

DEVELOPMENT OF NERVOUS SYSTEM

By

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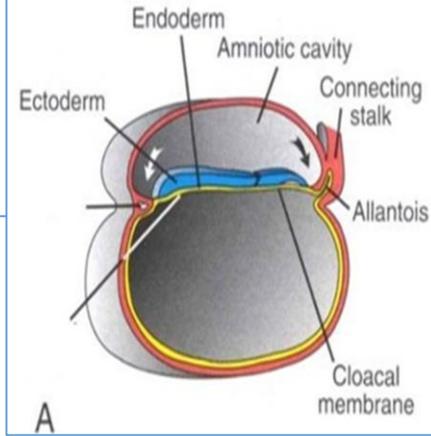
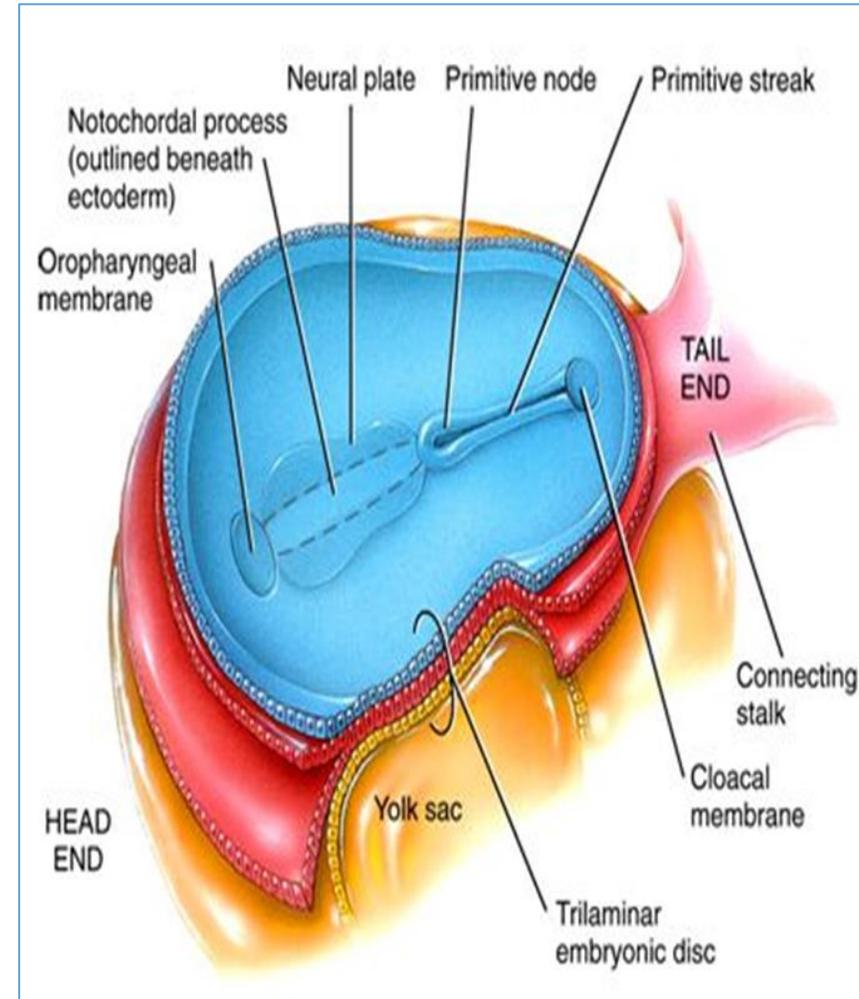
Faculty of medicine- Tanta university

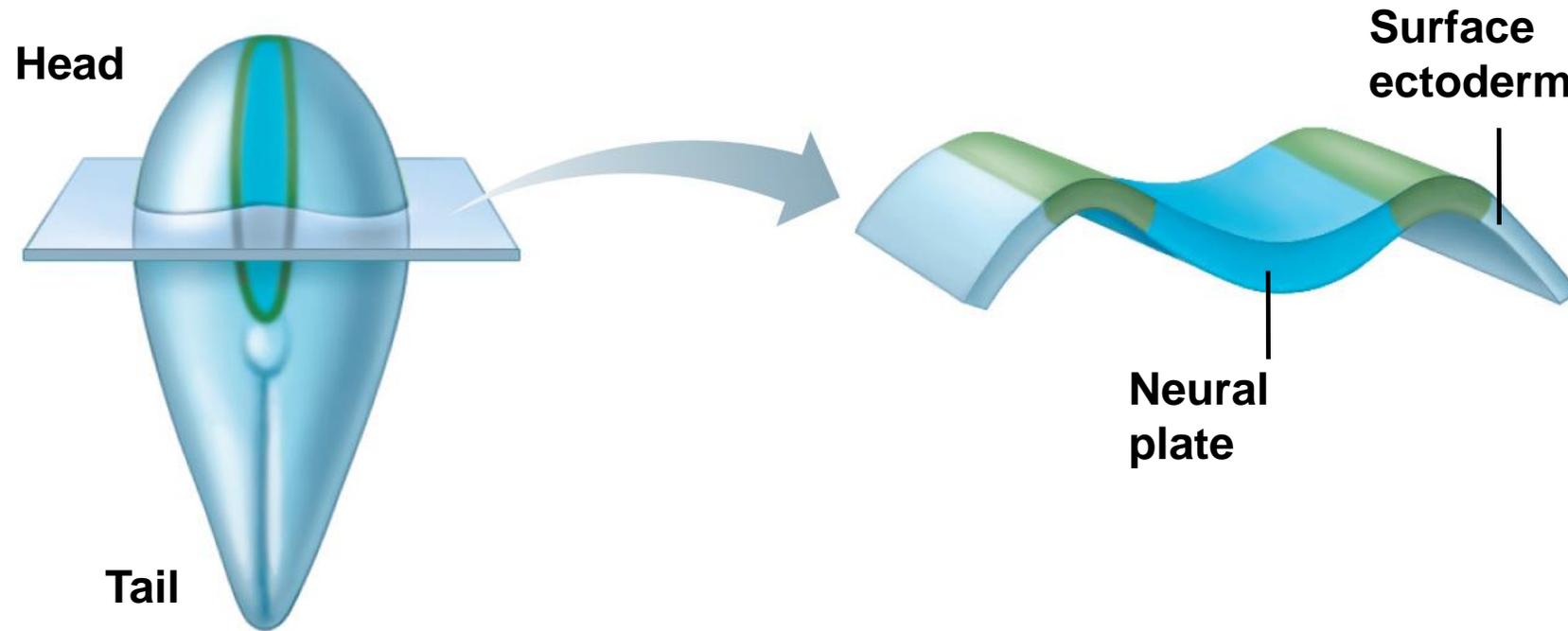
Lecture ILOs/ Objectives:

- **By the end of this lecture the student will be able to:**
- **Understand basic steps of central nervous system development.**
- **Understand the process of neural tube differentiation.**
- **Identify how the spinal cord and the brain are developed.**

