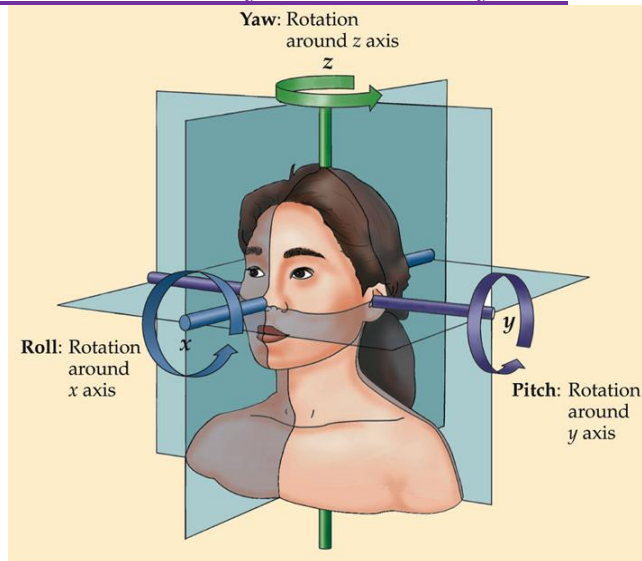


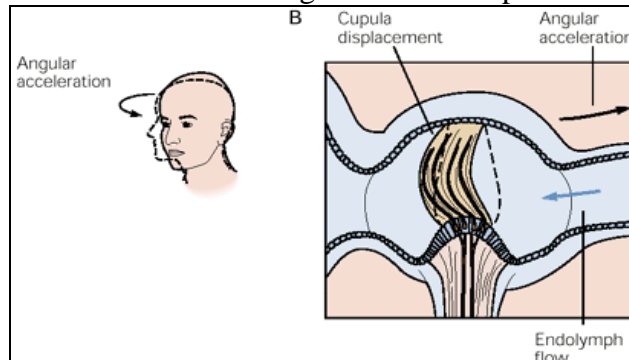


- Direction of movement is detected by the vestibular system:



- The vestibular system is composed of 2 parts:

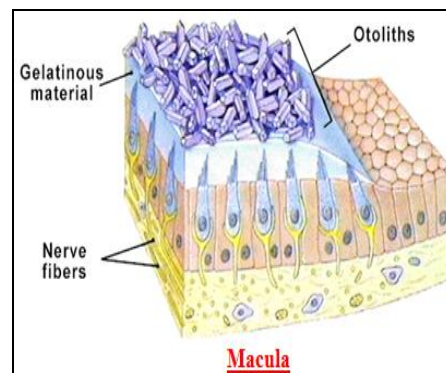
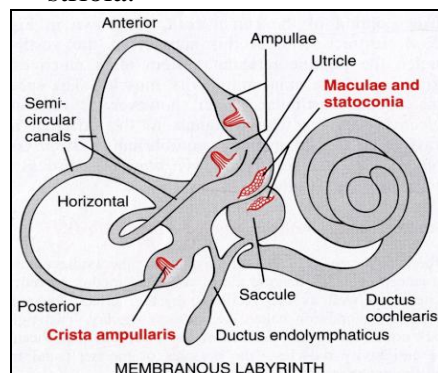
- **Semicircular canals (superior, posterior and lateral):** they are perpendicular to each other and function in detecting angular motion through cristae (e.g. rotation of the head to the right or left sides). Notice that semicircular canals have expansions at their edges known as “crista ampullaris” which contain a structure called cupula → in angular head movement the cupula is displaced by the movement of endolymph → therefore, hair cells will be stimulated to generate action potentials.



- **Otoliths:**

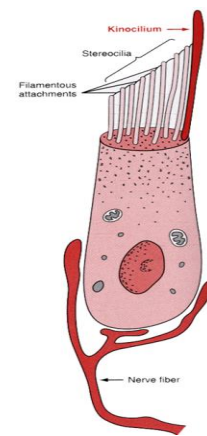
- ✓ **Utricule:** detecting linear horizontal movement (e.g. if someone is sitting in a moving train → this movement is detected by the utricule part of the vestibular system).
- ✓ **Sacculle:** detecting linear vertical movement and head tilt (e.g. if someone is standing in an ascending or descending elevator → this movement is detected by the sacculle part of the vestibular system).

