Neuro-electrical Muscle Stimulation

ELSEVIER
SAUNDERS

TEXTBOOK OF

Medical Physiology

ELEVENTH EDITION

GUYTON & HALL

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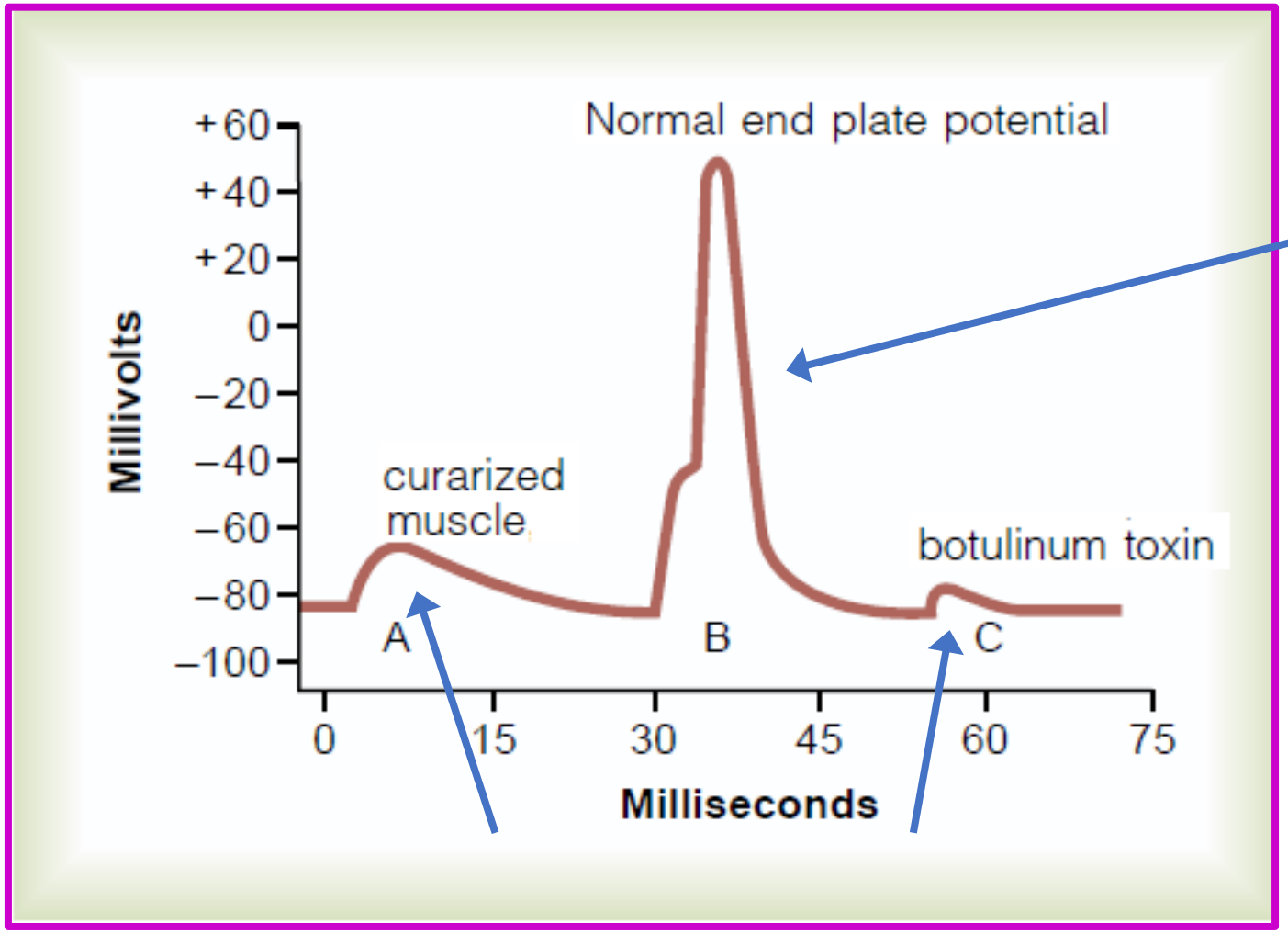
Recap: **Only End-plate Potential having normal amplitude (+60 mV) contracts a Muscle**



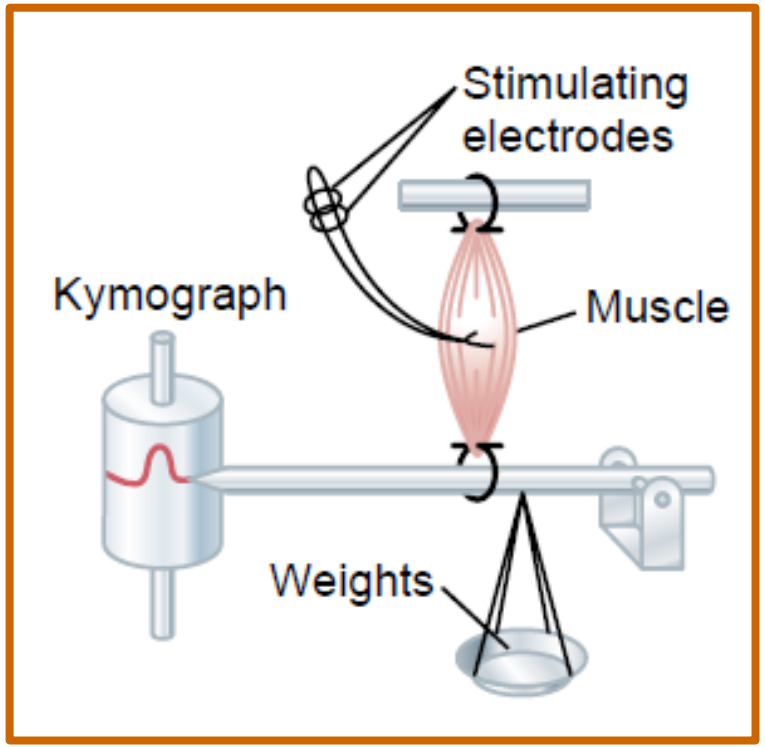
Muscle Contracts

No Muscle Contraction

2 types of Muscular activity

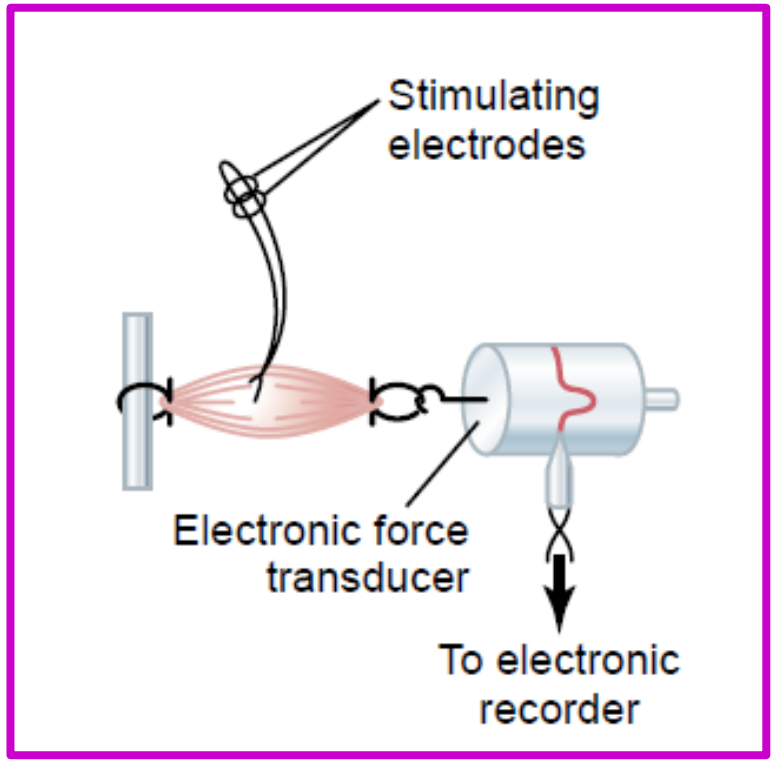
Isotonic Activity

Isotonic: Muscle pulls with constant force (tone)



