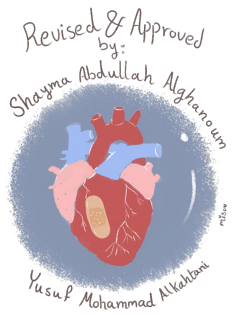


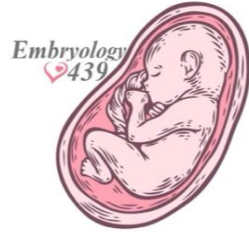
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Editing file

EMBRYOLOGY OF THE LIMBS

Musculoskeletal Block

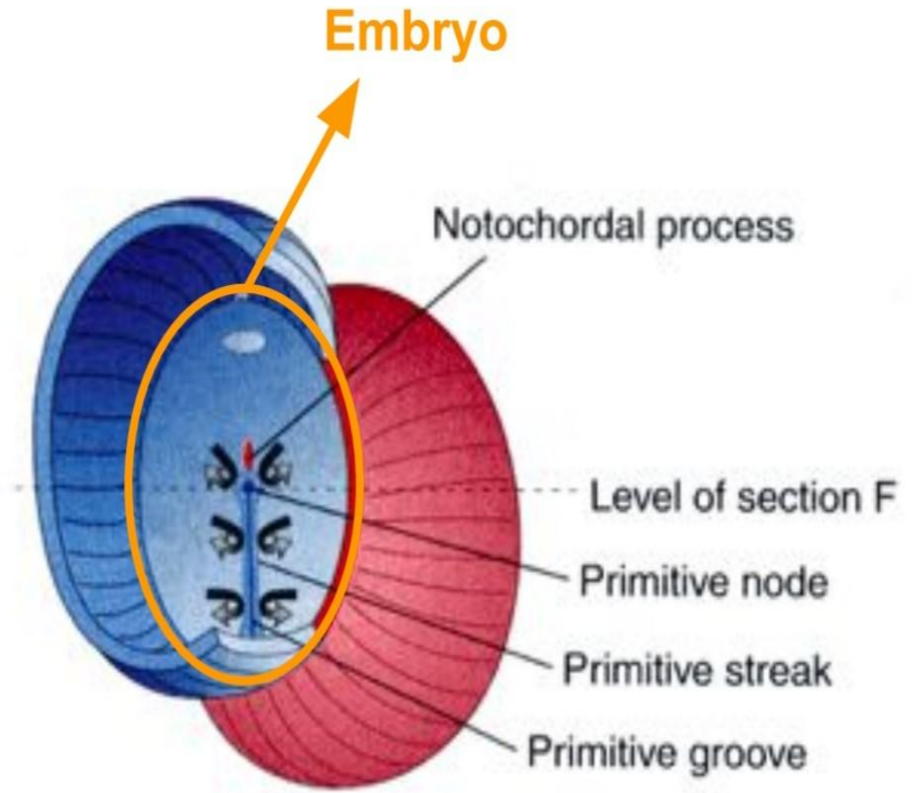
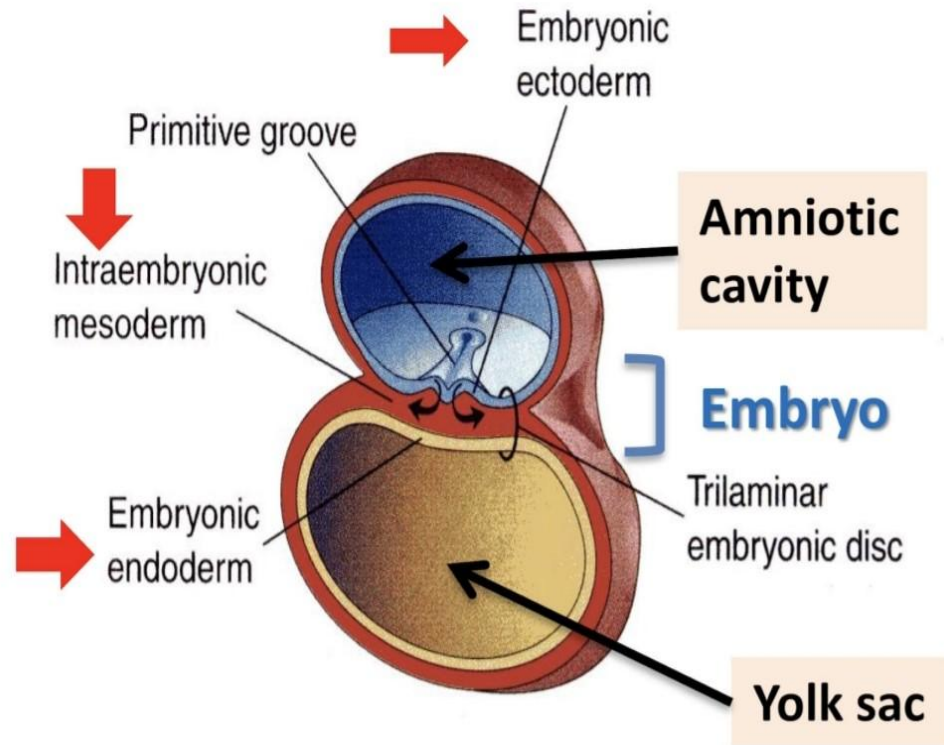


