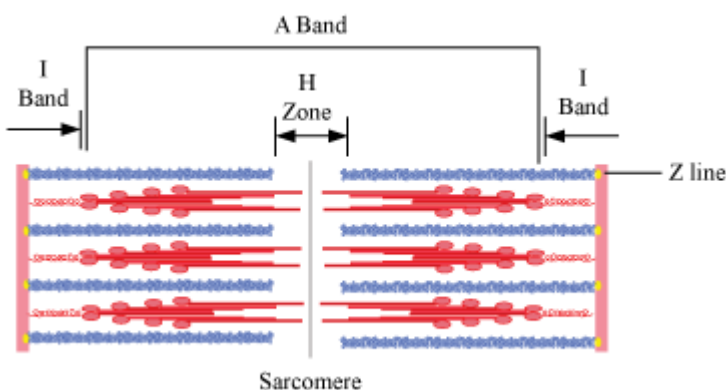


Locomotion and Movement

- 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

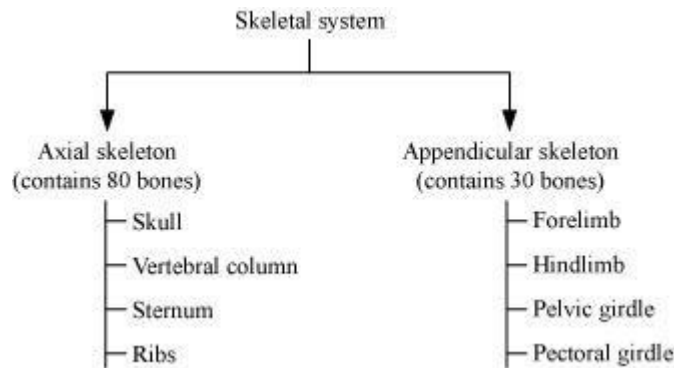
Concentration of Ca^{2+} decreases

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 1st and 2nd 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 – 8th, 9th, and 10th pair; as they are not attached to the sternum directly
- Floating ribs – 11th and 12th (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.

Bones of pelvic girdle

— Clavicle
— Scapula

Bones of pectoral girdle

— Ilium
— Ischium
— Pubis

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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- **Osteoporosis** – Abnormal loss of bony tissue resulting into fragile porous bone occurs due to decreased estrogen levels
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