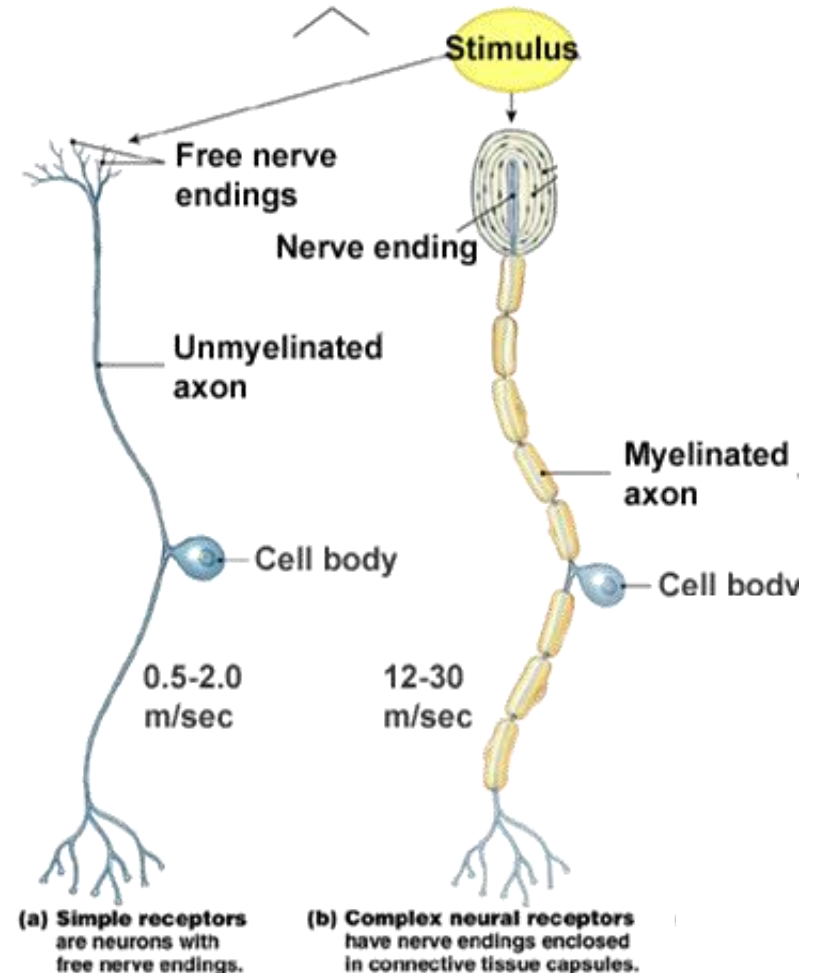


7

**Somatosensitivity,
viscerosensitivity, proprioception
and pain III**

Evolutionary point of view

- The signals indicating potential damage are the most important and the corresponding systems evolved early
 - Pain
 - Temperature
- The touch signals have adaptive value and evolved later



Evolutionary point of view

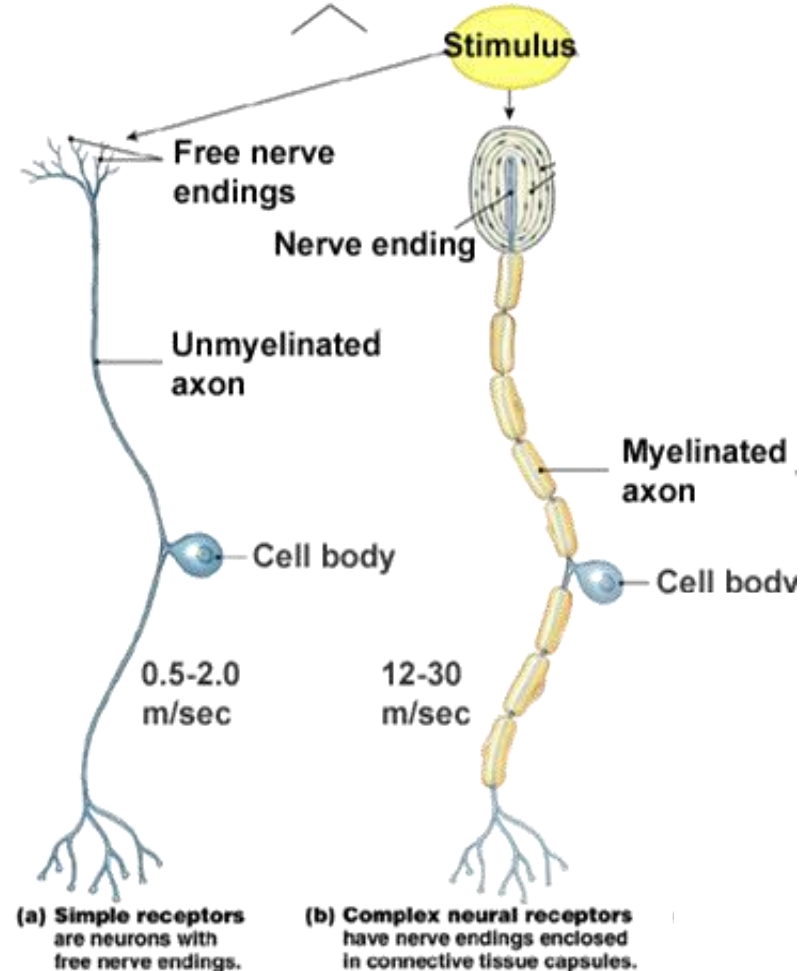
- The signals indicating potential damage are the most important and the correct response evolved

Immediate survival

- Temperature

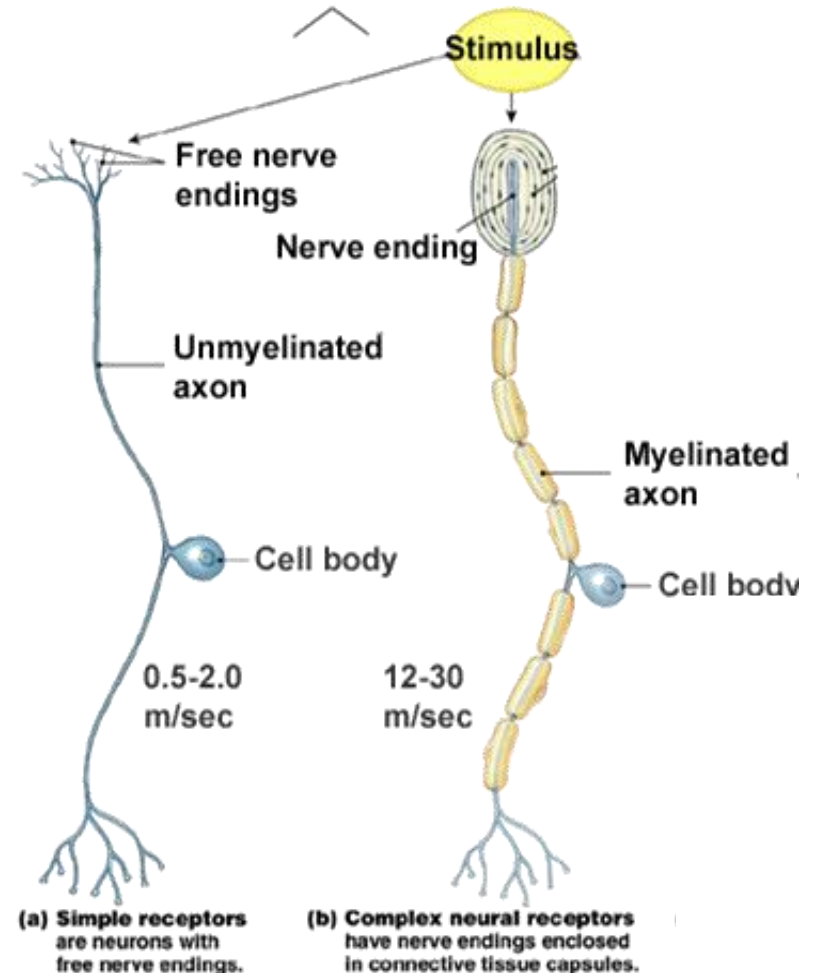
- The evolution of more complex neural receptors have adaptive value

