

# Anatomy & Physiology Notes -- Skeletal System (KEY)

## Bone structure: parts of a long bone, etc

### exterior

**epiphysis** -- end of the long bone

**diaphysis** -- shaft of the long bone

**articular cartilage** -- covers parts of epiphysis, aids in movement

**periosteum** -- tough, fibrous covering of the bone (continuous with tendons/ligaments)

### interior

**compact bone** -- (**cortical bone**), tightly packed cells, very strong, in diaphysis

**spongy bone** -- (**cancellous bone**), cells spaced apart, found in epiphyses

**endosteum** -- lining of the medullary cavity

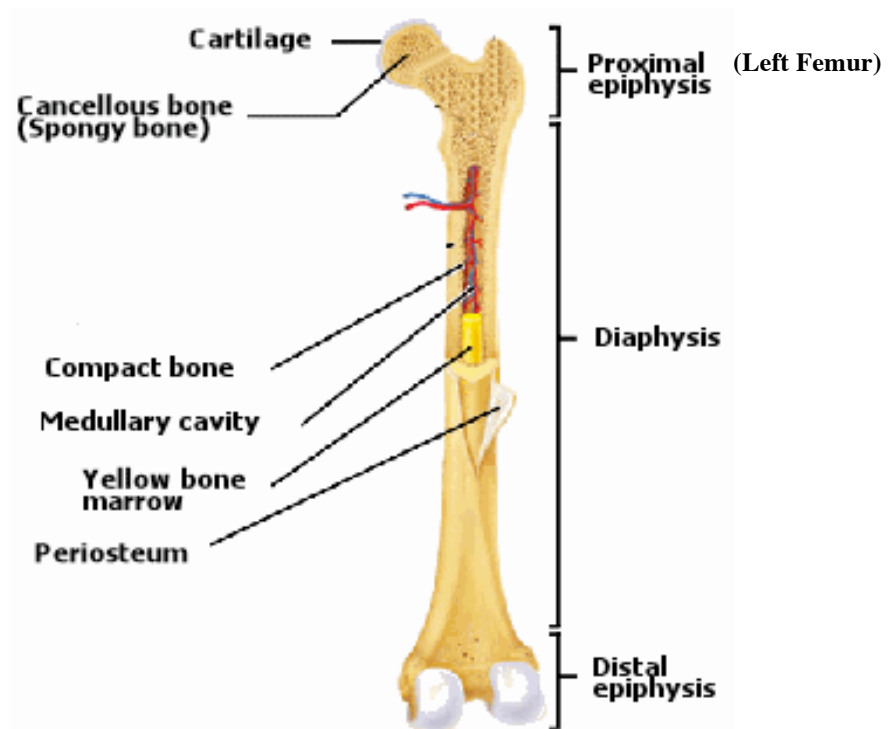
**medullary cavity** -- hollow space inside diaphysis of long bones, contains blood vessels, nerves, and marrow

**marrow** -- very soft connective tissue

**red marrow** -- produces blood cells

**yellow marrow** -- stores fat

Diagram of a Long Bone



## Microscopic structure of bone.

**osteocyte** -- bone cell

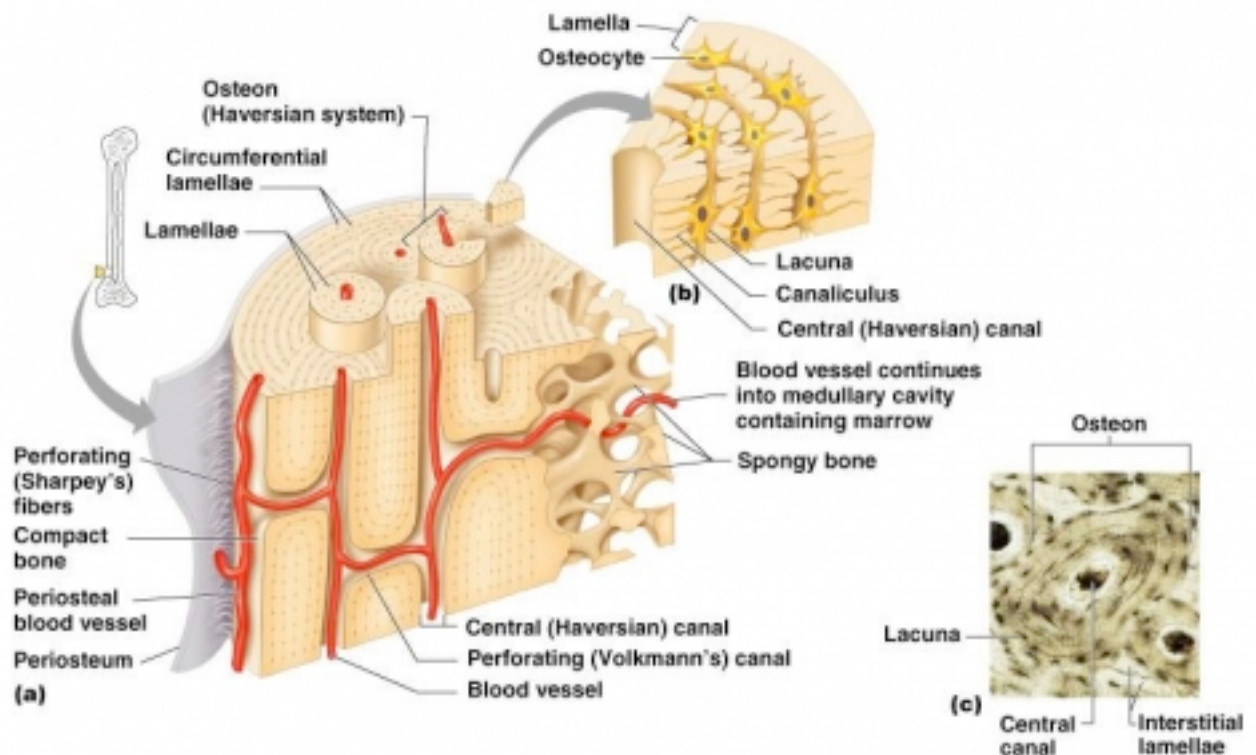
**osteon** -- circular functional unit of cortical bone

