BHARATHIDASAN UNIVERSITY

Program: M.Sc., Biomedical Science

Course Title: Neurobiology

Muscle Contraction

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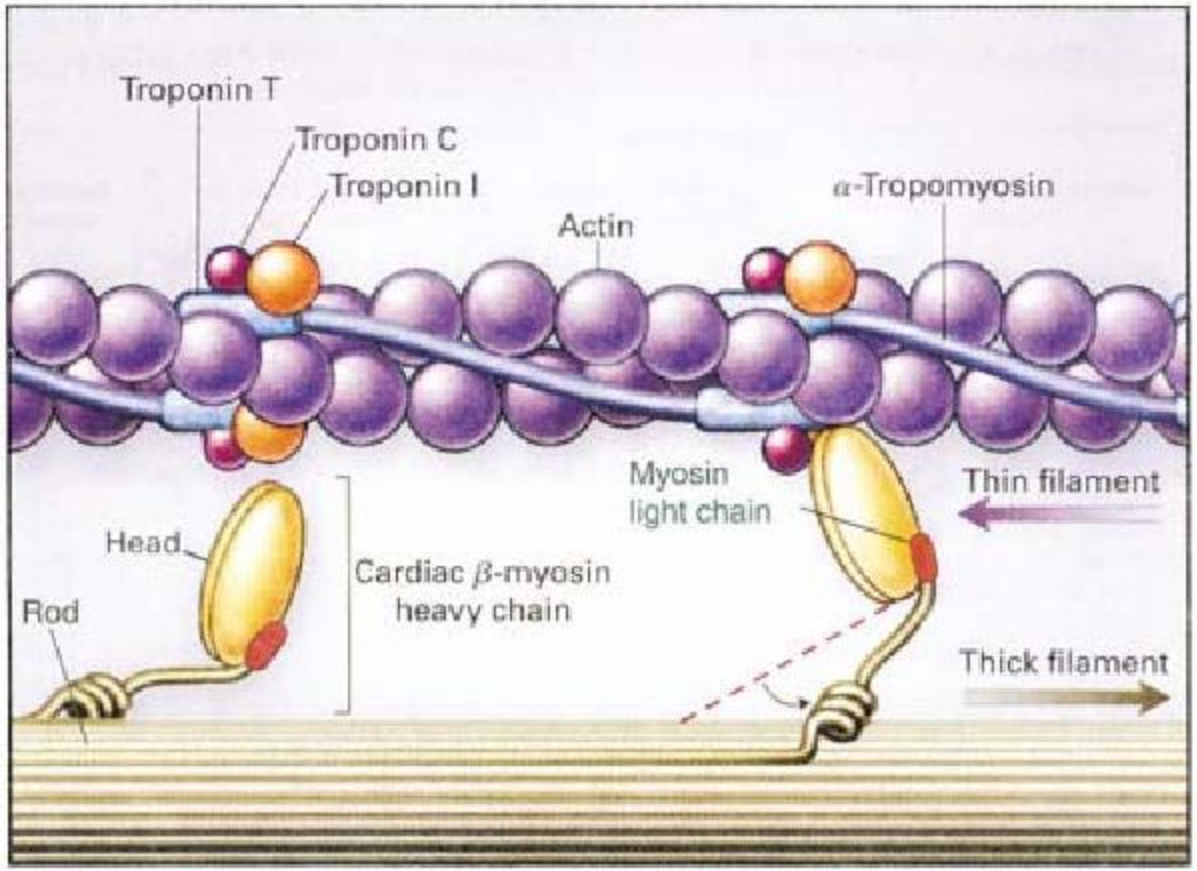
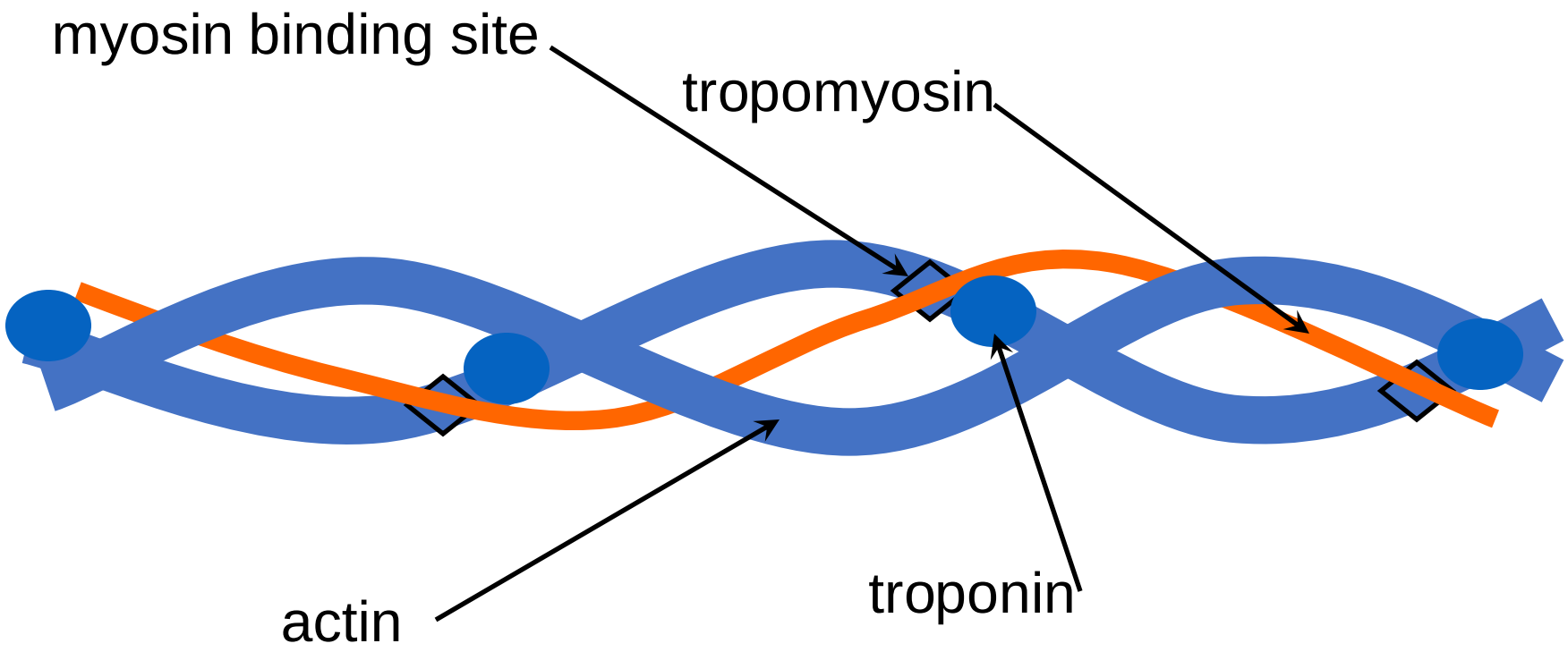


