

Reflex Control of Muscle Activity

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VETS30015 / VETS90121

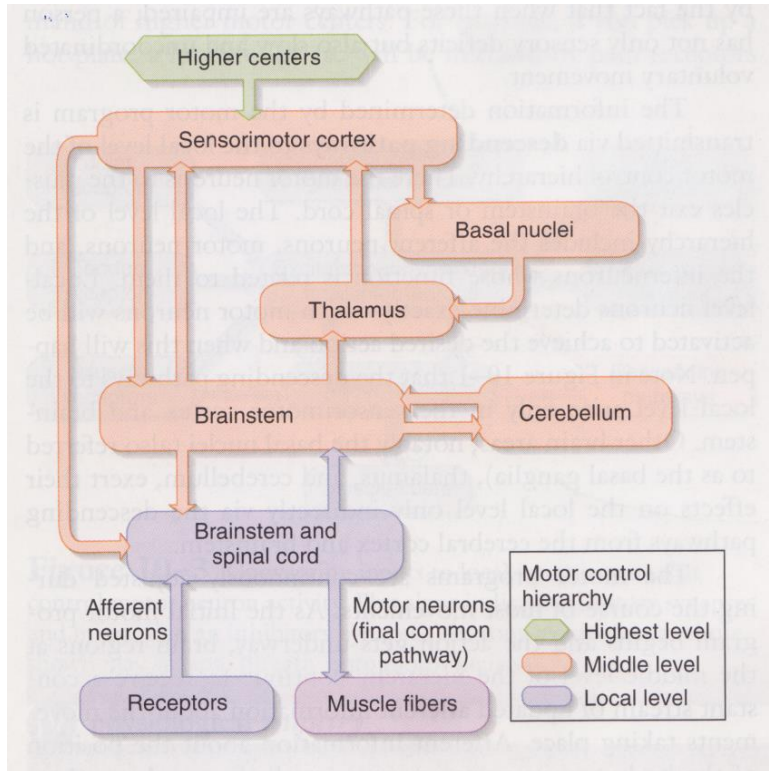
Reflex control of muscle activity

- Muscle spindles and the Golgi tendon organs provide afferent information essential for controlling muscle activity
- Proprioceptors in muscles
 - Golgi Tendon Organs
 - Present in tendons
 - Report muscle tension (contraction) development
 - Muscle Spindles
 - Embedded within muscle
 - Report muscle position, “Stretch”

Reflex control of muscle activity

- This information is used in 2 ways
 1. Appraisal of motor areas of the brain about muscle length and tension.
 2. Control of muscle length and tension in a negative-feedback fashion by means of local spinal reflexes

