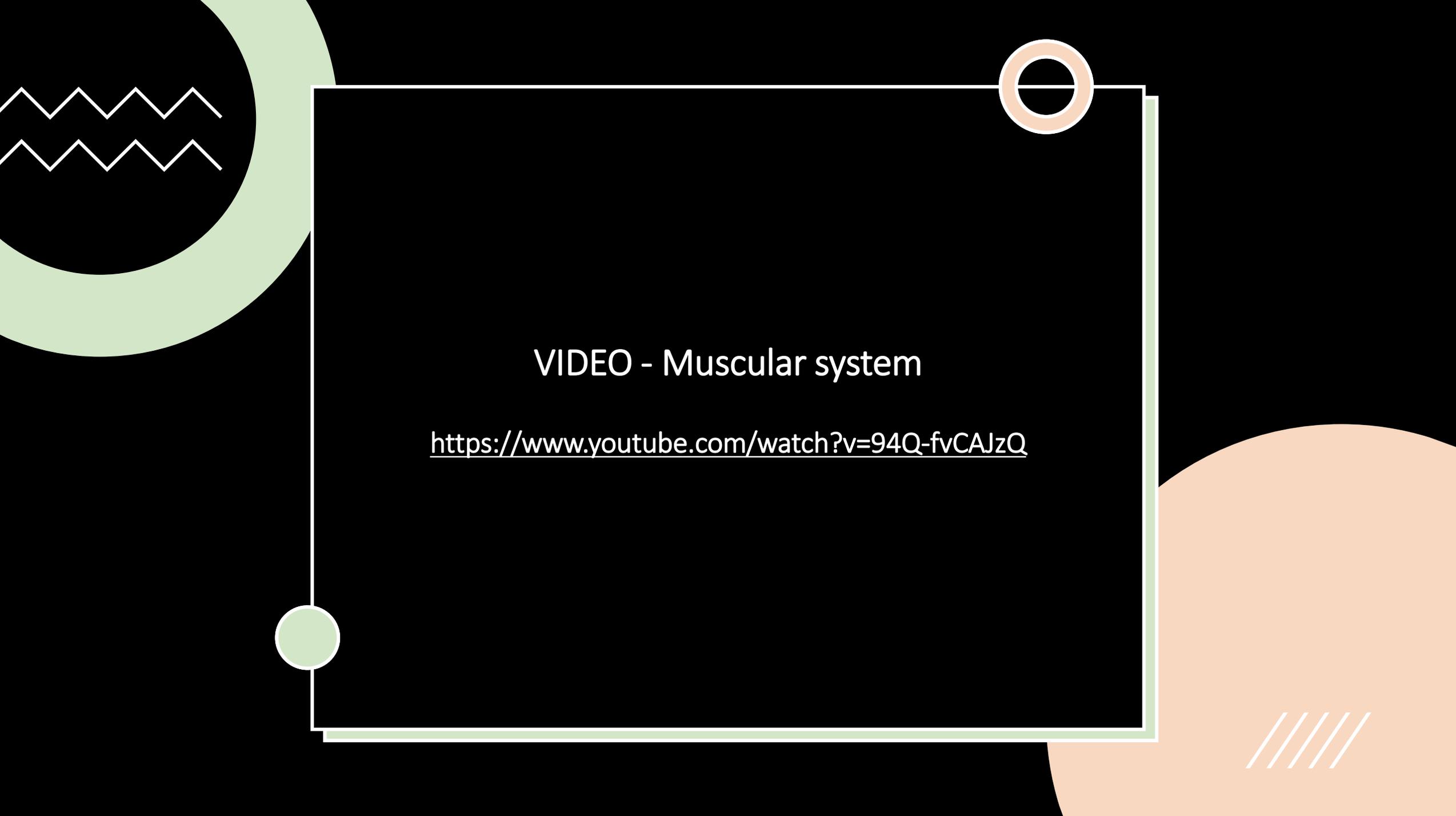




**AUM**

**American University Of The Middle East**

**PES111**

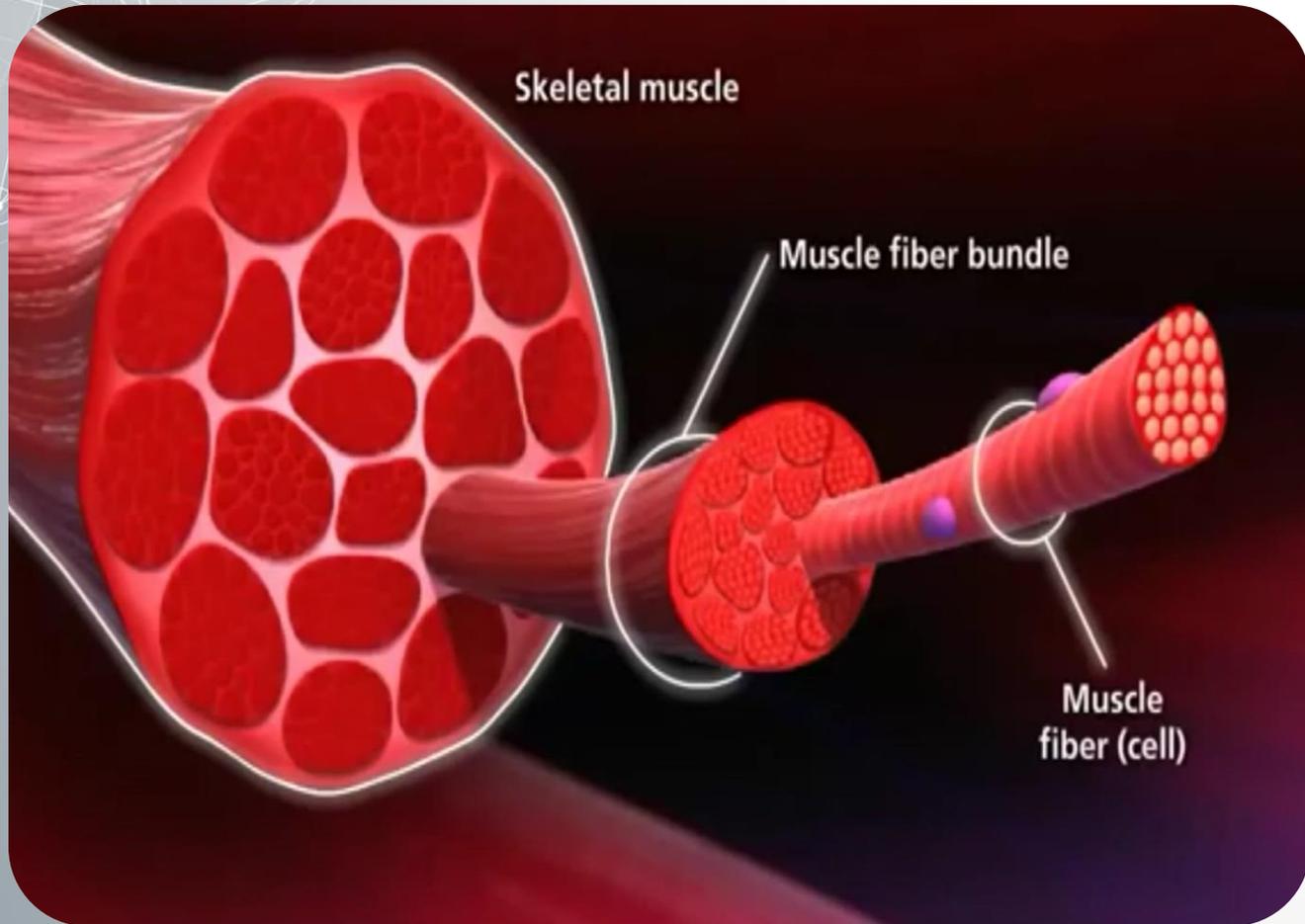


## VIDEO - Muscular system

<https://www.youtube.com/watch?v=94Q-fvCAJzQ>

# Muscles

Muscles make up more than 40% of your body mass.

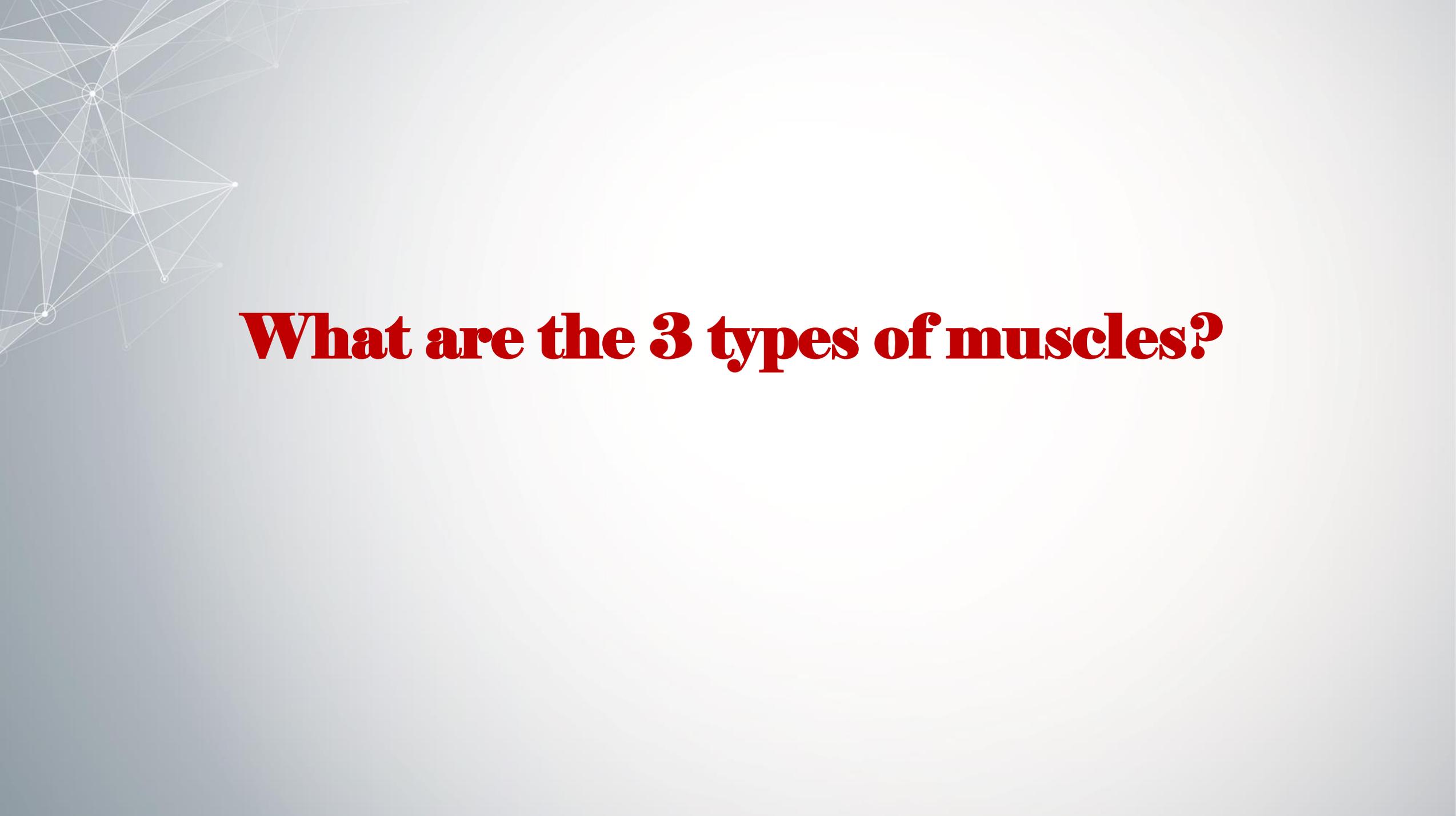


The basic function of muscle is to generate force.

Muscles can provide some shape and form to the organism.

