CHAPTER 49
SENSORY AND MOTOR SYSTEMS

Section D: Hearing And Equilibrium

1. The mammalian hearing organ is within the ear
2. The inner ear also contains the organs of equilibrium
3. A lateral line system and inner ear detect pressure waves in most fishes and aquatic amphibians
4. Many invertebrates have gravity sensors and are sound-sensitive
1. The mammalian hearing organ is within the ear

- The **outer ear** includes the external pinna and the auditory canal.
  - Collects sound waves and channels them to the **tympanic membrane**.
• From the tympanic membrane sound waves are transmitted through the **middle ear**.
  
  • **Malleus → incus → stapes.**
  
  • From the stapes the sound wave is transmitted to the **oval window** and on to the inner ear.
  
  • **Eustachian tube** connects the middle ear with the pharynx.
• The **inner ear** consists of a labyrinth of channels housed within the temporal bone.

  • The **cochlea** is the part of the inner ear concerned with hearing.
    
    • Structurally it consists of the upper vestibular canal and the lower tympanic canal, which are separated by the cochlear duct.
    
    • The vestibular and tympanic canals are filled with perilymph.
• The cochlear duct is filled with endolymph.

• The **organ of Corti** rests on the basilar membrane.
  
  • The tectorial membrane rests atop the hair cells of the organ of Corti.
• From inner ear structure to a sensory impulse: follow the vibrations.
  
  • The **round window** functions to dissipate the vibrations.

• Vibrations in the cochlear fluid → basilar membrane vibrates → hair cells brush against the tectorial membrane → generation of an action potential in a sensory neuron.
Fig. 49.18

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• **Pitch** is based on the location of the hair cells that depolarize.

• **Volume** is determined by the amplitude of the sound wave.
2. The inner ear also contains the organs of equilibrium

- Behind the oval window is a vestibule that contains the **utricle** and **saccule**.
  - The utricle opens into three **semicircular canals**.
The utricle and saccule respond to changes in head position relative to gravity and movement in one direction.

- Hair cells are projected into a gelatinous material containing otoliths.
- When the head’s orientation changes the hair cells are tugged on → nerve impulse along a sensory neuron.
• The semicircular canals respond to rotational movements of the head.
  • The mechanism is similar to that associated with the utricle and saccule.
3. A lateral line system and inner ear detect pressure waves in most fishes and aquatic amphibians

- Fishes and amphibians lack cochleae, eardrums, and openings to the outside.
  - However, they have saccules, utricles, and semicircular canals.
Most fish and amphibians have a **lateral line system** along both sides of their body.

- Contains mechanoreceptors that function similarly to mammalian inner ear.
- Provides a fish with information concerning its movement through water or the direction and velocity of water flowing over its body.

Fig. 49.20
Many invertebrates have gravity sensors and are sound-sensitive

- **Statocysts** are mechanoreceptors that function in an invertebrates sense of equilibrium.

- Statocysts function is similar to that of the mammalian utricle and saccule.
• Sound sensitivity in insects depends on body hairs that vibrate in response to sound waves.
  • Different hairs respond to different frequencies.
• Many insects have a tympanic membrane stretched over a hollow chamber.