Musculoskeletal System: Muscular Components and Functions

Unit: Body Systems

Problem Area: Musculoskeletal System

Lesson: Musculoskeletal System: Muscular Components and Functions

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Explain the functions of the muscular system.**
2. **Differentiate the types of muscle in the muscular system.**
3. **Define the criteria used to name muscles.**
4. **List major muscles.**

Resources.

The following resources may be useful in teaching this lesson:

E-unit(s) corresponding to this lesson plan. CAERT, Inc. http://www.mycaert.com.

Chabner, Davi-Ellen. *The Language of Medicine,* 11th ed. Elsevier 2017.

Gerdin, Judith. *Health Career Today,* 6th ed. Mosby 2015.

"Muscular System - Muscles of the Human Body." *Innerbody*. Accessed June 01, 2019. https://www.innerbody.com/image/musfov.html.

Remmert. *Mosby's Essentials for Nursing Assistants,* 5th ed. Mosby 2013.

Singh, Arun Pal, and Singh. "Types of Muscles and Their Functions." *Bone and Spine*. November 09, 2018. Accessed June 01, 2019. https://boneandspine.com/types-of-muscles-and-there-functions/.

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Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Key Terms. The following terms are presented in this lesson (shown in bold italics):

- adduct
- autorhythmic
- biceps
- cardiac
- contractility
- elasticity
- excitability
- extend
- extensibility
- gluteus
- insertion
- involuntary
- maximus
- medius
- origin
- quadriceps
- shivering
- skeletal
- smooth
- striated
- striations
- tendons
- thermogenesis
- transversely
- triceps
- voluntary

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Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

> *Begin this lesson with the TedEd video "How your muscular system works" by Emma Bryce, explaining the muscular system found at https://www.youtube.com/watch?v=VVL-8zr2hk4. Facilitate a discussion with students to access prior knowledge. Ask students to name muscles they are familiar with and their locations.*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Describe the functions of the muscular system.

Anticipated Problem: What are the functions of the muscular system.

I. Functions of the muscular system.

A. The main function of the muscular system is movement. The types of movement are:

1. *Locomotion* allowing for motions such as walking. Bodies move when muscles contract and exert force on the bones to initiate an action.
2. *Propulsion of substances* such as circulation and peristalsis. The cardiac and visceral muscles are primarily responsible for transporting substances like blood or food from one part of the body to another.
3. *Controlling body opening* sizes as in the contraction and relaxation of the iris of the eye, or bladder control.

B. Muscles stabilize the human skeleton and provide proper posture. Muscles hold the body upright throughout the day without becoming tired.

1. Flexibility and strength are keys to maintaining proper posture. Stiff neck muscles, weak back muscles, or tight hip muscles can throw off your alignment.
2. Poor posture can affect parts of your body and lead to joint pain and weaker muscles.

C. The final function of muscle tissue is the generation of body heat. Muscles help to produce a great amount of heat through the chemical changes involved in muscular action.

1. Muscles generate most of the heat needed to keep the body at 98.6 degrees Fahrenheit.
2. ***Thermogenesis*** is the production of body heat.

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3. Heat produced by muscles is very important in cold climates when ***shivering*** (rapid small contractions) boosts heat output to keep the body warm.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–A to summarize muscular system functions. Refer students to Chapter 18 in "Health Careers Today by Gerdin to reinforce the lesson topics.*

Objective 2: Differentiate the types of muscle in the muscular system.

Anticipated Problem: What are the types of muscle in the muscular system?

II. Types of muscle in the muscular system.

A. The muscular system consists of all the muscles of the body. Muscles are organs composed mainly of muscle cells, which are also called muscle fibers. Each ***muscle fiber*** is a very long, thin cell that can contract, or shorten.

B. There are over 650 muscles in the human body making up roughly half of a person's body weight. Each of these muscles is a discrete organ constructed of muscle fibers, blood vessels, tendons, and nerves.

C. There are three different types of muscle and each type has its own function within the body.

1. ***Skeletal*** (or ***voluntary***) muscles usually work in pairs or groups (biceps flex the elbow and the triceps extends it) and they are attached to bones by ***tendons*** (flexible bands of fibrous tissue) to produce movement. Every muscle has no fewer than two attachments. One of these attachments, the ***origin***, is attached to the immovable or less movable bone. The ***insertion*** is attached to the movable bone, and when the muscle contracts, the insertion moves toward the origin.

a. Skeletal muscles are heavily ***striated*** (marked by transverse dark and light bands and made up of elongated fibers.)

b. They act not only to produce movement, but also to stop movement such as resisting gravity to maintain posture. The process of muscle movement is as follows:

(1) ***Contractility*** – allows muscles to change shape to become shorter and thicker.

