Addressing the Learning Outcomes

1. COMPARE THE THREE TYPES OF MUSCLE TISSUE.

EXERCISE 8-1

Write the appropriate term in each blank from the list below.

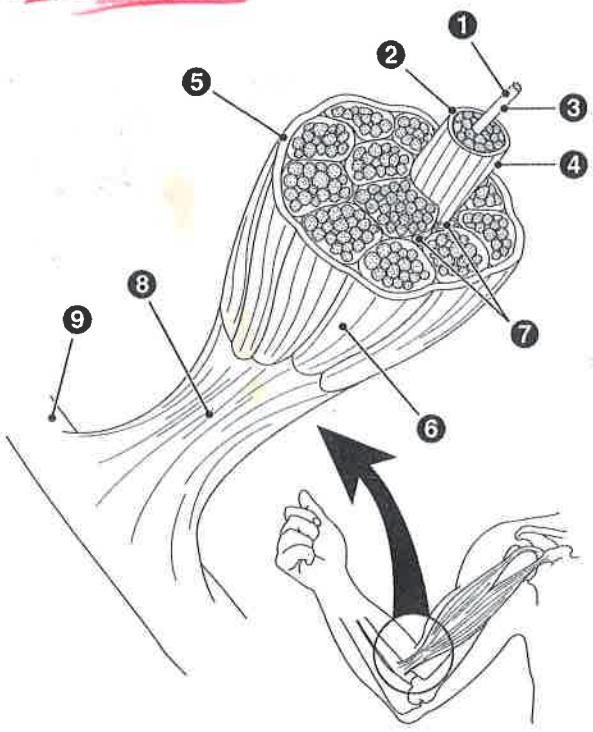
cardiac muscle **skeletal muscle** **tendon** **fascicle** **ligament**
endomysium **smooth muscle** **perimysium** **epimysium**

1. A cordlike structure that attaches a muscle to bone — tendon
2. A bundle of muscle fibers — fascicle
3. A connective tissue layer surrounding muscle fiber bundles — perimysium
4. Muscle under voluntary control — skeletal muscle
5. The only muscle type that does not have visible striations — smooth muscle
6. An involuntary muscle containing intercalated disks — cardiac muscle
7. The innermost layer of the deep fascia that surrounds the entire muscle — epimysium
8. The connective tissue membrane surrounding individual muscle cells — endomysium

EXERCISE 8-2: Structure of a Skeletal Muscle (Text Fig. 8-1)

Label each of the indicated parts. Hint: Parts 3, 4, and 5 are membranes.

1. muscle fiber
2. fascicle
3. endomysium
4. perimysium
5. epimysium
6. muscle body
7. blood vesseles
8. tendon
9. bone



2. DESCRIBE THREE FUNCTIONS OF SKELETAL MUSCLE.

EXERCISE 8-3

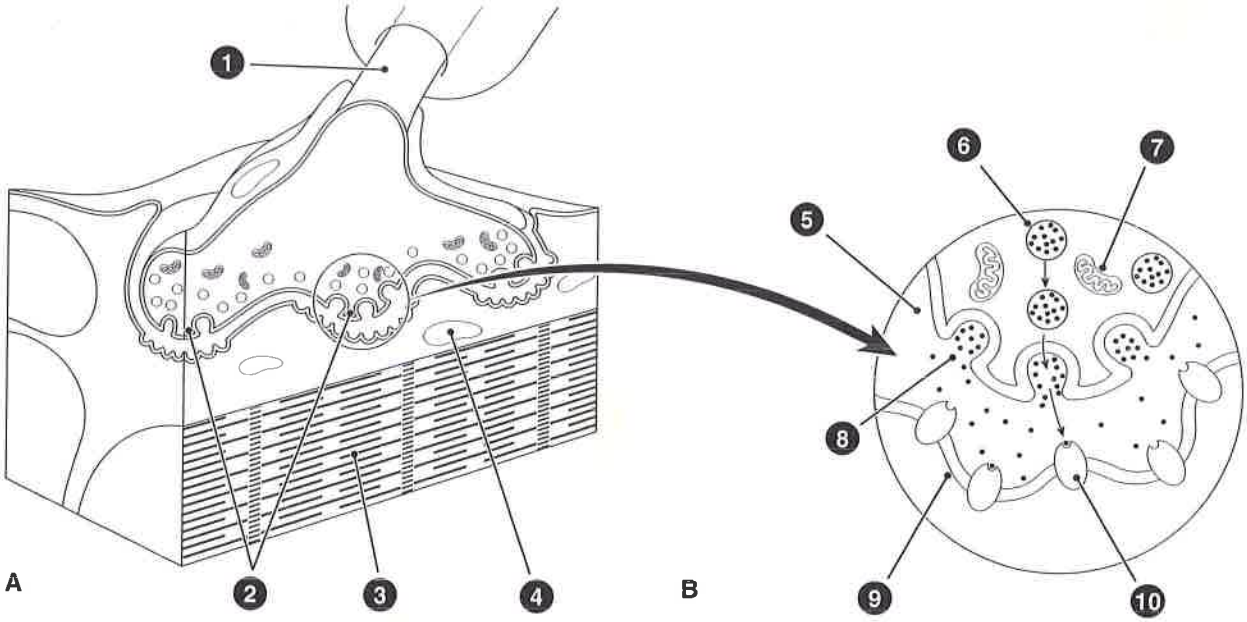
List three functions of skeletal muscle in the spaces below.

