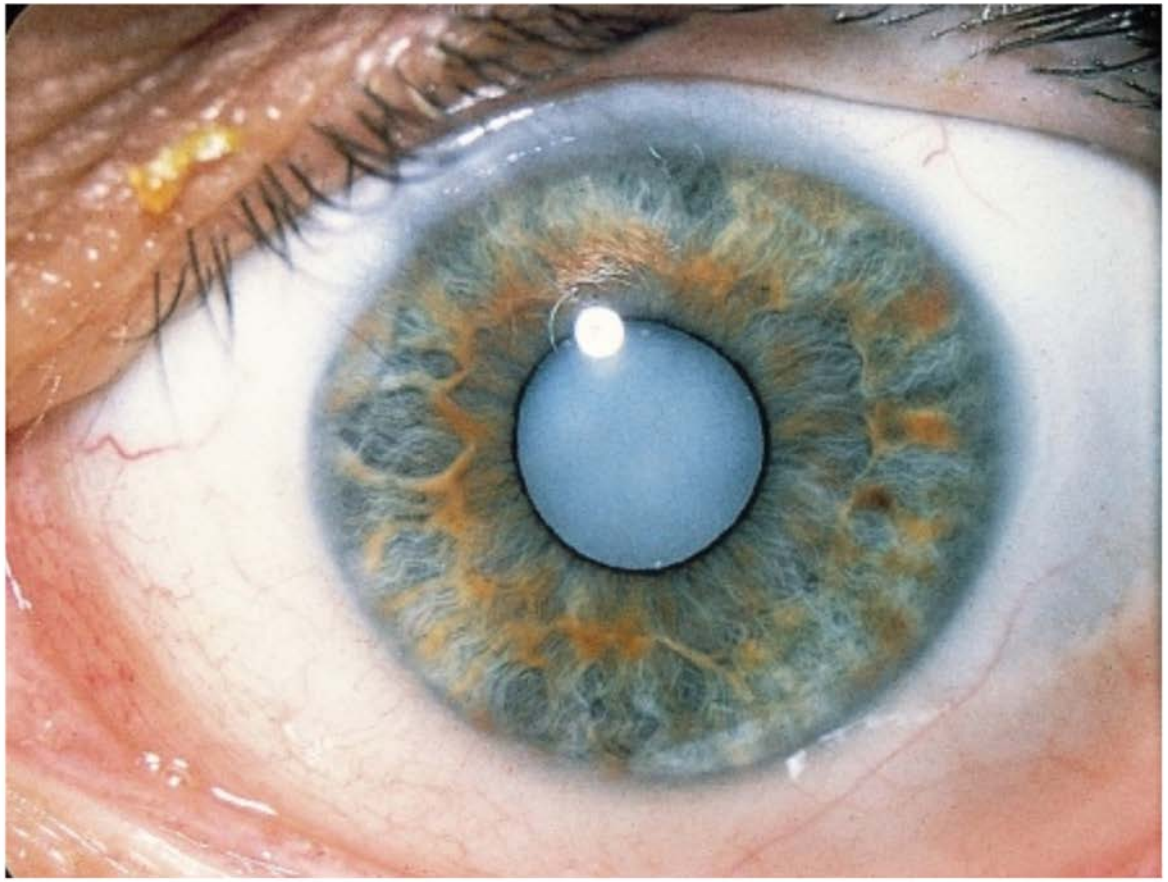
Cataract of the crystalline lens



Age of onset

- Congenital
- Age-related

Location

- Nuclear sclerotic
- Cortical
- Posterior
- Subcapsular

Cause

- Age-related
- Traumatic
- Diabetic

