

## + Motivational Corner:

There's no elevator to success, you have to take the stairs.



### Objectives:

By the end of this lecture you should be able to:

- Identify and describe the histological structure of the three types of muscle cells and list the differences between them.

Extra notes

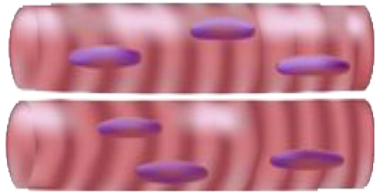
Important notes in red

# MUSCULAR TISSUE

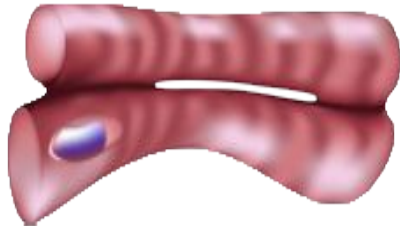
# + Types of muscles

Remember:  
LM = Light Microscope  
EM = Electron Microscope

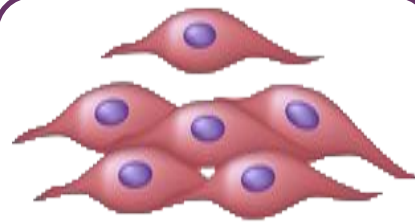
Made of elongated muscle cells (fibers).



Skeletal Muscle



Cardiac Muscle



Smooth Muscle

Striated

Voluntary

Striated

Involuntary

Non-striated

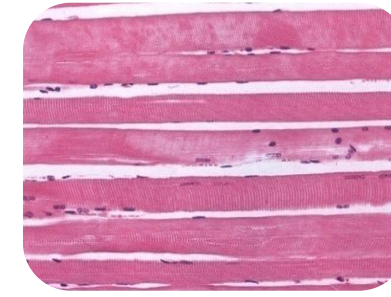
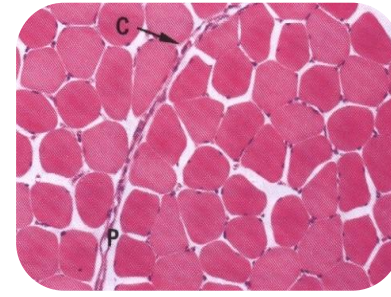
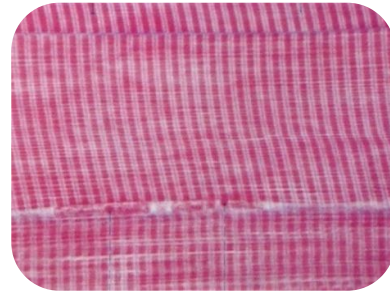
Involuntary

## New Vocabularies in this lecture:

- Epimysium
- Perimysium
- Endomysium
- Contractile threads
- Sarco-lemma
- Sarco-plasm
- Sarco-plasmic Reticulum (SR)
- Sarcomere
- Intercalated discs

