

The Human Senses

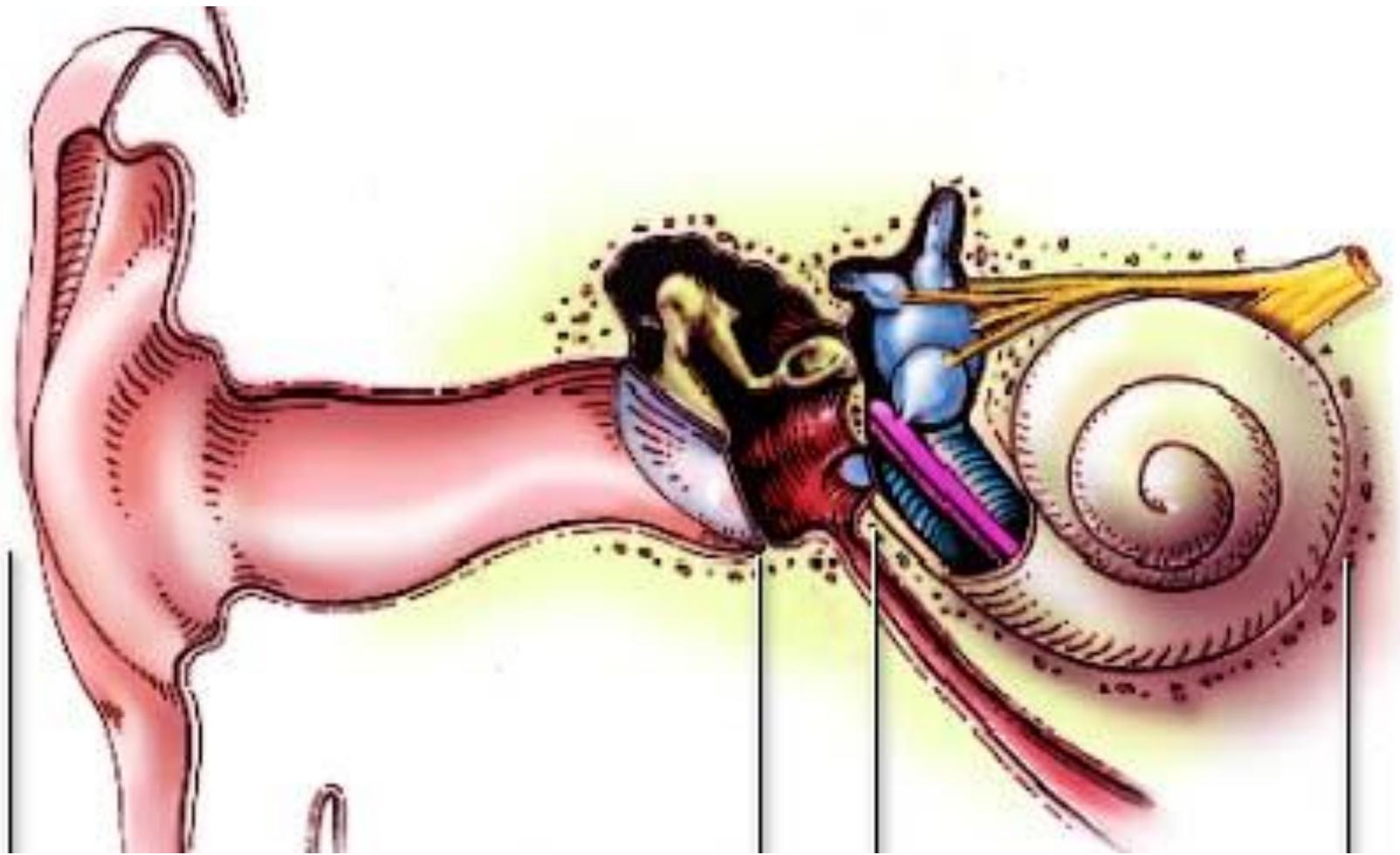


Hearing and Balance



3 Major Parts

- Outer Ear: Hearing
- Middle Ear: Hearing
- Inner Ear: Hearing & Balance (Equilibrium)





