CONTROL OF MOVEMENT: STRIATED MUSCLES

SKELETAL (STRIATED) MUSCLE:
- each muscle = ____________________________________
- each muscle cell = _______________________________________
- Myosin: Filamentous protein with cross bridges
- Actin: Filamentous protein where cross bridges of myosin bind

ANATOMY OF SKELETAL MUSCLE

MUSCLE CONTRACTION

Watch muscle contraction movie

Heads of cross bridges:
1. Attach to active sites on actin filaments
2. “Ratchet” forward
3. Release
4. Repeat
- Only occurs in the presence of __________

How is calcium released? From activity at neuromuscular junction
**NEUROMUSCULAR JUNCTION**

Synapse between terminal of ___________ and a _________ is called a neuromuscular junction:

Terminals of alpha motor neurons synapse on ___________ - grooves along the surface of muscle fibers;

When motor neuron fires, _________ is liberated from terminals at the endplate and depolarizes muscle fibers - ___________

Depolarization of muscle fiber opens ___________ ____________, producing a large calcium influx into the fiber;

Calcium triggers the actin-myosin “rowing” action leading to the _________ of muscle fibers;

Calcium is extruded from fiber by “pump”;

Endplate potential _____ cause muscle fiber to fire = contraction or “twitch” of fiber.

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**MOTOR UNITS**

Motor unit:

Motor pool: All motor neurons that innervate fibers of a single muscle.

- weak muscular contraction = ________________
- strong contraction = ________________
- discrete/fine movements = ________________
- crude/gross movements = ________________
Localization and distribution of motor neurons in the spinal cord

Somatosensory (mechano) and nociceptive (pain) receptors

Glabrous skin: _________________________________
Hairy skin: __________________________________

There are 3 groups of somatosensory receptors:
1. ______________ 2. ______________ 3. ______________

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<tr>
<th>Receptors (pain and temperature)</th>
<th>Adaptation</th>
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<td>Free nerve endings for pain</td>
<td>Slow</td>
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<td>Muscle spindles (muscle stretch)</td>
<td>Rapid</td>
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<td>Golgi tendon organs (tendon stretch)</td>
<td>Rapid</td>
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<td>Joint receptors (joint movement)</td>
<td>Rapid</td>
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Somatosensory pathway from receptors to somatosensory (primary) cortex:

- Dorsal-root ganglion neurons that carry fine touch and pressure information...
- Have large, myelinated axons whose receptors are located in the skin, muscles, and tendons.

How pain reaches the somatosensory cortex:

1. Dorsal-root ganglion neurons respond to fine touch and pressure, joint, tendons, and muscle changes and pain and temperature.
2. The ventrolateral thalamus relays sensory information to the somatosensory cortex.
3. The thalamus contains areas that carry sensory information to the ventrolateral thalamus.
4. The thalamus contains areas that carry sensory information to the ventrolateral thalamus.
5. The ventrolateral thalamus receives input from pain and temperature receptors and then sends the pathway called the medial lemniscus.
How is the phenomenon of “referred pain” produced?

Arm and shoulder pain “referred” from heart pain receptors during heart attack.

MONOSYNAPTIC STRETCH REFLEX

Involves:
- __________________________
- __________________________
- __________________________
- __________________________
- __________________________
- __________________________

Watch stretch reflex movie
How muscle spindles work!
- Gamma motor neurons provide the _______
- without gamma motor neurons, the spindles would become “slack” and unresponsive ________
- gamma motor neurons function to adjust the length of intrafusal muscles to an appropriate degree of tension

POLYSYNAPTIC REFLEXES:
EXAMPLE OF WITHDRAWAL FROM PAIN
- reflexes requiring ________________________
- concept of ______________________________
- ex., biceps vs. triceps of arms
- reciprocal innervation (excitatory vs. inhibitory)
- excitatory and inhibitory interneurons work together to withdraw limb from pain.
**CROSSED EXTENSOR REFLEX**

Think of this reflex as being “connected” with previous polysynaptic withdrawal reflex.

For example, if flexion reflex triggered in one leg, ________________________

All this happens ____________________:
the brain has nothing to do with it.

This serves to:
- help remove or push entire body away from ___ painful stimulus: _______
- help restore balance when flexed leg is ______ withdrawn.

An example of a complex sensorimotor reflex is ________.
- spinal cat, when placed on a treadmill can initiate normal walking when provided with somatosensory feedback of treadmill on feet.

**GOLGI TENDON REFLEX**

or how not to shred your muscles and bones!

Golgi Tendon Organ: receptor organ sensitive to stretch and located at the junction of the tendon and muscle.
- only contacts __________________
- if maximally activated, ________________

- helps prevent tearing of muscles and tendons from bone

![](golgi_tendon_reflex_diagram.png)