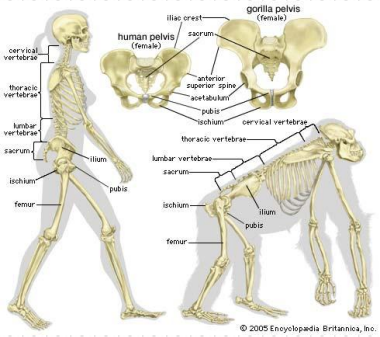
Locomotion and Movement



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- Movement is one of the significant features of living beings. Animals and plants exhibit a wide range of movements. Streaming of protoplasm in the unicellular organisms like Amoeba is a simple form of movement. Movement of cilia, flagella and tentacles are shown by many organisms. Human beings can move limbs, jaws, eyelids, tongue, etc. Some of the movements result in a change of place or location. Such voluntary movements are called locomotion. Walking, running, climbing, flying, swimming are all some forms of locomotory movements.

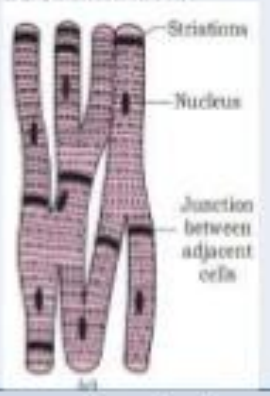
TYPES OF MOVEMENT

- Amoeboid-macrophages and leucocytes in blood exhibit amoeboid movement. It is effected by pseudopodia formed by the streaming of protoplasm (as in Amoeba).
- Ciliary - Ciliary movement occurs in most of our internal tubular organs which are lined by ciliated epithelium. Passage of ova through the female reproductive tract is also facilitated by the ciliary movement.
- Muscular- Movement of our limbs, jaws, tongue, etc, require muscular movement.

MUSCLE

- Muscle is a specialised tissue of mesodermal origin. About 40-50 per cent of the body weight of a human adult is contributed by muscles. They have special properties like excitability, contractility, extensibility and elasticity.
- Based on their location, three types of muscles are identified : (i) Skeletal (ii) Visceral and (iii) Cardiac

TYPES OF MUSCLE TISSUE

STRIPED or STRIATED/ SKELETAL/ VOLUNTARY MUSCLE FIBRES	UNSTRIPED or NON-STRIATED / INVOLUNTARY MUSCLE FIBRES	CARDIAC MUSCLE FIBRES
 	 	 
Called **striped or striated muscles** as they have light and dark bands or striations. Called **voluntary muscles** as they move as per our will. Called **skeletal muscles** as attached to all bones and help in movement.	**Called unstriped/non striated muscles** as they do not show light and dark bands. Called **involuntary** as they do not move as per our will.	Structure in **between striated and non-striated muscle** fibres and are **involuntary.** ***These muscles show rhythmic contraction and relaxation throughout life and pump blood.***
STRUCTURE • long cylinder shaped unbranched cells • multinucleated (many nuclei) • fibres arranged in form of bundles • have dark and light bands	**STRUCTURE** • spindle shaped cells • uninucleated • fibres arranged in form of sheets • dark and light bands absent	**STRUCTURE** • short cylinder shaped,branched cells • uninucleated • fibres arranged in form of network • faint dark and light bands
LOCATION Limbs (arms,legs),tongue,body,face neck	**LOCATION** Iris,ureters,bronchi of lungs, alimentary canal wall,blood vessels	**LOCATION** walls of heart
WORKING Contract quickly but can't remain contracted for a long .So get fatigued/tired.	**WORKING** Contract slowly but can remain contracted for long .So don't get fatigued/tired.	**WORKING** Contract quickly and rhythmically.Therefore do not get fatigued/tired.

