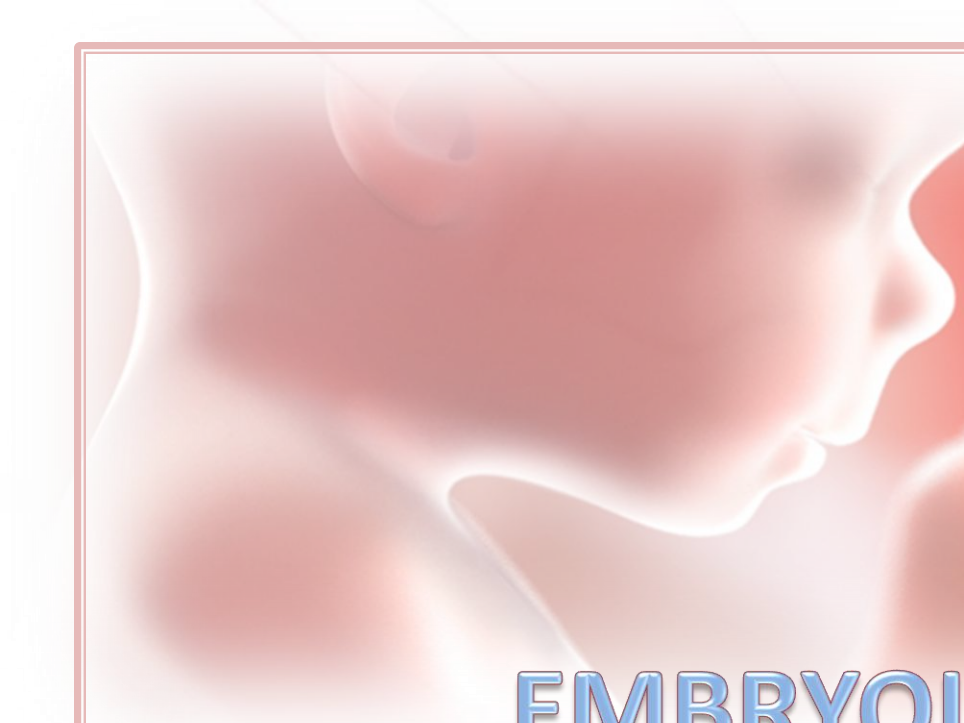


College of medicine
1431

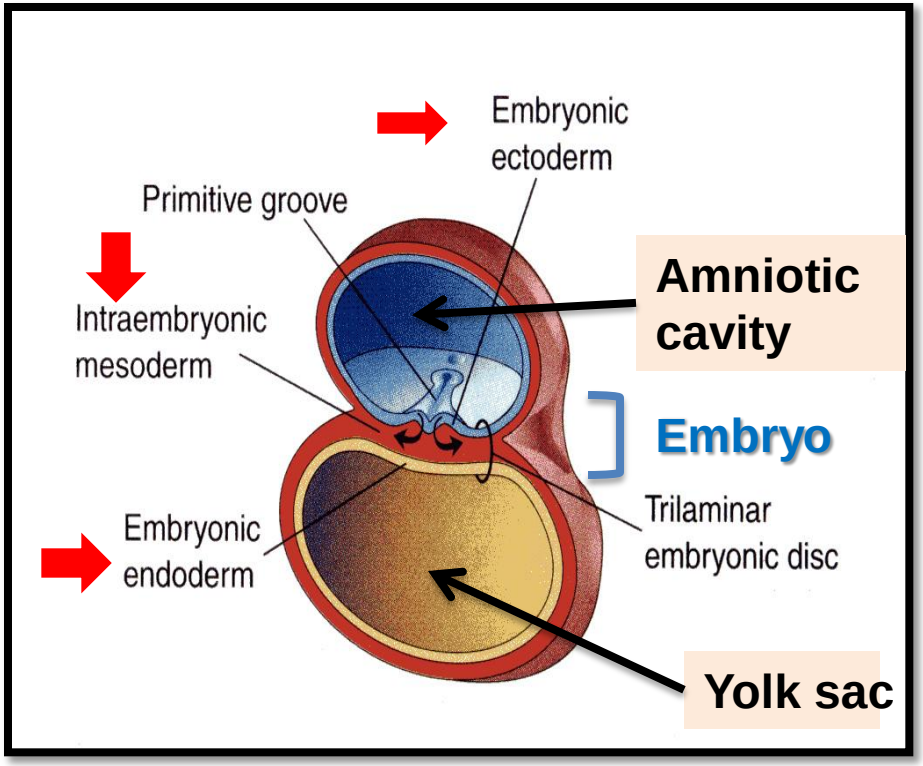
EMBRYOLOGY TEAM

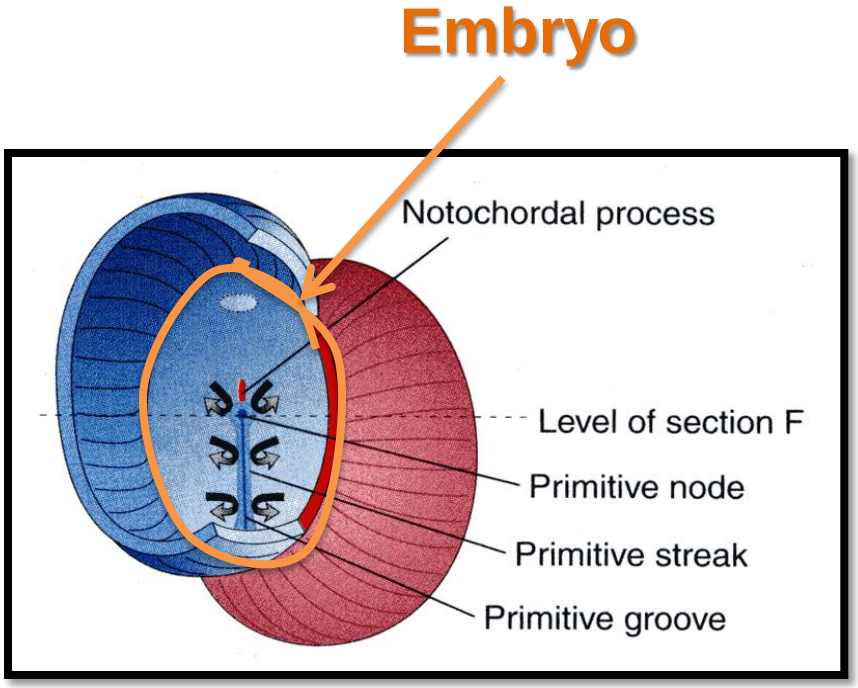
- Sara Al-Mutairi
- Nora Al-Refaie
- Sara Al-khelb
- Nawaf Modahi

DEVELOPMENT OF SKELETAL & MUSCULAR SYSTEM

OBJECTIVES

- Division of **the intraembryonic mesoderm.**
- Formation and division of **somite.**
- Derivatives of somite **(sclerotome & myotome).**
