Hearing (Practical)

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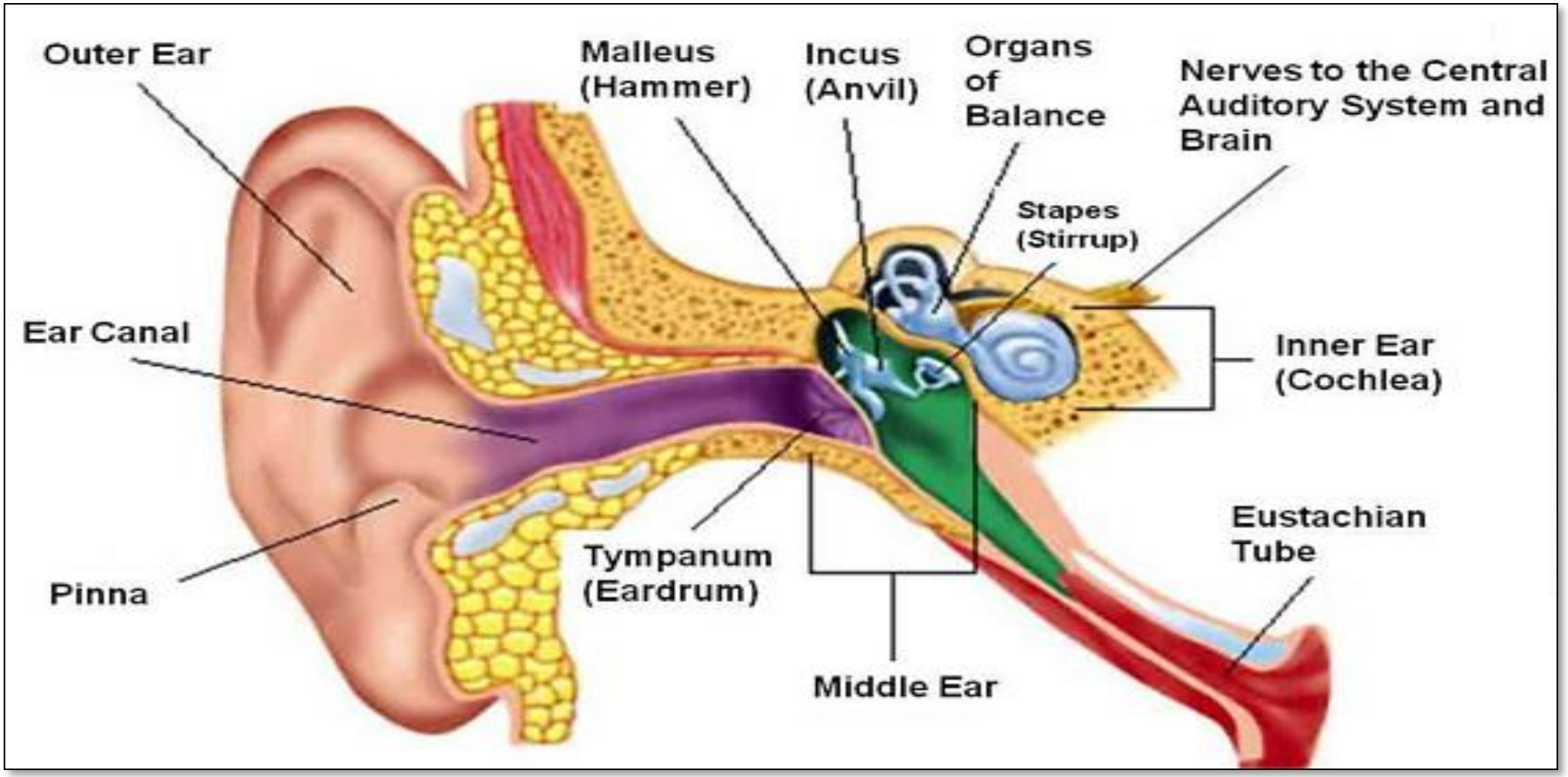
❖ The human ear is divided into 3 parts