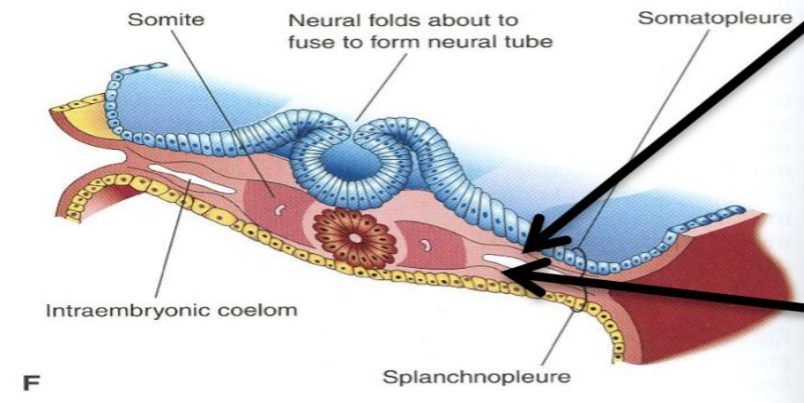
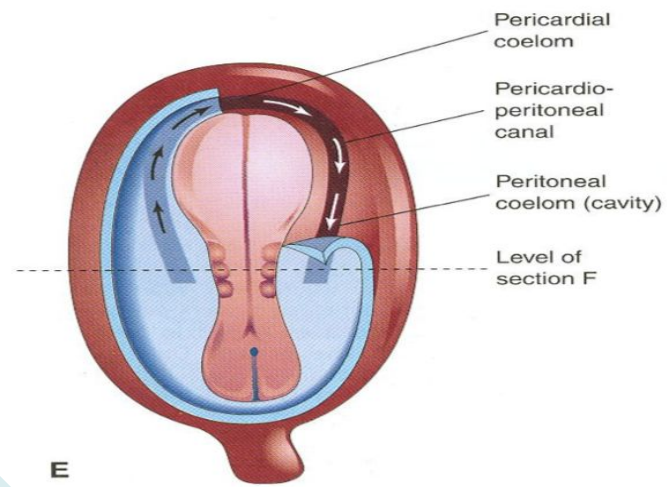
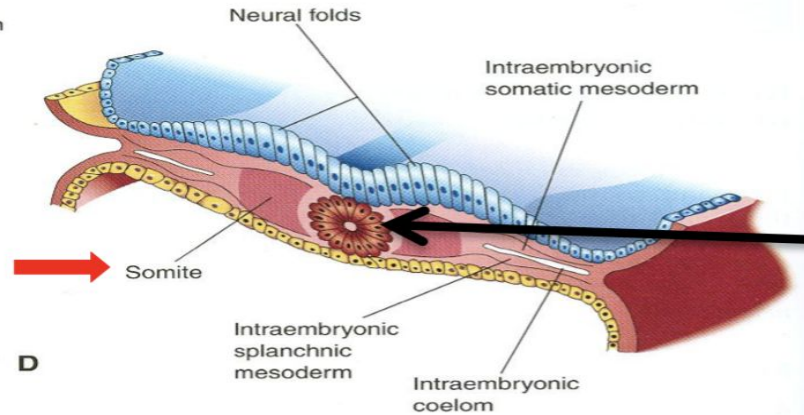
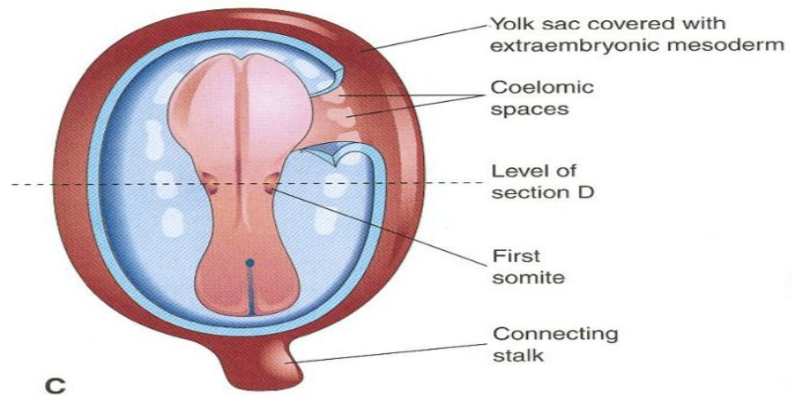
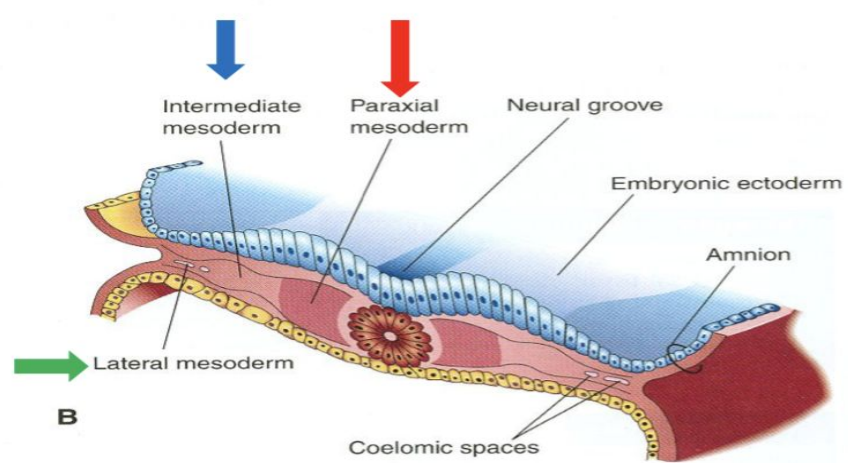
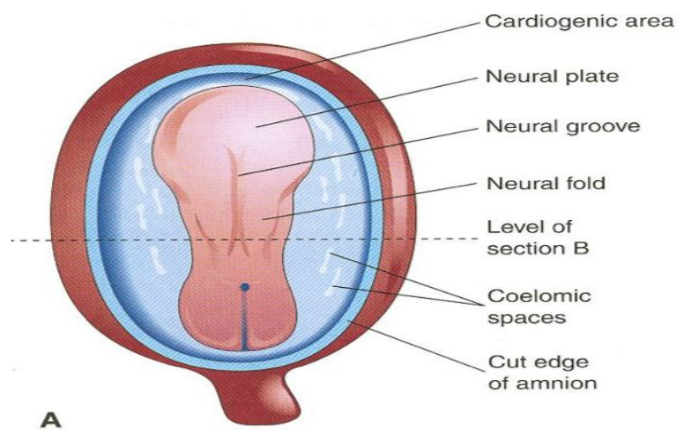
Color index:
important & Doctor's notes
Extra information

Objectives :

- List the different parts of mesoderm and the different divisions of somites.
- Differentiate bones according to their embryological origin and mode of ossification.
- Describe the ossification of long bones.
- Describe the main steps for development of limbs.
- Differentiate muscles according to their embryological origin.

