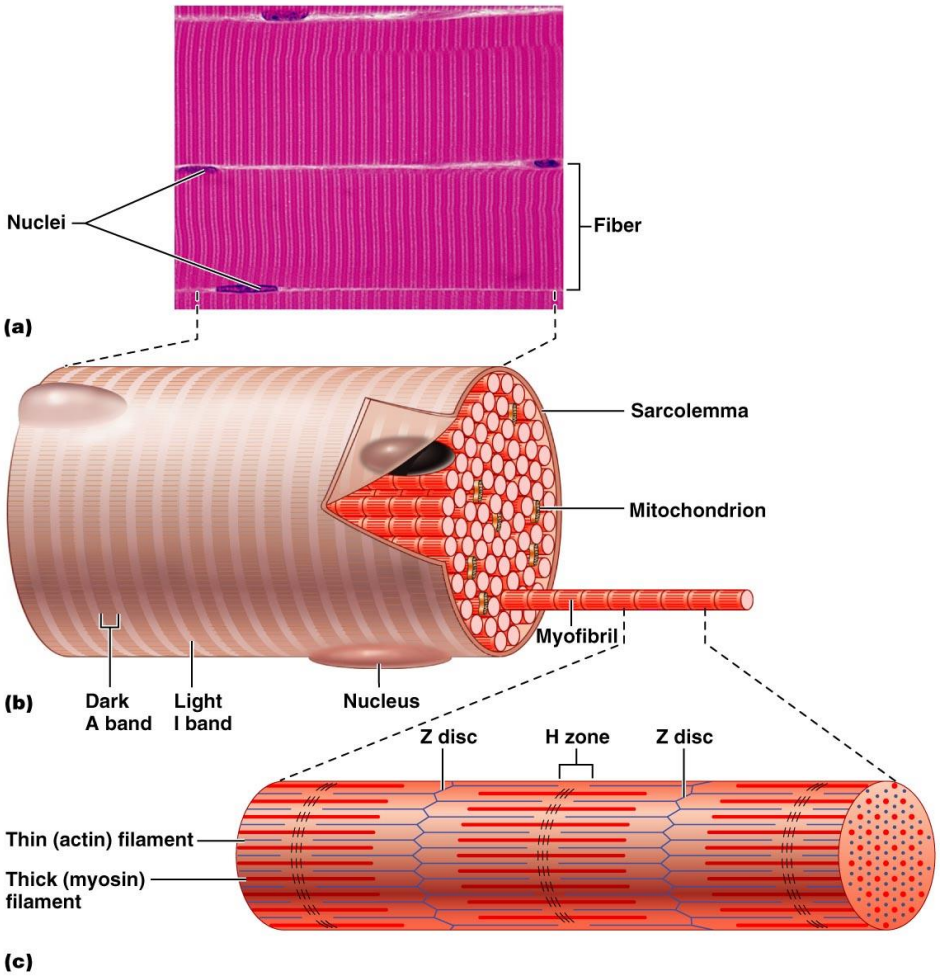
Chapter 9
Muscles and Muscle Tissue

Microscopic Anatomy

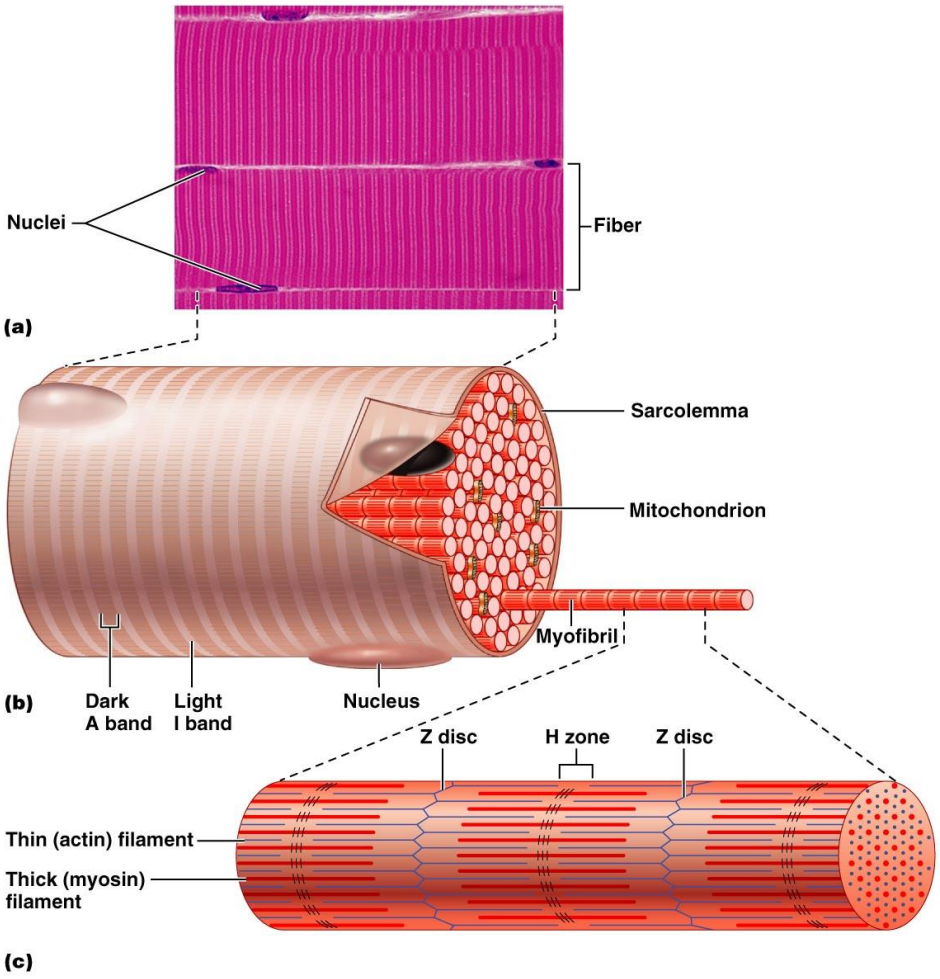
Skeletal Muscle Fibers – Microscopic Anatomy