**osteonic canal** – (AKA **Haversian canals**) inner “hole” through which blood vessels and nerves pass in an osteon

**perforating canal** – transverse “bridge” between osteonic canals, contains larger blood vessels and nerves

**caniculus** – (plural **caniculi**) microscopic canal that connects lacunae

**lacuna** – (plural **lacunae**) spaces within the matrix of bone where osteocytes are found



## Development of bone.

**Intramembranous bone.** -- found in broad, flat bones (ex--skull bones)

1. thin membranelike layers of connective tissue form framework
2. Some cells differentiate and become osteoblasts
3. Osteoblasts deposit matrix of calcium salts
4. Periosteum forms on outside, spongy bone forms in middle, thin layer of compact bone is on outside of spongy bone
5. Osteoblasts give rise to osteocytes

**Endochondral bone.** found in most other bones in the body

1. Hyaline cartilage frameworks are formed
2. Parts of the cartilage calcifies at the diaphysis center
3. Cells in the diaphysis form periosteum and primary ossification centers (for deposition of calcium salts); blood vessels grow
4. Secondary ossification centers form at epiphyses
5. Epiphyseal disks (growth plates) remain at the junctures
6. At adulthood, epiphyseal disks close and growth stops

## Homeostasis of bone.

between 3 - 5% of adult bone mass is “turned over” per year  
lost calcium salts are replaced by calcium in the diet

**osteoclasts** --carry calcium from bone into bloodstream (resorption)

**osteoblasts** -- bring calcium to bone from bloodstream (deposition)

## **4 Functions of Bone**

### **1. Support and Protection**

legs, hips, and spine support body weight

skull protects brain, eyes, and internal ears

rib cage protects heart and lungs

### **2. Body movement.**

skeleton is the framework that is moved by muscles

motions are determined by the position and shape of the bone(s) involved

### **3. Blood Cell Formation.**

**hematopoiesis** -- formation of blood cells by the bone marrow

red bone marrow contains cells that make red blood cells, white blood cells,  
and platelets

infants have more red marrow than adults

adults have red marrow in skull, ribs, sternum, clavicles, vertebrae, and pelvis

### **4. Storage of Inorganic Salts.**

most common salt stored is calcium phosphate

heavy metals can also be stored in bone (arsenic, lead, strontium, mercury)

calcium is removed from bone for many processes in the body

bone mass is maintained through proper intake of calcium plus weight-bearing  
exercise

bone mass begins to decline after age 35

**osteoporosis** -- thinning of the bone due to loss of calcium

most commonly seen in post-menopausal Caucasian women, but can be  
found in other groups and ages

## Two major parts of the skeleton.

**axial skeleton** bones that support and protect organs of head, neck, and trunk

**appendicular skeleton** bones of the upper and lower limbs and bones that anchor them to the axial skeleton

total number of bones in the adult skeleton   206  

The number of bones in an infant skeleton is greater than the number of bones in an adult

**Axial Skeleton.**   80   bones

**skull**

22 bones

**8 cranial bones**

frontal  
parietal (2)  
occipital  
temporal (2)  
sphenoid  
ethmoid

**13 facial bones**

maxilla (2)  
zygomatic(2)  
palatine (2)  
inferior nasal concha (2)  
lacrimal (2)  
nasal (2)  
vomer

**1 mandible**

**middle ear**

6 bones

malleus (2)

incus (2)

stapes (2)

**hyoid**

1 bone

(found at the top of the throat)

**vertebral column**

26 bones

cervical vertebrae (7)  
thoracic vertebrae (12)  
lumbar vertebrae (5)  
sacrum  
coccyx

**thoracic cage**

25 bones

ribs (24)

sternum

**Appendicular skeleton**      \_\_126\_\_ bones

**pectoral girdle**

4 bones

scapula (2)

clavicle (2)

**upper limbs**

60 bones

**6 arm bones**

humerus (2)

radius (2)

ulna (2)

**16 wrist bones**

carpal (16)

trapezium (2)

trapezoid (2)

capitate (2)

triquetrum (2)

pisiform (2)

lunate (2)

scaphoid (2)

**28 finger bones**

phalanx (28)

**10 hand bones**

metacarpal (10)

**pelvic girdle**

2 bones

coxal bone (2)

**lower limbs**

60 bones

**8 leg bones**

femur (2)

tibia (2)

fibula (2)

patella (2)

