

LOCOMOTION AND MOVEMENT

INTRODUCTION:

- A simple form of movement is the **streaming of protoplasm in protozoans** Ex: *Amoeba*
- Movement of an animal results in a change of place or location is **locomotion**
- Locomotion plays a vital role in searching the **food and shelter, meeting their mate and protection from their predator**

TYPES OF MOVEMENTS:

- Three main types of movements are found in animals – **Amoeboid, ciliary and muscular**
- Amoeboid movement is brought about by **pseudopodia**
- Amoeboid movement is exhibited by *Amoeba*, **phagocytes, macrophages etc,**
- Ciliary movement is exhibited by **cilia**
- Ciliary movement is shown by *Paramecium*, **internal tubular organs of higher animals etc,**
- Passage of ova in female reproductive tract is **ciliary movement**
- Movement of limbs, jaws, tongue etc, in human is **muscular movement**

LOCOMOTION IN HUMANS:

MUSCLES:

- Locomotion in humans depends on the movements of **muscles**
- Muscles are the derivatives of **mesoderm**
- Percentage of total body weight occupied by muscles is **40 – 50**
- Properties of muscles are **excitability, contractility, extensibility and elasticity**
- Striped and voluntary muscles – **Skeletal muscles**
- Locomotory actions and changes of body postures are controlled by **Skeletal muscles**
- Unstriped and involuntary muscles – **Smooth or visceral muscles**
- Walls of visceral organs such as intestinal, genital, urinary and respiratory organs are made up of **smooth muscles**
- Walls of blood vessels are provided with **smooth muscles**
- Striped and involuntary muscle is **cardiac muscle**

Types of muscles based on function:

- Muscles contract to bring two bones closer – **Flexors Ex: Biceps**
- Muscles that increase the angle of a joint – **Extensors Ex: Triceps**
- Muscles that raise the parts upwards – **Elevator Ex: Masseter**
- Muscles that lower the part raised by elevator – **Depressor Ex: Depressor mandibularis**
- Muscles move the parts away from the axis of the body – **Abductor Ex: Deltoid**
- Muscles pull the parts towards the axis of the body – **Adductor Ex: Latissimus dorsi**
- Muscles that rotate the parts – **Rotator Ex: Piriformis**
- Muscles that constrict an aperture – **Constrictor Ex: Sphincter**
- Muscles that dilate an aperture – **Dilator Ex: Dilator**
- Muscles that make a part tense or more rigid – **Tensor**
- Muscle that rotate the forearm and turns hand/palm upward – **Supinator**
- Muscle that turn palm or hand downward – **Pronator**

Physical properties of muscles:

- Muscle fibres and the motor neurons that supply to them collectively called **motor unit**
- A response to a single brief stimulus is **muscle twitch**
- Period during which a muscle will not respond is **refractory period**
- All the muscles in the body at a given time are never found in a perfectly relaxed state and in a state of mild contraction – **Tonicity**
- A continued state of contraction caused by rapid succession of many stimuli – **Tetanus**
- Inability of a muscle to contract due to depletion of its chemical and lactic acid accumulation by repeated contraction – **Muscle fatigue**
- The lower limit of stimulus capable to bring contraction of muscles – **Threshold or minimal stimulus or rheobase**
- If muscle fibres contract in response to a stimulus, it contracts maximally or not at all – **All or none response**
- The rigidity of muscles that occurs after death – **Rigor mortis**

Structure and function of skeletal muscle:

- Connective tissue around the skeletal muscle – **Epimysium**
- Bundle of muscle fibres in a skeletal muscle – **Fascicle**
- Connective tissue around the fascicle – **Perimysium**
- Bundles of fascicles surrounded by a tough membrane – **Fascia**
- A muscle fibre of skeletal muscle enveloped by **endomysium**
- Physiological unit of skeletal muscle – **Muscle fibre or muscle cell**
- Mitochondria of muscle fibre – **Sarcosomes**
- Thin rod like parallel structures in muscle fibre – **Myofibrils**
- Units of muscle contraction in myofibril – **Sarcomeres**
- Space between two Z-lines – **Sarcomere**
- Most abundant mineral in muscle fibre – **Potassium**
- Oxygen carrying iron-protein pigment in muscle – **Myoglobin**
- Monomeric components in myosin – **Meromyosins**
- Abundant mitochondria are found in **red muscle fibres**
- Abundant sarcoplasmic reticulum is seen in **white muscle fibres**
- Aerobic muscle fibres are **red muscle fibres**
- Anaerobic muscle fibres are **white muscle fibres**
- Muscle fibres that do not store oxygen – **White muscle fibres**
- Eye ball muscle is the example of **white muscle fibres**
- Muscle contraction can be explained by **sliding filament hypothesis**
- Sarcomere shortens by the shortening of **I-band**
- Immediate backup source of energy for muscle contraction in vertebrate muscle is **creatine phosphate**
- Anaerobic process in muscle leads to accumulation of **lactic acid**
- A cycle that helps in conversion of lactic acid accumulated in muscle into glycogen formed in liver is **Cori cycle**
- Apparatus used to record muscle contraction are **kymograph and polygraph**

SKELETON IN HUMANS:

- Number of bones in human skeleton – **206**
- Human skeleton is divided into **axial skeleton and appendicular skeleton**

- Axial skeleton includes **skull, vertebral column, sternum and ribs**
- Appendicular skeleton includes **girdles and limb skeleton**
- The skeleton of human has the following bones

Cranial bones (8):

- [Frontal Bone](#)
- [Parietal Bone](#) (2)
- [Temporal Bone](#) (2)
- [Occipital Bone](#)
- [Sphenoid Bone](#)
- [Ethmoid bone](#)

Facial bones (14):

