

BIOL 217 Worksheet
Chapter 9 Muscular System

Name: _____

Date Due: _____

1. A skeletal muscle is covered with loose fibrous connective tissue called
 - a. fascia.
 - b. aponeuroses.
 - c. perimysium.
 - d. sarcolemma.
2. Layers of connective tissue which extend into the muscle to form partitions between muscle bundles and are continuous with attachments of muscle to the periosteum are called
 - a. ligaments.
 - b. tendons.
 - c. aponeuroses.
 - d. elastin.
3. Bundles of muscle fibers are called _____.
4. Each bundle is covered by layers of connective tissue called _____.
5. The connective tissue that divides the individual muscles into compartments is the
 - a. deep fascia.
 - b. superficial fascia.
 - c. epimysium.
 - d. perimysium.
6. A surgical procedure to relieve pressure within a muscle compartment is a _____.
7. The characteristic striated appearance of skeletal muscle is due to the arrangement of alternating protein filaments composed of _____ and _____.
8. Striated muscle tissue is also known as _____ muscle.
 - a. voluntary
 - b. involuntary
 - c. skeletal
 - d. visceral
9. The segment of the myofibril between two successive Z lines is called a _____.
10. The union between a nerve fiber and a muscle fiber is the
 - a. motor neuron.
 - b. motor end plate.
 - c. neuromuscular junction.
 - d. neurotransmitter.
11. The response of muscle tissue to stimulation is _____.
12. The precision of movement produced by a muscle is due to
 - a. the size of the muscle fiber, small fibers being more precise.
 - b. the small muscle fiber to neuron ratio within a motor unit.
 - c. many muscle fibers being present for each neuron in a motor unit.
 - d. the number of branches in the neuron, many branches being associated with diffuse stimulation.
13. The finer and more precise the movement produced by a particular muscle, the (fewer/greater) the number of muscle fibers in the motor unit.
14. The most abundant protein in muscle is _____.
15. When the filaments of actin and myosin merge within the myofibril, the result is
 - a. shortening of the muscle fiber.
 - b. membrane polarization.
 - c. release of acetylcholine.
16. The role of acetylcholine in membrane depolarization is to _____ the muscle fiber membrane.
17. What ion is necessary in relatively high concentrations to allow formation of cross-bridges between actin and myosin?

18. When a muscle fiber is at rest, the protein complex _____ prevents the formation of cross-bridges between actin and myosin.
19. The above protein complex is rendered inactive by the presence of
a. acetylcholine. c. anticholinesterase.
b. calcium. d. sodium.
20. The substance that halts the stimulation of a muscle fiber by a neuron is _____.
21. A toxin that can prevent the release of the neurotransmitter from motor nerve fibers is produced by the bacterium _____.
22. The energy used in muscle contraction is supplied by the decomposition of _____.
23. The primary source of energy to reconstruct ATP from ADP and phosphate is a substance called _____.
24. A person feels out of breath after vigorous exercise because of oxygen debt. Which of the following statements help explain this phenomenon?
a. Anaerobic respiration increases during strenuous activity. c. Conversion of lactic acid to glycogen occurs in the liver and requires energy.
b. Lactic acid is metabolized more efficiently when the body is at rest. d. Priority in energy use is given to ATP synthesis.
25. After prolonged muscle use, muscle fatigue occurs due to an accumulation of _____.
26. The partial contraction of skeletal muscles after death is called _____.
27. The rate of speed at which various muscles contract is related to
a. the number of muscle fibers in the motor unit. c. the number of mitochondria present in the cytoplasm of the muscle cells.
b. the amount of myoglobin present in muscle tissue. d. differences in cell membrane permeability in various muscle cells.
28. When muscles are active, large amounts of _____ are released.
29. The minimal strength stimulus needed to elicit contraction of a single muscle fiber is called a _____.
30. The strength of a muscle contraction in response to different levels of stimulation is determined by
a. the level of stimulation delivered to individual muscle fibers. c. the number of motor units stimulated.
b. the number of fibers that respond in each motor unit. d. the characteristics of each muscle group.
31. A record of a muscle's response to stimulation is called a _____.
32. The period of time following a muscle response to a stimulus when it will not respond to a second stimulus is called the
a. latent period. c. refractory period.
b. contraction.

