Section 7: Motor Movements and Audition

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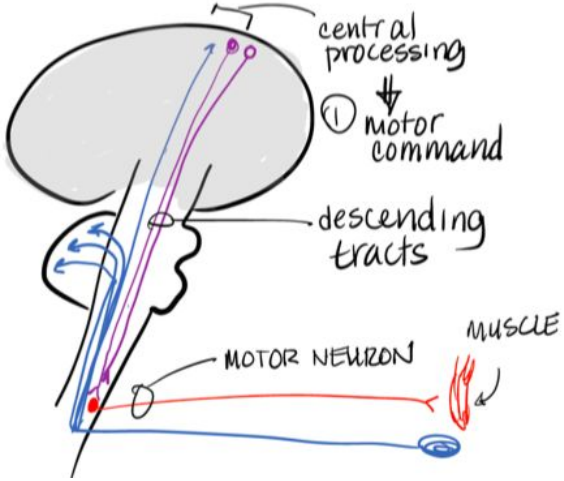
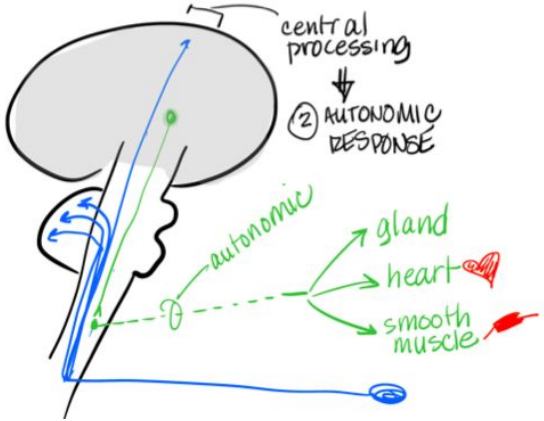
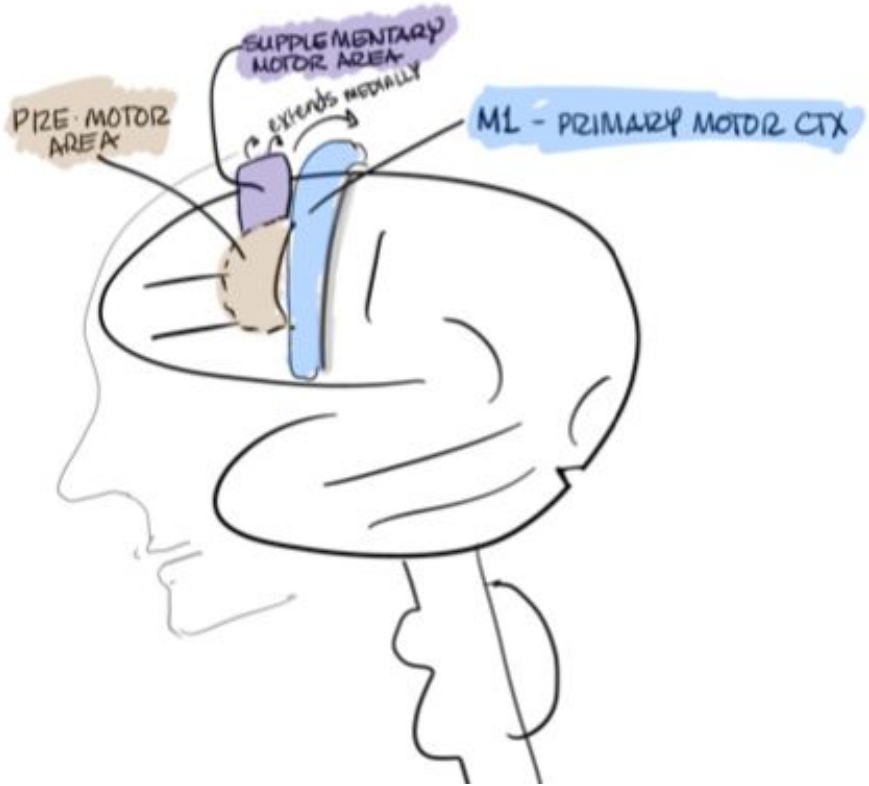
Descending Tracts

- Purpose:
  - Bring motor decisions from higher cortical levels to lower levels of the CNS
- Produces a Motor Response in 2 Ways:
  - Skeletal muscles
  - Autonomic motor
    - Glands
    - Smooth muscle
    - Heart





Motor Cortex

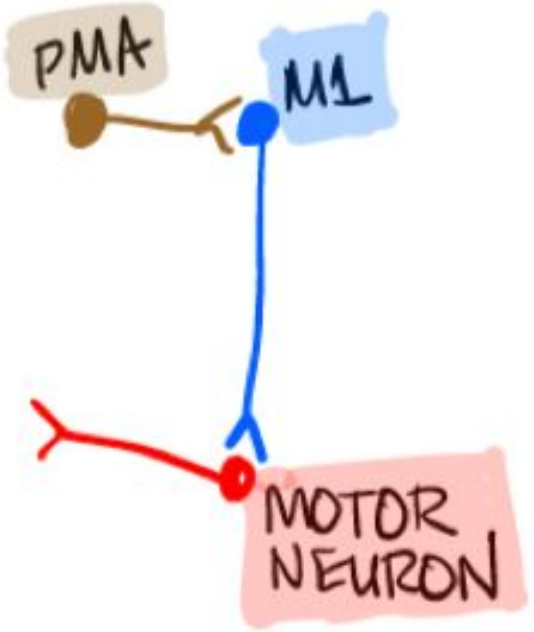


Premotor Area (PMA)

