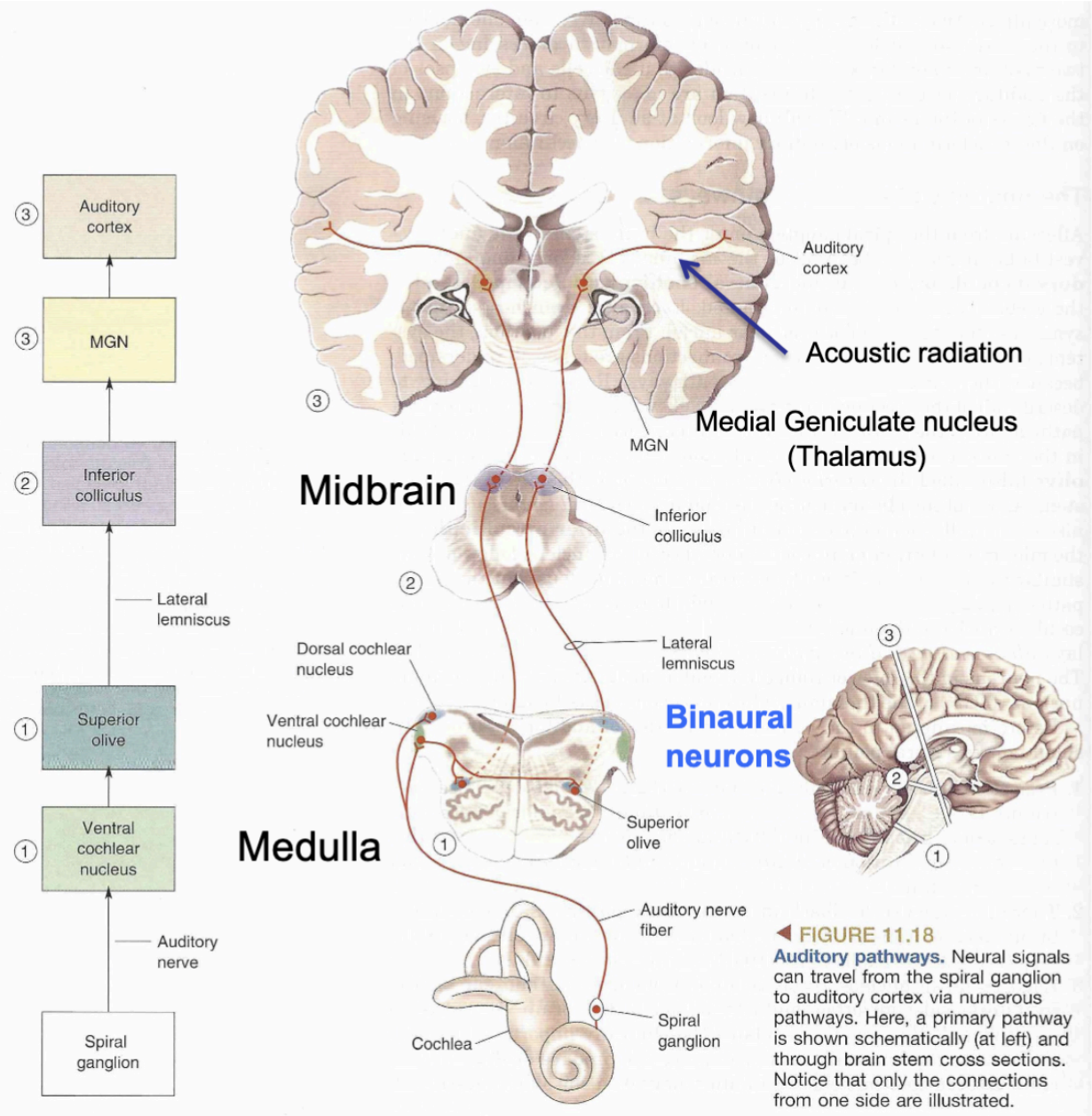
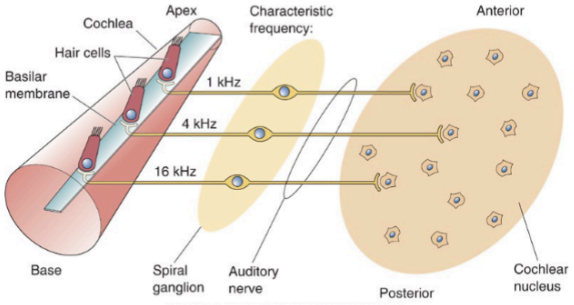
Auditory Pathway



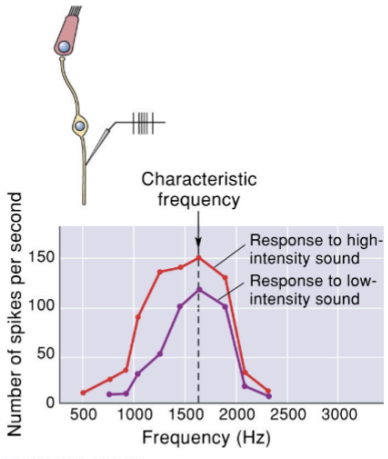

◀ FIGURE 11.18
**Auditory pathways.** Neural signals can travel from the spiral ganglion to auditory cortex via numerous pathways. Here, a primary pathway is shown schematically (at left) and through brain stem cross sections. Notice that only the connections from one side are illustrated.

