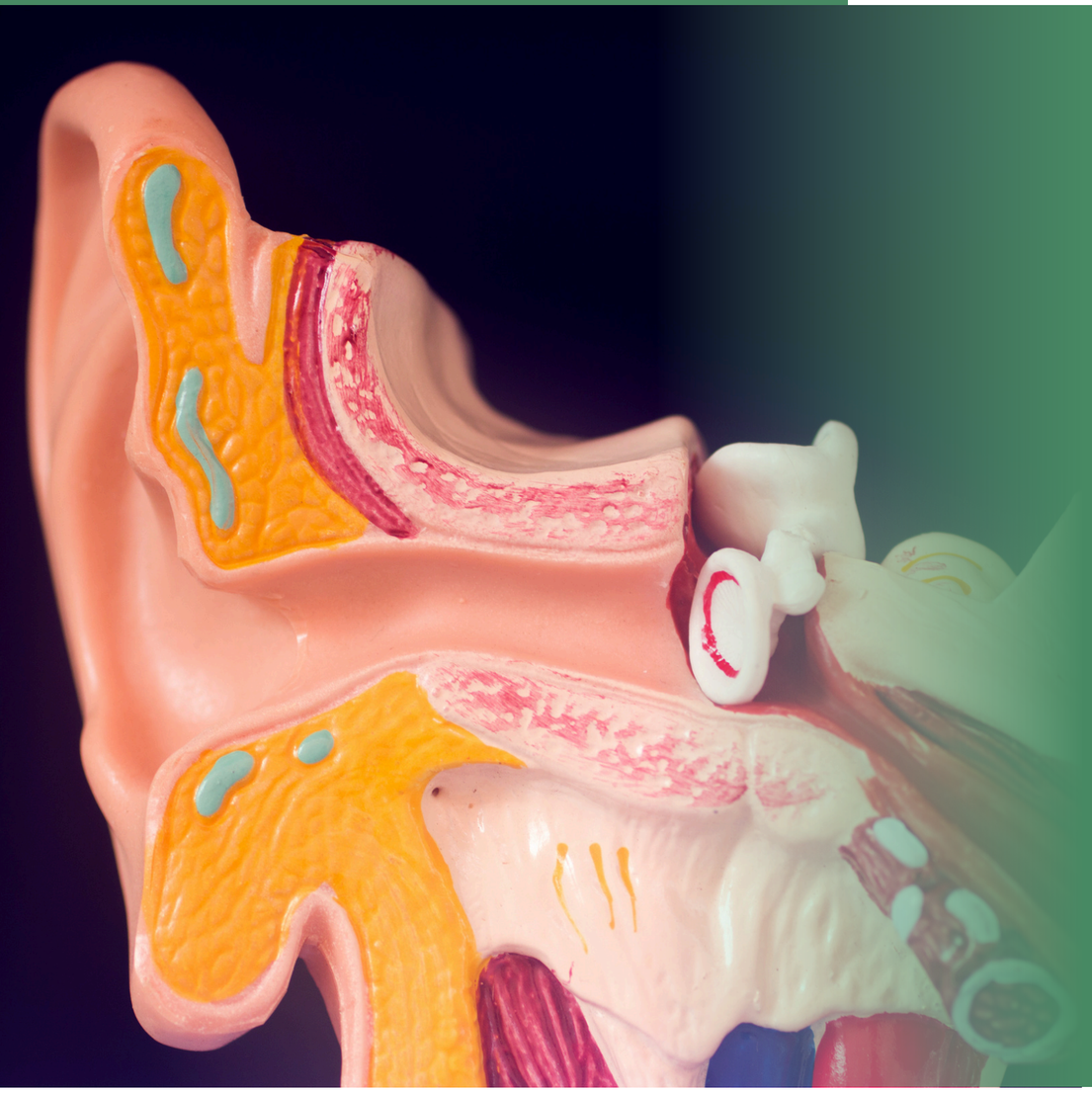
LECTURE #9 (12/11/2024)



STRUCTURE AND FUNCTION OF EAR

BS MLT-II

H/DR. AYESHA RAUF

www.medmedals.com/bs-mlt-2

OVERVIEW OF EAR ANATOMY

Human Ear

The human ear is the sensory organ responsible for hearing and balance. It detects sound waves and converts them into signals that the brain can interpret, while also maintaining equilibrium of the body.

Location

The ears are located on both sides of the head.
Their external position allows them to capture sound waves from the environment efficiently.

OVERVIEW OF EAR ANATOMY

Hearing Range (dB and Frequency)

- The normal ear can hear sounds from 0 dB (threshold of hearing) to about 120–140 dB (threshold of pain).
- Prolonged exposure above 85 dB may cause hearing damage.
- Frequency range: 20 Hz to 20,000 Hz (20 kHz) in young individuals.

OVERVIEW OF EAR ANATOMY

Parts of the Human Ear

The ear is divided into three main parts:

Outer Ear

Pinna (Auricle): Collects sound waves.

Ear Canal: Directs sound waves toward the eardrum.

Eardrum (Tympanic Membrane): Vibrates when sound waves hit it.

Middle Ear

Contains three small bones called ossicles:

Malleus (hammer)

Incus (anvil)

Stapes (stirrup)

These bones amplify vibrations from the eardrum and pass them to the inner ear.

Inner Ear

Cochlea: A spiral-shaped organ filled with fluid and sensory hair cells that convert vibrations into electrical signals for the brain.

