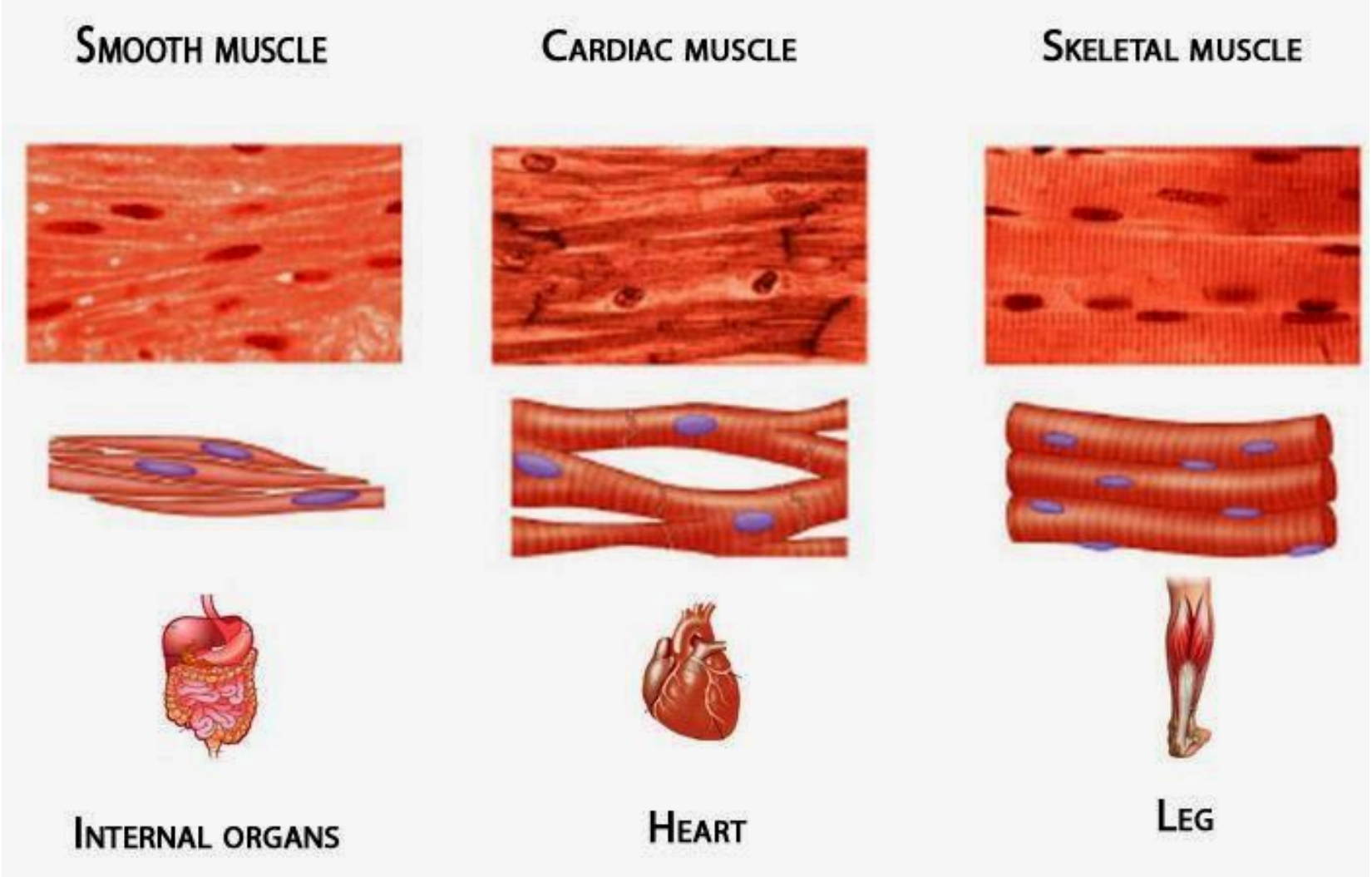
