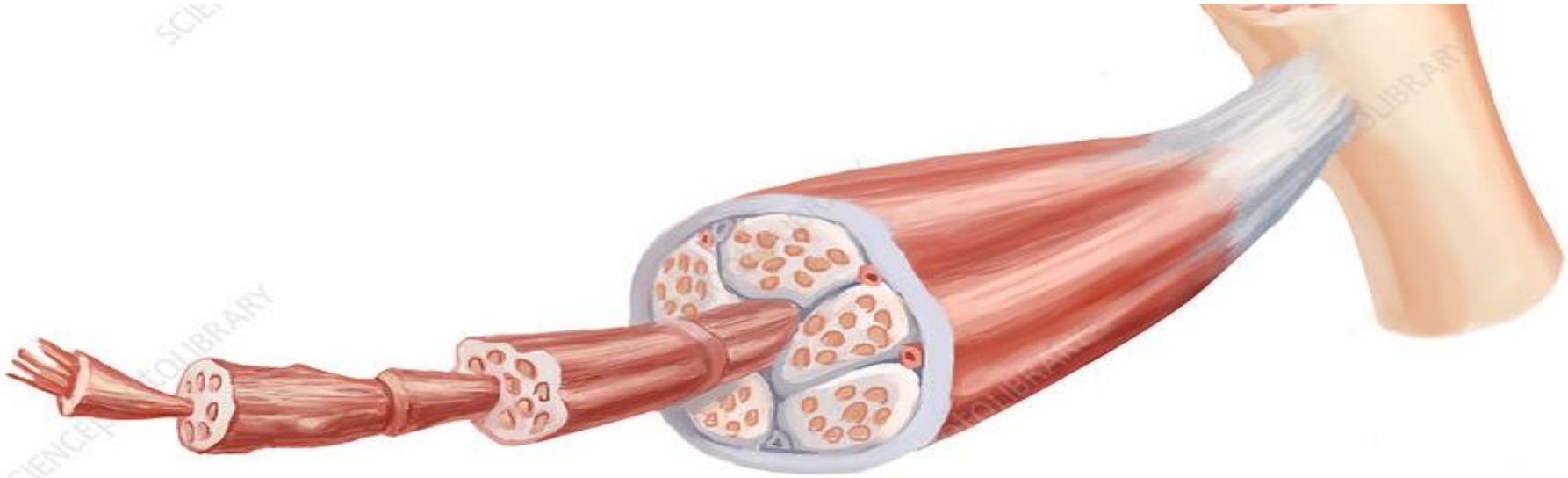
Musculoskeletal Module-II

Skeletal Muscle

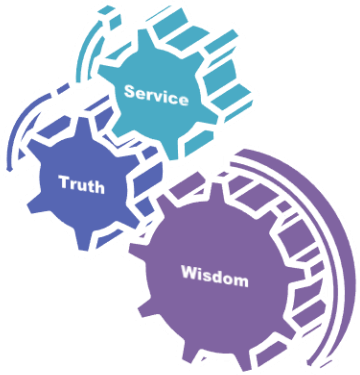


Presenter
Dr. Mohtasham Hina

Date:29-05-2025

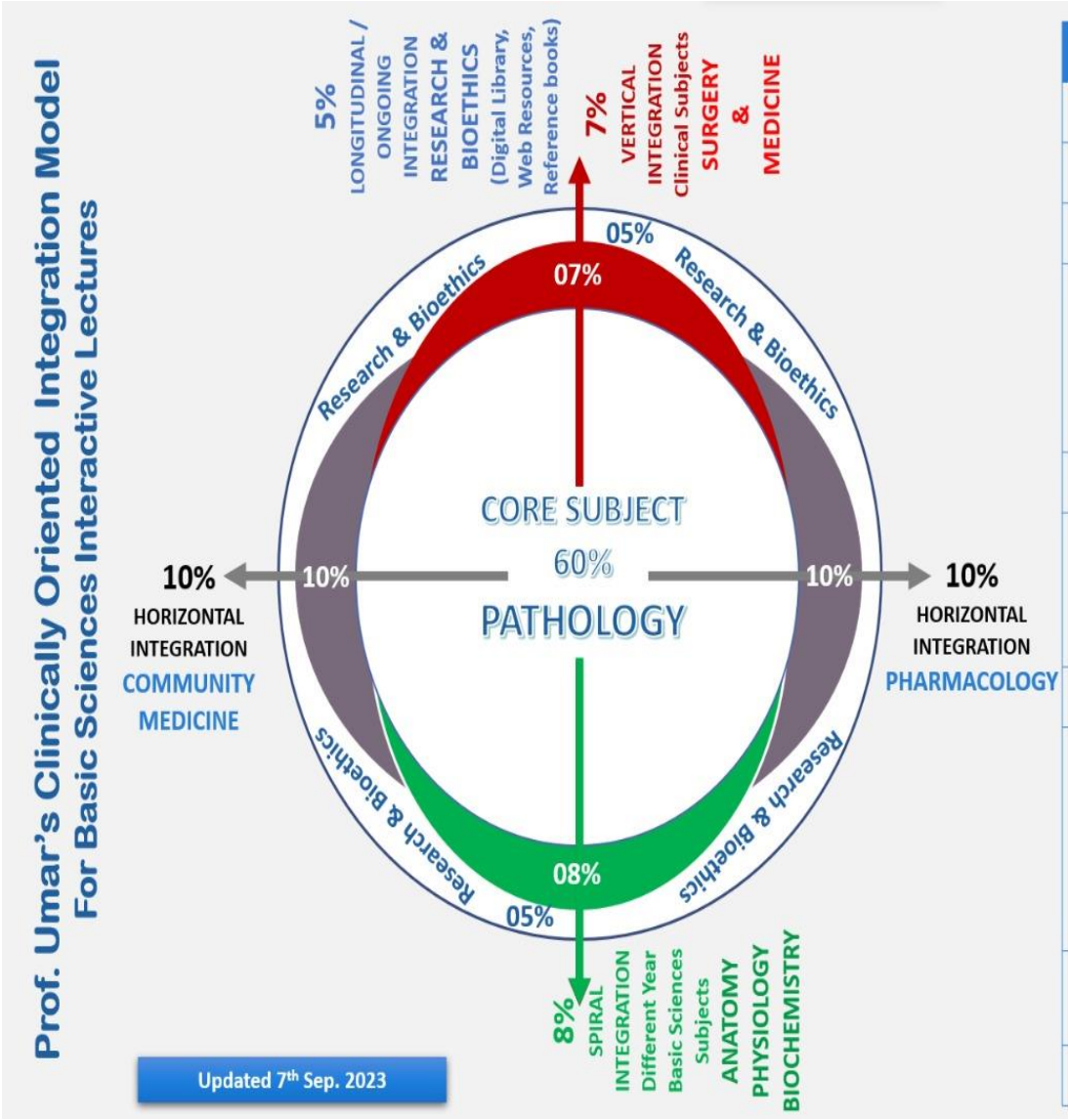
Vision; The Dream/Tomorrow

- **Motto**



- To impart evidence based research oriented medical education
- To provide best possible patient care
- To inculcate the values of mutual respect and ethical practice of medicine

Professor Umar Model of Integrated Lecture



Model 3rd Year Pathology LGIS (≈30 slides)	
Core Subject – 60% (≈ 18-20 slides)	
Pathology (≈ 18-20 slides)	
Horizontal Integration – 20% (≈ 5-6 slides)	
Same Year Subjects	• Pharmacology (10%) (≈ 2-3 slides) • Community Medicine (10%) (≈ 2-3 slides)
Vertical Integration – 07% (≈ 2-3 slides)	
Clinical Subjects	• Medicine (3-5%) (≈ 1-2 slides) • Surgery (3-5%) (≈ 1-2 slides)
Spiral Integration – 08% (≈ 2-3 slides)	
Different Year Basic Sciences Subjects	• Anatomy (1-3%) (≈ 1-2 slides) • Physiology (1-3%) (≈ 1-2 slides) • Biochemistry (1-3%) (≈ 1-2 slides)
Longitudinal / Ongoing Integration – 05% (≈ 1-2 slides)	
Research & Bioethics (≈ 1-2 slides)	

Learning Objectives

At the end of the session, student will be able to

- Classify the muscular tissue
- Discuss the ultra structure of skeletal muscle
- Describe the different types of proteins present in skeletal muscles
- Discuss the mechanism of muscle contraction
- Discuss the skeletal muscle regeneration

Duchenne Muscular Dystrophy

A 5 years old Ali's parents noticed that he has been falling more frequently. He also seems to have difficulty getting up from a seated position and climbing stairs.

History: His parents mentioned that Ali reached his early developmental milestones on time, but they have noticed a slowing in his physical abilities over the past year. They also mentioned that Ali seems to walk on his toes a lot.

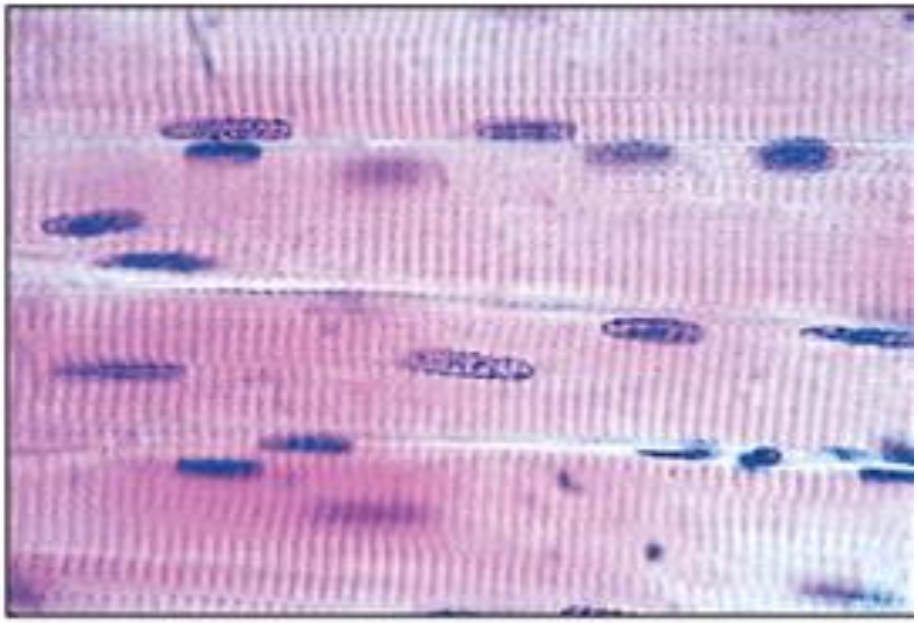
Physical Examination: On examination, significant calf muscles hypertrophy was noticed. Ali exhibits a positive Gower's sign - he uses his hands to "walk" up his own body from a squatting position due to lack of hip and thigh muscle strength.

