Muscle histology

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- Muscle is a collection of muscle fibers supported by connective tissue.
- Mesodermal in origin.

Special terms

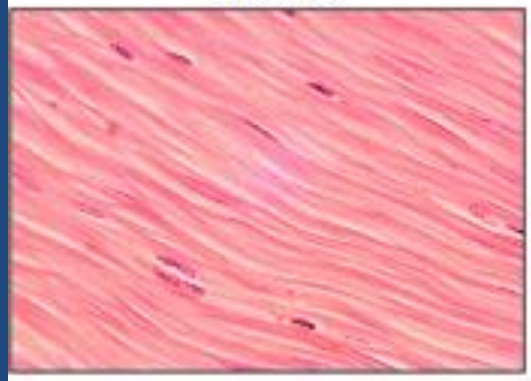
- Plasma membrane – Sarcolemma
- Cytoplasm – sarcoplasm
- Smooth ER – sarcoplasmic reticulum
- Mitochondria – sarcosomes

- Muscle tissue is made up basically of cells called MYOCYTES
- Myocytes are elongated in one direction - MUSCLE FIBRES

TYPES

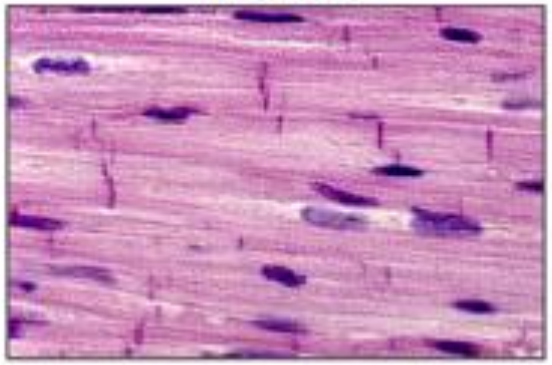
1. Skeletal Muscle
2. Smooth Muscle
3. Cardiac Muscle

