OVERVIEW OF MUSCLE TISSUES

1. Nine characteristics of muscle tissue are listed below and on page 104. Identify the muscle tissue type described by choosing the correct response(s) from the key choices. Enter the appropriate term(s) or letter(s) of the key choice in the answer blank.

Key Choices

A. Cardiac    B. Smooth    C. Skeletal

A, B SMOOTH  1. Involuntary
A, C SKELETAL  2. Banded appearance
B SMOOTH  3. Longitudinally and circularly arranged layers
C SKELETAL  4. Dense connective tissue packaging
A CARDIAC  5. Figure-8 packaging of the cells
A CARDIAC  6. Coordinated activity to act as a pump
C SKELETAL  7. Moves bones and the facial skin
C SKELETAL  8. Referred to as the muscular system
C SKELETAL  9. Voluntary

2. Identify the type of muscle in each of the illustrations in Figure 6–1. Color the diagrams as you wish.

Figure 6–1
Chapter 6  The Muscular System

MICROSCOPIC ANATOMY OF SKELETAL MUSCLE

4. First, identify the structures in Column B by matching them with the descriptions in Column A. Enter the correct letters (or terms if desired) in the answer blanks. Then, select a different color for each of the terms in Column B that has a color-coding circle and color in the structures on Figure 6-2.

Column A

G Perimysium  1. Connective tissue surrounding a fascicle
B Epimysium  2. Connective tissue ensheathing the entire muscle
I Sarcomere  3. Contractile unit of muscle
D Fiber  4. A muscle cell
A Endomysium  5. Thin connective tissue investing each muscle cell
H Sarcolemma  6. Plasma membrane of the muscle cell
F Myofibril  7. A long, filamentous organelle found within muscle cells that has a banded appearance
E Myofilament  8. Actin- or myosin-containing structure
K Tendon  9. Cordlike extension of connective tissue beyond the muscle, serving to attach it to the bone
C Fascicle  10. A discrete bundle of muscle cells

Column B

A. Endomysium
B. Epimysium
C. Fascicle
D. Fiber
E. Myofilament
F. Myofibril
G. Perimysium
H. Sarcolemma
I. Sarcomere
J. Sarcoplasma
K. Tendon

Figure 6-2
5. Figure 6–3 is a diagrammatic representation of a small portion of a relaxed muscle cell (bracket indicates the portion enlarged). First, select different colors for the structures listed below. Use them to color the coding circles and corresponding structures on Figure 6–3. Then bracket and label an A band, an I band, and a sarcomere. When you have finished, draw a contracted sarcomere in the space beneath the figure and label the same structures, as well as the light and dark bands.

- Myosin
- Actin filaments
- Z disc

Looking at your diagram of a contracted sarcomere from a slightly different angle, which region of the sarcomere shortens during contraction—the dark band, the light band, or both?
6. Complete the following statements relating to the neuromuscular junction. Insert the correct answers in the numbered answer blanks.

1. **Motor Unit**
   - A motor neuron and all of the skeletal muscle cells it stimulates is called a __________.
2. **Axonal Terminals**
   - The axon of each motor neuron has numerous endings called __________.
3. **Synapse or Synaptic Cleft**
   - The actual gap between an axonal ending and the muscle cell is called a __________.
4. **Acetylcholine**
   - Within the axonal endings are many small vesicles containing a neurotransmitter substance called __________.
5. **Action Potential**
   - When the __________ reaches the ends of the axon, the neurotransmitter is released, and it diffuses to the muscle cell membrane to combine with receptors there. Binding of the neurotransmitters with muscle membrane receptors causes the membrane to become permeable to sodium, resulting in the influx of sodium ions and __________ of the membrane. Then contraction of the muscle cell occurs.
6. **Depolarization**

7. Figure 6–4 shows the components of a neuromuscular junction. Identify the parts by coloring the coding circles and the corresponding structures in the diagram. Add small arrows to indicate the location of the ACh receptors and label appropriately.

- **Mitochondrion**
- **T tubule**
- **Sarcomere**
- **Synaptic vesicles**
- **Synaptic cleft**

**Figure 6–4**
8. Number the following statements in their proper sequence to describe the contraction mechanism in a skeletal muscle cell. The first step has already been identified as number 1.