- Cell membrane → **sarcolemma**
- Long cylindrical cell with multiple oval nuclei.
- Nucleus is just below the cell membrane
- Diameter 10 – 100um (10x's larger than average body cell)



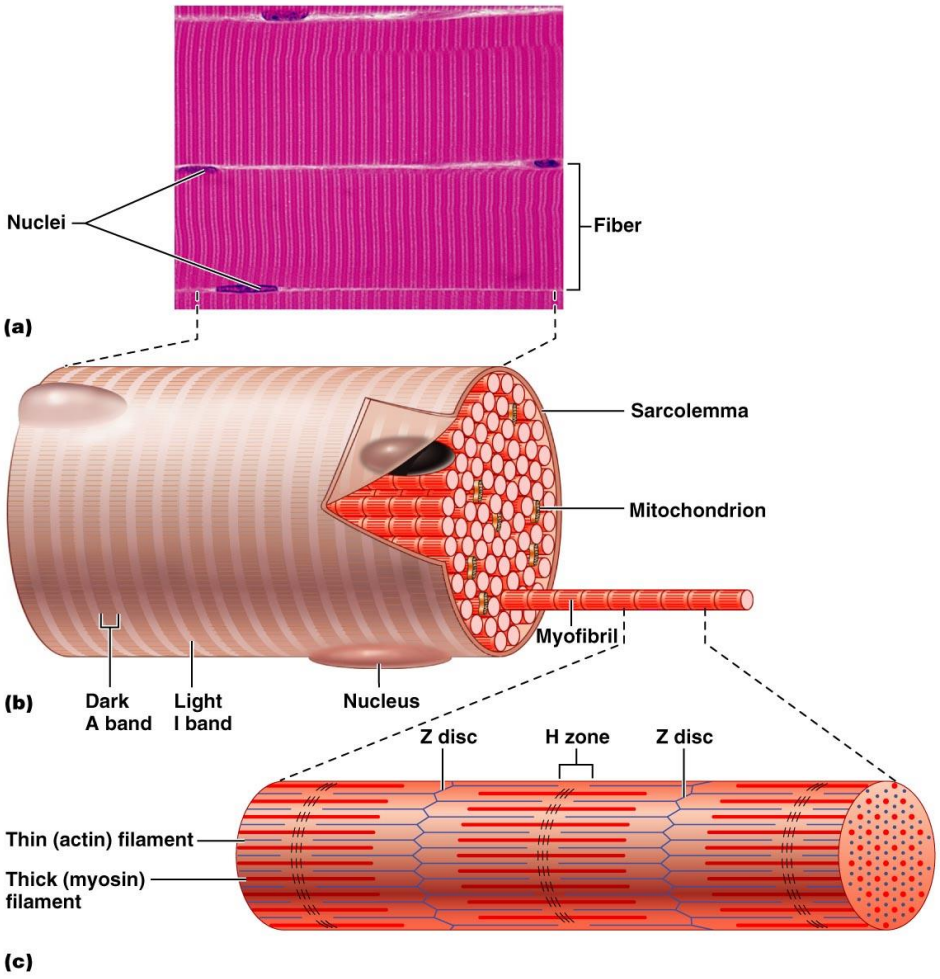
Skeletal Muscle Fibers – Microscopic Anatomy

- Cells are long → up to 30 cm
- Why so big?
  - Each skeletal muscle fiber is actually a produced by the fusion of hundreds of embryonic cells!
  - Thus the multiple nuclei



