

+ Motivational Corner:

It is not about being the best, it is about being better than you were yesterday.



Objectives:

By the end of this lecture you should be able to:

- By the end of this lecture, the student should describe the microscopic structure, distribution and growth of the different types of:
- (1) Cartilage.
- (2) Bone.

CARTILAGE & BONE

Extra notes

Important notes in red

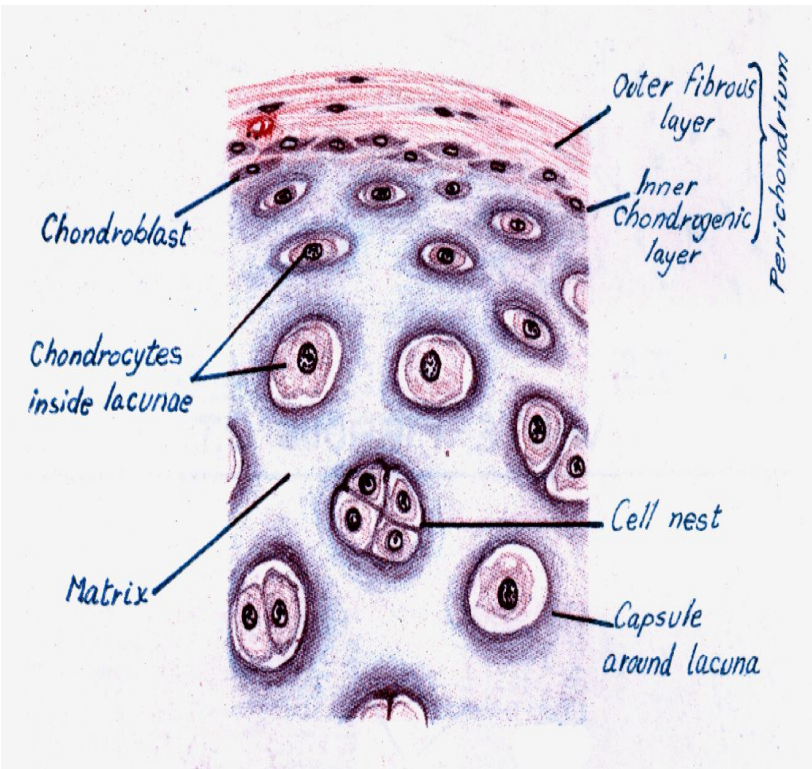
+ Cartilage

- Cartilage is a special type of C.T. with a rigid matrix.
- Cartilage is usually **non vascular (avascular)**.