PERIOD 8

Mechanism of Muscle Contraction

- Each organised skeletal muscle in our body is made of a number of muscle bundles or fascicles held together by a common collagenous connective tissue layer called fascia. Each muscle bundle contains a number of muscle fibres.
- muscle fibre is lined by the plasma membrane called sarcolemma enclosing the sarcoplasm. Muscle fibre is a syncitium as the sarcoplasm contains many nuclei. The endoplasmic reticulum, i.e., sarcoplasmic reticulum of the muscle fibres is the store house of calcium ions
- A characteristic feature of the muscle fibre is the presence of a large number of parallelly arranged filaments in the sarcoplasm called myofilaments or myofibrils. Each myofibril has alternate dark and light bands on it. A detailed study of the myofibril

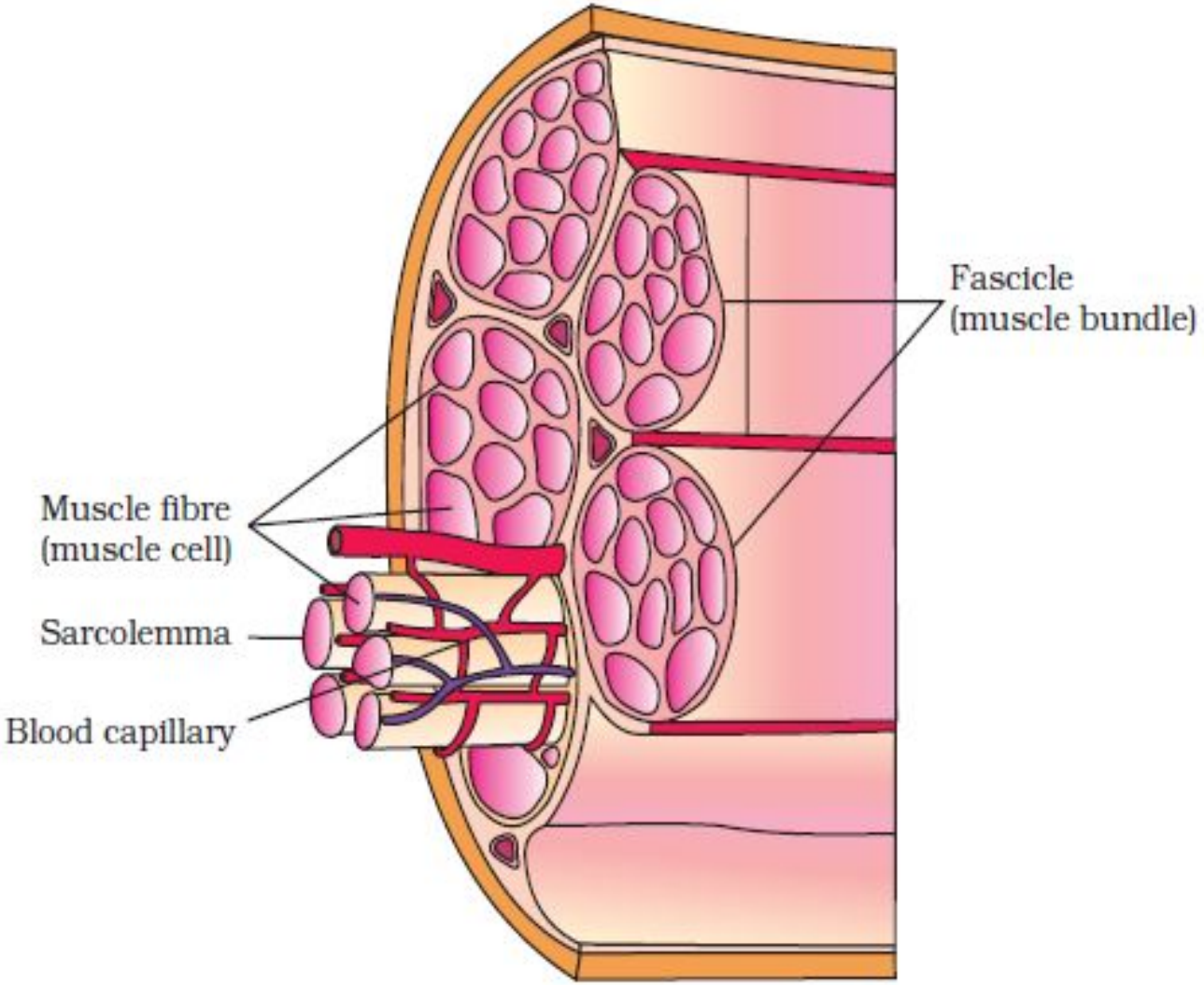
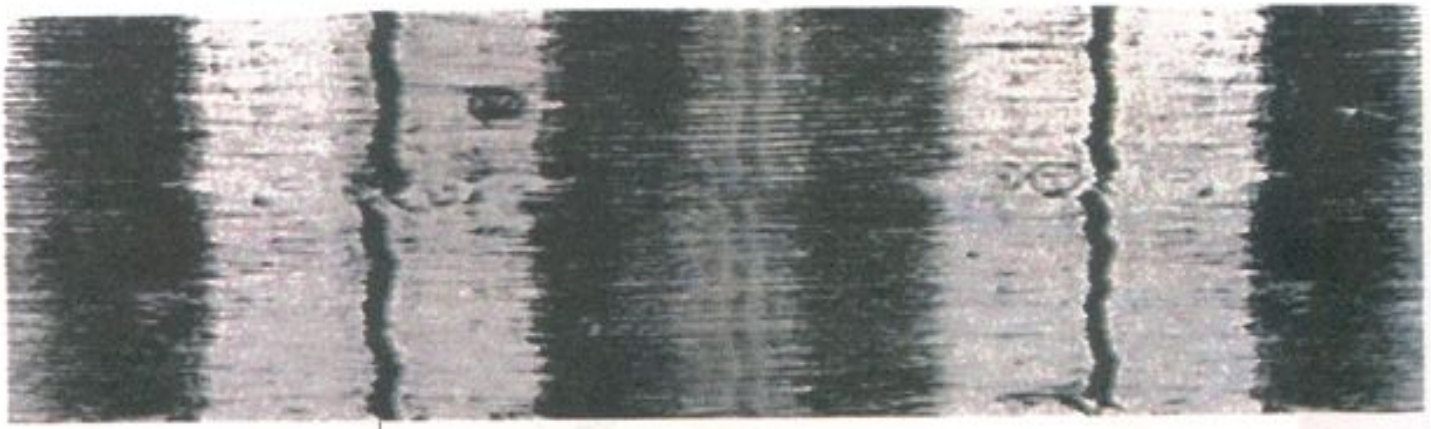
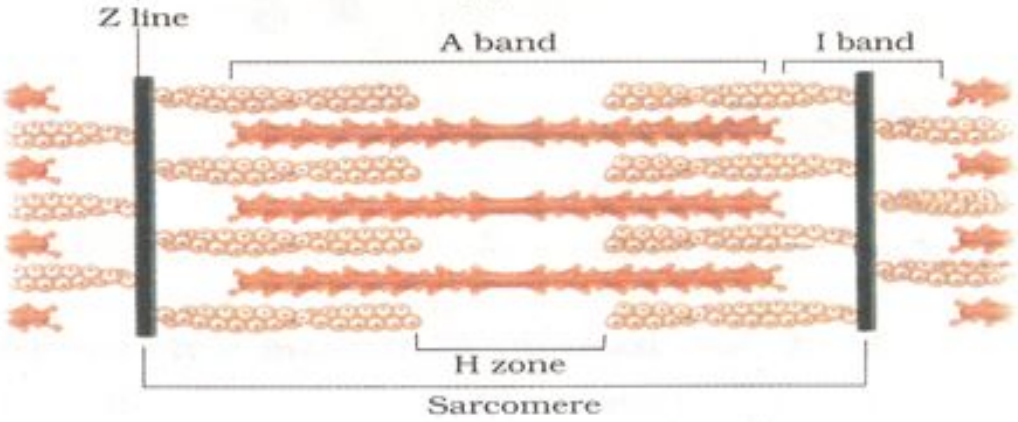


