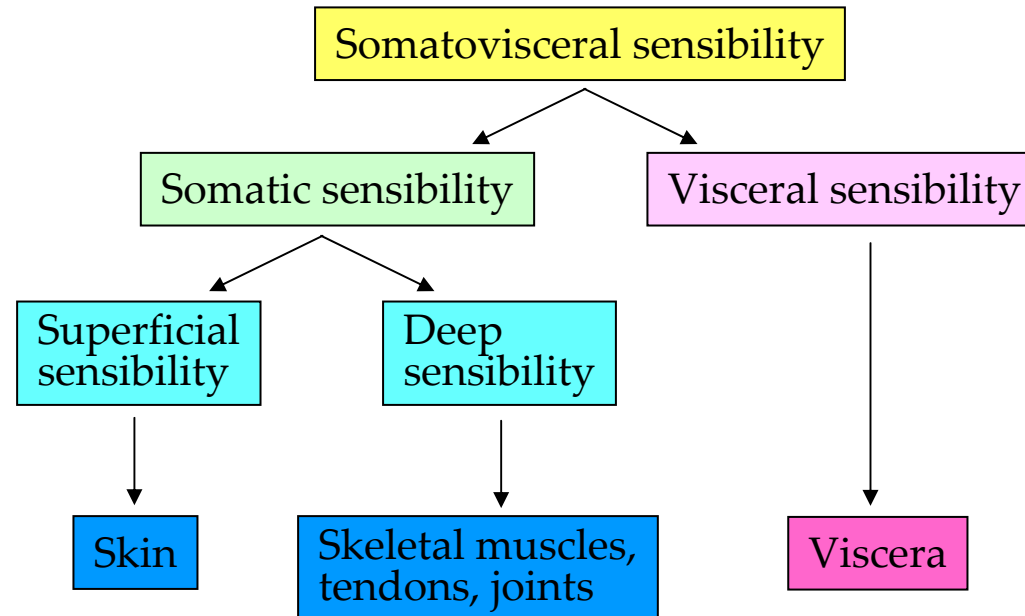


The somatic sensory system

Somatosensory system {
Detection of mechanical stimuli
Detection of painful stimuli and temperature



Sensory modalities

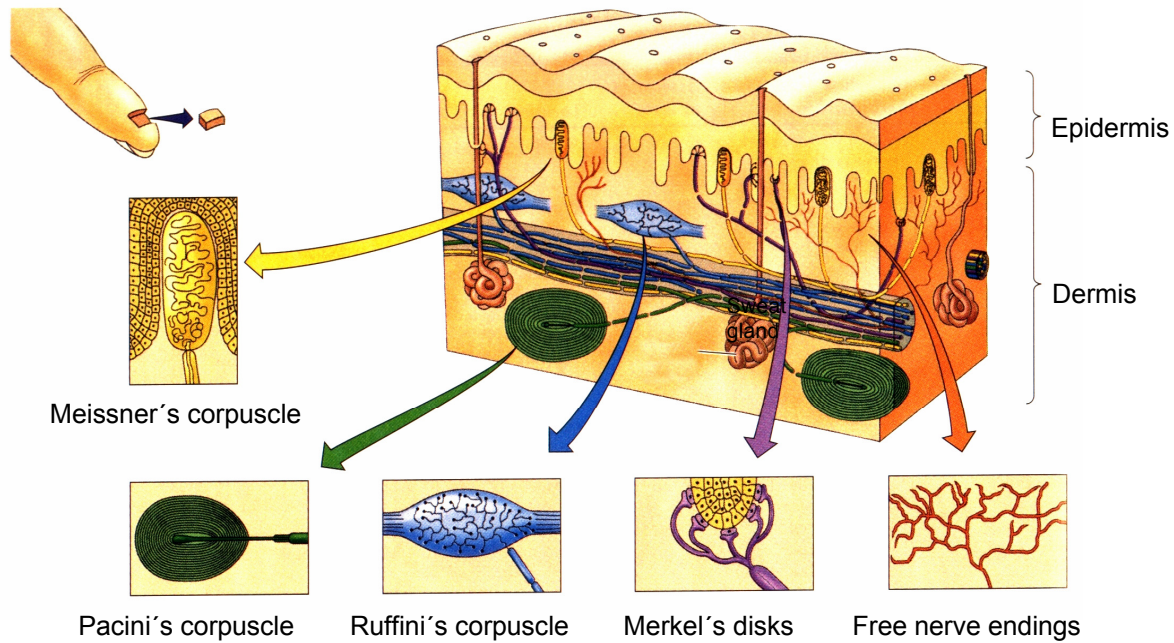
Touch

Proprioception

Nociception (pain)