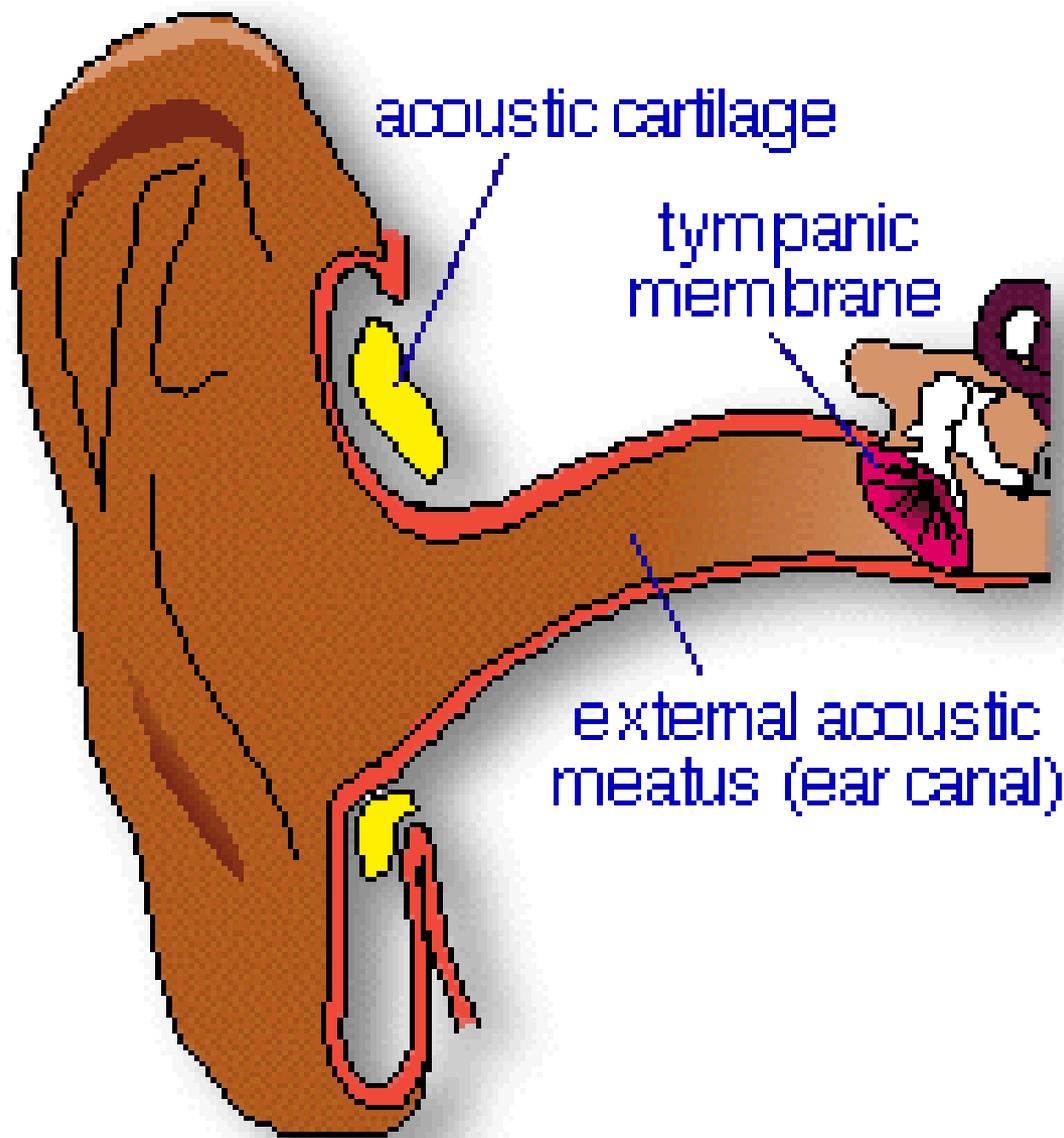
Outer Ear (3 parts)

- Pinna (auricle)
- External auditory canal
- Tympanic membrane



Outer Ear (continued)

- Sound waves are collected by the pinna
- Sent down the 1" canal. This canal contains modified sweat glands called **ceruminous glands** that produce a yellow-brown substance called **cerumen** (earwax.)
- The tympanic membrane or ear drum separates the outer from middle ear.



acoustic cartilage

tympanic
membrane

external acoustic
meatus (ear canal)



The Eardrum

- Vibrations of the t.m., caused by incoming sound waves, transmit energy to the structures of the middle ear.



