Muscle Anatomy & Physiology - Ch. 10

- Skeletal Muscle
  - –Striated, voluntary (somatic motor nerves control), relatively large cells, most of the muscle mass of body
- Cardiac Muscle
  - –Striated, involuntary (ANS, hormones control), autorhythmic (pacemaker)
- Smooth Muscle
  - –Non-striated, involuntary (ANS & hormones), line hollow vessels, airways, organs, some autorhythmic, efficient

Structure/Function well understood

- Molecular Level: contractile proteins, energy stores, oxygen-binding molecules
- Cellular level: mitochondria, nuclei, motor end place, sarcolemma, sarcoplasm, sarcoplasmic reticulum
- Organ level: muscle mechanics, shape and attachment, motor units
- Support systems: capillary density
- Organismal level: performance (speed vs. power, fast vs. slow, fatigue vs. not, aerobic vs. anaerobic

Skeletal muscle & connective tissue (Fig 10.1)

- ORGAN: Muscle surrounded by epimysium
- Fascicle surrounded by perimysium
- CELL: myofiber separated by endomysium
- Tendon

Organelle level

- Myofibril (up to 80% of cell contents)
- Sarcomere: functional contractile unit
- Thick and Thin filaments (see Fig 10.4)
- Know the names of the proteins, zones, lines in a sarcomere (Fig 10.5)

Muscle proteins (Fig 10.6)

- Thick filament (myosin heads and tails)
  - –About 300 molecules, head to the outside
- Thin filament (actin, F & G, tropomyosin and troponin
- Titin and other proteins provide structure & elasticity

Sliding filament mechanism of contraction (Fig 10.7)

- What happens to the length of the sarcomere, A band, I band and H zone during contraction?
- What does this tell you about how filaments slide during contraction?

Sliding filaments

- The filaments don't change length
- Slide past one another
- Cross bridges form between them
- Pull the filaments toward the center of the sarcomere so that the sarcomere gets shorter (or develops tension)

Myosin roles

1. Structure role
2. Cross bridge role
3. Enzymatic role (ATPase)

- Cross bridges protrude out at ~120° and twist so that next set stick out about 60° off from the previous set
- Contact the actin molecule binding site

Cross bridges

- Muscle at rest, cross bridges broken
- During contraction, ~ 1/2 cross bridges made and 1/2 broken, repeat, like pulling a rope toward you, hand over hand
- Power stroke

Thin filament (fig 10.6)

- Two coiled strands of F-actin (filamentous) made of G-actin (globular) sub-units
- Each G actin has a binding site for myosin
- Tropomyosin- rod-like, over the actin groove, covers myosin binding site in relaxed state
- Troponin- globular protein with 3 subunits, binds tropomyosin, binds Ca^{++}, binds actin
- Regulatory role for tropomyosin and troponin

Resting/ contracting states

- Resting- no cross bridges formed because tropomyosin "in the way"
- Contracting-
  - Ca^{++} causes conformational change
  - tropomyosin shifts into the actin groove
  - actin's binding site revealed
  - myosin binds to form bridge
  - Myosin bridge rotates to pull actin toward sarcomere center

Next time

- Where does energy come from and how is it used?
- Where does the calcium come from and how is it controlled?
- Excitation - contraction coupling
  - –How does nerve function translate into muscle function