260-2017-11-08-action-II

Rick Gilmore

2017-11-07 12:50:12

Prelude

Earth, Wind & Fire - Fantasy

Prelude

Woody Guthrie-This Land Is Your Land

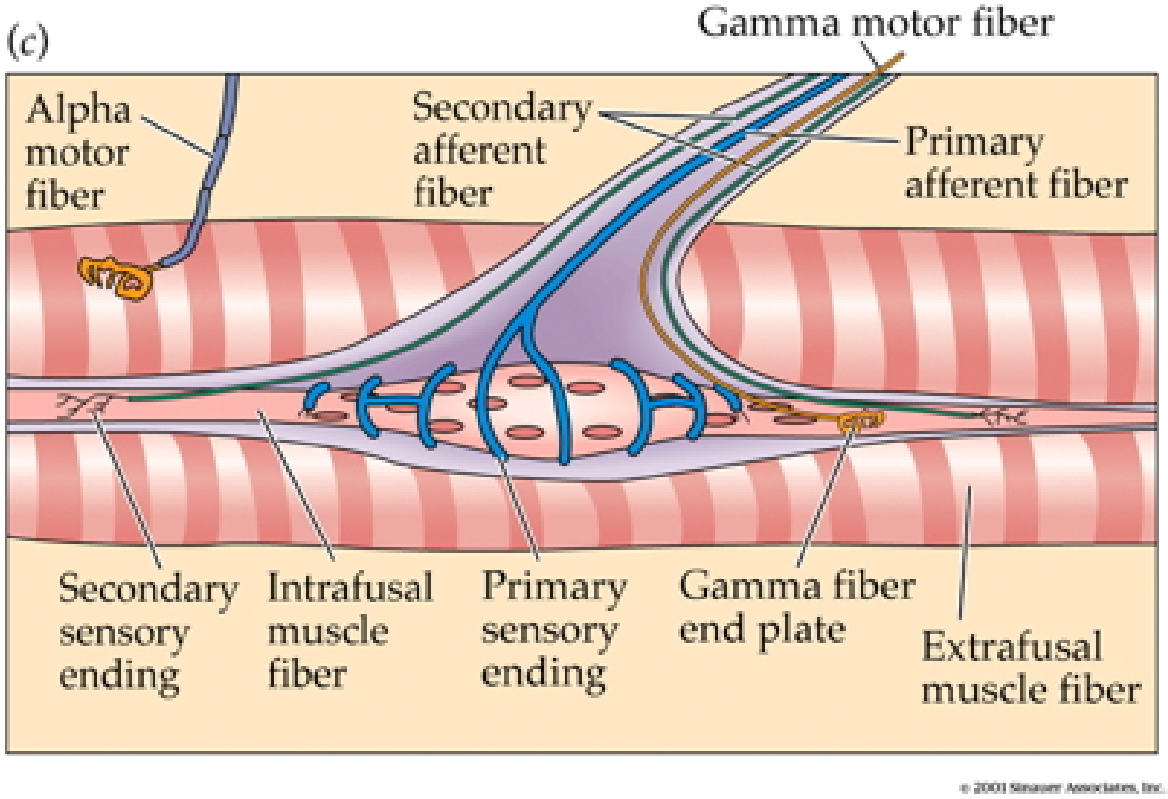
Today's Topics

- The neuroscience of action
- Review for Exam 3

Muscles are sensory organs, too!

