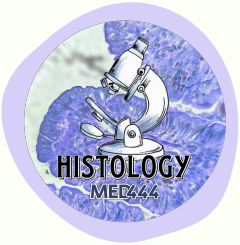
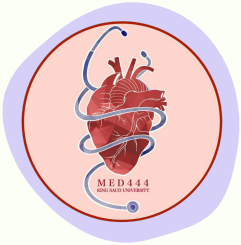
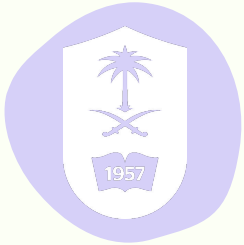
Musculoskeletal Block







Cartilage and Bone

Color Index:
-Main Text -Important -Notes
-Male Slides -Female Slides -Extra

Editing File

Objectives

By the end of this lecture, the student should be able to:

1. Describe the microscopic structure of cartilage and bone
2. Classify cartilage: hyaline, elastic and fibrocartilage
3. Classify bone: compact and cancellous bone
4. Describe the distribution of different types of cartilage and bone
5. Describe the growth of cartilage and bone

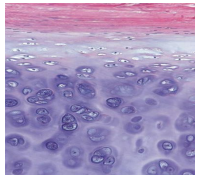
Cartilage

- Cartilage is a specialized type of C.T., With a **Rigid** matrix.
  (all types of Cartilage contain collagen type II, but they would be different in which type of fibers is more abundant in each type)

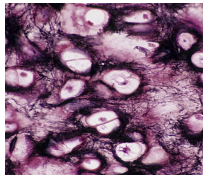
- it's usually non vascular (Avascular).
  (Cartilage is the avascular like epithelium, doesn't contain nerves and blood vessels).

Types:

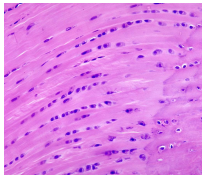
Hyaline cartilage
(Glass like)
Collagen type II



Elastic cartilage
Rich in elastic fibers



Fibrocartilage
Collagenous fibers
Collagen type I



Peri = surround
chondro = cartilage
Perichondrium=capsule surround the cartilage

Hyaline cartilage

Chondro = cartilages
Osteo = bones

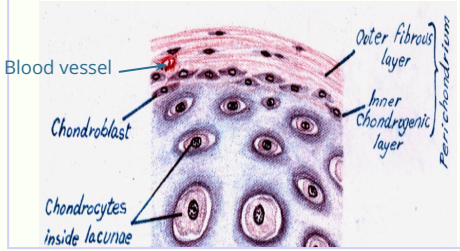
Perichondrium

Vascular C.T. membrane formed of 2 layers:

1- **Outer** fibrous layer (rich of blood vessels):
Dense fibrous C.T.
Irregular dense collagenous C.T. with blood capillaries which supplies the Cartilage with nutrients

2- **Inner** chondrogenic layer :
Chondroblasts (No Lacunae).
Lacunae =الفراغ المحيط بالخلية

Its functions: They secrete **Cartilage matrix** and give rise to **Chondrocyte.**
(maturation of chondroblasts (most active) gives chondrocytes (less active))



Cells (Chondrocytes)

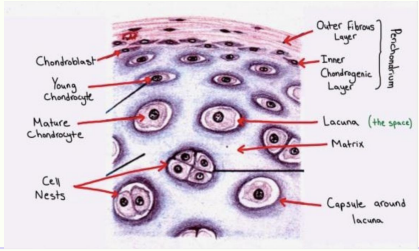
Found **in** spaces called **Lacunae**

- Young Chondrocyte:

Small & present **singly** in their Lacuna.Peripherally located under the perichondrium)

- Mature Chondrocytes:

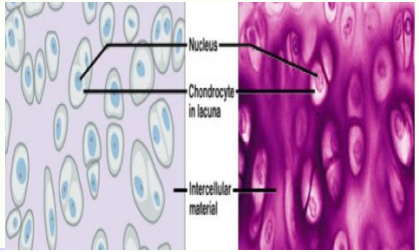
Large, and found singly or **in groups** of 2,4 or 6 cells in their **Lacunae (Cell Nests).** Cell nests are capsules containing multiple mature chondrocytes, كأنها عش طيور



Matrix

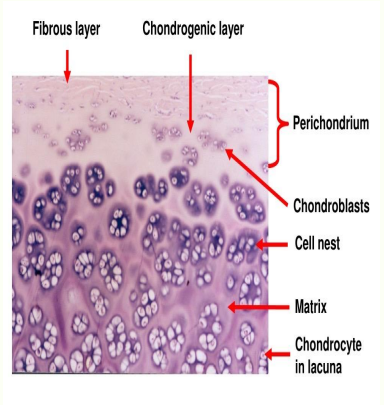
- Homogenous and **basophilic**
(متجانس مافيه شوائب زي الموية homogeneous)

- Contains Collagen **type II**



Sites :

- **Foetal skeleton**
- **Costal cartilage**
  Costal is relating to the ribs
- **Articular surface of the bone**
- **Respiratory tract (nose trachea & bronchi)**



Elastic cartilage & Fibrocartilage

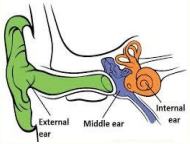
Elastic cartilage

Similar to Hyaline cartilage + Elastic fibers in the matrix. Have the same characteristics of hyaline cartilage, the only difference is the presence of elastic fibers)

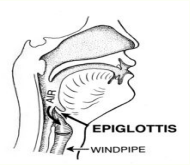
The Matrix has collagen type II but it is rich in elastic fibers to give it elasticity or stretching feature)

Sites:

- **External ear**
- **Epiglottis** لسان المزمار



At the time of eating food or swallowing, it moves backward (relaxed) to prevent food from entering the windpipe. because it is always moving, it needs to have an elasticity feature



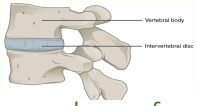
Fibrocartilage

- **No perichondrium** No blood supply
- **Rows of chondrocytes** in lacunae (and few matrix in between)separated by parallel bundles of collagen fiber **Type I**

Most of the matrix is occupied by bundles of collagen type I, and there is no space to form cell nests

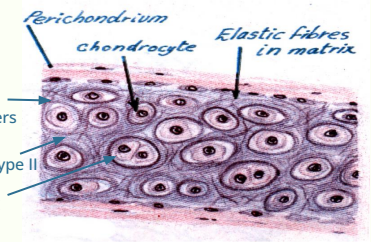
Site :

- **Intervertebral disks**



The nutrient material comes from the spongy bone of vertebrae which the disk is between (by diffusion). There will be no healing due to low blood supply

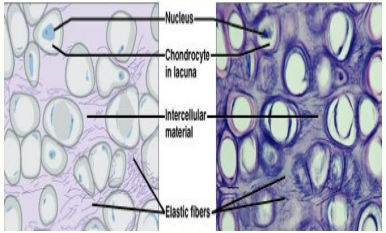
Q from dr :
Fibrocartilage has collagen type 2 ? **Yes**
But ! fibrocartilage rich in ? **Collagen type 1**

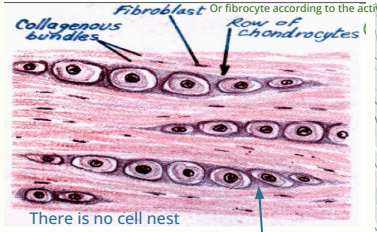


Matrix is not homogeneous contain elastic fibers

Contain collagen type II

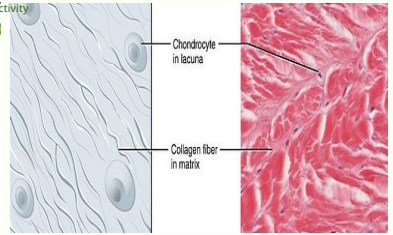
Cell nest





There is no cell nest

Matrix



Bones

Bone is a specialized type of C.T. With a hard matrix (rich in blood vessels and nerves)

