

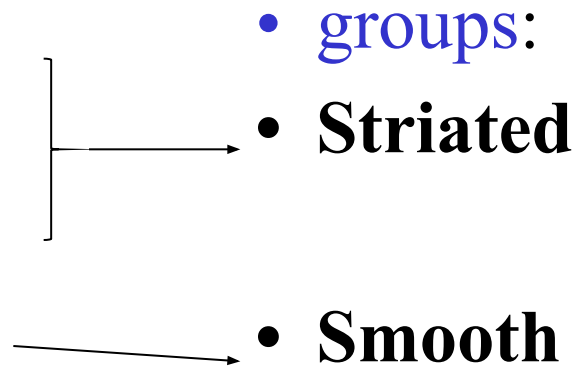
# Muscle tissue

Lecture N7

- Muscle tissue satisfy requirement of the body in movement.

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

1. skeletal
2. cardiac
3. smooth

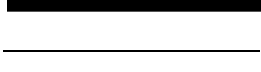


# Why do muscles contract?

- 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* --

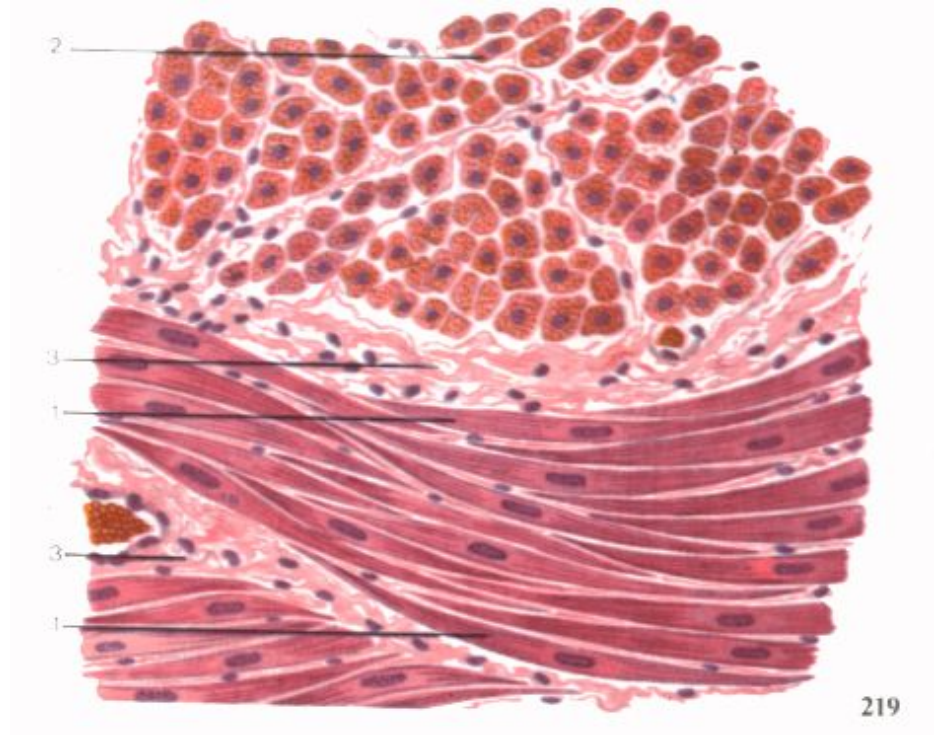
(peristaltics)

