Personal Training Notes

Chapter 1

- Structure and function of the muscular, nervous, and skeletal systems
  - 3 types of muscle
    - Smooth (no control of)
    - Cardiac (can be trained) (other striated)
    - Skeletal – Attaches to bone > movement (mainly focused on)
      - Striated
  - Connective Tissue
    - Epimysium
      - Surrounds each skeletal muscle
    - Perimysium
      - Surrounds each fascicle (bundle of muscle fibers)
    - Endomysium
      - Surrounds individual muscle fibers
    - Together…
      - These connective tissues help transmit the force of muscle contraction to the bone via tendon.
  - Fascicle
    - AKA – Fasciculus
    - Bundle of muscle fibers
    - Not all the same size
      - Can contain up to 150 fibers
    - Encased by Perimysium
  - Muscle Fiber
    - AKA – Muscle Cell
    - Cylindrical cell containing hundreds of nuclei
    - Can be as long as 30 centimeters
    - Encasing each muscle fiber is Endomysium
  - Muscle Organization
    - Whole muscle > Fascicle > Muscle fiber > Myofibrils > Myofilaments
  - Within The Muscle Fiber…
    - Myofibrils
    - Opening to T-Tubule
    - Mitochondrion
    - Sarcoplasmic reticulum
    - T-Tubule
    - …
  - Myofibrils – The contractile element of skeletal muscle
  - Inside the myofibrils

        - Sarcomere
            - "Functional unit of muscle"
            - Extends from one Z-line to an adjacent…
    - Myosin
        - Attaches to Actin to create muscle contraction
    - Sarcomere
        - A-band
            - Determined by the width of a myosin filament
                - Myosin filaments are "anchored" to Z-line via Titin
            - Provides the <u>dark striation</u> of skeletal muscles
        - I-band
            - Spans the distance between ends of adjacent myosin filaments
            - Less dense than A-bands
            - Responsible for giving skeletal muscles its <u>light striation</u>
        - H-zone
            - Area of A-band that contains myosin <u>not</u> actin
        - M-line
            - Dark line in the middle of the H-zone
            - Helps align adjacent myosin filaments
    - Sliding Filament Theory
        - 1. Action potential is generated and transverses the axon to the axon terminal which releases stored acetylcholine (ACh) in synaptic vesicles into the neuromuscular junction (NMJ)
        - 2. ACh migrates across the synaptic cleft to the the ACh receptors (ligandgated) on the motor endplate
        - 3. Action potential is created along the sarcolemma which travels down the t-tubulues, triggering the release of Ca^{2+} from the sarcoplasmic reticulum (SR)
        - 4. Ca^{2+} migrates to and binds with troponin
        - 5. Binding results in conformation changes in troponin which results in the exposure of myosin head binding sites on actin
        - 6. Myosin head attach to the binding sites on the actin filament forming a cross-bridge. ADP and P, dissociate from the myosin head resulting in a "power-stroke" action. ATP binds to the myosin heads and is quickly hydrolyzed…
        - 7. ….
    - Types of Muscle Actions
        - Concentric
            - Muscular force is <u>greater than</u> the external force
            - Muscle shortens
        - Eccentric

            - Muscular force is less than the external force
            - Muscle lengthens although the muscle is attempting to shorten
        - Isometric
            - Muscular force is equal to that of the external force
            - No length changes
    - DOMS – Delayed-Onset Muscle Soreness
        - Originally believed to be the result of lactic acid/lactate + H' accumulation!!!
        - Recently, it has been demonstrated that DOMS is a result of **microscopic tears** in connective and muscle tissues
        - Treatment:
            - Supplements, massage, ice, ultrasound, EXERCISE
    - Muscle Fiber Types:
        - Type I: Slow oxidative (SO), Slow Twitch
            - Generate ATP primarily via aerobic means
                - High oxidative capacity
                - LOTS of mitochondria
                - VERY dense vasculature
                - Contains myoglobin (muscle version of hemoglobin)
        - Type IIa and Type IIx: Fast oxidative glycolytic (FOG) and Fast glycolytic (FG)
            - Generate ATP via anaerobic means
            - High ATPase activitiy
        - Type IIx: …
    - Organization of the nervous system
    - Neurons
        - Motor neurons
            - Conduct impulses from the CNS to the muscles
        - Sensory neurons
            - Carry impulses from the periphery to the CNS
        - Dendrites receive excitatory and inhibitory signals; if sufficiently excited, a neuron will generate an AP
            - Cell body and dendrites found in anterior gray horn of the spinal cord…
    - Proprioceptors
        - WHY are specialized receptors in muscles, joints, and tendons IMPORTANT??
        - Muscle Spindles – spindle-shaped sensory organ found within skeletal muscles… Monitors Stretch
        - Golgi Tendon Organs…. Monitors Tension
    - DONE TAKING NOTES…