

Bone Growth & Development

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Types of Bone Cells

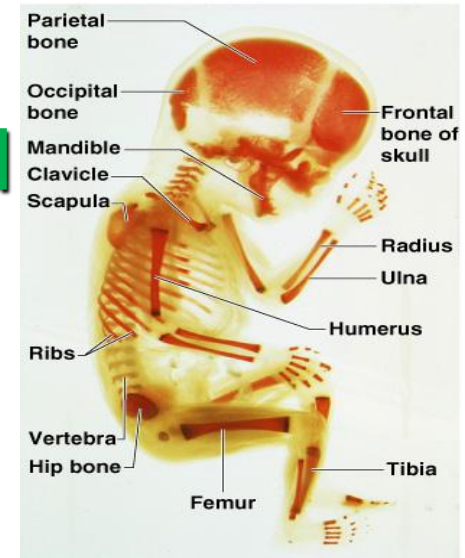
- **Osteocyte** – mature bone cell, enclosed in lacuna
- **Osteoblast** – bone-forming cell; secretes ECM of bone tissue (collagen fibers & calcium salts)
- **Osteoclast** – bone-destroying cell; breaks down ECM to release calcium into the bloodstream



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Bone Formation

- Bone is formed a process called Osteogenesis or ossification
- Bones are originated from mesenchymal cells
- This process begins before birth (during 6th week of embryonic development) & continues till 21 years of age



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TYPES

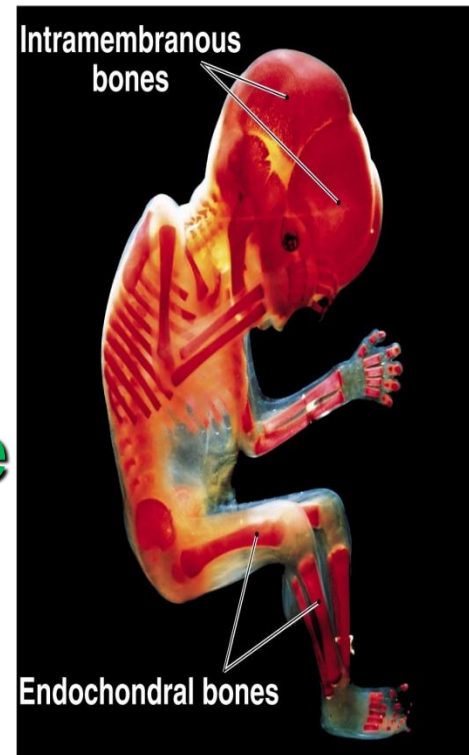
Bones are developed in 2 ways

- **Intramembranous ossification**

Bones develop from fibrous membrane (membrane model)
eg: Flat bones of skull & clavicle

- **Intra cartilagenous ossification**
(Enchondral ossification)

Bones develop from hyaline cartilage (cartilage model)
eg: long bones



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**Bone Formation in
16-Week-Old Fetus**



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OSSIFICATION PROCESS

During the process of bone development osteoblasts secrete osteoid which gradually replaces the initial model. Then this osteoid is progressively calcifies & forms bones



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DEVELOPMENT OF LONG BONES (ENCHONDRAL OSSIFICATION)

- Long bones develop in the fetus from rods of cartilage (cartilage model)
- Ossification begin from the primary centres of ossification

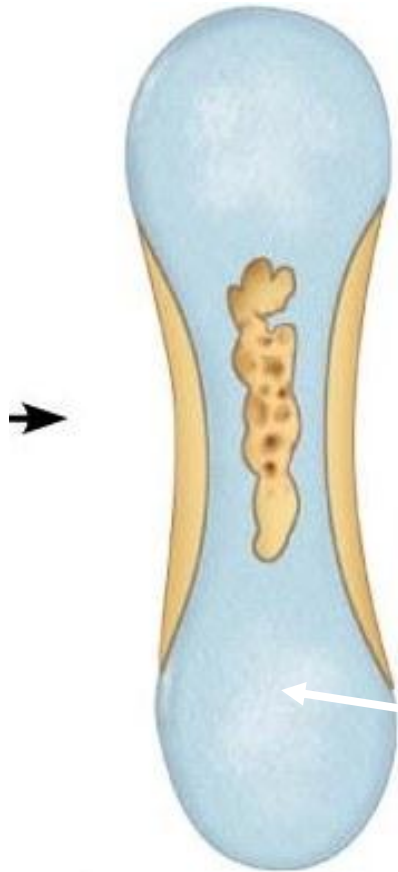


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- **Bone collar develops around the diaphysis**



