

OSSIFICATION

rvsd 21 Oct 02 18 Oct 04, 15 Oct 08, 14Oct09, 18Oct10, 17Oct11, 1Feb13, 17Sept15

Martini's 5th. , Martini's 6th: 191-194, 8th: 194-205 10th: 189-196

Development of Bone:

Three types of bone cells associated with bone formation and maintenance:

- osteoblasts early bone forming cells
- osteocytes bone maintenance
- osteoclasts remodel bone, release calcium

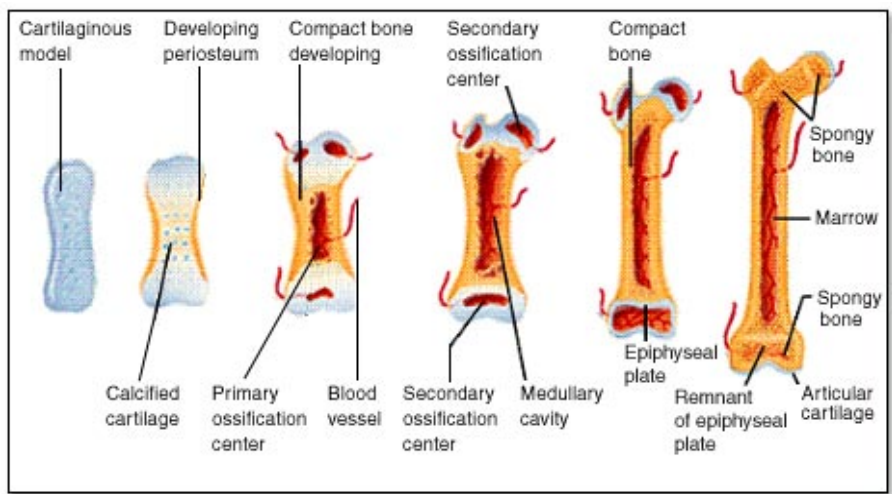
Three types of ossification:

embryonic:

- Intramembranous form flat bones
- primary endochondrial forms long bones

growth:

- 2dary endochondrial elongation, long bones



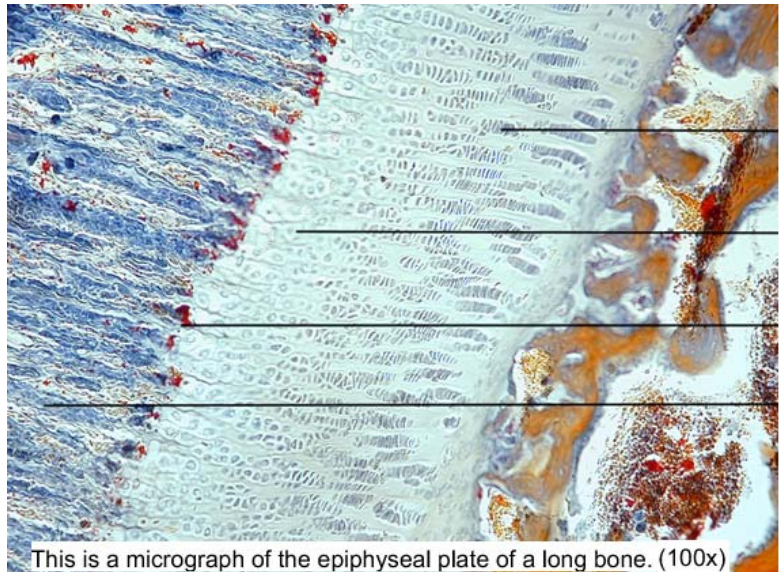
ENDOCHONDRAL OSSIFICATION:

(of hyaline cartilage)

PRIMARY ENDOCHONDRAL OSSIFICATION :

190-191

- 1) **chondroblasts** form cartilage model
- 2) **perichondrium** converted to **periosteum**
- 3) **osteoblasts** gather inside form collar of compact bone
- 4) internal cartilage reduced to thin partitions
- 5) **cartilage matrix begins to ossify**
- 6) **chondroblasts starve, die**
- 7) **osteoclasts** hollow out medullary cavity