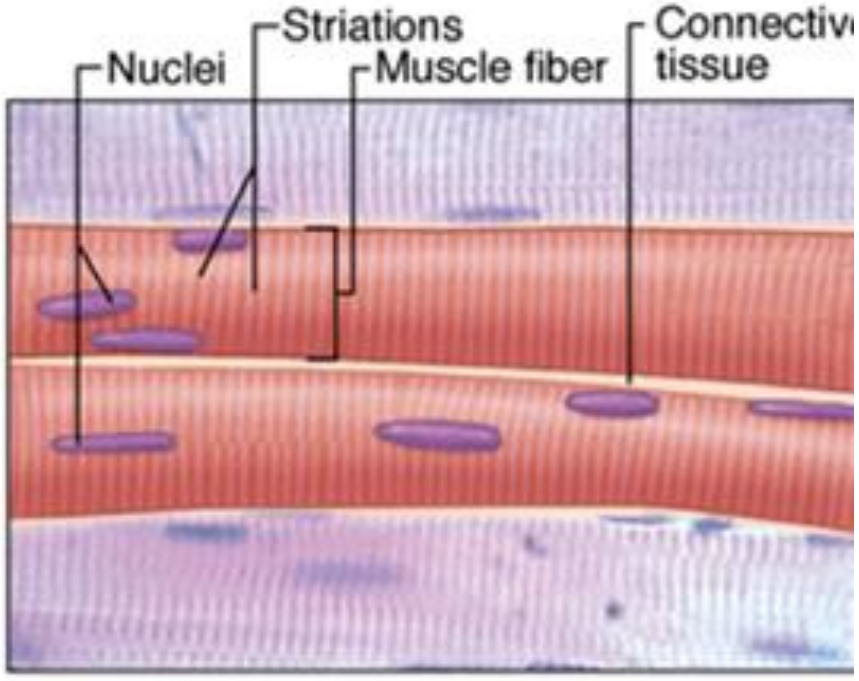
Core Concept

Duchenne Muscular Dystrophy

Core Concept

Skeletal Muscle

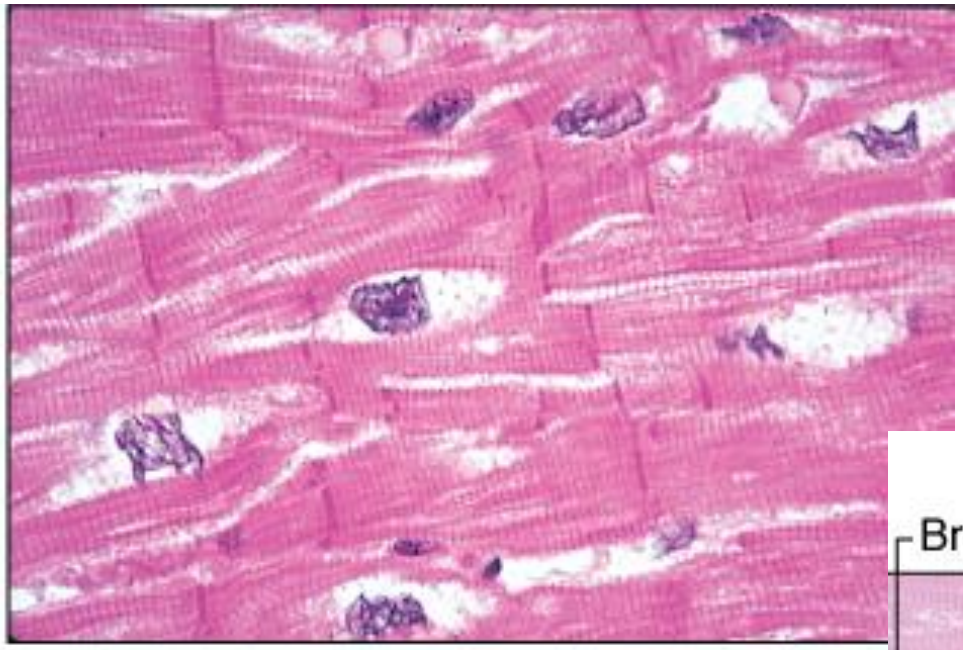


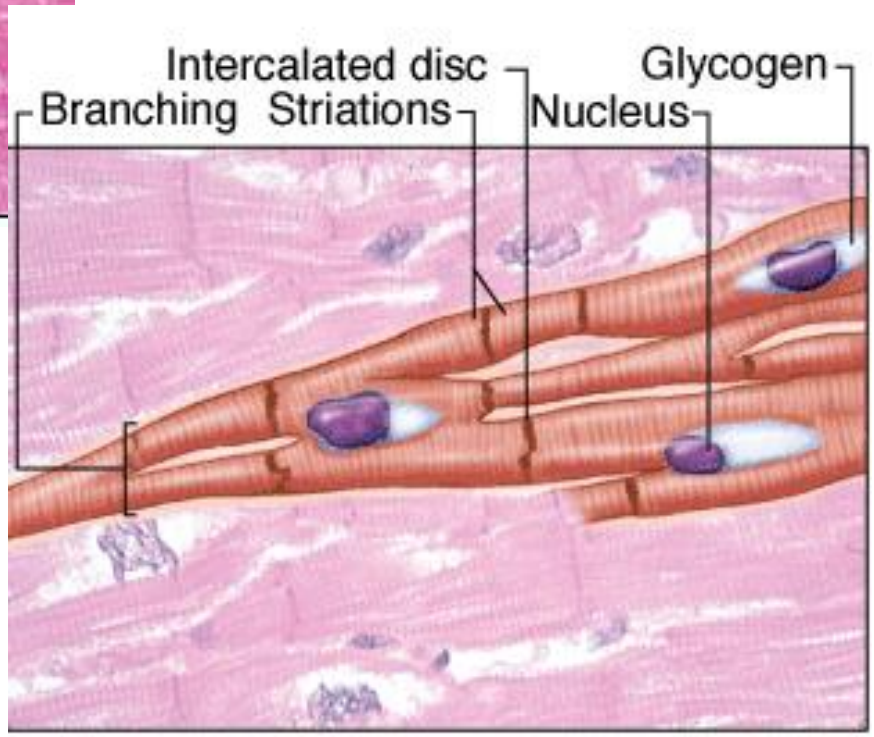


a Skeletal muscle

Core Concept

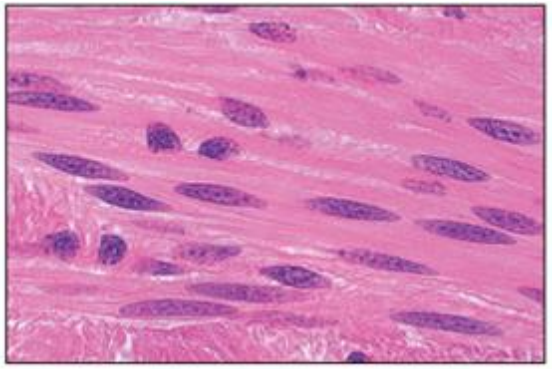
Cardiac Muscle

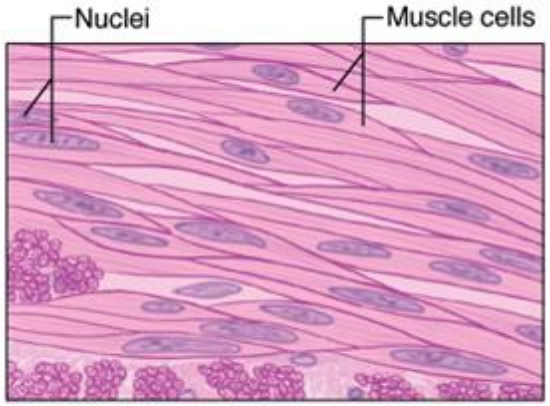




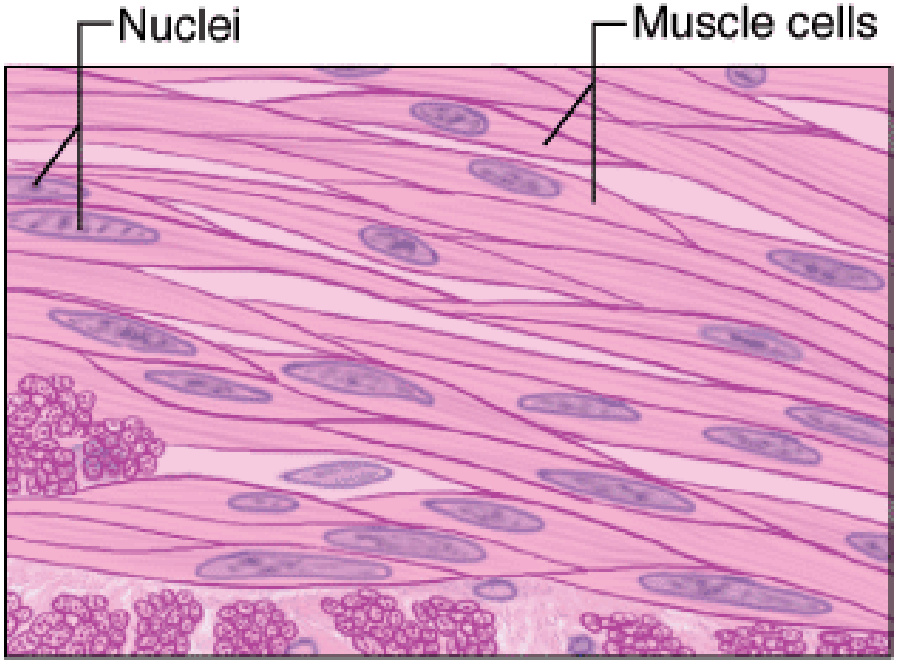
Core Concept

Smooth Muscle



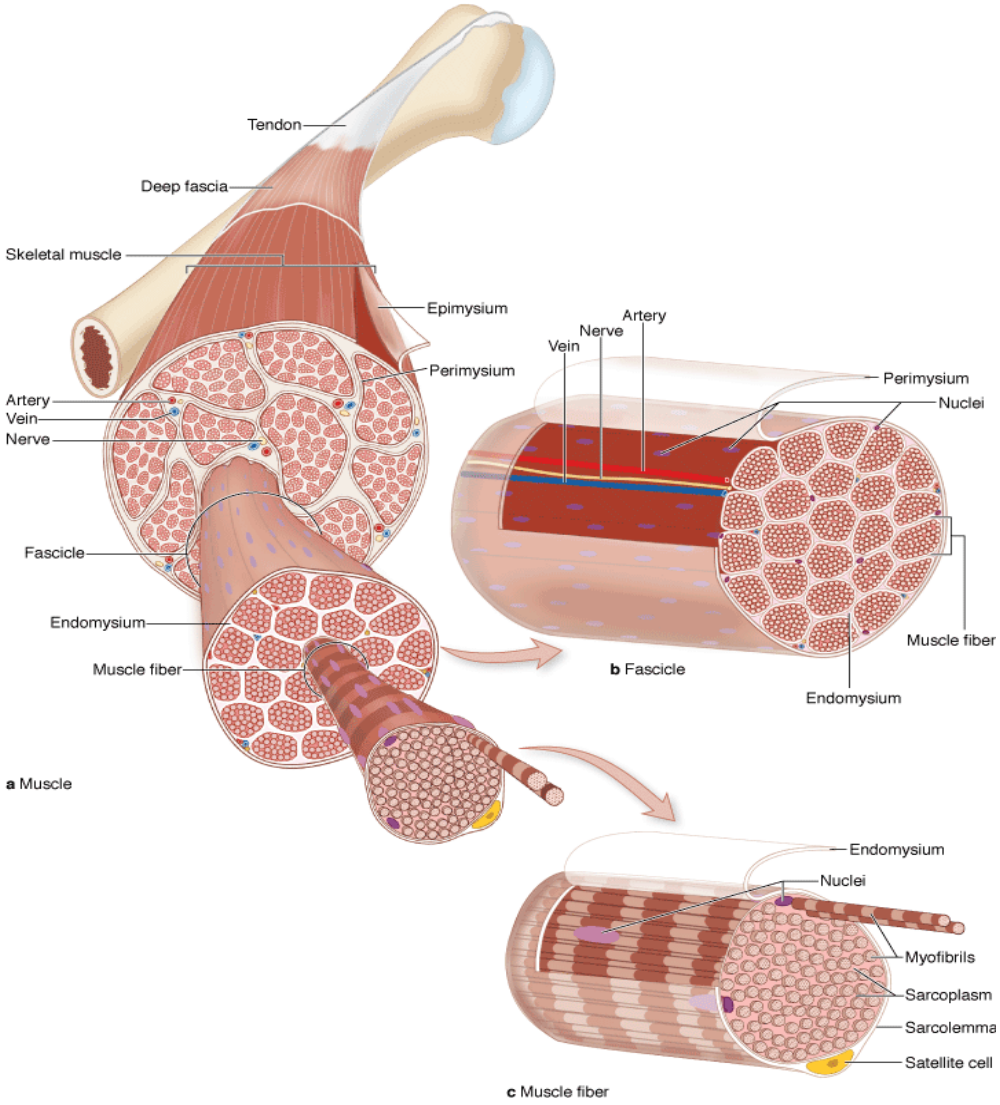


c Smooth muscle



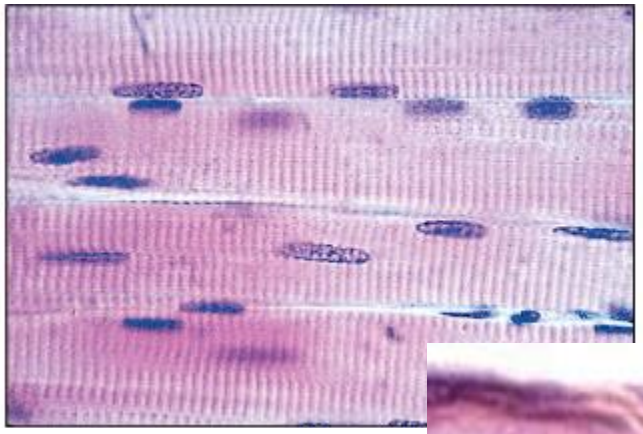
