

Embryology of the limbs

Editing File

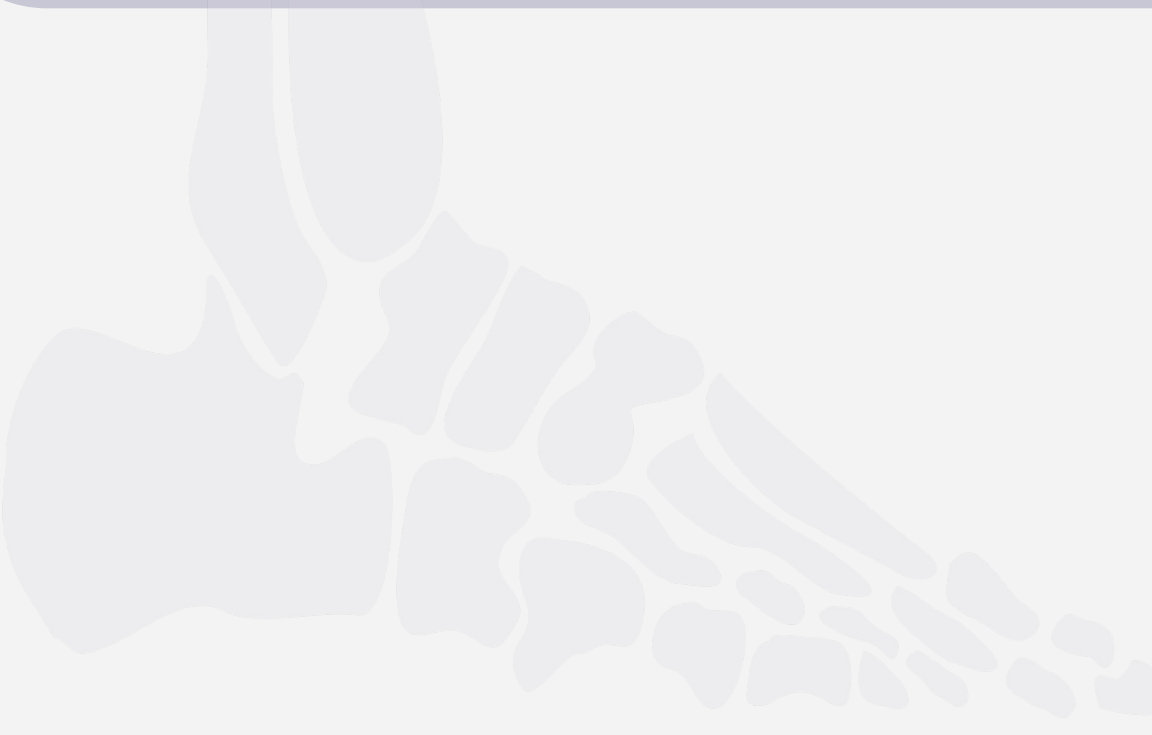
Color Index:

- Main Text
- **Important**
- Female slides
- Male slides
- **Doctor's notes**
- Extra info

يُدَبِّرُ الْأَمْرَ مِنَ السَّمَاءِ إِلَى الْأَرْضِ

فَمَا لَذَّةَ الْعَيْشِ دُونَ تَحَدٍّ ؟

وَمَا قِيَمَةَ الْحُلْمِ إِنْ كَانَ سَهْلًا مَيْسِرًا ؟





Objectives

At the end of the lecture, students should be able to:

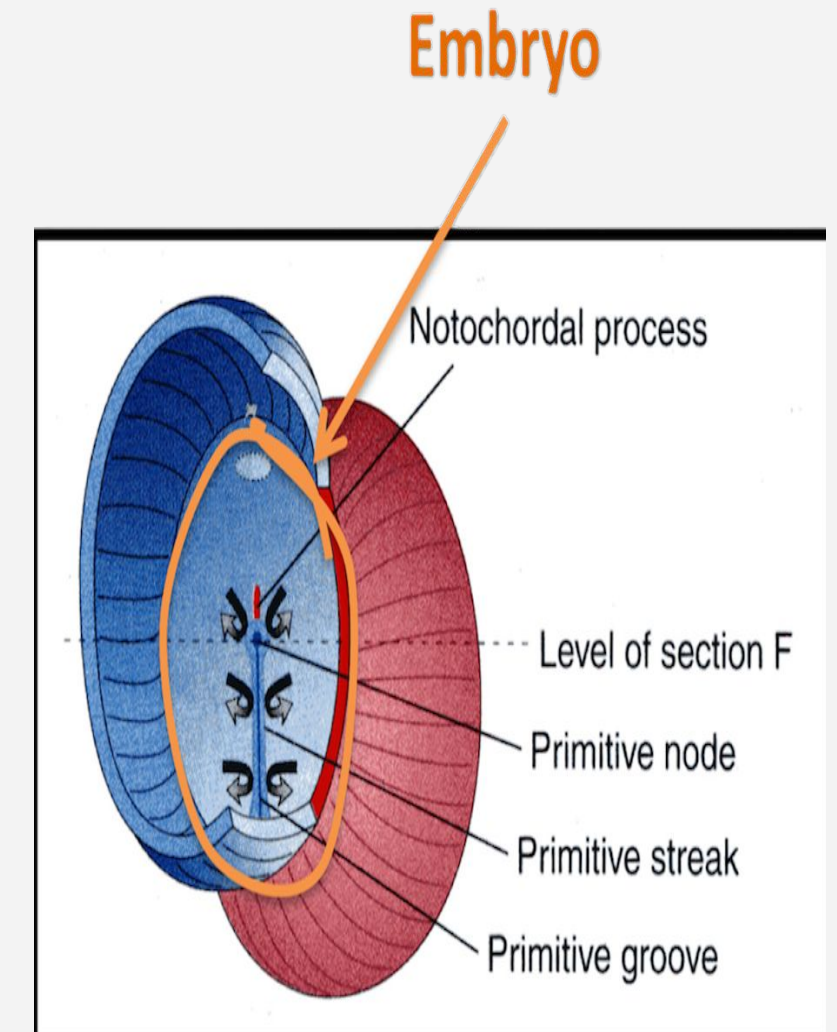
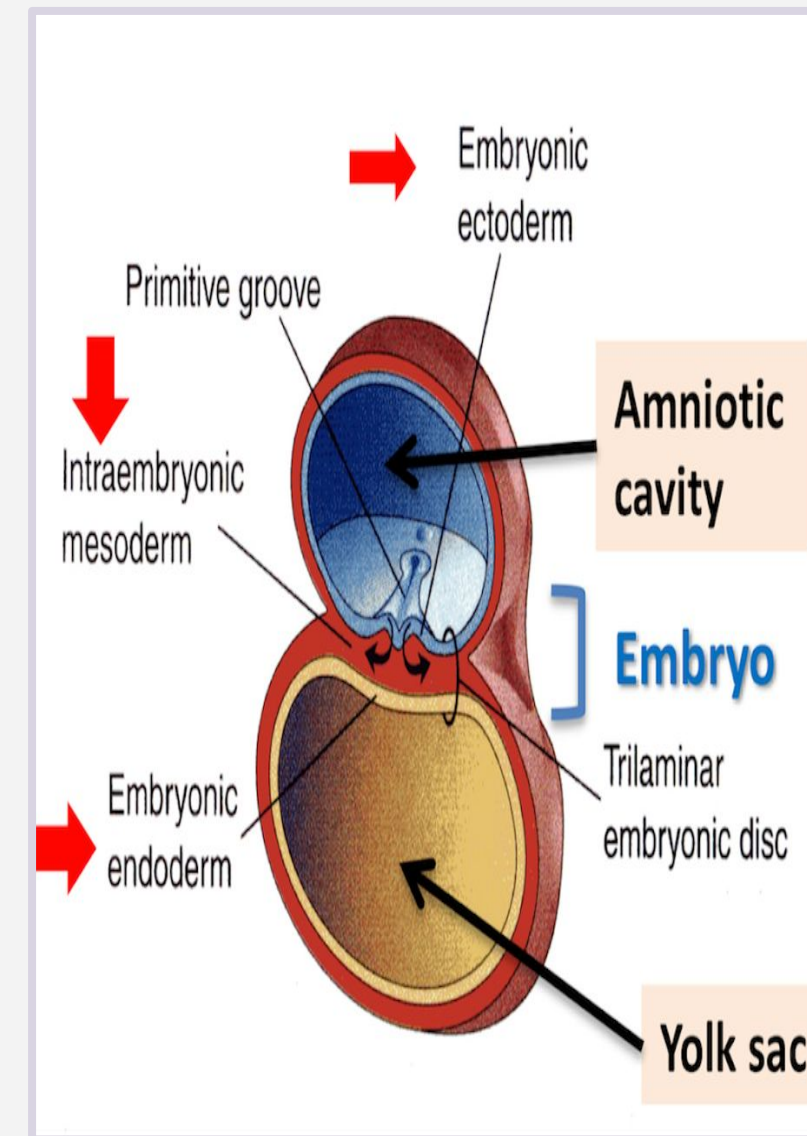
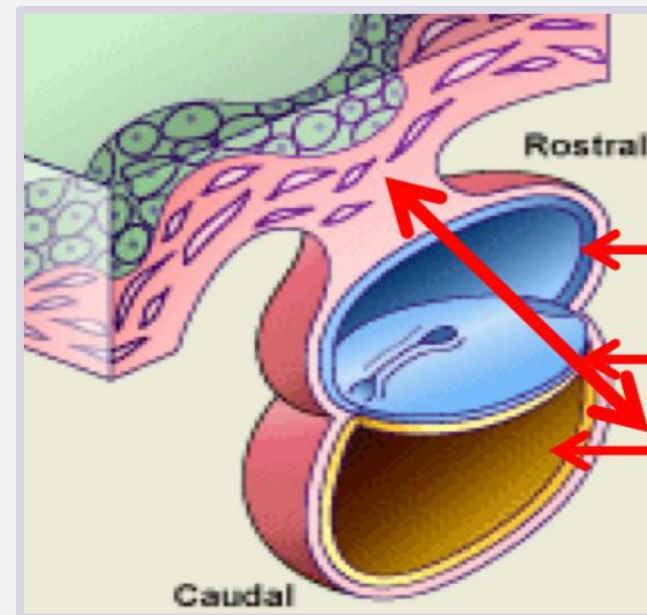
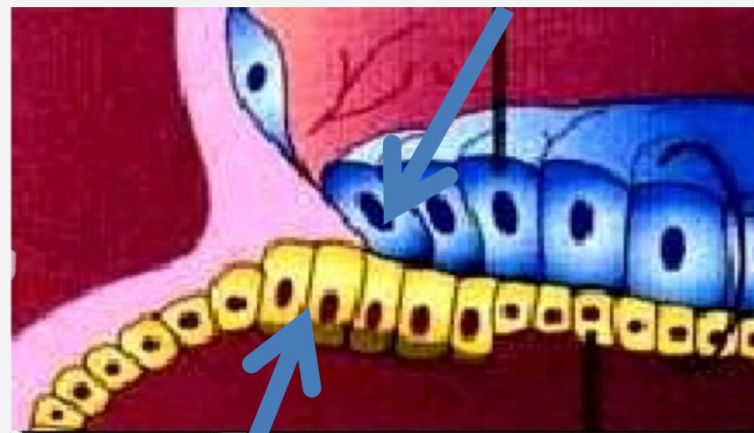
- **List the different parts of mesoderm and the different divisions of somites.**
- **Differentiate bones according to their embryological origin and mode of ossification.**
- **Describe the ossification of long bones.**
- **Describe the main steps for development of limbs.**
- **Differentiate muscles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



