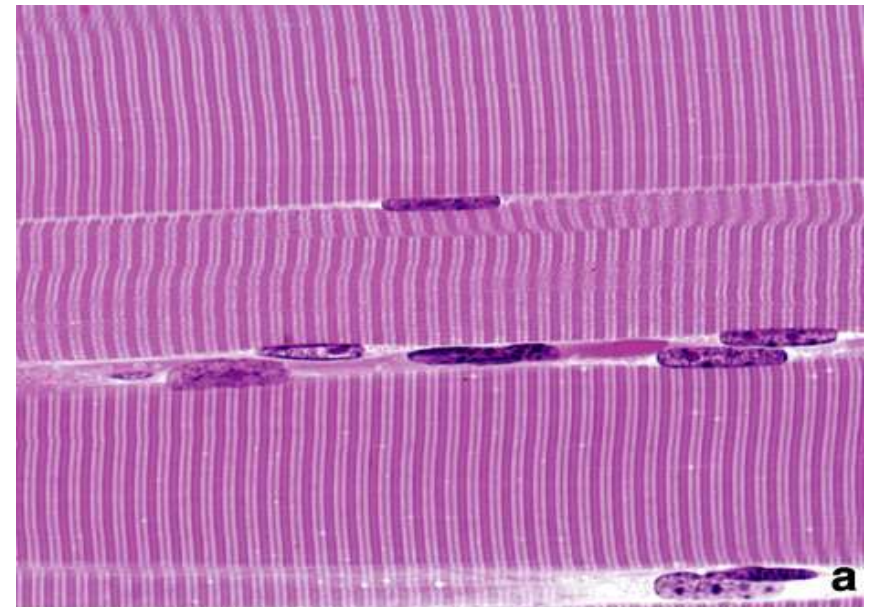
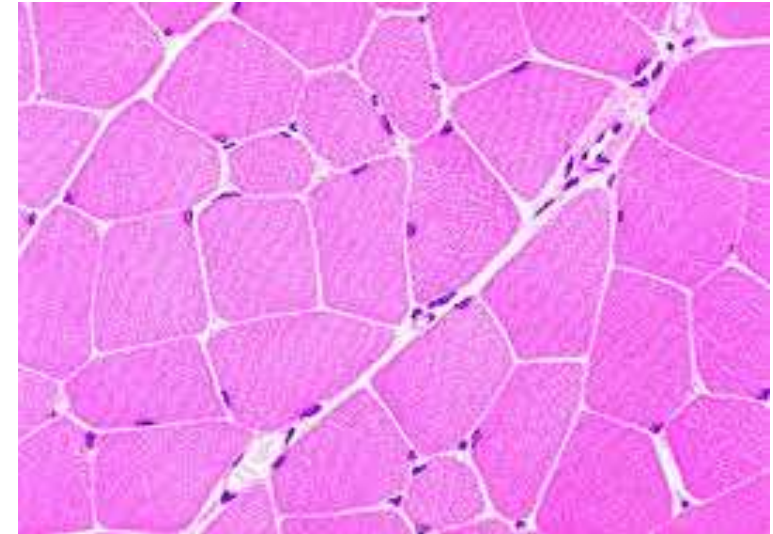


Muscular Tissue

- **Composed of different cells containing the contractile fibers**
- **Most of the muscle cells are **mesodermal** in origin**
- **Three** types of muscle fibers can be distinguished according to morphological and functional differences

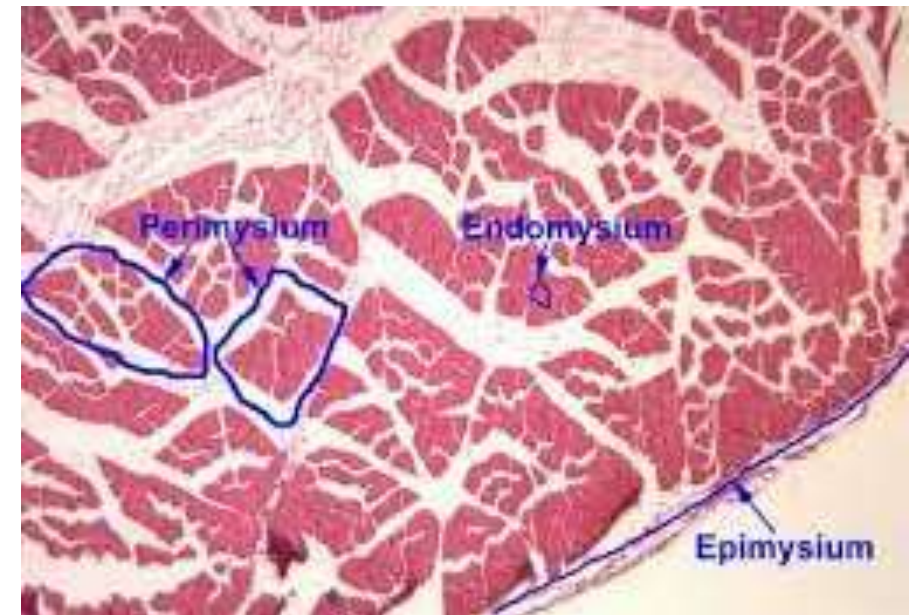
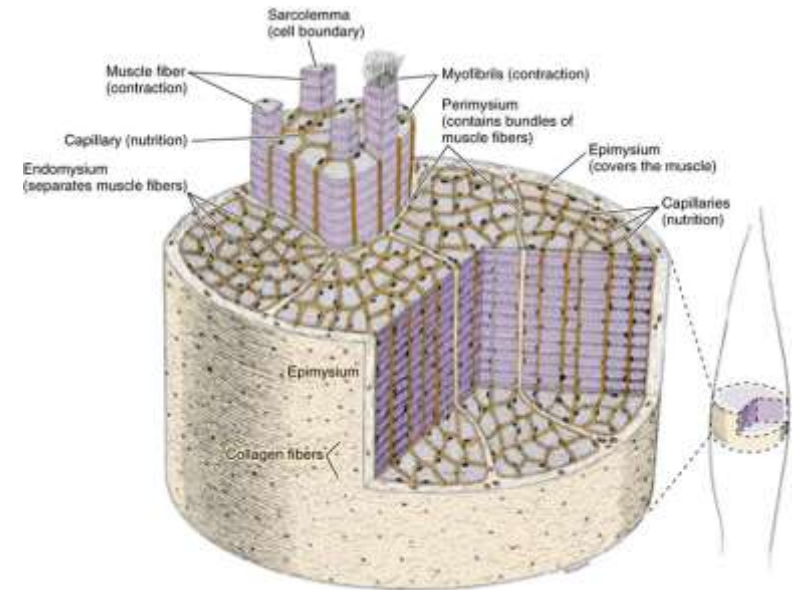
Skeletal Muscle

