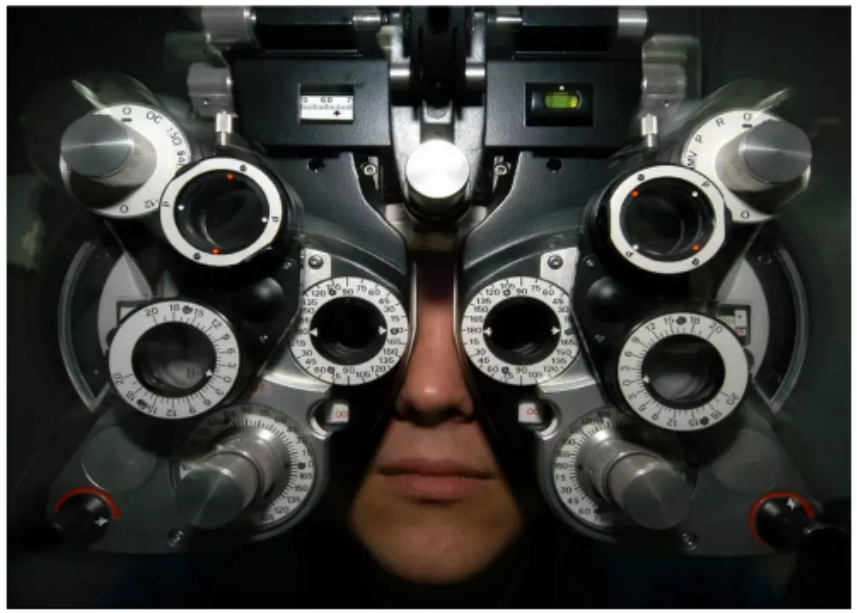
Introduction to ophthalmology

By Raghad Alami M.D.

Lecturer at Mutah University

What is ophthalmology?

- Opthalmos=eye
- Logos=word, thought, discourse
- The science of eyes

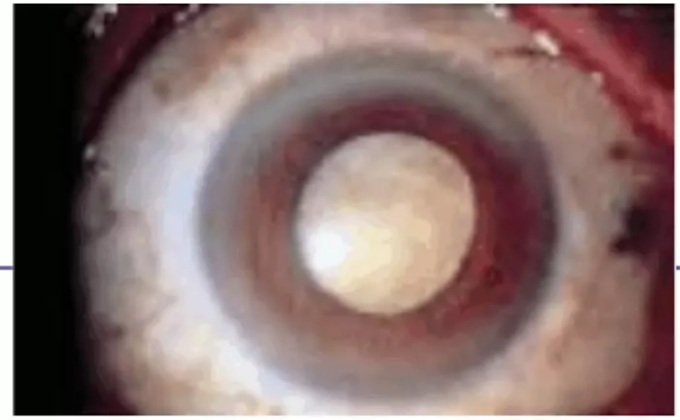


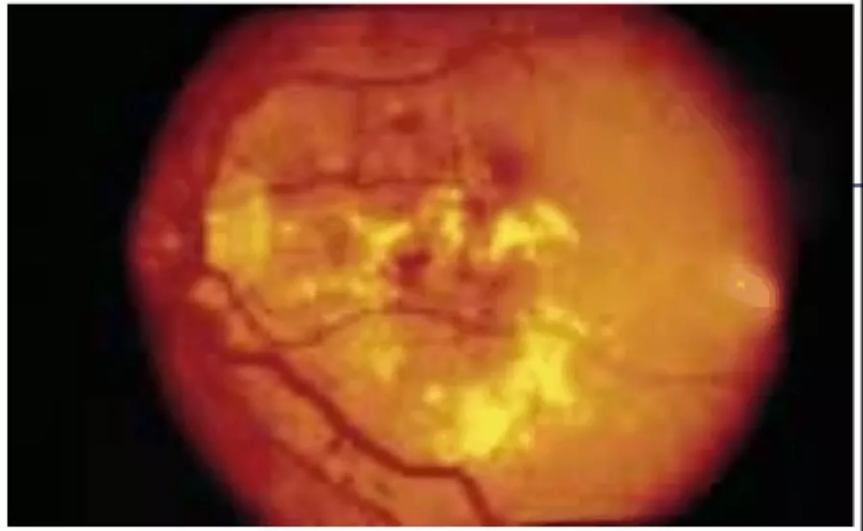
- The branch of medicine concerned with the eyes
  - Anatomy
  - Function
  - Disease
- Medical and surgical care of the eye, the adjacent adnexal and periocular area and the visual system

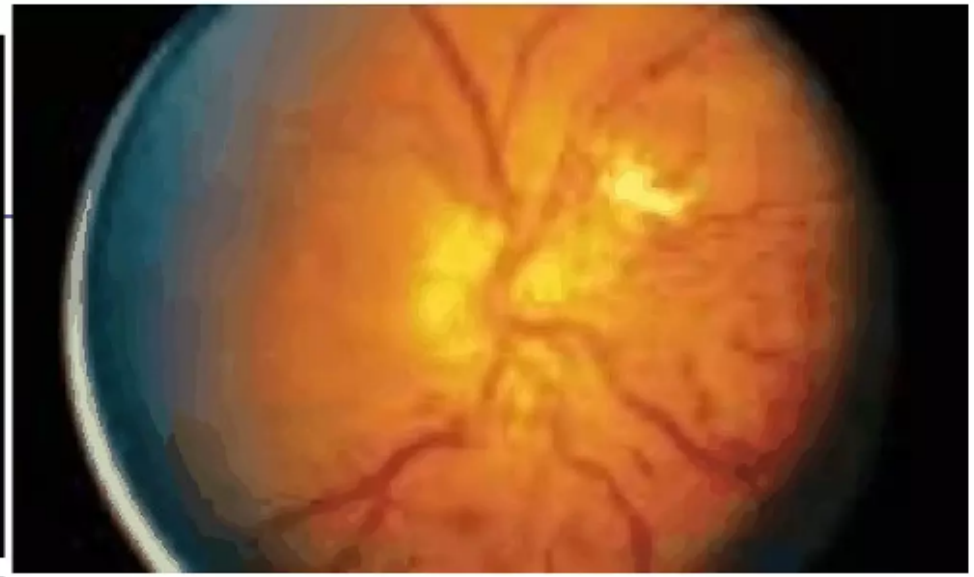
- Minimally invasive microsurgery and lasers as well as delicate plastic surgical techniques
- Type of patients
- Our team:
  - Ophthalmologists,
  - MOs,
  - Optometrists,
  - Ophthalmic nurses,
  - Medical assistants

Main causes of blindness

- Developing countries
  - Cataract
  - Glaucoma
  - Trachoma
  - Vitamin A deficiency
  - Onchocerciasis
- Developed countries
  - Age-related macular degeneration
  - Glaucoma
  - Cataract
  - Diabetic retinopathy
  - Refractive error








Courtesy of Mary Lou Lewis, MD and J. Donald Gass, MD
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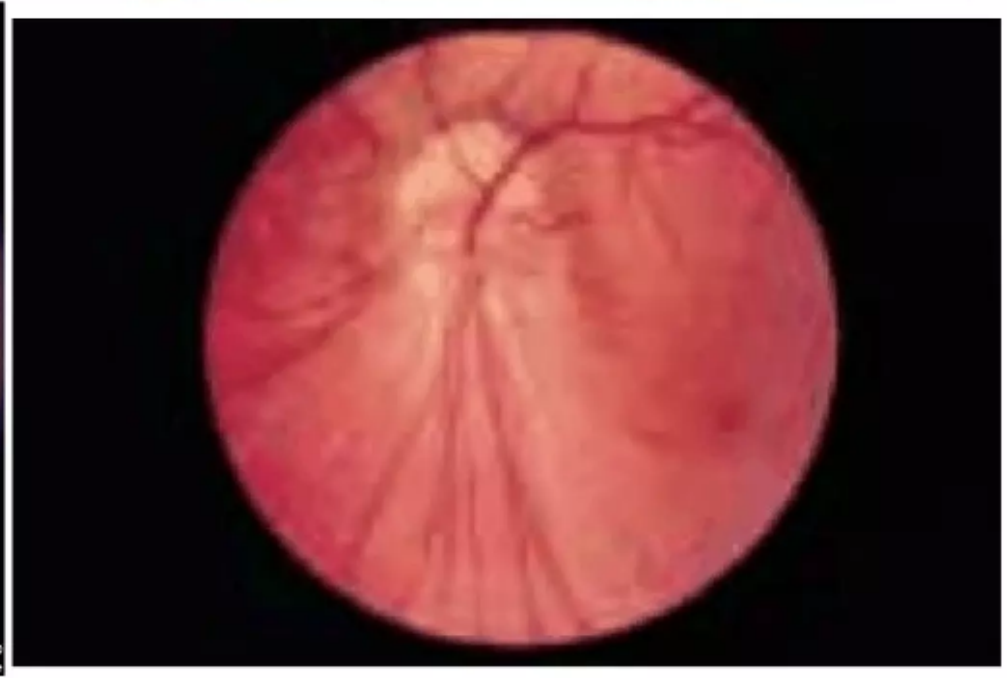
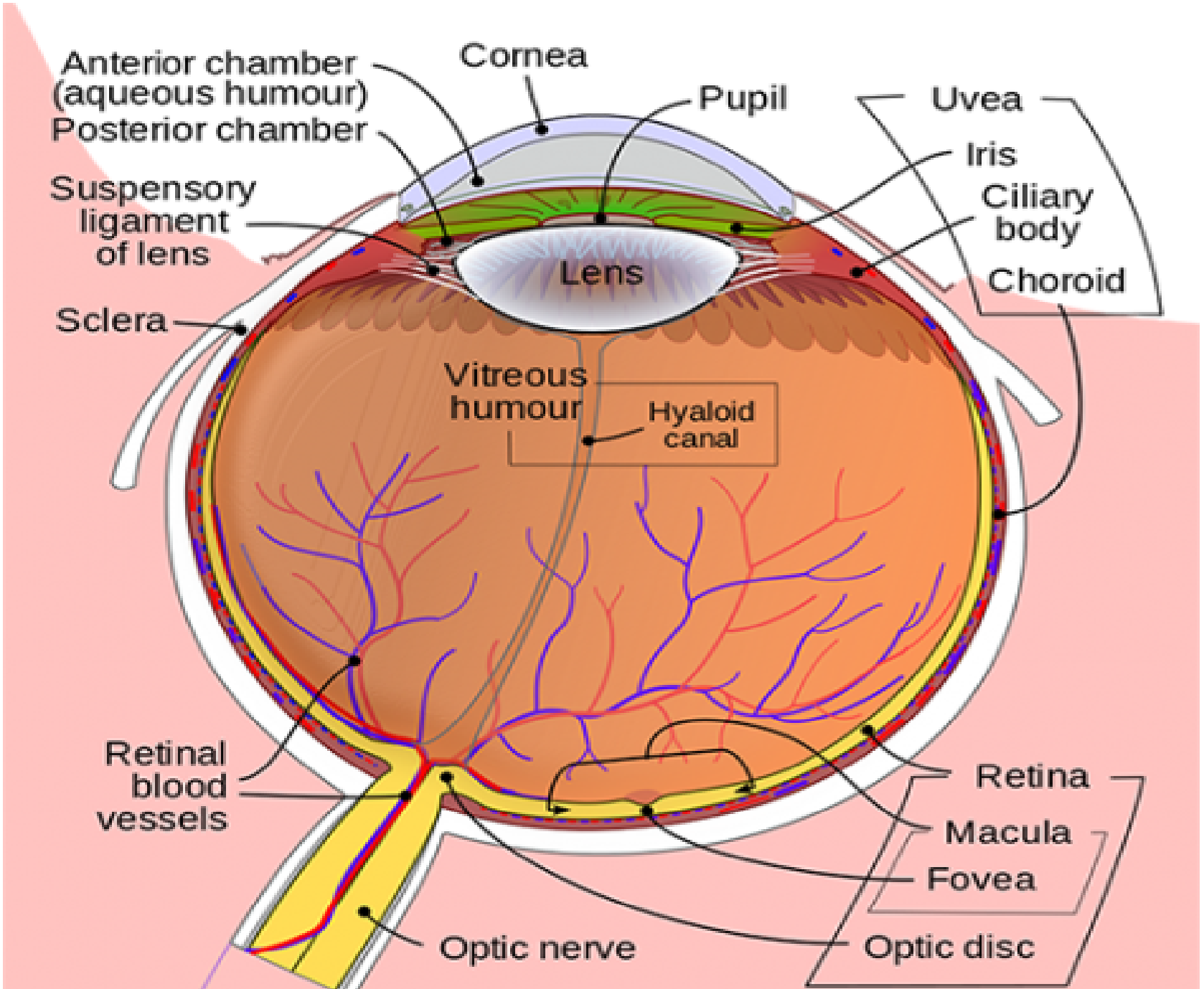
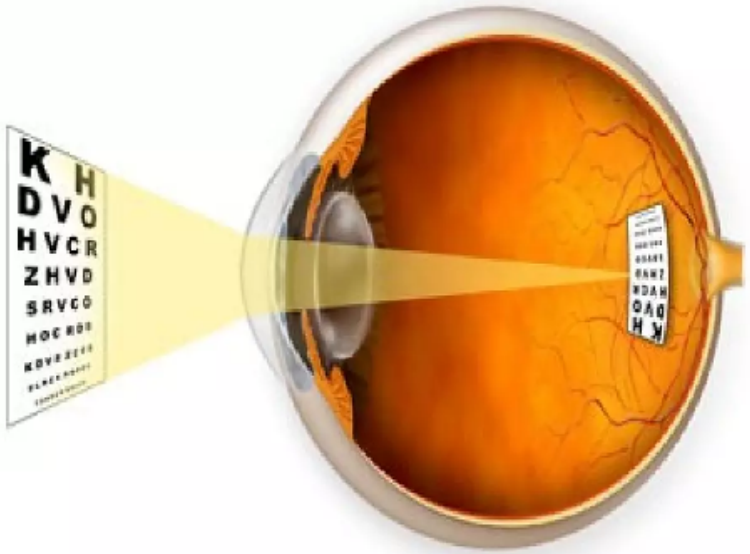