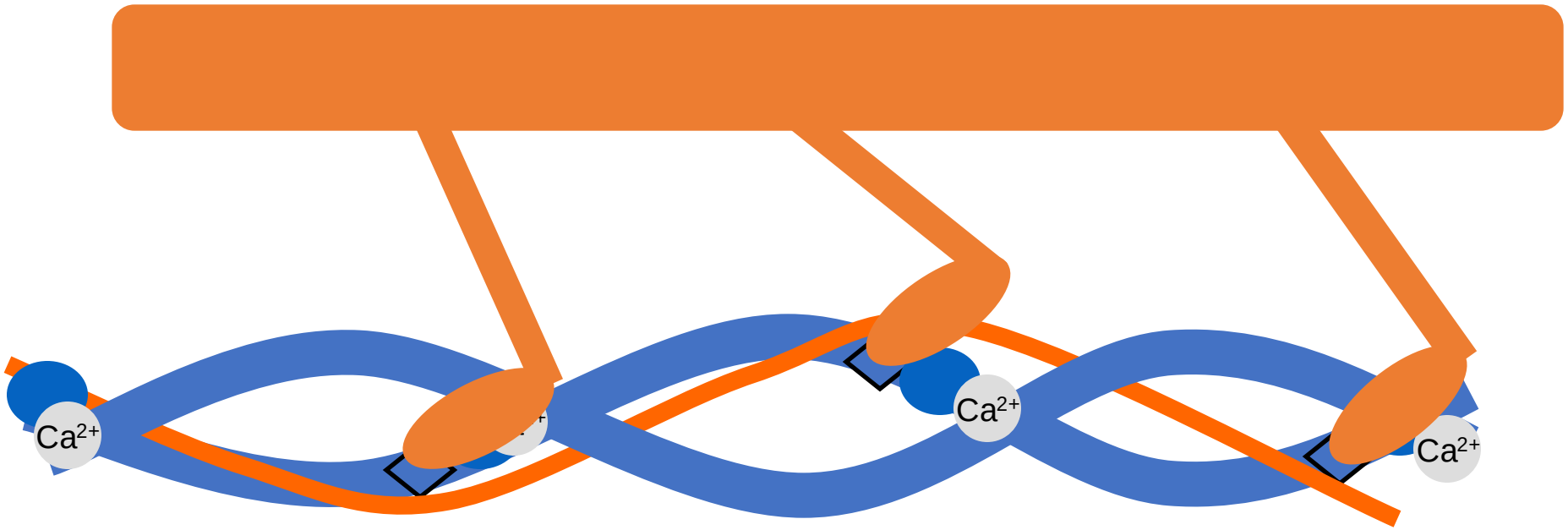
Proteins in the thin filament include the troponin complex (T, C, and I), actin, and α-tropomyosin. Myosin heavy chain and light chains are constituents of the thick filaments. Contraction begins with calcium entry into the sarcomere that releases troponin I inhibition of actin and enables actin–myosin binding. Myosin, the molecular motor of the sarcomere, hydrolyzes ATP and undergoes a series of conformational changes, initiated in the globular head domain and transmitted through flexible joints to the rod domain, so that the thick filament is propelled with respect to the thin filament. As calcium is sequestered by the sarcoplasmic reticulum, troponin I inhibition of actin–myosin interactions is reestablished.