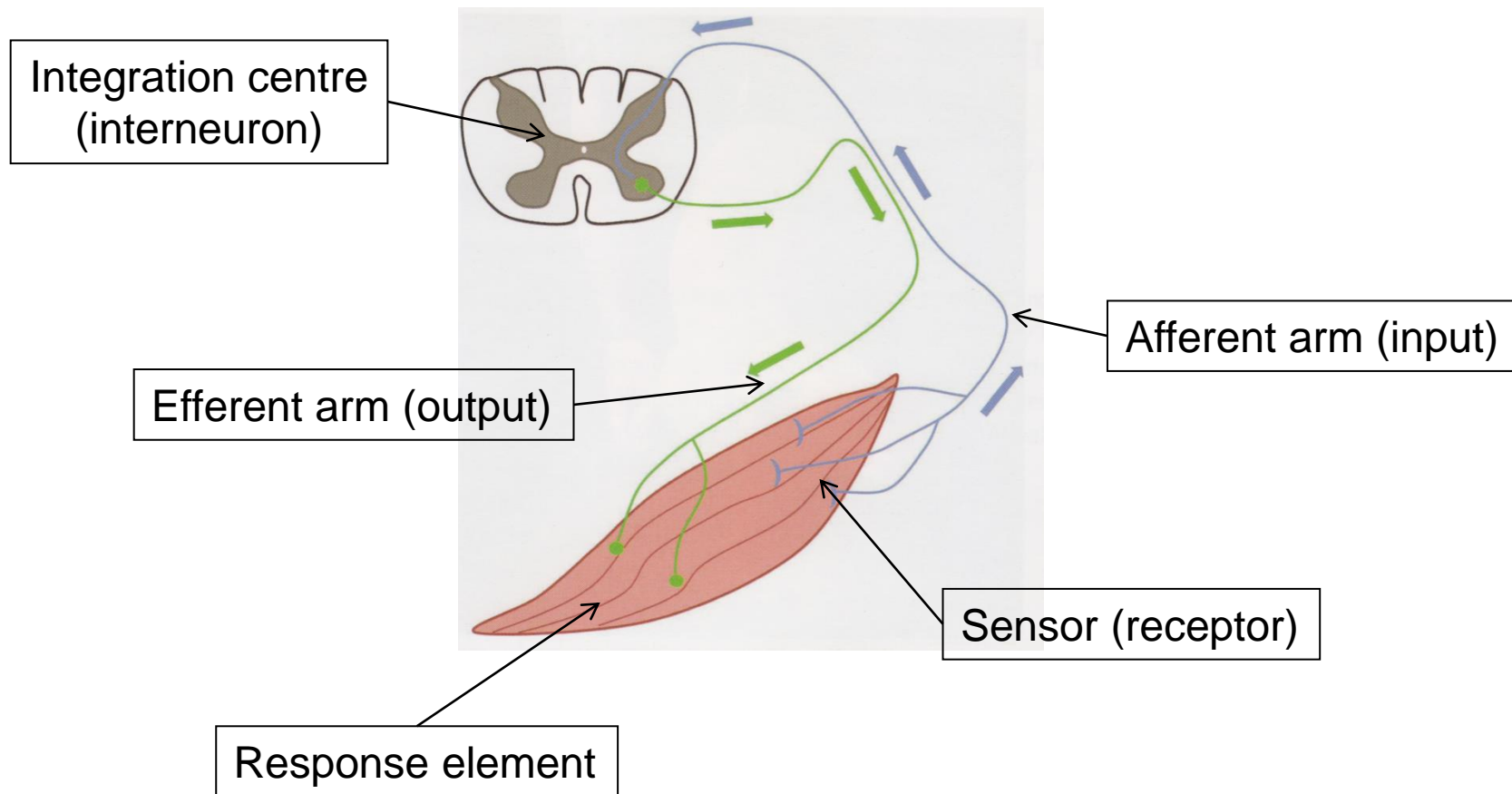
Conceptual hierarchical organisation of motor control



Motor neurons are influenced by

1. Local reflex circuitry
2. Descending pathways from the brain stem and cerebral cortex

Components of a simple reflex



Interneurons

- Most descending synaptic input does not go directly to motor neurons
- Synapse with interneurons which synapse with motor neurons
- 90% of spinal cord neurons
- Integrate input from higher centres, peripheral receptors and other interneurons

Local Afferent Input

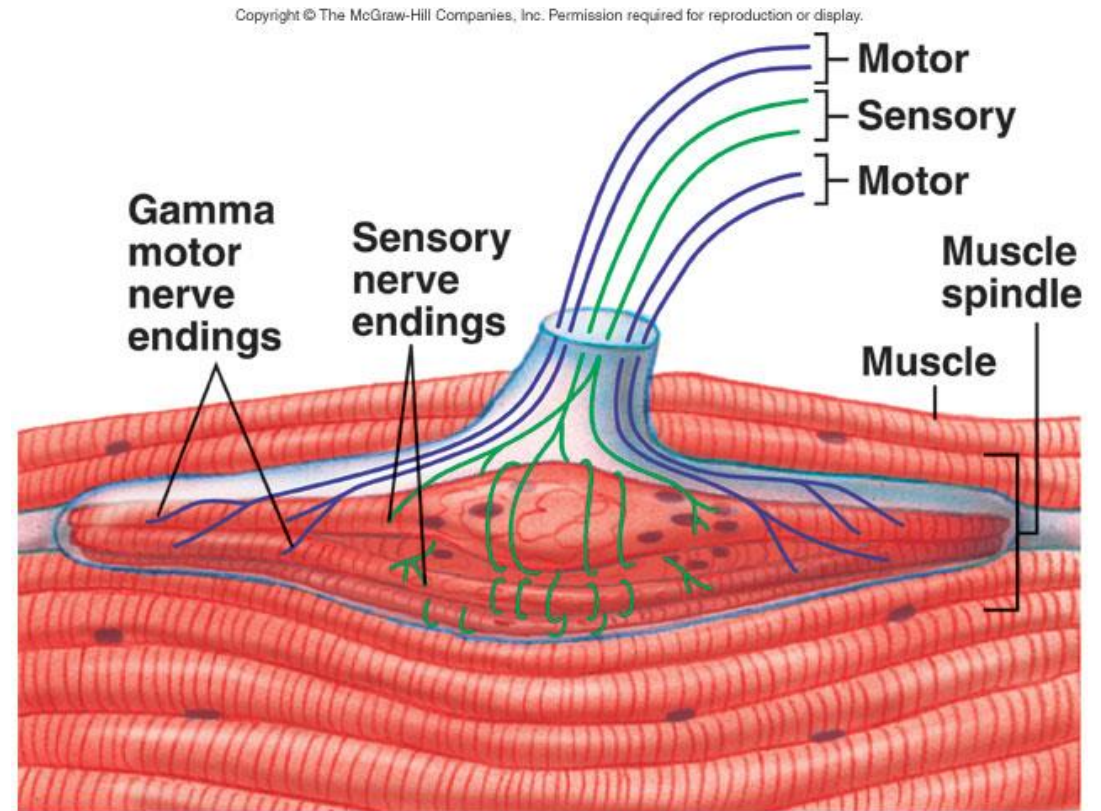
- Afferent fibres carry information from sensory receptors in three sources
 1. In skeletal muscles controlled by motor neurons
 2. In other nearby muscles, especially antagonists
 3. In the tendons, joints, and skin of body parts affected by muscle action

