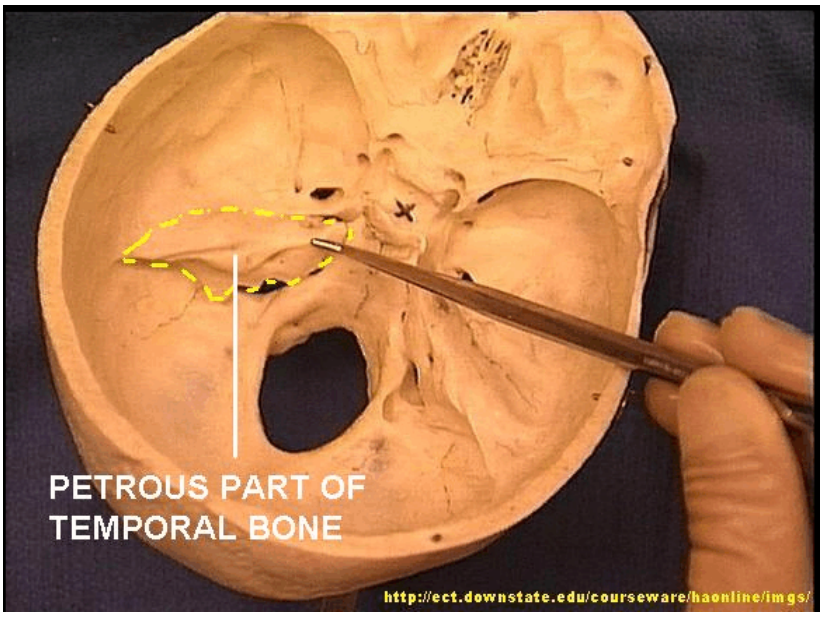
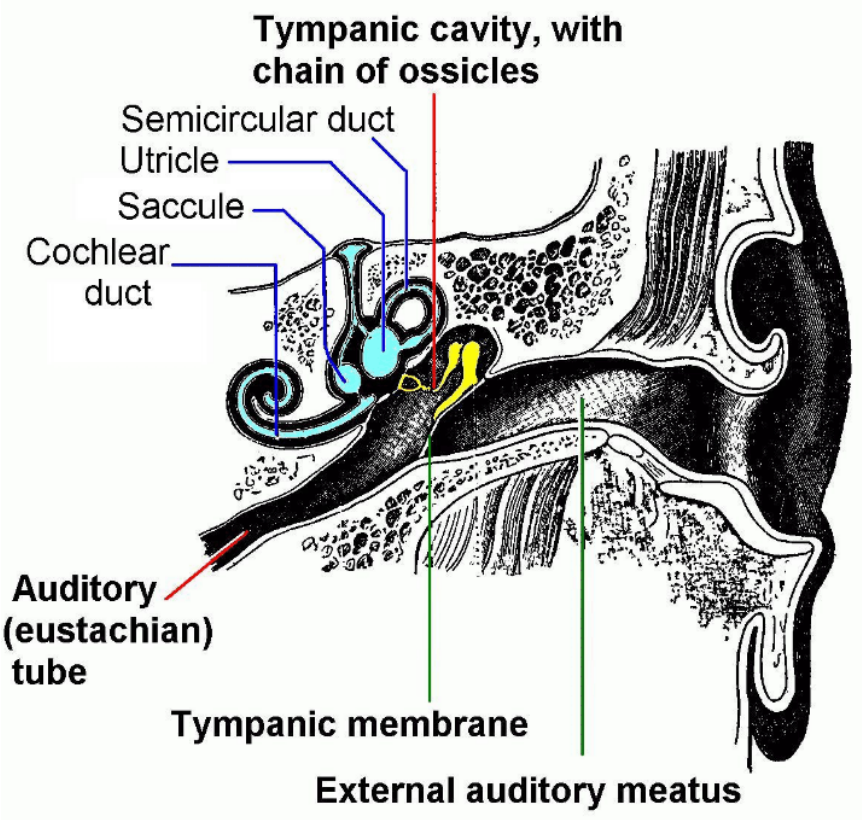
AUDITORY SYSTEM



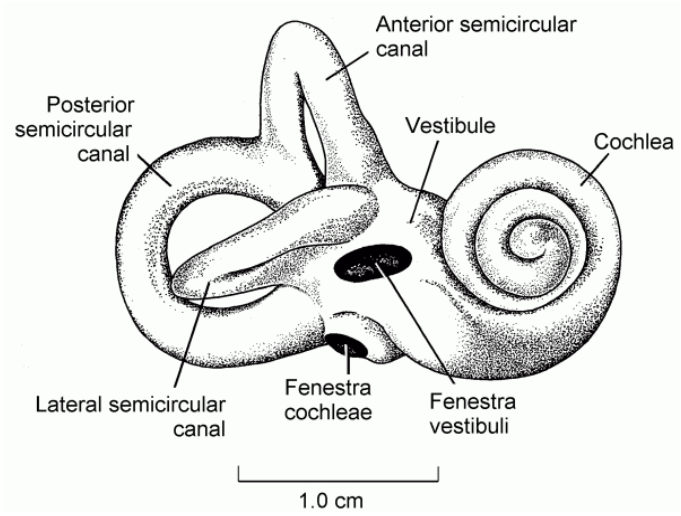
The structures of the **inner ear** are entombed in the **petrous part of the temporal bone**.

