

Organs of special sense

“5 Special Senses”

Smell

Olfactory epithelium of nasal cavity

Taste

Taste buds

Hearing

Ear

Equilibrium

Ear

Sight

Eye

Touch

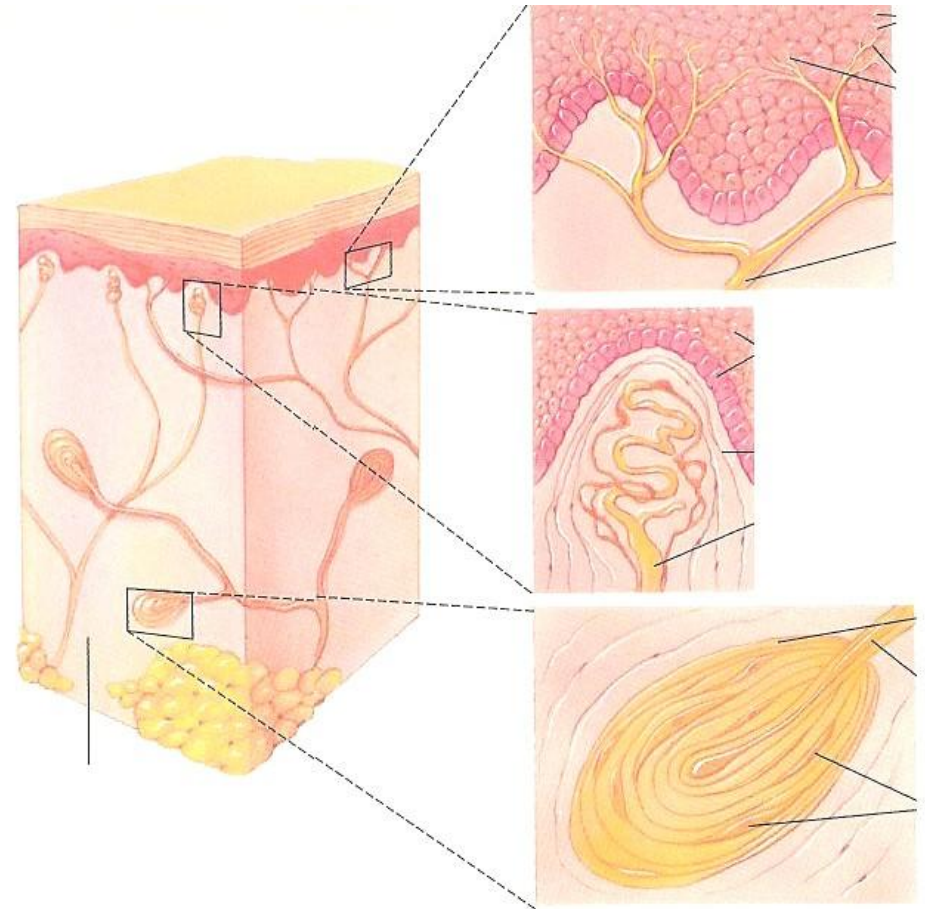
Sensory endings

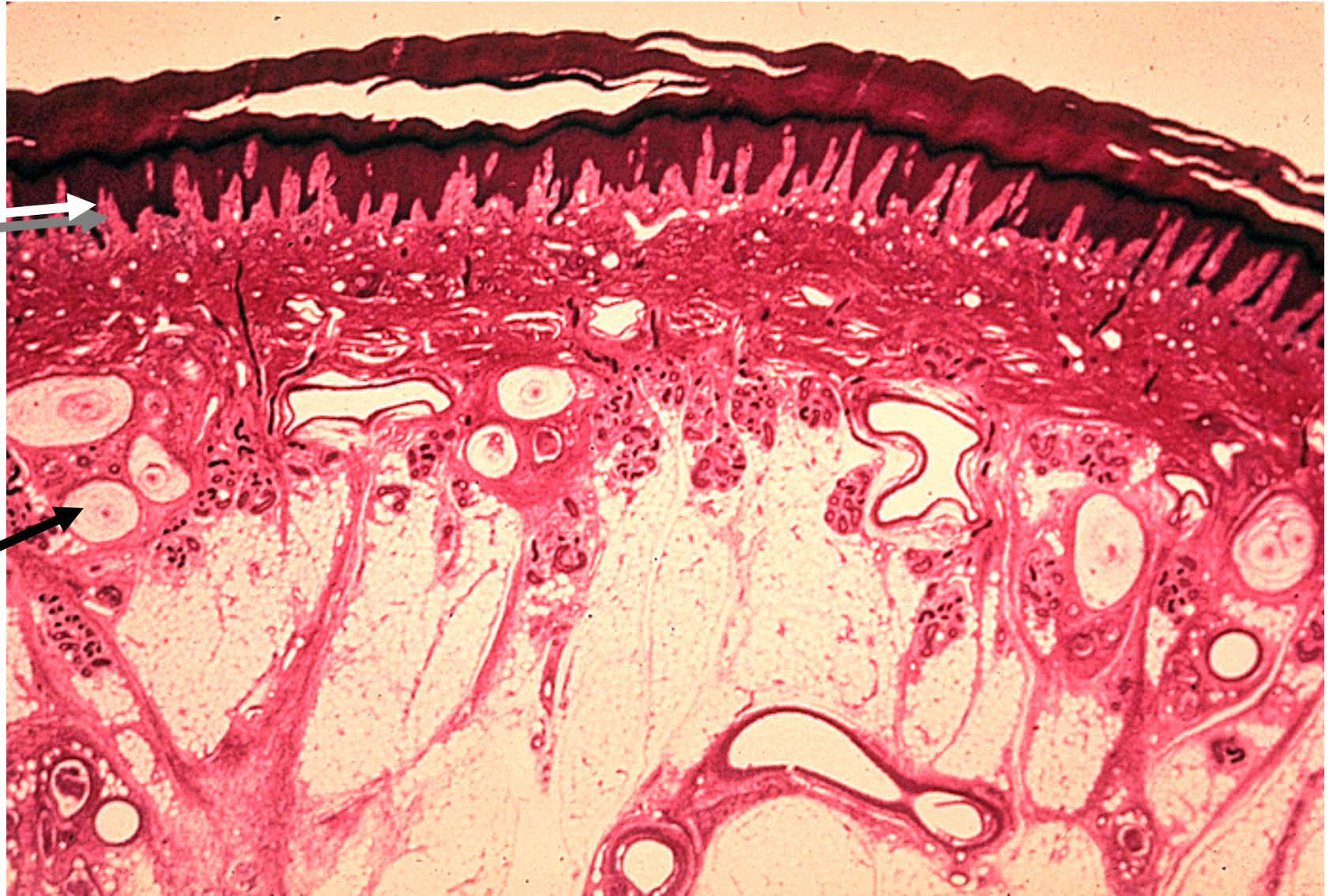
1) Pacinian corpuscle

Deep pressure

2) Meissner's corpuscle

Light, superficial pressure





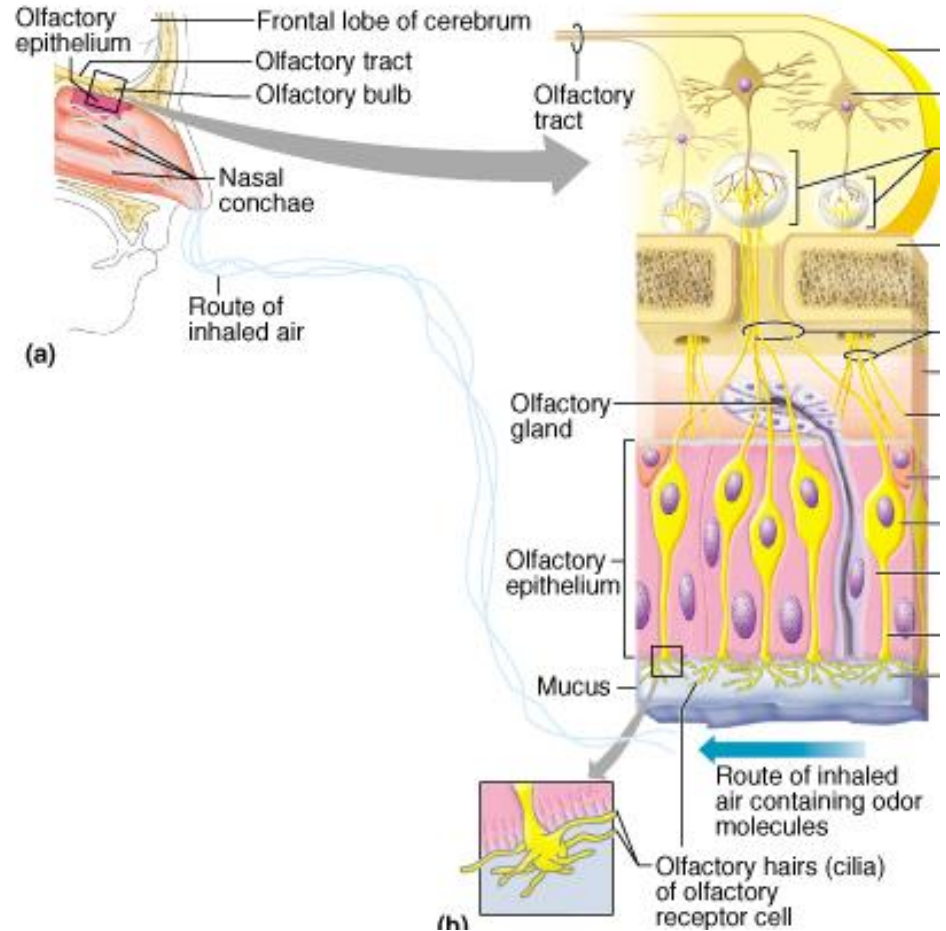
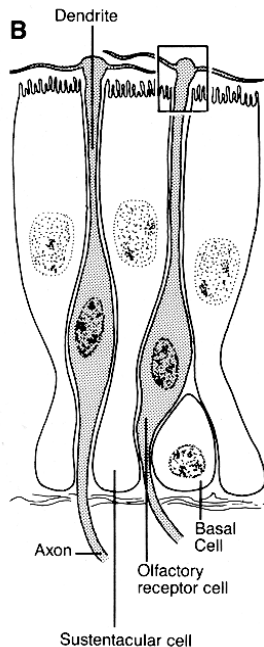
Smell

Olfactory epithelium

Specialized pseudostratified epithelium

Contains sensory cells for olfaction

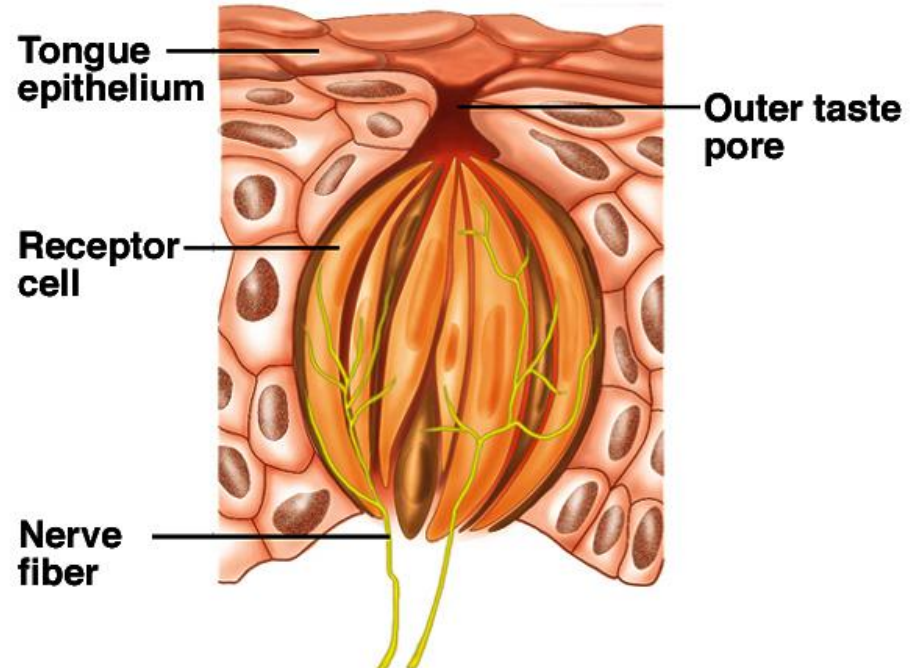
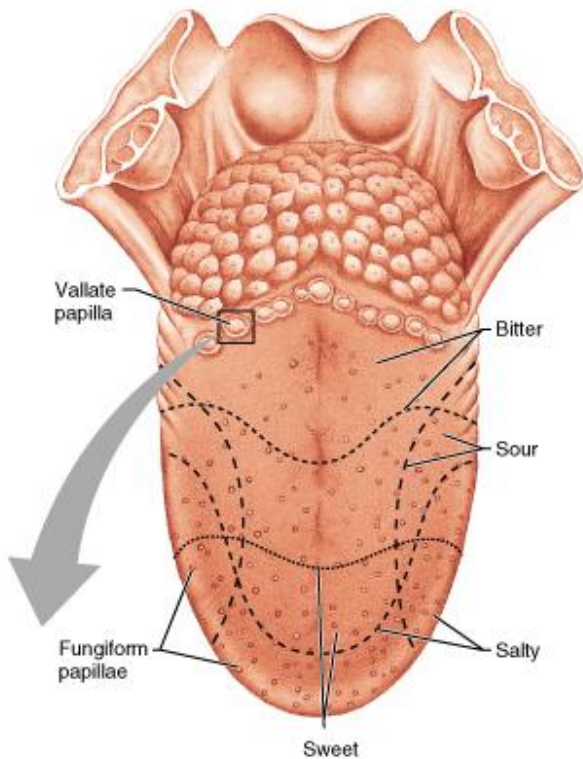
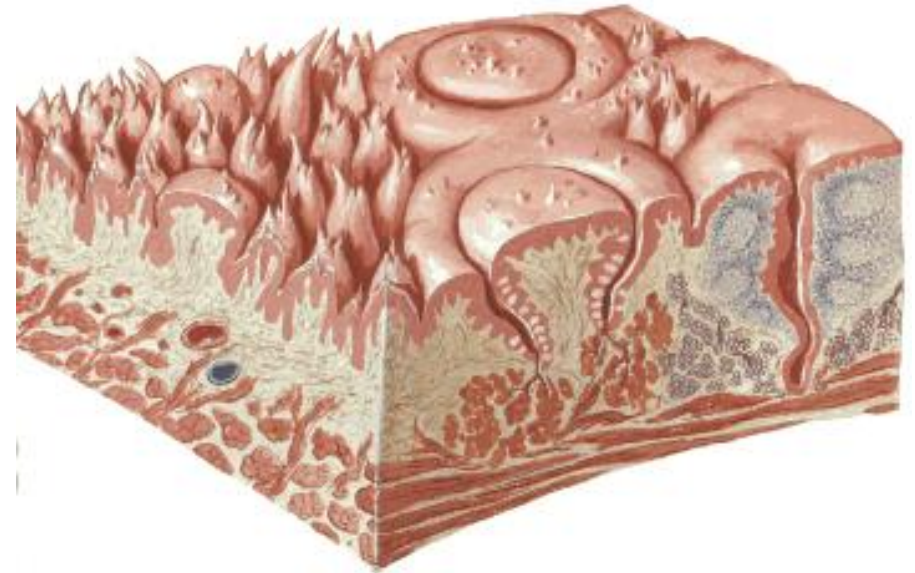
In roof of nasal cavities

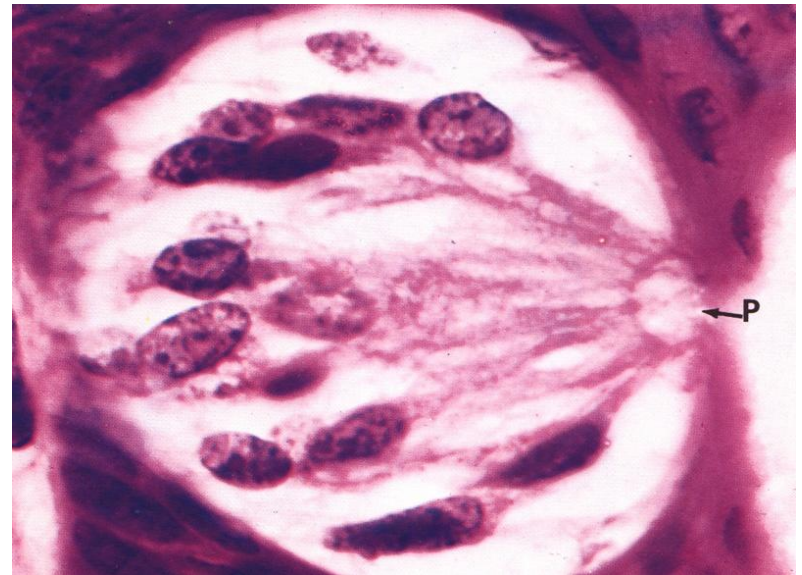
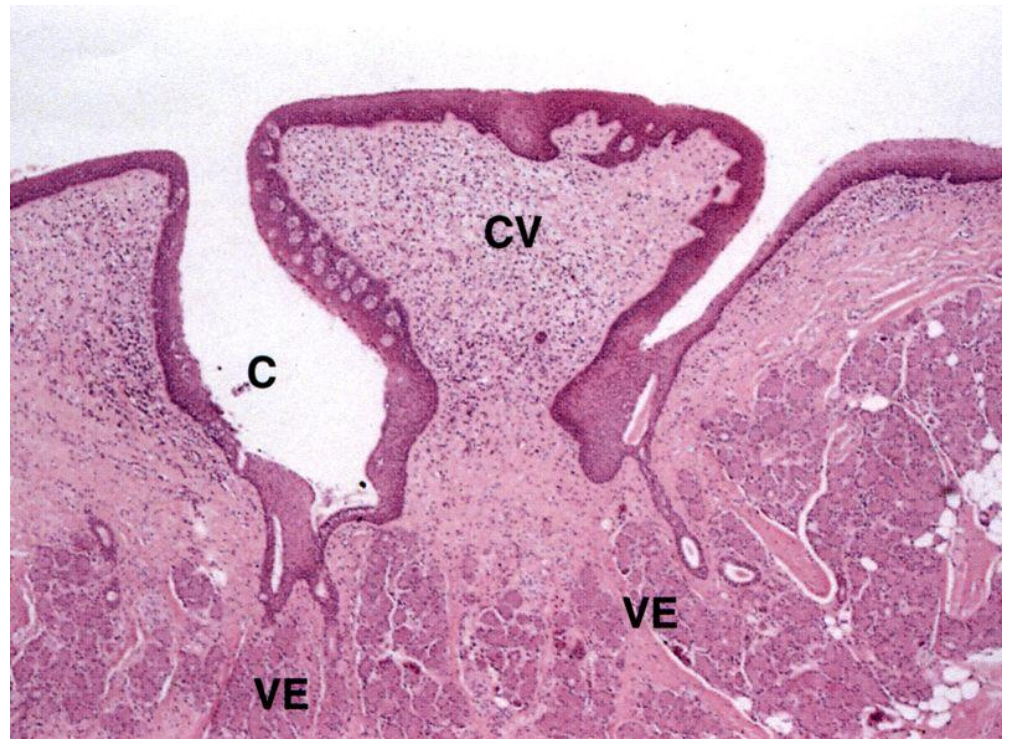


Taste

Taste buds

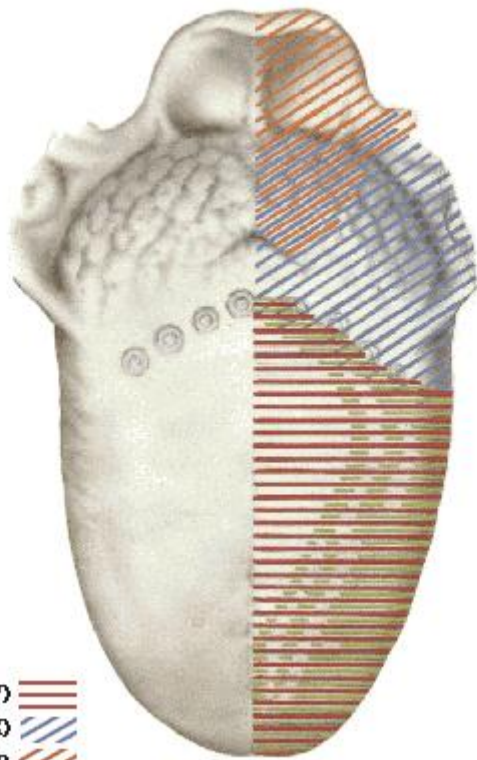
Epithelial structures within stratified epithelium lining dorsum of tongue