33. Muscle tone refers to
- a state of sustained, partial contraction of muscles that is necessary to maintain posture.
 - a feeling of well-being following exercise.
 - the ability of a muscle to maintain contraction against an outside force.
 - the condition athletes attain after intensive training.
34. When exercise activates primarily the slow, red fibers, the result is
- increased muscle strength.
 - increased muscle size.
 - increased resistance to fatigue.
 - increased anaerobic tolerance.
35. Smooth muscle contracts (more slowly/more rapidly) than skeletal muscle following stimulation.
36. Two types of smooth muscle are _____ muscle and _____ muscle.
37. Peristalsis is due to which of the following characteristics of smooth muscle?
- capacity of smooth muscle fibers to excite each other
 - automaticity
 - rhythmicity
 - sympathetic innervation
38. The self-exciting property of cardiac muscle is probably due to
- the presence of intercalated disks between muscle cells.
 - a well-developed sarcoplasmic reticulum.
 - a cell membrane more permeable to sodium ions.
 - the presence of increased amounts of nonionized calcium.
39. In the following statements, does statement *a* explain statement *b*? _____
- Cardiac muscle remains refractory until a contraction is completed.
 - Sustained tetanic contraction is not possible in heart muscle.
40. The attachment of a muscle to a relatively fixed part is called the _____; the attachment to a relatively movable part is called the _____.
41. Smooth body movements depend on _____ giving way to prime movers.
42. The muscle that compresses the cheeks inward when it contracts is the
- orbicularis oris.
 - epicranius.
 - platysma.
 - buccinator.
43. Excessive use of jaw muscles to clench the jaw may lead to _____ syndrome.
44. The muscle that moves the head so that the face turns to the opposite side when one side contracts is the
- sternocleidomastoid.
 - splenius capitis.
 - semispinalis capitis.
 - longissimus capitis.
45. The muscle that abducts the upper arm, and can both flex and extend the humerus is the
- biceps brachii.
 - deltoid.
 - infraspinatus.
 - triceps brachii.
46. The muscle that extends the arm at the elbow is the
- biceps brachii.
 - brachialis.
 - supinator.
 - triceps brachii.
47. The band of tough connective tissue that extends from the xiphoid process to the symphysis pubis and serves as an attachment for muscles of the abdominal wall is the _____.
48. The heaviest muscle in the body, which serves to straighten the leg at the hip during walking, is the
- psoas major.
 - gluteus maximus.
 - adductor longus.
 - gracilis.
49. The tendon that connects the gastrocnemius muscle with the calcaneus is the _____ tendon, or the _____ tendon.

Learning Exercises

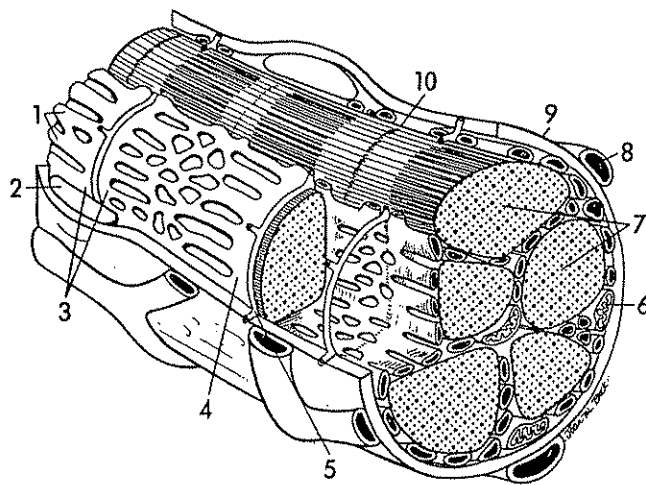
1. Use these terms to label the parts of a skeletal muscle cell (section) indicated in Figure 11-1.

capillary
mitochondrion
muscle triad
myofibrils

nucleus
sarcolemma
sarcoplasmic reticulum
terminal cisterna

transverse tubule
Z line

Figure 11-1



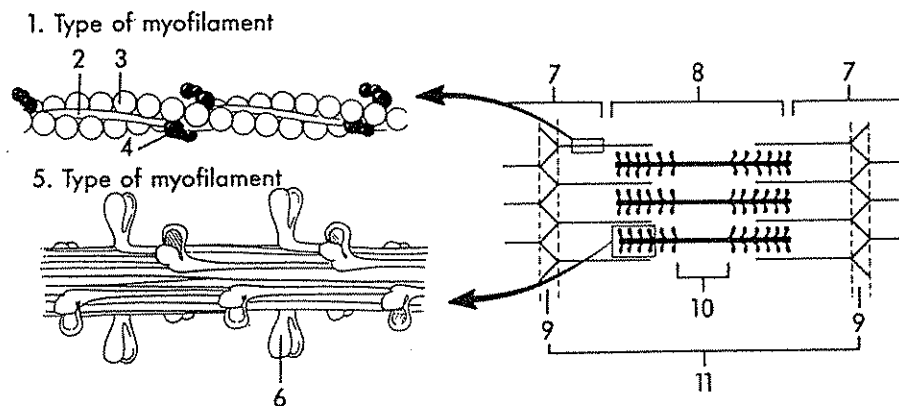
- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____
- 9 _____
- 10 _____

