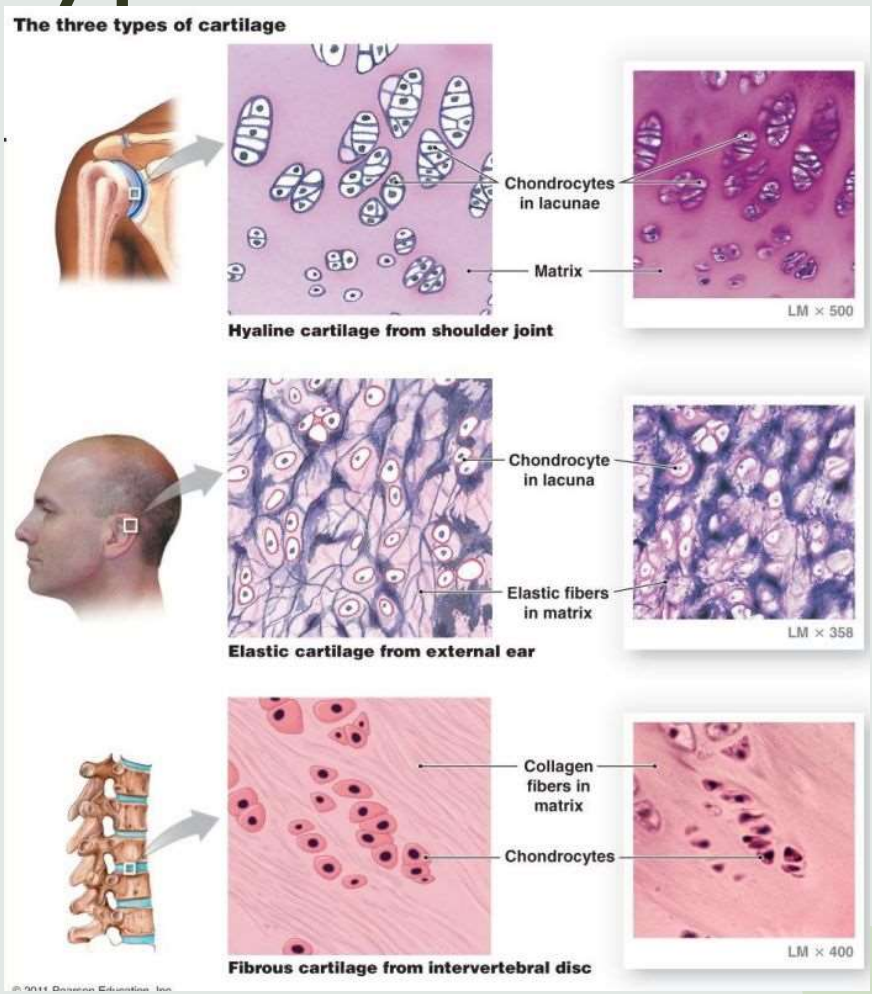

Structure of different types of cartilage
Classification of cartilage
Endochondral ossification types (appositional growth, interstitial growth)
Intramembranous ossification

What is cartilage?

- Specialised form on connective tissue that is made up of cell and extracellular matrix
  - has chondrocytes embedded within it – in a space called lucanae
- Make up of types 2,6,9,11 of collagen
- Its is weight baring

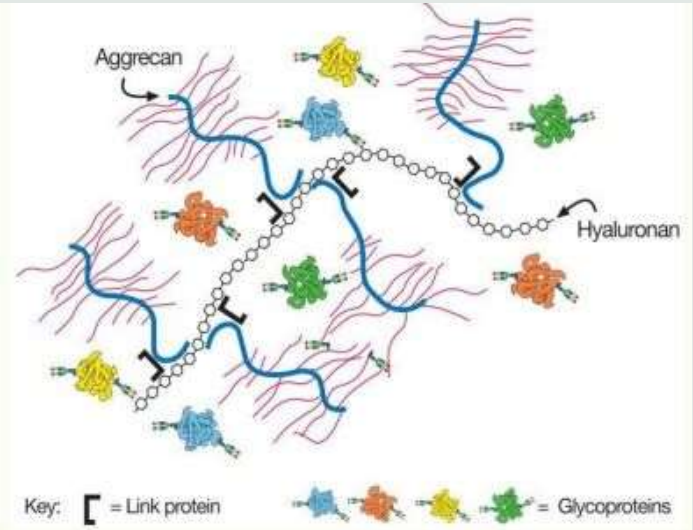
What are the different types?

