

# LOCOMOTION & MOVEMENT

- \* Movement is a significant characteristic of living organism
- \* Human can move its limbs, jaw, tongue etc.
- \* Activity through which change in place or location is called ~~or movement~~ locomotion.
- \* Change in posture shape are movement.
- \* Walking, running, climbing, swimming are example of locomotion
- \* Movement is possible through 2 ways:-

- Skeleton system
  - associated with a frame work of bone & few cartilages.
  - System has a significant role in movement by the body.

\* It classify in 2 ways:-

## 1. Exoskeleton

- \* present outside the body
- \* Ectodermal in origin
- \* eg hair, nail, hoof, horn, claw, feather, scales

## 2. Endoskeleton

- \* present inside in body.
- \* Mesodermal in origin.
- \* Bones, cartilage

- in fishes & reptiles scales are exoskeleton.
- in some fishes mesodermal scales are also present eyelids of fishes. While reptiles are ectodermal scales are present.
- exoskeleton of tortoise is mesodermal bony scutes. (cell on their outer body layer.)
- horn is modification of hair ectodermal in origin.
- But in deer horn is bony so mesodermal in origin.
- further endoskeleton is of 2 part.

## 1. axial

- \* have skull
- \* sternum, ribs, vertebral

Skull :- (29)

Sternum:- 1

Ribs :- 24

Vertebral column:- 26

## 2. appendicular

- \* Fore limb :- 60
- \* hind limb :- 60
- \* Rectal glide :- 4
- \* Pelvic glide :- 2

\* Number bone during different stages in human:-

adult human :- 206

child :- 270

embryo :- 306

→ Total number of bone in animal:-

Rabbit :- 260

Frog :- 160

- long, largest & heaviest bone is femur of right.
- smallest bone is stapes in ear.
- Total number of muscle is 639±
- largest & heaviest muscle :- gluteus maximus.
- smallest muscle :- stapedius (in ear).
- longest muscle :- tailor muscle (rectus).
- strongest muscle :- Jaw muscle.

## LIMBS

→ 2 types

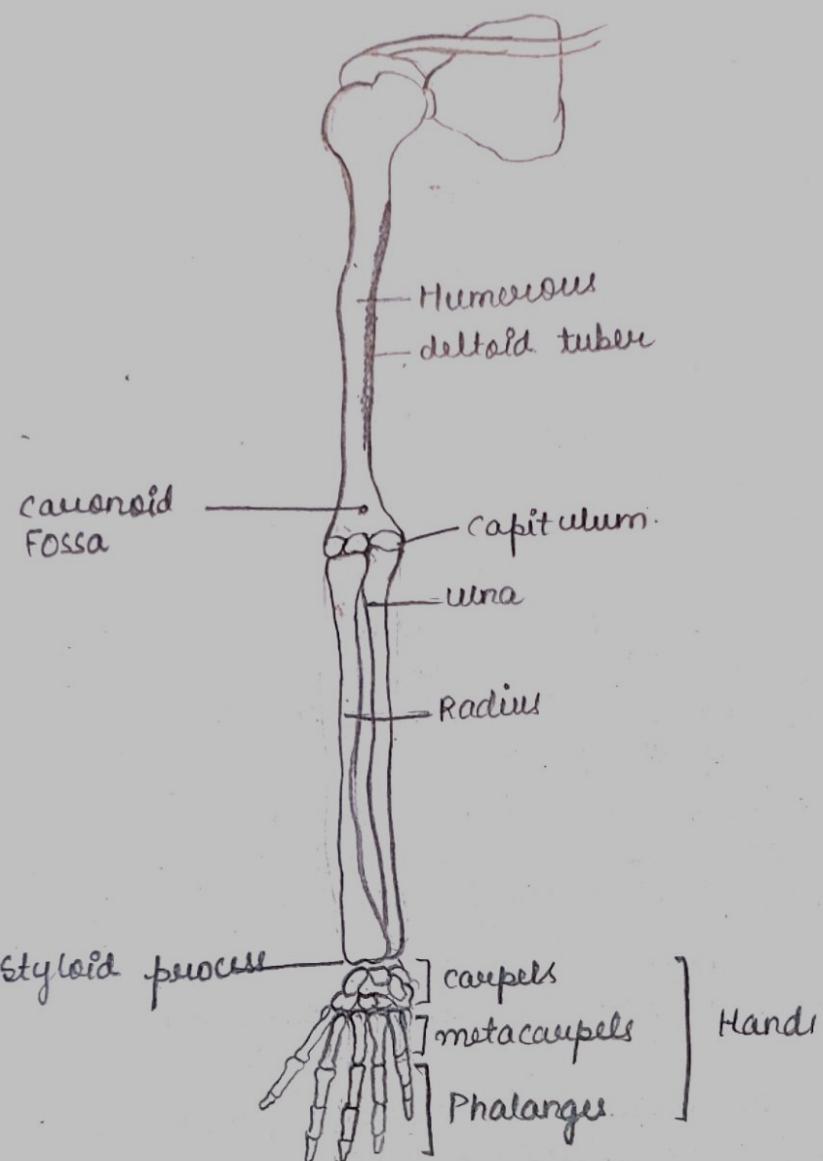
1. Fore limbs

2. Hind limb

→ each limb is made from 30 bones

→ bone of hand is called fore limb

- humerus
- Radius
- Ulna
- carpals (wrist bone) 8
- metacarpals (Palm) 5
- Phalanges 14



- humerus is longest bone of fore limb of each forelimb
- consist of 30 diff bones.
- end of long bones are covered by hyline cartilage
- head of humerus fit into glenoid cavity of pectoral girdle & forearm solder joints that is ball and socket joint.
- deltoid ridge present on the shaft of humerus is mainly for muscle attachment at distal end of humerus of distal end of humerus that is situated away from the centre of body having two condyle.
- i) inner trochlear
- ii) outer capitulum