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

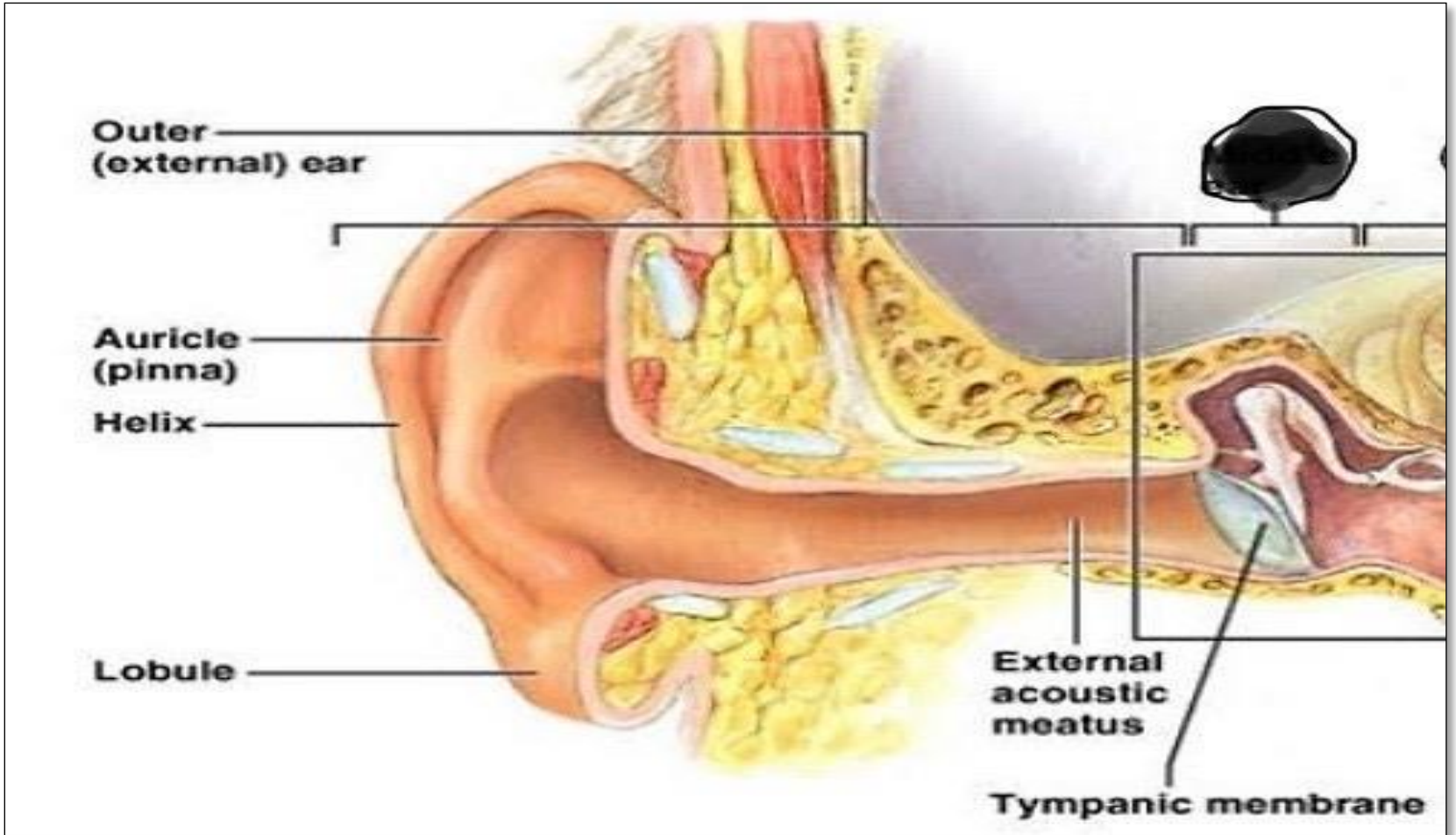


External Ear:

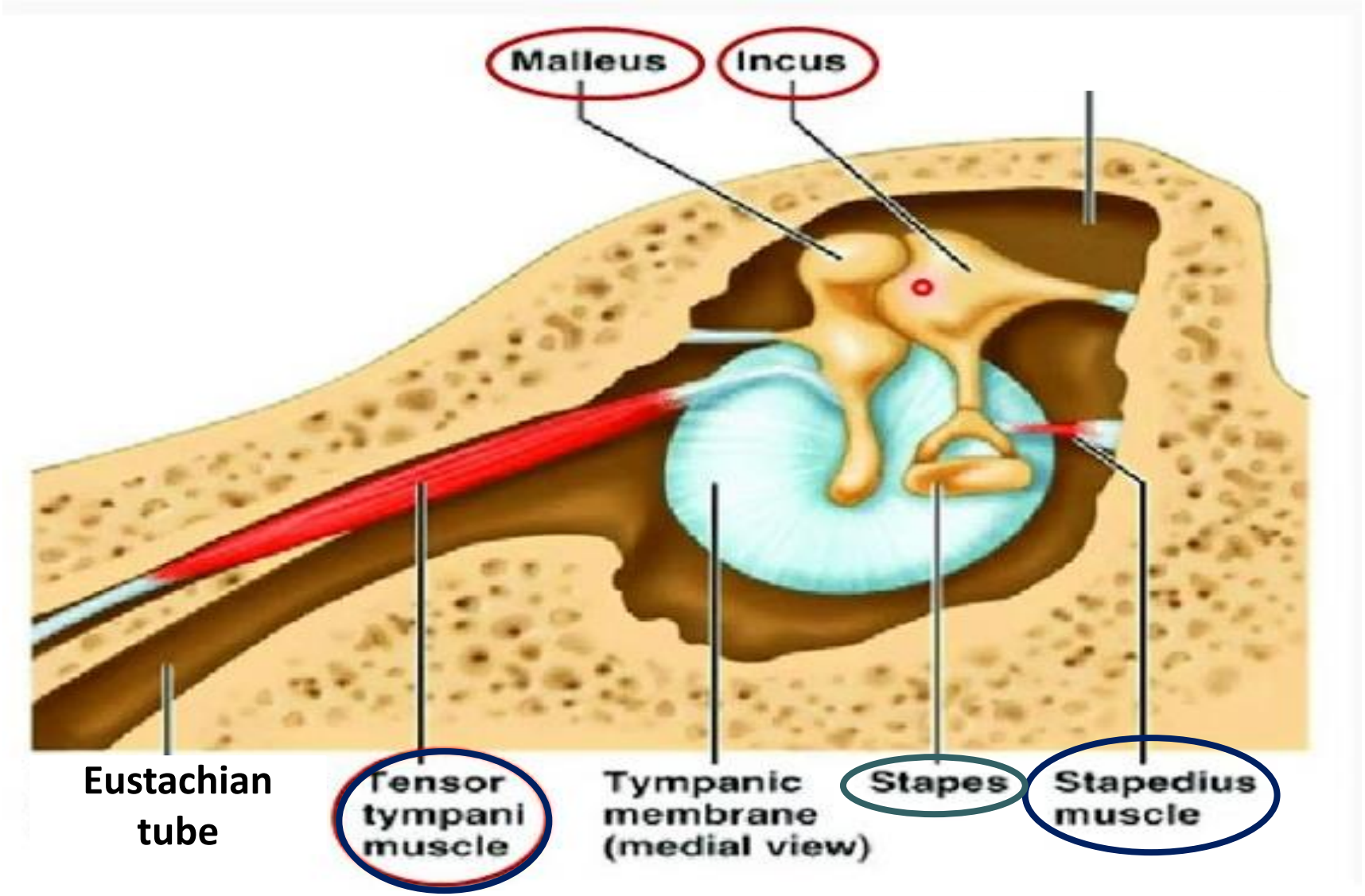
1- Ear pinna (auricle)

