

Muscle tissue

Lecture N7

- Muscle tissue satisfy requirement of the body in movement.

Classification – The 3 *types* of muscle tissue:

1. skeletal

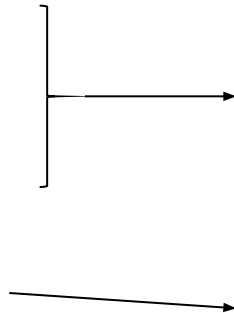
2. cardiac

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 **Anisotropic (A)**
- Actin – *thin*, light and **Isotropic (I)** 
- Actin and myosin form special organelles – **myofibrils**, responsible for muscle contraction.

SMOOTH MUSCLE

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

(stomach).

Functions: *involuntary movement* --

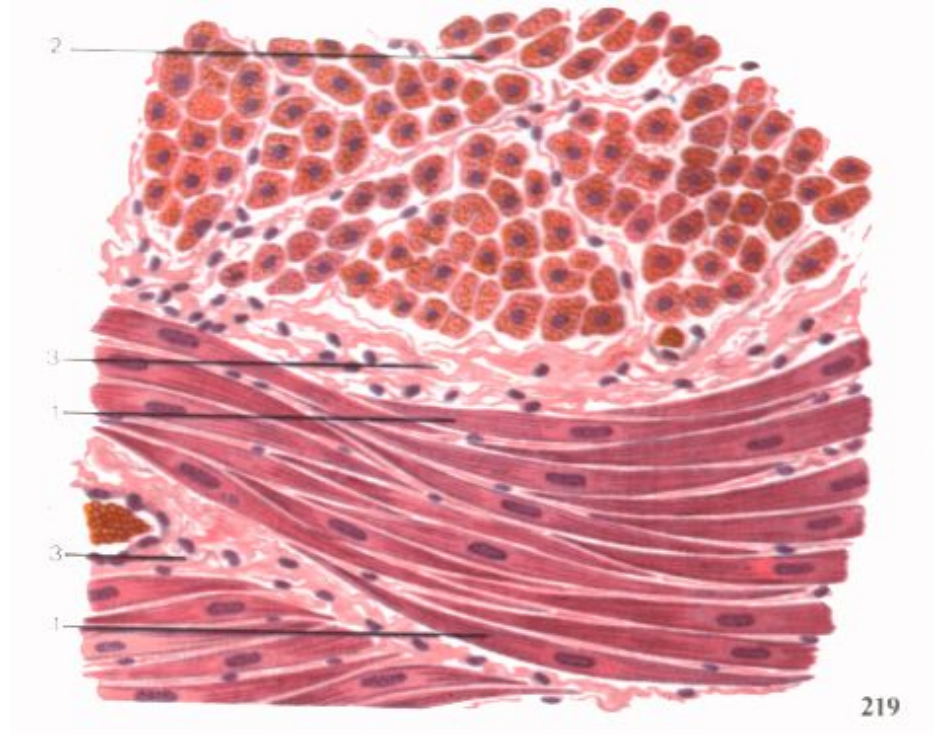
(peristaltics)

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

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

Contraction is usually slow.

