Locomotion and Movement

- The cells of human body exhibit amoeboid, ciliary, and muscular types of movements.

  - Amoeboid movement – Example: leucocytes present in the blood
  - Ciliary movement – Example: passage of ova through fallopian tube
  - Muscular movement – Example: movement of limbs, jaws, and tongue

Muscle

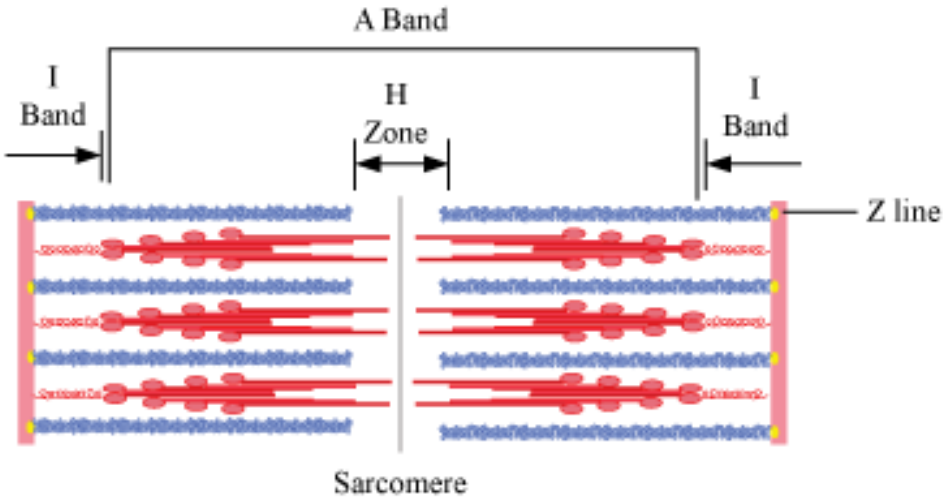
- Based on location, muscles are of three types;

  - Skeletal muscles/striated muscles – Voluntary in nature
  - Visceral muscles/smooth muscles – Involuntary in nature
  - Cardiac muscles – Involuntary in nature

- Myofibril is one of the several contractile filaments that make up a striated muscle fibre.
- Sarcomere is a part of myofibril.
- Sarcomere composed of two contractile proteins:

  - Actin – Thin filament and called I band
  - Myosin – Thick filament and called A band

- Z line bisects the centre of each I band.
- The functional unit of contraction between two successive Z lines is known as sarcomere.



- Troponin and tropomyosin are complex regulatory proteins that form a part of an actin filament.
- Troponin is attached to protein tropomyosin and masks the active binding sites for myosin on resting actin filament.
- Each myosin filament is made up of many monomeric protein called meromyosins.
- Meromyosin is made up of light meromyosin and heavy meromyosin. They help in cross bridge formation.

- Based on myoglobin, two types of muscle fibres are present:

(i) **Red muscle fibres** contain an abundance of myoglobin. Lots of mitochondria are present in red muscle fibres.

(ii) **White muscle fibres** contain less amount of myoglobin. Less number of mitochondria is present in white muscle fibres.**Sliding filament theory**

- It states that during the process of muscle contraction, the thin filaments slide over the thick filaments.
- During muscle contraction:

  - The distance between adjacent Z-lines decreases.
  - I band gets reduced while A band retains its original length.
  - H-zone gets reduced.
  - The size of sarcomere decreases.

- Steps of muscle contraction and relaxation:

Release of acetylcholine

↓

Generation of action potential

↓

Release of Ca^{2+} ions into sarcoplasm

↓

Binding of Ca^{2+} with troponin

↓

Unmasking of binding active site for myosin

↓

Cross bridge formation

↓

Muscle contraction

↓

Breaking of cross bridge

↓

Concentration of Ca^{2+} decreases

↓

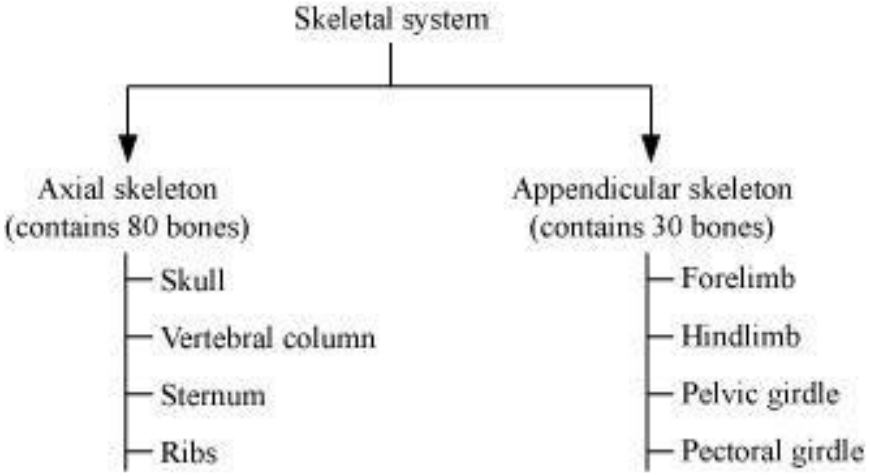
Masking of actin filament by troponin

↓

Muscle relaxation

Skeletal system

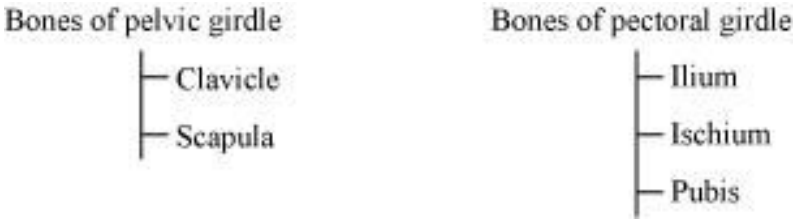
- Human skeletal system is made up of 206 bones.
- A typical bone consists of osteocytes or bone cells that are embedded in a ground matrix made up of collagen fibres and calcium and phosphorus salts.



- Vertebral column forms the axis of skeleton.
- It comprises a series of 26 vertebrae.
- Vertebral formula - Bones of vertebral column starting from skull is $C_7T_{12}L_5S_1Co_1$.
- Atlas (articulate with occipital condyles) and Axis are the 1^{st} and 2^{nd} vertebrae respectively.
- Sternum is a flat bone on the ventral midline of thorax.
- Ribs (12 pairs) are flat bones attached dorsally to vertebral column and ventrally to sternum.
- True ribs – Upper seven pairs
- False ribs – 8^{th}, 9^{th}, and 10^{th} pair; as they are not attached to the sternum directly
- Floating ribs – 11^{th} and 12^{th} (last two pairs); as they are not attached ventrally

Bones of forelimbs (in both for limbs)	Bones of hind limbs (in both for limbs)
Humerus -2	Femur – 2
Radius and ulna -4	Tibia and fibula – 4
Carpals (wrist bone) - 16	Tarsals (ankle bones) - 14
Metacarpals (palm bones) - 10	Metatarsals - 10
Phalanges (Digits) - 28	Phalanges - 28
	Patella (knee cap) - 2

- Pectoral and pelvic girdle helps in articulation of forelimbs and hind limbs with axial skeleton.



Joints

- Fibrous – Do not allow any movement

  Example: between cranial bones

- Cartilaginous joints – Bones joint together with the help of cartilage

  Example: joint between adjacent vertebrae

- Synovial joint – Have fluid-filled synovial cavity

  It is of five types:

- Ball and socket joint – Example: between humerus and pectoral girdle, femur and acetabulum

- Hinge joint – Example: knee joint
- Pivot joint – Example: between atlas and axis
- Gliding joint – Example: between carpals
- Saddle joint – Example: between carpal and metacarpal of thumb

Disorders

- **Myasthenia gravis** – Autoimmune disease that affects the neuromuscular junction
- **Muscular dystrophy** – Genetic disorder that leads to weakening of skeletal muscles
- **Tetany** – Associated with painful and involuntary contraction due to low calcium ions in body fluids
- **Arthritis** – Degenerative joint disease that occurs due to inflammation of joints
- **Osteoporosis** – Abnormal loss of bony tissue resulting into fragile porous bone
- **Gout** – Accumulation of uric acid crystal that leads to inflammation of joints

Disorders of Muscular and Skeletal system

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