- Long thin multinucleated fibers
- 10-100 μm in diameter and may reach 70 cm in length
- Peripheral flat nuclei
- Red in color due to myoglobin
- They are striated and attached to bone
- Sarcoplasmic reticulum, sarcolemma, sarcoplasm
- **Hypertrophy** and **hyperplasia**



Organization of Skeletal Muscle

- Epimysium
- Perimysium
- Endomysium
- Connective tissue serves in:
 - Transmits the force generated by individual fibers
 - Blood and lymphatic vessels run in the connective tissue



Organization of Skeletal Fiber

- In a sarcomere, identify the following:

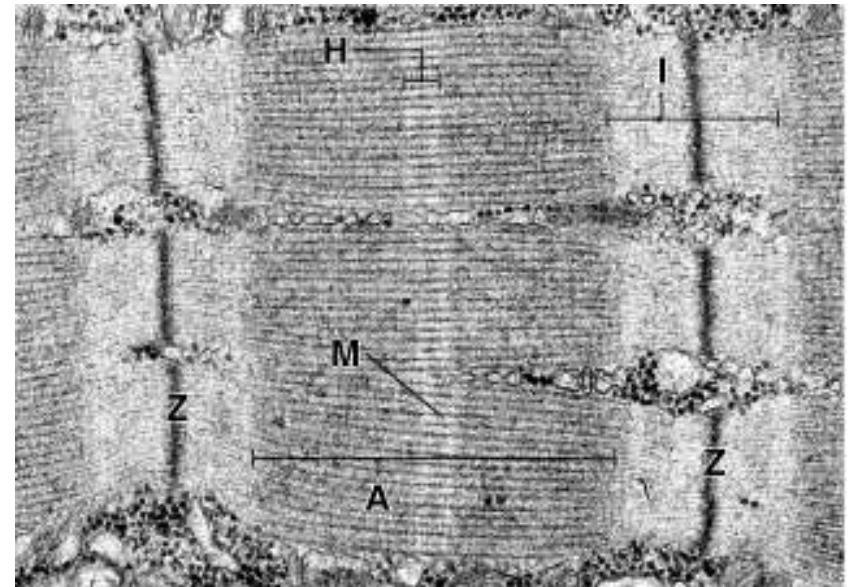
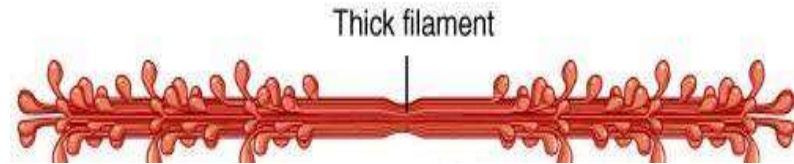
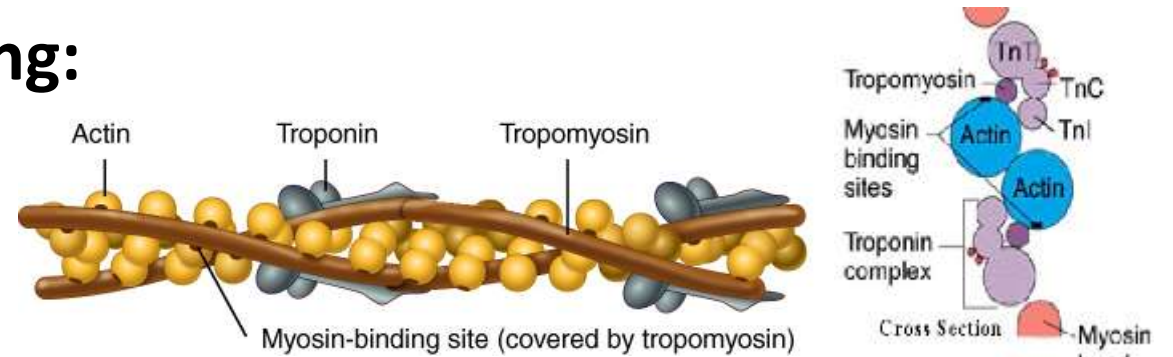
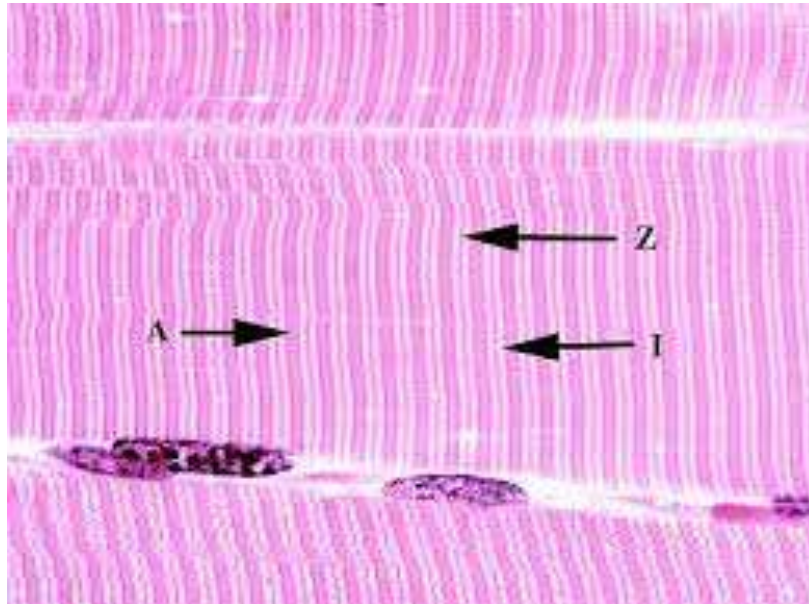
A-band and myosin filaments