- Several other projections are not described here
- All ascending auditory pathways converge onto **inferior colliculus**
- Inferior colliculus send axons to superior colliculus to integrate auditory information with visual inputs (Not shown)
- Extensive feedback pathways exist
- Except cochlear nucleus, all other auditory nuclei receive inputs from both ears (binaural)

# Stimulus Intensity & Frequency coding




Tonotopic maps on the basilar membrane

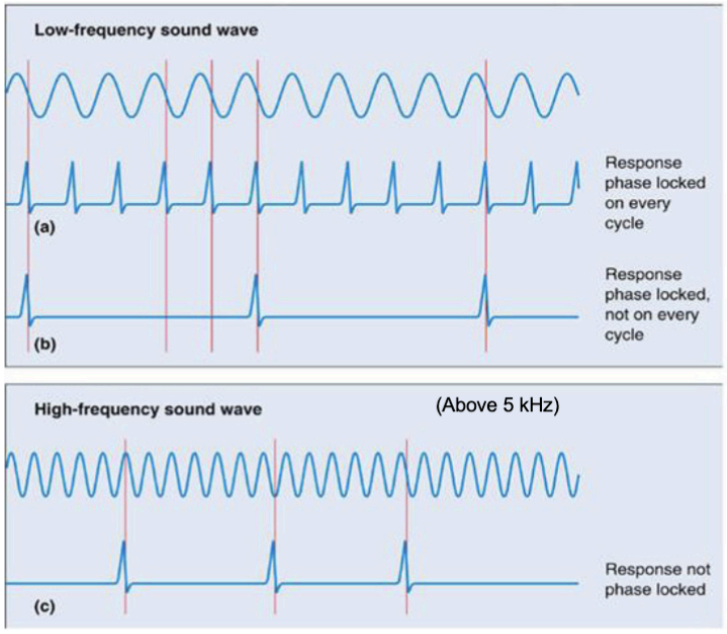



**Sound intensity** is coded by number of active neurons and their firing rates

- Intensity는 소리를 작게 내냐 크게 내냐 (힘) 차이
- Frequency는 low pitch냐 high pitch냐 (소리 크기는 일정)

Phase Locking

- Low frequencies: phase-locking on every cycle or some fraction of cycles (up to 5kHz)
- High frequencies: not fixed



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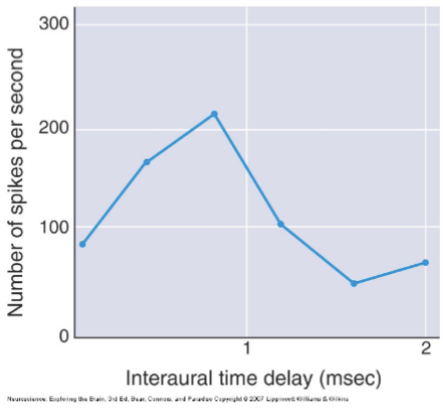
- Low frequency: Phase locking
- Intermediate frequency: Phase locking and tonotopy
- High frequency: Tonotopy

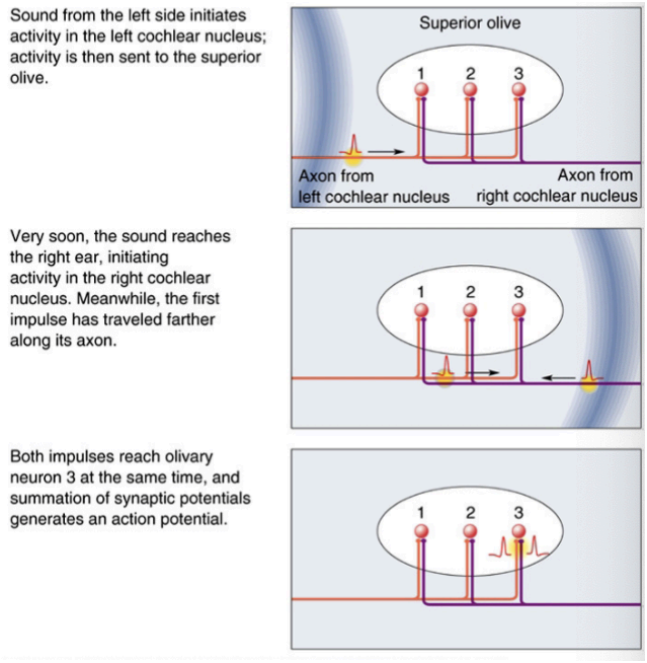
Localizing the sound

- Interaural time delay and interaural intensity difference
- 20-2000 Hz: Interaural time delay
- 2-20 KHz: Interaural intensity difference
- Duplex theory of sound localization
- Accoustic shadow?

