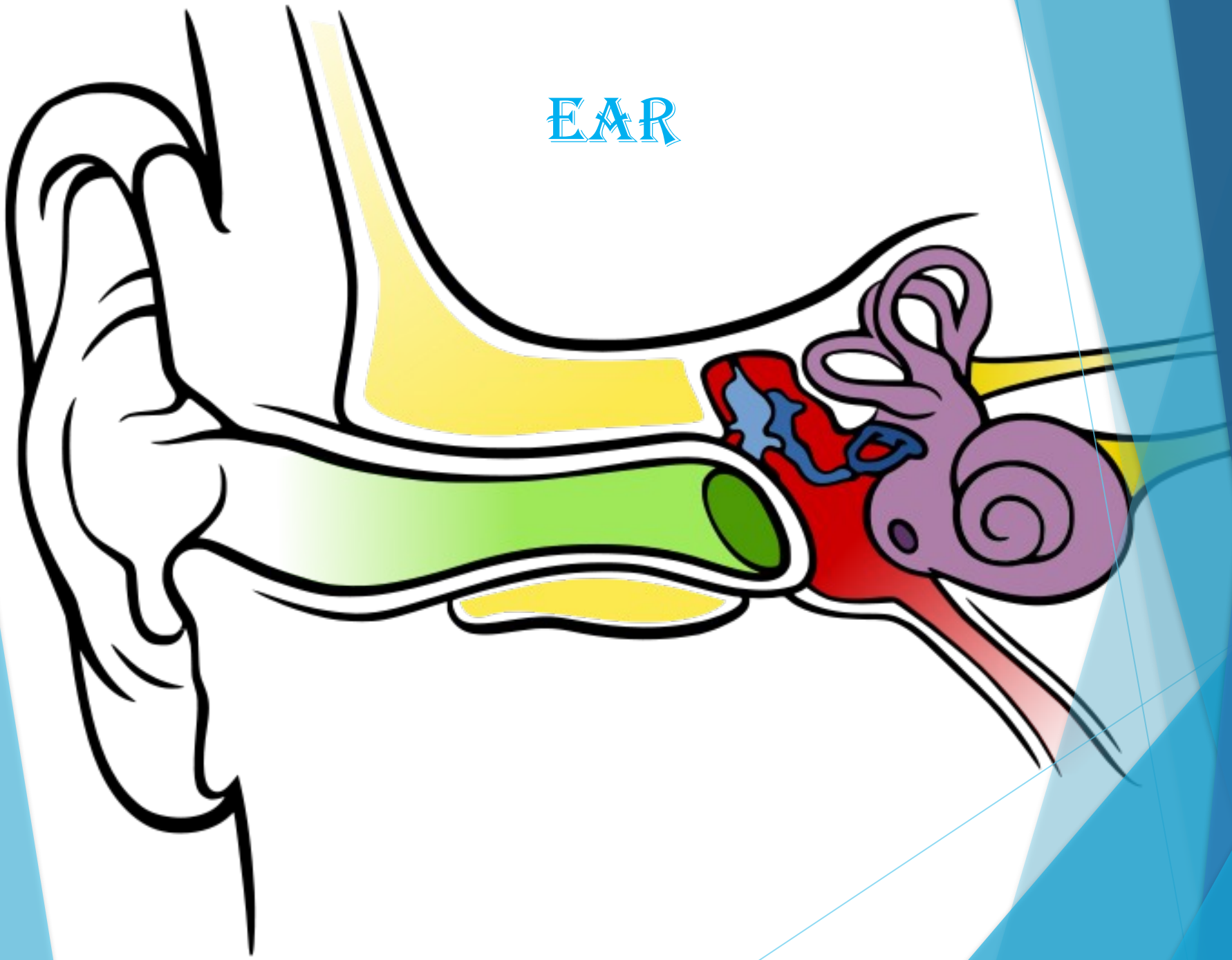
EAR



OVERVIEW

- The ear is a sensory organ with dual functions—hearing and balance. The sense of hearing is essential for normal development and maintenance of speech as well as the ability to communicate with others. Balance, or equilibrium, is essential for maintaining body movement, position, and coordination.

