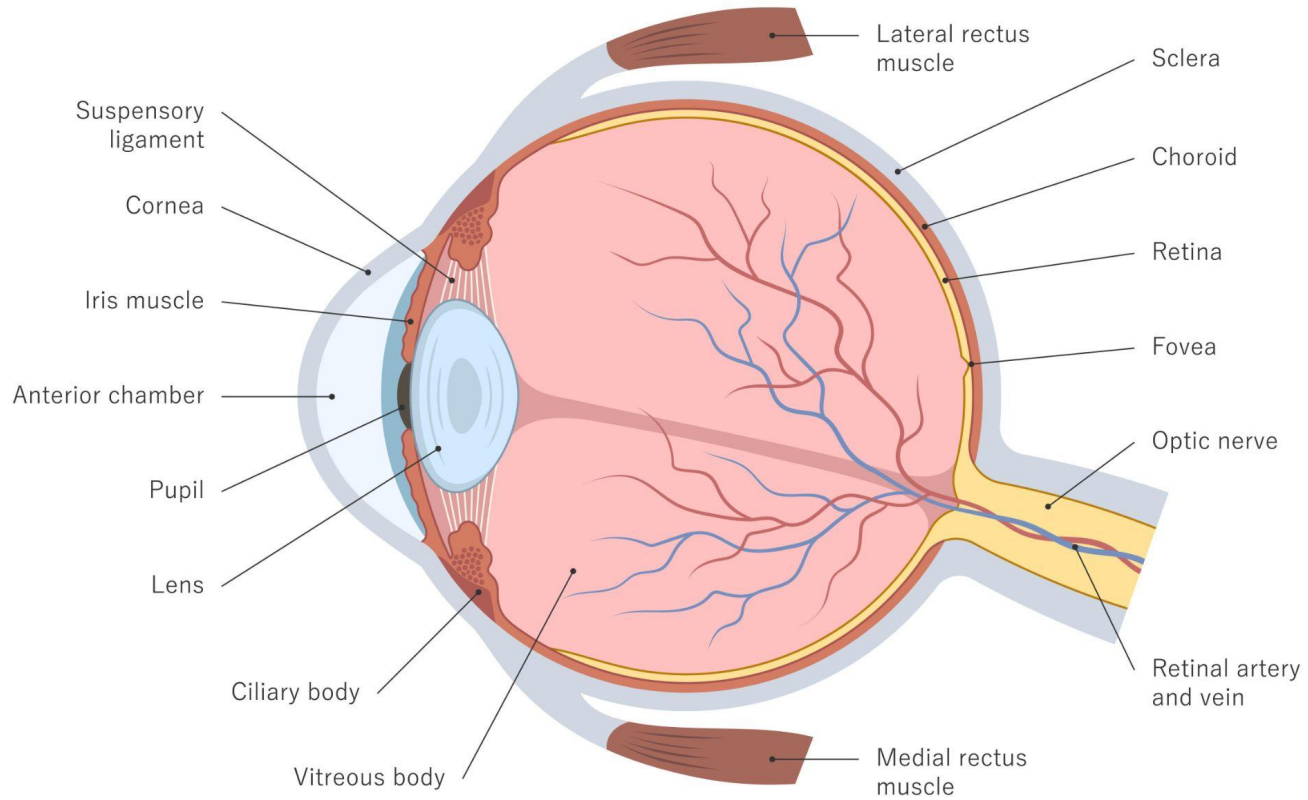


Visual System

Human Eye Anatomy



Visual System

Visual System

Vision is a complex **physiological and psychological process** consisting of three stages:

- reception (perception) of a stimulus,
- its transmission,
- and its integration and recognition.

These processes are enabled by a **properly structured and functioning visual system**.

- The visual system includes the **eyeball located in the orbit**, which receives visual stimuli through the **retina** and transmits them via the **visual pathways** to the **cortical visual centers of the brain**

Components of the Visual System

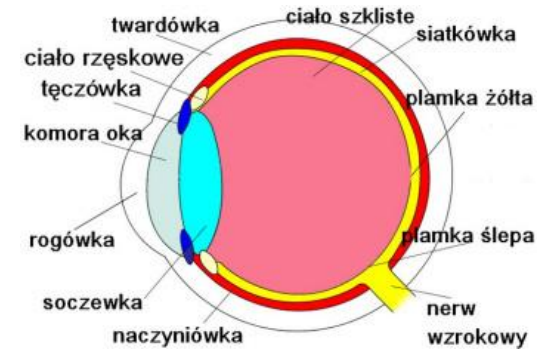
Components of the Visual System

1. **Eyeball with the optic nerve (CN II)**
2. **Protective apparatus of the eye:** conjunctiva, lacrimal gland, lacrimal drainage system, eyebrows, eyelashes
3. **Motor apparatus:** extraocular muscles

Visual pathways

Cortical visual centers

Eyeball

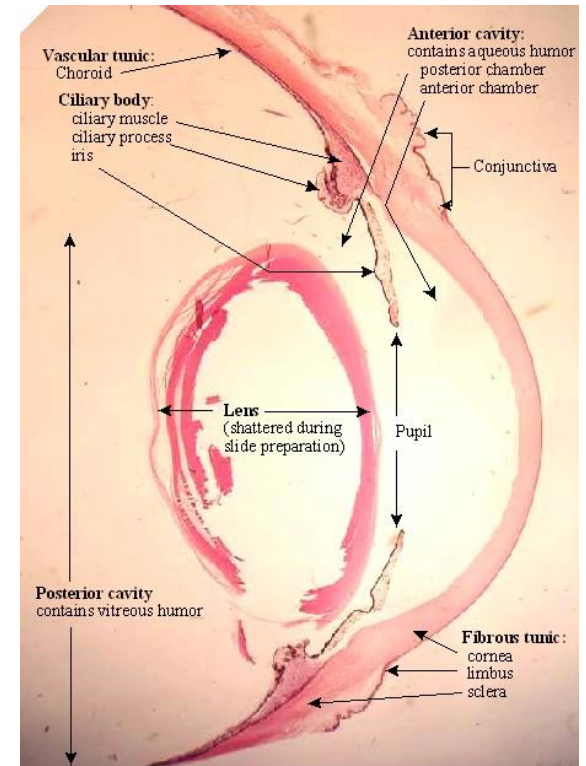


Structure of the wall:

- **Fibrous layer** – sclera and cornea
- **Vascular layer** – choroid, ciliary body, iris
- **Neural layer** – sensory retina and non-sensory retina

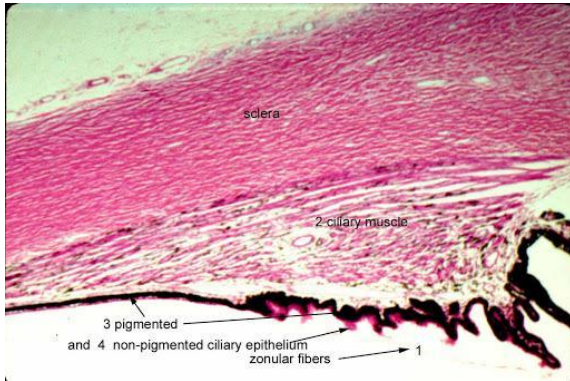
Internal structures:

- Anterior chamber
- Posterior chamber
- Lens
- Vitreous body



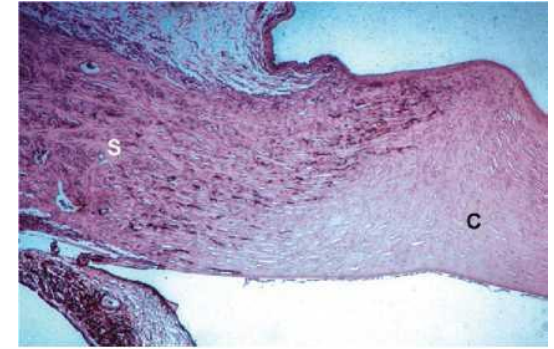
Sclera

The **outermost layer of the eyeball**, covering about **5/6 of its surface**, which **anteriorly continues into the cornea**.