2- External auditory meatus / canal

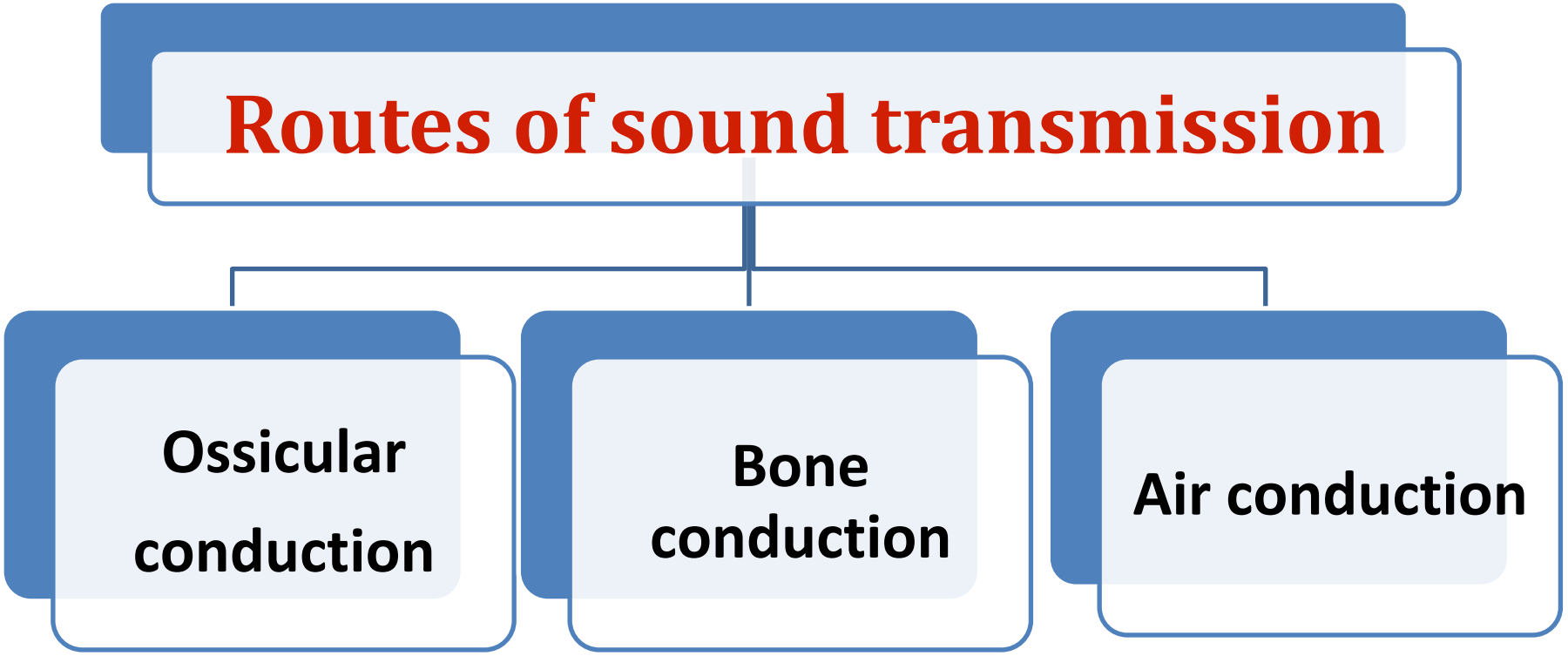
3- Tympanic membrane



Middle ear


Malleus
Incus
Eustachian tube
Tensor tympani muscle
Tympanic membrane (medial view)
Stapes
Stapedius muscle

Routes of sound transmission



1) Ossicular route:

- It is the rout that occurs in healthy normal ear.
- Mediated via tympanic membrane ⇨ **3 ossicles** ⇨ **oval** window.
- It gives optimum and best hearing sensations. (**22 times magnification**).

2) Air route:

- It is inefficient & gives weak sensations.
- Occurs when tympanic membrane and bony ossicles are destroyed.
- Sound waves cause vibration of the **secondary tympanic membrane** that covers the **round window** ⇨ vibrations are transmitted to the fluid of the inner ear ⇨ vibration of the basilar membrane.

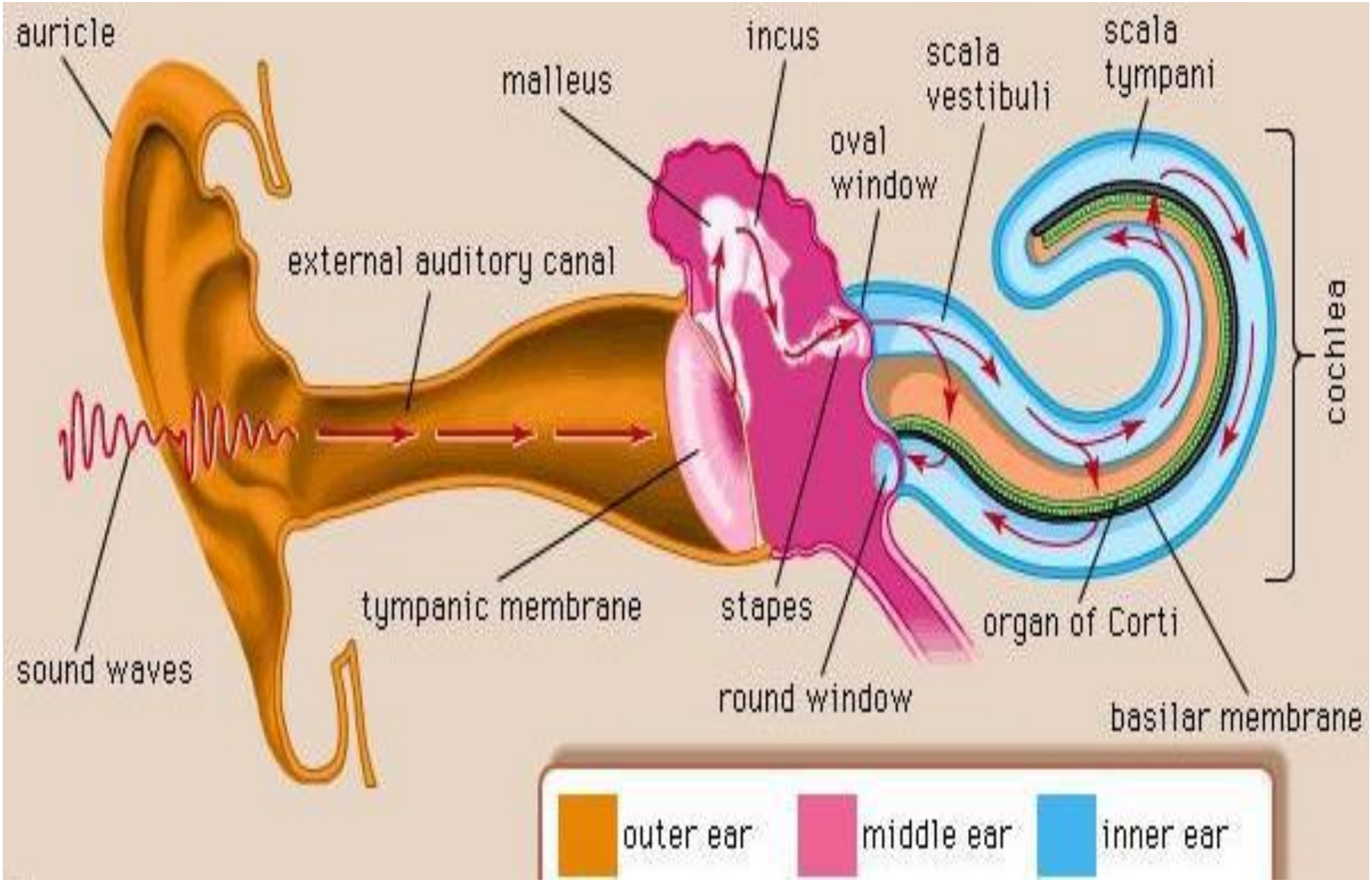
3) Bone route or bone conduction:

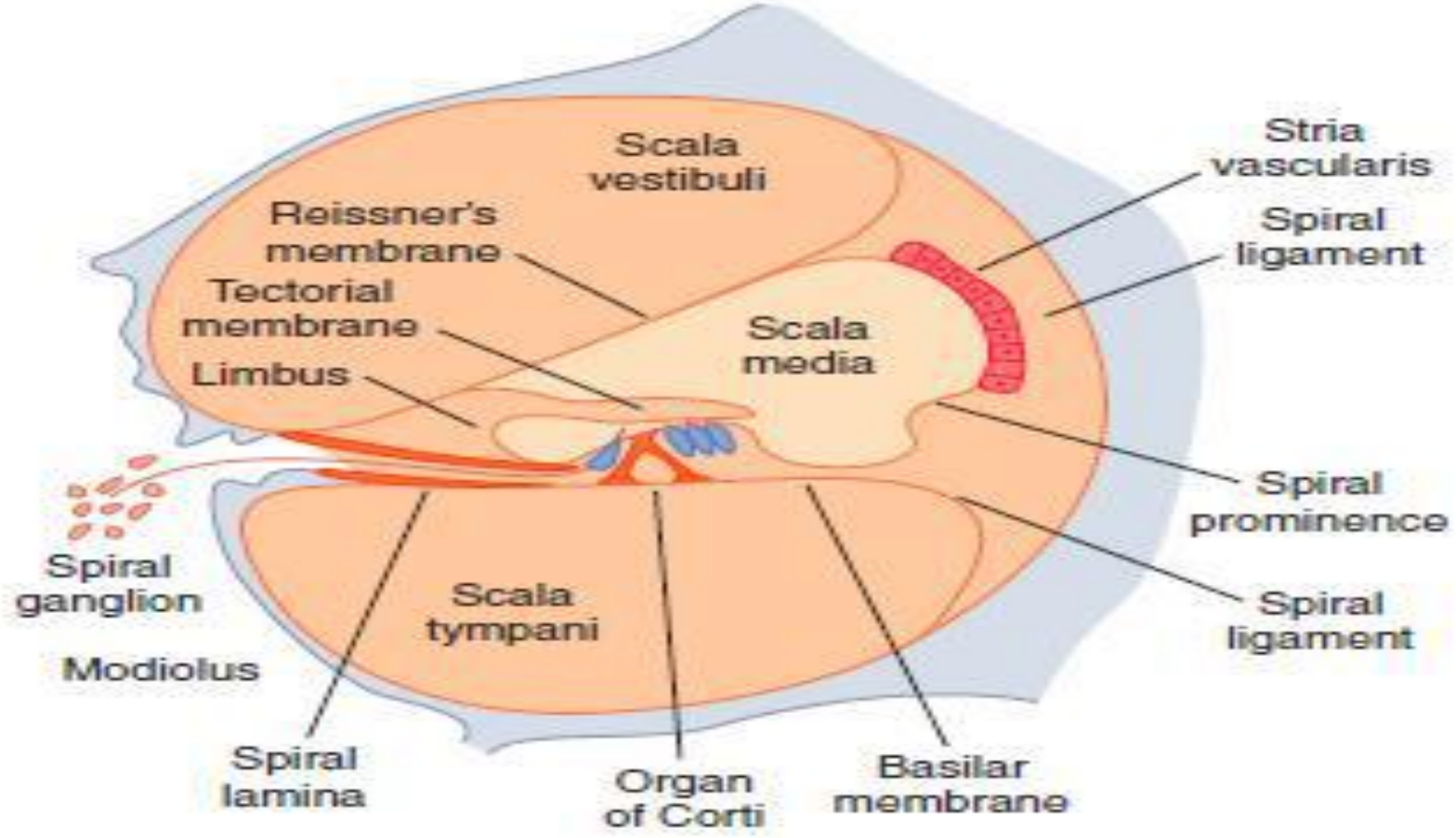
- It is inefficient in comparison to ossicular route.
- Vibrations in bones ⇨ transmitted to the fluid in the inner ear.
- It occurs either by:

a) Extreme loud sound.

b) Application of **vibrating objects** on skull or mastoid (tuning fork).

- **Bone conduction is better in case of conductive deafness. (no masking)**


auricle
malleus
incus
scala vestibuli
scala tympani
oval window
external auditory canal
cochlea
tympanic membrane
stapes
organ of Corti
sound waves
round window
basilar membrane
outer ear
middle ear
inner ear


Scala vestibuli
Stria vascularis
Reissner's membrane
Spiral ligament
Tectorial membrane
Scala media
Limbus
Spiral prominence
Spiral ganglion
Scala tympani
Spiral ligament
Modiolus
Spiral lamina
Organ of Corti
Basilar membrane

Deafness

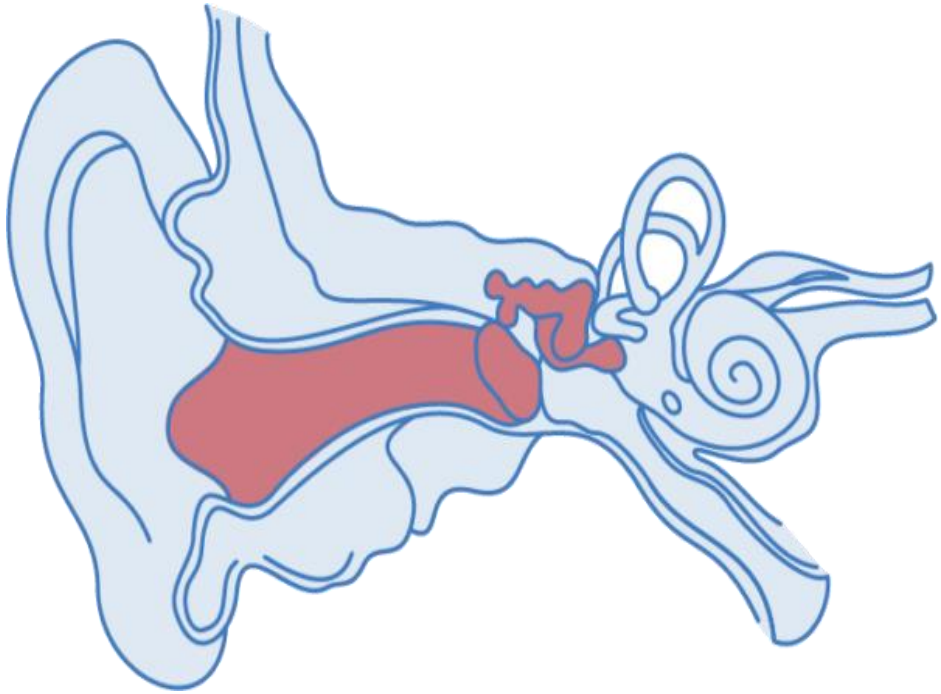
Definition: It is impairment of auditory acuity either partial or complete.

