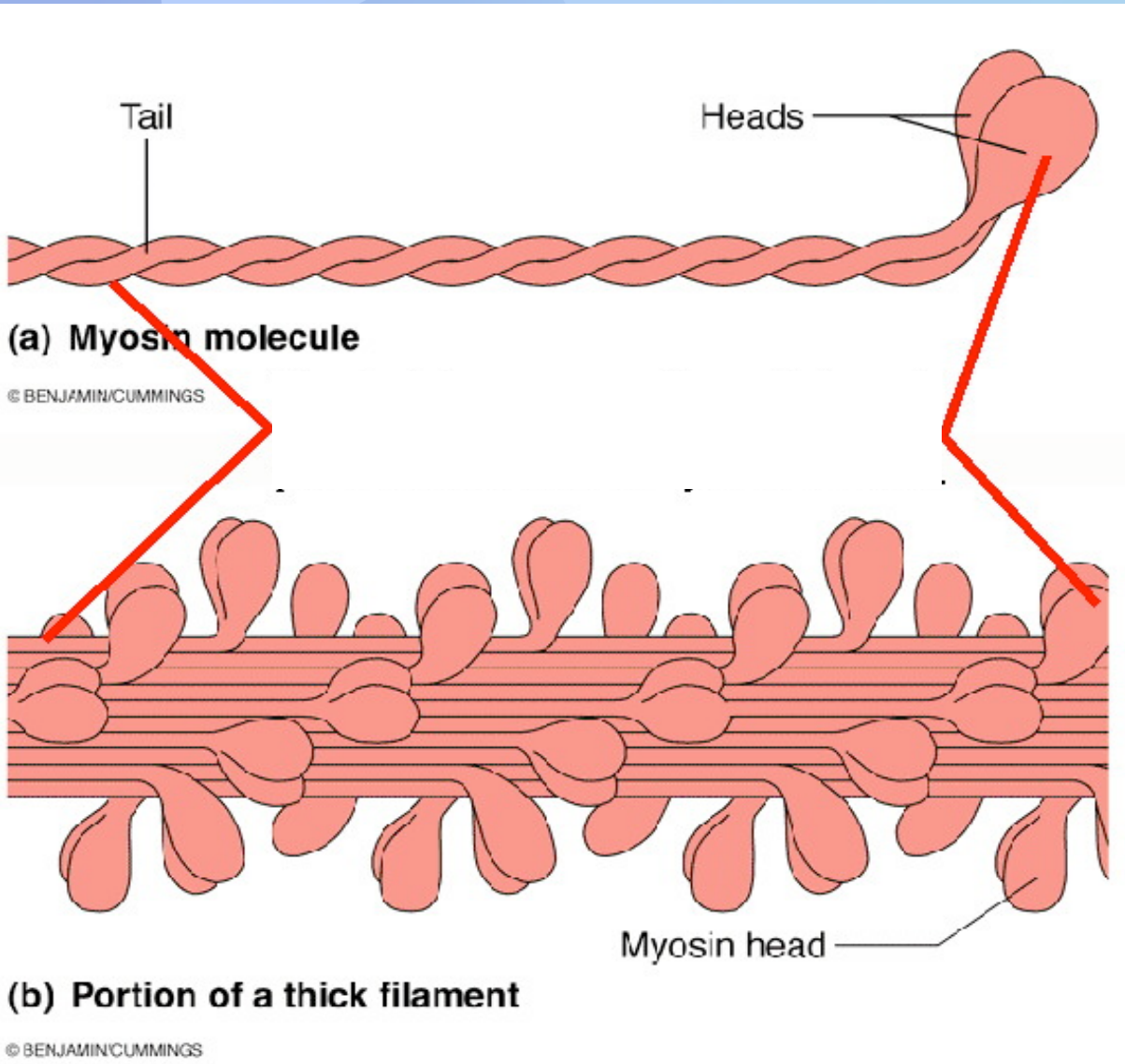


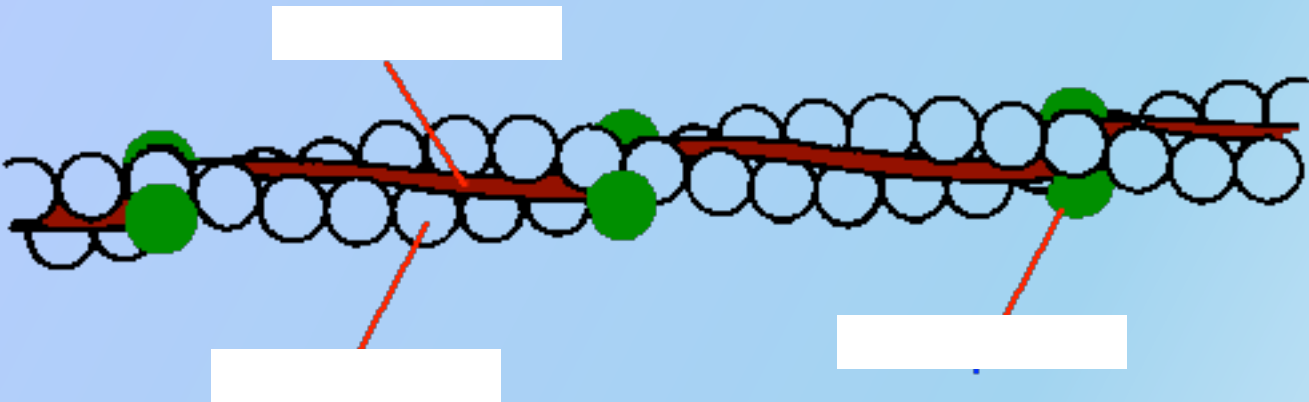
MUSCLE CONTRACTION

MUSCLE FILAMENTS

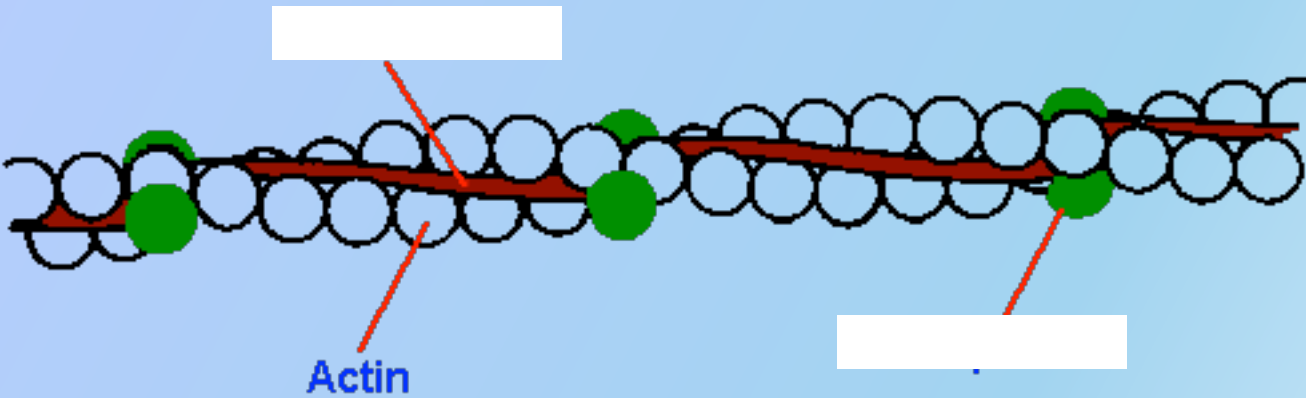


- Myosin comprises the thick filaments
- Consist of six polypeptide chains
 - One pair heavy chains
 - Two pairs light chains
- The head binds actin and ATP

