

BONE, SKELETON, JOINT

objectives

- Human bone: functional anatomy
- Human skeleton classification
- Joint type and classification

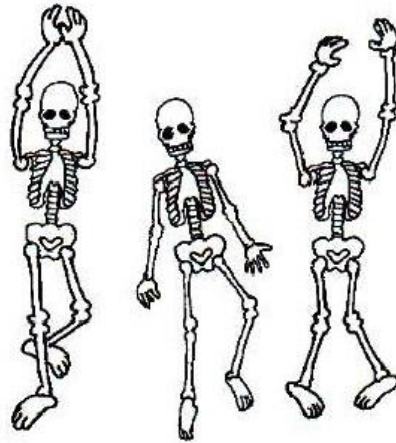
What is bones? What is skeleton? What is joint?
What are the function of bones/skeleton/joint?



Osteology

Definition:

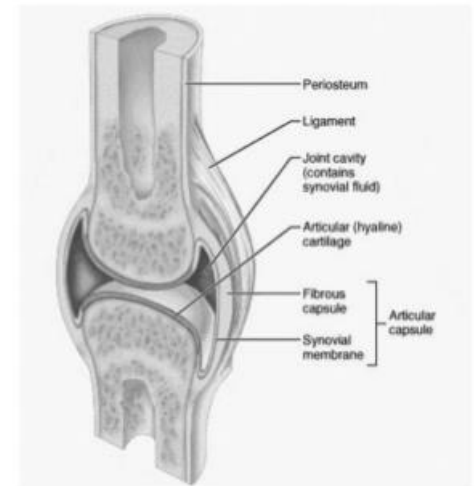
- Greek, (*osteon*= bone), (*logos*= science).
- The branch of anatomy that deals with the structure and function of bones.



Arthrology

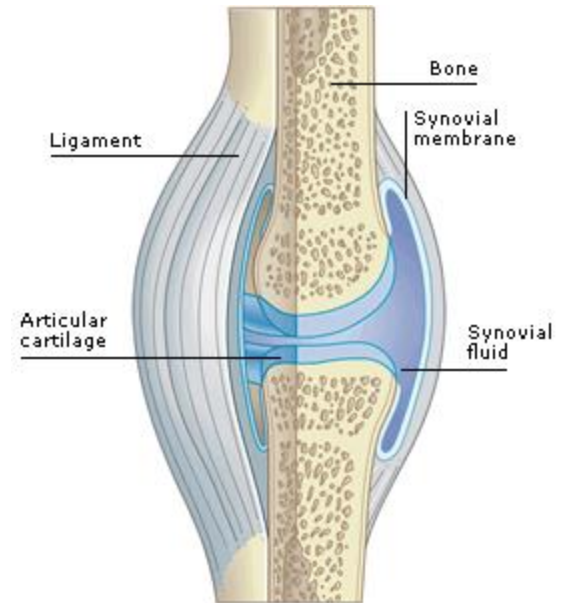
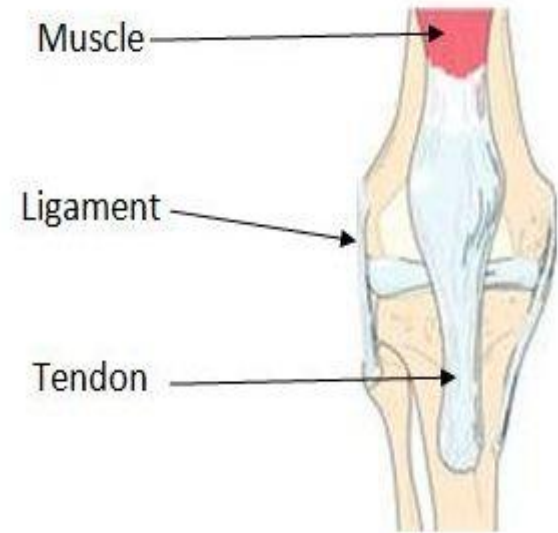
Definition:

- Greek, (*arthro*= joint), (*logos*= science).
- **Arthrology** is the scientific study of joints, and articulations.
- Site where rigid elements of the skeleton meet are called articulations.



Bone, Skeleton, Joint

- Bone, or **osseous tissue**
- is a remarkable material with properties that make it ideal for its **support and movement** functions.
- The skeleton is built of bone tissue.
- Joints, or articulations, are the intersections between bones. Ligaments connect bones at the articulations, thus reinforcing the joints.
- The skeleton consists of approximately **20% of total body weight**.



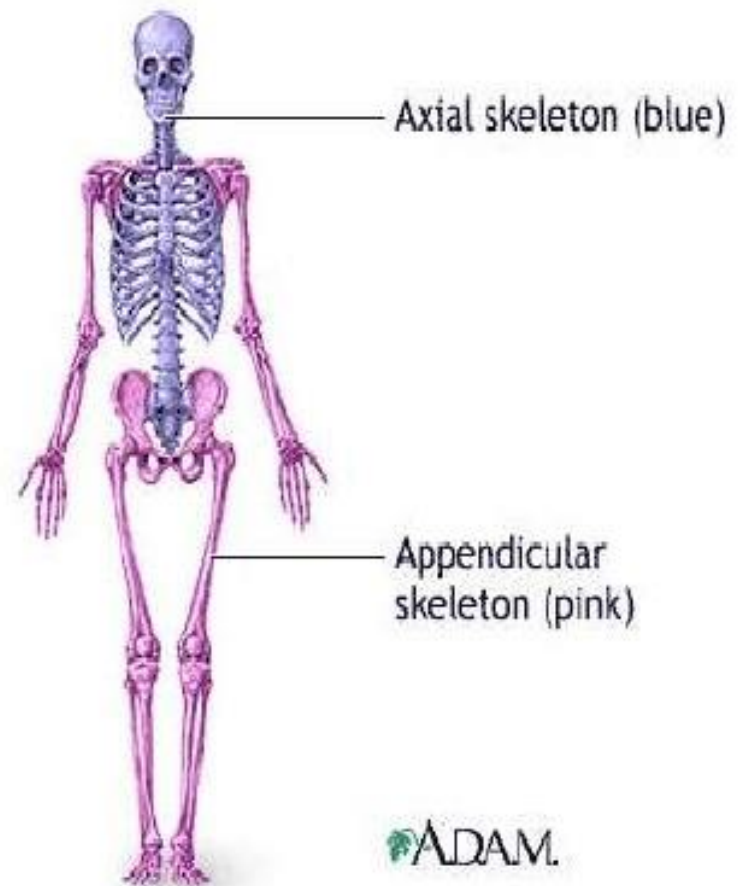
- Humans, are born with an incredible 270 different bones! Some of these join together leaving 206 unique bones by the time you're an adult.
- Do you know the name of 206 bones?

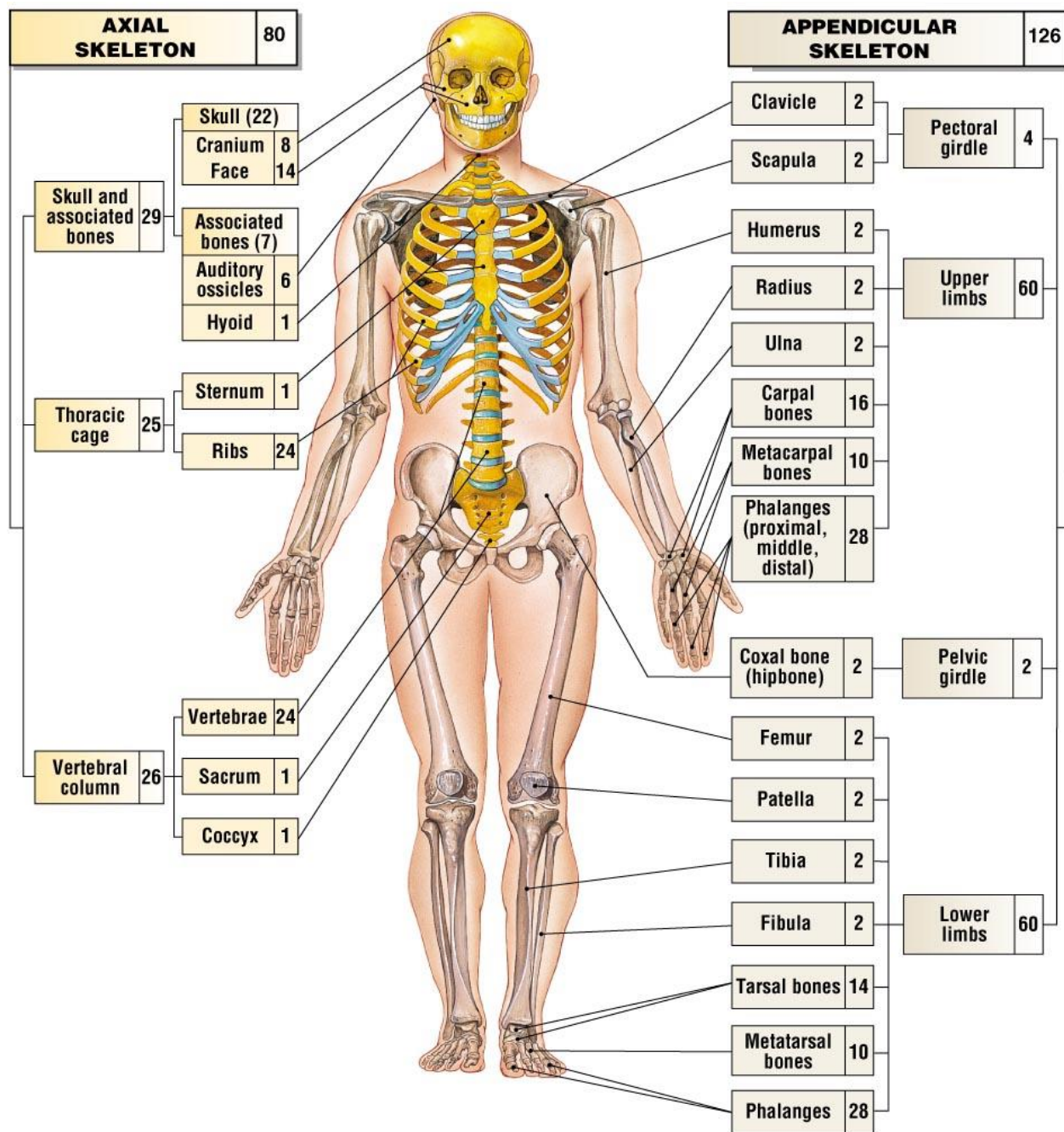


Classification of bones

Bones are classified according to their position:

- Axial Skeleton
- Appendicular skeleton





Osteology

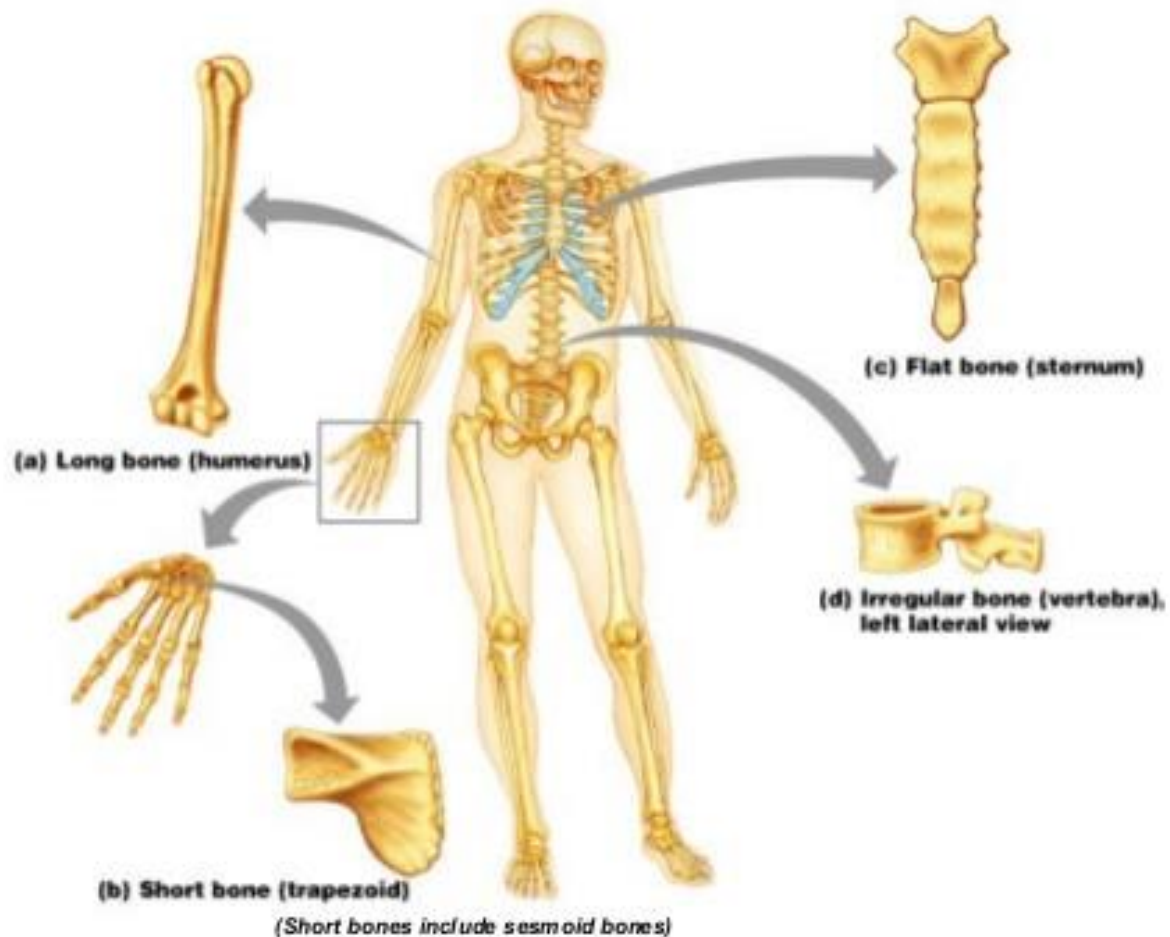
- In the skeleton of the adult there are 206 distinct bones as follows:

	Vertebral column	26
	Skull	22
Axial Skeleton	Hyoid bone	1
	Ribs and sternum	25
		---74
Appendicular	Upper extremities	64
Skeleton	Lower extremities	62
		---126
Auditory ossicles		6

	Total	206

Classification of bones by shape

- Long bones
- Short bones
- Flat bones
- Irregular bones
- Pneumatized bones
- Sesamoid bones

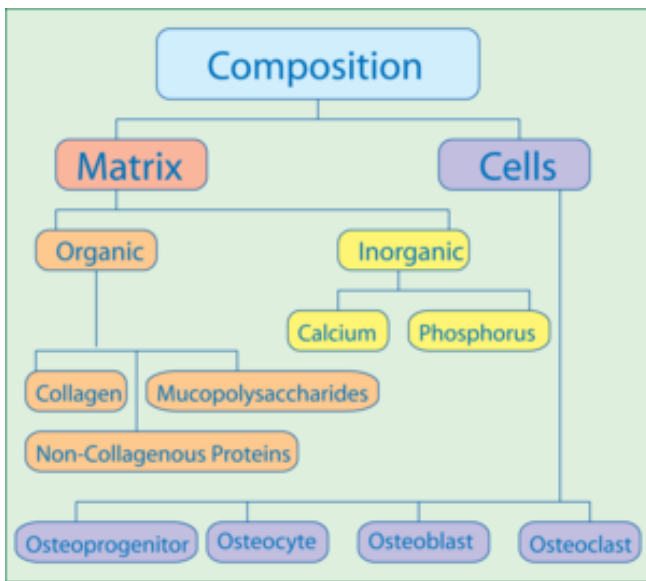


Classification of bones

- 1. Long bones:** each long bone consist of a shaft or body and two ends or extremities
- 2. Short bones:** the short bones are roughly in cuboid shape. They distribute in wrist and foot including the carpal and tarsal bones
- 3. Flat bones:** the flat bones consist of two plates of compact bone with spongy bone and marrow between them like(occipital, parietal, frontal, nasal, lacrimal, vomer, scapula ,sternum and ribs).

Classification of bones

- 4. Irregular bones:** the irregular bones are greatly varied in shape, carry out different functions, and can not be classified in the preceding like(vertebrae, sacrum, coccyx, temporal, sphenoid, ethmoid, zygomatic, maxilla, mandible, palatine, inferior nasal concha, and hyoid).
- 5. Sesamoid bones:** develop in some tendons in locations where there is considerable friction, tension, and physical stress. They may form in the palms of the hands and the soles of the feet, however their presence and quantity varies considerably from person to person. Example (the patellae)



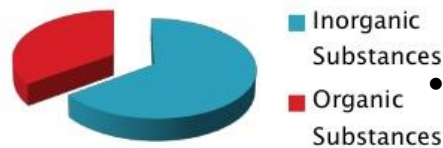
Function : support the body, store calcium

- Osseous tissue is strong and is one of the body's hardest structures because of its combination of inorganic and organic elements.
- Bone is composed of a matrix of inorganic salts and collagen, an organic material found in all connective tissue.
- The inorganic minerals, calcium and phosphate, along with the organic collagen fibers, make up approximately 60% to 70% of bone tissue.
- Water constitutes approximately 25% to 30% of the weight of bone tissue
- Collagen provides bone with tensile strength and flexibility, and the bone minerals provide compressive strength and rigidity
- It is light but it has high tensile and compressive strength and a significant amount of elasticity.
- As much as a half a gram of calcium may enter or leave the adult skeleton every day, and humans recycle 5% to 7% of their bone mass every week.