Muscle Spindle



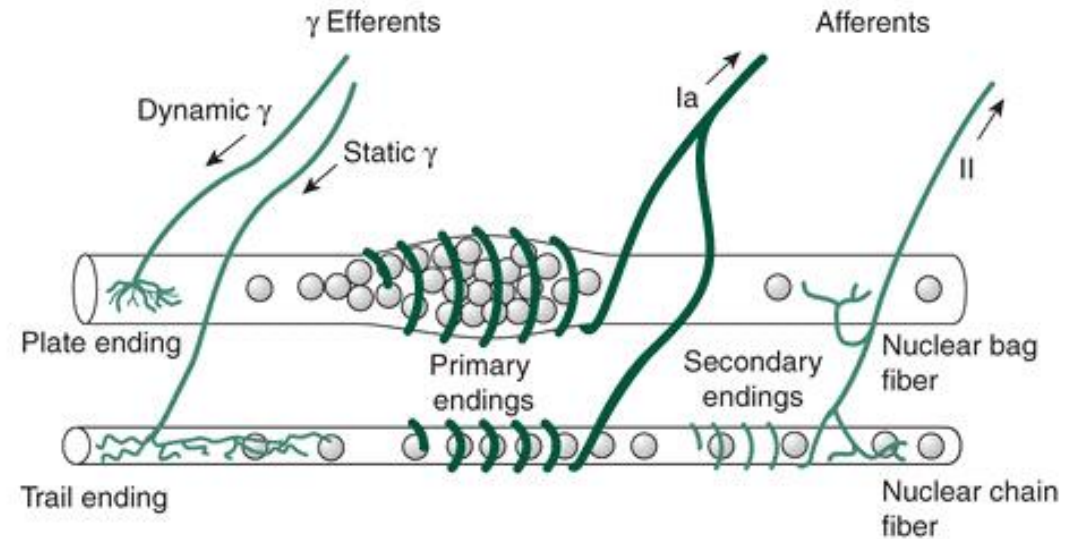
Muscle Spindle

- located within fleshy part of muscle
- Intrafusal fibers parallel to extrafusal fibers
- Noncontractile central portion
- Detects:
 - *rate of change* at which the muscle fibers are stretched
 - changes in *length* of muscle fibers
- aids in coordination and efficiency of muscle contraction