- **Types of deafness:**

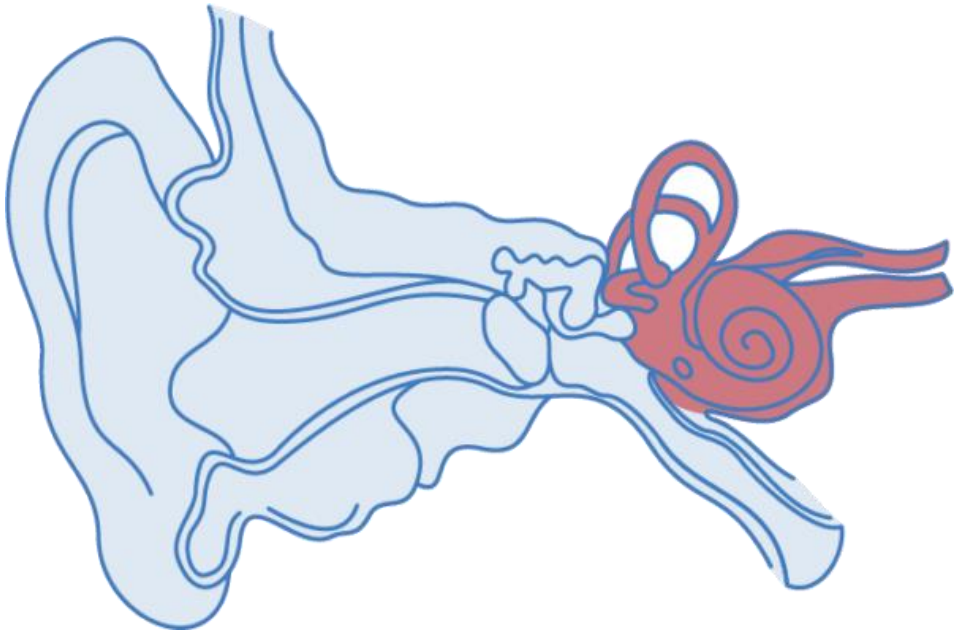
	Conductive deafness	Perceptive deafness
Causes	Block of sound waves **conduction** from external ear till the oval window by: 1) **Obstruction in external auditory canal** like wax, insects, fungus or foreign bodies. 2) **Rupture drum**. 3) **Otitis externa** or **otitis media** 4) ***Tumor*** *in external or middle ear* 5) **Eustachian tube obstruction** as in common cold, tonsillitis & adenoid. 6) **Presbyacusis (senile deafness)** i.e. loss of mobility of bony ossicles due to aging process. **Otosclerosis.**	Defect in auditory **impulse transmission** from the cochlea till auditory Cortex due to: 1) **Chronic exposure** to high pitched sound (damage of hair cells). 2) **Sudden exposure** to very high sound like gun shot. 3) **Drugs** as streptomycin → irreversible damage of hair cells. 4) **Meniere's disease** (↑ endolymph pressure). 5) **Vascular lesion in auditory pathway** (thrombosis or hemorrhage). 6) Tumor or Trauma in the brain. 7) **Auditory cortex lesion** as vascular lesions, **meningitis, encephalitis** & **CO poisoning.** 8) **Genetic deafness:** abnormality in myosin IV & myosin VII (important for Motility of cilia in hair cells).