Long-term survival



Evolutionary point of view

- The signals indicating potential damage are the most important and the corresponding systems evolved early
 - Pain
 - Temperature
- The touch signals have adaptive value and evolved later
- The structure of the receptor, nerve fibers and pathways reflects the evolution



Somatosensory pathways

- Three systems
- (Archispinothalamic)
 - Interconnection of adjacent segments (tr. Spinothalamicus)
- Paleospinothalamic
 - tr. Spinoreticularis, tr. Spinotectalis...
- Neospinothalamic
 - tr. Spinothalamicus
- Dorsal column system
 - tr. Spinobulbaris

Somatosensory pathways

- Three systems
- (Archispinothalamic)
 - Interconnection of
- Paleospinothalamic
 - tr. Spinoreticulus
- Neospinothalamic
 - tr. Spinothalamic
- Dorsal column system
 - tr. Spinobulbaris

EVOLUTION....
Evolutionary old structures have not been replaced by new ones during evolution, but the old has been kept and the new added

Somatosensory pathways

- Paleospinothalamic
 - Low resolution – dull, diffuse pain („slow pain“)
- Neospinothalamic
 - High resolution – sharp, localized pain („fast pain“), temperature
 - Low resolution – touch
- Dorsal column system
 - High resolution – touch, proprioception

Somatosensory pathways

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Immediate survival

Long-term survival

Somatosensory pathways

*Table I
The Sensory Modalities Represented by the Somatosensory Systems*

Modality	Sub Modality	Sub-Sub Modality	Somatosensory Pathway (Body)	Somatosensory Pathway (Face)
Pain	sharp cutting pain		Neospinothalamic	Spinal Trigeminal
	dull burning pain		Paleospinothalamic	
	deep aching pain		Archispinothalamic	
Temperature	warm/hot		Paleospinothalamic	
	cool/cold		Neospinothalamic	
Touch	itch/tickle & crude touch		Paleospinothalamic	
	discriminative touch	touch	Medial Lemniscal	Main Sensory Trigeminal
		pressure		
		flutter		
		vibration		
Proprioception	Position: Static Forces	muscle length		
		muscle tension		
		joint pressure		
	Movement: Dynamic Forces	muscle length		
		muscle tension		
		joint pressure		
	joint angle			

Paleospinothalamic system

- Tr. Spinoreticularis, spinotectalis...

Paleospinothalamic system

- Tr. Spinoreticularis, spinotectalis...
- Evolved before neocortex

Paleospinothalamic system

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- The primary connection to the subcortical structures
- Basic defensive reactions and reflexes - vegetative response, reflex locomotion - opto-acoustic reflexes etc.

Paleospinothalamic system

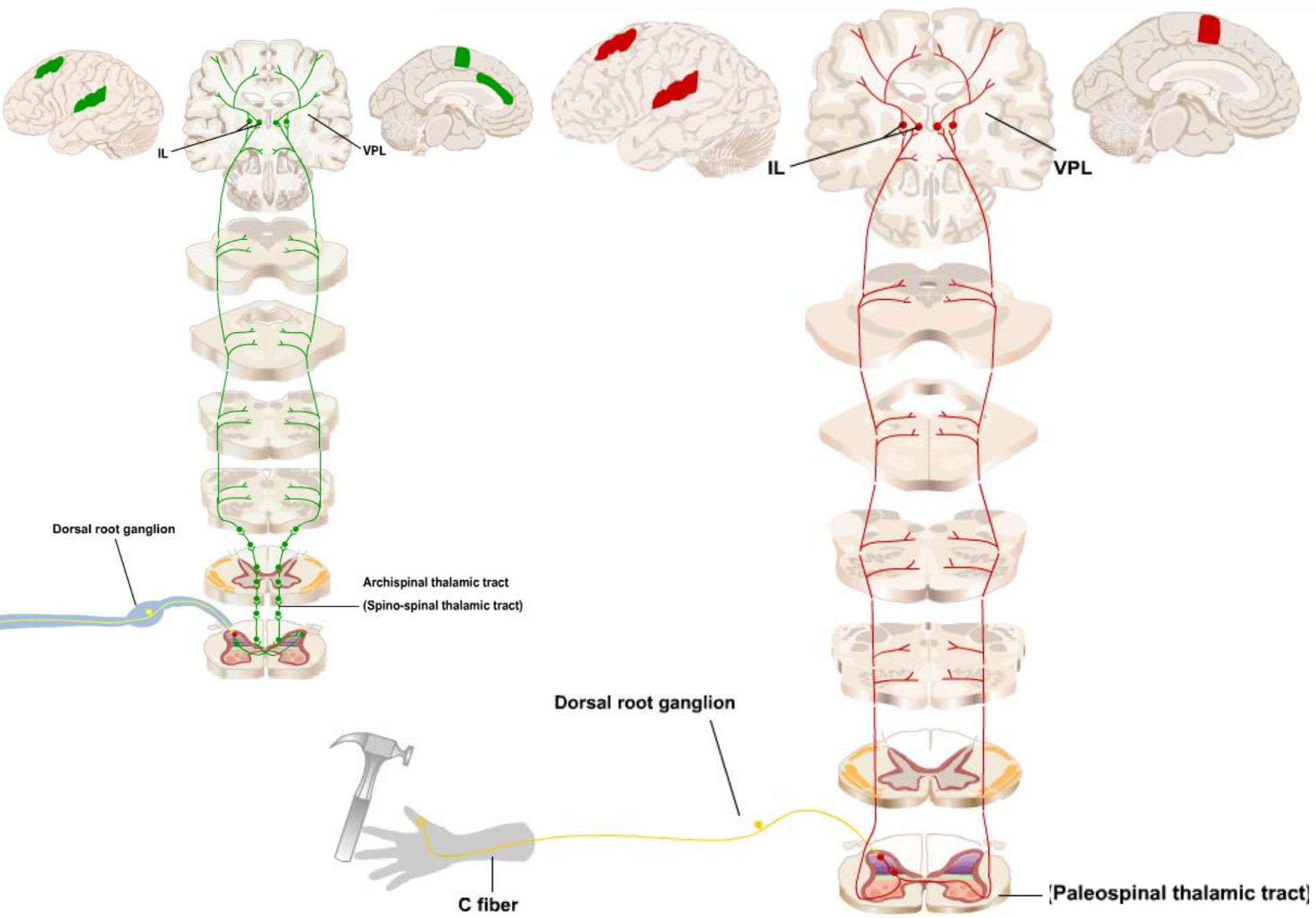
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- This tract is not designed for „such a powerful processor as neocortex“
- Approximately half of the fibers cross the midline



