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HISTOLOGI

HISTOLOGI RESEPTOR SENSORIS

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Departemen Histologi
PROGRAM STUDI PENDIDIKAN DOKTER
FAKULTAS KEDOKTERAN UNIVERSITAS TRISAKTI

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Capaian Pembelajaran Mata Kuliah (CPMK)	
CPMK 1	Mengidentifikasi dan menganalisis molekul, struktur dan fungsi sel dan jaringan normal terkait sistem muskuloskeletal dan neurosensoris berbasis bukti (*Evidence Based*). (CPL-4,5,6)

Sub-CPMK (ABCD – kemampuan yang dinilai, indikator, kondisi)	
	Bila dihadapkan pada skenario kasus dan data sekunder di bidang sel, jaringan, genetika biomolekular dan sistem neurosensori - muskuloskeletal, mahasiswa semester 1 mampu:
Sub-CPMK1	Menjelaskan struktur, fungsi, proses biokimia sel dan jaringan yang relevan (meliputi epitel, kelenjar dan jaringan penyambung) (CPMK -1,2)
Sub-CPMK3	Mengidentifikasi struktur sel dan jaringan yang relevan secara mikroskopik dan biomolekular (CPMK -1,2)
Sub-CPMK4	Menjelaskan struktur dan fungsi organ yang membentuk sistem neurosensori-muskuloskeletal. (CPMK -1,2)

Pendahuluan

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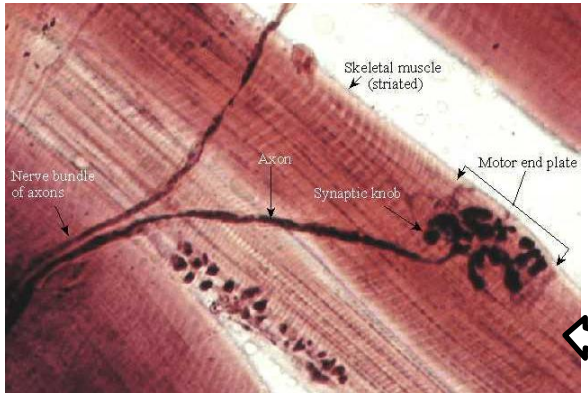
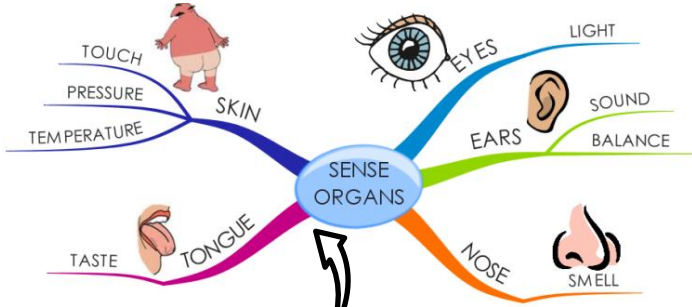


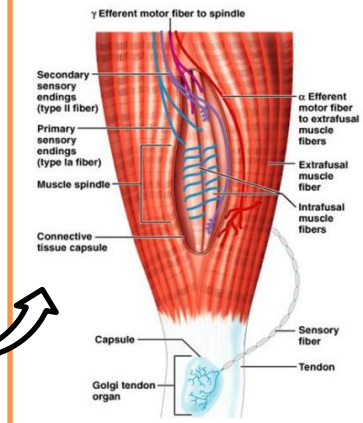
Organ indera

- Organ penerima berbagai stimulus/rangsang sensorik, dan meneruskannya ke SSP.
- Terminal dendrit, ujung sensoris atau **reseptor**



Ujung saraf tepi

- Ujung motorik/efektor
- Ujung sensorik/reseptor
  - eksteroseptor
  - proprioseptor
  - interoseptor



Modalitas sensori

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Sensory System	Modality	Stimulus Energy	Receptor Class	Receptor Cell Types
Somatosensory	Touch	Tap, flutter 5–40 Hz	Cutaneous mechanoreceptor	Meissner corpuscles
Somatosensory	Touch	Motion	Cutaneous mechanoreceptor	Hair follicle receptors
Somatosensory	Touch	Deep pressure, vibration 60–300 Hz	Cutaneous mechanoreceptor	Pacinian corpuscles
Somatosensory	Touch	Touch, pressure	Cutaneous mechanoreceptor	Merkel cells
Somatosensory	Touch	Sustained pressure	Cutaneous mechanoreceptor	Ruffini corpuscles
Somatosensory	Proprioception	Stretch	Mechanoreceptor	Muscle spindles
Somatosensory	Proprioception	Tension	Mechanoreceptor	Golgi tendon organ
Somatosensory	Temperature	Thermal	Thermoreceptor	Cold and warm receptors
Somatosensory	Pain	Chemical, thermal, and mechanical	Chemoreceptor, thermoreceptor, and mechanoreceptor	Polymodal receptors or chemical, thermal, and mechanical nociceptors
Somatosensory	Itch	Chemical	Chemoreceptor	Chemical nociceptor
Visual	Vision	Light	Photoreceptor	Rods, cones
Auditory	Hearing	Sound	Mechanoreceptor	Hair cells (cochlea)
Vestibular	Balance	Angular acceleration	Mechanoreceptor	Hair cells (semicircular canals)
Vestibular	Balance	Linear acceleration, gravity	Mechanoreceptor	Hair cells (otolith organs)
Olfactory	Smell	Chemical	Chemoreceptor	Olfactory sensory neuron
Gustatory	Taste	Chemical	Chemoreceptor	Taste buds

Reseptor perifer khusus

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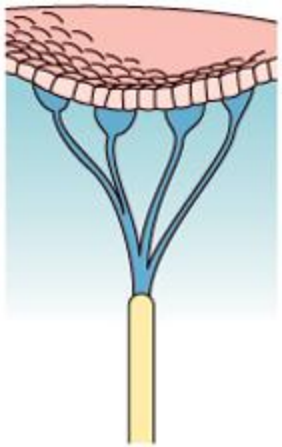
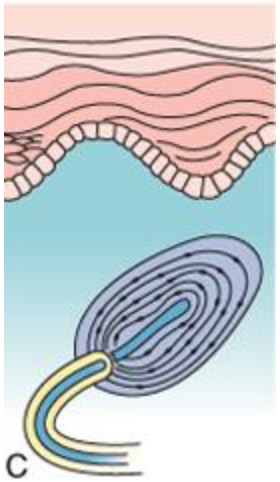
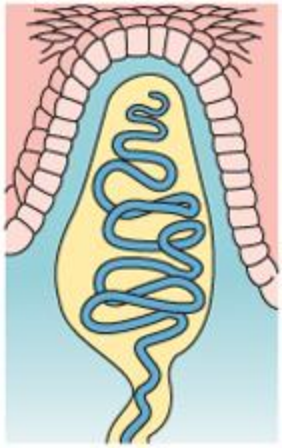


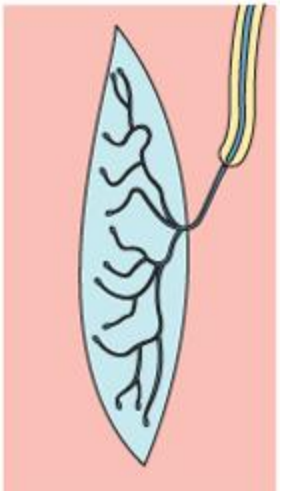
cakram Merkel



Badan Pacini

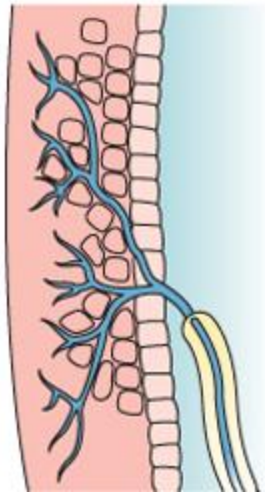


Badan Meissner

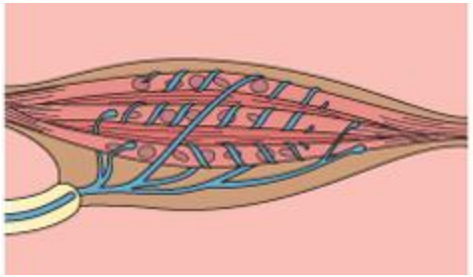


Badan Ruffini

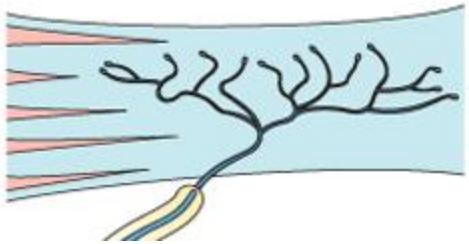
Badan Krause



Akhir saraf Peritricial



Muscle spindle



Organ tendon Golgi

Reseptor perifer khusus

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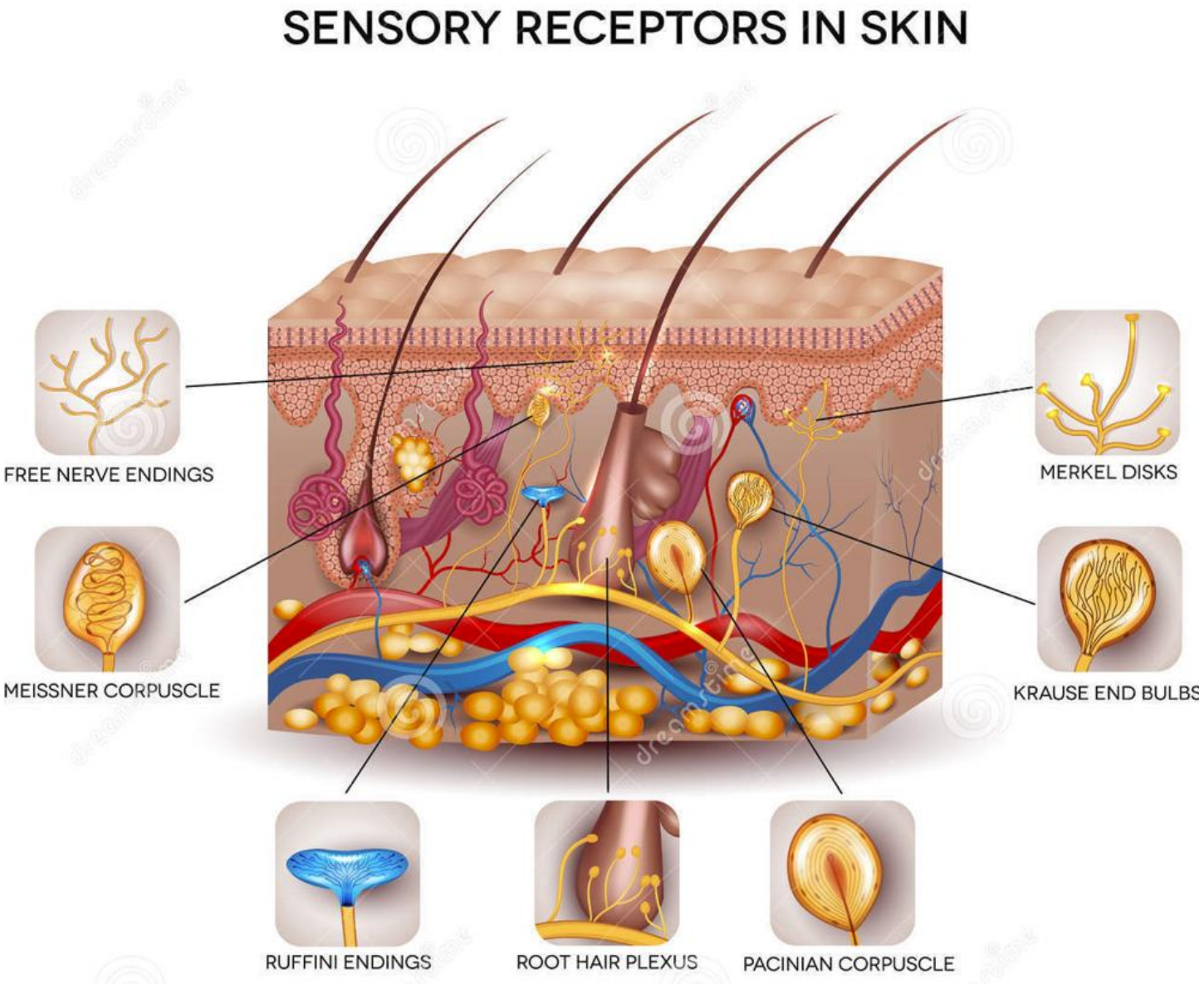

Reseptor perifer khusus

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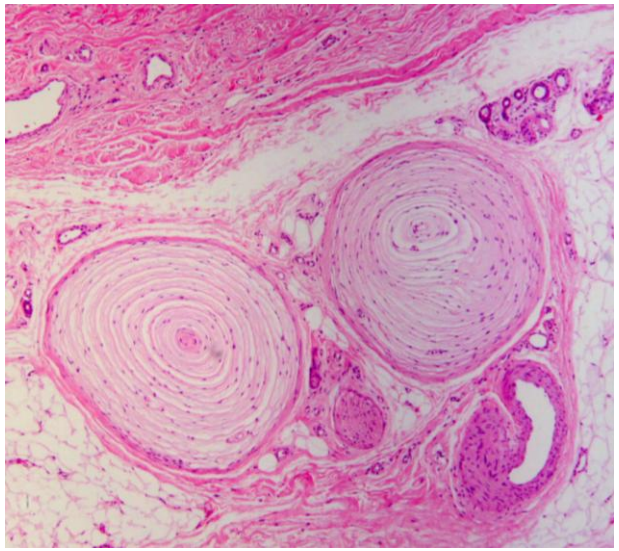
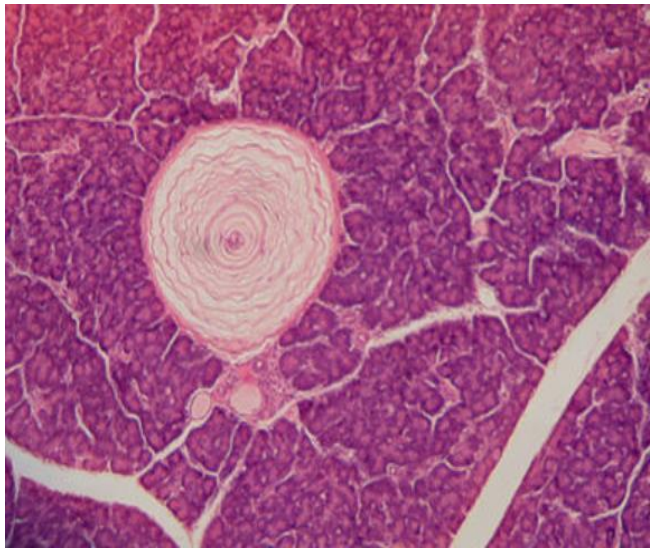
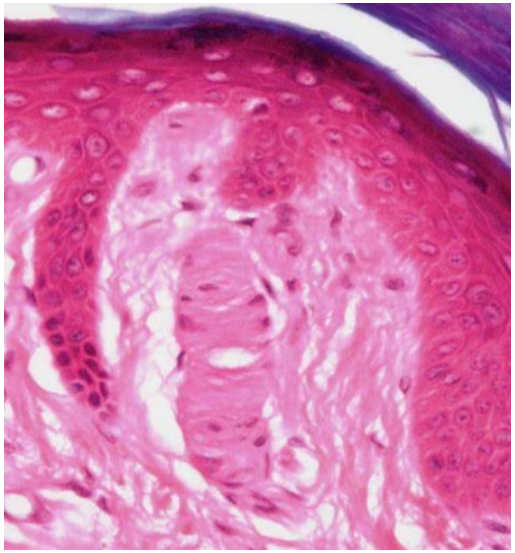
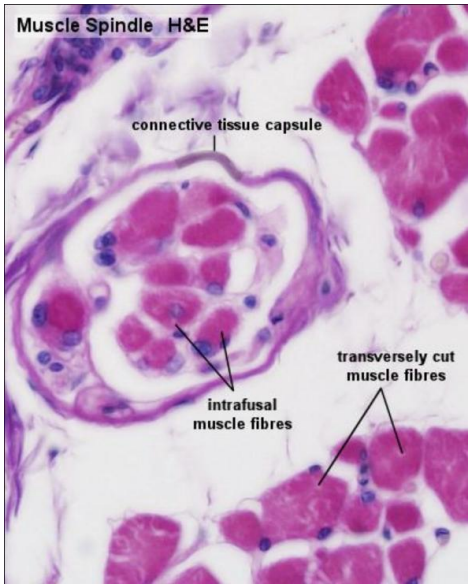




