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Sense organs : Sylabus for foreign students

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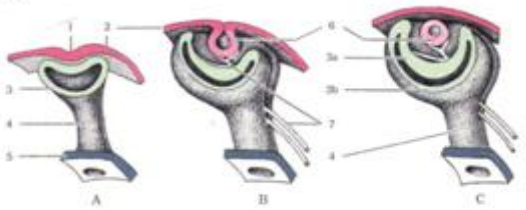
Development of the eye

1.Lens placod – ectoderm of lateral part of prosencephalon - lens vesicle

2. Optic vesicle - cup – neuroectoderm of proencephalon, connecting stalk
inner layer - pars optica retinae – 10 layers
outer layer - pigment epithelium



3. Mesenchyme – gives rise to connective tissue derivatives

Layers of the eye – three concentric layers

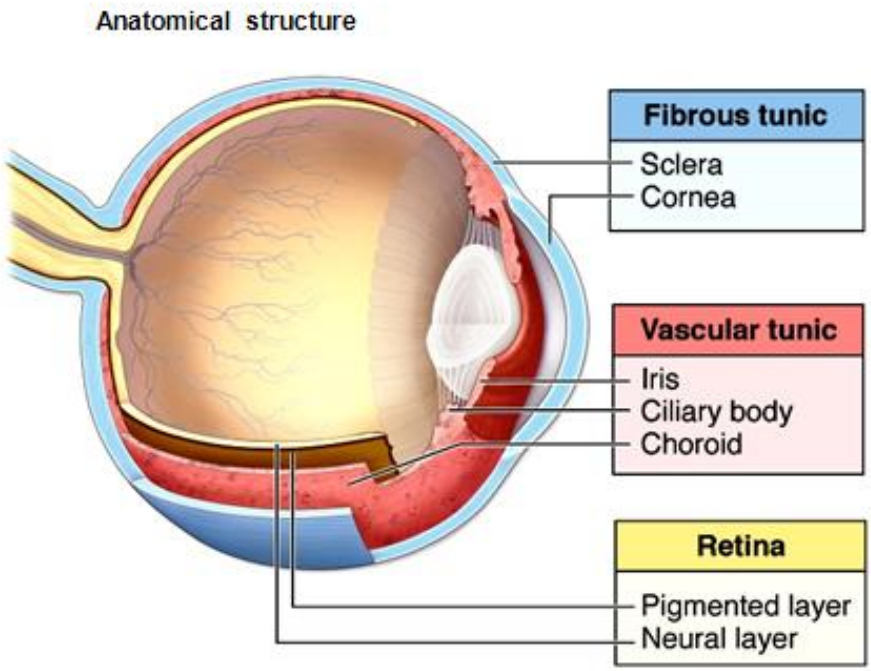
a. **Tunica fibrosa bulbi → connective tissue – Tennon´ s capsule**
   - **sclera**
   - **cornea**

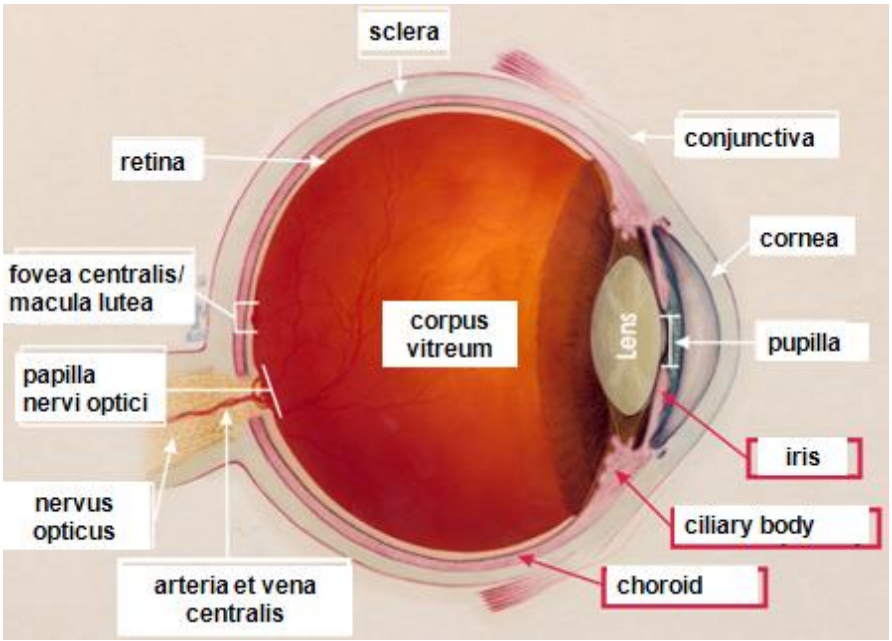
b. **Tunica vasculosa bulbi → vascular layer**
   - **choroid**
   - **ciliary body**
   - **iris**

