

Spinal Reflexes

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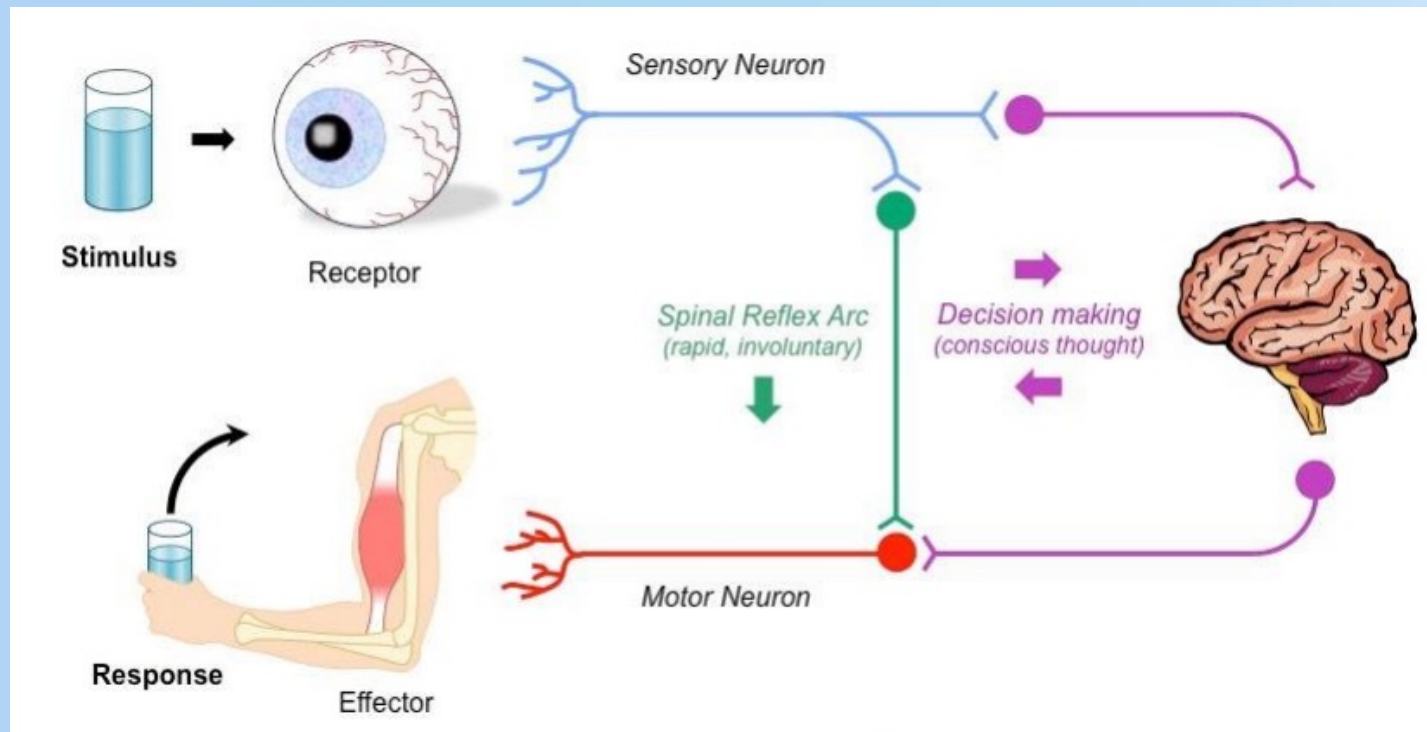
Overview

- Definiton
- Reflex arc
- Types of muscle fibers
 - Extrafusal fibers
 - Intrafusal fibers - muscle spindle
 - Nuclear chain fibers
 - Nuclear bag fibers
- Muscle spindle innervation
- Renshaw inhibition
 - Clinical correlation
- How to move a limb
- Stretch reflex
- Golgi tendon reflex
- Flexor Withdrawal reflex



Spinal reflexes

They are protective motor responses to specific kinds of stimuli (i.e. stretching of a muscle or a pain stimulus) that does not require consciousness.

