

Exercise 7: Axial Muscular System

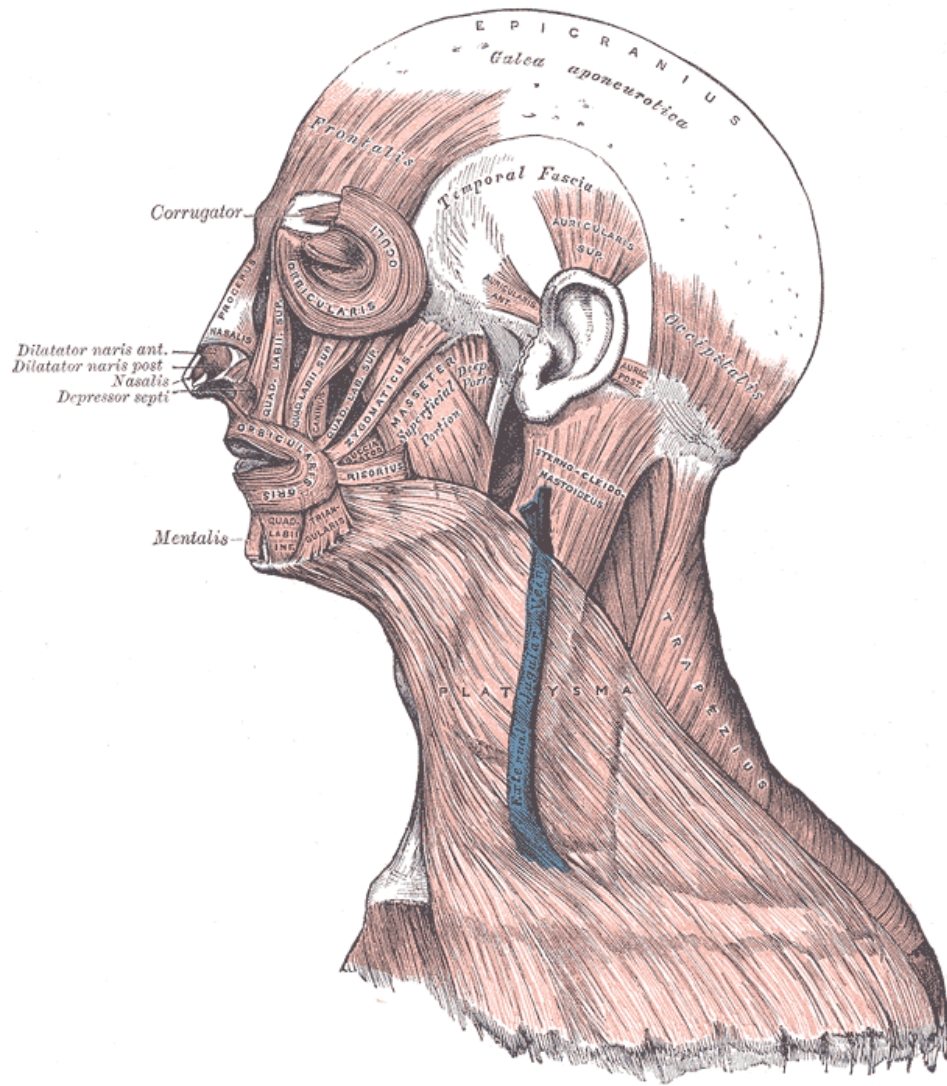


Figure 7.1. Muscles of the head and neck drawn to show their relative positions and muscle fiber orientation. (<https://upload.wikimedia.org/wikipedia/commons/f/fa/Gray378.png>)

Exercise 7 Learning Goals

After completing this lab you should be able to:

- Describe how skeletal muscles are named
- Describe the fascicle orientation and how it is related to function
- Describe the origin, insertion and action of select muscles:
 - Involved in facial expression
 - That move the eye
 - The muscles of mastication
 - That move the head
 - Of the abdomen
 - Involved in breathing

Pre-Lab Activity 7.1 Muscle name & O.I.A. Flashcards

At the end of this chapter there are flash card templates for each muscle group. Before lab starts please make sure you research and write down the **origins** and **insertions** for each muscle listed on the flash cards. You do not have to fill out the **action** section yet (**although this is not strictly prohibited**).

Lab Exercise 7: The Axial Muscular System

There are over 700 different muscles associated with the human body. As we learned from the previous lab, skeletal muscle contractions cause the muscle to shorten. This shortening leads to movement of the skeleton. Movement can only take place at joints. Therefore, each muscle nearly always crosses a joint and attaches to the bones that forms the joint. Each muscle has an origin attachment and an insertion attachment. The **origin** is where a muscle attaches to a stationary bone and the **insertion** is where a muscle attaches to the bone that moves during action. The **action** of a muscle is a particular movement of the skeleton when the muscle has contracted. All muscles have one movement, and that is to shorten. Therefore, by looking at the origin and insertion of each muscle, we can infer the action of the particular muscle.

