

# HUMAN ANATOMY AND PHYSIOLOGY

## UNIT 2 NOTES

### INTEGUMENTARY SYSTEM

- SKIN
- HAIR & NAILS

### SKELETAL SYSTEM

- BONES
- CLASSIFICATION OF SKELETAL SYSTEM
- ORGANISATION OF SKELETAL MUSCLE
- NEUROMUSCULAR JUNCTION

### JOINTS

- TYPES OF JOINTS
- ON THE BASIS OF STRUCTURE
- ON THE BASIS OF FUNCTION



## CONNECT WITH US ON :



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# INTEGUMENTARY SYSTEM

- The word Integumentary stands for covering.
- It consist of skin and accessory organs i.e., hair, nails & skin glands.
- Dermatology is the branch of science that deals with the study & treatment of integumentary system.

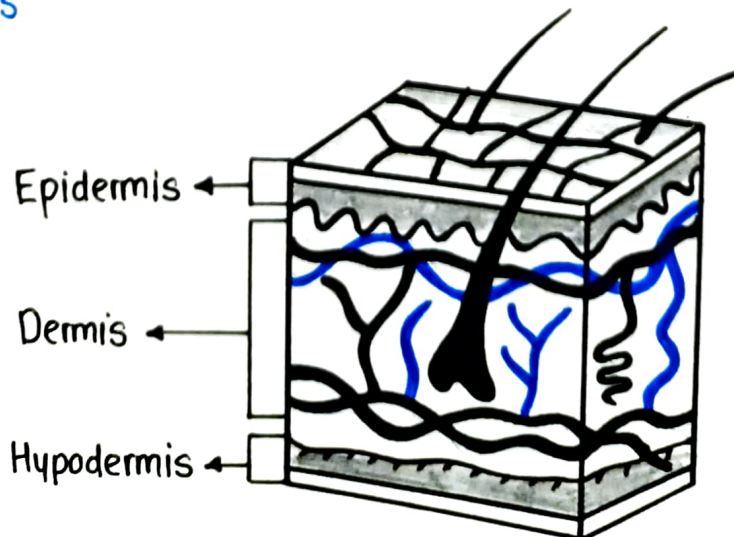
## SKIN

- The skin is the outer covering of the body.
- In humans, It is the largest organ of integumentary system.
- Skin consist of 12-15% of total body weight.
- The thickness of skin varies from 0.5 mm (on the eyelids) to 4.0 mm (on the sole).

### Layers of Skin

Skin is composed of three layers :

- ① Epidermis
- ② Dermis
- ③ Hypodermis



## Epidermis

- Epidermis is the outermost layer of the skin
- It is composed of keratinized stratified squamous epithelium.
- The epidermis has no blood vessels.
- They get nourished by diffusion of nutrients from underlying dermis layer
- Epidermis consist of 4 major types of cells.
  - ① keratinocytes
  - ② Melanocytes
  - ③ Langerhan's Cells
  - ④ Merkel Cells

### Keratinocytes

- About 90% of epidermal cells are keratinocytes which produces 'keratin'
- It is tough, fibrous protein that provides hardness and make skin waterproof.

### Melanocytes

- About 8% of epidermal cells are melanocytes which produces 'melanin'
- Melanin is yellowish to brownish pigment that contributes to skin colour and protect from UV light.

### Langerhan's Cells

- They arise from red bone marrow and involves in immune responses to protect our skin from microbes.

### Merkel Cells

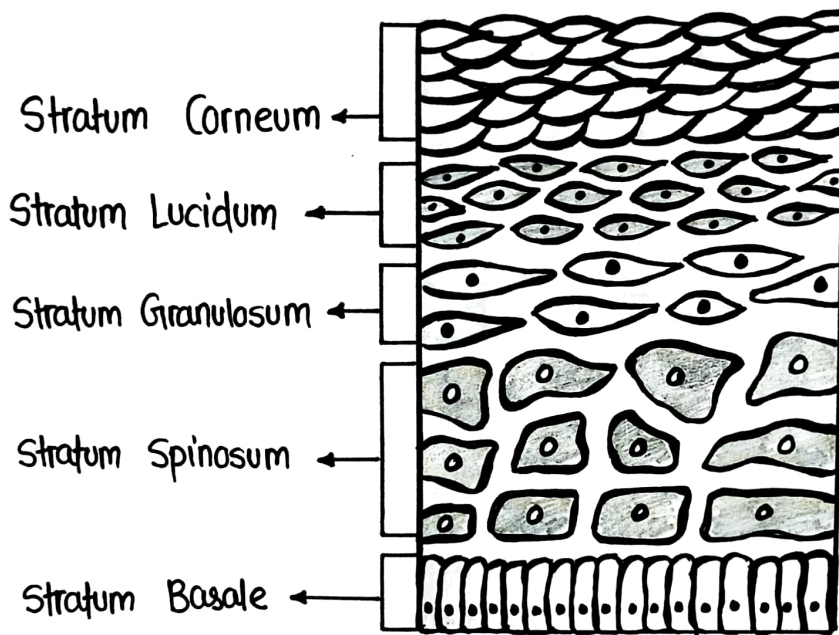
- They are specialized cells that receives the sensation of touch, pain etc.



## Layers of Epidermis

Epidermis is composed of five layers

- ① Stratum Corneum
- ② Stratum Lucidum
- ③ Stratum Granulosum
- ④ Stratum Spinosum
- ⑤ Stratum Basale



[ EPIDERMIS ]

### Stratum Corneum

- It is the uppermost layer of epidermis
- It consists of 25-30 layers of flat, dead, keratinized cells.
- It acts as a barrier against heat, water & many other chemicals

### Stratum Lucidum

- It is found only in thick skin
- It contains flat, dead, keratinized cells.



## Stratum Granulosum

- It is present in the middle of the epidermis.
- It consist of 3-5 layers of flat keratinocytes cells.

## Stratum Spinosum

- It is present above the stratum basale.
- It consist of 8-10 layer of keratinocytes

## Stratum Basale

- It is the deepest layer of epidermis.
- It forms a strong bond between epidermis and dermis.
- It helps in the formation of fingerprints.

## Dermis

- It is second deeper layer of the skin
  - It is mainly consist of connective tissue
  - It contains blood vessels, Glands, hair follicles and nerve endings.
  - The dermis can be divided into two sub layer
- ① Papillary Layer
  - ② Reticular Layer

Papillary Layer	Reticular Layer
<ul style="list-style-type: none"><li>• It mainly consist of loose connective tissue</li><li>• It is rich in small blood vessels</li><li>• It contains nerve endings that receives sensation of touch, pain, hot, cold etc.</li></ul>	<ul style="list-style-type: none"><li>• It is mainly consist of dense connective tissue</li><li>• It contains fat cells, blood vessels, glands &amp; hair follicles</li><li>• It provides strength to the skin</li></ul>

## Hypodermis / Subcutis

- It is not actually the part of the skin and present below the dermis layer.
- It attach the skin to underlying bones and muscles.
- It helps in the storage of fat.

## Functions of Skin

### Protection

- The skin provides protection to the body in various ways
- keratin protects underlying tissues from bacteria, virus, heat & other chemicals
- The melanin pigment helps skin to protect skin from harmful UV rays.

### Absorption

- The skin is the route by which substance can enter inside the body.
- It helps in the absorption of various drugs that are in the form of lotion, gel and ointments.

### Regulation of Body Temperature

- Skin regulates the body temperature by various mechanism.
- Sweat glands release sweat to cool the body when body temperature exceeds above  $37^{\circ}\text{C}$ .
- Blood vessels dilates when body temperature rises and requires cooling
- Blood vessels contracts when body temperature falls and requires heating.

### Secretion

- Sweat glands secrete sweat to excrete small amount of salt.
- Sebaceous glands produce sebum which protects body from dehydration.