# + Skeletal muscle

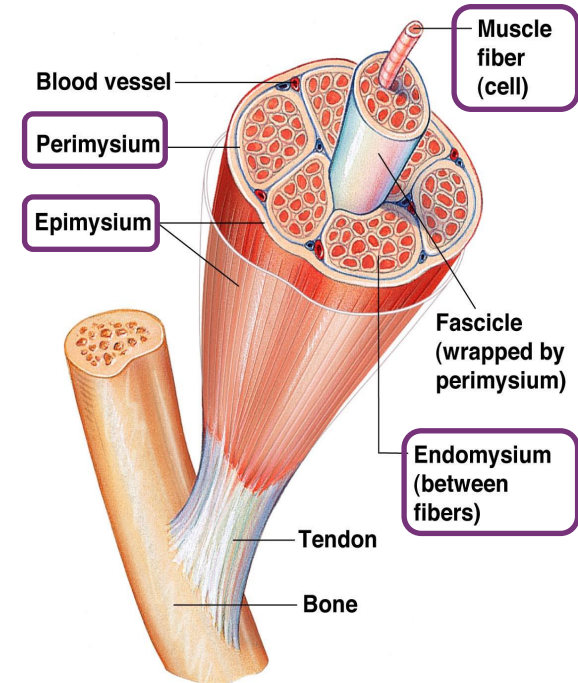
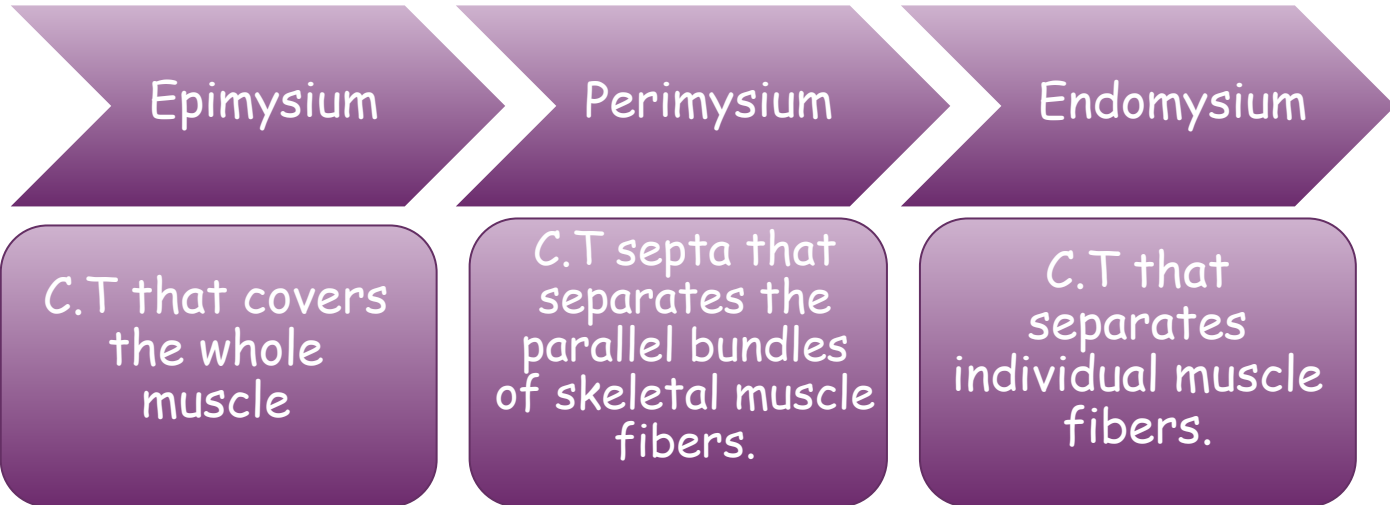
LM pictures:



- Cylindrical in shape.
- Non-branched.
- Covered by a clear cell membrane, the **Sarcolemma**.
- **Multinucleated**: nuclei are multiple and are peripherally located (close to the sarcolemma).
- Cytoplasm (sarcoplasm) is **acidophilic** and shows clear transverse striations.

**REMEMBER:**  
Bone and cartilage have Basophilic cytoplasm

We have 3 connective tissues that covers the muscle cell, from inside (**Endomysium**) covers the muscle fibers then the muscle fibers becomes a group to form bundles that are covered by (**perimysium**) then those bundles are covered by (**Epimysium**)



Mysium = Flesh  
Epi = Over  
Peri = Surrounding

Septa = plural of septum i.e partition to separate 2 or more compartment from each other.

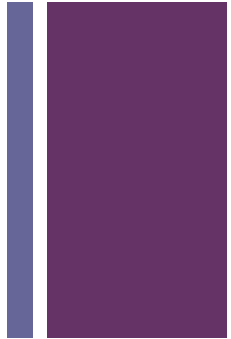
+

Regeneration of Skeletal muscle cells

Can not divide

Limited regeneration by satellite cells (stem cells on the muscle cell's surface).

There's a video in the summary slide that explains the satellite cells check it, it's so helpful.



