SOMATIC SENSORY PATHWAYS

Different sensory modalities

Discriminative touch – Two-point discrimination, recognition of textures, lateral movement of stimuli on skin

Conscious proprioception – This is awareness of position and movement of joints.

Medial lemniscus system (= posterior column system)

Simple or "crude" touch – Even light stimuli can be accurately localized, but without detailed recognition of the object that is in contact with the skin.

Thermal sensation. The skin recognizes differences in temperature, but absolute values cannot be accurately judged.

Pain _ The conscious feeling of injurious stimuli.

Spinothalamic (anterolateral) system

Somatic sensory pathways.

General principles

1. There are two pathways, which carry different types of sensation from skin, muscles etc (not internal organs) to the first somatic sensory area of the cerebral cortex.

2. Each pathway consists of three populations of neurons :–

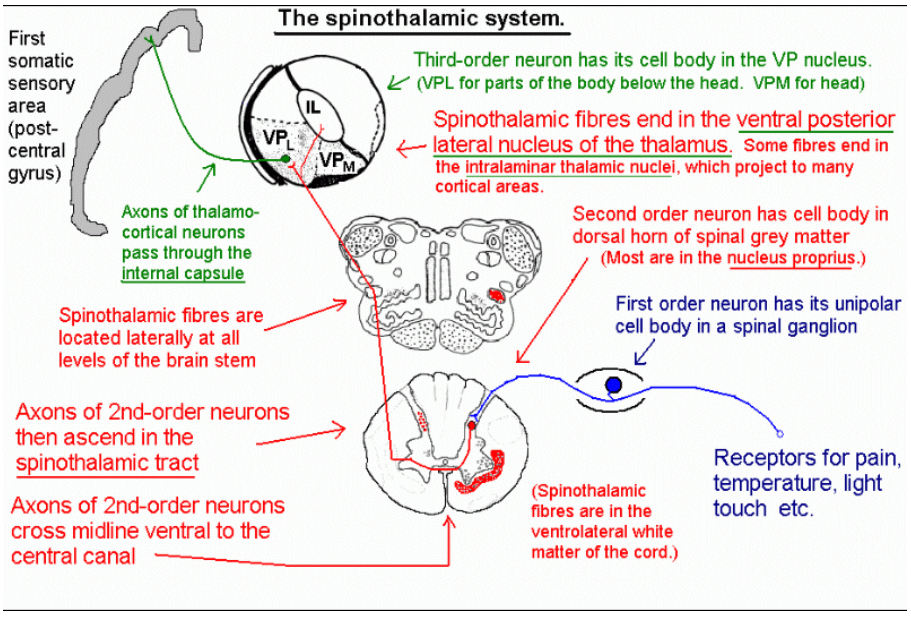
First-order, Second-order and Third-order.

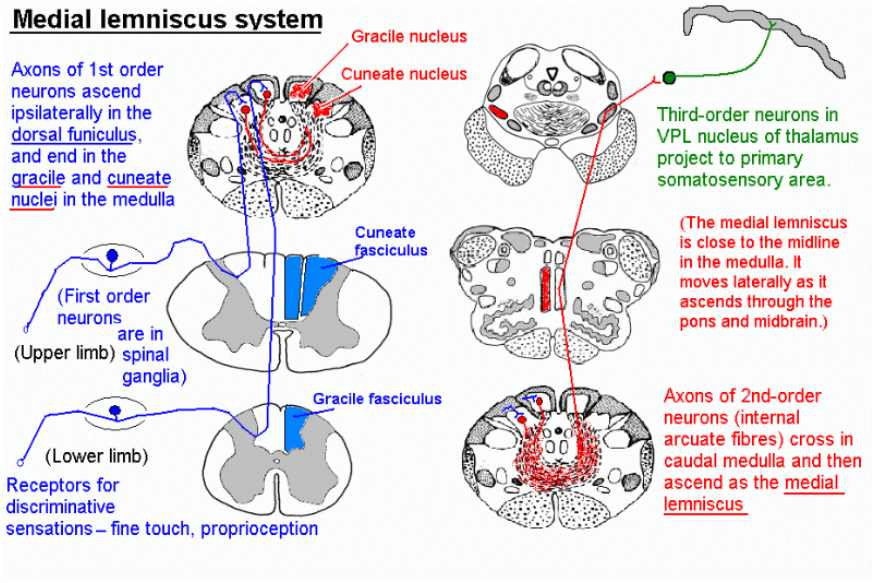
Unipolar, with its cell body in a sensory ganglion

Its axon
- decussates.
- ends in the thalamus.