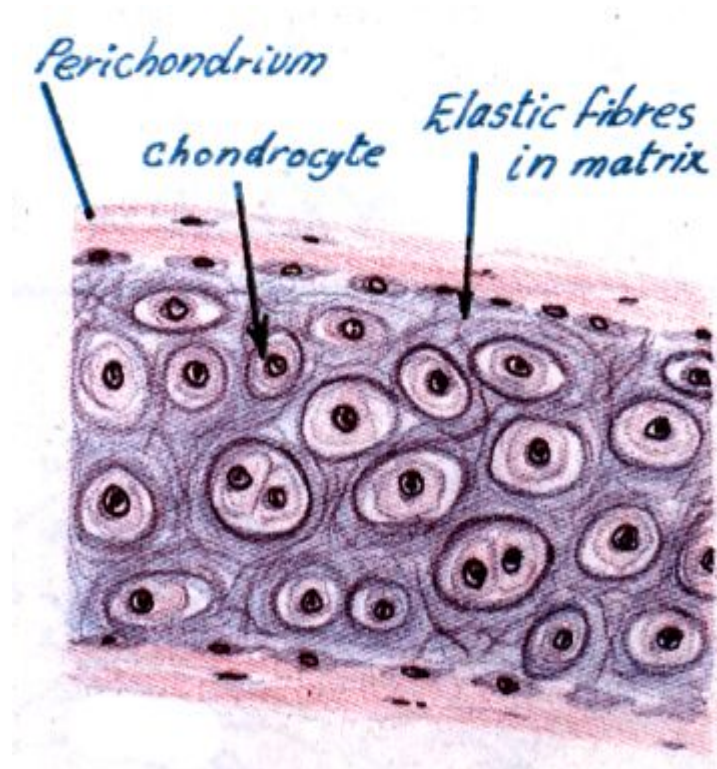
YouTube

Types of Cartilage

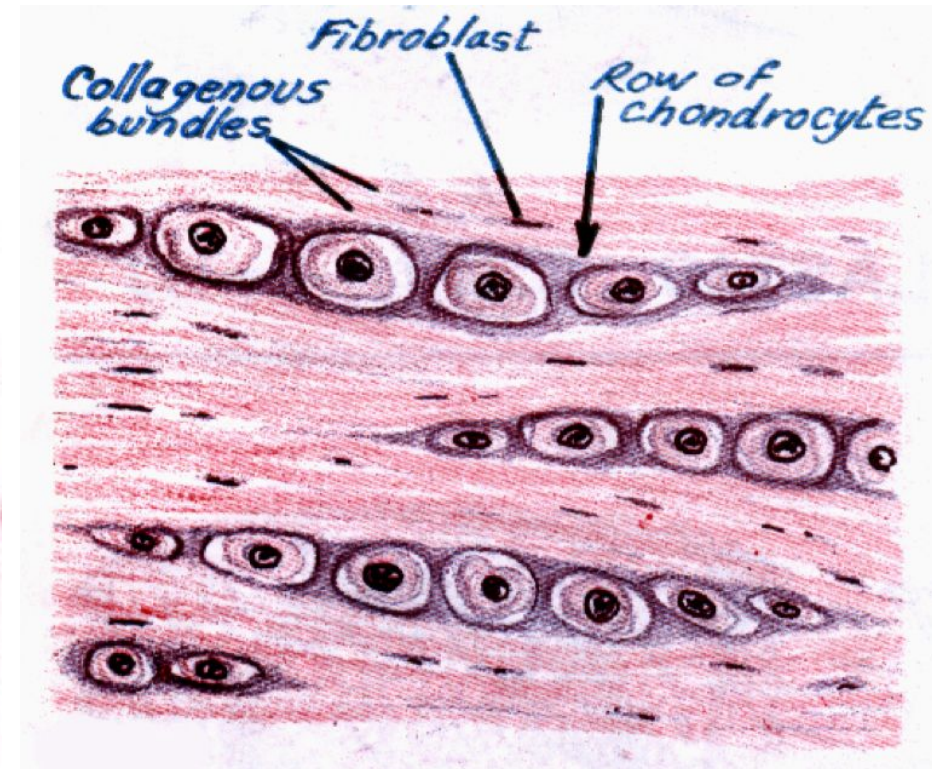
Hyaline Cartilage



Elastic Cartilage

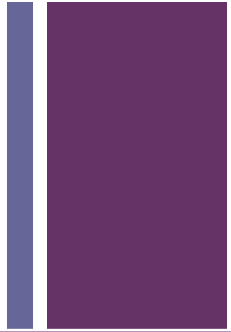


Fibrocartilage



Go back to the previous slide to link the pictures to the table.