Neospinothalamic system

- Tr. Spinothalamicus

Neospinothalamic system

- Tr. Spinothalamicus
- Younger structure primarily connected to neocortex
- „High capacity/resolution“

Neospinothalamic system

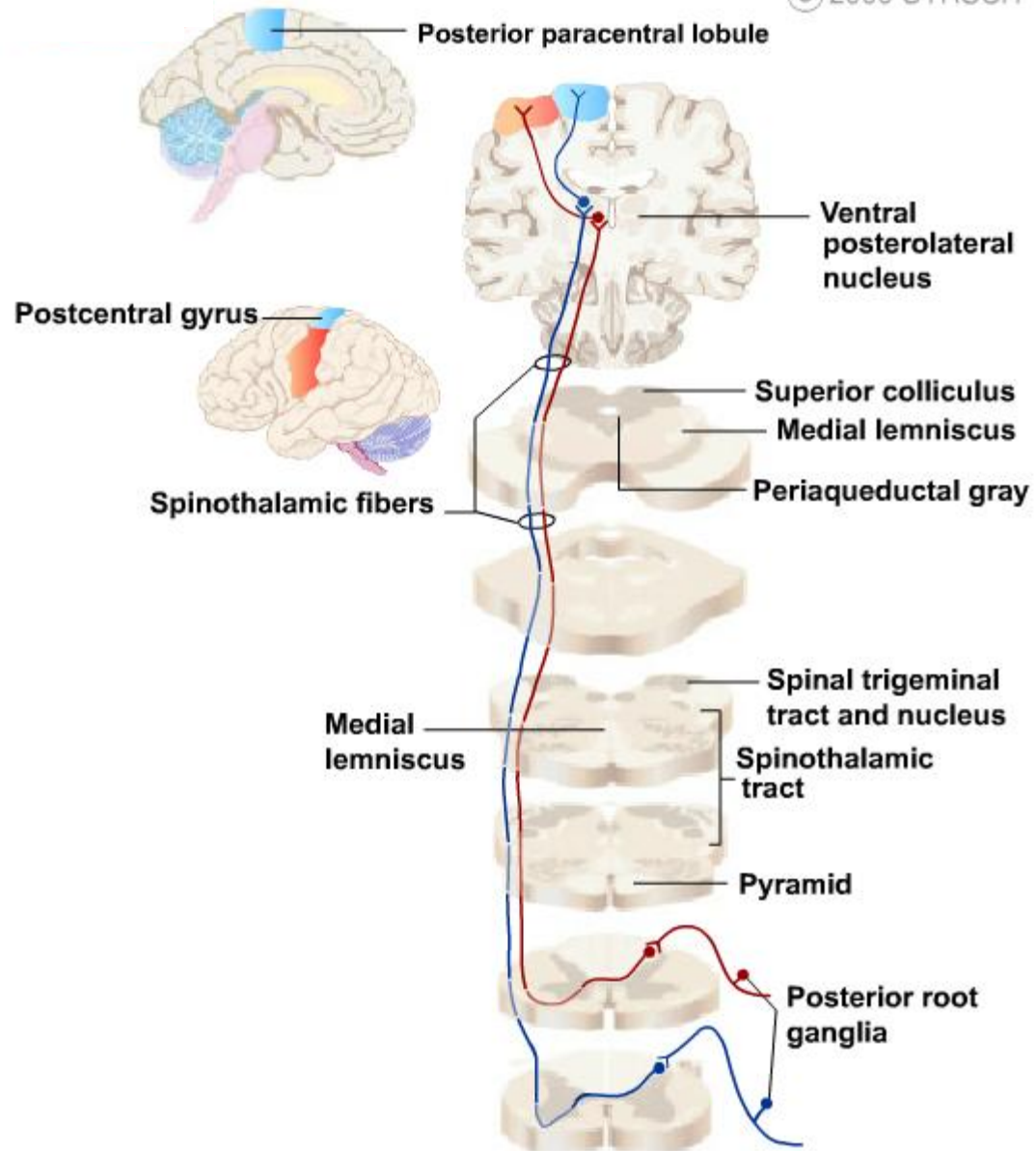
- Tr. Spinothalamicus
- Younger structure primarily connected to neocortex
- „High capacity/resolution“
- Detail information about pain stimuli (sharp, localized pain)
- Information about temperature

Neospinothalamic system

- Tr. Spinothalamicus
- Younger structure primarily connected to neocortex
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- Detail information about pain stimuli (sharp, localized pain)
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- Crude touch sensation

Neospinothalamic system

- Tr. Spinothalamicus
- Younger structure primarily connected to neocortex
- „High capacity/resolution“
- Detail information about pain stimuli (sharp, localized pain)
- Information about temperature
- Crude touch sensation
- The fibers cross midline at the level of entry segment



Dorsal column system

- Tr. Spinobulbaris

Dorsal column system

- Tr. Spinobulbaris
- The youngest system
- High capacity

Dorsal column system

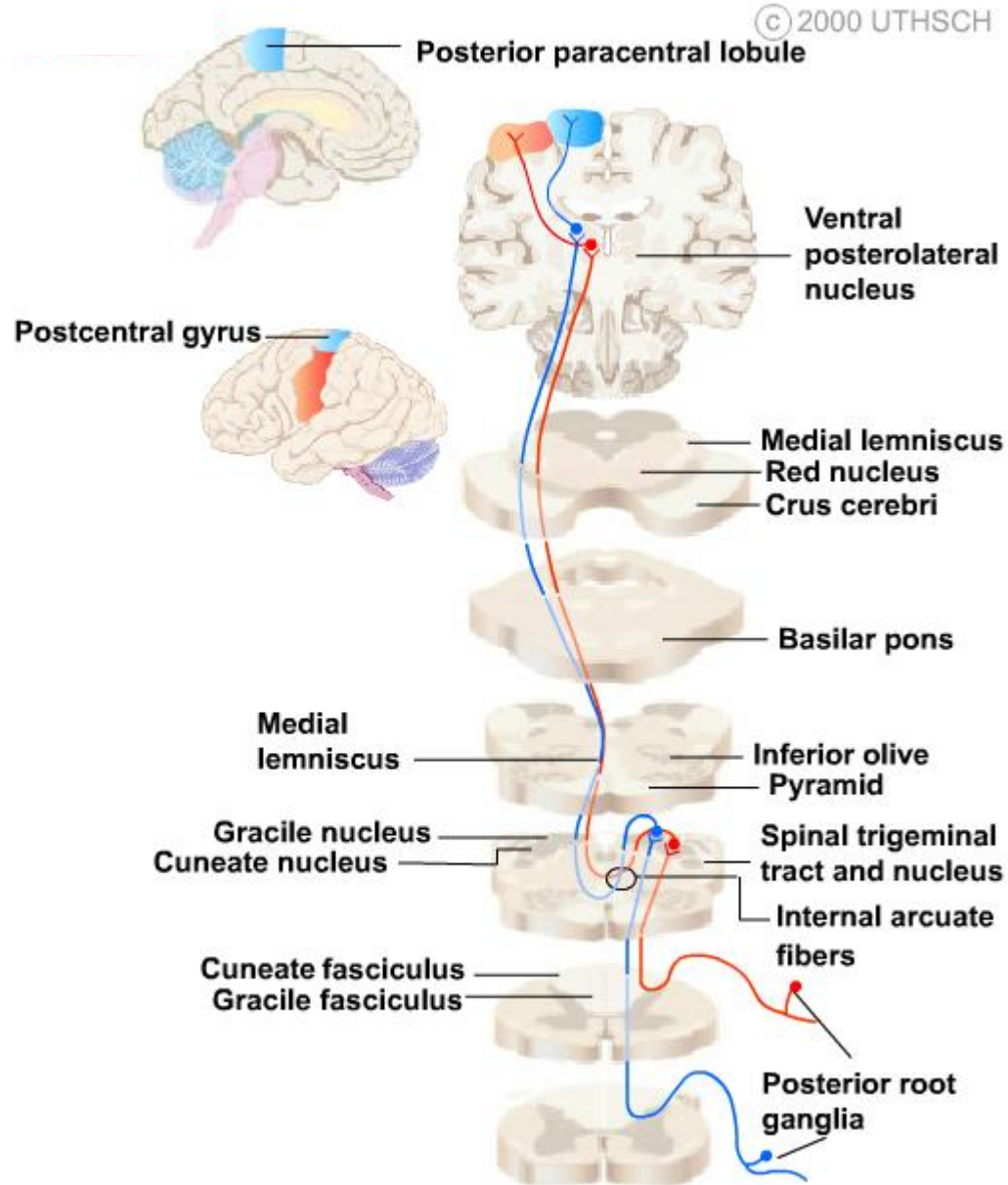
- Tr. Spinobulbaris
- The youngest system
- High capacity
- Tactile sensation
- Vibration
- Proprioception