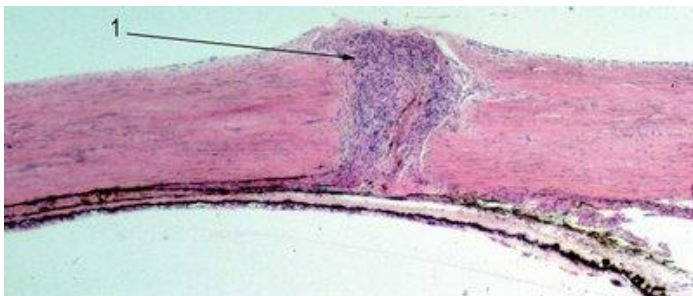
A **fibrous connective tissue layer** with a thickness of approximately **10–140 μm** . The sclera is **rich in elastic fibers** and contains **smooth muscle cells**.

Corneoscleral limbus



Lamina fusca (suprachoroidal lamina)

Bundles of **collagen and elastic fibers** with **melanocytes**.

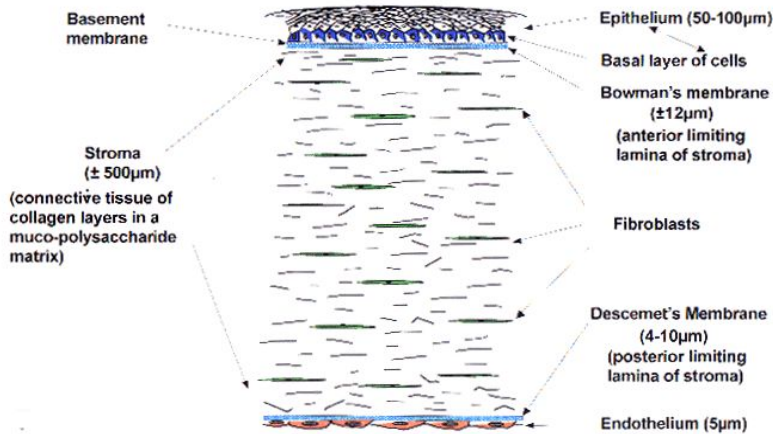


Suprachoroidal space

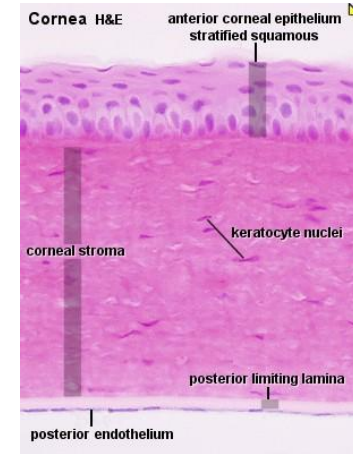
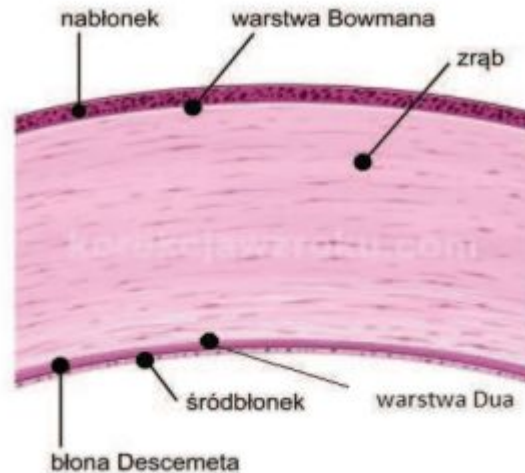
A narrow layer of connective tissue **separating the sclera from the choroid**.

Axenfeld loop

SCHEMATIC TRANVERSE SECTION THROUGH THE CORNEA

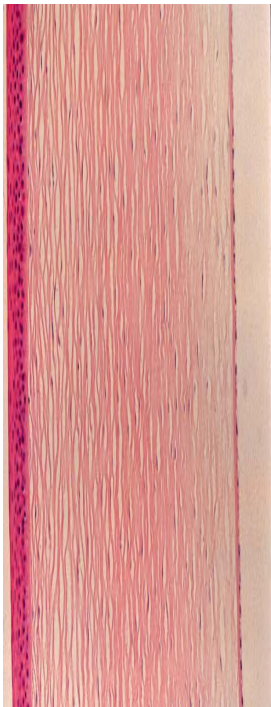


Cornea



Dua's layer

- Located anterior to Descemet's membrane
- Acellular layer



In 2013, H. Dua described an additional **sixth layer of the cornea.**

Corneal Epithelium
Superficial layer

- **Light cells** – numerous **microvilli** and **microplicae**
- **Dark cells** – single microvilli

Intermediate layer

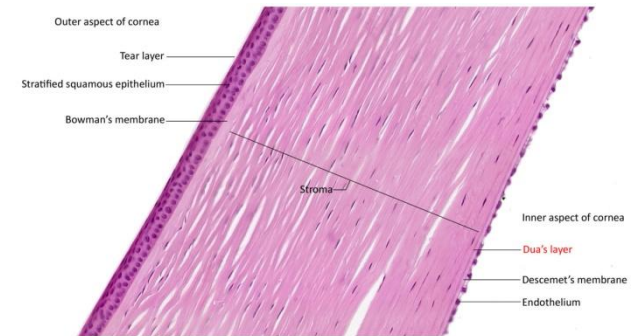
- **Wing cells** – convex on the anterior surface and concave on the posterior surface

Basal layer

- Columnar cells

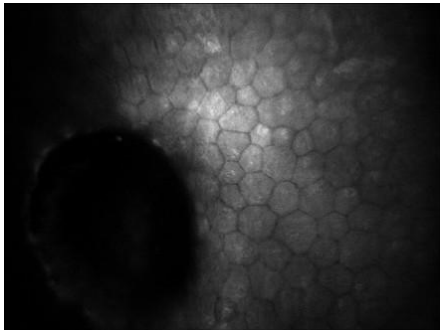
Vogt's palisades-Stem cells located in the limbus

Cornea



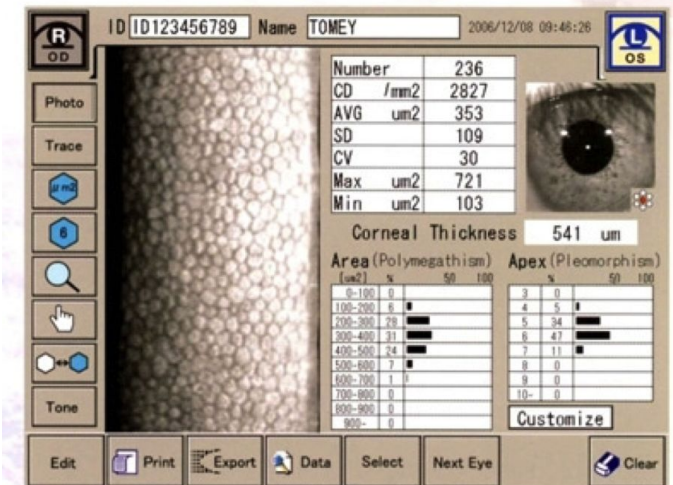
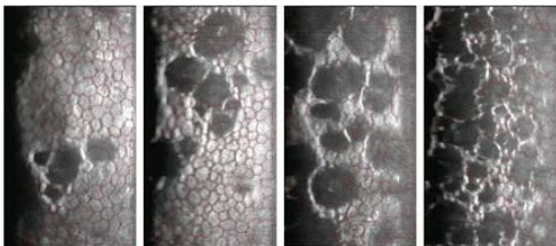
Stroma (Substantia propria)

- Collagen fibers – arranged in a diffraction lattice
- Glycosaminoglycans (GAGs)
- Keratocytes



