

Chapter 6: The Muscular System

OVERVIEW

The purpose of this chapter is to teach the anatomy and physiology of the muscular system.

This chapter begins with an explanation of muscle attachments and actions before muscle identification. The chapter covers muscle origins, insertions, and functions, but not the innervation for each muscle. The nervous system is covered in Chapter 6. Muscles are introduced before microanatomy to give the students more time to study and identify muscles and their actions. Microanatomy follows muscle identification because it leads directly into the physiology of a muscle contraction at the molecular level. This chapter also expands on cellular respiration (discussed in Chapter 2), explaining aerobic versus anaerobic respiration. After the identification of select muscles and the physiology of muscle action, there is a discussion regarding the pathophysiology of muscles.

A table listing all the skeletal muscles in Chapter 6 is located under Individual Outcome 6.4 of this instructor's manual (IM) chapter. The table includes blank columns for origin, insertion, and actions. You can tailor the table to meet your course needs by adding muscles to or deleting muscles from the list. Providing the students with your customized chart can facilitate their note-taking, and help them know exactly what muscles they need to learn. A Simon Says activity is also described under Individual Outcome 6.4. This activity can be done each day at the end of a class period as a fun, informal summary assessment on muscles and their actions. It works especially well for kinesthetic learners.

Chapter figures can be found in the Online Learning Center (OLC). Discussion points, group activities, and quizzes listed in the summary table below are explained under their individual outcomes following the table. Answer keys to the text chapter review questions, workbook concept maps, and workbook review questions are located at the end of the chapter.

A review guide is also available on the OLC. This guide lists all of the learning outcomes for the chapter and gives space for students to take notes and make sketches. This can be an important tool to encourage students to pay attention to what they are learning and to use to either take initial notes or to organize their existing notes before exams.

COMPETENCY CORRELATION GRID

Learning Outcome	CAAHEP Competencies	ABHES Competencies
6.1 Use medical terminology related to the muscular system.	I.C.1. Describe structural organization of the human body	3.a. Define and use entire basic structure of medical words and be able to accurately identify in the correct context, i.e., root, prefix, suffix, combinations, spelling and definitions

6.2 Define terms concerning muscle attachments and the ways muscles work in groups to aid, oppose, or modify each other's actions.	I.C.1. Describe structural organization of the human body	3.a. Define and use entire basic structure of medical words and be able to accurately identify in the correct context, i.e., root, prefix, suffix, combinations, spelling and definitions
6.3 Demonstrate actions caused by muscles.	I.C.2. Identify body systems	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.4 Identify muscles, giving the origin, insertion, and action.	I.C.2. Identify body systems	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.5 Describe the structural components of a muscle, including the connective tissues.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.6 Describe the structural components of a skeletal muscle fiber, including the major proteins.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.7 Explain the five physiological characteristics of all muscle tissue.	I.C.4. List major organs in each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.8 Explain how a nerve stimulates a muscle cell at a neuromuscular junction.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.9 Describe a muscle contraction at the molecular level.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.10 Compare and contrast a muscle twitch and tetany with regard to the steps of a muscle contraction at the molecular level.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.11 Define a motor unit and explain the effect of recruitment.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.12 Compare and contrast isotonic and isometric contractions.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.13 Describe an example of a lever system in the human body, giving the resistance, effort, and fulcrum.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.14 Compare aerobic and anaerobic respiration in terms of amount of ATP produced, speed, and duration.	I.C.1. Describe structural organization of the human body	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.15 Explain the basis of muscle fatigue and soreness.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.16 Compare and contrast skeletal, cardiac, and smooth muscle tissue in terms of appearance, structure, type of nerve stimulation, type of respiration, and location.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.17 Explain the nutritional requirements of the muscular system.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

6.18 Summarize the five functions of the muscular system and give an example or explanation of each.	I.C.5. Describe the normal function of each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.19 Summarize the effects of aging on the muscular system.	I.C.10. Compare body structure and function of the human body across the life span	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.20 Describe a common diagnostic test used to diagnose disorders of the muscular system.	I.C.13. Identify skeletal muscle diagnostic tests.	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.
6.21 Describe muscle disorders and relate abnormal function to pathology.	I.C.6. Identify common pathology related to each body system	2.b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms and etiologies.

SUMMARY TABLE 5

LEARNING OUTCOME	LECTURE OUTLINE	ACTIVITIES – TALKING POINTS	ASSESSMENTS	CONNECT	INSTRUCTOR NOTES
6.1 Use medical terminology related to the muscular system.		<i>WkBk Word Roots and Combining Forms</i>	<i>WkBk Review Questions:</i> <ul style="list-style-type: none">Word deconstruction: 1-5	<ul style="list-style-type: none">NCLEX Style Questions	
6.2 Define terms concerning muscle attachments and the ways muscles work in groups to aid, oppose, or modify each other's actions.	I. Overview II. Anatomy of the muscular system A. Anatomical terms 1. Terms of attachment a. origin b. insertion c. intrinsic muscle d. extrinsic muscles 2. Terms that indicate the interrelated actions of muscles a. fixator b. synergists	Talking point: Many muscle attachments will be associated with skeletal terms.	<i>WkBk Review Questions:</i> <ul style="list-style-type: none">MS: 1, 3	<ul style="list-style-type: none">RMA Style QuestionsCMA Style Questions	

	<p>c. prime mover</p> <p>d. antagonist</p> <p>Chapter Figure:</p> <p>6.1 (The Muscular System)</p>				
<p>6.3 Demonstrate actions caused by muscles.</p>	<p>B. Muscle actions</p> <p>a. flexion</p> <p>b. extension</p> <p>c. abduction</p> <p>d. adduction</p> <p>e. protraction</p> <p>f. retraction</p> <p>g. retraction</p> <p>h. lateral excursion</p> <p>i. medial excursion</p> <p>j. dorsiflexion</p> <p>k. plantar flexion</p> <p>l. inversion</p> <p>m. eversion</p> <p>n. rotation</p> <p>o. circumduction</p> <p>p. supination</p> <p>q. pronation</p> <p>Chapter Figures:</p> <p>6.2 (Flexion and extension)</p>	<p>Talking Point: It is important to keep in mind anatomical position when learning muscle actions.</p> <p>Talking Point: Encourage students to say the name of a muscle aloud, point to the origin and insertion on their own bodies, and contract the muscle to see and feel the action.</p> <p>Group activity: 1</p> <p>(See Individual Outcome 6.4)</p>	<p>WkBk Review Questions:</p> <ul style="list-style-type: none">• MS: 10• Critical thinking: 3	<ul style="list-style-type: none">• RMA Style Questions• CMA Style Questions• Audio Definitions• Audio Spelling	

	6.3 (Abduction and adduction) 6.4 (Protraction, retraction, lateral excursion, and medial excursion) 6.5 (Dorsiflexion, plantar flexion, inversion, and eversion) 6.6 (rotation and circumduction) 6.7 (Supination and pronation) 6.8 (Opposition) 6/9 (Elevation and depression)				
6.4 Identify muscles giving the origin, insertion, and action.	<p>C. Muscles by region</p> <p>1. Muscles of the head and neck</p> <p>2. Muscles of the thorax and abdomen</p> <p>3. Muscles of the back</p> <p>4. Muscles of the arm</p> <p>5. Muscles of the forearm</p> <p>6. Muscles of the thigh</p> <p>7. Muscles of the leg</p> <p>Chapter Figures:</p> <p>6.10 (Muscles – anterior view)</p> <p>6.11 (Muscles – posterior view)</p> <p>6.12 (Muscles of the head and neck)</p> <p>6.13 (Muscles of the thorax and abdomen)</p>	<p>Group activity: 1</p> <p>(See Individual Outcome 6.4)</p> <p>Class activity: 1. Simon Says</p> <p>(See Individual Outcome 6.4)</p> <p>Talking Point: Stress how knowing the insertion and origin of muscles can help with their identifications. For example: all flexors in the forearm originate on the medial epicondyle of the humerus, while all the extensors originate on the lateral epicondyle of the humerus.</p> <p>Talking Point: Have the student contract a muscle. Have them palpate to feel the contracted muscle. While they palpate it, have them identify the origin and</p>	<p><i>Spot check:</i> 1, 2</p> <p>Quiz: 1</p> <p>(Covers LOs 5.2-5.4)</p> <p>Figure IMQ 5.1</p> <p>Quiz: 2</p> <p>(Covers LOs 5.2-5.4)</p> <p>Figure IMQ 5.2</p> <p>WkBk Review Questions:</p> <ul style="list-style-type: none">MS: 2, 3	<ul style="list-style-type: none">Digital DissectionDigital AtlasDigital ColoringNCLEX Style QuestionsAudio DefinitionsAudio Spelling	