- [Mandible](#)
- [Maxilla](#) (2)
- [Palatine Bone](#) (2)
- [Zygomatic Bone](#) (2)
- [Nasal Bone](#) (2)
- [Lacrimal Bone](#) (2)
- [Vomer](#)
- [Inferior Nasal Conchae](#) (2)

In the [middle ears](#) (6):

- [Malleus](#) (2)
- [Incus](#) (2)
- [Stapes](#) (2)

In the [throat](#) (1):

- [Hyoid Bone](#)

In the [shoulder](#) girdle (4):

- [Scapula](#) or shoulder blade (2)
- [Clavicle](#) or collarbone (2)

In the [thorax](#) (25):

- [Sternum](#) (1) – 3 bones

[Manubrium](#), [body of sternum](#) (gladiolus)

and [xiphoid process](#)
- [Ribs](#) (2 x 12)

In the [vertebral column](#) (24):

- [Cervical Vertebrae](#) (7)
- [Thoracic Vertebrae](#) (12)
- [Lumbar Vertebrae](#) (5)

In the [arms](#) (2):

- [Humerus](#) (2)

In the [forearms](#) (4):

- [Radius](#) (2)
- [Ulna](#) (2)

In the [hands](#) (54):

- [Carpal](#) (wrist) bones:
 - [Scaphoid Bone](#) (2)
 - [Lunate Bone](#) (2)
 - [Triquetral Bone](#) (2)
 - [Pisiform Bone](#) (2)
 - [Trapezium](#) (2)
 - [Trapezoid Bone](#) (2)

- [Capitate Bone](#) (2)
- [Hamate Bone](#) (2)
- [Metacarpus](#) (palm) bones:
- [Metacarpal Bones](#) (5 × 2)

- Digits of the hands
 - [Proximal Phalanges](#) (5 × 2)
 - [Intermediate Phalanges](#) (4 × 2)
 - [Distal Phalanges](#) (5 × 2)

In the [pelvis](#) (4):

- [Sacrum](#)
- [Coccyx](#)
- [Os Coxae](#) (innominate bone or hip bone) (2)

In the [thighs](#) (2):

- [Femur](#) (2)

In the [legs](#) (6):

- [Patella](#) (2)
- [Tibia](#) (2)
- [Fibula](#) (2)

In the [feet](#) (52):

- [Tarsal](#) (ankle) bones:
 - [Calcaneus](#) (heel bone) (2)
 - [Talus](#) (2)
 - [Navicular Bone](#) (2)
 - [Medial Cuneiform Bone](#) (2)
 - [Intermediate Cuneiform Bone](#) (2)
 - [Lateral Cuneiform Bone](#) (2)
 - [Cuboid Bone](#) (2)

- [Metatarsus](#) bones:

- [Metatarsal Bone](#) (5 × 2)
- Digits of the feet
 - [Proximal Phalanges](#) (5 × 2)
 - [Intermediate Phalanges](#) (4 × 2)
 - [distal phalanges](#) (5 × 2)

JOINTS:

- The place of articulation of two or more bones is **joint**
- Articulating bones firmly associated together – **Fixed/immovable/fibrous joint**
- Joint in immovable joint held by – **Dense irregular connective tissue**
- Articulating movements allow little movements – **Imperfect/slightly movable/ cartilaginous joint**
- In slightly movable joint, the joint has – **Fibrocartilage**
- Articulating bones allow free movement – **Perfect/freely movable/synovial joint**
- Free movement in all directions – **Ball and socket (Spheroidal)**
- Examples of ball and socket joint – **Shoulder joint and hip joint**
- Angular movement in one direction – **Hinge (Ginglymi)**
- Examples of hinge joint – **Elbow joint, knee joint, joint between phalanges**
- Rotatory movement – **Pivot (Trochoid joint)**
- Example of pivot joint – **Joint between atlas and axis vertebrae**
- Restricted movement in all directions – **Gliding/planar joint**
- Examples of gliding joints – **Joints between vertebrae, carpals and tarsals**
- Joint similar to ball and socket joint but not fully developed – **Saddle/sellar joint**
- Joint seen only in primates is – **Saddle joint**
- Examples of saddle joint – **Joint between metacarpal and carpal of thumb of primates**
- Joints where angular movement is allowed in two planes – **Angular/ellipsoid/condyloid**
- Examples of condyloid joints - **Radio-metacarpal joint and metacarpo-phalangeal joints**

Disorders of muscular and skeletal systems:

- An autoimmune disorder that causes chronic, progressive damage of the neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle – **Myasthenia gravis**
- Myasthenia gravis is caused by a defect in – **the transmission of nerve impulses to the muscles**

- A genetic disorder where progressive degeneration of skeletal muscle occurs – **Muscular dystrophy**
- Rapid spasms in muscle due to low calcium ions in the body fluid – **Tetany**
- Inflammation in muscle and its tendon - **Myotenositis**
- A sudden pull or twist may cause the stretching of ligaments – **Sprain**
- Displacement of articulating bones due to tearing of ligaments – **Dislocation**
- Displacement of vertebrae from vertebral column – **Slipped disc**
- Acute pain in the joint due to lack of synovial fluid or deposition of uric acid crystals in the joint – **Arthritis**
- Three types of arthritis – **Rheumatoid arthritis, osteoarthritis and gouty arthritis**
- Gradual softening and bending of bones accompanied by severe pain, common in persons having kidney failure attributed with vitamin D deficiency – **Osteomalacia**
- Degeneration or thinning of bone tissue, resulting in decreased thickness, enlarge marrow and structural weakness – **Osteoporosis**
- Sarcomatous tumor growing in bone – **Osteosarcoma**
- Increased density of hardness of bone - **Osteosclerosis**