NEURODEVELOPMENT

PART I: NEURULATION & SPINAL CORD DEVELOPMENT

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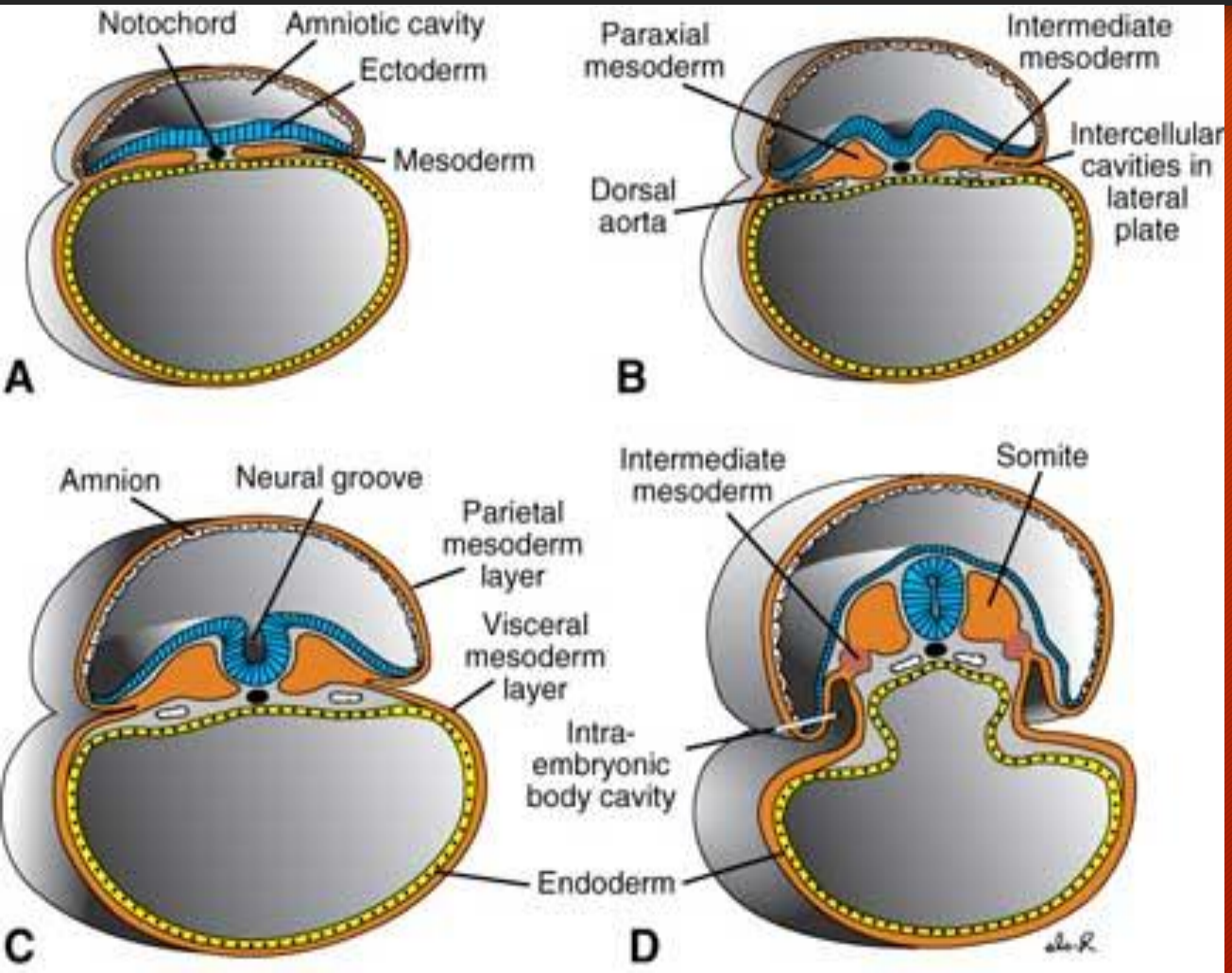
NEURODEVELOPMENT

I. Neurulation and spinal cord development
II. Brain – cerebrum, cerebellum, brainstem
III. Post natal changes of the central nervous system

Expected Learning Outcomes:

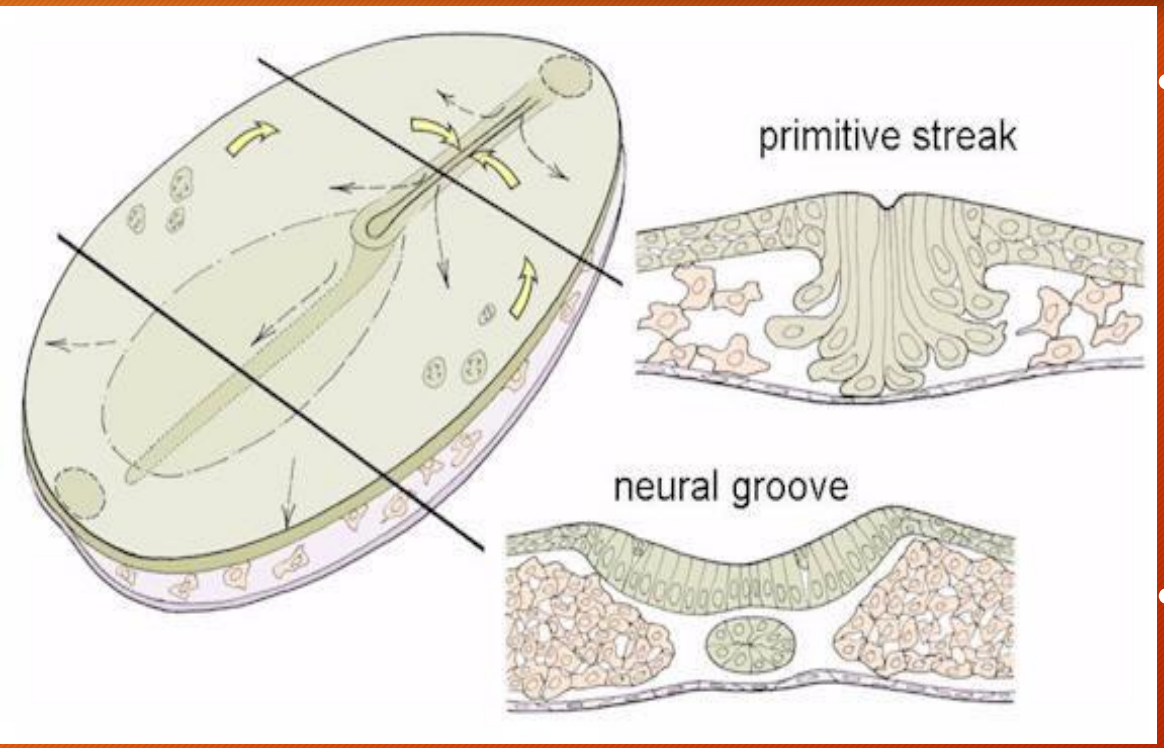
1. To state the embryonic origin of the nervous system
2. Describe the process of primary & secondary neurulation
3. Outline neural crest derivatives and associated anomalies
4. Parts and derivatives of the neural tube
5. Differentiation of the caudal neural tube to form the various components of the spinal cord
6. Positional changes in the spinal cord levels
7. Congenital malformations of the spinal cord