	6.14 (Muscles of the neck, back and buttocks) 6.15 (Pectoral and brachial muscles) 6.16 (Muscles of the forearm) 6.17 (Carpal tunnel syndrome) 6.18 (Anterior muscles of the thigh) 6.19 (Posterior muscles of the thigh) 6.20 (Muscles of the leg)	insertion. WkBk Coloring book: <ul style="list-style-type: none">Skeletal muscles Figures 6.1 (Muscles of the head and neck) 6.2 (Muscles of the thorax and abdomen) 6.3 (Pectoral and brachial muscles) 6.4 (Muscles of the forearm) 6.5 (Back and gluteal muscles) 6.6 (Muscles of the thigh) 6.7 (Muscles of the leg)			
6.5 Describe the structural components of a muscle, including the connective tissues.	D. Anatomy of a skeletal muscle Chapter Figure: 6.21 (Connective tissue and structural components of a thigh muscle)	WkBk Lab exercises and activities: <ul style="list-style-type: none">Muscle model Talking Point: Muscle model This activity shows how the connective tissues running through a muscle come together at the ends to form a tendon. WkBk Concept maps: <ul style="list-style-type: none">Figure 6.11 (Anatomy of a muscle)	WkBk Review Questions: <ul style="list-style-type: none">MS: 9	<ul style="list-style-type: none">RMA Style QuestionsCMA Style Questions	
6.6 Describe the structural components of a skeletal	E. Anatomy of a muscle cell	WkBk Concept maps: <ul style="list-style-type: none">Figure 6. 12 (Muscle cell	WkBk Review Questions: <ul style="list-style-type: none">MS: 4	<ul style="list-style-type: none">Digital AtlasRMA Style Questions	

muscle fiber, including the major proteins.	Chapter Figures: 6.22 (Structure of a muscle fiber) 6.23 (Muscle fiber (cell) striations and sarcomeres) 6.24 (Protein structure of thick and thin myofilaments)	anatomy)		<ul style="list-style-type: none">• CMA Style Questions• Audio Definitions• Audio Spelling	
6.7 Explain the five physiological characteristics of all muscle tissue.	III. Physiology of the muscular system A. Physiological characteristics of muscle tissue	WkBk Concept maps: <ul style="list-style-type: none">• Figure 6.13 (Characteristics of muscle tissue)	WkBk Review Questions: <ul style="list-style-type: none">• MS: 4• Completion: 1-5	<ul style="list-style-type: none">• RMA Style Questions• CMA Style Questions	
6.8 Explain how a nerve stimulates a muscle cell at a neuromuscular junction.	B. Neuromuscular junction Chapter Figure: 6.25 (A neuromuscular junction)	WkBk Concept maps: <ul style="list-style-type: none">• Figure 6.14 (Neuromuscular junction)	WkBk Review Questions: <ul style="list-style-type: none">• Critical thinking: 1	<ul style="list-style-type: none">• Digital Dissection• Digital Atlas• NCLEX Style Questions• RMA Style Questions• CMA Style Questions• Audio Definitions• Audio Spelling	
6.9 Describe a muscle contraction at the molecular level.	C. Muscle contraction at the molecular level Chapter Figure: 6.26 (Sliding filament model)	Group activity: 2 (See below under Individual Outcome 5.9) WkBk Lab exercises and activities: <ul style="list-style-type: none">• Muscle twitch Figure 5.9 WkBk Concept maps: <ul style="list-style-type: none">• Figure 6.15 (Muscle contraction)	Spot check: 3 Quiz: 2 (Covers LO 5.9) WkBk Review Questions: <ul style="list-style-type: none">• MS: 1• Matching 1-5		

		Talking Point: You can type in your computer browser, “muscle contraction video.” Numerous YouTube videos will appear. Select a good video that shows the movement of the actin filament, etc.	<ul style="list-style-type: none">Critical thinking: 1		
6.10 Compare and contrast a muscle twitch and tetany with regards to the steps of a muscle contraction at the molecular level.	D. Types of muscle contractions Chapter Figures: 6.27 (Graph of a muscle twitch) 6.28 (Graph showing tetany)		WkBk Review Questions: <ul style="list-style-type: none">MS: 5	<ul style="list-style-type: none">Digital Atlas	
6.11 Define a motor unit and explain the effect of recruitment.	E. Motor units and recruitment		Spot check: 4 WkBk Review Questions: <ul style="list-style-type: none">MS: 1, 10		
6.12 Compare and contrast isotonic and isometric contractions.	F. Isotonic and isometric contractions	Group Activity: 3 (See Individual Outcome 6.12)	Spot check: 5 WkBk Review Questions: <ul style="list-style-type: none">MS: 1	<ul style="list-style-type: none">NCLEX Style Questions	
6.13 Describe an example of a lever system in the human body giving the resistance, effort, and fulcrum.	G. Levers Chapter Figure: 6.29 (Lever systems showing the resistance (R), the effort (E), and the	WkBk Lab exercises and activities: <ul style="list-style-type: none">Figure 6.10 (Levers)	Quiz: 3 (Covers LOs 5.3, 5.4, 5.13) WkBk Review Questions: <ul style="list-style-type: none">MS: 1		

	fulcrum (F).				
6.14 Compare aerobic and anaerobic respiration as to amount of ATP produced, speed, and duration.	H. Muscle metabolism 1. Aerobic respiration 2. Anaerobic respiration Chapter Figure: 6.30 (Muscle metabolism)	Discussion Point: 1 Chicken versus wild duck (See Individual Outcome 6.14) WkBk Concept maps: <ul style="list-style-type: none"> Figure 6.16 (Muscle metabolism) 	WkBk Review Questions: <ul style="list-style-type: none"> Critical thinking: 2 	<ul style="list-style-type: none"> NCLEX Style Questions 	
6.15 Explain the basis for muscle fatigue and soreness.	I. Fatigue	WkBk Concept maps: <ul style="list-style-type: none"> Figure 6.17 (Fatigue) 	Spot check: 6 WkBk Review Questions: <ul style="list-style-type: none"> MS: 6 	<ul style="list-style-type: none"> RMA Style Questions CMA Style Questions 	
6.16 Compare and contrast skeletal, cardiac, and smooth muscle tissue as to appearance, structure, type of nerve stimulation, type of respiration, and location.	J. Comparison of muscle tissues	WkBk Concept maps: <ul style="list-style-type: none"> Figure 6.18 (Types of muscle tissue) Talking Point: At this point, be sure to discuss the concept that skeletal muscles appear striated due to the overlap of actin and myosin filaments.	WkBk Review Questions: <ul style="list-style-type: none"> Matching 6-10 	<ul style="list-style-type: none"> NCLEX Style Questions 	
6.17 Explain the nutritional requirements of the muscular system.	K. Nutritional requirements of muscle tissue		Spot check: 7		
6.18 Summarize the five functions of the muscular system and give an example or explanation for each.	L. Functions of the muscular system a. movement b. stability c. control of body openings and passages		WkBk Review Questions: <ul style="list-style-type: none"> MS: 3 		

	d. communication e. heat production Chapter Figure: 6.31 (Sam)				
6.19 Summarize the effects of aging on the muscular system.	IV. Effects of aging on the muscular system		<i>Spot Check</i> : 8 <i>WkBk Review Questions:</i> <ul style="list-style-type: none">MS: 7		
6.20 Describe a common diagnostic test used to diagnose disorders of the muscular system.	V. Diagnostic Test for Muscular System Disorders		<i>Spot Check</i> : 9		
6.21 Describe muscle disorders and relate abnormal function to pathology.	VI. Muscular system disorders <ul style="list-style-type: none">A. herniasB. crampsC. muscular dystrophyD. sprainsE. muscle strainF. myalgiaG. fibromyalgiaH. tendinitisI. atrophyJ. shin splints Chapter Figure: 6.32 (Inguinal hernia)		<i>WkBk Review Questions:</i> <ul style="list-style-type: none">MS: 8 <i>Spot Check</i> : 10, 11	<ul style="list-style-type: none">NCLEX Style Questions	

INDIVIDUAL OUTCOMES:

OUTCOME 6.4

Spot Check 1: If you put one finger on the origin of the right sternocleidomastoid (the mastoid process posterior to your right ear lobe) and another finger on the insertion of the right sternocleidomastoid (the manubrium at the base of the neck) you can determine which direction the right sternocleidomastoid rotates the head. Muscles can only shorten when they contract. First turn your head right, and then turn your head left. Which direction caused your fingers to come closer together indicating that the muscle shortened?

Answer: Left

Spot Check 2: Which muscles are synergists for hip flexion? Which muscles are antagonists to hip flexors?

Answer: Synergists for hip flexion: pectineus, iliacus, psoas major, iliopsoas, sartorius, and rectus femoris. Antagonists to hip flexors: biceps femoris and gluteus maximus.