Binaural Neurons & Sound Location

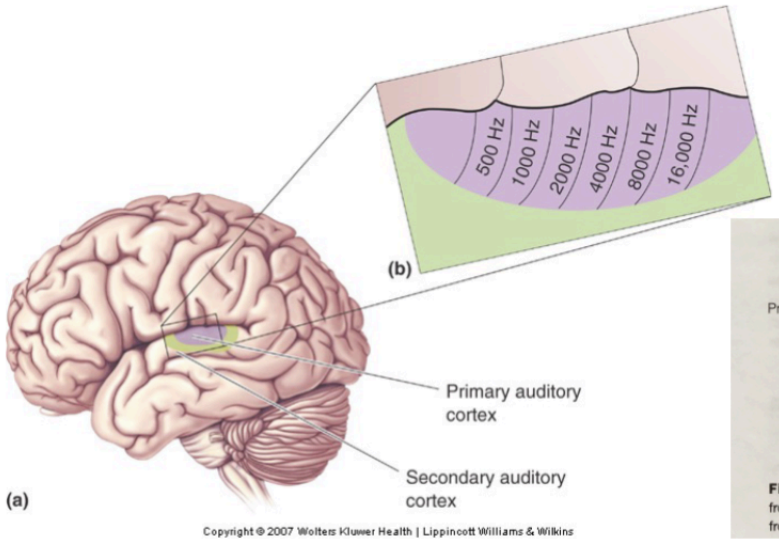
- Response of neuron in superior olive sensitive to interaural time delay. In other words, an olivary neuron gives its greatest response to a particular interaural delay




Primary Auditory Cortex

- Axons leaving MGN project to auditory cortex via internal capsule in an array
- Structure of A1 (Brodmann's area 41) and secondary auditory areas: Similar to corresponding visual cortex areas
- Unilateral lesion of A1 doesn't disrupt normal hearing (contrast to visual system, where unilateral lesion of V1 leads to loss of vision in contralateral hemifield. Bilateral lesion of A1 leads to deafness




Ref: Sensation and Perception
~Goldstein

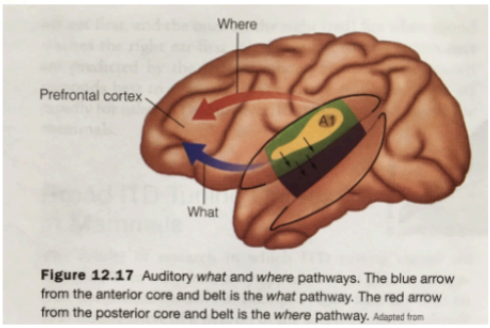



**Figure 12.17** Auditory *what* and *where* pathways. The blue arrow from the anterior core and belt is the *what* pathway. The red arrow from the posterior core and belt is the *where* pathway. Adapted from

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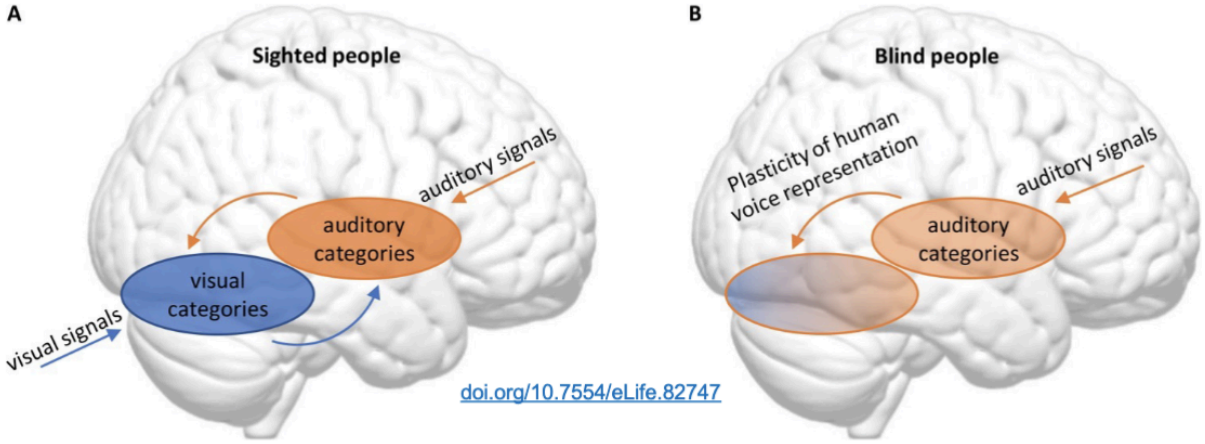
Blindness triggers a reorganization in the visual and auditory cortices in the brain

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