Excitation contraction coupling

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Features

- Excitable
- Contractile
- Extensible
- Elastic

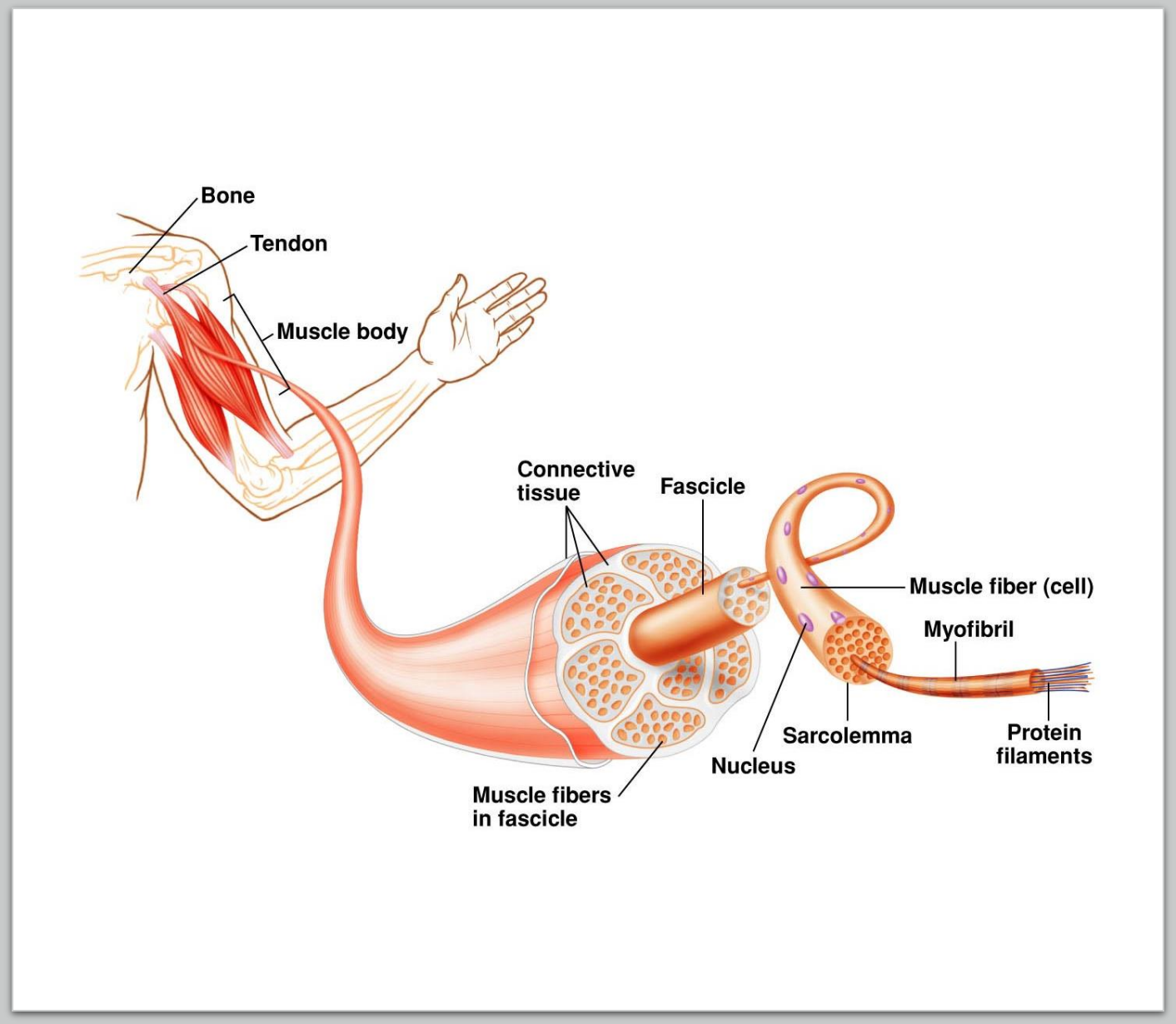
Function

- Producing movement
- Posture
- Stabilize joint
- Generate heat