Group Activity: 1

Customize the Muscle Table below to meet the needs of your course. Divide the muscle list among groups in the class. Give each group the assignment to fill out the table for their portion of the muscle list and be prepared to present to their portion of the completed table to the class including a demonstration of the actions of the muscles. The muscle action demonstrations satisfy LO 5.3

<u>Muscle</u>	<u>Origin</u>	<u>Insertion</u>	<u>Action</u>
Orbicularis oris			
Orbicularis oculi			
Frontalis			
Temporalis			
Buccinator			
Masseter			
Platysma			
Sternocleidomastoid			
Pectoralis major			
Pectoralis minor			
Serratus anterior			
Diaphragm			
External abdominal oblique			

Internal abdominal oblique

Rectus abdominis

Transverse abdominis

Trapezius

Latissimus dorsi

Erector spinae

Deltoid

Biceps brachii

Triceps brachii

Brachialis

Brachioradialis

Extensor carpi radialis

Extensor carpi ulnaris

Palmaris longus

Flexor carpi radialis

Flexor carpi ulnaris

Flexor digitorum

Extensor digitorum

Gluteus maximus

Gluteus medius

Tensor fascia latae

Gracilis

Sartorius

Rectus femoris

Vastus lateralis

Vastus medialis

Vastus intermedius

Biceps femoris

Semitendinosus

Semimembranosus

Gastrocnemius

Soleus

Peroneus/fibularis
Tibialis anterior
Iliacus
Iliopsoas
Psoas Major
Adductor longus
Pectineus

Class Activity: 1 Simon says

This activity is based on the children's game of Simon Says. It is a fun, effective way to check for understanding of muscle identification and muscle actions.

Explain the rules:

- The game begins with everyone standing.
- An instruction is given by the leader (instructor). If the leader says "Simon says" before the instruction, everyone is to do what Simon says, but if the leader does not say Simon says, no one is to follow the instruction. For example: "Contract your left deltoid muscle" (no one should move). "Simon says contract your left deltoid muscle" (everyone should abduct their left arm).
- If a mistake is made in anyway (doing something Simon didn't say, or doing the wrong action if Simon did say something) the student must sit down and is out of the game. The last person standing wins.

After explaining the rules, say "OK, understand? Let's get started. Everybody stand up." Many in the class will immediately stand up, but of course, they will now be out of the game because you did not say "Simon says stand up". And so the fun begins.

Catching students off guard by randomly omitting the Simon Says takes the pressure off the students and makes the game more fun. The fact that college students are having trouble following the directions of a children's game makes it more fun. Having fun makes learning muscle actions much easier. This activity can be repeated often, and becomes more effective each time. You will find students are looking around the room to see what they should be doing if they do not know. Once the activity has been explained the first time, Simon Says can be done in as little as 5 minutes at the end of a class period.

Some suggestions for commands are listed below. You decide when to add Simon says and what muscles to include from your customized list.

Contract your right gastrocnemius.

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Contract your left gastrocnemius.

Relax both.

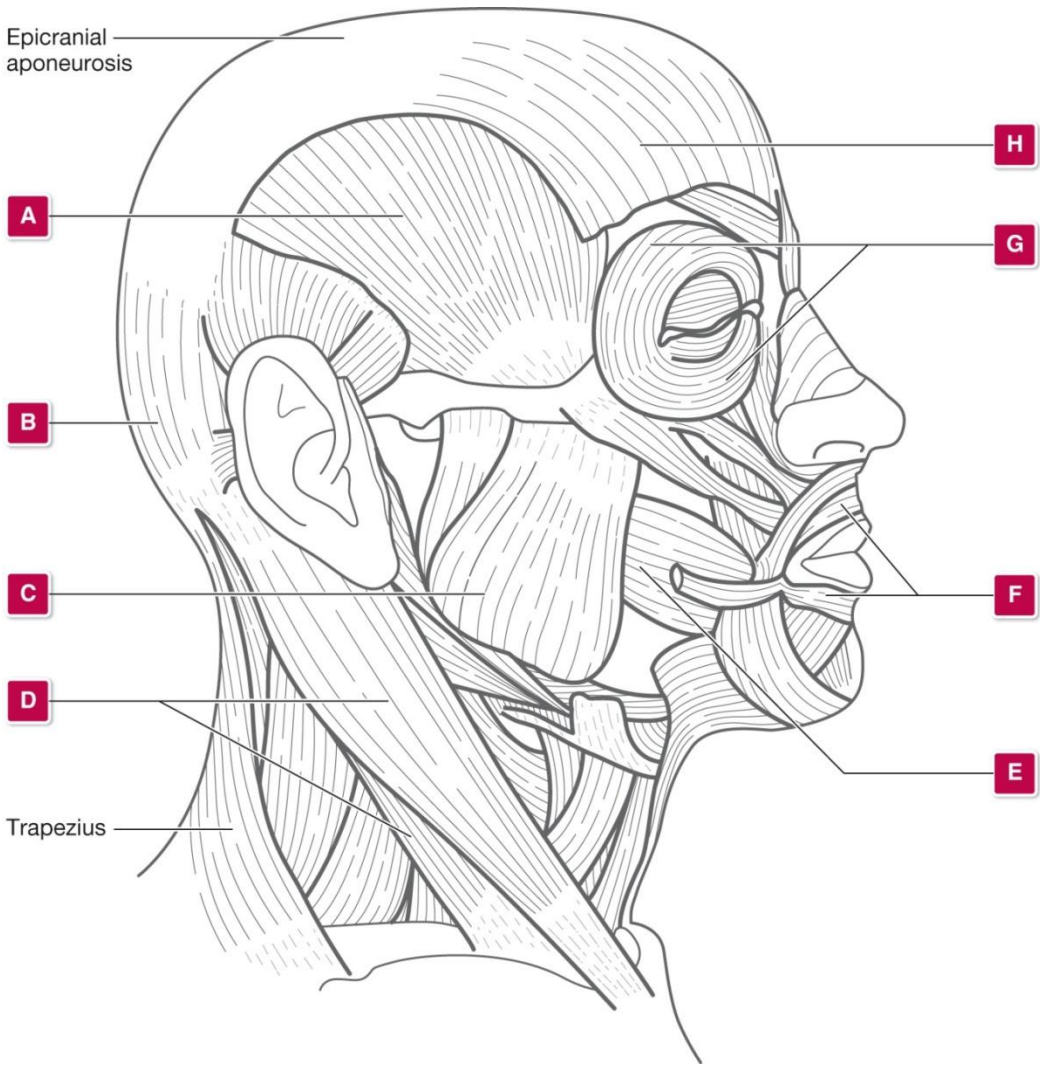
Contract your platysma.

Contract your masseter muscles.

Contract your left hamstring muscles.

Contract your deltoid muscles.

Quiz: 1



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1. Identify muscle A.	<i>Temporalis m.</i>
2. What is the action of muscle A?	<i>Elevates, retracts, and causes medial and lateral excursion of the mandible</i>
3. Identify muscle C.	<i>Masseter m.</i>
4. What is the function of muscle C?	<i>Elevate the mandible</i>
5. What term can be used for A and C to show how they are interrelated?	<i>Synergists</i>
6. Identify muscle H.	<i>Frontalis m.</i>
7. Identify muscle F.	<i>Orbicularis oris m.</i>
8. Identify muscle E.	<i>Buccinator m.</i>
9. What is the action of muscle E?	<i>Compresses the cheeks</i>
10. Identify muscle D.	<i>Sternocleidomastoid m.</i>