© Can Stock Photo

Two muscle fiber types



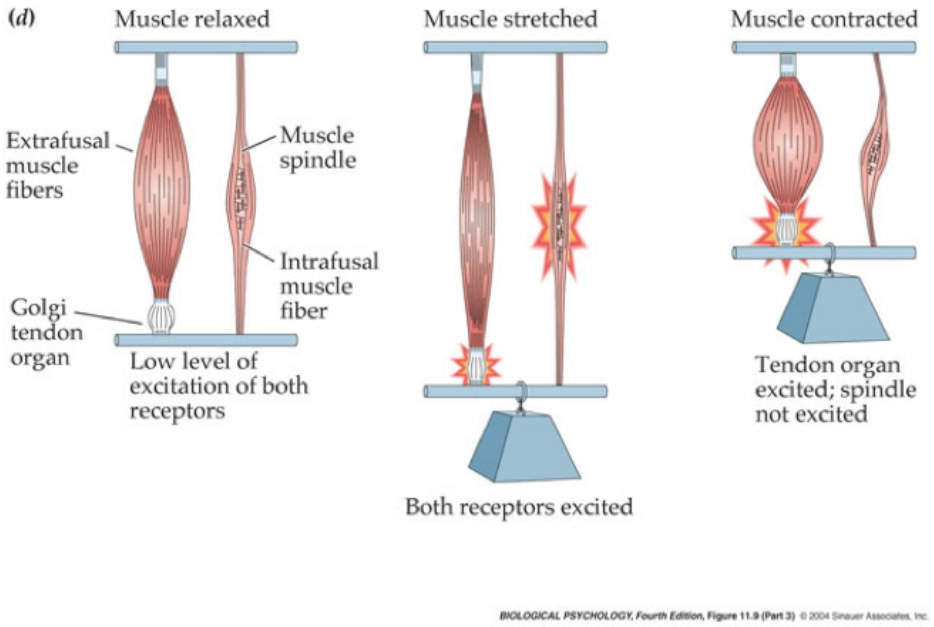
Two muscle fiber types

- Intrafusal fibers
  - Sense length/tension
  - Contain muscle spindles linked to Ia afferents
  - ennervated by gamma (γ) motor neurons
- Extrafusal fibers
  - Generate force
  - ennervated by alpha (α) motor neurons

Monosynaptic stretch (myotatic) reflex

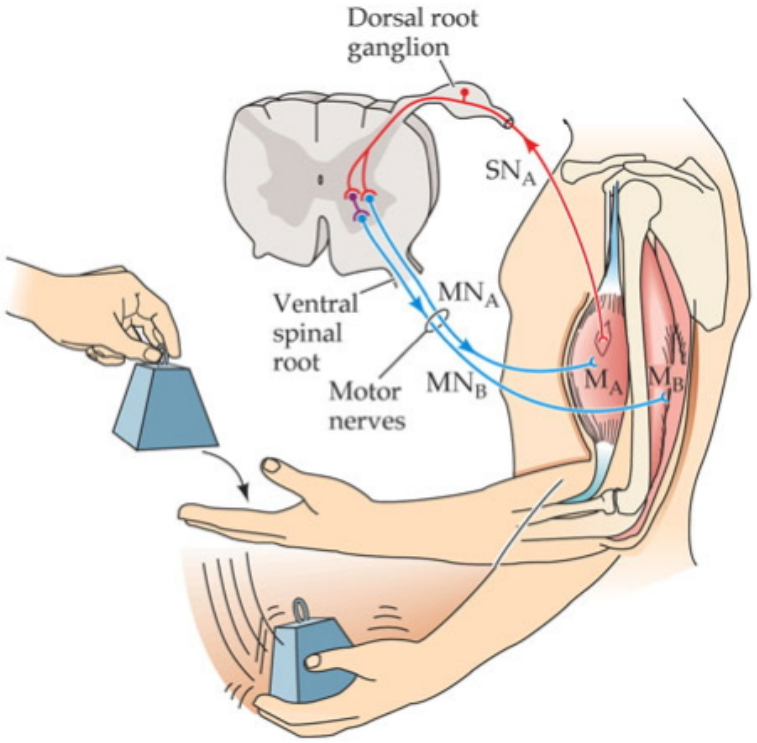
- Muscle stretched (length increases)
- Muscle spindle in intrafusal fiber activates
- Ia afferent sends signal to spinal cord
    - Activates alpha (α) motor neuron
- Muscle contracts, shortens length

Monosynaptic stetch (myotatic) reflex



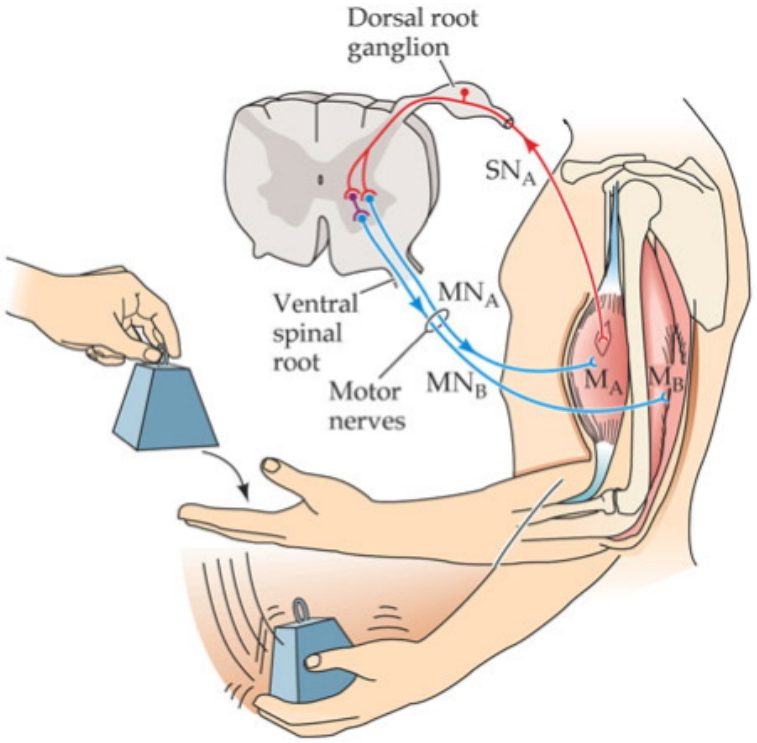
- Gamma (γ) motor neuron fires to take up intrafusal fiber slack