I-band and actin filaments and **titin**

Z line and **α actinin**

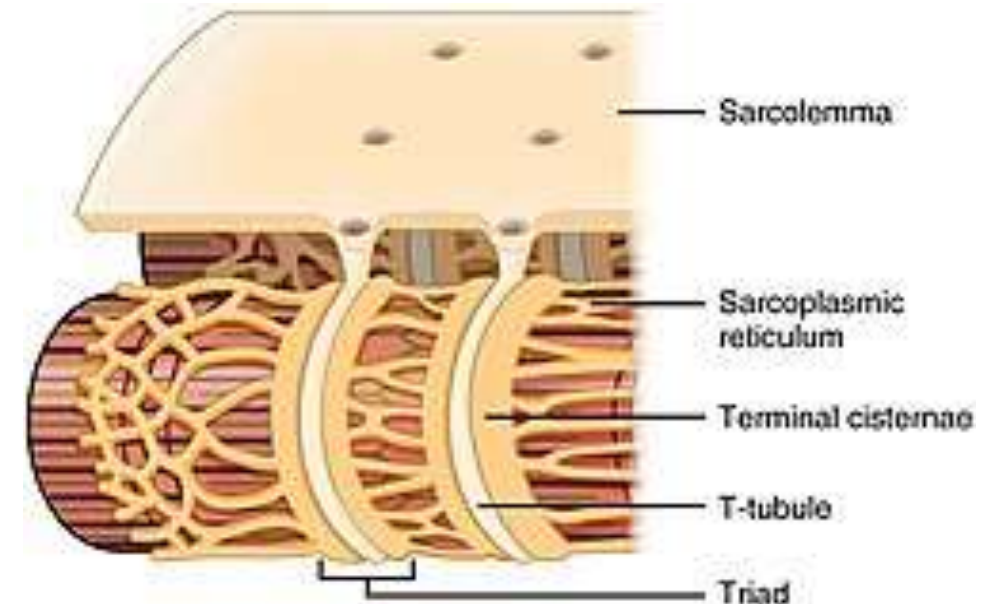
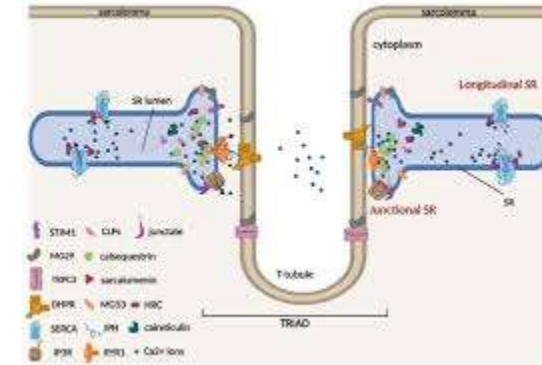
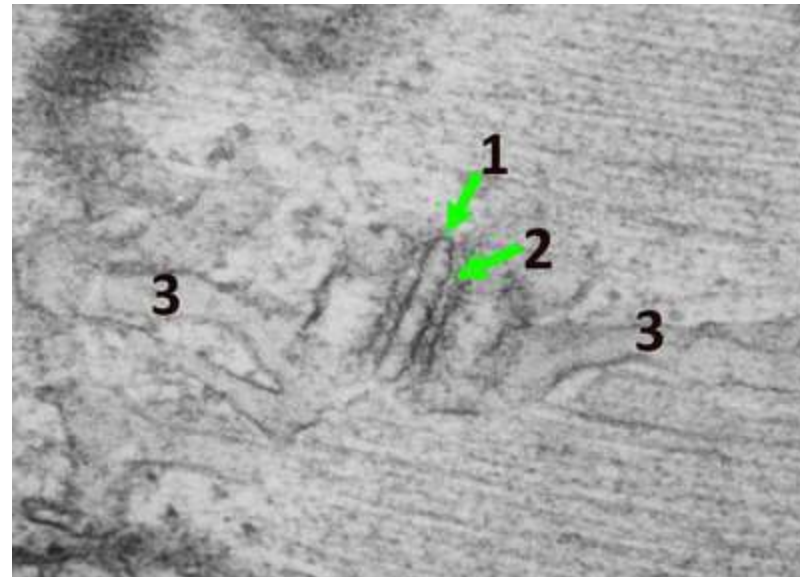
M line and creatine kinase and myomesin