(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





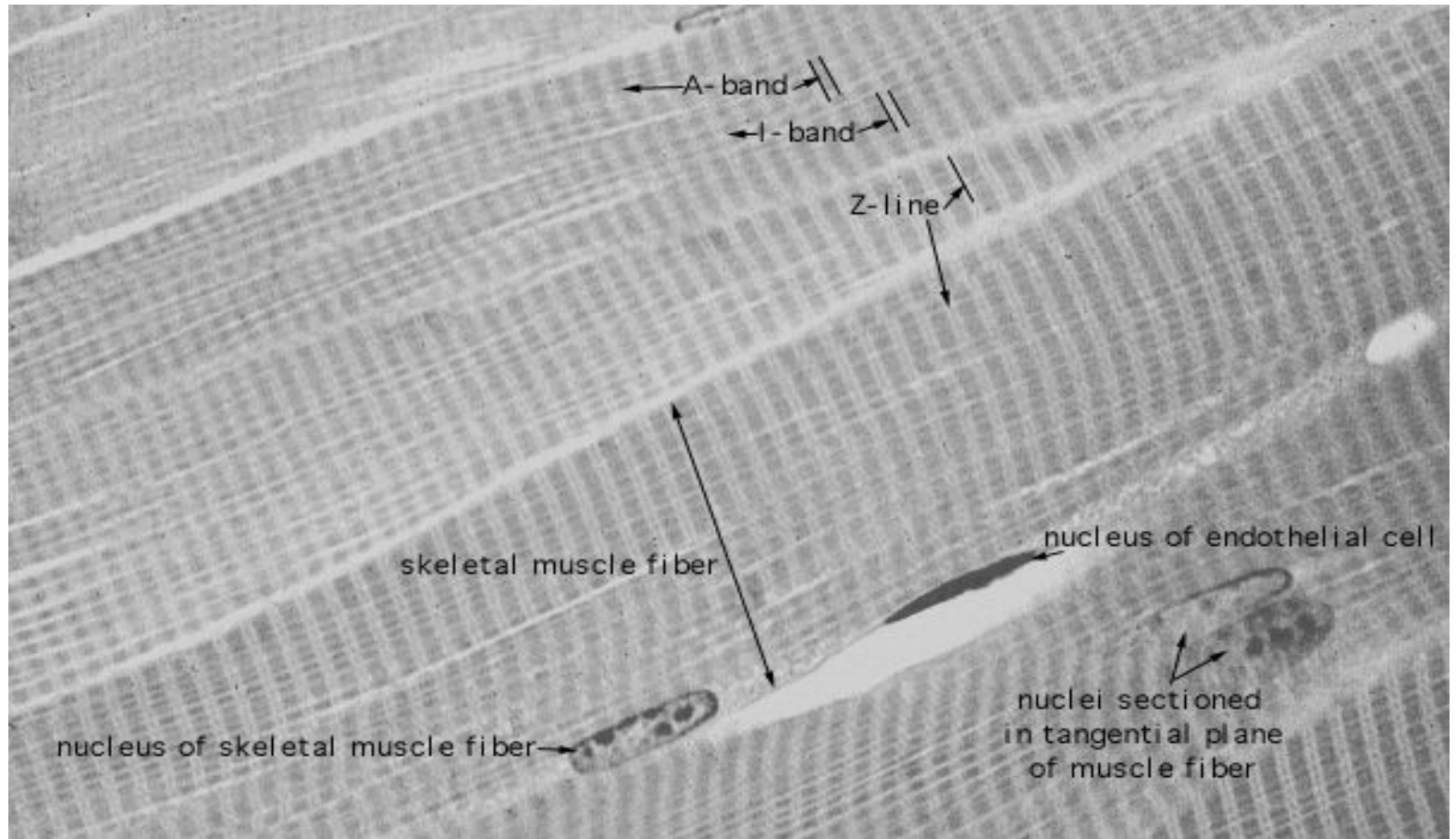
# Origin of smooth muscle

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

# Striated muscles

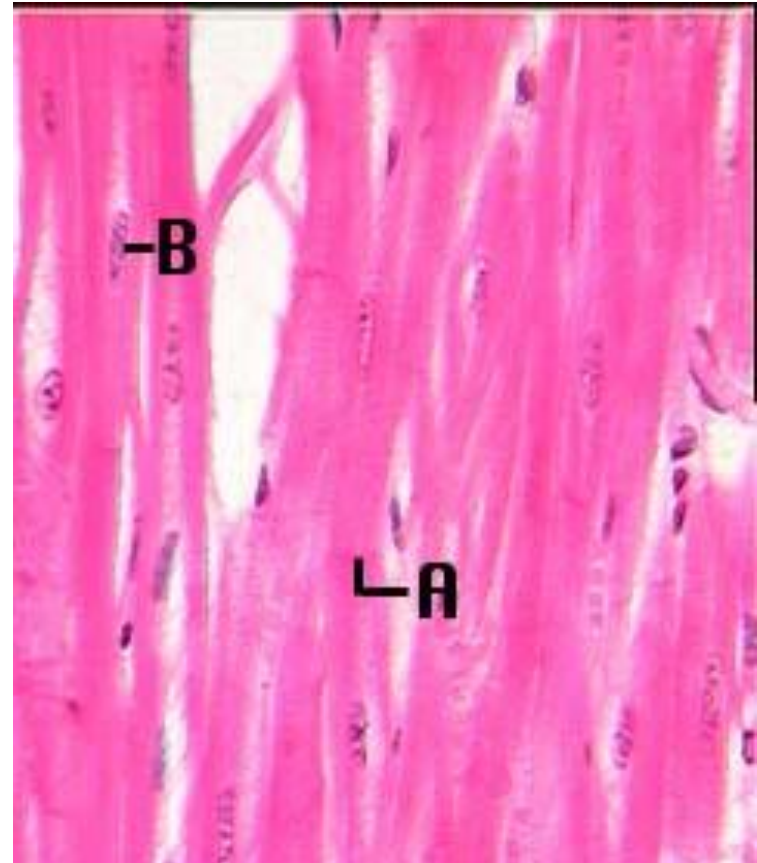