Revision





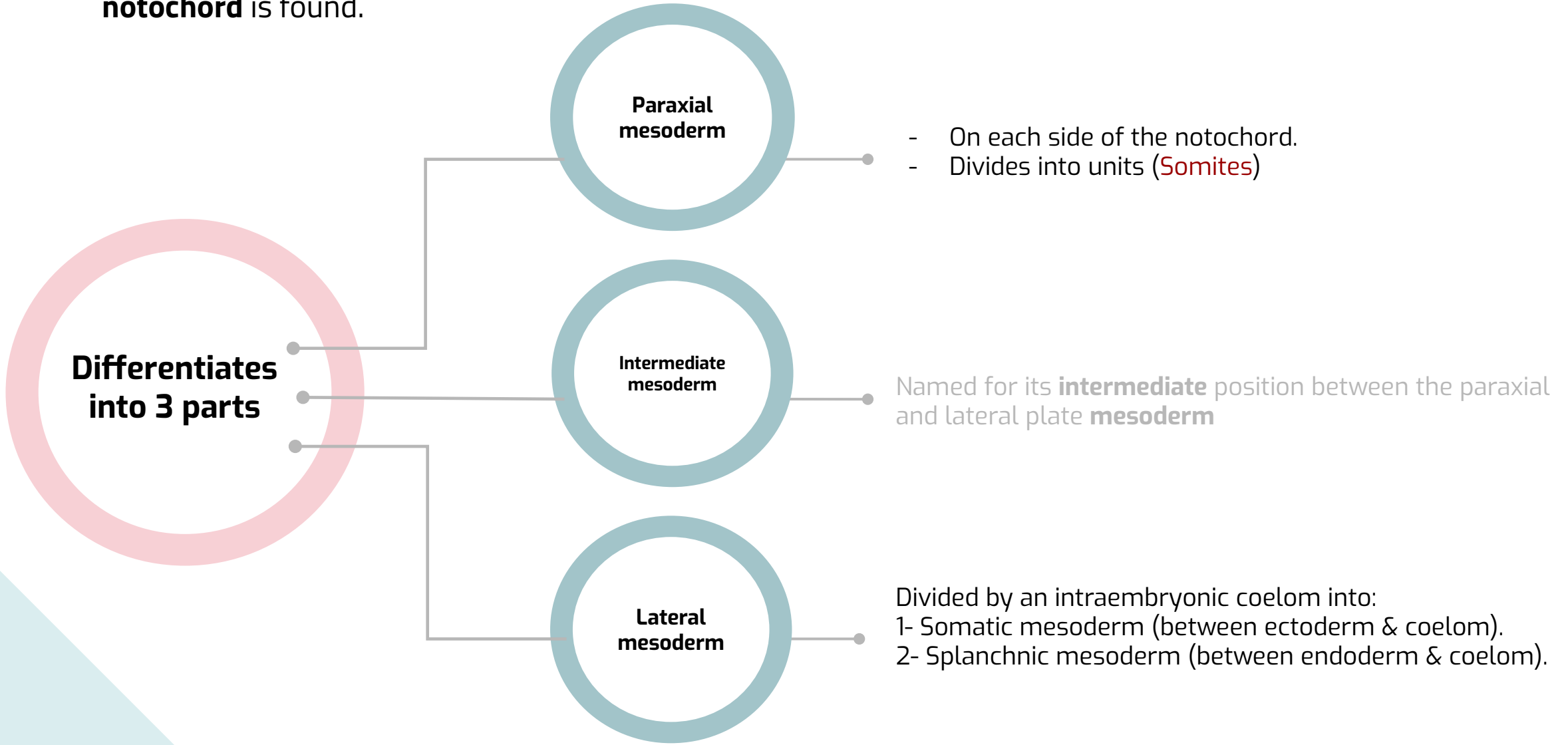
Notochord:
stimulates neural tube
formation