## Sensation

- Skin contains millions of nerve endings that act as sensory receptors.
- Sensory reaction includes sensation of touch, heat, cold, pain, pressure etc.

## Division of Skeletal System

The adult human skeleton usually consist of 206 bones.

These bones can be divided into two divisions

- axial skeleton
- appendicular skeleton





# SKELETAL SYSTEM

- The skeletal system is the structural framework that supports the whole body and protect internal organs
- An adult human skeleton consist of 206 bones.
- Bone tissues make up about 18% of total body weight.
- Osteology is the branch that deals with the structure and function of skeletal system.
- A skeletal system is mainly composed of :
  - ① Bones
  - ② Cartilage
  - ③ Joints
  - ④ Ligaments

## Functions of Skeletal System

**Support** : Hard structural framework that supports body.

**Protection** : Protect internal organs such as brain, heart, spinal cord.

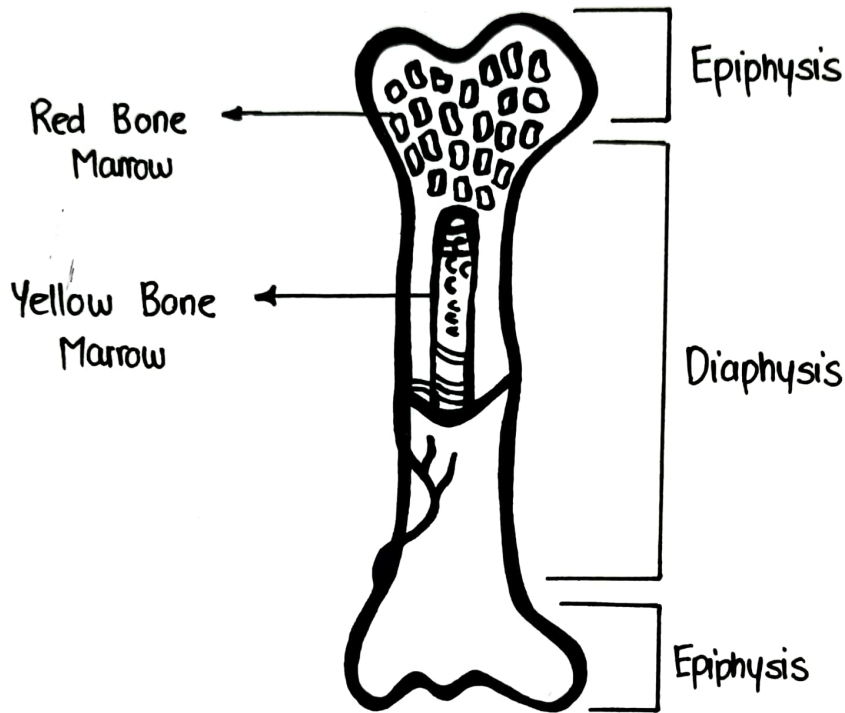
**Movement** : Provide movement as they are attached with skeletal muscles.

**Storage** : Stores minerals such as calcium, phosphate and fat storage.

**Blood Production** : Blood cells are produced in the red bone marrow.

## Structure of Bone

- Bone is the hardest connective tissue that is capable of growth & perform various functions.
- It basically consist of two parts :
  - ① Diaphysis
  - ② Epiphysis



### Diaphysis

- It is the long, cylindrical and main portion of the body.
- It mainly consist of red bone marrow and yellow bone marrow.
- Red bone marrow produced blood cells.
- Yellow bone marrow stores fat and in emergency it converts into red bone marrow.

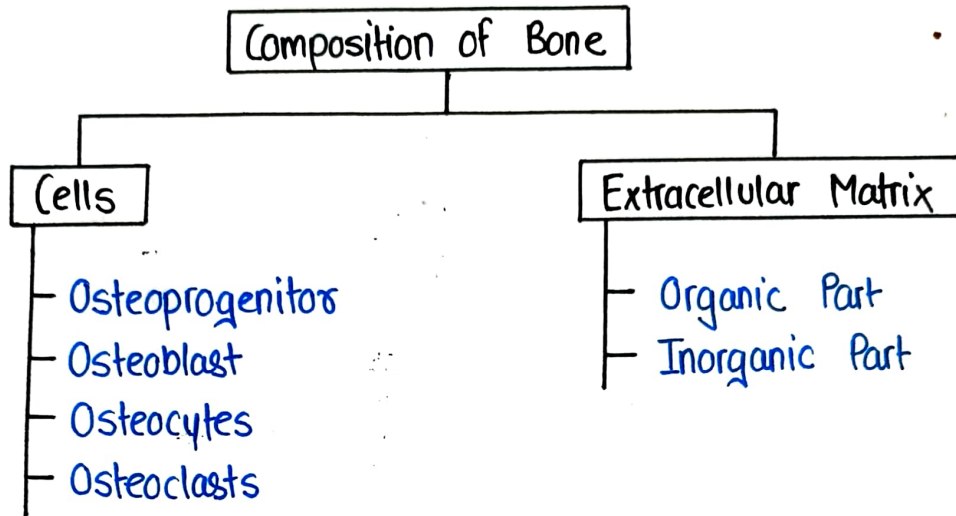
### Epiphysis

- These are the end parts of the bones and consist of spongy bones.

## Composition of Bone

A bone is mainly composed of two parts :

- Cells
- Extracellular Matrix



### Cells :

#### Osteoprogenitor

- Osteoprogenitor cells, also known as osteogenic cells are stem cells in the bone that plays vital role in bone repair and growth.
- These cells undergo cell divisions and develops into osteoblasts.

#### Osteoblasts

- These are bone building cells
- They produce organic part of the extracellular matrix in the bones.

#### Osteocytes

- These are main cells in bone tissue and maintain its daily metabolism such as exchange of nutrients with blood.

## Osteoclasts

- These are large multinucleated cells.
- These cells are responsible for resorption of bones.

## Extracellular Matrix :

### Organic Part

The organic part of extracellular matrix is mainly consist of collagen (Type -I) and Non- collagen including glycoprotein, lipid etc.

### Inorganic Part

The inorganic part of extracellular matrix is mainly consist of calcium, phosphate, magnesium and other trace elements.



## Types of Bones

There are mainly five types of bones :

- ① Long bones
- ② Short bones
- ③ Flat bones
- ④ Irregular bones
- ⑤ Sesamoid bones

### Long Bones

- Long bones mainly supports the weight of the body and allow movement.
- Example : Femur

### Short Bones

- These are cube shaped bones having equal length and wide.
- They mainly provide stability and movement.
- Example : Carpals and Tarsals

### Flat Bones

- These are thin and flat shaped bones.
- They mainly protect the internal organs.
- Example : Skull Bones

### Irregular Bones

- These bones are vary in shape and size and having complex structure.
- They mainly provide protection and support.
- Example : Vertebarae .



## Sesamoid Bones

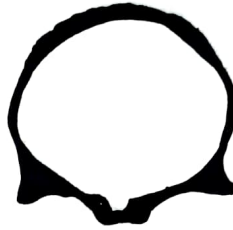
- These are small rounded bones present in tendons
- example : Patella.