Girls slide only

Second week:

- Epiblast
- Hypoblast
- Amniotic cavity
- Yolk sac cavity



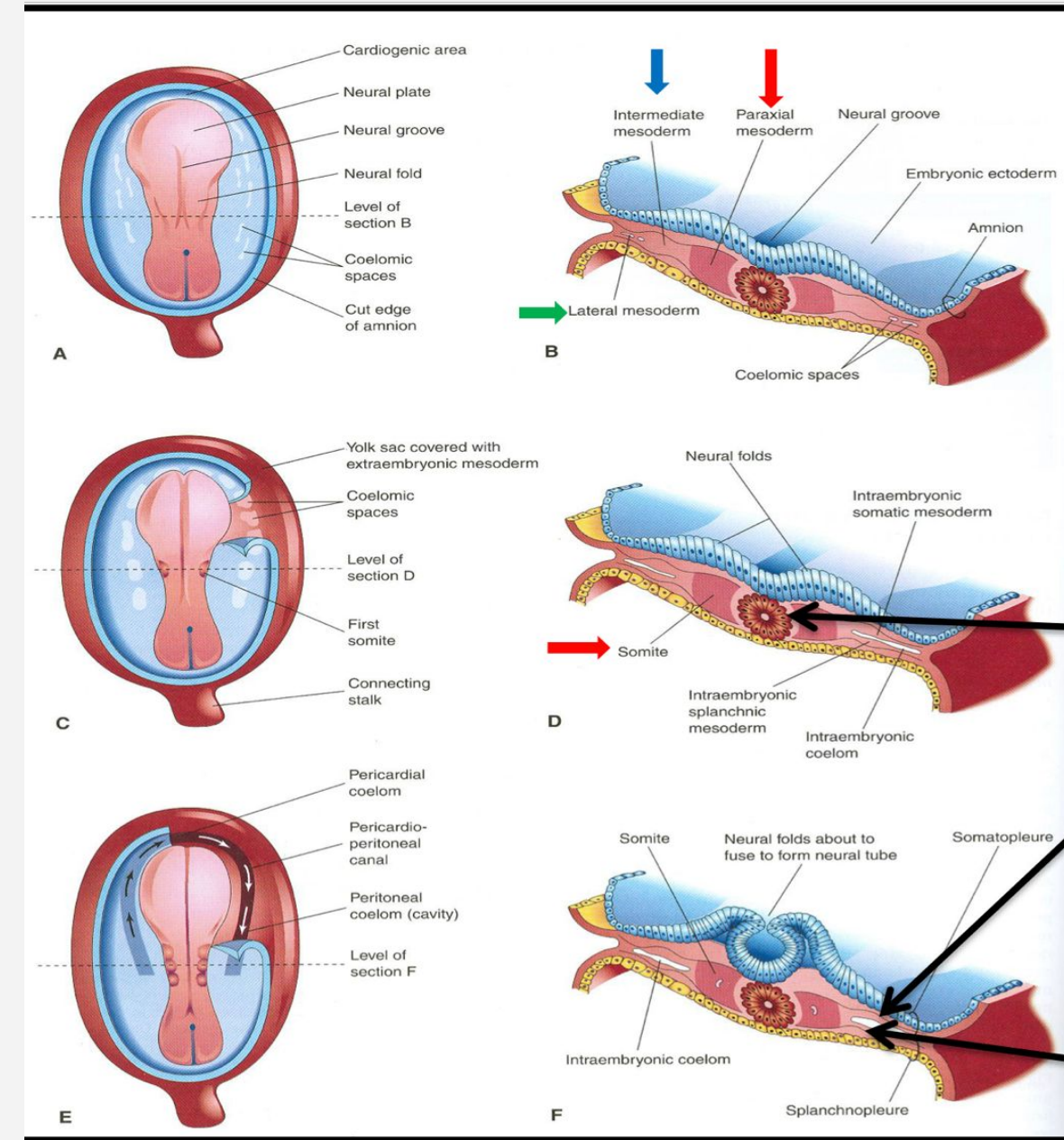
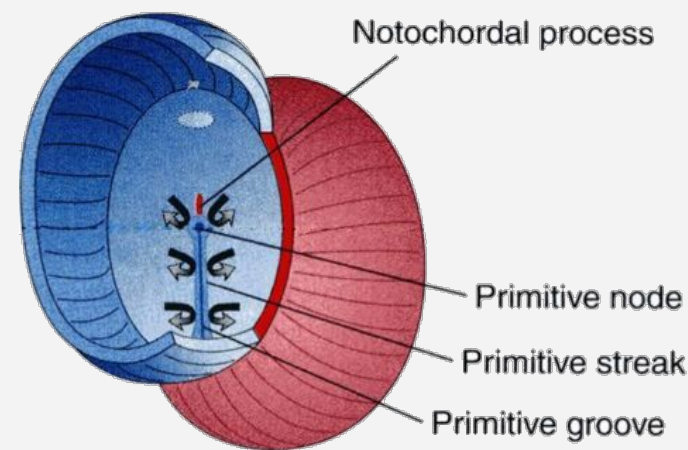
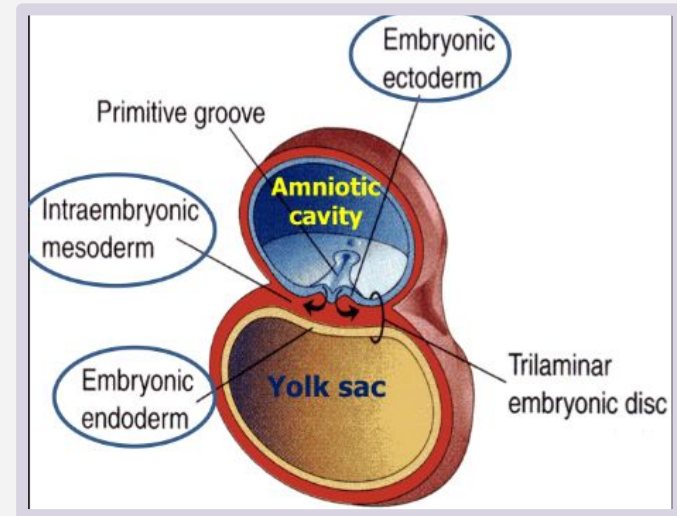
Girls slide only

The Three Germ Layers:

- Ectoderm
- Mesoderm
- Endoderm

Notochord stimulates neural tube formation which in turn stimulates development of the vertebral column.