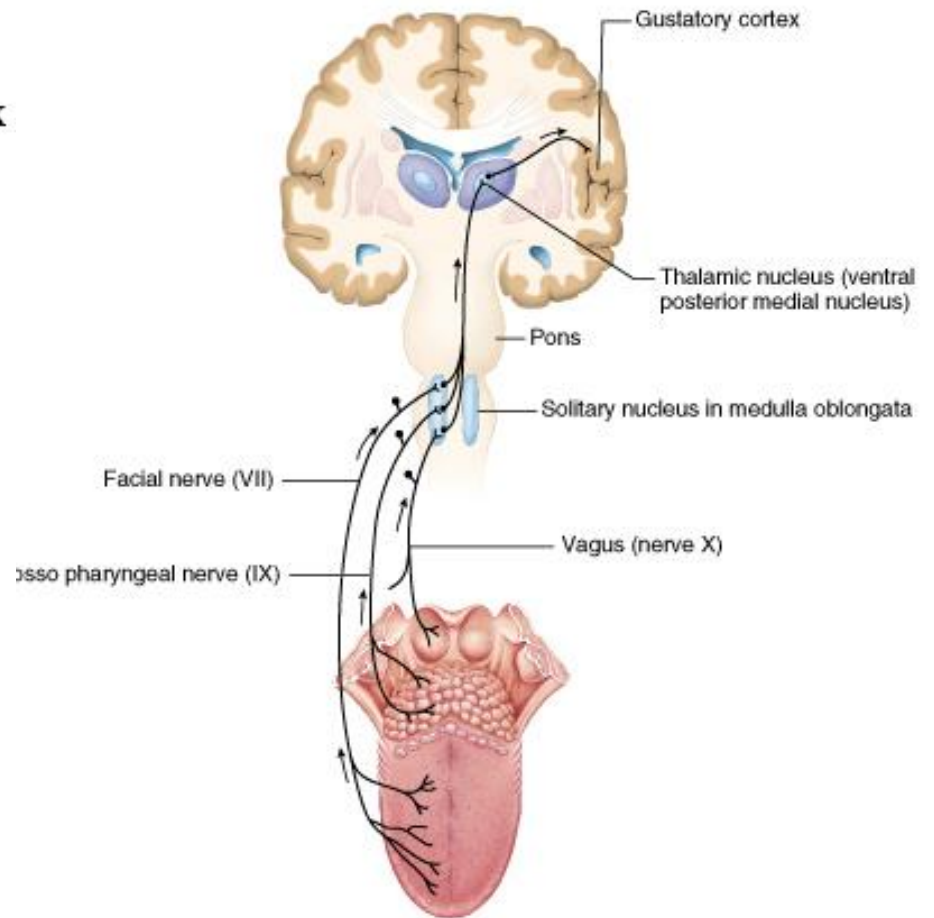


Afferent Innervation of Mouth and Pharynx

Dorsum of Tongue



- Trigeminal nerve (V) 
- Glossopharyngeal nerve (IX) 
- Vagus nerve (X) 
- Facial nerve (VII) 



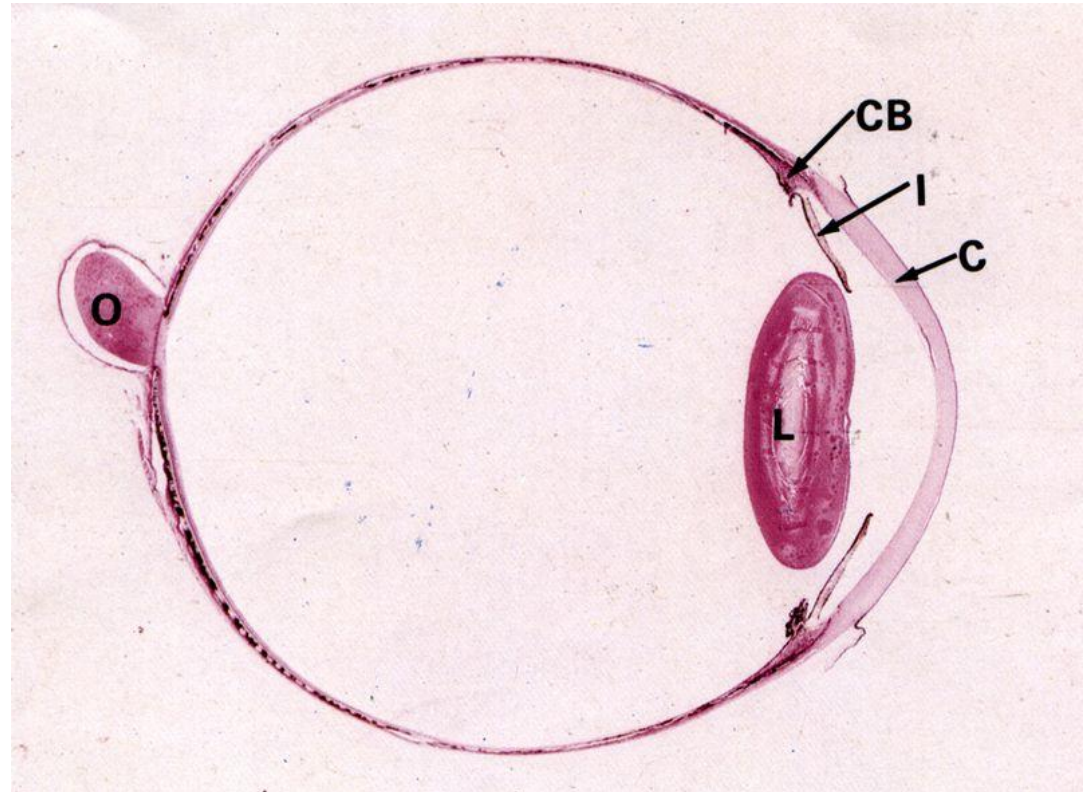
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Eye

Eyeball

Retina

Extrinsic muscles



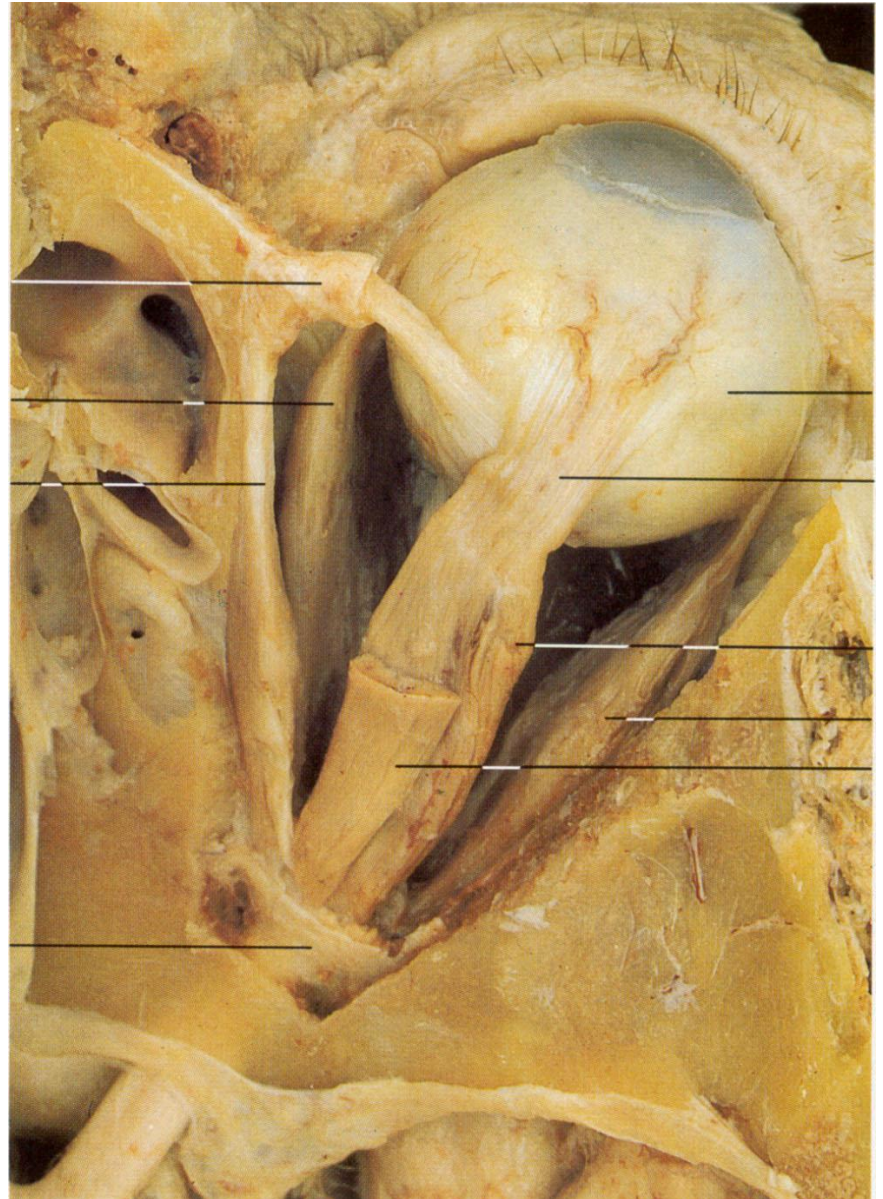
Lacrimal apparatus

Eye

Eyeball

Sphere - 2 ½ cm.
Diameter

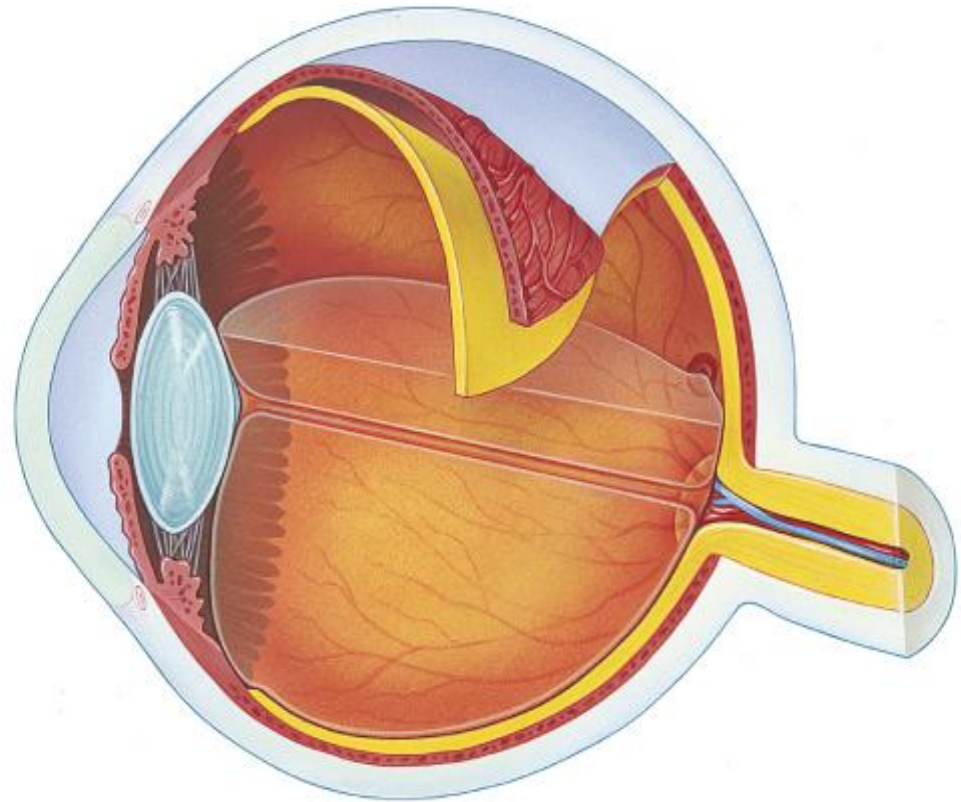
Embedded in fascia and
fat of the orbital fossa



Anterior Segment: Anterior and Posterior Chambers

Posterior Segment: Vitreous body

Lens



(a)

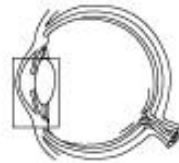
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Anterior and Posterior Chambers

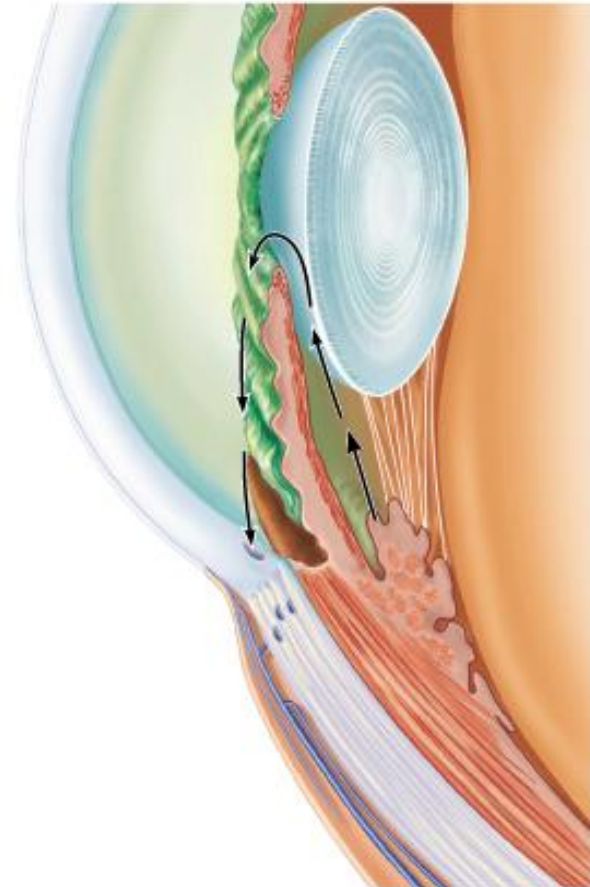
chambers named relative to iris

Filled with **aqueous humor**

Dilute, alkaline solution



ANTERIOR



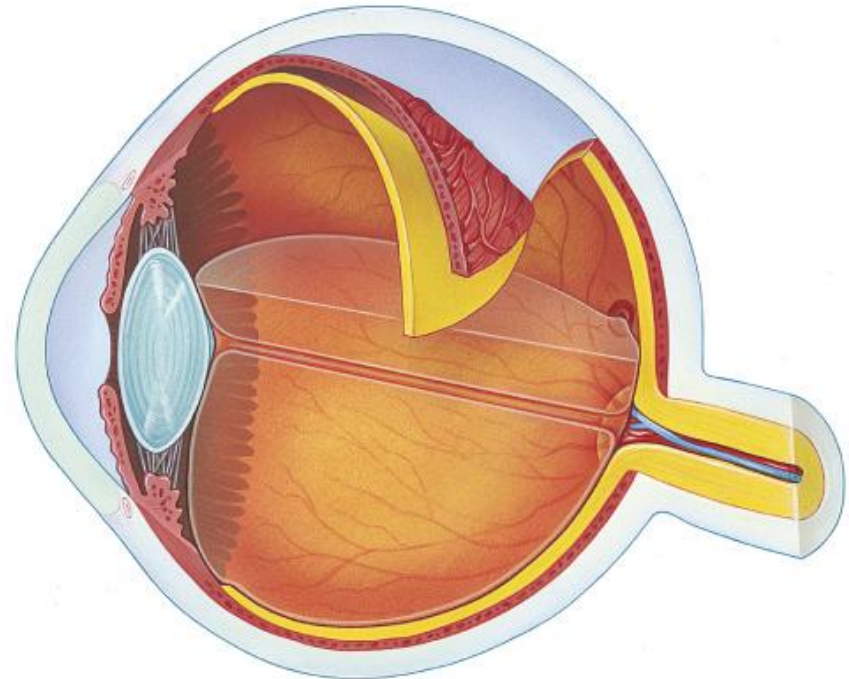
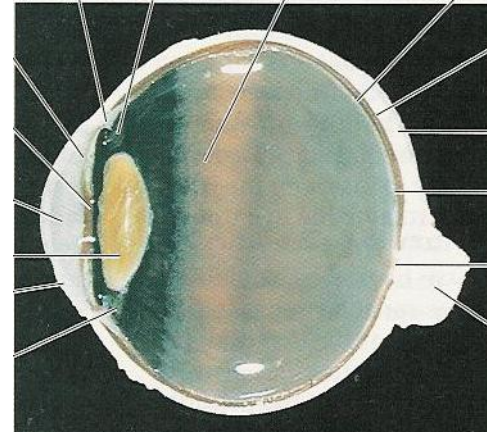
Vitreous body

Transparent

Semi gelatinous

Mostly water and
albumin

Maintains shape of
eye



(a)

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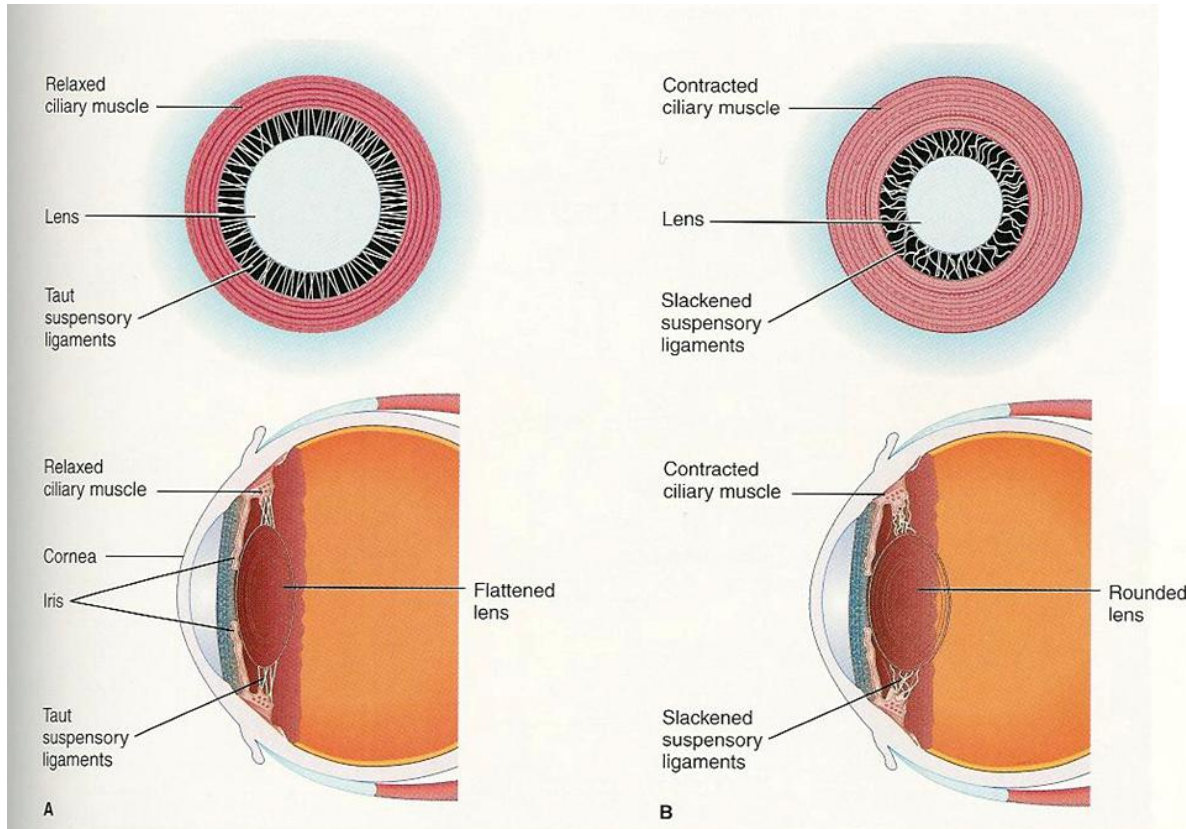
Lens