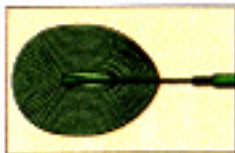
Thermoception

Sensory receptors in the skin

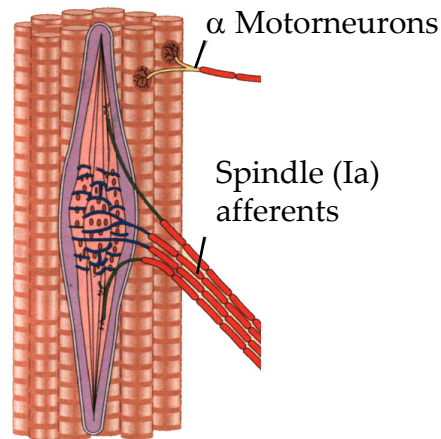


Proprioceptive receptors

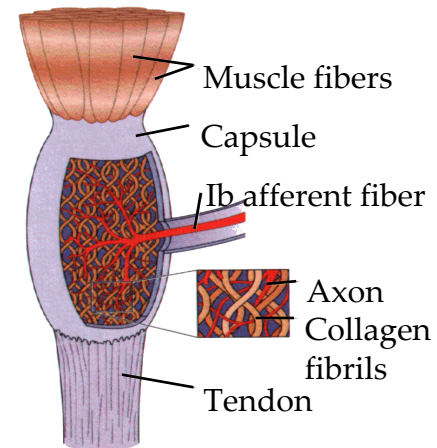
Pacini's corpuscle in ligaments



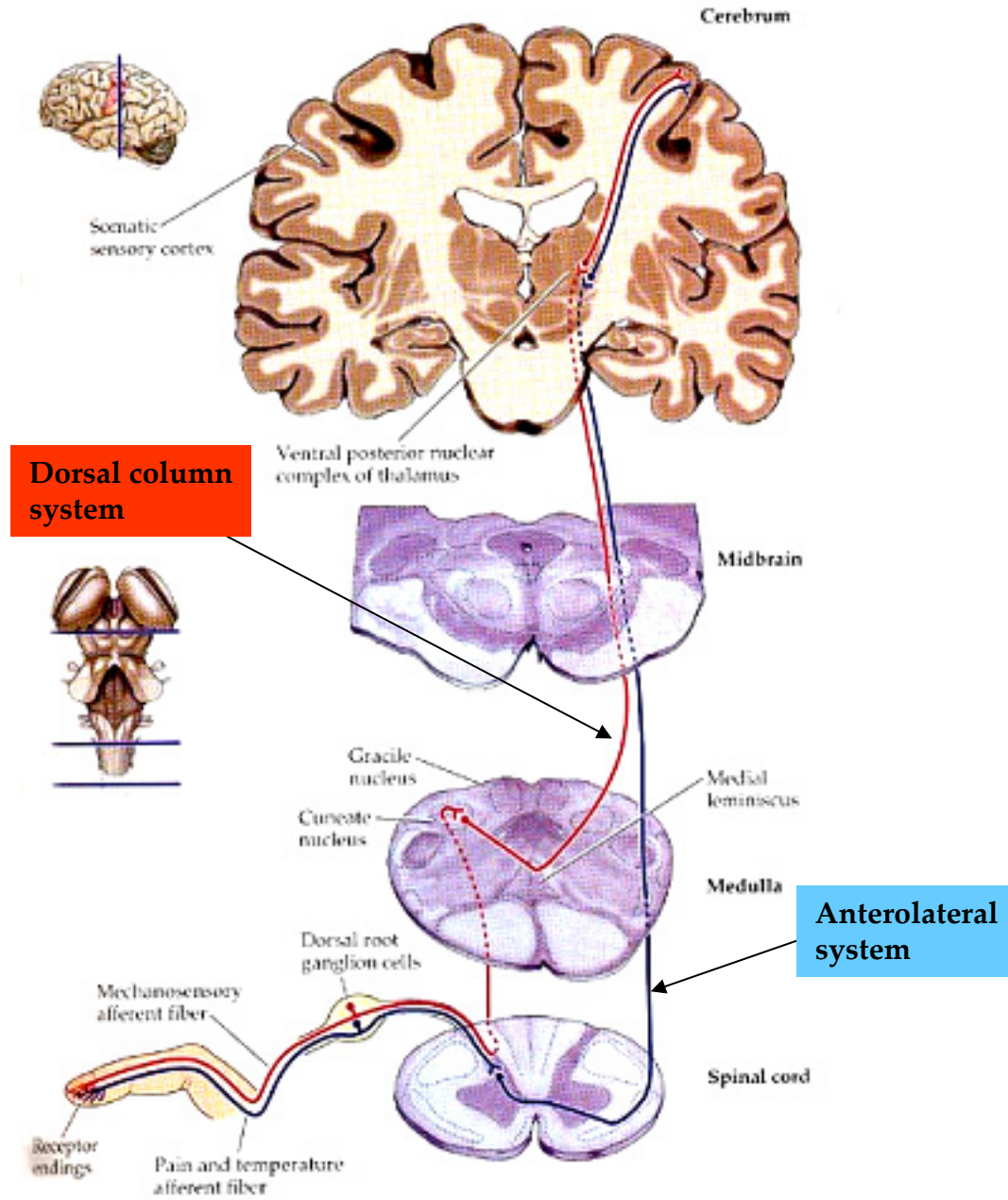
Muscle spindle



Golgi tendon organ