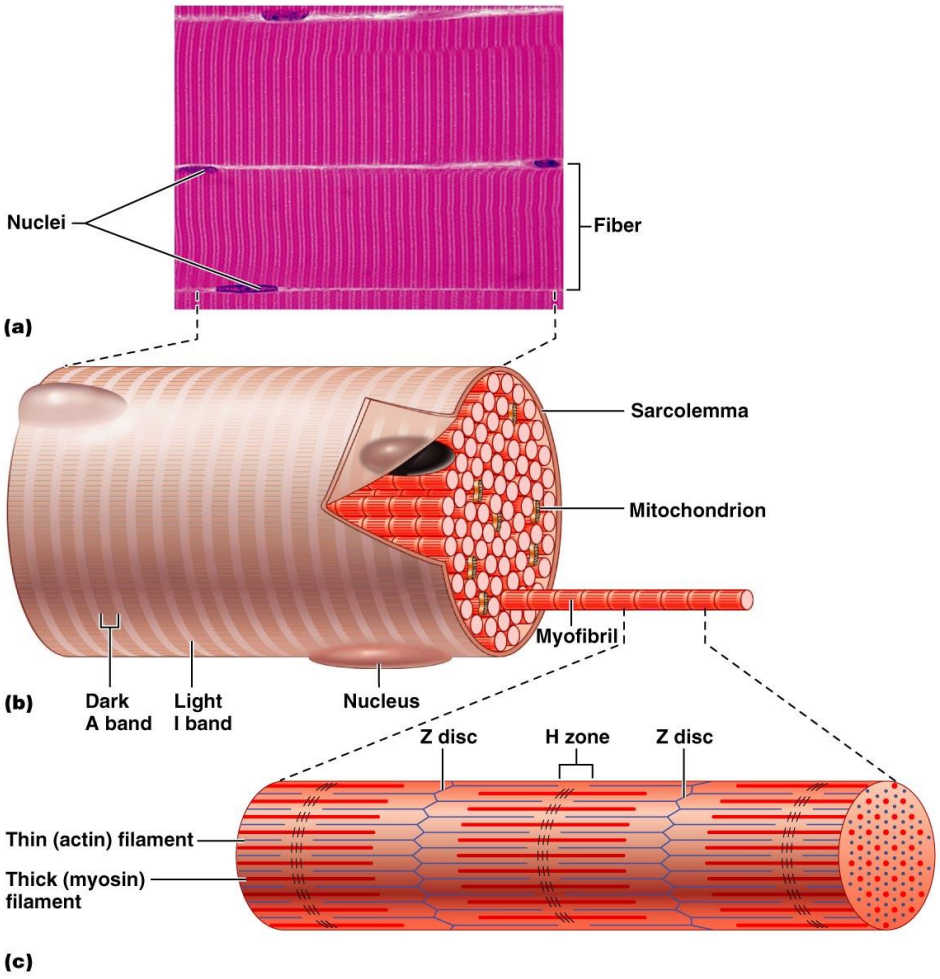
Skeletal Muscle Fibers – Microscopic Anatomy

- **Sarcoplasma (cytoplasm)**
  - Contains unusually large amounts of glycogen (sugar)
  - myoglobin (a unique oxygen binding protein) red pigment that stores oxygen (similar to hemoglobin that transports oxygen in the blood)



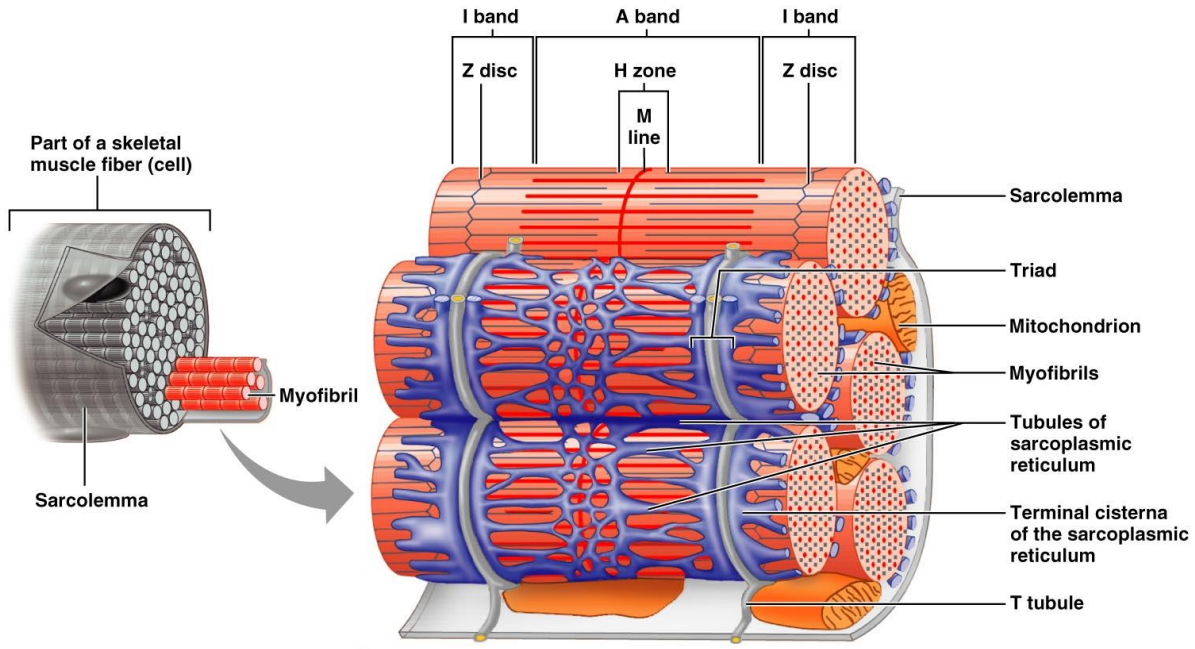
Skeletal Muscle Fibers – Microscopic Anatomy