The **Neural Tube** is a derivative of the ectoderm.



Notochord:
stimulates neural tube formation

Somatic mesoderm

Splanchnic mesoderm

Intraembryonic Mesoderm

Proliferates **between Ectoderm & Endoderm** **EXCEPT** in the central axis of embryo where **NOTOCHORD** is found.

Differentiates into 3 parts:

Paraxial mesoderm

- on each side of the notochord.
- Paraxial mesoderm divides into units (**somites**).

Intermediate mesoderm

439 note: Named for its intermediate position between the paraxial into 3 parts and lateral plate mesoderm.

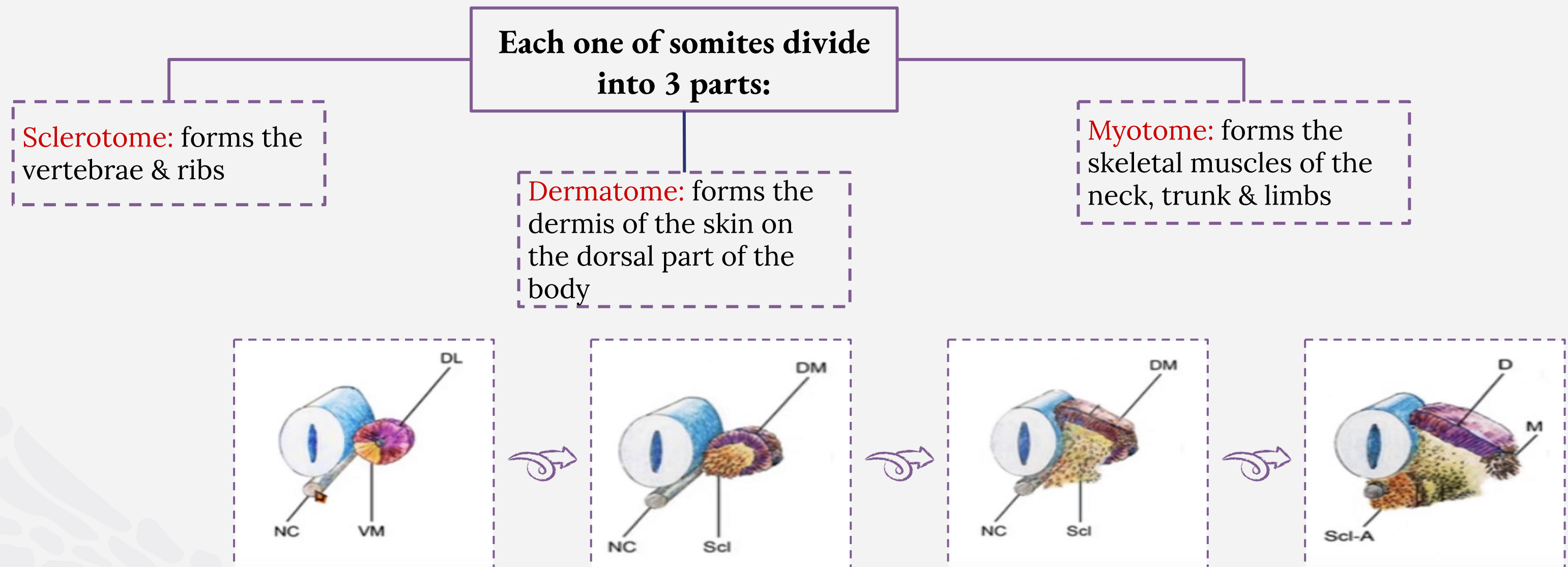
Lateral mesoderm

Divides by intraembryonic coelom into:

1. Somatic mesoderm (between ectoderm & coelom).
2. Splanchnic mesoderm (between endoderm & coelom).

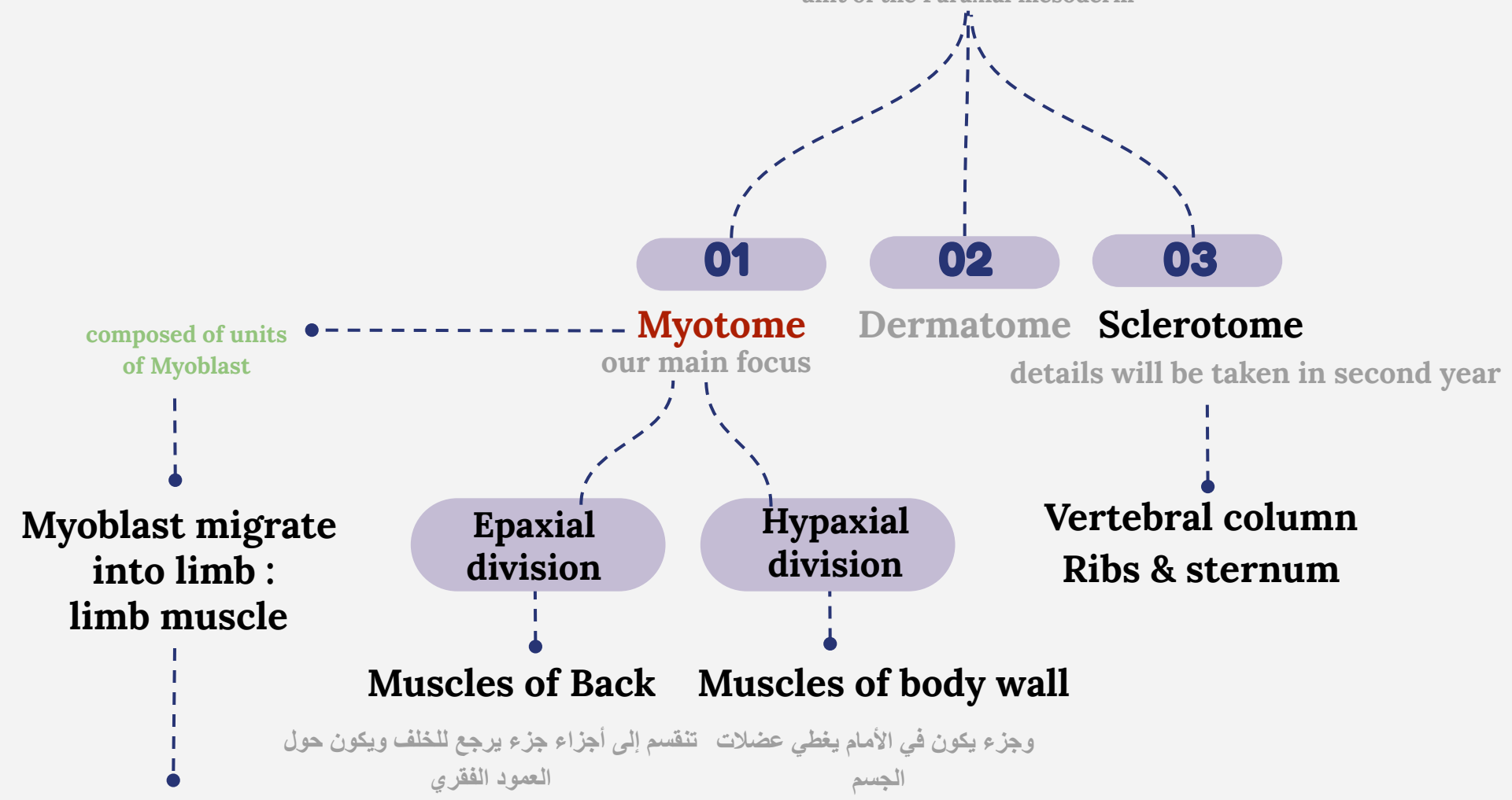
Specialization of Mesoderm

- 1 Appearance of the notochord (first sign)
- 2 Three collections of the mesoderm appear lateral to the notochord:
 - Somites
 - Intermediate mesoderm
 - Double sheets of lateral plate mesoderm