Figure 20.1 Diagrammatic cross sectional view of a muscle showing muscle bundles and muscle fibres

- The light bands contain actin and is called I-band or Isotropic band, whereas the dark band called 'A' or Anisotropic band contains muscle fibre is lined by the plasma membrane called sarcolemma enclosing the sarcoplasm.
- Muscle fibre is a syncitium as the sarcoplasm contains many nuclei. The endoplasmic reticulum, i.e., sarcoplasmic reticulum of the muscle fibres is the store house of calcium ions.
- A characteristic feature of the muscle fibre is the presence of a large number of parallelly arranged filaments in the sarcoplasm called myofilaments or myofibrils. Each myofibril has alternate dark and light bands on it. A detailed study of the myofibril has established that the striated appearance is due to the distribution pattern of two important proteins – Actin and Myosin. The light bands contain actin and is called I-band or Isotropic band, whereas the dark band called



(a)



(b)

Figure 20.2 Diagrammatic representation of (a) anatomy of a muscle fibre showing a sarcomere (b) a sarcomere

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
- Each myosin (thick) filament is also a polymerised protein. Many monomeric proteins called Meromyosins (Figure 20.3b) constitute one thick filament. Each meromyosin has two

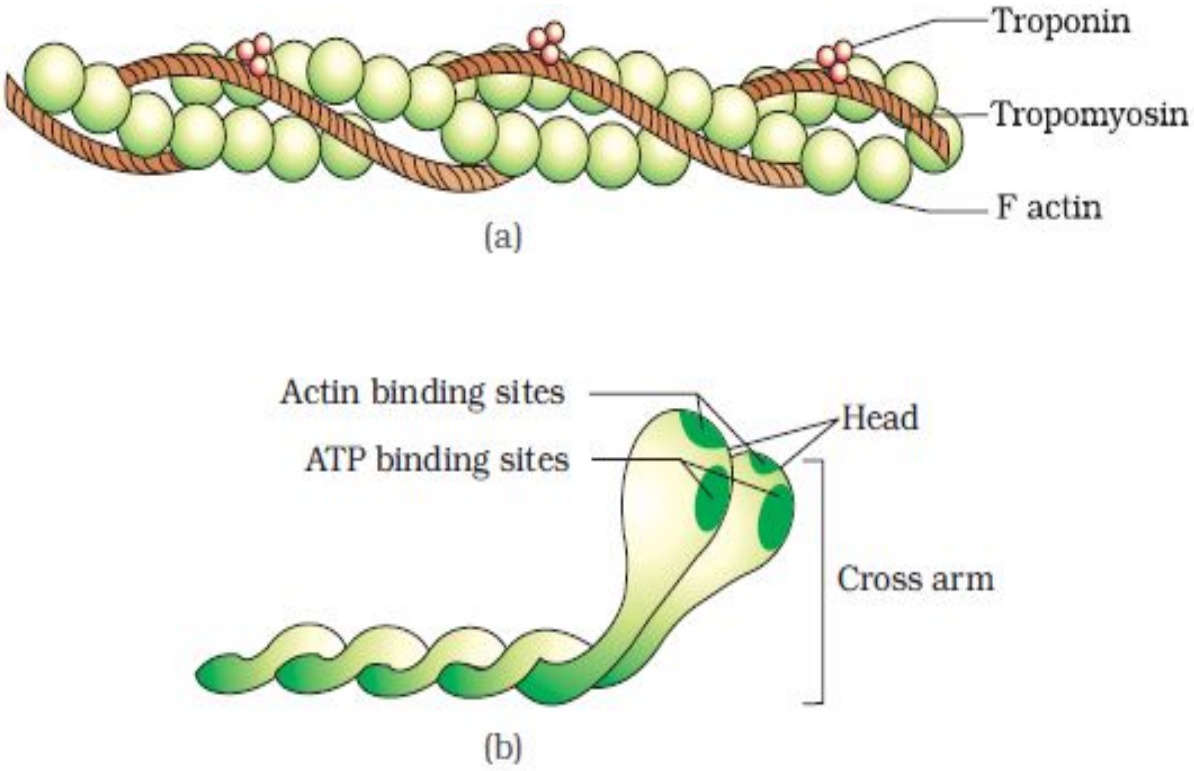


Figure 20.3 (a) An actin (thin) filament (b) Myosin monomer (Meromyosin)