- were radius ulna bone attached with tracheas & Radius with capitulum.
- at distal end of humerus it self is coronoid fossa is present.
- at the Radial position Radius fossa is present.
- at the Posterior side olecranon fossa is present.
- Ulna is also long middle on middle bone towards middle thumb side. little finger side.
- Radius is short lateral that is present toward thumb side.
- at proximal end of ulna Radial Notch & tracheal Notch are present.
- on radial head of radius articulate are four pivot joint (trochoid joint) on tracheolar notch of ulna, and trochle of humerus fit
- humerus bone articulate with Radius & also bone & fore arm elbow joint (hinge joint).
- in human between radius & ulna pivot joint is present so human can show both pronation & supination position are stage of hand. b/w radius & ulna space is present that is called Nutritional foramen.
- Nutritional for arm or vascular channel is small tunnel through the cortex of a long bone containing a nutrients artery with supply the bone.

\* Pronation :- When walk or move your weight tend to move toward inner side of your foot.

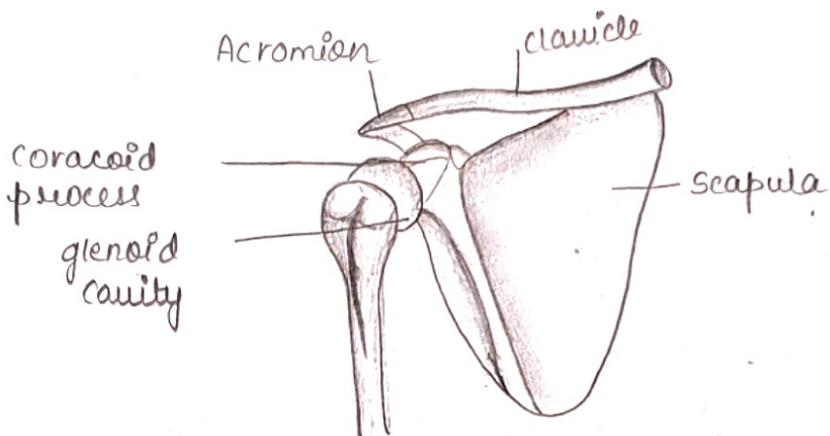
\* Supination :- When your weight tend to move out side your foot.

- Wrist consist of 8 short bone that is called carpal this are arrange into two Row 4+4
- b/w carpal gliding joint are present
- Metacarpal :- are find long bones that is called present in palm and this are five bones
- Phalanges :- are long bones for fingers on digits are 14 in Number.
- between phalanges hinge joint are present

→ humerus head is made up of cartilage maximum  
bone of body a cartilaginous type endoskeleton is embryo  
is made up of cartilage.

\* Pectoral girdle & Pelvic girdle

\* Pectoral girdle consist of two bone ie clavicle & scapula.