1 - Origin of the nervous system



- Ectoderm
- Neuroectoderm
- Neurulation
- Neural tube & neural crest

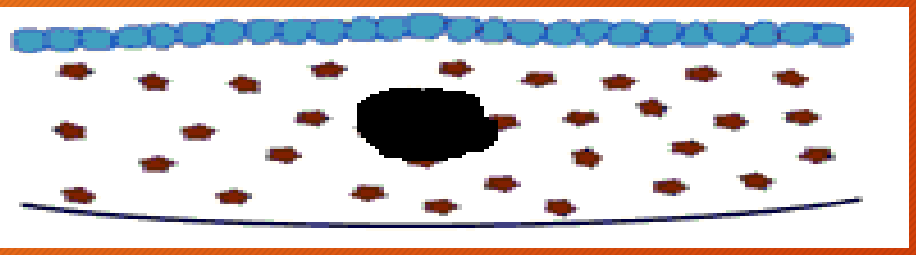
2 - Neurulation

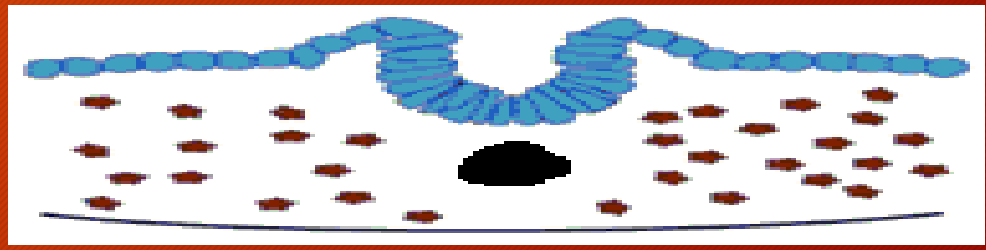


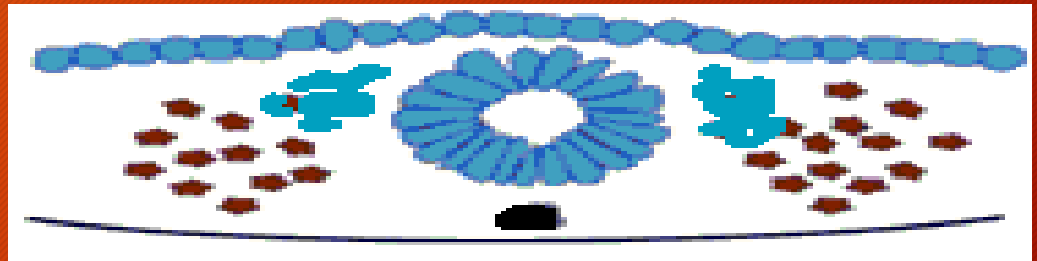
- Process of formation of the neural tube – primordium of the CNS
- Primary and secondary neurulation