Somite

unit of the Paraxial mesoderm

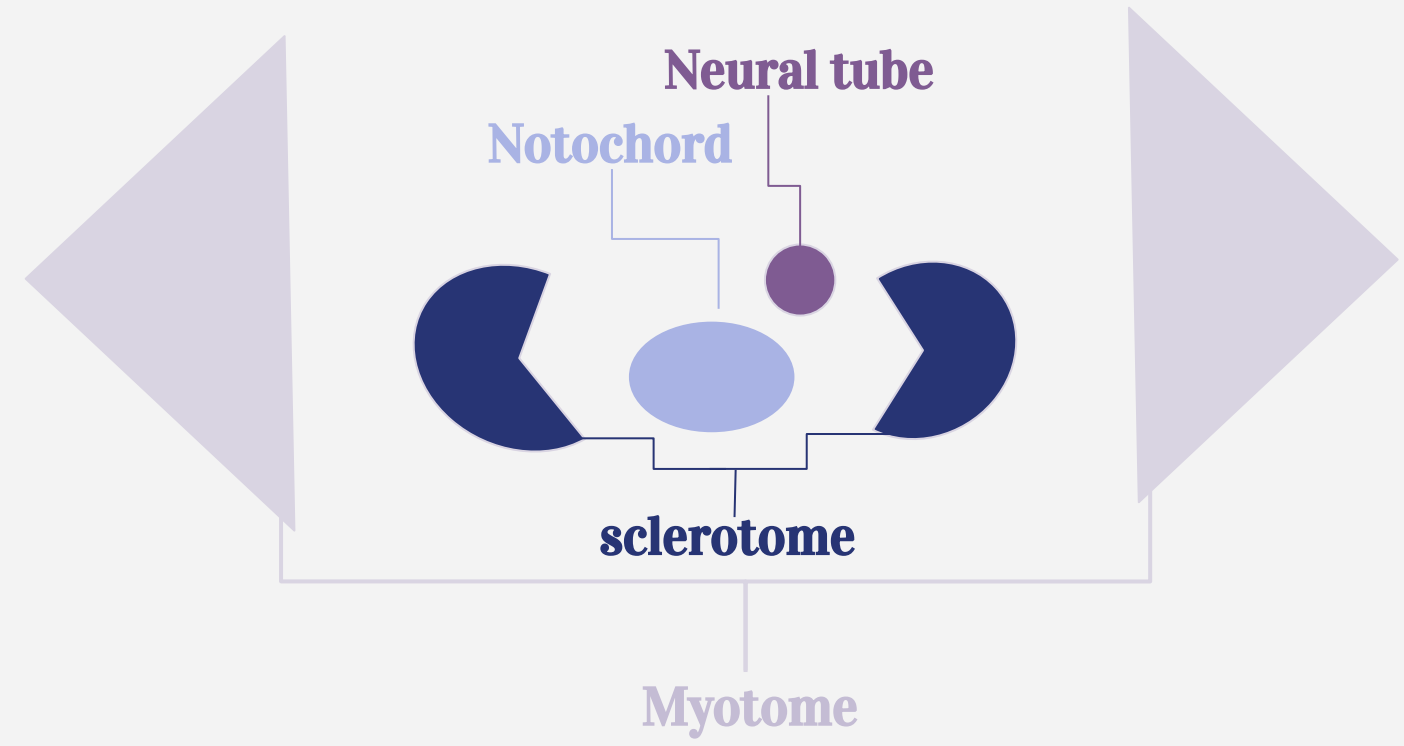


note

For better understanding go back to R44 male, time 11:40

Note: **sclerotome** gives All bones of the axial skeleton **except the skull** and **Myotome** gives All skeletal muscle **except muscle of the head and neck**

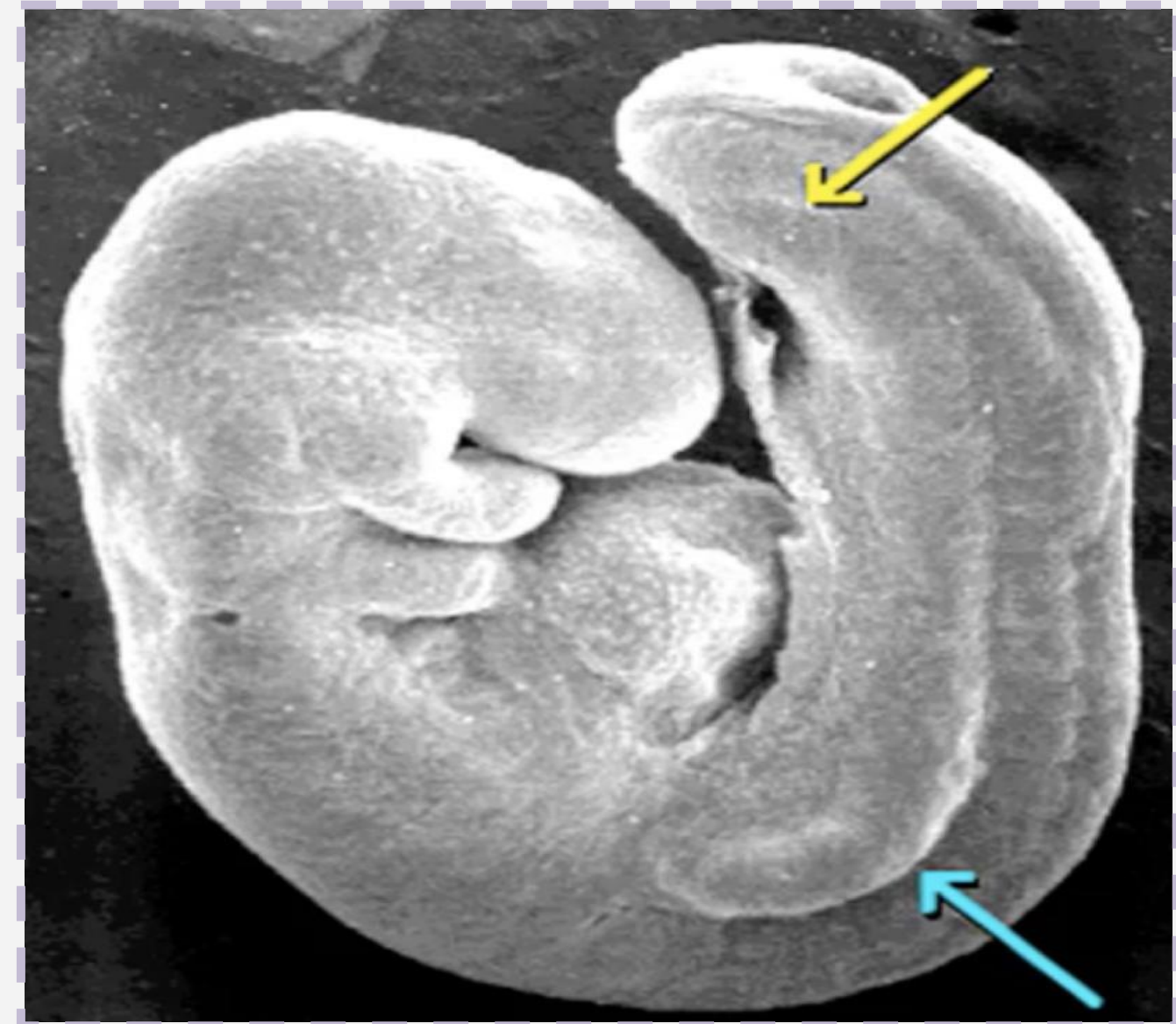
443 note: Important to know which body part comes from where