Dorsal column system

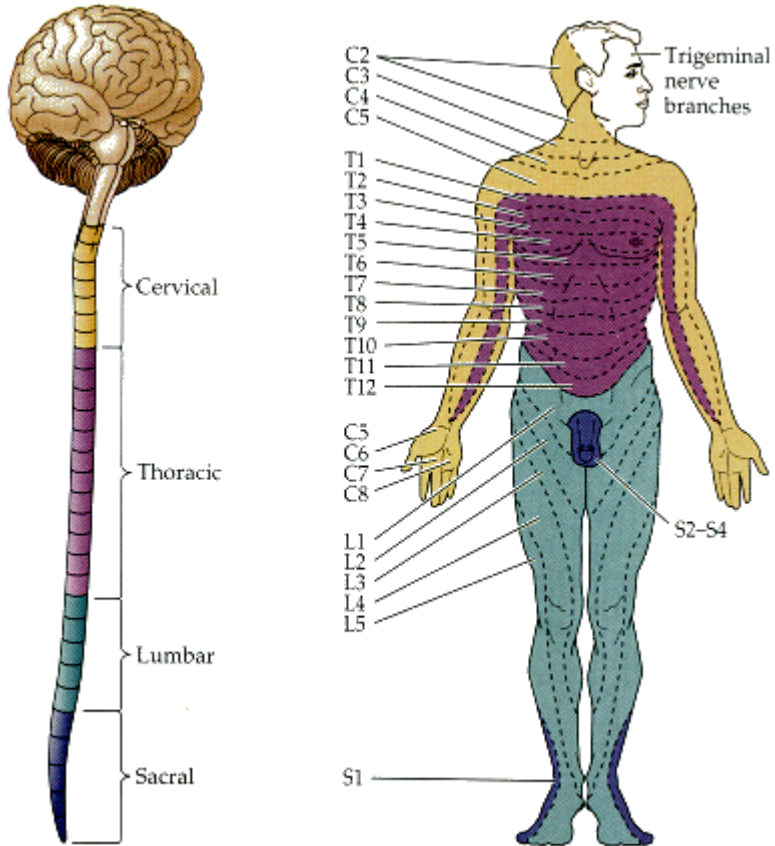
- Tr. Spinobulbaris
- The youngest system
- High capacity
- Tactile sensation
- Vibration
- Proprioception
- Fine motor control
- Better object recognition
- Adaptive value

Dorsal column system

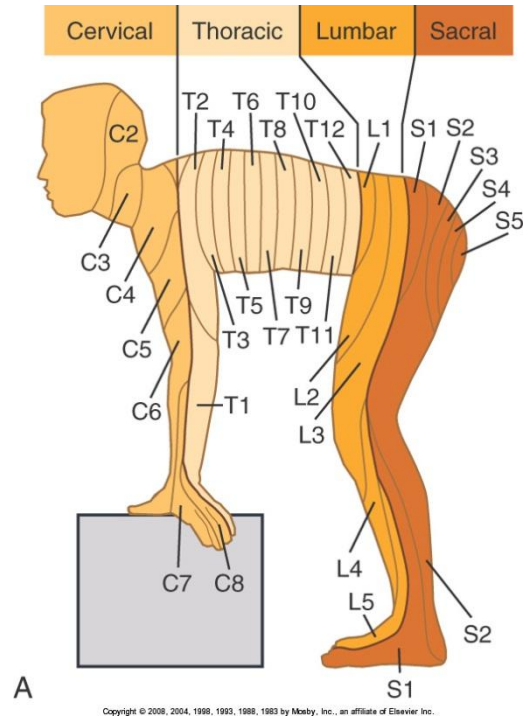
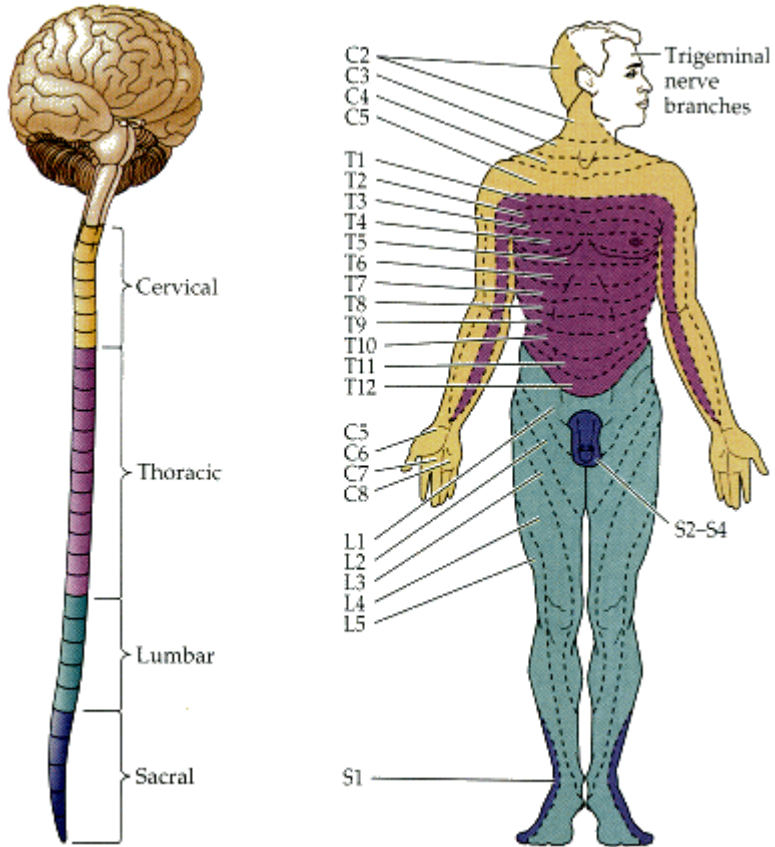
- Tr. Spinobulbaris
- The youngest system
- High capacity
- Tactile sensation
- Vibration
- Proprioception
- Fine motor control
- Better object recognition
- Adaptive value
- The fibers cross midline at the level of medulla oblongata



