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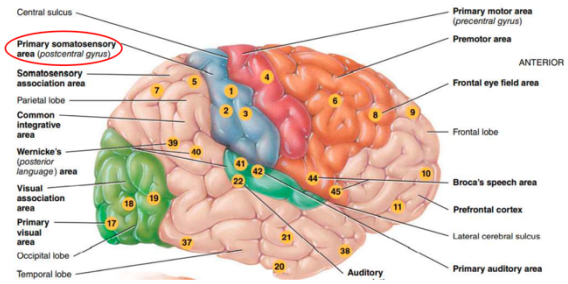
Somatic Sensory Pathways

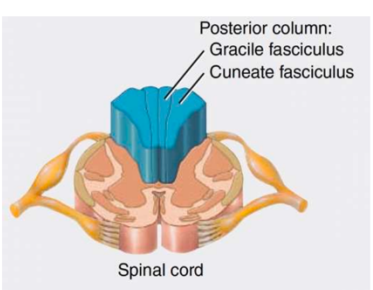
Cerebral cortex

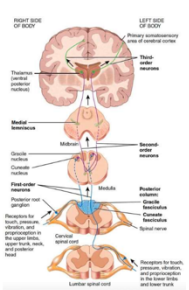
- **Most important integrative part** of the **somatic sensation**
- The primary somatosensory area is **located** in the **postcentral gyrus** of the **parietal lobe**



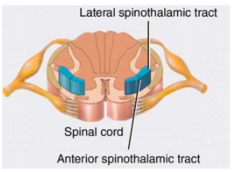
General Info about the pathways:

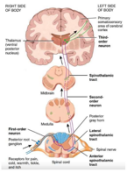
1. Posterior (Dorsal) Column- Medial Lemniscus Pathway
   - Somatic sensation are transmitted to the CNS through several pathways e.g this pathway the posterior column- medial meniscal pathway
   - The name can tell you whether its ascending or descending and can tell you the main structures that this neuron and this pathway will pass through
   - The **neurons** will **go through** the **posterior column then** to the **medial meniscal** which is a **structure** in the **brain stem**
   - The **neurons** will also **pass through other structures**
   - The **direction** from the **posterior column** to the **medial meniscal** is **ascending** so it's a **sensory pathway**
   - Notice that this pathways will **transmit** this **information** from **sensory receptors** in the **periphery** through **spinal nerves** up **until** the **cerebral cortex**



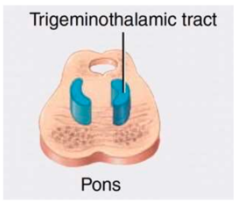


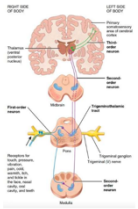
2. Antero-Lateral Spinothalamic Pathways
    - Another **ascending** pathway getting **info from** the **spinal nerve through spinal cord** up to the **thalamus** then **continue** to the **cerebral cortex**



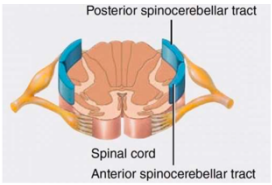


3. Trigeminothalamic Pathway
    - **Transmit somatic sensations** through a **cranial nerve**, more **specifically** the **trigeminal nerve**, that will **go** to the **brain stem** and then **ascends** until it **reaches** the **cerebral cortex passing** though the **thalamus** hence the name





4. Anterior and Posterior Spinocerebellar Pathways
    - In this pathway they would carry **somatic sensation**, more specifically **proprioceptive**, up to the **cerebellar** to get **integrated there**
    - And since the **integration** is in the **subcortical region** you can notice that we don't have the perception for the processing of this information
    - These **pathways** area **important** for **maintaining balance**, **posture** and **coordination** of the **skilled movements**
    - Somatic sensation can be **integrated** in the **spinal cord** for **spinal cord reflexes**



Somatic sensory pathways

- A somatic sensory pathway to the cerebral cortex consist of thousands of sets of three neurons:
    - a first-order neuron (brings info from the receptors)
    - a second-order neuron
    - a third- order neuron.
- **Integration** (processing) of **information occurs** at **each synapse** along the pathway.

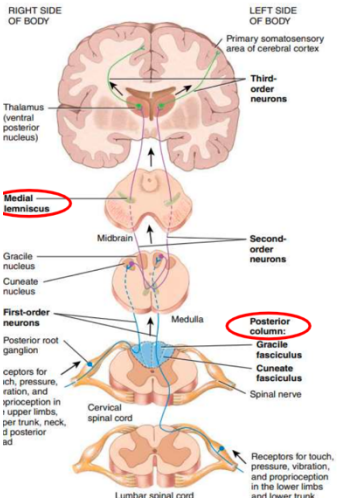
- First-order (primary) neurons
  - Sensory neurons that **conduct impulses** from **somatic sensory receptors** into the **brainstem** or **spinal** cord.
  - Somatic sensory impulses **propagate along spinal** or **cranial nerves**.
  - All **other neurons** in a **somatic sensory** pathway are **located completely** within the **CNS**.
    - A part of the first order neuron will be in the PNS
- Second-order (secondary) neurons
  - **Conduct impulses** from the **brainstem** or **spinal** cord to the **thalamus**.
  - **Axons** of **second-order neurons decussate** (cross over to the opposite side) as **they course through** the **brainstem** or **spinal** cord **before ascending** to the **thalamus**.
    - **Thalamus** is considered a **major** relay **station** for the sensory information because **most** of the **sensory information** will **synapse within** the **thalamus**
    - While for the **somatic sensation** the **synapse** is **mainly** in the **ventrobasal complex**

- Third-order (tertiary) neurons
  - **Conduct impulses** from the **thalamus** to the **primary somatosensory area** on the **same side**.
    - not that the **crossing happens only once** by the **second order neuron**
  - **Somatic sensory** information **on one side** of the body is **perceived** by the primary somatosensory area on the **opposite side** of the **brain**.

