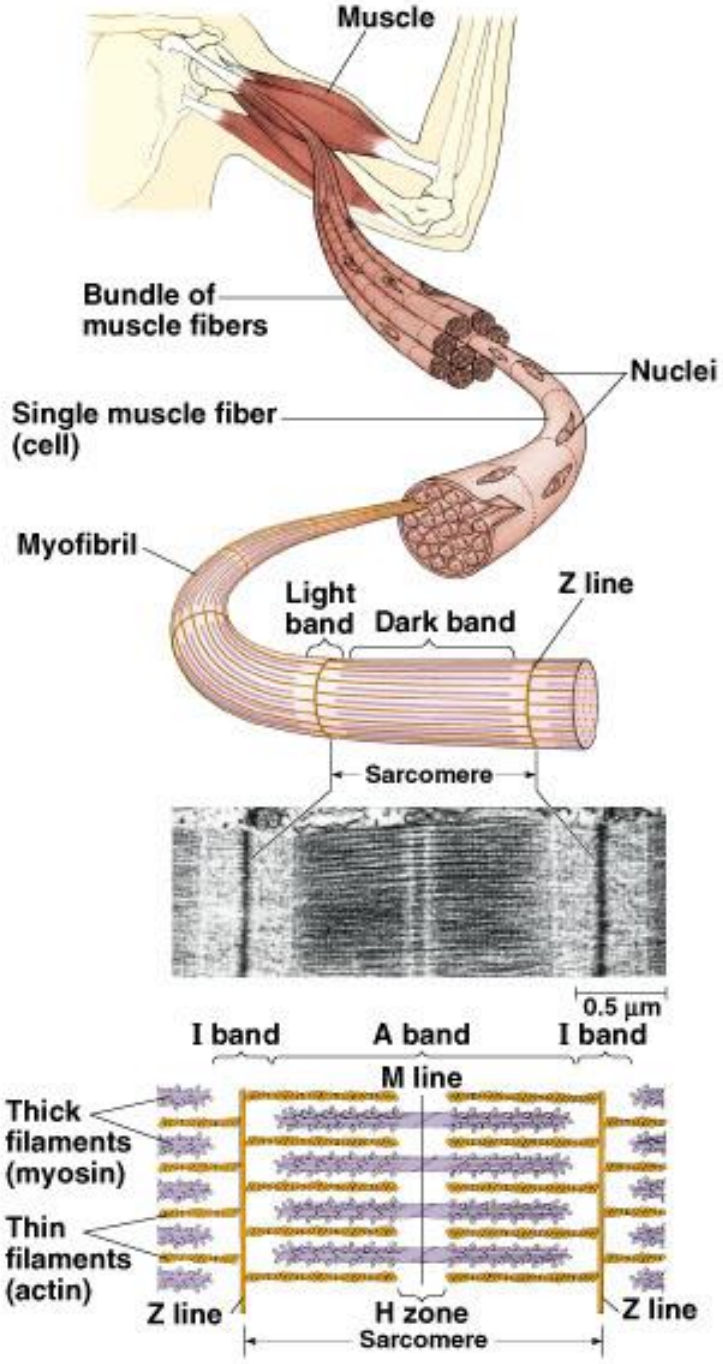
Nervous System: Part V
Interactions With The Muscular System

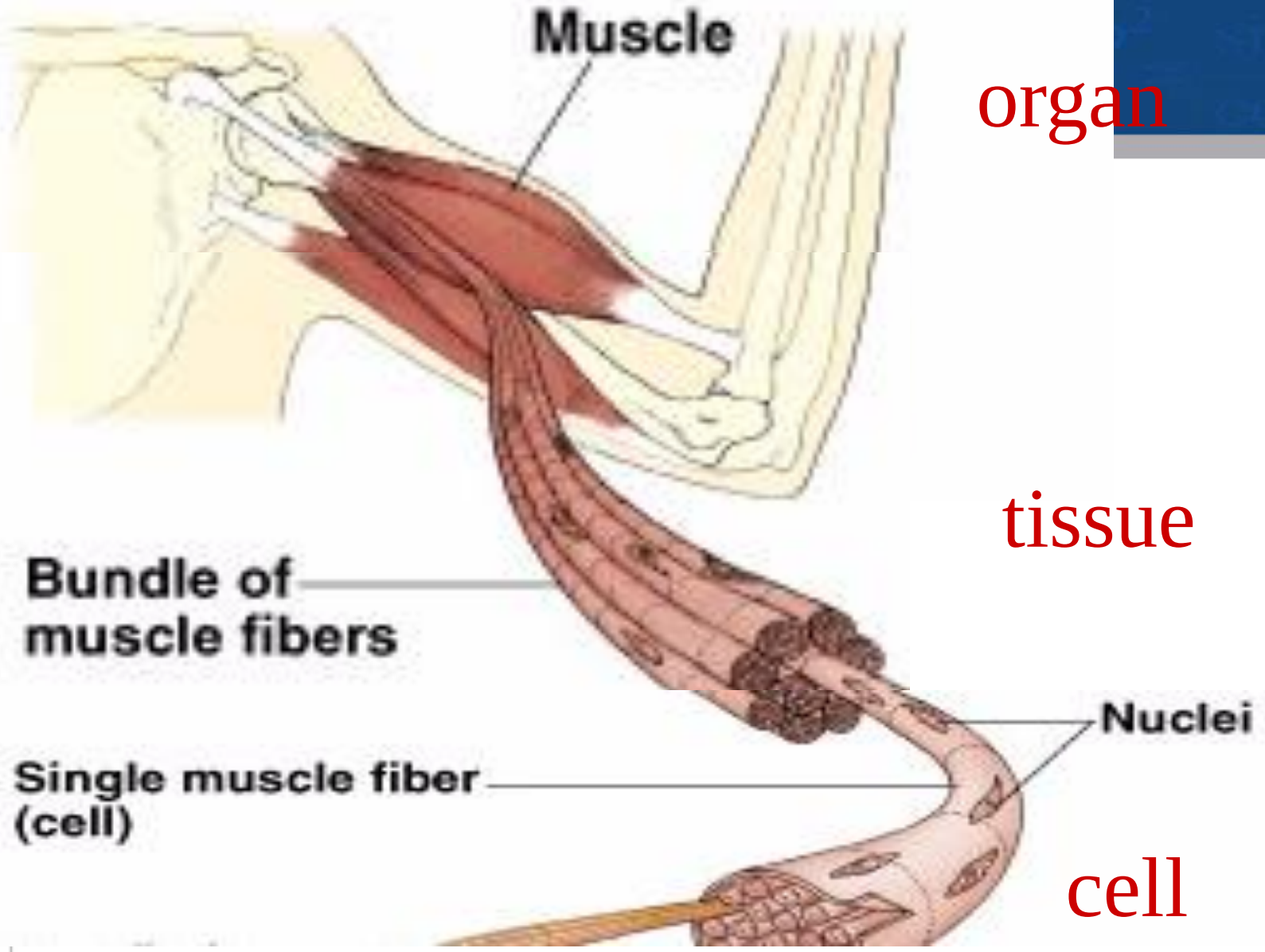
NATIONAL MATH + SCIENCE INITIATIVE

Enduring Understanding 4.A.4.b Interactions among systems

- Interactions and coordination between systems provide essential biological activities
  - Illustrative example:
    - Nervous and muscular



