Special Senses
Hearing and balance

The Ear
- Houses two senses
  - Hearing
  - Equilibrium (balance)
- Receptors are mechanoreceptors
- Different organs house receptors for each sense

Anatomy of the Ear
- The ear is divided into three areas
  - External (outer) ear
  - Middle ear (tympanic cavity)
  - Inner ear (bony labyrinth)

The External Ear
- Involved in hearing only
- Structures of the external ear
  - Auricle (pinna)
  - External acoustic meatus (auditory canal)
    - Narrow chamber in the temporal bone
    - Lined with skin and ceruminous (wax) glands
    - Ends at the tympanic membrane
The Middle Ear (Tympanic Cavity)

- Air-filled cavity within the temporal bone
- Only involved in the sense of hearing

Two tubes are associated with the inner ear
- The opening from the auditory canal is covered by the tympanic membrane
- The auditory tube connecting the middle ear with the throat
  - Allows for equalizing pressure during yawning or swallowing
  - This tube is otherwise collapsed

Three bones (ossicles) span the cavity
- Malleus (hammer)
- Incus (anvil)
- Stapes (stirrup)

Function
- Vibrations from eardrum move the malleus → anvil → stirrup → inner ear
- Muscles attached can adjust vibration intensity to adapt us to sound levels and prevent hearing damage.

Includes sense organs for hearing and balance
- Filled with perilymph
- A maze of bony chambers within the temporal bone
  - Cochlea
  - Vestibule
  - Semicircular canals
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Anatomy of the Ear

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Organs of Hearing

- Organ of Corti
  - Located within the cochlea
  - Receptors = hair cells on the basilar membrane
  - Gel-like tectorial membrane is capable of bending hair cells
  - Cochlear nerve attached to hair cells transmits nerve impulses to auditory cortex on temporal lobe

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Organs of Hearing

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Organs of Hearing

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Mechanism of Hearing

- Vibrations from sound waves move tectorial membrane
- Hair cells are bent by the membrane
- An action potential starts in the cochlear nerve
- Continued stimulation can lead to adaptation
Mechanism of Hearing

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Figure 8.16a

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Mechanism of Hearing

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Figure 8.16b–c

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Organs of Equilibrium

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- Equilibrium receptors of the inner ear are called the vestibular apparatus
- Vestibular apparatus has two functional parts
  - Static equilibrium
  - Dynamic equilibrium

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Organs of Equilibrium

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- Macula—receptors in the vestibule
  - Report on the position of the head
  - Send information via the vestibular nerve
- Anatomy of the macula
  - Hair cells are embedded in the otolithic membrane
  - Otoliths (tiny stones) float in a gel around the hair cells
  - Movements cause otoliths to bend the hair cells

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Static Equilibrium

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Dynamic Equilibrium

- Crista ampullaris—receptors in the semicircular canals
- Tuft of hair cells
- Cupula (gelatinous cap) covers the hair cells

Action of angular head movements
- The cupula stimulates the hair cells
- An impulse is sent via the vestibular nerve to the cerebellum