The Middle Ear

- Is an air filled chamber inside the temporal bone.
- The middle ear ends at two membrane covered openings
 - The superior oval window
 - The inferior round window

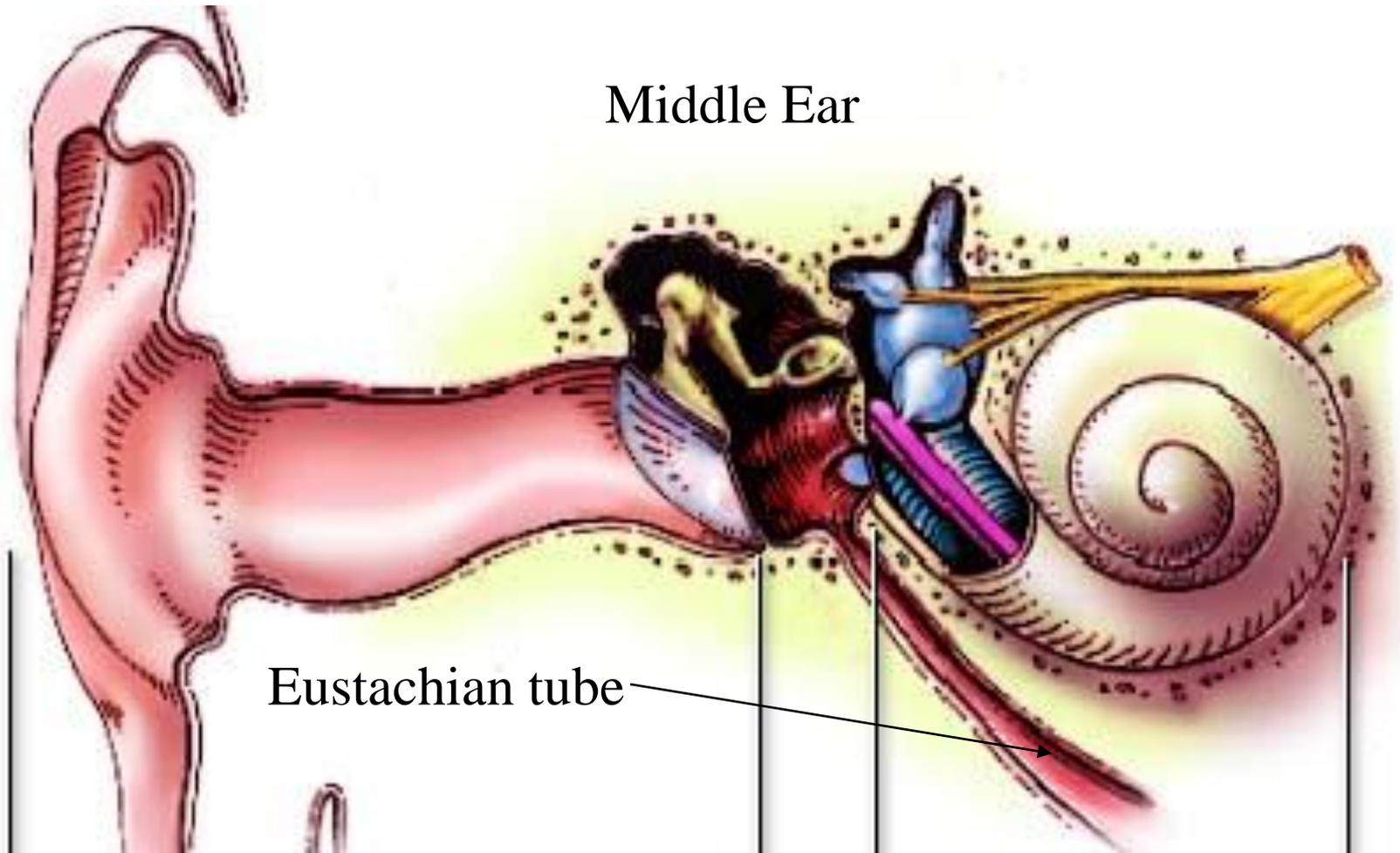


The Middle Ear (2)

- The middle ear also has an opening to the back of the throat through the **eustachian tube**.
- This tube allows the middle ear to equalize air pressure.