# Skeletal Muscle Fibers

(EM picture)

## Sarcoplasm contains:

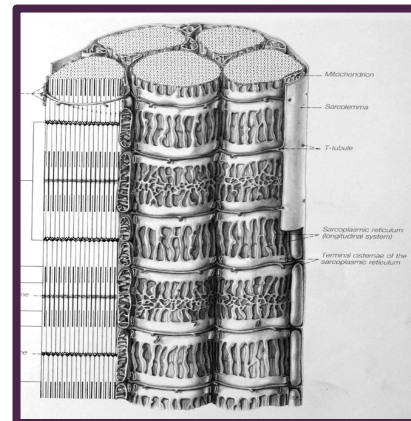
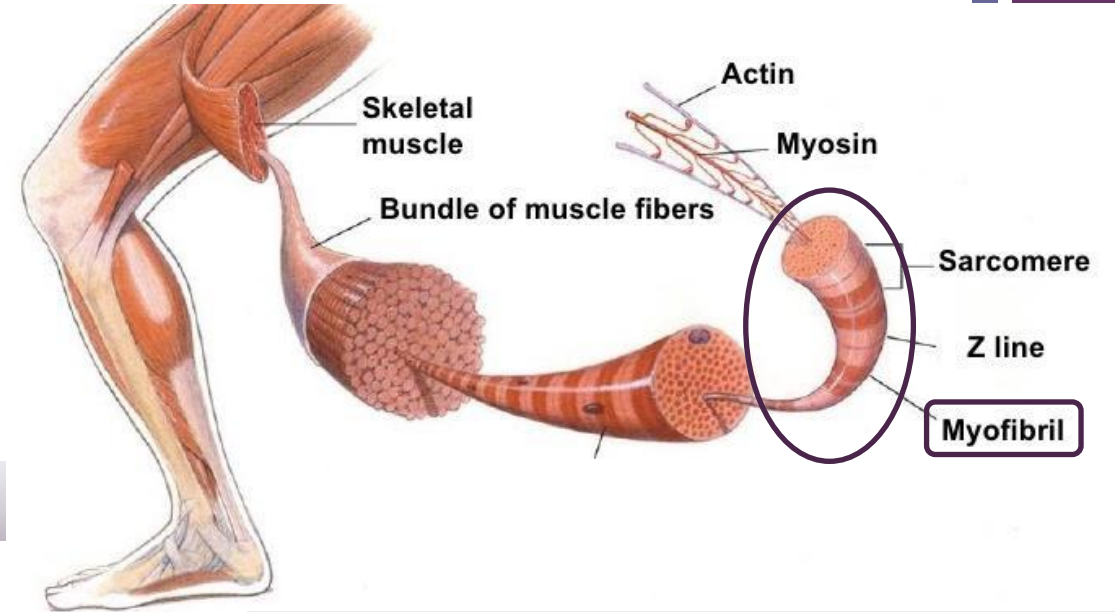
- Parallel myofibrils.\*
- Numerous mitochondria arranged in rows between the myofibrils.

Because you're smart you know that skeletal muscle needs so much energy that's why it have so many mitochondria :)

- Well developed smooth endoplasmic reticulum\*

(Sarcoplasmic reticulum) "SR".

- Myoglobin pigment. [carry & store O<sub>2</sub>]
- Glycogen. [store food]



Smooth ER is abundant because it secretes glycogen + calcium

- Myofibrils = fibers in the muscle cells
- Myofilaments = actin + myosin

(Group of myofilaments gives me myofibrils)

- Arrangement of actin + myosin is what gives us striation

# + Skeletal Muscle fibers (EM picture)

- Contractile threads (organelles), arranged longitudinally in the sarcoplasm.

Dark = A band  
Light = I band

- Each myofibril shows alternating dark (A) and light bands (I).

- The **A band** shows a pale area in the middle (H band) which is divided by a dark line (M line). *You know H&M shop? :)*

- The **(I) band** shows a dark line in the middle (Z line).

