Skeletal System

bones, cartilage and ligaments are tightly joined to form a strong, flexible framework called skeletal system

Functions of the skeletal system

- Movement: Skeletal system provides points of attachment for muscles. Your legs and arms move when the muscles pull on the bones.
- Support: The backbone is the main support center for the upper body. It holds your head up and protects your spinal cord.

- Protection: The bones of skull protect your brain. Ribs protect your lungs and heart from injury.
- Makes Blood: Red and white blood cells are formed by tissue called marrow, which is in the center of the bone.
- Storage: Bones store minerals, such as calcium and phosphorus.

Types of bones

- bones can be categorized according to their general shape:
- long bone
- short bone
- flat bone
- irregular bone

Long bones:

- These are cylindrical, longer than wide
- E.g femur, tibia, fibula

Short bones:

- length nearly equal to width
- limited motion
- eg. carpals, tarsals, patella

Flat bones:

- thin sheets of bone tissue
- enclose and protect organs
- broad surfaces for muscle attachments
- eg. sternum, ribs, most skull bones, scapula

Irregular bones:

- These bones have irregular shapes
- eg. vertebrae, sphenoid, ethmoid

- **Bone Structure**
- bones have outer shell of **compact bone**
- usually encloses more loosely organized bone tissue

- **epiphyses**
- large surface area for muscle attachment and pivot
- **spongy bone with trabeculae;**
- contains **red marrow (=hemopoietic tissues)**
- produces blood cells in delicate mesh of reticular
- tissues
- in adults red marrow is limited to vertebrae, sternum,
- ribs, pectoral and pelvic girdles, proximal heads of
- humerus and femur
- with age, red marrow is replaced by yellow marrow

- **articular cartilage**
- on surface of epiphyses resilient cushion of hyaline cartilage

- **diaphysis**
- thick **compact bone but light;**
- **hollow medullary cavity**

- **medullary cavity**
- **yellow marrow – fat (adipose) storage**
- “fat at the center of a ham bone”
- in event of severe anemia, yellow marrow can
- transform back into red marrow to make blood cells

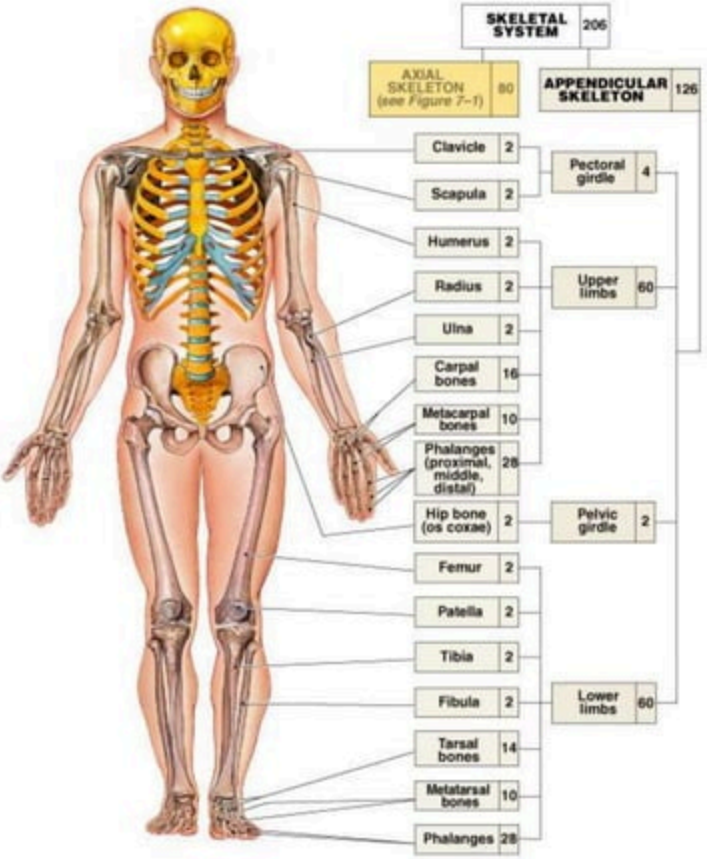
- **periosteum**
- white fibrous connective tissue continuous with tendons
- penetrates bone – welds blood vessels to bone
- **endosteum**
- fibrous CT that lines medullary cavity