SMOOTH MUSCLE



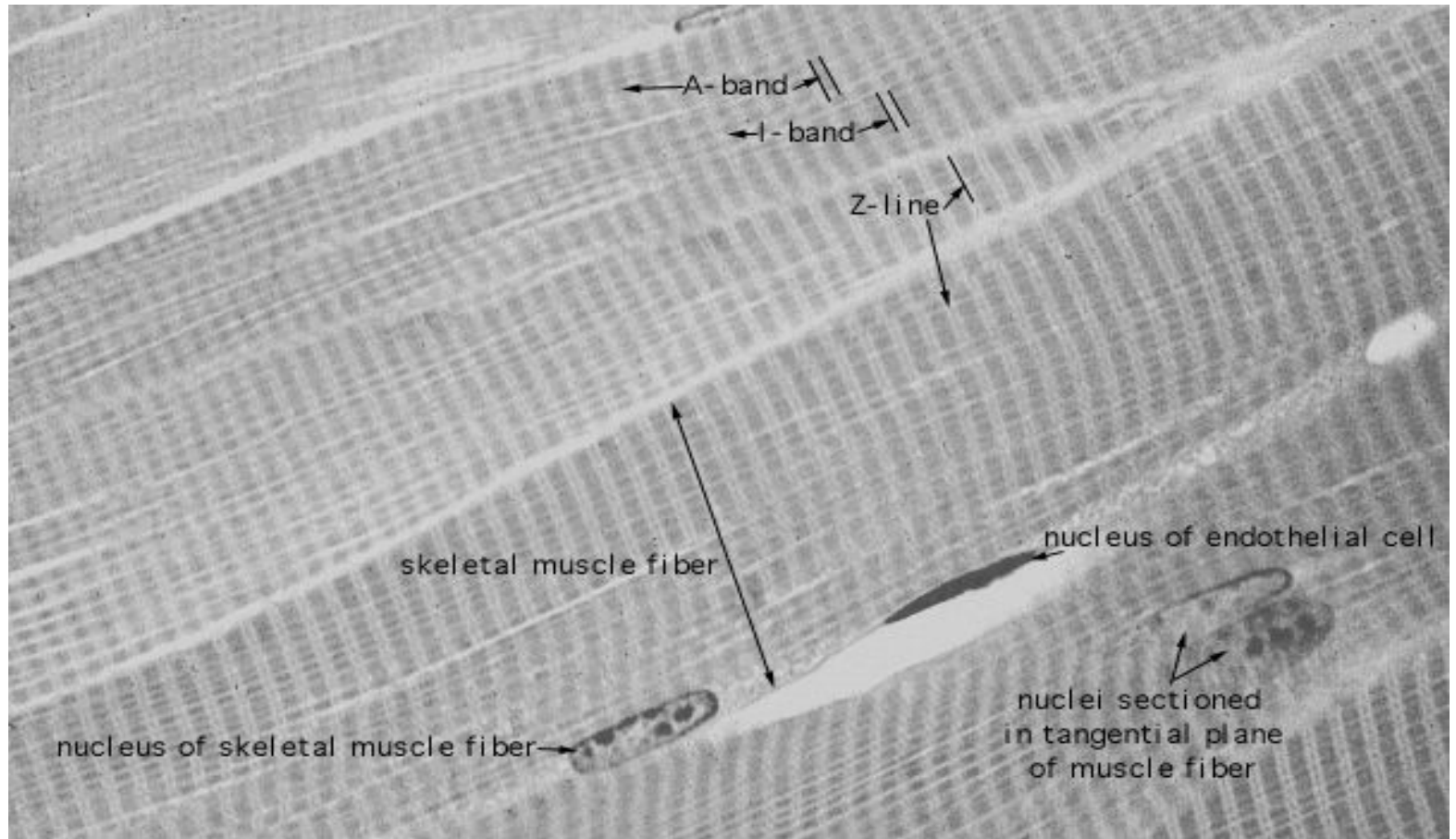
Origin of smooth muscle

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

Striated muscles

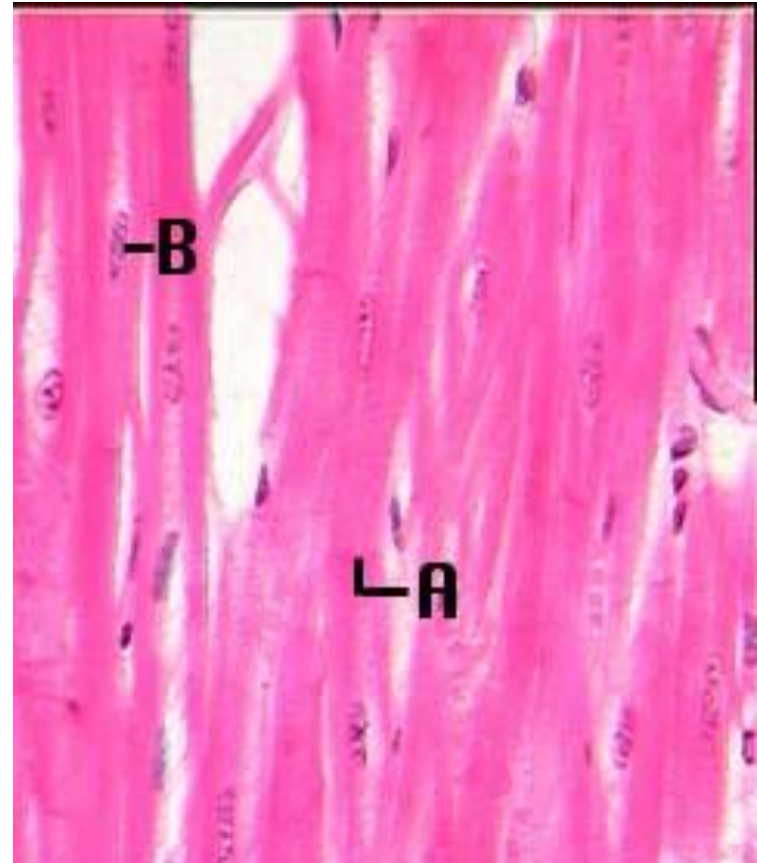


See: regular organization of the myofibrils