Skeletal Muscle Structure

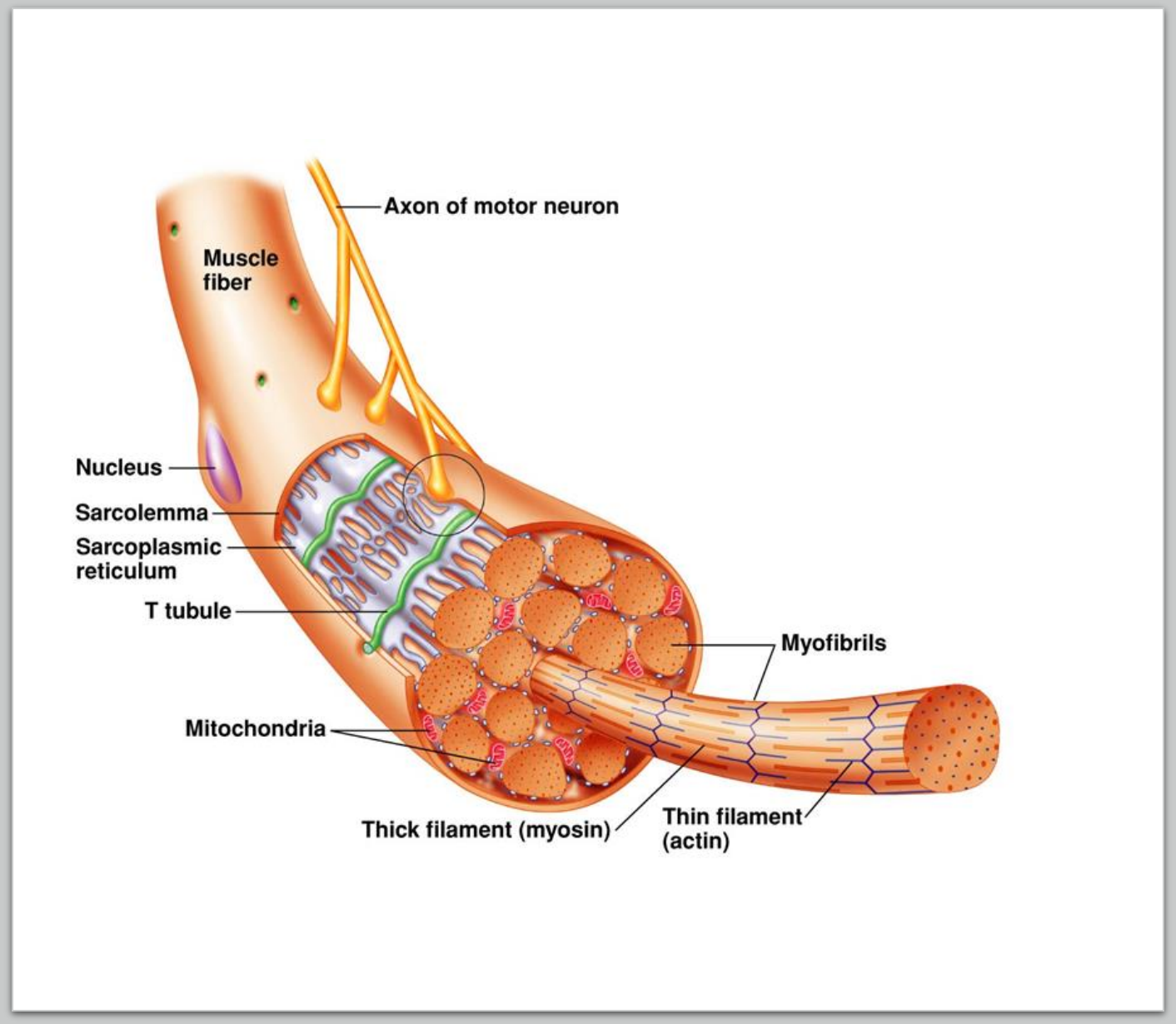
Muscle = group of fascicles

- Muscle fiber contracts ---C.T sheets pulled on (epi, peri, endomysium)……pull on tendon…..pull or move the Bone
- Elasticity
- Blood and nerve running over