Types of Cartilage



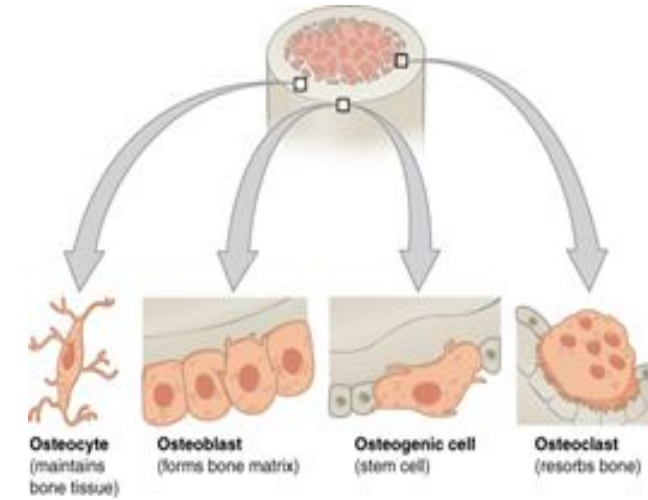
| three types of cartilage | Perichondrium | Cells | Matrix | Site |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Hyaline Cartilage | <p>Vascular C.T. membrane formed of 2 layers:</p> <p>1- Outer fibrous layer: dense fibrous C.T.</p> <p>2- Inner chondrogenic layer: contains chondroblasts (no lacunae). They secrete cartilage matrix and give rise to chondrocytes.</p> | <p>Found in spaces called <u>lacunae</u>.</p> <p>-Young chondrocytes: are small & present singly in their lacunae.</p> <p>-Mature chondrocytes: are large, and are found singly or in groups of 2, 4 or 6 cells in their lacunae (<u>cell nests</u>).</p> | <p>-Homogeneous and basophilic.</p> <p>-Contains collagen type II.</p> | <p>1- Foetal skeleton.</p> <p>2- Costal cartilages.</p> <p>3- Articular surfaces of bones.</p> <p>4- Nose, trachea & bronchi.</p> |
| Elastic Cartilage | <p>Similar to hyaline cartilage + <u>elastic fibres</u> in the matrix.</p> | | | <p>1- External ear.</p> <p>2- Epiglottis.</p> |
| Fibrocartilage | <p><u>No perichondrium.</u></p> | <p>Rows of chondrocytes in lacunae separated by parallel <u>bundles of collagen fibers (type I)</u> (We took in foundation that collagen always tend to form bundles)</p> | | <p>1- Intervertebral disks.</p> |



+ Bones

specialized type of C.T. with a hard matrix.

| Components | Functions |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1- Bone Cells: 4 types.</p> <p>2- Bone types: 2 types. Compact and spongy</p> <p>3- Bone matrix: hard because it is <u>calcified</u> (Calcium salts).</p> <ul style="list-style-type: none"> - It contains type I collagen fibers. - It forms bone lamellae and trabeculae. | <ul style="list-style-type: none"> - body support. - protection of vital organs as brain & bone marrow. - calcium store. |



Bone cells

Osteogenic cells

In periosteum & endosteum.

Fate: give rise to osteoblasts.



Osteoblast

In periosteum and endosteum.

Origin: osteogenic cells

Function: they secrete the bone matrix & deposit Ca salts in it.

Fate: change to osteocytes



Osteocyte

Branched cells. present singly in lacunae, their branches run in the canaliculi.

Origin: Osteoblast

Function: maintain the bone matrix



Osteoclast

Large multinucleated cells on bony surfaces, in howship's lacunae. they have striated or ruffled border.

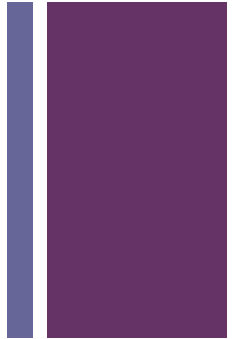
Cytoplasm is rich in lysosomes.

Origin: blood monocytes
function: bone resorption.



Howship is the scientist that discovered the spaces "lacunae"

+ 1- Compact bone



| | Compact bone |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Site | It is found in the <u>diaphysis of long bones</u> . |
| Components | <p><u>1-Periosteum:</u> <u>Outer fibrous layer.</u> <u>Inner osteogenic layer.</u></p> <p><u>2-Endosteum.</u></p> <p><u>3-Bone Lamellae.</u></p> <p><u>4-Bone Cells.</u></p> |
| Special features | <u>Haversian system</u> |

bone Lamellae in compact bone:

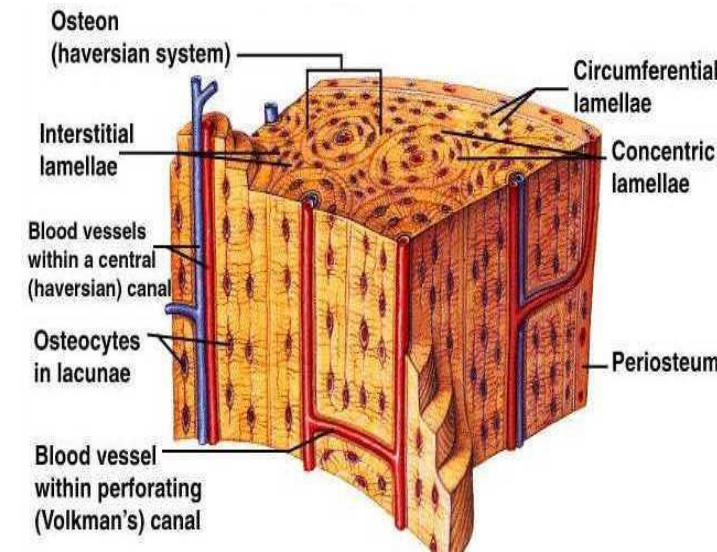
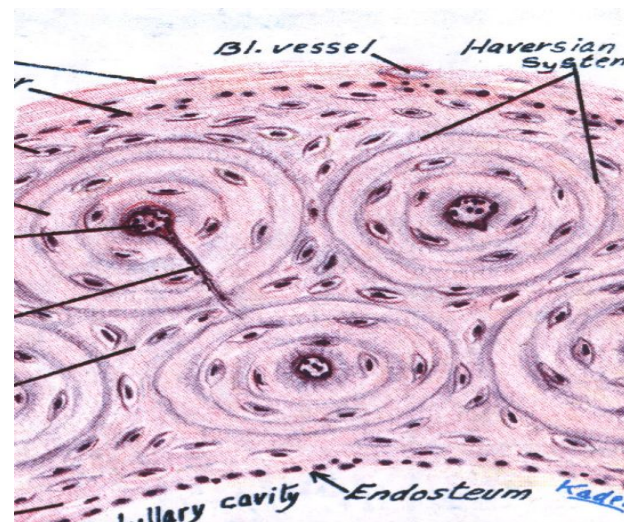
1- Haversian Systems (Osteons):

- Longitudinal cylinders.
- Each is formed of concentric bone lamellae & a Haversian canal, running in the center.
- Volkman's canals: connect the Haversian canals together. They run obliquely or transversely.

2. External Circumferential Lamellae.

3- Internal Circumferential Lamellae.