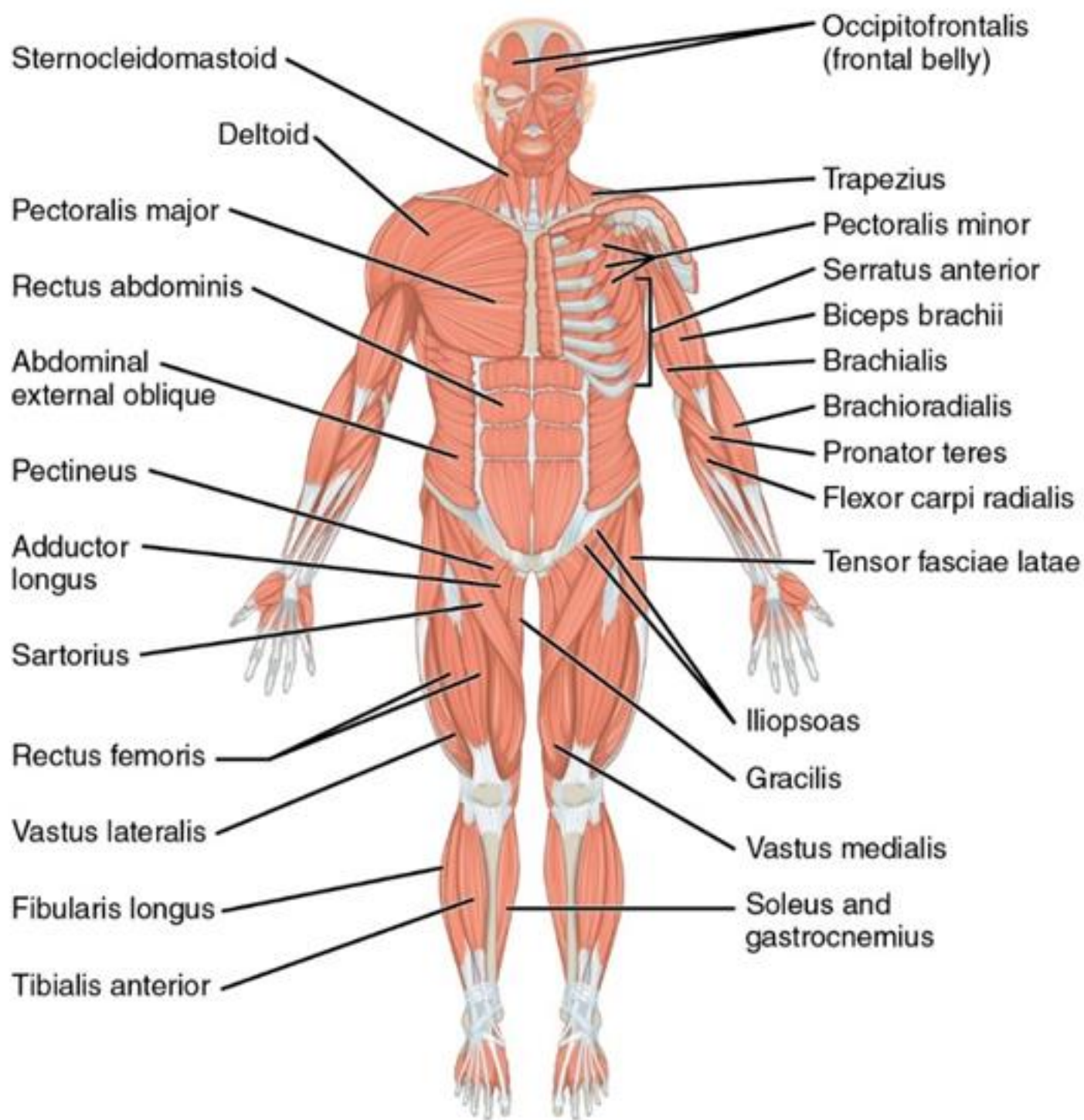
Lab Activity 7.1: Naming of Skeletal Muscles

There are a number of ways to determine names of muscles. In general, muscles are named by one or more of the following criteria:

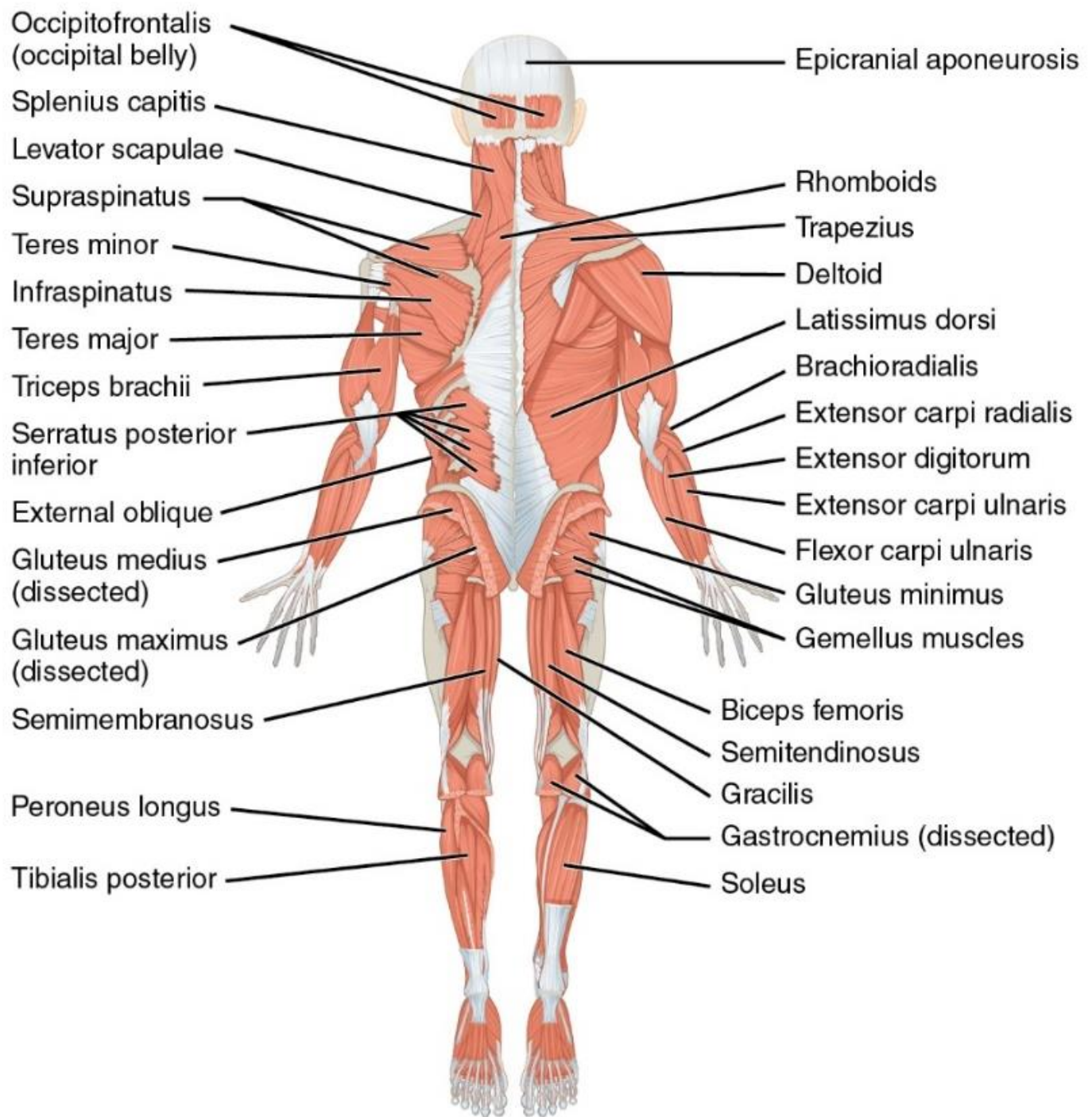
1. Shape of muscle
2. Size of the muscle compared to other muscles in the area (relative size)
3. Location of muscle in the body
4. Location of muscle's origins and insertions
5. Number of origins a muscle has
6. Principal action of the muscle
7. Direction of the muscle's fibers

Using **Figure 7.2** and the anatomical models in lab, give an example of **two muscles** named based on the following criteria for each category.

1. **Shape of muscle**
2. **Size of the muscle compared to other muscles in the area (relative size)**
3. **Location of muscle in the body**
4. **Location of muscle's origin and insertion**
5. **Number of muscle origins**
6. **Principal action of the muscle**
7. **Direction of the muscle's fibers**



Major muscles of the body.
Right side: superficial; left side:
deep (anterior view)



Major muscles of the body.
Right side: superficial; left side:
deep (posterior view)

Figure 7.2 a & b: Overview of the muscle system (<http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@15.1.>)

Muscle Fascicles

As we learned from the previous chapter, skeletal muscle fibers are organized into structures called fascicles and covered with perimysium connective tissue. All muscle fibers are bundled into individual fascicles and will always be parallel with one another. However, this is not the case for bundles of fascicles. The orientation of fascicles within the muscle belly vary in different ways depending on the function of the muscle. Muscles can be grouped as a **parallel, pennate, circular or convergent fascicle arrangement**.

Parallel muscles contain fascicles that run parallel with the long axis of the muscle with tendons on either side to bone. Most muscles in the body have parallel fascicle arrangements. A parallel muscle typically has a central, large belly that is spindle-shaped, meaning it tapers as it extends to its origin and insertion, it sometimes is called **fusiform**.

Pennate muscles contain fascicles that run at an angle to the tendon. Because of this, they cannot move bone to the same extent that a parallel muscle can. However, more fascicles can be packed into a similarly sized tendon. This means pennate muscles tend to be able to produce more force compared to similarly sized parallel muscles (more fascicles = more contractile proteins!). If all fascicles are on the same side of the tendon the muscle is called **unipennate**. If there are fascicles running along either side of a tendon the muscle is called **bipennate**. If the tendon branches within the muscle it is called **multipennate** (see figure 3).

Circular muscles contain fascicles that are arranged in circles, normally around an opening. When the muscle contracts, it will decrease the diameter of the opening. Examples include sphincters controlling openings in the digestive system like the external anal sphincter and muscles around the eyes (orbicularis oculi) and mouth (orbicularis oris).

Convergent (triangular) muscles contain fascicles that are spread out on one end of the muscle attachment and come together (or converge) on the other end of the attachment. This normally creates a triangular shaped muscle, such as the pectoralis major or temporalis.