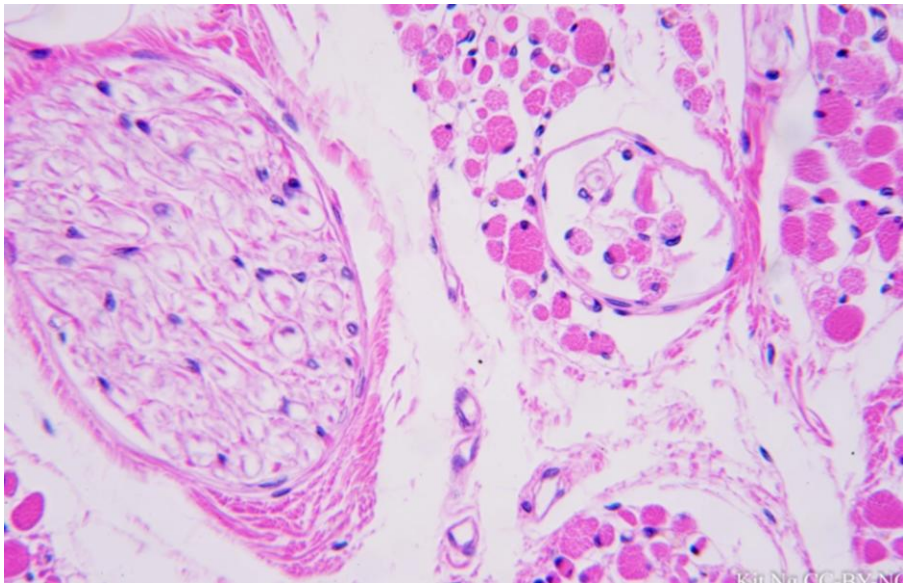
Badan Pacini



Badan Meissner



Muscle spindle



Reseptor bau

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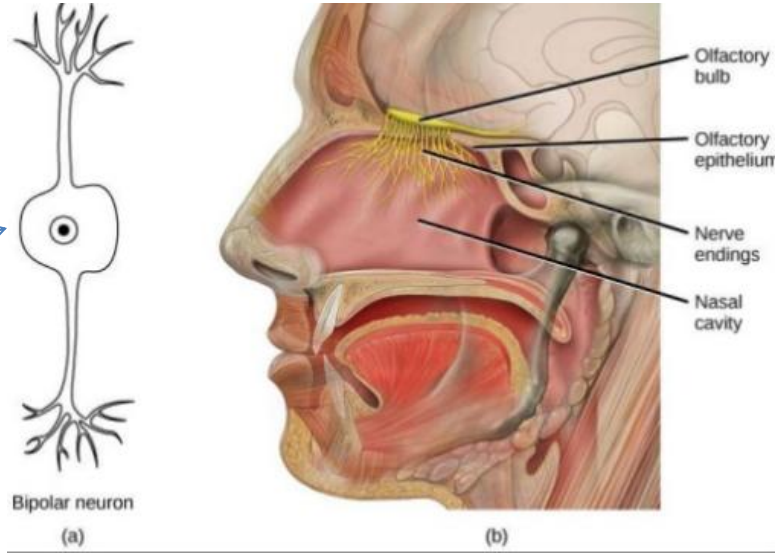
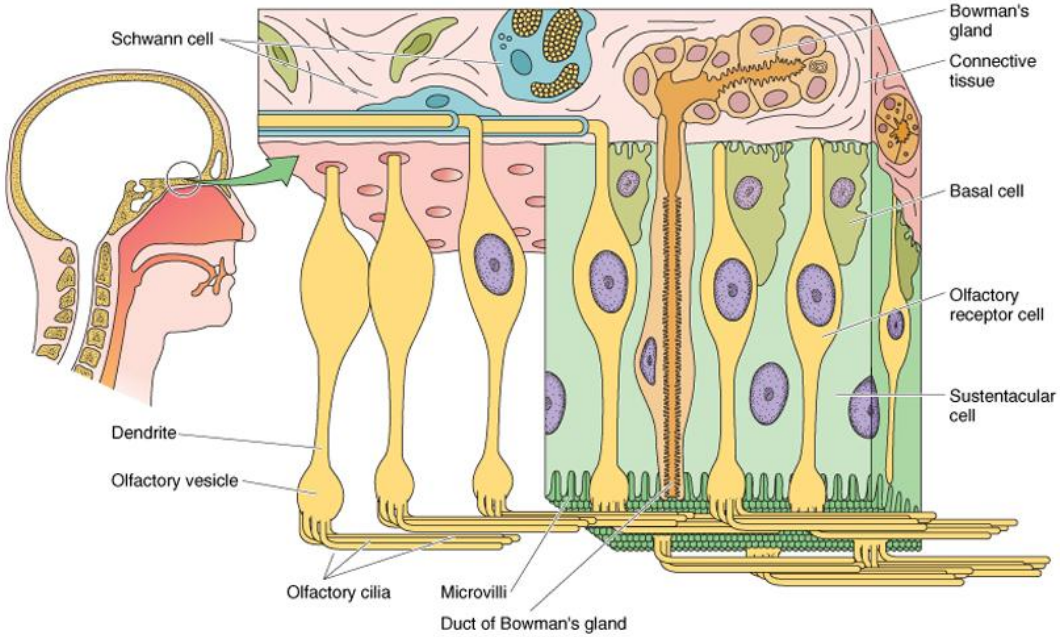
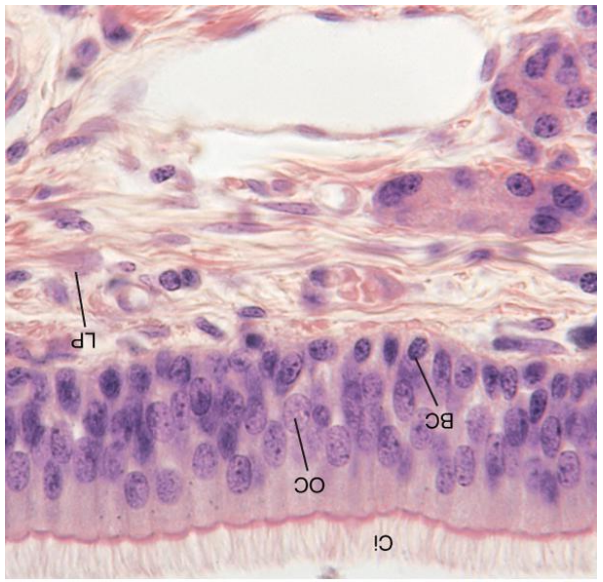
Regio olfaktori → epitel olfaktori

- ✓ Sel olfaktori (OC) + silia (Ci)
- ✓ Sel sustentakular
- ✓ Sel basal (BC)







Reseptor bau

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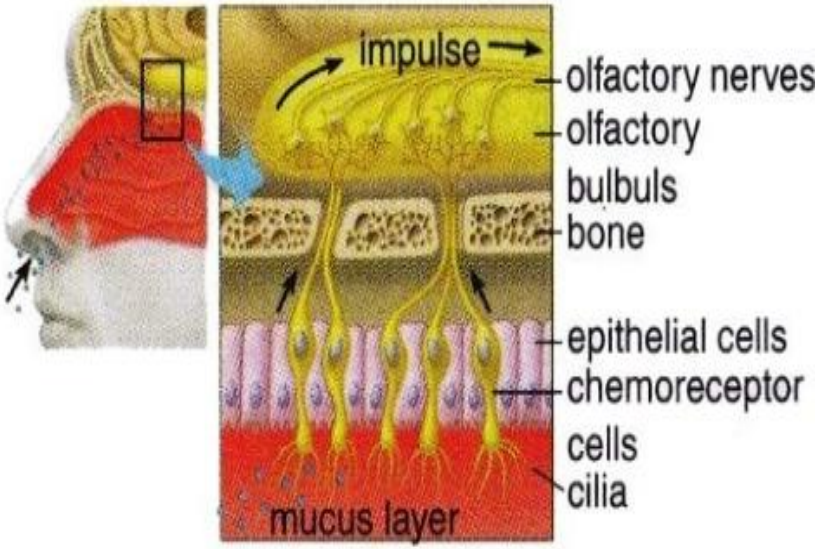
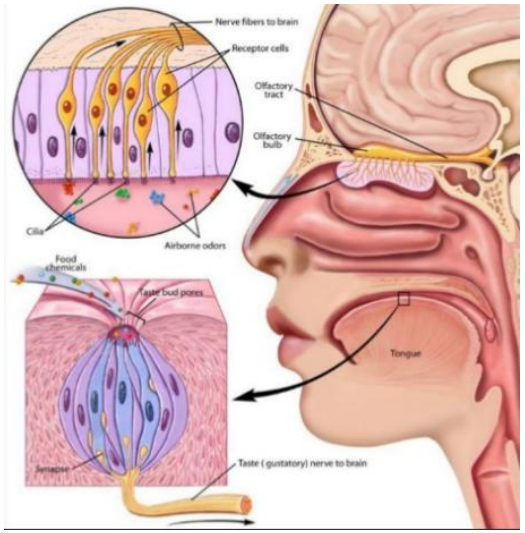
Mekanisme penciuman bau:

- Molekul zat berbau → reseptor bau spesifik → mencapai ambang → rangsang sel olfaktori → potensial aksi.
- Informasi → akson → bulbus olfaktori → korteks olfaktori





Reseptor rasa

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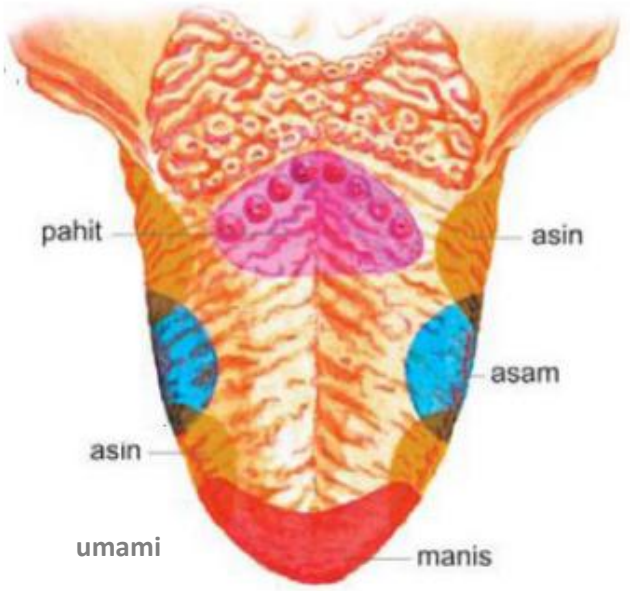
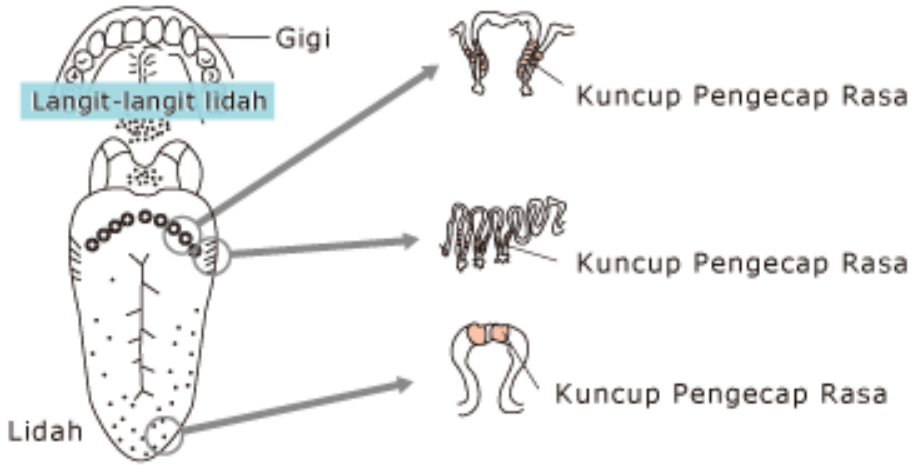
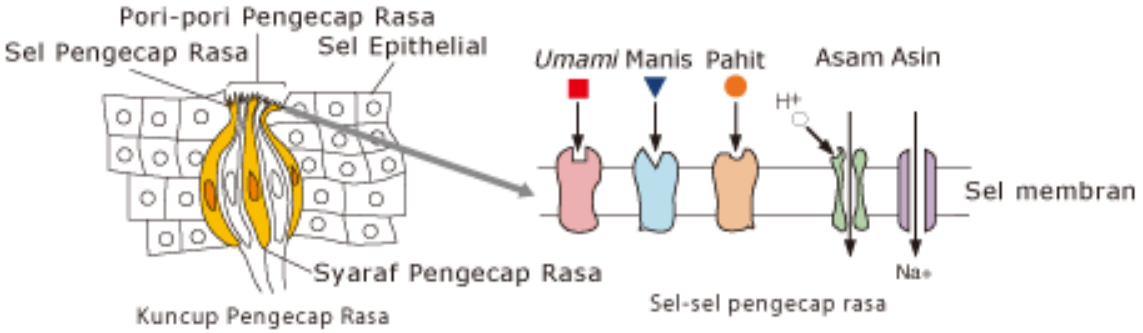
Sensasi rasa:



- Papila fungiformis

Kuncup kecap (*taste bud*)





Reseptor rasa

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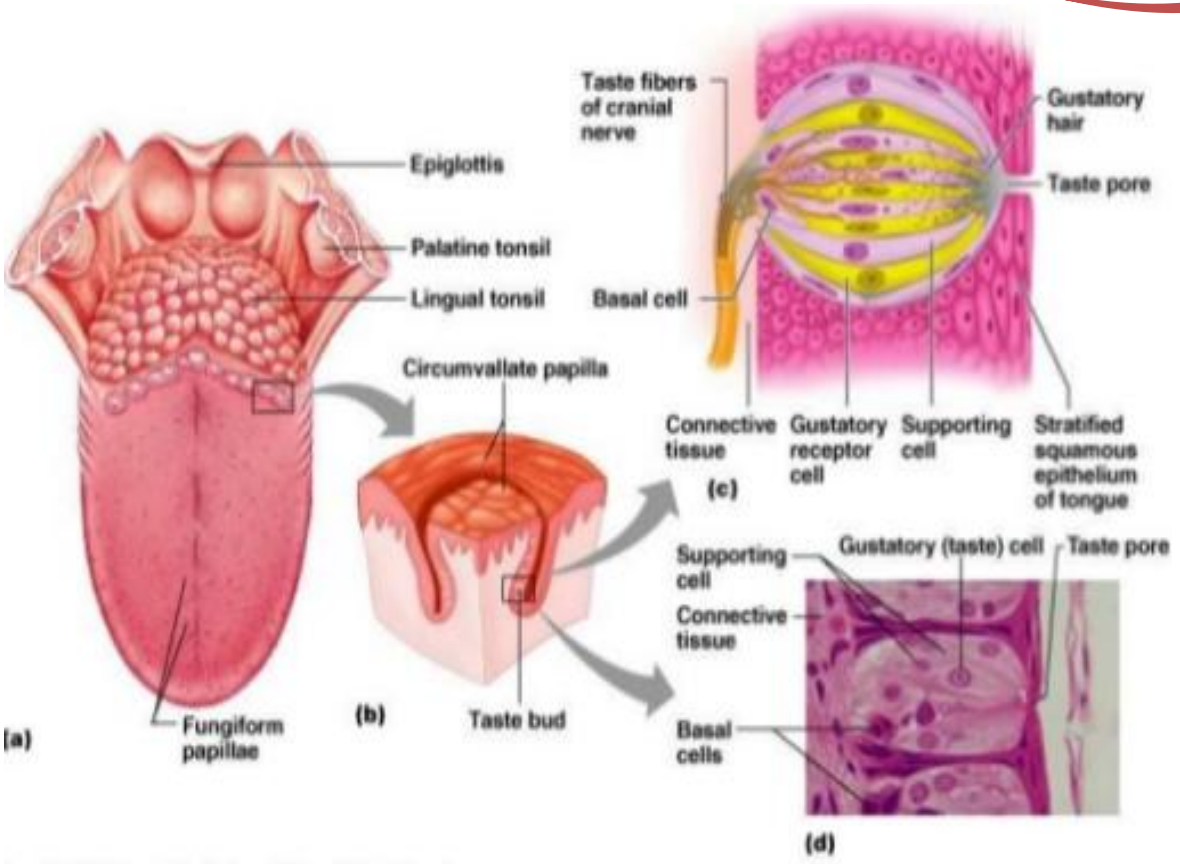
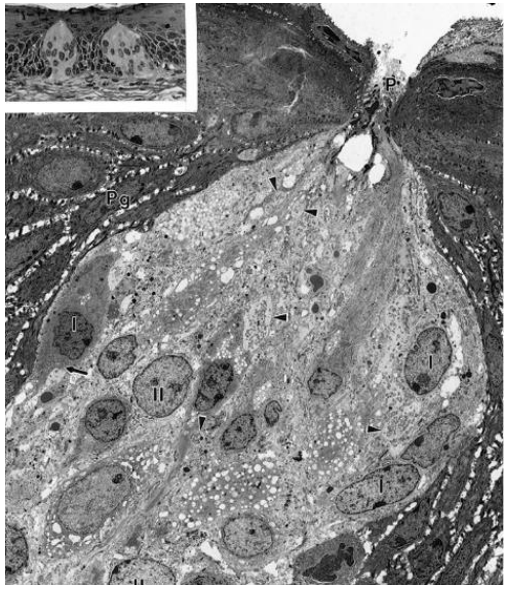
Kuncup kecap (*taste bud*)