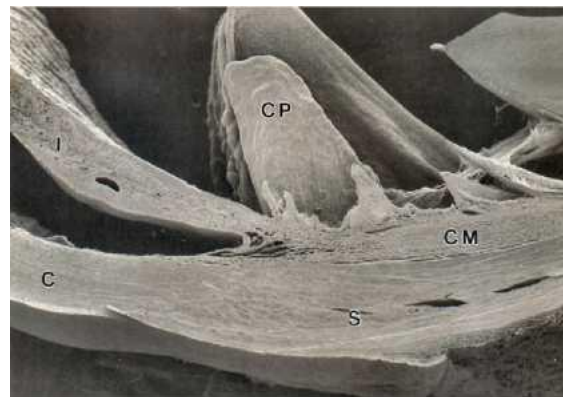
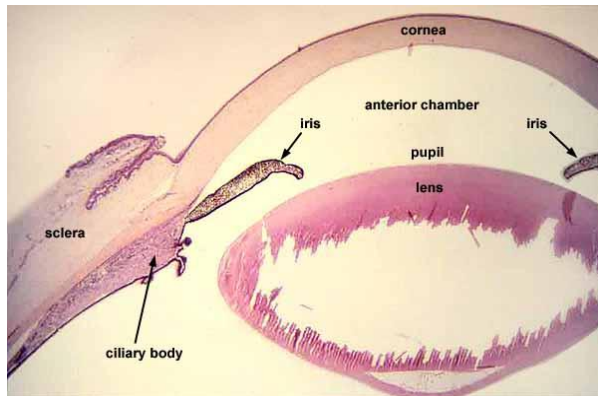
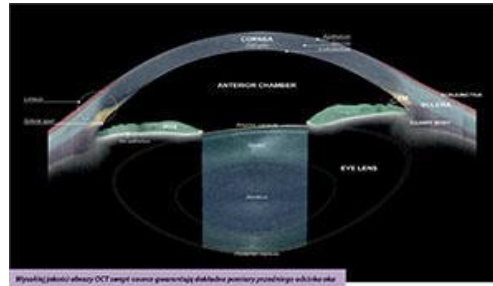
Corneal Endothelium

- Hexagonal cells
- Honeycomb-like appearance

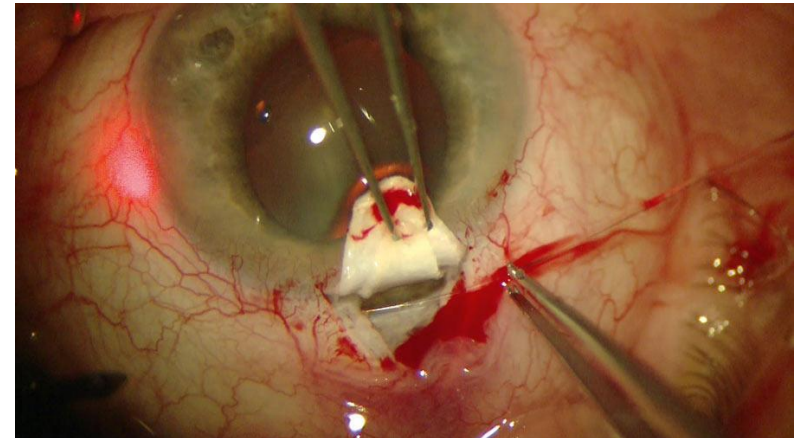
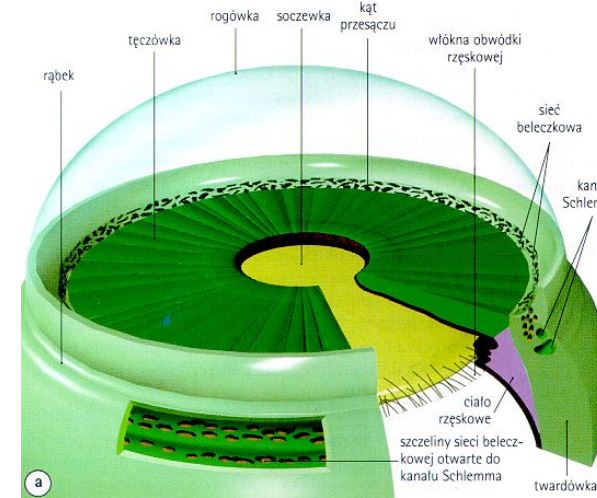
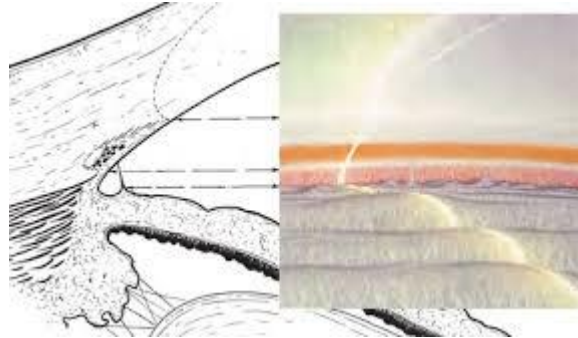
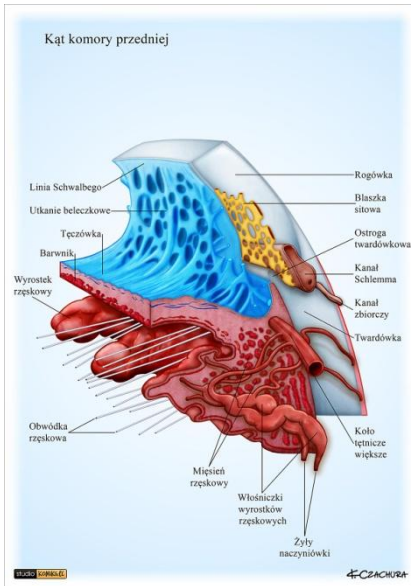


Analysis results screen

Anterior Segment of the Eye

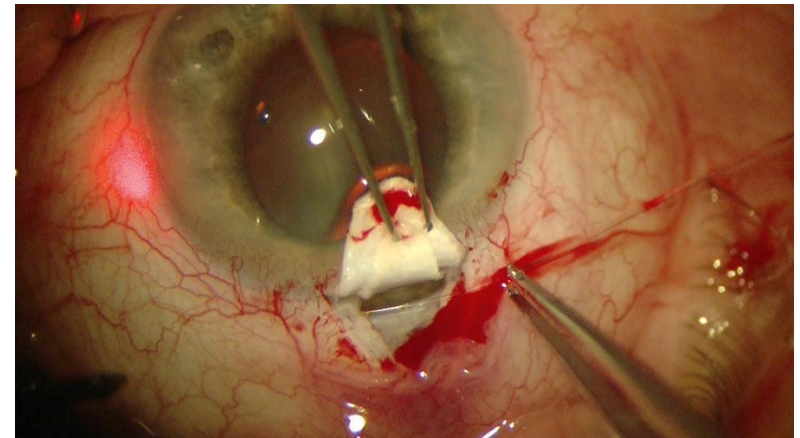
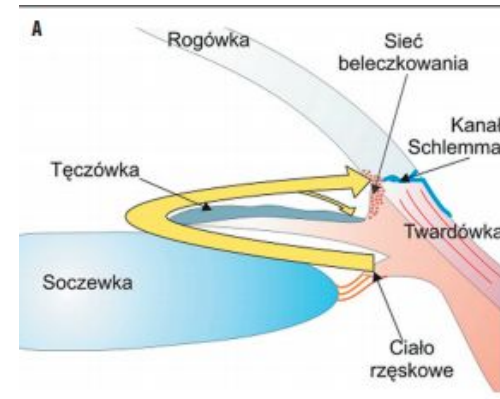


Iridocorneal angle (aqueous outflow angle)



Trabeculectomy – catheter placement in Schlemm's canal

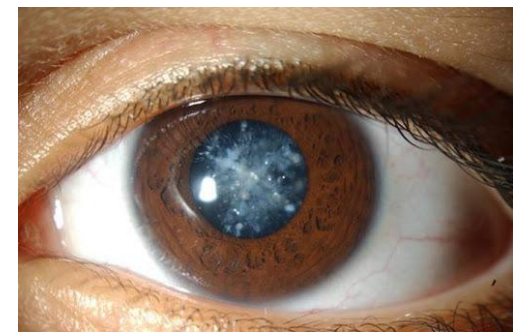
Lens and Zonular Fibers (Zinn's Zonule)



