Different types of muscle and their structures

1.Skeletal muscle:

Skeletal muscle is muscle tissue that is attached to bones by **tendons**, which are bundles of collagen fibers. Whether you are moving your eyes or running a marathon, you are using skeletal muscles. Contractions of skeletal muscles are voluntary, or under the conscious control of the central nervous system via the somatic nervous system. Skeletal muscle tissue is the most common type of muscle tissue in the human body. By weight, an average adult male is about 42 percent skeletal muscles, and the average adult female is about 36 percent skeletal muscles. Some of the major skeletal muscles in the human body are labeled in Figures.

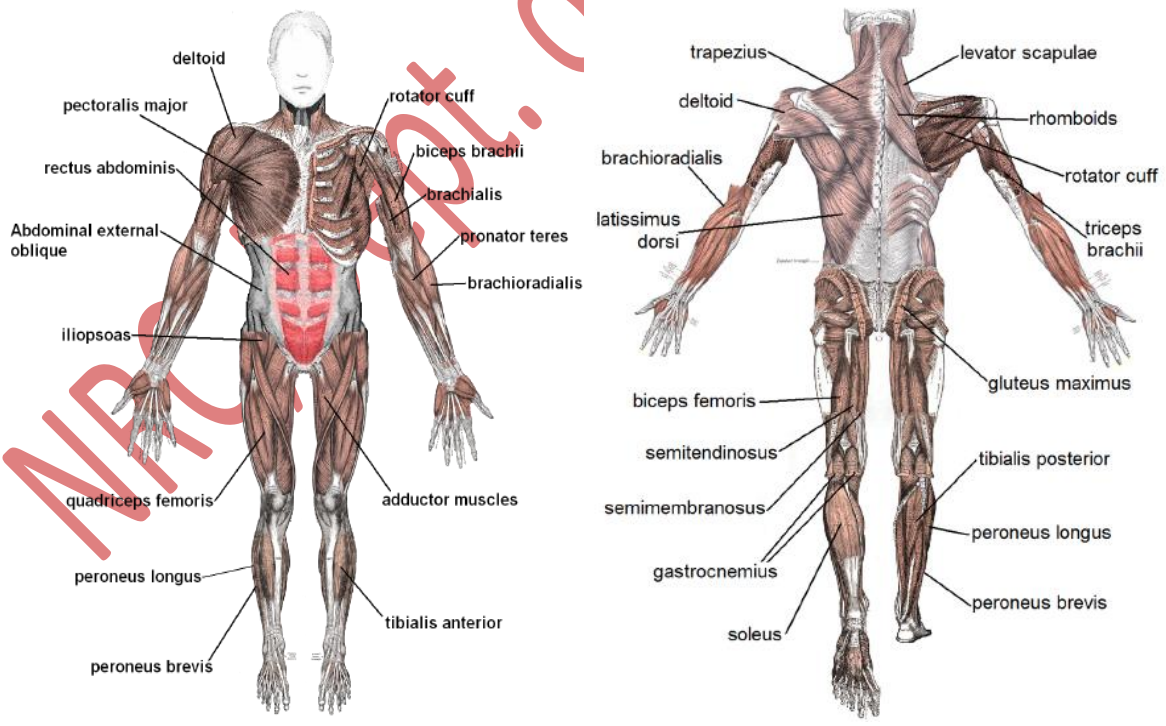

Figure 1: Major skeletal muscles in the front (anterior) of the body. (public domain; *Mikael Häggström, 2014; via wikimedia.org; Muscles anterior labeled.png*)

Figure 2: Major skeletal muscles in the back (posterior) of the body. (public domain; *Mikael Häggström, 2014; via wikimedia.org; muscles posterior labeled.png*)

♣ Skeletal Muscle Pairs:

To move bones in opposite directions, skeletal muscles often consist of muscle pairs that work in opposition to one another. For example, when the biceps muscle (on the front of the upper arm) contracts, it can cause the elbow joint to flex or bend the arm, as shown in the figure below. When the triceps muscle (on the back of the upper arm) contracts, it can cause the elbow to extend or straighten the arm. The biceps and triceps muscles are an example of a muscle pair where the muscles work in opposition to each other.

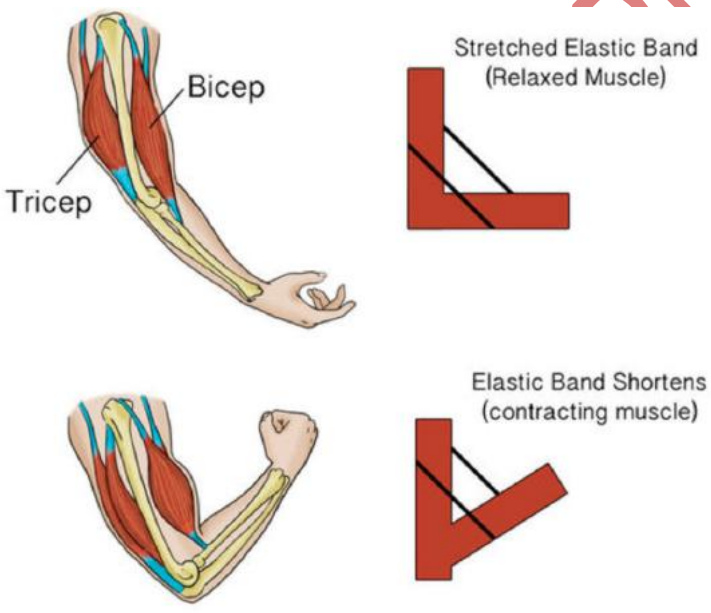

Figure 3: Triceps and biceps muscles in the upper arm are opposing muscles that move the arm at the elbow in opposite directions. (CC BY-NC 3.0; CK-12 Foundation)