Outer Ear

Middle Ear



Eustachian tube

Inner Ear



3 Bones (ossicles) of the Middle Ear

1. Malleus (hammer)
 2. Incus (anvil)
 3. Stapes (stirrup)
- The malleus is connected to the tm, while the stapes is connected to the oval window.

head of malleus

lateral process

anterior process

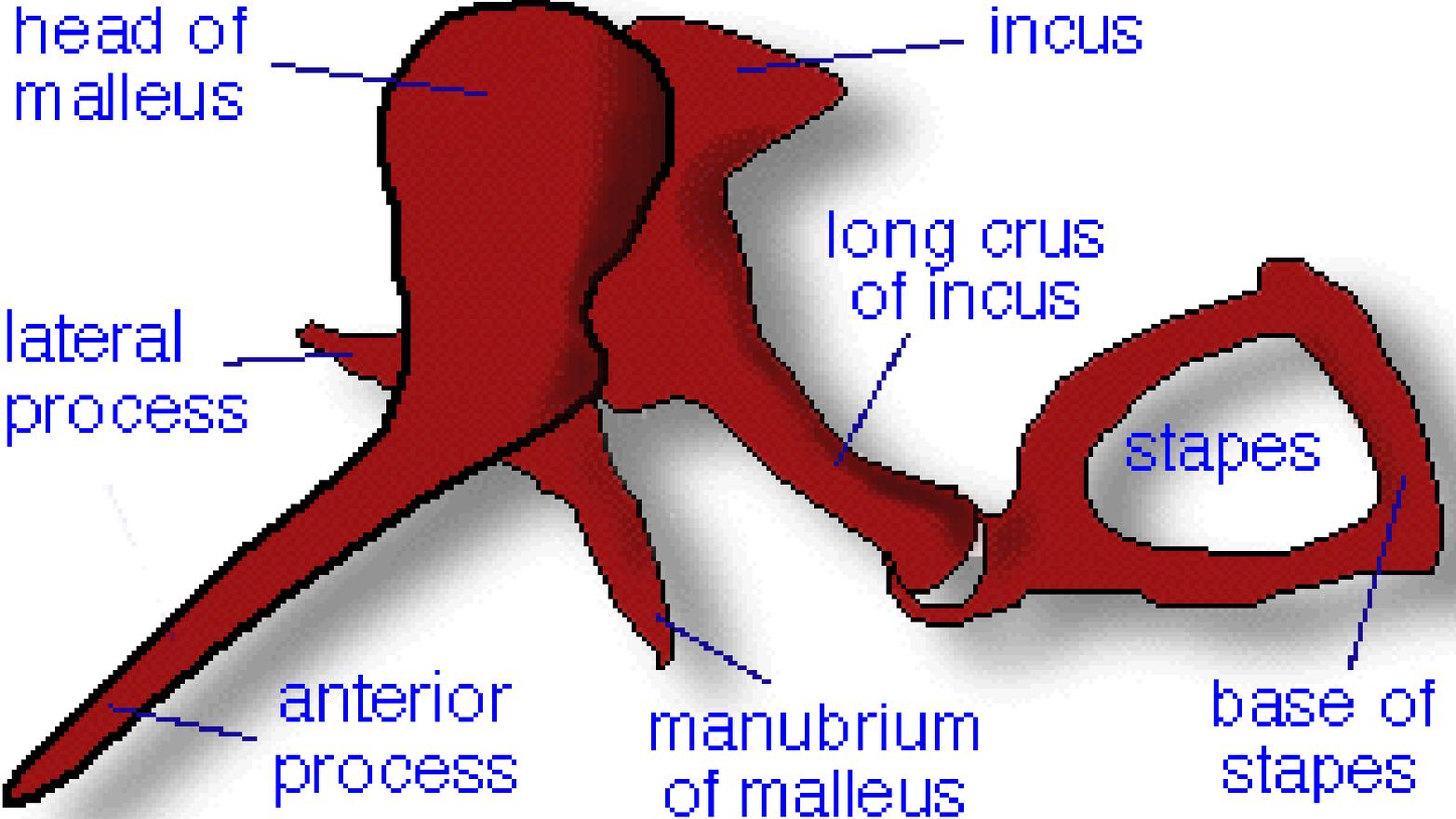
manubrium of malleus

incus