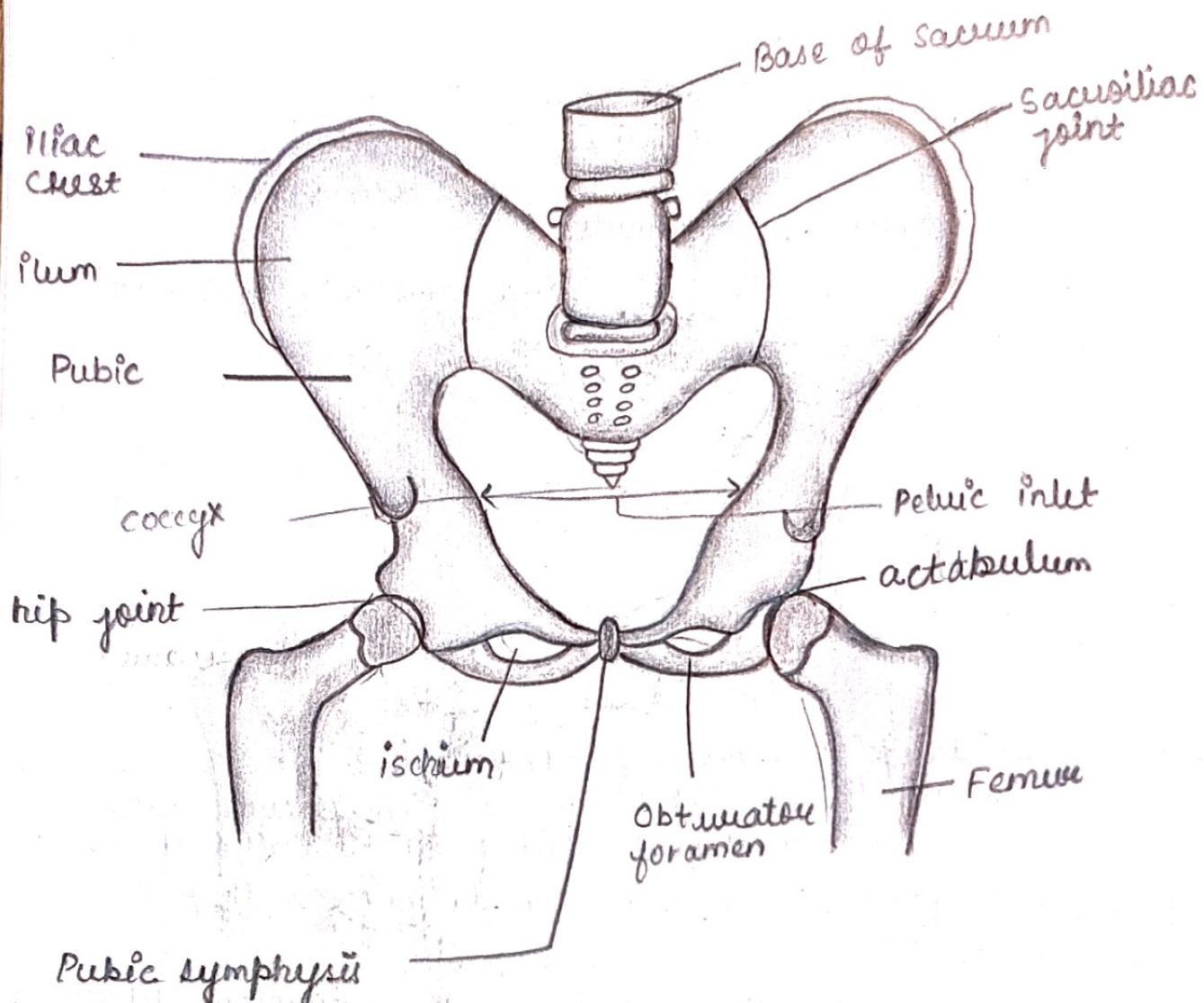


- \* Scapula is large triangular flat bone present in the dorsal part of thorax between the sixth and seven ribs.
- \* Scapula has a slightly elevated ridge that is called spine.
- \* Spine which project as a flat upper process that is called acromion.

Clavicle:- is superficially and below the acromion depur which called as glenoid cavity.  
→ this are articulated with humerus to form shoulder joint.

- clavicle is a long splinter bone with two rounded ie bone of collar
- collar started from acromia coracoid process pectoral girdle. having 3 process
- Spinous process
- Acromion process
- Coracoid process

## Pelvic girdle



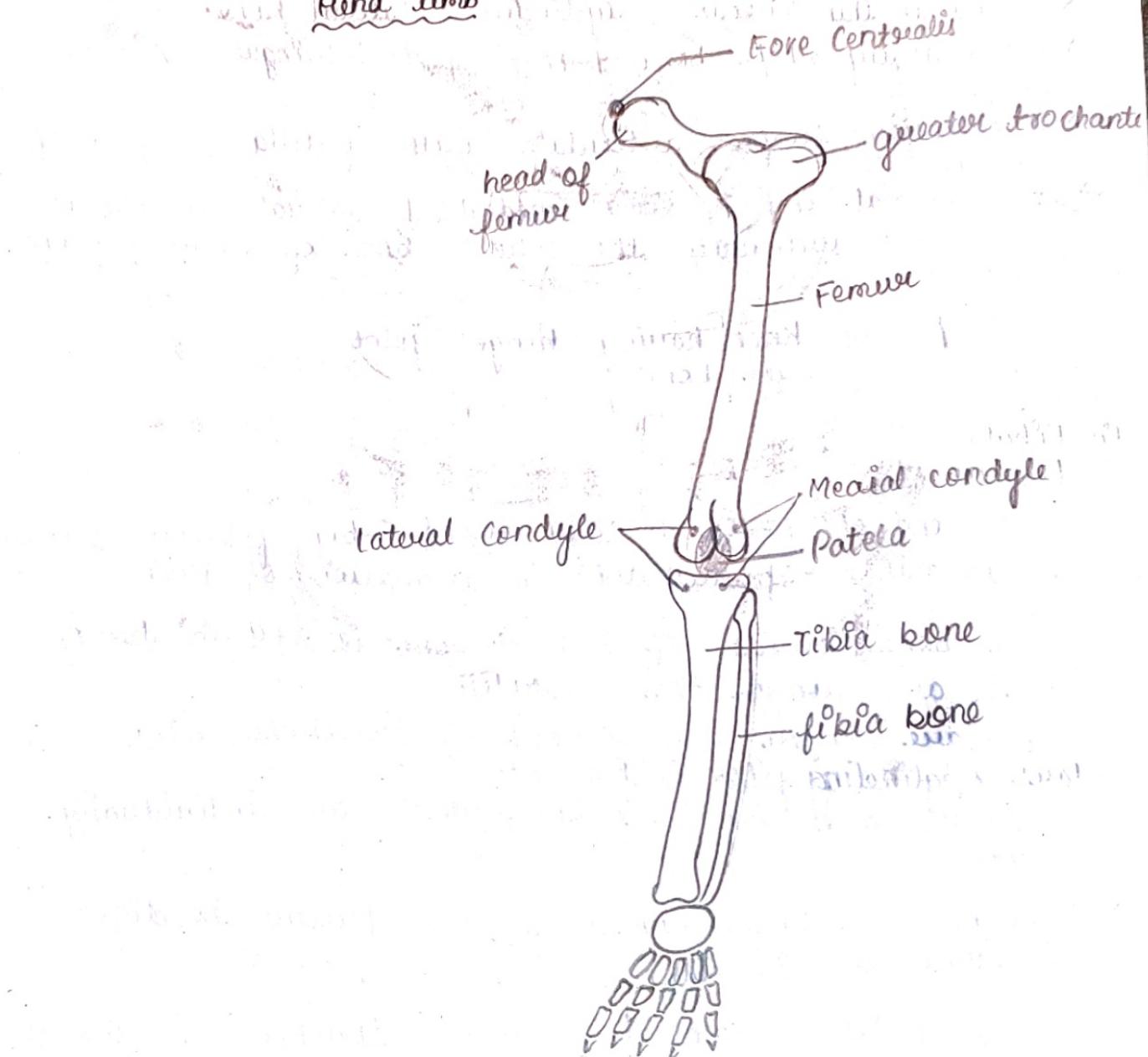
### Pubic symphysis

#### Pelvic girdle:-

- consist of 2 coxial bone consist of 2 half bone
- each coxial bone consist of fusion of 3 bone
  - ilium
  - Pubic
  - Ischium.
- at the fusion point 3 bones having depression is present called acetabulum.
- At acetabulum femur bone (head of) articulated.
- b/w pubic & ischium obturator foramen is present through which blood vessels & nerve passes.

- at dorsal surface ilium articulate with sacrum bone of vertebral column & form illosacral joint. i.e fibrous immovable joint
- male pelvis is longer & narrower than female pelvis
- Space b/w two pubic bone is pubic symphysis.