Girls slide only

Limbs Buds

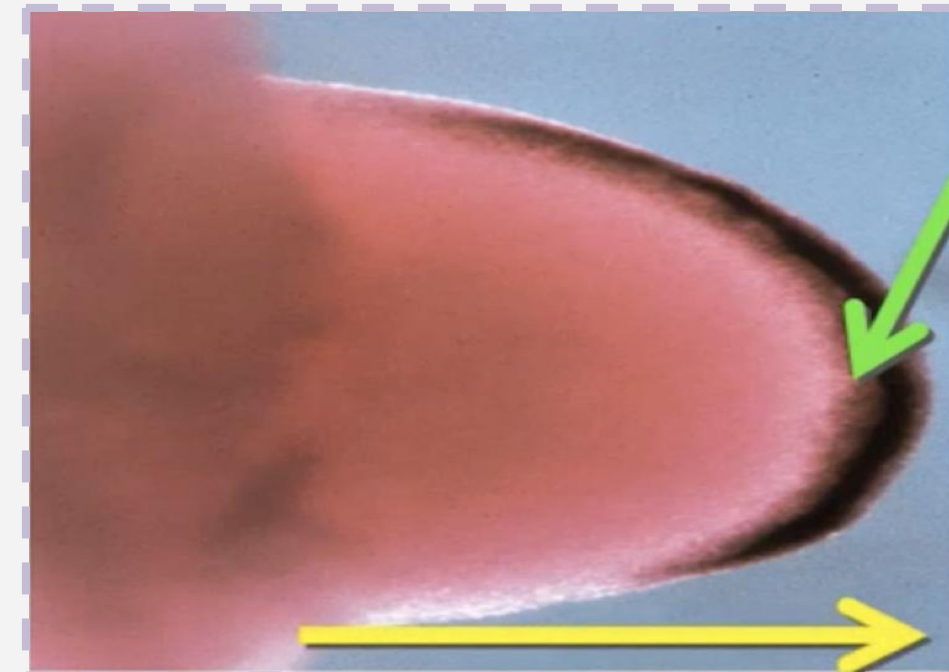
- The upper and lower limbs develop from limb buds
- The **upper** limb bud appears earlier than that of the lower limb bud
- The upper bud \rightarrow C4-T1
- The lower bud \rightarrow L2 - S3



Girls slide only

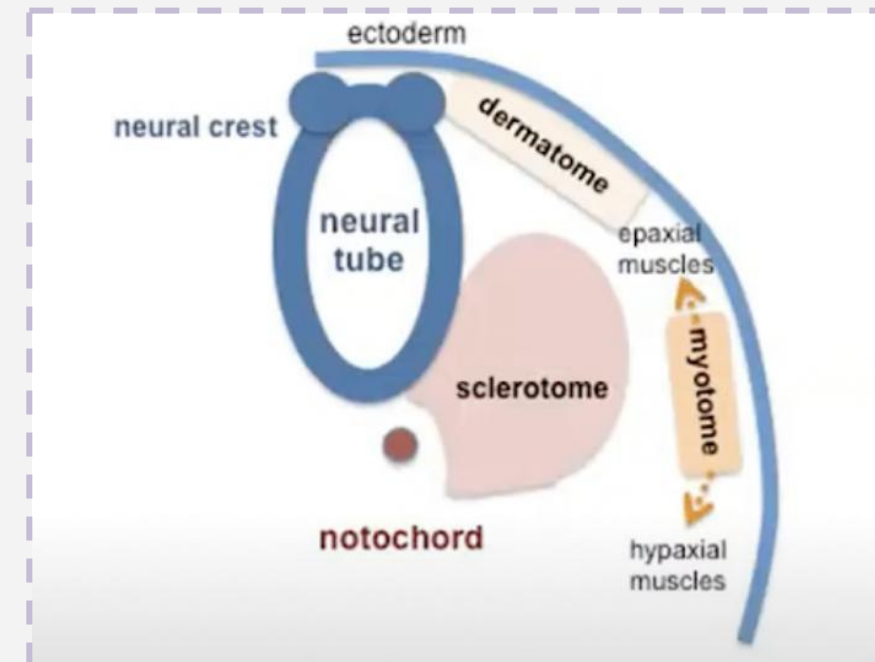
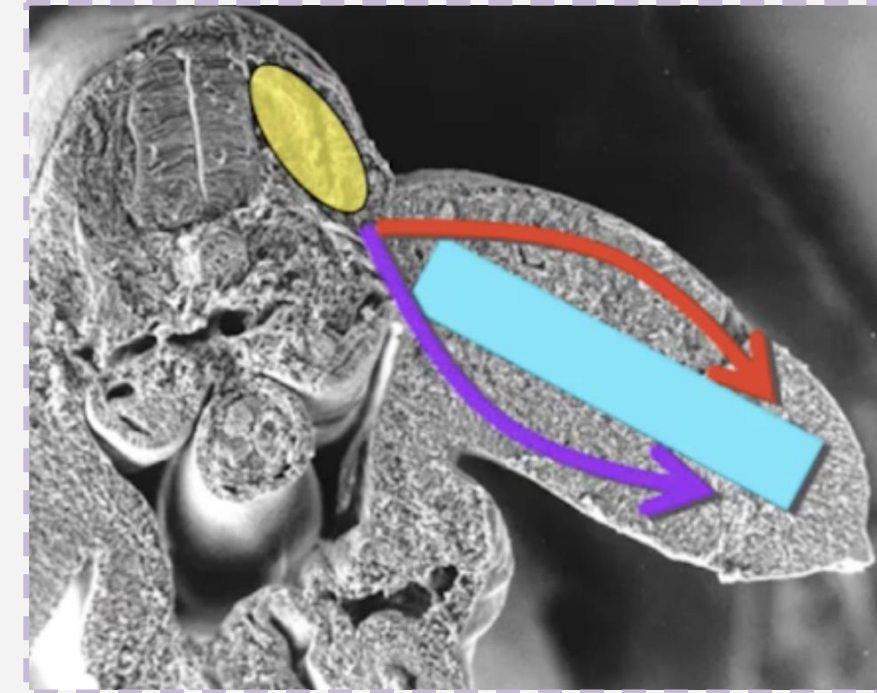
Apical Ectodermal Ridge

- **Apical ectodermal ridge (AER)** is a thick ectodermal area at the **tip** of the bud
- It stimulates the mesenchymal cells beneath it to divide (**progress zone**) → Limb bud grows



Muscle formation

- Myoblasts form a **dorsal (epaxial)** and a **ventral (hypaxial)** blocks of muscle tissue (extensors and flexors)
 - **Hypaxial division:** Muscles of limbs & body wall
 - **Epaxial division:** Extensors muscles of back, neck & spine
- Then, the motor nerves invade the limb bud



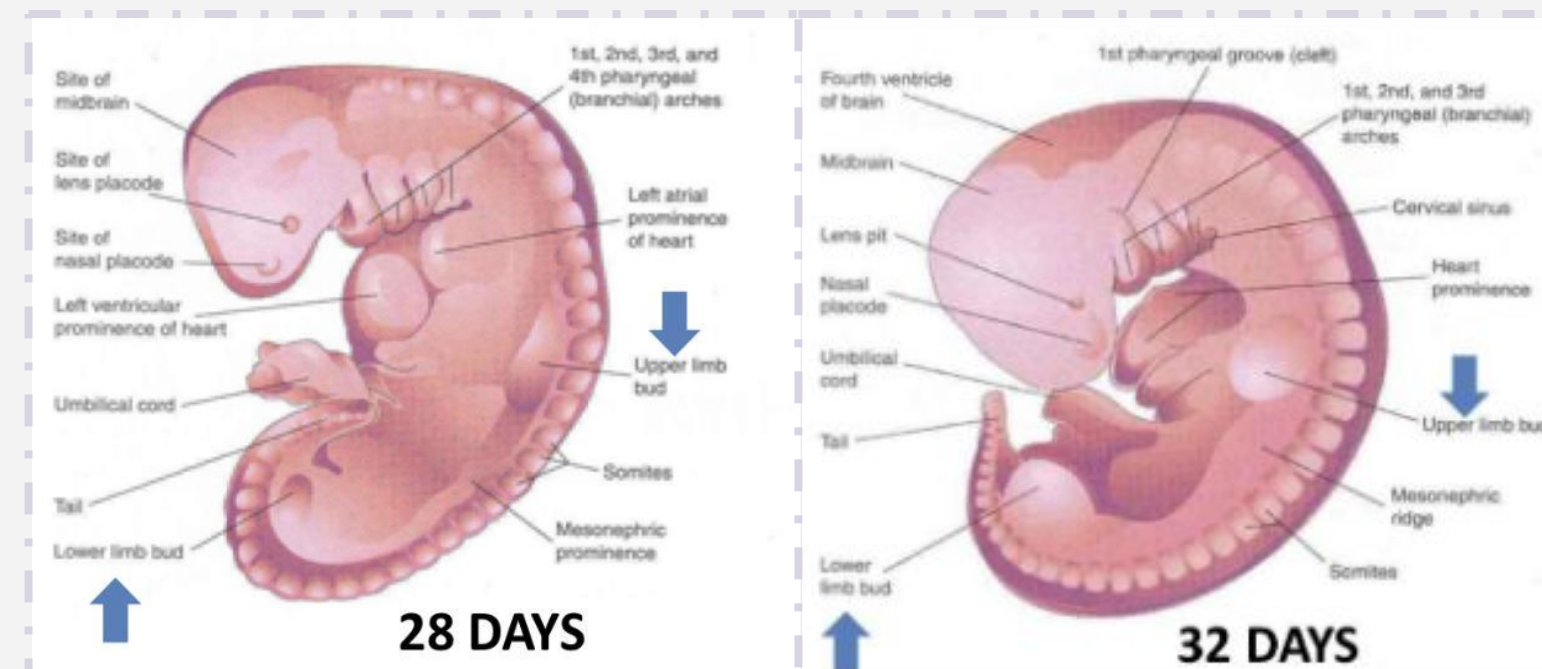
Development of limbs

The limb bud appears as an elevation on the **ventrolateral body wall** resulting from proliferation of mesenchyme of the somatic layer of lateral mesoderm.