Anatomy and physiology of the eye


Anterior chamber
(aqueous humour)
Posterior chamber
Cornea
Pupil
Uvea
Iris
Ciliary body
Choroid
Suspensory ligament of lens
Lens
Sclera
Vitreous humour
Hyaloid canal
Retinal blood vessels
Retina
Macula
Fovea
Optic nerve
Optic disc

The visual system

- A coordinated pair of eyes
- The appropriate protective mechanisms
- The necessary neural apparatus to interpret visual information



- To produce a clear image of the external world and transmit this to visual cortex of brain

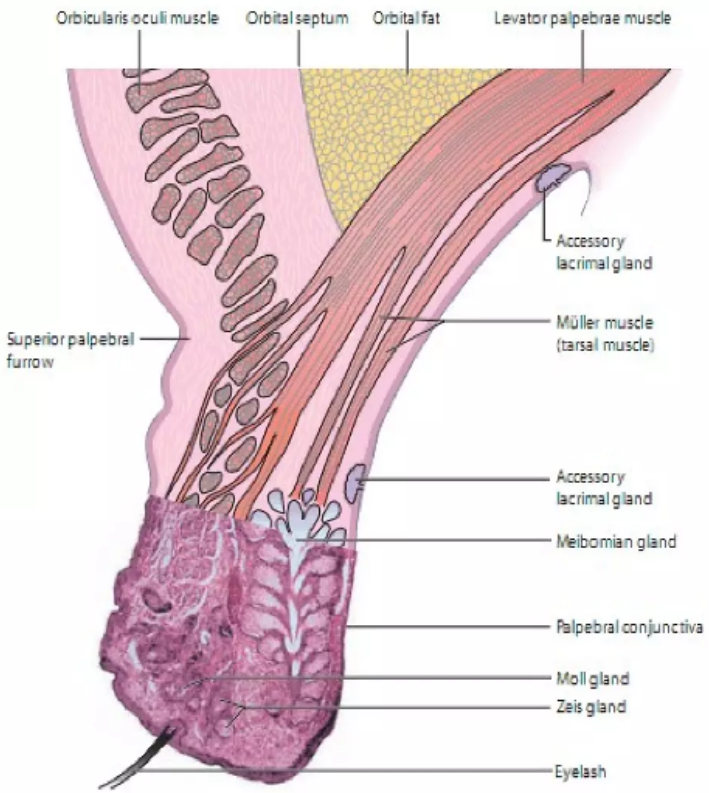
Requirements

- Constant dimension of eye
  - From its mechanical properties and the intraocular pressure
- Clear optical pathway
  - Transparent ocular media with ability to focus (refract) light on retina
- Intact retina (photochemistry)
- Visual pathway
- Coordinated movements of two eyes
- Integration of visual information from both eyes to produce binocular single vision

Orbit

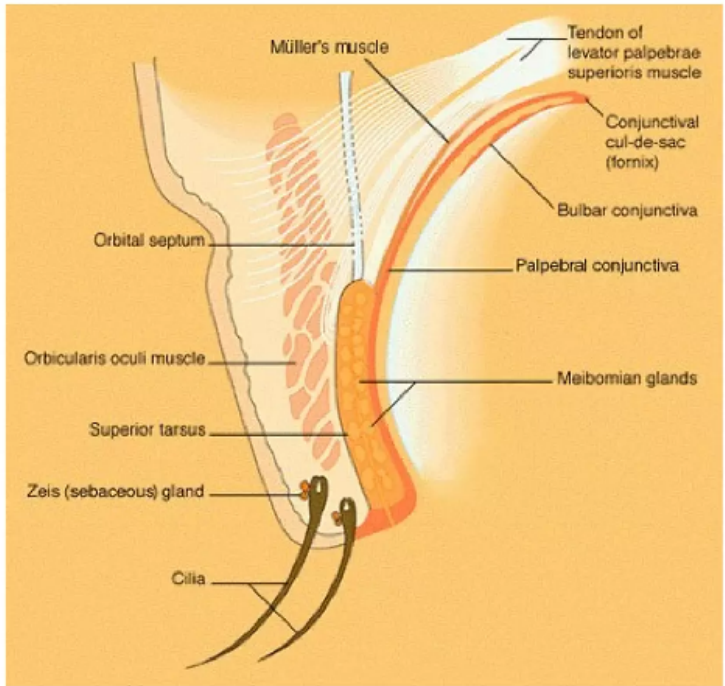
- 7 bones:
  - Frontal,
  - Sphenoid,
  - Ethmoidal,
  - Lacrimal,
  - Maxillary
  - Zygomatic
  - Palatine
- Roof, lateral wall, medial wall, floor
- Relations of the bony orbit

Eyelids



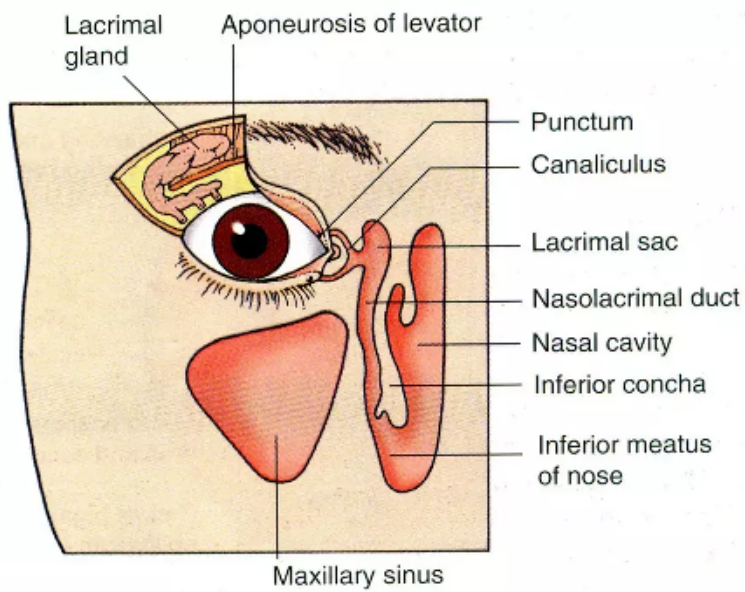
- **Skin**
- **Subcutaneous tissue**
- **Orbicularis oculi m.:**
  - closes the eyelids
- **Orbital septum**
- **Orbital fat**
- **Levator Palpebrae Superioris m.:**
  - elevates the upper lid
- **Tarsal plate** (meibomian gland)
- **Conjunctiva**

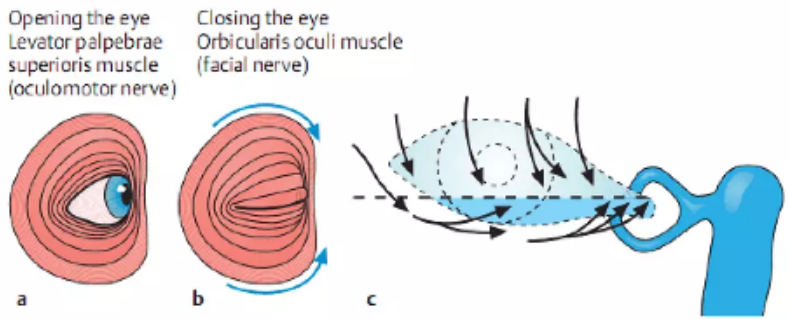
Conjunctiva



- Thin mucous membrane
- Palpebral, fornix, bulbar
- **Function**:
  - Tears production by the goblets cells
  - Protection
  - Smooth surface for the lids to blink