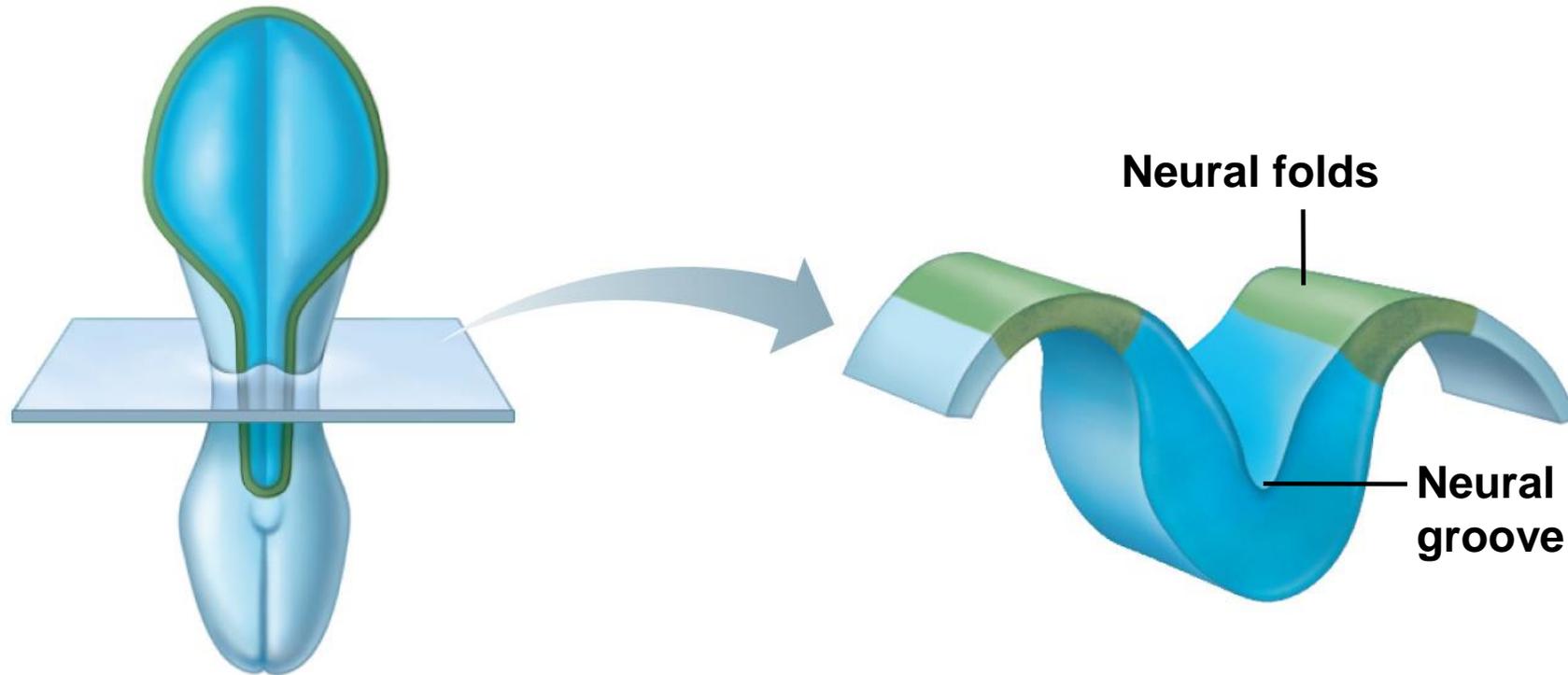
Development of Central nervous system

- The central nervous system develops from the ectoderm.
- At the beginning of the 3rd week
- it appears as an elongated plate of thickened ectoderm called the neural plate.
- Its lateral edges become elevated to form the neural folds thus, the neural plate is transformed into neural groove.
- Then, the neural folds approach each other in the midline and fuse forming the neural tube.