- Purpose
  - Plans the motor activity
- Receives info from the ascending tracts of the CNS
  - Cerebellum
    - Body positions
    - Tendon and muscle tension
  - Sensory cortical regions
- After the plan, the descending fibers will execute it

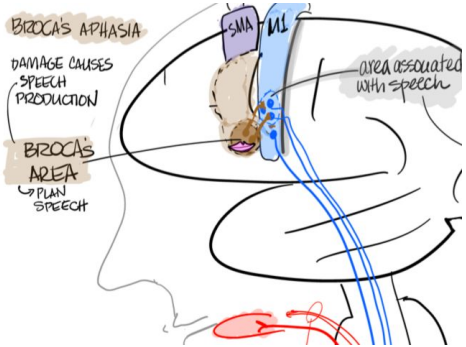
PMA Neurons

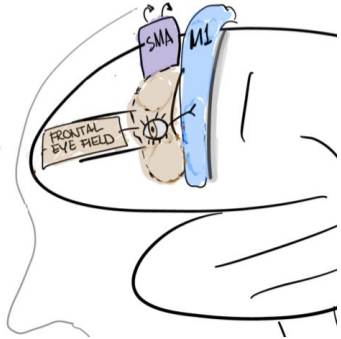
- Do not have a direct connection to the muscles
- Motor programs in the PMA stimulate M1 neurons
- M1 neurons do not have planning capacity

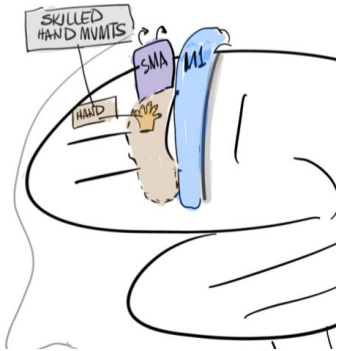


3 Important Parts of the PMA

- Broca's Area
  - Plans speech
  - Connects to the area in M1 associated with speech that controls:
    - Facial expressions, larynx, pharynx, and tongue
  - Broca's aphasia
    - Damage causes speech production errors
- Frontal Eye Field
  - Controls eye movements on the contralateral side
- Premotor Area Homunculus
  - Body mapped with motor purpose
  - Controls bilateral primitive movements
  - Also in M1







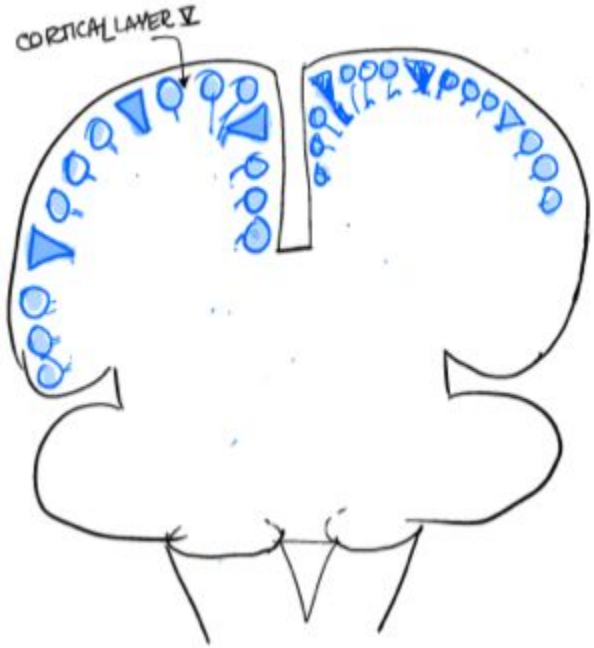
Supplementary Motor Area (SMA)

- Primitive movements
- Controls lower body movements
  - Truck control: lower spine and hip movements
- Controls bilateral movement