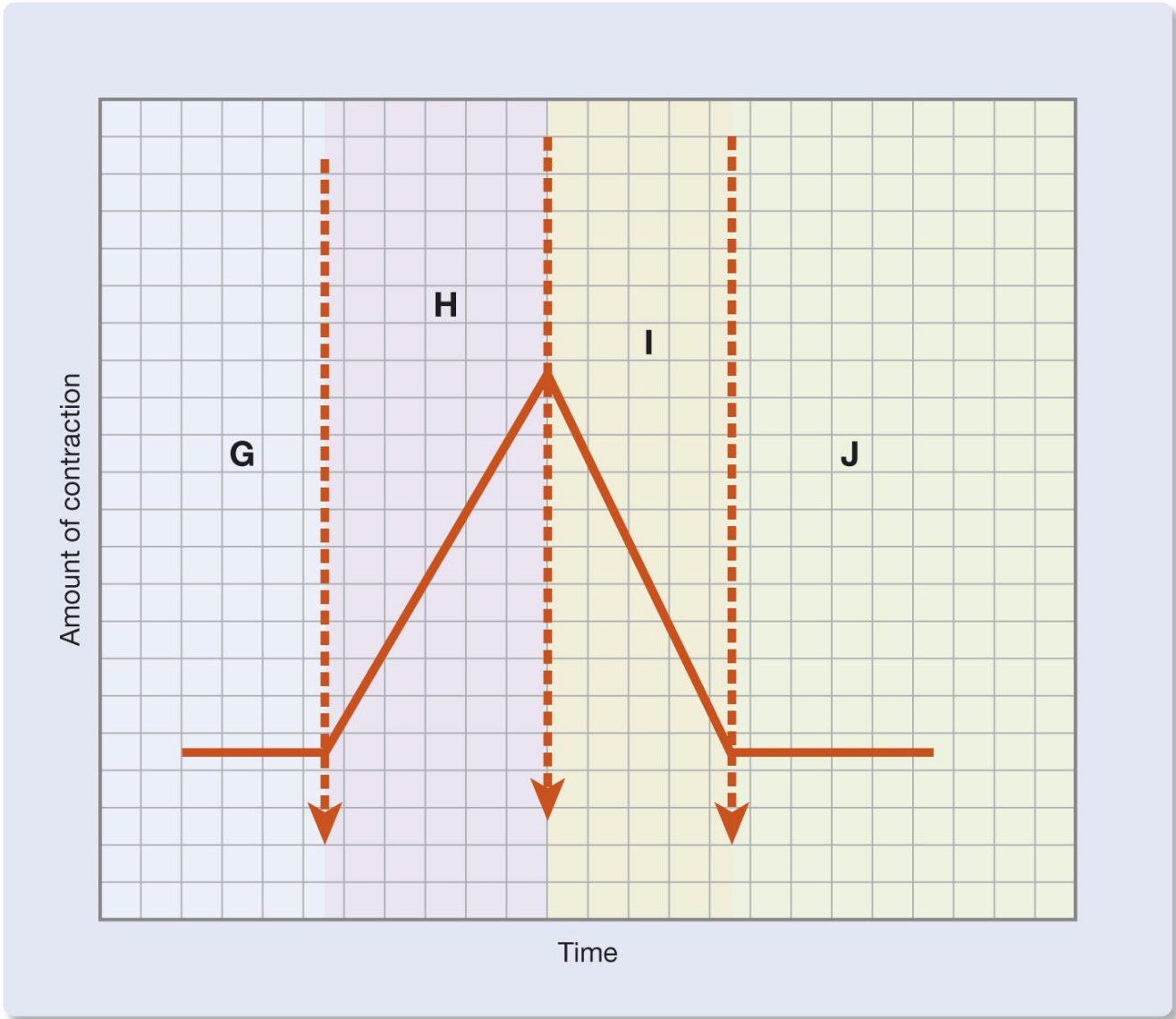
OUTCOME 6.9

Spot Check 3: How much acetylcholine was necessary for the contraction to happen?

Answer: A threshold amount.

Group Activity: 2

Divide the class into groups of 2 to 3 students. Have the students study their notes for 2 minutes concerning a muscle contraction at the molecular level. One student in each group should put his or her notes aside and tell the other member(s) the steps of a muscle contraction at a molecular level. The other member(s) check(s) notes for accuracy. This is repeated until all members of the group have had a turn. This works well as preparation for Quiz 2 a day or two before Quiz 2 is administered.



This figure shows the phases of one muscle twitch. Use this graph to answer the following questions.

- | | |
|---|-----------------------------|
| 1. What is the term for phase G on this graph? | <i>Latent phase</i> |
| 2. What is the term for phase H on this graph? | <i>Contraction phase</i> |
| 3. What is the term for phase I on this graph? | <i>Relaxation phase</i> |
| 4. What is the term for phase J on this graph? | <i>Refractory phase</i> |
| 5. During which phase is acetylcholinesterase produced? | <i>Refractory phase, J</i> |
| 6. During which phase does a power stroke happen? | <i>Contraction phase, H</i> |
| 7. During which phase must a threshold amount of stimulus be applied? | <i>Latent phase, G</i> |
| 8. During which phase does myosin grab hold of active sites on actin? | <i>Latent phase, G</i> |
| 9. During which phase is calcium released? | <i>Latent phase, G</i> |
| 10. During which phase is calcium actively transported? | <i>Refractory phase, J</i> |

OUTCOME 6.11

Spot Check 4: What causes the difference between gently holding an egg in your fist and crushing an egg in your fist?

Answer: More motor units are recruited when an egg is crushed.

OUTCOME 6.12

Spot Check 5: Put the palms of your hands together at your chest. Now push your palms together equally as hard as you can. Was pushing your palms together an isotonic or isometric contraction?

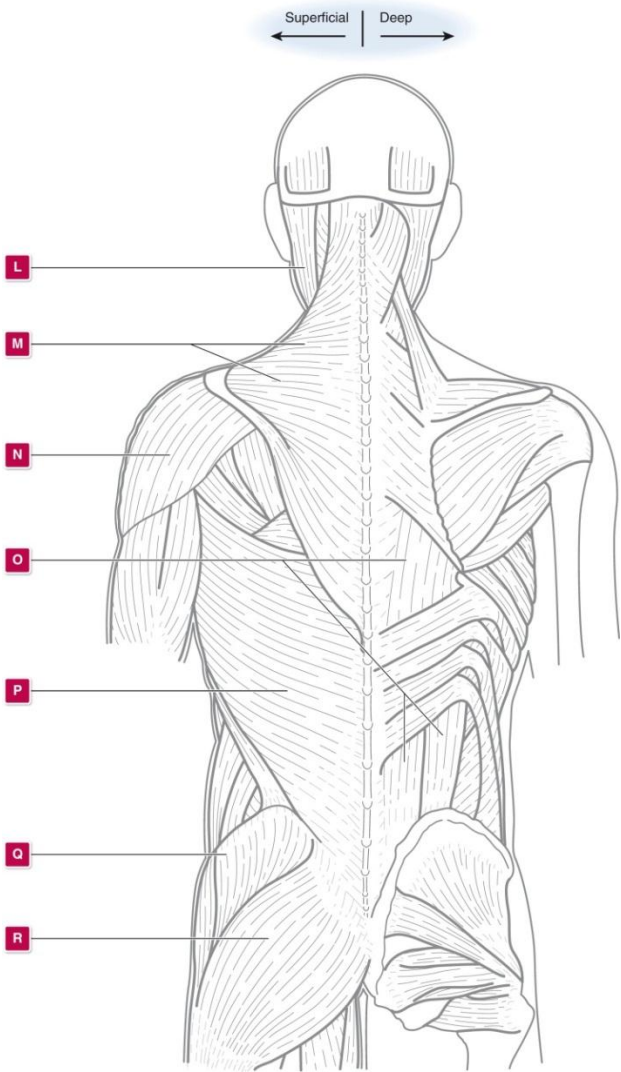
Answer: Isometric, muscles tensed but no motion resulted.

Group Activity: 3

Divide your customized list of muscles amongst your groups of students. Have each group of students come up with one isometric and one isotonic exercise for each of the muscles for their group. The groups should be prepared to demonstrate their exercises.

OUTCOME 6.13

Quiz: 3



IM Ch 6

1. Identify muscle N.	<i>Deltoid m.</i>
2. What is the origin of muscle N?	<i>Clavicle and scapula</i>
3. What is the insertion of muscle N?	<i>Deltoid tuberosity of the humerus</i>
4. What is the action of muscle N?	<i>Abducts humerus</i>
5. What joint would be the fulcrum for the lever system for muscle N?	<i>Shoulder</i>
6. Where would the effort be applied in the lever system for muscle N?	<i>Deltoid tuberosity of the humerus</i>
7. What would be the resistance in the lever system for muscle N?	<i>The arm</i>
8. What class lever system is used when muscle N does its action?	<i>Third class</i>
9. Identify muscle P.	<i>Latissimus dorsi</i>
10. Identify muscle R.	<i>Gluteus maximus</i>

OUTCOME 6.14

Discussion Point: 1

Chicken versus duck

Ask students if they eat chicken. If so, what type of chicken do they prefer: white or dark meat? Why? (Students will often mention not liking to see vessels in thighs and legs.) Ask which pieces of chicken are white meat and which pieces are dark. Ask what types of activities concerning muscle action do chickens do all day? (They walk around, peck at the ground, but do not fly more than short distances at any one time). Ask if any students have ever eaten wild duck. (Wild duck is all dark meat). Ask students what types of activities concerning muscle action do ducks do all day, especially in the spring and fall. (Ducks must fly long distances when they migrate.) Have the students discuss in their groups how both birds have adapted their musculature and muscle metabolism to fit their lifestyle.

Chickens have primarily fast twitch fibers specializing in anaerobic respiration in their wings and breast. These fibers are whiter in color (less myoglobin) and the meat has less of a blood supply (fewer visible vessels). The dark meat of a chicken (legs and thighs) has a better blood supply (more visible vessels) and more myoglobin (darker color) so these slow-twitch muscle fibers can do aerobic respiration for long periods of time. Wild ducks have primarily slow-twitch fibers throughout their bodies to perform aerobic respiration that allows them to fly and to swim for long periods of time.

Humans have a mix of fast- and slow-twitch fibers in every muscle, the proportion of which is genetically determined.

OUTCOME 6.15

Spot Check 6: Jessica and Jennifer are twins, but not identical. They are both going out for track at their high school. They live together, have similar diets, and train together. Explain why Jessica is better than Jennifer at running the 100-meter dash and Jennifer is better than Jessica at the 1600-meter run. What other events or activities may show similar results?