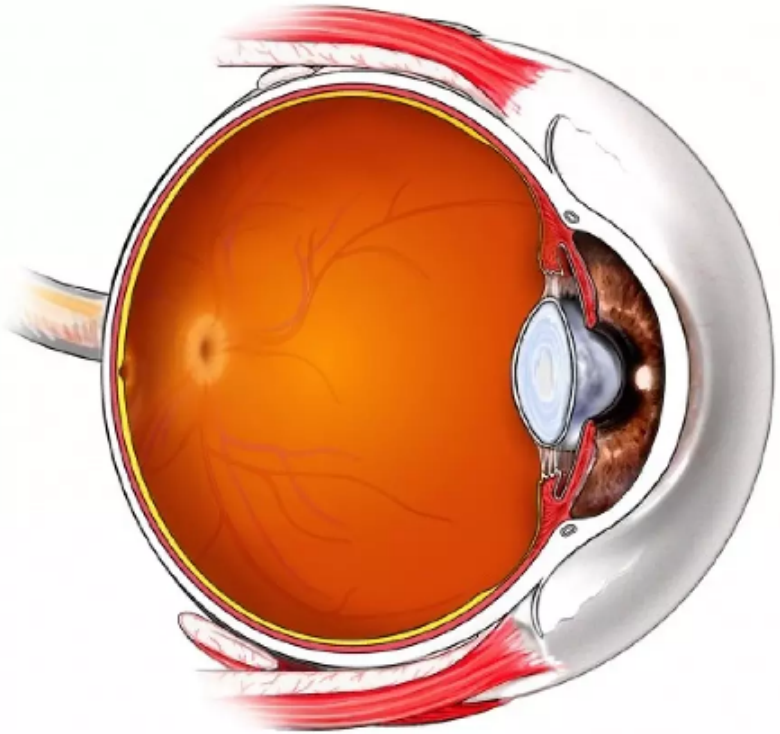
Lacrimal apparatus





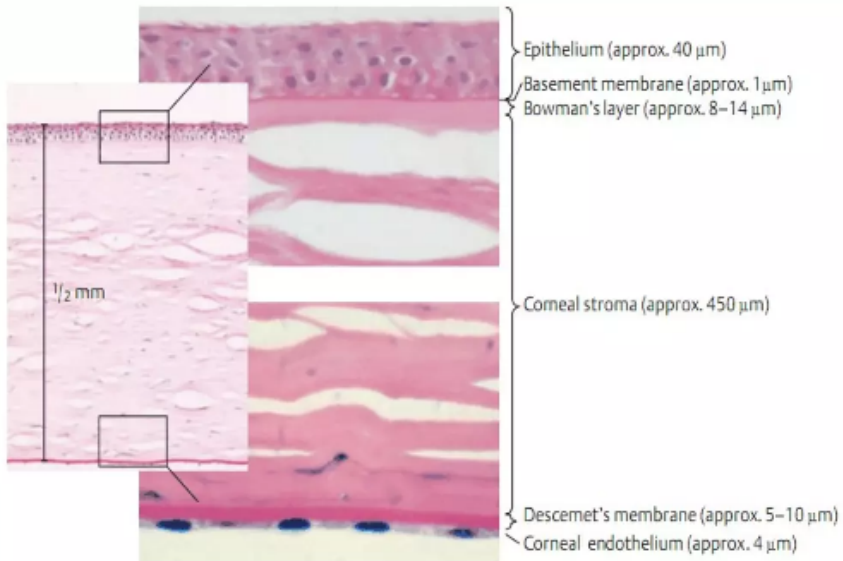
- Secretory:
  - Lacrimal gland
  - Accessory lacrimal glands
- Excretory:
  - Punctum
  - Canaliculus
  - Lacrimal sac
  - Nasolacrimal duct

Eyeball



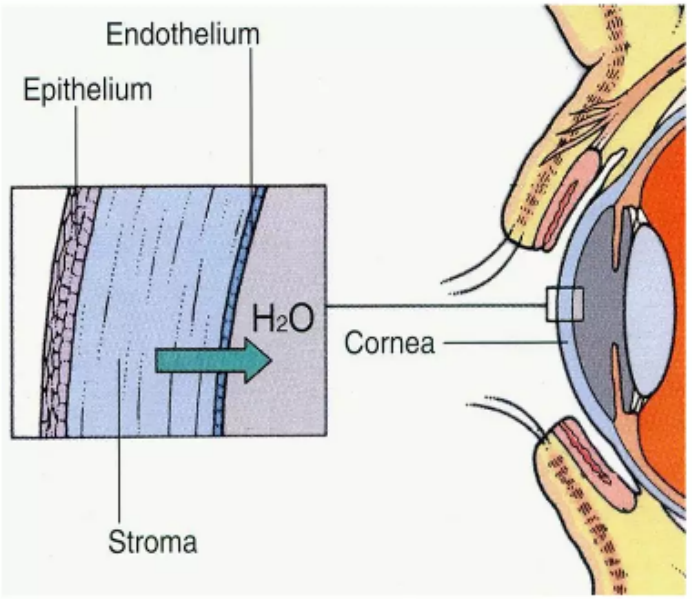
- **Fibrous coat**
  - Cornea, sclera
- **Vascular coat (uveal tissue)**
  - Iris, ciliary body, choroid
- **Nervous coat**
  - Retina

Cornea - anatomy



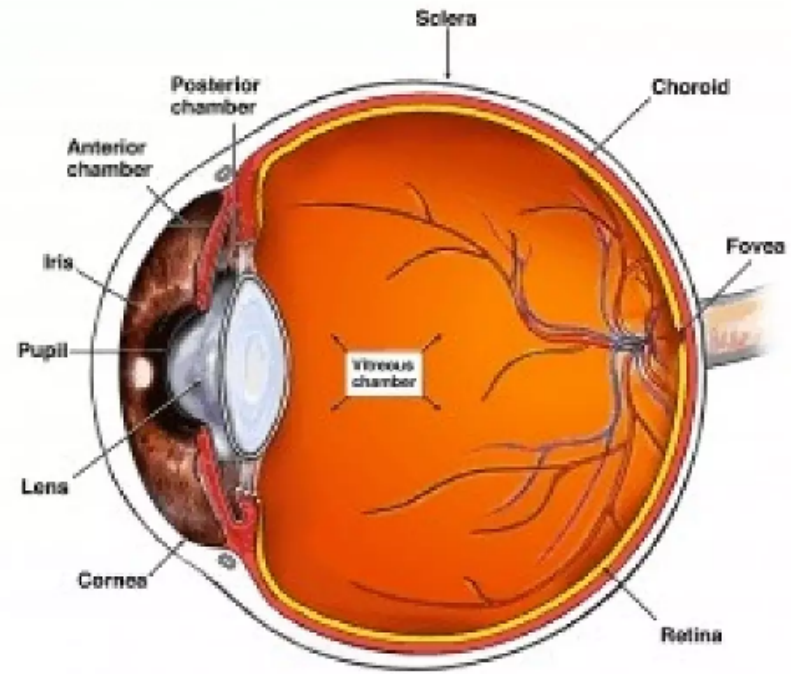
- 500-700 µm thick
- Transparent, avascular
- Forms approximately the anterior 1/6 of the outer coat of the eye and is continuous posteriorly with the sclera
- 5 layers:
  - **Epithelium**
  - **Bowman's membrane**
  - **Stroma**
  - **Descemet's membrane**
  - **Endothelium**

Cornea



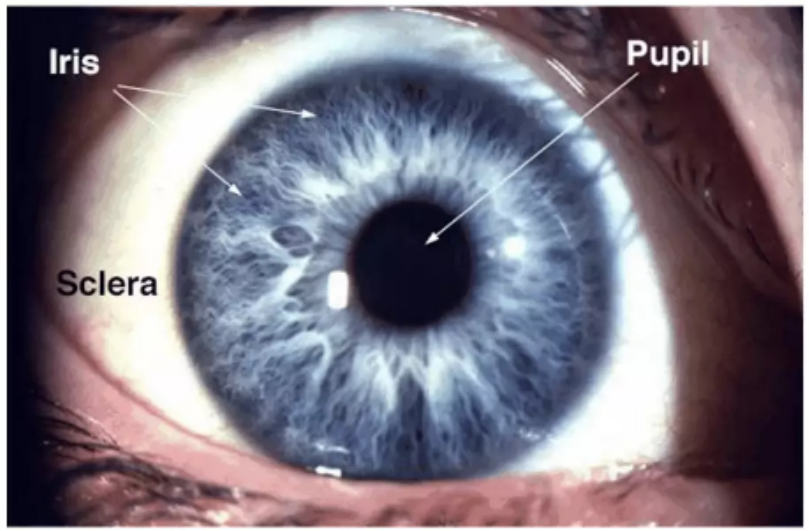
- Transparency
  - Relative dehydration of the stroma (75-80%) is maintained by the impermeable epithelial barrier and active pumping mechanisms of the corneal endothelium
  - The regular spacing of individual stromal collagen fibrils
- Refraction
  - The cornea is the major refractive component of the eye - 43 dioptres
- Barrier to infection and trauma

Sclera



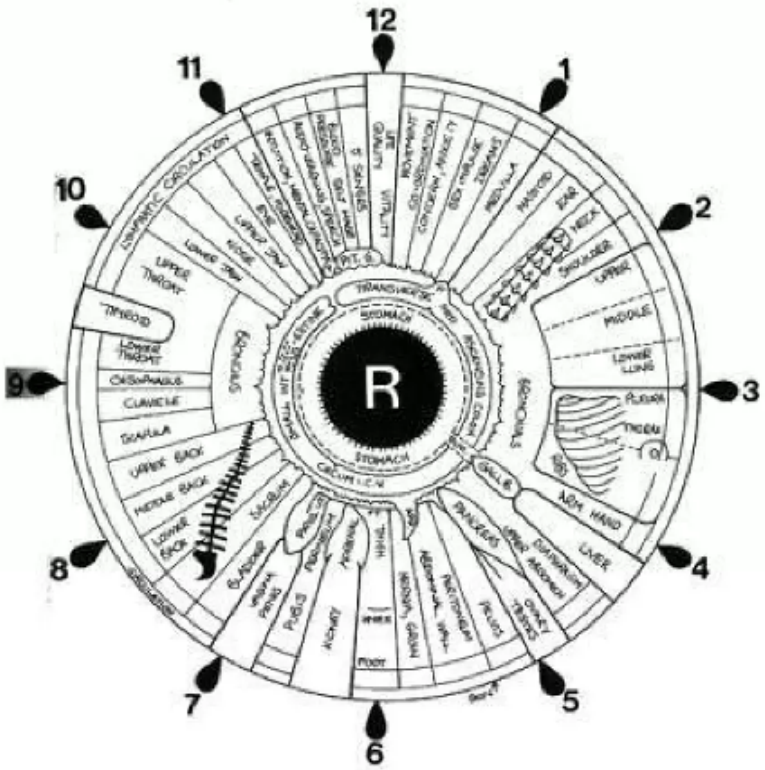
- Collagen
- Variable thickness
  - 1mm around optic nerve head, limbus
  - 0.3mm posterior to muscle insertions, at equator)
- Tough, opaque, mainly avascular
- Outer wall of the eyeball -protects intraocular contents, preserve shape
- Attachments for the extraocular muscles

Iris and pupil



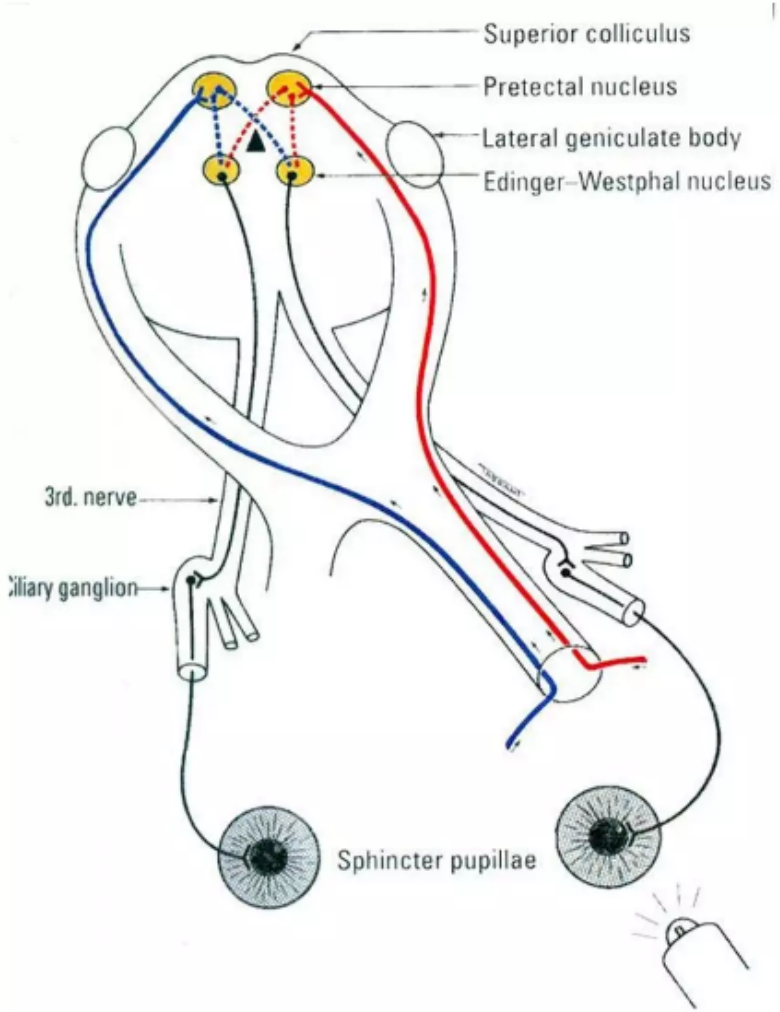
- Attached to ciliary body
- Forms pupil at center
- Stroma layer:
  - Smooth muscle
- Epithelial layer:
  - Anterior
  - Posterior (pigmented)