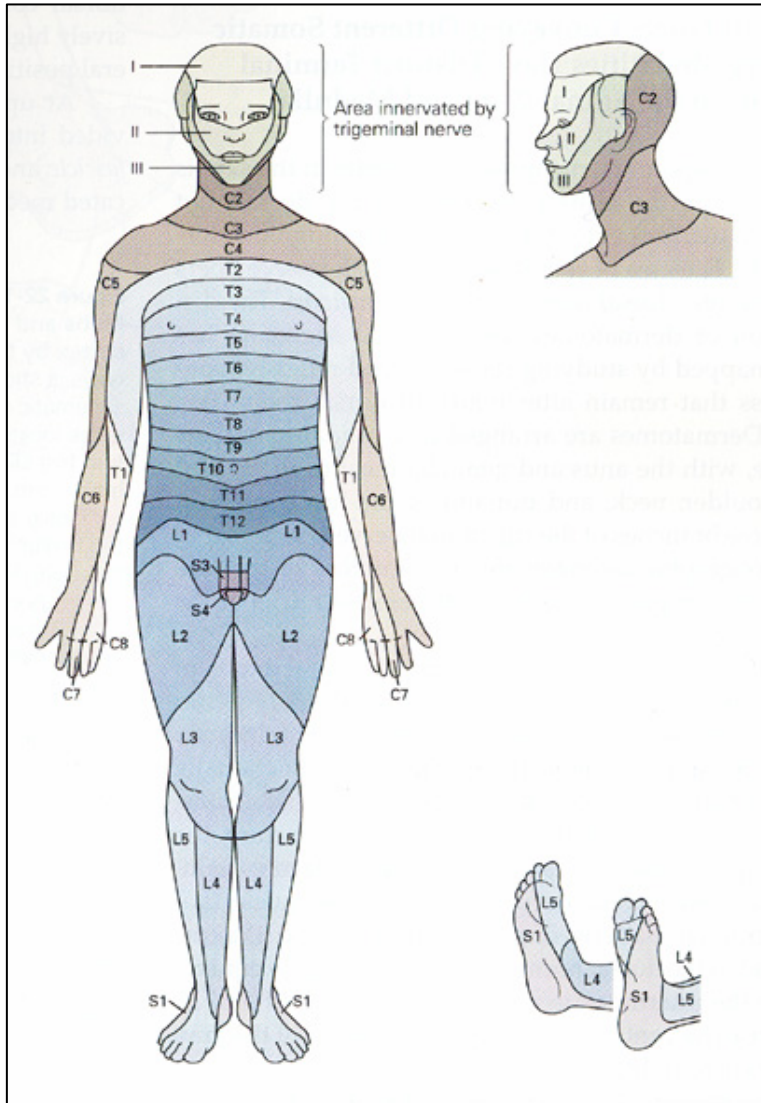


Organization of the somatosensory system

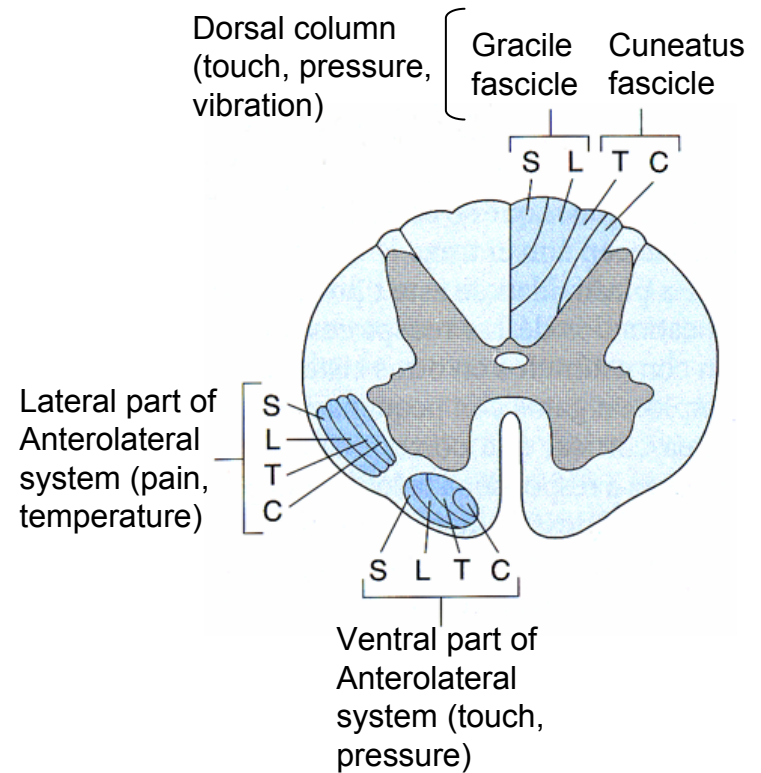


Topographic arrangement of somatosensory receptors in the skin

Dermatomal map

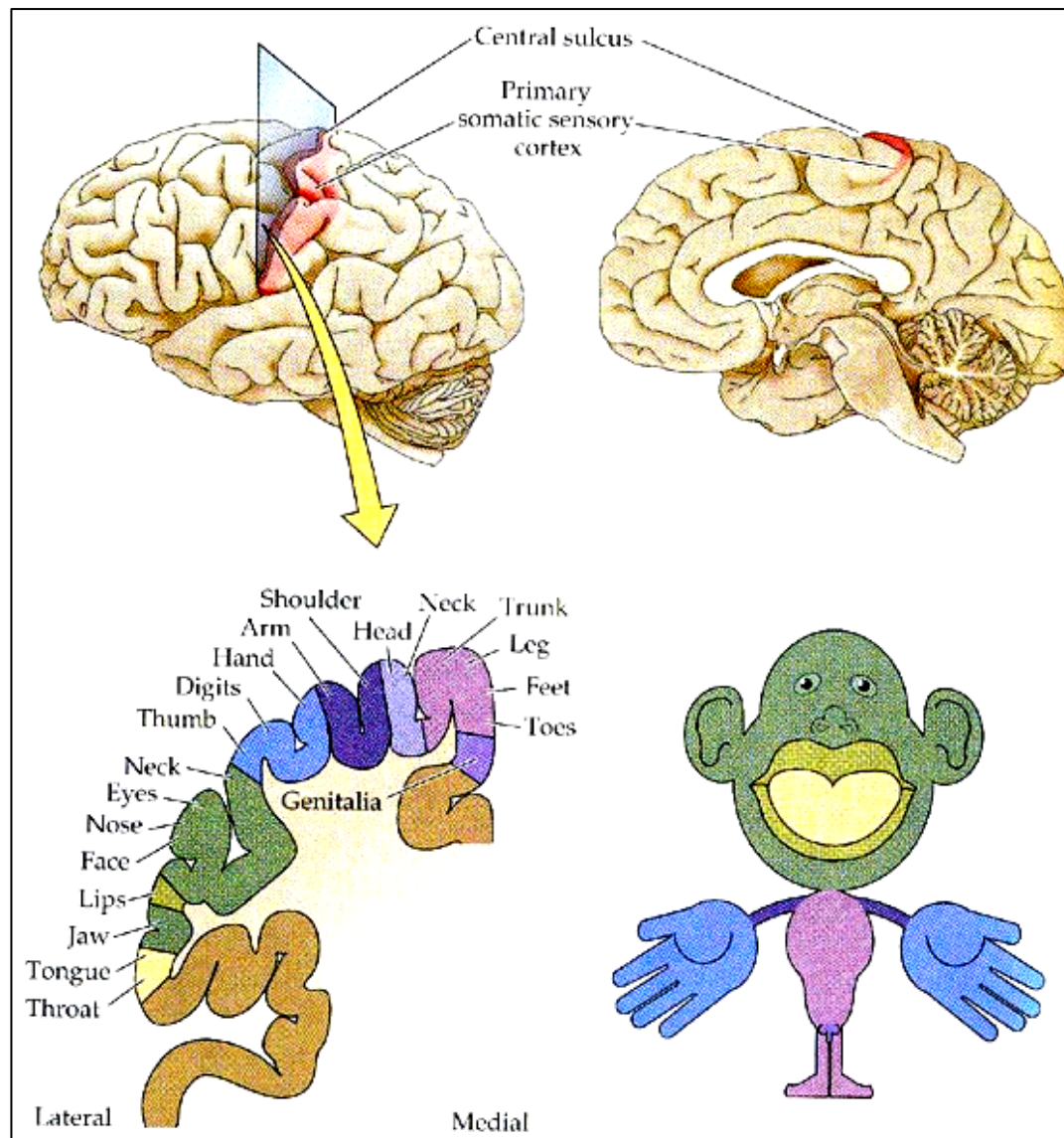


Laminar arrangement of somatosensory receptors and their relay fibers in the spinal cord