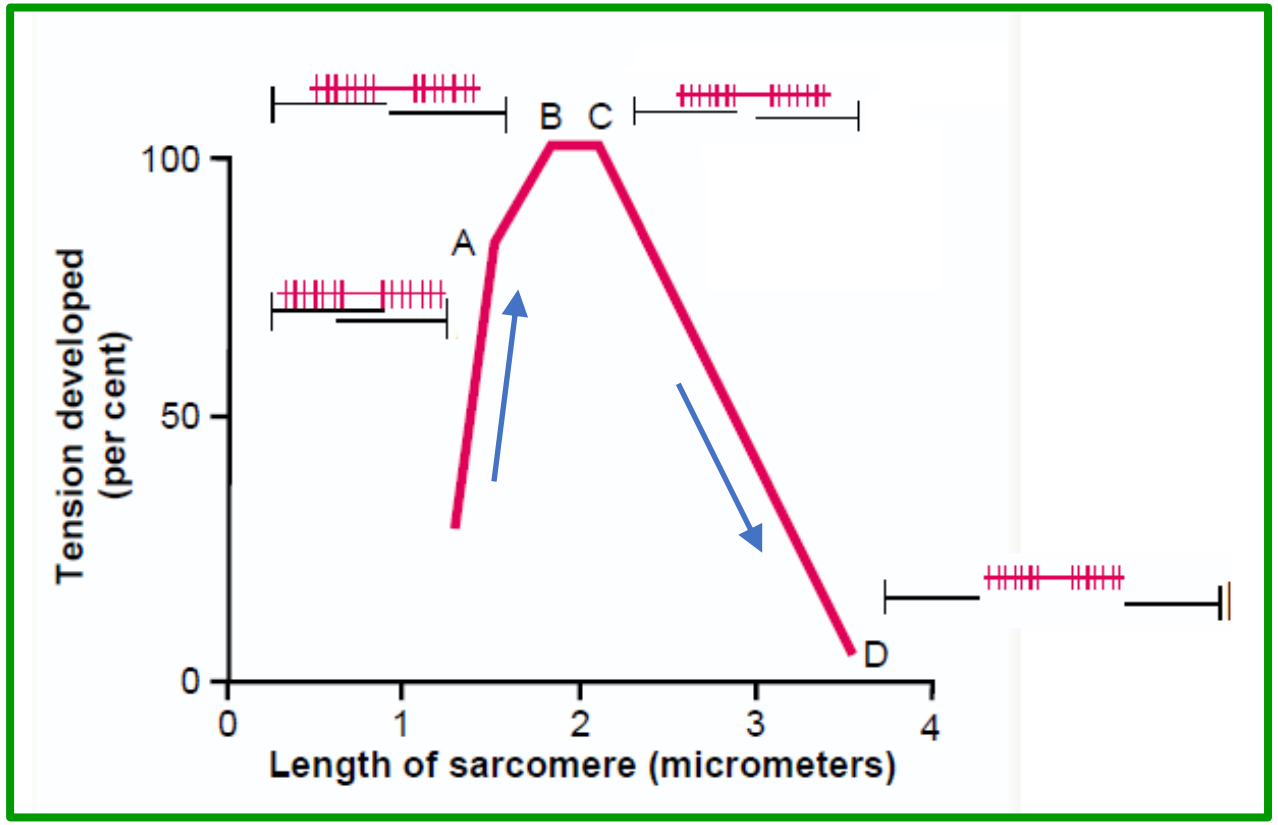
Isometric Activity

Isometric: Muscle pulls with constant length (metric)