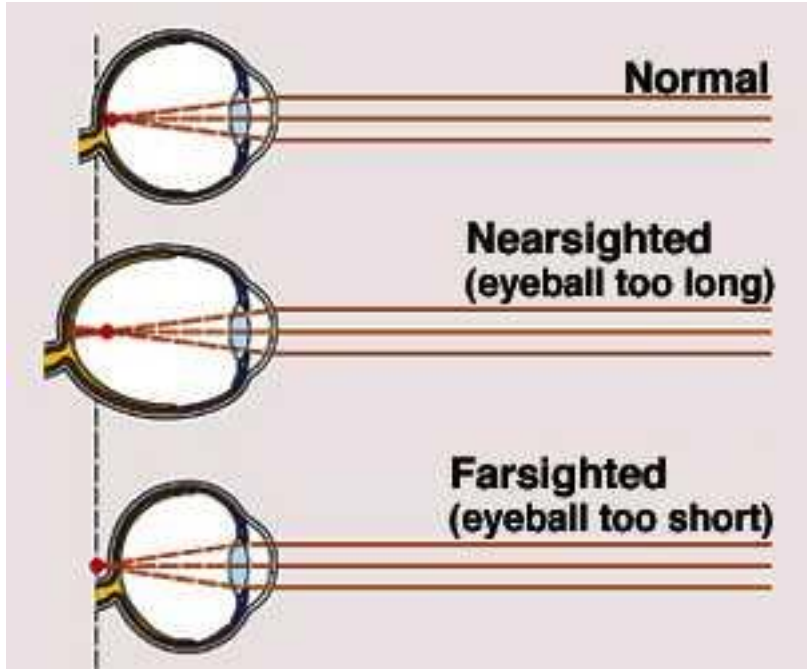
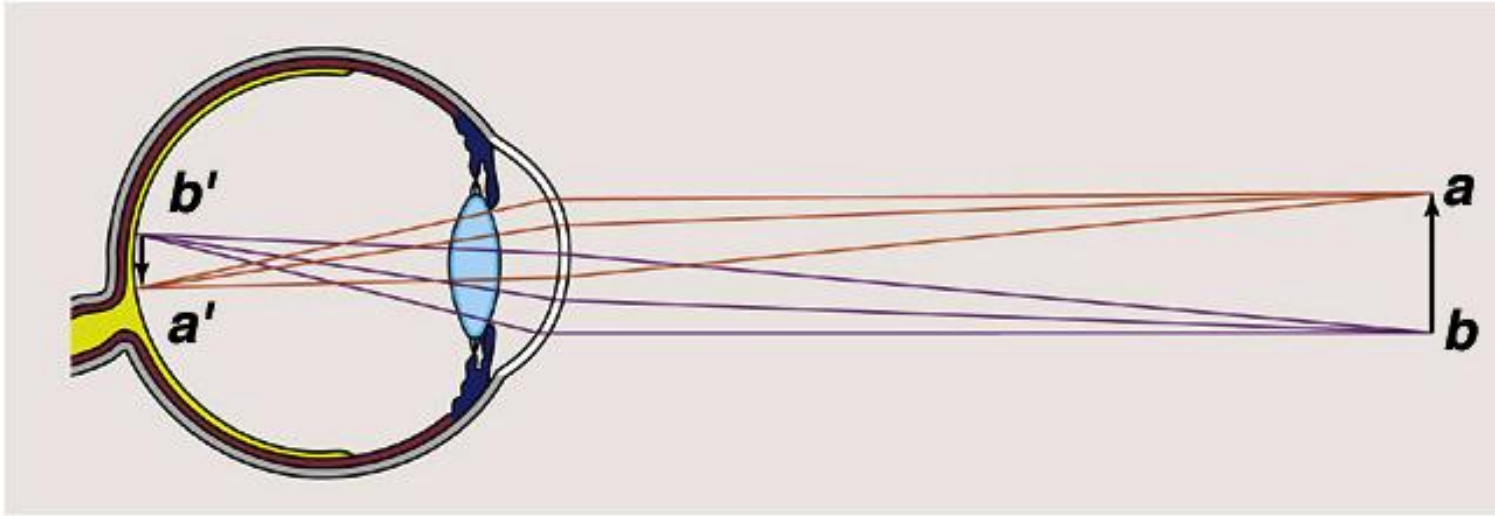
Transparent

Biconvex disc

Held by ligaments to ciliary processes

Changes shape (thickness) to focus







Extrinsic muscles of eye

Superior rectus muscle

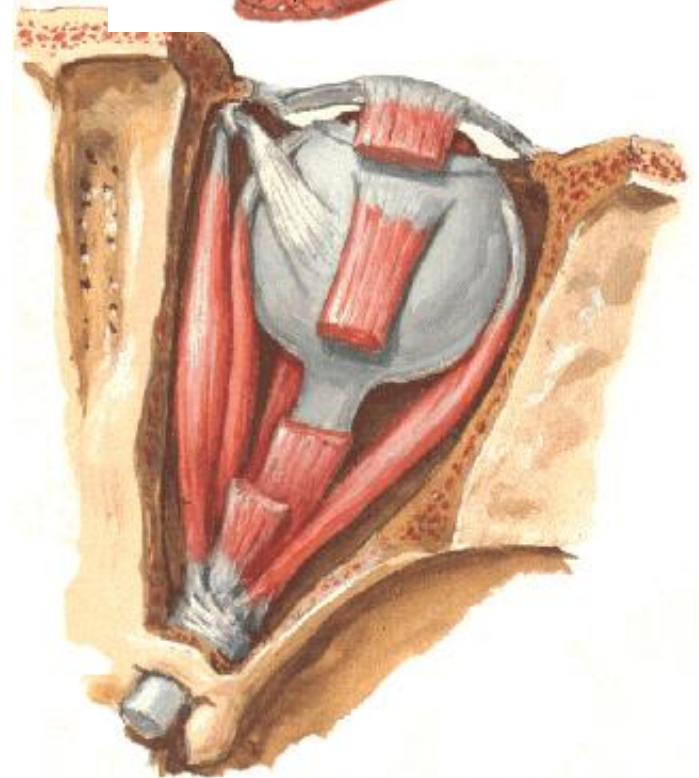
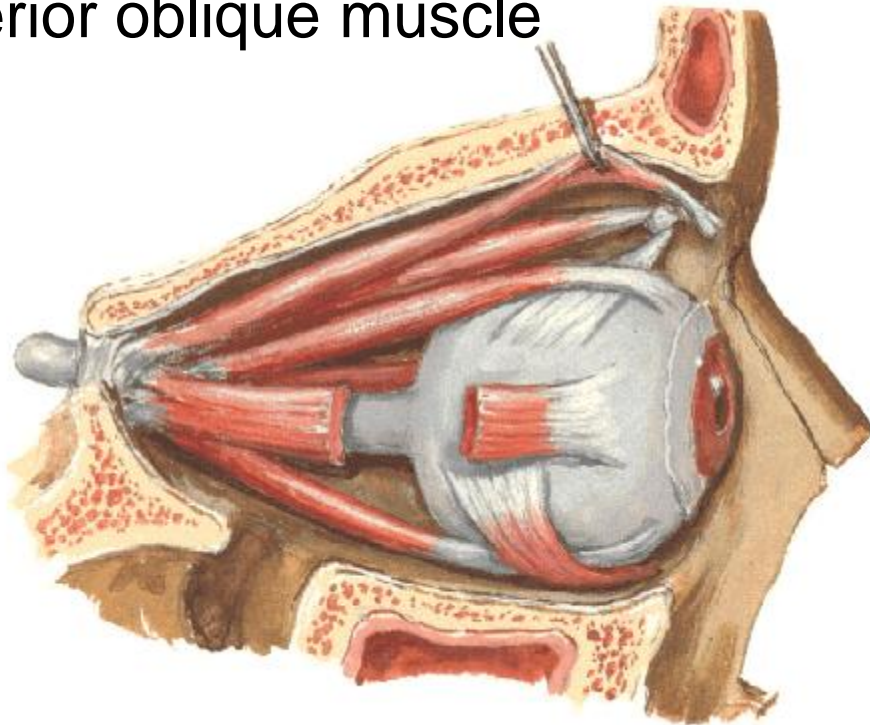
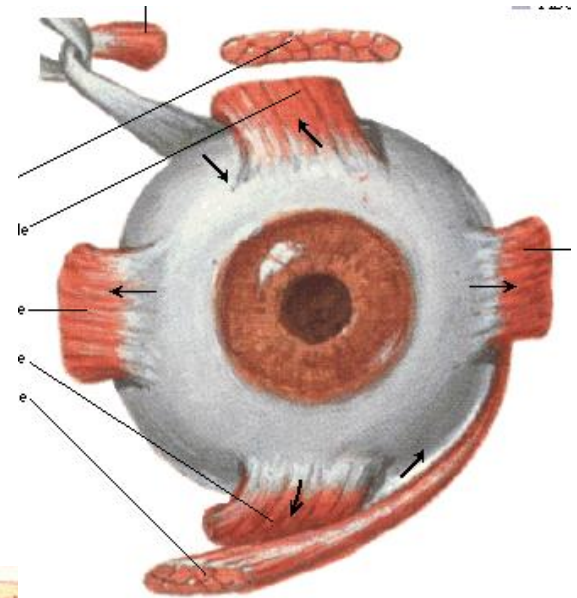
Inferior rectus muscle

Lateral rectus muscle

Medial rectus muscle

Superior oblique muscle

Inferior oblique muscle



3 tunics

1) Fibrous tunic

Sclera

Cornea

2) Vascular tunic

Choroid

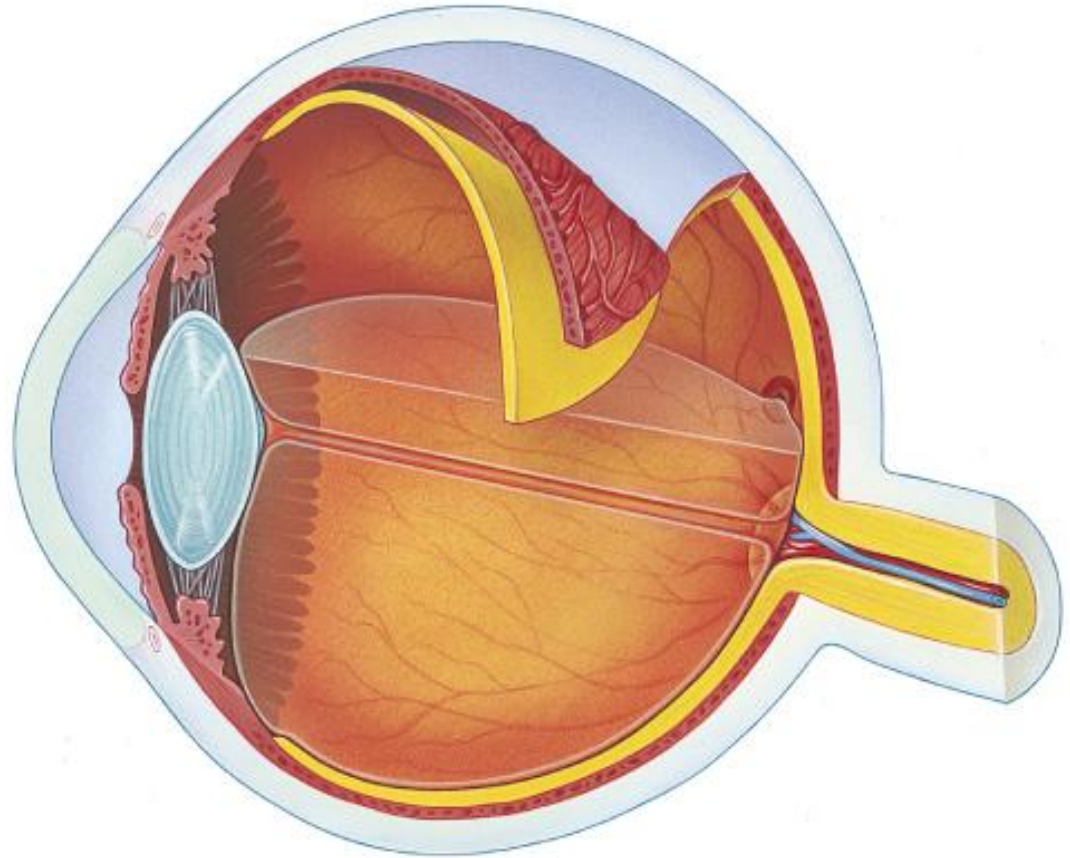
Ciliary body

Iris

3) Nervous tunic

Retina

Pigment epithelium



Fibrous tunic:

Sclera

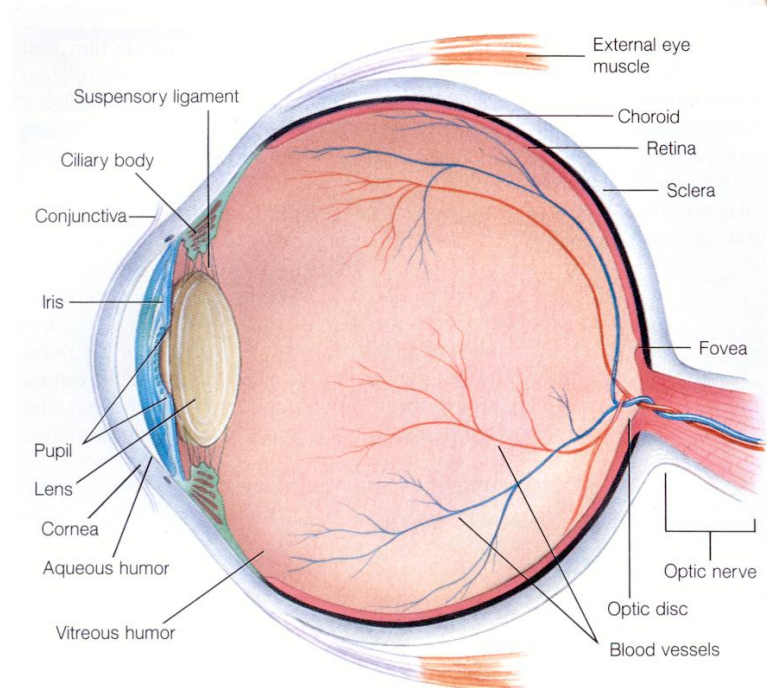
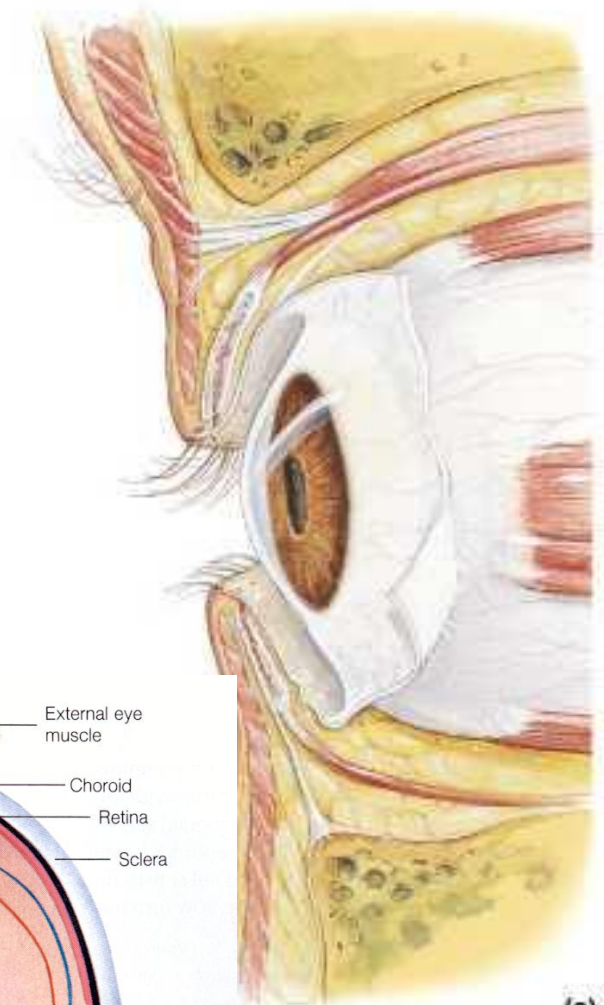
Posterior 5/6 of eye

White

Cornea

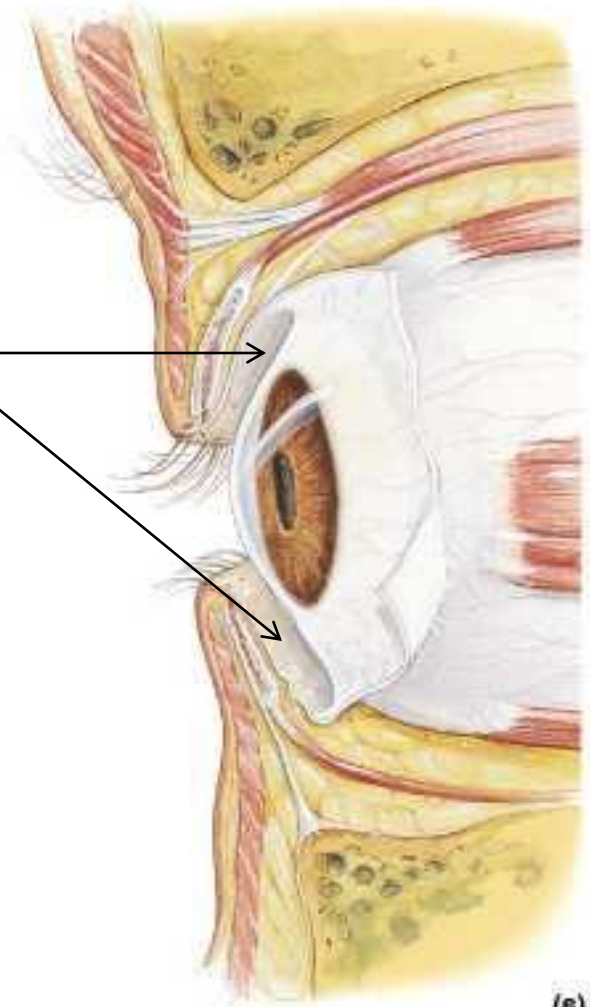
Clear

Bulges forward

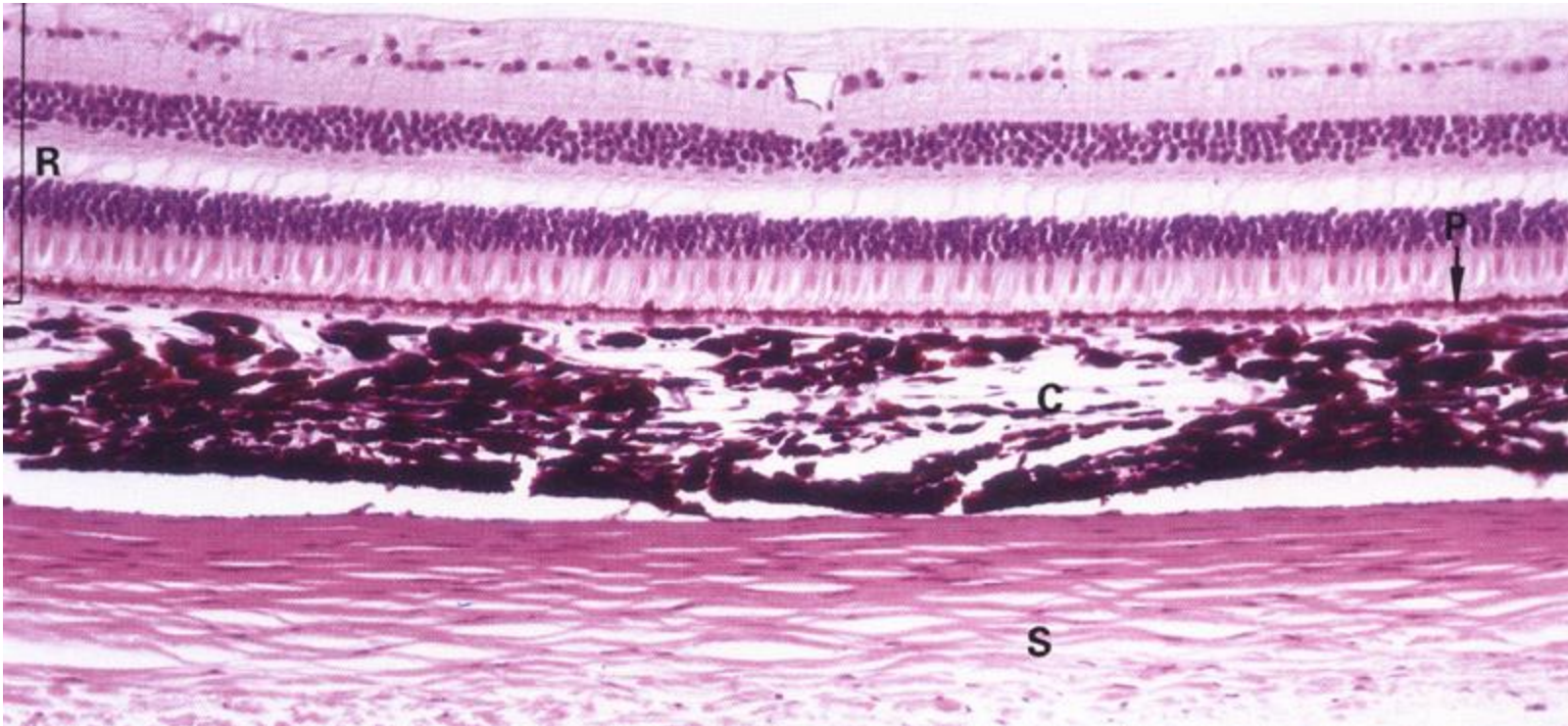


Conjunctiva

- Stratified squamous epithelium;
- Lines anterior part of sclera (but not cornea);
- Reflects back onto inside of eyelids to create *conjunctival sac* that holds tears;
- Punctured in upper lateral region by ducts from lacrimal gland



