

# The Muscular System

## I. Introduction

A. The three types of muscle in the body are \_\_\_\_\_  
\_\_\_\_\_.

B. This chapter focuses on \_\_\_\_\_.

## II. Structure of a Skeletal Muscle

A. Each muscle is an organ, comprised of skeletal muscle tissue, \_\_\_\_\_  
\_\_\_\_\_.

### B. Connective Tissue Coverings

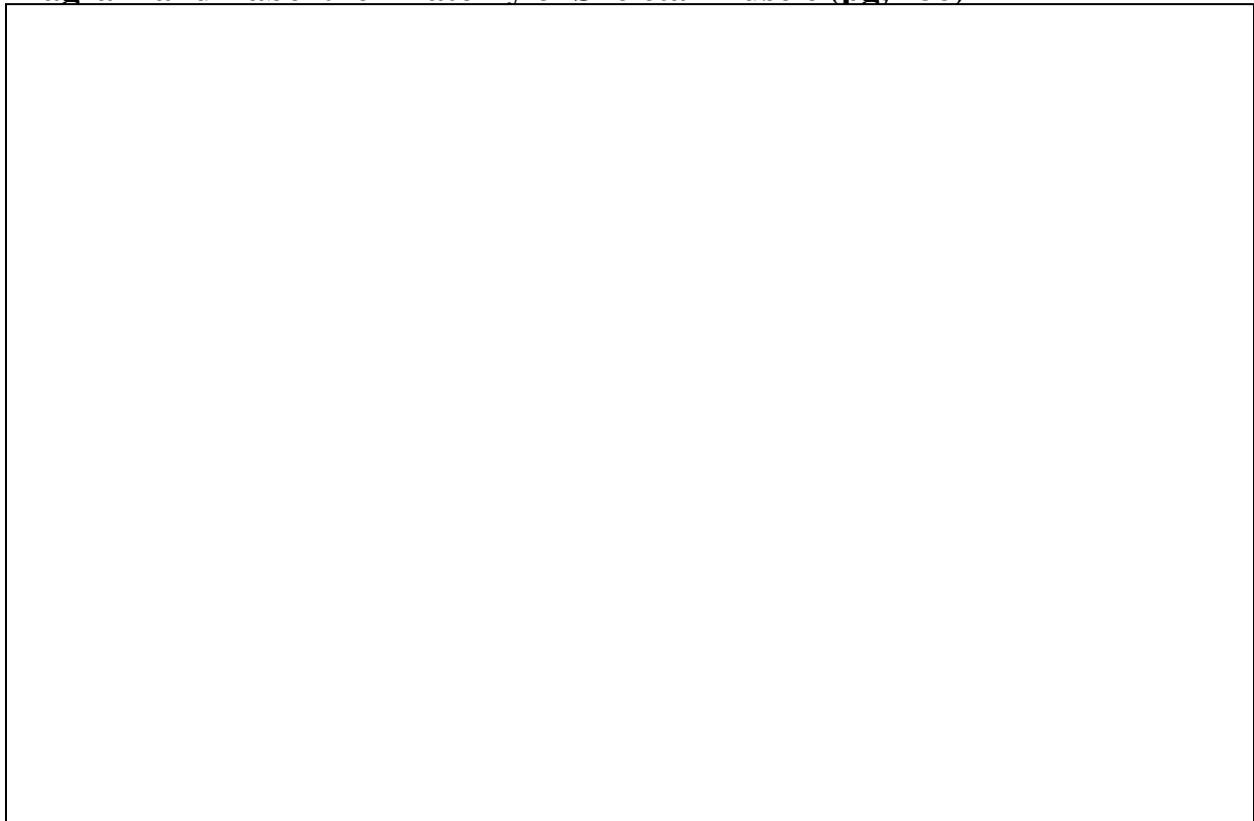
1. Layers of \_\_\_\_\_ connective tissue (\_\_\_\_\_),  
surround and \_\_\_\_\_.

2. Fascia extends beyond the ends of the muscle and \_\_\_\_\_  
\_\_\_\_\_ that are fused to the \_\_\_\_\_  
of bones.

3. Sometimes tendons are broad sheets of connective tissue called  
\_\_\_\_\_.

4. The layer of connective tissue around each whole muscle is the  
\_\_\_\_\_  
a. the \_\_\_\_\_ surrounds individual  
bundles (\_\_\_\_\_) within each muscle.  
b. each muscle cell (\_\_\_\_\_) is covered by a  
connective tissue layer called \_\_\_\_\_.