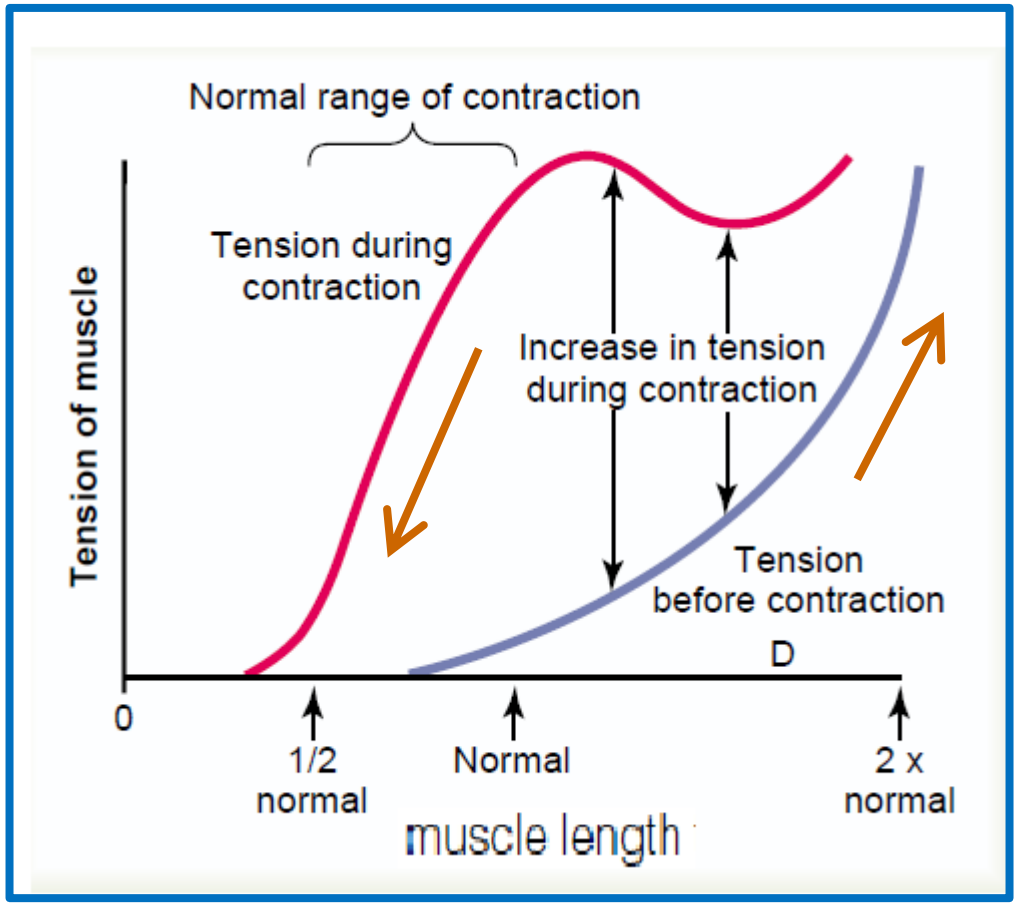
Muscle Relaxation

← Length - Tension Diagram : Optimality



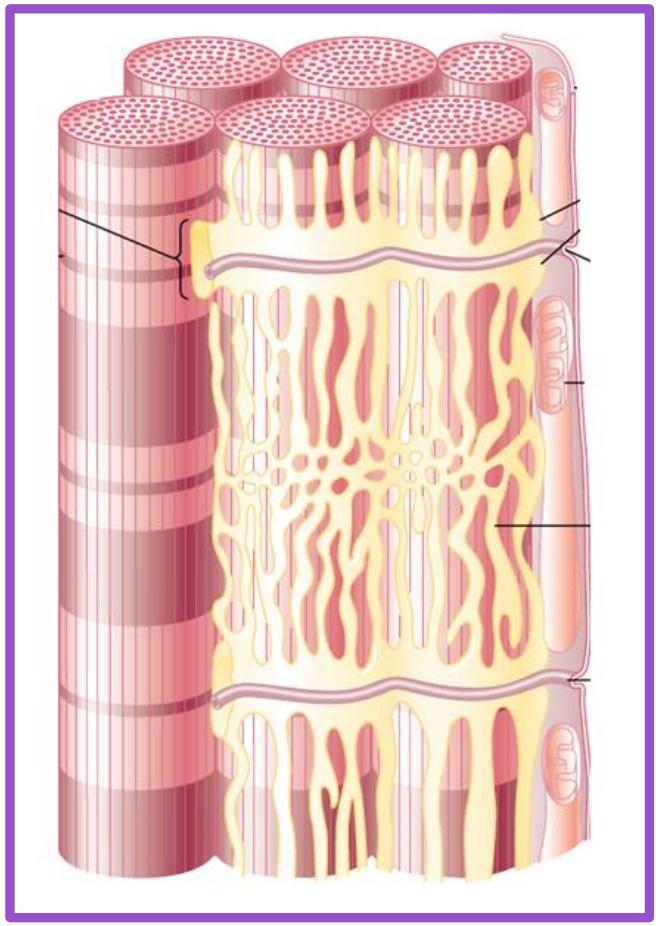
Expansion

Hysteresis-type Dynamics: Relax/Contract Cycle →

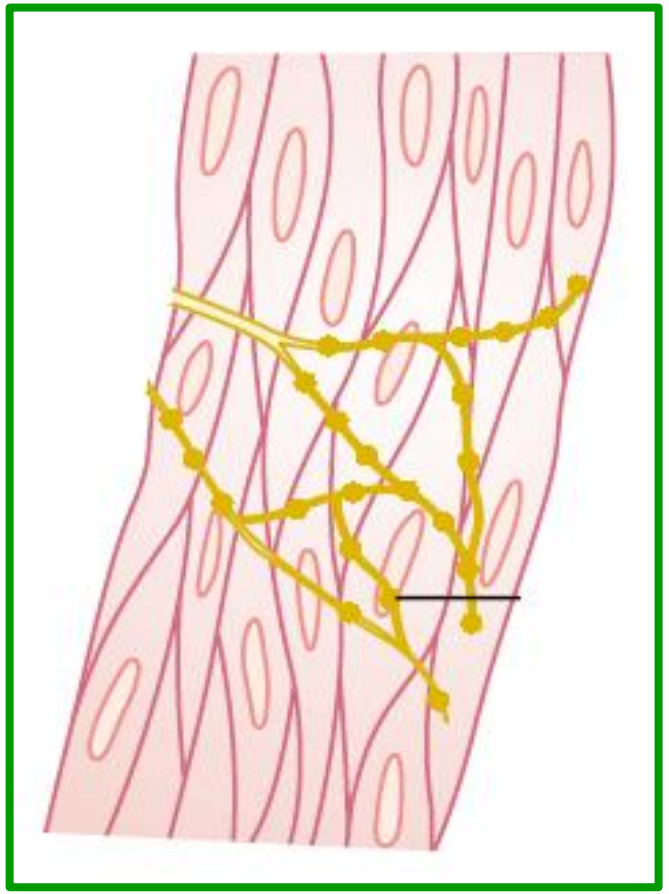


Three Muscle Systems in Comparison

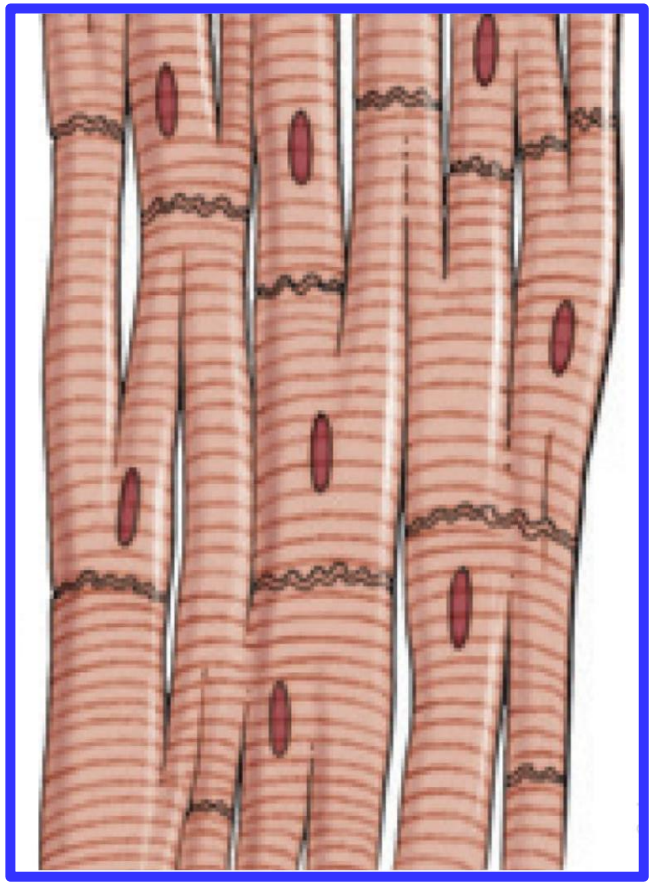
Skeletal



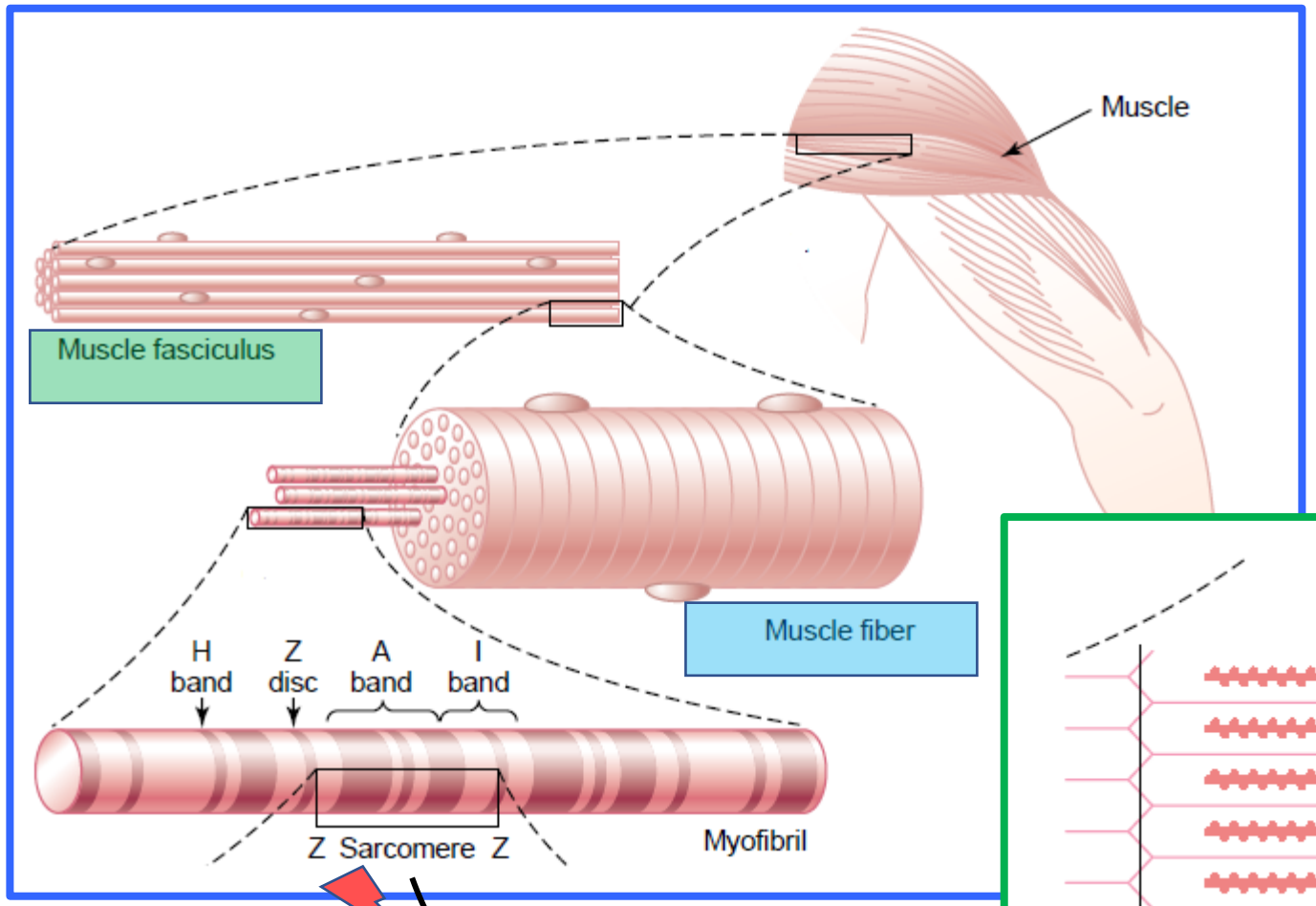
Smooth (Organ-based)