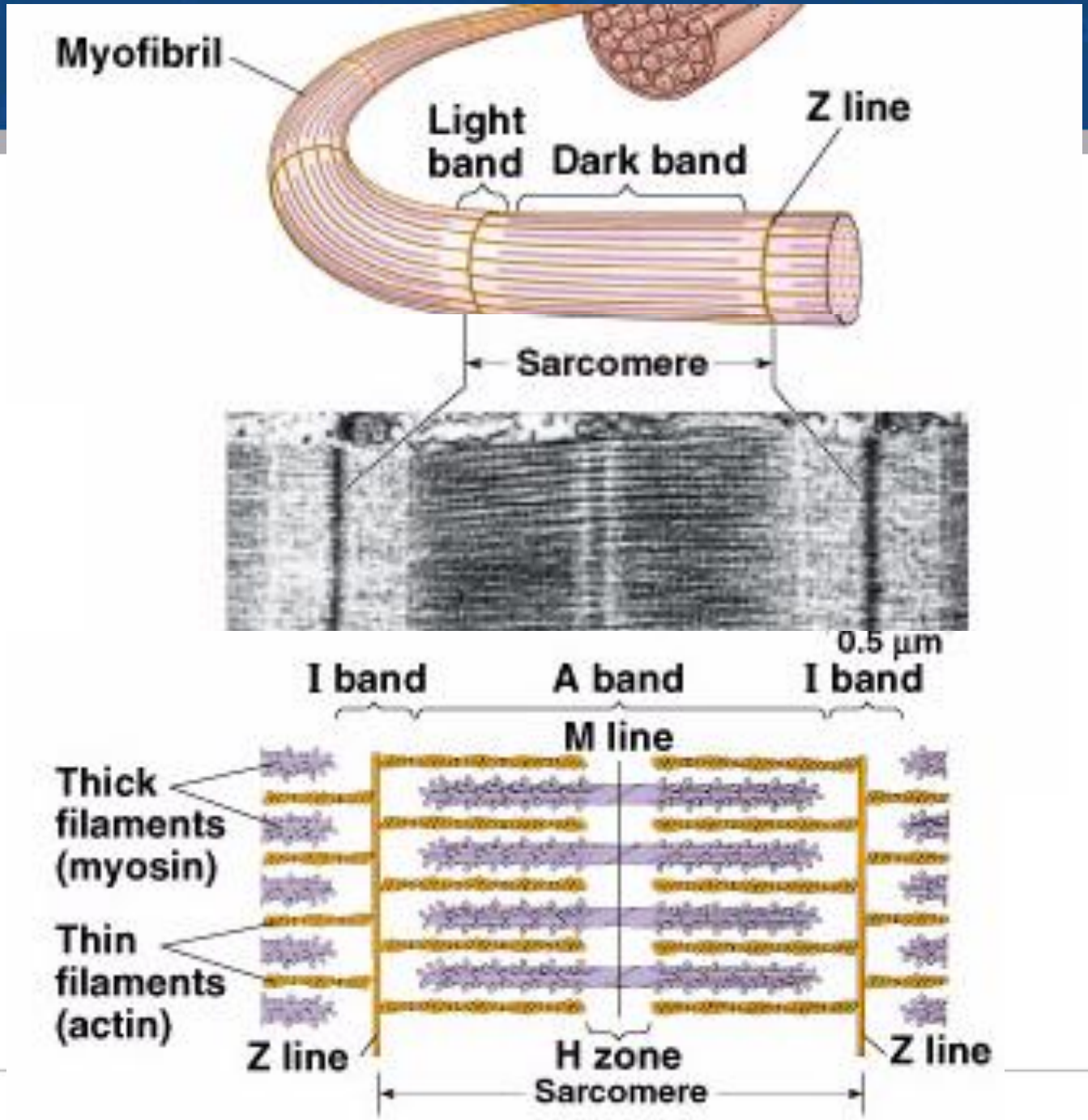
- The contraction of a muscle is a typical response generated by the nervous system.
- Muscle contraction demonstrates the *interdependence* of the nervous and muscle systems.



organ

tissue

cell

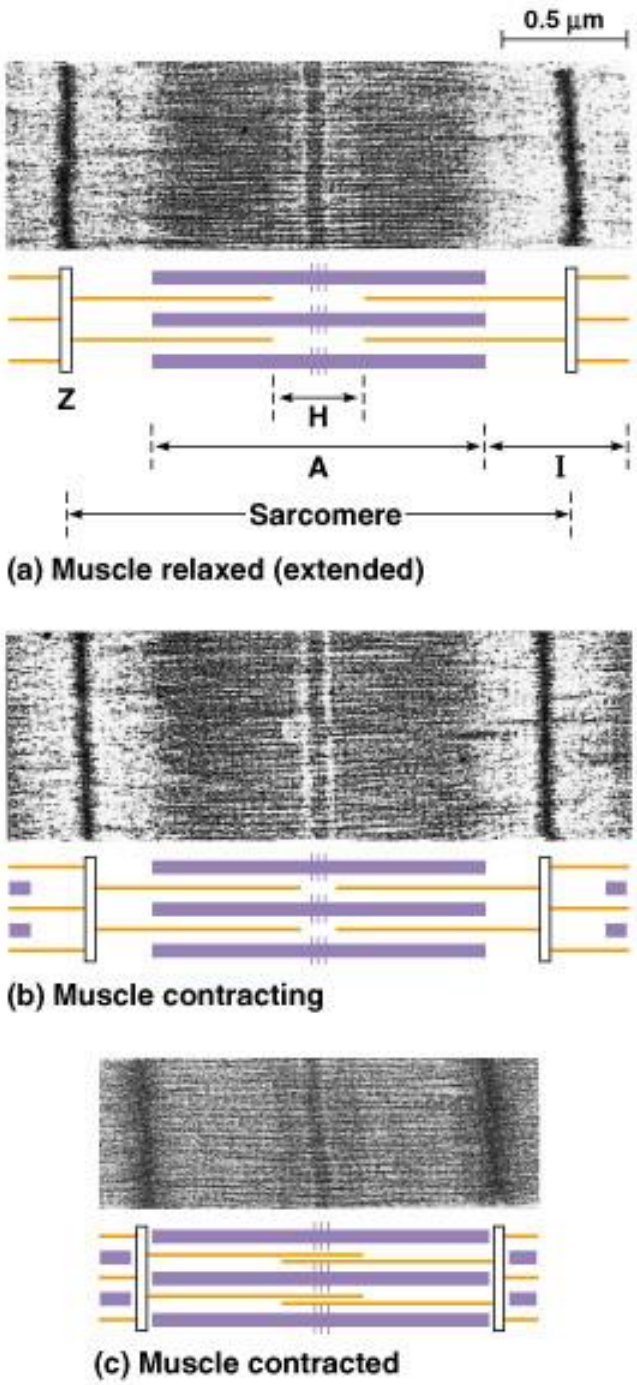

Myofibril
Light band
Dark band
Z line
Sarcomere
0.5 µm
I band
A band
I band
M line
Thick filaments (myosin)
Thin filaments (actin)
Z line
H zone
Z line
Sarcomere

Arrange These In A Decreasing Hierarchy:

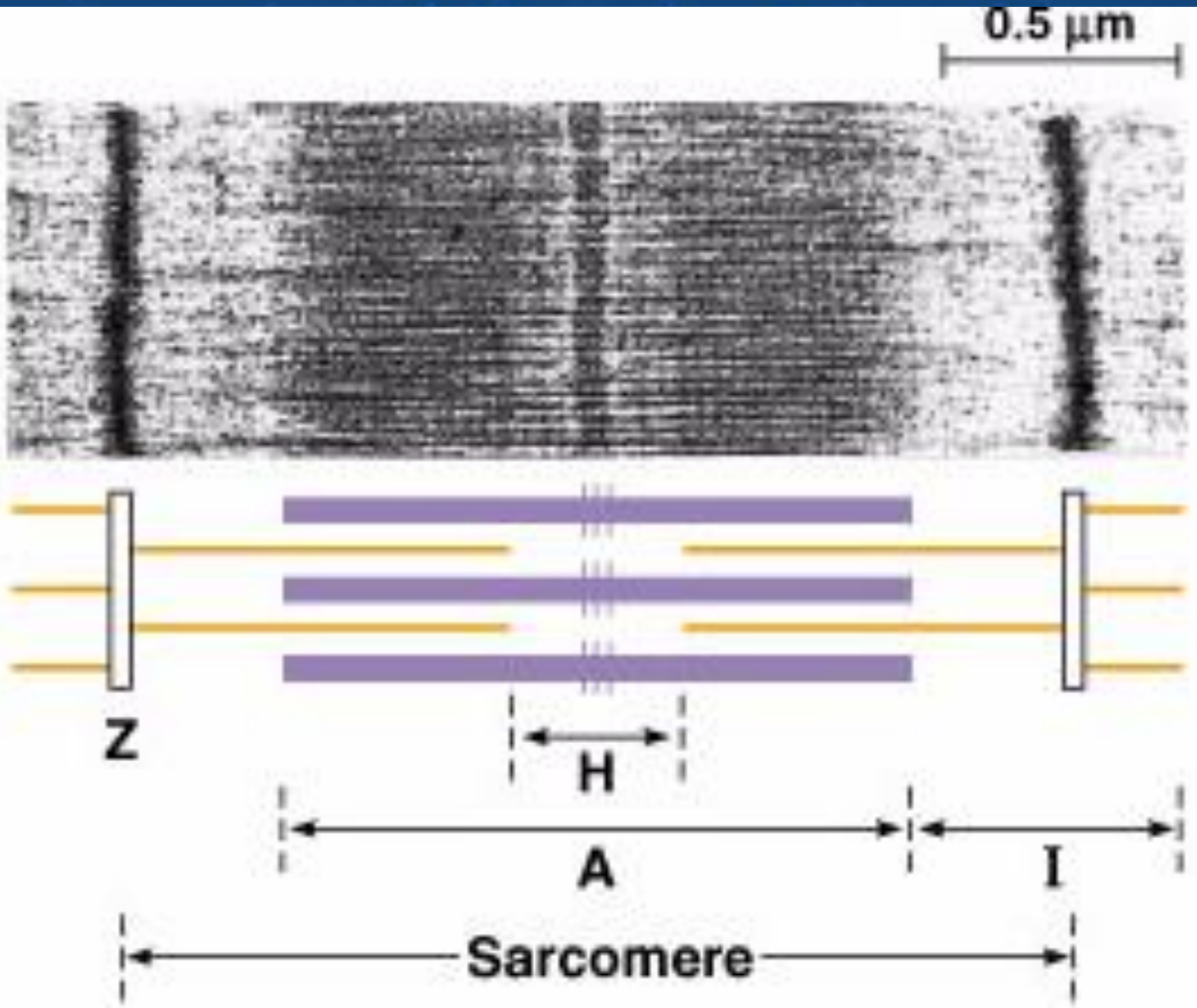
- Muscle
- Muscle fiber cell
- Actin
- Myofibril
- Muscle fibers in bundle
- Sarcomere
- Myosin

CORRECTLY Arranged Into a Hierarchy:

- Muscle
- Muscle fibers in bundle
- Muscle fiber cell
- Myofibril
- Sarcomere
- Myosin
- Actin

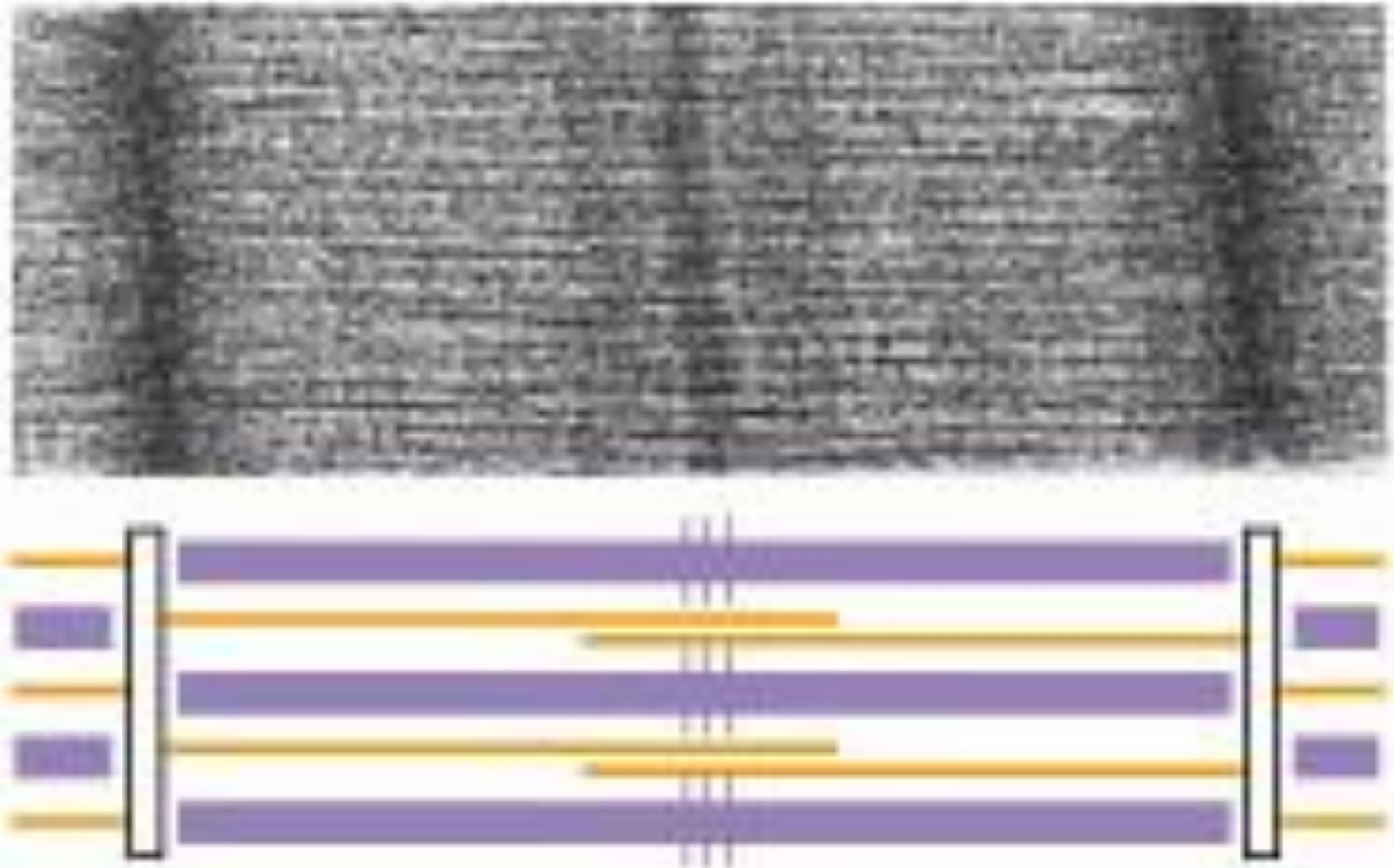


- What noticeable difference do you see in the relaxed and contracted sarcomere?

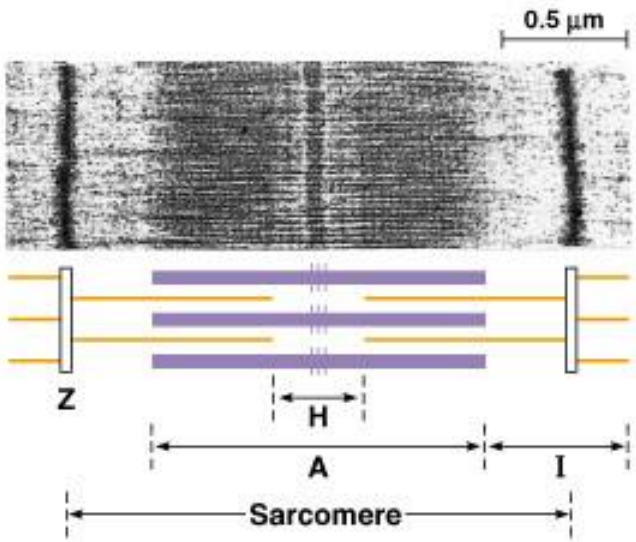


(a) Muscle relaxed (extended)

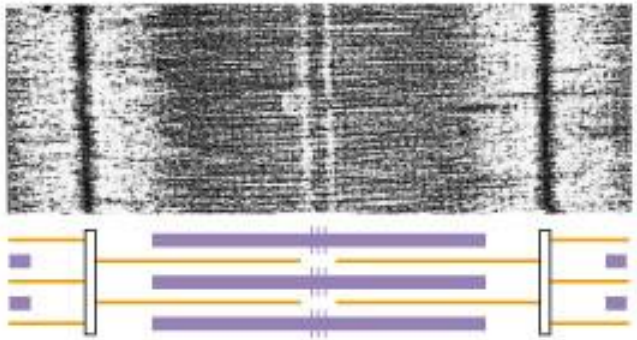
(b) Muscle contracting



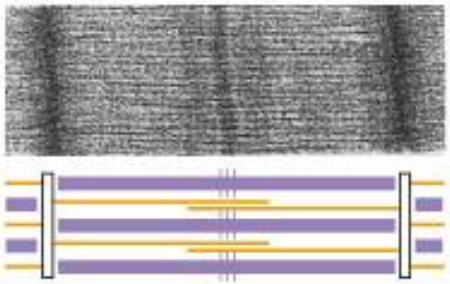
(c) Muscle contracted



(a) Muscle relaxed (extended)

