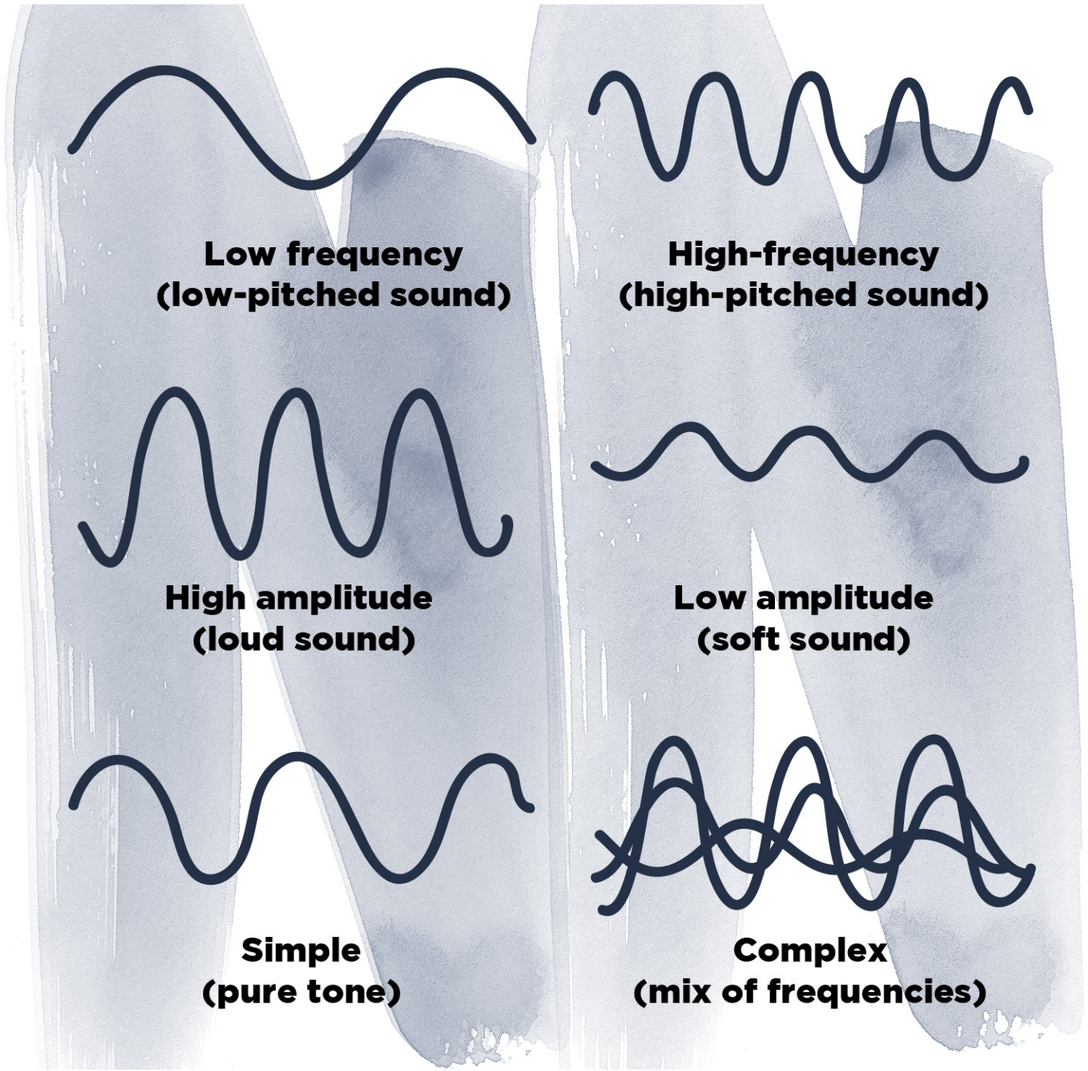
Auditory System



steven j. barnes

- Understand the relationship between: (1) frequency and pitch, (2) amplitude and loudness, and (3) complexity and timbre
- Know the major structures of the ear.
- Know the major structures of the cochlea.
- Explain what ‘tonotopic organization’ means and give examples of it in the auditory system.
- Know the brain structures that help with the localization of sound.
- Explain what ‘presbycusis’ is.

Learning Goals

Frequency

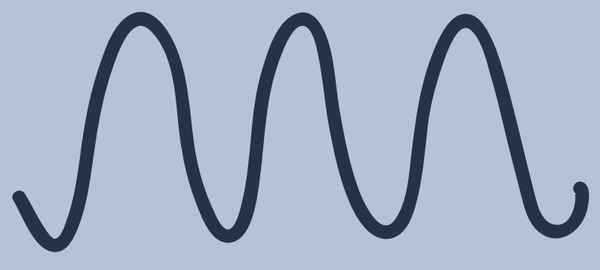
Corresponds to our perception of pitch.

Low frequency (low-pitched sound)

High-frequency (high-pitched sound)

Amplitude

Corresponds to our perception of loudness.