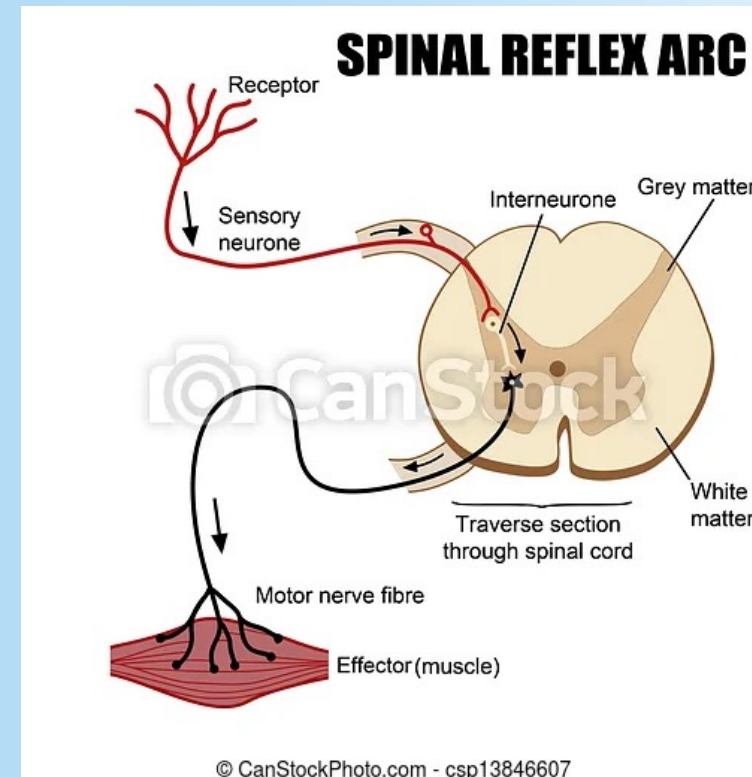


Reflex arc

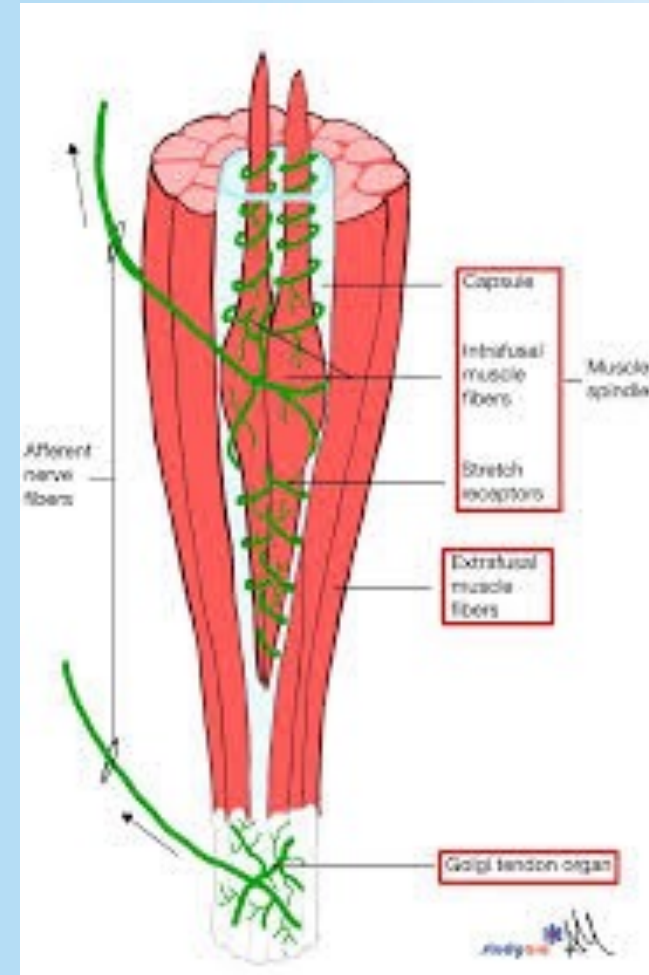
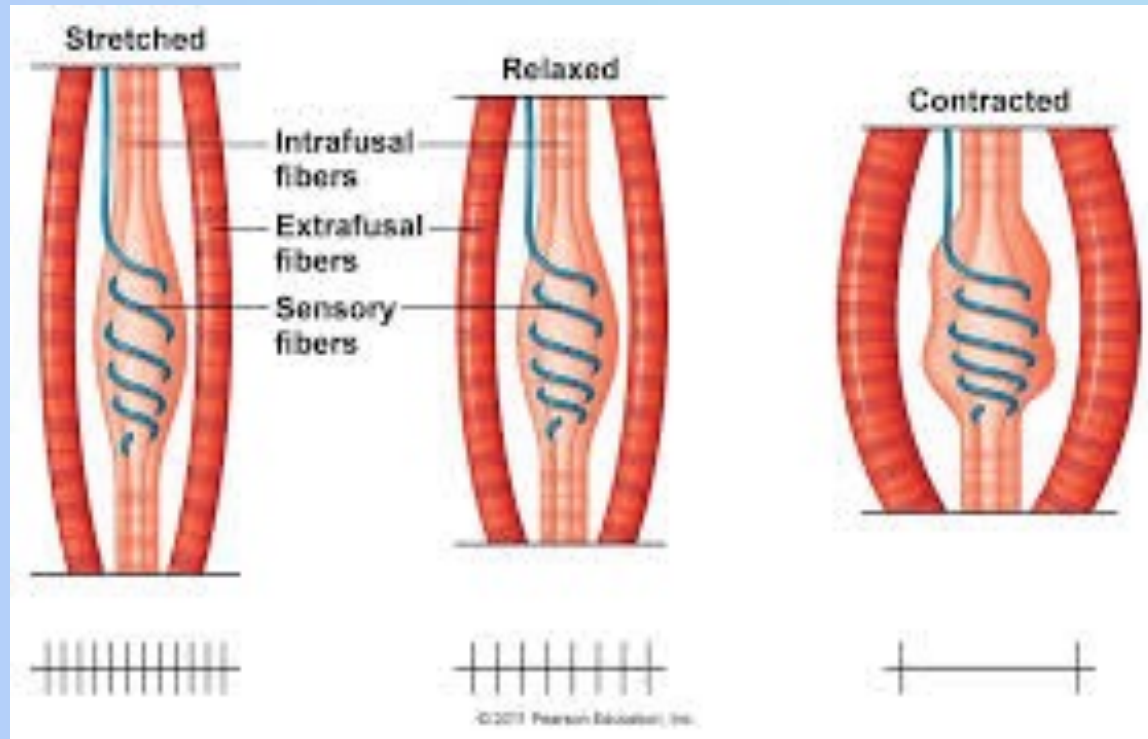
- Population of nerves that connects via synapses to carry out a specific function when activated

Elements of the reflex arc:

1. Sensory receptor (i.e. nociceptor)
2. Afferent pathway (sensory neurons)
3. Interneurons (integration center)
4. Efferent pathway (motor neurons)
5. Effector (muscle)