Pupil movements



- **Mydriasis** (Dilation):
  - Dilator pupillae muscles
  - Low-intensity light, excitement, fear
  - **Sympathetic**
- **Miosis** (Constriction):
  - Sphincter pupillae muscle
  - Bright light, accommodation
  - **Parasympathetic**

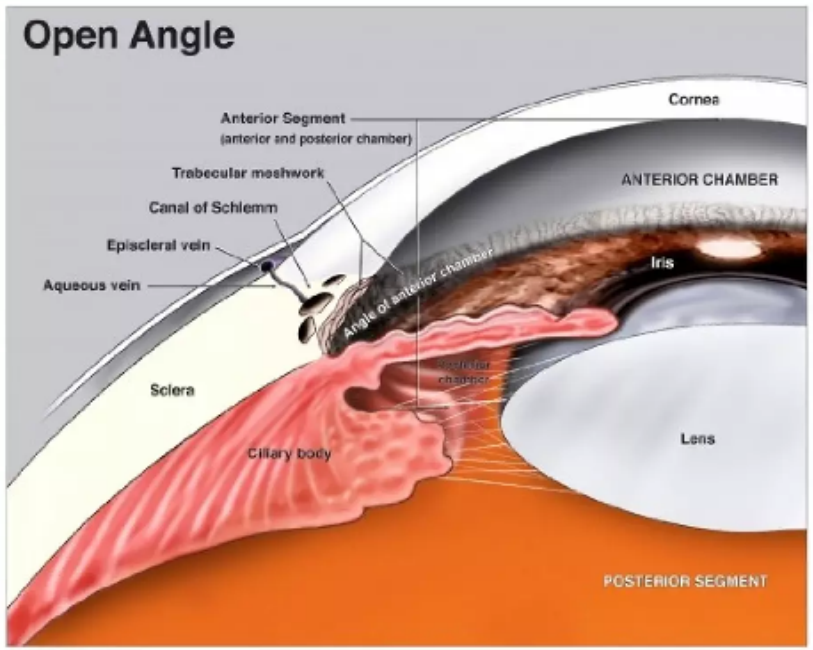
Pupillary light reflex



Consensual

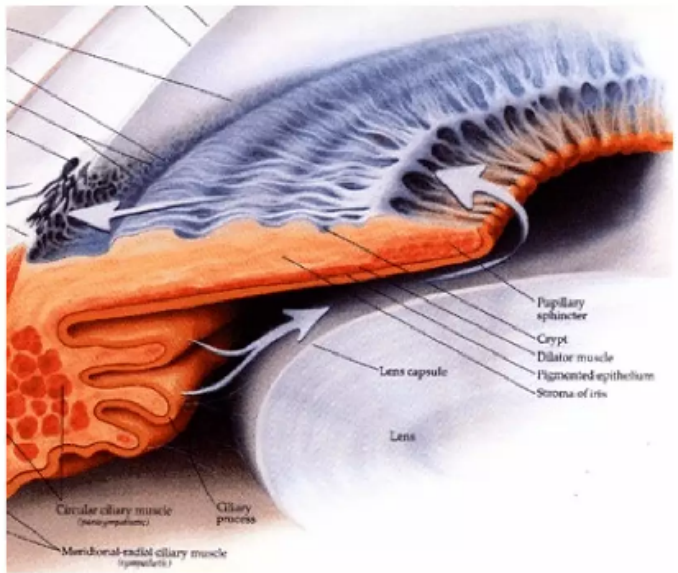
Direct

Ciliary body



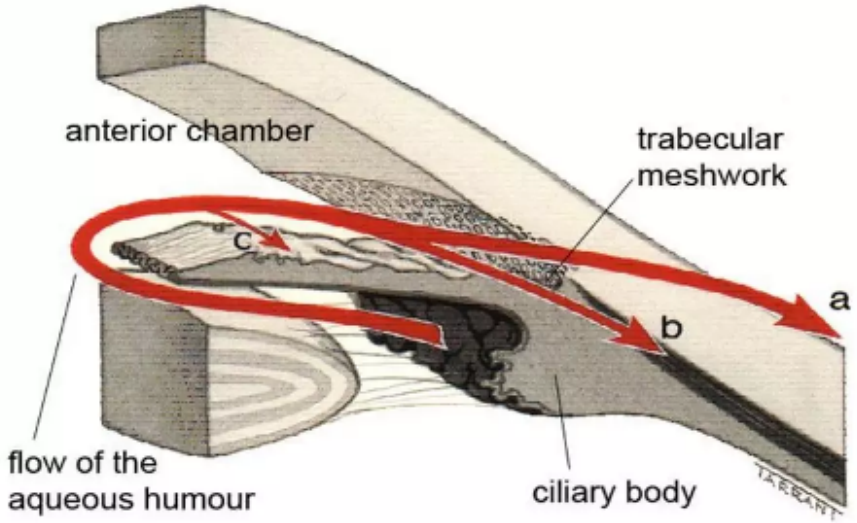
- Connects the iris and the choroid
- 2 parts:
  - Pars plicata (ciliary processes)
  - Pars plana
- Ciliary body has 3 layers:
  - Ciliary epithelium
  - Ciliary stroma
  - Ciliary muscle
- Functions:
  - Aqueous humor production
  - Suspension of lens, accommodation

1. Aqueous Humour production



- Active secretion by the epithelium of the ciliary processes of the ciliary body
- **β-adrenergic** receptors
- **Function**:
  - Carries O_2, nutrients to lens, cornea and waste products away
  - Maintain shape of eye by **intraocular pressure**
  - Flushes away blood, macrophages, inflammatory cells

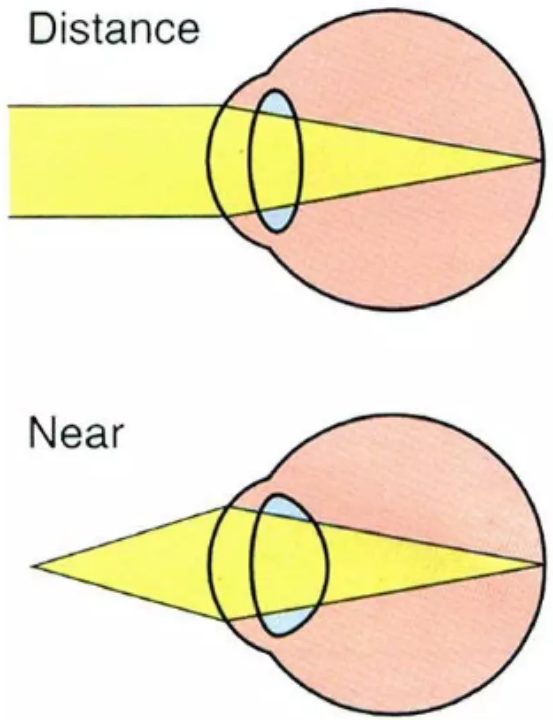
Aqueous Humour drainage



- **a. Conventional** outflow:
  - Trabecular meshwork → Schlemm's canal → episcleral vessels (90%)
- **b. Uveoscleral** outflow:
  - Anterior face of ciliary body → choroidal vessels
- *Aqueous production & drainage are balanced to maintain an appropriate intraocular pressure*
- Normal IOP range from 8 to 21 mmHg, average 15 mmHg
- Diurnal variation

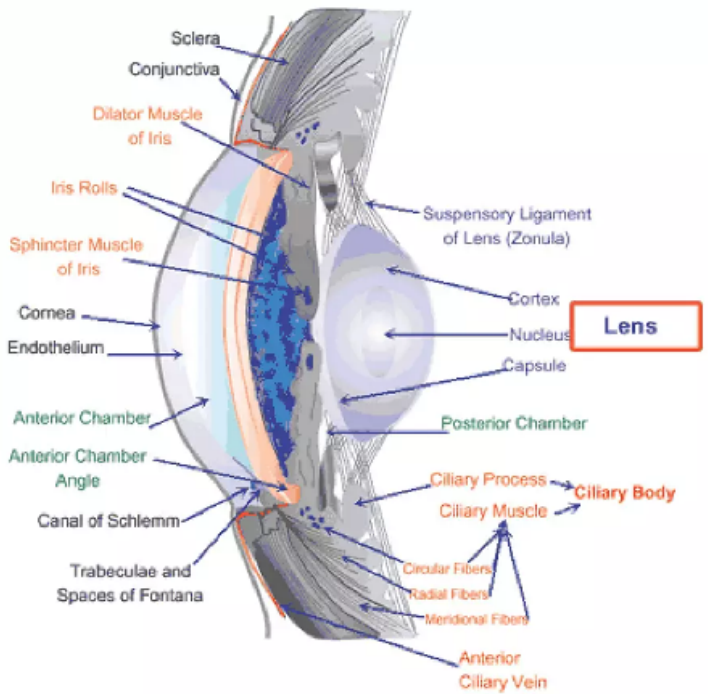
2. Accommodation

Near versus distance vision



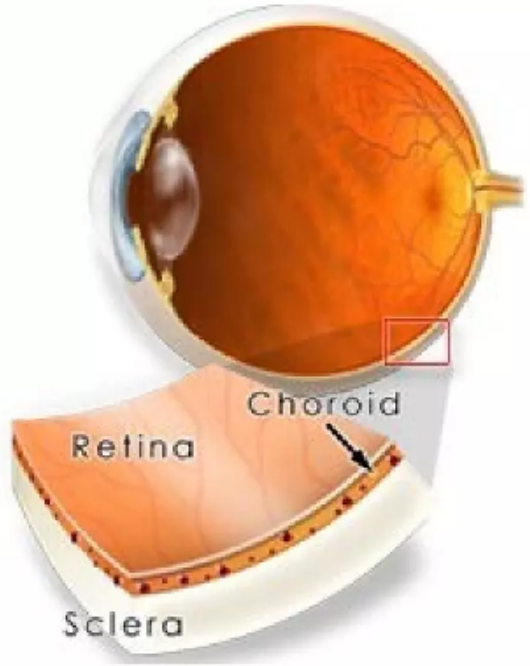
- Ciliary body anchors lens via the zonules
- The zonular fibers are under tension during distant viewing
- When the ciliary muscle contracts, it reduces the tension on the zonules
- The lens (elastic) becomes more convex
- Refractive power increase