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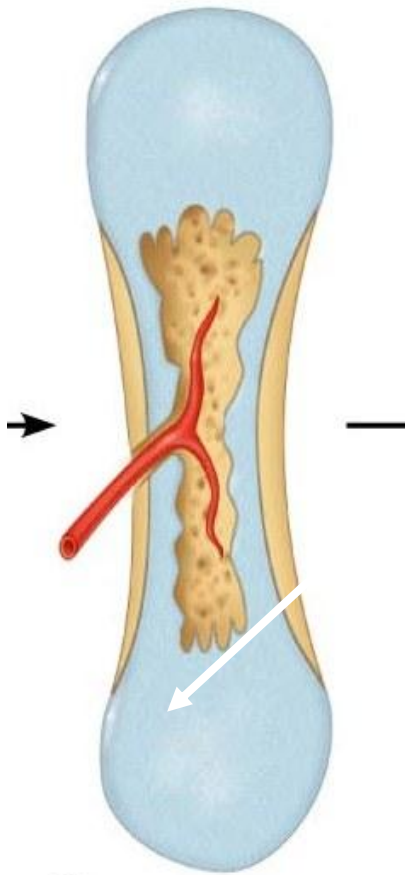
Cartilage in primary ossification center calcifies, then the cells die and cavities form (cavitates)

- Bone collar provides stability during cavitation

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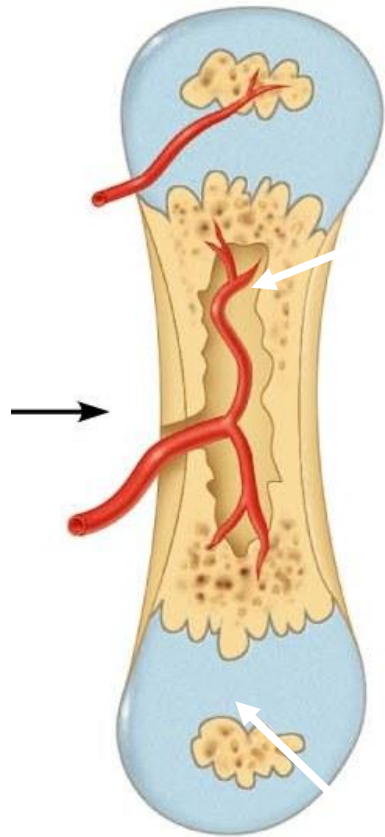
Periosteal bud (lymph, blood vessels, nerves) enters cavity.

Osteoblasts secrete osteoid components in the shaft. So the bone tissue replaces cartilage

■ The ossification continues & spreads to the epiphyses. So the bone lengthens



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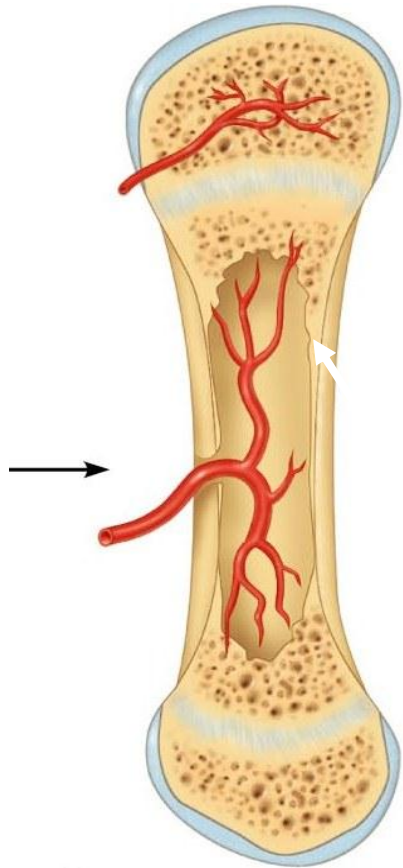


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- Secondary ossification centre form in the epiphyses. Osteoclasts in this area produce spongy bone that replace the cartilage.
- Osteoclasts break down the central bone tissue in the middle of the shaft. This forms a medullary canal



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- Hyaline only remains in epiphyseal surface (forms articular cartilage) and diaphysis and epiphysis junction (forms epiphyseal plates)