(2) ***Extensibility*** – allows living muscle cells to be stretched and extended as they become longer and thinner.

(3) ***Excitability*** – allows muscles to receive and respond to stimulation.

(4) ***Elasticity***- once the stretching force is removed, a living muscle returns to its original shape.

d. Skeletal muscles usually work in pairs or groups (biceps flex the elbow and the triceps extends it.)

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e. Skeletal muscle protects internal organs (particularly abdominal and pelvic organs) by acting as an external barrier or shield to external trauma and by supporting the weight of the organs.
f. The nervous system stimulates this muscle to contract since it is voluntary muscle and does not move without conscious control.
g. Skeletal muscle forms most of the human body weight.
h. It is important to remember that muscles can only pull, they never push.

2. ***Smooth*** muscle, (or ***visceral*** muscle) contracts slowly and automatically meaning it moves on its own without the person having to control it. It is controlled by the nervous system.
   a. Smooth muscle is the weakest of all muscle tissues. It lines the walls of hollow organs like the urinary bladder, uterus, stomach, intestines, and in the walls of passageways, such as the arteries and veins of the circulatory system, and the tracts of the respiratory, urinary, and reproductive systems
   b. It is present in the eyes, where it functions to change the size of the iris and alter the shape of the lens; and in the skin where it causes hair to stand erect in response to cold temperature or fear.
   c. When seen under the microscope, smooth muscle does not have any striation in contrast to the other two types of muscles.
3. ***Cardiac*** (heart) muscles are exclusively found in the human heart and are responsible for pumping blood throughout the body.
   a. They are extremely strong and striated muscles that work involuntarily. Cardiac muscles are ***autorhythmic*** (self-stimulating or intrinsically controlled.)
   b. Membranes between the cardiac cells allow electrical impulses to travel rapidly through them so that contractions can be better coordinated.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–B to summarize the characteristics of each muscle type.VM–C illustrates the tendons of the knee. Refer students to Chapter 18 in "Health Careers Today by Gerdin to reinforce the lesson topics.*

Objective 3: Describe the criteria used to name skeletal muscles.

Anticipated Problem: What are the used to name muscles?

III. Criteria used to name skeletal muscles.

A. Understanding how a muscle is used will provide information about the name of the muscle. Conversely, deciphering the significance of a muscle's name will give you information about the muscle.

B. Skeletal muscles are named based on many different factors, including their location, origin and insertion, number of origins, shape, size, direction, and function.

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1. *Location*. Many muscles derive their names from their anatomical region.
    a. The rectus abdominis and transverse abdominis, for example, are found in the abdominal region.
    b. Some muscles, like the tibialis anterior, are named after the part of the bone (the anterior portion of the tibia) that they are attached to.
    c. Other muscles use a hybrid of these two, like the brachioradialis, which is named after a region (brachial) and a bone (radius.)
2. *Origin and Insertion.* Some muscles are named based upon their connection to a stationary bone (origin) and a moving bone (insertion.)
    a. These muscles become very easy to identify once you know the names of the bones that they are attached to.
    b. Examples of this type of muscle include the sternocleidomastoid (connecting the sternum and clavicle to the mastoid process of the skull) and the occipitofrontalis (connecting the occipital bone to the frontal bone.)
3. *Number of Origins.* Some muscles connect to more than one bone or to more than one place on a bone, and therefore have more than one origin.
    a. A ***biceps*** muscle has two origins.
    b. A ***triceps*** muscle has three origins.
    c. A ***quadriceps*** muscle has four origins.
4. *Shape, Size, and Direction.*
    a. Muscles are classified by their shapes.
        (1) Deltoids have a delta or triangular shape.
        (2) Serratus muscles feature a serrated or saw-like shape.
        (3) Rhomboid major is a rhombus or diamond shape.
    b. The size of the muscle can be used to distinguish between two muscles found in the same region. The gluteal region contains three muscles differentiated by size: the gluteus ***maximus*** (large), gluteus ***medius*** (medium), and ***gluteus*** minimus (smallest).
    c. The direction in which the muscle fibers run can be used to identify a muscle. In the abdominal region, there are several sets of wide, flat muscles. Muscle fibers running straight up and down are the rectus abdominis, the ones running ***transversely*** (left to right) are the transverse abdominis, and the ones running at an angle are the obliques.
5. *Function*. Muscles are sometimes classified by the type of function that they perform.
    a. Most of the muscles of the forearms are named based on their function because they are located in the same region and have similar shapes and sizes.
    b. The flexor group of the forearm flexes the wrist and the fingers. The supinator is a muscle that ***supinates*** (turns or holds) the wrist by rolling it over to face palm up.

