FREE NOTES · NCERT + NEET LEVEL

Locomotion & Movement

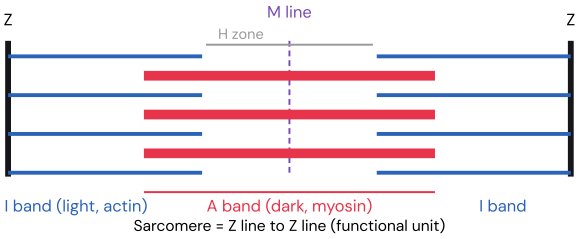
Types of movement, skeletal muscle structure, contractile proteins, sliding filament theory, skeletal system, joints and disorders of muscular and skeletal system.

01 Types of movement
02 Structure of skeletal muscle
03 Contractile proteins
04 Mechanism of muscle contraction
05 Skeletal system
06 Joints and disorders
07 Extra + tricks
08 Important Q&A
09 Common mistakes
10 Practice (NEET style)
11 Quick revision

01 Types of movement

- **Amoeboid**: pseudopodia by streaming protoplasm (macrophages, leucocytes); cytoskeletal microfilaments involved.
- **Ciliary**: trachea (removes dust), fallopian tube (ova transport).
- **Muscular**: limbs, jaws, tongue. Locomotion = movements that change location.
- Muscle is mesodermal; properties: excitability, contractility, extensibility, elasticity.
- Muscle types: skeletal (striated, voluntary), visceral (smooth, involuntary), cardiac (striated, involuntary).

02 Structure of skeletal muscle



A sarcomere

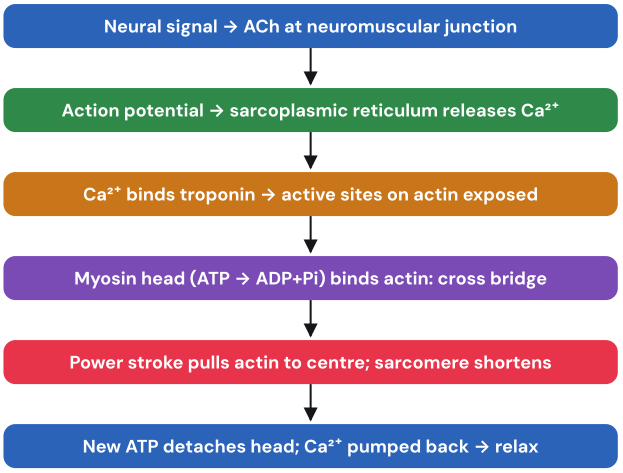
- Muscle → fascicles (bundles, covered by fascia) → muscle fibres (syncytium; sarcolemma, sarcoplasm, many nuclei, sarcoplasmic reticulum stores Ca^{2+}) → myofibrils.
- Myofibrils show alternate dark **A bands** (anisotropic, myosin) and light **I bands** (isotropic, actin). Z line bisects I band; M line in middle of A band; H zone = central part of A band not overlapped by thin filaments.

03 Contractile proteins

Filament	Made of	Details
Thin (actin)	2 F-actin (polymers of G-actin) helically wound + tropomyosin + troponin	Troponin masks active binding sites on actin at rest
Thick (myosin)	Polymer of meromyosins	Each meromyosin: heavy meromyosin (HMM: globular head + short arm, the cross arm) and light meromyosin (LMM: tail). Head is an active ATPase with binding sites for ATP and actin

04 Mechanism of muscle contraction

- **Sliding filament theory**: thin filaments slide over thick filaments.
- Motor neuron + its muscle fibres = **motor unit**.
- During contraction: I band shortens, A band length stays same, H zone disappears, Z lines come closer.
- Repeated activation ⇒ lactic acid accumulates (anaerobic breakdown of glycogen) ⇒ **fatigue**.
- **Red fibres**: much myoglobin, many mitochondria, aerobic. **White fibres**: little myoglobin, more sarcoplasmic reticulum, anaerobic.