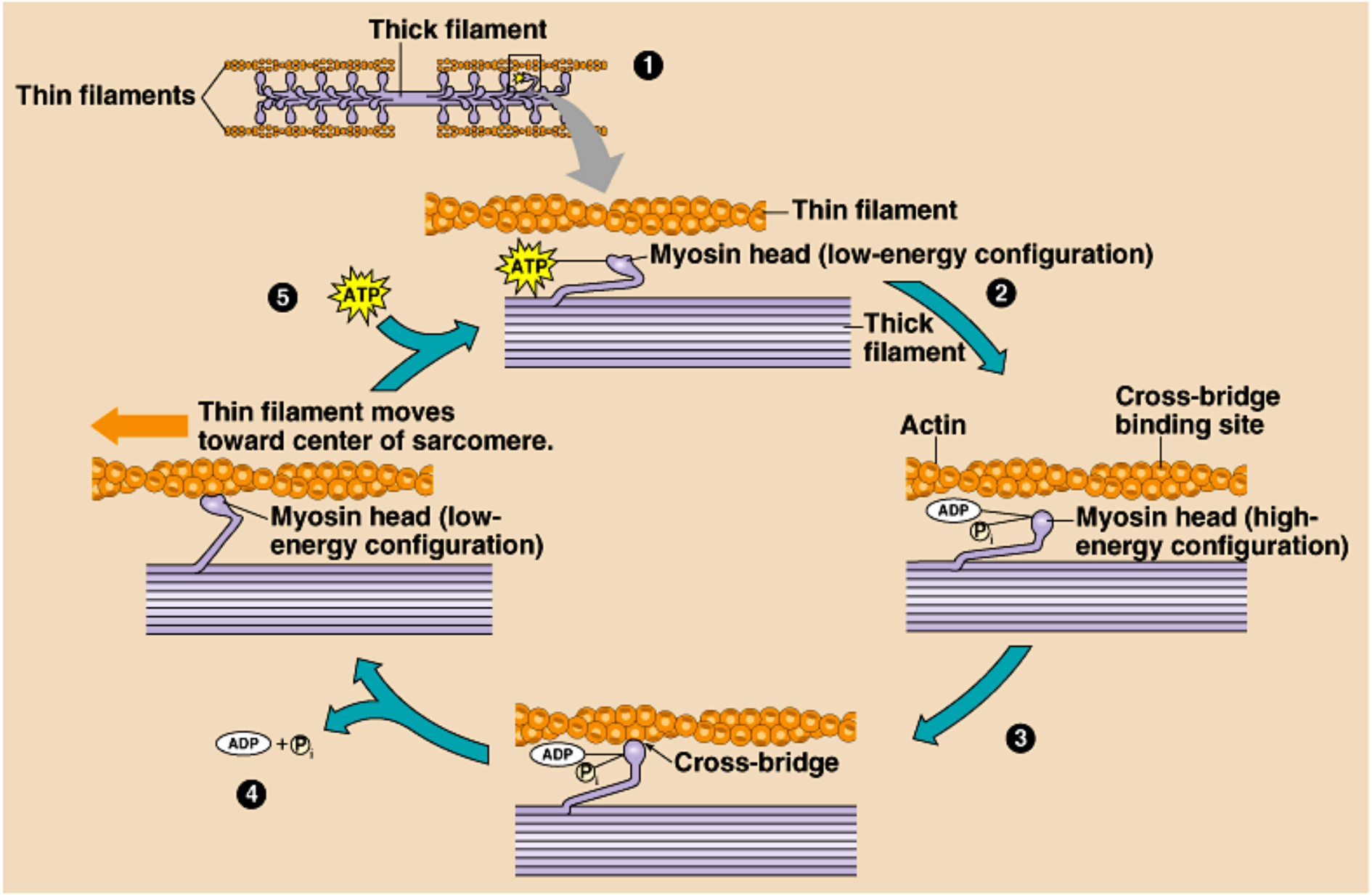


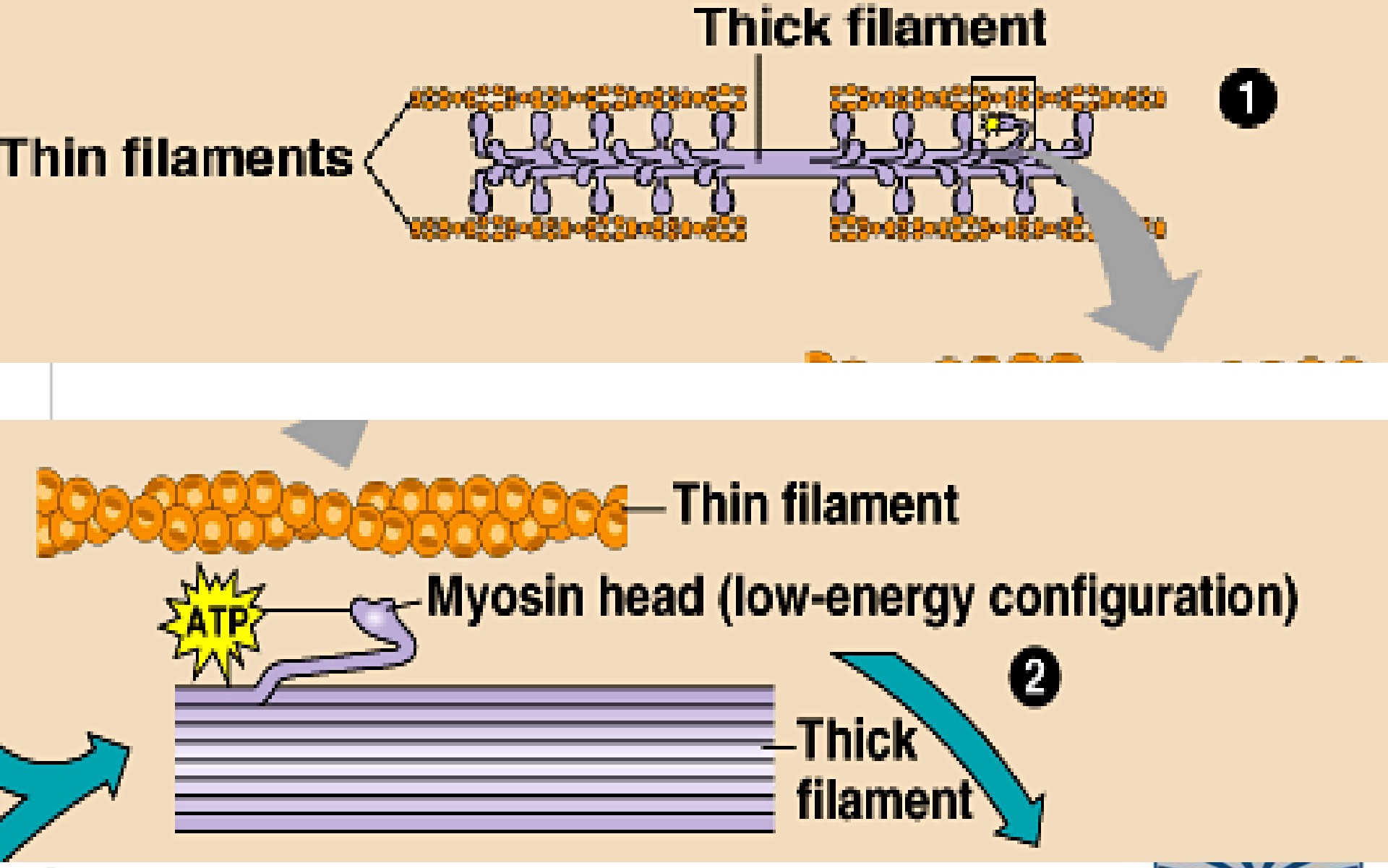
(b) Muscle contracting

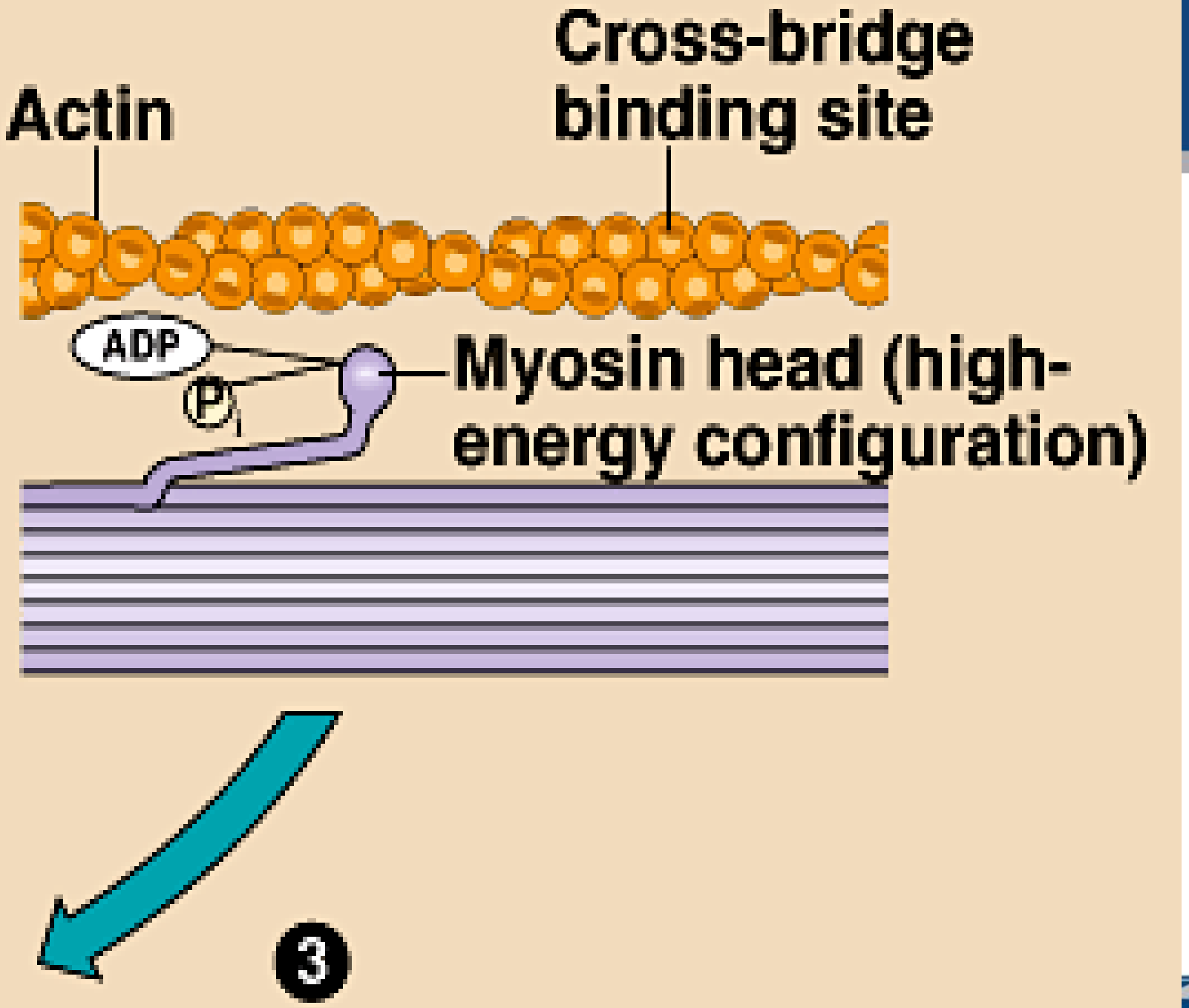