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c. In the leg, there are muscles called adductors whose role is to ***adduct*** (pull together) the legs.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–D to summarize the criteria used for muscle naming. Refer students to Chapter 18 in "Health Careers Today by Gerdin to reinforce the lesson topics.*

Objective 4: List major muscles in the body.

Anticipated Problem: What are major muscles in the body?

IV. Major muscles in the body.

A. One deltoid is located in each shoulder; they help move the shoulder in all directions. The shoulder is the only joint in the body that is able to move 360 degrees, largely due to the deltoid muscle.

B. One pectoralis major can be found on each side of the chest. These muscles help to flex the upper arm and move the upper arm forward for actions such as reaching across your chest.

C. The rectus abdominus helps to ***flex*** (bend) the trunk of the body and is the muscle that body builders proudly display: "six-pack abs."

D. If you try to show off the muscle in your upper arms (think Popeye), you will be working your biceps muscle.

E. Quadriceps muscles are located in the front of the thigh. Runners and bikers often have well developed quadriceps. These muscles allow people to flex their thighs and ***extend*** (straighten) their legs.

F. Gastrocnemius is located in the back of the calf; this muscle works to extend the foot and flex the lower leg.

Teaching Strategy: *Many techniques can be used to help students master this objective. Use VM–E and VM–F (Muscles of the Body — anterior and posterior) to display locations of major muscles. Refer students to Chapter 18 in Health Careers Today by Gerdin to reinforce the lesson topics.*

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. If a textbook is being used, questions at the ends of chapters may also be included in the Review/Summary.

Application. Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.

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Evaluation.

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. g
2. e
3. d
4. j
5. a
6. b
7. i
8. h
9. c
10. f

Part Two: Multiple Choice

1. e
2. c
3. a
4. b
5. b
6. d
7. c
8. b

Part Three: Short Answer

1. Answers will vary and should include movement, maintaining posture and body shape, and maintaining body temperature.
2. Answers will vary and would include location, origin and Insertion, number of origins, shape, size, and direction, and function.

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Sample Test

Name _____

Musculoskeletal System: Muscular Components and Functions

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. autorhythmic
b. contractility
c. elasticity
d. excitability
e. extensibility
f. insertion
g. origin
h. shivering
i. tendons
j. thermogenesis

_____1. attached to the movable bone

_____2. allows living muscle cells to be stretched and extended as they become longer and thinner

_____3. allows muscles to receive and respond to stimulation

_____4. the production of body heat

_____5. self-stimulating or intrinsically controlled

_____6. allows muscles to change shape to become shorter and thicker

_____7. flexible band of fibrous tissue that attach skeleton muscle to bone

_____8. rapid small contractions to boost heat output to keep the body warm

_____9. once the stretching force is removed, a living muscle returns to its original shape

____10. attached to the immovable or less movable bone

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Part Two: Multiple Choice

Instructions: **Circle the letter of the correct answer.**

1. Which movement of the body requires the use of the muscular system to complete?

   a. walking
   b. talking
   c. eating
   d. swimming
   e. all the above

2. Another name for skeletal muscle is _____.

   a. smooth muscle
   b. visceral muscle
   c. voluntary muscle
   d. cardiac muscle

3. The flexible band of fibrous tissue that attach skeleton muscle to bone.

   a. tendons
   b. ligaments
   c. muscle
   d. insertion

4. Visceral muscle is another name for _____.

   a. skeletal muscle
   b. smooth muscle
   c. voluntary muscle
   d. cardiac muscle

5. The muscle type that lines the walls of hollow organs, like the urinary bladder, is _____.

   a. Skeletal muscle
   b. Smooth muscle
   c. Voluntary muscle
   d. Cardiac muscle

6. _____ muscle is exclusively found in the human heart and is responsible for pumping blood throughout the body.

   a. Skeletal muscle
   b. Smooth muscle
   c. Voluntary muscle
   d. Cardiac muscle

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7. An example of autorhythmic is _____.

   a. The iris of the eyes changing size
   b. Dancing to the beat of music
   c. The electrical conduction of the heart
   d. Food moving through the intestines

8. Skeletal muscles are named based on many different factors, including their _____.

   a. body system and area
   b. location, shape, and size
   c. muscle type and movement
   d. length and action

