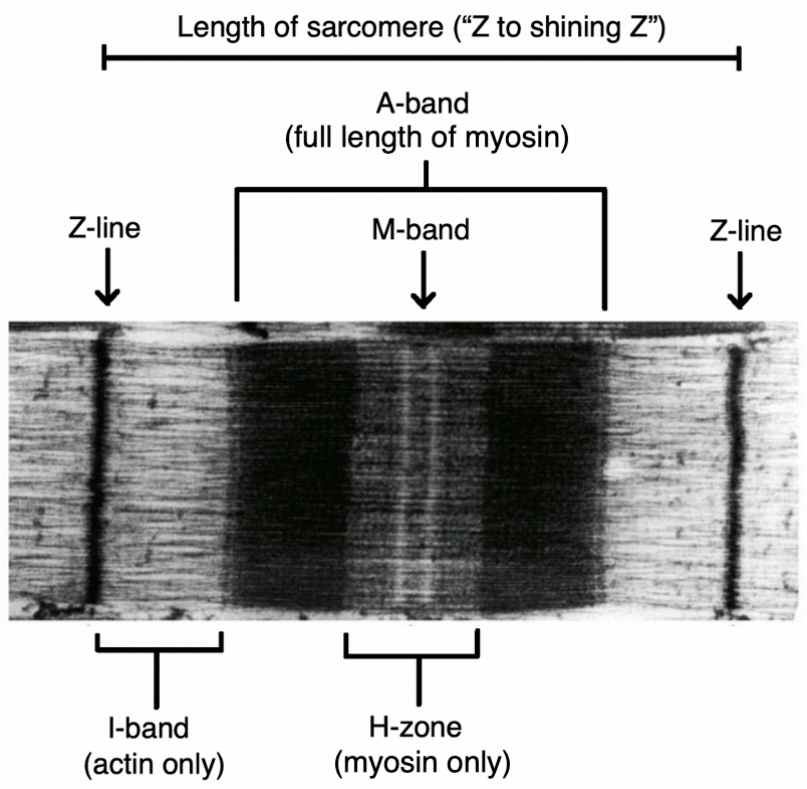
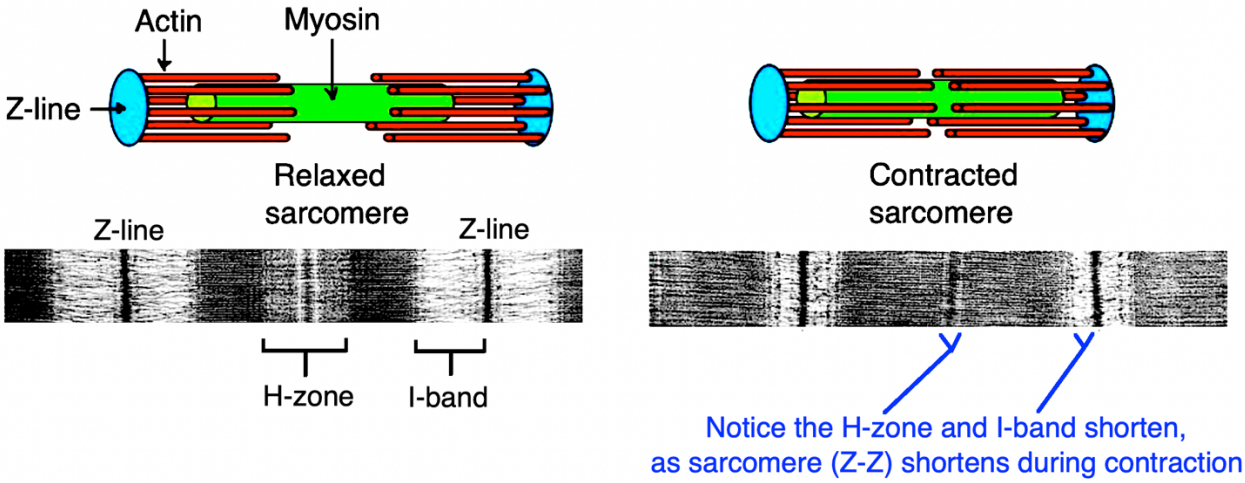
HY Anatomy/MSK/Rheum

- Student Q showed electron micrograph (EM) pic of sarcomere + they asked what does not change length during muscle contraction + had letters at different locations. Answer = A-band.



