

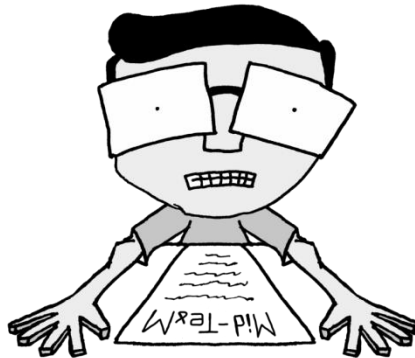
# Section 6

## Vestibular & Somatosensory System

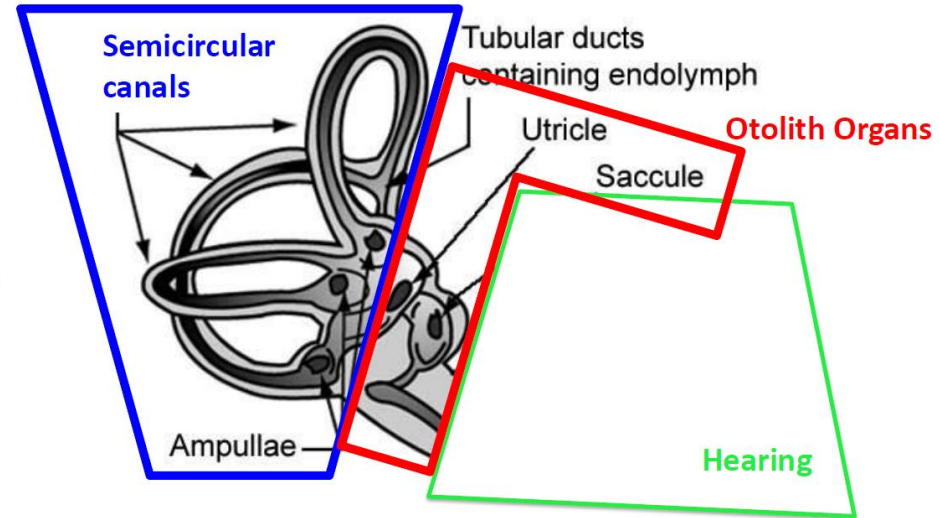
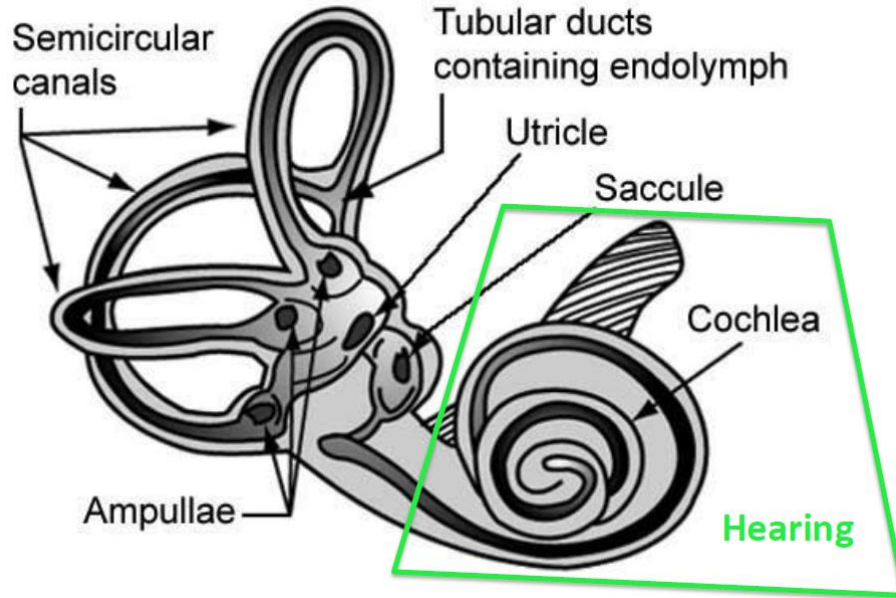
Sujin Park  
COGS 17 A05  
05/12/25

