Table 6.1 Comparison of Skeletal, Cardiac, and Smooth Muscles

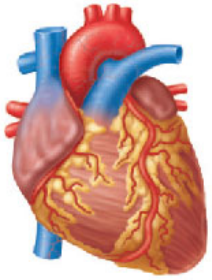
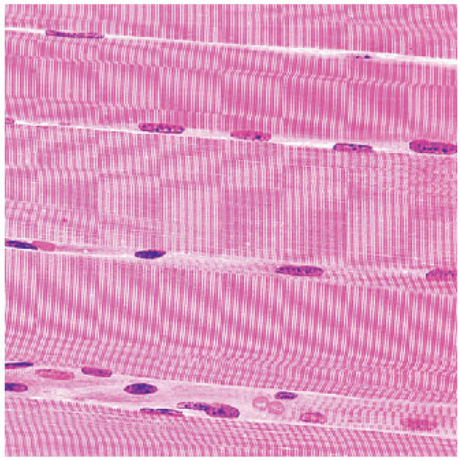
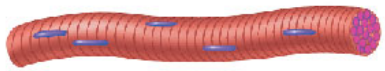
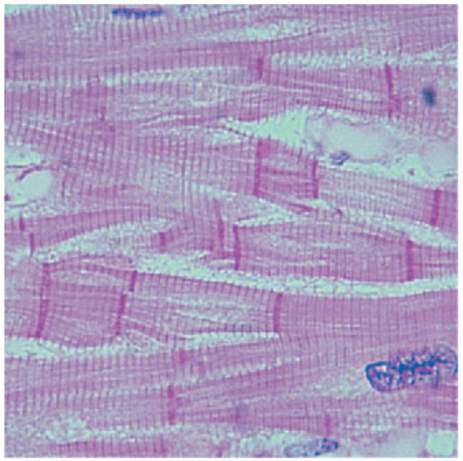
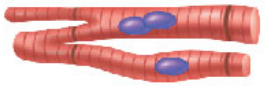
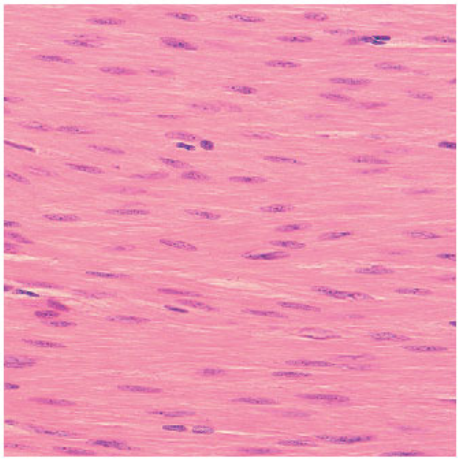
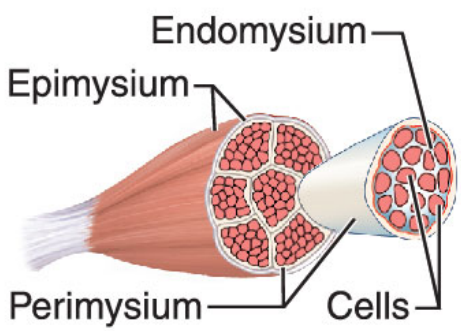
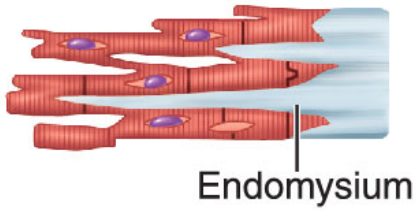
Characteristic	Skeletal	Cardiac	Smooth
Body location	Attached to bones or, for some facial muscles, to skin 	Walls of the heart 	Mostly in walls of hollow visceral organs (other than the heart) 
Cell shape and appearance	Single, very long, cylindrical, multinucleate cells with very obvious striations  	Branching chains of cells; uninucleate, striations; intercalated discs  	Single, fusiform, uninucleate; no striations  

Table 6.1 **Comparison of Skeletal, Cardiac, and Smooth Muscles** (*continued*)

Characteristic	Skeletal	Cardiac	Smooth
Connective tissue components	Epimysium, perimysium, and endomysium	Endomysium attached to the fibrous skeleton of the heart	Endomysium





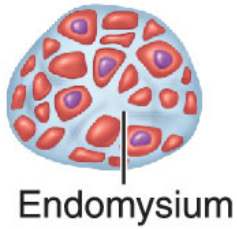
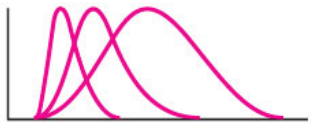
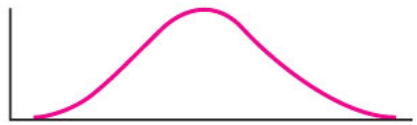
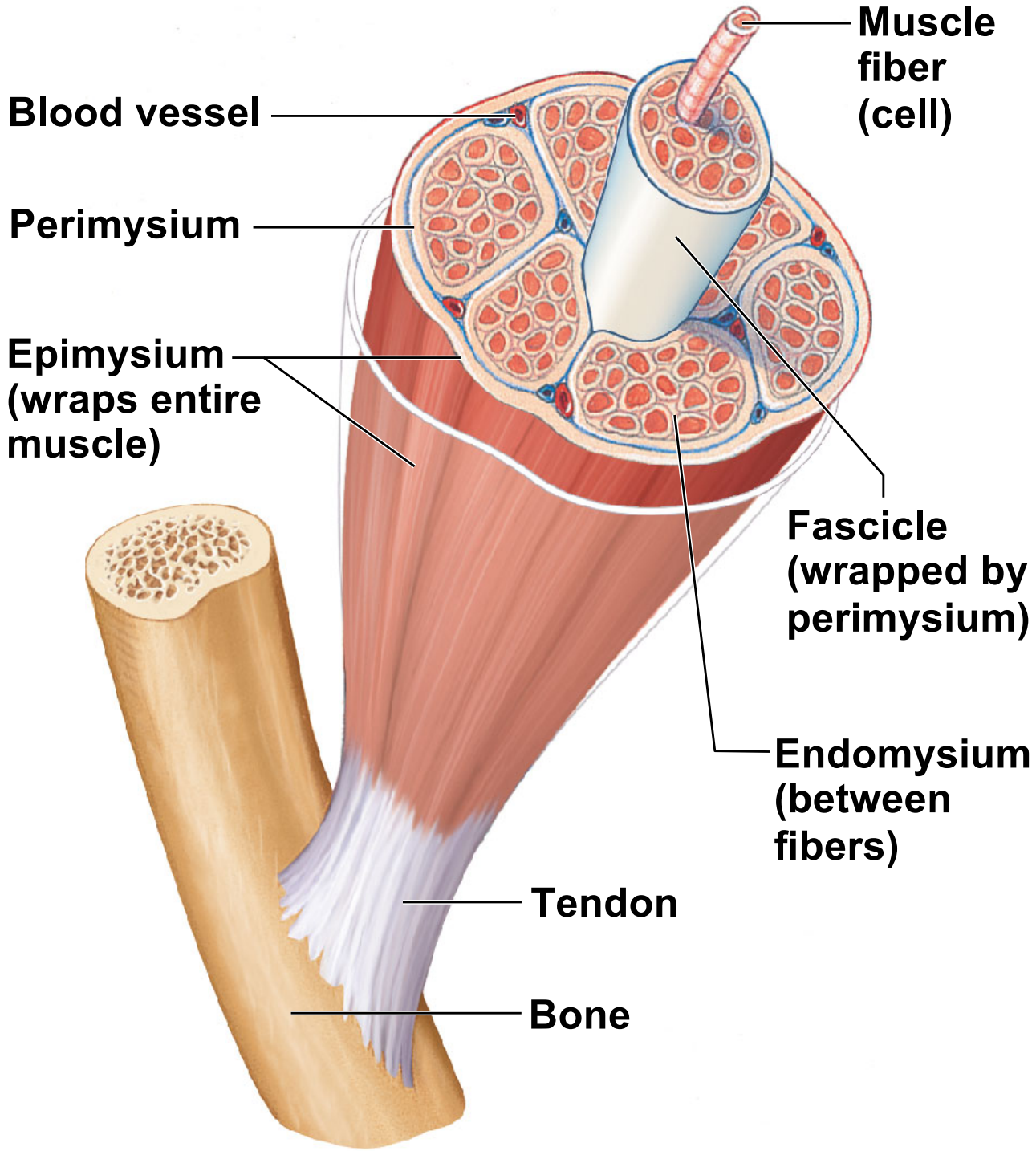
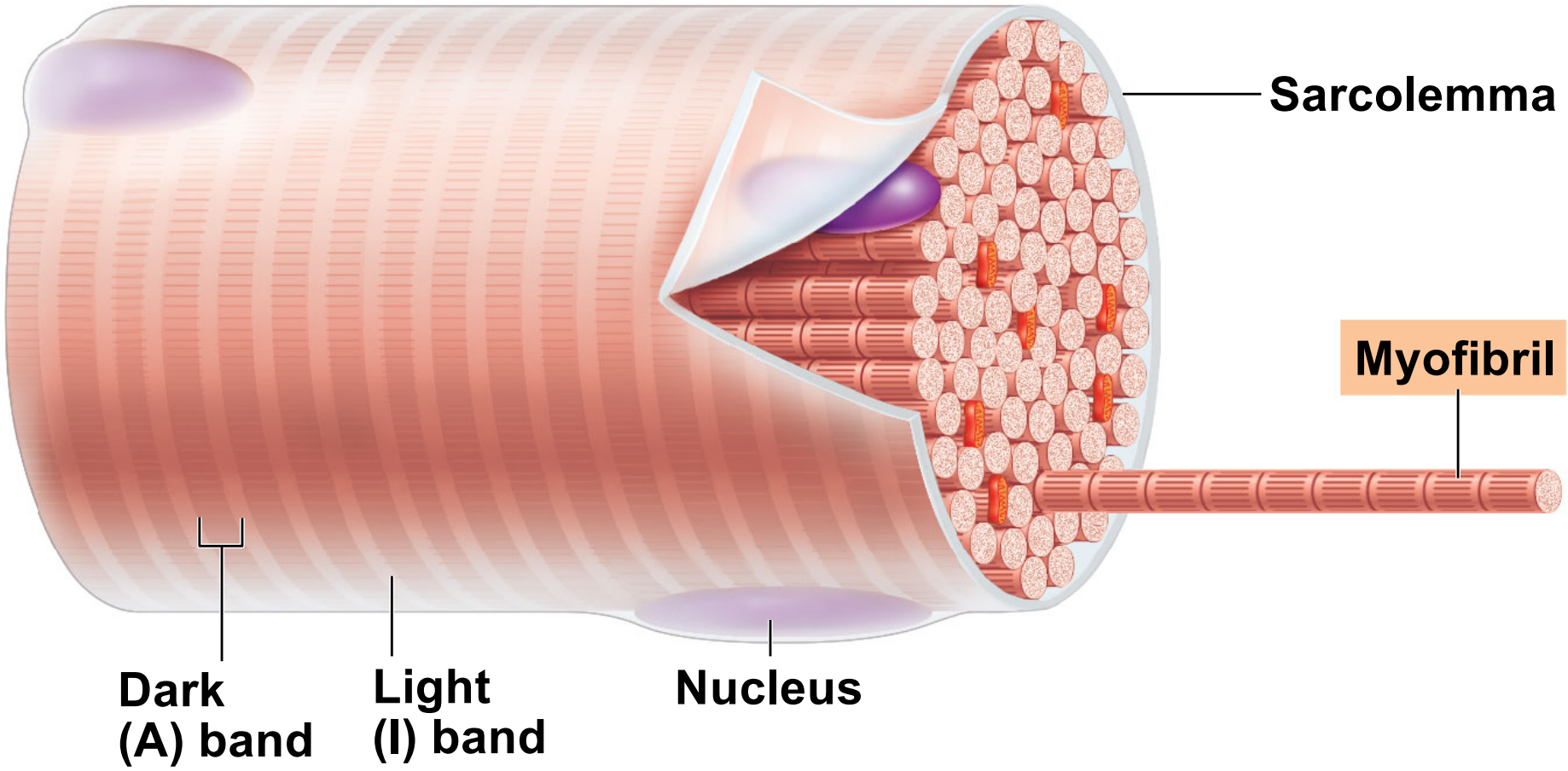