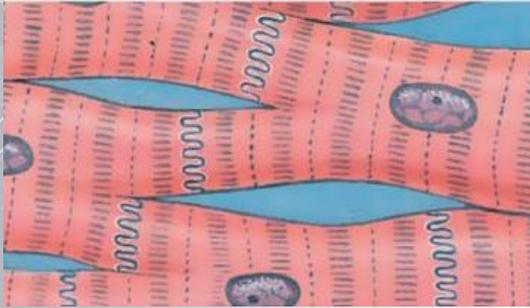
# Muscles

- Muscles attached to bones or internal organs and blood vessels, are responsible for movement. Nearly all movement in the body is the result of muscle contraction.
- The integrated action of joints, bones, and skeletal muscles produces obvious movements such as walking and running.
- Skeletal muscles also produce more subtle movements that result in various facial expressions, eye movements, and respiration.
- In addition to movement, muscle contraction also fulfills some other important functions in the body, such as:
  - **Posture** such as sitting and standing, is maintained as a result of muscle contraction.
  - **Joint stability.**
  - **Heat production.** {Nearly 85% of the heat produced (to maintain body temperature) is the result of muscle contraction.}



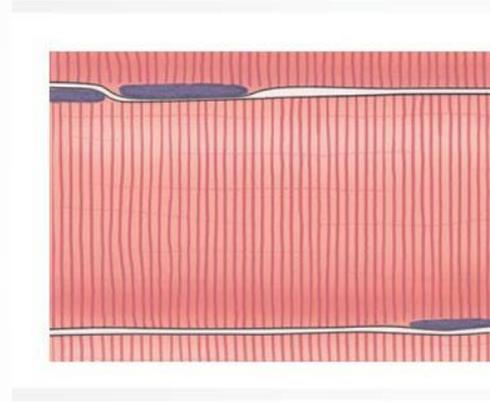
**What are the 3 types of muscles?**

# There are three types of muscle: skeletal, smooth, and cardiac.



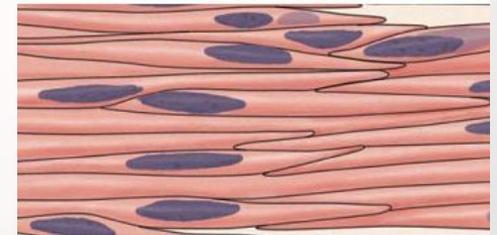
**Cardiac muscle:**  
Found in the walls of  
the heart.

The contraction of  
cardiac muscle is  
involuntary, strong,  
and rhythmical.



**Skeletal muscle:**  
attached to bones, is  
responsible for  
skeletal movements  
(voluntary).

**Smooth muscle:** Found in the  
walls of the hollow internal  
organs. It cannot be controlled  
consciously (involuntary).  
Smooth muscle contracts slowly  
and rhythmically.