**14 ankle bones**

tarsal (14)

talus (2)

calcaneus (2)

cuneiform (6)

cuboid (2)

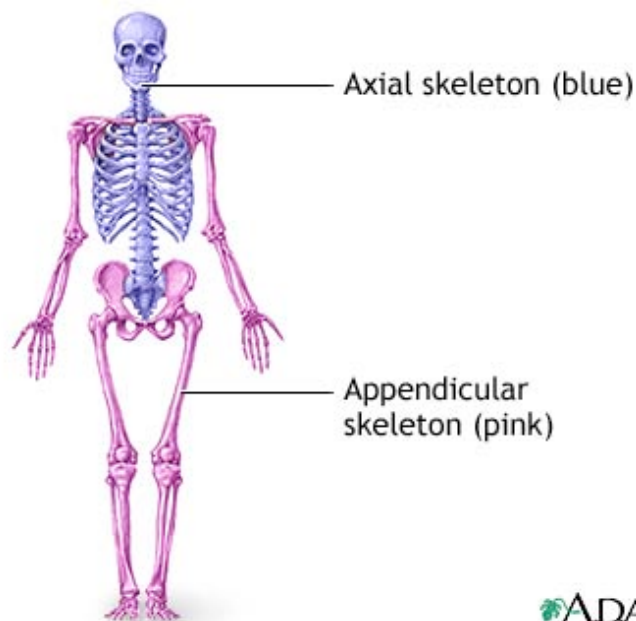
navicular (2)

**28 toe bones**

phalanx (28)

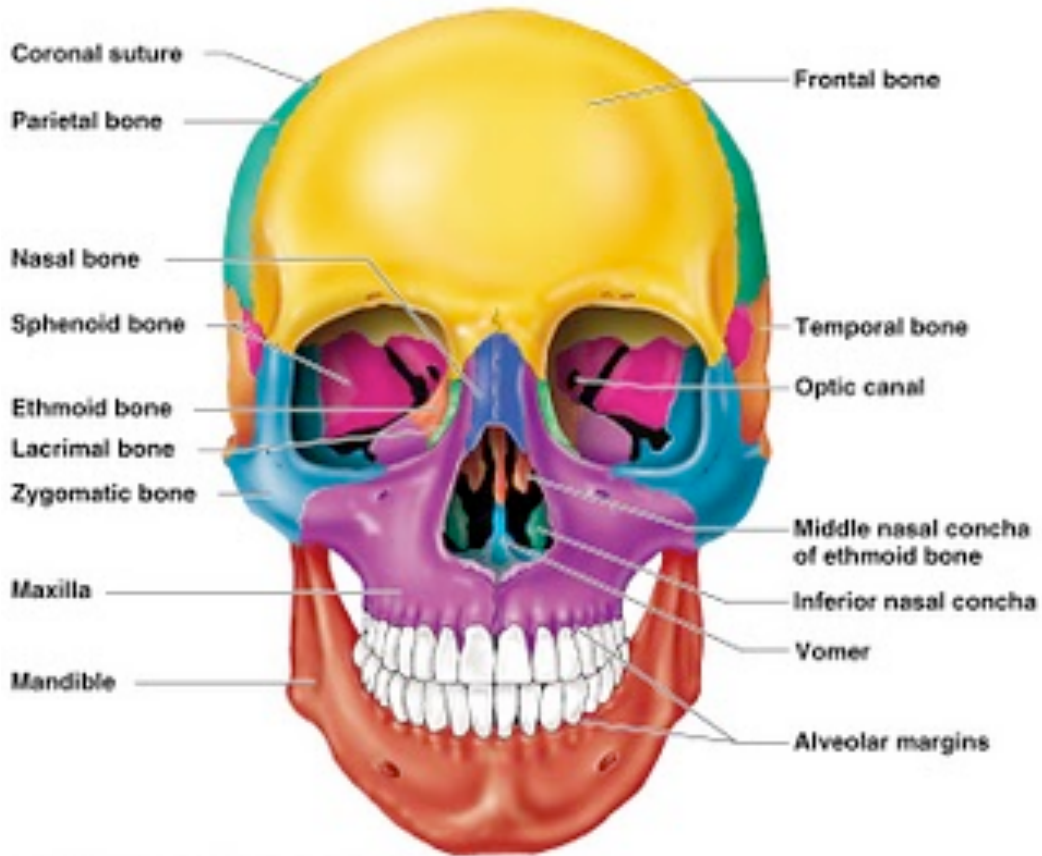
**10 foot bones**

metatarsal (10)