Smooth Muscle Tissue



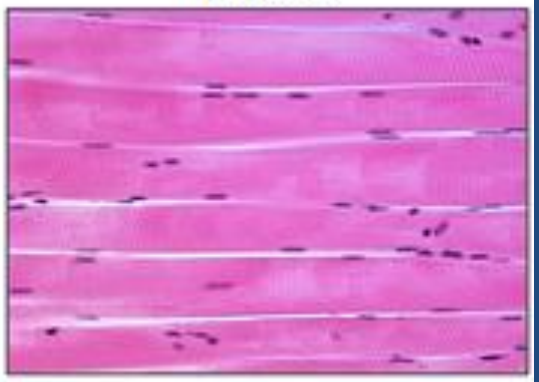
Involuntary Control

Cardiac Muscle Tissue



Involuntary Control

Skeletal Muscle Tissue



Voluntary Control

SKELETAL MUSCLE

- Made up of long, cylindrical fibers
- Multinucleated cells

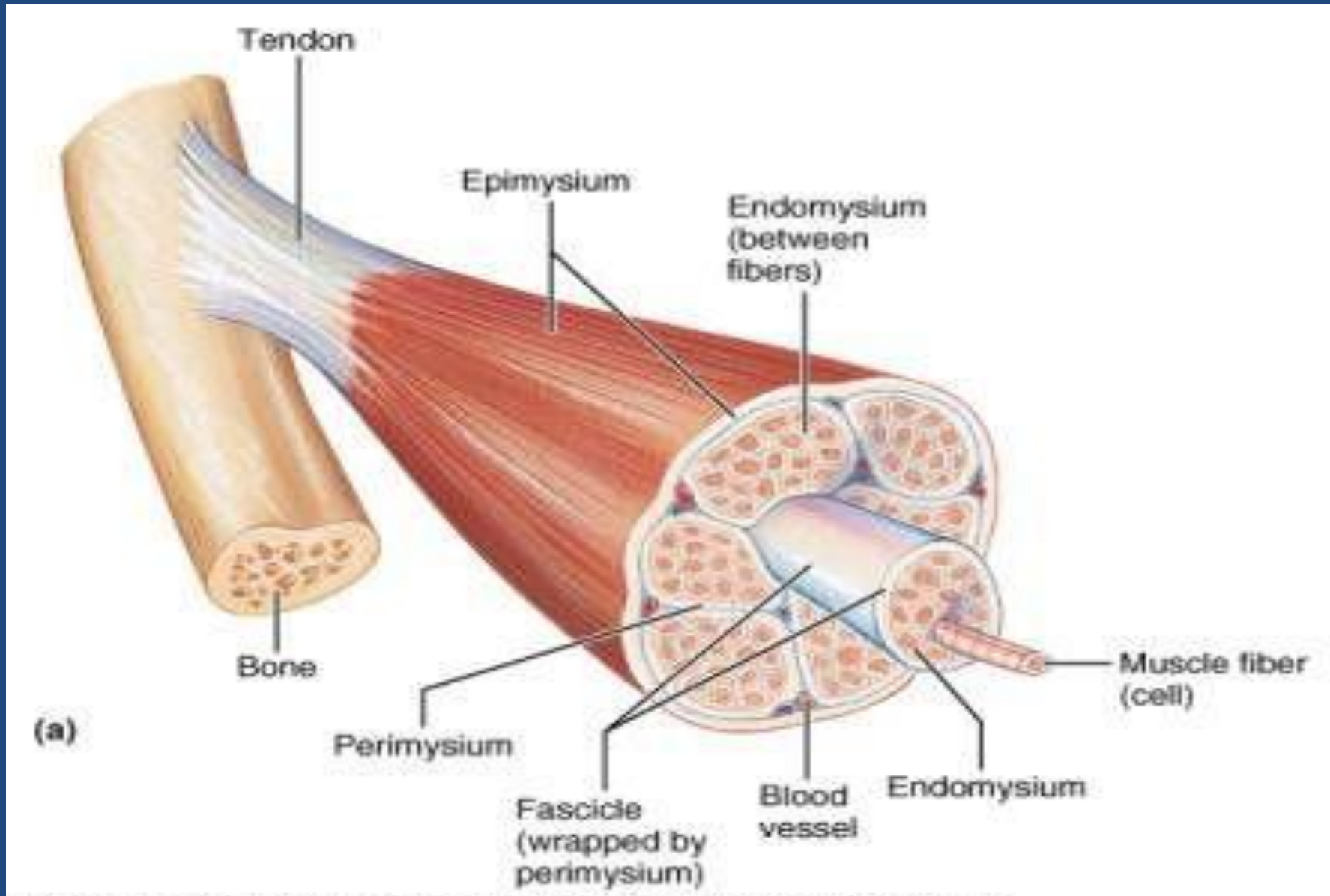
General Architecture

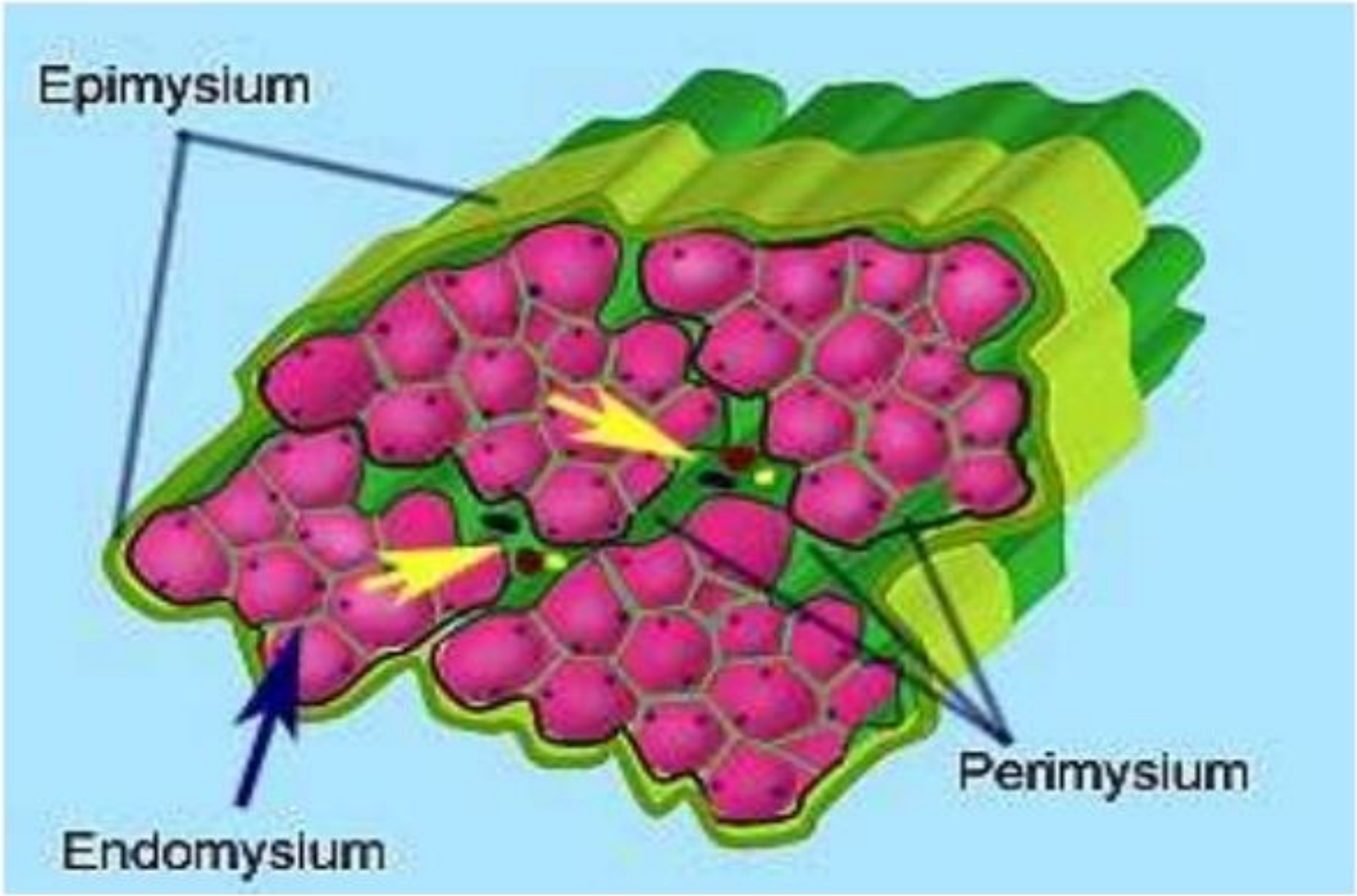
Supported by connective tissue framework Carries blood vessels & nerves Transmits the force of contraction

