YAKEEN NEET 2.0

2026

22.08.2025

LOCOMOTION AND MOVEMENT

ZOOLOGY | Lecture – 3

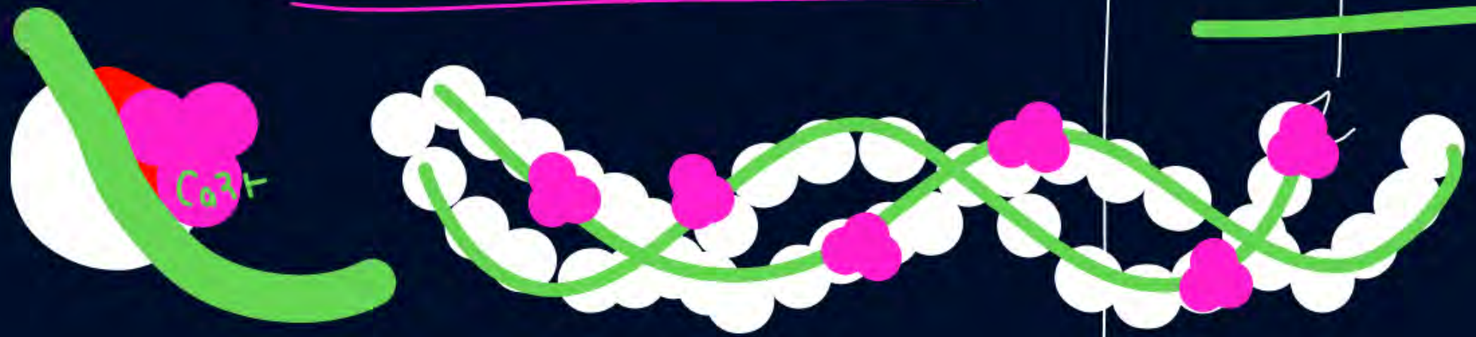
By- SAMAPTI MAM

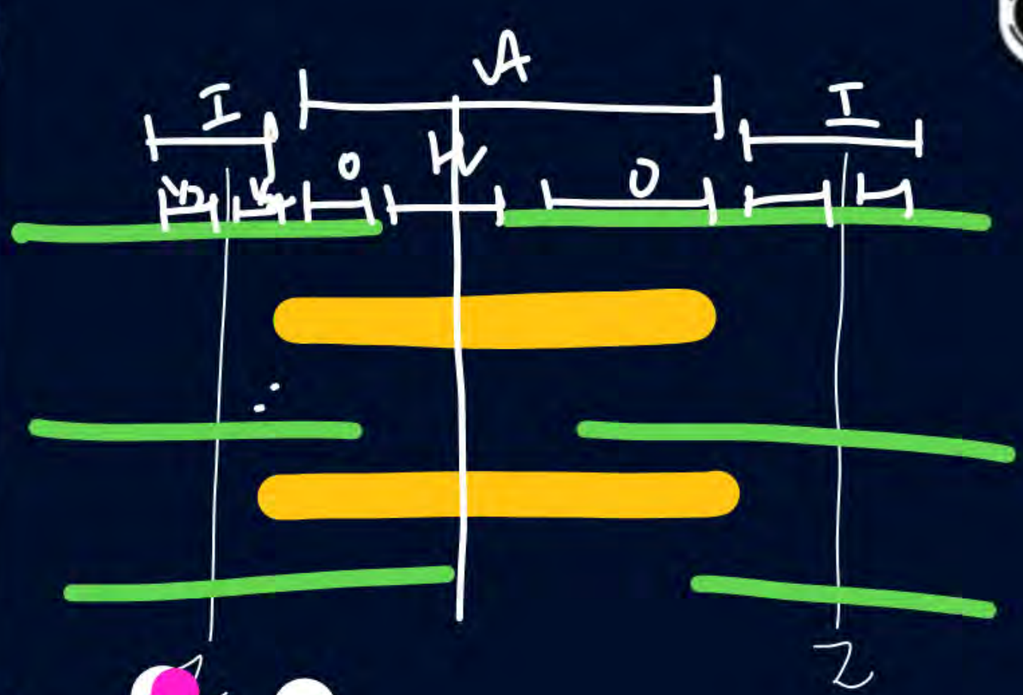
Topics to be covered

1. MUSCLE CONTRACTION
2.
3.
4.

MY TELEGRAM

#Sarcomere





Thick myofilament (Myosin filament)