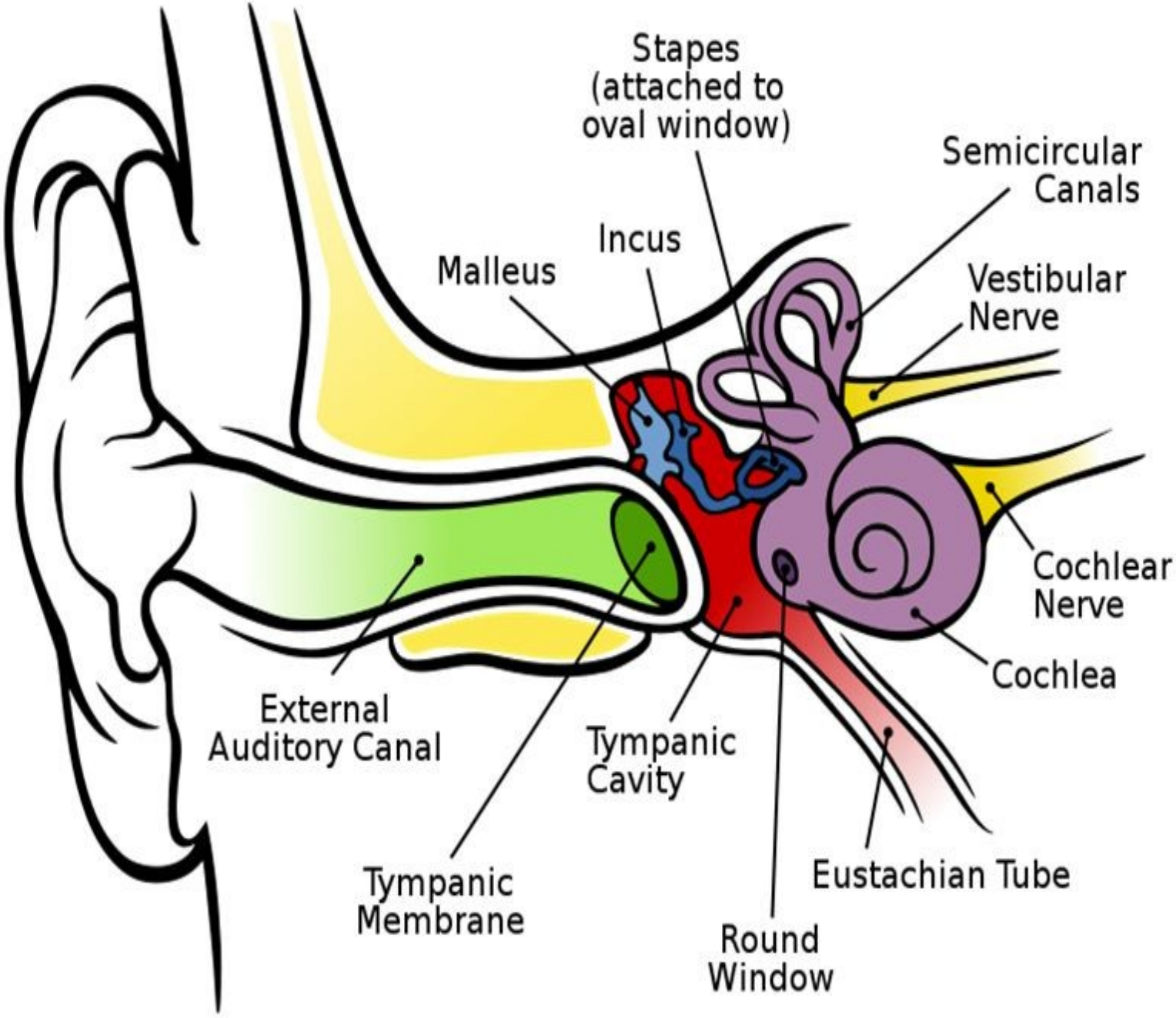
- **It is supplied by the 8th cranial nerve i.e. the cochlear part of the vestibulocochlear nerve, which is stimulated by vibrations caused by sound waves.**

STRUCTURE

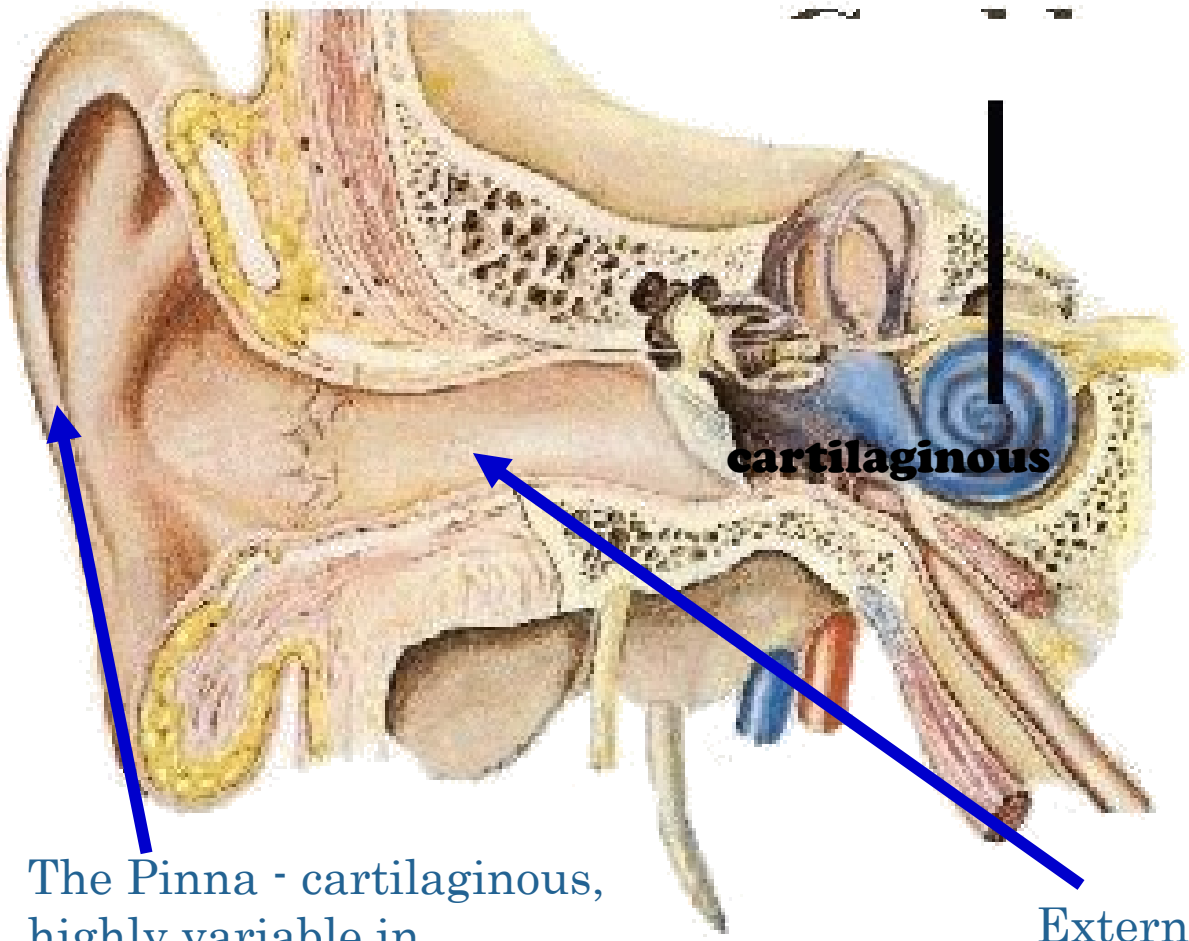
- **Outer Ear**
- **Middle Ear**
- **Inner Ear**
- **Central Auditory Nervous System**

