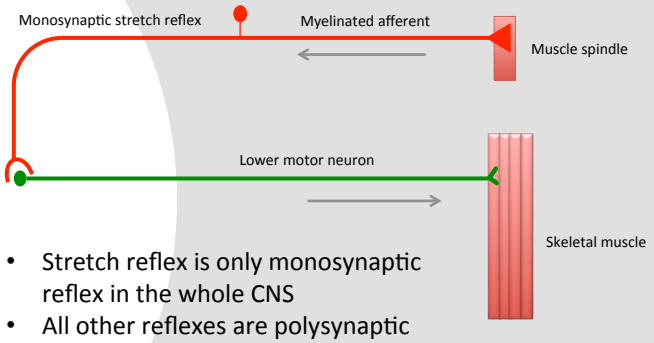
Spinal Cord Circuitry

Dec '14

Spinal cord

Stretch Reflex

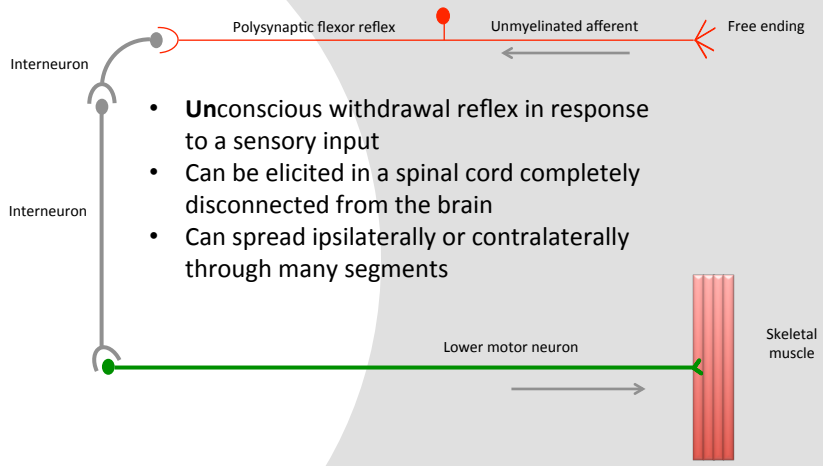


- Stretch reflex is only monosynaptic reflex in the whole CNS
- All other reflexes are polysynaptic

Image adapted from Felton 2003

Spinal cord

Withdrawal Reflex

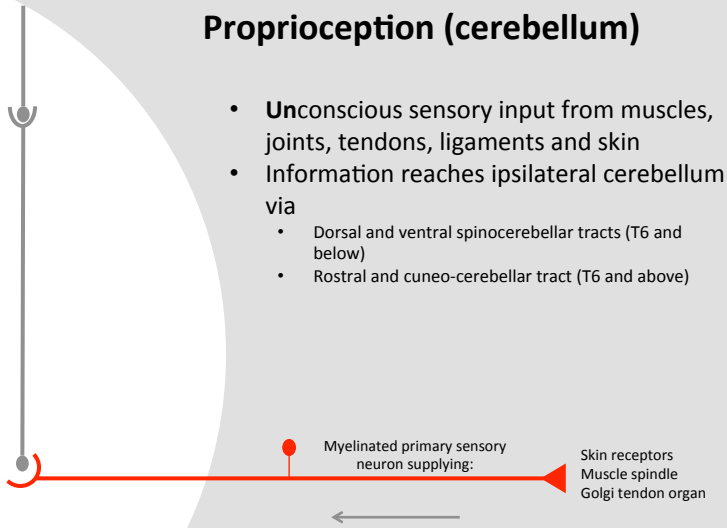


- **Un**conscious withdrawal reflex in response to a sensory input
- Can be elicited in a spinal cord completely disconnected from the brain
- Can spread ipsilaterally or contralaterally through many segments

Image adapted from Felton 2003

Central nervous system

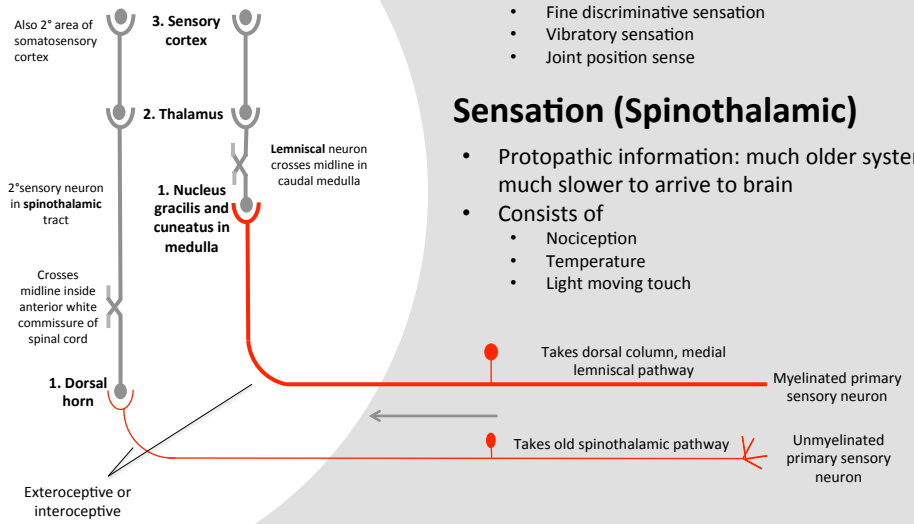
Proprioception (cerebellum)



