

## Locomotion and Movement

- ❖ **Locomotion:** Voluntary movements resulting in change in place/location.
- ❖ **Movement:** Significant feature of living beings.
- ❖ All locomotions are movements but all movements are not locomotion.

**Table:** Types of Movement / Locomotion

Type	Structure	Examples and functions
<b>Amoeboid</b>	Protoplasmic streaming	• Leucocytes, macrophages, <i>Amoeba</i>
<b>Ciliary</b>	Cilia	• Removing dust particles from trachea • Passage of ova through female reproductive tract
<b>Flagellar</b>	Flagella	• Water current in Canal System of Sponges • Locomotion in <i>Euglena</i> • Swimming of spermatozoa
<b>Muscular</b>	Muscles	• Movement of limbs, jaws, tongue, etc.

## Muscles

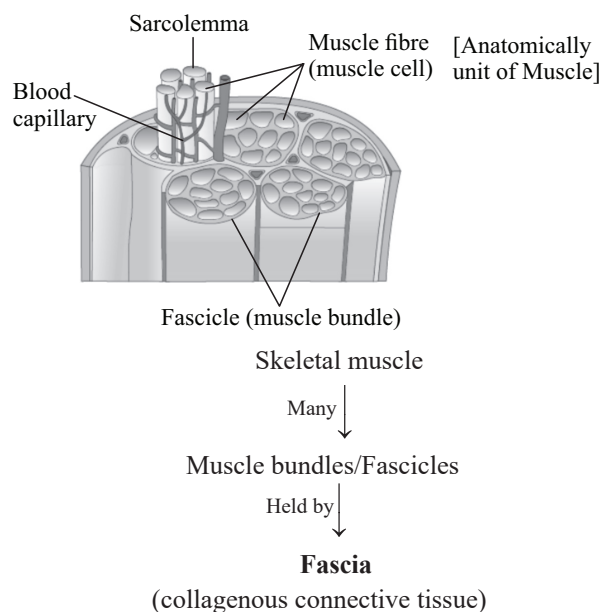
- ❖ Mesodermal in origin.
- ❖ 40-50% of the body weight of a human adult is contributed by muscles.
- ❖ **Properties:** Excitability, contractility, extensibility and elasticity.

**Table:** Types of Muscles based on Appearance, Nature of Regulation and their Location

Muscles	Appearance	Regulation	Location
<b>1. Skeletal</b>	Striated	Voluntary	Muscles of limbs
<b>2. Smooth</b>	Non-striated/smooth	Involuntary	Inner walls of visceral organs
<b>3. Cardiac</b>	Striated	Involuntary	Muscles of heart

## Skeletal Muscle

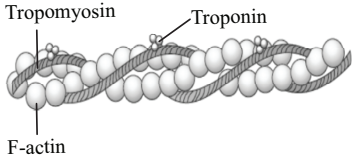
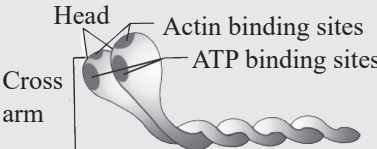
- ❖ Closely associated with the skeletal components of the body.
- ❖ Primarily involved in locomotion and body posture.