### Hind limb



\* hind limb = 30 bone

\* femur is the longest and heaviest of largest bone.

\* head of femur is made up calcified cartilage.

\* head of fit into acetabulum cavity of pelvic which having specific joint is present at pelvic girdle & it is called ball & socket joint.

- greater & lesser trochanter present in it.
- Muscle attachment
- at posterior distal end of femur medial & lateral condile is present.
- Fibia, long, strong & straight medial bone.
- Fibula is thin weak & cylindrical lateral bone.
- Patella is cup shape bone & it is flat & triangular sigmoid bone.
- its posterior surface articulate with patella surface of femur.
- at proximal end of fibia medial & lateral condile is present that articulate the condile bone of femur & form knee joint.
- due to patella knee having hinge joint
- knee is from three bones

(i) Tibia  
(ii) Fibula  
(iii) Femur

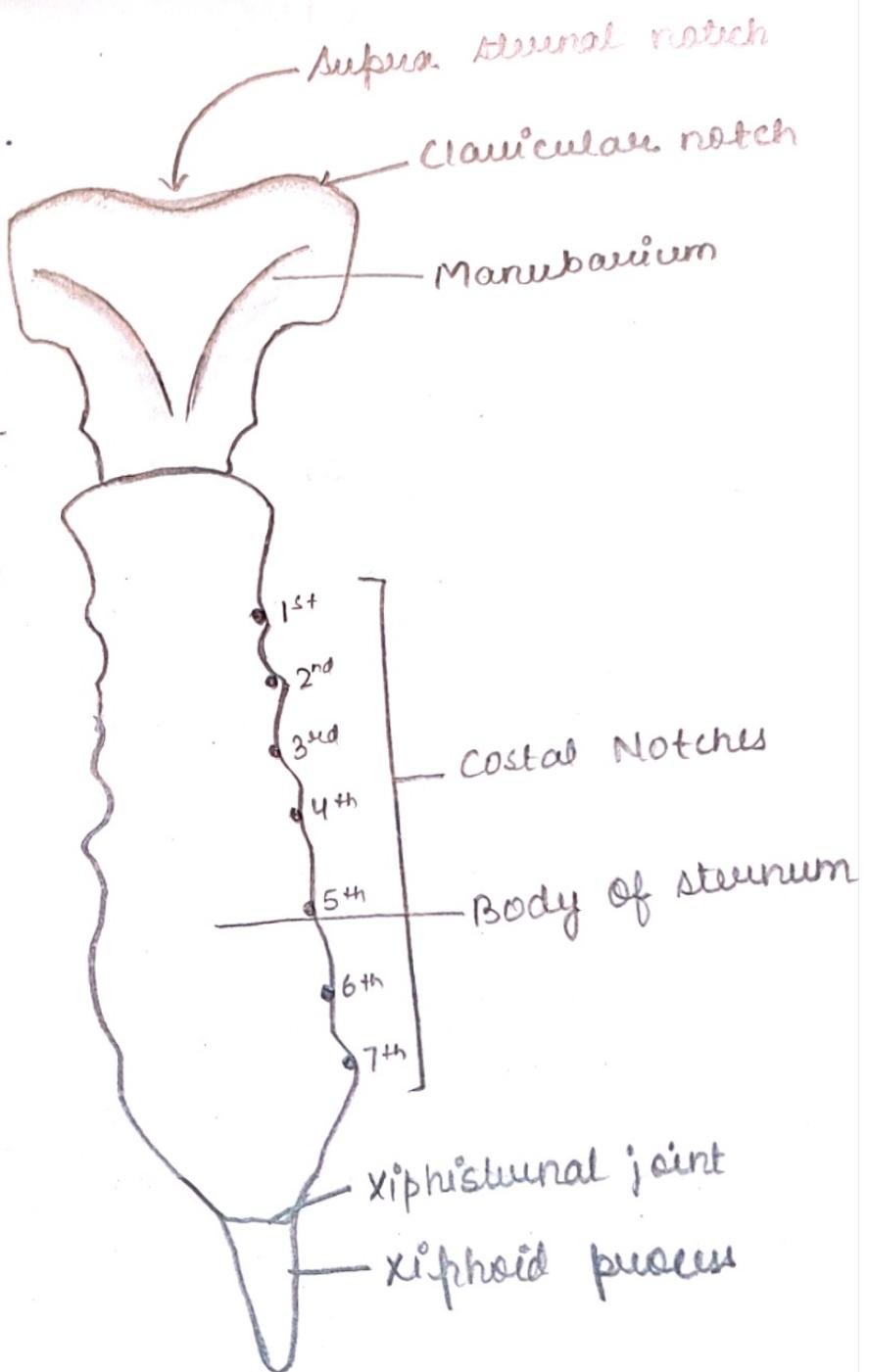
- distal end of fibula & tibia fused by fibrous joint
- fibula is not participated in formation of knee
- ankle bone consist of 3 short bone i.e. 3+4 i.e. tarsals
- tarsals are longer than carpal.
- tarsals are longer than carpal of forelimbs b/w tarsals gliding joint is present.
- metatarsals are five long bone which are individually present.
- Phalanges are 14 in number & it is present in digit & formulae is 2,3,3,3,3

axial bone:- axial skeletal is part of skeleton in which human consist of 80 bones & having six part.