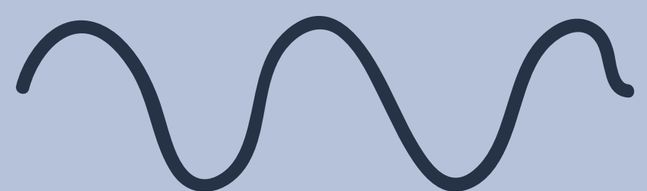


High amplitude (loud sound)

Low amplitude (soft sound)

Complexity

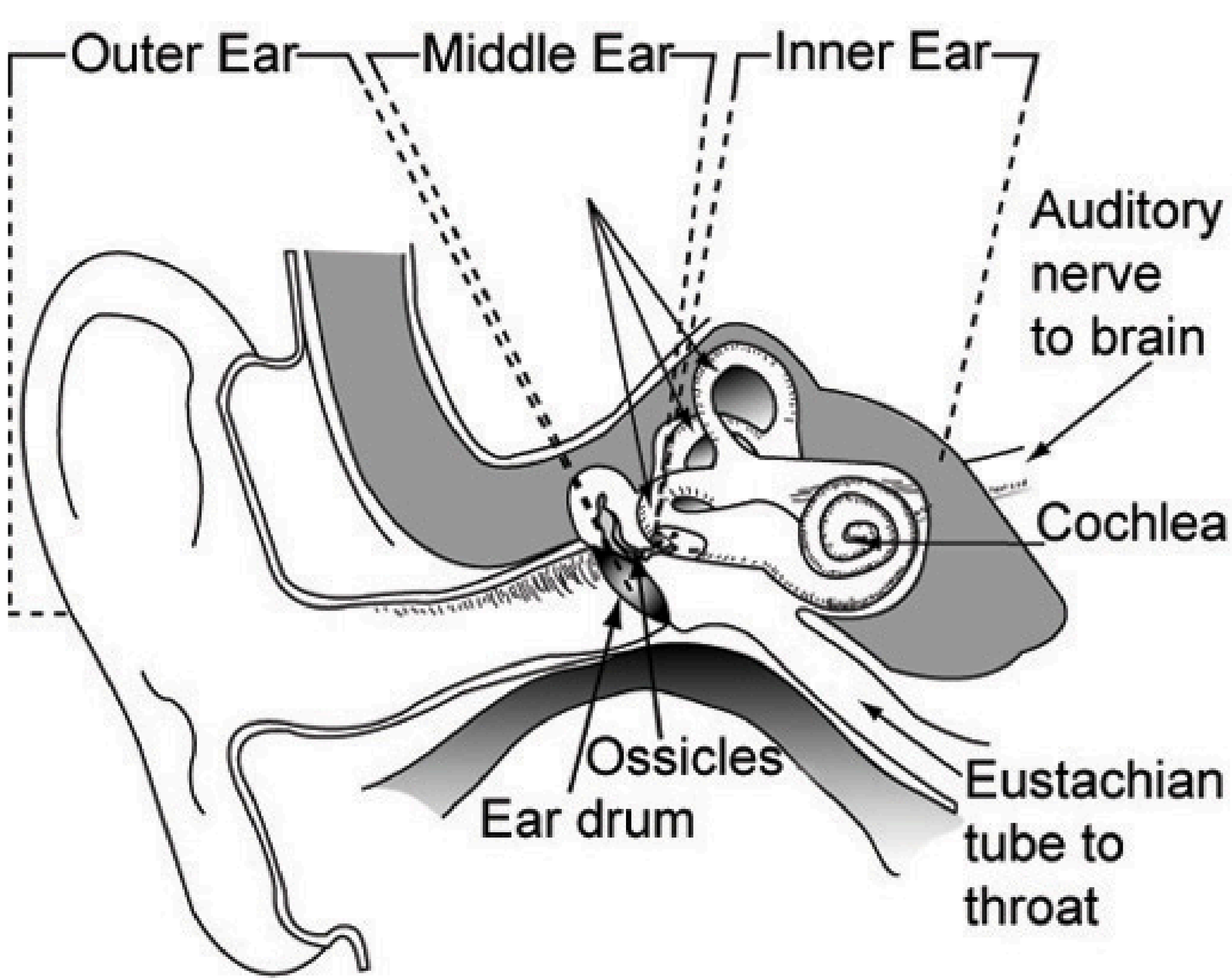
Corresponds to our perception of timbre.



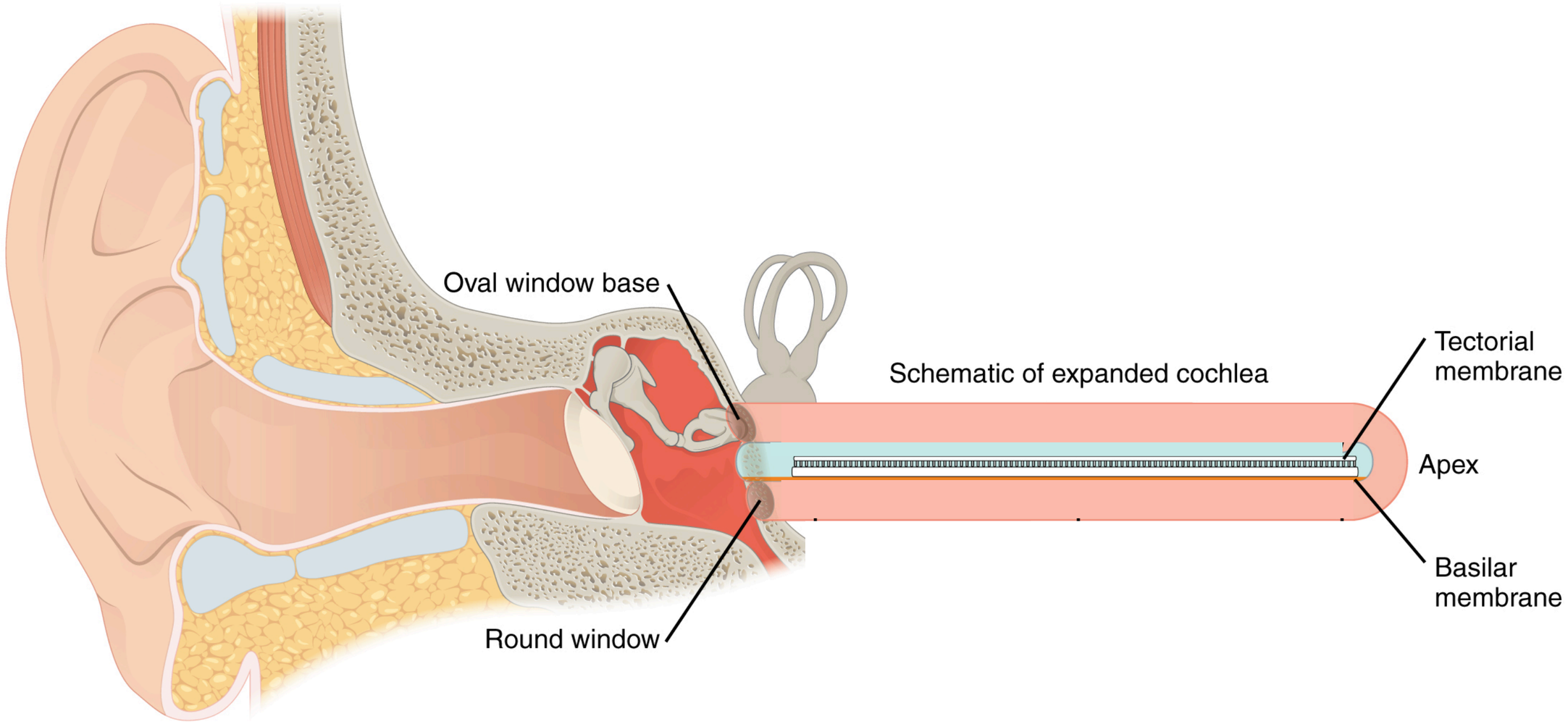
Simple (pure tone)