2a – Primary Neurulation

- Neurulation by notochordal induction of the overlying cranial ectoderm

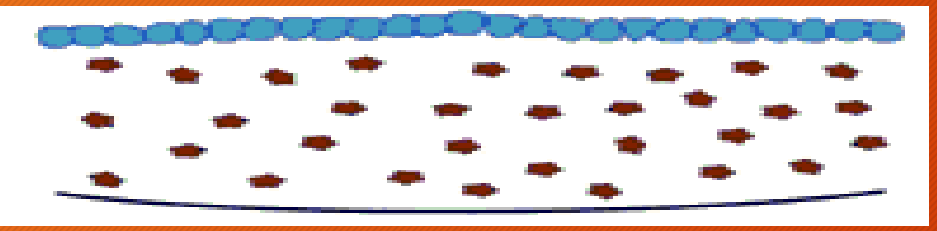


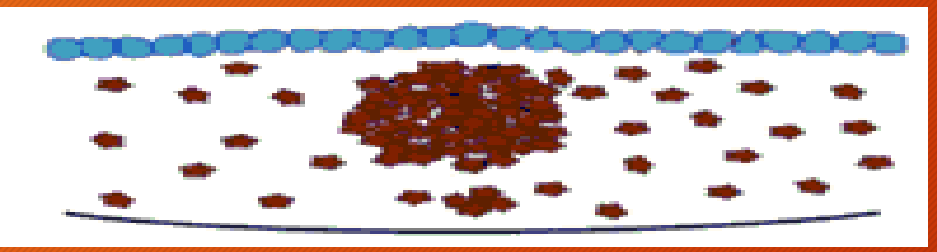


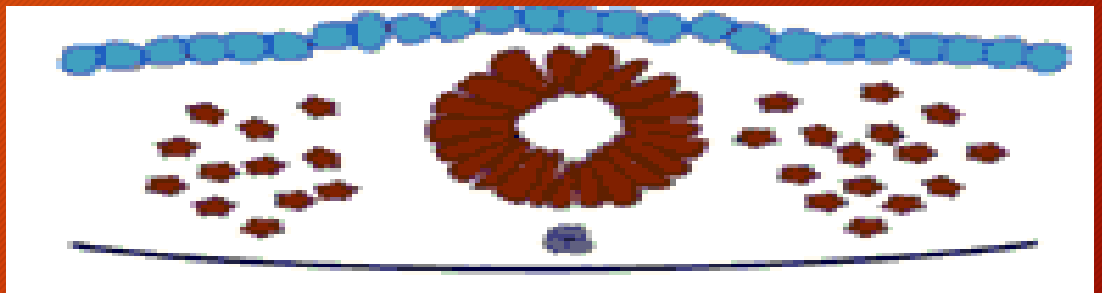


2b – Secondary neurulation

- Neurulation by mesenchymal condensation & transition of the caudal mesoderm

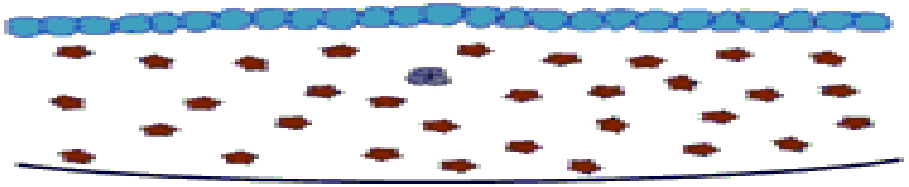






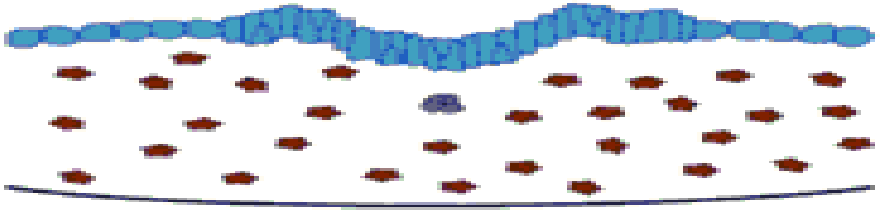
Primary Neurulation

1. Initial epithelium

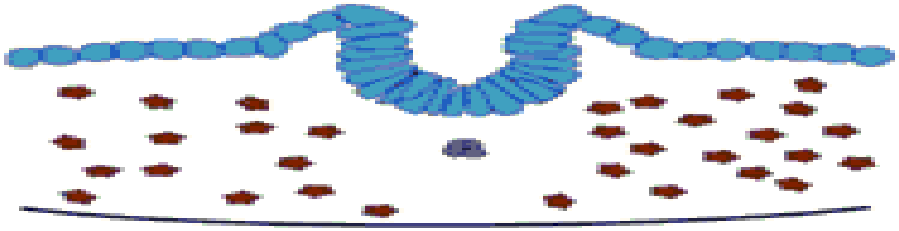


2. Columnarization

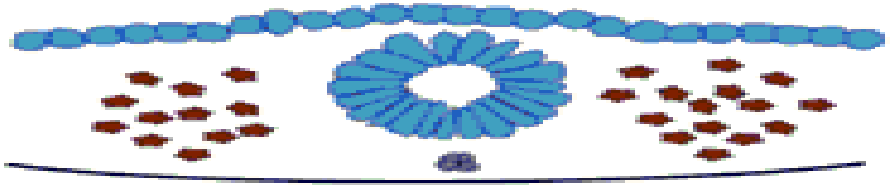
3. Rolling/folding



4. Closure

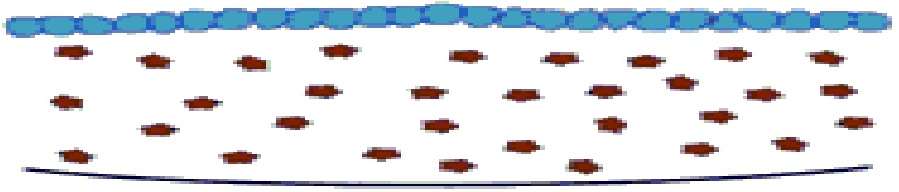


5. Neural tube complete

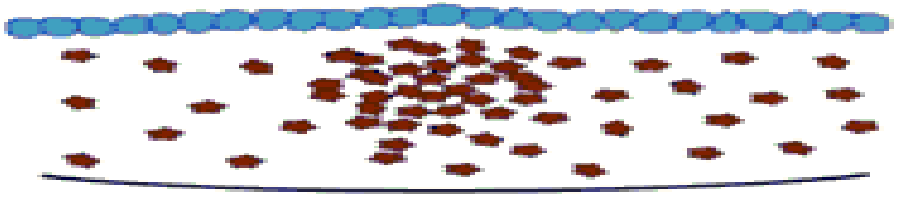


Secondary neurulation

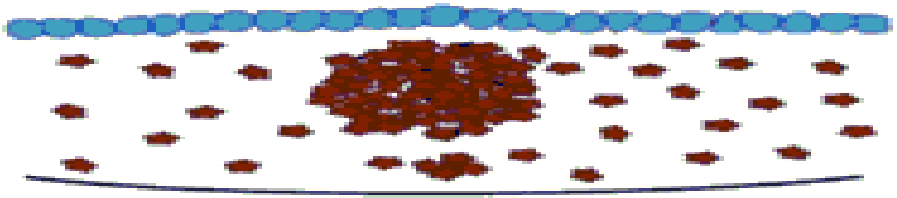
1. Dispersed mesenchyme



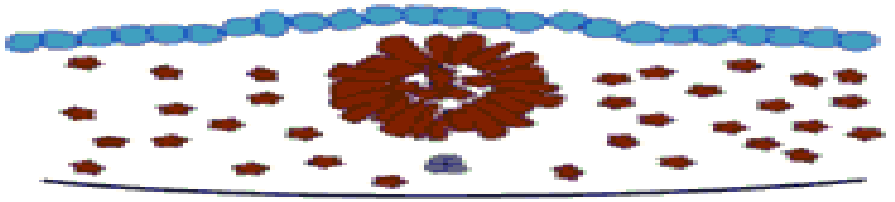
2. Mesenchymal condensation



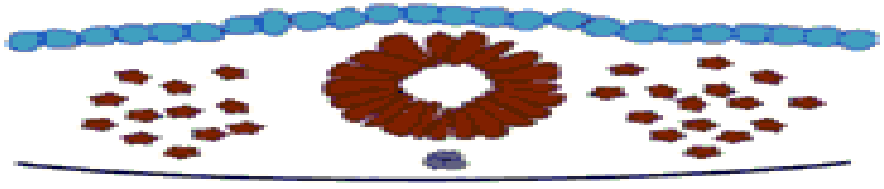
3. Medullary cord/neural rod



4. Epithelial transition/cavitation



5. Neural tube complete



3 – Neural crest cells

- Characteristics
- Classification**
- Role in development**
- Derivatives
- Associated anomalies

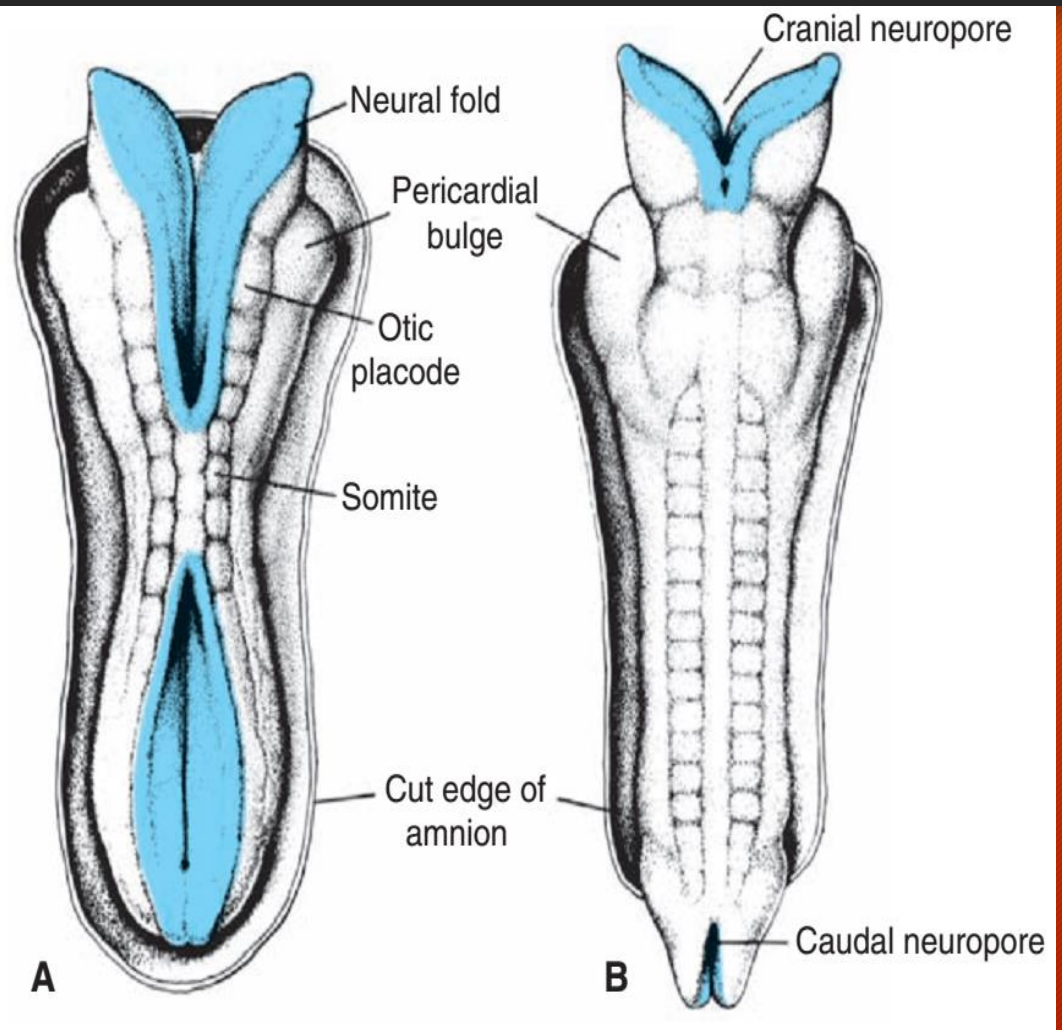
3a – Neural crest derivatives

- Peripheral nervous system
- Endocrine system
- Integument system
- Cardiovascular system
- Craniofacial region

3b – Anomalies associated with neural crest

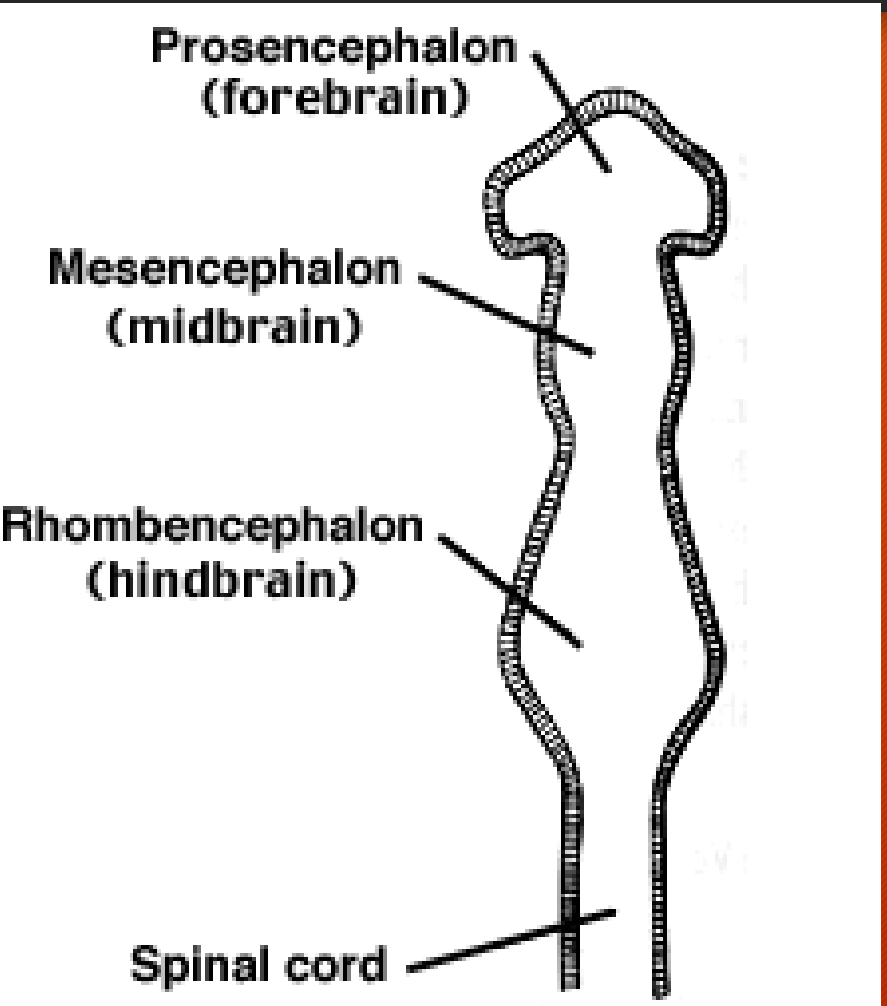
- Mechanisms – defective migration, induction
- Congenital aganglionic megacolon (Hirshprung's disease)
- Conotruncal septation defects
- 1st arch syndrome
- Disorders of skin pigmentation