ANATOMY OF THE EXTERNAL EAR

- **The external ear includes the auricle (pinna) and the external auditory canal .The external ear is separated from the middle ear by a disk-like structure called the tympanic membrane (eardrum).**

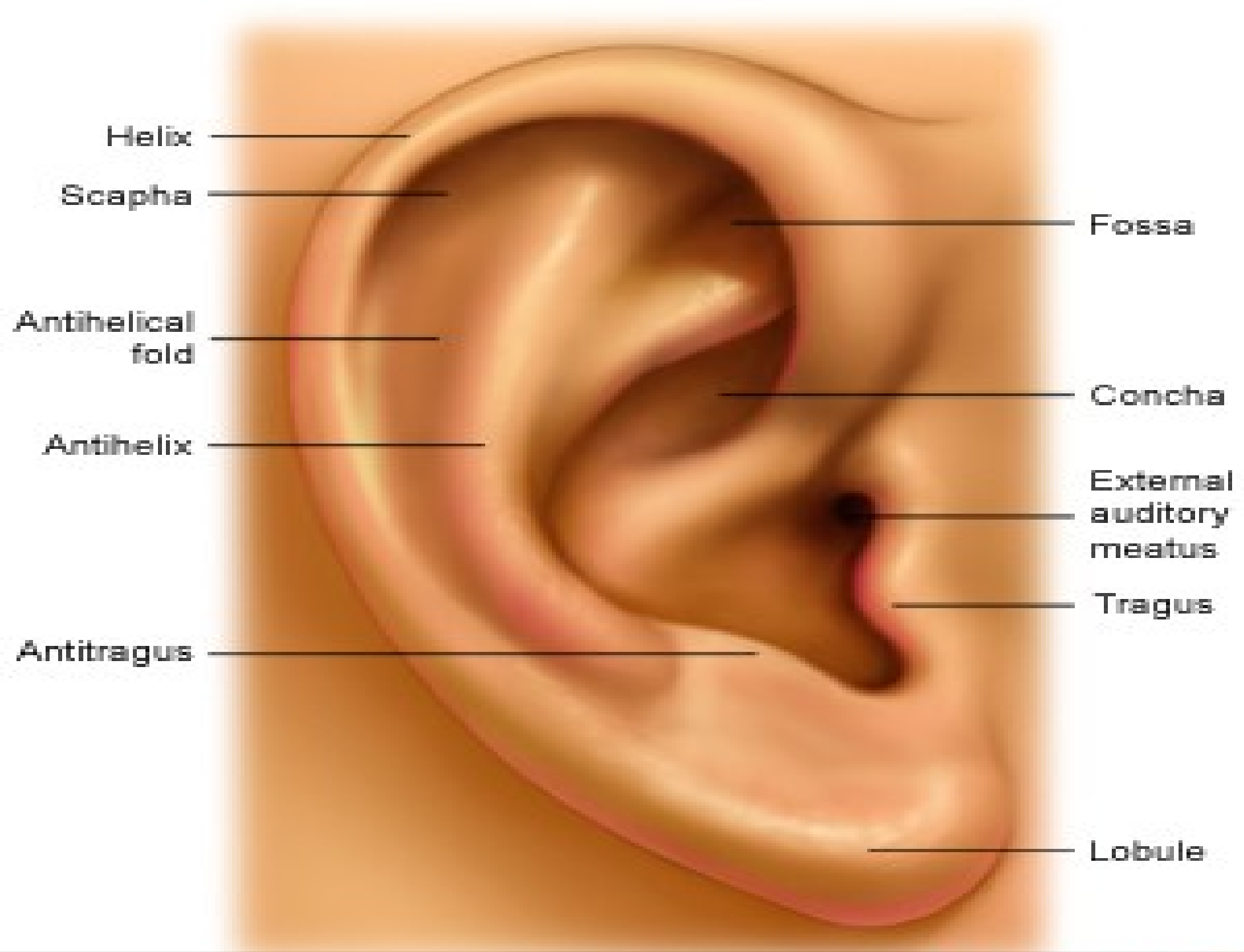

Stapes
(attached to
oval window)
Semicircular
Canals
Incus
Malleus
Vestibular
Nerve
Cochlear
Nerve
Cochlea
External
Auditory Canal
Tympanic
Cavity
Tympanic
Membrane
Eustachian Tube
Round
Window

THE OUTER EAR CONSISTS OF:



The Pinna - cartilaginous, highly variable in appearance, some landmarks

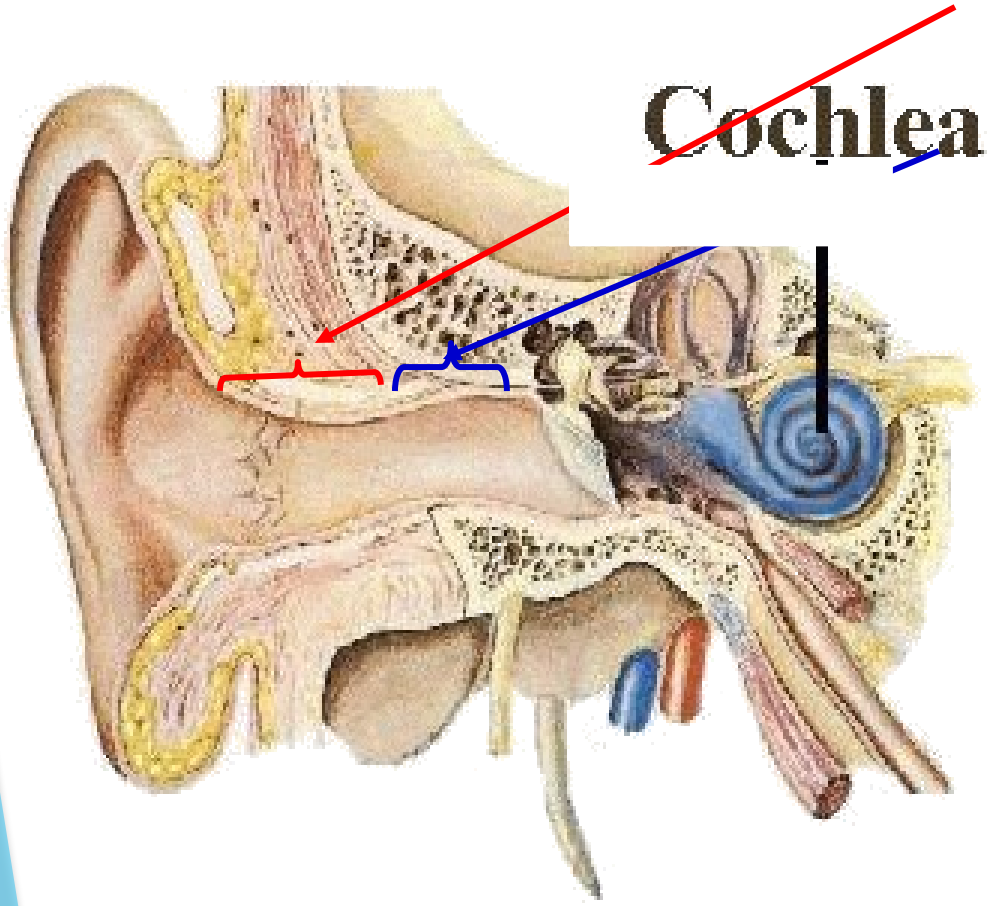
External Auditory Canal (or external auditory meatus) - 2.5 cm tube.


Helix
Scapha
Fossa
Antihelical fold
Concha
Antihelix
External auditory meatus
Tragus
Antitragus
Lobule

PINNA (AURICLE)

- **The auricle, attached to the side of the head by skin, is composed mainly of cartilage, except for the fat and subcutaneous tissue in the earlobe. The auricle collects the sound waves and directs vibrations into the external auditory canal.**

EXTERNAL AUDITORY CANAL



- **lateral portion- cartilage**
- **medial portion- osseous**
- **lined with epidermal (skin) tissue**
- **hairs in lateral part**
- **cerumen (ear wax) secreted in lateral part.**

EXTERNAL AUDITORY CANAL

- **The external auditory canal is approximately 2.5 cm long. The lateral third is an elastic cartilaginous and dense fibrous framework to which thin skin is attached. The medial two thirds is bone lined with thin skin. The external auditory canal ends at the tympanic membrane.**

- **The skin of the canal contains hair, sebaceous glands, and ceruminous glands, which secrete a brown, wax-like substance called cerumen (ear wax).**
- **The ear's self-cleaning mechanism moves old skin cells and cerumen to the outer part of the ear.**
- **Just anterior to the external auditory canal is the temporomandibular joint.**

OUTER EAR FUNCTIONS

- **Amplification / Filtering**
- **Protection**
- **Localization**

ANATOMY OF THE MIDDLE EAR

- **The middle ear, an air-filled cavity, includes the tympanic membrane laterally and the otic capsule medially**

- **The middle ear is connected by the eustachian tube to the nasopharynx and is continuous with air-filled cells in the adjacent mastoid portion of the temporal bone.**

- **Eustachian tube, which is approximately 1 mm wide and 35 mm long, connects the middle ear to the nasopharynx.**
- **Normally, the eustachian tube is closed, but it opens by action of the tensor veli palatini muscle when the person performs a Valsalva maneuver, yawns, or swallows.**
- **It drains normal and abnormal secretions of the middle ear and equalizes pressure in the middle ear with that of the atmosphere.**