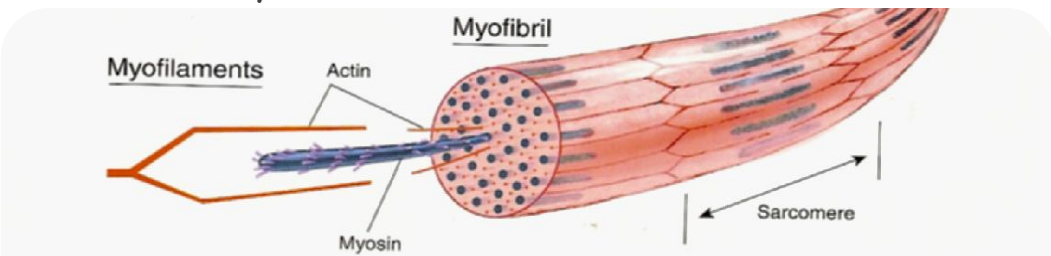
- The sarcomere is the segment between 2 successive **Z lines**. It is the contractile unit of a myofibril.

- The myofibrils are formed of myofilaments (thick myosin and thin actin)

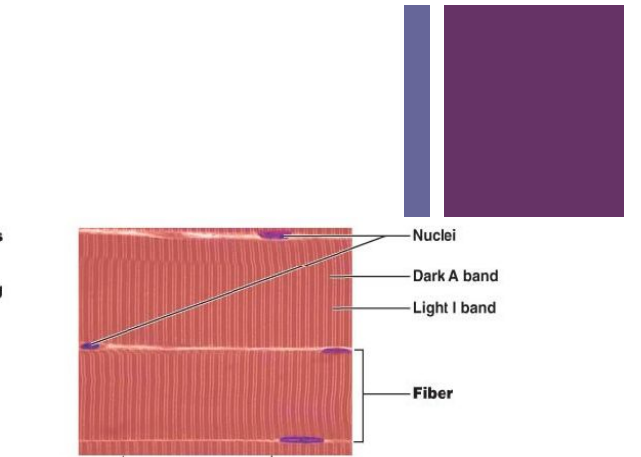
- The (A) band is formed of **myosin** myofilaments mainly and the terminal ends of actin myofilaments.

- The (I) band is formed of **actin** myofilaments.

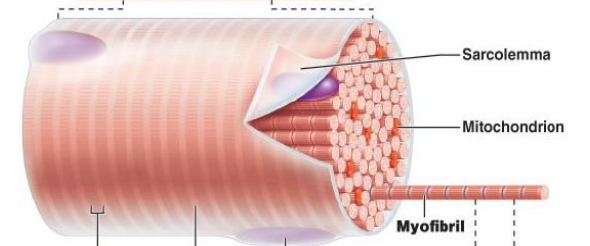
Didn't get it? Don't worry!  
Check this Video



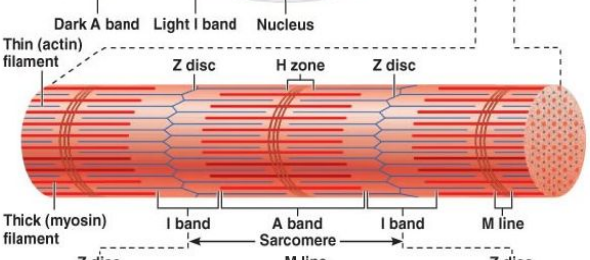
(a) Photomicrograph of portions of two isolated muscle fibers (700X). Notice the obvious striations (alternating dark and light bands).



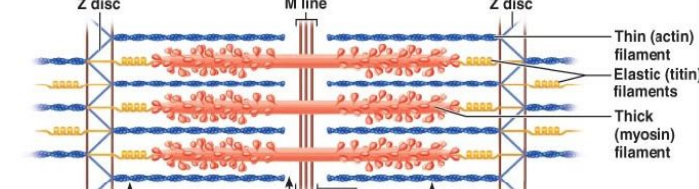
(b) Diagram of part of a muscle fiber showing the myofibrils. One myofibril extends from the cut end of the fiber.