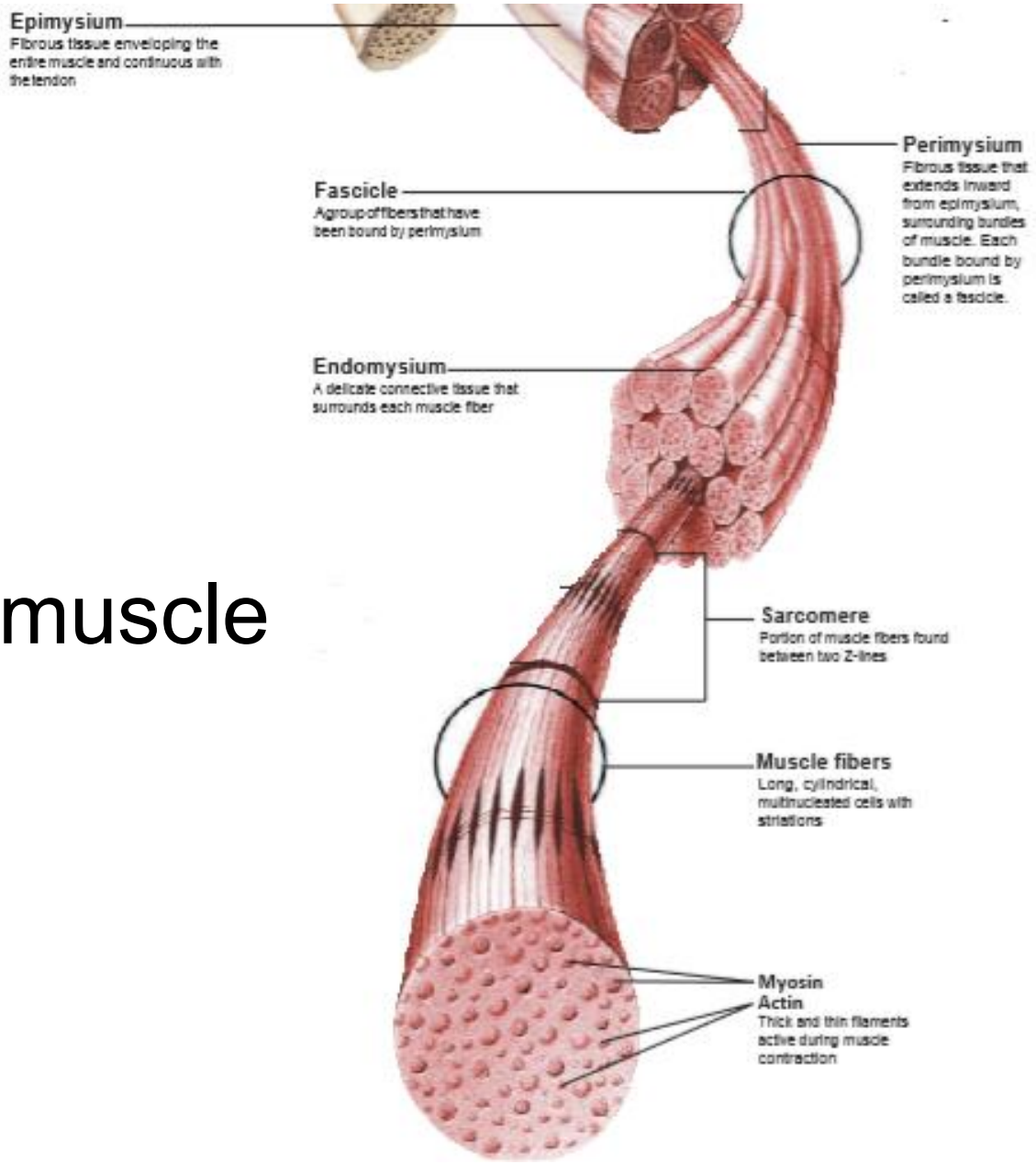