Vascular tunic
Choroid
Ciliary body
Iris

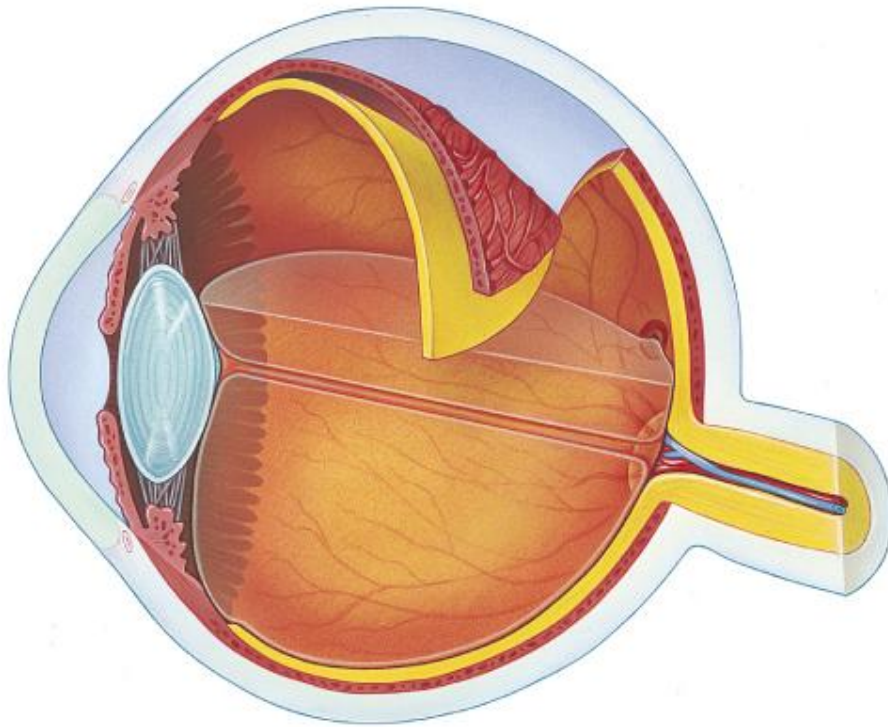


Choroid

Posterior 5/6, inside sclera

Dark brown, pigment

Highly vascular



Ciliary body

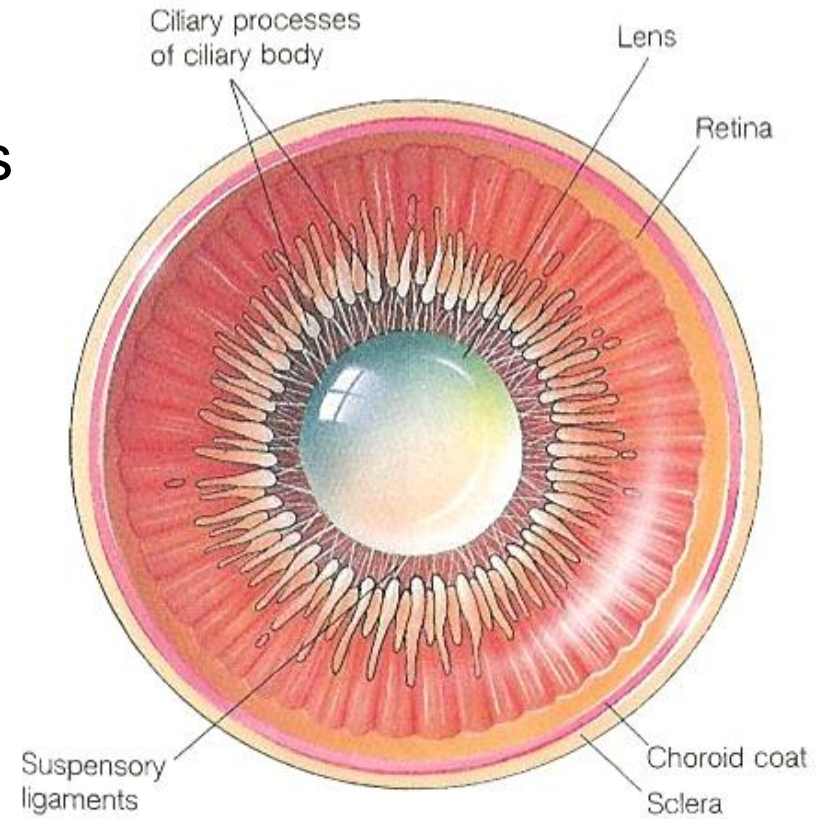
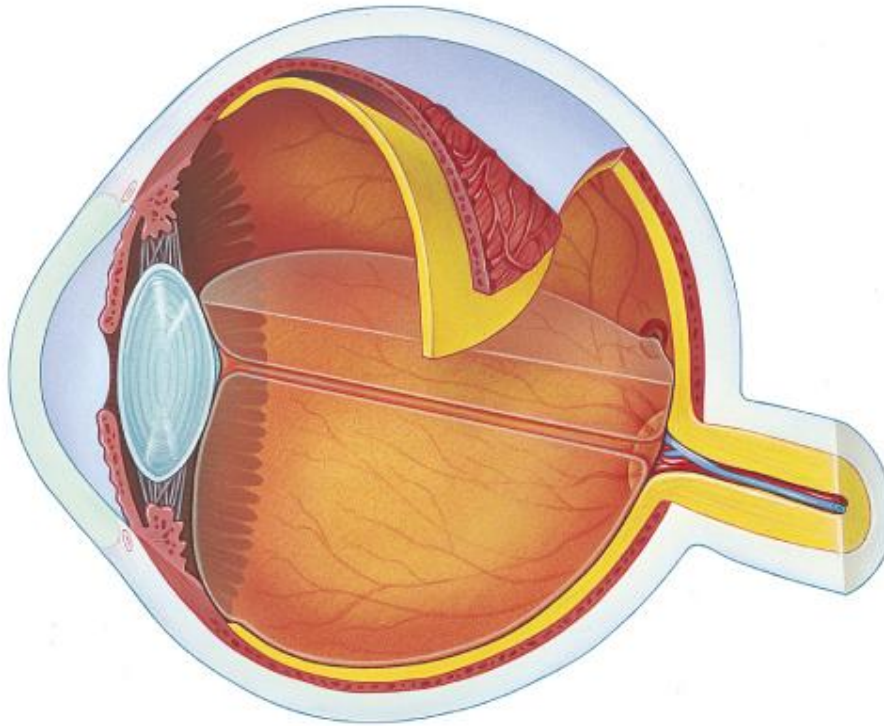
Ciliary muscle

Ciliary processes

Suspensory ligament of lens

Accommodation = focusing

CN III (oculomotor n.)



Iris

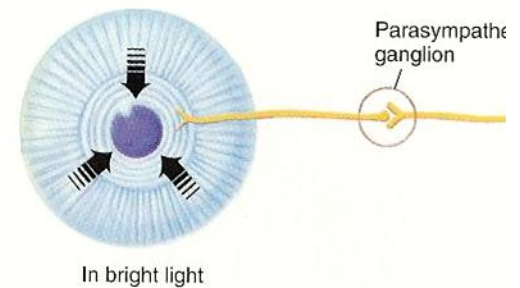
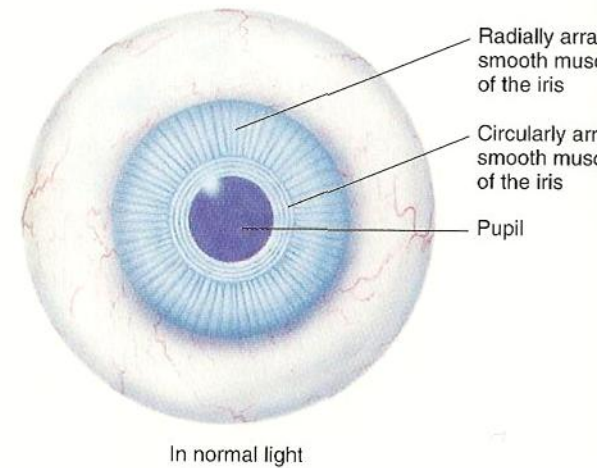
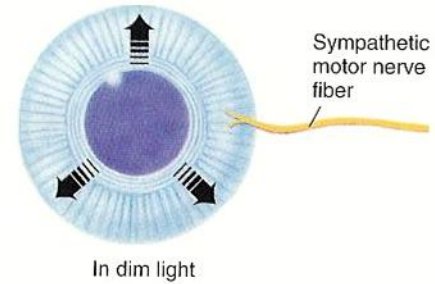
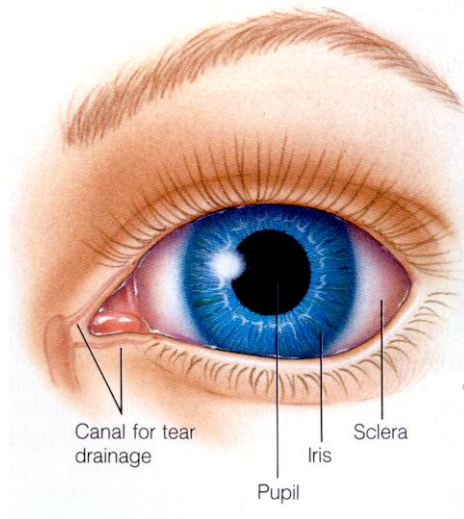
Colored

Circular and radiating muscle

Constrict and dilate pupil

Autonomic NS via CN III &

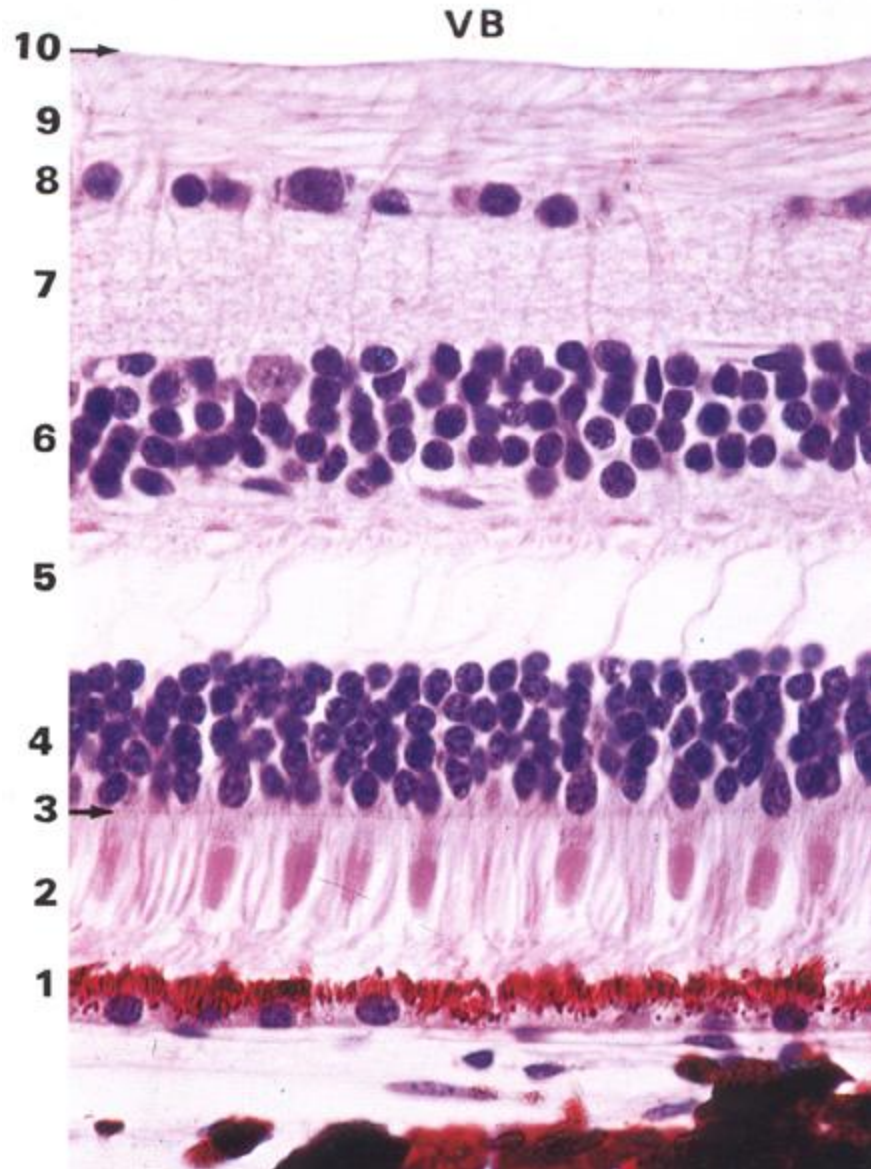
Sympathetics



Neural tunic

Neural retina

Pigment epithelium



Neural retina

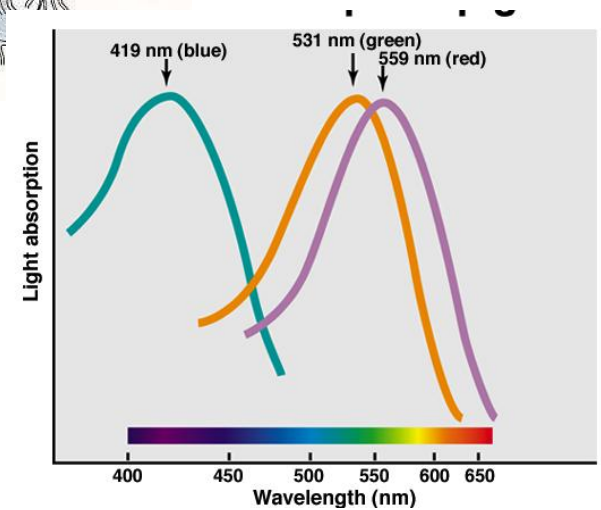
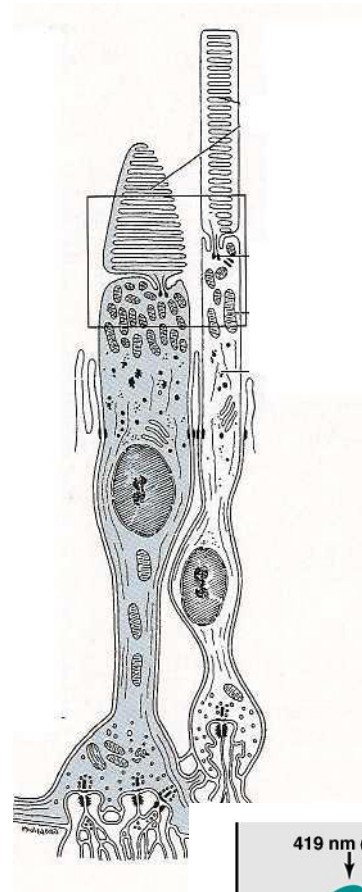
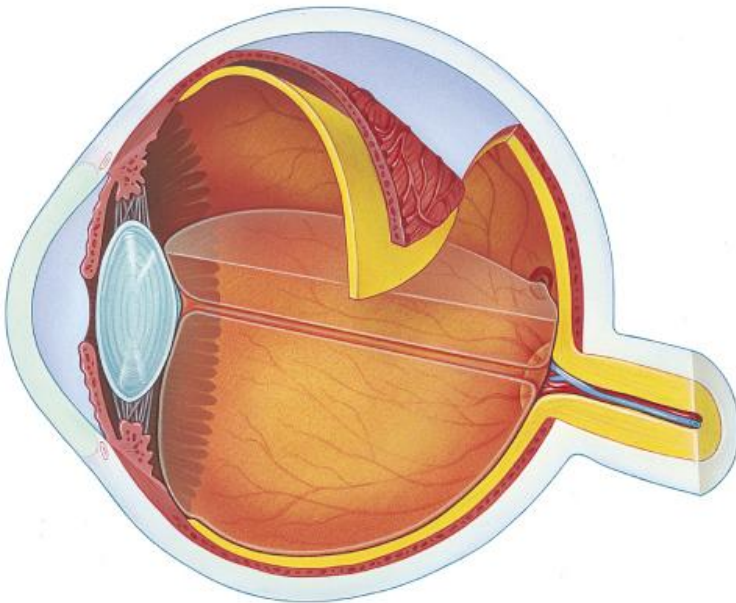
Photoreceptors = Visual cells

1) Rods

Dim light, highly sensitive

2) Cones

Color sensitive



Neural retina

3 layers

1) Photoreceptors

2) Bipolar cells

Bipolar

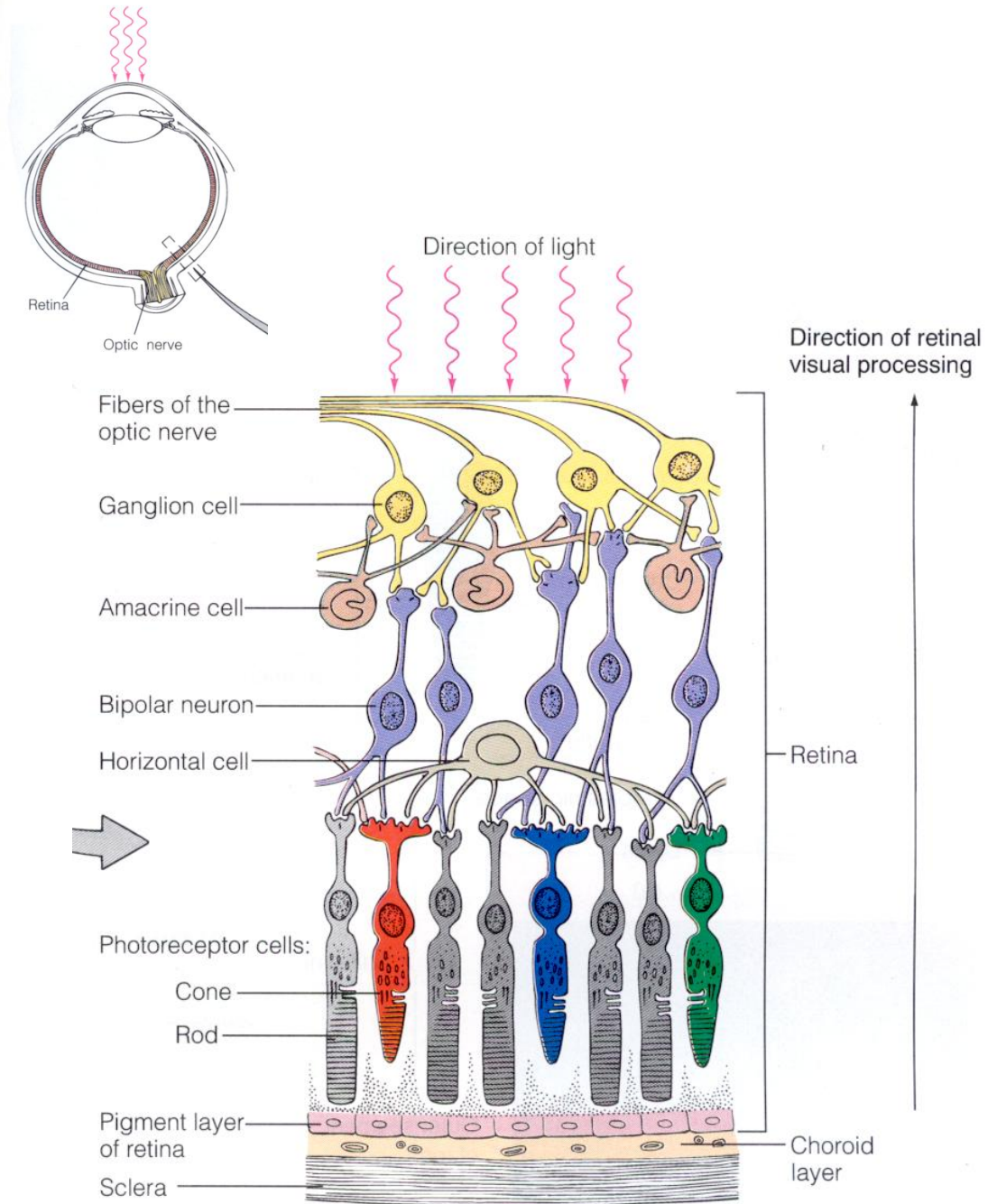
3) Ganglion cells

Multipolar

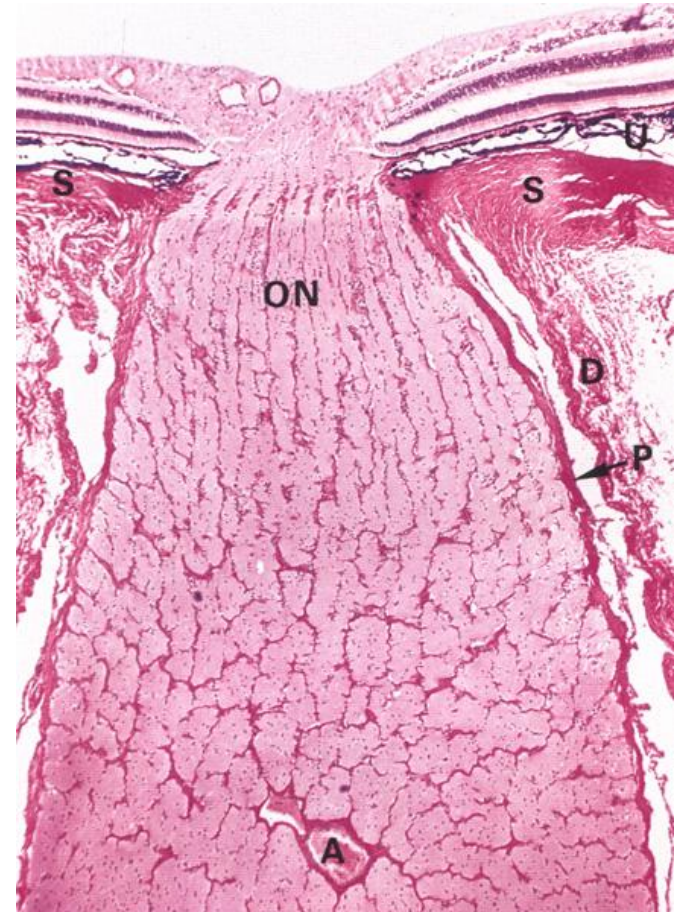
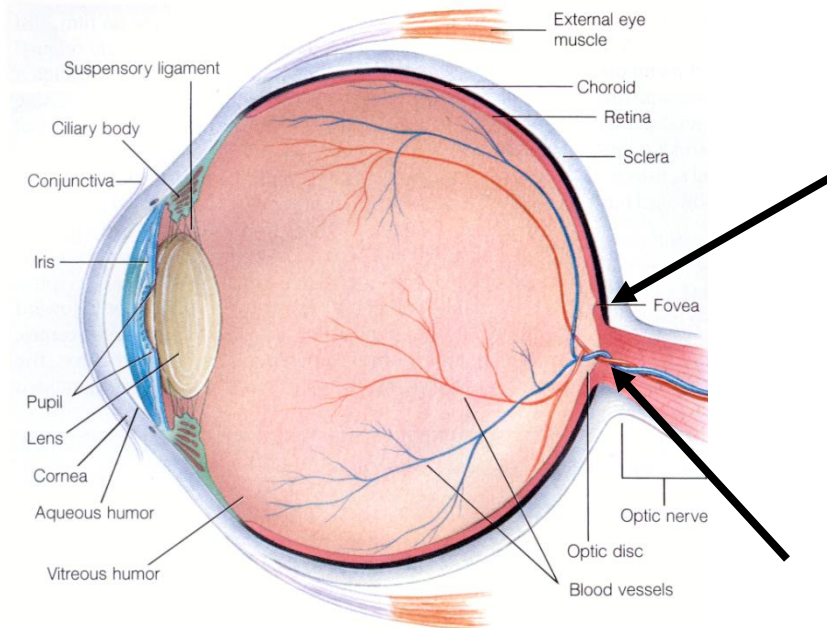
Horizontal cells