Somatic mesoderm

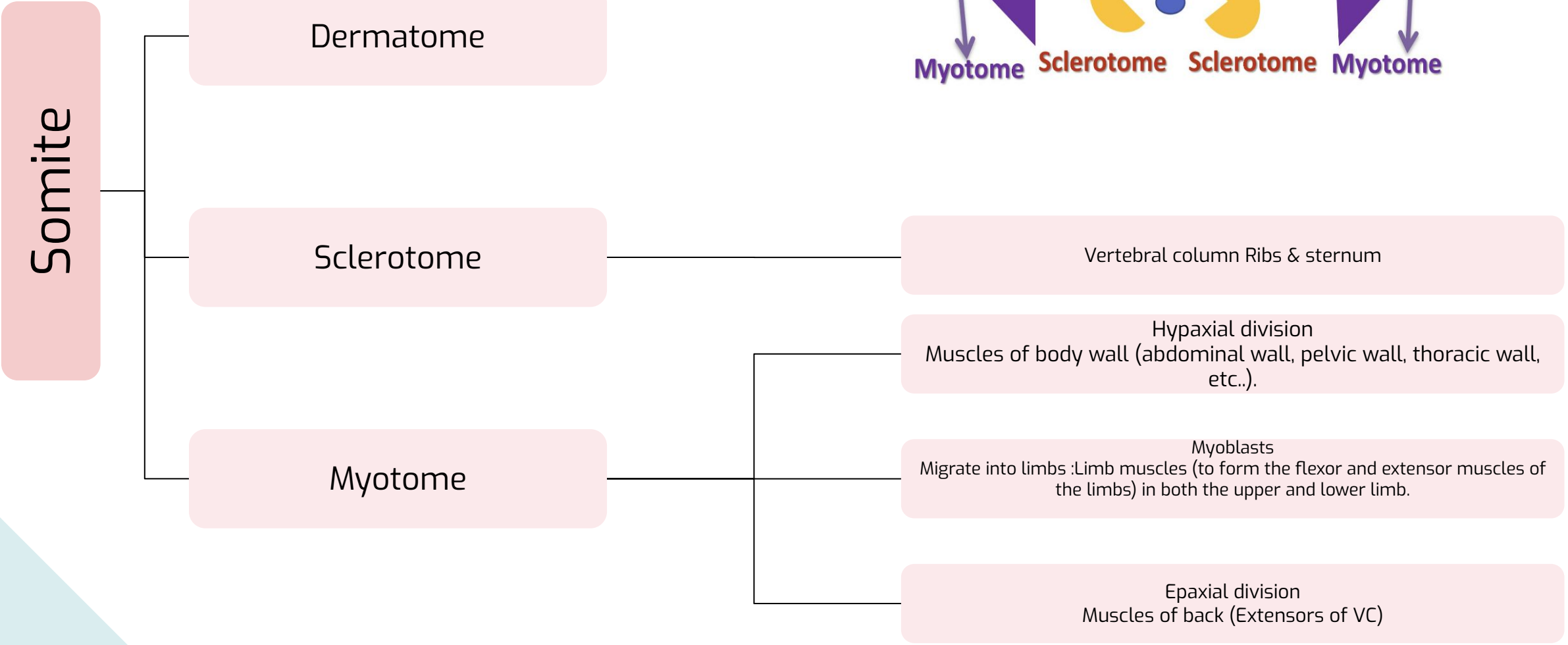
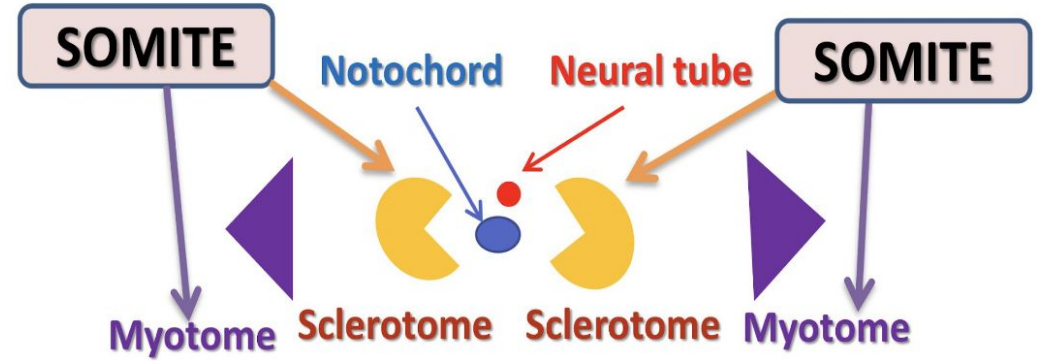
**Splanchnic
mesoderm**

Intraembryonic Mesoderm

- ❖ Proliferates between the ectoderm & endoderm except in the central axis of the embryo where **notochord** is found.



- ❖ Paraxial mesoderm differentiates into units, each unit is called a **Somite**



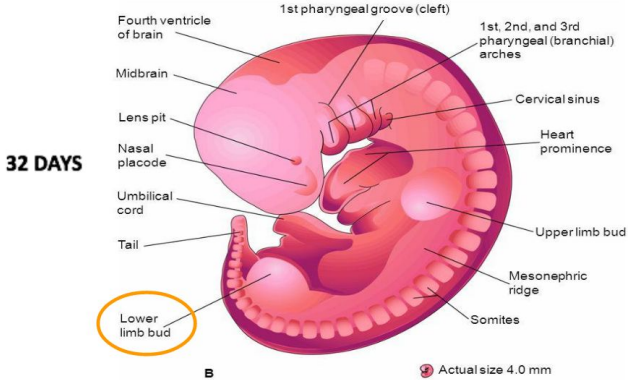
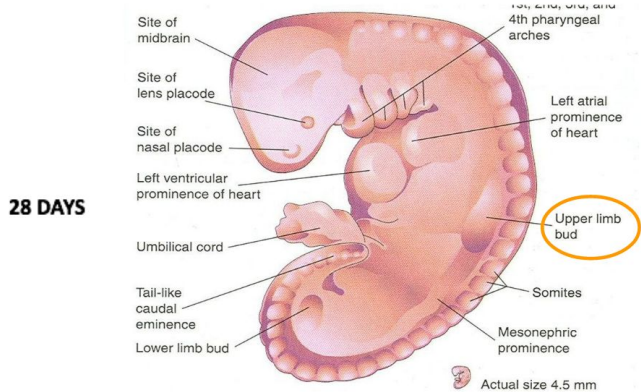
Development of The Limbs:

The **limb bud** appears as an elevation on the ventrolateral body wall resulting from proliferation of mesenchyme of the **somatic layer of the lateral mesoderm**.
Each limb bud is surrounded by an area of ectoderm.

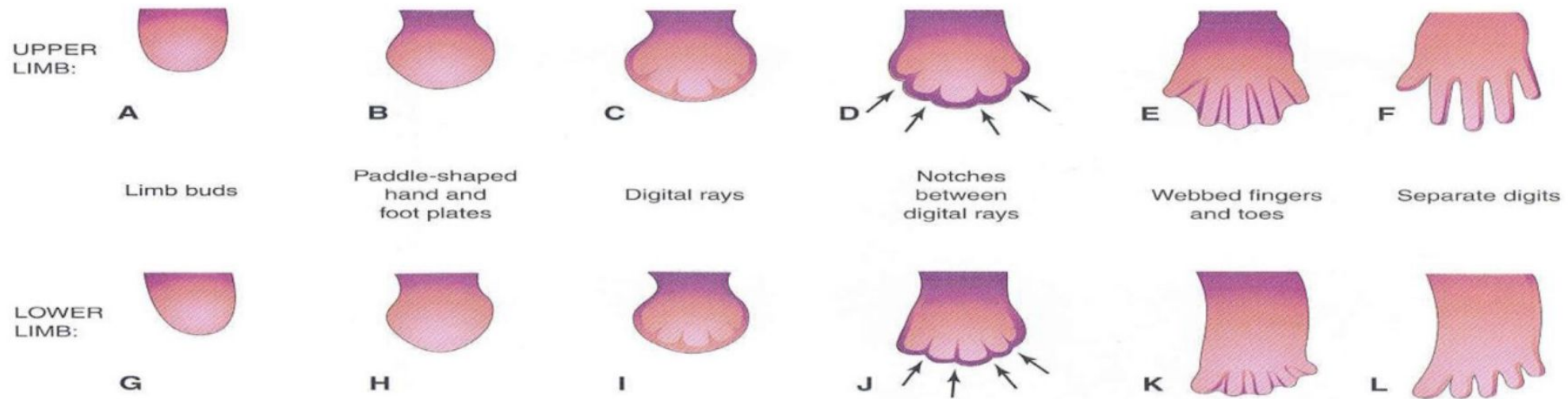
Limb Buds

Upper limb bud:
Appear at day 26 opposite to the lower cervical segments.

