Chapter 6
Cartilage and Bone

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Ⅰ. Cartilage

Being composed of cartilage tissue and perichondrium

Cartilage tissue： chondrocytes and cartilage matrix (ground substance and fibers)

Avascularity

1.1 Cartilage tissue

(1) Chondrocytes

LM: young and mature chondrocyte , round nucleus and basophilic cytoplasm, isogenous, located in cartilage lacunae

EM: well-developed RER, Golgi complex

Function: producing of cartilage matrix (including fibers and ground substance)

（2）Cartilage matrix

Ground substance and fibers

a. Proteoglycan and water

（molecular sieve)

more chondroitin sulfate

cartilage capsule

b. Different fibers

Types of cartilage

1. Hyaline cartilage

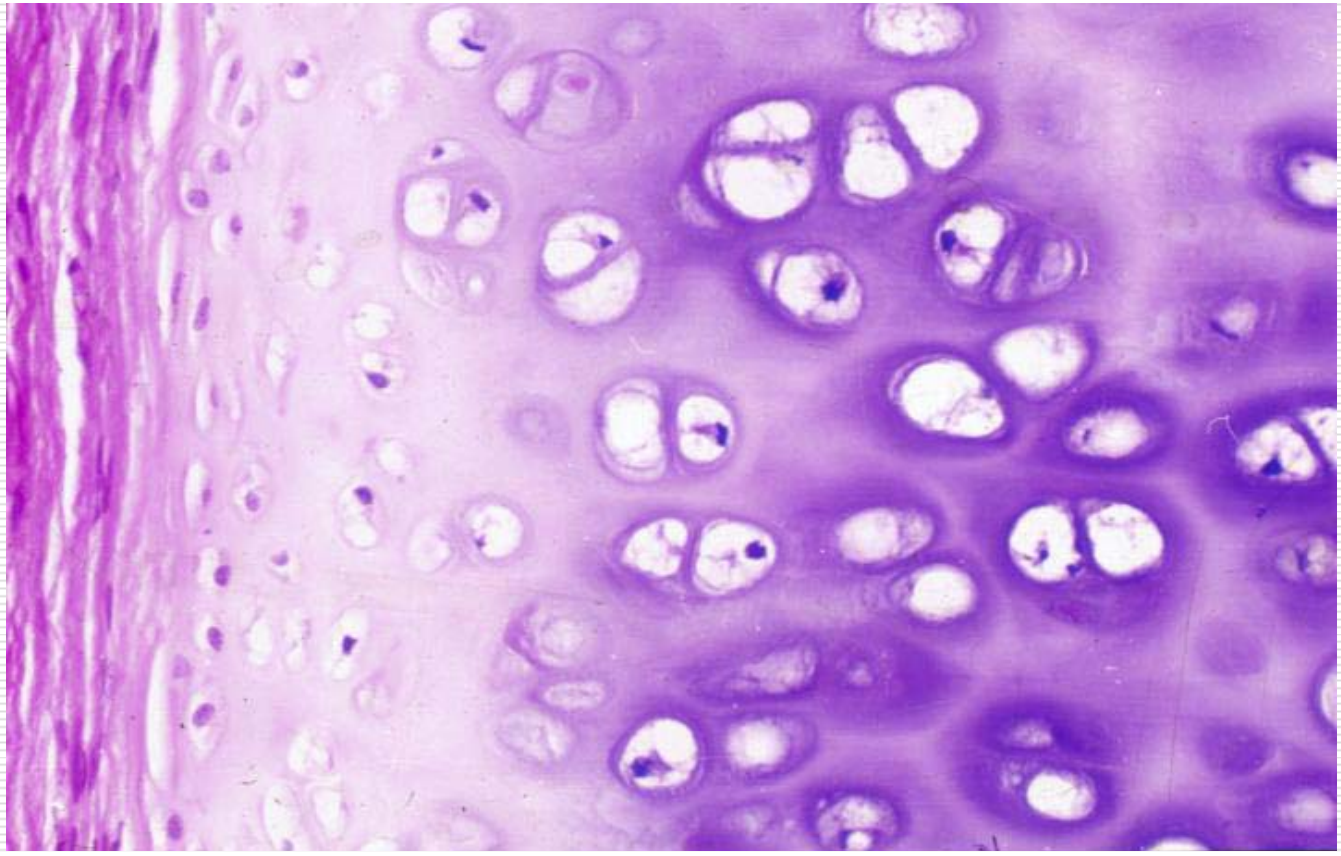
contribution：

feature of cartilage matrix:

Collagenous fibrils and more water

Function:

Hyaline cartilage



1.2 Perichondrium

Dense connective tissue

the outer zone：more fibers，less cells and blood vessles, protection function

The inner zone：loose，less fibers，more osteogenic cells and blood vessles

2. Elastic cartilage

contribution：

the characters：elastic fibers in ground substance

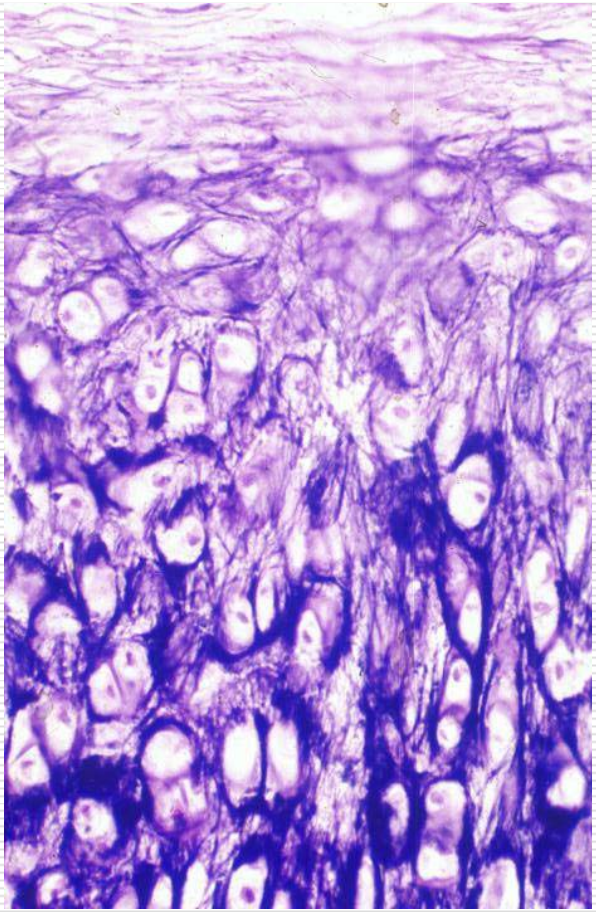
more elasticity

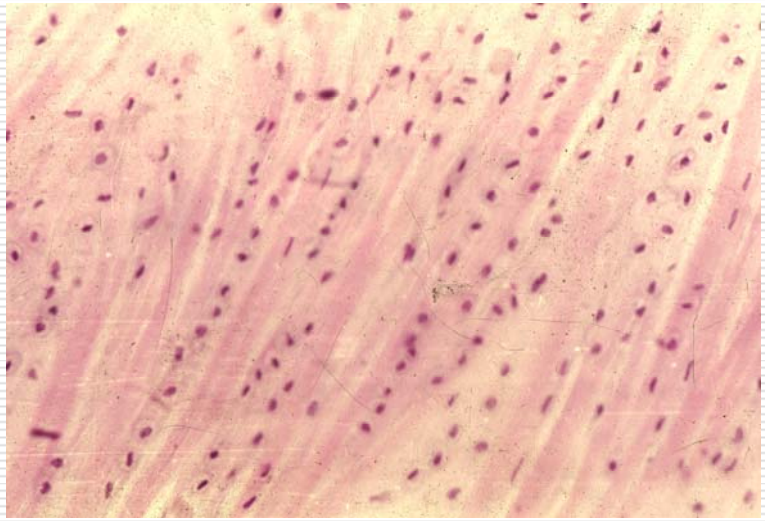
3. Fibrous cartilage

contribution：

characters：large number of collagenous fibers in ground substance, smaller chondrocytes arranged in rows

Elastic cartilage and fibrous cartilage





1. 3 Growth of cartilage

Origin: mesenchyme

（1） appositional growth

Osteogenic cell→ chondroblast→ chondrocyte →producing cartilage matrix

（2） Interstitial growth

Histoengineering:

Human ear 聚乙醇酸


Photocome / sina

Ⅱ.**Bone**

Bone: osseous tissue

periosteum

bone marrow

1. Osseous tissue

being composed of 4 kinds of cells and calcified intercellular substance (bone matrix)

1.1 Bone matrix

（1） Organic matter： collagen fibers and ground substance

collagen fiber: type Ⅰ collagen

ground substance: proteoglycan

（2） Inorganic component：

So called bone salt （65%）

hydroxyapatite crystals ($Ca_{10}(PO4)_6(OH)_2$)

（羟基磷灰石结晶）

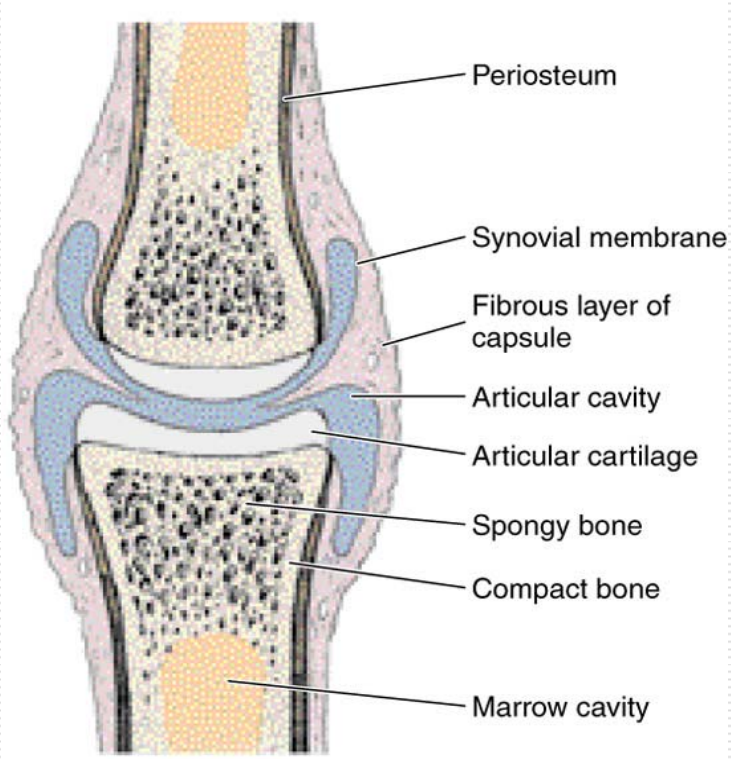
Osteoid, calcification

Bone lamella

Compact bone

Bone trabecula

Spongy bone



1.2 The cells of osseous tissue

（1）Osteoprogenitor cell (osteogenic cell)