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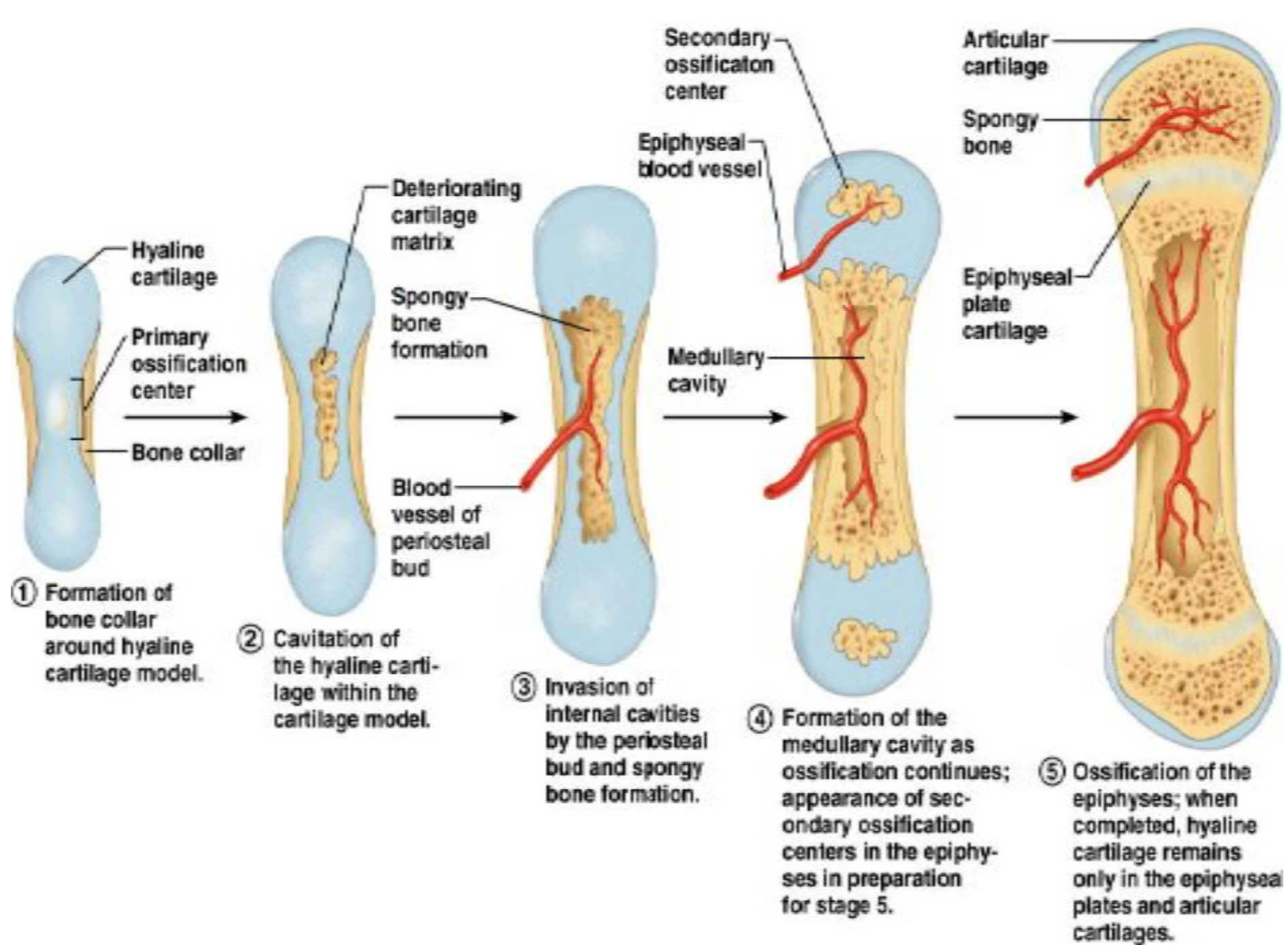


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- During childhood long bones continue to lengthen due to epiphyseal plate at each end of the bone. It produce new cartilage & is then turned to bone.
- At puberty due to sex hormones the epiphyseal plate growth slows down & is replaced by bone. Then further lengthening of bone is not possible



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Bone Growth

- During childhood all bones grow in thickness by appositional growth & long bones lengthen by interstitial growth.