Amacrine cells

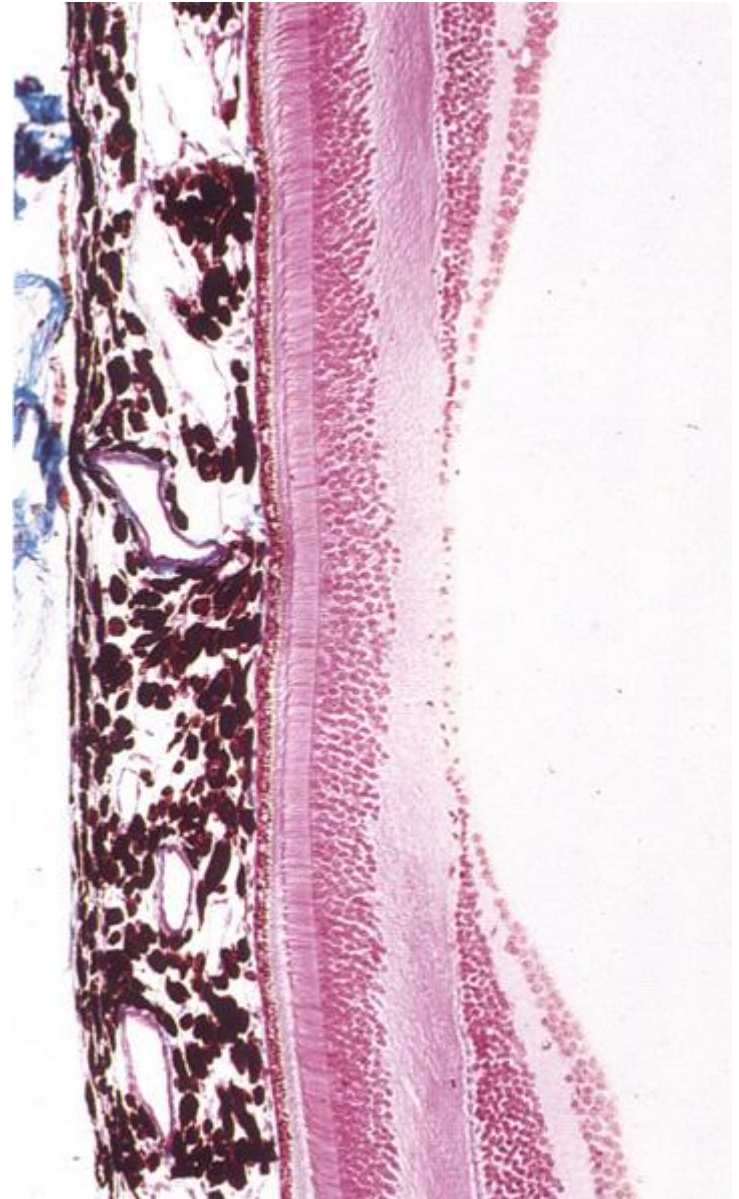
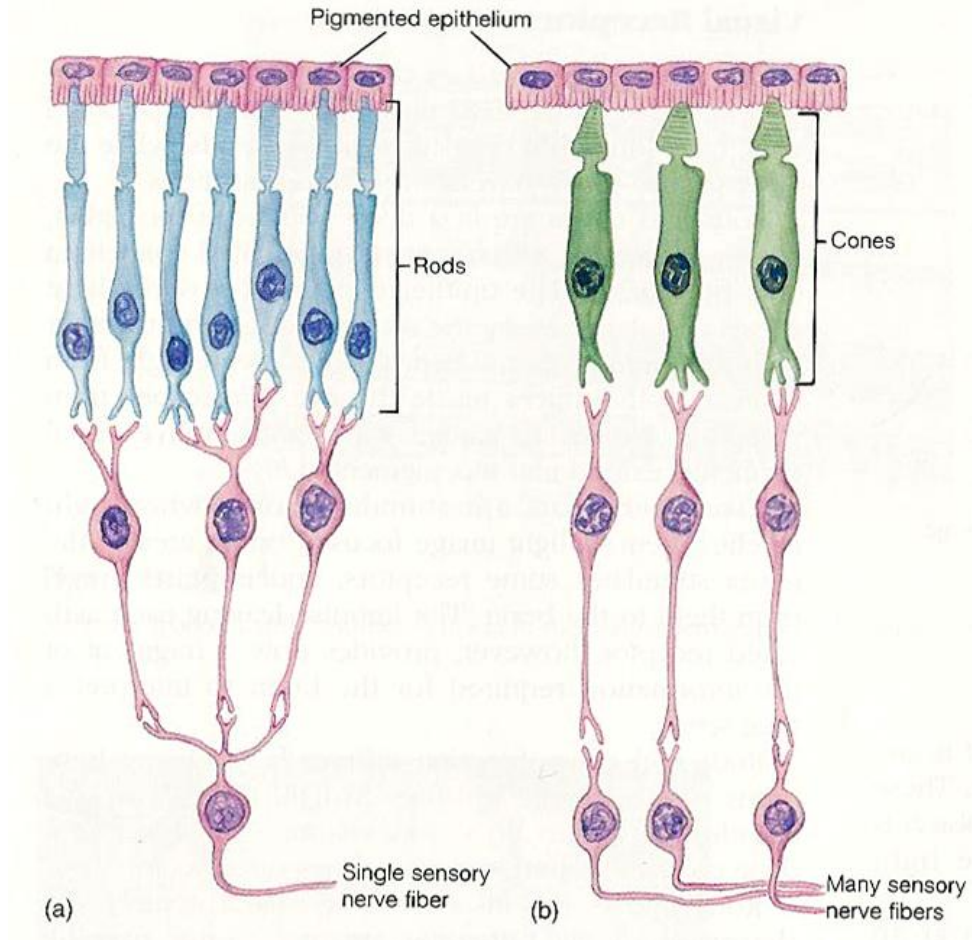
Muller cells



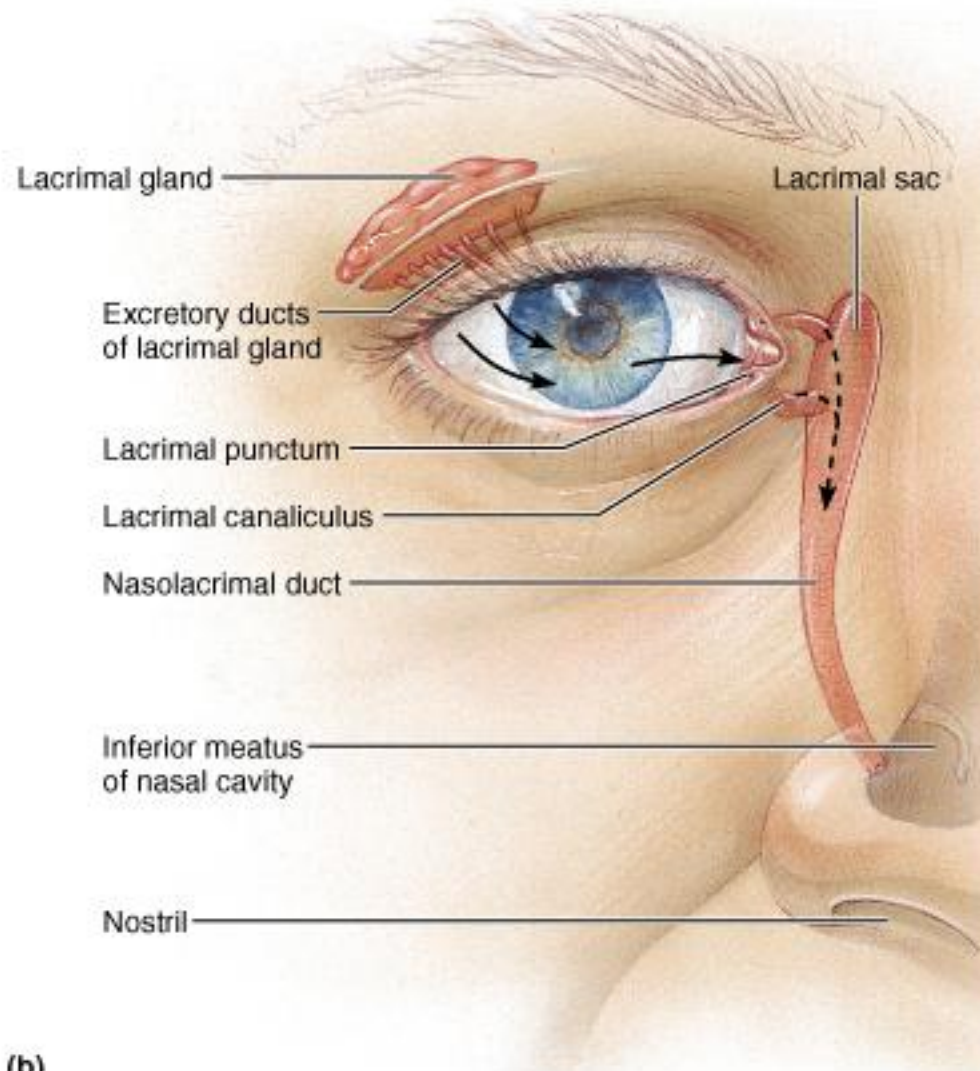
Blind spot = optic disc = exit of optic nerve, travel of blood vessels



Fovea centralis = cones only = greatest visual acuity



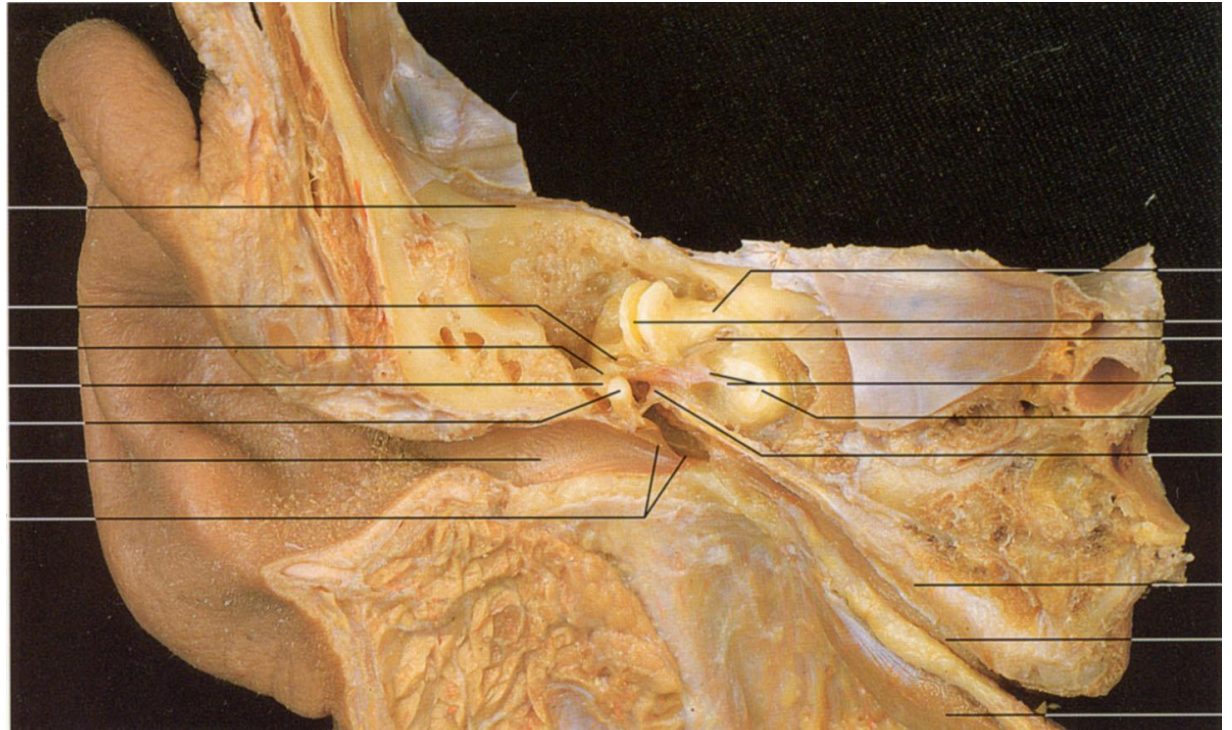
Lacrimal apparatus



Ear

Hearing and Equilibrium

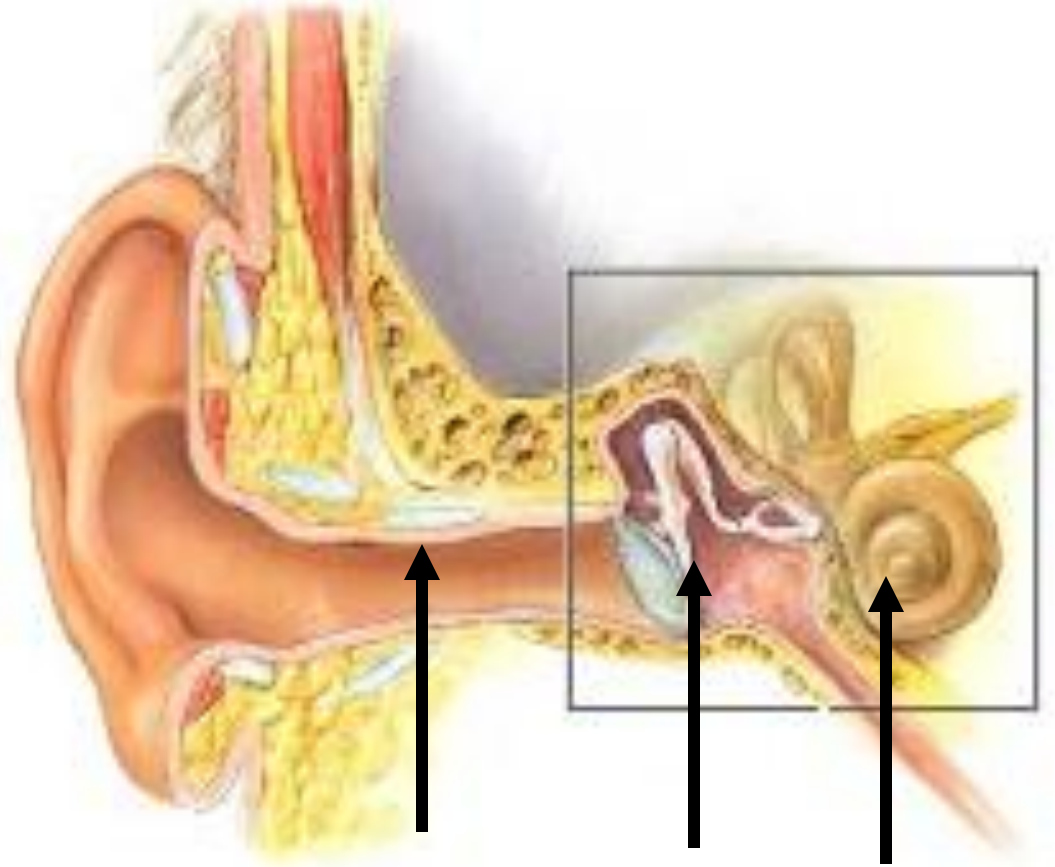
- 1) External ear
- 2) Middle ear
- 3) Inner ear