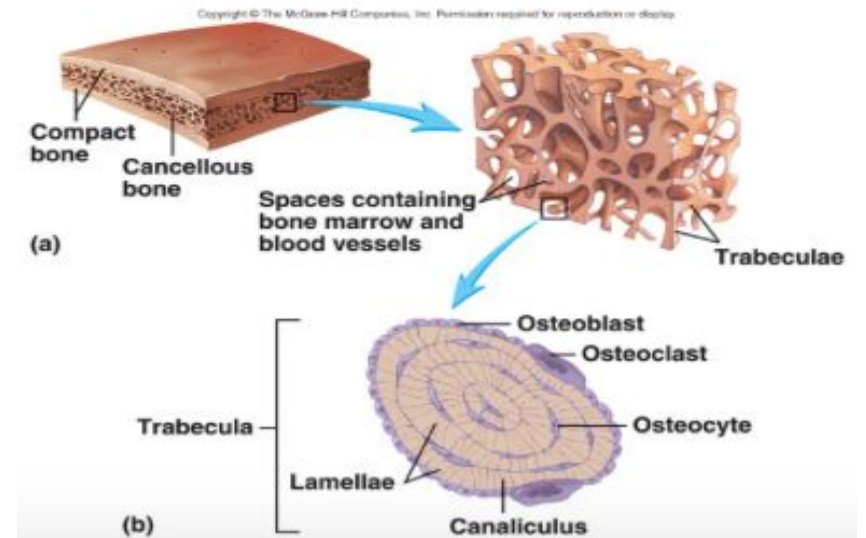
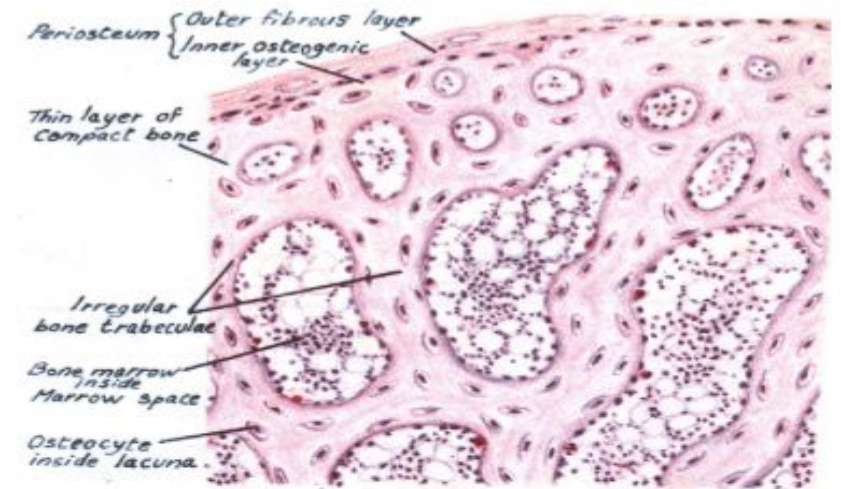
4- Interstitial Lamellae: between osteons.



+ 2- Spongy bone



| Spongy (Cancellous) bone | |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Site | In flat bones & epiphysis of of long bones. |
| Components | <ol style="list-style-type: none"> 1. Periosteum. 2. Endosteum. 3. <u>Irregular</u> bone trabeculae. 4. Many <u>irregular</u> bone marrow spaces. 5. Bone Cells. |
| Special features | <ol style="list-style-type: none"> 1. <u>No Haversian systems (no osteons).</u> |



Remember:

bone is vascular while the cartilage is avascular.

+

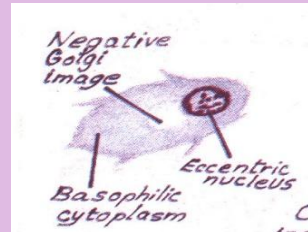
Growth of bone VS growth of cartilage

Appositional growth
(increase in width)

Interstitial growth
(increase in length)

Bone

- Produced by the activity of:
Osteoblast

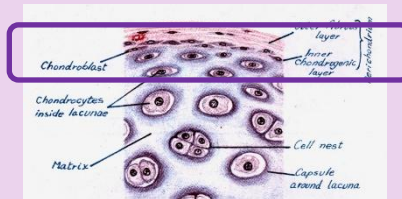


- Produced by the activity of:
Epiphyseal plate of the cartilage.