Anatomy of Skeletal System

- **Foramen:** opening in bone – passageway for nerves and blood vessels
- **Fossa:** shallow depression – eg a socket into which another bone articulates
- **Sinus:** internal cavity in a bone
- **Condyle:** rounded bump that articulates with another bone
- **Tuberosity:** large rough bump – point of attachment for muscle
- **Spine:** sharp slender process

The skeletal system is devided into two parts:

1. Axial skeleton(80 bones)
2. Appendicular skeleton(126 bones)


SKELETAL SYSTEM 206
AXIAL SKELETON (see Figure 7–1) 80
APPENDICULAR SKELETON 126
Clavicle 2
Scapula 2
Pectoral girdle 4
Humerus 2
Radius 2
Ulna 2
Upper limbs 60
Carpal bones 16
Metacarpal bones 10
Phalanges (proximal, middle, distal) 28
Hip bone (os coxae) 2
Pelvic girdle 2
Femur 2
Patella 2
Tibia 2
Fibula 2
Lower limbs 60
Tarsal bones 14
Metatarsal bones 10
Phalanges 28


appendicular skeleton
axillary skeleton
appendages
shoulder girdle
pelvic girdle
skull
clavicle
scapula
sternum
humerus
ribs
vertebral column
ulna
sacrum
radius
pelvis
carpals
metacarpals
femur
phalanges
patella
tibia
fibula
tarsals
metatarsals
phalanges
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- Axial Skeleton: The axial skeleton includes the skull, spine, ribs and sternum.

- Appendicular Skeleton:

  The appendicular skeleton includes the appendages of the body, which are the shoulders, arms, hips, and legs.

The axial skeleton: It consists of

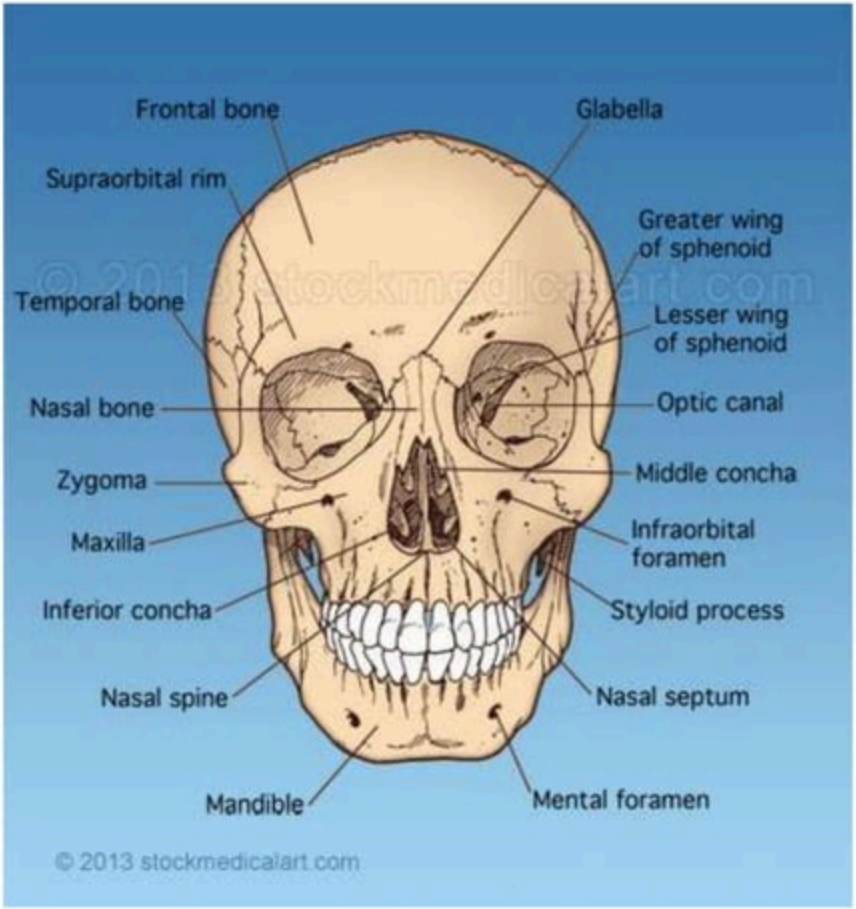
- Skull
- Vertebral column
- Sternum
- ribs