Muscle fysiology

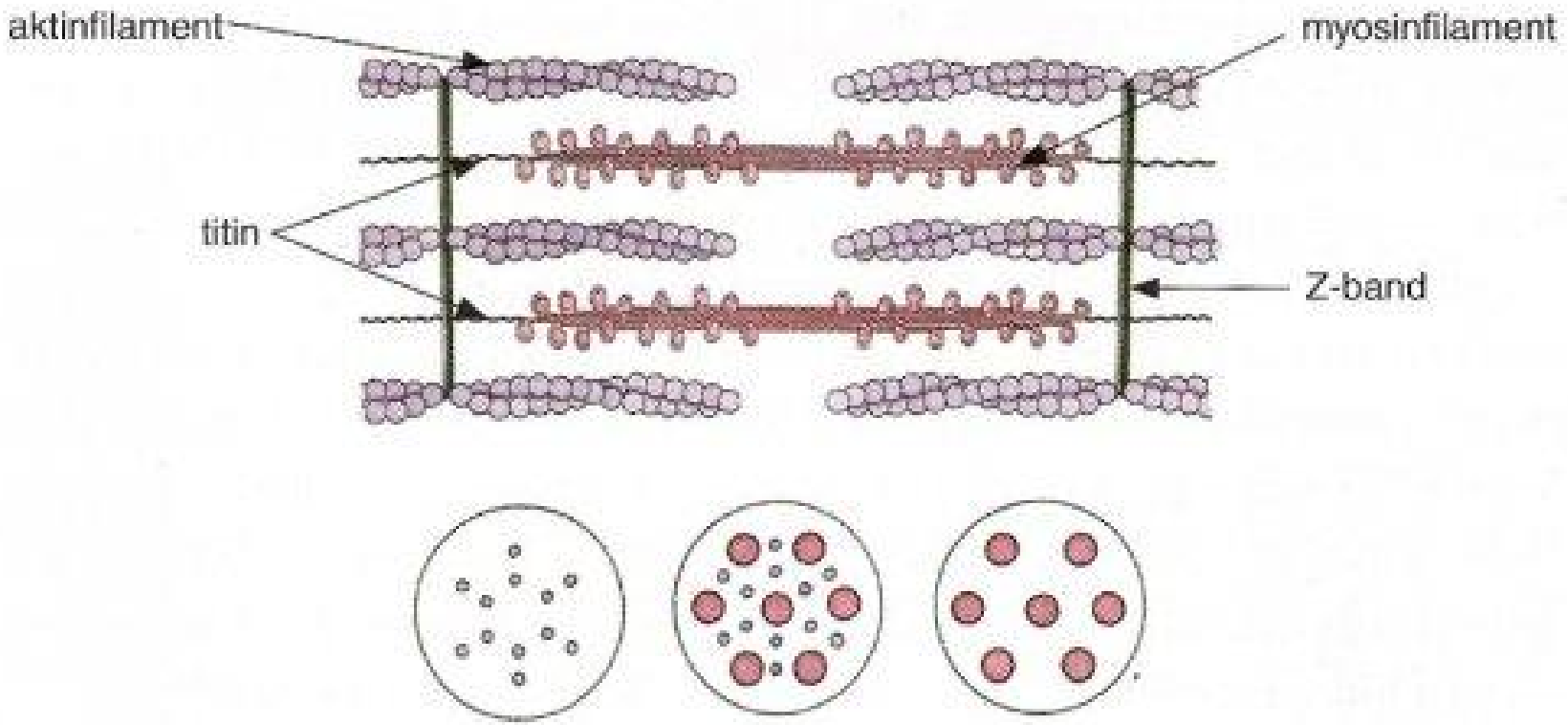
Three types of muscle



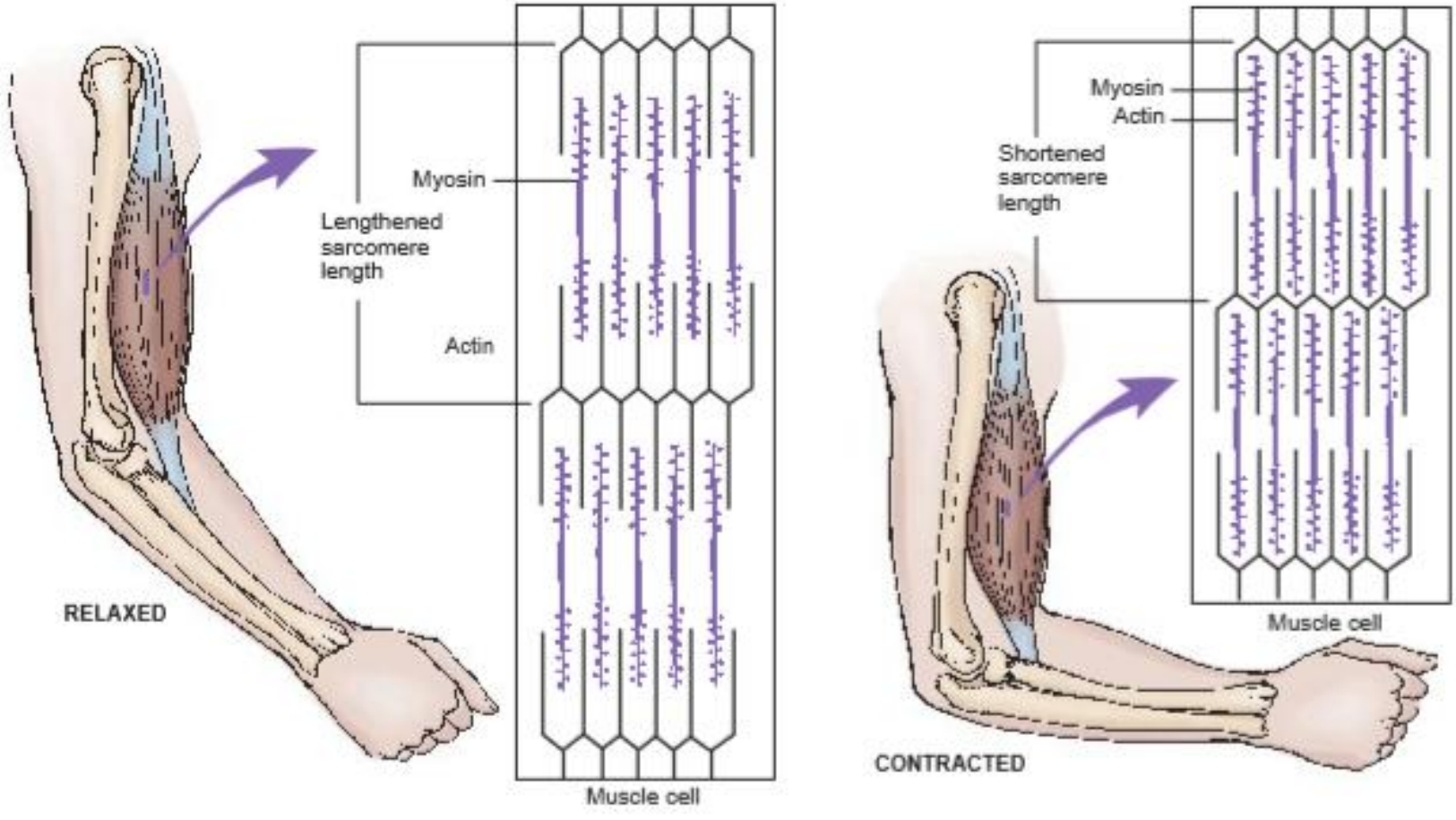
Structure of the muscle



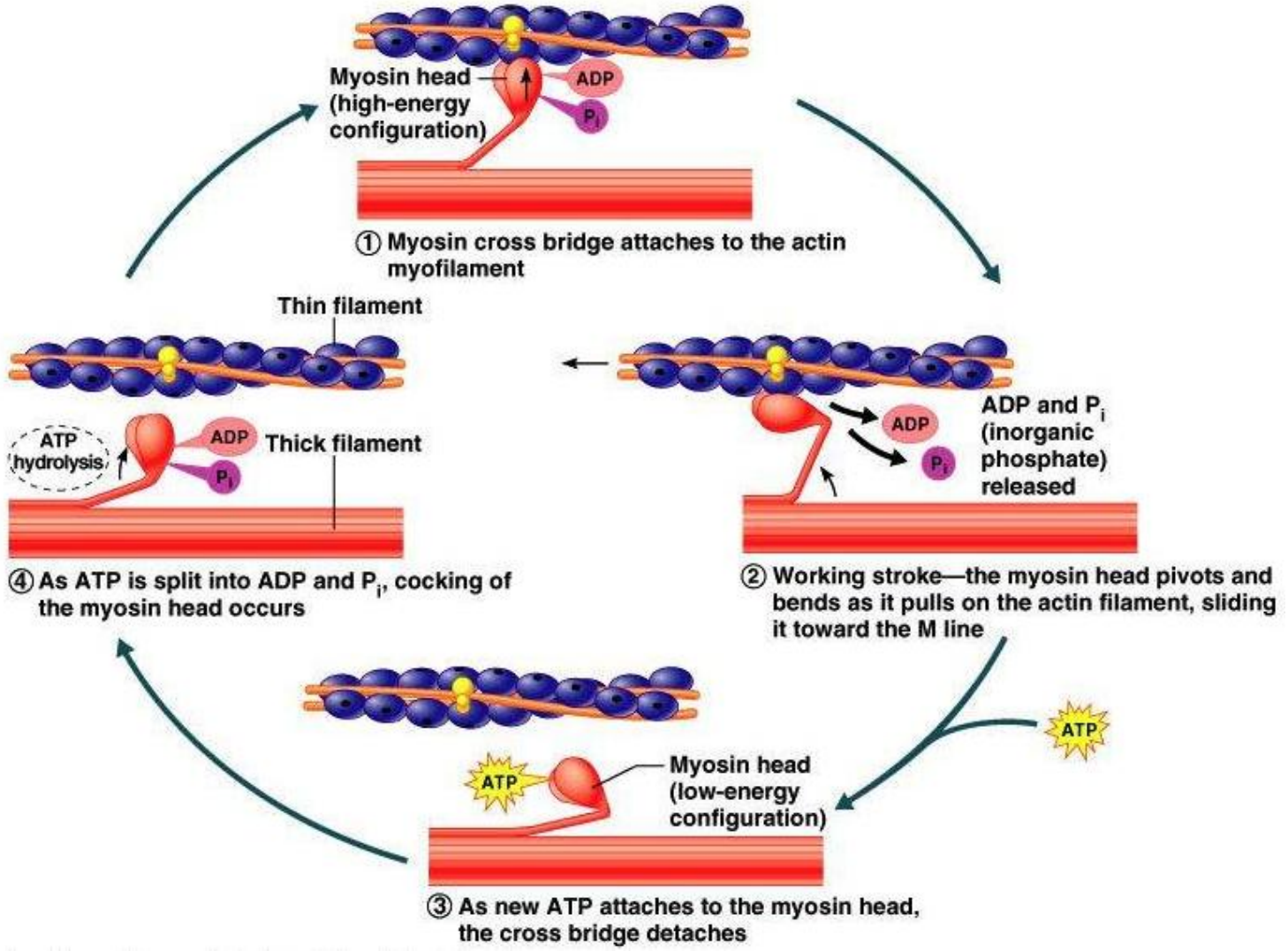
The sarcomere



Sliding-filament theory



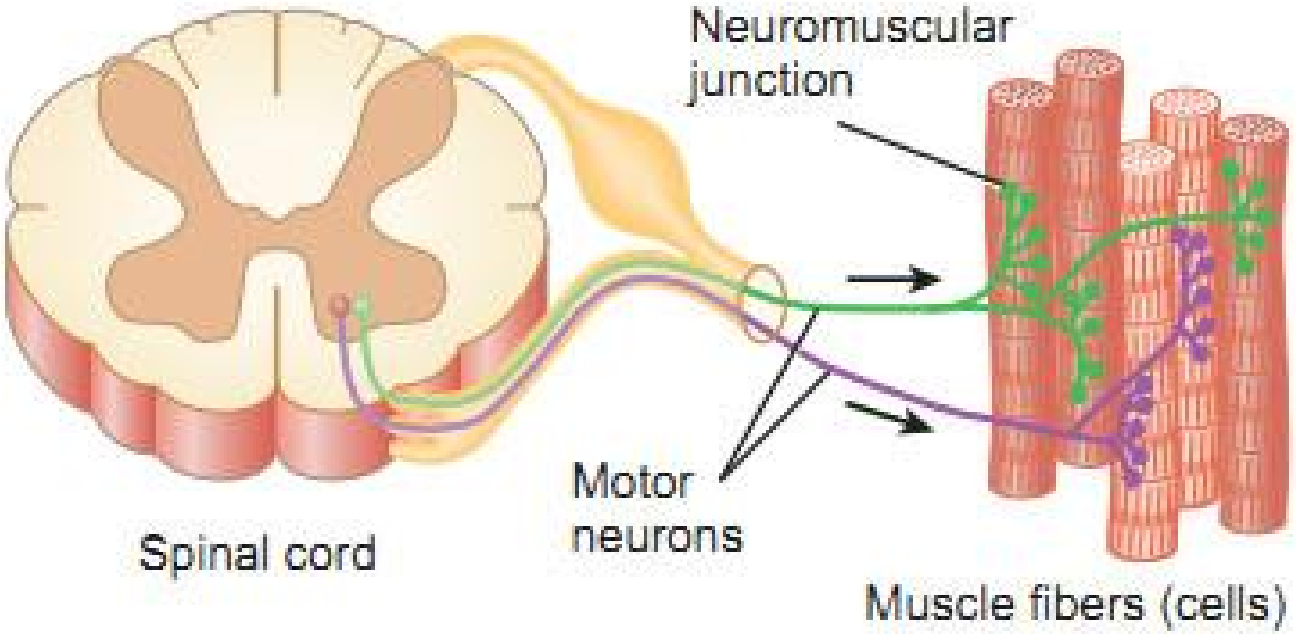
The cross bridge cycle



The cross bridge cycle - explained

- Step 1: The myosin head binds to actin. Pi is released
