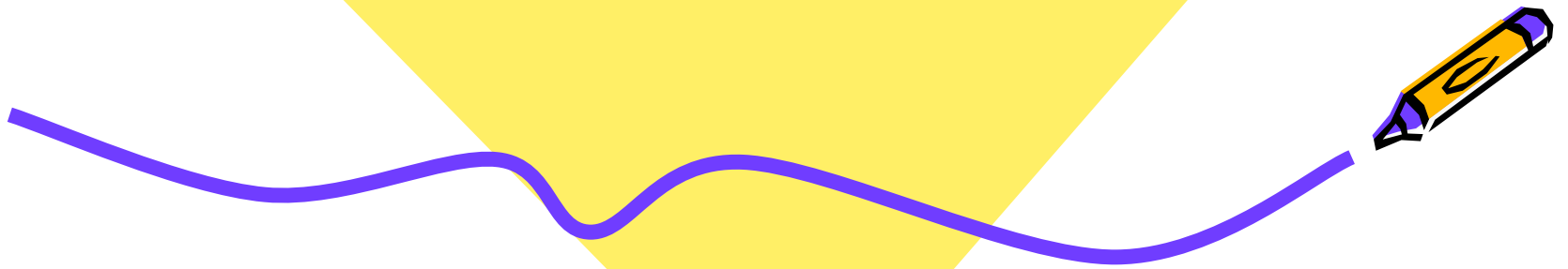
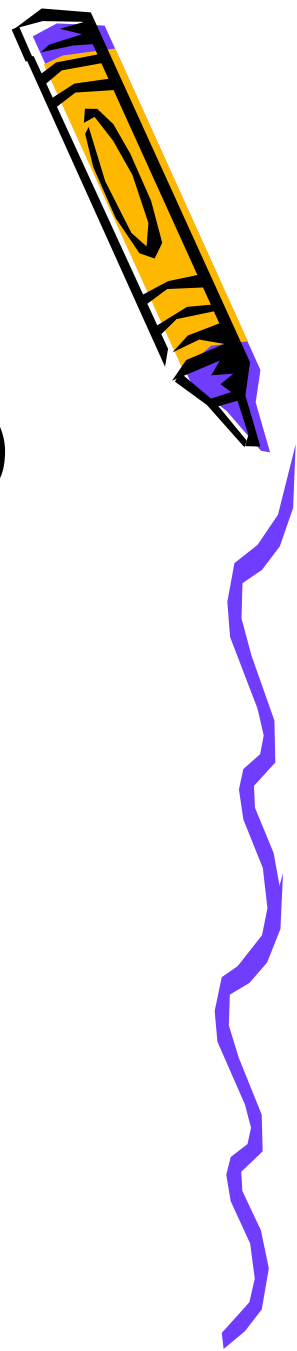




Anatomy of The Ear



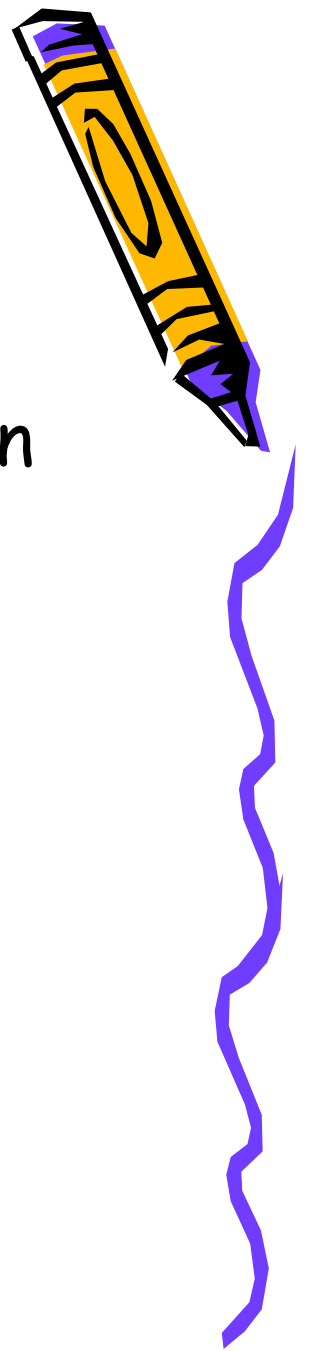
Range Of the Human Ear



- Sound is recorded as decibels (dB)



Range Of the Human Ear

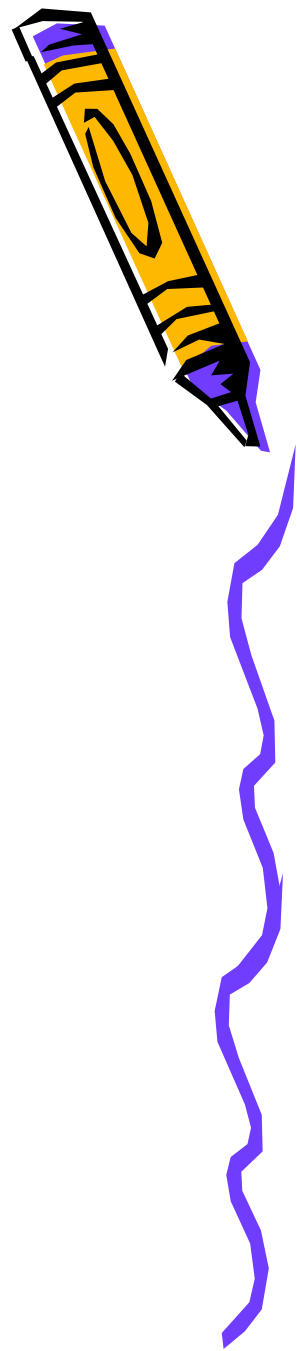


- The range of pressures that the ear can hear is enormous.
- The quietest sound that the average healthy 18 year old can hear has a pressure of 20 micropascals or 0 dB.

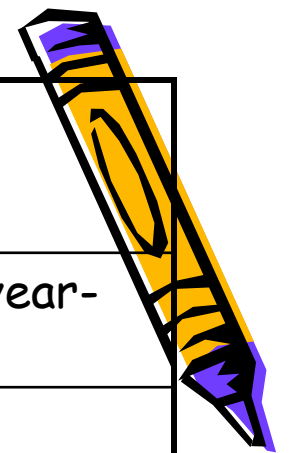


Range Of the Human Ear

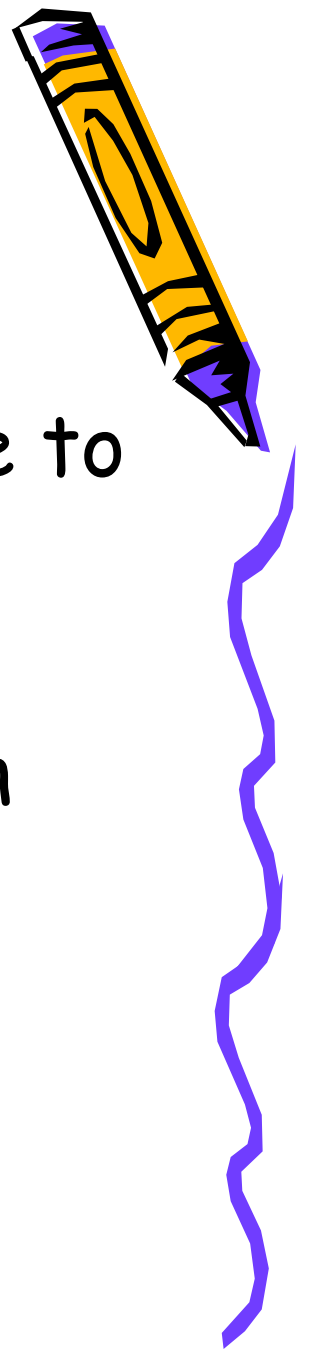
- We can hear 400,000 approx sounds
- A frequency spectrum of 10 octaves



