Medical Biology

COLLEGE OF DENTISTRY

COLLEGE OF DENTISTRY

UNIVERSITY OF BASRAH

Muscular Tissue

Muscle tissue:

❑The muscle tissue is a type of the four basic tissues form nearly half of the body weight, made of specialized cells able to generate motile forces through a contraction process.

❑ Most muscle cells are develops from mesoderm.

❑ On basis of their structure, location and function, the muscle tissues is found in the body in three forms:

1- skeletal muscle

2- cardiac muscle

3- smooth muscle

Functions of Muscular Tissue

1- Movement:- muscle contraction leads to different types of body movements and local organs movements. The skeletal muscle act in locomotion of the body

2- Maintain the posture of the body :- the skeletal muscle acts in bearing of the body and maintain it's stand and seat positions.

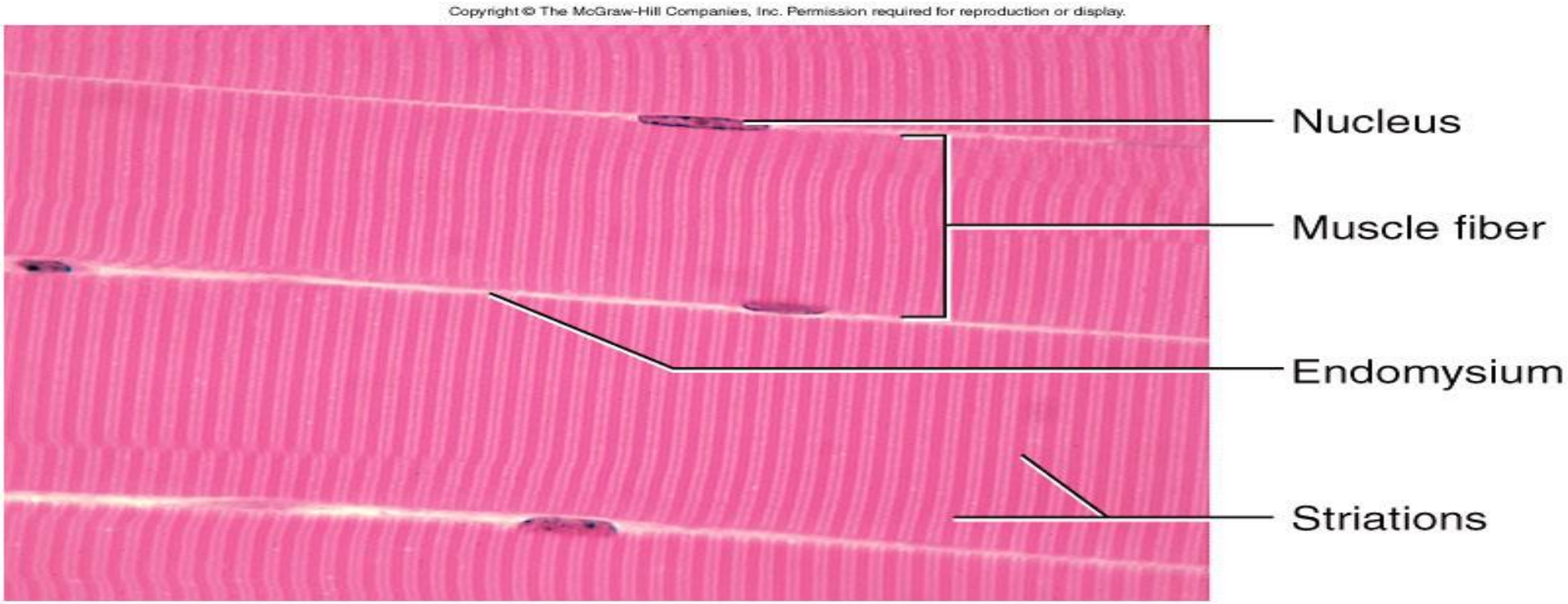
3- Heat generation :- contraction of the muscle tissue produces heat, important in maintaining the body temperature.

4- Stabilization of joints:- Even as muscles pull on bones to cause movements, they stabilize and strengthen the joints of the skeleton

5- Moving Substances Within the Body :- Heart muscle pumping blood and moving substances in the digestive tract

Structure of the skeletal muscle

The skeletal muscle is found covering the skeleton and attached to the bones, to generate a locomotion and movement of the body. Skeletal muscle consists of muscle fibers, bundles of very long (up to 30 cm) cylindrical, striated, multinucleated fibers with a diameter of 10-100 μm. Multinucleation results from the fusion of embryonic mononucleated myoblasts (muscle cell). The oval nuclei are usually found under the cell membrane (sarcolemma).