Answer: Jessica's muscles have a higher ratio of fast twitch fibers adapted for anaerobic respiration. Jennifer's muscles have a higher ratio of slow twitch fibers adapted for aerobic respiration. Answers may vary for additional events. Jennifer's events should require endurance. Jessica's events should require quick bursts of energy.

OUTCOME 6.17

Spot Check 7: Which type of diet, vegetarian or nonvegetarian, requires more planning to meet the needs of the muscular system? Explain.

Answer: Vegetarian. A nonvegetarian diet has more complete protein sources.

OUTCOME 6.19

Spot Check 8: What would be the effect of reduced muscle tone on posture?

Answer: The posture becomes more stooped.

OUTCOME 6.20

Spot Check 9: Explain how electromyography works

Answer: This is a procedure that assesses the health of the muscles by testing how a muscle responds to electric stimuli.

OUTCOME 6.21

Spot Check 10: What is the difference between a sprain and a strain?

Answer: A sprain is a tear in a ligament whereas a strain is a tear in a tendon.

OUTCOME 6.21

Spot Check 8: What disorders of the muscular system are common to athletes? Why do you think these disorders affect athletes?

Answer: Strains, sprains, myalgia, tendinitis, and shin splints. These are common because they all involve either overuse of a muscle or trauma to a muscle

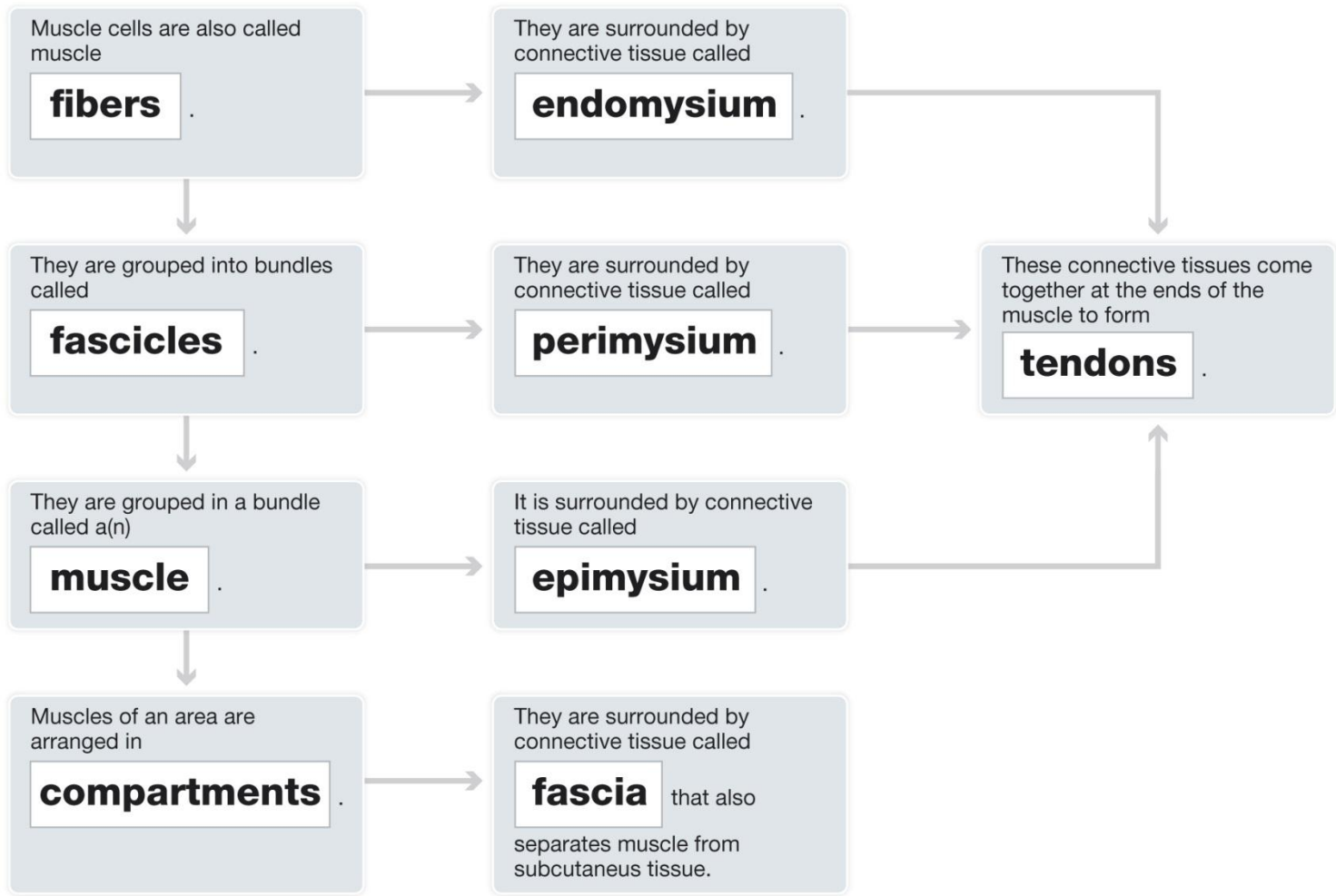
ANSWER KEYS

Chapter Review Questions

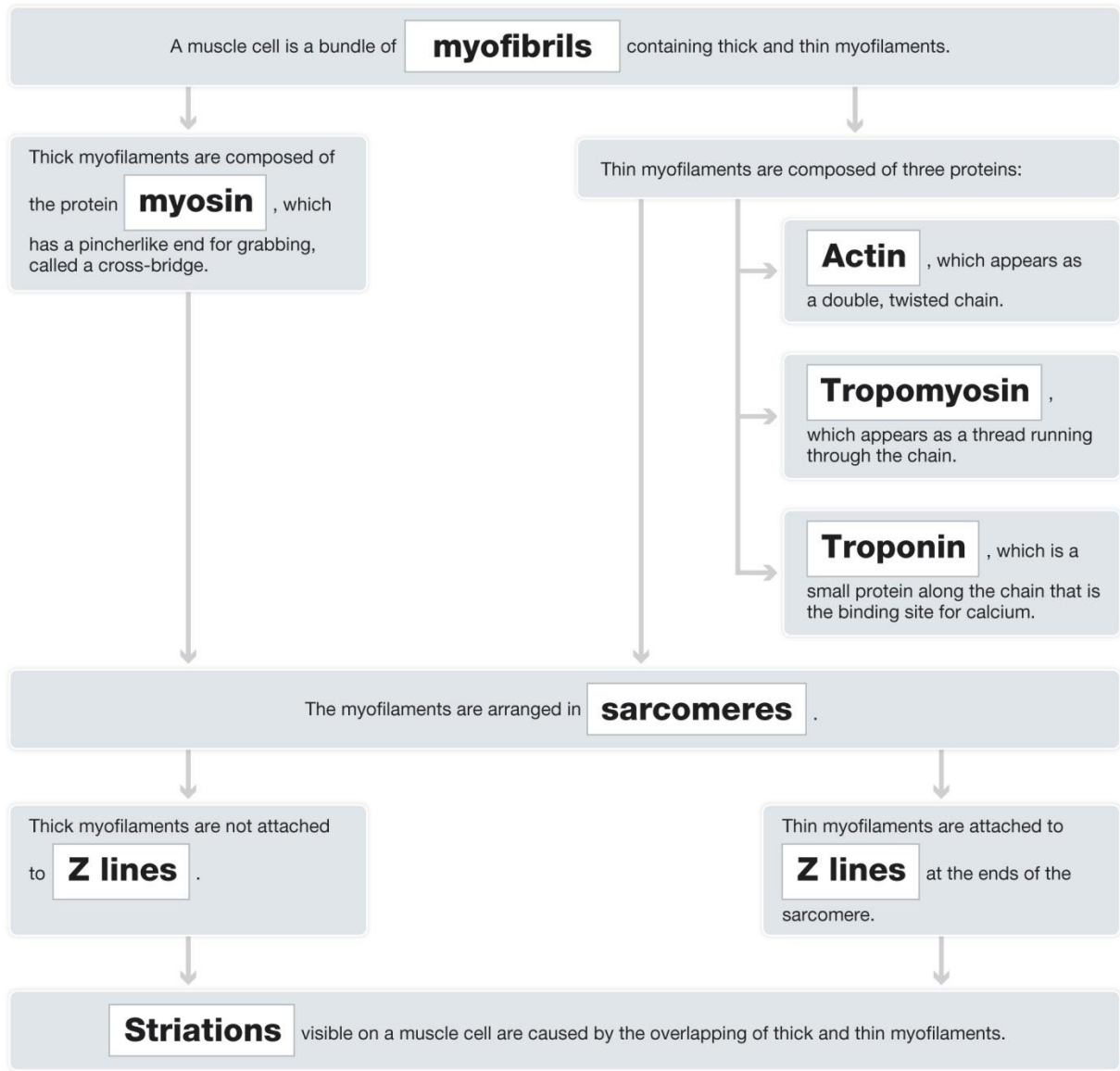
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Workbook Concept Maps

