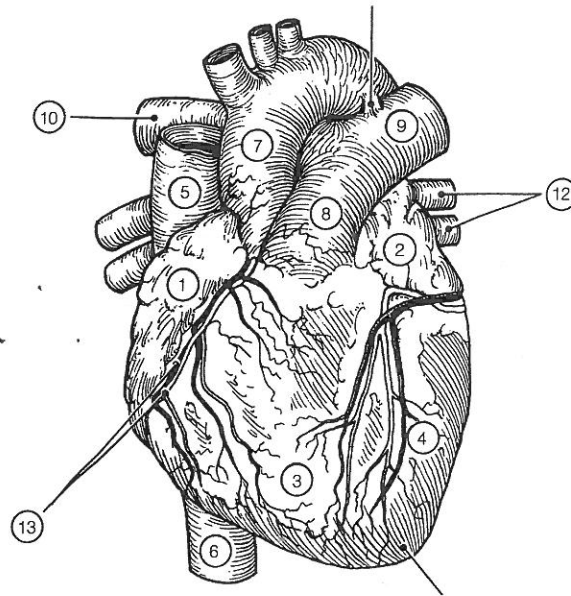


6 THE MUSCULAR SYSTEM



Muscles, the specialized tissues that facilitate body movement, make up about 40% of body weight. Most body muscle is the voluntary type, called skeletal muscle because it is attached to the bony skeleton. Skeletal muscle contributes to body contours and shape, and it composes the organ system called the muscular system. These muscles allow you to grin, frown, run, swim, shake hands, swing a hammer, and to otherwise manipulate your environment. The balance of body muscle is smooth and cardiac muscles, which form the bulk of the walls of hollow organs and the heart. Smooth and cardiac muscles are involved in the transport of materials within the body.

Study activities in this chapter deal with microscopic and gross structure of muscle, identification of voluntary muscles, body movements, and important understandings of muscle physiology.

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

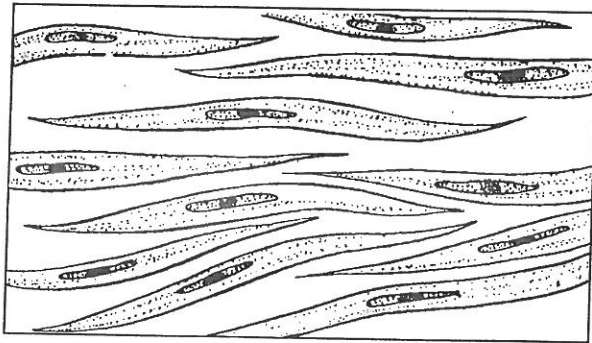
A. Cardiac B. Smooth C. Skeletal

- _____ 1. Involuntary
- _____ 2. Banded appearance
- _____ 3. Longitudinally and circularly arranged layers
- _____ 4. Dense connective tissue packaging
- _____ 5. Figure-8 packaging of the cells
- _____ 6. Coordinated activity to act as a pump

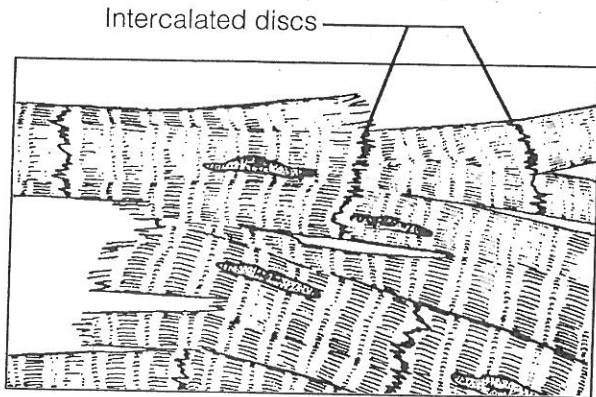


- _____ 7. Moves bones and the facial skin
- _____ 8. Referred to as the muscular system
- _____ 9. Voluntary

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



A _____



B _____

Figure 6-1

3. Regarding the functions of muscle tissues, circle the term in each of the groupings that does not belong with the other terms.