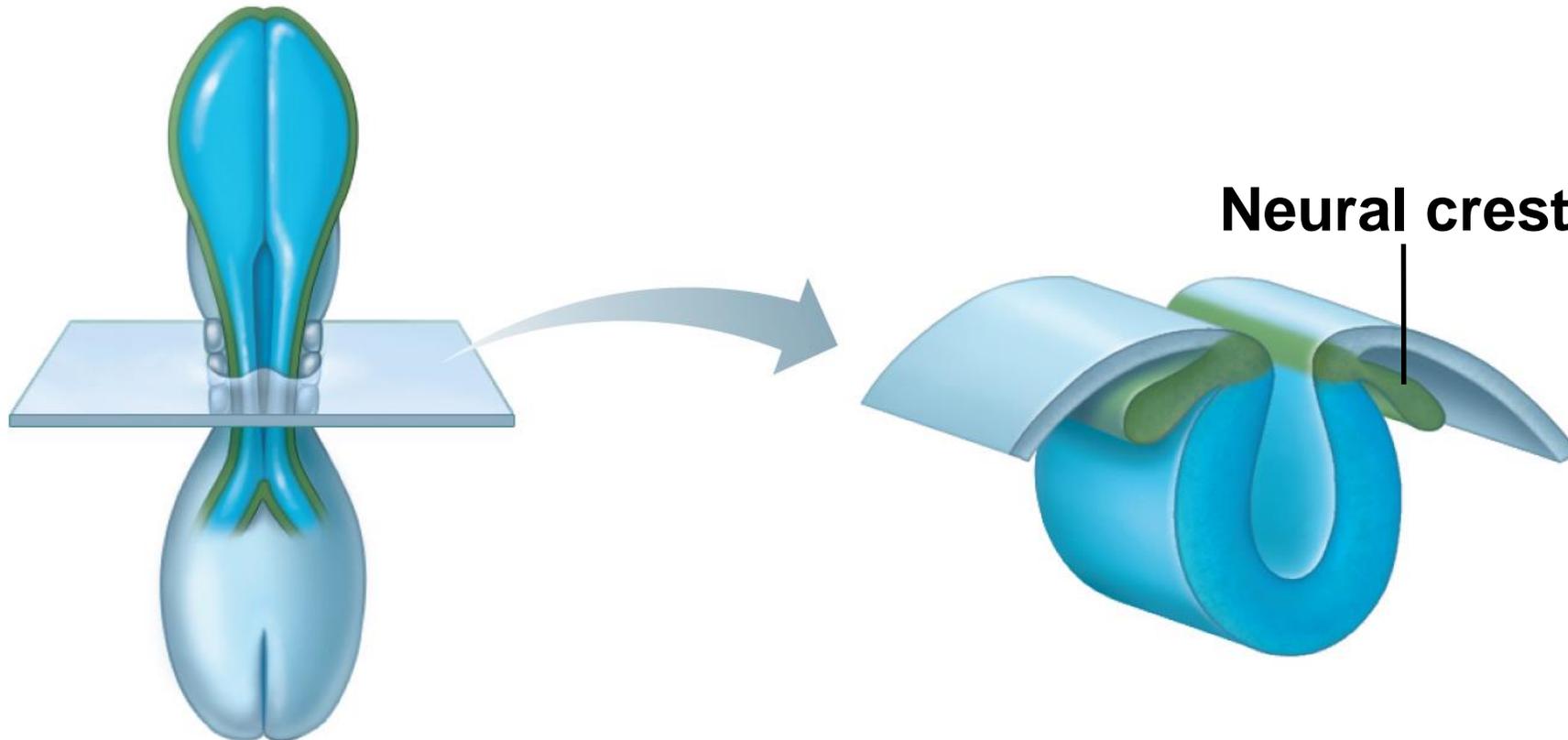




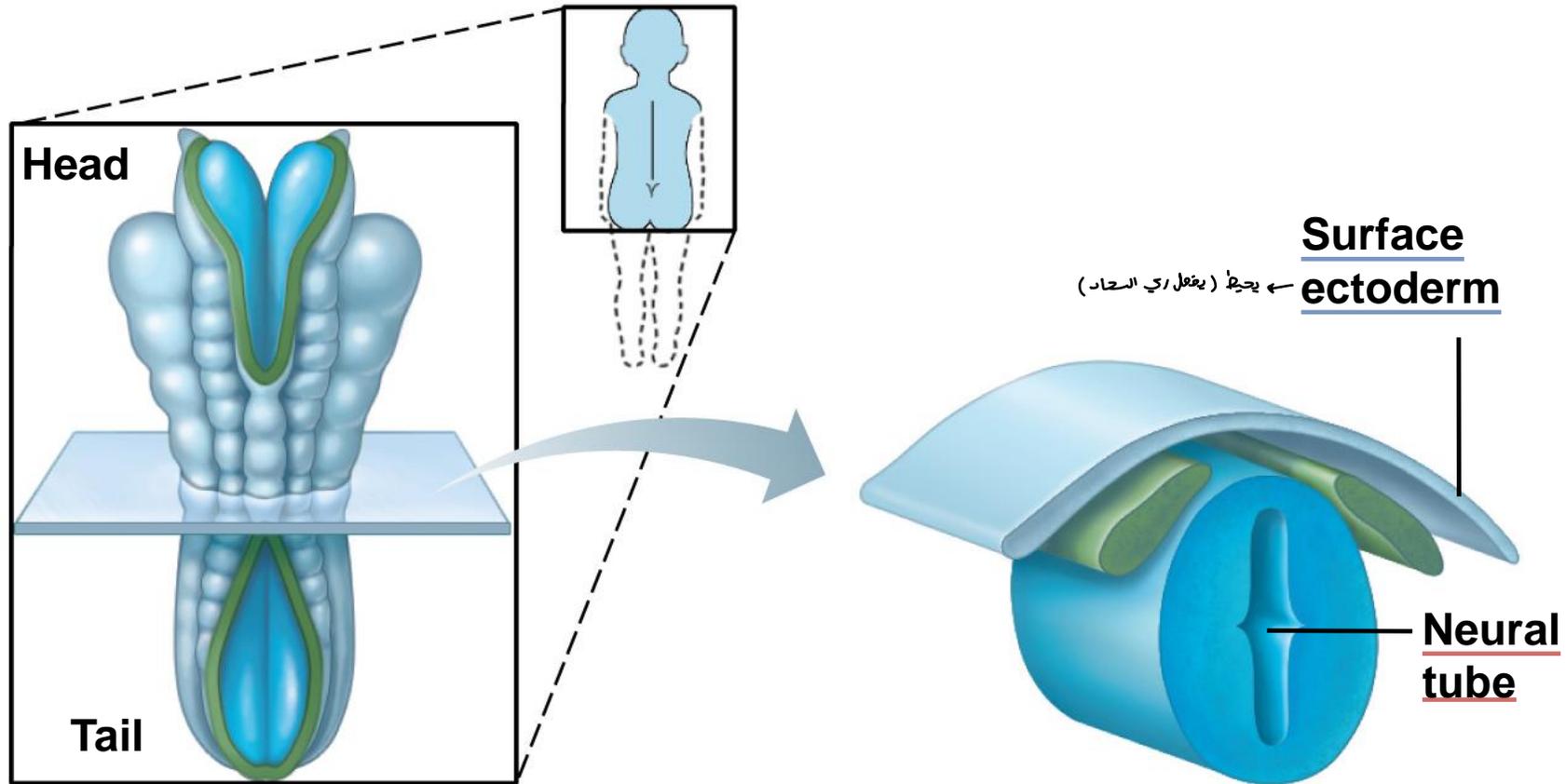
The neural plate forms from surface ectoderm.



The neural plate invaginates, forming the neural groove, flanked by neural folds.



Neural fold cells migrate to form the neural crest, which will form much of the PNS^① and many^② other structures.



The neural groove becomes the neural tube, which will form CNS structures.

