



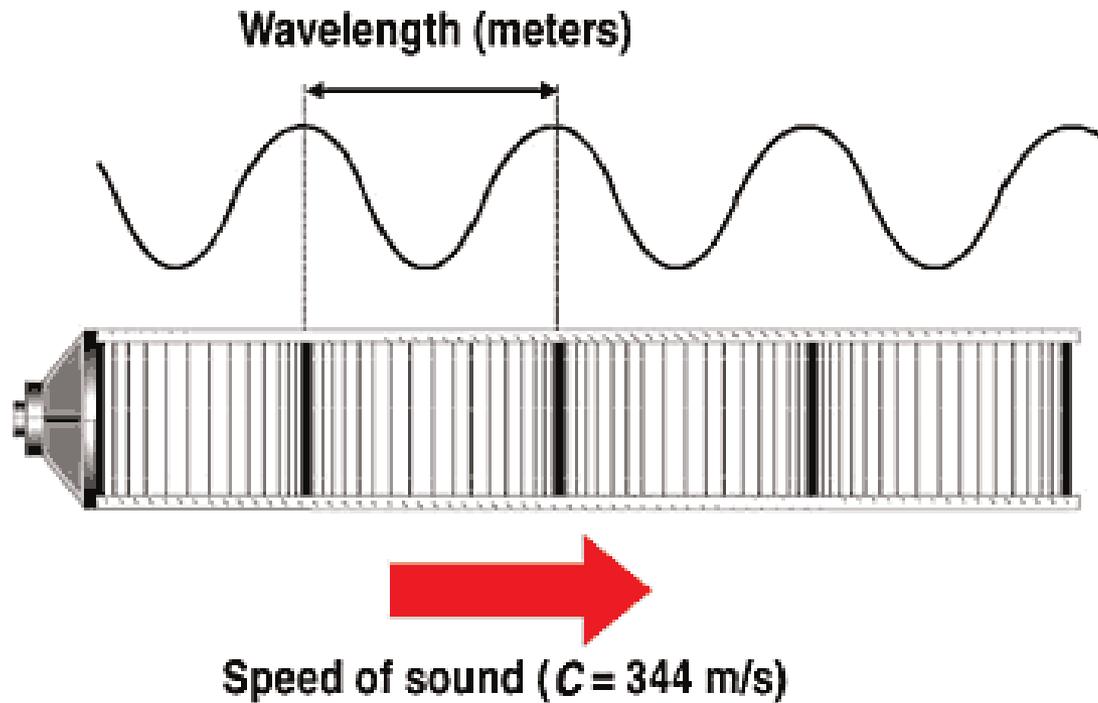
# SENSORY SYSTEM VII

## THE EAR



# Waves

- Sound