Decibels dB	Micropascals μPa	Typical Perception
0	20	The quietest sound an 18 year-old healthy ear can hear
20	200	A very soft whisper
45	300-800	A softly spoken voice
60	5,000	An average spoken voice
70	20,000	A shout
80	100,000	A noisy motorcycle on a narrow street
90-100	500,000	Jackhammers within 50 feet
100-120	5,000,000	A heavy metal rock concert
120-140	20,000,000	The noise of a jet engine within 250 yds



Range Of the Human Ear

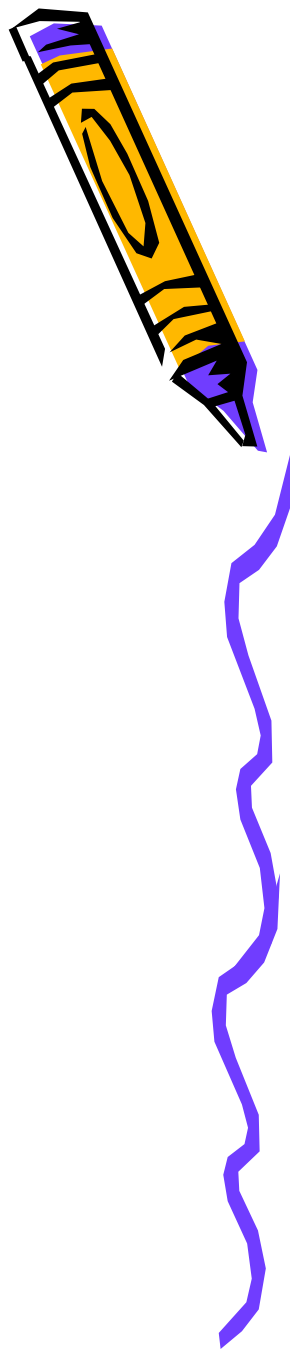


- Vibrations of the ear-drum can be to about the diameter of a hydrogen atom
- People living in the countryside can actually hear random motion of air molecules bouncing against their eardrums!