Composition of Bone

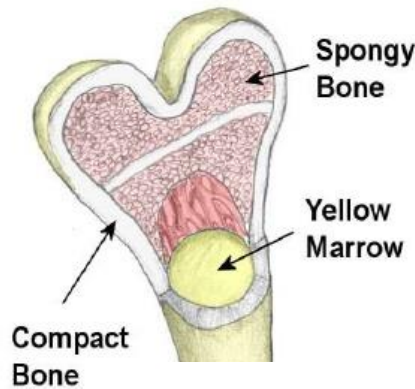
- ▶ 65% Inorganic matter (Hydroxyapatite)
 - Mostly Calcium and inorganic orthophosphate deposited between collagen
- ▶ 35% Organic
 - 28–30% collagen
 - 5–7% non-collagenous proteins.
 - Osteocalcin
 - Bone Sialoprotein
 - Phosphoprotein
 - Osteonectin
 - Bone morphogenetic protein

Composition of bones

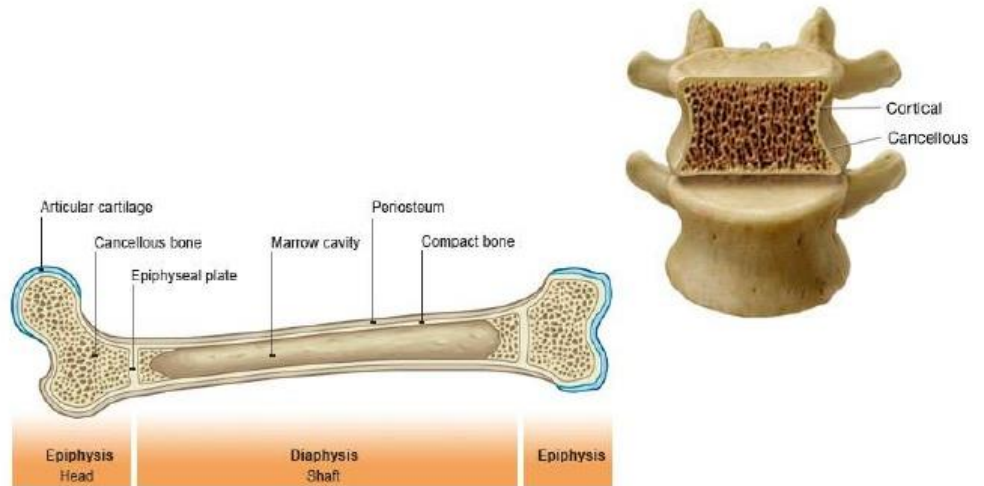


Structural Types of Bone

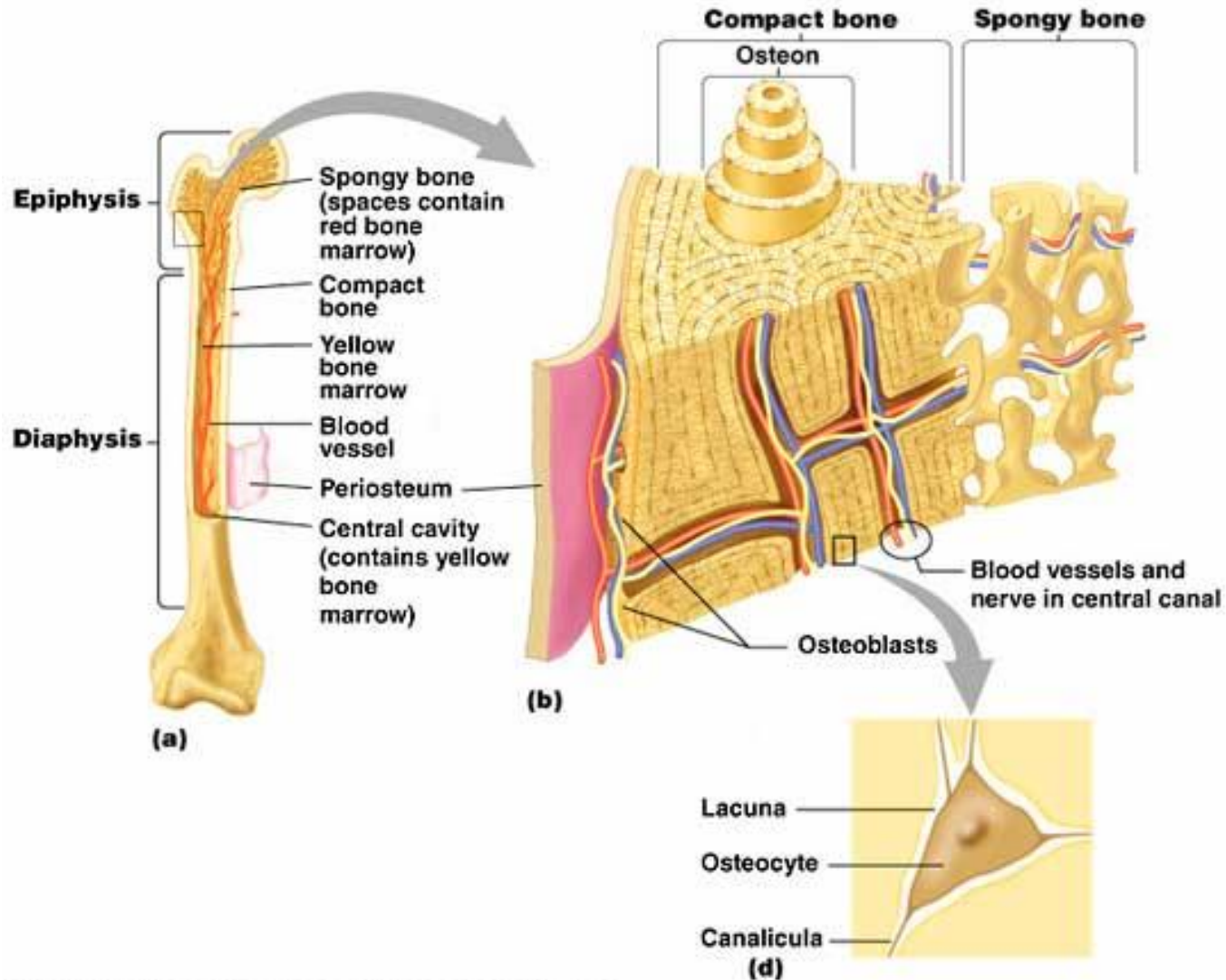
- **Cortical (compact) bone**
 - With a dense outer layer — the cortex.
 - This structure resists bending
- **Cancellous (spongy or trabecular) bone**
 - Tissue is located beneath the compact bone and consists of a meshwork of bony bars (trabeculae) with many interconnecting spaces containing bone marrow.



Cancellous (spongy) bone



Compact and spongy bones

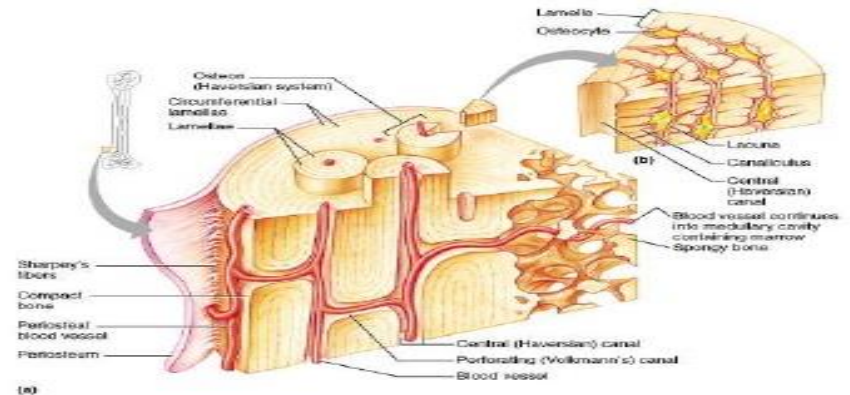


Microscopic structure of compact bone

- The structural unit of Compact bone is the ***osteon, or haversian system***.

Each osteon

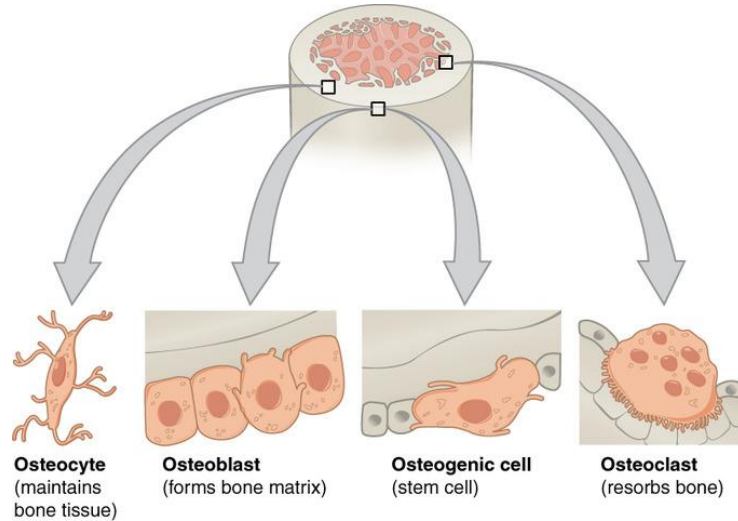
- Is an elongated cylinder
- Oriented parallel to the
- Long axis of the bone.



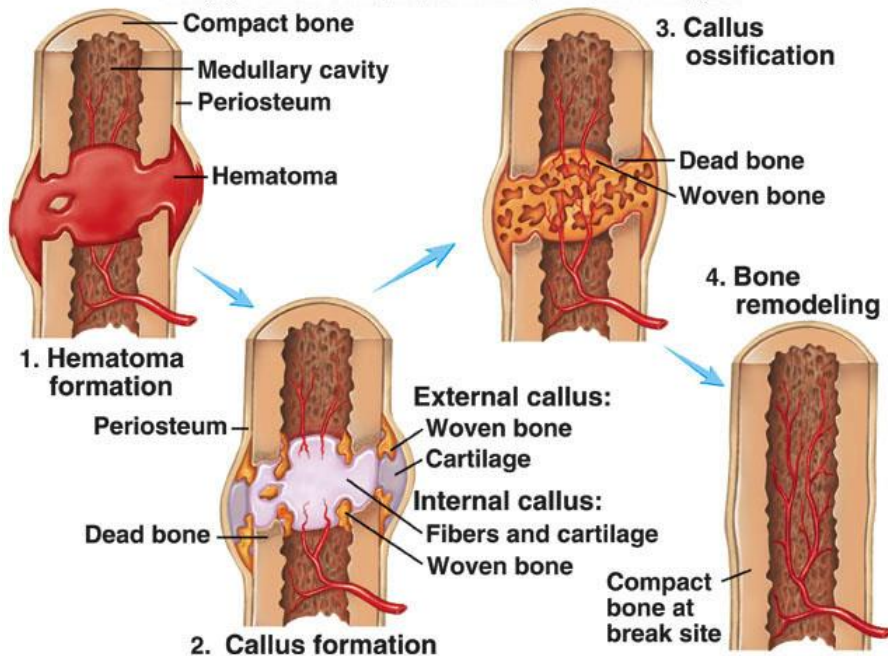
Spongy Bone

- ***Spongy bone*** composes the *inner portion* of the bone lining the marrow cavity. It contains trabeculae and spicules giving it a honeycomb appearance. Although it looks poorly organized it is designed to withstand the specific stresses put on each bone because of their trabeculae.
- ***Trabeculae*** are tiny bone struts or plates that form very strong support structure for the spongy bones.
- Trabeculae are irregularly arranged and contain lamellae and osteocytes, but contain no osteons as they receive nutrients from the marrow tissue.

Bone cells and its function

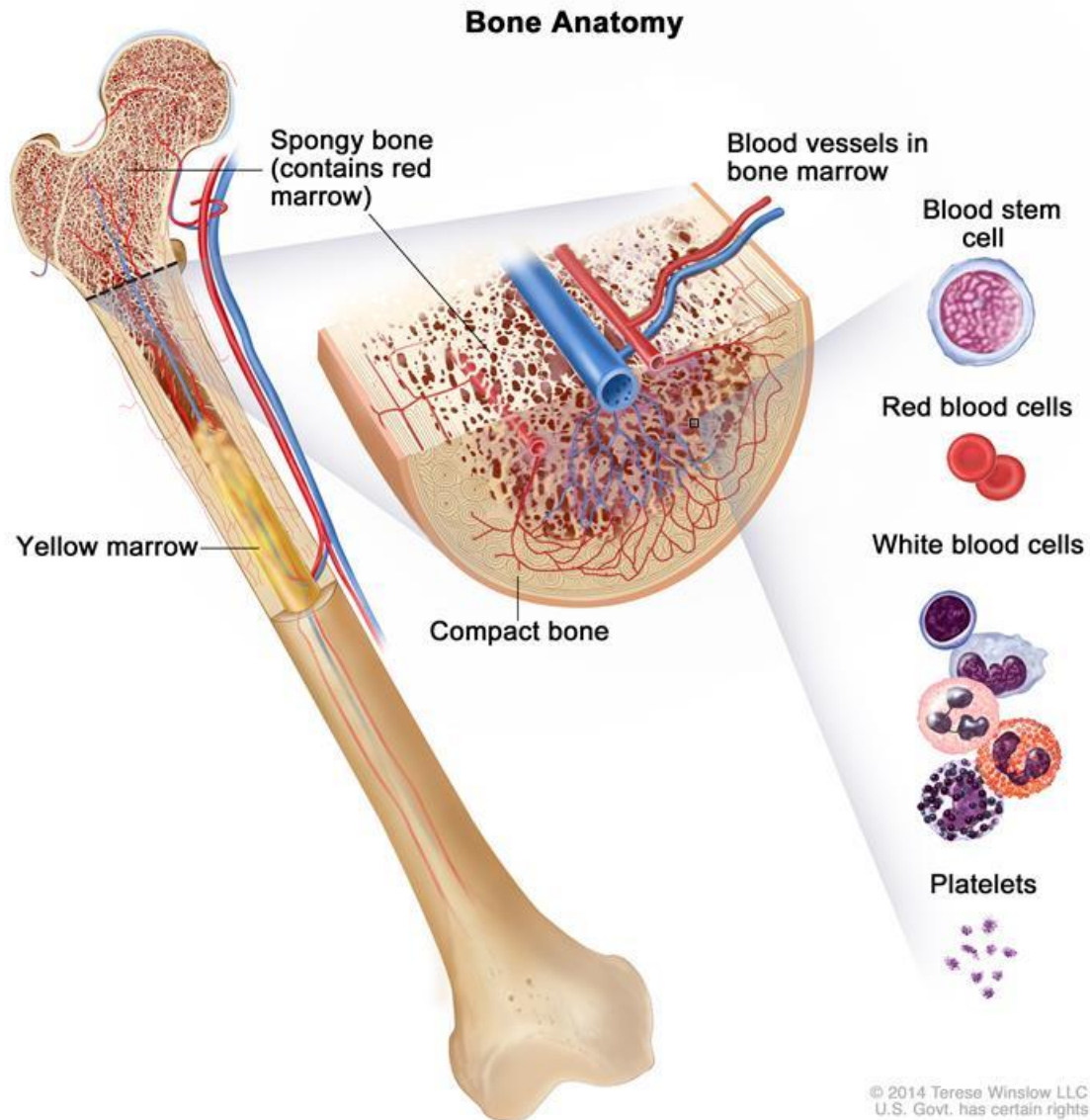


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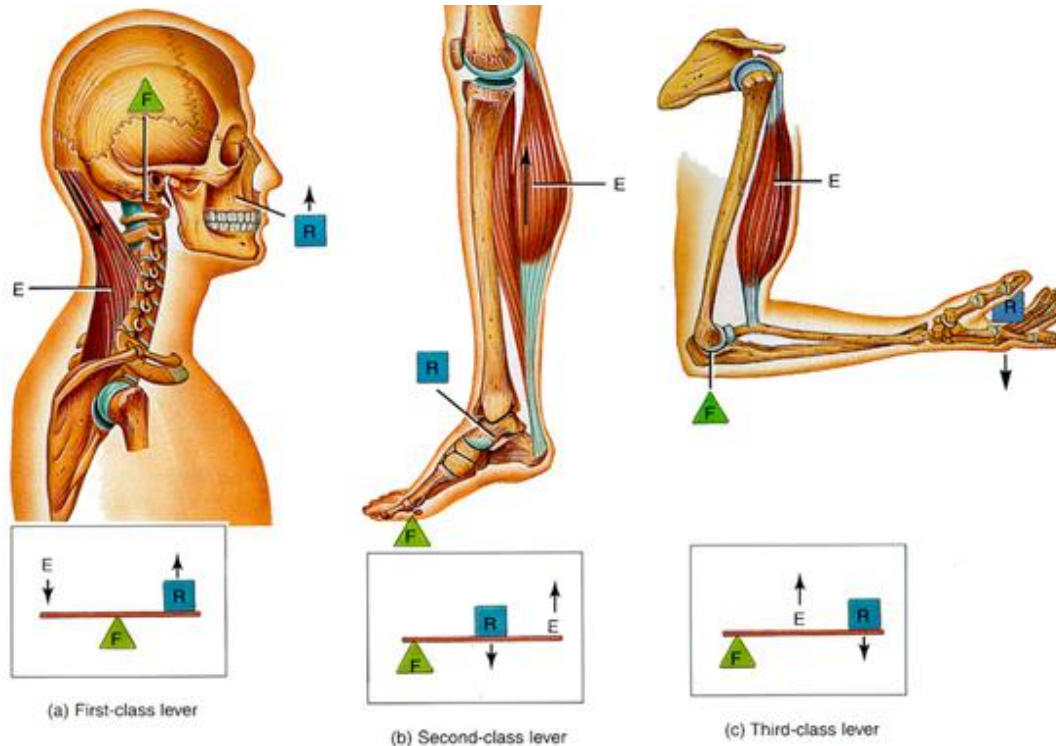
- Bone cells are referred to as **osteocytes**.
- The two types of these cells are referred to as **osteoblasts** and **osteoclasts**.
- These cells are responsible for remodeling bone. **Osteoclasts are the cells that break down bone** and convert calcium salts into a soluble form that passes easily into the blood.
- **Osteoblasts produce the organic fibers on which the calcium salts are deposited.**
- A balance in the activities of these two cells maintains a constant bone mass
- Bone can also be made to grow in different ways, and it is tissue that is continually being modified, **reshaped, remodeled, and overhauled.**

Function: Blood cells formation



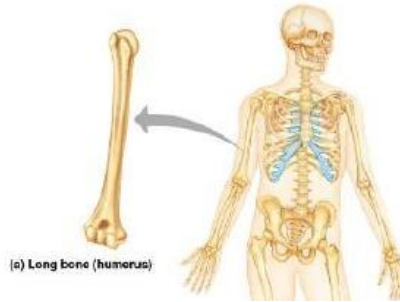
Function: Leverage

- The skeletal system provides the levers and axes of rotation about which the muscular system generates the movements.
- A lever is a simple machine that magnifies the force, speed, or both of movement and consists of a rigid rod that is rotated about a fixed point or **axis called the fulcrum**.
- The rigid rod in a skeletal lever system is primarily the longer bones of the body, and the fixed point of rotation or **axis is the joints** where the bones meet.
- The skeletal lever system transmits movement generated by muscles or external forces.