is a compression wave

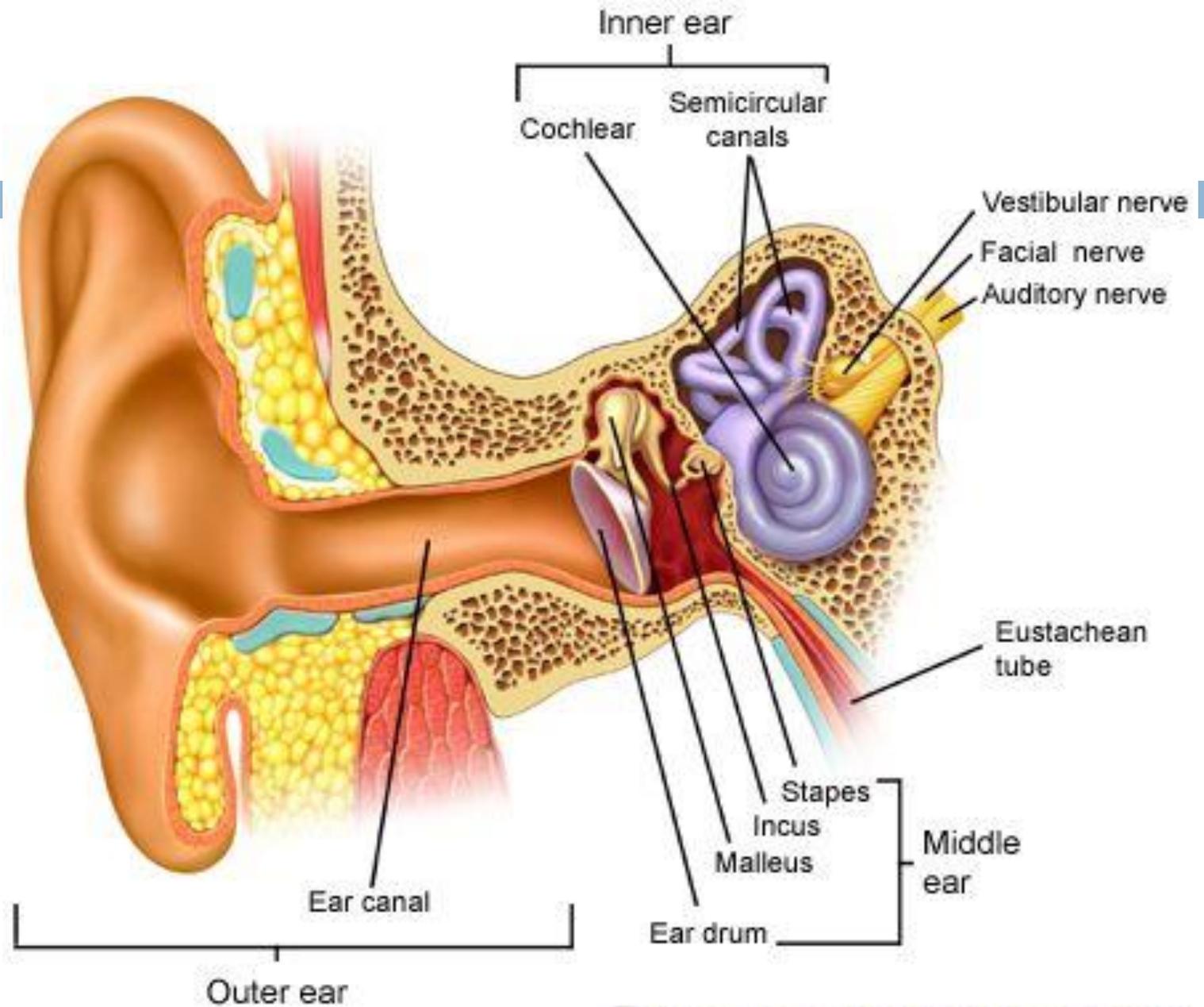


(Courtesy of Jack Heeg, 1999)