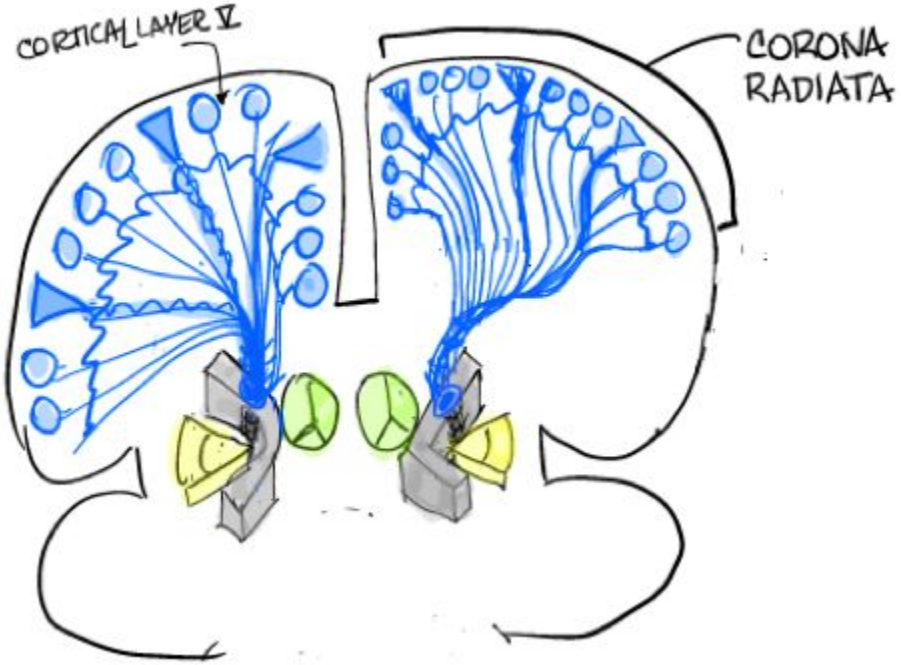
3 Levels of Control and Corresponding Brain Regions

- Strategy
  - Plans the movement/goal
  - Brain regions: cortex and basal ganglia
- Tactics
  - Controls muscle sequences to execute the goal
  - Brain regions: motor cortex and cerebellum
- Execution
  - Adjusts posture and movement to achieve the goal
  - Brain regions: brain stem and spinal cord

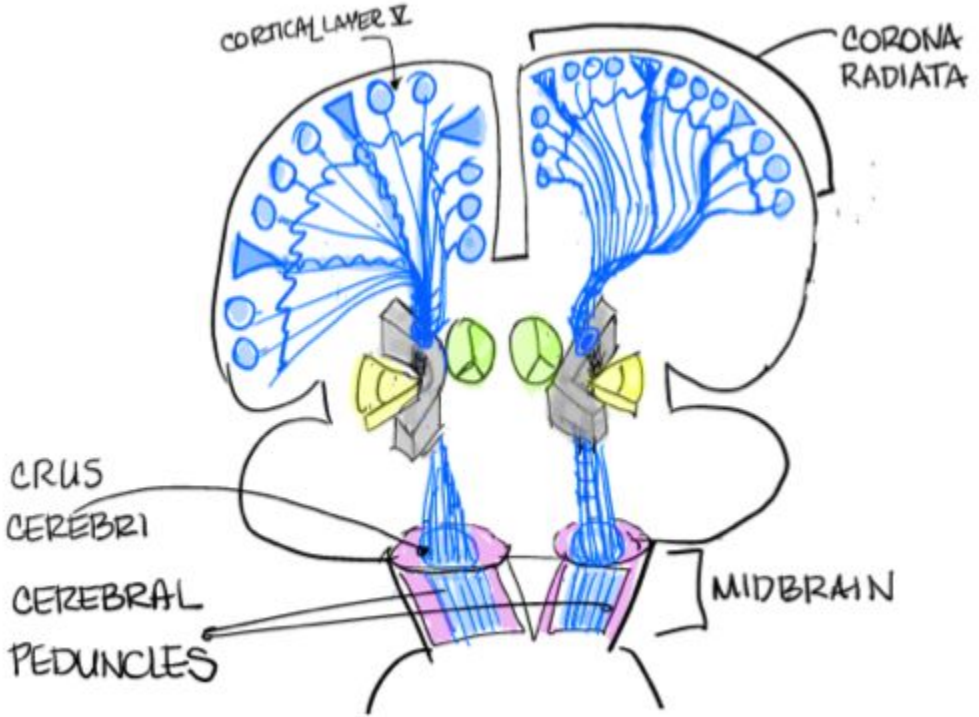
Pyramidal Decussation Stop 1: Layer 5 of Cortex



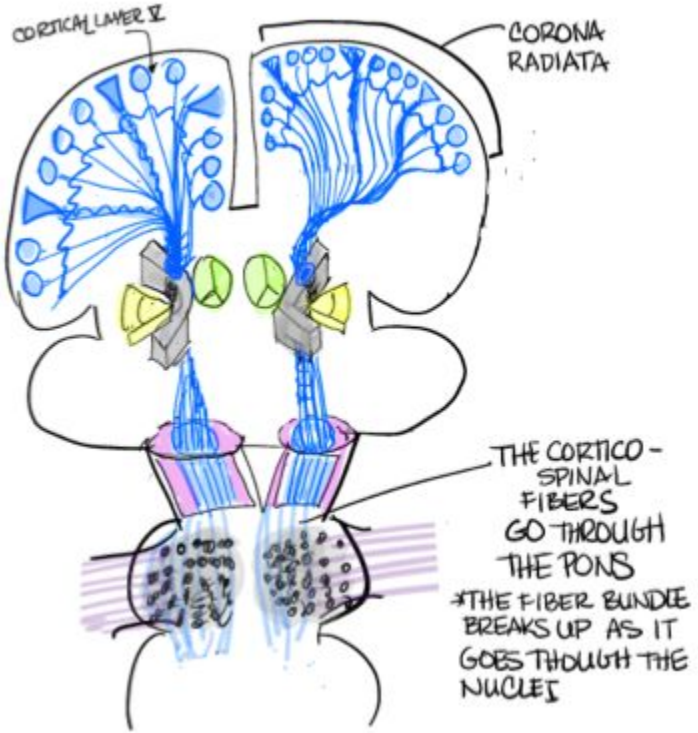
Pyramidal Decussation Stop 2: Internal Capsule



