Muscle tissue

Lecture N7

- Muscle tissue satisfy requirement of the body in movement.

Classification –
The 3 ***types*** of muscle tissue:

1. skeletal
2. cardiac
3. smooth

- groups:
- **Striated**
- **Smooth**

Why do muscles contract?

- Muscle cells have contractile proteins -

actin and **myosin**,

and some another .

The interaction of **actin** and **myosin** mediates the contraction of muscle cells.

Why do muscles contract?

- Actin and myosin form ***myofilaments:***
- Myosin - **thick**, dark and **An**isotropic (A)
- Actin – *thin*, light and **I**sotropic (I)
- Actin and myosin form special organelles – **myofibrils,** responsible for muscle contraction.

SMOOTH MUSCLE

- Locations: **walls of *visceral* hollow organs**

(stomach).

Functions: ***involuntary movement* --**

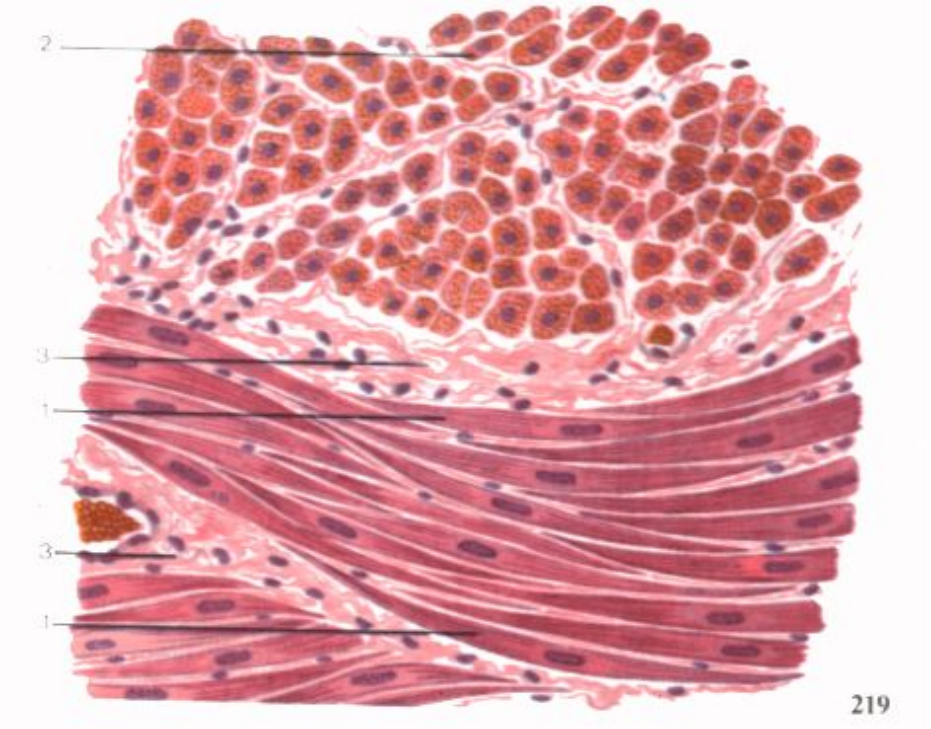
(peristaltics)

(The innervation -- by *autonomic nervous system*)

SMOOTH MUSCLE

- Unit – ***spindle shaped*** cell -- myocyte
- Individual cells are organized ***in sheath***
- In hollow organs forms **layers**

Contraction is usually slow.