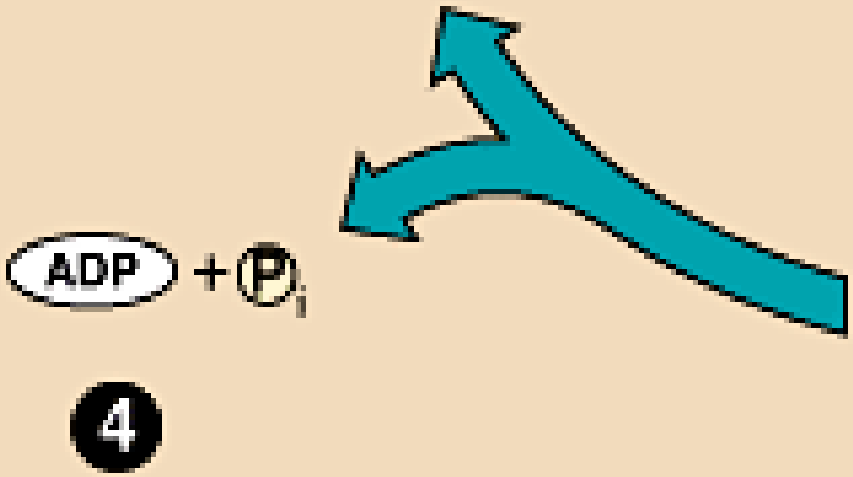
(c) Muscle contracted

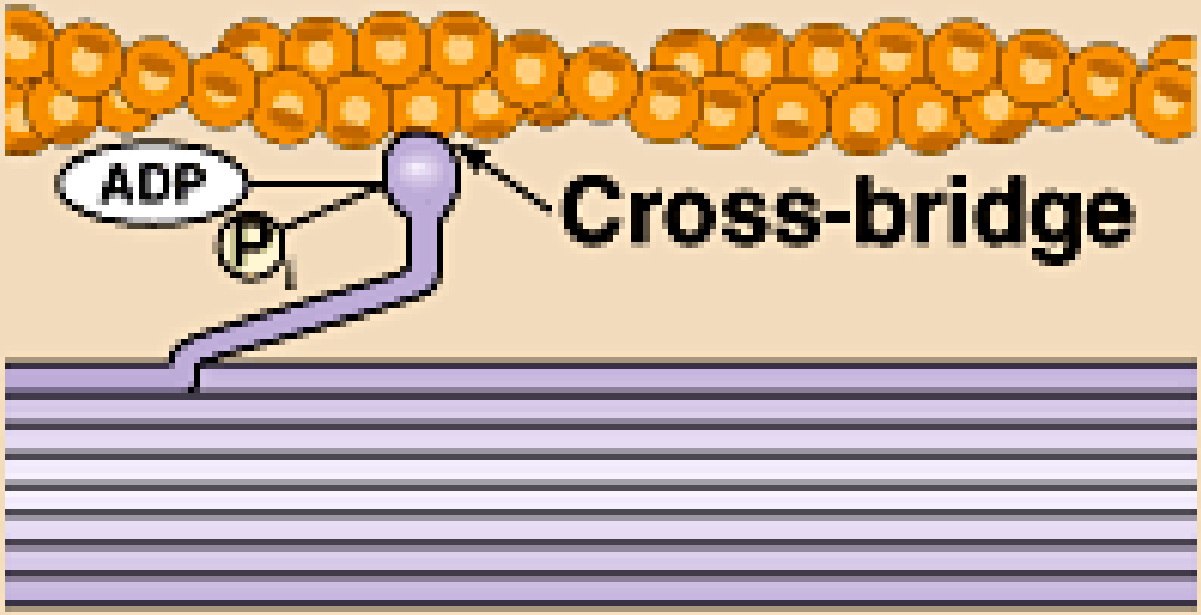
Now lets examine contraction on a molecular level.

