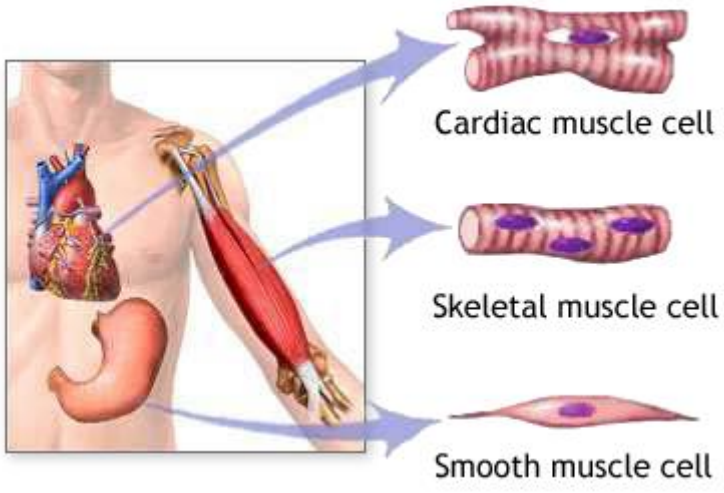
TYPES OF MUSCLES



In the body, there are three types of muscle: skeletal (striated), smooth, and cardiac.

Skeletal Muscle

Skeletal muscle, attached to bones, is responsible for skeletal movements.
The peripheral portion of the central nervous system (CNS) controls the skeletal muscles. Thus, these muscles are under conscious, or voluntary, control. The basic unit is the muscle fiber with many nuclei. These muscle fibers are striated (having transverse streaks) and each acts independently of neighboring muscle fibers.

Smooth Muscle

Smooth muscle, found in the walls of the hollow internal organs such as blood vessels, the gastrointestinal tract, bladder, and uterus, is under control of the autonomic nervous system. Smooth muscle cannot be controlled consciously and thus acts involuntarily. The non-striated (smooth) muscle cell is spindle-shaped and has one central nucleus. Smooth muscle contracts slowly and rhythmically.

Cardiac Muscle

Cardiac muscle, found in the walls of the heart, is also under control of the autonomic nervous system. The cardiac muscle cell has one central nucleus, like smooth muscle, but it also is striated, like skeletal muscle. The cardiac muscle cell is rectangular in shape. The contraction of cardiac muscle is involuntary, strong, and rhythmical.

Smooth and cardiac muscle will be discussed in detail with respect to their appropriate systems. This unit mainly covers the skeletal muscular system.

STRUCTURE AND PROPERTIES OF SKELETAL MUSCLES

Skeletal Muscle Definition

Skeletal muscle is one of the three types of muscles in the human body- the others being visceral and cardiac muscles. In this lesson, skeletal muscles, its definition, structure, properties, functions, and types are explained in an easy and detailed manner.

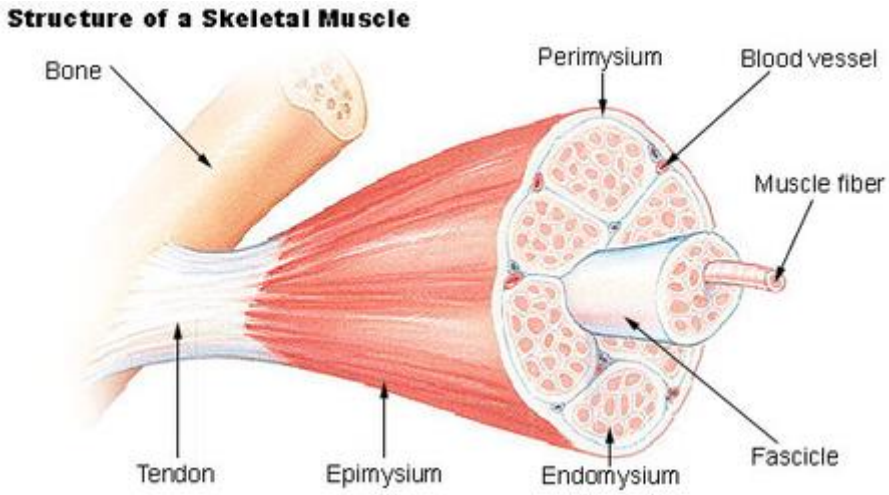
Skeletal muscle is a muscle tissue that is attached to the bones and is involved in the functioning of different parts of the body. These muscles are also called voluntary muscles as they come under the control of the nervous system in the body.