Types of bone

- Compact Bone
- Spongy Bone (cancellous)

Components

- Bone cells (4 types)
  - Osteogenic cells
  - Osteoblasts
  - Osteocytes
  - Osteoclasts
- Bone matrix (calcified osteoid tissue)
  - Hard because it is calcified (calcium salts)
  - Has **type I** collagen fibers (gives it pink or red color)
  - Forms bone lamellae and trabeculae
- Periosteum
- Endosteum
  lining of bone marrow spaces

To help you remember:
B(one) is type (one) collagen

Functions

- Body support
- Protection of vital organs
  - Such as: Brain and bone marrow
- Storage of calcium

Bone cells:

1 Osteogenic -immature osteoblasts-

- Site: in periosteum & endosteum
- Fate: give rise to osteoblasts.

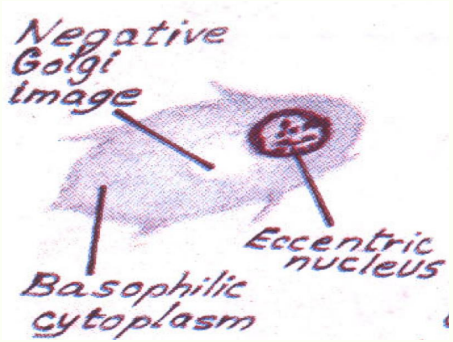
Osteogenic cells → Osteoblasts → Osteocytes

Bone forming cells: osteogenic cells, osteoblasts, and osteocytes.
Bone resorption cell: Osteoclasts (in next slide)

To help you remember:
Osteoclasts : كسر Osteoblasts : بناء

2 Osteoblasts
(خلايا شباب وشغاله بنيان)

- Site: In periosteum & endosteum.
- Origin: osteogenic cells
- They secrete the bone matrix & deposit Ca^{2+} salts in it.
- Fate: change to osteocytes.



Bone cells:

3 Osteocytes
(خلايا متقاعدة ومستقرة)

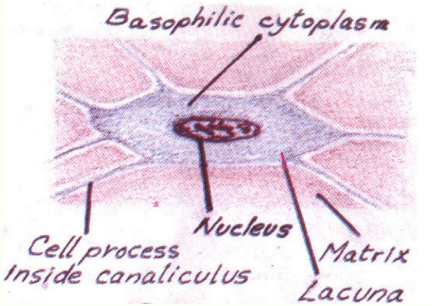
- Branched cells.

- Present singly in **lacunae**
Their branches run in canaliculi (Tiny channels) to reach nearby blood vessels in the bone for nutrients because the hard matrix does not permit diffusion of nutrients through it.

- Origin: osteoblasts

- Maintain the bone matrix

-Can not divide because it is tightly enclosed in its lacuna



* 3 types of cells have lacunae: chondrocytes, osteocytes, and osteoclasts

4 Osteoclasts
443:The only motile cell in bone

- Large multinucleated cells on bony surface, in Howship's lacunae (area on one side of the osteoclast "outside the cell"). (its lacunae are different than in osteocytes and chondrocytes, but it is still considered as lacunae)

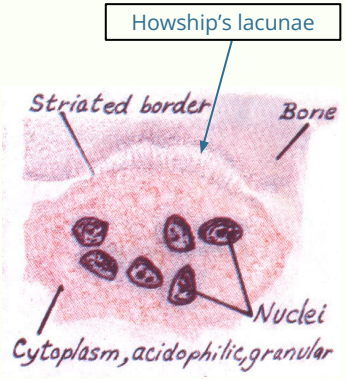
- They have striated or ruffled border (to increase surface area).