Muscle fiber components

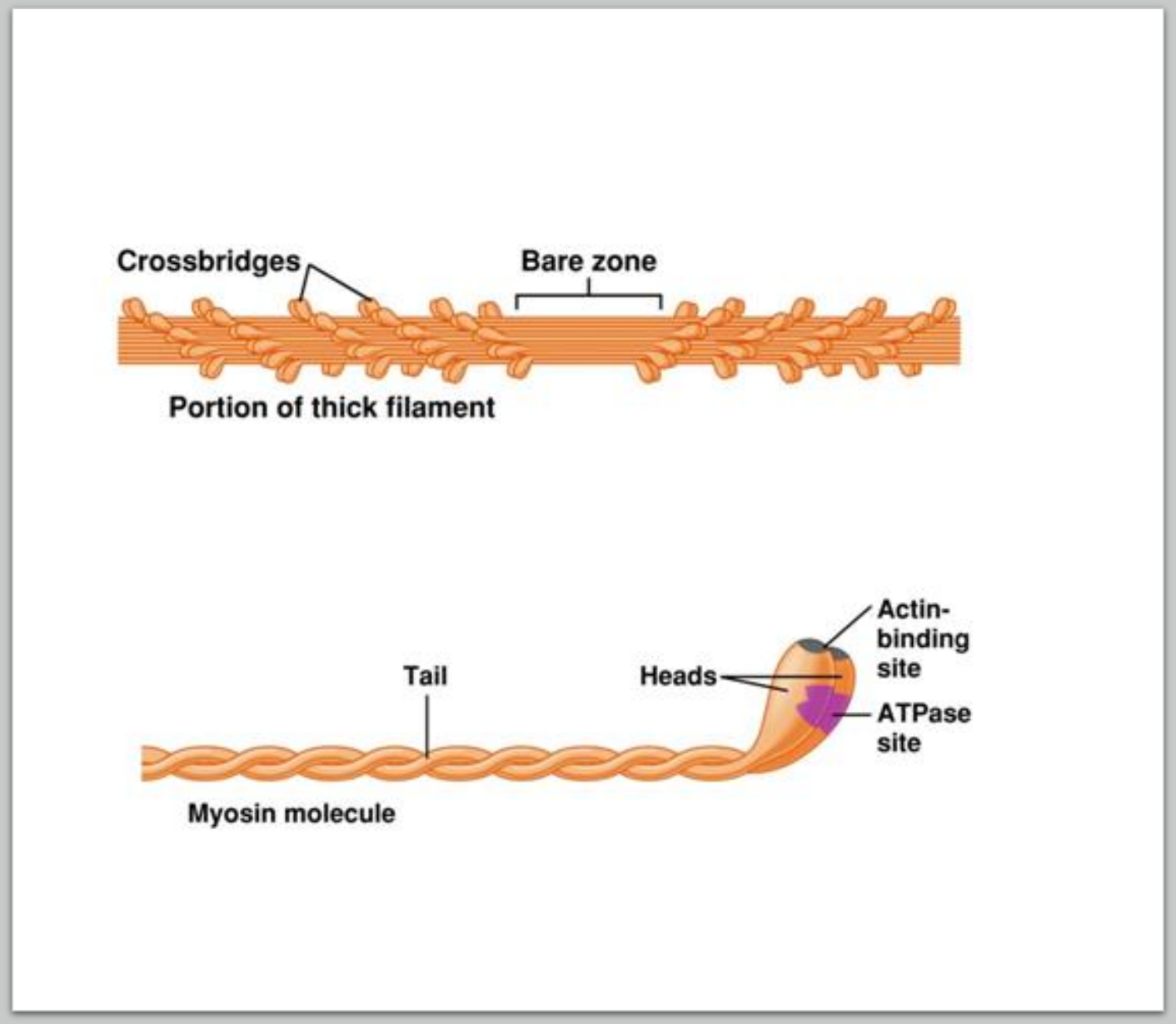
- Sarcolemma: muscle cell membrane
- Sarcoplasma: muscle cell cytoplasm
- Motor end plate: contact surface with axon terminal
- T tubule: cell membrane extension into the sarcoplasm (to reach the myofibrils)
- Cisternae: areas of the endoplasmic reticulum dedicated to Ca++ storage (located on each side of the T-tubules)
- Myofibrils: organized into sarcomeres