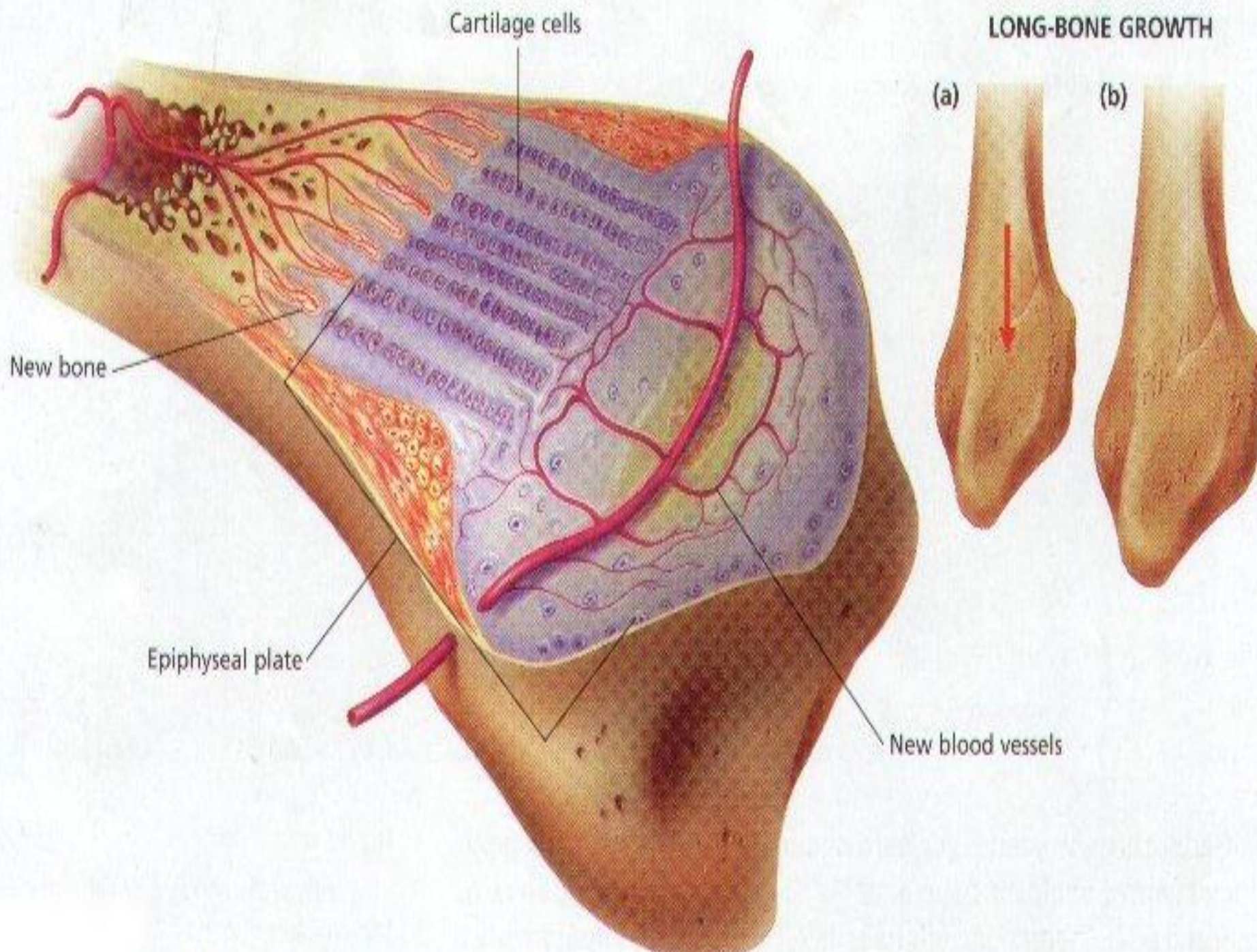
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Longitudinal Growth (Growth in length)

- The epiphyseal plate or growth plate is a cartilage between the diaphysis & epiphysis of long bones.
- The activity of the epiphyseal plate makes the bone to grow in length



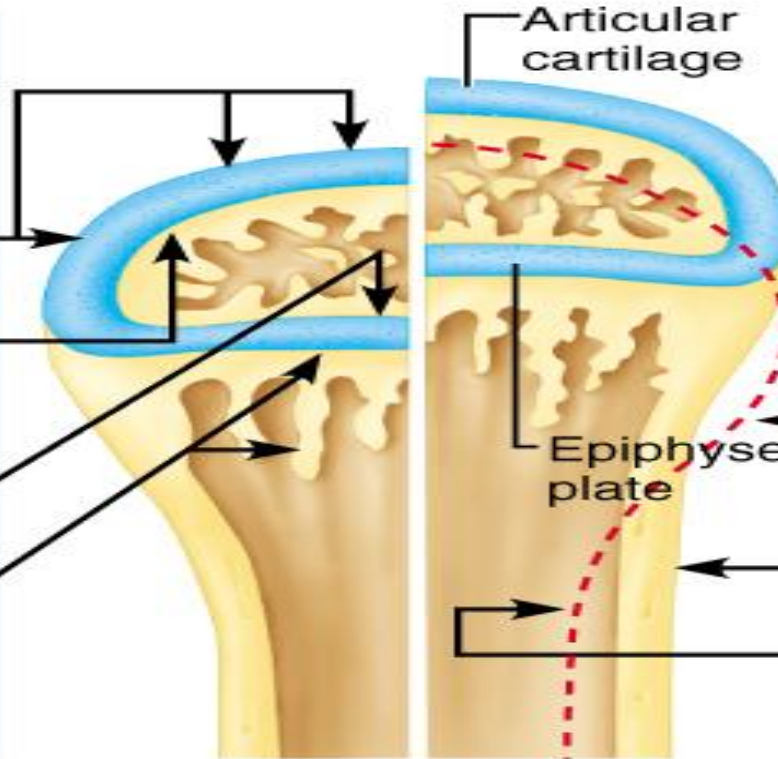
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Growth