Core Concept

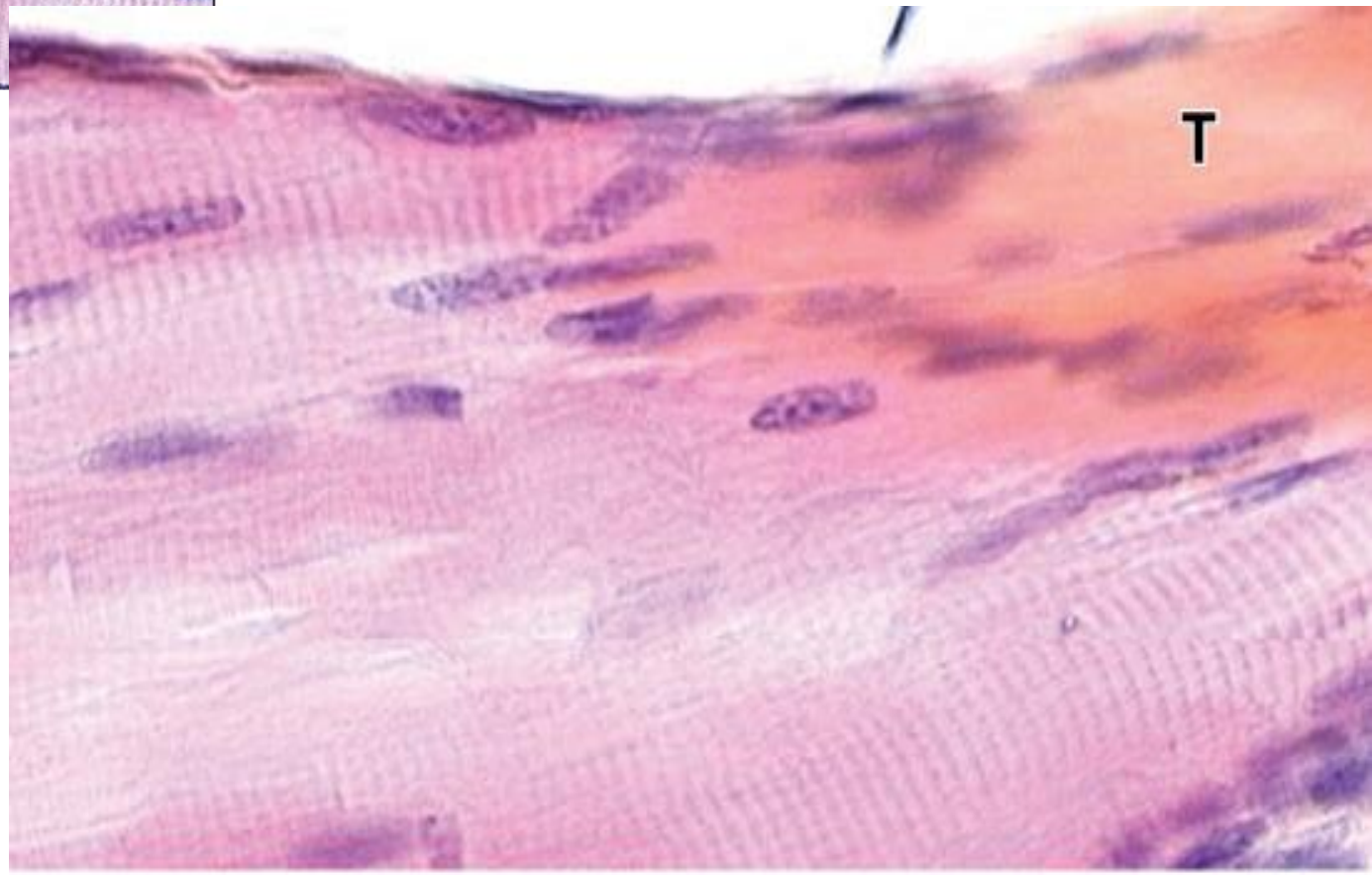
Organization



Core Concept

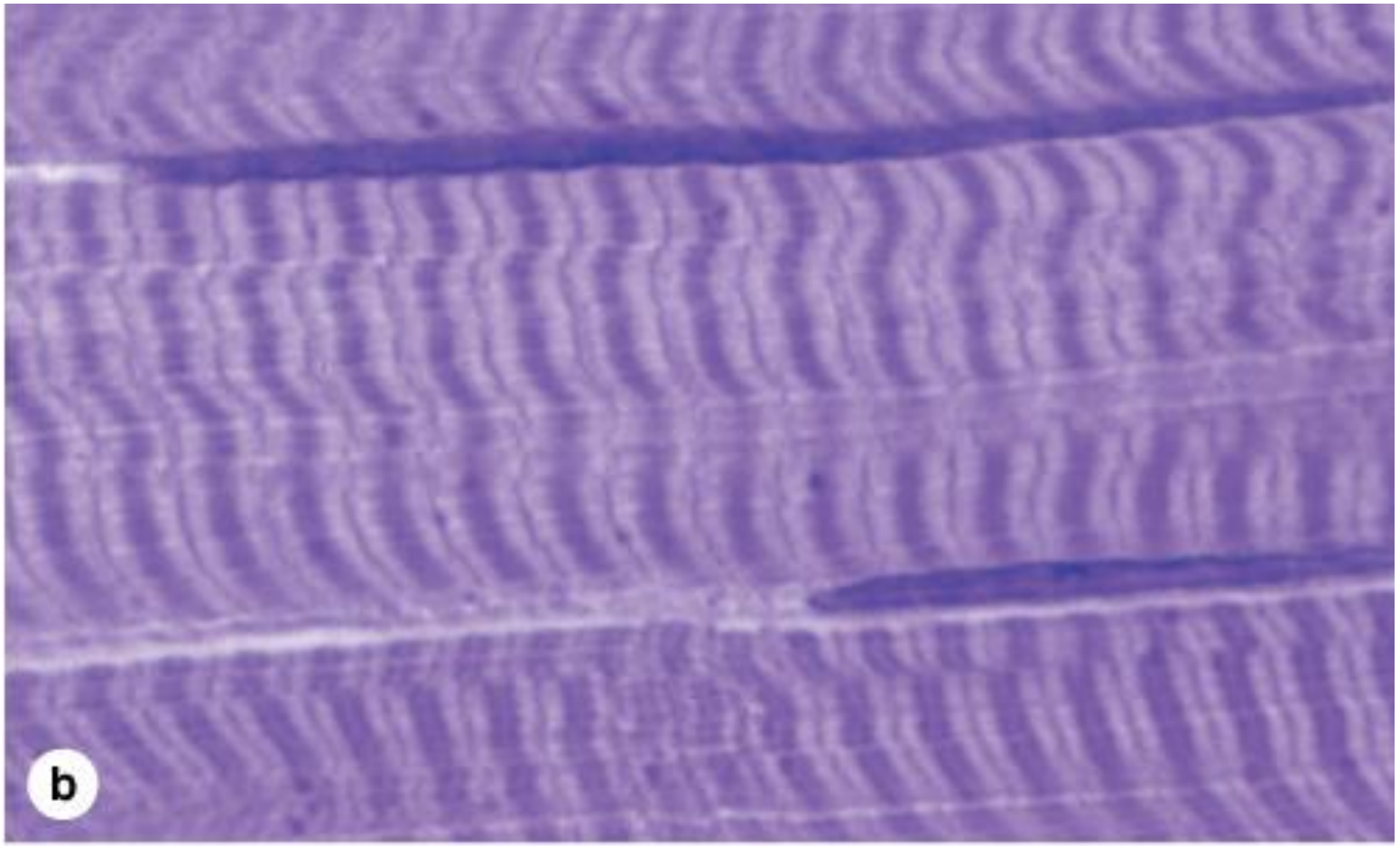
Skeletal Muscle





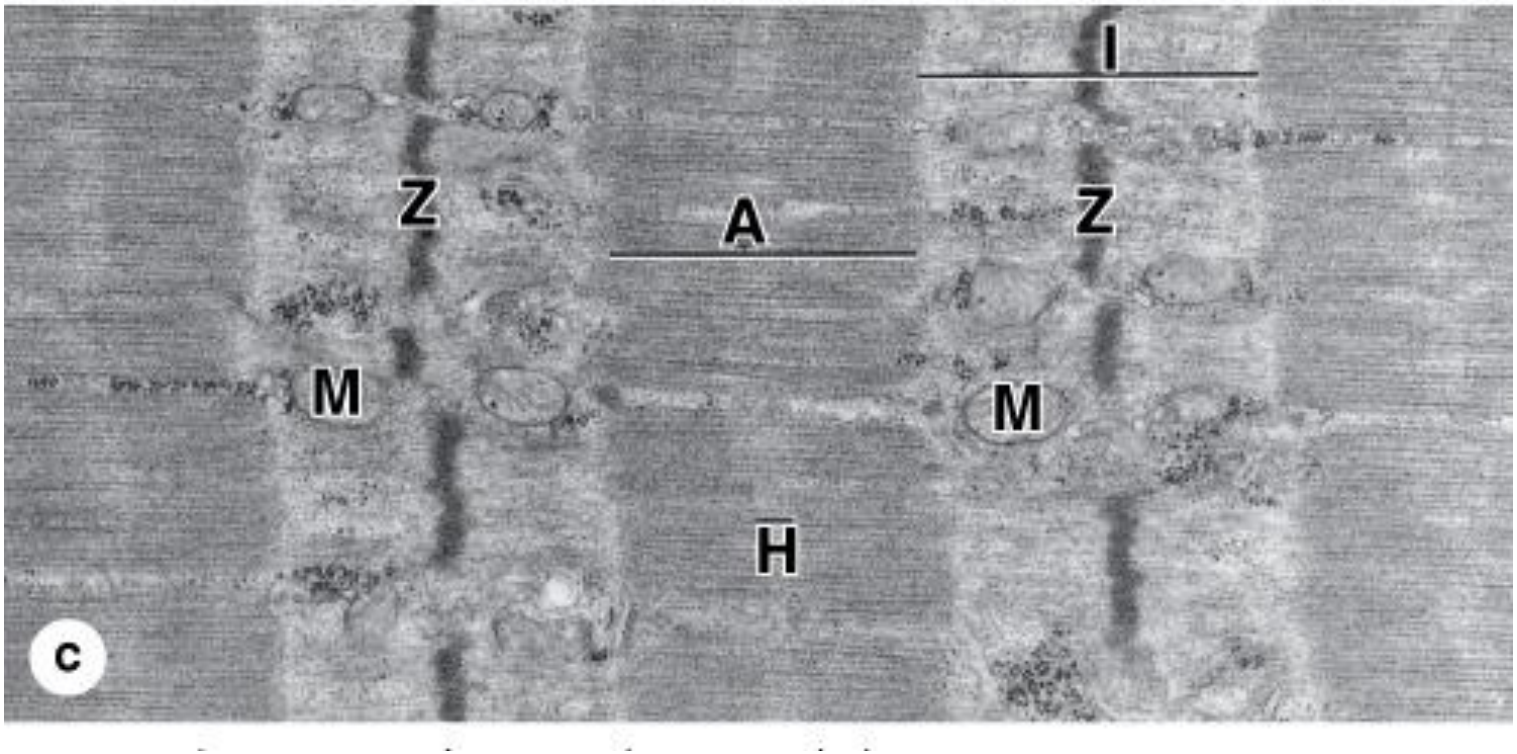
Core Concept

Skeletal Muscle

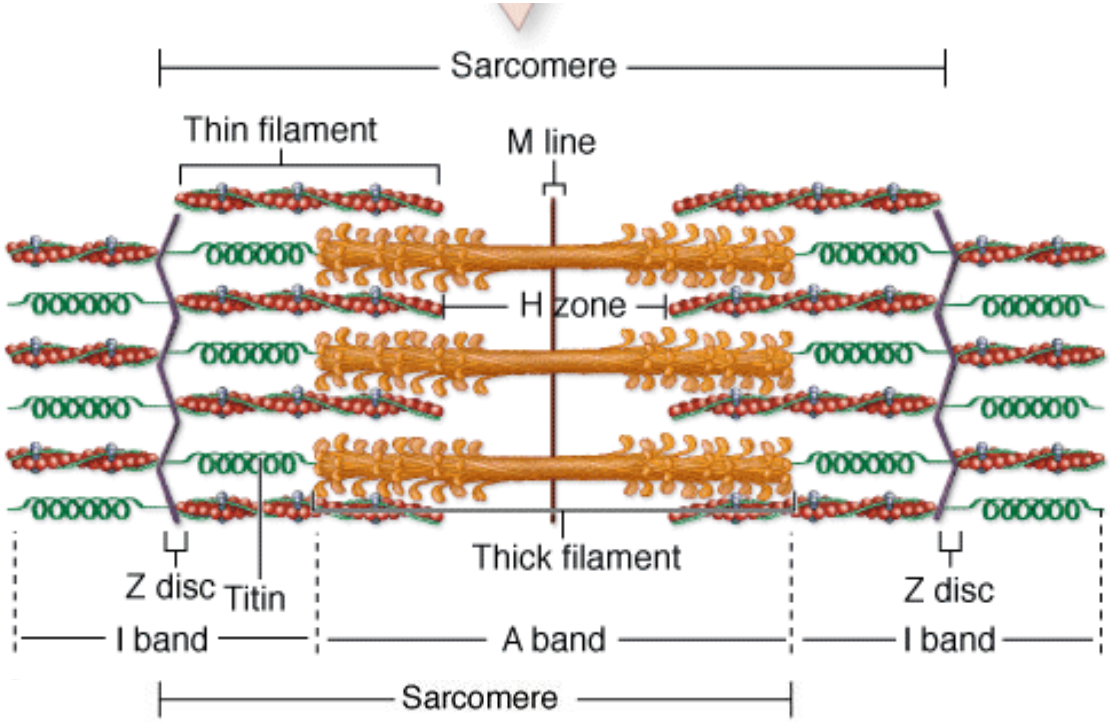


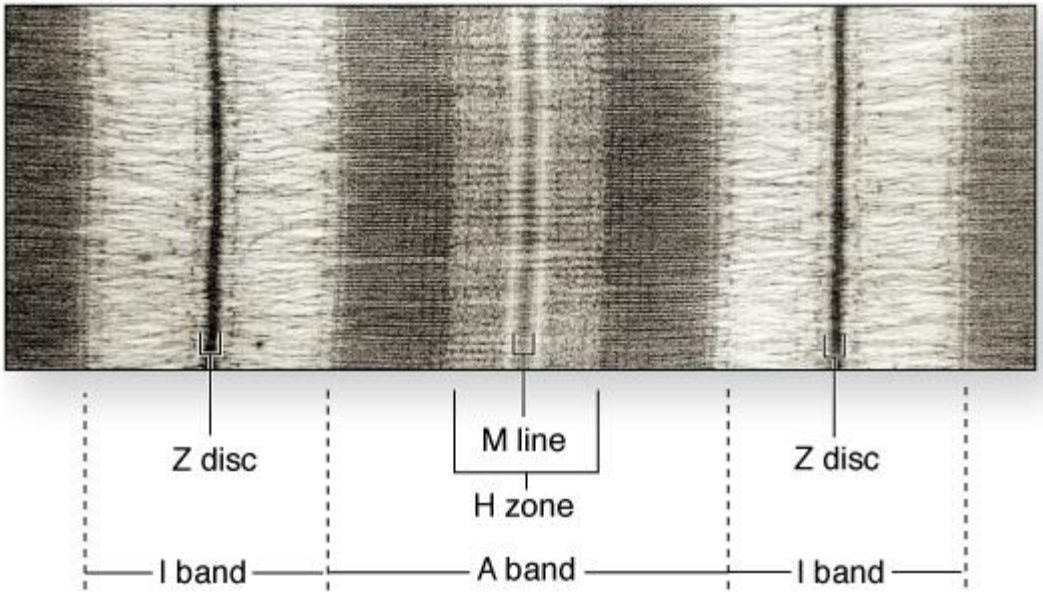
Core Concept

Sarcomere



Core Concept



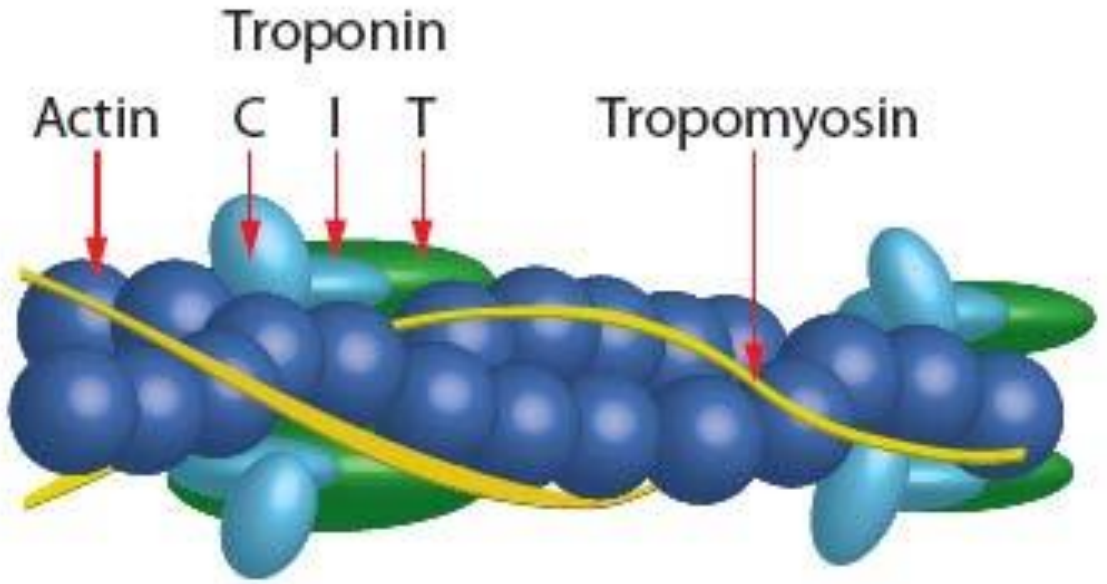


Core Concept

Thin Filaments

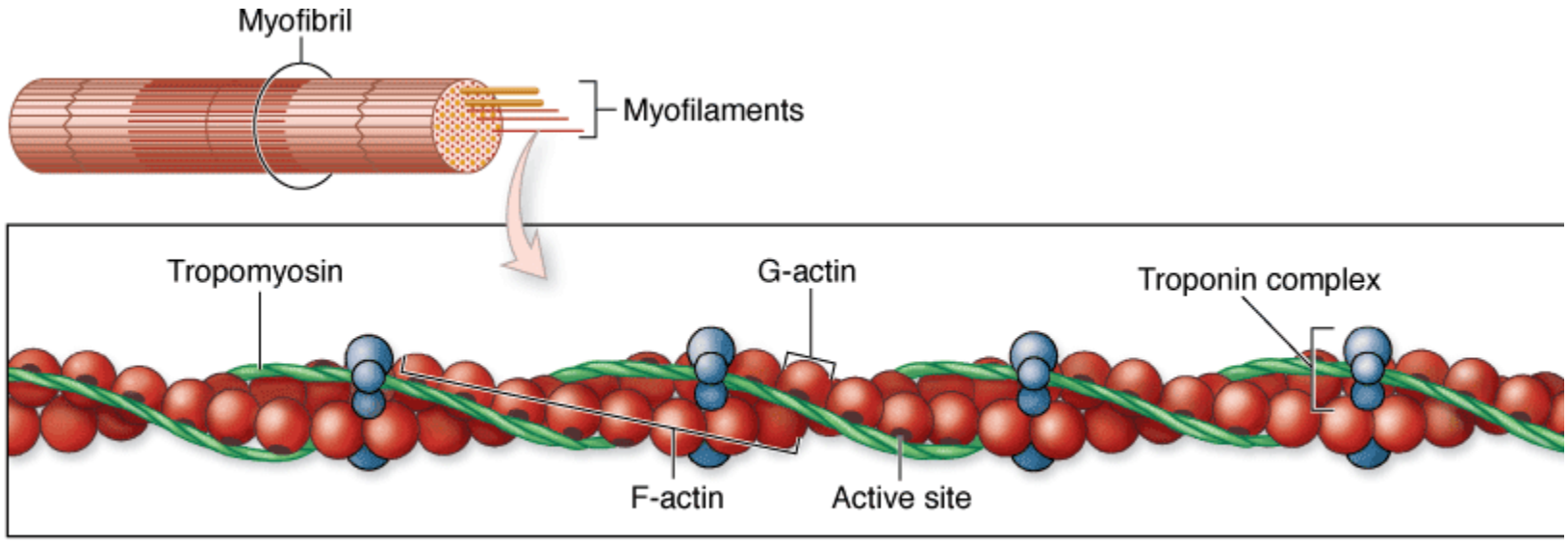
- F actin

- Troponin
- Tropomyosin



Core Concept