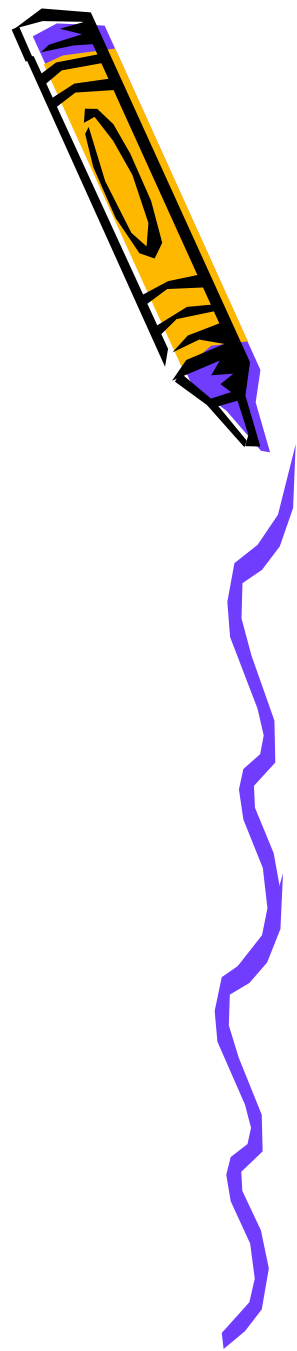


The Ear

- Transfers sound energy into electrical nerve impulses



The Mechanics of the Ear

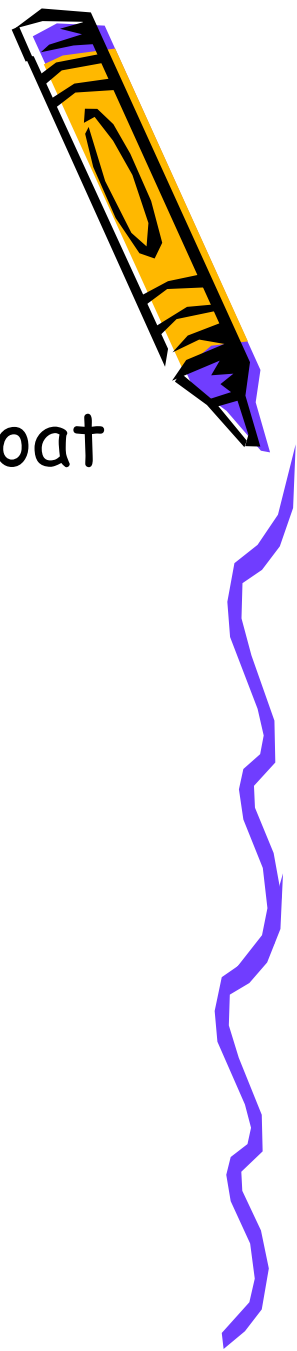


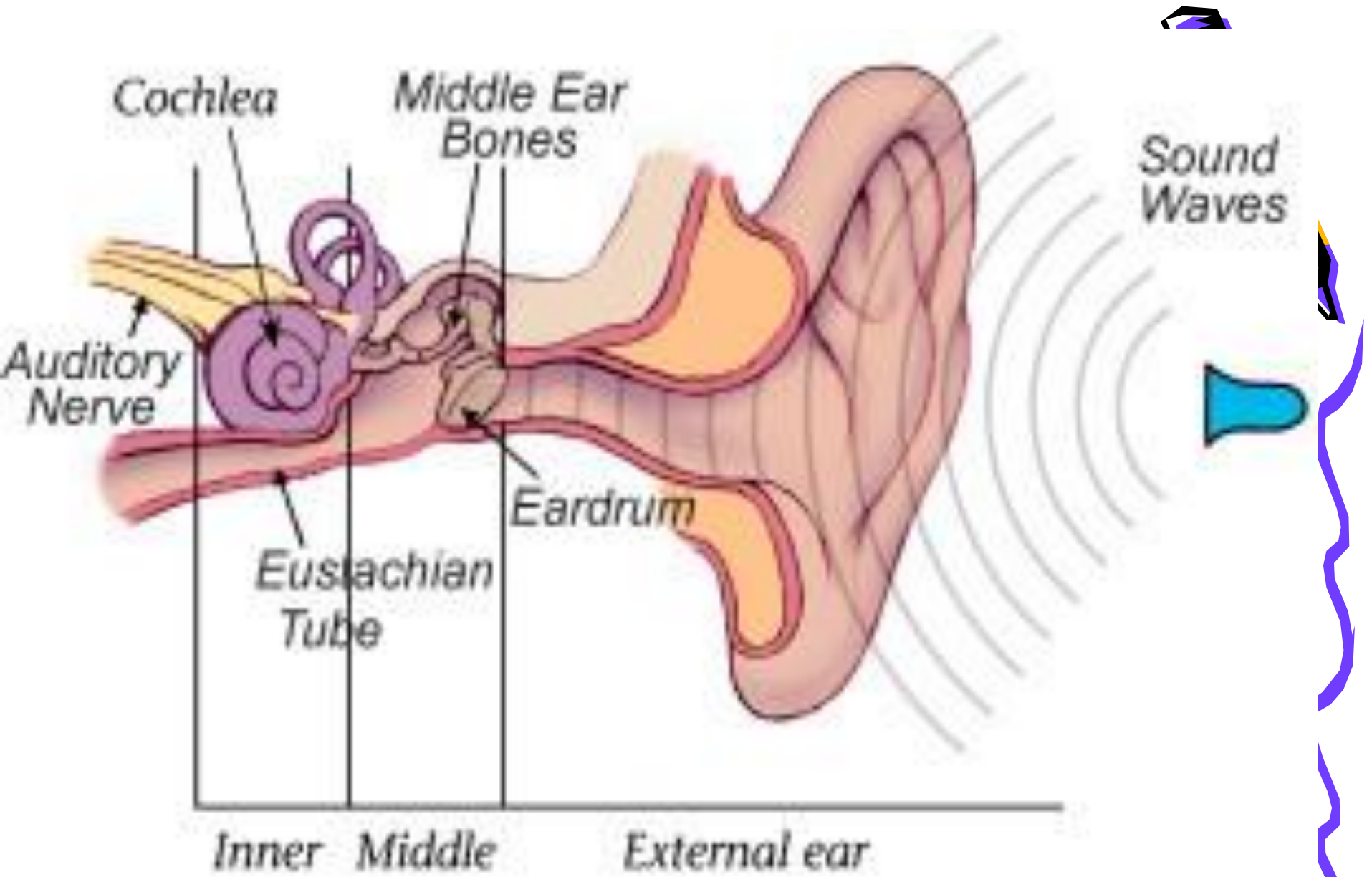
- The ear is made up of three basic structures:
 - the outer ear
 - the middle ear
 - and the inner ear.



The Mechanics of the Ear

- Connecting the middle ear to the throat is a canal called the Eustachian tube.