long crus of incus

stapes

base of stapes





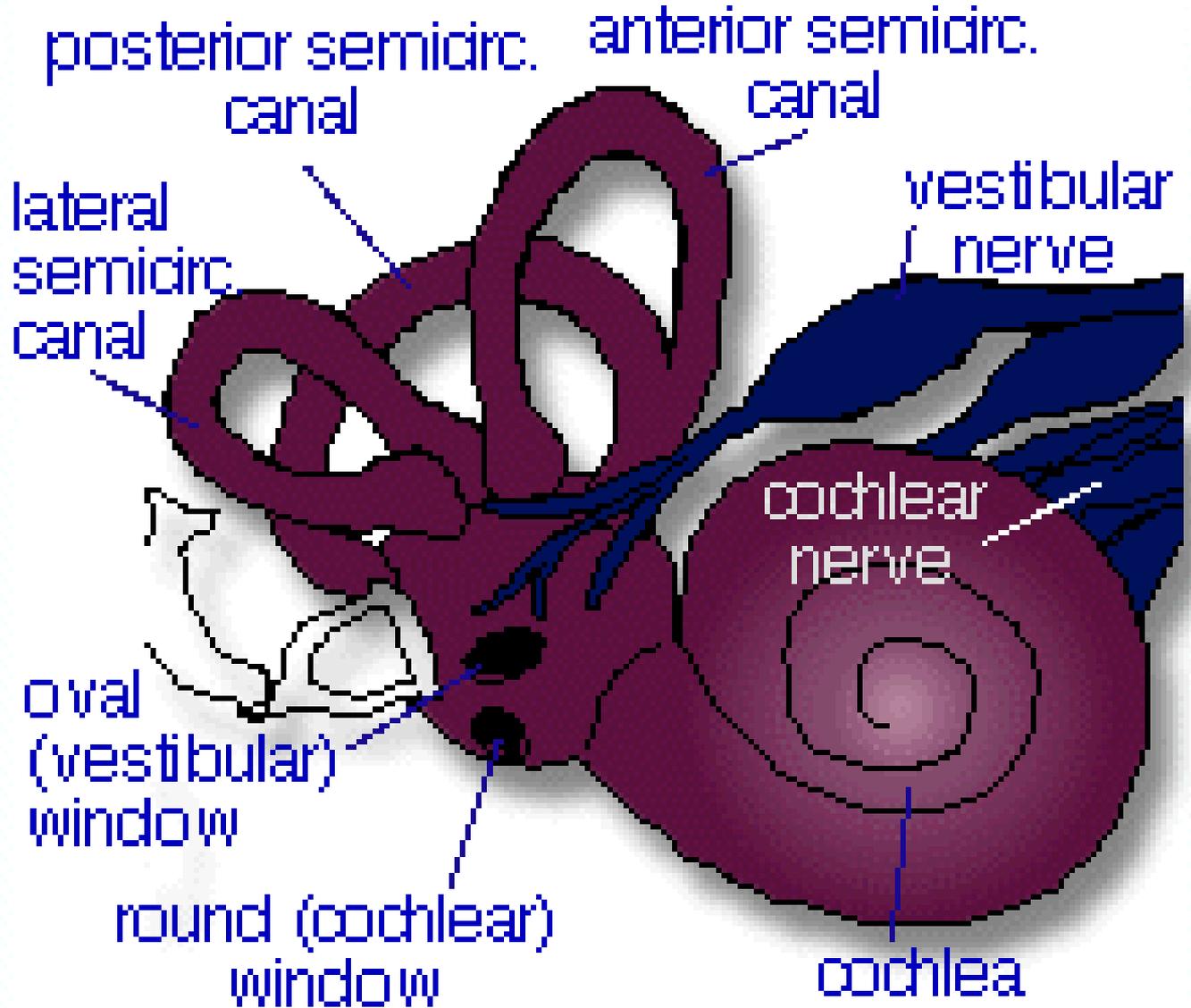
The Inner Ear

- Starts at the oval window.
- Consists of a complex series of chambers and canals for organs that control both hearing and balance.
- These canals are filled with a fluid called **perilymph**.
- 2 main parts: **Semicircular canals** and the **Cochlea**.