Part Three: Short Answer

Instructions: **Answer the following.**

1. Describe the functions of the muscular system.

2. Explain the criteria used in naming muscles.

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MUSCULAR SYSTEM FUNCTIONS

- Movement
  - Locomotion
  - Propulsion
  - Controlling body opening sizes
- Provide proper posture
- Maintain body temperature — thermogensis

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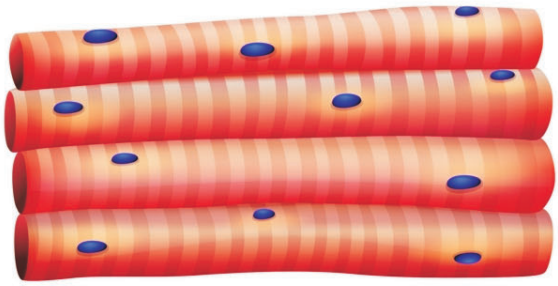
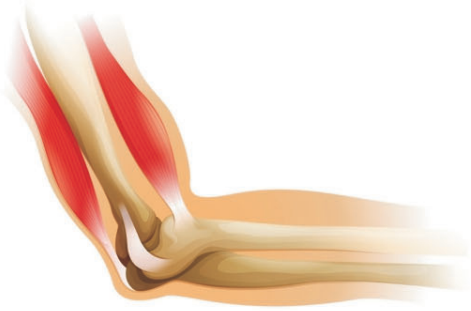
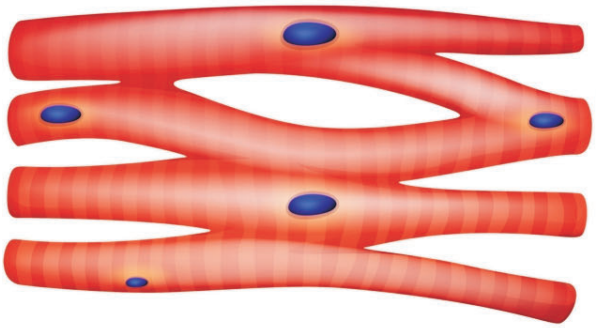
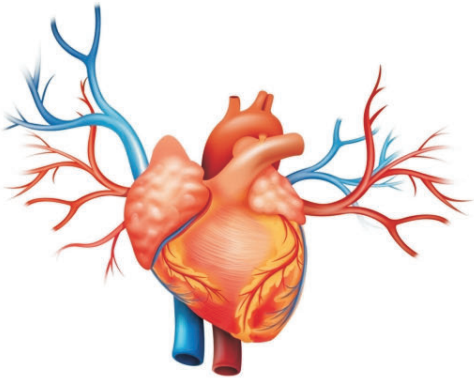
CHARACTERISTICS OF MUSCLE TYPES



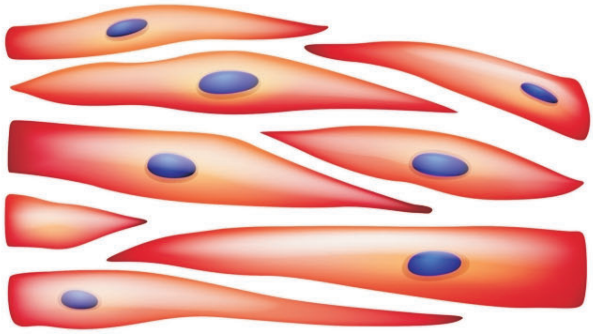


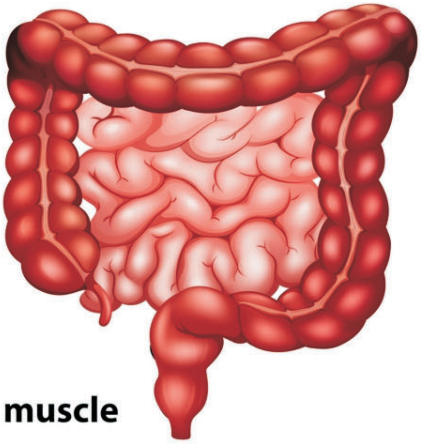
skeletal muscle





cardiac muscle





smooth muscle

The Muscular System is comprised of three different types of muscle.