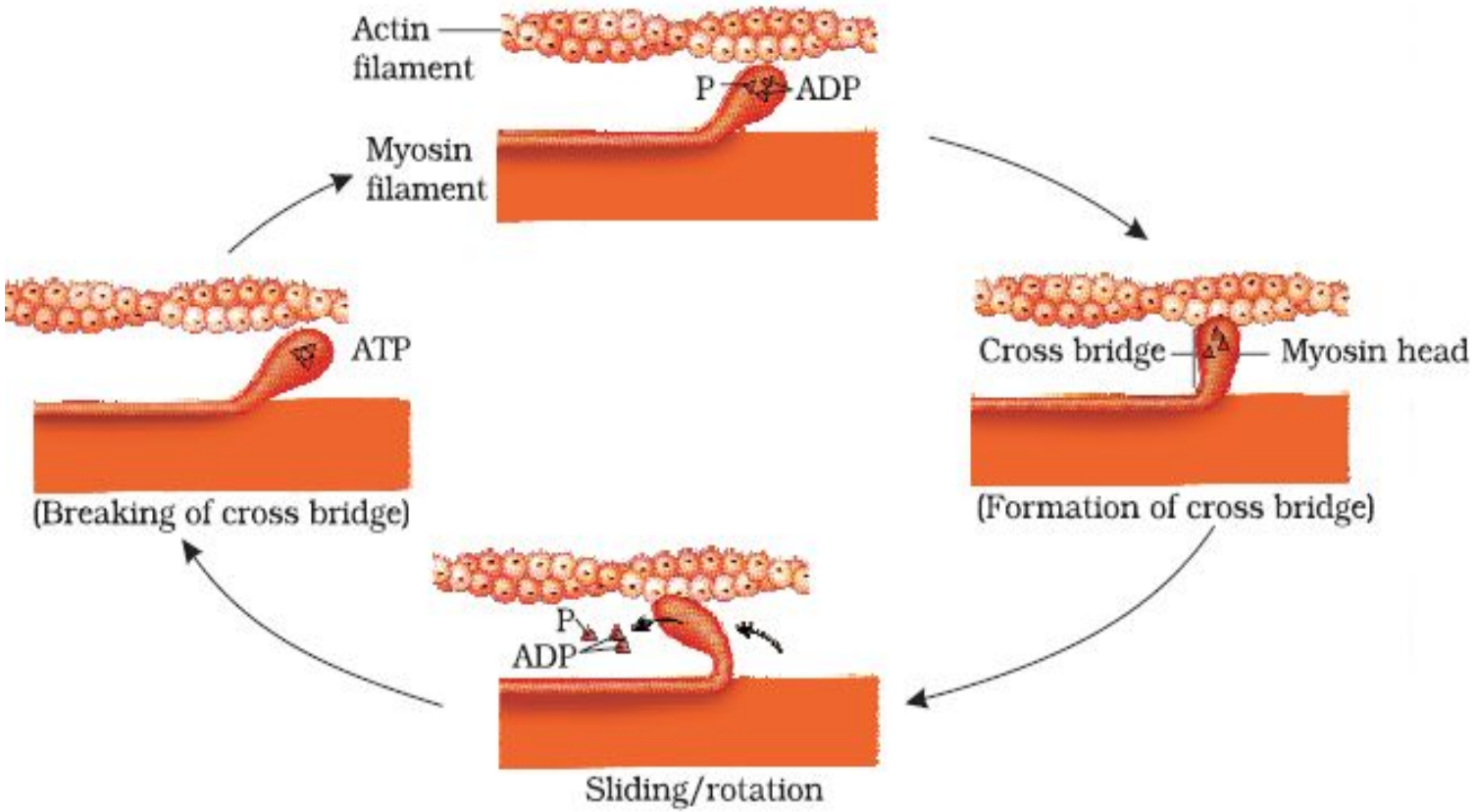