Semicircular Canals

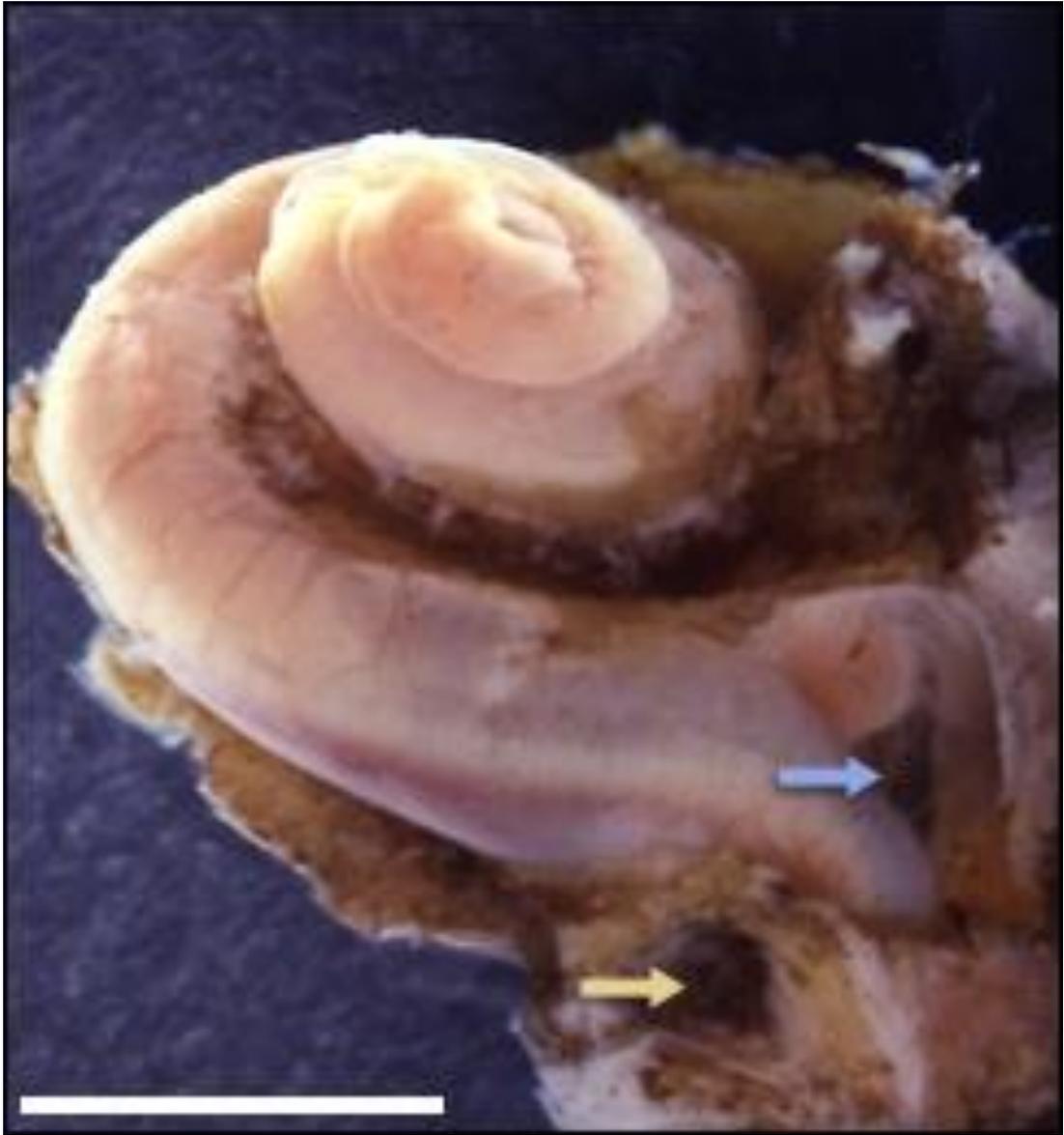
- There are 3 canals used for balance.
- **Static equilibrium** is the orientation of the body relative to the ground – we know we are standing.
- **Dynamic equilibrium** is the ability to maintain our balance when we are moving in different directions.