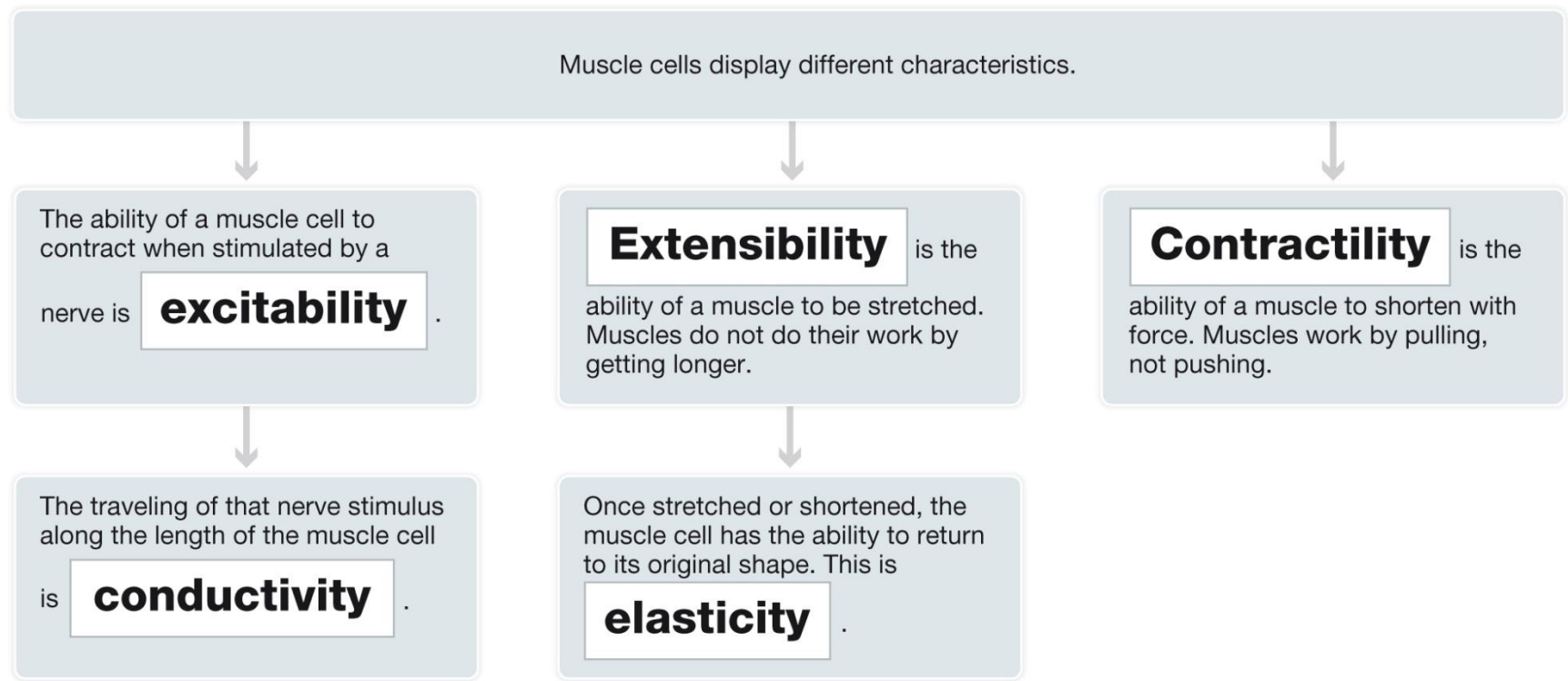
Anatomy of a muscle



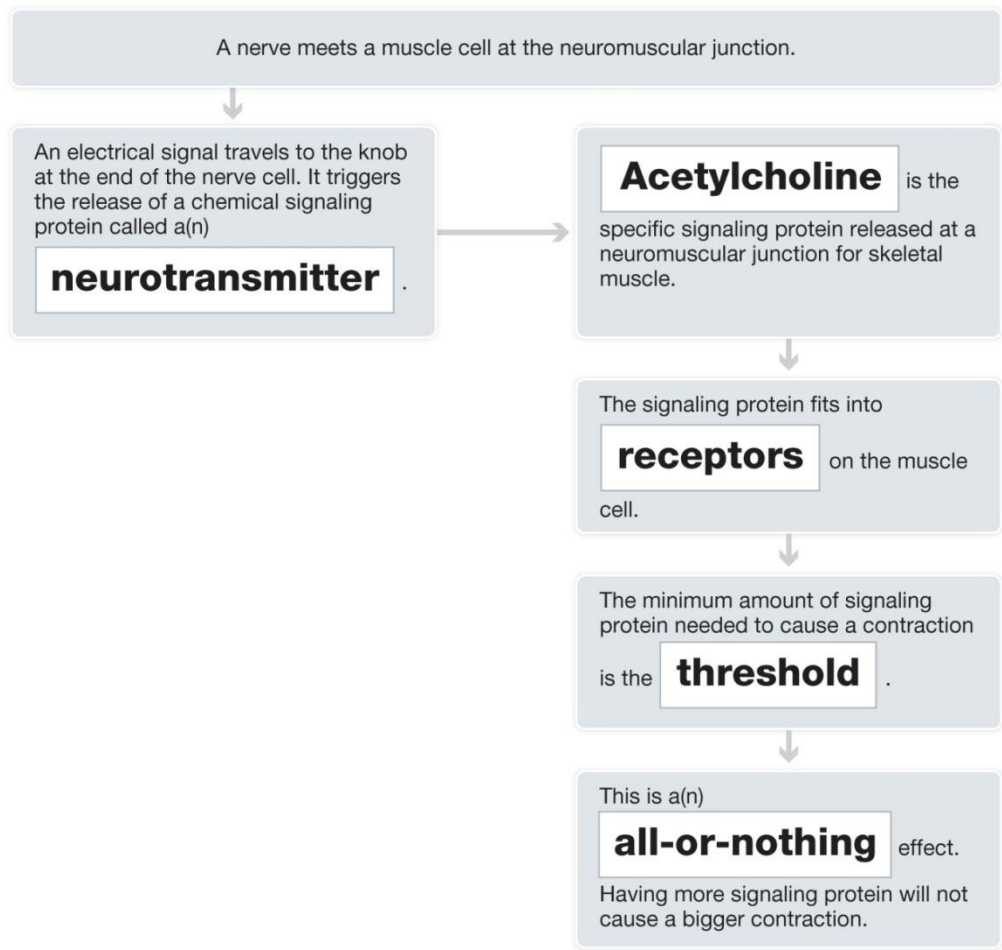
Muscle cell anatomy



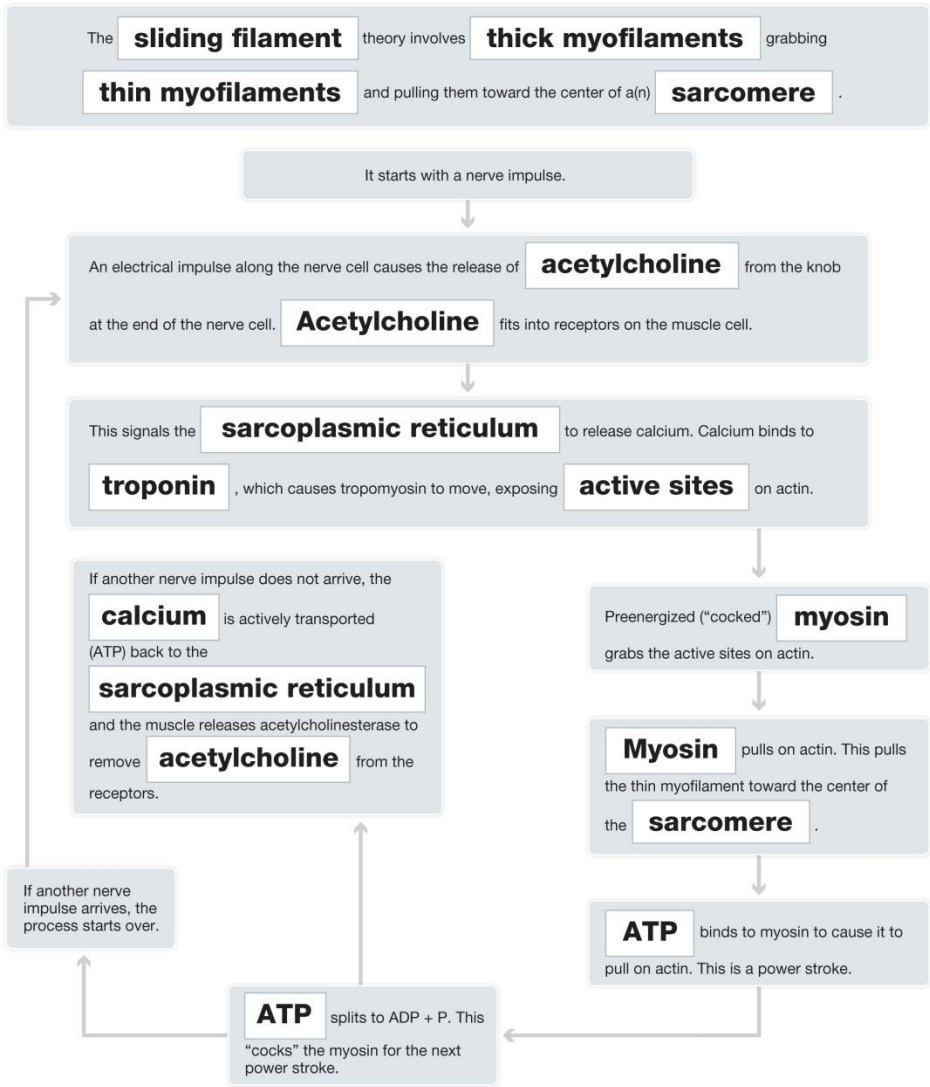
Characteristics of muscle tissue



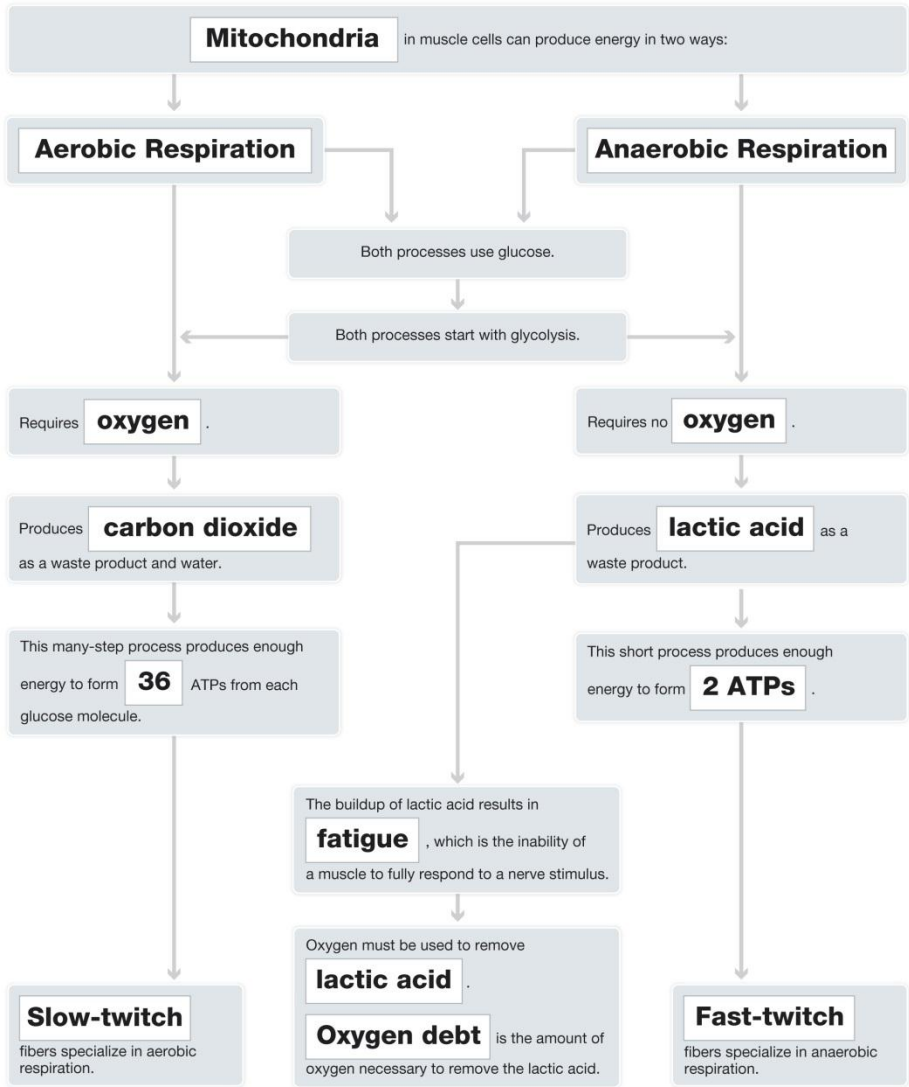
Neuromuscular junction



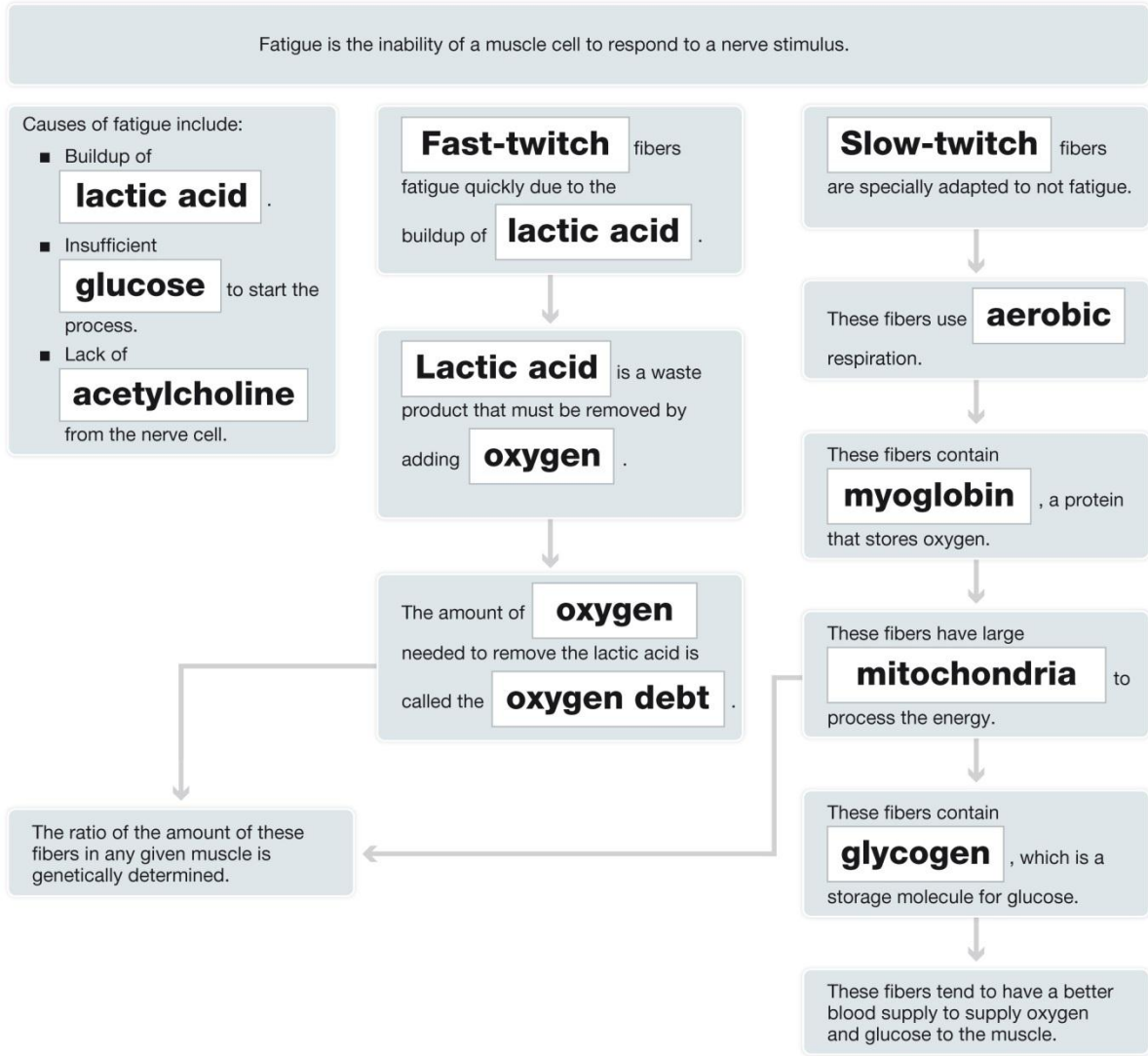
Muscle contraction



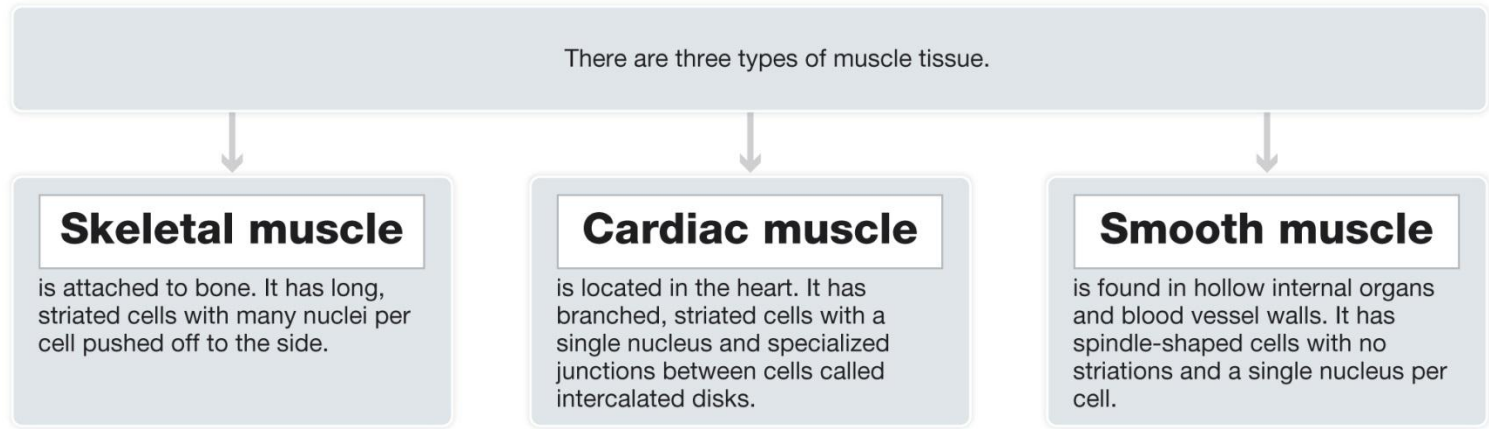
Muscle metabolism



Fatigue



Types of muscle tissue



WORKBOOK CHAPTER REVIEW QUESTIONS:

Word Deconstruction:

In the textbook, you built words to fit a definition using combining forms, prefixes, and suffixes. Here you are to break down the term into its parts (prefixes, roots, and suffixes) and give a definition. Prefixes and suffixes can be found inside the back cover of the textbook.

FOR EXAMPLE: Dermatitis: dermat/ it is-inflammation of the skin

- 1. Myasthenia: My/ asthenia, muscle weakness
- 2. Cardiomyopathy: Cardio/ myo/ pathy, disease of the heart muscle
- 3. Fibromyalgia: Fibro/ my/ algia, muscle fiber pain
- 4. Sarcocarcinoma: Sarco/ carcin/ oma, cancerous tumor of the flesh
- 5. Muscular dystrophy: Muscular dys/ trophy, abnormal muscle development

Multiple Select:

Select the correct choices for each statement. The choices may be all correct, all incorrect, or any combination of correct and incorrect.

- 1. What happens during a muscle contraction?
 - a. Myofibrils slide past each other during a contraction.
 - b. Tension increases in the muscle in an isotonic contraction.
 - c. *The origin may be determined by another muscle.*

d. The placement of the insertion determines the mechanical advantage.

e. There is rapid recruitment in a boxer's punch.

2. Which of the following statements is (are) true concerning the rectus femoris?

a. It is the prime mover for knee flexion.

b. It is a synergist to the vastus intermedius for hip flexion.

c. It is a synergist to the vastus lateralis for knee extension.

d. It is an antagonist to the semimembranosus.

e. It is part of the hamstrings.

3. Which of the following statements is (are) true concerning the platysma?

a. It is intrinsic to the head.

b. It is extrinsic to the thorax.

c. It gives off heat.

d. It is used for communication.

e. It is a synergist to the temporalis muscle.

4. Which of the following statements is (are) true about skeletal muscle tissue?

a. Skeletal muscle appears striated due to the presence of Z lines.

- b. Skeletal muscle can either push or pull at the insertion.
- c. Skeletal muscle cells have a single nucleus.
- d. Skeletal muscle cells are spindle-shaped.
- e. Skeletal muscle cells branch.

5. Which step(s) of a muscle contraction would *not* be completed during tetany?

- a. Active transport of calcium*
- b. Release of calcium