**See:** regular organization of the myofibrils gives rise to the *cross-striation*, which characterises skeletal and cardiac muscle.



# CARDIAC MUSCLE

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



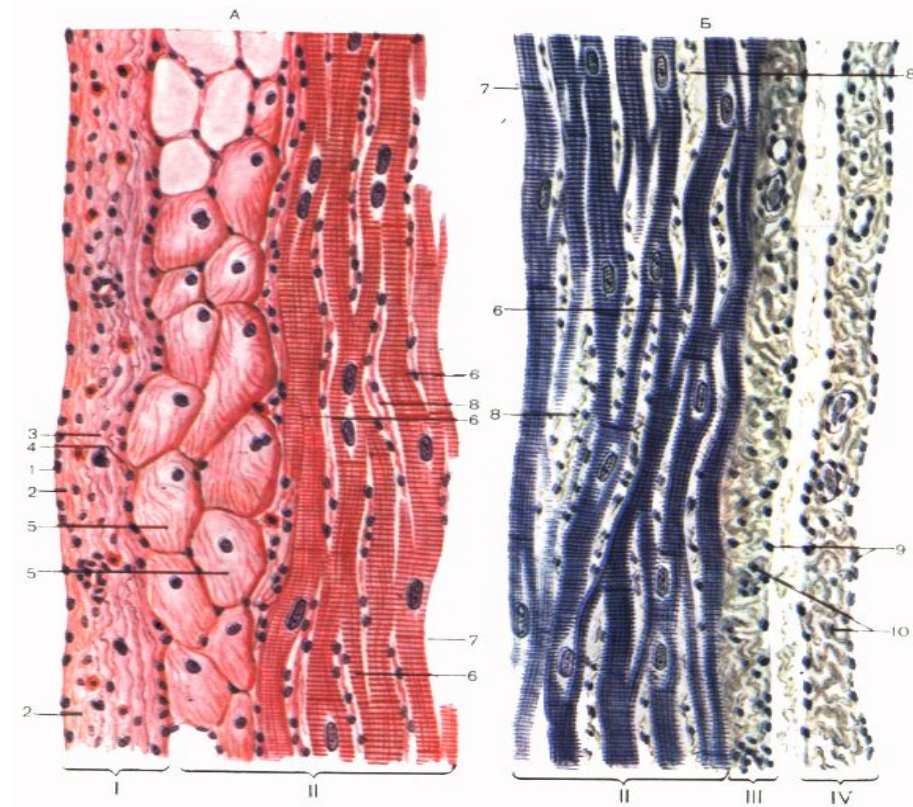
# Cardiac muscle cells:

3 types:

- **Contractile,**
- Conducting
- Secretory

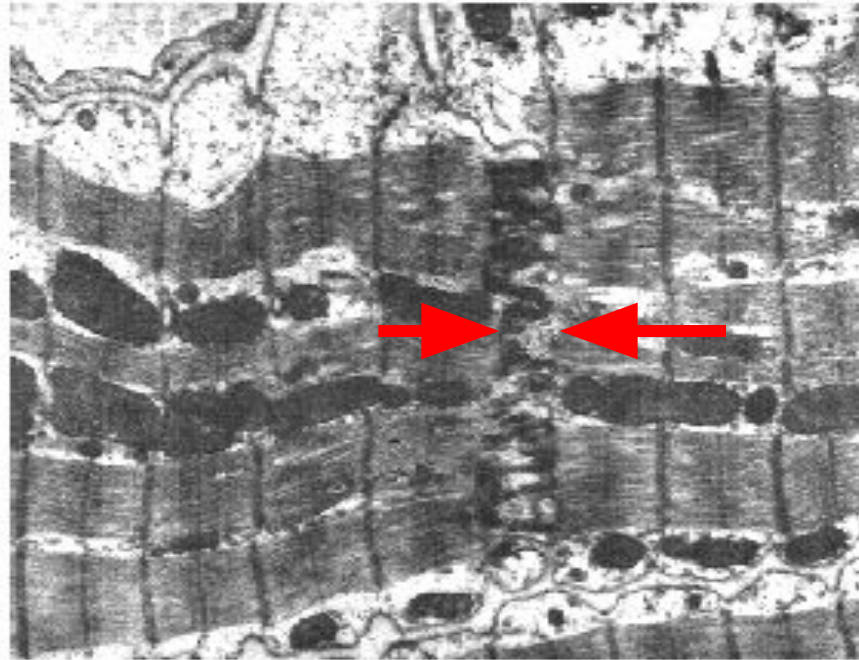
# CARDIAC MUSCLE

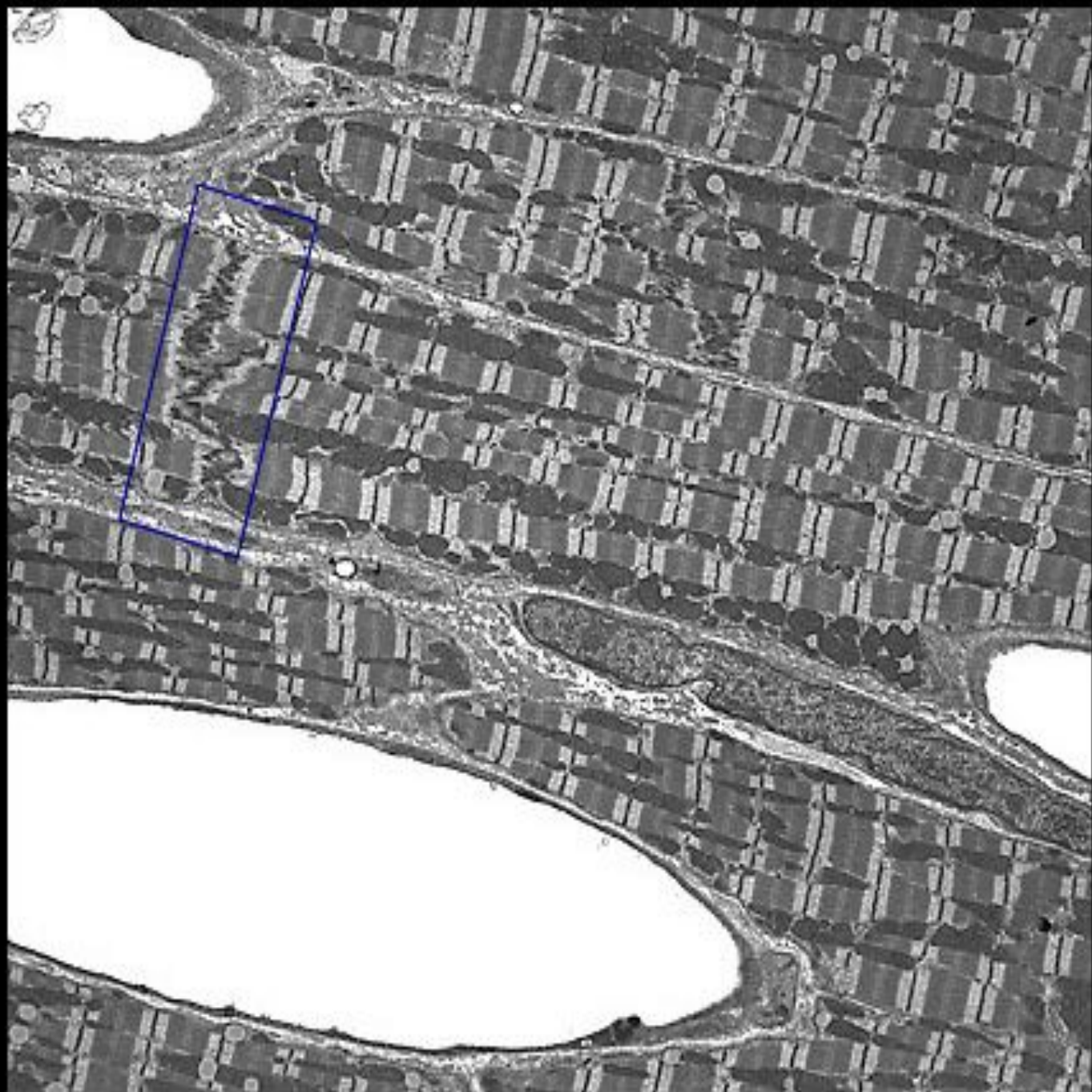
cardiac muscle cells are cylindrical,  
connect end-by-end,  
and form “**functional fiber**”, which  
often branch at acute angles.