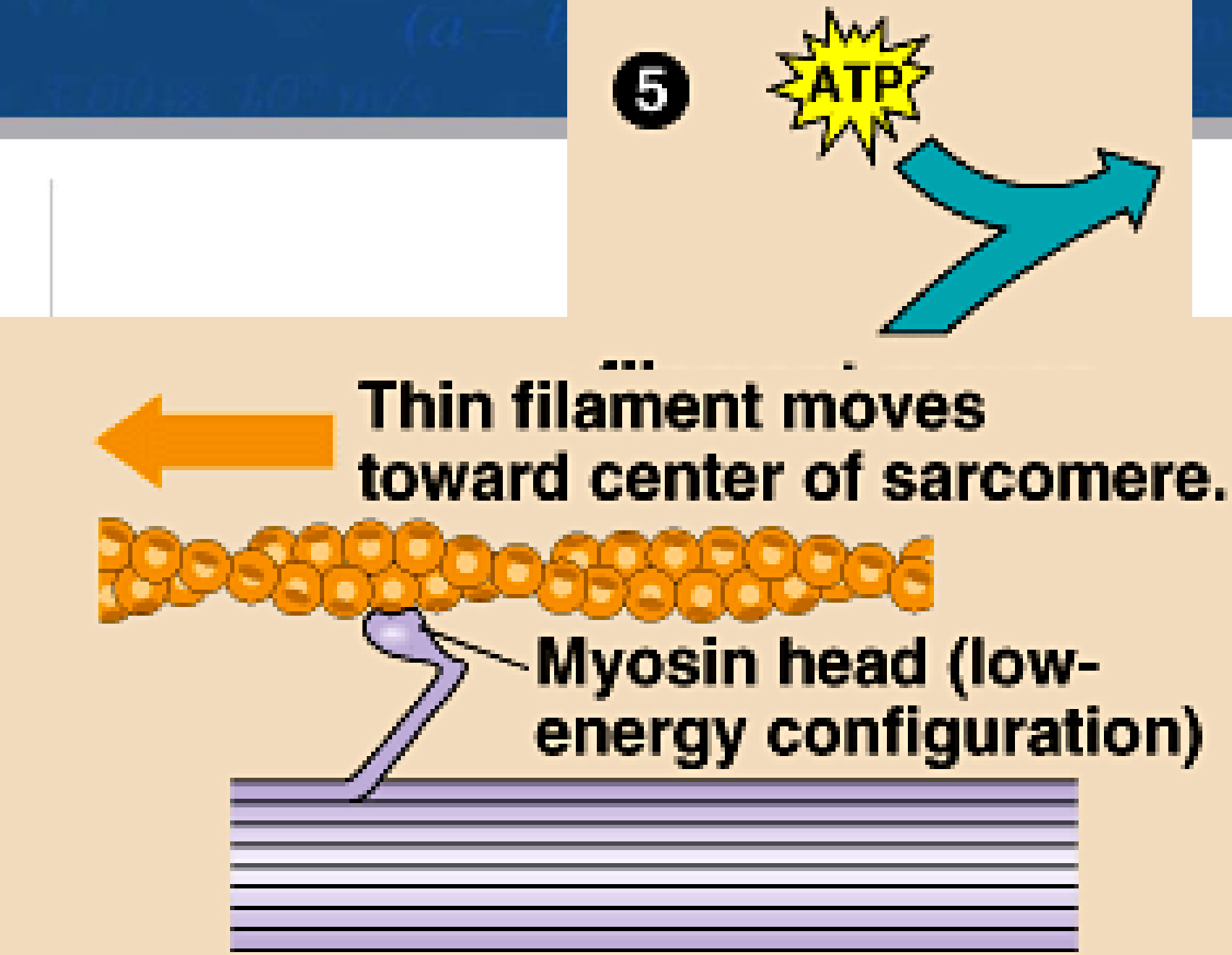


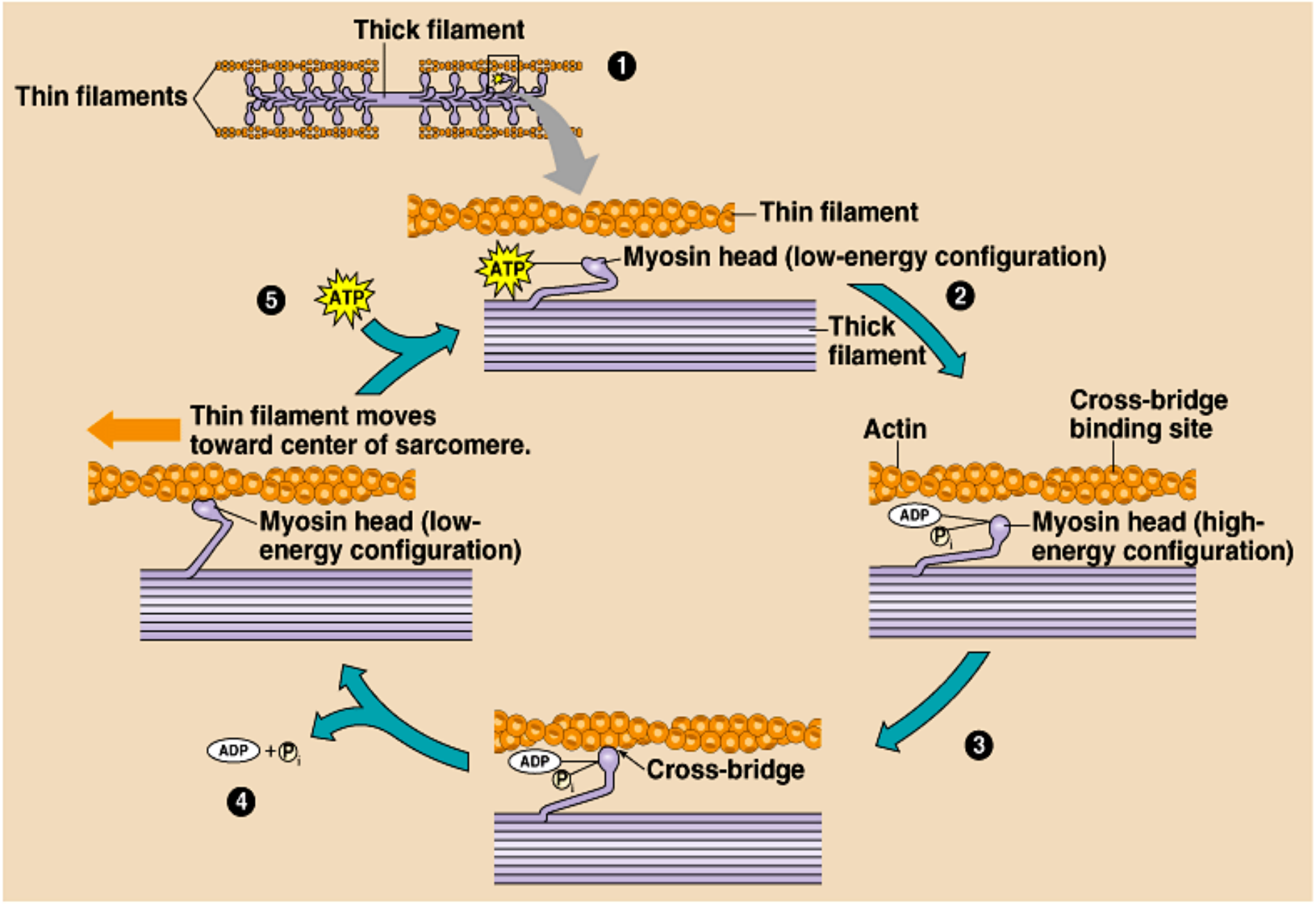

Thick filament
Thin filaments
1
Thin filament
ATP
Myosin head (low-energy configuration)
2
Thick filament