- Hyaline cartilage
  - Present in synovial joints to make articular cartilage
  - Function
    - Distribute load
    - Allow movement
- Elastic cartilage
  - Present in the larynx, epiglottis and etc
- Fibrocartilage
  - Found in secondary cartilaginous joints e.g pubic symphysis
  - And in intervertebral disc, meniscus etc

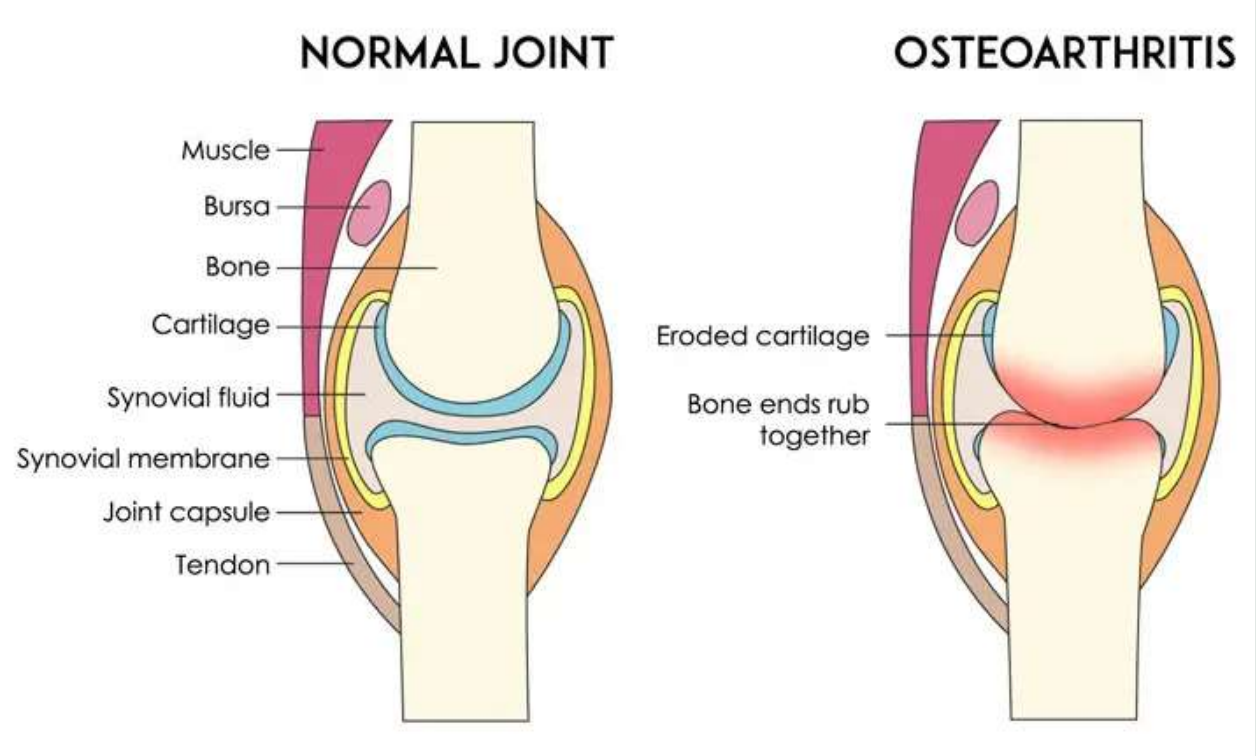