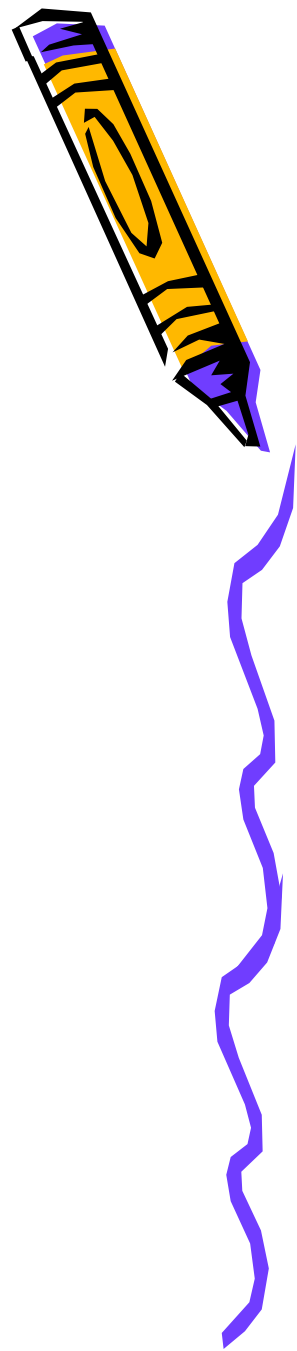


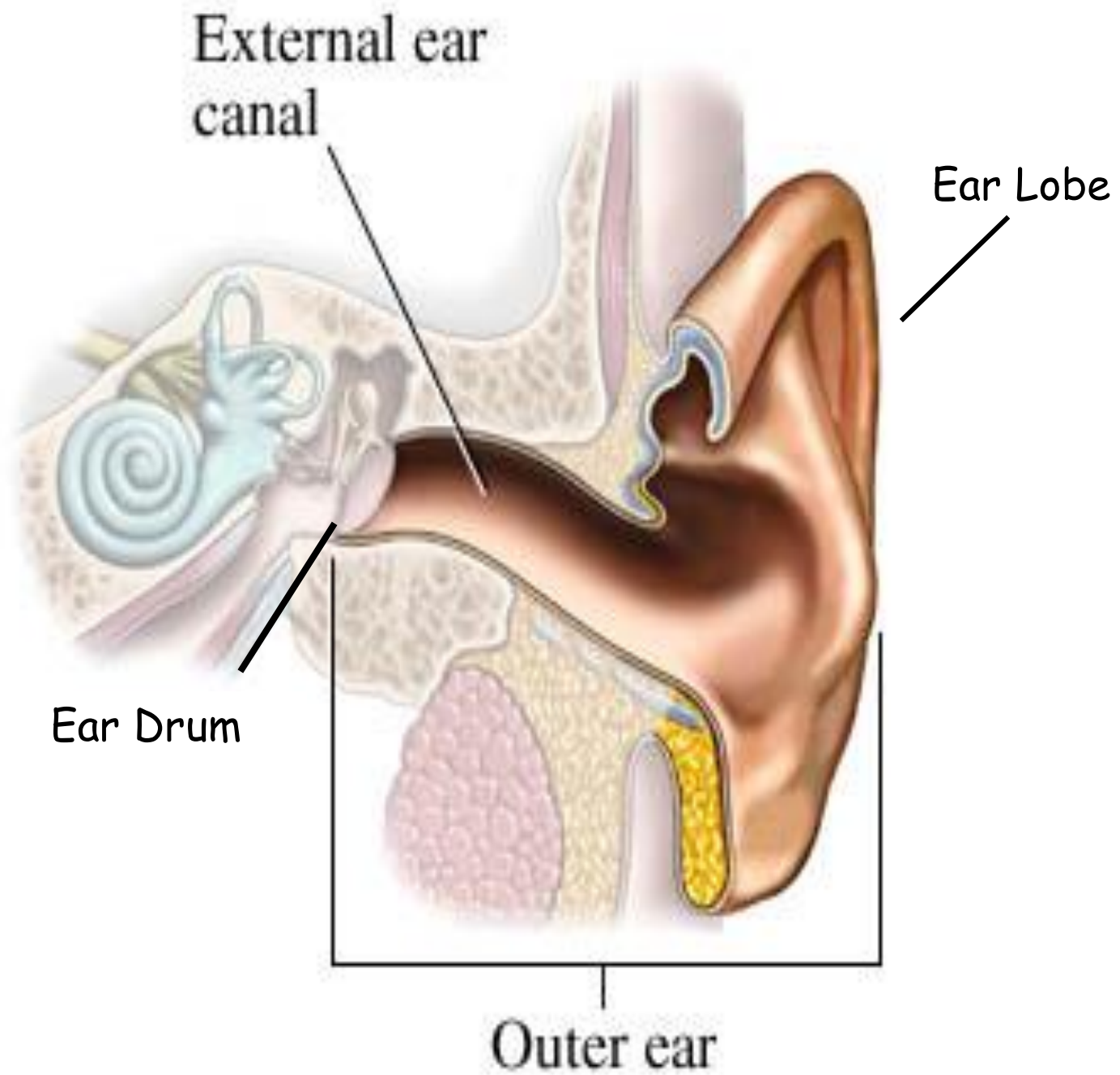


Anatomy of the Ear

How the Outer Ear Works

- The outer ear consists of:
 - The ear lobe
 - The ear canal
 - The ear drum





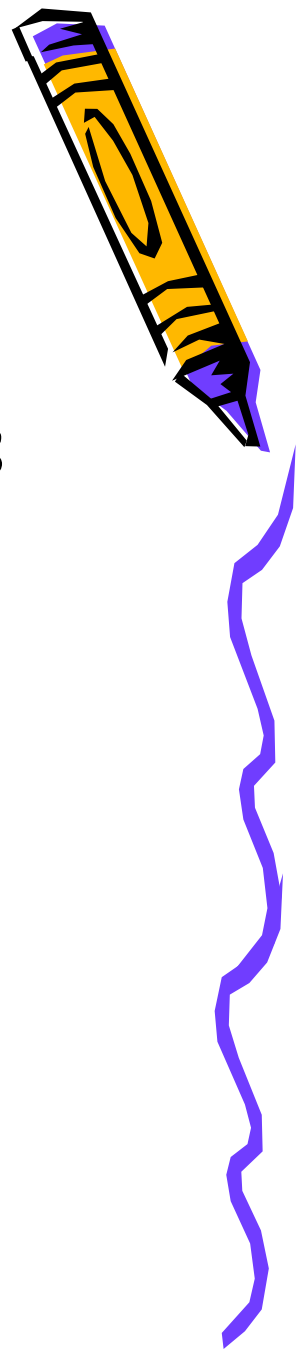
How the Outer Ear Works



- The ear lobe and the outer ear canal, delivers sound to the middle ear.
- Wax-producing glands and hairs that protect the middle ear.



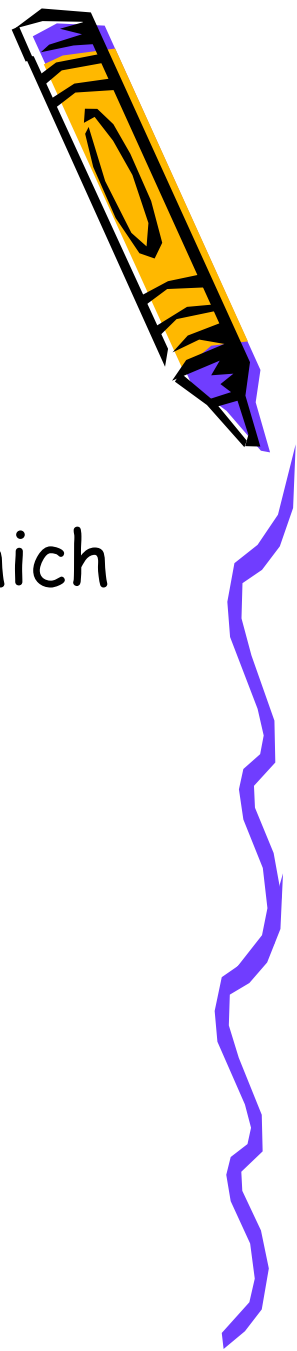
How the Middle Ear Works



- The purpose of the middle ear is to:
 - Transmit and amplify sounds
 - Act as a dampener on loud sounds



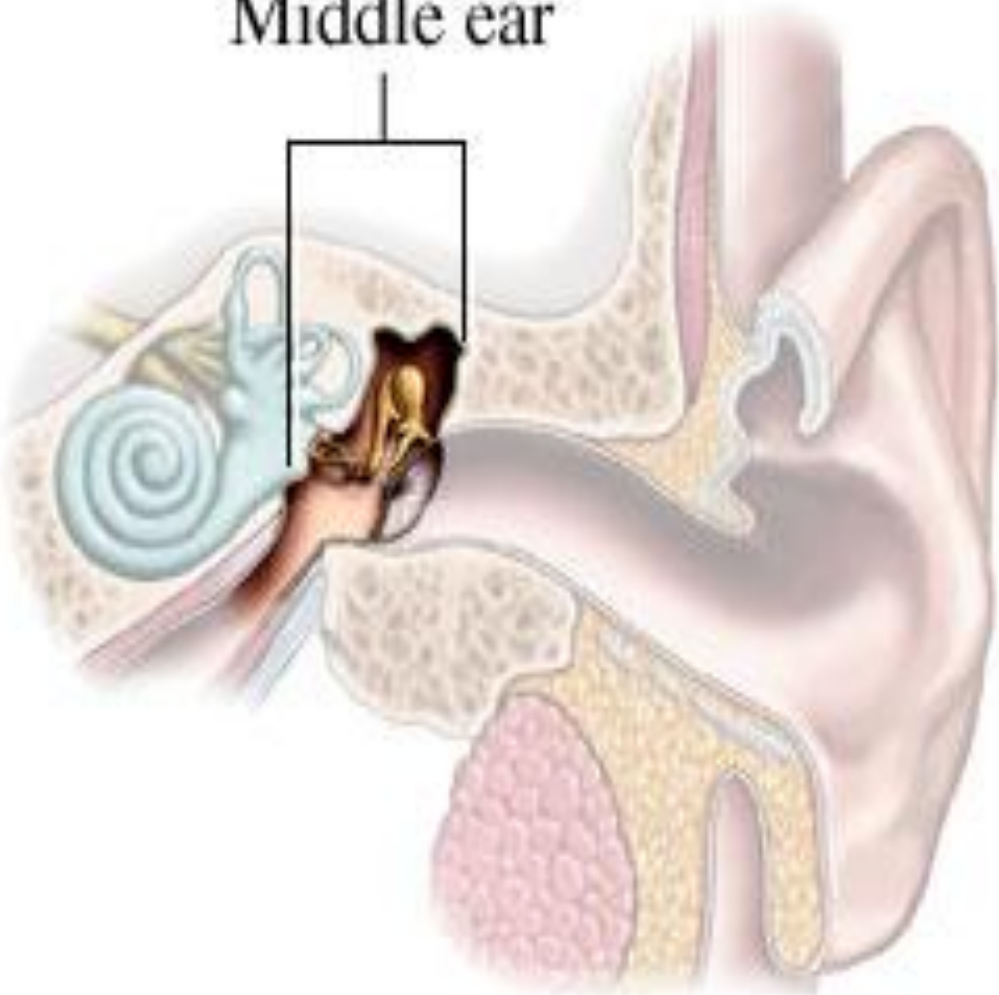
How the Middle Ear Works



- The middle ear consists of:
 - The inner part of the ear drum to which one end of the hammer is attached
 - The hammer
 - The anvil
 - The stirrup