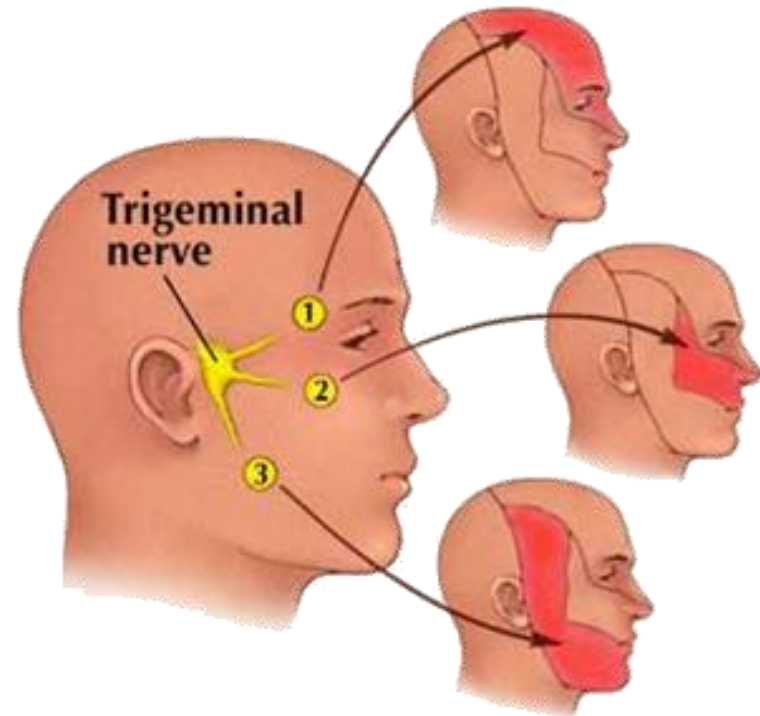
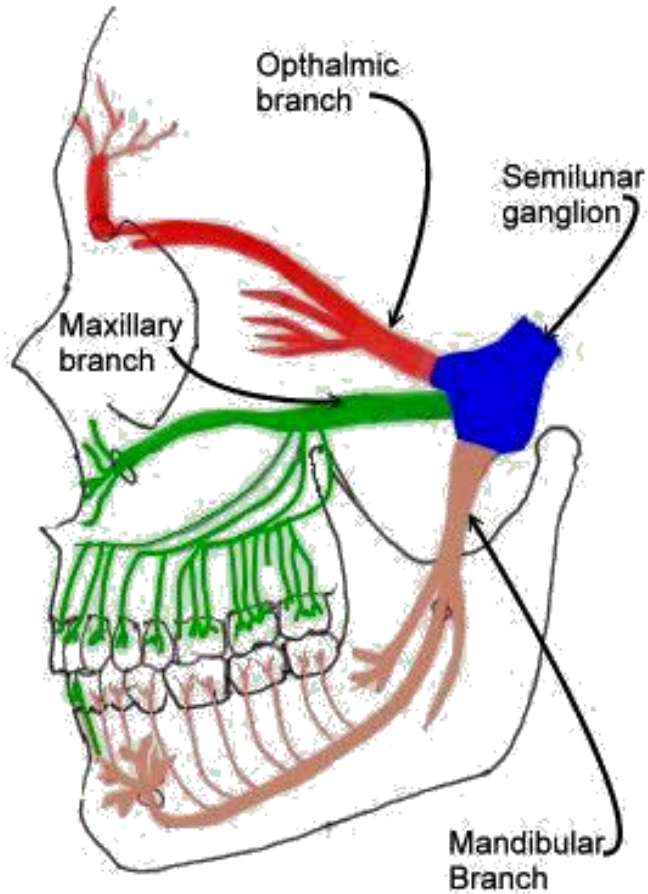
Dermatomes