- Cytoplasm is rich in lysosomes.
(Because it secretes acids to remove calcium from bone into circulation if needed, and to resorb old bone cells)

- Origin: blood monocytes.

- Function: Bone resorption (destruction of bone to release calcium)

Monocytes → Osteoclasts



Types of bones

Compact (cortical)
It is found in the Diaphysis of long bones.

Consists of
Next slides

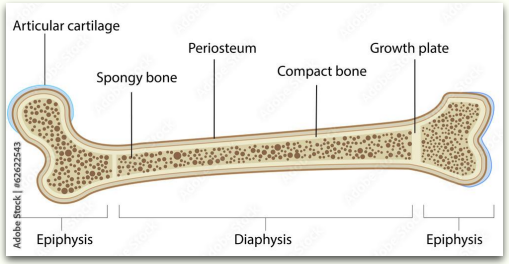
Has many characteristics
Next slides

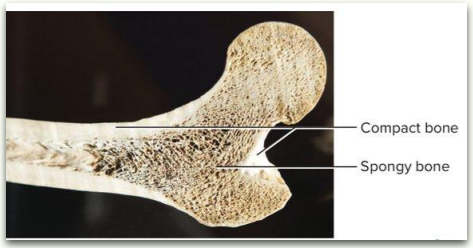
Spongy (cancellous)
(trabecular)
In flat bones & Epiphysis of long bones

Consists of
Next slides

One characteristic:
No Haversian systems (no osteons).

Good photo to know your terms





Compact bones

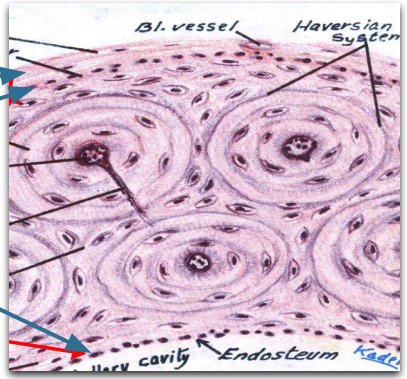
1 **Consists of:**

1- Periosteum
- Outer fibrous layer.
- Inner Osteogenic Layer.

2-Endosteum

3-Bone cells (osteocytes)

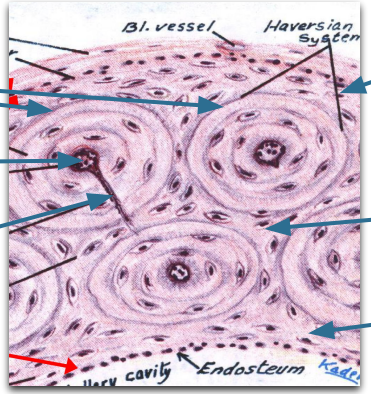
4-Bone lamellae (The matrix of the bone in the form of swirls)



singular-Lamella
plural-Lamellae

Bone lamellae:

1-Haversian Systems (Osteons) (the unit of compact bone):
- **Longitudinal** Cylinders (the circles)
- Each cylinder is formed of:
  Haversian canal in the Center (red dot)
  (With blood vessels and nerves running through it)
  Surrounded by concentrically arranged (like swirls) **bone lamellae** separated by **Osteocytes** in lacunae.
- Volkmann's canals:
  connect the Haversian canals together (to allow the passage of blood vessels and nerves). They run obliquely or transversely (مثل الجسر)



