

**MUSCLES: CLASSIFICATION,  
PROPERTIES OF SKELETAL MUSCLE,  
COMPARISON WITH  
SMOOTH & CARDIAC MUSCLES**

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- muscle refers to a number of muscle fibers bound together by connective tissue
- differentiation is completed around the time of birth
- differentiated fibers continue to ↑ in size during growth from infancy to adult
- muscular tissue produces body movements, maintains posture, & generates heat
- use ATP to generate force

## Functions of Muscular Tissue

- 1. Producing body movements***
- 2. Stabilizing body positions***
- 3. Generating heat***
- 4. Storing & moving substances within the body***

## **1. *Producing body movements***

- movements of the whole body
- localized movements

## **2. *Stabilizing body positions***

- skeletal muscle contractions stabilize joints & maintain body positions
- postural muscles contract continuously

## **3. *Generating heat***

- as muscular tissue contracts, it produces heat, a process known as **thermogenesis**

#### **4. *Storing & moving substances within the body***

- skeletal muscle contractions promote the flow of lymph & aid the return of blood to the heart

# Properties of Muscular Tissue

## 1. Electrical excitability

- a property of both muscle & nerve cells, is the ability to respond to certain stimuli by producing electrical signals called *action potentials*
- can travel along a cell's plasma membrane due to the presence of specific voltage- gated channels
- two main types of stimuli trigger action potentials
  - autorhythmic electrical signals arising in the muscular tissue itself
  - chemical stimuli, such as neurotransmitters released by neurons, hormones distributed by the blood

## 2. Contractility

- is the ability of muscular tissue to contract forcefully when stimulated by an action potential

### **3. Extensibility**

- is the ability of muscular tissue to stretch without being damaged
- normally, smooth muscle is subject to the greatest amount of stretching

### **4. Elasticity**

- is the ability of muscular tissue to return to its original length & shape after contraction or extension