Skull

- Rests on the upper end of the vertebral column
- It consists of :

1. Cranial bones(8)
2. Facial bones(14)

- The cranial bones includes:
- 1 frontal bone
- 2 parietal bones
- 2 temporal bones
- 1 occipital bone
- 1 sphenoid bone
- 1 ethmoid bone


Frontal bone
Glabella
Supraorbital rim
Greater wing of sphenoid
Temporal bone
Lesser wing of sphenoid
Nasal bone
Optic canal
Zygoma
Middle concha
Maxilla
Infraorbital foramen
Inferior concha
Styloid process
Nasal spine
Nasal septum
Mandible
Mental foramen
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Frontal bone

- This is the bone of forehead
- Forms the part of the orbital cavities(eye sockets) and prominent ridges above the eyes, *supraorbital margins*

Parietal bones:

- Forms the sides and the roof of the skull.
- Inner surface is concave and accomodates the brain and the blood vessels

Temporal bones:

- These bones lie on each side of the head and form the sutures with the parietal, occipital, sphenoid and zygomatic bones.

occipital bone

- Forms the back of the head and part of the base of the skull
- foramen magnum - large opening in base
- through which spinal cord passes
- occipital condyles - articulation of vertebral column

sphenoid bone

- Occupies the middle portion of the base of the skulll and articulates with the occipital, temporal, pareital and frontal bones.
- irregular, unpaired bone
- resembles bat or butterfly;

Ethmoid bone

- Occupies the anterior part of the base of the skull and helps to form the orbital cavity,the nasal septum, and the lateral walls o f the nasal cavity.
- irregular, unpaired bone
- On each side are two projections into the nasal cavity, the superior and middle conchae or turbinated process

The facial bones:

The face is formed by 13 bones in addition to the frontaal bone.

2 zygomatic bone

1 maxilla

2 nasal bones

2 lacrimal bones

1 vomer

2 palatine bones

2 inferior conchae

1 mandible

Zygomatic(cheek) bones:

- Originates as two bones that fuse before irth.
- Form the prominences of the cheeks and the part of the floor and lateral walls of the orbital cavities.

Maxilla (upper jaw bone):

- Originates as two bones that fuses before birth
- Forms the upper jaw, the anterior part of the roof of the mouth, the lateral walls of the nasal cavity and part of the floor of the orbital cavities

Nasal bone:

- These are the two small flat bones that forms the greater part of the lateral and the superior surfaces of the bridge of the nose.

- **Lacrimal bones:**

These two small bones are posterior and lateral to the nasal bones and form apart of the medial walls of the orbital cavities

Vomer:

- The vomer is a thin flat bone that extends upwards from the middle of the hard palate to form the most of the inferior part of the nasal septum

Palatine bones:

- These are the two small L-shaped bones.
- These horizontal parts unite to form the posterior part of the hard palate and the perpendicular part s project upwards to form parts of the ethemoid bone.

Inferior conchae:

- Each conchae is a scroll- shaped bone, which forms the part of the lateral wall of the nasal cavity and projects into it below the middle conchae.

Mandible(lower jaw bone)

- Only movable jaw of the skull
- Originates as two parts that unite at the middle

hyoid bone

- single “U” or “horseshoe-shaped” bone in neck just below mandible
- suspended from styloid process of temporal bone
- serves as point of attachment for tongue and several other muscle

Fontanels

- ossification of skull begins in about 3rd month of fetal development and not completed at birth.
- Some of the bones have not yet fused
- These gaps are known as **fontanels**
- at this stage skull is covered by tough membrane for protection

The fontanels include:

- The fontannelAnterior (Bregmatic): “soft spot”, closes at 18 months
- Posterior (Occipital): triangular, closes at 2 – 3 months
- Anteriolateral (Sphenoidal): at 2 temples, closes at 2 – 3 months
- Posterolateral (Mastoidal): 2 behind ears, closes at 1 year

Sutures

- Skull bones interconnect at immovable joints called sutures
- Coronal Suture: between the frontal and parietal bones
- Sagittal Suture: between right and left parietal bones
- Lambdoidal Suture: between the parietal and occipital bones
- Squamous Suture: between temporal and parietal bones