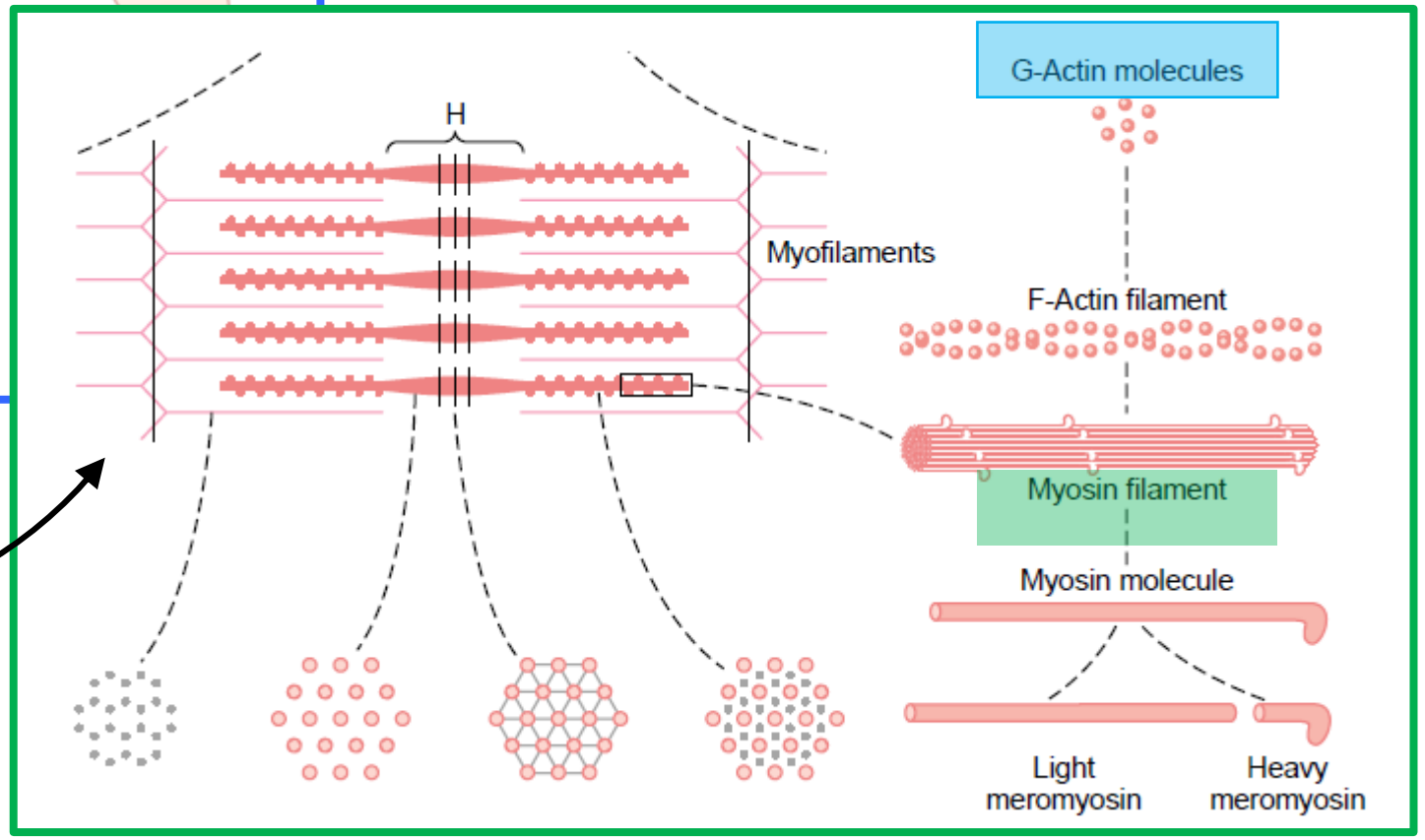


Heart

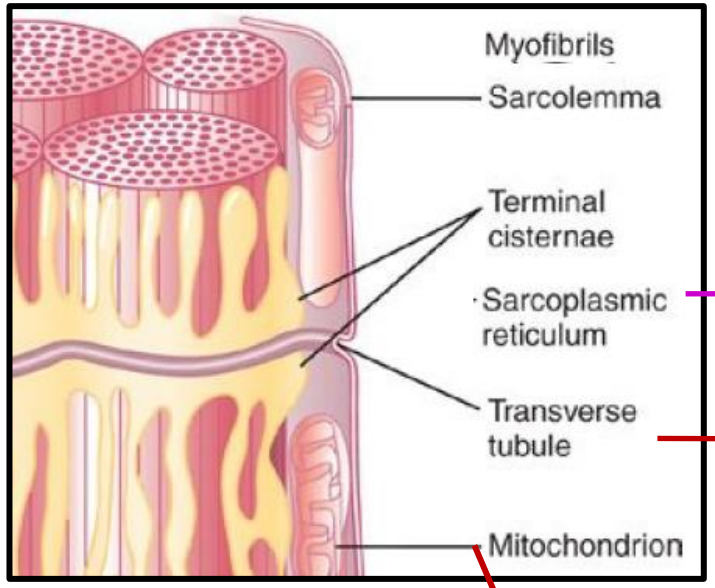


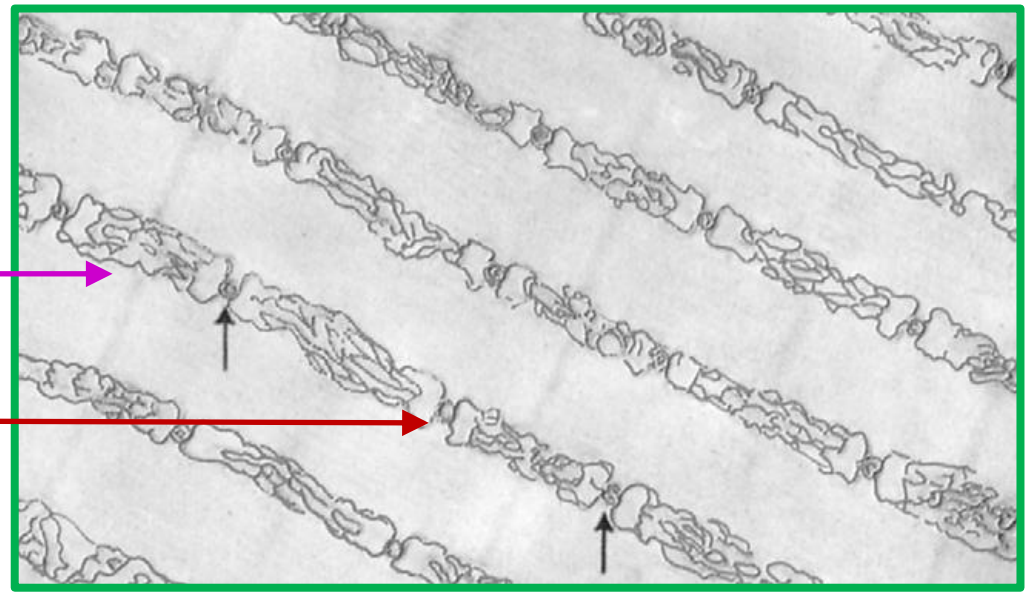
Micro-organization of Skeletal Muscle

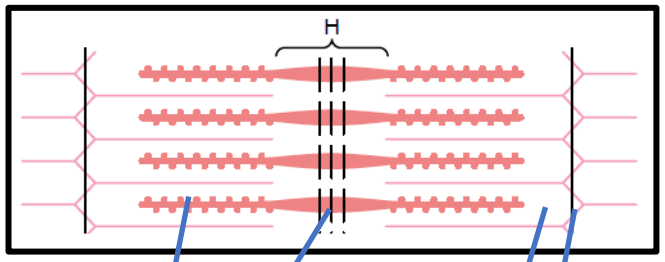


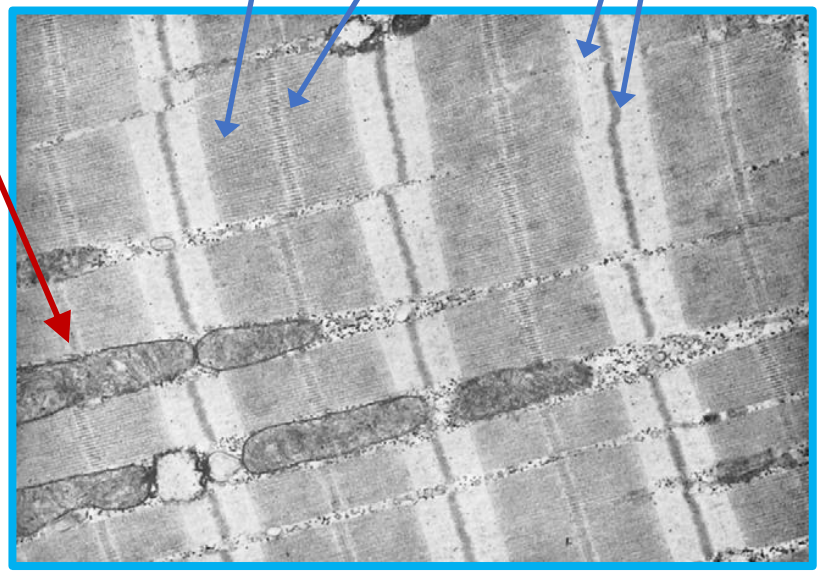


Myofibril Structure