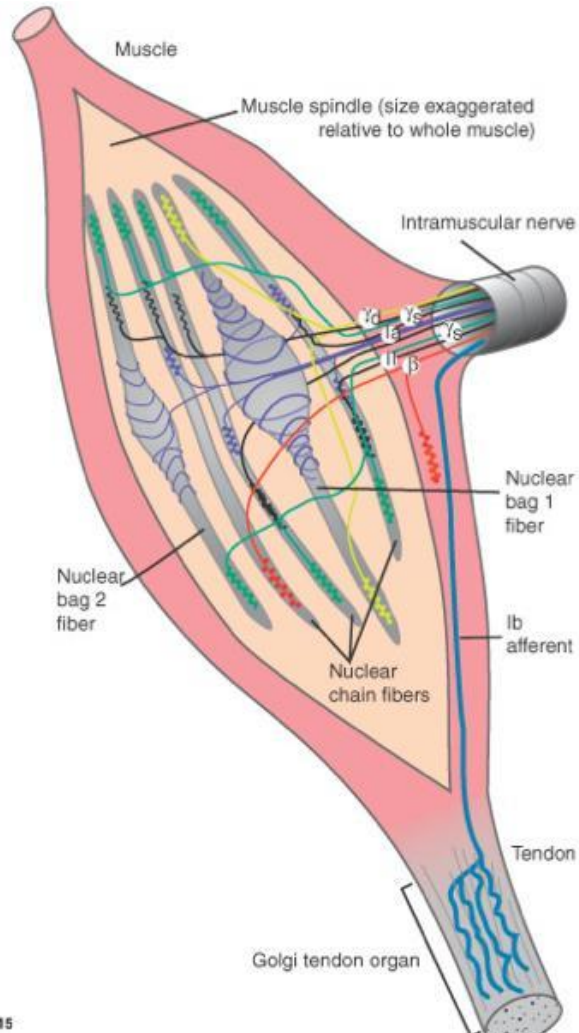


Types of nerve fibres in muscle spindle

- Nuclear bag fibres
 - Large number nuclei packed into mid-portion
 - Sense onset of stretch
- Nuclear chain fibres
 - Nuclei in longitudinal row
 - Sense sustained stretch
- Both are activated with rapid stretch