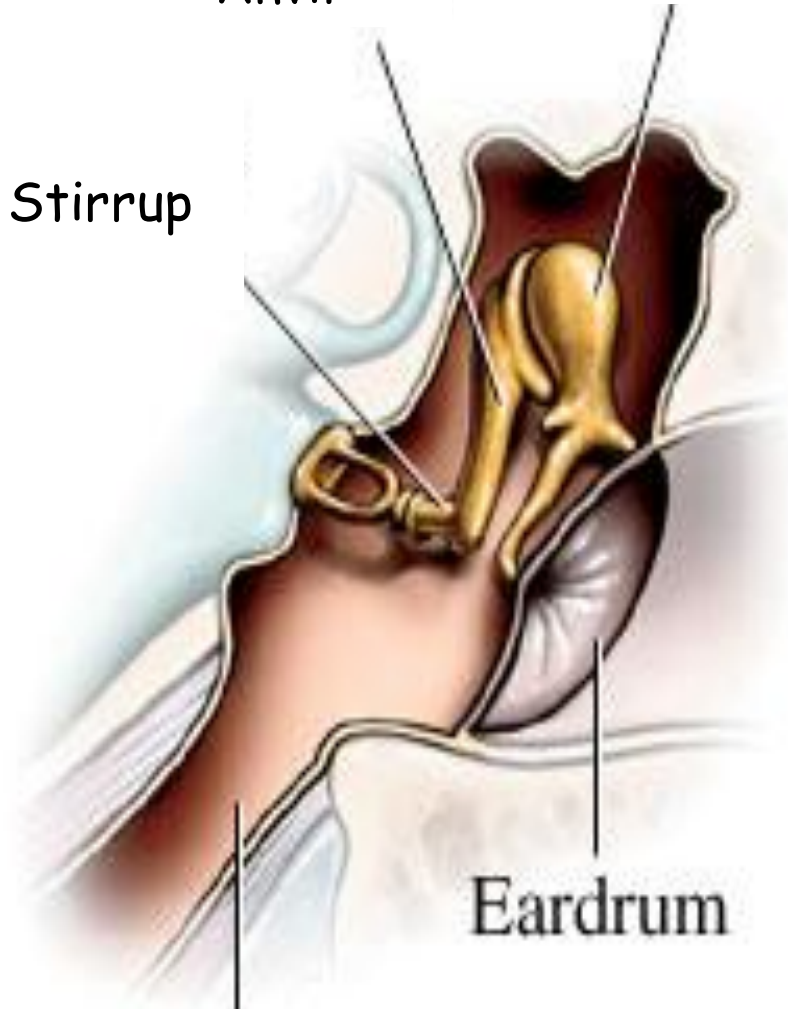
Middle ear



Anvil

Hammer

Stirrup

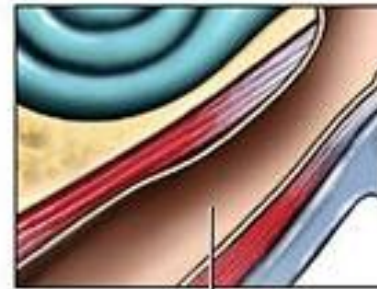
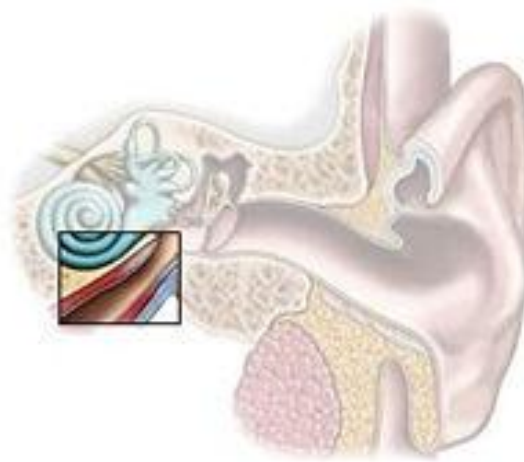


Eardrum

Eustachian tube

Eustachian Tube

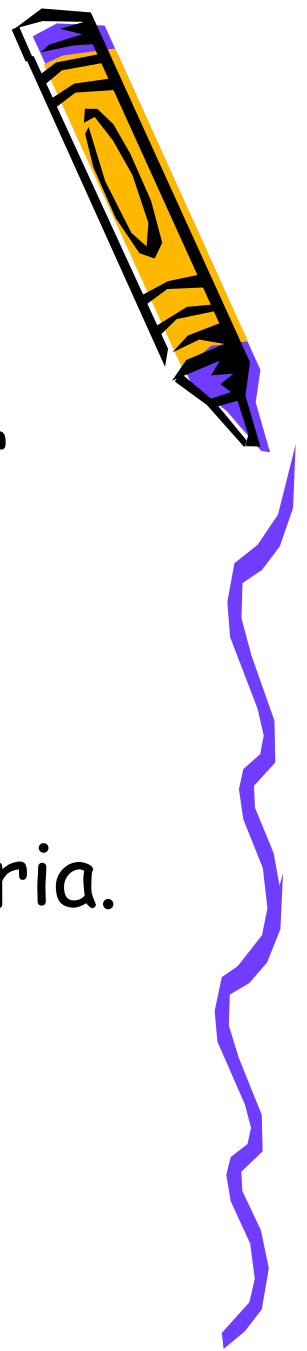
- The middle ear is connected by a narrow channel to the throat called the Eustachian tube.



Eustachian tube



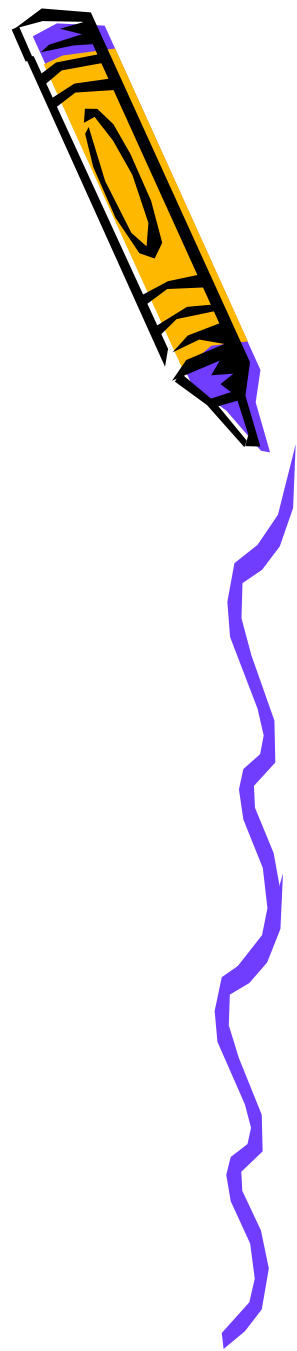
Purpose of The Eustachian tube



- Pressure valve between outside air pressure and the middle ear chamber.
- Used to drain accumulations in the middle ear such as mucus or bacteria.



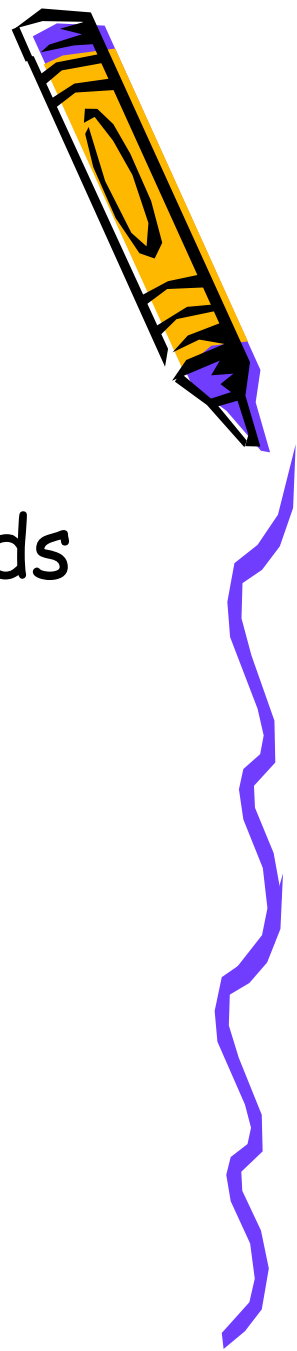
How the Inner Ear Works



- The inner ear contains the most important parts of the hearing mechanism
 - the semicircular canals
 - the cochlea.