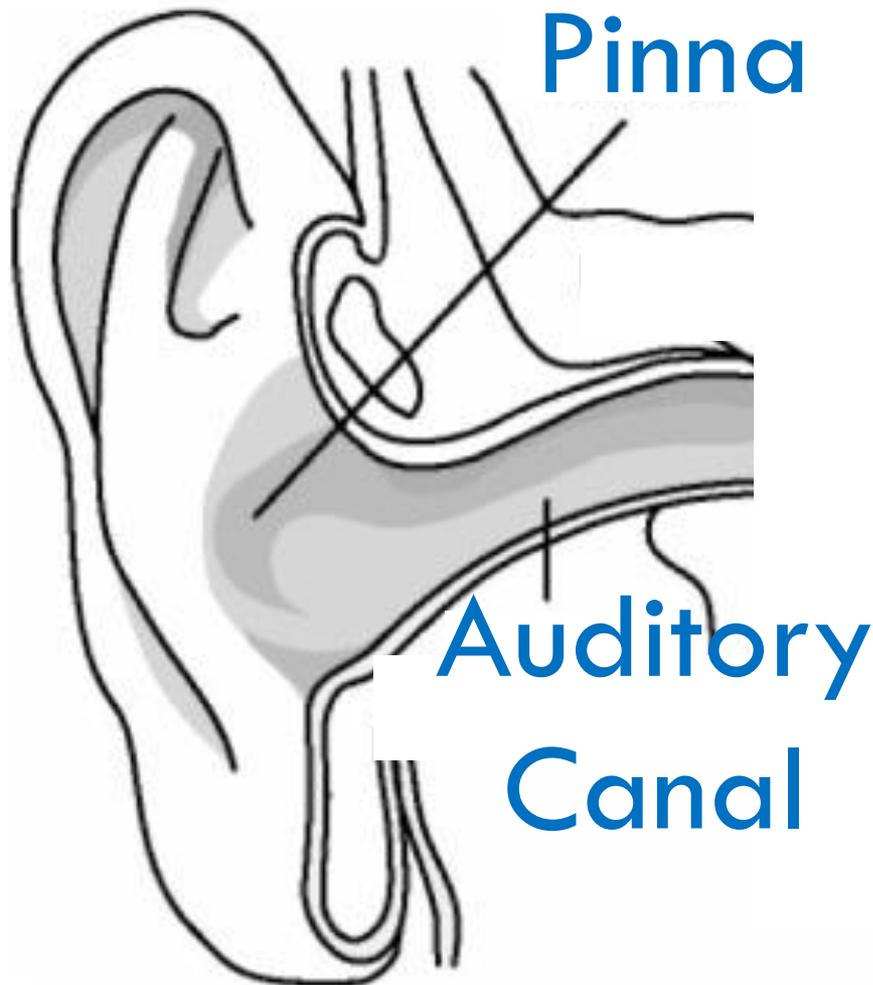
# The Ear



# Ear



# Outer Ear



## Outer ear:

- Made up of the pinna and the auditory canal



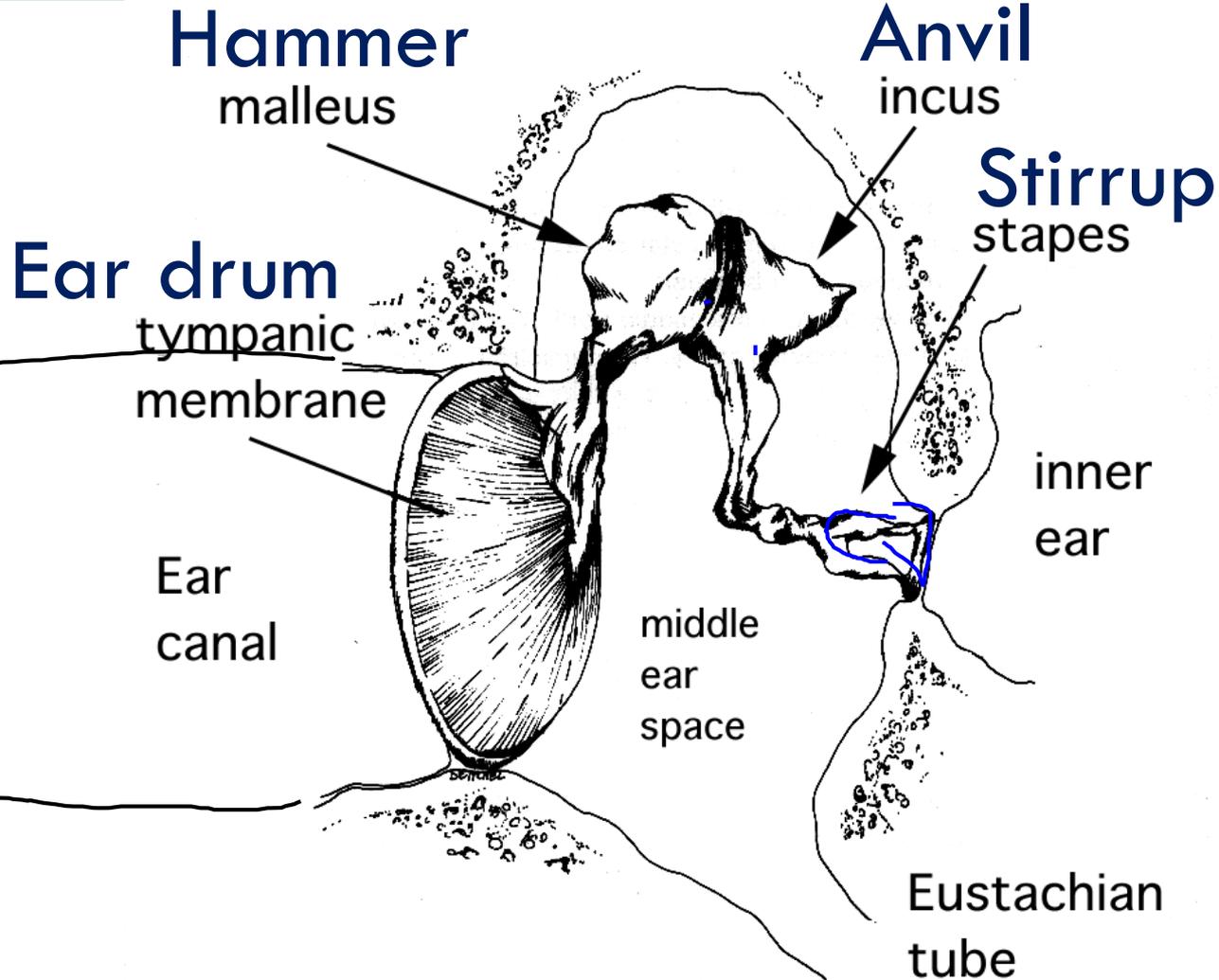
# Outer Ear

- **Pinna** (also called the auricle)
  - The only visible part of the ear
  - Shaped like a funnel to pick up sound and carry it into the auditory canal
- **Auditory canal**
  - 2.5 cm long canal that carries sound to the eardrum
  - Lined with small hairs and sebaceous glands
    - The glands produce wax

# Earwax

- **Importance of earwax (cerumen):**
  - **Protects** the skin of the human ear canal, assists in **cleaning** and lubrication, and also provides some protection from **bacteria, fungi, insects** and **water**.
- **Why the hairs?**
  - The hairs act like a **filter** to help trap material and prevent it from entering the ear

# Middle Ear



# Middle Ear

## □ Tympanic membrane (ear drum)

- A thin, flexible and fibrous membrane about 1 cm in diameter
- Vibrates when sound waves come in contact with it
  - Turning sound waves into mechanical wave

## □ Ossicles

- Small bones located in the temporal bone
- Made up of 3 bones:
  - Hammer
  - Anvil
  - Stirrup

The ossicles are the  
smallest bones in the  
body!

# Middle Ear

This process allows  
sound to be magnified  
~20 times

- **Ossicles (cont'd)**
  - ▣ The hammer (malleus)
    - Touches the eardrum and moves as a response to the movements of the eardrum
    - It then hits the anvil
  - ▣ The anvil (incus)
    - The anvil transfers vibrations from the hammer to the stirrup
  - ▣ The stirrup (stapes)
    - the stirrup transfers vibrations from the anvil to the oval window (another membrane)

# Middle Ear

## □ Eustachian tube:

- The canal that links the middle ear to the pharynx (throat)
- Allows for pressure equalization on either side of the eardrum by swallowing
  - There is air on either side of the ear drum that can be at different pressures
  - The Eustachian tube is usually closed but can be opened to allow air in or out in order to equalize the pressure on both sides

# Middle Ear

- **Eustachian tube** (cont'd):
  - The Eustachian tube also allows for mucus to drain from the middle ear during allergies or an infection; this build up of fluid can also lead to conduction hearing loss

Why do you sometimes have trouble hearing when you have a cold?