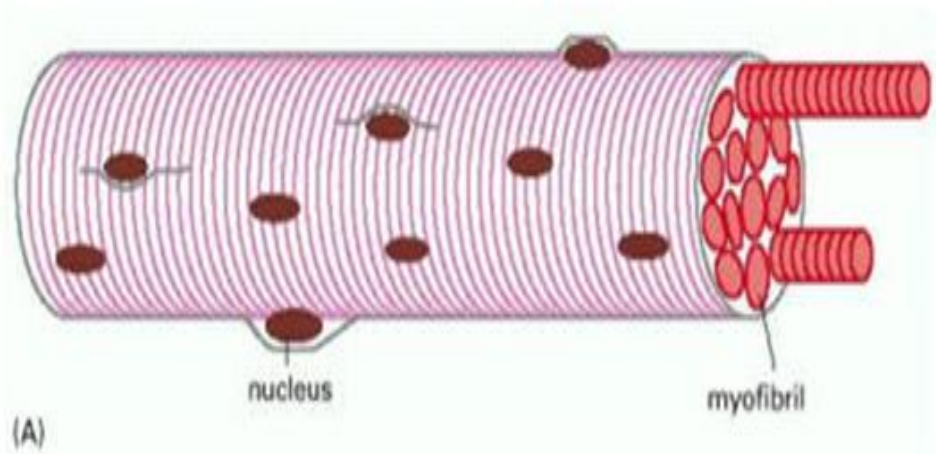


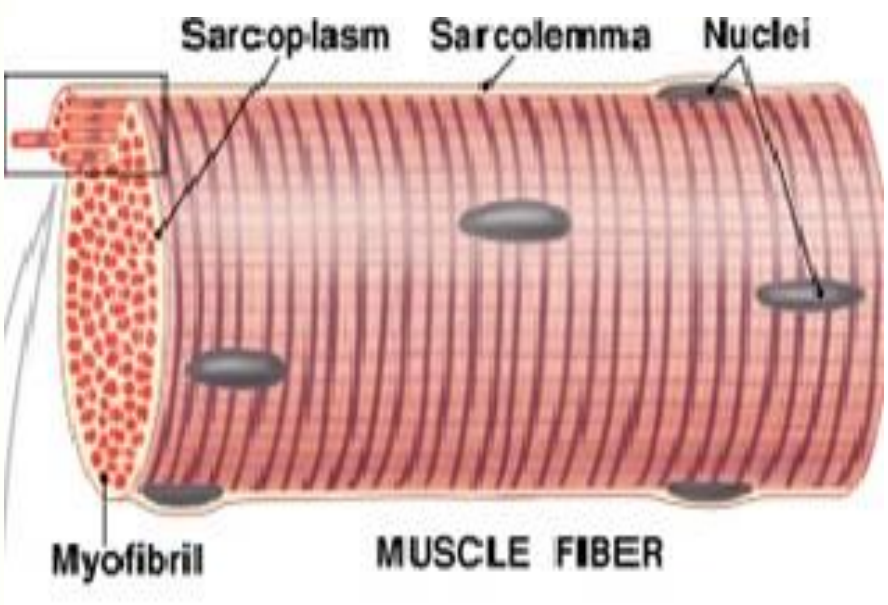
STRUCTURE OF MUSCLE FIBRES

sarcolemma (cell membrane):- surrounded the muscle fibers

sarcoplasm (cytoplasm) contains mitochondria, sarcoplasmic reticulum, Golgi body and others, but it is lacking of centrioles thus it can't go in cell division.

Myofibrils:- Each muscle fiber contains a large number of rodlike myofibrils that run parallel to its length, hundreds to thousands of myofibrils are in a single muscle fiber, depending on its size. The myofibrils contain the contractile elements of skeletal muscle cells(Striations, Sarcomeres, and Myofilaments).



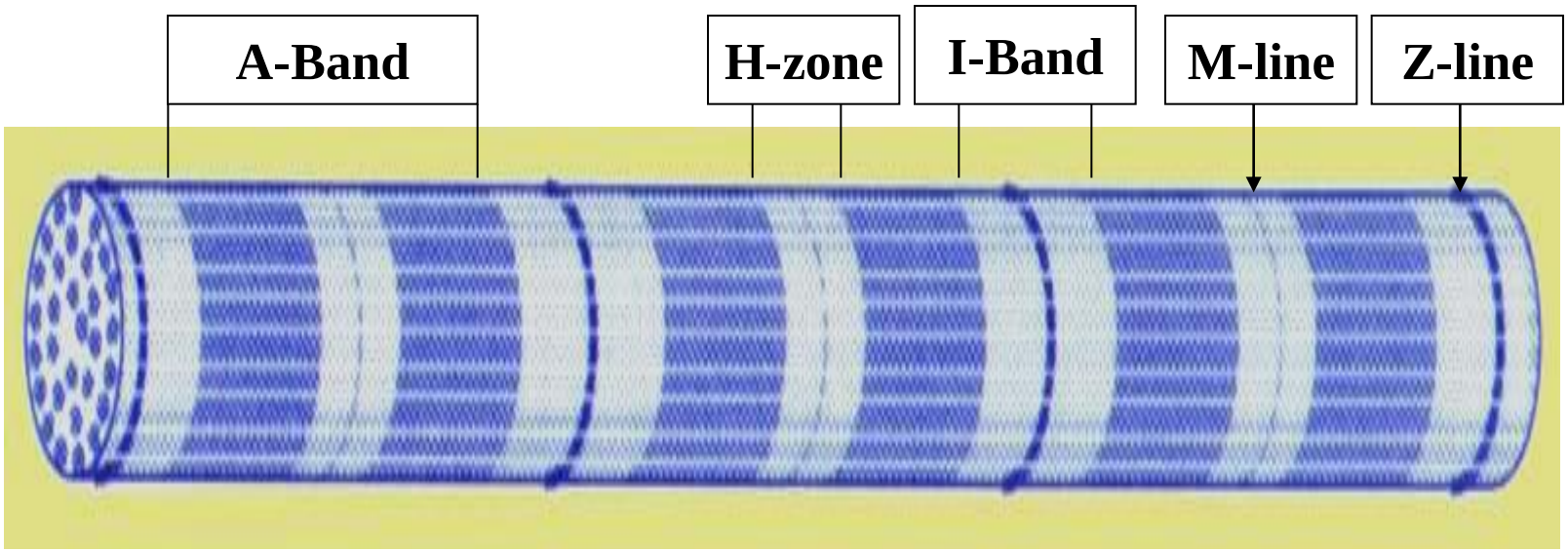


Striation :-

A relaxed muscle fiber shows a distinct striations, reflecting alternate light and dark bands of its myofibrils.

