

Muscle Physiology

Muscle tissue is subdivided into three categories

(1) skeletal muscle tissue.

(2) cardiac muscle tissue.

(3) smooth muscle tissue, based on its cellular structure and biochemistry muscle tissue is sometimes

voluntary or involuntary muscle tissue. described as striated or nonstriated muscle tissue

Functions of the muscular system

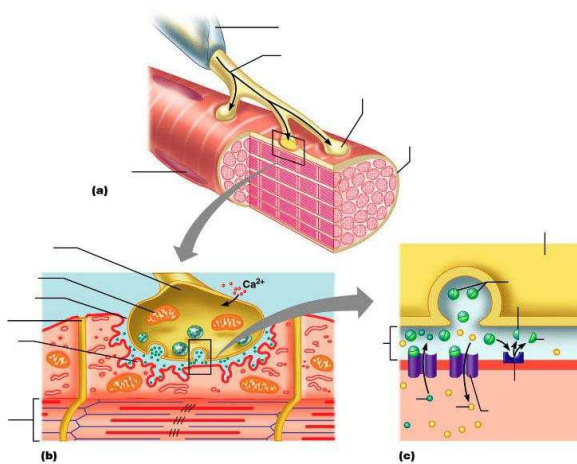
- 1. **Locomotion**
- 2. **Vasoconstriction and vasodilatation**- constriction and dilation of blood vessel Walls are the results of smooth muscle contraction.
- 3. **Peristalsis** – wavelike motion along the digestive tract is produced by the Smooth muscle.
- 4. **Cardiac motion**

properties of muscles

- **Striation:** only present in skeletal and cardiac muscles. Absent in smooth muscle.
- **Nucleus:** smooth and cardiac muscles are contain one nucleus per cell(uninucleated). skeletal muscle is multinucleated (several nuclei per cell).
- **Transverse tubule (T tubule):** well developed in skeletal and cardiac muscles to transport calcium. Absent in smooth muscle.
- **Intercalated disk:** specialized intercellular junction that only occurs in cardiac muscle.
- **Control:** skeletal muscle is always under voluntary control, with some exceptions (the tongue and pili arrector muscles in the dermis). smooth and cardiac muscles are under involuntary

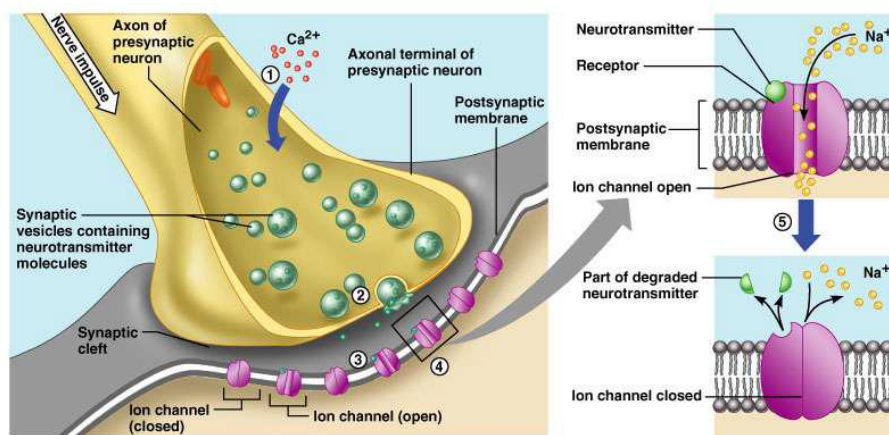
Innervation: motor unit

■ a) a **motor nerve** and a **myofibril** from a **neuromuscular junction** where gap (called **synapse**) occurs between the two structures. at the end of motor nerve, neurotransmitter (i.e. acetylcholine) is stored in **synaptic vesicles** which will release the neurotransmitter using exocytosis upon the stimulation of a nerve impulse. Across the synapse the surface the of myofibril contains **receptors** that can bind with the neurotransmitter