1. posture
2. heat
3. movement

3. EXPLAIN HOW SKELETAL MUSCLES CONTRACT.

EXERCISE 8-4: Neuromuscular Junction (Text Fig. 8-2)

Label each of the indicated parts. Hint: Part 8 is a chemical.



1. neuron
2. neuron + branches
3. muscle fiber
4. nucleus
5. synaptic cleft
6. vesicle
7. mitochondria
8. acetylcholine
9. motor end plate
10. receptor

EXERCISE 8-5

Write the appropriate term in each blank from the list below.

synaptic cleft **motor end plate** **motor unit** **actin** **sarcoplasmic reticulum**
myosin **troponin** **sarcomere** **tropomyosin**

1. The protein that makes up muscle's lighter, thin filaments — actin
2. The protein that interacts with actin to form crossbridges — myosin
3. The membrane of the muscle cell that binds ACh — motor end plate
4. The space between the neuron and the muscle cell — synaptic cleft
5. A single neuron and all of the muscle fibers it stimulates — motor unit
6. A protein that binds calcium during muscle contraction — troponin
7. The organelle that stores calcium in resting muscle cells — sarcoplasmic reticulum
8. A contracting subunit of skeletal muscle — sarcomere

EXERCISE 8-6

In the blanks, write the name of the substance that is accomplishing each action. Each term may be used more than once.

ATP **calcium** **acetylcholine**
myoglobin **creatine phosphate** **glycogen**

1. Substance released into the synaptic cleft — acetylcholine
2. The immediate source of energy for muscle contraction — ATP / creatine phosphate
3. Binds to troponin when muscle contracts — calcium
4. Used to detach the myosin head — ATP
5. Pumped back into the ER when muscle relaxes — calcium
6. Causes an action potential when it binds the motor end plate — acetylcholine
7. A compound similar to ATP that can be used to generate ATP — creatine phosphate
8. A polysaccharide that can be used to generate glucose — glycogen
9. A compound that stores oxygen within muscle cells — myoglobin

EXERCISE 8-7

The events of muscle contraction are listed below, but they are out of order. Number the steps in the order in which they occur by writing the correct number in the blank. The first step has been numbered for you.

__1__ a. Acetylcholine (ACh) is released from an axon terminal into the synaptic cleft at the neuromuscular junction.

__7__ b. Using stored energy, myosin heads pull actin filaments together within the sarcomeres and the cell shortens.

__6__ c. Myosin heads bind to actin, forming crossbridges.

__2__ d. ACh binds to receptors in the muscle's motor end plate and produces an action potential.

__8__ e. New ATP is used to detach myosin heads and move them back to position for another "power stroke."

__3__ f. The action potential travels to the sarcoplasmic reticulum (SR).

__5__ g. Calcium shifts troponin and tropomyosin so that binding sites on actin are exposed.

__9__ h. Muscle relaxes when stimulation ends and the calcium is pumped back into the sarcoplasmic reticulum.

__4__ i. The sarcoplasmic reticulum releases calcium into the cytoplasm.

4. LIST COMPOUNDS STORED IN MUSCLE CELLS THAT ARE USED TO GENERATE ENERGY.

See Exercises 8-6 and 8-8.

