Muscular System Study Guide
Answer Key
Fall 2011
1. List the three types of muscle tissue and location or example of each. Indicate whether the muscle is generally voluntary or involuntary. Finally, briefly state one histological aspect of the muscle type that would distinguish it from the other two. (12 pts)

<table>
<thead>
<tr>
<th>Muscle Type</th>
<th>Location/Example</th>
<th>Voluntary or Involuntary?</th>
<th>Histological Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Skeletal</td>
<td>Skeletal muscle - biceps</td>
<td>Vol.</td>
<td>Multiple Nuclei - Striations</td>
</tr>
<tr>
<td>B. Smooth</td>
<td>Organs - Stomach</td>
<td>Invol.</td>
<td>Single Nucleus - No Striations</td>
</tr>
<tr>
<td>C. Cardiac</td>
<td>Heart</td>
<td>Invol.</td>
<td>Single Nucleus - Faint Striations</td>
</tr>
</tbody>
</table>

2. Layers of fibrous connective tissue called **Fascia** separate an individual skeletal muscle from adjacent muscles and hold it in position. This tissue often projects beyond the end of the bone to form a cordlike **Tendon**. Fibers within this often intertwine with a bone's periosteum attaching the muscle to the bone. Excess strain on a tendon can cause it to begin to separate and tear from the bone which can be very painful. An example of this is what occurs in the pulling away of the tibialis anterior muscle from the tibia or shinbone. We often call this "**shin splint**". Proper stretching and warming of a muscle prior to vigorous exercise may help avoid this.

3. When a tendon becomes painfully inflamed and swollen following injury or the repeated stress of athletic activity, this is known as **tendonitis**.

4. An individual muscle like the biceps brachii is actually a large bundle of fibers. These individual fibers are called **Fascicles** each of which is actually a bundle of smaller muscle fibers that are the individual cells. These cells are known as **fibrils**. Each muscle fibril contains yet smaller fibers known as **myofibrils**. Inside each of these fibers are tiny protein threads called **filaments**. These threads are of two types. The thick, dark threads are called **myosin** and the thin, light threads are called **actin**. These threads are arranged in repeating microscopic patterns called **sarcosomes**. These patterns are responsible for the striation appearing histologically in skeletal muscle. It is here where the actual contraction of the muscle occurs.
5. Muscles can actively both shorten and lengthen. True False [X]

6. Briefly state the five requirements necessary for a muscle to contract.
   I. Neuron Stimulation
   II. Oxygen
   III. Energy
   IV. Calcium
   V. Not too acidic pH

7. Oxygen is stored in muscle tissue bonded to a protein molecule called myoglobin. When oxygen levels are high, the muscle is bright red in color. Of what blood protein does this remind you? Hemoglobin
   As butchered meat ages, this protein breaks down and along with it, the muscles' ability to hold oxygen. This gives the "old" meat a grayish color. The same thing occurs when meat is cooked.

8. Glucose is the body's first or ultimate choice of energy.

9. Cellular Respiration is the process by which glucose is oxidized (broken down) for energy. It results in the formation of cellular "bomb" molecules that can be broken down to release energy. It occurs in the mitochondria, cellular organelle.

10. Fill in the chart below to indicate the two types of cellular respiration based upon available oxygen levels in the cells. Indicate the number of ATP molecules formed from one oxidized glucose and whether or not lactic acid is produced during the process. (6 pts)

<table>
<thead>
<tr>
<th>Cellular Respiration Type</th>
<th>Number of ATP produced from 1 glucose</th>
<th>Produces lactic acid (Yes or No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Aerobic</td>
<td>36</td>
<td>No</td>
</tr>
<tr>
<td>B. Anaerobic</td>
<td>2</td>
<td>Yes</td>
</tr>
</tbody>
</table>
11. What causes the burning sensation in a fatigued muscle?  
   Lactic acid builds up.