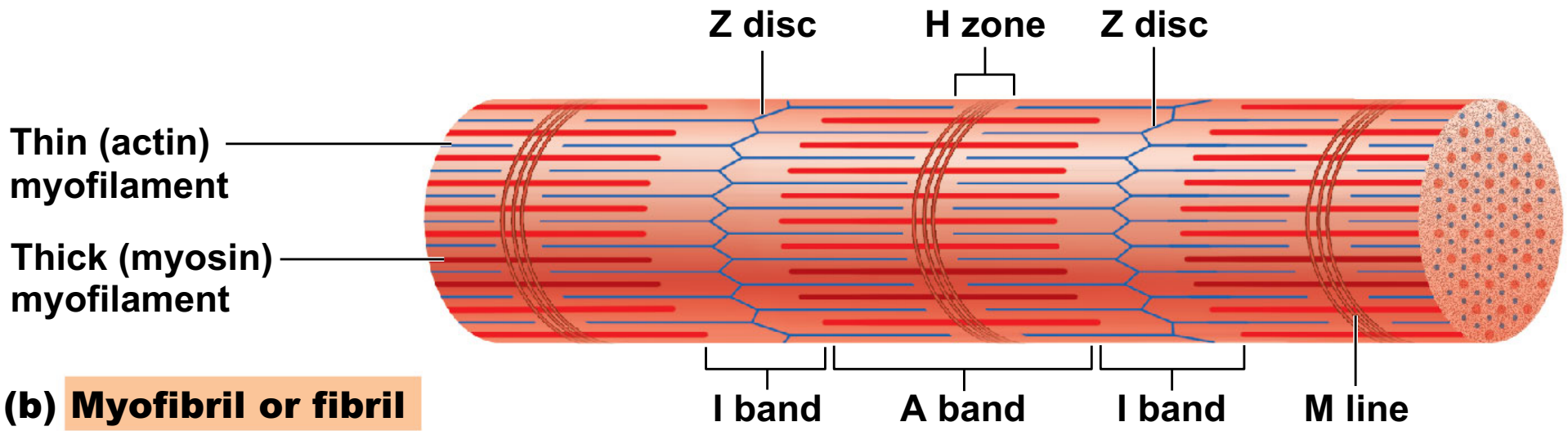
Table 6.1 **Comparison of Skeletal, Cardiac, and Smooth Muscles** (*continued*)

Characteristic	Skeletal	Cardiac	Smooth
Regulation of contraction	Voluntary; via nervous system controls	Involuntary; the heart has a pacemaker; also nervous system controls; hormones	Involuntary; nervous system controls; hormones, chemicals, stretch
Speed of contraction	Slow to fast 	Slow 	Very slow 
Rhythmic contraction	No	Yes	Yes, in some