Distribution: located in periosteum

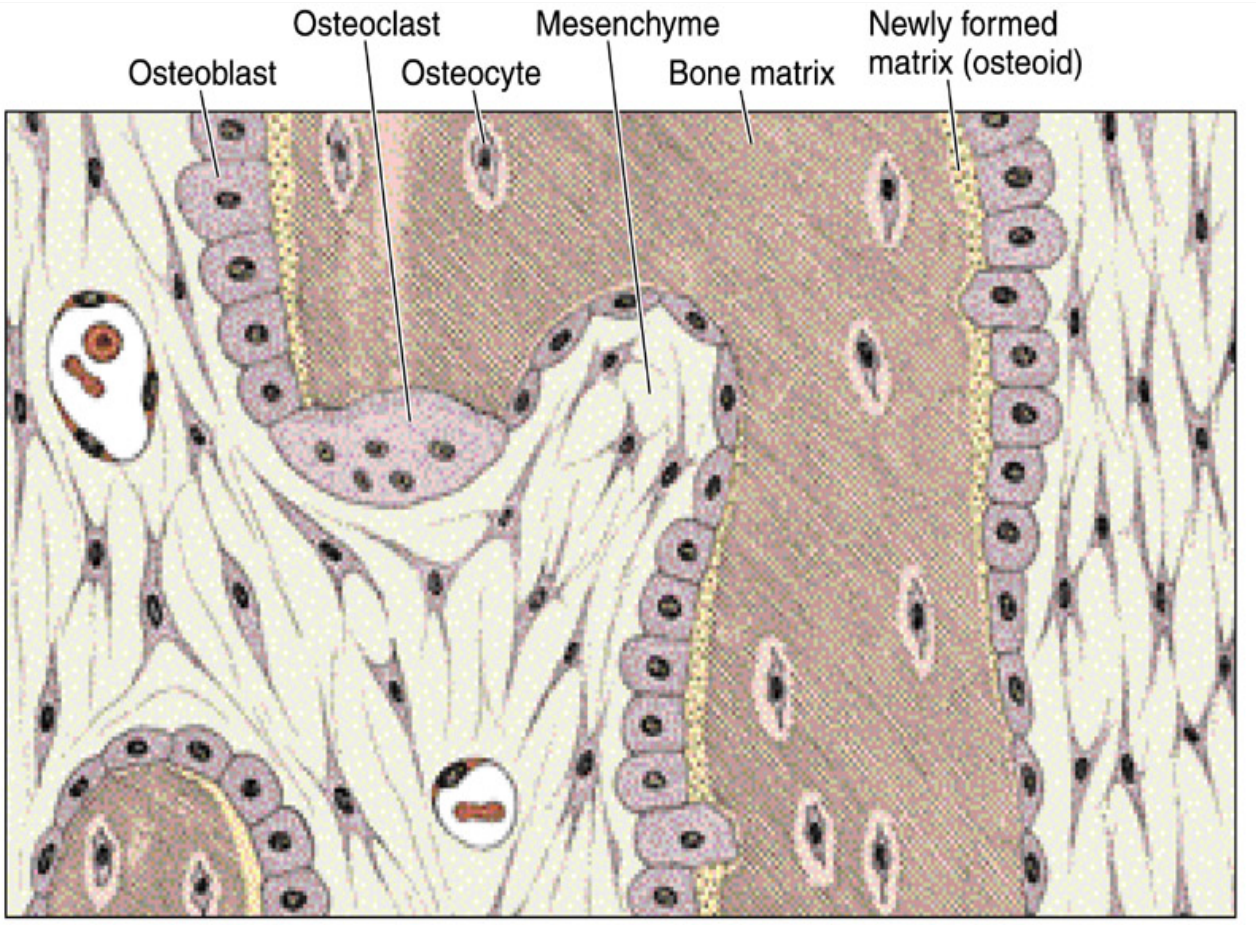
osteogenic cell → osteoblast → osteocyte

↘ chondroblast → chondrocyte

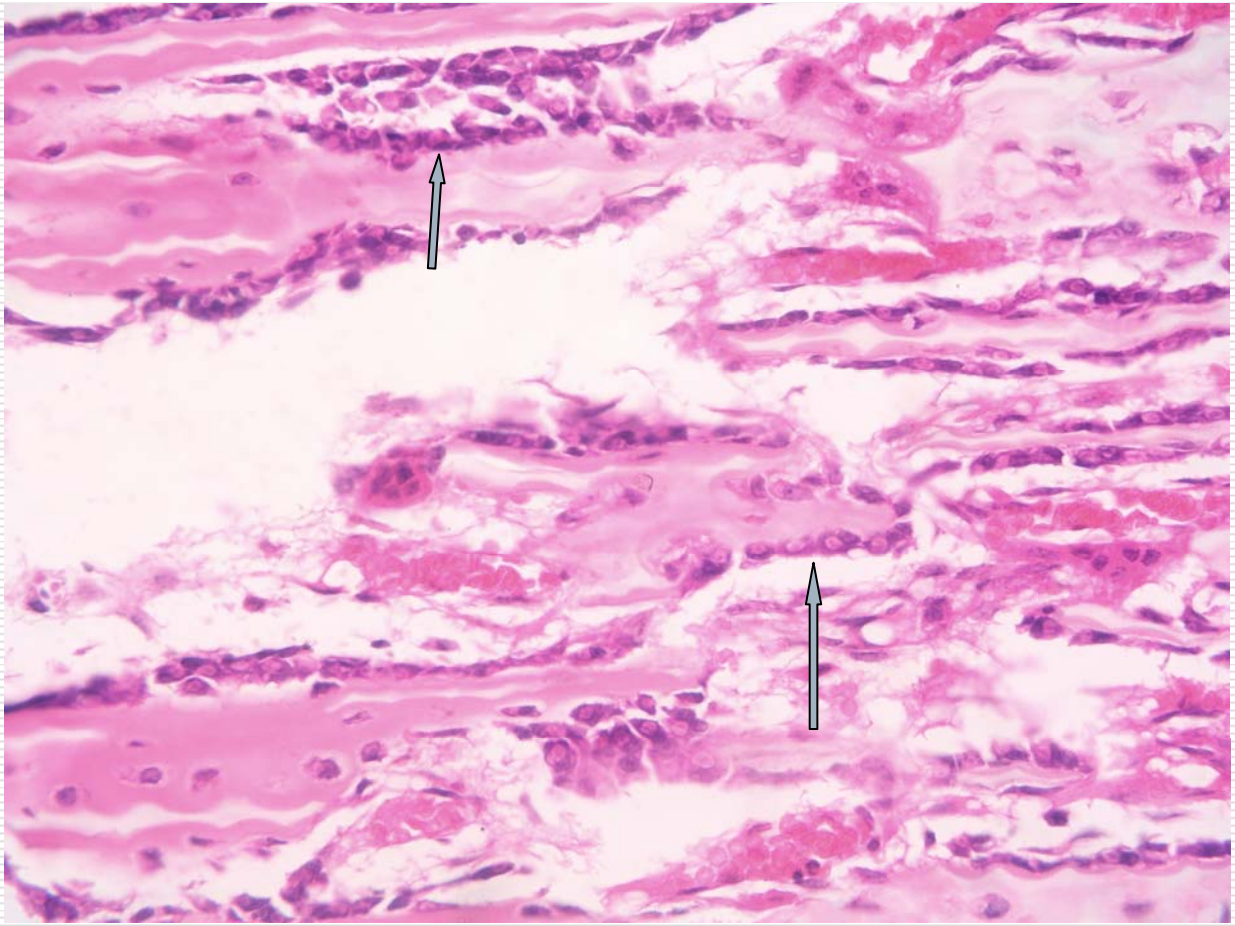
(2) Osteoblast

Distribution: arrange as an epithelioid layer on the surface of the new bone tissue