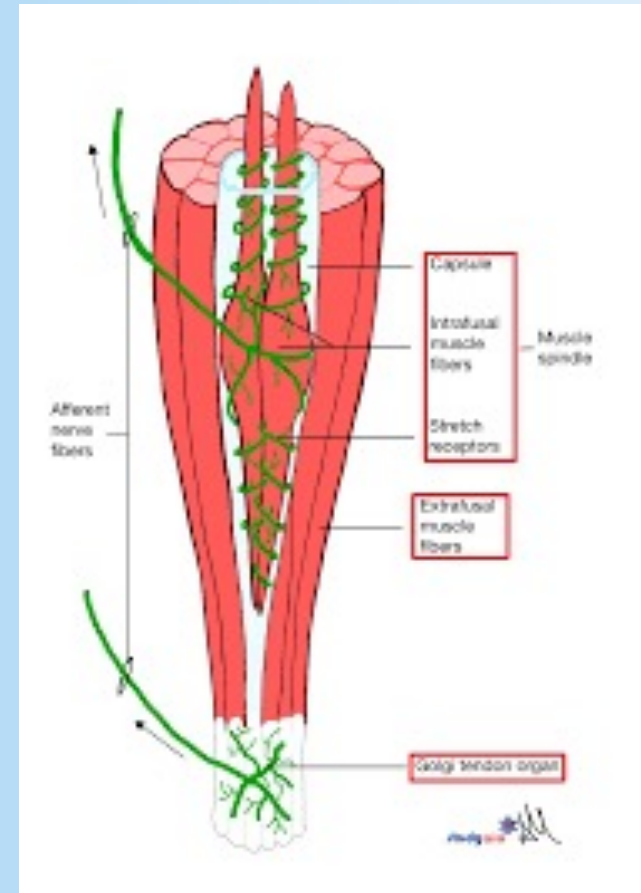


Muscle fibers



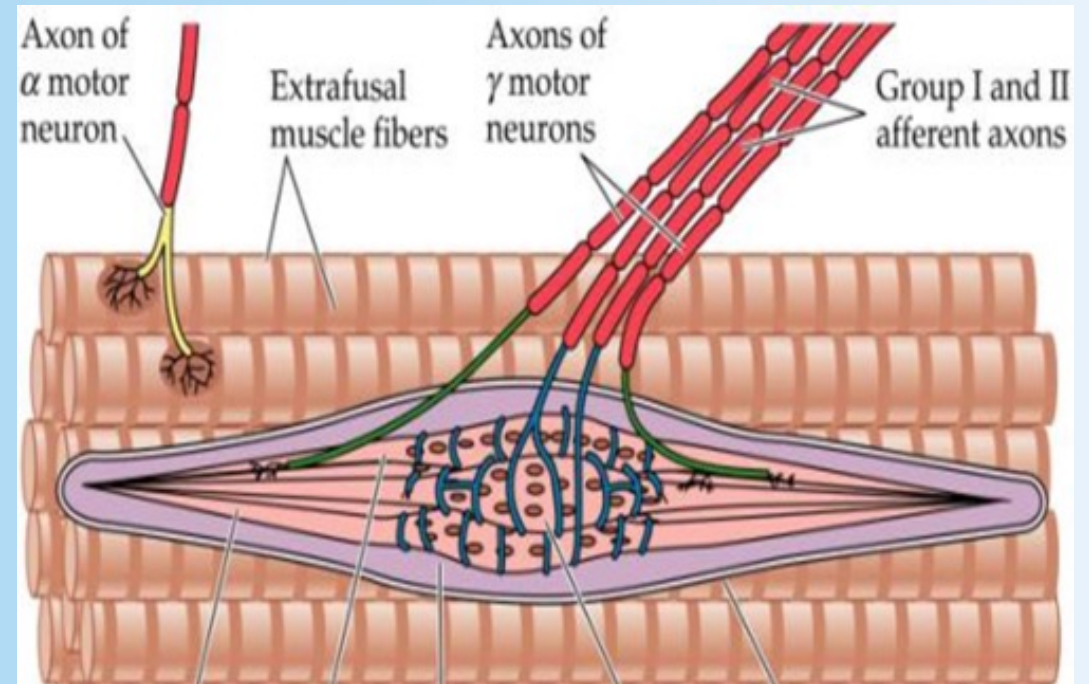
Extrafusal fibers

- Majority of skeletal muscle
- Innervated by α -motoneurons (efferent)
- Generate force
- Attached to tendons



Intrafusal fibers

- Innervated by γ -motoneurons (efferent)
- Do not generate force
- Encapsulated in sheaths
- Parallel to extrafusal fibers



Intrafusal fibers - muscle spindle

- Muscle spindles are distributed among extrafusal fibers
- Numerous in muscles used for fine movements
- Innervated by both sensory and motor nerve fibers
- Function: Sense muscle length
- 2 types of intrafusal fibers: Nuclear bag fibers and nuclear chain fibers (more)

Muscle spindle

Nuclear Bag Fibers

- Nuclei are accumulated in a central bag region
- Innervated by group Ia afferent nerve