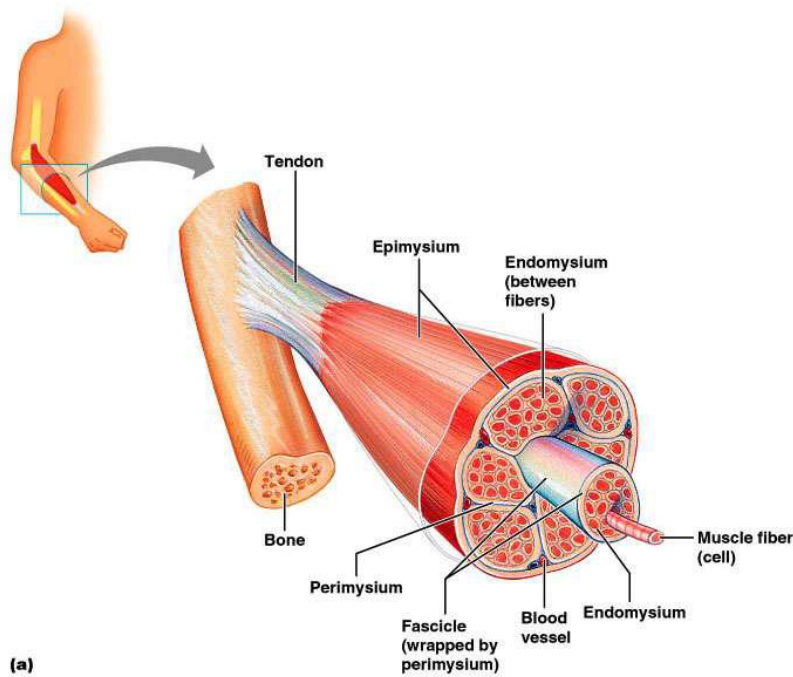


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Neuromuscular junction



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(a)

The **epimysium** is the dense connective tissue that surrounds the entire muscle tissue. The epimysium usually contains many bundles (fascicles) of muscle fibers.

The **perimysium** is the connective tissue that surrounds each bundle of muscle fibers.

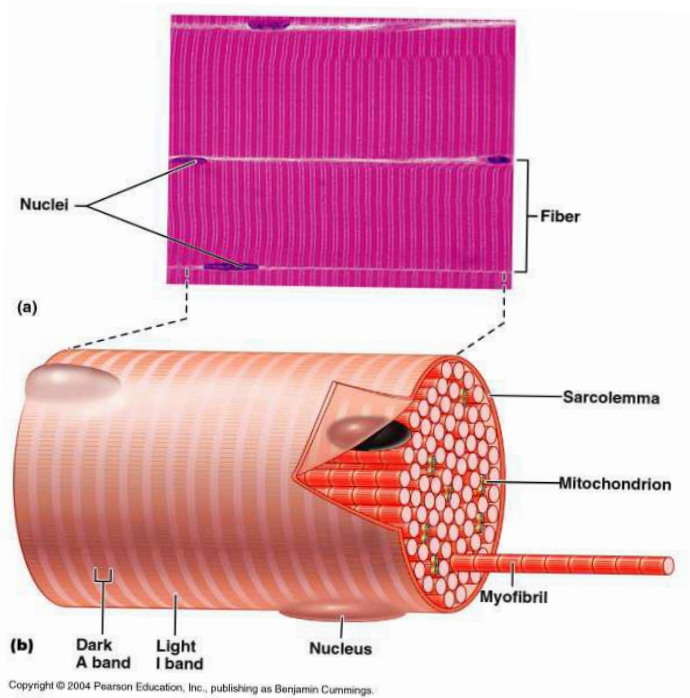
The **endomysium** is the connective tissue that covers each single muscle fiber or myofiber or muscle cell.