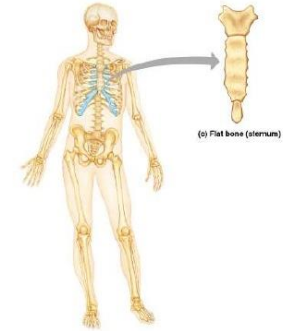
Long Bones

- **Long bones** are longer than they are wide.
- Long bones have 2 epiphyses, and a diaphysis.
- All of the bones of the limbs, except the patella, ankle, and wrist, are long bones.



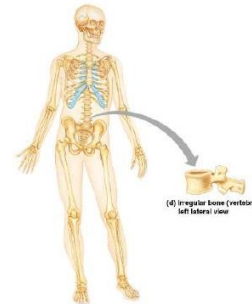
Flat Bones

- **Flat bones** are thin, flattened, and a bit curved.
- The sternum, scapulae, ribs, and most of the bones of the skull are flat bones.



Irregular Bones

- **Irregular bones** have
- complicated shapes that fit none of the preceding classes.
- The vertebrae, the bones of the hip, and some facial bones.



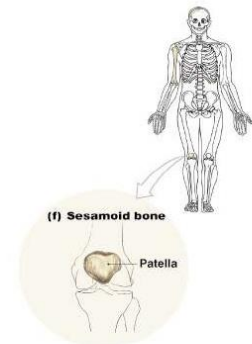
Short Bones

- **Short bones** are cube shaped, nearly equal in length and width.
- The bones of the wrist and ankle are examples of short bones.



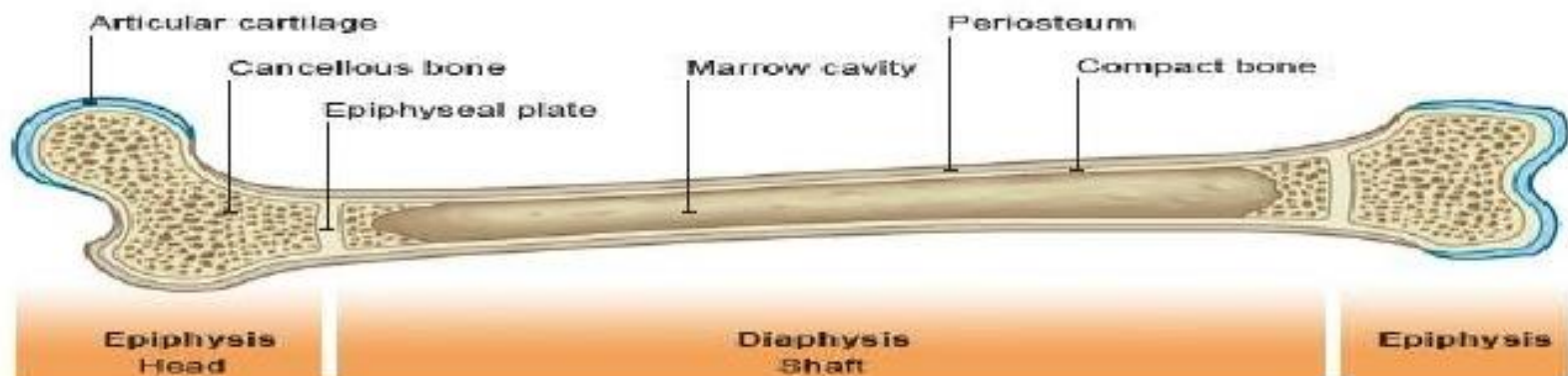
Sesamoid bones

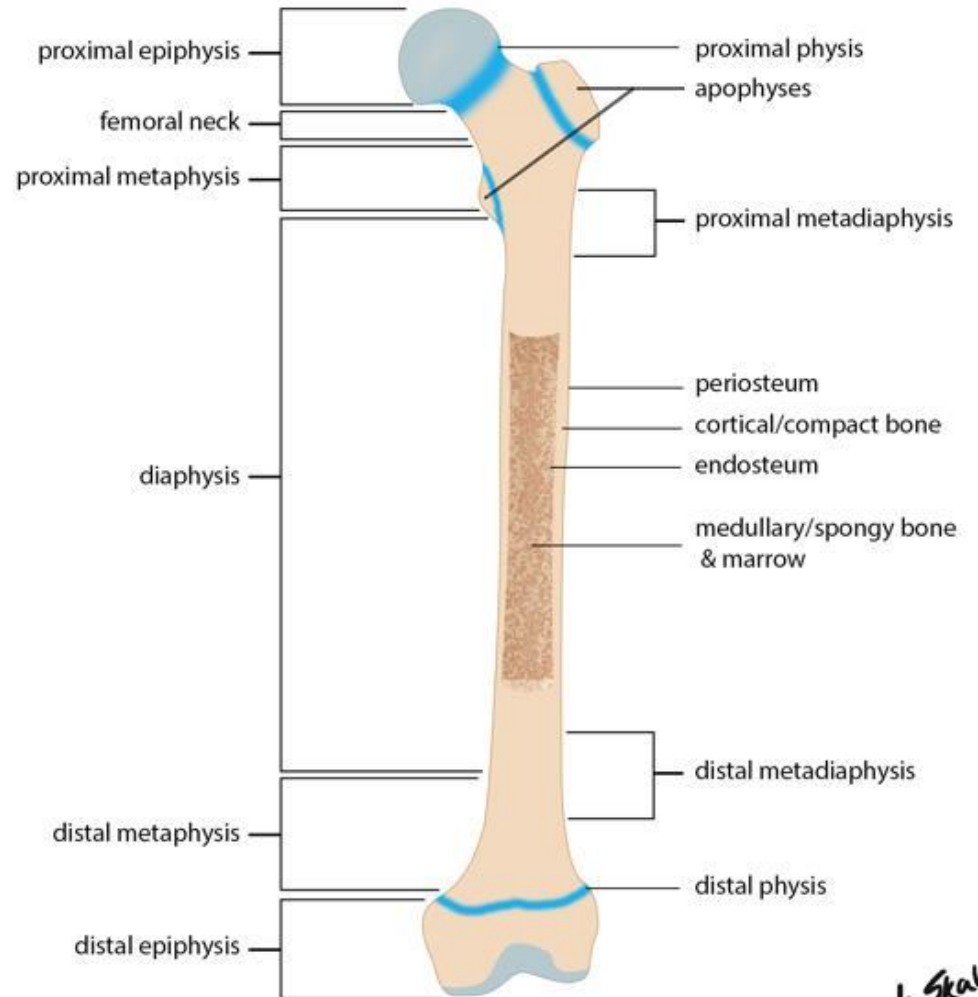
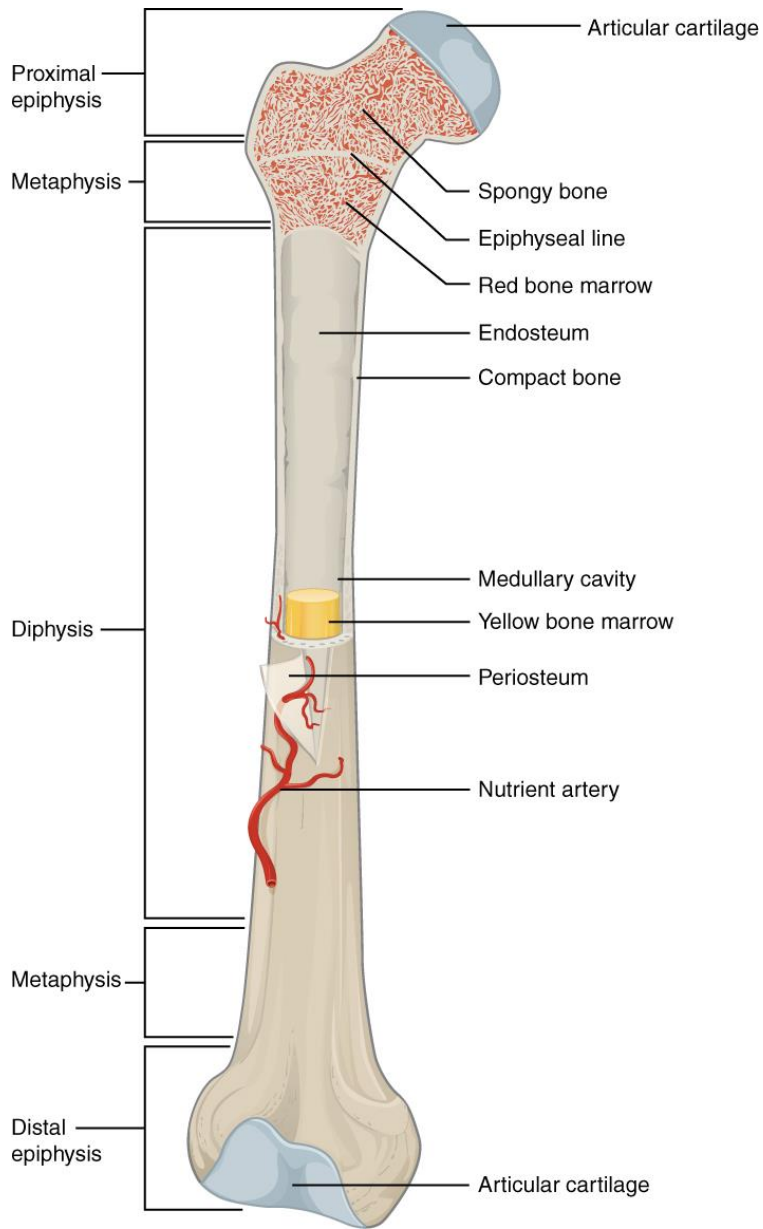
- **Sesamoid bones** are small more or less rounded masses embedded in certain tendons and usually related to joint surfaces.
- Their functions probably are to modify pressure, to diminish friction, and occasionally to alter the direction of a muscle pull.



“GROSS” structure of a typical bone

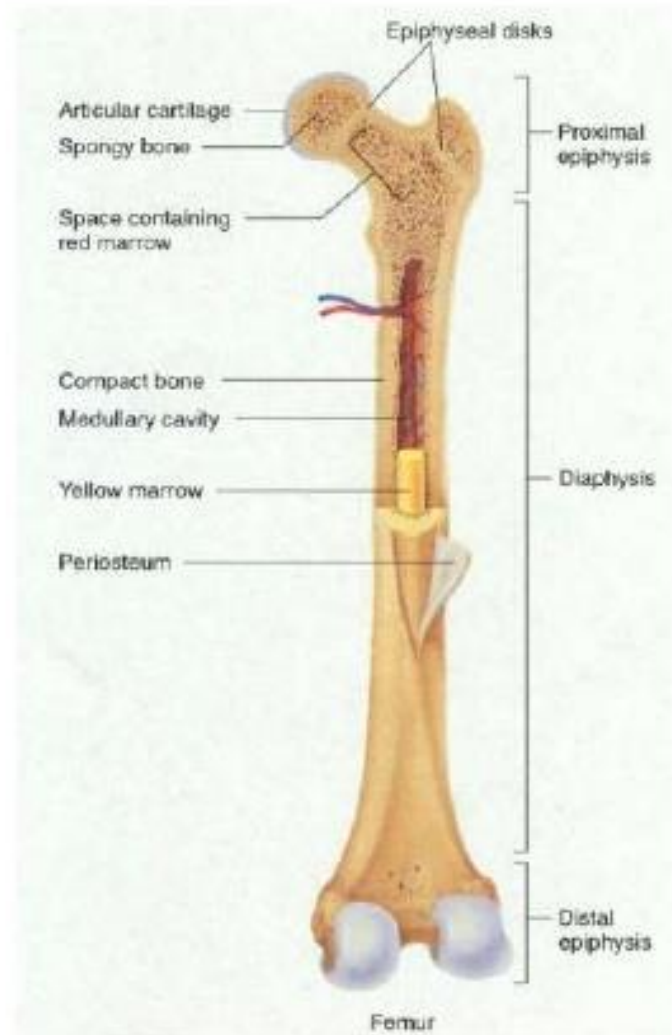
- **Articular cartilage:** Consists of Hyaline cartilage covering the end of the bone surface where it articulates with another bone, (e.g. femur and tibia, humerus and scapula). Fibrocartilage makes up the menisci of the knee joints.
- **Epiphyses:** The end of the bone. One at each end of long bones.
- **Epiphyseal line:** Remnant of the cartilaginous “growth plate” or epiphyseal plate.
- **Diaphyses:** The shaft of the bone. It Consists of a thick collar of compact bone surrounding a central marrow cavity.





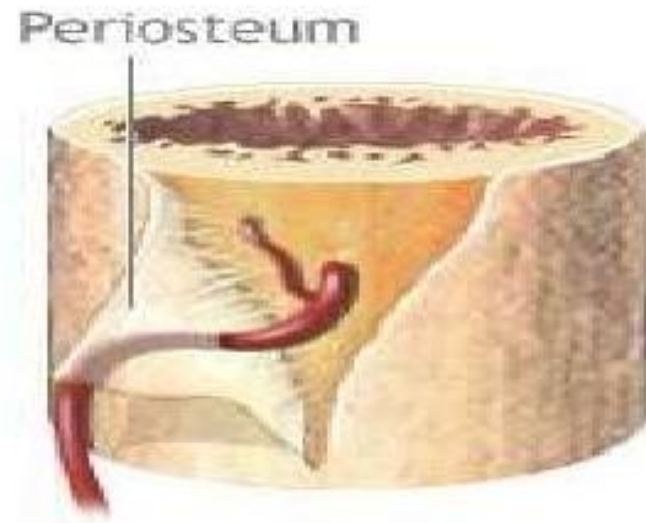
Long Bone Structure

- Shaft plus 2 expanded ends.
- Shaft is known as the **diaphysis**.
 - Consists of a thick collar of compact bone surrounding a central marrow cavity
 - In adults, the marrow cavity contains fat - yellow bone marrow.
- Expanded ends are **epiphyses**
 - Thin layer of compact bone covering an interior of spongy bone.
 - Joint surface of each epiphysis is covered w/ a type of hyaline cartilage known as **articular cartilage**. It cushions the bone ends and reduces friction during movement.



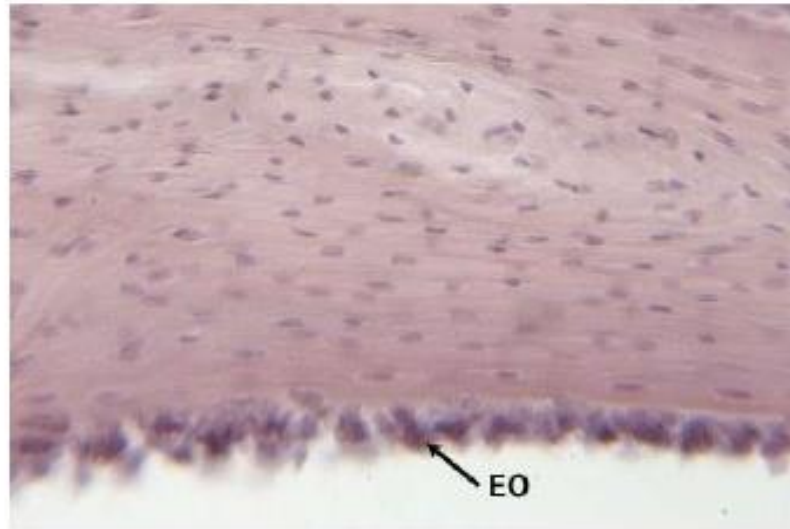
Long Bone Structure

- The external surface of the entire bone except for the joint surfaces of the epiphyses is covered by a double-layered membrane known as the **periosteum**.
 - Outer fibrous layer is dense irregular connective tissue.
 - Inner cellular layer contains osteoprogenitor cells and osteoblasts.
 - Periosteum is richly supplied with nerve fibers, lymphatic vessels and blood vessels.
 - These enter the bone of the shaft via a **nutrient foramen**.
 - Periosteum is connected to the bone matrix via strong strands of collagen.