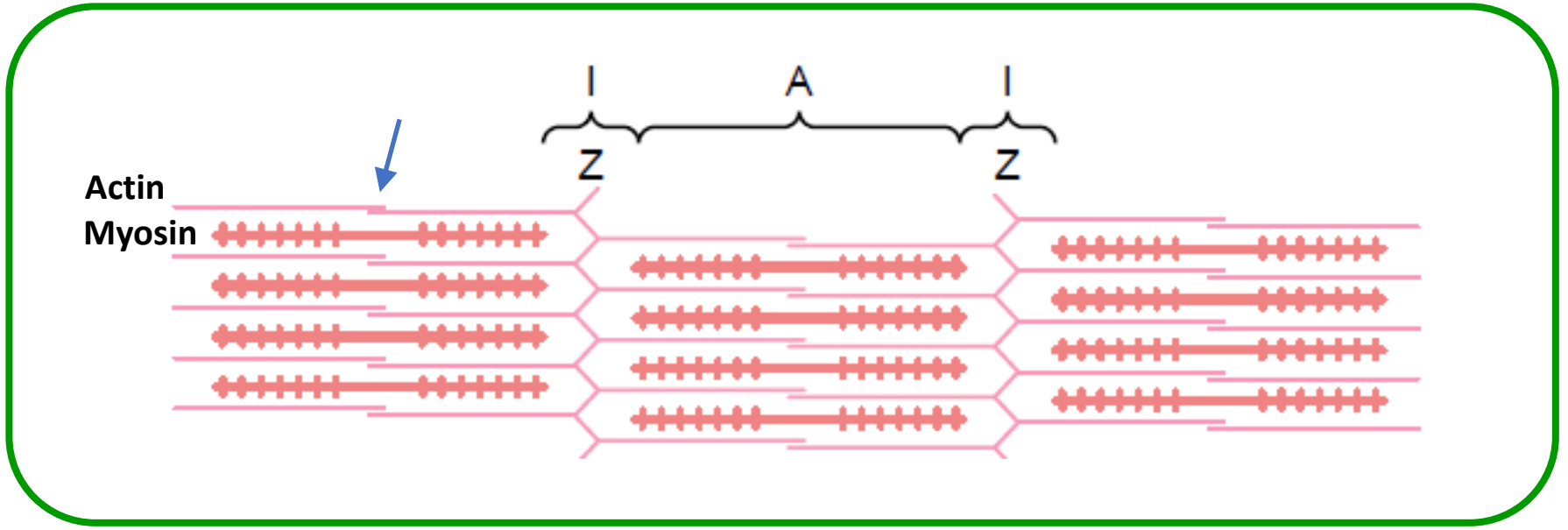




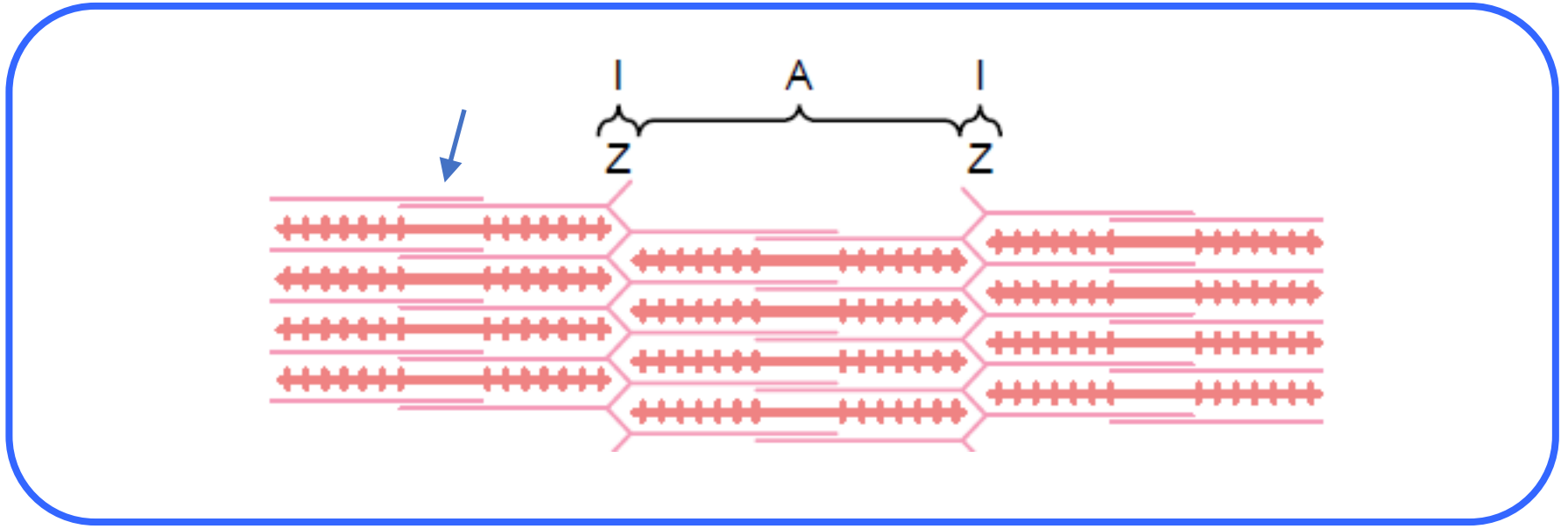
Electron Microscopy

Myofibril Dynamics

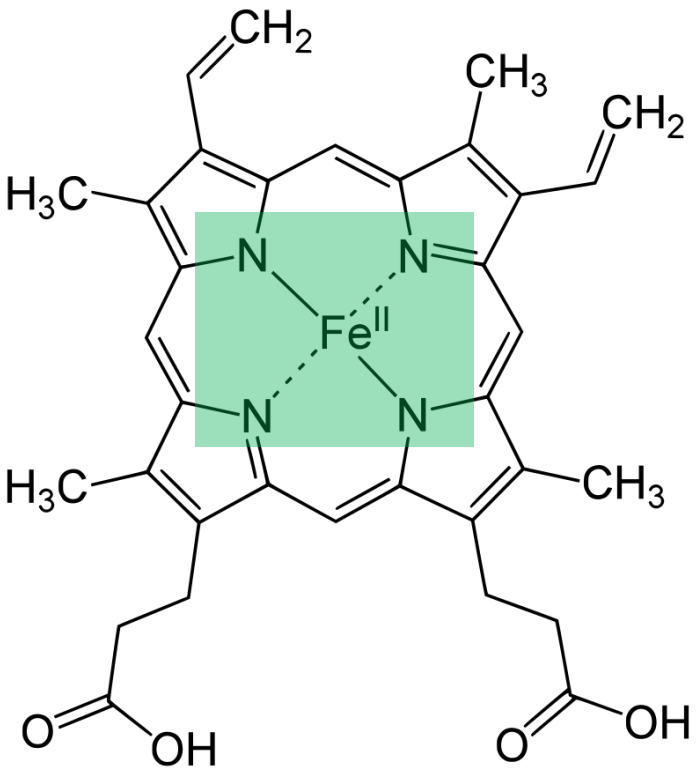
RELAXED

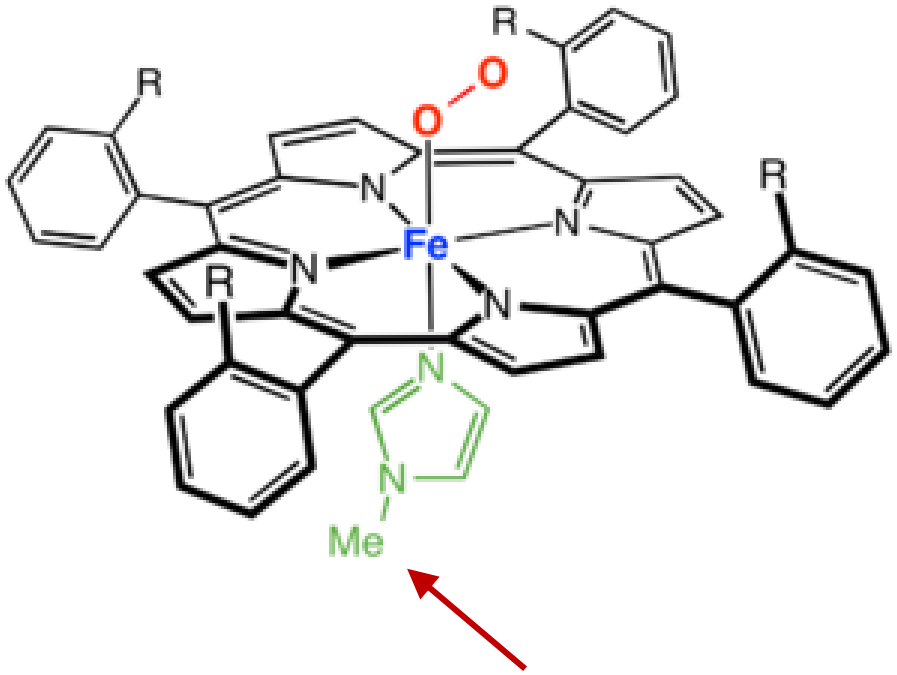


CONTRACTED

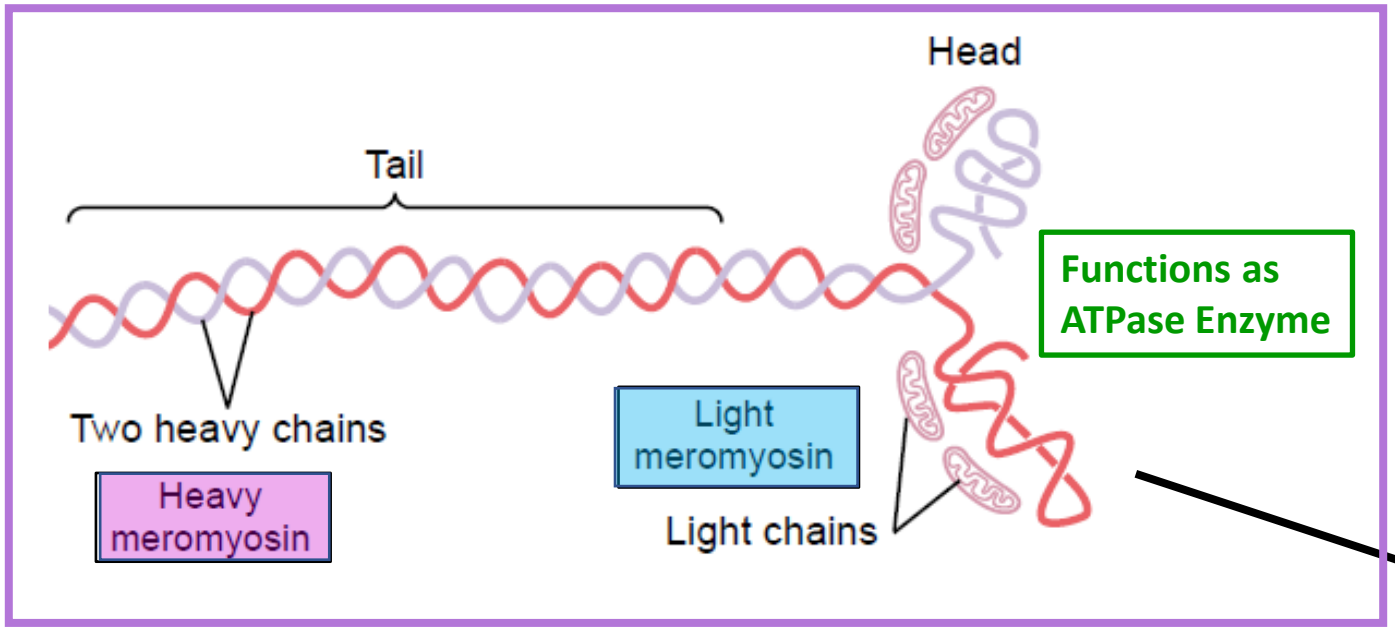


Myosin





