IV- Muscle Tissue

Muscle tissue is an association of cells called muscle fibers or myocytes. These contain protein filaments of actin and myosin that slide over each other, producing a contraction that changes both the length and shape of the cell.

Muscle tissue originates from the mesoderm. There are three types of muscle: **skeletal (voluntary), cardiac, and smooth (involuntary).**

Muscles participate in various functions essential to the body's life (respiration, digestion, blood circulation, elimination, etc.) and its adaptation to the environment (locomotion).

The plasma membrane of muscle cells is called the sarcolemma, the cytoplasm is called the sarcoplasm, and the smooth endoplasmic reticulum is called the sarcoplasmic reticulum.

Muscle tissue is characterized by excitability, conduction, and contraction.

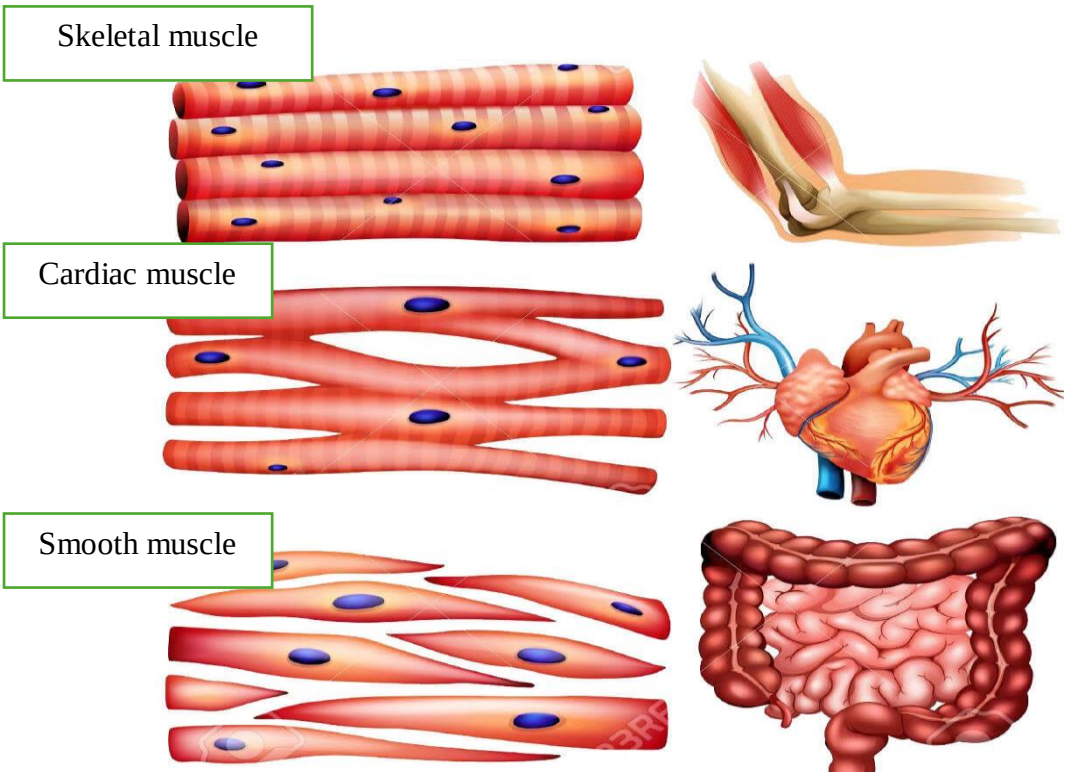

Figure : types of muscle

IV-1- Skeletal Striated Muscles

Striated muscles are composed of parallel, juxtaposed muscle cells (rhabdomyocytes) organized into bundles.

The muscle is surrounded by vascular connective tissue: the epimysium, from which connective tissue trabeculae extend to form the perimysium, which divides the muscle into bundles. Each

muscle fiber is also surrounded by connective tissue: the endomysium, originating from the perimysium.