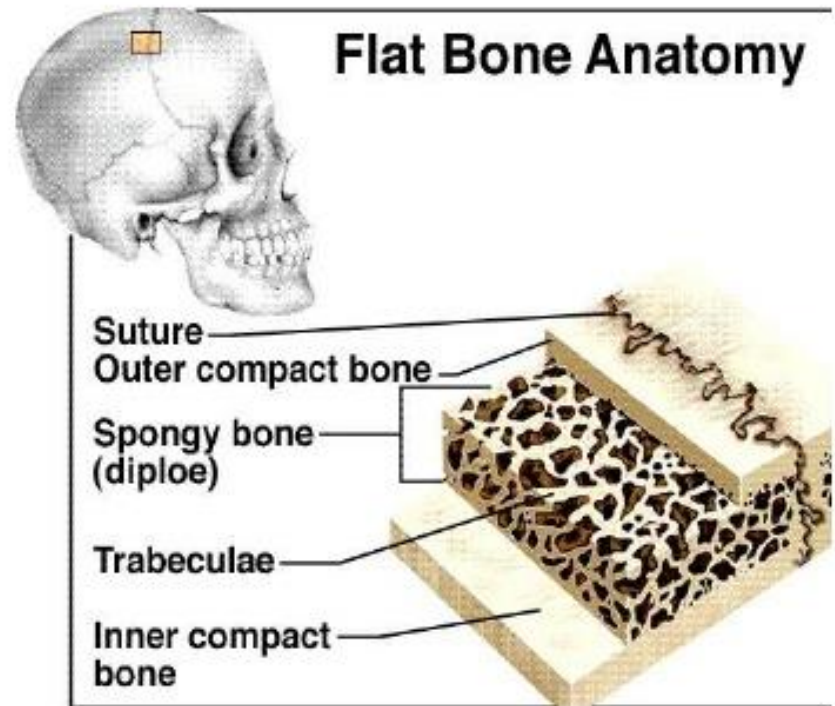
Long Bone Structure

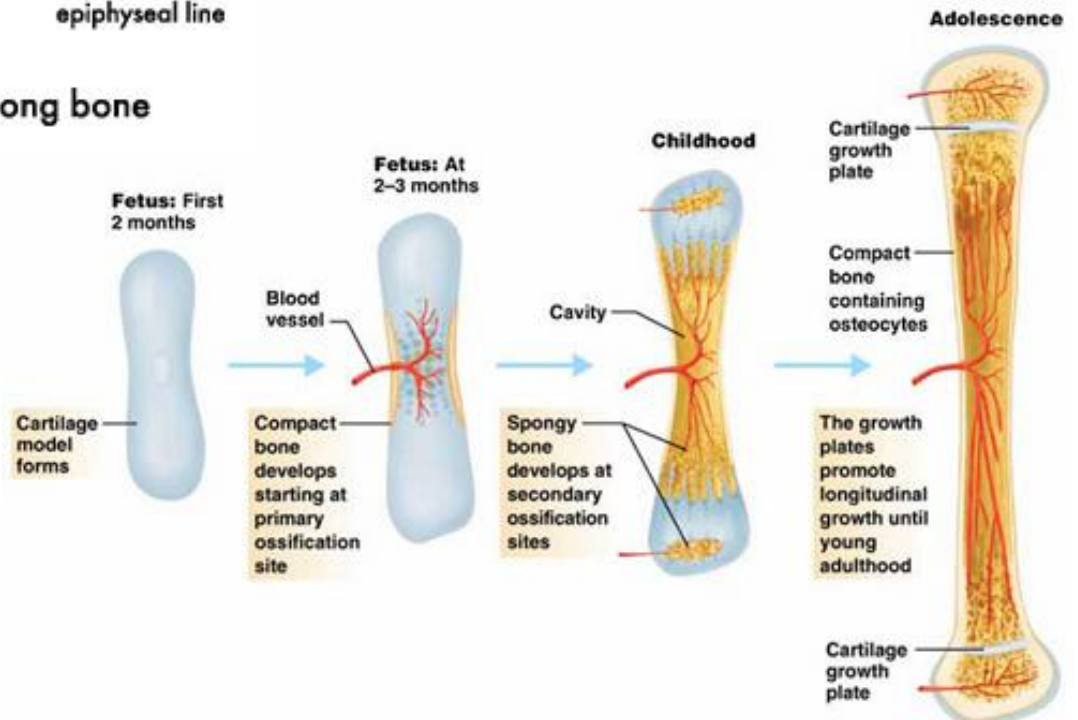
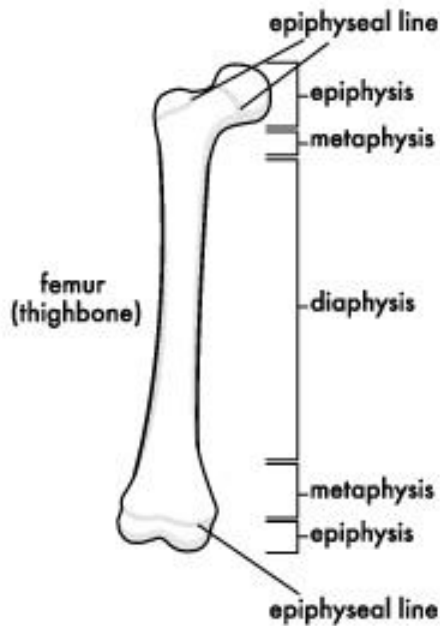
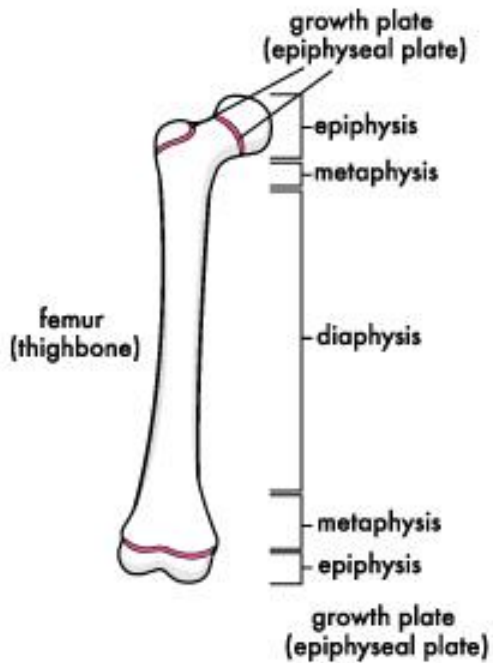
- Internal bone surfaces are covered with a delicate connective tissue membrane known as the ***endosteum***.
 - Covers the trabeculae of spongy bone in the marrow cavities and lines the canals that pass through compact bone.
 - Contains both osteoblasts and osteoclasts.



Structure of Short, Irregular, and Flat Bones

- Thin plates of periosteum-covered compact bone on the outside and endosteum-covered spongy bone within.
- Have no diaphysis or epiphysis because they are not cylindrical.
- Contain bone marrow between their trabeculae, but no marrow cavity.
- In flat bones, the internal spongy bone layer is known as the *diploë*, and the whole arrangement resembles a stiffened sandwich.

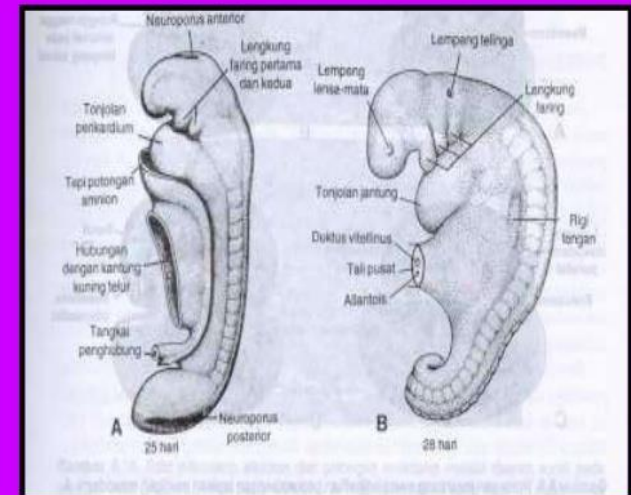
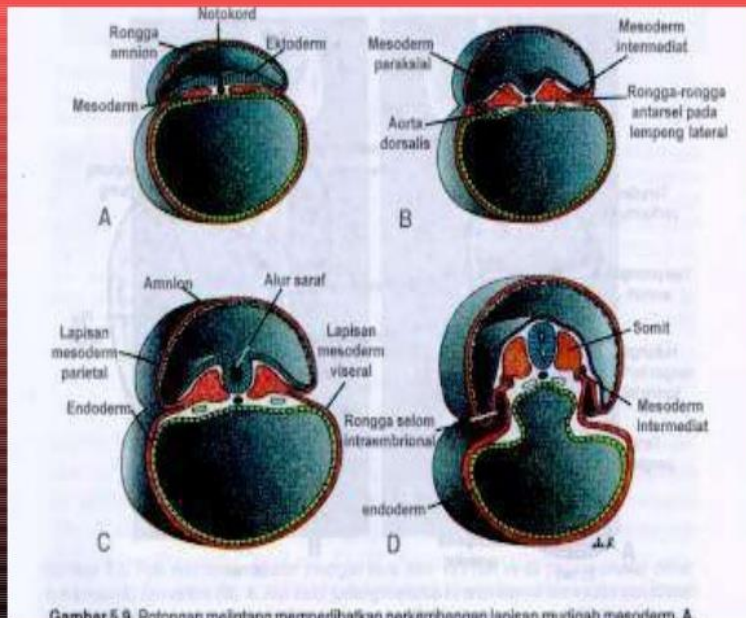
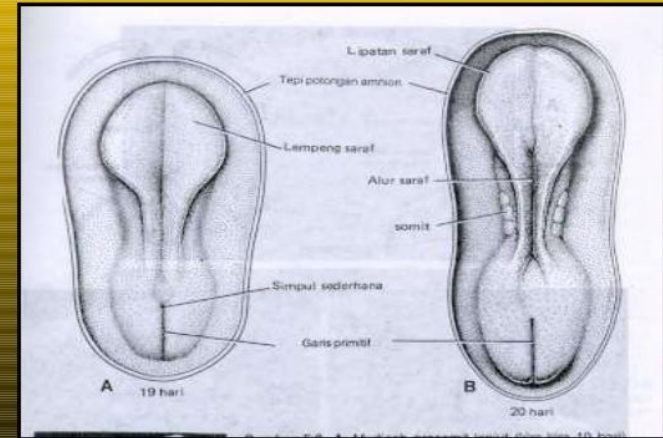




Entoderm
Ectoderm
Mesoderm

Perkembangan somit

- Sclerotom
 - Menjadi **mesenchym**
 - Mesenchym** berkembang menjadi: **fibroblast, chondroblast, osteoblast.**
- Dermomyotom :
 - Dermatom dan Myotom

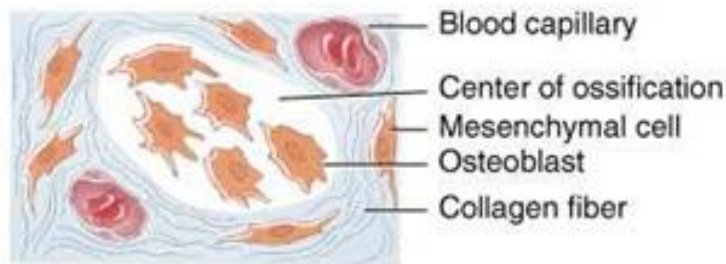


Gambar 5.9 Potongan melintang memperlihatkan perkembangan lapisan multiples mesoderm. A

Intramembranous (between membranes)

Ossification occurs in flat bones

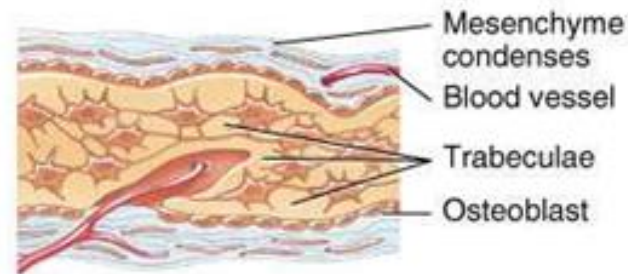
- Skull, mandible, clavicle.
- Fibrous membrane, Os. center, trabeculae



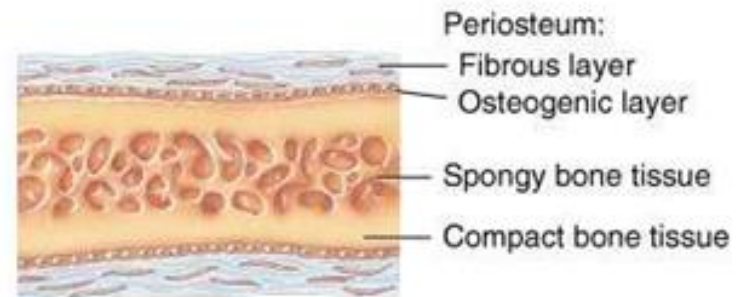
1 Development of center of ossification



2 Osteocytes deposit mineral salts (calcification)

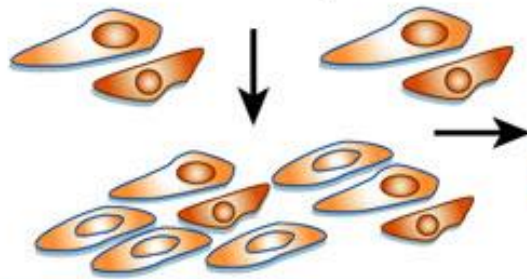


3 Formation of trabeculae

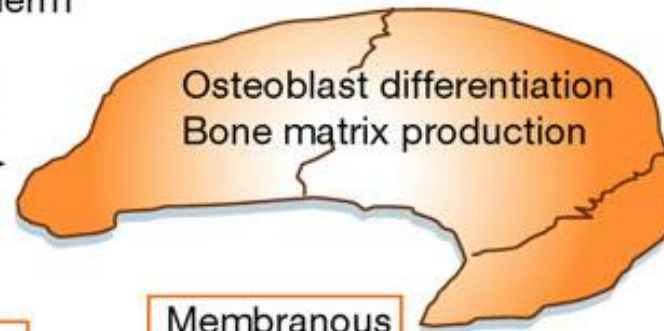


4 Development of periosteum, spongy bone, and compact bone tissue

Cells from cranial neural crest,
somites and lateral plate mesoderm



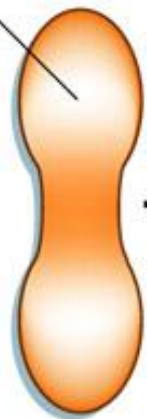
Mesenchymal cell condensation



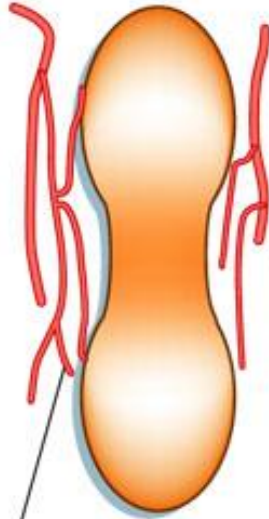
Osteoblast differentiation
Bone matrix production

Membranous
ossification

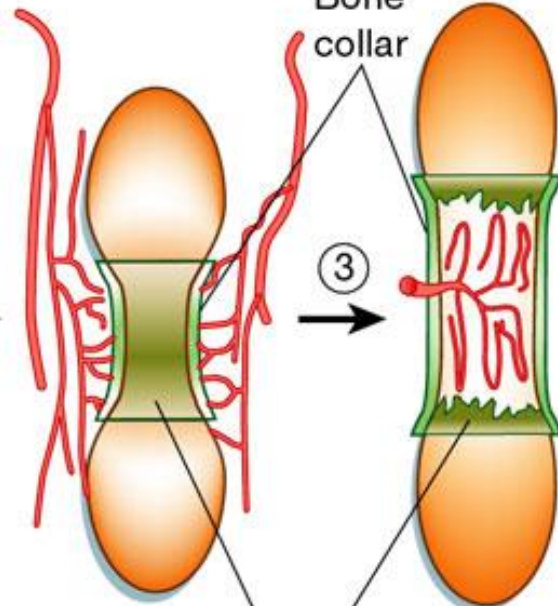
Cartilage
anlage



①



②



Bone
collar

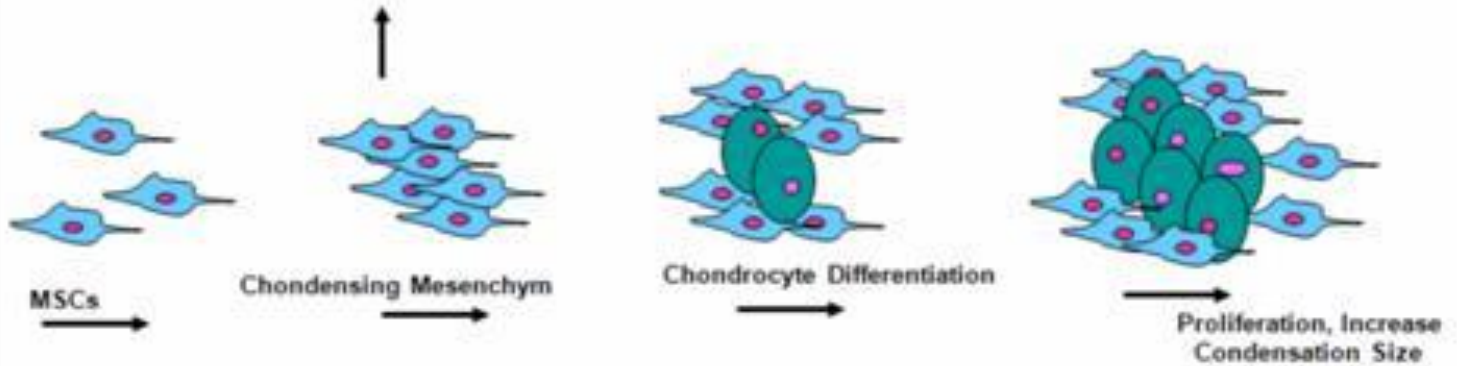
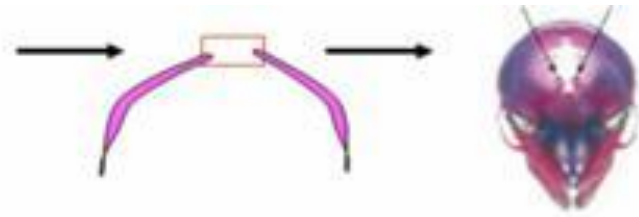
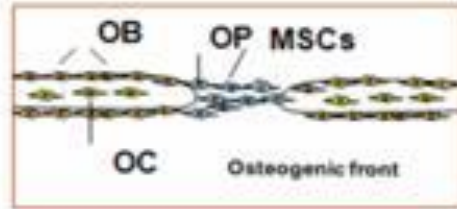
③