Ear

Hearing and Equilibrium

- 1) External ear
- 2) Middle ear
- 3) Inner ear



External ear

Auricle

= pinna

Core of elastic cartilage

Directs sound waves into ear

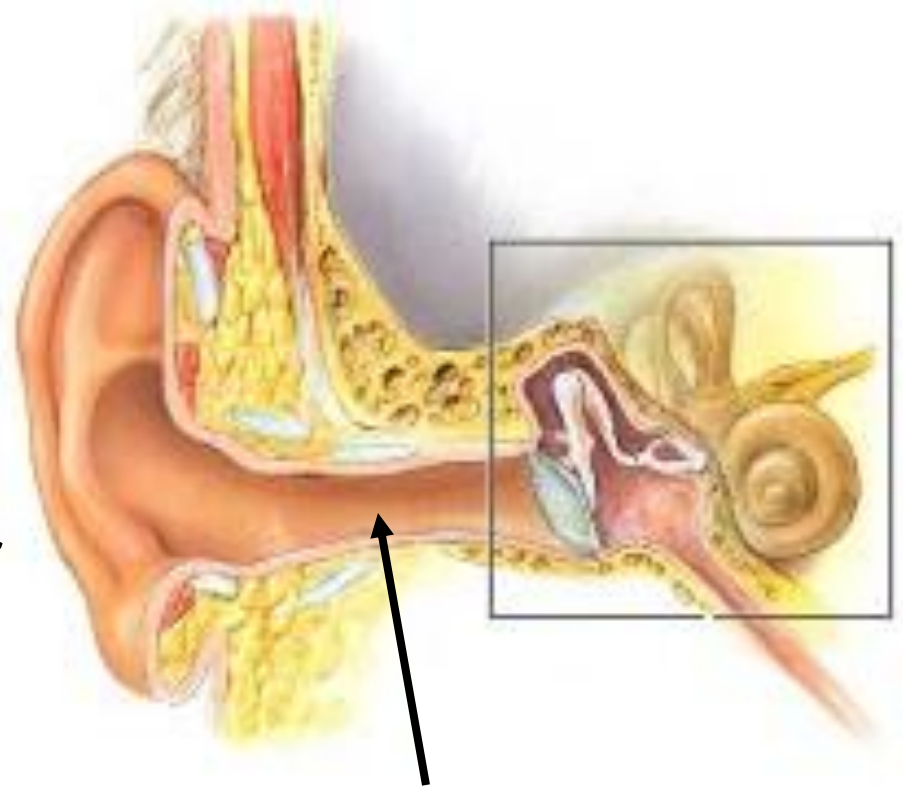
External acoustic meatus

2 ½ cm

S shaped, cartilage and bone

Hairs and wax protect against foreign materials

Wax from modified sweat glands



Middle ear

Cavity within petrous temporal bone - lined by mucous membrane

1) Tympanic membrane

Separates middle from external ear
= ear drum

2) Bony wall separates middle from inner ear

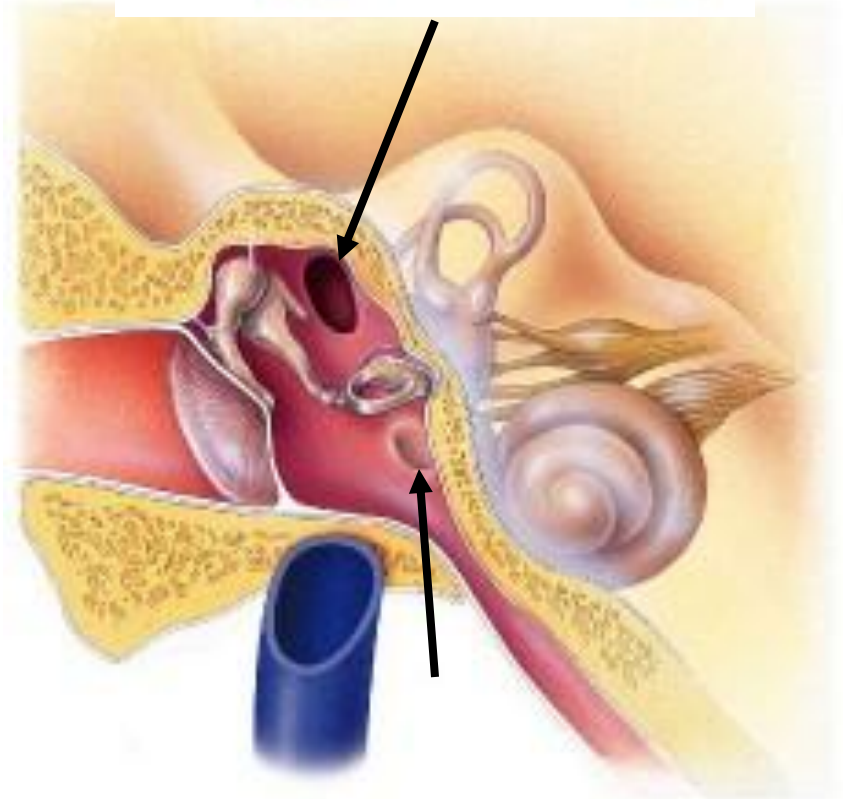
2 holes

1) **Oval window**

2) **Round window**

3) Eustachian tube

4) Mastoid air cells



Middle ear

1) Tympanic membrane

2) . 1) Oval window

2) Round window

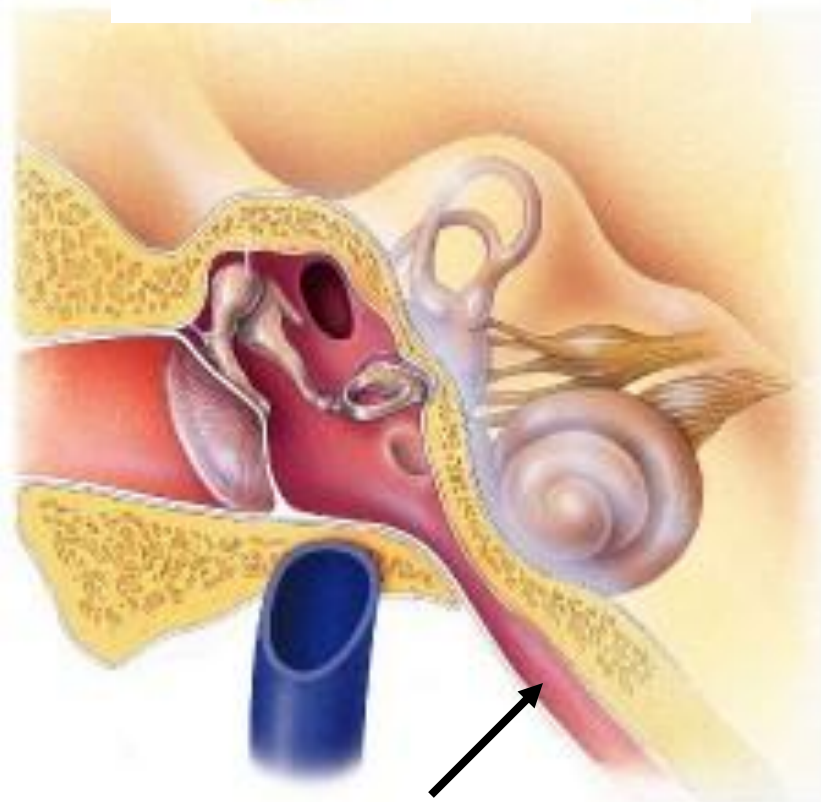
3) Eustachian (Auditory) tube

Opens anteriorly to
nasopharynx

Equalizes pressure with
atmospheric pressure
across tympanic
membrane

4) Mastoid air cells

Open to middle ear



Ossicles

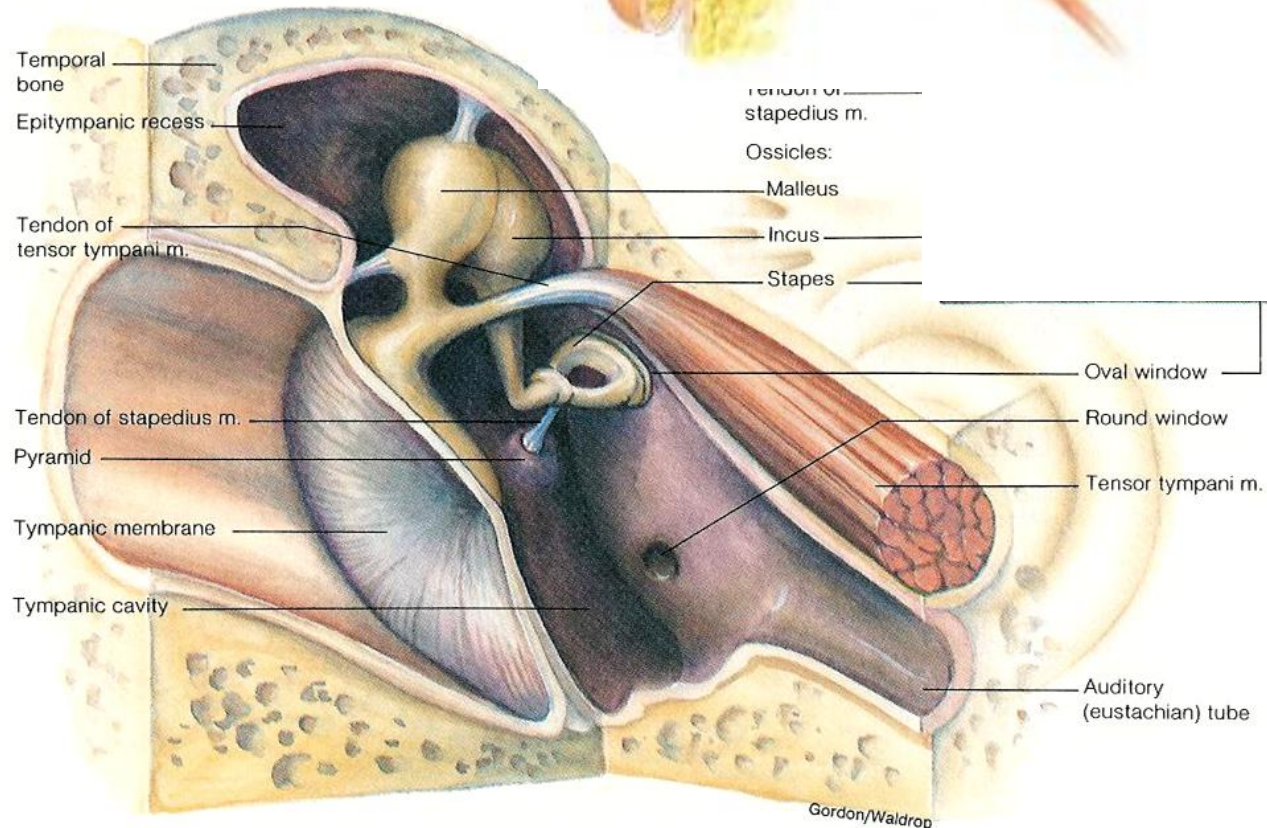
3 bones with synovial joints

Transmit vibrations of tympanic membrane to oval window

1) Malleus – hammer

2) Incus – anvil

3) Stapes - stirrup

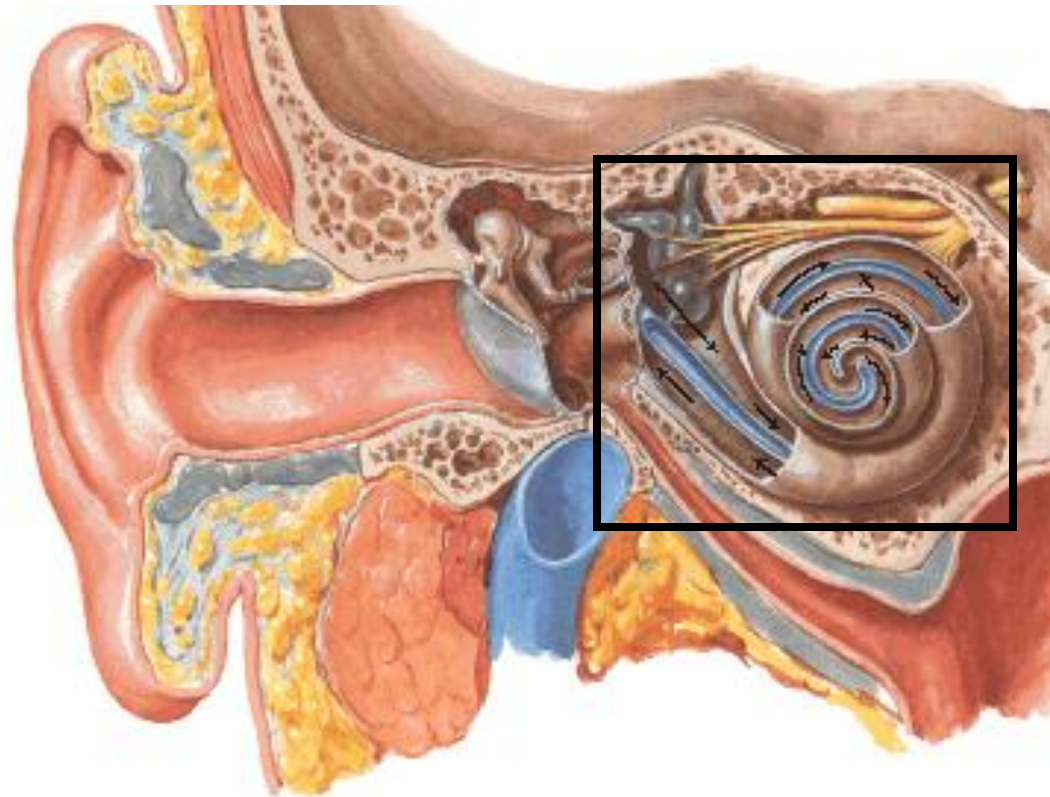


Inner ear

Organs for hearing and equilibrium

1) **Bony labyrinth**

2) **Membranous labyrinth**



Bony labyrinth

Series of channels within bone

Lined by serous membrane

Secretes fluid = perilymph

1) Vestibule

2) Semicircular canals

3) Cochlea



Vestibule

Main chamber

Oval window opens to it

Semicircular canals

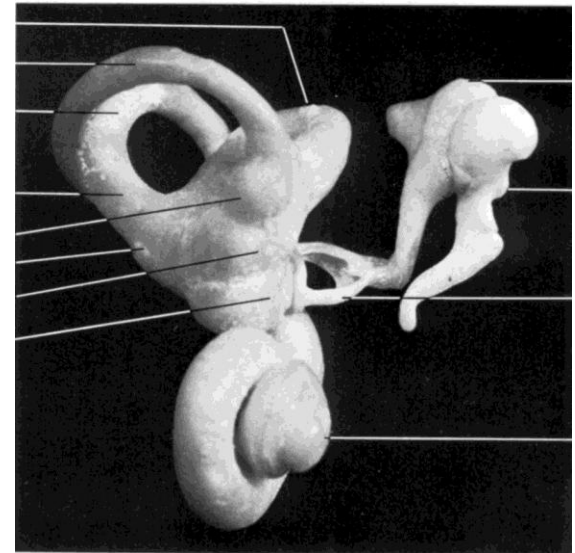
Anterior, posterior, lateral

3 planes of space

Open to posterior vestibule

Cochlea

Spiral, 2 $\frac{3}{4}$ turns



Cochlea

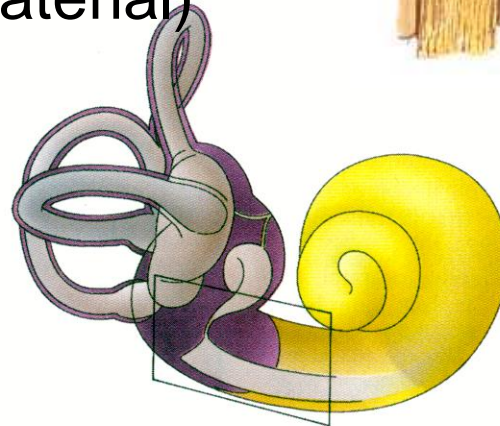
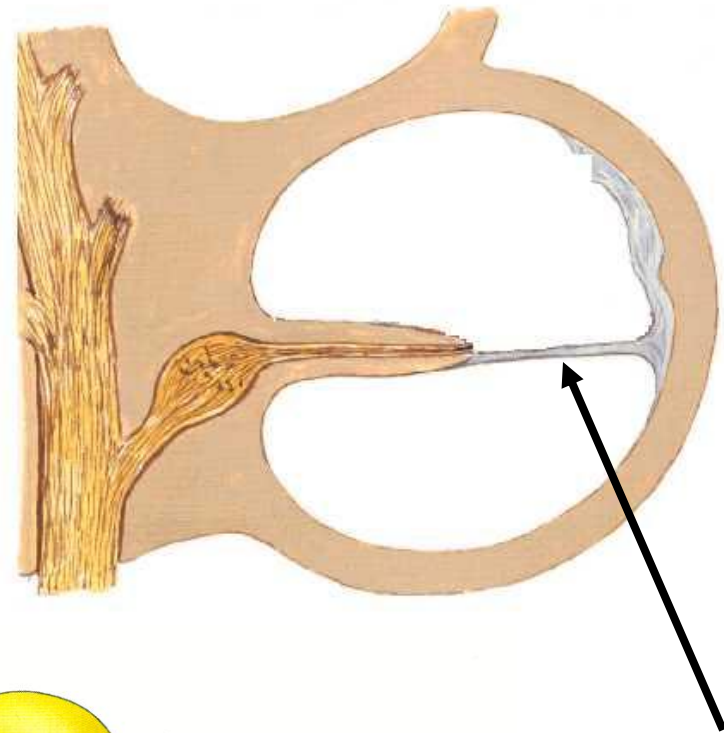
2 canals

Continuous at apex

Separated by

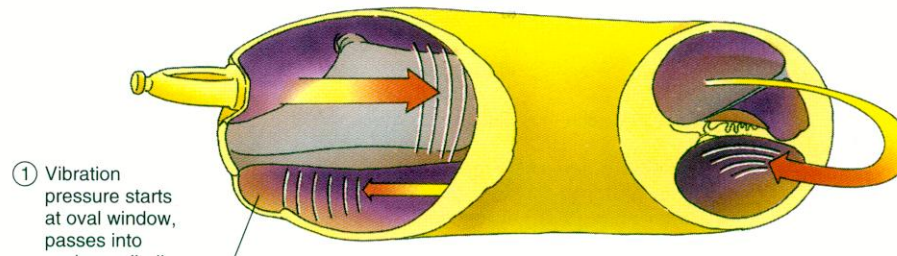
1) Projection of bone

2) Basilar membrane
(extracellular material)



Schematic cutaway of vestibule and cochlea with cochlear duct:

② Wave returns via scala tympani and resonates with a specific section of cochlear duct



① Vibration pressure starts at oval window, passes into ...

Cochlea

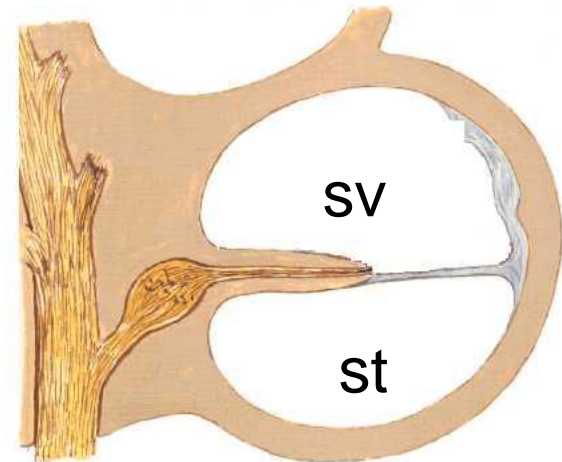
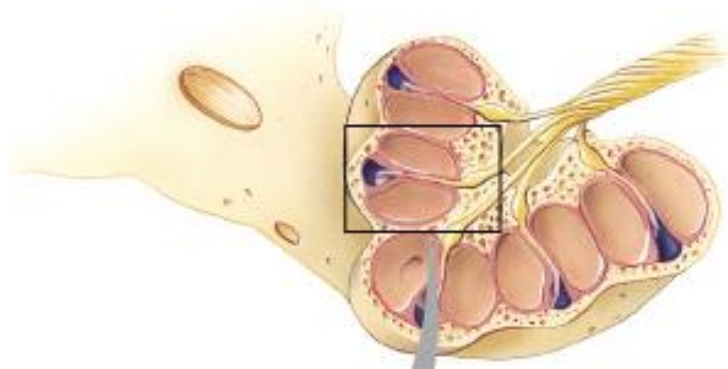
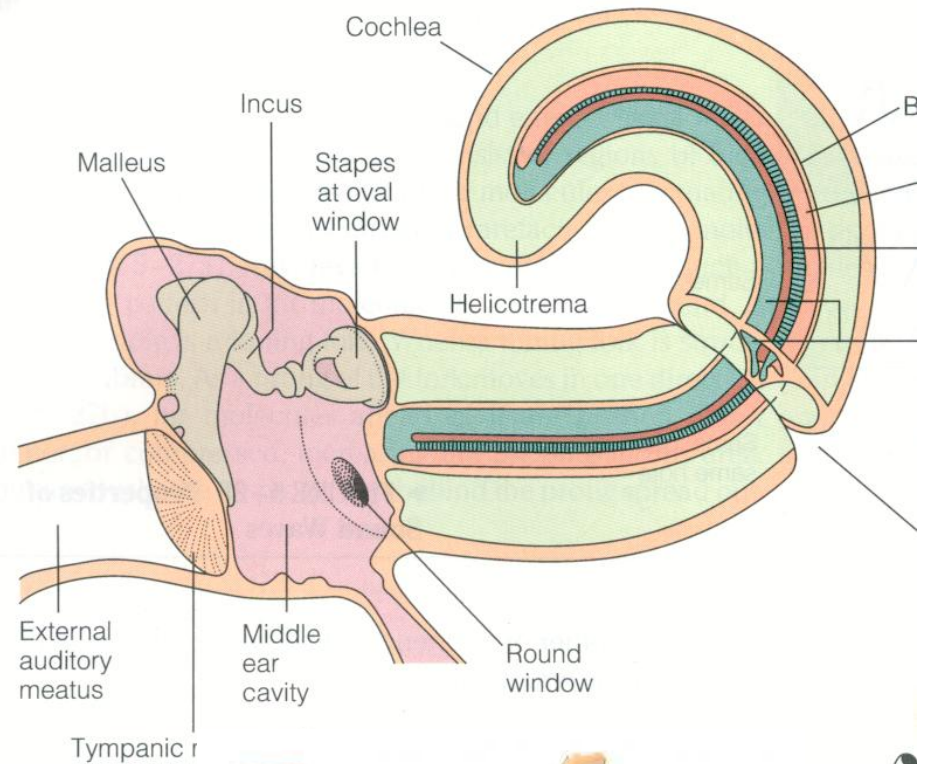
2 canals open to vestibule