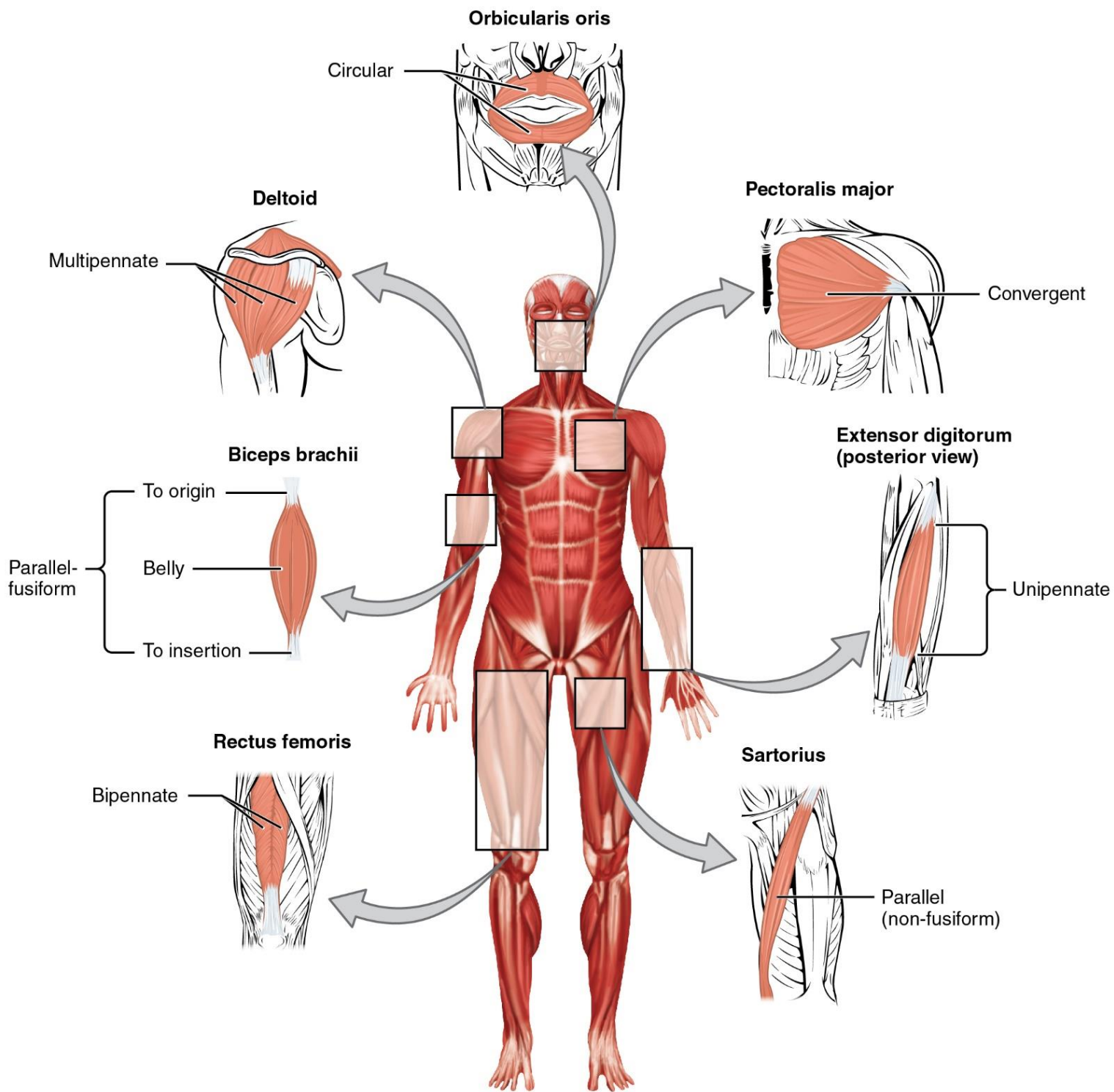


Figure 7.3: Examples of fascicle arrangements in muscles (<http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@15.1>.)

Activity 7.2: Origins, Insertions, Actions and Fascicle arrangement of axial muscles

For each of the following groups of muscles, use the anatomical models in the lab and the figures in this chapter to exam the individual muscle's origins, insertions and fascicle arrangement. Fill out the table after completing your examination of the anatomical models and figures.

Muscles of facial expression

The origins of the muscles of facial expression are on the surface of the skull (remember, the origin of a muscle does not move). The insertions of these muscles are connected to the dermis of the skin. Because the muscles insert in skin rather than bone, when they contract, the skin moves to create facial expression.