Composition of cartilage

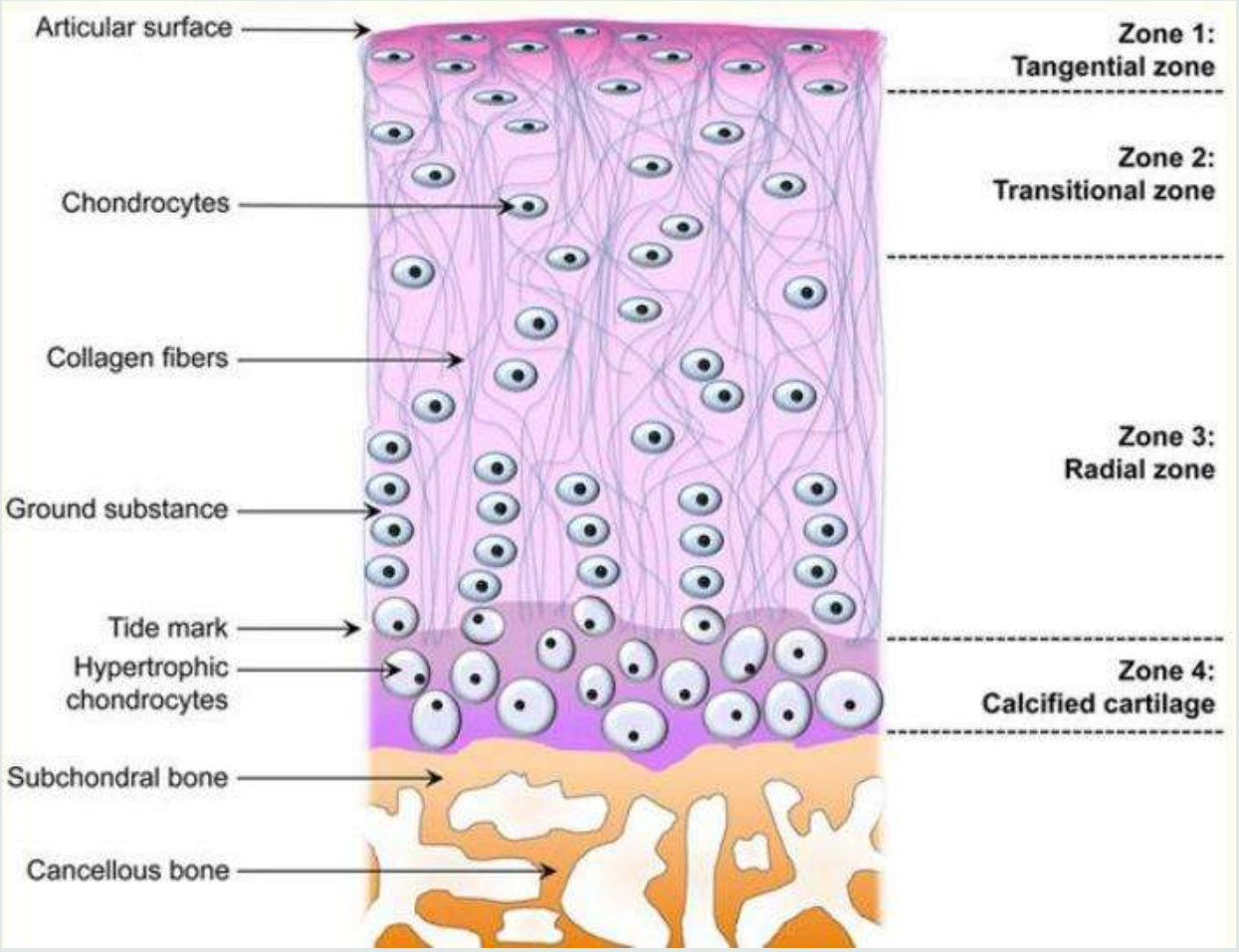
- Contains:
- Collagen for strength
- Elastic for flexibility
- Proteoglycan for large osmotic effect
  - Provides a large osmotic effect because it has loads of negatively charged sugar chains which pull more cations (positive charge) like Na+ and Ca2+. And where sodium goes water follows.