c. **Tunica nervosa bulbi –retina**
   optical part
   blind part
   - **macula lutea with fovea centralis → maximal visual acuity**
   - **papilla nervi optici or optic disc →blind part**

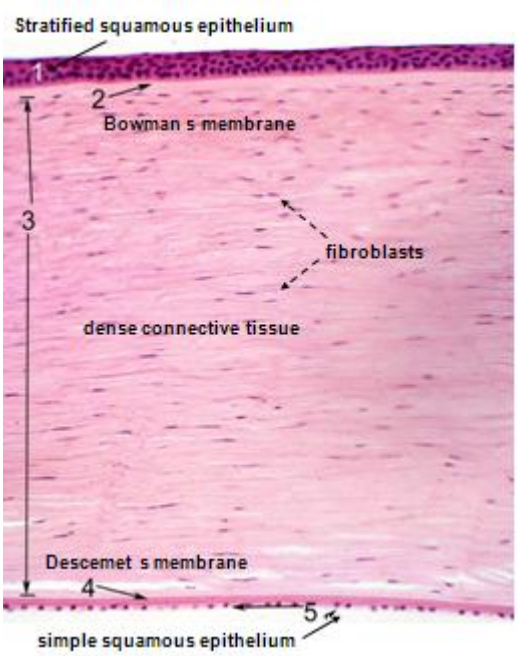
Refractive structures:
cornea, humor aquaeus, lens, corpus vitreum

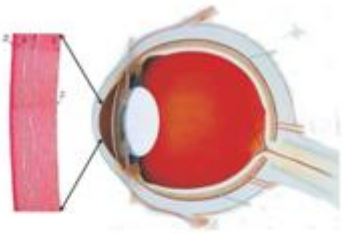
Accesory structures of the eye:
a. musculi bulbi
b. eyelids - palpebrae oculi
c. conjunctiva
d. lacrimal apparatus





1. **External fibrous layer - cornea**

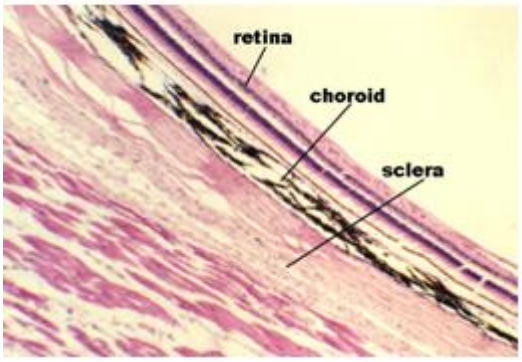




colorless, without blood vessels
many nerve endings
good regeneration
5 layers

1- anterior epithelium
2- Bowman s membrane
3- stroma
4- Descemet s membrane
5- posterior epithelium- endothelium

sclera



- dense connective tissue
- a few fibroblasts
- thin bundles of collagen fibres
- almost without blood vessels
- capsula Tenoni et spatium Tenoni

2. Middle, vascular layer - tunica vasculosa:

- Choroid
- Ciliary body
- Iris

Choroid is a thin, vascularized, and pigmented layer

Composition:

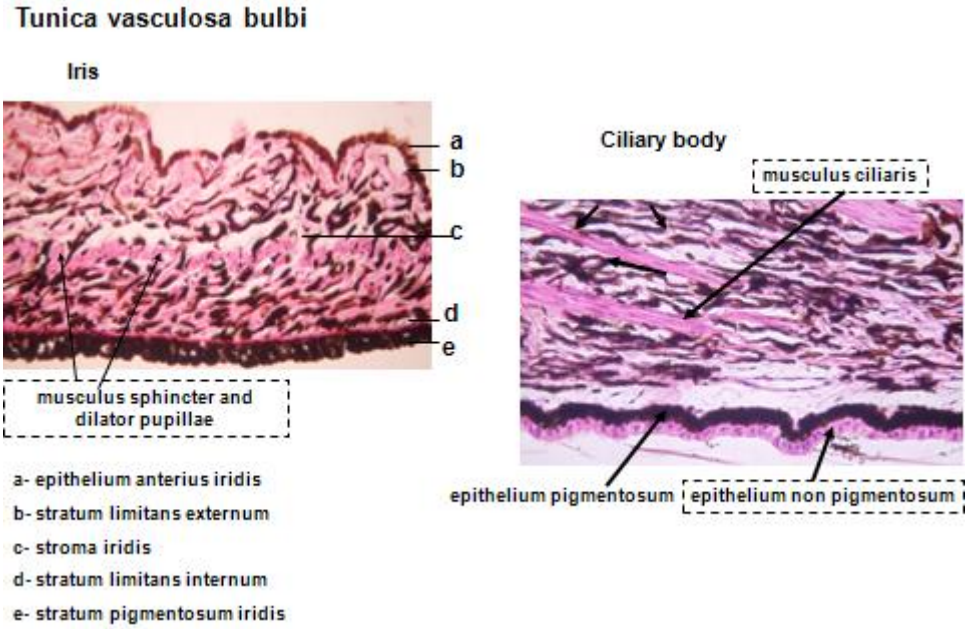
1. **Lamina suprachoroidea**
2. **Lamina vasculosa - substantia propria**
3. **Lamina choroidocapillaris**
4. **Lamina basalis (seu vitrea) – Bruch´s membrane**

Ciliary body

continuation of choroid

Composition:

- **musculus ciliaris:** ○ **fibrae meridionales**
  ○ **fibrae radiales**
  ○ **fibrae circulares**
- **proccessus ciliares – loose connective tissue**
- **pars ciliaris retinae - epithelium pigmentosum**
  - epithelium non pigmentosum



Iris

Is a circular plate – continuation of ciliary body

in the middle a round opening- pupil

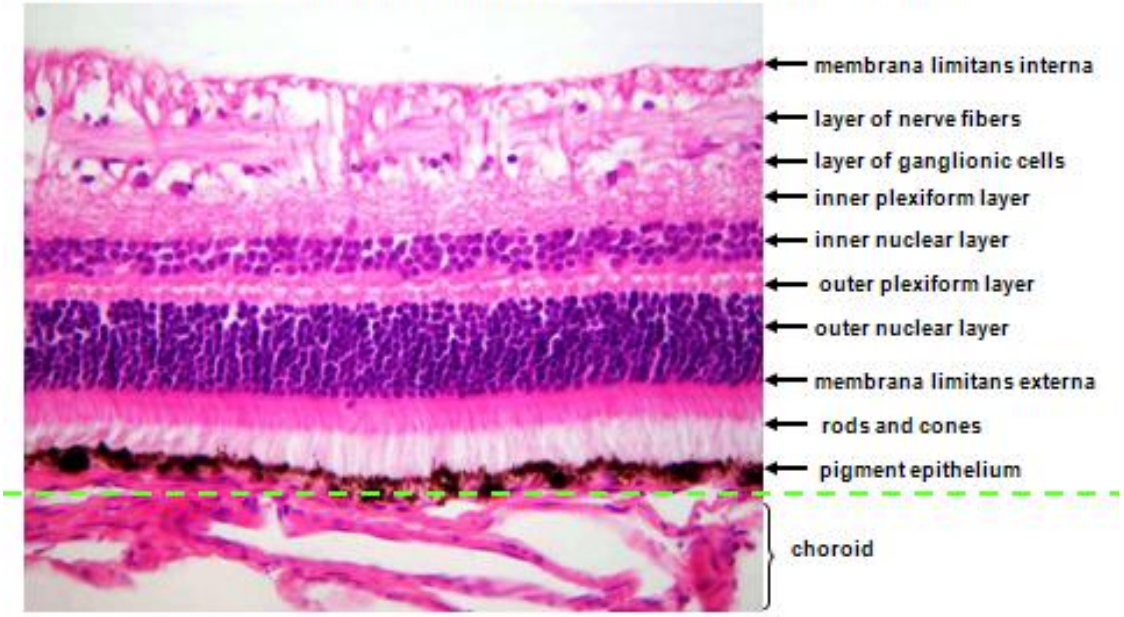
Composition - 5 layers:

1. **epithelium anterius iridis**
2. **stratum limitans externum**
3. **stroma iridis- muscles + CT**
4. **stratum limitans internum**
5. **stratum pigmentosum iridis**

3.Tunica nervosa bulbi - retina

most inner layer

- composed of 2 parts→ optical and blind part
- pars optica retinae → pigment epithelium + nervous layer of retina - 10 layers



(1) – Membrana limitans interna- end parts of Müller cell processes, limited by lamina basalis

(2) – Layer of nerve fibers- a layer of parallel axons of ganglionic cells

(3) – Layer of ganglionic cells

(4) – Inner plexiform layer

- synapses between axons of bipolar cells and dendrites of multipolar ganglionic cells

(5) – Inner nuclear layer

- cell bodies and nuclei of bipolar, amacrine and Müller cells

(6) – Outer plexiform layer

- synapses between cones and rodes and dendrites of bipolar cells

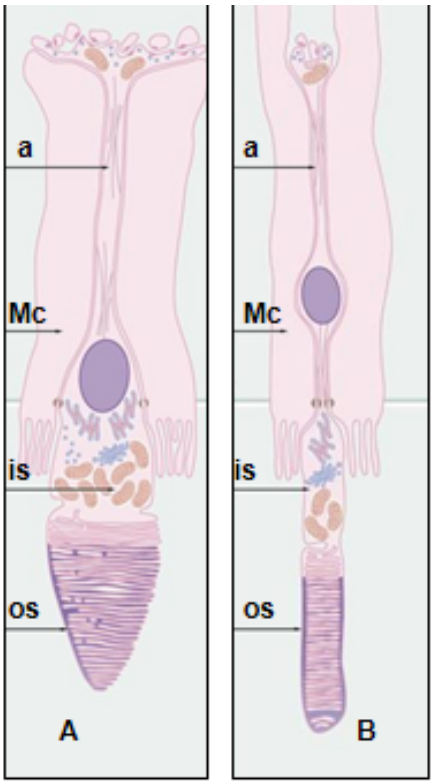
(7) – Outer nuclear layer- cell bodies with nuclei of cones and rods

(8) – Membrana limitans externa- processes of supporting Müller cells

(9) – Cones and rods- peripheral segments of photosensitive cells

(10) – Pigment epithelium- a layer of cuboidal cells, cytoplasmic processes contain pigment – melanin

Cones and rods



A – Cone cells

- fotopigment - iodopsin

3 types of cones sensitive for red, green, and blue color

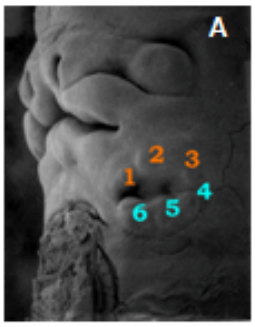
B – Rod cells

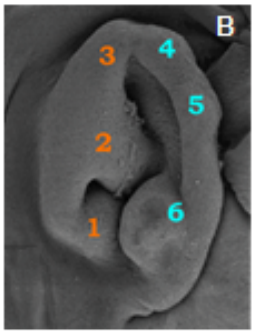
- fotopigment - rhodopsin
- sharp black and white vision