- Formation of **somatic and splanchnic layers of lateral plate mesoderm** and their derivatives.
- Difference between the **intramembranous and intracartilaginous ossification** and name the bones developed by these processes.
- The origin of **skeletal, cardiac and smooth muscles** in the body.

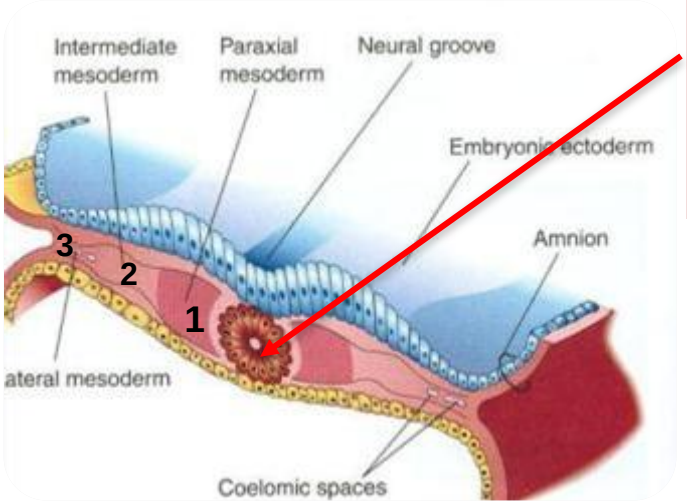




Muscles and **bones** raise from Intarembryonic mesoderm : between ectoderm and endoderm .