The dark bands are called A (anisotropic). In the center of this band a light area , called the H zone (hell = bright), consists of a dark line called M–line (Mid-line), supply enzymes necessary for muscle contraction.

The light bands are called I bands (isotropic). A dark transverse line, called the Z line (Zwichen = in between).

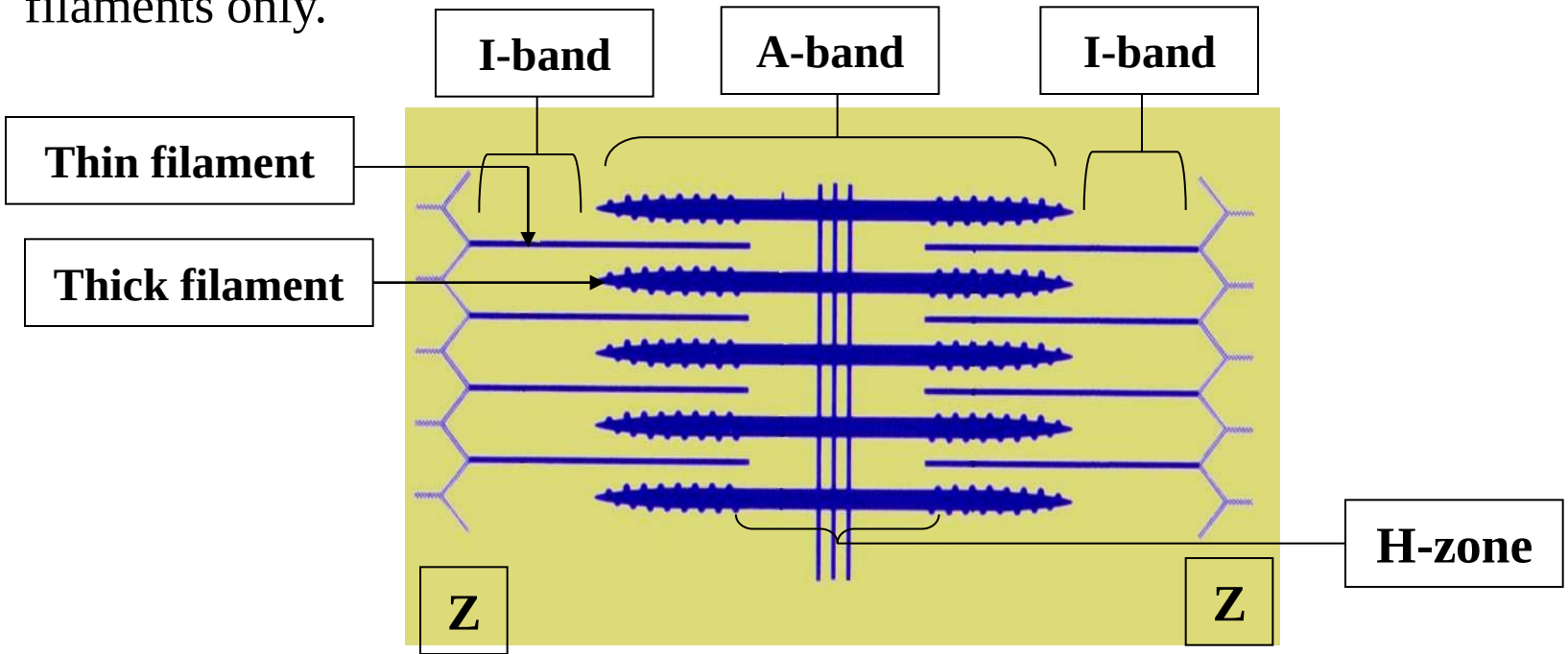


Sarcomeres

The basic units of contraction in striated muscles. A single sarcomere extends from one Z line to the next. The sarcomere is consisting of thick and thin filaments.

The thick filaments are found occupy the central portion of the sarcomere, along the entire length of the A-band. The thin filaments are attached to the Z-lines on one end, extend across the I-band and run parallel between the thick filaments into the A-band.

The A-bands consist of thick filaments, and a portion of overlapped thick and thin filaments. The I-band are consisting thin filaments only. The H-zone has thick filaments only.