Structure Of Skeletal Muscle

The structure of skeletal muscles is shown below-

This muscle is attached to the bones by an elastic tissue or collagen fibres called tendons. These tendons are comprised of connective tissues. The skeletal muscles consist of a bundle of muscle fibres namely fascicule. These fascicules are cylindrical in shape as shown in the figure. These muscle fibres are surrounded by blood vessels and a number of layers of other tissues enclosing it.

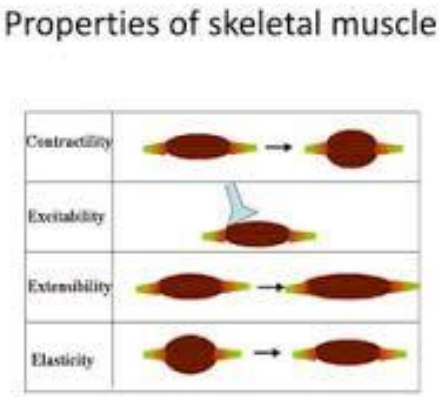
Each muscle fibre is lined by plasma membrane namely sarcolemma reticulum. It encloses a cytoplasm called sarcoplasm which has the endoplasmic reticulum. The muscle fibres consist of myofibrils, which have two important proteins, namely actin and myosin in it. The fascicule is enclosed by perimysium and the endomysium is the connective tissue that encloses the muscle fibres.



Properties Of Skeletal Muscle

The skeletal muscles have the following properties:

- Extensibility: It is the ability of the muscles to extend when it is stretched.
- Elasticity: It is the ability of the muscles to return to its original structure when released.
- Excitability: It is the ability of the muscle to respond to a stimulus.
- Contractility: It is the ability of a muscle to contract when in contact with a stimulus.



Types Of Skeletal Muscle

There are two types of skeletal muscles named as red and white muscles-

- **Red Muscles**

Red muscles are due to the red pigment called myoglobin, which is in high amounts in the human body. These muscles are smaller in diameter and have a large number of mitochondria in it. The myoglobin stores the oxygen, which is used by the mitochondria for the synthesis of ATP. Red muscles have a large number of blood capillaries in it.

- **White Muscles**

Unlike the red muscles, the white muscles are bigger in diameter and have a small amount of myoglobin in it. They also have less number of mitochondria in it.

Parallel muscles have fascicles that are arranged in the same direction as the long axis of the muscle (Figure 2). The majority of skeletal muscles in the body have this type of organization. Some parallel muscles are flat sheets that expand at the ends to make broad attachments. Other parallel muscles are rotund with tendons at one or both ends. Muscles that seem to be plump have a large mass of tissue located in the middle of the muscle, between the insertion and the origin, which is known as the central body. A more common name for this muscle is **belly**. When a muscle contracts, the contractile fibers shorten it to an even larger bulge. For example, extend and then flex your biceps brachii muscle; the large, middle section is the belly (Figure 3). When a parallel muscle 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**.