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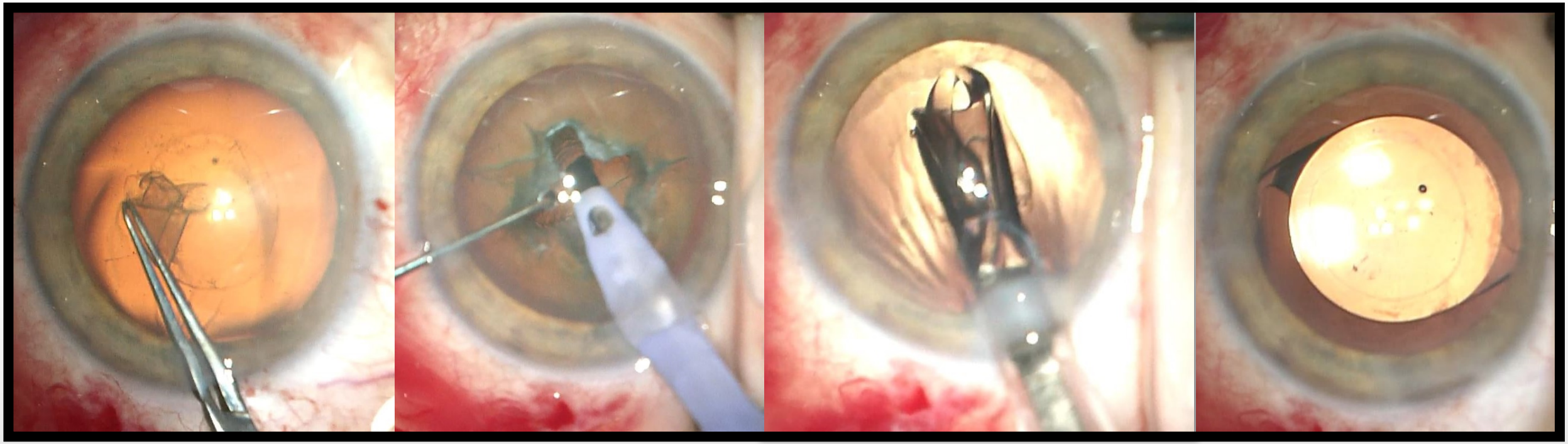
Phacoemulsification cataract surgery



Capsulorrhexis | Phacoemulsification | Injection of foldable IOL | IOL in capsular bag