➔ RAPID



- Detect velocity of length change
- Innervated by **dynamic** gamma motoneurons

Nuclear Chain Fibers

- Nuclei are arranged in chains
- Innervated by group Ia afferent nerve

➔ RAPID

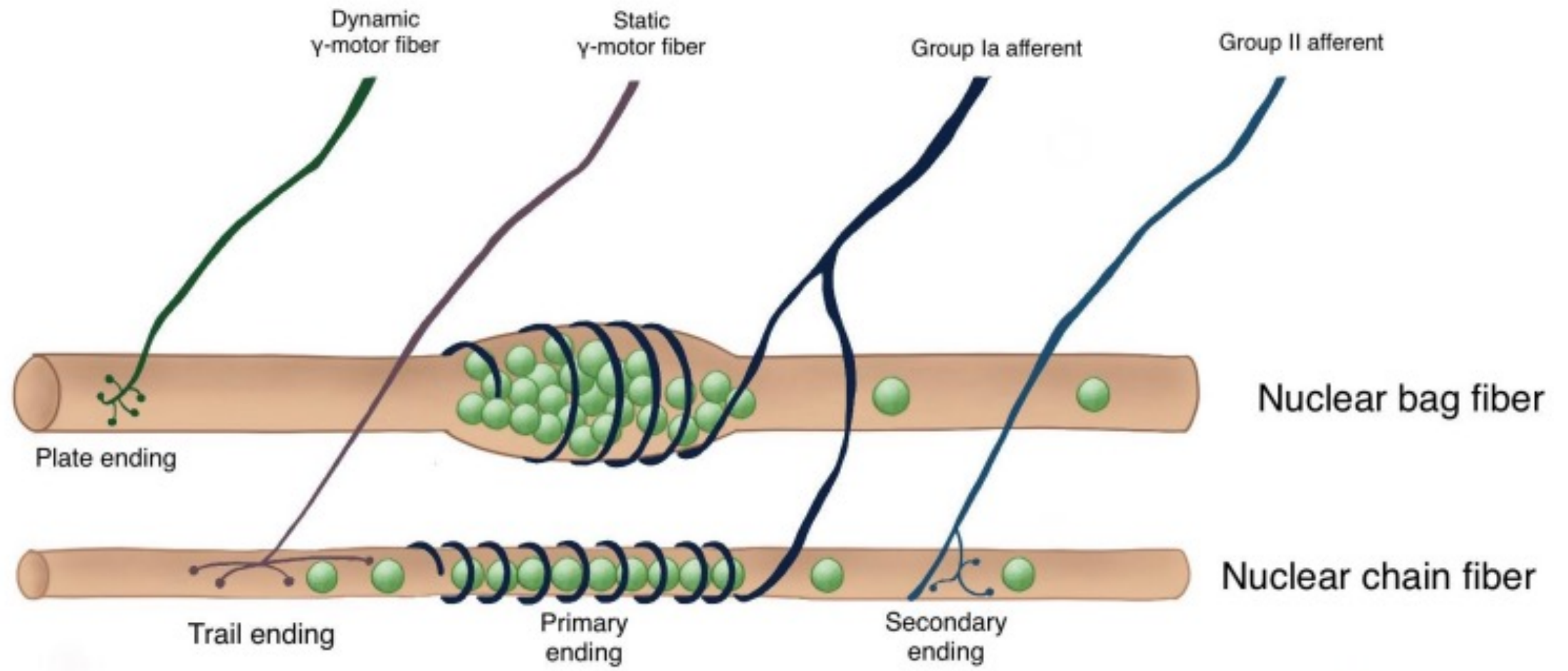


- Also innervated by group II afferent nerves

➔ SLOW



- Detect the length of the muscle fiber
- Innervated by **static** gamma-motoneurons

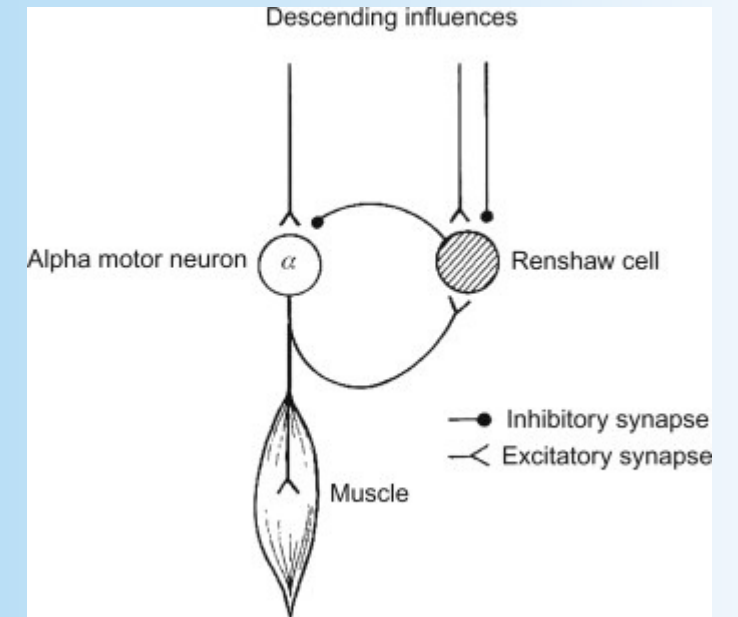


Function of the muscle spindle

- Muscle stretches - extrafusal fibers are lengthened - intrafusal fibers are also lengthened
- Stretch is detected by the afferent nerves which sends information about this to your spinal cord
- Group Ia afferent - velocity of the length change
- Group II afferent - length of muscle fiber/degree of stretch