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Skeletal Muscle

- Voluntary muscle
- Heavily striated
- Works in pairs or groups
- Attached to bones by tendons and produces movement
- More than 600 individual skeletal muscles
- Protects internal organs and defines body shape

Smooth Muscle (Visceral Muscle)

- Moves involuntarily
- Has no striations
- Lines hollow organs

Cardiac muscle (heart)

- Works involuntarily
- Striated
- Autorhythmic

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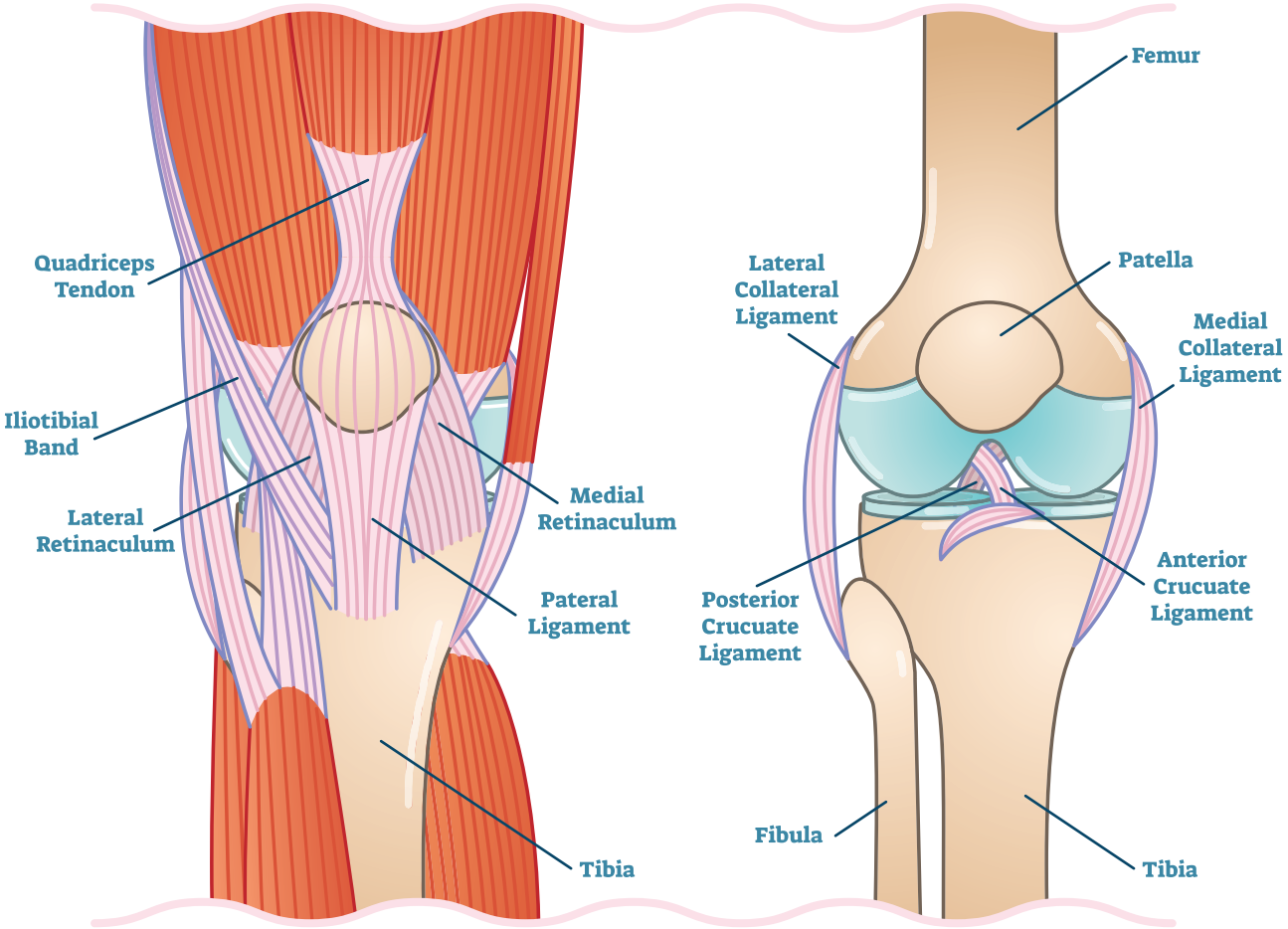
TENDONS

A tendon is fibrous connective tissue which attaches muscle to bone. Tendons may also attach muscles to structures such as the eyeball. A **tendon** serves to move the bone or structure. A **ligament** is a fibrous connective tissue which attaches bone to bone, and usually serves to hold structures together and keep them stable.