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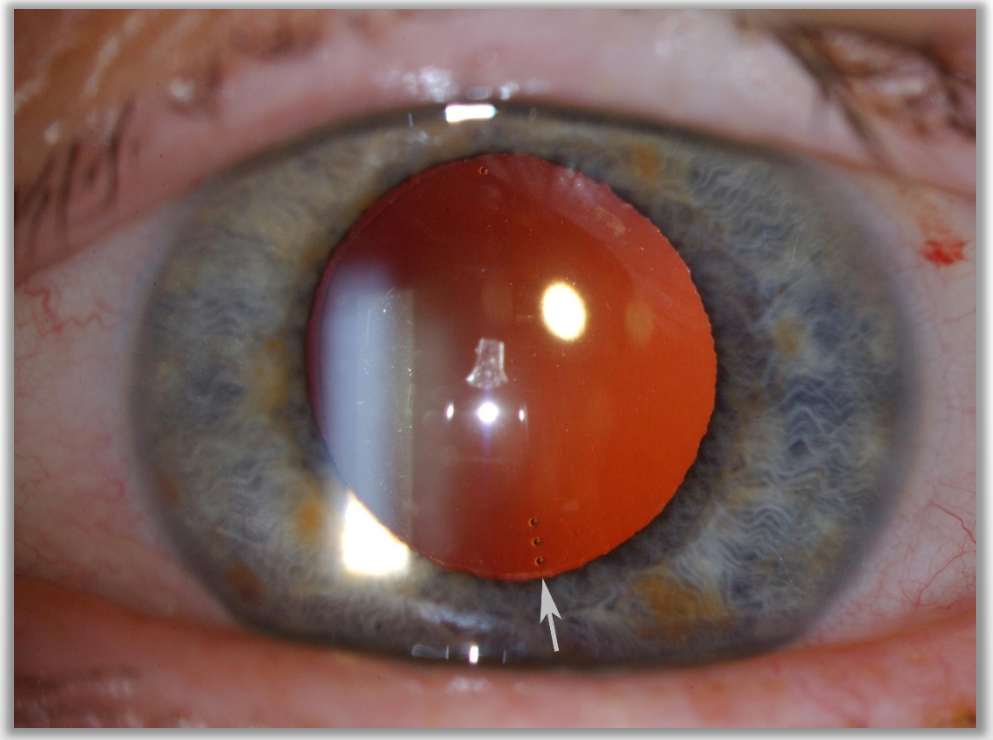