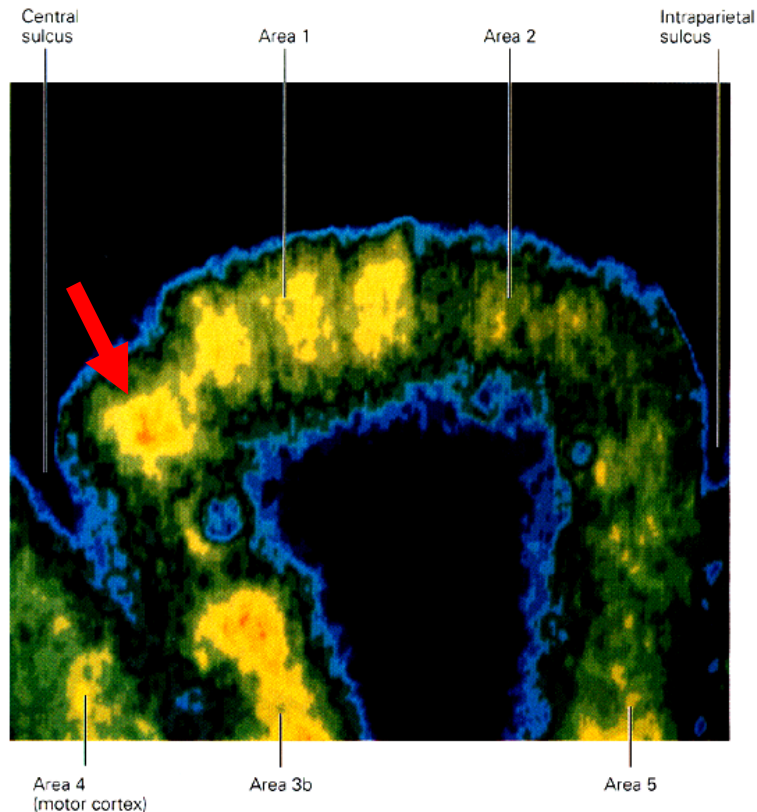
Somatic sensory cortex

Somatotopic organization



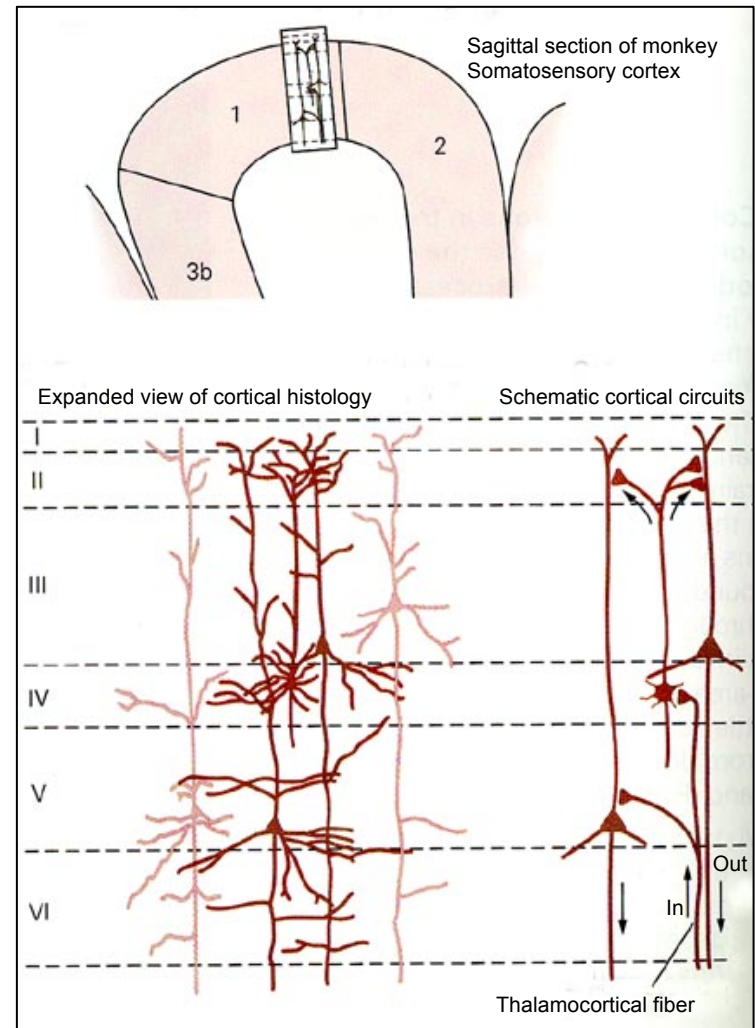
Columnar organization of the somatosensory cortex

Columns of neurons are the functional modules of cortical processing of somatosensory information



Neuronal activity in a section of the somatosensory cortex after mechanical stimulation of the hand.

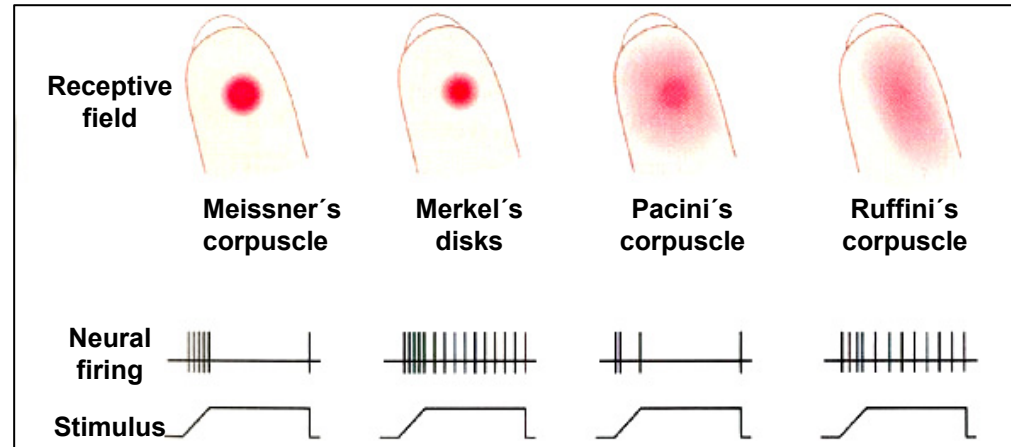
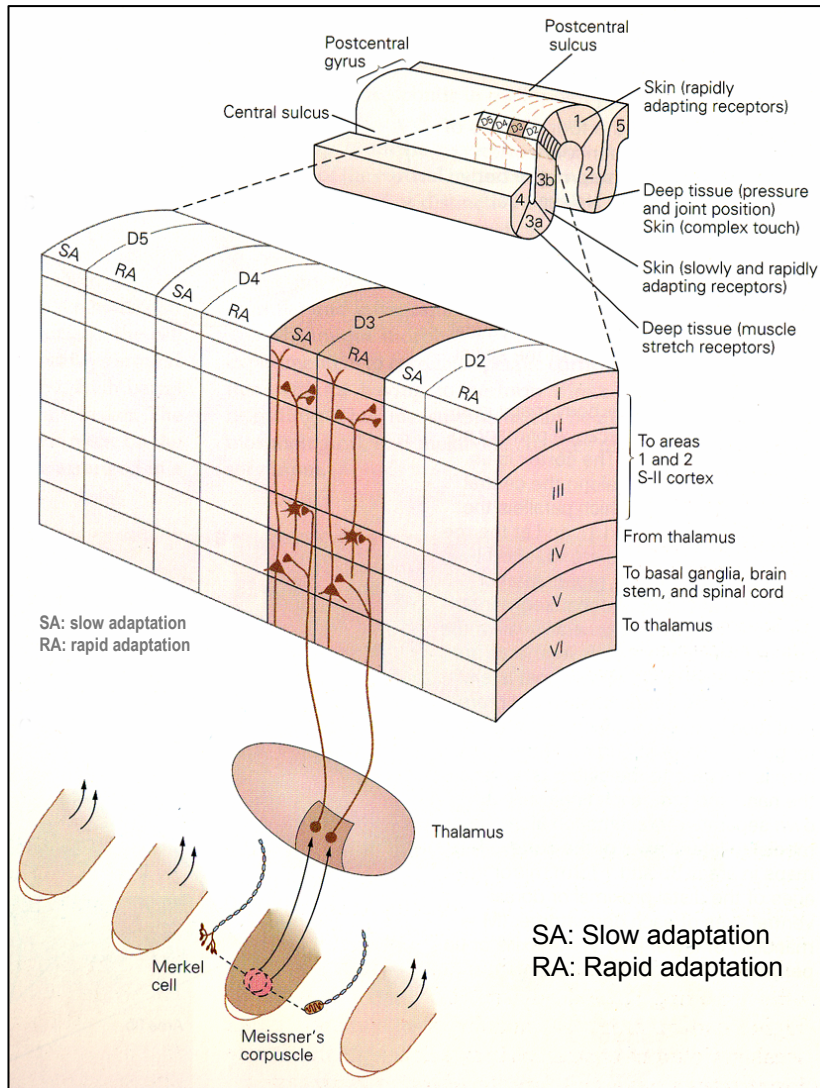
The columnar organization of somatosensory cortex is a consequence of the pattern of connections between neurons in different layers of cortex.