- c. Release of acetylcholinesterase*
- d. Release of acetylcholine
- e. Binding of calcium to troponin to expose active sites on actin

6. Which of the following possibly cause(s) fatigue?

- a. Lack of glucose*
- b. Lack of ATP*
- c. Lack of acetylcholine*
- d. Buildup of glycogen
- e. Buildup of lactic acid*

7. Which of the following is (are) the result of aging on the muscular system?

a. Lean muscle mass decreases.

b. Fat deposition in muscle

c. Gait shortens.

d. Movement slows.

e. Fatigue happens more rapidly.

8. Which of the following statements is (are) accurate concerning muscular system disorders?

a. Muscular dystrophy is hereditary.

b. Myasthenia gravis is an autoimmune disease

c. A cramp can be caused by dehydration.

d. A hiatal hernia involves a loop of intestine pushing through the abdominal wall.

e. Compartment syndrome is a problem with the endomysium of a muscle.

9. Which of the following statements accurately describe(s) the connective tissues of muscle?

a. Endomysium surrounds a fascicle.

b. Perimysium surrounds a muscle.

c. Fascia surrounds muscle of an area.

d. A tendon is composed of epimysium, endomysium, and perimysium, but not fascia.

e. Epimysium surrounds myofibrils.

10. What is true about making a fist?

a. The frequency of nerve impulses matters if the fist is to be held.

b. The frequency of nerve impulses determines how tight the fist is made.

c. The number of motor units determines how tight the fist is made.

d. The number of nerve cells used determines the number of motor units used.

e. Making a fist requires flexor muscles that originate on the medial epicondyle of the humerus.

Matching:

Match the step of a muscle contraction at the molecular level to the phase in which it would occur in a twitch. Some answers may be used more than once.

___*d*___ 1. Acetylcholinesterase is released.

a. Latent phase

___*a*___ 2. Myosin grabs an active site on actin.

b. Contraction phase

___*b*___ 3. Myosin pulls (power stroke).

c. Relaxation phase

___*a*___ 4. Calcium is released.

d. Refractory phase

___*d*___ 5. Calcium is actively transported

Matching:

Match the description to the type of muscle tissue. Some answers may be used more than once. Some questions have more than one answer.

- | | |
|--------------------------------------|---------------------------|
| <u>a, b</u> 6. Striated | a. Cardiac muscle tissue |
| <u>b</u> 7. Voluntary | b. Skeletal muscle tissue |
| <u>a</u> 8. Autorhythmic | c. Smooth muscle tissue |
| <u>b</u> 9. Multiple nuclei per cell | |
| <u>a</u> 10. Branching | |

Completion:

Fill in the blanks to complete the following statements about the physiological characteristics of muscle.

1. Extensibility is the ability to be stretched.