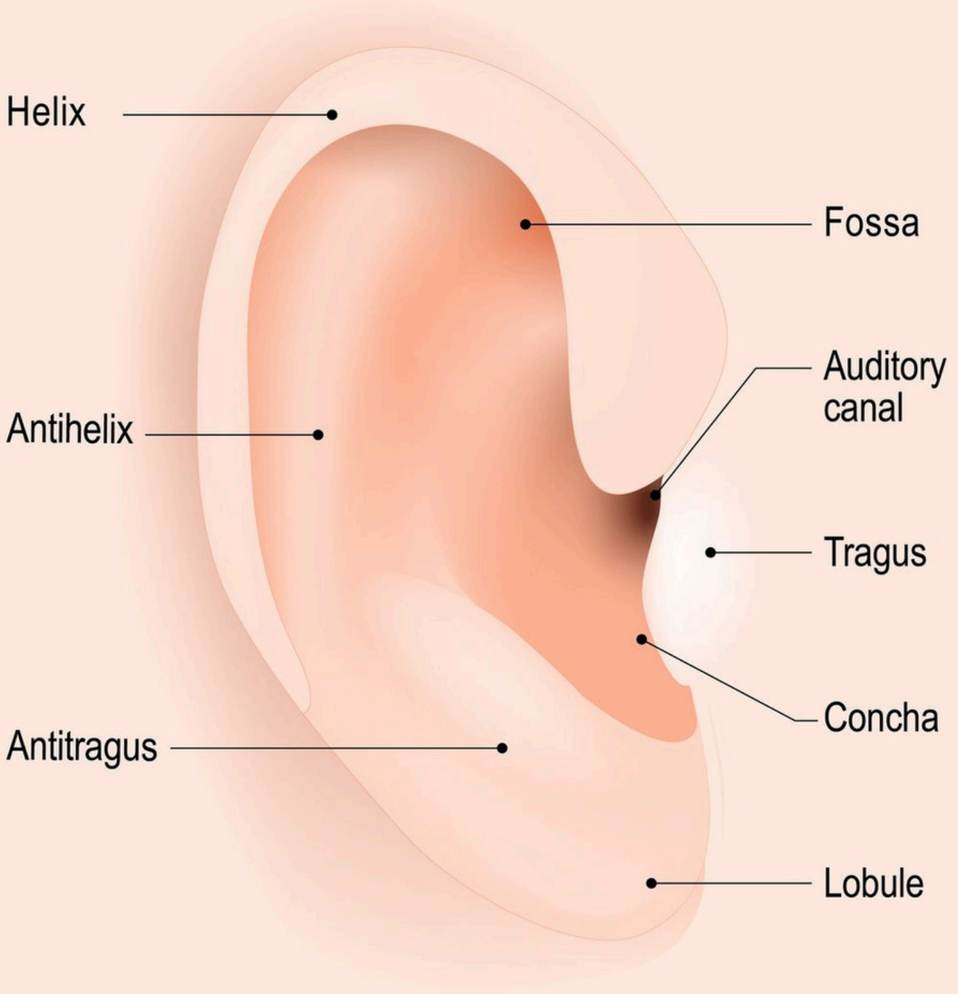
Semicircular Canals & Vestibule: Help maintain body balance and posture.

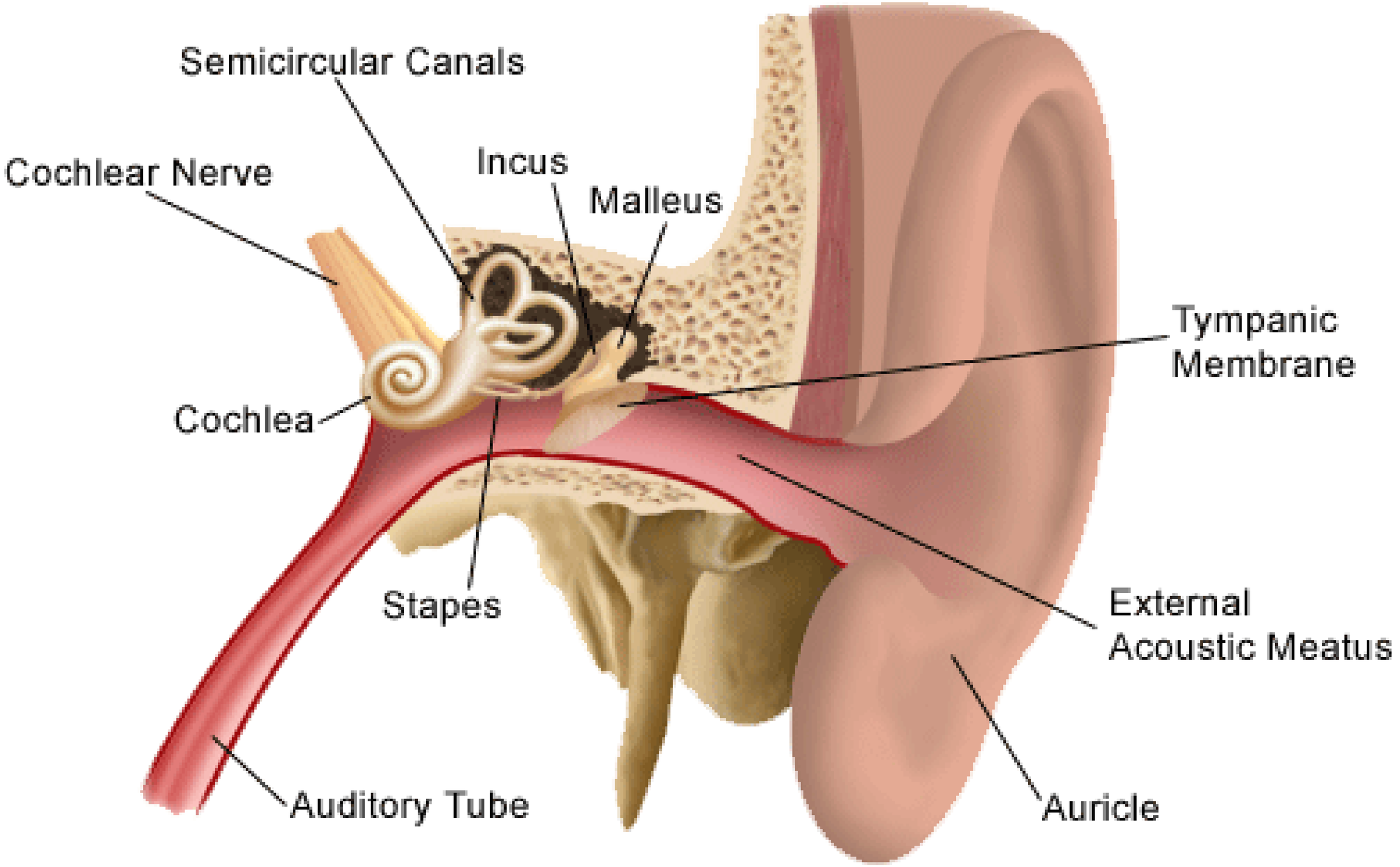
Auditory Nerve: Carries signals from the cochlea to the brain for interpretation as sound.