**Midterm 2** is Thursday, May 15

**No TA discussion section** on May 19

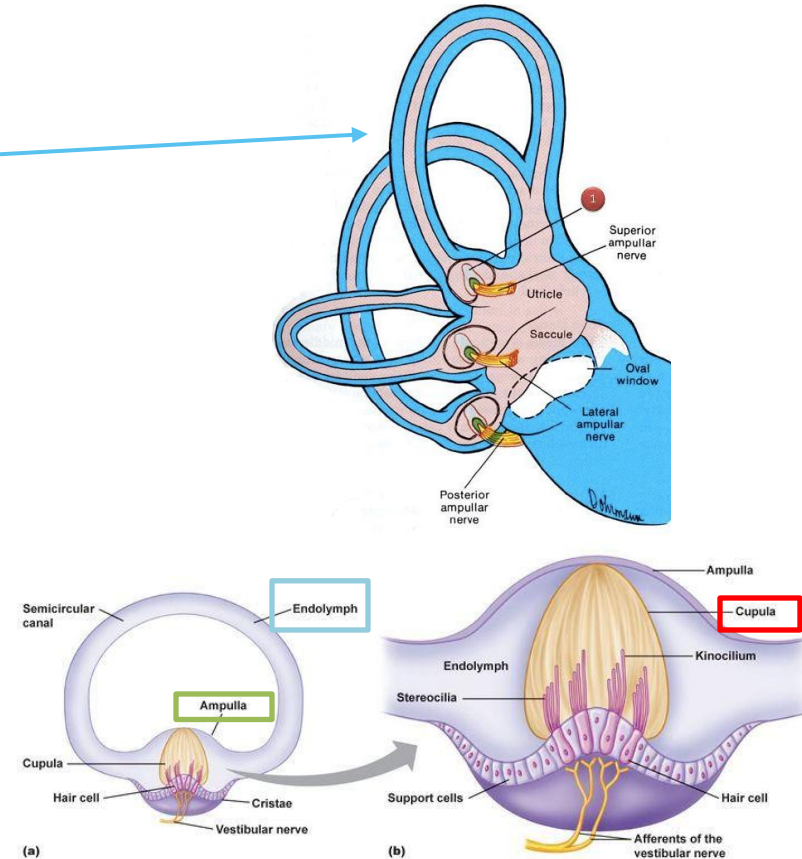


# Vestibular System



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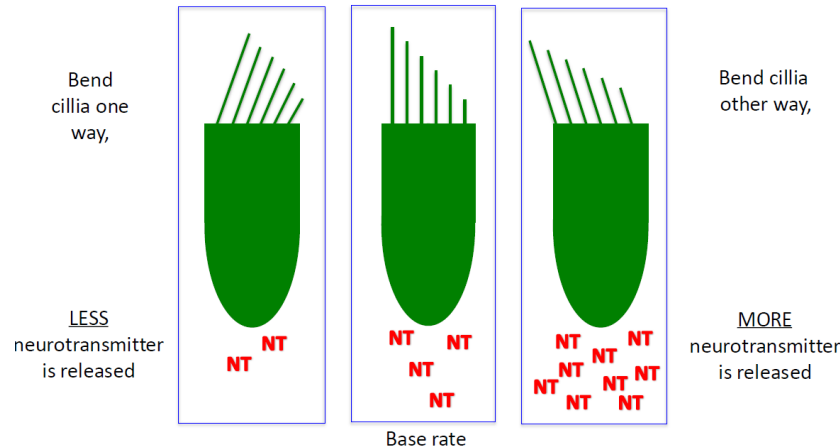
- 2 structures: **Semi-circular canals (for ROTATION) & Otolith Organs (HEAD TILT)** → provide movement and balance info
- **Semi-circular canals**
  - 3 looped tubes orientated to different orthogonal planes (XYZ-planes) - filled with K<sup>+</sup> rich **endolymph fluid**
  - **Hair cell (vestibular receptor cells):** in a chamber (Ampulla) at the base of the semi-circular canals, embedded in a gelatinous cap (Cupula), its cilia are bent by flow of endolymph in Ampulla
  - When the head rotates (start of rotation), fluid in ampulla lags behind movement
  - When head movement stops (end of rotation), the fluid overshoots movement
  - This motion deforms the cilia of the hair cells and alters NT release