→ Monomeric unit : MEROMYOSIN

polymerises

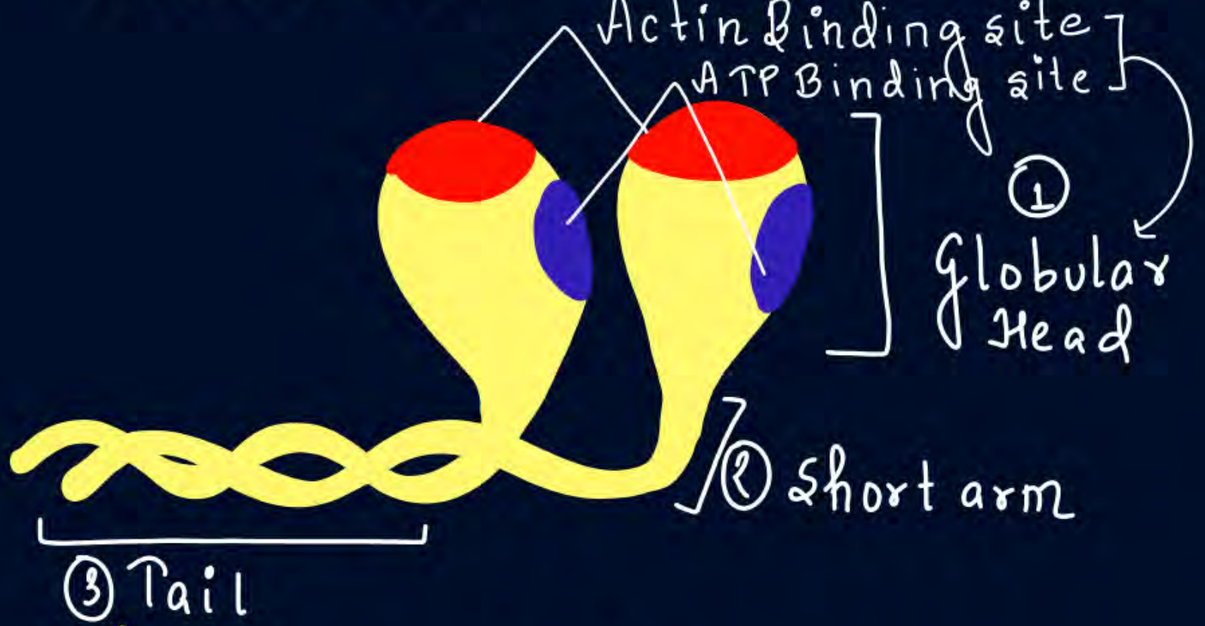


fig: Meromyosin (Tadpole like)

Meromyosin

(2 Components)

① HMM
- Heavy meromyosin
- Mol. wt ↑
- Head + Short art

together k/a Cross arm.

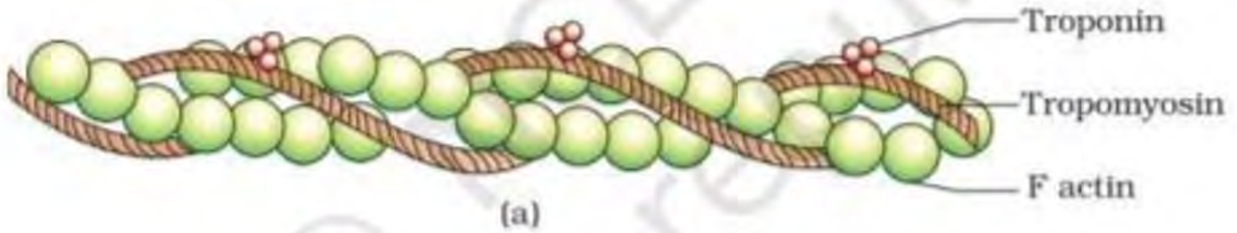
② LMM
- Light Meromyosin
- Mol wt ↓
- Tail

* Head also has ATPase activity
→ Breakdown ATP.