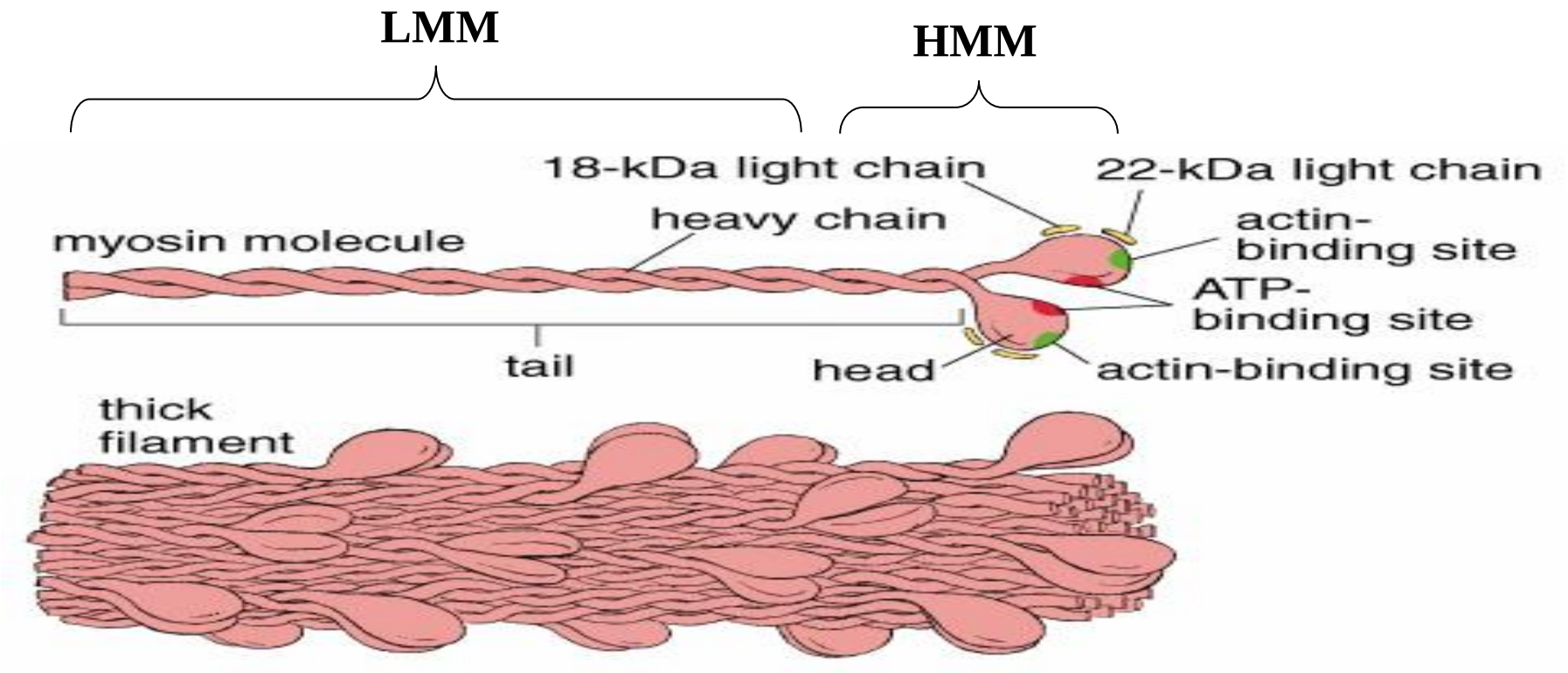


Molecular composition of the thick filaments:

Each thick filament is composed of about 200 myosin molecules, Each myosin molecule has a rodlike tail terminating in two globular heads. The tail consists of two interwoven heavy polypeptide chains.

the heads contain actin binding sites, ATP binding sites and ATPase enzymes that split ATP to generate energy for muscle contraction.

The head and third of the tail form a heavy meromyosin (HMM) protein, while the rest, the two thirds of the tail, is the light meromyosin (LMM) protein.



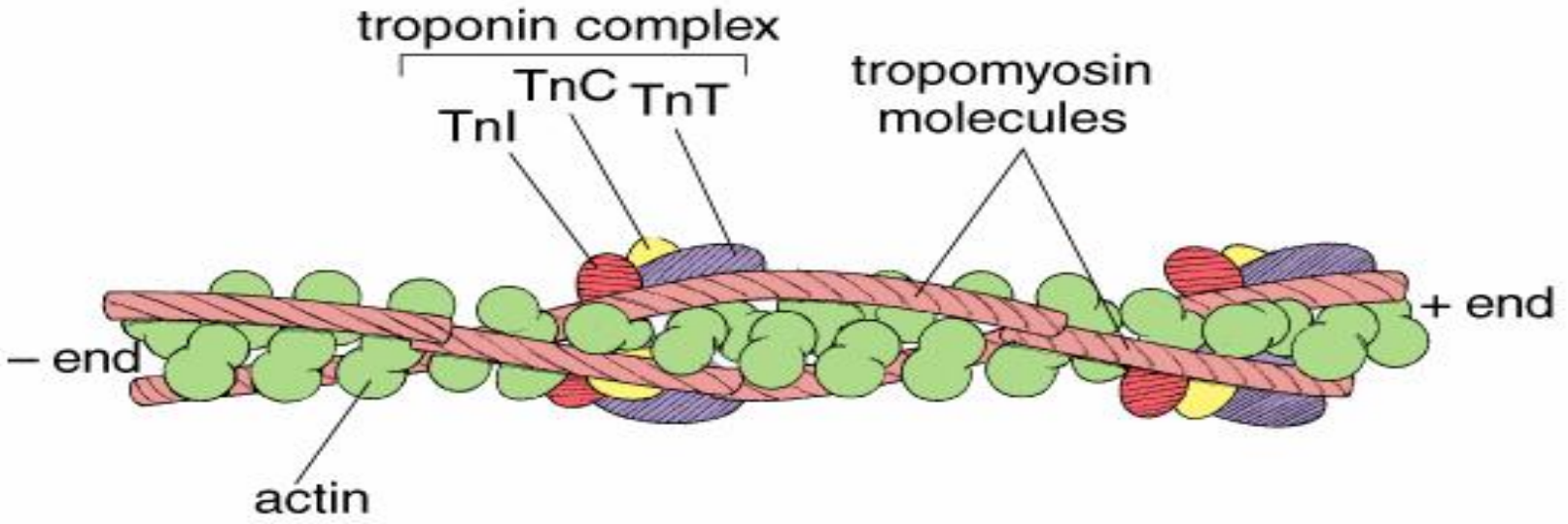
Molecular Composition of the thin filaments:

The thin filaments are composed of three types of proteins :-

1- Actin :- is the backbone of the thin filaments, consists of two strand of filamentous F-actin protein molecules. Each strand is of a polymerized globular, G-actin molecules.

2- Tropomyosin :- a rod-shaped protein, found attached to the F-actin covering the active sites of the actin molecules in a resting state, so that the myosin heads cannot bind to the thin filaments.

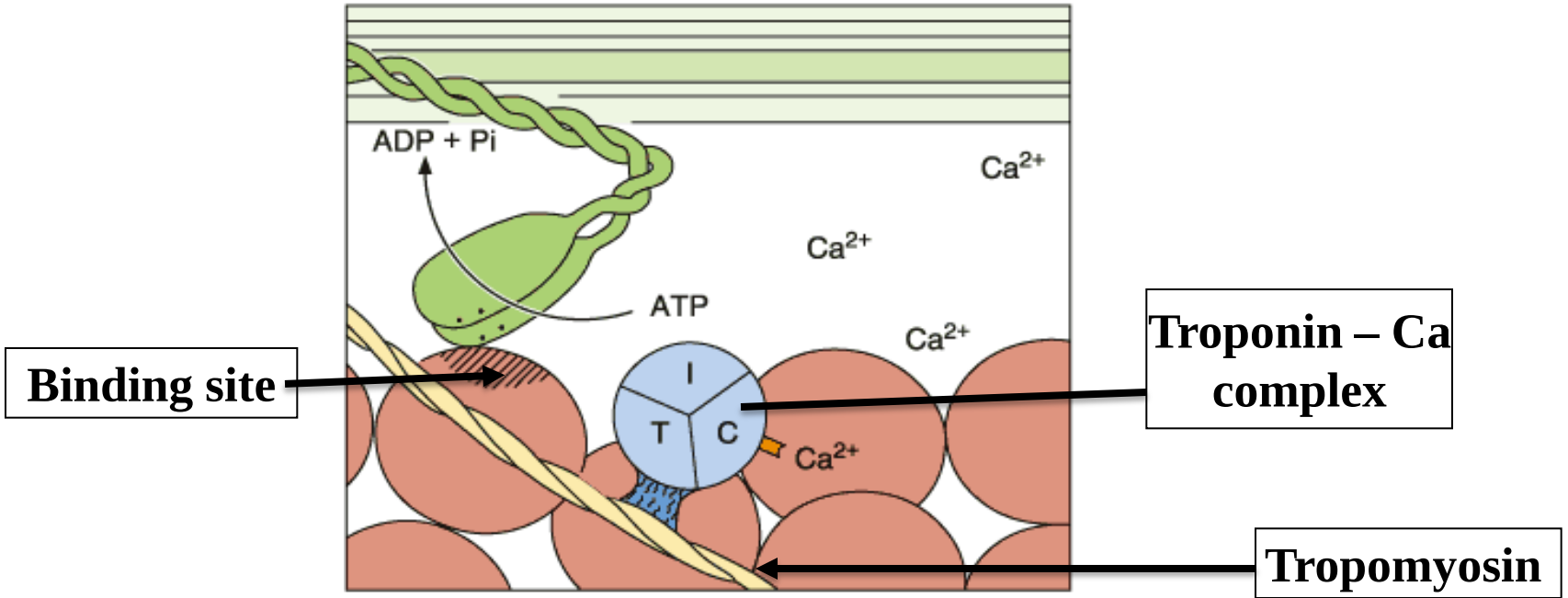
3- Troponin :- is a three-polypeptide complex. One of these polypeptides (TnI) is an inhibits actin-myosin interaction; another (TnT) binds to tropomyosin , The third (TnC) binds calcium ions. Both troponin and tropomyosin help control the myosin-actin interactions involved in contraction.



The contraction mechanism:

The muscle contraction process is initiated by binding of the calcium ions Ca^{+2} released from the surrounding sarcoplasmic reticulum (sER) to react with the TnC subunit of the troponin molecules and form a complex. This complex acts in insertion the tropomyosin strands between the actin molecules and expose the binding sites.