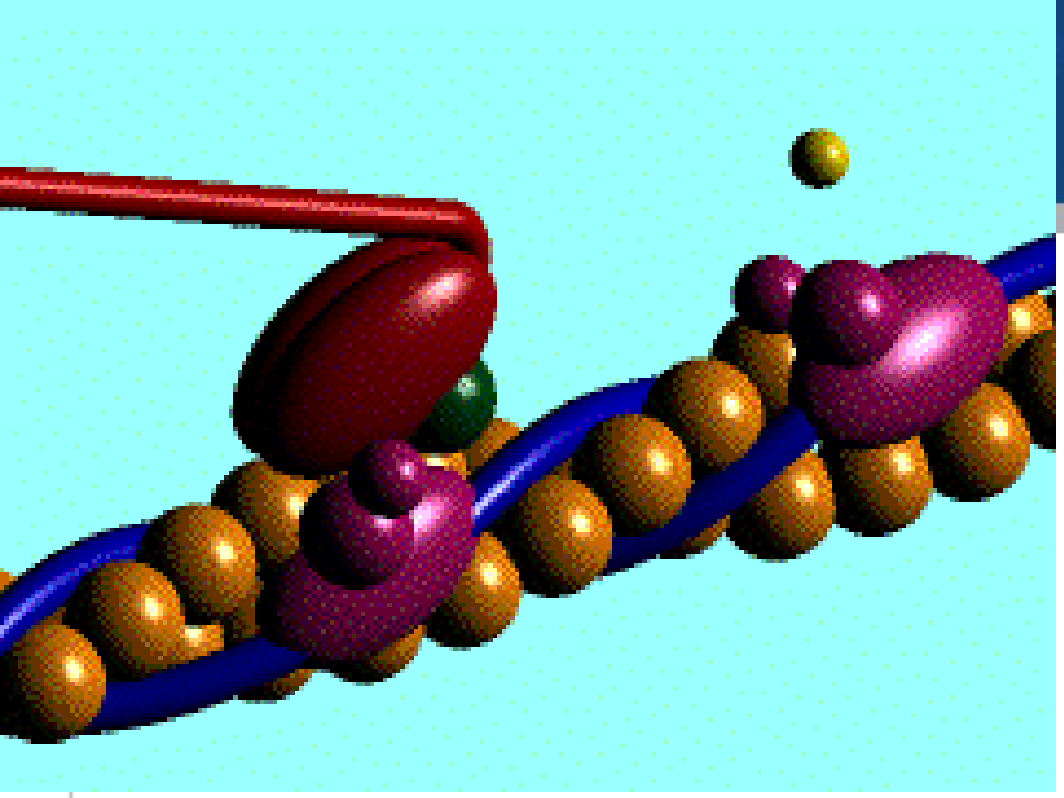

Cross-bridge binding site
Actin
ADP
P_i
Myosin head (high-energy configuration)
3