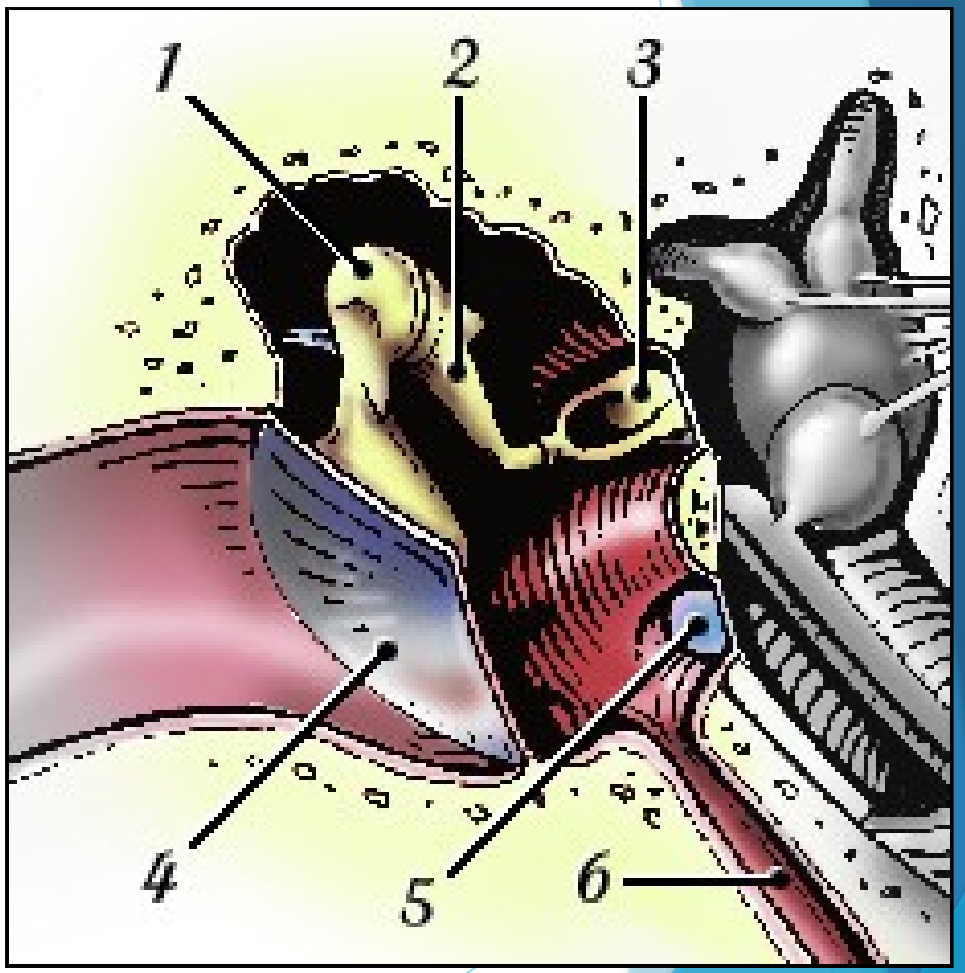
MIDDLE EAR STRUCTURES

1- Malleus
2- Incus
3- Stapes
} Ossicles

4- Tympanic Membrane (Eardrum)

5- Round Window

6- Eustachian Tube



OSSICLES

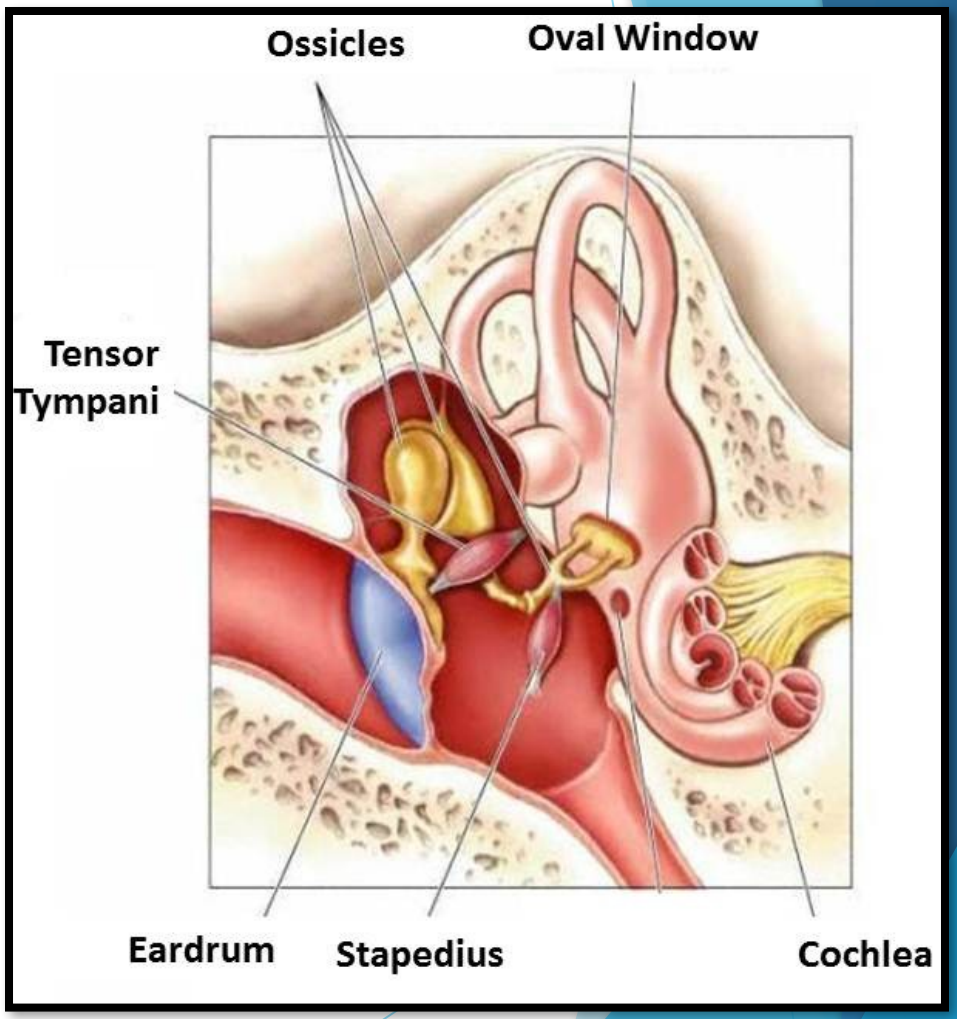
- The middle ear contains the three smallest bones (the ossicles) of the body: the malleus, the incus, and the stapes. ossicles, which are held in place by joints, muscles, and ligaments, assist in the transmission of sound.
- Two small fenestrae (oval and round windows), located in the medial wall of the middle ear, separate the middle ear from the inner ear.
- The footplate of the stapes sits in the oval window, secured by a fibrous annulus (ring-shaped structure). The footplate transmits sound to the inner ear. The round window, covered by a thin membrane, provides an exit for sound vibrations

TYMPANIC MEMBRANE

The tympanic membrane protects the middle ear and conducts sound vibrations from the external canal to the ossicles. The sound pressure is magnified 22 times as a result of transmission from a larger area to a smaller one.