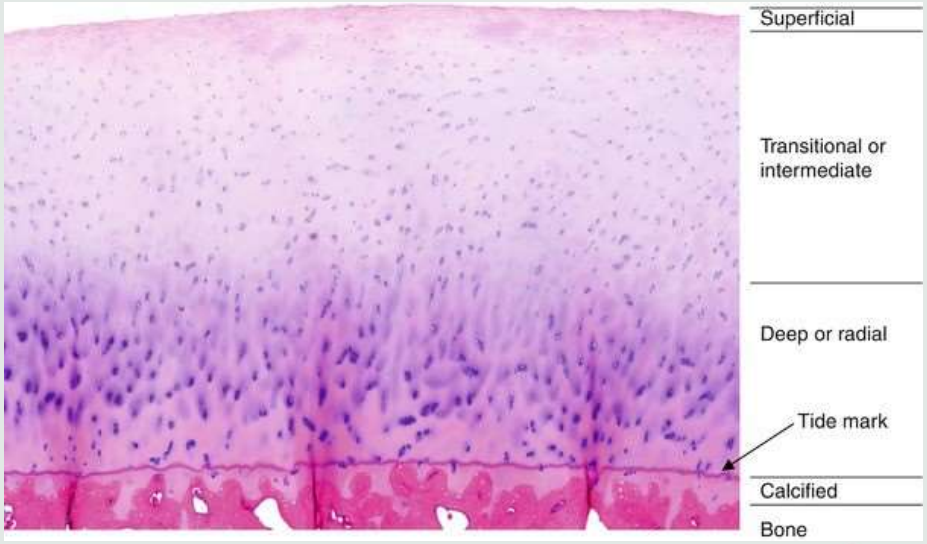


Articular cartilage



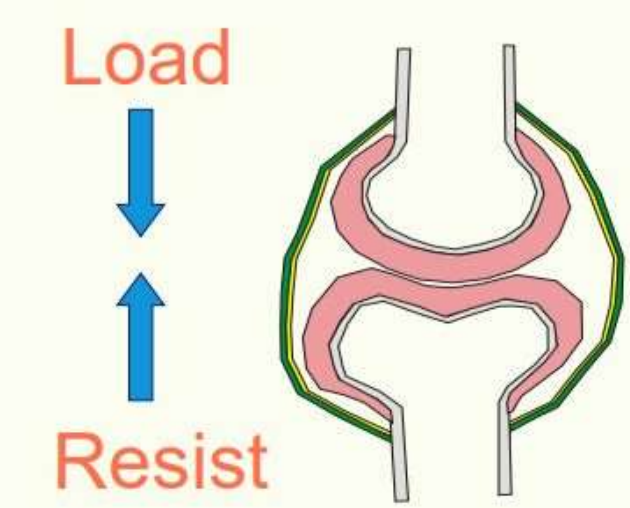
Histology of articular cartilage





Properties of articular cartilage

- The articular cartilage is made up of hyaline cartilage
- Like we said this are a high osmotic effect
- Meaning it brings in more water -> Swelling of the cartilage
- This swelling is counteracted by resistance of the intact collagen fibers
- This provides joints to resist compressive forces while maintaining high tensile strength