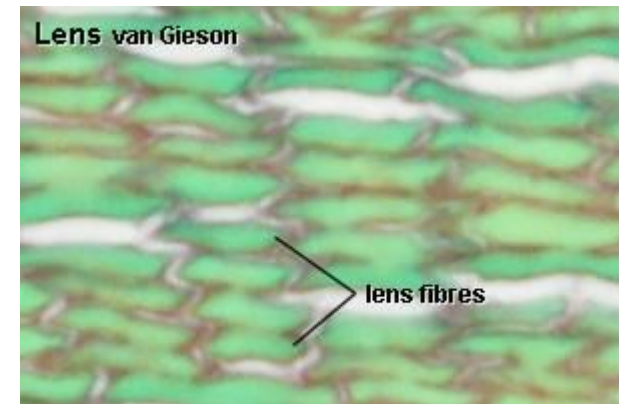
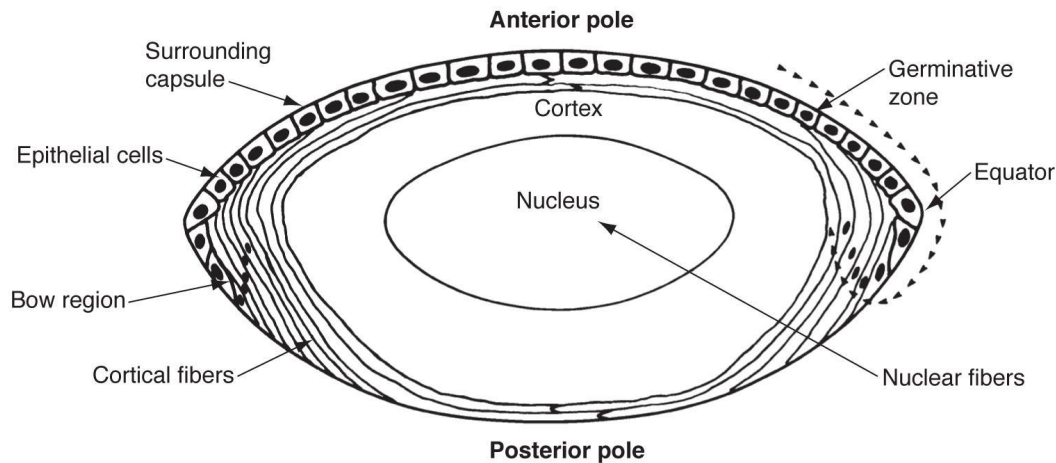
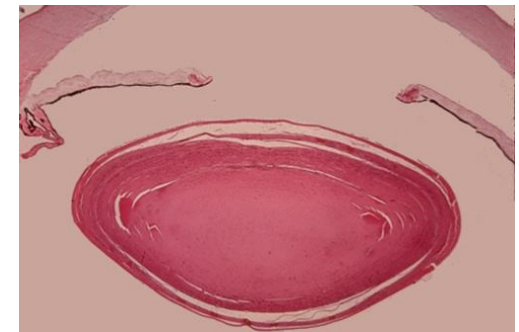
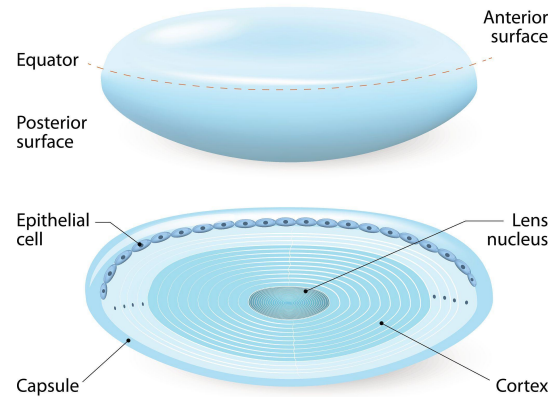
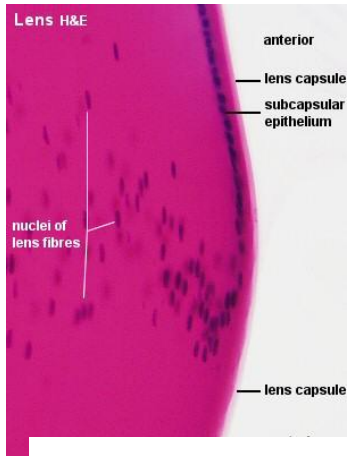
Trabeculectomy – catheter placement in Schlemm's canal



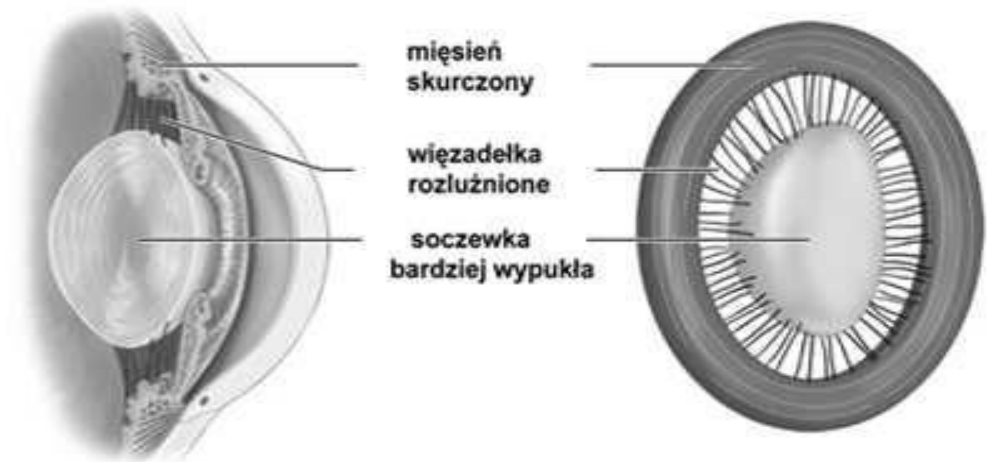
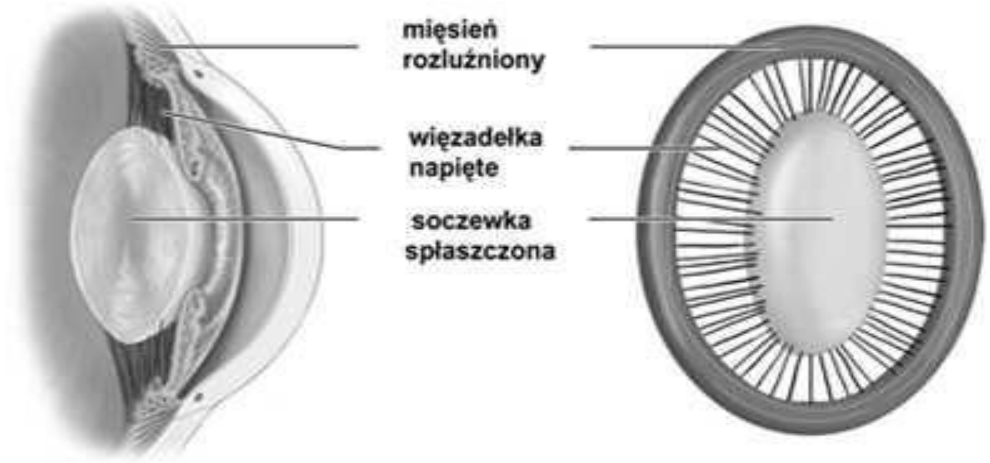
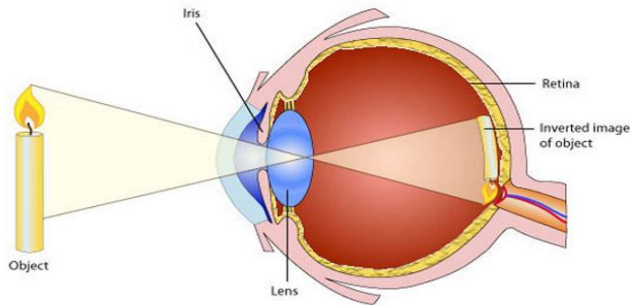
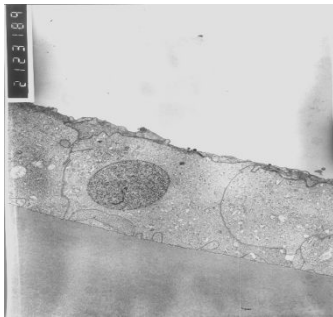
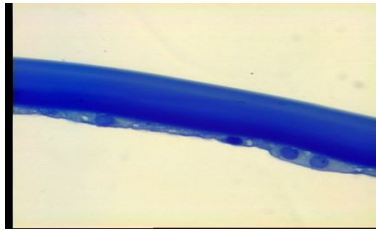
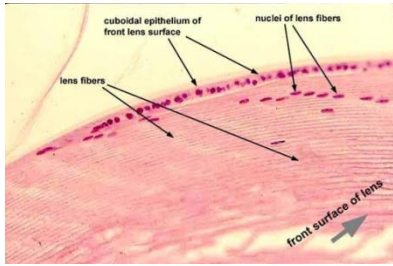
Lens



