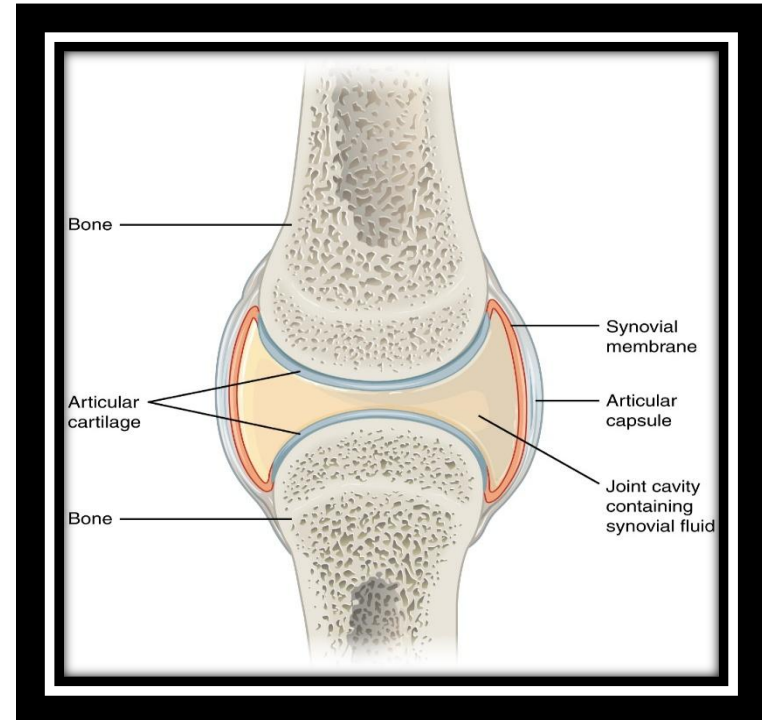


BONE FORMATION & JOINTS



By

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LEARNING OUTCOMES

1. Recognize the ways of **bone development**.
2. Know the types of **bone growth**.
3. Recognize the main events in the process of **bone repair**.
4. Identify **bone remodeling**.
5. Identify the different **types of joints**.
6. Describe the structure of **mobile joints** .

Bone formation

When??:

- **Formation of bone in an embryo (development).**
- **Growth of bones until adulthood.**
- **Remodeling of bone.**
- **Repair of fractures.**

Bone development (osteogenesis) (Ossification):

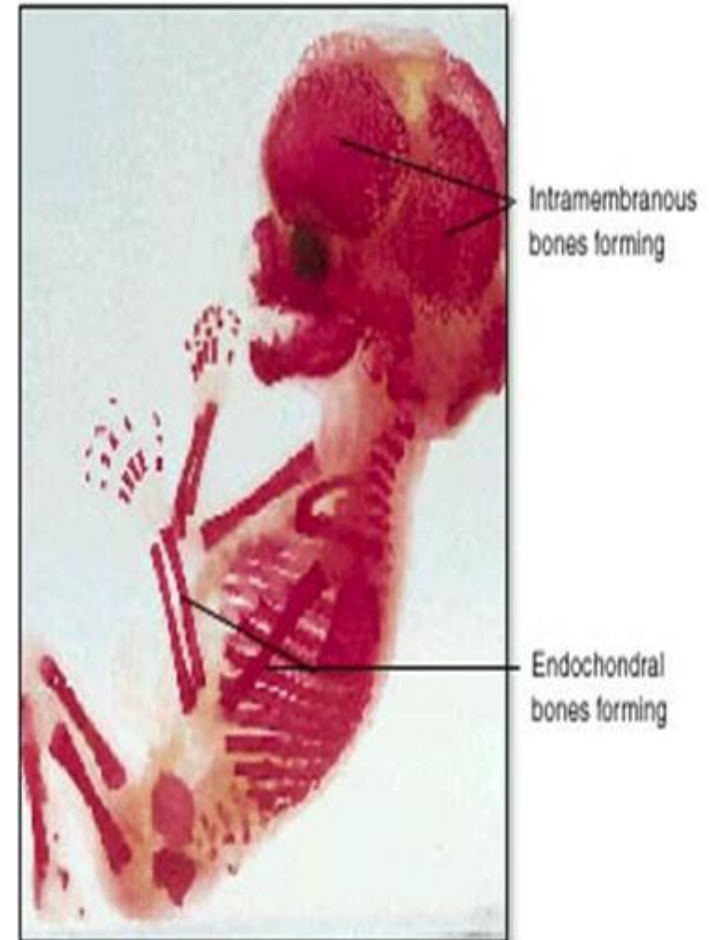
There are two types of bone development:

1-Intramembranous ossification:

Bone develop (**directly**) from **mesenchyme**.

2-Endochondral (Intracartilagenous) ossification: occurs by the replacement of **cartilage by bone (indirectly)**.

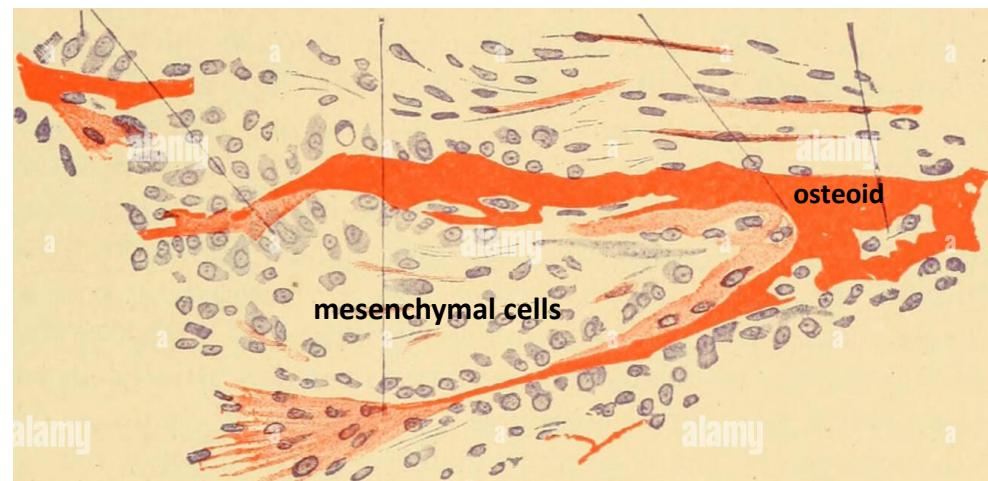
- *The names refer to the mechanisms by which the bone forms **initially**.*
- *in both processes, the bone tissue that appears **first is temporary woven bone**, which is soon **replaced** by stronger lamellar bone.*
- ***During growth of all bones, areas of woven bone, areas of bone resorption, and areas of lamellar bone all exist next to one another.***



Intramembranous ossification:

The **mesenchymal cells** within the mesenchymal membrane differentiate into **osteoblasts** which begin secreting **osteoid** (organic matrix).

- **Occurs at:**
- ✓ **Embryonic life:** to form **Flat bones**.
- ✓ **Postnatal life:** to **increase** the width of long bone.



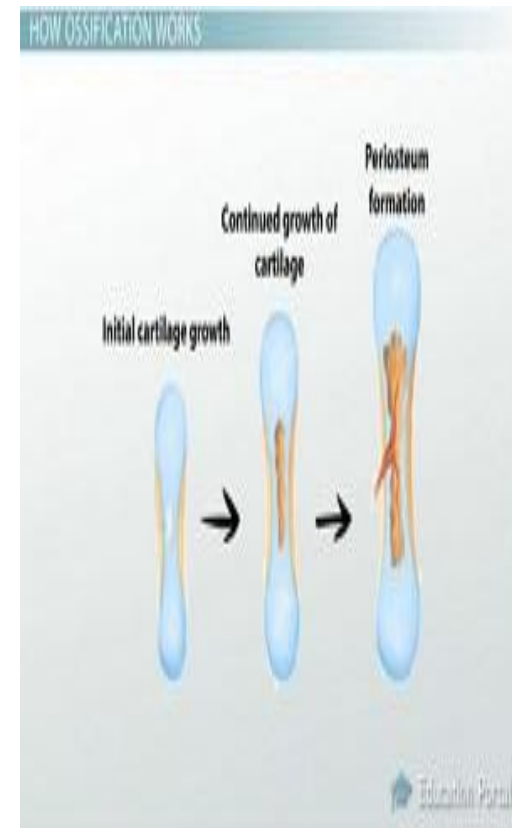
Endochondral (Intracartilagenous) ossification:

In which a preexisting **matrix of hyaline cartilage** is eroded and **invaded by osteoblasts**, which then begin **osteoid production** followed by resorption of the cartilage.

- **Forms:** Most bones of the body (**short, long**).

hyaline cartilage shape resembles

a small version, or model, of the bone to be formed.

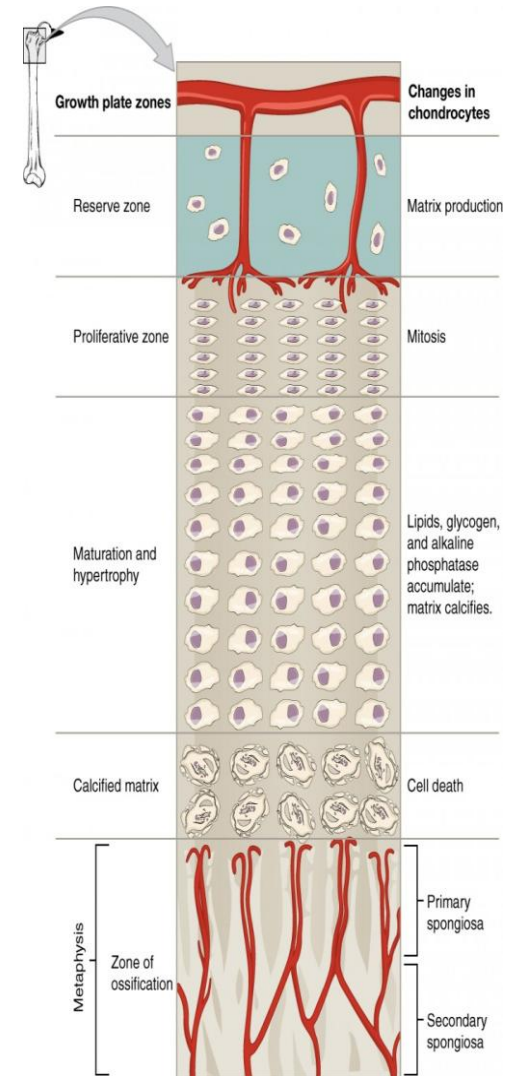


Bone growth

- The layer of **articular cartilage** within joints which usually persists through adult life and *does not* contribute to bone growth.
- The organized **epiphyseal cartilage** (also called **epiphyseal plate** or growth plate), which connects each epiphysis to the diaphysis are responsible for **continued elongation of bones** until the body's full size is reached "epiphyseal closure".