4 – Neural tube



- Neuropores
- Communicate with amnion
- Cranial – Day 25
- Caudal – 3 days later

4b – Neural tube derivatives



- Caudal neural tube
- Cranial neural tube:

✓Primary brain vesicles

✓Secondary brain vesicles

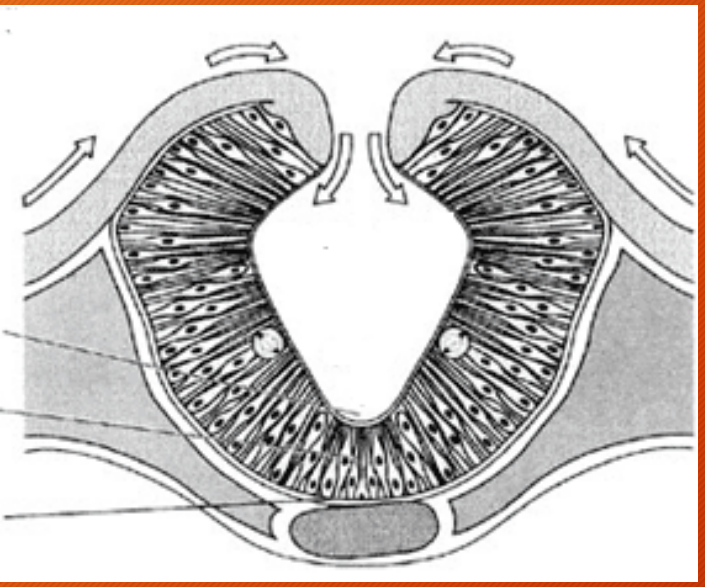
✓Other derivatives

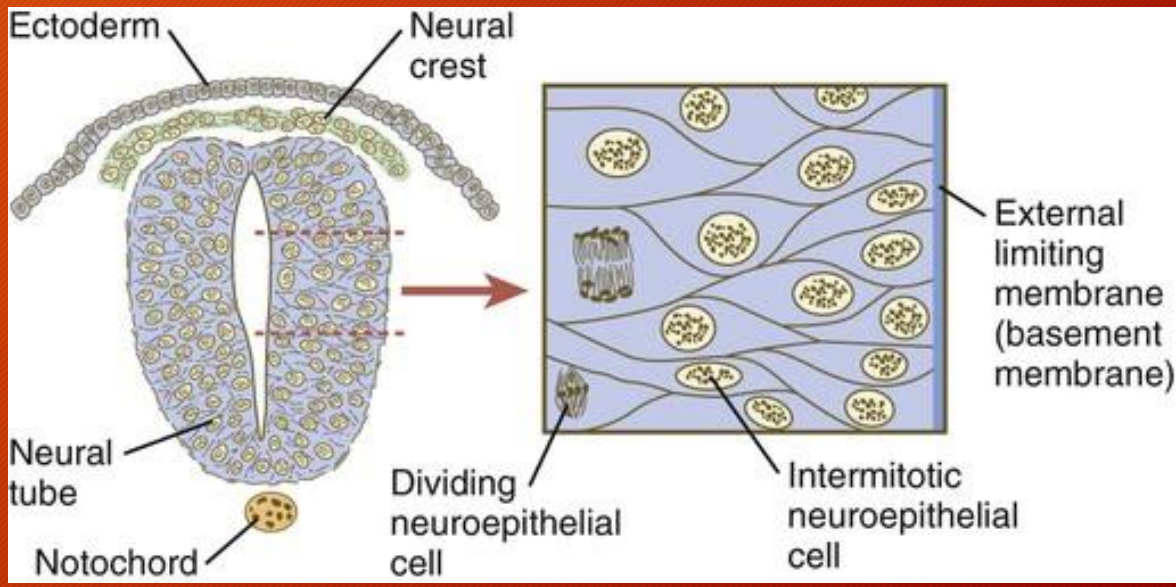
5 – Spinal cord development

- ✓Origin
- ✓Differentiation of the caudal neural tube
- ✓Positional changes
- ✓Related congenital anomalies