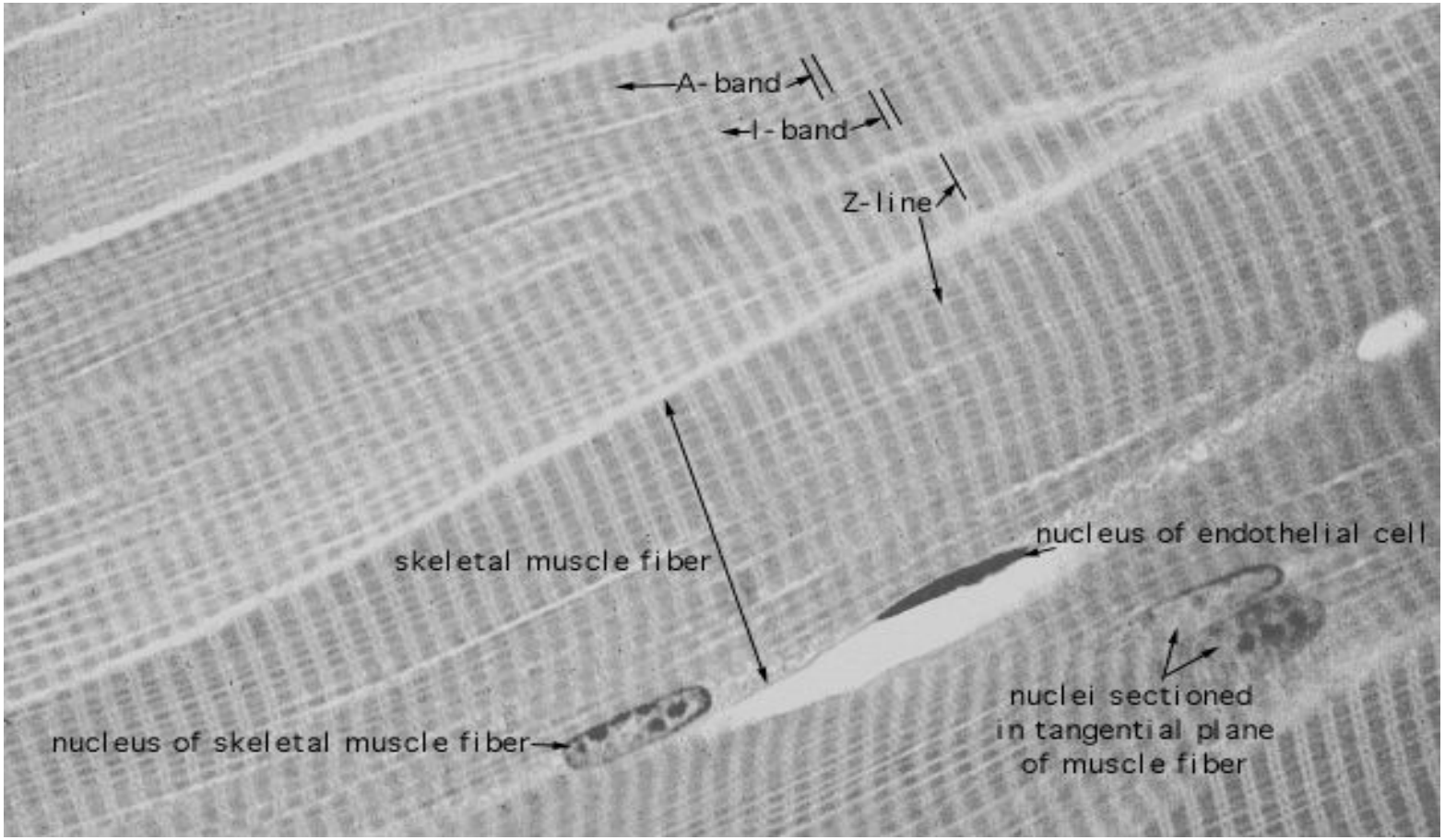


Origin of smooth muscle

- Smooth muscle cells arise from **mesenchymal** cells.