Connective tissue coverings of skeletal muscle

The framework of connective tissue provides support to muscle fibers in following manner:

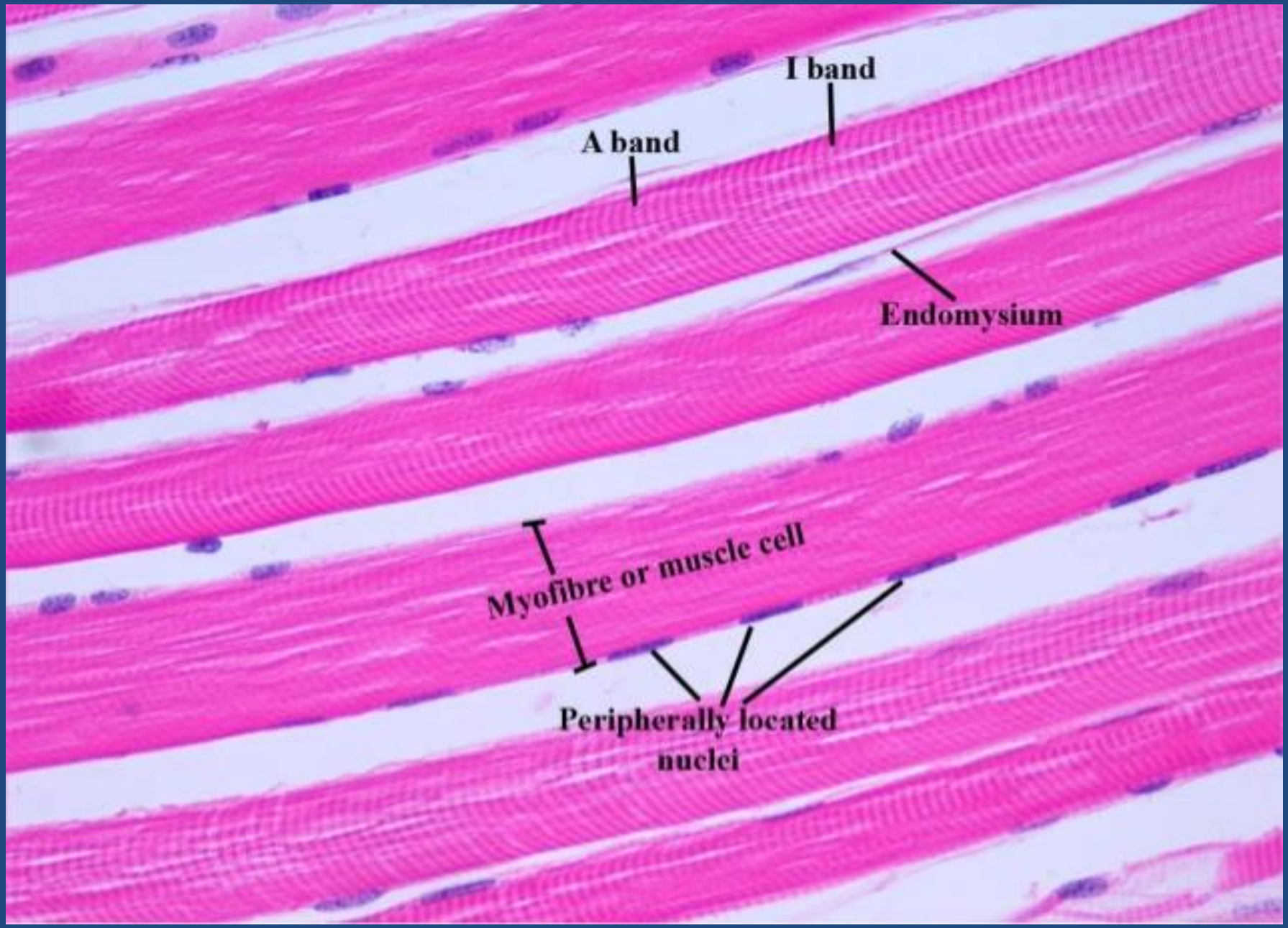
- ***EPIMYSIUM***: dense connective sheath surrounding the entire muscle.
- ***PERIMYSIUM:*** connective tissue covering bundles of muscle fibers (fascicles).
- ***ENDOMYSIUM***: loose connective tissue composed of reticular fibers supporting individual muscle fiber.