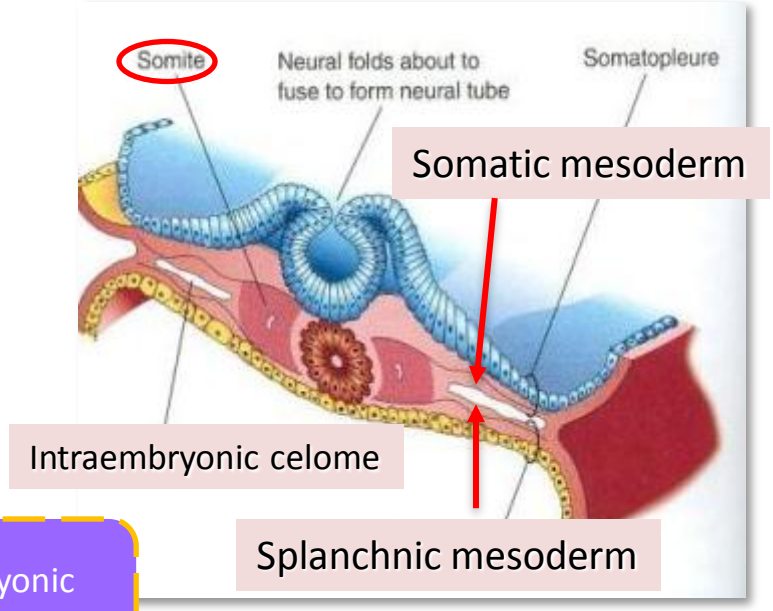
Intraembryonic Mesoderm

- Develops between Ectoderm & Endoderm EXCEPT in the central axis of embryo where NOTOCHORD is found.
- Differentiates into 3 parts:
  1. Paraxial mesoderm: on each side of notochord.
  2. Intermediate mesoderm
  3. Lateral mesoderm



Notochord: stimulates neural tube formation

- Paraxial mesoderm divides into units (somites).
- **Lateral mesoderm** divides by intraembryonic coelom into:
  - Somatic mesoderm (between ectoderm & coelom).
  - Splanchnic mesoderm (between endoderm & coelom).



somites are masses of mesoderm distributed along the two sides of the neural tube and that will eventually become dermis (dermatome), skeletal muscle (myotome), and vertebrae (sclerotome).

Intraembryonic coelom : is a cavity

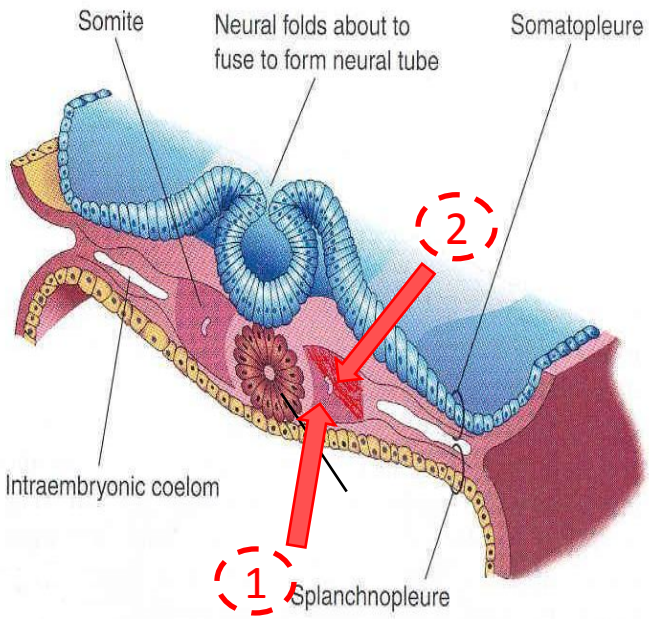
- A small cavity, the myocele appears in each somite but soon disappears

Each somites will divide into two parts by an oblique line.

Each somite divides into

ventromedial part called **sclerotome**

dorsolateral part called **dermomyotome**



- Sclerotome: Bones of the axial skeleton (cranium, vertebral column, ribs and sternum)
- Myotome: Associated muscles of the back
- Dermatome: The adjacent dermis of the skin

"dermomyotome" describe the combined dermatome and myotome

Development of the Bones

Based on the *mode of development*, there are two types of bones in the body:

type of bone	Cartilage bones	Membrane bones
develop via	**intracartilagenous (endochondral ossification)** A **cartilage model first** forms and is eventually replaced with bone **cartilage formation > ossification of the cartilage > bone.**	**intramembranous ossification** **Bone** forms **directly** from mesenchymal cells without the prior formation of cartilage **Membrane bone: model > directly the bone is formed.**
Example.	formation of the bones of the axial & appendicular skeletons and the cranial base. **Model: cells will give arise to bone.**	majority of bones of the face and skull

Development of Cranium (Skull)

- The skull bones develops from mesoderm around the developing brain.
- The skull consists of:
  - Neurocranium: **protective** case for brain
  - Viscerocranium: skeleton of **face**