Muscle contraction: Cell events

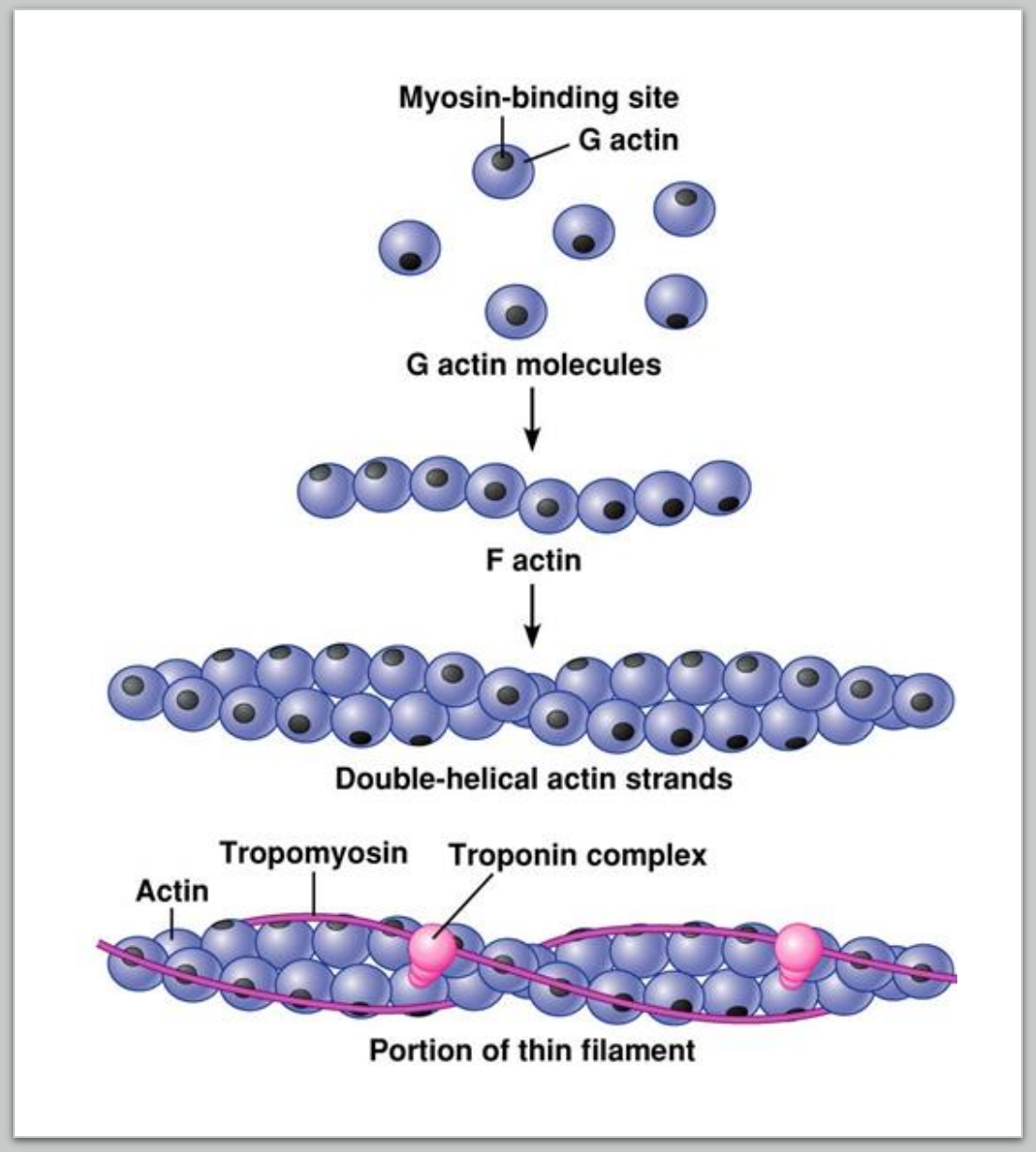
Myosin structure

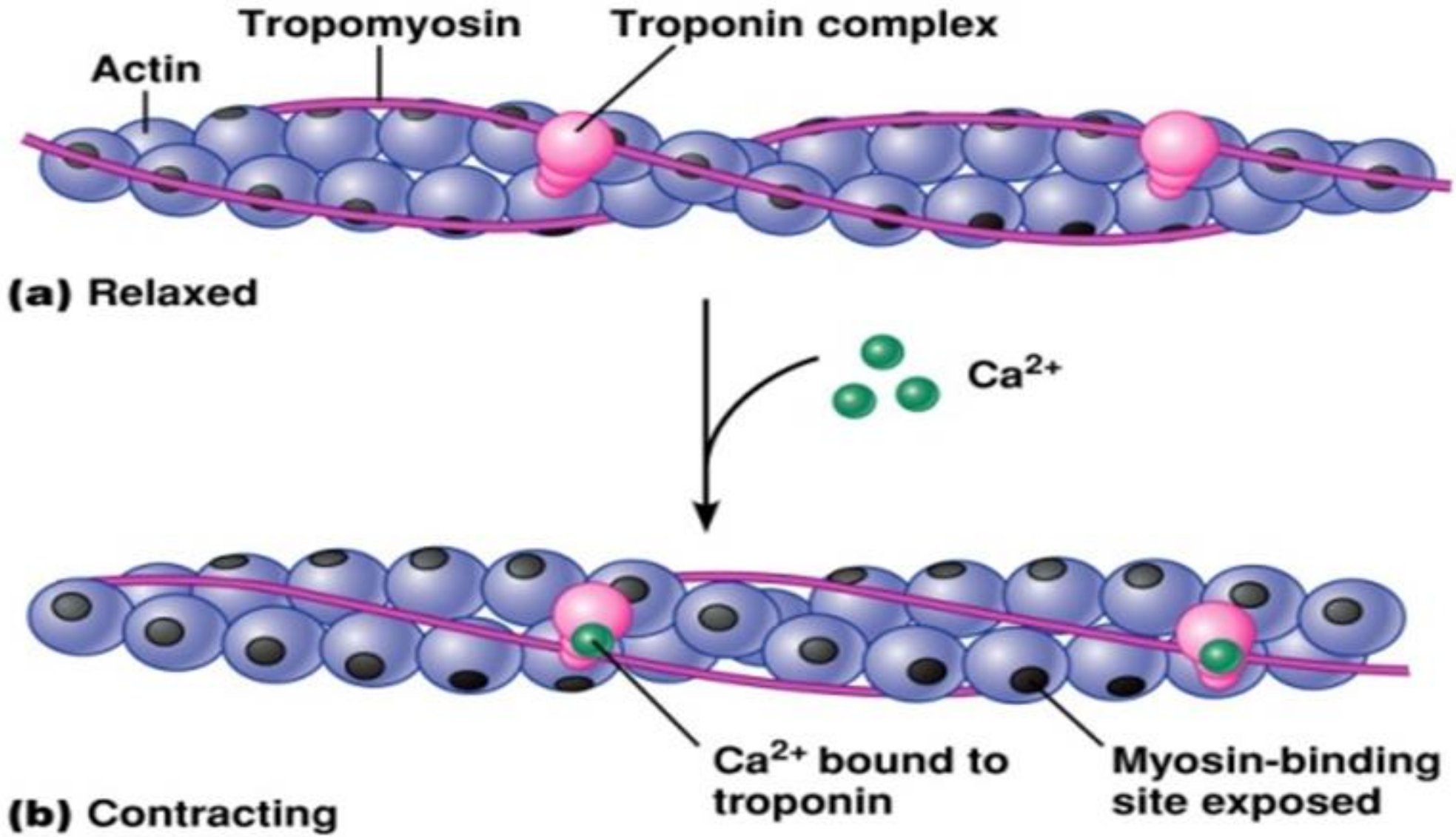
- Many myosin molecules per filament, golf club shape
- Long tail topped by a thickening: the head → forms crossbridges with the thin filament
- Presence of the enzyme, ATPase in the head → release energy for contraction