Actin Filaments



a Thin filament

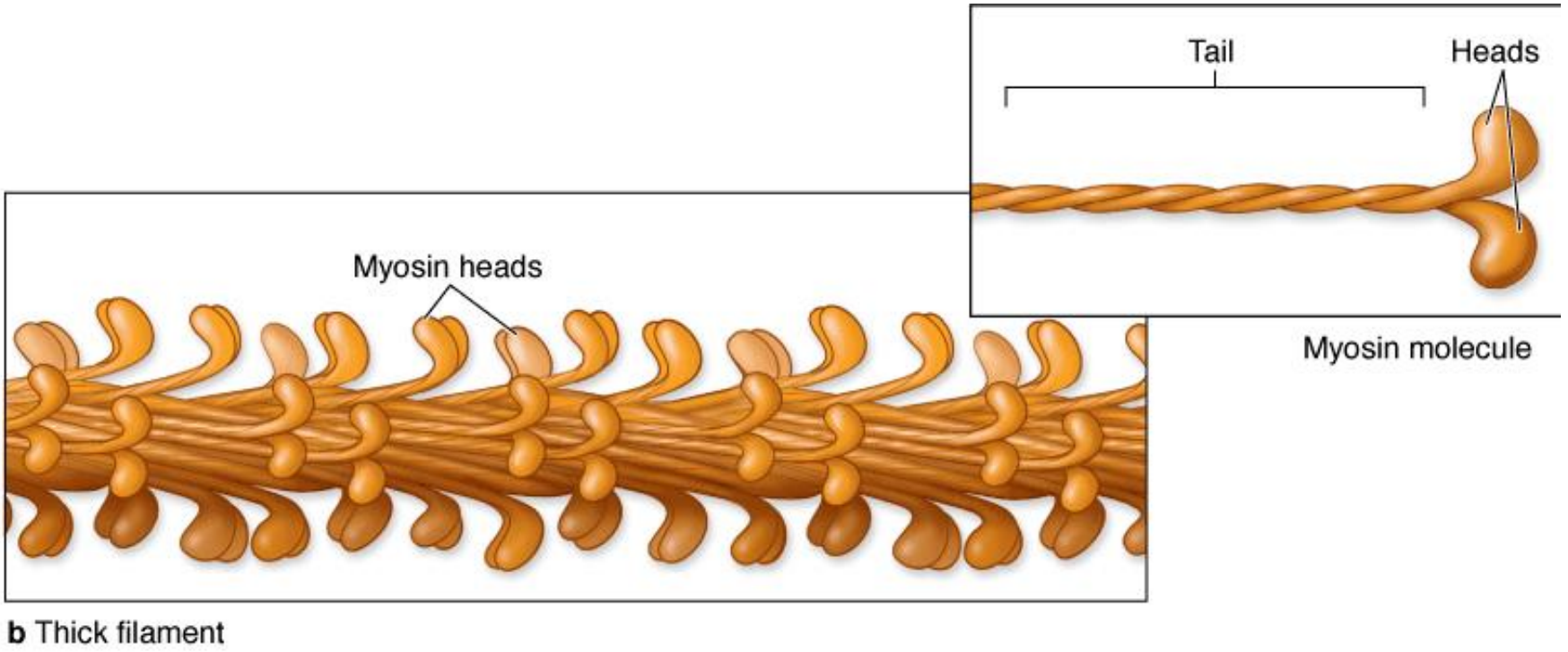
Core Concept

Thick Filaments

- 2 heavy chains tail
- 2 pairs of light chains head

Core Concept

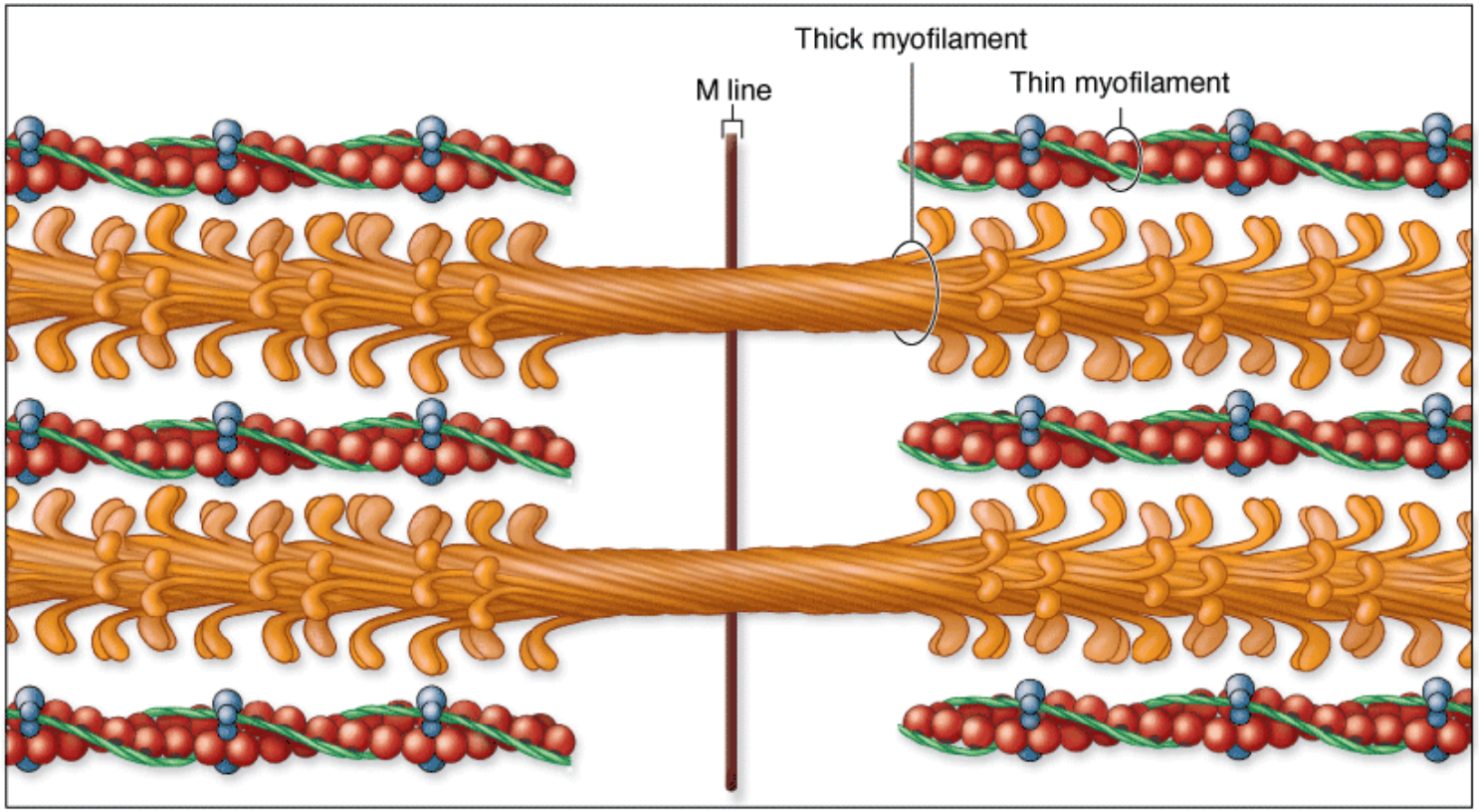
Myosin Filaments



b Thick filament

Core Concept

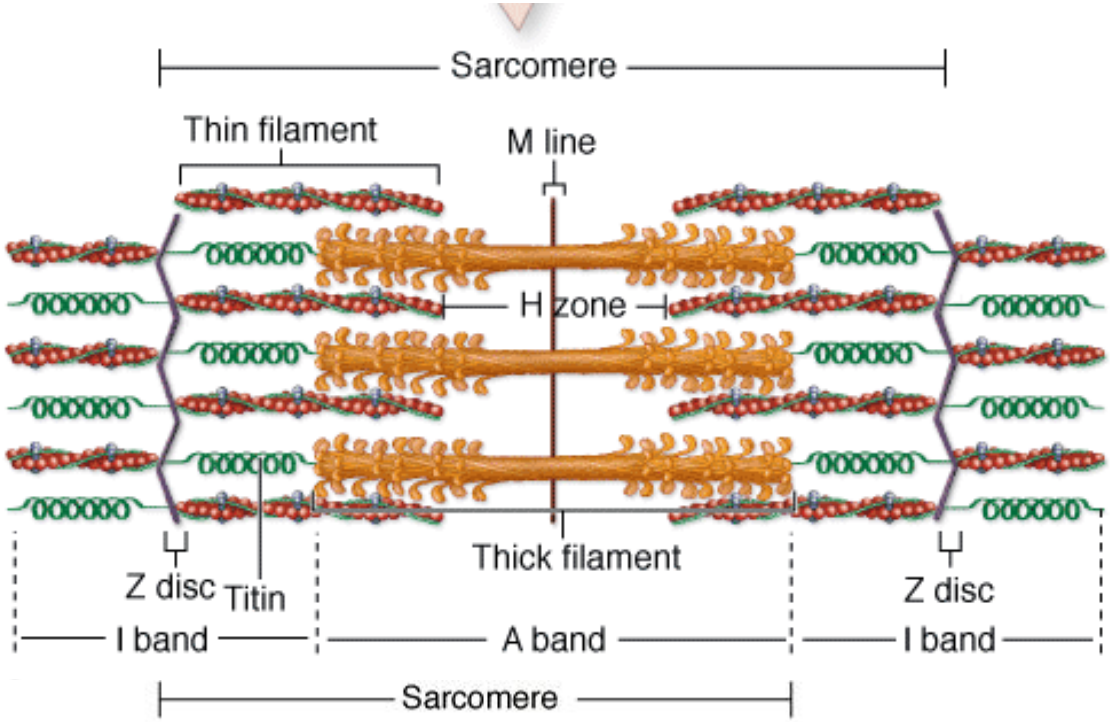
Thick Filaments

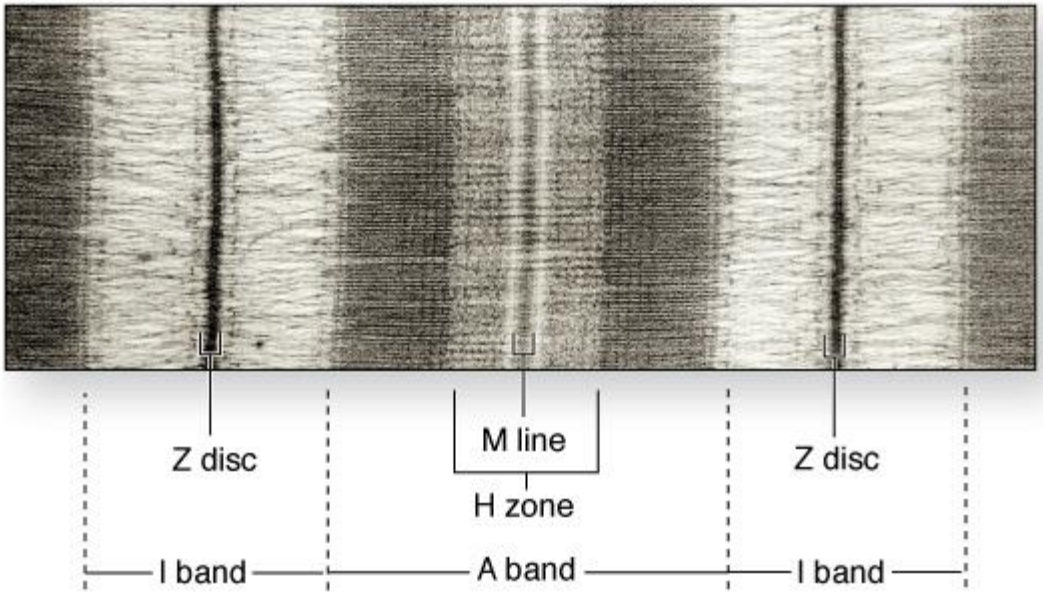


c Comparison of thick and thin filaments

Source: Mescher AL: *Junqueira's Basic Histology: Text and Atlas, 12th Edition:* http://www.accessmedicine.com