Skull Cavities

- inside of skull contains several significant cavities:
- cranial cavity – largest (adult – 1,300 ml); part of dorsal
- body cavity
- orbits – eye sockets
- nasal cavity
- buccal cavity
- middle and inner ear cavities

sinuses: Cavities within the cranium
Lined with mucous membrane

- Decrease weight of skull

The sinuses include:

- frontal -2
- maxillary -2
- ethmoid -1
- sphenoid -1

- Frontal sinuses (2): above eyebrows, open into nasal cavity
- Ethmoid sinuses (2): between the eyes
- Spenoidal sinus (1): posterior to ethmoidal sinus, opens into nasopharynx
- Maxillary sinus (2): on either side of the nose, opens into the lateral wall of the nasal cavity

Functions of skull

- Protection of delicate structures including the brain, eyes, and inner ears
- Maintaining patency of the nasal passage enabling breathing
- the mandible, controlled by muscles of the lower face, allows chewing.
- The sinuses in some face and skull bones give resonance to voice.

Vertebral Column

- main axis of body
- Consists of 26 bones
- permits foreward, backward, and some sideways
- movement

Characteristics of a typical vertebra

The body:

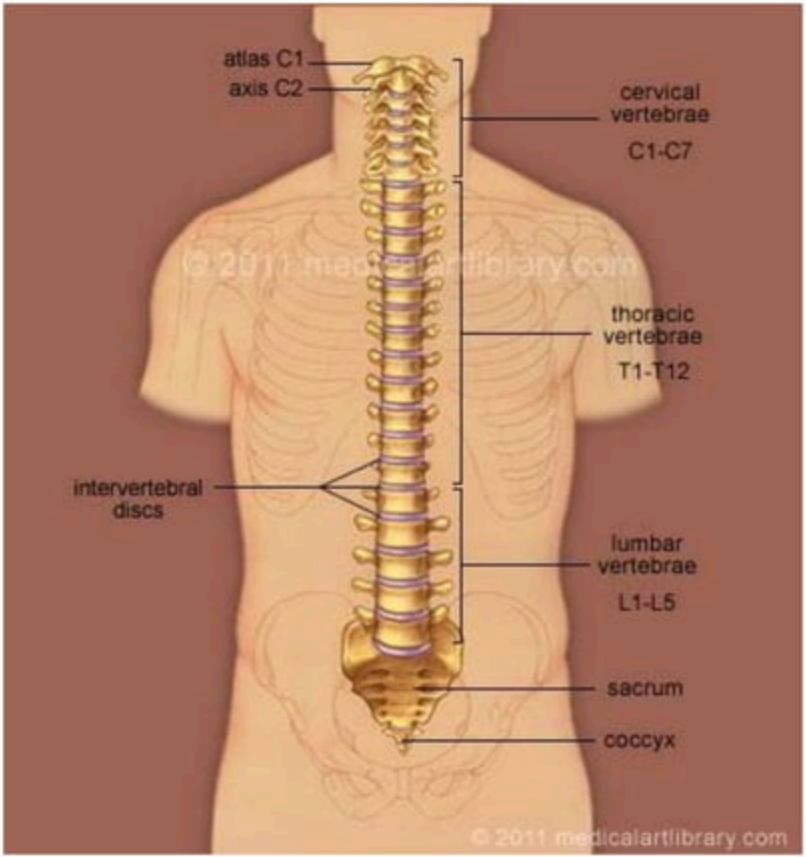
- Broad, flattened, largest part of the vertebra.
- The body of the vertebra lie to the front of the vertebral column

The vertebral(neural arch):

- Encloses a large vertebral foramen.
- Lies behind the body and forms behind the posterior and lateral walls of the vertebral foramen.

