

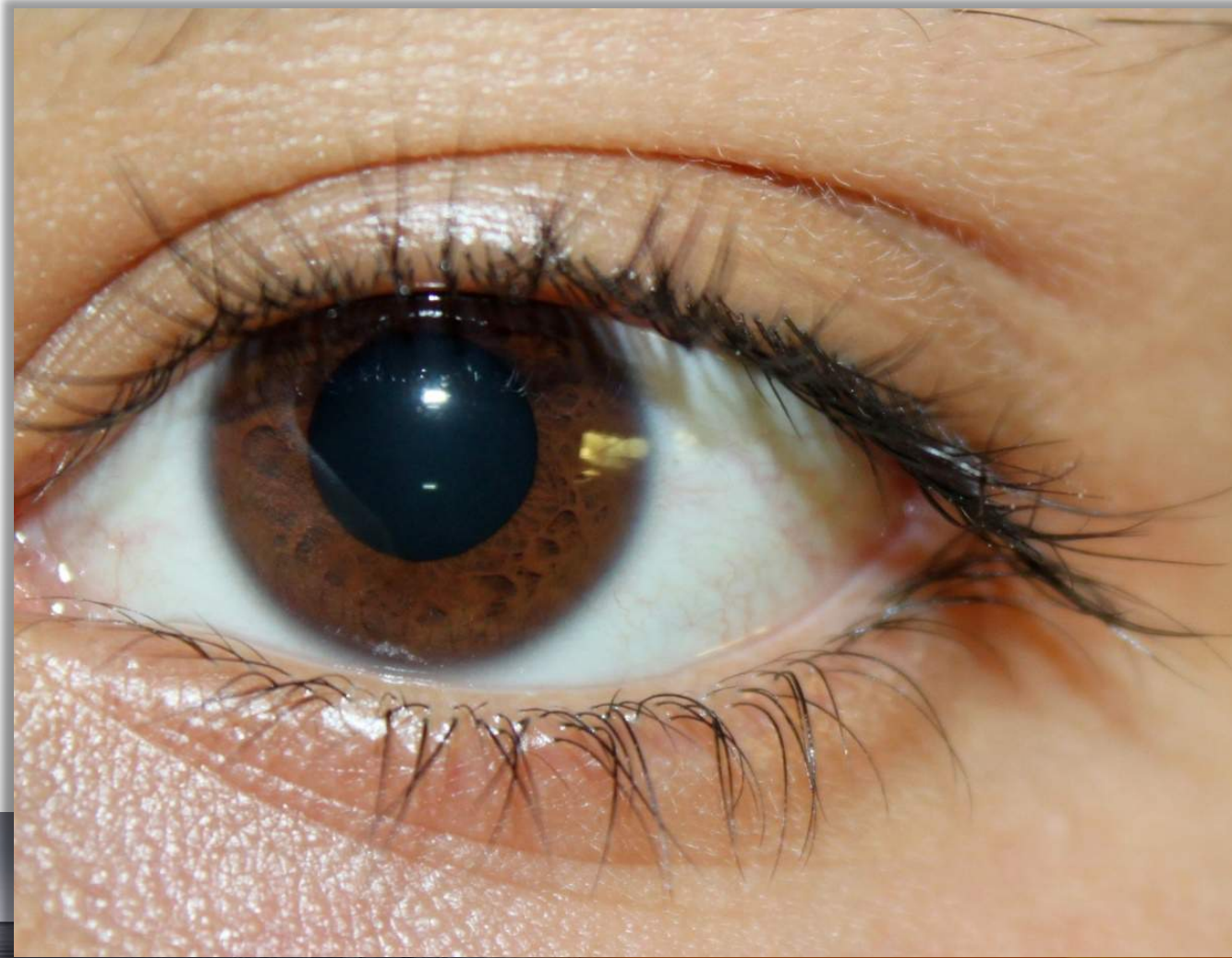
Eye Anatomy & Function

Dr Jie Zhang PhD
Senior Research Fellow

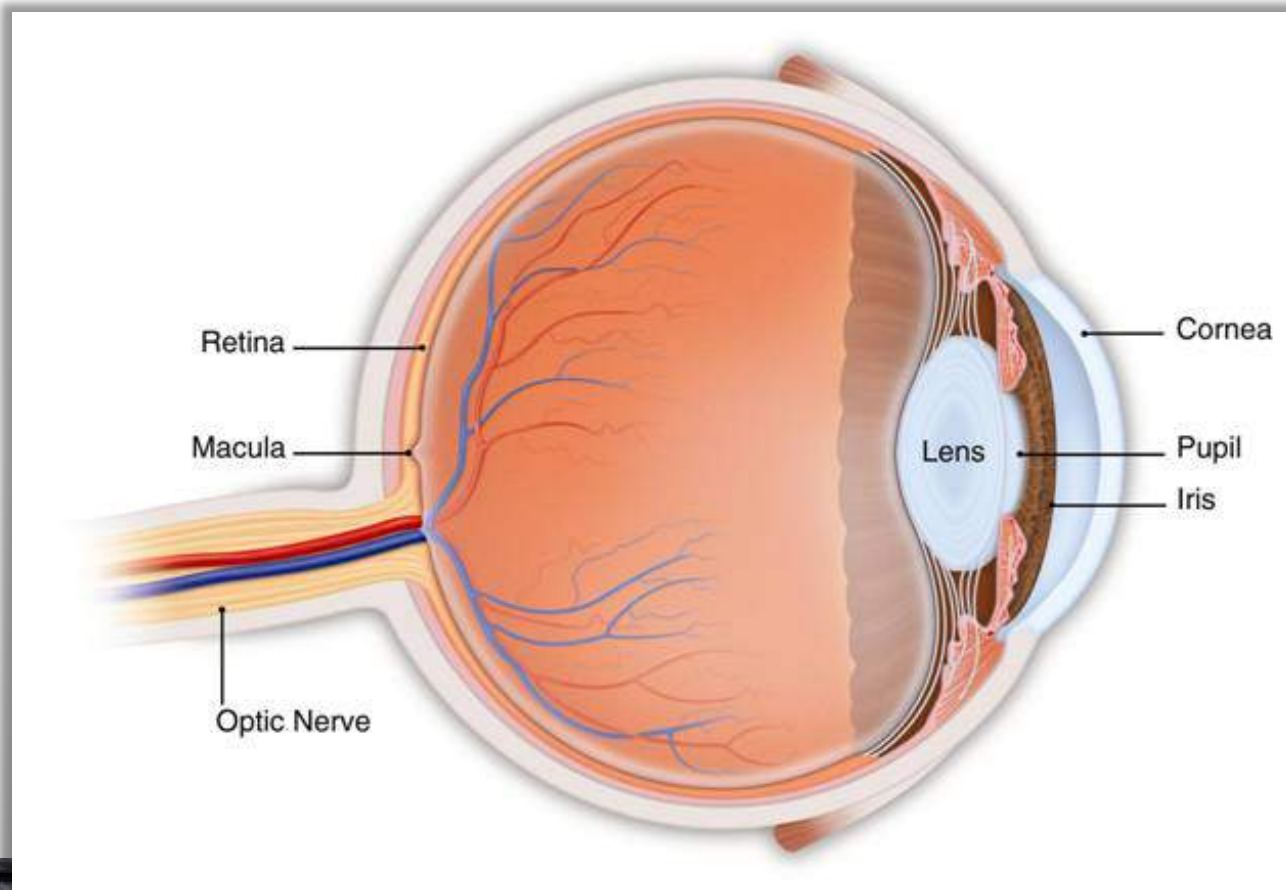
Associate Professor Bruce Hadden
LLD, FRACS, FRANZCO



External ocular appearance



Key Eye Functions



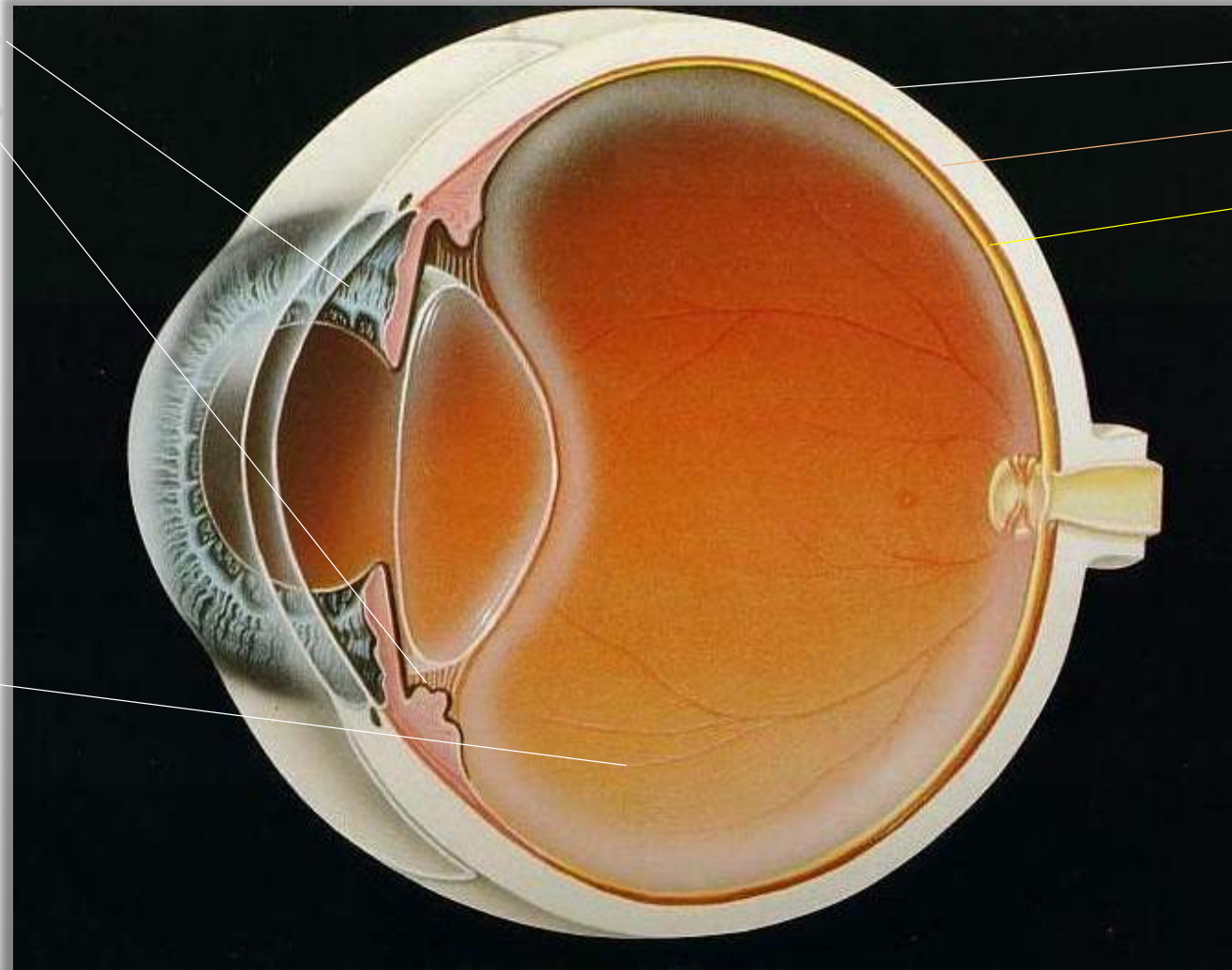
- Transmits and refracts light from the front to the back of the eye
 - *Transparent light path*
 - *Includes structures that bend light (refract)*
- Converts light energy into action potentials transmitted to brain



Layers and chambers of the eye

Anterior Chamber
Posterior Chamber

Fibrous Tunic
Vascular Tunic
Nervous Tunic



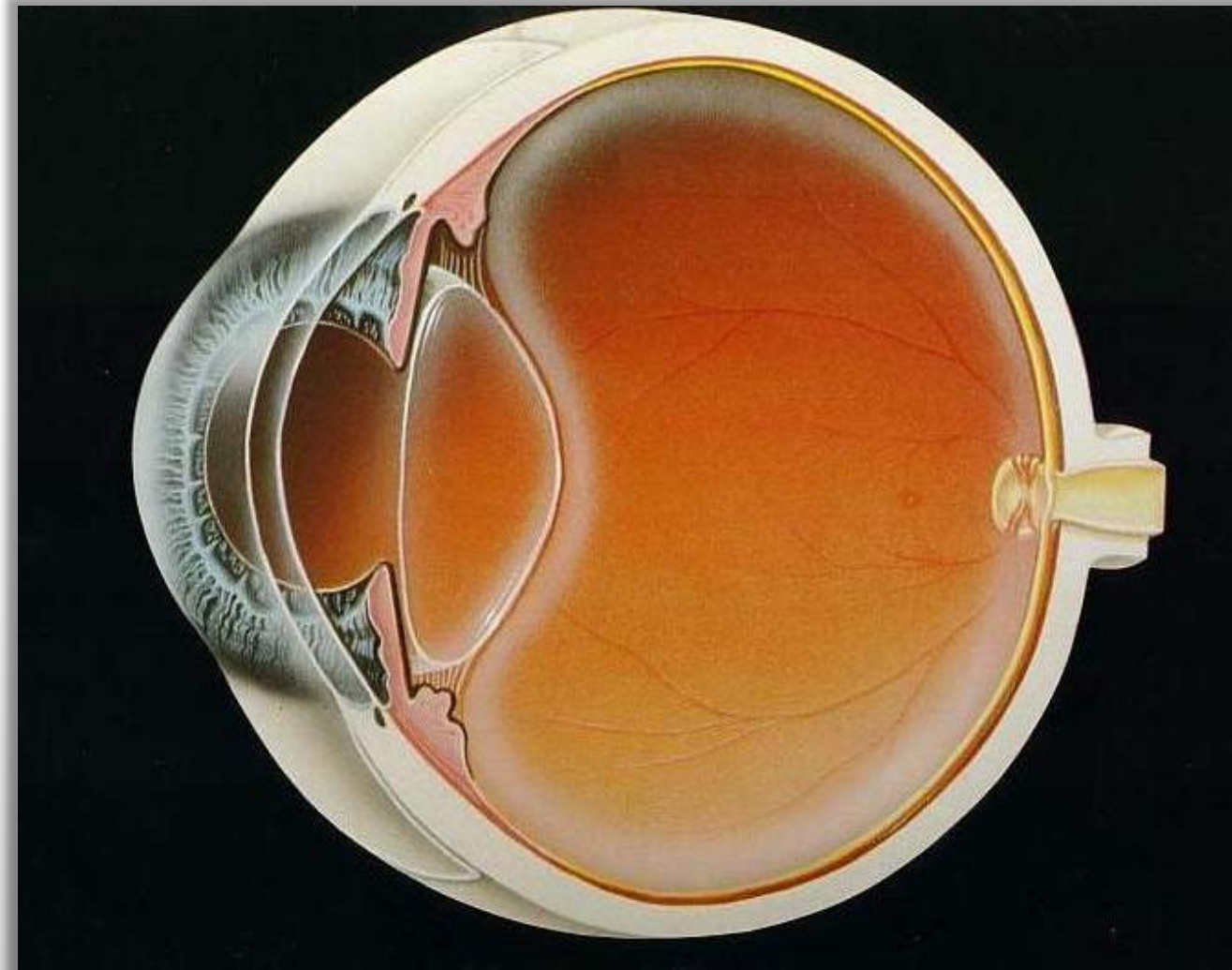
Vitreous Chamber

Defining ocular segments

Anterior segment:

Structures in front of vitreous:

Cornea,
iris,
ciliary body,
and lens

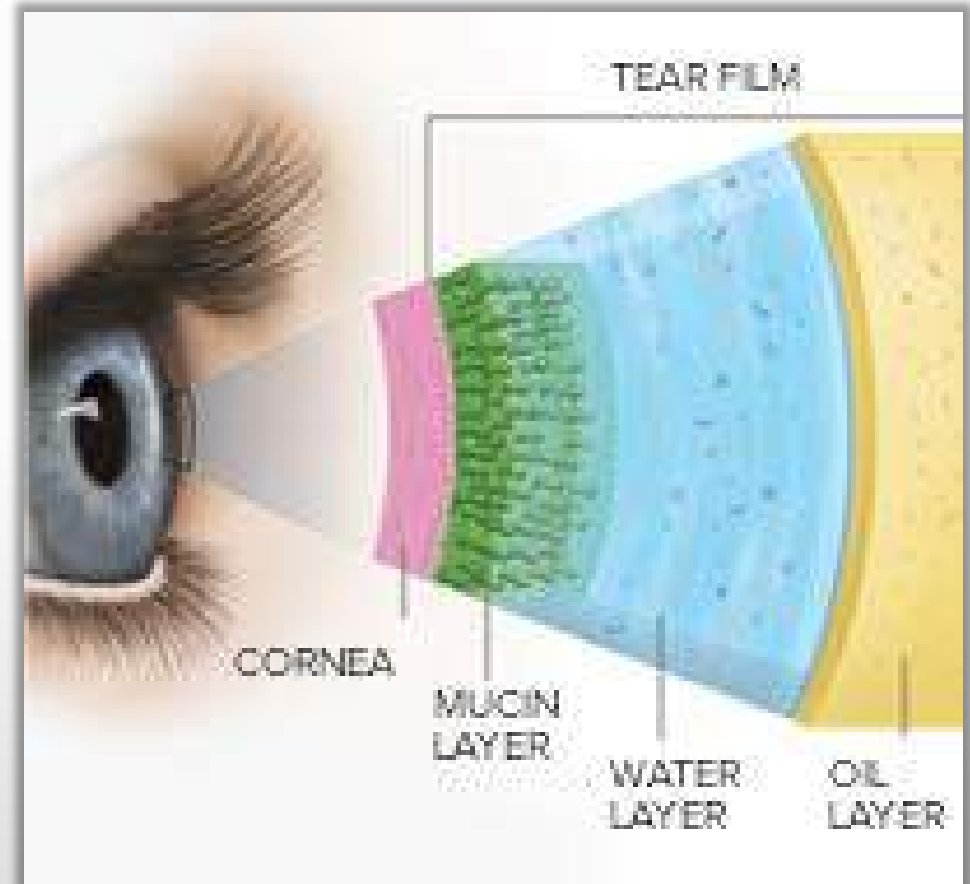


Posterior segment:

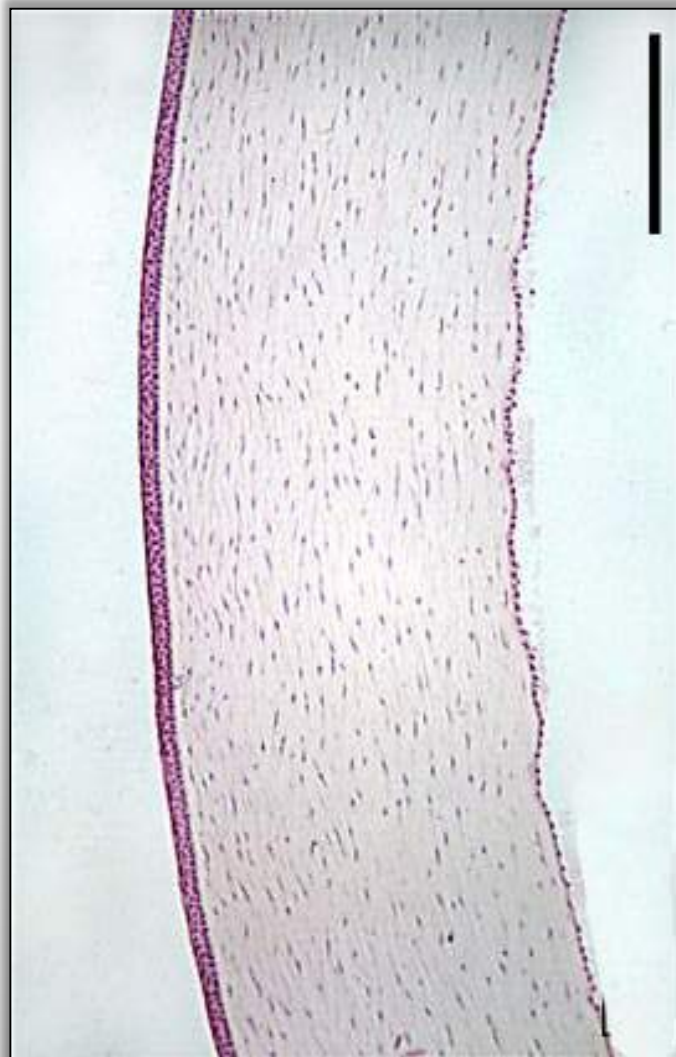
Vitreous,
retina,
choroid,
optic nerve

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

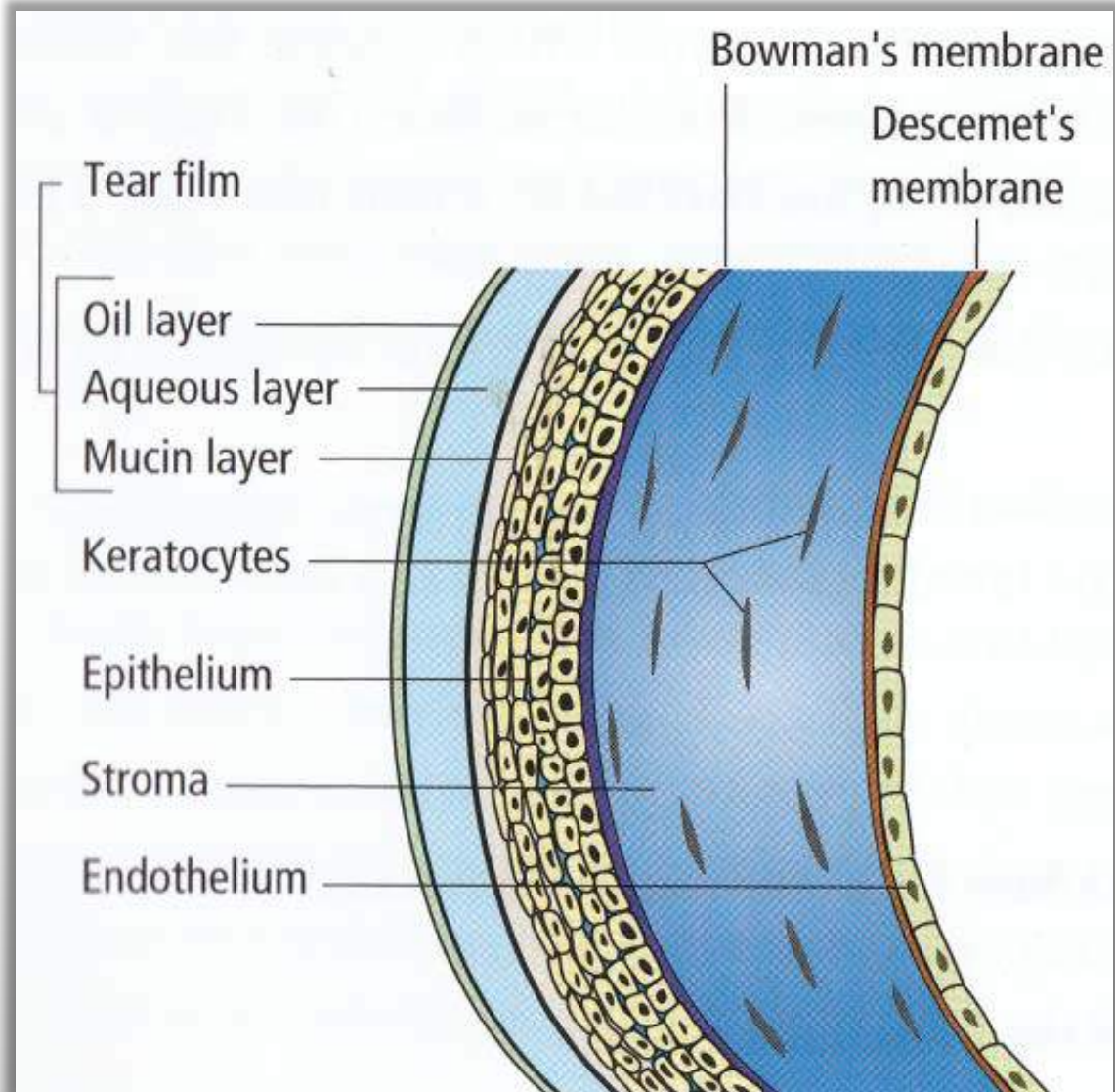


Cornea functions



- **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

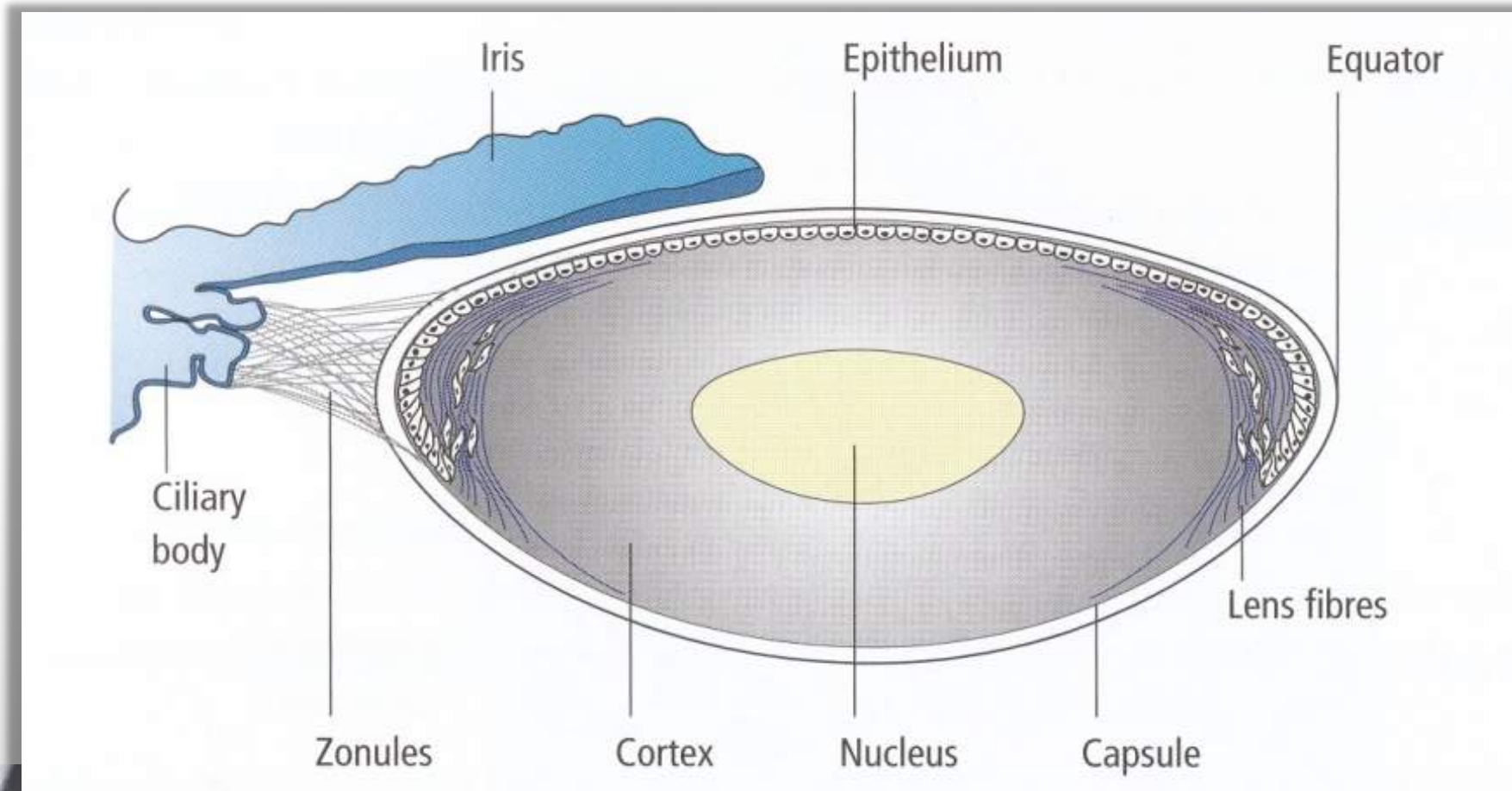
Dense innervation:

Most sensitive organ in the body
Immune privilege
Rapid tearing reflex

The cornea:

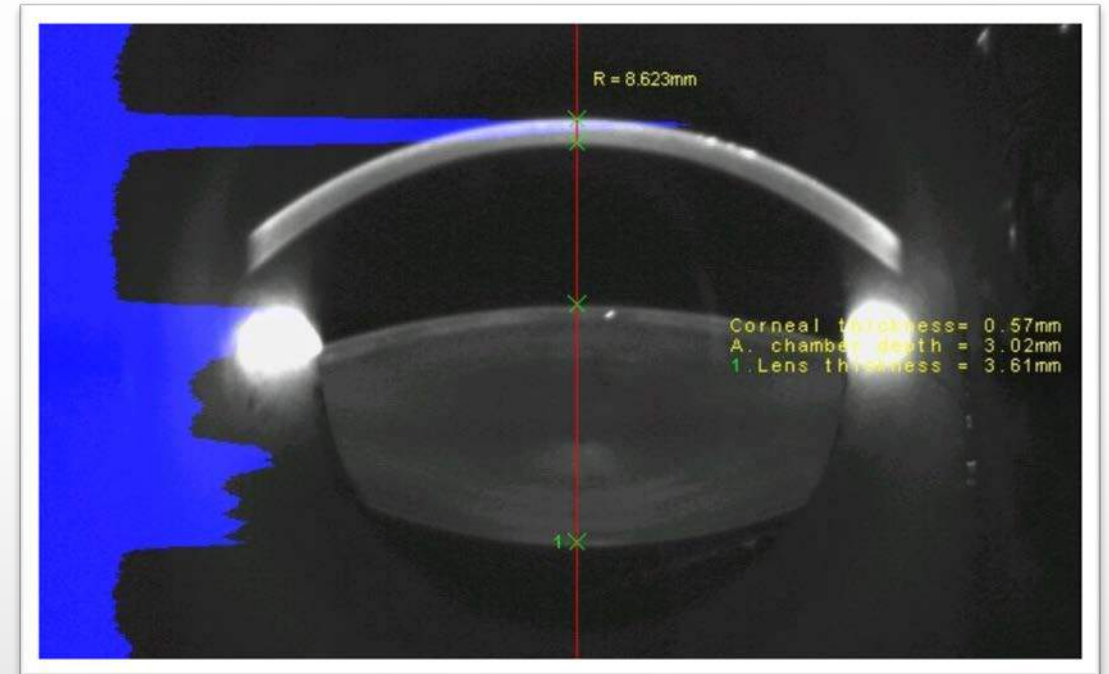
Transmits light
Refracts lights
Protects ocular interior

Structure of the crystalline lens



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

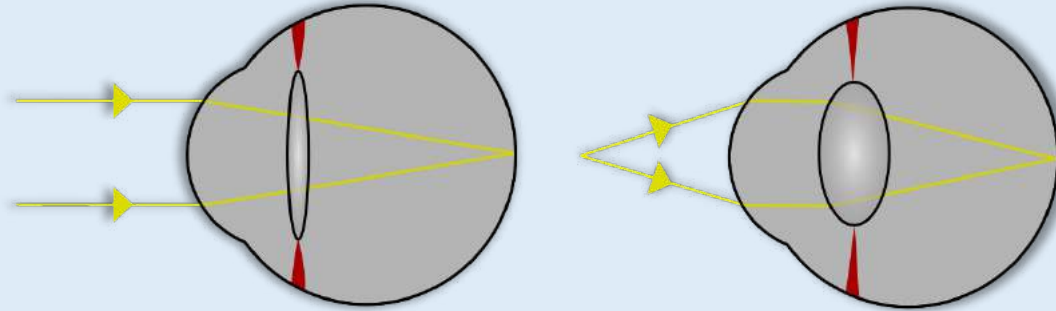


Cornea 2/3rd and lens 1/3rd refracting power

Accommodation

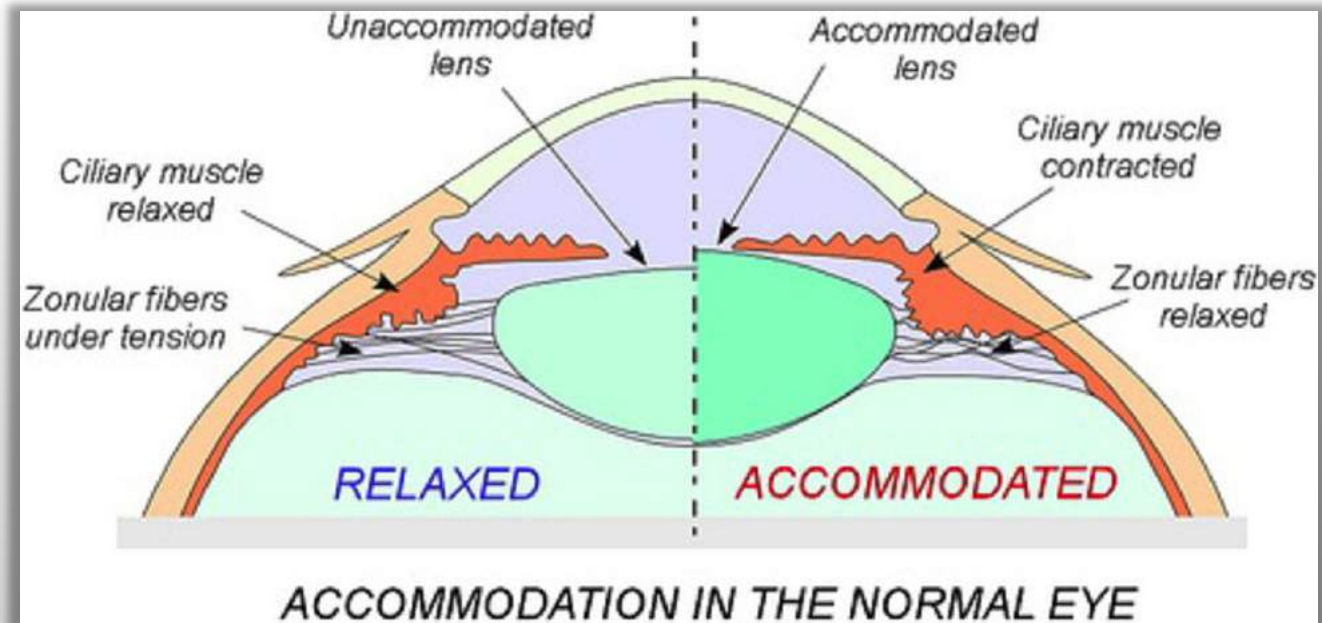
Far objects:

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

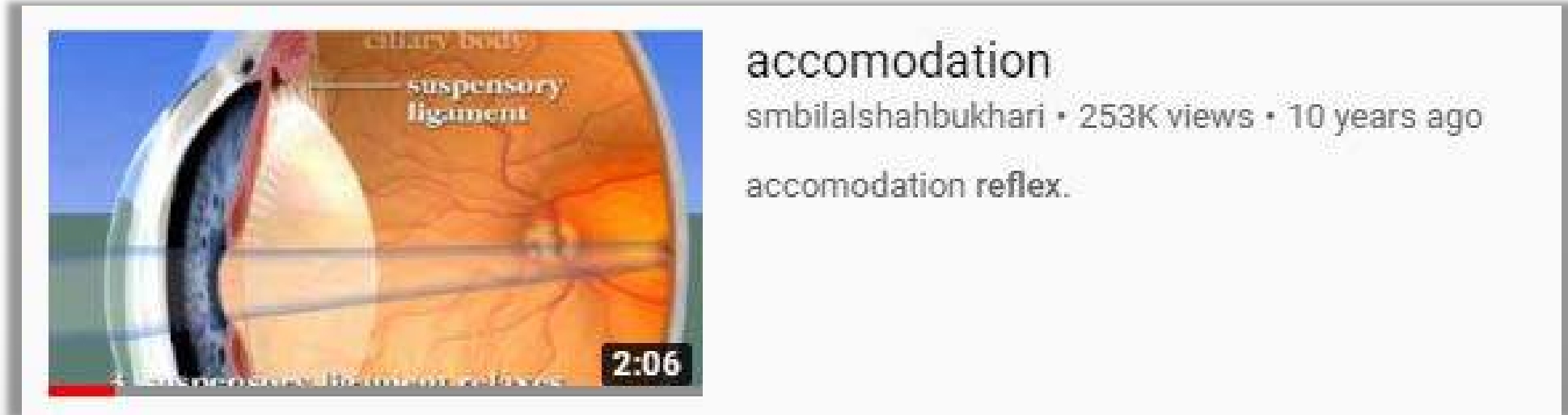


Near objects:

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



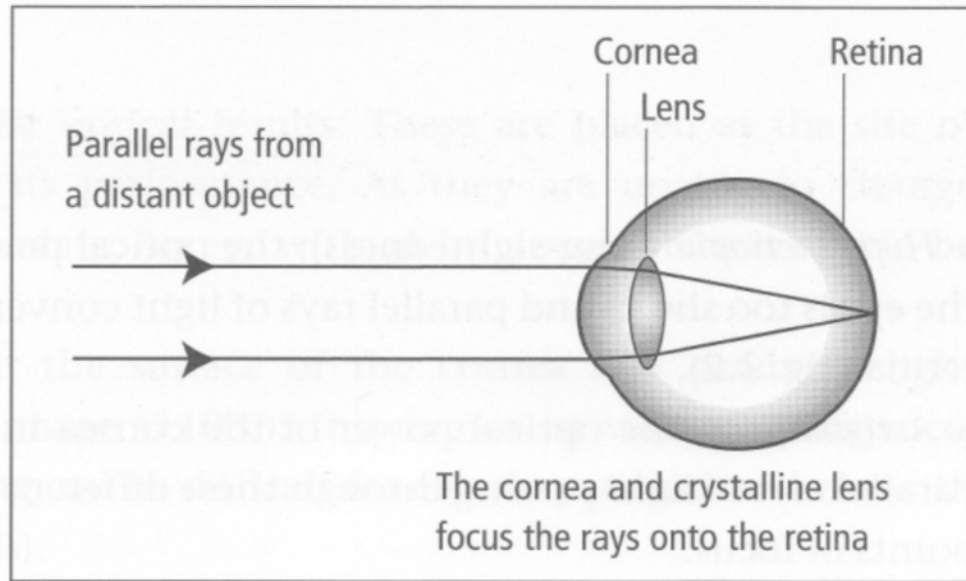
Accommodation video



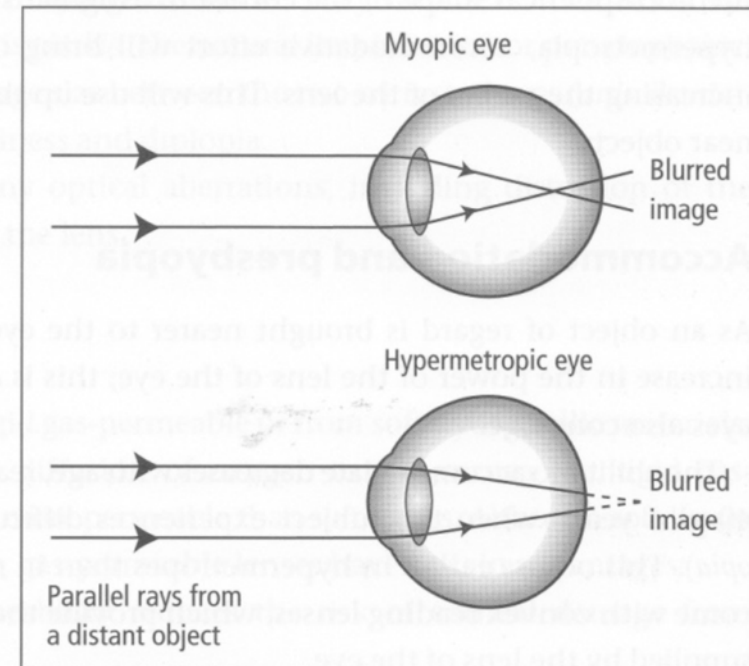
- https://www.youtube.com/watch?v=p_xLO7yxgOk&list=WL&index=3&t=0s
- Search for accommodation reflex on youtube

Emmetropia, Myopia & Hypermetropia

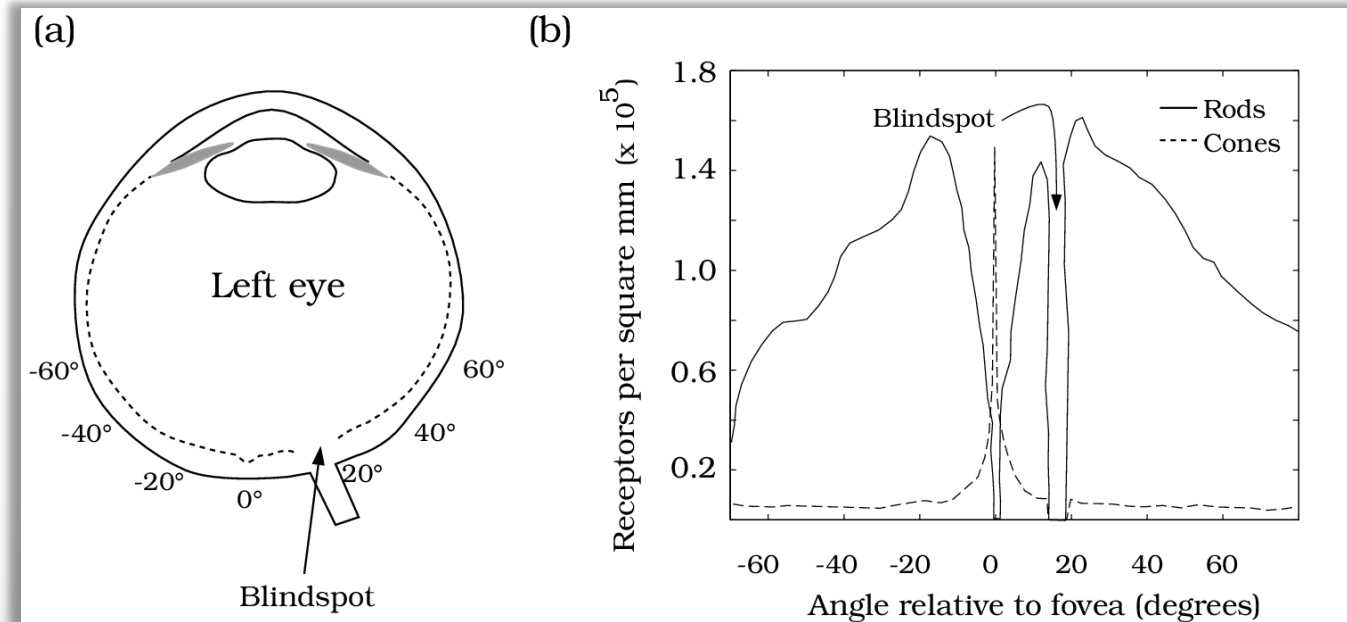
Emmetropia: cornea/lens/eye length "normal"



Myopic eye = long, hyperopic eye = short



Retinal Function



- **Photoreceptors: conversion of light into action potentials**

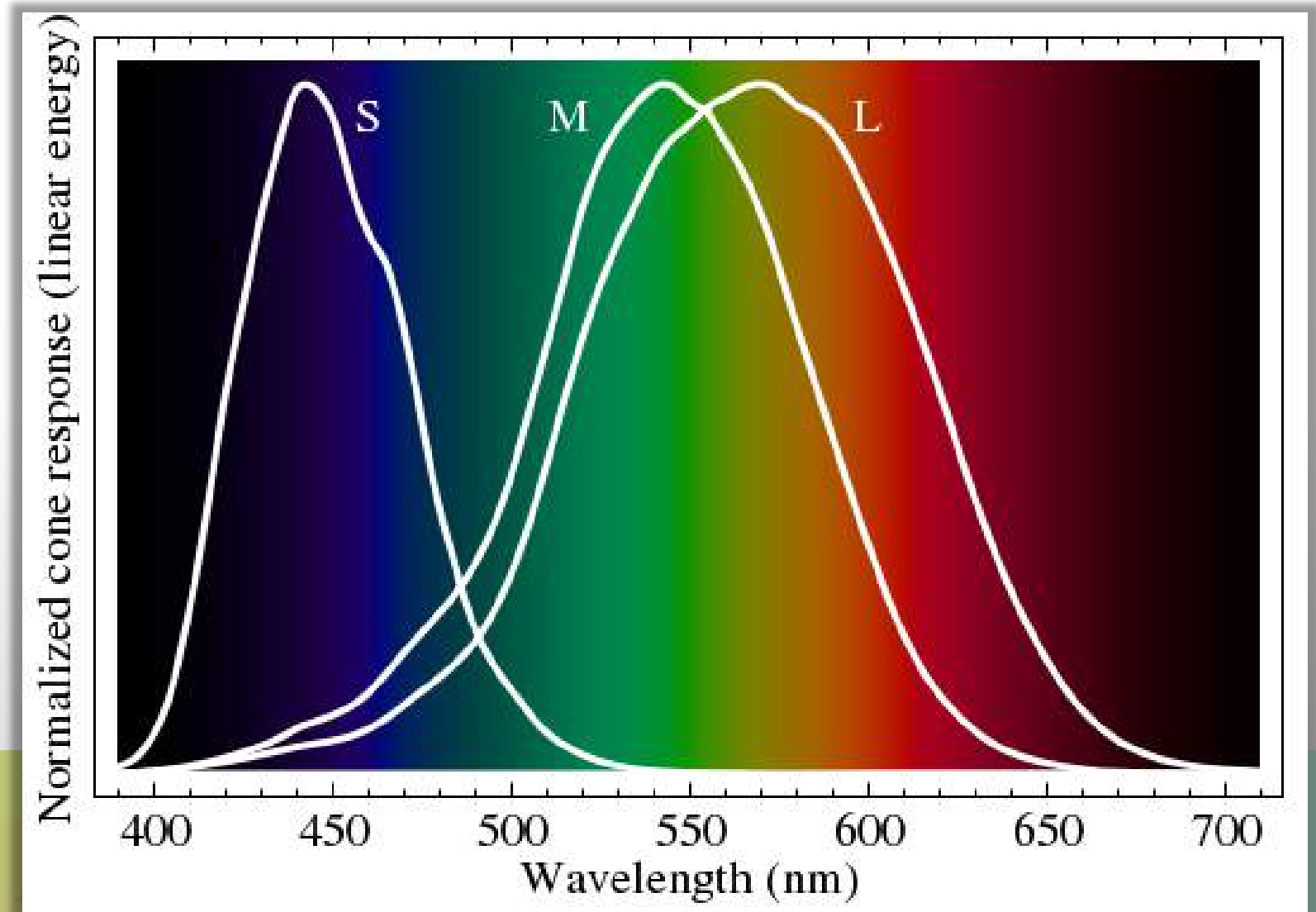
- Cones. 6 million. High threshold to light. High acuity. Light adapted (photopic) vision. Colour vision- 3 types of cones: blue, green, red.
- Rods. 120 million. Low threshold to light. Sensitive to movement. Dark adapted (scotopic) vision. No colour. Low resolution.
- Synapse with bipolar cells → Retinal 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



Vitreous

Inner limiting membrane

Nerve fibre layer

Ganglion cell layer

Inner plexiform layer

Inner nuclear layer

Outer plexiform layer

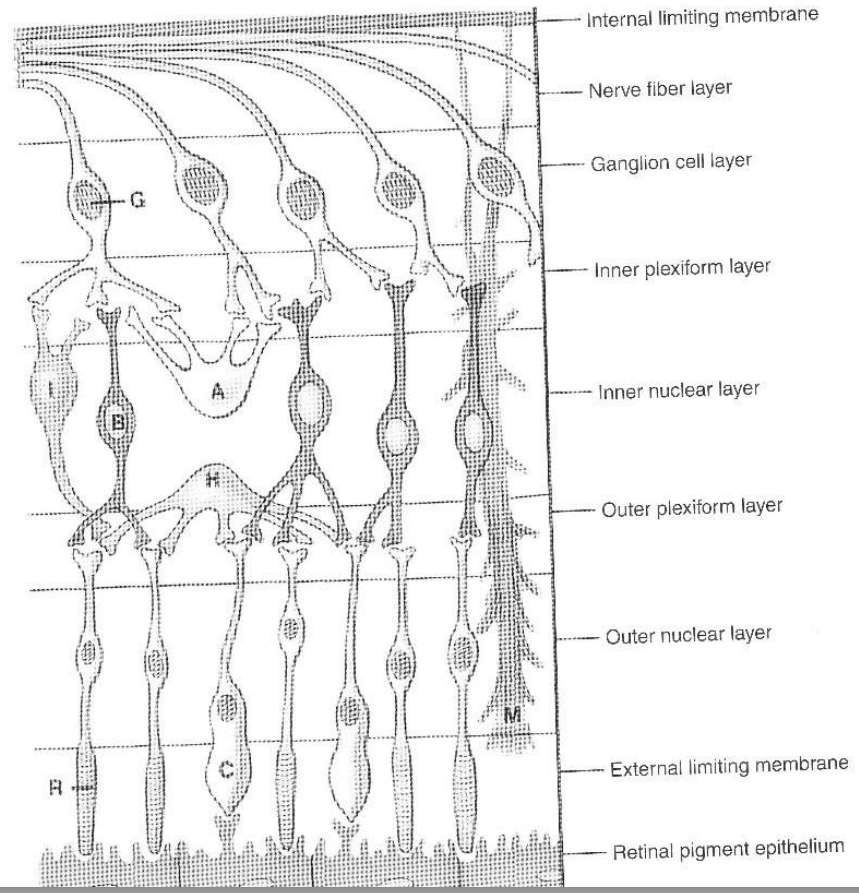
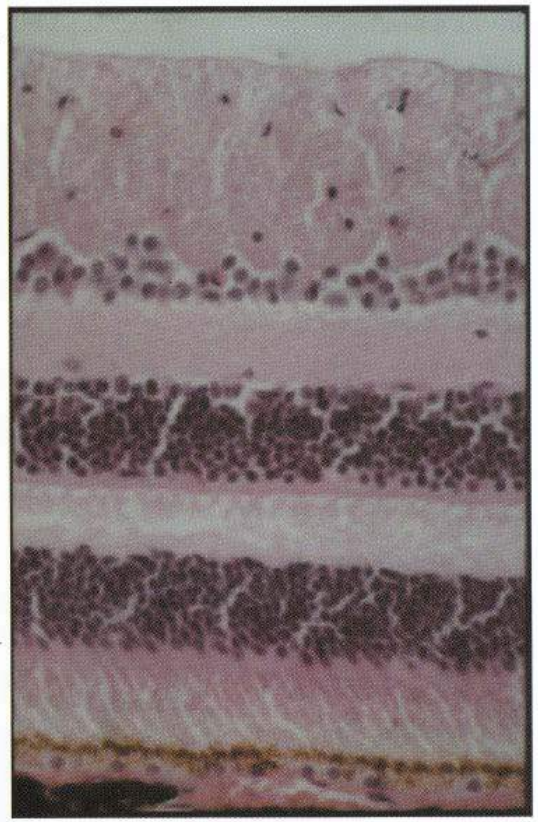
Receptor nuclear layer

External limiting membrane

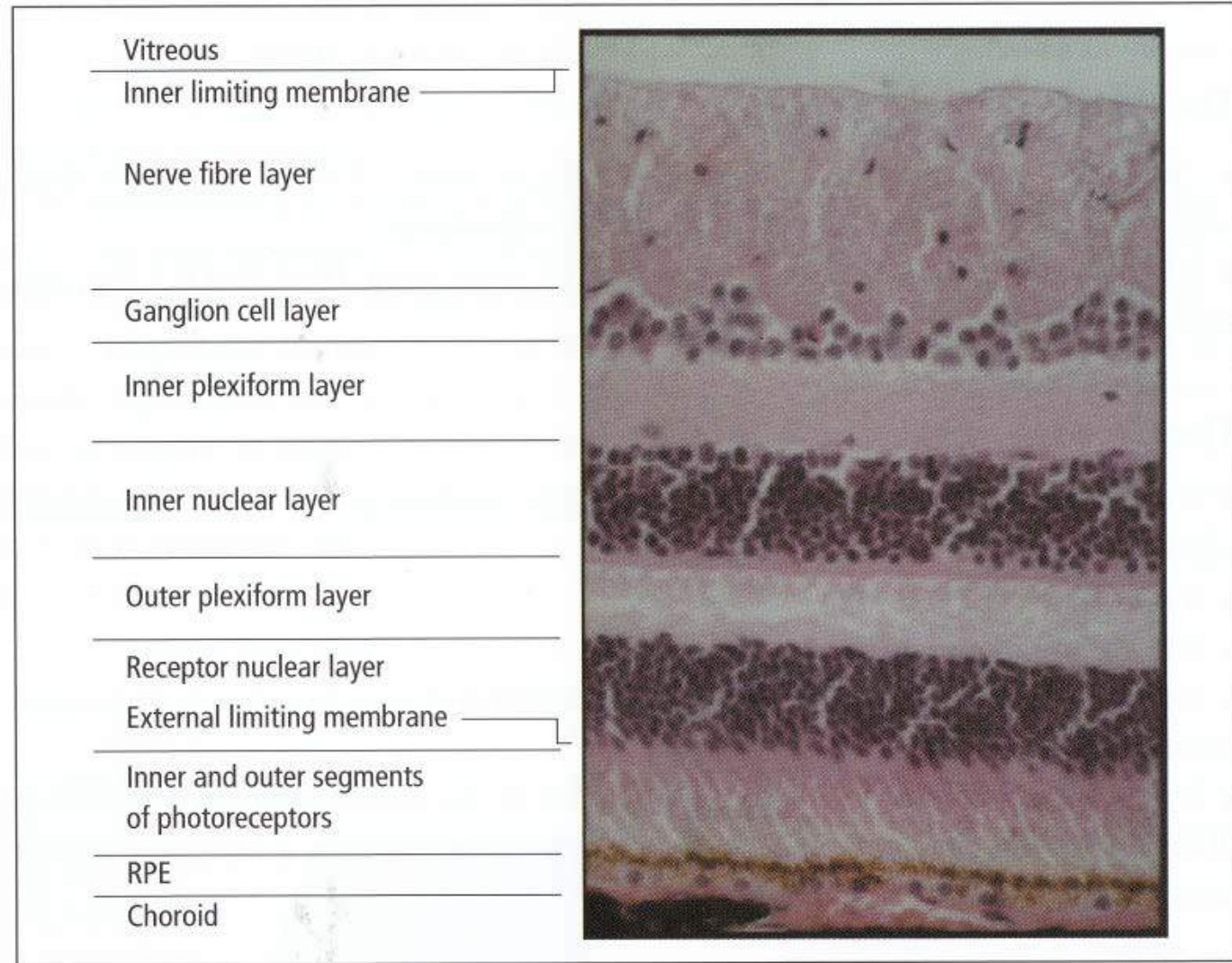
Inner and outer segments of photoreceptors