# CARDIAC MUSCLE

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

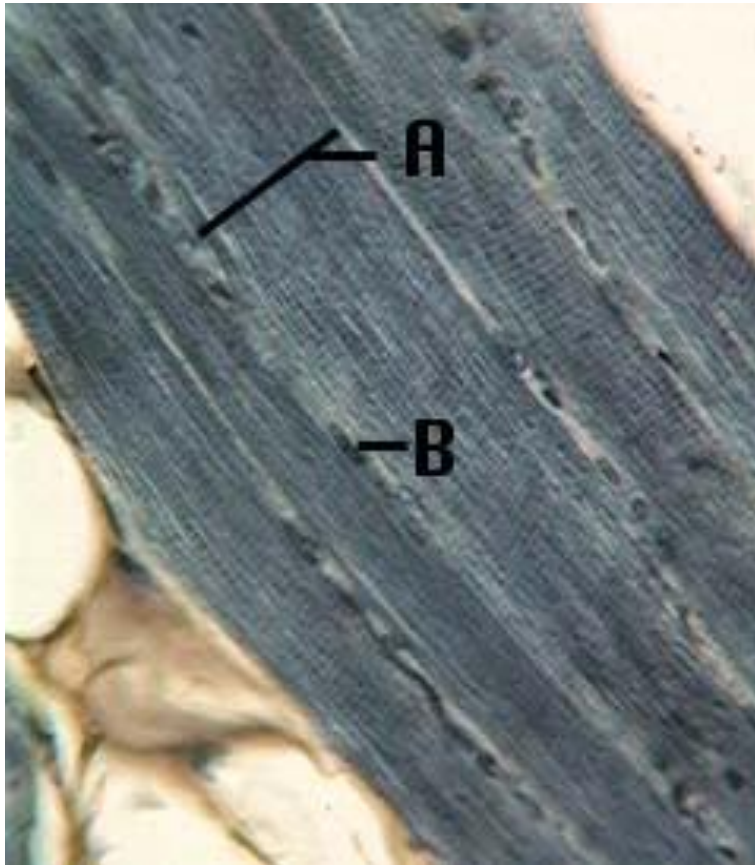






# **SKELETAL MUSCLE**

# Location



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

# SKELETAL MUSCLE

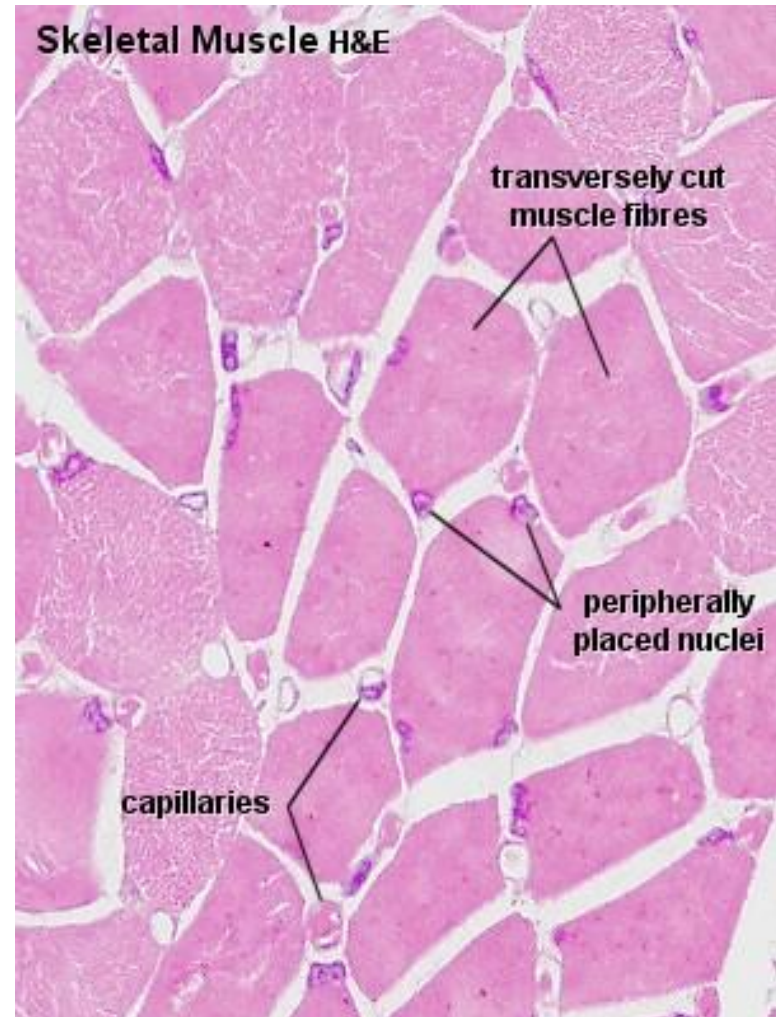