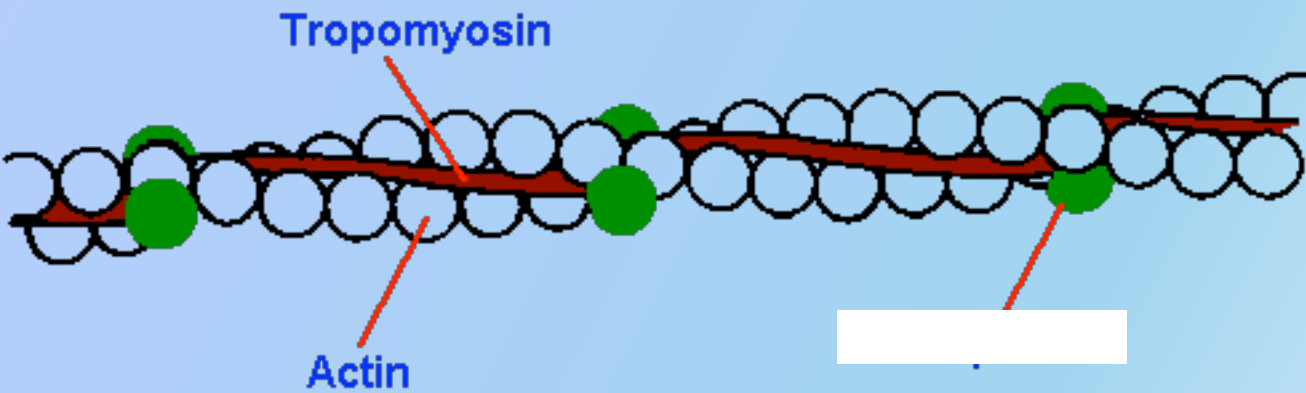
MUSCLE FILAMENTS



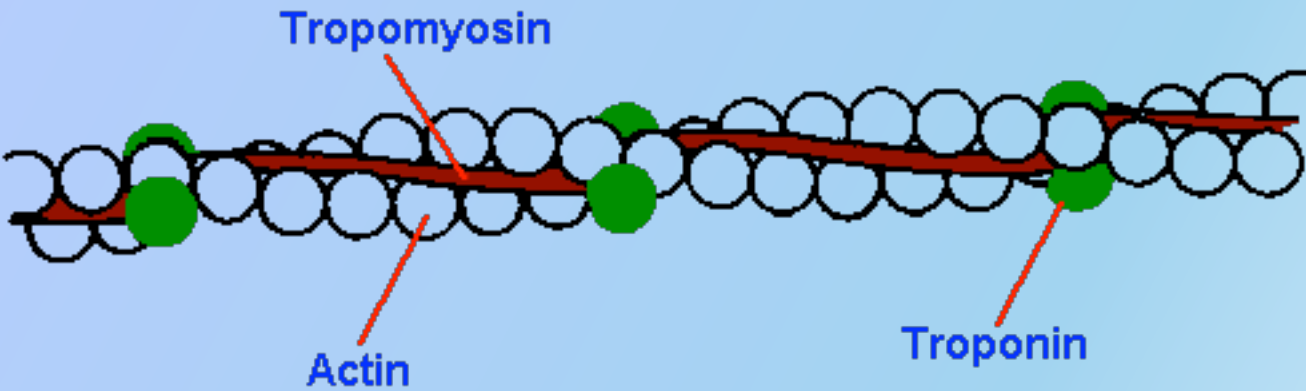
MUSCLE FILAMENTS



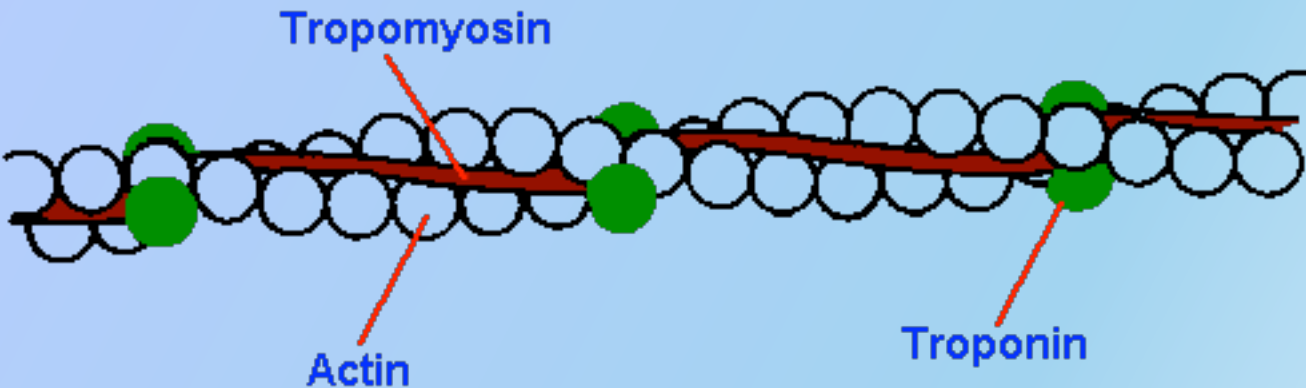
MUSCLE FILAMENTS



MUSCLE FILAMENTS

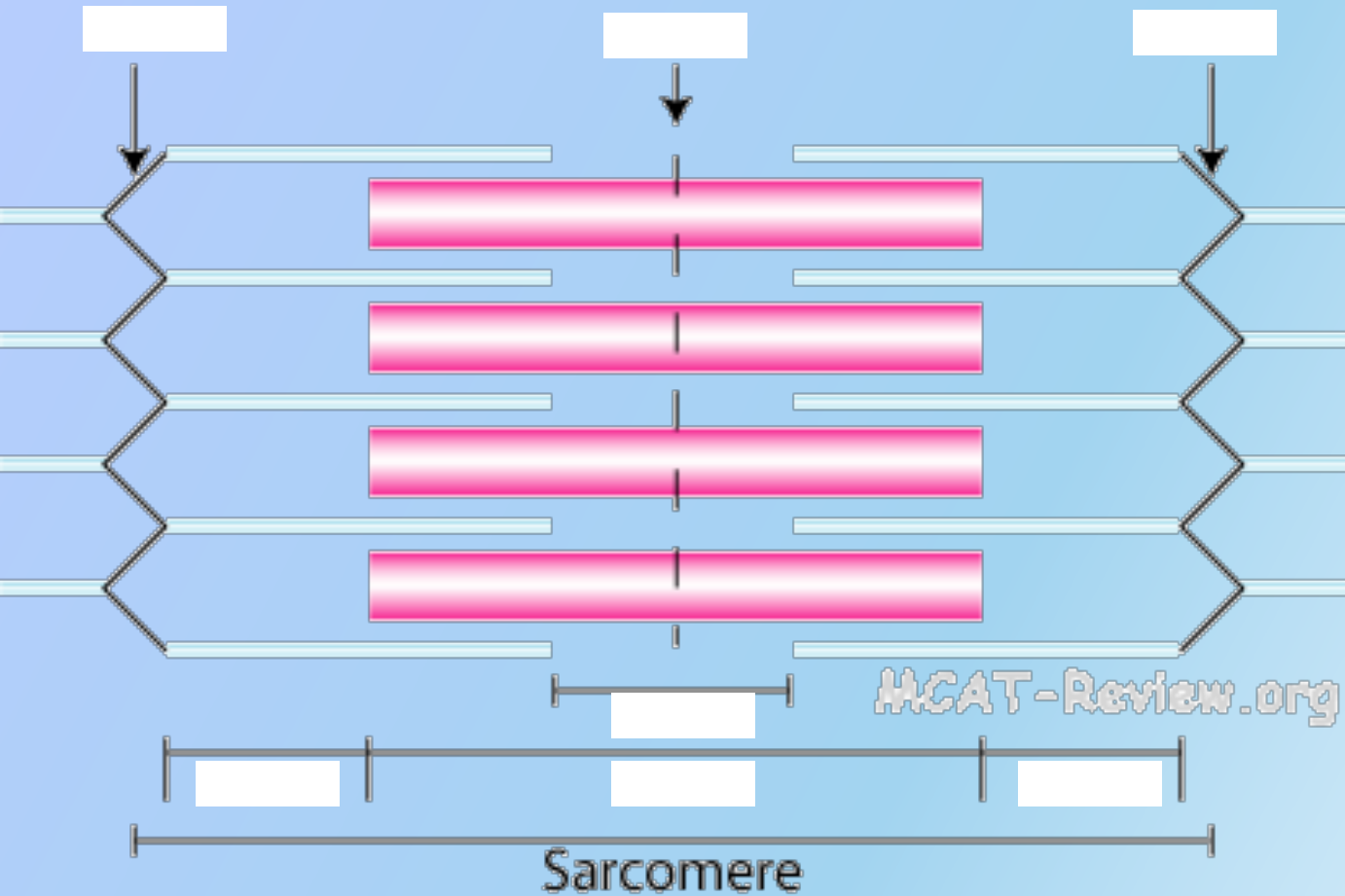


MUSCLE FILAMENTS