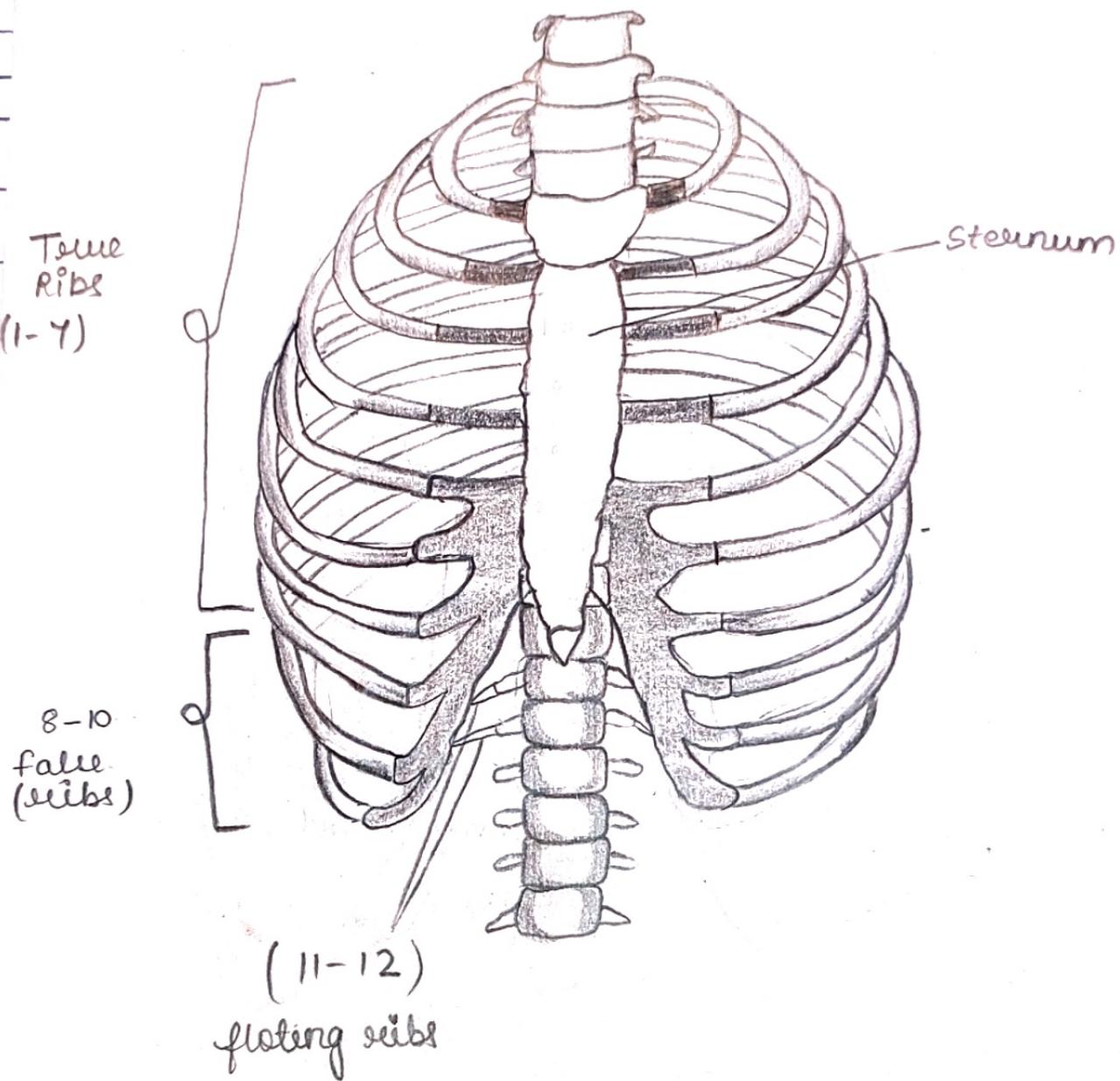
1. Sternum
2. Ribs
3. Skull
4. Ear ossicles
5. Hyoid bone
6. Vertebral column

## STERNUM

- \* Sternum is 1 bone ster. 4 it is flat & long.
- \* present at mid ventral surface of thorax
- \* 1 pair of clavicles & 1<sup>st</sup> to 7<sup>th</sup> pair of ribs bones are attached or articulated with its ventral side
- \* Rib cage is formed by Sternum & 12 pairs ribs at ventral column.



# RIBS



- \* Rib is a flat, curve & thin
- & in human no of ribs are 12 pair
- & out of 12 pair only pairs are true ribs & rest 5 are false ribs
- in vertebral ventral end articulated with sternum with hyline cartilage.
- if dorsal end articulated with thoracic vertebra
- dorsal end are 2 articulated surface head 4 transversals.  
So human ribs are biaxial

## SKULL

\* Human skull consist of 2 region of differentiated embryo logical origin.

1. Neurocranium or ~~N.~~ cranial
2. Visceral cranial or facial.
3. Ear ossicle.
4. Hyoid

### \* Neurocranium

- frontal - 1
- parietal - 2
- Temporal - 2
- Occipital - 1
- Sphenoid - 1
- Ethmoid - 1

### \* facial

- Mandibular - 1
- Vomer - 1
- Maxilla - 2
- Lacrimal - 2
- Nasal - 2
- Zygomatic - 2
- Platine - 2
- terminal or inferior Nasal Conche - 2

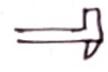
### \* ear ossicle \* hyoid !

- Malleus
- Incus
- Stapes

\* Mandibular bone form the lower jaw.

- longest & strongest bone of skull.
- it is immovable & articulated with temporal bone of skull.
- Number of movable bone is 7 ie ear ossicle & one mandible.
- socket of jaw bone in which our teeth is present is called alveoli.
- upper jaw made of maxilla
- nasal & vomer form olfactory capsule.
- frontal is common b/w face & cranium.
- Sphenoid is butterfly shape bone, it has a depression ie called sella turcica in which pituitary gland present.
- Zygomatic bone is also called cheek bone or malar.
- in most of animal made up of dentary muscle.
- cranial is made up of 8 flat membranous immovable bone
- These bones are connected by fibrous connective tissue
- base of cranium a pore is there ie called foramen magnum & it is present through spinal cord where it is come out.
- This pore is surrounded by condyle (upholding str.) so human skull is dycondylar. (amphibians & mammals)
- Monocondylar (Birds & reptiles)

- composed of skull bone of mesobranchial body & it is called Fontanel.
- hyoid is a single horse shoe shape bone present in upper throat region.
- Posterior part of tongue articulated with it.
- hyoid is the single bone which does not attach with any other bone.
- Ear ossicle are movable tiny bone Stapes is smallest bone
- b/w Malleus & Incus hinge joint is present b/w incus & stapes ball & socket joint is present.