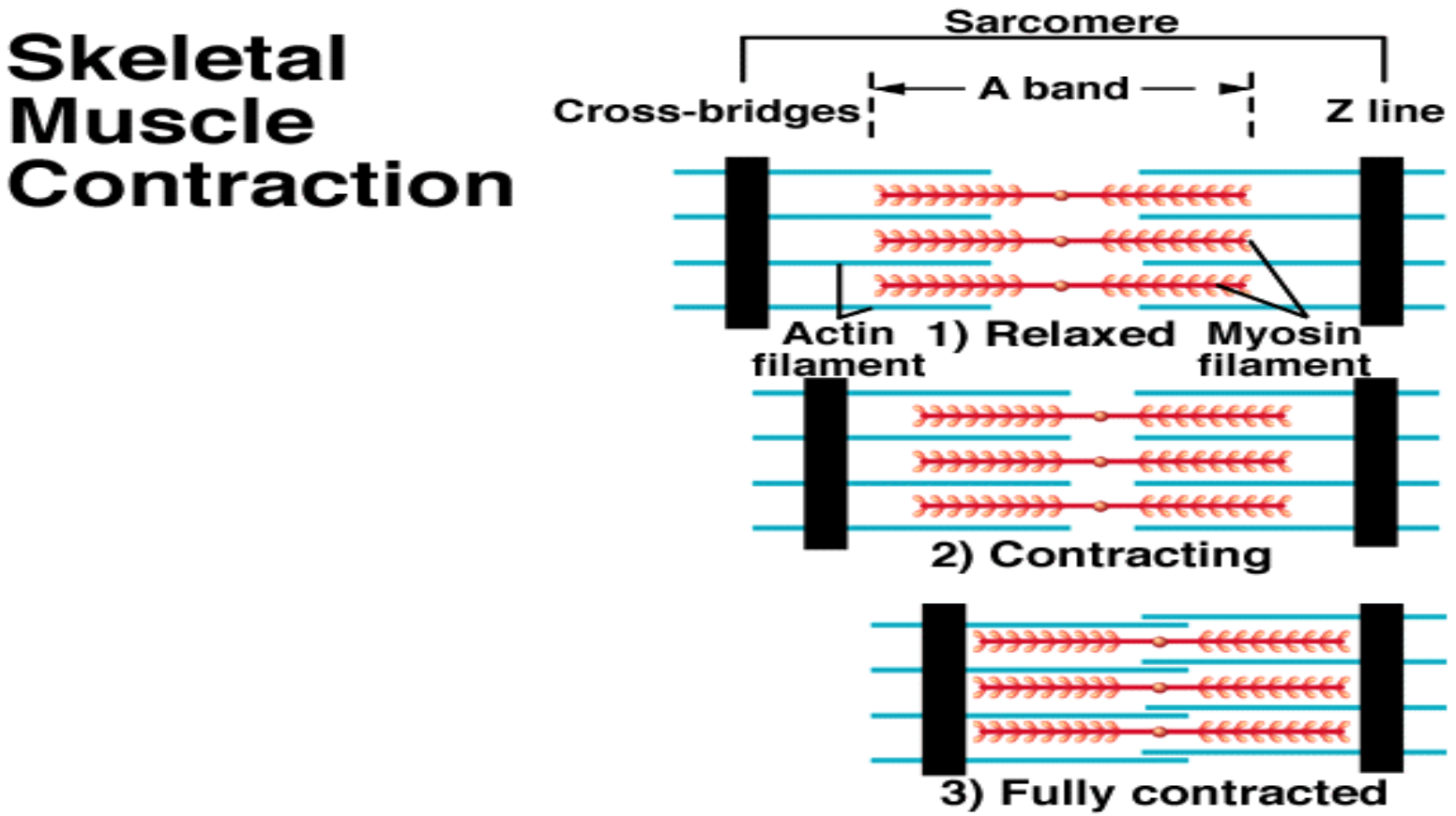
Movement of the cross bridge (heads of the myosin molecule) to actin molecules to produce energy used for insertion of the thin filaments in between the thick filaments leads to shorting of the sarcomere and then contraction of the muscle fibrils, muscle fibers and the muscle organ.



The sliding filament hypothesis:

The thick & thin filaments (myosin & actin) slide past one another; the z lines move closer together, shortening the sarcomere , when sarcomere shortens a skeletal muscle contracts

During contraction, the I-bands decrease in length as the thin filaments are inserted between the thick filaments in the A-band , the H-zone gradually being narrow and then disappear in a fully contracted fiber.