5. EXPLAIN WHAT HAPPENS IN MUSCLE CELLS CONTRACTING ANAEROBICALLY.

EXERCISE 8-8

Circle all answers that are correct (there are two).

In muscle cells contracting anaerobically:

(a.) creatine phosphate can generate ATP.
b. mitochondria break down fatty acids for energy.
c. lactic acid accumulation causes fatigue.
(d.) glycolysis can generate ATP by partially breaking down glucose.
e. muscle fatigue results when cells run out of ATP.

5. CITE THE EFFECTS OF EXERCISE ON MUSCLES.

EXERCISE 8-9

Label each of the following statements as true (T) or false (F).

1. Resistance exercise causes muscle hypertrophy. True
2. Blood vessels constrict in actively contracting muscles. false
3. Weight lifting is the most efficient way to improve endurance. false
4. Regular exercise increases the number of capillaries in muscles. True
5. Regular exercise decreases the number of mitochondria in muscles. false

7. COMPARE ISOTONIC AND ISOMETRIC CONTRACTIONS.

See Exercise 8-10.

8. EXPLAIN HOW MUSCLES WORK IN PAIRS TO PRODUCE MOVEMENT.

EXERCISE 8-10

Write the appropriate term in each blank from the list below.

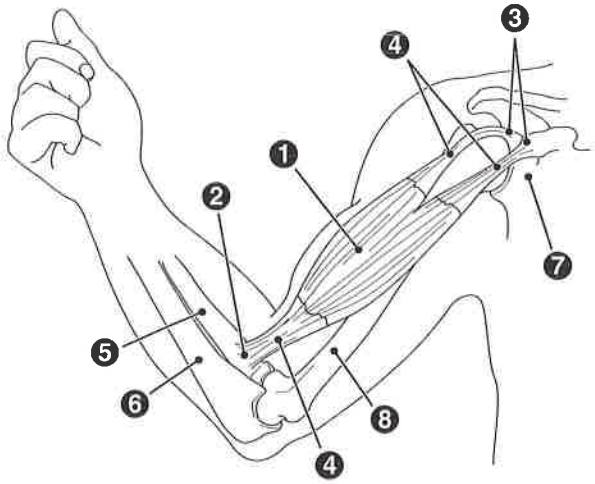
origin **agonist** **antagonist** **synergist**
isotonic **isometric** **insertion**

1. A muscle acting as a helper to accomplish a particular movement synergist
2. The muscle attachment joined to the more moveable part insertion
3. The muscle attachment joined to the less moveable part origin
4. The muscle that produces a given movement agonist
5. A muscle that relaxes during a given movement antagonist
6. A contraction in which the muscle shortens but muscle tension remains the same isotonic
7. A contraction in which muscle tension increases but muscle length is unchanged isometric

EXERCISE 8-11: Muscle Attachment to Bones (Text Fig. 8-6)

Label each of the indicated parts.

1. biceps brachii
2. insertion
3. origin
4. tendons
5. radius
6. ulna
7. scapula
8. humerus



9. COMPARE THE WORKINGS OF MUSCLES AND BONES TO LEVER SYSTEMS.

EXERCISE 8-12

For each of the following muscle actions, state which class of lever (1st, 2nd, or 3rd) is the most applicable.

1. Nodding the head first
2. Performing a biceps curl third
3. Standing on tiptoes second

10. EXPLAIN HOW MUSCLES ARE NAMED.

EXERCISE 8-13

For each muscle name, write the characteristic(s) used for the name. Choose between the following six options: location, size, shape, direction of fibers, number of heads, action. The number of blanks indicates how many characteristics apply to each muscle. Note that femoris means thigh, brachii means arm, teres means long and round.

1. trapezius shape
2. quadriceps femoris number of heads location
3. rectus abdominus direction of fibers location
4. flexor carpii action location
5. teres minor size → shape