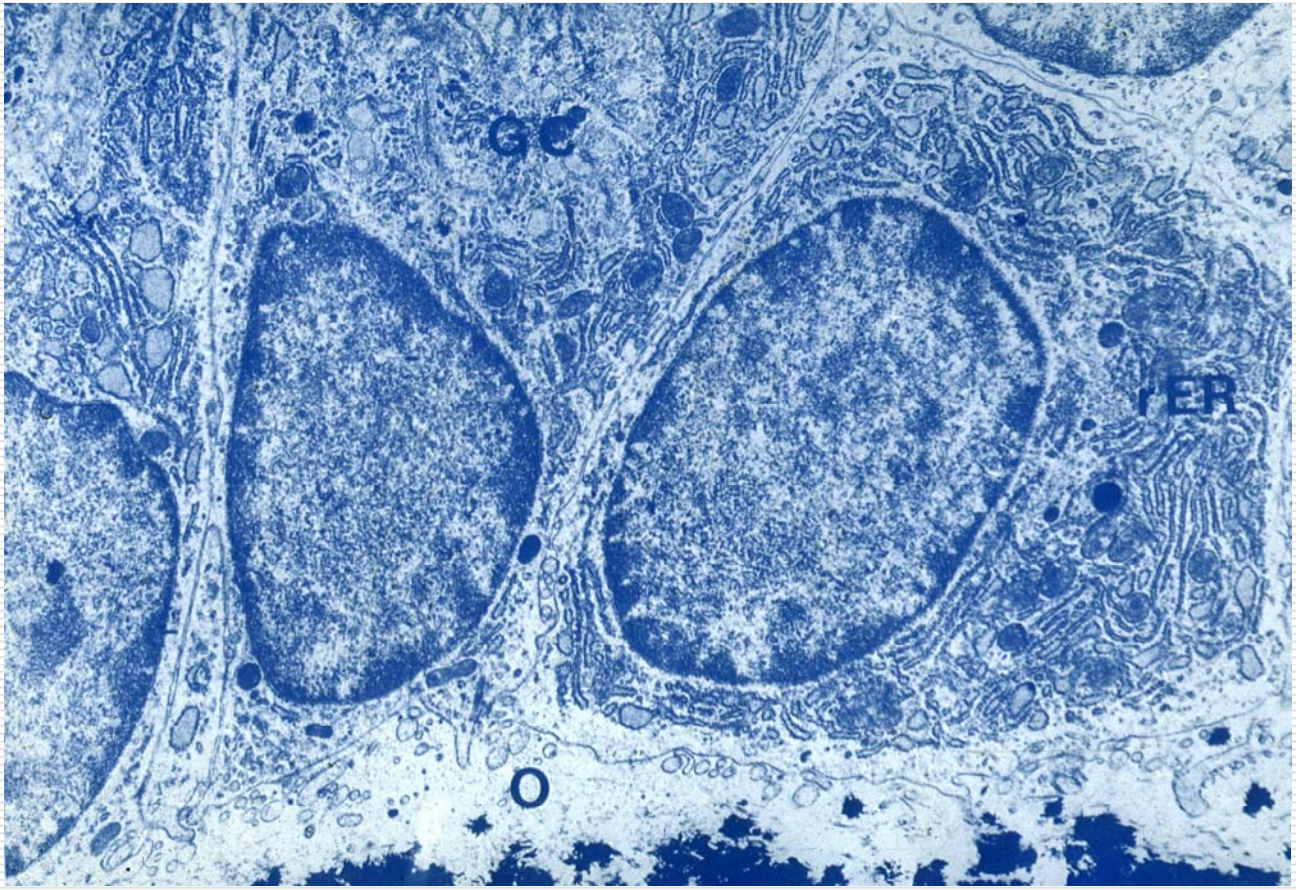
Osteoblast (model)



Spongy bone and osteoblast（LM）



Osteoblast（TEM）



LM: cuboidal or columnar shape, strong basophilic cells

EM: well-developed RER and Golgi complex

matrix vesicles

Function: synthesis of osteoid (newly-formed, uncalcified bone matrix)

producing cytokines

osteoblast → osteocytes

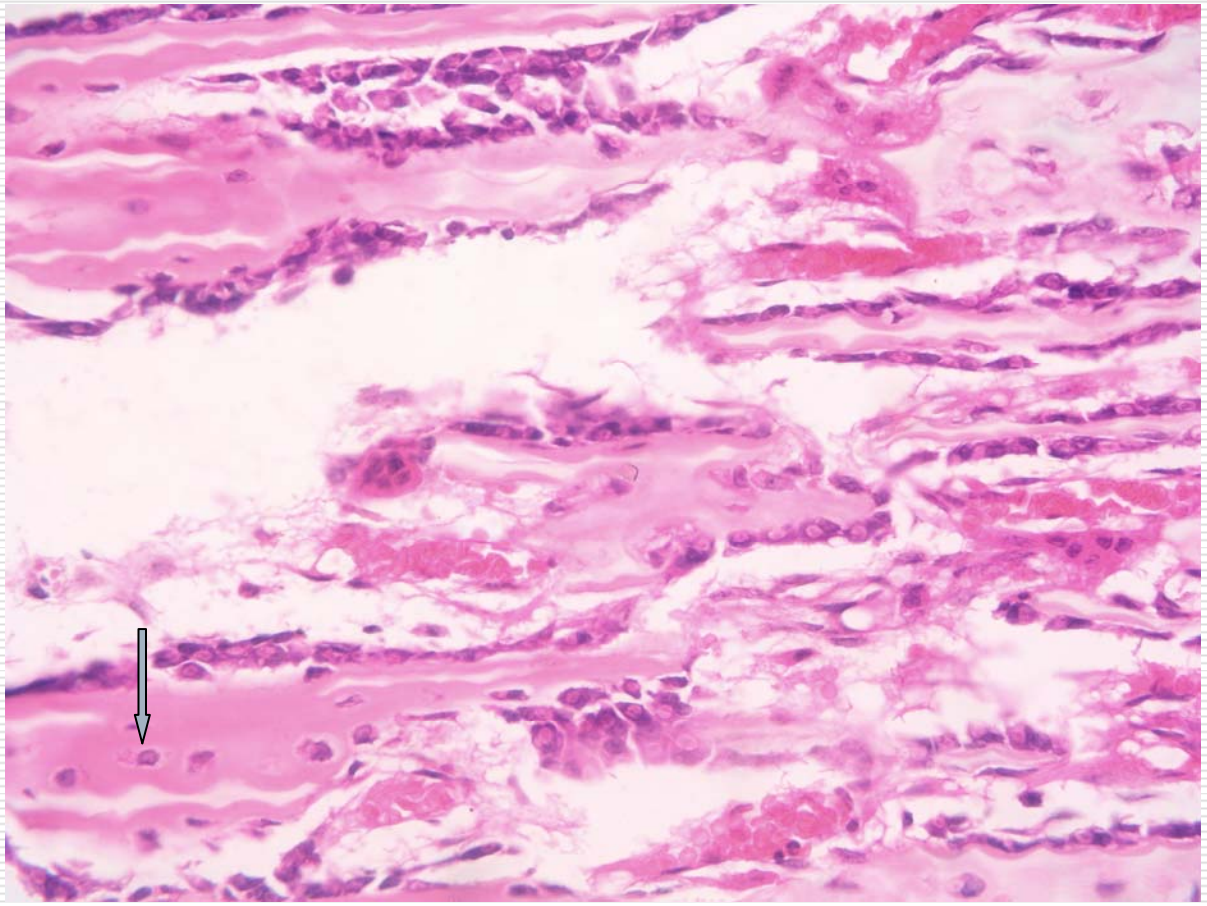
(3) Osteocyte

Distribution：single spread in bone lamela and between bone lamela

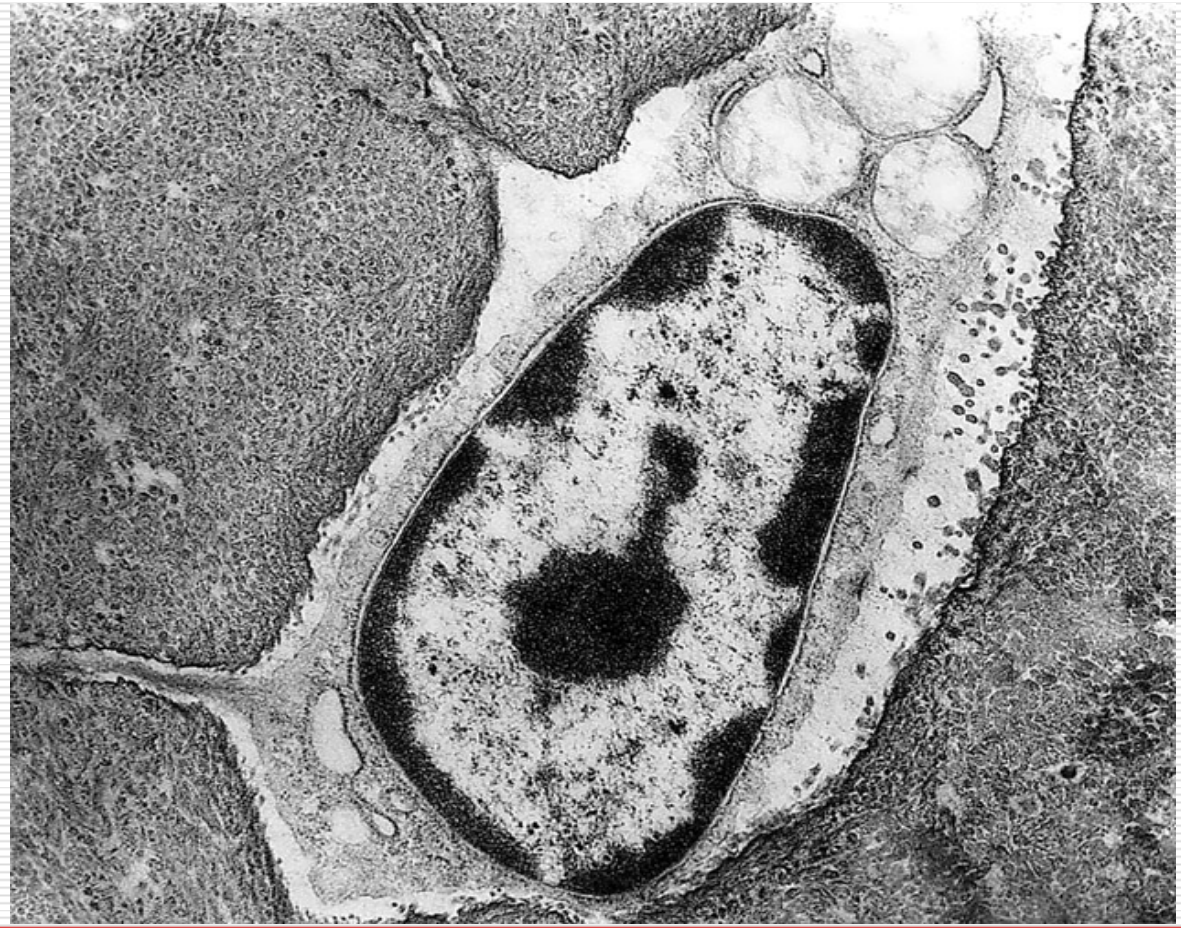
LM: smaller ovoid shape, fine processes of cell, acidophilic cytoplasm

EM: The body of osteocytes is embedded in bone lacuna, and the processes are located in bone canaliculus and connect with each other via gap junction, Less organelles.