17.2.1 Structure of Contractile Proteins

Each actin (thin) filament is made of two 'F' (filamentous) actins helically wound to each other. Each 'F' actin is a polymer of monomeric 'G' (Globular) actins. Two filaments of another protein, tropomyosin also run close to the 'F' actins throughout its length. A complex protein Troponin is distributed at regular intervals on the tropomyosin. In the resting state a subunit of troponin masks the active binding sites for myosin on the actin filaments (Figure 17.3a).

Each myosin (thick) filament is also a polymerised protein. Many monomeric proteins called Meromyosins (Figure 17.3b) constitute one thick filament. Each meromyosin has two important parts, a globular head with a short arm and a tail, the former being called the heavy meromyosin (HMM) and the latter, the light meromyosin (LMM). The HMM component, i.e.; the head and short arm projects outwards at regular distance and angle from each other from the surface of a polymerised myosin filament and is known as cross arm. The globular head is an active ATPase enzyme and has binding sites for ATP and active sites for actin.



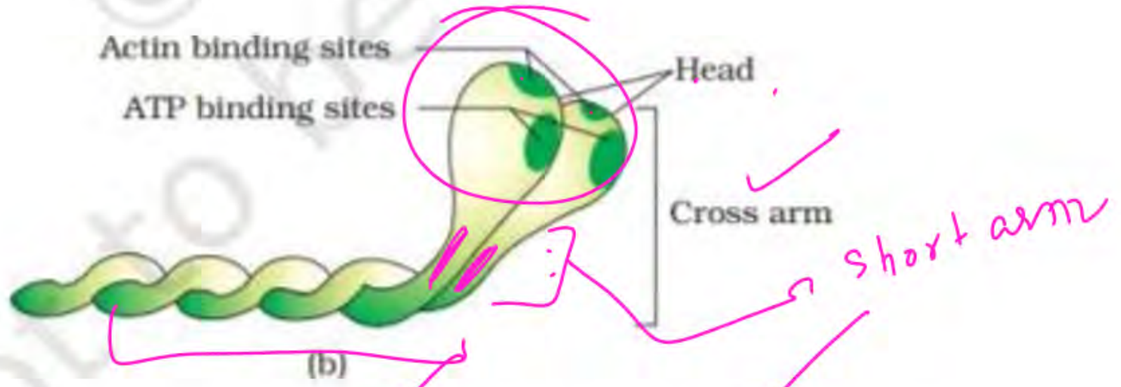
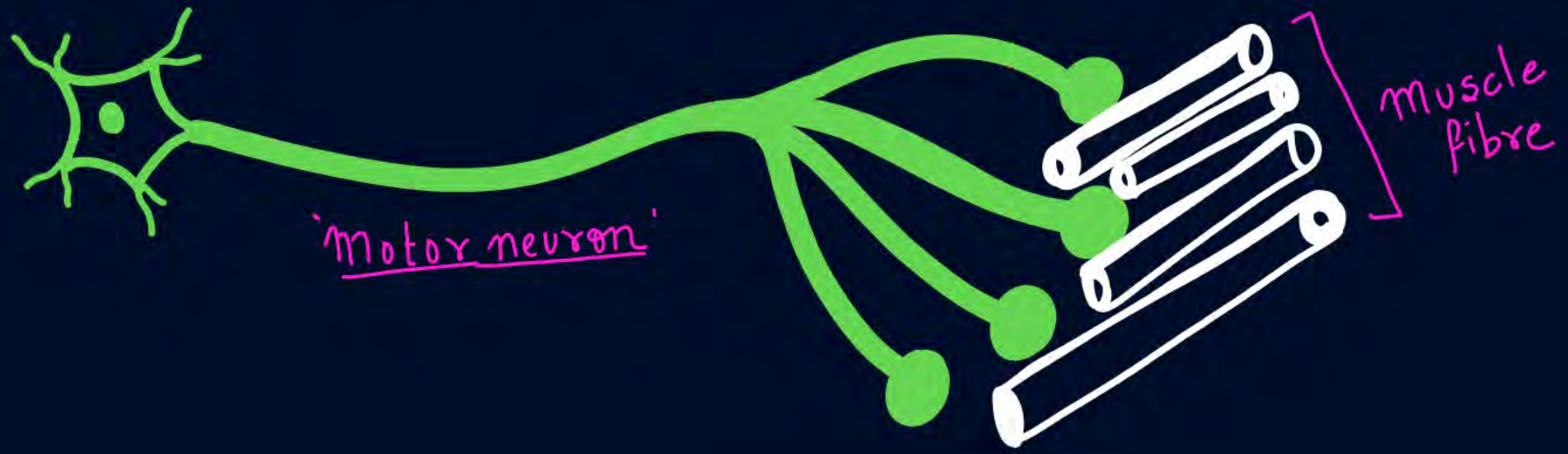