- **Sarcoplasma (cytoplasm)**
  - Usual organelles present
  - Unique organelles – myofibrils and sarcoplasmic reticulum and T tubules



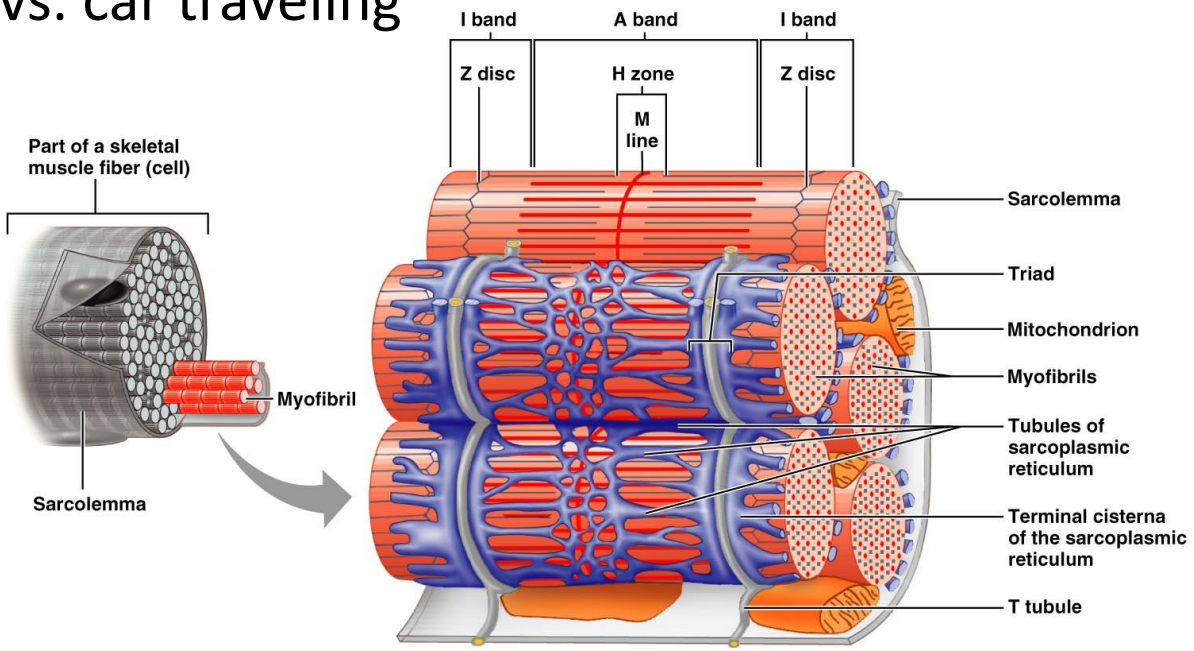
Skeletal Muscle Fibers – Microscopic Anatomy

- **T Tubules**
  - The sarcolemma of the muscle fiber penetrates into the cell to form an elongated tubule (transverse tubule → t tubule)