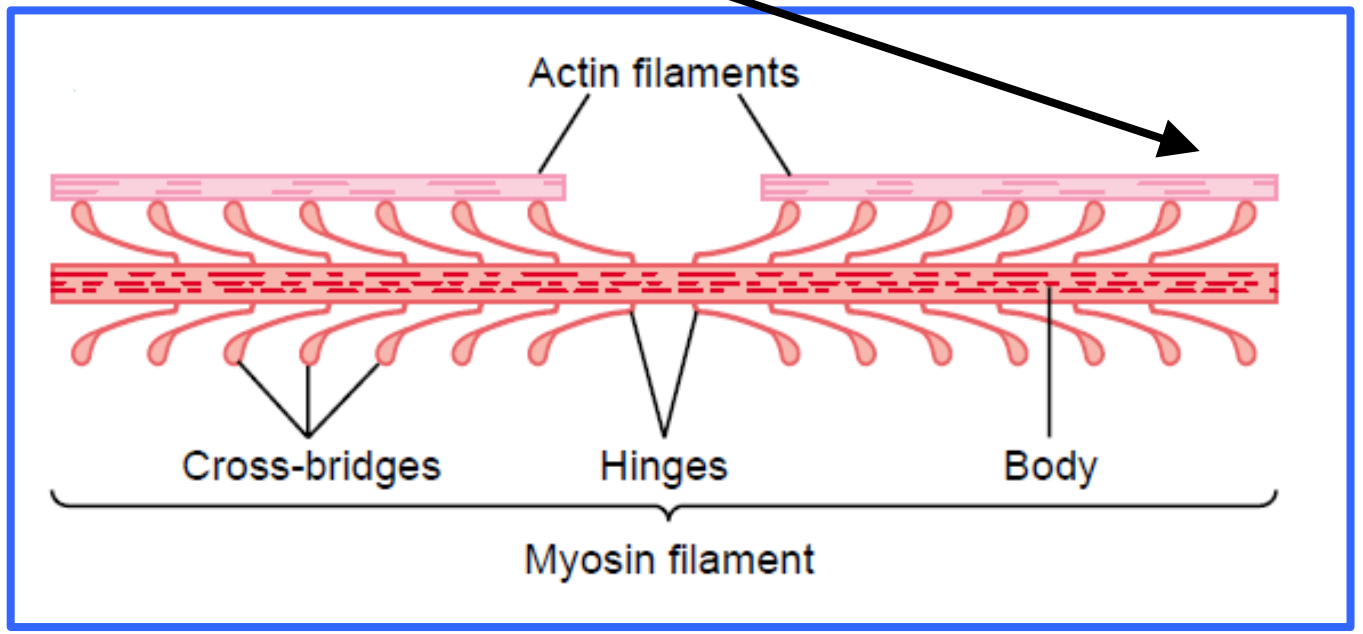
Actin - Myosin Interaction



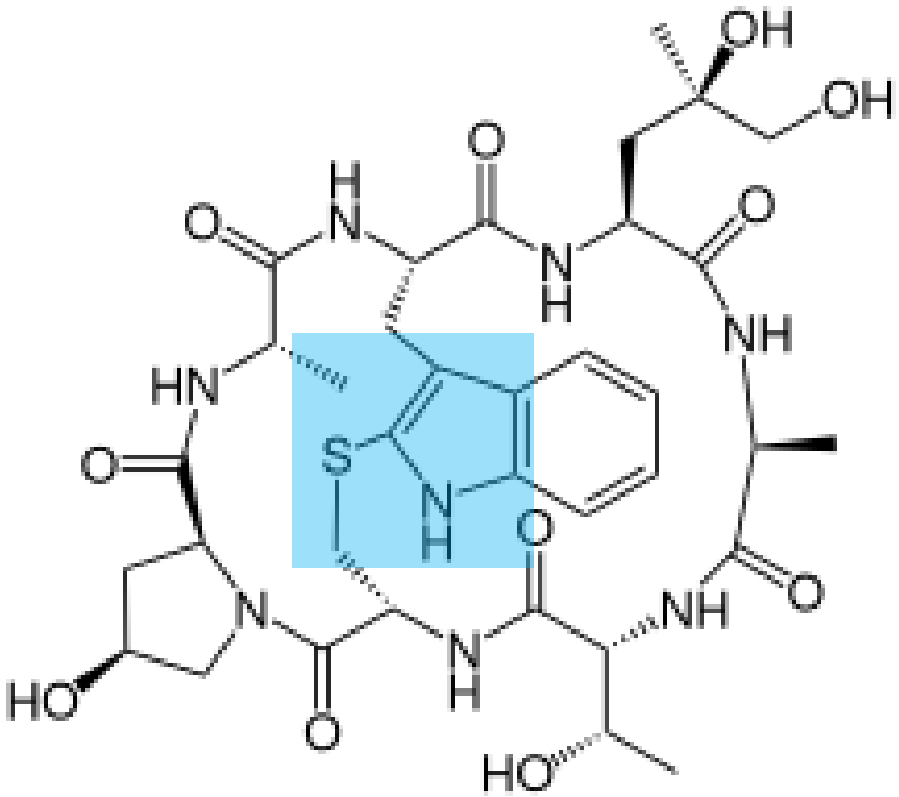
Myosin Molecule

Fenn effect

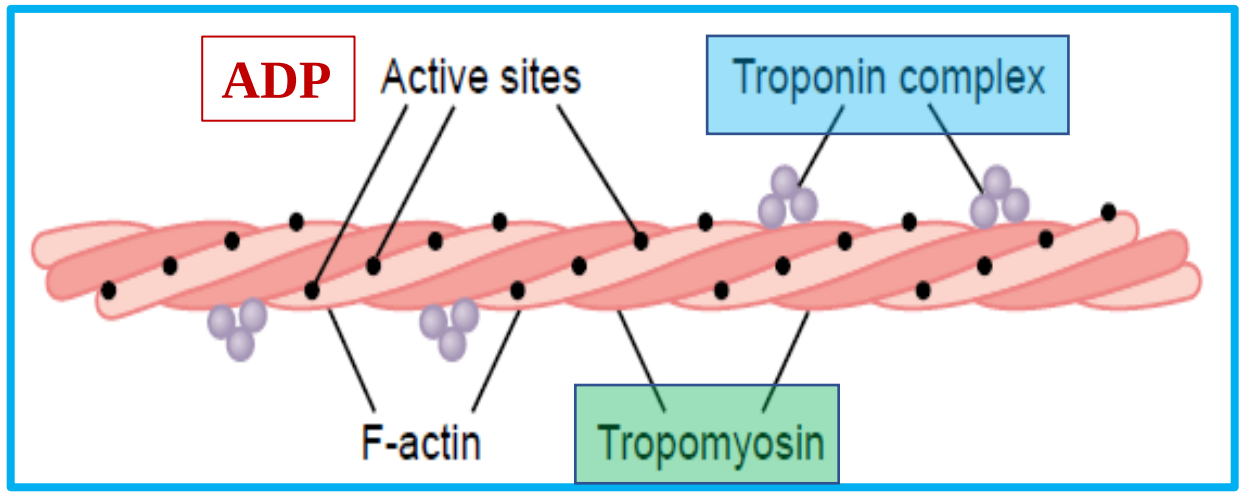
- ***Many Actin Molecules → Actin Filament***
- **Many Myosin Molecules → Myosin Filament**