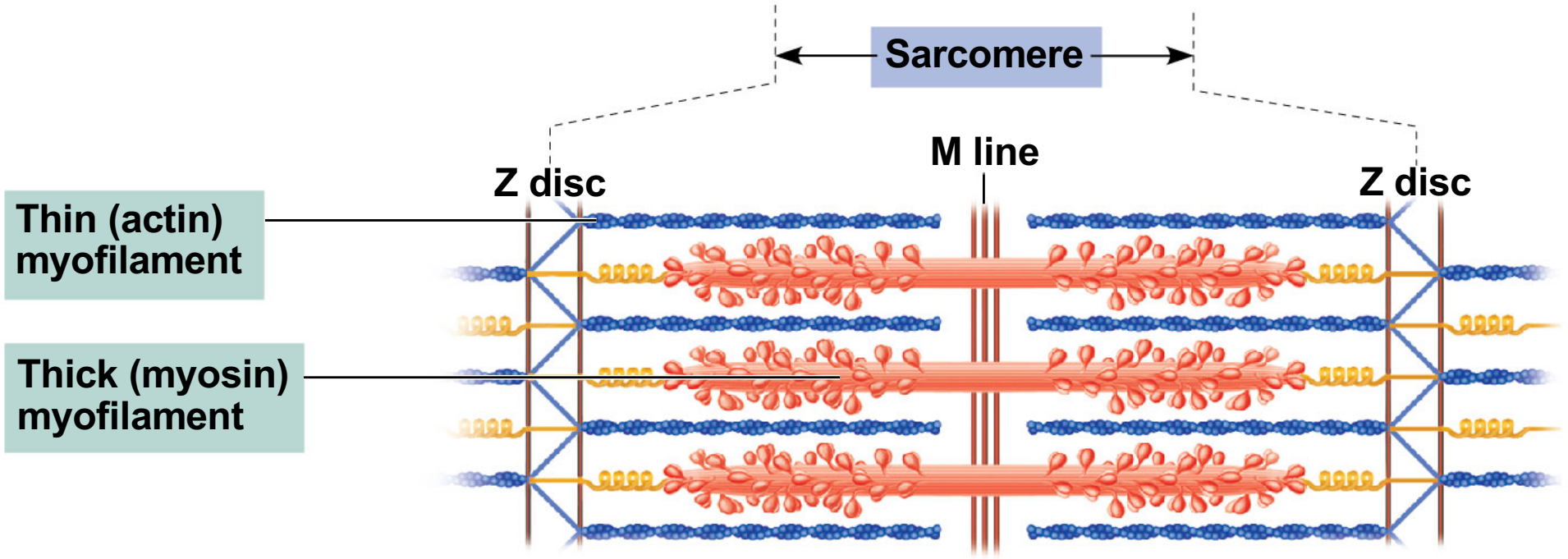




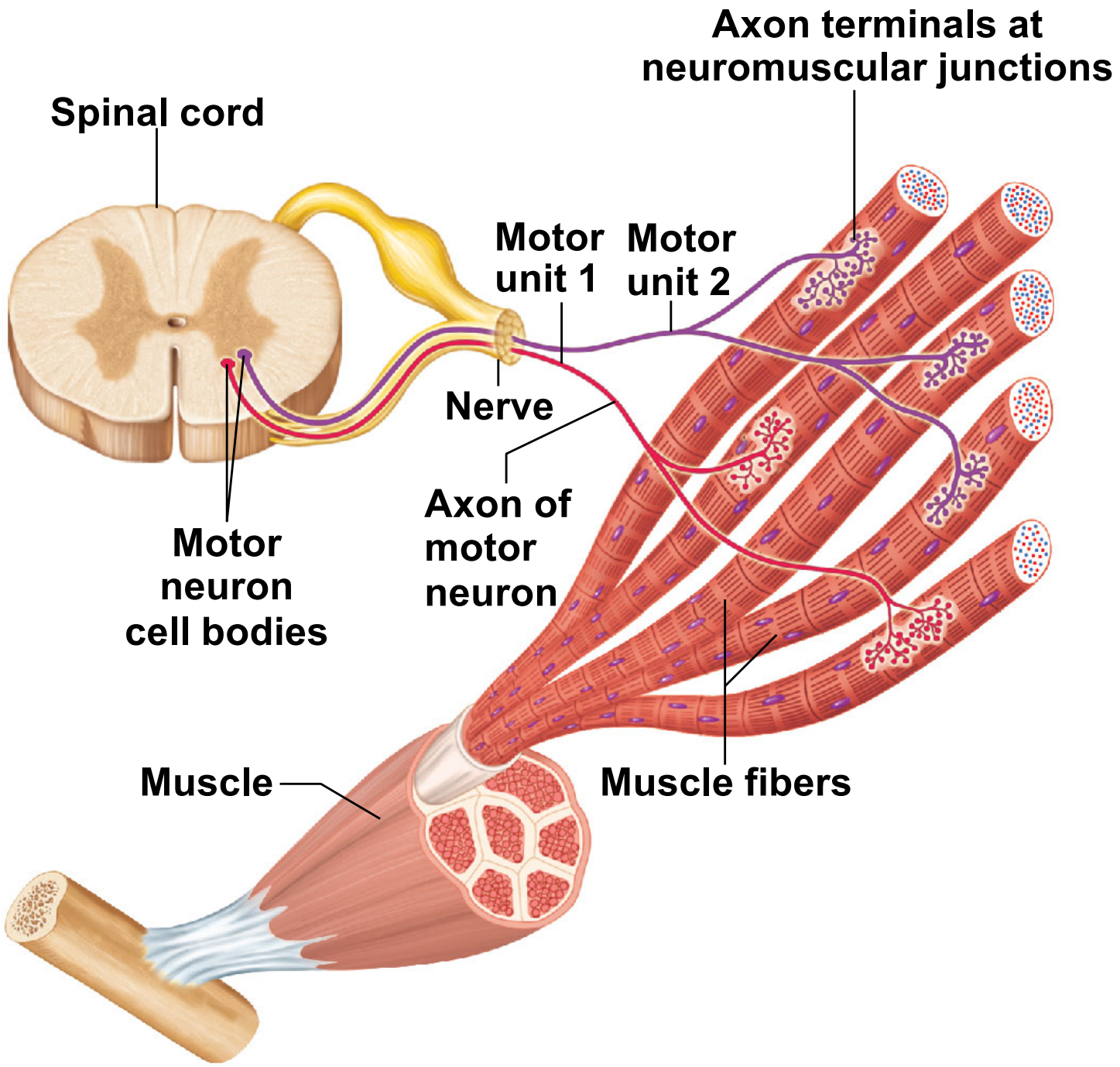
(a) Segment of a muscle fiber (cell)



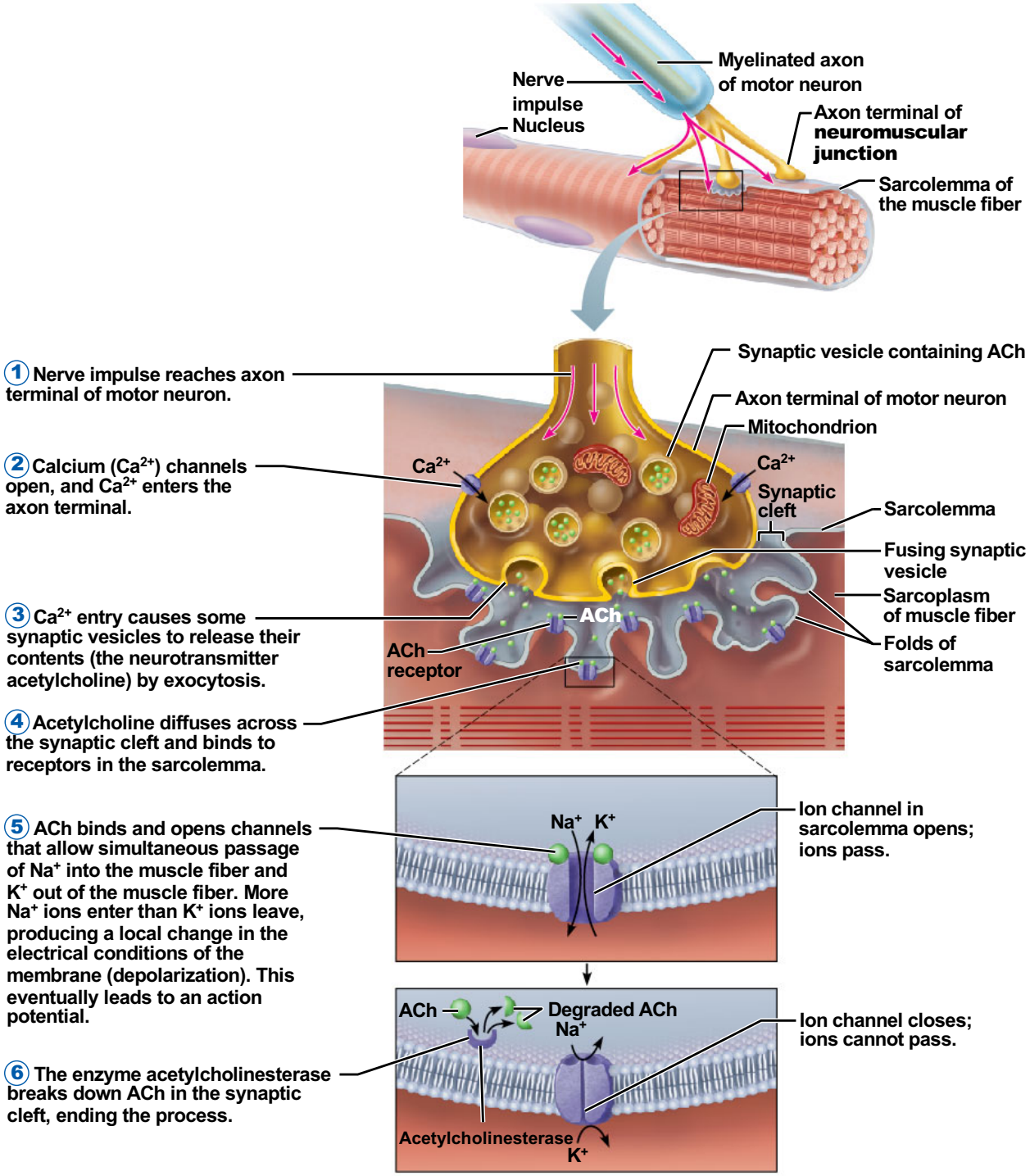
(b) Myofibril or fibril (complex organelle composed of bundles of myofilaments)