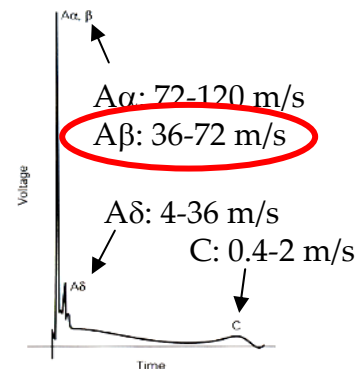
Detection of mechanical stimuli

Functional specializations of mechanosensory receptors

Each type of receptor send information to different columns in the mechanosensory cortex.



Mechanosensory receptor neurons have myelinated A β fibers.



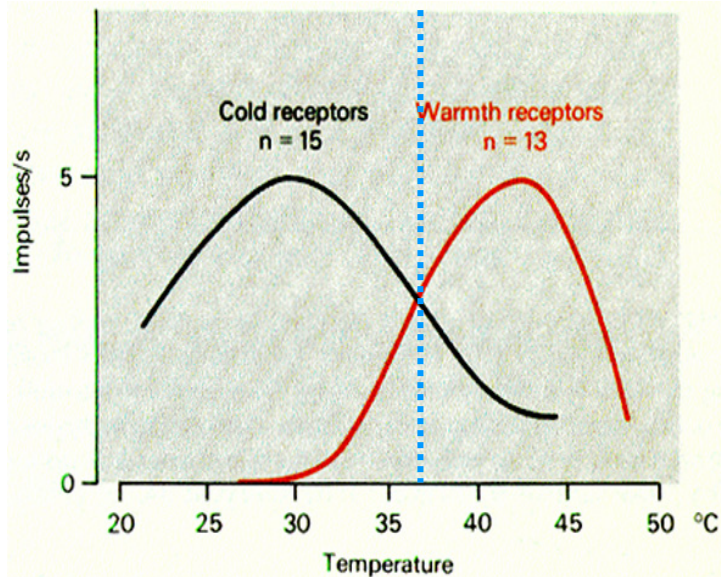
Compound action potential measures conduction velocities of peripheral nerves.

Thermoreceptors

Receptors for temperature are specialized sensory receptors

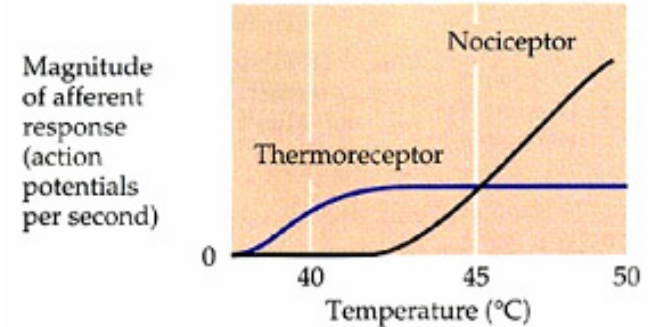
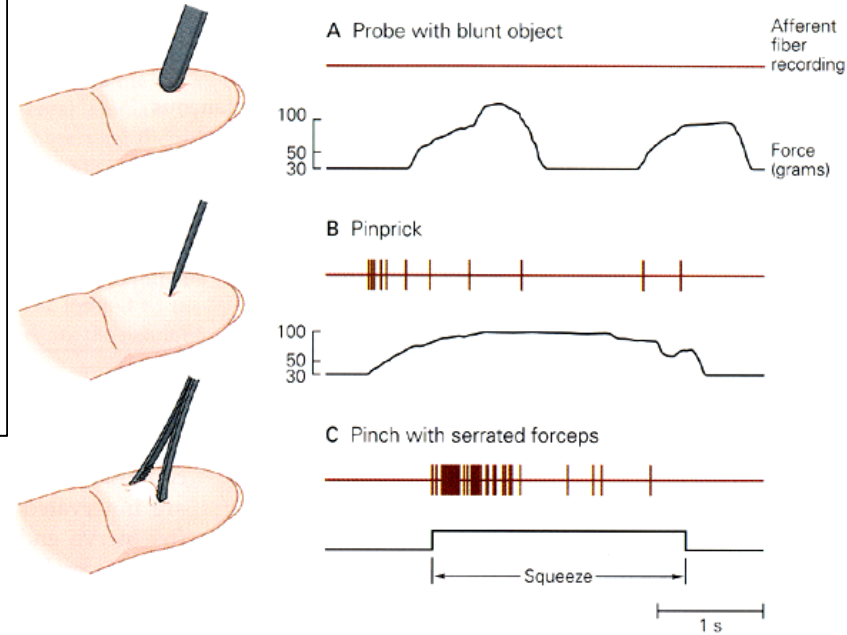
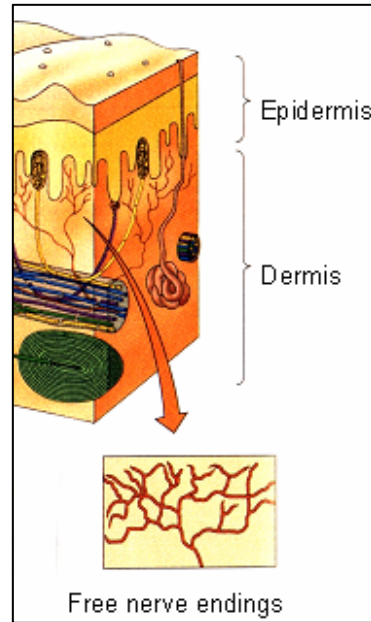
Types of thermal receptors