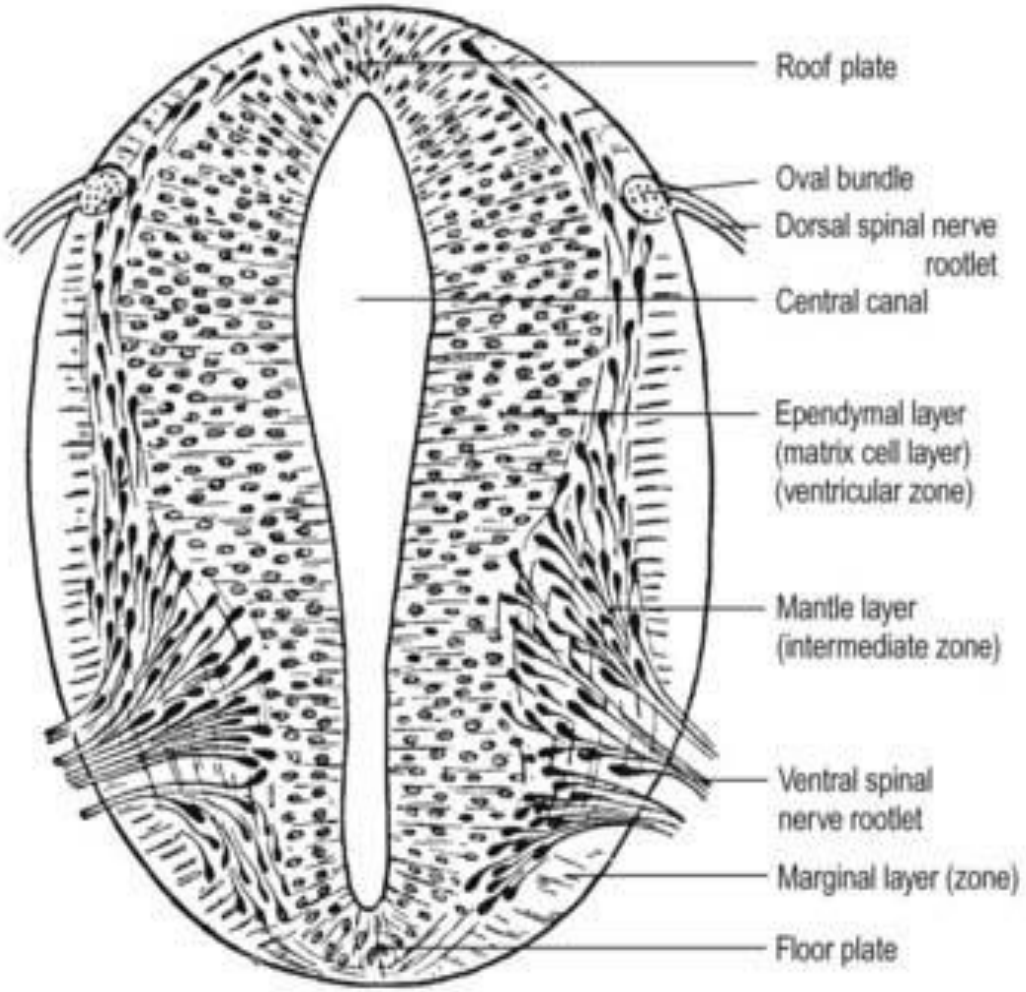
5a – Cellular organization

- Pseudostratified columnar epithelium
- Neuroblasts, neuroglial cells



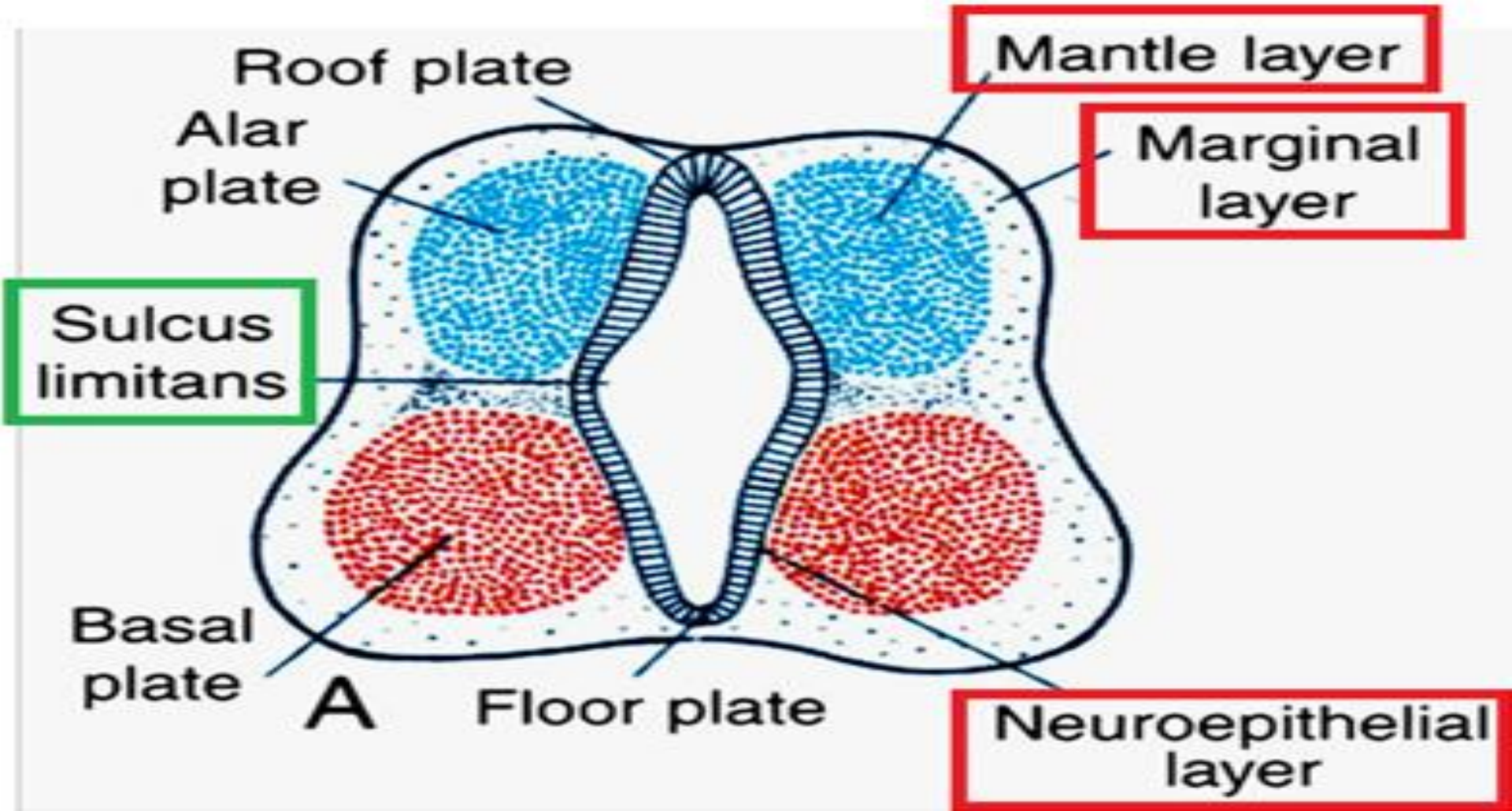


5b – Zonation of the neural tube

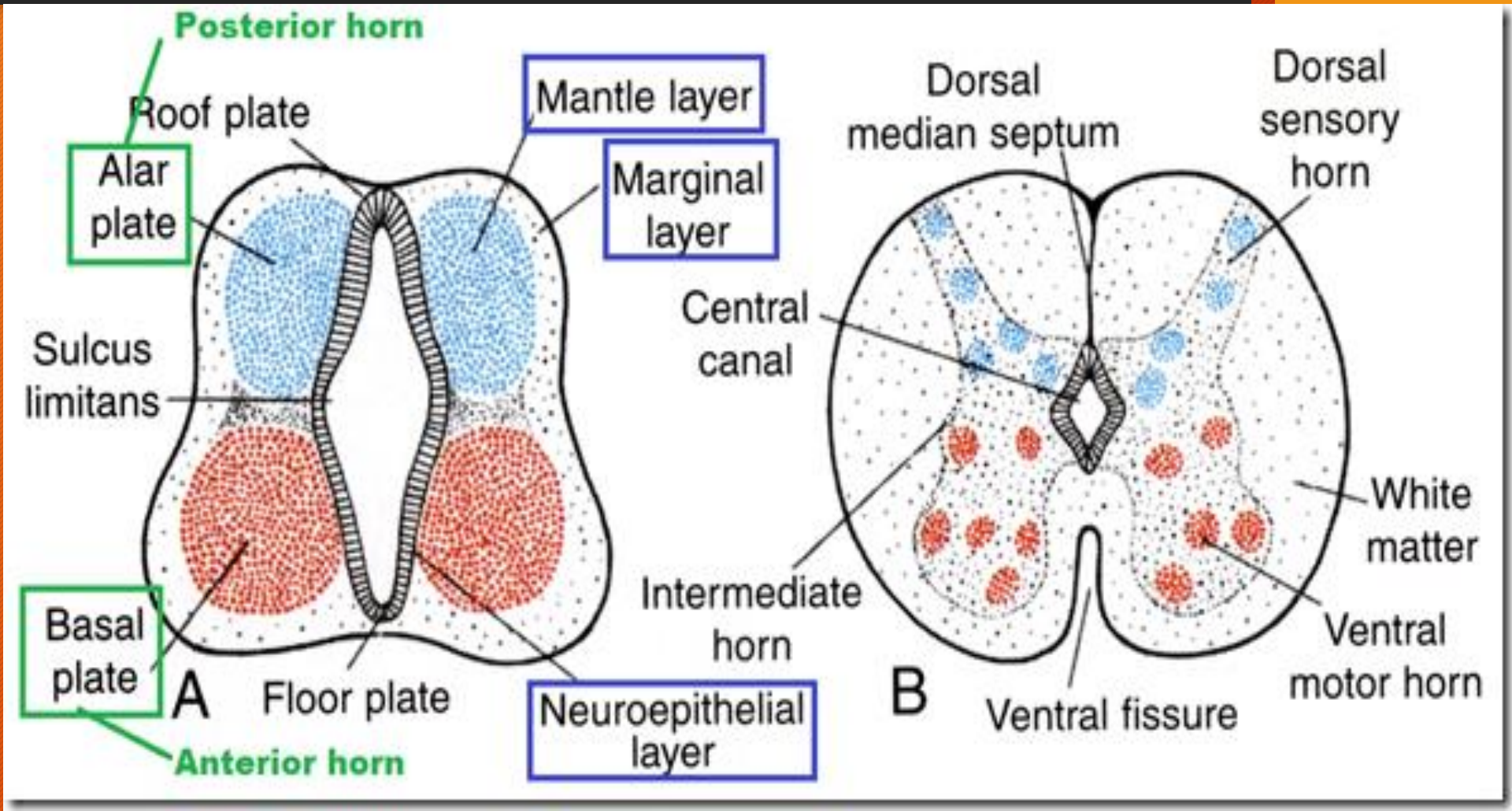