- **Un**conscious sensory input from muscles, joints, tendons, ligaments and skin
- Information reaches ipsilateral cerebellum via
  - Dorsal and ventral spinocerebellar tracts (T6 and below)
  - Rostral and cuneo-cerebellar tract (T6 and above)

Image adapted from Felton 2003

Central nervous system



Sensation (Lemniscal)

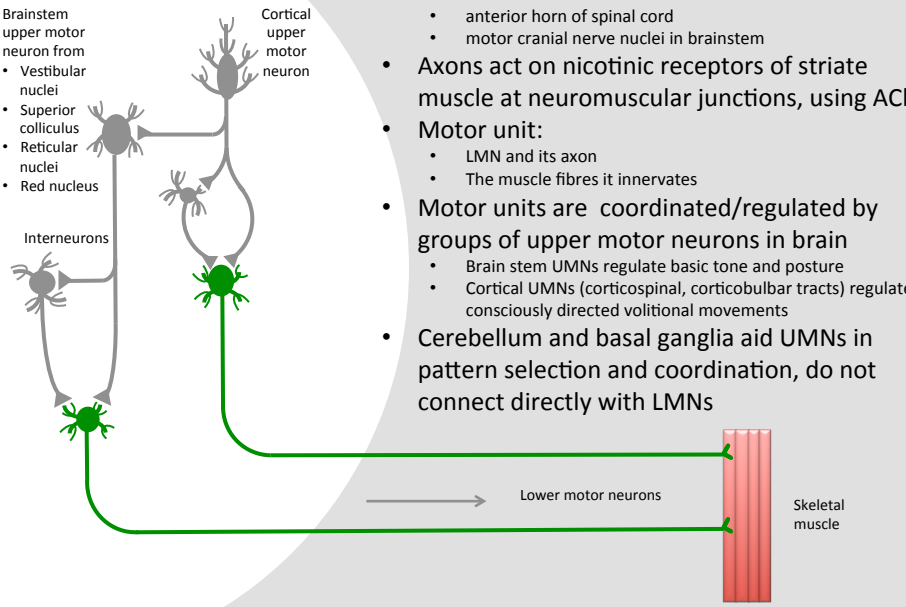
- Epicritic information: **consciously** perceived, subjected to fine-grained analysis by the sensory cortex
- Consists of
  - Fine discriminative sensation
  - Vibratory sensation
  - Joint position sense

Sensation (Spinothalamic)

- Protopathic information: much older system, much slower to arrive to brain
- Consists of
  - Nociception
  - Temperature
  - Light moving touch

Image adapted from Felton 2003

Central nervous system

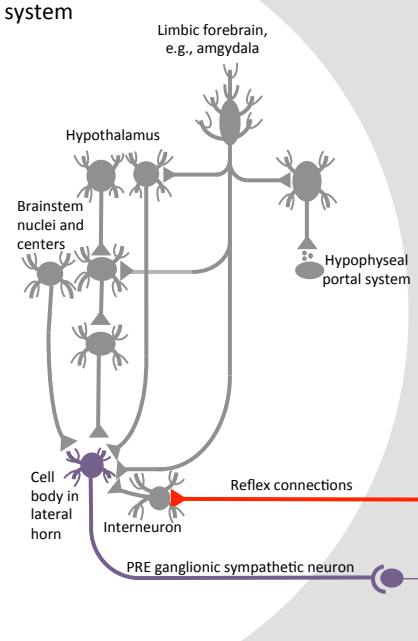


Motor outflow

- Cell bodies of lower motor neurons are in
  - anterior horn of spinal cord
  - motor cranial nerve nuclei in brainstem
- Axons act on nicotinic receptors of striate muscle at neuromuscular junctions, using ACh
- Motor unit:
  - LMN and its axon
  - The muscle fibres it innervates
- Motor units are coordinated/regulated by groups of upper motor neurons in brain
  - Brain stem UMNs regulate basic tone and posture
  - Cortical UMNs (corticospinal, corticobulbar tracts) regulate consciously directed volitional movements
- Cerebellum and basal ganglia aid UMNs in pattern selection and coordination, do not connect directly with LMNs

Image adapted from Felton 2003

Autonomic outflow



SNS

- cell bodies are in lateral horn, T1-L2
- Preganglionic axons synapse close to spinal cord in chain ganglia or prevertebral ganglia
- Post ganglionic axons travel long distance to target
- Fight or flight, responds to emergency demands

PsNS

- cell bodies are in nuclei of CNs III, VII, IX, X, and S2-4 intermediate grey matter in spinal cord
- Preganglionic axons travel long distance, synapse in intramural ganglia in or near target organ
- Homeostatic reparative system

Targets:

- Smooth muscle
- Cardiac muscle
- Secretory glands
- Metabolic cells
- Immune cells

Image adapted from Felton 2003