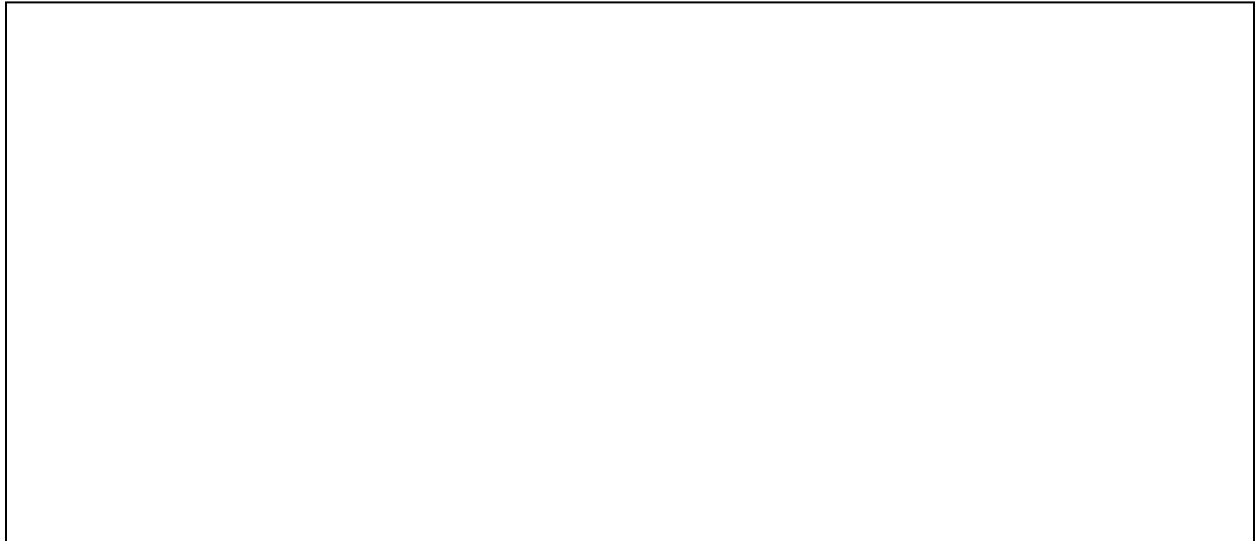
### Diagram and Label the Anatomy of Skeletal Muscle (pg, 186)



### C. Skeletal Muscle Fibers

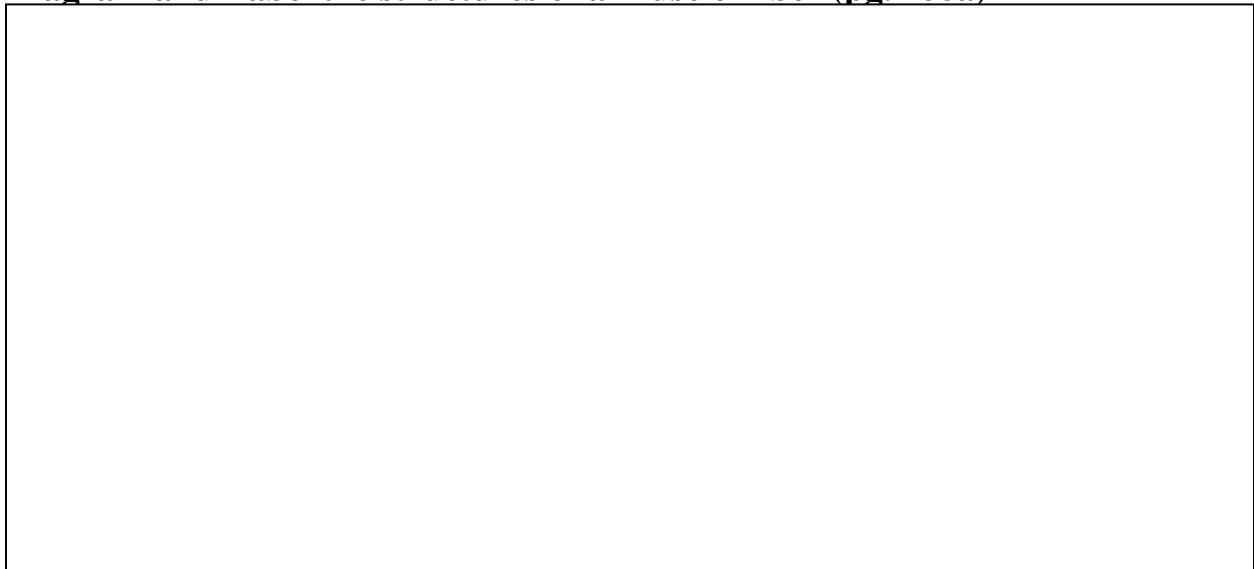
1. Each muscle fiber is a \_\_\_\_\_, long, cylindrical \_\_\_\_\_.
2. Beneath the sarcolemma (\_\_\_\_\_) lies sarcoplasm (\_\_\_\_\_) with many \_\_\_\_\_.
3. The sarcoplasm contains \_\_\_\_\_.
  - a. \_\_\_\_\_ filaments are made up of the protein \_\_\_\_\_.
  - b. \_\_\_\_\_ filaments are made up of the protein \_\_\_\_\_.
  - c. The organization of these filaments produces \_\_\_\_\_.
4. A \_\_\_\_\_ extends from Z line to Z line.
  - a. I bands (\_\_\_\_\_) made up of \_\_\_\_\_ filaments are anchored to Z lines.
  - b. A bands (\_\_\_\_\_) are made up of overlapping \_\_\_\_\_ filaments.
  - c. In the center of A bands is an \_\_\_\_\_, consisting of \_\_\_\_\_.