OVERVIEW OF EAR ANATOMY

1. **Outer Ear: Collects sound waves.**
2. **Middle Ear: Transfers sound vibrations.**
3. **Inner Ear: Converts sound to nerve impulses and maintains balance**

AURICLE


Helix
Fossa
Auditory canal
Antihelix
Tragus
Concha
Antitragus
Lobule

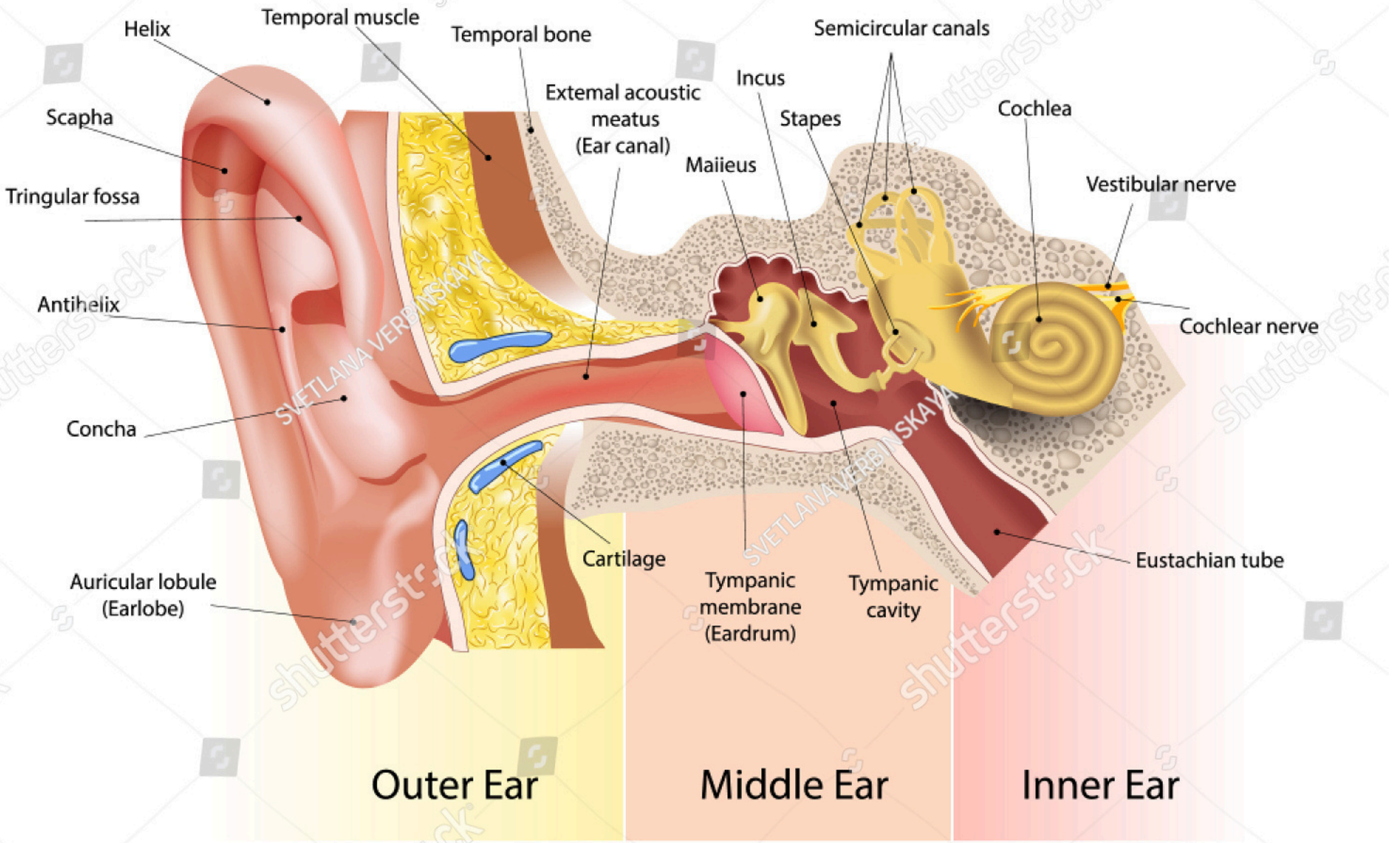

Semicircular Canals
Cochlear Nerve
Incus
Malleus
Tympanic Membrane
Cochlea
Stapes
External Acoustic Meatus
Auditory Tube
Auricle

THE OUTER EAR

Structures:

1. **Pinna (Auricle):** The visible part, collects sound.
2. **External Auditory Canal:** Directs sound to the eardrum.
3. **Tympanic Membrane (Eardrum):** Vibrates in response to sound waves.
4. **Function:** Collects and funnels sound into the ear canal.