Growth of capillaries around
the cartilage anlagen

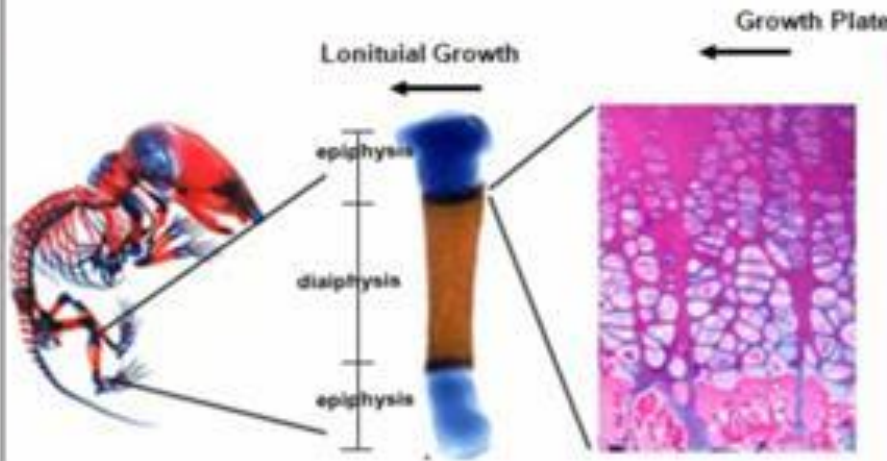
Hypertrophic cartilage with
high-level VEGF expression

Endochondral ossification

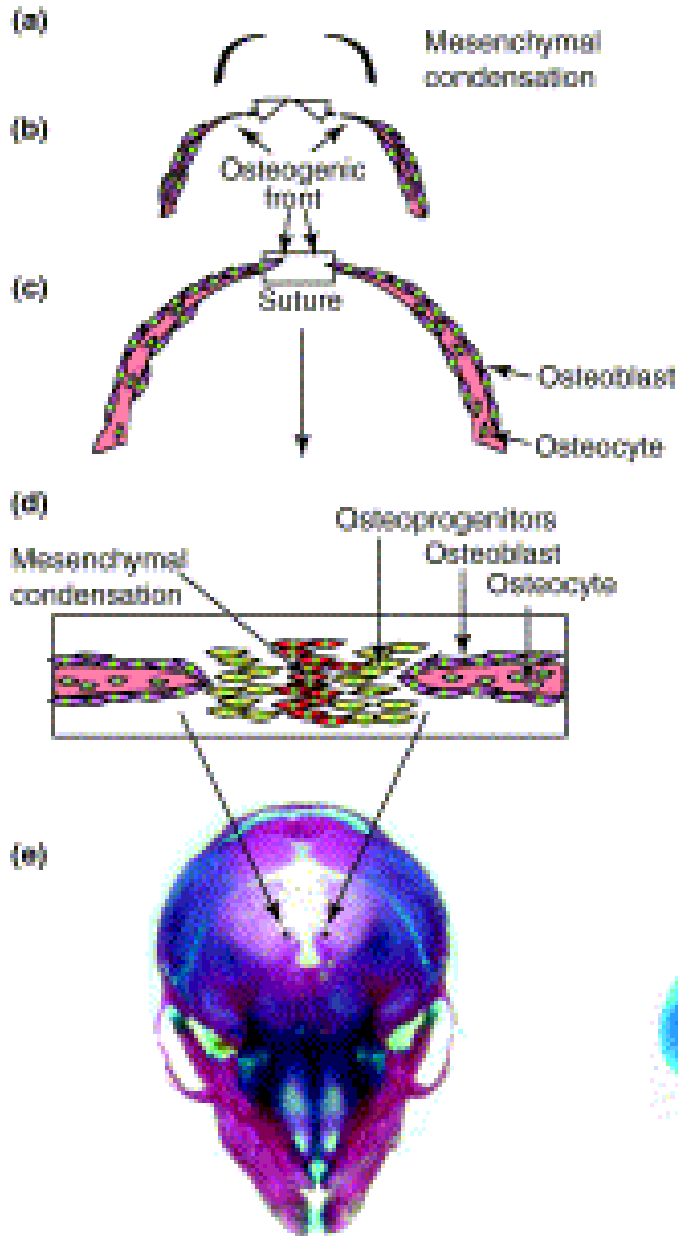
Intramembranous
Ossification



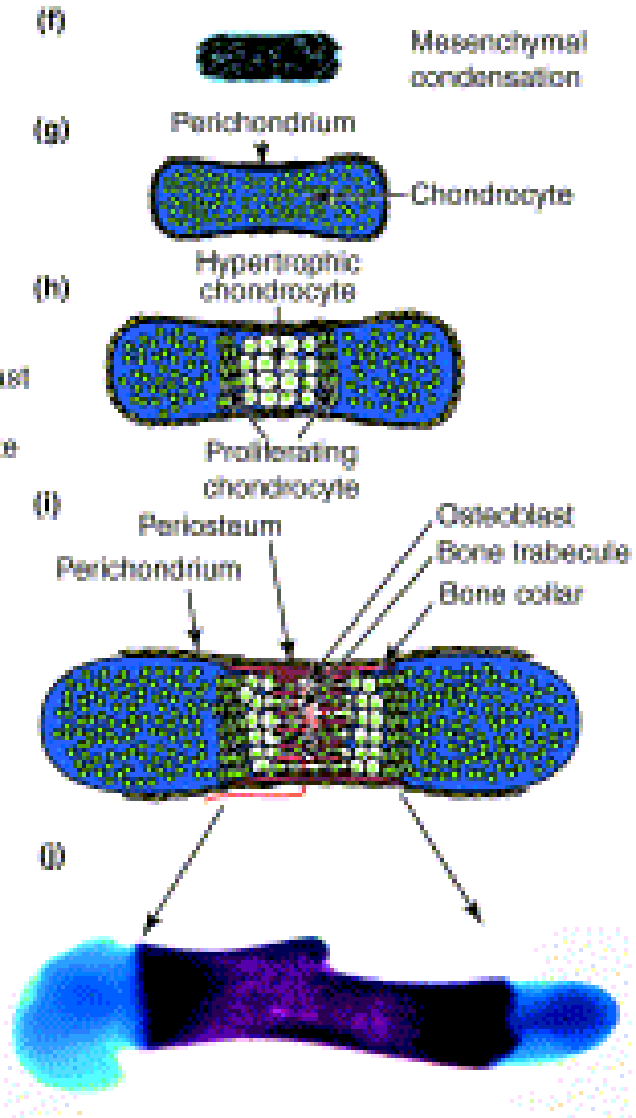
Endochondral
Ossification

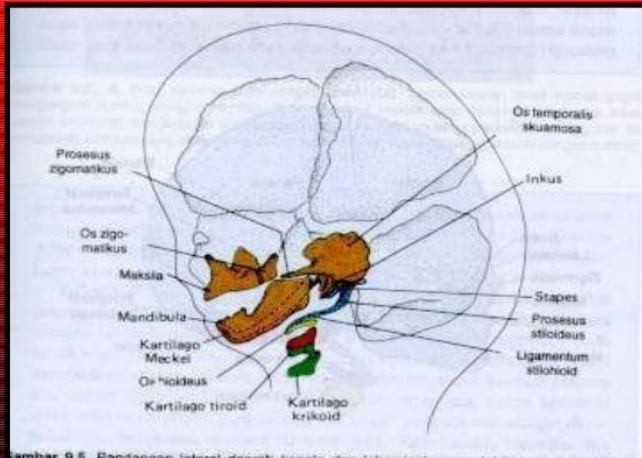


Intramembranous ossification

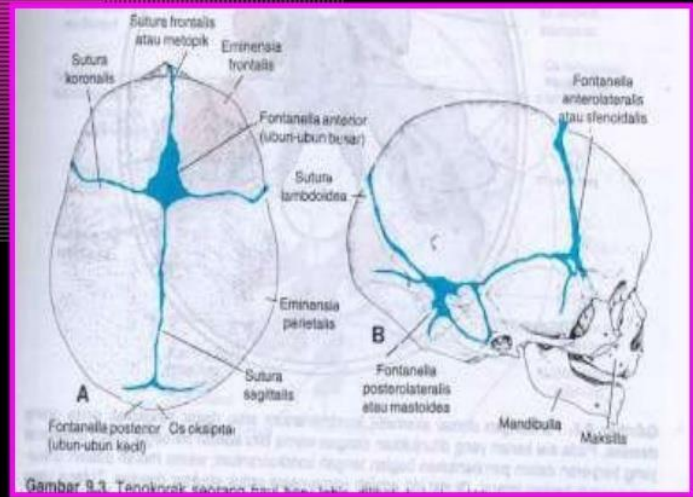


Endochondral ossification

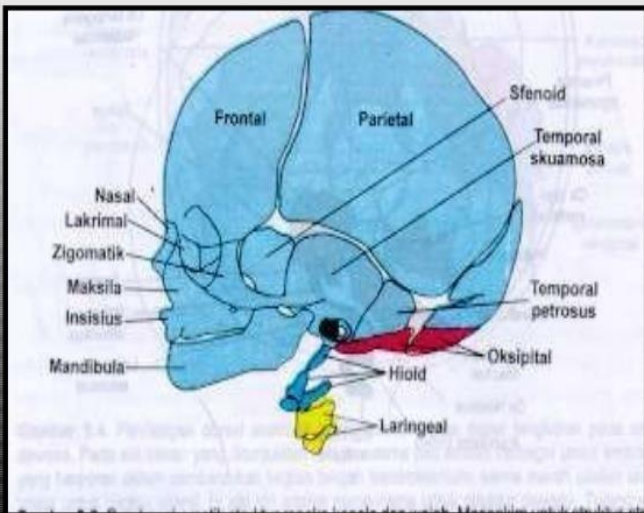




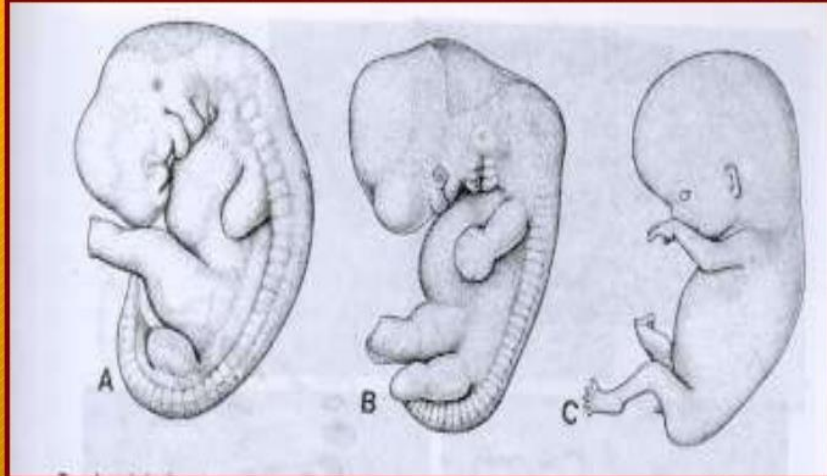
Gambar 9.2. Pandangan lateral dasar tengkorak dan wajah janin.

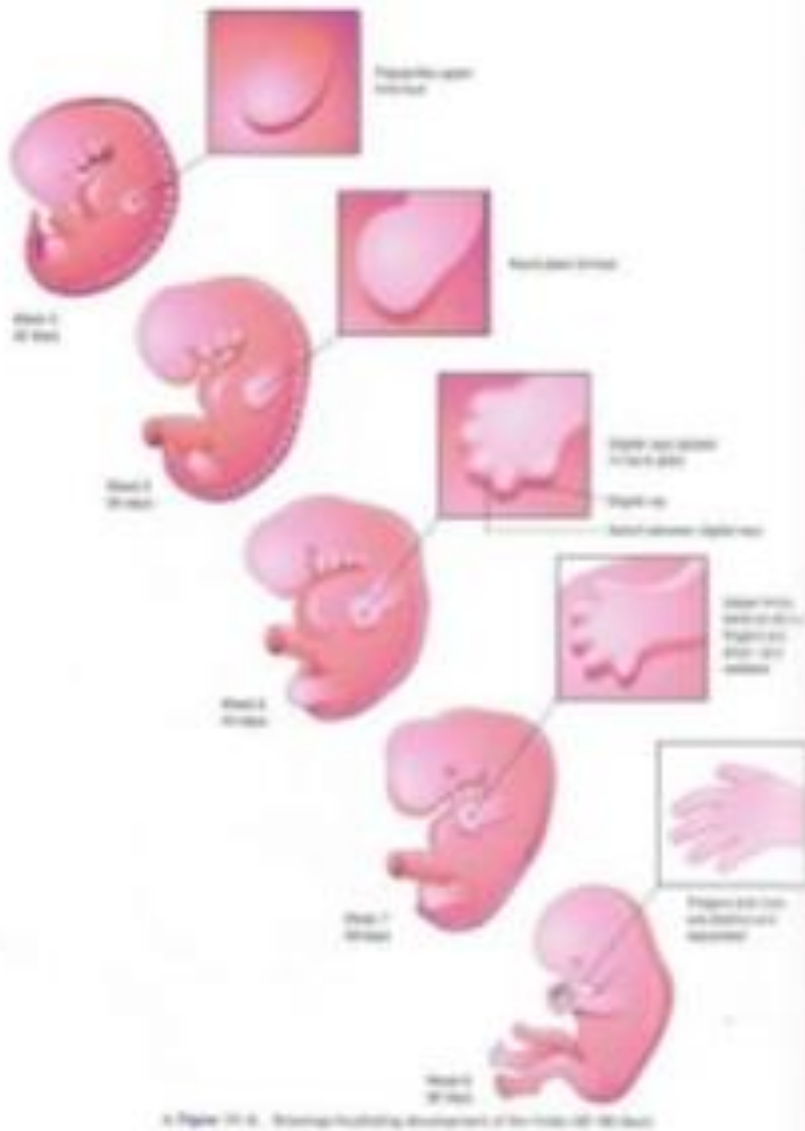


Gambar 9.3. Tengkorak superior dan lateral janin.

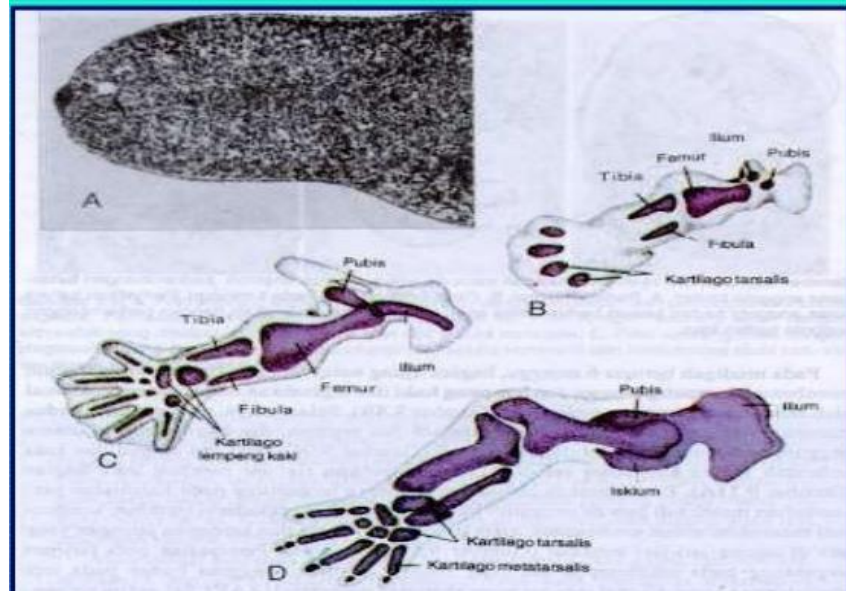
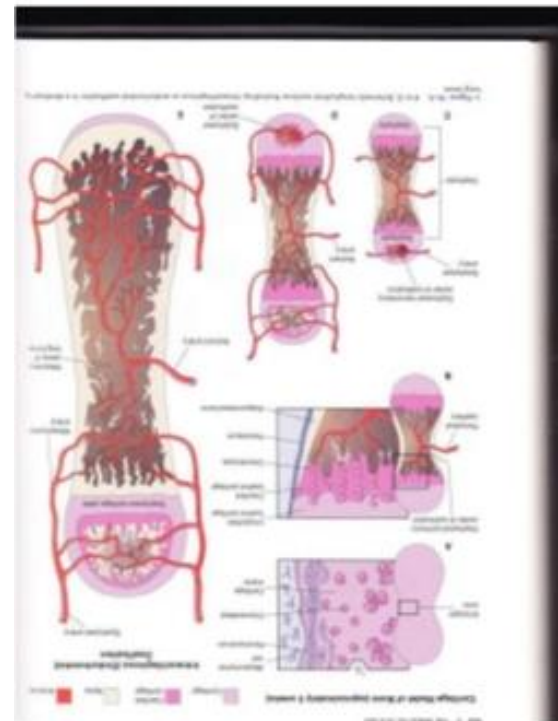


Gambar 9.4. Pandangan dasar dan lateral tengkorak dan wajah janin.





a Figure 10.8. Stages of hindlimb development of the mouse (a-f) (a-f) (a-f)

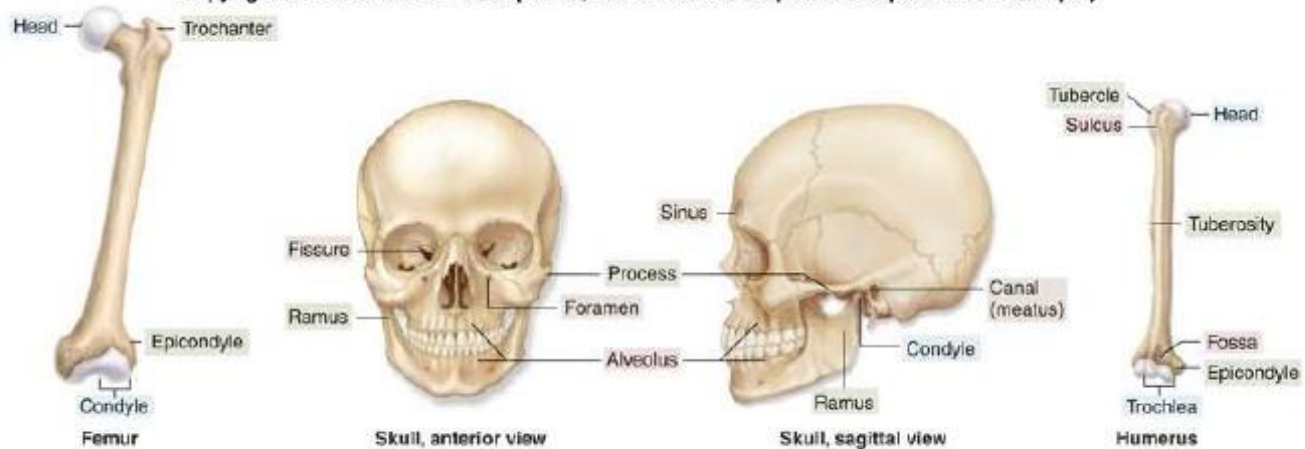


Gambar 9.10. A. Potongan memanjang melalui tunas anggota badan pada mudiqah tikus, yang

identification (age, gender, race, pathology); site of muscle attachment, passthrough vessel nerve