gives rise to the ***cross-striation***, which characterises skeletal and cardiac muscle.



CARDIAC MUSCLE

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



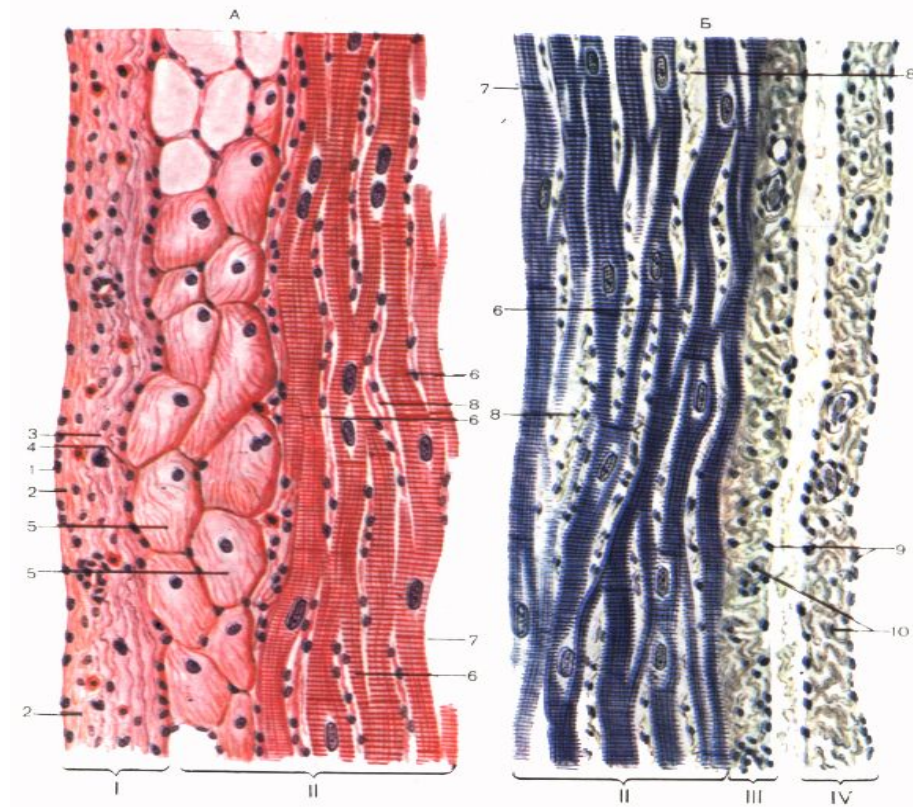
Cardiac muscle cells:

3 types:

- **Contractile,**
- **Conducting**
- **Secretory**

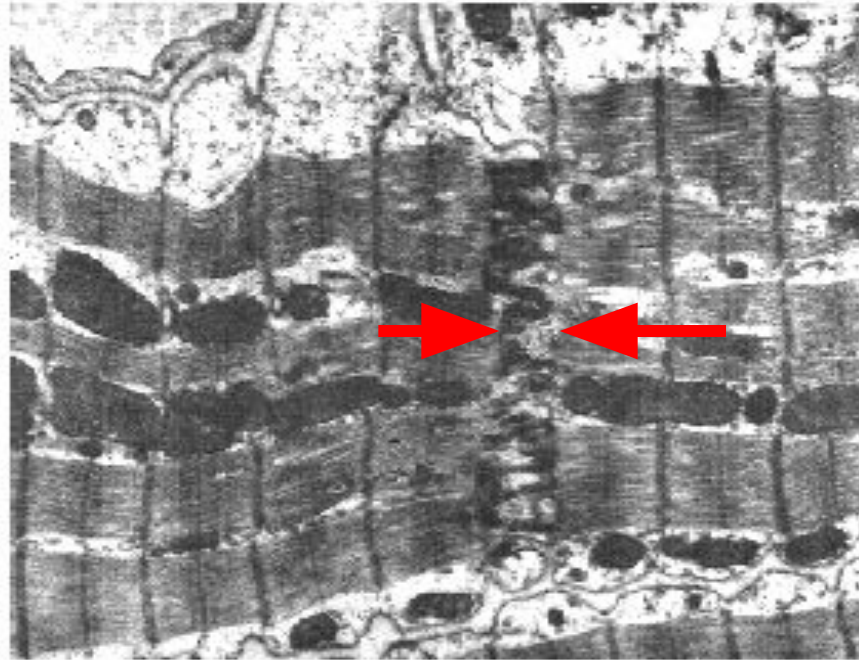
CARDIAC MUSCLE

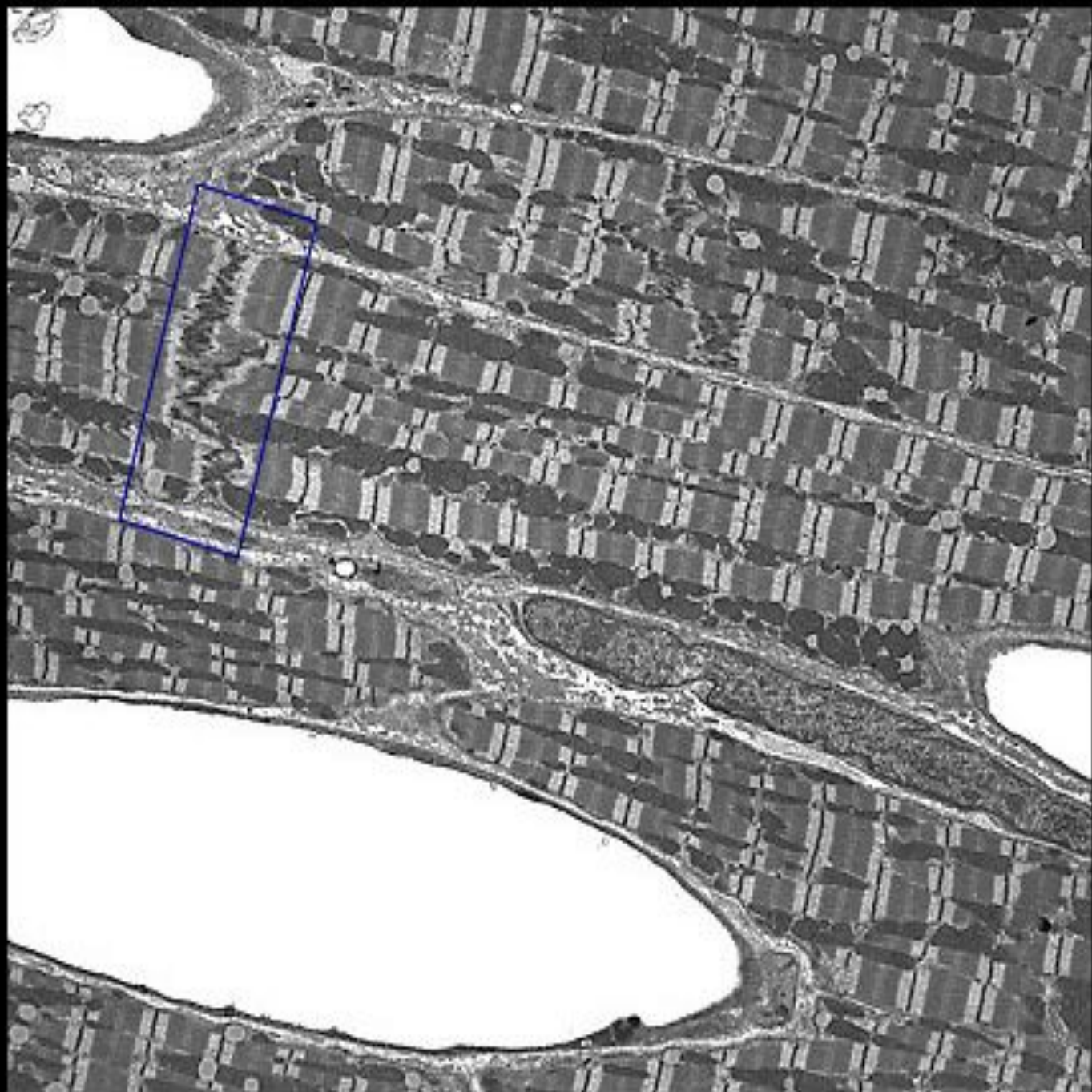
cardiac muscle cells are cylindrical,
connect end-by-end,
and form “**functional fiber**”, which
often branch at acute angles.