Osteocyte



Osteocyte（TEM）



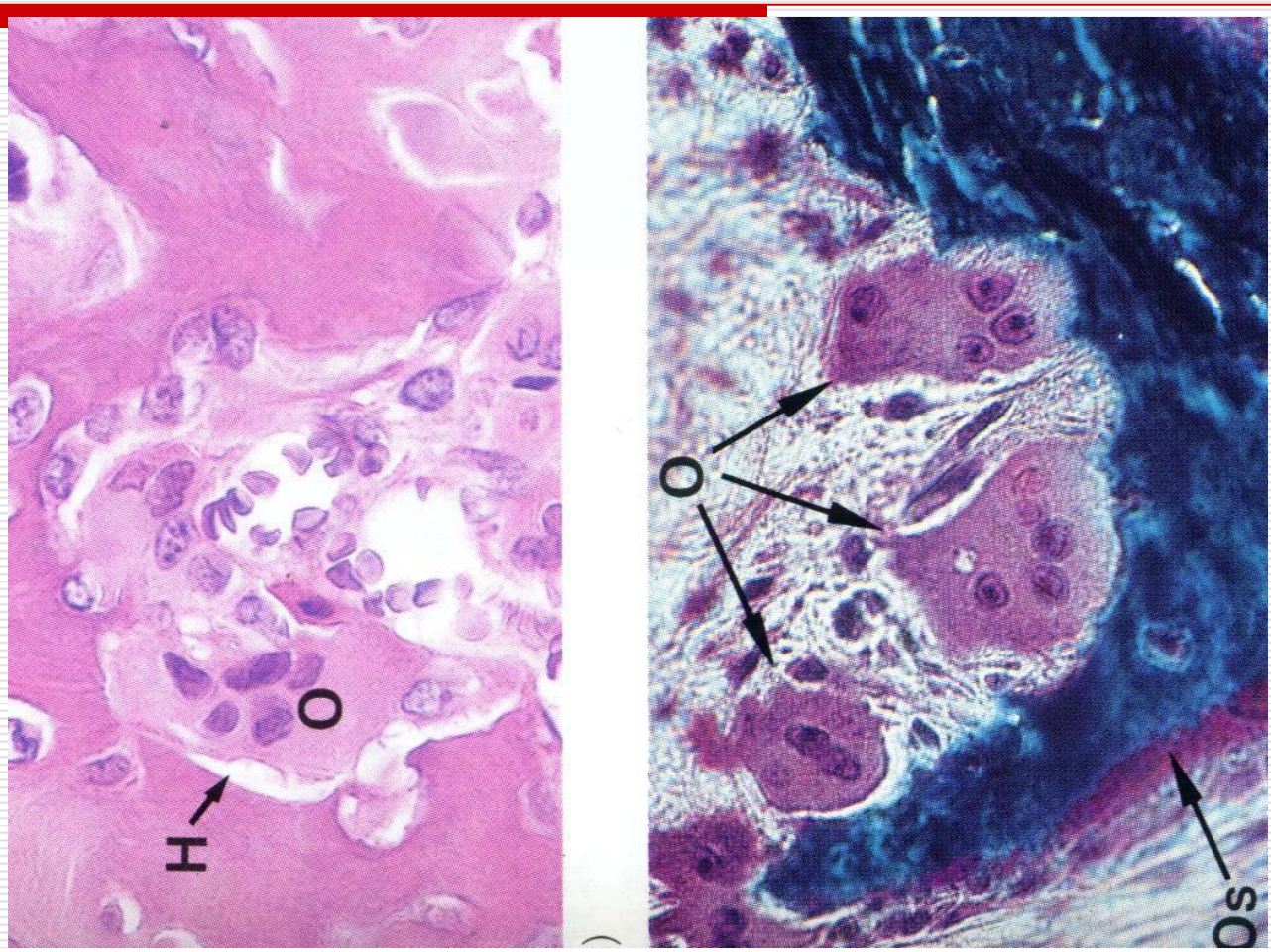
（4）Osteoclast

Distribution：resorption bay

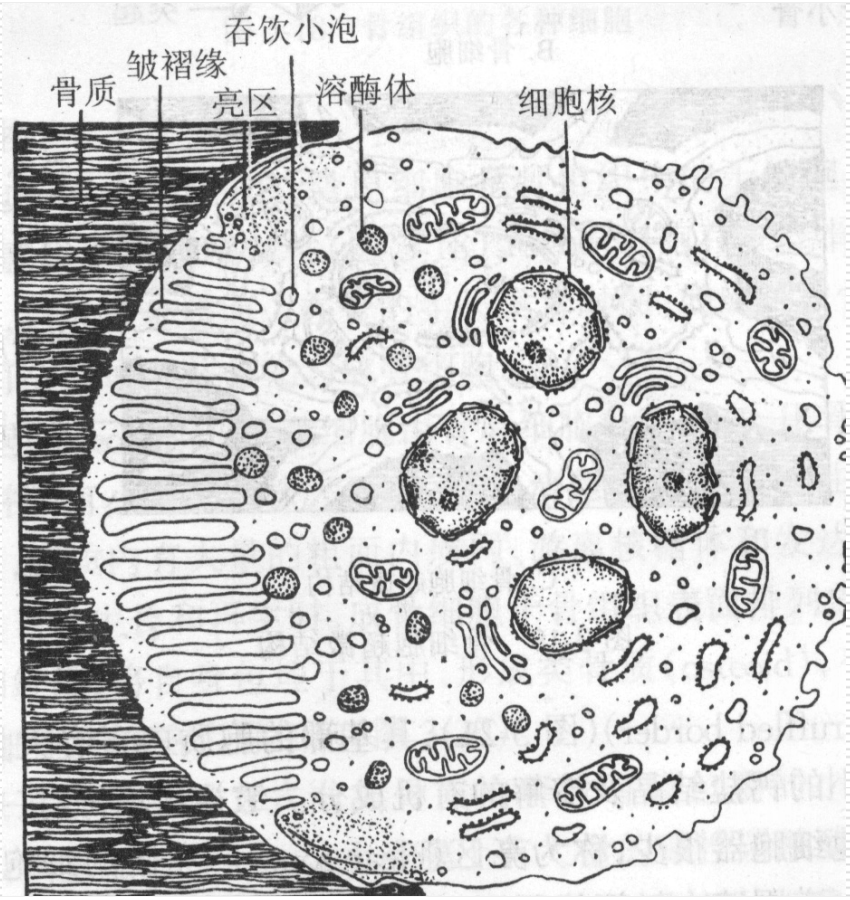
LM：very large, many nuclei, acidophilic cytoplasm (origin: monocyte)

EM: ruffled border, numerous lysosomes and mitochondria microfilaments in the clear zone

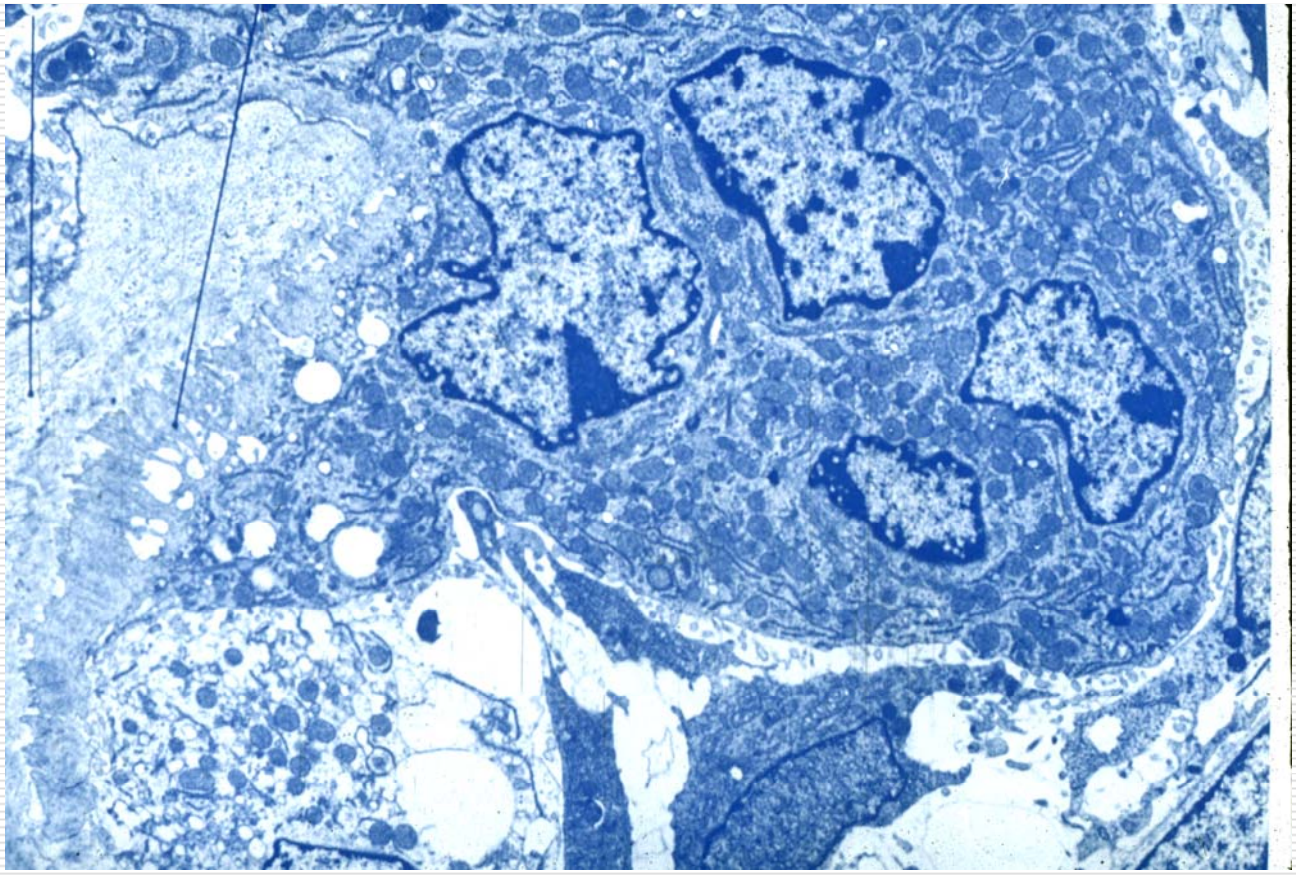
Osteoclast（LM）



Osteoclast (TEM, model)



Osteoclast（TEM）



Function: secreting hydrolytic enzyme and organic acid to resolve the organic matter and bone salt.