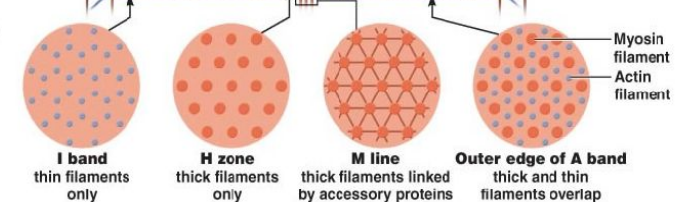
(c) Small part of one myofibril enlarged to show the myofilaments responsible for the banding pattern. Each sarcomere extends from one Z disc to the next.



(d) Enlargement of one sarcomere (sectioned lengthwise). Notice the myosin heads on the thick filaments.



(e) Cross-sectional view of a sarcomere cut through in different locations.



# + Cardiac muscle

- Found in the myocardium.
- Striated and involuntary.
- No regenerative capacity

## L.M Picture

- Cylindrical in shape.
- Intermediate in diameter between skeletal and smooth muscle fibers.
- Branched and anastomose.
- Covered by a thin sarcolemma.
- Mononucleated. Nuclei are oval and central.
- Sarcoplasm is acidophilic and shows non-clear striations (fewer myofibrils).
- Divided into short segments (cells) by the intercalated discs.

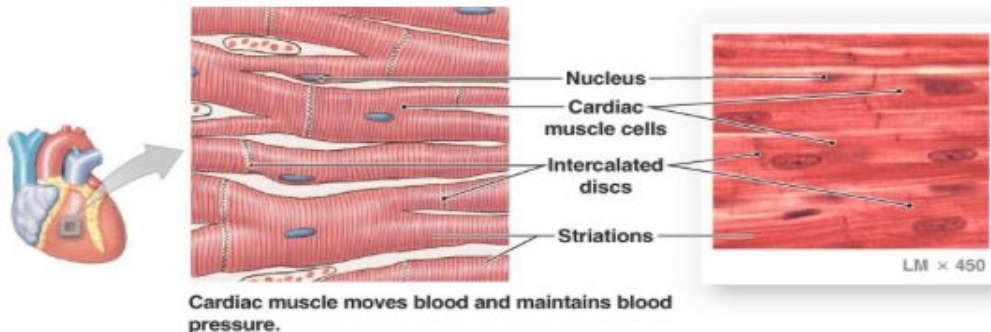
## E.M Picture

- Few myofibrils.
- Numerous mitochondria.
- Less abundant SR. (Smooth ER)
- Glycogen & myoglobin. (Source of energy)
- Intercalated discs: are formed of the two cell membranes of 2 successive cardiac muscle cells, connected together by junctional complexes (desmosomes and gap junctions).



Remember:

Cardiac muscle is covered by Thin sarcolemma but Skeletal muscle is covered by thick sarcolemma.

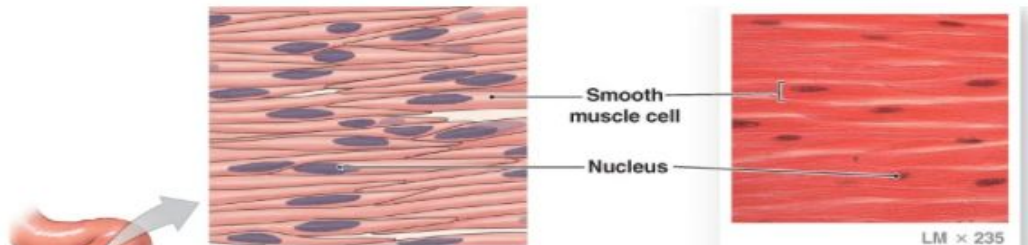


Skeletal muscle is not branched but cardiac muscle is branched because we need every part of the heart to contract at the same time.