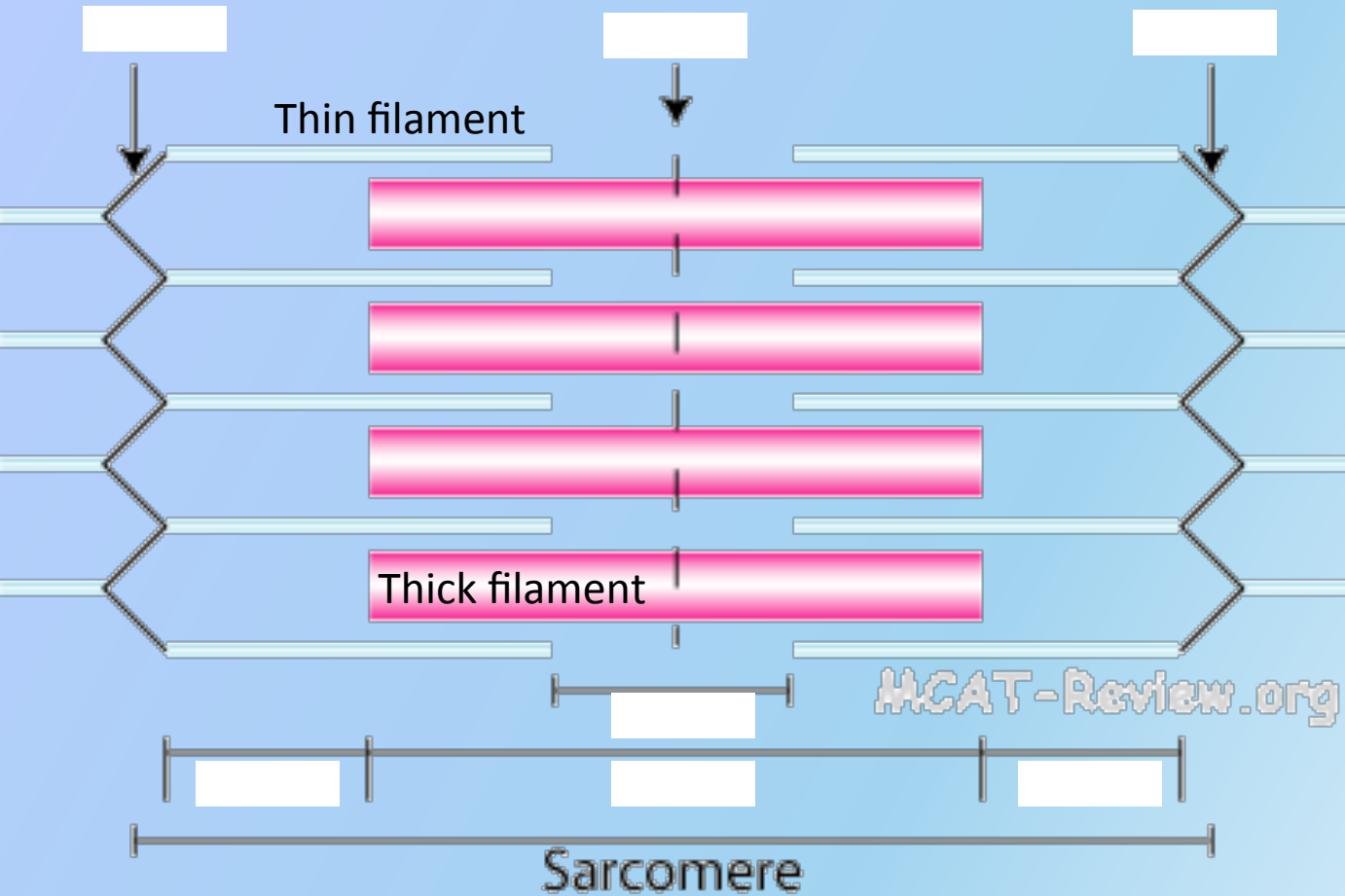


- Actin has myosin-binding sites
- At rest the binding sites are blocked by **tropomyosin**
 - For contraction to occur tropomyosin must be moved out of the way
- Troponin consist of three proteins
 - Troponin T
 - Troponin I
 - Troponin C