#### **Diagram and label the striations of Actin and Myosin in a Sarcomere (pg. 188b)**



5. Beneath the sarcolemma lies the sarcoplasmic reticulum (\_\_\_\_\_).
6. Sarcoplasmic Reticulum is associated with transverse (T) tubules (\_\_\_\_\_).
  - a. Each T tubule lies between two \_\_\_\_\_ of the sarcoplasmic reticulum.
  - b. The sarcoplasmic reticulum and transverse tubules activate the \_\_\_\_\_ when the fiber is stimulated.

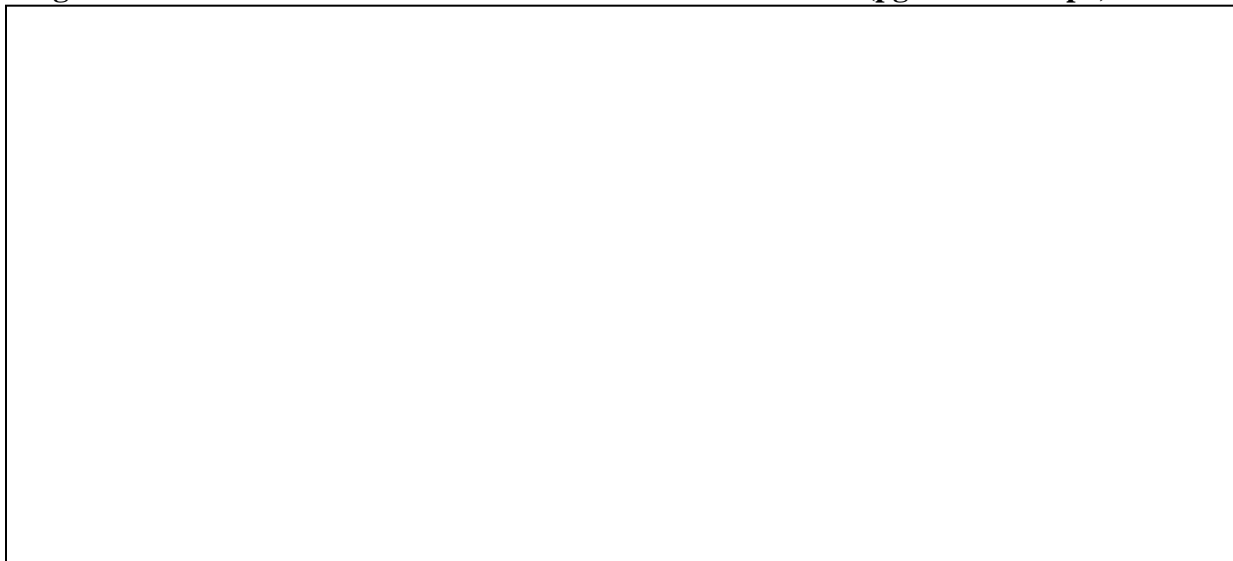
**Diagram and Label the structures of a Muscle Fiber (pg. 188a)**