Figure 17.3 (a) An actin (thin) filament (b) Myosin monomer (Meromyosin)

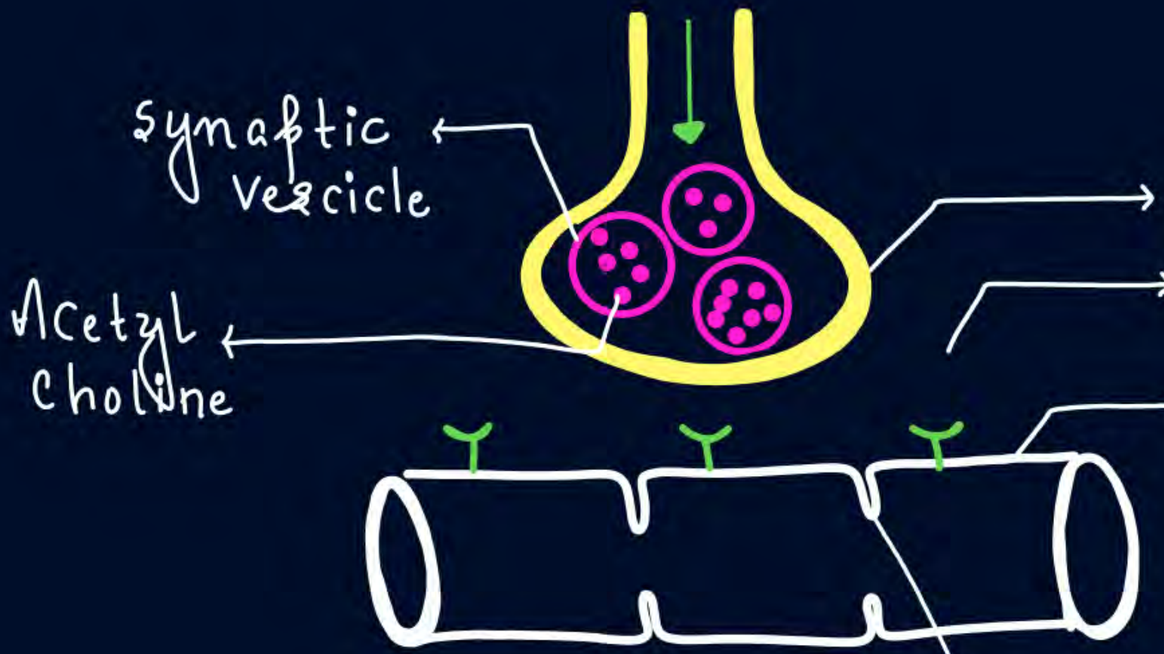
Muscle Contraction:

- Signal for Contraction: Comes from 'CNS': via 'MOTOR' / 'EFFERENT' NEURON
- **Motor unit:** One motor Neuron along with all muscle fibre that it forms Junction with or innervates.



Motor End Plate / Neuromuscular Junction (NMJ):

- The Junction / synapse b/w Motor Neuron & the Muscle fibre.