Cranial nerves **VII** and both parts of **VII** enter the medial aspect of the bone by way of the **internal auditory meatus**.

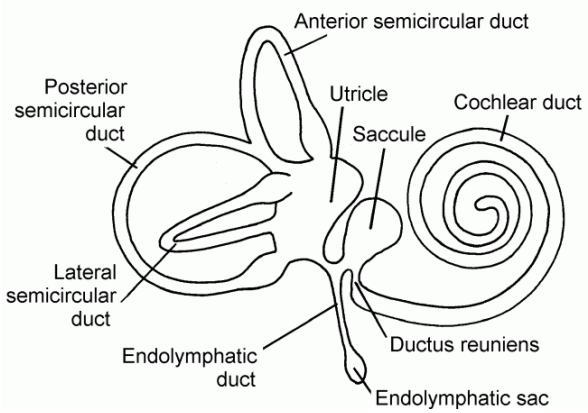


Coronal section through external, middle and inner ear.

Each labelled structure has a function.



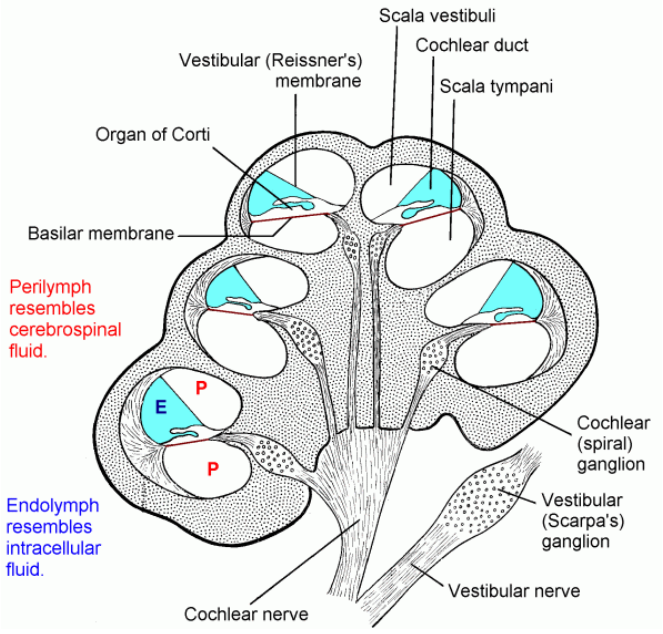
The **bony labyrinth** contains the **membranous labyrinth**, which contains the sensory epithelia of the auditory and vestibular systems.

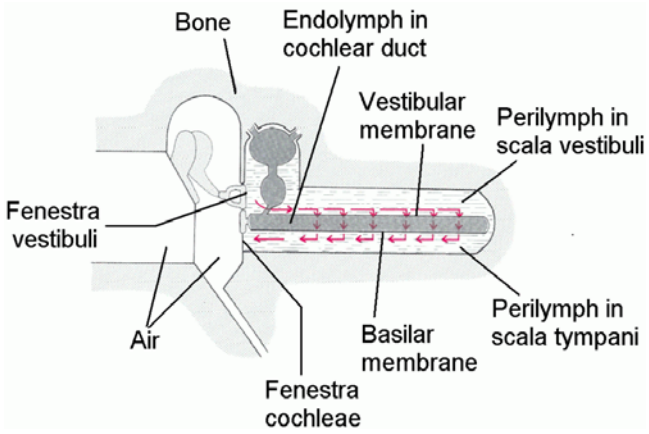


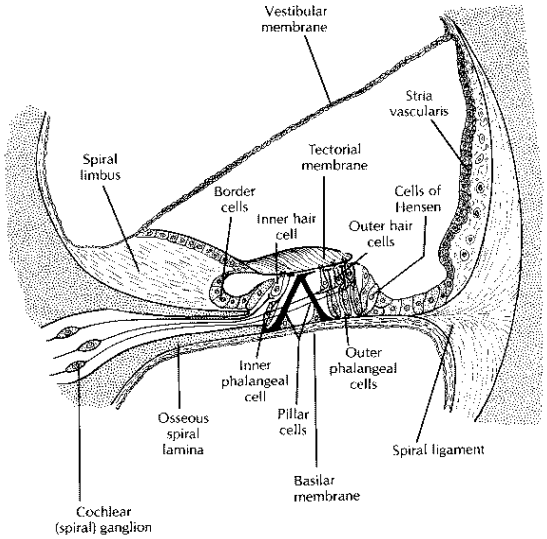
The membranous labyrinth contains **endolymph**, which is secreted in the cochlear duct and absorbed from the endolymphatic duct and sac. Endolymph is similar to cytosol, with high [K^+] and low [Na^+]. **Perilymph** is similar to CSF.