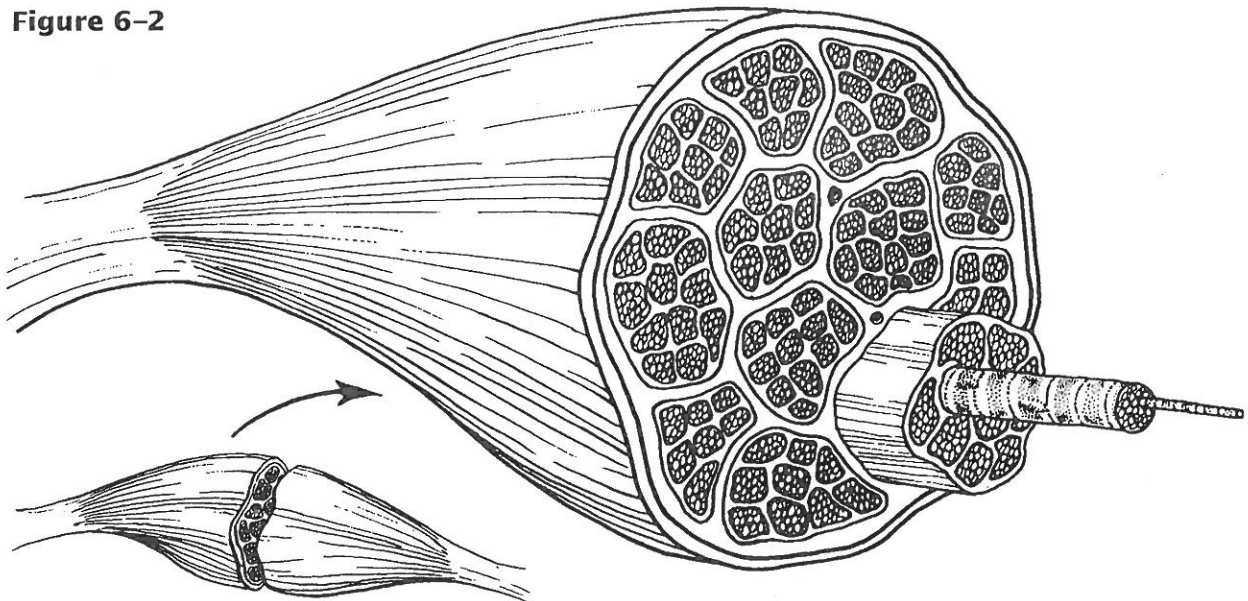
- | | | | |
|-----------------------|------------------------|-----------------|-----------------------------|
| 1. Urine | Foodstuffs | Bones | Smooth muscle |
| 2. Heart | Cardiac muscle | Blood pump | Promotes labor during birth |
| 3. Excitability | Response to a stimulus | Contractility | Action potential |
| 4. Ability to shorten | Contractility | Pulls on bones | Stretchability |
| 5. Maintains posture | Movement | Promotes growth | Generates heat |