Malleus :- hammer shape 

Incus :- Anvil shape 

Stapes :- stirrup shape 

### Vertebral column

Vertebral column in human = 26 (Spinal column)

No of vertebrae in embryonic = 33

" " in frog = 10

" " in rabbit = 46

→ Out of 33, 24 are movable & 4 are immovable.

1. cervical vertebrae (7)

2. lumbar vertebrae (5)

3. sacral vertebrae (5)

4. coccygeal vertebrae (4)

→ Vertebral formula [C7][T12][L5][Co 4]

## Joint :-

joints having following types

1. Immovable joint (Fibrous joint)
2. Slightly movable or (Cartilaginous)
3. Completely movable joint (Synovial joint)

### 1. Immovable joint :-

with the help of dense fibrous connective tissue that is situated between the scapula & facial bone that is fix with this type of bone but except mandibular bone joint and four immovable joints. It is not allow any movement dense connective tissue also form cranium.

### 2. Cartilaginous joints :-

this bones are joint together with help of cartilaginous to form cartilaginous joint. It this are found in intervertebral b/w to vertebral. It permit limited movement pubic symphysis & pubic bone in female during parturition or child birth.

### 3. Synovial joint :-

is also called completely movable joint this joint is present of a ~~float~~ fluid filled by synovial. cavity b/w surface of two bones which fixed or articulated this joints allow considerable movement this joint allow help in locomotion & many other movements. Some joints due to synovial joint.

1. Ball and socket b/w humerus and pectoral
2. hinge joint in knee
3. Pivot joint - atlas & axis
4. Gliding joint - carpal
5. Saddle joint - b/w carpal & metacarpal thumb.

### 1. Ball and socket joint :-

having humerus of hand articulated with glenoid cavity of pectoral girdle head of femur articulated with acetabulum.

### 2. hinge joint :-

it allows unidirectional movement of knee gliding joint. elbow.

(iii) gliding joint :- carpel joint and ankle joints having gliding joint.

(iv) saddle joint :- it is poorly develop and having socket joint where as maximum movement occurs in all directional between metacarpals or thumb & carpal.

(v) pivot joint :- present between atlas & axis ulnae & b/w radius & ulna.

atlas → first cervical Ulna

axis → sec " "

## MUSCULAR SYSTEM :-

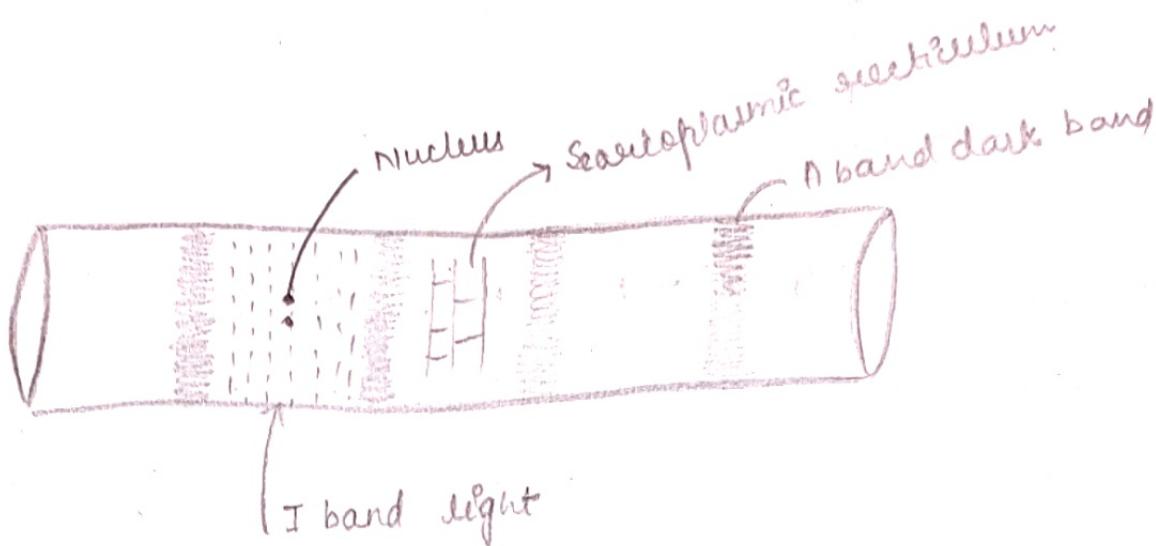
Muscular system having five diff types of movement

(i) ciliae :- it occur by cilia - cilia is a cytoskeleton str having 9+2 arrangement.  
movement of cilia occur like waves in coordinative manner or back forth.  
\* cilia also help in spreading of fluid on surface, cilia is found in diff places like nasal chamber, trachea, fallopian tube.

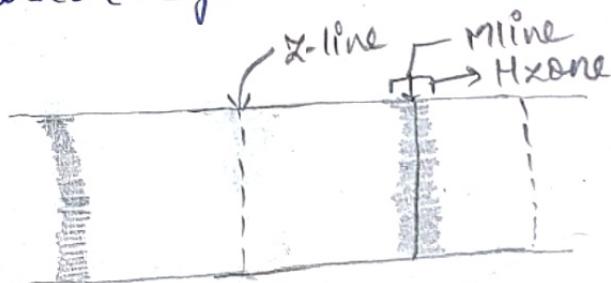
## (ii) flagellary :-

It is also a cytoskeletal str that found in lower eukaryotes like bacteria, some protoscoan dinoflagellates and plants etc. flagellum also occur in spear tails arrangement of flagella that is 9+2 type but in bacteria str of flagella differ on the basis of tubular arrangement movement of flagella is whip like str of horses like.