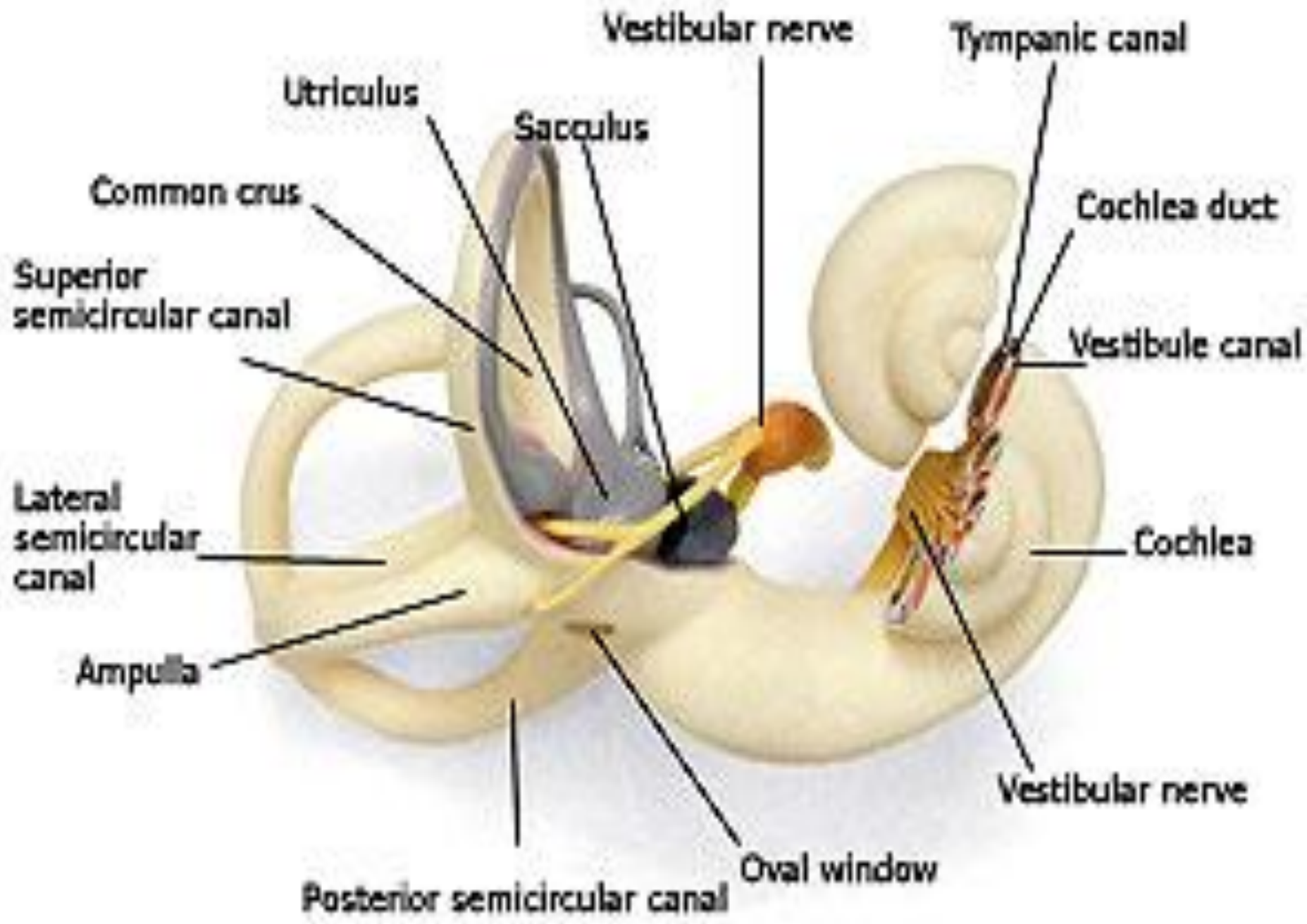


How the Inner Ear Works

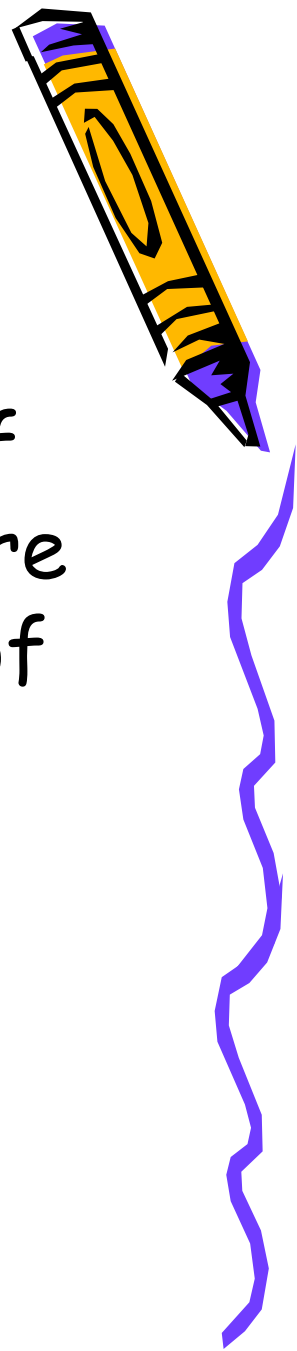


- Both the semicircular canals and cochlea are filled with various fluids





How the Inner Ear Works



- The semicircular canals consists of elaborately formed canals which are largely responsible for the sense of balance.