a – axon, Mc – Müller cell, is – inner segment, os – outer segment

The ear – vestibulo–cochlear apparatus

Development of the ear





4 week

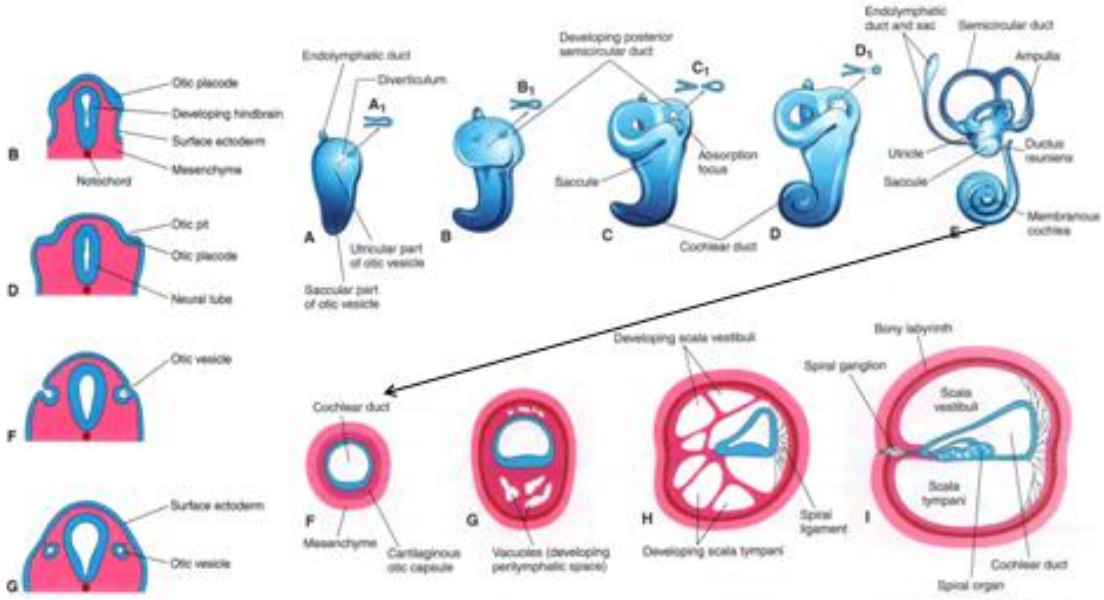
- The ear gives rise from:

1. otic (ear) ectodermal placode on lateral part of developing rhombencephalon and neuroectoderm of neural crest → together form internal ear - labyrinthus membranaceus

   from otic placode → otic pit → otic vesicle
2. bony labyrint → mesenchyme of temporal bone
3. tympanic cavity → endodermal origin of 1. pharyngeal pouch
4. auditory ossicles → mesenchymal origin – cartilages of 1.and 2. branchial arches
5. meatus acusticus externus → ectoderm of 1. branchial groove
6. auricle gives rise from 6 swellings of mesenchyme around the 1. branchial groove and is covered by ectoderm

Development of otic vesicle

1. Dorsal part - 3 semicircular ducts
2. Central part - utricle, saccule
3. Ventral part – cochlear duct



The ear is composed of:

A. Auris externa – external ear

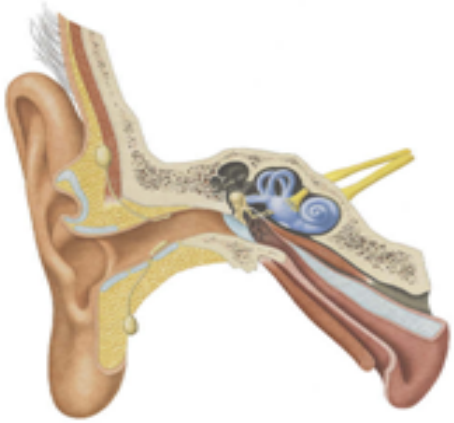
auricle
meatus acusticus externus
membrana tympany

B. Auris media- middle ear

cavum tympany
ossicula auditus → malleus, incus, stapes
tuba auditiva

C. Auris interna – internal ear

labyrinthus osseus
labyrinthus membranaceus

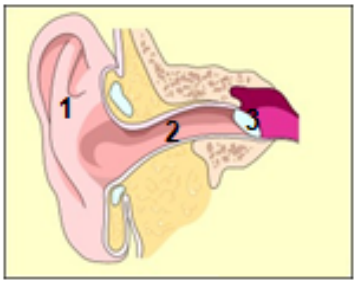


► bony labyrinth
- vestibulum
- canales semicirculares
- cochlea

► membranous labyrinth
- utricle and saccule
- ductuli semicirculares

= ductus cochlearis

A – External ear - auris externa

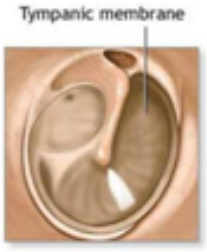


- Auricle - auricula, pinna
  - a plate of elastic cartilage
  - skin → many sebaceous glands – ceruminous