Actin



Contraction Mechanism



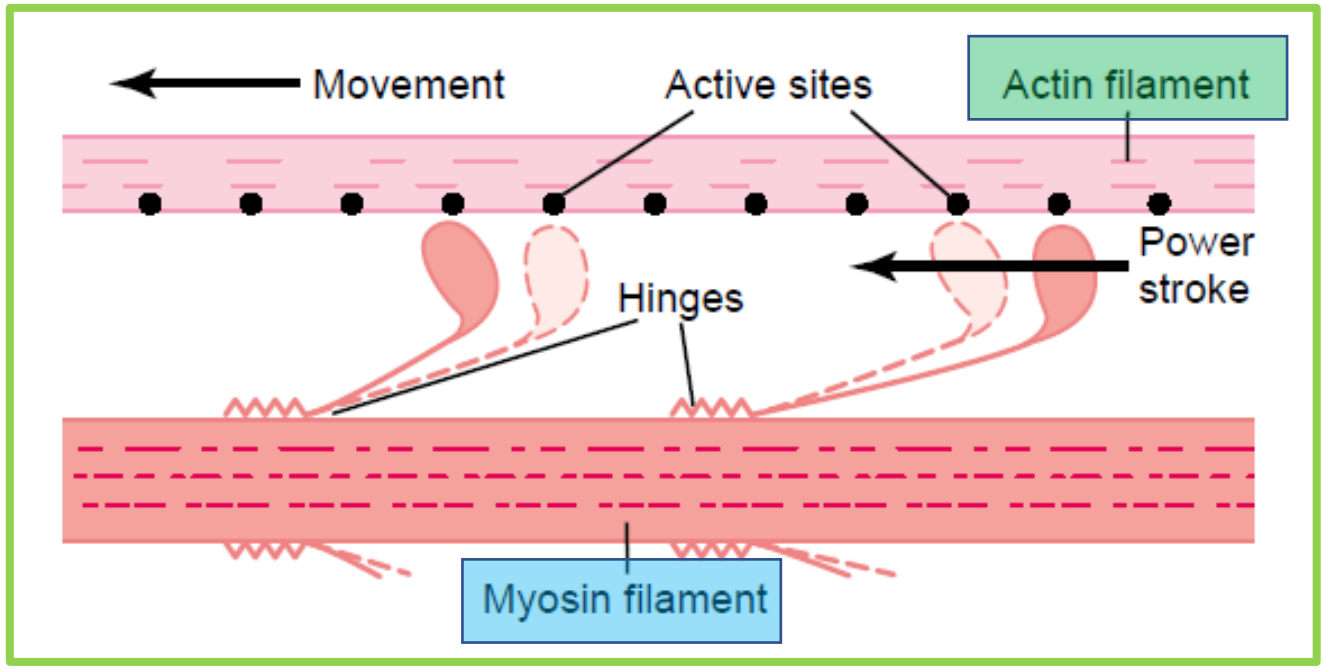
Actin Filament

(3 molecules Helix, like Collagen)