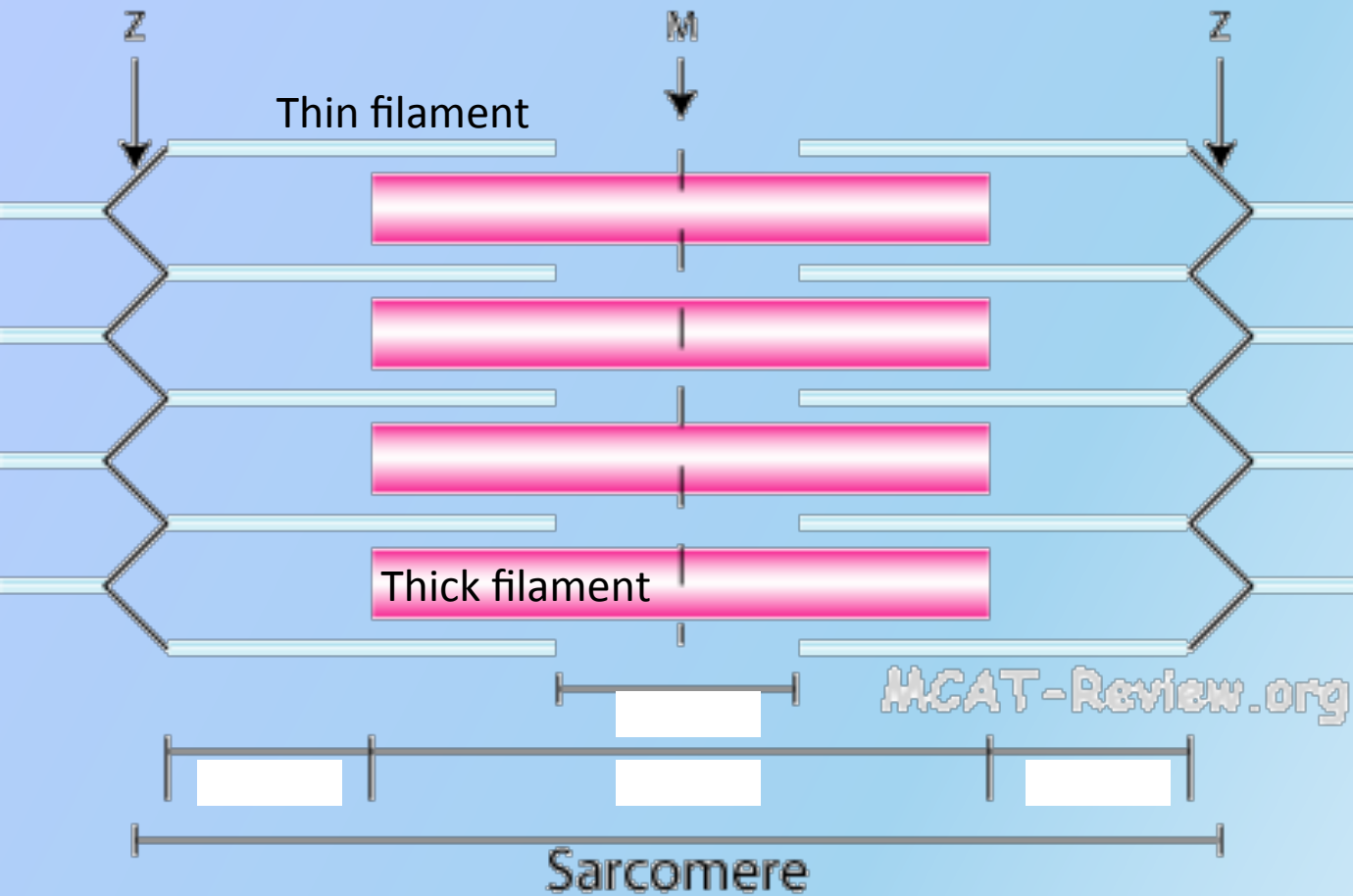
THE SARCOMERE



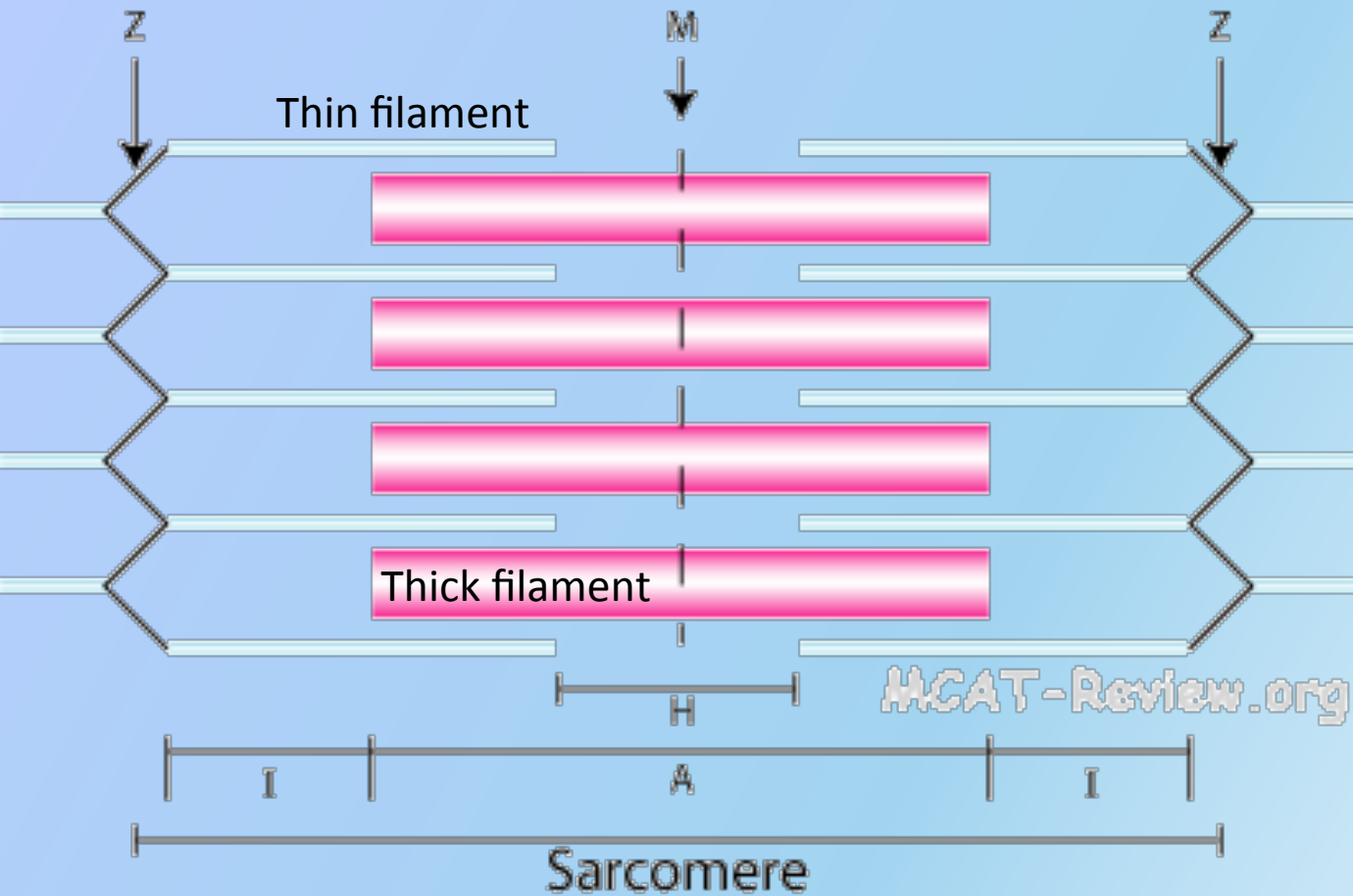
THE SARCOMERE



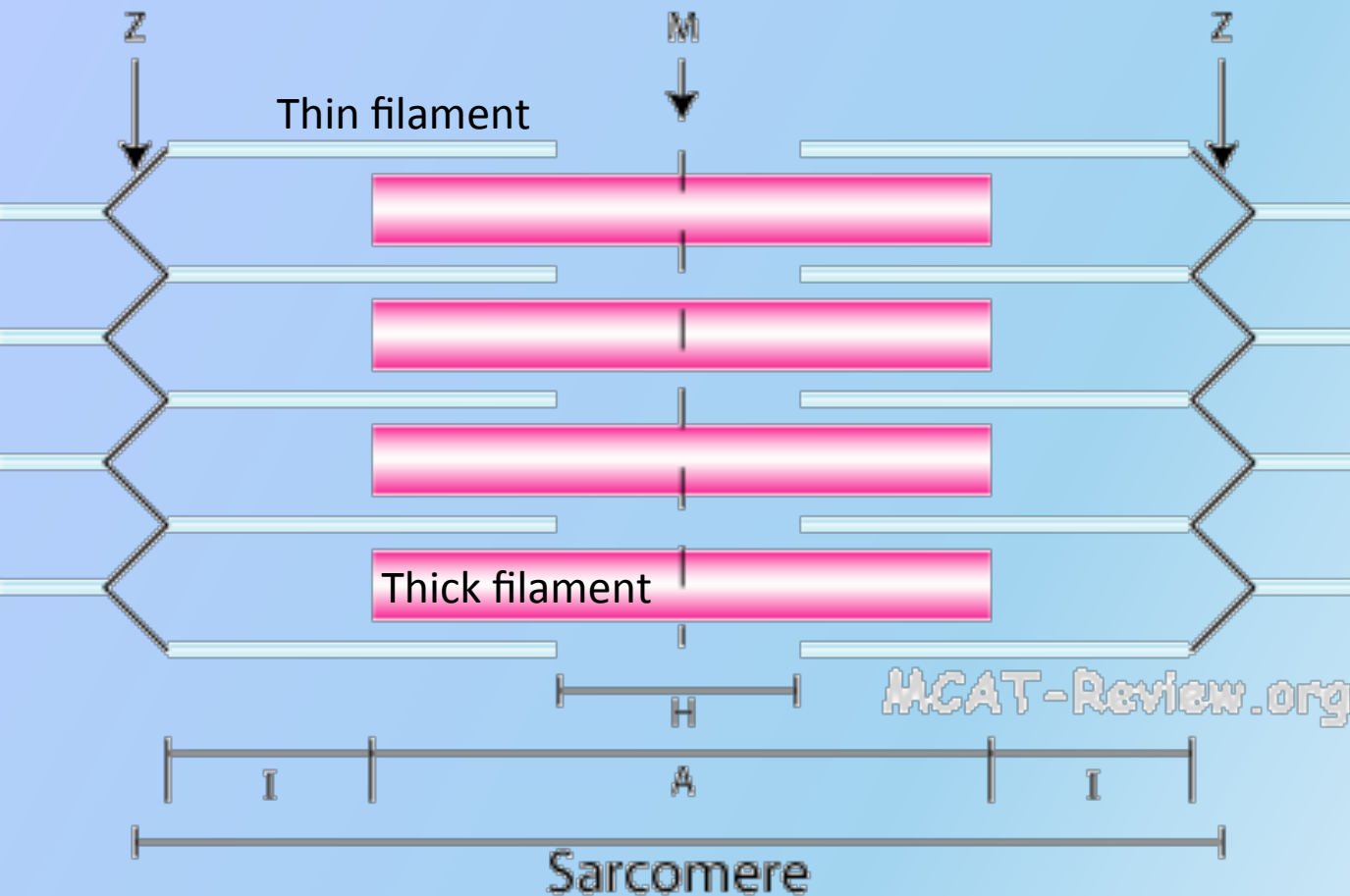
THE SARCOMERE



THE SARCOMERE

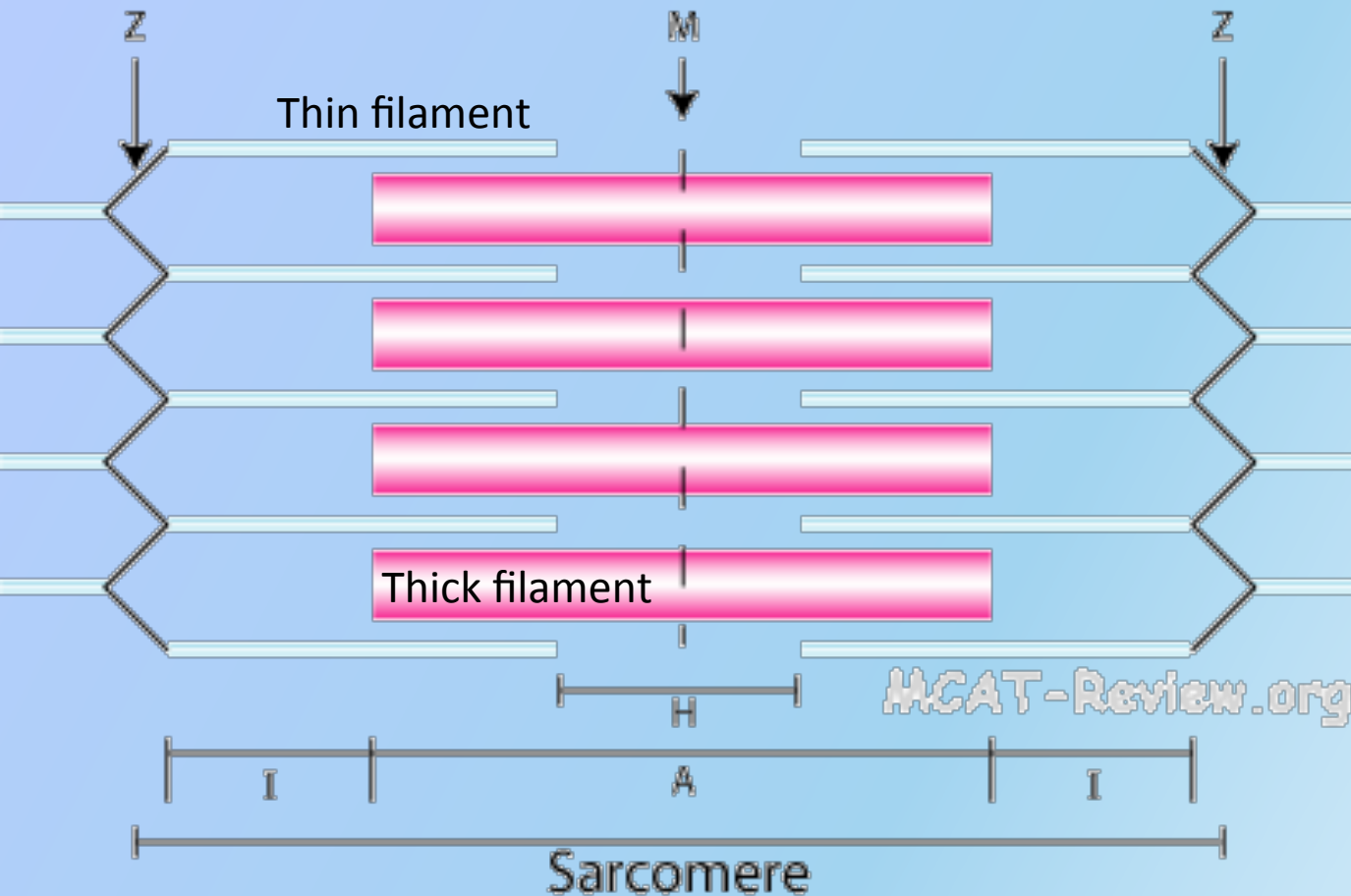


THE SARCOMERE