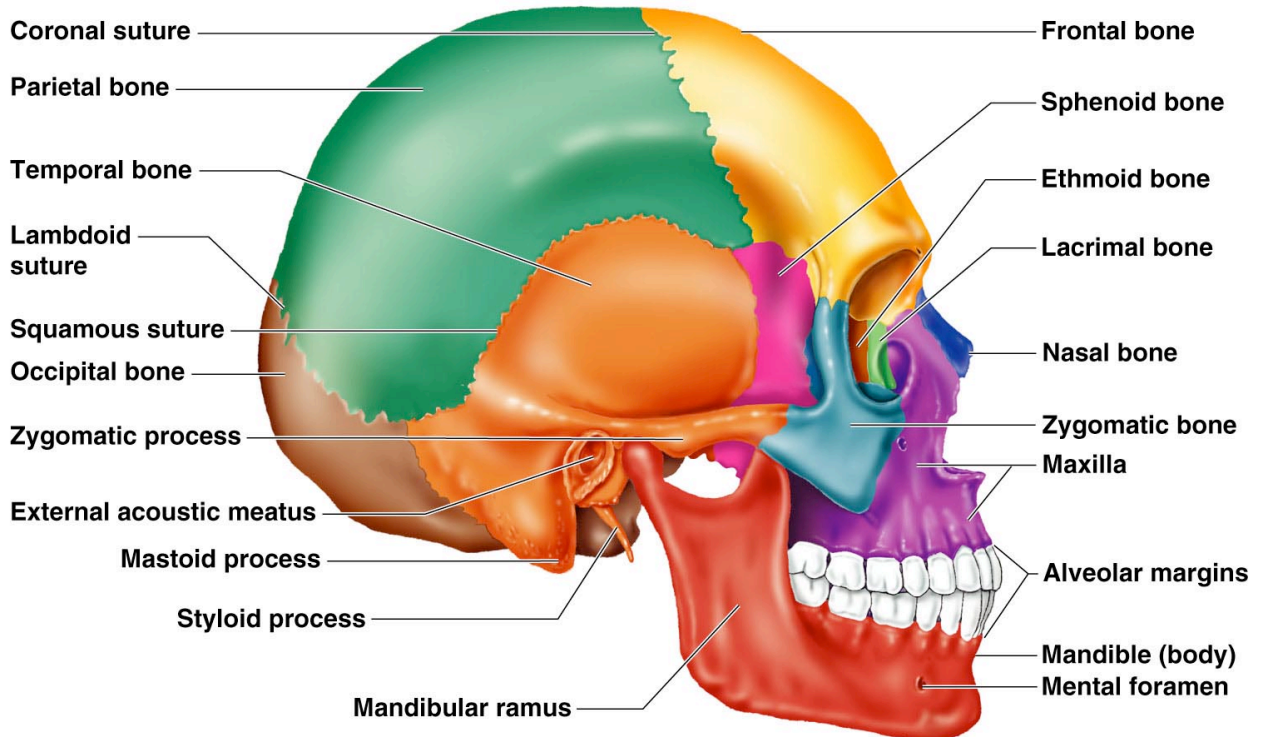


# Axial Skeleton Diagrams

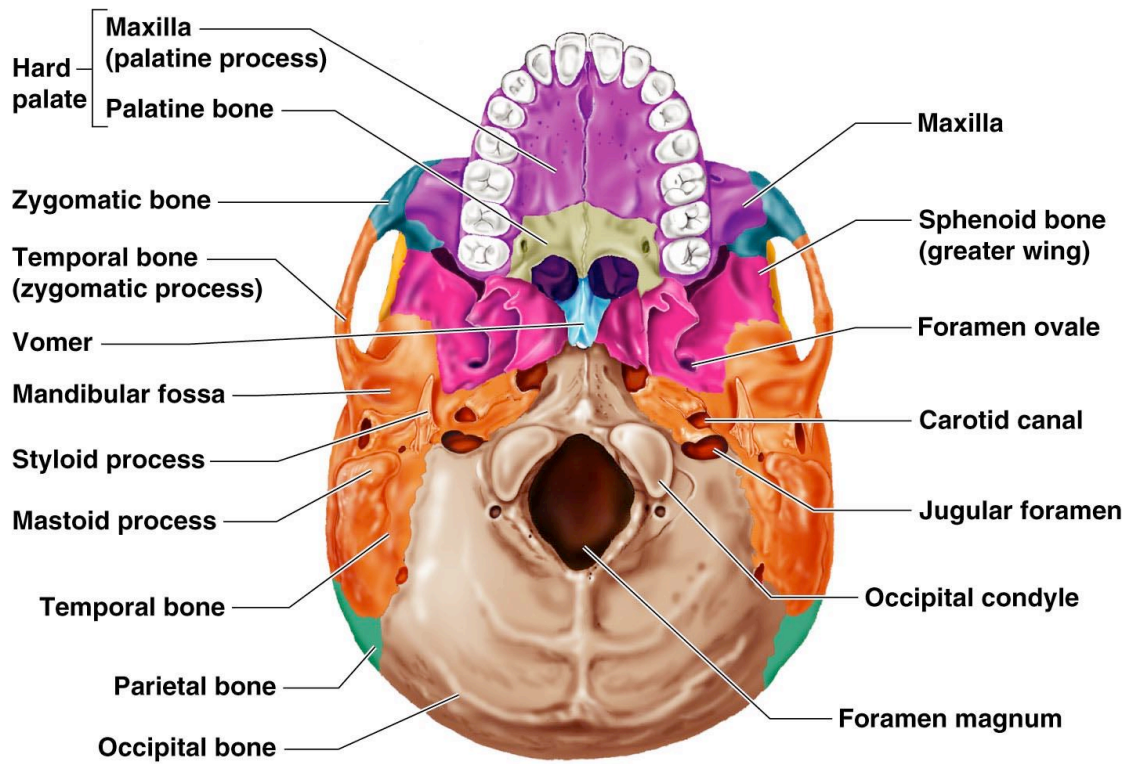
## Skull Bones



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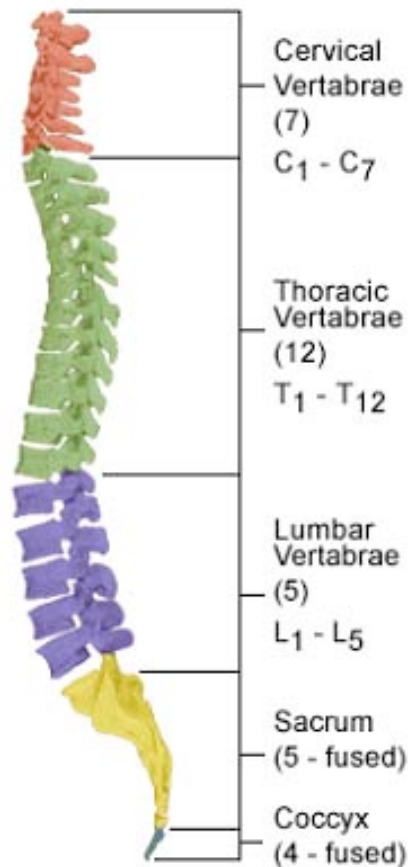
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## Spinal Column Bones

### Spinal Column with Vertebrae





# Thoracic Cage

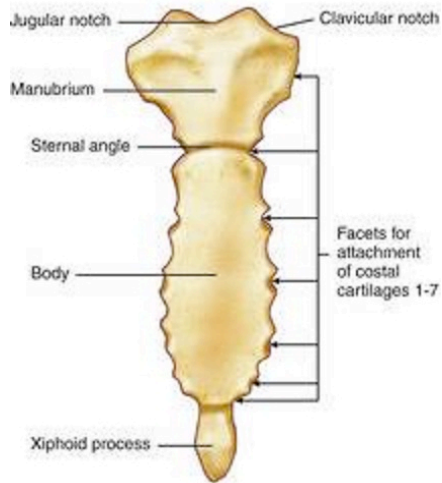
## Sternum

3 parts:

manubrium (top triangular portion of sternum)

body (main part of the sternum)

xiphoid process (pointed bottom portion of sternum)



## Ribs

True ribs

(top 7 pairs of ribs)

attach directly to the sternum by costal cartilage

False ribs

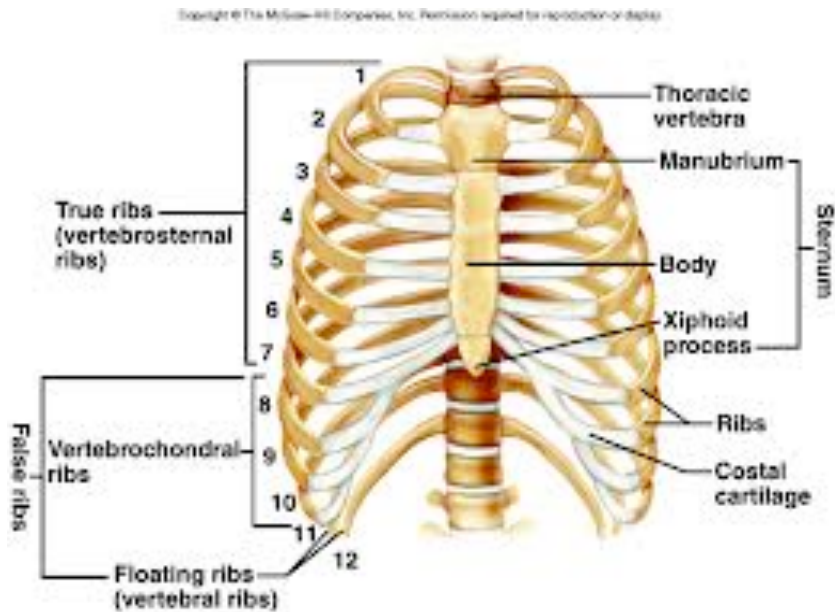
(bottom 5 pairs of ribs)

attach indirectly to the sternum by costal cartilage

Floating ribs

(last 2 pairs of false ribs)