1. Acetylcholine is released into the neuromuscular junction by the axonal terminal.
2. The action potential, carried deep into the cell, causes the sarcoplasmic reticulum to release calcium ions.
3. Depolarization occurs, and the action potential is generated.
4. The muscle cell relaxes and lengthens.
5. Acetylcholine diffuses across the neuromuscular junction and binds to receptors on the sarcolemma.
6. The calcium ion concentration at the myofilaments increases; the myofilaments slide past one another, and the cell shortens.
7. As calcium is actively reabsorbed into the sarcoplasmic reticulum, its concentration at the myofilaments decreases.

9. The following incomplete statements refer to a muscle cell in the resting, or polarized, state just before stimulation. Complete each statement by choosing the correct response from the key choices and entering the appropriate letter in the answer blanks.

**Key Choices**

A. Na\(^+\) diffuses out of the cell
B. K\(^+\) diffuses out of the cell
C. Na\(^+\) diffuses into the cell
D. K\(^+\) diffuses into the cell
E. Inside the cell
F. Outside the cell
G. Relative ionic concentrations on the two sides of the membrane during rest
H. Electrical conditions
I. Activation of the sodium-potassium pump, which moves K\(^+\) into the cell and Na\(^+\) out of the cell
J. Activation of the sodium-potassium pump, which moves Na\(^+\) into the cell and K\(^+\) out of the cell

There is a greater concentration of Na\(^+\) \(\boxed{1}\), and there is a greater concentration of K\(^+\) \(\boxed{2}\). When the stimulus is delivered, the permeability of the membrane is changed, and \(\boxed{3}\), initiating the depolarization of the membrane. Almost as soon as the depolarization wave begins, a repolarization wave follows it across the membrane. This occurs as \(\boxed{4}\). Repolarization restores the \(\boxed{5}\) of the resting cell membrane. The \(\boxed{6}\) is (are) reestablished by \(\boxed{7}\).
10. Complete the following statements by choosing the correct response from the key choices and entering the appropriate letter or term in the answer blanks.

**Key Choices**

A. Fatigue  
B. Isotonic contraction  
C. Muscle cell  
D. Muscle tone  
E. Isometric contraction  
F. Whole muscle  
G. Tetanus  
H. Few motor units  
I. Many motor units  
J. Repolarization  
K. Depolarization

1. G-Tetanus is a continuous contraction that shows no evidence of relaxation.

2. B-Isotonic is a contraction in which the muscle shortens and work is done.

3. I-Many Motor Units To accomplish a strong contraction, ______ are stimulated at a rapid rate.

4. H-Few Motor Units When a weak but smooth muscle contraction is desired, ______ are stimulated at a rapid rate.

5. A-Fatigue When a muscle is being stimulated but is not able to respond because of "oxygen debt," the condition is called ______.

6. E-Isometric A(n) ______ is a contraction in which the muscle does not shorten, but tension in the muscle keeps increasing.

11. The terms in the key refer to the three ways that muscle cells replenish their ATP supplies. Select the term(s) that best apply to the conditions described and insert the correct key letter(s) in the answer blanks.

**Key Choices**

A. Coupled reaction of creatine phosphate (CP) and ADP  
B. Anaerobic respiration  
C. Aerobic respiration

1. B-Fermi Accompanied by lactic acid formation

2. B-Fermi Supplies the highest ATP yield per glucose molecule

3. A-Fermi Involves the simple transfer of a phosphate group

4. A-B-Fermi Requires no oxygen

5. C-Fermi The slowest ATP regeneration process

6. C-Fermi Produces carbon dioxide and water

7. B-Fermi The energy mechanism used in the second hour of running in a marathon

8. B-Fermi Used when the oxygen supply is inadequate over time

9. A-Fermi Good for a sprint
12. Briefly describe how you can tell when you are repaying the oxygen deficit.

**Breathing Rate Increases, Breathing is MORE DEEP**

13. Which of the following occur within a muscle cell during oxygen debt? Place a check (✓) by the correct choices.

- [✓] 1. Decreased ATP
- [✓] 2. Increased ATP
- [✓] 3. Increased lactic acid
- [✓] 4. Decreased oxygen
- [ ] 5. Increased oxygen
- [ ] 6. Decreased carbon dioxide
- [✓] 7. Increased carbon dioxide
- [ ] 8. Increased glucose

**MUSCLE MOVEMENTS, TYPES, AND NAMES**

14. Relative to general terminology concerning muscle activity, first label the following structures on Figure 6–5: insertion, origin, tendon, resting muscle, and contracting muscle. Next, identify the two structures named below by choosing different colors for the coding circles and the corresponding structures in the figure.

