Intro to Bone
- Key cell:
  - osteoblast - bone building cell

35% organic material
- Golgi bodies - produces/releases mucopolysaccharides (cement matrix)
- E.R. - secretes - protein - collagen fibers (reinforces matrix)

65% inorganic material
- Calcium salts $\text{Ca}_3(\text{PO}_4)_2$ and some $\text{CaCO}_3$
  - (hardens matrix)

Bone formation –
Ossification = Osteogenesis

I. Intramembranous ossification
1. Fibrous membranes form template
   - Locations: parts of skull (frontal, parietal, occipital, & temporal b.), part of mandible, clavicle
2. Osteoblasts mature and produce bone
   - mucopolysaccharides, collagen fibers, & calcium salts are layed down by osteoblasts

Fetal Skeleton at 12 weeks
Intramembraneous ossification (continued)
3. original bone (woven bone)
4. Woven Bone breaks down & reconstructs resulting in the formation of cancellous (spongy) & compact bone

Intramembraneous ossification (continued)
► spaces in spongy (cancellous) bone are filled with red marrow
► Red Marrow = Hemopoietic tissue that forms white & red blood cells

II. Endochondral ossification
• hyaline cartilage forms template
• location: all other bones

Endochondral ossification (continued)
A . PRIMARY OSSIFICATION
① Formation of bone collar in diaphysis
② chondrocytes - mature & enlarge then rupture & die → due to pH changes
③ blood vessels develop in the diaphysis which stimulates the formation of osteoblast

Endochondral ossification (cont.)
④ osteoblast lay down matrix material forming bone. At the same time chondrocytes die.
• 1 to 4 PRIMARY OSSIFICATION this occurs in the diaphysis

Endochondral ossification (cont.)
B . SECONDARY OSSIFICATION
1. hyaline cartilage forms template
2. chondrocytes - mature & enlarge then rupture & die → due to pH changes
Endochondral ossification (cont.)
3. blood vessels development in the **epiphyses** - stimulate osteoblast development resulting in bone formation
4. osteoblast lay down matrix material forming bone. At the same time chondrocytes die
   • 1 to 4 SECONDARY OSSIFICATION ➔ occurs in the **epiphyses**

**Endochondral ossification (cont.)**

**INCREASE IN LENGTH**
A. in between the diaphysis & epiphyses is a cartilaginous plate called the epiphyseal plate
B. at ends on the epiphyseal side of this plate cartilage (chondrocytes) are actively reproducing ➔ extends length

Endochondral ossification (cont.)
C. ossification (bone formation) occurs at the diaphyseal side of this plate
D. this continues until the epiphyseal plate is completely ossified
   • Result: epiphyseal line

Endochondral ossification (cont.)
• initial bone is always - woven bone
• destruction & reconstruction of bone occurs forming either compact or spongy bone
• even after bone growth stops: destruction & reconstruction continue

**Increase in Diameter**
• Osteoclast (Type of cell)
  - breakdown(dissolve) bone tissue from within (middle)
  - forming medullary cavity
• Osteoblast
  - in the osteogenic layer of the periosteum lay down new bone

**Overall Bone Growth**
• Initial Growth: Growth > Decay
• Middle Years: Growth = Decay
• Later Years (starting between 35 to 40) Growth < Decay
Hormones effecting bone growth

I. GH growth hormone - pituitary gland
- stimulate cartilage production target:
  1. epiphyseal side of epiphyseal plate
- stimulate osteoblast activity in the:
  1. osteogenic layer of periosteum
  2. diaphyseal side of epiphyseal plate

II. PTH parathyroid hormone - parathyroid glands (4)
- stimulates osteoclast activity
- increases Ca^{+2} levels in blood

III. Calcitonin: thyroid gland
- stimulates osteoblast activity:
  1. periosteum (osteogenic layer) &
  2. epiphyseal plate (diaphyseal side)
- increases deposit of calcium salts in bone
- decreases Ca^{+2} levels in the blood

Ca^{+2} uses in the body - Bones serve as a warehouse (storage)
- transmission of nerve impulses
- contraction of muscles
- blood coagulation (clotting)
- cell division