

## 20D-1

### Objectives

- Compare the three types of human muscle
- Describe the structures of a typical skeletal muscle fiber

## 20D-1 Muscle Anatomy

Muscle tissue, composed of a great number of cells called **muscle fibers**, is supported by layers of connective tissues. In any description of muscle tissue, the words *fiber* and *cell* are synonymous, but in other body tissues the word *fiber* refers to either a part of the cell (nerve fiber) or a nonliving strand of matrix in connective tissues.

### Types of Muscle Tissue

There are three types of muscle tissue in the human body. Each type has properties that fit it for particular functions. These muscle types are distinguished by their location, microscopic appearance, and type of nervous control.

The first type, named for its location, is **skeletal muscle** tissue. It is usually attached to bones. It is also called *striated* (STRY ay tid) *muscle* because there are dark and light stripes in its cells when viewed with a microscope. These striations are actually filaments of protein in the muscle cells. Skeletal muscle is also known as *voluntary* muscle tissue because it is primarily controlled by conscious thought. However, the term *voluntary* does not always apply (for example, when a person moves while sleeping).

The diaphragm (the primary muscle of breathing) functions under voluntary control when a person speaks or sings, but at other times it functions involuntarily. Therefore, it is difficult to classify the diaphragm, even though it is skeletal by its location and appears striated. The muscular tissues in the walls of the pharynx (throat) are also classified as striated because of their appearance, but they are neither voluntary nor attached to a bone.

The second type is **visceral muscle** tissue. The term *visceral* refers to internal organs. The name fits well because visceral muscle is located in the walls of internal organs such as the stomach, intestines, blood vessels, and urinary bladder. Visceral muscle is also located in the iris of the eye and causes the diameter of the pupil to increase or decrease, depending on the brightness of the environment.

Most of the *sphincters*\* (SFINGK turz), circular bundles of muscles that regulate the diameter of various tubular organs and openings, are visceral muscles. The muscular valves at both ends of the stomach are examples of sphincters.

Visceral muscle is also called *nonstriated* or *smooth* because it does not have dark and light stripes. All visceral muscle tissue is termed *involuntary* because it is *not* directly controlled by conscious thought. In other words, visceral muscle tissue can function (and, in fact, functions most regularly) when a person is asleep.

**Cardiac\* muscle**, the third type of muscle, is located only in the heart. Cardiac muscle tissue is *striated* and *involuntary*. The striations, however, are not as regular and distinct as in skeletal muscle. Cardiac muscle fibers branch and join together. This network of interwoven fibers allows nerve impulses to spread quickly through the muscular walls of the heart and produces effective pumping of the blood.

Visceral and cardiac muscle tissues are discussed in greater detail in connection with other body systems (see Chaps. 21–25). The remainder of this chapter deals with skeletal muscle tissue.

### Muscle Structure

A skeletal muscle fiber (cell) is barely visible to the unaided eye. Each fiber is a multinucleate cylinder wrapped in a thin sheath of connective tissue. Groups of ten to a hundred fibers are bound together with other layers of connective tissue to form a **fascicle**. A thicker connective tissue layer encloses groups of fascicles to form the muscle itself. At the ends of the muscle, the connective tissue

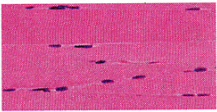
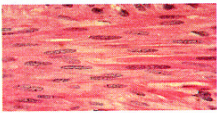
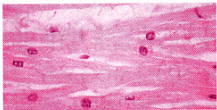