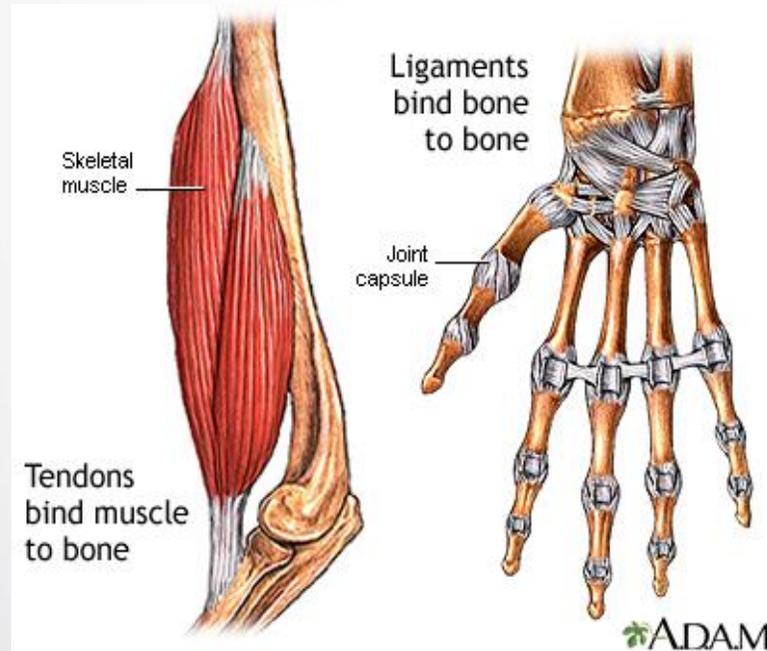




**What is the difference between  
tendons and ligaments?**

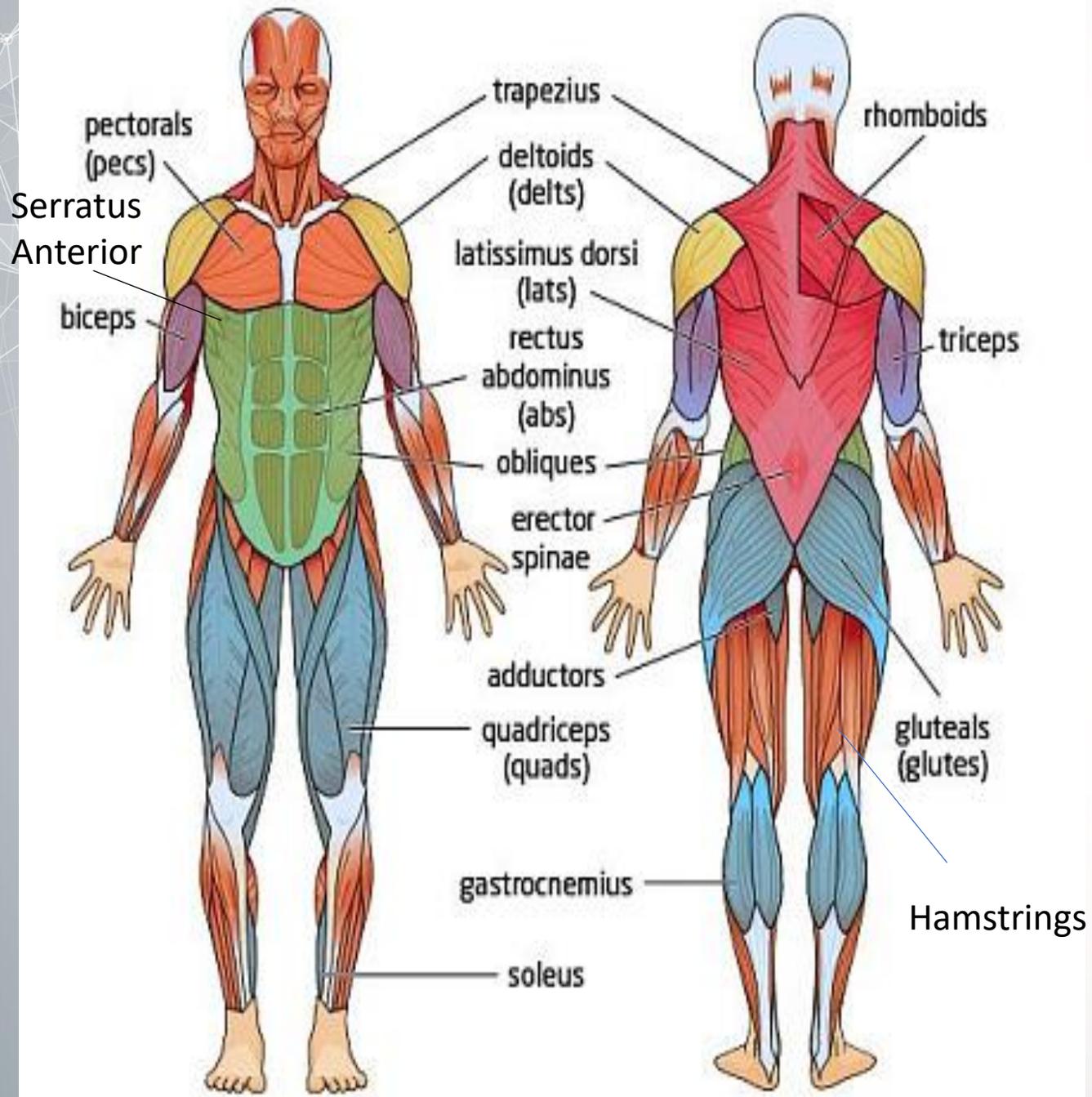
# Tendons and Ligaments

- A tough band of Fibrous tissue.
- Connects muscle to bone or other structures such as the eyeball.
- Serves to move the bone or structure.