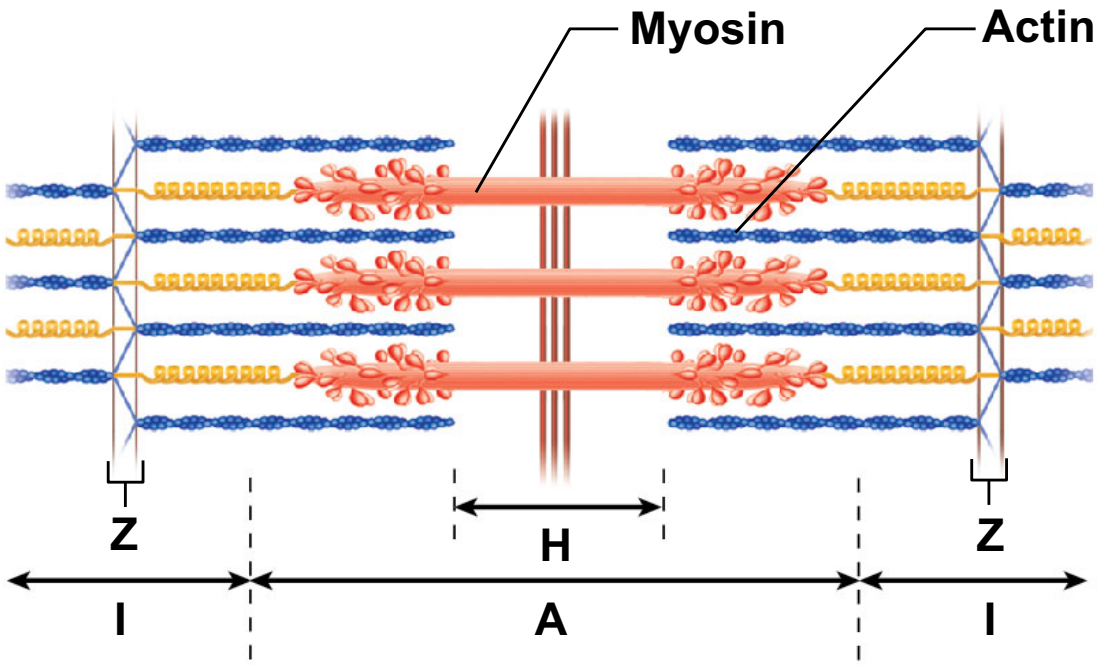


(c) Sarcomere (segment of a myofibril)

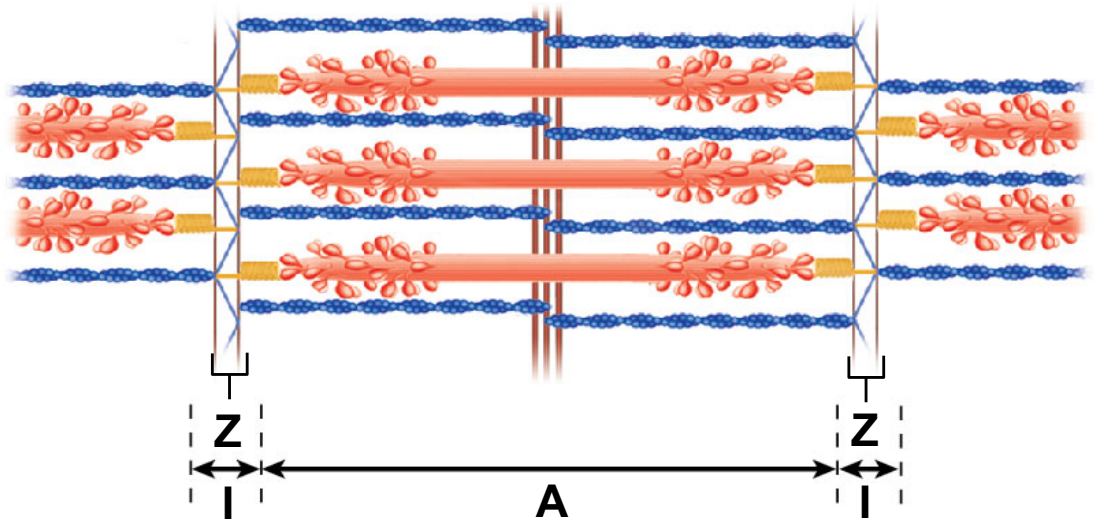


(a)

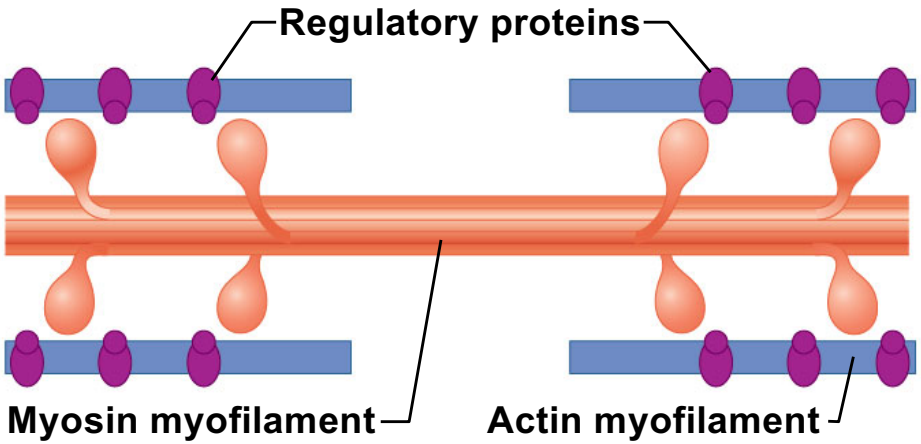




(a) Relaxed sarcomere

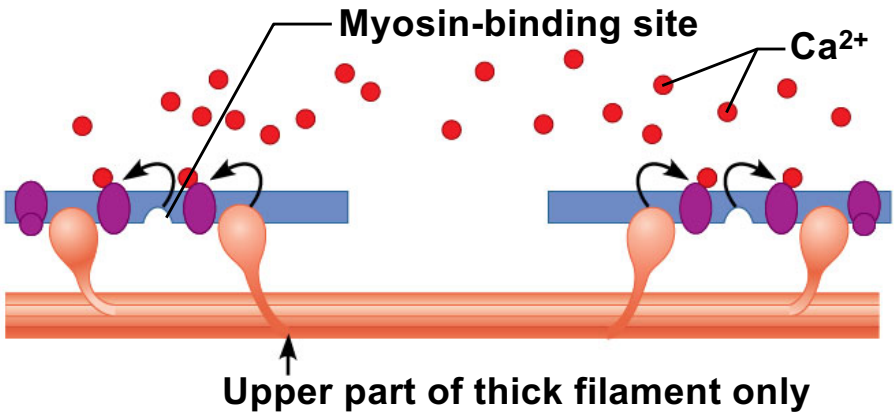


(b) Fully contracted sarcomere



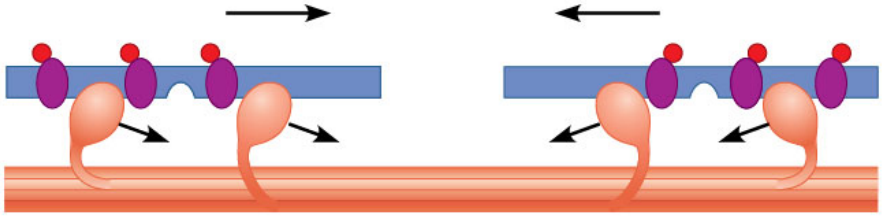
(a)

In a relaxed muscle fiber, the regulatory proteins forming part of the actin myofilaments prevent myosin binding (see **a**). When an action potential (AP) sweeps along its sarcolemma and a muscle fiber is excited, calcium ions (Ca^{2+}) are released from intracellular storage areas (the sacs of the sarcoplasmic reticulum).



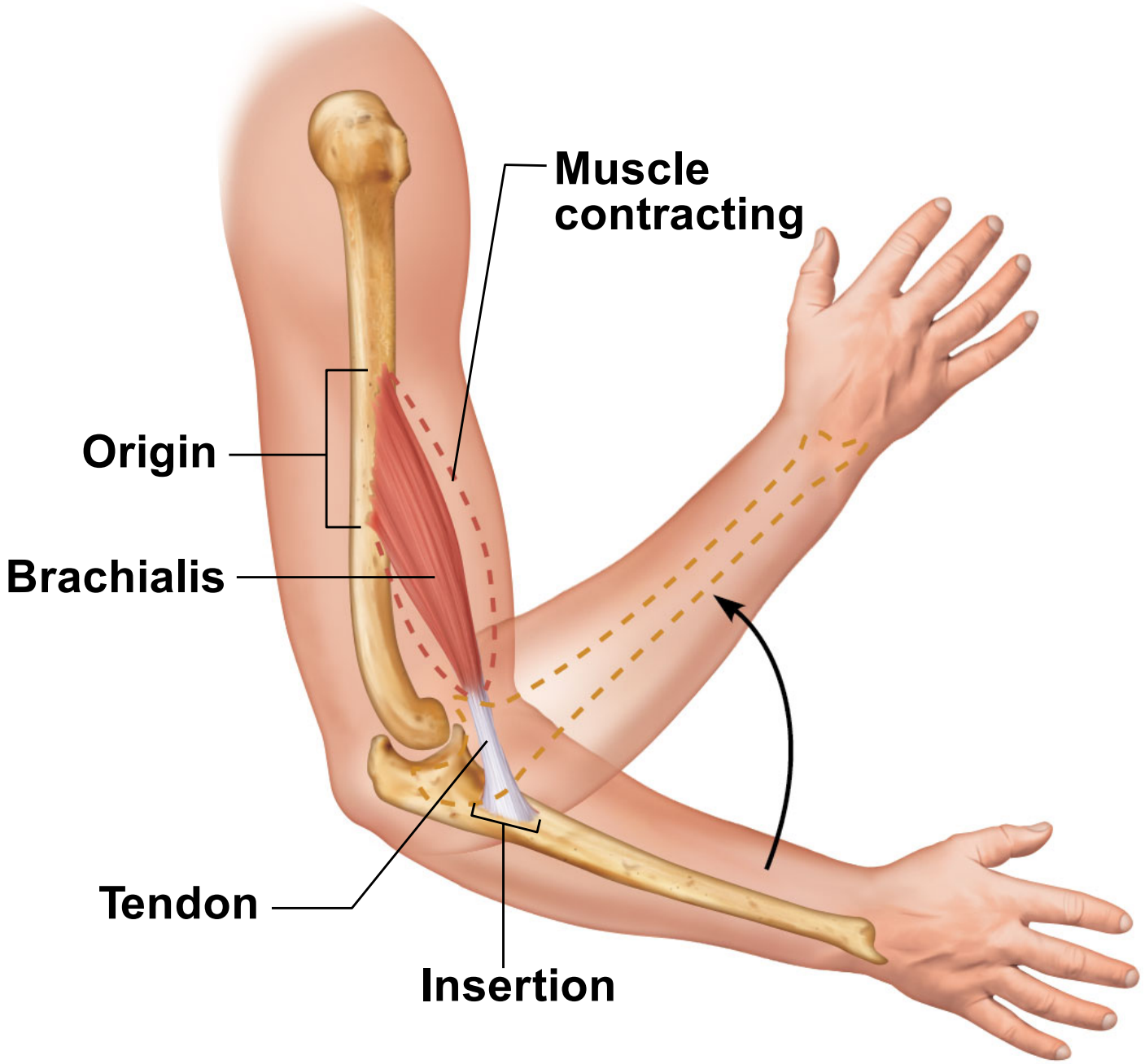
(b)