Crystalline lens



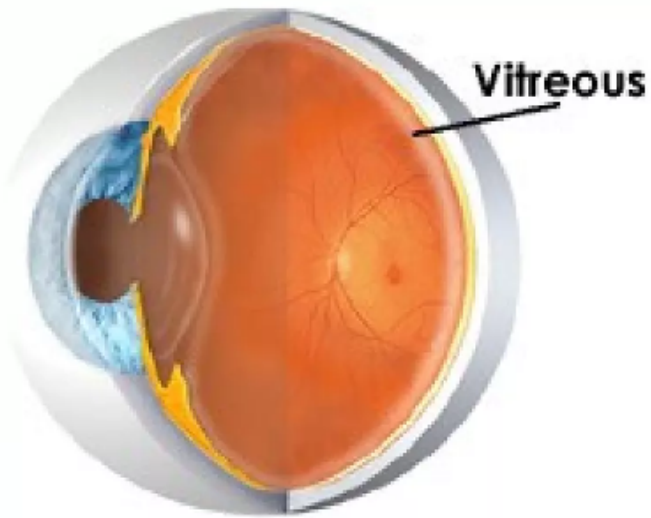
- Transparent, biconvex structure
- Contributes 15D (total 58D entire eye)
- Radially arranged zonule fibers that insert into the lens around its equator connect the lens to the ciliary body
- Can change diopteric power but amplitude of accommodation reduces with age (presbyopia)

Choroid



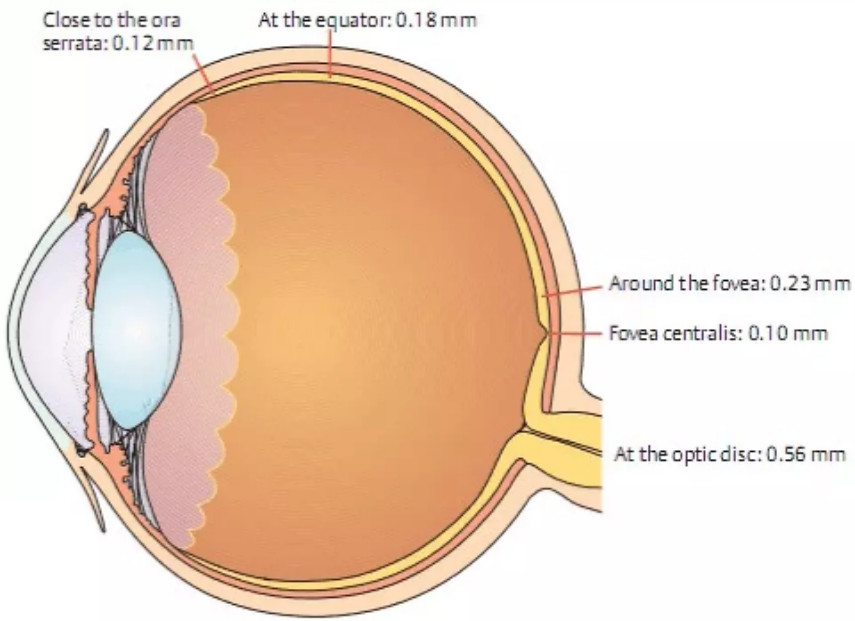
- Highly vascularised structure between the sclera and the retina
- Vessel layer, capillary layer, Bruch's membrane
  - provides O_2 + nutrition to the **outer** retinal layer,
  - Temperature homeostasis
  - Conduct blood vessels
  - Absorb excess light

Vitreous body



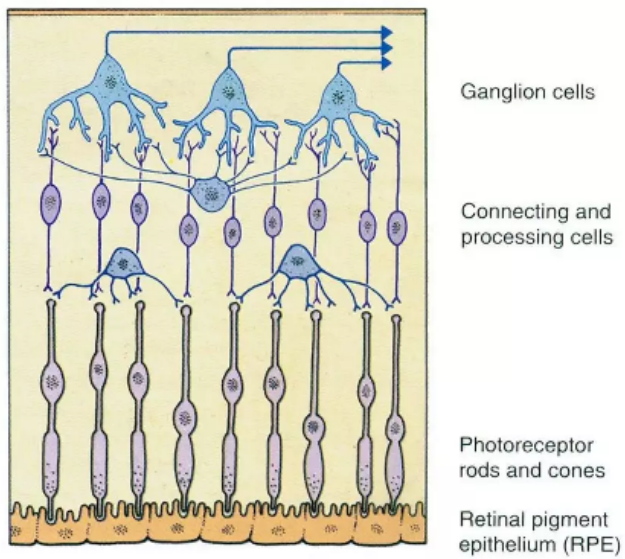
- Clear gel-like structure that fills the posterior eye
- 98% water+ 2% collagen (type 2), hyaluronic acid, soluble proteins
- Transmission of light onto the retina, cushion to the eyeball during trauma, nutritive and supportive role in retinal metabolism
- Adherent to the retina:
  - the optic disc
  - ora serrata, pars plana (vitreous base)
  - Posterior lens
  - Around retinal vessels

Retina



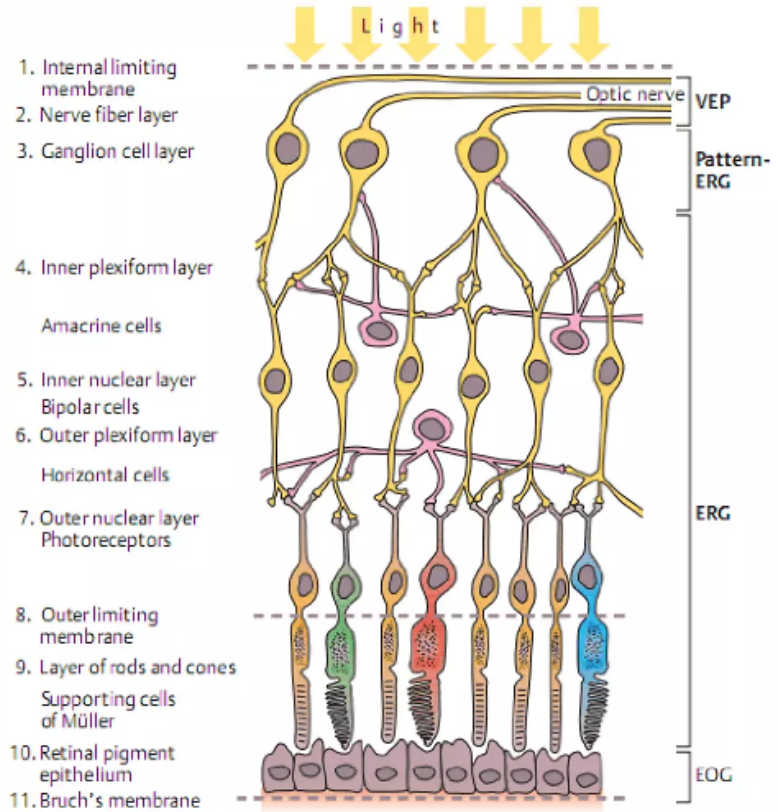
- Converts light into nerve impulses
- From the optic disc to the ora serrata
- Multilayered, 10
- 2 functional layers:
  - Neurosensory retina
  - Retinal pigment epithelium (RPE)

1. Retinal pigment epithelium (RPE)



- Single layer
- Microvilli at the apex where the photoreceptors attach
- **Functions:**
  - Melanin pigments which absorb light (antireflection)
  - Participate in turnover of photoreceptors
  - Recycle vitamin A to form photosensitive pigments
  - Form **outer blood retinal barrier**

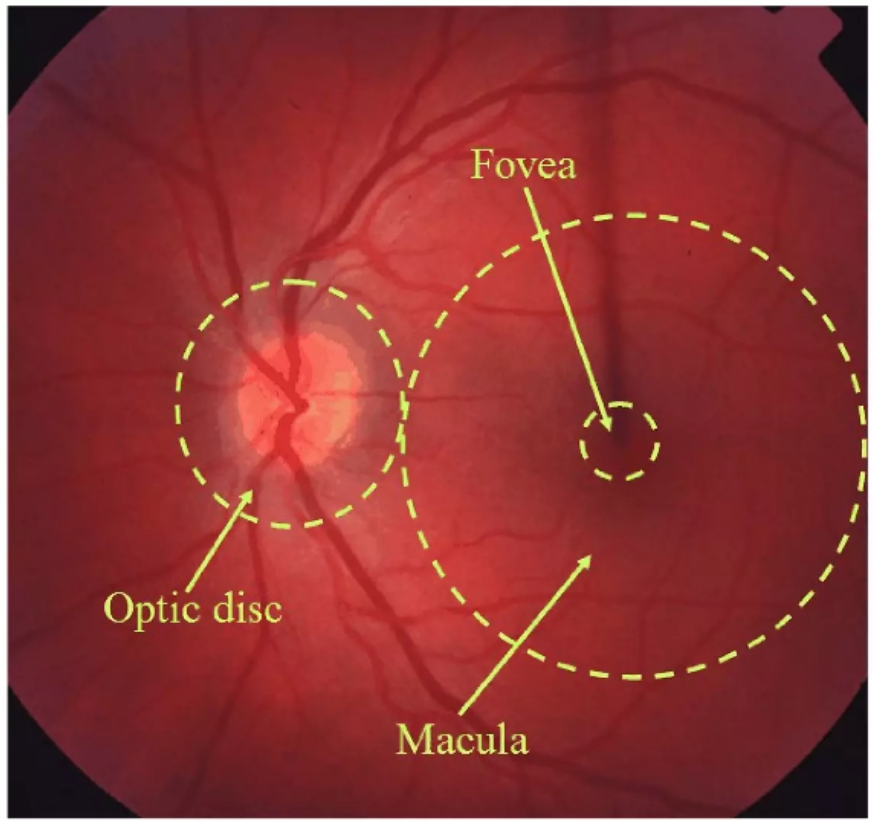
2. Neurosensory retina



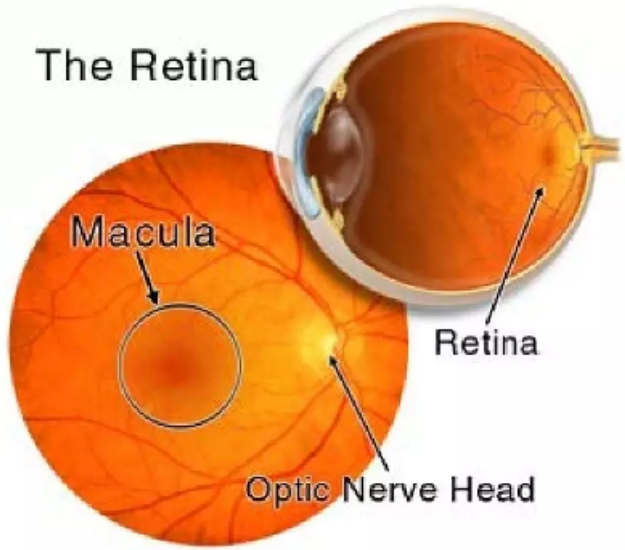
- 3 main groups of neuronal cells: photoreceptors, bipolar cells, ganglion cells
- Photoreceptor cells (**rods + cones**) undergo photochemical changes (**phototransduction**)
- Bipolar cells relay nerve impulse to ganglion cells
- Ganglion cell exit at optic disc to become optic nerve
  - Amacrine cells -likely to play modulatory roles, allowing adjustment of sensitivity for photopic and scotopic vision
  - Horizontal cells - integrate and regulate the input from multiple photoreceptors