Short



Long



Flat



Irregular



Sesamoid

# AXIAL SKELETON

The axial consist of

- Skull
- Auditory ossicles / Ear bones
- Vertebral Column
- Hyoid. Bones
- Thoracic Cage / Rib Cage
- Sternum

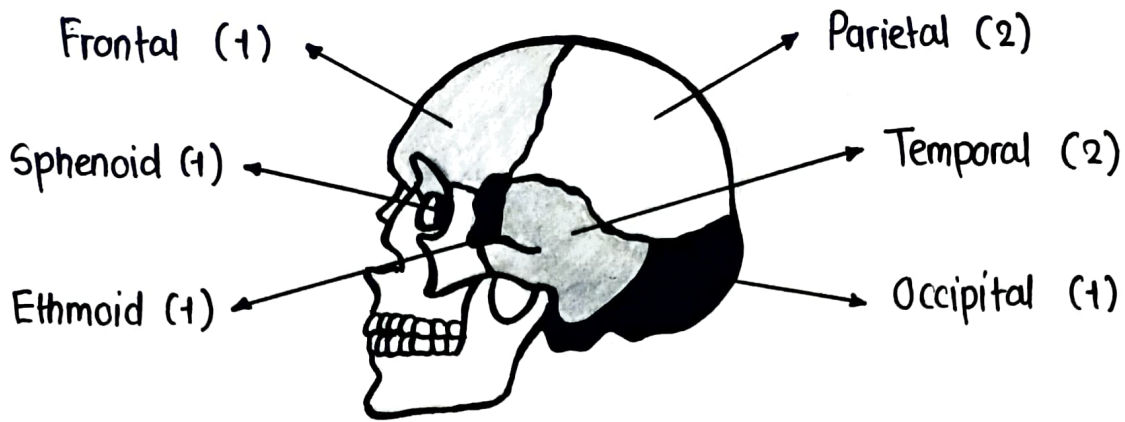
## SKULL

- The skull is situated on the upper end of vertebral column which supports and protects brain and structure of face.
- It is divided into two parts
  - ① The cranium
  - ② The Face

### The Cranium

It is formed by flat and irregular bones that provide protection to brain. The cranium consist of following 8 bones :

① Frontal Bone	It forms the forehead and parts of eye socket
② Parietal Bones	It forms the side and roof of the skull
② Temporal Bones	It forms immovable joints of the skull
① Occipital Bone	It forms back of head and base of skull
① Sphenoid Bone	It occupies middle portion of base of skull
① Ethmoid Bone	It forms nasal septum and lateral wall of nose



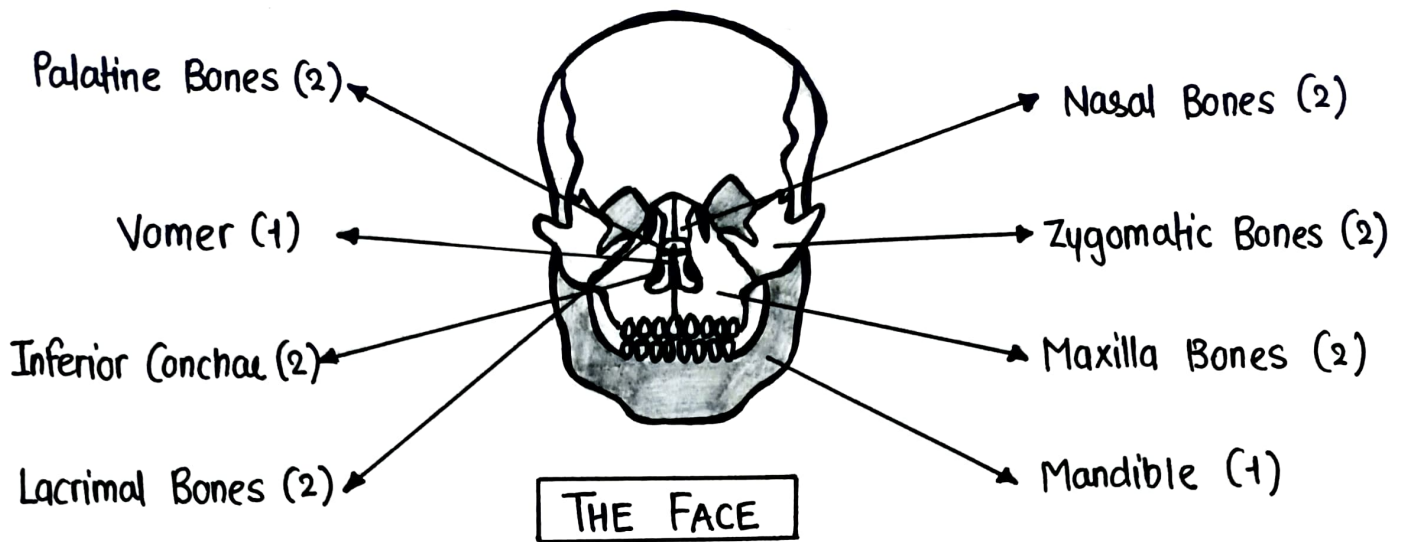
THE CRANIUM

## The Face

- Facial bones form framework of face.
- Forms cavities for sense organs (eye, mouth, nose).
- Provide attachment for facial muscles.
- Hold the teeth
- Protect the eyes
- It consist of following 14 bones :

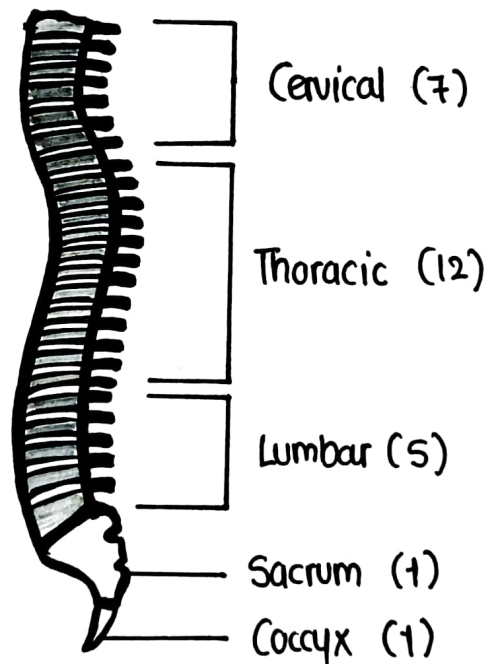
② Zygomatic Bones	It forms the prominences of the cheeks .
② Maxilla Bones	It forms the upper jaw and carries upper teeth
② Nasal Bones	It forms lateral and superior surfaces of the nose
② Lacrimal Bones	It supports the structures of lacrimal apparatus
② Inferior Conchae	It forms the part of nasal cavity
② Palatine Bones	It forms floor of the nasal cavity
① Mandible Bone	It is only movable bone of skull carries lower teeth
① Vomer Bone	It is thin flat bone that divides the nasal cavity





# VERTEBRAL COLUMN

- Vertebral column is also known as backbone
  - It is made up of series of bones called as Vertebrae.
  - The vertebral consist of spinal cord.
  - The adult vertebral column consist of 26 vertebrae.
- ① 7 Cervical Vertebrae
  - ② 12 thoracic Vertebrae
  - ③ 5 Lumbar Vertebrae
  - ④ 1 Sacrum
  - ⑤ 1 Coccyx



## Cervical Vertebrae

- It consist of first seven vertebrae
- They are smaller and present in the neck region
- First vertebrae is called 'Atlas'
- Second vertebrae is called 'Axis'
- Joint between atlas and axis is called as 'Atlanto-axial'

## Thoracic Vertebrae

- They are larger and stronger than cervical vertebrae.
- They consist of 12 thoracic vertebrae from which ribs are connected.

## Lumbar Vertebrae

- Lumbar vertebrae are the strongest and largest.
- They consist of 5 vertebrae.

## Sacrum

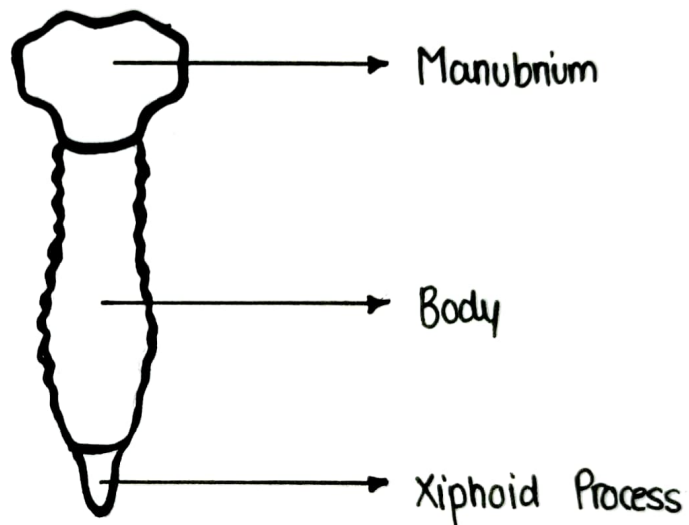
- It is present in the pelvic region.
- Female sacrum is wider than male sacrum.