MIDDLE EAR MUSCLES

1. **The Stapedius Attaches to Stapes,Contracts in Response to Loud sounds, chewing, speaking; Facial (VIIth cranial) nerve**
2. **The Tensor Tympani Helps open Eustachian tube**

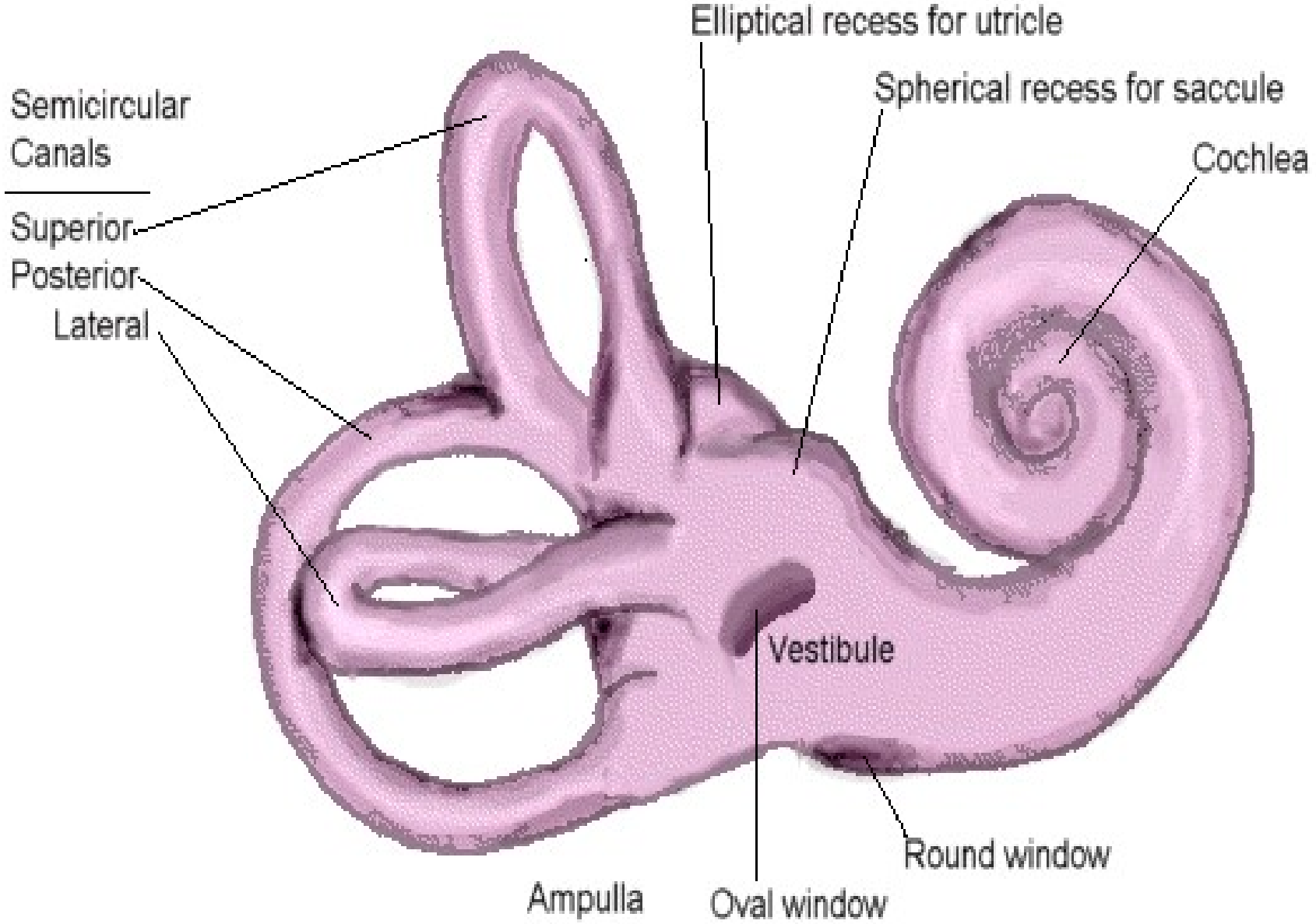


MIDDLE EAR FUNCTIONS

- **Impedance Matching**
- **Filtering**
- **Acoustic Reflex**

ANATOMY OF THE INNER EAR

- **The inner ear is housed deep within the temporal bone. The organs for hearing (cochlea) and balance (semicircular canals), as well as cranial nerves VII (facial nerve) and VIII (vestibulocochlear nerve), are all part of this complex anatomy**


Elliptical recess for utricle
Spherical recess for saccule
Semicircular Canals
Cochlea
Superior
Posterior
Lateral
Vestibule
Round window
Ampulla
Oval window