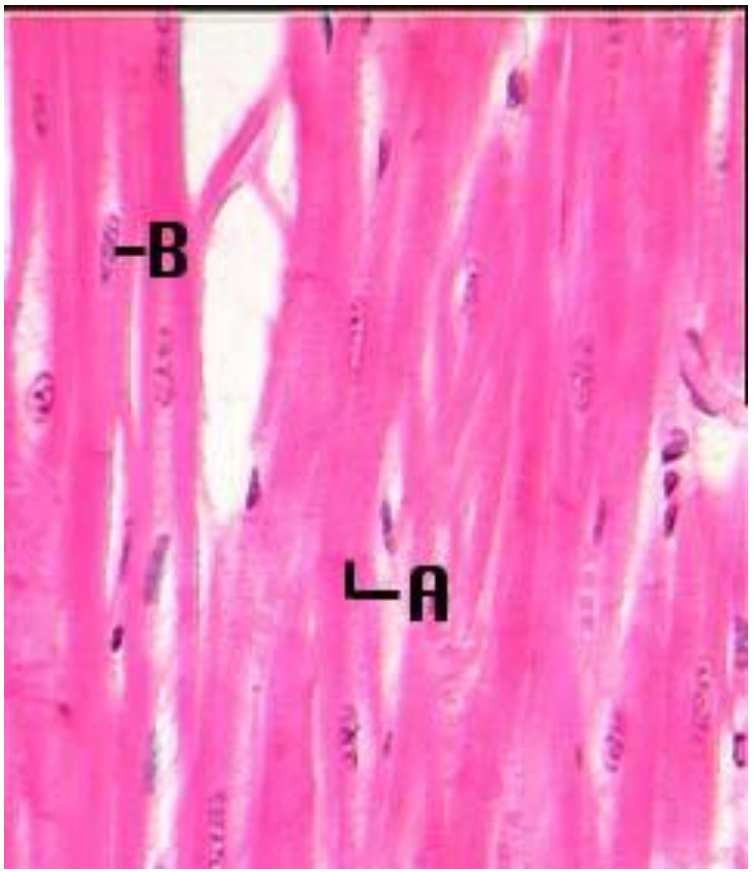
Striated muscles

See: regular organization of the myofibrils gives rise to the ***cross-striation***, which characterises skeletal and cardiac muscle.



CARDIAC MUSCLE

- Locations: heart
- Function: involuntary, rhythmic contraction
- Unit – cardiomyocyte (cell)



Cardiac muscle cells:

3 types:

- **Contractile**,
- Conducting
- Secretory

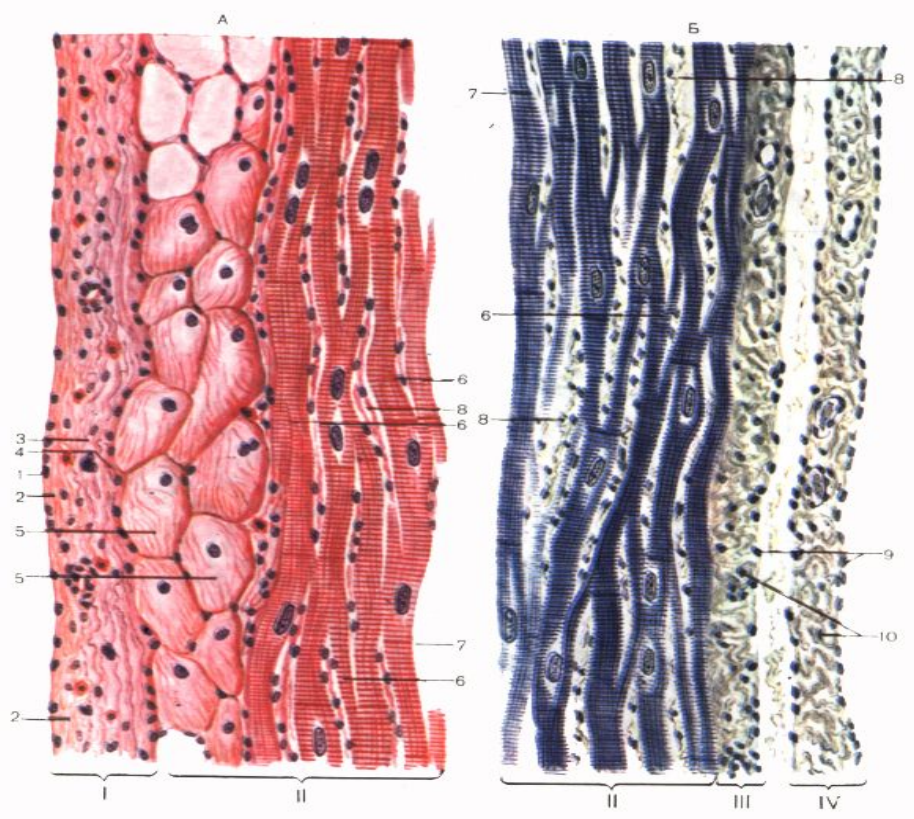
CARDIAC MUSCLE

cardiac muscle cells are cylindrical,

connect end-by-end,

and form "**functional fiber**", which

often branch at acute angles.