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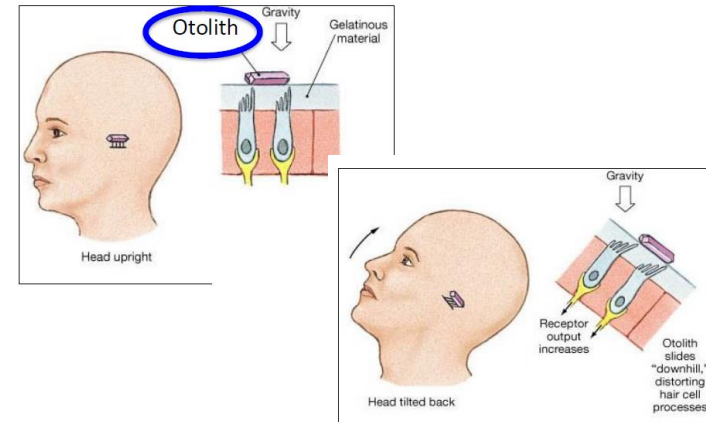
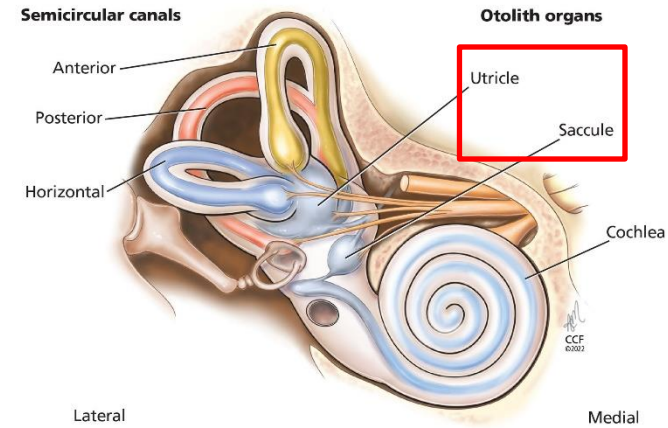
# Vestibular Hair Cells

- Similar with Hair Cells in Auditory system, except... that Vestibular HC has spontaneous firing, in the absence of input
  - = When no rotation, hair cells release a base rate of NTs
- Rotation of endolymph fluid causes the cilia of hair cells to bend
  - $K^+$  in the endolymph fluid enters the hair cells to open  $Ca^{2+}$  gates which facilitates NT release
  - If the cilia bends towards the **tallest**, **more** NT is released (opposite: **shortest** → **less** NT)
  - Graded potentials based on the magnitude of rotation/bend



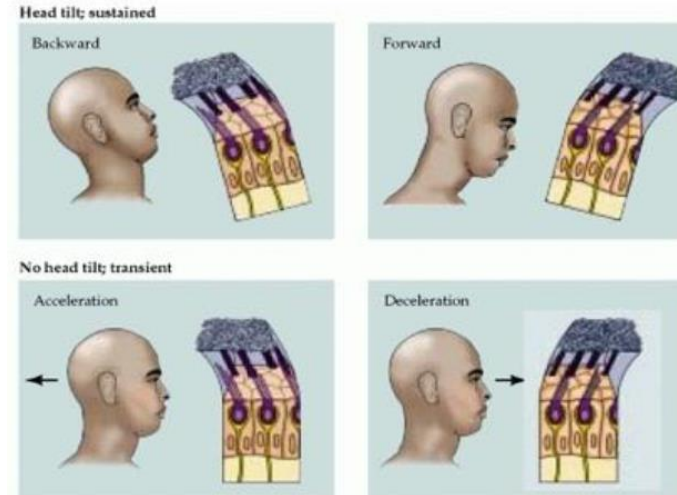
# Otolith Organs

- Detects changes in head tilt relative to the body
- Consists of the 2 chambers (together form the **Macula**): HCs line the walls of these Endolymph-filled chambers
- “**Ear Stones**” (**Otoliths**): Calcium-Chloride crystals sit in gelatinous material in which HCs are embedded
- When head is upright: Base firing rate
- Whichever angle you tilt your head, some Otoliths weigh down the cilia of some HCs (Again, bend one way, fire more, bend other way, fire less)
- Note that Acceleration & Deceleration has the same effect as tilt backward & tilt forward, respectively
- Otolith organs detect the start/stop of locomotion as well as head tilt



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# Vestibular Pathway

- HCs cause NT release which synapses onto vestibular ganglions
- Vestibular ganglions project to 8<sup>th</sup> cranial nerve
- From the 8<sup>th</sup> cranial nerve splits:
  - Cerebellum: Direct connection for maintaining balance
  - Vestibular nuclei: Multiple overlapping functions, plays an essential role in maintaining equilibrium, posture, head position, etc. Disruption leads to Nausea
- Medulla projects to spinal cord/brain stem (posture), superior colliculus (coordinate with visual motion), and cranial nerves 3,4, and 6 (eye movements)
- Higher pathways are still areas of research
- **Motion sickness:** When vestibular and visual systems are not coordinated or improperly integrated.