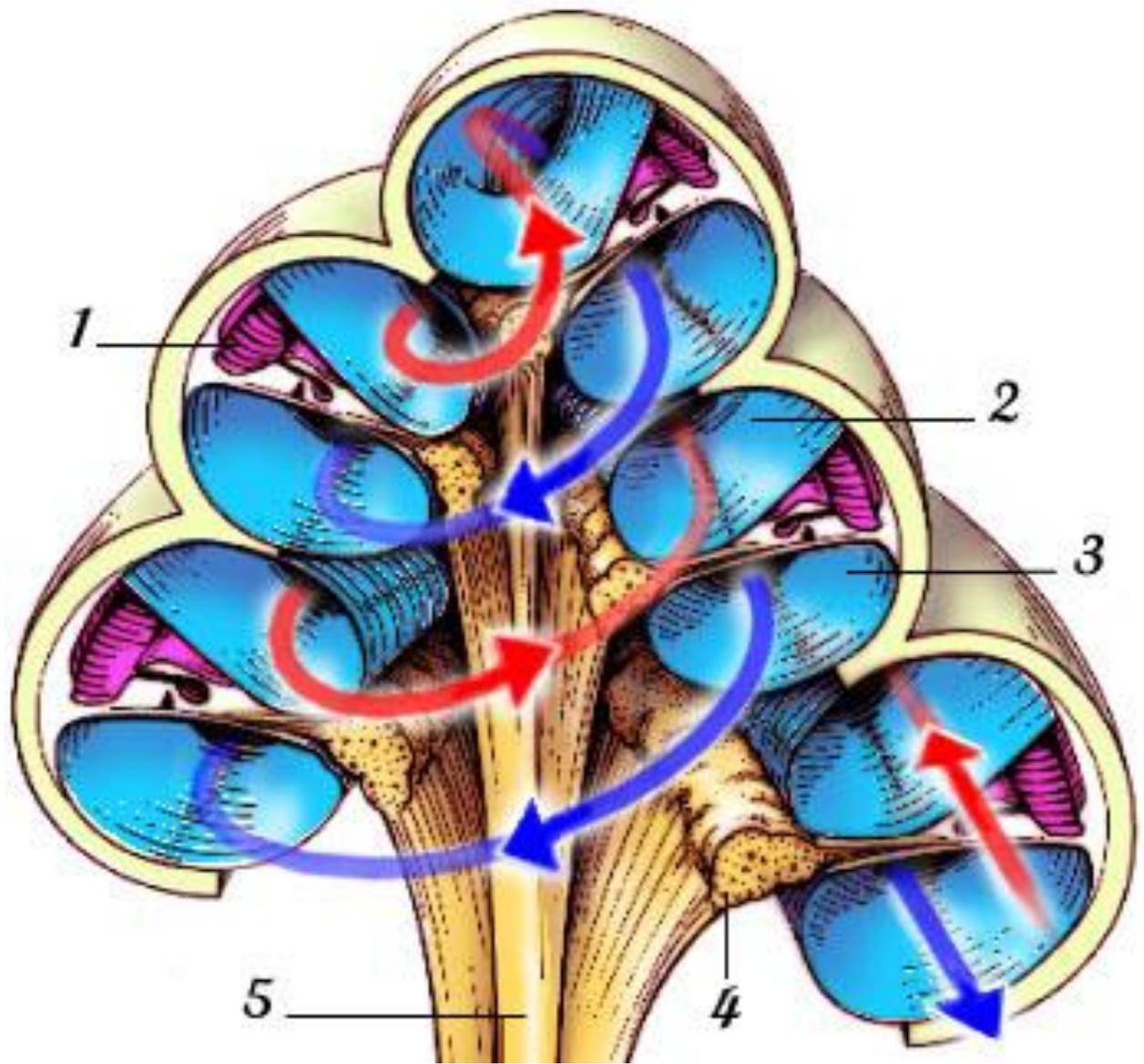




The Cochlea

- A snail shaped structure, it makes 2 ½ turns around a bony core.
- Two membranes, **the vestibular & basilar membranes** divide the cochlea into three chambers.
- One of these chambers contains the **organ of Corti**, the actual organ of hearing.