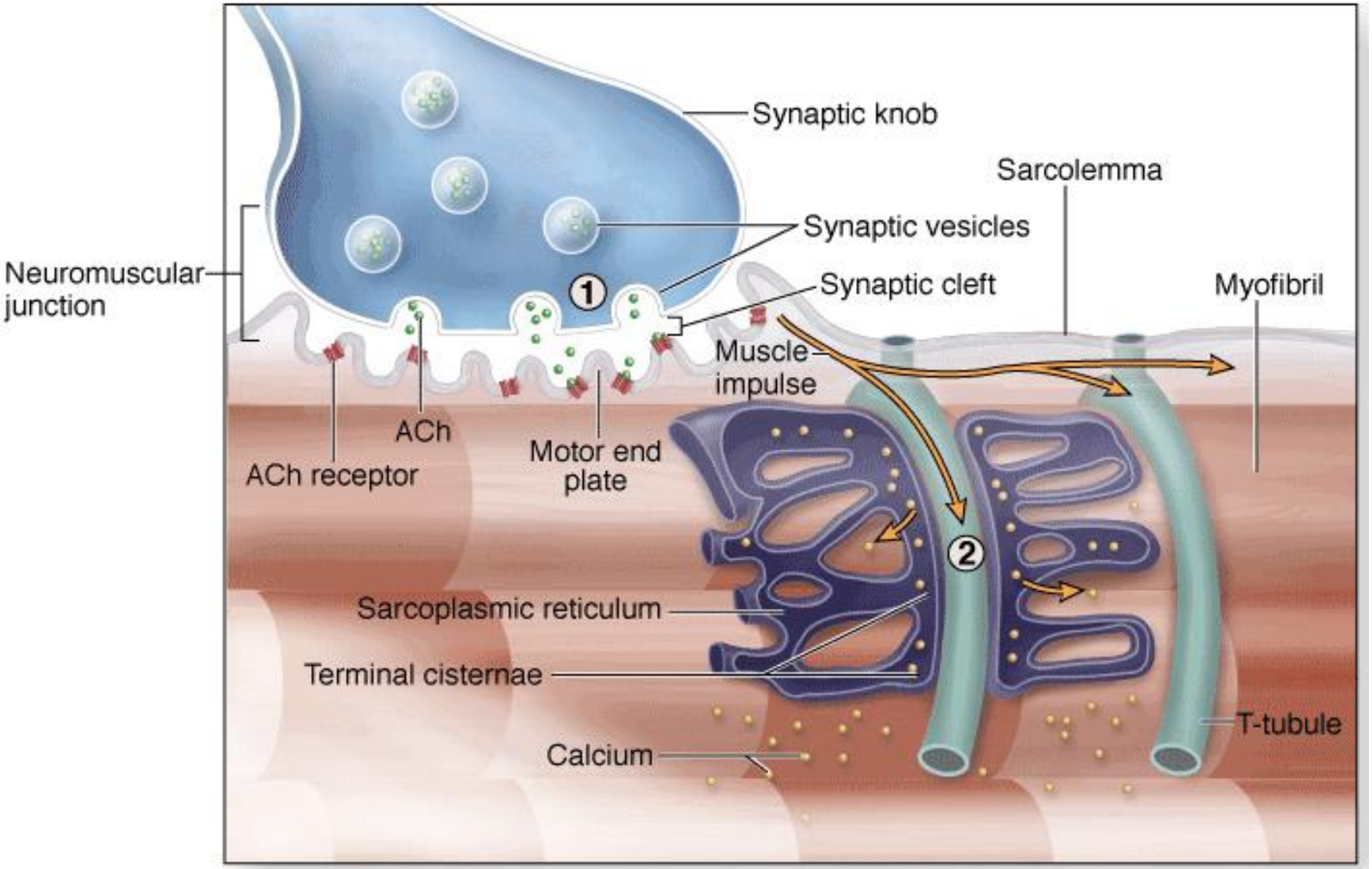
Core Concept



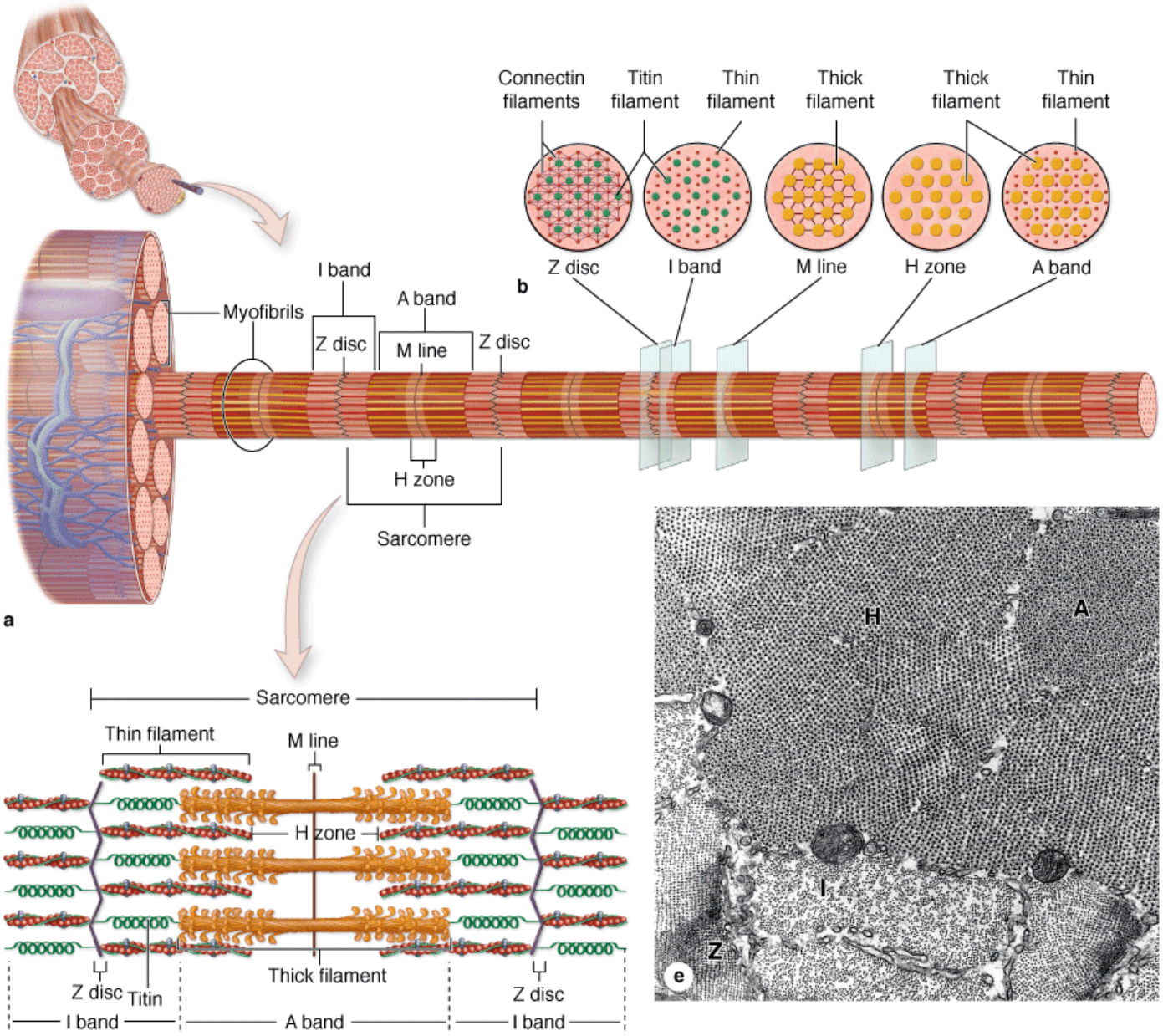


Core Concept

Sarcoplasmic Reticulum & Transverse Tubule System



Core Concept

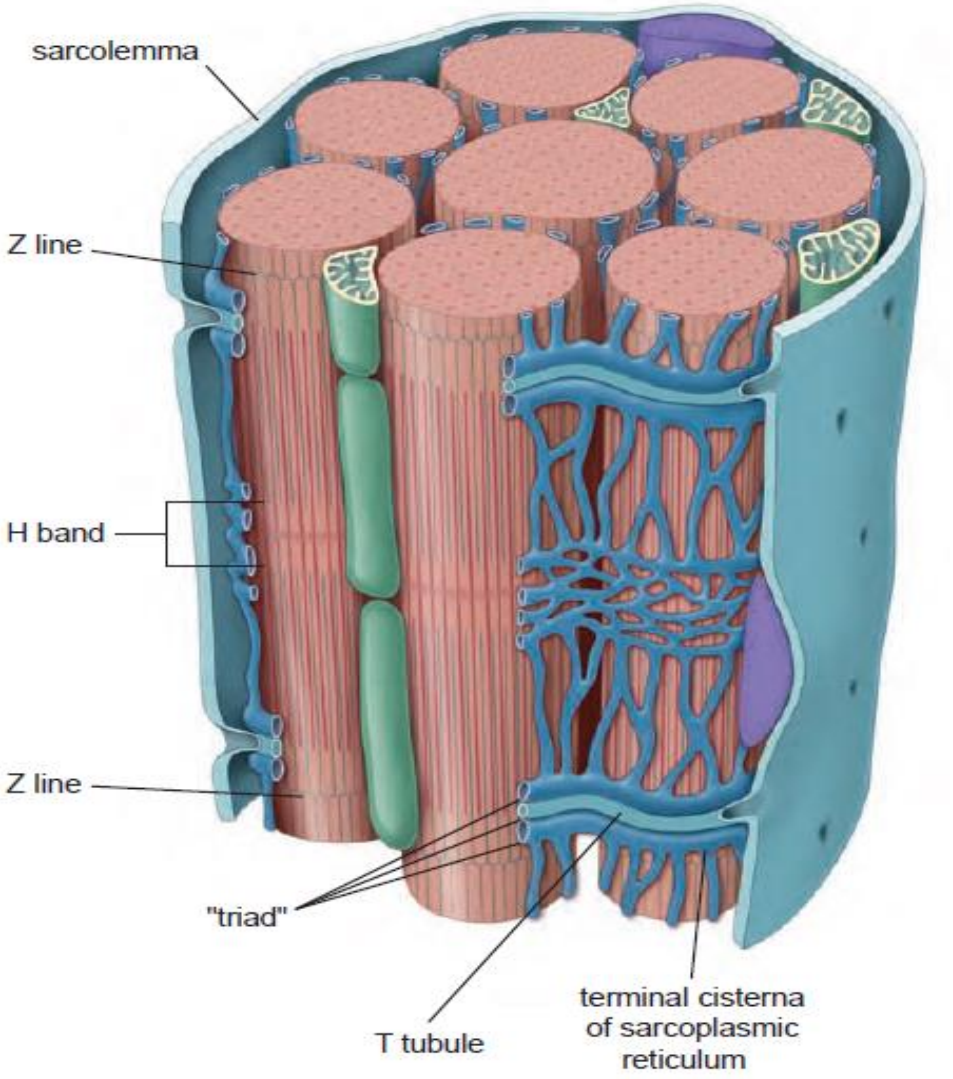


Core Concept

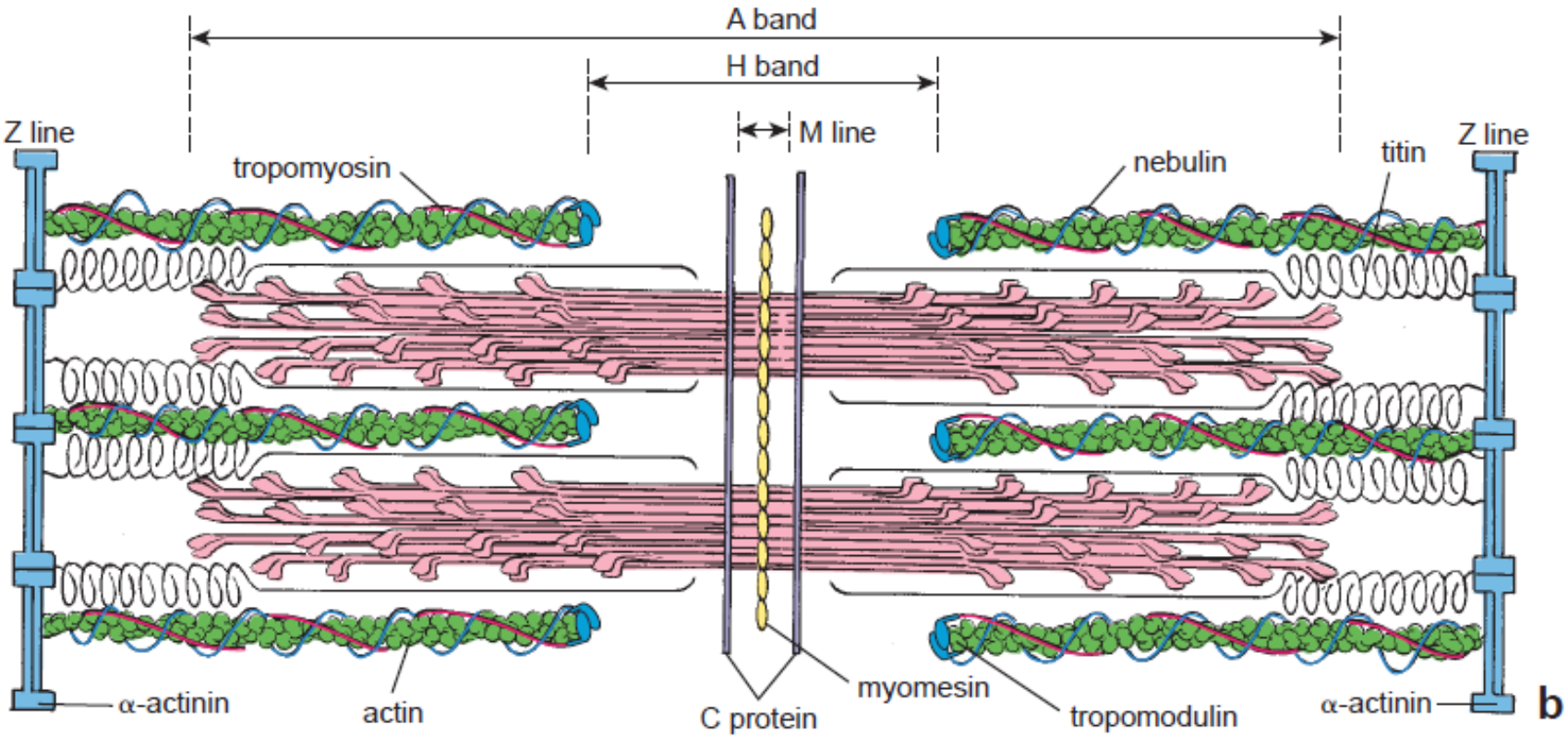
Mechanism Of Muscle Contraction