CARDIAC MUSCLE

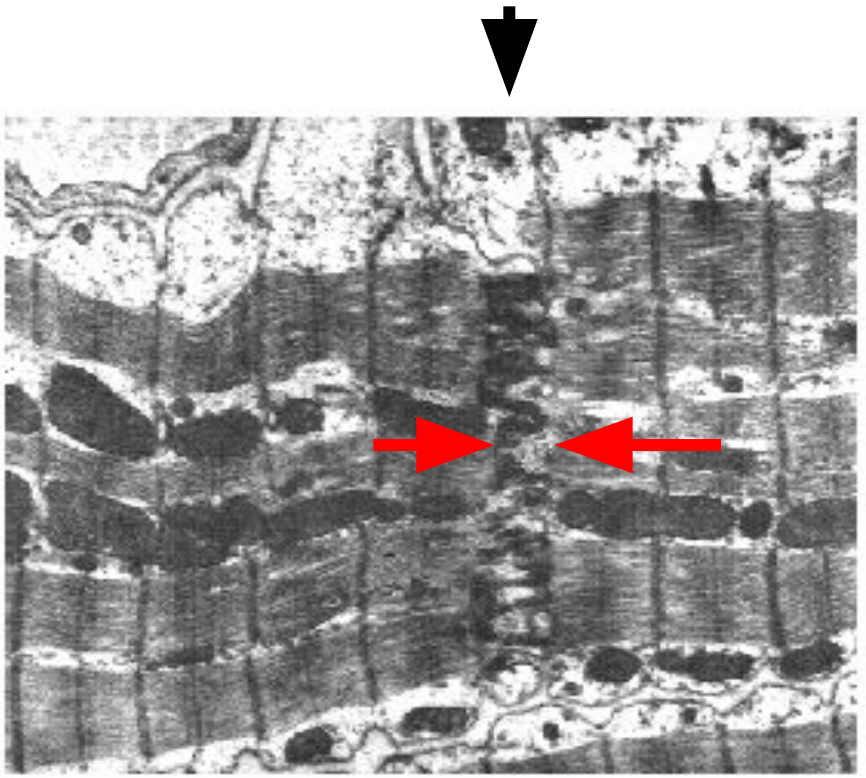
- They are connected by special junction -