H band



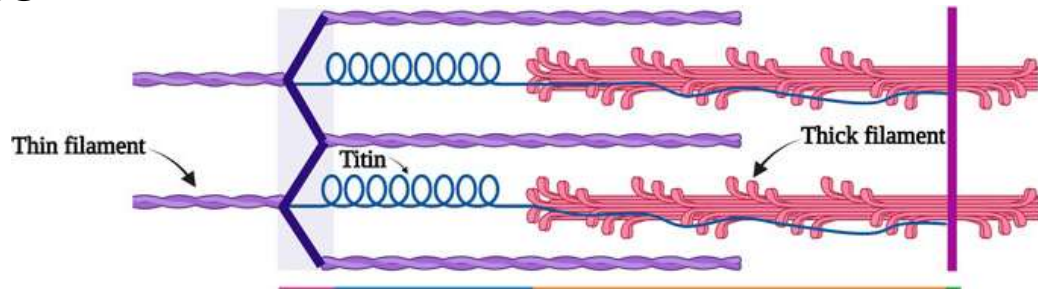
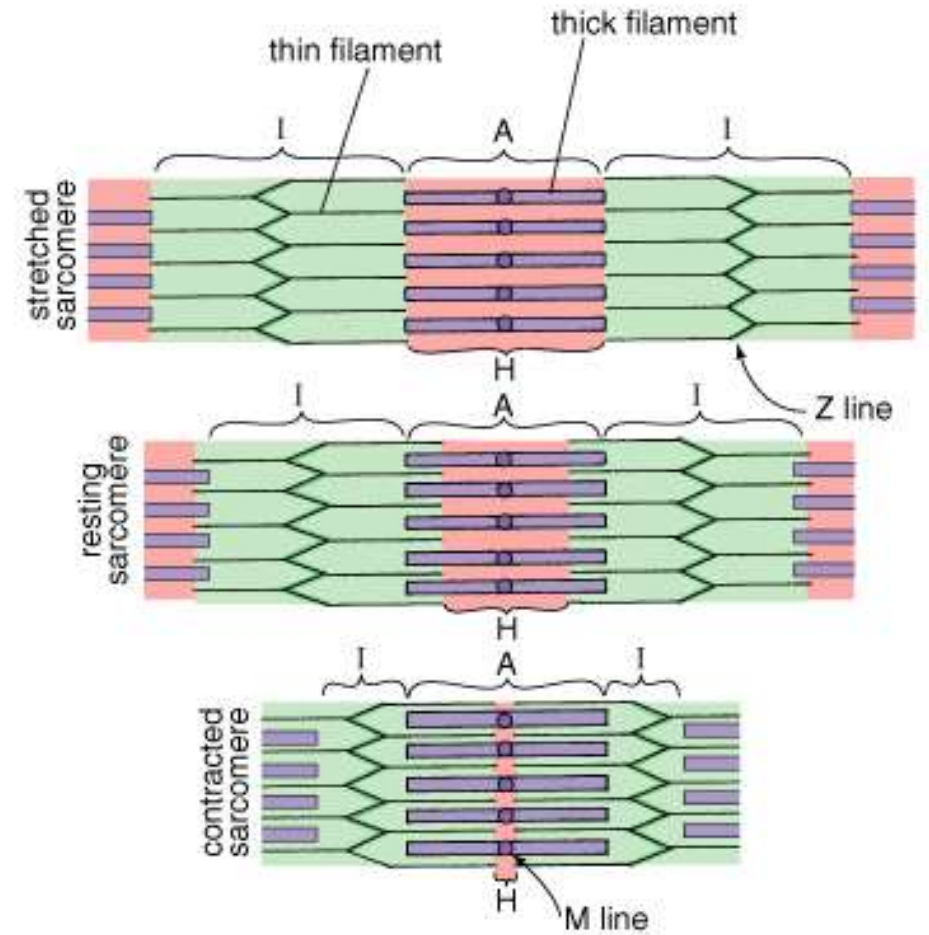
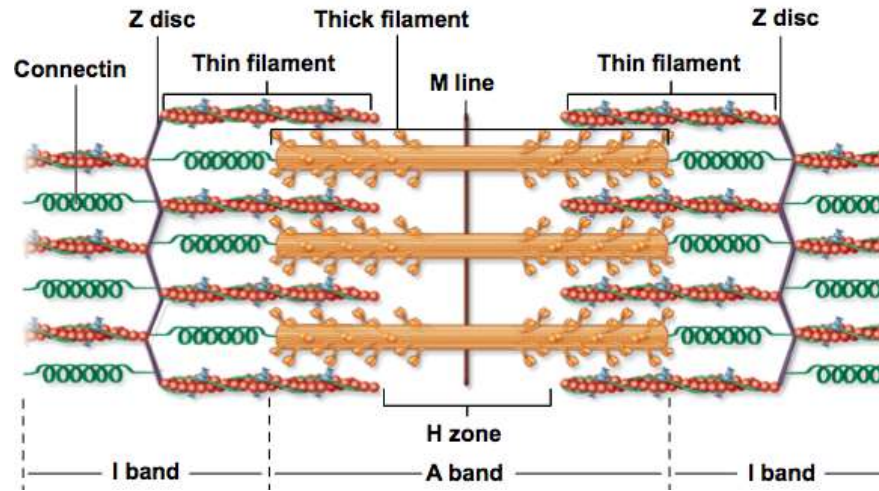
Sarcoplasmic Reticulum

- Depolarization at the myoneural junction leads to the release of Ca^{2+}
- Transverse (T) tubules: invagination of sarcolemma at the level of A-I bands
- Triade: T-tubule with dilated cisternae of sarcoplasmic reticulum at the sides of T-Tubule
- Rigor Mortis