Ⅱ. Structure of long bone

Diaphysis and osteoepiphysis

1. Diaphysis

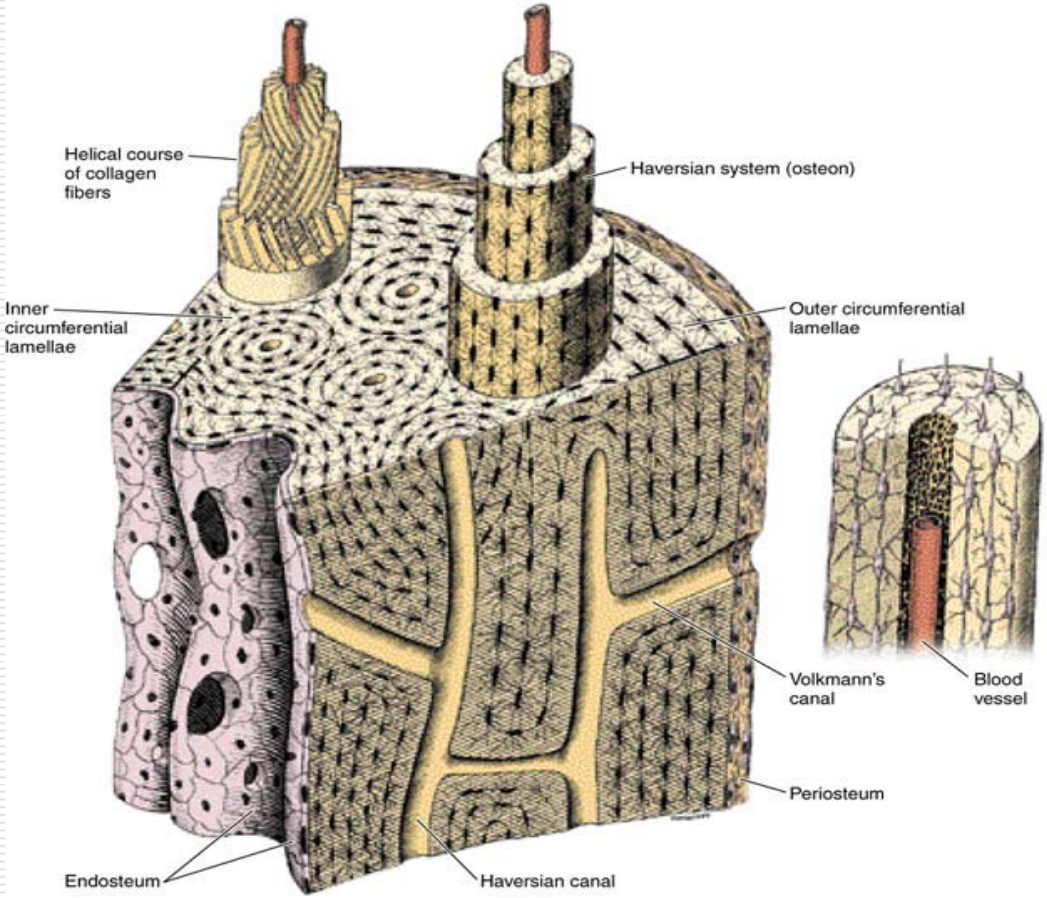
(1) Circumferential lamellae

(2) Osteon (Haversian system)

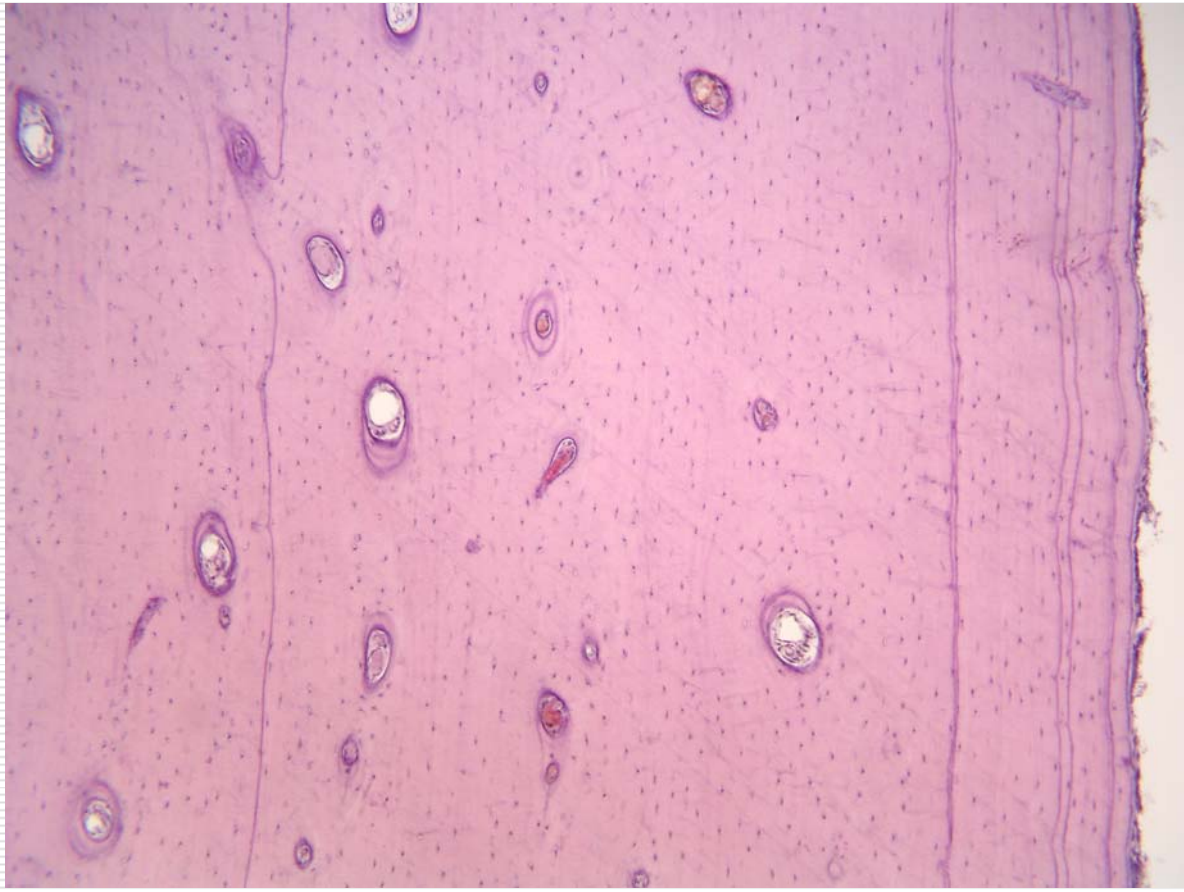
central canal and Haversian lamella, bone canaliculus and bone lacuna

(3) Interstitial lamella ,cement line

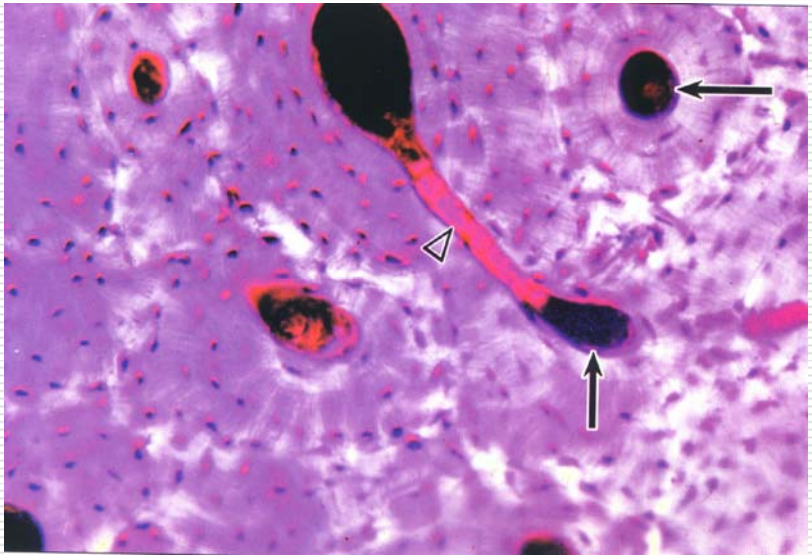
Compact bone of long bone (model)