The vertebral column is divided into 5 regions:

- 7 cervical vertebrae (C1-C7)
- 12 thoracic vertebrae (T1-T12)
- 5 lumbar vertebrae (L1-L5)
- 1 sacrum (5 fused)
- 1 coccyx (3-5 fused)


atlas C1
axis C2
cervical vertebrae
C1-C7
thoracic vertebrae
T1-T12
intervertebral discs
lumbar vertebrae
L1-L5
sacrum
coccyx
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Cervical vertebrae (7):

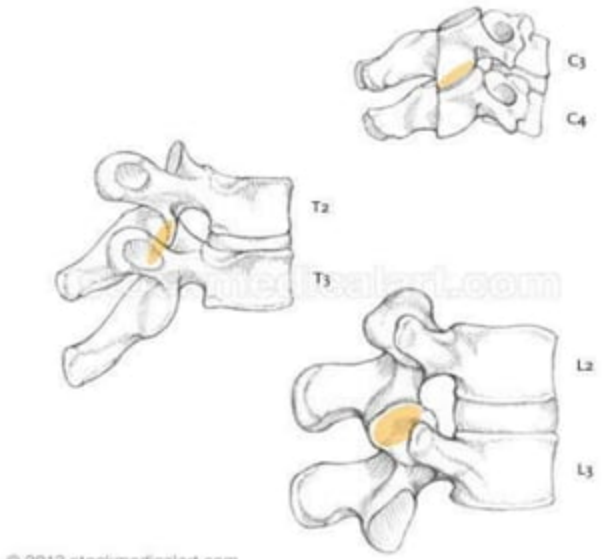
- Smallest vertebrae
- The transverse processes have a foramen through which a vertebral artery passes upwards to the brain.
- C1- atlas
- C2- axis
- C7- vertebra prominens

Thoracic (12):

- These are larger than the cervical vertebra.
- The bodies and the transverse processes have facets for articulation with the ribs

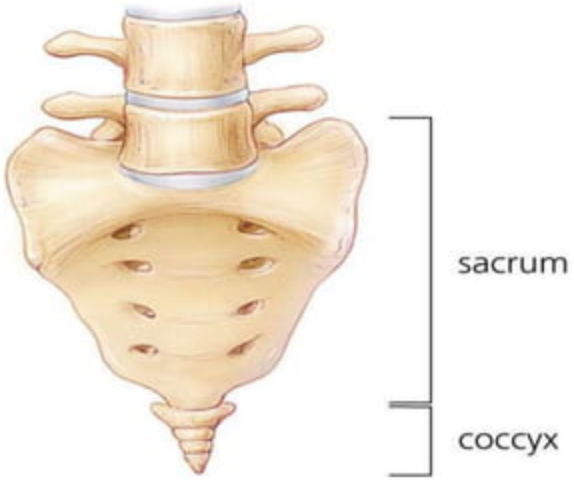
Lumbar (5):

- These are the largest of the vertebra because they have to support the weight of the upper body.
- Have short and thick spinous processes modified for attachment of powerful back muscles



The cervical, thoracic and lumbar vertebrae

- **Sacrum (5 fused):**
- Triangular or wedge shaped bone formed from 5 fused vertebrae



Coccyx (4 fused):

- Consists of four terminal vertebra fused to form a very small triangular bone
- The base articulates with the tip of the sacrum