- Sel gustatorius
- Sel sustentakular
- Sel basal





Mekanisme pengecapan:

Tastan → kanal ion/reseptor pengecap (mikrovili) → potensial aksi → otak

Mata

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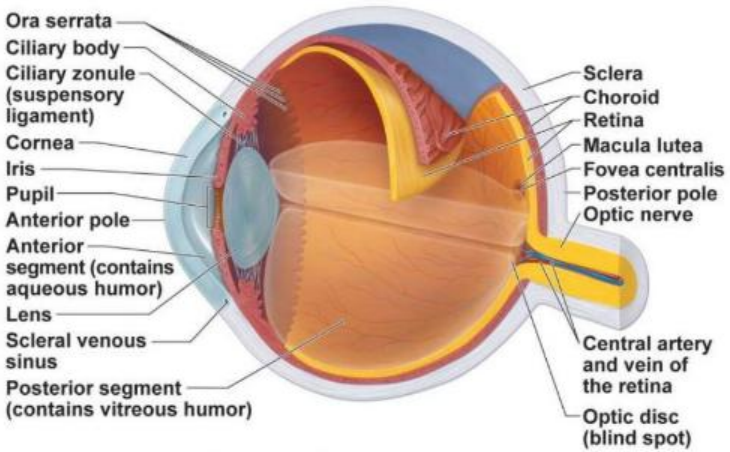
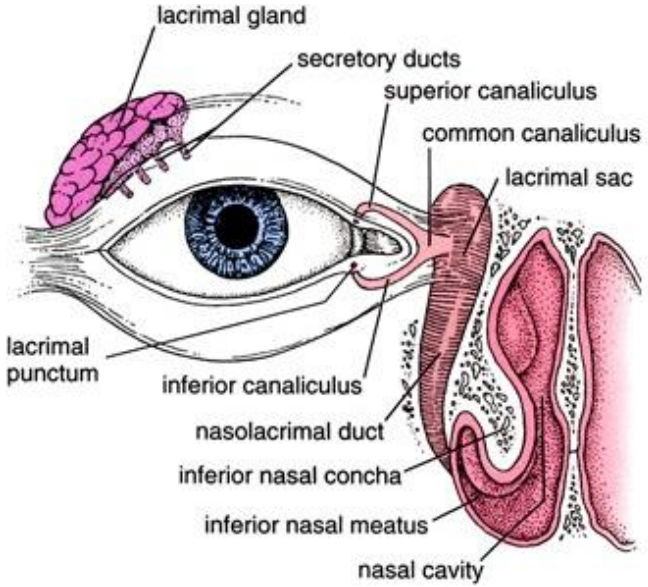
I. Bulbus oculi
II. Adnexa mata (palpebra; kel.lakrimalis; muskuli ekstrinsik bola mata)

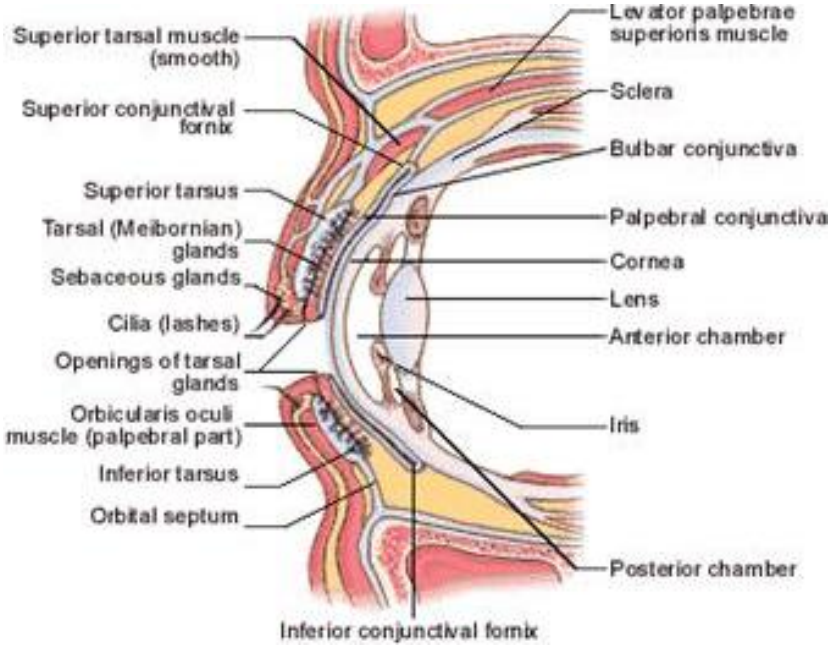


(a) Diagrammatic view. The vitreous humor is illustrated only in the bottom part of the eyeball.

Dinding bola mata:

- Tunika fibrosa
- Tunika vaskularis
- Tunika neuralis





Mata (organ fotosensoris)

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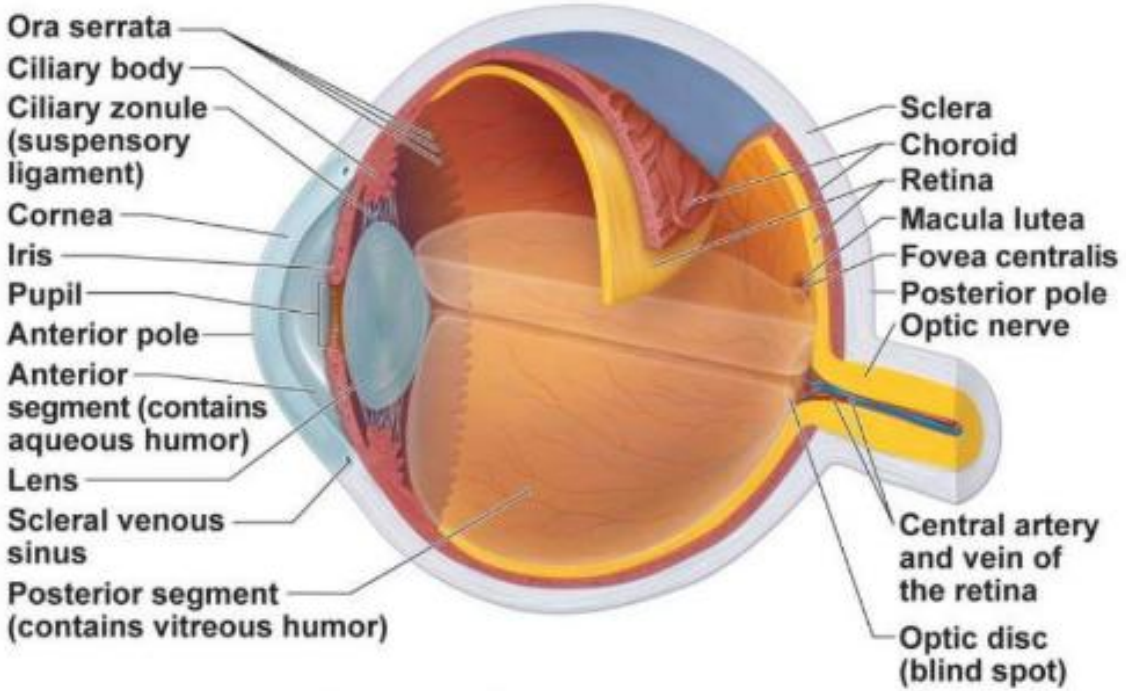
Cahaya → media refraksi → retina → n.optikus → otak



(a) Diagrammatic view. The vitreous humor is illustrated only in the bottom part of the eyeball.

Dinding bola mata:

- Tunika fibrosa (**sklera**; **kornea**)→ lapisan luar bola mata.
- Tunika vaskularis/vaskulosa (**koroid**; **korpus siliaris**; **iris**)→ lapisan tengah, kaya akan PD dan pigmen.
- Tunika neuralis/nervosa (**retina**)→ lapisan paling dalam.

Mata

Dinding bola mata:

- **Tunika fibrosa**
- Tunika vaskularis
- Tunika neuralis

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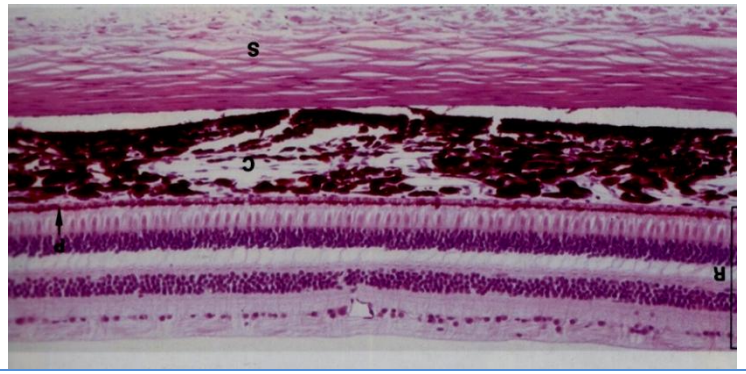
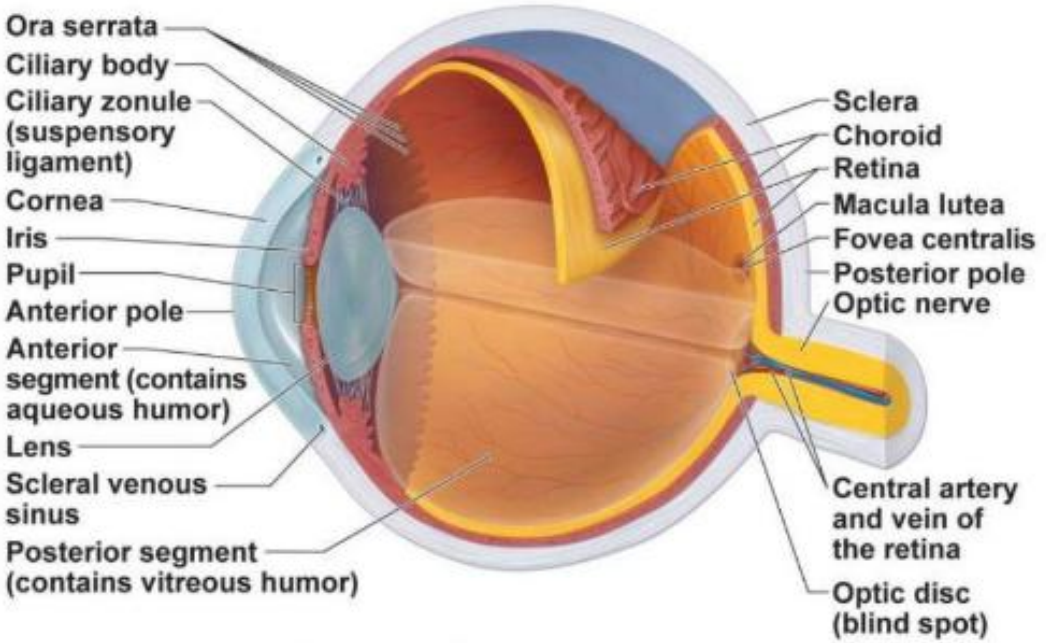
SKLERA

- Bagian padat, putih, 5/6 posterior bola mata (limbus-lamina kribrosa)
- Fibroelastik (kolagen tipe 1+elastin).
- Relatif non vascular
- Tempat insersi tendo mm. ekstrinsik bola mata
- Susunan sklera, tdd:

1. episklera
2. Sklera sebenarnya
3. Lamina fusca/ lamina suprakoroid





(a) Diagrammatic view. The vitreous humor is illustrated only in the bottom part of the eyeball.

Mata

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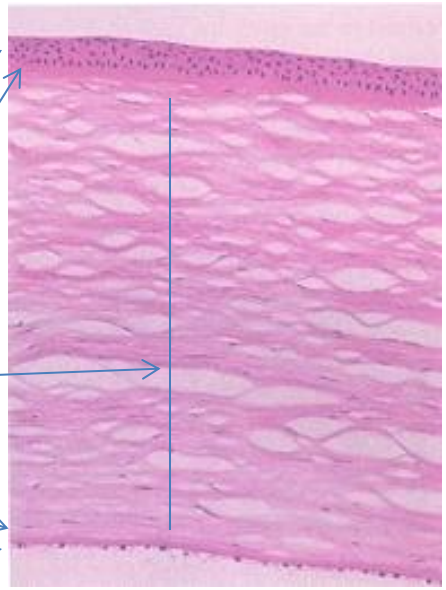
Dinding bola mata:

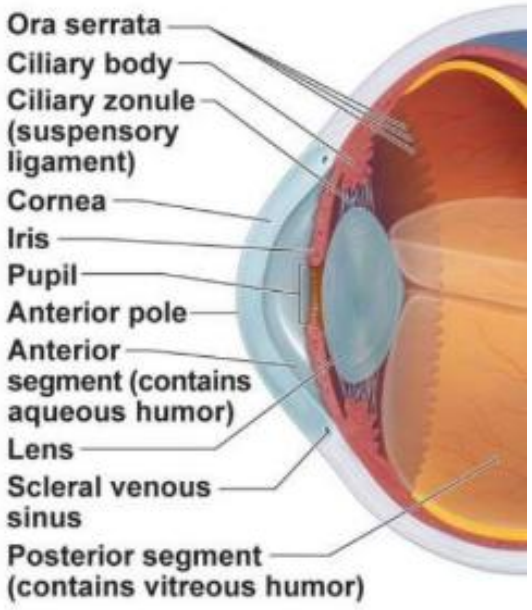
- **Tunika fibrosa**
- Tunika vaskularis
- Tunika neuralis

KORNEA

- Transparan., 1/6 anterior bola mata.
- 5 lapisan:
  - ✓ Epitel kornea
  - ✓ Membran Bowman
  - ✓ Stroma
  - ✓ Membran Descement
  - ✓ Endotel kornea



- Avaskular (nutrisi dari humor akweus, PD limbus, air mata)
- Regenerasi epitel kornea baik
- Serabut saraf sensoris (cab. sensoris N.V - *free nerve ending*)



(a) Diagrammatic view. The vitreo humor is illustrated only in the bottom part of the eyeball.

Mata

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Lapisan Kornea:

1. **Ep. berlapis gepeng tanpa lap. Tanduk**

   50 – 70 µm, 5 – 6 lapis sel-sel, >>> ujung saraf bebas

   pinggir kornea: gmb mitosis di str. basale (7 hr)

   Fungsi: transfer air dan ion dari stroma ke sakus konjungtiva.

2. **Memb. Bowman**

   lapisan fibrilar kolagen tipe I, 7 – 12 µm, jernih, aselular

3. **Substansia propria/ stroma kornea**

   90% tebal kornea, avaskular, fibroblast + ser. Kolagen I + elastin dalam subst. dasar amorf tdd kondroitin sulfat dan keratan sulfat.

4. **Memb. Descemet**

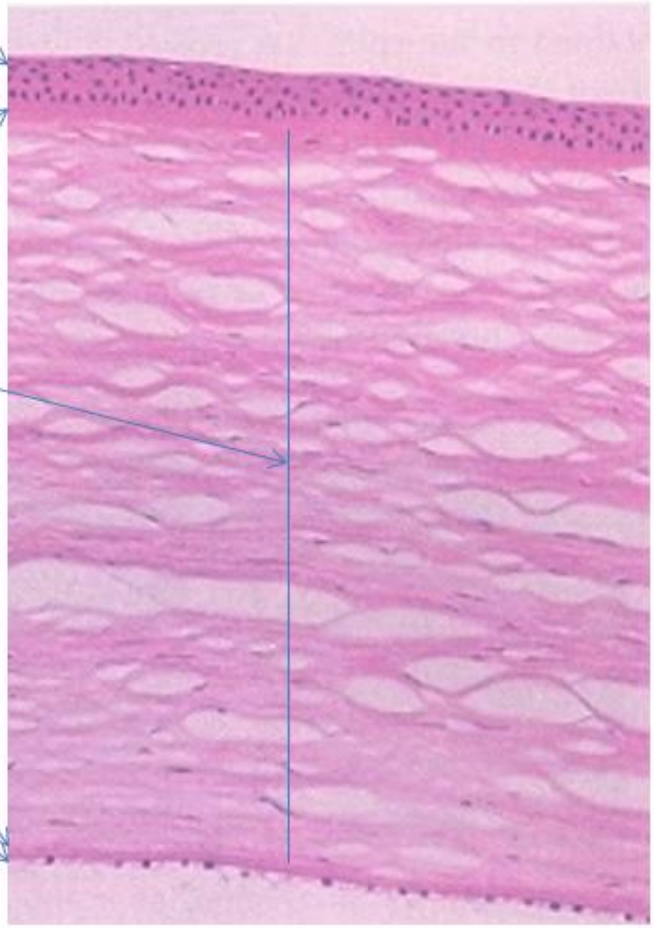
   5 – 10 µm, fibril kolagen halus disekresi endotel kornea

5. **Lap. endotel kornea**

   epitel selapis gepeng + organel2, banyak vesikel pinositosis.