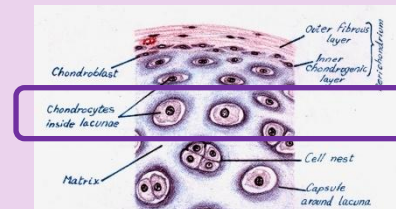


Cartilage

- Produced by the activity of:
Chondroblast
In the inner chondrogenic layer

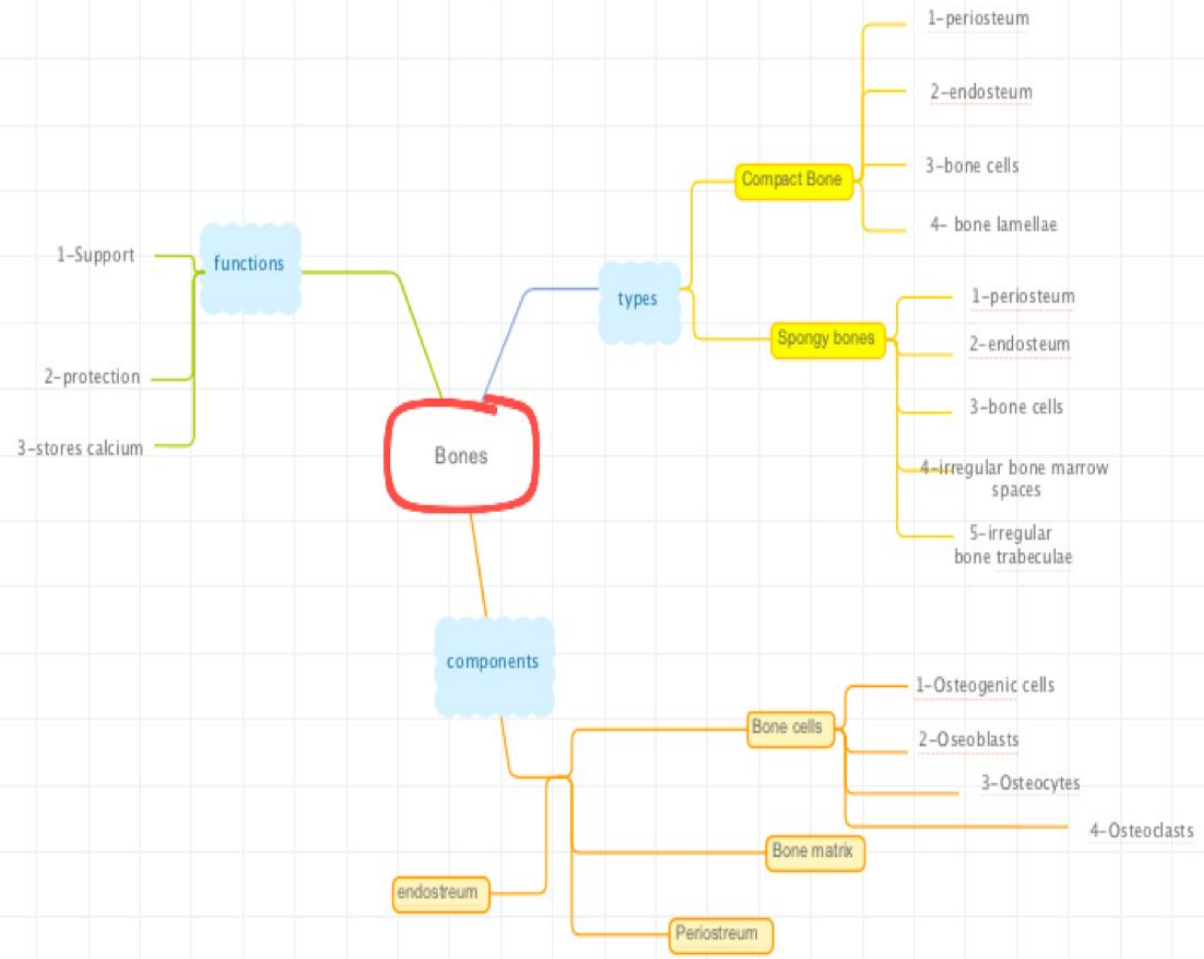
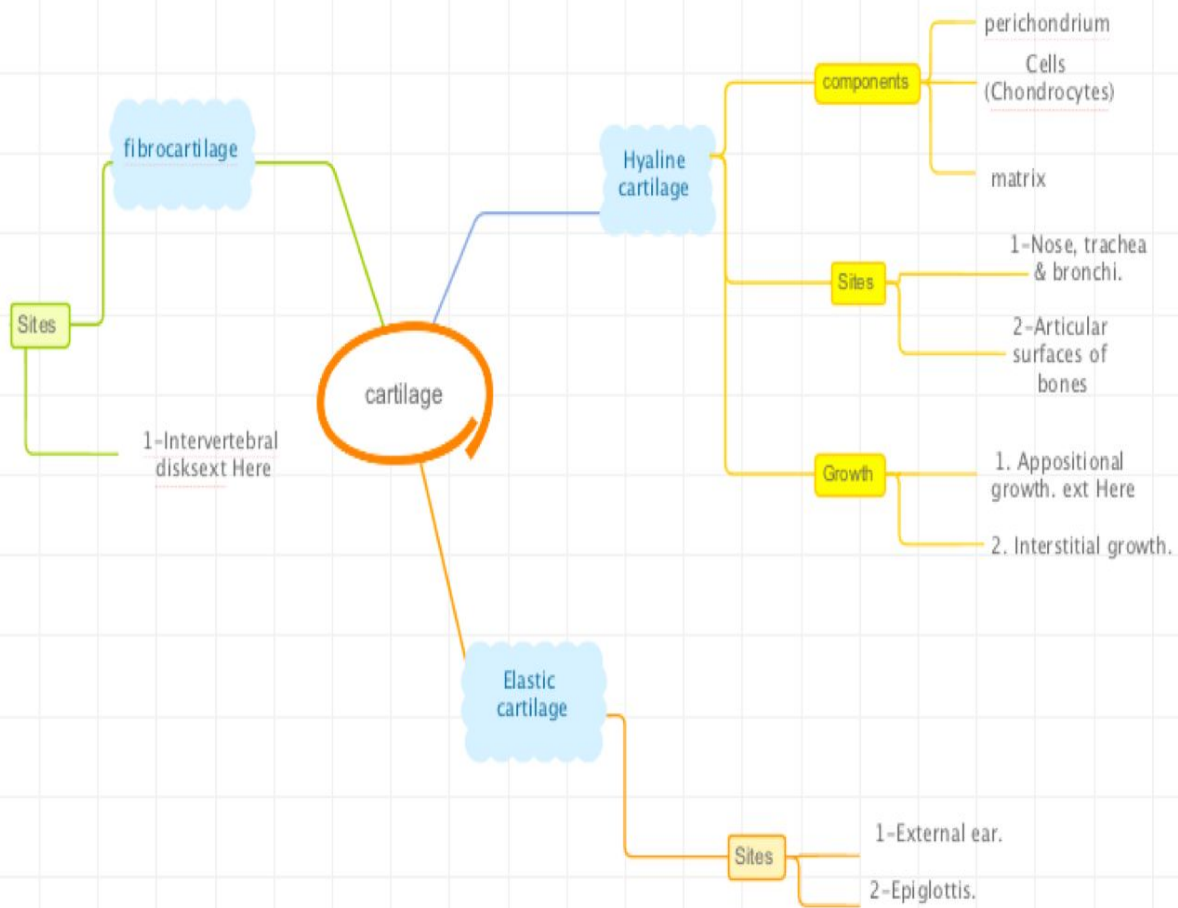