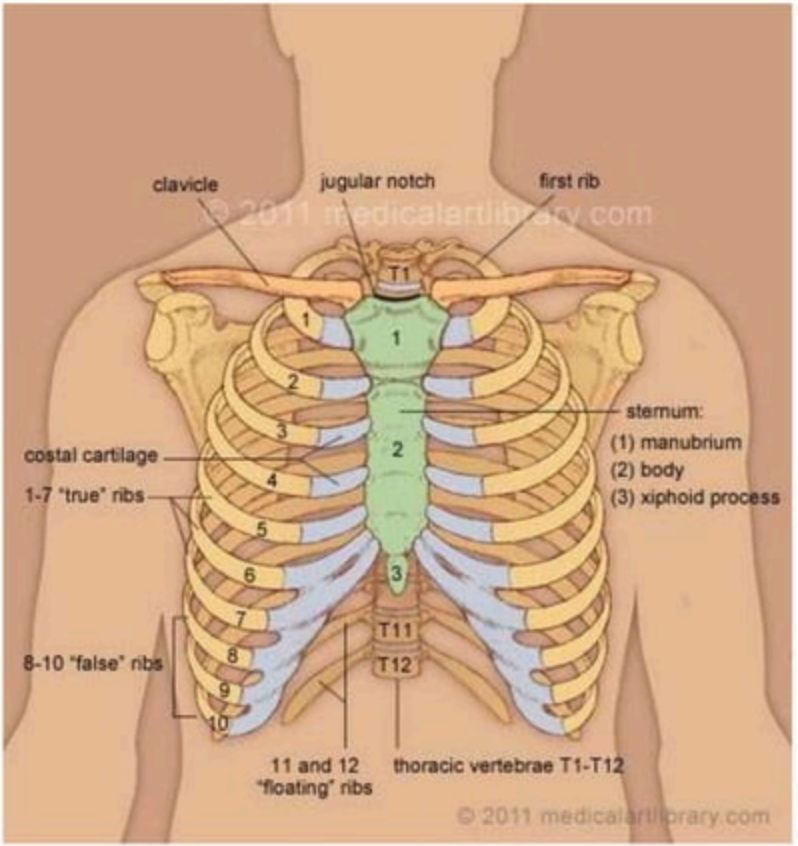
Functions of vertebral column

- Protects the spinal cord and the spinal nerves
- In the thoracic region the ribs articulate with the vertebrae forming joints that helps in the movement of the rib cage during respiration

Ribcage

- Also called Thoracic cage (25 bones)
- Consists of:

a) sternum(1)
b) ribs(12 pairs)


clavicle
jugular notch
first rib
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T1
1
1
2
2
3
sternum:
(1) manubrium
(2) body
(3) xiphoid process
costal cartilage
4
1-7 "true" ribs
5
6
3
7
T11
8-10 "false" ribs
8
T12
9
10
11 and 12
"floating" ribs
thoracic vertebrae T1-T12
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Sternum(breast bone)

- The flat bone in the middle of the rib cage
- Uppermost section is called *manubrium*
- The body or the middle portion gives attachment to the ribs
- The inferior tip is called *Xiphoid process*

Ribs

- The 12 pairs of ribs forms the lateral walls of the thoracic cage.
- 7 pair true ribs: separate costal cartilage to attach to sternum
- 3 pair false ribs: common shared costal
- cartilage to attach to sternum
- 2 pair floating ribs: no cartilage, no attachment to sternum

Functions of the rib cage

- Protects the content of the thorax including the heart lungs and blood vessels
- Forms a joint between the upper limbs and the axial skeleton
- Gives attachment to the muscles of respiration
- Helps in breathing

- Appendicular skeleton = 126 bones
- consists of limbs and limb girdles to provide
- movement
- Pectoral or shoulder girdle 4 bones
- Upper limbs 60 bones
- Pelvic girdle 2 bones
- Pelvic girdleLower limbs

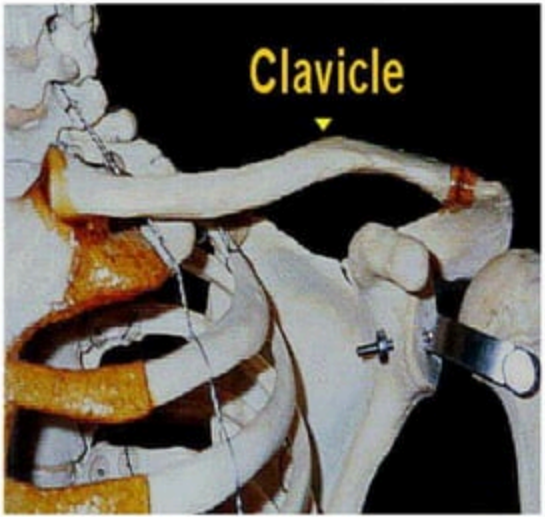
Shoulder girdle

- Each shoulder girdle Consists of a clavicle and a s



Clavicle or Collarbone

The clavicle, or collar bone, holds the shoulder joint away from the rest of the upper body and is only as thick as your little finger.