## Coccyx

- It is also known as tailbone.
- It is the final segment of the vertebral column.

# STERNUM

- It is also known as breast bone
  - It is a flat bone present under the skin in the middle of front of the chest.
  - It gives attachment to the ribs
  - It consist of three parts
- ① Manubrium (Uppermost Section)
  - ② Body (Middle Part)
  - ③ Xiphoid Process (End Part)

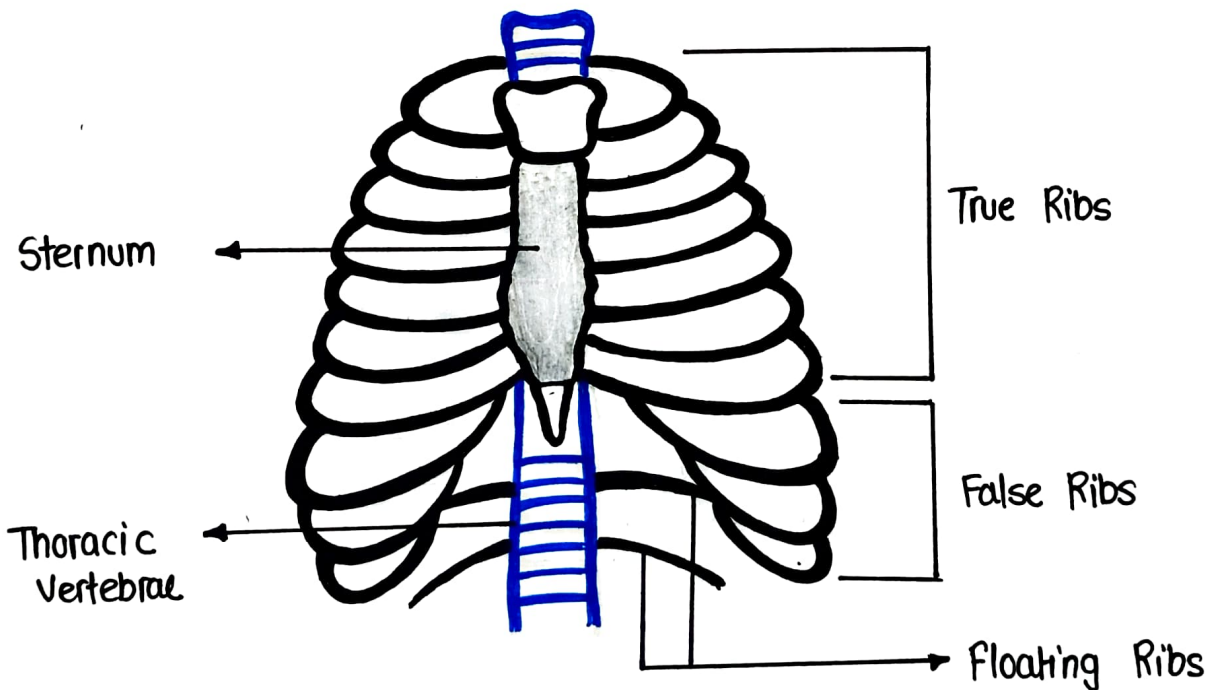


STERNUM



# THORACIC CAGE

- It is also known as Rib Cage
  - Thoracic cage includes (1 Sternum + 12 Pair of Ribs + 12 Thoracic Vertebrae)
  - Ribs are the main bone of thoracic cage.
  - Rib is a thin flat bone
  - There are 12 pair of ribs
  - From backside it is attached with vertebral column and from front it is joint with sternum
  - There are three types of ribs present in thoracic cage.
- ① True Ribs
  - ② False Ribs
  - ③ Floating Ribs



THORACIC CAGE

## True Ribs

- First seven pair of ribs are called true ribs.
- From front they are attached with sternum and from back they are attached with thoracic vertebrae.

## False Ribs

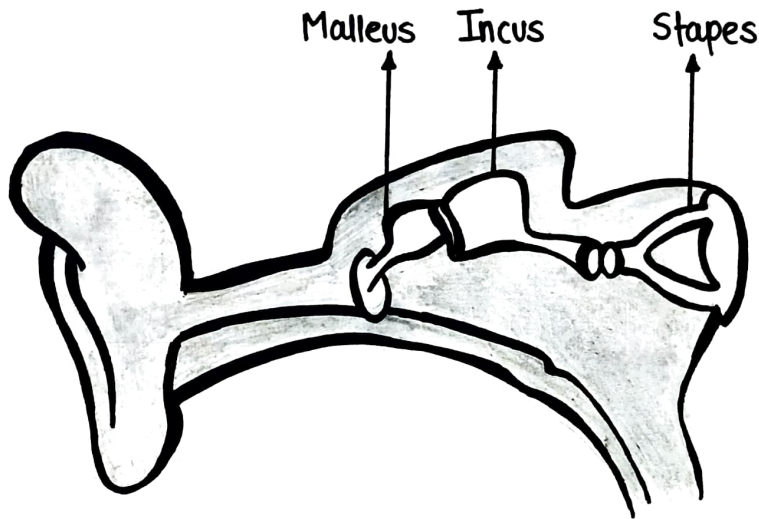
- 8<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> pair of ribs are called False ribs.
- They are joint with th 7<sup>th</sup> pair of ribs

## Floating Ribs

- 11<sup>th</sup> and 12<sup>th</sup> pair of ribs are called Floating ribs.
- One end of the rib is attached with thoracic vertebrae and other end is free.

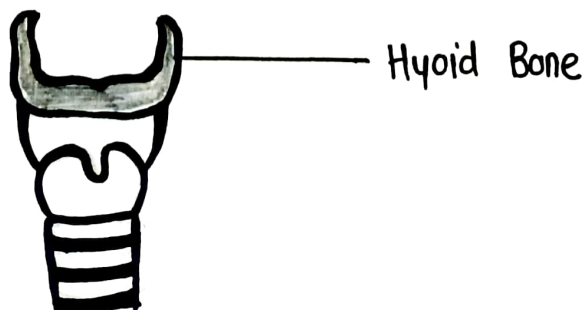
## AUDITORY OSSICLES

- These are three smallest bone of the human body found in the ears.
  - They allow the transmission of sound waves.
  - These are as follows :
- ① Malleus
  - ② Incus
  - ③ Stapes



## HYOID BONE

- The Hyoid bone is a U-shaped bone located in front of the neck just below the lower jaw.
- It carried the weight of the tongue and playing a vital role in speech and swallowing.



# APPENDICULAR SKELETON

Appendicular skeleton consist of

- Pectoral Girdle
- Pelvic Girdle
- Limb Bones

## PECTORAL GIRDOLE

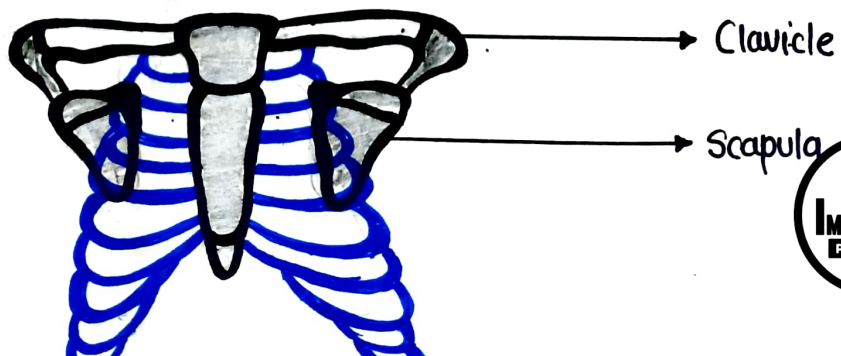
- The human body consist of two pectoral girdle that attach the bones of the upper limbs to the axial skeleton.
- The pectoral Girdle consist of
  - ① Clavicle
  - ② Scapula

### Clavicle

- It is 'S' shaped long bone that has a double curve.
- Its one end is attached with scapula and other end is attached with sternum.