## Structure of muscle fibre



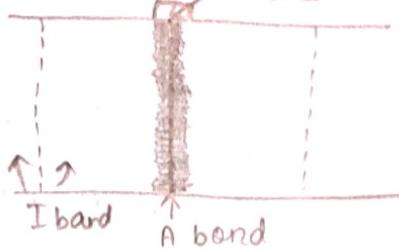
- \* Inside muscle fibre many microfibrils or myofilament present in parallel manner.
- \* further these myofibrils, which are arranged in straightened pattern are again superficially present into band form.
  - isotropic band or light band or actin band.
  - i)→ anisotropic or dark or myosin band or thick band.



- \* Sarcomere  $\Rightarrow$  [half  $\frac{1}{2}$  I band. + A band +  $\frac{1}{2}$  I band.]
- \* Sarcomere is the structural & functional unit of muscle.
- \* Muscle fibres are second largest.
- \* A band is mainly the combination of myosin and little amount of actin.
- \* A band is divided by M
- \* actin is also called thin filament while myosine is thick
- \* I band made up of actin.

## STRUCTURE OF SARCOMERE

(Heller) H zone M line (Myomesine)



$$\text{Sarcomere} = \left(\frac{1}{2} \text{ I band}\right) + \left(\text{A band} + \frac{1}{2} \text{ I band}\right)$$

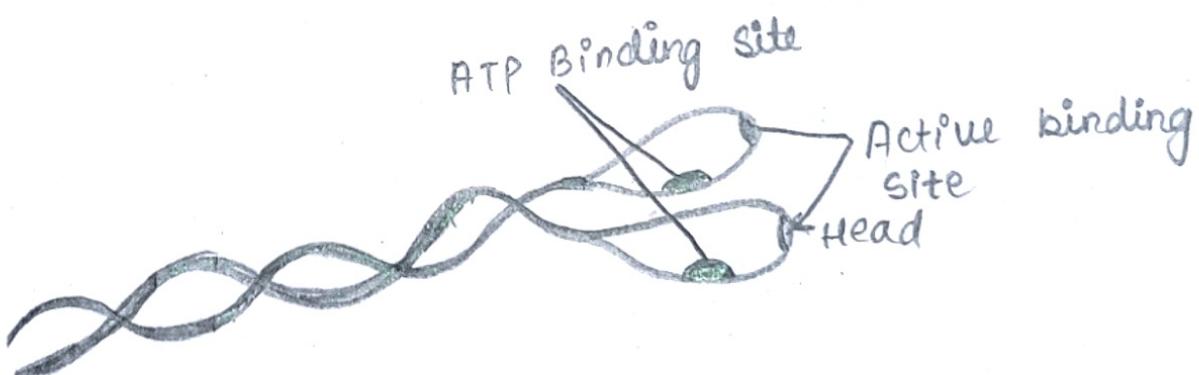
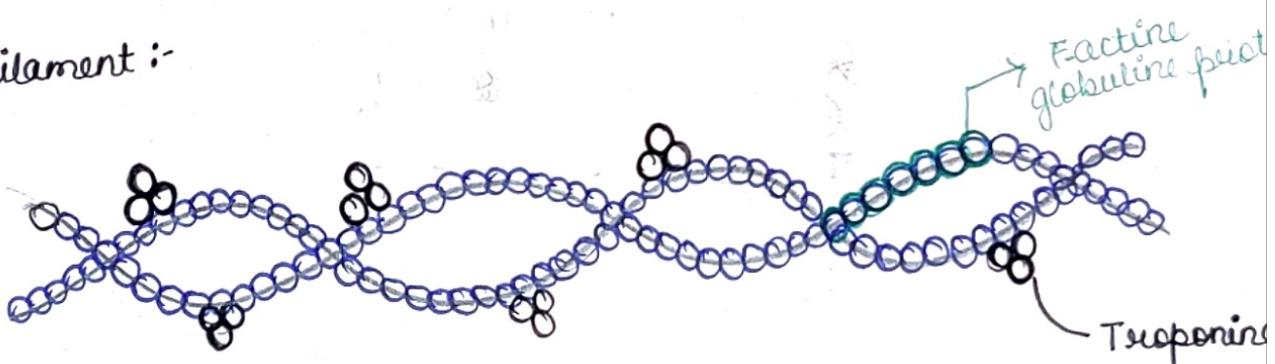
- # Sarcomere is structural unit of myofibrils.
- # Str b/w 2 consecutive Z line is called sarcomere.
- # Z-line (Zwischen):-

Intermediate line of I band.

→ Sarcomere is made up of complete A band + two half I band.

- H zone (Heller zone):- place of myosin on A band where Actin filament are absent.
- M line (Myomesin):- It is intermediate portion of H zone which hold all attach myosine filament.