Lower limb bud:
Appear at day 28 opposite to the lumbar & sacral segments.



Development of The Limbs, Contd..



A & G

Apical ectodermal ridge: appears at the apex of limb bud and stimulates proliferation of mesenchyme and elongation of limb bud.

B & H

Distal ends of buds **flatten** into paddle-like hand & foot plates.

C & I

Digital rays: appear as mesenchymal condensations that outline the patterns of digits

D & J

Notches appear between digital rays.

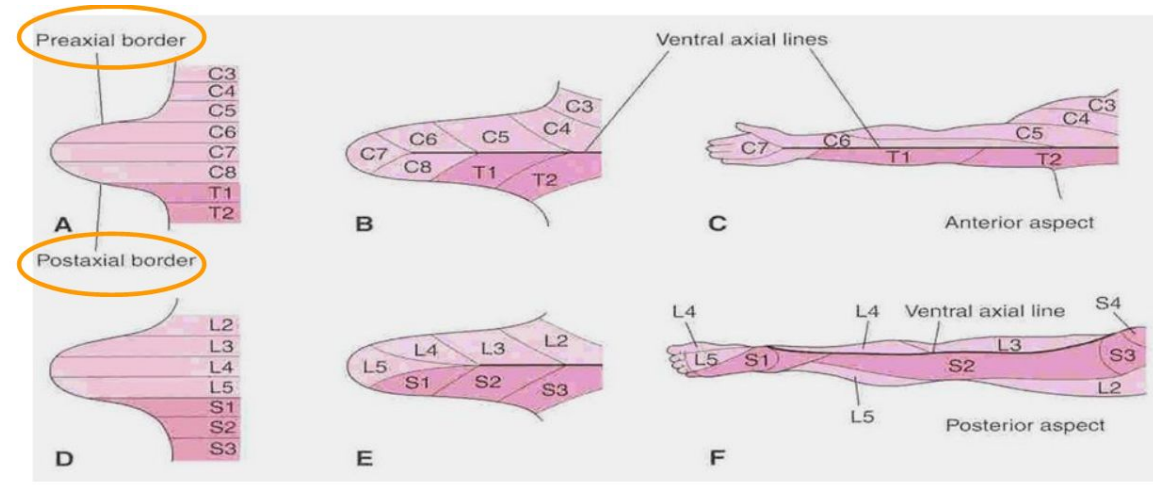
E & K

Digits form inside rays, elongate & appear **webbed**.

F & L

Mesenchyme between digits **disappear** to separate them.

Development of The Limbs, Contd..



Originally, limb buds were at right angle of the trunk with:

- 1- Cranial (preaxial) & Caudal (postaxial) borders: **radius** and **tibia** are preaxial bones.
- 2- Ventral & Dorsal surfaces: **flexor muscles** are ventral.

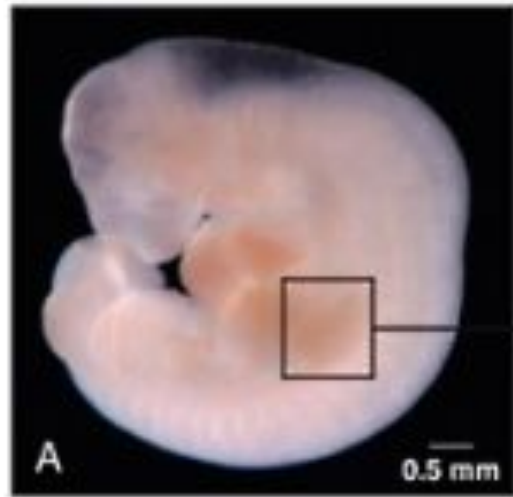
During 7th week, adduction of limb buds occurs with 90° rotation:

- 1- **In upper limb**, rotation occurs **laterally** → radius is lateral & flexor muscles are anterior.
- 2- **In lower limb**, rotation occurs **medially** → tibia is medial & flexor muscles are posterior.

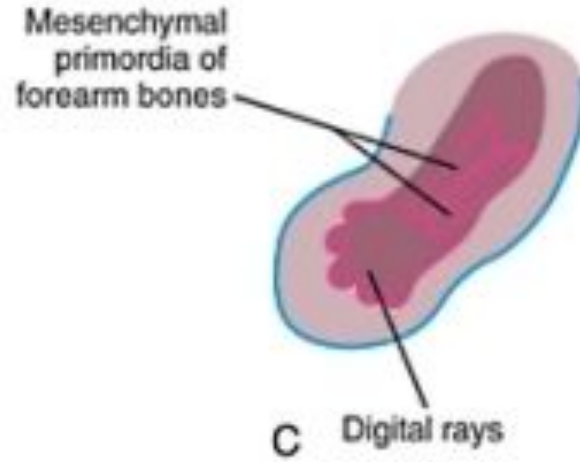
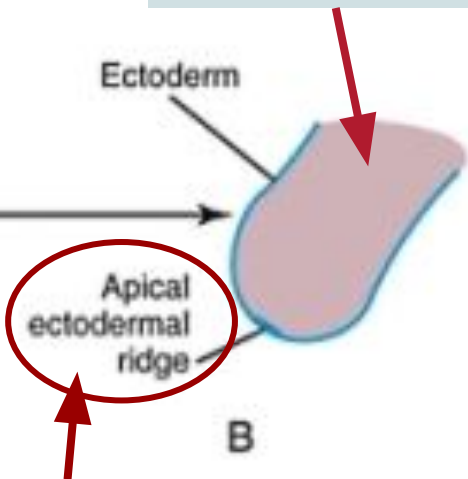
Loose mesenchyme