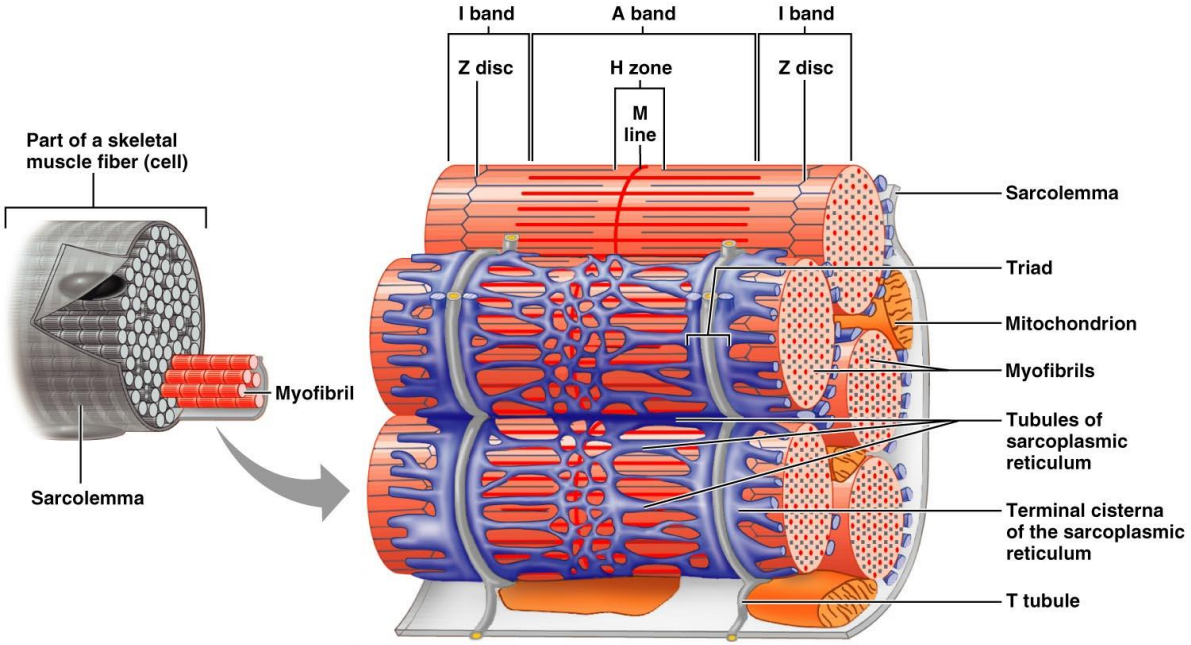
Skeletal Muscle Fibers – Microscopic Anatomy

- **T Tubules**
  - A skeletal muscle fiber is very large; all regions of the cell must contract simultaneously → Allows the electrical stimulus and extracellular fluid to come in close contact with deep cell regions → makes reaction occur quicker → horse vs. car traveling



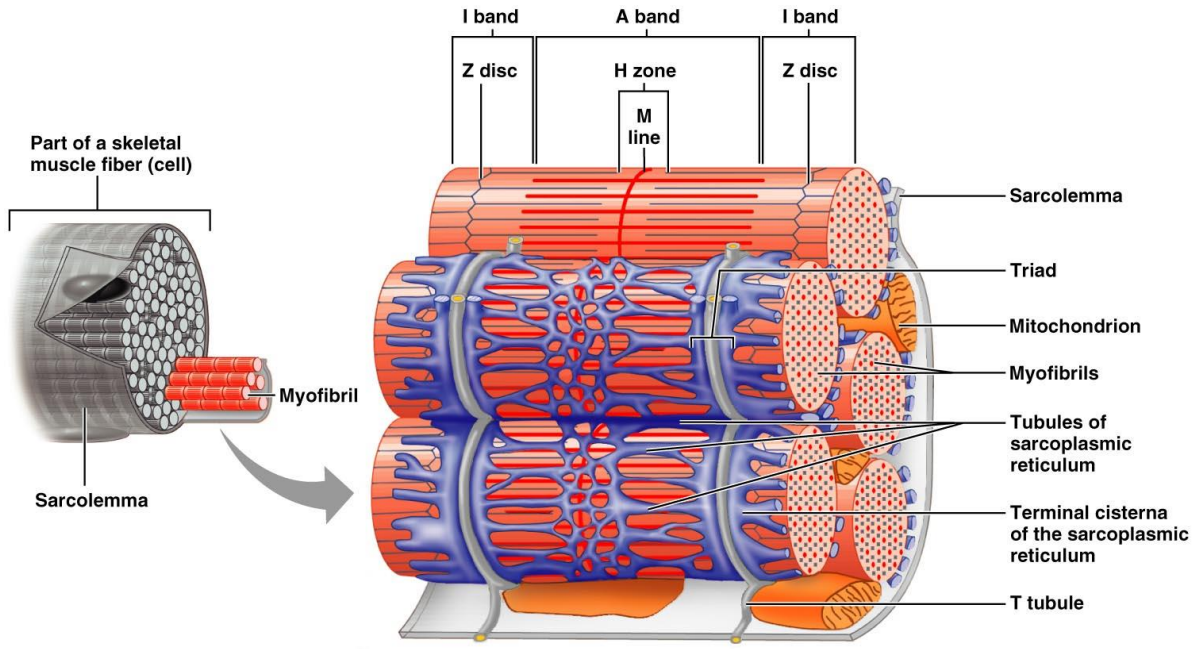
Skeletal Muscle Fibers – Microscopic Anatomy