do not attach to sternum



## Appendicular Skeleton diagrams

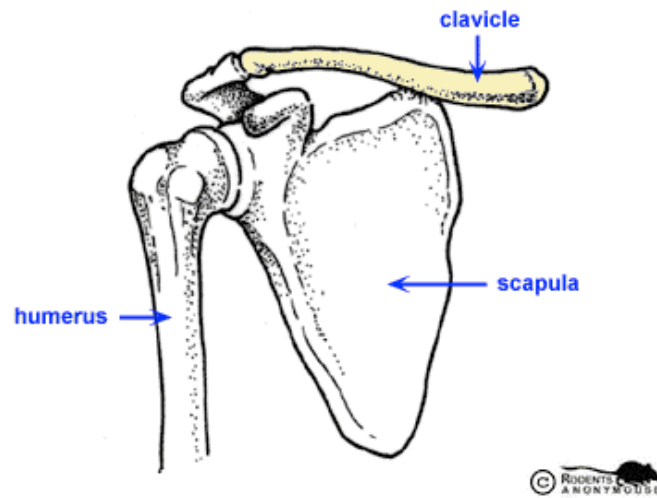
### Pectoral girdle

clavicle

collarbone

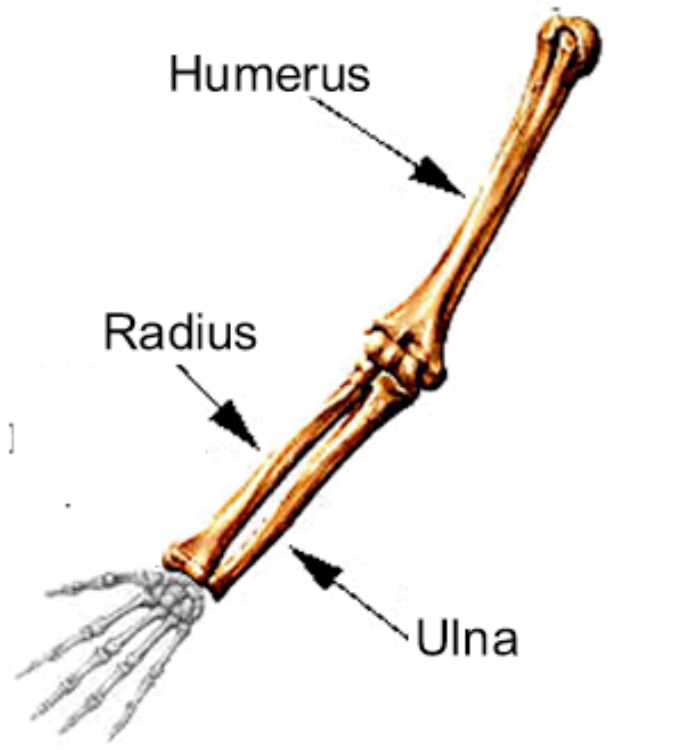
scapula

shoulder blade

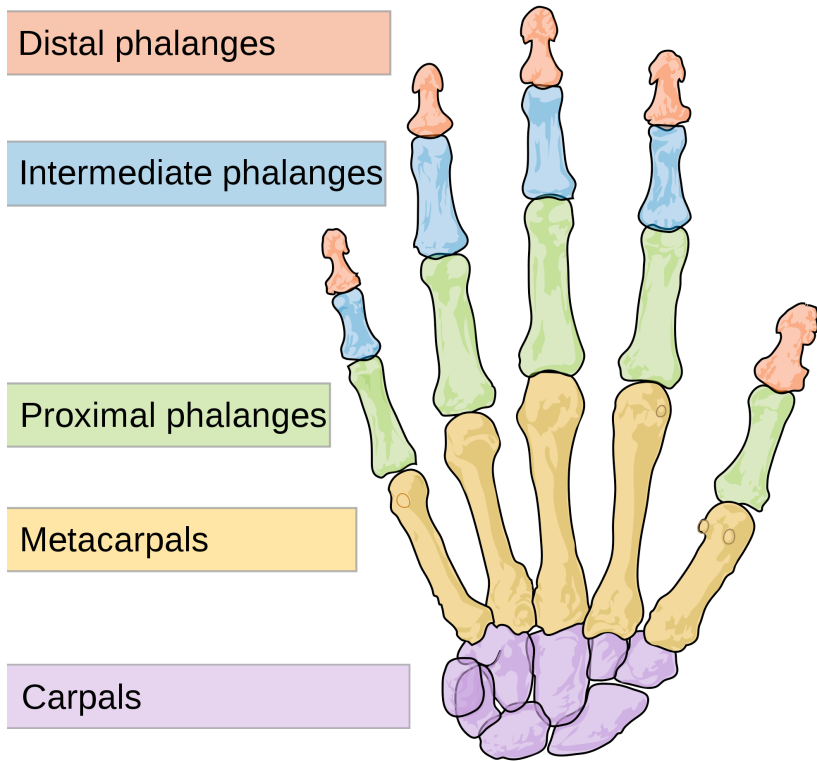
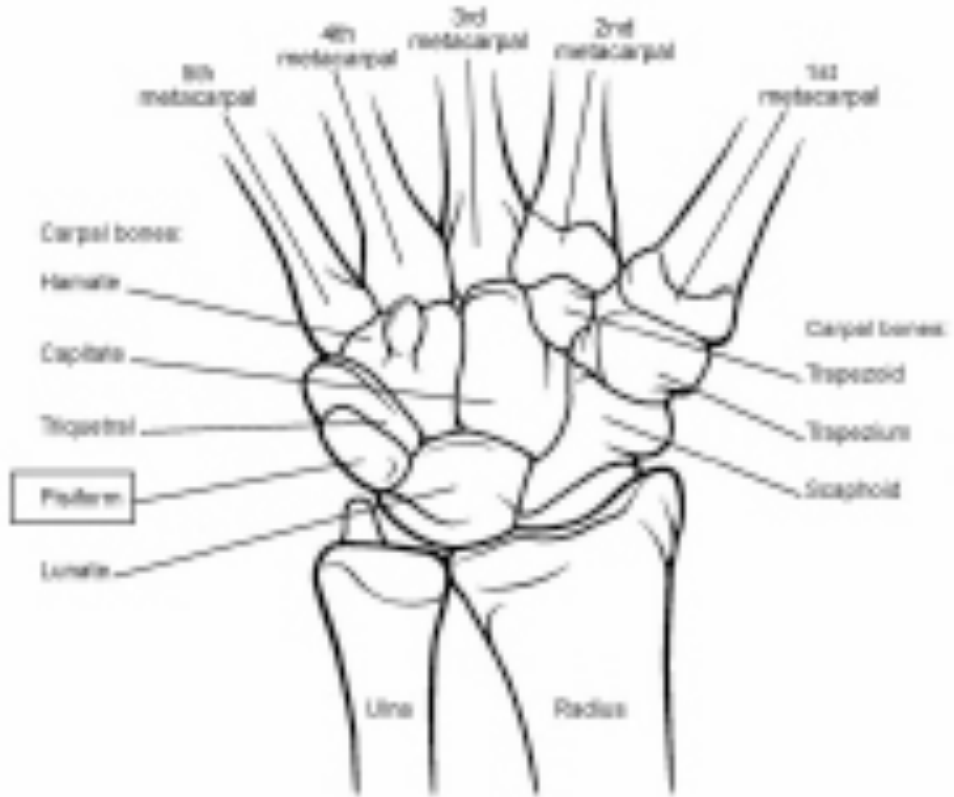