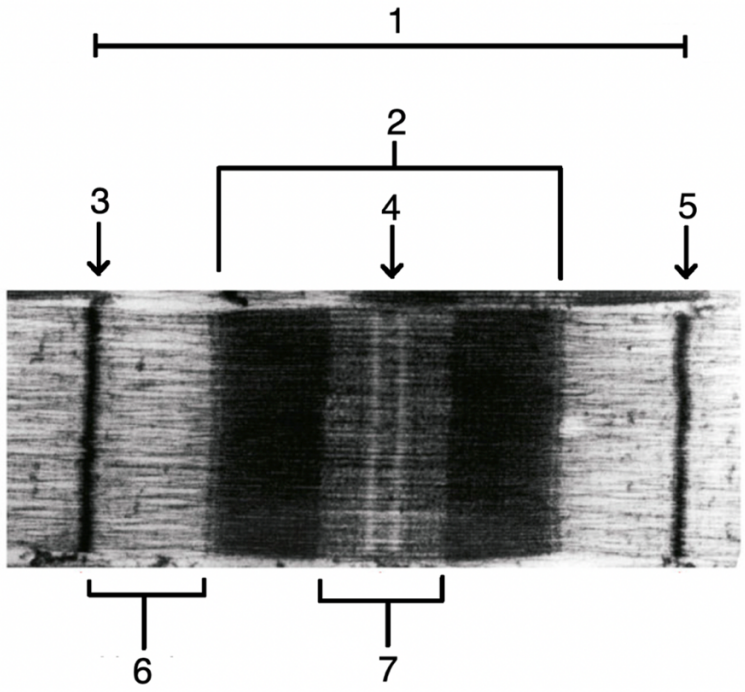
  - Before you instantly freak out, relax. First look at above EM of sarcomere. Then compare with bottom images here:



  - All you need to know is: as the myosin and actin overlap during muscle contraction, the H-zone, I-band, and sarcomere (Z-Z) shorten. The A-band (myosin; neon-green bar above) does not change in length.

- Tropomyosin is a protein on actin that covers up myosin binding sites. During contraction, calcium is released from the sarcoplasmic reticulum and binds to troponin, causing a conformational change that releases tropomyosin from actin, thereby allowing myosin to bind.
- ATP is required to *relax* muscle (i.e., rigor mortis in the deceased due to ↓ ATP).

- 24M + partakes in research study of muscle contraction; Q asks, on the following electron micrograph of a sarcomere, which segment will not change length? (choose the number):



- Answer = #2 (A-band). In contrast, the I-band (#6), H-zone (#7), and length of sarcomere (#1; Z-Z) all shorten during contraction.

Muscle fiber type	**Slow-twitch (type I)**	**Fast-twitch (type II)**
Predominance in whom	Long-distance runners	Powerlifters; sprinters
Oxygen usage	Aerobic	Anaerobic
Glycogen content	Low	High
Fatiguability	Slow to fatigue	Quick to fatigue
Mitochondria	Many	Few
Myoglobin content (red in color)	High (more red)	Low (more white)

- 28M + femoral nerve injury resulting in denervation of rectus femoris; Q asks what is most likely to be seen during nerve recovery; answer = “fiber type grouping of type I and II muscle cells”; you need to know that reinnervation of muscle results in aberrant reorganization of type I and II muscle units. This aberrant reorganization is called fiber type grouping. This is answer on an NBME.

- 24M + partakes in powerlifting routine; Q asks ↑ or ↔ for changes in muscle cell number, muscle cell size, and mitochondria; answer = ↔ muscle cell number, ↑ muscle cell size, and ↔ mitochondria. Skeletal muscle response to activity is hypertrophy, not hyperplasia. Powerlifting is anaerobic and does not increase mitochondria.
- 20F + paraplegic following accident; Q asks what is most likely to be seen in this patient; answer = "polyubiquitination"; proteins are tagged with ubiquitin in order to be sent to the proteasome for breakdown; atrophy in the setting of inactivity = ↑ ubiquitination.
- 31M + in wilderness for 3 weeks without food; Q asks what allows him to maintain normal serum glucose levels during this time; answer = "skeletal muscle protein" → you must know that skeletal muscle does **not** contain glucose-6-phosphatase and therefore does not directly carry out gluconeogenesis; glucogenic amino acids can be liberated in the fasting state from skeletal muscle, with the liver carrying out the gluconeogenesis. The **kidney** can also carry out gluconeogenesis.
- 16F + receives insulin injection + serum glucose lowers; Q asks why; answer = "increased glucose uptake by skeletal muscle"; both skeletal muscle and adipose tissue take up glucose via GLUT4 in response to insulin.
- Q on offline Step 1 NBME form asks why ATP does not fall appreciably during a series of muscle twitches → answer = "ATP is quickly regenerating from creatine phosphate."
- "What do I need to know about shoulder anatomy for USMLE?" → USMLE is known to occasionally give images of shoulder, clavicular, and humeral fractures. Spending a few moments to gain an idea of normal shoulder anatomy is not "nitpicky."