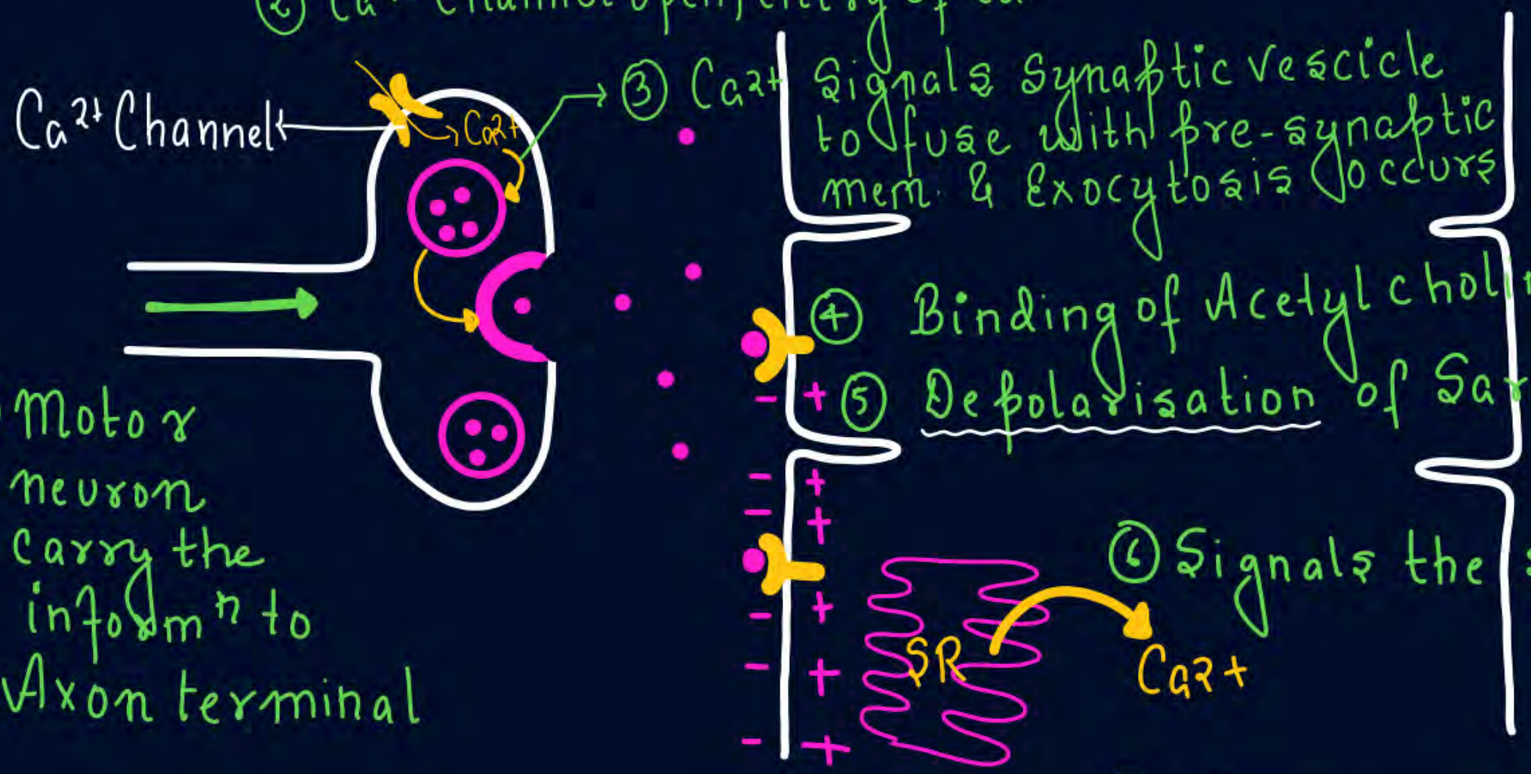
→ Pre-synaptic membrane

→ Synaptic cleft

→ Post synaptic memb. (Sarcolemma)
↳ has Receptor for Acetyl choline

→ T-tubules (Transverse): folds of Sarcolemma
↳ Spread action potential throughout.

Inform^{n} comes to the Muscle fibre via Motor Neuron:



⑦ Binding of Ca^{2+}: (TpC): Confirmational change in Trop$\overline{o}$nin, Entire tropo$\overline{n}$in along with tropo-myosin shifts away from Active site on Actin.

17.2.2 Mechanism of Muscle Contraction

Mechanism of muscle contraction is best explained by the sliding filament theory which states that contraction of a muscle fibre takes place by the sliding of the thin filaments over the thick filaments.

Muscle contraction is initiated by a signal sent by the central nervous system (CNS) via a motor neuron. A motor neuron along with the muscle fibres connected to it constitute a motor unit. The junction between a motor neuron and the sarcolemma of the muscle fibre is called the neuromuscular junction or motor-end plate. A neural signal reaching this junction releases a neurotransmitter (Acetyl choline) which generates an action potential in the sarcolemma. This spreads through the muscle fibre and causes the release of calcium ions into the sarcoplasm. Increase in Ca^{++} level leads to the binding of calcium with a subunit of troponin on actin filaments and thereby remove the masking of active sites for myosin. Utilising the energy from ATP hydrolysis, the myosin head now binds to the exposed active sites on actin to form a cross bridge (Figure 17.4).