Epimysium
Perimysium
Endomysium

Structure of skeletal muscle fiber

- Elongated
- Has *many flat nuclei* located just beneath the sarcolemma
- Shows cross striations
- Made up of compactly packed long cylindrical *myofibrils* in the sarcoplasm arranged parallel to the long axis


I band
A band
Endomysium
Myofibre or muscle cell
Peripherally located
nuclei

Types of skeletal muscle fibers

- RED
- WHITE
- INTERMEDIATE

RED MUSCLE FIBRE

- High content of myoglobin & cytochrome
- Many mitochondria
- Rich blood supply
- Slow & continuous contraction
- larger in diameter
- E.g.: postural muscles

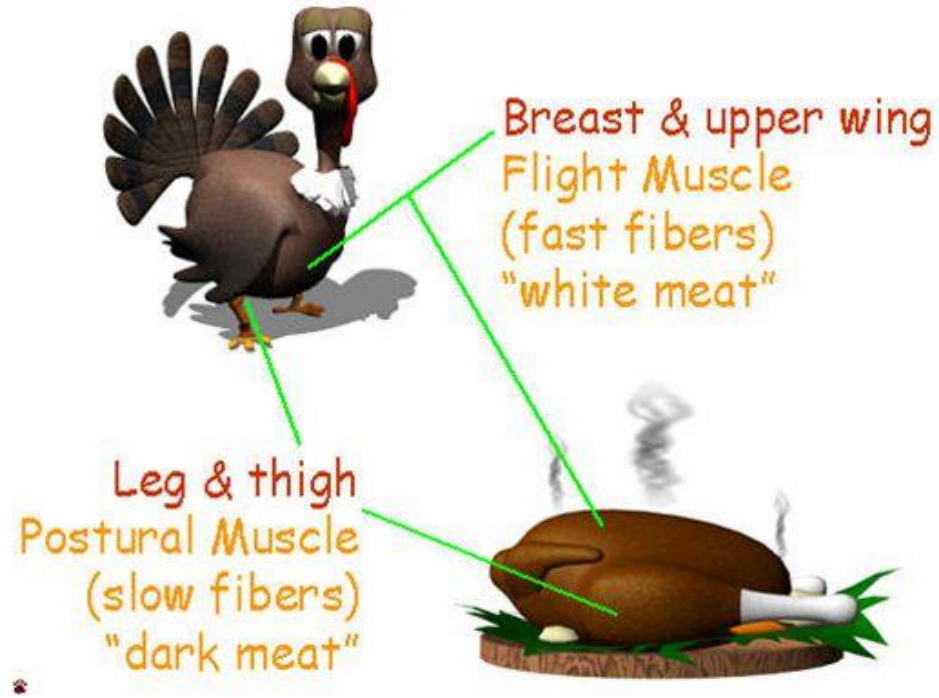
WHITE MUSCLE FIBRE

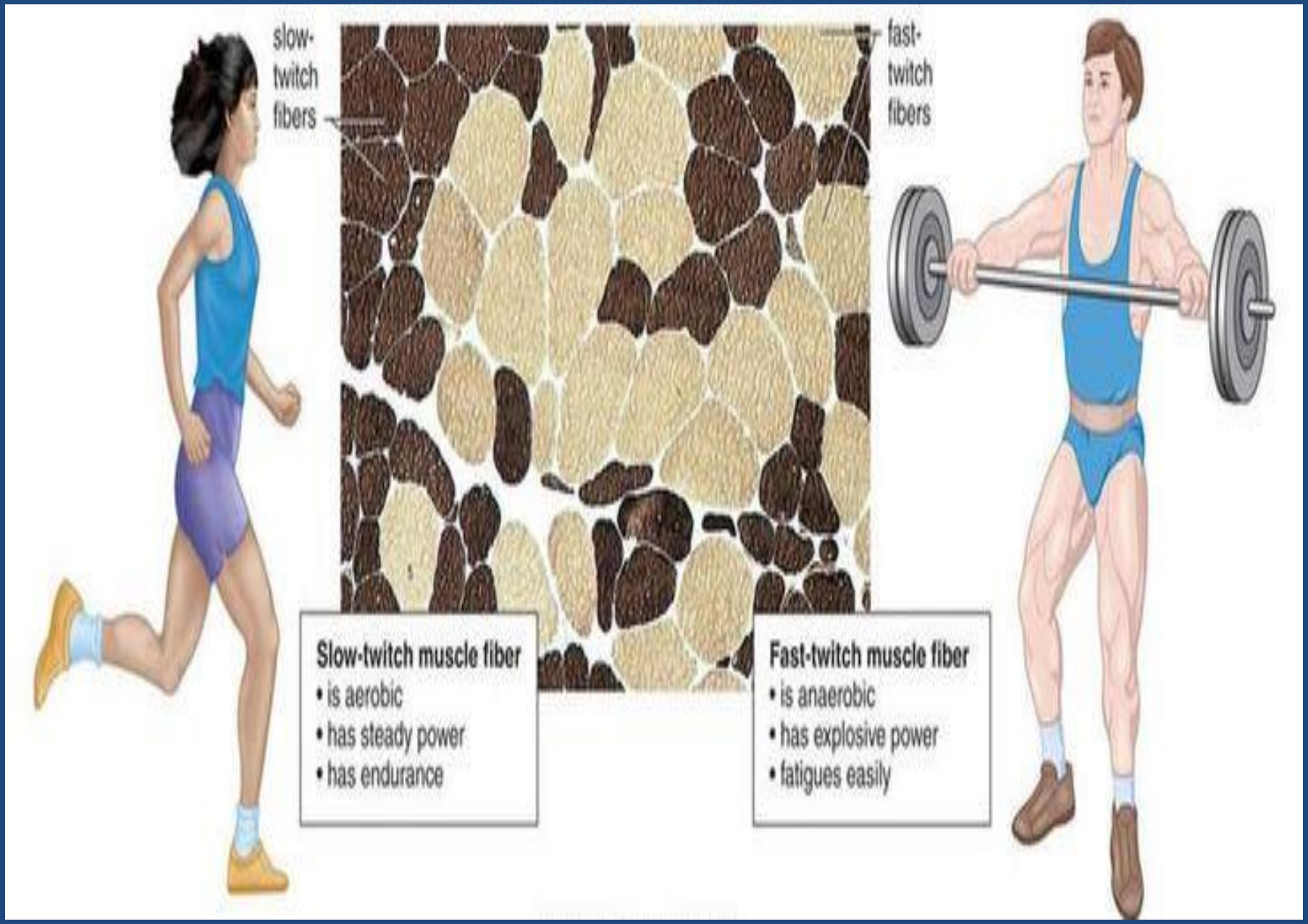
- Low content of myoglobin & cytochrome
- Few mitochondria
- Poor blood supply
- Rapid contractions
- smaller in diameter
- E.g: extra ocular muscles
- *NOTE: Most human muscles are combination of both therefore appear pink*

