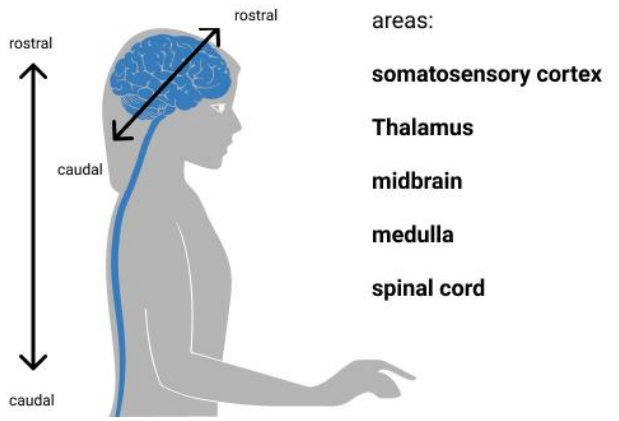
Neuroscience BIO-311 Mathis

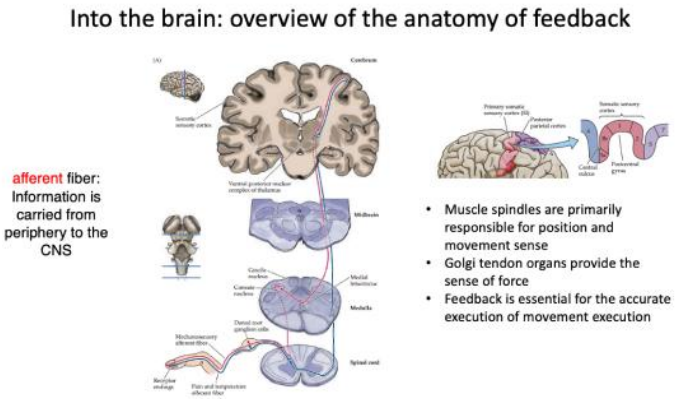
Exercise **SOLUTIONS** for :
Somatosensory system

1) *Introduction to brain anatomy*: Name 5 substructures of the brain *from rostral to caudal*.

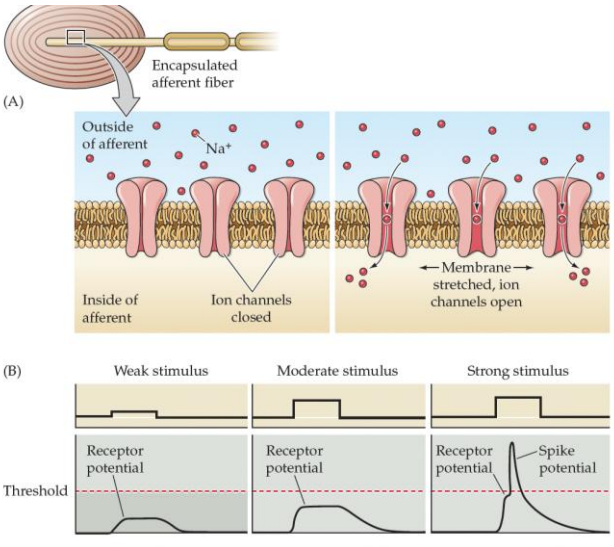
Rostral and caudal: In animals with linear nervous systems, the term rostral (from the Latin rostrum, meaning "beak") is synonymous with anterior and the term caudal (from the Latin cauda, meaning "tail") is synonymous with posterior.

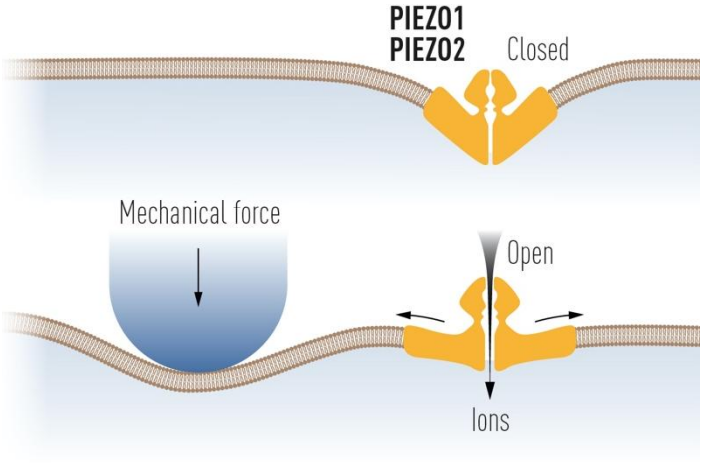
This exercise is to get you to consider information processing across the brain/CNS: in somatosensation, information flows from receptors in the periphery to central structures. Therefore, know this anatomy gives you understanding into information flow. If you draw the somatosensory system from rostral to caudal, there are two axes to consider, in the brain and the CNS:





2) Somatosensory system: Explain the primary sensory transduction process in a touch receptor. What is a mechanosensitive ion channel, and for which ions is it permeable?