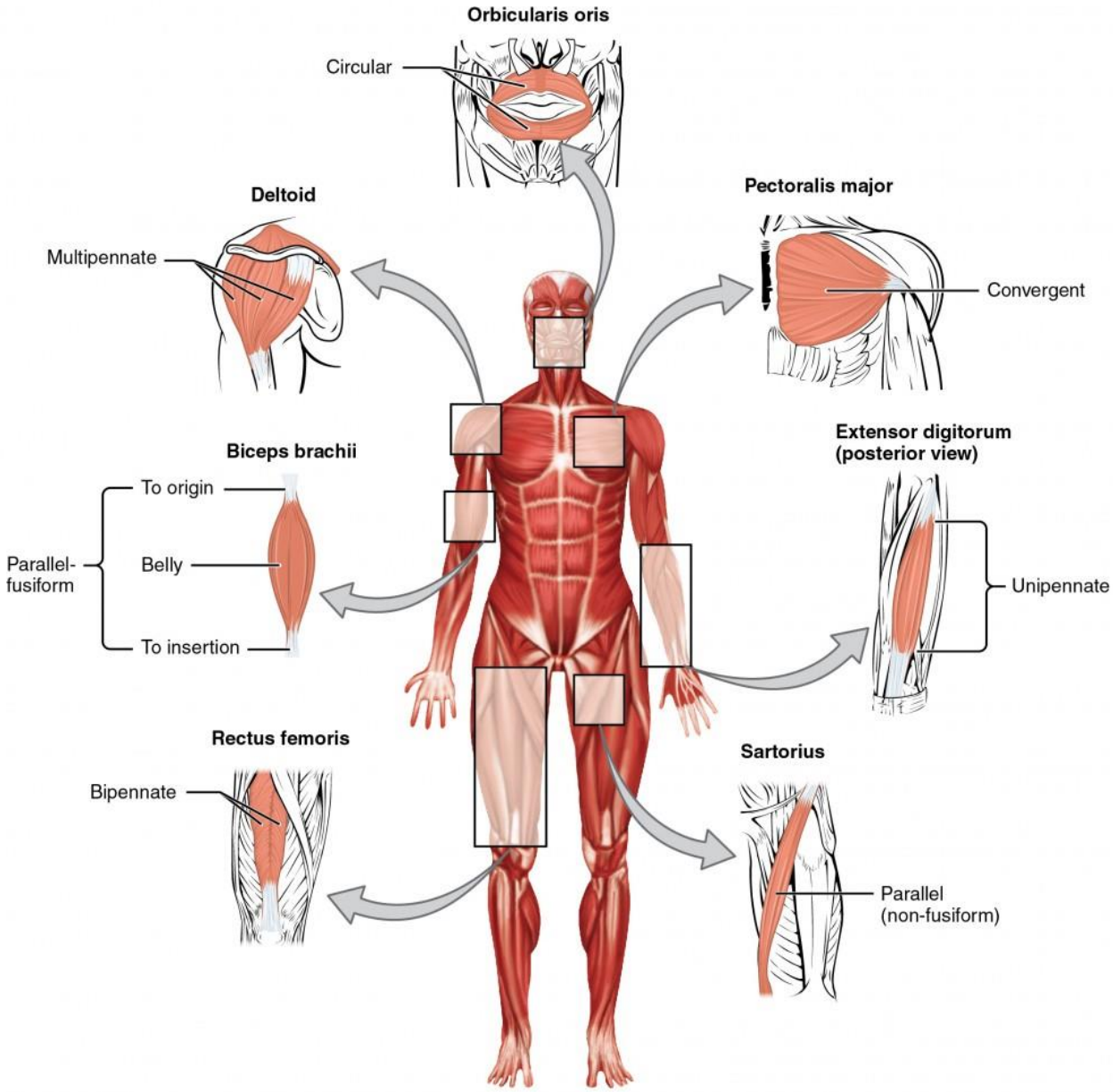


Figure 2. Muscle Shapes and Fiber Alignment. The skeletal muscles of the body typically come in seven different general shapes.