Fast vs. Slow Twitch Muscle Fibers

- **White Muscle Fibers (white)** – fast contracting, fewer myoglobin, hemoglobin, and mitochondria than red muscles.

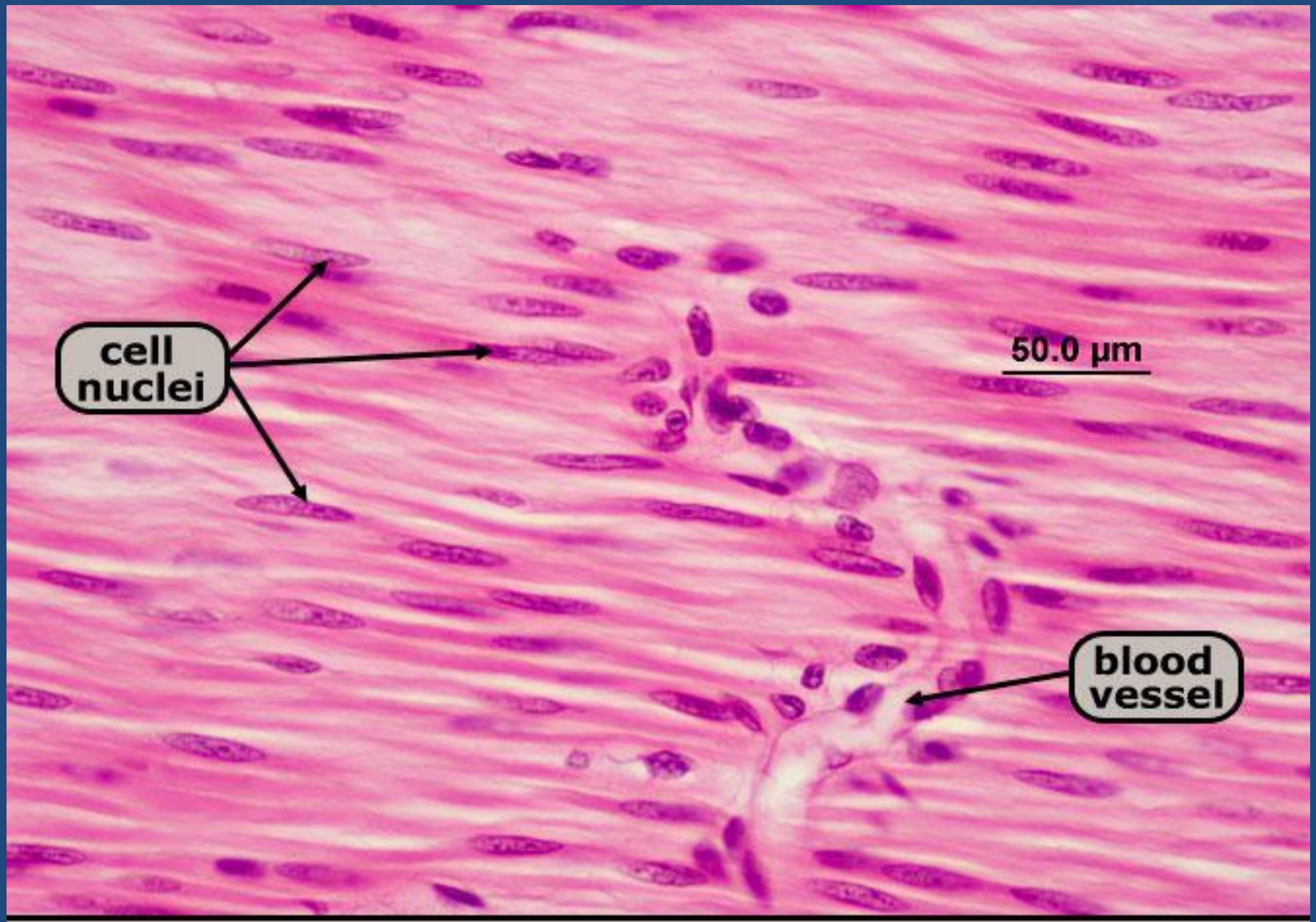
  Have extensive SR so it can contract quickly due to ability to store and reabsorb Ca+, but fatigue quickly.