ANATOMY OF THE INNER EAR

- **The cochlea and semicircular canals are housed in the bony labyrinth.**
- **The bony labyrinth surrounds and protects the membranous labyrinth, which is bathed in a fluid called perilymph.**
  - **<u>Membranous Labyrinth</u>: The membranous labyrinth is composed of the utricle, the saccule, the cochlear duct, the semicircular canals, and the organ of Corti. The membranous labyrinth contains a fluid called endolymph.**

ANATOMY OF THE INNER EAR

- **The three semicircular canals —posterior, superior, and lateral, which lie at 90-degree angles to one another—contain sensory receptor organs, arranged to detect rotational movement. The utricle and saccule are involved with linear movements.**

- **Organ of Corti:** The organ of Corti is located in the cochlea, a snail-shaped, bony tube about 3.5 cm long with two and a half spiral turns.
- The organ of Corti, also called the end organ for hearing, transforms mechanical energy into neural activity and separates sounds into different frequencies.
- This electrochemical impulse travels through the acoustic nerve to the temporal cortex of the brain to be interpreted as meaningful sound.

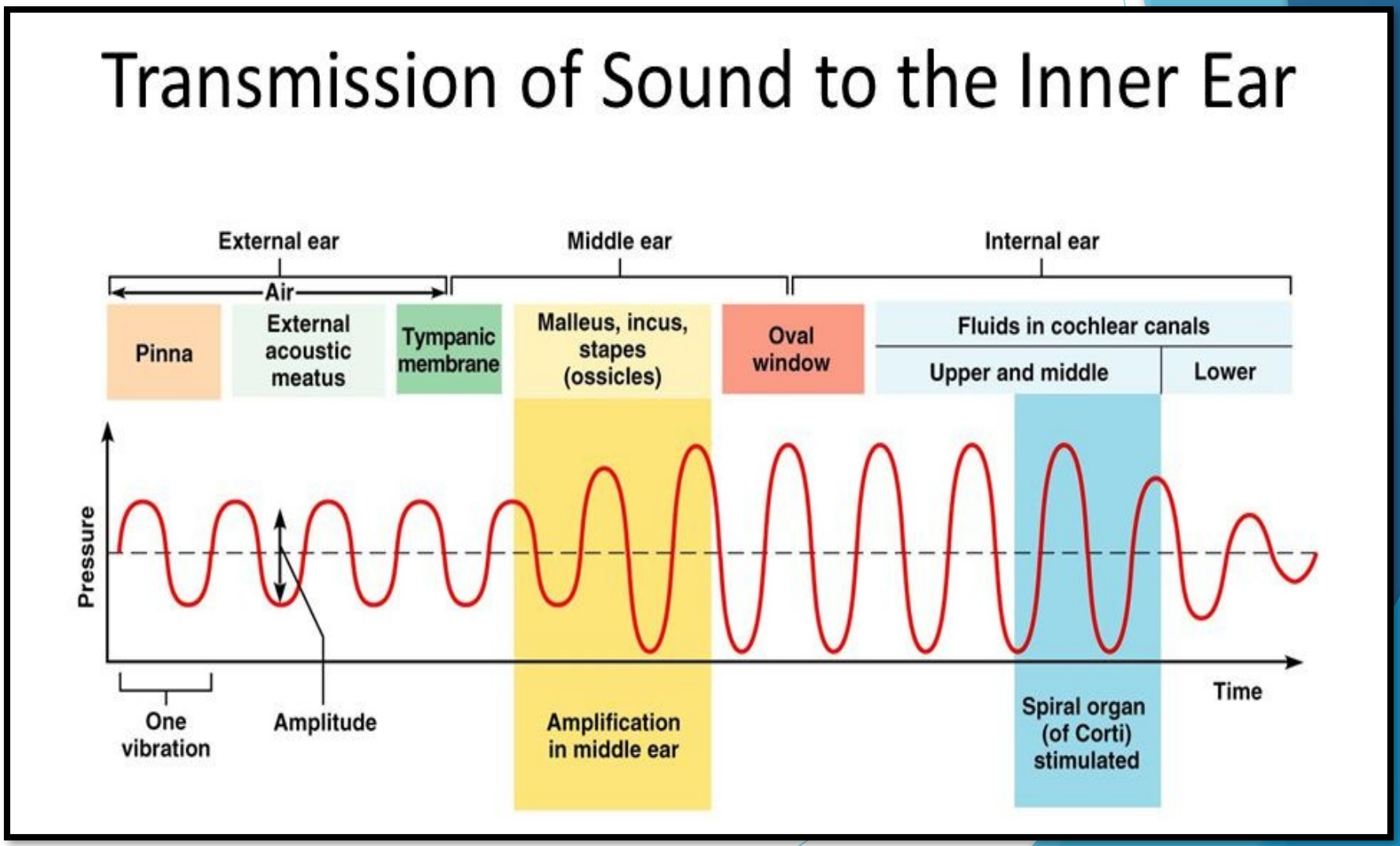
ANATOMY OF THE INNER EAR

- **In the internal auditory canal, the cochlear (acoustic) nerve, arising from the cochlea, joins the vestibular nerve, arising from the semicircular canals, utricle, and saccule, to become the vestibulocochlear nerve (cranial nerve VIII).**
- **This canal also houses the facial nerve and the blood supply from the ear to the brain**