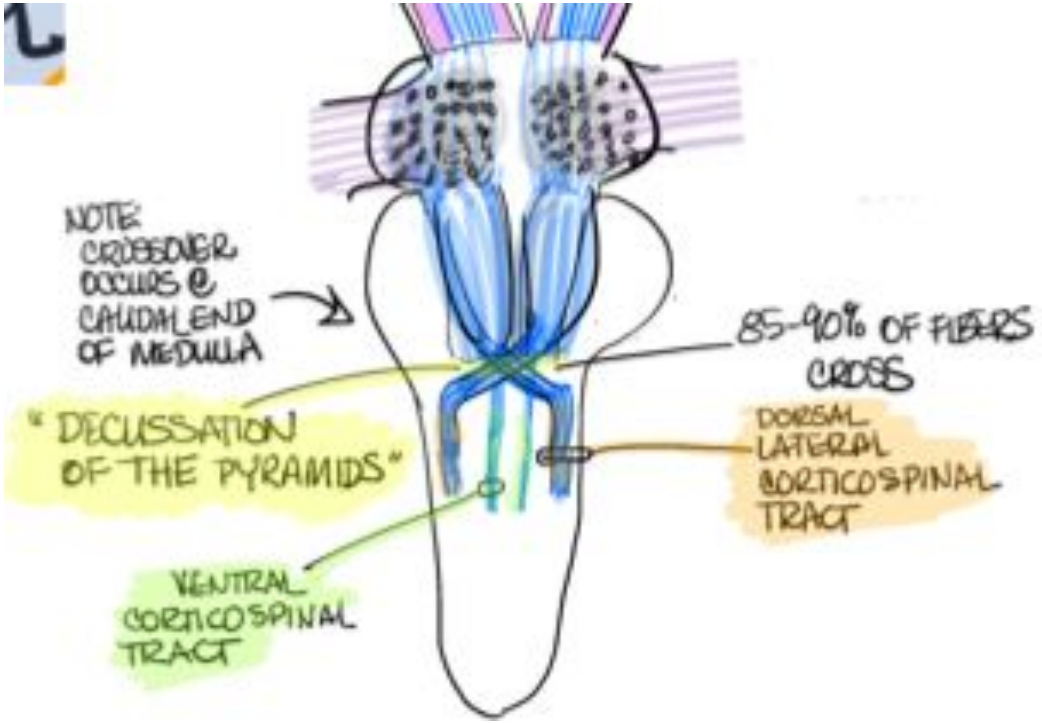
Pyramidal Decussation Stop 3: Midbrain



Pyramidal Decussation Stop 4: Pons

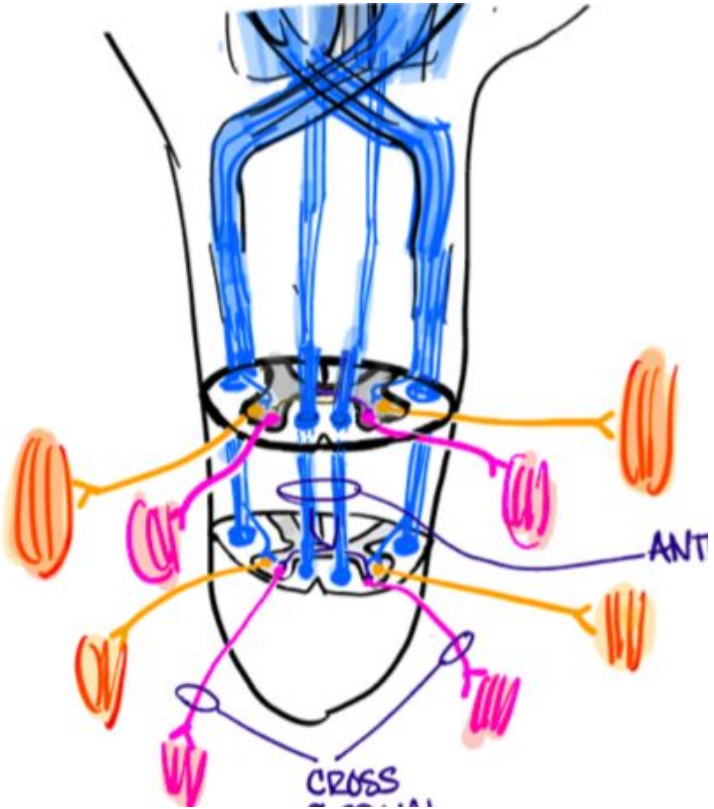


Pyramidal Decussation Stop 5: Medulla



Two Tracts in the Spinal Cord

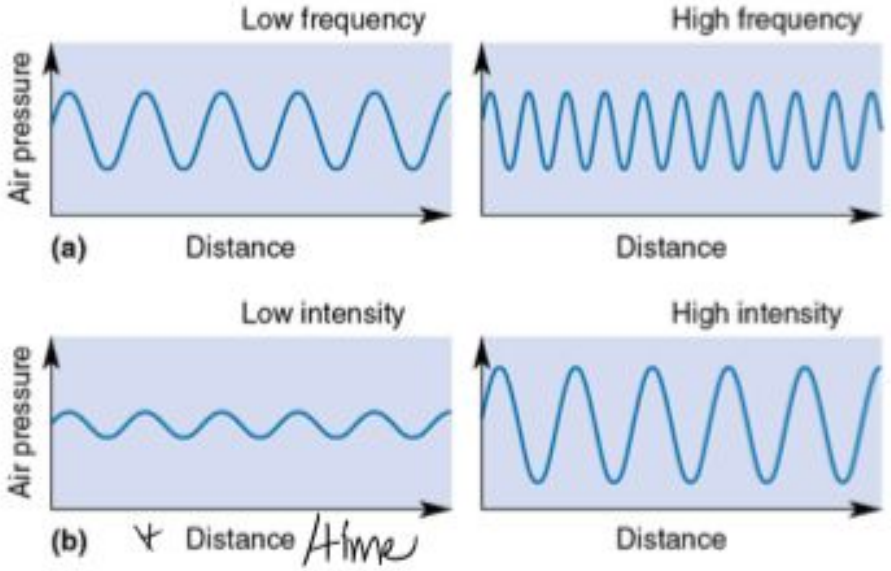
- Dorsal Lateral Corticospinal Tract
  - Made up of fibers that cross in the pyramids of the medulla
    - “Decussation of the pyramids”
  - Controls further away, distal skeletal muscles
- Ventral Corticospinal Tract
  - Made up of fibers that do <u>not</u> cross in the medulla