- External auditory meatus
  - a canal → elastic cartilage
    → - bone
  - covered by skin - glandulae ceruminosae, hairs

- Tympanic membrane
  - thin membrane, outside covered by skin = stratified squamous keratinized epithelium
  - inside = mucosa of tympanic cavity covered by simple cuboidal epithelium
  - between – loose connective tissue

Tympanic membrane transmits sound vibrations to the ossicles of middl ear.

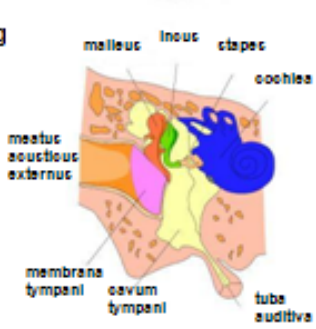


B – Middle ear - auris media

- Tympanic cavity
  - irregular space in the temporal bone filled with air and lined by simple squamous or cuboidal epithelium

- Auditory ossicles
  - malleus, incus, stapes, small bones covered by simple squamous epithelium

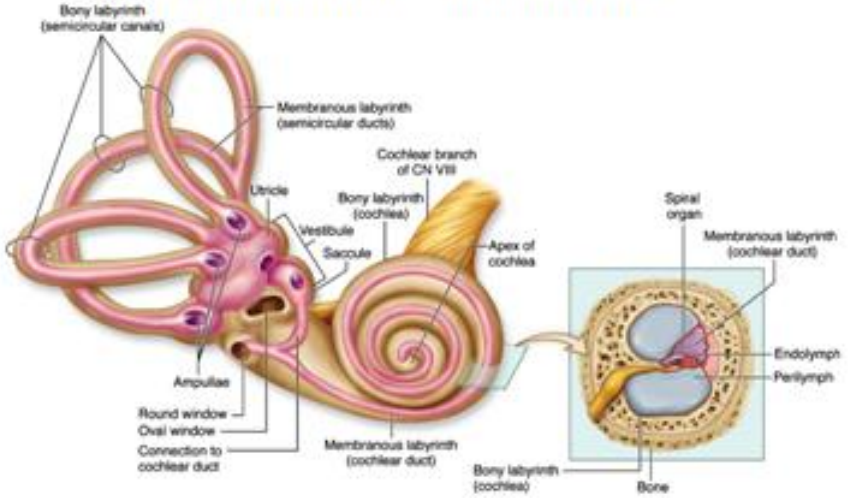
- Eustachian tube- tuba auditiva
  - communication between tympanic cavity and pharynx
  - the tube opens during the process of swallowing, balancing middle ear with atmospheric pressure
  - cartilage + bone covered by pseudostratified columnar epithelium



3. Internal ear - auris interna

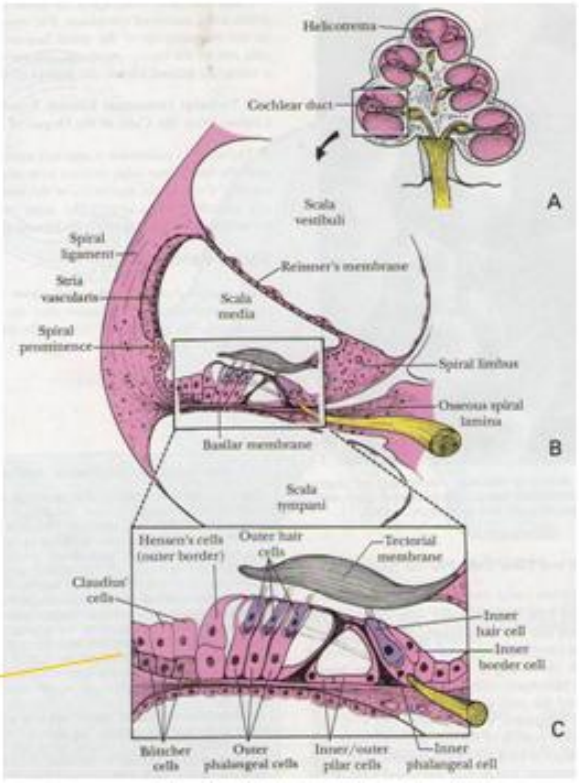
- bony labyrinth - labyrinthus osseus
  - vestibulum, canales semicirculares, cochlea
- membranous labyrint - labyrinthus membranaceus