**sphincters:** (Gk. SPHINGEIN, to bind tight)

**cardiac:** (heart)

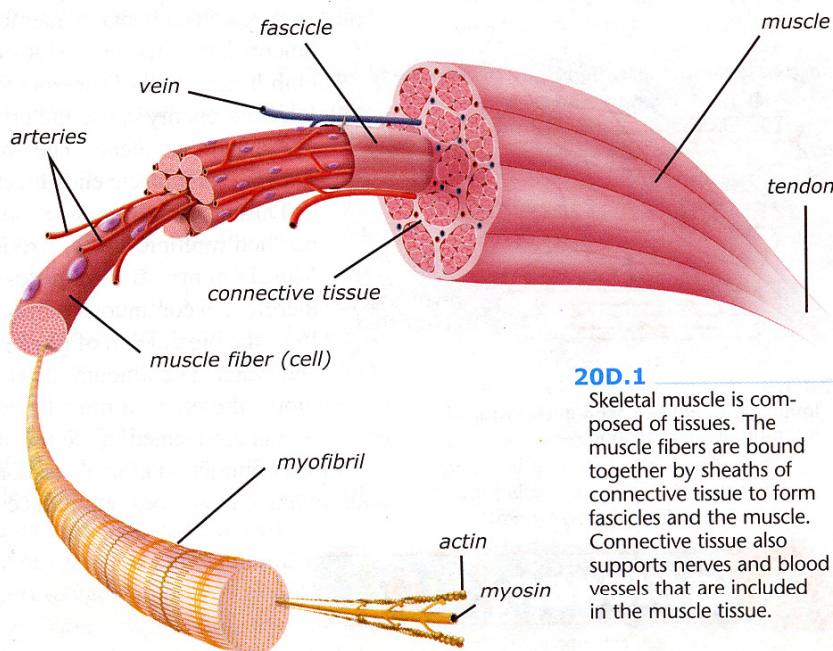


**Table 20D-1 Muscle Classification**

Kind of muscle	Location of muscle	Function of muscle	Kind of fibers	Voluntary or involuntary
Skeletal 	Primarily attached to bones and other movable structures	Move parts of the body	Striated	Voluntary
Visceral 	Walls of internal organs and blood vessels	Move organ or substance within the organ	Smooth	Involuntary
Cardiac 	Heart	Contract heart to pump blood	Striated	Involuntary

merges to form the tendons that attach the muscle to bones. The connective tissues not only hold the muscle fibers together but also support blood vessels and nerves that supply the fibers.

The cytoplasm within each muscle fiber contains numerous tiny threadlike **myofibrils**\* (MYE uh FYE bruhlz). These myofibrils parallel each other and extend the length of the fiber. There are two kinds of protein filaments in each myofibril—thick filaments made of the *myosin* (MYE uh sin) and thin filaments made of the *actin*. The overlapping arrangement of these filaments is repeated to produce the striated appearance. The actin filaments are anchored at their midline to a structure called the **Z line**. The distance from one Z line to another is called a **sarcomere**—the functional unit of muscle contraction.



#### 20D.1

Skeletal muscle is composed of tissues. The muscle fibers are bound together by sheaths of connective tissue to form fascicles and the muscle. Connective tissue also supports nerves and blood vessels that are included in the muscle tissue.

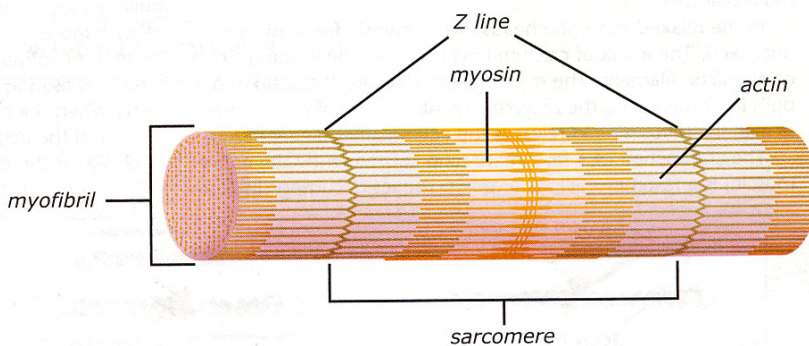
#### Muscle Cell Terminology

Because a skeletal muscle fiber is actually a fusion of several cells into one, its parts have special names. The prefix *sarco-* comes from the Greek word *sarko*, meaning flesh.

- sarcolemma—plasma membrane
- sarcoplasm—cytoplasm
- sarcoplasmic reticulum—endoplasmic reticulum
- sarcosome—mitochondrion



**myofibril:** myo- (Gk. MUS, muscle) + -fibril (fiber)



#### 20D.2

Sarcomere: the functional unit of a muscle