**D. Neuromuscular Junction**

1. The site where the \_\_\_\_\_ neuron and \_\_\_\_\_
  - a. The muscle fiber membrane forms a \_\_\_\_\_ in which the \_\_\_\_\_ is tightly folded and where \_\_\_\_\_ are abundant.
  - b. The cytoplasm of the \_\_\_\_\_ contains numerous \_\_\_\_\_ and \_\_\_\_\_ storing \_\_\_\_\_.

**Diagram and Label the structures of a Neuromuscular Junction (pg. 191b & step1)**



**E. Motor Units**

1. A \_\_\_\_\_ and the \_\_\_\_\_ it controls.

2. When stimulated to do so, the muscle fibers of the motor unit
- \_\_\_\_\_.

**Diagram and Label the structures of a Motor Unit (pg. 197)**



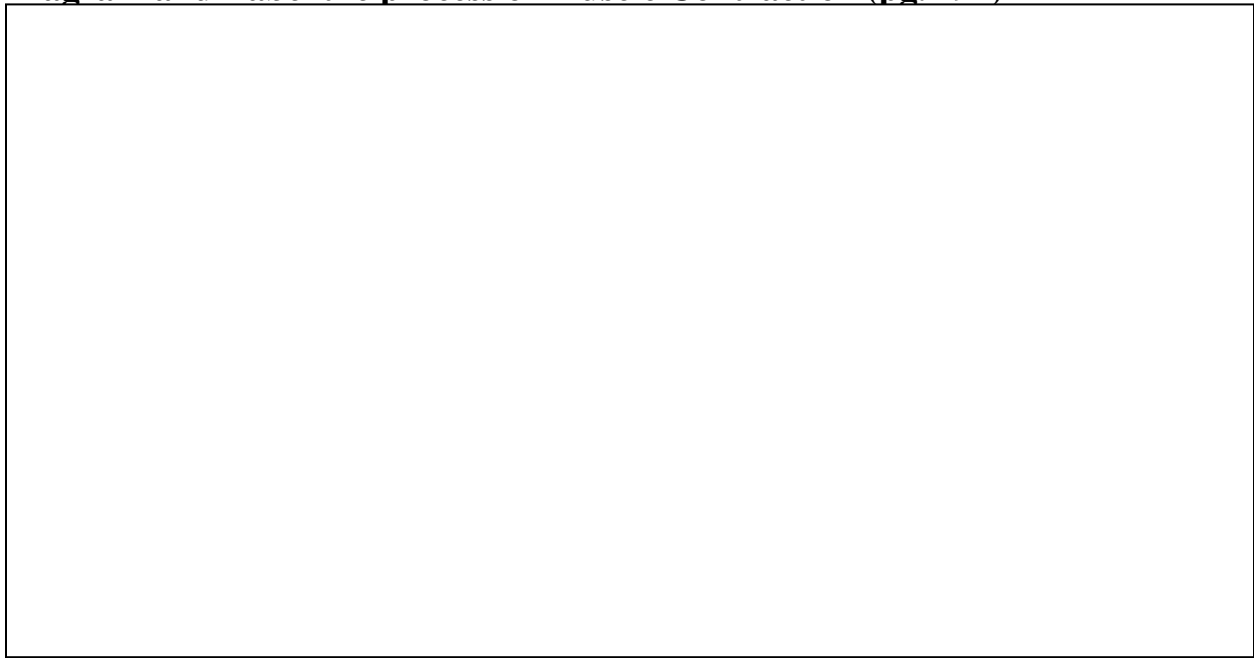
**III. Skeletal Muscle Contraction**

A. Involves several components that results in the shortening of \_\_\_\_\_, and the pulling of the muscle against its \_\_\_\_\_.