Yaw: Rotation
around z axis

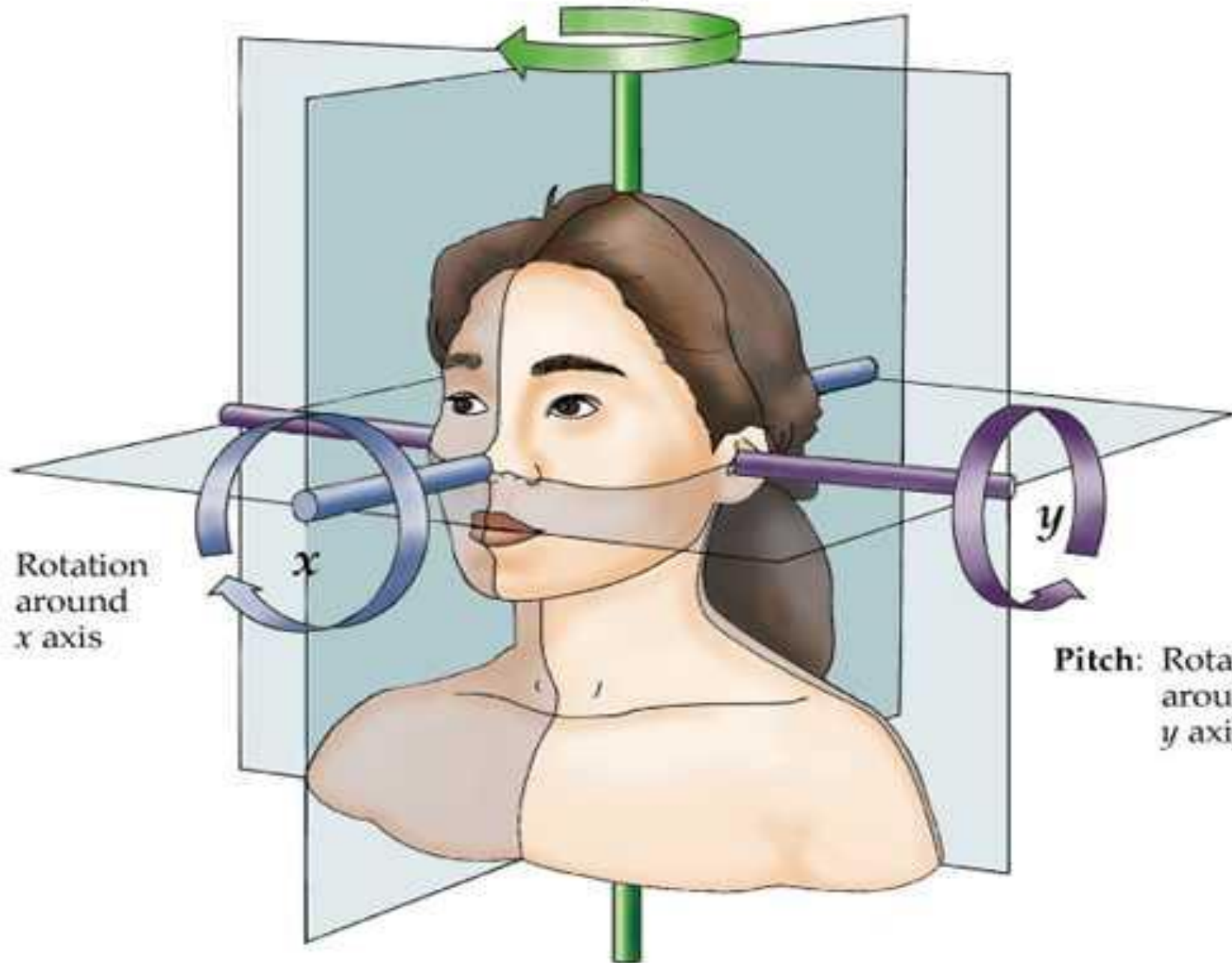
z

Roll: Rotation
around
 x axis

x

y

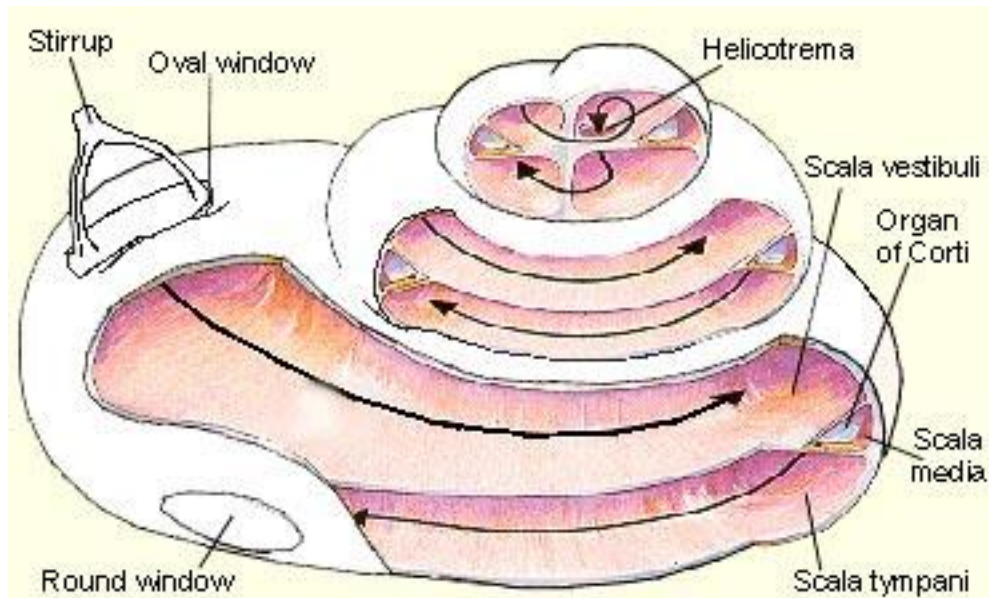
Pitch: Rotation
around
 y axis



How the Inner Ear Works



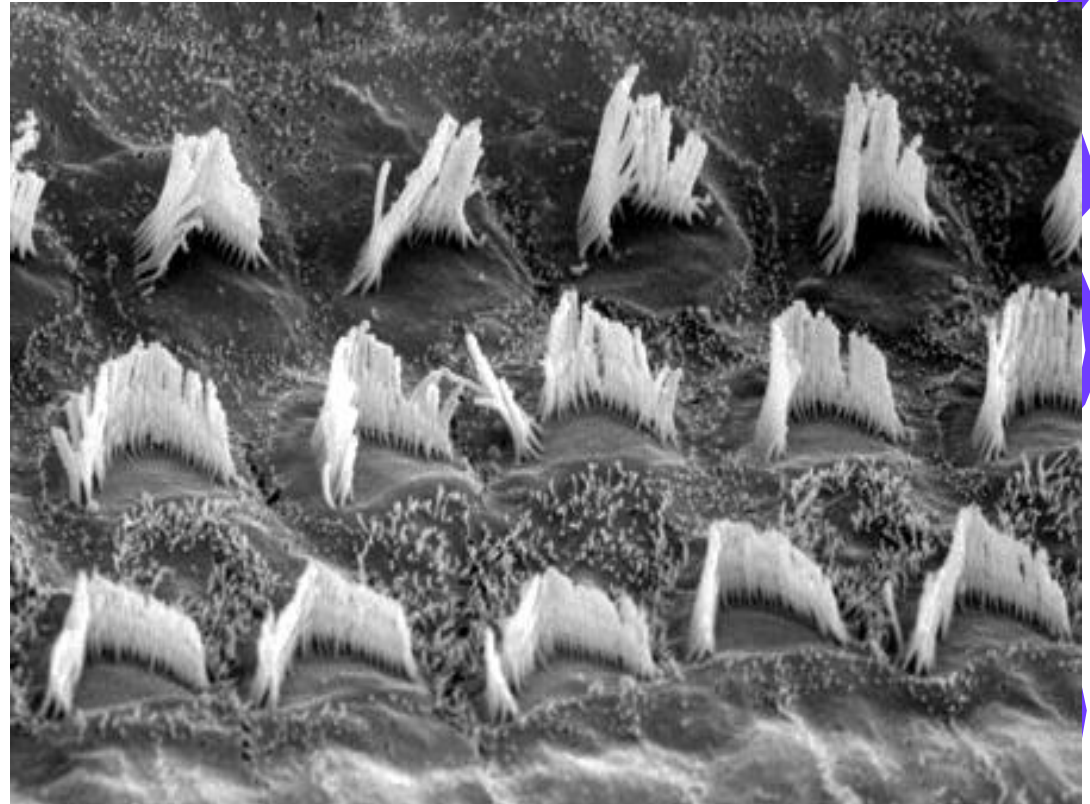
- The cochlea, resembles a snail shell.