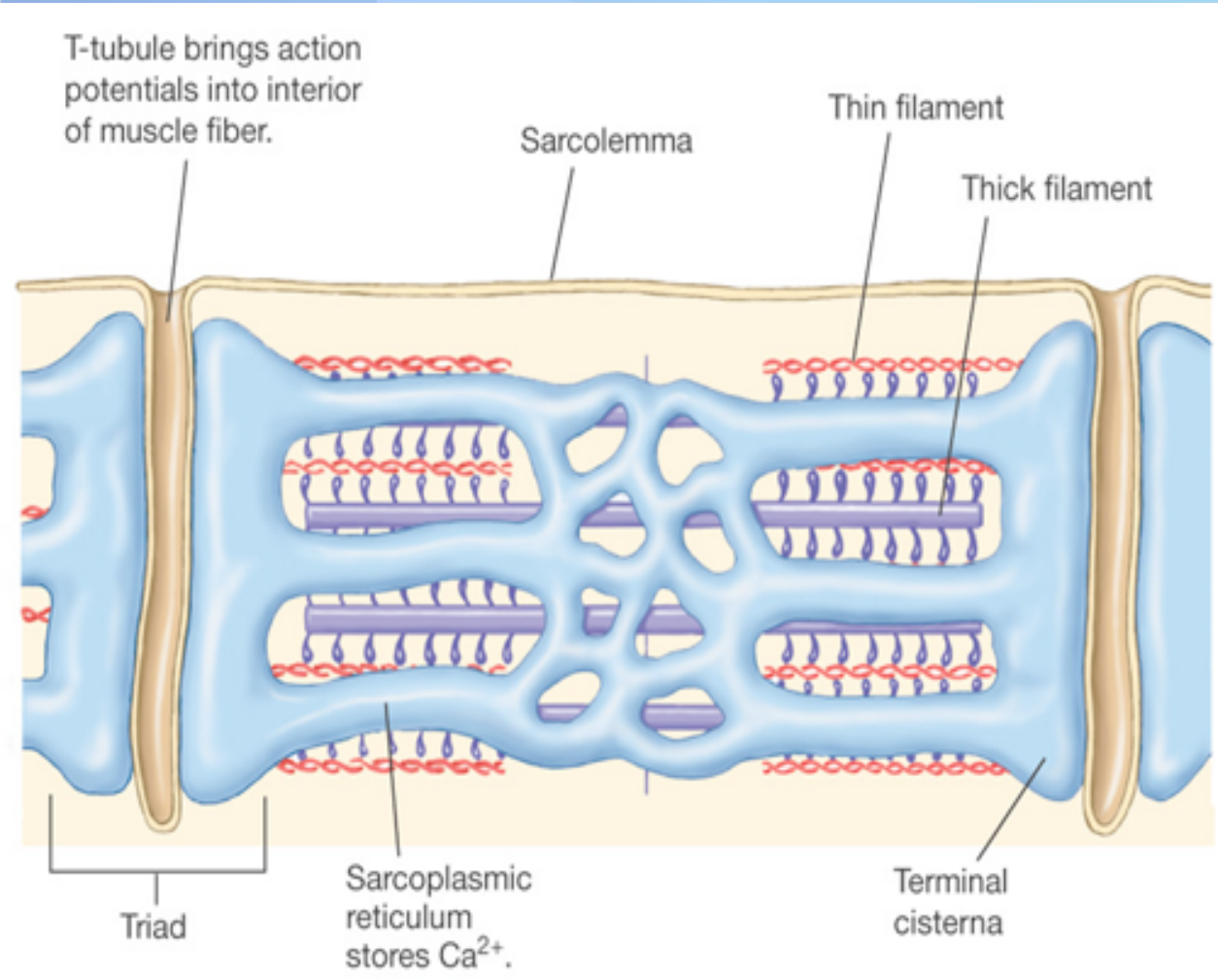
- Thick and thin filaments may overlap in the A band
 - Potential sites of cross-bridge formation
- I bands contain thin filaments, filamentous proteins and Z-disks
- Z-disks is the border of each sarcomere

CYTOSKELETAL PROTEINS