Scapula

- The scapula is located on the back side of the ribcage and helps provide part of the shoulder joint and movement for the arms





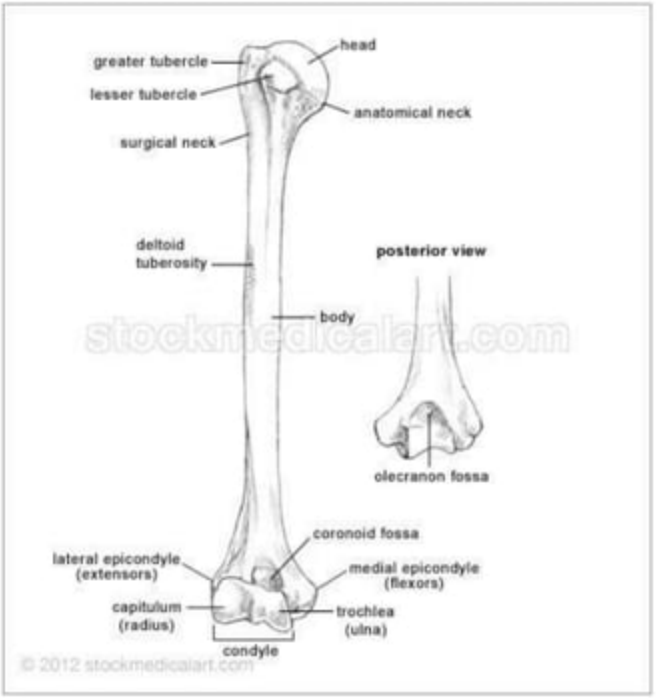
Upper limbs:

each upper limb comprises

- 1 humerus
- 1 radius
- 1 ulna
- 8 carpal bones
- 5 metacarpal bones
- 14 phalanges

Humerus:

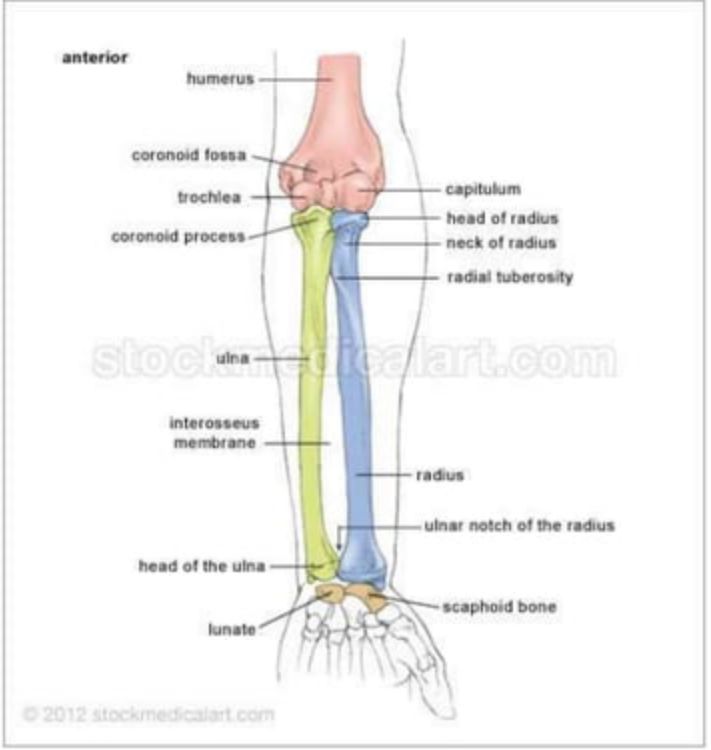
- This is the bone of the upper arm.
- Head of the femur joins the scapula at glenoid cavity forming the shoulder joint.
- Distal to the head two roughened projections of the bone, the graeter and the lesser tubercles articulates with the radius and the ulna to form the elbow joint.



The humerus bone

Ulna and radius:

- These are the bones of forearm
- Ulna is longer and medial to the radius
- The two bones articulate with each other at the distal and proximal radioulnar joints



The radius and the ulna

Carpal(wrist bones)