Composition : a) equilibrium - pars statica → utricle
saccule
3 semicircular canals -anter., post. et lateral
b) hearing - pars auditiva → ductus cochlearis



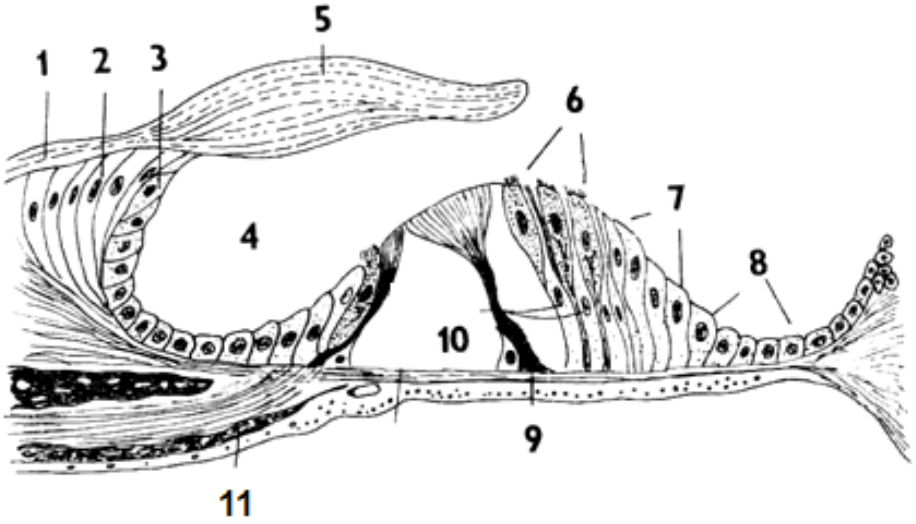
Internal ear- cochlea

2 ¾ turns of the bony cochlea



Organ of Corti

1.labium vestibulare limbi spiralis 2.epith.of limbus 3.epith.of sulcus spiralis int. 4. sulcus spiralis int..



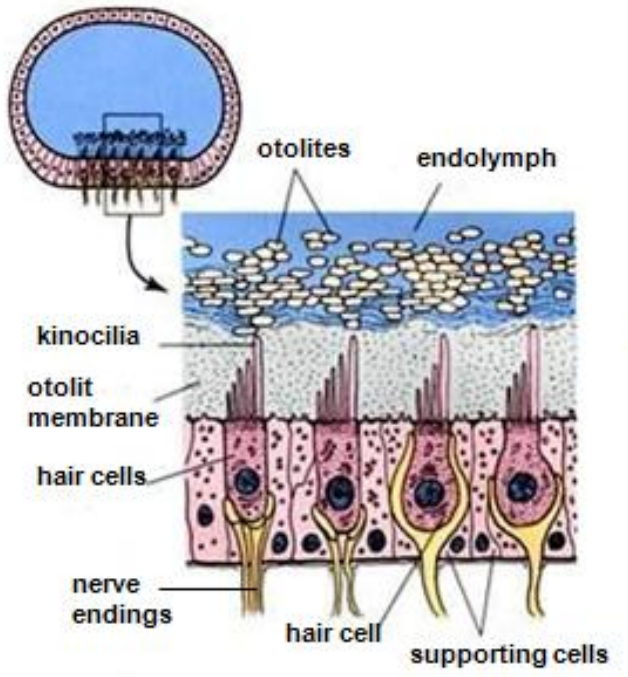
5.tectorial membrane 6. outer hair cells 7.Hensen cells 8.Claudius cells 9.basilar membrane 10. tunel of Corti 11. nerv fibers