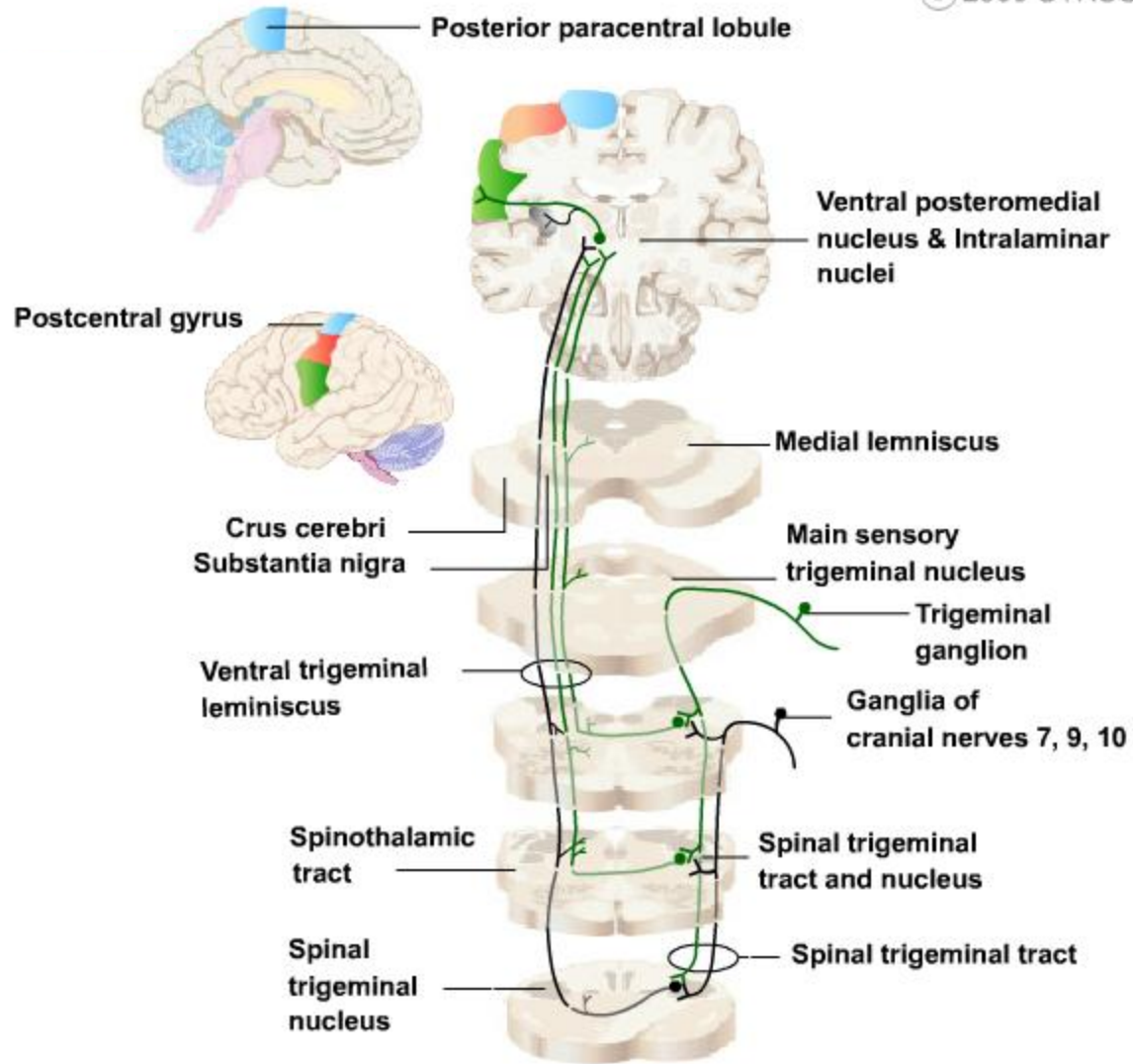


Dermatomes



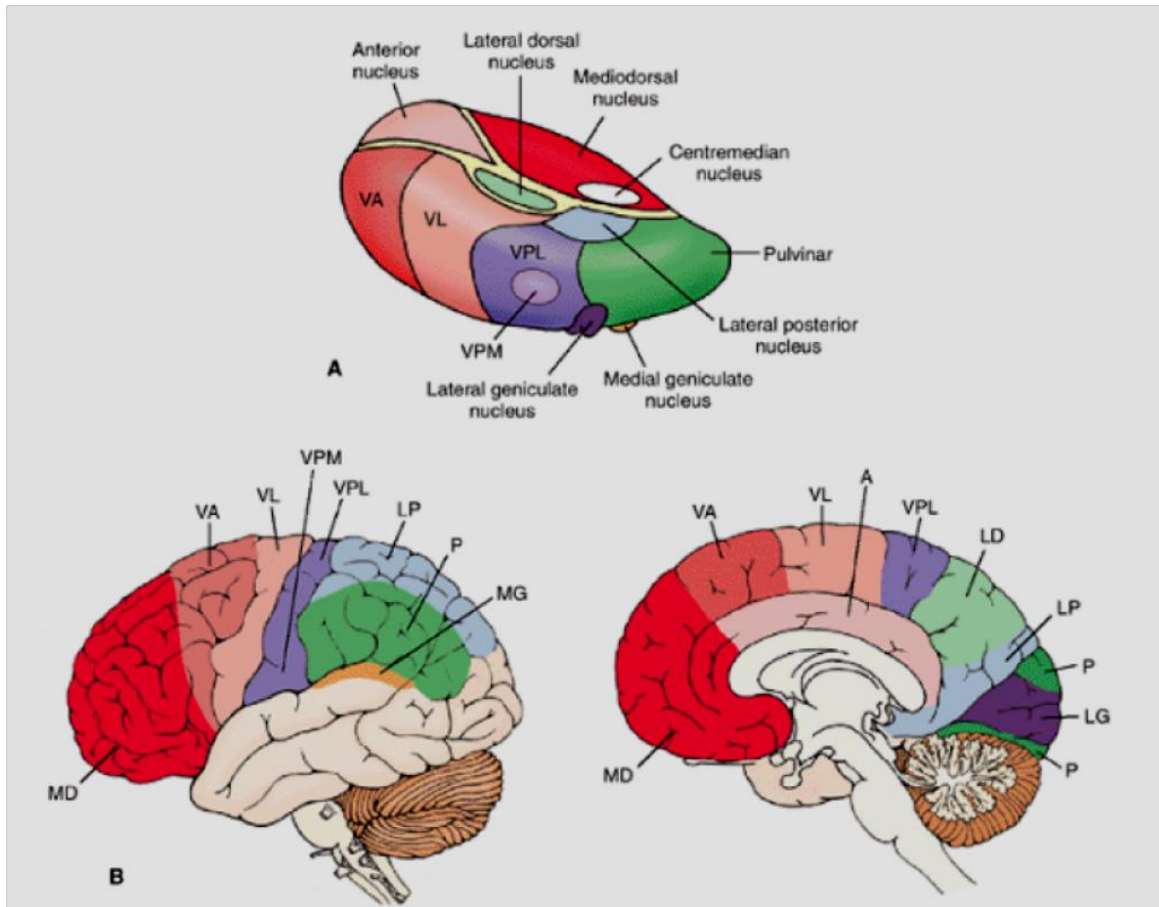
Trigeminal system



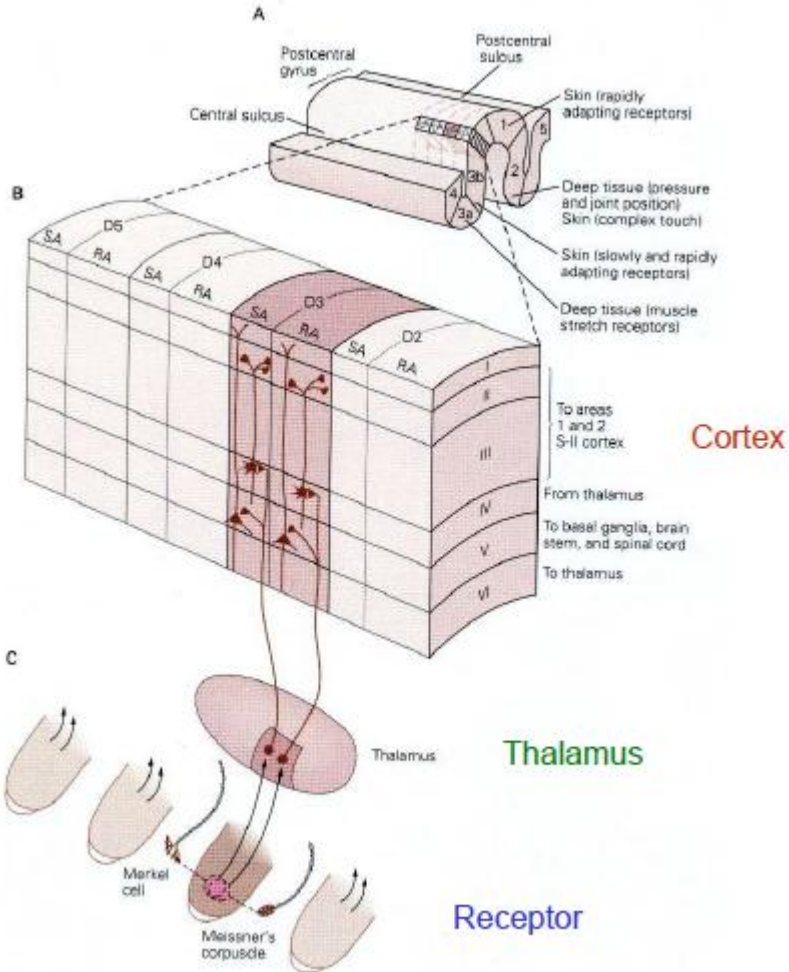
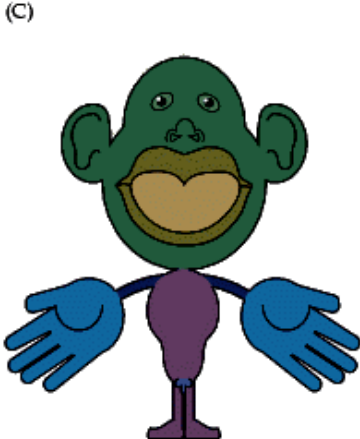
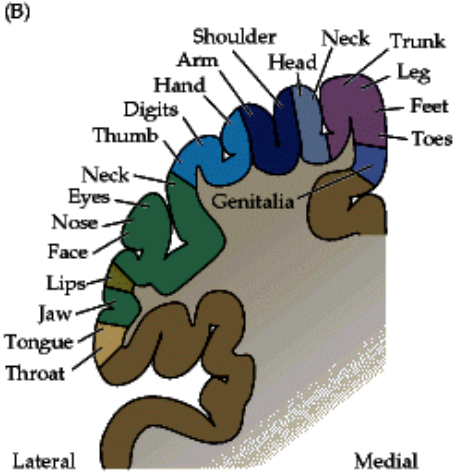
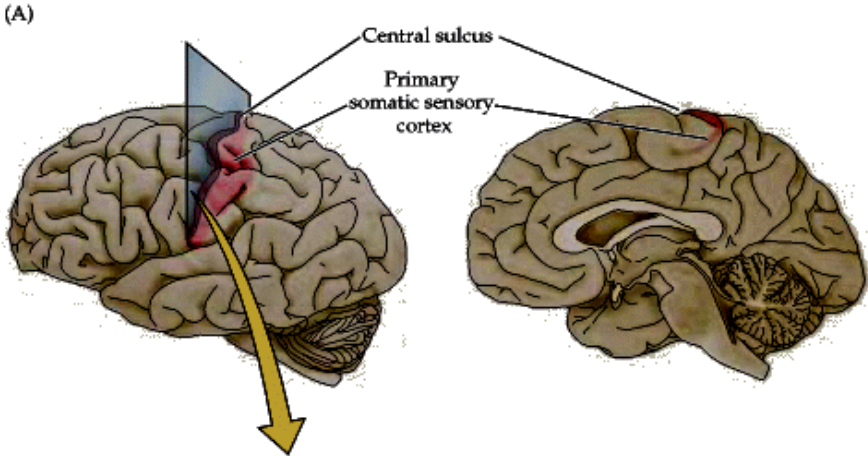