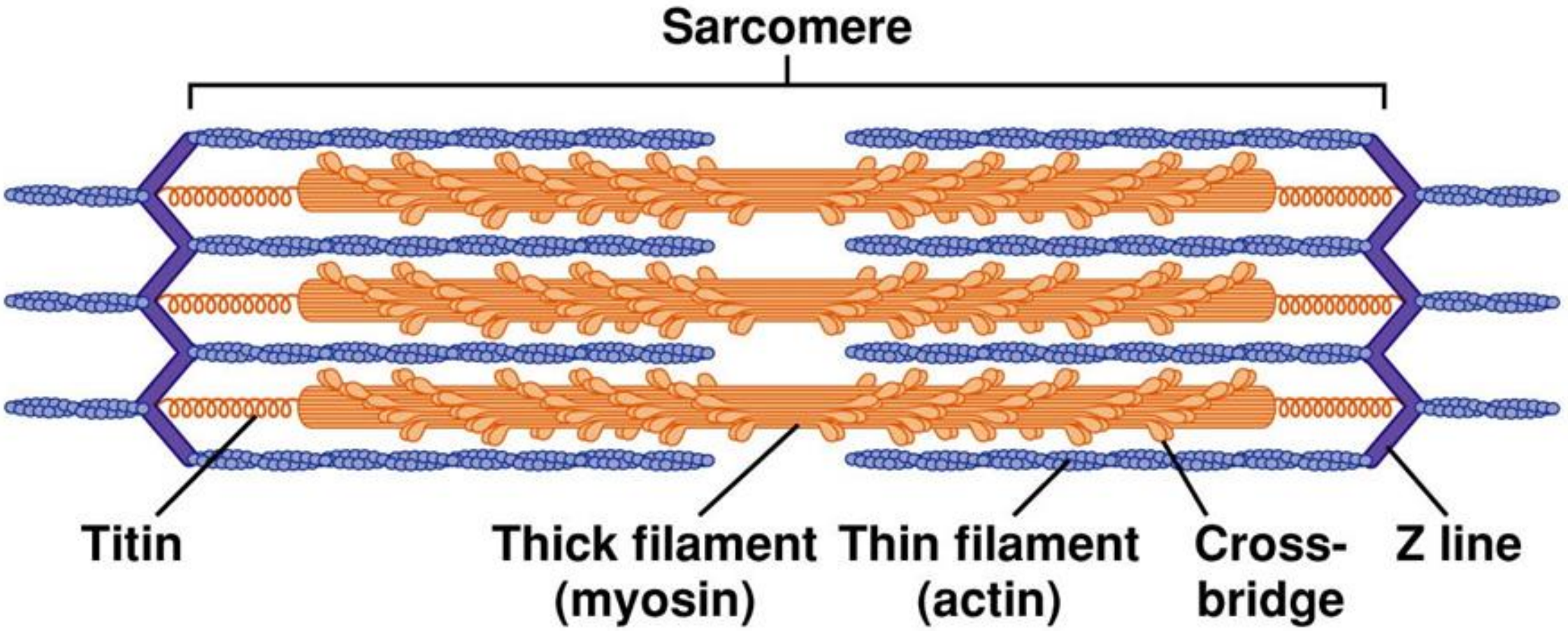


Actin structure

- Formed by 3 different proteins:
- globular (G) actins: bind to myosin heads
- tropomyosin: long, fibrous molecule, extending over actin, and preventing interaction between actin and myosin
- troponin: binds reversibly to calcium and able to move tropomyosin away from the actin active site




Tropomyosin
Troponin complex
Actin
(a) Relaxed
Ca^{2+}
Ca^{2+} bound to troponin
Myosin-binding site exposed
(b) Contracting


Sarcomere
Titin
Thick filament (myosin)
Thin filament (actin)
Cross-bridge
Z line