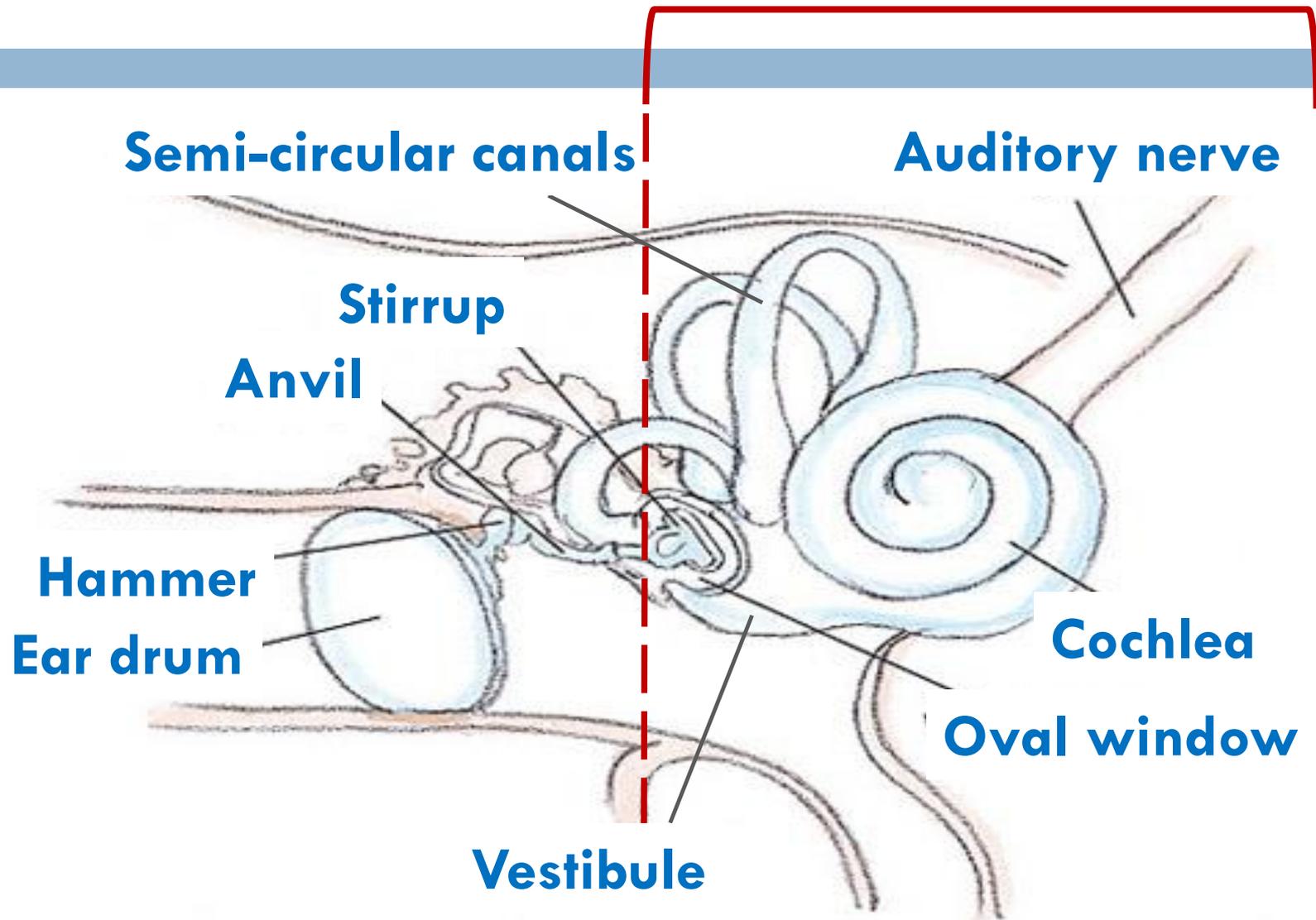


# Middle Ear

- **Why do you sometimes have trouble hearing when you have a cold?**
  - The build up of mucus can prevent the equalization of air between the middle ear and throat and thus decrease the ability of the ear drum or ossicles to conduct sound properly.

# Inner Ear

# Inner Ear



# Inner Ear

## □ Semi-circular canals:

- 3 sets of liquid-filled tubes
- Help in spatial orientation and balance when the body is in motion

## □ Vestibule:

- Liquid-filled structure that links the semi-circular canals to the cochlea
- Helps with balance when the body is in a static position
- Linked to the vestibular nerve

# Inner Ear

## □ Cochlea:

- Liquid-filled structure lined with hair-like auditory receptor cells
- Connected to the auditory nerve
- The auditory nerve then transmits nerve impulses to the temporal lobe of the brain
  - Remember from our notes on the brain?

# Hearing Loss

- **Two main types of hearing loss:**
  - Conduction deafness
  - Nerve deafness

What do you think is the difference between the two?

In which parts of the ear do you think each one happens?

# Hearing Loss

- **Conduction deafness:**
  - Conduction deafness occurs when there is a problem conducting sound waves
  - It is a mechanical problem
- **Where does conduction deafness occur?**
  - Conduction deafness can occur anywhere along the route that sound travels. This can be in the outer ear, the tympanic membrane (eardrum) or in the middle ear (damage to ossicles).
  - It could also occur due to a build up of cerumen or pus (in an ear infection)



**\*Yuck\***

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# Hearing Loss

## □ Nerve deafness:

- Occurs when there is damage done to or abnormalities in the vestibulocochlear nerve, the inner ear or the processing centres in the brain