Bones of skull ossify either by

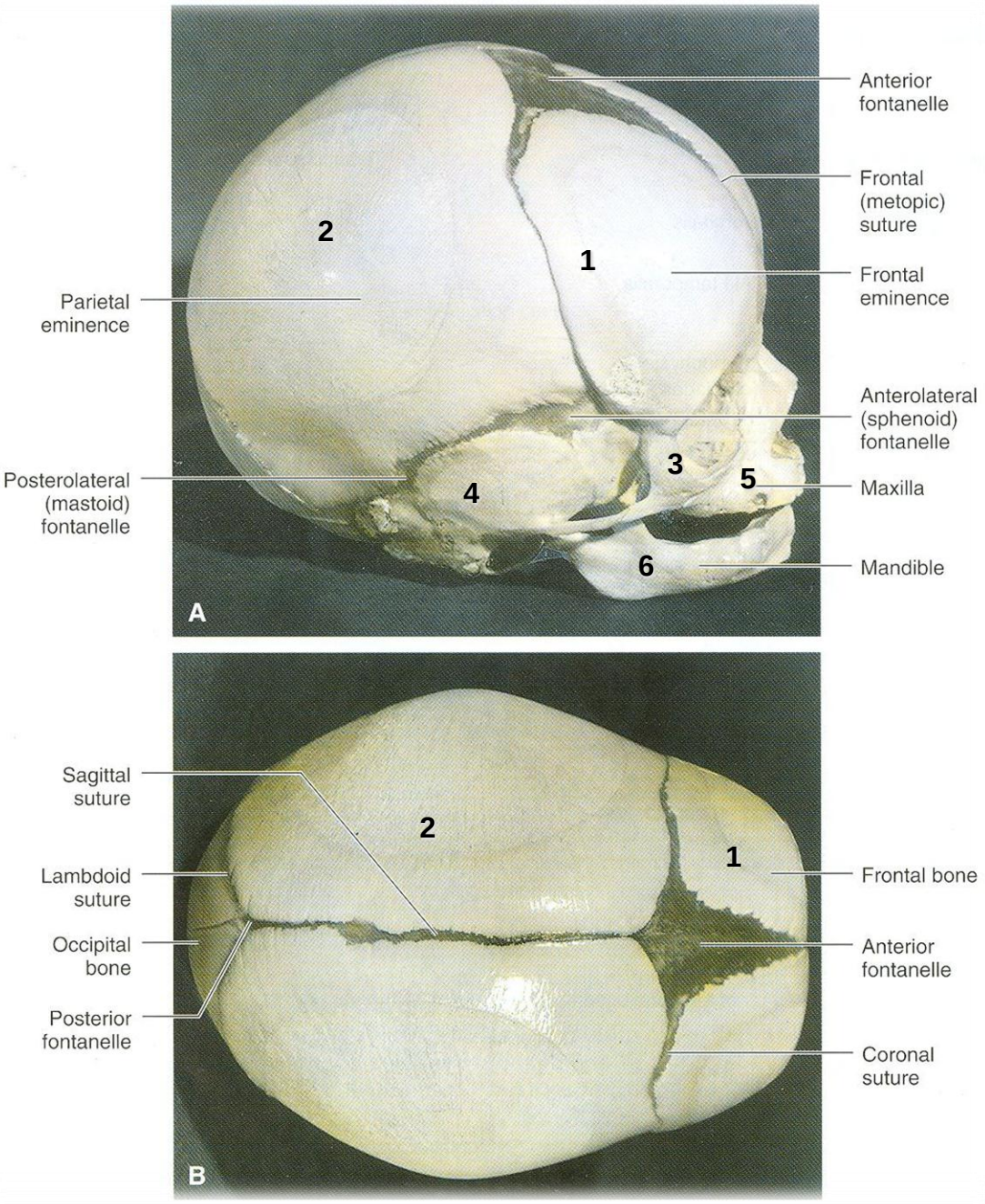
- **Intracartilagenous (Endochondral) ossification**
- **Intramembranous ossification**

ossification: formation of bone.