**B. Role of Myosin and Actin**

1. Myosin- two twisted strands with \_\_\_\_\_ projected outward along the strands.
2. Actin
  - a. globular protein with \_\_\_\_\_
  - b. \_\_\_\_\_ are two proteins associated with the surface of the actin filaments.
3. \_\_\_\_\_ of muscle contraction
  - a. The myosin \_\_\_\_\_ attaches to the \_\_\_\_\_ on the actin filament and \_\_\_\_\_, pulling on the actin filament.
  - b. Myosin then \_\_\_\_\_ and attaches to the \_\_\_\_\_ on the actin, pulling again.
4. Energy from the conversion of \_\_\_\_\_ is provided to the cross-bridges from the enzyme \_\_\_\_\_, causing them to be in a “\_\_\_\_\_” position.

**Diagram and Label the process of Muscle Contraction (pg. 194)**



**C. Stimulus for Contraction**

1. The \_\_\_\_\_ releases the neurotransmitter \_\_\_\_\_ from its synaptic vesicles into the \_\_\_\_\_.
2. \_\_\_\_\_ in the motor end plate detect the \_\_\_\_\_.
3. A \_\_\_\_\_ spreads over the surface of the sarcolemma and into the T tubules, where it reaches the \_\_\_\_\_.
4. Muscle impulse causes the sarcoplasmic reticulum to release its \_\_\_\_\_ into the \_\_\_\_\_ of the muscle fiber.
5. The high concentration of calcium in the sarcoplasm interacts with the \_\_\_\_\_ molecules, which move aside, \_\_\_\_\_ the myosin binding sites on the \_\_\_\_\_.
6. \_\_\_\_\_ now bind and pull on the actin filaments, causing the sarcomeres to \_\_\_\_\_.
7. After the nervous impulse has been received, \_\_\_\_\_ rapidly decomposes the \_\_\_\_\_.
8. Then, \_\_\_\_\_ is returned to the sarcoplasmic reticulum, and the linkages between myosin and actin are \_\_\_\_\_.

**D. Energy Sources for Contraction**

1. Energy for contraction comes from molecules of \_\_\_\_\_.
2. \_\_\_\_\_, stores excess energy released by the mitochondria and is present to regenerate ATP from \_\_\_\_\_.

3. Whenever the supply of ATP is sufficient, \_\_\_\_\_ promotes the synthesis of creatine phosphate.
4. As ATP decomposes, \_\_\_\_\_ from creatine phosphate can be transferred to ADP molecules, converting them back to \_\_\_\_\_.

#### E. Oxygen Supply and Cellular Respiration

1. The early phase of cellular respiration (\_\_\_\_\_) yields few molecules of ATP, so muscle has a high requirement for \_\_\_\_\_, which enables the complete breakdown of glucose in the \_\_\_\_\_.
2. \_\_\_\_\_ in red blood cells carries oxygen to muscle.
3. The pigment \_\_\_\_\_ stores oxygen in muscle tissue.

#### F. Oxygen Debt

1. During rest or moderate activity, there is enough oxygen to support \_\_\_\_\_.
2. Oxygen deficiency may develop during strenuous exercise, and \_\_\_\_\_ as an end product of \_\_\_\_\_.
3. Lactic acid diffuses out of muscle cells and is carried in the bloodstream to the \_\_\_\_\_.
4. Oxygen debt refers to
  - a. the amount of oxygen that \_\_\_\_\_ require to convert the accumulated lactic acid into \_\_\_\_\_
  - b. the amount of oxygen that \_\_\_\_\_ need to resynthesize ATP and \_\_\_\_\_ to their original concentrations.
5. Repaying oxygen debt may take \_\_\_\_\_.

#### G. Muscle Fatigue

1. When a muscle loses its \_\_\_\_\_ during strenuous exercise.
2. Usually arises from the accumulation of \_\_\_\_\_ in the muscle.
3. A \_\_\_\_\_ as a result of accumulated lactic acid prevents the muscle from \_\_\_\_\_.
4. A muscle cramp occurs due to a lack of \_\_\_\_\_ required to return \_\_\_\_\_ back to the sarcoplasmic reticulum so muscle fibers can \_\_\_\_\_.

