

DEVELOPMENT OF THE CEREBRUM AND CEREBELLUM

LECTURE

#2





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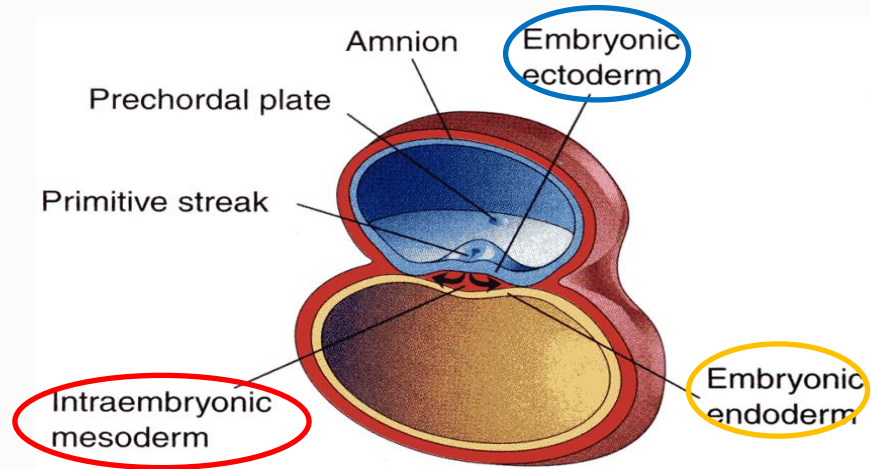
OBJECTIVES

By the end of the lecture, you should be able to:

- # Describe the **formation** of the neural tube.
- # List the **3 brain vesicles** and their derivatives.
- # Describe the **brain flexures**.
- # Describe briefly the development of the cerebrum.
- # Describe briefly the development of the cerebellum.
- # Enumerate some congenital **anomalies** in development of CNS.

#Formation of the neural tube:

By the beginning of the 3rd week of development, three germ cell layers become established, **Ectoderm**, **Mesoderm** and **Endoderm**



➤ Early development of the neural tube:

Dorsal plate (Neural plate)

- During the middle of the 3rd week, *the dorsal midline ectoderm* undergoes called Dorsal plate.

Neural folds

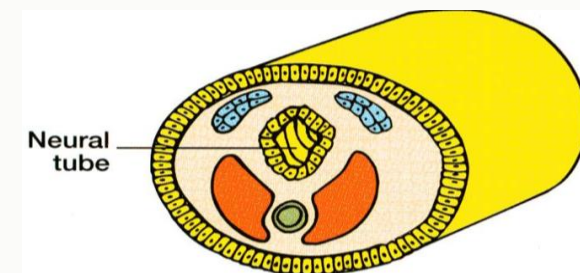
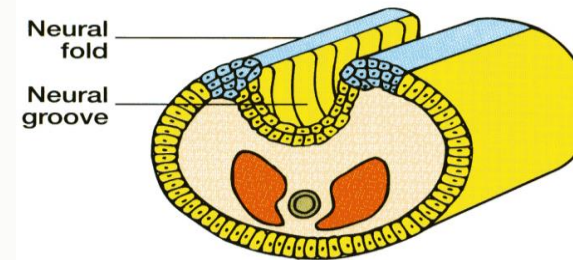
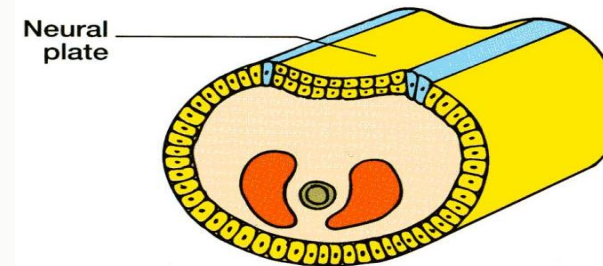
- The margins of the neural plate become elevated, forming Neural folds.

Neural groove

- A longitudinal, midline depression

Neural tube

- The 2 neural folds then fuse together, thus sealing the neural groove.