RPE

Choroid

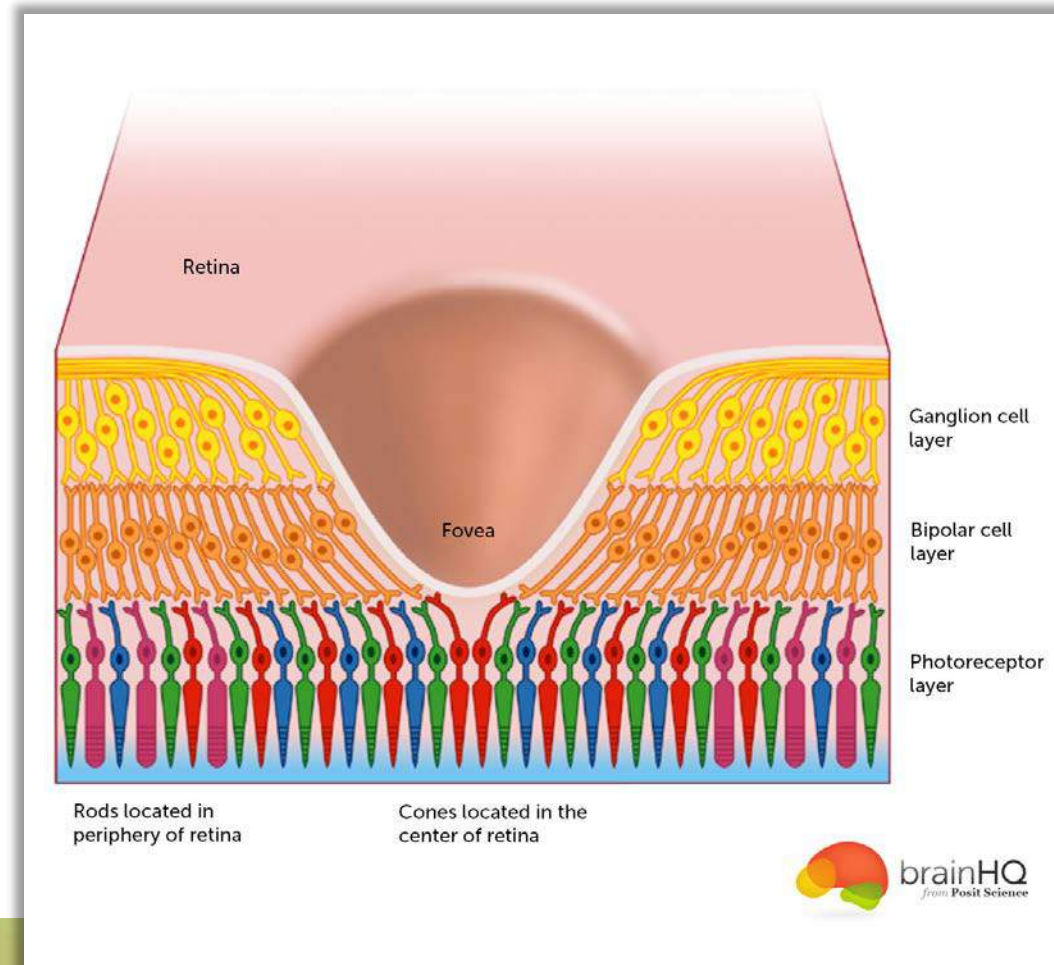


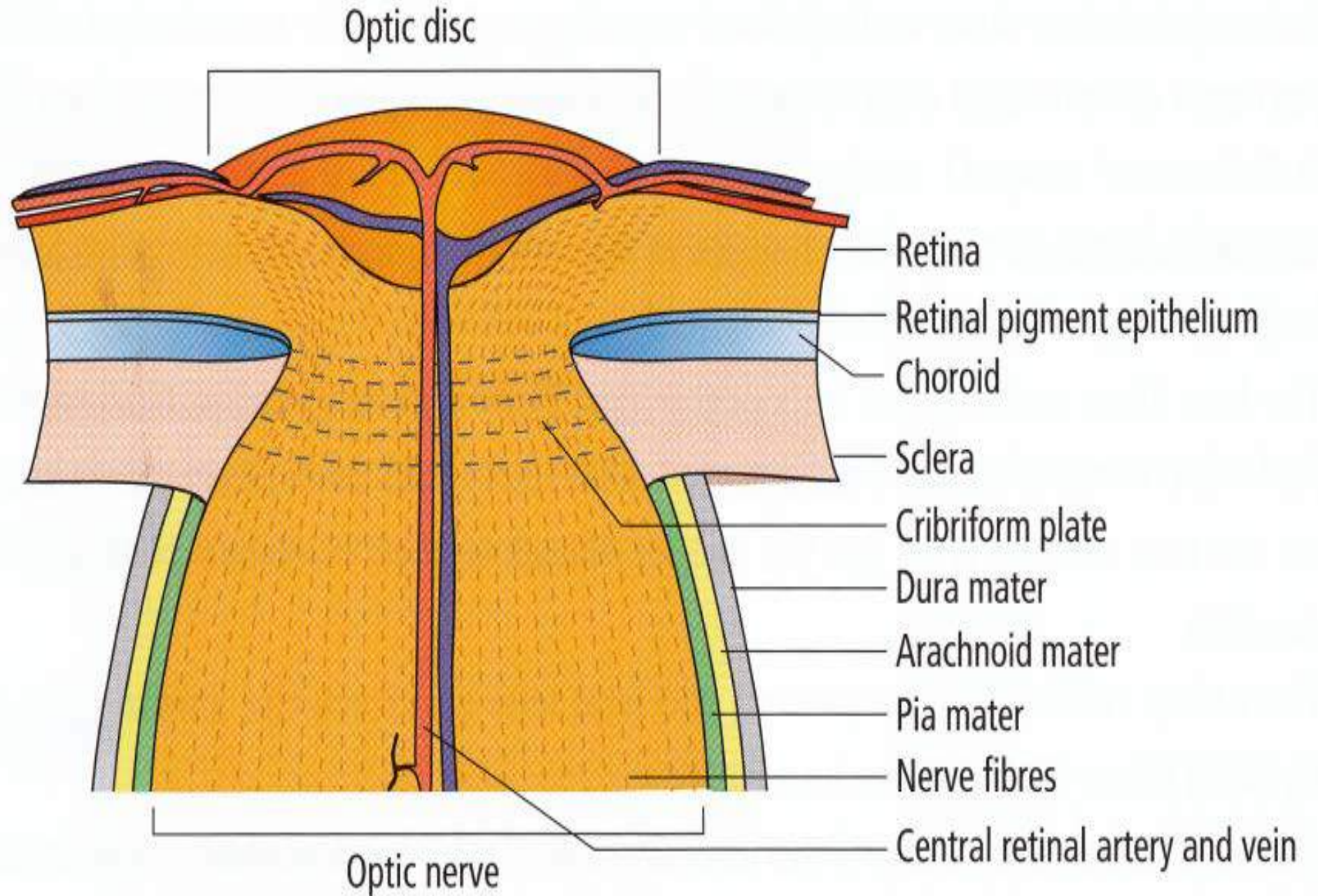
RETINAL MICRO-STRUCTURE



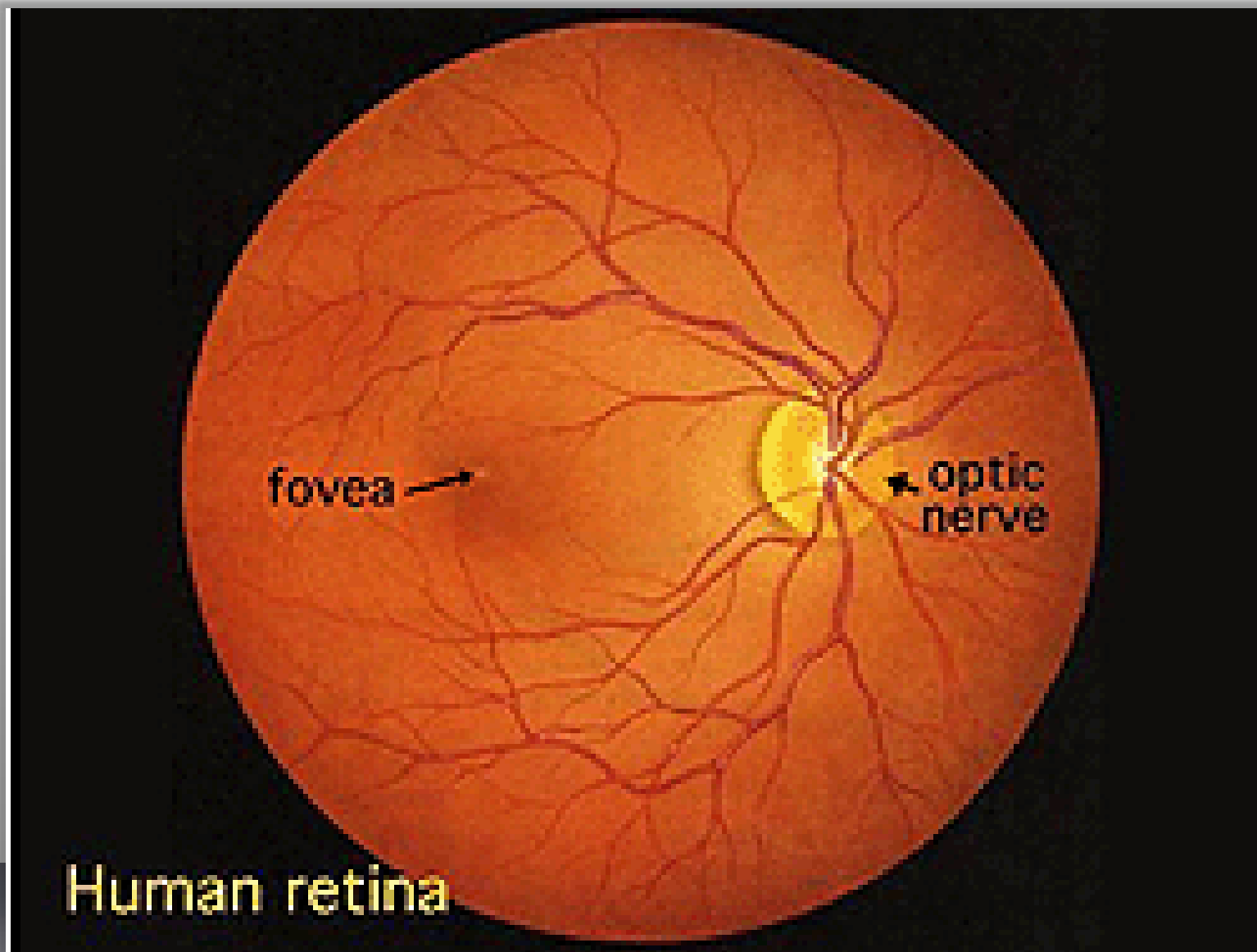
RETINAL MICRO-STRUCTURE

Fovea is within the central macula





Temporal

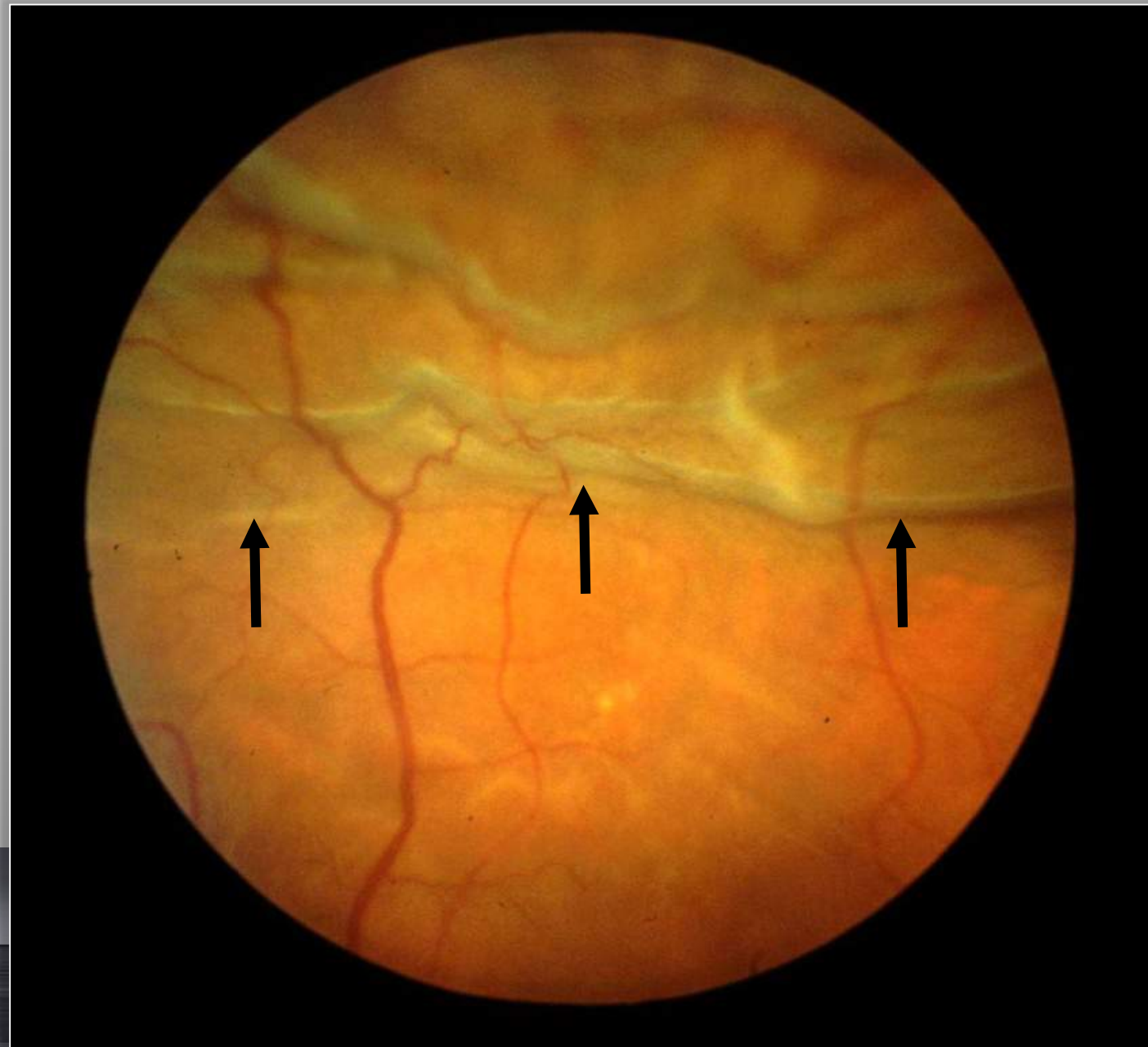


Nasal

Human retina

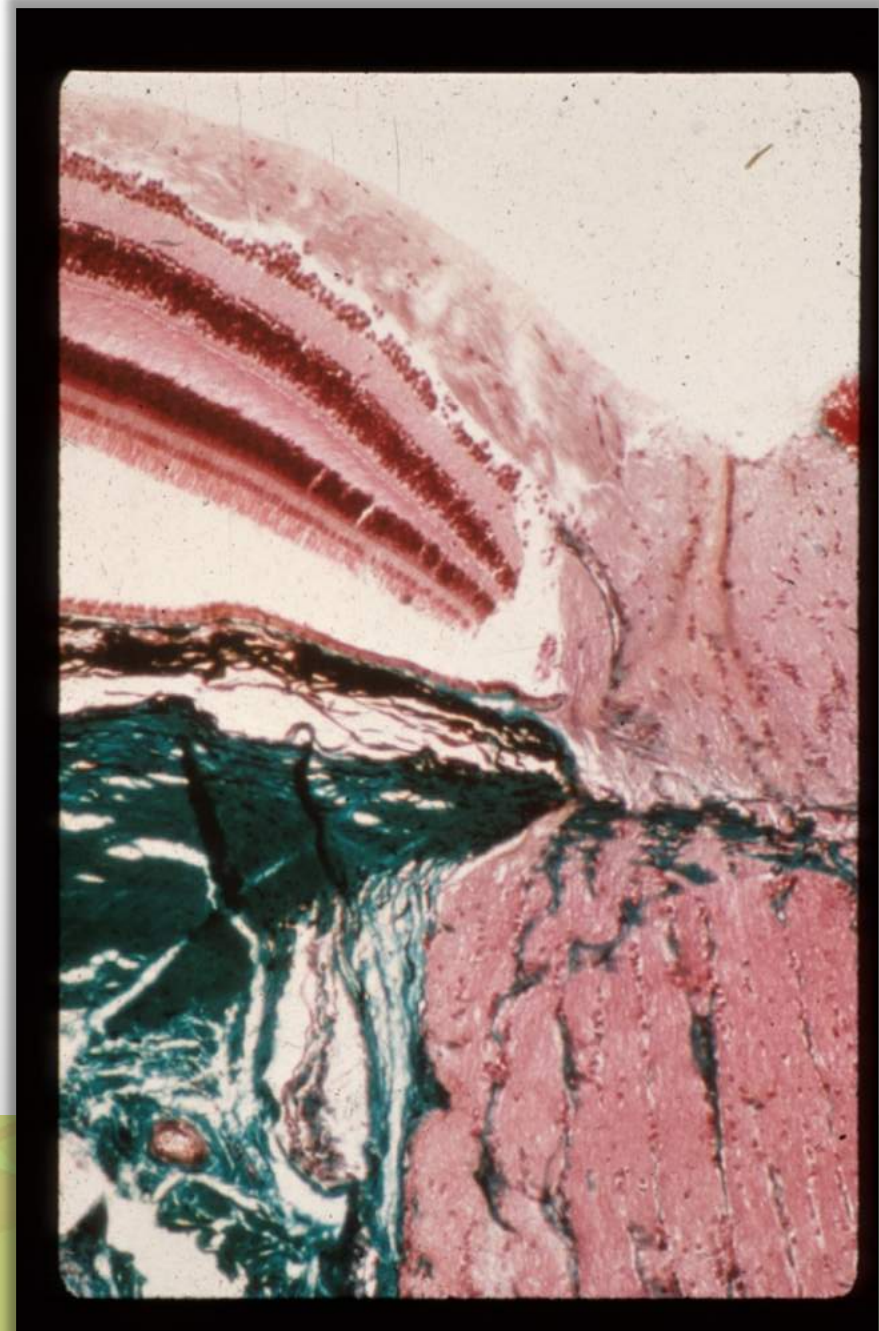


Superior Retinal Detachment



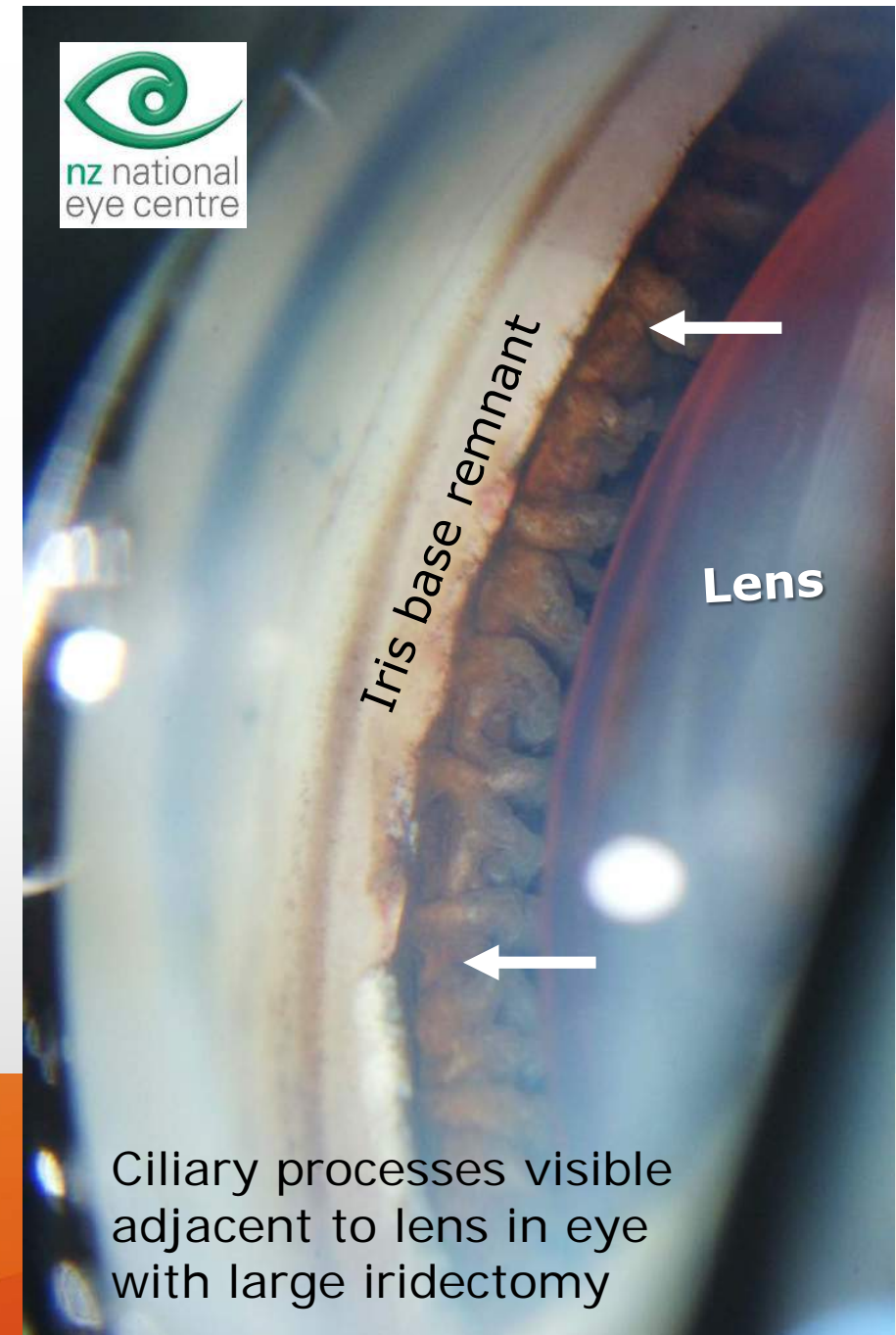
Optic nerve head and adjacent retina

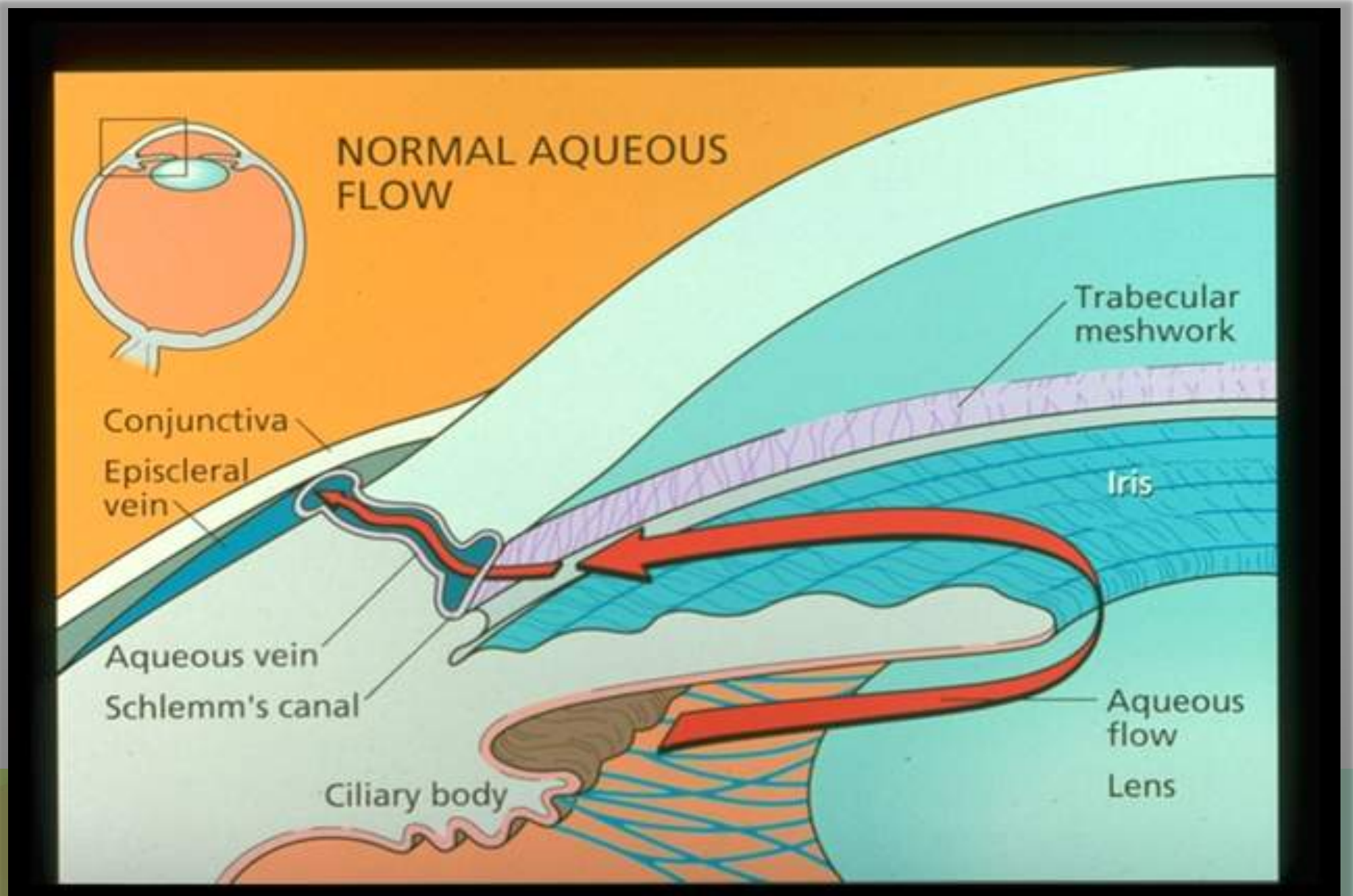
(Masson's trichrome)



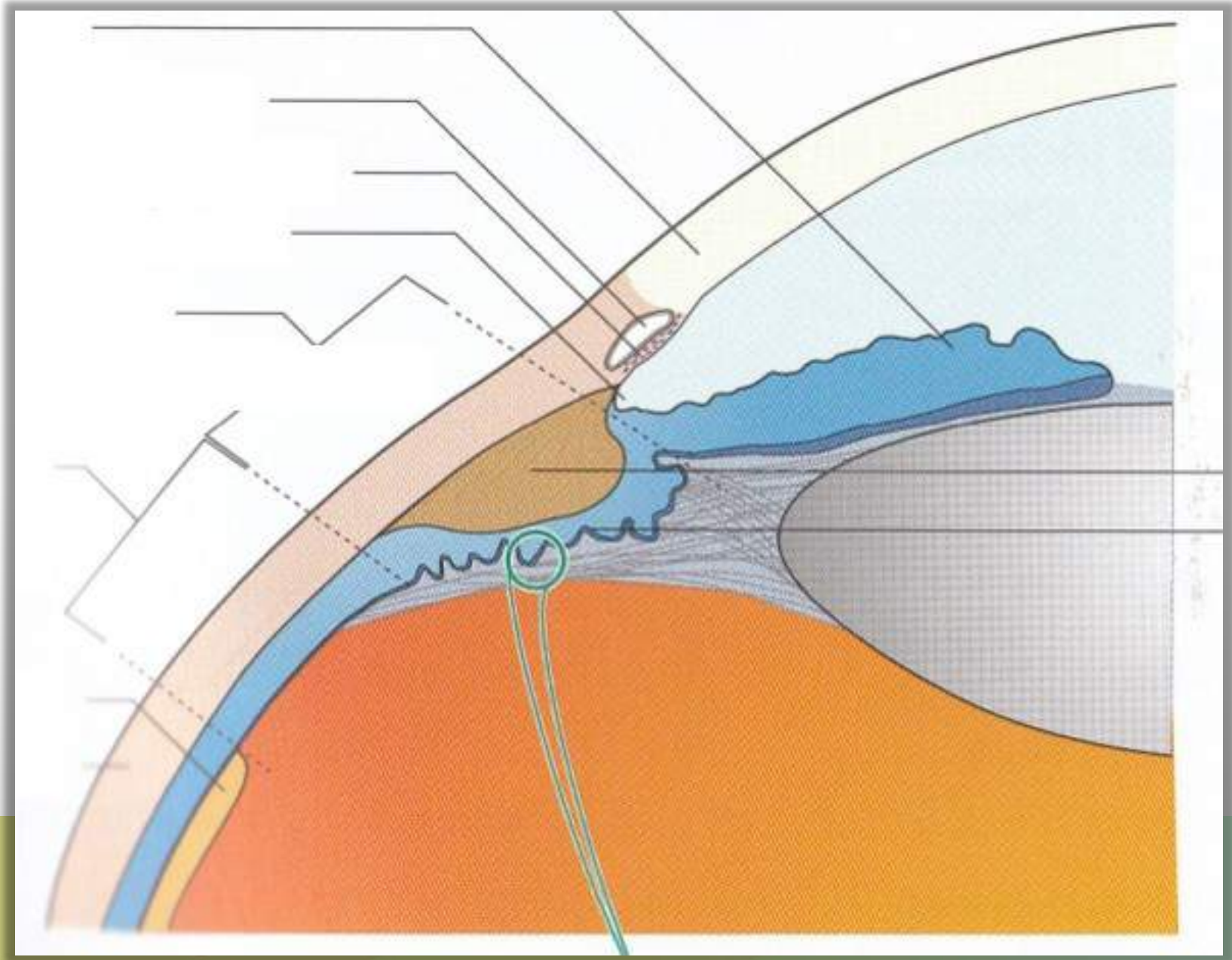