Bones of skull that ossify by intramembranous ossification:

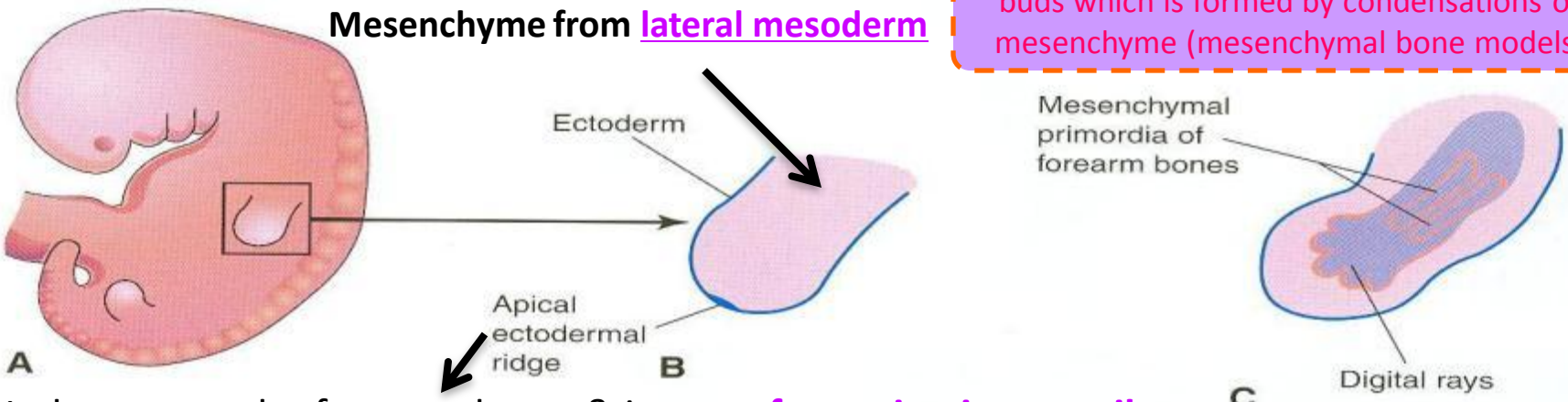
1. Frontal
2. Parietal
3. Zygomatic
4. Squamous temporal
5. Maxilla
6. Mandible

Base of skull develops by **intracartilagenous** ossification

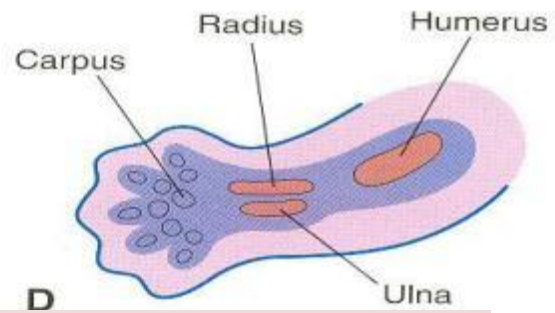


Mesenchyme from lateral mesoderm

buds which is formed by condensations of mesenchyme (mesenchymal bone models)