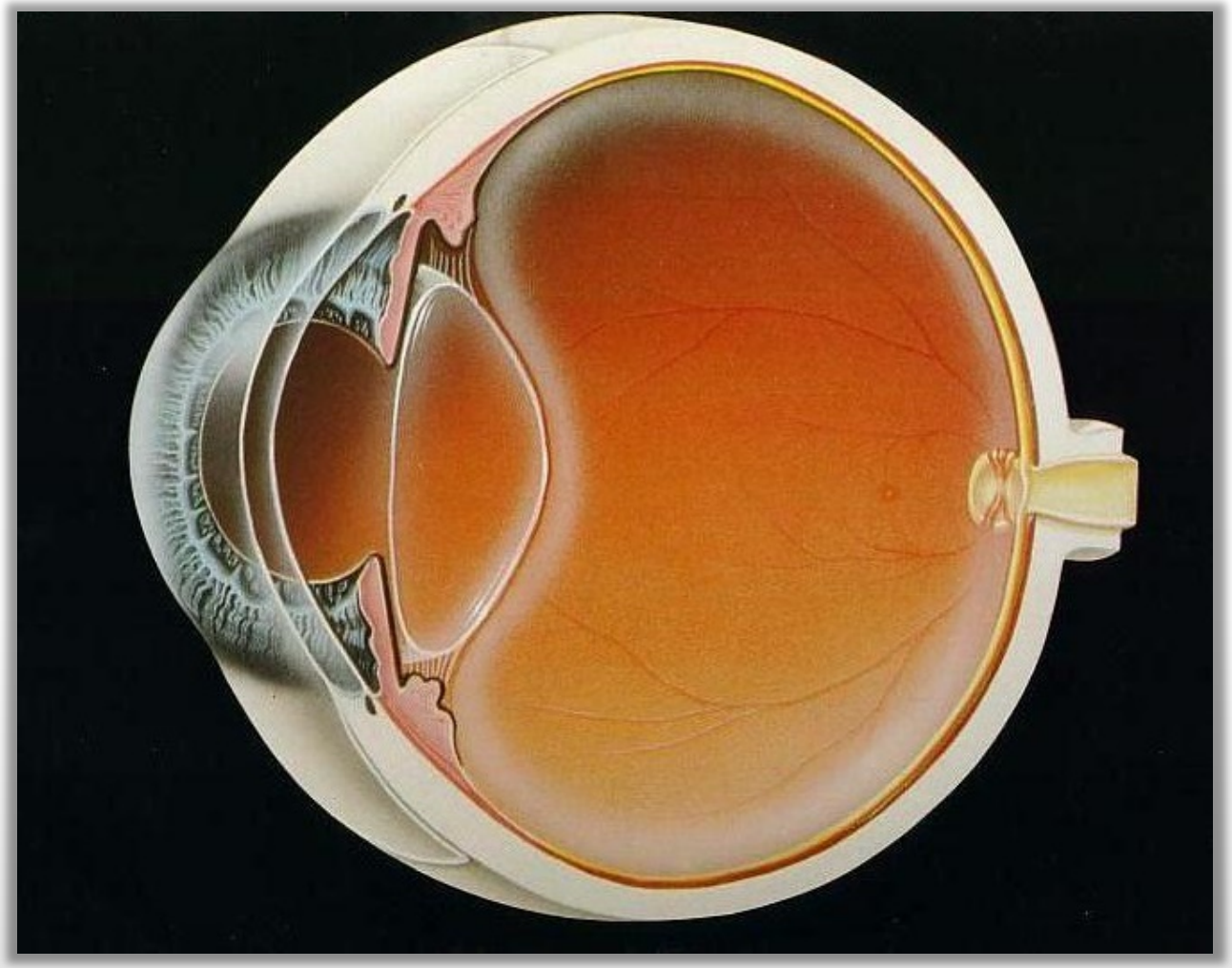
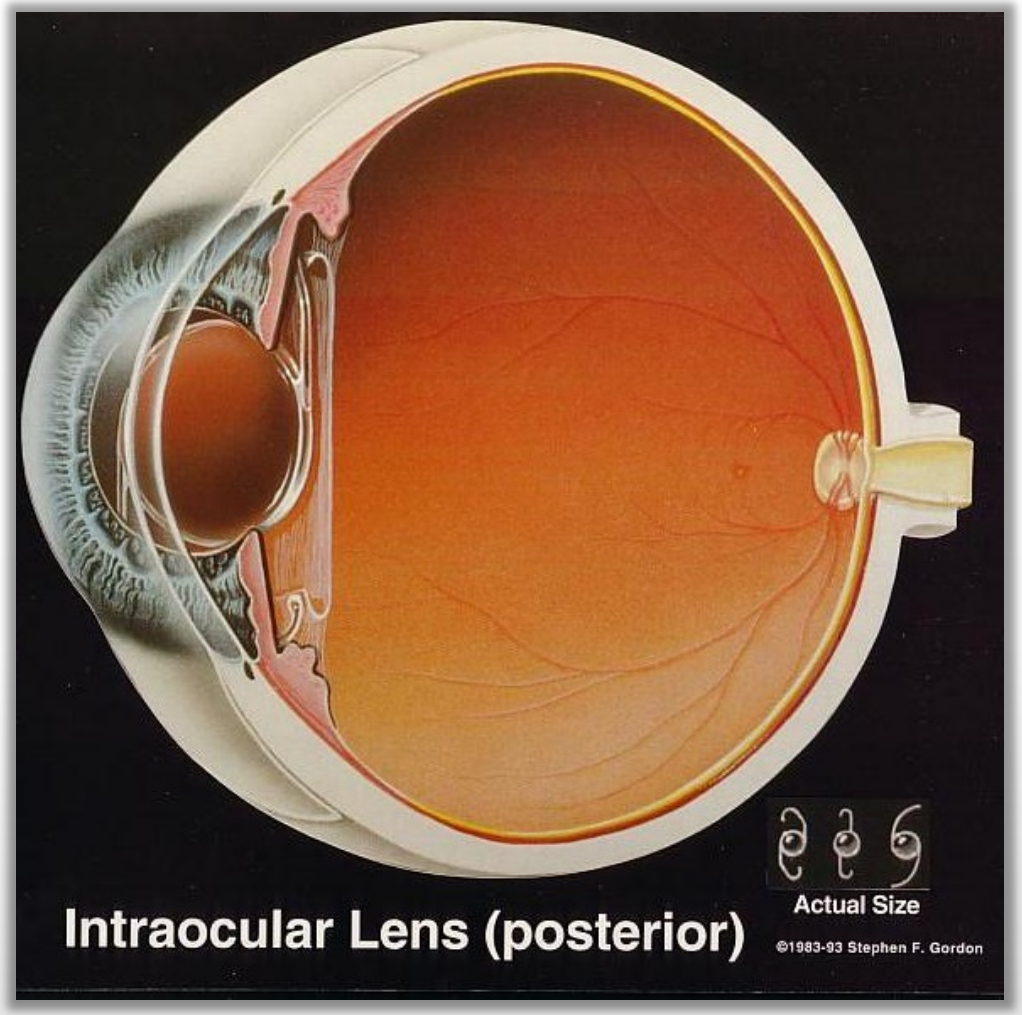
Intra-ocular lens (multifocal and toric)