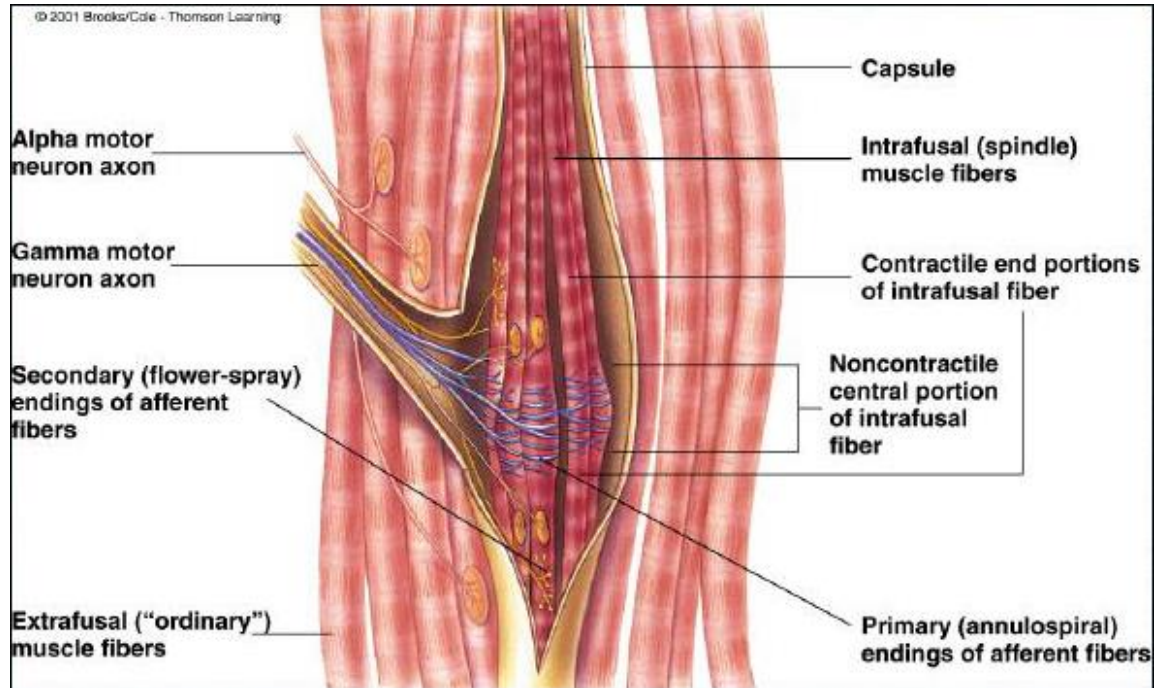


Muscle Spindle ~ Nerve supply



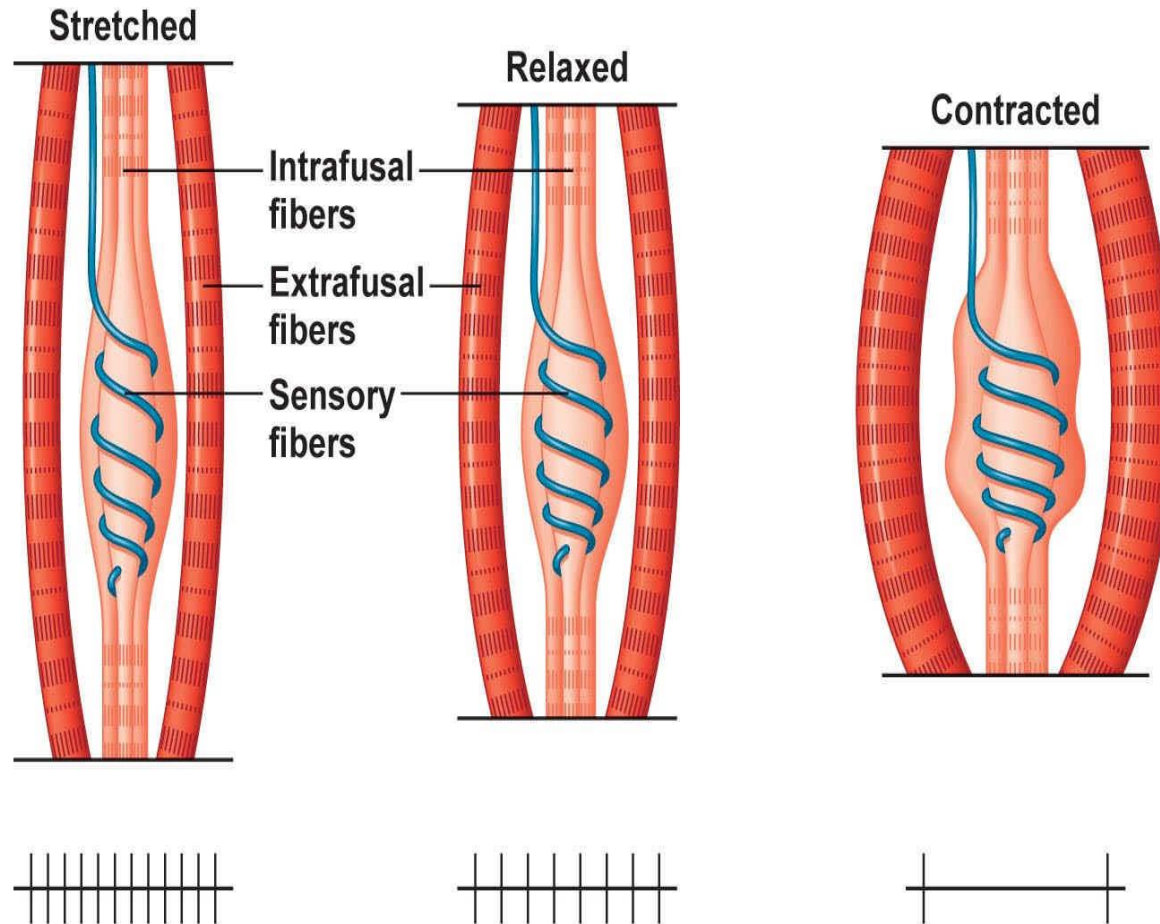
- Efferent neuron which innervates intrafusal fibres = gamma (γ) motor neuron
- Extrafusal fibres = alpha (α) motor neuron

Muscle Spindle



- Muscle spindles are attached by connective tissue in parallel to the extrafusal fibres.
- External force stretching the muscle also stretches the intrafusal fibres activating their receptor endings