   Membran endotel: pompa natrium → pompa ion Na+ ke bilik mata depan (Cl- dan air mengikuti pasif).

   → stroma sedikit dehidrasi utk mempertahankan kualitas refraksi kornea.



Mata

Dinding bola mata:

- **Tunika fibrosa**
- Tunika vaskularis
- Tunika neuralis

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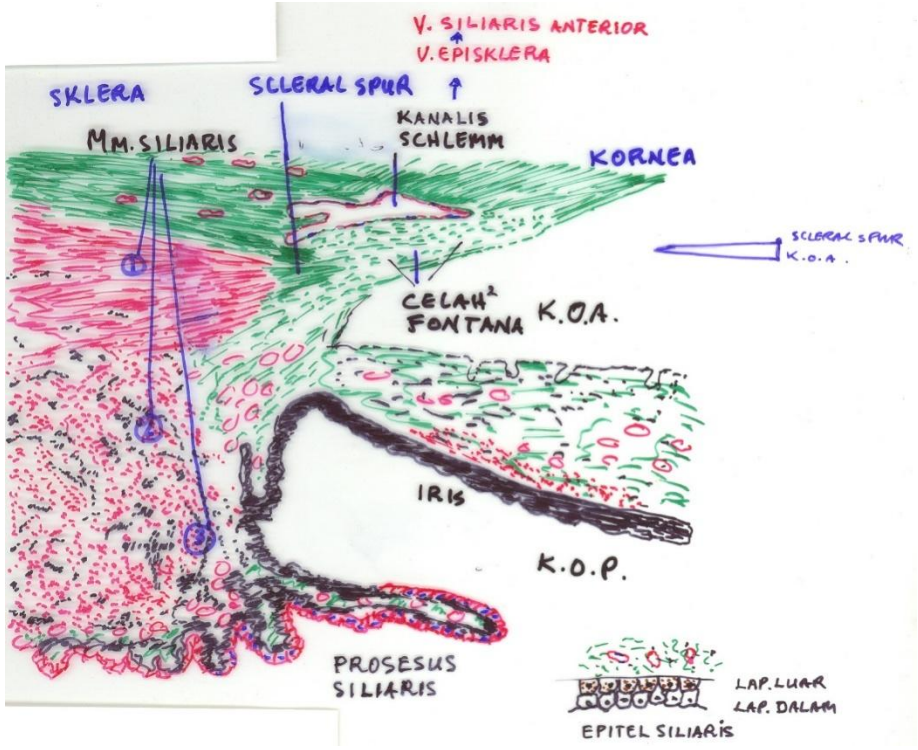
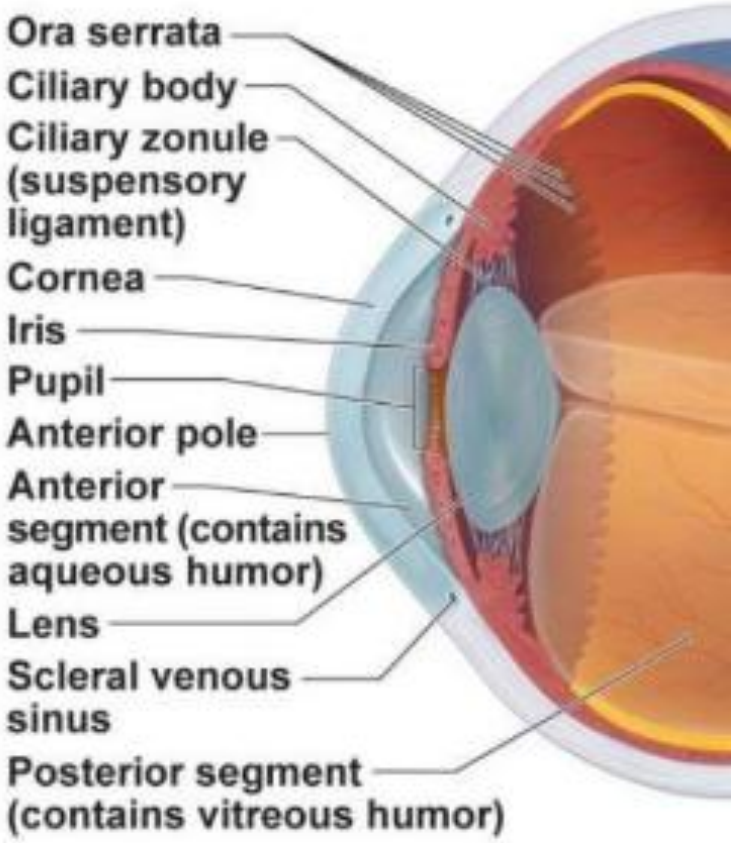
Limbus kornea

Daerah peralihan kornea – sklera: ± 1 mm

- Stroma tansparan bersatu dengan sklera opak
- mikrovaskular
- >> sel punca
- Jaring trabekular (celah2 Fontana): sistem kanal berlapis endotel → utk drainase humor akweus
- kanal Schlemm





Mata

Dinding bola mata:

- Tunika fibrosa
- **Tunika vaskularis >>> PD**
- Tunika neuralis

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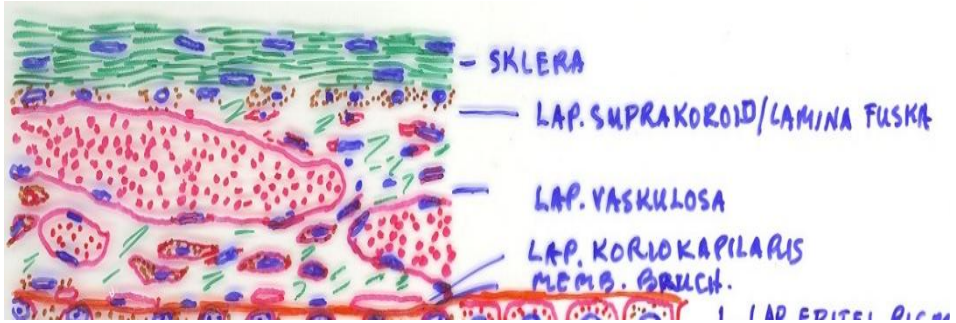
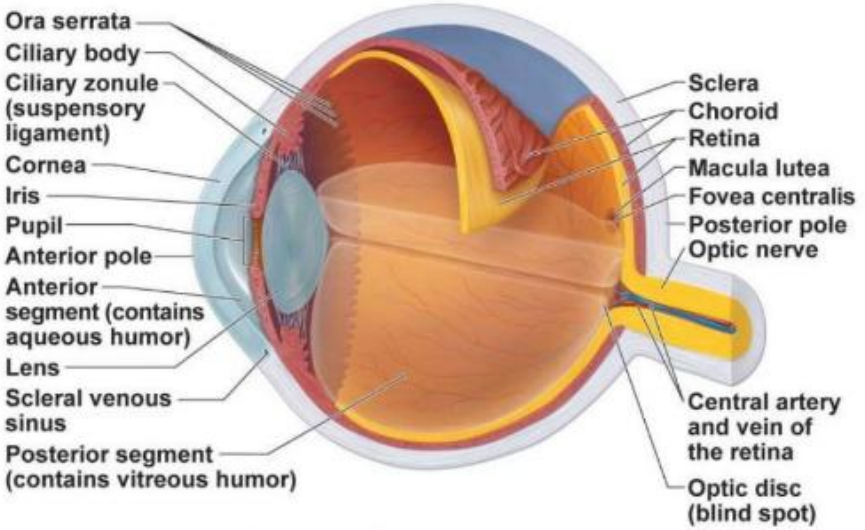
Koroid

Lap. post. bola mata, berpigmen, vaskularisasi baik, melekat longgar pada tunika fibrosa.

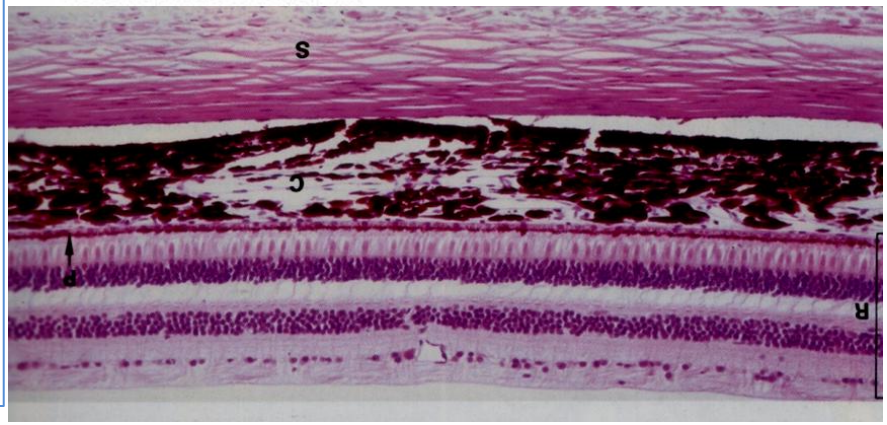
Susunannya: jar ikat longgar + fibroblast, banyak PD kecil dan melanosit.

1. Lap. suprakoroid + melanosit
2. Lap. vaskulosa →V. VORTIKOSA
3. Lap. Koriokapilaris (nutrisi retina)
4. Membrana Bruch (lamina elastika)





(a) Diagrammatic view. The vitreous humor is illustrated only in the bottom part of the eyeball.



Mata

Dinding bola mata:
- Tunika fibrosa
- **Tunika vaskularis**
- Tunika neuralis

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Korpus siliaris (terletak antara ora serata-iris)

Perluasan koroid berbentuk baji, melingkari dinding dalam bola mata (setingkat lensa).

Korpus siliaris : jar ikat longgar, kaya mikrovaskular dan serat elastin.

Bagian tengah menonjol ke arah lensa → **prosesus siliaris** → **Fibrilin** (serat zonule) menyebar dari pros. siliaris utk masuk melekat pada lensa (**lig. suspensorium lensa**)

Bagian dalam dilapisi **pars siliaris retina**:

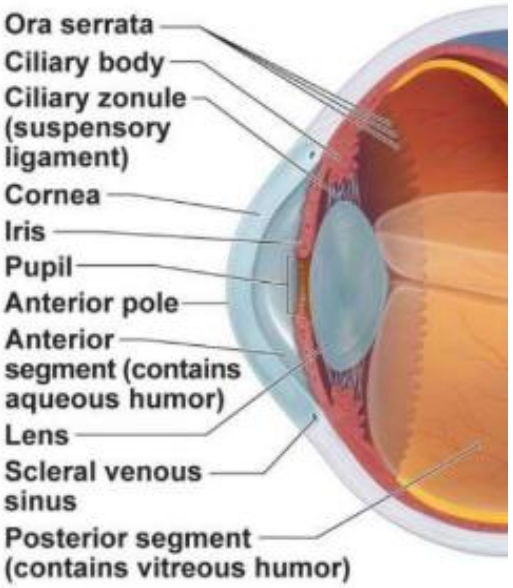
2 lapisan sel kubis (lapisan pigmen retina)

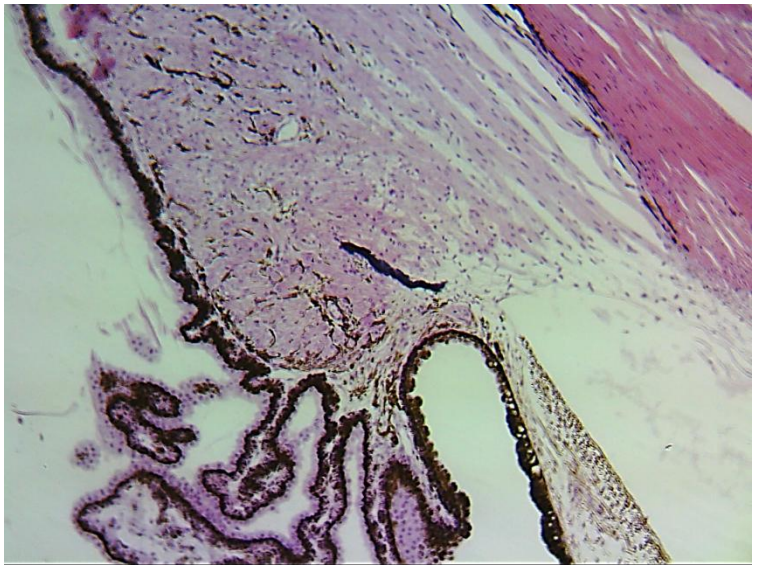
- epitel selapis silindris berpigmen (>>> melanin) langsung melapisi stroma siliar
- epitel selapis silindris tidak berpigmen, langsung bersambung dengan lapisan sensorik retina.
  → produksi humor akweus.

Korpus siliaris disusun 3 berkas otot siliaris:

N.III → kontraksi → tekanan lig. sus menurun → lensa cembung

Relaksasi→ tekanan lig sus meningkat → lensa memipih (**AKOMODASI**)





Mata

Dinding bola mata:

- Tunika fibrosa
- **Tunika vaskularis**
- Tunika neuralis

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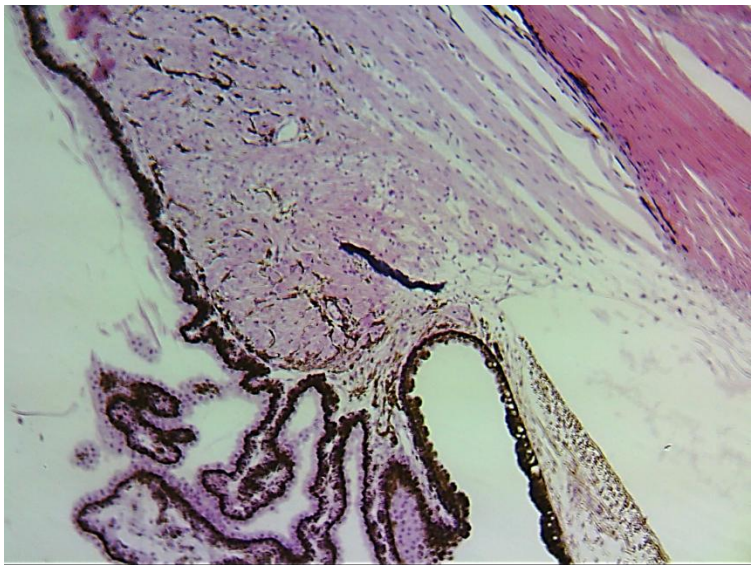
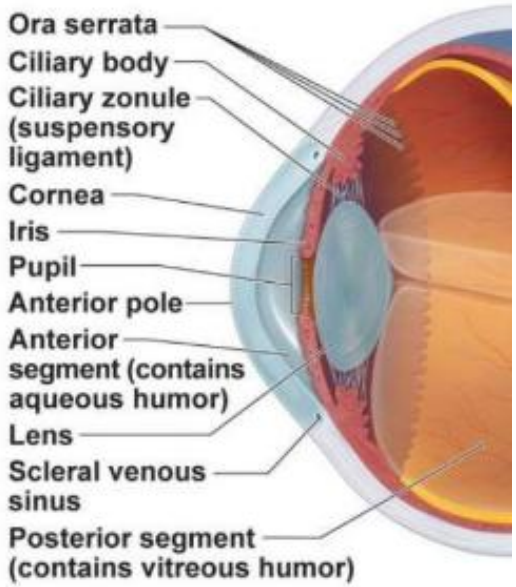
Korpus siliaris, tdd:

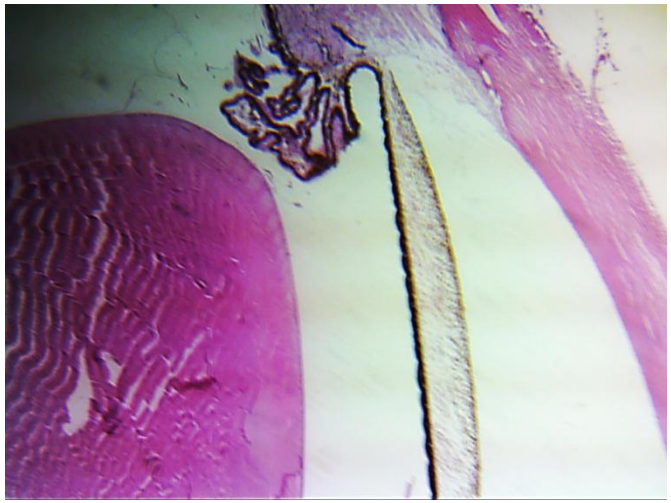
- Prosesus siliaris
- Zonula siliaris Zinnii
- Humor aqueous

Aliran humor aqueous :

k.o.p. → pupil → k.o.a. → jar. trabekular / celah Fontana → kanal Schlemm → v. aqueous → vena episclera → v. siliaris anterior







Mata

Dinding bola mata:
- Tunika fibrosa
- **Tunika vaskularis**
- Tunika neuralis

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Iris

Perluasan koroid bagian depan

Memisahkan k.o.a. dan k.o.p.