A **muscle fascicle** is a bundle of skeletal muscle fibers surrounded by perimysium, a type of connective tissue

Skeletal muscle fiber

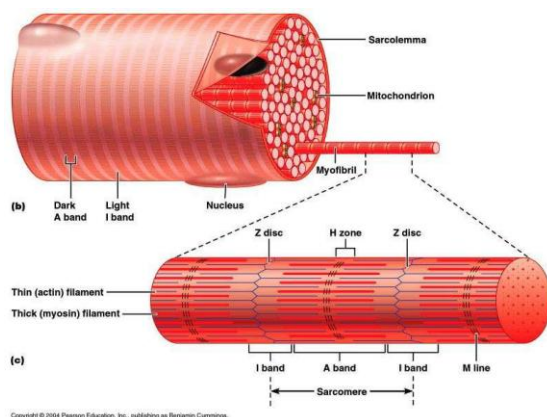
1. Each skeletal muscle fiber is a single muscle cell which is the unit of contraction.

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- 2. Muscle fibers are cylindrical cells with many nuclei.
- 3. The cell membrane is called Sarcolemma the cytoplasm is called sarcoplasm.
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- 4. The sarcoplasm contains abundant , parallel thread like myofibrils , that run in parallel fashion



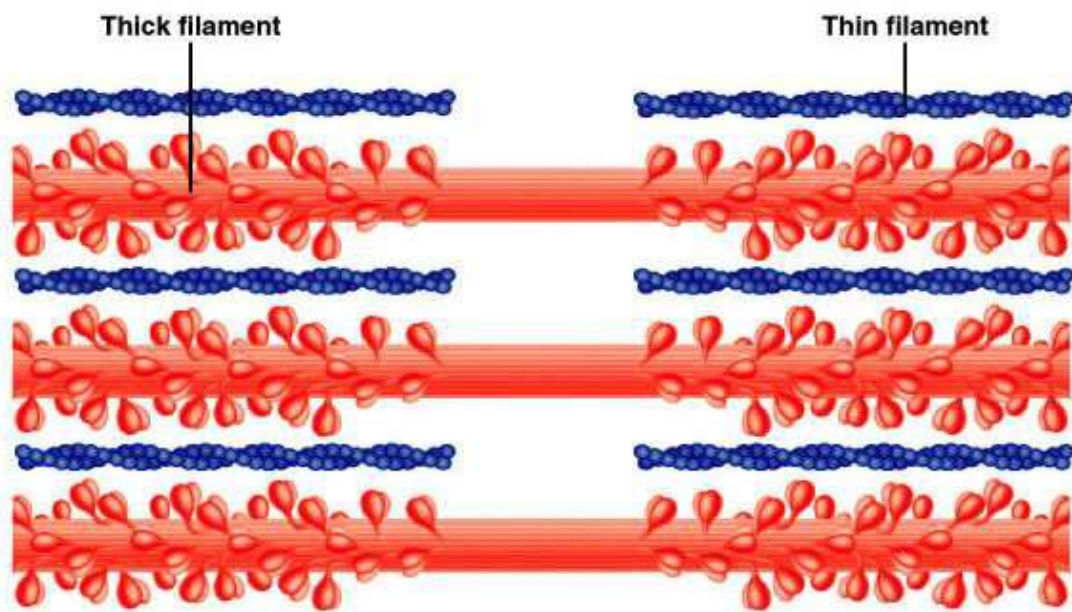
5. The myofibrils contain 2 kinds of protein filaments .

- a. Thick filaments – composed of **myosin** .
- b. Thin filaments – composed of **Actin** , troponin and tropomyosin .
- c. striations are produced by alternating light and dark filament