Core Concept

Cardiac Muscle

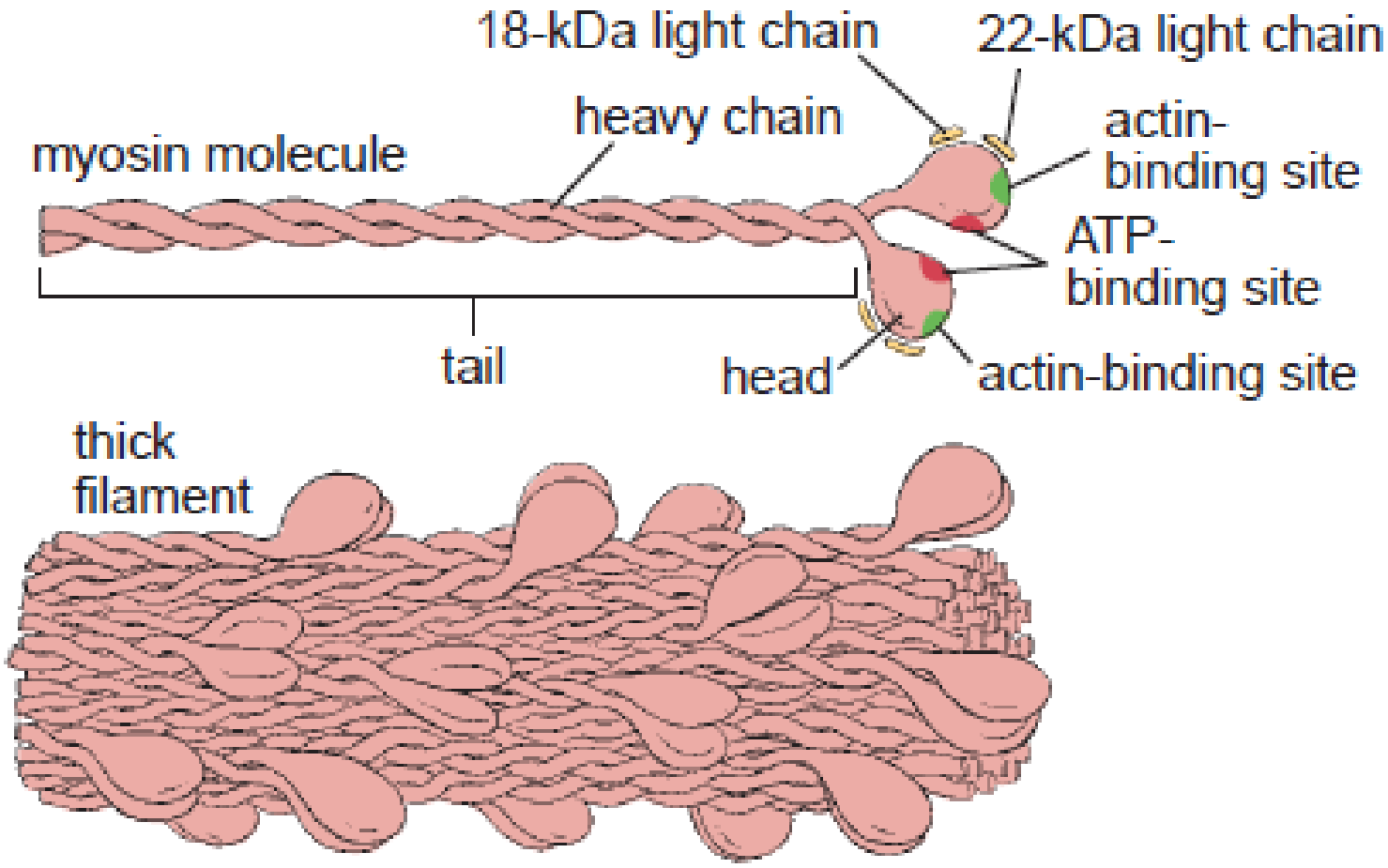


Core Concept



Core Concept

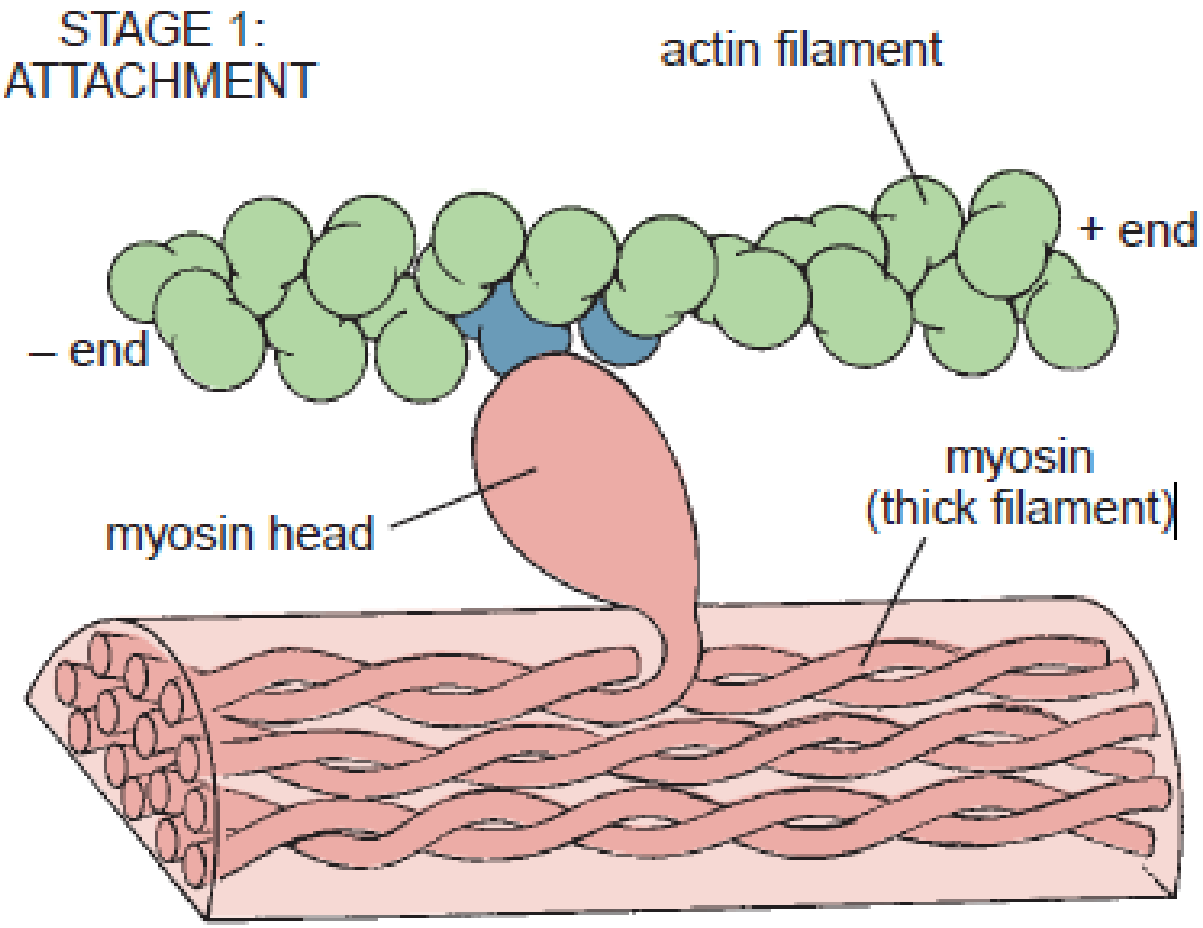
Contraction Cycle



Core Concept

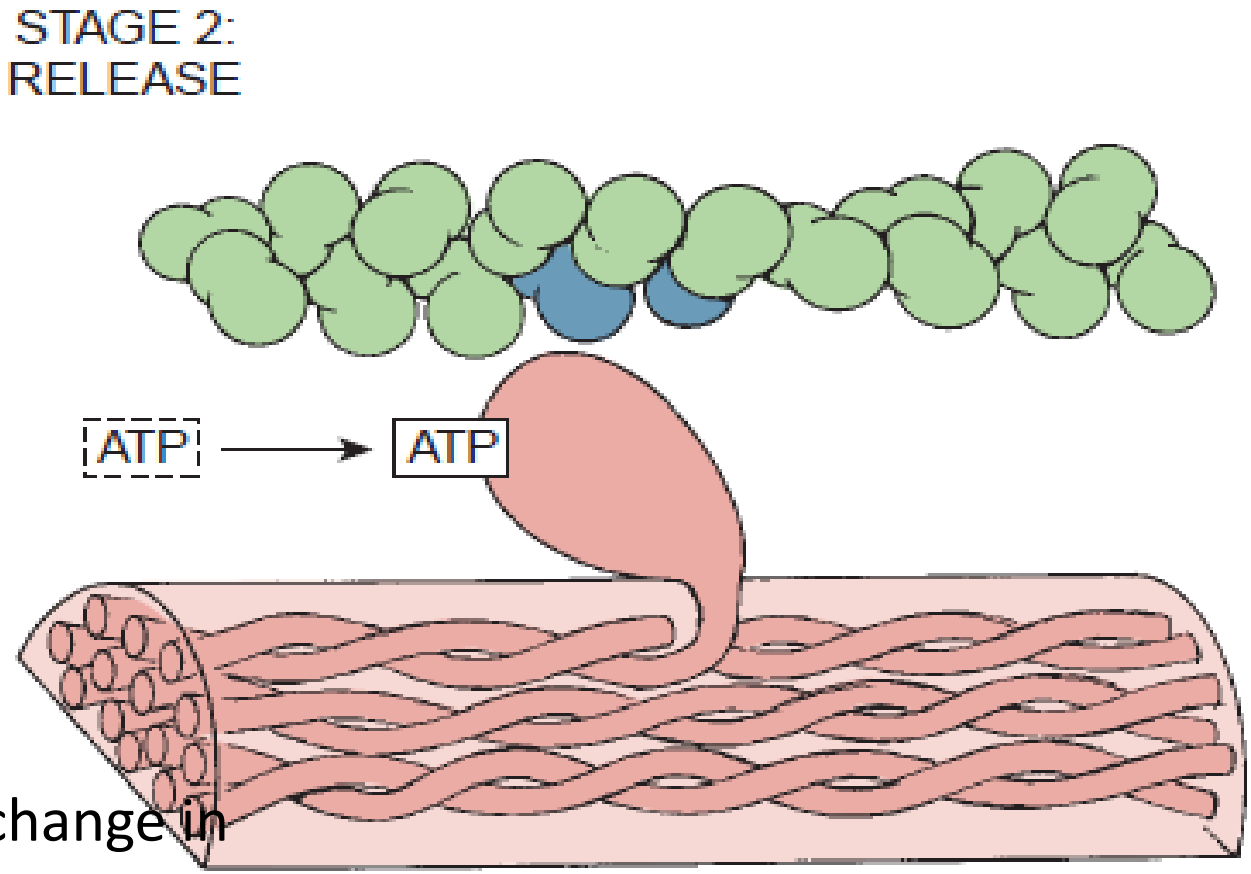
Contraction Cycle

- Rigor configuration
- No ATP involved



Core Concept