- Ventricular zone
- Mantle zone
- Marginal zone

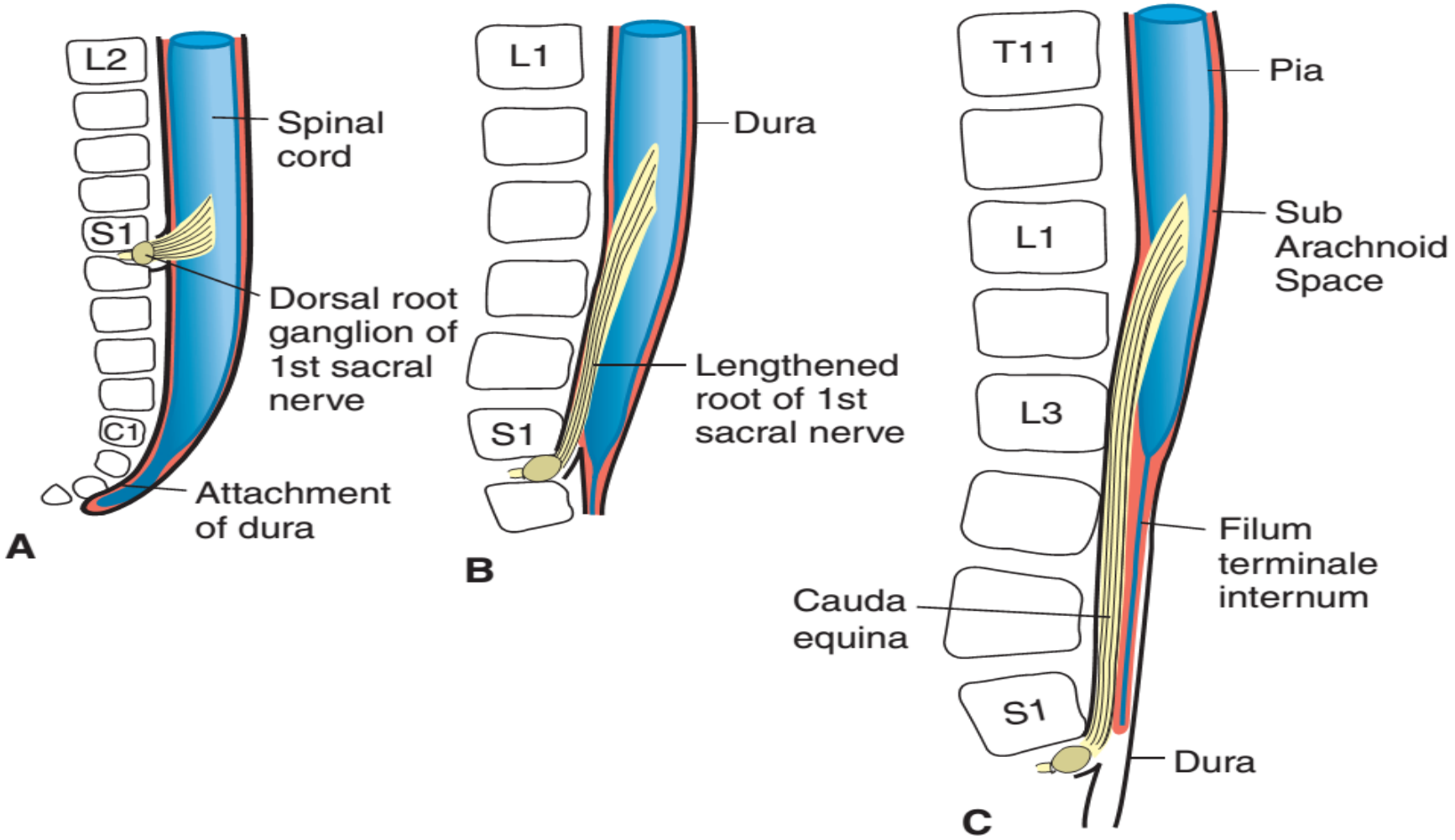
The mantle layer



Derivatives of the Mantle Layer



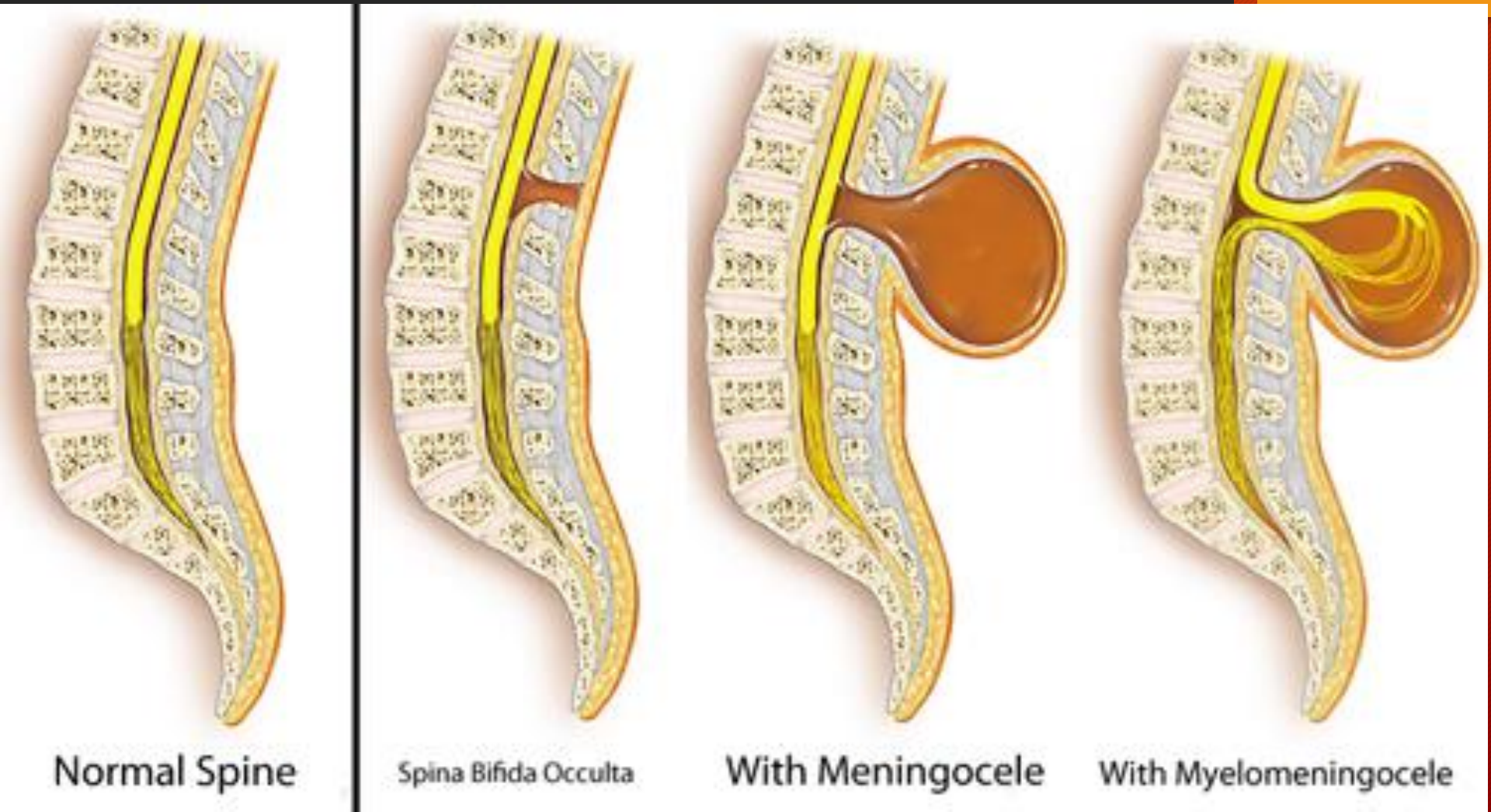
6 - Developmental changes in Spinal Cord Level