Condensed mesenchyme

Cartilage



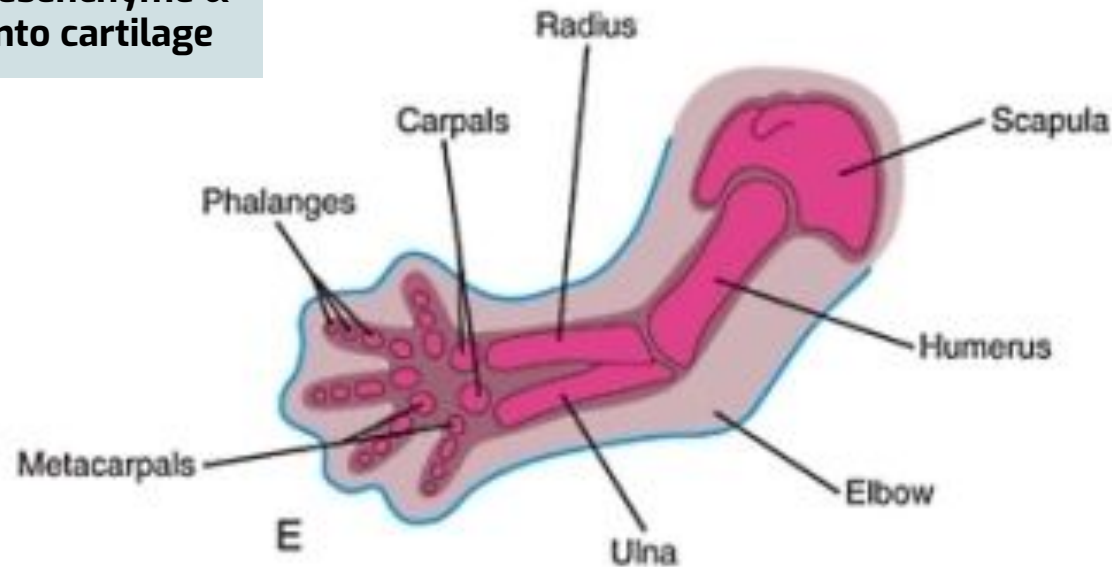
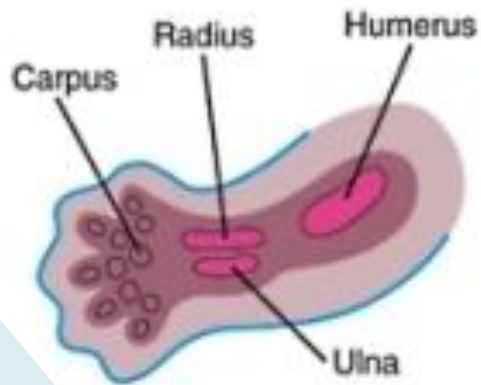
Mesenchyme from lateral mesoderm



Induces growth of mesenchyme & its transformation into cartilage

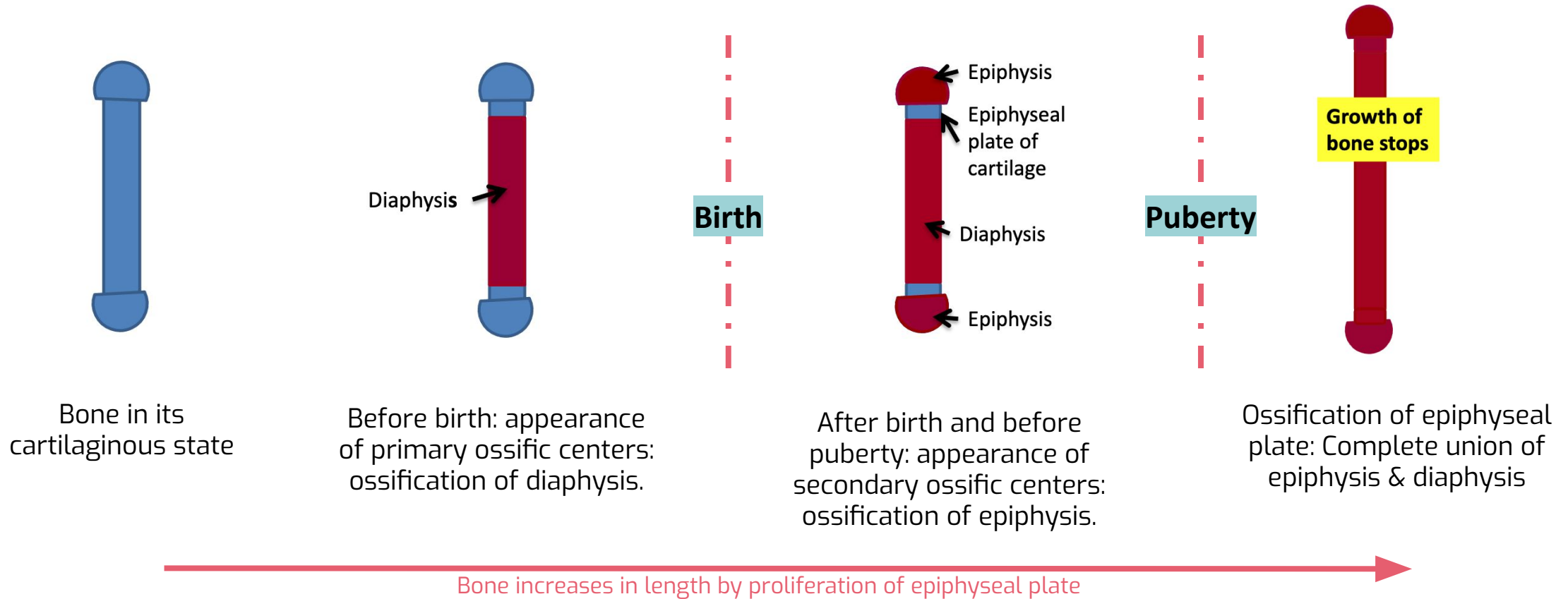
❖ Cartilage ossifies by: **Endochondral ossification.**