### Upper Limbs

Arm bones



# Wrist and Hand Bones



## Pelvic Girdle

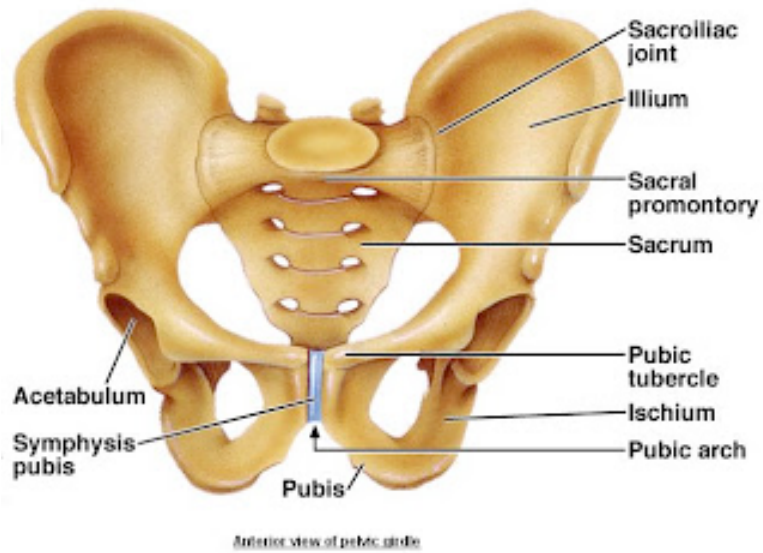
Coxal bone

3 parts

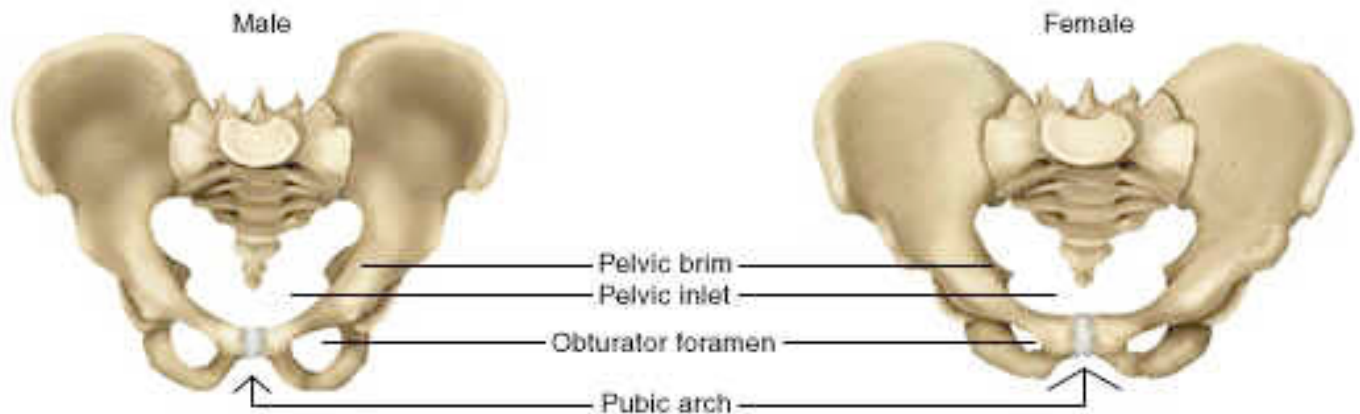
ilium

ischium

pubis



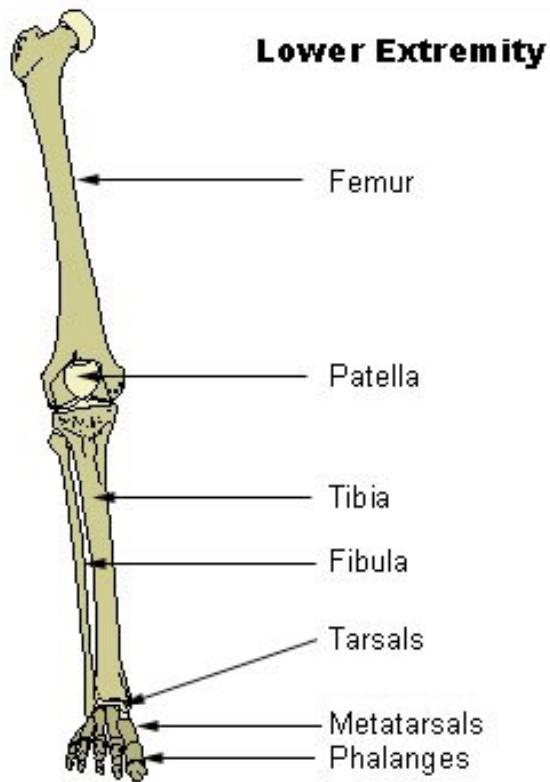
## **Differences between male and female pelvic girdles**



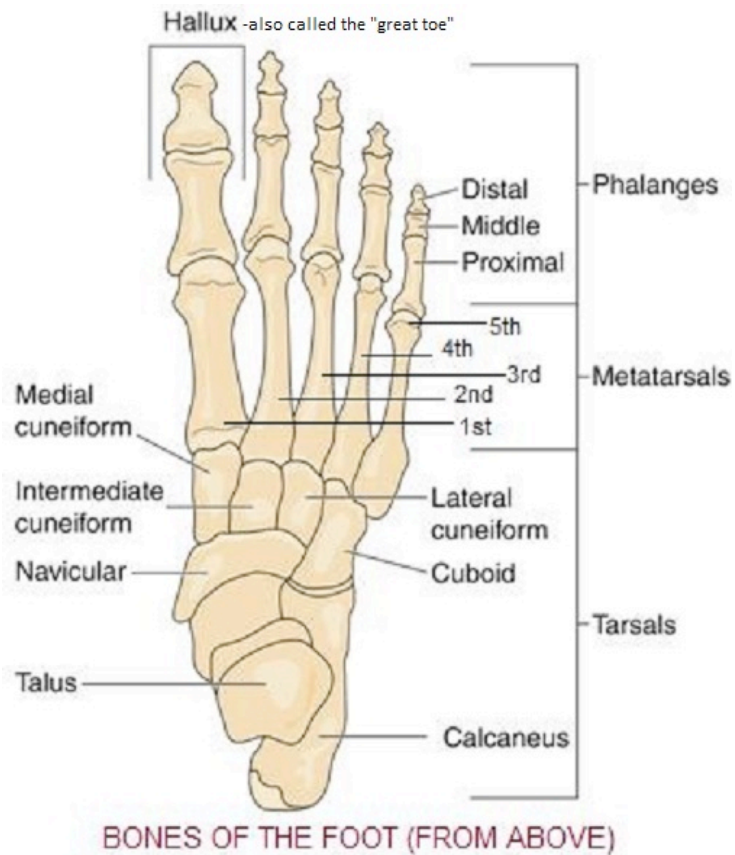
	<b>Male</b>	<b>Female</b>
Iliac crest	narrow	flared
Pubic arch	narrow	wide
Pelvic brim	narrow and deep	wide and shallow
Sacrum	long and narrow	short and wide
Coccyx	curved	flatter

## Lower Limb

### Leg and foot bones



### Foot and Ankle bones



## Major Types of Joints

Type	Characteristics	Locations
Fibrous (fixed)	joint is filled with a thin layer of dense connective tissue  *no movement between bones in joint	skull
Cartilaginous	joint is hyaline cartilage or fibrocartilage  *limited movement (ex: bending of vertebral column)	spine, front of pelvis (symphysis pubis)
Synovial	bones are surrounded by a joint capsule (ligaments and synovial fluid)  ends of bones covered by hyaline cartilage (articular cartilage)  *most common type of joint	most joints in body (see next chart)

## Types of Synovial Joints

Type	Description	Locations
Ball-and-socket	ball-shaped end of one bone fits into cup-shaped end of another bone	hip (coxal & femur), shoulder (humerus & scapula)
Condylloid	oval-shaped end of one bone fits into elliptical end of another bone	between metacarpals and phalanges
Gliding	surfaces of connecting bones are flat or slightly curved	carpals, tarsals
Hinge	convex surface of one bone fits into concave surface of another bone	elbow, phalanges
Pivot	cylindrical surface of one bone attached to ring of bone and ligament	proximal ends of radius and ulna
Saddle	both bones have convex and concave areas; bones fit into complementary surfaces	between carpal and metacarpal of thumb

## Types of Movements

elevation	raising a body part
depression	lowering a body part
abduction	moving a body part away from the midline (laterally)
adduction	moving a body part toward the midline
flexion	decreasing angle between 2 bones by moving at the joint
extension	increasing angle between 2 bones by moving at the joint
hyperextension	excess extension of a joint beyond anatomical position
dorsiflexion	bending the foot at the ankle upward
plantar flexion	bending the foot at the ankle downward
rotation	moving a part around an axis
circumduction	tracing a circular path with a body part
pronation	turning the hand so the palm is downward
supination	turning the hand so the palm is upward
protraction	moving a part forward
retraction	moving a part backward
eversion	turning the foot so the sole is facing outward
inversion	turning the foot so the sole is facing inward