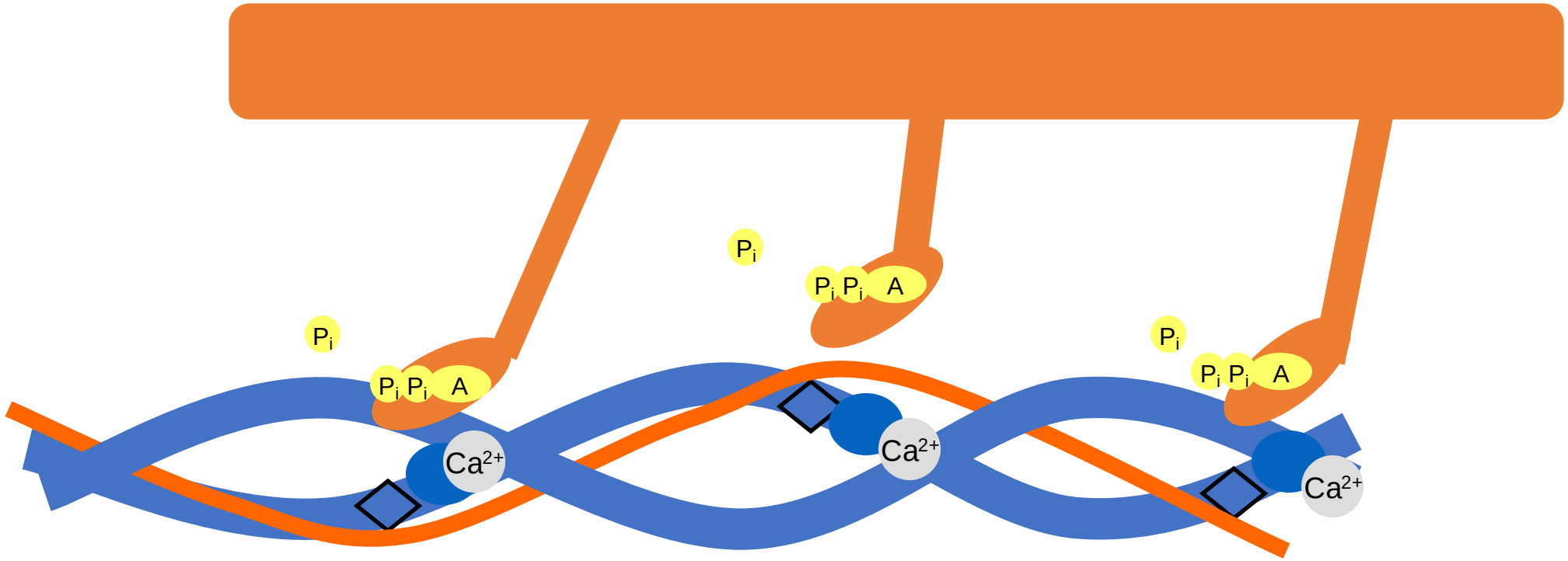
J.G. Seidman, and C. Seidman, The Genetic Basis for Cardiomyopathy: from Mutation Identification to Mechanistic Paradigms. Cell, Vol 104, 557-567, 2001