- Produced by division and activity of:
Mature Chondrocyte



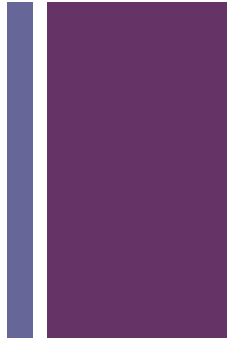
Note:
Because the ground substance and ECF in the cartilage are rubbery it gives space for expansion, but in bones the ground substance and ECF are hard so the osteocyte can not divide in the lacunae because there is no space and hard so it is unable to expand.

+ Mind maps (these mind maps are from team 434, we added them after taking their permission)





MCQ's



1- Cartilage is :

- a. Usually nonvascular.
- b. Has 3 types.
- c. Specialized type of C.T.
- d. All.

2- Chondroblasts secrete cartilage matrix and give rise to chondrocytes

- a. True.
- b. False.

3- Mature chondrocytes are :

- a. Found singly only.
- b. Small and found singly.
- c. Large and found singly or in groups of 2,4,6 cells.
- d. Found in perichondrium.

4- Which of them are the sites of hyaline cartilage :

- a. Stomach.
- b. Kidney.
- c. Nose , trachea and bronchi.
- d. Liver.

5- Appositional growth leads to increase in length

- a. True.
- b. False.

6- Collagen type 2 are found in the:

- a. Elastic cartilage.
- b. Hyaline cartilage.
- c. Fibrocartilage.
- d. a and b.

7- collagen type 1 are found in the

- a. Bone and fibrocartilage.
- b. Elastic cartilage.
- c. Bone only.
- d. Hyaline cartilage.

8- the origin of Osteoclasts :

- a. Osteoblast.
- b. Blood monocytes.
- c. Osteocytes.
- d. Osteogenic cells.

9- compact bone found in, and spongy bone found in.....

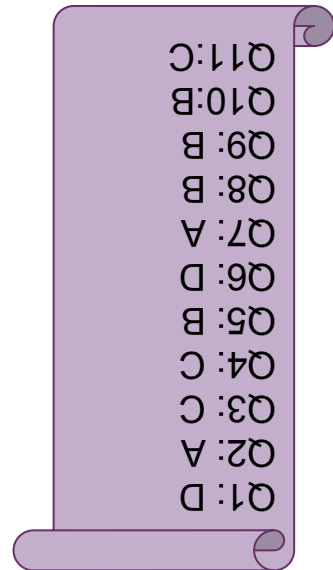
- a. Epiphysis , diaphysis of long bone.
- b. Diaphysis , epiphysis of long bone.
- c. Nose , intervertebral disk.
- d. Skull, diaphysis of long bone.

10- Appositional growth of the bone produced by activity of epiphyseal plate of cartilage.

- a. True.
- b. False.

11- haversian systems (osteons) found in :

- a. Cartilage.
- b. Spongy bone.
- c. Compact bone.
- d. All .



+ Extra notes

3 minutes will help you understand the lecture more :) if you were on hurry just read the ones in red.

- hyaline = glassy.
- Cartilage is usually avascular, but the perichondrium is VASCULAR to supply it.
- Blast = active cell.
- Lacunae = spaces.
- **Mature chondrocytes are the only ones that divide.**
- Fetal skeleton changes from cartilage to bone during child growth.
- **Hyaline cartilage is in the joints for making their surfaces smooth and to prevent the friction.**
- Fibrocartilage receives a very poor blood supply -because it doesn't have perichondrium- so for example **if someone is injured in their intervertebral disk it is almost impossible for it to heal** so it is most likely replaced. note that there is no perichondrium so the cell must get its nutrients from neighboring cells.
- Spaces inside spongy bones contain bone marrow.
- Spongy bones are the main source of bone marrow after old age. (The bone marrow found in the shaft of compact bone is converted into fat).
- Function of canaliculi: communication between cells and transport the nutrition into the bone marrow of the cell. (We can find canaliculi only in bone.)
- Q: Can we find canaliculi on chondrocyte? NO
- **Ca is important for muscles contraction. if we were on a diet or the level of Ca in blood decreased for any reason osteoclasts will start to free Ca from bones. So, the Ca level in blood will be raised but in bone will be decreased. (lose its balance)**
- Bone forming cells: osteogenic, osteoblast and osteocytes.
- Bone destruction cell: osteoclasts. (Osteoclasts are responsible for bone modulation "sculpture" in case of injury, it removes the extra bone tissue after the healing of fracture)
- Haversian systems are made of Haversian canals which carry the blood vessels (arteries and veins), nerves, and possibly lymph vessels through it. Around the canals in whorl-like arrangements are the osteocytes entrapped within the bony matrix (concentric bone lamellae).
- Volkmann's canal is not part of the Haversian system, it is only a way to communicate with other Haversian systems
- **Bones are highly vascular while cartilage is avascular. Remember: bones fractures are dangerous because fractured bones may cut vessels causing hemorrhage.**

+ Credit

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Thanks for checking our work, Good luck.

-Team histology.



HISTOLOGY
— 435 —



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