Bone markings and landmarks

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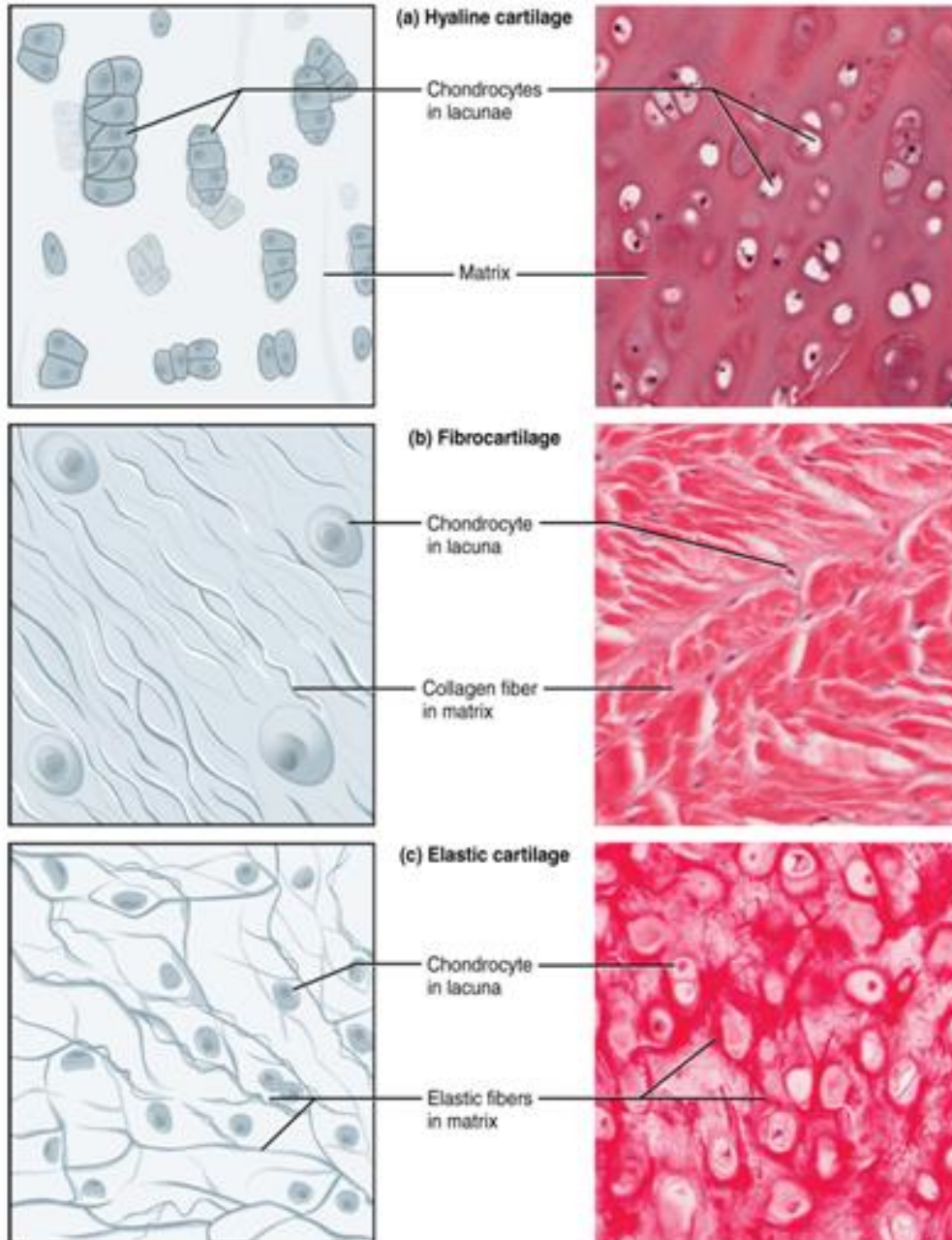


Bone markings and landmarks

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General Structure	Anatomical Term	Description
Articulating surfaces	Condyle	Large, smooth, rounded articulating oval structure
	Facet	Small, flat, shallow articulating surface
	Head	Prominent, rounded epiphysis
	Trochlea	Smooth, grooved, pulley-like articular process
Depressions	Alveolus	Deep pit or socket in the maxillae or mandible
	Fossa	Flattened or shallow depression
	Sulcus	Narrow groove
Projections for tendon and ligament attachment	Crest	Narrow, prominent, ridgelike projection
	Epicondyle	Projection adjacent to a condyle
	Line	Low ridge
	Process	Any marked bony prominence
	Ramus	Angular extension of a bone relative to the rest of the structure
	Spine	Pointed, slender process
	Trochanter	Massive, rough projection found only on the femur
	Tubercle	Small, round projection
	Tuberosity	Large, rough projection
Openings and spaces	Canal (meatus)	Passageway through a bone
	Fissure	Narrow, slitlike opening through a bone
	Foramen	Rounded passageway through a bone
	Sinus	Cavity or hollow space in a bone

3 type of cartilage



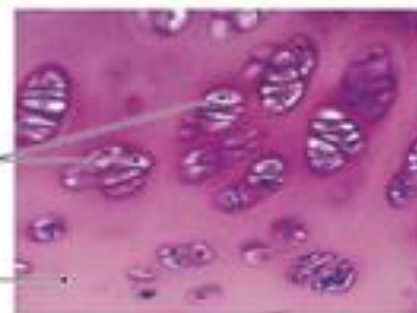
The three types of cartilage



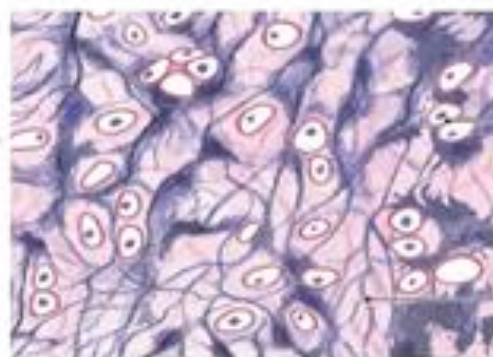
Chondrocytes
in lacunae

Matrix

Hyaline cartilage from shoulder joint



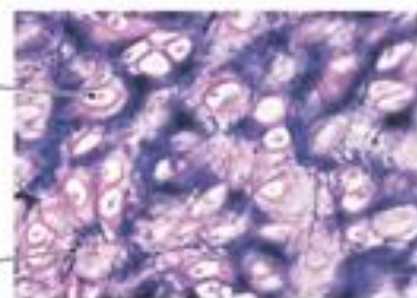
LM \times 500



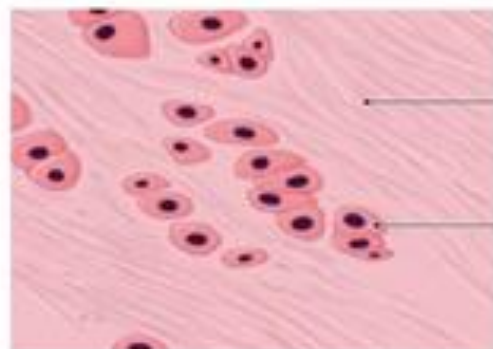
Chondrocyte
in lacuna

Elastic fibers
in matrix

Elastic cartilage from external ear



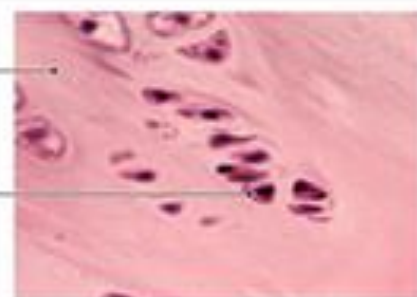
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Collagen
fibers in
matrix

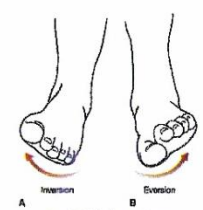
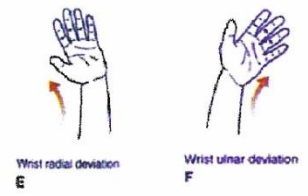
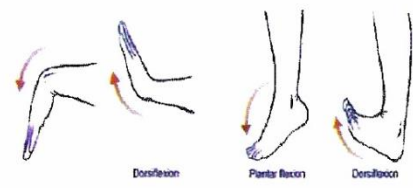
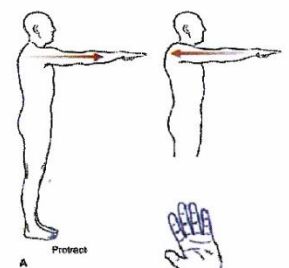
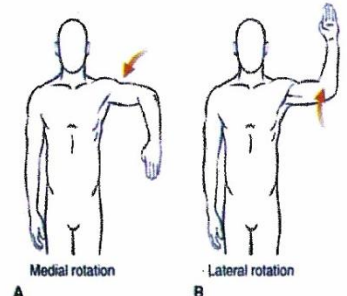
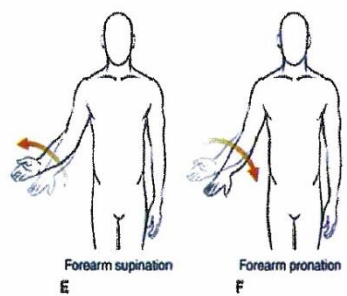
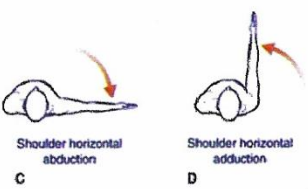
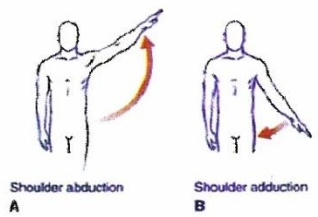
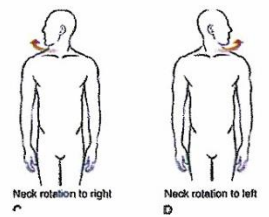
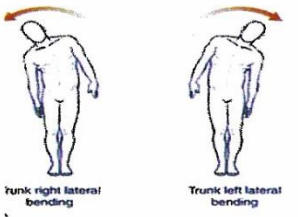
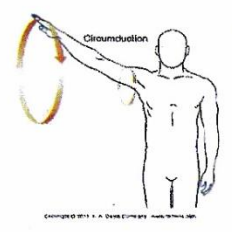
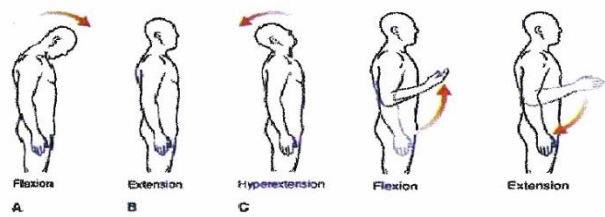
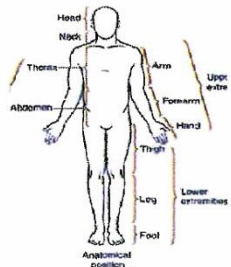
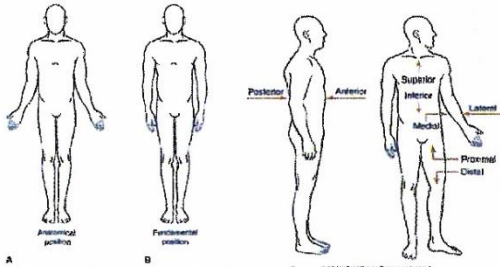
Chondrocytes

Fibrous cartilage from intervertebral disc



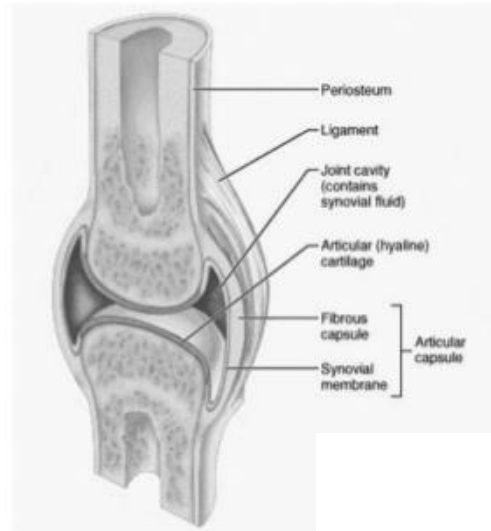
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JOINT MOVEMENT (OSTEOKINEMATICS)



Joints

- Joints are places of union between two or more skeletal elements



Classification of Joints

- Classification based on function
- Classification based on structure



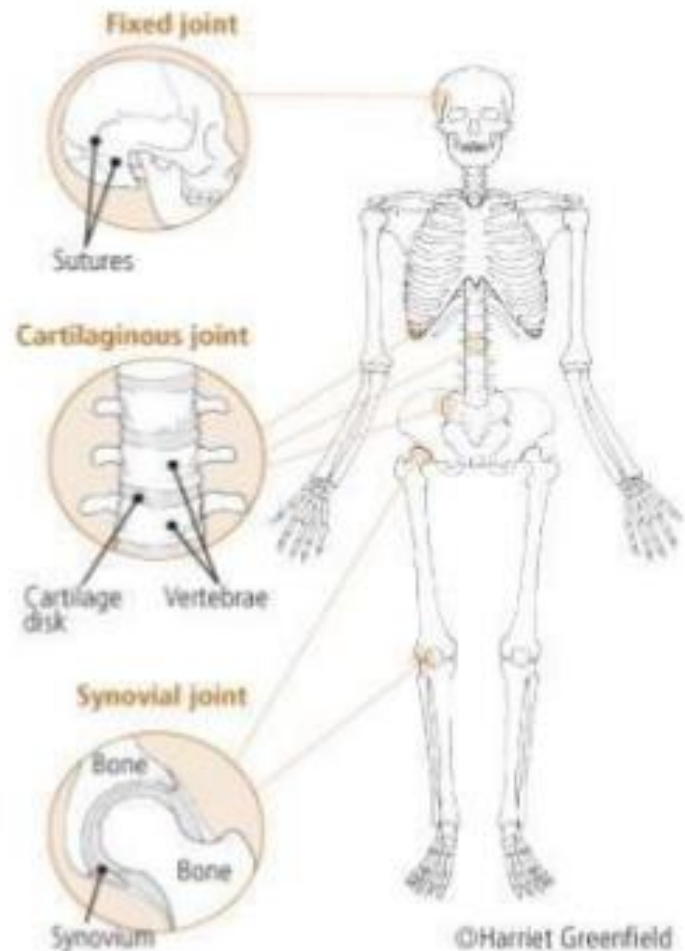
arthrology

- the study of joints:
 - All Movements occur at joints
 - Movement depends on the type of joint
 - There is usually a continuum from joints that are stable with good boney fit and tight ligaments (ankle) to joints that are freely moveable with loose ligaments (shoulder).
- factors that affect range of motion
- -bony structure
 - lengths of ligaments and other connective tissues
 - muscle tightness
 - (lots of looseness leads to double jointedness)

Classification Based on Structure

Based on the material that binds the bones together, and on the presence or absence of joint cavity.

1. **Fibrous joints** are fixed, and immovable
2. **Cartilagenous joints** are slightly moveable, semimovable
3. **Synovial joints** are movable.



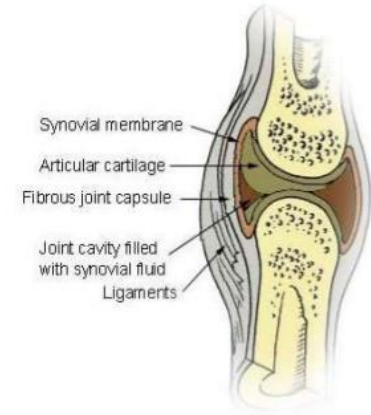
Classification Based on Function

- **Synarthroses**-immovable joints (sutures)
- **Amphiarthroses**- slightly movable joints(fibrous connection)(intervertebral discs)
- **Diarthroses**-freely movable joints(synovial)
- Synarthroses and amphiarthroses are largely restricted to the axial skeleton
- Diarthroses predominate in the limbs.