    - Instead cross in the spinal cord
  - Controls closer, axial & truncal muscles



Audition

Sound Waves

- Range: 20 Hz to 20,000 Hz
  - Units: Hertz (HZ) -> cycles per second
- Pitch/Frequency
  - High pitch = high frequency
- Intensity/Amplitude
  - High intensity is louder

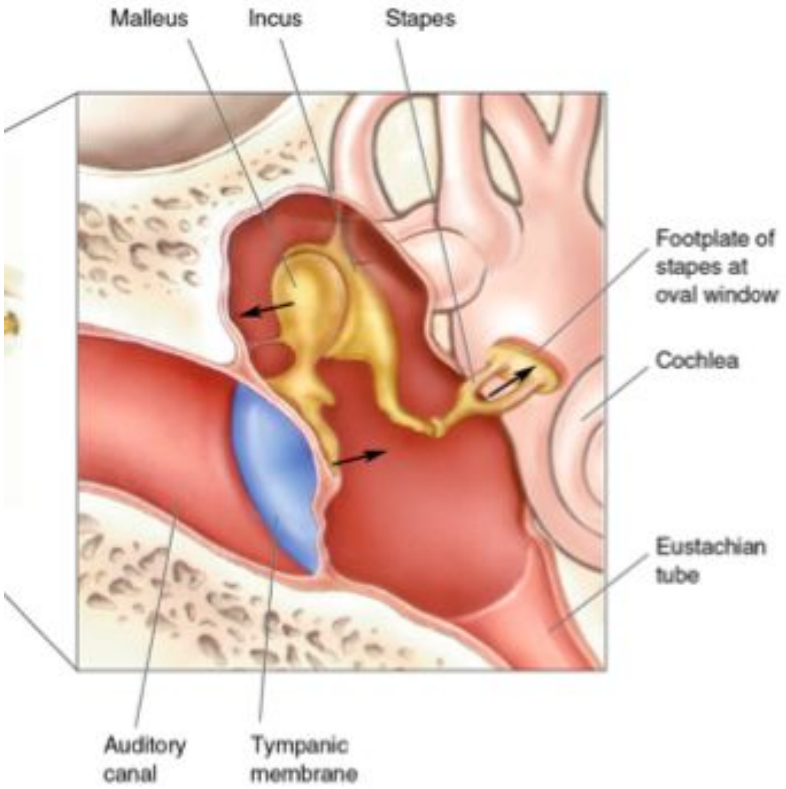


Outer Ear

- Purpose:
  - Collect sounds
  - Orientation
  - Localization
- Parts:
  - Pinna: individually distinct outer ear
  - Auditory canal: channel where molecules move and ink to the eardrum