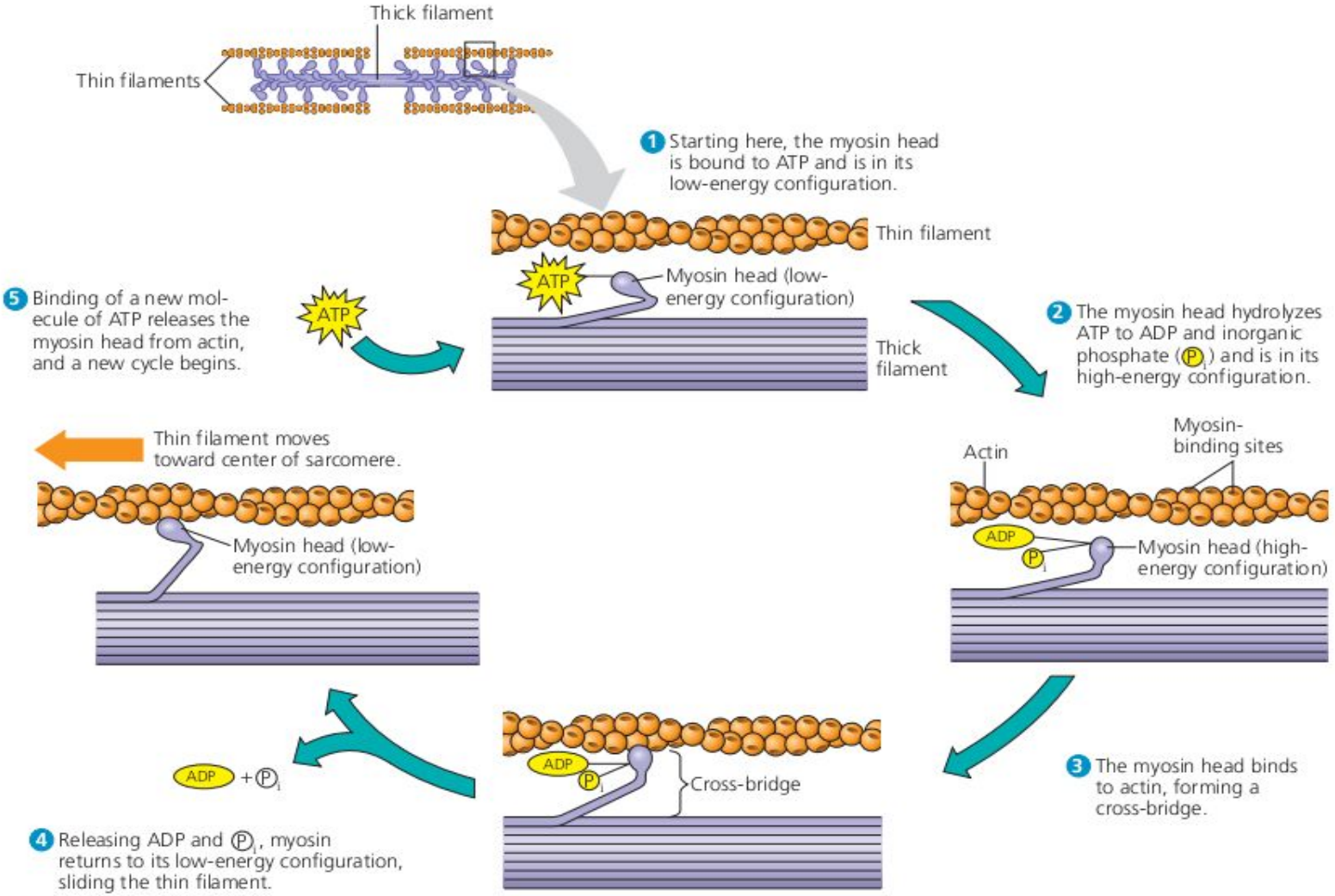