22-23 days of Human

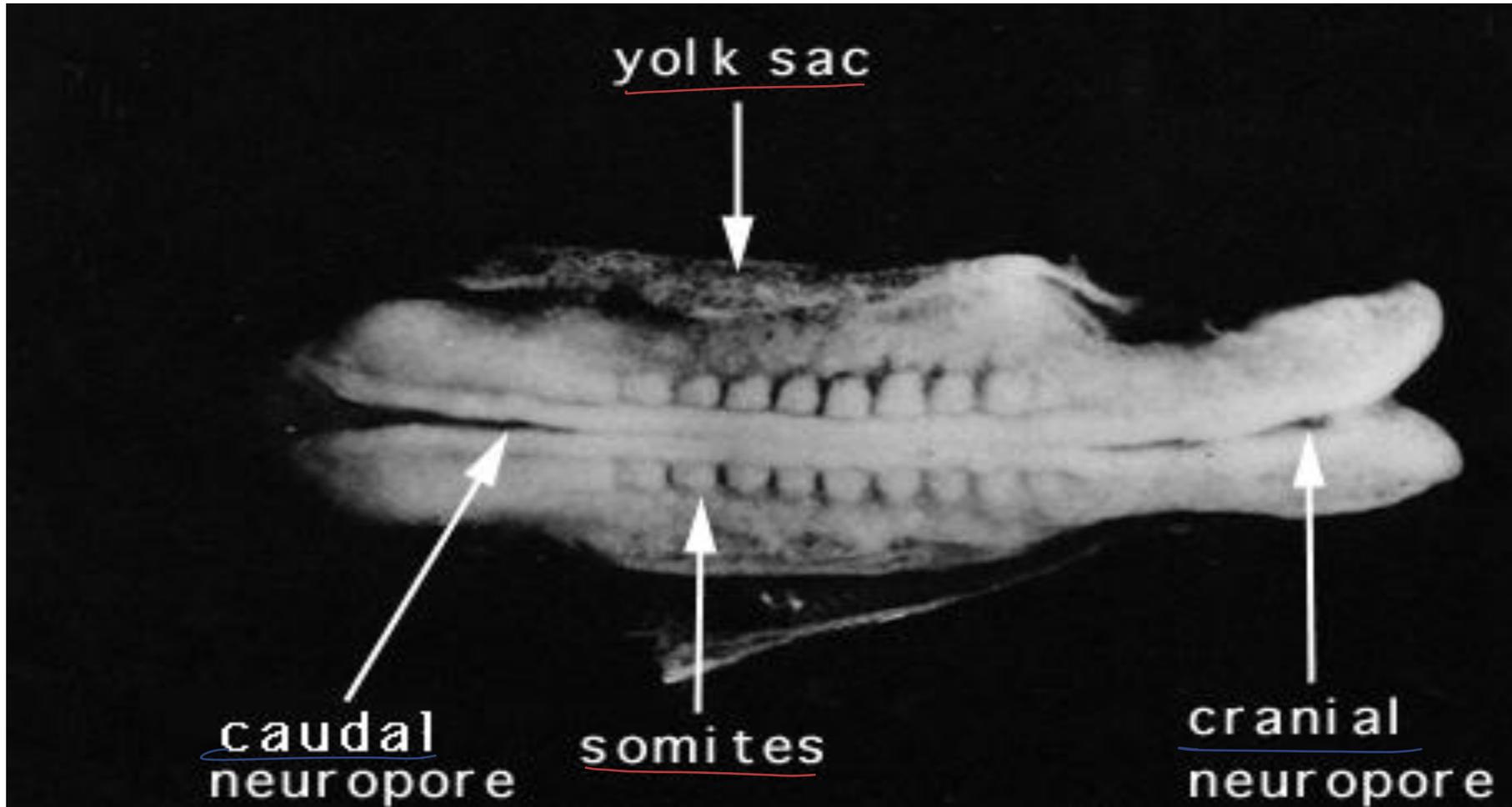
لے حواي الانبوع اسانك

☞ خلا الانبوع 27 بكون كرا

ectoderm انبوع بما فيهم ال

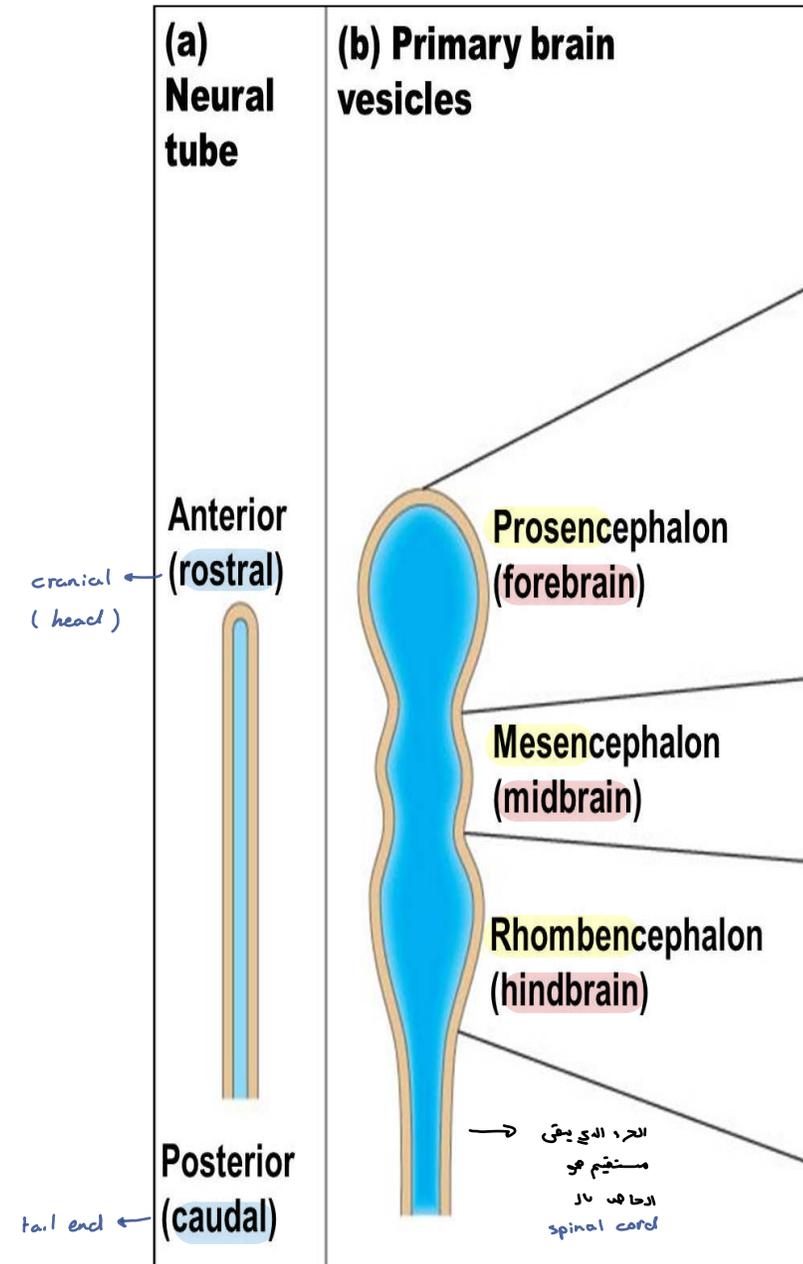
(cranial / caudal neuropore)

آخر بي بطق



Development of Brain

- The caudal slender part of the neural tube forms the spinal cord.
- The cephalic end shows three dilatations; the primary brain vesicles:
 - 1) The **prosencephalon** or forebrain
 - 2) The **mesencephalon** or midbrain
 - 3) The **rhombencephalon** or hindbrain



- Then at the age of 5 weeks
- the prosencephalon differentiates into 2 parts:

a) The telencephalon: The primitive cerebral hemispheres.

b) The diencephalon

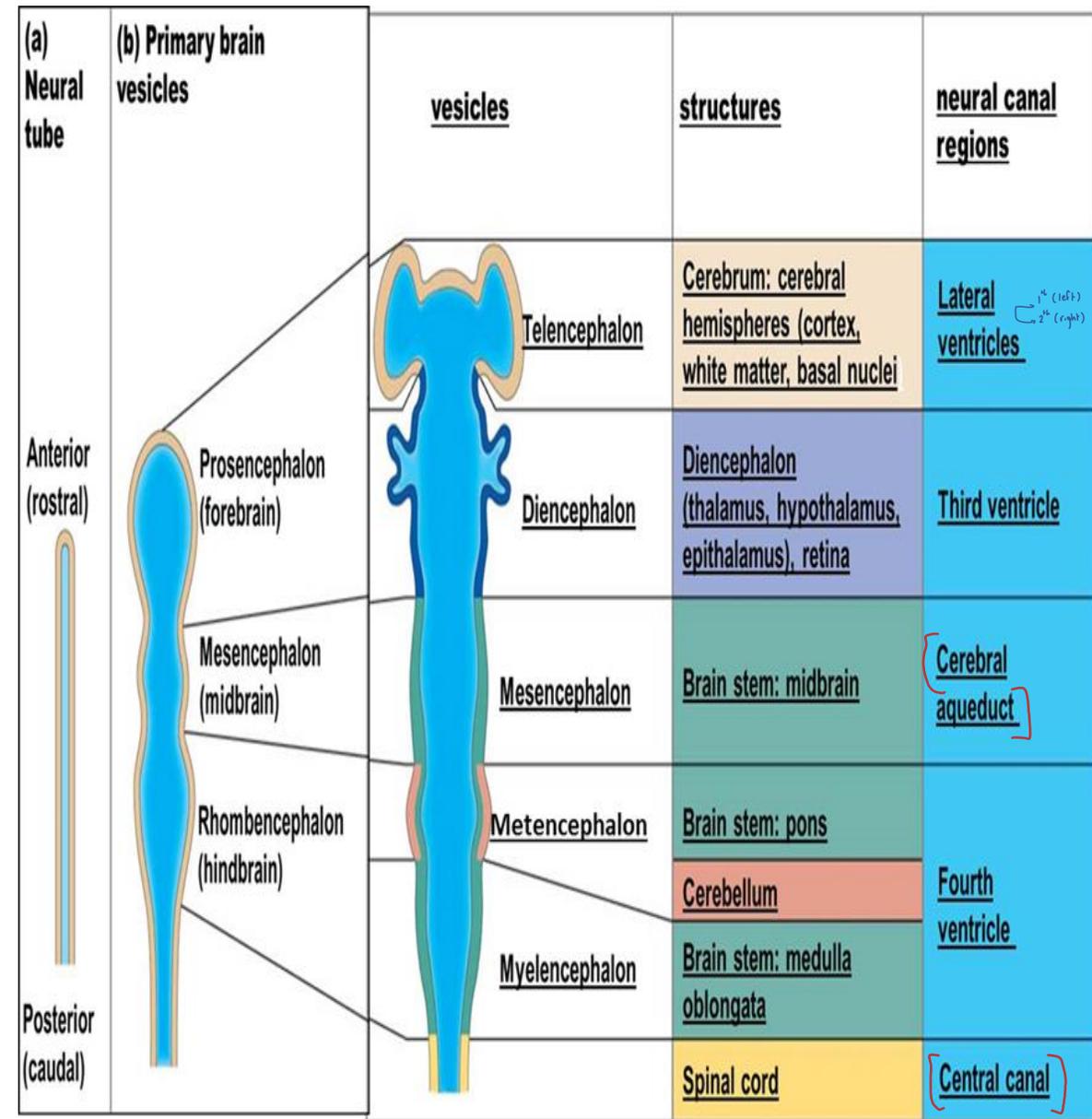
CSF
 ← يوجد في
 ventricular in brain
 central canal in spinal cord

- The mesencephalon will be differentiated into the midbrain.