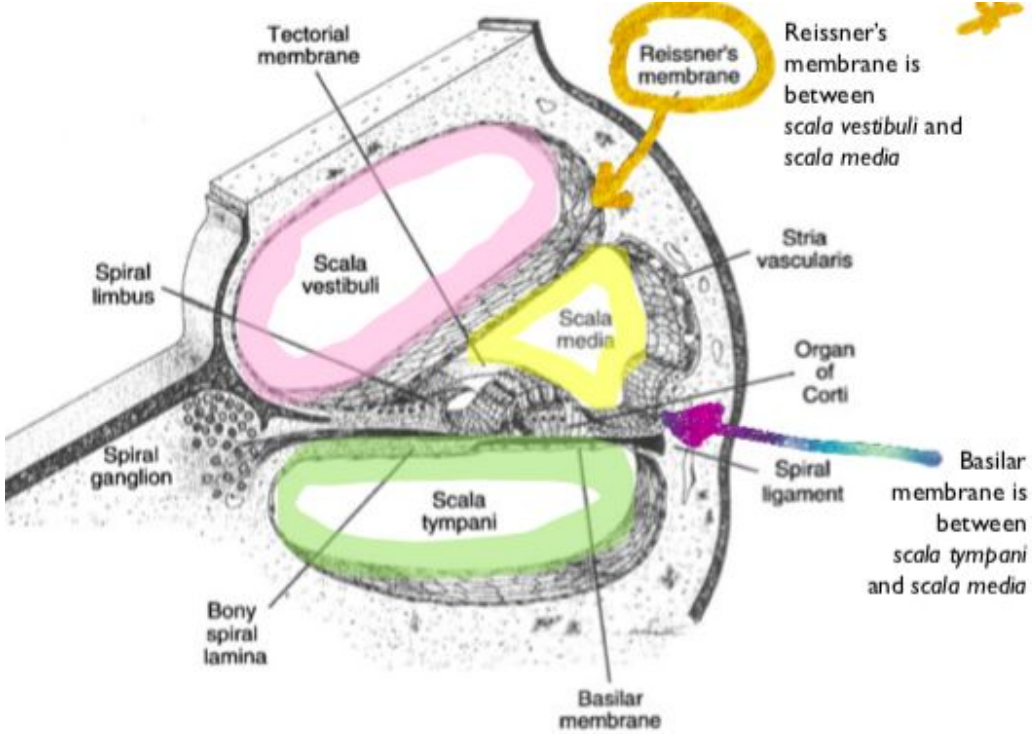
Middle Ear

- Tympanic Membrane
  - Also called the eardrum
  - Connects to the ossicles
- Ossicles
  - Made up of 3 bones: malleus, incus, and stapes
  - Transfers the movement of the tympanic membrane to the oval window
  - Amplifies the force of the sound
    - Need to convert the sound energy into a more powerful signal since the cochlear fluid is harder to vibrate than the air molecules



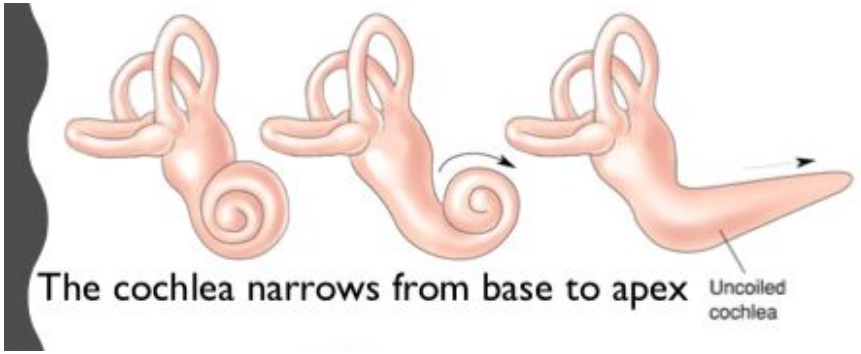
Inner Ear: Cochlea

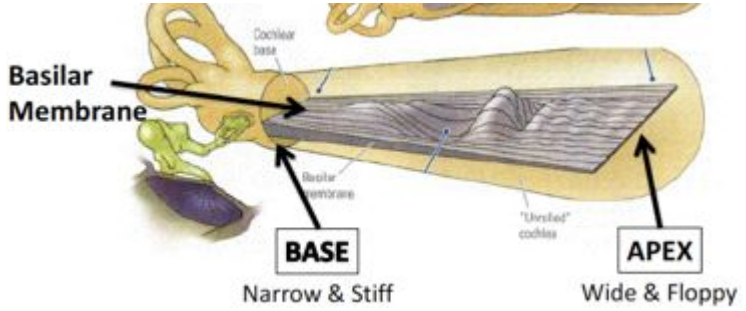
- Fluid filled chambers:
  - Scala vestibuli
  - Scala media
  - Scala tympani
- Membranes: Reissner's and Basilar
- Types of fluids:
  - Perilymph
  - Endolymph
- Purpose:
  - Converts sound to neural signals



Place Coding

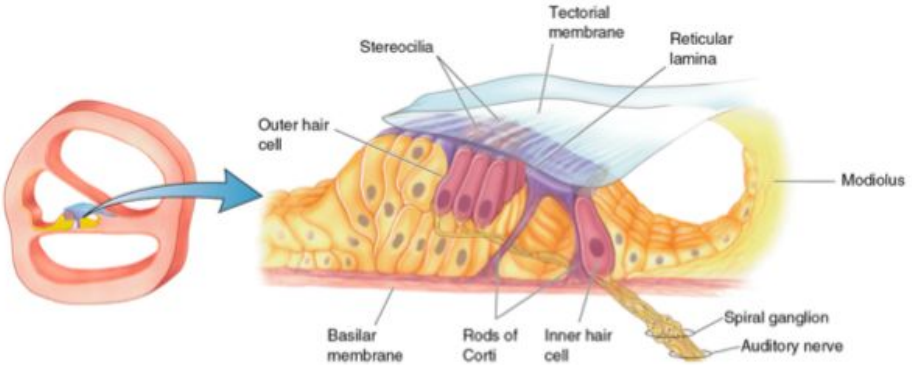
- Base of the Basilar Membrane
  - Closest to the oval window
  - Narrow and stiff
  - Moved most by high frequencies
- Apex of the Basilar Membrane
  - Far end of the cochlea
  - Wide and floppy
  - Moved most by low frequencies