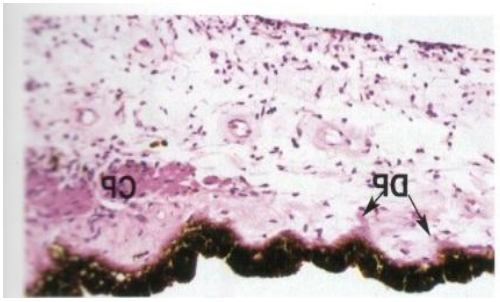
Celah di tengah : **pupil**

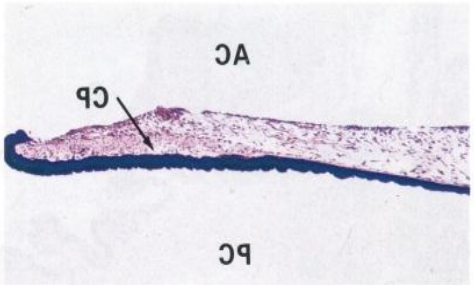
Perm. anterior iris: lapisan diskontinu fibroblast dan melanosit yang ireguler;

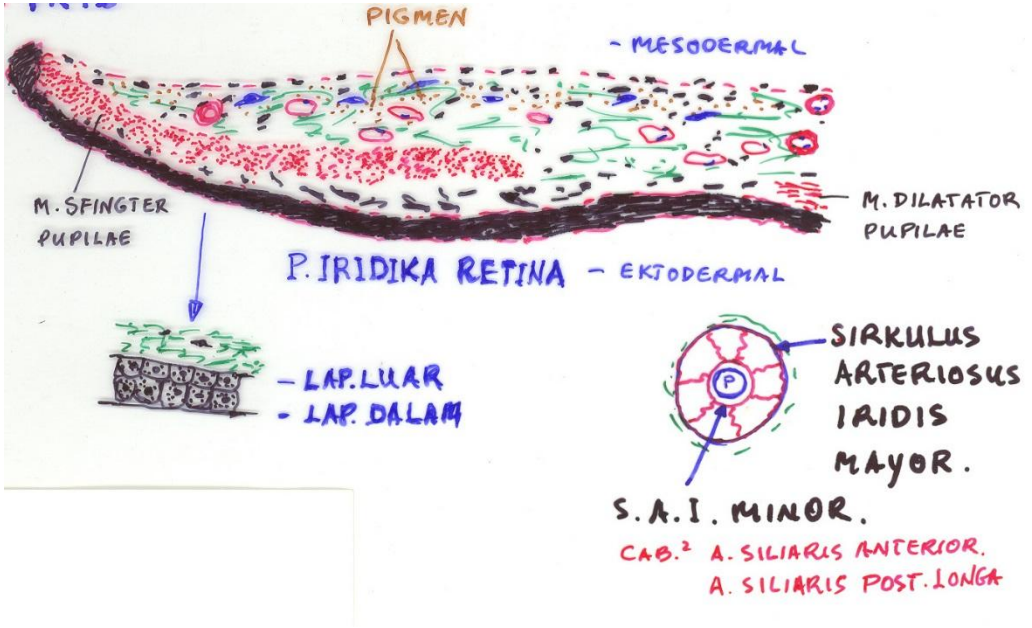
Sebelah dalam: stroma jar ikat, PD sedikit, fibroblast, melanosit.

Perm. posterior iris: lanjutan 2 lapisan epitel pigmen retina (**pars iridika retina**)

Perm. yang menghadap lensa disusun sel-sel pigmen utk menghalangi cahaya melintas melalui iris; dan memberi warna mata.







Lensa mata

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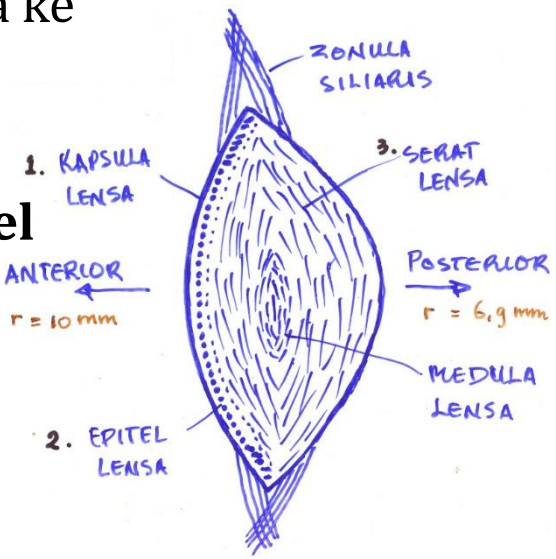
Struktur fleksibel,bikonveks, jernih

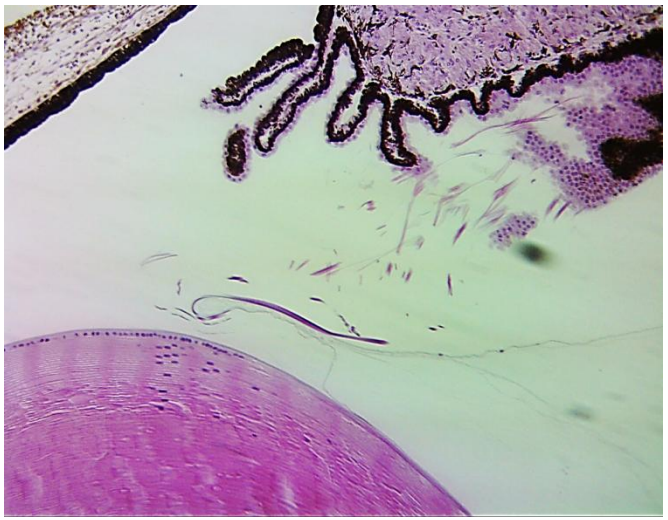
Fungsi: menfokuskan cahaya ke retina

1. Kapsula lensa
2. Epitel lensa (**selapis sel kuboid**)
3. Serat lensa (**kristalin**)

Zonula siliaris Zinnii

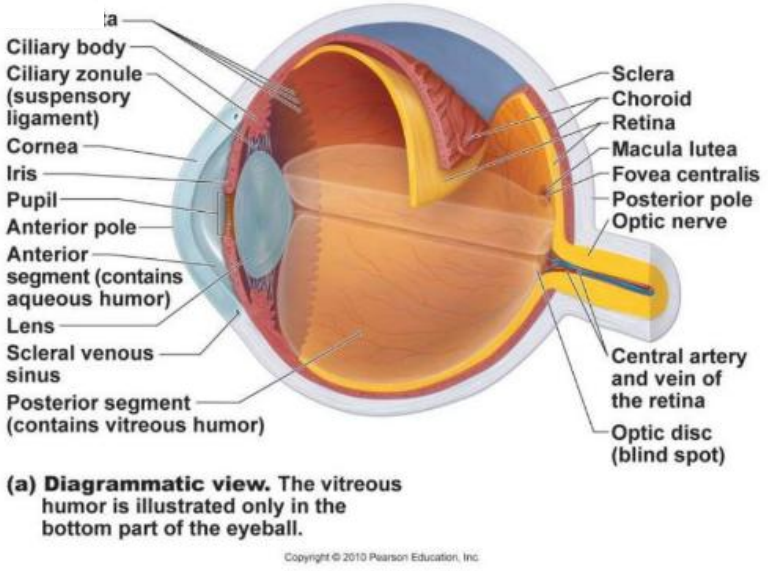
(radier, jumlah sekitar 70)





Badan vitreus

- Letak: posterior terhadap lensa
- Konsistensi spt. gel; Index refraksi 1,334
- Tdd. air (elektrolit+serat kolagen) + asam hialuronat → 99%
- Hialosit + makrofag
- Kanal hyaloid (a. hyaloid pada fetus)



Mata

Dinding bola mata:
- Tunika fibrosa
- Tunika vaskularis
- **Tunika neuralis**

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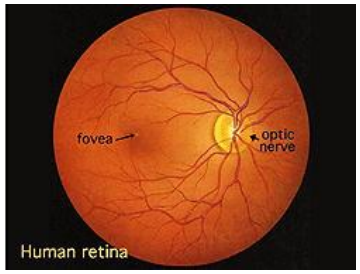
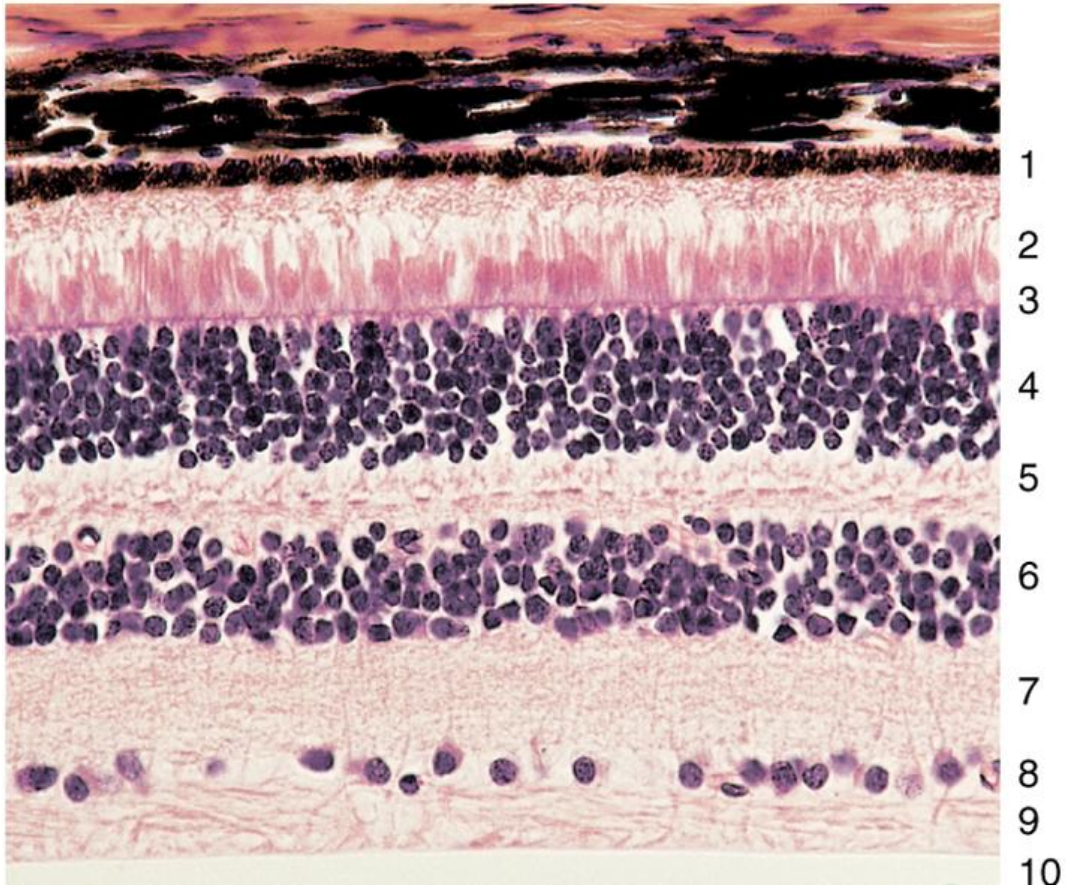


TUNIKA NEURALIS/NERVOSA:
- Pars optika retina (10 lapisan)
- Pars seka retina:
  - Pars iridika retina
  - Pars siliaris retina

Ora serata

RETINA

- **10 Lapisan:**
  1. **Epitel pigmen**
  2. **Lapis batang dan kerucut**
  3. **Membran limitans luar**
  4. **Lapis inti luar**
  5. **Lapis pleksiform luar**
  6. **Lapis inti dalam**
  7. **Lapis pleksiform dalam**
  8. **Lapis sel-sel ganglion**
  9. **Lapis serat nervus optikus**
  10. **Membran limitans dalam**



Mata

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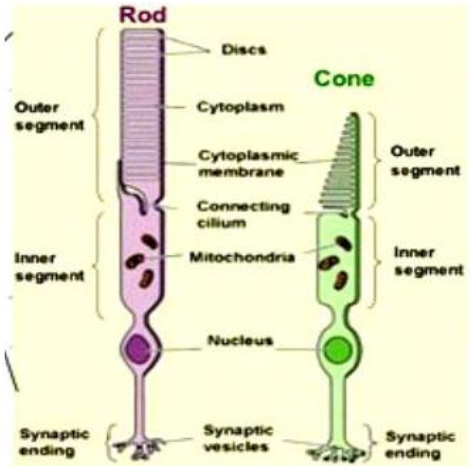
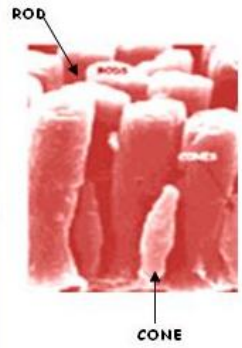
Dinding bola mata:

- Tunika fibrosa
- Tunika vaskularis
- **Tunika neuralis**





- **Sel Batang** → reseptor untuk cahaya redup → pigmen **rhodopsin**
- **Sel kerucut** → reseptor untuk cahaya terang dan warna → pigmen **iodopsin**

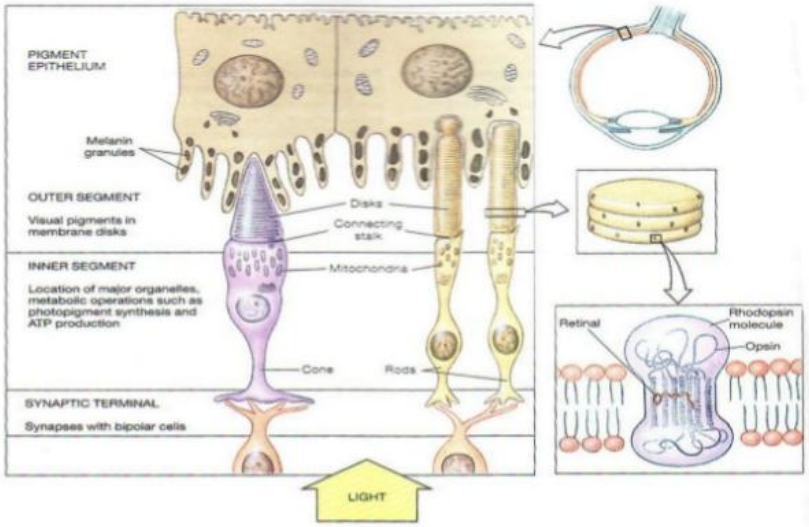


Figure 10-34 **Photoreceptors: rods and cones** Light transduction takes place in the outer segment of the photoreceptor, where visual pigments are contained in the membranes of disklike structures. In rods, the visual pigment is rhodopsin, composed of opsin and an attached retinal molecule. Depolarization of the photoreceptor causes release of neurotransmitter from the synaptic terminal onto bipolar cells. The dark pigment layer absorbs extra light and prevents it from reflecting back and distorting vision.