#### H. Heat Production

1. From \_\_\_\_\_ of skeletal muscle.
2. From the energy produced through the reactions \_\_\_\_\_.

#### IV. Muscular Responses

- A. One method of studying muscle function is to remove a \_\_\_\_\_ and connect it to a device that records its responses to \_\_\_\_\_.
- B. \_\_\_\_\_ - muscle remains unresponsive to stimulation unless the stimulus is of a certain \_\_\_\_\_.
- C. All-or-None Response: A fiber contracts to its \_\_\_\_\_; it cannot contract \_\_\_\_\_.
- D. Recording a Muscular Contraction
1. A \_\_\_\_\_ is the recording of an electrically-stimulated muscle \_\_\_\_\_.
  2. A single, short contraction involving only a \_\_\_\_\_ is referred to as a \_\_\_\_\_.
  3. The \_\_\_\_\_ between when the stimulus is applied and when the muscle contracts is called the \_\_\_\_\_ (less than 0.01 second).
  4. The latent period is followed by a period of contraction and then a period of \_\_\_\_\_.
- E. Summation
1. When the force of individual \_\_\_\_\_ combine without complete \_\_\_\_\_.
  2. If the sustained contraction lacks any relaxation, it is called \_\_\_\_\_ (tetanus).
- F. Recruitment of Motor Units- An increase in the \_\_\_\_\_ of activated motor units within a muscle at higher \_\_\_\_\_ of stimulation.
- G. Sustained Contractions
1. \_\_\_\_\_ together can produce a sustained contraction of increasing strength.
  2. \_\_\_\_\_ is achieved by a continuous state of sustained contraction of motor units within a muscle.

#### V. Smooth Muscles

##### A. Smooth Muscle Fibers

1. Elongated with tapered ends, \_\_\_\_\_, and have a relatively undeveloped \_\_\_\_\_.
2. Two types of smooth muscles.
  - a. \_\_\_\_\_
    - 1) In the blood \_\_\_\_\_ of the eye
    - 2) Fibers occur \_\_\_\_\_ rather than as sheets.
  - b. \_\_\_\_\_
    - 1) Occurs in \_\_\_\_\_ and is found in the walls of \_\_\_\_\_

- 2) These fibers can stimulate one another and display \_\_\_\_\_, are thus responsible for \_\_\_\_\_ in hollow organs and tubes.

#### B. Smooth Muscle Contraction

1. The myosin-binding-to-actin mechanism is mostly \_\_\_\_\_ for smooth muscles and skeletal muscles.
2. Both \_\_\_\_\_ and \_\_\_\_\_ stimulate and inhibit smooth muscle contraction, depending on the target muscle.
3. \_\_\_\_\_ can also stimulate or inhibit contraction.
4. Smooth muscle is \_\_\_\_\_ to contract and relax than is skeletal muscle, but can contract \_\_\_\_\_ using the same amount of \_\_\_\_\_.

#### VI. Cardiac Muscle

- A. Contraction is essentially \_\_\_\_\_ as that for skeletal and smooth muscle, but with some differences.
- B. Cardiac muscle has \_\_\_\_\_ that supply \_\_\_\_\_, and can thus contract for longer periods.
- C. Complex membrane junctions, called \_\_\_\_\_, join cells and transmit the force of contraction from one cell to the next, and aid in the rapid \_\_\_\_\_ of impulses throughout the heart.
- D. Cardiac muscle is \_\_\_\_\_, and the whole structure contracts as a unit.

#### VII. Skeletal Muscle Actions

##### A. Origin and Insertion

1. The immovable end of a muscle is the \_\_\_\_\_.
2. The movable end is the \_\_\_\_\_.
3. Contraction pulls the insertion \_\_\_\_\_ the origin.
4. Some muscles have \_\_\_\_\_ insertion or origin.

##### B. Interaction of Skeletal Muscles

1. Of a group of muscles, the one doing the majority of the work is the \_\_\_\_\_.
2. Helper muscles are called \_\_\_\_\_.
3. Opposing muscles are called \_\_\_\_\_.

#### VIII. Major Skeletal Muscles

- A. Muscles are named according to any of the following criteria: Size, shape, location, action, number of attachments, or \_\_\_\_\_.

##### B. Muscles of Facial Expression

1. Attach to underlying bones and overlying \_\_\_\_\_ of skin.

2. Major muscles include (for action, origin, and insertion(AOI), refer to Table 7-4): \_\_\_\_\_, orbicularis oculi, orbicularis oris, \_\_\_\_\_, zygomaticus, and \_\_\_\_\_.

#### C. Muscles of Mastication

1. Include \_\_\_\_\_ as well as side-to-side grinding motions of muscles attached to the skull and \_\_\_\_\_.
2. Chewing muscles include (for AOI refer to Table 7-4): \_\_\_\_\_ and \_\_\_\_\_.