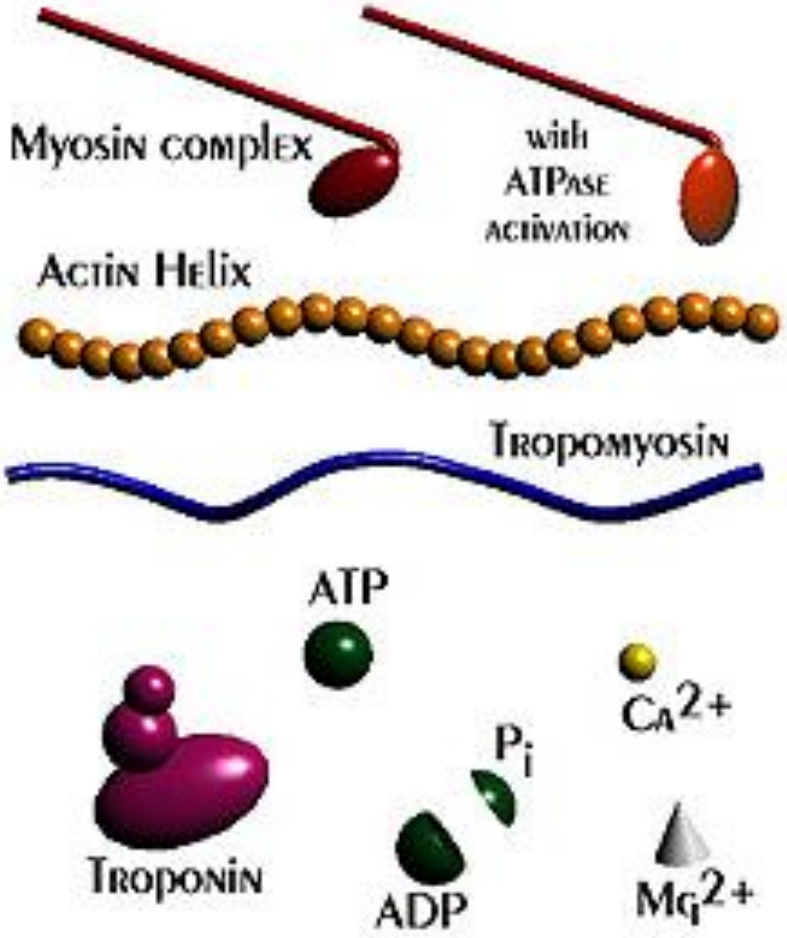

ADP
+ P_i
4

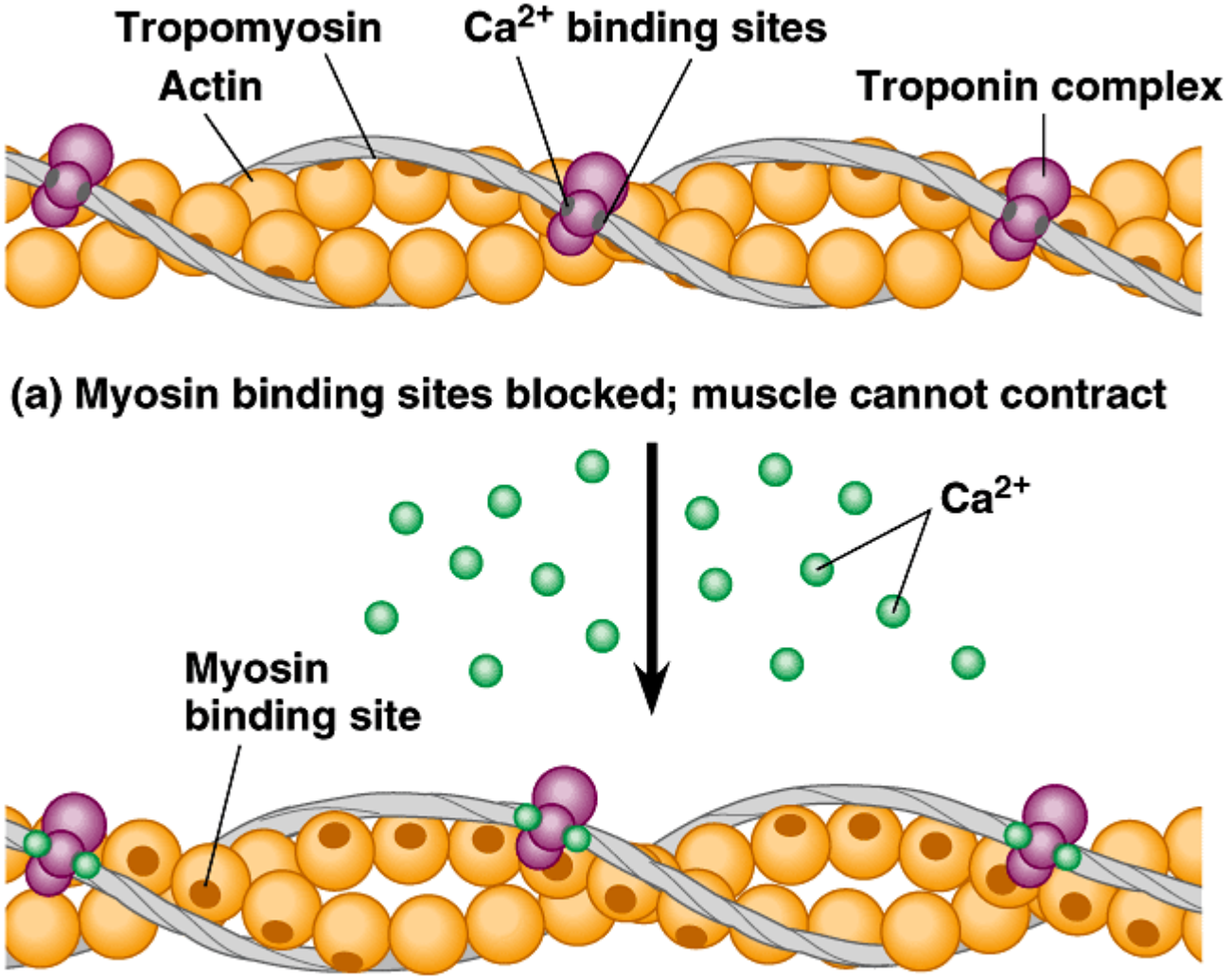

ADP
P_i
Cross-bridge


5
ATP
Thin filament moves toward center of sarcomere.
Myosin head (low-energy configuration)

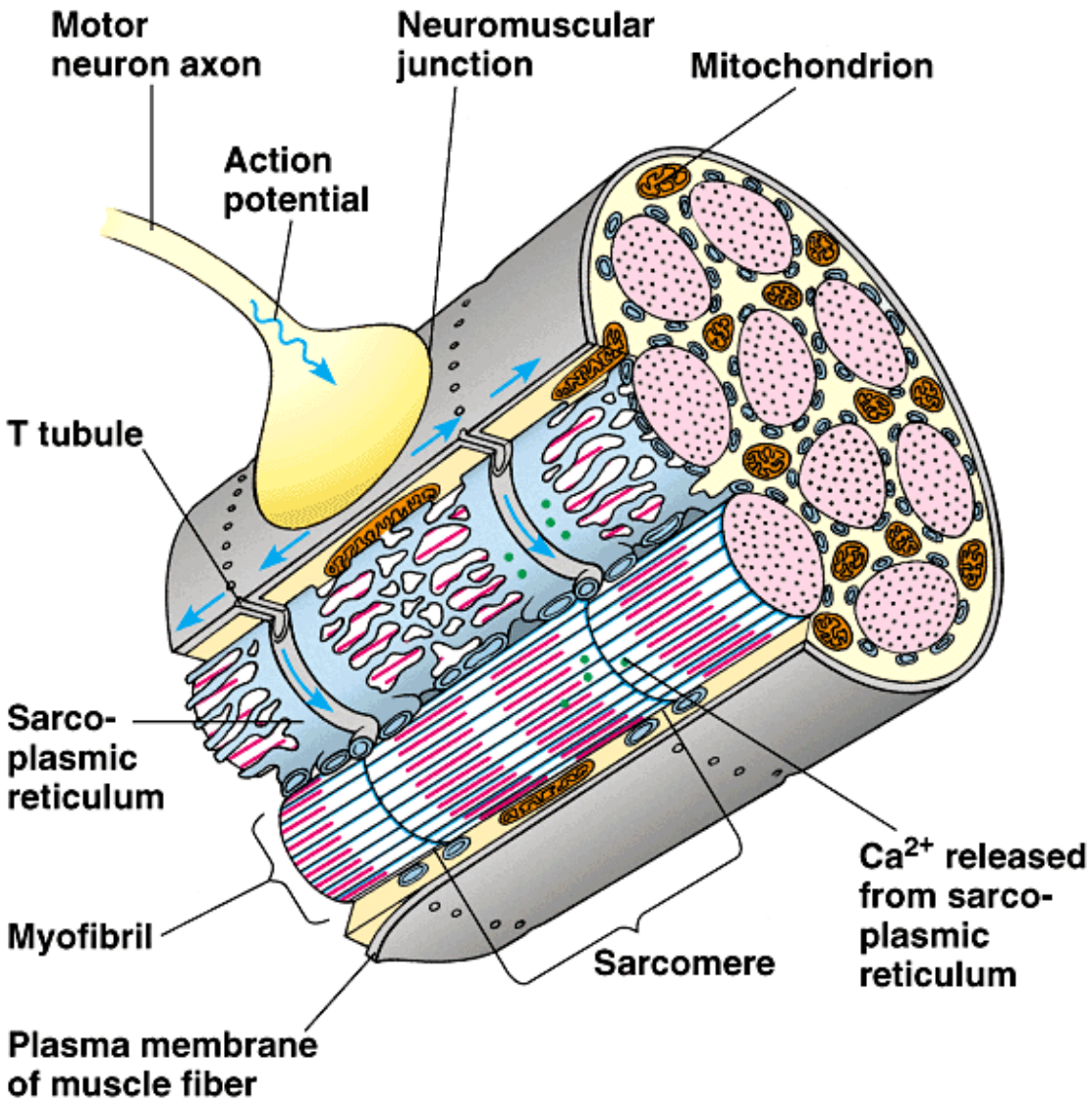


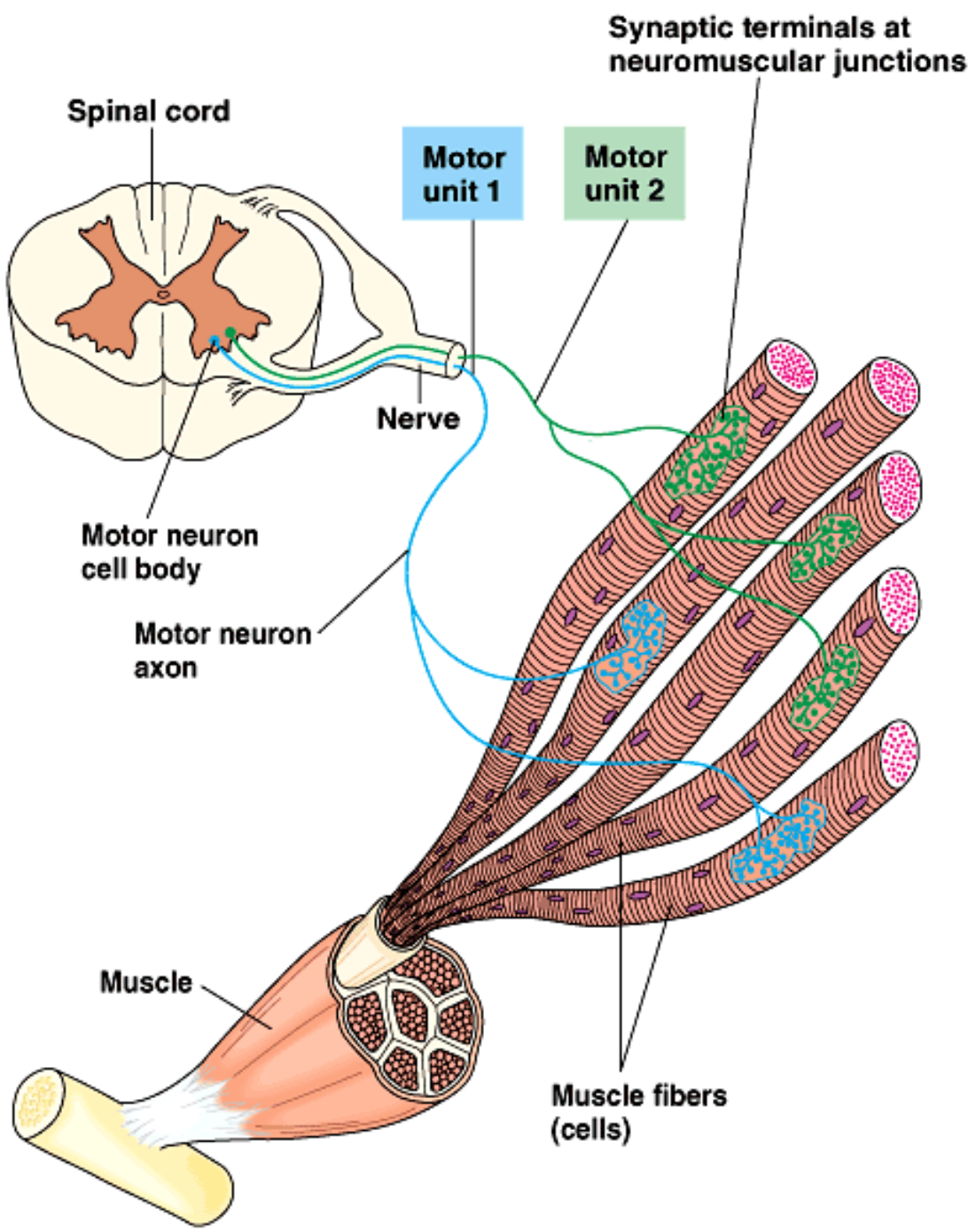



Myosin complex
with
ATPase
activation
Actin Helix
Tropomyosin
ATP
Troponin
ADP
Pi
Ca2+
Mg2+



- The arrival of the action potential causes the sarcoplasmic reticulum to release calcium





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