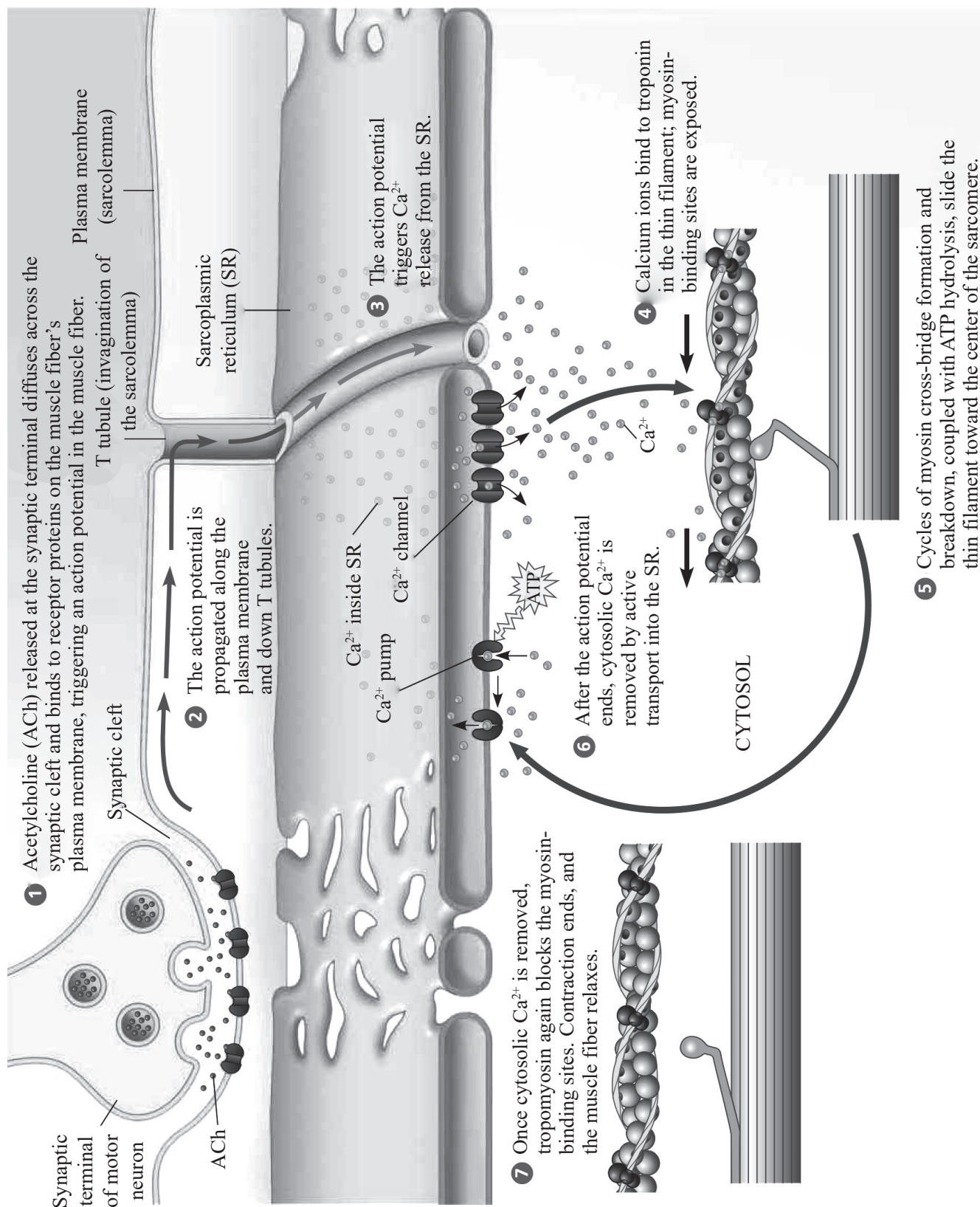


Types of muscle fibres		
Features	Red	White
Myoglobin	↑	↓
Mitochondria	↑	↓
SR	↓	↑
Respiration	Mainly aerobic	Mainly anaerobic

- ❖ Each muscle bundle contains a number of muscle fibres.
- ❖ Muscle fibre is a syncytium (sarcolemma contains many nuclei).
- ❖ Endoplasmic reticulum, i.e., sarcoplasmic reticulum of muscle fibre is the store house of calcium ions.
- ❖ Each muscle fibre has many parallelly arranged myofibrils/myofilaments.
- ❖ Each myofibril has dark and light bands due to actin and myosin distribution that establish striated appearance.

**Table: Myofilaments and Structure of Contractile Proteins**

Filament	Held by	Protein
<ul style="list-style-type: none"> <li>❖ Thin</li> </ul> 	Z-line (bisect I-band)	<ul style="list-style-type: none"> <li>❖ Actin (contractile)</li> <li>❖ Made of two 'F' actins (Polymer of 'G' actin)</li> <li>❖ Tropomyosin</li> <li>❖ Troponin</li> </ul>
<ul style="list-style-type: none"> <li>❖ Thick</li> </ul> 	<ul style="list-style-type: none"> <li>❖ M-line (thin fibrous membrane)</li> </ul>	<ul style="list-style-type: none"> <li>❖ Myosin (contractile)</li> <li>❖ Monomeric protein - meromyosin.</li> </ul> <pre> graph TD     Meromyosin --&gt; LMM["LMM&lt;br/&gt;(Light)"]     Meromyosin --&gt; HMM["HMM&lt;br/&gt;(Heavy)"]     LMM --&gt; Tail     HMM --&gt; Head     HMM --&gt; Short_arm[Short arm]     </pre>