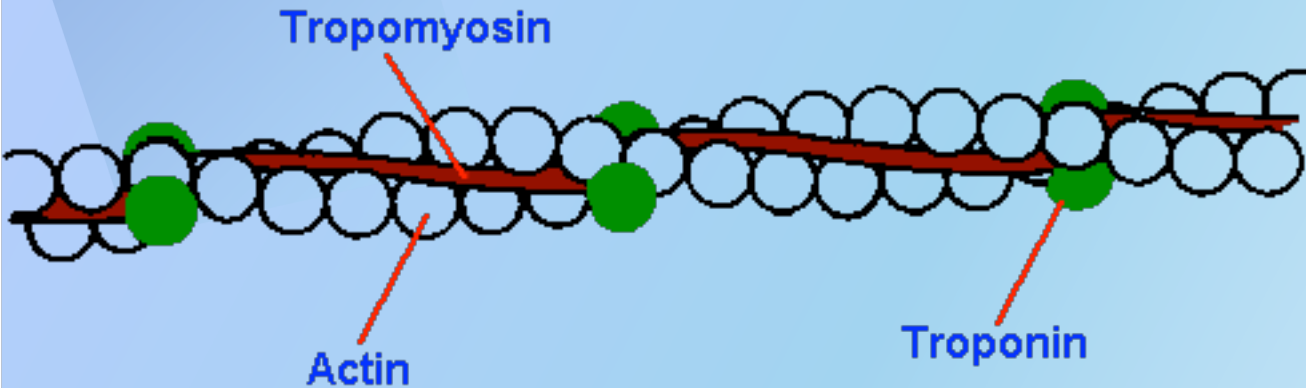
- Dystrophin binds to actin and anchors myofibrils to cell membrane
- Titin binds thick filaments to Z-discs
- Nebulin sets the length of actin molecules
- α -Actinin anchors thin filaments to Z-discs