Diarthrosis

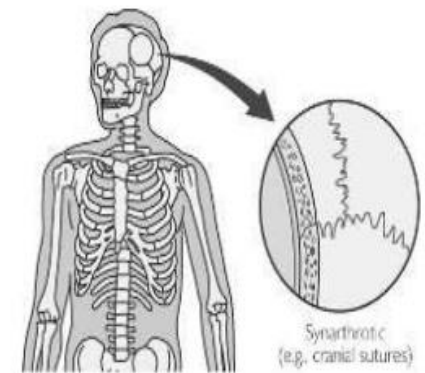
(Synovial Joints)

- Allow for free movement
- Have 3 characteristics:
 - 1) **Synovial membrane:** A serous membrane that produces synovial fluid which reduces friction and absorbs shock.
 - 2) **Articular cartilage**
 - 3) **Capsule:** Dense connective tissue covering the joint



Synarthrosis

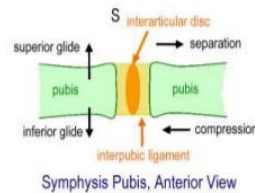
- Also called a synostosis or syndesmosis
 - is a bone to bone union
 - begins as a joint where there is a fibrous membrane between the two bones.
- They are sometime **Fibrous Joints or Ligamentous**
 - Non moveable
 - Fontanelles are examples



Amphiarthrosis

(cartilagenous joints)

- Moveable and immovable
- Cartilage between two bones
- These joints allow some movement while still providing protection.



summary

- Articulation/joint: place when 2 bones meet

- Structural joints

Fibrous joints

Cartilaginous joints

synovial joints

- Functional joints

Synarthroses

Amphiarthroses

Diarthroses

- Fibrous joints: composed of fibrous tissue with no joint cavity
- Cartilaginous joints: articulating bones are united by cartilage and no joint cavity present
- Synovial joints: articular bones are separated by a fluid-filled joint cavity.
all synovial joints are diarthrotic

- Synarthrosis: immovable joints
- Amphiarthroses: slightly movable joints (vertebral bodies and pubic bones)
- Diarthroses: freely movable joints (most appendicular joints

Synarthrosis

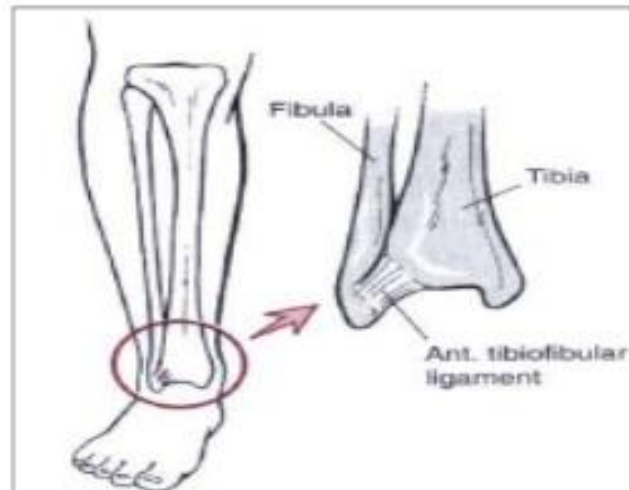
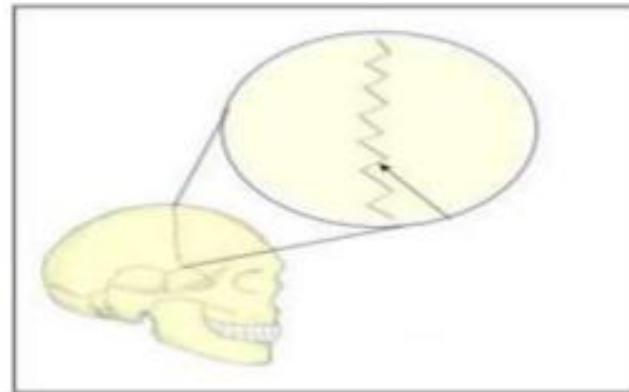
- Sutures: contain dense fibrous connective tissue until adulthood when they ossify (synostosis) skull bones (plates
- Syndesmosis: bones are connected by a filamentous sheet or cord (ligament or interosseous membrane); fibers are longer than are in sutures but are only slightly more resilient, movement can range from slight to considerable. Tibiofibular joint and the radioulnar joint.
- Gomphosis: Articulation of tooth with body alveolar surface. Peg in a socket. possesses a fibrous connection called the periodontal ligament.

Based on possible movement

- Amphiarthroses
- Sychondrosis (cartilaginous joint):hyaline cartilage unites bones at a synchondrosis. Cartilage is replaced by bone and becomes synarthrotic. Epiphyseal plate and the costal cartilage of the first rib and the manubrium of the sternum.
- Symphysis (cartliaginous joint):articular surface of bone covered by hyaline cartilage fused to an intervening pad or plate. However, it is compressible, resilient and functionally amphiarthrotic. (Pubic symphysis and the intervertebral discs.)

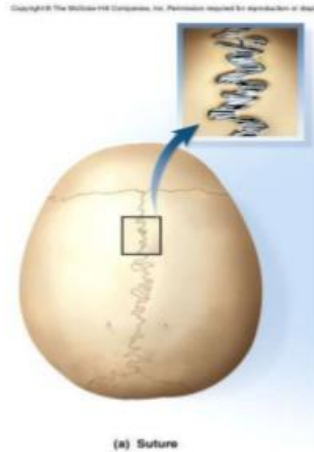
Fibrous Joints

- Bones connected by fibrous tissue
- No joint cavity
- a) Sutures
- b) Syndesmoses
- c) Gomphoses



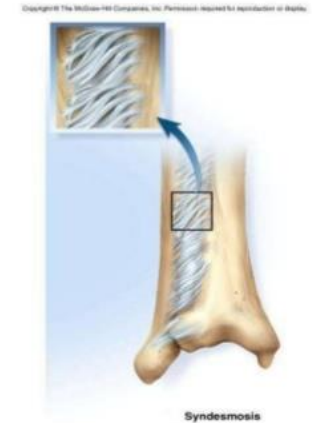
Sutures

- Thin layer of dense fibrous connective tissue uniting bones of the skull
- Irregular/interlocking edges give added strength & prevent fracture
- Synarthrosis because immovable
- Synostosis = suture that has fused completely & been replaced by bone



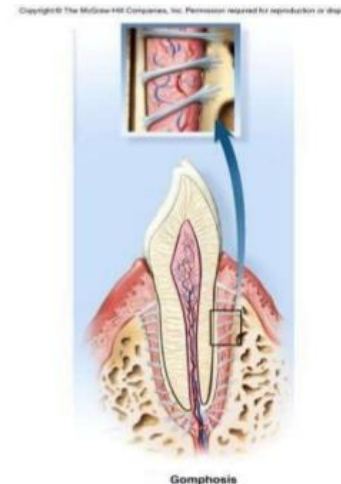
Syndesmoses

- Greater distance between articulating bones & more fibrous C.T. than sutures
- Arrangements of C.T.
 - bundles = ligament
 - sheets = inteross. memb.
- Amphiarthrosis: limited movement
- Examples
 - Anterior tibiofibular joint
 - Interosseous membranes in forearm and leg



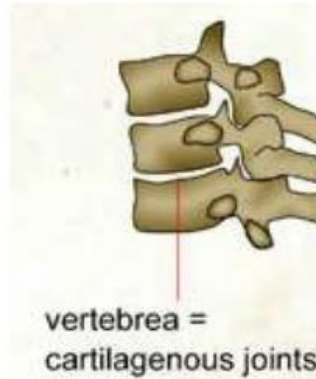
Gomphoses

- Dentoalveolar joints: cone-shaped pegs in bony socket
- Synarthrosis
- **Only example = teeth in alveolar processes of maxillae and mandible**



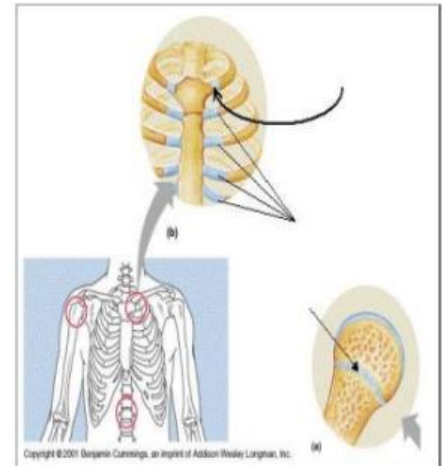
Cartilaginous joints

- The bones are united by cartilage
 - There is no joint cavity
- A. Synchondrosis(hyaline cartilage unites the bones)
- B. Symphyses(fibrocartilage unites the bones)



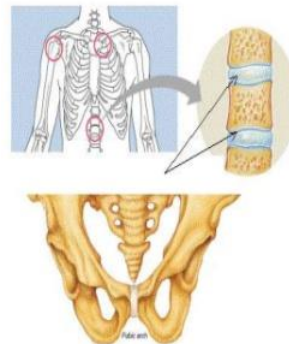
Synchondrosis

- Connecting material = hyaline cartilage
- Synarthrosis
- Examples:
 - Epiphyseal plates
 - Articulation of first rib w/ manubrium of sternum
 - Become synostoses when bone replaces cartilage



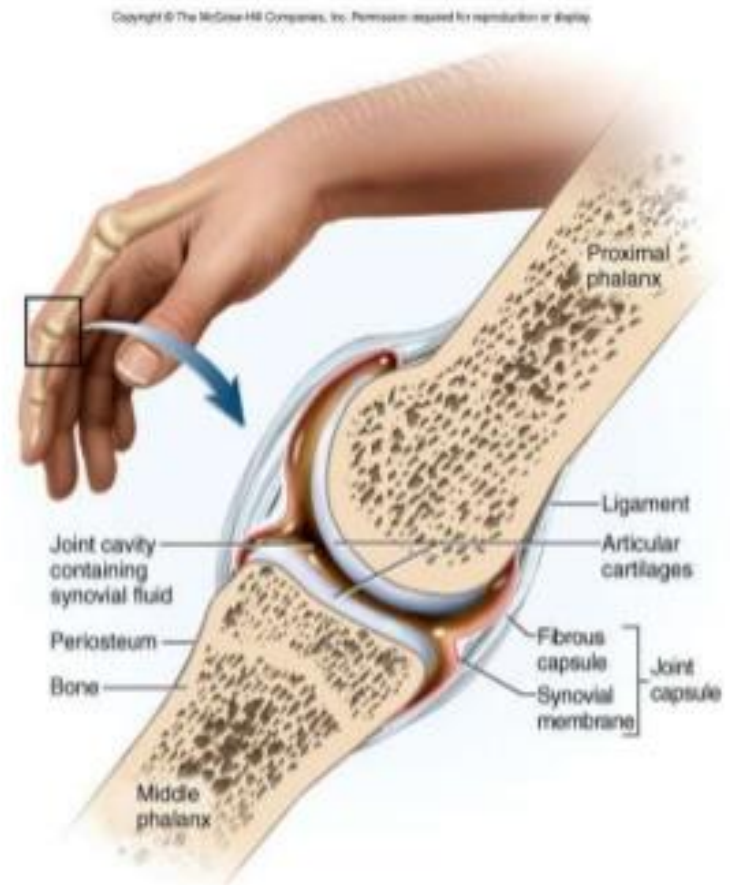
Symphysis

- Ends of articulating bones covered w/ hyaline cartilage
- **Thin disc of fibrocartilaginous** connects bones
- **All occur in midline of body**
- Amphiarthrosis
- Examples:
 - Intervertebral disc
 - Pubic symphysis



Synovial Joints

- Most movable joints in the body
- There is a joint cavity.(Synovial cavity, synovial fluid)
- Articular cartilage(covers the ends of the opposing bones)
- Articular capsule(it encloses the joint cavity.2 layered)
- Reinforcing ligaments
- Bursae
- Movement vs stability

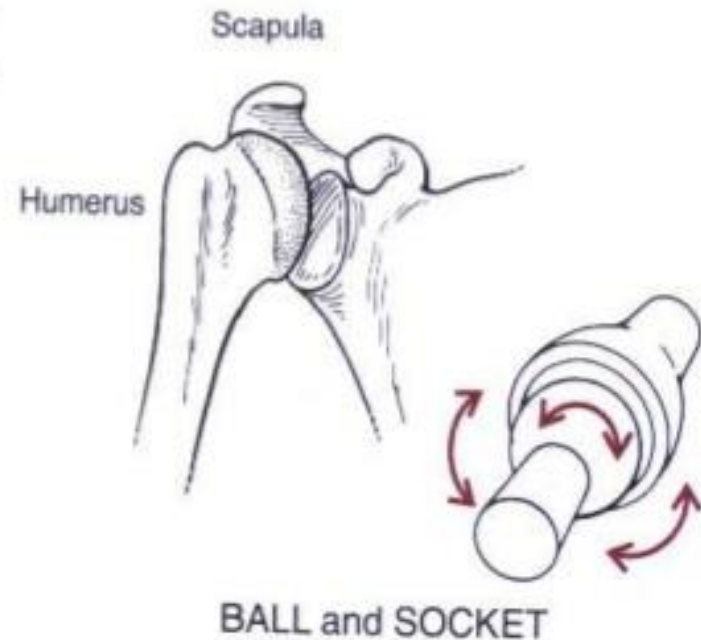


Types of Joints (Articulations)

1. Ball and Socket Joint

- Allow for the most freedom of movement

- **Triaxial** movement – flexion, extension, abduction, adduction, circumflexion, and rotation



Types of Joints (Articulations)

2. Hinge joint

- **Uniaxial** – allows movement in only one direction. Back and forth
- Allows only flexion and extension in one plane (sagittal)
- Many times the articular surfaces will have a distinct shape (ie: spool shaped trochlear surface of the humerus)



Types of Joints (Articulations)

3. Pivot joint

- Allows rotation (**uniaxial**)
- Rounded, pointed, or conical surface on one bone that fits into a ring of bone on another.



4. Saddle joint

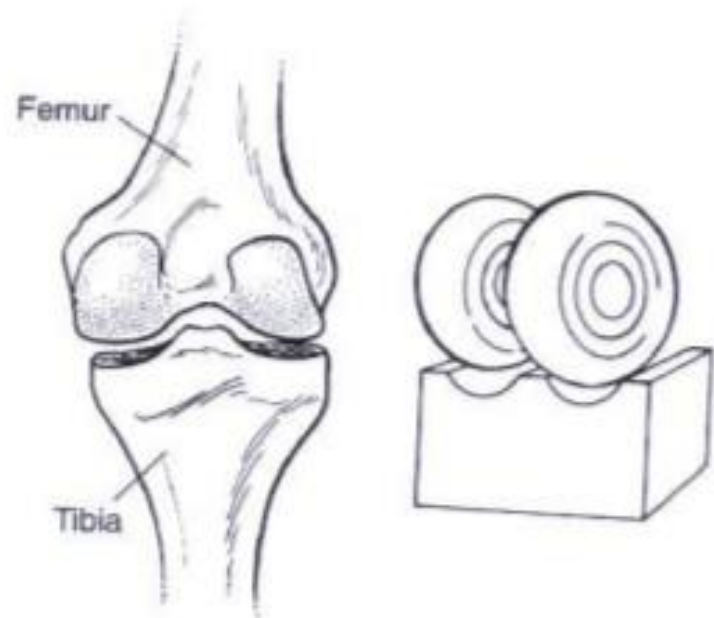
- **Biaxial**
- Allows flexion, extension, abduction, adduction, and circumduction.
- Surfaces are inverted relative to each other.



Types of Joints (Articulations)

5. Condyloid joint

- **Biaxial**
- One bone is concave (hollowed out depression) and the other is convex (rounded or elliptical).
- Allows flexion, extension, abduction, and adduction.
- No rotation




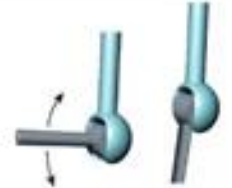
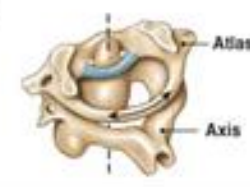
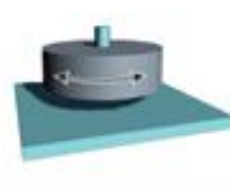








CONDYLOID

Types of Joints (Articulations)

6. Sliding or gliding joint
- **Biaxial**
 - Side to side, back and forth
 - Two flat surfaces that slide over each other
 - No angular motion



Types of Synovial Joints	Models of Joint Motion	Examples
<p>Gliding joint</p>  <p>Clavicle Manubrium</p>		<ul style="list-style-type: none"> • Acromioclavicular and sternoclavicular joints • Intercarpal and intertarsal joints • Vertebrocostal joints • Sacro-iliac joints
<p>Hinge joint</p>  <p>Humerus Ulna</p>		<ul style="list-style-type: none"> • Elbow joints • Knee joints • Ankle joints • Interphalangeal joints
<p>Pivot joint</p>  <p>Atlas Axis</p>		<ul style="list-style-type: none"> • Atlas/axis • Proximal radio-ulnar joints
<p>Ellipsoid joint</p>  <p>Scaphoid bone Radius Ulna</p>		<ul style="list-style-type: none"> • Radiocarpal joints • Metacarpophalangeal joints 2-5 • Metatarsophalangeal joints
<p>Saddle joint</p>  <p>Metacarpal bone of thumb Trapezium</p>		<ul style="list-style-type: none"> • First carpometacarpal joints
<p>Ball-and-socket joint</p>  <p>Humerus Scapula</p>		<ul style="list-style-type: none"> • Shoulder joints • Hip joints

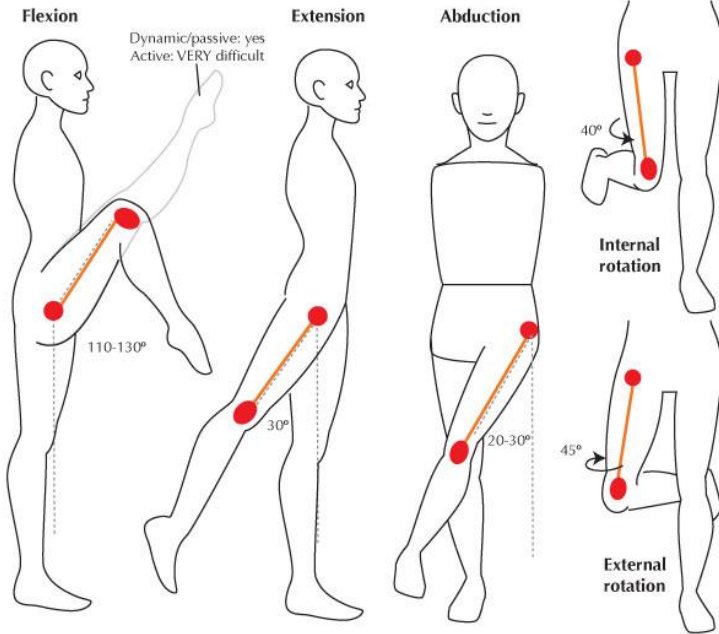
Types of Joints (Articulations)