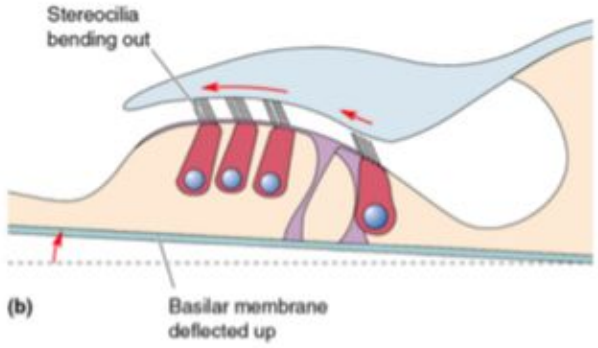




Organ of Corti Anatomy

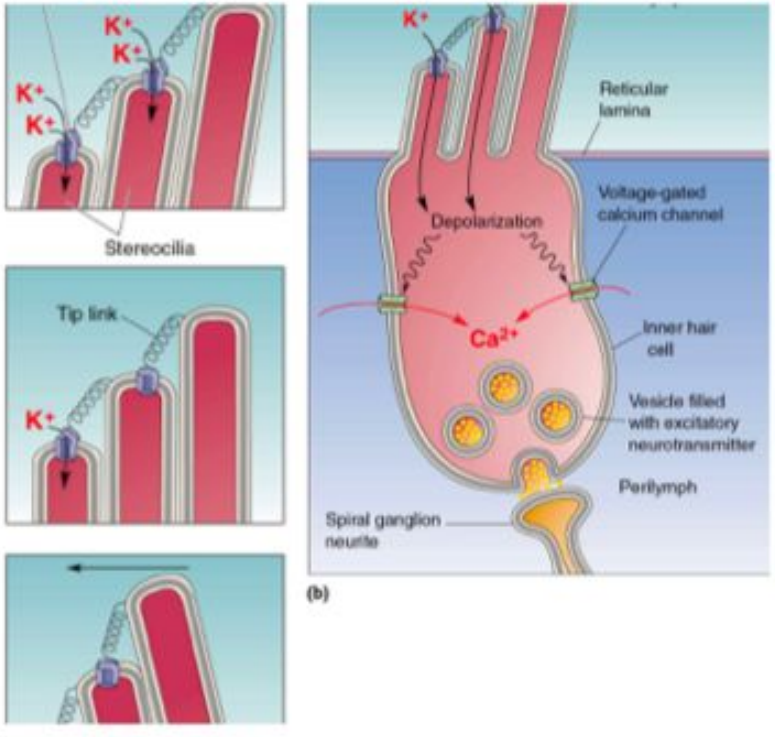
- In the scala media
- Hair cells between 2 membranes
  - Tectorial membrane on top
  - Basilar membrane on bottom
- Hair Cells
  - Depolarize or hyperpolarize depending on which direction the cilia bend
  - As the basilar membrane moves from the sound waves, the cilia bend
  - Inner Hair Cells
    - Divergent connections
    - For details
  - Outer Hair Cells
    - Act as cochlear amplifiers
    - Convergent connection