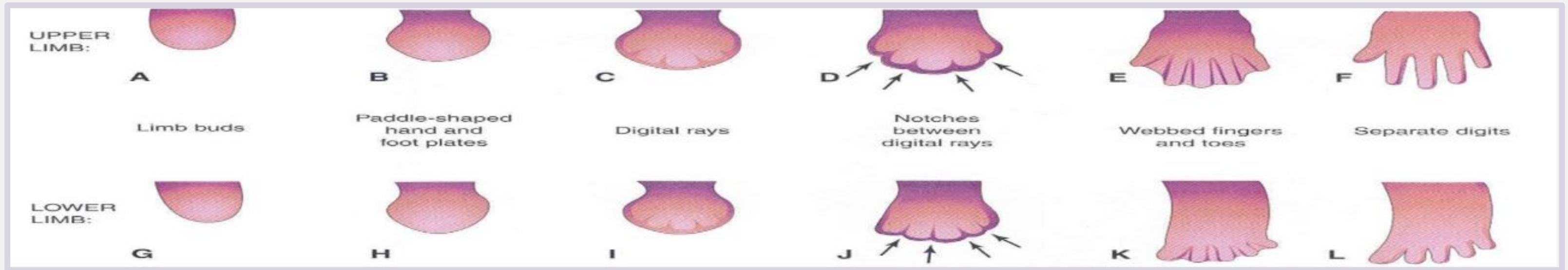
- Each limb bud is surrounded by an area of ectoderm.

Upper limb buds appear at **day 26** opposite the **lower cervical segments**.

Lower limb buds appear at **day 28** opposite the **lumbar & sacral segments**.

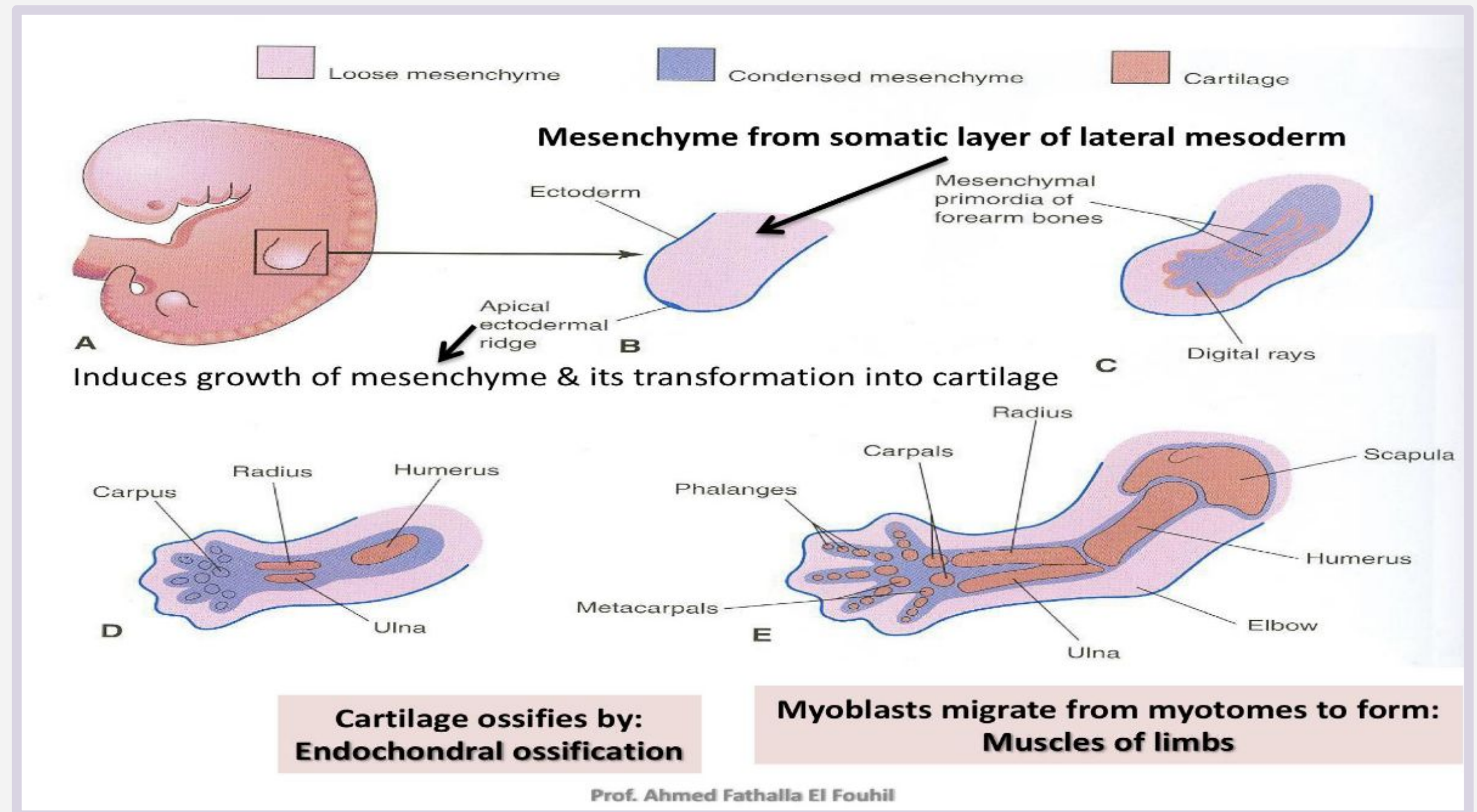


Development of limbs-cont



A & G	B & H	C & I	D & J	E & K	F & L
<p>Apical ectodermal ridge: appears at the apex of limb bud and stimulates proliferation of mesenchyme and elongation of limb bud.</p>	<p>Distal ends of buds flatten into paddle-like hand & foot plates.</p>	<p>Digital rays: appears as mesenchymal condensations that outline the patterns of digits.</p>	<p>Mesenchyme between rays disappears to form notches.</p>	<p>Digits form inside rays, elongate & appear webbed.</p>	<p>Mesenchyme between digits disappears so digits are now separated.</p>

- Cartilage ossifies by: Endochondral ossification.
- Myoblasts migrate from myotomes to form: Muscles of limbs.



Development of limbs-cont

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

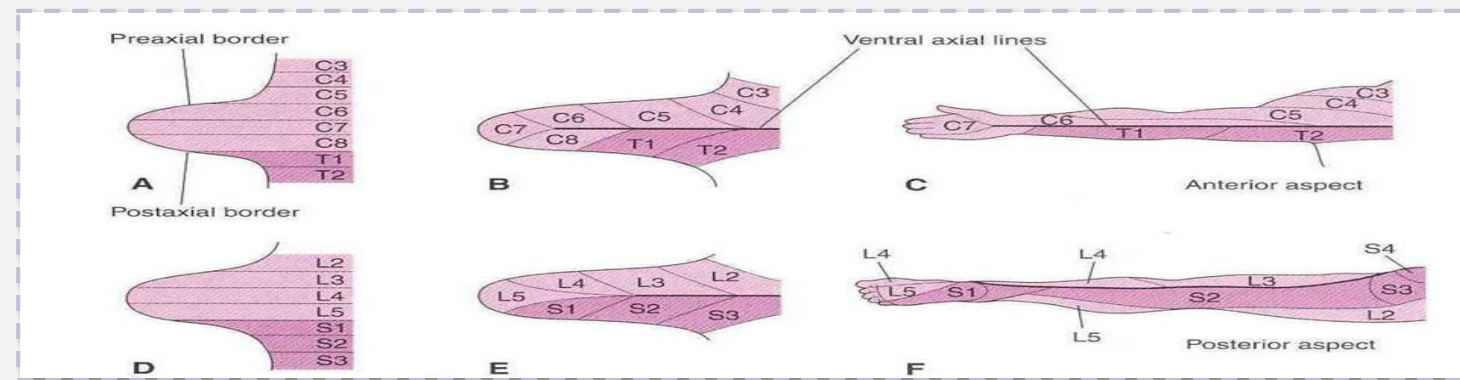
1 • Cranial (preaxial) & Caudal (postaxial) borders: radius and tibia are preaxial bones.