Ciliary Body

- 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





Name
these
ocular
structures



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

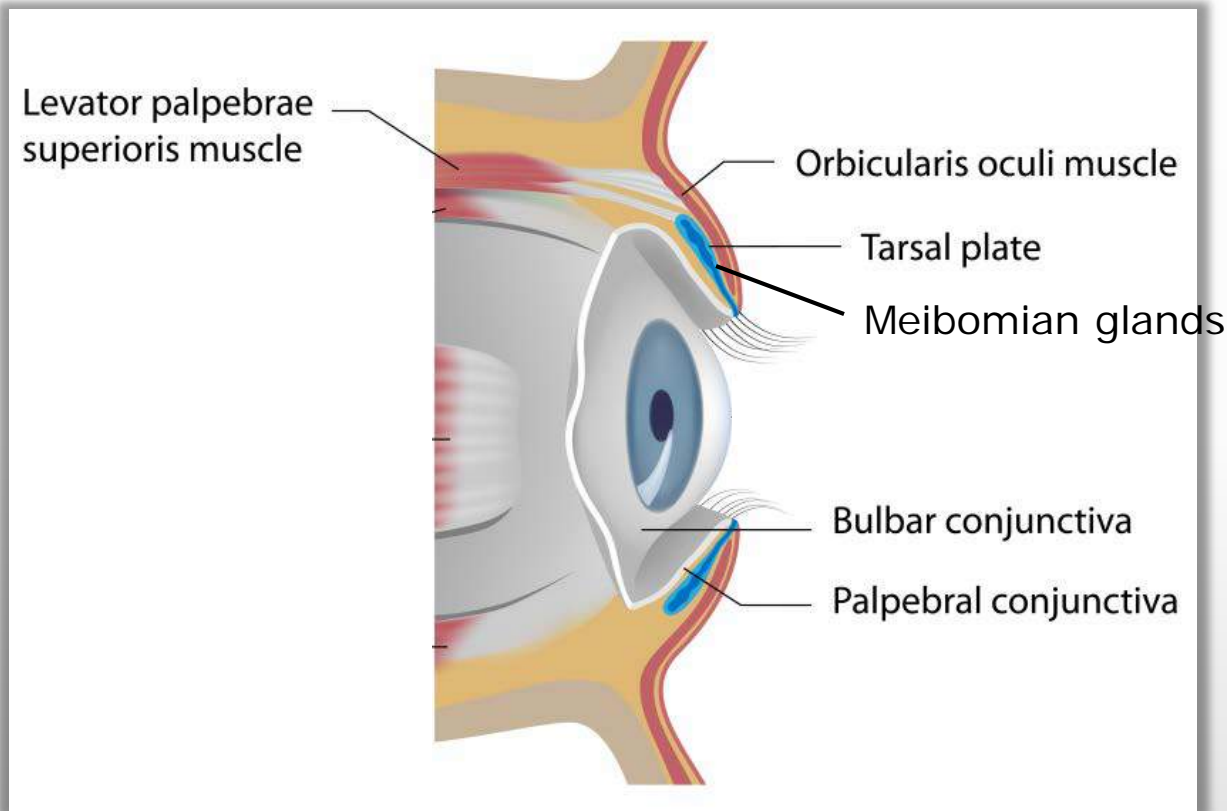
Choroid

Nutrition of retina and sclera

The most vascular tissue in the body



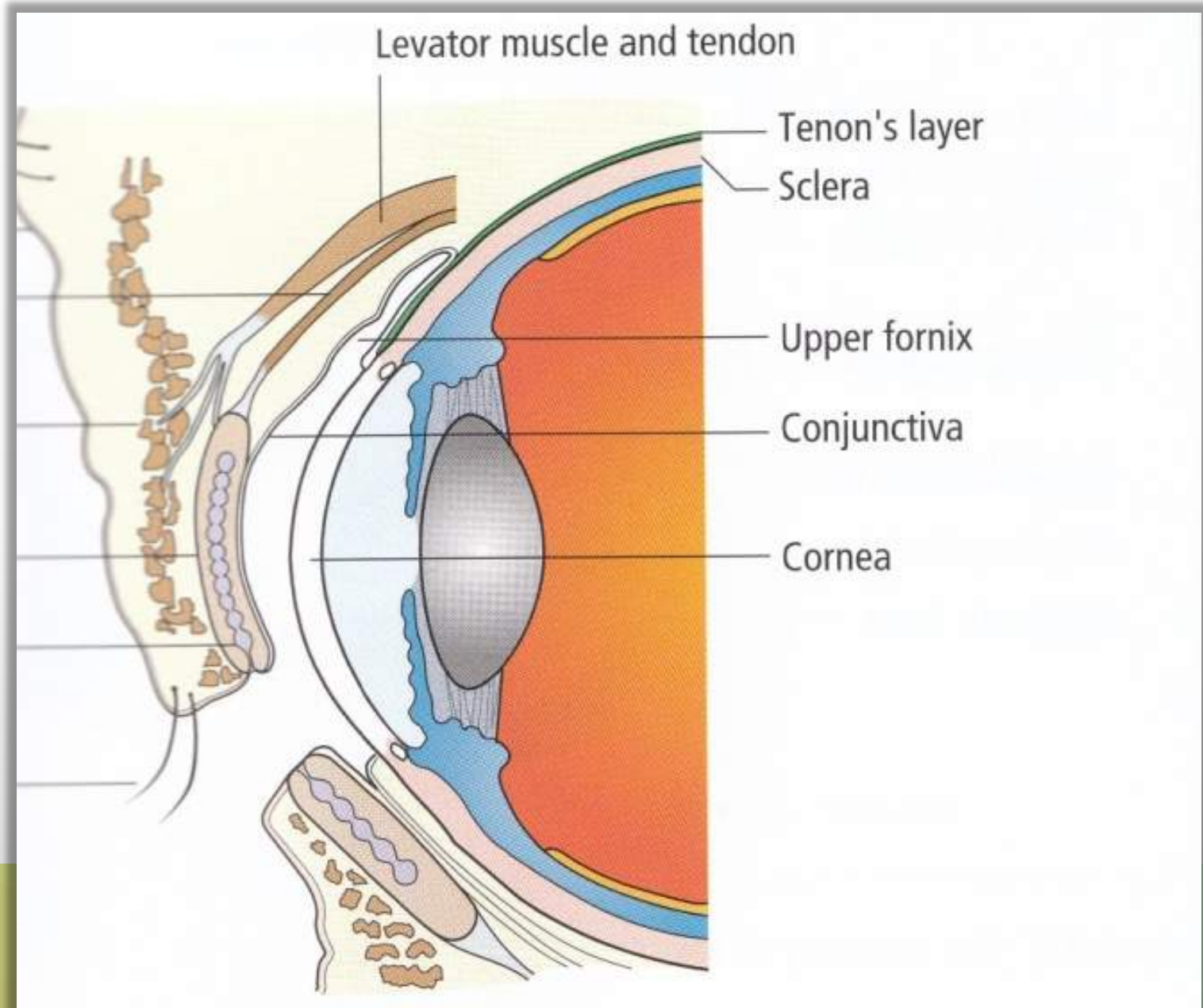
Eyelids and conjunctiva



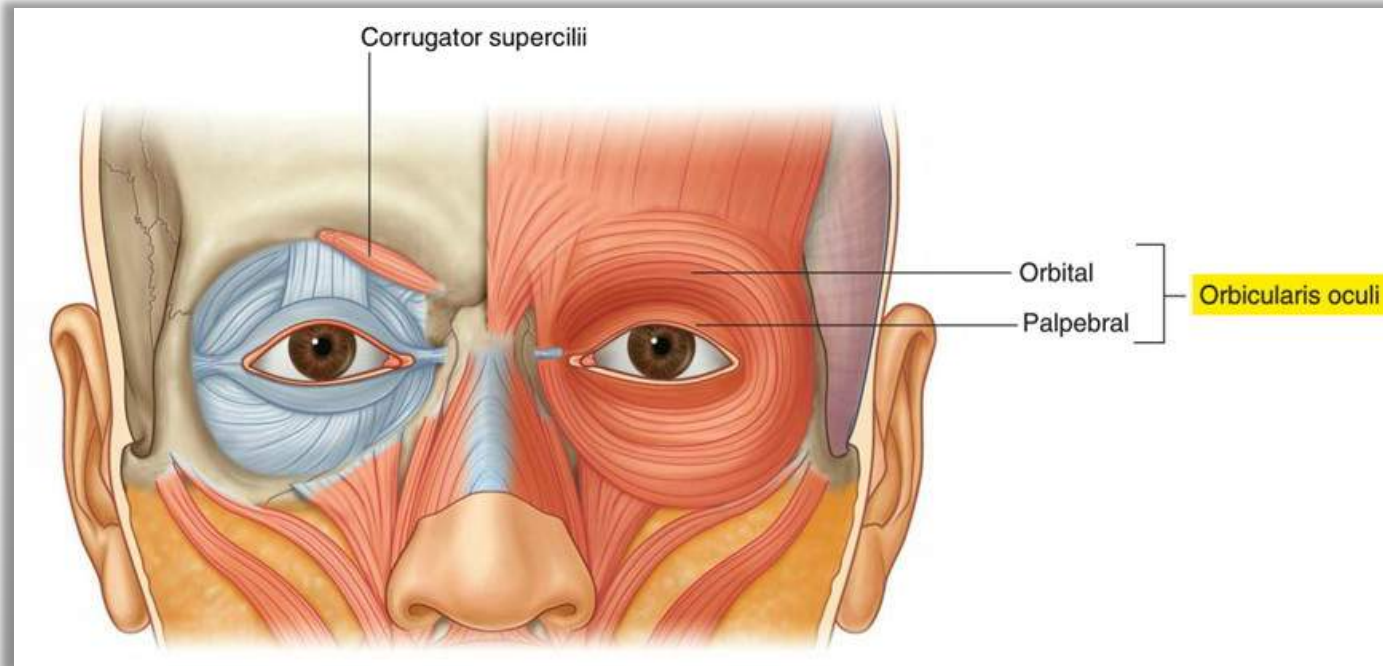
1. Skin
2. Muscles
3. Tarsal plate - mechanical stability & Meibomian glands – oil layer of tear
4. Conjunctiva
Attach eyeball to orbit & lids & permits rotation