Complex (mix of frequencies)

Sound Waves



Anatomy of the Human Ear


Oval window base
Schematic of expanded cochlea
Tectorial membrane
Apex
Basilar membrane
Round window

Cochlea

Each sensory system has cells that transduce energy from the outside world into a neural response: Receptors.

Within a single sensory system (e.g., somatosensory system), there are classes of receptors that are particularly sensitive to one stimulus (e.g., heat) but not to another (e.g., muscle stretch).

Receptors

Receptor Types Vary Across Sensory Systems

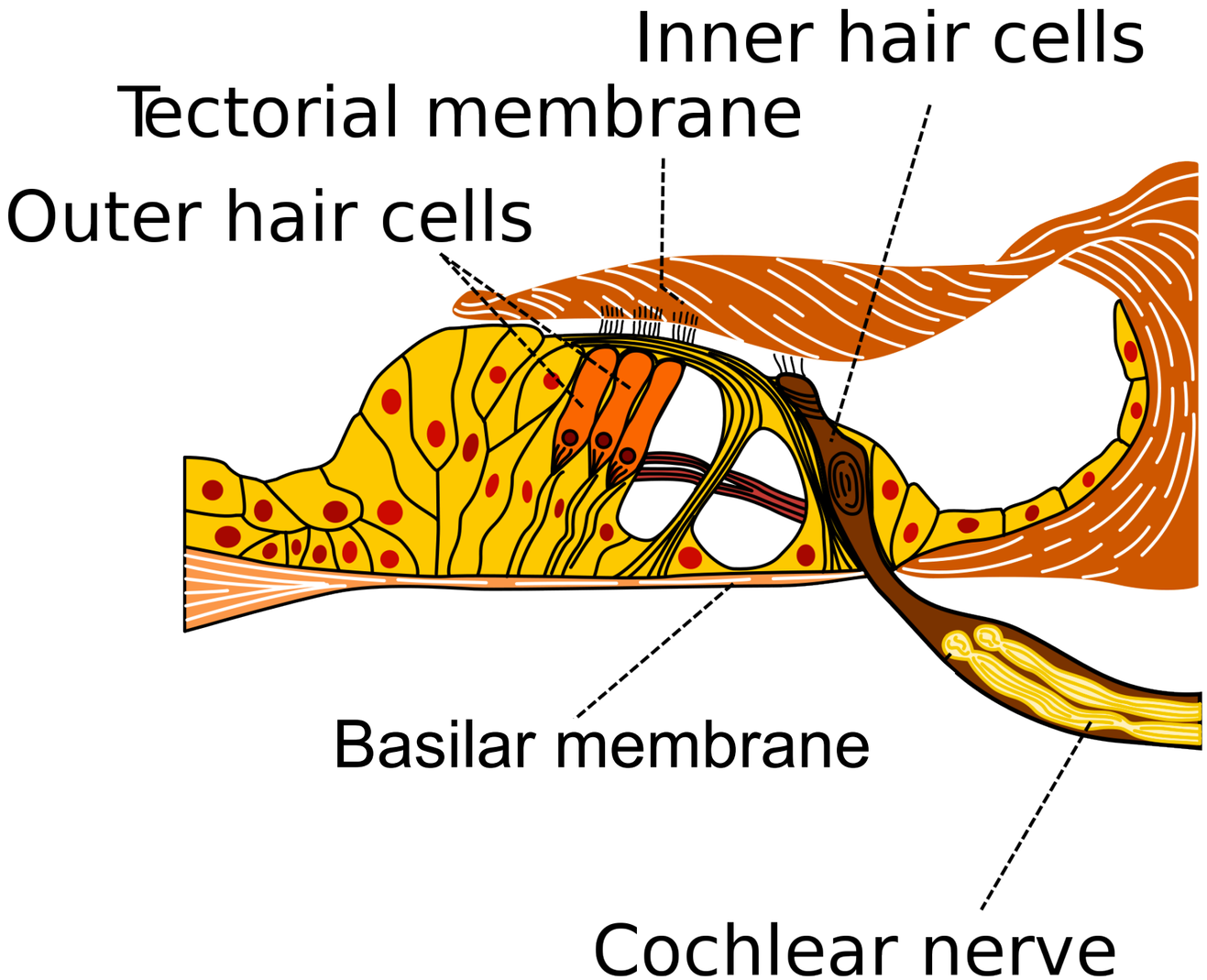
Systems differ in how many receptor types they have.