- Step 2: The angle of the myosin head changes ("the stroke") and the actin filament is drawn towards the center of the sarcomere. ADP is released from the myosin.
- Step 3: A new ATP molecule attaches to the myosin head. The myosin head is released from actin
- Step 4: ATP is cleaved to ADP and Pi and the myosin head "flips" back to its original position

A motor unit consists of a somatic motor neuron plus all the muscle fibers it stimulates.



Muscle fiber types

	Type I fibers	Type II a fibers	Type II x fibers
Contraction time	Slow	Moderately Fast	Fast
Resistance to fatigue	High	Fairly high	Moderate
Activity Used for	Aerobic activity	Long-term anaerobic activity	Short-term anaerobic activity
Maximum duration of use	Hours	Less than 30 minutes	Less than 5 minutes
Power produced	Low	Medium	High
Mitochondrial density	Very High	High	Medium
Capillary density	High	Intermediate	Low
Oxidative capacity	High	High	Moderate



Fibre type distribution

- The muscles of the body have different distribution of Type 1 and Type 2 fibers

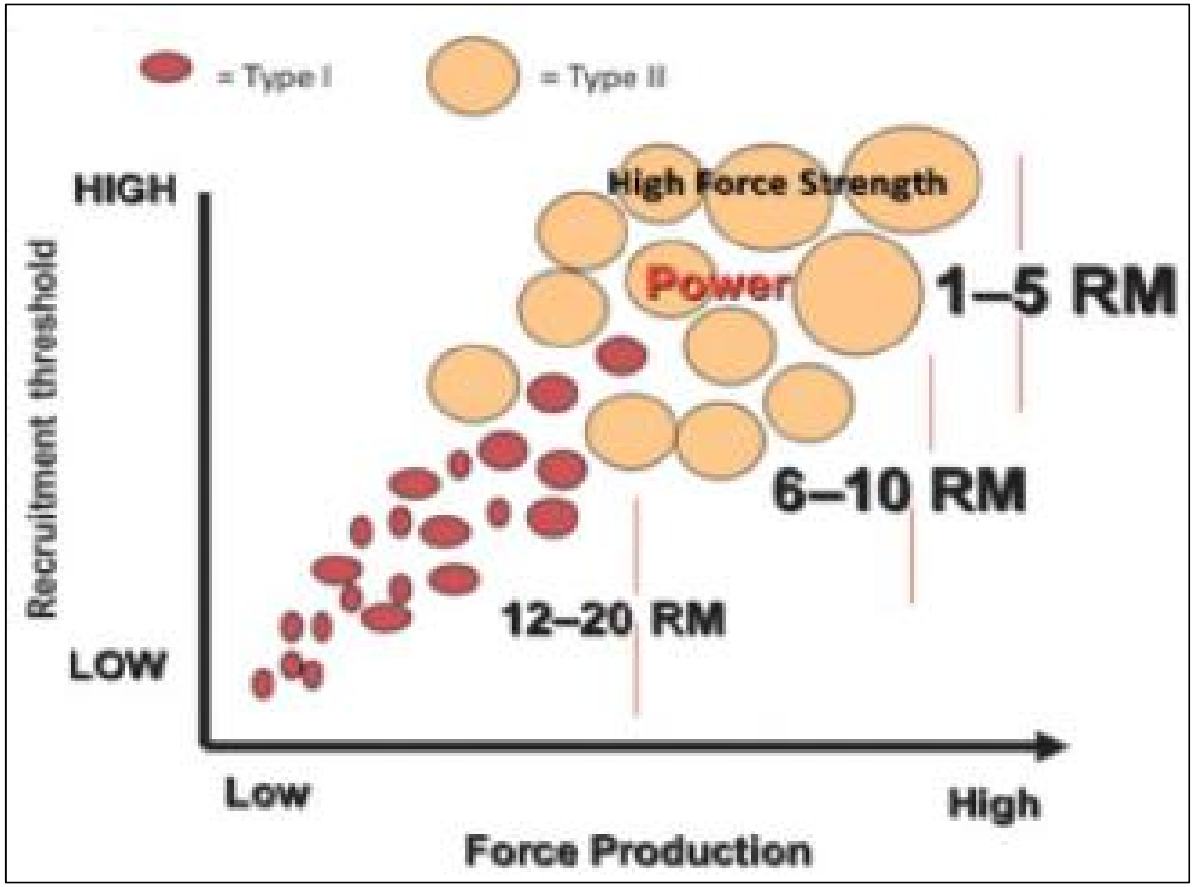
- High amount of type 1 in postural muscles (Gastrocnemius, Erector Spinae) and trunk muscles