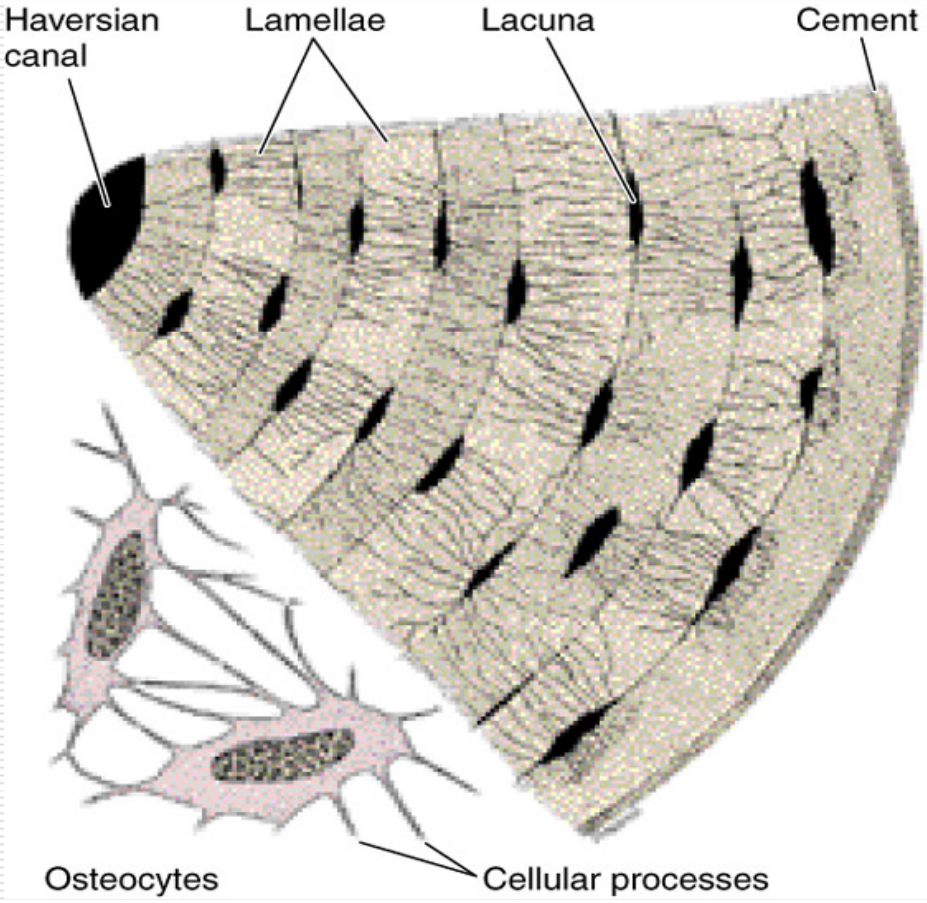
Compact bone



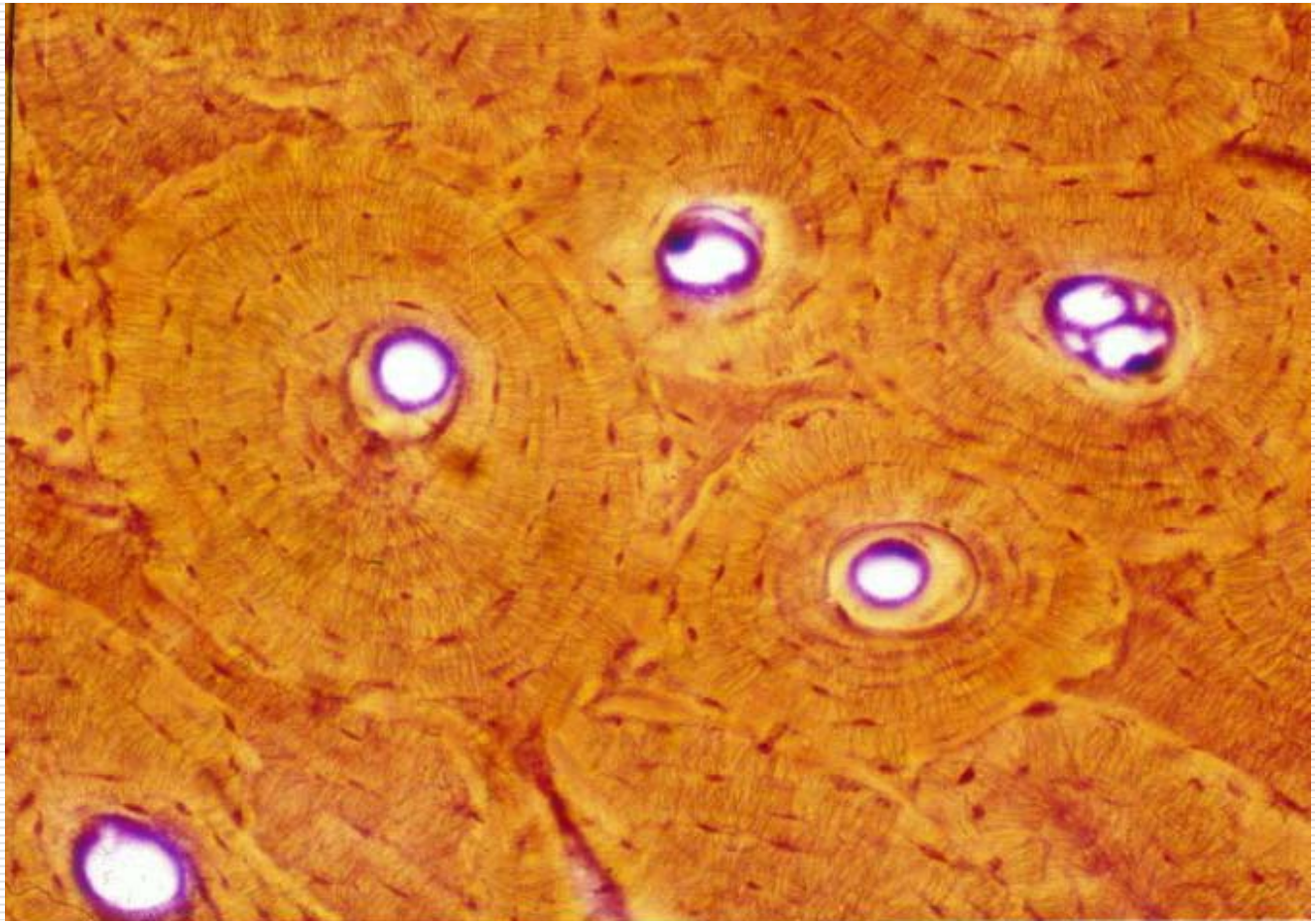
Perforating canal（LM）



Osteon(model)

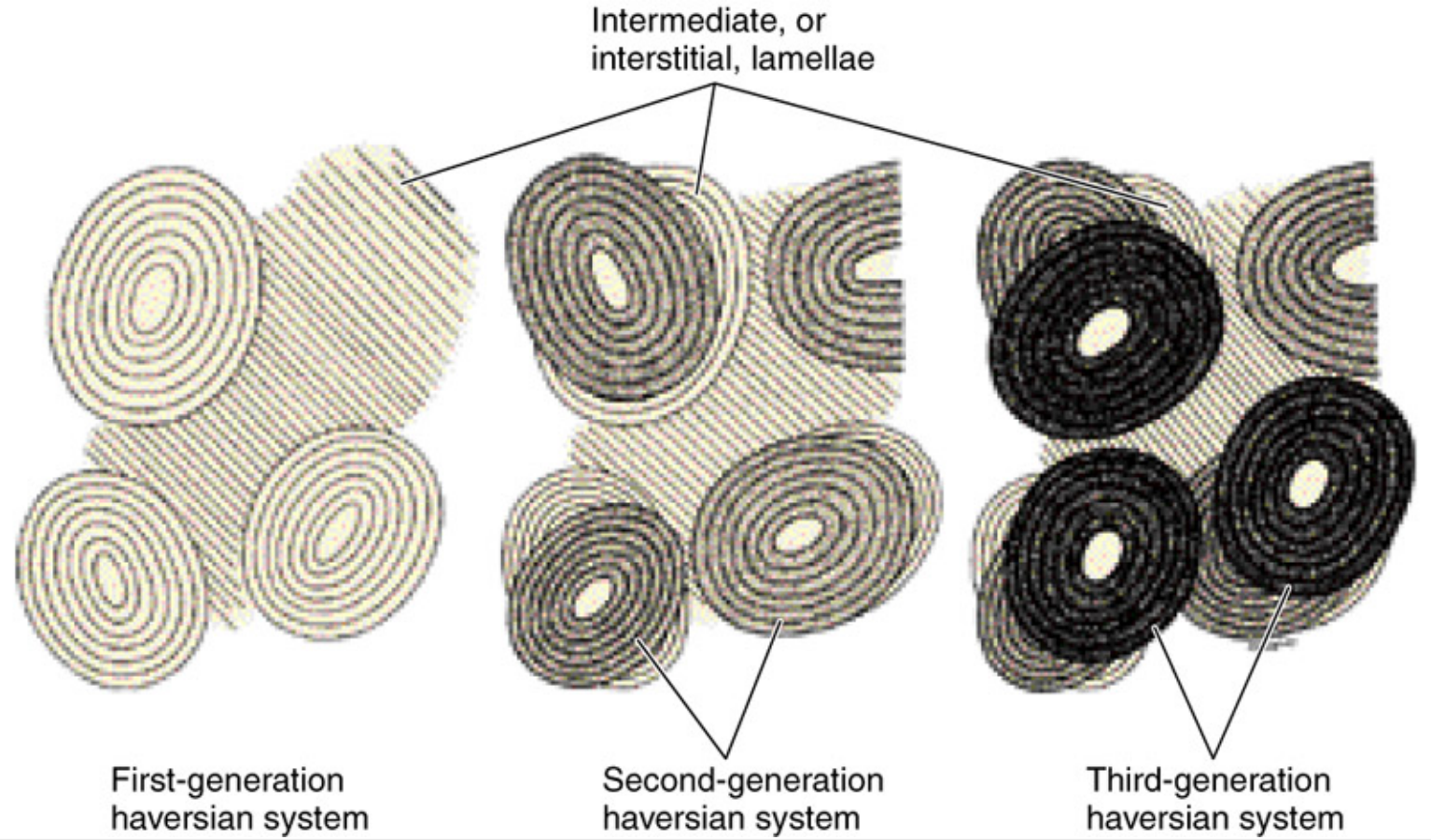


osteon（LM）



Bone lacuna and canaliculus

Interstitial lamela (model)