Monosynaptic stretch (myotatic) reflex



BIOLOGICAL PSYCHOLOGY, Fourth Edition, Figure 11.10 (Part 1)

Why doesn't antagonist muscle respond?



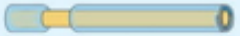
BIOLOGICAL PSYCHOLOGY, Fourth Edition, Figure 11.10 (Part 1) © 2004 Sinauer Associates, Inc.

Why doesn't antagonist muscle respond?

- Polysynaptic inhibition of antagonist muscle
- Prevents/dampens tremor

Brain gets fast(est) sensory info from spindles

TABLE 8.2 *Fibers That Link Receptors to the CNS*

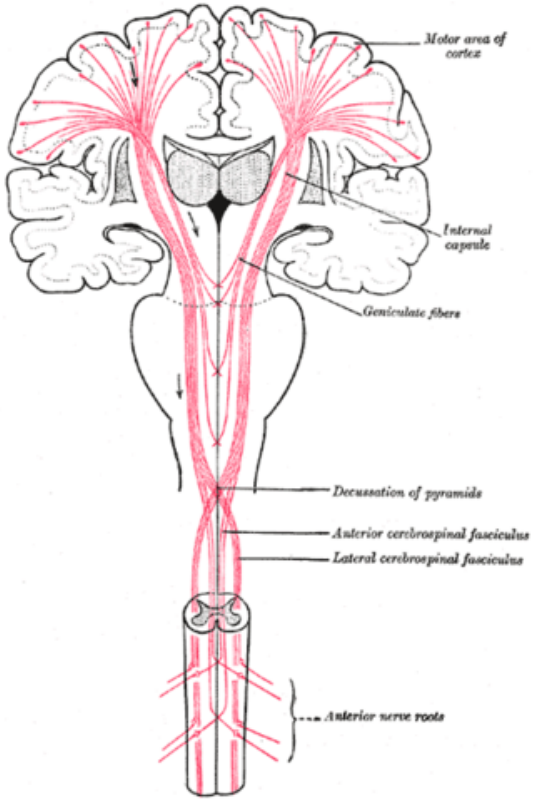
Sensory function(s)	Receptor type(s)	Axon type	Diameter (μm)	Conduction speed (m/s)
Proprioception (see Chapter 11)	Muscle spindle	 Aα	13–20	80–120
Touch (see Figures 8.12 and 8.13)	Pacinian corpuscle, Ruffini's ending, Merkel's disc, Meissner's corpuscle	 Aβ	6–12	35–75
Pain, temperature	Free nerve endings; VRL1	 Aδ	1–5	5–30
Temperature, pain, itch	Free nerve endings; VR1, CMR1	C	0.02–1.5	0.5–2

BIOLOGICAL PSYCHOLOGY, Fourth Edition, Table 8.2 © Sinauer Associates, Inc.

How the brain controls the muscles

- Pyramidal tracts
  - Pyramidal cells (Cerebral Cortex Layer 5) in primary motor cortex (M1)
  - Corticobulbar (cortex -> brainstem) tract
  - Corticospinal (cortex -> spinal cord) tract
- Crossover (decussate) in medulla
  - L side of brain ennervates R side of body