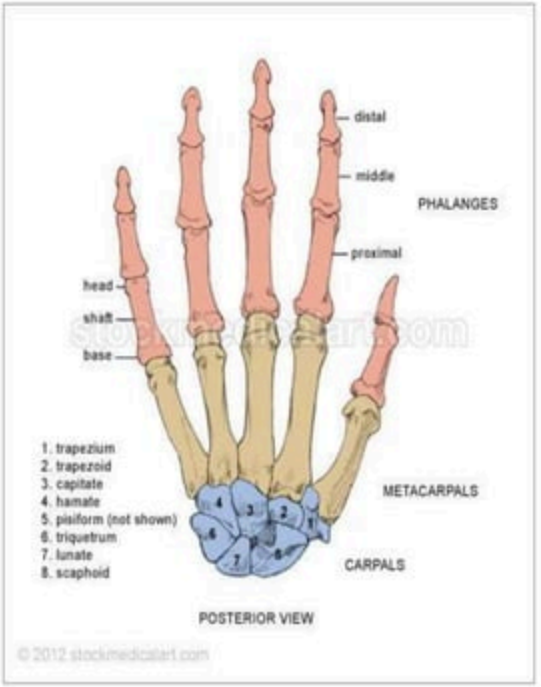
- There are 8 carpal bones arranged in two rows of 4
- Proximal rows: scaphoid, lunate, triquetrum, pisiform
- Diatal rows: trapezium, trapezoid, capitate, humate.

Metacarpal bones(bones of the hand)

- These five bones form the palm of the hand.
- The proximal ends articulate with the carpal bones and the distal end with the phalanges

Phalanges:

- 14 in number
- 3 in each finger and 2 in the thumb
- Articulate with the metacarpal bones and with each other by hinge joint.



Carpals, mrtacarpals and phalanges

Innominate (hip) bones

Each hip bone consists of three fused bones

1. Ileum
2. Ischium
3. Pubis

- The union of the three bones takes place in the acetabulum

1. Ileum:
   - Upper flattened part of the bone and it presents the iliac crest
   - The anterior curves are called superior and inferior anterior iliac spines
   - The posterior spines are called superior and inferior posterior iliac spines

2. Ischium:
   - inferior and posterior part.
   - The rough inferior projections are called ischial tuberosity

3. Pubis:
   - anterior part of the bone and articulates with the pubis and other hip bone at a cartilaginous joint, the symphysis pubis

lower limbs: each lower limb comprises

- 1 femur
- 1 tibia
- 1 fibula
- 7 tarsal bones
- 5 metatarsal bones
- 14 phalanges

Femur(thigh bone)

- Longest and the heaviest bone of the body
- Head is spherical and fits into the acetabulam of the hip bone

Tibia(shin bone)

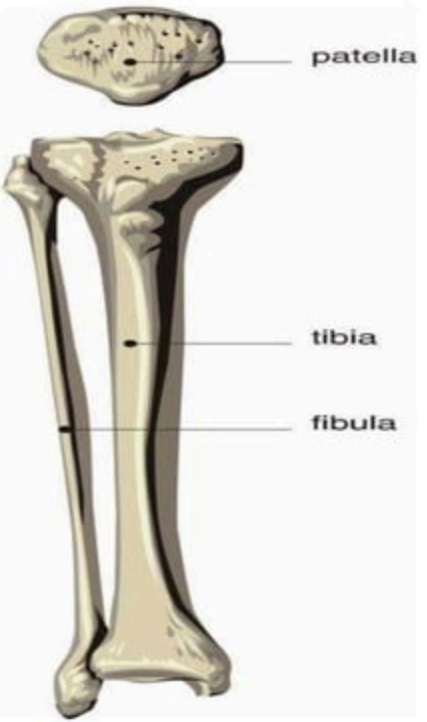
- Tibia is the medial of the two bones of the lower leg
- The proximal extrimity is broad and flat and presents the two condyles for articulations with the femur

Fibula

- Long slender lateral bone in the leg
- The head or the upper extrimity articulates with the lateral condyle of the tibia forming the proximal tibiofibular joint

Patella(knee cap)

- Roughly triangular-shaped sesamoid bone associated with the knee joint
- Its posterior surface articulates with the patellar surface of the femur in the knee joint.



Tarsal(ankle bones)

- Seven in number
- Talus, calcaneous, navicular, cuboid and three cuneiform bones

Metatarsals(bones of the foot)

- These are 5 in number which form the greater part of the dorsum(sole) of the foot
- At the proximal end they articulate with the tarsal bones and at the distal end with the phalanges.

Phalanges(toe bones)

- There are 14 phalanges arranged in a similar manner to those of the fingers
- 2 in the great toe(the hallux) and 3 in each of the other toe



Functions of the appendicular skeleton

- Voluntary movement: the bones, muscles and joints of the limbs help in the movement of the skeleton
- Protection of the blood vessels and the nerves