Contraction of Skeletal Muscle

- A-band
- I-band
- Z lines
- H-band
- M-line
- Z-lines



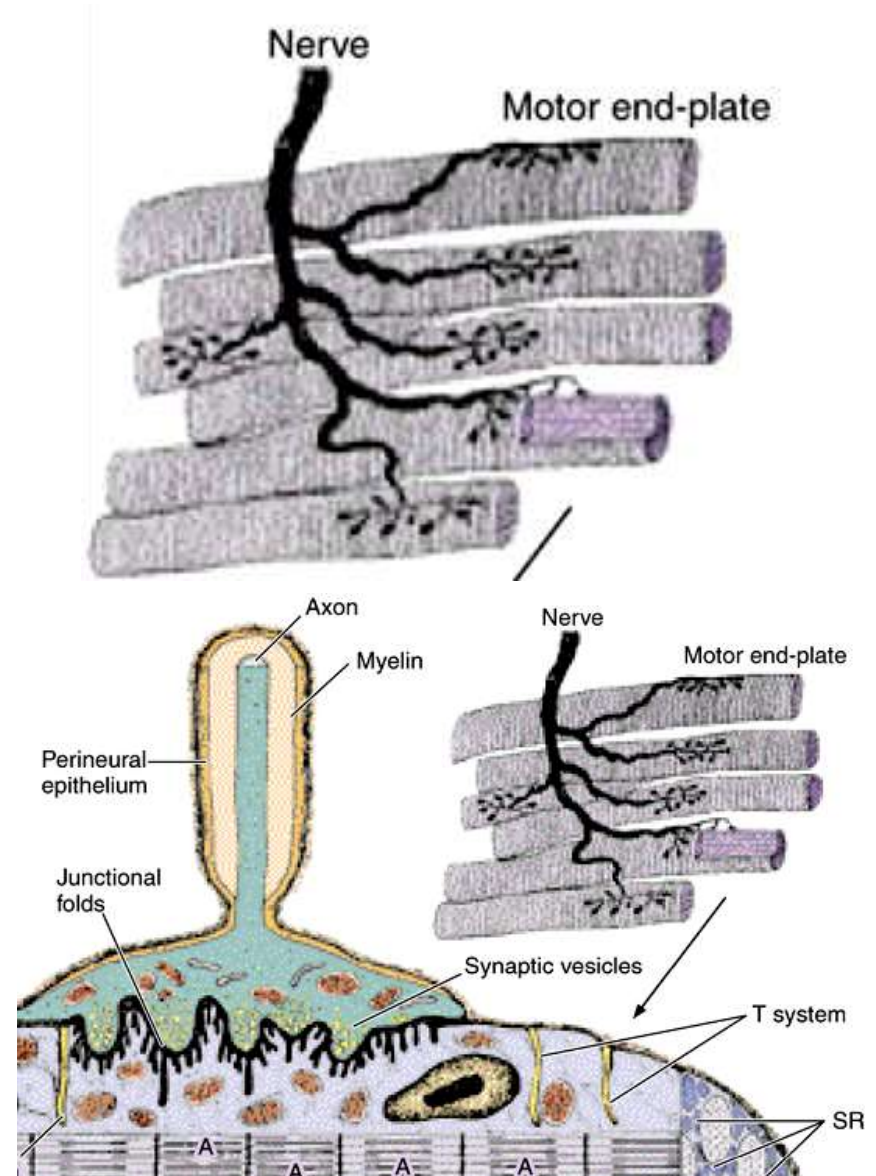
Innervation

Myoneural Junction

Structure

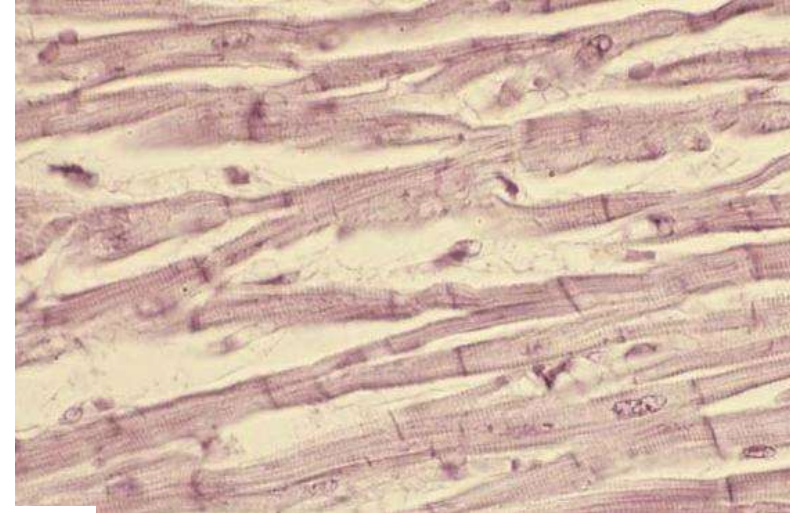
Motor Unit

Myasthenia gravis



Cardiac Muscle Fiber

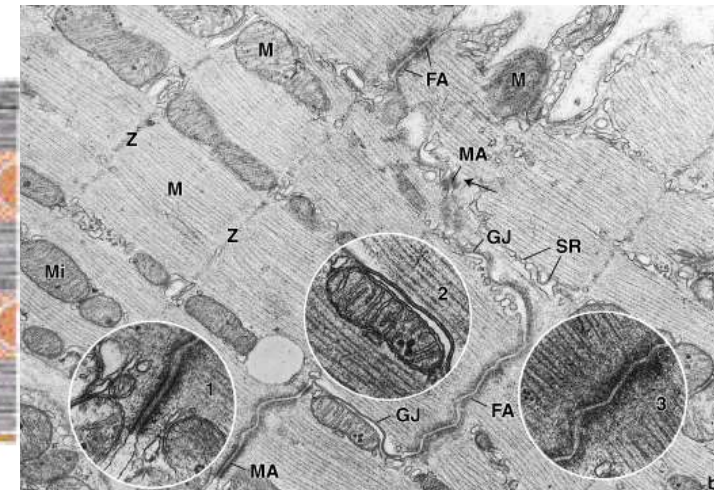