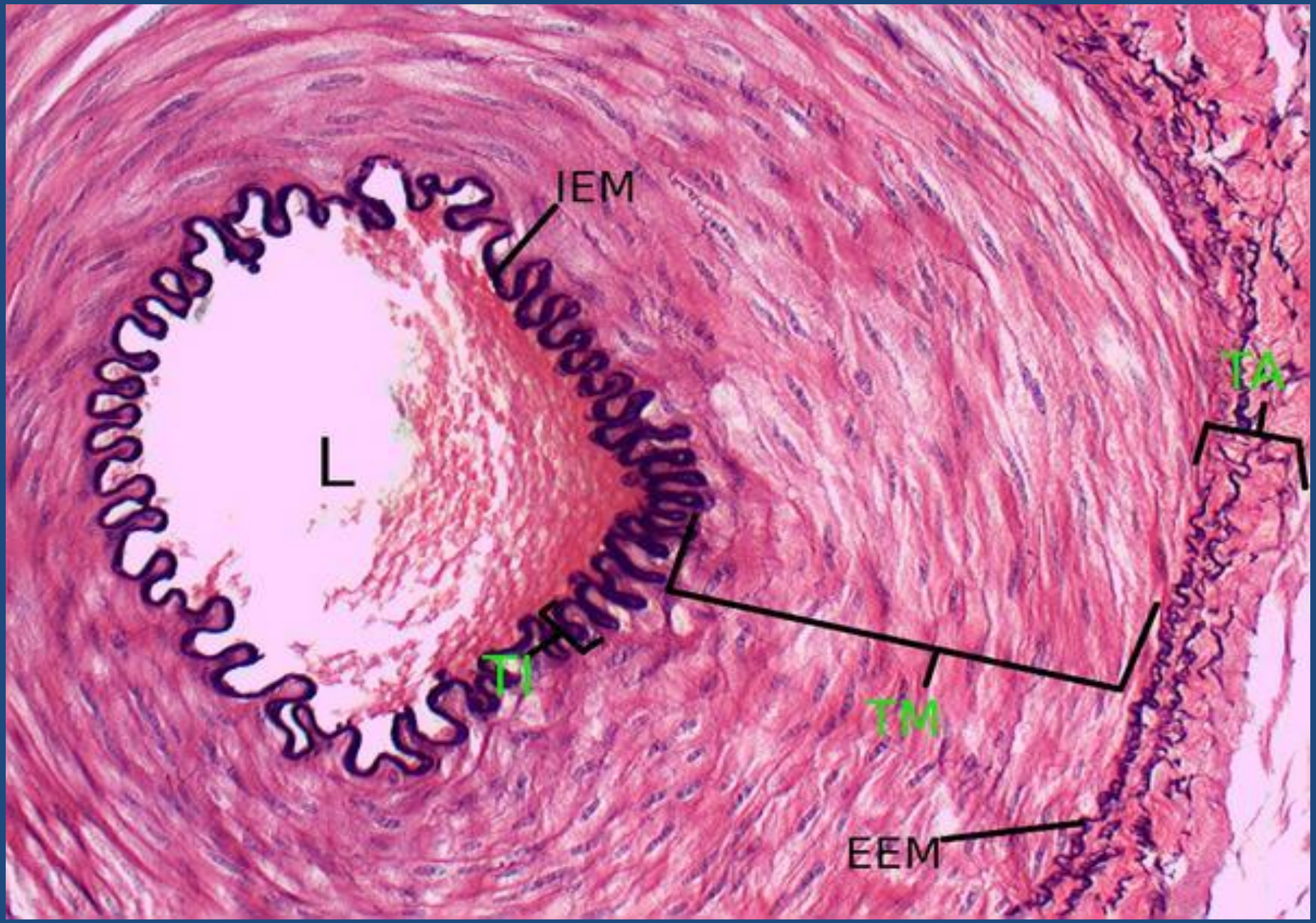

slow-twitch fibers
fast-twitch fibers
Slow-twitch muscle fiber
• is aerobic
• has steady power
• has endurance
Fast-twitch muscle fiber
• is anaerobic
• has explosive power
• fatigues easily