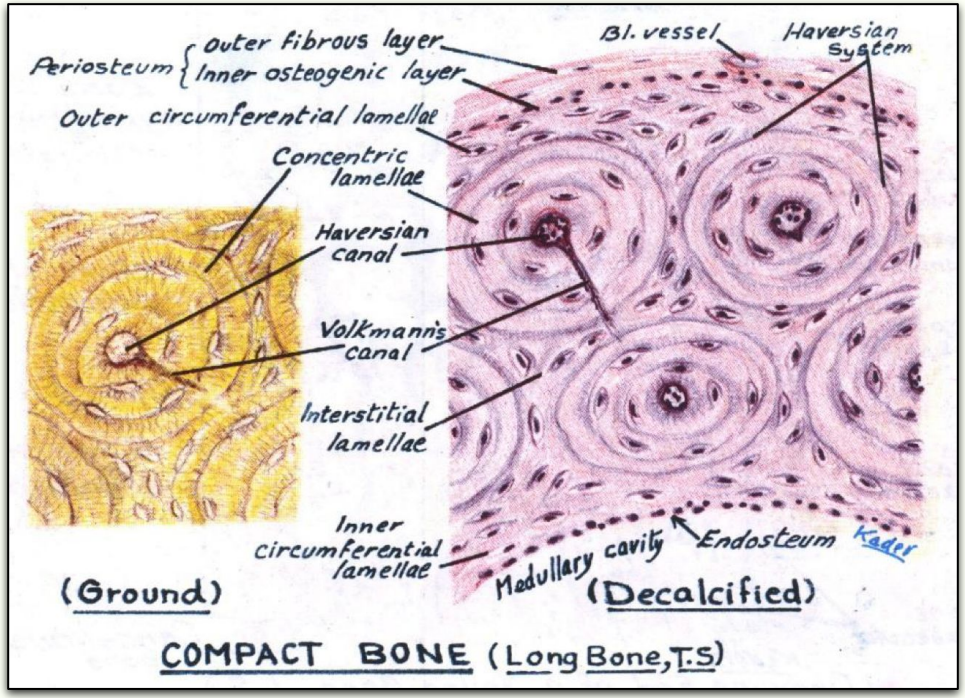
2-External Circumferential Lamellae.

3-Interstitial Circumferential Lamellae: Between Osteons.

4-Internal circumferential Lamellae.

Compact bones

Picture from slides



Spongy bone

Consists of:

1- Periosteum.

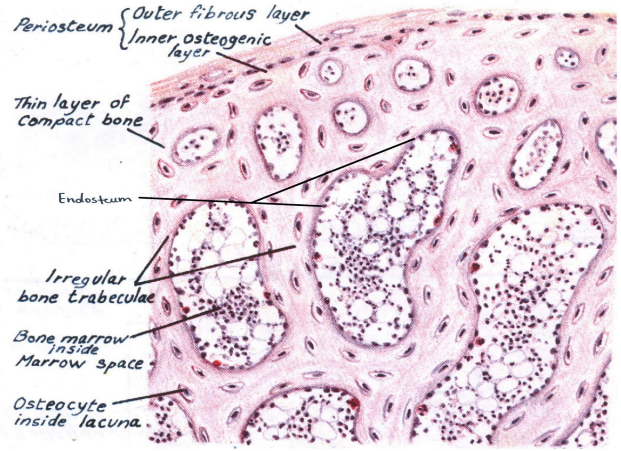
2- Endosteum.
(Found in spongy bone more than compact bone)

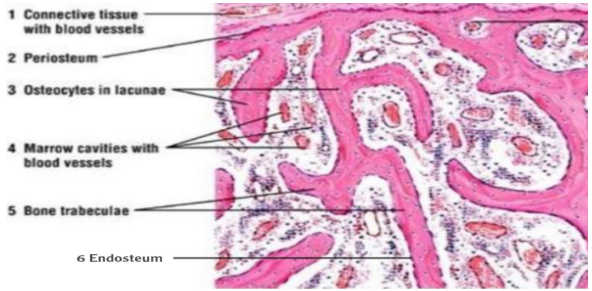
3- Irregular bone trabeculae
(bone plates)
(are formed of irregular bone lamellae separated by osteocytes inside lacunae).