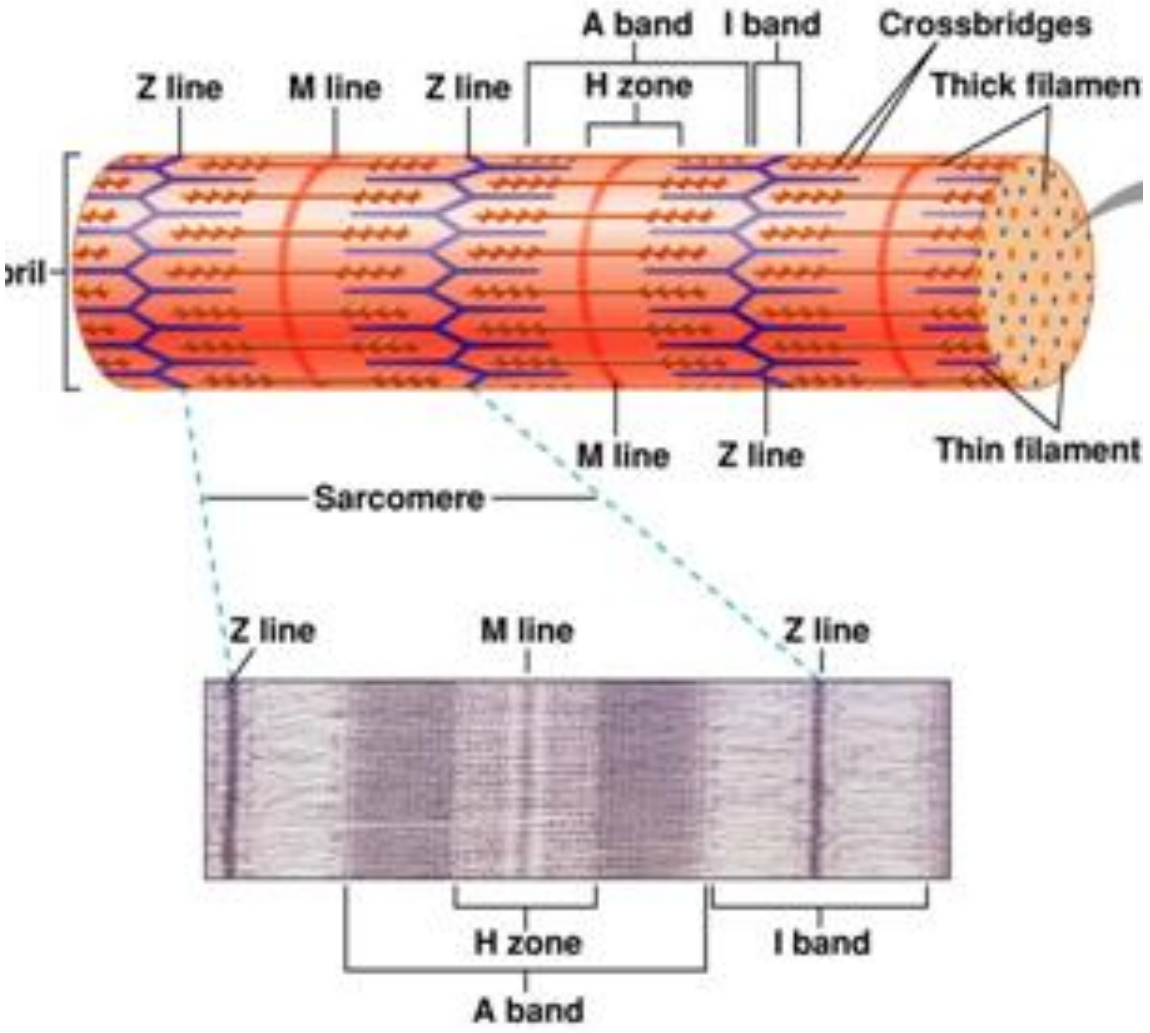
The sarcomere

- The myofibrils are organized into a repetitive pattern, the sarcomere
- Myosin: thick filament
- Actin: thin filament: nebulin to Z
- Bands formed by pattern: A and I and H bands
- Z line: area of attachment of the actin fibers; alpha Actinin
- M line: Myomesin