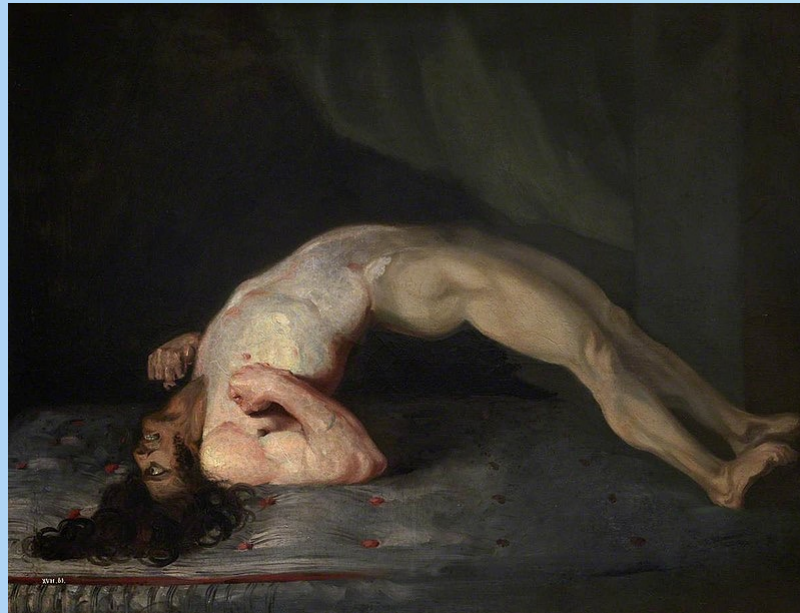
Renshaw inhibition

- Inhibitory interneurons that are associated in two ways with an alpha motor neuron:
 - They receive excitatory collateral from the motor root
 - They send inhibitory axon synapse with the alpha neuron
- Negative feedback (glycine)
- Prevents hyperactive muscle contraction



Clinical correlation: tetanus

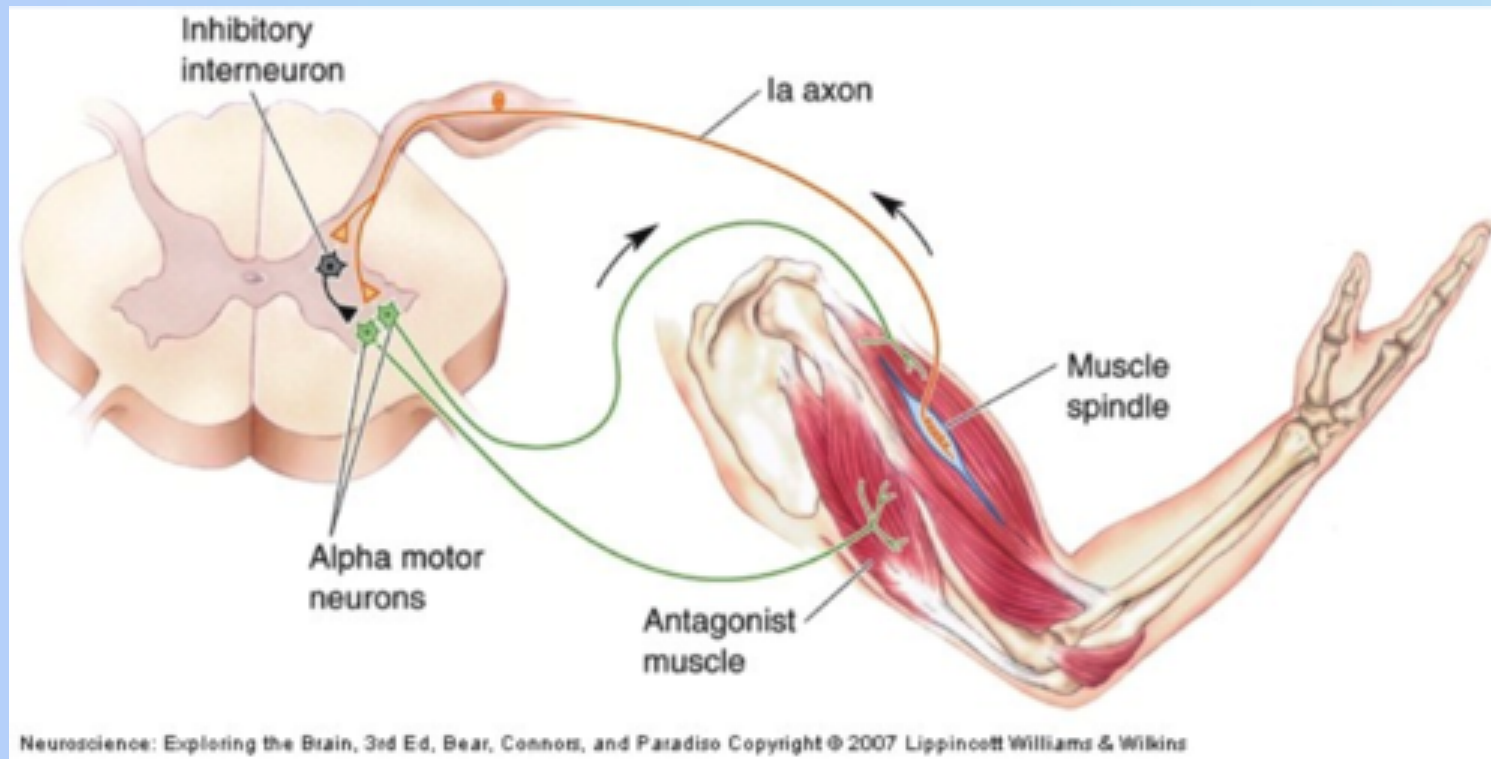
- Renshaw cells are the target of the toxin clostridium tetani
- Causes tetanus by inhibiting glycine
- Alpha motor neurons become hyperactive and muscle constantly contract