Visual system: Two broad classes of receptors (rods and cones); transduce light energy of different wavelengths.

Auditory system: Two classes of receptors (inner and outer hair cells of the cochlea); transduce mechanical energy.

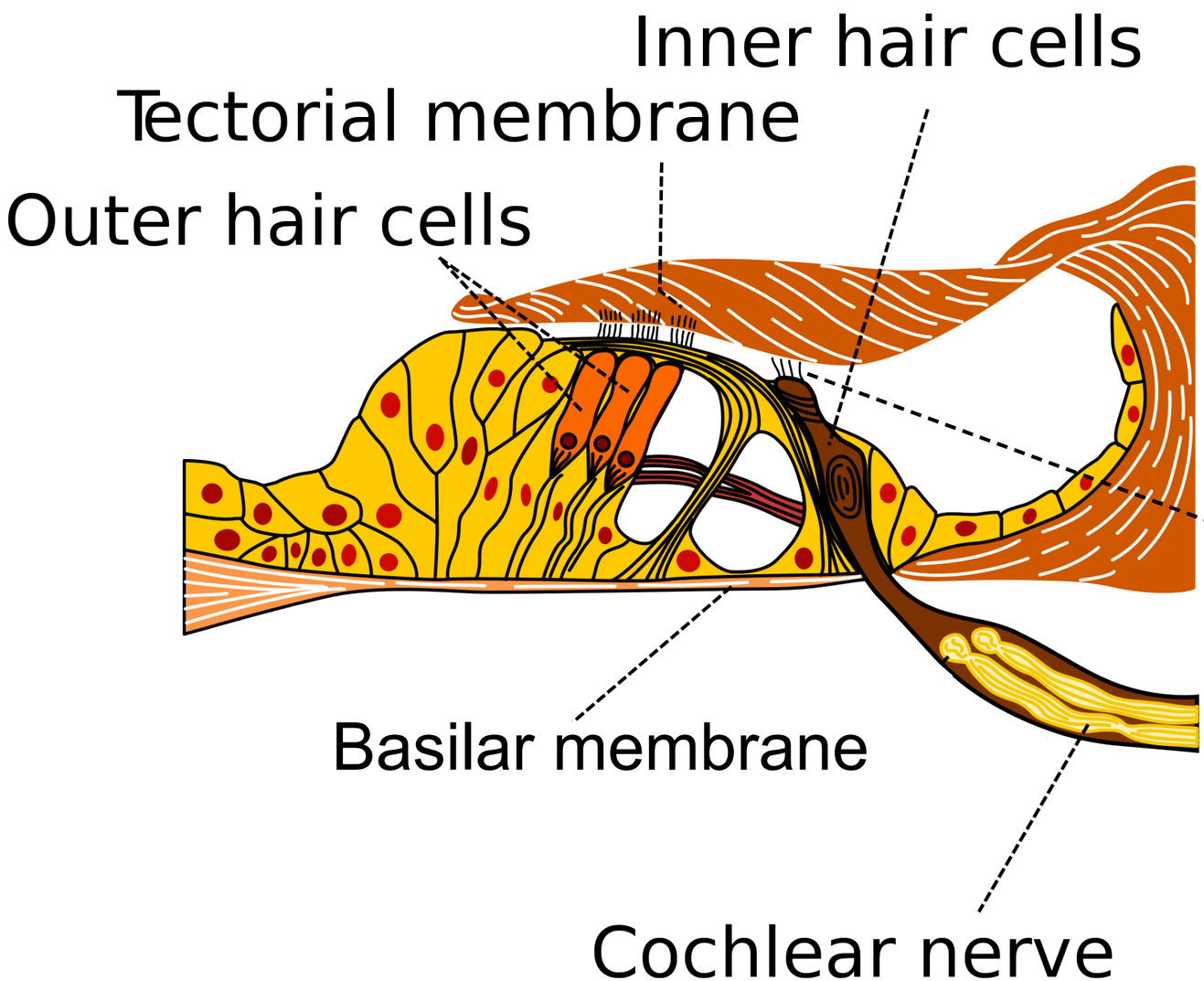
Receptors

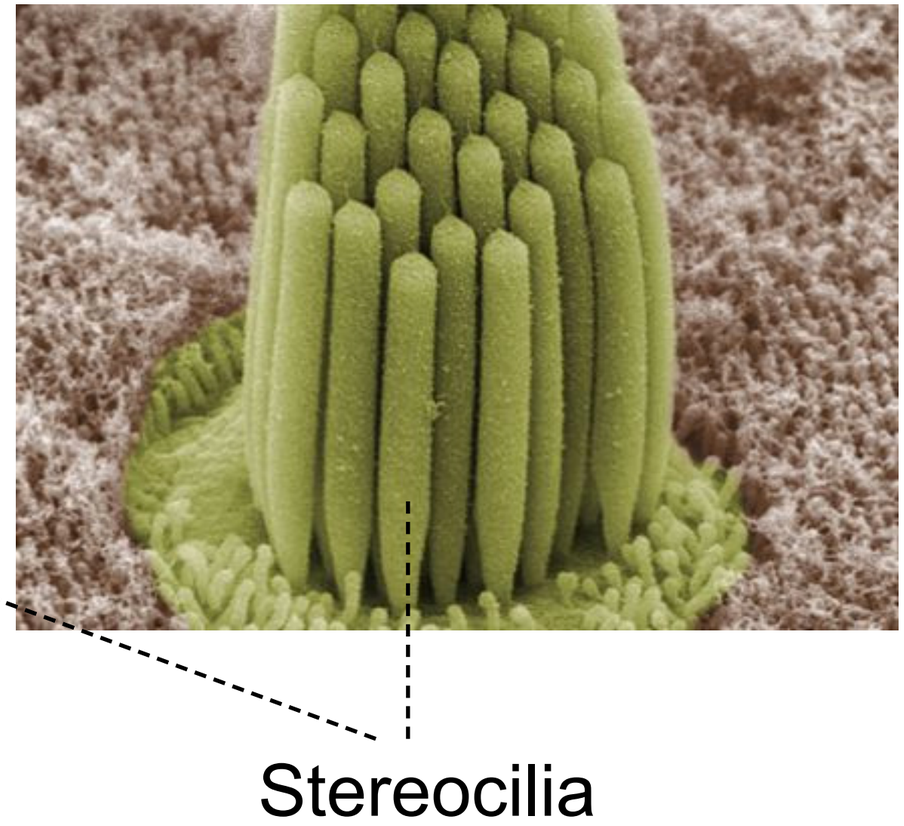
Inner and Outer Hair Cells



Auditory Receptors

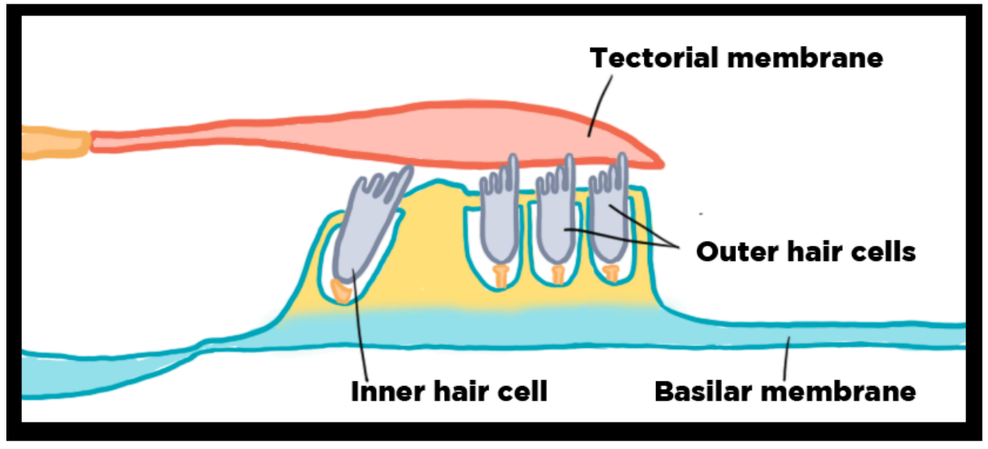