  c protein

  creatine kinase

Connecting the titin and titin connecting thick filament to Z line



Muscular dystrophy

- Duchene

No dystrophy

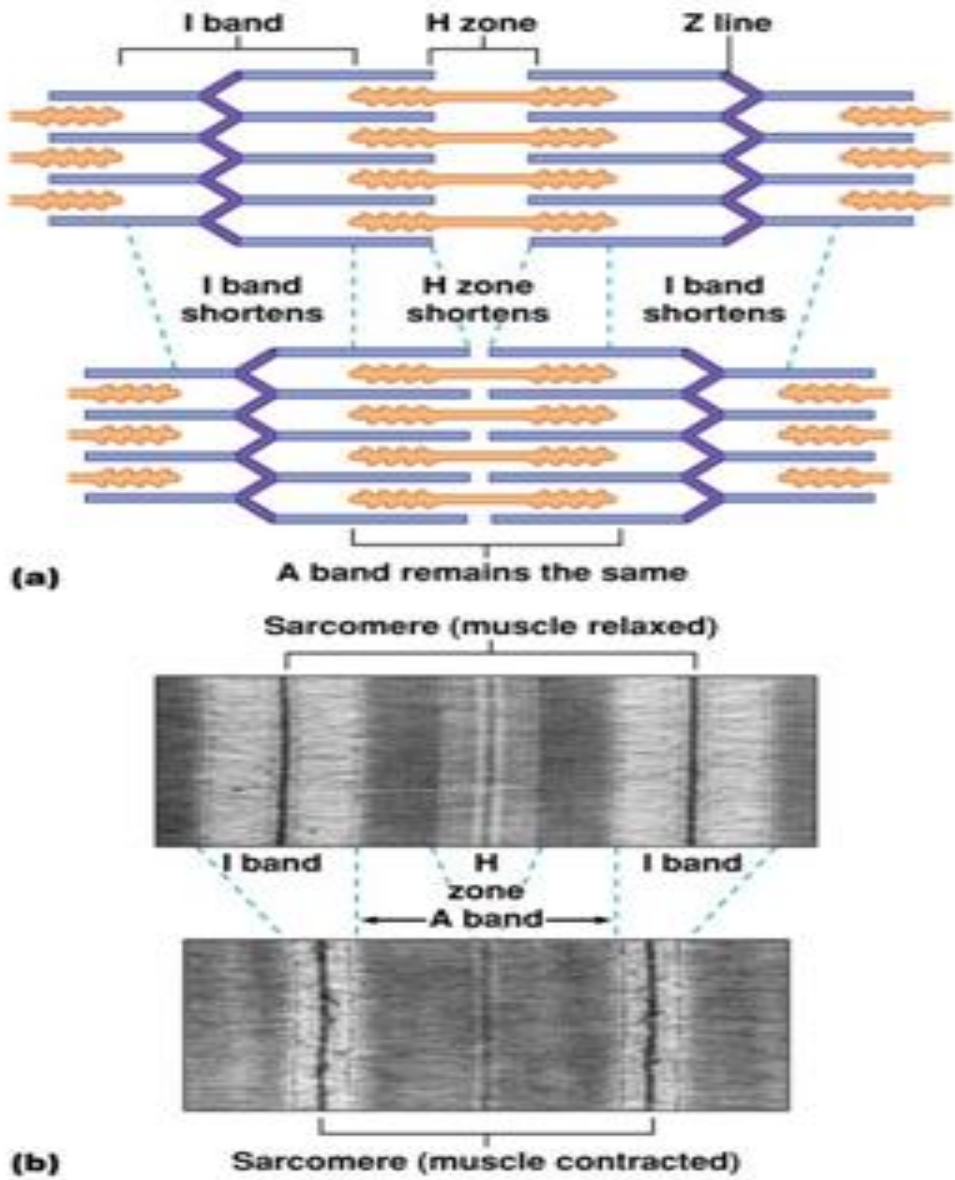
Sever

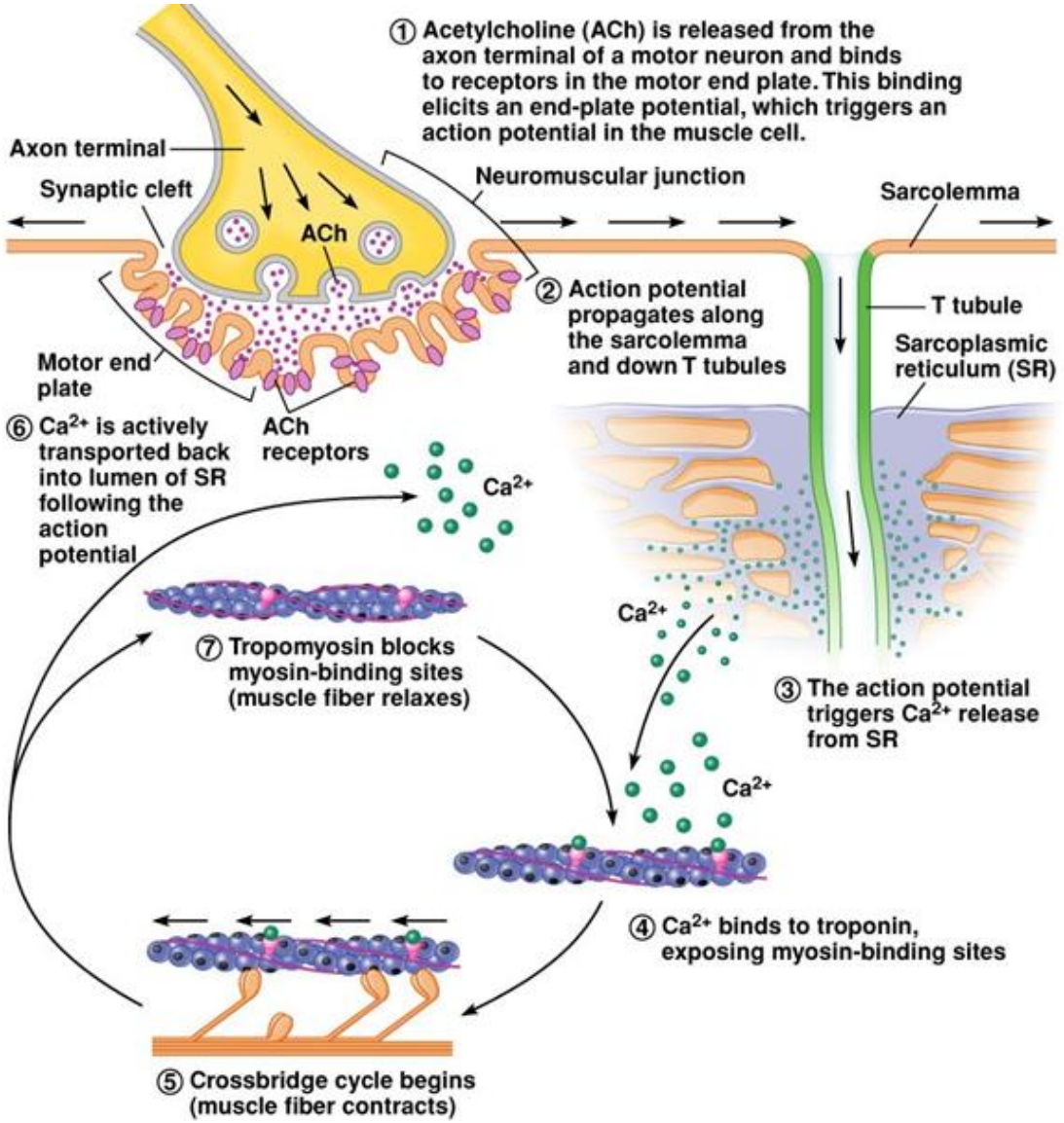
5 to 6yr

- Becker (multifold protein)