### Scapula

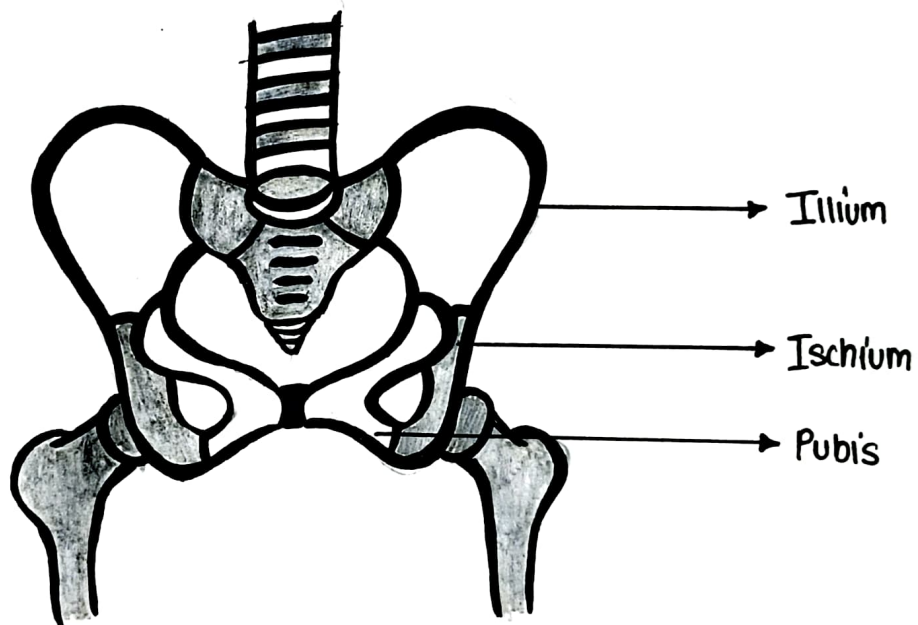
Scapula is a flat triangular bone that connects the clavicle to the humerus. It is also known as shoulder blade.





# PELVIC GIRDLE

- It consist of two hip bones called as 'Pelvic Bones'
- It provides a strong support for the vertebral column and lower abdominal organs.
- A hip is a fusion of three bones.
  - ① Ilium
  - ② Ischium
  - ③ Pubis



PELVIC GIRDLE

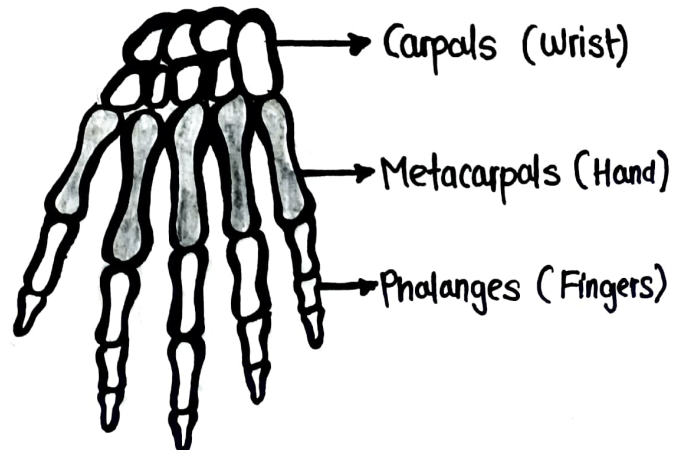
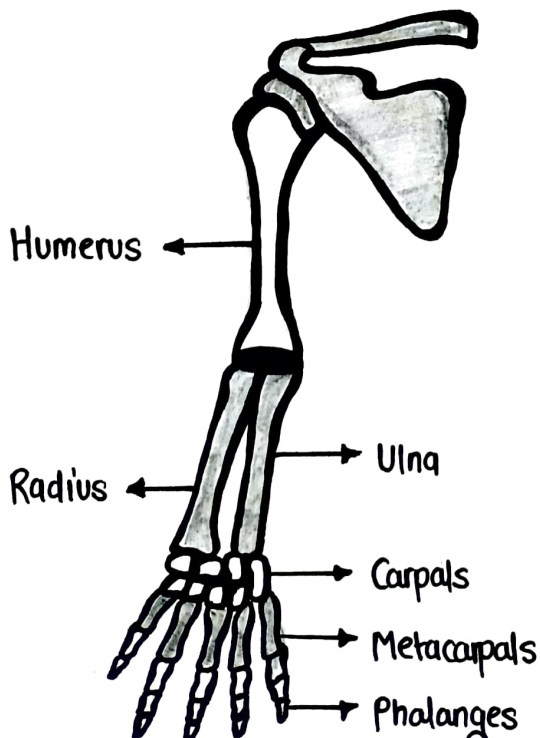
# LIMB BONES