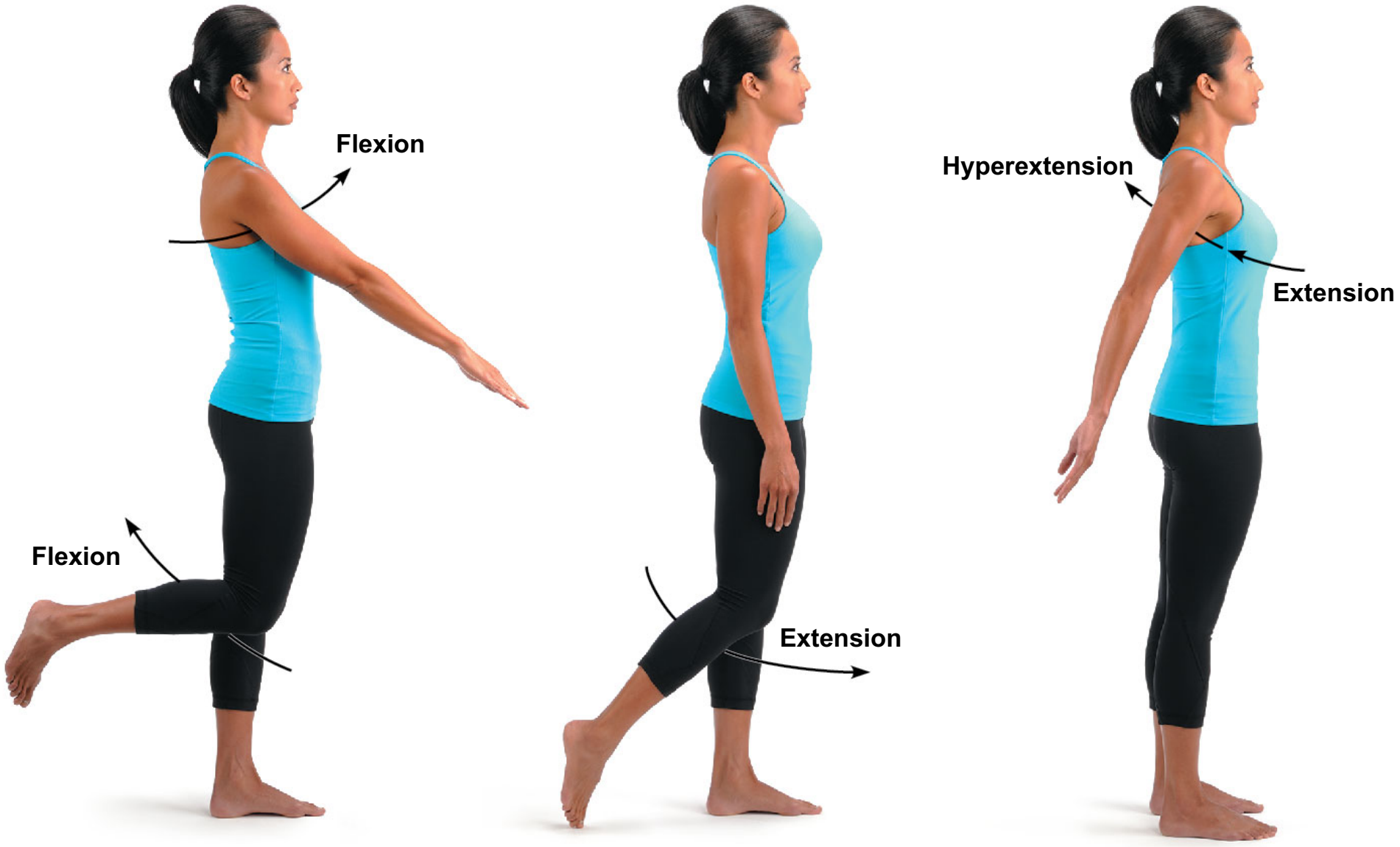
The flood of calcium acts as the final trigger for contraction, because as calcium binds to the regulatory proteins on the actin filaments, the proteins undergo a change in both their shape and their position on the thin filaments. This action exposes myosin-binding sites on the actin, to which the myosin heads can attach (see b), and the myosin heads immediately begin seeking out binding sites.



(c)

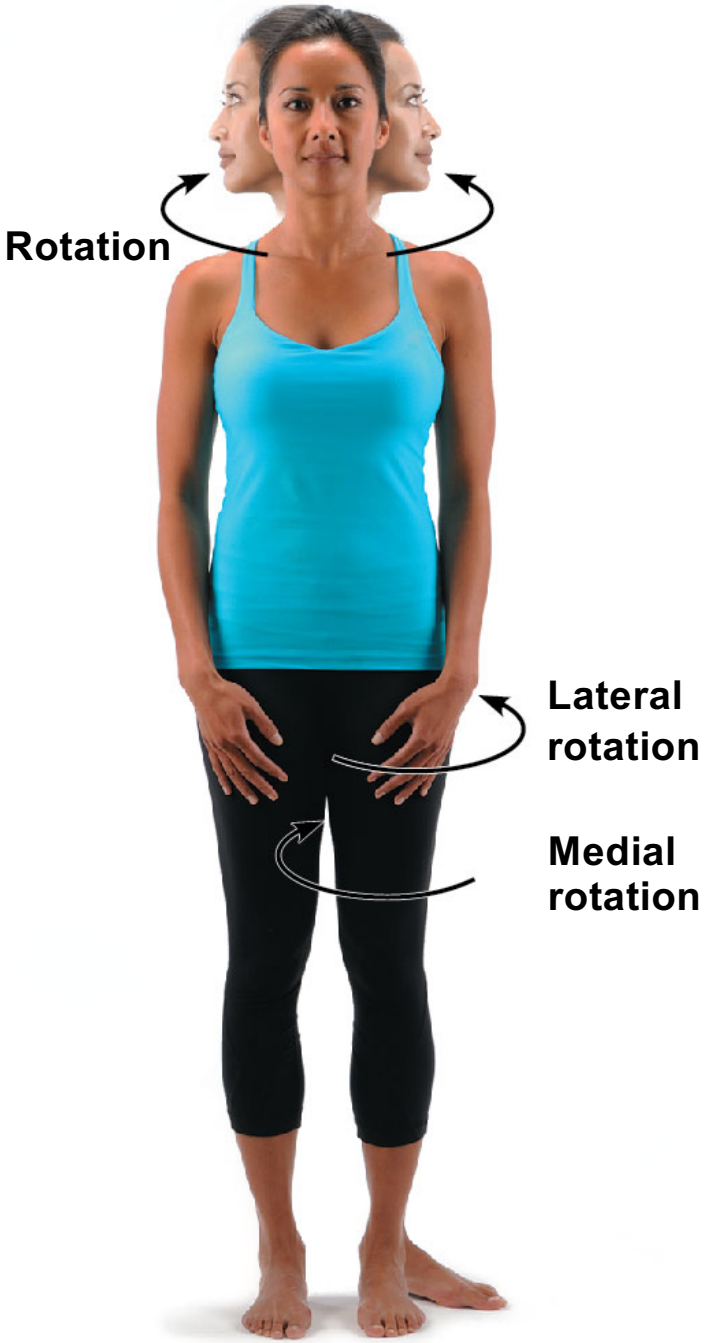
The free myosin heads are “cocked,” much like an oar ready to be pulled on for rowing. Myosin attachment to actin causes the myosin heads to snap (pivot) toward the center of the sarcomere in a rowing motion. When this happens, the thin filaments are slightly pulled toward the center of the sarcomere (see **c**). ATP provides the energy needed to release and recock each myosin head so that it is ready to attach to a binding site farther along the thin filament.