myosin binding site
tropomyosin
actin
troponin

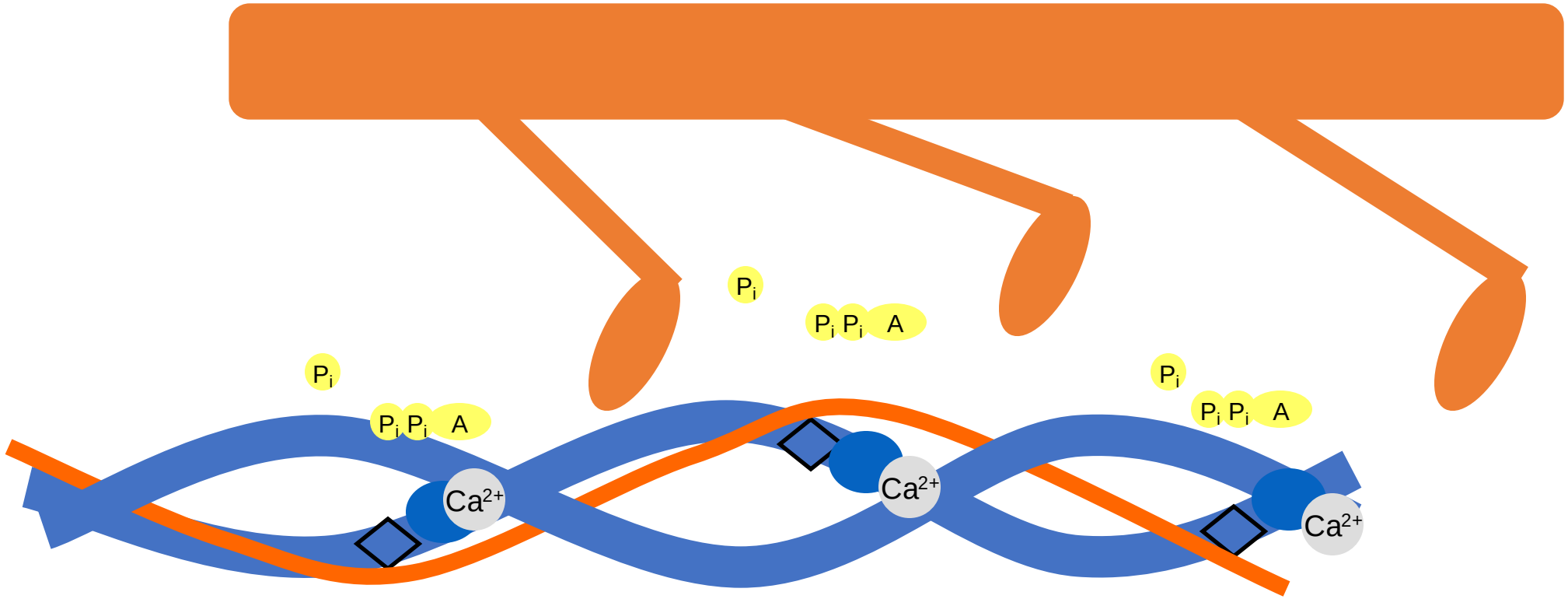

Ca2+
Ca2+
Ca2+
Ca2+


Ca^{2+}
Ca^{2+}
Ca^{2+}
Ca^{2+}


Ca2+
Ca2+
Ca2+



hydrolysis of ATP provides the energy to “re-cock” the heads



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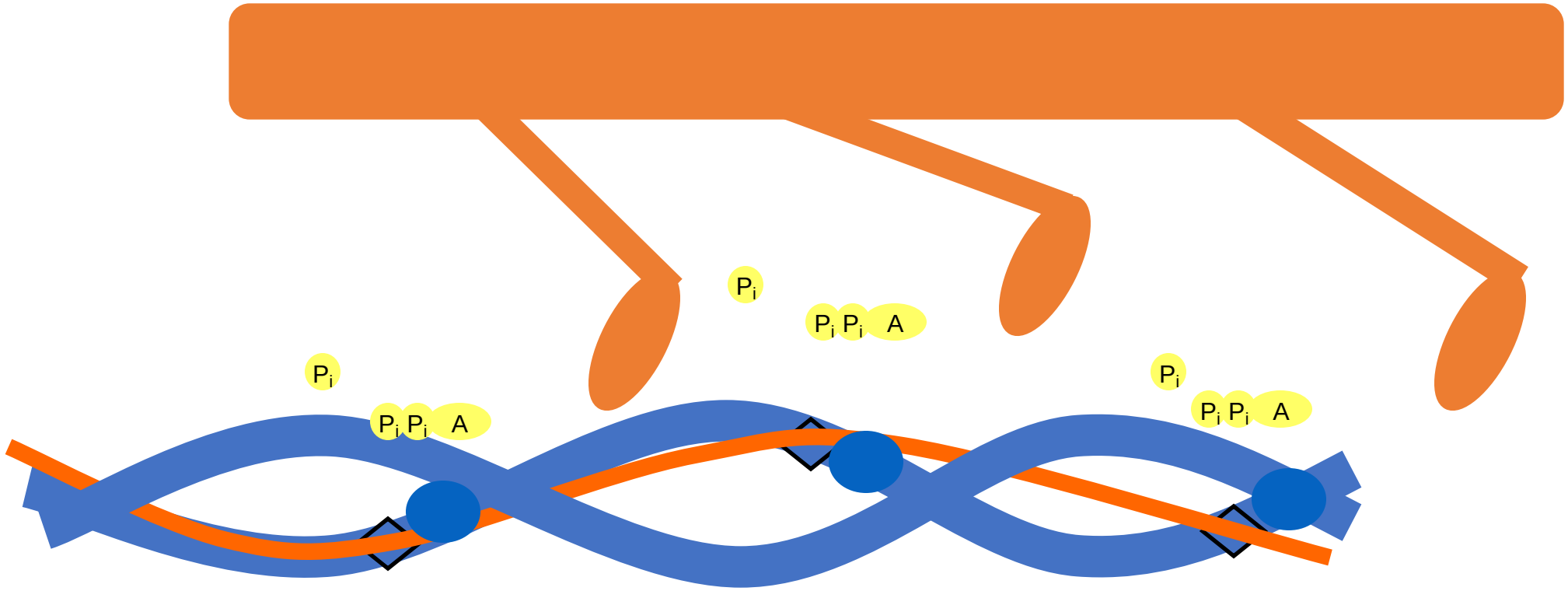