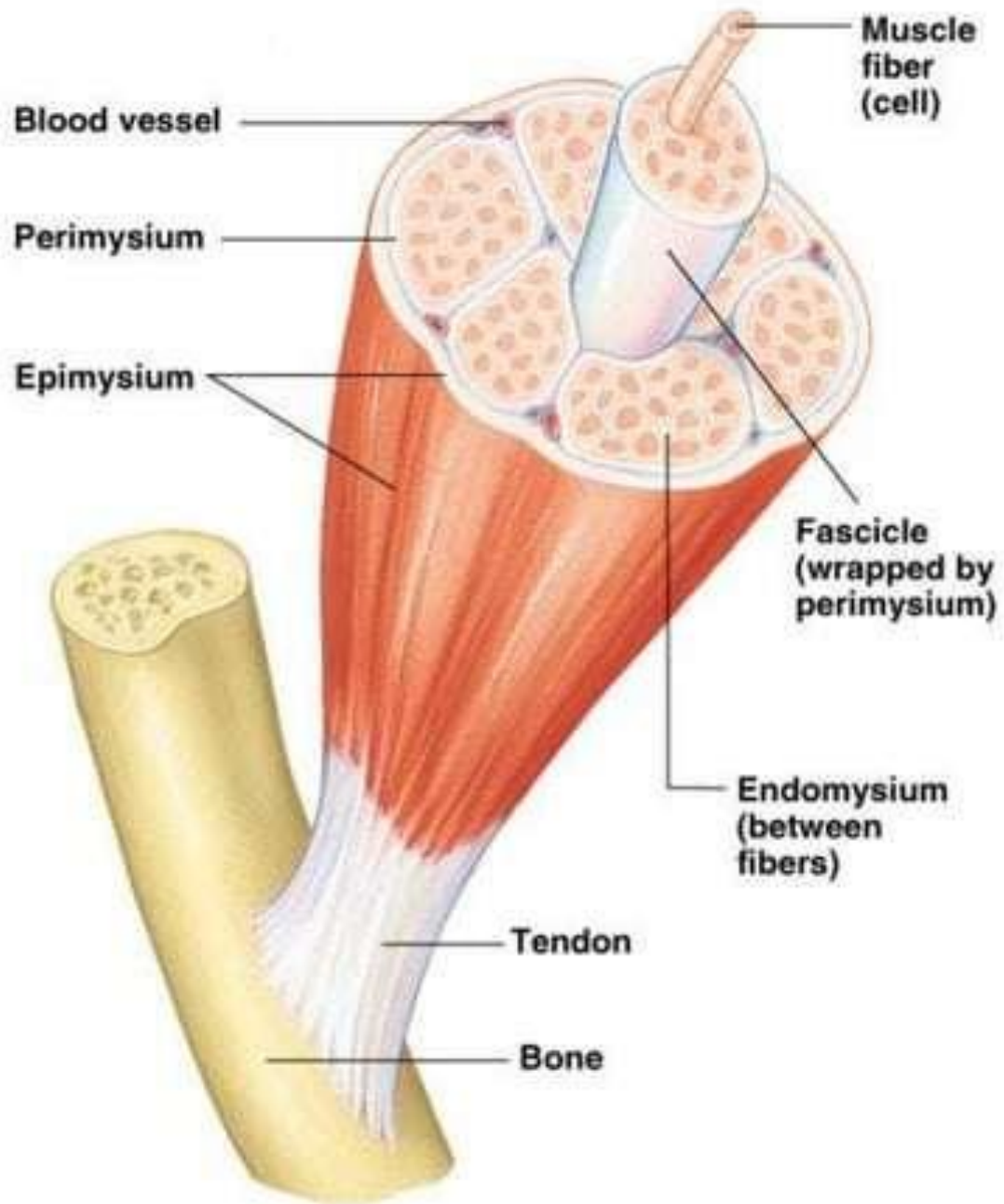
## Classification

1. Depending upon of striations
  1. Striated muscle
  2. Nonstriated muscle
2. Depending upon the control
  1. Voluntary muscle
  2. Involuntary muscle
3. Depending upon the function
  1. Skeletal muscle
  2. Cardiac muscle
  3. Smooth muscle



## Skeletal Muscle

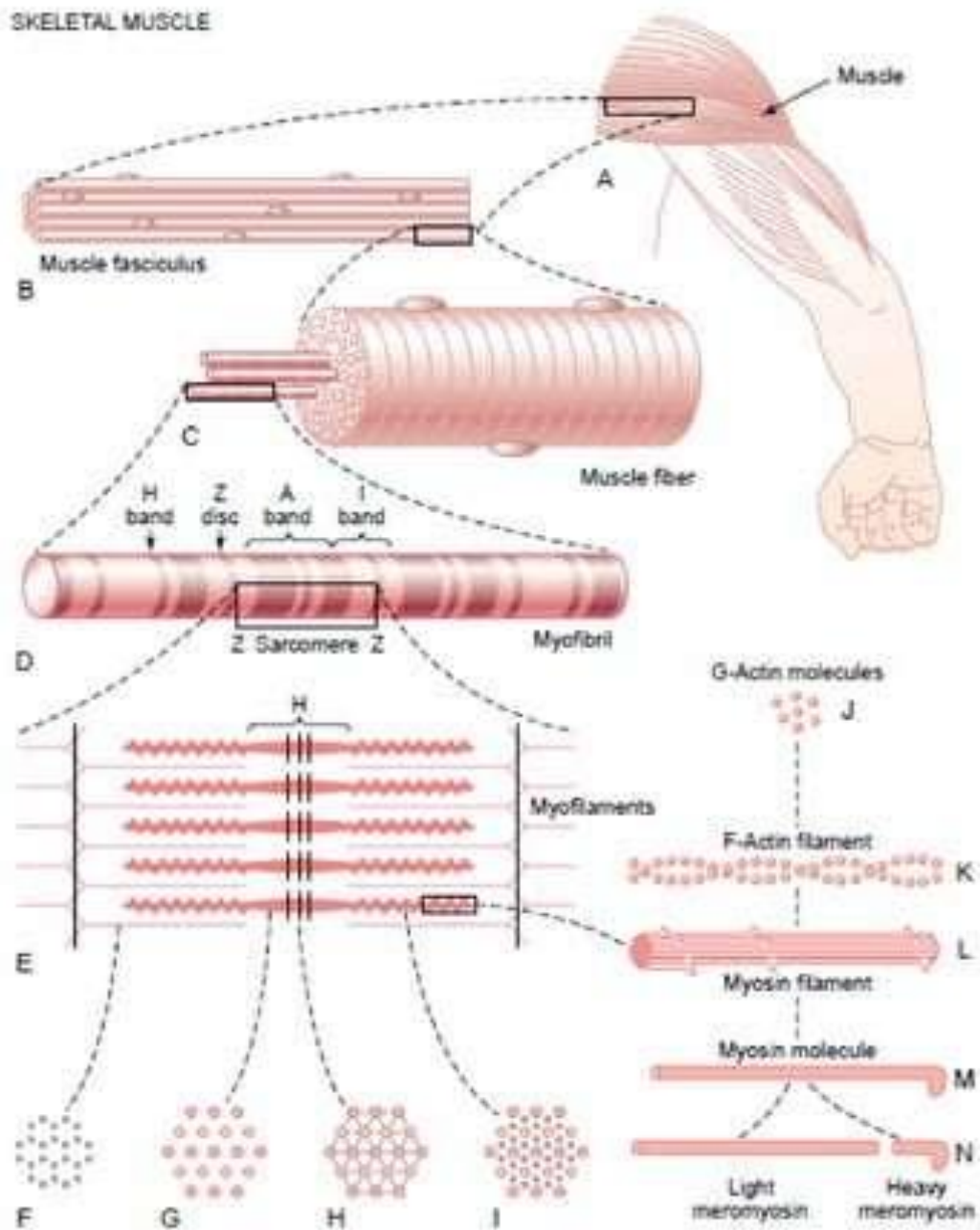
- about 40 % of the body is skeletal muscle, & 10 % is smooth & cardiac muscle
- formed by the fusion of a number of undifferentiated, mononucleated cells (myoblasts) into a single cylindrical, multinucleated cell
- adult skeletal muscle fibers have diameters between 10 & 100  $\mu\text{m}$  & lengths extend up to 20 cm
- muscles are linked to bones by bundles of collagen fibers known as tendons