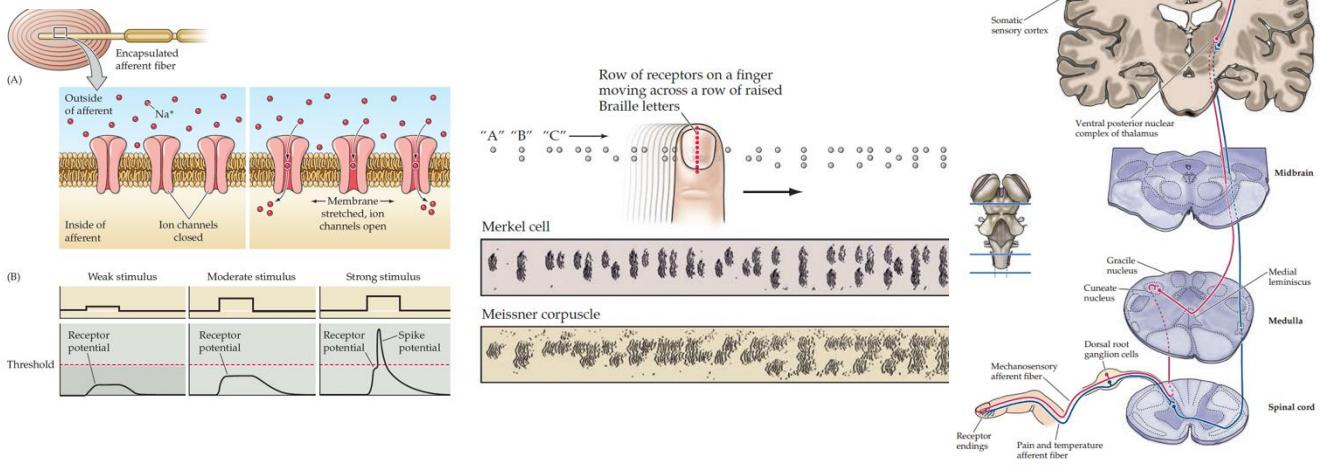




Force leads to a stretching of the membrane of afferent fiber, increasing the possibility of opening ***mechanotransduction channels*** *in the membrane. Opening of these cation channels lead to depolarization of the afferent fiber and action potential can be generated. They are (minimally) permeable to sodium (Na+) ions.*

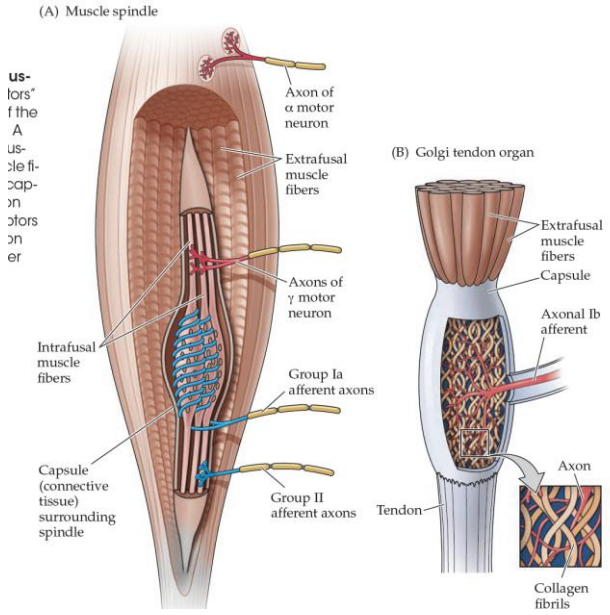
3) Briefly recapitulate in a drawing the anatomical pathway for the somatosensory system for touch. How is this anatomical pathway called?

Consider the whole pathway: from the receptor/afferent fiber to the activity pattern of neurons, through the whole pathway, which is called the dorsal column-medial lemiscus pathway (read more: https://en.wikipedia.org/wiki/Dorsal_column%E2%80%93medial_lemniscus_pathway)



4) **What is proprioception? For this, consider what the afferent fibers of the mus cle spindle measure:**

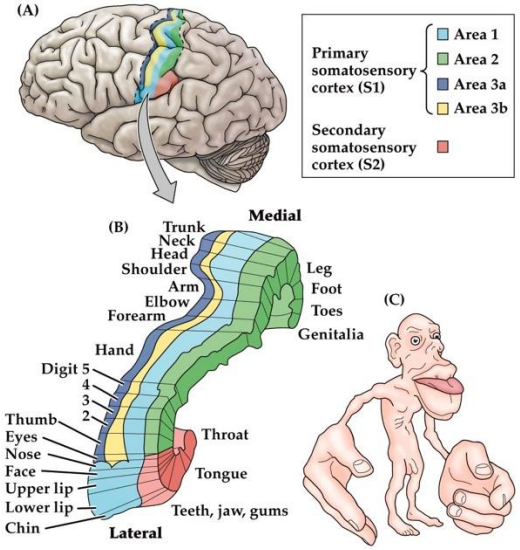
Sensory function	Receptor type	Afferent axon type[a]	Axon diameter	Conduction velocity
Proprioception	Muscle spindle	Ia, II	13–20 μm	80–120 m/s



Prioprioception is the sensation for one to know the status (velocity and movement) and position of the body in the space.
Both Ia and II afferent axons are sensitive to the length of muscle spindles.

- Group Ia afferents measures the velocity and direction of the movement.
- Group II afferents provide information about the static position of limb.
- Golgi tendon organs, mostly formed by branches of Group Ib afferents, measure tensions in the muscle.

5) What is a somatotopic map? Do you think that for a somatotopic map to exist in the primary somatosensory cortex (S1), there should also be a somatosensory map in the thalamus, and in the medulla?



In somatosensory cortex, neurons have receptive field to different parts of the body therefore a spatial map between body regions and brain exists (though is not 1 to 1 in size, it varies based on receptor density). And, yes! Somatotopy exists in the brainstem (medulla) and in thalamus!