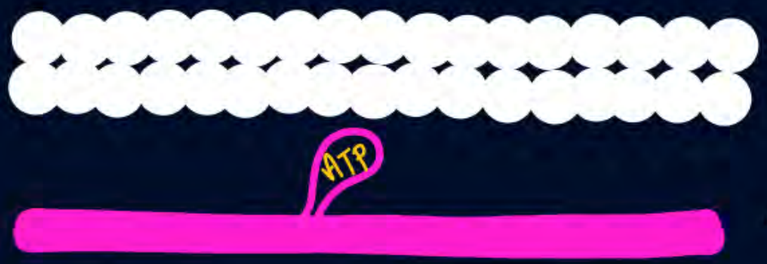
T-tubule

Sliding filament theory: Explains 'Muscle Contraction'

↓

- 'Thin filament' slides over 'thick filament'

When ATP is available it Binds to Myosin Head (Breaks Cross Bridge)



Actin filament

Myosin filament

ATP is hydrolysed : ADP + Pi ; head is now energised.

Utilising the energy, now the myosin Binds to actin : CROSS-BRIDGE, thin filament slides over thick filament.

'Sliding / Rotation'

ADP + Pi removed

Muscle contracts, Still cross Bridge seen

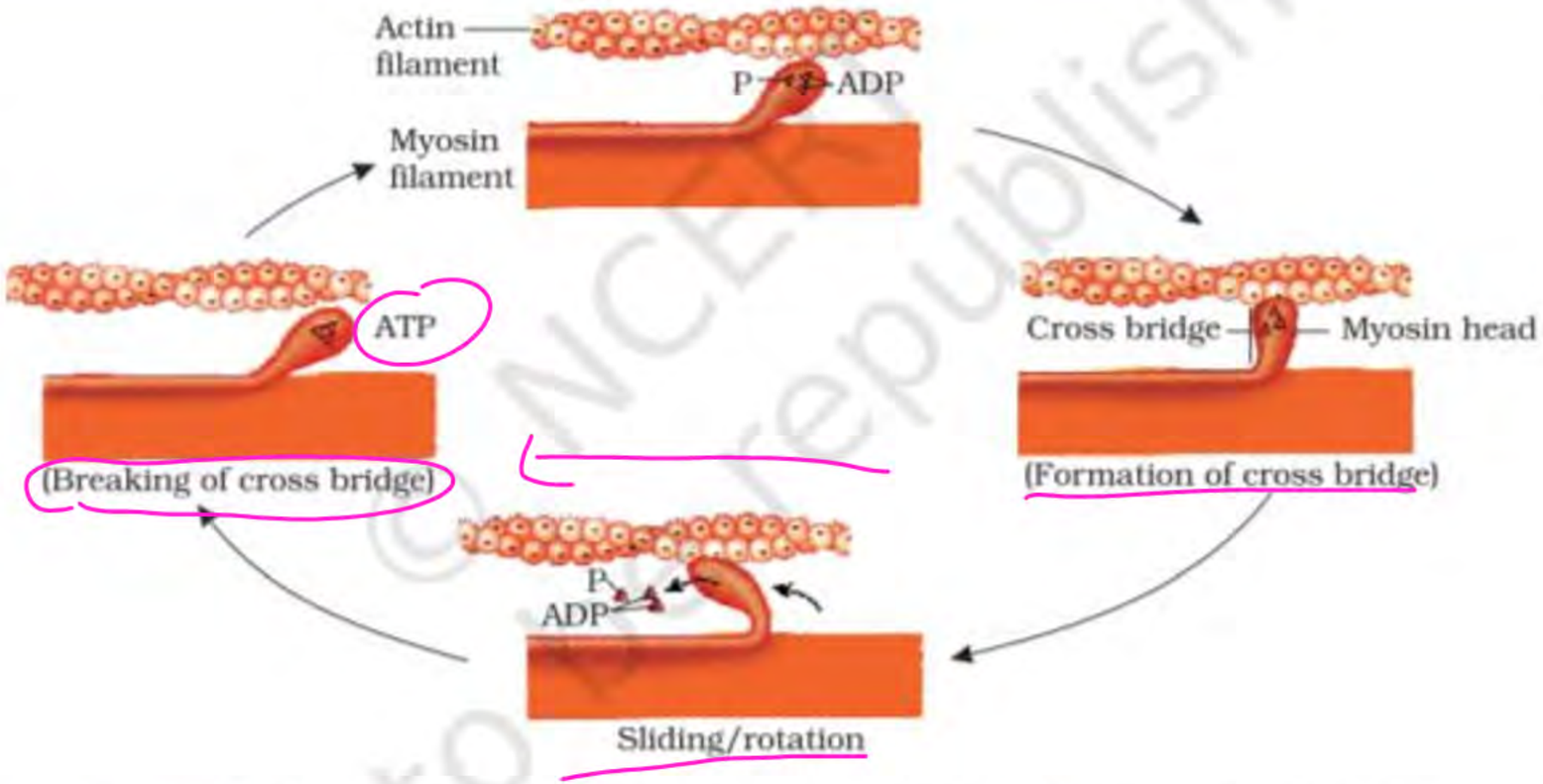


Figure 17.4 Stages in cross bridge formation, rotation of head and breaking of cross bridge

Rigor mortis
↓
'Death'

This pulls the attached actin filaments towards the centre of 'A' band. The 'Z' line attached to these actins are also pulled inwards thereby causing a shortening of the sarcomere, i.e., contraction. It is clear from the above steps, that during shortening of the muscle, i.e., contraction, the 'I' bands get reduced, whereas the 'A' bands retain the length (Figure 17.5). The myosin, releasing the ADP and P_i goes back to its relaxed state. A new ATP binds and the cross-bridge is broken (Figure 17.4). The ATP is again hydrolysed by the myosin head and the cycle of cross bridge formation