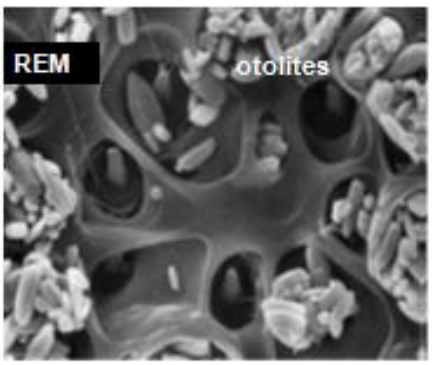
Vestibular apparatus - equilibrium

- **proprioreceptors are concentrated in :**
  - **a) macula sacculi et utriculi – identical histologic structure**
    - **ovoid plates of sensory epithelium inervated by branches of vestibular nerve, situated in the wall of saccule and utricle**
    - **contain proprioreceptors (hair cells) and supporting cells**
    - **there is a gelatinous glycoprotein layer on the surface + otolites = crystals of CaCO3**
  - **b) in semicircular ducts are cristae amplullares**
    - **receptors form ridge-like structures – cristae**
    - **histologic structure is similar to maculae**
    - **glycoprotein layer is thicker and is not covered by otoliths, is conical in shape - cupula**

Function in head movement → change in movement of endolymph → otolites movement → movement of glycoprotein layer with the processes of hair cells → stimulation of nerve endings around hair cells

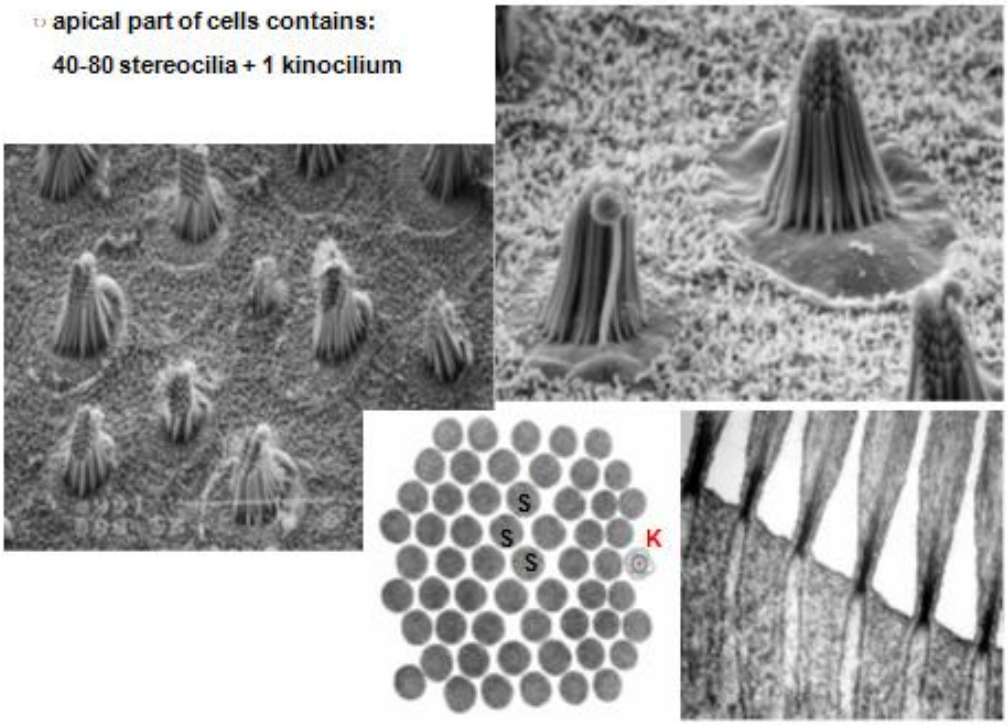
Macula sacculi et macula utriculi





Hair cells of macula sacculi et utriculi

- apical part of cells contains:
  40-80 stereocilia + 1 kinocilium



Cristae ampullares