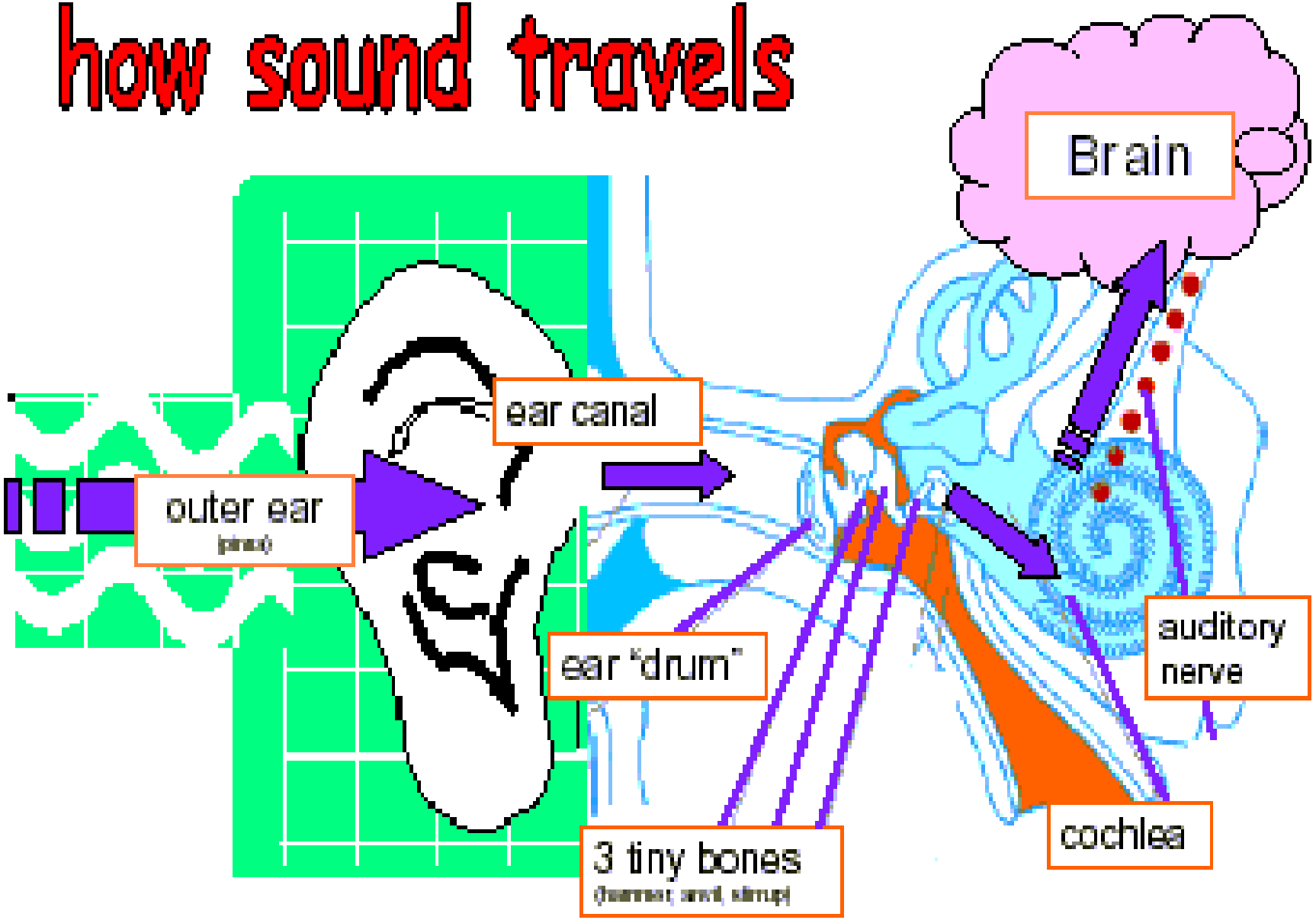
Function

- **Hearing: Hearing is conducted over two pathways: air and bone.**
- **Sounds transmitted by air conduction travel over the air-filled external and middle ear through vibration of the tympanic membrane and ossicles.**
- **Sounds transmitted by bone conduction travel directly through bone to the inner ear, bypassing the tympanic membrane and ossicles.**
- **Normally, air conduction is the more efficient pathway. However, a defect in the tympanic membrane or interruption of the ossicular chain disrupts normal air conduction, which results in a conductive hearing loss**

PHYSIOLOGY OF HEARING



how sound travels



Balance and the ear

The semicircular canals and the vestibule-

- The semicircular canals have no auditory function although they are closely associated with the cochlea.
- They provide information about the position of the head in space, contributing to maintenance of posture and balance.

- The semicircular canals, like the cochlea, are composed of an outer bony wall and inner membranous tubes or ducts. The membranous ducts contain endolymph and are separated from the bony wall by perilymph.
- The urticle is a membranous sac which is part of the vestibule and the three membranous ducts open into it at their dilated ends, the ampullae. The saccule is a part of the vestibule and communicates with the urticle and the cochlea.
- In the walls of the utricle, saccule and ampullae they are fine, specialised epithelial cells with minute projections, called hair cells. Amongst the hair cells there are receptors on sensory nerve endings, which continue forming the vestibular part of the vestibulocochlear nerve.

Physiology of balance-

- The semicircular canals and the vestibule (utricle and saccule) are concerned with balance. Any change of position of the head causes movement in the perilymph and endolymph, which bends the hair cells and stimulates the sensory receptors in the utricle, saccule and ampullae.
- The resultant nerve impulses are transmitted by the vestibular nerve, which joins the cochlear nerve to form the vestibulocochlear nerve. The vestibular branch passes first to the vestibular nucleus, then to the cerebellum.

- **The cerebellum also receives nerve impulses from the eyes and proprioceptors (sensory receptors) in the skeletal muscles and the joints. Impulses from these three sources are coordinated and efferent nerve impulses pass to the cerebrum and the skeletal muscles.**

- **This results in awareness of body position, maintenance of upright position and fixing of the eyes on the same point, independently of head movements.**

Thank you