Limb bones are divided into two parts

- Upper Limbs
- Lower Limbs

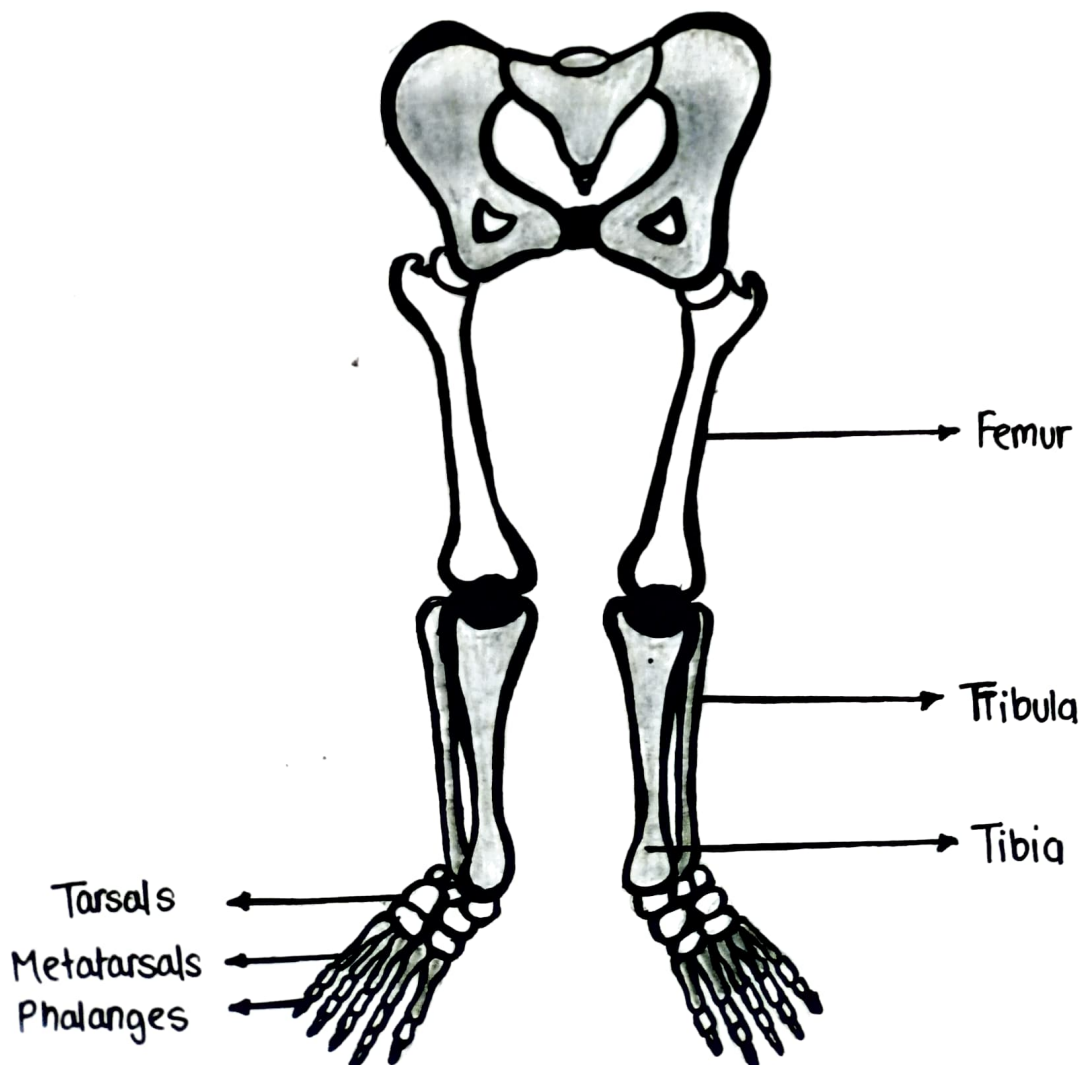
## UPPER LIMBS

- They are present in a pair.
- Each upper limb has 30 bones
- Single long bone of upper arm is called 'Humerus'
- The two bones present at the lower arm are 'Ulna' & 'Radius'  
Radius is shorter than Ulna
- Carpals are wrist bones consist of 8 small bones.
- Metacarpals are hand bones present in the intermediate region consist of 5 bones.
- Phalanges are finger bones consist of 14 bones.



## LOWER LIMB

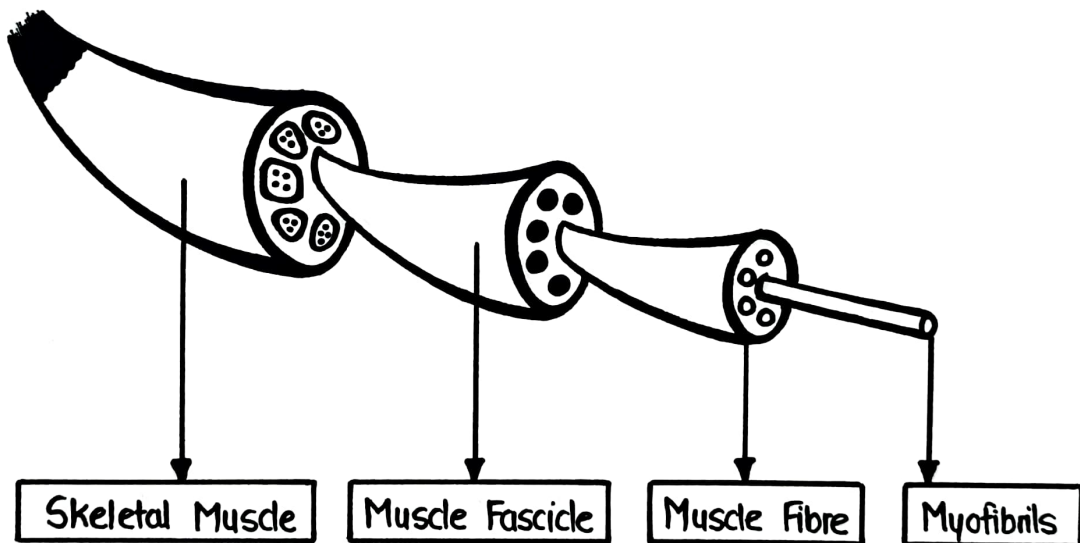
- They are also present in a pair.
- Each lower limb has 30 bones
- Single longest and strongest bone is called Femur.
- The two bones that are present in the lower region are called Tibia and Fibula.
- A small, triangular bone present at the knee joint is called Patella.
- 7 bones of the ankles are called Tarsals.
- 5 bones of the sole are called Metatarsals.
- 14 bones that form toes are called Phalanges.



# SKELETAL MUSCLE

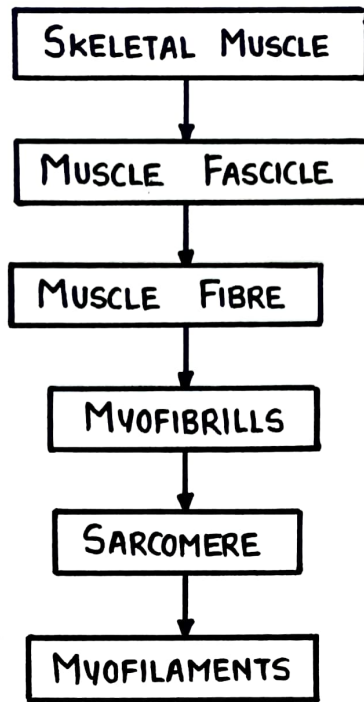
- Skeletal Muscles are those muscles which are attached to the skeleton/bones.
- Skeletal muscle composed 40% of body mass.
- Skeletal muscles are mainly responsible for locomotion, contraction and relaxation.
- Skeletal muscles are voluntary in nature.

## STRUCTURE OF SKELETAL MUSCLE



- The outer covering / layer of skeletal muscle is Epimysium.
- The outer covering of muscle fascicle is Perimysium.
- The outer covering of muscle fibre is Endomysium.



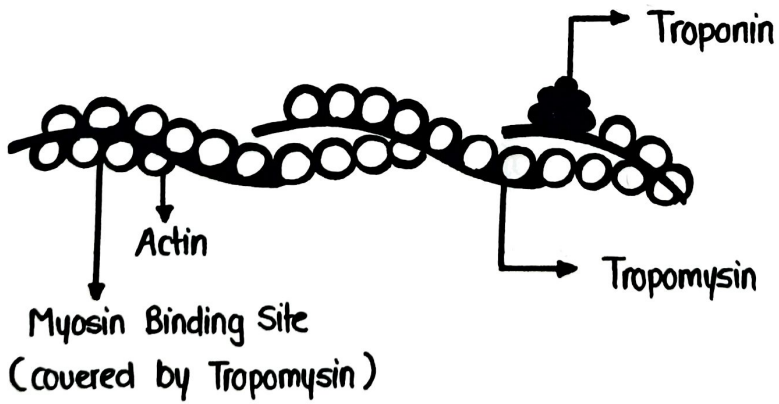
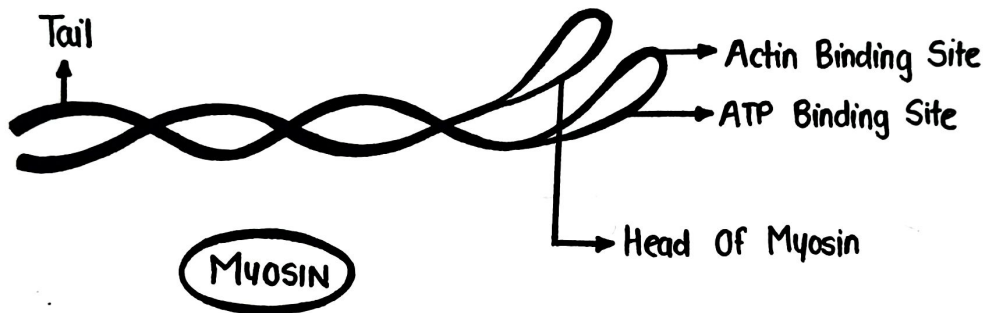
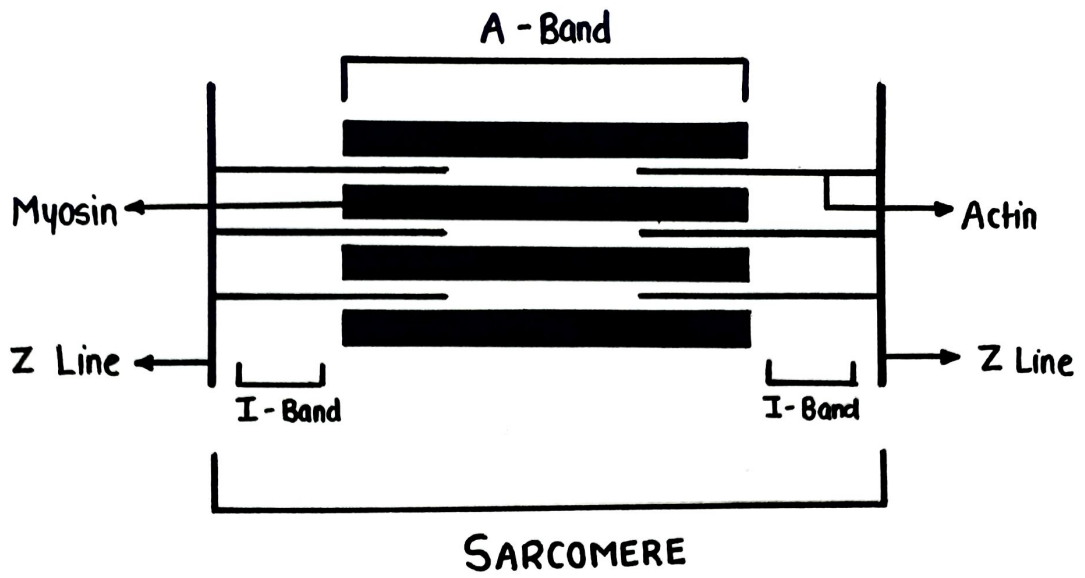