# + Smooth muscle

E.M. Picture	L.M. Picture	Features
Sarcoplasm contains mitochondria and sarcoplasmic reticulum	Fusiform in shape	Present in walls of blood vessels and viscera (digestive, urinary, genital.... etc).
	Small diameter	
<u>Myosin &amp; actin</u> filaments are <u>irregularly arranged</u> (that's why no striations could be observed)	Non-branched	Non-striated and involuntary
	Thin sarcolemma	
Cells are connected together by gap junctions for cell communication	<u>Mononucleated Nuclei</u> are oval & central in position	
	Sarcoplasm <u>is non-striated and acidophilic</u>	

All involuntary muscles (Cardiac + smooth) have Gap junctions to allow impulses to pass through a regulated gate between cells.  
(check the video in the previous slide)



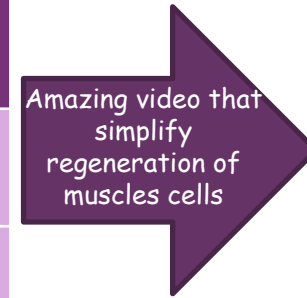
Smooth muscle moves food, urine, and reproductive tract secretions; controls diameter of respiratory passageways and regulates diameter of blood vessels.

## Smooth muscle cells regeneration:

- Can divide.
- Regenerate from pericytes.
- active regenerative response

## + Summary:

	SMOOTH	CARDIAC	SKELETAL
Site	Viscera, e.g. stomach	Myocardium of the heart	Muscle attached to skeleton
Shape	<b>Fusiform</b>	Cylindrical	Cylindrical
Diameter	Smallest	Medium-sized	Largest
Branching	Non-branched	<b>Branched</b>	Non-branched
Striations	Absent	Not clear	Clear
<b>Intercalated discs</b>	Absent	<b>Present</b>	Absent
Nuclei	One central nucleus	One central nucleus	Numerous and peripheral
Action	Involuntary	Involuntary	<b>Voluntary</b>
Regeneration	<b>Active</b>	No	Limited



YouTube

**Interesting extra note Dr. Raeesa mentioned in the lecture:**

If you have a patient that is suffering from hypertension and we took a chest x-ray, if we found the heart has hypertrophied it means that he's been suffering from hypertension for a while, but if the heart appeared normal then hypertension has just started.

NOTE: During cardiac hypertrophy the number of cardiac muscle cells is not increased; instead, they become longer and larger in diameter.





# MCQ's

Q1: Which one of these features appears in the L.M of the skeletal muscle?

- A. Multinucleated: Nuclei are peripherally located
- B. Mononucleated: Nuclei are central located
- C. Multinucleated: Nuclei are central located
- D. Mononucleated: Nuclei are peripherally located

Q2: The contractile unit of myofibril ?

- A. Sarcoplasmic reticulum
- B. Sarcolemma
- C. Sarcomere
- D. Sarcoplasm

Q3: What is the name of the dark line in the middle of The ( I ) band ?

- A. M line
- B. H line
- C. E line
- D. Z line

Q4: The (A) band is contains only myosin myofilaments.

- A. True
- B. False

Q5: Which of the following C.T. separates each individual skeletal muscle fibres:

- A. Epimysium.
- B. Endomysium.
- C. Perimysium.
- D. Sarcoplasm.

Q6: Cytoplasm (sarcoplasm) of skeletal muscles fibres is basophilic:

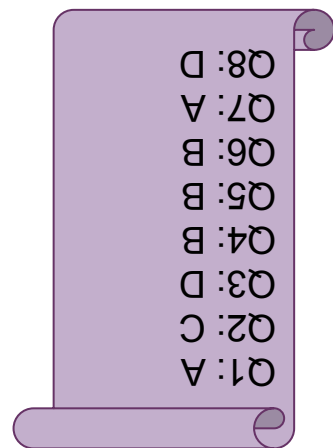
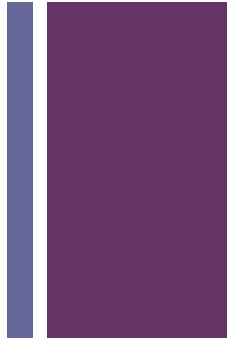
- A. True.
- B. False.

Q7: Intercalated discs is present in which of the following type of muscle fibres.

- A. Cardiac muscle.
- B. Smooth muscle.
- C. Skeletal muscle.

Q8: Which one of the following is a common feature in both smooth and cardiac muscles?

- A. Steriation.
- B. Fusiform cells.
- C. Multinucleated.
- D. Gap junctions.



# + Credit

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Thanks for checking our work, Good luck.

-Team histology.



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