Figure 20.4 Stages in cross bridge formation, rotation of head and breaking of cross bridge



▲ Figure 50.28 Myosin-actin interactions underlying muscle fiber contraction.

? *When ATP binds, what prevents the filaments from sliding back into their original positions?*

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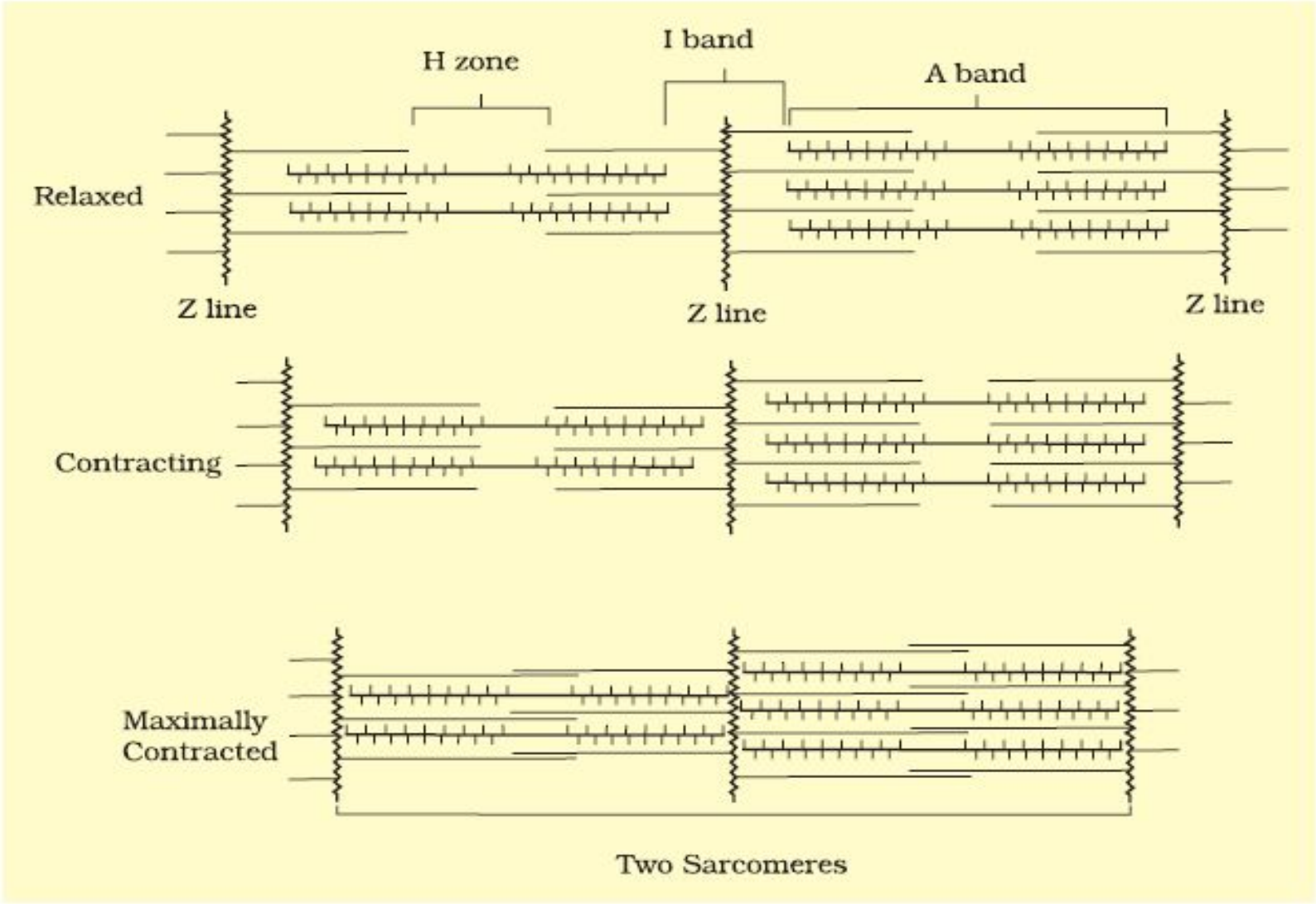

Figure 20.5 Sliding-filament theory of muscle contraction (movement of the thin filaments and the relative size of the I band and H zones)

SKELETAL SYSTEM

- Skeletal system consists of a framework of bones and a few cartilages
- It is grouped into two principal divisions – the axial and the appendicular skeleton.

Axial

Skull 28 – Cranium 8,Facial 14,Ear Oscicle 6

Vertibral Column 27 – Hyiod bone 1,Vertibrae(in Adult) 26

Tharax 25- Sternum 1,ribs 24

Appendicular Skeleton –

Upper region Pectoral girdle 4,arm and hands 60

Lower Region – Pelvic girdle 2,Legs and feets 60

Total Bones - 206

- Joint are essential for all types of movements involving the bony parts of the body
- Fibrous joints do not allow any movement. This type of joint is shown by the flat skull bones which fuse end-to-end with the help of dense fibrous connective tissues in the form of sutures, to form the cranium.
- In cartilaginous joints, the bones involved are joined together with the help of cartilages. The joint between the adjacent vertebrae in the vertebral column is of this pattern and it permits limited movements.

- Synovial joints are characterised by the presence of a fluid filled synovial cavity between the articulating surfaces of the two bones. Such an arragement allows considerable movement. These joints help in locomotion and many other movements. Ball and socket joint (between humerus and pectoral girdle), Hinge joint (knee joint), Pivot joint (between atlas and axis), Gliding joint (between the carpals) and Saddle joint (between carpal and metacarpal of thumb) are some examples.

DISORDERS OF MUSCULAR AND SKELETAL SYSTEM

- Myasthenia gravis: Auto immune disorder affecting neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.
- Muscular dystrophy: Progressive degeneration of skeletal muscle mostly due to genetic disorder.
- Tetany: Rapid spasms (wild contractions) in muscle due to low Ca^{++} in body fluid.
- Arthritis: Inflammation of joints.
- Osteoporosis: Age-related disorder characterised by decreased bone mass and increased chances of fractures. Decreased levels of estrogen is a common cause.
- Gout: Inflammation of joints due to accumulation of uric acid crystals.