Growth at epiphyseal plate

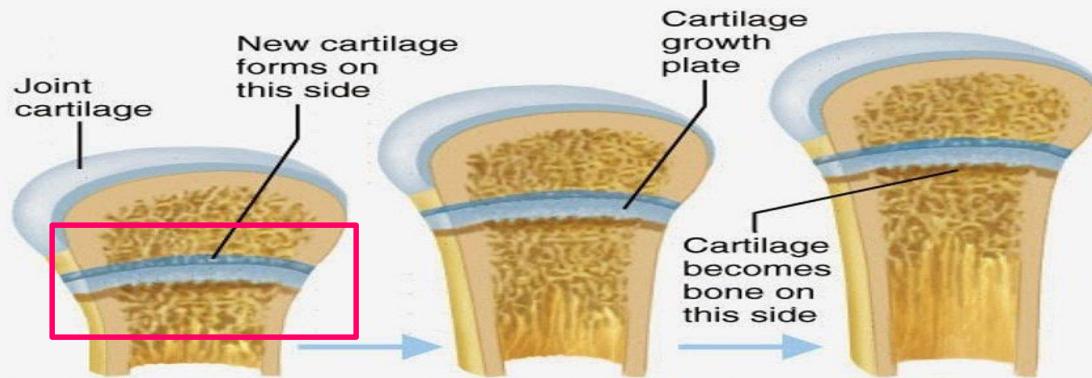
- Growth in **length** of a long bone.
- Occurs by proliferation of **chondrocytes** in the epiphyseal plate.
- Chondrocytes hypertrophy, their **matrix becomes calcified**, and the cells die.
- **Osteoblasts** lay down **new bone** on the calcified cartilage matrix.



Types of Bone growth:

❑ Interstitial growth of epiphyseal plate=Increase in length :

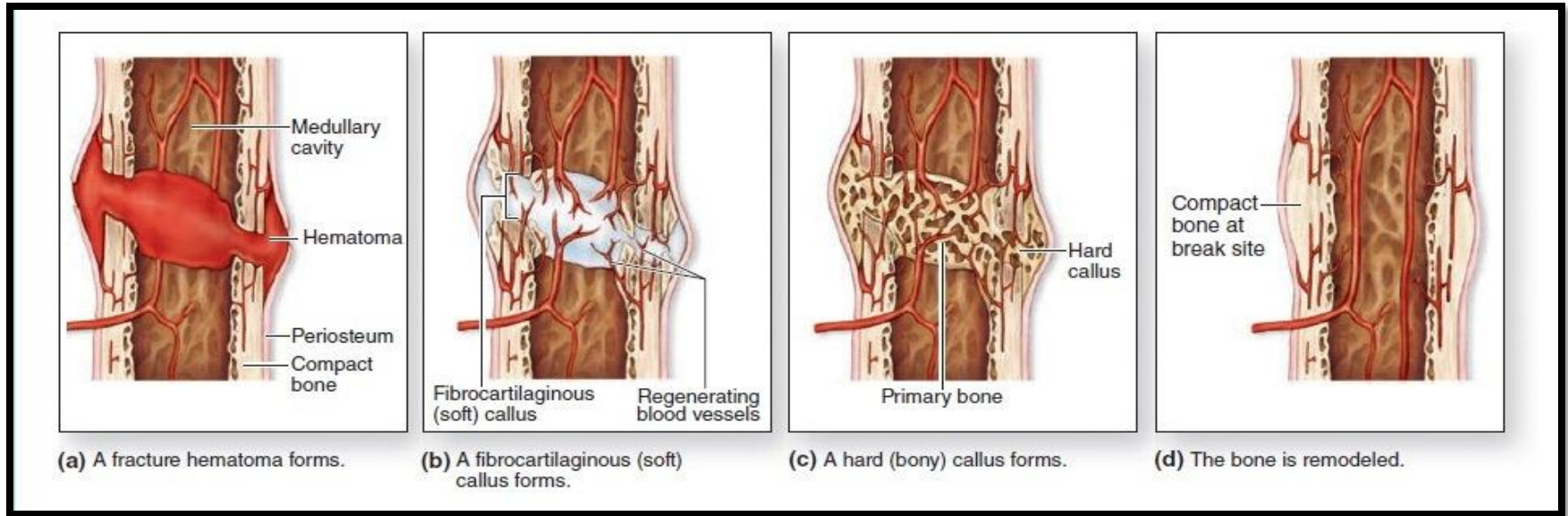
After the long bone is formed, its further longitudinal growth depends on the presence of the epiphyseal plate of cartilage.



❑ Appositional growth =Increase in width:

Osteoblasts lay down new bone matrix under the periosteum in layers on outer surface, while **osteoclasts** dissolve bone at endosteal surface (inner surface) depositing new bone matrix under the periosteum on the outer surface, while **osteoclasts** resorb bone from the endosteal surface (inside), enlarging the medullary cavity to prevent bones from becoming too heavy.