	Cones	Rods
Function	Daytime vision, Color vision	Night vision, detection of movement
Total number	6-7 million	120 million
Highest density	Macula	Peripheral retina

Fundus of the eye

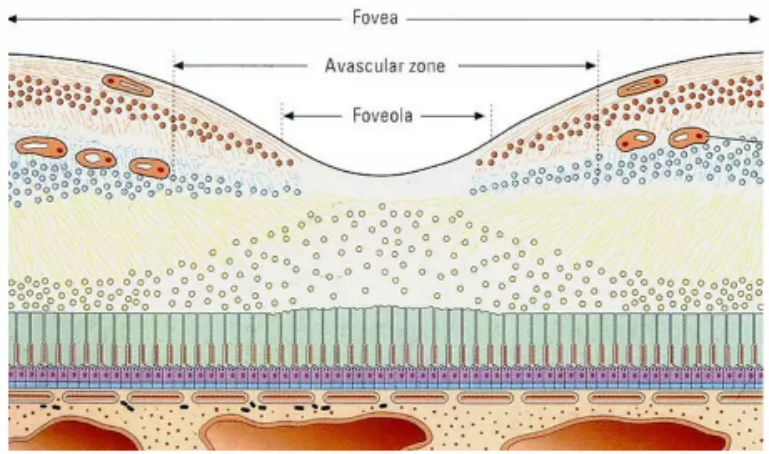


Macula lutea



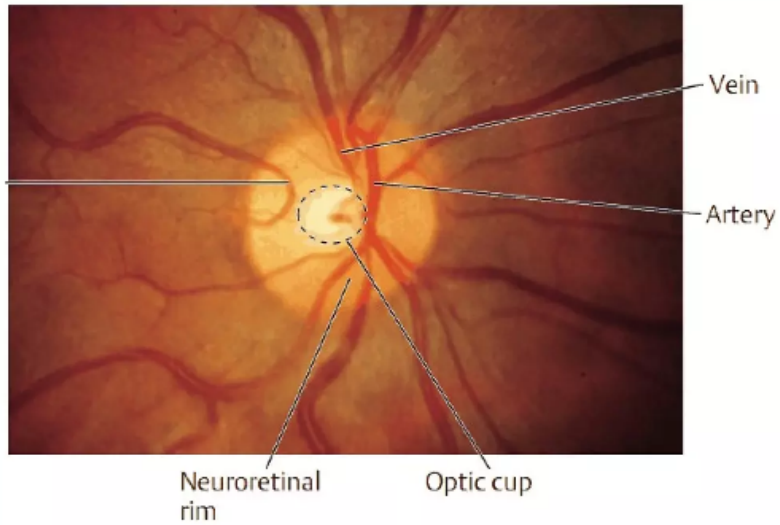
- Oval, yellowish area at center of posterior part of retina measuring 5mm (temporal to optic disc)
- Darker color compared to surrounding fundus
- Specialized area of the retina with fovea at its centre responsible for **photopic** (day vision) and **color vision**

Fovea centralis



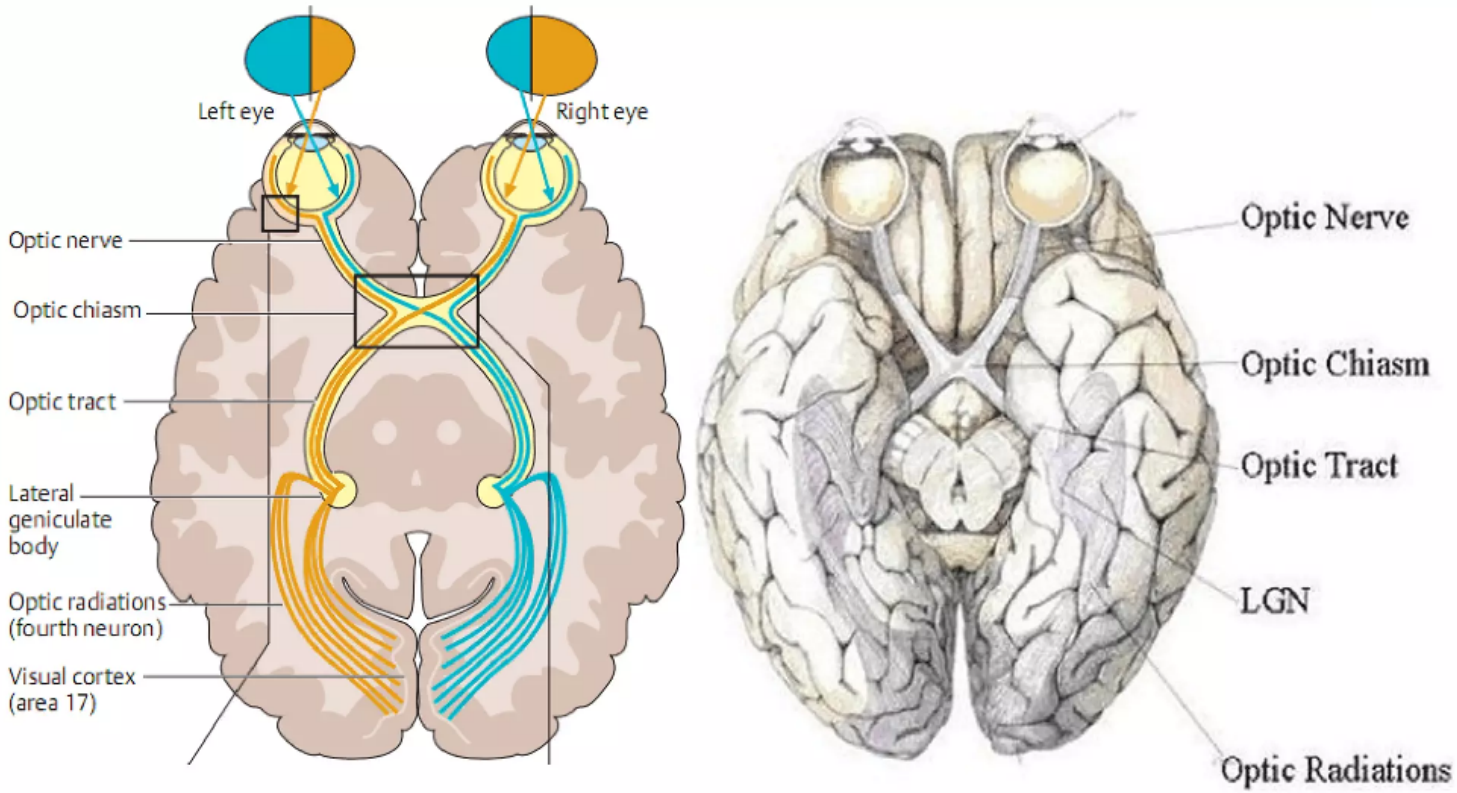
- The point at which visual perception is sharpest
  - Bipolar cells, ganglion cells, blood vessels displaced laterally
  - Only photoreceptors in the center
  - Maximize the amount of light to fall onto the exposed photoreceptor
  - Only **cones** in the floor of the fovea (highest concentration)

Optic disc

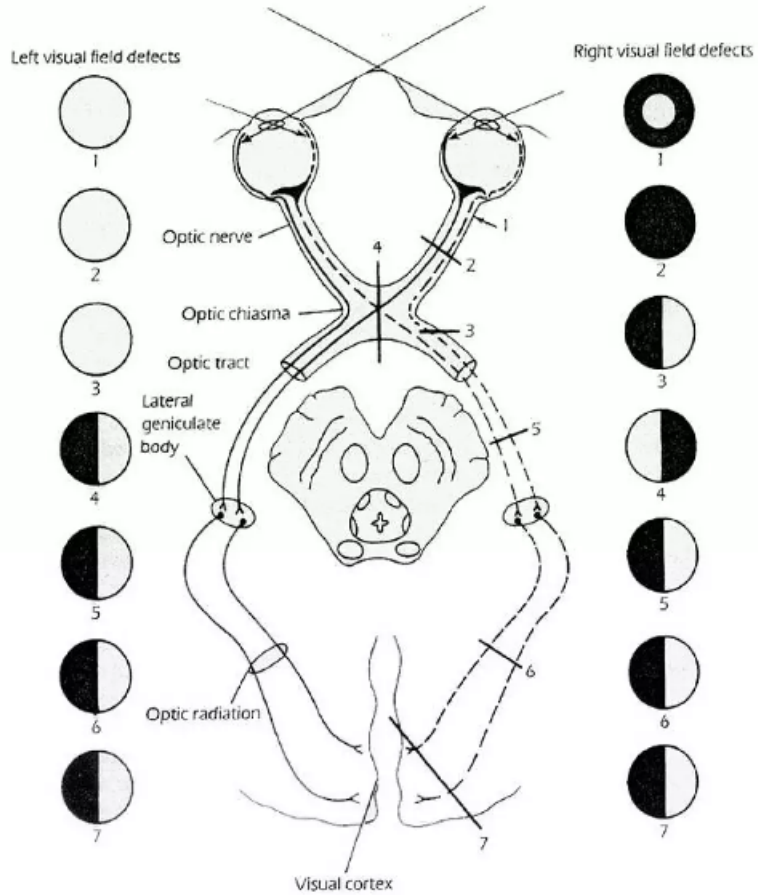


- The location where ganglion cell axons exit the eye to form the optic nerve
- Yellowish orange color (we say pink)
- 1.5mm diameter (may vary), vertically oval
- Central retinal vessels enter and leave the eye here
- No photoreceptors: physiological **blind spot**
- Centre of the optic disc, there is pale central cavity – optic cup, no nerve fibers exit here

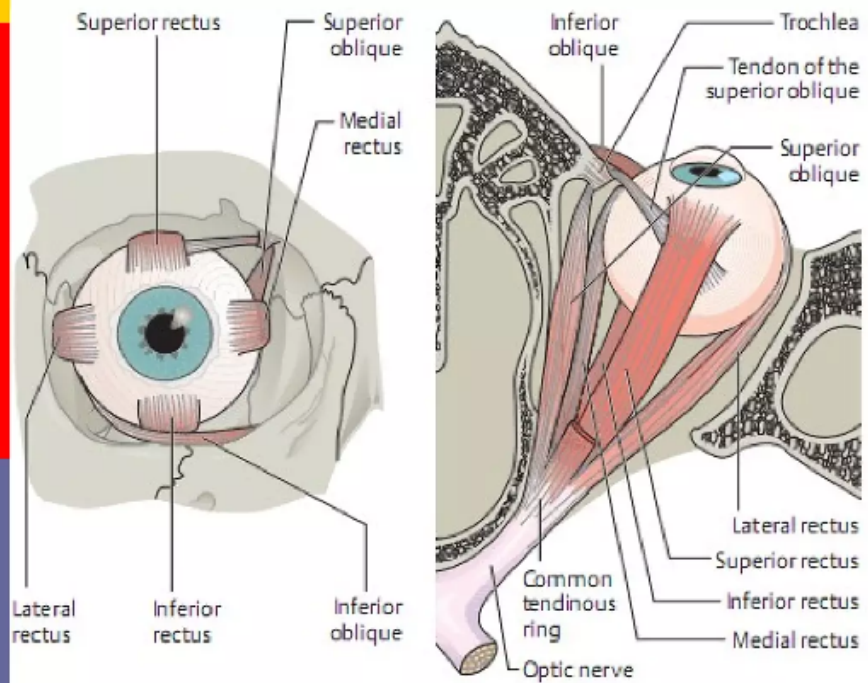
Visual pathway



Visual field defects



Extraocular muscles



- 7 extraocular muscles
- The movements of the eyeballs are produced by the following extraocular muscles:
- 4 rectus (superior, medial, lateral, inferior)
- 2 oblique (superior, inferior)
  - Levator palpebrae superioris