### MUSCLE FIBRES

- The cells of skeletal muscle are known as Muscle Fibres.
- Muscle cells contains many nuclei.
- The cytoplasm of muscle cells is called Sarcoplasm.
- The plasma membrane of muscle cells is called Sarcolemma.

### MYOFIBRILLS

- The muscle fibre of skeletal muscle contains Myofibrils.
- Myofibrils consist of protein chains called Myofilaments.
- These Myofilaments are of two types :
  - ① Thick Myofilament ( Myosin )
  - ② Thin Myofilament ( Actin )
- Sarcomere is the unit of myofibrils containing both Actin & Myosin.



# PHYSIOLOGY OF MUSCLE CONTRACTION

- The length of skeletal muscle shortens during contraction because the thick & thin filaments slide over one another, the process is known as Sliding Filament Mechanism.
- The thick filament contains 300 myosin molecules.
- Myosin consists of two main parts:
  - ① Myosin Tail
  - ② Myosin Head

## STEPS OF MUSCLE CONTRACTION

A cycle of muscle contraction consists of 4 steps:

- ① ATP Hydrolysis
- ② Attachment of Myosin to Actin to Form Cross Bridge
- ③ Power Stroke
- ④ Detachment of Myosin from Actin.

### ATP Hydrolysis

- The myosin head includes an ATP binding site & an ATPase (An enzyme that converts ATP into ADP & Phosphate Group).
- The conversion ( $ATP \rightarrow ADP + P$ ) gives energy to myosin head.

### Attachment of Myosin to Actin to Form Cross Bridge

- The energized myosin head attaches with the Actin on Myosin binding site.
- Now this attachment is referred as Cross-Bridge.

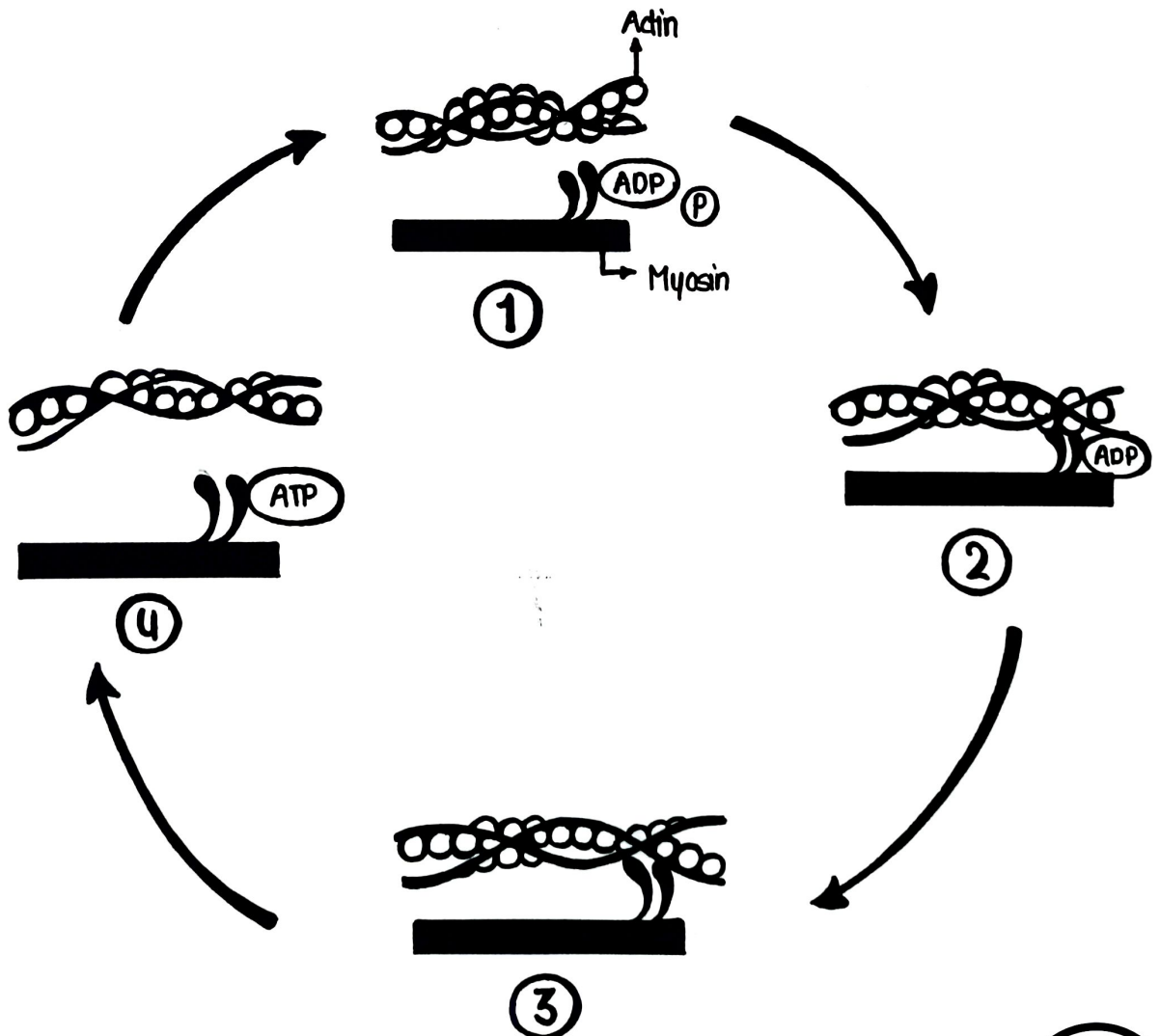


## Power Stroke

- Once the cross-bridge formed, the power stroke occurs.
- In power stroke the cross-bridge rotates towards the centre of sarcomere and contraction occurs.
- The power stroke generates a force which slide the thin filament over the thick filament.