- The rhombencephalon consists of two parts:

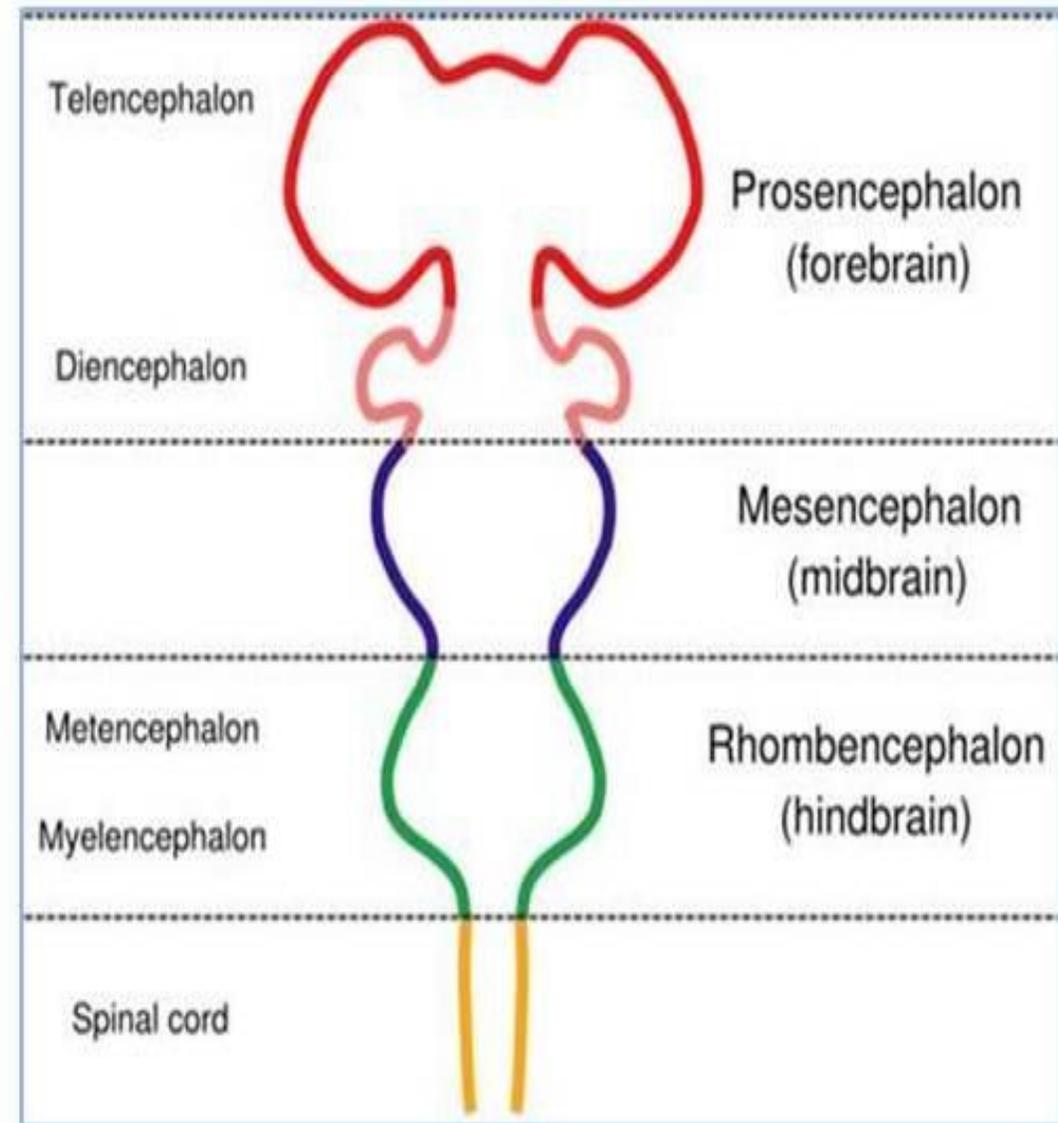
1) Metencephalon (pons and cerebellum)

2) Myelencephalon (medulla oblongata)



Formation of ventricles and central canal

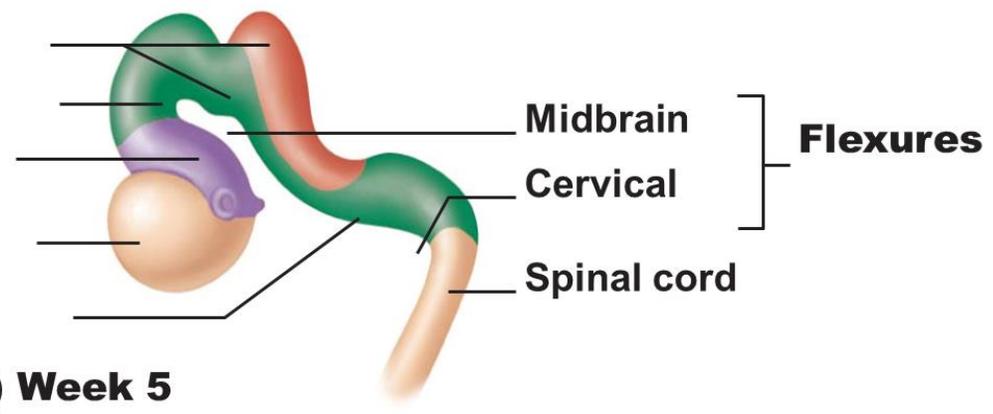
- The lumen of the spinal cord is the (**central canal**)
- The cavity of the rhombencephalon is the (**fourth ventricle**)
- The cavity of the diencephalon is the (**third ventricle**)
- The cavity of the cerebral hemisphere is the (**lateral ventricle**)



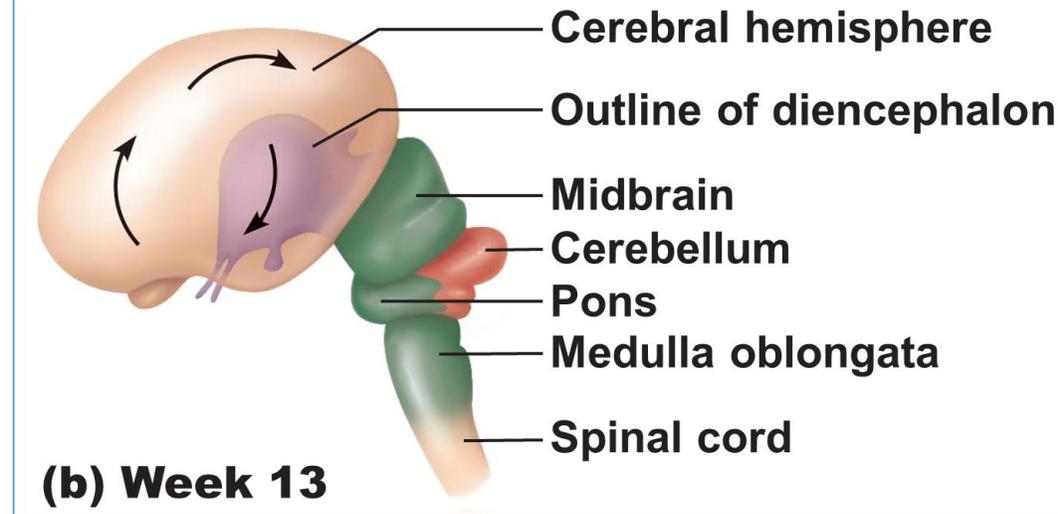
Anterior (rostral)