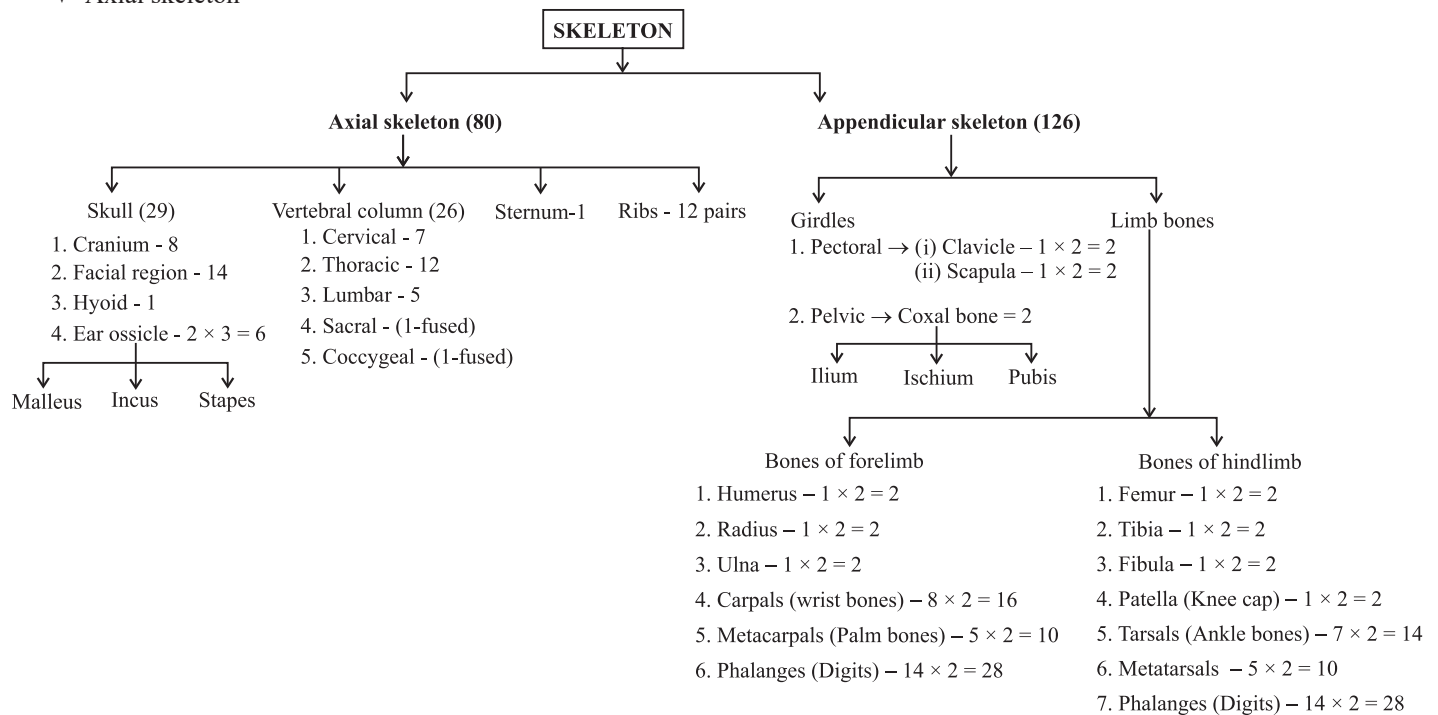


## Mechanism of Muscle Contraction

- ❖ Contraction of muscle fibre takes place by the sliding of the thin filaments over the thick filaments.
- ❖ A motor neuron + Muscle fibres = Motor unit

## Skeletal System

- ❖ Framework of 206 bones & few cartilages.
- ❖ Principle division
  - + Appendicular skeleton
  - + Axial skeleton



- ❖ **Scapula**, expanded to form acromion process that articulates with clavicle.
- ❖ **Glenoid cavity** in scapula articulates with humerus head to form shoulder joint.
- ❖ **Acetabulum**, articulates with femur to form hip joint.
- ❖ 2 halves of pelvic girdle meet ventrally to form **pubic symphysis** containing **fibrous cartilage**.

## Joints

- ❖ They are essential for all types of movements.
- ❖ Force generated by muscle is used to carry out movement through joint, where joint acts as **fulcrum**.

**Table: Types of Joints**

Types	Bones joined by	Movement	Examples
<b>Fibrous</b>	Dense fibrous connective tissue	Do not allow any movement	Flat skull bones fused end to end via sutures to form cranium
<b>Cartilaginous</b>	Cartilage	Limited movement	Adjacent vertebrae
<b>Synovial</b>	Fluid filled synovial cavity between 2 bones	Considerable movement, helps in locomotion and many other movements	Humerus & pectoral girdle (Ball and socket joint), Knee joint (Hinge joint), Atlas & axis (Gliding joint), Between carpals (Gliding joint), Carpal & metacarpal of thumb (Saddle joint)

**Table: Disorder of Muscular and Skeletal System**

Disease	Causes	Impact
<b>Myasthenia gravis</b>	Autoimmunity	<ul style="list-style-type: none"> <li>• Affect neuromuscular junction</li> <li>• Fatigue, weakening and paralysis of skeletal muscles</li> </ul>
<b>Muscular dystrophy</b>	Genetic	<ul style="list-style-type: none"> <li>• Progressive degeneration of skeletal muscles</li> </ul>
<b>Tetany</b>	Low $\text{Ca}^{2+}$ in body fluid	<ul style="list-style-type: none"> <li>• Rapid spasms in muscle (wild contractions)</li> </ul>
<b>Arthritis</b>	Inflammation	<ul style="list-style-type: none"> <li>• Inflammation of joints</li> </ul>
<b>Gout</b>	Accumulation of uric acid crystals	<ul style="list-style-type: none"> <li>• Inflammation of joints</li> </ul>
<b>Osteoporosis</b>	<ul style="list-style-type: none"> <li>❖ Age related</li> <li>❖ Decreased levels of estrogen</li> </ul>	Decreased bone mass, increased chances of fracture