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## Somatosensory pathway

The somatosensory system is a part of the sensory nervous system. The somatosensory system is a complex system of sensory neurons and neural pathways that responds to changes at the surface or inside the body. The axons (as afferent nerve fibers) of sensory neurons connect with, or respond to, various receptor cells. These sensory receptor cells are activated by different stimuli such as heat and nociception, giving a functional name to the responding sensory neuron, such as a thermoreceptor which carries information about temperature changes. Other types include mechanoreceptors, chemoreceptors, and nociceptors which send signals along a sensory nerve to the spinal cord where they may be processed by other sensory neurons and then relayed to the brain for further processing. Sensory receptors are found all over the body including the skin, epithelial tissues, muscles, bones and joints, internal organs, and the cardiovascular system.

Touch is a crucial means of receiving information. This photo shows tactile markings identifying stairs for visually impaired people.

Somatic senses are sometimes referred to as somesthetic senses, with the understanding that somesthesia includes the sense of touch, proprioception (sense of position and movement), and (depending on usage) haptic perception.

The mapping of the body surfaces in the brain is called somatotopy. In the cortex, it is also referred to as the cortical homunculus. This brain-surface ("cortical") map is not immutable, however. Dramatic shifts can occur in response to stroke or injury.

A somatosensory pathway will typically have three long neurons: primary, secondary, and tertiary. The first always has its cell body in the dorsal root ganglion of the spinal nerve.

Dorsal root ganglion: Sensory nerves of a dorsal root ganglion are depicted entering the spinal cord.

The second has its cell body either in the spinal cord or in the brainstem; this neuron's ascending axons will cross to the opposite side either in the spinal cord or in the brainstem. The axons of many of these neurons terminate in the thalamus, and others terminate in the reticular activating system or the cerebellum.

In the case of touch and certain types of pain, the third neuron has its cell body in the ventral posterior nucleus of the thalamus and ends in the postcentral gyrus of the parietal lobe.

In the periphery, the somatosensory system detects various stimuli by sensory receptors, such as by mechanoreceptors for tactile sensation and nociceptors for pain sensation. The sensory information (touch, pain, temperature, etc.) is then conveyed to the central nervous system by afferent neurons, of which there are a number of different types with varying size, structure, and properties.

Generally, there is a correlation between the type of sensory modality detected and the type of afferent neuron involved. For example, slow, thin, unmyelinated neurons conduct pain whereas faster, thicker, myelinated neurons conduct casual touch.

## **Ascending Pathways**

In the spinal cord, the somatosensory system includes ascending pathways from the body to the brain. One major target within the brain is the postcentral gyrus in the cerebral cortex. This is the target for neurons of the dorsal column–medial lemniscal pathway and the ventral spinothalamic pathway.

Note that many ascending somatosensory pathways include synapses in either the thalamus or the reticular formation before they reach the cortex. Other ascending pathways, particularly those involved with control of posture, are projected to the cerebellum, including the ventral and dorsal spinocerebellar tracts.

Another important target for afferent somatosensory neurons that enter the spinal cord are those neurons involved with local segmental reflexes.

## **Parietal Love: Primary Somatosensory Area**

The primary somatosensory area in the human cortex is located in the postcentral gyrus of the parietal lobe. This is the main sensory receptive area for the sense of touch.

Like other sensory areas, there is a map of sensory space called a homunculus at this location. Areas of this part of the human brain map to certain areas of the body, dependent on the amount or importance of somatosensory input from that area.

For example, there is a large area of cortex devoted to sensation in the hands, while the back has a much smaller area. Somatosensory information involved with proprioception and posture also target an entirely different part of the brain, the cerebellum.

## **Cortical Homunculus**

This is a pictorial representation of the anatomical divisions of the primary motor cortex and the primary somatosensory cortex; namely, the portion of the human brain directly responsible for the movement and exchange of sensory and motor information of the body.

## **Thalamus**

The thalamus is a midline symmetrical structure within the brain of vertebrates including humans; it is situated between the cerebral cortex and midbrain, and surrounds the third ventricle.

Its function includes relaying sensory and motor signals to the cerebral cortex, along with the regulation of consciousness, sleep, and alertness.

## **Somatic Sensory Pathways to the Cerebellum**

The ventral and dorsal spinocerebellar tracts convey proprioceptive information from the body to the cerebellum. A sensory system is a part of the nervous system responsible for processing sensory information. A sensory system consists of sensory receptors, neural pathways, and the parts of the brain involved in sensory perception. Commonly recognized sensory systems are those for vision, hearing, somatic sensation (touch), taste, and olfaction (smell).

In short, senses are transducers from the physical world to the realm of the mind where we interpret the information, creating our perception of the world around us.

The ventral spinocerebellar tract conveys proprioceptive information from the body to the cerebellum. It is part of the somatosensory system and runs in parallel with the dorsal spinocerebellar tract.

Both tracts involve two neurons. The ventral spinocerebellar tract will cross to the opposite side of the body then cross again to end in the cerebellum (referred to as a double cross). The dorsal spinocerebellar tract does not decussate, or cross sides, at all through its path.