♣ Skeletal Muscle Structure:

Each skeletal muscle consists of hundreds or even thousands of skeletal muscle fibers, which are long, string-like cells. As shown in the figure below,

skeletal muscle fibers are individually wrapped in connective tissue called **endomysium**. The skeletal muscle fibers are bundled together in units called **muscle fascicles**, which are surrounded by sheaths of connective tissue called **perimysium**. Each fascicle contains between ten and 100 (or even more!) skeletal muscle fibers. Fascicles, in turn, are bundled together to form individual skeletal muscles, which are wrapped in connective tissue called **epimysium**. The connective tissues in skeletal muscles have a variety of functions. They support and protect muscle fibers, allowing them to withstand the forces of contraction by distributing the forces applied to the muscle. They also provide pathways for nerves and blood vessels to reach the muscles. In addition, the epimysium anchors the muscles to tendons.

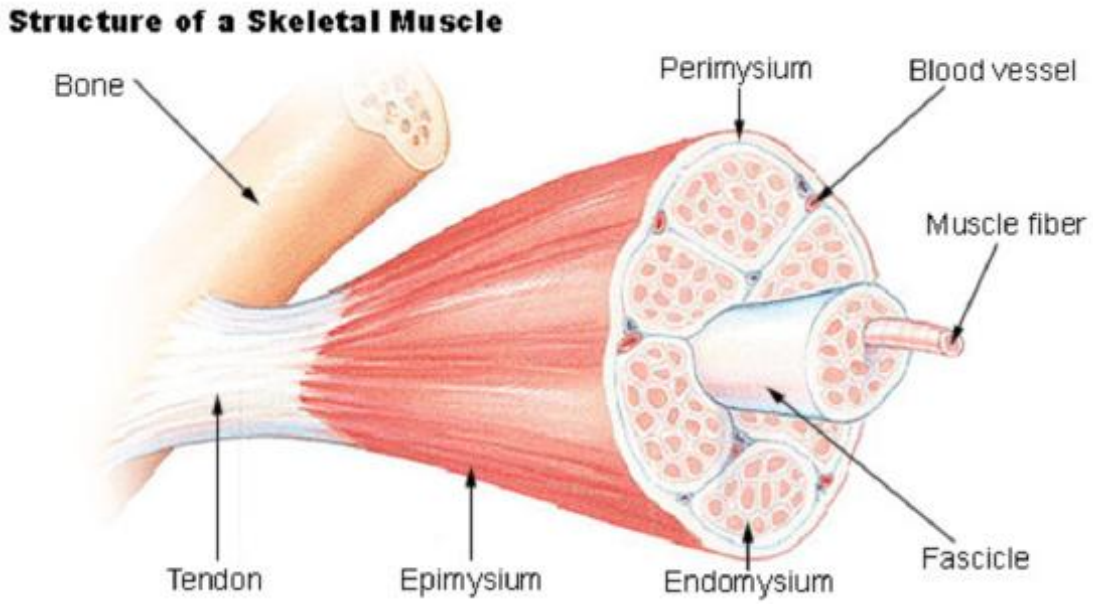

Figure 4: Each skeletal muscle has a structure of bundles within bundles. Bundles of muscle fibers make up a muscle fascicle, and bundles of fascicles make up a skeletal muscle. At each level of bundling, a connective tissue membrane surrounds the bundle. (Arcadian; public domain; *via wikimedia.org; muscle structure*)

The same bundles-within-bundles structure is replicated within each muscle fiber. As shown in the figure below, a muscle fiber consists of a bundle of myofibrils, which are themselves bundles of protein filaments. These protein

filaments consist of thin filaments of the protein **actin** which are anchored to structures called Z discs and thick filaments of the protein **myosin**. The filaments are arranged together within a myofibril in repeating units called **sarcomeres,** which run from one Z disc to the next. The sarcomere is the basic functional unit of skeletal (and cardiac) muscles. It contracts as actin and myosin filaments slide over one another. Skeletal muscle tissue is said to be striated because it appears striped. It has this appearance because of the regular, alternating A (dark) and I (light) bands of filaments arranged in sarcomeres inside the muscle fibers. Other components of a skeletal muscle fiber include multiple nuclei and mitochondria.