- Aid in a wide range of motion and act to resist pressures; hence, it is important that they vary in shape and size.

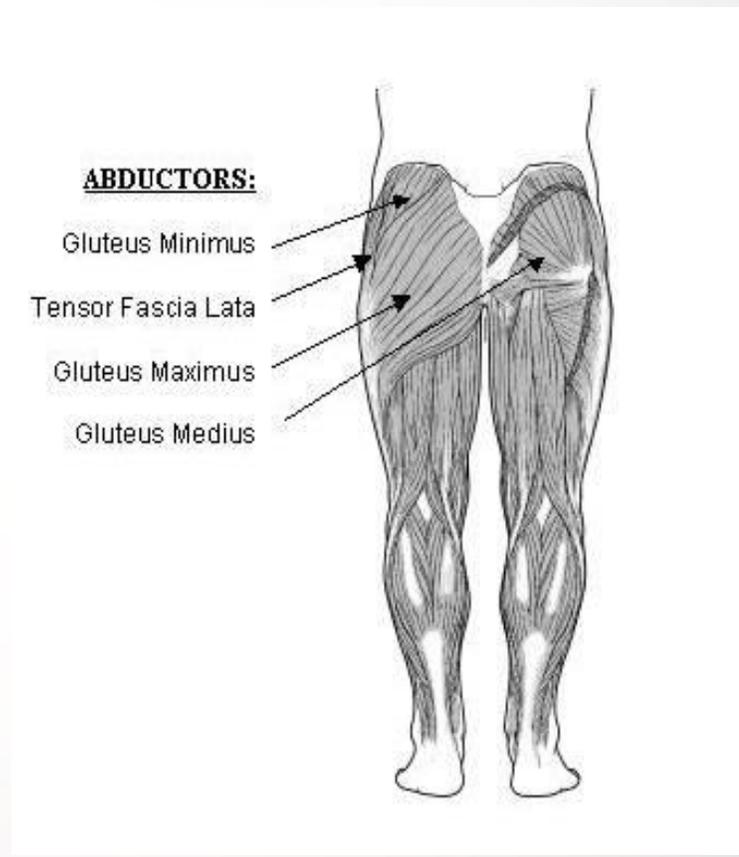


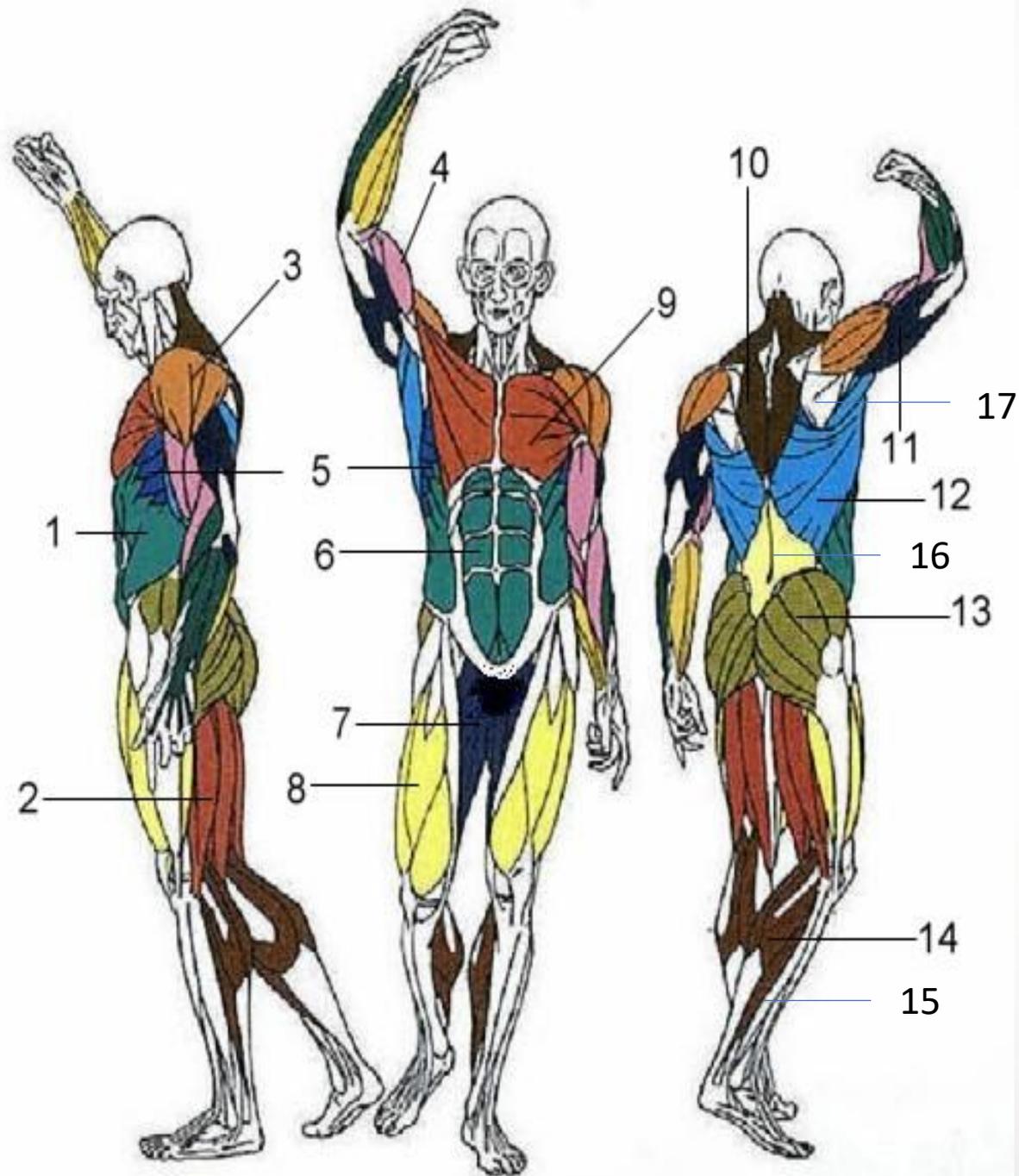
- A tough band of Fibrous tissue.
- Attaches bone to bone
- Serves to hold structures together and keep them stable.
- come in a variety of sizes and shapes to support, strengthen and stabilize the joints