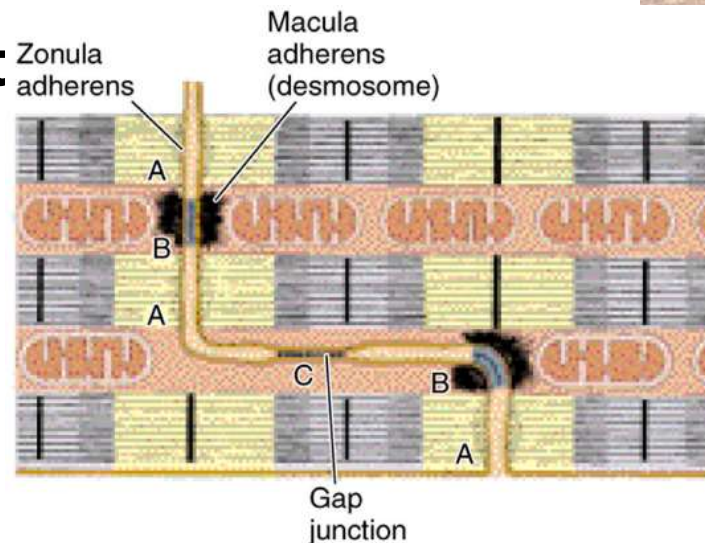
- Striated with a central round nucleus
- They are 10x100 μm
- Short branching fibers
- Endomysium surrounds each muscle fiber
- Intercalated discs



Fascia adherens (Act

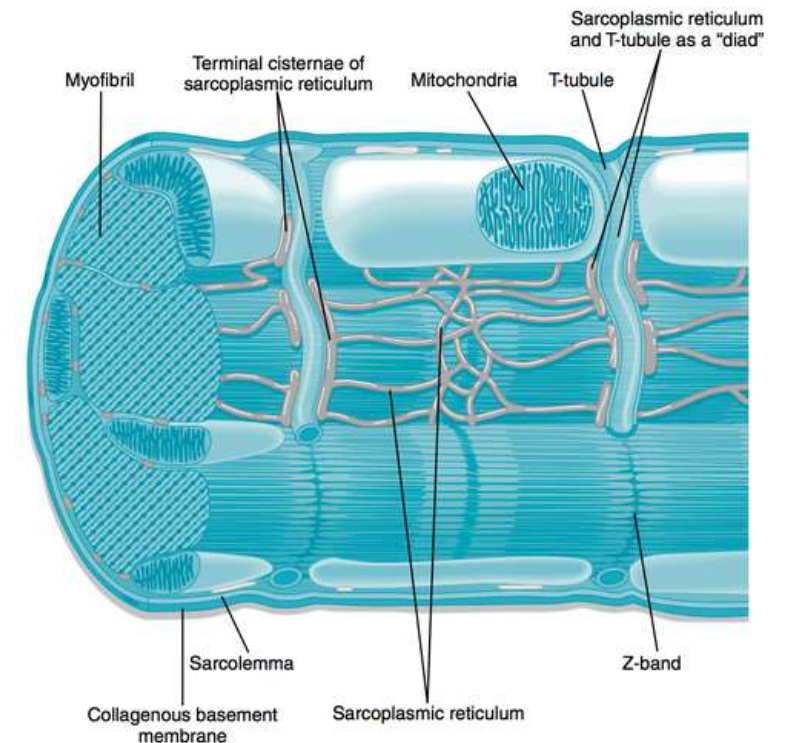
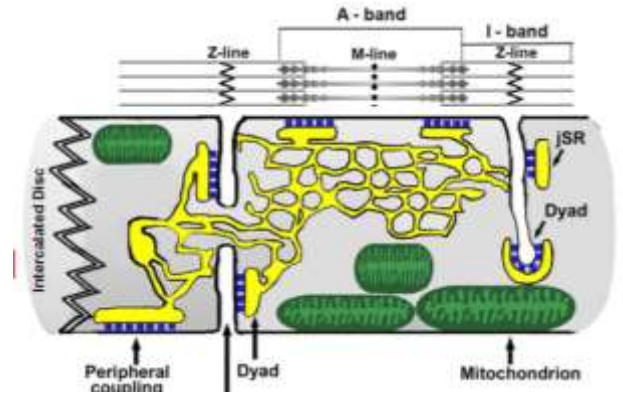
Macula adheres