Co-activation of γ and α motor neurons



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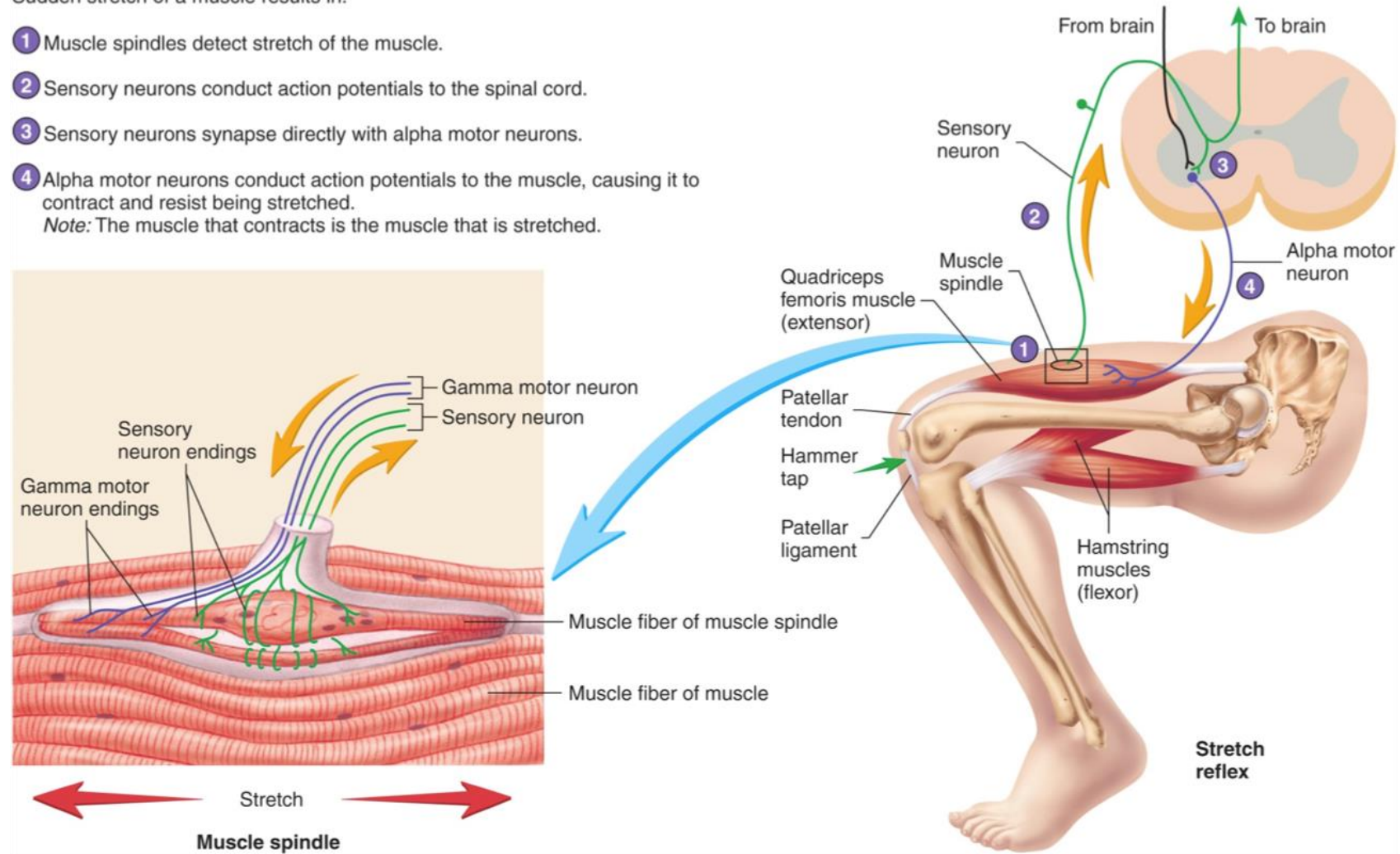
The more or the faster the muscle is stretched, the greater the rate of receptor firing

Stretch Reflex

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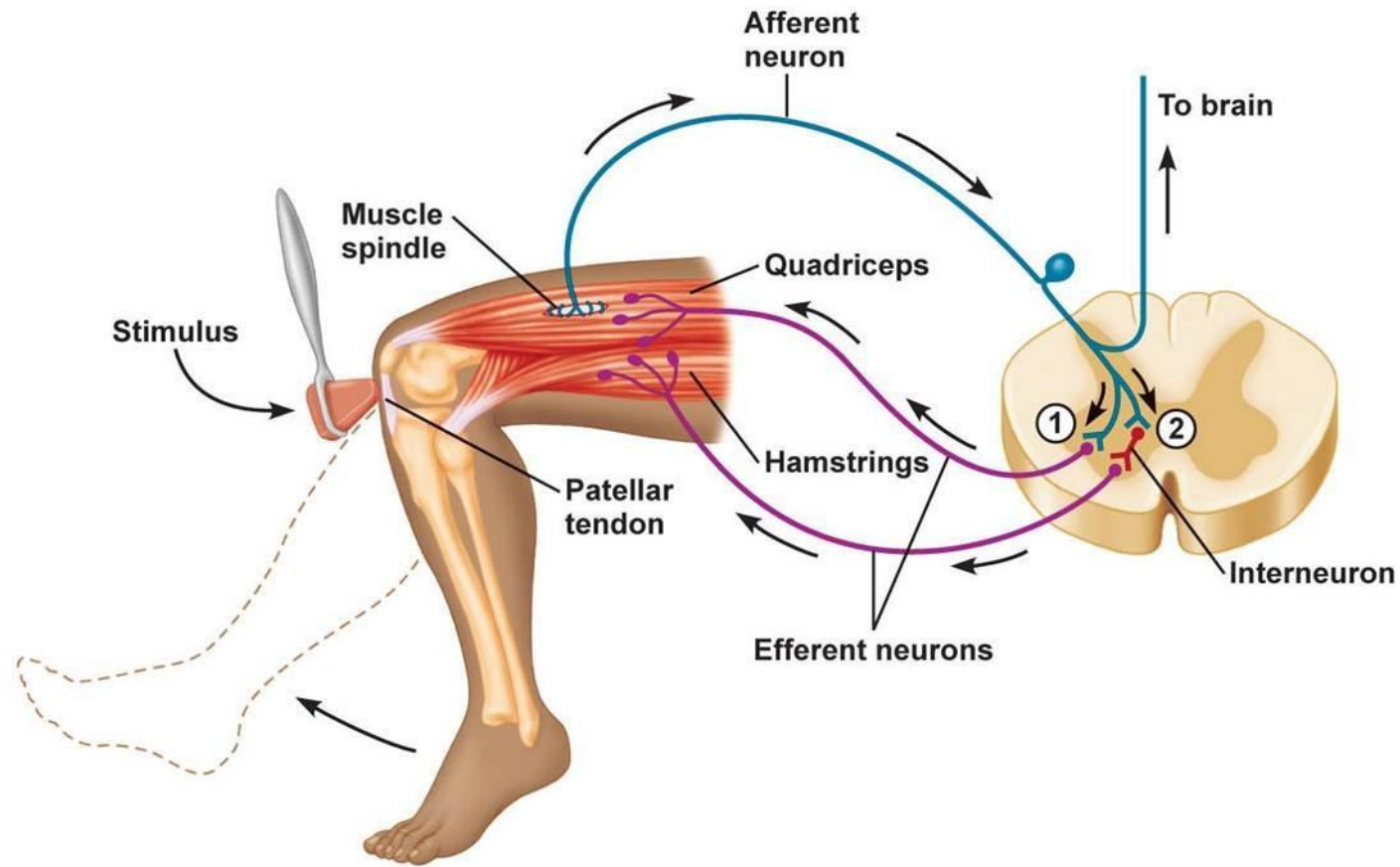
Sudden stretch of a muscle results in:

- 1 Muscle spindles detect stretch of the muscle.
 - 2 Sensory neurons conduct action potentials to the spinal cord.
 - 3 Sensory neurons synapse directly with alpha motor neurons.
 - 4 Alpha motor neurons conduct action potentials to the muscle, causing it to contract and resist being stretched.
- Note:* The muscle that contracts is the muscle that is stretched.



Similar things happens when a quick change in posture is made

Reciprocal Innervation



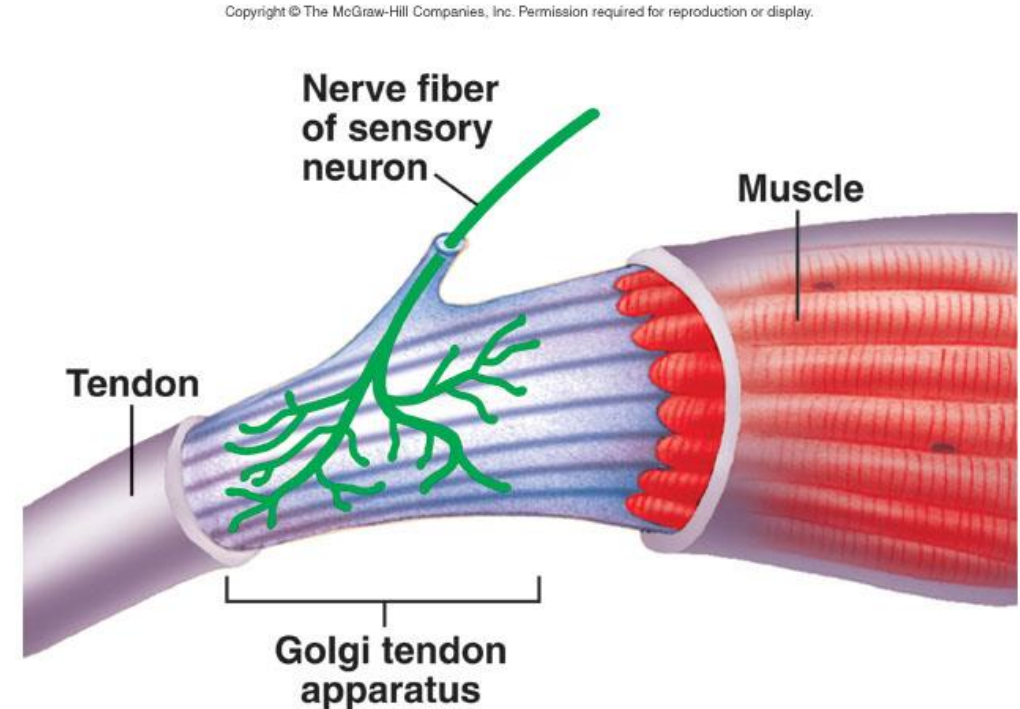
Stretch reflex

- The stretch, or myotactic, reflex
 - Produces rapid corrections of motor output in the moment to moment control of movement
 - Forms the basis for postural reflexes to maintain body position.