Corticospinal tract

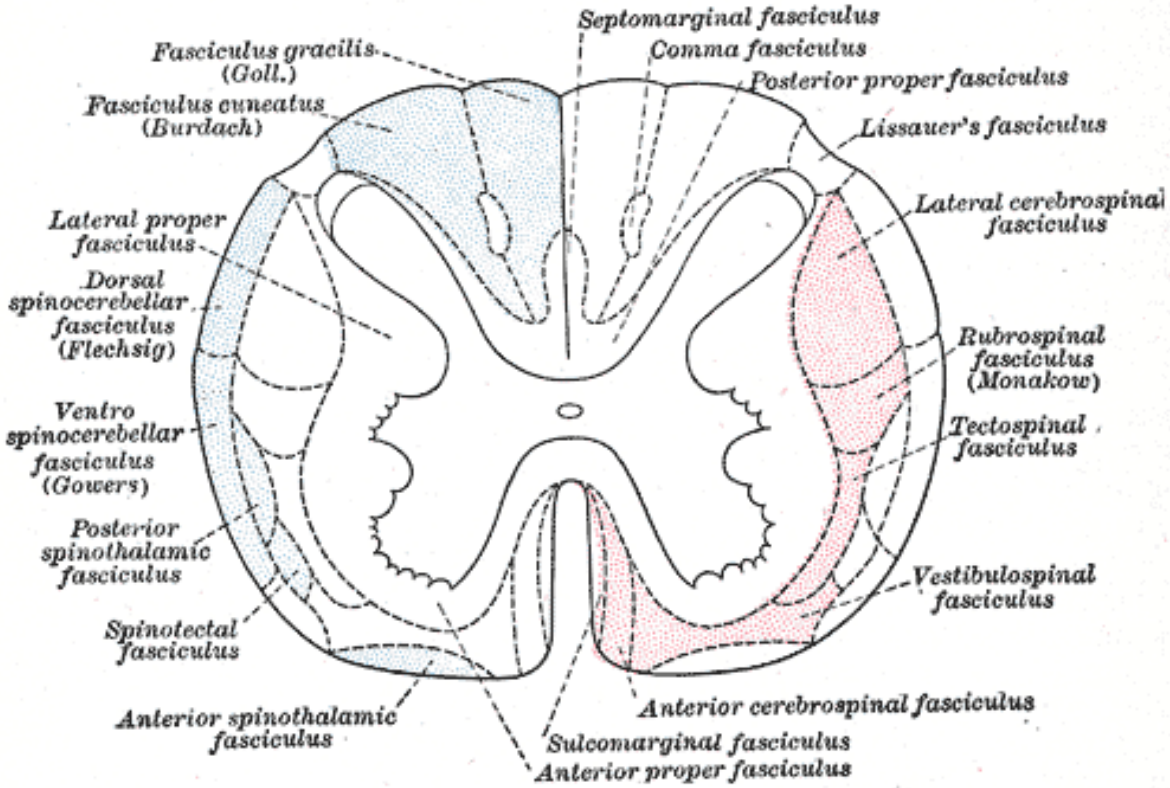


https://commons.wikimedia.org/wiki/File:Gray764.png#/me

How the brain controls the muscles

- Extrapyramidal system
  - Tectospinal tract
  - Vestibulospinal tract
  - Reticulospinal tract
- Involuntary movements
  - Posture, balance, arousal

Extrapyramidal system



https://upload.wikimedia.org/wikipedia/commons/b/be/Gr

Disorders

- Parkinson's
- Huntington's

The Faces of Parkinson's

Faces of Parkinson's

Parkinson's

- Slow, absent movement, resting tremor
- Cognitive deficits, depression
- DA Neurons in substantia nigra degenerate
- Treatments
  - DA agonists
  - DA agonists linked to impulse control disorders in ~1/7 patients (Ramirez-Zamora et al. 2016)
  - Levodopa (L-Dopa), DA precursor

Huntington's

http://cp91279.biography.com/1000509261001/100050926guthrie-centennial-1.jpg

Huntington's

- Formerly Huntington’s Chorea
  - "Chorea" from Greek for "dance"
  - “Dance-like” pattern of involuntary movements
- Cognitive decline
- Genetic + environmental influences
- Disturbance in striatum
- No effective treatment

Huntington's

A family struggles with Huntington's Disease

Final thoughts

- Control of movement determined by multiple sources
- Cerebral cortex + basal ganglia + cerebellum + spinal circuits

Next time…

- Exam 3

References

Ramirez-Zamora, Adolfo, Lucy Gee, James Boyd, and José Biller. 2016. “Treatment of Impulse Control Disorders in Parkinson’s Disease: Practical Considerations and Future Directions.” *Expert Review of Neurotherapeutics* 16 (4): 389–99. doi:10.1586/14737175.2016.1158103.