- **Sarcoplasmic reticulum**
  - Smooth ER
  - Surround myofibril
  - Regulates calcium → stores and releases Ca for contraction
  - We will discuss why calcium is important later



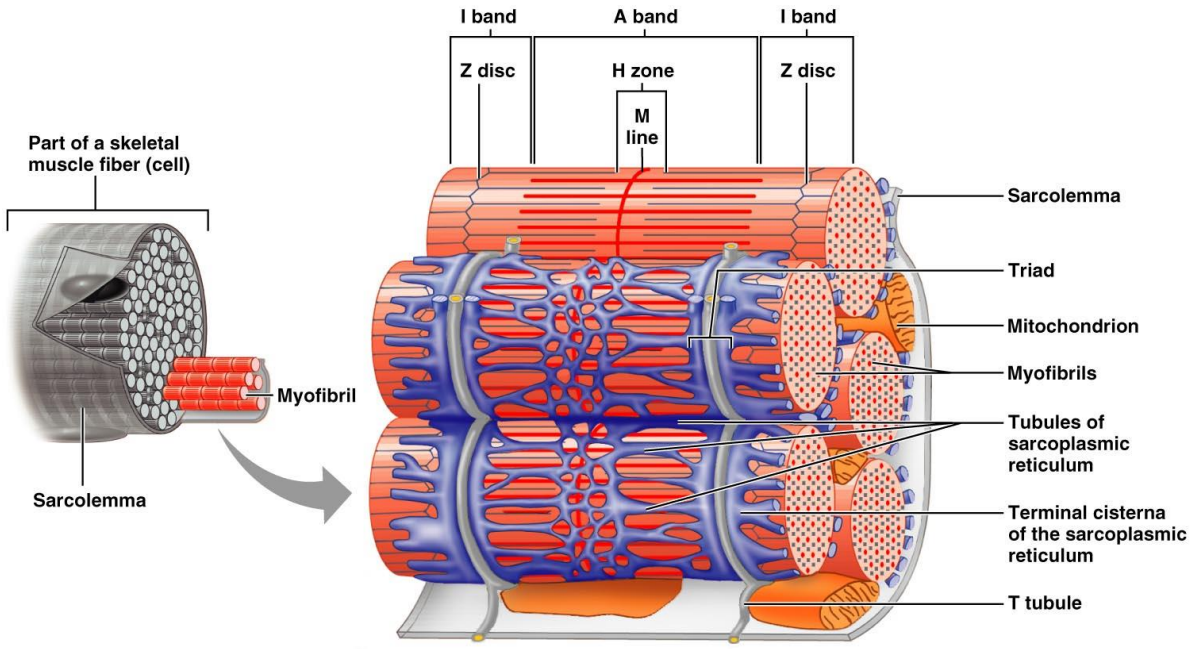
Skeletal Muscle Fibers – Microscopic Anatomy

- **Myofibrils**
  - Inside the muscle fiber → contractile unit of the muscle
  - Each muscle fiber contains 100's – 1,000's myofibrils



Skeletal Muscle Fibers – Microscopic Anatomy

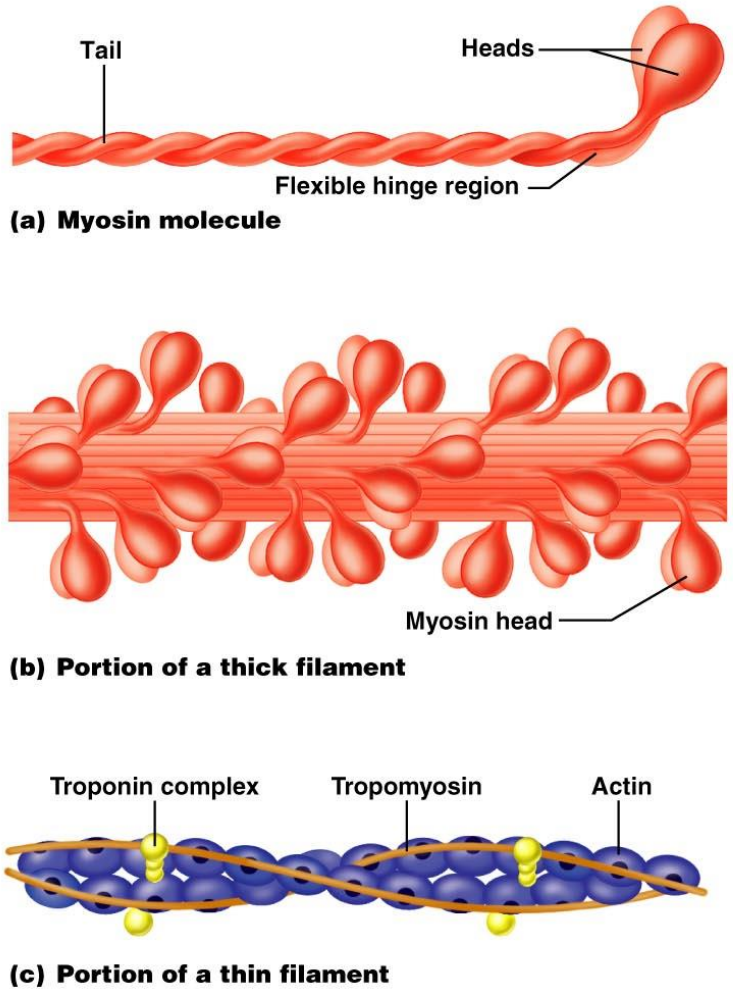
- **Myofibrils**
  - Account for 80% of cell volume
  - Run entire length of fiber
  - Very densely packed → all other organelles are squeezed between them