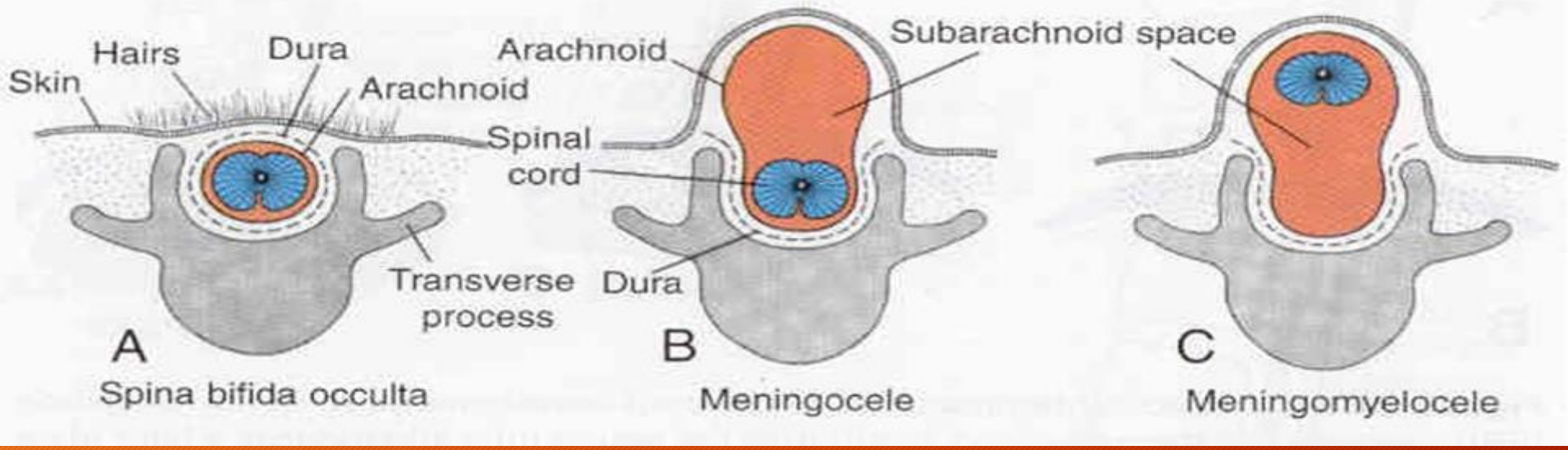


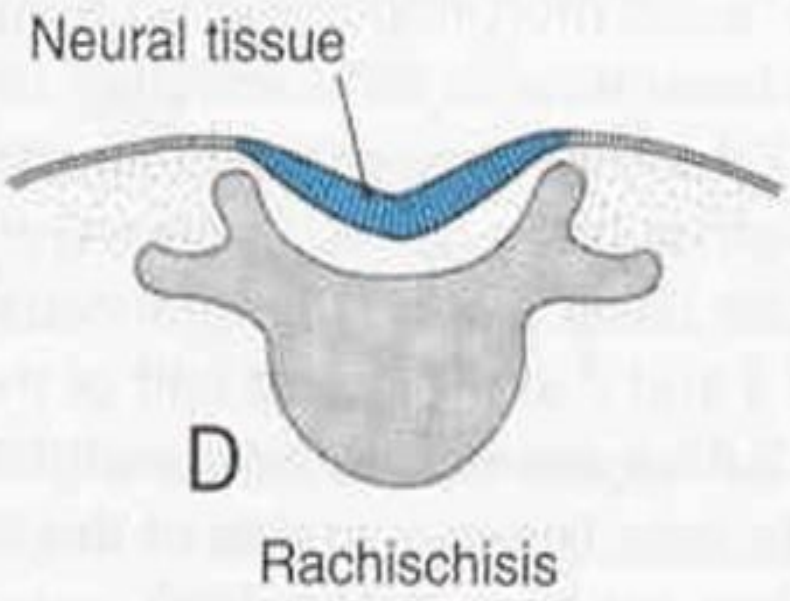
7 - Associated Anomalies

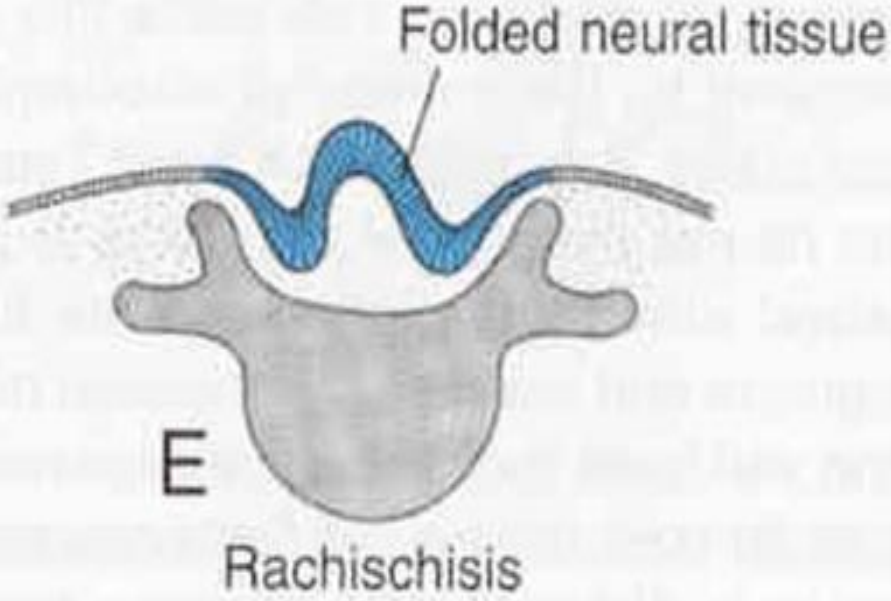
- Neural tube defects
- Rachischisis
- Syringomyelia
- Tethered spinal cord