EXCITATION-CONTRACTION COUPLING IN SKELETAL MUSCLE

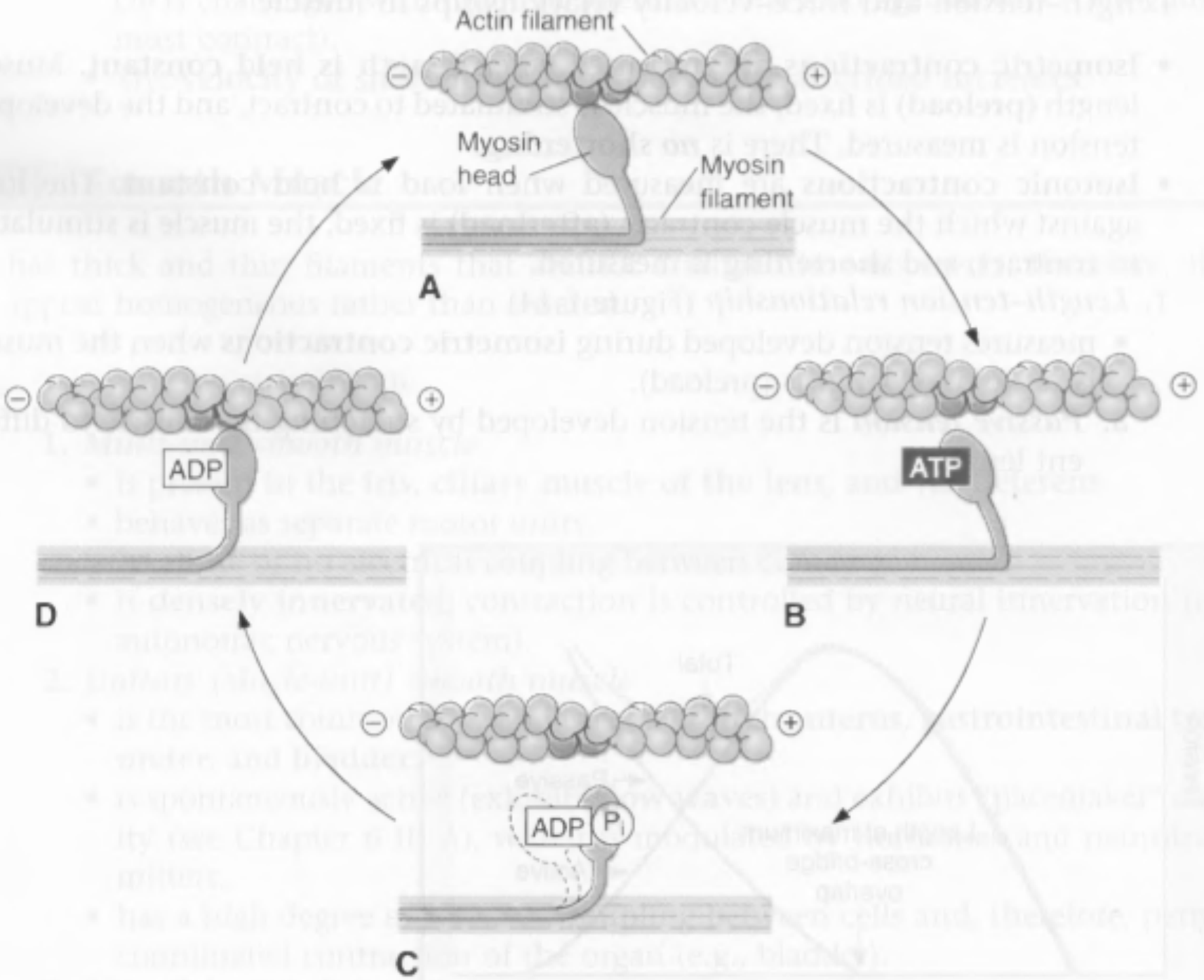


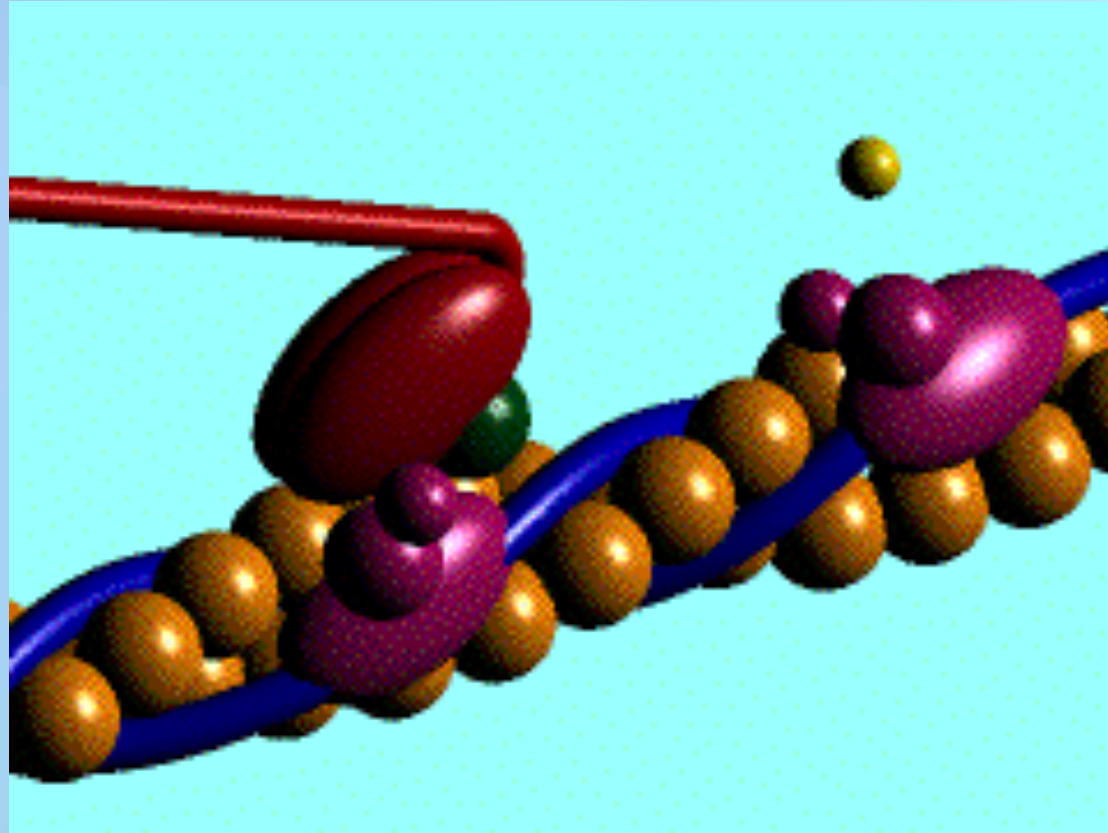
- T-tubules carry depolarization
 - Dihydropyridine receptor is activated
- Ryanodine receptors in SR opens, releasing Ca^{2+}
- Ca^{2+} binds to troponin C
 - Tropomyosin to moves out of the way

EXCITATION-CONTRACTION COUPLING IN SKELETAL MUSCLE



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RELAXATION

- Ca^{2+} reaccumulates in SR by Ca^{2+} ATPase (SERCA)
- In SR Ca^{2+} is bound to calsequestrin
- The binding to calsequestrin results in a low amount of free Ca^{2+} in SR



RIGOR MORTIS

- What is rigor mortis?
 - Stiffness of death
- Why are the muscles in the *rigor* position?
 - Because there is no ATP for Ca^{2+} ATPase to use
- Why doesn't the myosin head move from the rigor position?
 - Because there is no ATP to bind to the myosin