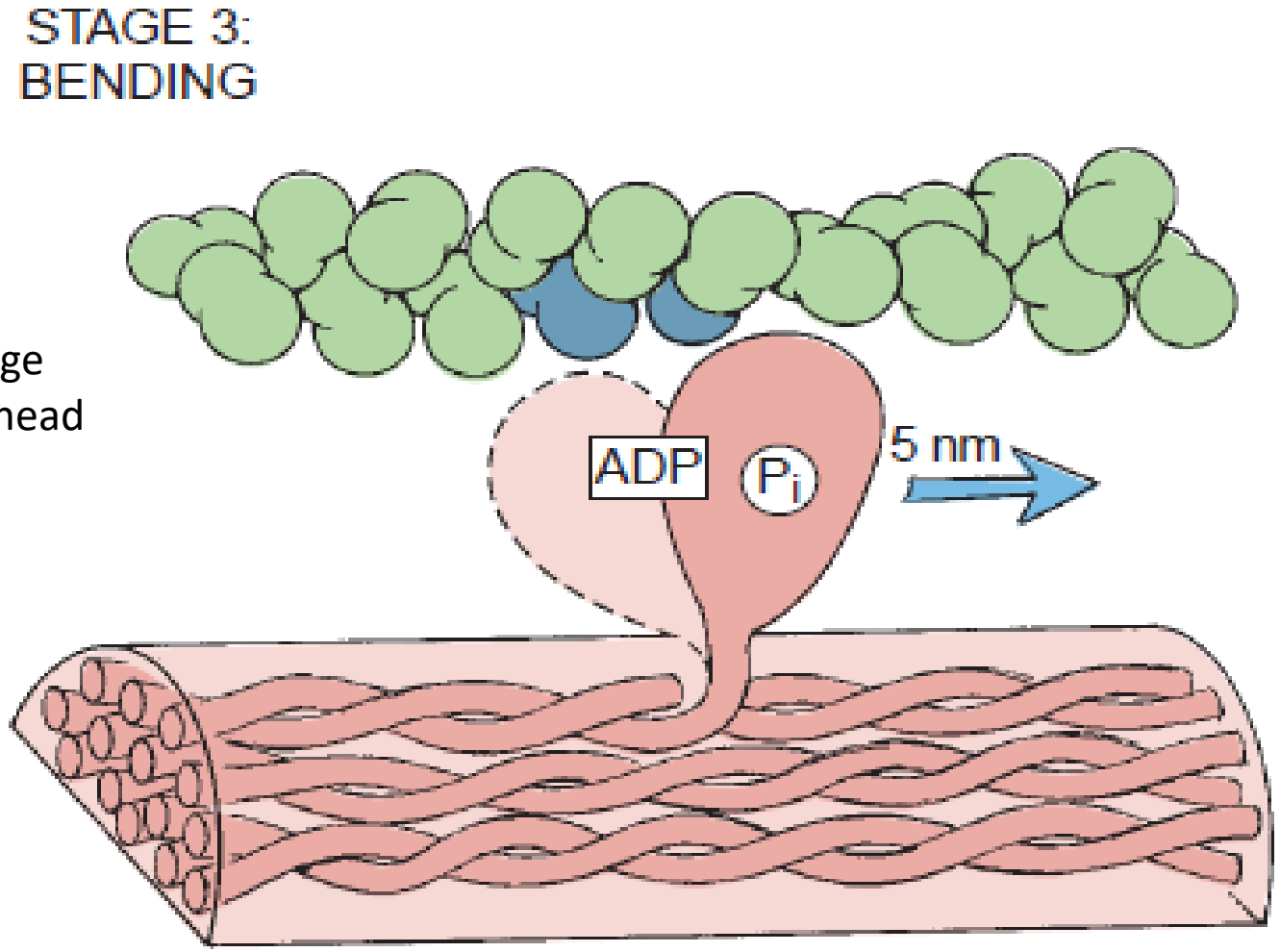
Contraction Cycle



- ATP attachment
- Configurational change in myosine binding site
- Low affinity
- uncoupling

Core Concept

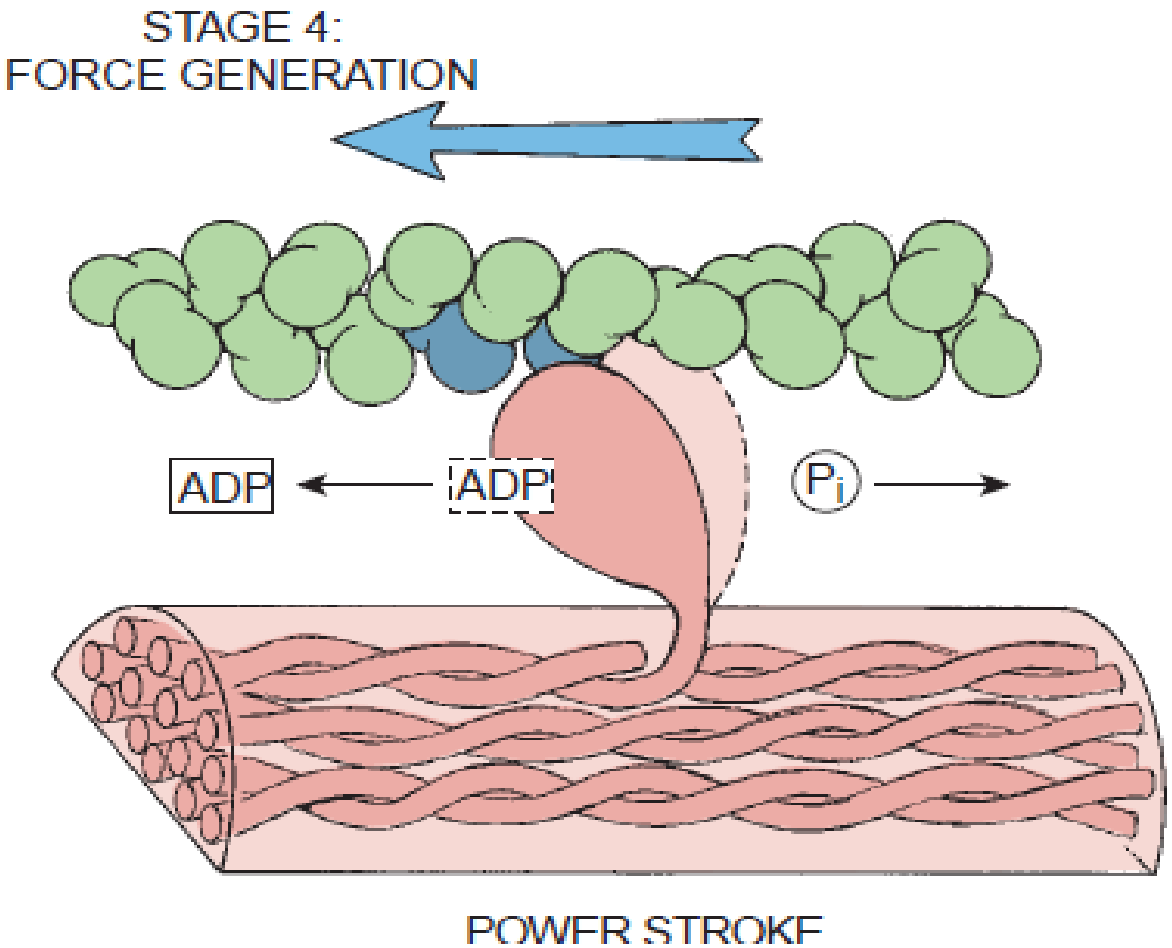
Contraction Cycle



- ATP hydrolysed
- Configurational change
- Bending of myosine head
- New binding site