Action of extraocular muscles from primary position

Muscle	Primary	Secondary	Tertiary
Medial rectus	Adduction	-	-
Lateral rectus	Abduction	-	-
Inferior rectus	Depression	Extorsion	Adduction
Superior rectus	Elevation	Intorsion	Adduction
Inferior oblique	Extorsion	Elevation	Abduction
Superior oblique	Intorsion	Depression	Abduction

- The superior muscles are intortors, inferior are extortors
- Vertical rectus muscles are adductors
- Oblique muscles are abductors

Basic history and eye examination

HISTORY

- **TYPES OF PATIENTS THAT YOU WILL ENCOUNTER IN THE CLINIC**

1. Patients with ocular symptoms
2. Patients with diagnosis who comes for follow up
3. Patients who desire routine ocular examination and refraction

STRUCTURAL ORGANISATION OF HISTORY

1. PERSONAL DATA
2. PRESENTING COMPLAINTS (P/C)
3. HISTORY OF PRESENTING COMPLAINTS (HxPC)
4. PAST OCULAR HISTORY (POHx)
5. PAST MEDICAL HISTORY (PMHx)
6. DRUG HISTORY (DHx)
7. ALLERGIC HISTORY (AHx)
8. FAMILY HISTORY (FHx)
9. SOCIAL HISTORY (SHx)

1. PERSONAL DATA

- File #
- Name
- Age
- Sex
- Marital Status
- NOK with contact phone #
- Residence
- Contact phone #

- **RELEVENCE OF THE DETAILS:**
  - Patient follow up and case tracing
  - Guide in making a diagnosis
  - Notification of relatives in case of any eventuality such as death
  - In research, retrospective study, helps to trace the file from archives
  - Make it personal ambition to ensure this demographic data is quality, rough estimate of age is better than "F/A"

PRESENTING COMPLAINTS (P/C)

- Headlines of ophthalmic history (main reason patient has come to the hospital)
- Specify laterality(BE, RE, LE)
- Specify duration (avoid writing dates, calculate duration)

HISTORY OF PRESENTING COMPLAINTS (HxPC

- **Briefly explore and develop the chief complaints**
- **Be concise, focused and chronological**

- When did the problem begin
- What happened?
- How was the progression?
- Where one or both eyes affected?
- What treatment was received?
- What are the aggravating factors?
- Course of symptoms.

Visual Symptoms

- Blurred vision
- Double vision
- Red eye
- Itchiness
- Pain
- Unable to read small prints

- Discharge (watery, mucopurulent, purulent and mucoid).
- Headache.
- Asthenopia.
- Floating spots and light flashes.
- Tearing.
- Abnormal appearance.

PAST OCULAR HISTORY (POHx)

- Any ocular medications, surgery, eye hospital visits
- Use of spectacles, contact lenses etc.
- Last time spectacles where changed.

PAST MEDICAL HISTORY (PMHx)

- DM
- HTN
- HIV
- RHEUMATOID ATHRITIS
- ASTHMA
- CARDIAC DISEASE
- SCD

DRUG HISTORY (DHx)

- BETA BLOCKERS
- ANTI COAGULANTS
- STEROIDS – in steroid responders, causes glaucoma
- TOPICAL GENTAMYCIN – causes epithelial toxicity

FAMILY HISTORY (FHx)

- Myopia,
- Squint,
- Glaucoma
- Eye cancer
- Blindness.

SHx

- Occupation
- Performance at school

EXAMINATION

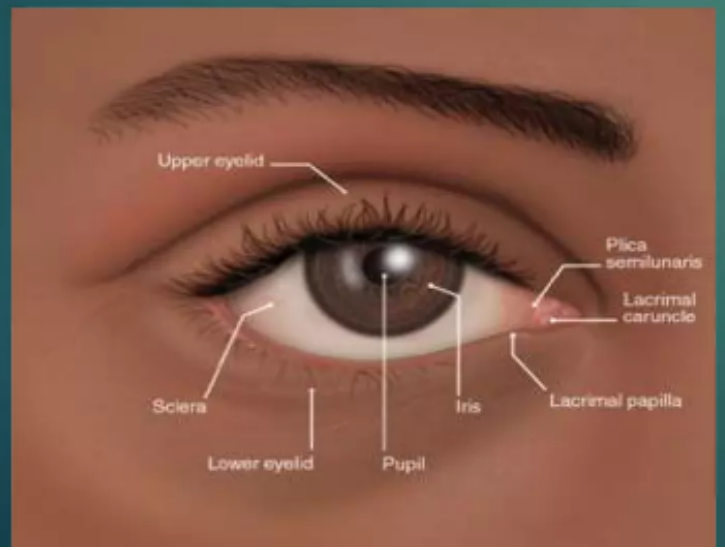
OD (oculus dexter)	right eye.	RE
OS (oculus sinister)	left eye.	LE
OU (oculus uterque)	both eyes	BE

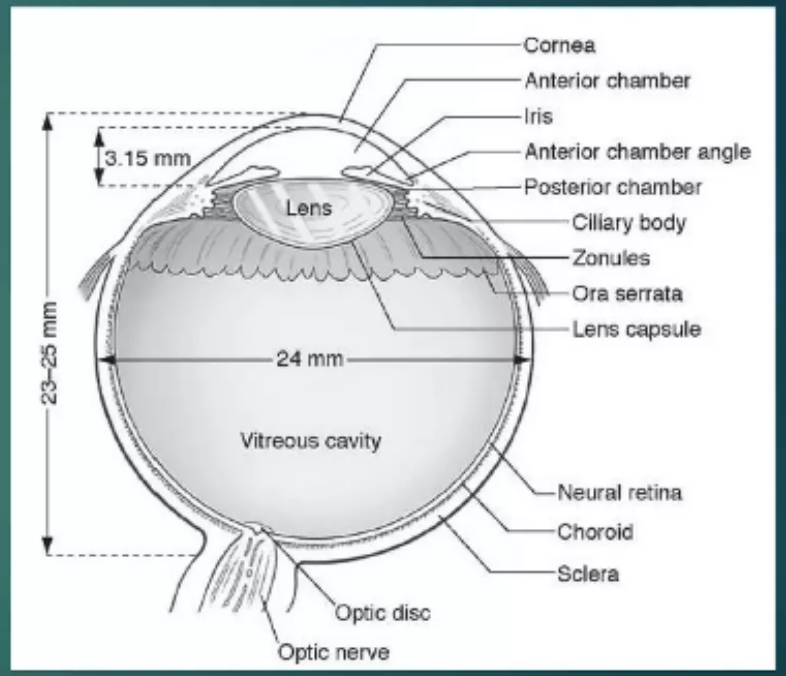
VITAL SIGNS

- BP
- VISUAL ACUITY
- IOP (9 – 21mmHg)

EXAMINATION

1. ADNEXA
2. ANTERIOR SEGMENT
3. POSTERIORS SEGMENT





ADNEXA

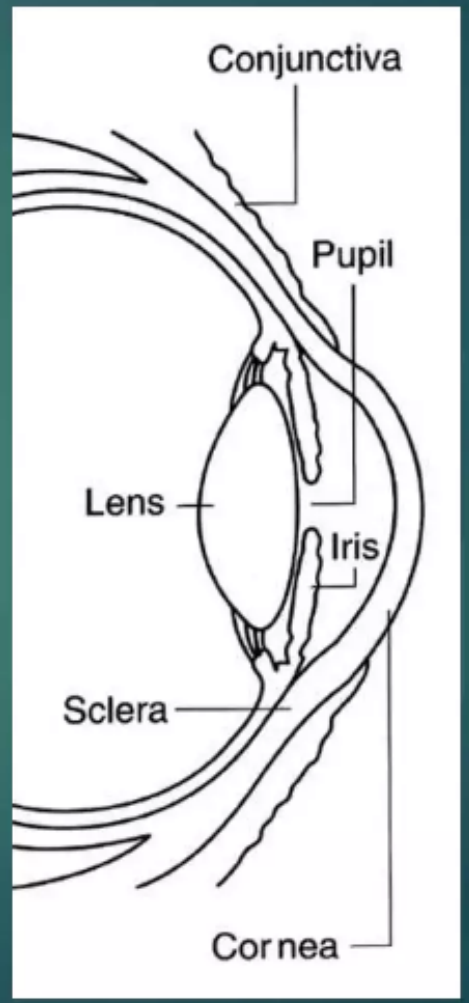
- ORBITAL RIM
- EYE BROW
- EYE LIDS
- EYE LASHES
- ORIFICES

SLIT LAMP BIOMICROSCOPE

"SLIT LAMP IS TO THE OPHTHALMOLOGIST AS THE HOE IS TO THE FARMER"