- --- is innervated by the *somatic nervous system* – ***voluntary!!***
- ---- consists of very long tubular cells (also called **muscle fibres**).

# 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  $\mu\text{m}$ .**

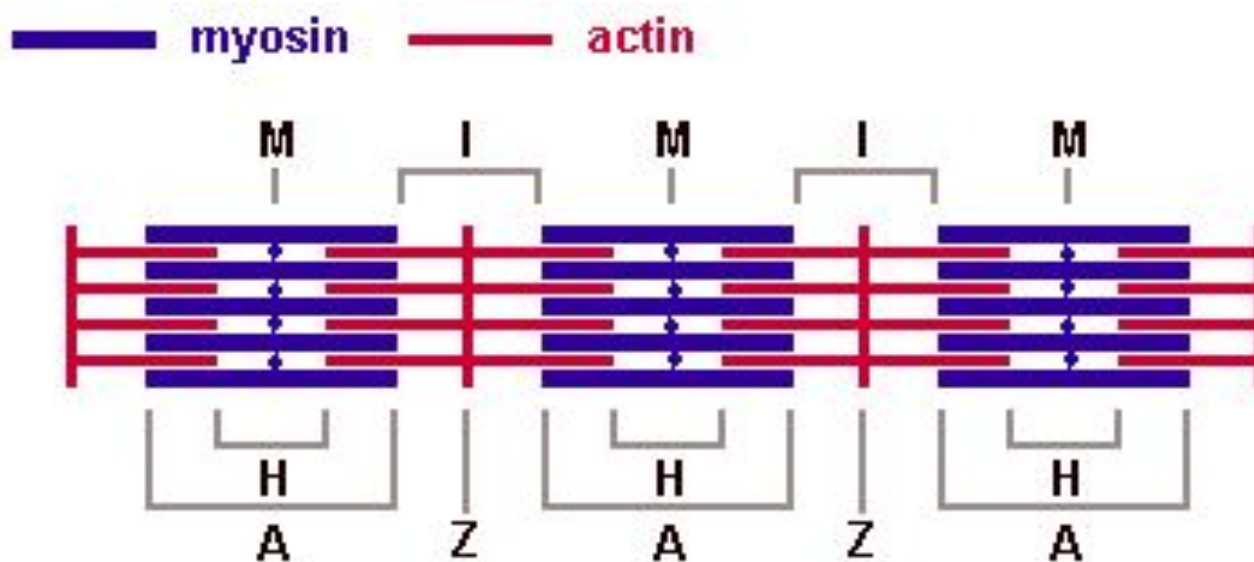
# Nuclei:

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



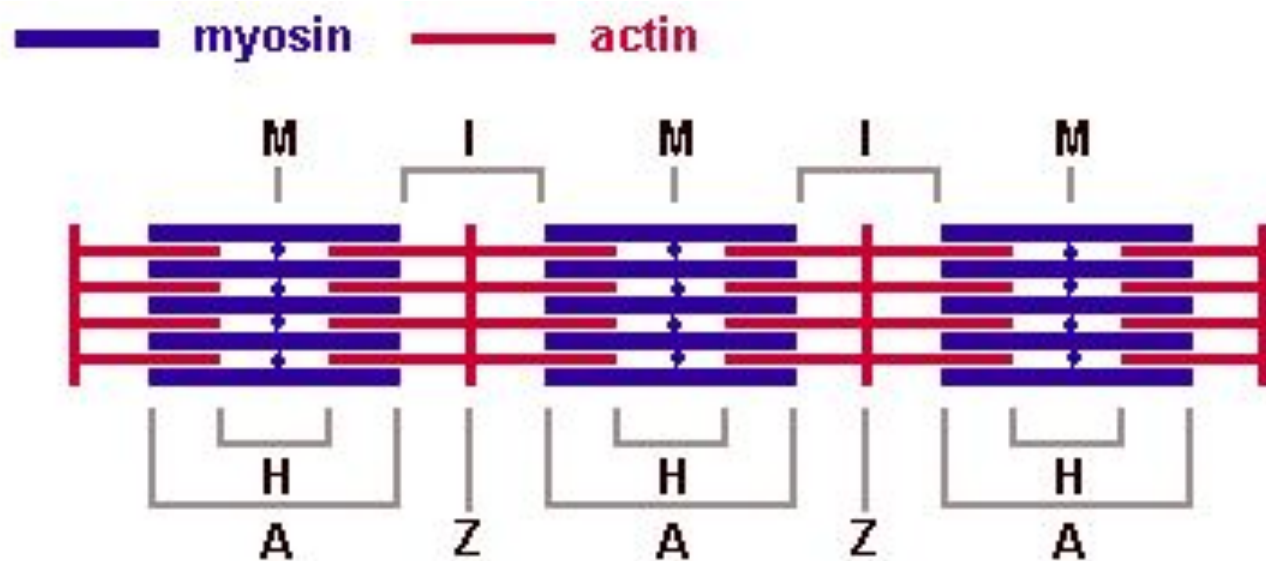
# Myofibrils

## Mechanism of contraction: Sliding filaments model



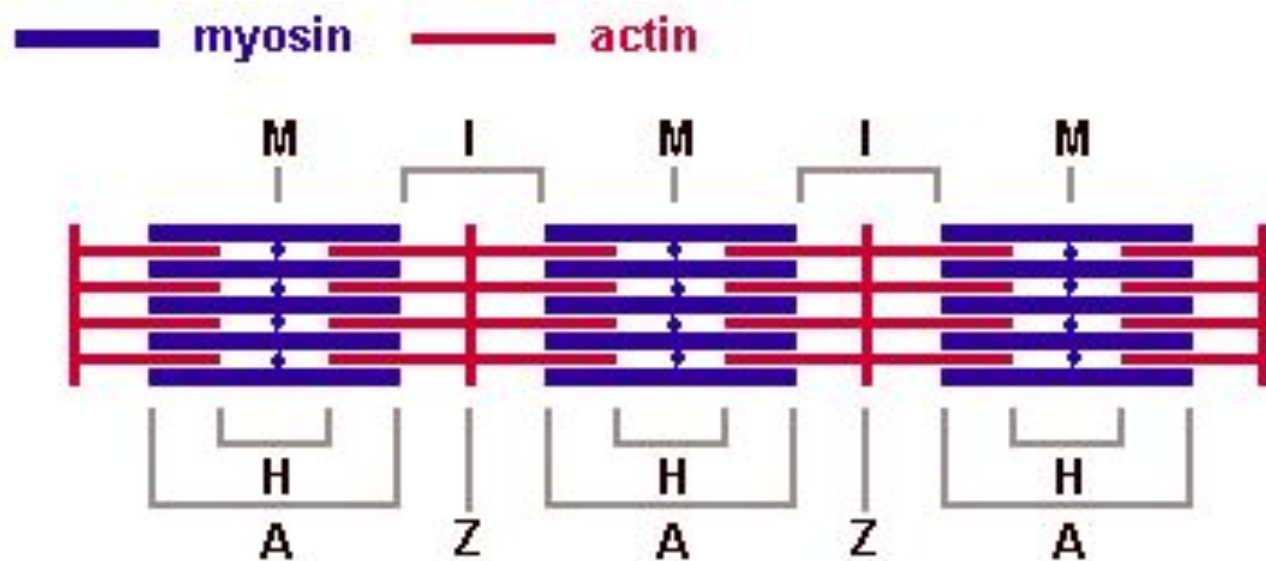
Bands and lines in the contractile apparatus of skeletal muscle