2. Elasticity is the ability to return to shape if stretched.
3. Contractility is the ability to shorten with force.
4. Conductivity is the ability to pass on a stimulus to the rest of the cell.
5. Excitability is the ability to be stimulated by a nerve.

Critical Thinking:

1. Some insecticides work by interfering with acetylcholinesterase. What would be the consequences to muscles if the insecticide was inhaled or absorbed through the skin? What would you expect to see? Explain in terms of muscle contractions at the molecular level.

Acetylcholine would remain in the receptors on the muscle cell. Ca^{2+} would continue to be released from the sarcoplasmic reticulum. Myosin would continue to grab hold of actin. As long as ATP was available the muscle would stay contracted.

2. If you have ever eaten chicken, you know the breasts and wings are considered white meat and the legs and thighs are considered dark meat. There are few blood vessels in the breasts, but many blood vessels in the thighs and legs. If you have seen live chickens, you have observed that they can fly for only short distances, but can walk around all day. How are fast-and slow-twitch fibers distributed in a chicken as compared to in a human. Explain. What type of respiration is done by each type of muscle fiber. How does the type of respiration influence their behavior?

Human muscles have both fast and slow twitch fibers in a ratio that is genetically determined. Chickens have fast twitch fibers that use anaerobic respiration in the breasts and wings. Chickens have slow twitch fibers that specialize in aerobic respiration in thighs and legs. Anaerobic respiration can only work for short periods of time – short flights. Aerobic respiration can last a long time – long walks.

3. Describe an exercise activity that works muscles: (a) of the anterior arm, (b) posterior arm, (c) abdominal muscles, and (d) thigh muscles.

Answers will vary: the exercise should include a) flexion of elbow exercise, b) extension of elbow, c) flex spine, d) flexion and extension of knee.

Case Study:

1. Asha is mostly likely suffering from shin splints. Asha symptoms of pain in the front of her lower leg along with the fact that she recently altered her workout lead to this conclusion.

2. Shin splints are caused by inflammation of the posterior and anterior tibialis muscles, tendons, and the periosteum covering the tibia.

3. Answers may vary but can include:

Compartment syndrome - Inflammation of muscles within a compartment due to over activity or trauma.

Muscle strain- A tear in muscle tissue or tendons.

Cramps - A painful muscle spasm.

Tendinitis - Inflammation of the tendon.

4. Treatment of shin splints involves resting and possibly changing the activity to avoid recurrence.