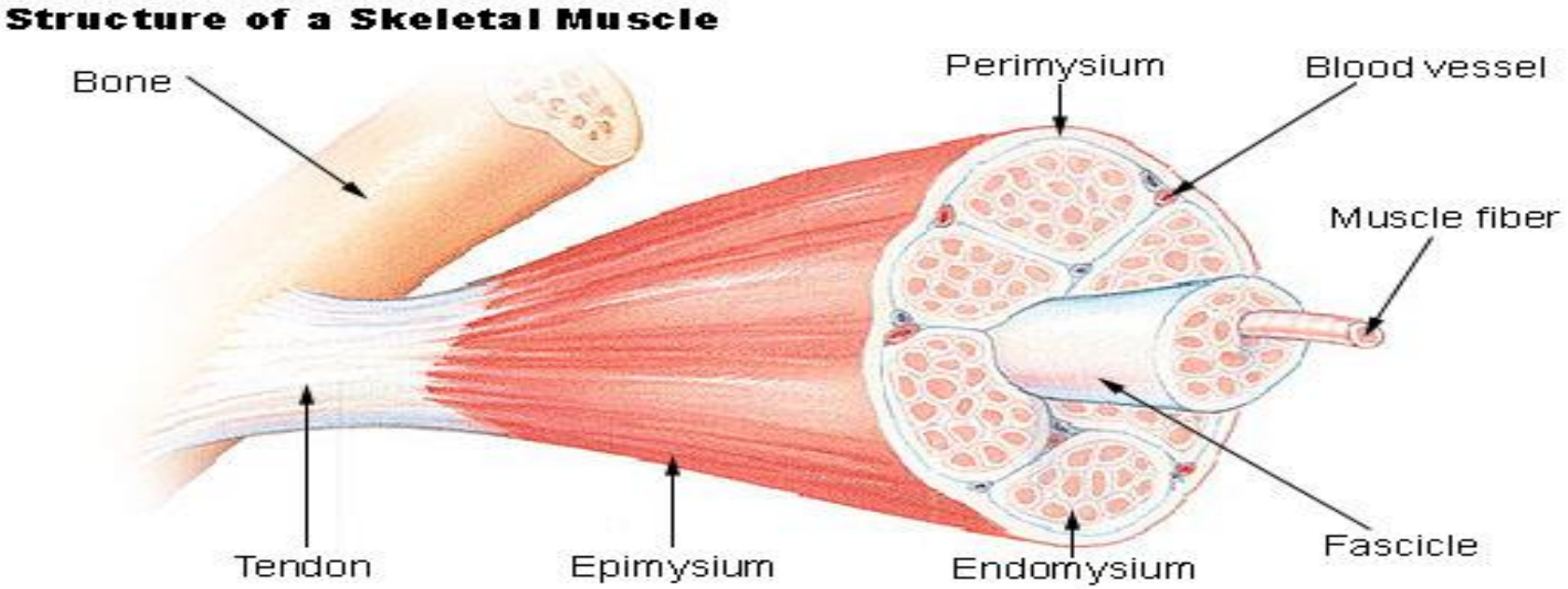
CONNECTIVE TISSUE Sheaths

1- **Epimysium** – layer of dense irregular connective tissue that surrounds the whole muscle

2- **Perimysium** – this layer extends inward from the epimysium & separates the muscle tissue into small sections called fascicles (bundles of skeletal muscle fibers in each fascicles)

3- **endomysium** – the sheath of reticular connective tissue surrounding each skeletal muscle fiber

❖The connective tissue play important role in supply nutrients to the muscle fibers, Transmit forces generated by contraction of muscle fibers and Connect muscle tissue to other adjacent tissues such as tendons and ligament



2- cardiac muscle

The cardiac muscle forms the wall of the heart and the first part of the blood vessels which come out from the heart, its contraction pump the blood to the whole body. This type of muscle tissue is characterize by:

1-Presence of long, branching and anastomosing fibers.

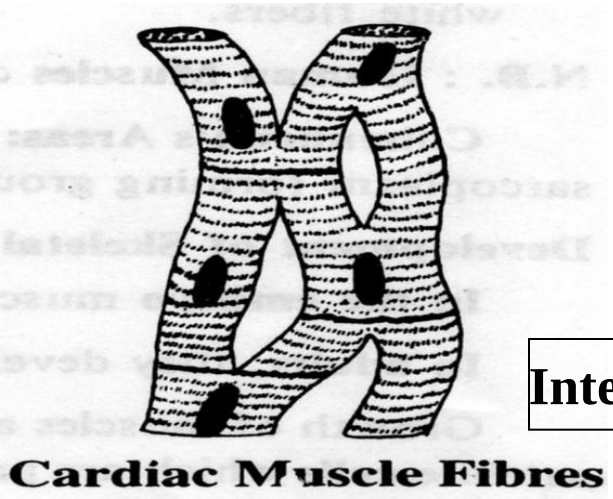
2- Each fiber consists of one or two centrally located nuclei.

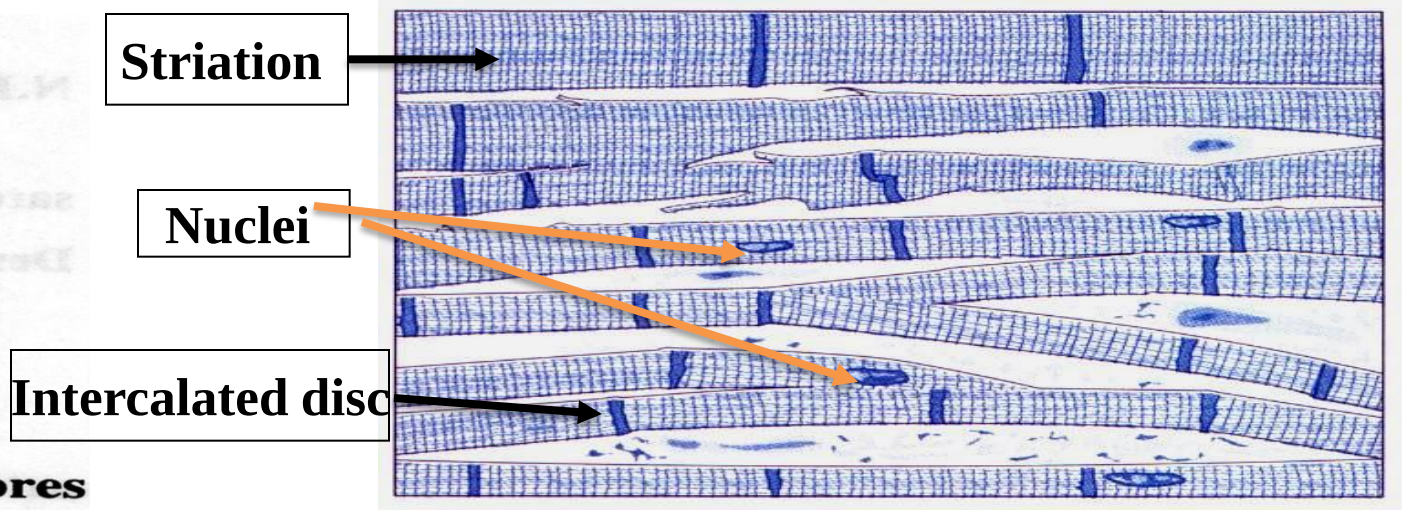
3- Cardiac muscle cells contain numerous mitochondria, which occupy 40% or more of the cytoplasmic volume , to supply energy requires for continuous muscle contraction.