Bone grows in length because:

- ① Cartilage grows here
- ② Cartilage replaced by bone here
- ③ Cartilage grows here
- ④ Cartilage replaced by bone here



Remodeling

Growing shaft is remodeled by:

- ① Bone resorbed here
- ② Bone added by appositional growth here
- ③ Bone resorbed here

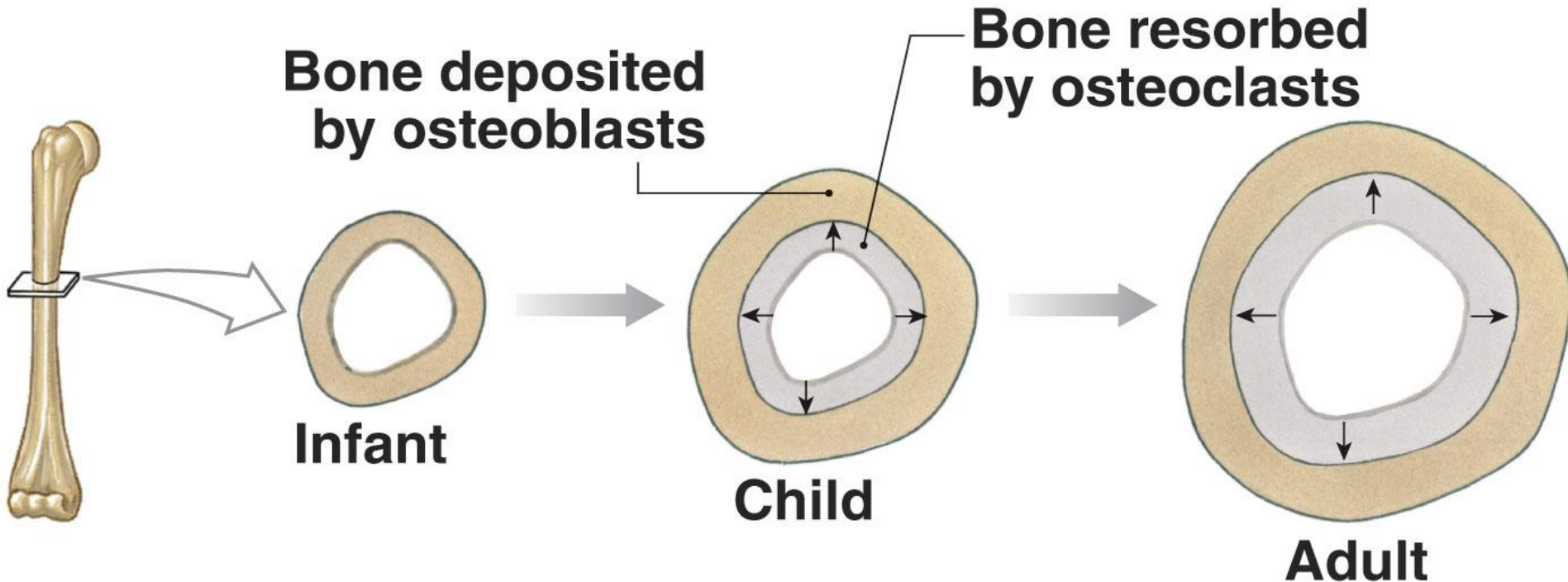
- As the bone grow new chondrocytes are formed on the epiphyseal side of the plate while old chondrocytes on the diaphyseal side of the plate are replaces by bone.
- In this way the bon en the diaphyseal side increases in length



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Appositional Bone Growth (Growth in thickness)

- As the new bone tissue is deposited on the outer surface of the bone, the bone tissue lining the medullary cavity is destroyed by osteoclasts.
- In this way the medullary cavity enlarges as the bone increases in thickness



- The epiphyseal cartilage cells stop dividing & get replaced by bone at about 18 years in females 21 years in males leaving a bony structure called the epiphyseal line.



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Thank you