- A large proportion of Type 2 fibers in the arms and legs

- The distribution of muscle fibers is determined from birth, but the properties can be affected by exercise



Henneman's size principle



Henneman's size principle

- Smaller, low-threshold, slow motor units are recruited initially during movement, followed by progressively larger, higher-threshold motor units as the force demands increase for a given task

- 2 primary factors are responsible for the extent of muscle recruitment:
  - level of muscle force
  - rate of force development

- heavy weight training: all motor units are recruited

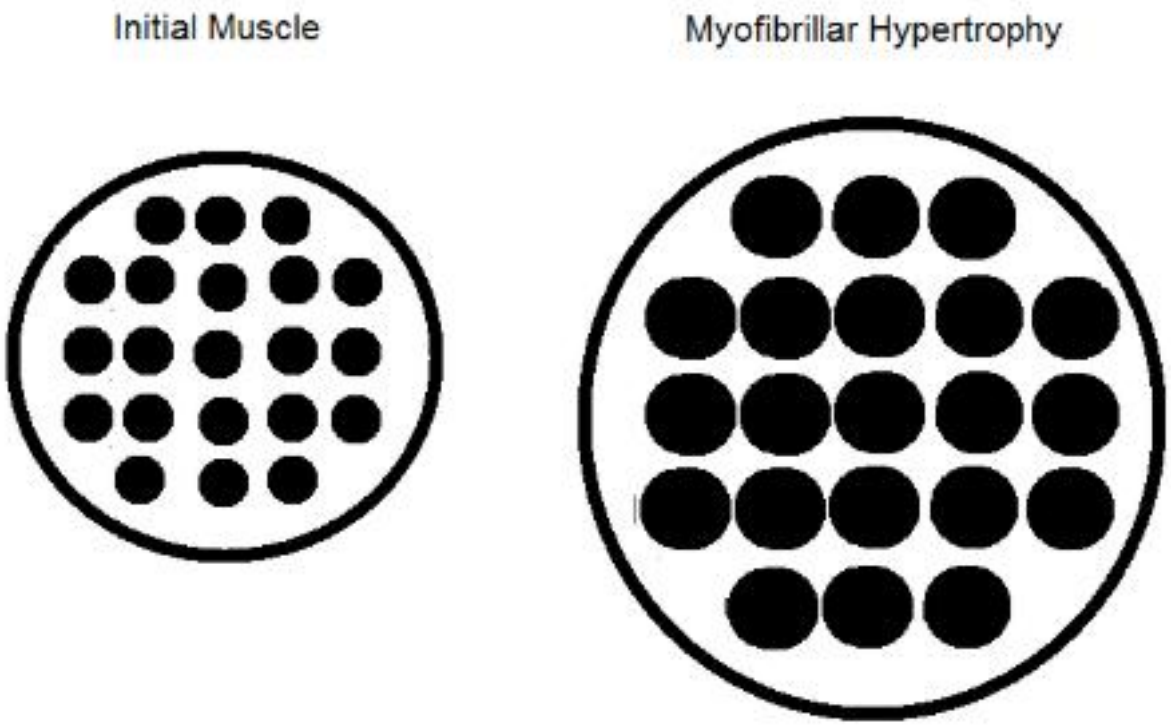
- movements with maximum power development: all motor units are recruited