Cell body in thalamus. Axon ends in cortex.

(Decussation = a place where axons from L & R sides cross the midline)

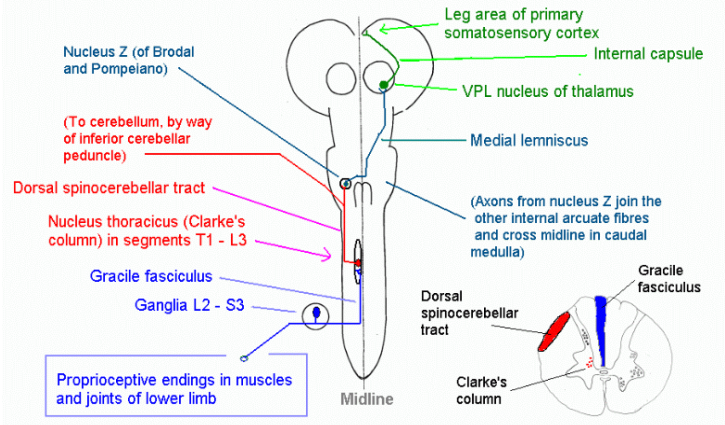




Comparison of the anterolateral with the dorsomedial system

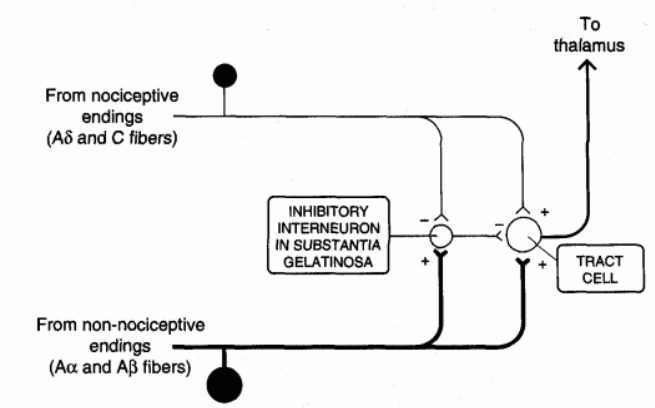
	Spinothalamic system	Medial lemniscus system
First order neurons	• Detect pain, temperature and non-discriminative touch. • Project to dorsal horn of spinal grey matter.	• Detect discriminative tactile features and position and movement of joints. • Long axons ascend in dorsal column, to end in the gracile and cuneate nuclei in medulla.
Second order neurons	• Axons decussate in spinal cord, ascend as contralateral spinothalamic tract. • Project to VPL thalamic nucleus; (also to IL nuclei). • Spinothalamic fibres have branches to reticular formation and periaqueductal grey matter.	• Axons decussate in caudal medulla, ascend as the medial lemniscus. • Project only to the VPL thalamic nuclus. • Axons do not have collateral branches in brain stem. • In dorsal column nuclei, feed-forward and feedback inhibition sharpen localization of most strongly stimulated part of the receptive field.
Third order neurons	• In ventral posterior nucleus of thalamus (lateral division). • Project to primary somatic sensory area (postcentral gyrus). • Intralaminar nuclei → whole cortex.	• In ventral posterior nucleus of thalamus (lateral division). • Project to primary somatic sensory area (postcentral gyrus).

There is an additional pathway for conscious proprioception from the lower limb.



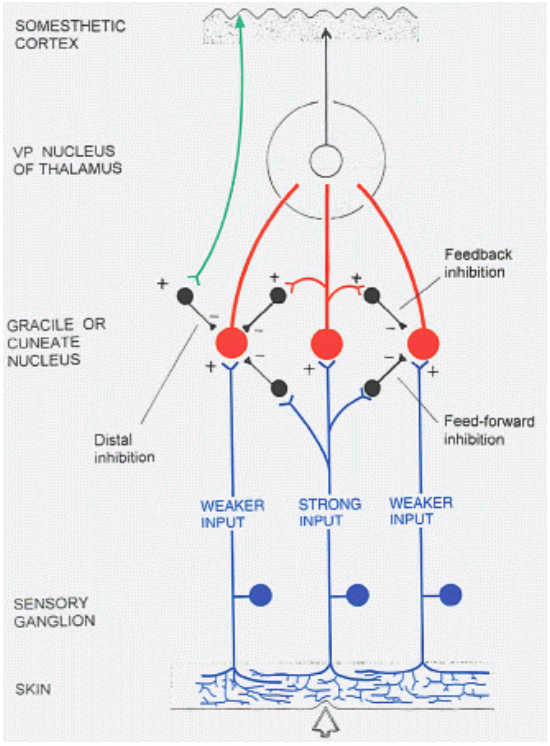
(A chain of four neurons)

Synapses do not simply relay signals. The signals are modified by other inputs to the postsynaptic neurons. The gate control theory is a postulated mechanism for determining whether a stimulus will be felt as being painful.