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Long thought extinct living **takahē** were rediscovered in an expedition led by Invercargill based ophthalmologist & ENT physician Dr Geoffrey Orbell near Lake Te Anau in the Murchison Mountains, in 1948.

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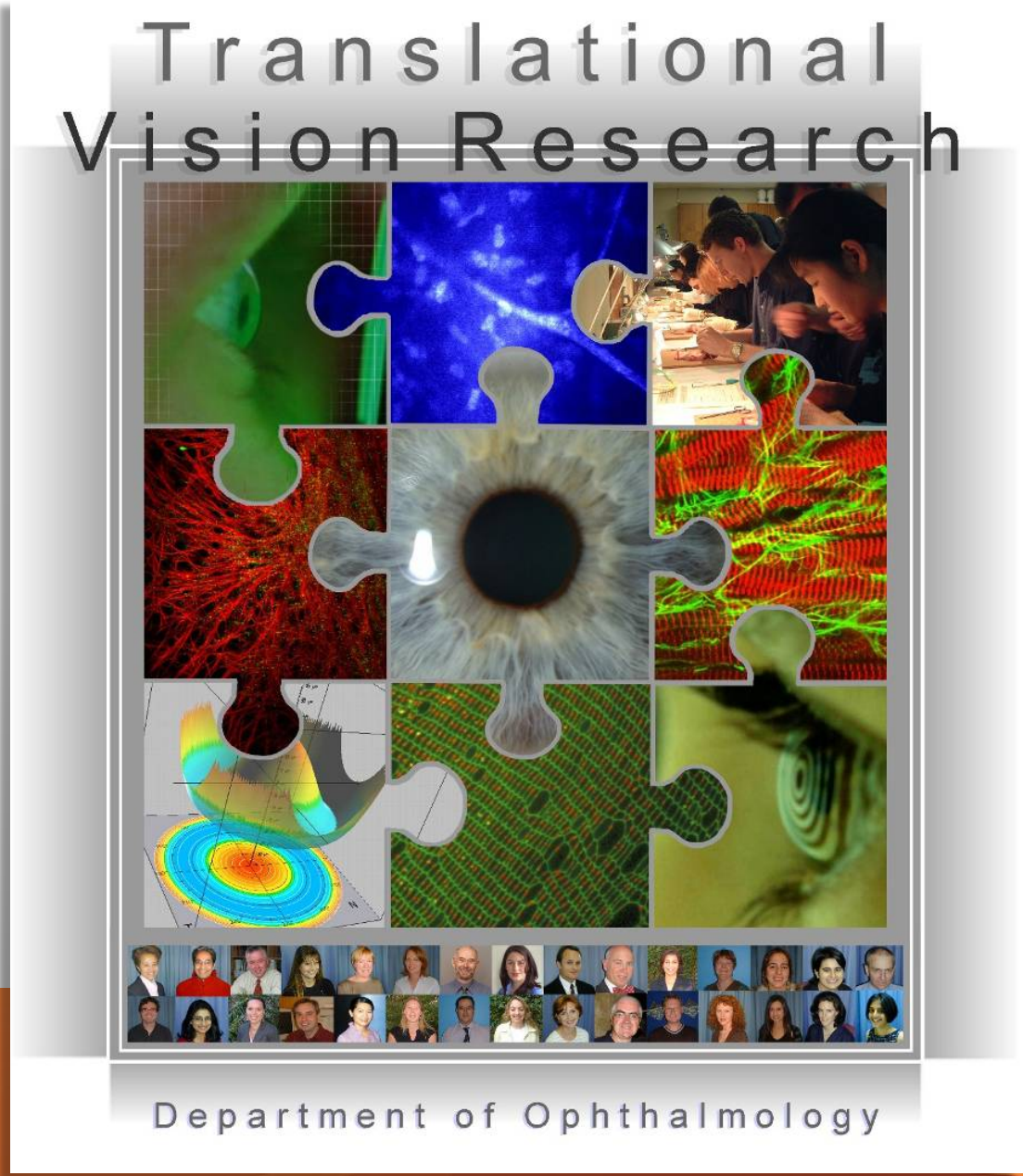

The End

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