Inner and Outer Hair Cells



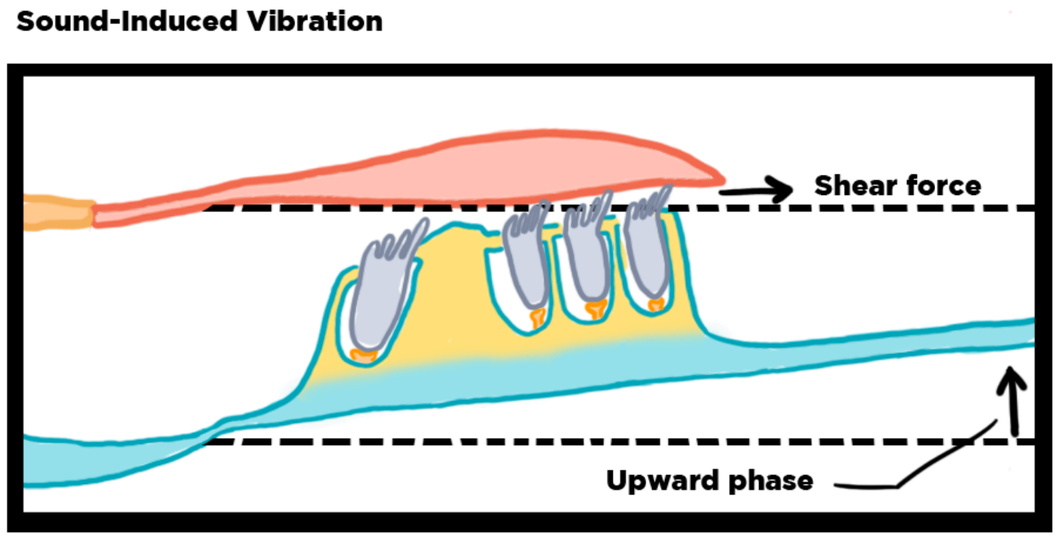


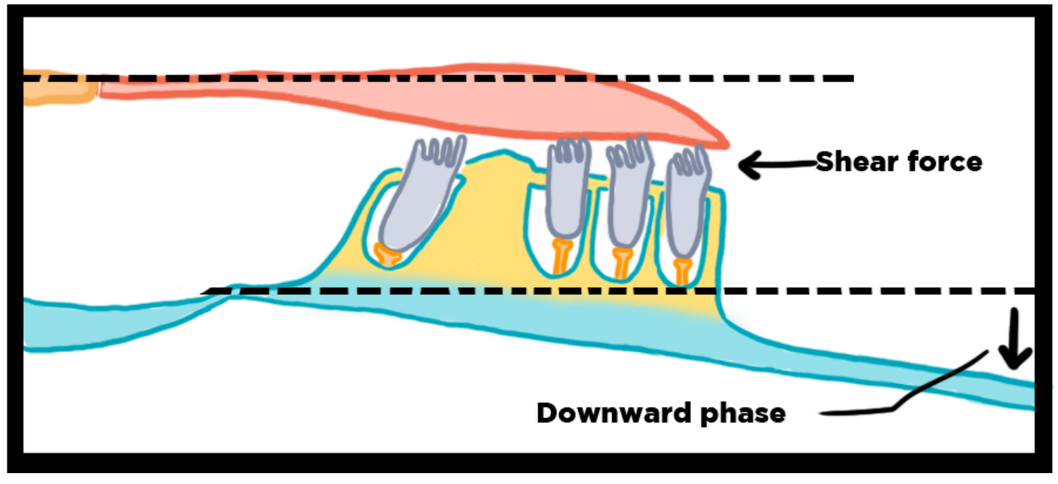
Auditory Receptors

Transduction of Mechanical Energy



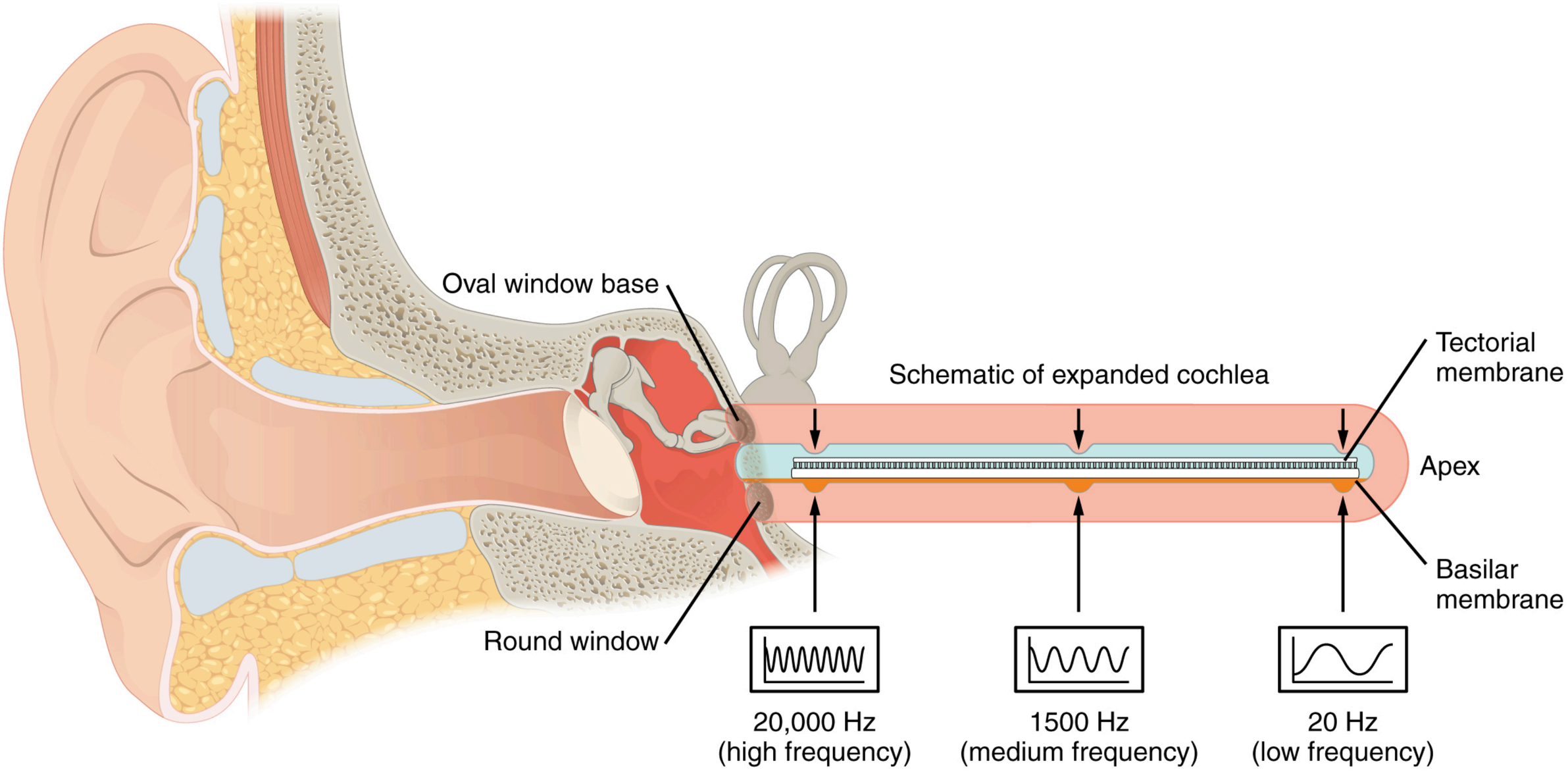
Resting position