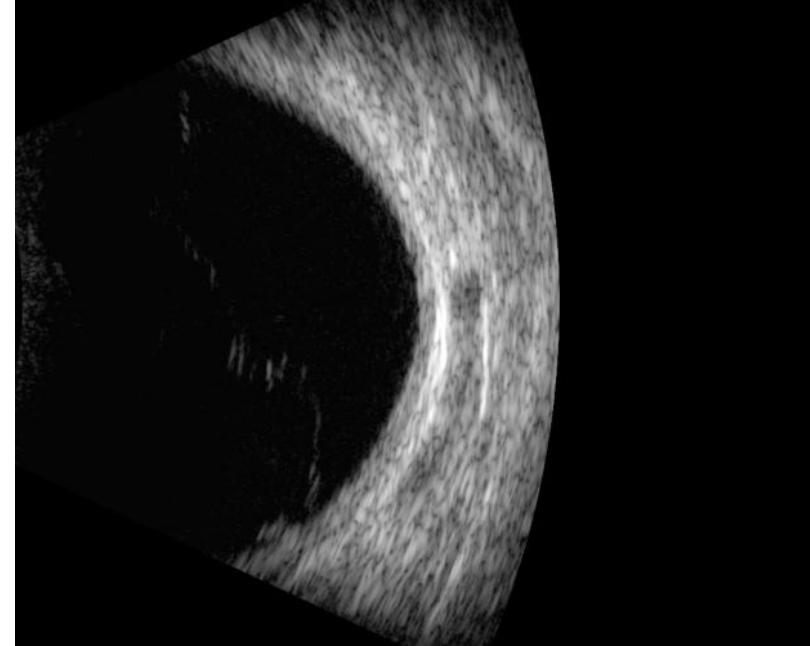
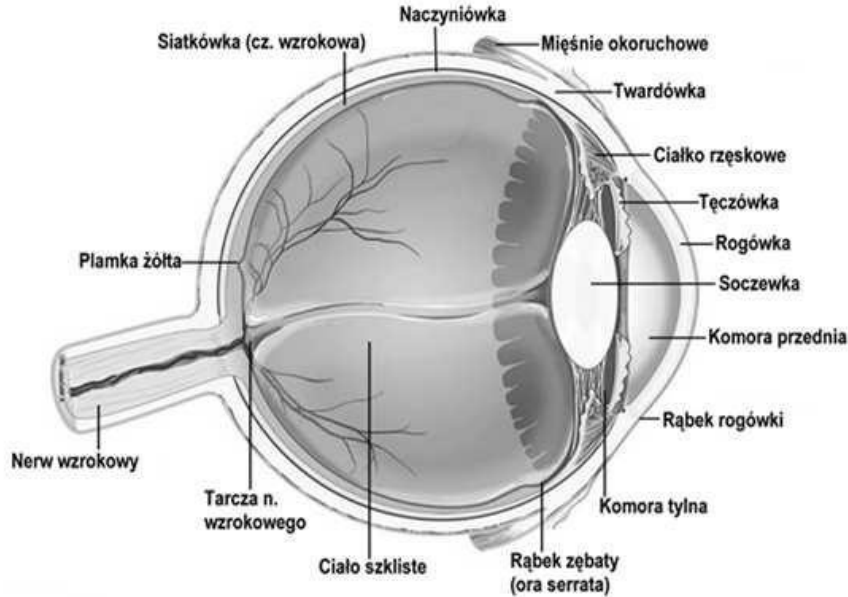
Crystalline lens



Accommodation



Vitreous Body



Structure

Fills the **vitreous chamber**, located **between the retina and the lens**

Composed of **~99% water**

Stroma:

- Glycosaminoglycans (GAGs)
- Collagen fibers

Cells

- Hyalocytes
- Connective tissue cells

Choroid

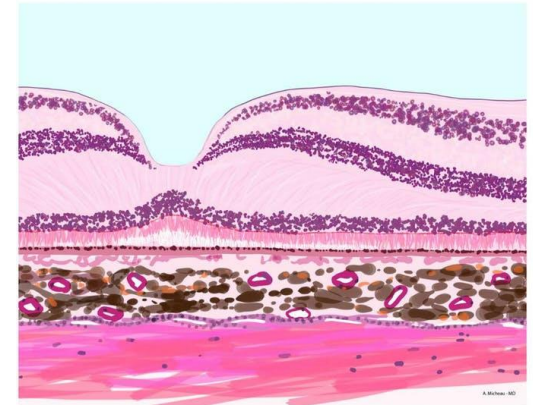
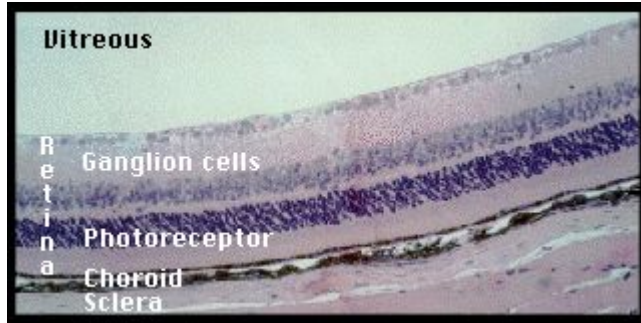
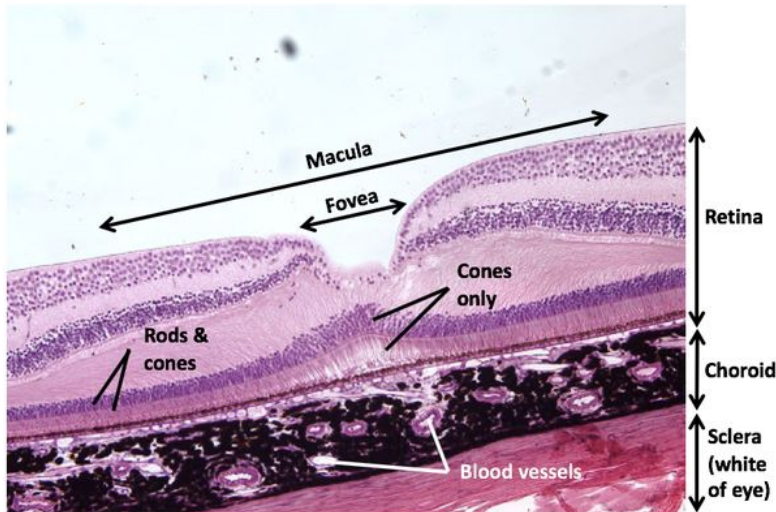