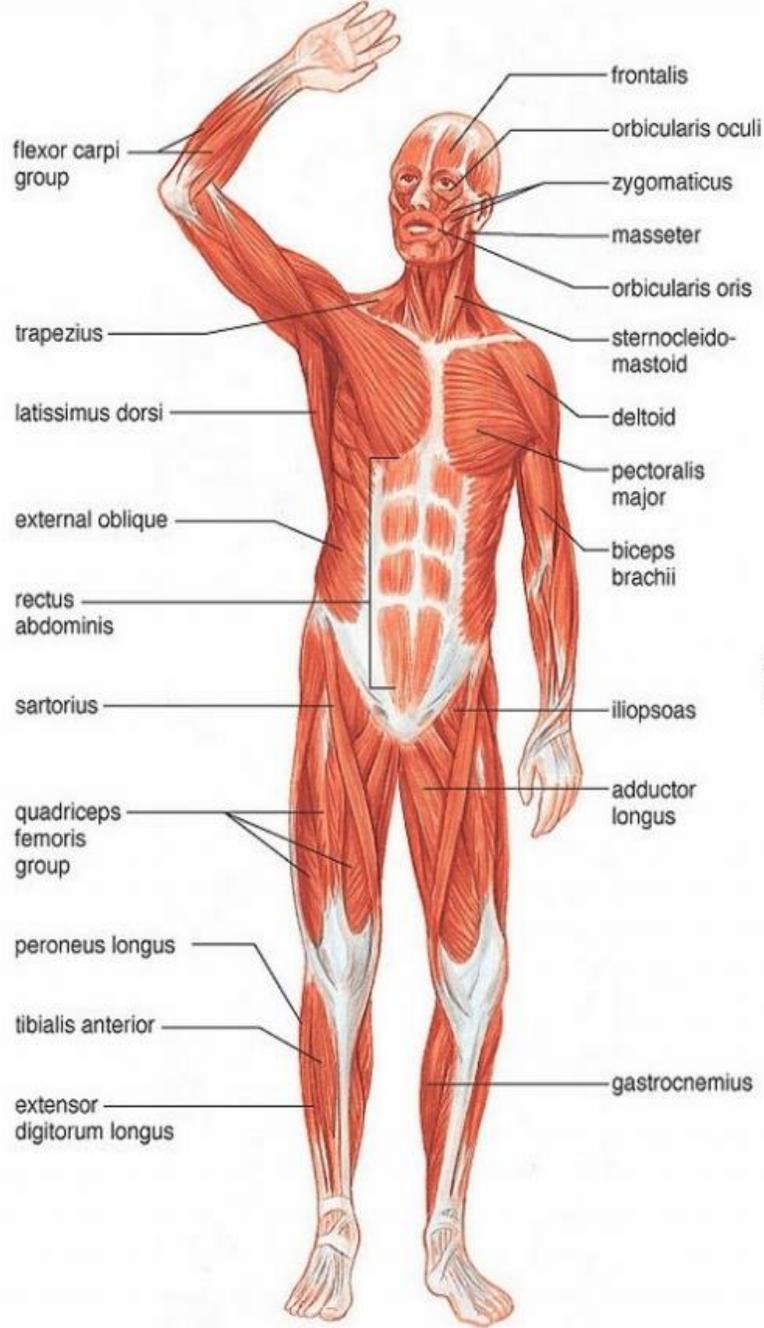
<https://www.nlm.nih.gov/medlineplus/ency/imagepages/19089.htm>