2. Use these terms to identify the parts of the contractile machinery of the skeletal muscle cell indicated in Figure 11-2.

A-band
 F-actin
 H-zone
 I-band
 myosin head
 sarcomere

thick
 thin
 tropomyosin
 troponin
 Z-line

Figure 11-2



- | | | |
|---------|---------|----------|
| 1 _____ | 5 _____ | 9 _____ |
| 2 _____ | 6 _____ | 10 _____ |
| 3 _____ | 7 _____ | 11 _____ |
| 4 _____ | 8 _____ | |

3. Arrange these events of skeletal muscle fiber excitation, contraction, and relaxation in the order in which they occur.

A binding site (for myosin) is exposed on actin
Acetylcholine binds with receptors in the sarcolemma
Acetylcholine is released into the (neuromuscular) synaptic cleft
Action potential reaches the presynaptic (motor) axon terminal
An action potential travels across the sarcolemma (excitation)
 Ca^{++} ions are released from the SR's terminal cisternae
 Ca^{++} ions bind to troponin molecules in the thin filaments
Depolarization moves from transverse tubules to SR cisternae
Spread of depolarization into the transverse tubule system
The power stroke of muscle contraction (crossbridge cycling)
Uptake of Ca^{++} back into the SR, inactivating binding sites on actin

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____
- 9 _____
- 10 _____
- 11 _____

1. The I-band of normal length, relaxed skeletal muscle fibers
 - a. lacks the protein myosin
 - b. lacks the protein actin
 - c. contains crossbridges
 - d. contains troponin
 - e. a and d are correct
2. A sarcomere
 - a. is separated by Z-lines
 - b. is the repeating unit of striated muscle
 - c. shortens when a muscle shortens
 - d. contains thick and thin filaments
 - e. all of the above
3. Components of the thick filaments of a skeletal muscle fiber include
 - a. actin
 - b. tropomyosin
 - c. calcium
 - d. myosin
 - e. a, b, and c
4. Troponin has binding sites for
 - a. actin
 - b. tropomyosin
 - c. calcium
 - d. myosin
 - e. a, b, and c
5. Calcium released from the terminal cisternae binds to
 - a. the sarcoplasmic reticulum
 - b. troponin
 - c. calcium
 - d. myosin
6. The force of contraction in a skeletal muscle depends on
 - a. filament overlap
 - b. intracellular Ca^{++} concentration
 - c. muscle length
 - d. the species of myosin
 - e. all of the above
7. During an isometric contraction
 - a. ATP is hydrolyzed
 - b. sarcomeres shorten
 - c. crossbridges periodically generate force
 - d. both a and c are correct
 - e. a, b, and c are correct
8. The velocity of shortening in an isotonic contraction is
 - a. less if the afterload is greater
 - b. less if the preload is greater
 - c. independent of the preload
 - d. constant
 - e. both a and b are correct
9. The total tension in a skeletal muscle can be increased by
 - a. facilitation
 - b. recruitment
 - c. changes in initial length
 - d. both a and b
 - e. a, b, and c are all possible

10. In a given skeletal muscle
- the number of fibers in a motor unit is constant
 - there is only one motor unit
 - motor units are recruited in the order of increasing size
 - individual motor units discharge at the same time
 - none of the above
11. In cardiac muscle
- there are no sarcomeres
 - there is no transverse tubule system
 - cells are electrically coupled
 - troponin is absent
 - none of the above
12. Increasing the extracellular calcium concentration
- increases the force of contraction of cardiac muscle
 - increases the force of contraction of skeletal muscle
 - has no effect on the force of contraction of skeletal or cardiac muscle
 - decreases the force of contraction of cardiac muscle
13. Smooth muscle contraction
- involves actin and myosin
 - is regulated by calmodulin
 - does not involve troponin
 - is not activated by Ca^{++}
 - a, b, and c are correct
14. Multiunit smooth muscle
- consists of electrically uncoupled cells like skeletal muscle
 - has a clear pattern of striations
 - has a well-developed tubular system
 - consists of electrically coupled cells like cardiac muscle
 - contains no myosin
15. Fast and slow skeletal muscle fibers differ in
- myosin content
 - susceptibility
 - pattern of striations
 - actin content
 - both a and b