Note: in utricule and sacculle, hair cells are populated in 2 orientations by the striola.





- In the vestibular system, there are supporting cells and hair cells (which are embedded in a gelatinous material (similar structure as organ of Corti)).
- Depolarization of hair cells occur as shorter stereocilia are moving toward the longer stereocilia (kinocilium).
- Calcium crystals are present on the gelatinous material and they augment the sensation of movement.
- In the macula, there are 2 sets of cells (stimulatory and inhibitory) while in semicircular canals there is only one group of cells (either stimulatory or inhibitory).
- Horizontal canals work together:

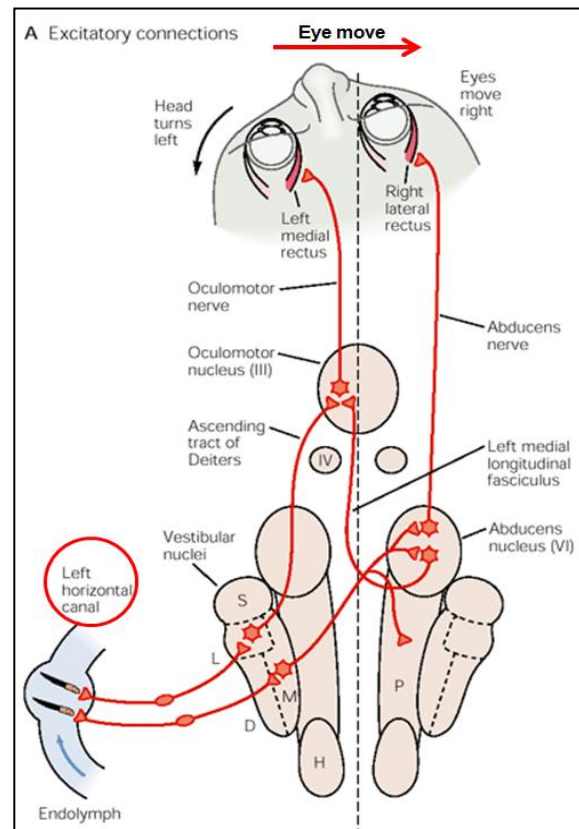


- **If the head turns to the left side** → the fluid in the left horizontal canal will shift to the opposite side (right side) → thus depolarizing hair cells in crista ampullaris and generating action potentials that will travel along the 8th cranial nerve.
- **In the right horizontal canal** → the movement of fluid will cause hyperpolarization of cells.

- Functions of the vestibular system:

- **Maintains gaze during movement (How?):**

- ✓ As mentioned above, when head moves to the left side → left semicircular canal is stimulated → leading to stimulation of the left vestibular nucleus which will result in:
 - ❖ Stimulation of the right abducens nerve (therefore, right eye turns to the right).
 - ❖ Stimulation of the left oculomotor nerve (therefore, left eye also turns to the right)
 - ❖ In addition, there will be inhibition of other nerves (left abducens nerve and right oculomotor nerve).



- **Position sense (to the cortex):** through vestibule-thalamo-cortical projection.
 - **Maintains posture and muscle tone:**
 - ✓ Lateral vestibular nucleus is concerned with body posture.
 - ✓ Medial vestibular nucleus is concerned with head reflexes.
- Note:** both of these nuclei are under the control of cerebellum.

- Motion sickness:

- **It occurs when the 2 signals are in conflict.** Suppose you are inside the cabin of a boat during a storm → your vestibular afferents are telling you that you are moving. Because you and the cabin are moving together → the visual system senses that you are not moving!
- This conflict generates a neural response that can produce motion sickness.
- To avoid motion sickness the best bet is to go out on the deck and look at the horizon.