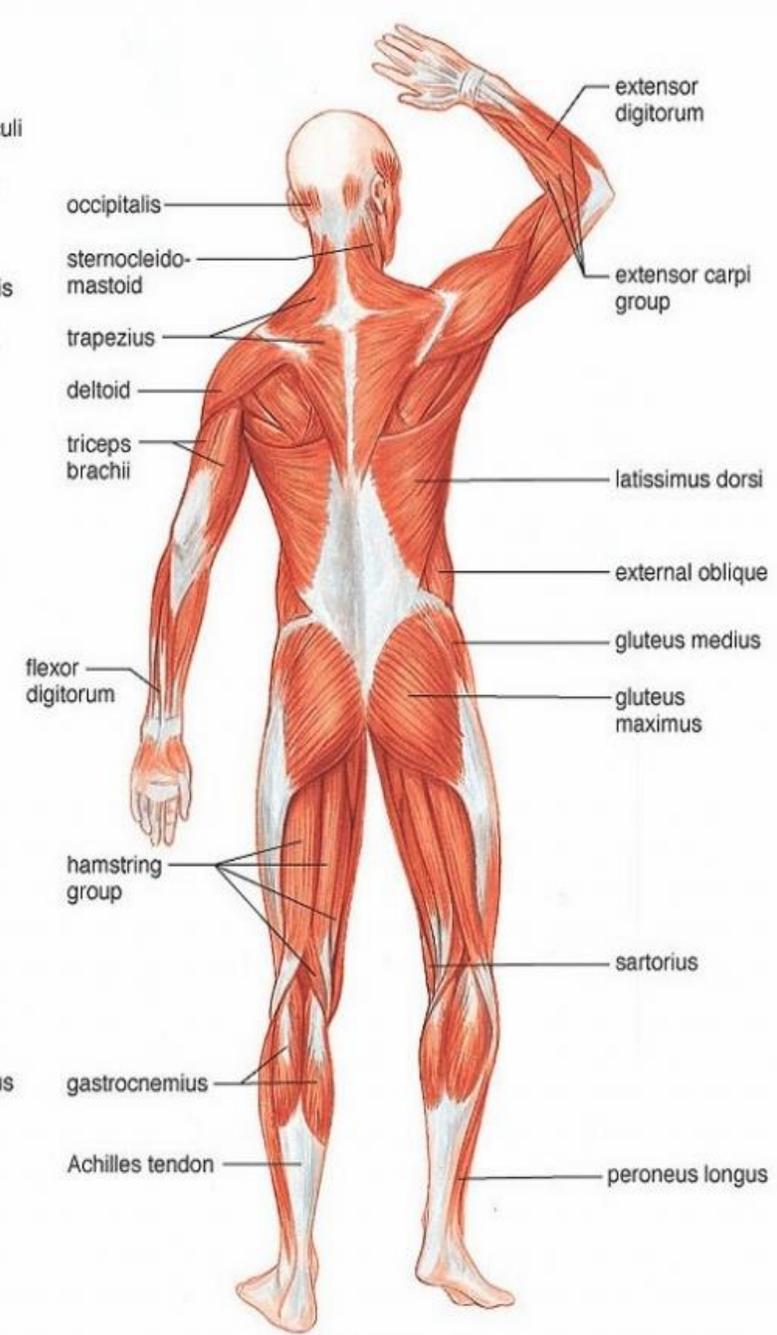
# MUSCULAR SYSTEM





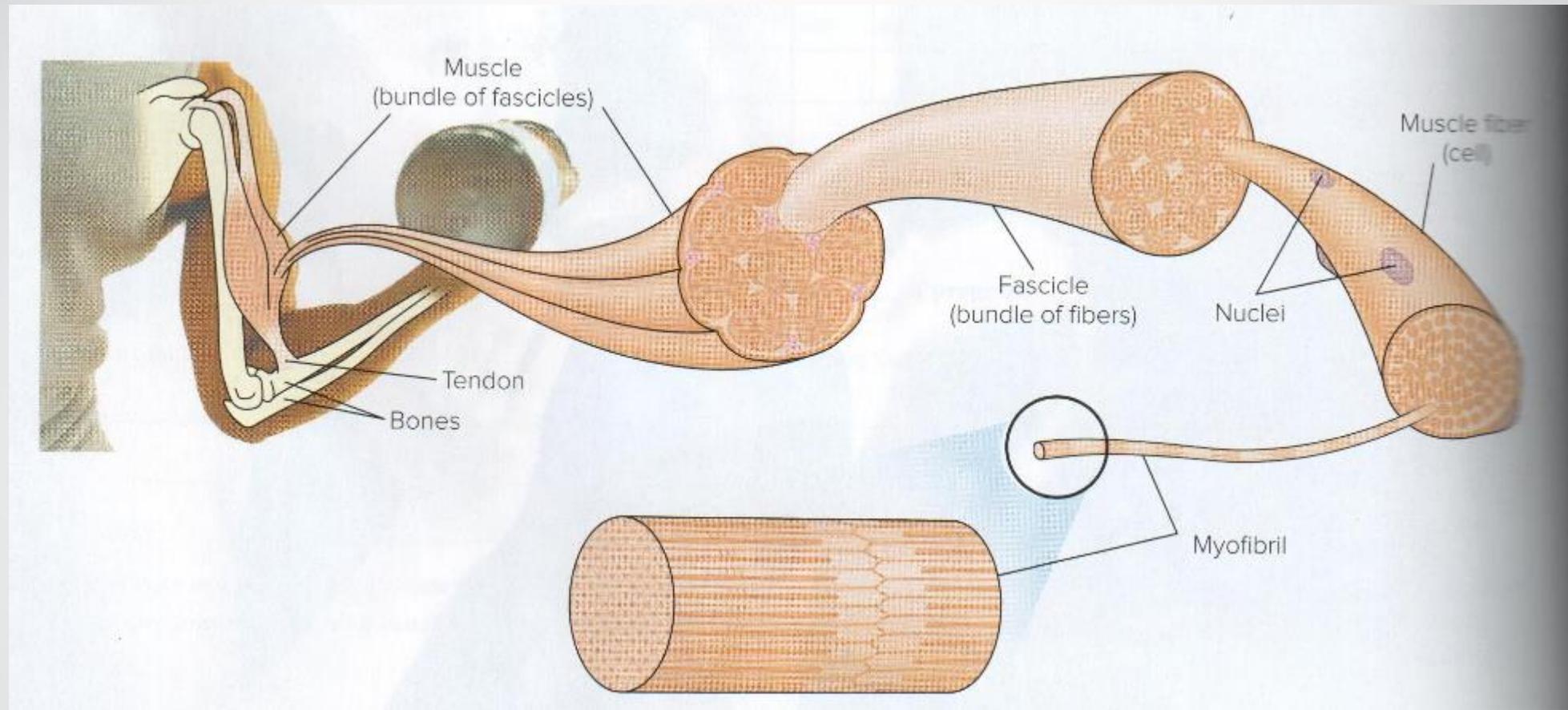


a. Anterior view



b. Posterior view

# Components of Skeletal muscle tissue



**Muscles** consist of individual **muscle cells**, or **muscle fibers**, connected in bundles called **fascicles**.

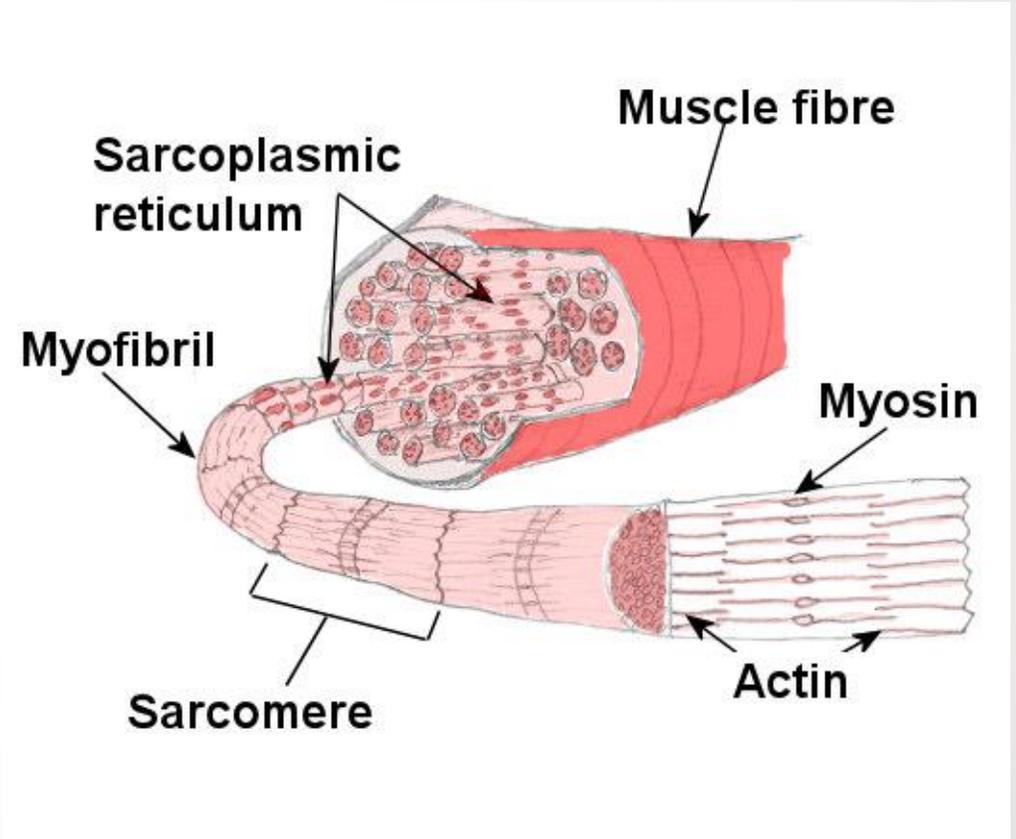