Fracture and repair



Repair of a fractured bone occurs through several stages

(a) Blood vessels torn within the fracture produce a **large hematoma**.

(b) **Hematoma** gradually removed by macrophages and replaced by a soft fibrocartilage-like mass (soft procallus). *periosteum reestablishes continuity over this tissue.*

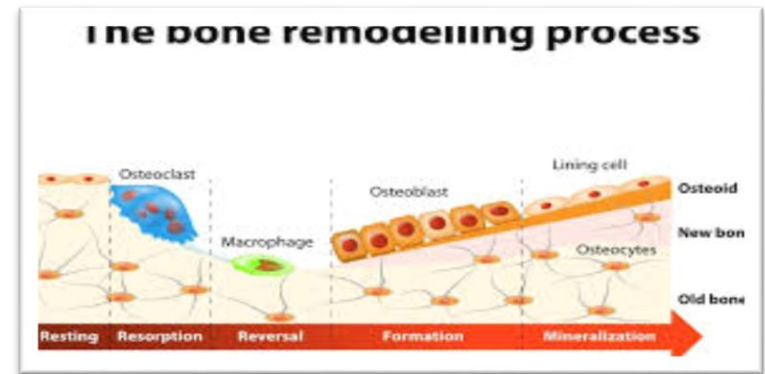
(c) This **soft procallus** is invaded by regrowing blood vessels and osteoblasts.

-In the next few weeks the *fibrocartilage* is gradually replaced by trabeculae of woven bone, forming a **hard callus**.

(d) The woven bone is then **remodeled** as compact and cancellous bone.

Bone remodeling

- ❑ Bone remodeling is a lifelong, continuous process where mature bone tissue is removed (resorption) by osteoclasts and new tissue is formed (ossification) by osteoblasts.
- ❑ This cycle
 - maintains **calcium homeostasis**.
 - repairs micro-damages.
 - reshapes bone to meet mechanical needs.



At Bone remodeling

- Primary bone is resorbed **and** replaced by secondary bone.
- **the original bone structure & contour are restored.**

JOINTS

Definition:

- Are places where bones meet, or articulate and held together firmly.
- Allowing bending *or* movement in that portion of the skeleton.

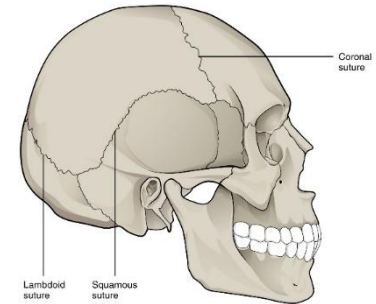
Joints classified according to the *degree of movement* between the bones into”.

1-Synarthroses: allow **very limited** or **no** movement.

2-Diarthroses: permit **free** bone movement.

Synarthroses: (Gr. *syn*, together + *arthrosis*, articulation):include:

- **Fibrous joints:** held together by **connective tissue** as **sutures of skull bones** in children
- **Cartilaginous joints:** held together by **pad of fibrocartilage** as the **pubic symphysis**.