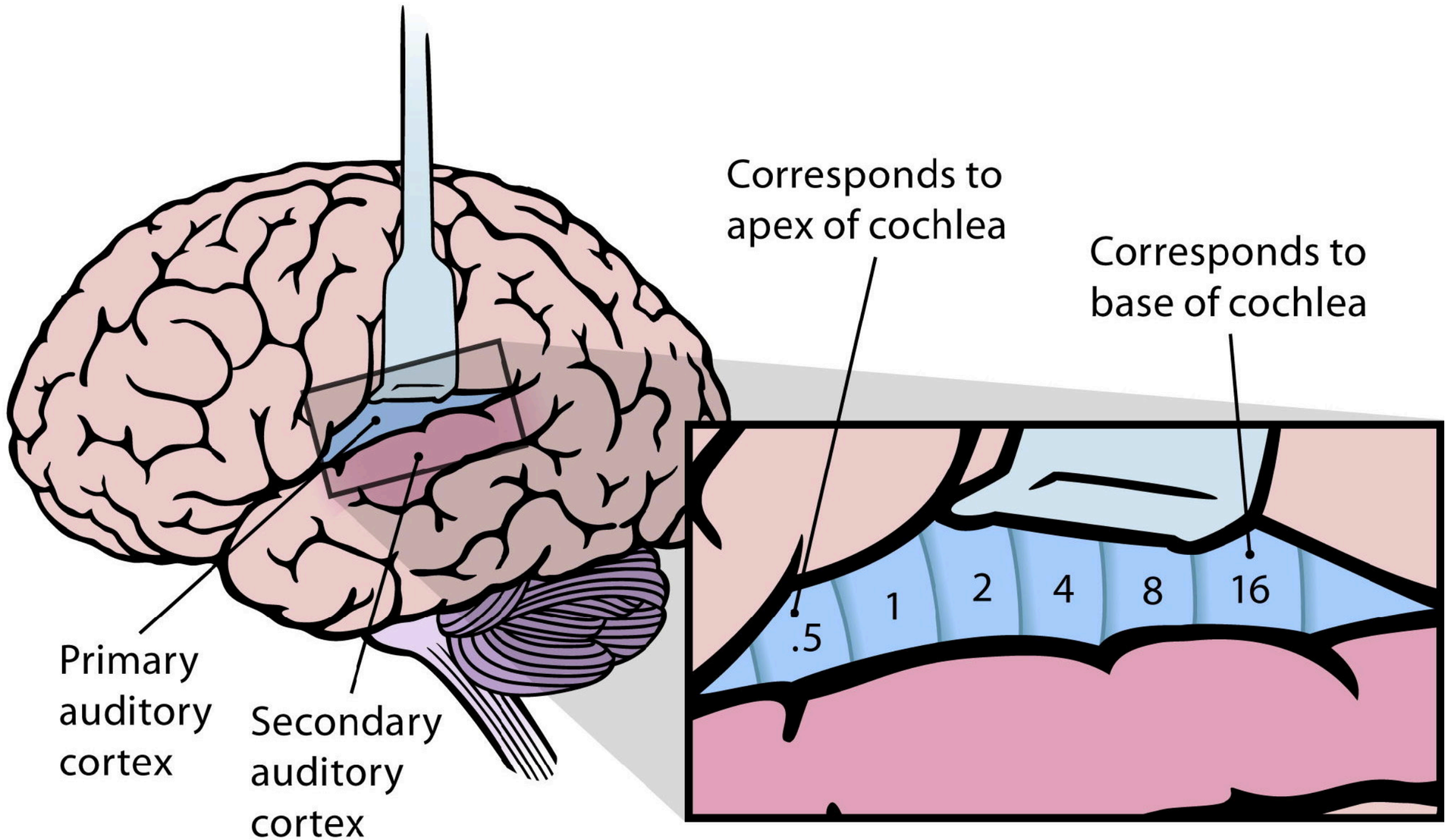
Auditory Receptors

Tonotopic Organization



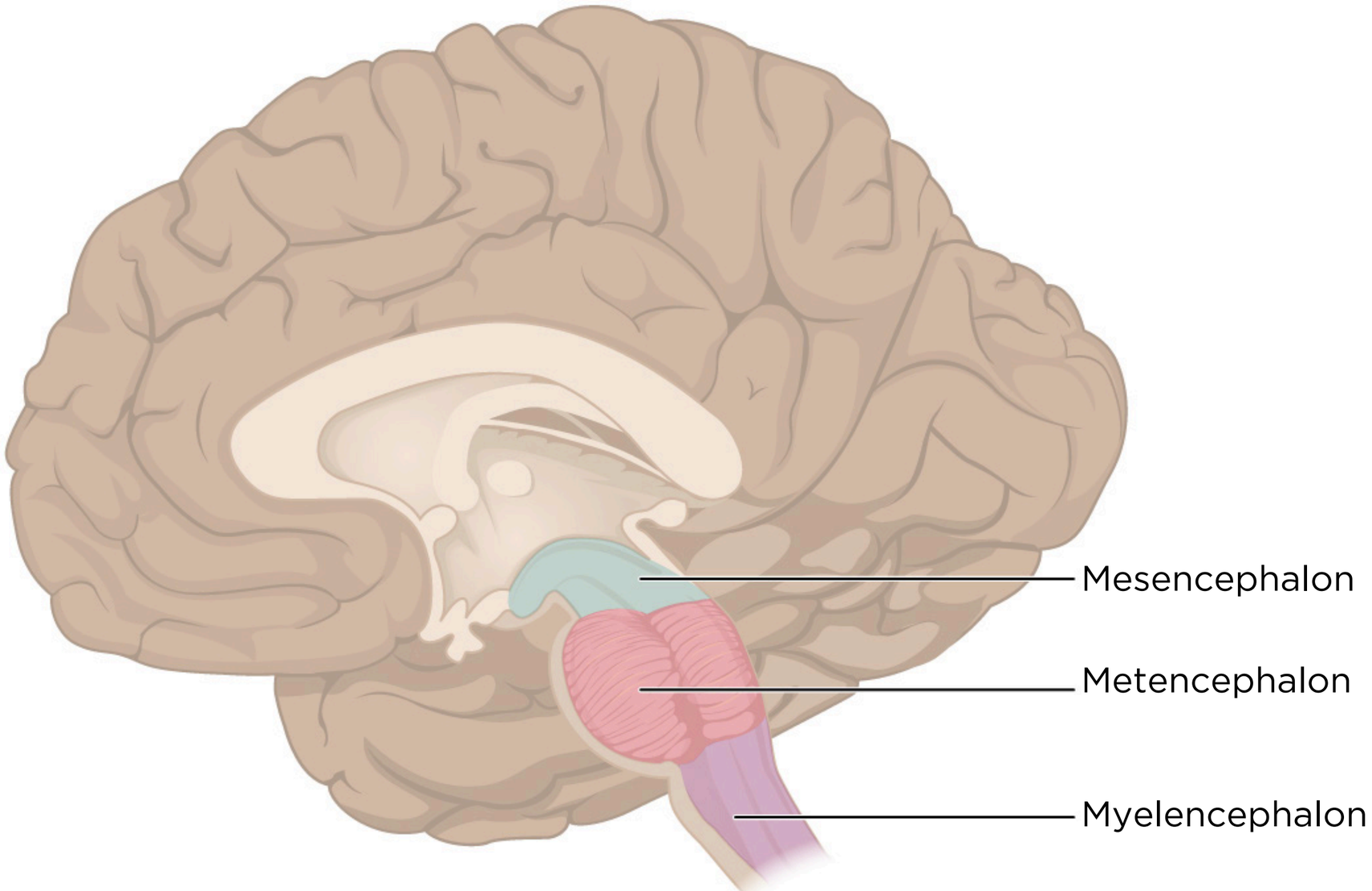
Auditory Receptors

Tonotopic organization in the primary auditory cortex (A1).



