

Muscle:

-Remember know the specific details via each of the slides!!

- 1. Muscle anatomy: Connective tissues, fascicles, and don't mix up fiber, fibril, filament, Anatomical summary and visualize figures will help answer questions**

Muscle and connective tissues -> tendons

Made up of fascicles, which are composed of individual muscle fibers

Sarcoplasm has myofibrils, composed of actin, myosin, filaments organized into sarcomere

- 2. Anatomy of the sarcomere**

I and A bands all line up on top of one another, so sarcomeres on top of another

Muscle boundaries of each sarcomere are the Z-lines bisecting each I-band

I band lighter; made of parallel thin filaments of actin

A band darker; thick filaments of myosin, overlapping with actin

Actin anchored to the Z line; Myosin to the M line

H-zone made up of myosin alone

- 3. Composition of actin and myosin and troponin/tropomyosin complex**

Actin: 2 strings of beads twisted together; each bead of G-Actin; polymerizes to form long strings of F-Actin

Tropomyosin: filamentous ptn in grooves within G-actin beads

Troponin Cpx: regular intervals along tropomyosin; globular proteins

These two intertwine w/ actin control muscle contraction

Bind Ca^{2+} which causes muscle contraction

Myosin: 2 heavy chains with helical tails w/ globular heads

2 myosin light chain proteins: one regulatory, one essential light chain

Many myosin molecules polymerize for one single myosin thick filament

- 4. Know the Importance of Sarcoplasmic Reticulum**

Sarcoplasmic reticulum wraps around each myofibril to allow calcium intake on all areas at once for synchronized contraction.

- 5. Know the Slides that put the entire picture together for the sliding filament theory, APs, and Ca control of skeletal muscle contraction**

Calcium binds so troponin leaves, allowing actin and myosin to bind, pulling the muscle fibers together.

6. Details of how the AP is conducted, causes, and events involved from electric current to how Ca is the intermediary between Electricity vs. mechanical force production

AP conducted through T-Tubules through the sarcoplasmic reticulum into terminal cisternae
Calsequestrin pulls calcium into and stores
Outside of the membrane and middle of sarcomere; little contraction occurred
Increase number of myofibrils, simulate muscle on top of z-disc
On z-disc is T-tubule; deliver AP deep into muscle cell
Organize muscle cell; T-tubules provide link btw plasma membrane and the myofibrils that lie deep to it.
Osmotically shock a muscle cell to pull T-tubules off of membrane; depolarize membrane, no contraction in deep myofibrils, more evidence T-Tubules deliver AP

7. ATP vs Ca in their importance in muscle contraction

ATP added causes a rapid dissociation of cpx into Actin/Myosin-ATP.
ATP is required for dissociation of actin and myosin.
ATP binds to isolated myosin; myosin heads are ATPases which split ATP
ADP and Pi are released slowly from myosin alone
ATP binds to myosin, splitting ATP, allowing myosin to bind to actin -> actomyosin-AD
Pi removed for power stroke to happen (swivel of globular heads towards M-line)
ATP binds, removing the ADP, releasing actin and myosin

8. How did Huxley add to our understanding of the sliding filament theory and How action potentials are delivered deep to muscle tissue

Huxley: stretch muscle past its resting length, the band stayed the same length, but H-zone and I-band would lengthen. When muscle contracted the I band and H zone were shorter in length, so Z discs would move closer to M line, but A band remained the same length. ---Thick and thin filaments do not shorten or lengthen.

9. Twitch vs Tetanus (differences physiologically → summation fused vs. unfused) (be able to explain them physiologically why these happen)

Twitch: brief contraction of muscle fibers that a motor neuron stimulates in response to single AP

Latent period: time it takes for muscle to respond to AP
Lag due to Calcium leaking out of SR to stimulate myofibrils; takes time to remove slack out of muscle before it moves joints
Contraction Period: muscle shortens
Relaxation Period: muscle relax and lengthen; caused by uptake Ca²⁺ by SR
Refractory Period: small period where another AP will not cause contraction

Occurs right in the middle of relaxation; over before muscle is relaxed

10. Note major anatomical differences between Skeletal, Smooth, and Cardiac muscle

Smooth: operates over wide range of length; stretch and still be effective
Layers run in different directions; change shape of organ/peristalsis
Contracts and relaxes more slowly
Uses less energy
Can stay contracted long time maintaining force w/o fatigue
Small fusiform cells, single nucleus, no striations

Skeletal: striated, voluntary control, attached to bones through tendons, large, multinucleated

Cardiac: involuntary striated, only in heart, uninucleated, intercalated discs connect them, branched.

11. Single vs Multiunit smooth muscle

Single unit: contracted by gap junctions, cells contract as single unit
Multiunit: electronically linked, each cell must be stimulated independently

12. Differences between where the muscle types receive Ca

Smooth muscle: intracellular calcium concentration increases when calcium enters cells and is released from SR; calcium binds to calmodulin

13. Anatomical differences between skeletal and smooth muscle particularly in the organization of actin and myosin and how contraction occurs (physiology and ways smooth muscle is told to contract)

Smooth muscle: calcium unbinds from calmodulin and myosin phosphate removes phosphate from myosin light chains, decreasing myosin ATPase activity; Less myosin ATPase results in decreased muscle tension

14. Calsequestrin vs Troponin/tropomyosin vs. comodulln

Calsequestrin: calcium-binding protein of SR; holds calcium in the cisterna of SR after a muscle contraction; store extraordinary amounts of calcium.

Troponin/Tropomyosin: integral in muscle contraction in skeletal and cardiac muscle; troponin attached to tropomyosin to block attachment site of myosin crossbridge preventing contraction. When stimulated by action potential, calcium channels open in