TXT:
Vaccines<33
#getvaccinated

How to move a limb

- The antagonizing muscle must always do the opposite
- Reciprocal innervation

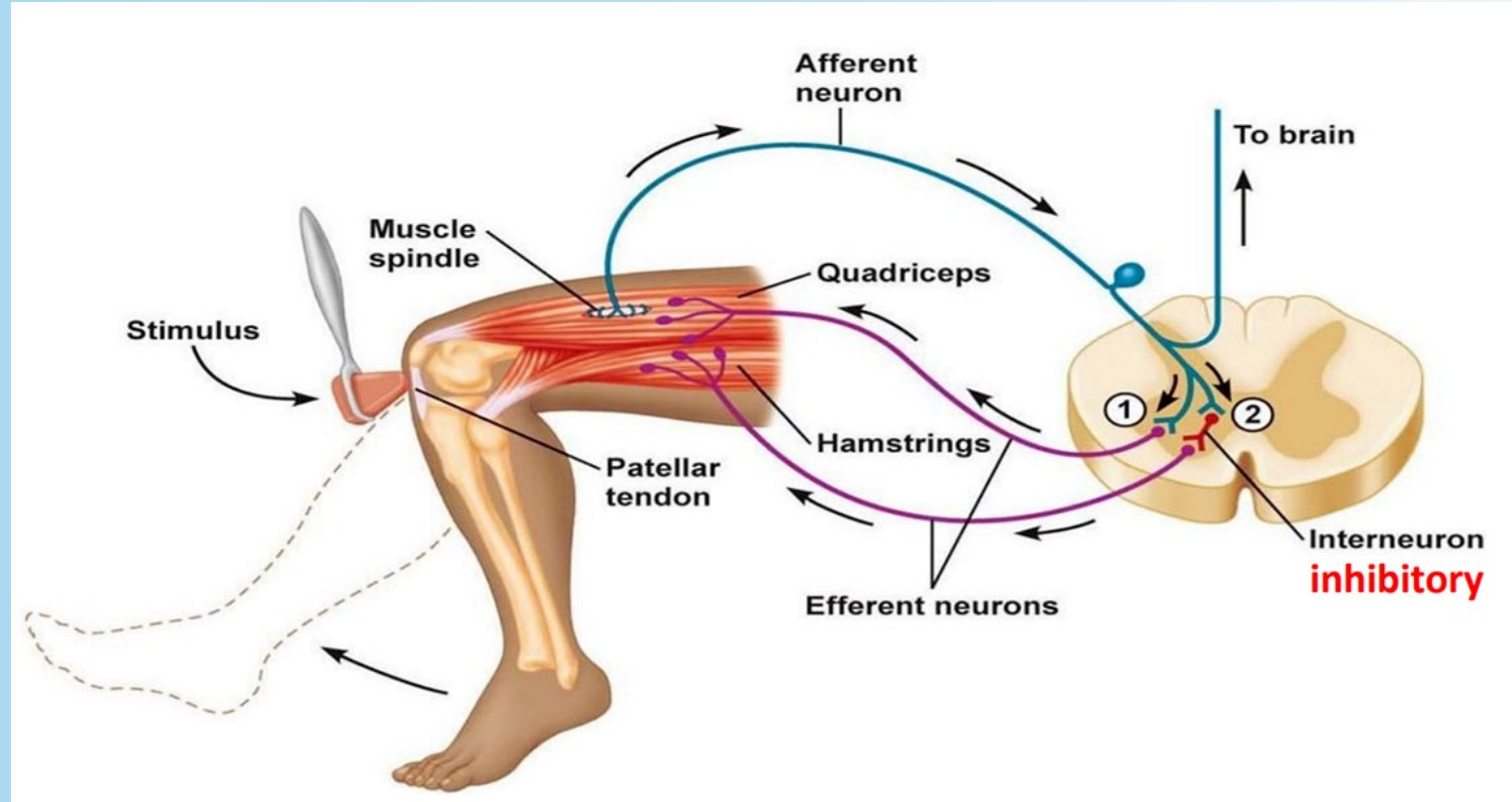


Biceps: Flexed by action of the alpha motor neuron

Triceps: Relaxed by inhibition of alpha motor neuron by inhibitory interneurons

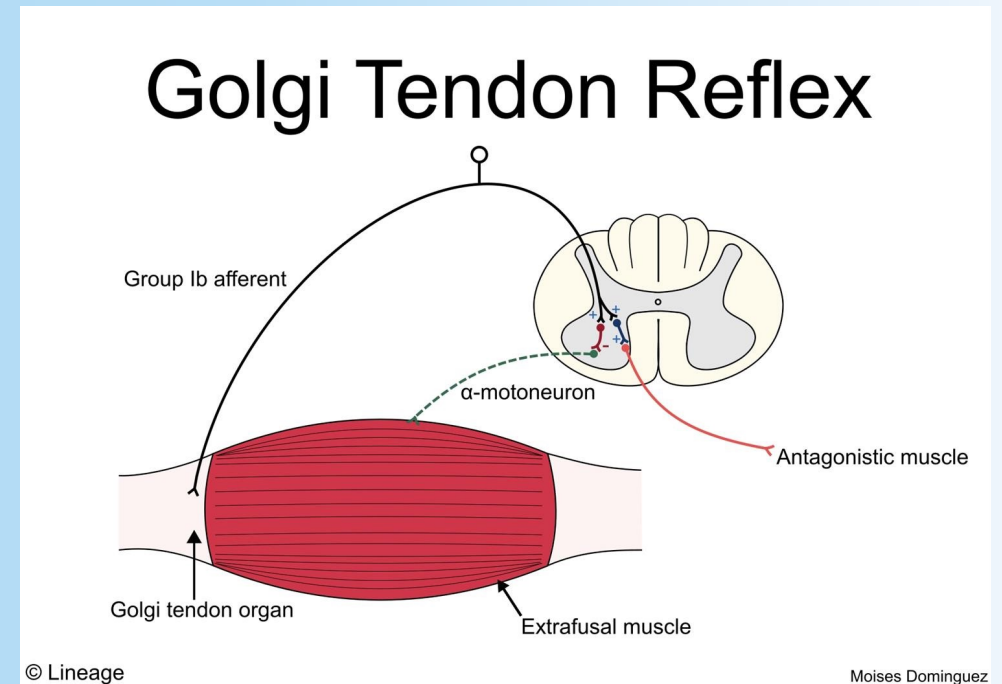
Stretch reflex (myotactic reflex)