Skeletal muscles generally attach to bones via tendons.

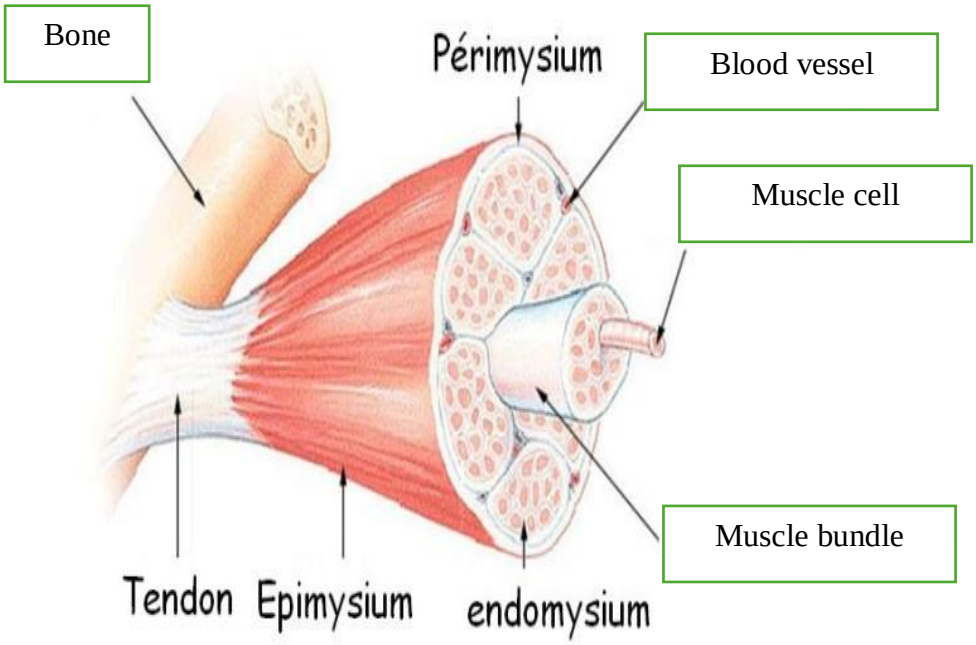

Figure : Skeletal Striated Muscles

Microscopic Description

Under a light microscope, muscle fibers appear as elongated, multinucleated elements with regular transverse striations. The nuclei are flattened and peripheral.

The fibers are described as striated, based on their appearance under a light microscope, with alternating light regions (I bands) and darker regions (A bands).