❖ **Myoblasts** migrate from myotomes to form: **Muscles of limbs**



Ossification of Long Bone

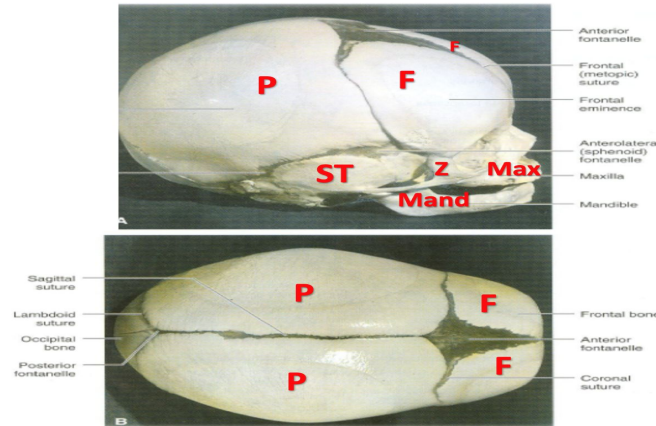
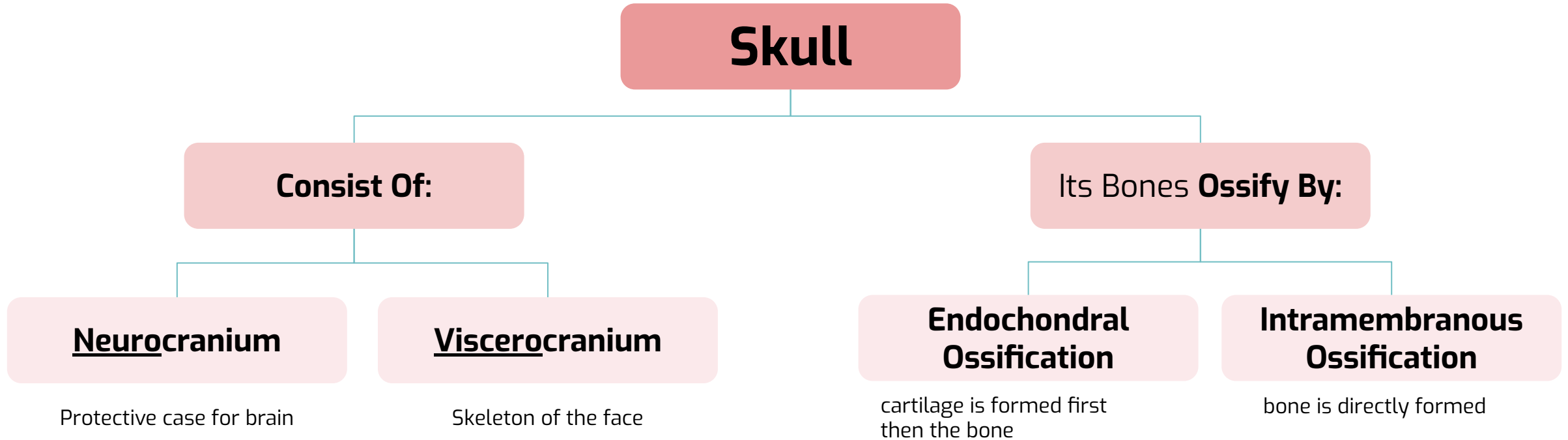
RED : Bone || BLUE : Cartilage



- ❖ **Bone age is a good index of general maturation. Bone age is determined by:**
 - 1- Appearance of ossific centers in diaphysis & epiphysis (specific for each bone & sex).
 - 2- Disappearance of epiphyseal plate (specific for each bone & sex).

Development of Cranium (Skull):