and breakage is repeated causing further sliding. The process continues till the Ca^{++} ions are pumped back to the sarcoplasmic cisternae resulting in the masking of actin filaments. This causes the return of 'Z' lines back to their original position, i.e., relaxation. The reaction time of the fibres can vary in different muscles. Repeated activation of the muscles can lead to the accumulation of lactic acid due to anaerobic breakdown of glycogen in them, causing fatigue. Muscle contains a red coloured oxygen storing pigment called myoglobin. Myoglobin content is high in some of the muscles which gives a reddish appearance. Such muscles are called the Red fibres. These muscles also contain plenty of mitochondria which can utilise the large amount of oxygen stored in them for ATP production. These muscles, therefore, can also be called aerobic muscles. On the other hand, some of the muscles possess very less quantity of myoglobin and therefore, appear pale or whitish. These are the White fibres. Number of mitochondria are also few in them, but the amount of sarcoplasmic reticulum is high. They depend on anaerobic process for energy.

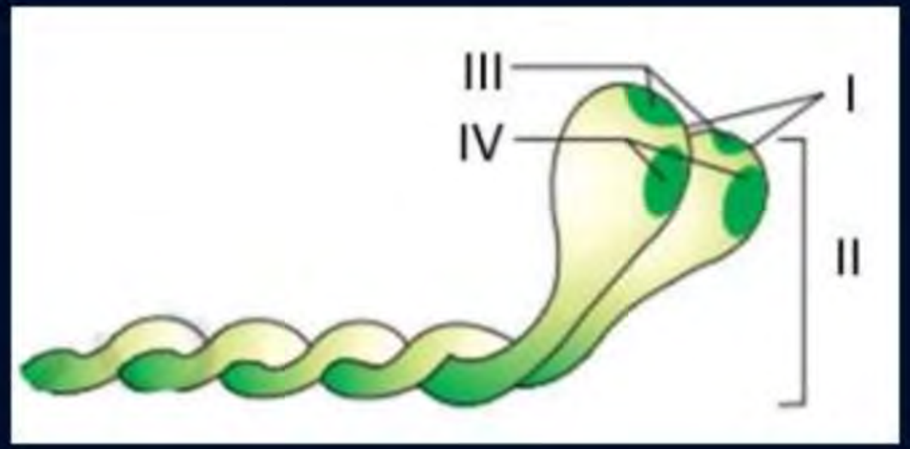
Note:

- Reaction time of different muscle fibre can vary (the way they respond)
- **Muscle relaxn:** No inform^{n} from Motor Neuron
  ↓
  No action potential
  ↓
  Ca^{2+} moves back to SR
  ↓
  Trofonin mask the actin's active site.