- Stimulus: hitting the patellar tendon
- Receptor: muscle spindle
- Afferent: Group Ia afferent fibers
- Monosynaptic
- Efferent: α -motoneurons
- Effector: Muscle (contraction)



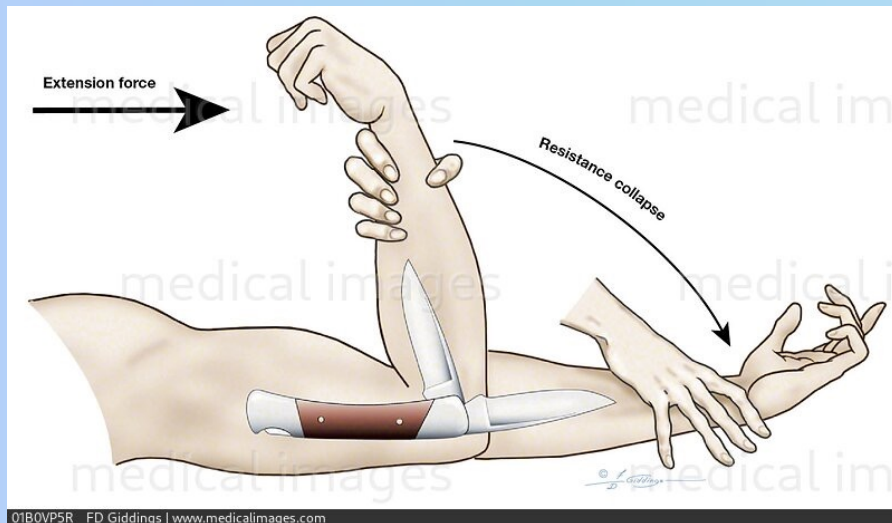
Golgi tendon reflex (inverse myotactic reflex)

- Stimulus: sustained contraction
- Receptor: GTO
- Afferent: Group Ib afferent nerves
- Disynaptic: Inhibitory interneurons
- Efferent: α -motoneurons (inhibited)
- Effector: Muscle (relaxation)



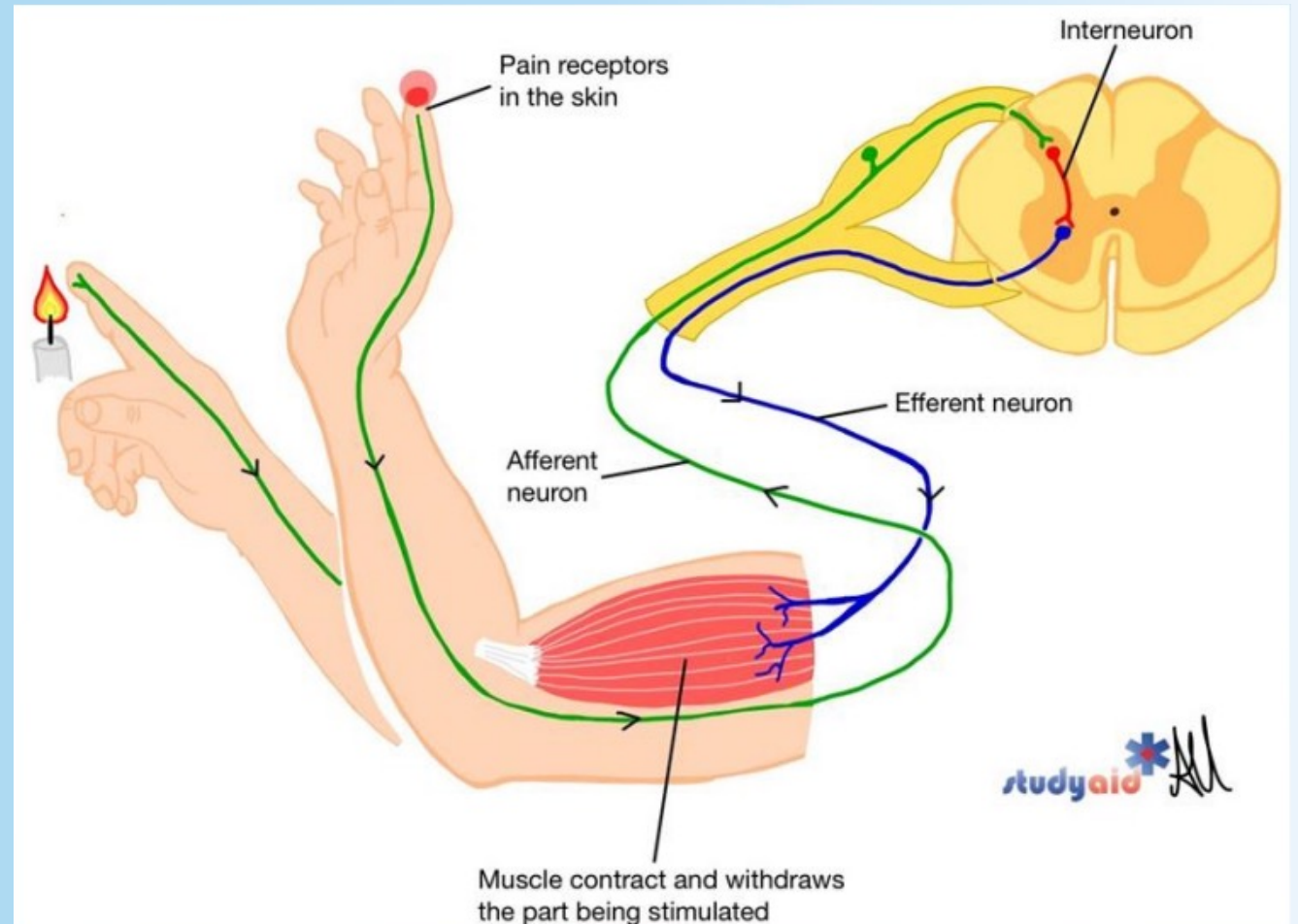
Clasp-knife reflex

- Abnormal reflex in patients with upper motor neuron lesion
- Uncontrolled lower motor neuron activity
- Muscle is passively flexed, antagonist muscle resist this movement
- So the tension in the antagonistic muscle activates golgi tendon organ
- Inhibits the antagonistic muscle, and the joint closes rapidly