Matching

Choose the correct response for Questions 1–3 from the following terms:

- a. muscle twitch
- b. tetanus

- c. ATP
- d. lactic acid

- _____ 1. Sustained contraction of a muscle
- _____ 2. Single muscle contraction produced by a single stimulus
- _____ 3. Muscle fatigue is caused by an accumulation of this substance

Choose the correct response for Questions 4–8 from the following muscles:

- a. sternocleidomastoid
- b. gastrocnemius

- c. masseter
- d. deltoid

- _____ 4. Has clavicle and scapula as its origin and humerus as its insertion
- _____ 5. Major muscle of chewing
- _____ 6. Extends foot
- _____ 7. Muscle used to turn the head
- _____ 8. Calf muscle

Multiple Choice

- _____ 9. Which of these muscles is present in the cat and absent in the human?
 - a. pectoralis major
 - b. gluteus maximus
 - c. epitrochlearis
 - d. sartorius
- _____ 10. Which of these muscles is named according to its function?
 - a. sternomastoid
 - b. semimembranosus
 - c. triceps brachii
 - d. adductor femoris
- _____ 11. The origin of a flexor muscle is located:
 - a. proximal to the insertion
 - b. distal to the insertion
 - c. lateral to the insertion
 - d. at its insertion
- _____ 12. Which muscle type can be microscopically identified by the presence of prominent A bands and peripherally located nuclei?
 - a. cardiac
 - b. smooth
 - c. skeletal
 - d. all of the above

- _____ 13. Pointing the toes (plantar flexion) involves contraction of which of these muscles?
a. tibialis anterior and extensor digitorum longus
b. gastrocnemius and soleus
c. peroneus longus and semitendinosus
d. calcaneus and peroneus tertius
- _____ 14. The longest phase of a skeletal muscle twitch is the:
a. latent period
b. contraction period
c. relaxation period
d. they are all the same length
- _____ 15. Which of these represents largest to smallest in diameter?
a. fasciculus, fiber, myofibril, myofilament
b. fiber, fasciculus, fibril, actin
c. actin, myofilament, fiber, fasciculus
d. actin, myosin, myofilament, fibril
- _____ 16. Which of these is *not* a muscle of the quadriceps femoris group?
a. rectus femoris
b. vastus lateralis
c. vastus intermedius
d. rectus abdominis
- _____ 17. In an adult, intramuscular injections are often given into which of these muscles?
a. gracilis
b. gluteus medius
c. latissimus dorsi
d. biceps femoris
- _____ 18. Which of the frog skeletal muscle contraction experiments required the greatest intensity of induction to induce contraction?
a. muscle twitch
b. multiple motor unit summation
c. tetanus
d. work performed by skeletal muscle
- _____ 19. Energy sources for skeletal muscular contraction include:
a. creatine phosphate
b. ATP
c. glycogen
d. all of the above
- _____ 20. The actual contractile elements of a skeletal muscle cell are the:
a. tonofibrils
b. sarcoplasm
c. desmosomes
d. myofibrils
- _____ 21. Which of the following is associated only with cardiac muscle?
a. intercalated discs
b. the lack of distinct myofibrils
c. reduced sarcoplasmic reticulum
d. sarcomeres
- _____ 22. The point of anatomical contact between a nerve and muscle is the:
a. sarcoplasm
b. motor end plate
c. epineurium
d. epimysium
- _____ 23. Which of the following is *not* a phase of a simple muscle twitch?
a. period of relaxation
b. period of contraction
c. latent period
d. summation period
- _____ 24. Tonus may be best described as:
a. the response of a whole muscle to a single stimulus
b. an increase in strength of response due to repeated strong stimuli
c. a continuous tension maintained because the nervous system sends periodic nervous impulses to muscles even when they are at rest
d. a single generalized muscle response due to a greater frequency of stimulation
- _____ 25. The threshold stimulus required to produce a muscle twitch is _____ when the gastrocnemius is stimulated directly than when the sciatic nerve is stimulated.
a. greater
b. less
c. the same
d. none of the above