Factors affecting the muscles capacity to develop force

- Cross-sectional area (CSA)
- Muscles length
- Type of action

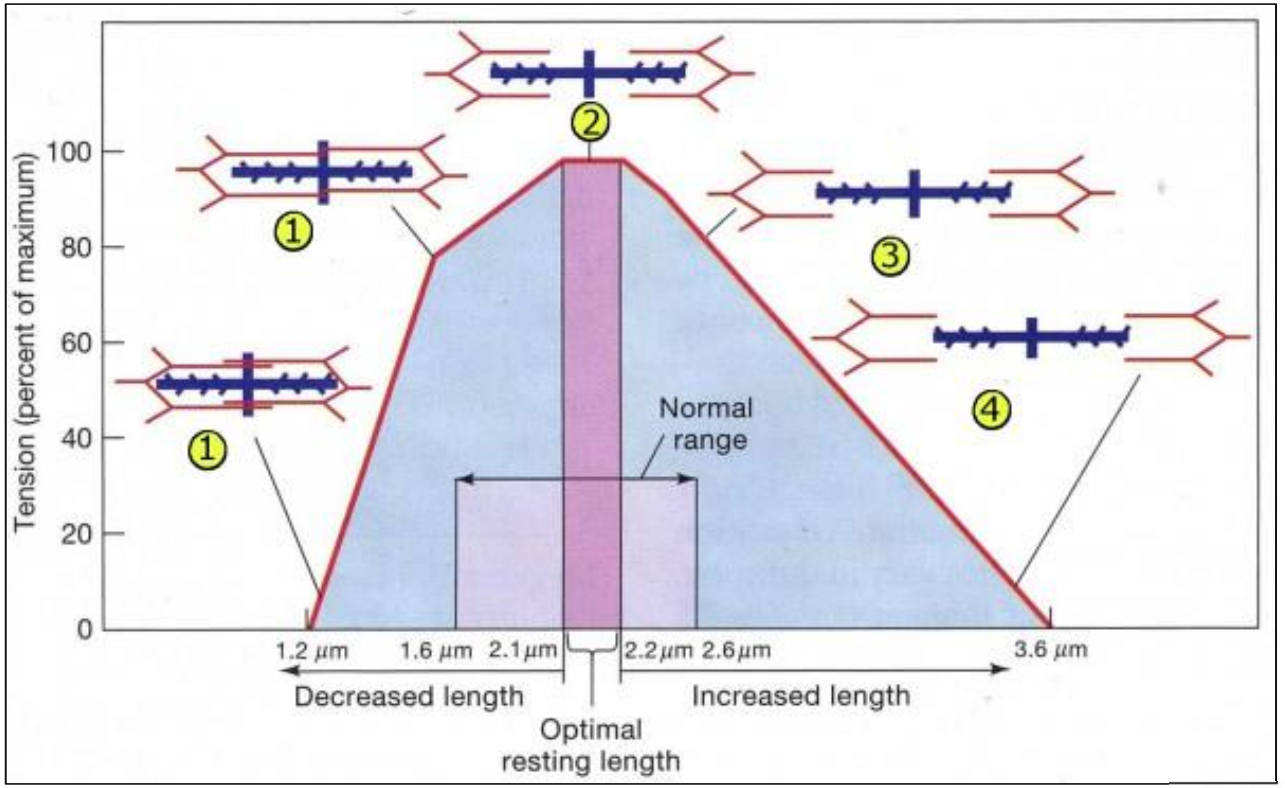


Cross-sectional area (CSA)



Muscle length

- The muscle is strongest at a certain length, when maximum number of cross-bridges can beformed
- For longer and shorter lengths: the force decreases



Type of action

- The capacity to generate force depends on the type of action:

  Concentric <Isometric (static) <Eccentric

- Maximal eccentric weight is 1.4 times the maximal concentric weight in the same muscle group/movement