#### D. Muscles that Move the Head

1. Paired muscles in the neck and back flex, extend, and \_\_\_\_\_.
2. Major muscles include (for AOI refer to Table 7-4,7-5): \_\_\_\_\_, splenius capitis, and semispinalis capitis.

#### E. Muscles that Move the Pectoral Girdle

1. The chest and shoulder muscles that move the \_\_\_\_\_.
2. Major muscles include (for AOI refer to Table 7-8): trapezius, rhomboideus major, levator scapulae, serratus anterior, and \_\_\_\_\_.

#### F. Muscles that Move the Arm

1. Connect the arm to the pectoral girdle, ribs, and vertebral column, making the \_\_\_\_\_.
2. \_\_\_\_\_ include the coracobrachialis and pectoralis major.
3. \_\_\_\_\_ include the teres major and latissimus dorsi.
4. \_\_\_\_\_ include the supraspinatus and the deltoid.
5. \_\_\_\_\_ : subscapularis, infraspinatus, and teres minor.
6. For AOI refer to Table 7-9

#### G. Muscles that Move the Forearm

1. Arise from the \_\_\_\_\_ and connect to the ulna and radius.
2. \_\_\_\_\_ are the biceps brachii, brachialis, and brachioradialis.
3. An extensor is the triceps brachii muscle.
4. \_\_\_\_\_ include the supinator, pronator teres, and pronator quadratus.
5. For AOI refer to Table 7-10

#### H. Muscle that Move the Wrist, Hand, Fingers

1. Movements of the hand are caused by muscles originating from the distal humerus, and the \_\_\_\_\_.
2. \_\_\_\_\_ include the flexor carpi radialis, flexor carpi ulnaris, palmaris longus, and flexor digitorum profundus.
3. \_\_\_\_\_ include the extensor carpi radialis longus, extensor carpi radialis brevis, extensor carpi ulnaris, and extensor digitorum.
4. For AOI refer to Table 7-10

## I. Muscles of the Abdominal Wall

1. Connect the rib cage and vertebral column to the \_\_\_\_\_
2. \_\_\_\_\_
  - a. A band of tough \_\_\_\_\_.
  - b. Extends from the xiphoid process to the \_\_\_\_\_.
  - c. Attachment for certain \_\_\_\_\_ wall muscles.
3. These four muscles include \_\_\_\_\_, internal oblique, transverse abdominis, and \_\_\_\_\_.
4. For AOI refer to Table 7-6

## J. Muscles of the Pelvic Outlet

1. The superficial \_\_\_\_\_
  - a. Fills the space within the \_\_\_\_\_.
  - b. Includes the superficial transversus perinei, bulbospongiosus, and \_\_\_\_\_.
2. The pelvic diaphragm
  - a. Forms the floor of the \_\_\_\_\_.
  - b. Includes the \_\_\_\_\_.
3. For AOI refer to Table 7-7

## K. Muscles that Move the Thigh

1. Are attached to the femur and to the \_\_\_\_\_.
2. \_\_\_\_\_ includes the psoas major and iliacus.
3. \_\_\_\_\_ is made up of the gluteus maximus, gluteus medius, gluteus minimus, and tensor fasciae latae.
4. Thigh \_\_\_\_\_ include the adductor longus, adductor magnus, and gracilis.
5. For AOI refer to Table 7-11

## L. Muscles that Move the Leg

1. Connects the tibia or fibula to the femur or \_\_\_\_\_.
2. \_\_\_\_\_ (hamstring group: biceps femoris, semitendinosus, semimembranosus, and sartorius).
3. \_\_\_\_\_ (quadriceps femoris group): rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius.
4. For AOI refer to Table 7-12

## M. Muscles that Move the Ankle, Foot, Toes

1. Are attached to the femur, fibula, or tibia, and move the foot upward, downward, or in a \_\_\_\_\_.
2. \_\_\_\_\_ include the tibialis anterior, peroneus tertius, and extensor digitorum longus.
3. \_\_\_\_\_ are the gastrocnemius, soleus, and flexor digitorum longus.
4. An \_\_\_\_\_ is the tibialis posterior.
5. An \_\_\_\_\_ is the peroneus longus.
6. For AOI refer to Table 7-13