- Green: Movable bone
- Orange: Immovable bone

![Figure 6–5](image-url)
15. Complete the following statements. Insert your answers in the answer blanks.

**Plantar Flexion** 1. Standing on your toes as in ballet is (1) of the foot. Walking on your heels is (2).

**Dorsiflexion** 2.

**Circumduction** 3. Winding up for a pitch (as in baseball) can properly be called (3). To keep your seat when riding a horse, the tendency is to (4) your thighs.

**Adduct** 4.

**Flexion** 5. In running, the action at the hip joint is (5) in reference to the leg moving forward and (6) in reference to the leg in the posterior position. When kicking a football, the action at the knee is (7). In climbing stairs, the hip and knee of the forward leg are both (8). You have just touched your chin to your chest; this is (9) of the neck.

**Extension** 6.

**Flexed** 8.

**Flexion** 9.

**Rotation** 10.

**Circumduction** 11.

**Rotation** 12.

**Pronation** 13.

**Abduction** 14.

Using a screwdriver with a straight arm requires (10) of the arm. Consider all the movements of which the arm is capable. One often used for strengthening all the upper arm and shoulder muscles is (11).

Moving the head to signify "no" is (12). Action that moves the distal end of the radius across the ulna is (13). Raising the arms laterally away from the body is called (14) of the arms.

16. The terms provided in the key are often used to describe the manner in which muscles interact with other muscles. Select the key terms that apply to the following definitions and insert the correct letter or term in the answer blanks.

**Key Choices**

A. Antagonist  B. Fixator  C. Prime mover  D. Synergist

**Prime Mover**

1. (A) Antagonist

2. (B) Fixator

3. (D) Synergist

4. (D) Synergist

5. (A) Antagonist

6. (B) Fixator

C. Prime mover

D. Synergist

Postural muscles for the most part

Stabilizes a joint so that the prime mover can act at more distal joints

Performs the same movement as the prime mover

Reverses and/or opposes the action of a prime mover

Immobilizes the origin of a prime mover
17. Several criteria are applied to the naming of muscles. These are provided in Column B. Identify which criteria pertain to the muscles listed in Column A and enter the correct letter(s) in the answer blank.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>E, G</td>
<td>A. Action of the muscle</td>
</tr>
<tr>
<td>A, G</td>
<td>B. Shape of the muscle</td>
</tr>
<tr>
<td>D, E</td>
<td>C. Location of the muscle’s origin and/or insertion</td>
</tr>
<tr>
<td>E, F</td>
<td>D. Number of origins</td>
</tr>
<tr>
<td>A, C, E</td>
<td>E. Location of muscle relative to a bone or body region</td>
</tr>
<tr>
<td>B</td>
<td>F. Direction in which the muscle fibers run relative to some imaginary line</td>
</tr>
<tr>
<td>E, F</td>
<td>G. Relative size of the muscle</td>
</tr>
<tr>
<td>E, F</td>
<td></td>
</tr>
</tbody>
</table>

8. External oblique

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General Body Muscle Review

23. Complete the following statements describing muscles. Insert the correct answers in the answer blanks.

DELTOID

GLUTEUS MEDIUS

QUADRICEPS

CALCANEAL

PROXIMAL

FOREARM

ANTERIOR

POSTERIORLY

KNEE

FLEX

Three muscles—(1), (2), and (3)—are commonly used for intramuscular injections in adults.

The insertion tendon of the (4) group contains a large sesamoid bone, the patella.

The triceps surae insert in common into the (5) tendon.

The bulk of the tissue of a muscle tends to lie (6) to the part of the body it causes to move.

The extrinsic muscles of the hand originate on the (7).

Most flexor muscles are located on the (8) aspect of the body; most extensors are located (9). An exception to this generalization is the extensor-flexor musculature of the (10).

The pectoralis major and deltoid muscles act synergistically to (11) the arm.