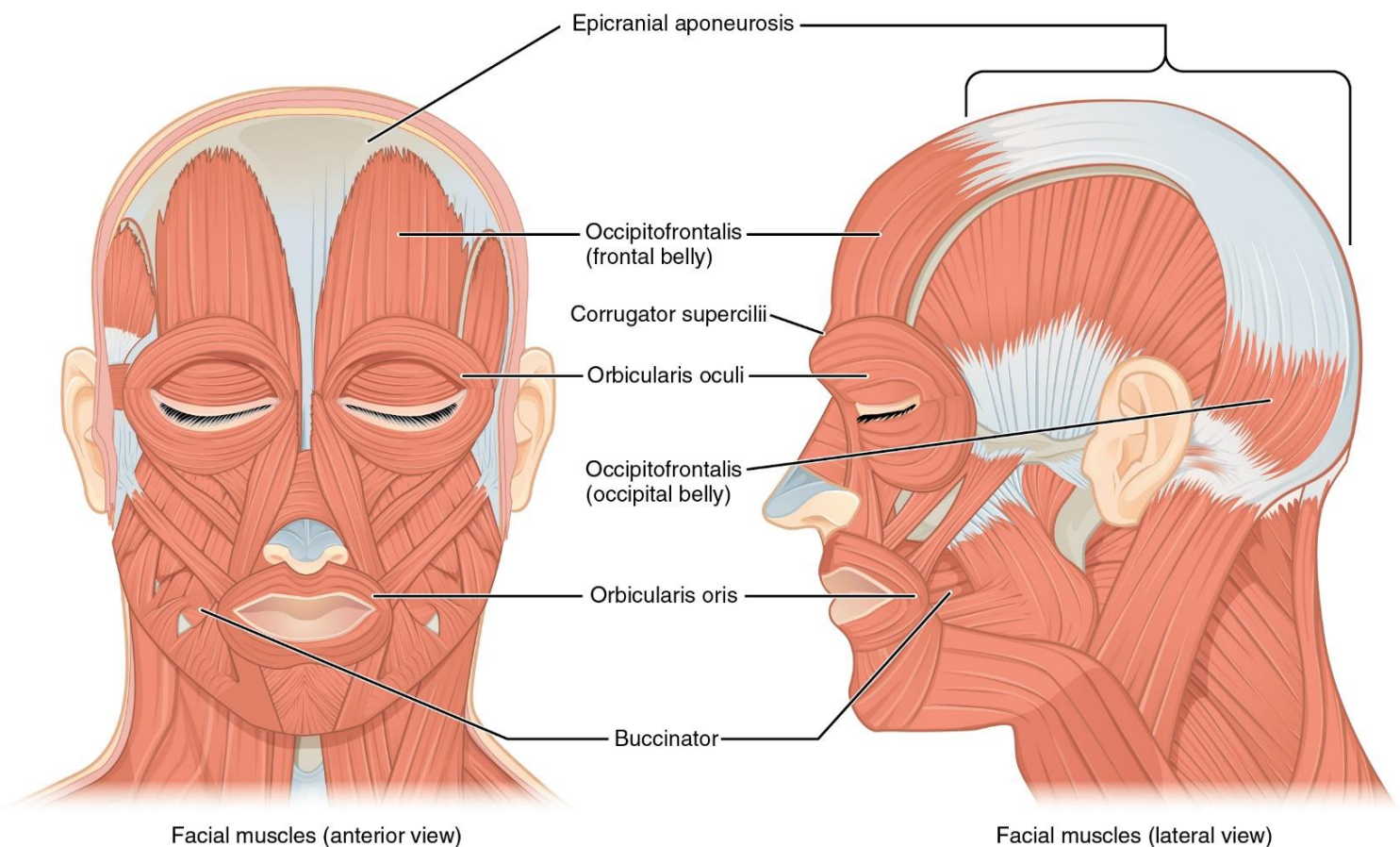


Figure 7.4: Muscles of Facial Expression (<http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@15.1.>)

Complete the table for Facial Muscles

Muscle Name	Origin	Insertion	Action
Frontalis			
Occipitalis			
Orbicularis oris			
Zygomaticus major			
Buccinator			
Mentalis			
Platysma			
Orbicularis oculi			

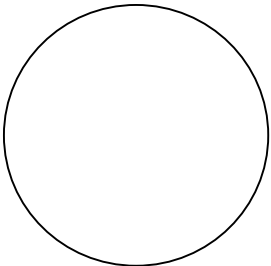
Anatomy in Clay® Instructions

To demonstrate your understanding of origins, insertions and fascicle arrangement of the muscles, you will use an oil-based clay to form select muscles on the Maniken®. Please follow the instructions below. If you are unsure of what to do, ask your instructor.

- Keep your space clean and organized.
- Keep track of your tools and supplies.
- Feel free to stand or sit when working on your model.
- Move your model around so it is easy to build on but be careful!
- Use dry paper towels to remove clay from hands and tools (DO NOT USE SOAP OR WATER).
- Use red/ terra cotta clay to build muscles.
- Keep the clay on the green mats at all times.

Clean Up at the end of lab period

1. Take all clay off of the model!
2. Roll into balls **NO BIGGER** than image below and organize into plastic bags.



3. Use dry paper towels to wipe off as much clay as possible from the model and tools used.
4. Return your model to its original place.

Anatomy in Clay® – Facial Muscles

On your model, place the muscles **frontalis** and **occipitalis**, **zygomaticus major**, **orbicularis oculi** and **orbicularis oris** and include fascicle orientation.

Muscles that move the Eye

It takes 6 extraocular muscles to create the fine tandem movements of the eyes. These muscles originate behind the eye and insert on the sclera (the white of the eye). Like the muscles of facial expression, the muscles that move the eye are a rare example of skeletal muscle inserting into non-bony attachments.