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

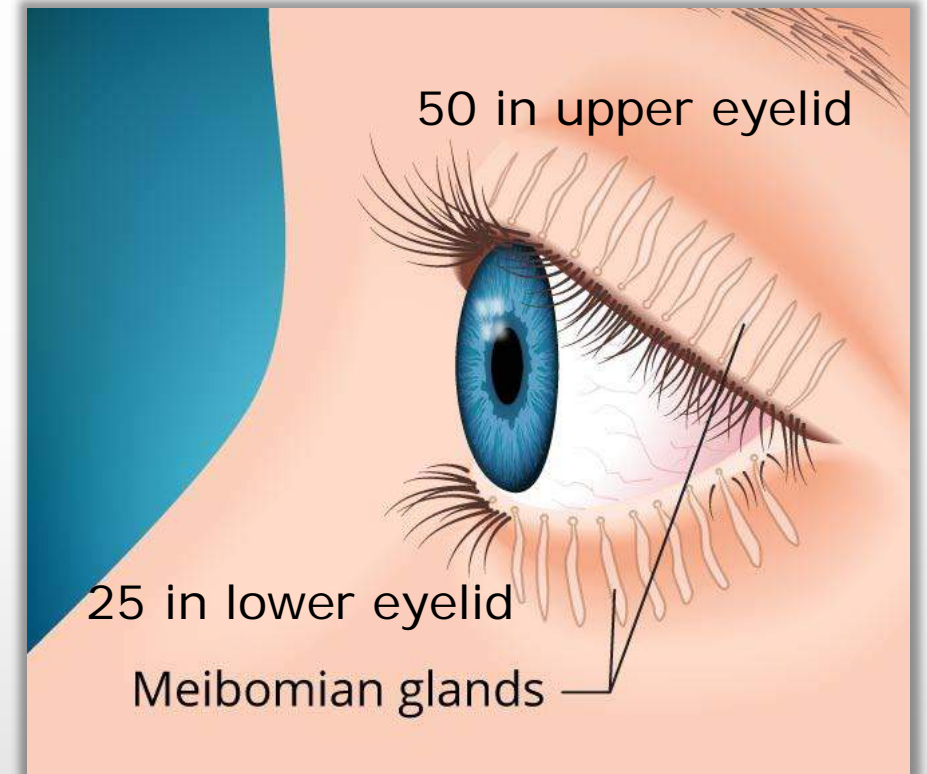
Eyelids and conjunctiva



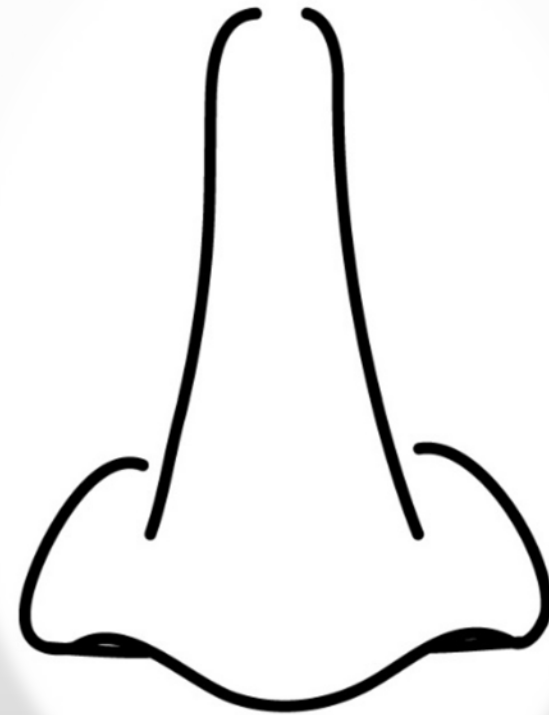
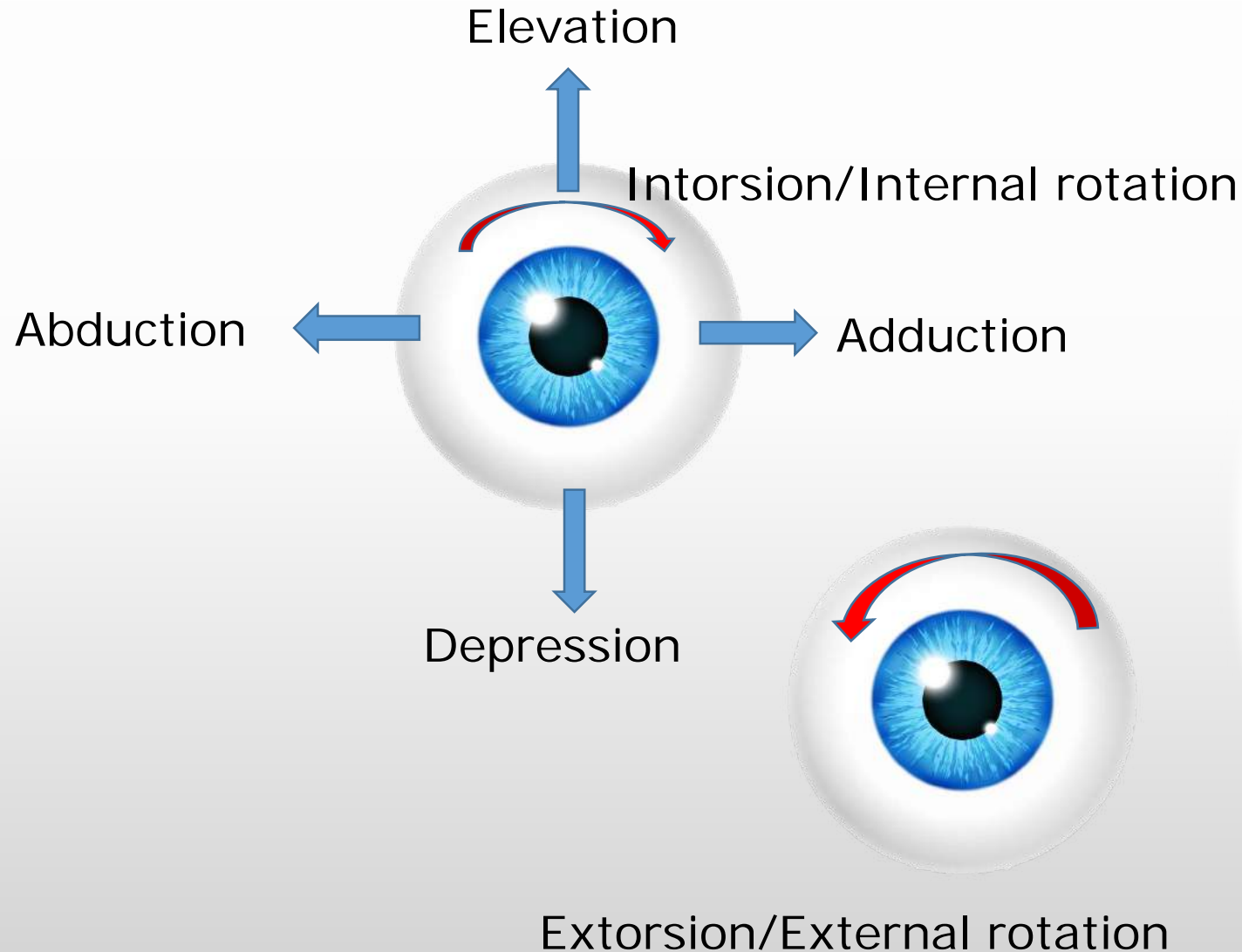
Orbicularis oculi and eyelids



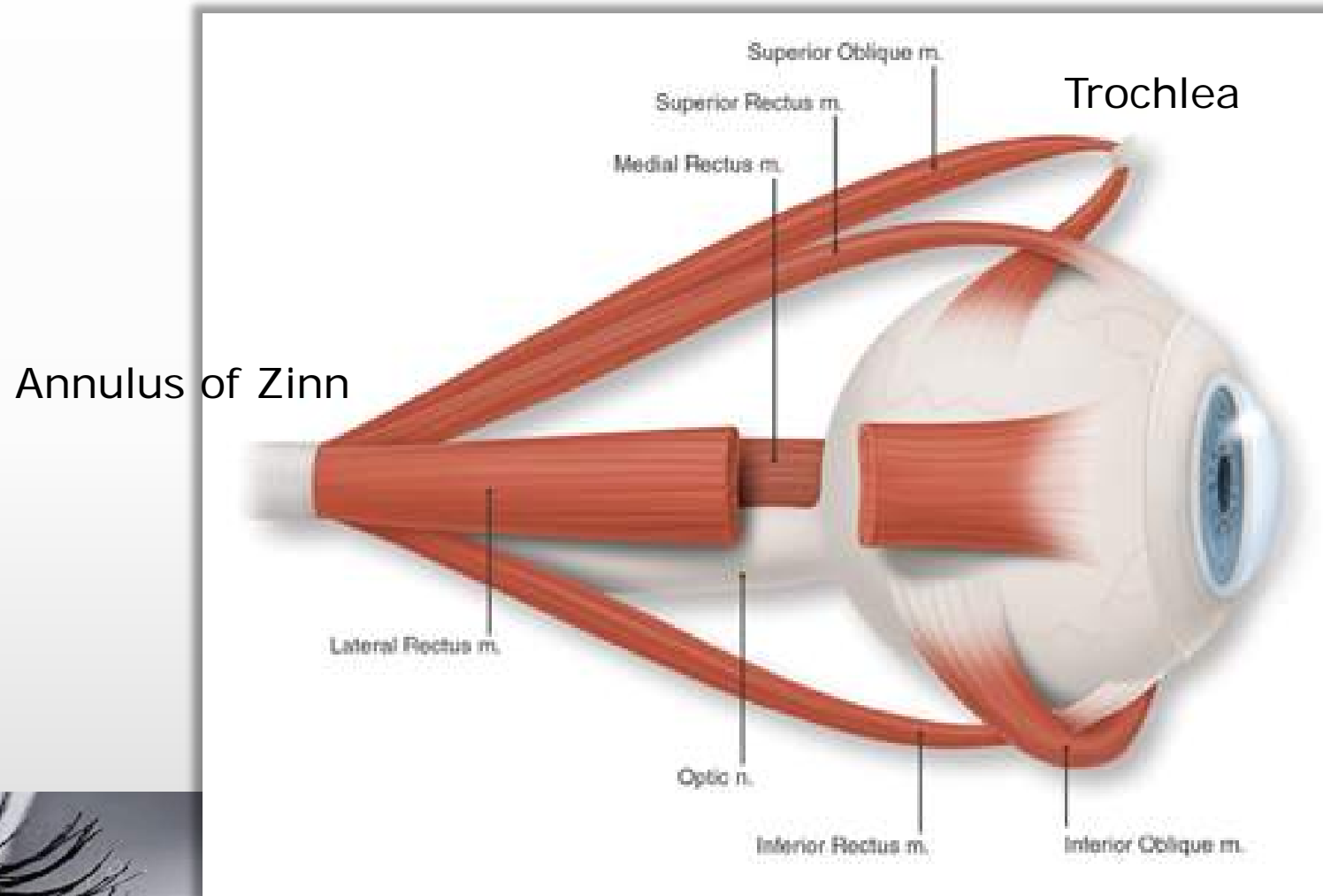
Orbicularis oculi muscle



Eye movements



Extra-ocular muscles

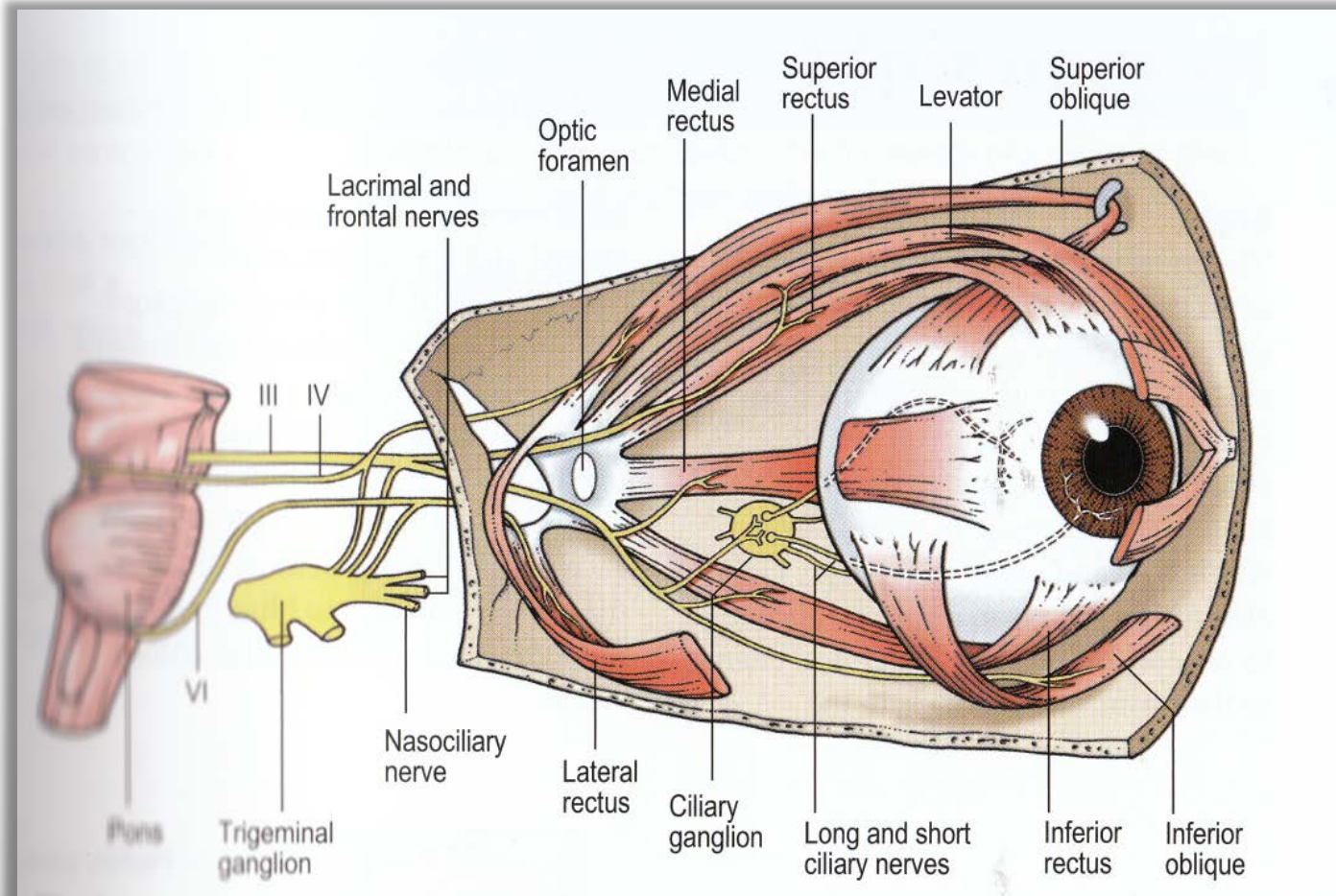


Extra-ocular muscles

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



Innervation of extraocular muscles

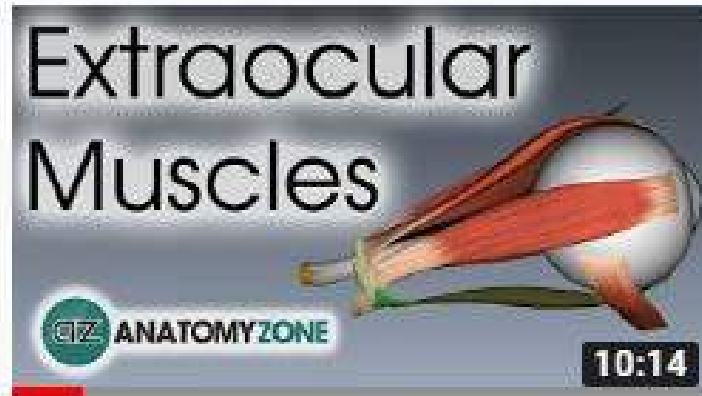


Lateral Rectus Muscle →
“Abducts” → Innervated by
Abducens nerve
= Cranial nerve 6