2 • Ventral & Dorsal surfaces: flexor muscles are ventral.

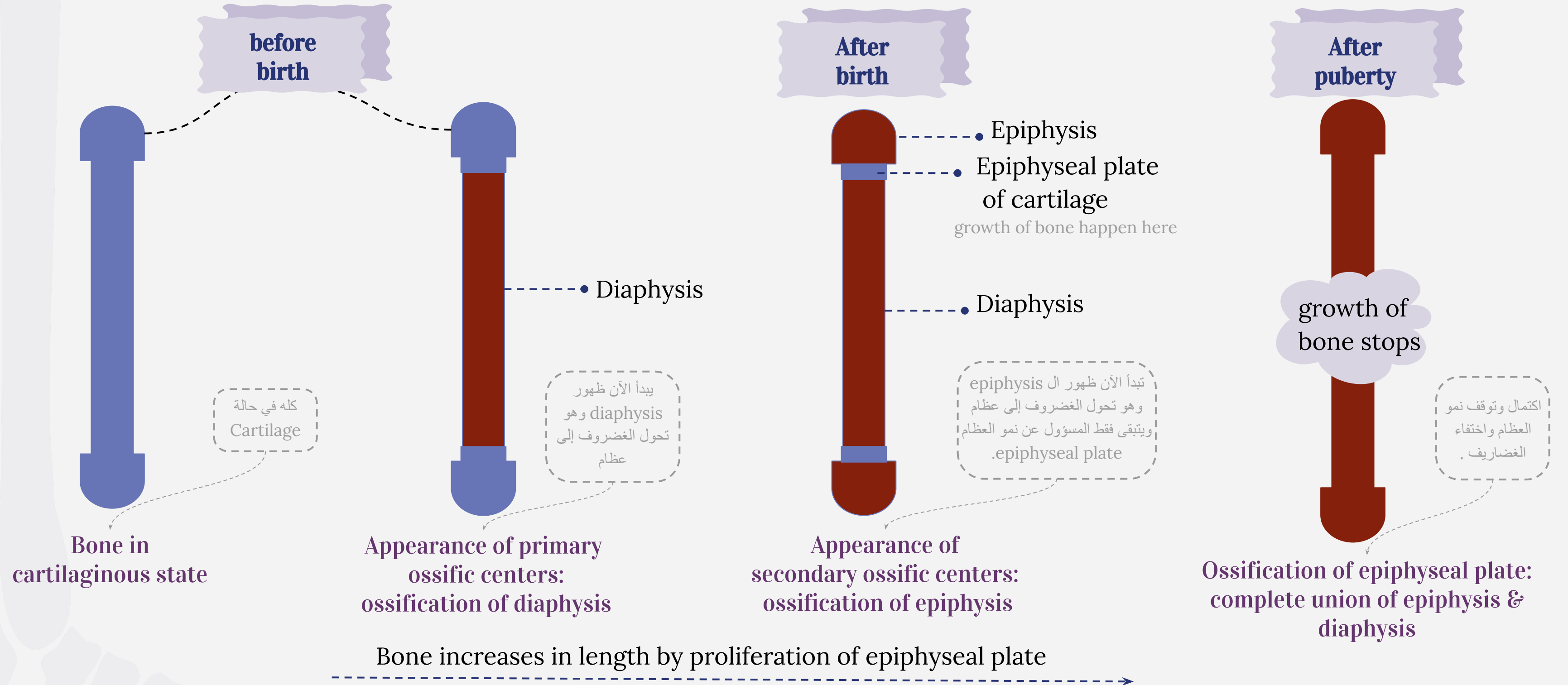
During 7th week, adduction of limb buds occurs with 90° rotation:

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.



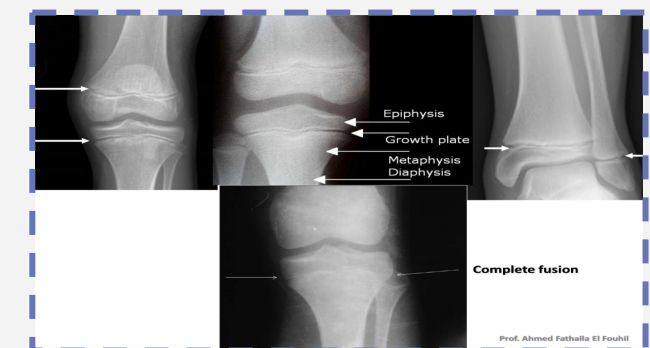
Ossification of long bone



Bone age is a good index of general maturation.

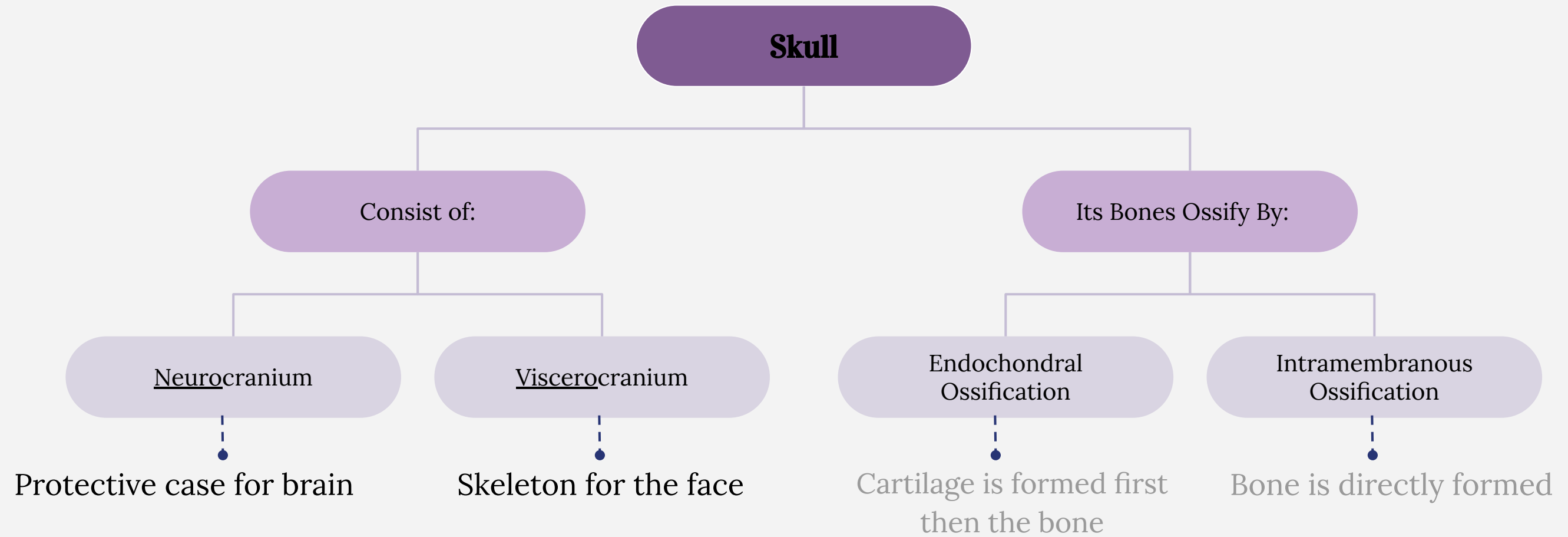
Bone age is determined by:

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



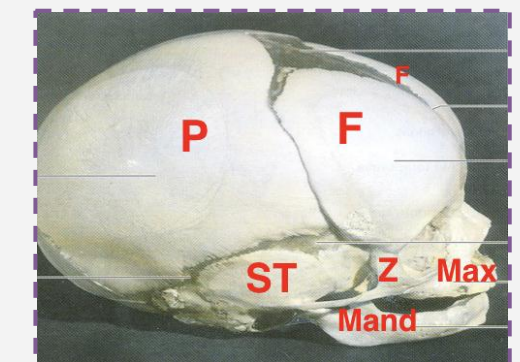
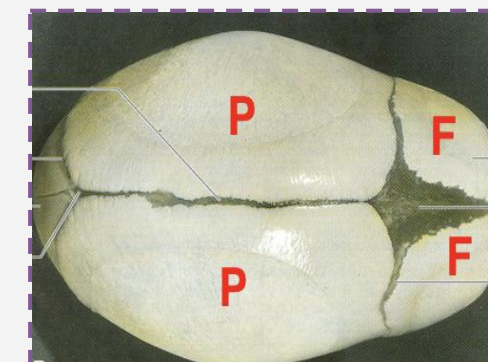
Development of cranium (Skull)

The skull develops from mesoderm around the developing brain



Bones of skull that ossify by **intramembranous** ossification:

- 01 F - Frontal
- 02 P - Parietal
- 03 Z - Zygomatic
- 04 ST - Squamous temporal
- 05 Mand - Mandible
- 06 Max - Maxilla



Joints



Joints develop from the mesoderm between the bones:

(قَالَ مَعَ الْعُسْرِ يُسْرًا) (إِنَّ مَعَ الْعُسْرِ يُسْرًا)
[سورة الشرح: 5,6].

