1.2Summarize the organelles and structures found in body cells - pp. 83-95
2.1Membrane Transport - pp. 63-79
2.2Physiology of the Neuron - pp. 390-414
2.3Physiology of Muscles - pp. 277-311

- Muscle fibers
  - Skeletal muscle
    - Attaches and covers *skeleton*
    - Longest muscle cells with stripes called *striations*
    - *Voluntary* muscle
    - tires easily but can be really powerful
    - each fiber is supplied with nerve ending to control activity
    - rich blood supply
  - Smooth muscle
    - hollow *visceral* organs (stomach, urinary bladder..)
    - *nonstriated* & elongated cells
    - Slow & sustained
    - *Involuntary*
    - can contract w/out nerve stimulation
  - Cardiac
    - *Heart* walls
    - *Striated*
    - *Involuntary*
    - steady rate
    - can contract w/out nerve stimulation

- Excitability (ability to receive and respond to a stimulus)
- Contractility (ability to shorten)
  - producing movement & locomotion
  - heat generation (maintaing *body temperature* because *skeletal muscles* account for 40% of body mass)
- Extensibility (extending & stretching ability)
- Elasticity (recoil and resume resting length)

  - maintaining posture & position (against gravity)
  - Stabilizing joints

- Epimysium
  - dense and irregular connective tissue that surrounds the outside of the whole muscle
- Perimysium/Fascicles
  - muscle fibers are grouped into bundles(F) that are surrounded by connective tissue (P)
- Endomysium
  - connective tissue surrounding every muscle fiber (fine areolar CT)

- Direct attachments
  - epimysium is fused to the periosteum of bone or perichondrium of cartilage
- Indirect attachments

- CT extends as a ropelike tendon or sheetlike aponeurosis which anchors it to the CT covering bone/fascia of other muscles
- Sarcolemma = muscle cell's plasma membrane
- Glycosomes = granules of store glycogen for glucose during activity)
- Myoglobin = stores oxygen
- Myofibrils
  - 1 muscle fiber has many myofibrils (80% of cellular volume)
  - dark A bands
    - light midsection H zone
      - bisected vertically by dark M line (myomesin protein)
  - light I bands
    - midline interruption of Z line
    - Z line to Z line = a sarcomere
  - Thick myosin filament (red)
    - extends entire length of A band
    - Anchored by M line
    - myosin heads
      - bear actin and ATP binding sites
  - Thin actin filaments (blue)
    - extend across I band and partway into A band
    - Anchored by Z discs
    - composed mainly of actin proteins
      - globular actin - bears active sites to which myosin heads attach
    - tropomyosin
      - stabilize
      - block myosin-binding sites
    - troponin
      - polypeptides
        - TnI – inhibitory subunit – binds to actin
        - TnT – binds to tropomyosin – position it on actin
        - TnC – binds calcium ions
  - Tintin (yellow)
    - extends from Z disc to thick filament
    - holds thick filaments in place
    - helps muscle regain shape after stretching
  - Dystrophin
    - links thin filaments to proteins of sarcolemma

- Triad relationship (T-Sarc-T)
  - Sarcoplasmic reticulum (dark blue “veins”)
    - regulates intracellular levels of ionic calcium
  - T Tubulues (light blue line)
    - Increases the muscle fiber's surface area
    - Conduct impulses to the deepest regions of the muscle cell
    - signals the release of calcium

- Muscle Contraction
    - Phase 1 (motor neuron stimulates muscle fiber~inside of muscle fiber is more negative)

1. Action potential reaches the terminal end of the axon at *neuro***muscular** junction
2. Ca2+ entry causes ACh to be released from axon which binds to receptors on (muscle) sarcolemma
3. Ion permeability of Sarcolemma changes (allowing Na+ into muscle and K+ out of muscle (more Na+ enters))
4. ACh effects are ended when acetylcholinesterase breaks down ACh in the synaptic cleft and diffuses away

    - Phase 2

1. Action potential travels across the entire sarcolemma
2. AP travels along the T tubules
3. Sarcoplasmic reticulum releases Ca2+ which then goes and binds to troponin(changes shape) causing tropomyosin filaments on actin to move and expose the myosin-binding sites (active sites)
4. Myosin heads use energy released from breaking ATP hydrolysis ADP and inorganic phosphate, myosin binds (inorganic phosphate is released = strengthens bond), ADP is released and activated myosin head pivots sliding thin myofilament towards centre of sarcomere, ATP attaches and weakens & breaks bond, etc..

- Action potential
    - End plate potential
        - depolarization – chemically gated ion channels allow Na+ and K+ to pass
    - Depolarization
        - threshold is reached
    - Repolarization (refractory period)
        - Na+ channels close and K+ channels open ~ restores negative conditions inside
        - cell cannot be stimulated again until this is complete
        - repolarization restores electric conditions
        - ATP pump for Na and K restores ionic conditions
- Excitation – Contraction Coupling
    - sequence of events where the AP along the sarcolemma causes myofilaments to slide
- Rigor mortis – calcium is unable to dissipate and all ATP is used us = stiffness
- Motor Unit
    - one motor neuron & muscle fibers that it innervates/supplies
    - fine control = small motor unit
    - stimulation of 1 motor unit = weak contraction of *entire* muscle
- Muscle Twitch
    - Latent period – cross bridges begin
    - Contraction period – cross bridges are active
    - Relaxation period – Ca exits ~ muscle relaxes
- Graded Muscle Response
    - stimulus frequency
        - wave/temporal summation = increasing firing rate of motor neurons (2^{nd} twitch stronger than 1^{st})

        - unfused /incomplete tenanus
            - fused/complete tenanus
    - stimulus strength
        - recruitment/multiple motor unit summation
        - smooth continuous muscle contractions
        - sub-threshold stimuli
        - threshold stimulus
        - maximal stimulus
- Isotonic contraction ~ muscle develops tension and overcomes resistance, shortens
    - concentric – does work
    - eccentric – generates force
- Isometric contraction ~ muscle is stimulated & develops tension but is unable to overcome resistance, does not shorten
- Muscle tone = relaxed muscles are always slightly contracted

- Direct Phosphorylation of ADP by creatine phosphate (CP)
    - CP w/ ADP transfers energy and a phosphate group from CP to ADP to form ATP quickly
- Anaerobic pathway: Glycolysis & Lactic Acid
    - pyruvic acid produced during glycolysis is converted into lactic acid
- Aerobic respiration
    - 95% of ATP

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