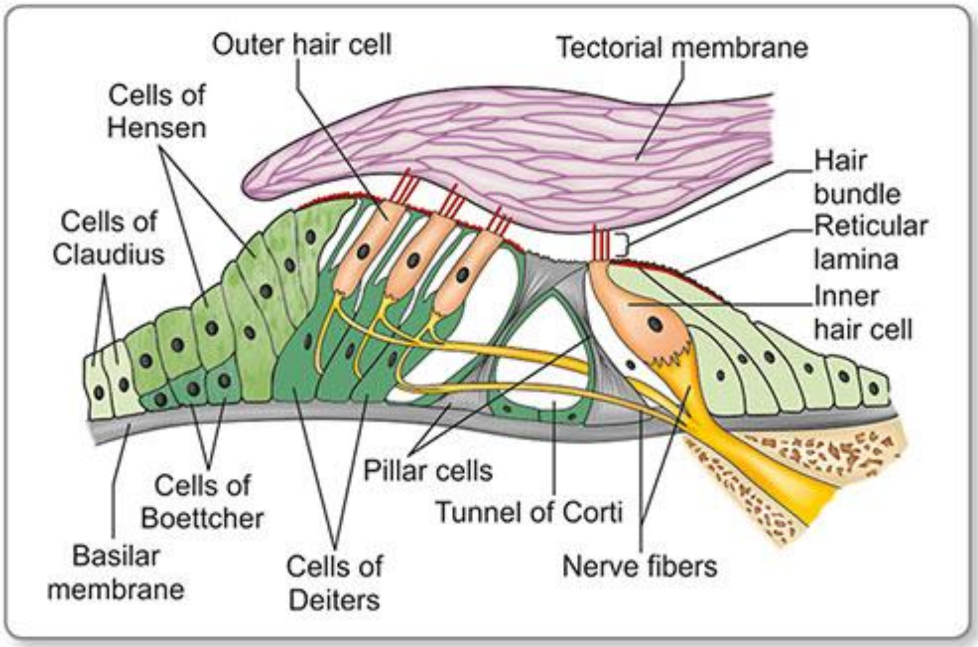
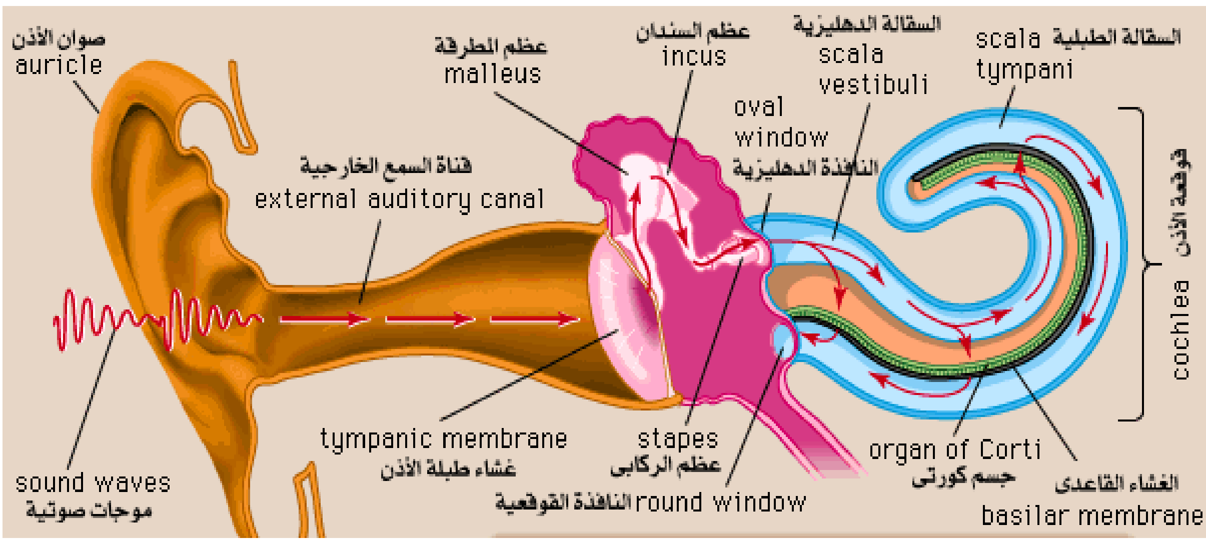
Hair cell: They are columnar cells, each with a bundle of 100-200 specialized cilia at the top, for which they are named. These cilia are the mechanosensors for hearing. Lightly resting atop the longest cilia is the tectorial membrane, which moves back and forth with each cycle of sound, tilting the cilia and allowing electric current into the hair cell. Hair cells, like the photoreceptors of the eye, show a graded response, instead of the spikes typical of other neurons. When the bones of the middle ear vibrate the oval window, these vibrations are transmitted to the fluid within the cochlea and eventually cause the round window on the cochlea to bulge outward. These vibrations deflect the membrane on which the Organ of Corti is located, causing the three rows of outer hair cells to "rub" against the overhanging tectorial membrane. By their muscle-like activity they amplify the weakest vibrations for the inner hair cells. The louder sounds are not amplified. The disturbed inner hair cells will then activate the cochlear nerve fibers. The current model is that cilia are attached to one another by "tip links", structures which link the tips of one cilium to another. Stretching and compressing the tip links may open an ion channel and produce the receptor potential in the hair cell. The nerve that innervates the cochlea is the cochlear nerve, and forms cranial nerve number VIII with the vestibular nerve from the balance organ.