Neural tube defects

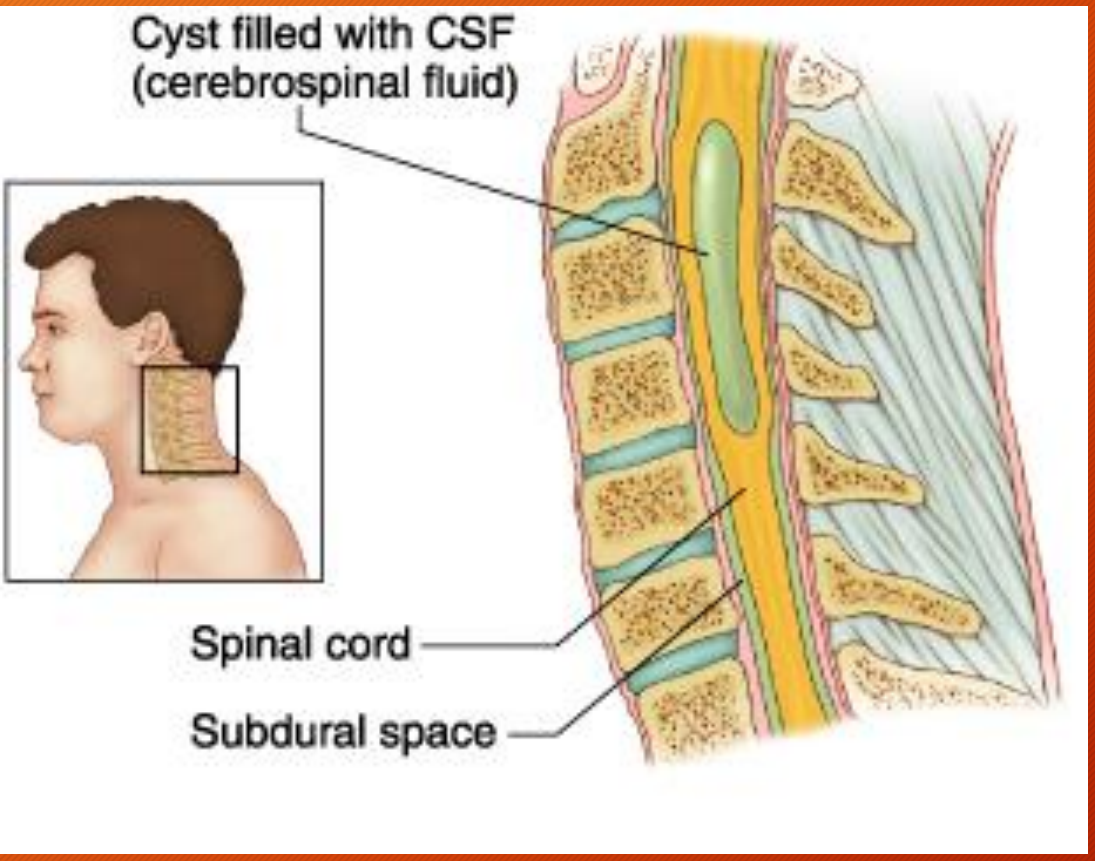


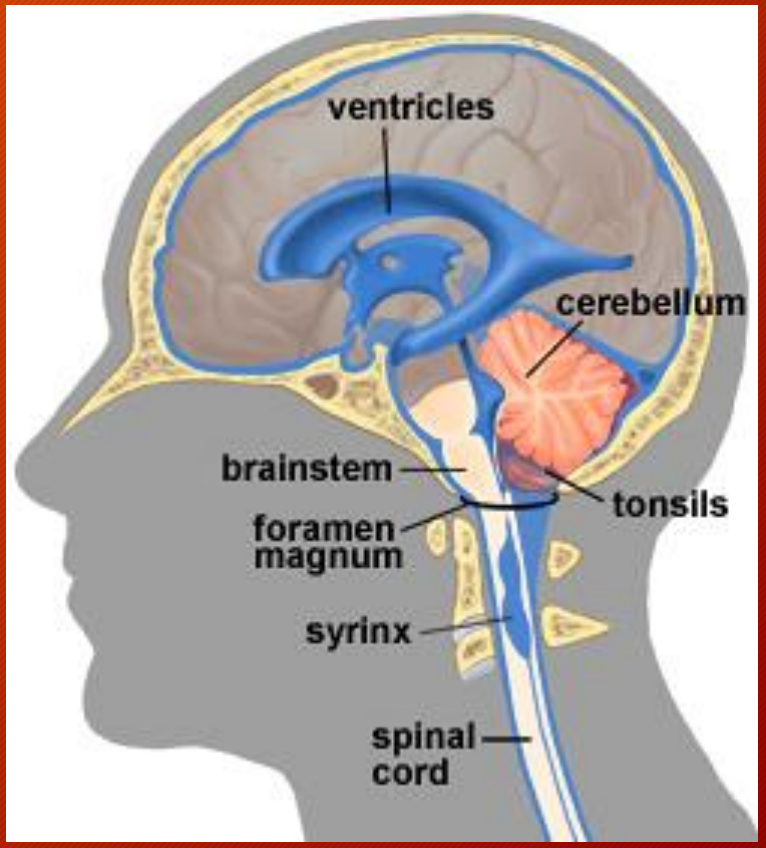

Skin
Hairs
Dura
Arachnoid
Spinal cord
Transverse process
A
Spina bifida occulta
Arachnoid
Subarachnoid space
Dura
B
Meningocele
C
Meningomyelocele


Neural tissue
D
Rachischisis

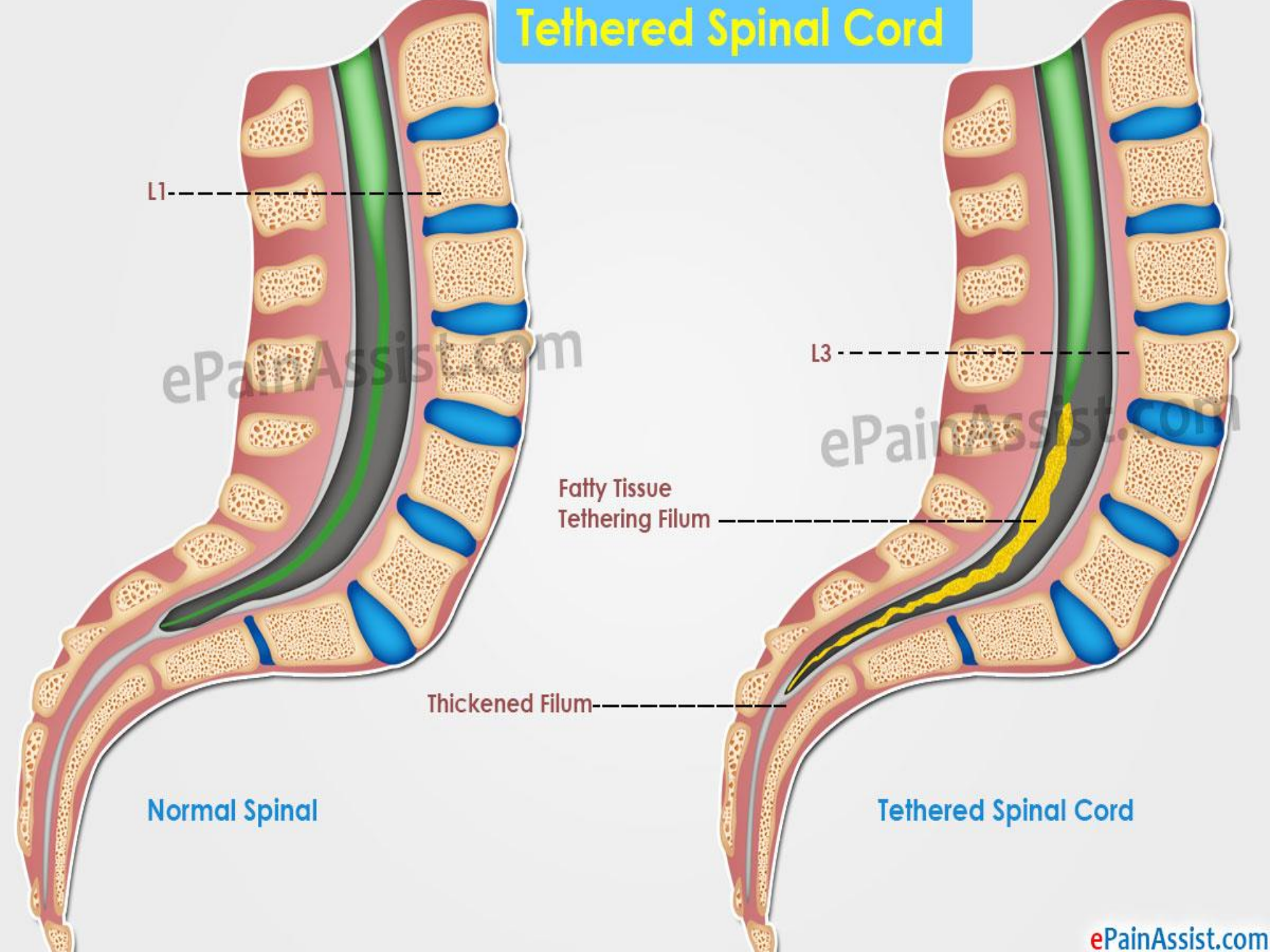

Folded neural tissue
E
Rachischisis

Syringomyelia





Tethered Spinal Cord



Summary

1. State the embryonic origin of the nervous system (2mks)
2. Give an account in the neurulation process (8 mks)
3. List Neural Crest Derivatives (10 mks)
4. Name the zones of the distal neural tube and state the derivatives of each (8mks)
5. State basis of spinal cord termination at L1/2 junction in adults (1mk)
6. Name the types of the neural tube defects (3mks)

THE END