CARDIAC MUSCLE

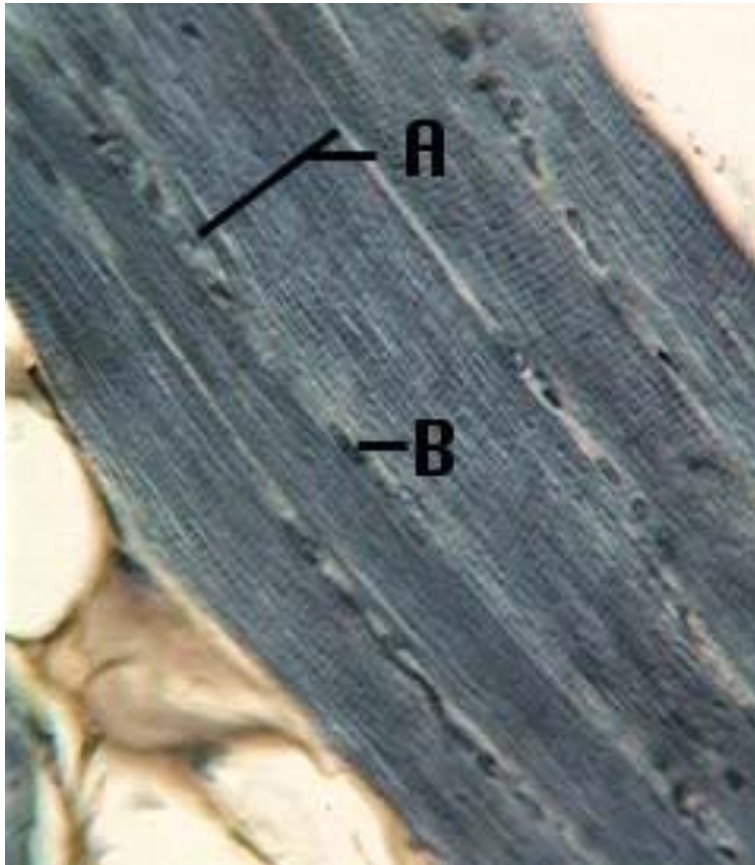
- They are connected by special junction - **intercalated discs** – consisting of gap junctions and desmosomes.





SKELETAL MUSCLE

Location



- Muscles associated with the skeleton (are connected to bones by tendons).
- Platysma and mimic muscles
- Voluntary sphincters of inner organs