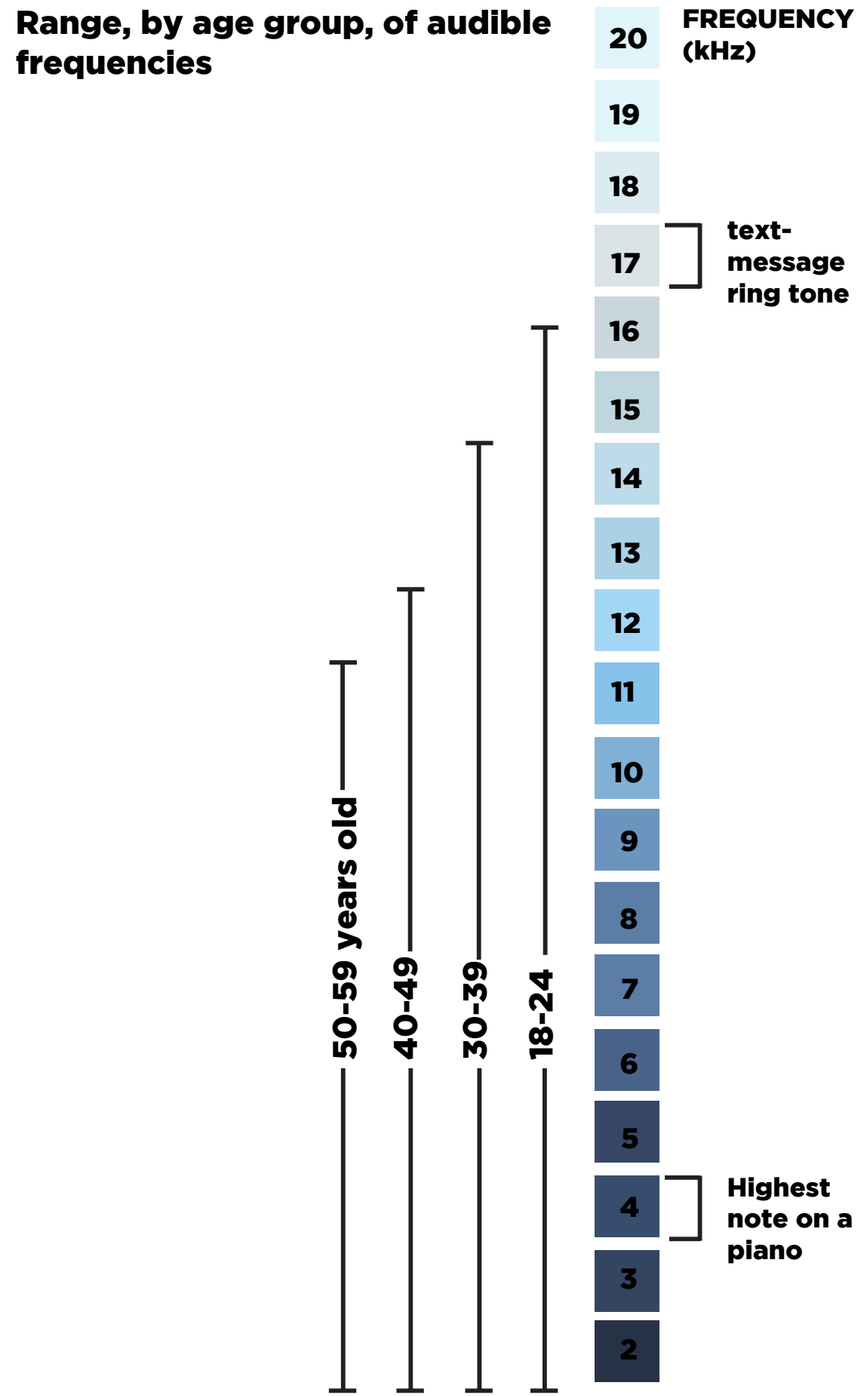
Primary Auditory Cortex

Interaural timing computed with help of a part of the tectum: the inferior colliculus.



Sound Localization

Presbycusis



Auditory Receptors