Examine the eye muscle model and complete the table below

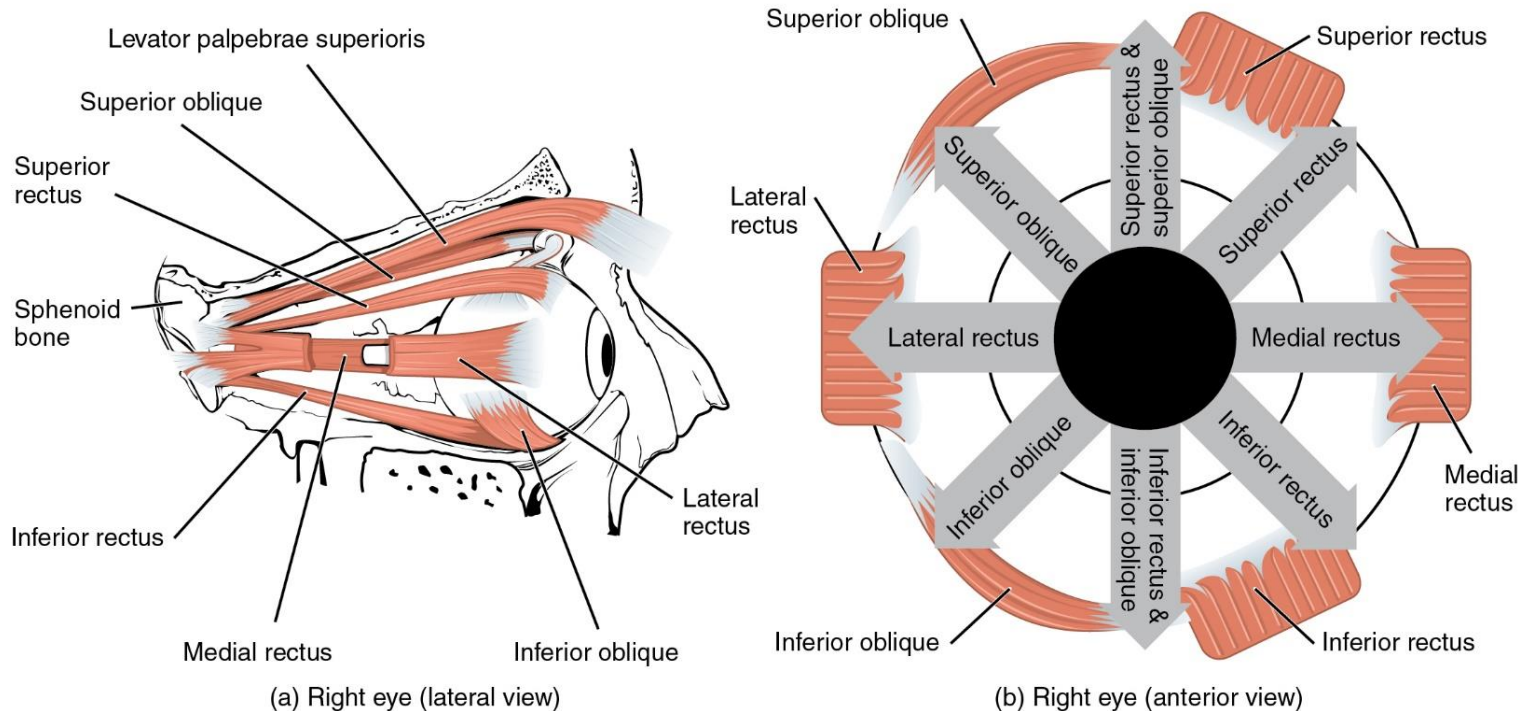


Figure 7.5 Muscles that Move the Eye (<http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@15.1>.)

Complete the table for Eye Muscles

Muscle Name	Origin	Insertion	Action
Superior rectus			

Muscle Name	Origin	Insertion	Action
Inferior rectus			
Lateral rectus			
Medial rectus			
Superior oblique			
Inferior oblique			

Muscles of Mastication

These muscles close the mandible. This movement is especially important when we chew food hence the name muscles of mastication (chewing).

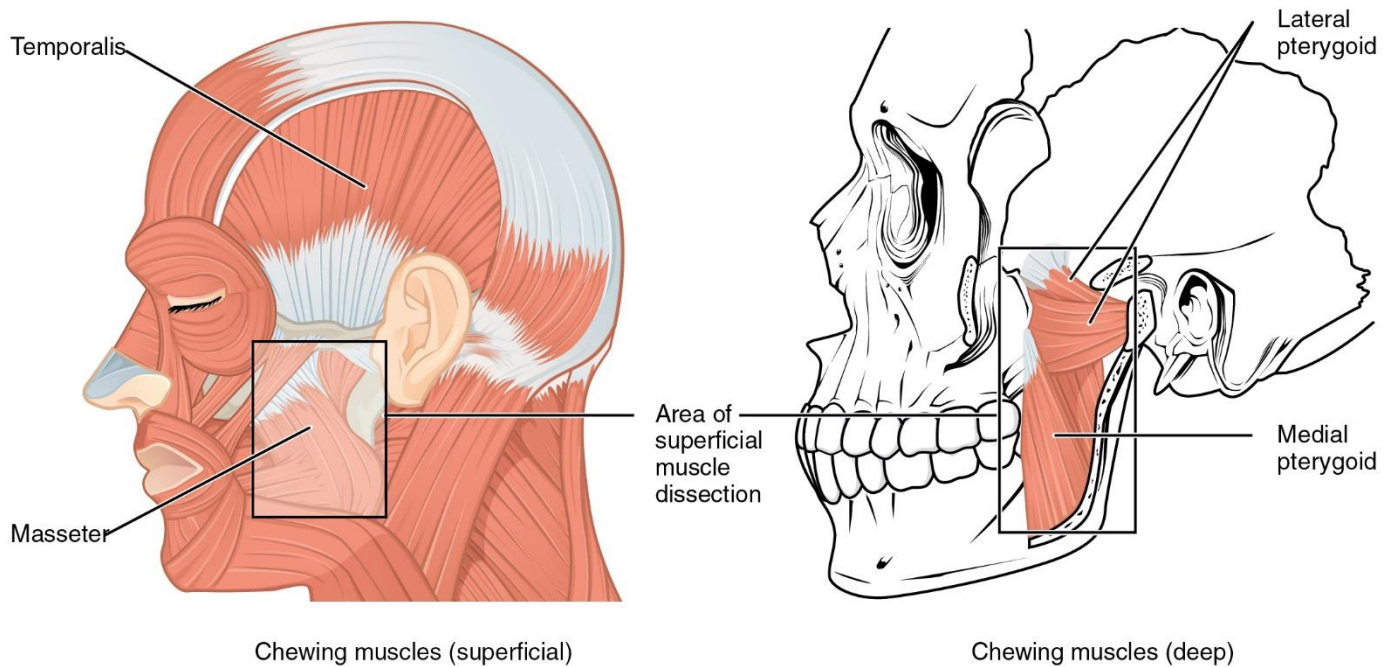


Figure 7.6 Muscles of Mastication (<http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@15.1>.)