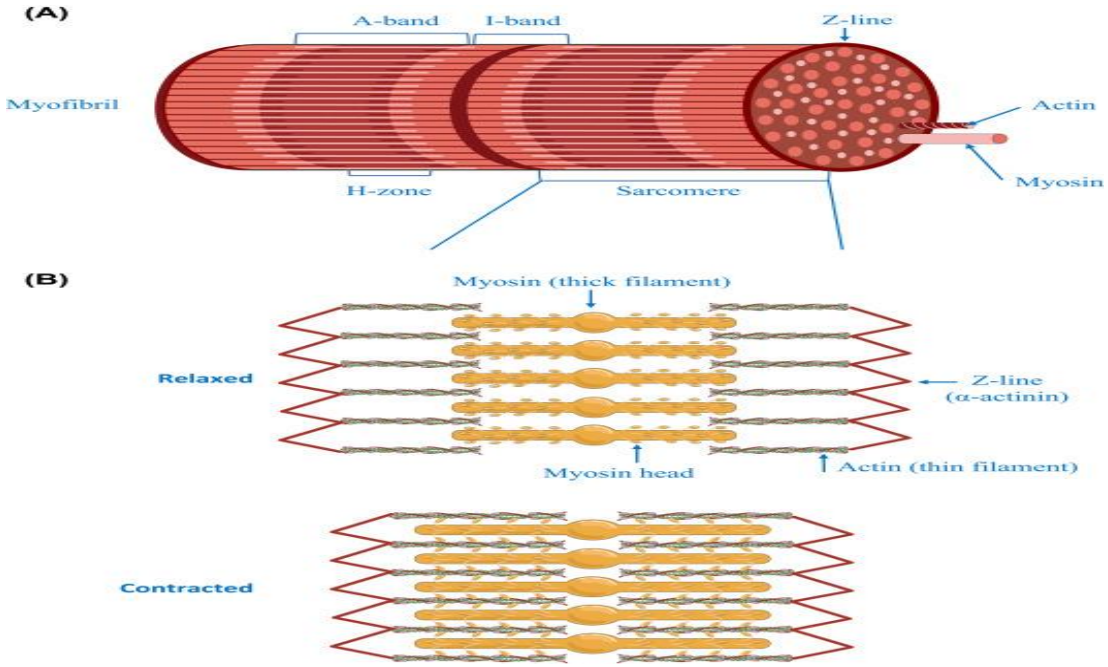

Figure: Striated muscle fiber

In electron microscopy, striation is a consequence of the axial organization of myofibrils, which form repetitive units called sarcomeres. Each sarcomere is bounded at both ends by a Z line. It comprises an A band in its central region and two I-bands on either side. Each A band has a lighter region in its central area, the H band, which itself contains, in its central portion, a narrower dark band, the M line.

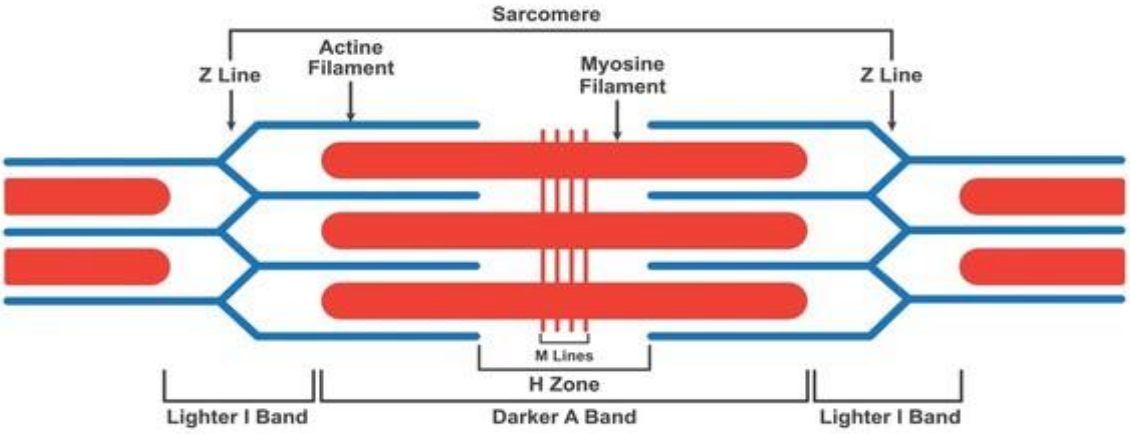

Figure : Sarcomere

Muscle cells do not divide. In case of injury, they are replaced by the division of satellite cells, inactive stem cells that are not visible under a light microscope. Under an electron microscope, they appear small and spindle-shaped, located between the basal lamina and the plasma membrane of the myocytes.

IV-2- Cardiac Striated Muscle

Cardiac muscle is a striated muscle, like skeletal muscle. It is composed of cardiac muscle cells, or cardiomyocytes.

Cardiac muscle cells are much shorter than skeletal muscle cells; they are cylindrical, mononucleated, and have a central nucleus. The cardiac fibers are anastomosed at their ends. They are coupled by gap junctions or nexuses, which facilitate the transmission of membrane excitation and synchronize muscle contraction.

In cardiac muscle, there are no stem cells analogous to the satellite cells of skeletal muscle, and therefore, muscle regeneration following injury is impossible.