Sound waves enter the scala vestibuli at the base of the cochlea (oval window), pass through Reissner's membrane and the endolymph, and cause vibration of the of the taut collagen fibres of the basilar membrane.

(Endolymph **cyan** in diagram)







At the apex of the cochlea the basilar membrane is wider (longer collagen fibres) than at the base. Shorter fibres vibrate with higher frequencies, so high frequency sound is transduced at the base and low frequency at the apex. Damage from loud noise first affects organ of Corti at the the base of the cochlea, causing high-tone deafness.

Sound = Compression waves

Can travel through air, liquid or solid

Compression waves in air make the tympanic membrane vibrate.

Ossicle chain amplifies force of vibration X15 from T.M. to fenestra vestibuli (oval window), where the sound is passed from the footplate of the stapes to the perilymph in the scala vestibuli.

Muscles (tensor tympani [V] and stapedius [VII]) protect against loud noise.

Vibration passes from perilymph in scala vestibulae, across vestibular membrane into endolymph of cochlear duct, then across basilar membrane into perilymph of scala tympani.

Fenestra cochleae (round window is elastic membrane that separates the perilymph of the scala tympani from the air in the tympanic cavity.

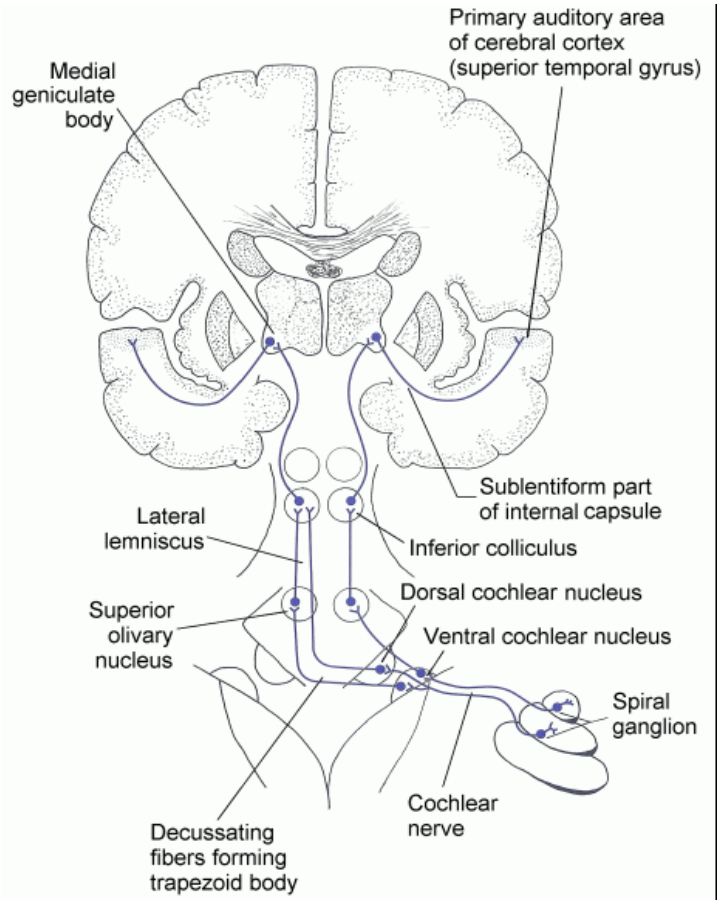
The basilar membrane is narrowest at the base of the cochlea (near the stapes) and becomes progressively wider towards the apex of the cochlea.

Its taut collagen fibres vibrate (resonate) in response to sound.

The shorter fibres resonate with high frequencies; the longer fibres with lower (bass) frequencies.

1. **Tonotopic representation along the basilar membrane.**
2. **Noise causes high frequency deafness, because high pitches resonate nearest to the oval window.**

ASCENDING AUDITORY PATHWAY



(From Kiernan JA 1987. *Introduction to Human Neuroscience*. Philadelphia: Lippincott.)

Bilateral through ventral cochlear nucleus.

Crossed, through dorsal cochlear nucleus.

SUPERIOR OLIVARY NUCLEUS COMPARES TIMES OF ARRIVAL OF SOUNDS IN THE TWO EARS.

First step in binaural (stereophonic) hearing.

UNILATERAL LESIONS ABOVE THE LEVEL OF THE COCHLEAR NUCLEI DO NOT CAUSE UNILATERAL HEARING LOSS.

Cortical lesions can impair ability to localize sources of sounds.

Tonotopic representation throughout the system, from cochlea to cerebral cortex.