Gap junction



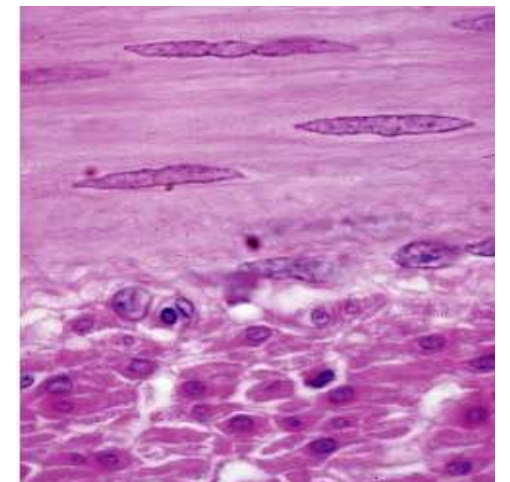
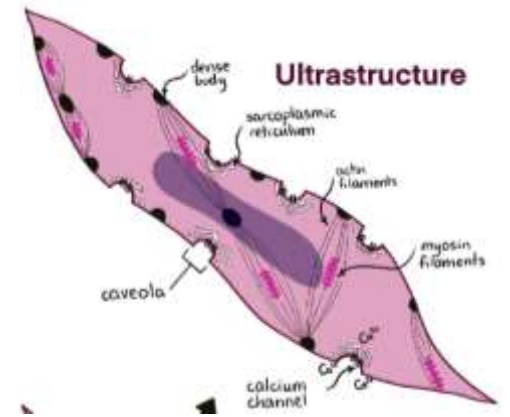
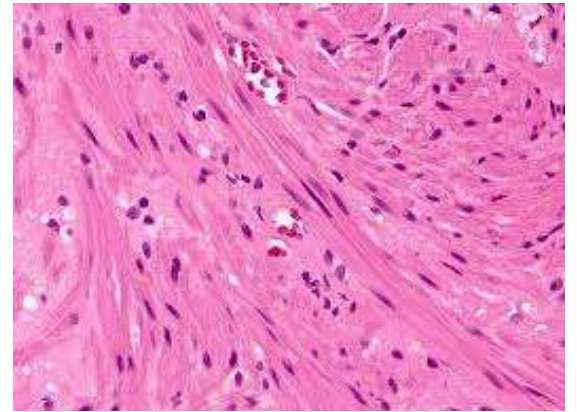
Characteristics of Cardiac Muscle

- More T-Tubules and form diads at Z-Line
- The sarcoplasmic reticulum is less profound and irregularly dispersed compared to skeletal one
- Contains numerous mitochondria (40% vz 2%)
- Fatty acids are stored in lipid droplets
- Lipofuscin pigments
- Membrane-bound granules in atria contain **Atrial Natriuretic Factor**
act on the kidney leads to Na and H₂O loss



Smooth Muscle Fiber

- Consists of elongated, non-striated muscle fibers
- It is surrounded by a basal lamina, reticular fibers, and collagen type-I comprising the **Endomysium**
- It has a central ovoid nucleus and other organelles
- Ill-developed sarcoplasmic reticulum which lacks T tubules
- It contains thin filaments made of **actin** and thick filaments made of **myosin**
- Calmodulin and Ca-sensitive myosin light-chain kinase
- Intermediate filaments (**Desmin and Vimentin**)
- **Dense bodies** (Membranous and cytoplasmic)



Types of Smooth Fibers

- **Visceral:**

They are found in the wall of the viscera.

They have gap junctions and poor nerve supply

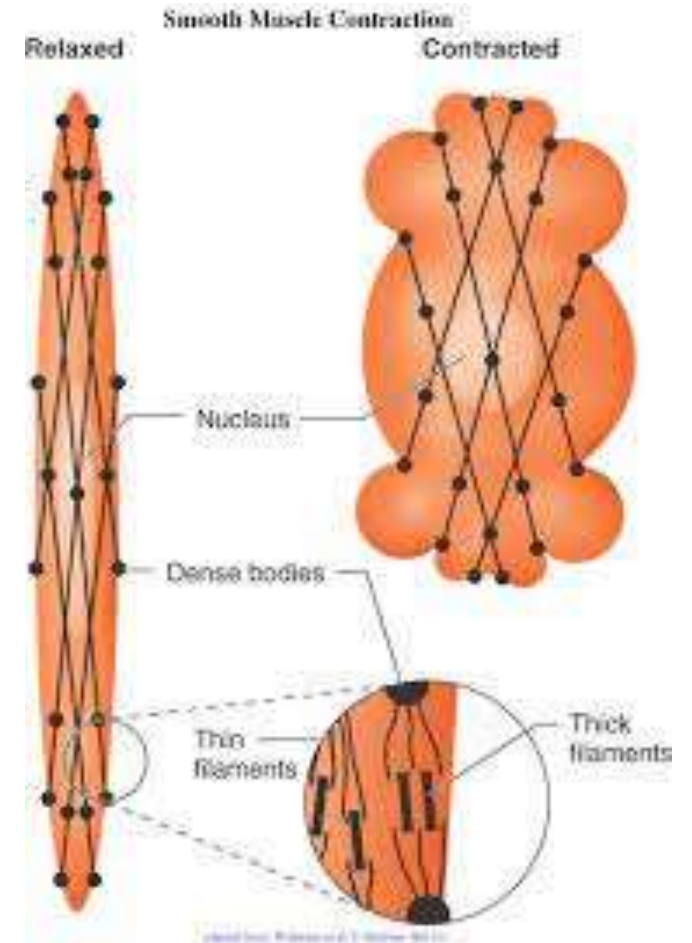
They contract in syncytial fashion (**Bulk contraction**)

- **Multiunit:**

They are found in the iris of the eye.