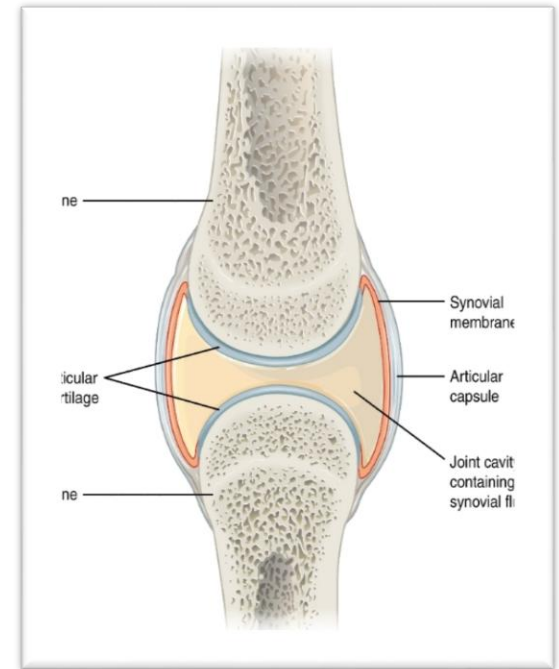


Diarthroses

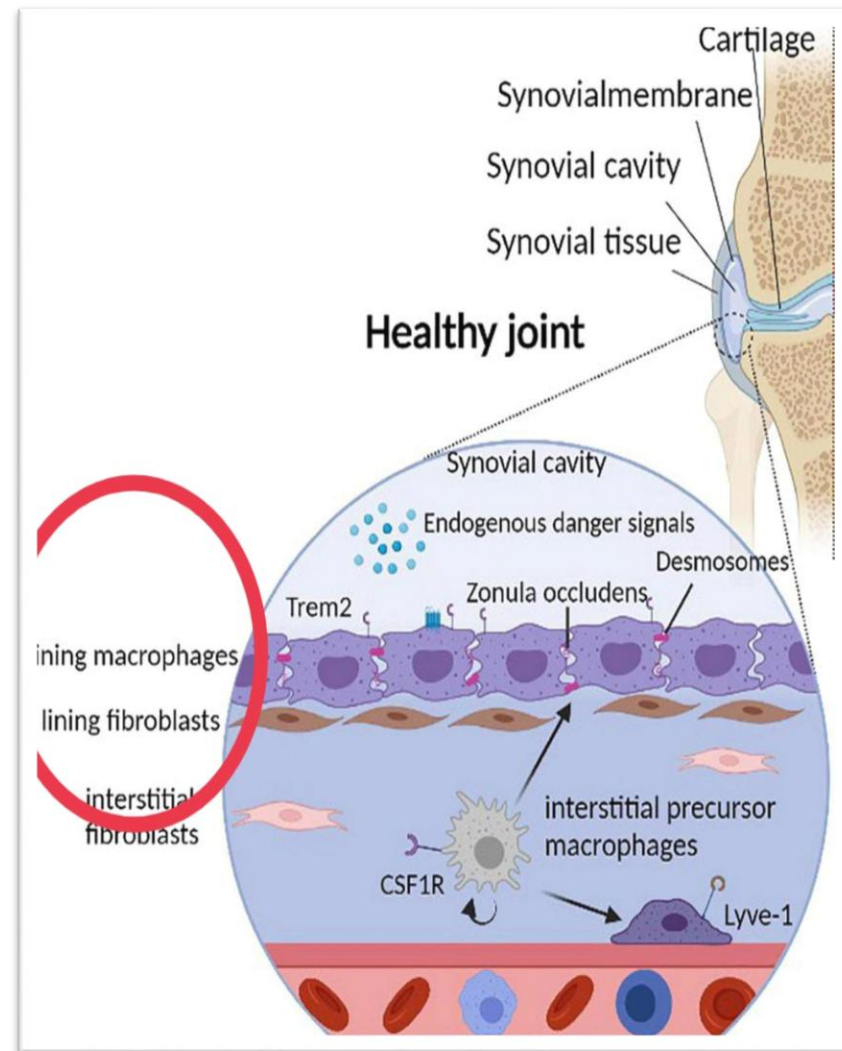
- Unite long bones
- Permit great bone movement.
- Examples: the elbow and knee joints

Structure:

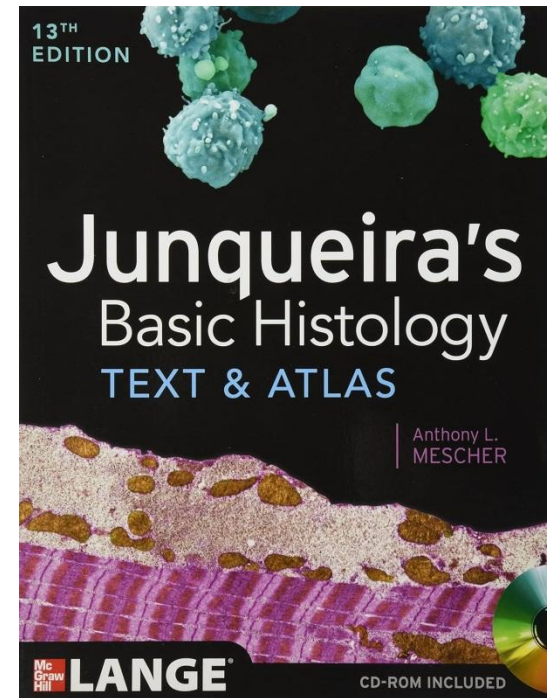
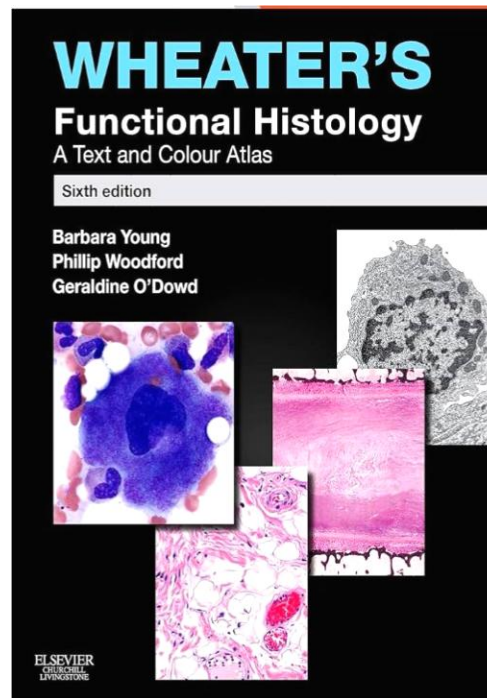
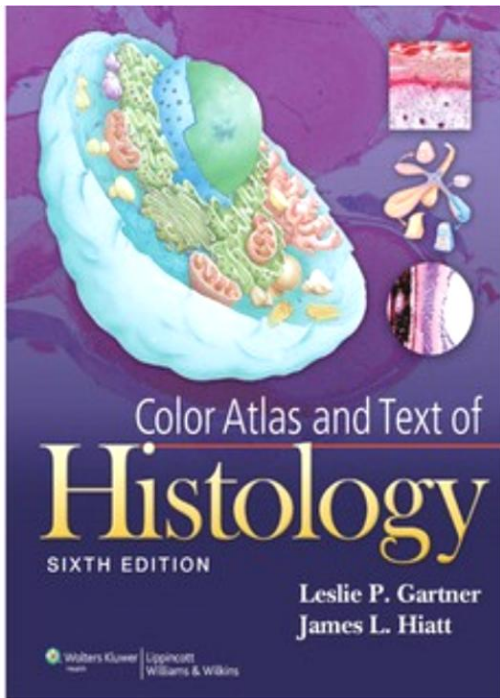
- **Capsule**= dense connective tissue
- **Ligaments** = dense connective tissue
- **The joint cavity :**
 - Sealed as it is enclosed by **capsule**
 - Contains** a clear, viscous liquid **called synovial fluid** with a high concentration of **hyaluronan**



- **Lining of joint cavity:** is specialized connective tissue called the **synovial membrane** that secretes synovial fluid.
- **Cells of synovial membrane**
 - ✓ **Macrophage-like synovial cells, or type A cells:**
 - Remove debris from the synovial fluid.
 - Important in regulating inflammatory events within joints.
 - ✓ **Fibroblastic synovial cells, or type B cells:**
 - Produce **abundant hyaluronan**.
 - **Function of synovial fluid:**
 - Lubricates the joint.
 - Reducing friction on all internal surfaces.
 - Supplies nutrients and oxygen to the articular cartilage.



References



Thank you