(a) Flexion, extension, and hyperextension of the shoulder and knee

(b) Flexion, extension, and hyperextension



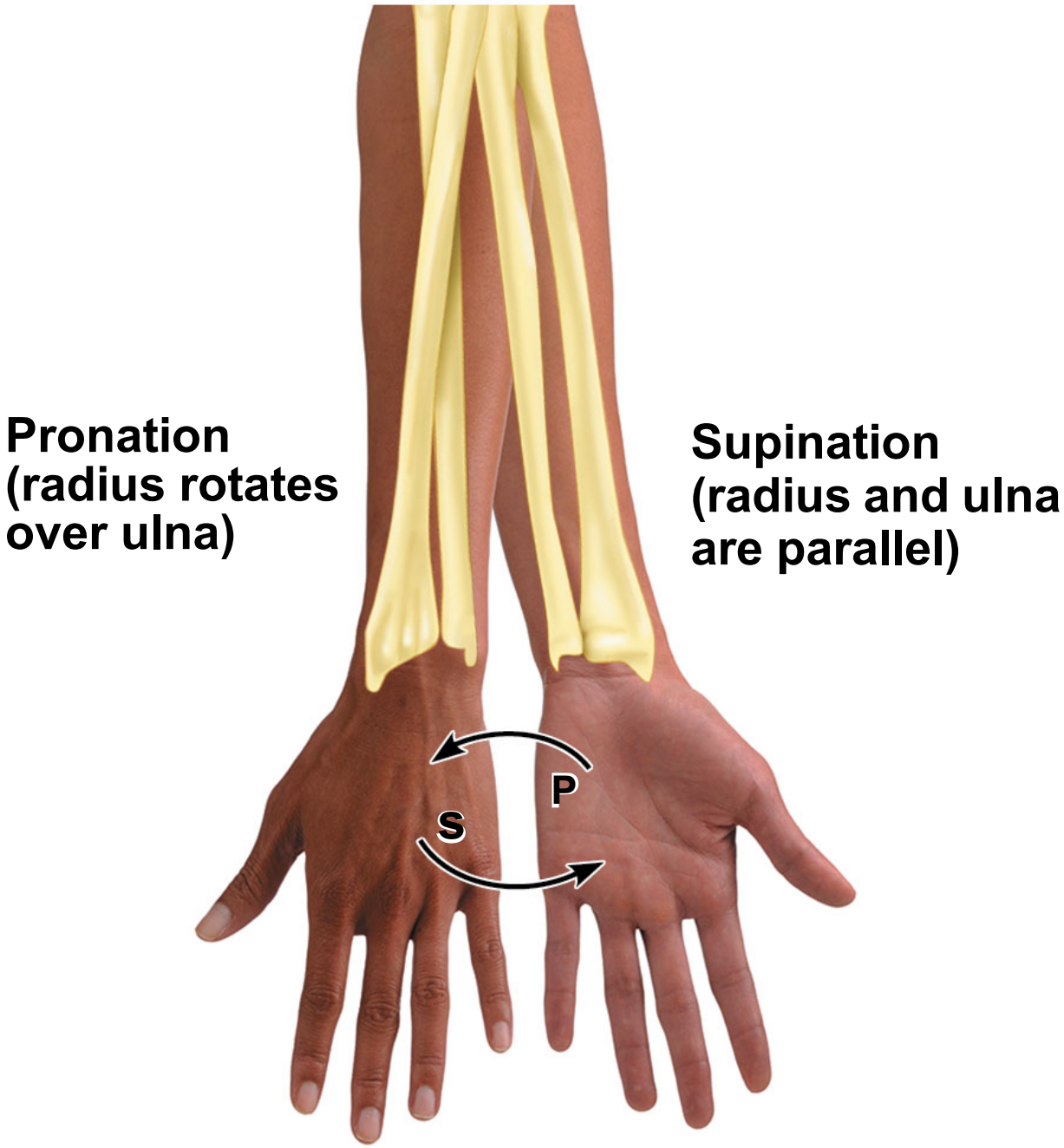
(c) Rotation

(d) Abduction, adduction, and circumduction

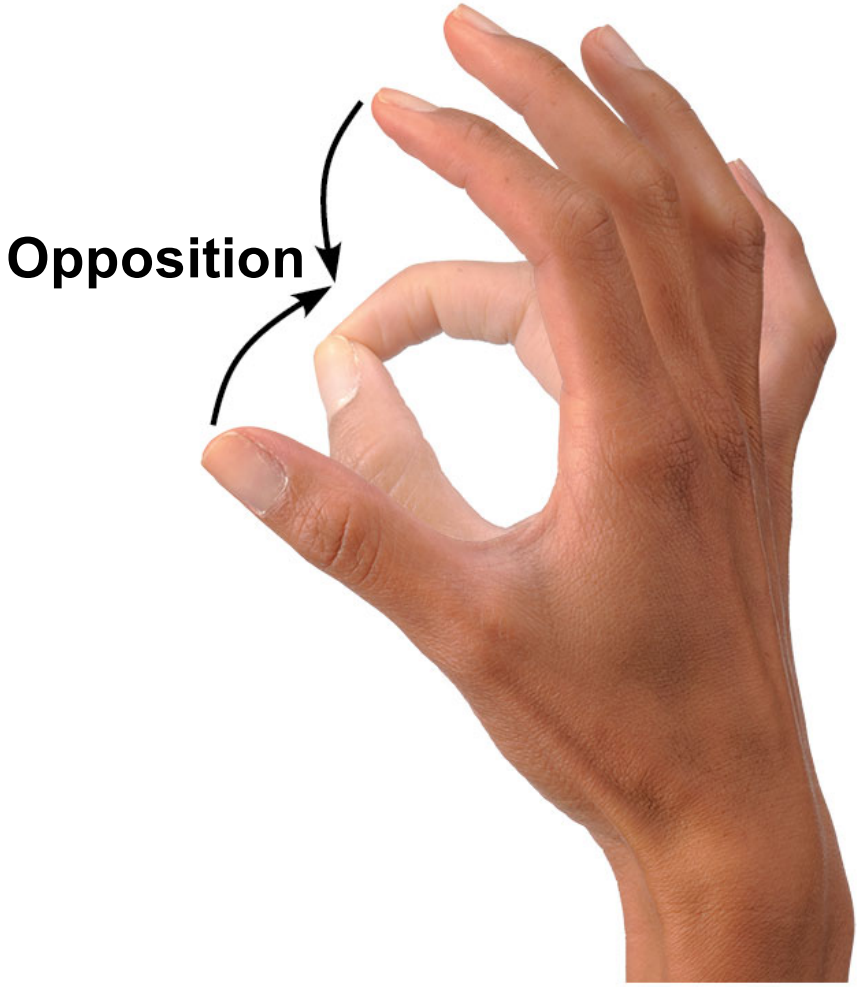
(d) Abduction, adduction, and circumduction

