MUSCLE TISSUE:

Three types of muscle tissue can be distinguished on the basis of morphologic and functional characteristics and the structure of each type is adapted to its physiologic role.

I-Skeletal muscle :

1-Its composed of bundles of very long, cylindrical,multinucleated cells that show cross-striations. Their contraction is quick,forceful, and usually under voluntary control.
2-It is caused by the interaction of thin actin filaments and thick myosin filaments whose molecular configuration allows them to slide upon one another. The forces necessary for sliding are generated by weak interactions in the bridges between actin and myosin.
3-Skeletal muscle consists of **muscle fibers,** Multinucleation results from the fusion of embryonic mesenchymal cells called **myoblasts**. The long oval nuclei are usually found at the periphery of the cell under the cell membrane.
4-This characteristic nuclear location is helpful in discriminating skeletal muscle from cardiac and smooth muscle, both of which have centrally located nuclei.

Skeletal Muscle Fibers:

1-As observed with the light microscope, longitudinally sectioned skeletal muscle fibers show cross-striations of alternating light and dark bands .
2-The darker bands are called **A bands** (*an*isotropic or birefringent in polarized light); the lighter bands are called **I bands** (*i*sotropic, do not alter polarized light).

Classification of Skeletal muscle fibers:
Skeletal muscle fibers of humans are classified into three types based on their physiological, biochemical, and histochemical characteristics. All three fiber types are normally found throughout most muscles.
***i)*Type I** or **slow, red oxidative fibers** contain many mitochondria and abundant **myoglobin**, a protein with iron groups that bind O2 and produce a dark red color. Red fibers derive energy primarily from aerobic oxidative phosphorylation of fatty acids and are adapted for slow, continuous contractions over prolonged periods, as required for example in the postural muscles of the back.
***ii)*Type IIa** or **fast, intermediate oxidative-glycolytic fibers** have many mitochondria and much myoglobin, but also have considerable glycogen.They utilize both oxidative metabolism and anaerobic glycolysis and are intermediate

between the other fiber types both in color and in energy metabolism. They are adapted for rapid contractions and short bursts of activity, such as those required for athletics.

iii)**Type IIb** or **fast, white glycolytic fibers** have fewer mitochondria and less myoglobin, but abundant glycogen, making them very pale in color. They depend largely on glycolysis for energy and are adapted for rapid contractions, but fatigue quickly. They are typically small muscles with a relatively large number of neuromuscular junctions, such as the muscles that move the eyes and digits.

II-Cardiac muscle:

1-They exhibit a cross-striated banding pattern comparable to that of skeletal muscle. Unlike multinucleated skeletal muscle, however, each cardiac muscle cell possesses only one or two centrally located pale-staining nuclei.Surrounding the muscle cells is a delicate sheath of endomysium containing a rich capillary network.

2-A unique and distinguishing characteristic of cardiac muscle is the presence of dark-staining transverse lines that cross the chains of cardiac cells at irregular intervals. These **intercalated discs** represent the interface between adjacent muscle cells where many junctional complexes are present .

3-Transverse regions of these steplike discs have many **desmosomes** and **fascia adherentes** (which resemble the zonula adherentes between epithelial cells) and together these serve to bind cardiac cells firmly together to prevent their pulling apart under constant contractile activity.

4-The more longitudinal portions of each disc have multiple **gap junctions**, which provide ionic continuity between adjacent cells. These act as "electrical synapses" and allow cells of cardiac muscle to act as in a multinucleated syncytium, with contraction signals passing in a wave from cell to cell.

Differentiation between atrial and ventricular muscle.

A few differences in structure exist between atrial and ventricular muscle.

a)The arrangement of myofilaments is the same in both, but atrial muscle has markedly fewer T tubules, and the cells are somewhat smaller.

b) Membrane-limited granules, are found at the poles of atrial muscle nuclei and are associated with Golgi complexes in this region .

c) These granules release the peptide hormone atrial natriuretic factor (ANF) which acts on target cells in the kidney to affect Na+ excretion and water balance.

d)The contractile cells of the heart's atria thus also serve an endocrine function.

III-Smooth muscle :

1-It is consists of collections of fusiform cells that do not show striations. Their contraction process is slow and not subject to voluntary control.
2-Smooth muscle fibers are elongated, tapering, and nonstriated cells, each of which is enclosed by a thin basal lamina and a fine network of reticular fibers. The connective tissues serve to combine the forces generated by each smooth muscle fiber into a concerted action, eg, peristalsis in the intestine.
3-Smooth muscle cells has a single nucleus located in the center of the cell's broadest part. the narrow part of one cell lies adjacent to the broad parts of neighboring cells.
4- Such an arrangement viewed in cross section shows a range of diameters, with only the largest profiles containing a nucleus . when smooth muscle contracts , the nucleus becomes distorted.