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

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

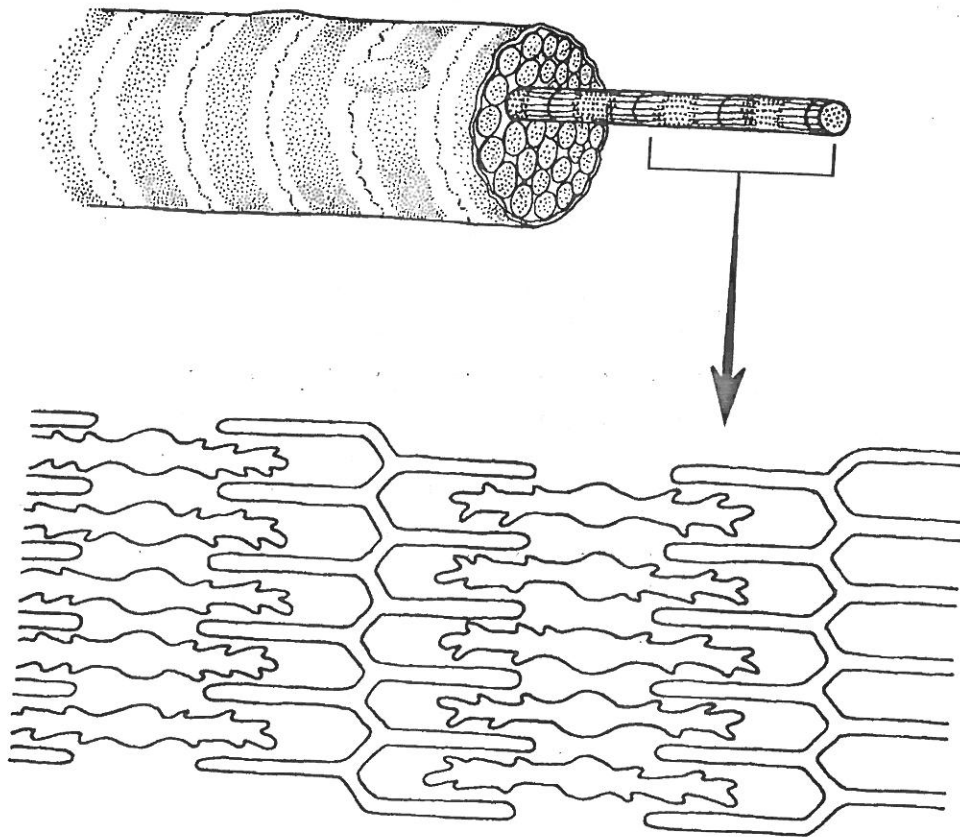


Figure 6-3

1. 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?

SKELETAL MUSCLE ACTIVITY

6. Complete the following statements relating to the neuromuscular junction. Insert the correct answers in the numbered answer blanks.

- _____ 1. A motor neuron and all of the skeletal muscle cells it stimulates is called a (1). The axon of each motor neuron
 _____ 2. has numerous endings called (2). The actual gap between an axonal ending and the muscle cell is called a (3).
 _____ 3. Within the axonal endings are many small vesicles containing a neurotransmitter substance called (4).
 _____ 4.
 _____ 5. When the (5) 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 (6) of the membrane. Then contraction of the muscle cell occurs.

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.

- | | | |
|---|--------------------------------------|--|
| <input type="radio"/> Mitochondrion | <input type="radio"/> T tubule | <input type="radio"/> Sarcomere |
| <input type="radio"/> Synaptic vesicles | <input type="radio"/> Synaptic cleft | <input type="radio"/> Junctional folds |

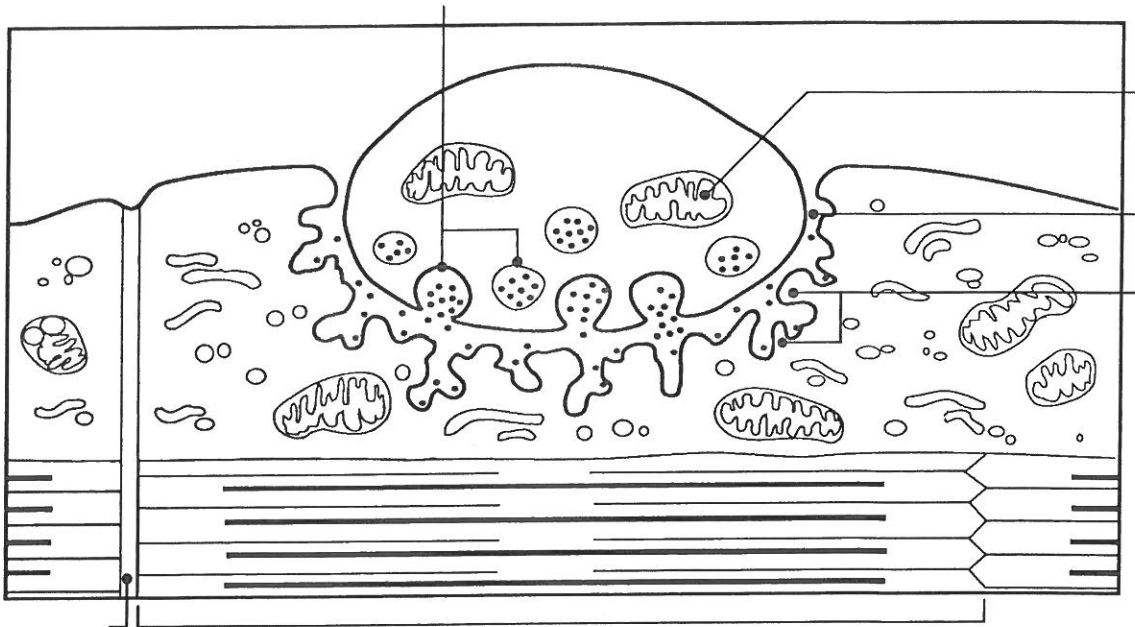


Figure 6-4

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 | E. Isometric contraction | I. Many motor units |
| B. Isotonic contraction | F. Whole muscle | J. Repolarization |
| C. Muscle cell | G. Fused tetanus | K. Depolarization |
| D. Muscle tone | H. Few motor units | L. Unfused tetanus |