A single muscle is made of many bundles of **muscle fibers** and is covered by layers of connective tissue that hold the fibers together.

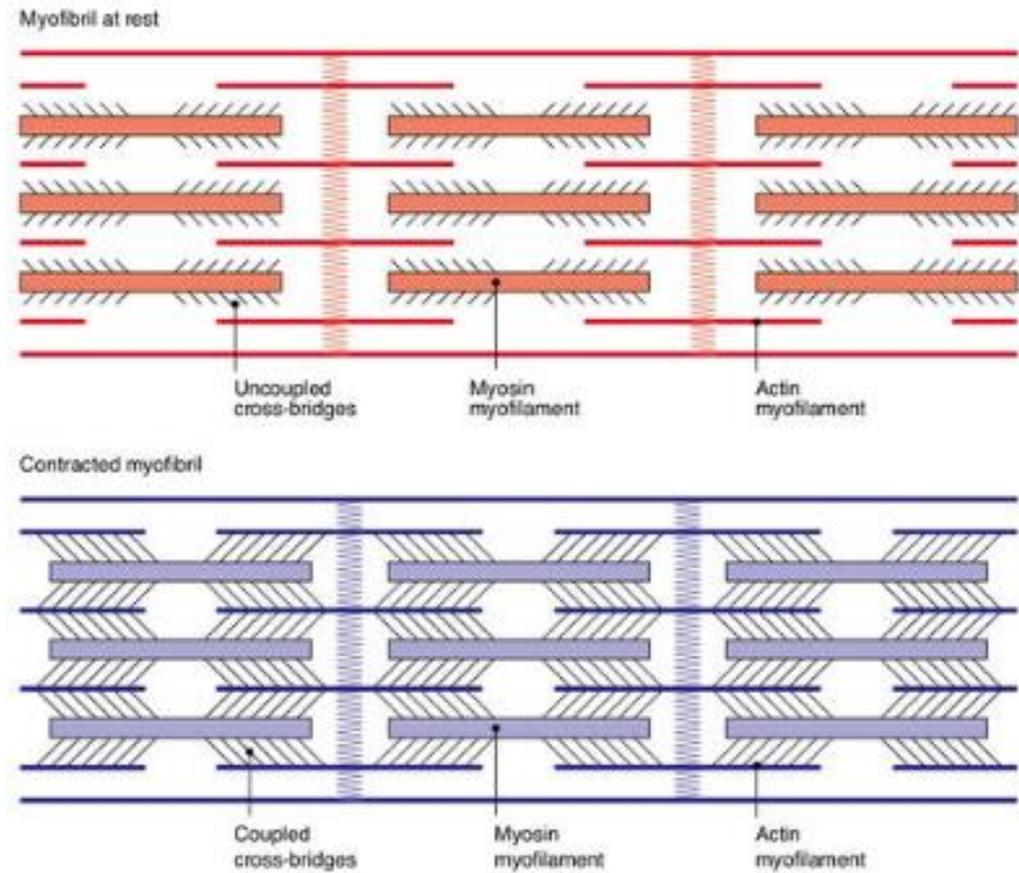
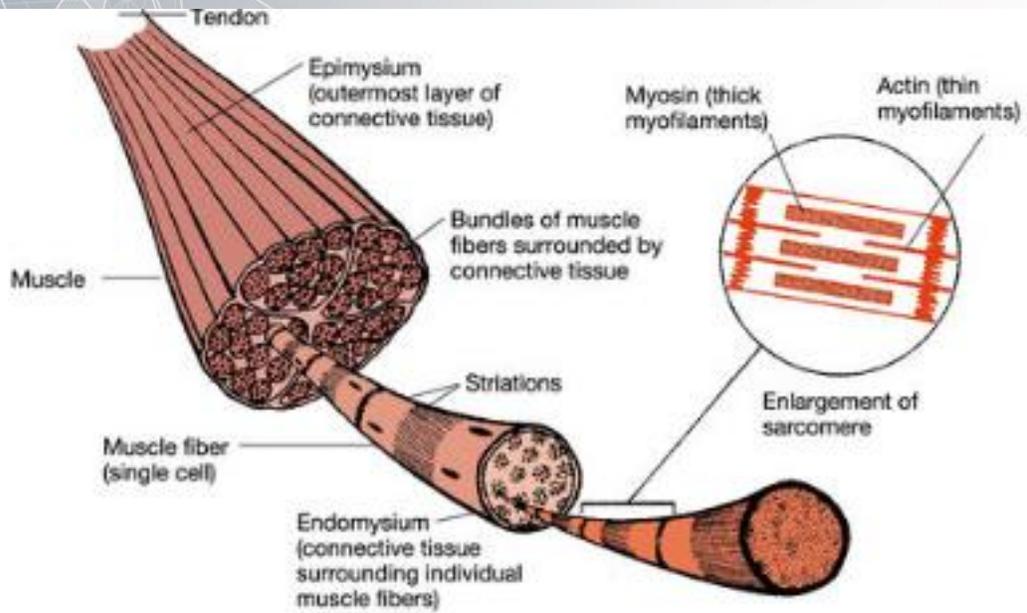
Muscle fibers are made up of smaller protein structures called **myofibrils**.