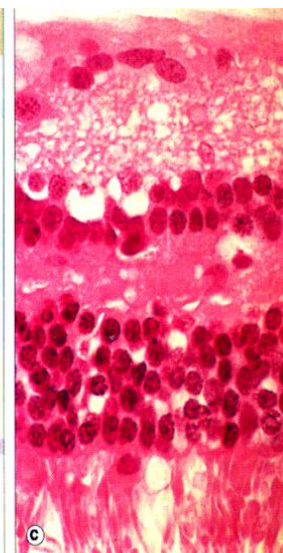
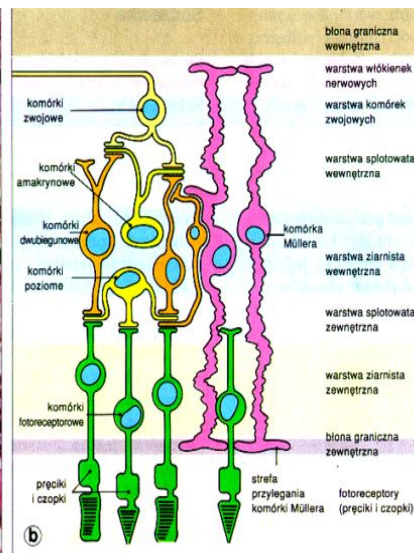
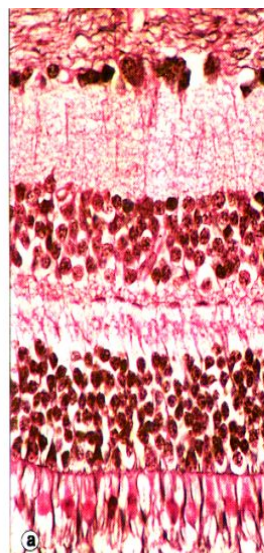
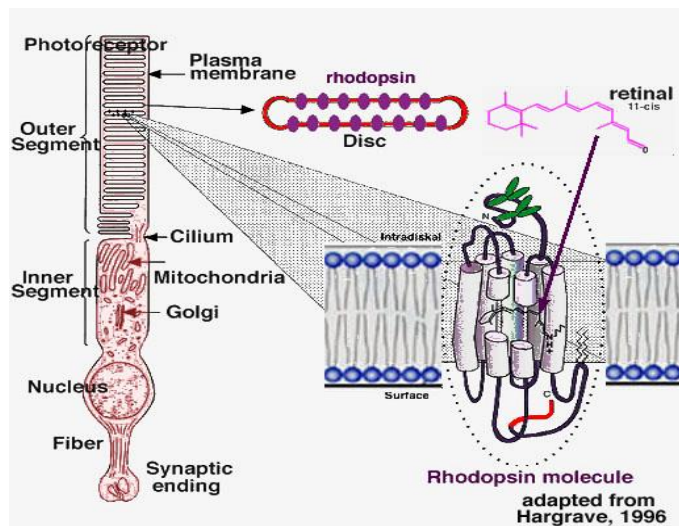
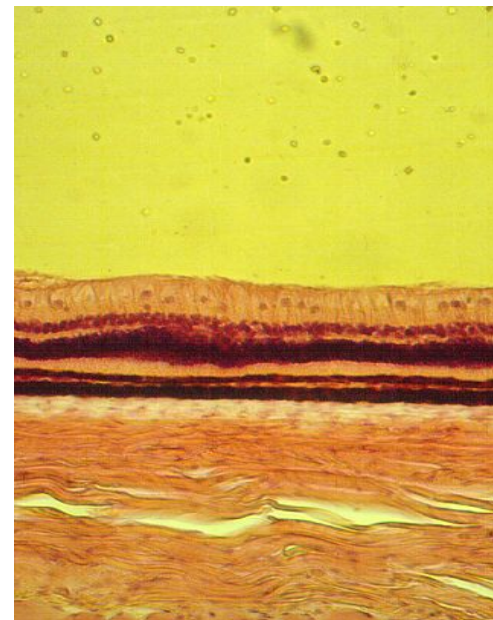
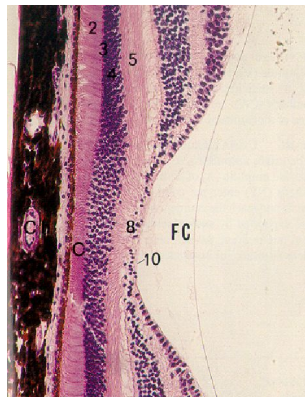
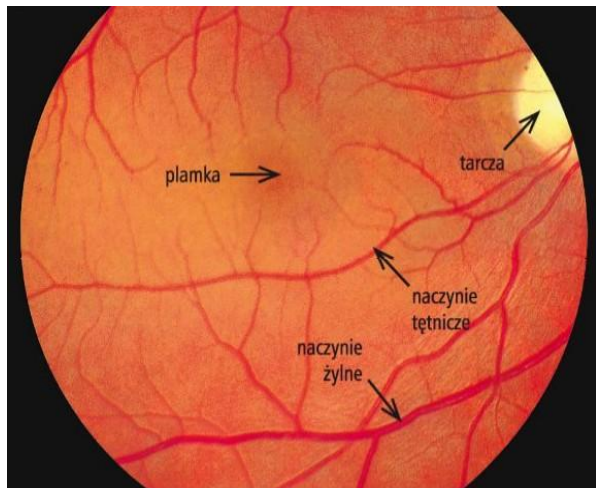
Illustration: Dr. A. Michau



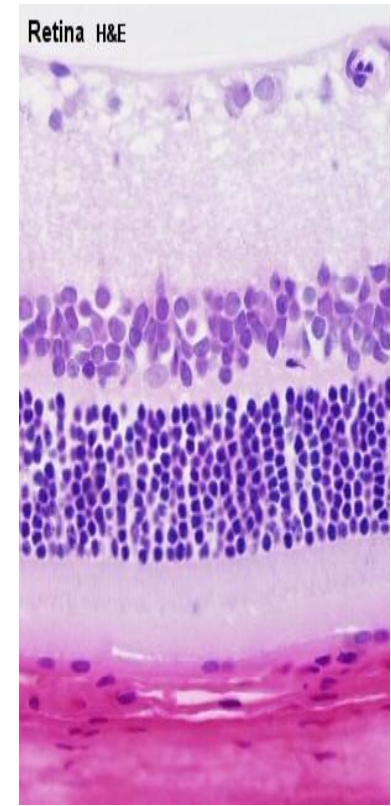
Histological Section of the Back of the Eye

Haller's layer – the outermost layer of the choroid, composed of large blood vessels
Sattler's layer – layer containing medium-sized blood vessels
Choriocapillaris – layer of capillaries
Bruch's membrane – the deepest layer of the choroid

Retina

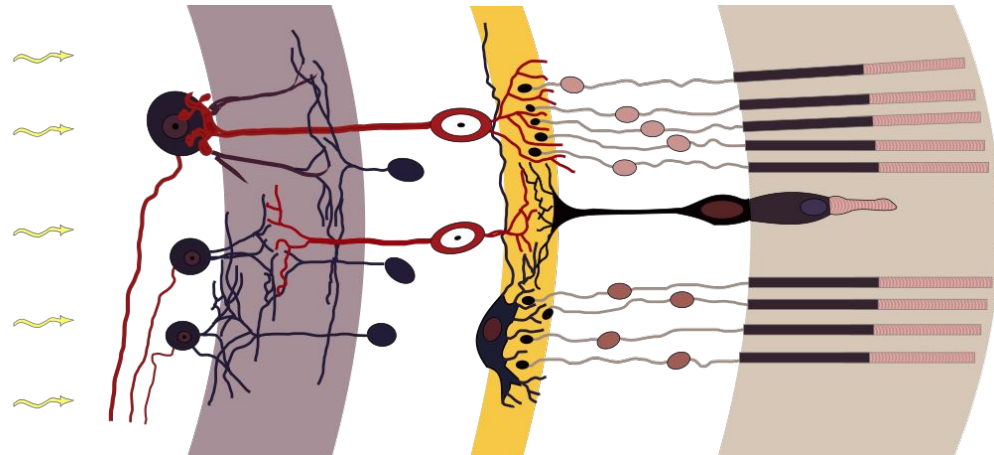


Structure of the Retina

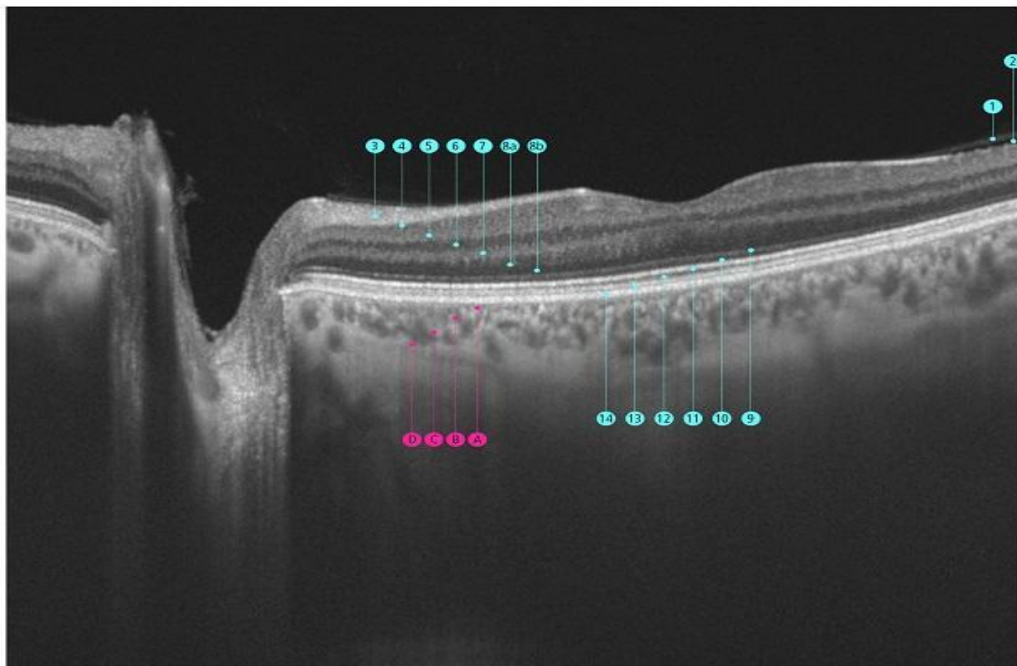


Ten layers can be distinguished in the **histological structure of the retina**:

1. Retinal pigment epithelium (RPE) – a simple cuboidal epithelium resting on a basement membrane; pigment cells contain melanin granules in the apical cytoplasm, which prevent light reflection inside the eyeball.
2. Layer of rods and cones – the photoreceptor layer, formed by the outer segments of rods and cones.
3. External limiting membrane
4. Outer nuclear layer
5. Outer plexiform layer
6. Inner nuclear layer
7. Inner plexiform layer
8. Ganglion cell layer
9. Nerve fiber layer
10. Internal limiting membrane



Retinochoroidal Complex in OCT

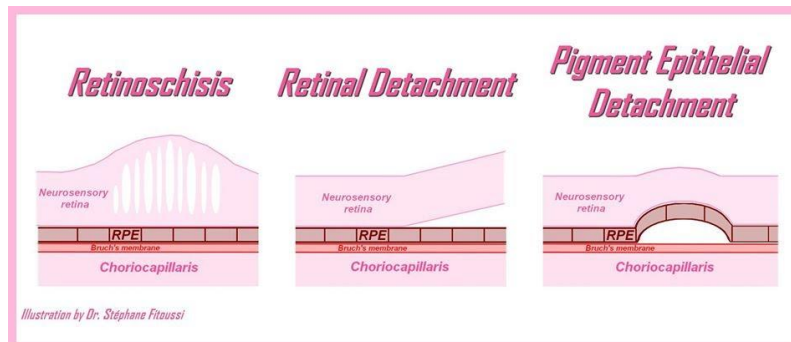
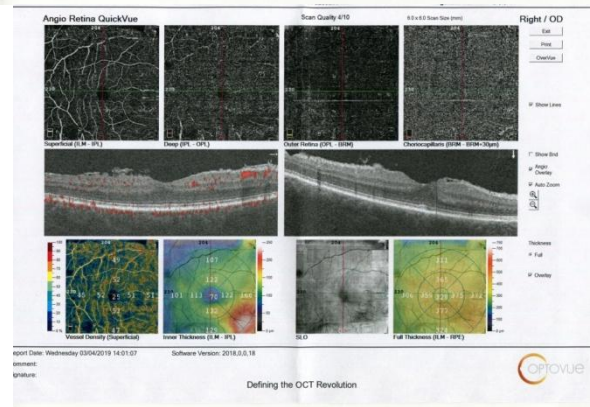
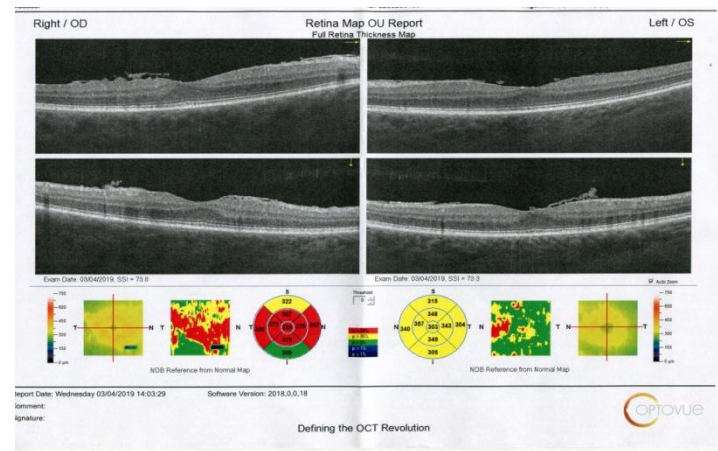


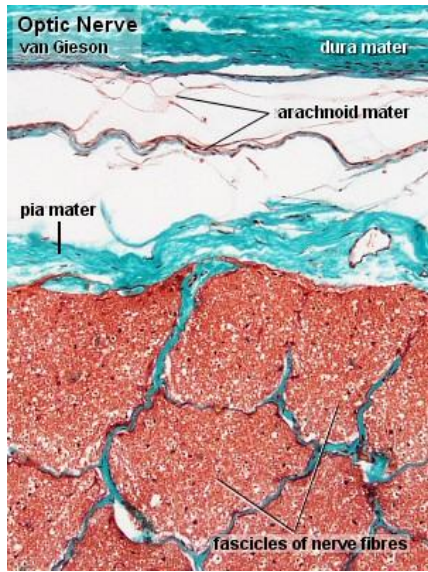
warstwy siatkówki:

- 1 – tyłne korowe ciało szkliste / Posterior Cortical Vitreous
- 2 – strefa przesiatkowa / Preretinal Space
- 3 – warstwa włókien nerwowych / Nerve Fiber Layer (NFL)
- 4 – warstwa komórek zwojowych / Ganglion Cell Layer (GCL)
- 5 – warstwa spłotowata wewnętrzna / Inner Plexiform Layer (IPL)
- 6 – warstwa jądrazta wewnętrzna / Inner Nuclear Layer (INL)
- 7 – warstwa spłotowata zewnętrzna / Outer Plexiform Layer (OPL)(dendritic)
- 8a – warstwa włókien nerwowych Henlego / Henle's Fiber Layer (axonal OPL)
- 8b – warstwa jądrazta zewnętrzna / Outer Nuclear Layer (ONL)
- 9 – błona graniczna zewnętrzna / External Limiting Membrane (ELM)
- 10 – strefa myoidalna fotoreceptorów / Myoid Zone (MZ)
- 11 – strefa elipsoidalna fotoreceptorów / Ellipsoid Zone (EZ)
- 12 – segmenty zewnętrzne fotoreceptorów / Outer Segments (OS)
- 13 – strefa ząbienia się czopków i RPE / Interdigitation Zone (IZ)
- 14 – kompleks RPE/błona Brucha / RPE/Bruch's Complex

warstwy naczyńki:

- A – choriokapilary / Choriocapillaris
- B – warstwa Sattlera / Sattler's Layer (Inner Choroid)
- C – warstwa Hallera / Haller's Layer (Outer Choroid)
- D – złącze naczyniówkowo-twardówkowe / Choroid Sclera Junction





Optic Nerve

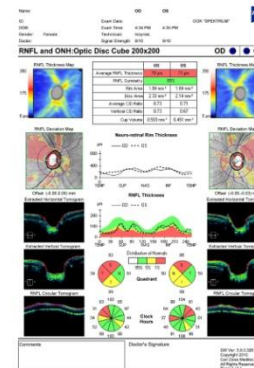
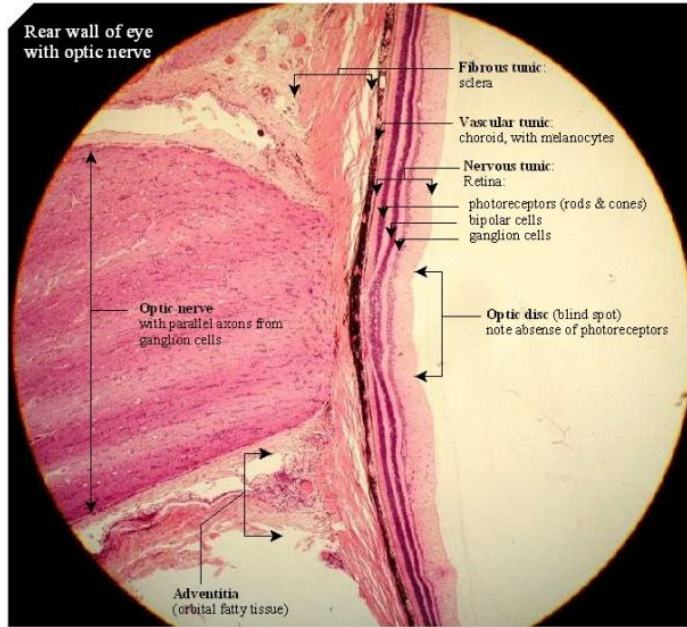
The organization of cranial nerve II corresponds to the structure of peripheral nerves.