Skeletal Muscle Fibers – Microscopic Anatomy

Myofibrils

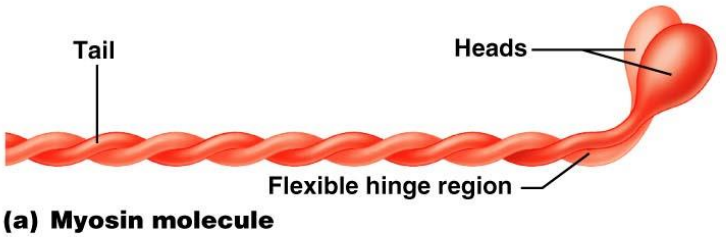
- Can actively shorten; responsible for skeletal muscle fiber contraction
- Consist of bundles of myofilaments
  - Actin → thin filaments
  - Myosin → thick filaments



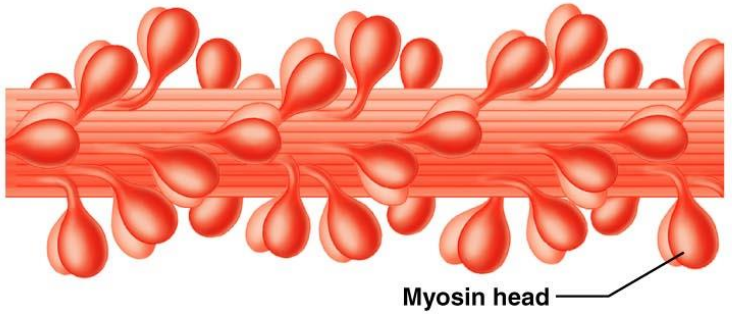
Skeletal Muscle Fibers – Parts of Myofibrils

Myosin – Thick Filaments

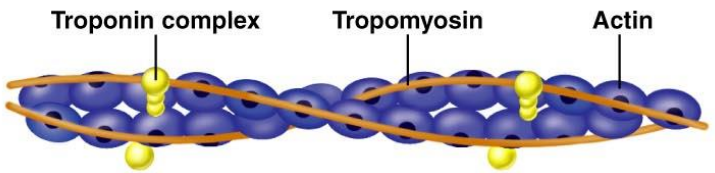
- Contains roughly 500 myosin molecules twisted around each other
  - Each myosin molecule has a rodlike tail terminating in two globular heads
  - Heads face outwards and tails face inwards – smooth middle



(a) Myosin molecule



(b) Portion of a thick filament

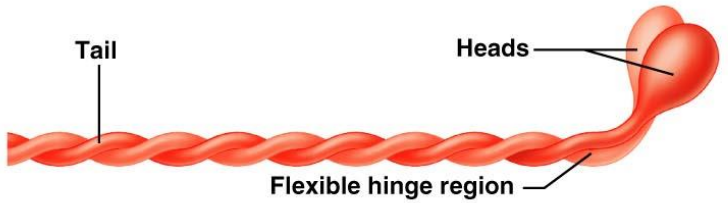


(c) Portion of a thin filament

Skeletal Muscle Fibers – Parts of Myofibrils

Myosin – Thick Filaments

- Heads also called cross-bridges (“business end”)
  - Heads link the thick and thin filaments together during contraction
- Heads contain ATP binding sites



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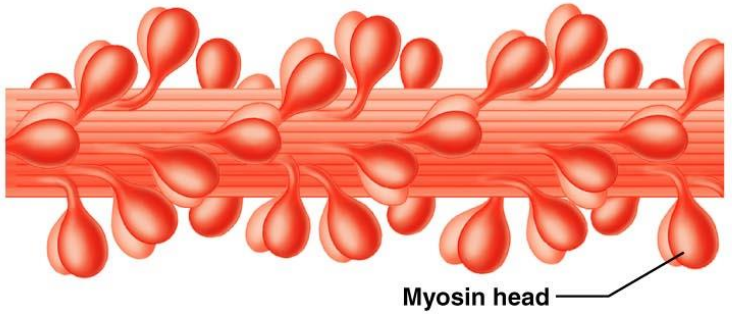