TYPES OF SMOOTH MUSCLE

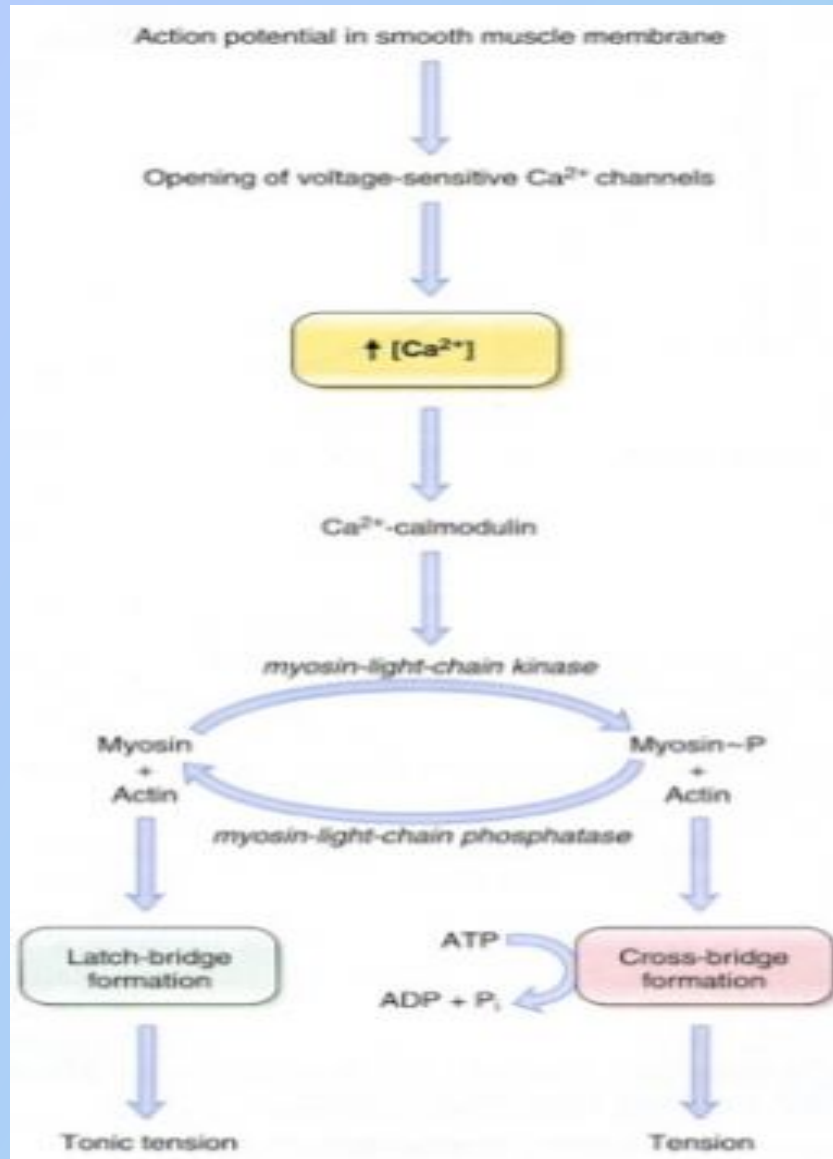
Unitary

- Found in:
 - GI
 - Bladder
 - Uterus
 - Ureter
- Linked by gap junctions
- Pacemaker activity, or slow waves

Multiunit

- Found in:
 - Iris
 - Ciliary muscles
 - Vas deferens
- Little or no coupling
- Parasympathetic/sympathetic nervous system regulate function

EXCITATION-CONTRACTION COUPLING IN SMOOTH MUSCLE



- Depolarization opens Ca^{2+} channels in membrane
- IC Ca^{2+} binds to calmodulin
 - Ca^{2+} -calmodulin complex activates myosin-light-chain kinase
- Phosphorylated myosin binds to actin to form cross-bridges
- IC Ca^{2+} decreases
 - Myosin-light-chain phosphatase

Ca²⁺ CHANNELS AND RECEPTORS

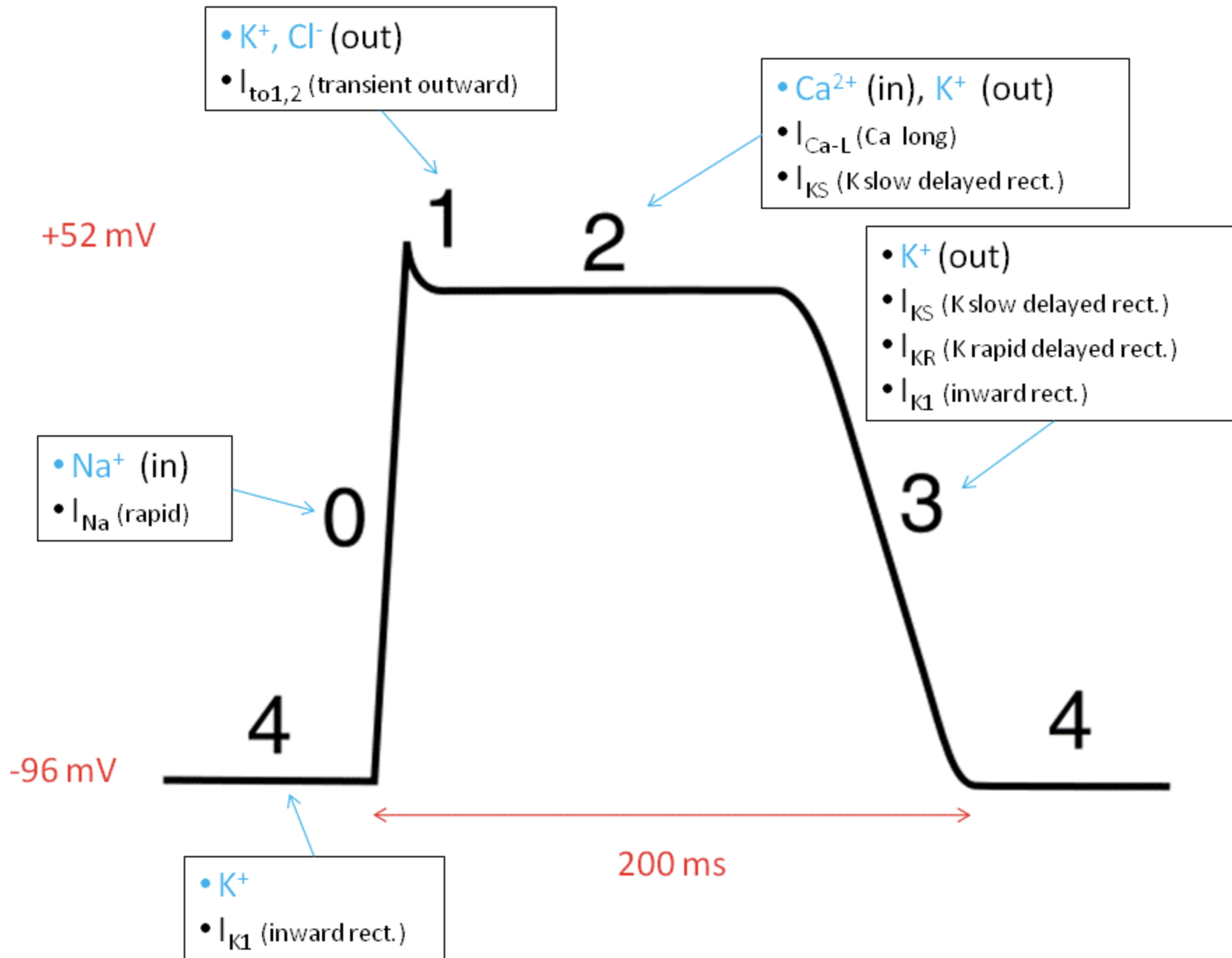
- Voltage-gated Ca²⁺ channels
- Ligand-gated Ca²⁺ channels
- IP₃-gated SR Ca²⁺ channels

TABLE 1-3

Comparison of Skeletal, Smooth, and Cardiac Muscle

Feature	Skeletal Muscle	Smooth Muscle	Cardiac Muscle
Appearance	Striated	No striations	Striated
Upstroke of action potential	Inward Na ⁺ current	Inward Ca ²⁺ current	Inward Ca ²⁺ current (SA node) Inward Na ⁺ current (atria, ventricles, Purkinje fibers)
Plateau	No	No	No (SA node) Yes (atria, ventricles, Purkinje fibers; due to inward Ca ²⁺ current)
Duration of action potential	~1 msec	~10 msec	150 msec (SA node, atria) 250–300 msec (ventricles and Purkinje fibers)
Excitation-contraction coupling	Action potential → T tubules Ca ²⁺ released from nearby SR ↑ [Ca ²⁺] _i	Action potential opens voltage-gated Ca ²⁺ channels in cell membrane Hormones and transmitters open IP ₃ -gated Ca ²⁺ channels in SR	Inward Ca ²⁺ current during plateau of action potential Ca ²⁺ -induced Ca ²⁺ release from SR ↑ [Ca ²⁺] _i
Molecular basis for contraction	Ca ²⁺ -troponin C	Ca ²⁺ -calmodulin ↑ myosin light-chain kinase	Ca ²⁺ -troponin C

IP₃ = inositol 1,4,5-triphosphate; SA = sinoatrial; SR = sarcoplasmic reticulum.



AND THEN I TOLD THEM



**THE TEST WILL BE JUST LIKE WHAT WE
COVERED IN LECTURE!!!**