Myofibrils consist of series of contractile units called **sarcomeres**, which are composed largely of **actin** and **myosin** molecules.

**Muscle cells** contract when the myosin molecule glide across the actin molecules in a ratchet-like movement.

Each muscle cell has many **nuclei** containing genes that control cell function and direct the production of enzymes and structural proteins required for muscle contraction.





**Figure 1-19**  
The sliding filament theory

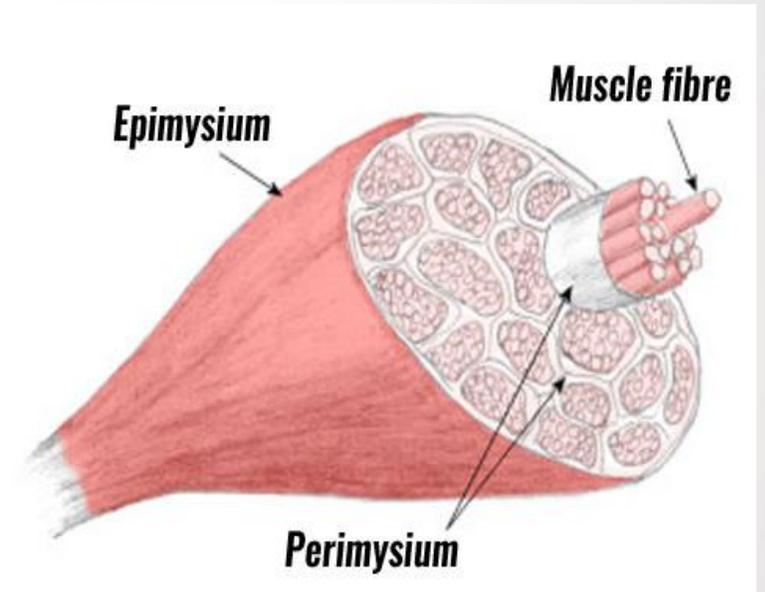
**Strength training** activates structures called **satellite cells** that provide additional muscle cell nuclei, which in turn enhances muscle repair and muscle protein synthesis.

These cells improve muscle function, and they persist even if you stop training intensely.

In response to strength training, **myofibrils** increase in size (thicken) and in number, resulting in **larger individual muscle fibers**.

**Larger muscle fibers** mean a larger and stronger muscle.

The development of large muscle fibers is called **hypertrophy**.





**The process of hypertrophy** begins after about 6 to 8 weeks of strength training.

Consistent with the fitness principle of reversibility, inactivity causes a decrease in muscle fiber size, known as **atrophy**, the reversal of this process.

# Definitions

- **Muscular strength** is the amount of force a muscle can produce with a single maximum effort.
- **Muscular endurance** is the ability to hold or repeat a muscular contraction for a long time.
- **Tendon** is a tough band of fibrous tissue that **connects a muscle to a bone** or other body part and transmits the force exerted by the muscle.
- **Ligament** is a tough band of tissue that **connects the ends of bones to other bones** or supports organs in place.
- **Cartilage** tough resilient tissue that acts as a cushion between the bones in a joint.
- **Testosterone** the principal male hormone, important in increasing muscle size.
- **Hypertrophy** an increase in the size of muscle fibers, usually simulated by muscular overload, as occurs during strength training.
- **Atrophy** a decrease in the size of muscle fibers, usually attributable to inactivity.

# Muscle fiber

Muscle fibers are classified as slow-twitch or fast-twitch fibers according to their strength, speed of contraction, and energy source.

- **Slow-twitch fibers** are relatively fatigue resistant, but they don't contract as rapidly or strongly as fast-twitch fibers. The principal energy system that fuels slow-twitch fibers is aerobic. Slow-twitch muscle fibers are typically reddish in color. (endurance activities: jogging uses slow-twitch fibers)
- **Fast-twitch fibers** contract more rapidly and forcefully than slow-twitch fibers but fatigue more quickly. They rely more on anaerobic metabolism. They are typically whitish in color. (strength and power activities: sprinting uses fast-twitch fibers).



Most muscles contain both slow-twitch and fast-twitch fibers.

The proportion is largely fixed at birth.

# Types of fibers



Long Distance

**Type 1**

Slow twitch



400m / 800m

**Type 2A**

Fast twitch oxydative



Short Sprints

**Type 2B**

Fast twitch glycolytic

Low



High

Fatigue rate



## Motor units

To exert force, a muscle recruits one or more motor units to contract.

A motor unit is made up of a nerve connected to a number of muscle fibers (it varies from 2 to 100s).

Small motor units contain slow-twitch fibers

Large motor units contain fast-twitch fibers

Strength training improves the body's ability to recruit motor units –a phenomenon called muscle learning- which increases strength even before muscle size increases.



## Motor units

As a person ages, motor nerves can become disconnected from the portion of muscle they control.

By age 70, 15% of the motor nerves in most people are no longer connected to muscle tissue.

Aging and inactivity also cause muscles to become slower and therefore less able to perform quick, powerful movements.

Strength training helps maintain motor nerve connections and the quickness of muscles.