SKELETAL MUSCLE

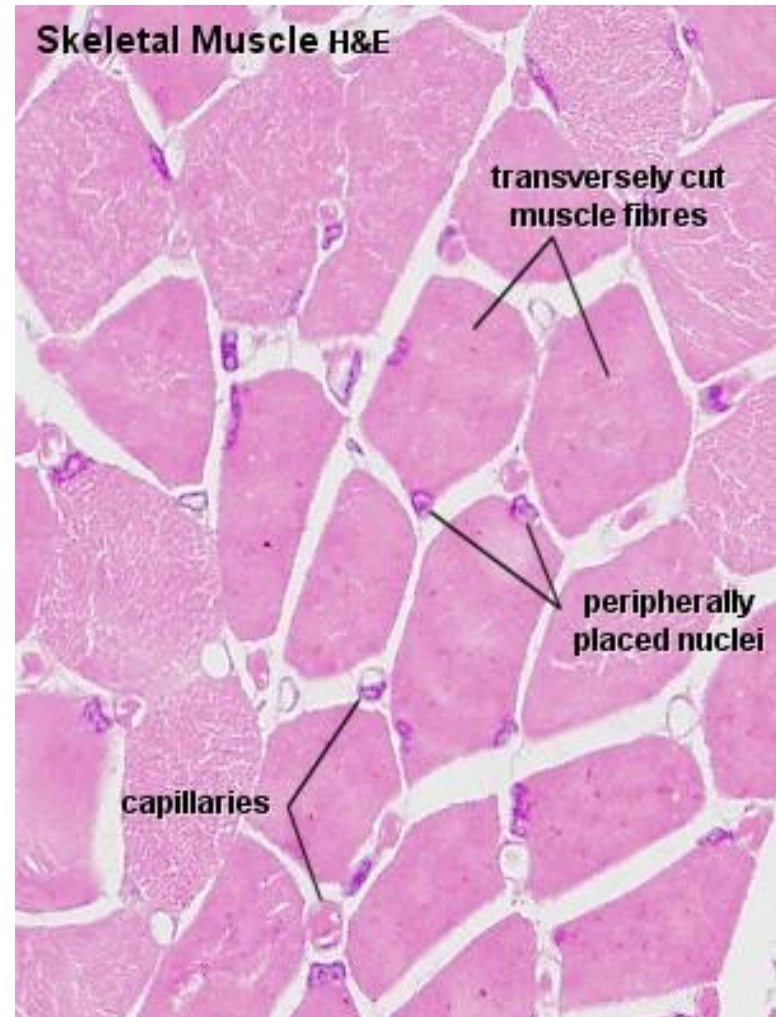
- --- is innervated by the *somatic nervous system* – ***voluntary!!***
- ---- consists of very long tubular cells (also called **muscle fibres**).

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 .**

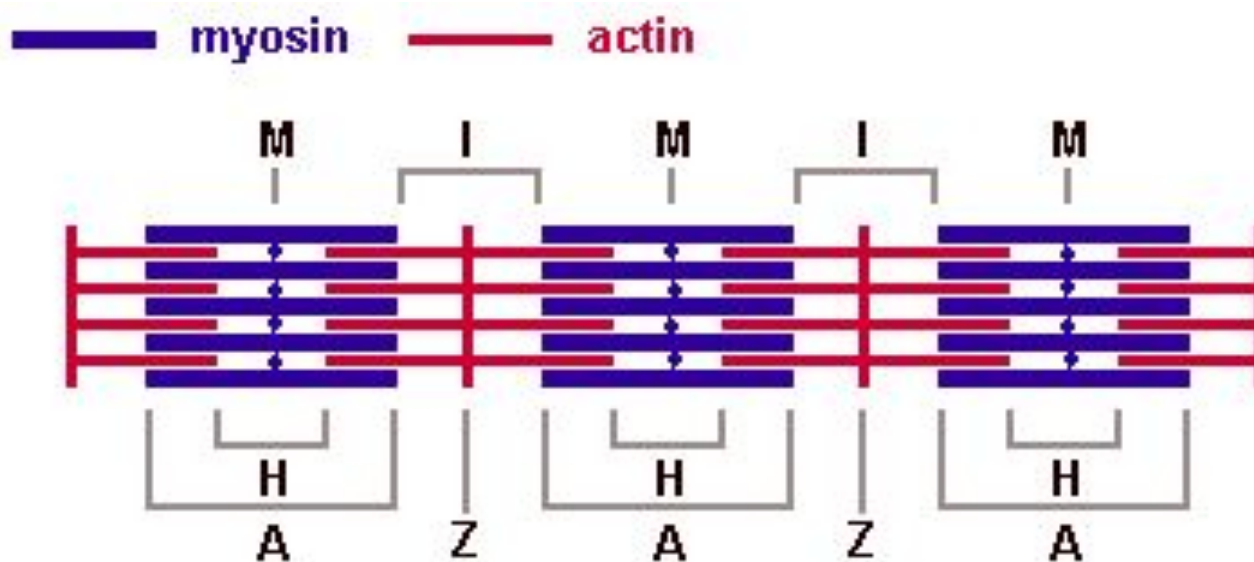
Nuclei:

- Skeletal muscle fibres contain many nuclei
(up to several hundred)
placed beneath the plasma membrane



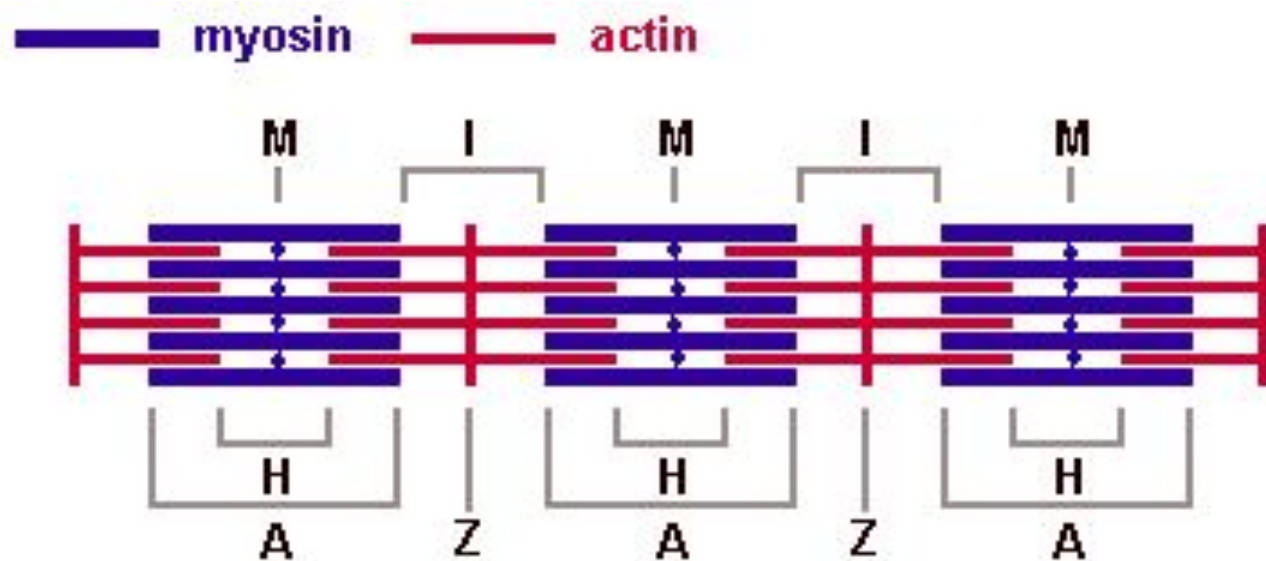
Myofibrils

Mechanism of contraction: Sliding filaments model

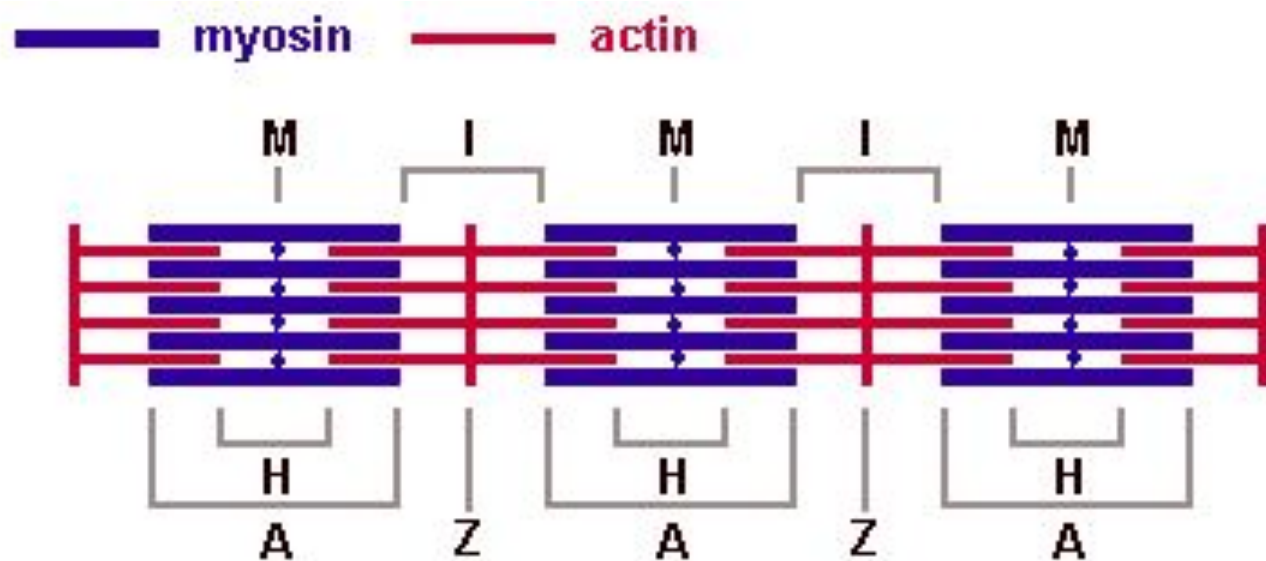


Bands and lines in the contractile apparatus of skeletal muscle

- **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



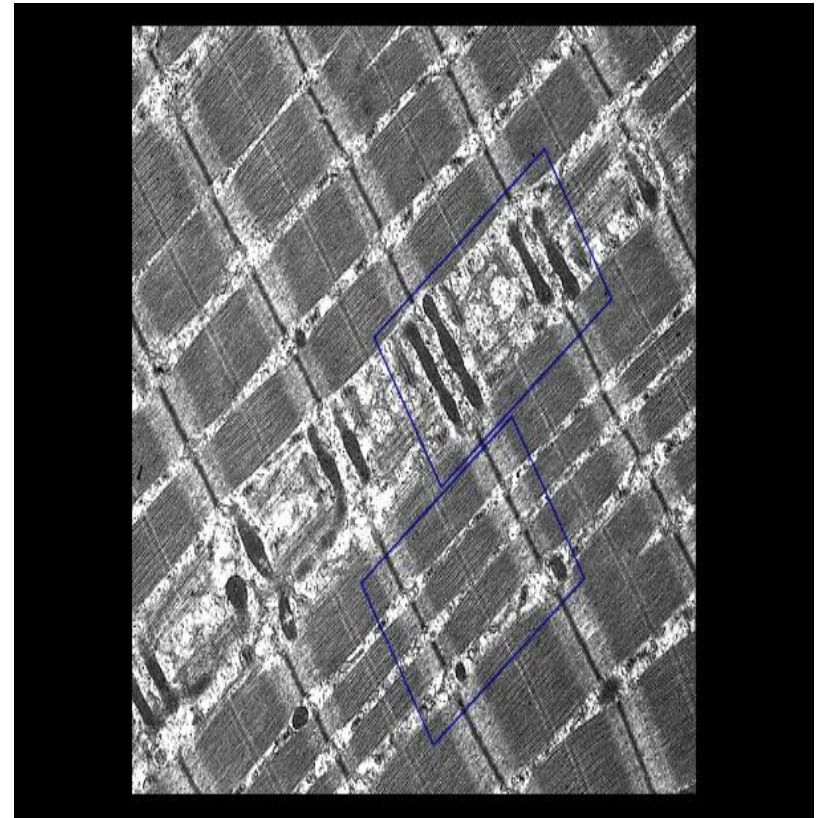
Bands and lines in the contractile apparatus of skeletal muscle



Bands and lines in the contractile apparatus of skeletal muscle

Sarcomeres --

- are parts, smallest contractile units of myofibrils.
- Sarcomere formula:
- $S = \frac{1}{2} I + A + \frac{1}{2} I$



Sarcomere formula after contraction

- $S = A$
- $(- \frac{1}{2} I, - \frac{1}{2} I, - H)$

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.