- **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**

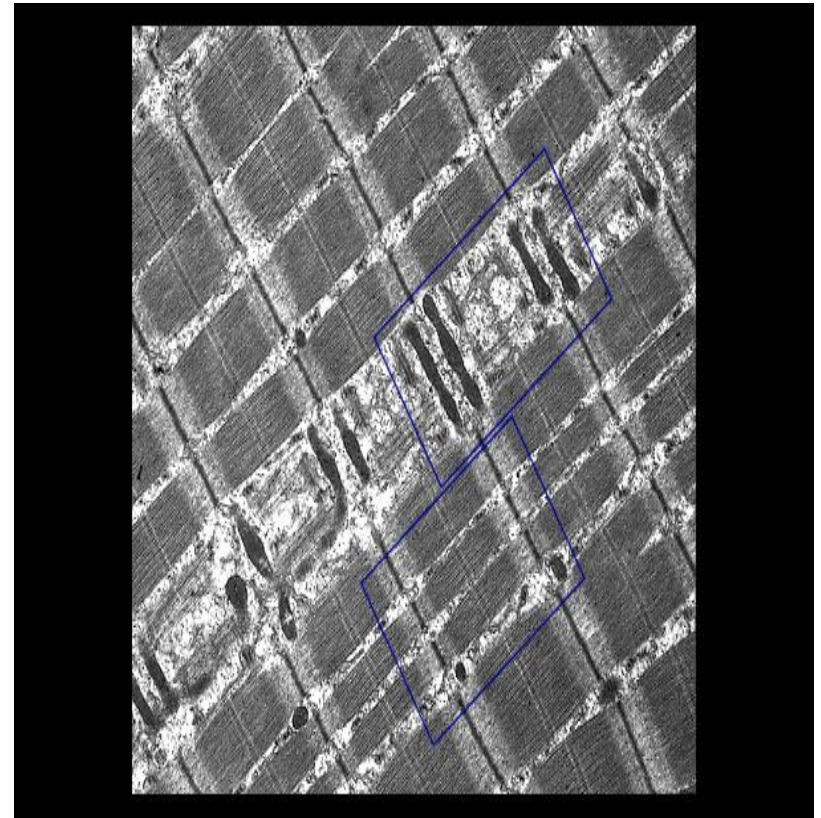




**Bands and lines in the contractile apparatus of skeletal muscle**

# 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.