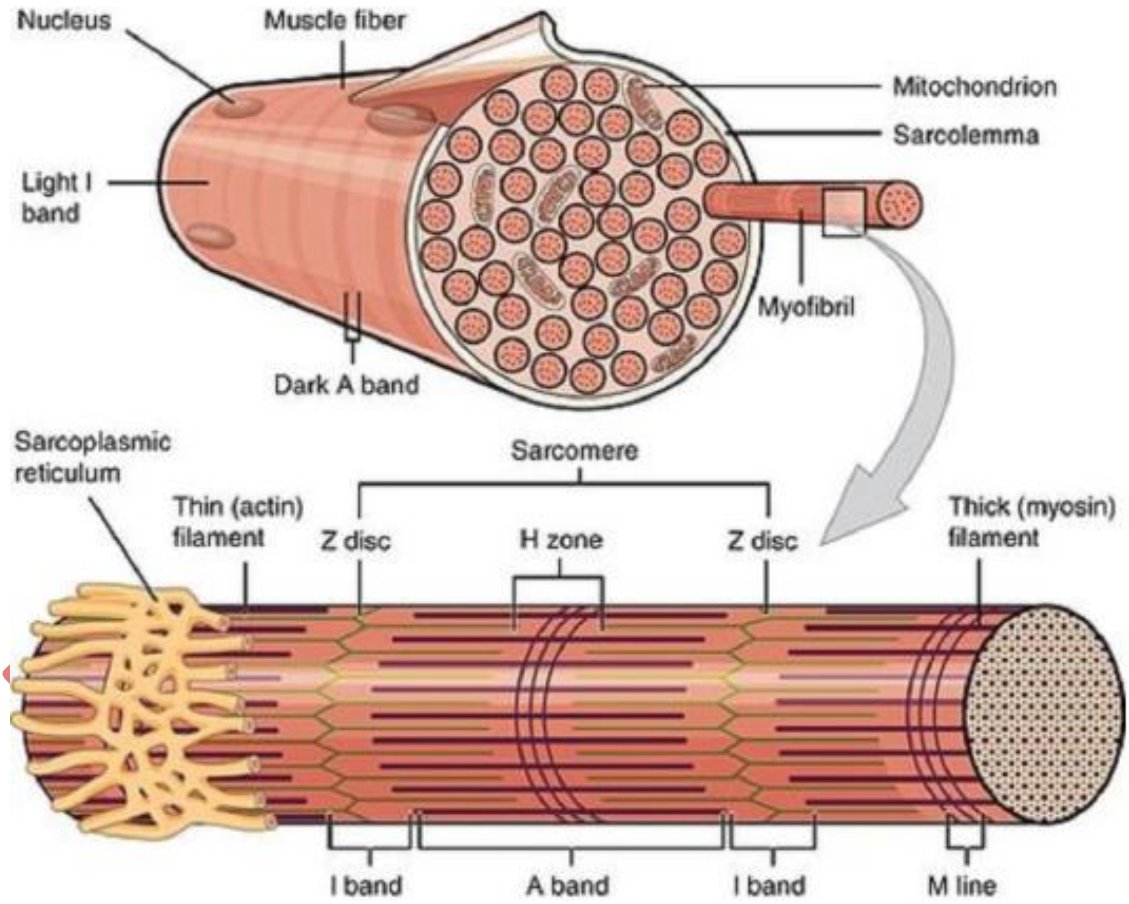

Figure 5: Bundles of protein filaments form a myofibril, and bundles of myofibrils make up a single muscle fiber. I and A bands refer to the positioning of myosin and actin fibers in a myofibril. Sarcoplasmic reticulum is a specialized type of endoplasmic reticulum that forms a network around each myofibril. It

serves as a reservoir for calcium ions, which are needed for muscle contractions. H zones and Z discs are also involved in muscle contractions, which you can read about in the concept of Muscle Contraction. (CC BY-NC 3.0; *OpenStax; via wikimedia.org; muscle fibers*)

Slow and Fast-Twitch Skeletal Muscle Fibers:

Skeletal muscle fibers can be divided into two types, called slow-twitch (or type I) muscle fibers and fast-twitch (or type II) muscle fibers.

- **Slow-twitch muscle fibers** are dense with capillaries and rich in mitochondria and myoglobin, which is a protein that stores oxygen until needed for muscle activity. Relative to fast-twitch fibers, slow-twitch fibers can carry more oxygen and sustain aerobic (oxygen-using) activity. Slow-twitch fibers can contract for long periods of time, but not with very much force. They are relied upon primarily in endurance events, such as distance running or cycling.
- **Fast-twitch muscle fibers** contain fewer capillaries and mitochondria and less myoglobin. This type of muscle fiber can contract rapidly and powerfully, but it fatigues very quickly. Fast-twitch fibers can sustain only short, anaerobic (non-oxygen-using) bursts of activity. Relative to slow-twitch fibers, fast-twitch fibers contribute more to muscle strength and have a greater potential for increasing in mass. They are relied upon primarily in short, strenuous events, such as sprinting or weight lifting.

Proportions of fiber types vary considerably from muscle to muscle and from person to person. Individuals may be genetically predisposed to have a larger percentage of one type of muscle fiber than the other. Generally, an individual who has more slow-twitch fibers is better suited for activities requiring endurance, whereas an individual who has more fast-twitch fibers is better suited for activities requiring short bursts of power.