## Detachment of Myosin From Actin

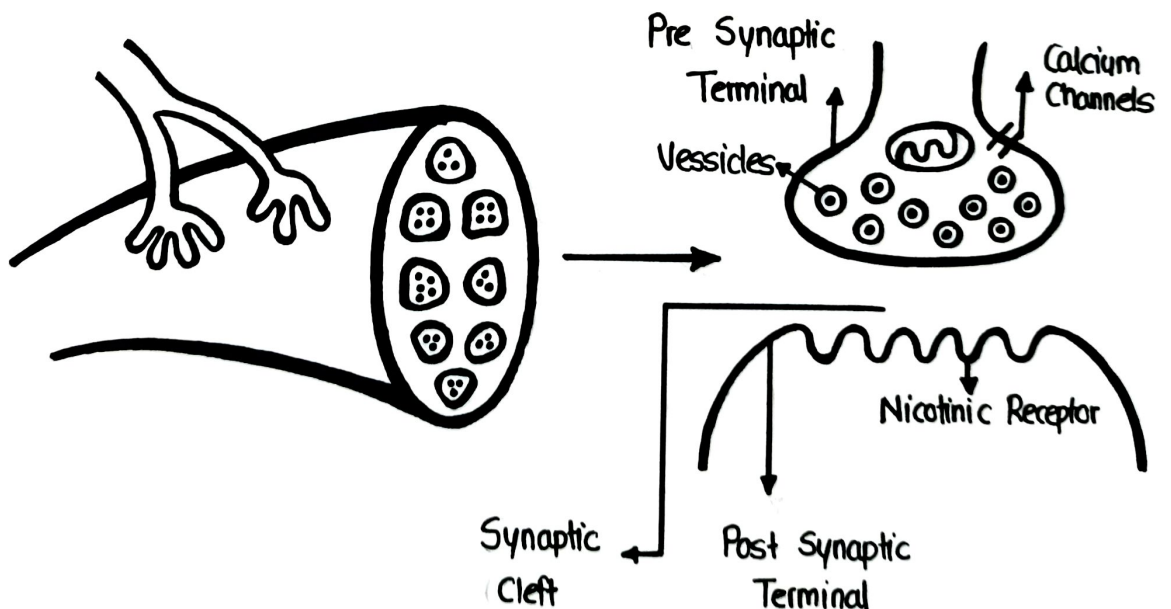
- Once the contraction ends, the ATP again binds on the ATP binding site on Myosin head & Myosin gets detached from the actin.





# NEUROMUSCULAR JUNCTION

- The Junction between Neuron Cells and Skeletal Muscle is known as Neuromuscular Junction.
- In neuromuscular junction, the end part of Neuron (axon-terminal) is connected with skeletal muscle.
- The axon terminal of neuron is known as Pre-Synaptic Terminal.
- The Axon-Terminal contains Acetylcholine packed inside vessicles.
- The axon-terminals also contain Calcium Channels which allows the movement of calcium.
- The site of skeletal muscle where axon terminal binds is called Post-Synaptic Terminal.
- Skeletal muscle contains Nicotinic Receptors where acetylcholine get binds during the process of muscle contraction.



# JOINTS

- A Joint is simply known as a connection between bones in the skeletal system.
- It is a site at which two or more bones meet together.
- They allow different types of movement in the bones.

## CLASSIFICATION OF JOINTS

Joints can be classified on the basis of two categories :

- ① On the basis of structure
- ② On the basis of function

### On The Basis Of Structure

On the basis of structure joints are classified into 3 types :

- ① Fibrous Joints
- ② Cartilaginous Joints
- ③ Synovial Joints

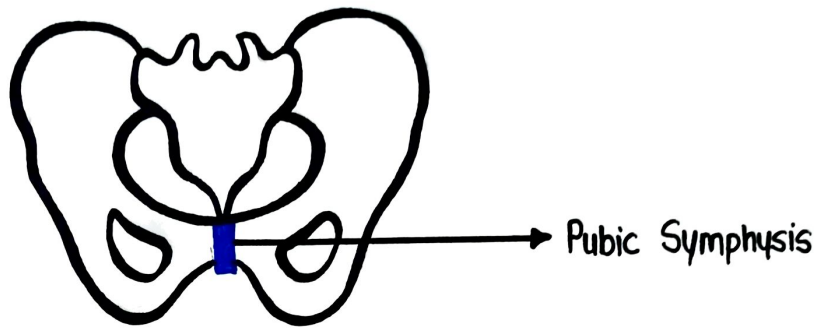
#### ① Fibrous Joints

- Fibrous joints are also known as Immovable Joints.
- They are fixed joints and there is no movement allowed between the bones in Fibrous Joints.
- Example : Cranial sutures between bones of the skull.



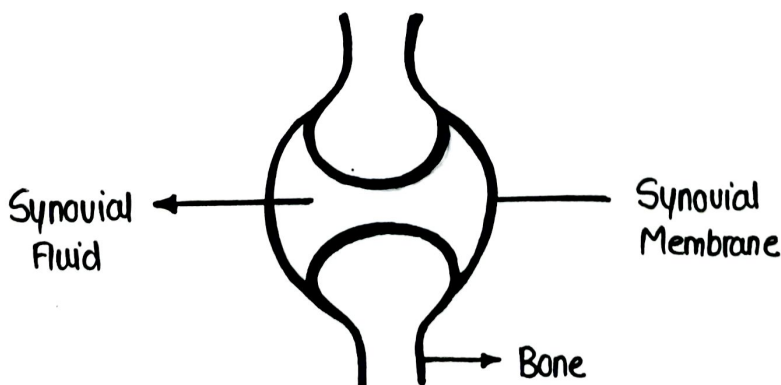
## ② Cartilaginous Joints

- Cartilaginous joints are slightly movable joints.
- They allow little or no movement.
- In cartilaginous joints bones are connected to each other by cartilage.
- Example : Pubic Symphysis.



## ③ Synovial Joints

- The synovial joints are the most common types of joints as this joints helps to perform various functions such as walking, running etc.
- They are freely movable joint which allows movement in one or more direction.
- These joints are covered by a membrane called Synovial Membrane.
- There is a fluid present in synovial membrane, called Synovial fluid that allows the movement of bones.



## Classification Of Synovial Joints

Synovial joints are further classified into following 6 types :

- ① Ball & Socket Joints
- ② Saddle Joint
- ③ Hinge Joint
- ④ Pivot Joint
- ⑤ Gliding Joint
- ⑥ Candyloid Joint

### Ball & Socket Joint

- They are the most freely movable joint.
- In this, ball of one bone is fitted into socket of other bone.
- example : Shoulder joint

### Saddle Joint

- It is basically a type of ball & socket joint.
- In this convex head of one bone fixes into the other bone.
- example : Thumb joint

### Hinge Joint

- They allow movement only in 1 plane.
- In this one bone is of convex shape & other one is of concave shape.
- Convex end of one bone attached with concave end of other bone.
- example : Elbow joint, knee joint.





## Pivot Joint

- This joint allows movement only in 1 plane.
- In pivot joint one bone is rounded or pointed shape in which other bone is attached.
- Rounded bone is fixed and other bone rotates over it
- example : Atlas and Axis joint.

## Gliding Joint

- In gliding joint bones are flat shaped.
- In this bones easily glides or slides over each other.
- They are also known as Planar joint.
- example : Wrist joint

## Candyloid Joint

- It is also known as Ellipsoid joint.
- In this ends of both the bones are of concave shaped.
- example : Carpals joint





## Classification On The Basis Of Function

On the basis of function joints can be classified into following 3 types :

- ① Synarthrosis
- ② Amphiarthrosis
- ③ Diarthrosis

### SYNARTHROSIS

- It is an immovable joint .
- They are generally fibrous joints .
- example : Sutures of the skull .

### AMPHIARTHROSIS

- It is a slightly movable joint
- They are generally cartilaginous joint .
- example : Pubic Symphysis .

### DIARTHROSIS

- It is a freely movable joint .
- It is a type of synovial joint .
- example : Shoulder joint , knee joint etc.



# THANK YOU

FOR CHOOSING IMPERFECT PHARMACY AS YOUR STUDY PARTNER



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