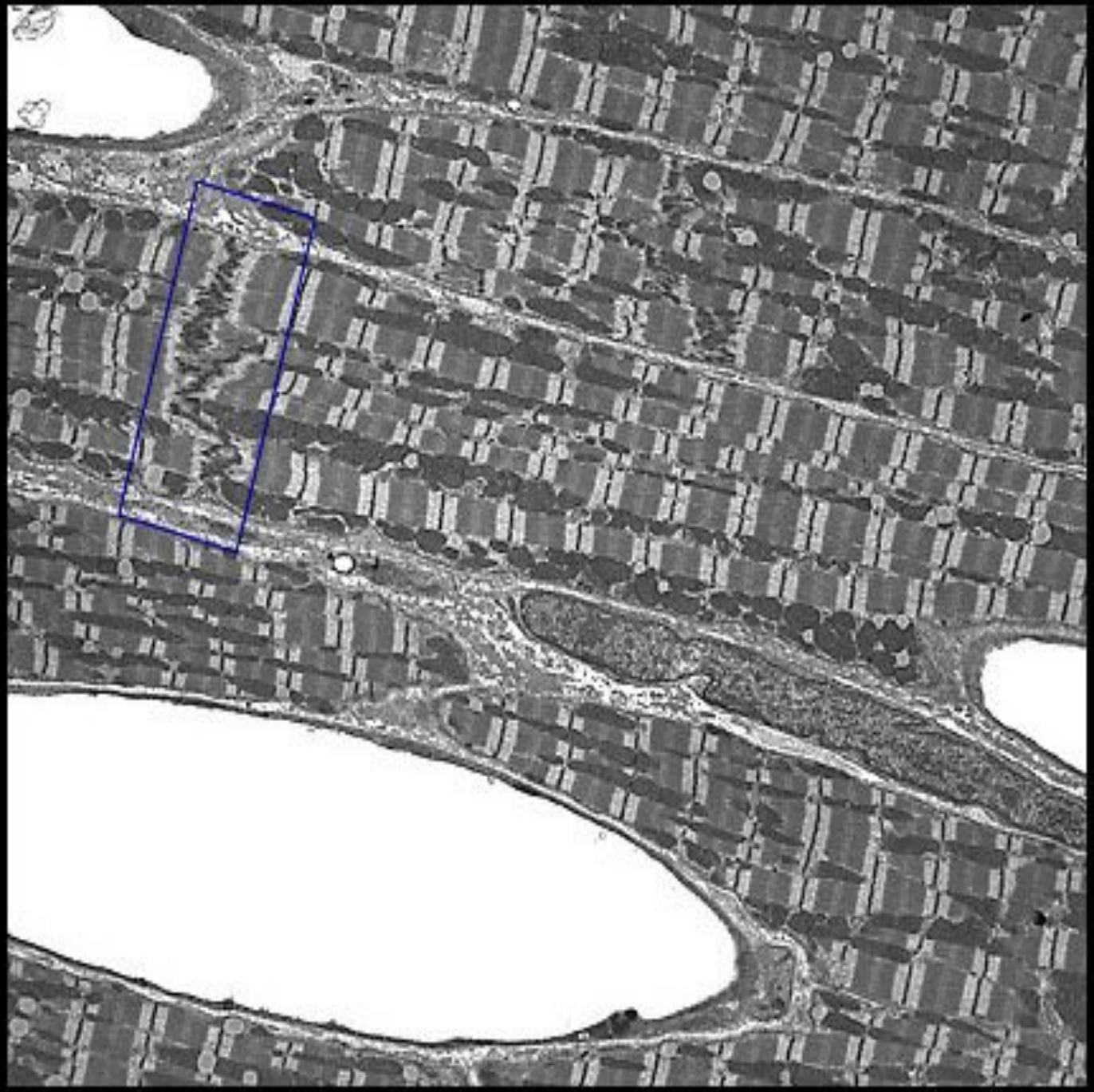
intercalated discs – consisting of

gap junctions

and

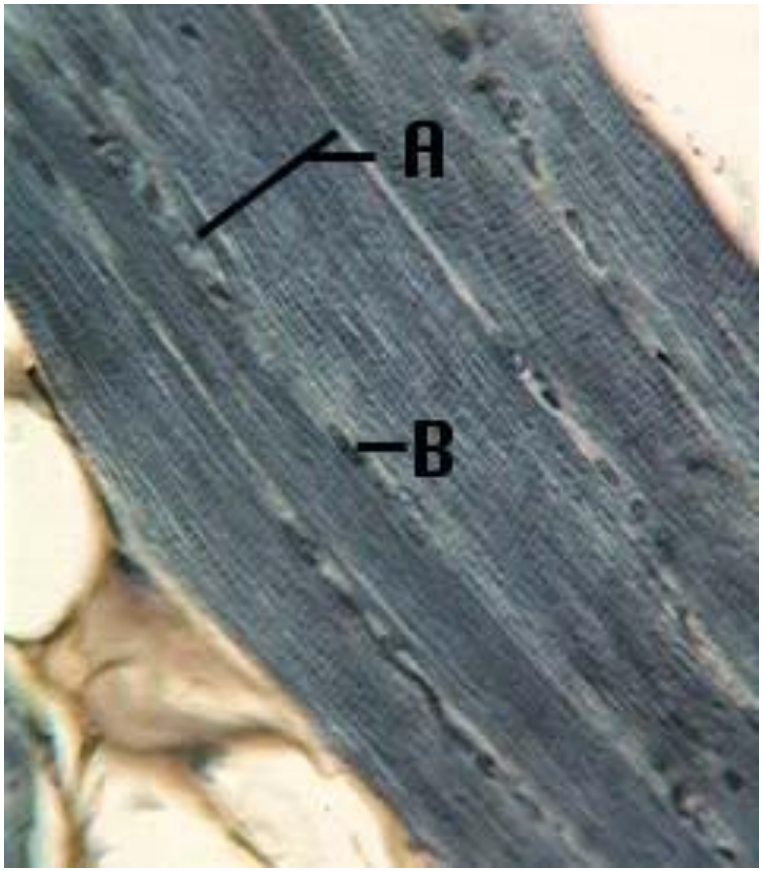
desmosomes.





SKELETAL MUSCLE

Location



- Muscles associated with the <u>skeleton</u> (are connected to bones by tendons).
- Platisma and mimic muscles
- Voluntary sphincters of inner organs

SKELETAL MUSCLE

- --- is innervated by the *somatic nervous system – **voluntary**!!*
- ---- consists of very long tubular cells (also called **muscle fibres**).

SKELETAL MUSCLE

- Skeletal muscle fibers run the full length of a muscle.