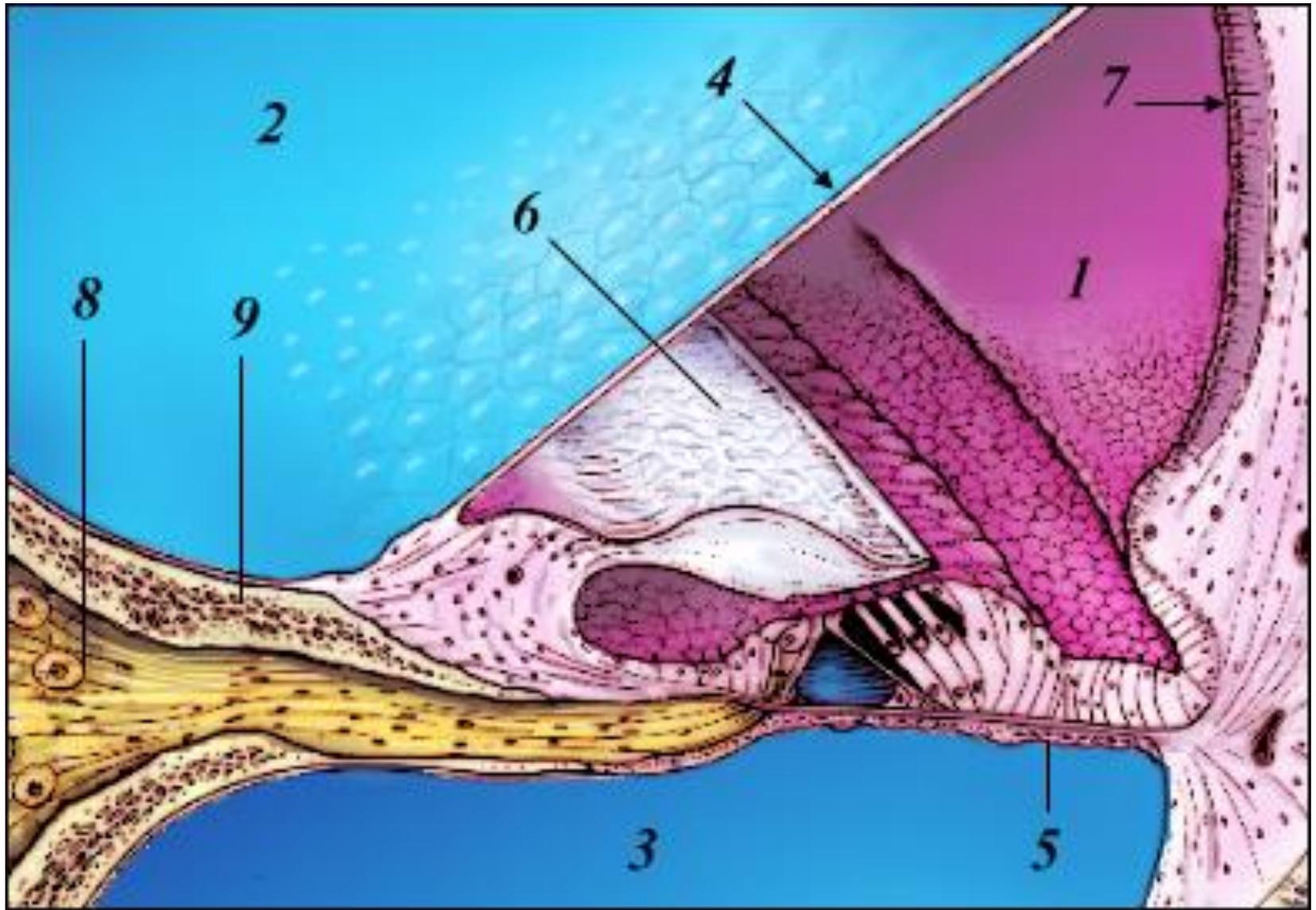






The organ of Corti

- This organ has two rows of hair cells embedded into a membrane called the tectorial membrane.
- The bottom of the hair cells sit on a membrane called the basilar membrane.



Physiology of Hearing

- Human range of hearing is from 20 to 20,000 hertz.

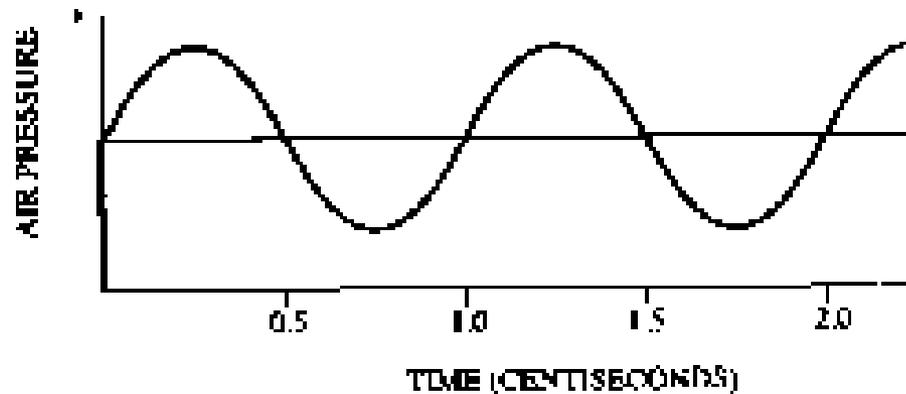


Figure 8.2 Sine wave



Hearing in a Nut Shell

- Sound waves collected by pinna
- Sent down external auditory canal
- Vibrate t.m.
- Vibrate the three bones
- The three bones vibrate the oval window
- The oval window makes the fluid in the cochlea move



Hearing in a Nut Shell (2)

- The fluid makes the basilar membrane vibrate
- This causes the hair cells to be stimulated
- The hair cells create an action potential that is sent to the brain via the auditory nerve – we hear!