2. Osteoepiphysis

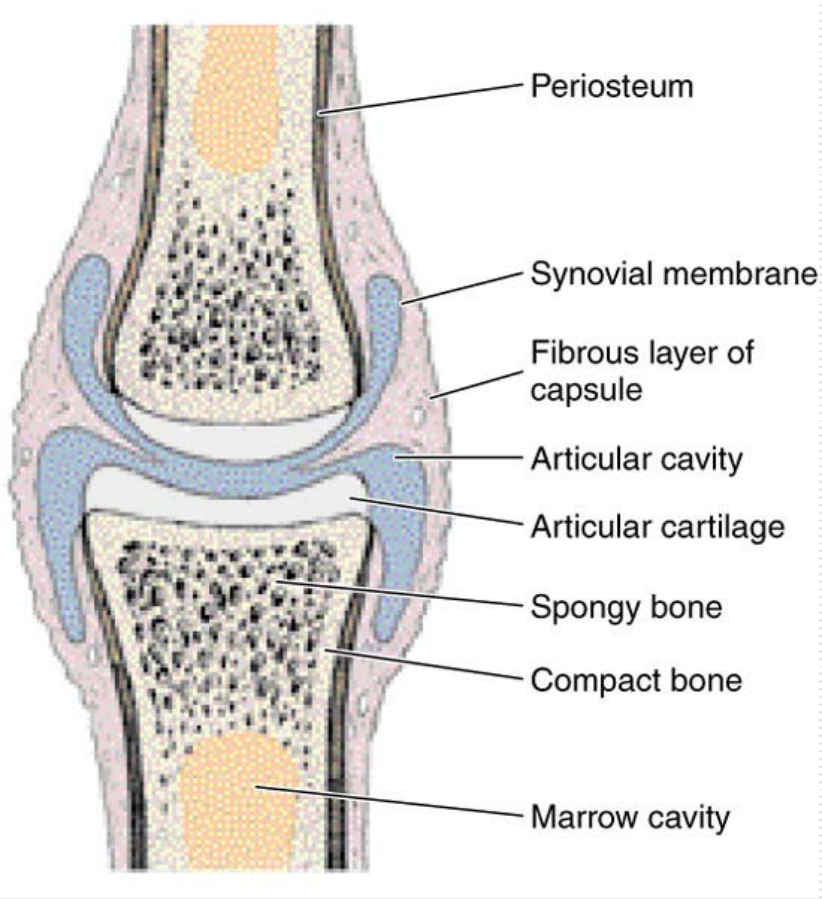
Distribution: ending of long bone

Spongy bone

amount as needles or fragments bone trabecula

structure of bone trabecula： a few layers of bone lamella and osteocytes

Osteoepiphysis



3. Periosteum and endosteum

Outer layer of periosteum:

DCT, perforating fiber

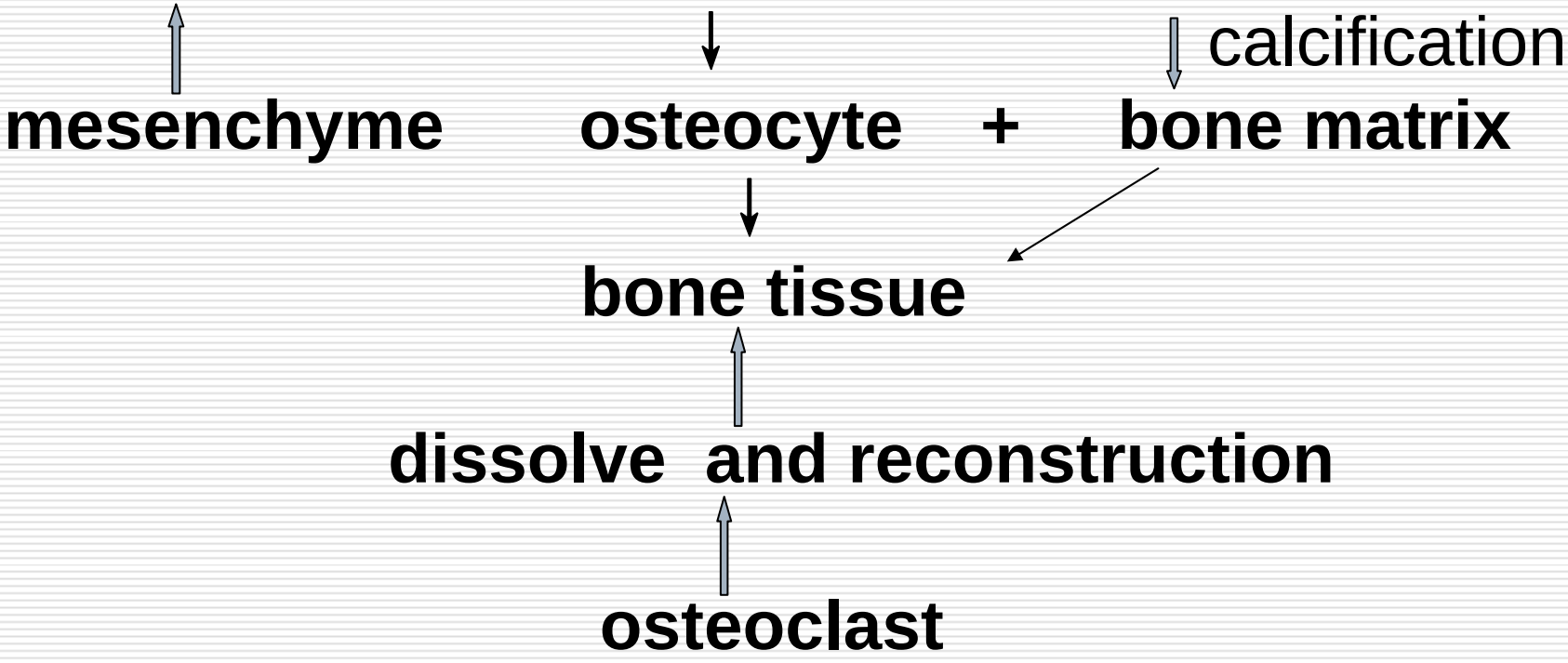
Inner layer: LCT, blood vessel, nerve and osteogenic cells