Posterior (caudal)

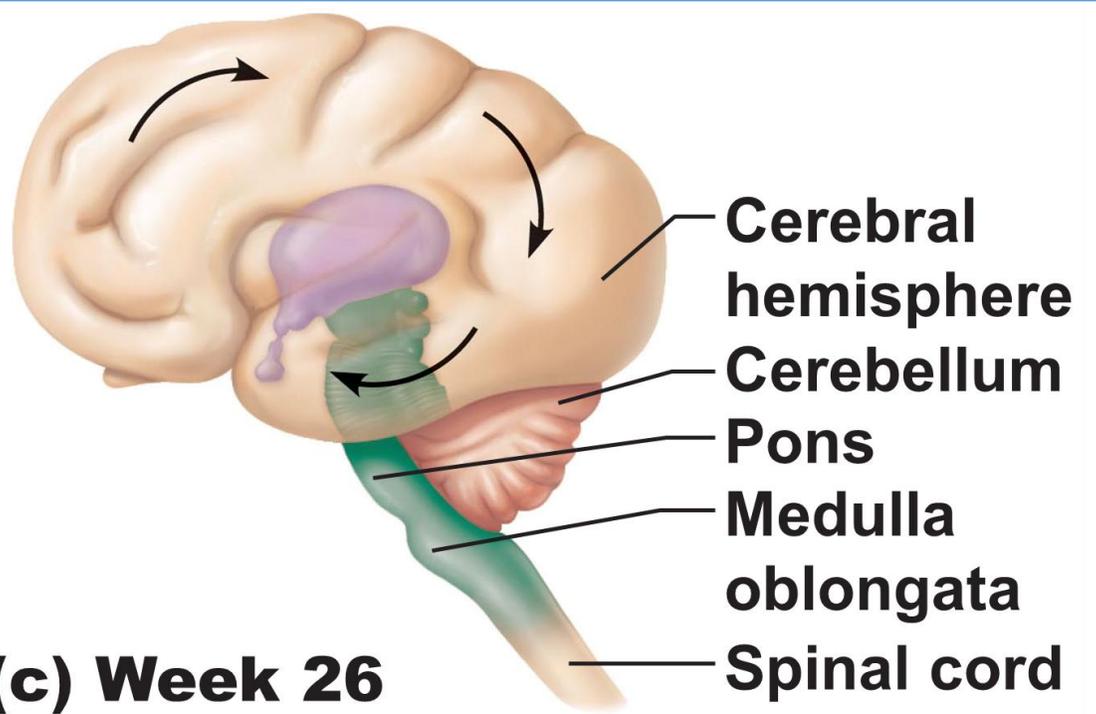
- Metencephalon
- Mesencephalon
- Diencephalon
- Telencephalon
- Myelencephalon



