Chp. 12 Muscular S.

Review: 3 types of muscle tissue
- Smooth – involuntary muscle found in hollow organs and vessels
- Cardiac – involuntary muscle found in the heart
- Skeletal – voluntary muscle that is attached to the skeleton

12.1 Overview of the muscular system

What are the functions of skeletal muscles?
1. Support the body by allowing us to stay upright
2. Allow for movement by attaching to the skeleton
3. Help maintain a constant body temperature
4. Assist in movement in the cardiovascular and lymphatic vessels
5. Protect internal organs and stabilize joints

How are skeletal muscles arranged?
- Attachments:
  - Tendon – connective tissue that connects muscle to bone
  - Origin – attachment of a muscle on a stationary bone
  - Insertion – attachment of a muscle on a bone that moves
- Action:
  - Antagonistic – muscles that work in opposite pairs
  - Synergistic – muscles working in groups for a common action
12.1 Overview of the muscular system

An example of muscle arrangement

Examples of how skeletal muscles are named

- Size – the gluteus maximus is the largest buttock muscle
- Shape – the deltoid is triangular (Greek letter delta is $\Delta$)
- Location – the frontalis overlies the frontal bone
- Direction of muscle fiber – the rectus abdominus (rectus means straight)
- Attachment – the brachioradialis is attached to the brachium and radium
- Number of attachments – the biceps brachii has two attachments
- Action – the extensor digitorum extends the digits
12.2 Skeletal muscle fiber contraction

Visualizing muscle structure

The sarcomere

- Made of two protein myofilaments
  - Myosin: are the thick filaments shaped like a golf club
  - Actin: are the thin filaments
  - These filaments slide over one another during muscle contraction

The beginning of muscle contraction: The sliding filament model

1. Nerve impulses travel down motor neurons to a neuromuscular junction
2. Acetylcholine (ACh) is released from the neurons and bind to the muscle fibers
3. This binding stimulates fibers causing calcium to be released from the sarcoplasmic reticula
12.2 Skeletal muscle fiber contraction

The beginning of muscle contraction

The beginning of muscle contraction

Muscle contraction continued…

4. Released calcium combines with troponin, a molecule associated with actin

5. This causes the tropomyosin threads around actin to shift and expose myosin binding sites

6. Myosin heads bind to these sites forming cross-bridges

7. ATP bind to the myosin heads and is used as energy to pull the actin filaments towards the center of the sarcomere = contraction now occurs

Visualizing the role of calcium and myosin in muscle contraction
Terms in whole muscle contraction

- Motor unit – a nerve fiber and all of the muscle fibers it stimulates
- Muscle twitch – a single contraction lasting a fraction of a second
- Summation – an increase in muscle contraction until the maximal sustained contraction is reached
- Tetanus – maximal sustained contraction
- Tone – a continuous, partial contraction of alternate muscle fibers causing the muscle to look firm

Physiology of skeletal muscle contraction

Where are the fuel sources for muscle contraction?

- Stored in the muscle:
  - Glycogen
  - Fat
- In the blood:
  - Glucose
  - Fatty acids
What are the sources of ATP for muscle contraction?

- Limited amounts of ATP are stored in muscle fibers
- Creatine phosphate pathway (CP) – fastest way to acquire ATP but only sustains a cell for seconds; builds up when a muscle is resting
- Fermentation – fast-acting but results in lactate build up
- Cellular respiration (aerobic) – not an immediate source of ATP but the best long term source

Types of muscle fibers

Health focus: Benefits of exercise

- Increases muscle strength, endurance and flexibility
- Increases cardiorespiratory endurance
- HDL increases thus improving cardiovascular health
- Proportion of protein to fat increases favorably
- May prevent certain cancers: colon, breast, cervical, uterine and ovarian
- Improve density of bones thus decreasing the likelihood of osteoporosis
- Enhances mood and may relieve depression
12.4 Muscle disorders

**Common muscle disorders**
- Spasms – sudden, involuntary muscle contractions that are usually painful
- Seizure – multiple spasms of skeletal muscles
- Cramps – strong, painful spasms often of the leg and foot
- Strain – stretching or tearing of a muscle
- Sprain – twisting of a joint involving muscles, ligaments, tendons, blood vessels and nerves
- Tendonitis – inflammation of a tendon usually due to overuse (i.e. tennis elbow)
- Bursitis – inflammation of a bursa usually from repetitive use or frequent pressure

**Muscular diseases**
- Fibromyalgia – chronic achy muscles that is not well understood
- Muscular dystrophy – group of genetic disorders in which muscles progressively degenerate and weaken
- Myasthenia gravis – autoimmune disorder that attacks ACh receptor and weakens muscles of the face, neck and extremities
- Amyotrophic lateral sclerosis (ALS) – commonly known as Lou Gehrig’s disease in which motor neurons degenerate and die leading to loss of voluntary muscle movement

12.5 Homeostasis

**Bioethical focus: Anabolic steroids?**
- Anabolic steroids are a group of steroids that usually increase protein production
- Most common side effects are high blood pressure, jaundice, acne and great increased risk of cancer
- Abuse of these drugs may also cause impotence and shrinking of the testicles
- May lead to increased aggressiveness and violent mood swings
- Are they worth the risk?
- Should they be legal to use in athletics?