Mata

Dinding bola mata:

- Tunika fibrosa
- Tunika vaskularis
- **Tunika neuralis**

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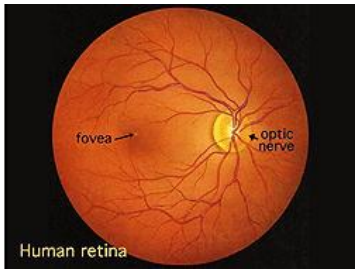

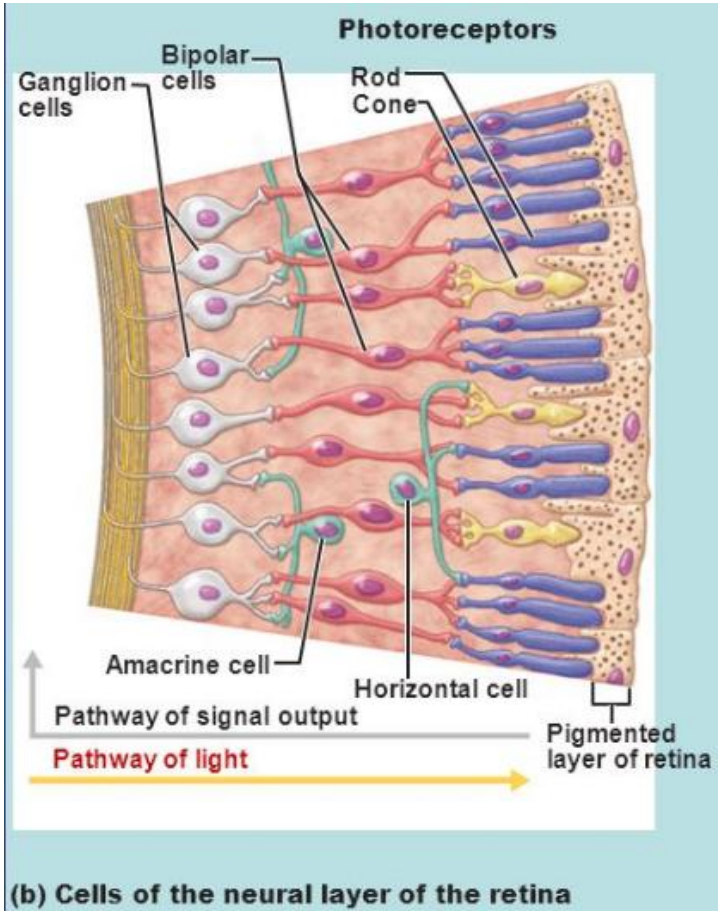

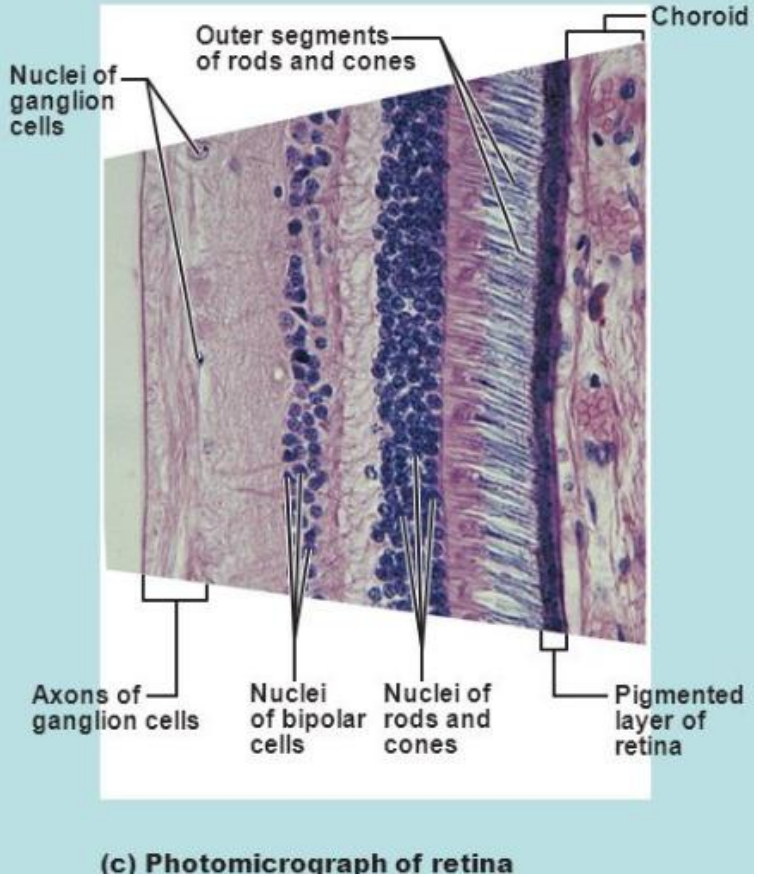

Cahaya → induksi hiperpolarisasi batang kerucut → transmisi sinyal melalui berbagai lapisan sel → aktivasi sel ganglion → potensial aksi akson → otak

Mata

Dinding bola mata:
- Tunika fibrosa
- Tunika vaskularis
- **Tunika neuralis**

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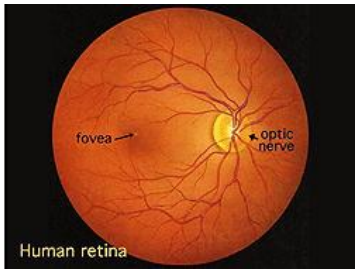
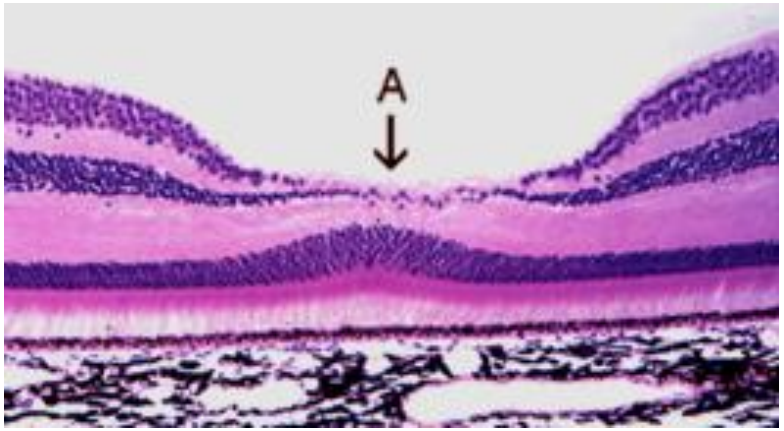
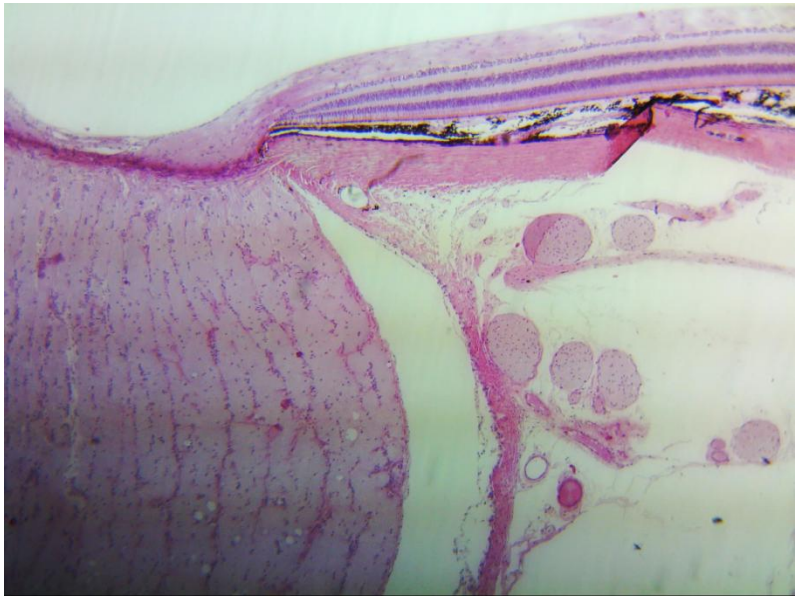




Fovea sentralis
(di dalam makula lutea)
→ aktivitas visual terbesar



Lempeng optik/ *blind spot*
(pintu keluar saraf optik)

Telinga

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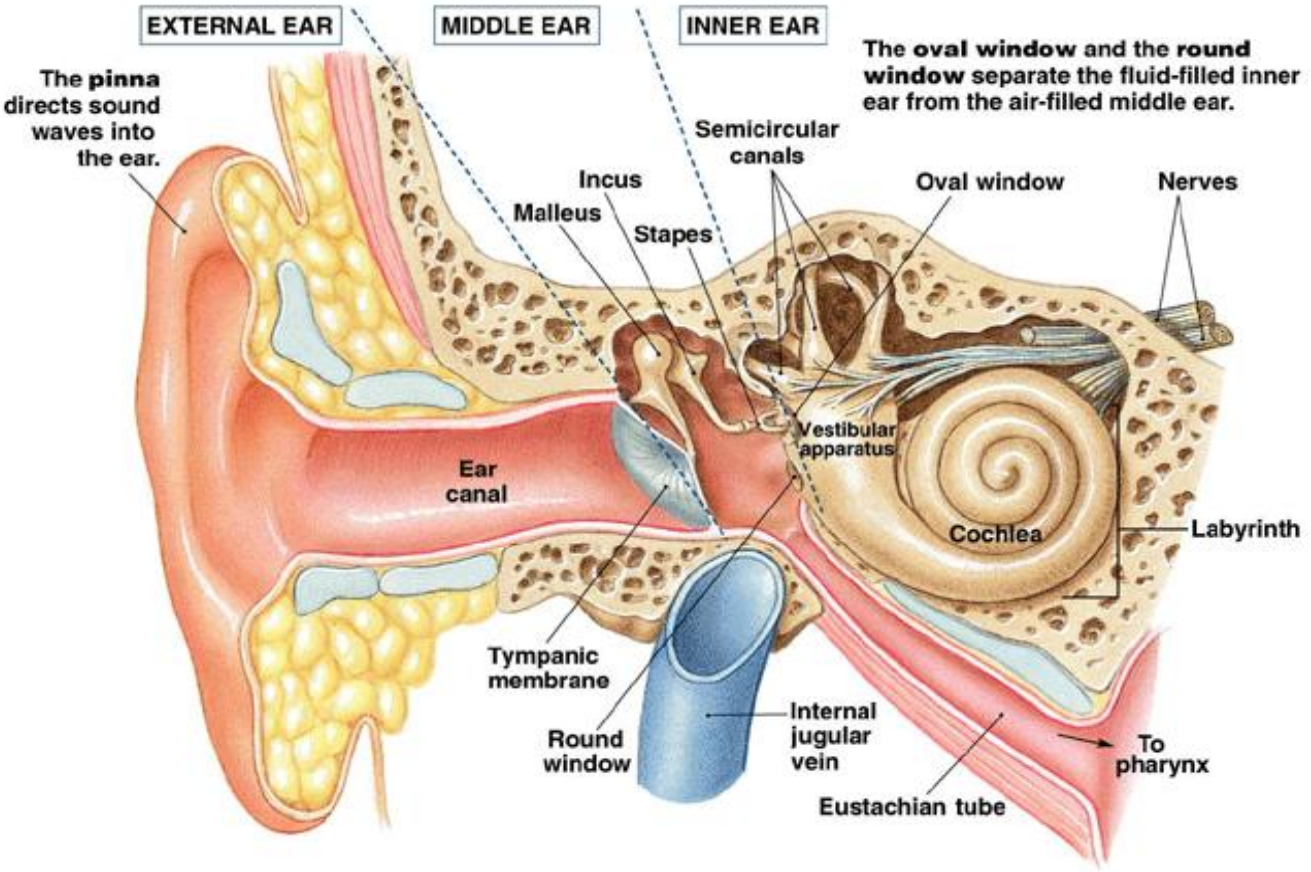
= Organ pendengaran dan ekuilibrium



Gelombang suara → telinga luar (membrane timpani)→ getaran mekanik → diamplifikasi oleh MIS → for. ovale → telinga dalam → N.VIII → otak

Telinga

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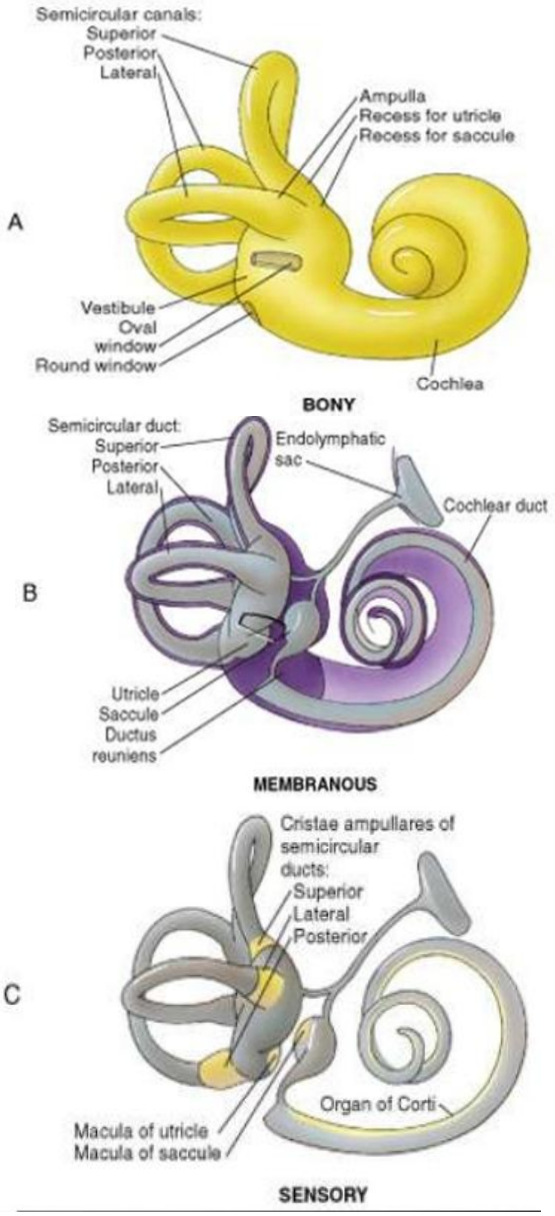
Telinga dalam

- **Labirin tulang** (kanal semisirkularis, vestibulum, koklea)
- **Labirin membranosa** (sakulus, utrikulus, duktus semisirkularis, duktus koklearis)

Bony Labyrinth	Membranous Labyrinth	Receptor Organs	Functions
Vestibule	Saccule & Utricle	Macula	Equilibrium (Linear acceleration)
Semicircular Canal	Semicircular Duct	Crista Ampullaris	Equilibrium (Angular acceleration)
Cochlea	Cochlea	Organ of Corti	Hearing



Telinga

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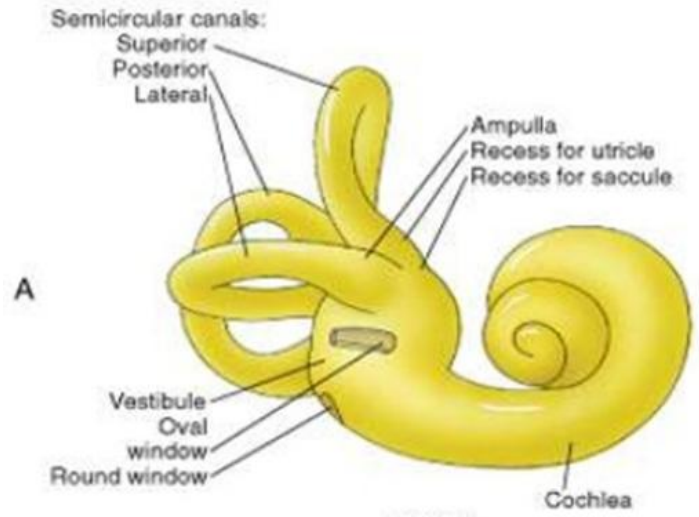
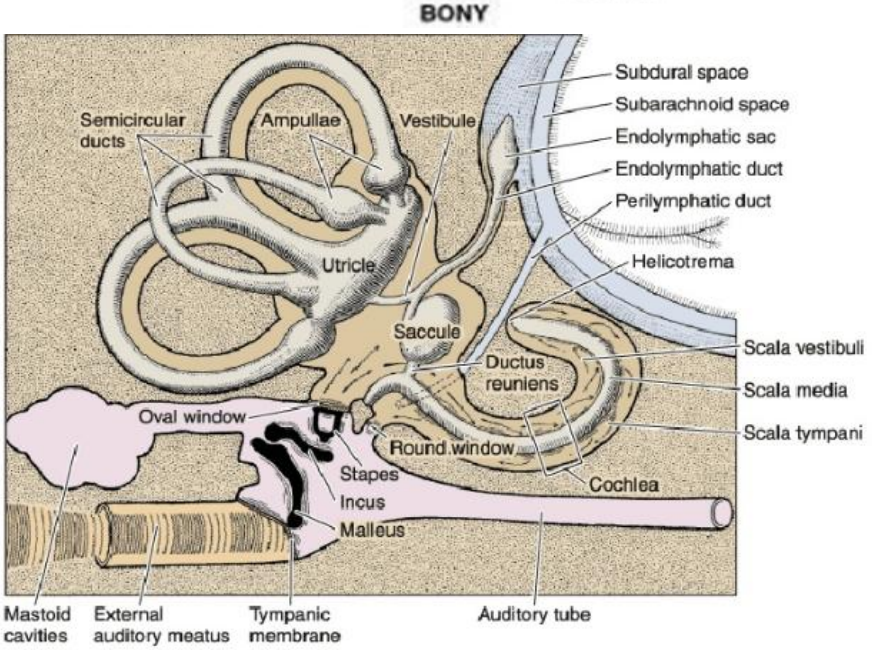
Labirin tulang

- Dilapisi endosteum
- Ruang perilimfatik berisi **perilimf**
- Bagian tengah: vestibulum

Vestibulum

- Dinding lateral **tingkap oval/fenestra vestibuli**, (tertutup membran tempat lempeng kaki stapes melekat); **tingkap bundar/fenestra koklea** (tertutup membran)
- Berisi utrikulus dan sakulus