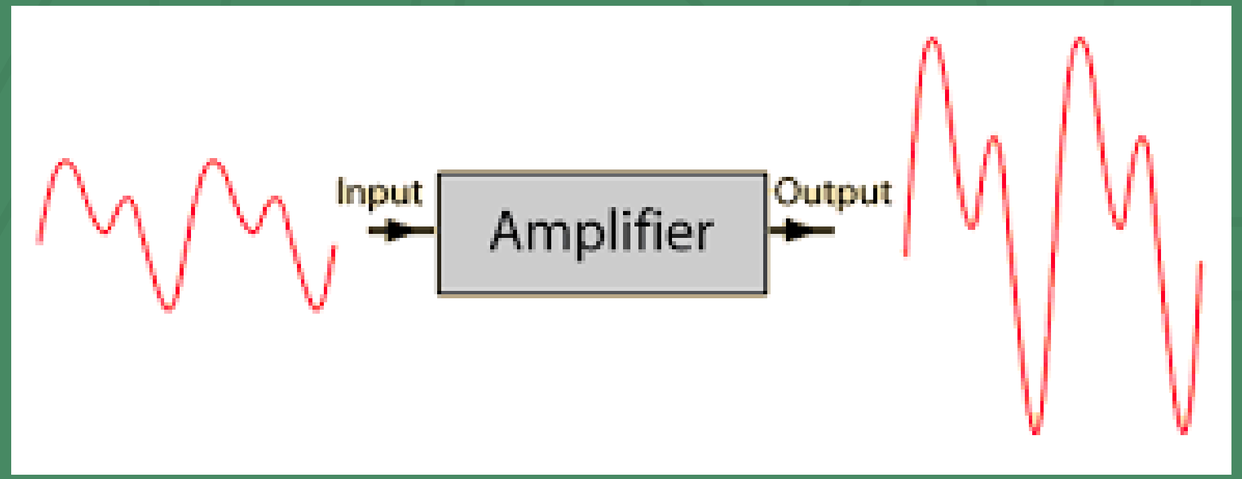
Anatomy of the Ear

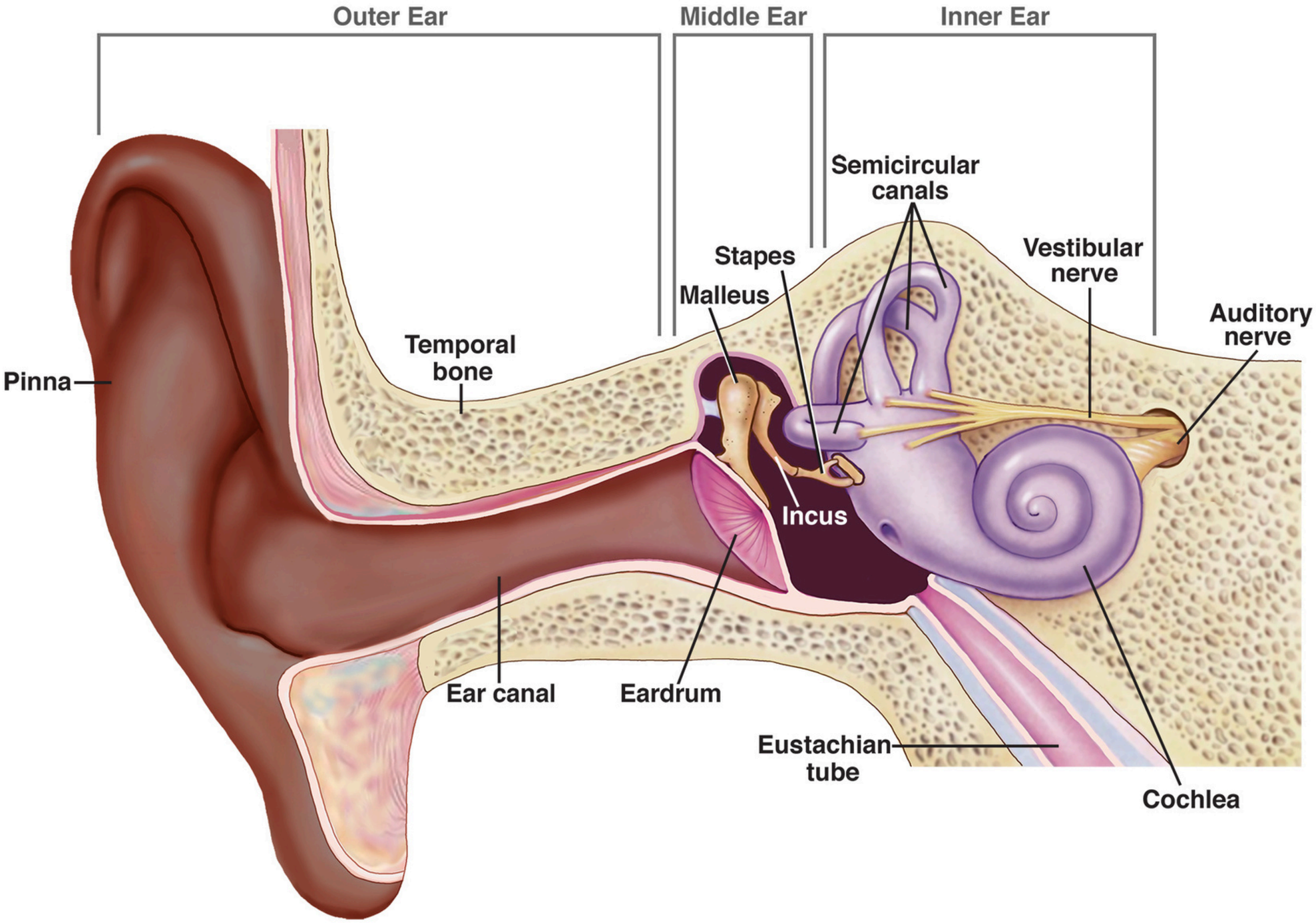


THE MIDDLE EAR

Structures:

1. **Ossicles: Small bones (Malleus, Incus, Stapes) that amplify sound.**
2. **Eustachian Tube: Balances air pressure.**
3. **Function: Transmits vibrations from the eardrum to the inner ear.**




Outer Ear
Middle Ear
Inner Ear
Semicircular canals
Stapes
Malleus
Vestibular nerve
Auditory nerve
Temporal bone
Pinna
Incus
Ear canal
Eardrum
Eustachian tube
Cochlea

THE INNER EAR

Structures:

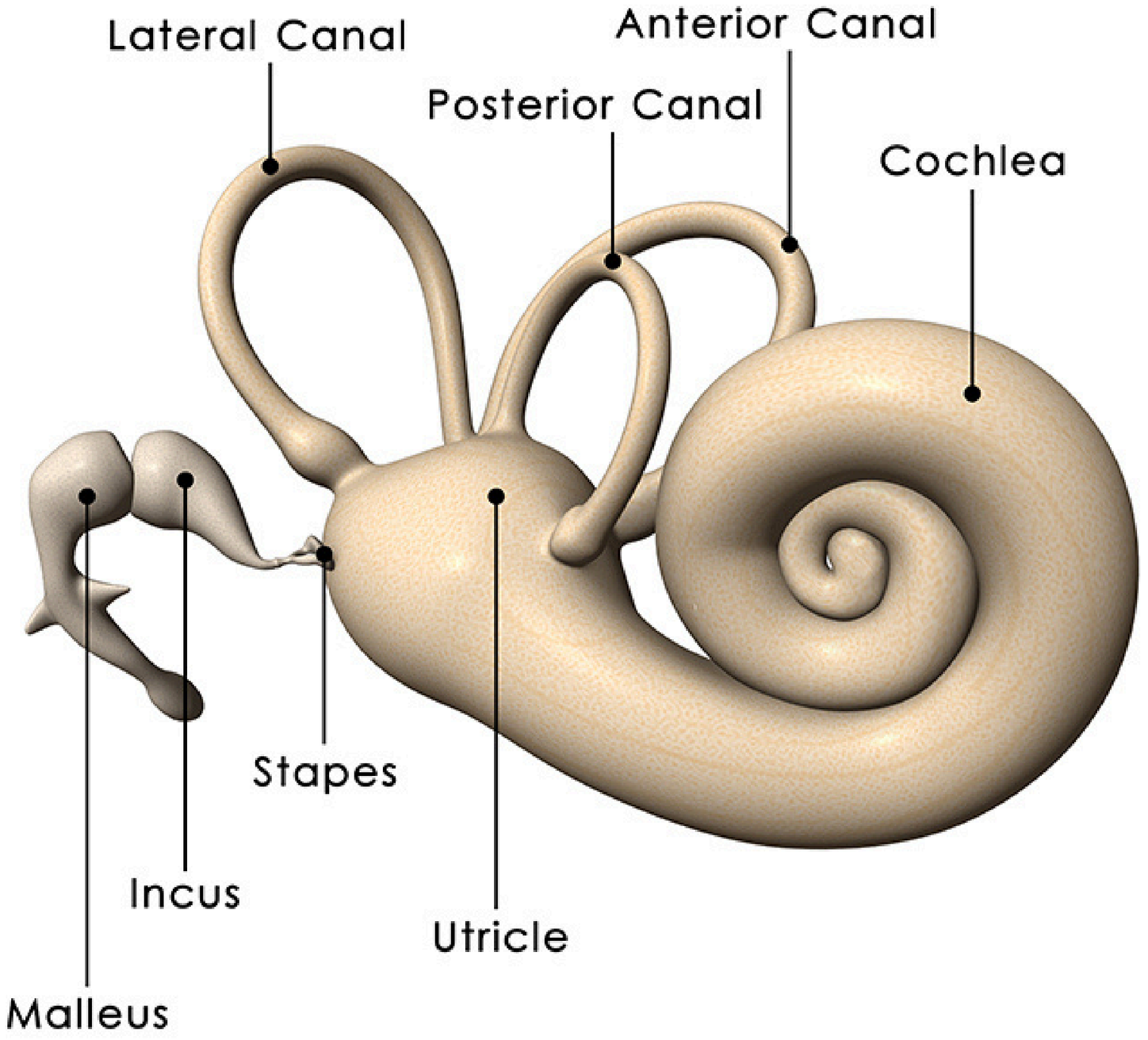
a. **Cochlea:** Spiral-shaped; translates sound into neural signals.

b. **Vestibule:** Important for balance.

c. **Semicircular Canals:** Detect head movements.

Function:

Converts mechanical vibrations into electrical impulses; also responsible for equilibrium.


Lateral Canal
Anterior Canal
Posterior Canal
Cochlea
Stapes
Incus
Utricle
Malleus

COCHLEA AND HEARING MECHANISM

- **Cochlea Function:**
  - **Contains hair cells that respond to different frequencies.**
  - **Transmits signals to the auditory nerve, leading to sound perception.**
- **Auditory Pathway:**

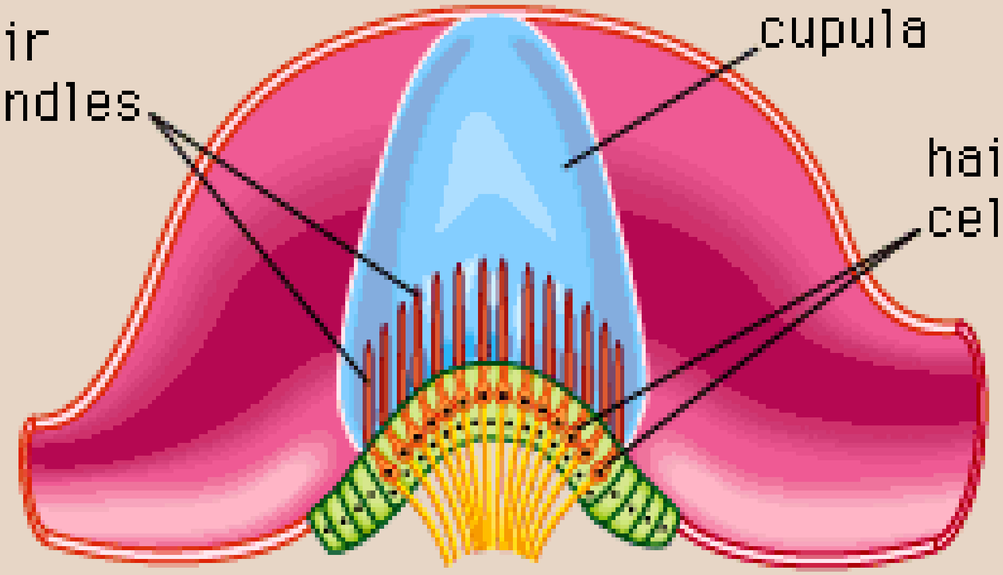
Cochlea → Auditory Nerve → Brain.

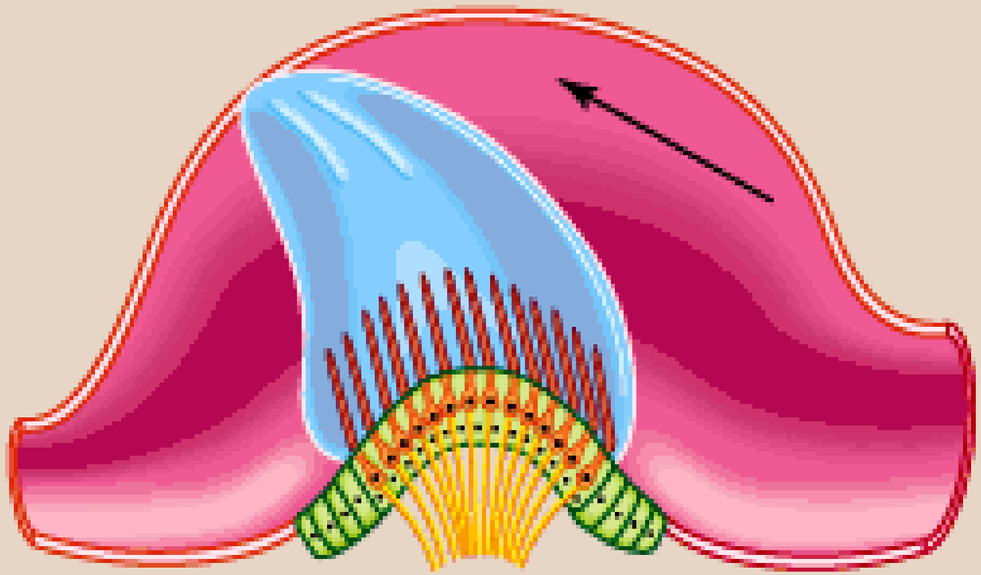
VESTIBULAR SYSTEM AND BALANCE

Vestibule and Semicircular Canals:

- Vestibule: Senses linear movements.
- Semicircular Canals: Detect rotational movements.
- Balance Mechanism:
- Works with visual and proprioceptive systems to maintain balance.

A



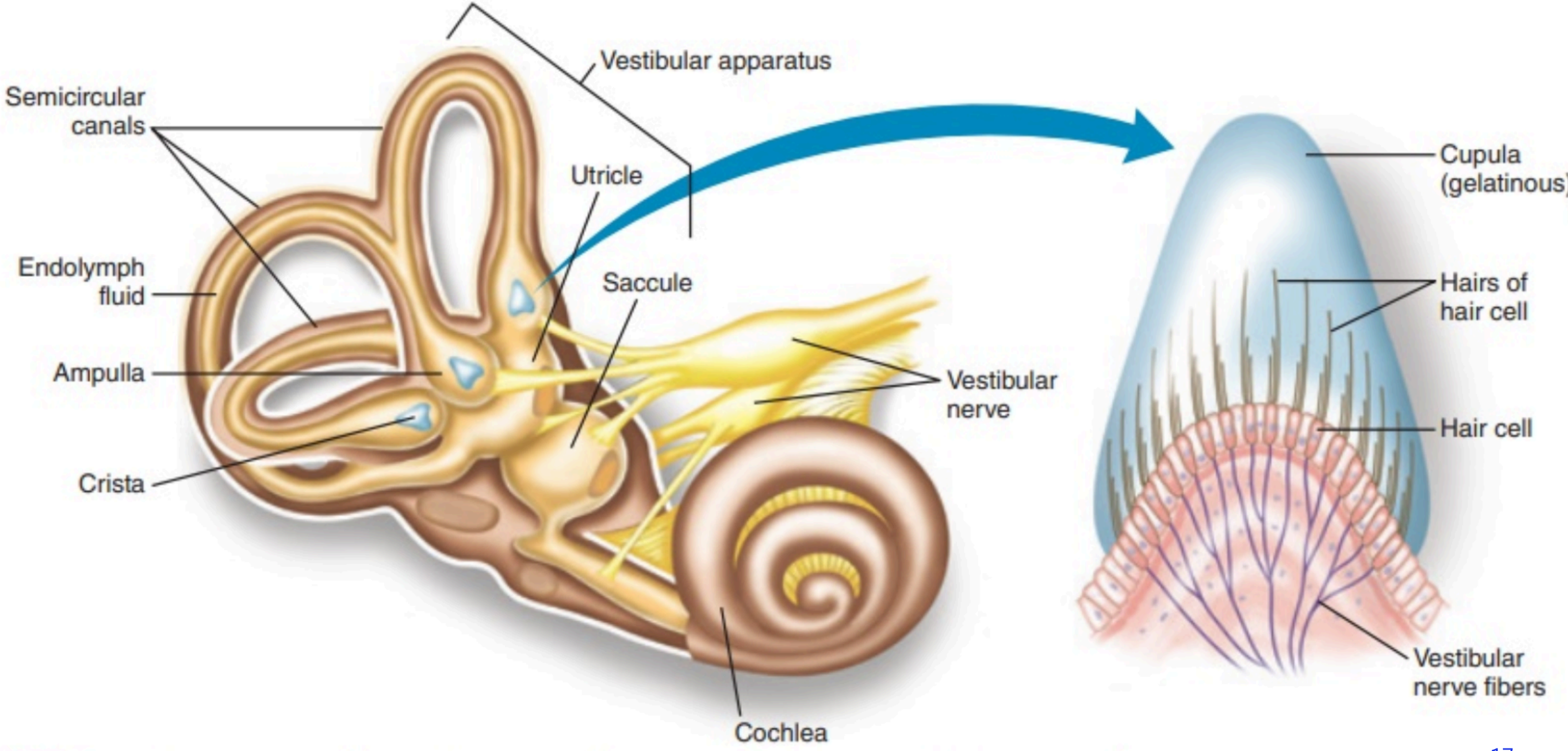


stationary section
of the crista
of the horizontal canal

rotating section
of the crista
of the horizontal canal

stationary

rotating

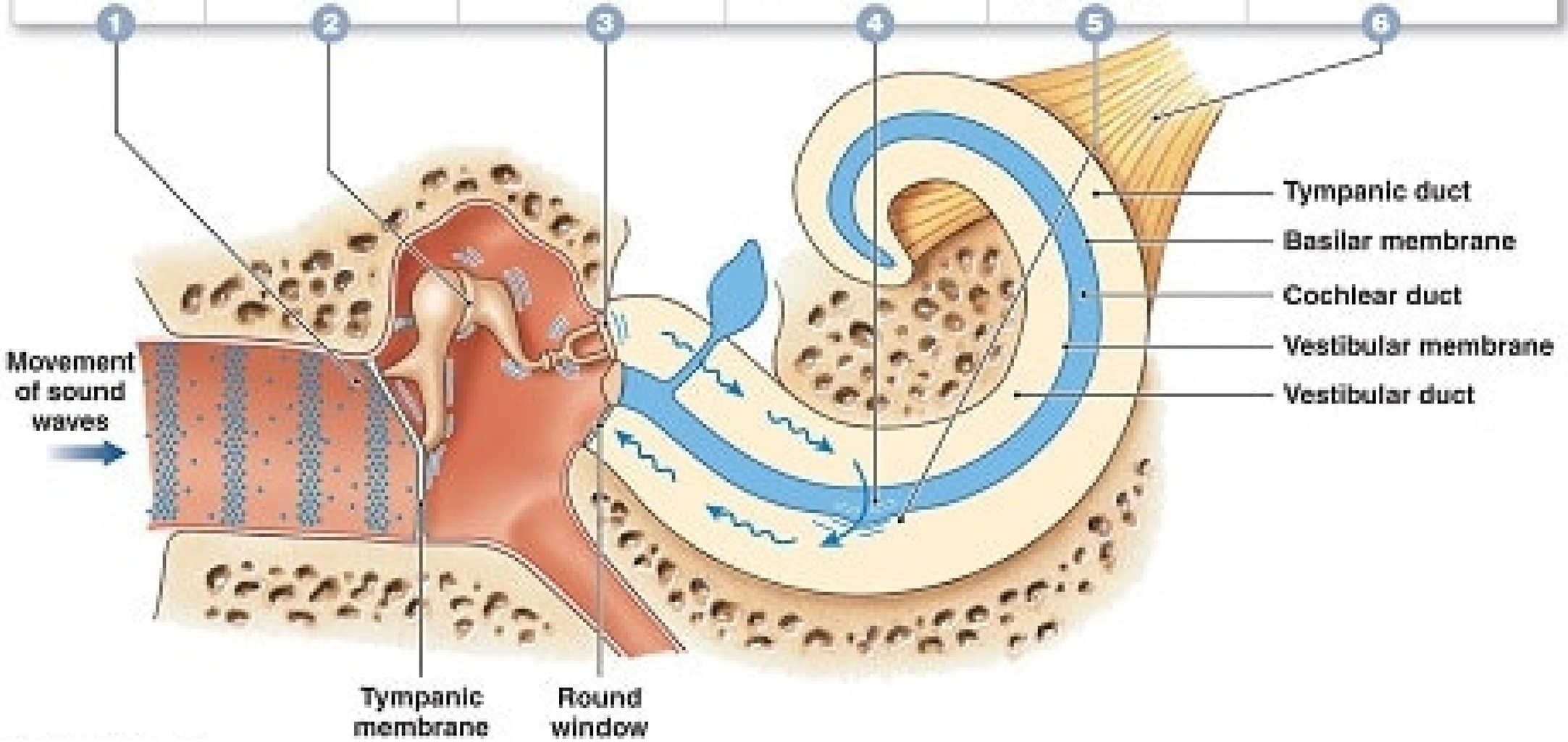

Vestibular apparatus
Semicircular canals
Utricle
Endolymph fluid
Saccule
Ampulla
Vestibular nerve
Crista
Cochlea
Cupula (gelatinous)
Hairs of hair cell
Hair cell
Vestibular nerve fibers

THE HEARING PROCESS (STEP-BY-STEP)

1. **Sound Collection:** Pinna directs sound into the auditory canal.
2. **Vibration Transmission:** Sound waves vibrate the tympanic membrane.
3. **Amplification:** Ossicles amplify vibrations to the inner ear.
4. **Signal Conversion:** Cochlea hair cells convert vibrations to neural signals.
5. **Signal Processing:** Auditory nerve transmits signals to the brain for interpretation.