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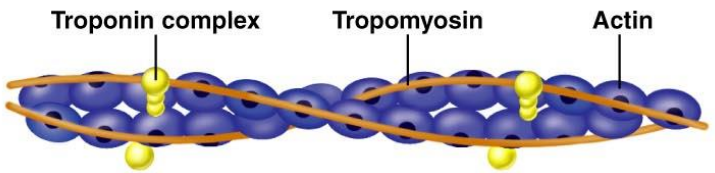
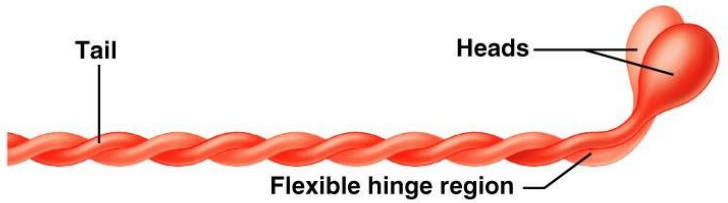


(c) Portion of a thin filament

Skeletal Muscle Fibers – Parts of Myofibrils

Actin - Thin filaments

- Bears active sites for the cross-bridges (heads of myosin)
  - Active site is covered when muscle is relaxed
- Has a site to bind calcium atoms



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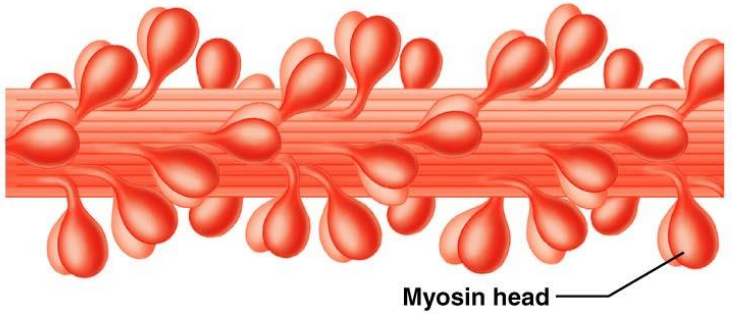

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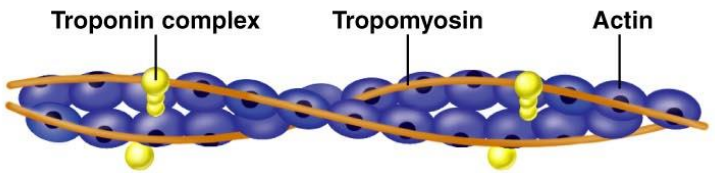
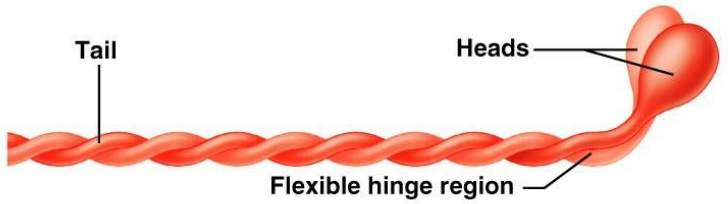


(c) Portion of a thin filament

Skeletal Muscle Fibers – Parts of Myofibrils

Actin - Thin filaments

- Titin – attaches thick and thin filaments to z disc
- Elastic so allows muscle cell to spring back into place



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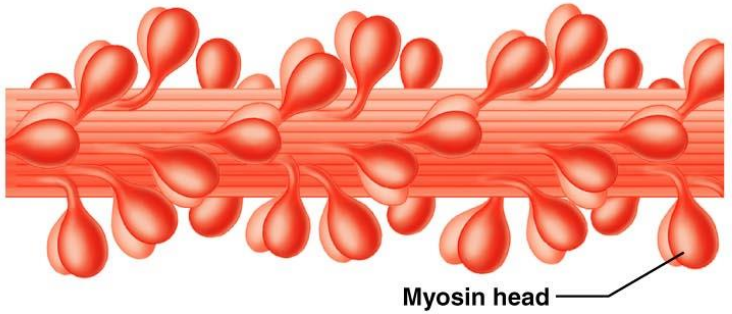

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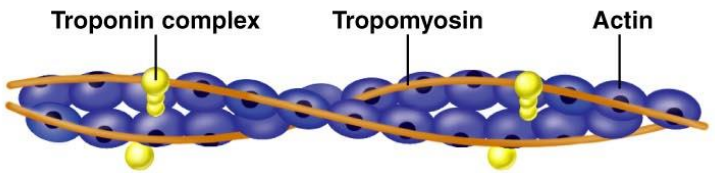

(c) Portion of a thin filament