Telinga

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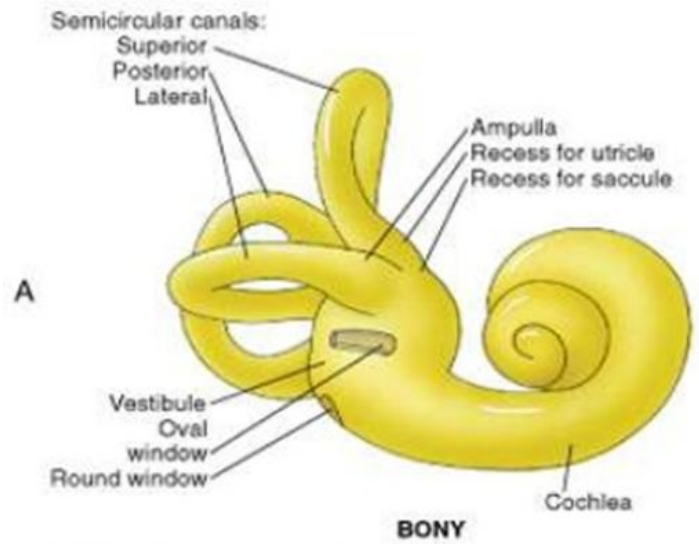
Kanal semisirkularis

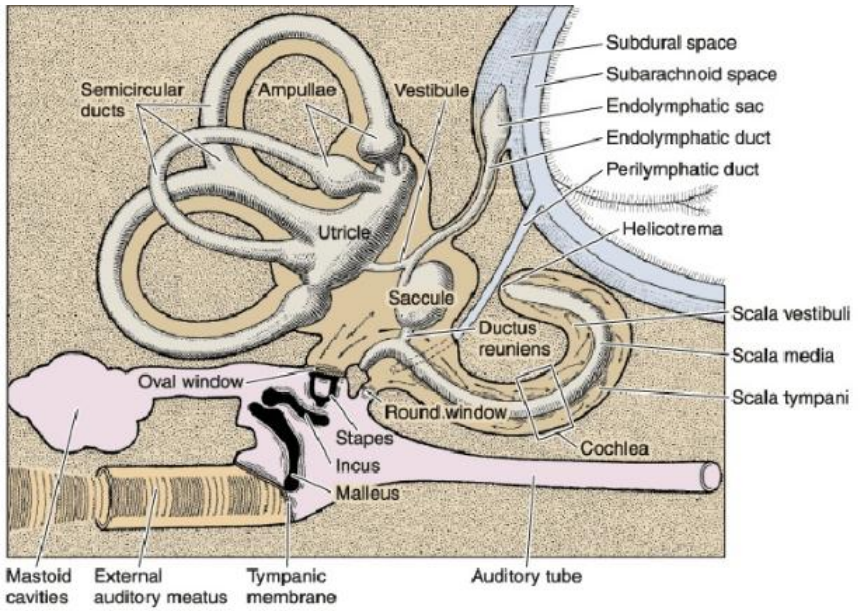
(superior, lateral, posterior)

- Ujung melebar: **ampula**
- Muara ke vestibulum
- Di dalam kanal menggantung **duktus semisirkularis**



Koklea

- Berbentuk spiral tulang berongga (pusatnya: **modiolus**)
- Dari modiolus keluar lamina spiralis tulang, tempat berjalannya p.d dan ganglion spiralis (bagian N.VIII)



Telinga

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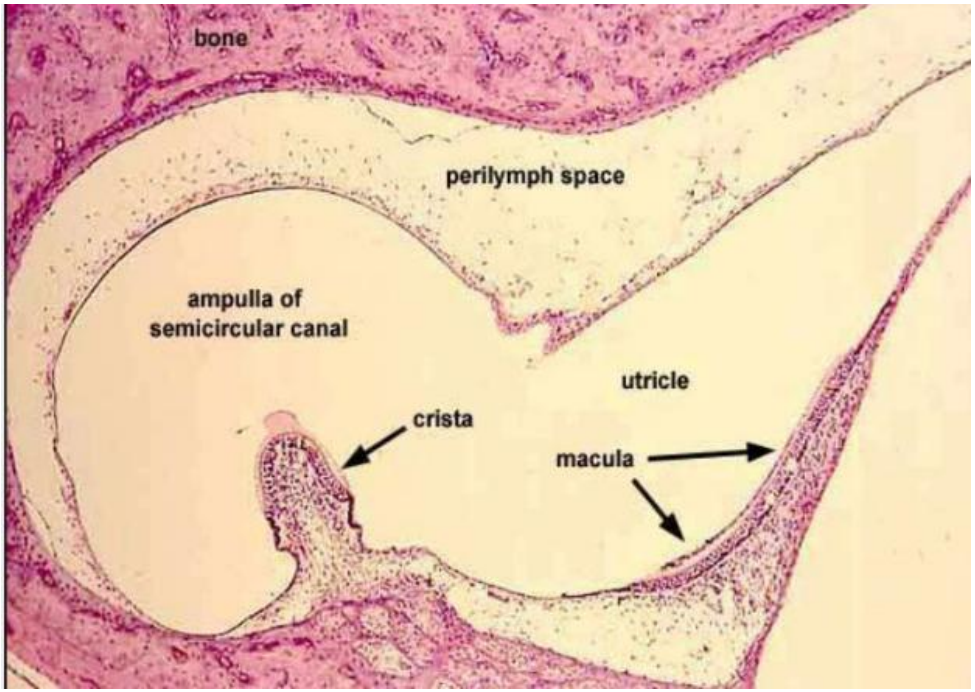
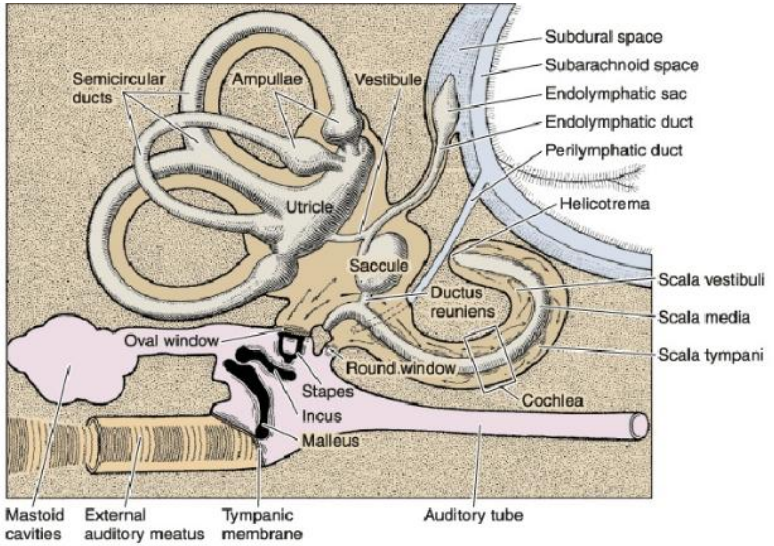
Labirin membranosa

- Dilapisi epitel, berisi **endolimf**
- Nutrisi dari p.d yg masuk melalui jaringan ikat yang menggantung labirin membranosa ke endosteum labirin tulang





Telinga

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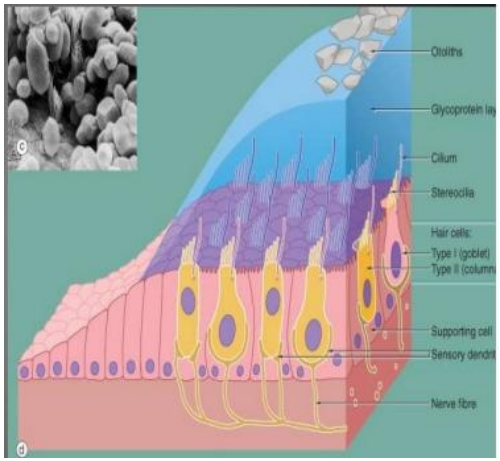
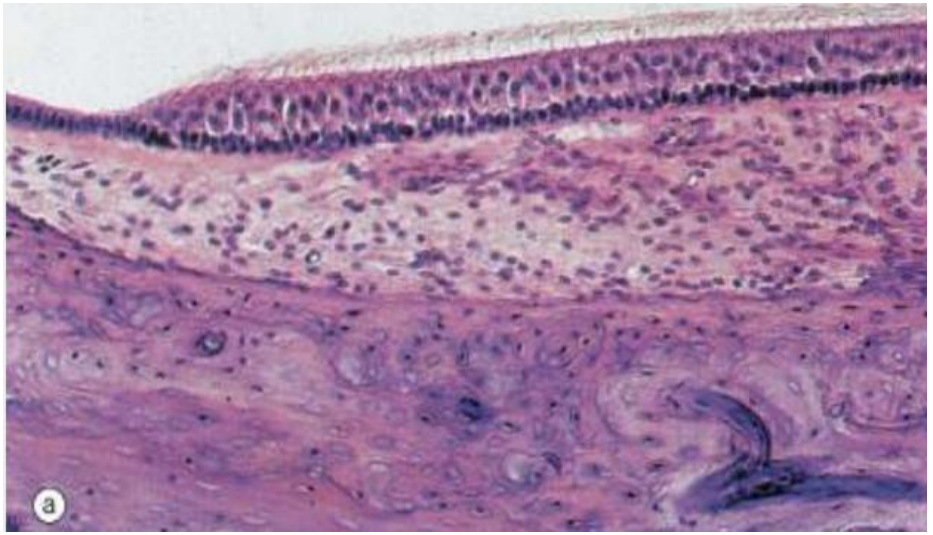
Utrikulus

- Di dalam vestibulum
- **Makula utrikuli**: terletak pada lantai → reseptor sensoris khusus (sel rambut neuroepitel) berfungsi sensasi posisi kepala dan pergerakan/akselerasi linear yg horisontal.



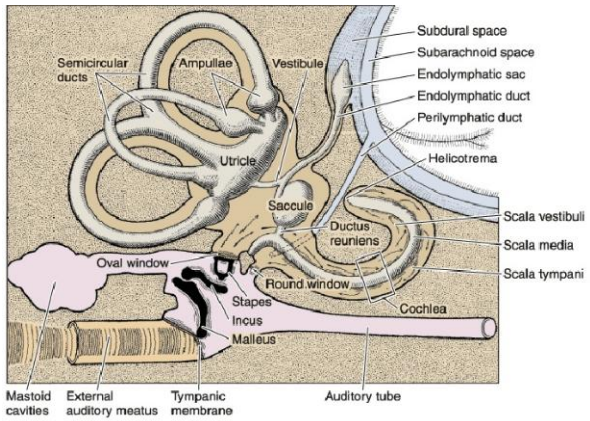


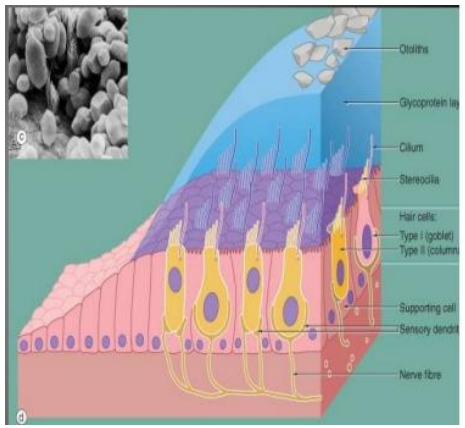
Telinga

UNIVERSITAS TRISAKTI

Sakulus

- Di dalam vestibulum
- **Makula sakuli**: terletak pada dinding → reseptor sensoris khusus (sel rambut neuroepitel) berfungsi mendeteksi percepatan linear yg vertikal





Telinga

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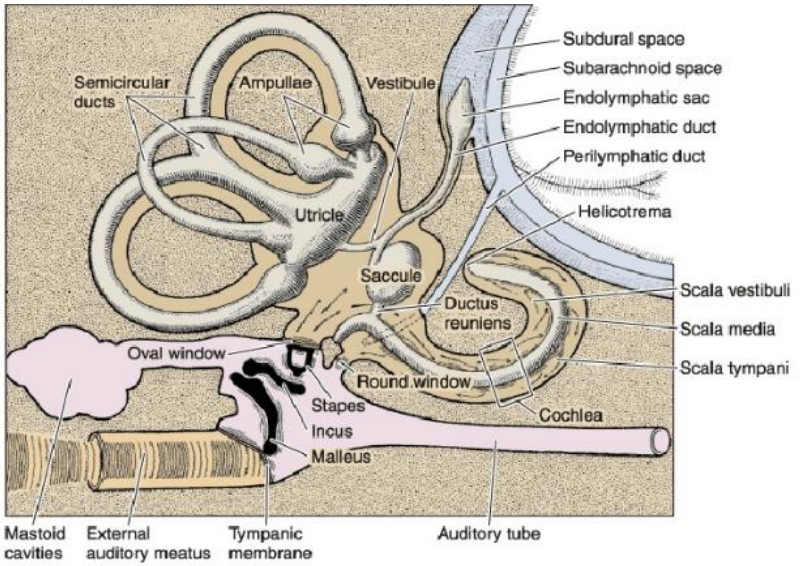
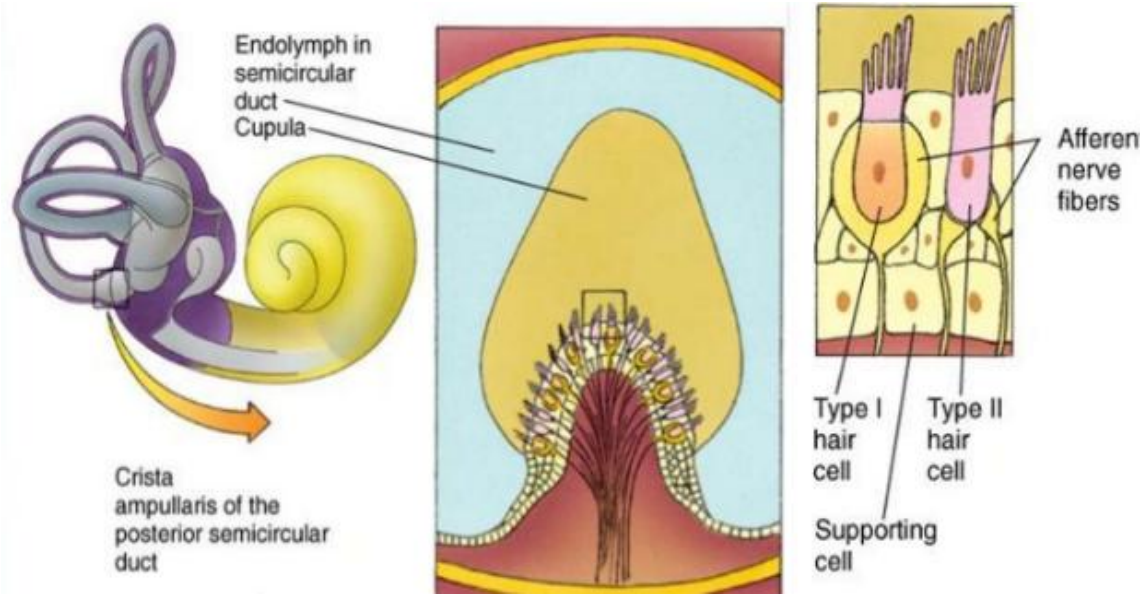
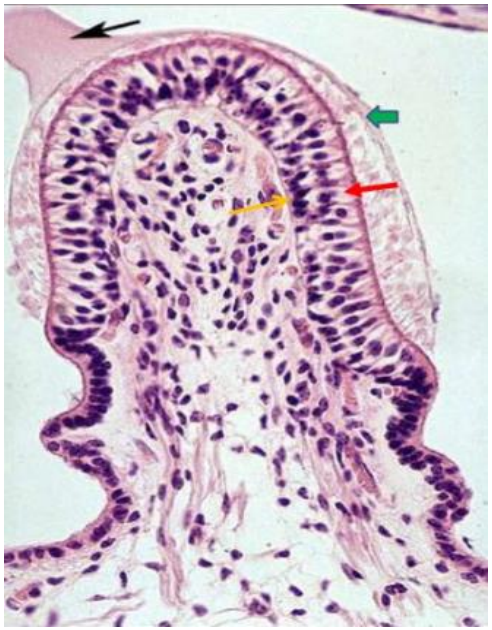
Duktus semisirkularis

- Ujung lateral ketiga duktus melebar: **ampula**, berisi **krista ampularis** (reseptor khusus (sel neuroepitel) berfungsi menerima kesan pergerakan angular/menyudut.