## Skeletal muscle fiber proteins

Contractile protein <ul style="list-style-type: none"><li>• Myosin</li><li>• Actin</li></ul>	Proteins that generate force during muscle contraction
Regulatory protein <ul style="list-style-type: none"><li>• Tropomyosin</li><li>• Troponin</li></ul>	Proteins that help switch muscle contraction process on & off
Structural protein <ul style="list-style-type: none"><li>• Titin</li><li>• <math>\alpha</math>-Actinin</li><li>• Nebulin</li><li>• Dystrophin</li></ul>	Proteins that keep thick & thin filaments of myofibrils in proper alignment, give myofibrils elasticity & extensibility, & link myofibrils to sarcolemma & extracellular matrix

SKELETAL MUSCLE

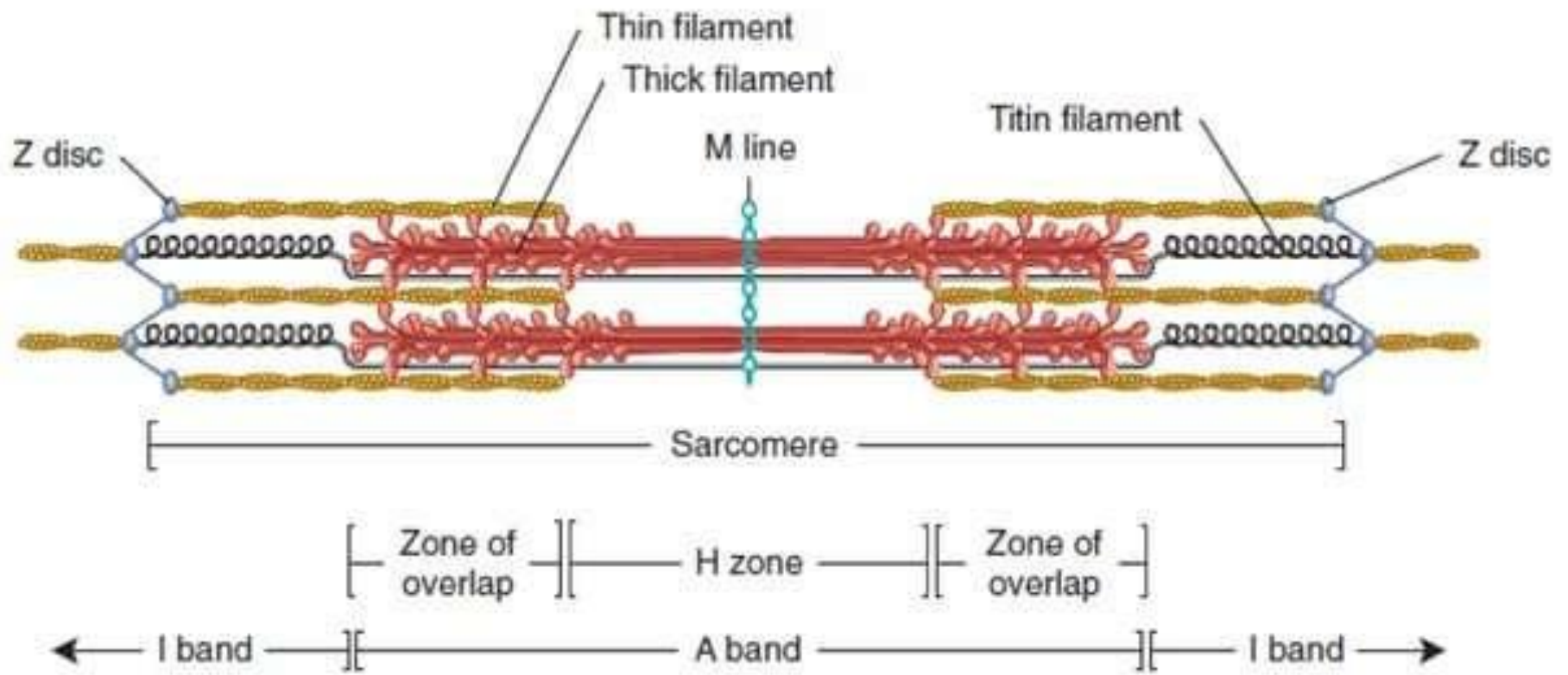


## Sarcolemma

- cell membrane of the muscle fiber

## Myofibrils

- each muscle fiber contains several hundred to several thousand *myofibrils*
- each myofibril is composed of about 1500 *myosin filaments* (thick) & 3000 *actin filaments* (thin)
- these are large polymerized protein molecules that are responsible for the actual muscle contraction



- myofibrils have alternate light & dark bands
- light bands contain only actin filaments & are called *I bands*
- dark bands contain myosin filaments, as well as the ends of the actin filaments where they overlap the myosin, & are called *A bands*

- the ends of the actin filaments are attached to *Z disc*
- Z disc attach the myofibrils to one another all the way across the muscle fiber
  - the entire muscle fiber has light & dark bands
  - give skeletal (also cardiac) muscle striated appearance
- portion of the myofibril (or of the whole muscle fiber) that lies between two successive Z discs is called a *sarcomere*



## **Sarcoplasm**

- within the sarcolemma is the **sarcoplasm**, the cytoplasm of a muscle fiber
  - glycogen, large quantities of potassium, magnesium, & phosphate, multiple protein enzymes, tremendous numbers of *mitochondria*

## **Sarcoplasmic Reticulum**

- has a special organization that is extremely important in controlling muscle contraction

Features	Skeletal muscle fiber	Cardiac muscle fiber	Smooth muscle fiber
Location	Bone	Heart	Visceral organ
Shape	Cylindrical & unbranched	Branched	Spindle shaped & unbranched
Length	1-4 cm	80-100 $\mu\text{m}$	50-200 $\mu\text{m}$
Diameter	10-80 $\mu\text{m}$	15-20 $\mu\text{m}$	2-5 $\mu\text{m}$
Nucleus	One or more	One	One
Striations	Present	Present	Absent
Sarcomere	Present	Present	Absent
'T' tubule	Long & thin	Short & broad	Absent
Depolarization	Upon stimulation	Spontaneous	Spontaneous

Features	Skeletal muscle fiber	Cardiac muscle fiber	Smooth muscle fiber
Plateau	No	Yes	No
Ca <sup>++</sup> binds	Troponin	Troponin	Calmodulin
Source of Ca <sup>++</sup>	SR	SR	Extracellular
Neuromuscular junction	Well defined	Not well defined	Not well defined
Action	Voluntary	Involuntary	Involuntary
Control	Neurogenic	Myogenic	Both
Nerve supply	Somatic	Autonomic	Autonomic

## References

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**Thank You**