Thalamus a neocortex

- Almost all the afferent information gated in the thalamus
- Olfaction is an exception
- Bilateral connections between neocortex and thalamus



Neocortex



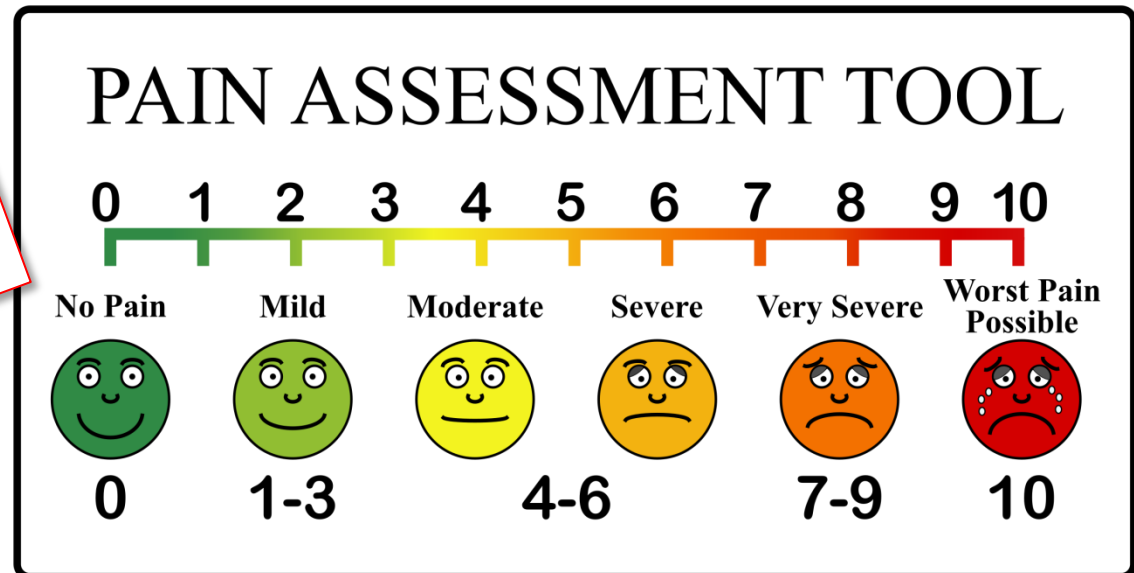
<http://www.slideshare.net/drpsdeb/presentations>

http://www.shadmehrlab.org/Courses/physfound_files/wang_5.pdf

Pain

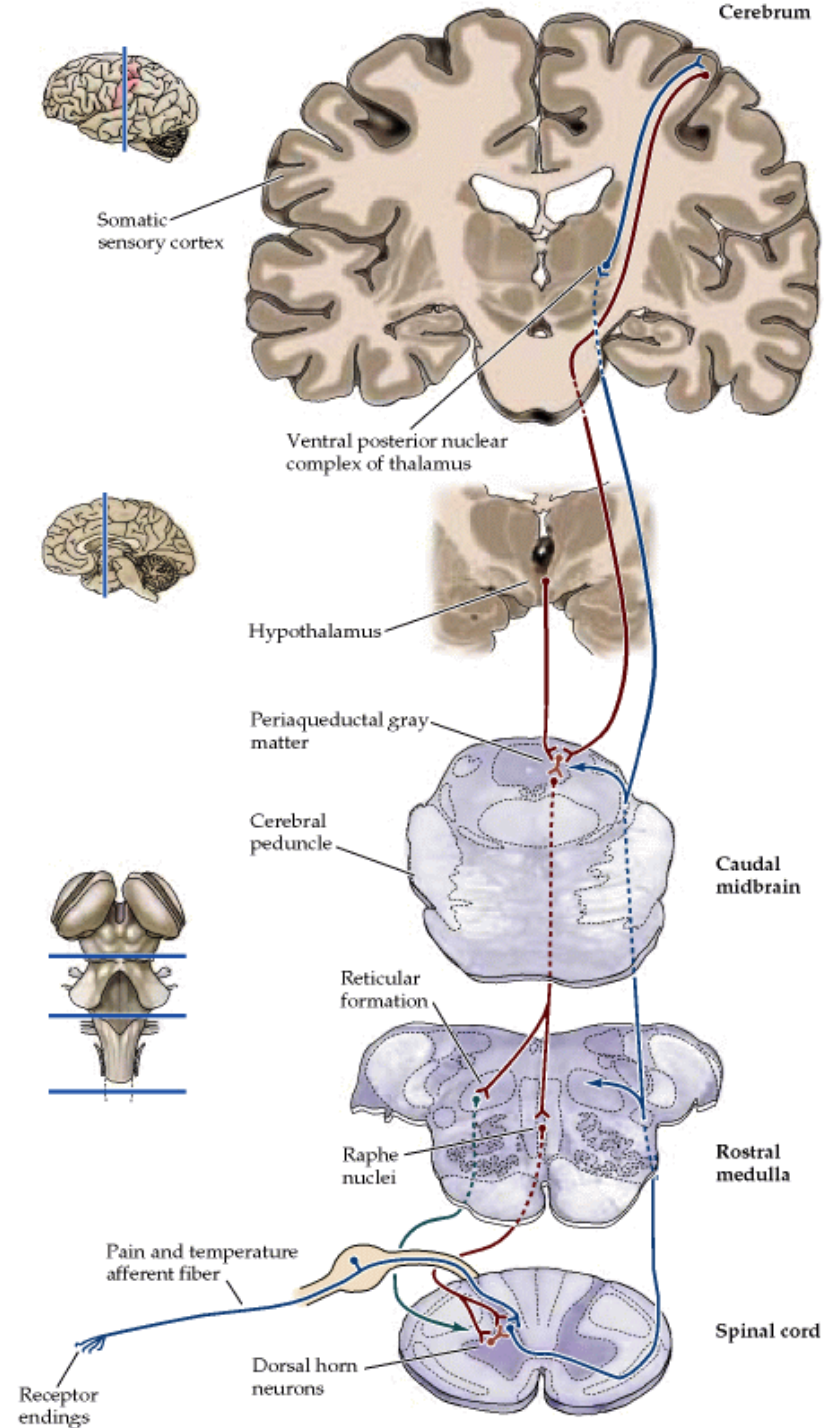
- Distressing feeling associated with real or potential tissue damage
- Sensor x psychological component
- Physiological x pathological pain
- Acute (up to 6months) x chronic (more than 6 months)