KNEE TENDONS



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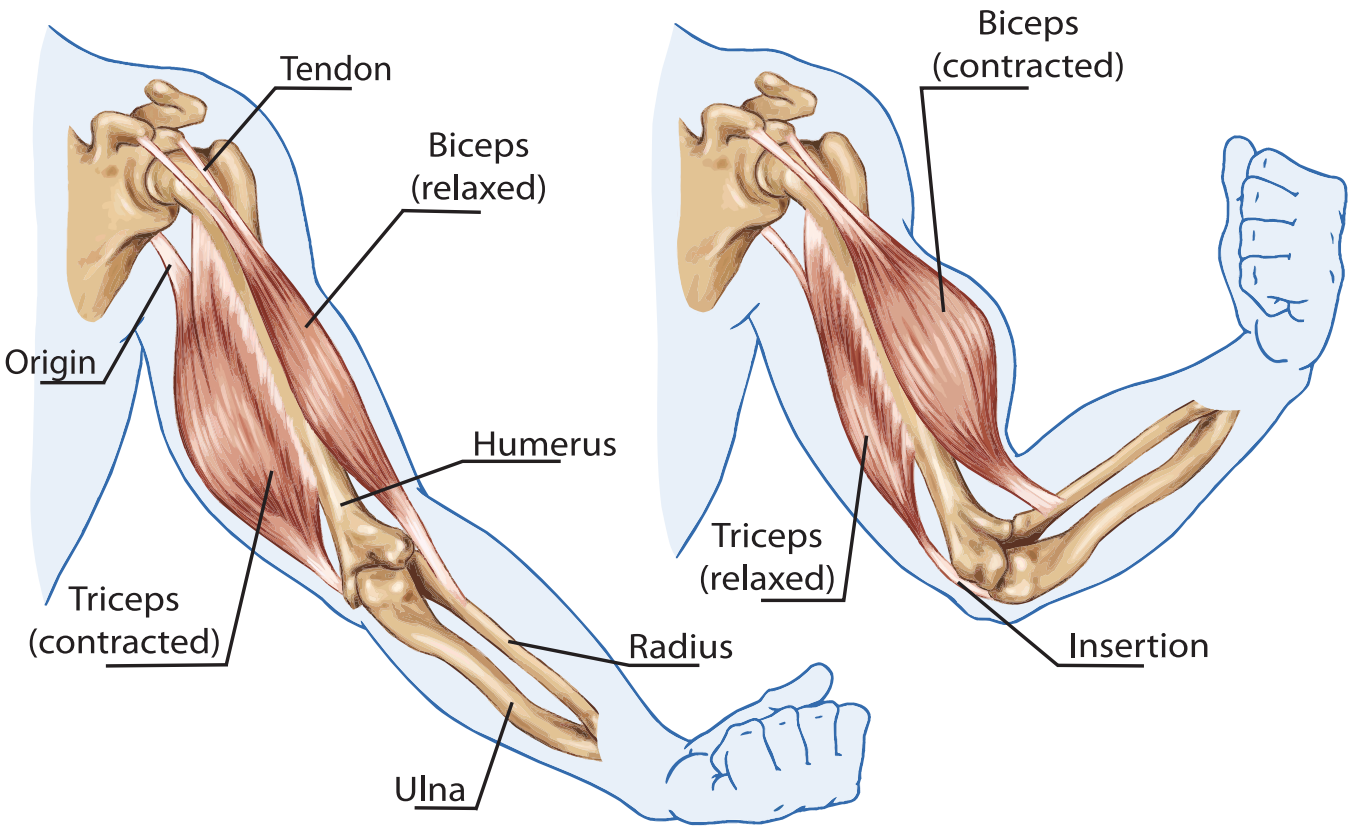
CRITERIA USED TO NAME MUSCLES

1. Size — the gluteus maximus is the largest buttock muscle.
2. Shape — the deltoid is triangular.
3. Location — the frontalis overlies the frontal bone.



The biceps brachii in your arm that has two points of attachment.

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4. Direction of muscle fiber — the rectus abdominus (rectus means straight.)

5. Attachment — the brachioradialis is attached to the brachium and radium.

6. Number of attachments — the biceps brachii has two attachments.

7. Action — the extensor digitorum extends the digits.

* The correct names of all muscle (except the platysma and the diaphragm) include the word “muscle” We may use the descriptive term alone, but the word “muscle” is always implied.