4- Many irregular red bone marrow spaces.
(Endosteum lines these spaces)

5- Bone Cells.

No haversian systems (no osteons)





Growth of cartilage & bone

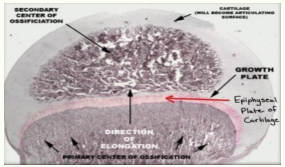
Interstitial growth never happens in bone because there are no cell nests (cells cannot divide)

Layers of chondroblast increase in childhood to give more chondrocytes and cell nests

Bone

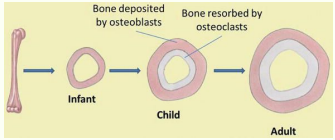
Growth in Length

Produced by the activity of **Epiphyseal plate of cartilage**



Appositional growth Increase in Width (thickness)

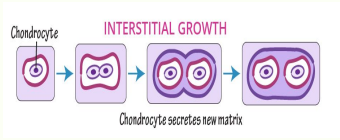
Produced by the activity of osteoblasts



Cartilage

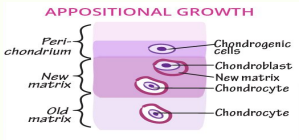
Interstitial growth Increase in Length

Produced by The division and activity of Mature chondrocytes (from inside)

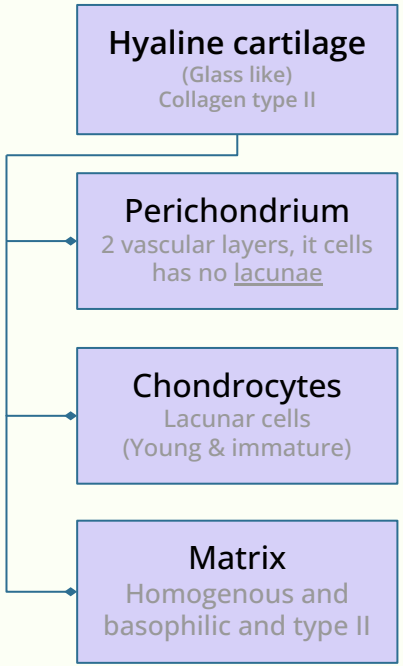


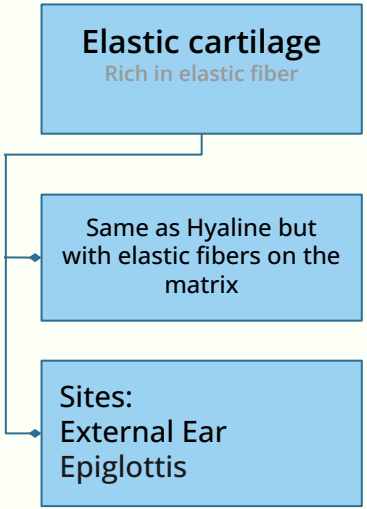
Appositional growth Increase in Width (thickness)

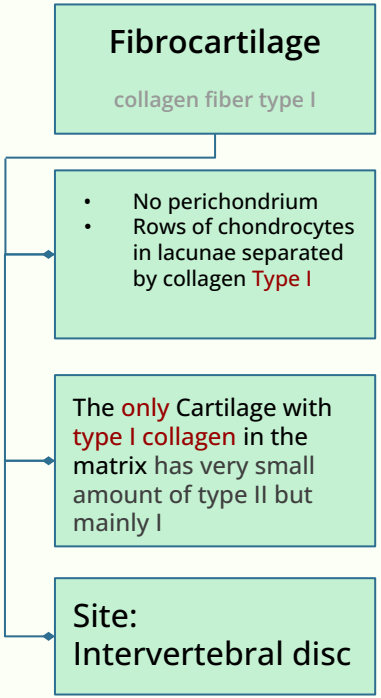
Produced by the activity of chondroblasts in the inner chondrogenic layer (from outside)