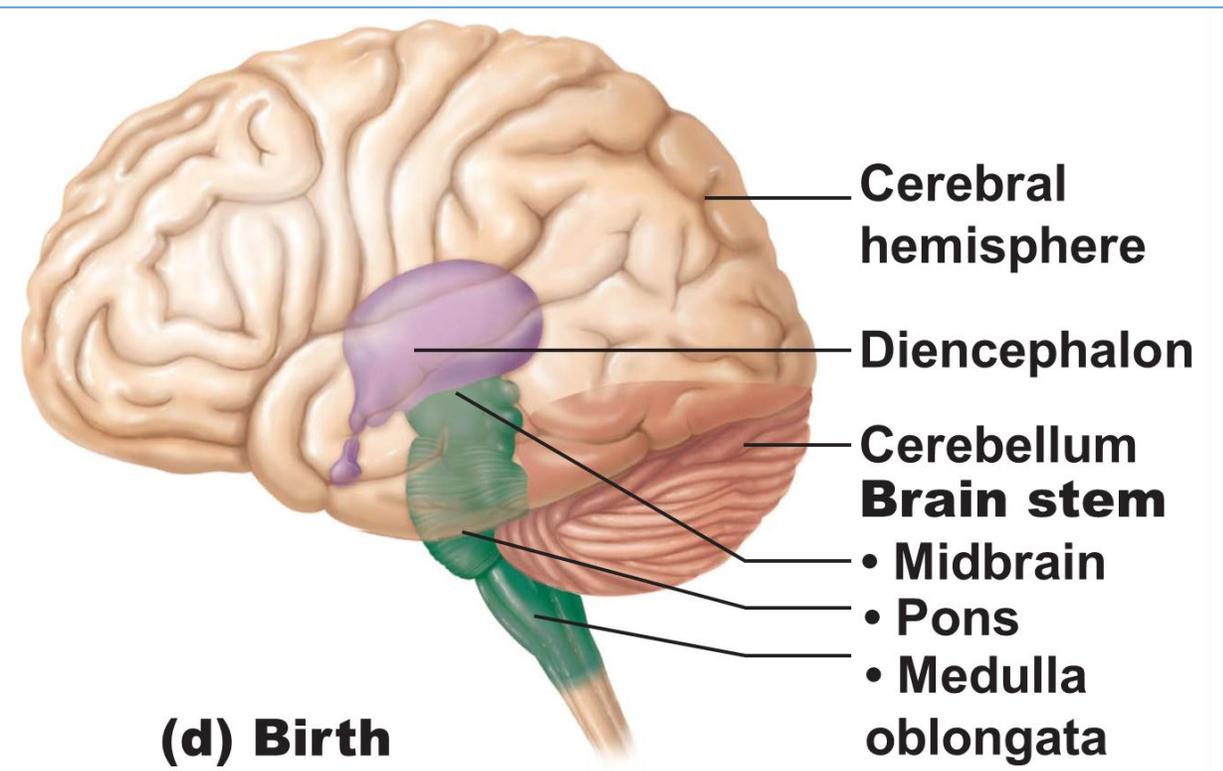
(a) Week 5



(b) Week 13



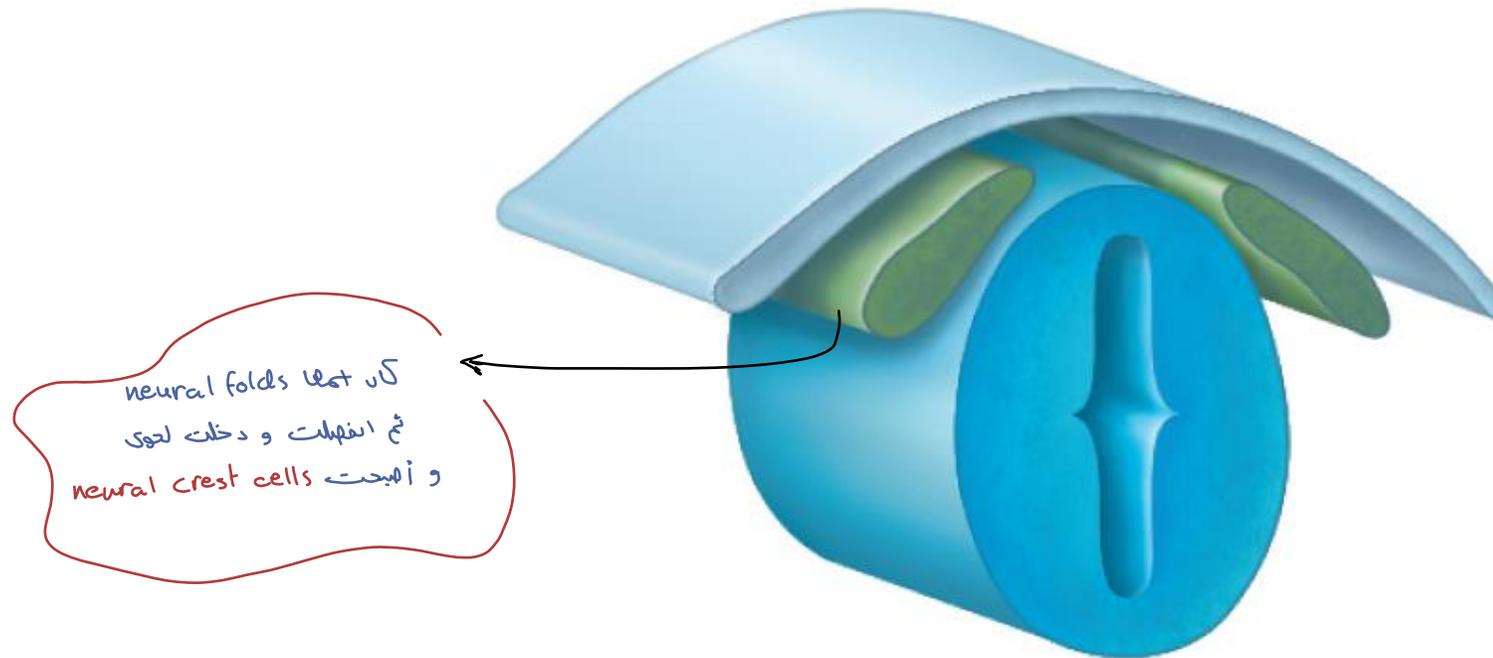
(c) Week 26



(d) Birth

NEURAL CREST

- *These are a group of ectodermal cells which appears along each edge of the neural groove during invagination of the neural plate.

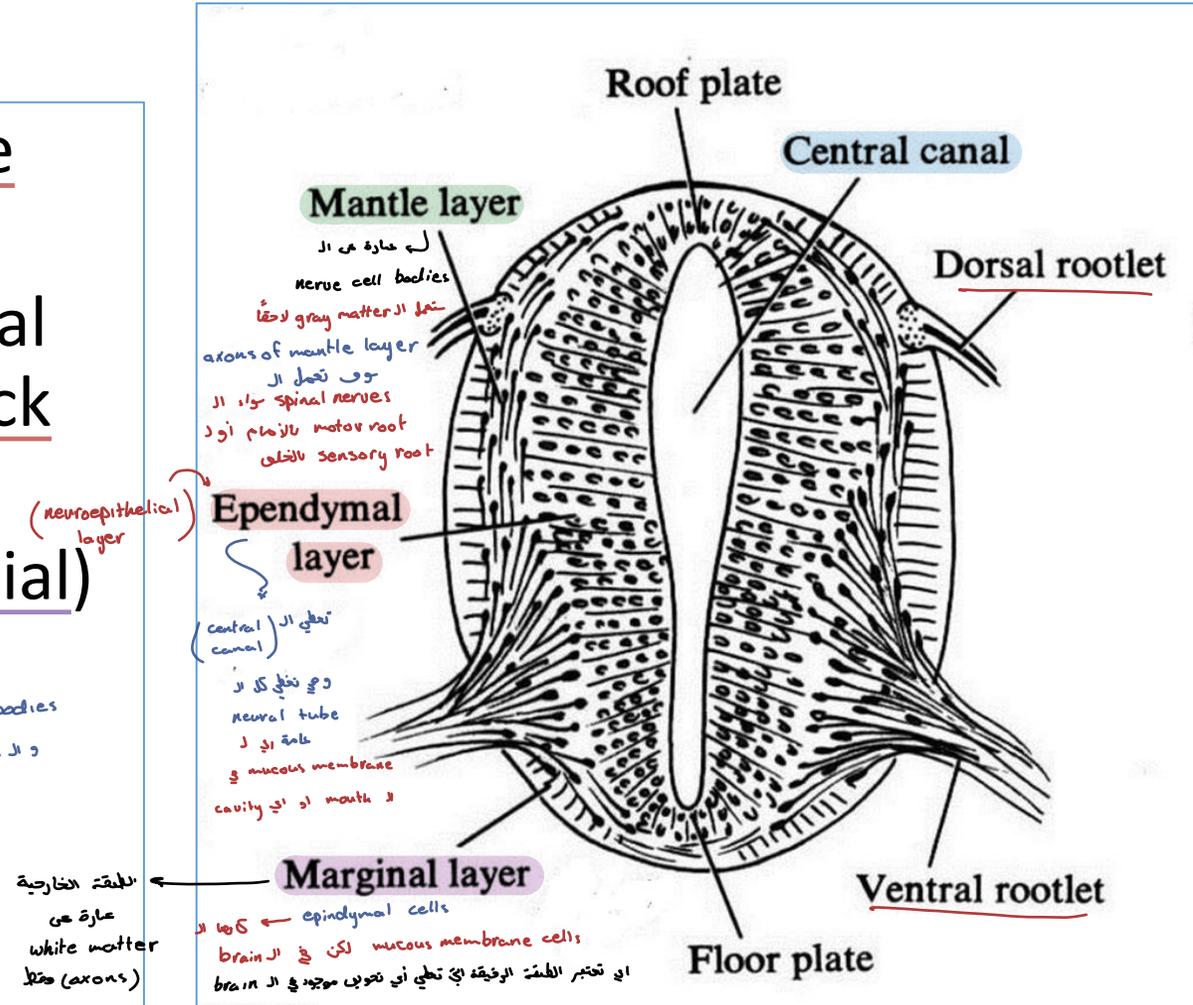


The neural crest gives many derivatives:

- 1-Cranial nerve ganglia of the trigeminal, facial, glossopharyngeal and vagus nerves. ↳ (sensory)
- 2-Dorsal root ganglia of the spinal nerves.
- 3-Sympathetic ganglia of the spinal nerves.
- 4-Parasympathetic ganglia in the head .
- 5-Schwann cells ↳ cell that produce myelin sheath ↳ lipid coated sheath on nerves ↳ myelinated axon faster than unmyelinated axon ↳ otic / sphenopalatine ↳ submandibular / ciliary
- 6-Melanocytes ↳ الخلايا التي تصبغ (لون العين / الجلد / الشعر)
- 7-Leptomeninges (pia-arachnoid).
- 8-Chromaffin cells of the suprarenal gland.
- 9-Sympathetic neurons.
- 10-Aortico-pulmonary septum of the heart.
- 11-Odontoblasts (dentine forming cells).
- 12-Skeletal & connective components of the pharyngeal arches.
- 13-Parafollicular cells (C cells calcitonin)