Function: nutrition and reparation

Endosteum: a layer osteogenic cells and thin connective tissue

Ⅲ.Osteogenesis

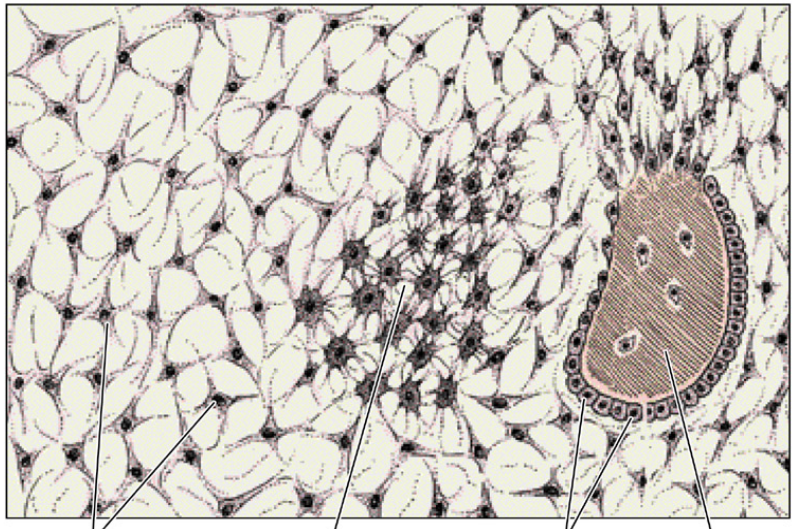
1. Basic process of osteogenesis



2. Intramembrane ossification

Mesenchyme → CT membrane

osteogenic cells → ossification center



3. Endochondral ossification

(1)Formation of cartilage model

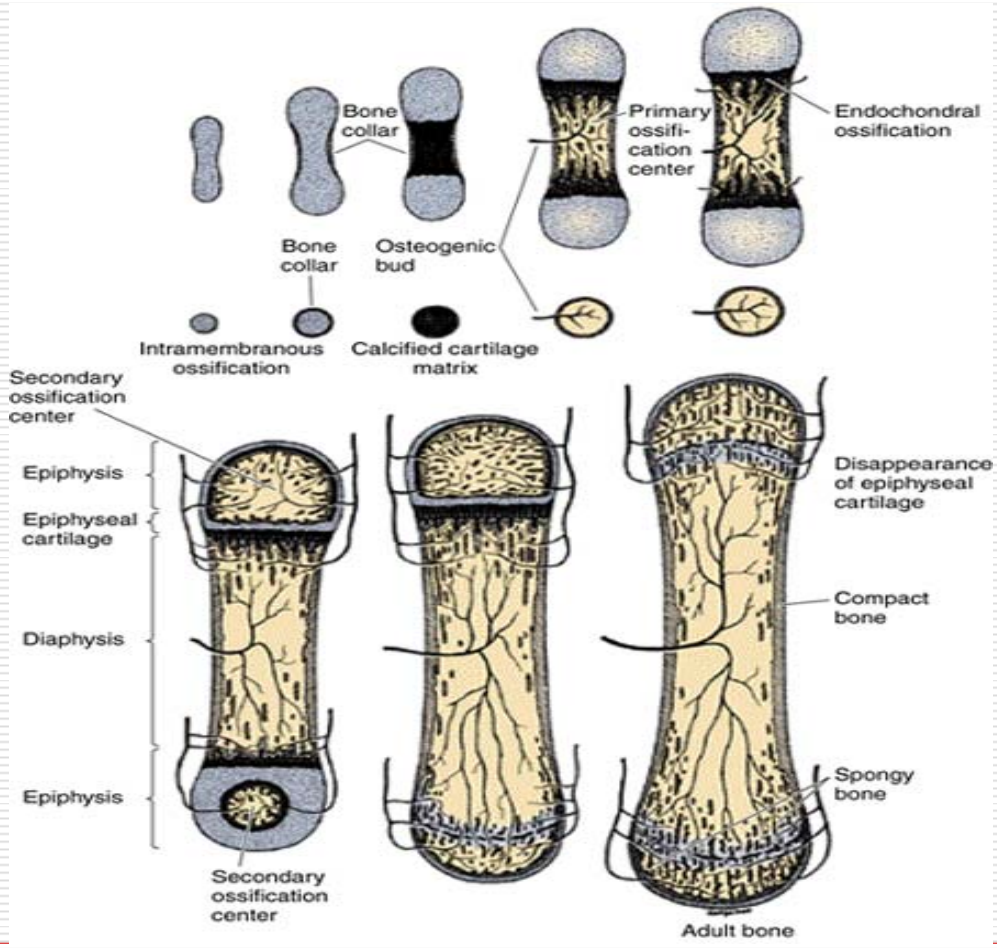
(2) Formation of bone collar

(3)Formation of primary ossification center and cavity of bone marrow

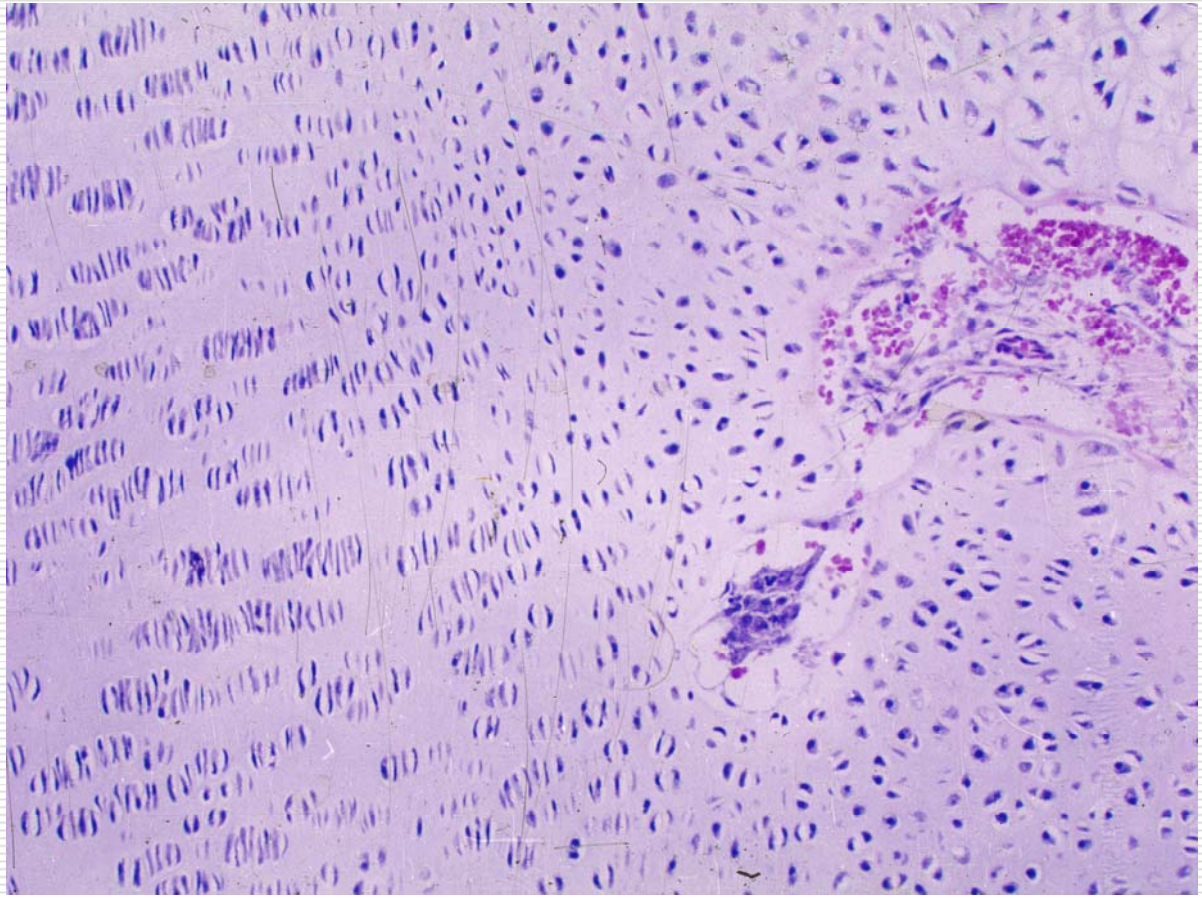
(4)Formation of secondary ossification center and osteoepiphysis

Epiphyseal plate

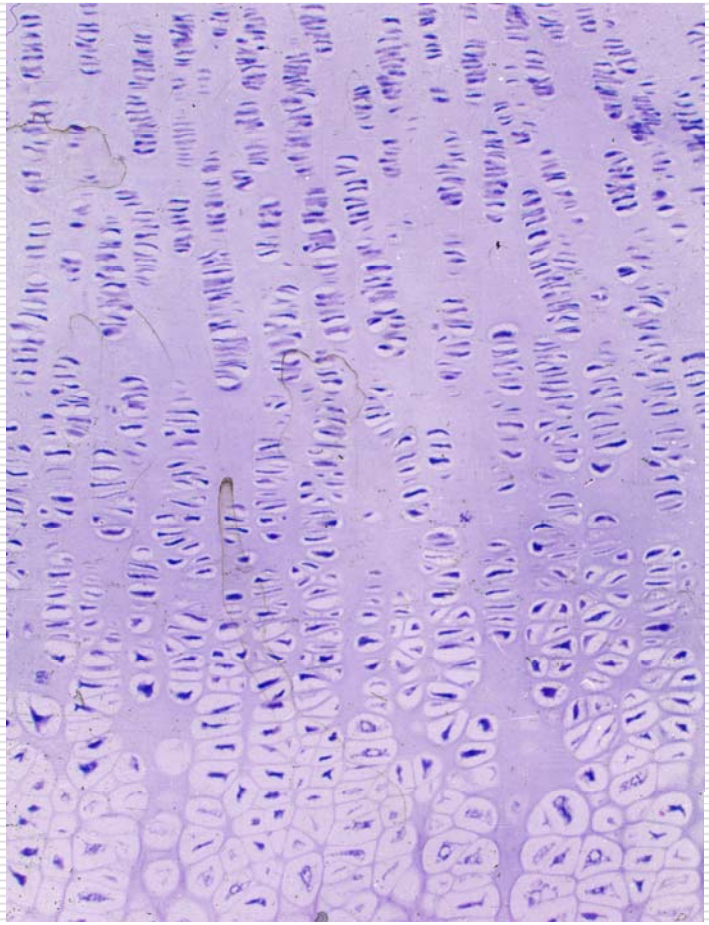
Intrachondral ossification(model)



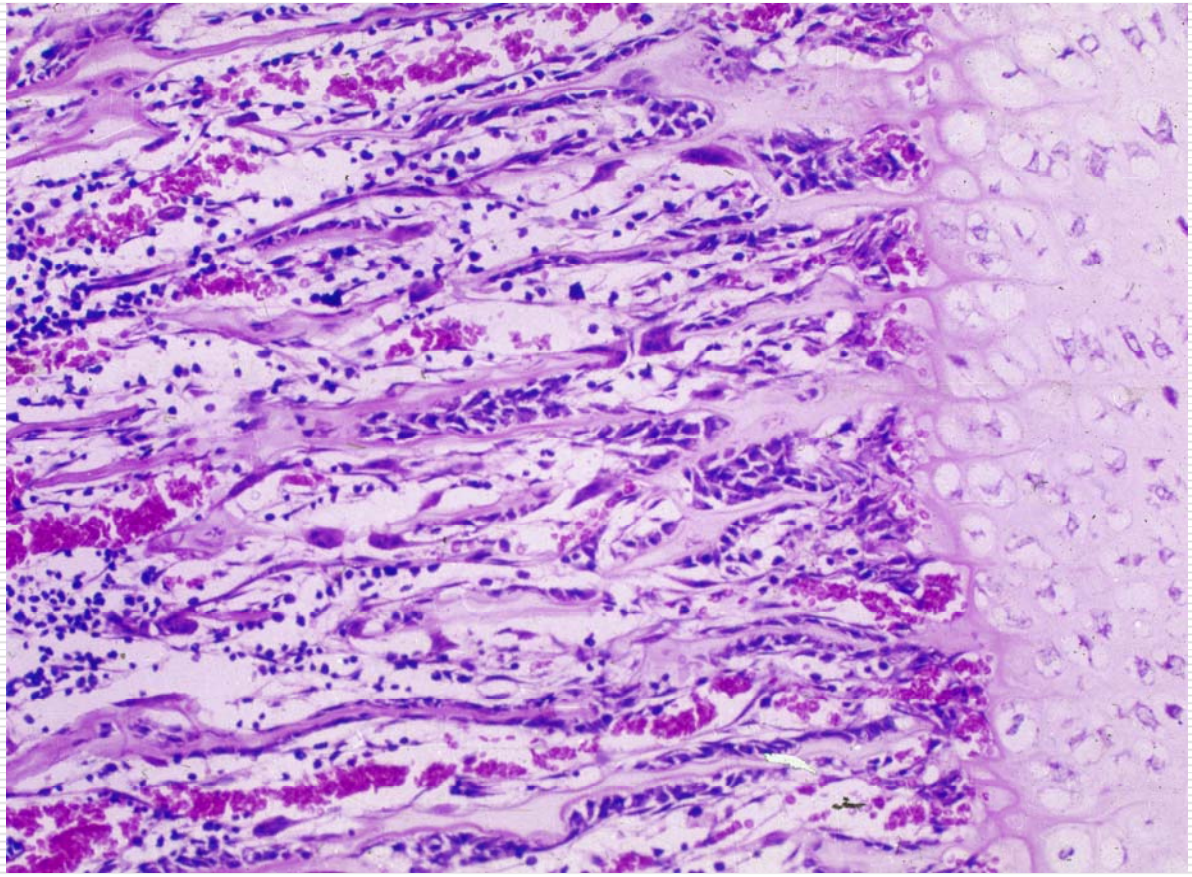
reserve cartilage zone



proliferating and calcifying cartilage zone



ossification zone



Growth of long bone

Increasing long

① reserve cartilage zone

② proliferating cartilage zone

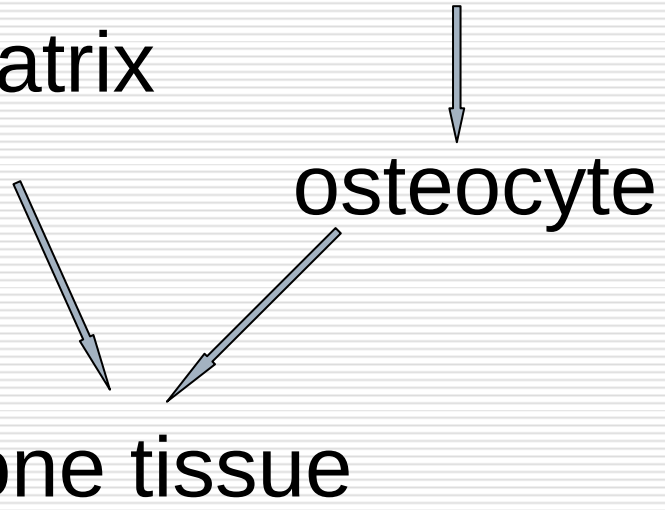
③ calcifying cartilage zone

④ ossification zone

Thicken of long bone

osteogenic cell in peristeum → osteoblast

→ → osteoid → bone matrix



Periosteum(HE)