The skull develops from mesoderm around the developing brain

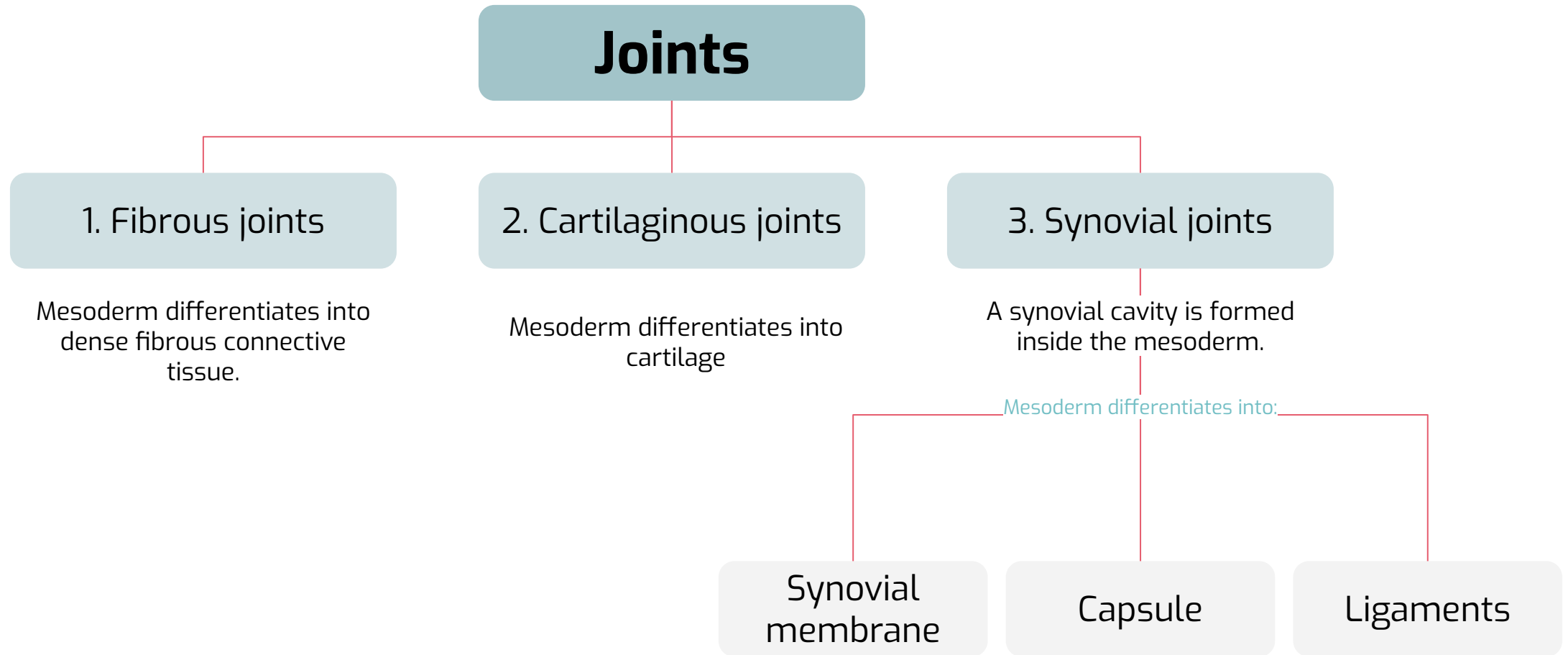


Bones of skull that ossify by intramembranous ossification:

1. F = Frontal
2. P = Parietal
3. Z = Zygomatic
4. ST = Squamous temporal
5. Mand = Mandible
6. Max = Maxilla

Joints

- ❖ Joints develop from the mesoderm between the bones.



Development of Muscles

Muscles develop from <u>Mesoderm</u>	Muscles develop from <u>Ectoderm</u>
<p>→ All other muscles.</p> <p>★ All skeletal muscles develop from myotomes of paraxial mesoderm EXCEPT some head & neck muscles (develop from mesoderm of pharyngeal arches)</p>	<p>→ Muscles of iris (eyeball).</p> <p>→ Myoepithelial cells of mammary & sweat glands.</p>

Cardiac Muscle	Smooth Muscle
Develop from lateral mesoderm (BOTH)	
<p>From: splanchnic part of lateral mesoderm</p>	<ul style="list-style-type: none">- In the wall of viscera from: splanchnic part of lateral mesoderm.- In the wall of blood & lymphatic vessels from: somatic part of lateral mesoderm.

Summary for Development of Bone

- ❖ All bones develop from Mesoderm.

AXIAL SKELETON	APPENDICULAR SKELETON
<ul style="list-style-type: none">- Vertebrae, Ribs & Sternum: From Sclerotomes of Somites (Paraxial Mesoderm).- Skull: From Mesoderm surrounding the Brain.	From Somatic part of Lateral Mesoderm.

All bones ossify by **Endochondral Ossification** except:

- 1- Some bones of Skull
- 2- Clavicle

Summary for Development of Limbs

- ❖ Mesenchyme from **somatic layer of lateral mesoderm** proliferates to form limb buds.
- ❖ **Apical ectodermal ridge** stimulates proliferation & elongation of buds then cartilage formation.
- ❖ All bones of limbs ossify by **endochondral ossification**
 - EXCEPT: clavicle.
- ❖ Muscles of limbs develop from **myotomes**.
- ❖ Rotation of limbs occur in **opposite** direction.
- ❖ Development of upper limb **precedes** that of lower limb.

Summary med436

BONE	MUSCLES	LIMBS
<p>All bones develop from MESODERM.</p> <p>AXIAL SKELETON:</p> <p>*Vertebrae, ribs & sternum: from sclerotomes of somites (paraxial mesoderm)</p> <p>*Skull: from mesoderm surrounding the brain.</p> <p>APPENDICULAR SKELETON:</p> <p>from somatic part of lateral mesoderm</p> <p>All bones ossify by enchondral ossification EXCEPT:</p> <ol style="list-style-type: none">1. Some bones of skull2. Clavicle	<p>☐ All muscles develop from MESODERM EXCEPT:</p> <ol style="list-style-type: none">1. Muscles of iris (eyeball) ECTODERM2. Myoepithelial cells of mammary & sweat glands, ECTODERM <p>☐ All skeletal muscles develop from myotomes of paraxial mesoderm EXCEPT: some head & neck muscles from mesoderm of pharyngeal arches</p> <hr/> <p>☐ Cardiac & smooth muscles develop from lateral mesoderm:</p> <ol style="list-style-type: none">1. Cardiac muscles from: splanchnic part of lateral mesoderm2. Smooth muscles: * In the wall of viscera from: splanchnic part of lateral mesoderm * In the wall of blood & lymphatic vessels from: somatic part of lateral mesoderm	<p>☐ Mesenchyme from somatic layer of lateral mesoderm proliferates to form limb buds.</p> <p>☐ Apical ectodermal ridge stimulates proliferation & elongation of buds then cartilage formation.</p> <p>☐ All bones of limbs ossify by enchondral ossification EXCEPT: clavicle.</p> <p>☐ Muscles of limbs develop from myotomes.</p> <p>☐ Rotation of limbs occur in opposite direction.</p> <p>☐ Development of upper limb precedes that of lower limb.</p>

MCOs:

1-which of the following develops the muscles of body wall?

A-Epaxial division

B-Sclerotome

C-Dermatome

D-Hypaxial division

2-which of the following bones will ossify by intramembranous ossification?

A-Sternum

B-Maxilla

C-Vertebrae

D-Scapula

3-Lower limb buds appears?

A-Day 26

B-Day 28

C-Day 32

D-Day 30

4-Bones of skull will ossify by?

A-Endochondral ossification

B-Intramembranous ossification

C- A&B

D-None

5-secondary ossific centers appears:

A-Before birth

B-After birth

C-During puberty

D-After puberty

1- D
2- B
3- B
4- C
5- B

This lecture was done by:

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