- _____ 1. _____ is a continuous contraction that shows no evidence of relaxation.
- _____ 2. A(n) _____ is a contraction in which the muscle shortens and work is done.
- _____ 3. To accomplish a strong contraction, _____ are stimulated at a rapid rate.
- _____ 4. When a weak but smooth muscle contraction is desired, _____ are stimulated at a rapid rate.
- _____ 5. When a muscle is being stimulated but is not able to respond because of "oxygen deficit," the condition is called _____.
- _____ 6. 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 glycolysis | C. Aerobic respiration |

- _____ 1. Accompanied by lactic acid formation
- _____ 2. Supplies the highest ATP yield per glucose molecule
- _____ 3. Involves the simple transfer of a phosphate group
- _____ 4. Requires no oxygen
- _____ 5. The slowest ATP regeneration process
- _____ 6. Produces carbon dioxide and water
- _____ 7. The energy mechanism used in the second hour of running in a marathon
- _____ 8. Used when the oxygen supply is inadequate over time
- _____ 9. Good for a sprint

12. Briefly describe how you can tell when you are repaying the oxygen deficit.

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

- | | | | |
|-------|--------------------------|-------|-----------------------------|
| _____ | 1. Decreased ATP | _____ | 5. Increased oxygen |
| _____ | 2. Increased ATP | _____ | 6. Decreased carbon dioxide |
| _____ | 3. Increased lactic acid | _____ | 7. Increased carbon dioxide |
| _____ | 4. Decreased oxygen | _____ | 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.

- Movable bone
- Immovable bone

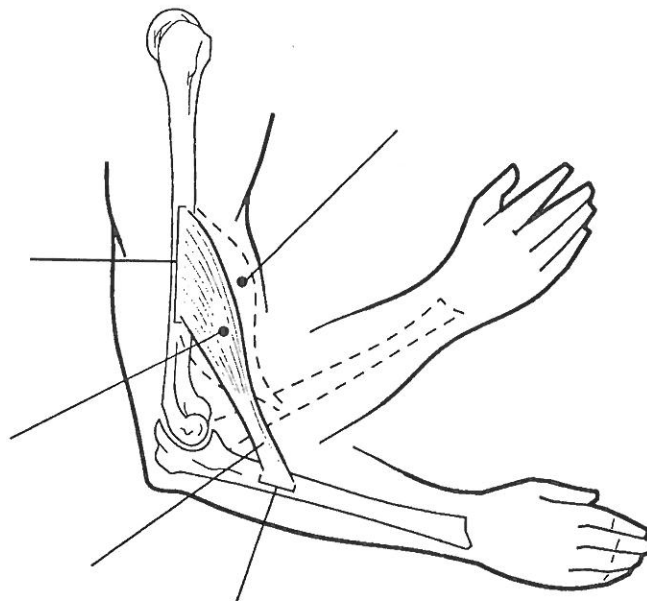


Figure 6-5

15. Complete the following statements. Insert your answers in the answer blanks.

- _____ 1. Standing on your toes as in ballet is (1) of the foot. Walking on your heels is (2).
- _____ 2. _____
- _____ 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.
- _____ 4. _____
- _____ 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.
- _____ 6. _____
- _____ 7. _____
- _____ 8. Using a screwdriver with a straight arm requires (10) of the arm. Consider all the movements of which the arm is capable.
- _____ 9. One often used for strengthening all the upper arm and shoulder muscles is (11).
- _____ 10. _____
- _____ 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.
- _____ 12. _____
- _____ 13. _____
- _____ 14. _____

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

- _____ 1. Agonist
- _____ 2. Postural muscles for the most part
- _____ 3. Stabilizes a joint so that the prime mover can act at more distal joints
- _____ 4. Performs the same movement as the prime mover
- _____ 5. Reverses and/or opposes the action of a prime mover
- _____ 6. Immobilizes the origin of a prime mover