Telinga

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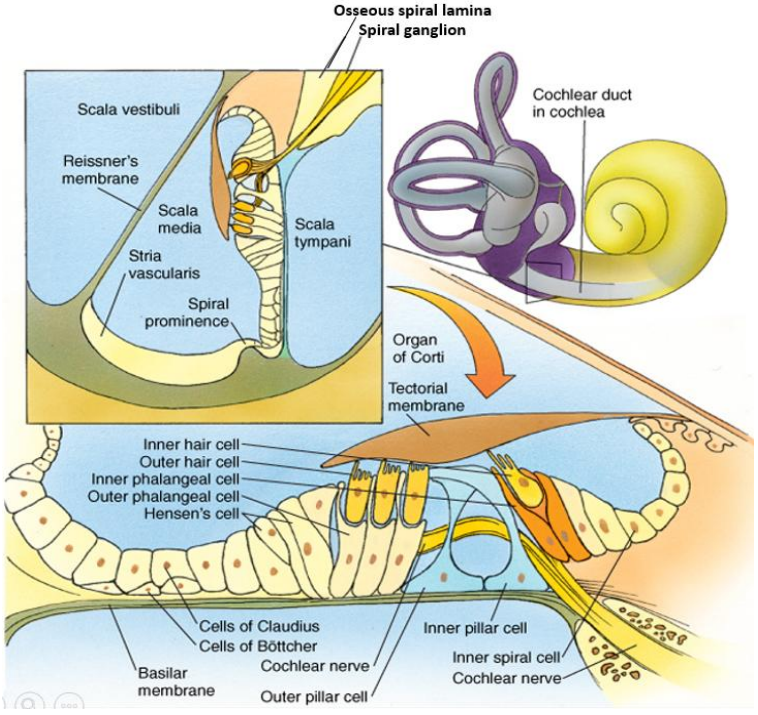
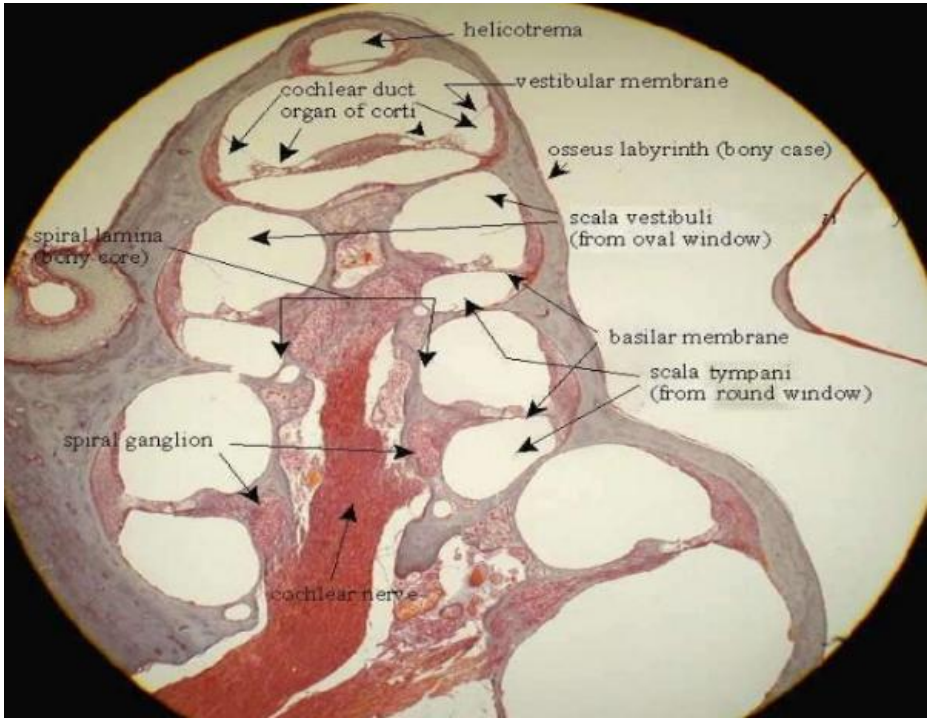
Duktus koklear/skala media

- Organ reseptor berbentuk baji, terletak dalam koklea tulang, berisi endolimf
- Bertanggungjawab untuk mekanisme pendengaran
- Atap skala media: **membran vestibular** (**Reissneri**), lantainya **membran basilar**.
- **Skala vestibuli**: ruang di atas membran vestibular, berisi perilimf
- **Skala timpani**: ruang di bawah membran basilar, berisi perilimf.
- **Helikotrema**: apeks koklea, tempat skala vestibuli dan skala timpani berhubungan.





Telinga

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Membran vestibular (Reissneri)

- Tersusun dari dua lapis epitel gepeng yang saling dipisahkan oleh lamina basalis.

Membran basilar

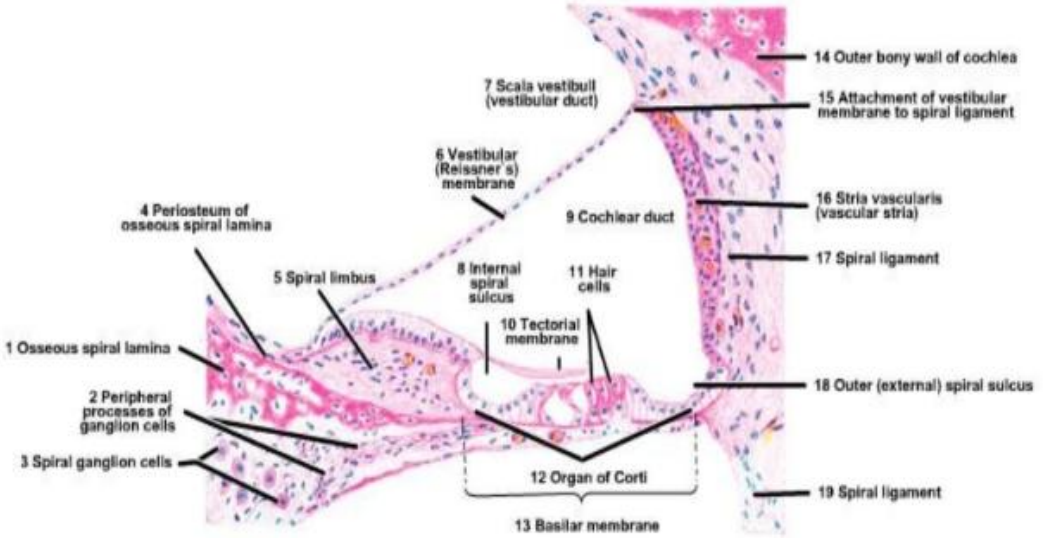
- Membentang dari lamina spiralis modiolus ke dinding lateral.
- Mendukung organ Corti

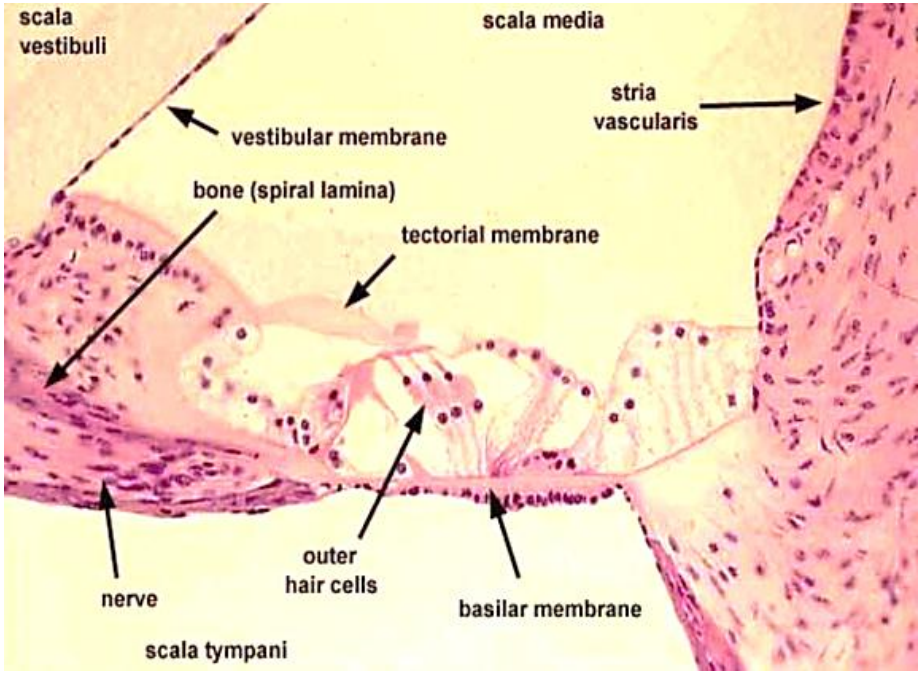
Stria vaskularis

- Epitel bertingkat yang menyusun dinding lateral duktus koklear, membentang antara membran vestibular dan prominensia spiralis.
- **Pleksus kapiler intraepitel**.

Membran tektoria

- Massa gelatinosa, kaya proteoglikan, menutup di atas organ Corti.





Telinga

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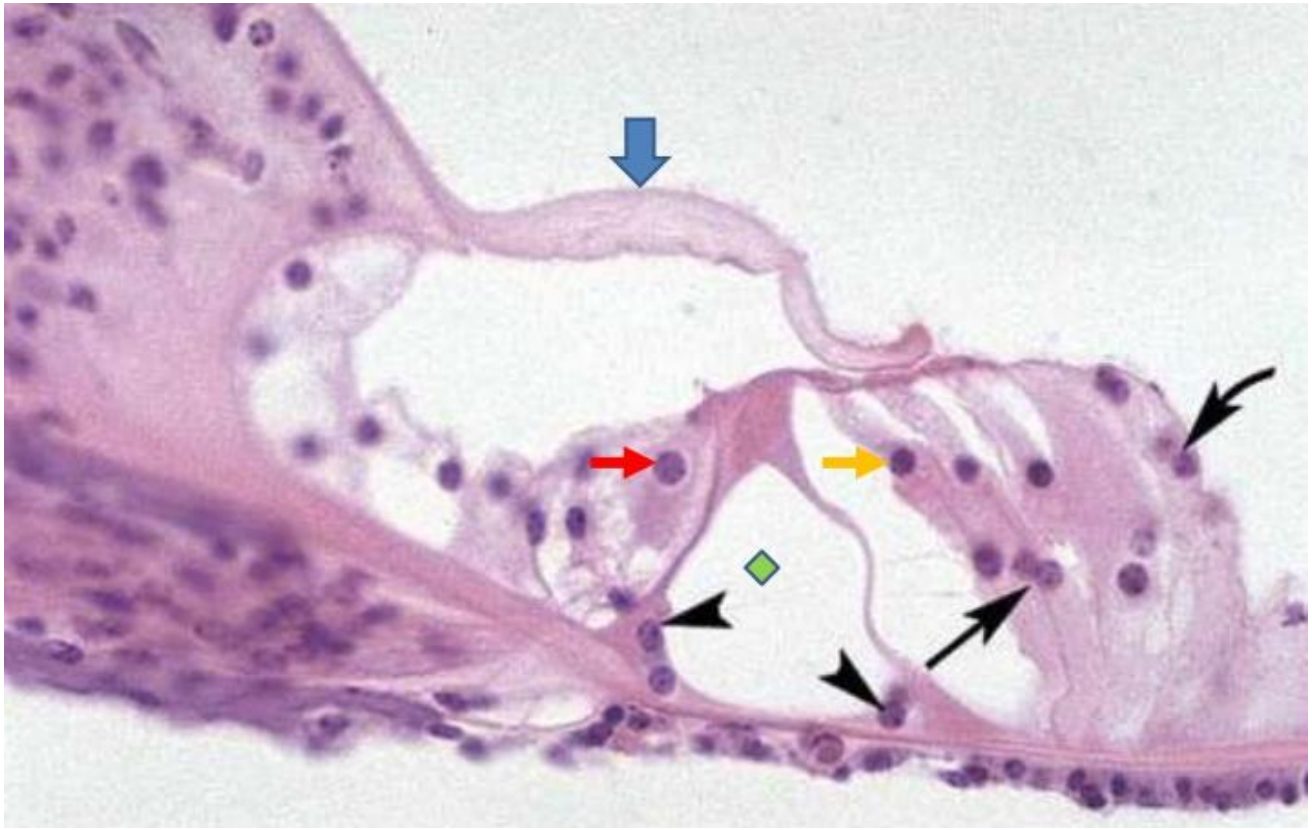
Organ Corti

- Organ reseptor khusus untuk pendengaran.
- Tersusun dari sel rambut neuroepitel dan sel penyokong.



Mata panah (kiri) – sel tiang dalam
Panah hitam – sel falang luar
Panah merah – sel rambut dalam
Panah melengkung – sel Hansen

Mata panah (kanan) – sel tiang luar
Panah biru – membran tektoria
Panah kuning – sel rambut luar
Kotak hijau – terowongan dalam

Telinga

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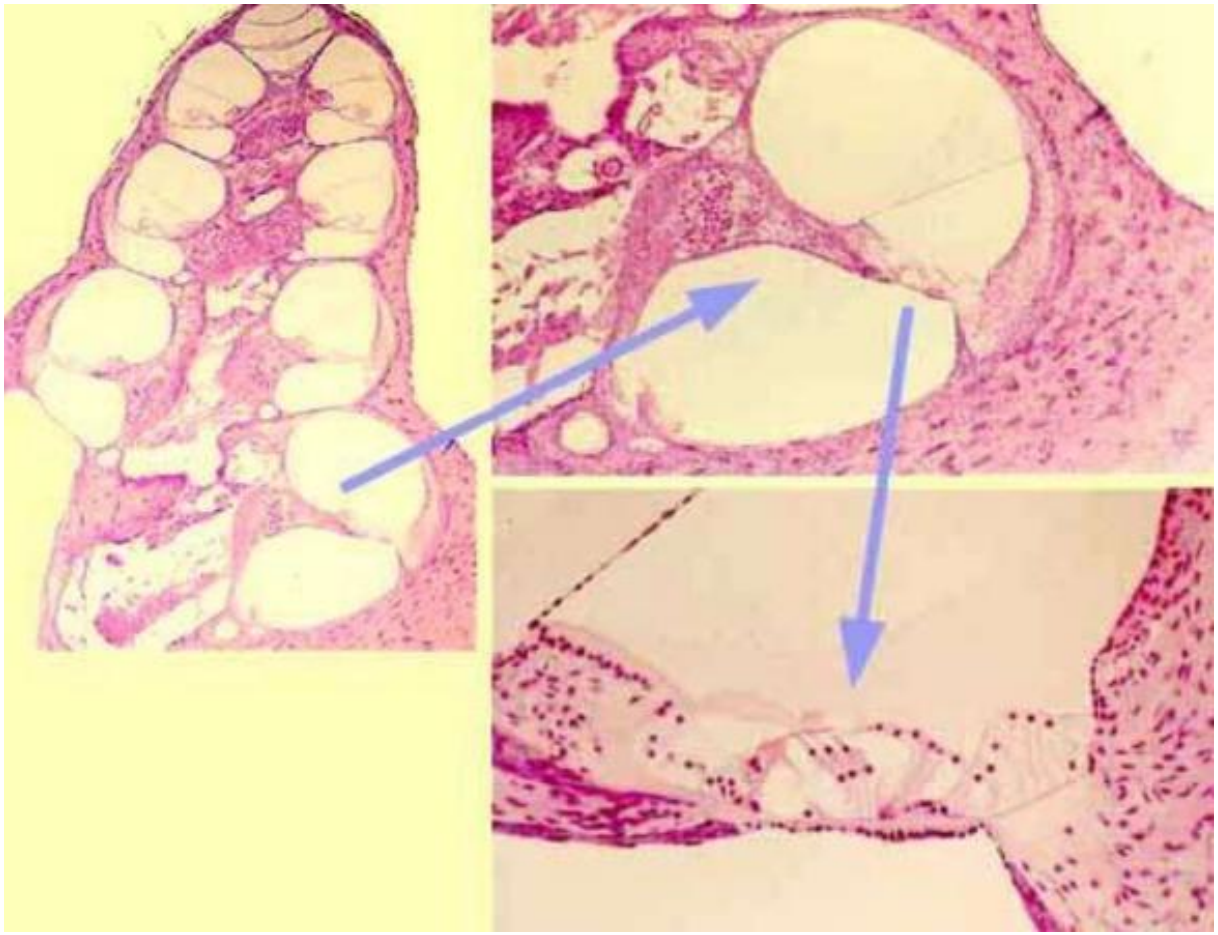

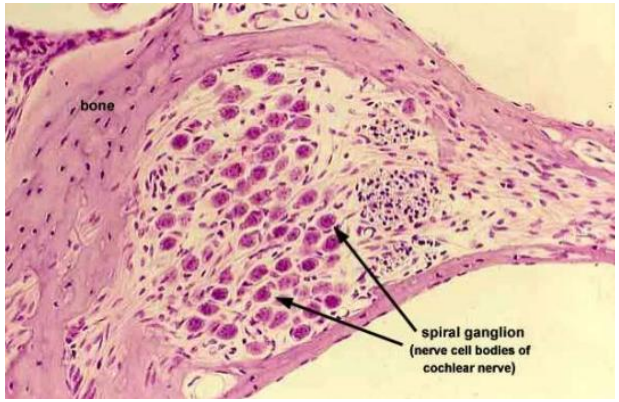

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Link video pembelajaran:

https://bit.ly/Saraf_Histologi

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Selamat belajar, semoga sukses.