This is a micrograph of the epiphyseal plate of a long bone. (100x)

SECONDARY ENDOCHONDRAL OSSIFICATION:

- 1) **chondroblasts** enlarge epiphyseal cartilage
- 2) cartilage towards diaphysis ossifies
- 3) as ossification occurs below, new cartilage forms above
- 4) **osteoclasts** remodel below
- 5) epiphyseal cartilage replaced by **epiphyseal line** by age 25

INTRAMEMBRANOUS OSSIFICATION page

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(also dermal bone b/c formed in deep dermis, as in the skull, etc.)

- 1) **fibroblasts** lay down **collagen**, forming a membrane
- 2) **osteoblasts** form **spongy bone** network inside the membrane (with blood supply)
- 3) **periosteal membrane** forms around
- 4) **osteoblasts** appear in periosteum, form compact bone = diploë

Exercise affects bone physiology:

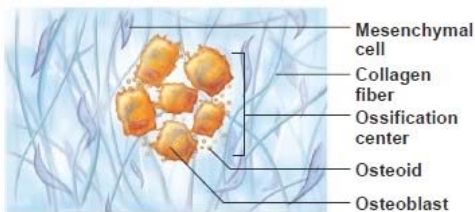
Bone grows in response to stress. No stress, salts withdrawn (astronauts can have severe bone loss)

Responds to compressional, functional and electrical forces (may stimulate alkaline phosphatase)

Bone formation: stressed bone forms a negative charge.

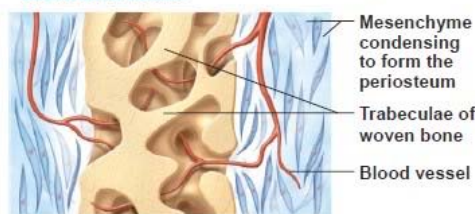
phosphate released by alkaline phosphatase combines with Ca under influence of calciferol to form colloidal precipitates.

Converts to hydroxyapatite: $3Ca_3(PO_4)_2 \cdot Ca(OH)_2$ Rickets (p. 159)



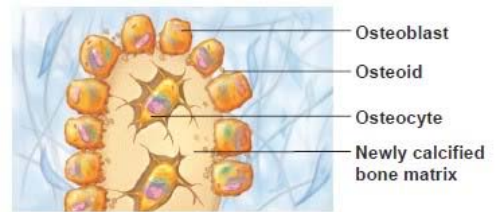
① Ossification centers appear in the fibrous connective tissue membrane.

- Selected centrally located mesenchymal cells cluster and differentiate into osteoblasts, forming an ossification center.



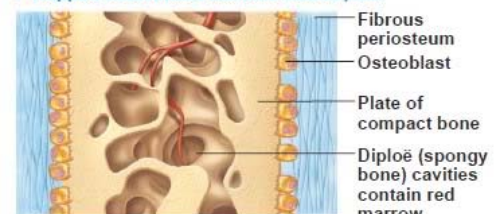
② Woven bone and periosteum form.

- Accumulating osteoid is laid down between embryonic blood vessels in a random manner. The result is a network (instead of lamellae) of trabeculae called woven bone.
- Vascularized mesenchyme condenses on the external face of the woven bone and becomes the periosteum.



③ Bone matrix (osteoid) is secreted within the fibrous membrane and calcifies.

- Osteoblasts begin to secrete osteoid, which is calcified within a few days.
- Trapped osteoblasts become osteocytes.



④ Lamellar bone replaces woven bone, just deep to the periosteum. Red marrow appears.

- Trabeculae just deep to the periosteum thicken and are later replaced with mature lamellar bone, forming compact bone plates.
- Spongy bone (diploë), consisting of distinct trabeculae, persists internally, and its vascular tissue becomes red marrow.