Based on the axon characteristics:
Cold receptors: Fibers A δ
Warmth receptors: Fibers C



Pain receptors

Receptors for pain (nociceptors) are specialized sensory receptors

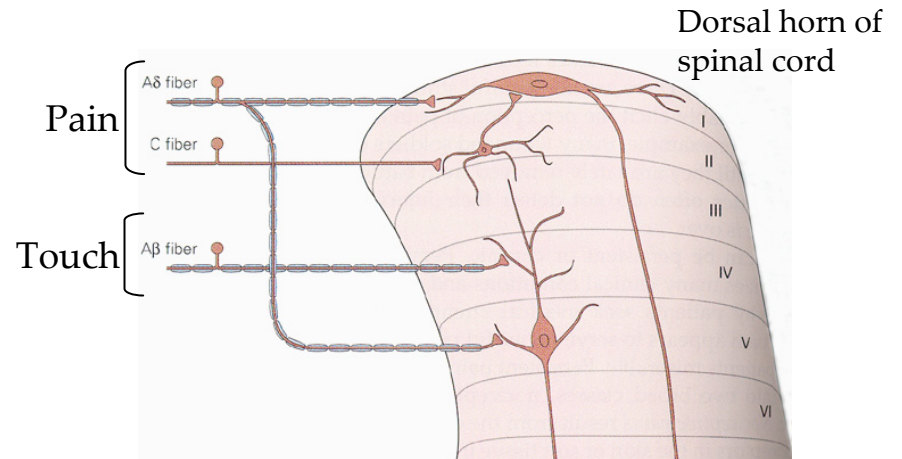


Pain receptors

Types of nociceptors

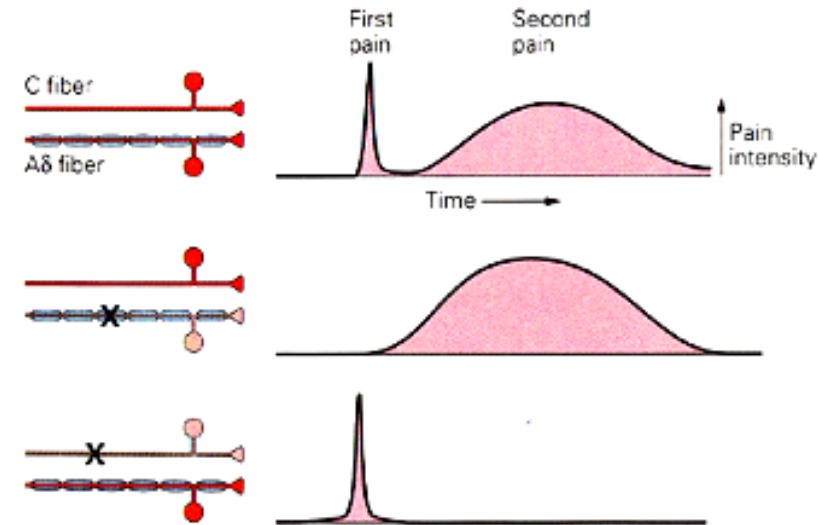
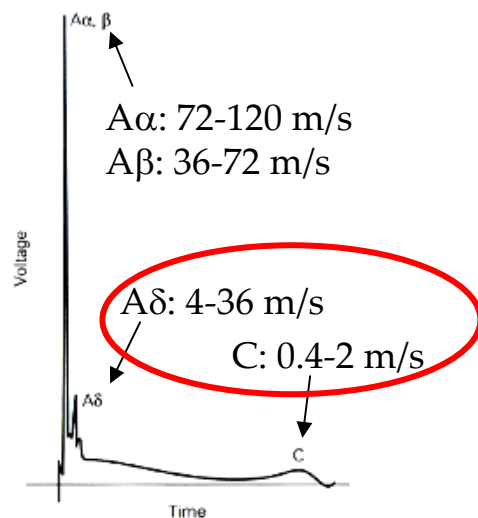
Based on the axon characteristics: Fibers A δ and C

- Fibers A δ* {
1. Mechanical nociceptors
 2. Thermal nociceptors
- Fibers C* {
3. Polymodal nociceptors
 4. Silent visceral nociceptors

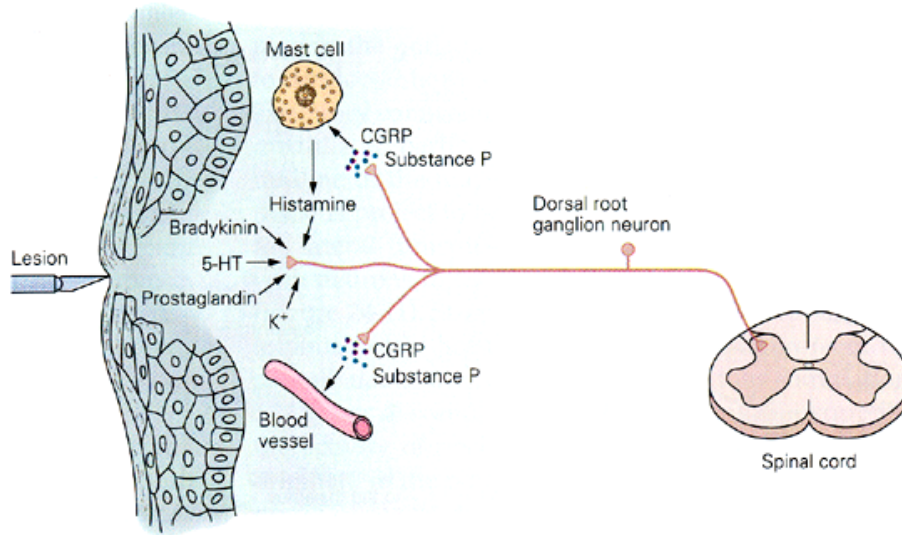


Different types of axon fiber determines types of pain:

1. sharp, first pain
2. slow, burning pain



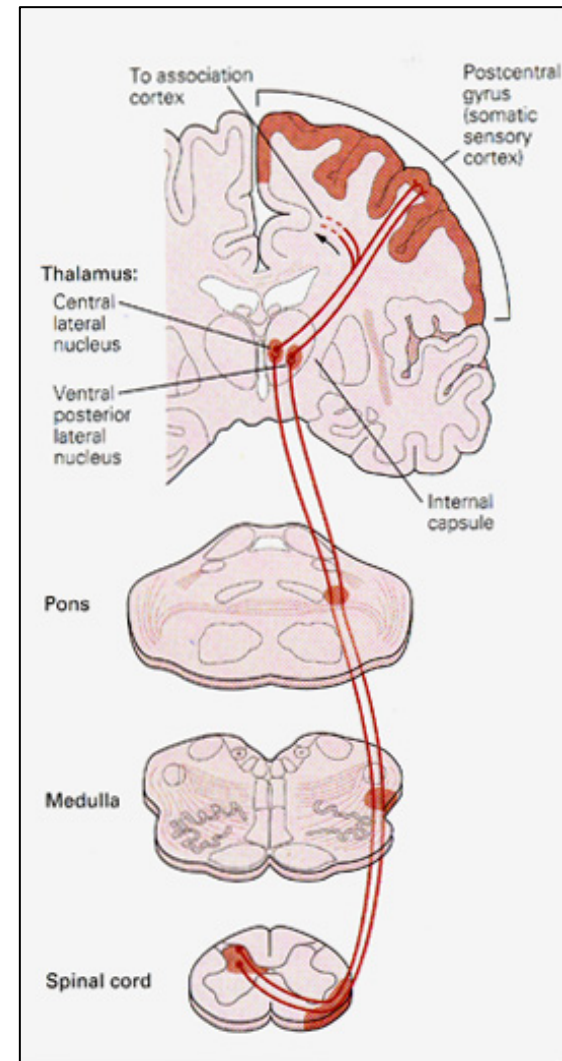
Agents that sensitize and activate nociceptors



Substance	Source	Effect on primary afferent fiber
K^+	Damaged cells	Activation
Serotonin	Platelets	Activation
Bradykinin	Plasma kininogen	Activation
Histamine	Mast cells	Activation
Prostaglandins and leukotrienes	Arachidonic acid-damaged cells	Sensitization
Substance P	Primary afferents	Sensitization

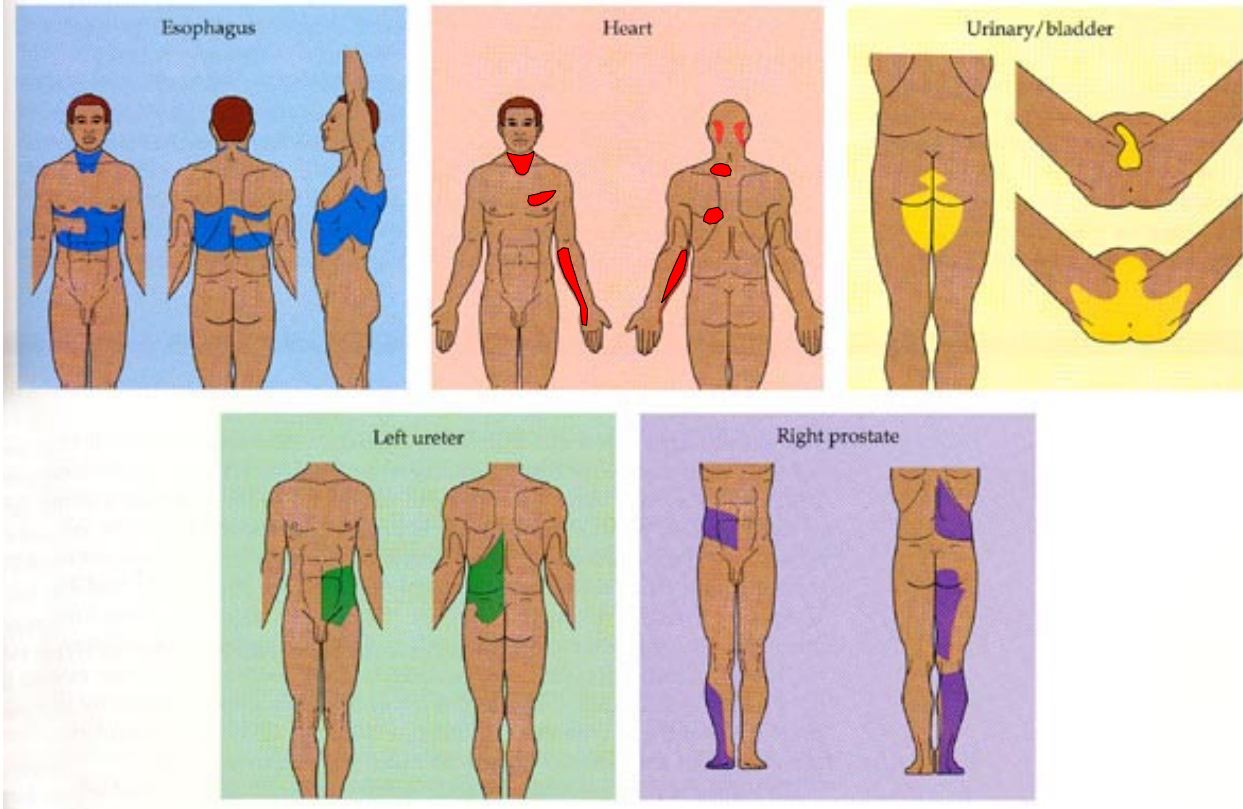
Ascending pathways that transmit nociceptive information to the cerebral cortex

Spinothalamic tract

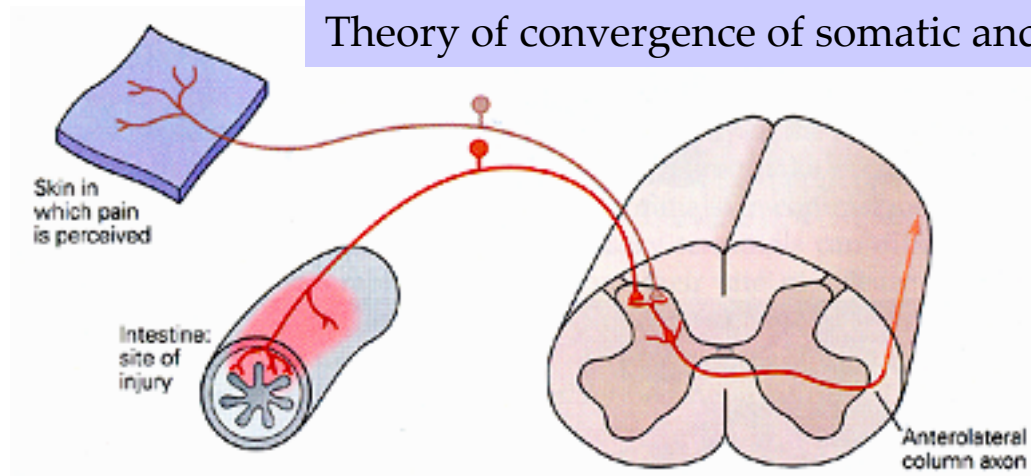


Referred visceral pain

Examples of pain arising from a visceral disorder referred to a cutaneous region (color).

