CONCEPT: ACTIN AND SKELETAL MUSCLE CONTRACTIONS

● Skeletal muscle contractions depend on _____ between actin and *myosin*

□ **Myosin II** are dimers with two globular ATPase heads and a long coiled-coil tail that extends outwards

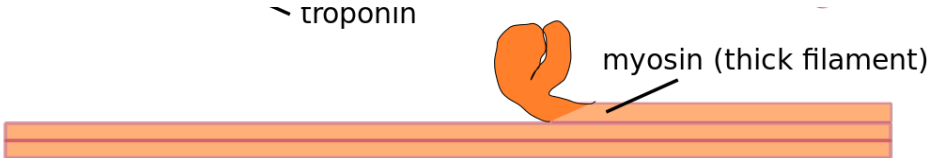
- **Myosin filaments** are formed by clusters of myosin II

- Myosin filaments look like a double headed arrow

□ Two myosin filaments bind to each _____ filament

- Each binds in opposite orientations, moving them in opposite directions

EXAMPLE: Myosin



● Skeletal muscle has a distinct _____ which allows for muscle contraction

□ **Myofibrils** are cylindrical bundles of myosin and actin

□ **Sarcomeres** are tiny contractile units that make up a myofibril

- **A band** (dark band): composed of myosin (**thick filaments)**

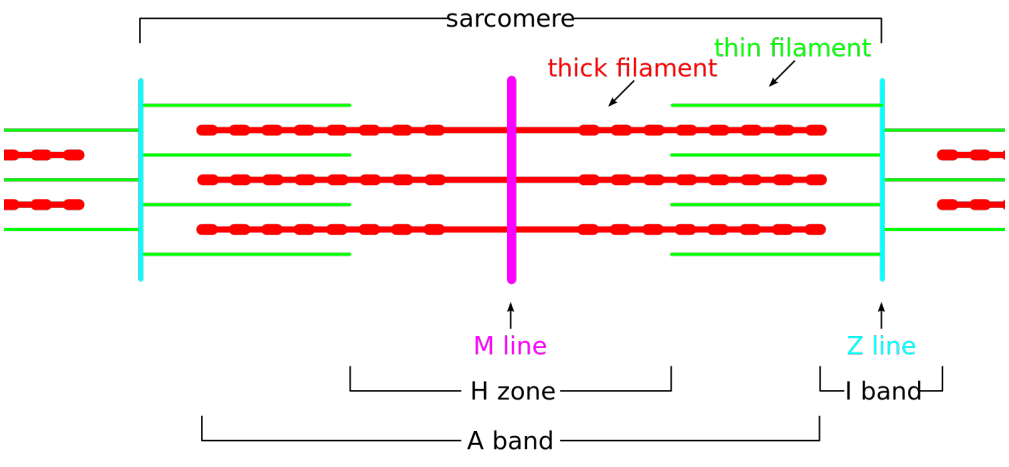
- **H zone:** lighter region of A band where myosin is not superimposed with actin

- **M line:** Disc in the middle of the sarcomere

- **I band** (light band): composed of actin **(thin filaments)**, but no myosin

- **Z line (disc):** Ends of the sarcomere

EXAMPLE: Sarcomere

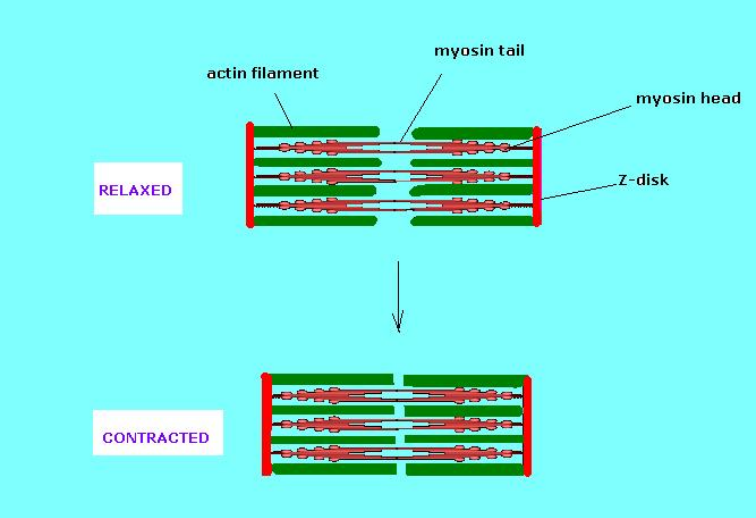


Steps to a Contraction

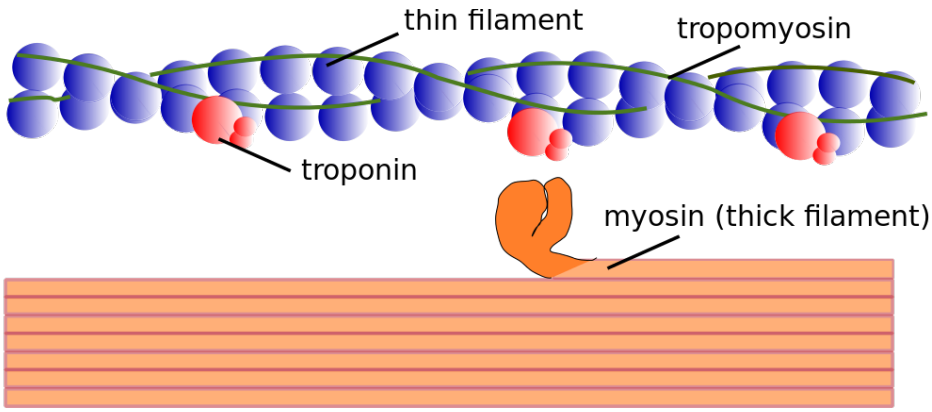
- Skeletal muscle contraction is caused from the shortening of sarcomeres

1. Myosin heads bind to actin
2. ATP hydrolysis results in the myosin head binding tightly, undergoing a conformational change, and moving
   - **Tropomyosin** is a protein that normally covers the actin binding site
   - Calcium binding to **troponin** molecules alter the structure of tropomyosin revealing the binding site
3. **Cross-bridge** forms, which is an overlap between thin and thick filaments (actin and myosin)
   - I band and H-zone shorten so the Z lines come closer together
   - All the band lengths stay the same – actin just slides passed myosin to result in sarcomere shortening
4. ATP binds, which disassociates the cross bridge and it returns to its relaxed state

EXAMPLE:



EXAMPLE: Troponin and tropomyosin



PRACTICE:

1. Which of the following is not a structure of the sarcomere?
    a. A band
    b. H zone
    c. Z line
    d. U zone

2. Which of the following structures is composed of actin, but no myosin?
    a. A band
    b. M line
    c. I band
    d. Z line

3. When calcium binds to troponin, what happens to tropomyosin?
    a. It binds and covers the actin binding site
    b. It is removed from the actin binding site
    c. It creates a crossbridge structure
    d. It triggers ATP hydrolysis and myosin movement

4. True or False: When a cross-bridge structure is formed during a muscle contraction, the band lengths shorten and contract.
    a. True
    b. False