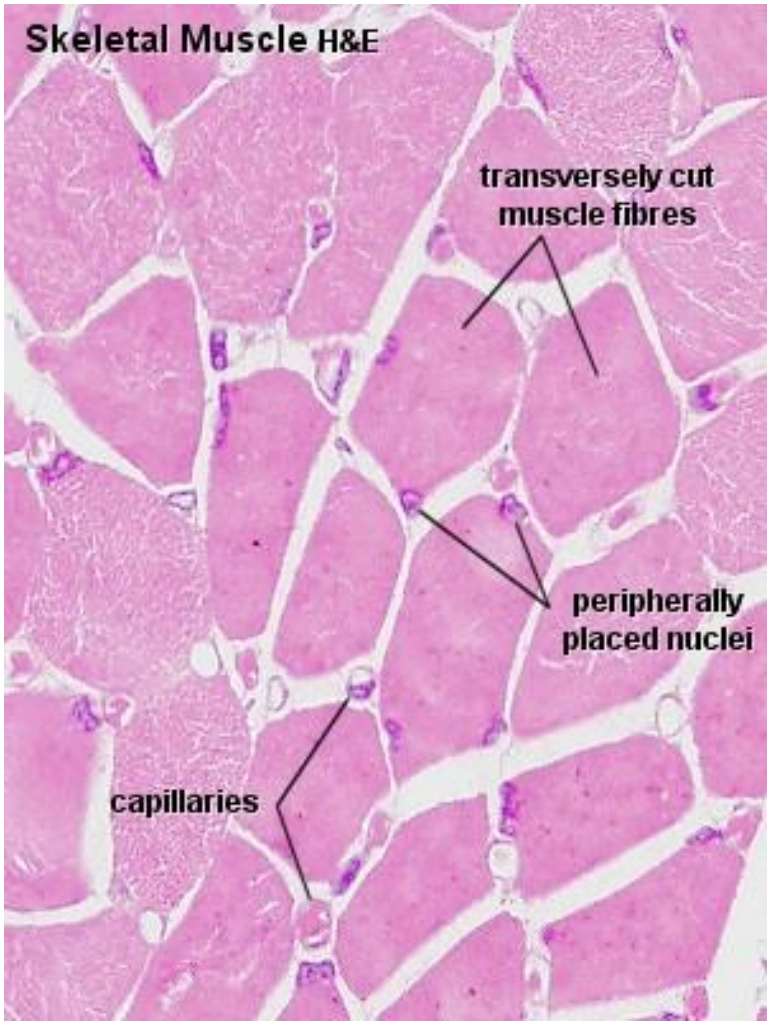
- **The average length of skeletal muscle cells in humans is about 3 cm (sartorius muscle up to 30 cm, stapedius muscle only about 1 mm). Their diameters vary from 10 to 100 μm.**

Nuclei:

- Skeletal muscle fibres contain many nuclei

(up to several hundred)

placed <u>beneath the plasma membrane</u>



Myofibrils

Mechanism of contraction:

Sliding filaments model

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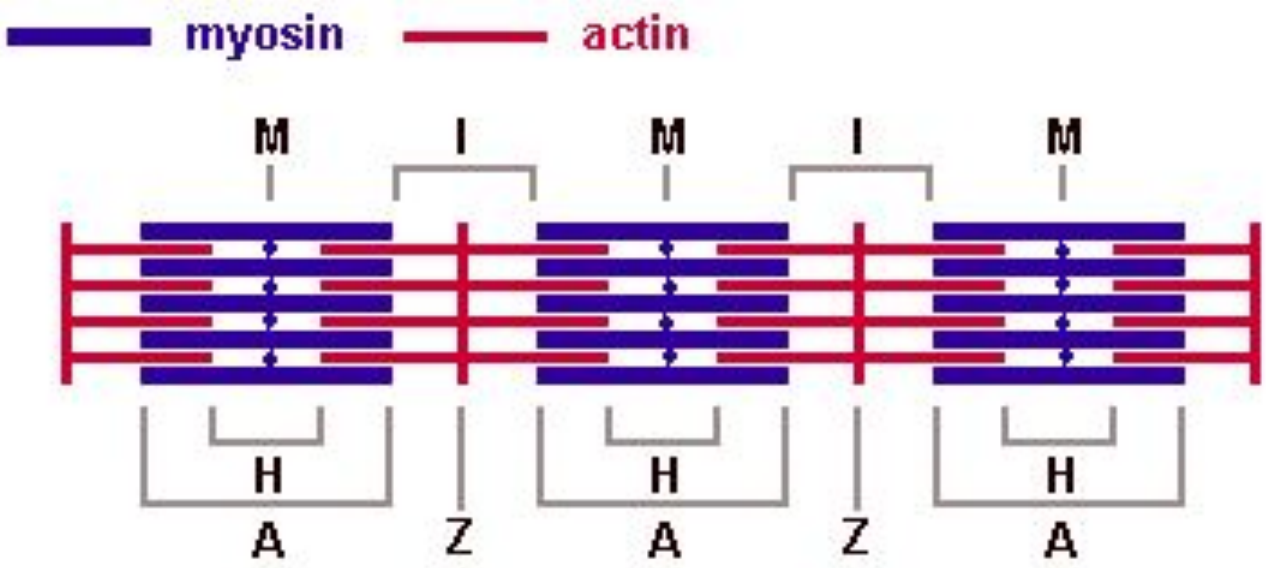
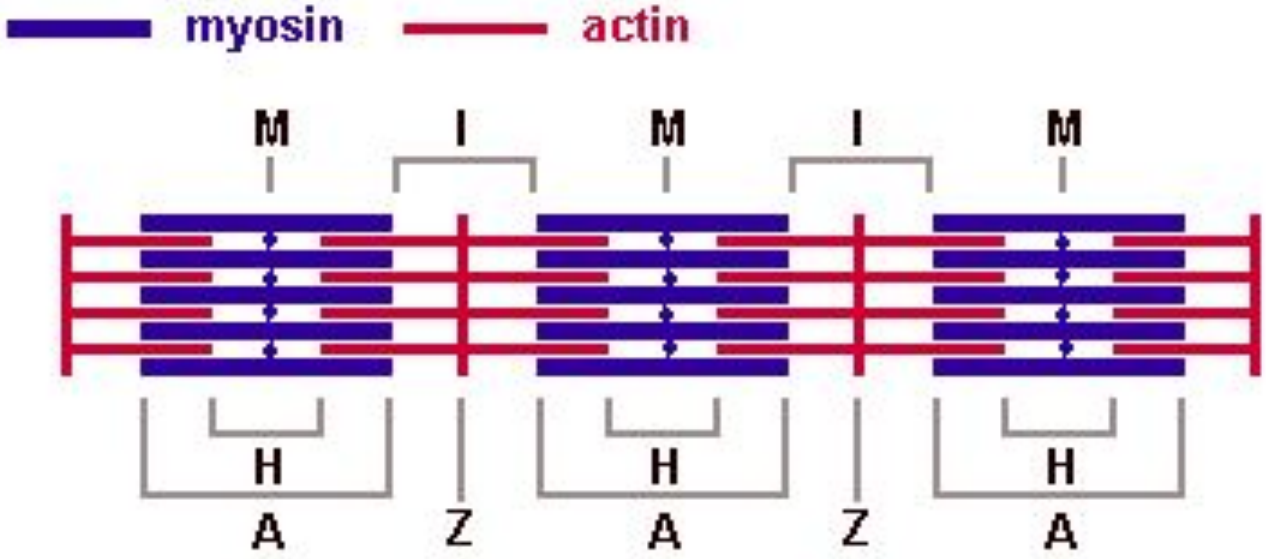
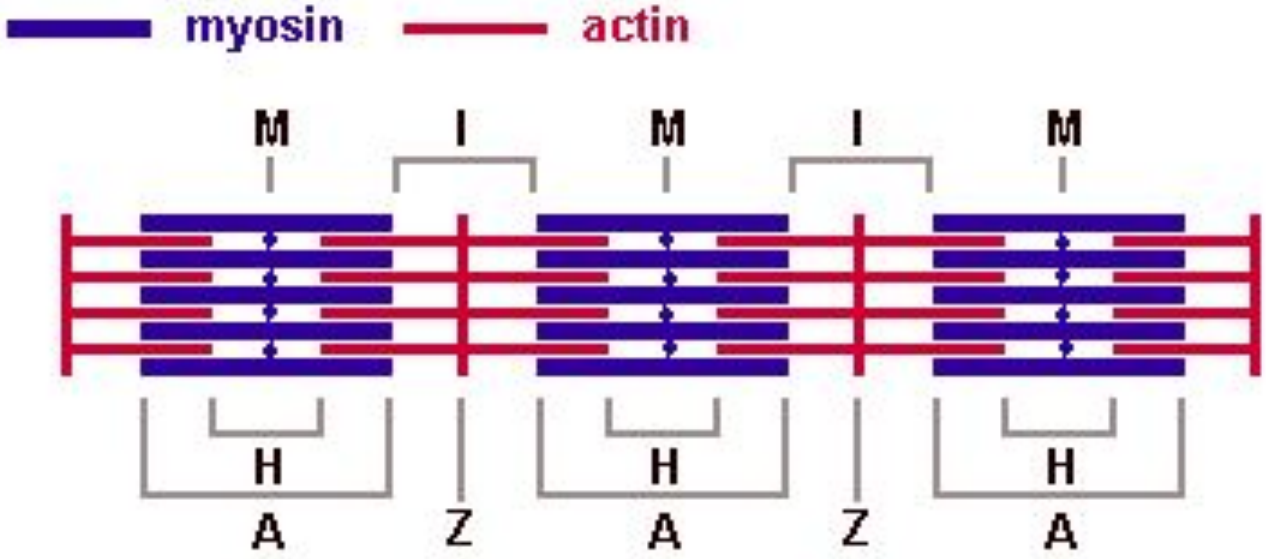