Posterior column - medial lemniscus pathway

- Information in this pathway come from:
  1. **Limbs**
  2. **Trunk**
  3. **Neck**
  4. **Posterior part of the head**
- **Sensory modalities** that are transmitted through this pathway are:
  1. **Touch/ crude touch**
  2. **Vibration**
  3. **Pressure**
  4. **Proprioception**
- **Information** form these **sensory modaltiies** will **enter** to the **spinal cord through spinal nerves** to the **posterior apart** of the **spinal cord** called the **posterior column**

- In this **pathways** the **type of nerve fibers** that are **transmit** these **information** are **large myelinated fibers** which means the **conduction velociry** is **very high**
- Pathway:

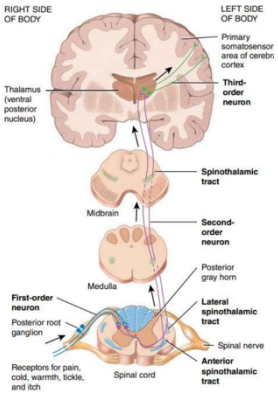


1. First of all the **first order neurons** which **come** from the **dorsal root ganglia** will **enter** the **posterior white column** and then **ascend** up to the **medulla** where there are **two nuclei** , **nucleus gracilis** (has fasciulus gracillus fibers) and **nucleus cuneatus** (has fasciulus cuneuatus fibers)
   - The more **medial one** is the **fasiculus gracillus** which carries info from the **lower body**
   - The more **lateral** one is the **fasiculus cuneatus** which carries info from the **upper body**
     - This **peculiar spatial orientation** is **important** for the **localization** of these **sensory modalities** coming through this pathway
2. The **first order neurons** will then **synapse with the second order neuron** in the **gracilis nucleus** and the **cuneuate nucleus**
3. Once it **synapses** the second order **neuron** will then **decussation at the level of the medulla**
4. After it decussated it will it will **continue ascending** to the **medial leminscus** and then **go** to the **thalamus**
5. Once it reaches the **thalamus** it will **synapse** with the **third order neuron** which is **found** in the **ventral posterolateral nuculeus** so they wil **synapse there**
6. It will then **continue** into the **primary somatosensory areas** of the cerebral cortex

Anterolateral spinothalamic pathway

- Modaliites of this pathway are:
  - **Pain**
  - **Itch**
  - **temperature**
  - **tickle**
  - some times **crude touch** and **sexual sensations** (some books it has that written)
- The **nerve fibres** that are transmitted through this pathway are **small fibers** so the **conduction velocity** in this pathway is much **slower** than the conduction velocity of the previous pathway and because it's **smaller** so it's PeTITe
- The **sensory modalities** come from: (just like the previous pathway)
  - **Neck**
  - **Trunk**
  - **Limb**
  - **Posterior part of the head**

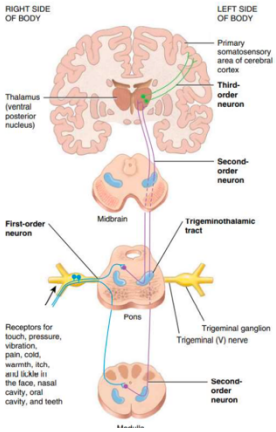
- Pathway:



1. The **first order neuron** will **come through** the **dorsal root ganglia** into the **spinal cord**
2. The **first order neuron and second order neuron shortly synapses** with each other at the **dorsal horn** of the **spinal gray matter**
3. The **second order neuron** will **decussate immediatey** to the other side to **join the anterior column** or the **lateral column** of the **spinothalamic tract up to the thalamus**
   - the **decussation level is in the spinal cord** different form the posterior column pathway which was in the medulla
4. the **thrid order neuron** will **start** in the **thalamus** then **continue up** to the **primary somatosensory area** of the cererbal cortex

Trigeminothalmic pathway

- The somatic sensation comes from:
  - Face
  - Oral cavity
  - Nasal cavity
  - Teeth
- **transmitted through** this pathway through the **cranial nerve**, the trigemnial pathways
- Pathway:



1. **First order neuron** will **enter** through the **trigemnial ganglion** to the **brain stem** where it **synapses with the second order neuron** at the **level** of the **pons** and the **medulla**
2. The **second order neuron** once **synaped** with the first order neuron will **deucssate at levels of the pons and medulla** (it **decussated twice**) and **continue up** to the **thalamus** there it will join the **somatic sensation** from the **body where we said that the thalamus is a major relay station for sensation**
3. The **third order** neuron **continues** from the **thalamus up** to the **priamry somatosensory area** for the **perception** and **integration** of the **information**

Mapping of the primary somatosensory area in the cerebral cortex

- Its **located** in the **postcentral gyrus** of the **parietal** lobe of the **cerbral cortex**
- The **left cerebral hemisphere receives** input from the **right side** of the **body** due to **decussation** that occurs
- **Distorted somatic sensory map** of the **body**: **sensory homunculus**