SMOOTH MUSCLE

- Smooth muscle fibers are elongated spindle shaped cells
- Non striated
- Single elongated nucleus central in position
- Involuntary
- Supplied by autonomic nervous system
- Found in the walls of hallow viscera G.I.T , blood vessels, ureters etc



Smooth muscle


IEM
L
TA
TI
TM
EEM

CARDIAC MUSCLE

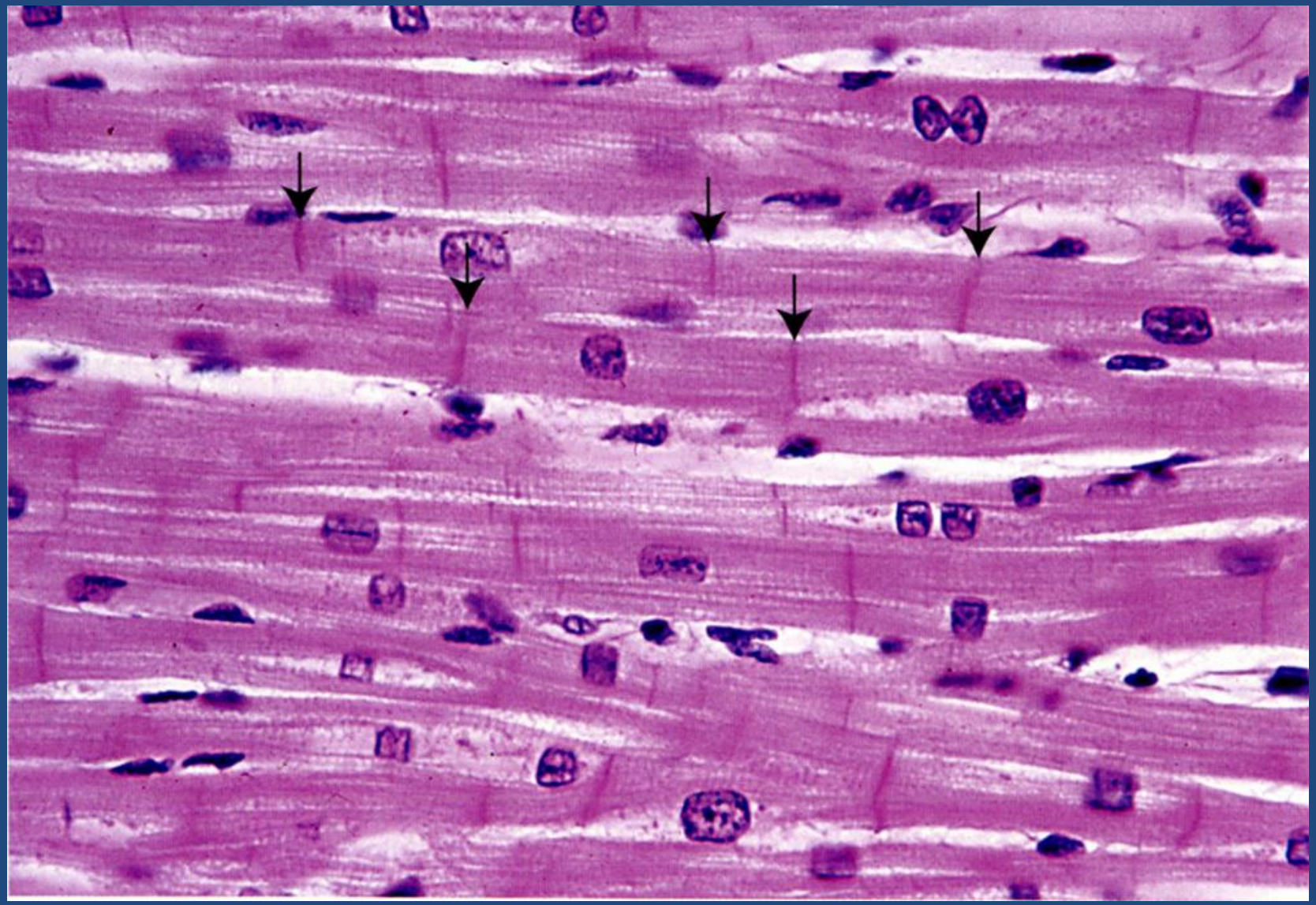
CARDIAC MUSCLE

Shows many structural & characteristics intermediate between those of skeletal & smooth muscle.