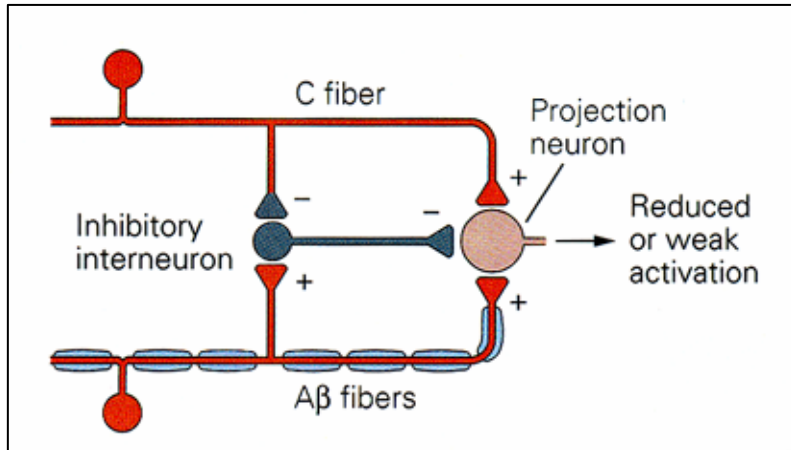
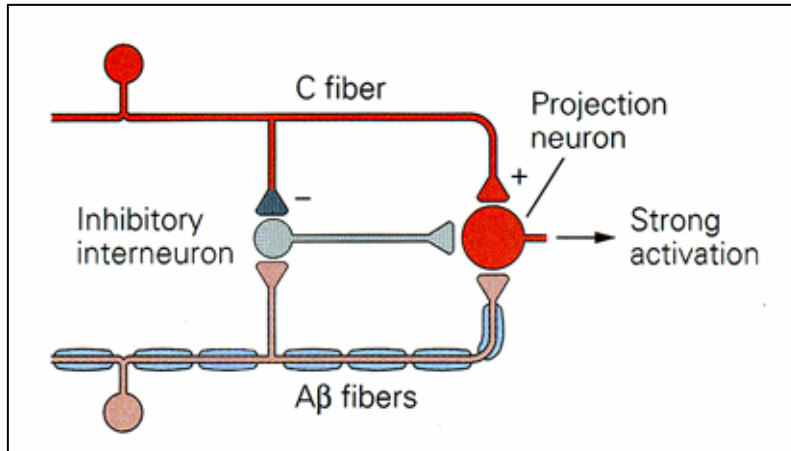


Theory of convergence of somatic and visceral nociceptors

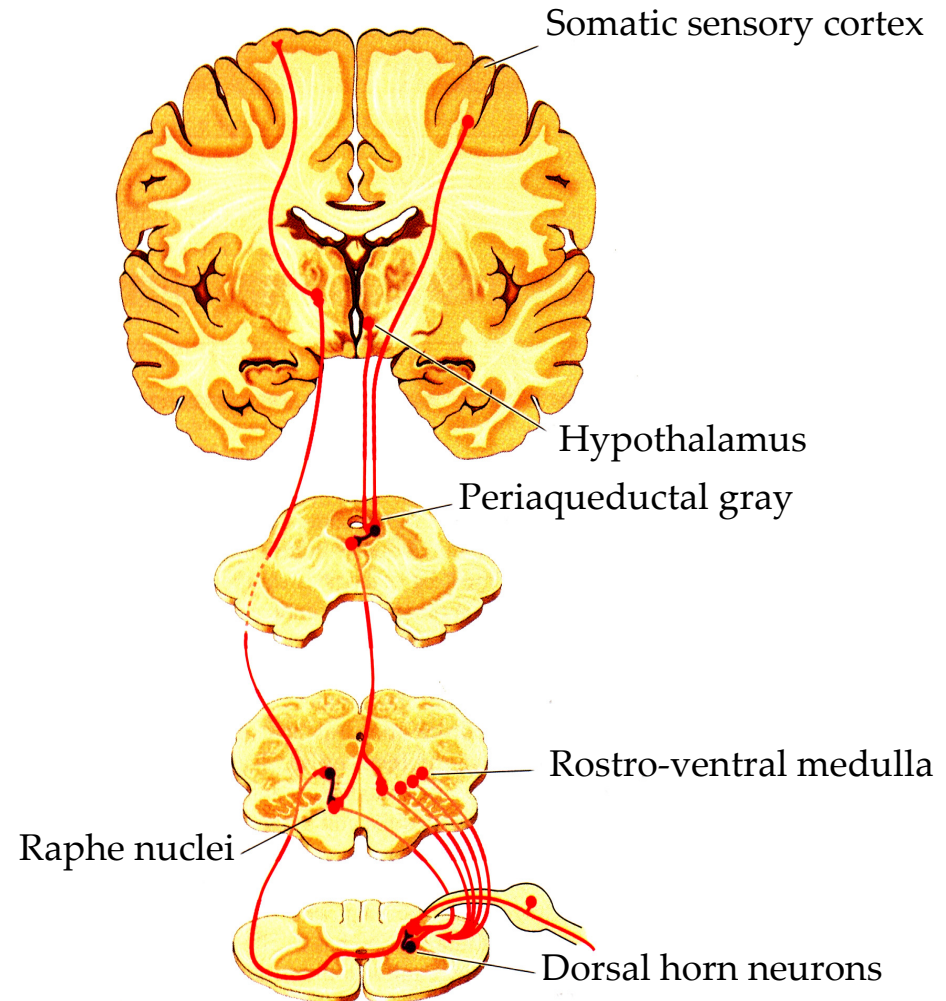


Modulation of pain sensation

The gate control theory



Endogenous pain control system



Endogenous opioid peptides

Leucine-enkephalin
Methionine-enkephalin
 β -endorphin
Dynorphin
 α -neoendorphin

Opioid receptors

μ , δ , and κ receptors

Integration at the dorsal horn of descending and afferent nociceptive fibers