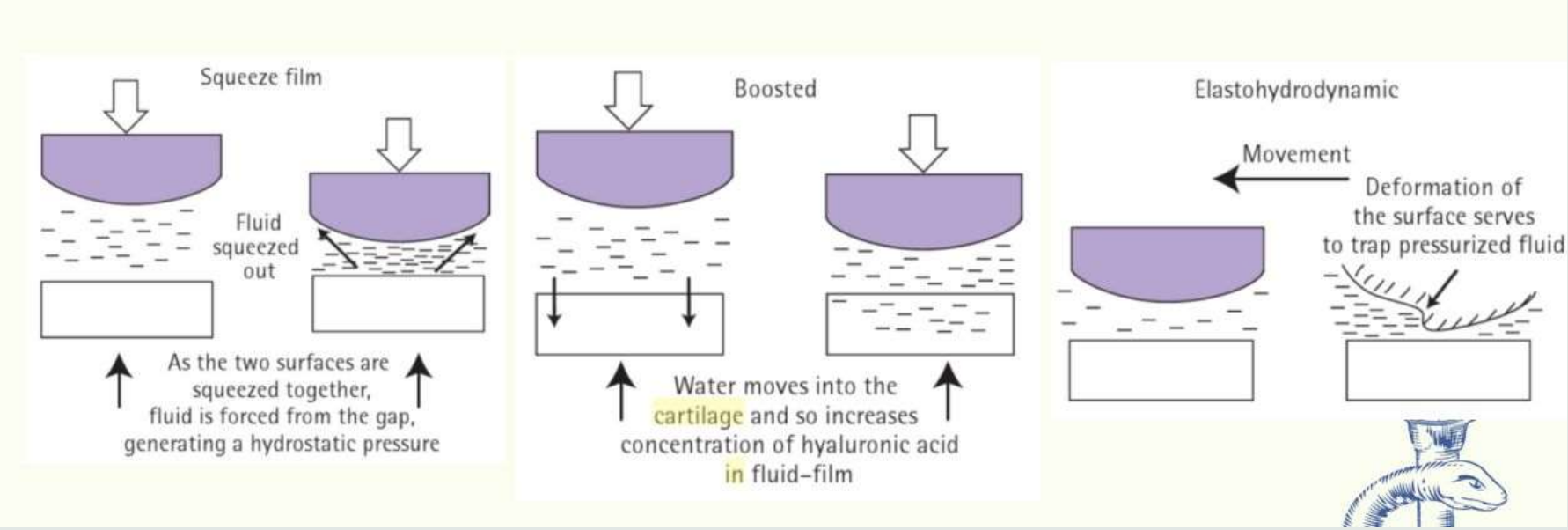


What is synovial fluid

- Fluid between the bones – in simple terms
- Function – lubrication to reduce friction
- 3 component – lubricin, phospholipids, hyaluronan
  - Hyaluronan – non-sulfated GAG composed of the repeating sugars glucuronic acid and N-acetylglucosamine.
  - Phospholipids - Provide hydrophobicity to the articular surface and shield asperities from solid–solid contact.
  - Lubricin - proteoglycan encoded by the gene prg4 secreted by both articular cartilage and synovium

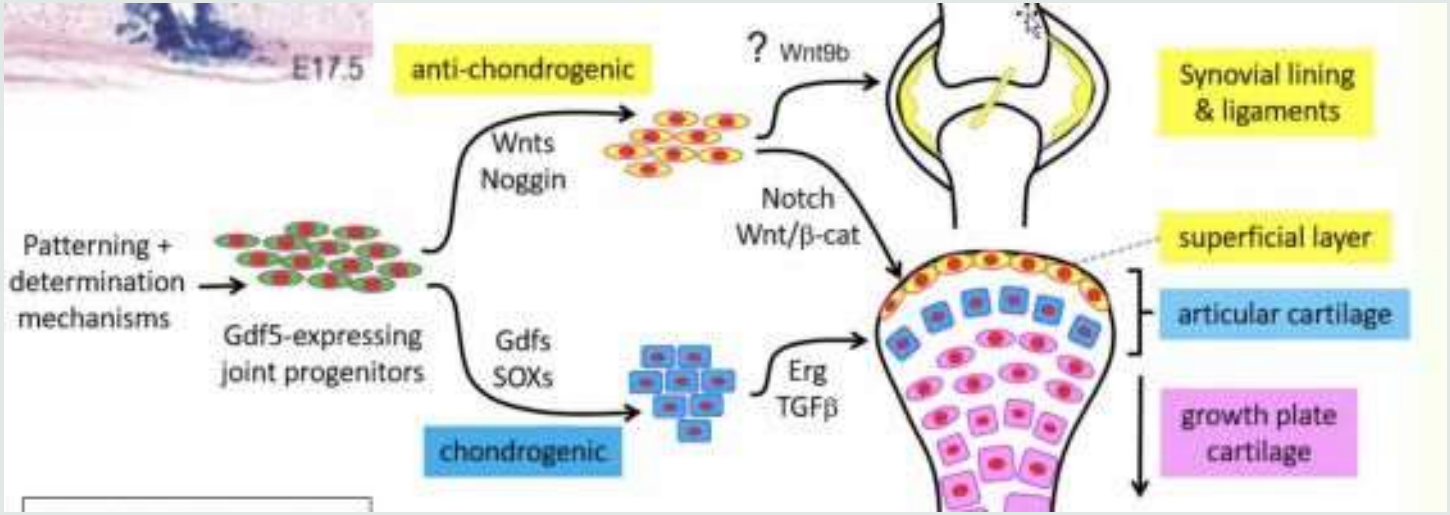
3 models of articular cartilage

- Squeeze film – when 2 surface squeeze together, fluid is forces from the gaps to generate hydrostatic pressure
- Boosted – water moves within the cartilage so increase the conc of hyaluronic acid in the fluid film
- Electrohydrodynamic – the surface is deformed to trap the pressurised fluid