Deafness

Conductive deafness

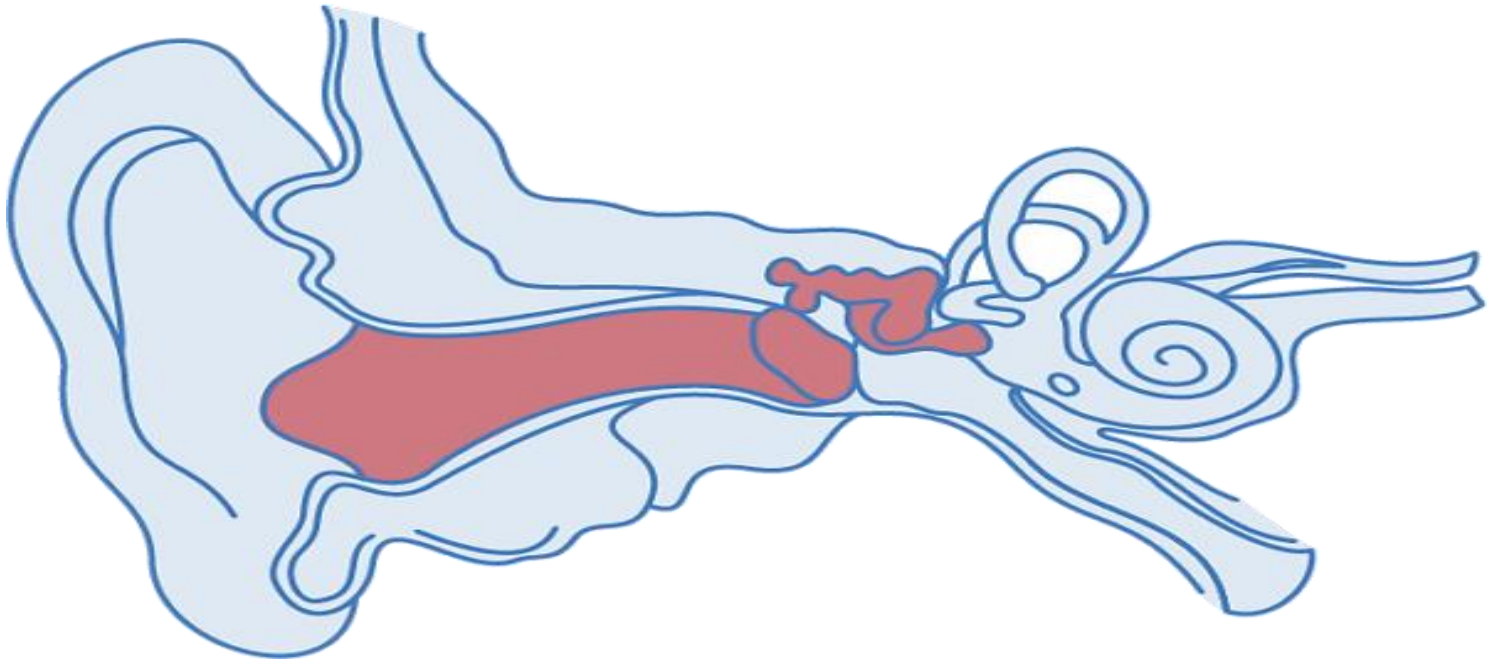


Nerve / perceptive/ sensineural deafness



Conductive deafness

- Occurs due to interference with the conduction of sound waves from external ear till the oval window.

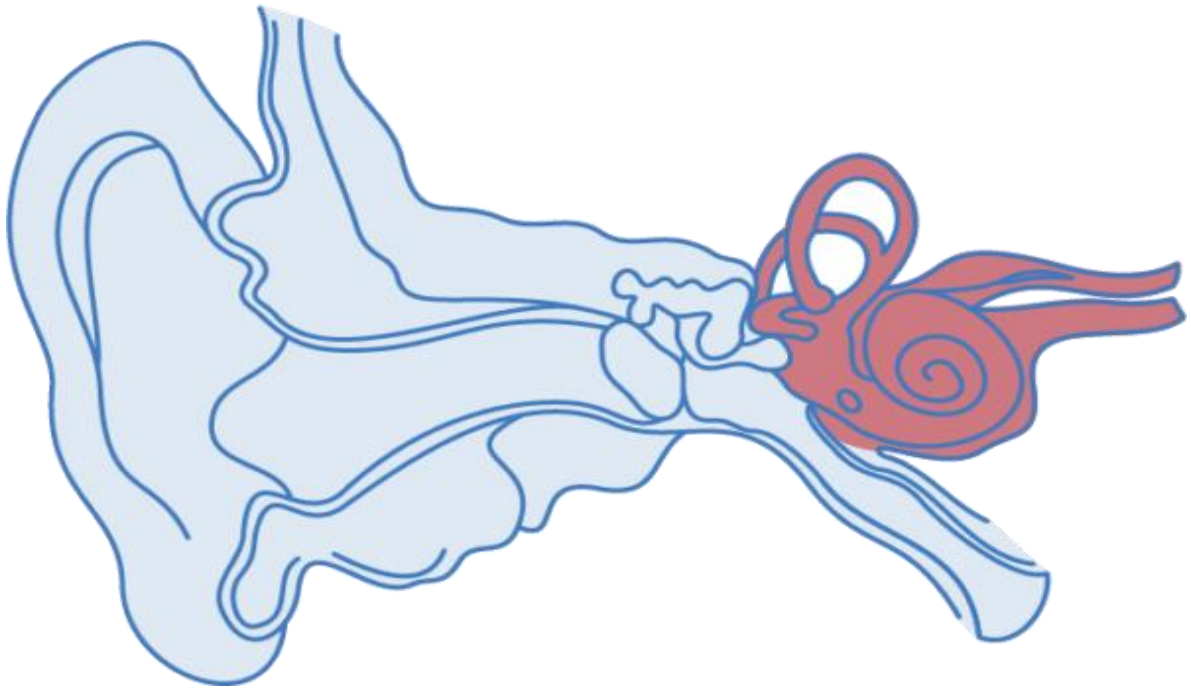


Criteria of conductive deafness

- Bone conduction >> Ossicular conduction.
- Patient speaks at low voice (because he hears his sound magnified).

Nerve (Perceptive) deafness

Occurs due to interference with auditory transmission from oval window till the auditory cortex.



Criteria of nerve deafness

- Ossicular conduction>> Bone conduction But both ossicular & bone conduction are reduced than normal.
- Patient speaks at high voice

Diagnosis of deafness

- Watch test.
- Hearing tests.
- Audiometry.

Hearing tests

Hearing tests

Definition: comparative tests to diagnose type of deafness, either conductive deafness or perceptive deafness .

Types:

1) Rinne's test.
2) Weber test.
3) Schwabach's test.