Ncert Catalyst
(H.W)

QUESTION

Examine the diagram of the meromyosin and identify the ATP binding site on it.



A II

B I

C III

D IV

QUESTION

Given below are two statements: one is labelled as Assertion and the other is labelled as Reason (R).
Assertion (A): The sliding filament theory explains the mechanism of muscle contraction.
Reason (R): Muscle contraction occurs due to the sliding of thick filaments over thin filaments.
In the light of the above statements, choose the correct answer from the options given below.

A. A is true but R is false.

B. A is false but R is true.

C. Both A and R are true and R is the correct explanation of A.

D. Both A and R are true but R is not the correct explanation of A.

QUESTION

Given below are two statements:

Statement I: A motor neuron along with the muscle fibres connected to it constitute a motor unit.

Statement II: In a resting state, the edges of thin filaments on either side of thick filaments fully overlap the free ends of thick filaments.

In the light of the above statements, choose the most appropriate answer from the options given below:

A. Statement I is correct but Statement II is incorrect.

B. Statement I is incorrect but Statement II is correct.

C. Both Statement I and Statement II are correct.

D. Both Statement I and Statement II are incorrect.

QUESTION

Statement I: Locomotion requires a perfect coordinated activity of muscular, skeletal and neural systems.

Statement II: muscle contraction is initiated by a signal sent from CNS via afferent neuron.

A

Statement I is correct but Statement II is incorrect.

B

Statement I is incorrect but Statement II is correct.

C

Both Statement I and Statement II are correct.

D

Both Statement I and Statement II are incorrect.

Select the correct statements regarding mechanism of muscle contraction.

A. It is initiated by a signal sent by CNS via sensory neuron.

B. Neurotransmitter generates action potential in the sarcolemma.

C. Increased Ca^{++} level leads to the binding of calcium with troponin on action filaments

D. Masking of active site for actin is activated.

E. Utilising the energy from ATP hydrolysis to form cross bridge.

Choose the most appropriate answer from the options given below:

A B, C and E only

B C, D and E only

C A and D only

D B, D and E only

Calcium is important in skeletal muscle contraction because it

A detaches the myosin head from the actin filament

B binds to troponin to remove the masking of active sites on actin for myosin

C prevents the formation of bonds between the myosin cross bridges and the actin filament.

D activates the myosin ATPase by binding to it

Which of the following statements are correct regarding skeletal muscle?

A. Muscle bundles are held together by collagenous connective tissue layer called fascicle.

B. Sarcoplasmic reticulum of muscle fibre is a store house of calcium ions.

C. Striated appearance of skeletal muscle fibre is due to distribution pattern of actin and myosin proteins.

D. M line is considered as functional unit of contraction called sarcomere.

Choose the most appropriate answer from the options given below:

A B and C only

B A, C and D only

C C and D only

D A, B and C only

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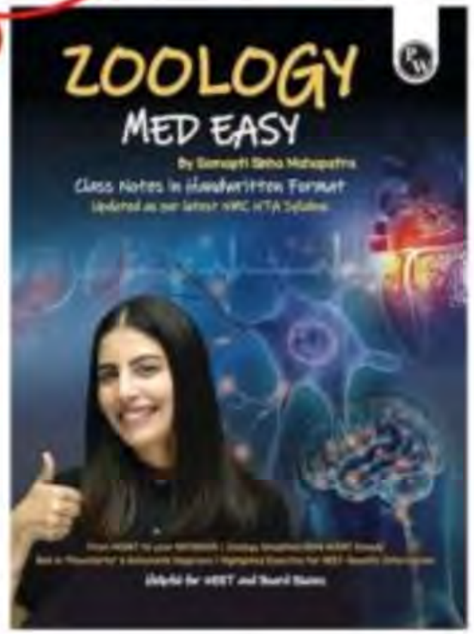

Homework

- REVISE CLAASNOTES / ZOOLOGY MED EASY

THANK YOU