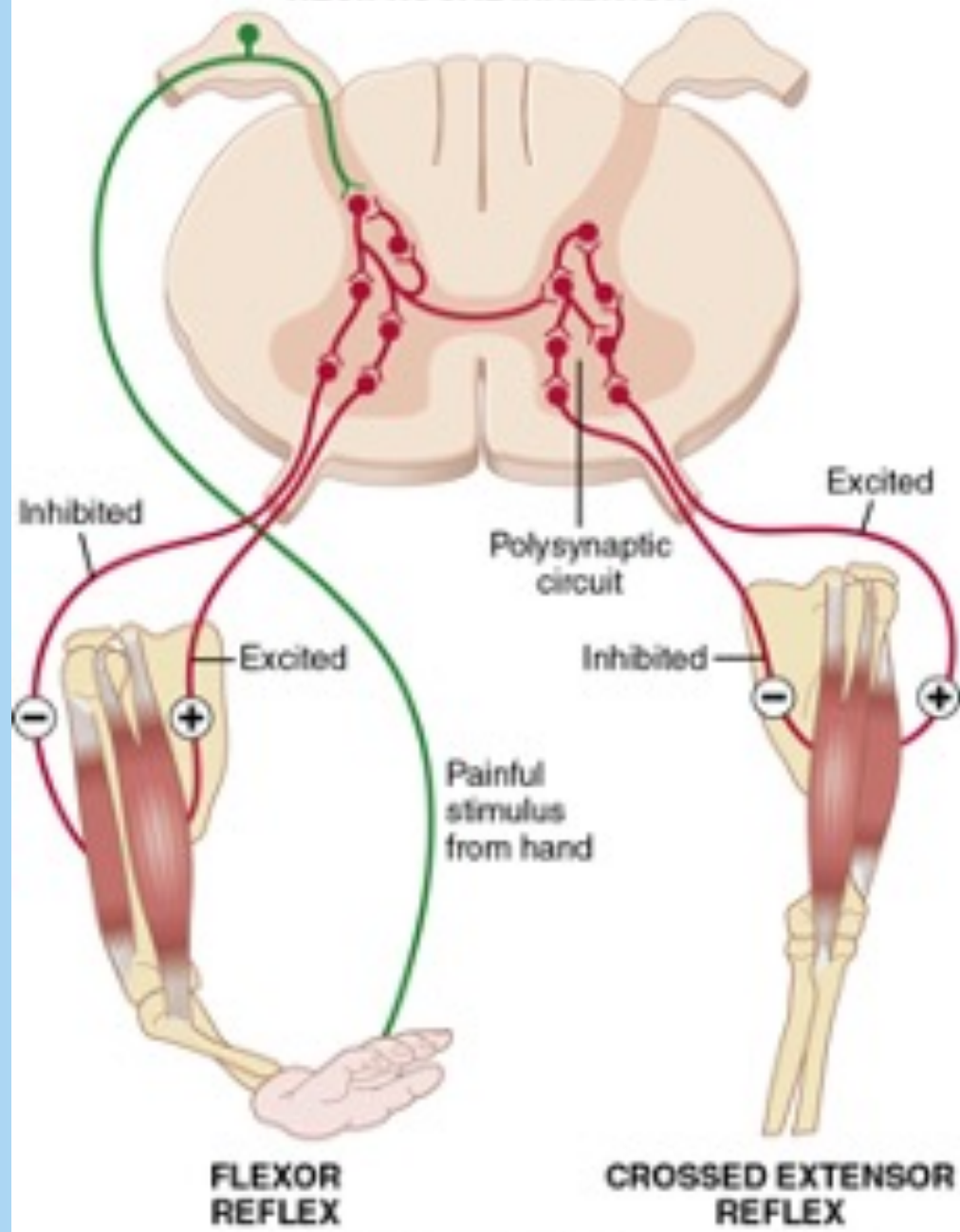


Flexor withdrawal reflex

- Stimulus: Noxious (pain)
- Afferent: group 2, 3 and 4
- Polysynaptic
- Efferent: α -motoneurons
- Effector: Muscles (contracts)
 - Ipsilateral side contraction of flexors
 - Contralateral side contraction of extensors
- Afterdischarge



RECIPROCAL INHIBITION



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	STRETCH REFLEX (myotatic reflex)	GOLGI TENDON REFLEX (inverse myotatic reflex)	FLEXOR WITHDRAWAL REFLEX
Stimulus	Muscle stretch	Sustained contraction of a muscle	Pain
Receptor	Muscle Spindle	Golgi tendon organ	Nociceptors
Afferent pathway	Group Ia fibers	Group Ib fibers	Group 2,3,4 fibers
Integration center	Monosynaptic	Disynaptic	Polysynaptic
Efferent pathway	α -motoneurons	α -motoneurons	α -motoneurons
Effector	Flexors relax Extensors contract	Inhibition (relaxation) of the contracted muscle and stimulation (contraction) of the antagonistic muscle	Contraction of flexors on ipsilateral side Contraction of extensors on contralateral side (antagonist muscle does the opposite on each side)

How to participate?



WEB

- 1 Connect to www.wooclap.com/REFLEXZ
- 2 You can participate