Figure 3. Biceps Brachii Muscle Contraction. The large mass at the center of a muscle is called the belly. Tendons emerge from both ends of the belly and connect the muscle to the bones, allowing the skeleton to move. The tendons of the bicep connect to the upper arm and the forearm. (credit: Victoria Garcia)

Circular muscles are also called sphincters (see Figure 2). When they relax, the sphincters' concentrically arranged bundles of muscle fibers increase the size of the opening, and when they contract, the size of the opening shrinks to the point of closure. The orbicularis oris muscle is a circular muscle that goes around the mouth. When it contracts, the oral opening becomes smaller, as when puckering the lips for whistling. Another example is the orbicularis oculi, one of which surrounds each eye. Consider, for example, the names of the two orbicularis muscles (orbicularis oris and oribicularis oculi), where part of the first name of both muscles is the same. The first part of orbicularis, orb (orb = "circular"), is a reference to a round or circular structure; it may also make one think of orbit, such as the moon's path around the earth. The word oris (oris = "oral") refers to the oral cavity, or the mouth. The word oculi (ocular = "eye") refers to the eye.

There are other muscles throughout the body named by their shape or location. The deltoid is a large, triangular-shaped muscle that covers the shoulder. It is so-named because the Greek letter delta looks like a triangle. The rectus abdomis (rector = "straight") is the straight muscle in the anterior wall of the abdomen, while the rectus femoris is the straight muscle in the anterior compartment of the thigh.

When a muscle has a widespread expansion over a sizable area, but then the fascicles come to a single, common attachment point, the muscle is called **convergent**. The attachment point for a convergent muscle could be a tendon, an aponeurosis (a flat, broad tendon), or a raphe (a very slender tendon). The large muscle on the chest, the pectoralis major, is an example of a convergent muscle because it converges on the greater tubercle of the humerus via a tendon. The temporalis muscle of the cranium is another.

Pennate muscles (penna = “feathers”) blend into a tendon that runs through the central region of the muscle for its whole length, somewhat like the quill of a feather with the muscle arranged similar to the feathers. Due to this design, the muscle fibers in a pennate muscle can only pull at an angle, and as a result, contracting pennate muscles do not move their tendons very far. However, because a pennate muscle generally can hold more muscle fibers within it, it can produce relatively more tension for its size. There are three subtypes of pennate muscles.

In a **unipennate** muscle, the fascicles are located on one side of the tendon. The extensor digitorum of the forearm is an example of a unipennate muscle. A **bipennate** muscle has fascicles on both sides of the tendon. In some pennate muscles, the muscle fibers wrap around the tendon, sometimes forming individual fascicles in the process. This arrangement is referred to as **multipennate**. A common example is the deltoid muscle of the shoulder, which covers the shoulder but has a single tendon that inserts on the deltoid tuberosity of the humerus.

Because of fascicles, a portion of a multipennate muscle like the deltoid can be stimulated by the nervous system to change the direction of the pull. For example, when the deltoid muscle contracts, the arm abducts (moves away from midline in the sagittal plane), but when only the anterior fascicle is stimulated, the arm will **abduct** and flex (move anteriorly at the shoulder joint).

Functions Of Skeletal Muscle

Following are the important skeletal muscle function:

1. The skeletal muscles are responsible for body movements such as typing, breathing, extending the arm, writing, etc. The muscles contract which pulls the tendons on the bones and causes movement.
2. The body posture is maintained by the skeletal muscles. The gluteal muscle is responsible for the erect posture of the body. The Sartorius muscles in thighs are responsible for body movement.
3. The skeletal muscles protect the internal organs and tissues from any injury and also provide support to these delicate organs and tissues.
4. These also support the entry and exit points of the body. The sphincter muscles are present around the anus, mouth and the urinary tract. These muscles contract which reduces the size of the openings and facilitates the swallowing of food, defecation, and urination.
5. The skeletal muscles also regulate body temperature. After a strenuous exercise, the body feels hot. This is due to the contraction of skeletal muscles which converts energy into heat.