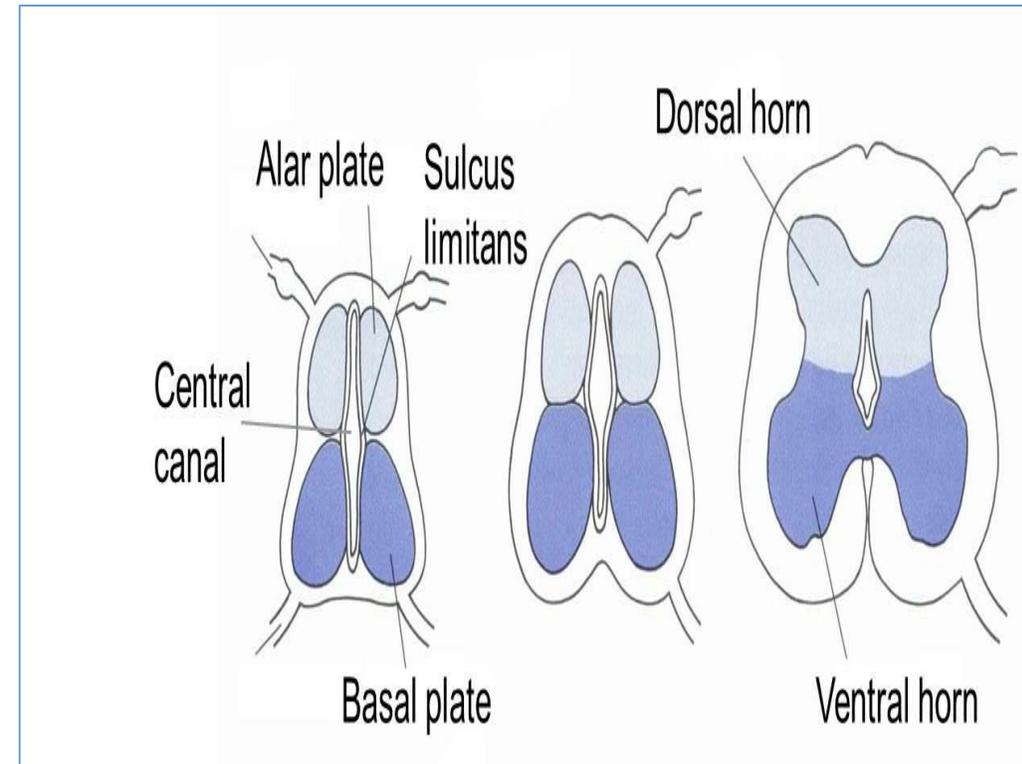
Development of spinal cord

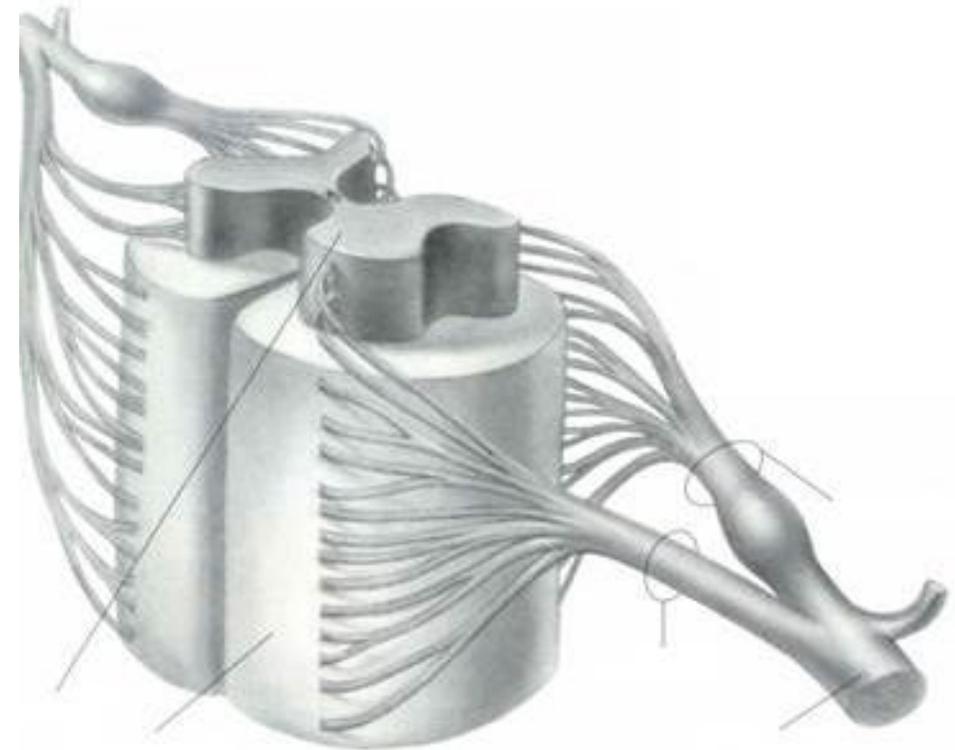
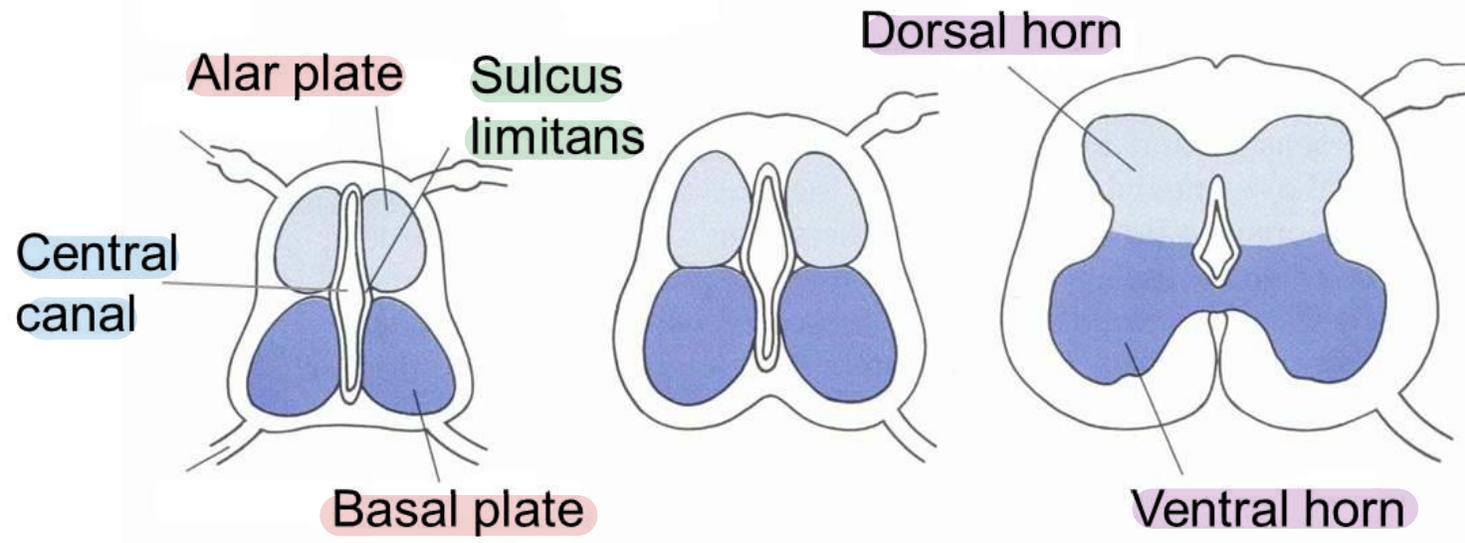
- At first the neural tube consists of one layer of cells,
- but rapid proliferation leads the lateral wall of the neural tube to become thick and to differentiate into 3 layers:
 - Inner or ependymal (neuroepithelial) layer
 - Middle or mantle layer
 - Outer or marginal layer



Development of spinal cord

- The mantle layer forms the grey matter while the marginal layer forms the white matter.
- A groove called the **sulcus limitans** appears on the inner surface of the thick lateral wall, dividing it into :
 - **Alar plate** (dorsally)
 - **Basal plate** (ventrally)
- The cells of the alar plate will form the **sensory** cells of the **posterior horns**
- while the cells of the basal plate will form the **motor** cells of the **anterior horns**.





REFERENCES

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Snell, R. S. (2010). *Clinical neuroanatomy*. Lippincott Williams & Wilkins.

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Veeramani, R., & Holla, S. J. (Eds.). (2019). *Gray's Anatomy For Students: Second South Asia Edition E-Book*. Elsevier Health Sciences.

THANK

YOU!