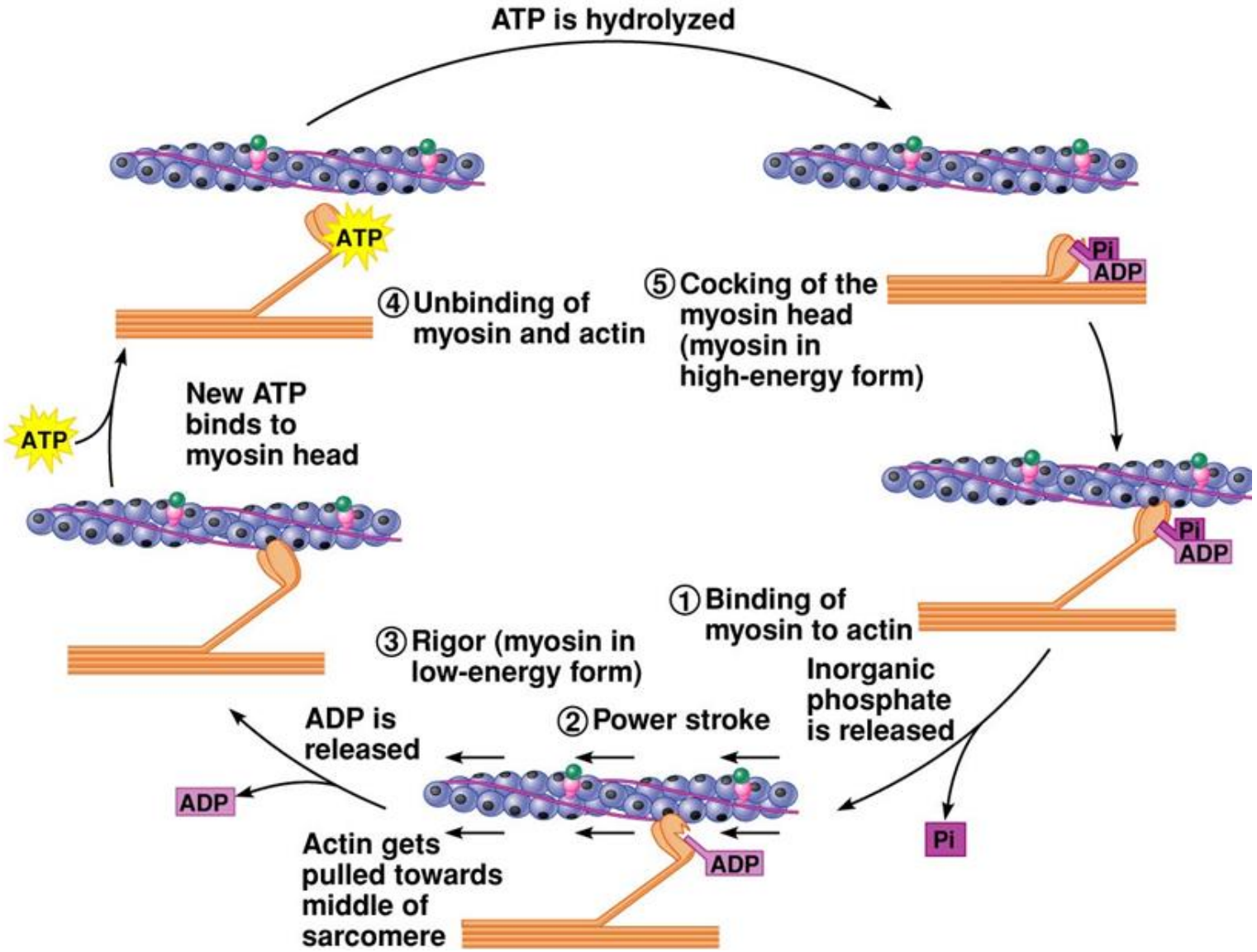
Less sever

10 -20 yr


I band
H zone
Z line
I band shortens
H zone shortens
I band shortens
A band remains the same
(a)
Sarcomere (muscle relaxed)
I band
H zone
I band
A band
Sarcomere (muscle contracted)
(b)



The mechanism of force generation in muscle


ATP is hydrolyzed
ATP
④ Unbinding of myosin and actin
⑤ Cocking of the myosin head (myosin in high-energy form)
Pi
ADP
New ATP binds to myosin head
ATP
Pi
ADP
① Binding of myosin to actin
③ Rigor (myosin in low-energy form)
Inorganic phosphate is released
ADP is released
② Power stroke
ADP
Pi
Actin gets pulled towards middle of sarcomere
ADP