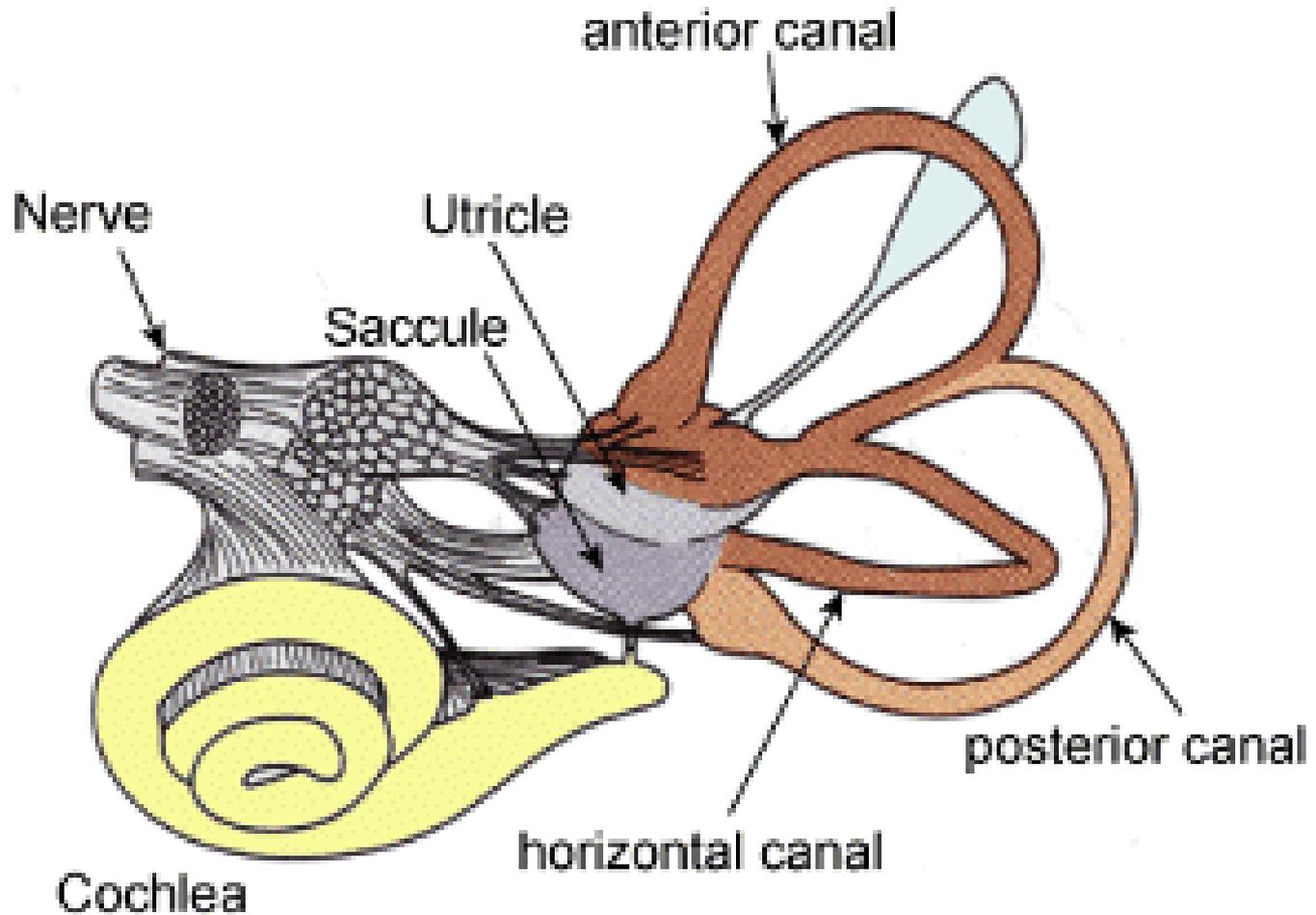
## □ Presbycusis:

- Age-related hearing loss that results from damage to the auditory sensory receptors in the cochlea
  - Ability to hear high frequencies is the first to go usually

# The Organs of Balance



# Organs of Balance



# Organs of Balance

- The organs of balance:
  - The semi-circular canals (3)
  - Vestibule:
    - Made up of the utricle and sacculle
- The organs of balance are again filled with fluid and lined with hair-like receptors that detect movement

# Maintaining Balance

## Vestibule

- The saccule and utricle are filled with a jelly-like fluid (endolymph) that contains small particles called otoliths.
  - Otoliths are small particles of calcium carbonate in the jellylike substance filled inside the saccule
- When the head moves, the particles move in response to gravity (so if you move your head down, the particles would move down) and this triggers hair cells which send impulses to the brain, letting it know the position of the head.

# Maintaining Balance

## The Semi-Circular Canals

- The semicircular canals help you to respond to changes in movement
  - ▣ like starting, stopping and turning
- The canals are set at right angles to one another and on different planes. The canals are filled with liquid and lined with hair cells that respond to the movement of the fluid.
  - ▣ The brain will recognize which impulses are coming from which canal and therefore lets it know which way your head is moving.