Joint Type	Example
Gliding	Intercarpal joints of foot
Condyloid	Knee
Hinge	Elbow
Saddle	Thumb
Pivot	Back of the neck(atlas & axis)
Ball and Socket	Hip

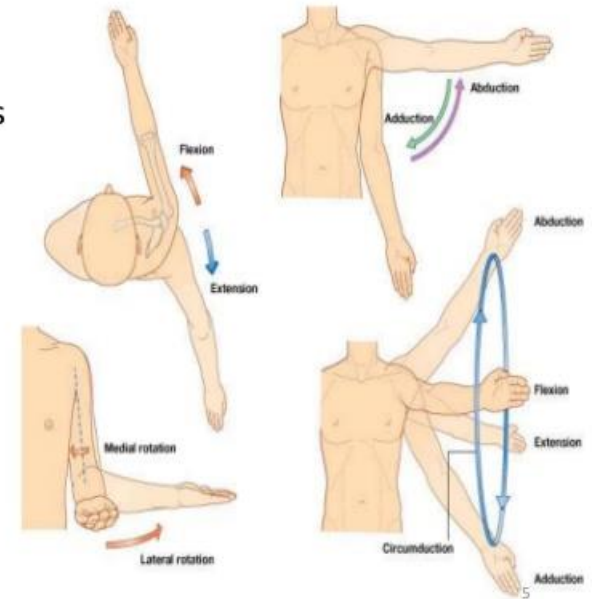
diarthroses

- **Plane joints** (sliding joint)(synovial) :articular surface is flat and only allows for short gliding movements.
- **Hinge joints** (synovial) (**trochlearis**) (**ginglimus**):cylindrical projection of one bone fits into a trough shaped surface on another bone. (elbow)
- **Pivot joints** (**trochoidea**) (synovial):rounded end of one bone protrudes into a sleeve or ring composed of bone or ligament(radius to ulna and axis to atlas)
- **Condylloid joints** (synovial):oval articular surface of one bone fits into a complimentary depression of another (metacarpophalanges: knuckles).
- **Saddle joints** (**sellar joint**) (synovial):each articular surface has a concave and convex area (carpometacarpal joint of the thumb)
- **Ellipsoidea** joint – radiocarpea joint
- **Ball and socket** (**globoidea**) (**spheroidea**) (synovial):the spherical end of one bone articulates with a cuplike socket of another bone (shoulder or hip joints)

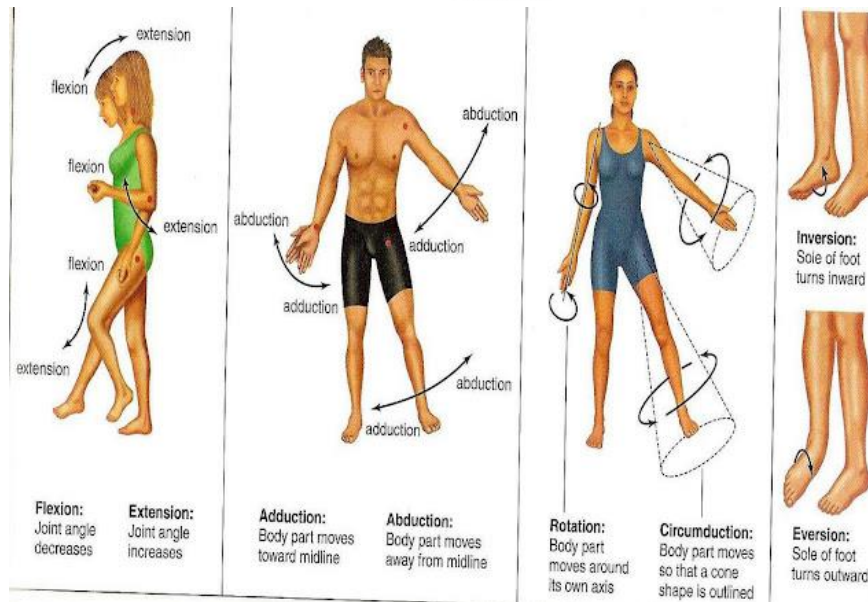
Movements at the shoulder joint



- It is a freely mobile joint.
- The following movements occur at the joint:-
- Abduction
- Adduction
- Flexion
- Extension
- Lateral rotation
- Medial rotation and
- Circumduction

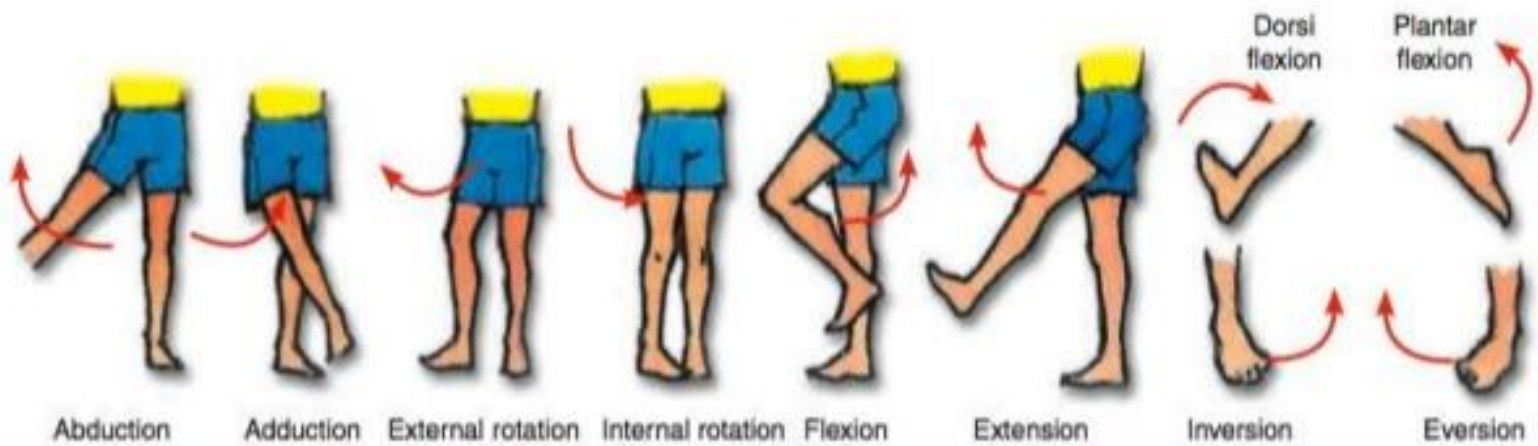
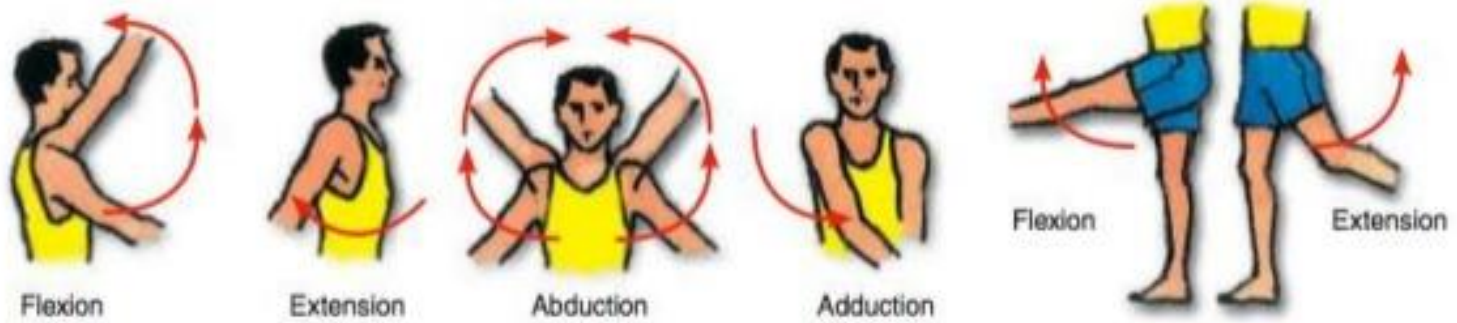
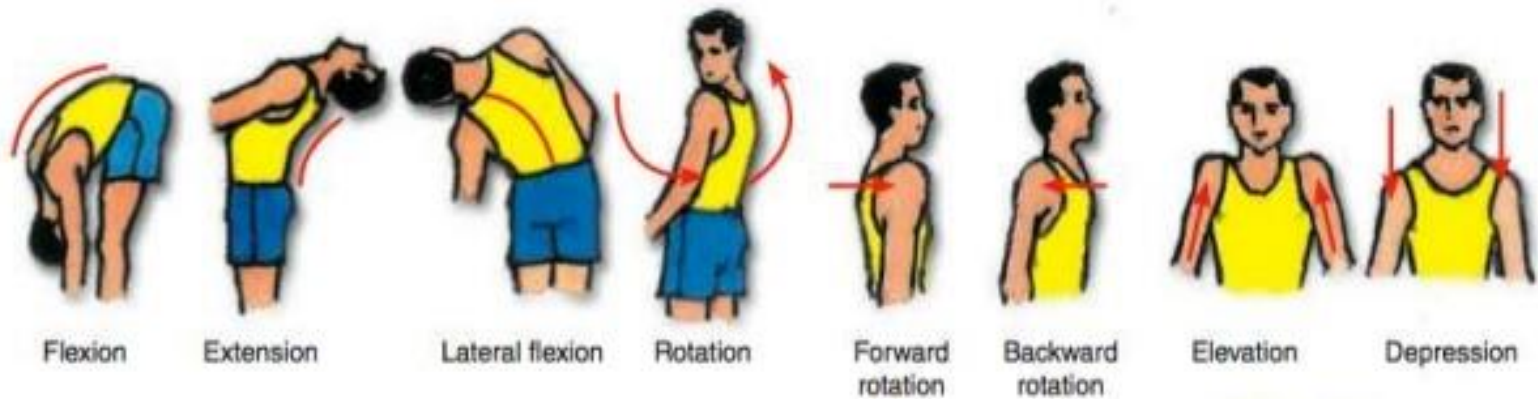


12/18/2014



Joint movements

- **Gliding**: bones displaced in relation to one another. (intercarpal and intervertebral joints)
- **Angular**: changing the angle between bones
- **Flexion**: decreasing the joint angle
- **Extension**: increasing the joint angle
- **Abduction**: moving away
- **Adduction**: moving towards
- **Circumduction**: draw around in a circle
- **Rotation**: turning movement of a bone around its own axis (can be medial or lateral)
- **Opposition** vs reposition
- **Protraction** vs retraction
- **Elevation** vs depression
- **Supination** vs pronation
- **Eversion** vs inversion



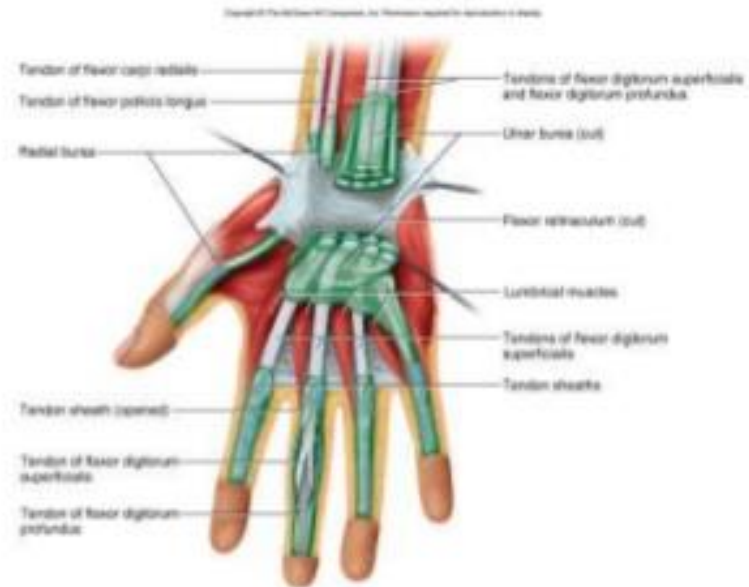
Diarthrosis/synovial joint

Basic Structure & General Anatomy

- Articular capsule encloses joint cavity
 - continuous with periosteum
 - lined by synovial membrane
- Synovial fluid = slippery fluid; feeds cartilages
- Articular cartilage = hyaline cartilage covering the joint surfaces
- Articular discs and menisci
 - jaw, wrist, sternoclavicular and knee joints
 - absorbs shock, guides bone movements and distributes forces
- Tendon attaches muscle to bone
- Ligament attaches bone to bone

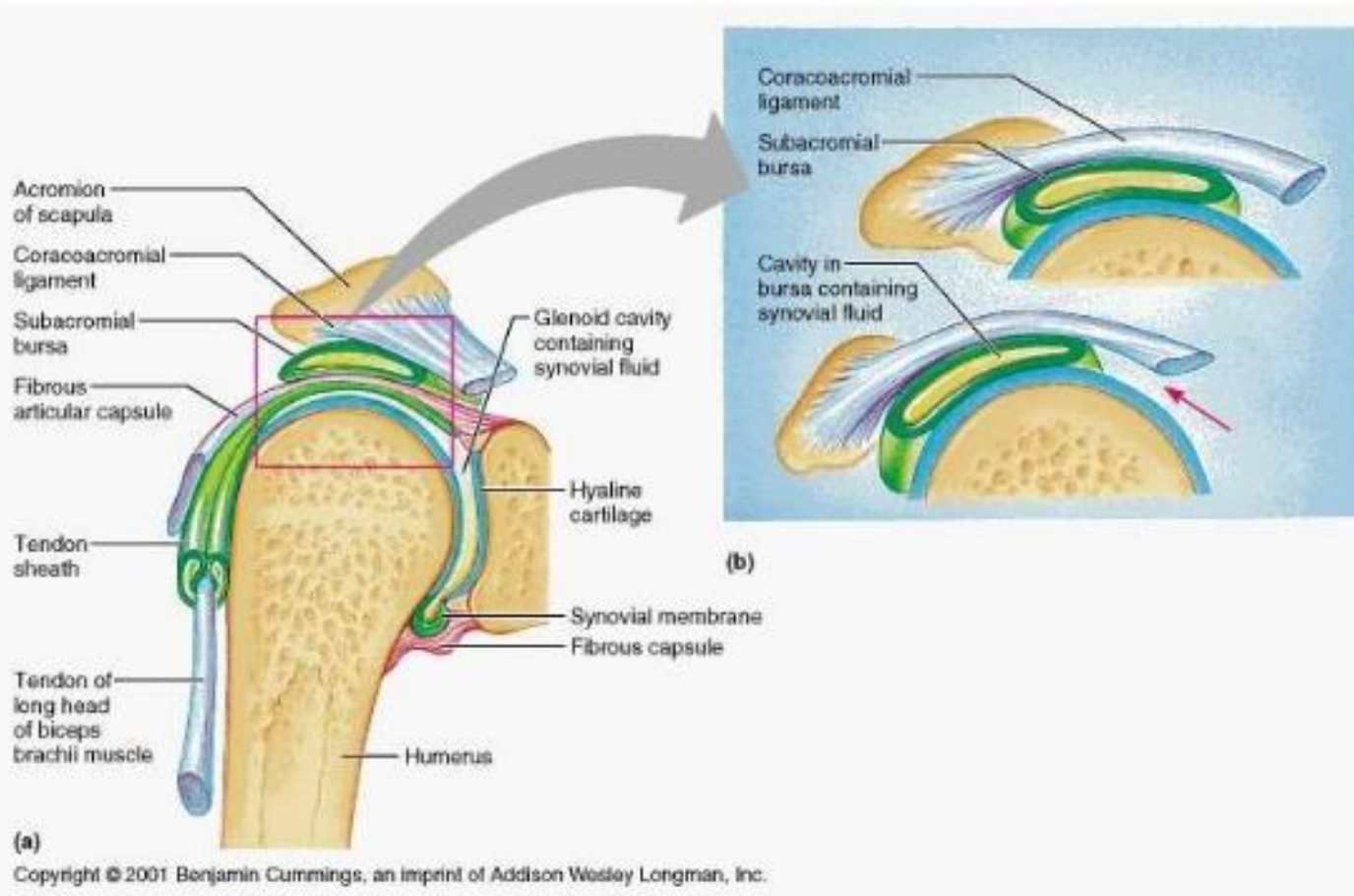
Tendon Sheaths and Bursae

- Bursa = saclike extension of joint capsule
 - between nearby structures so slide more easily past each other
- Tendon sheaths = cylinders of connective tissue lined with synovial membrane and wrapped around a tendon



- articular cartilage (synovial):hyaline type forms a glassy smooth surface over the opposing ends of bones.
- joint cavity (synovial):small space
- Synovial fluid (synovial):largely derived from blood; has a viscous egg white consistency; leaks out of cartilage; weeping lubrication
- articular capsule (synovial): a: fibrous capsule (external)
b: synovial membrane: (internal
- reinforcing ligaments (synovial):support and strengthen the joint.
- Bursa:contained in synovial joints. These structures are flattened sacs lined with a synovial membrane and contain a thin film of synovial fluid. Bursa are located where ligaments , muscle, and tendons overlie and rub against bone.
- Menisci of the knee:some synovial joints have pads of fibrocartilage between the ends of bones.

Bursae and Tendon Sheaths



Summary of Joint Classification

Structural Class	Characteristics	Types	Mobility
Fibrous	Bones united by collagen fibers	<ol style="list-style-type: none"> 1. Suture 2. Syndesmosis 3. gomphosis 	<ol style="list-style-type: none"> 1. Immobile (synarthrosis) 2. Slightly moveable (amphiarthrosis) 3. Immobile
Cartilaginous	Bone ends united by cartilage	<ol style="list-style-type: none"> 1. Synchondrosis (hyaline) 2. Symphysis (fibrocartilage) 	<ol style="list-style-type: none"> 1. Immobile 2. Slightly moveable
Synovial	Bone ends covered with articular cartilage and enclosed within a capsule lined with a synovial membrane	<ol style="list-style-type: none"> 1. Plane 2. Hinge 3. Pivot 4. Condylloid 5. Saddle 6. Ball and socket 	Freely moveable (diarthrosis) which depends on joint design

Thank you