Complete the table for muscles of mastication

Muscle Name	Origin	Insertion	Action
Temporalis			
Masseter			
Lateral Pterygoid			
Medial Pterygoid			

Anatomy in Clay®- Muscles of Mastication

On your model, place the **temporalis** and **masseter** muscles. Do not forget to include the fascicle orientation.

Muscles that move the Head

The head pivots on the vertebral column and as such can flex, extend and rotate. The muscles of the head perform flexion, extension and rotation depending on the coordination of contraction. For example, if only one sternocleidomastoid contracts (**unilaterally**), the head will rotate but if both sternocleidomastoids contract (**bilaterally**), the head will flex.

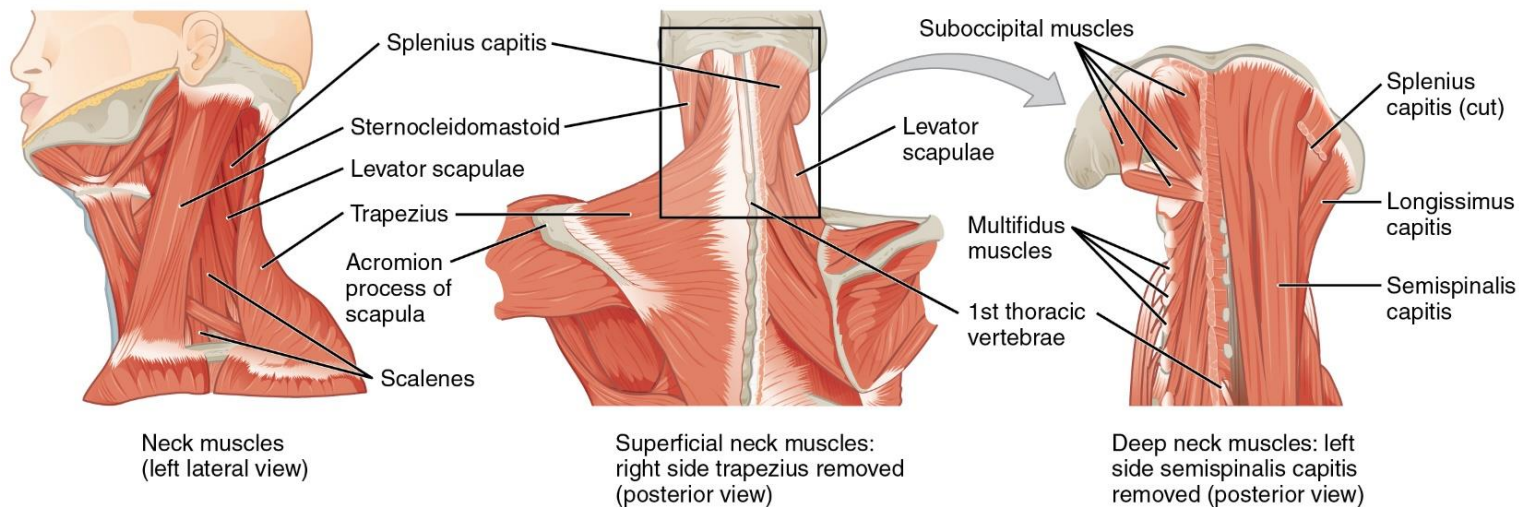


Figure 7.7 Muscles that Move the Head (<http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@15.1>.)

Muscle Name	Origin	Insertion	Action
Sternocleidomastoid			
Semispinalis capitis			

Muscle Name	Origin	Insertion	Action
Splenius capitis			
Longissimus capitis			

Anatomy in Clay® - Muscles that move the Head

On your model, place the **sternocleidomastoid** and **semispinalis capitis** muscles and include the fascicle orientation.

Muscles that Act on the Anterior Abdominal Wall

These muscles are important to human locomotion as they stabilize our core and help with posture. There are four pairs of abdominal muscles that cover the anterior and lateral abdominal region and meet at the midline of the body anteriorly. The muscles of the anterolateral abdominal wall can be divided into four groups: the **external obliques**, the **internal obliques**, the **transversus abdominis**, and the **rectus abdominis**.