Steps of contraction

05 Skeletal system

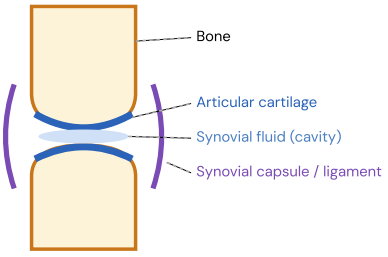
Part	Bones
Total	**206** bones in adult human; axial 80 + appendicular 126
Skull (22)	Cranium 8, face 14; hyoid (U-shaped) + 3 ear ossicles each side (malleus, incus, stapes); two occipital condyles (dicondylic)
Vertebral column (26)	Cervical 7, thoracic 12, lumbar 5, sacral 1 (fused), coccygeal 1 (fused). First vertebra = atlas
Sternum + ribs	Flat sternum; 12 pairs ribs: true ribs 1–7 (attached to sternum by hyaline cartilage), false 8–10 (vertebrochondral), floating 11–12
Limbs (30 each)	Forelimb: humerus, radius, ulna, 8 carpals, 5 metacarpals, 14 phalanges. Hindlimb: femur (longest bone), tibia, fibula, 7 tarsals, 5 metatarsals, 14 phalanges, patella (knee cap)
Girdles	Pectoral: clavicle (collar bone) + scapula (with glenoid cavity, acromion). Pelvic: two coxal bones (ilium, ischium, pubis) with acetabulum; pubic symphysis

06 Joints and disorders

- **Fibrous** (immovable): skull sutures. **Cartilaginous** (limited movement): between vertebrae. **Synovial** (freely movable, synovial fluid): ball and socket (humerus–pectoral girdle), hinge (knee), pivot (atlas–axis), gliding (carpals), saddle (carpal–metacarpal of thumb).
- **Myasthenia gravis**: autoimmune, affects neuromuscular junction, fatigue, weakening, paralysis. **Muscular dystrophy**: genetic, progressive degeneration. **Tetany**: rapid spasms due to low Ca^{2+} in body fluid.
- **Arthritis**: inflammation of joints. **Osteoporosis**: age-related, decreased bone mass, fractures; low oestrogen is a factor. **Gout**: uric acid crystals in joints.

07 Extra + tricks

Skull (22)	Bones
Cranium (8)	Frontal 1, parietal 2, temporal 2, occipital 1, sphenoid 1, ethmoid 1
Face (14)	Nasal 2, maxilla 2, zygomatic 2, lacrimal 2, palatine 2, inferior nasal concha 2, vomer 1, mandible 1



A synovial joint

- Ear ossicles: malleus, incus, stapes (stapes = smallest bone). Hyoid: U-shaped, at base of buccal cavity.
- **Gomphosis**: fibrous joint fixing teeth in jaw sockets.
- Carpals 8 (wrist), tarsals 7 (ankle); phalanges 14 in each hand and foot.
- Trick for vertebrae: "**breakfast at 7, lunch at 12, dinner at 5**" = 7 cervical, 12 thoracic, 5 lumbar.

08 Important Q&A

Q1. What happens to A band, I band and H zone during contraction?

A band unchanged; I band shortens; H zone narrows/disappears; sarcomere shortens.

Q2. What is the role of Ca^{2+} in contraction?

Ca^{2+} binds troponin, removing masking of active sites on actin so myosin can bind.

Q3. Count the ribs and classify.

12 pairs: 7 true, 3 false (vertebrochondral), 2 floating.

09 Common mistakes

- Saying A band shortens during contraction.
- Calling knee a ball and socket joint (it is hinge).
- Writing 33 vertebrae for adult (26 after fusion).
- Confusing tetany (low Ca^{2+}) with tetanus (bacterial).

10 Practice (NEET style)

1. Functional unit of muscle?
2. Longest bone?
3. Joint between atlas and axis?
4. Protein masking actin sites?
5. Number of bones in each limb?

ANSWERS

1) Sarcomere · 2) Femur · 3) Pivot · 4) Troponin · 5) 30

11 Quick revision: 5 minutes before the exam

MUSCLE

- A band myosin, I band actin
- Sarcomere Z to Z
- Red fibres: myoglobin, aerobic

CONTRACTION

- Ca^{2+} + troponin
- Cross bridge, ATP
- I band and H zone shrink

SKELETON

- 206 = 80 + 126
- Vertebrae 7-12-5-1-1
- Ribs 7 true, 3 false, 2 floating

JOINTS/DISORDERS

- Synovial types
- Myasthenia gravis autoimmune
- Gout: uric acid

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.