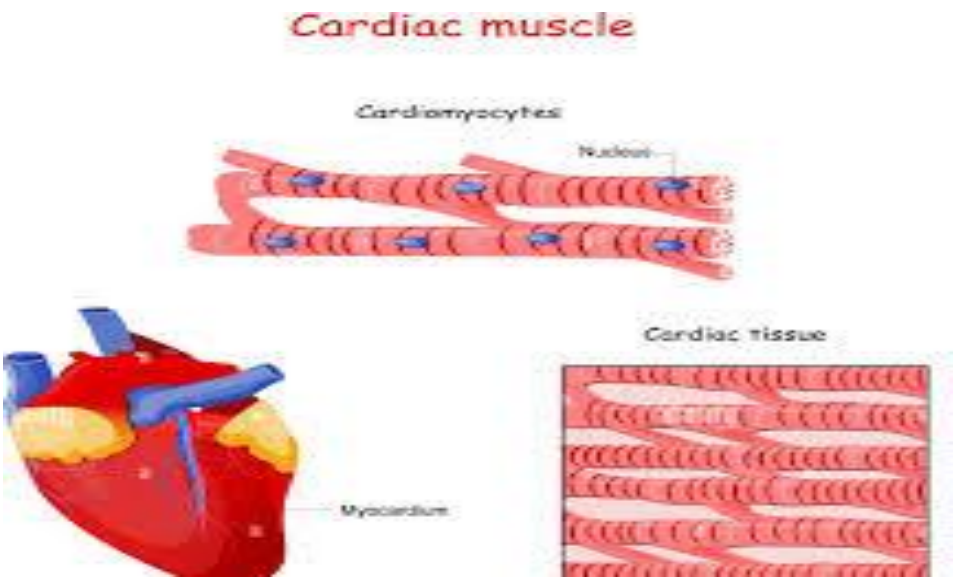

Figure : Cardiac muscle

VI-3- Smooth Muscle

Smooth muscles are present in the walls of many organs; they form dense layers that line the inner walls of blood vessels and hollow organs (blood vessels, intestines, uterus). They are associated with involuntary, autonomic functions.

Microscopic Description

Smooth muscle cells, or **leiomyocytes**, are spindle-shaped, single-nucleated cells of varying sizes (20 to 200 µm) with a centrally located nucleus. The cytoplasm has a well-defined zone

containing the cell's organelles (capping both poles of the nucleus) and another zone that occupies most of the cell and contains the myofilaments. The actin myofilaments (thin myofilaments), visible under electron microscopy, are grouped in irregular bundles.

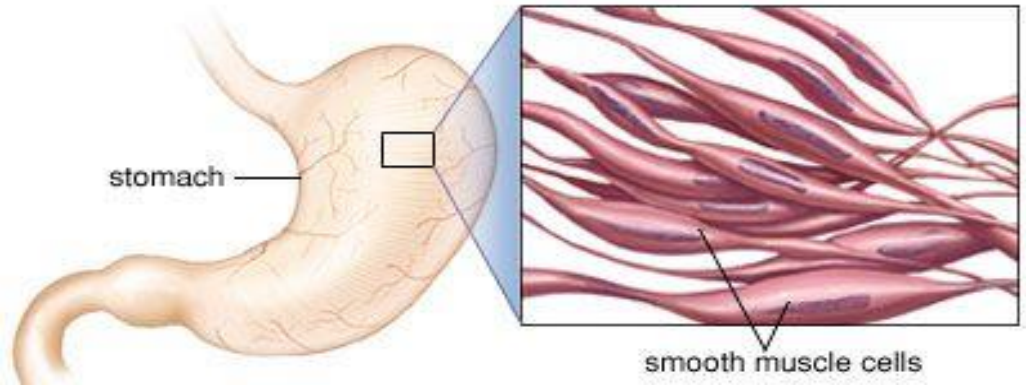

Figure : Smooth Muscle