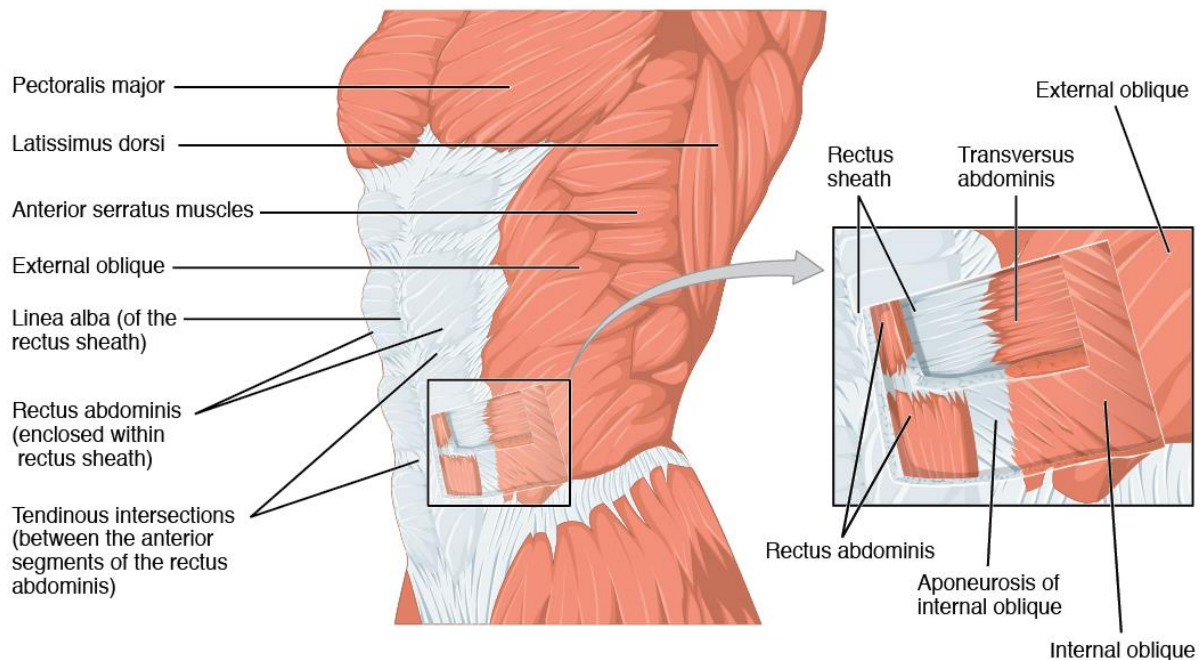


Figure 9 Muscles that Act of the Anterior Abdominal Wall (<http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@15.1>.)

Muscle	Origin	Insertion	Action
Rectus abdominis			
External oblique			
Internal oblique			
Transverse oblique			

Anatomy in Clay® - Muscles of the Anterior Abdominal Wall

On your model, place the **rectus abdominis** and **transverse obliques** muscles and include the fascicle orientation.

Diaphragm: the **primary** muscle of Breathing.

The volume of the thoracic cavity changes during breathing and is due to the alternating contraction and relaxation of the **diaphragm** (figure 9). Additionally it serves as a physical barrier between the thoracic and abdominal cavities. The superior surface of the diaphragm is convex, creating the elevated floor of the thoracic cavity. The inferior surface is concave, creating the curved roof of the abdominal cavity.

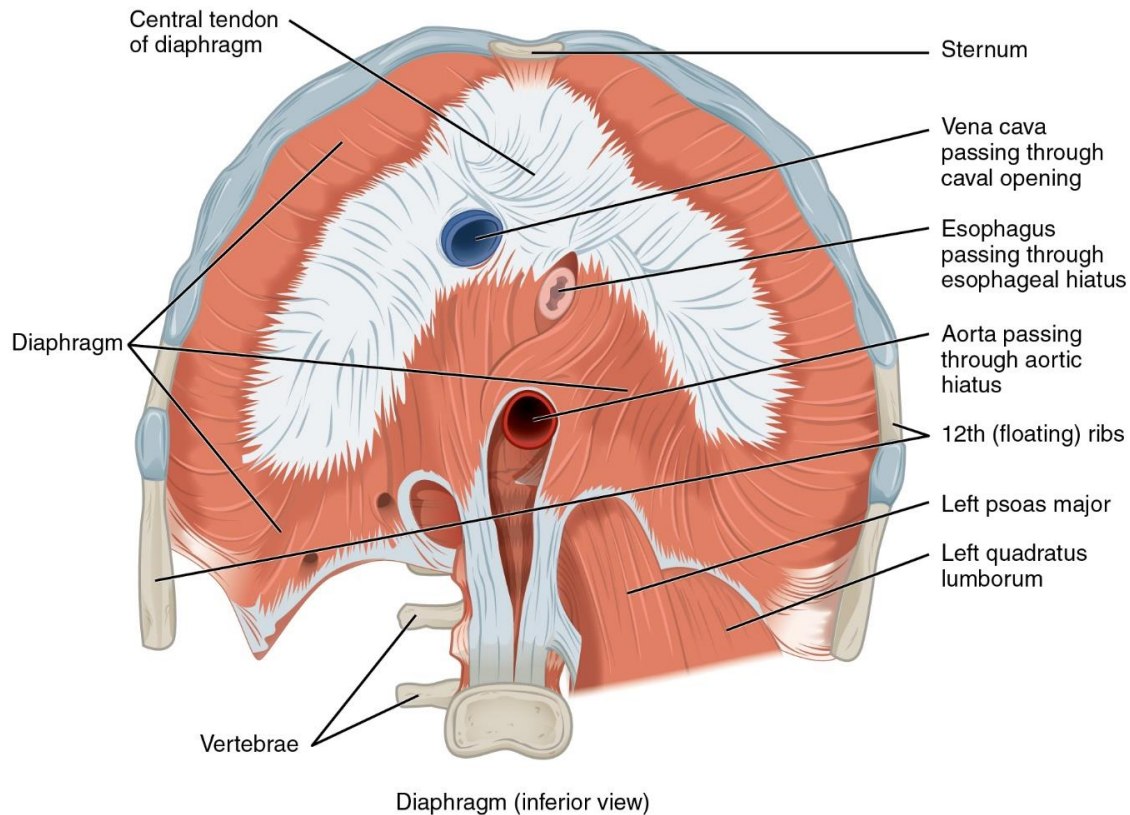


Figure 7.9 Muscles used in Breathing (<http://cnx.org/contents/14fb4ad7-39a1-4eee-ab6e-3ef2482e3e22@15.1>.)

Muscle	Origin	Insertion	Action
Diaphragm			
External intercostal			
Internal intercostal			