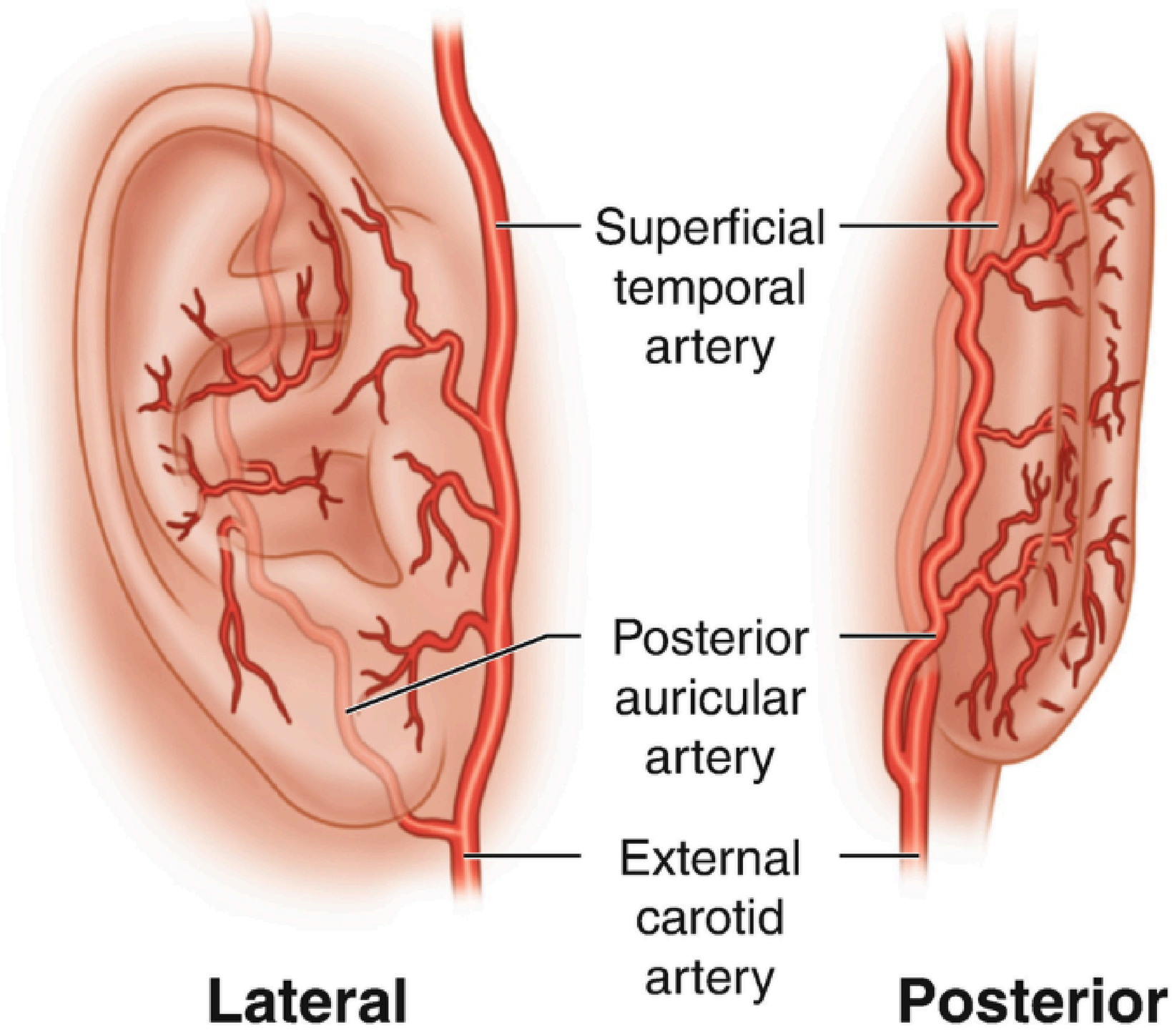
Events Involved in Hearing

1	2	3	4	5	6
Sound waves arrive at the tympanic membrane.	Movement of the tympanic membrane causes displacement of the auditory ossicles.	Movement of the stapes at the oval window establishes pressure waves in the perilymph of the vestibular duct.	The pressure waves distort the basilar membrane on their way to the round window of the tympanic duct.	Vibration of the basilar membrane causes vibration of hair cells against the tectorial membrane.	Information about the region and the intensity of stimulation is relayed to the CNS over the cochlear branch of cranial nerve VIII.



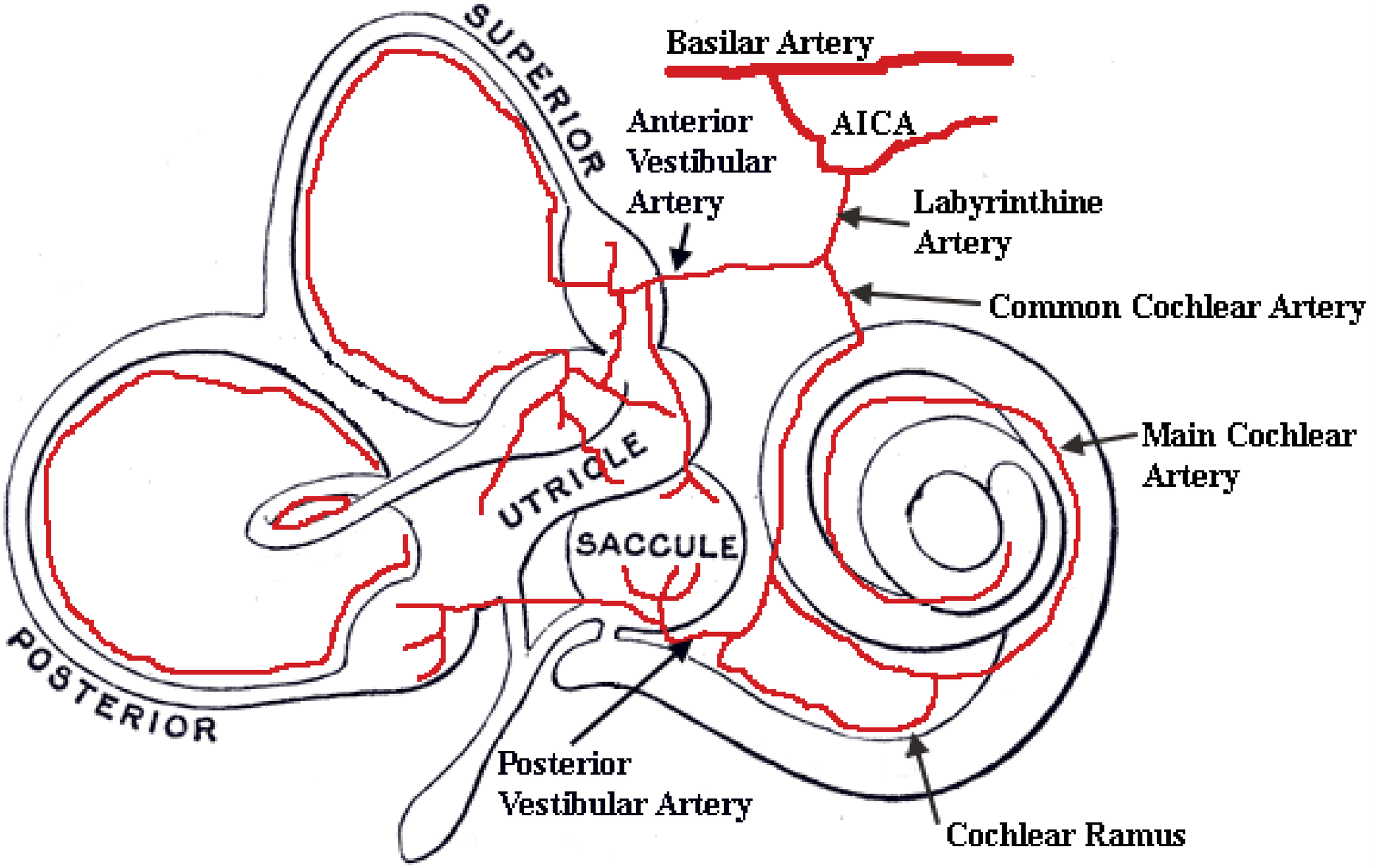
COMMON DISORDERS OF THE EAR

- **Hearing Loss:**
  - **Conductive (outer/middle ear)**
  - **Sensorineural (inner ear/auditory nerve)**
- **Ear Infections: Otitis media, otitis externa.**
- **Balance Disorders: Vertigo, Meniere’s disease.**


Superficial temporal artery
Posterior auricular artery
External carotid artery
Lateral
Posterior

EAR'S MUSCLES, BLOOD SUPPLY, AND NERVE SUPPLY

- **Muscles:** Tensor tympani and stapedius (middle ear), auricular muscles (outer ear).
- **Blood Supply:** Branches from the external carotid artery for the outer and middle ear; labyrinthine artery for the inner ear.
- **Nerve Supply:** Facial nerve (CN VII), vestibulocochlear nerve (CN VIII), glossopharyngeal nerve (CN IX), along with auricular nerves for the outer ear.


Basilar Artery
AICA
Anterior Vestibular Artery
Labyrinthine Artery
Common Cochlear Artery
Main Cochlear Artery
SUPERIOR
UTRICLE
SACCULE
POSTERIOR
Posterior Vestibular Artery
Cochlear Ramus