“Walk-along” Mechanism: Muscle Contraction

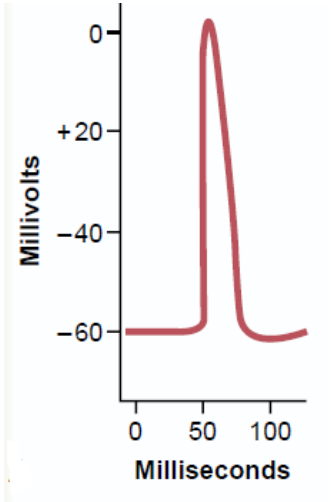
A: Actin Filament

M: Myosin Filament

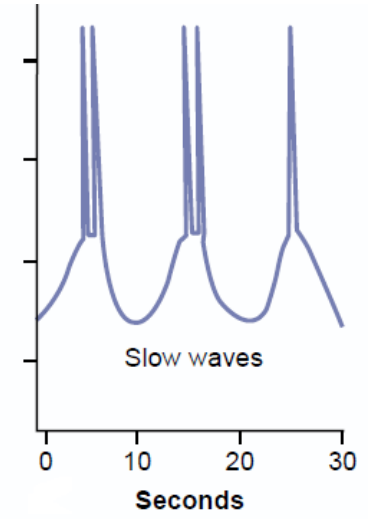


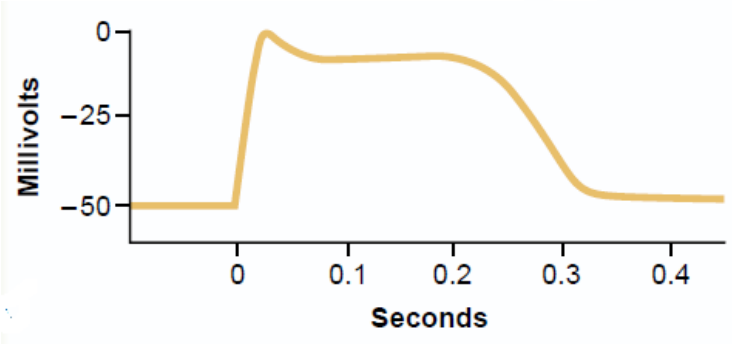
Action Potentials of Smooth Muscle

"Spike" Potential By External stimulus



Repetitive Spikes: Intestinal Peristalsis

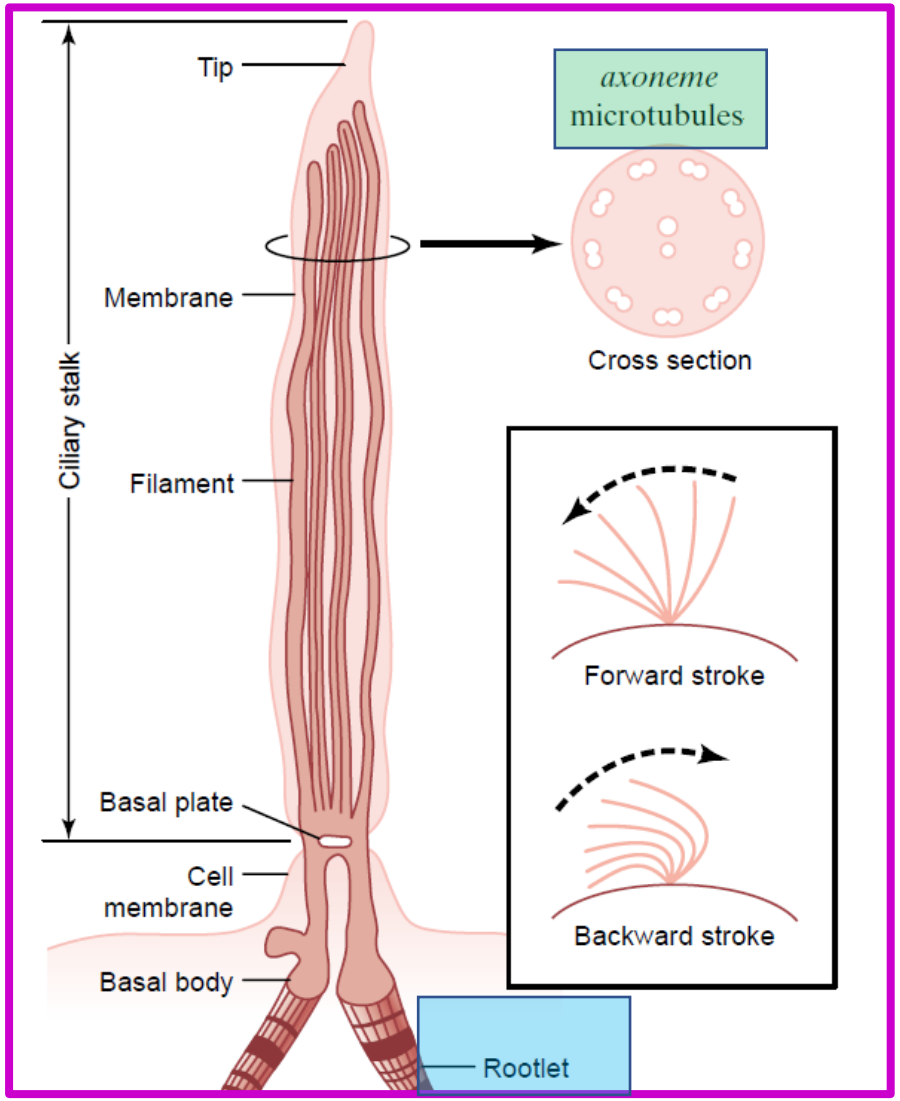




"Plateau" Potential - Prolonged contraction of Uterus: Expelling baby at birth

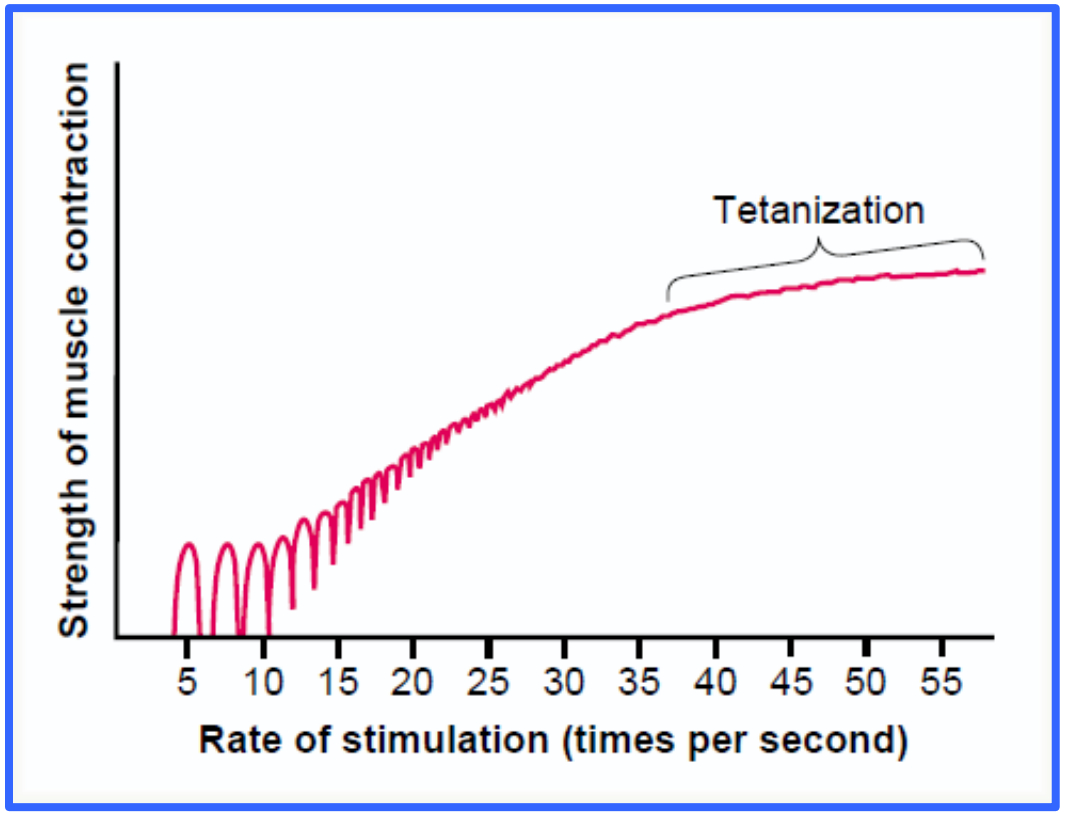
Ciliary Myofilament: Whip Movement

10 Hertz : Nose, Lung, Ovarian Tube, Sperm

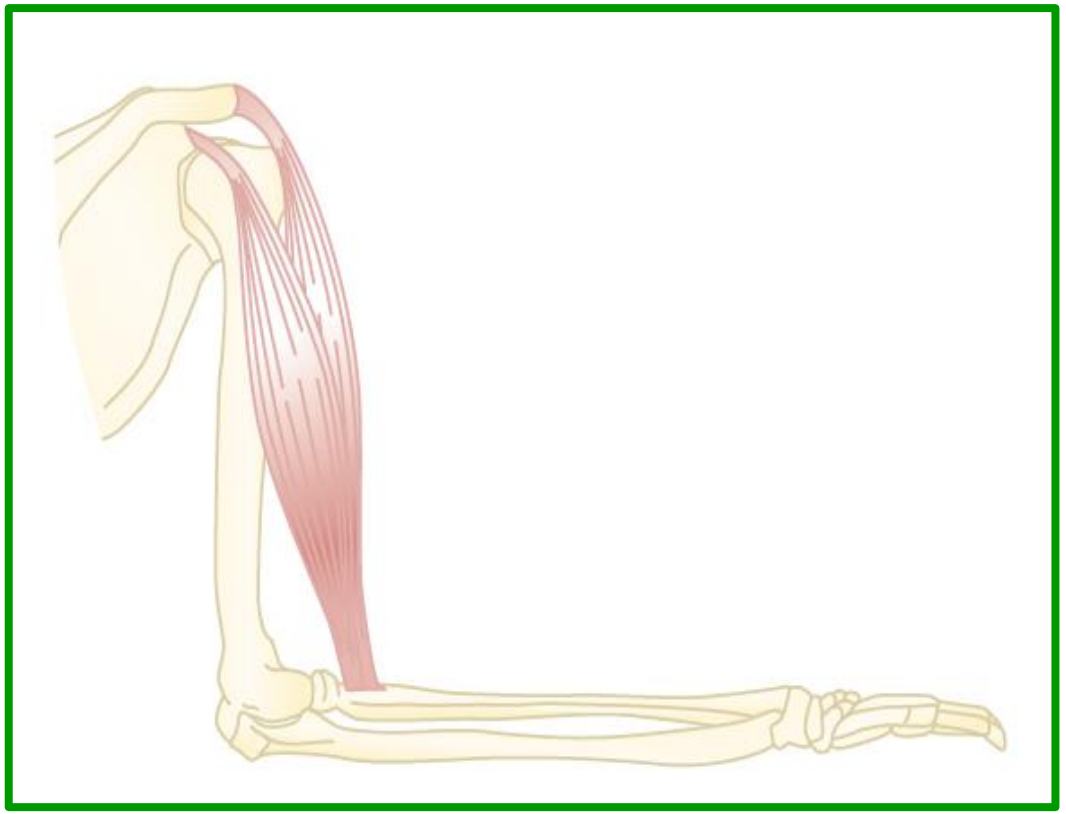


Distributed Operations

Repetitive Activity Summation: Tetanization



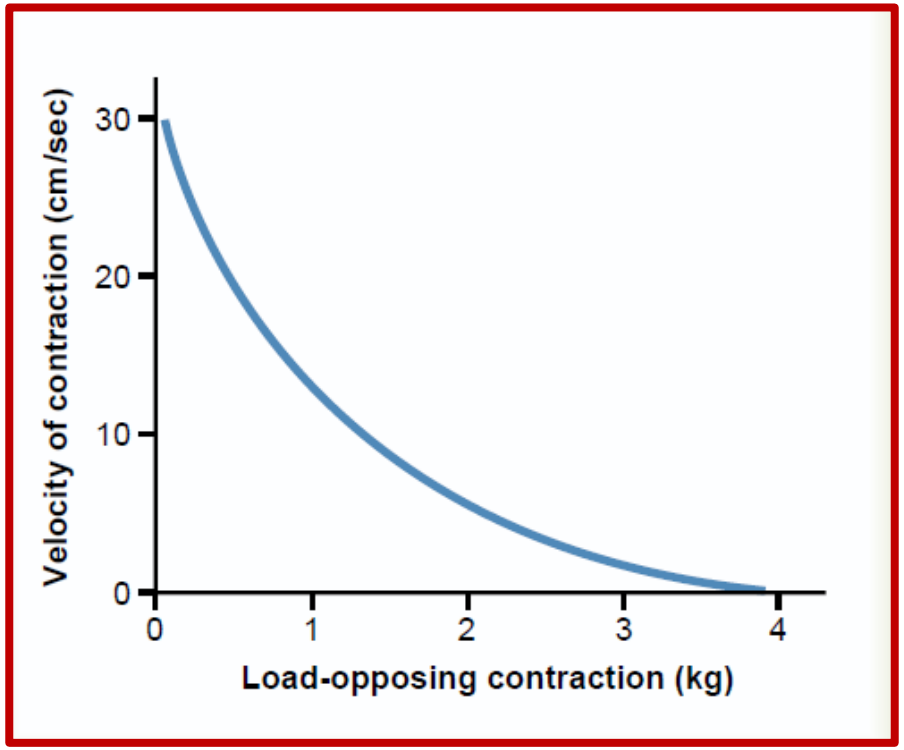
Lever Action: Muscle → Tendon → Bone



Muscle Activation Characteristics

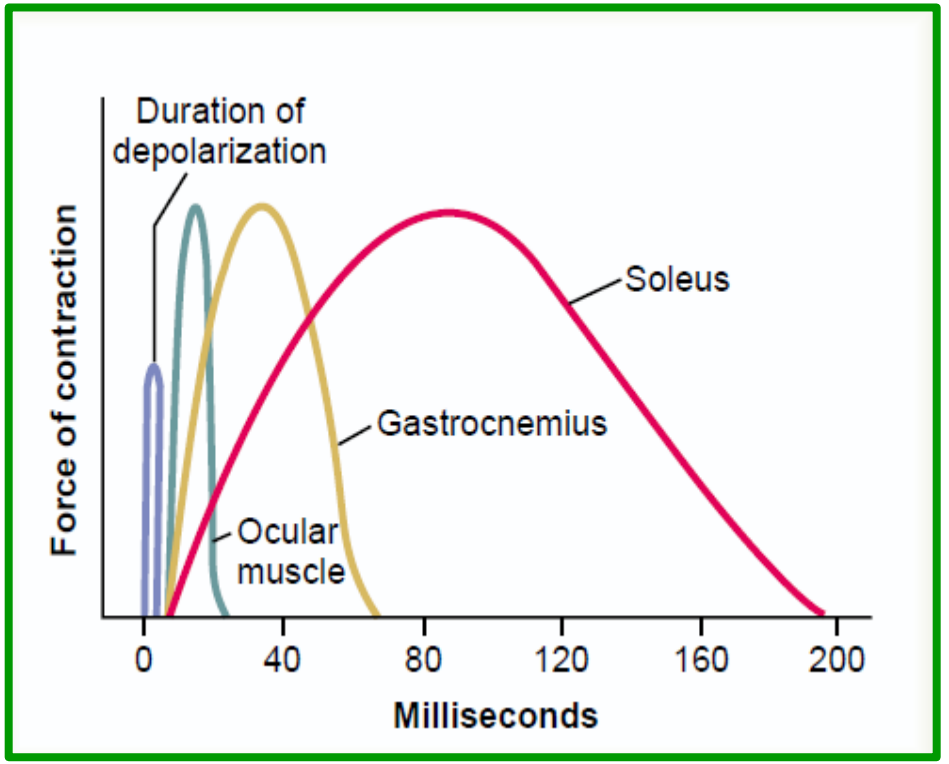
Velocity - Force Diagram in Muscle Activity

Reciprocality



Response Latency in Muscle Activity:

More peripheral the muscle: More the Slowness



Performance: $W = L \times D$