How the Inner Ear Works

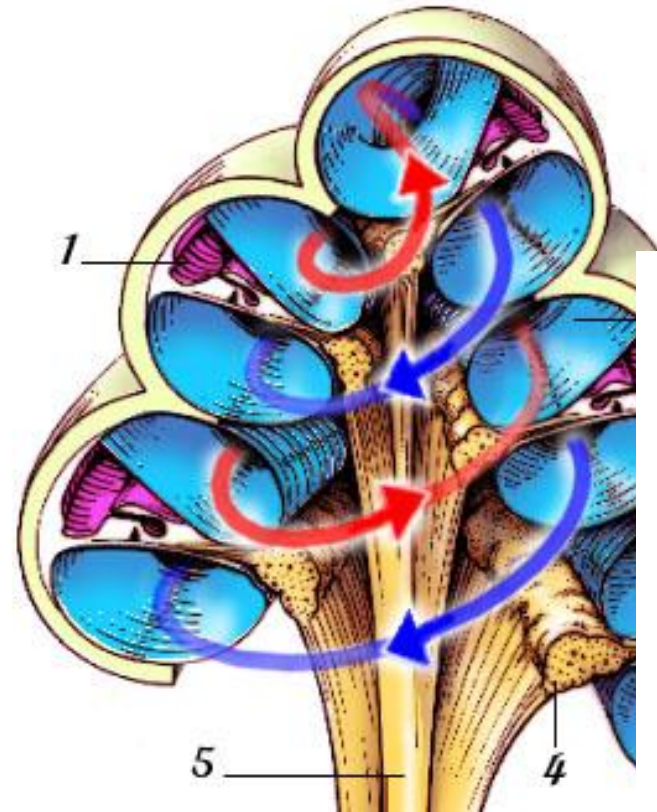


- Tiny hairs line the curves of the cochlea.
 - 24,000 hairs

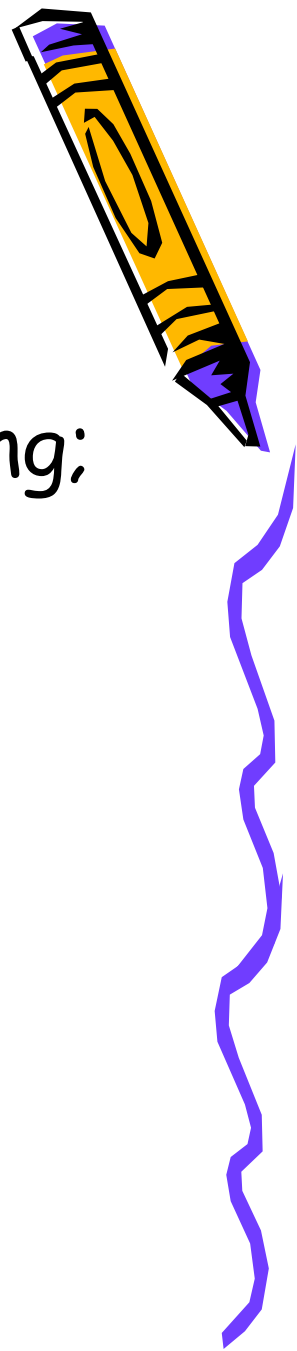


How the Inner Ear Works

- Actual Organ of hearing

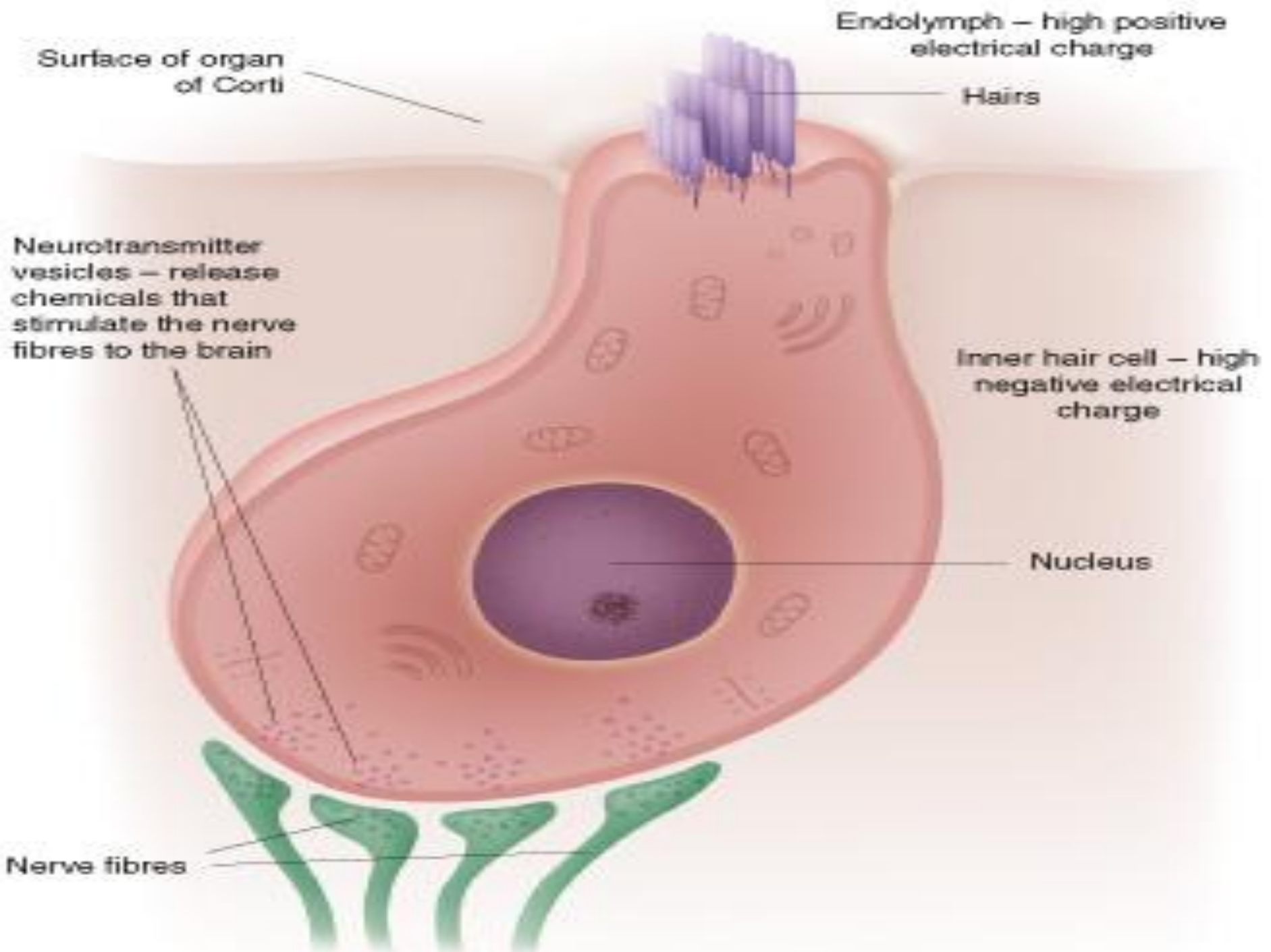


How the Inner Ear Works



- The hair cells are critical to hearing;
- it is the inner hairs that move in reaction to pressure waves





Endolymph – high positive electrical charge

Surface of organ of Corti

Hairs

Neurotransmitter vesicles – release chemicals that stimulate the nerve fibres to the brain

Inner hair cell – high negative electrical charge

Nucleus

Nerve fibres