- Actin filament :-



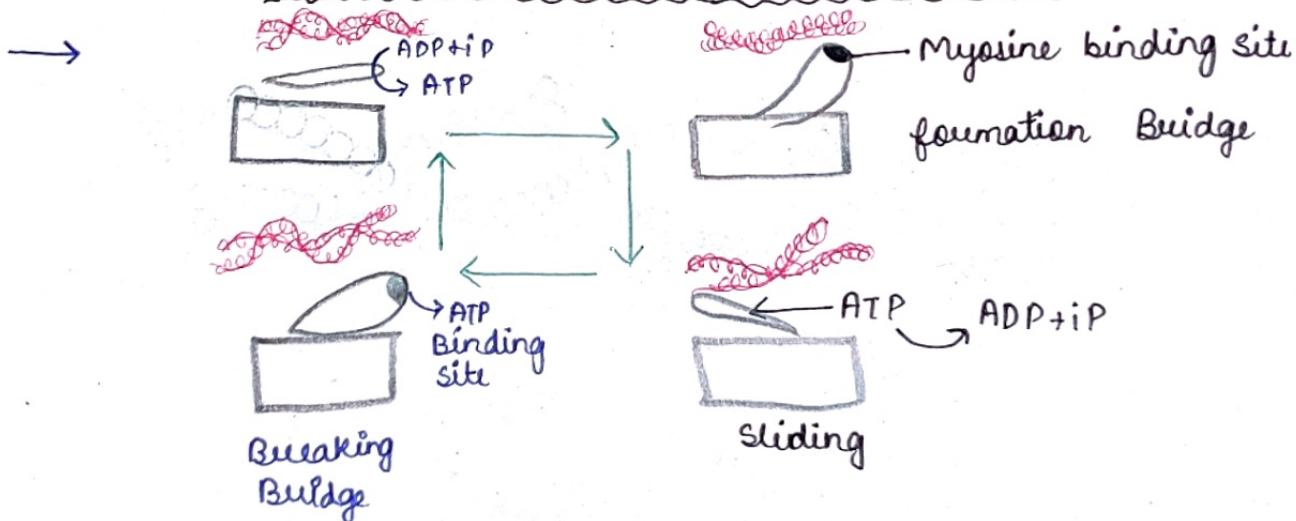
- Actin filament :- made up of 2 filamentous protein which are helically wound to each other.
- each filamentous actin protein is globular protein ie g protein
  - 2 filaments of another protein tropomyosin are near close to F actin throughout out the length.
  - complete protein like tropomysine that is complete protein also present on tropomyosine at regular interval
  - at their resulting stage A muscle of tropomysine Subunit that active binding site for myosine on actin filament.

### Myosine filament:-

- myosine or myomysine having 2 part.
  - (i) head
  - (ii) tail

- head having short arm & long heavy myosine accumulation
- it having light myomysine

### Mechanism of muscle contraction



- It is explain by sliding filament through b/w actin & myosine troponyosine
- A/ this concept contraction of muscle fibre takes place by the sliding of thin filament over thick filament.
- Muscle contraction is initiated by a signal sent by CNS.  
(Nervous system = CNS & PNS)  
(CNS = Brain + spinal cord)  
(PNS = rest of CNS)
- Via a motor neurons b/w muscle.
- Points related to contraction of muscle.
  - \* Sliding of filament b/w Actin & myosine (troponyosine)
  - \* motor neuron is a type of neuron used for sending signal b/w source & destination.
  - \* acetylcholine — neurotransmitter used to generate action potential b/w 2 neurons (motor) & it generate action potential.
  - \* Ca ions release from sarcoplasmic reticulum once specific activity like contraction finished then  $Ca^{2+}$  return to sarcoplasmic reticulum
  - \* b/w nerve & muscles form a junction ie called neuromuscular junction or motor end plate
  - \* acetylcholine is generated an action that potentialised & release the calcium ion from sarcoplasmic reticulum
  - \*  $Ca^{2+}$  binds with troponyosine & unmask the active site for myosine
  - \* ATP initialising the myosine head binding with active site & actin from a cross bridge & this pulls the actin filament toward center of A band.
  - \* Z line attach to this actin are also ~~pulled~~ pulled inward & cause shortening of sarcomere
  - \* in contraction I band get reduce & A band retain the length ie no change in A band.
  - \* the myosine releasing ADP & IP goes back to its release state, a new ATP binds and break this process repeatedly again & again until all  $Ca^{2+}$  get back to sarcoplasmic reticulum & due to this Z line become extend at their previous position (relaxation).

## Type Of Striated muscle:

It is of two types

### 1. Red muscle

- also called red fibre
- They are in colour due to presence of red coloured O<sub>2</sub> storing pigment.
- red coloured O<sub>2</sub> storing pigment called myoglobin
- its main content is iron or ferric
- myoglobin store O<sub>2</sub> & form myooxyglobin or oxygymoglobin
- contain large number or plenty of mitochondria
- also called aerobic muscles
- It is slow acting muscle.

### 2. White muscle

- having very less amount of myoglobin (negligible myoglobin)
- fast acting muscle.
- No of mitochondria are very less.
- sarcoplasmic reticulum very ↑.
- It is also an aerobic muscles.

## Disorder of Muscular & Skeleton System:

### 1. Myasthenia gravis:-

chronic disease or chronic auto immune neuromuscular disease, in this cell mediated immunity of body start against their own body so, immune system of body destroying the receptor of nerve transmitter so nerve arises but to fail.

- fail contracting the muscle.
- ie person weakness, paralysis & death may occur.

### 2. Muscular dystrophy:-

- genetic disorder, gene responsible for dystrophin protein is affected & muscle started degeneration
- mostly occur in childhood.

→ Their continuous effect shows weakness, paralysis & at last death occur.

Tetani :-

- If few amount of Ca ions are present in sarcoplasm then normal condition then it is responsible for normal tightness or tonic condition.
- due to Ca metabolism excess, amount of Ca ion decreases in sarcoplasm which shows in voluntary contraction in skeletal muscle without any motor neurons signally.

Arthritis :-

- disease of inflammation or internal swelling.

Osteoporosis :-

- condition cause weak & brittle bone it is occur due imbalance of thyro calcitonine & parathyroid hormone PCT & PTH.
- ↓ in estrogen hormone in female after menopause due to this low amount of calcium occur.
- in alimentary canal improper calcium absorption occurs internally bone get perforated due to deaminilism of Ca ion.

Gout :- it is occur due to protein metabolism excess due to this amount of Uric acid crystal increases & get deposited in joint & cause pain.

- such patient is advised to consume low protein diet.
- No protein diet.
- It is also called uric acid disease.

end