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



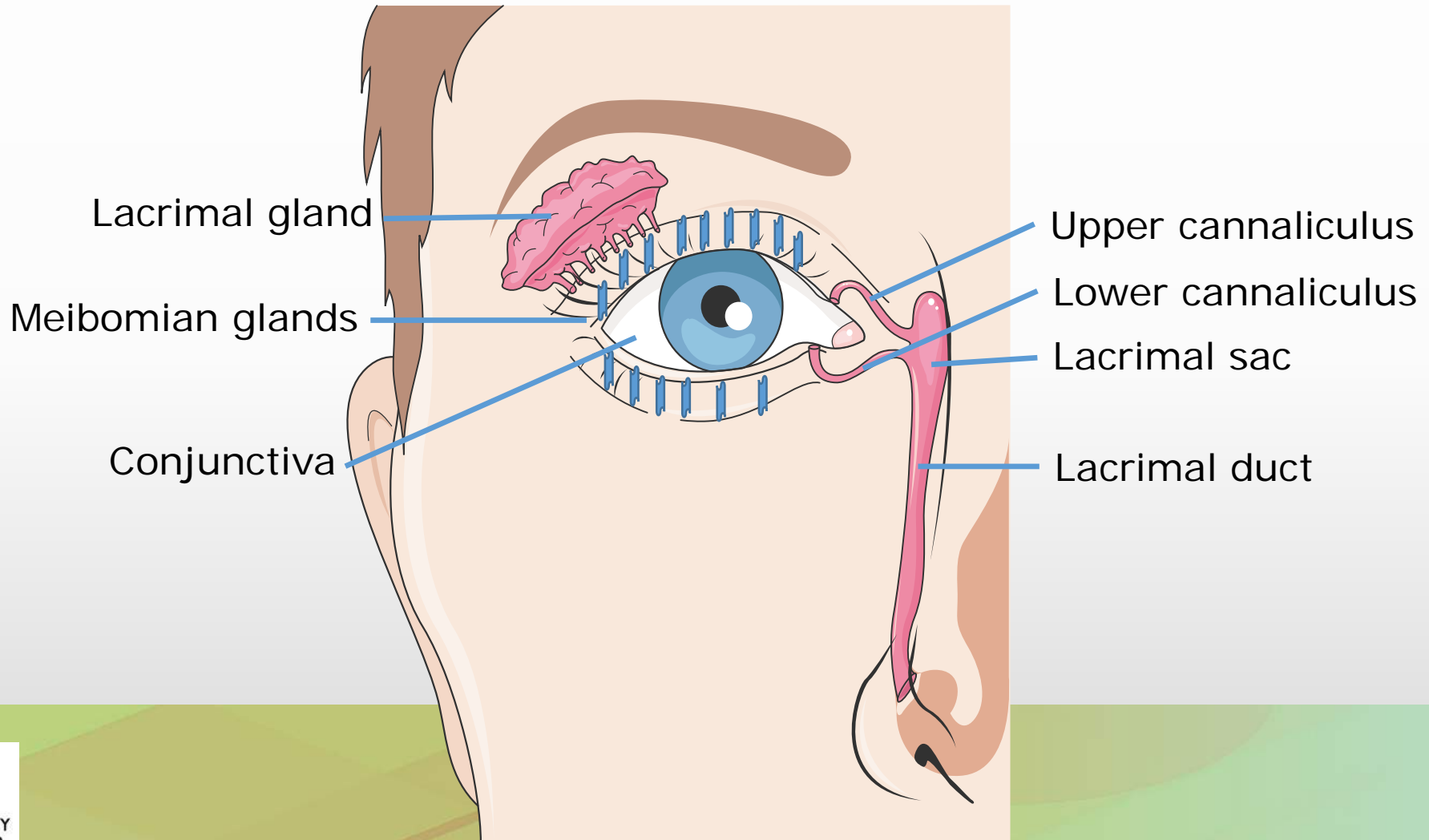
Extraocular Muscles | Eye Anatomy

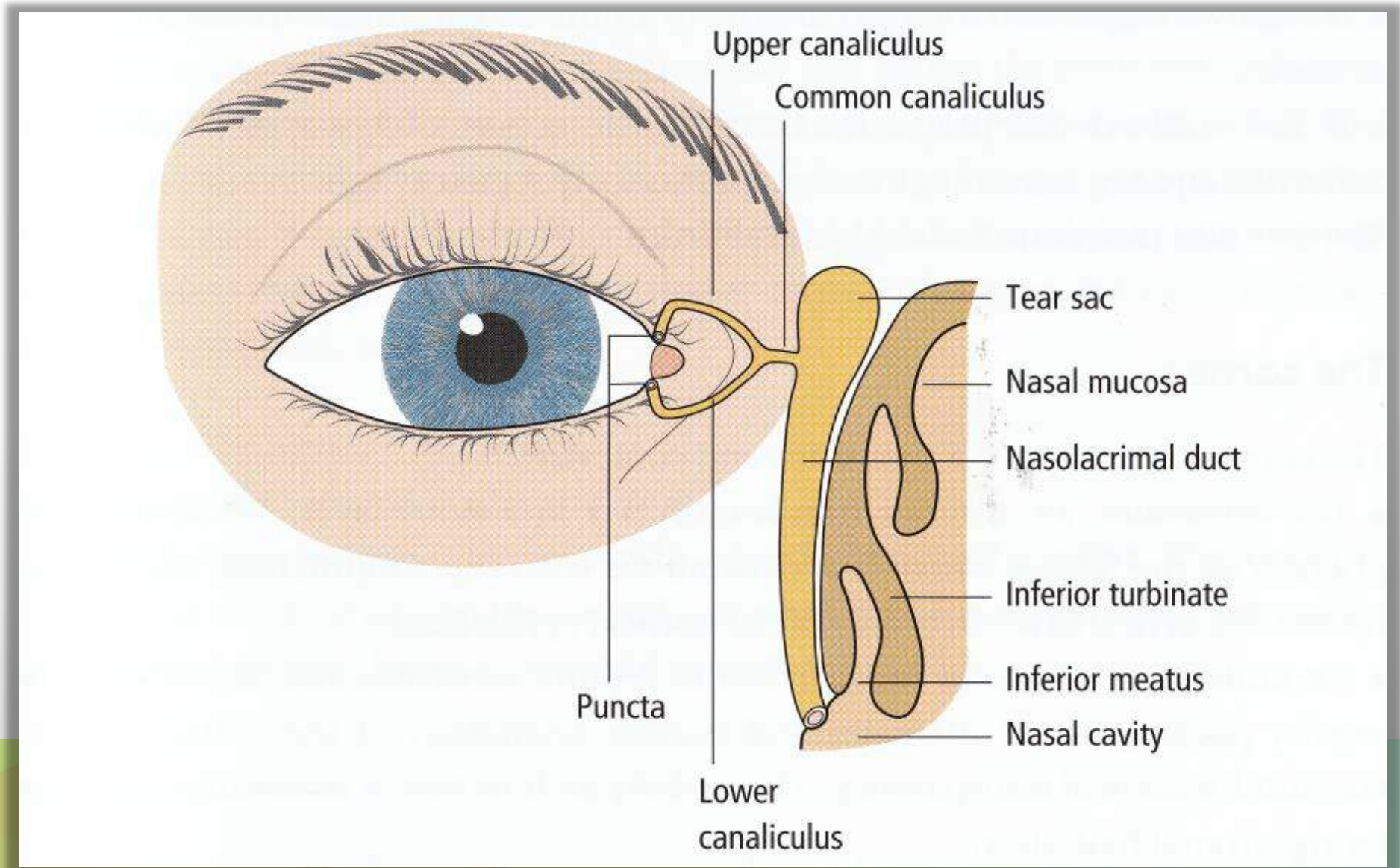
AnatomyZone  460K views • 3 years ago

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

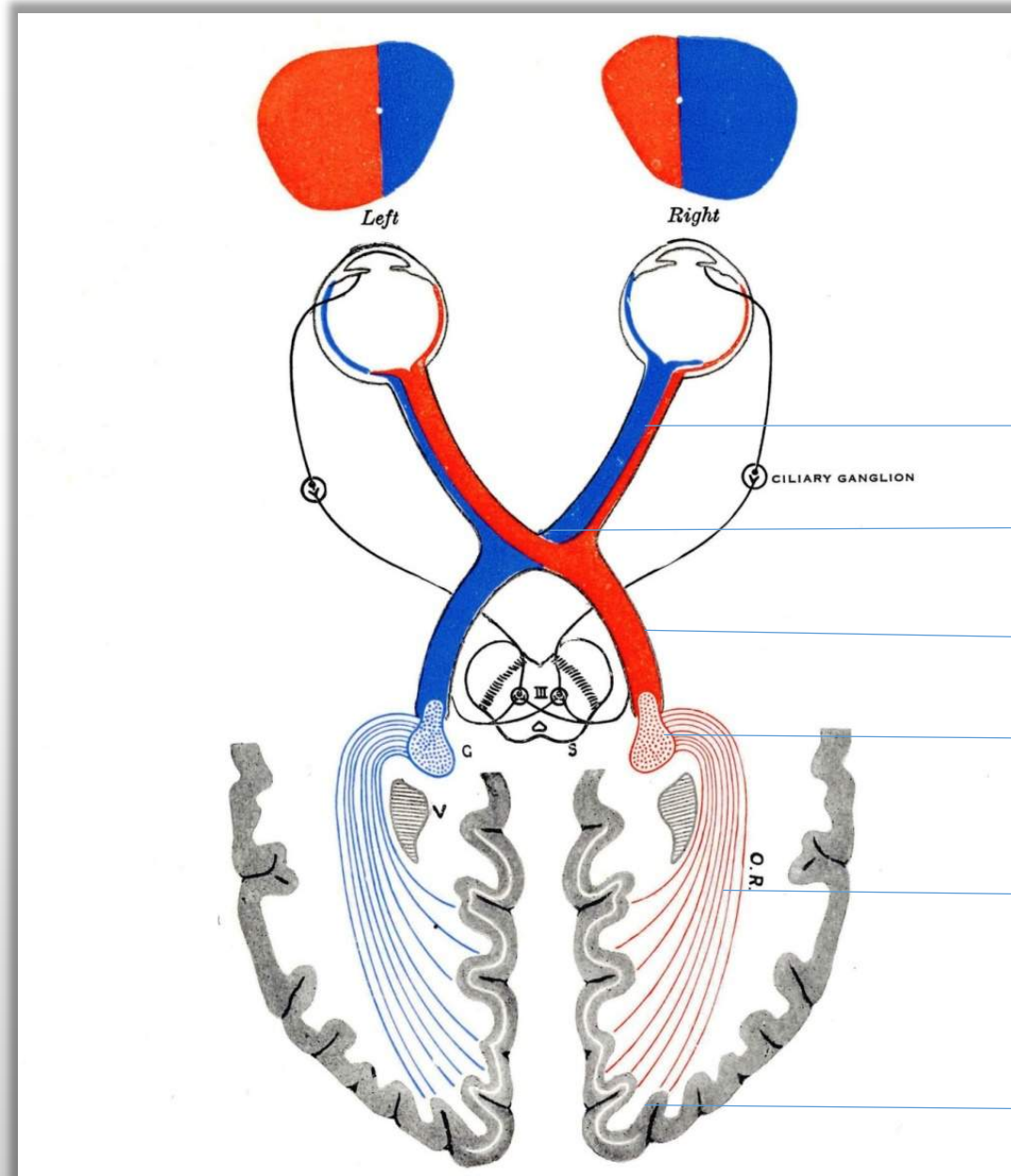
Search for 'extraocular muscles eye anatomy' on youtube
https://www.youtube.com/watch?v=f_rb6FMVHPk&t=7s

