

Modalities of Sensation

- specific sensory receptors distinguish between different modalities
 - cutaneous receptors - pressure, temperature, pain
 - air and head vibrations - auditory (air vibration) and vestibular (head vibration)
 - chemicals - taste, olfaction, pH
 - visible light - vision (rods + cones)
- all sensory receptors convert specific forms of external energy into action potentials
- all sensations must be converted into action potentials by receptors
 - Transduction - convert external energy into action potential energy
 - Amount of energy is encoded as frequency
 - higher frequency → more energy

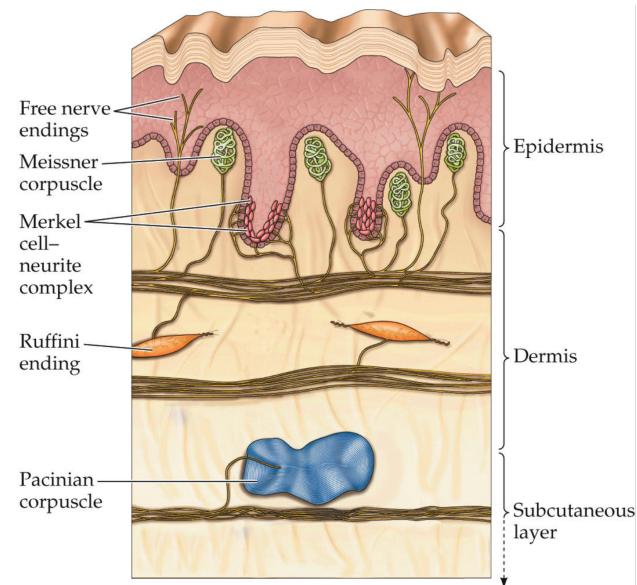
Mechanical Sensory Transduction

- mechanical force activates somatosensory receptors on the body
- Cutaneous touch receptors have specialized membrane capsules w/ ion channels that are mechanically gated
- mechanically gated ion channels produce local potential (depolarizing) when stretched
- if stretched enough (aka depolarization > threshold), the amplitude of the local potential is encoded as action potential frequency in sensory nerves

Cutaneous Receptors - exist in the skin and detect touch (pressure + vibration), pain and temperature

- Encapsulated (TOUCH) - contain capsule which is formed by connective tissue, which makes receptors more sensitive → all are innervated by type AB

- Meissner's corpuscle - most superficial encapsulated receptors and responds to light pressure
- Merkel's DiskS - located in the crypts/depressions of the epidermis
- Ruffini Ending
- Pacinian Corpuscle - responds to vibration
- Hair follicle receptors - has nerve ending that wraps around base of the hair. When hair moves, receptors stretch → hairs act like levers and are very sensitive



Unencapsulated (Pain + Temperature)

- free nerve endings

Somatosensory Fiber Types

Sensory Function	Receptor Type	Afferent axon type	Axon Diameter	Axon velocity
proprioception	muscle spindle	A α , Type II	13 - 20 μm	80 - 120 m/s
touch	merkel, meissner, pacinian, ruffini	A β , Type II	6 - 12 μm	35 - 50 m/s
pain/temperature	free nerve endings	A δ , Type III	1 - 5 μm	5 - 30 m/s
pain/temp/itch	free nerve endings	C, Type IV (no myelin)	.2 - 1.5 μm	.5 - 2 m/s

- Nerve in the periphery is composed of fascicles

- Fasciculus is a bundle of nerves in the CNS

Dermatome Map

- Trigeminal Nerve (CN5) - innervates face

Cervical Levels

- no C1 → C1 purely has muscular innervations in face
- C2 - C7 innervate back of head, front of arms, and neck

Thoracic Levels

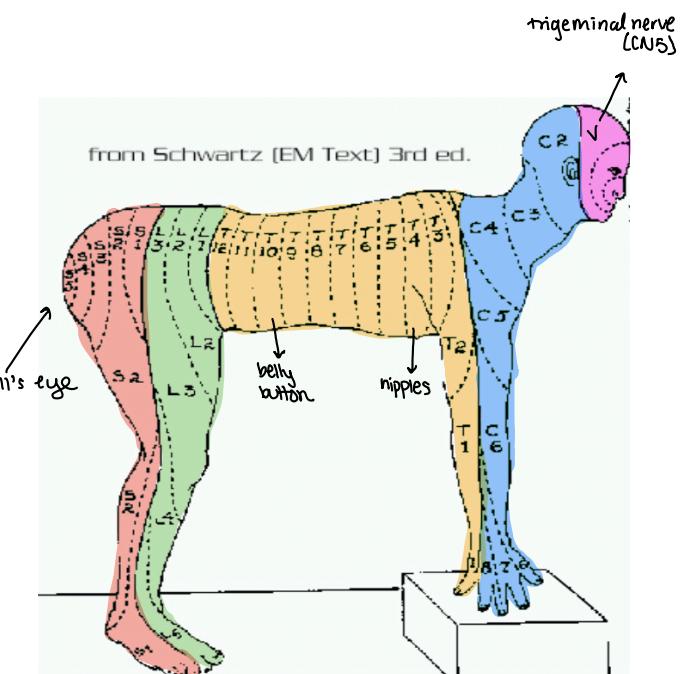
- T4 → at nipples
- T10 → at belly button (umbilicus)

Lumbar Levels

- innervate front of legs + butt

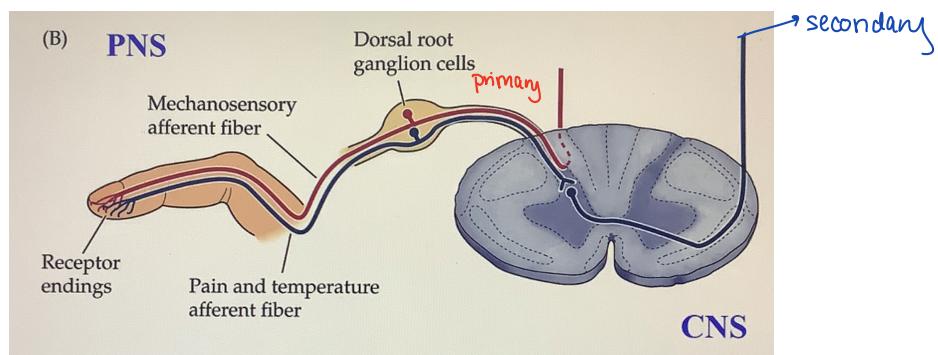
Sacral Levels

- innervate back of legs and butt
- levels form a bull's eye



Afferent Fibers

- primary afferent fibers don't cross
- secondary afferent fibers do cross
→ "synapse then cross"



Pain + Temperature → secondary afferent fibers cross in the spinal cord

Mechanosensory afferent fiber → secondary afferent fibers cross in medulla

Somatosensory Pathways

pathway	function	crossing
dorsal columns / medial lemniscus	fine touch + conscious proprioception	caudal medulla
antrolateral fasciculus	pain + temperature	spinal cord
trigemino-thalamic	fine touch, conscious proprioception, pain, temperature from the face	multiple places
dorsal, ventral spinocerebellar	unconscious proprioception	multiple places