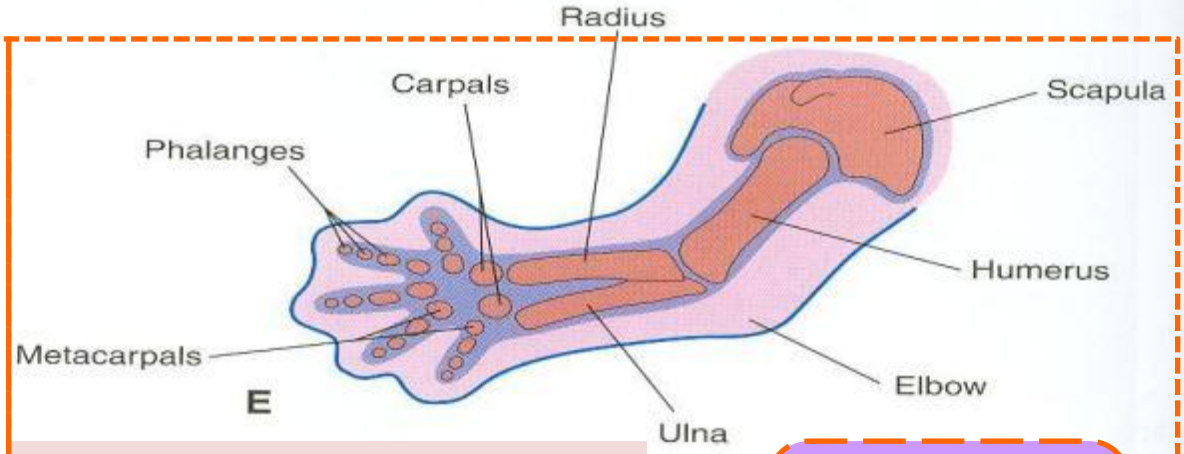


Induces growth of mesenchyme & its **transformation into cartilage**



Cartilage ossifies by:
Endochondral ossification

mesenchymal bone models undergo chondrification to form cartlige bone model



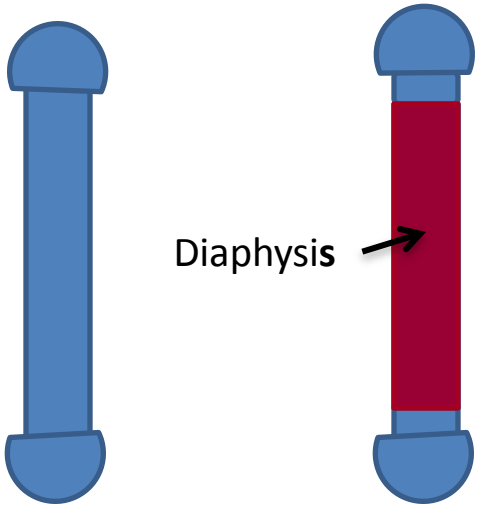
Myoblasts migrate from myotomes to form:
Muscles of limbs

completed cartilaginous models of the bone of the upper limb

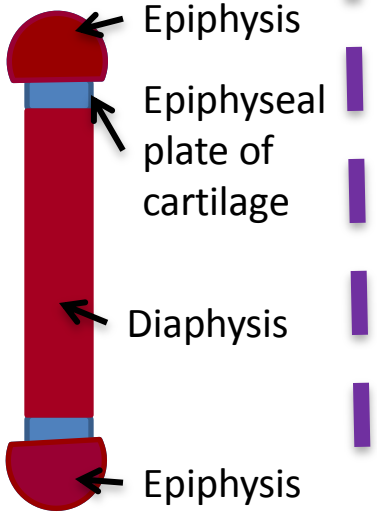
Ossification of Long Bones

Bone in cartilaginous state

Appearance of primary ossification centers: ossification of diaphysis



Appearance of secondary ossification centers: ossification of epiphysis



Ossification of epiphseal plate: Complete union of epiphysis & diaphysis

Growth of bone stops

BIRTH → **PUBERTY**

Bone increases in length by proliferation of epiphyseal plate

Bone age is a good index of general maturation. Bone age is determined by:

1. **Appearance of ossification centers in diaphysis & epiphysis (specific for each bone & sex)**
2. **Disappearance of epiphyseal plate (specific for each bone & sex)**

Summary of Development of Bone

All bones develop from **MESODERM**

- **AXIAL SKELETON:**
  - Vertebrae, ribs, sternum → from sclerotomes of somites (paraxial mesoderm)
  - Skull → from mesoderm surrounding the brain
- **APPENDICULAR SKELETON** → from somatic part of lateral mesoderm

All bones ossify by endochondral ossification EXCEPT:

1. Some bones of skull
2. Clavicle

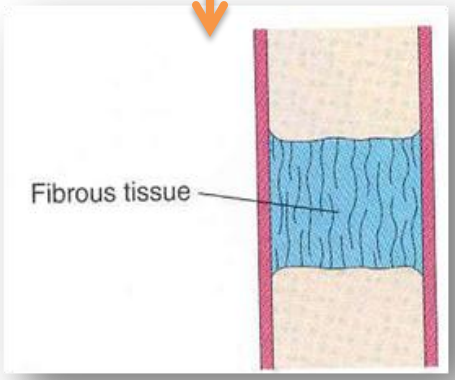
Long bones are formed by cartilaginous ossification

Flat bones are formed by membranous ossification

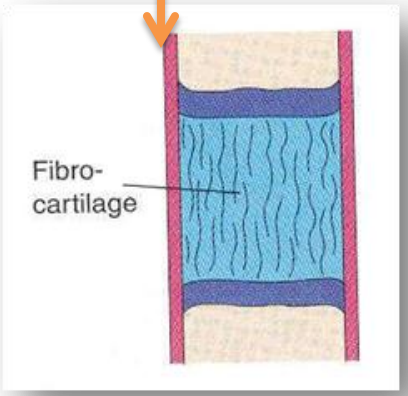
Development of Joints

They develop from **mesoderm lying between bones**:

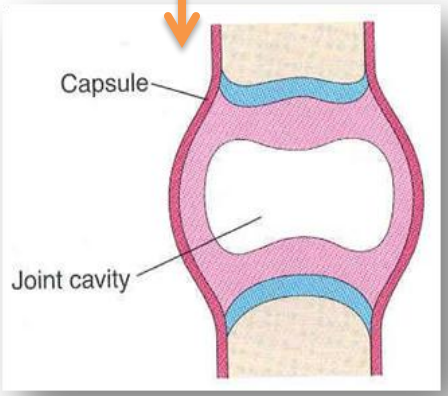
In fibrous joints: mesoderm differentiates into **dense fibrous connective tissue**



In cartilaginous joints: mesoderm differentiates into **cartilage**.