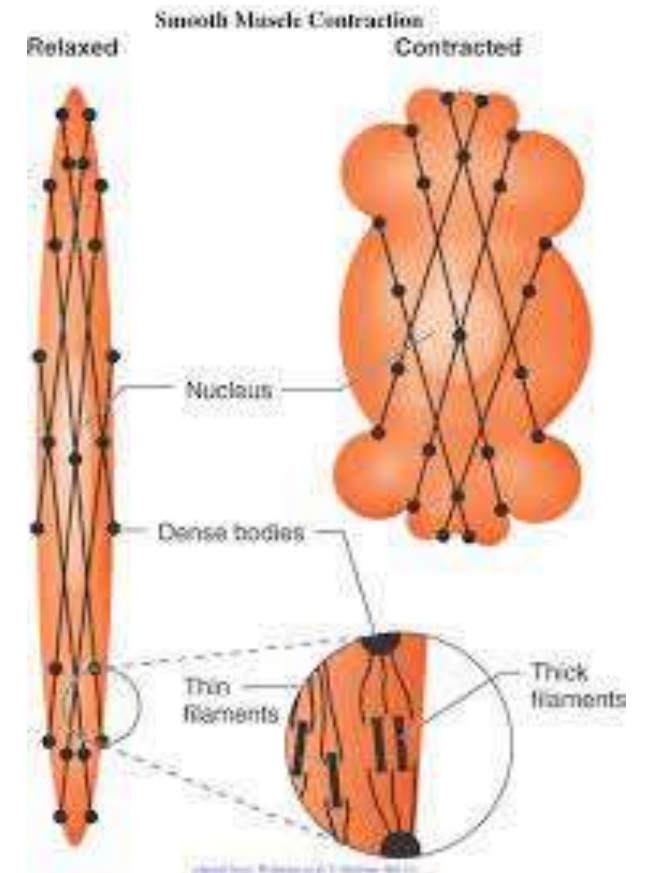
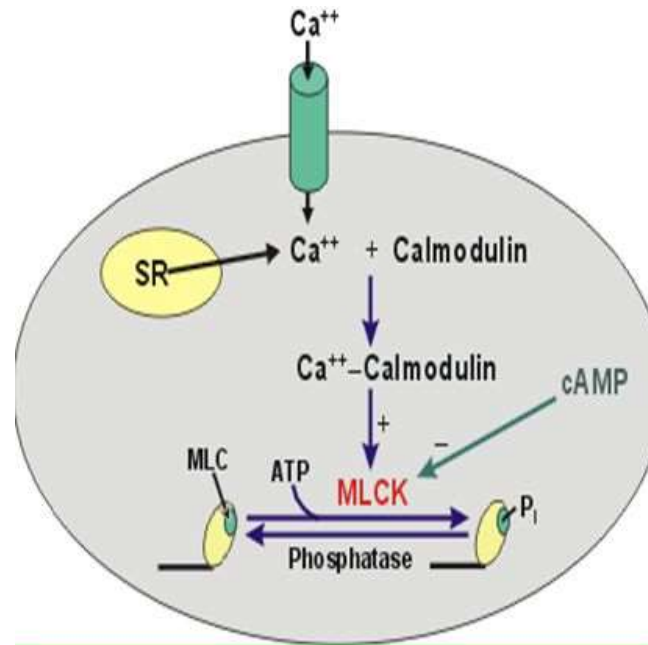
They have rich innervation

They contract in graded and precise action.



Mechanism of contraction

- In skeletal and cardiac muscle fibers, calcium binds to troponin leading to change in the geometry of thin and thick filaments leading to contraction (**sliding theory**).
- In smooth muscle fiber, calcium binds to calmodulin which activates myosin light chain kinase leading to myosin phosphorylation
- Factors leading to **increase** or **decrease** in cAMP levels lead to **contraction** and **relaxation**, respectively



Regeneration of Muscle Tissue

- Injured cardiac fibers after childhood are replaced by fibrous tissue
- Injured skeletal fibers have limited potential for regeneration. Satellite cells (**Undifferentiated myoblasts**) within the basal lamina of skeletal fibers become activated and proliferate and fuse together to give new muscle fibers
- Injured smooth fibers have active regenerative activity

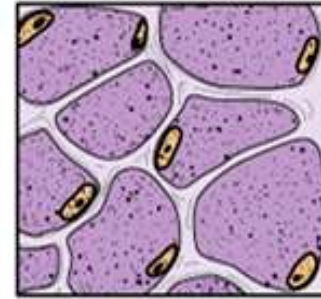
- saffffs

Skeletal muscle



Nuclei

Cross sections

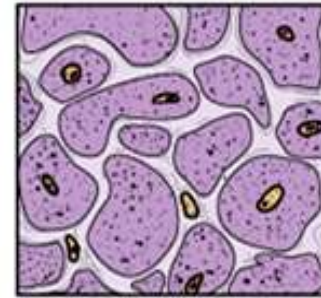


Strong, quick discontinuous voluntary contraction

Cardiac muscle

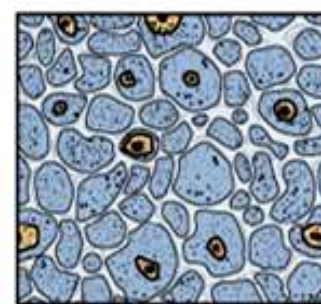
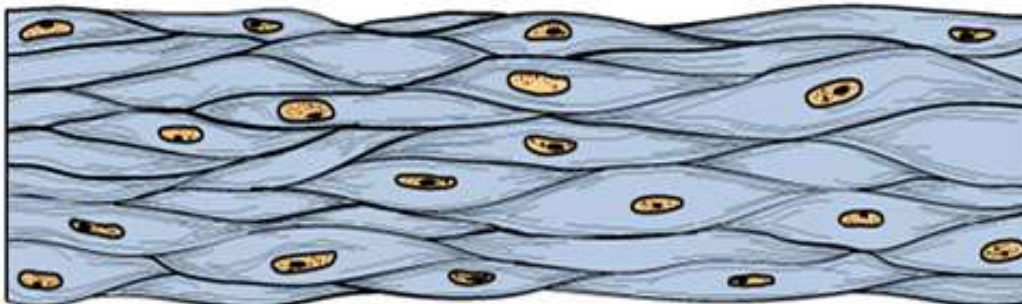


Intercalated disks



Strong, quick continuous involuntary contraction

Smooth muscle



Weak, slow involuntary contraction