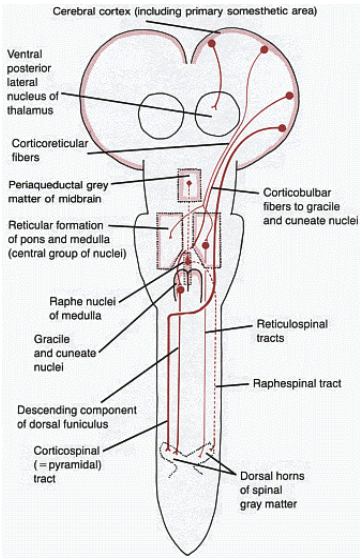


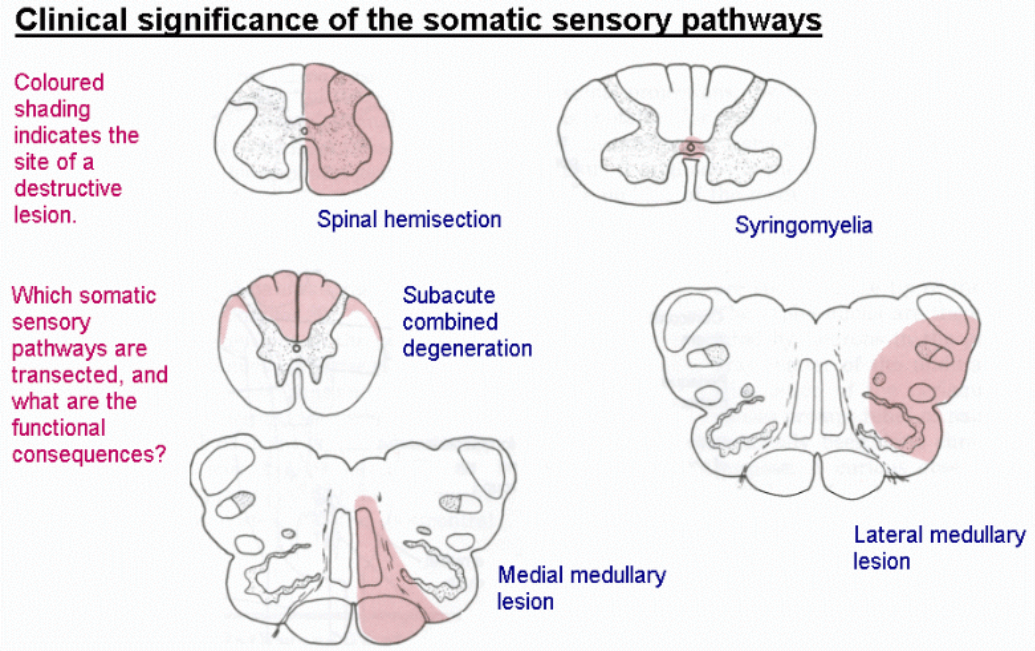
Simple illustration of the gate control theory of pain. Non-nociceptive sensory fibers stimulate the inhibitory interneurons, whereas nociceptive afferents inhibit them. An increase in non-nociceptive input will reduce the rate of firing of the spinothalamic tract neurons.

Inhibition is also used to sharpen the localization of the most strongly stimulated site, by suppressing the transmission of weaker signals from adjacent areas. This happens in the gracile and cuneate nuclei and in many other places.



Descending tracts can modify the upward transmission of sensory data





Consider also:

Pressure on nerve root S1 by a disk protrusion.

Damage to the larger myelinated axons in the radial nerve (e.g. diabetic mononeuropathy).

Destruction of a small part of the postcentral gyrus (e.g. small tumour or stroke).

A longitudinal surgical incision that bisects the spinal cord (separating its left & right halves) in the range S1-S5. (Why might this be done?)

Position of a surgical incision for the relief of severe pain (not relieved by drugs) in the right leg.