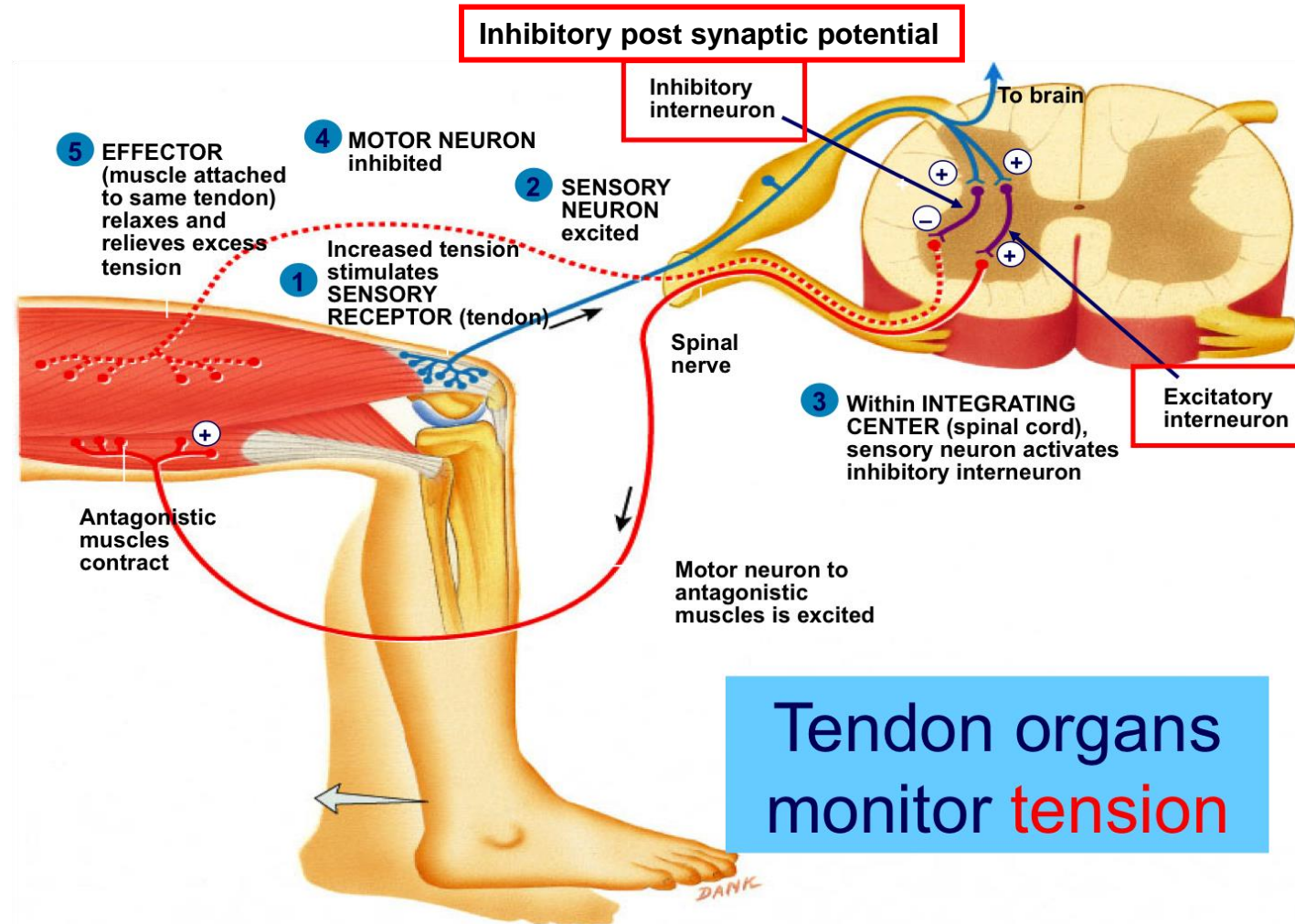
Golgi Tendon Organs

Golgi tendon organ

- located at junction of tendon and muscle
- detects:
 - *force of muscle contraction*
 - *tension applied to tendon*
- protects tendon and muscle from excessive tension
- A large diameter myelinated type 1b axon arises from each GTO
- Muscle contraction stretches the GTO and generates AP
- Greater the force of contraction higher firing rate



Tendon reflex





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THE END

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