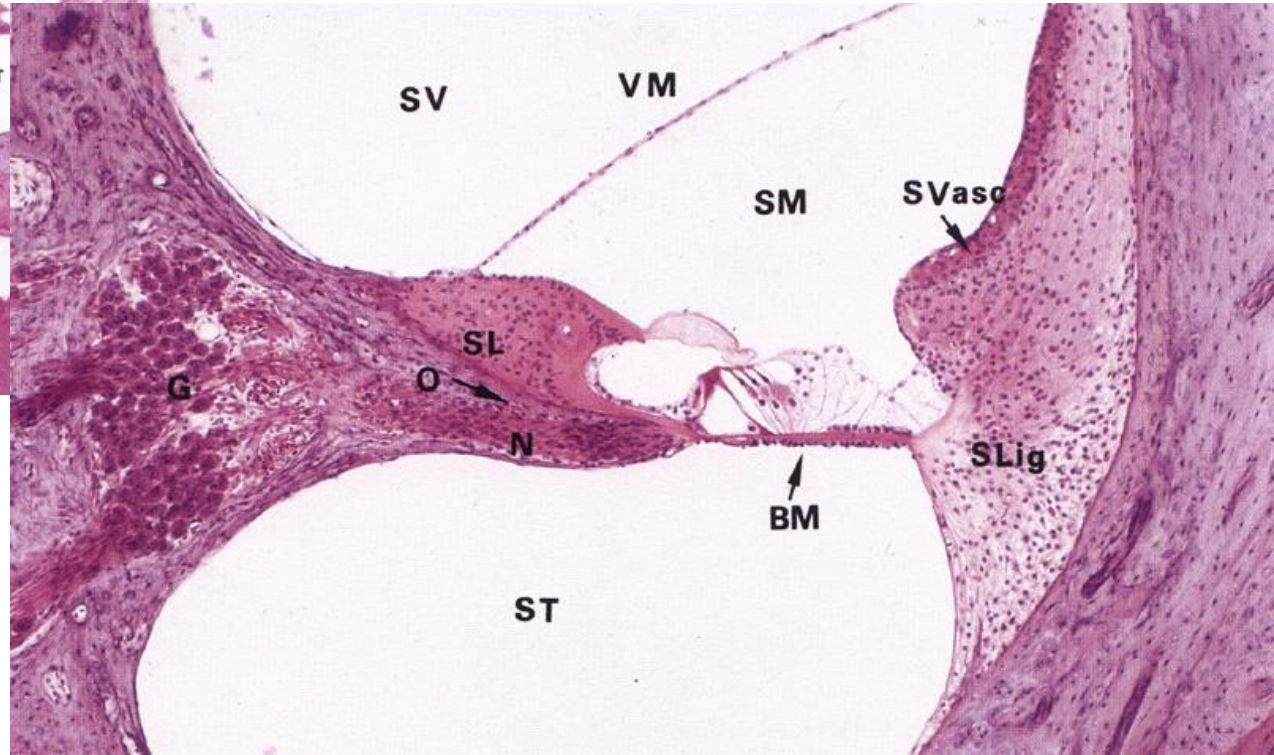
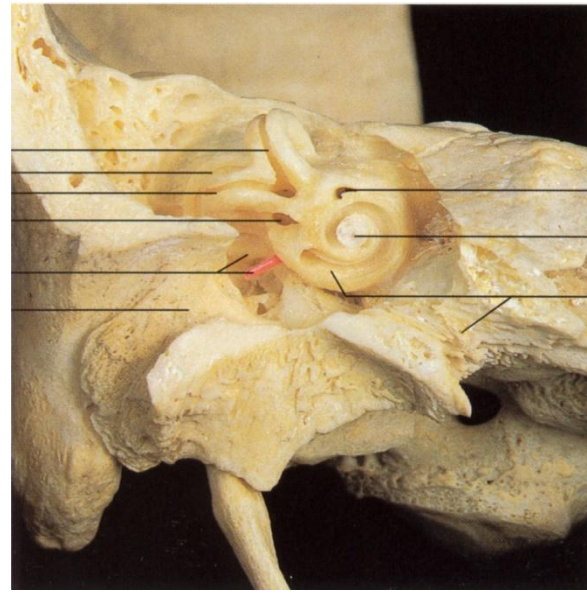
1) Scala vestibuli

at oval window
covered by stapes

1) Scala tympani

at round window
covered by
membrane (drum)





Membranous labyrinth

Membranous sac within the bony labyrinth

Utricle
Sacculle } Within vestibule

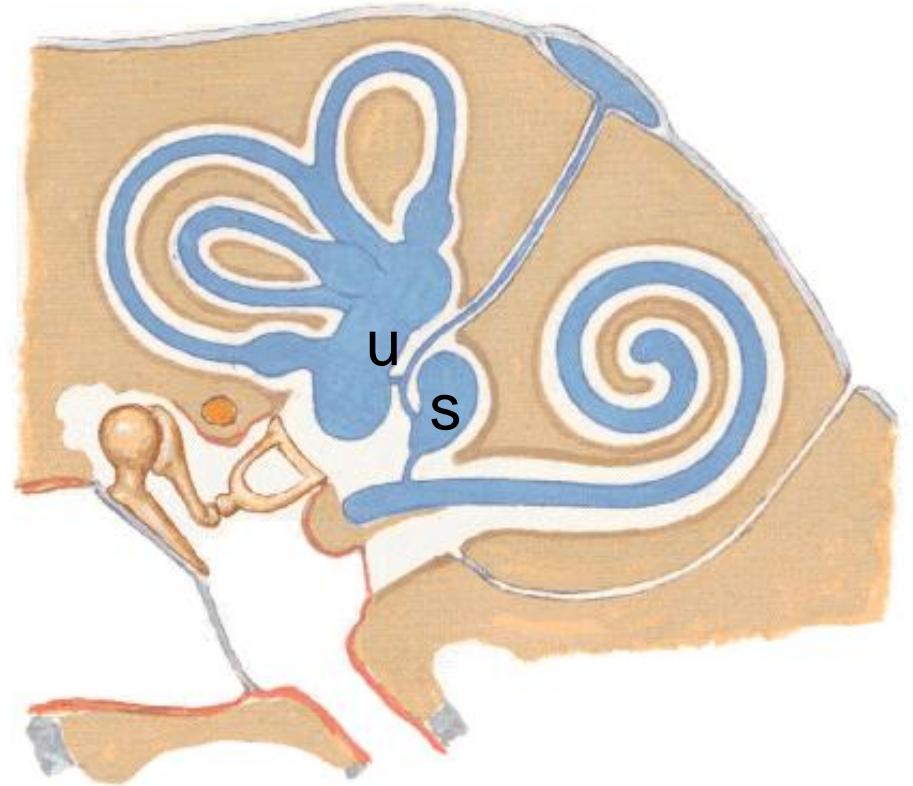
Semicircular ducts

Cochlear duct

Filled with endolymph

Surrounded by perilymph

(thus membranous labyrinth is smaller than bony labyrinth)

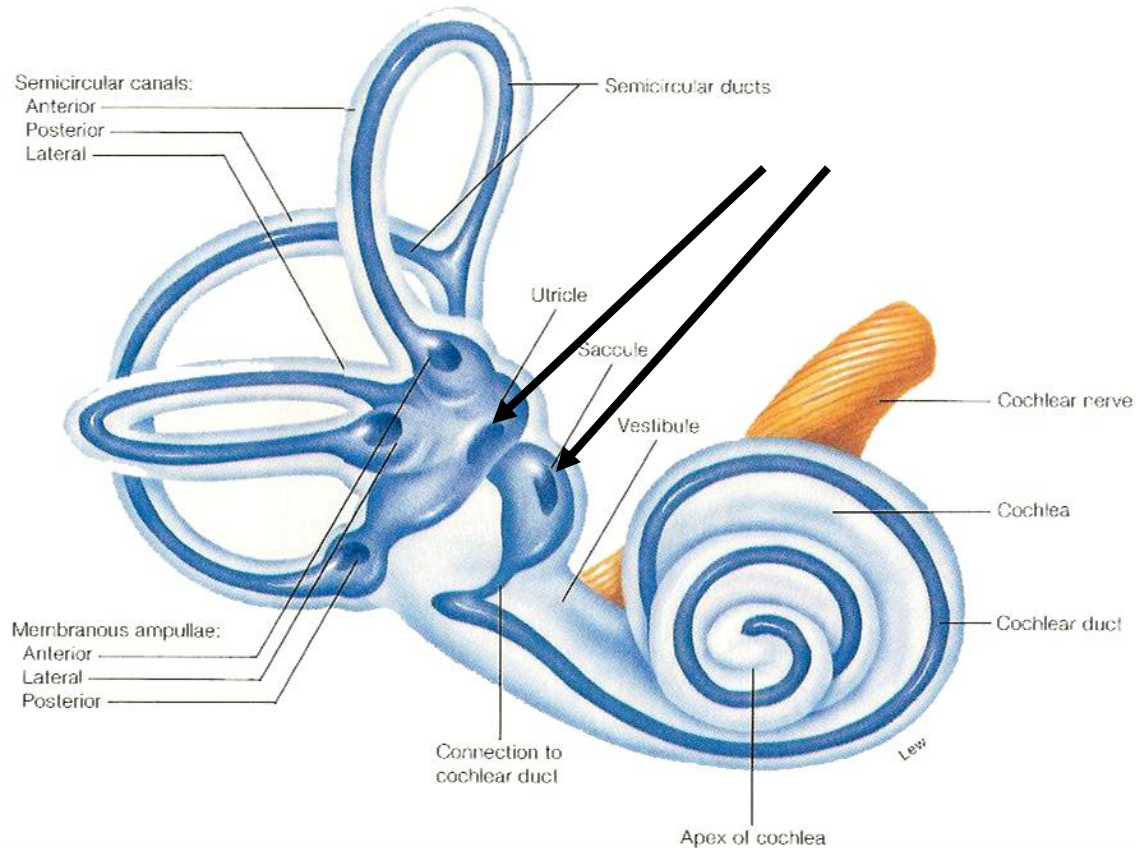


Otolithic Organs = Maculae

In floor of utricle - oriented horizontally

In floor of saccule – oriented vertically

Sense linear acceleration and gravitational pull



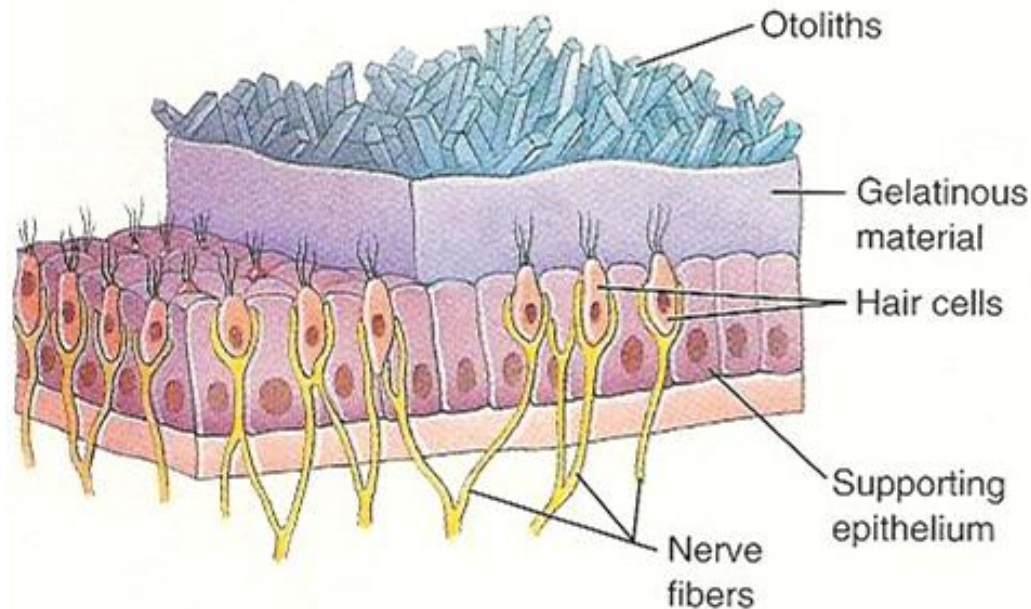
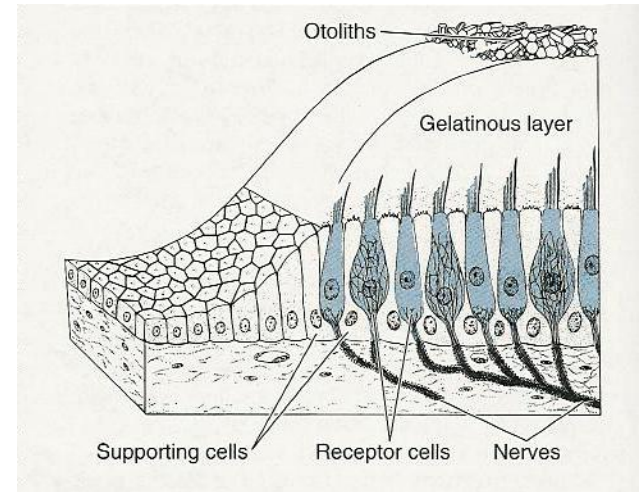
Otolithic Organ = Macula

Otolith

Calcium carbonate **crystals**

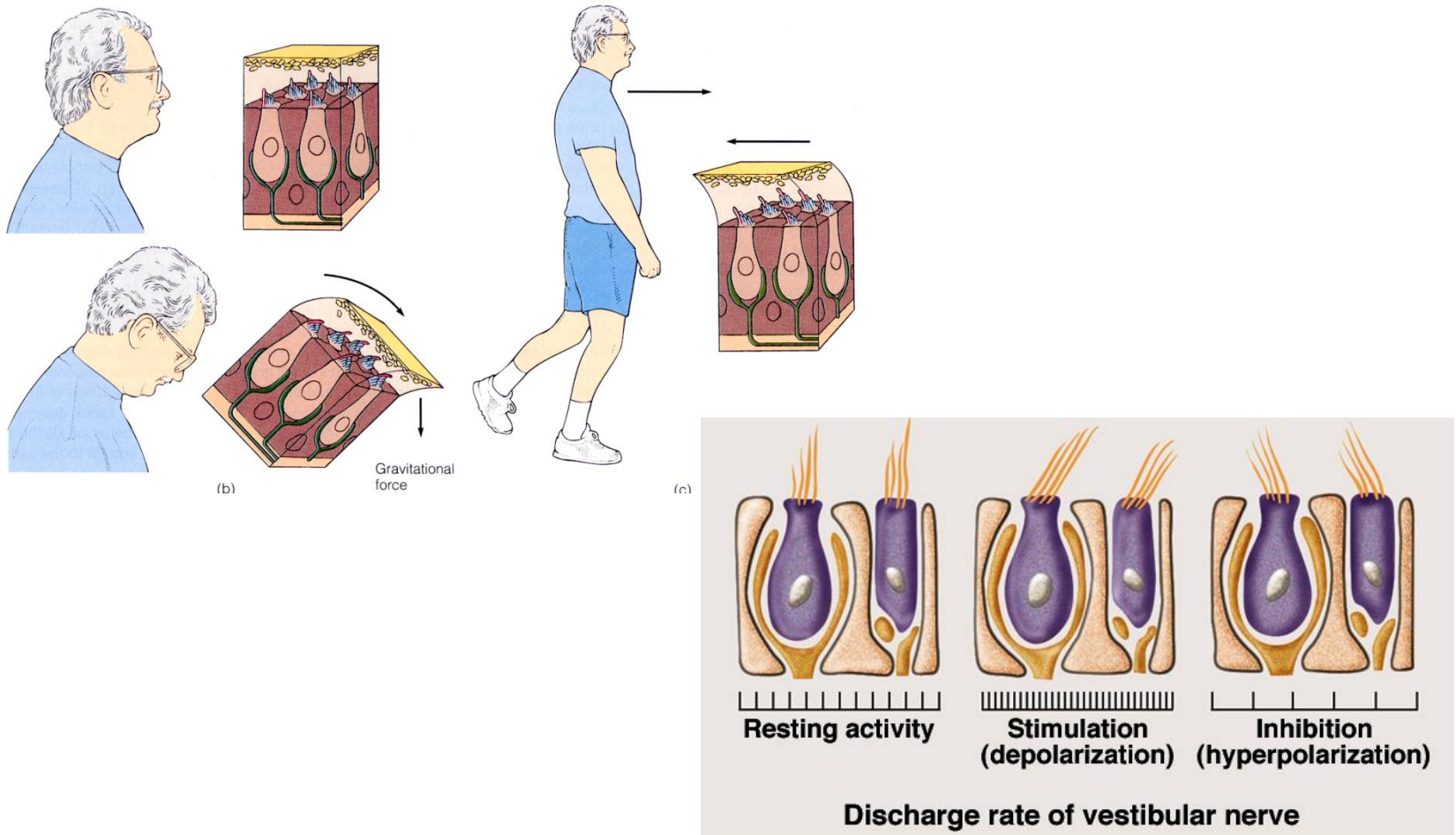
Gelatinous mass

Hair cells = receptors



Otolithic Organ = Macula

Weight of crystals > drag > hair cells bend > activation

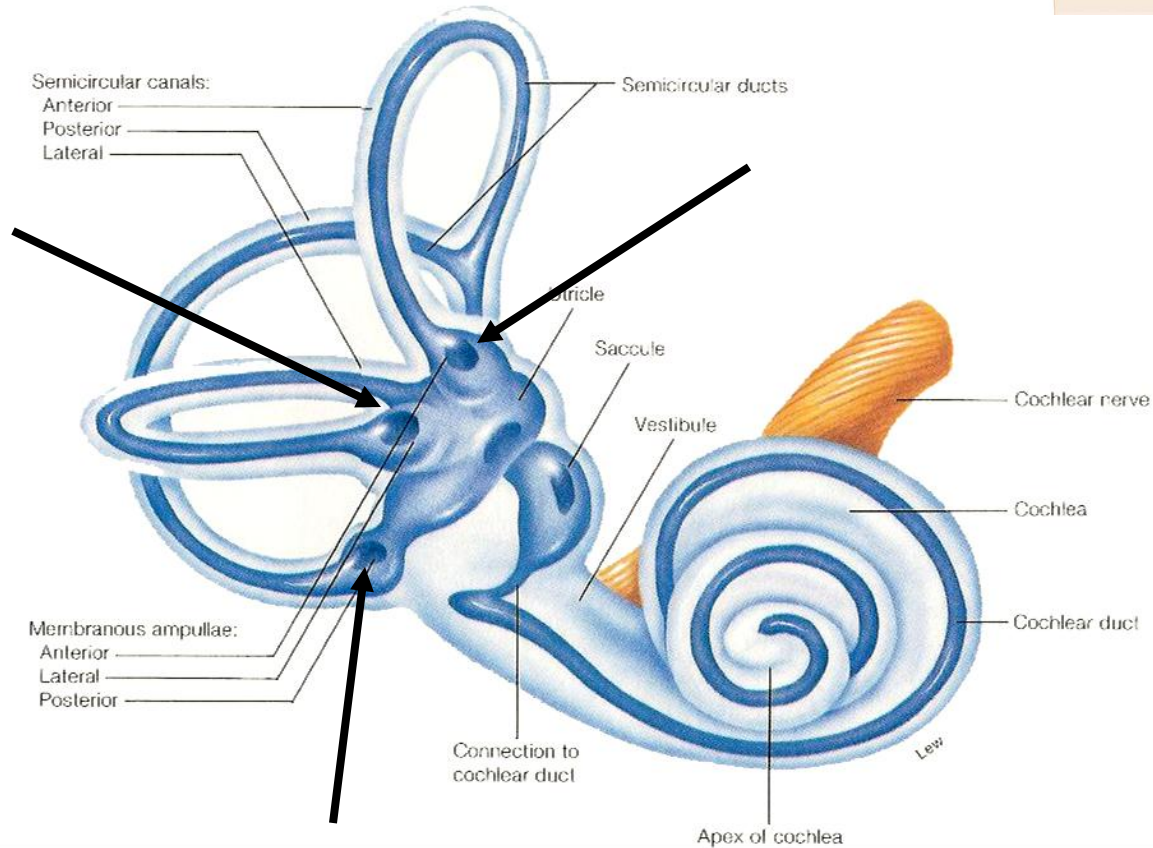
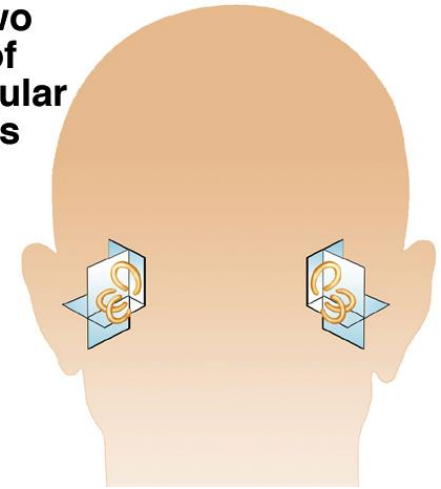