In synovial joints: a **synovial cavity** is formed inside mesoderm; mesoderm differentiates into **synovial membrane, capsule & ligaments.**



DEVELOPMENT OF MUSCLES

All muscles develop from **MESODERM** EXCEPT :

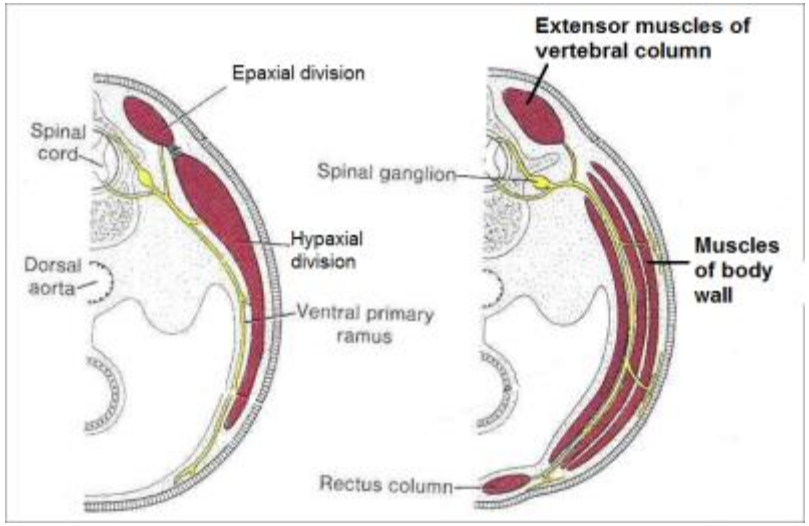
muscles of iris قزحية(eyeball) and myoepithelial cells of mammary (the secretive part of the gland)& sweat glands which develop from **ECTODERM**

Muscle type	develop from
Cardiac muscles	splanchnic part of **lateral mesoderm**
Smooth muscles	•In the wall of viscera : splanchnic part of **lateral mesoderm** •In the wall of blood & lymphatic vessels from: somatic part of **lateral mesoderm**
skeletal muscles	myotomes of **paraxial mesoderm** **EXCEPT** some head & neck muscles which develop from mesoderm of **pharyngeal arches**

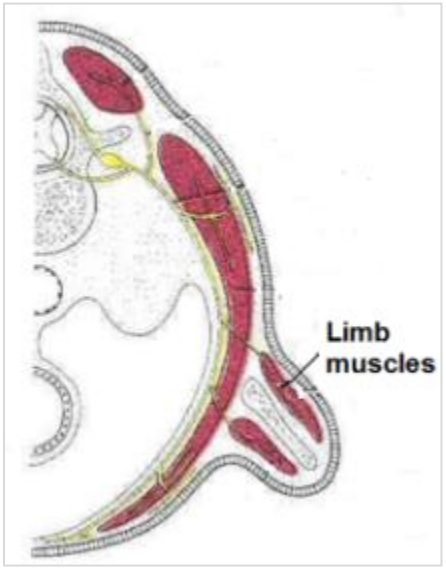
Myotome

Each myotome divides into:

- Dorsal Epaxial division
- Ventral Hypaxial division

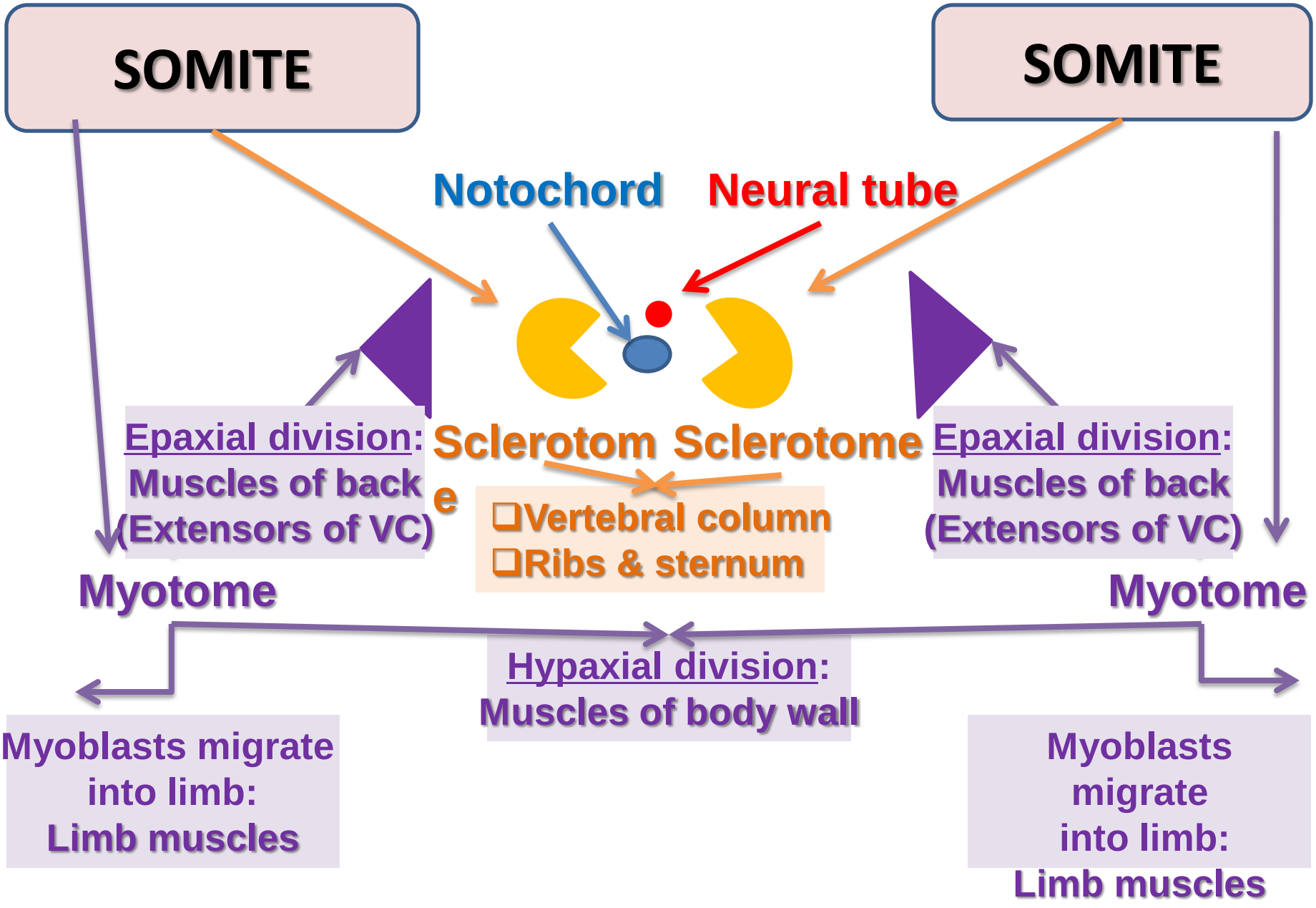


- The Epaxial division gives rise to the **muscles of the back** (extensor muscles of the vertebral column)
- Ventral Hypaxial division gives rise to the **muscles of the ventral body wall**



Myoblasts migrate into limb and give Limb muscles

Tome = small part


SOMITE
SOMITE
Notochord
Neural tube
Epaxial division:
Muscles of back
(Extensors of VC)
Sclerotom
e
Sclerotome
❑Vertebral column
❑Ribs & sternum
Epaxial division:
Muscles of back
(Extensors of VC)
Myotome
Myotome
Hypaxial division:
Muscles of body wall
Myoblasts migrate
into limb:
Limb muscles
Myoblasts
migrate
into limb:
Limb muscles

QUESTION 1

- Which one of the following group of muscles are derivatives from epaxial division of myotomes?

1. Muscles of back
2. Muscles of limbs
3. Muscles of viscera
4. Cardiac muscles

QUESTION 2

- Which one of the following bones ossifies by intramembranous ossification?

1. Vertebra
2. Humerus
3. Ribs
4. Mandible

QUESTION 3

❖ Regarding the ossification of long bones, which one of the following statement is correct?

1. Primary ossification centre appears after birth.
2. Secondary ossification centre leads into ossification of diaphysis.
3. Long bones ossify by intramembranous ossification.
4. When epiphysis unites with diaphysis, growth of bone stops. ⬅

QUESTION 4

❖ The base of the skull develops by ?

1. intramembranous ossification
2. intracartilagenous ossification ⬅

QUESTION 5

- All bones ossify by endochondral ossification EXCEPT ?

1. ribs
2. Hip
3. Clavicle ⬅
4. vertebra

QUESTION 6

- myoepithelial cells of mammary are develop from ?

1. ECTODERM ⬅
2. ENDODERM
3. MESODERM


GOOD LUCK