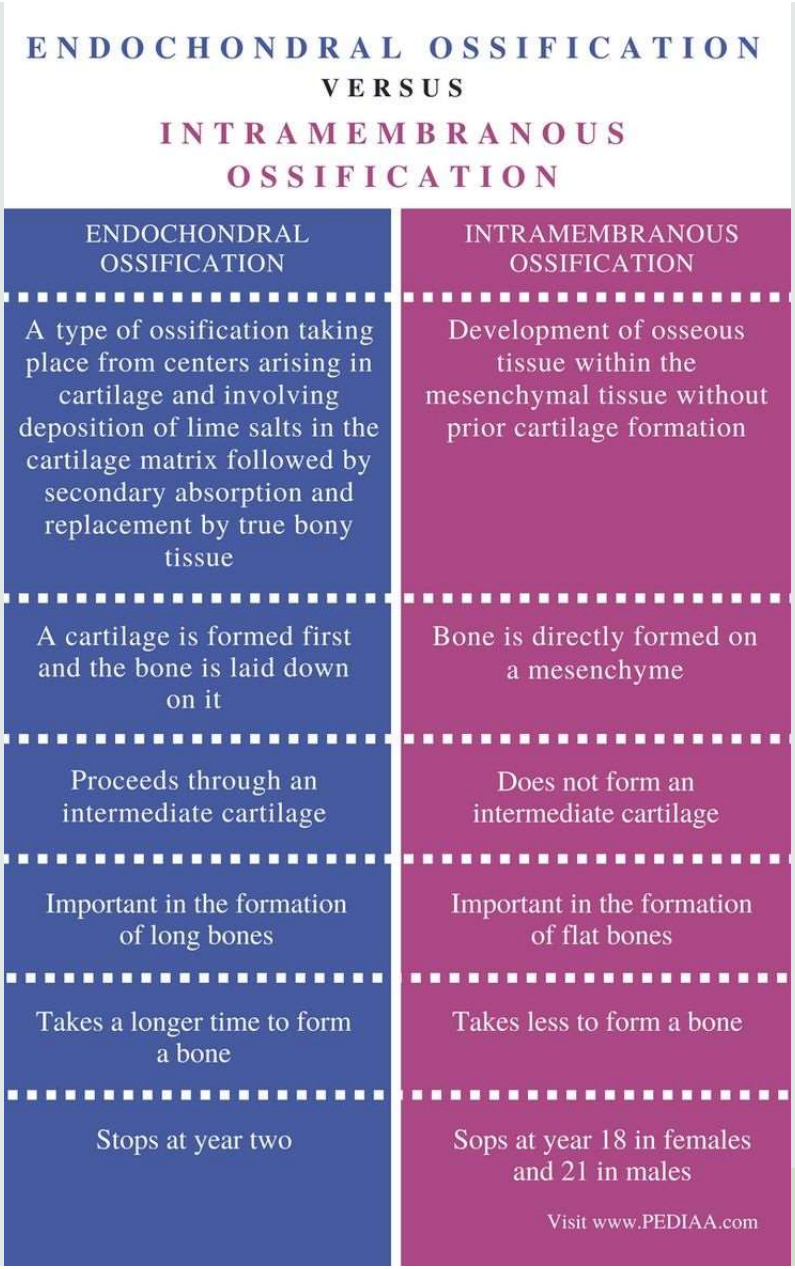
How is synovial cartilage formed

- Patterning and determination mechanism cause GDF5-expressive joint progenitors to form Wnt Noggins and GDFs SOXs
- Wnt noggin is ant chondrogenic – so from the synovial components
- GDF SOXs is chondrogenic – so forms the cartilage i.e growth plate and articular cartilage



2 types of ossification

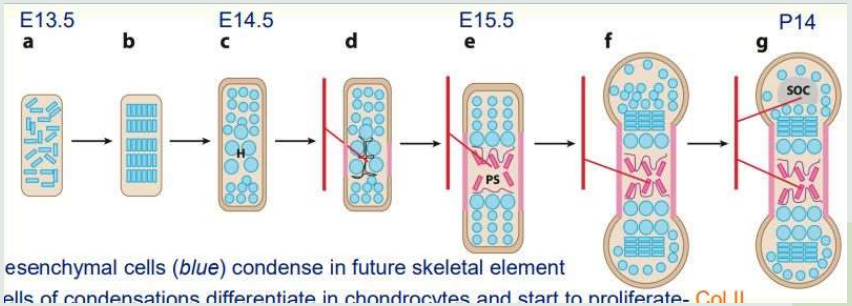
- Endochondral
  - Bone replaces existing cartilage model
- Intramembranous
  - Bone develops directly from mesenchyme or fibrous connective tissue
  - Only flat bone e.g skull, clavicle, and most of the cranial bones