Tear production and drainage





Visual Pathway



Optic nerve

Optic chiasm

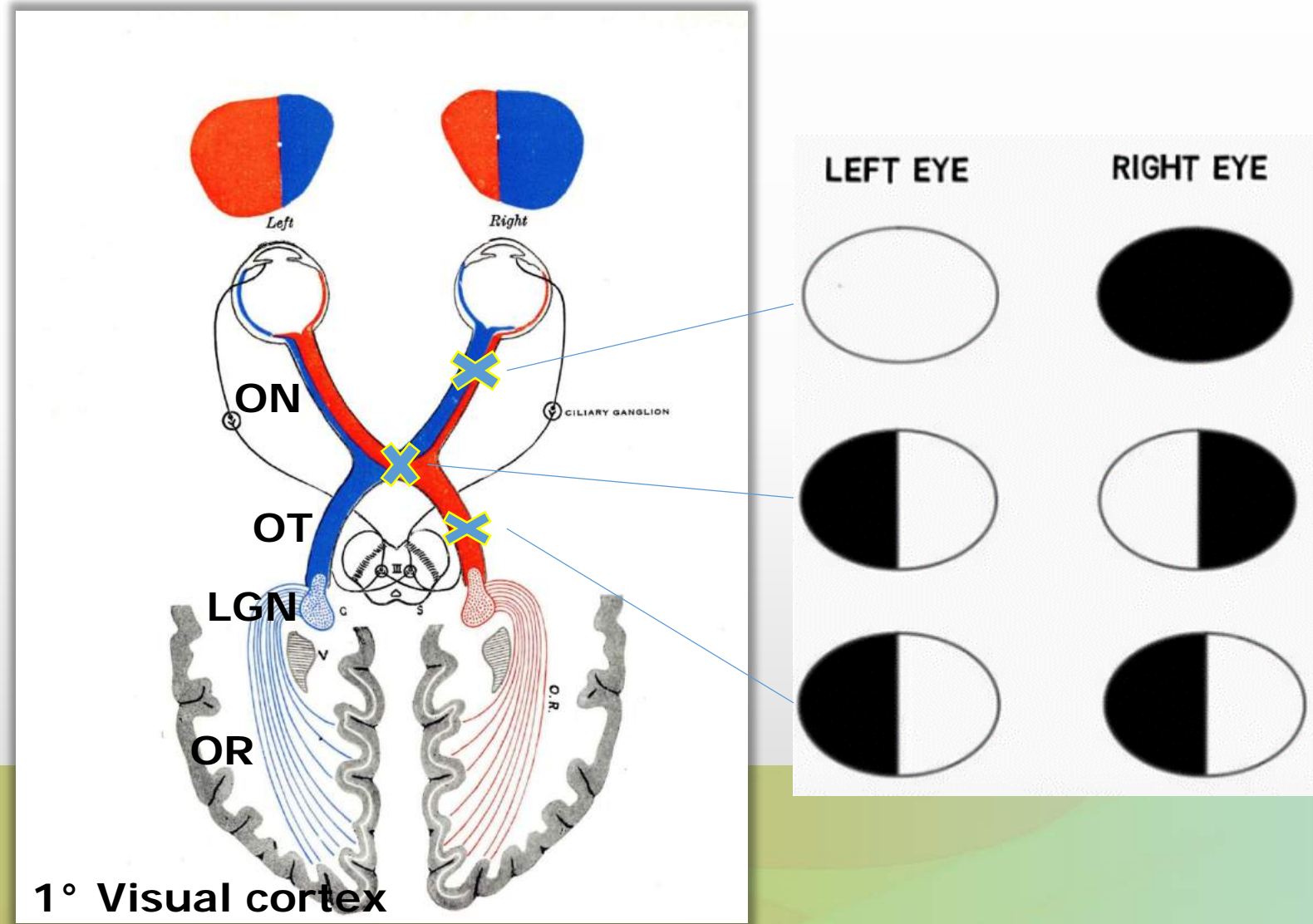
Optic tract

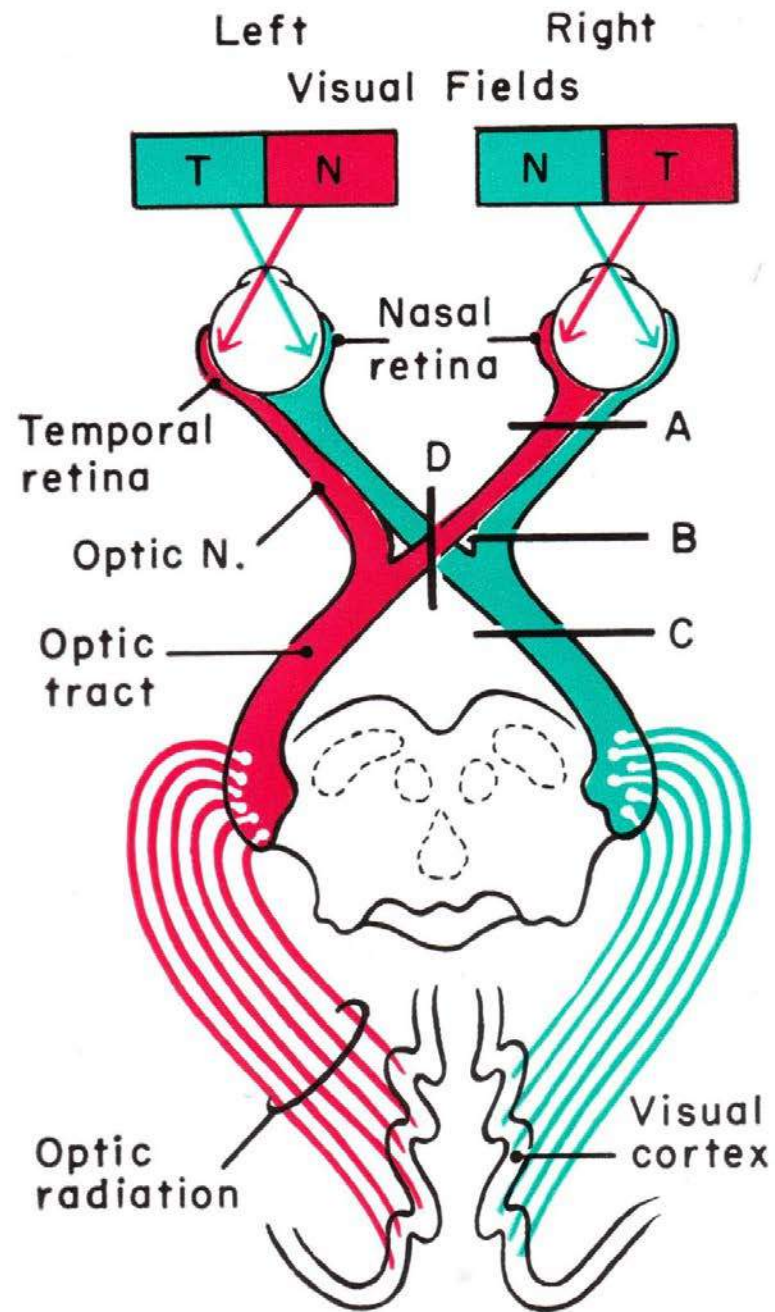
Lateral geniculate nucleus









Optic radiation

Primary visual cortex

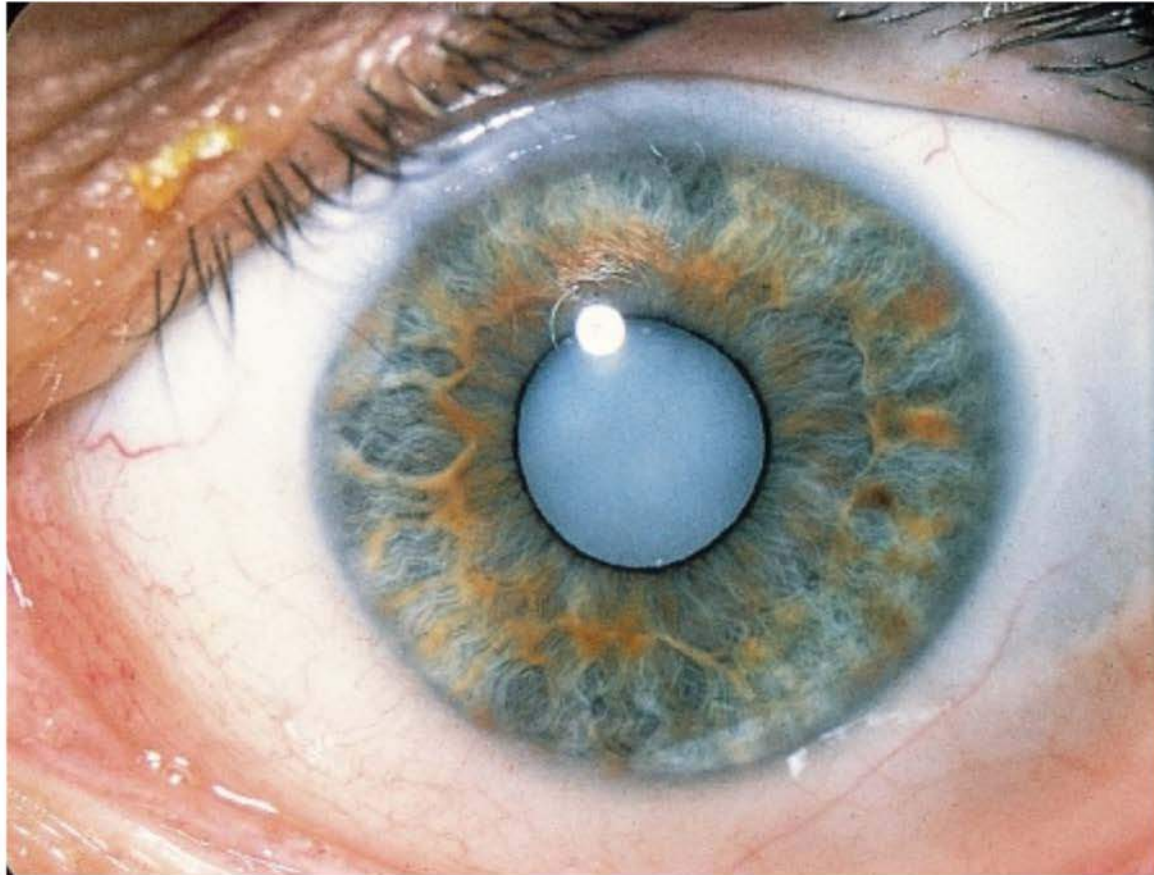
Injuries to Visual Pathway





- | Left | Right |
|---|---|
| A  |  |
| Total blindness of right eye | |
| B  |  |
| Right nasal hemianopsia | |
| C  |  |
| Left homonymous hemianopsia | |
| D  |  |
| Bitemporal heteronymous hemianopsia | |

Cataract of the crystalline lens



Age of onset

- Congenital
- Age-related

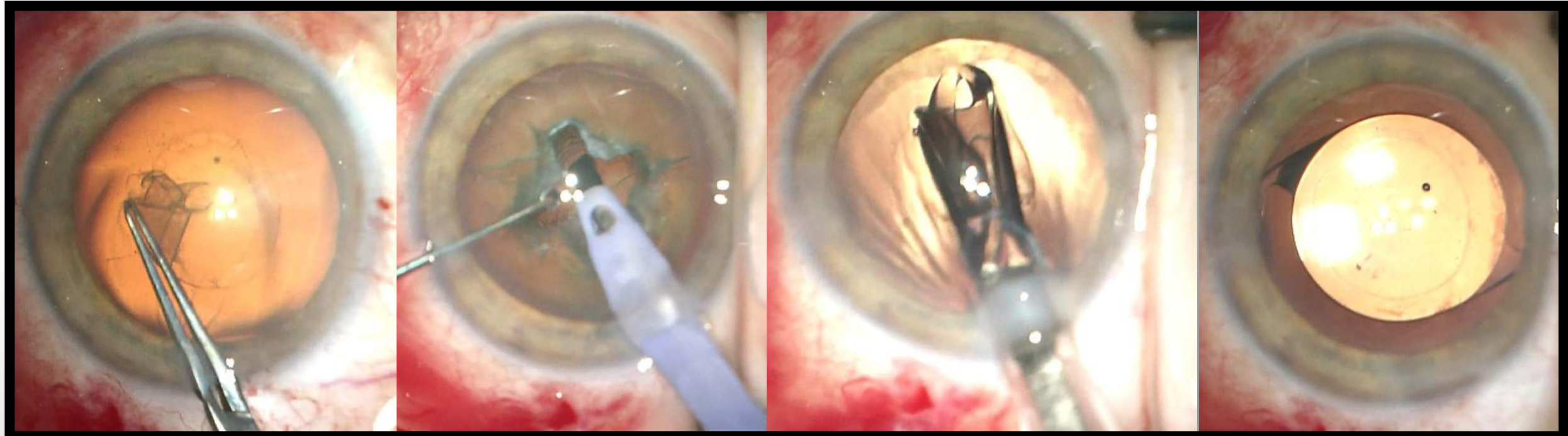
Location

- Nuclear sclerotic
- Cortical
- Posterior
- Subcapsular

Cause

- Age-related
- Traumatic
- Diabetic

Phacoemulsification cataract surgery



Capsulorrhexis

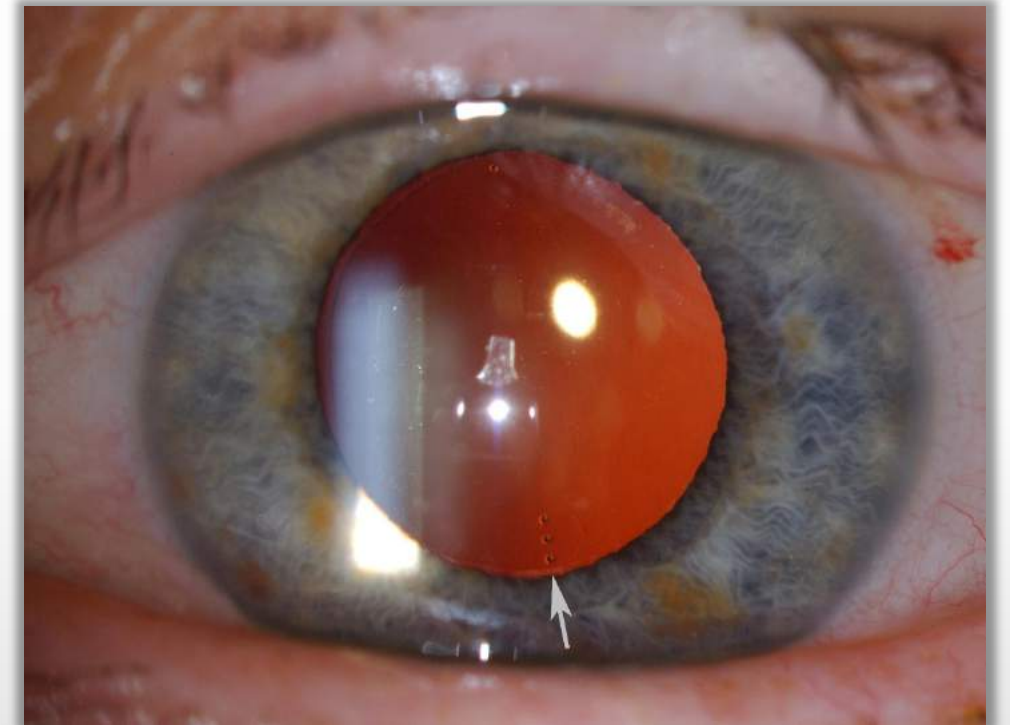
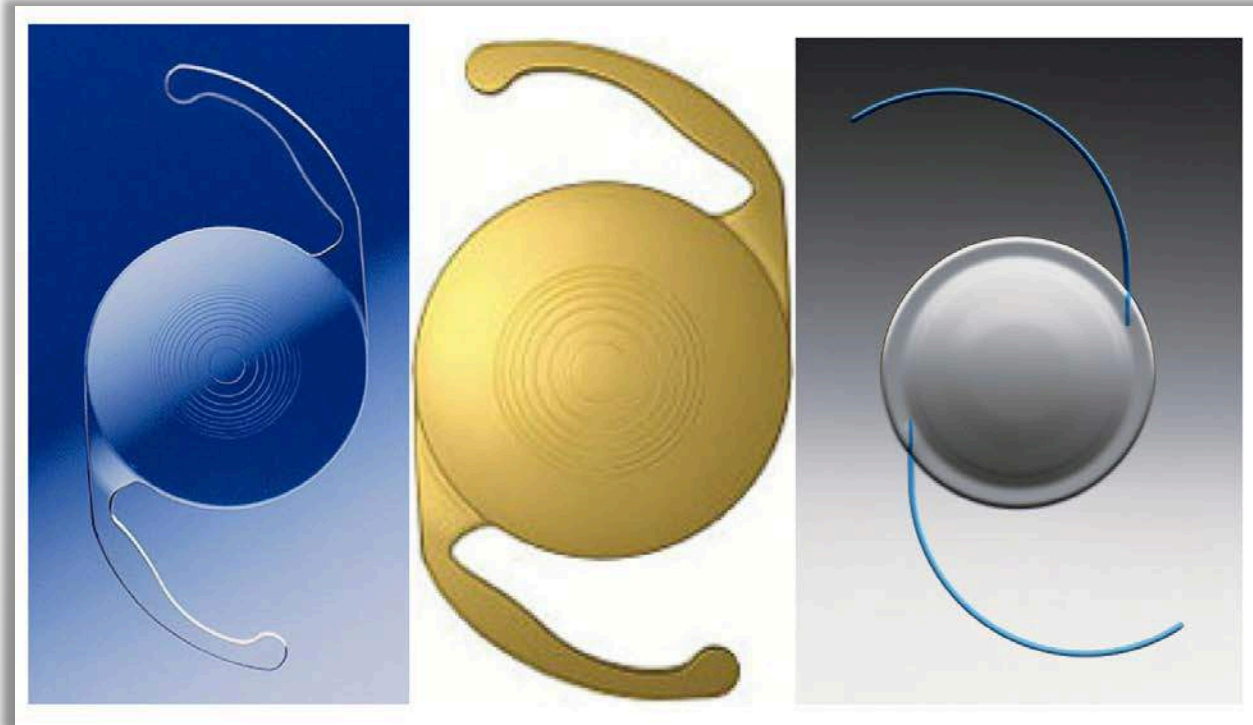
Phacoemulsification

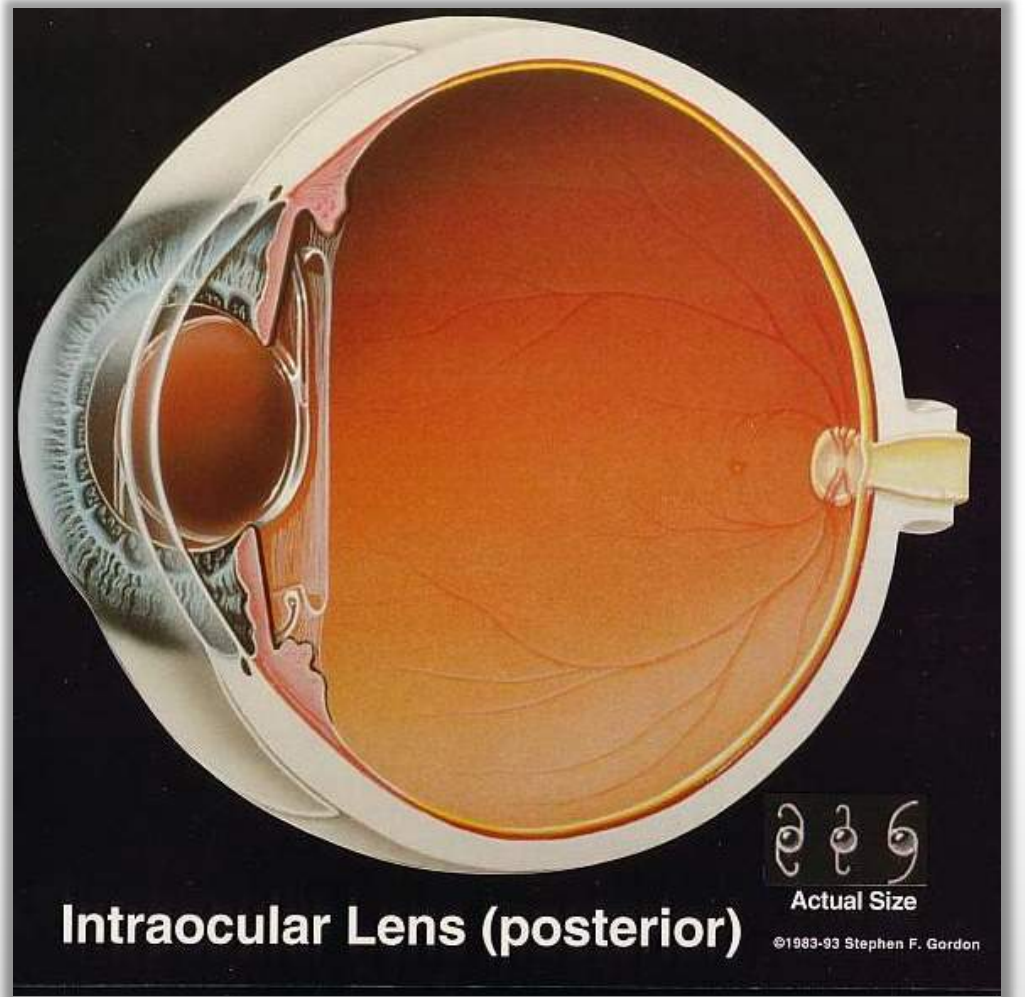
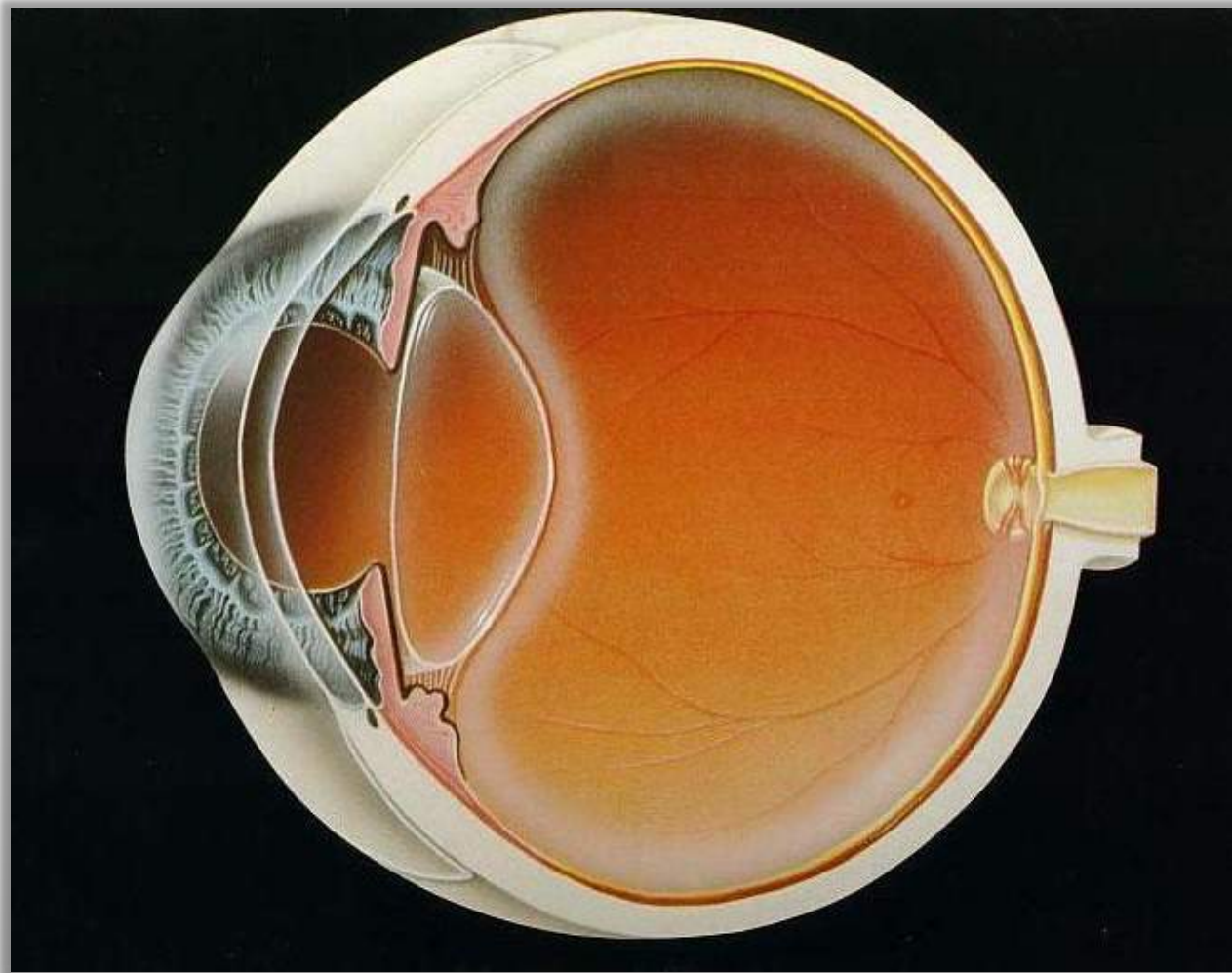
Injection of foldable IOL

IOL in capsular bag



Intra-ocular lens (multifocal and toric)





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.



Translational Vision Research



Department of Ophthalmology

The End

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