Subdural space

Subarachnoid space

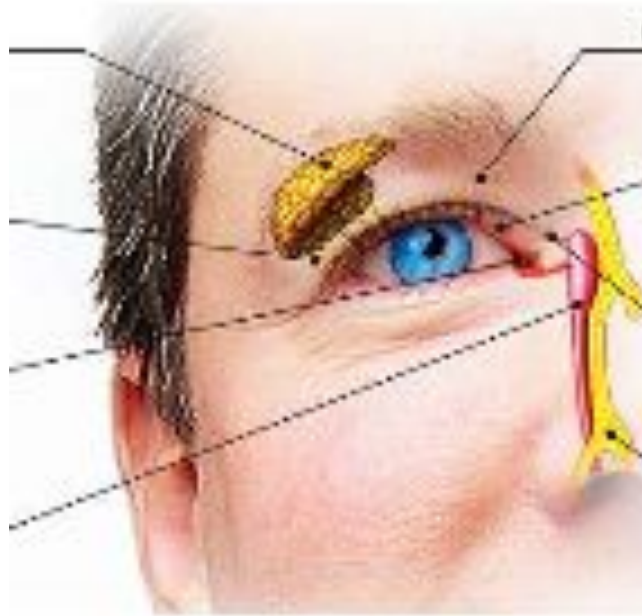
Sheaths of the optic nerve:

- Dura mater
- Arachnoid mater
- Pia mater



Protective Apparatus of the Eye

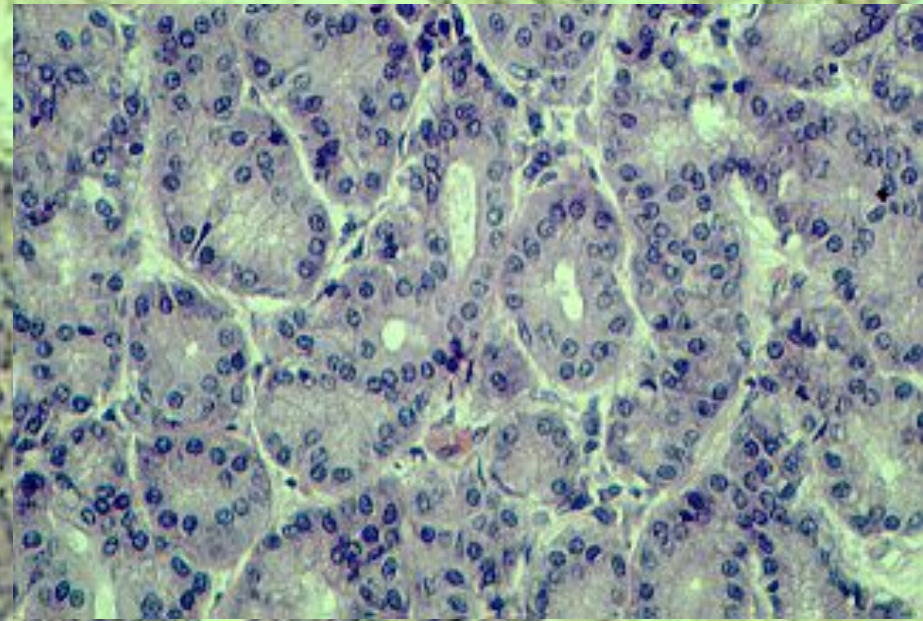
- Lacrimal gland
- Excretory ducts of the lacrimal gland
- Inferior lacrimal punctum
- Nasolacrimal duct



Lacrimal Gland

The lacrimal gland is divided into **an orbital part** and a **palpebral part**.

Function:
Participation in the **production of the tear film**



Accessory lacrimal glands

Krause's conjunctival glands

Glandular epithelium

Intralobular ducts – simple cuboidal epithelium

Interlobular ducts – stratified columnar epithelium

Eyelid

Eyelid Glands

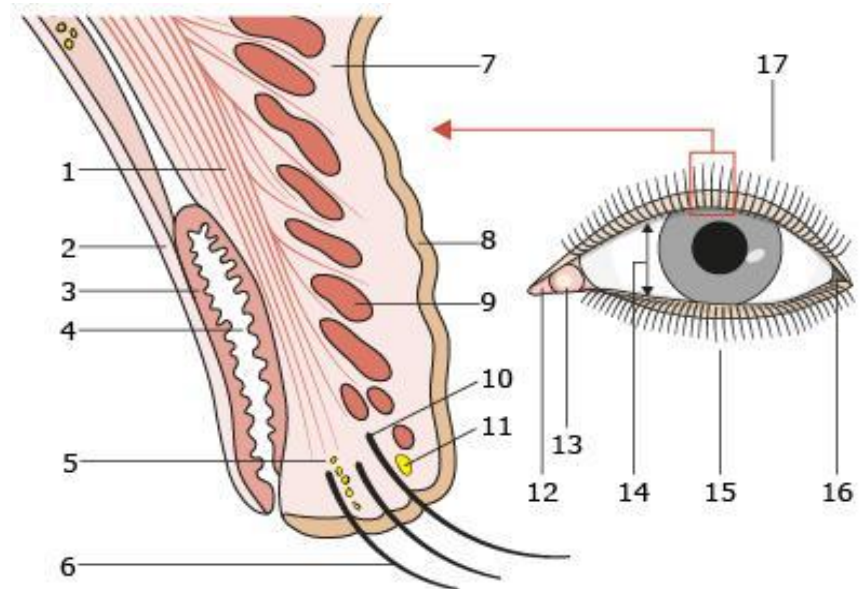
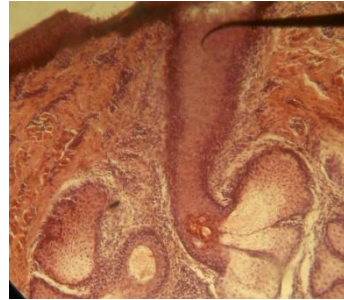
Meibomian glands (tarsal glands)

Zeis glands – sebaceous glands opening into the hair follicle

Moll glands (ciliary glands) – sweat glands

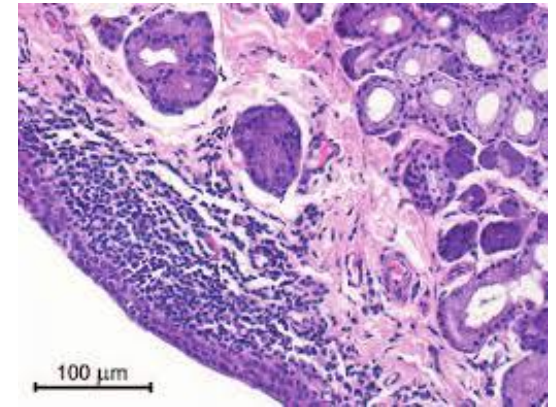
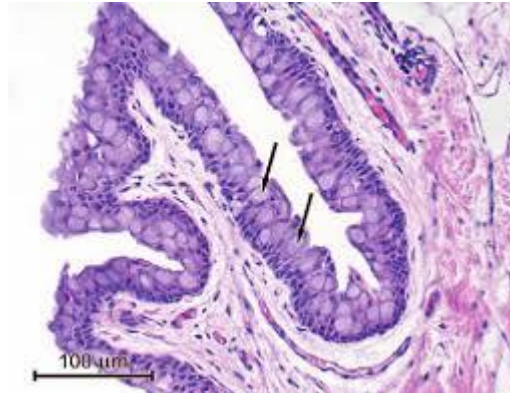
Diagram Labels

- 1 – Levator palpebrae superioris muscle
- 2 – Palpebral conjunctiva
- 3 – Tarsal plate
- 4 – Meibomian (tarsal) gland
- 5 – Ciliary glands (Moll glands)
- 6 – Eyelash
- 7 – Subcutaneous tissue
- 8 – Skin
- 9 – Orbicularis oculi muscle
- 10 – Hair follicle
- 11 – Sebaceous glands (Zeis glands)
- 12 – Medial canthus
- 13 – Lacrimal caruncle
- 14 – Palpebral fissure
- 15 – Lower eyelid
- 16 – Lateral canthus
- 17 – Upper eyelid





Conjunctiva



Type of mucous membrane

- Stratified non-keratinized squamous epithelium – in the region of the eyelid margin and near the limbus
- Stratified columnar epithelium – in the remaining areas

Lamina propria

- Loose connective tissue
- Numerous lymphocytes and plasma cells