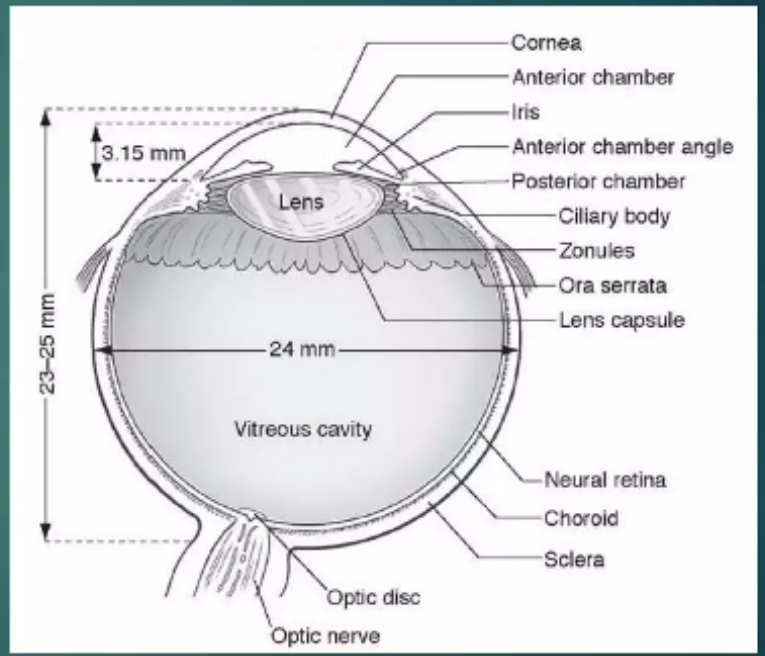
ANTERIOR SEGMENT

- **CONJUNCTIVA**
- **CORNEA**
- **A/C**
- **PUPIL**
- **IRIS**
- **LENS**

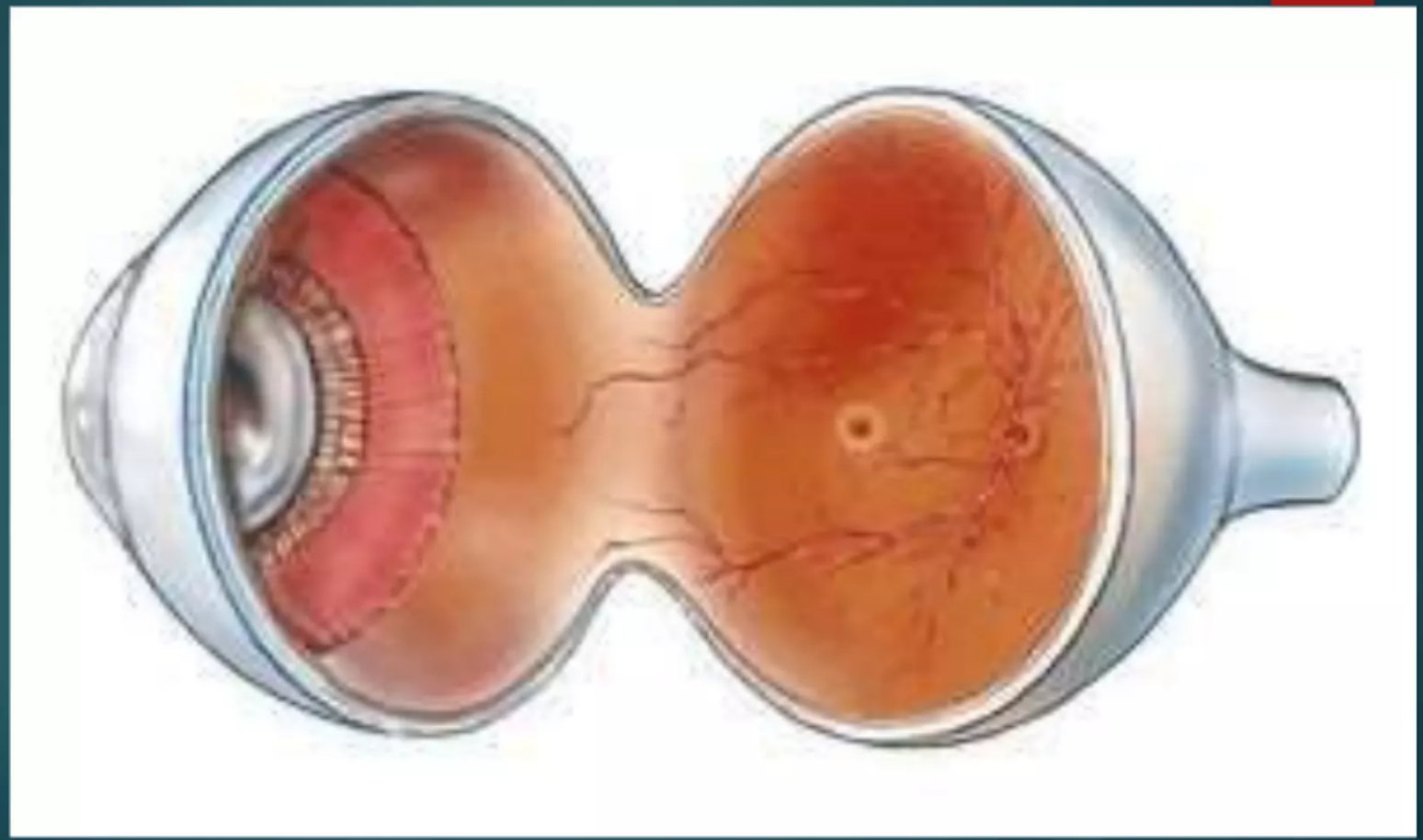


POSTERIOR SEGMENT

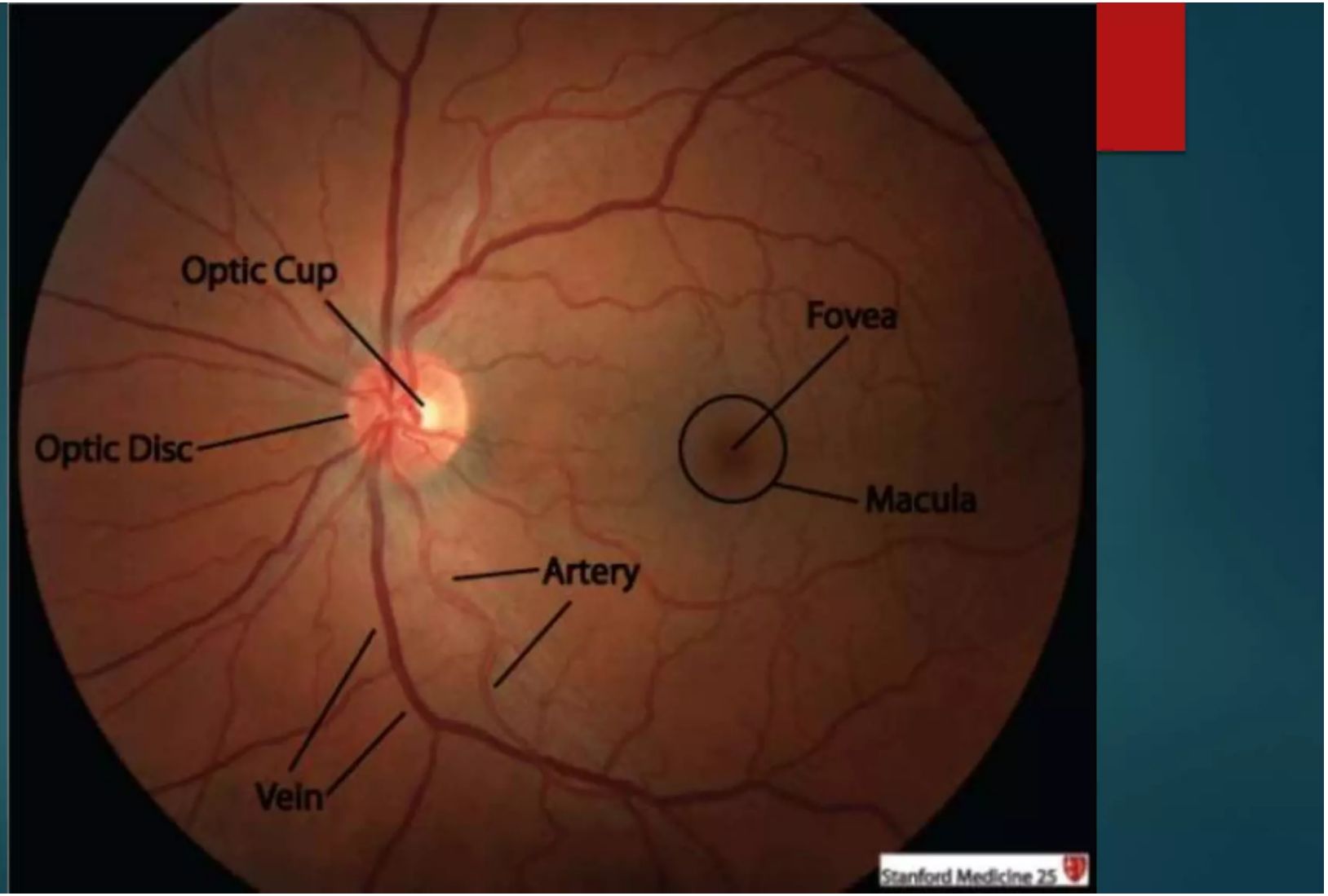
- VITREOUS: Haziness, cells, h'age
- OPTIC NERVE: CDR, pale, blurred margin
- VESSELS: aneurysm, Ghost vessels
- MACUALR: normal, dull reflex, h'age. hole



POSTERIOR SEGMENT



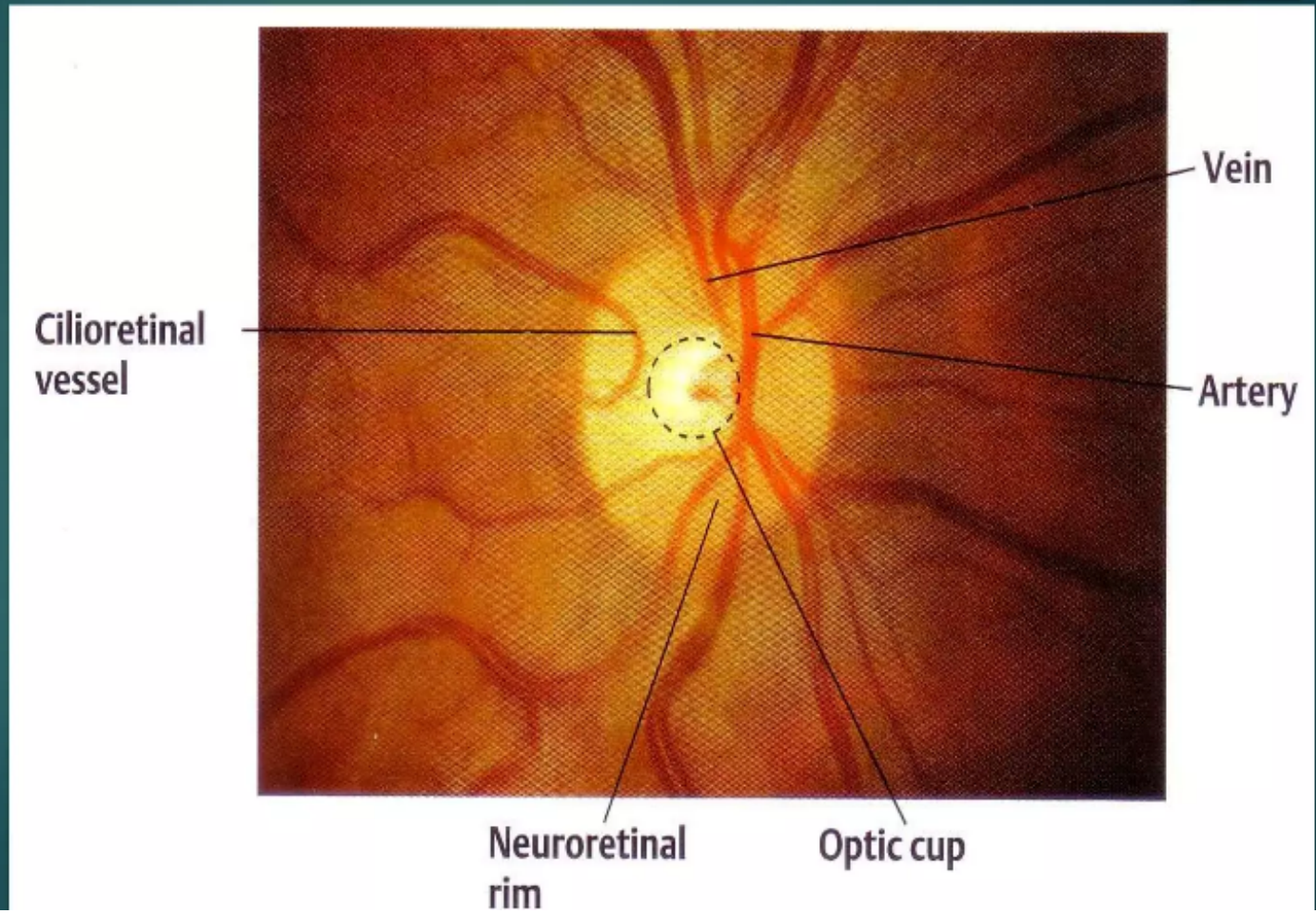
FUNDUS


Optic Cup
Optic Disc
Fovea
Macula
Artery
Vein
Stanford Medicine 25

OPTIC NERVE HEAD

CONSISTS OF :

1. **OPTIC DISC**
2. **NEURORETINAL RIM**
3. **OPTIC CUP**



Thank you