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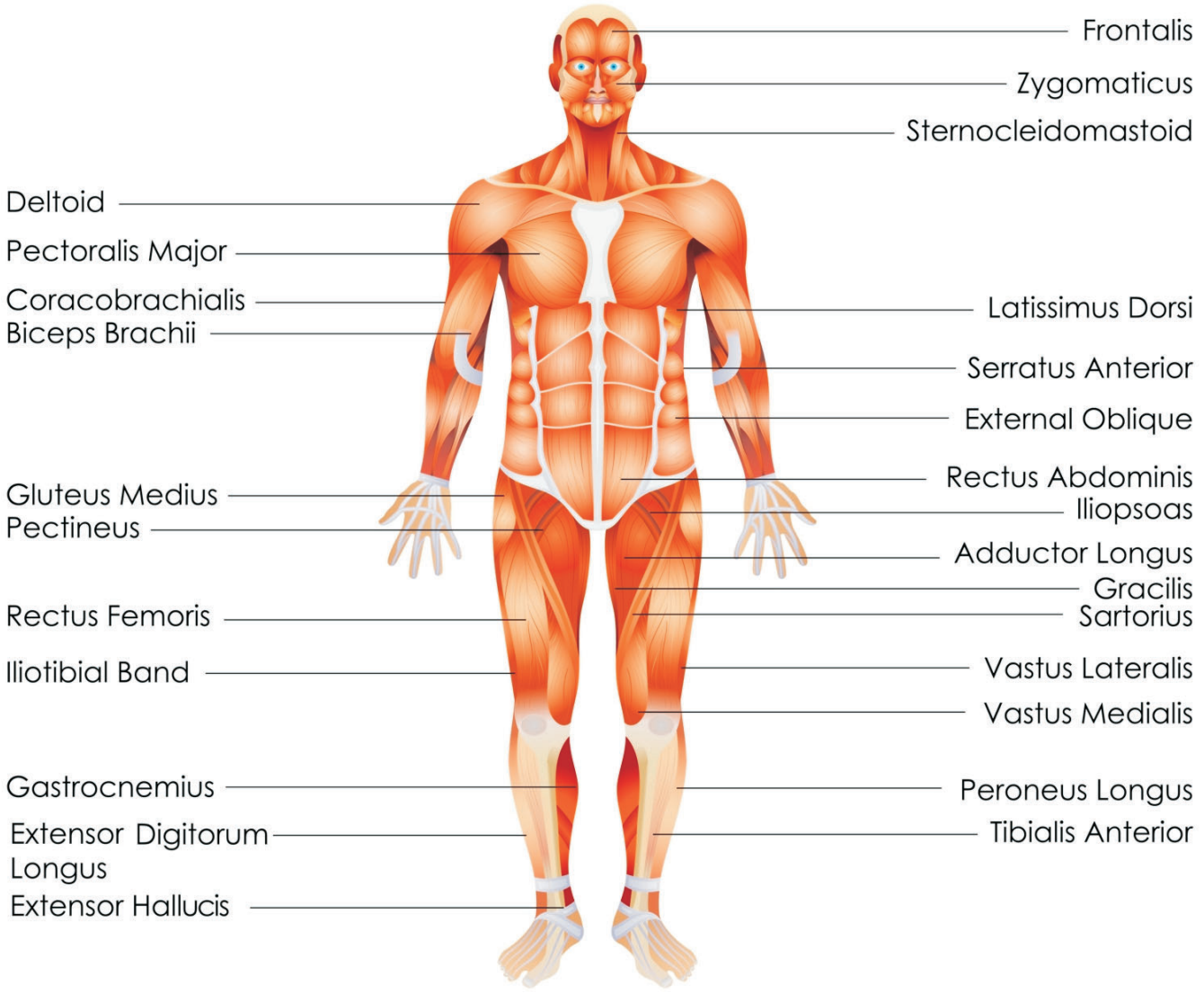
VM–E