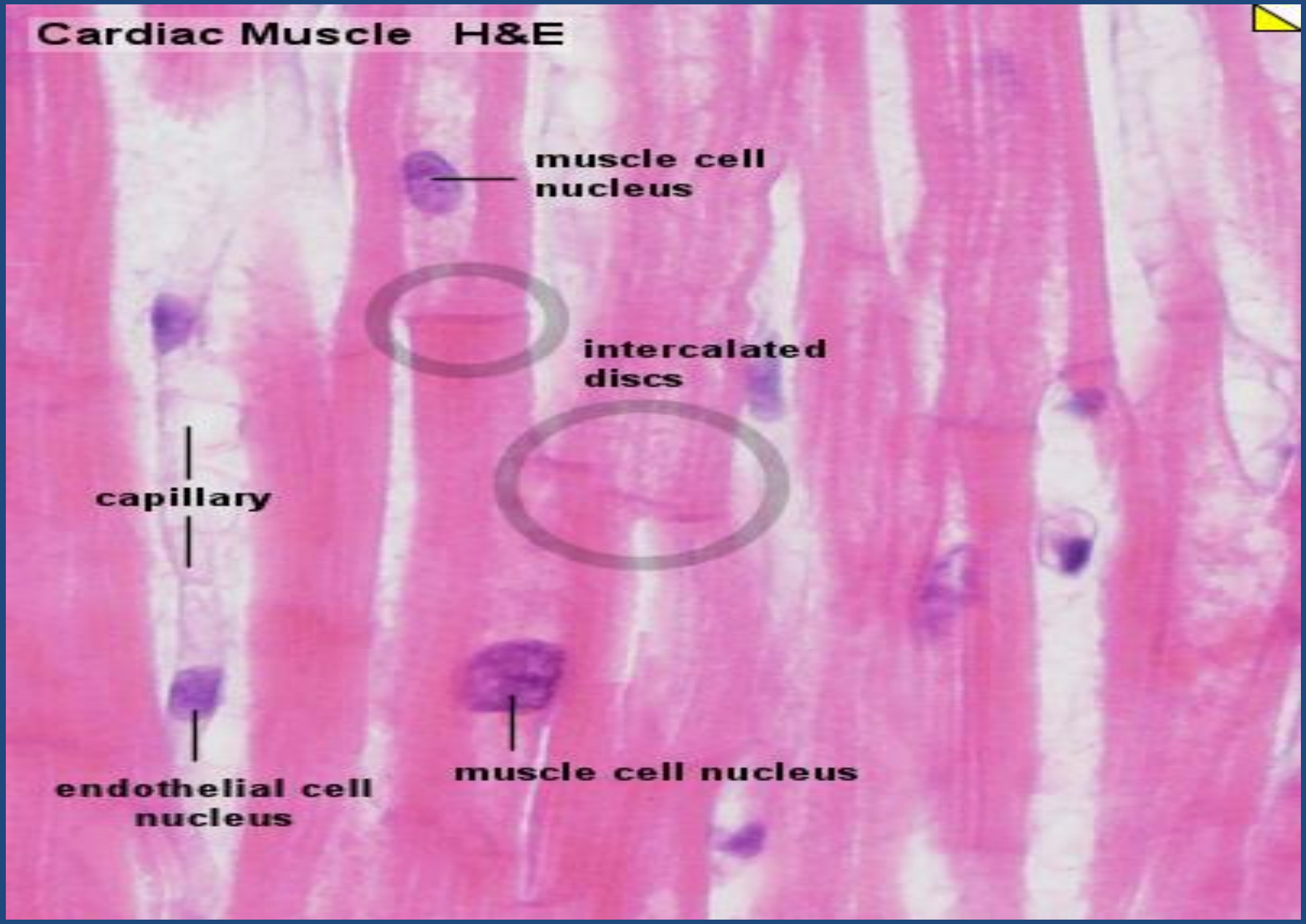
Cardiac muscle

- Cardiac muscle fibers are shorter than the skeletal muscle fibers & show *branching pattern.*
- One or two nuclei placed in the centre
- Presence of darkly staining transverse lines across the fibers -*intercalated discs*
- Specialized cell junctions between the ends of adjacent muscle fibers

Cardiac Muscle (longitudinal section)



- Central nuclei, often with a biconical, clear area next to nucleus –this is where organelles and glycogen granules are concentrated (and atrial natriuretic factor in atrial cardiac muscle)
- Striated, branched fibers joined by intercalated disks (arrows) forms interwoven meshwork


Cardiac Muscle H&E
muscle cell nucleus
intercalated discs
capillary
endothelial cell nucleus
muscle cell nucleus

Muscle Regeneration and Growth

Skeletal Muscle

- Increase in size (hypertrophy)
- Increase in number (regeneration/proliferation)
    - Satellite cells are proposed source of regenerative cells

Smooth Muscle

- Increase in size (hypertrophy)
- Increase in number (regeneration/proliferation)
    - Smooth muscle cells are proliferative
    (e.g. uterine myometrium and vascular smooth muscle)
    - Vascular pericytes can also provide source of smooth muscle

Heart Muscle

- Increase in size (hypertrophy)
- Formerly thought to be non-proliferative
    - Post-infarction tissue remodeling by fibroblasts (fibrosis/scarring)
    - New evidence suggests mitotic cardiomyocytes and regeneration by blood or vascular-derived stem cells


KU

Thank you