Endochondral ossification

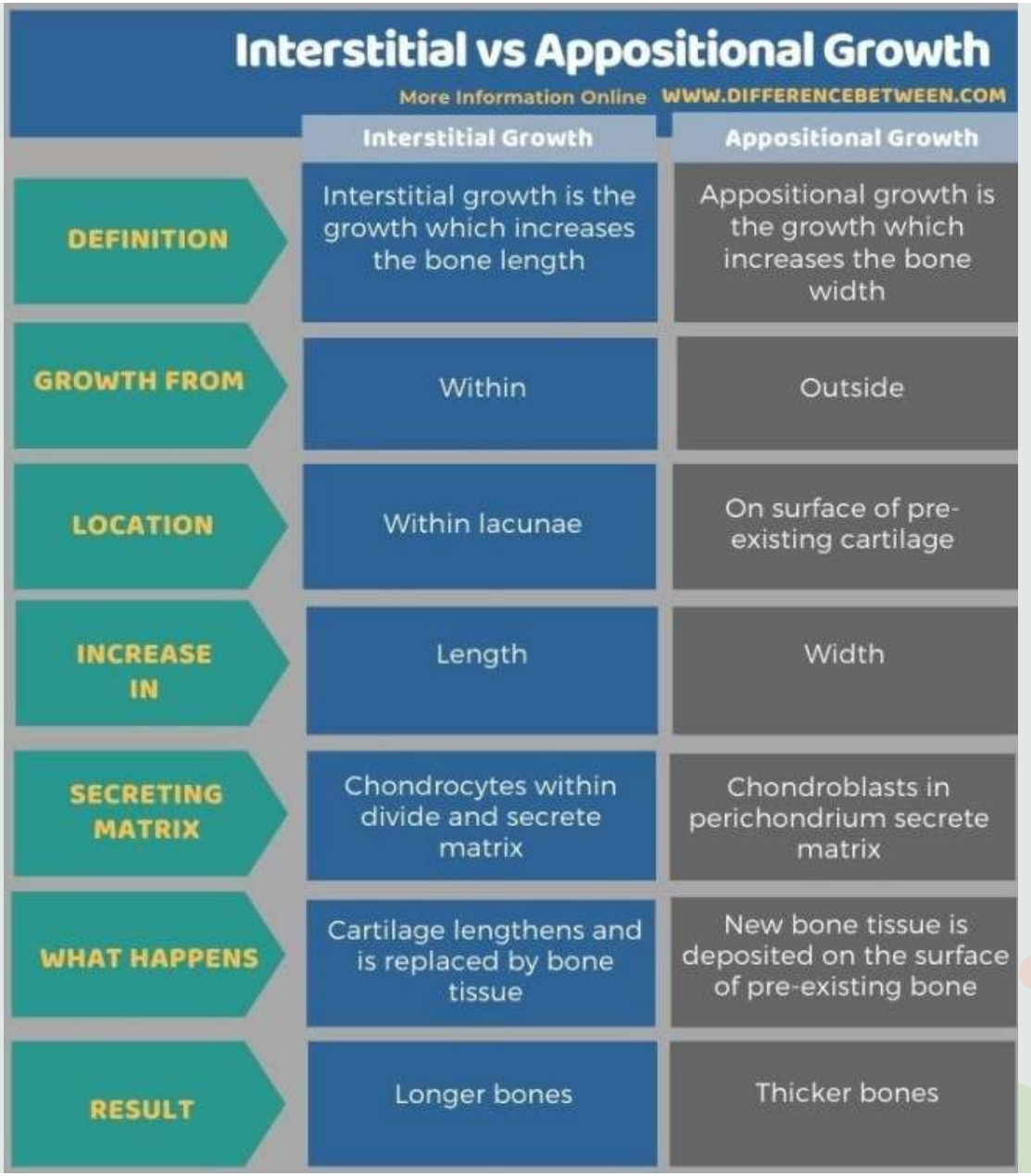
1. Mesenchymal cells condense to form chondrocytes and start to proliferate to form Collagens Type 1
2. Hypertrophic chondrocyte differentiation leads to formation of Collagen Type 10
3. The hypertrophic chondrocytes apoptosis favours matrix mineralisation and blood vessel invasion
4. Perichondral cells differentiate in osteoblasts forming the bone collar
5. Osteoblasts forms the primary spongiosa
6. Chondrocytes proliferate to lengthen the bones
7. The secondary ossification centres forms through vascular invasive