MUSCLES OF THE BODY — ANTERIOR



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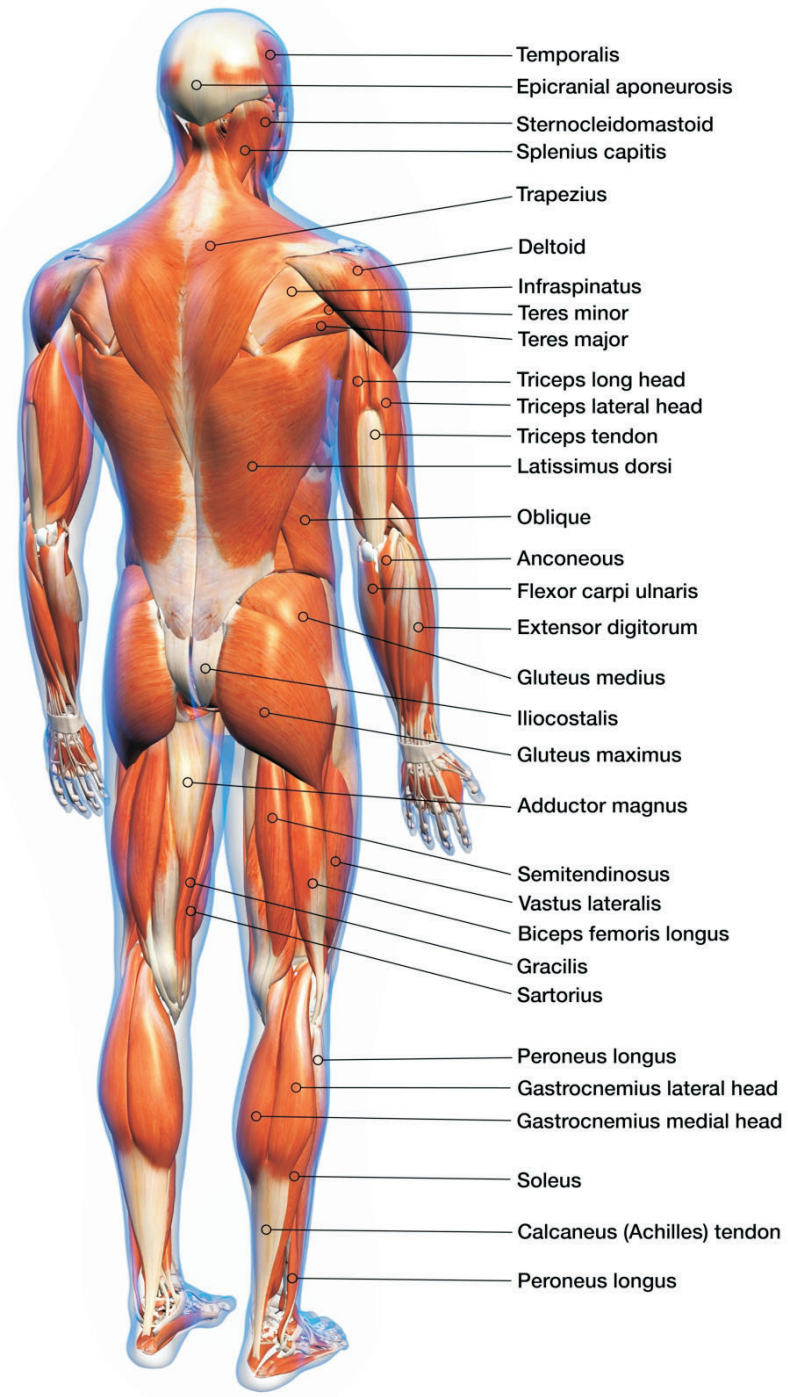
MUSCLES OF THE BODY — POSTERIOR



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Name _____

Muscle Rules

Purpose

The purpose of this activity compares the structure and function of the three types of muscle tissue.

Objective

Use your notes, textbook, or research information on the internet to complete the table with the type of shock or its cause.

Materials

- lab sheet
- device with Internet access
- pen or pencil

Procedure

1. Work independently or with a partner to complete this lab activity.
2. Research the various types of muscle tissue and complete the lab sheet.
3. Turn your completed research in to your instructor as directed.

Research the three types of muscle tissue: skeletal muscle, smooth muscle and cardiac muscle. Fill in the table below.

Muscle Type	Description
Skeletal	
Smooth	
Cardiac	

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Type of Muscle	Striations? (Y/N)	Voluntary? (Y/N)	Location in Body	Function in Body
Skeletal Muscle				
Smooth Muscle				
Cardiac Muscle				

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Muscle Rules

Muscle Type	Description
Skeletal	A form of striated muscle tissue which is under the voluntary control of the somatic nervous system. Most skeletal muscles are attached to bones by tendons.
Smooth	Smooth muscle generally forms the supporting tissue of blood vessels and hollow internal organs, such as the stomach, intestine, and bladder. Smooth muscle is involuntary not striated.
Cardiac	Cardiac muscle (heart muscle) is involuntary and striated.

Type of Muscle	Striations? (Y/N)	Voluntary? (Y/N)	Location in Body	Function in Body
Skeletal Muscle	yes	yes	Attached to bones	Movement, Heat, Posture
Smooth Muscle	no	no	Lines blood vessels and hollow internal organs, such as the stomach, intestine, and bladder	Movement of Blood Through Vessels, Food through Digestive System
Cardiac Muscle	yes	no	heart	Heart Contractions

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