12. With which contraction requirement does this interfere, causing poor ability of the muscle to contract?  
   Too low pH

13. What happens to lactic acid that diffuses into the bloodstream? (2 pts)  
   To what organ does it go?  
   Liver  
   To what is it "recycled"?  
   Glucose

14. Complete depletion of ATP within a muscle cell causes the muscle to "lock up", often called a cramp. Dependent on surrounding temperature this occurs a few hours after death to every muscle cell. The term for this is known as RIGOR MORTIS. Once the muscle proteins begin to decompose, the body relaxes again.

15. If a person lifts weights to build up their muscles, what is this called?  
   Hypertrophy
   What actually happens to the tiny actin and myosin filaments in the worked muscle cells? (2pts)  
   Torn; repair and rebuild more

16. Atrophy occurs to muscles if they are not worked for a period of time. This often occurs when limbs are placed in casts, when one suffers some type of paralysis, or one is bedridden for long periods of time.

17. What type of organism causes botulism food poisoning?  
   Bacteria

18. In what type of food condition is it most likely to be found?  
   Canned

19. How does the toxin from the botulism organism cause death?  
   Doesn't allow acetylcholine release to respiratory muscles → no contraction

13
20. Based on the above question, what substance is injected into some facial muscles by physicians to lessen the appearance of wrinkles? (2 pts)
   
   **Botox**

   Name one facial muscle into which it might be injected.
   
   **Frontalis**

21. Briefly describe what happens in the disease Muscular Dystrophy in a very **general** sense. (Be aware that several forms of the disease exist with varying severity, age of onset, prognosis and even causes, most being genetic.) (2 pts)

   Protein dystrophin missing - helps hold actin in place - missing in MD patient's muscles weaken, degenerate - replaced by fat and connective tissue

22. How does the viral disease polio impact the muscular system? List two ways. (2 pts)

   **Virus** - Attacks motor neurons of brain/Spinal - can't stimulate muscles 

   **Virus** - Causes paralysis

23. The space between a neuron axon and a muscle fiber is known as the **neuromuscular junction**.

24. The chemical that must diffuse from the neuron axon to the muscle fiber is generally known as a **neurotransmitter**. One of the most common ones released to stimulate muscles is **acetylcholine**.

25. **Calcium** is the ion electrolyte that must diffuse into a stimulated muscle to remove inhibiting proteins from the bonding active sites on actin filaments.
Energy supplied to allow the actin and myosin to interact within a sarcomere is provided by the breakdown of ATP. One of these molecules "cocks" and elongates the thin myosin filament crossbridge, allowing it to extend and bond with the thin actin filament active site. This allows the thin filament to be pulled to the center of the sarcomere. A second ATP energy molecule is split that allows the bond to be broken. As the process alternately makes and breaks bonds, it thereby shortens or contracts the entire muscle. This process occurs in billions of sarcomeres along the length of the muscle.

Relaxation of the sarcomere/muscle occurs when calcium ions are actively transported out of the sarcomere and the inhibiting proteins once again cover the bonding sites. The actin fibers slide backwards.

Athletes have purposefully injected synthetic versions of the male sex hormone testosterone (steroids) into their bodies. The reasoning behind this is that the hormone leads to the build up of more muscle fibers and therefore an increase in the muscle's strength.
In males, the body responds by producing (more less) natural testosterone. Name two symptoms a male might exhibit as a result of this steroid use.
A. Sterility, impotence
B. Violence
In females, the effects tend to be masculinizing. Name two symptoms a female might exhibit as a result of this male steroid use.
A. Masculine hair, enlarged clitoris
B. Enlarged larynx, deep voice
Loss of menstrual cycle

Type of muscle fibers might one have as a majority in her body muscle mass if she is good at long distance running?
Type of muscle fibers might one have as a majority in his body muscle mass if he is good at weight lifting or short sprint running?

Fast Twitch
Slow Twitch
Label the diagram below showing a neuromuscular junction between and its stimulating neuron. Use these choices: muscle fiber, actin, neuron axon, myosin, sarcomere, muscle cell nucleus, motor end plate, neuron axon, myofibril, mitochondria, actin, myosin, sarcomere, acetylcholine.