phosphocreatine regenerates ATP

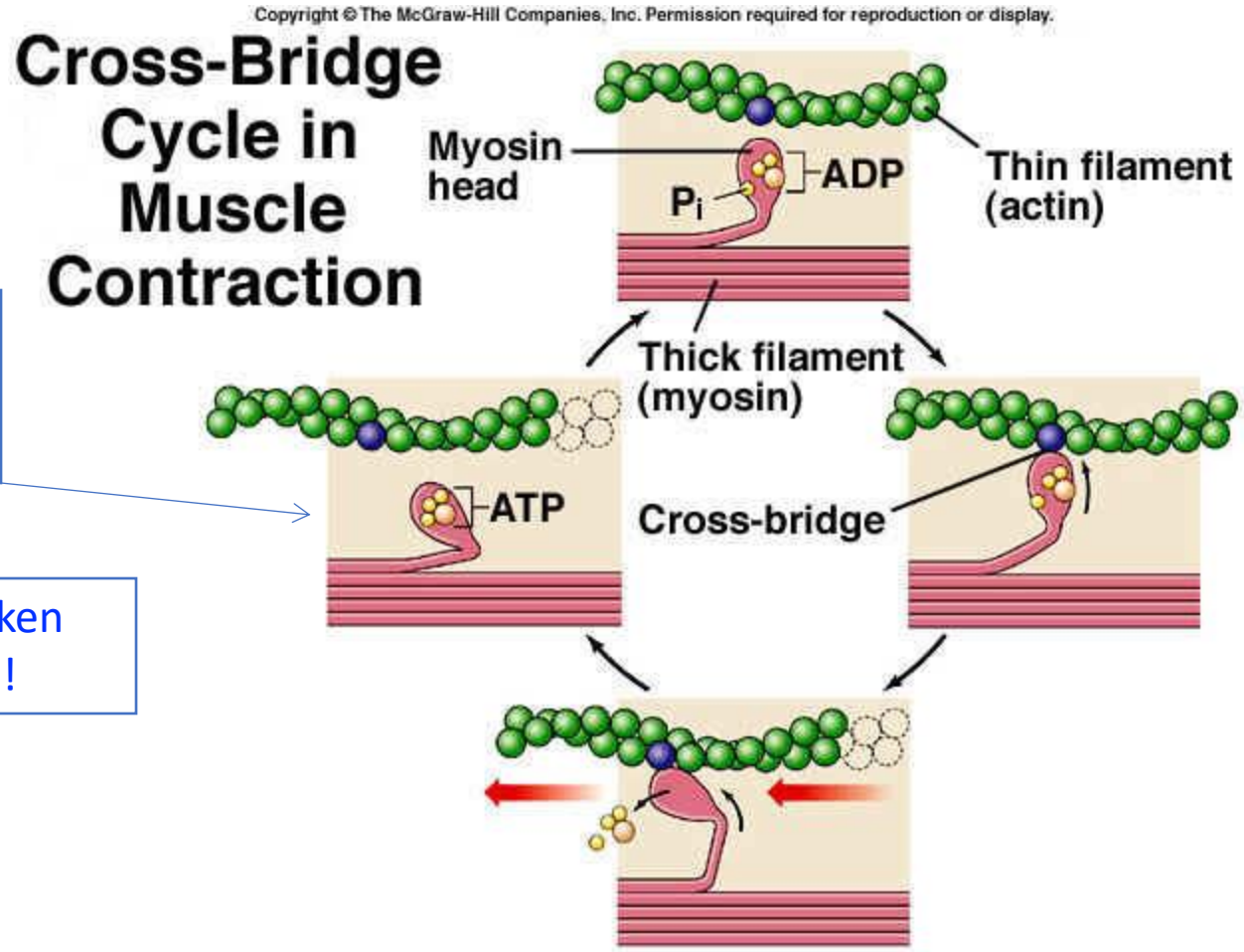
Troponin I & T – molecular characteristics

- Three main types of Troponin:
  - Troponin C: calcium-binding site
  - Troponin I: blocks actin-myosin binding site
  - Troponin T: binds tropomyosin, anchors complex and involved in conformational change

Is ATP needed for muscles to contract or to relax?

What is happening when ATP binds the myosin head?

The cross-bridge is broken and the muscle relaxes!



What is rigor mortis?

- It literally means “Stiffness of death”
- When a person stops making ATP, the muscles cannot relax and they maintain contraction until the tissue starts to breakdown.

A pathologist can use rigor mortis to estimate time of death

Body temperature	Rigor mortis	Time since death
Warm	Not yet stiff	Dead not more than 3 hours
Warm	Stiffness starting in head	Dead 3 to 8 hours
Cold	Stiff	Dead 9 to 36 hours
Cold	No longer stiff	Dead more than 36 hours