(e) Dorsiflexion and plantar flexion

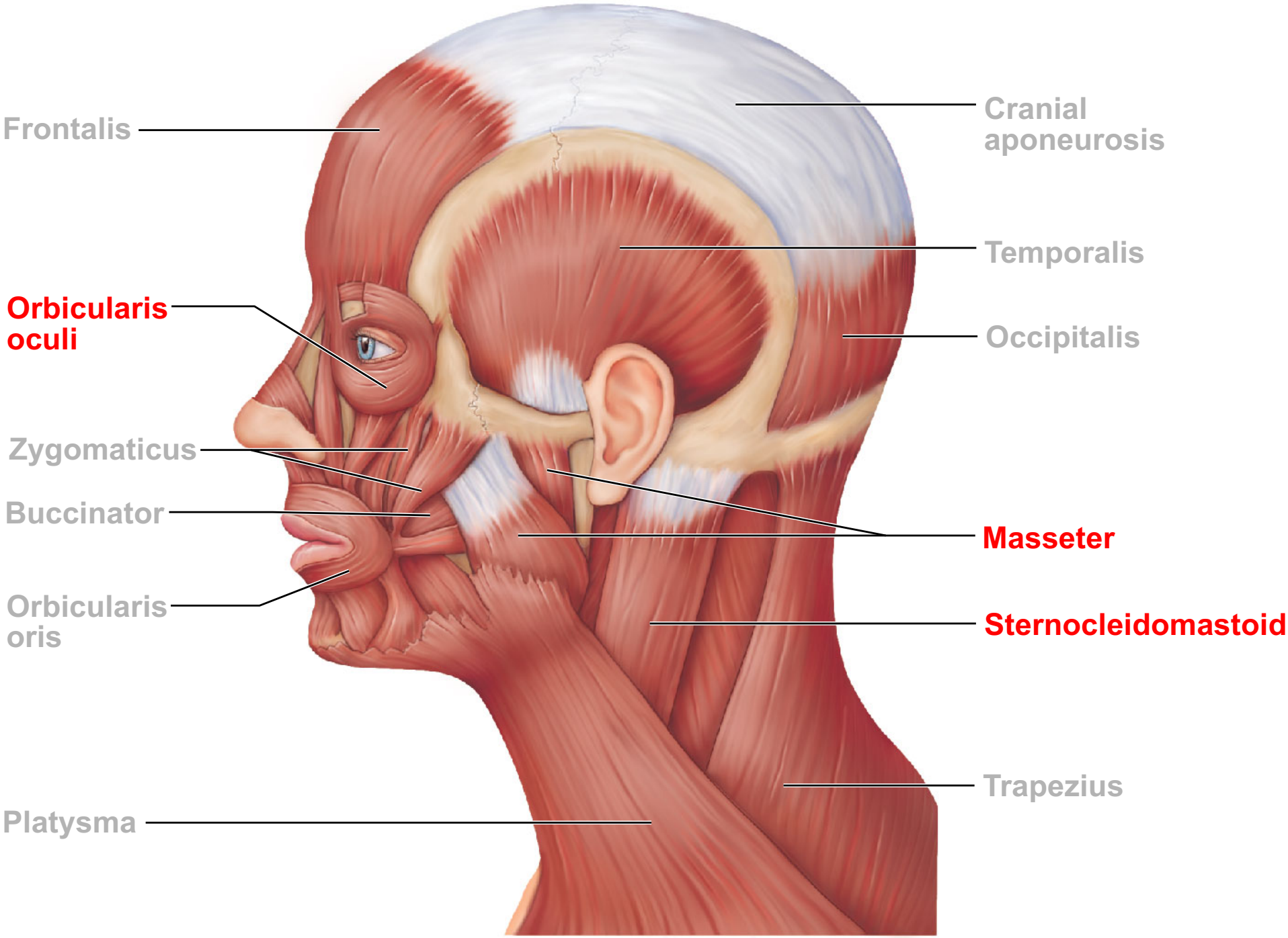
(f) Inversion and eversion

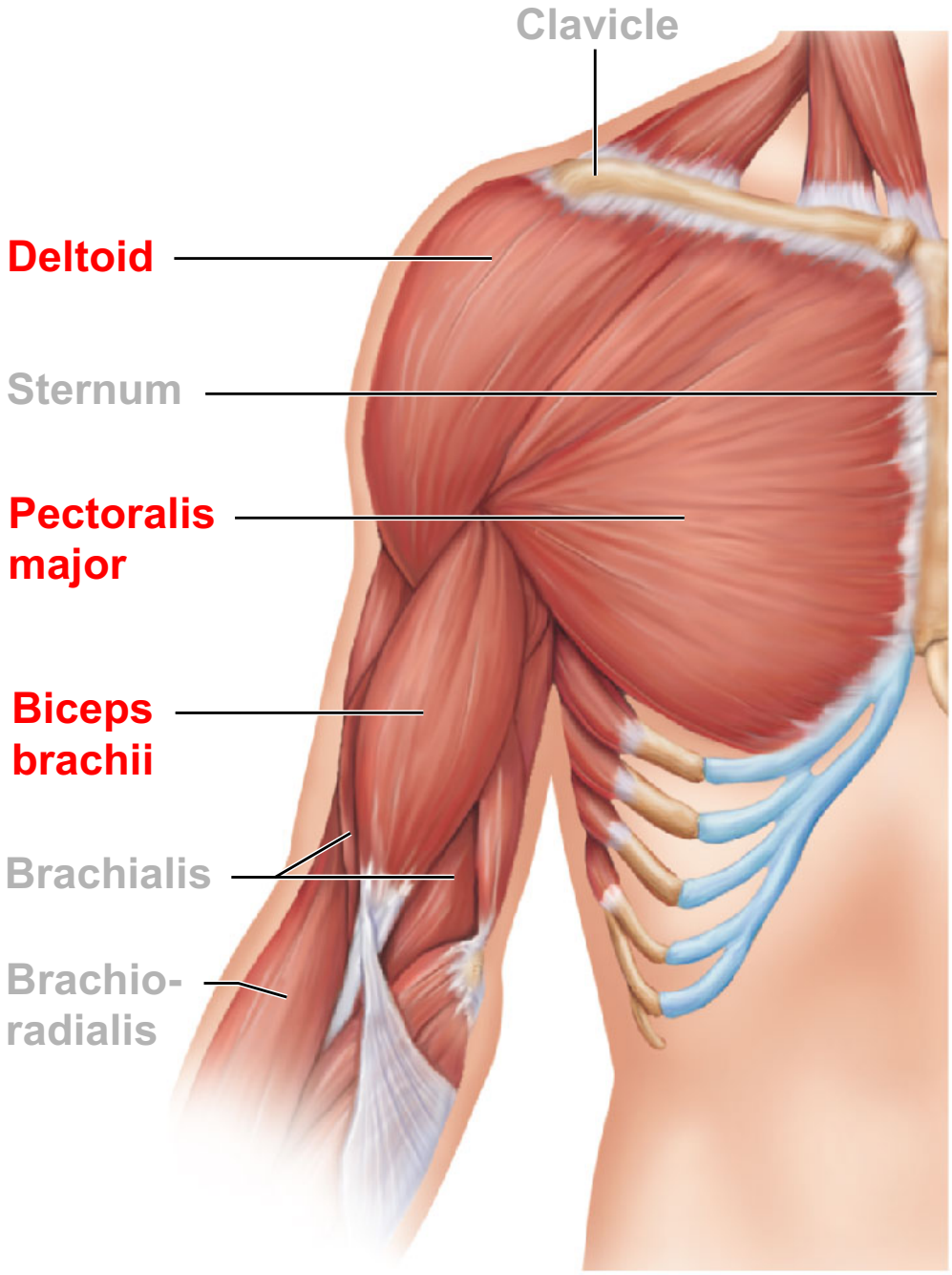


(g) Supination (S) and pronation (P)