Mechanism of hearing

- Sound waves enter your outer ear and travel through your ear canal to the middle ear.
- The ear canal channels the waves to your eardrum, a thin, sensitive membrane stretched tightly over the entrance to your middle ear.
- The waves cause your eardrum to vibrate.
- It passes these vibrations on to the hammer, one of three tiny bones in your ear. The hammer vibrating causes the anvil, the small bone touching the hammer, to vibrate. The anvil passes these vibrations to the stirrup, another small bone which touches the anvil.
- Inside the cochlea, The base plate of the stirrup or stapes moves in the oval window, creating waves in the cochlear fluid that presses the basilar membrane and makes it move, and the hair cells of the organ

of Corti slip onto the tectorial membrane hanging over it, and as a result the hair cells are bent, which causes batches in the cochlear nerve fibers in contact with these cells. The cochlear nerve transfers these impulses to the temporal lobe, the auditory center of the brain, and the brain translates these impulses into sounds.



<u>Ear equilibrium</u>

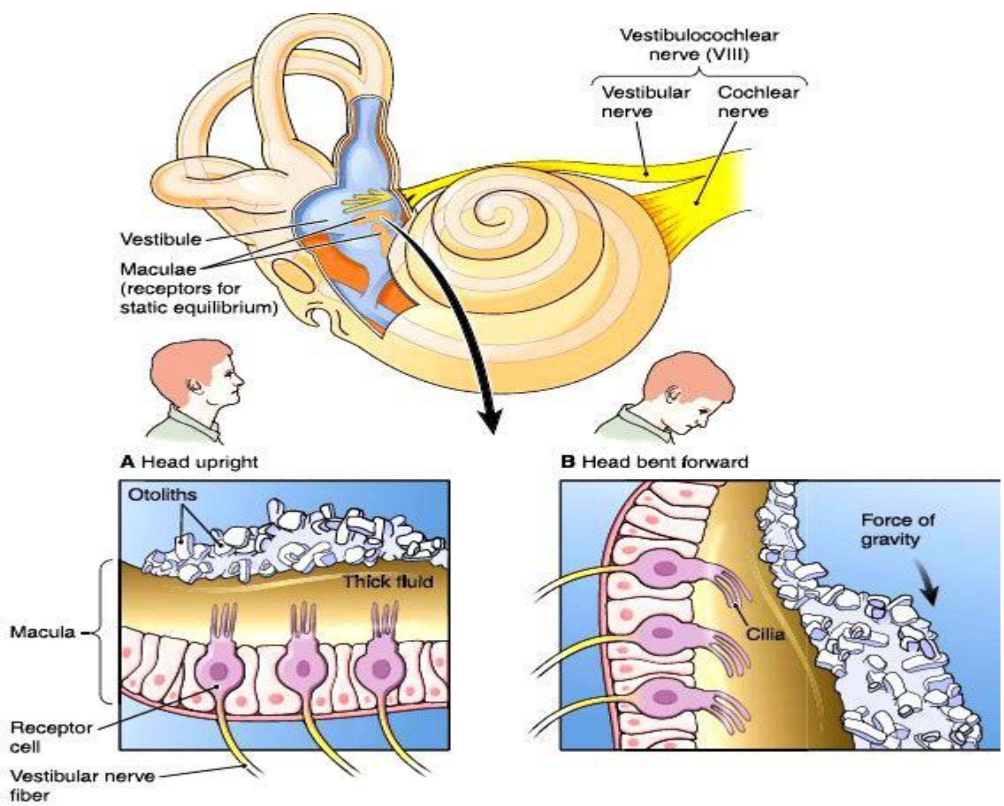
- Equilibrium is a response to movements of the head.
- Vestibular Apparatus: the equilibrium receptors of the inner ear
- Divided into static and dynamic equilibrium

Static equilibrium (The body is not moving**):**

- The information for static equilibrium comes from

the utricle and saccule within the vestibule. The saccule and utricle each contain a sense organ, called the macula.

- Maculae: receptors within the membrane sacs of the vestibule that report on the position of the head with respect to the pull of gravity when the body is not moving.
- Each macula is a patch of receptor cells with their “hairs” embedded in the otolithic membrane
- Otolithic Membrane: a jelly-like substance containing otoliths
- Otoliths: tiny stones made of calcium salts that roll in response to changes in the pull of gravity.
- When otoliths move, they pull on the gel and this bends the hairs.
- Activated hair cells send impulses along the vestibular nerve.
- Vestibular Nerve: (Cranial Nerve VIII) transmits signals to the cerebellum.



Dynamic equilibrium (The body is moving**):**

- Receptors in the semicircular canals respond to angular or rotary movements of the head.
- Semicircular canals are oriented in the three planes of space
- In the case of the semicircular ducts, a dilated "ampula" is associated with each. The ampula contains a flame-shaped crista.
- Crista: receptor region that consists of a tuft of hair cells covered with a gelatinous cap called the cupula
- When the head moves in an angular direction, the cupula bends.
- This stimulates hair cells to transmit signals to the vestibular nerve
- When you are moving at a constant rate, receptors stop sending impulses
- You no longer have the sensation of motion until you change speed or direction
- Vision plays a significant role in balance. Approximately twenty percent of the nerve fibers from the eyes interact with the vestibular system.