Crista ampullaris = cupula

Within ampulla of each semicircular canal

Sense rotational acceleration

The two sets of semicircular canals

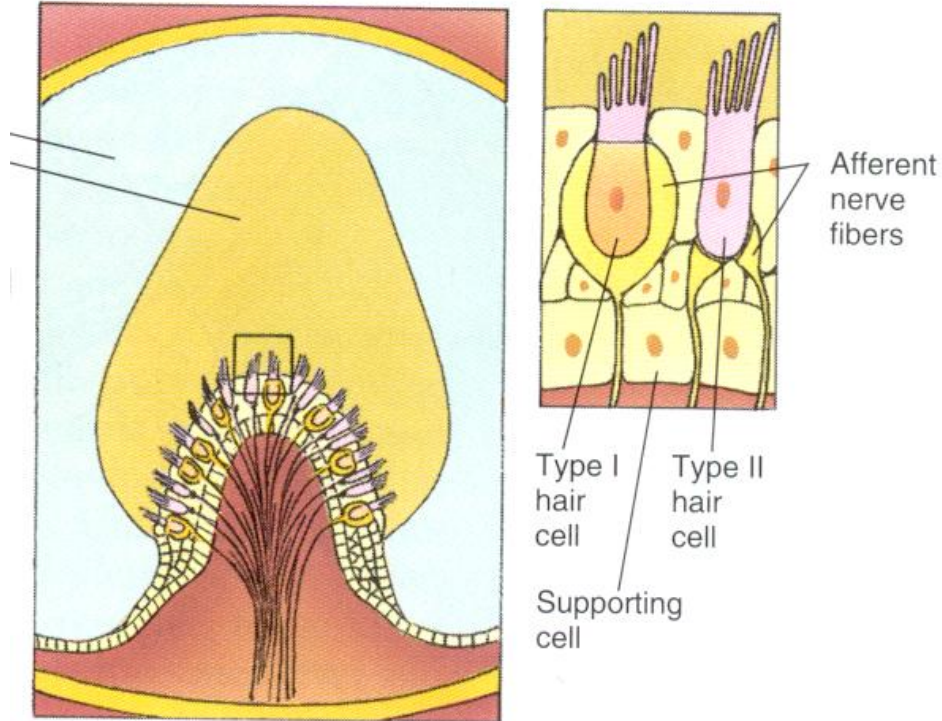
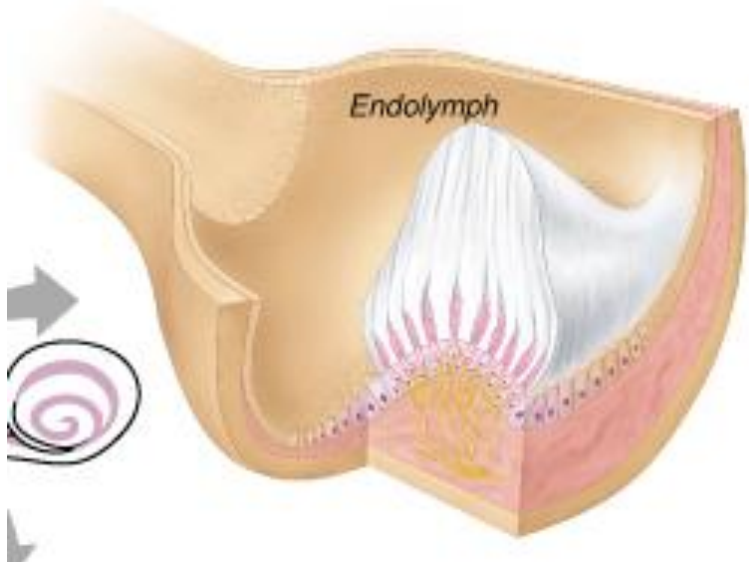


Crista ampullaris = cupula

Cupula

Gelatinous mass

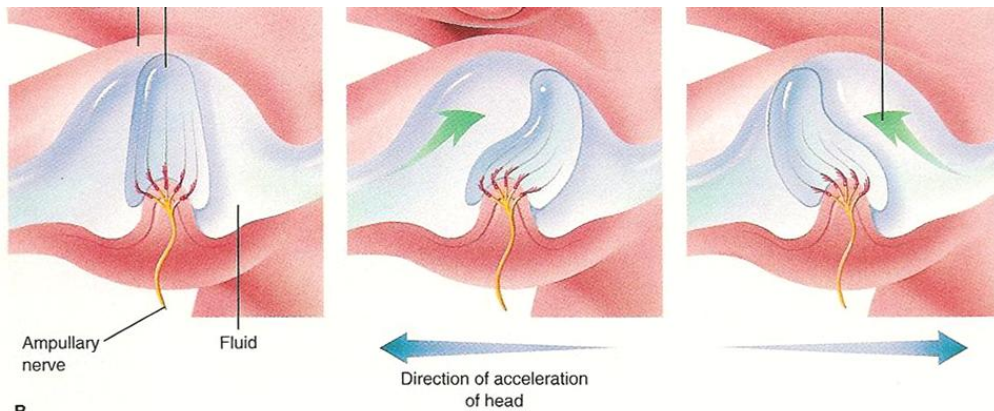
Hair cells



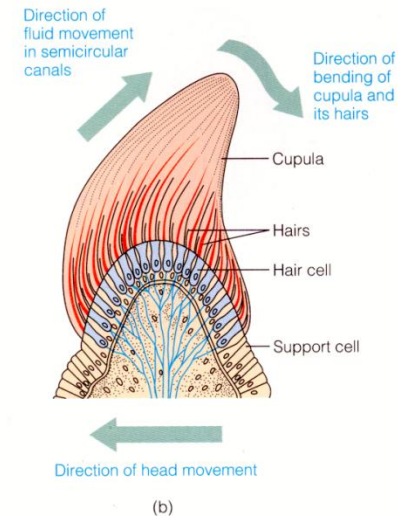
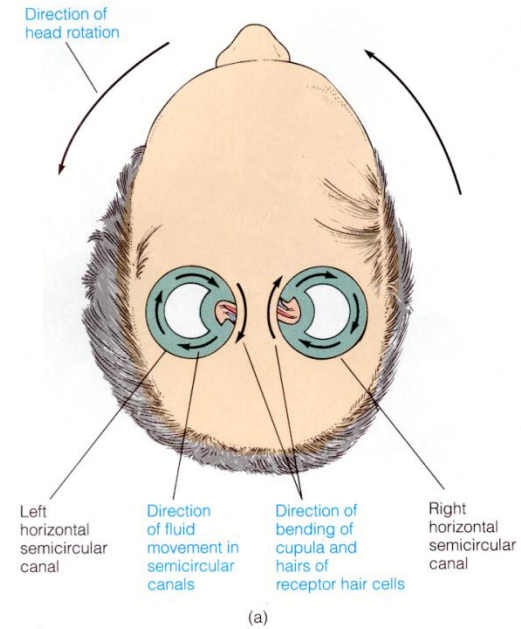
Crista ampullaris = cupula

Door like action

Swings in response to fluid motion of endolymph caused by rotational acceleration > hair cell activation



B

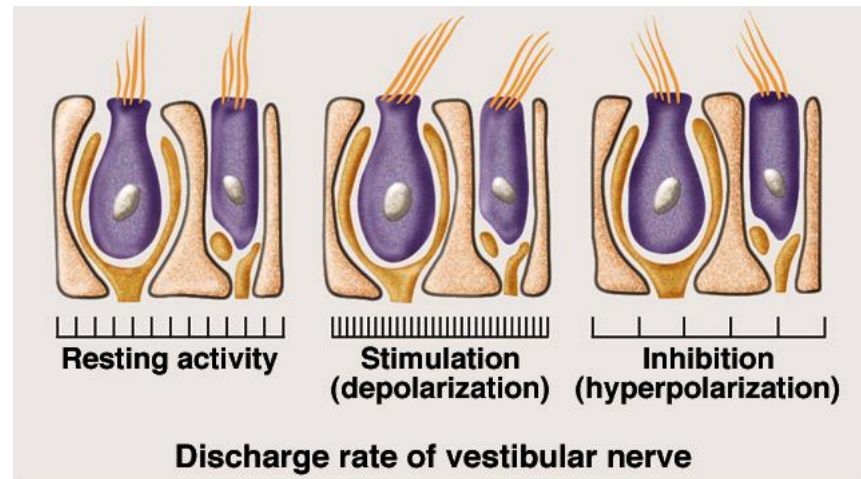


► FIGURE 5-35 Activation of Hair Cells in Semicircular Canals

Hair cells of macula and cupula act as receptor cells

Activation stimulates sensory neurons of vestibular portion of CN VIII

Direction and extent of bending codes for direction and extent of acceleration



Organ of Corti

= receptor for hearing

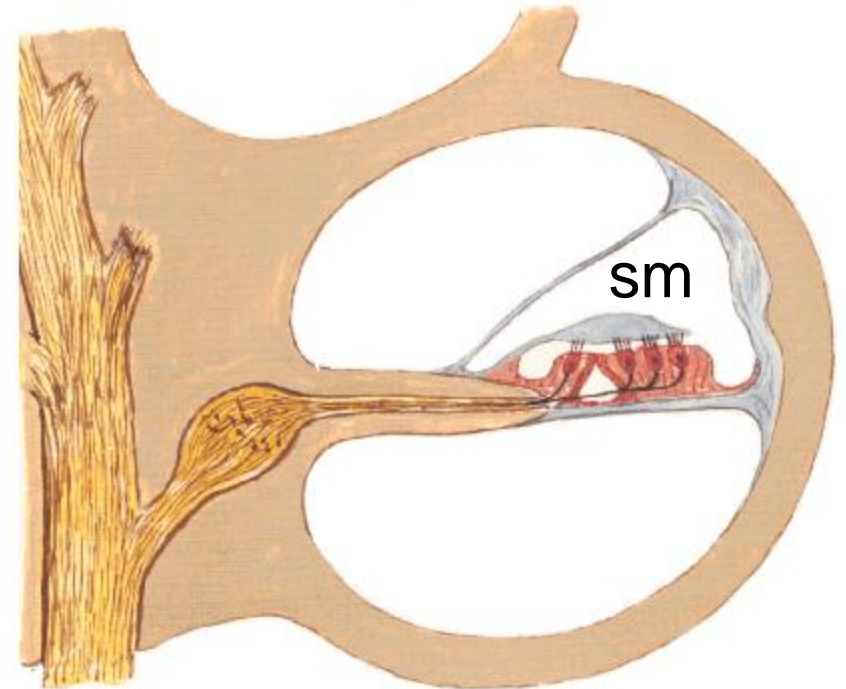
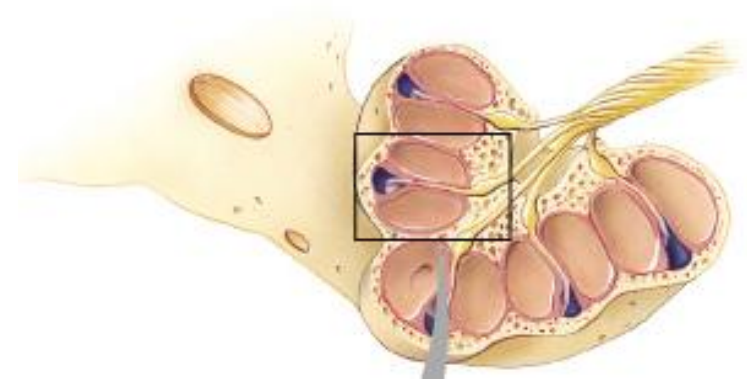
Within cochlear duct

Lumen of cochlear duct =
scala media

Filled with endolymph

Rests on basilar membrane

Organ of Corti is in wall of
scala media and rests on
basilar membrane

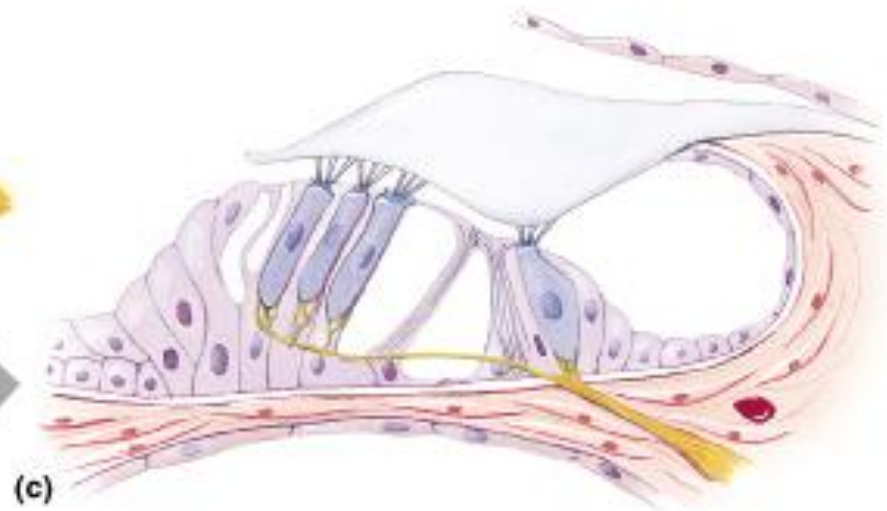
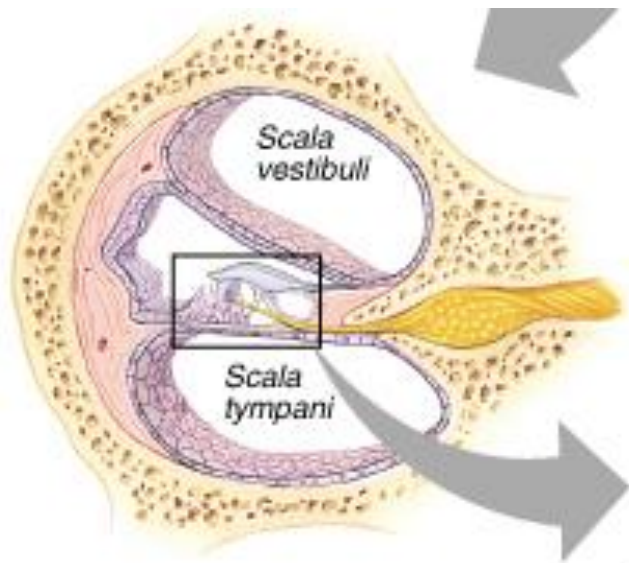
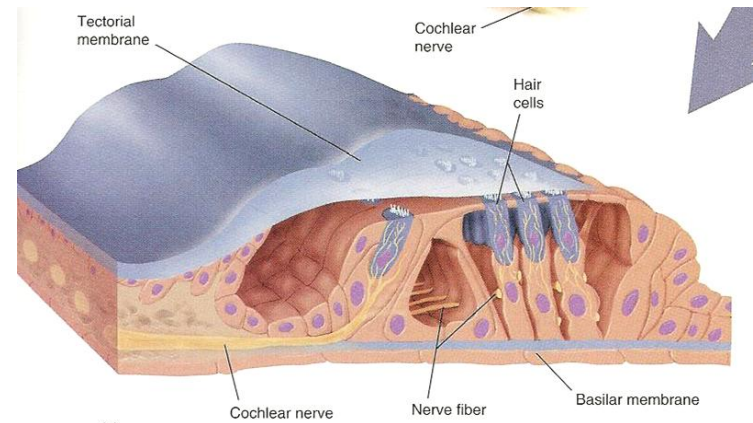


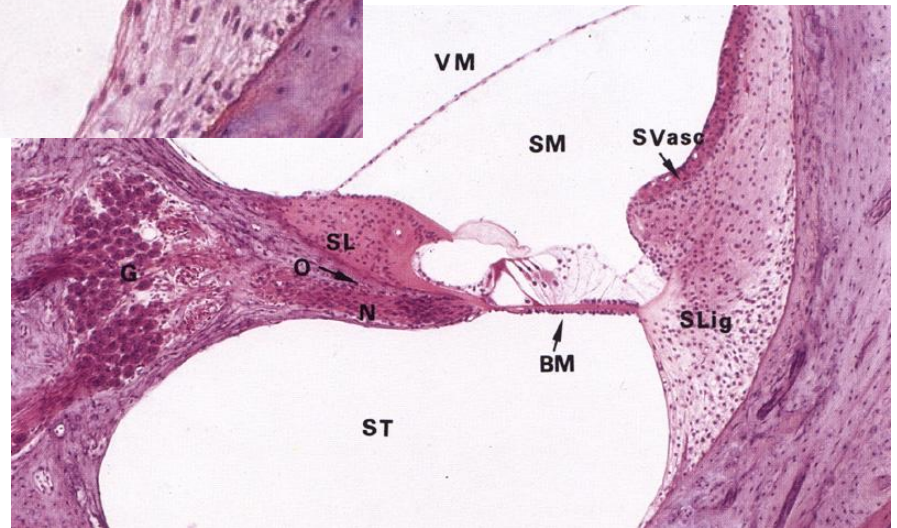
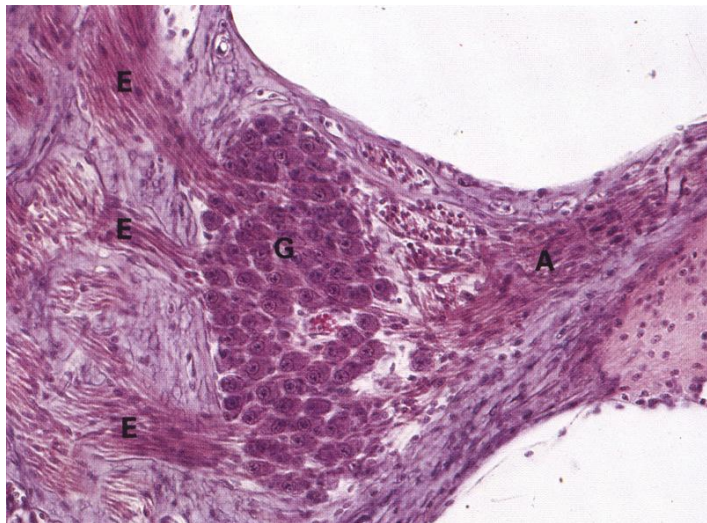
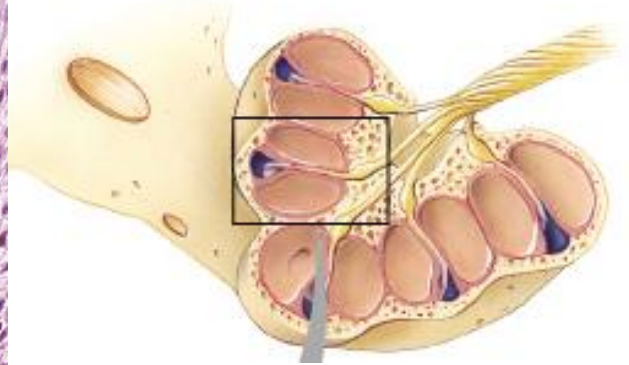
Organ of Corti

Hair cells

Tectorial membrane –
gelatinous material

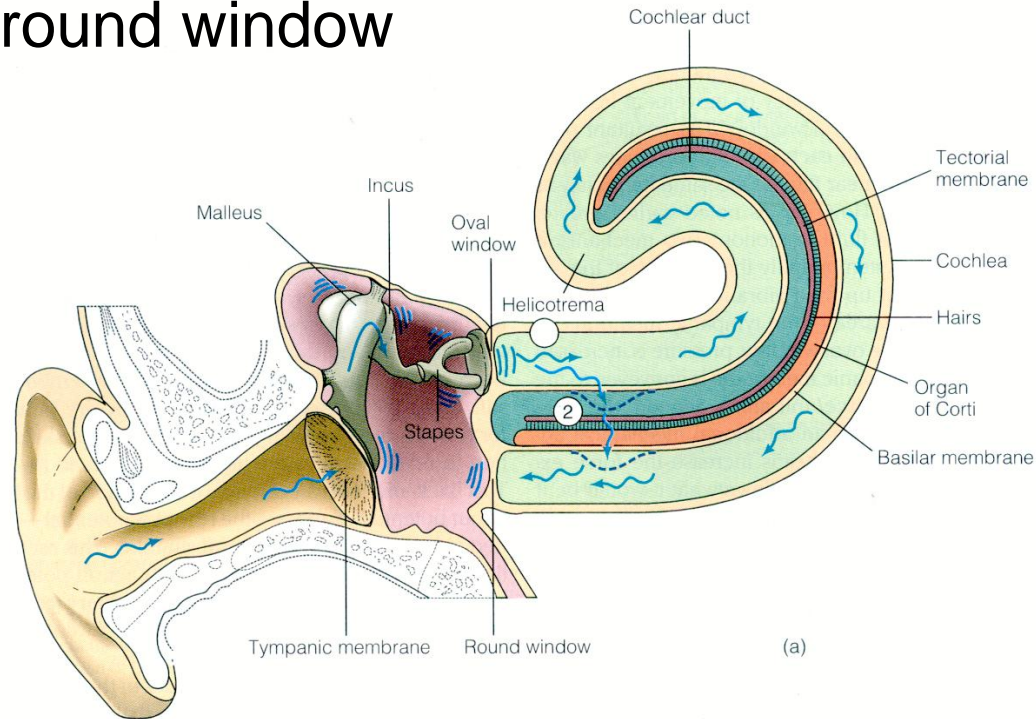
Spiral ganglion





Hearing

- > Vibrate tympanic membrane
- > vibration of ossicles
- > vibration of stapes in oval window
- > waves in perilymph and endolymph in scala vestibuli and scala media
- > vibrations in basilar membrane
- > waves in perilymph of scala tympani
- > dissipated at round window



Distortion of basilar membrane > hairs on hair cells bend in relation to tectorial membrane > generation of action potential

Basilar membrane changes in thickness and width as approach the apex, therefore different parts of the membrane respond to different wavelengths

Activation of different hair cells is interpreted as different sounds