Arrangement of the Filaments in a Sarcomere

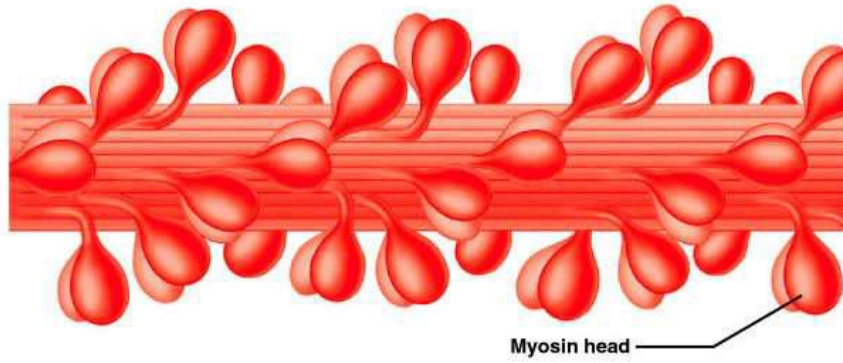
- Longitudinal section within one sarcomere



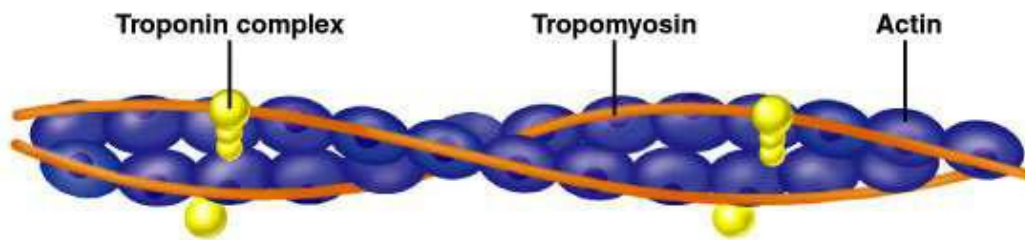
(d) Longitudinal section of filaments within one sarcomere of a myofibril



(a) Myosin molecule



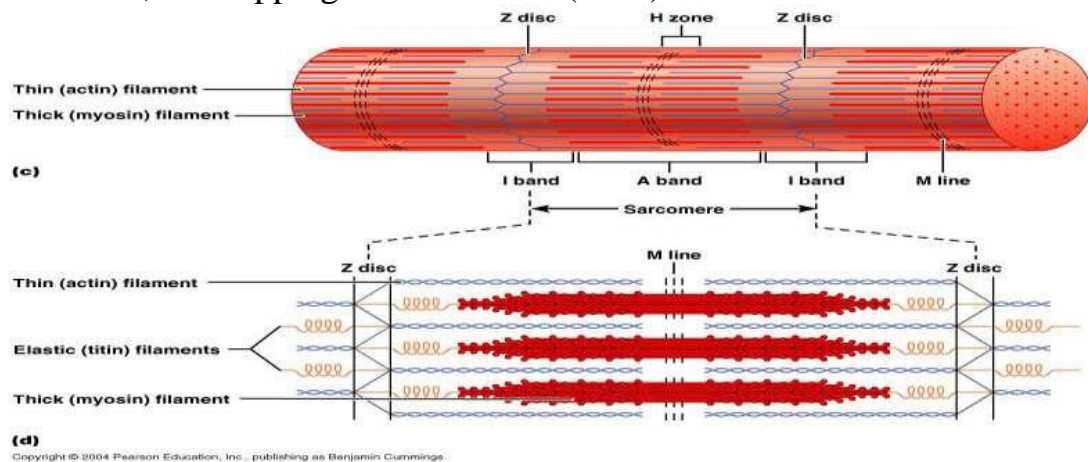
(b) Portion of a thick filament



(c) Portion of a thin filament

Striation pattern of skeletal muscles: 2 parts

- 1. The I bands (The light bands) -
 - Extends from the edge of one stack of thick filaments to the edge of next stack of thick filaments .
 - - The I band is composed of thin actin filaments .
- 2. The A bands (The dark bands) – composed of thick myosin filaments , overlapping thin filaments (actin) .



myosin filaments are held together by Z lines

- - A band consist of a region Where the thick and thin filaments overlap , and a region called central region (H zone) , consisting of only thick filaments . In the center of A band is a dark band called the M line .
- Sarcomere : The segment of myofibrils that extends from one Z line to the next Z line.