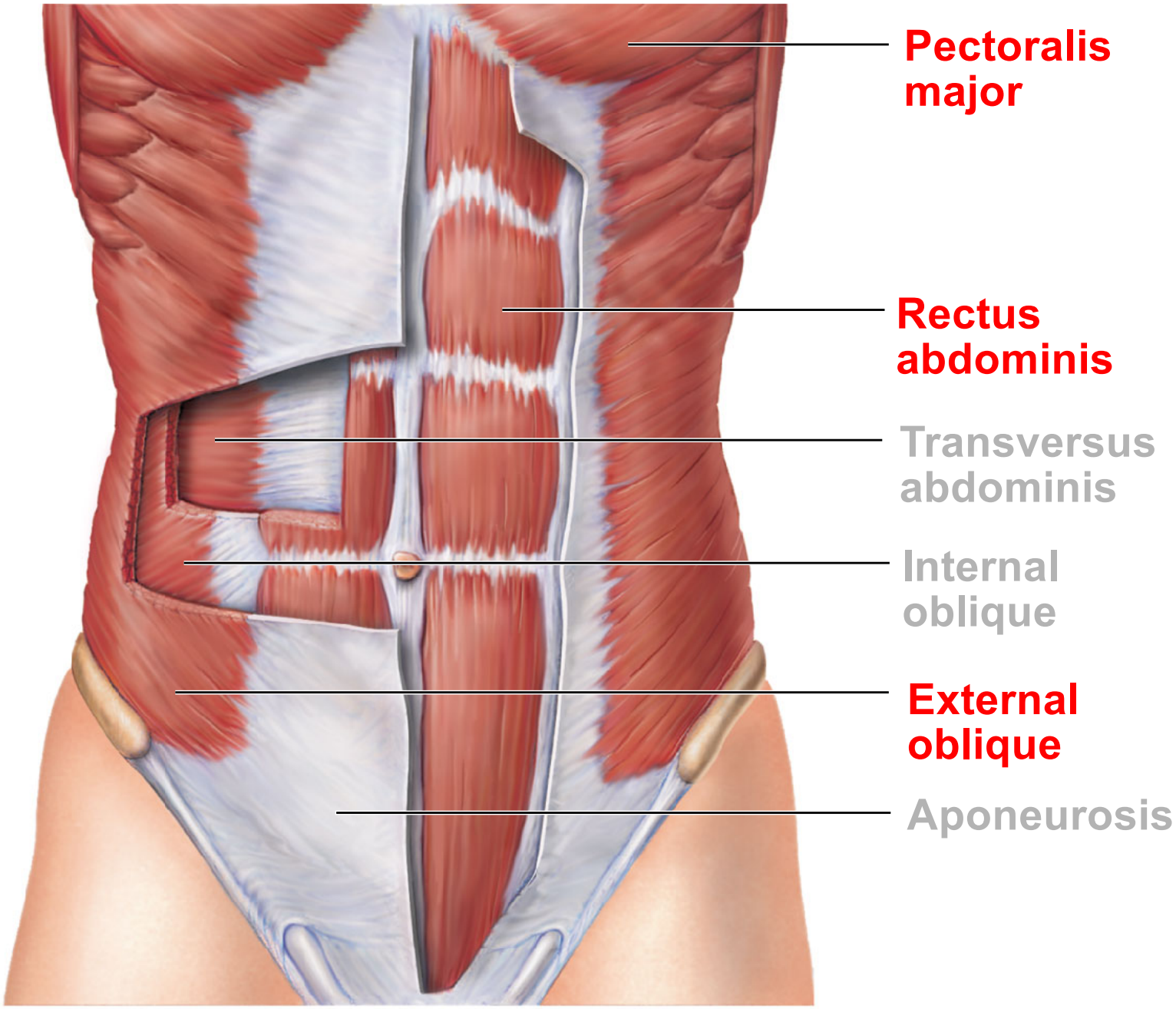


(h) Opposition

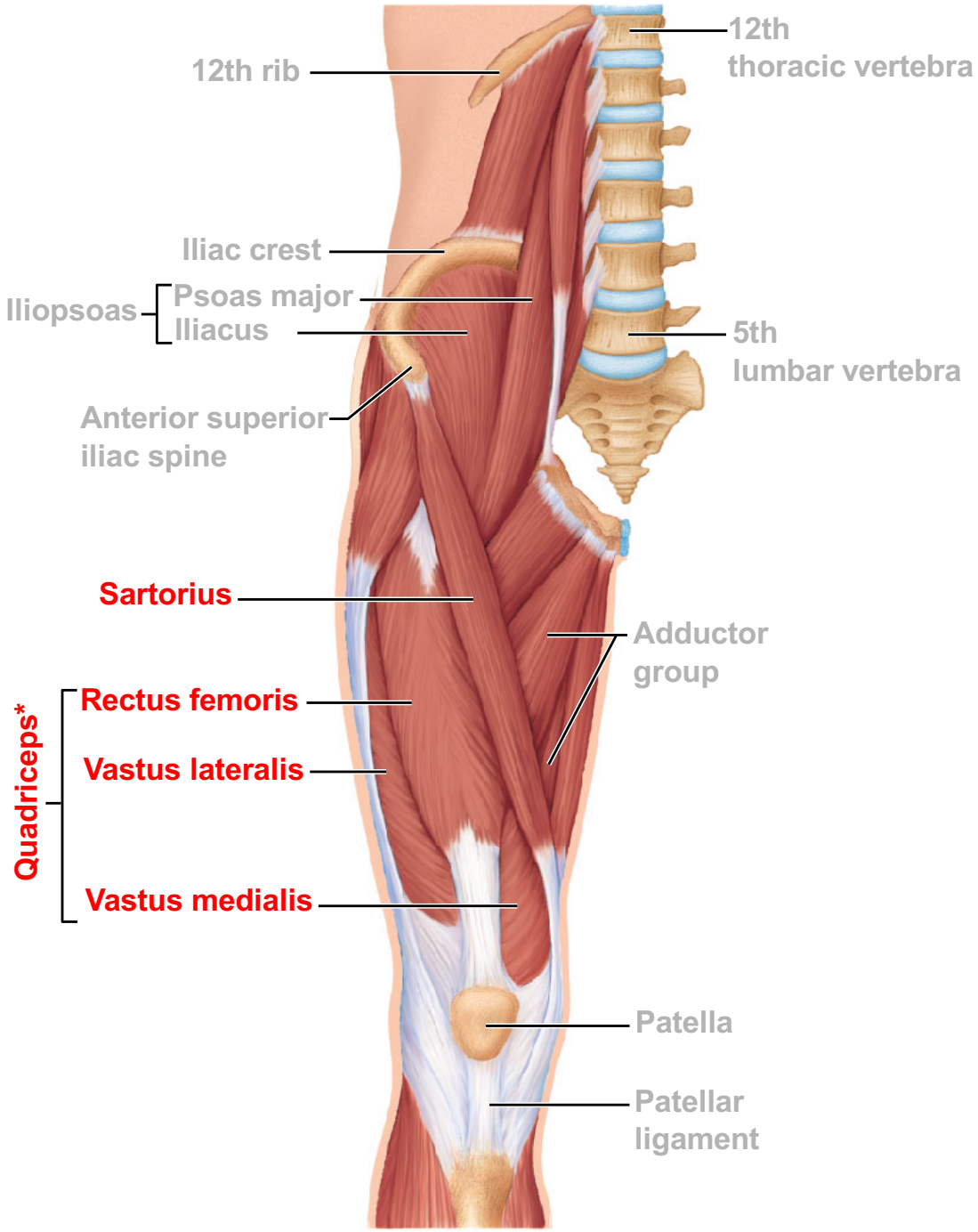




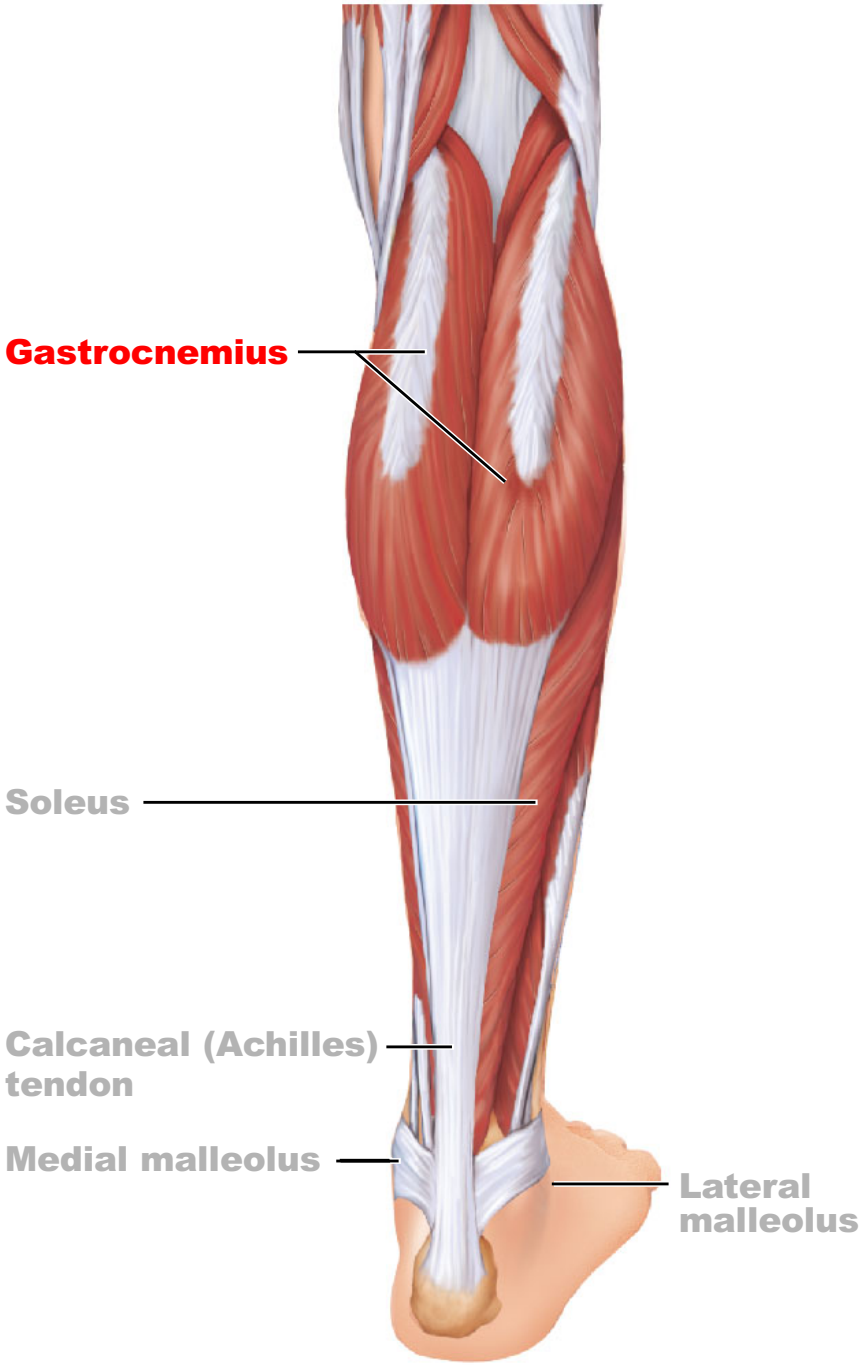
(a)



(b)



(c)



(b)