**Subjective
character**



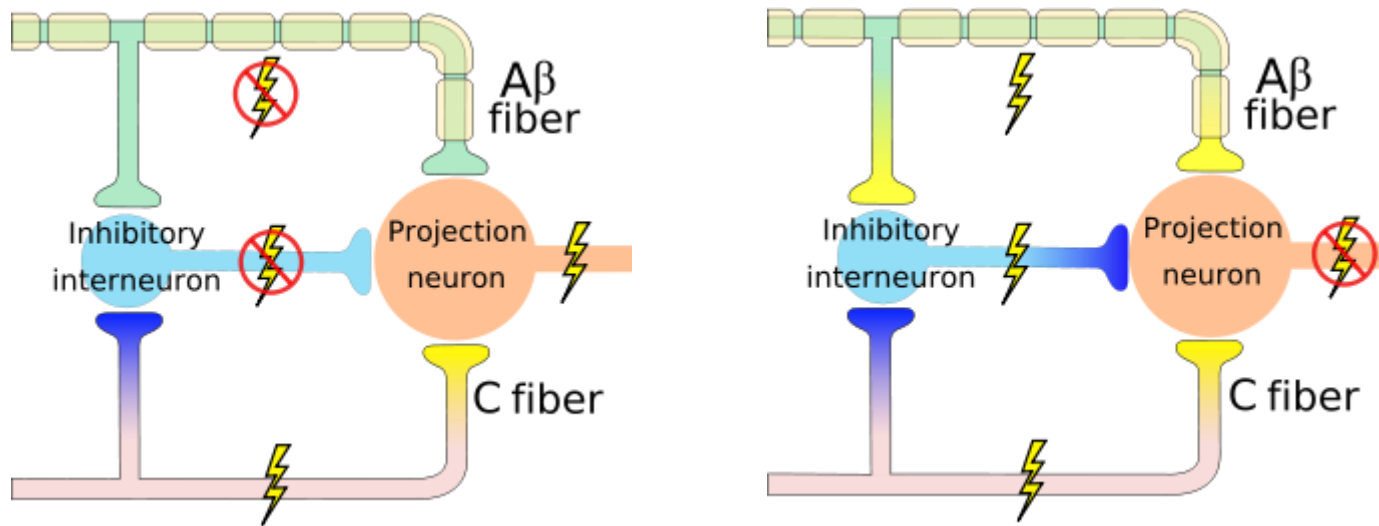
Descendent pathways modulating pain

- Somatosensory cortex
- Hypothalamus
- Periaqueductal gray
- Nuclei raphe

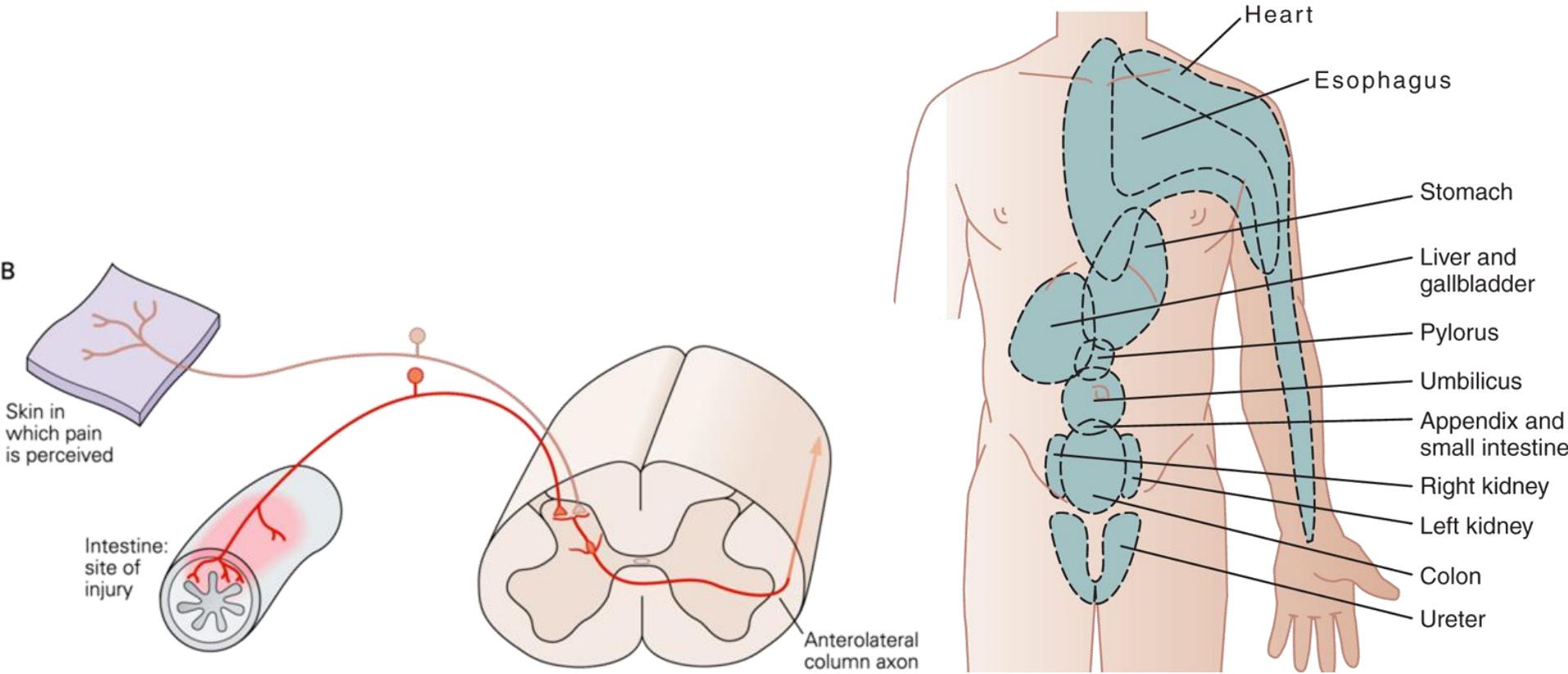


Pain modulation on the spinal level

Gate control theory of pain



Referred pain



Phantom limb pain