1

Fibrous joints

Mesoderm differentiates into dense fibrous connective tissue.

2

Cartilaginous joints

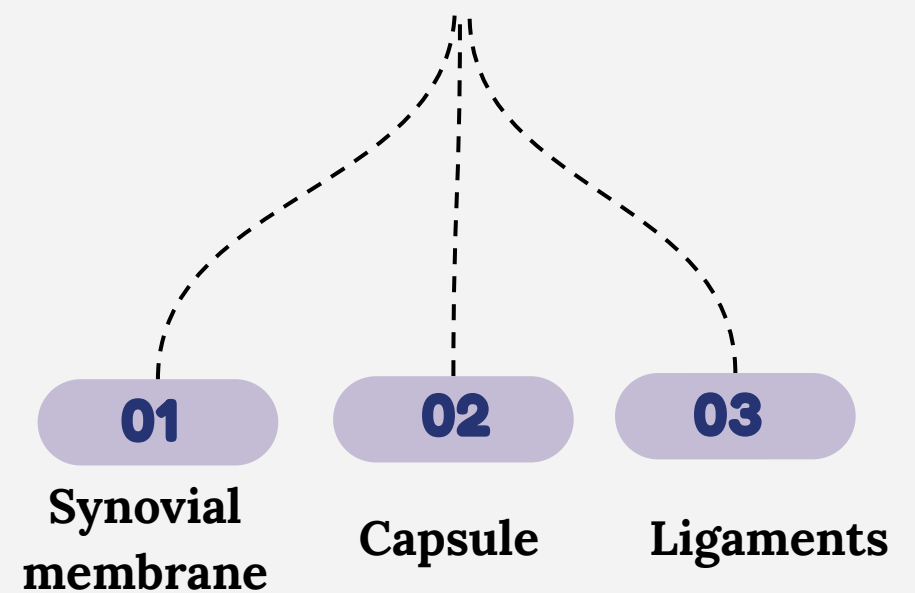
Mesoderm differentiates into cartilage.

3

Synovial joints

A synovial cavity is formed inside the mesoderm.

Mesoderm differentiates into:



01

Synovial membrane

02

Capsule

03

Ligaments

Congenital Anomalies Of Limbs

1

Failure of formation of parts

Amelia:

One or more extremities are absent
congenital absence of limb or limbs

- اليد أو الرجل بالكامل غير موجودة

Meromelia:

- absence of a part of a limb or limbs
- The proximal & middle Segments are absent
- Hand or foot attached directly to the trunk

- اليد أو الرجل موجودة لكن غير مكتملة (غير طبيعية)



2

Failure of Differentiation

Syndactyly:

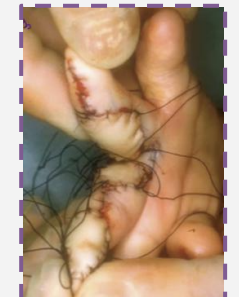
- Cutaneous syndactyly → تلاصق اصبعين بالجلد
- Osseous syndactyly → تلاصق اصبعين بالعظم
- Fusion of digits

it could correct surgically

Congenital hip dislocation:

- A complete or partial displacement of the femoral head out of the acetabulum: may be due to underdevelopment of acetabulum or generalized laxity of the joint
- Mal development of the hip joint
- Lack of abduction

it could correct surgically & common in newborn



note

Make it easy to understand!

A=absence, melia = limp

syn=together dactyly=fingers

poly=many dactyly= fingers or digits

Congenital Anomalies Of Limbs

3

Duplication

Polydactyly:

- Extra digit, medial or lateral
- supernumerary digits

it could correct surgically & common in newborn

Oligodactyly:

- Missing digits

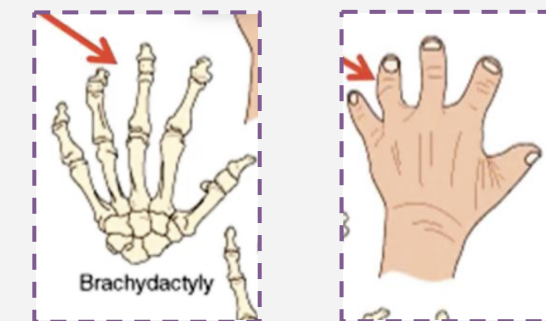


4

Undergrowth

Brachydactyly:

- The phalanges are short
- Short fingers or toes
- shortness of digits



note

Make it easy to understand!
A=absence , melia = limp
syn=together dactyly=fingers
poly=many dactyly= fingers or digits

SUMMARY

01

DEVELOPMENT OF BONE ----- • All bones develop from MESODERM

All bones ossify by endochondral ossification EXCEPT: Some bones of skull & Clavicle

AXIAL SKELETON:
 - from mesoderm surrounding the brain ----- Skull
 - sclerotomes of somites (paraxial mesoderm) ----- Vertebrae, ribs & sternum

APPENDICULAR SKELETON: ----- • somatic part of lateral mesoderm

02

DEVELOPMENT OF MUSCLES

All muscles develop from MESODERM EXCEPT:
 from ECTODERM.
 1-Muscles of iris (eyeball)
 2. Myoepithelial cells of mammary & sweat glands

All skeletal muscles develop from myotomes of paraxial mesoderm EXCEPT:
 some head & neck muscles ----> from mesoderm of pharyngeal arches

BOTH Smooth and Cardiac muscles develop from lateral Mesoderm
 - Cardiac From: splanchnic part of lateral mesoderm -----
 - Smooth:
 - splanchnic part of lateral mesoderm ----- • In the wall of viscera
 - Somatic part of lateral mesoderm ----- • In the wall of blood & lymphatic vessels

03

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

-Rotation of limbs occur in opposite direction

-Muscles of limbs develop from myotome

-Development of upper limb precedes that of lower limb.

MCQs:

this Q is very important !! From the Doctor!

3-4
this is not
from the Dr
but she said
100% the
anomalies
will come
like cases .

1	which of the following bone ossify by Endochondral?			
	A) Frontal	B) Zygomatic	C) Vertebra	D) Mandible
2	which of the following bone ossifies by Intramembranous ossification?			
	A) Vertebra	B) Humerus	C) Ribs	D) Mandible
3	pregnant women drived a baby with extra digit what it's condition ?			
	A) Syndactyly	B) Meromelia	C) Polydactyly	D) Brachydactyly
4	pregnant women drived a baby with hand attached directly to the trunk what it's condition ?			
	A) Failure of formation of parts	B) Failure of Differentiation	C) Duplication	D) Undergrowth
5	Which one of the following group of muscles are derivatives from epaxial division of myotomes?			
	A) Muscles of back	B) Muscles of limbs	C) Muscles of viscera	D) Cardiac muscles
6	Which one of the following is the result of rotation of upper limb?			
	A) The tibia becomes lateral	B) The flexor muscles become posterior	C) The ulna becomes medial	D) The preaxial digit becomes medial.

DON'T LOOK!

1) C
2) D
3) C
4) A
5) A
6) C

MCQs:

7	Regarding the ossification of long bones, which one of the following statements is correct?			
	A) Primary ossific centre appears after birth.	B) Secondary ossific centre leads into ossification of diaphysis.	C) Long bones ossify by intramembranous ossification.	D) When epiphysis unites with diaphysis, growth of bone stops.
8	secondary ossific centers appears:			
	A) Before birth	B) After birth	C) During puberty	D) After puberty
9	which of the following bones will ossify by intramembranous ossification?			
	A) Sternum	B) Maxilla	C) Vertebrae	D) Scapula
10	which of the following develops the muscles of body wall?			
	A) Epaxial division	B) Sclerotome	C) Dermatome	D) Hypaxial division
11	Bones of skull will ossify by?			
	A) Endochondral ossification	B) Intramembranous ossification	C) A&B	D) None
12	Which one of the following bones is classified through intramembranous ossification?			
	A) Ribs	B) Tibia	C) Clavicle	D) Sternum

DON'T LOOK!

7) D
8) B
9) B
10) D
11) C
12) C

Meet our team!

Leader

**Jana
Alomairini**

Member

**Rimaz
Alhammad**

Member

**Mubarak
Alqaddan**



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