4- The striations are less distinguished than in the skeletal muscles.

5- Presence of intercalated discs, dark lines used for attachment of the fibers.

6- The fibers contract spontaneously even they are under the control of autonomic nervous system.


Cardiac Muscle Fibres



3- Smooth muscle

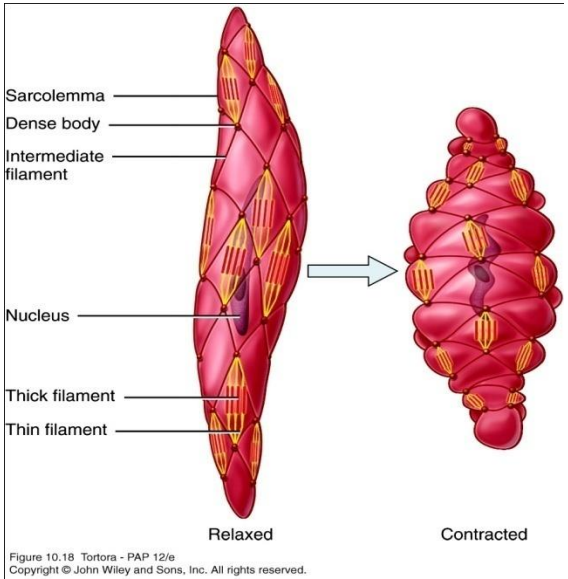
The smooth muscle are non striated forming the wall of various hollow organs and tubes, such as stomach, intestinal tract, urinary bladder, and others..

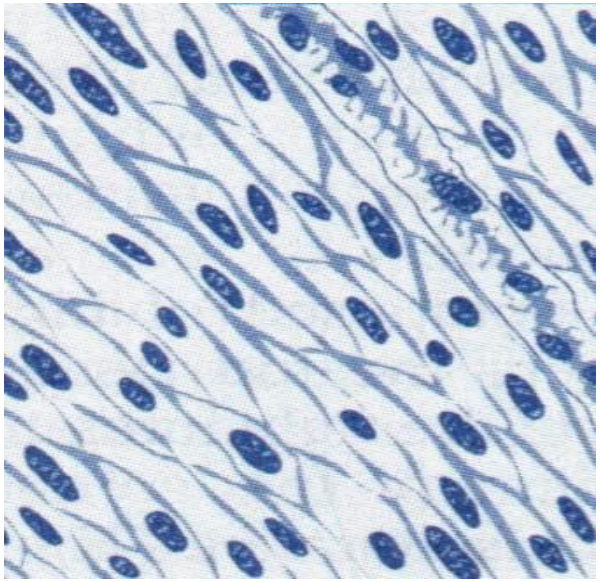
This type of muscle tissue is characterize by:

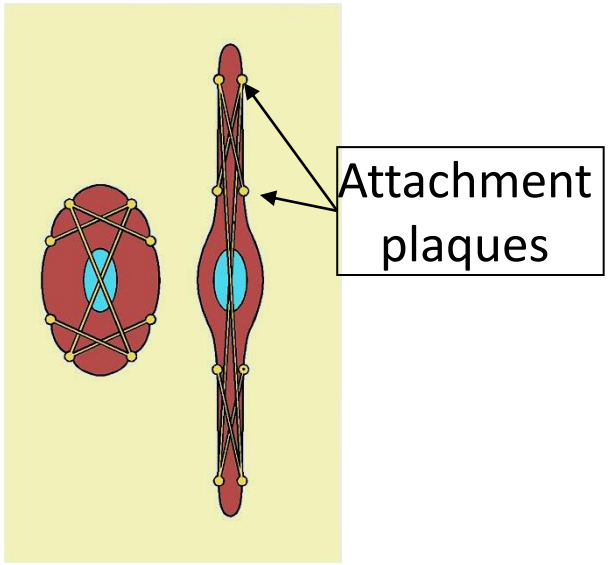
1- The smooth muscle cells are spindle in shape with single ovoid, centrally located nuclei, situated in the wider area of the cell.

2- Three types of filaments are present in the cytoplasm of smooth muscle fibers : thick and thin filaments, An intermediate filaments are also found attached to dense bodies on the inner surface of the sarcolemma, serve as attachment plaque, which are functionally similar to the Z lines in skeletal muscle fibers.

3- Contraction of smooth muscle changes the size and shape of the organs to do their functions








Thank you