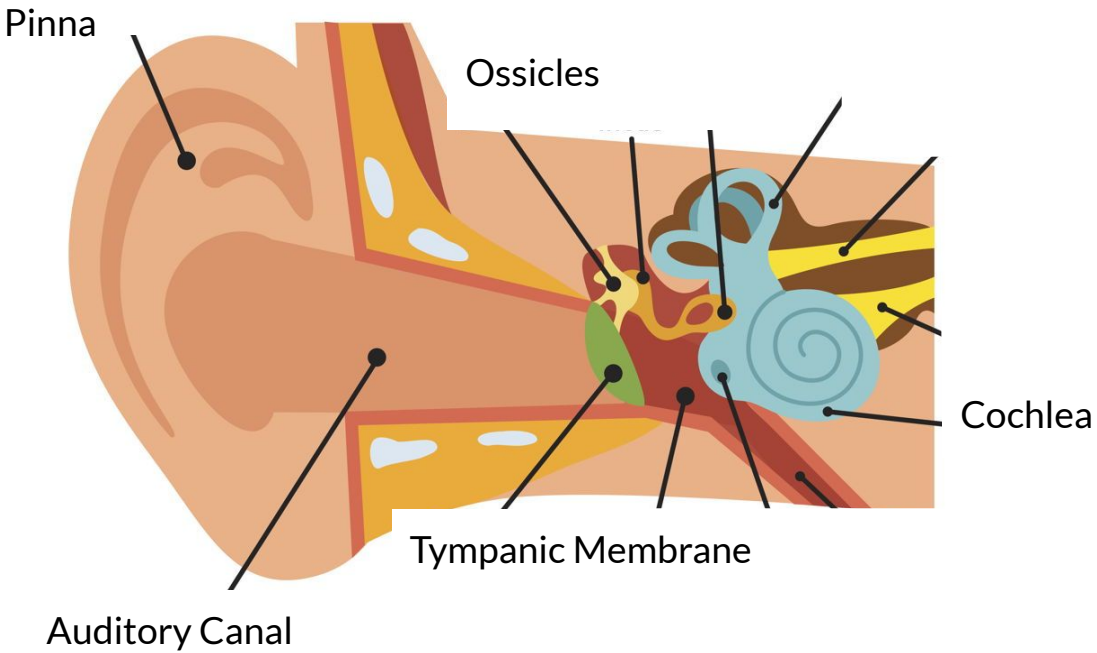


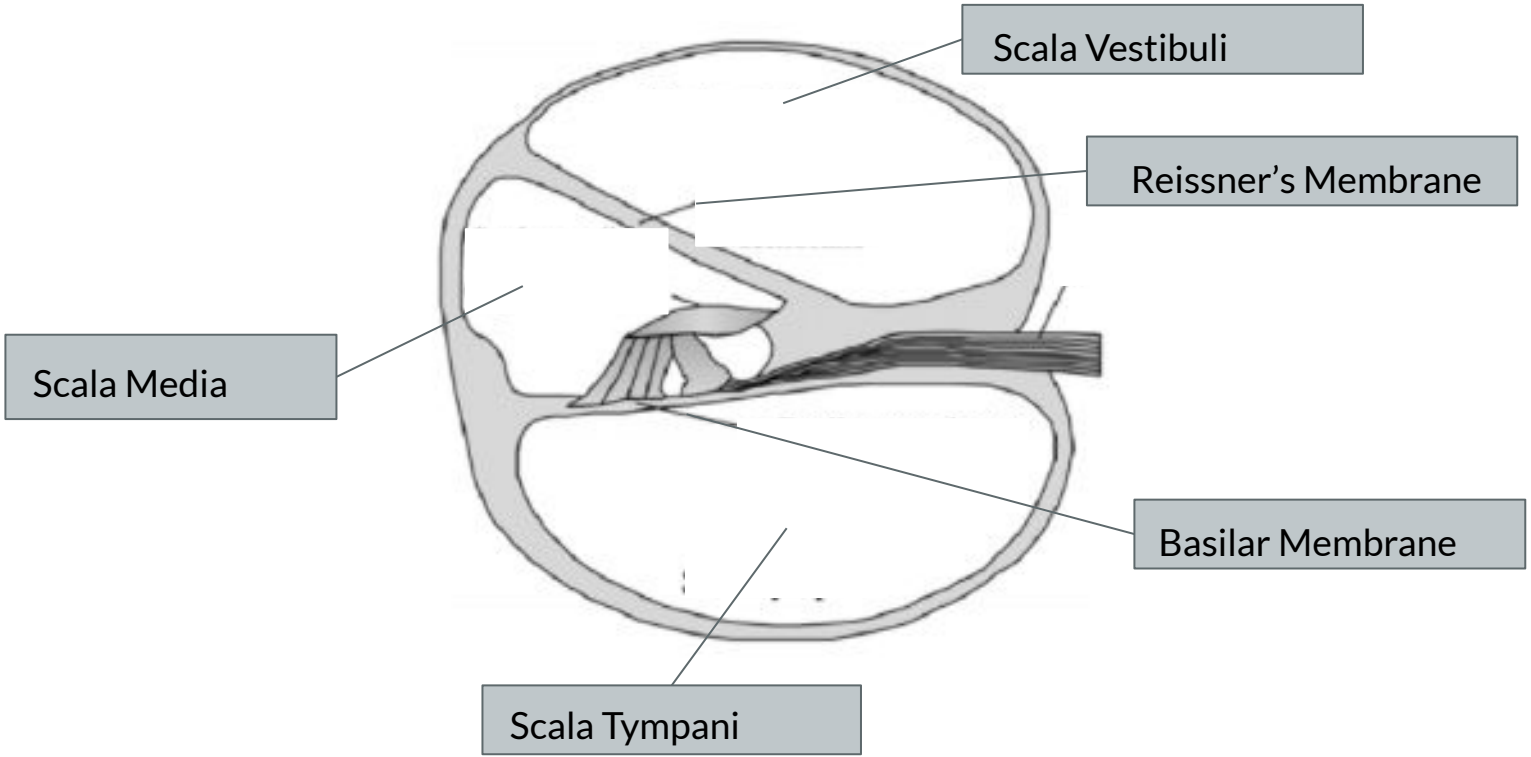


Transduction of Hair Cells

- Basilar membrane bends the cilia
  - Tip links stretch and open the K+ channels
  - Hair cell depolarizes when K+ enters the cell
- Ca++ channels then open which causes the release of glutamate
- Receptors on the spiral ganglion receive the signal




Pinna
Ossicles
Cochlea
Tympanic Membrane
Auditory Canal


Scala Vestibuli
Reissner's Membrane
Scala Media
Basilar Membrane
Scala Tympani