Bands and lines in the contractile apparatus of skeletal muscle

- Myofibrils has some bands and lines depending on the distribution and interconnection of myofilaments -- :
- **I-band** - actin filaments only,
- **A-band** - myosin filaments which *may* overlap with actin filaments
- **T or Z-line** -- band of connections between actin filaments; zone of apposition of actin filaments belonging to two neighboring sarcomeres;
- **M-line** - band of connections between myosin filaments.
- **H-band** - zone of myosin filaments only (no overlap with actin filaments) within the A-band



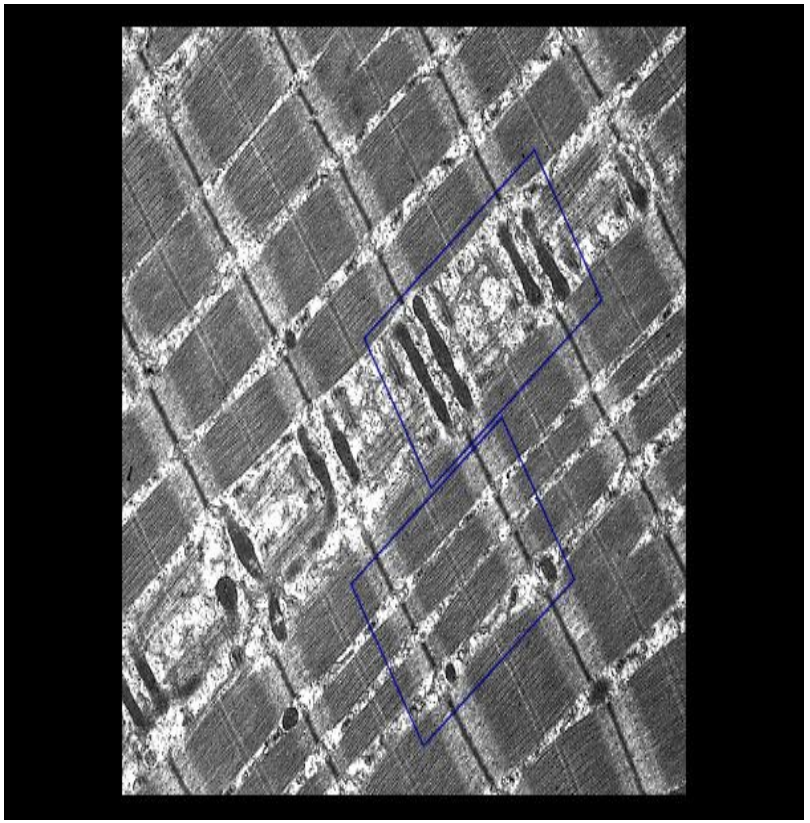
Bands and lines in the contractile apparatus of skeletal muscle



Bands and lines in the contractile apparatus of skeletal muscle

Sarcomeres --

- **are parts, smallest contractile units** of myofibrils.
- Sarcomere formula:
- **S = ½ I + A + ½ I**



Sarcomere formula after contraction

- S = A
- (- ½ I, - ½ I, - H)

Mechanism of contraction

Origin of skeletal muscle

- The myoblasts of all skeletal muscle fibres originate from the paraxial mesoderm - **myotome**.

- 1. **Myoblasts** undergo frequent divisions and coalesce with the formation of a multinucleated, syncytial muscle fibre or **myotube**. The nuclei of the myotube are still located centrally in the muscle fibre.

- 2. In the course of the synthesis of the myofilaments and myofibrils, the nuclei are gradually displaced to the periphery of the cell.

Regeneration. Satellite cells

- ***Satellite cells*** are small cells which are closely apposed to muscle fibers within the basal lamina which surrounds the muscle fiber.
- Satellite cells are believed to represent persistent *myoblasts*. They may regenerate muscle fibers in case of damage.