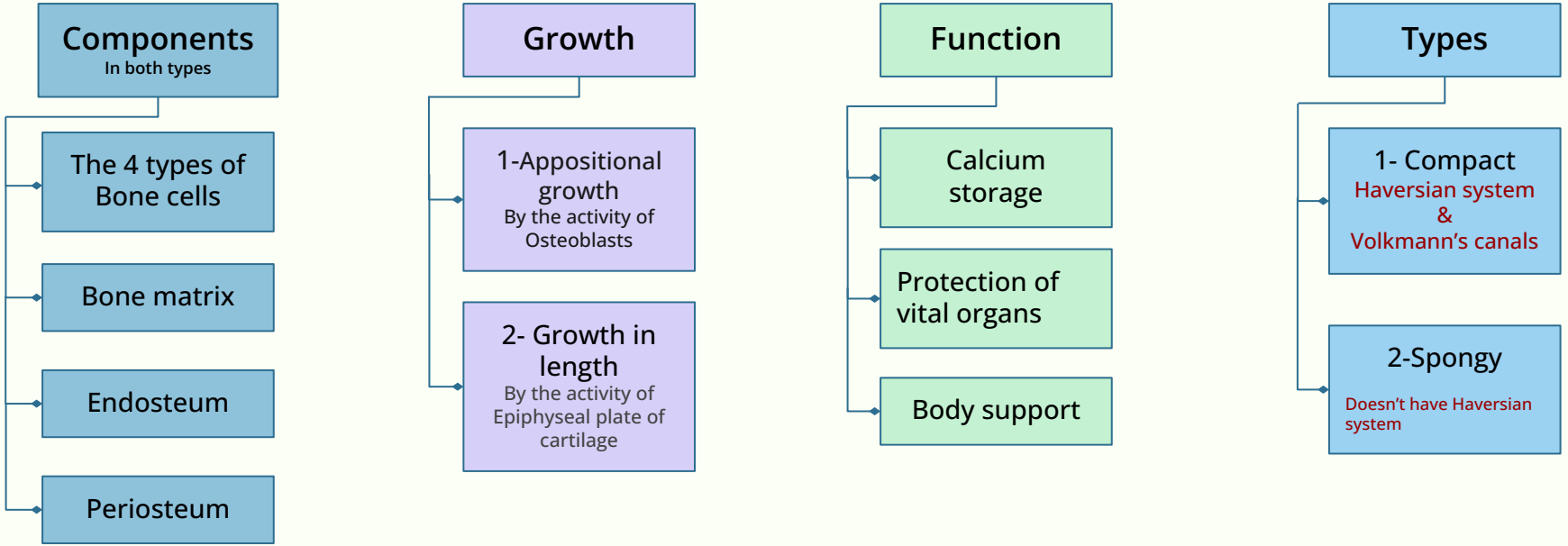
Summary of Cartilage







Summary of Bones



MCQs

Q1: “ maintain the bone matrix “ is the function of:			
A- osteogenic cell	B- osteoclasts	C- osteocytes	D- spongy bone

Q2: A branched cells present singly in lacunae:			
A- chondroblasts	B- osteocytes	C- chondrocytes	D- Osteon

Q3: The matrix of hyaline cartilage is:			
A- Homogeneous and basophilic	B- Heterogeneous and eosinophilic	C- Heterogeneous and basophilic	D- Homogeneous and eosinophilic

1)C	2)B	3) A

MCQs

Q4: Which of the following is a unit of compact bone:			
A- Endosteum	B- Periosteum	C- Osteon	D- Bone lamellae

Q5:The site of elastic cartilage is:			
A- Foetal skeleton	B- Intervertebral	C- Epiglottis	D- Respiratory tract

Q6: Appositional growth of bone produced by:			
A- Activity of osteoblast	B- Activity of chondroblast	C- Activity of epiphyseal plate	D- Activity of Osteoclasts

1)C	2)C	3) A

Team Leaders

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