Hypertrophic chondrocytes secrete metalloproteinases -> which remodel the cartilage so the bone can invade



There are 2 types of Endochondral ossification

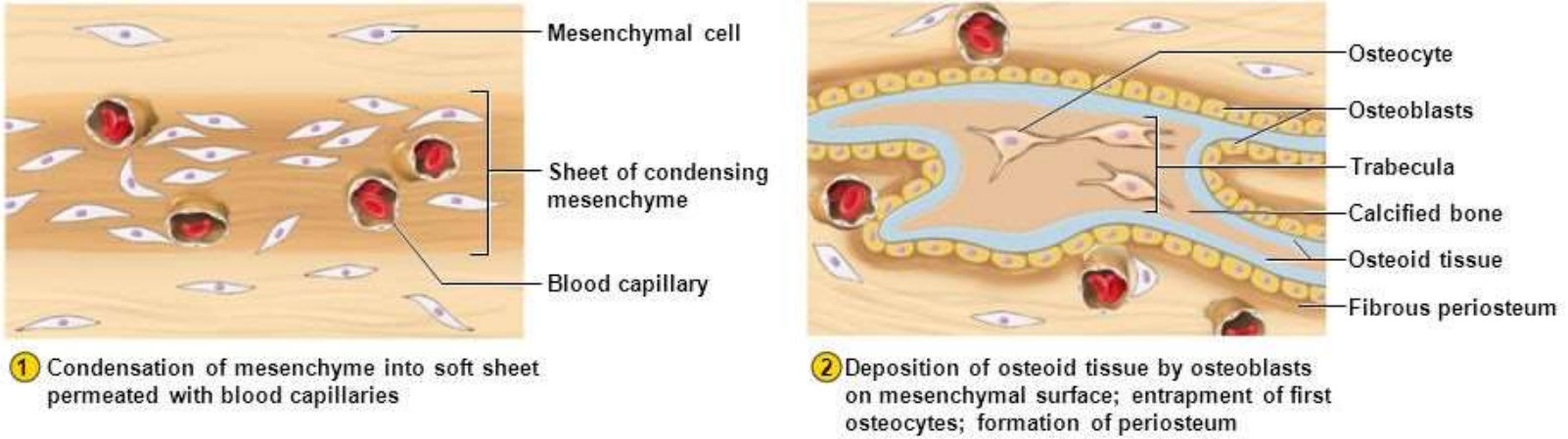
- Appositional growth - When osteoblasts lay new bone tissue on the surface of old bone tissue.
- Interstitial growth - Where chondrocytes embedded in the cartilage continue to produce extracellular matrix. Increasing the length of cartilage



Intramembranous ossification

1. Mesenchymal cells differentiate into osteoblasts and group into ossification centers
2. Osteoblasts become entrapped by the osteoid they secrete, transforming them to osteocytes
3. Trabecular bone and periosteum form
4. Compact bone forms superficially to the trabecular bone
5. Blood vessels form the red marrow

Intramembranous Ossification



1. Condensation of mesenchyme into soft sheet permeated with blood capillaries
2. Deposition of osteoid tissue by osteoblasts on mesenchymal surface; entrapment of first osteocytes; formation of periosteum
3. Honeycomb of bony trabeculae formed by continued mineral deposition; creation of spongy bone
4. Surface bone filled in by bone deposition, converting spongy bone to compact bone. Persistence of spongy bone in the middle layer.

Figure 7.8

produces flat bones of skull and clavicle

Questions

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b) Perichondrium
c) Endosteum
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