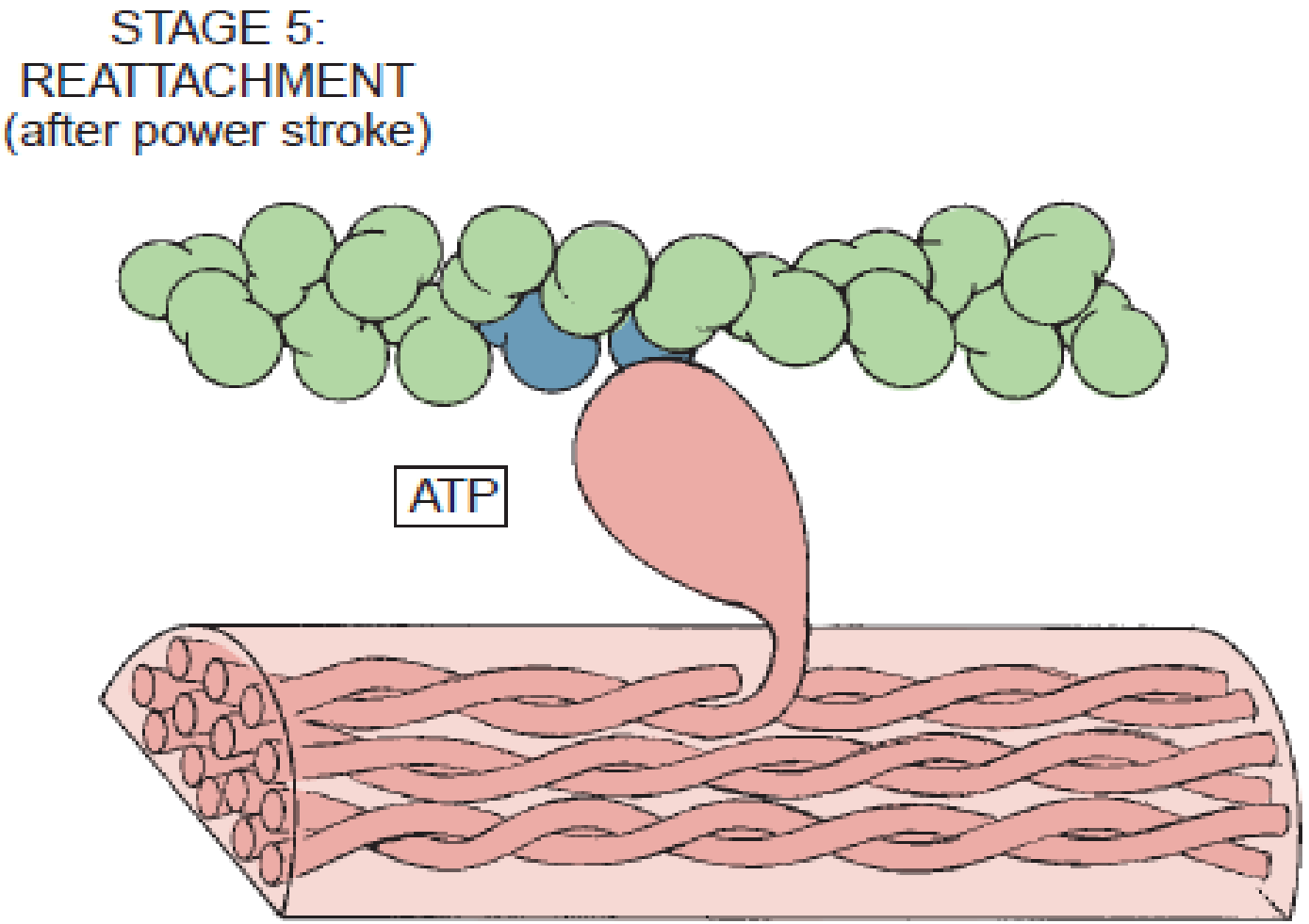
Core Concept

Contraction Cycle



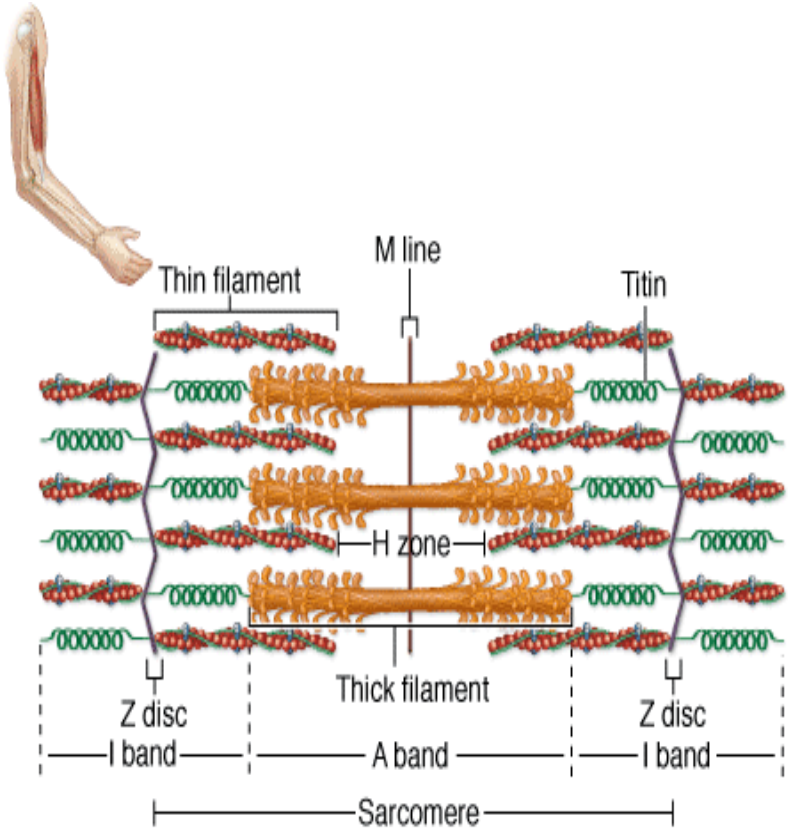
Core Concept

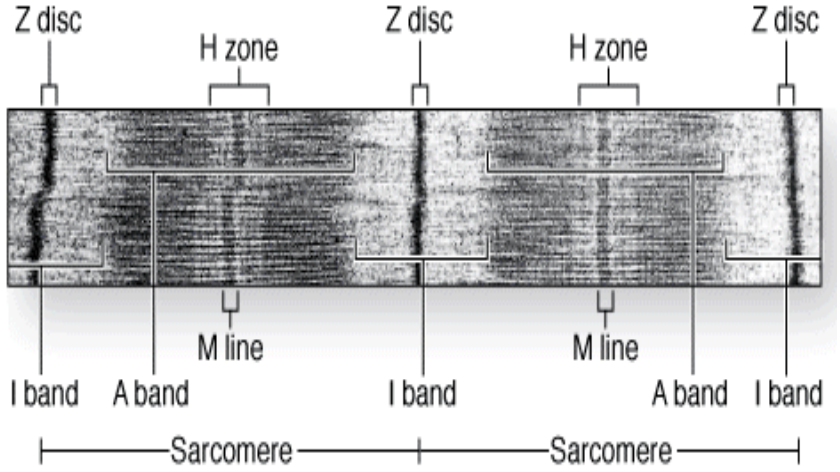
Contraction Cycle



Core Concept

Relaxed State



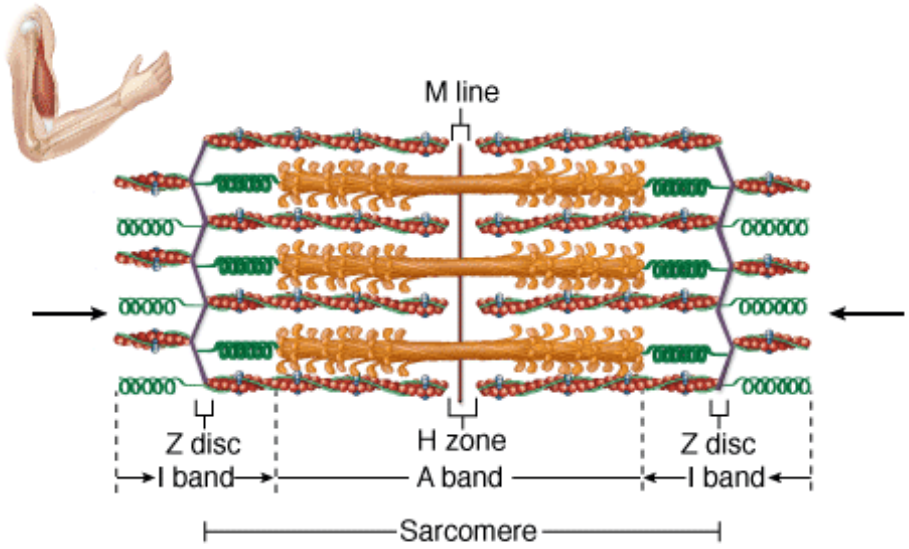


a Relaxed muscle

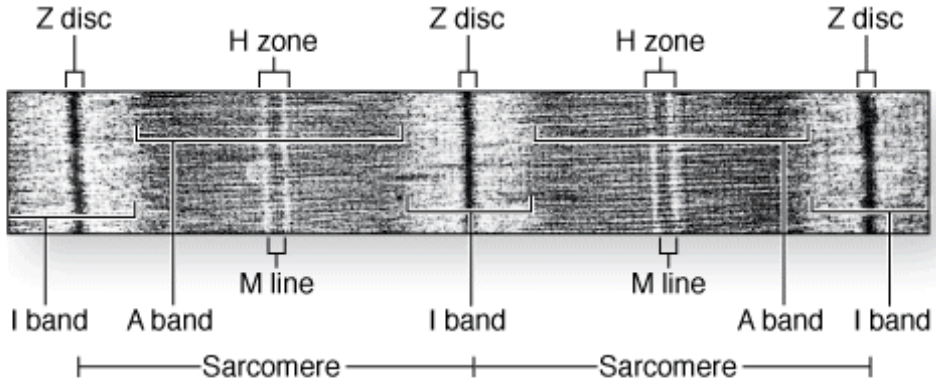
Sarcomere, I band, and H zone at a relaxed length.

Core Concept

Partial Contraction

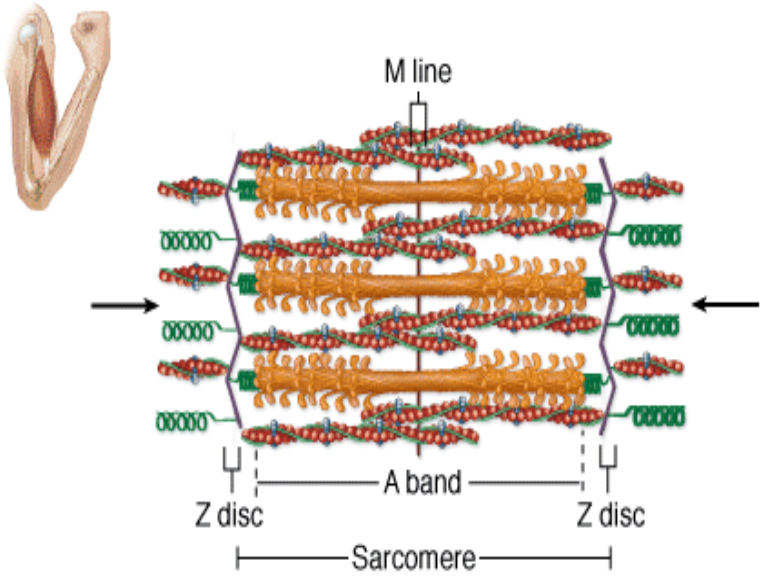


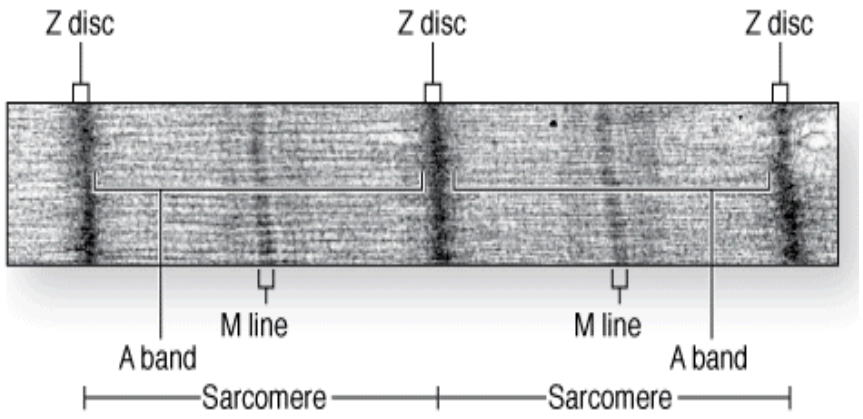
b Partially contracted muscle
Thick and thin filaments start to slide past one another. The sarcomere, I band, and H zone are narrower and shorter.



Core Concept

Full Contraction

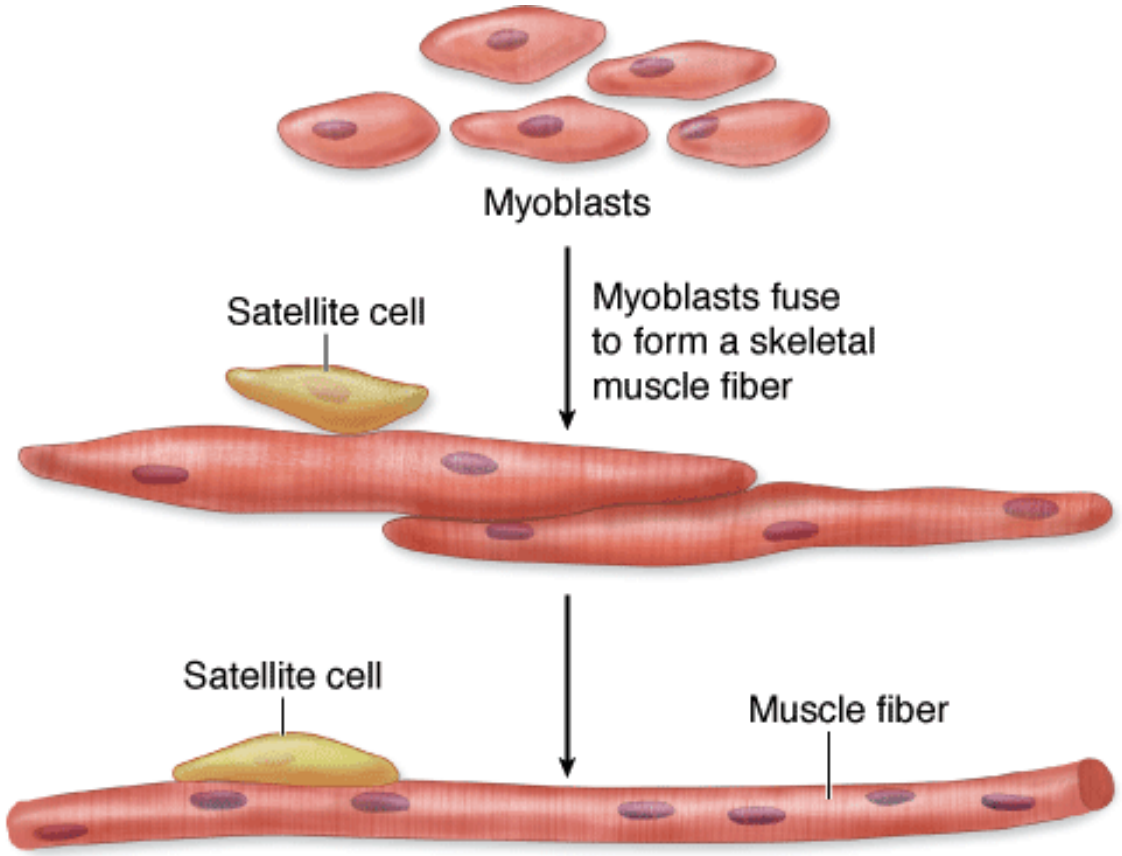




c Fully contracted muscle
The H zone and I band disappear, and the sarcomere is at its shortest length. Remember the lengths of the thick and thin filaments do not change.

Core Concept

Regeneration of Muscle Tissue



Tissue growth by an increase in the number of cells is termed **hyperplasia** (*hyper* + Gr. *plasis,* molding), which takes place most readily in smooth muscle, whose cells have not lost the capacity to divide by mitosis.

The increase in muscle thus obtained is caused by formation of new myofibrils and a pronounced growth in the diameter of individual muscle fibers. This process, characterized by increased of cell volume, is called **hypertrophy** (Gr. *hyper,* above, + *trophe,* nourishment).

Duchenne Muscular Dystrophy

- **investigations**
- serum creatine kinase (CK) test, which comes back significantly elevated.
- Genetic testing which confirms a deletion mutation in the dystrophin gene on the X chromosome.
- **Diagnosis**: Based on the clinical findings and investigations, Ali is diagnosed with Duchenne Muscular Dystrophy.
- **Management**: The management plan includes referral to a multidisciplinary team for comprehensive care. This includes physiotherapy for maintaining mobility, corticosteroids to slow muscle degeneration, and regular cardiac and respiratory assessments. Genetic counseling is also provided to the family.

Management

- The management plan includes referral to a multidisciplinary team for comprehensive care. This includes
- Physiotherapy for maintaining mobility
- Corticosteroids to slow muscle degeneration
- Regular cardiac and respiratory assessments.
- Genetic counseling is also provided to the family.

Counseling

- **Empathy and Support**: Begin by acknowledging the emotional impact of the diagnosis. It's important to provide emotional support and assure them that they are not alone in this journey
- **Information Sharing**: Provide clear and accurate information about DMD, its progression, and management. Explain the genetic nature of the disease and discuss the implications for other family members
- **Genetic Counseling**
- **Future Planning**
- **Encourage Open Communication**

Research Article

TITLE:

Repairing skeletal muscle: regenerative potential of skeletal muscle stem cells:

Skeletal muscle damaged by injury or by degenerative diseases such as muscular dystrophy is able to regenerate new muscle fibers. Regeneration mainly depends upon satellite cells, myogenic progenitors localized between the basal lamina and the muscle fiber membrane. However, other cell types outside the basal lamina, such as pericytes, also have myogenic potency.

https://pubmed.ncbi.nlm.nih.gov/?term=Tedesco%20FS%5BAuthor%5D

Learning Resources

- Junqueira's Basic Histology 12th Edition, Chapter 10
- Histology , A text and Atlas by Michael H.Ross 6th Edition, Chapter 6
- Histology , A text and Atlas by Michael H.Ross 6th Edition, Chapter 11
- Google scholar