512 Hz
tuning fork

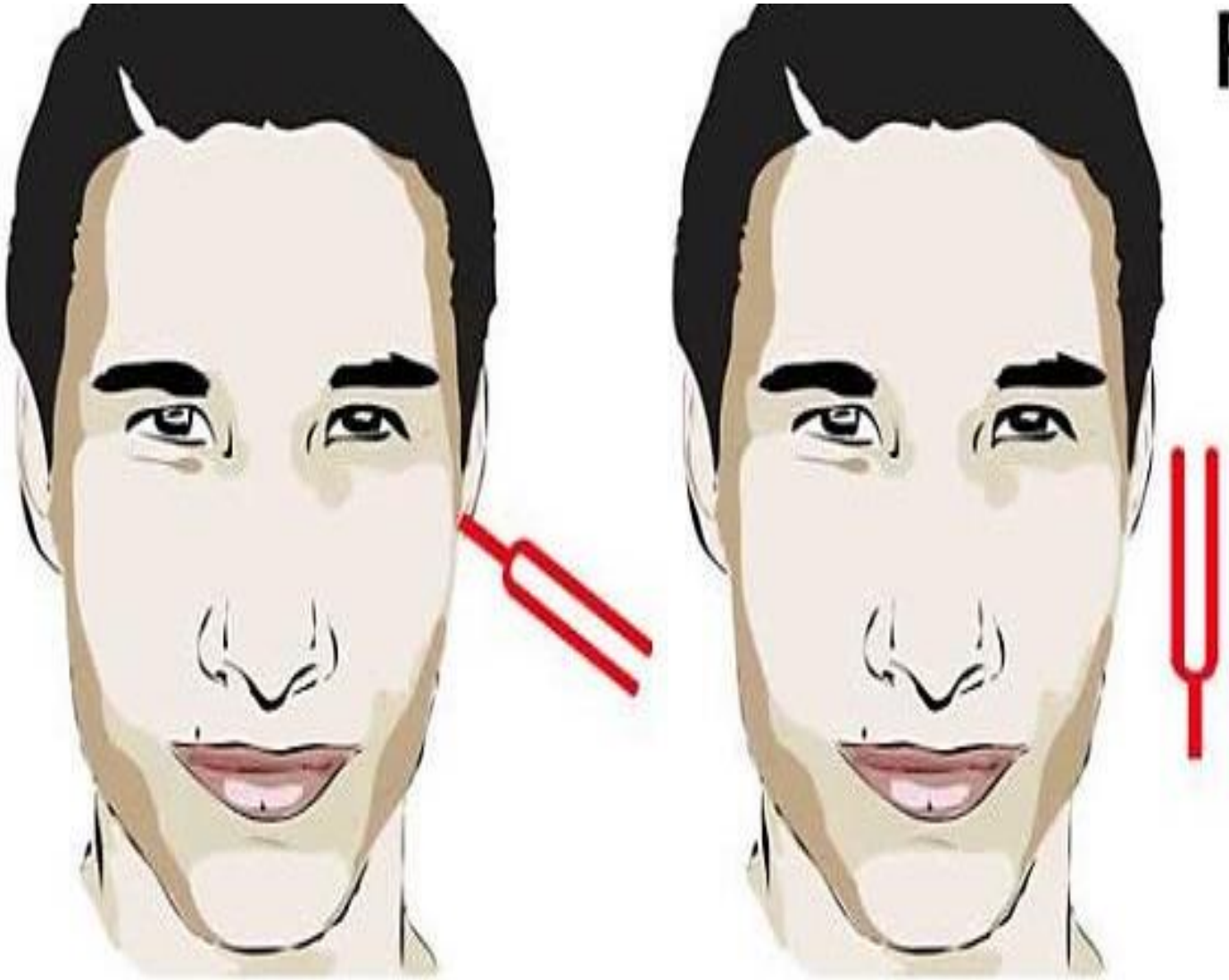
Rinne's test

- Compare between ossicular conduction & bone conduction in same person each ear separately.

-Results

- Normally: Ossicular conduction is better than bone conduction for 45 sec **(Rinne +ve).**
- Conductive deafness: Bone conduction is better than ossicular conduction **(Rinne –ve)**
- Perceptive deafness: Ossicular conduction is better than bone conduction, but both are reduced **(Reduced Rinne)**

Rinne's Test



With a 512 Hz tuning fork press against the mastoid bone and then hold it 1cm away from the ear.

'Which is louder, behind the ear or in front?'

Weber test

- Compare bone conduction between the two ears, in the same person.

- Results:

- Normally: The sound is heard equally in both ears.
- Conductive deafness: Sound is louder in diseased ear (due to absent masking effect of noise on diseased ear).
- Perceptive deafness: Sound is louder in normal ear.

Schwabach's test

- Compare bone conduction between two persons: patient & examiner, Provided that, the examiner is normal.

-Results:

- Normally: Equal time of hearing.
- Conductive deafness: Patient is better (due to absent masking effect of noise on diseased ear).
- Perceptive deafness: Examiner is better i.e.; the patient stops hearing before the examiner.

Weber Test	• Compare bone conduction in both ear.
Rinne Test	• Compare air and bone conduction.
Schwabach's Test	• Compare bone conduction between the subject &the examiner provided that the examiner is normal.

2-Audiometry

- This instrument can generate sound waves of different frequencies from lowest to highest.
- Intensity (loudness or volume) of sound at each frequency is adjusted based on previous studies in normal persons.
- Thus, before calibrating the instrument, minimum (threshold) volume or intensity or loudness, for each frequency of sound heard by normal persons is determined.
- Minimum intensity is set in the instrument as zero. Now, while testing the patient, the loudness is increased above zero level
- Intensity of sound is expressed in decibel (dB).

- The audiometry tests are conducted in a quiet sound-proof room. Earphones will be placed on your head. You will be asked to sit still and not talk.
- The earphones are connected to audiometer that will deliver the tones and different sounds of speech to your ears.
- In audiometer, in addition to being equipped with an earphones for testing air conduction by the ear, is equipped with a mechanical vibrator for testing bone conduction from the mastoid process of the skull into the cochlea.

- At a particular frequency, if the patient hears the sound with loudness of **30 dB** above zero level, the person is said to have **hearing loss of 30 dB** for that frequency.
- During the tests by audiometer, the subject's ability to hear the sounds with 8 to 10 different frequencies is observed and the hearing loss is determined for each frequency.
- By using these values, the audiogram is plotted.

❖Hearing loss is often described as follows:

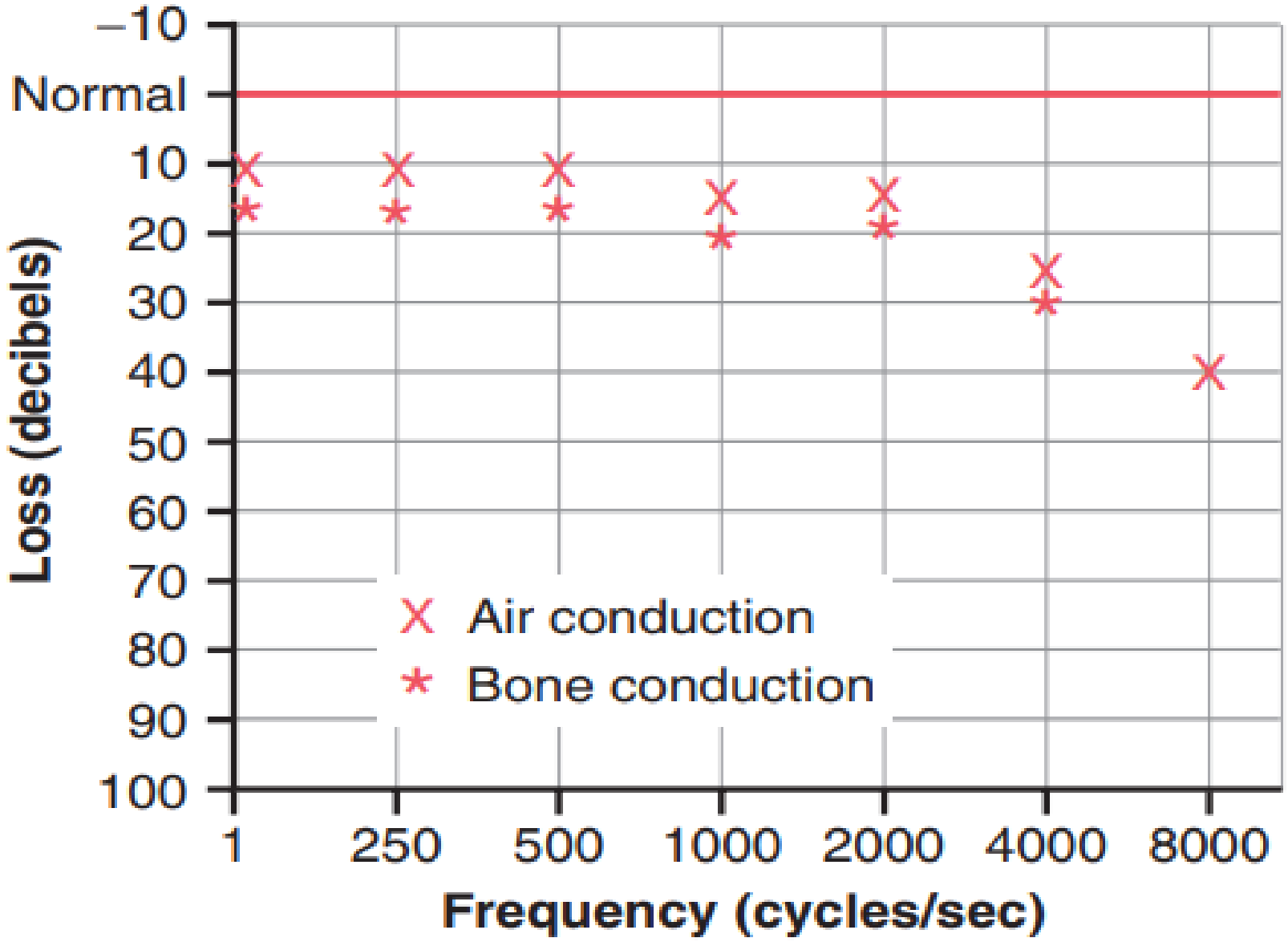
-Normal = less than 25 dB HL.

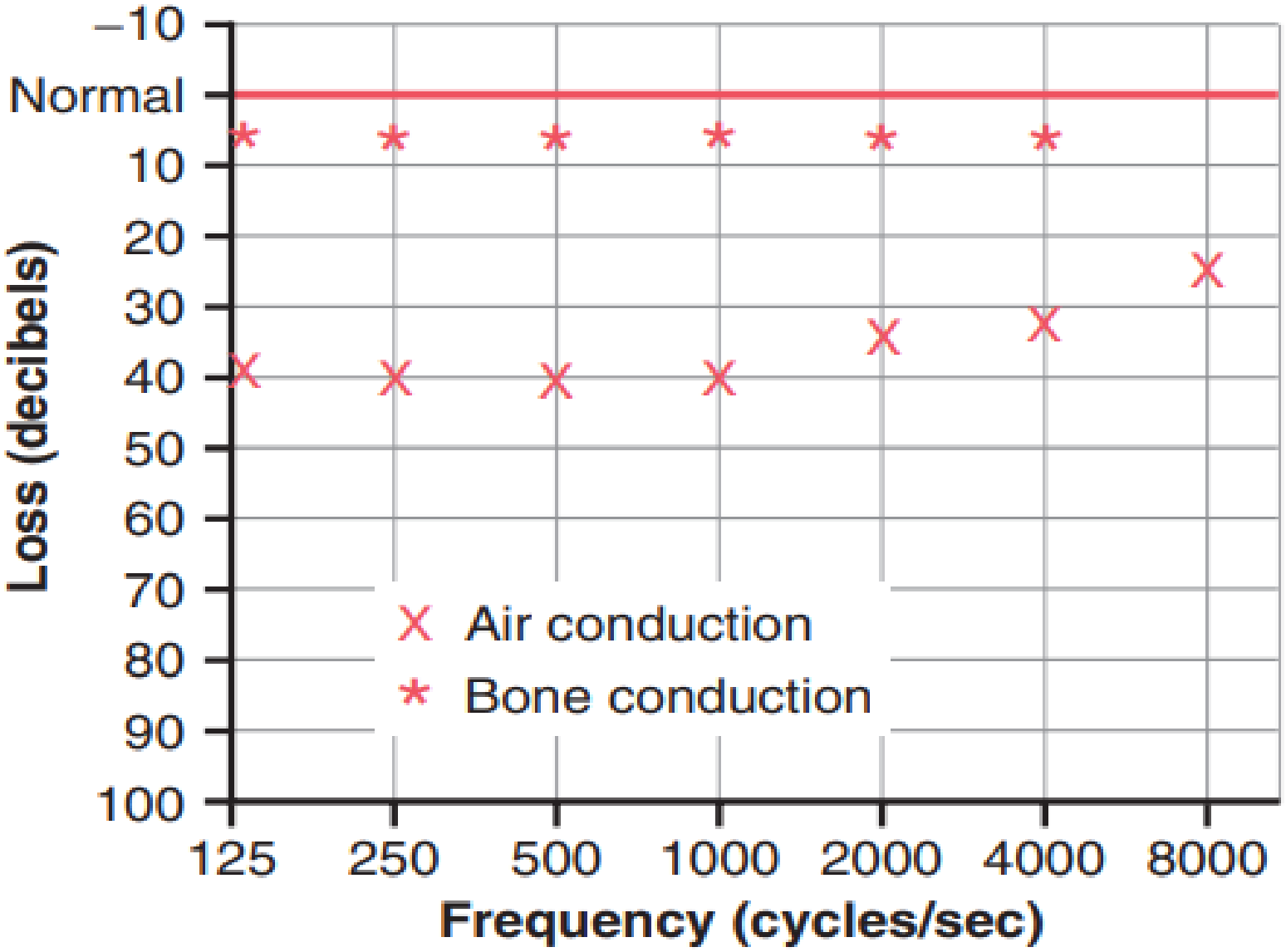
-Mild = 25-40 dB HL.

-Moderate = 41-65 dB HL.

-Severe = 66-90 dB HL.

-Profound = more than 90 dB HL.


−10
Normal
10
20
30
40
50
60
70
80
90
100
Loss (decibels)
X Air conduction
* Bone conduction
1
250
500
1000
2000
4000
8000
Frequency (cycles/sec)


−10
Normal
10
20
30
40
50
60
70
80
90
100
Loss (decibels)
Air conduction
Bone conduction
125
250
500
1000
2000
4000
8000
Frequency (cycles/sec)


THANK YOU