#Neural Tube Development

Three-vesicles stage:

➤ Formation of the neural tube is completed by the **middle of the fourth week**

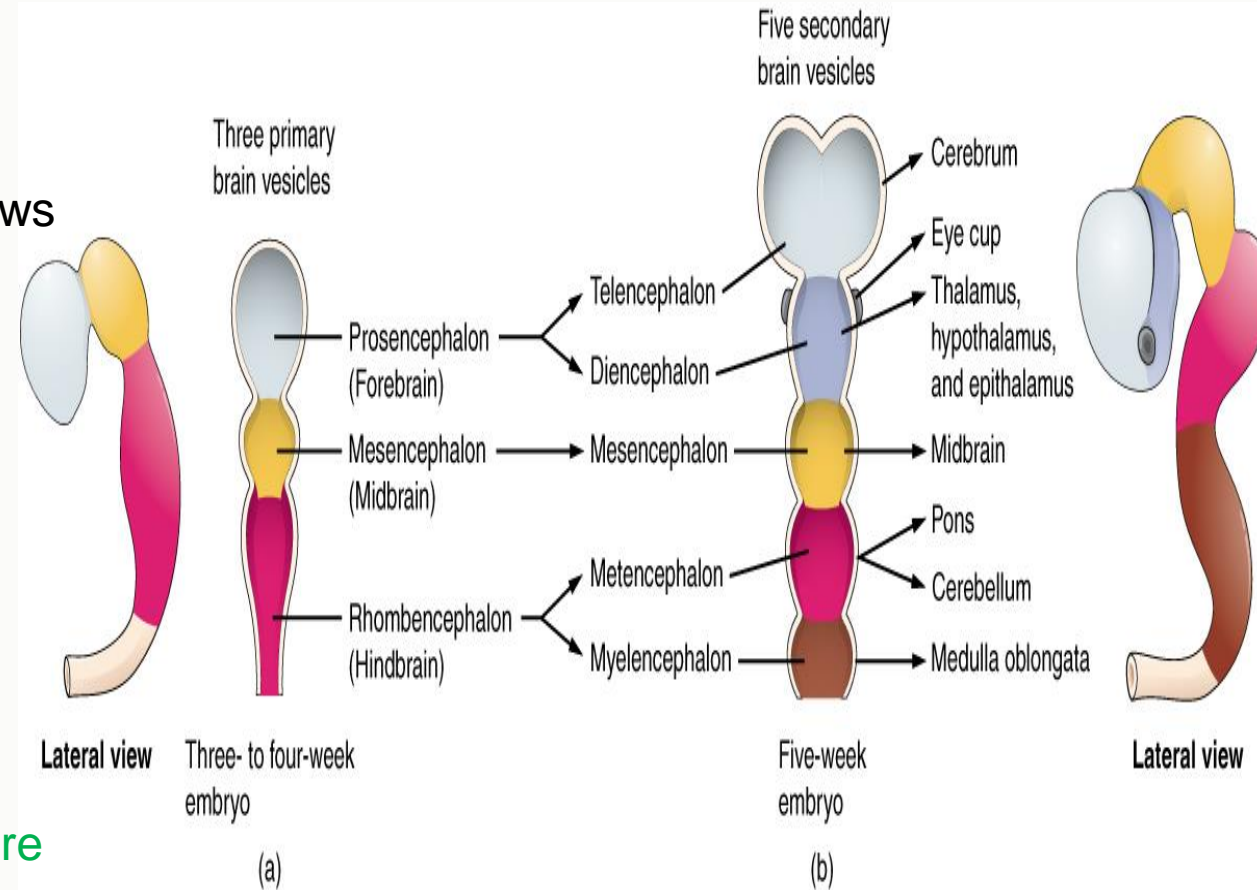
➤ By the **end** of the 4th week its upper end dilates and shows **3 vesicle:**

1. Prosencephalo (forebrain)
2. Mesencephalon (midbrain)
3. Rhombencephalon (hindbrain)

➤ By the **5th week** further differentiation distinguishes five secondary brain vesicles:

1- Prosencephalon divides into the **two telencephalon** (future brain) and one **diencephalon** (future thalamus).

2- Rhombencephalon divides into **metencephalon** (future pons, Cerebellum) and **myelencephalon** (future medulla)

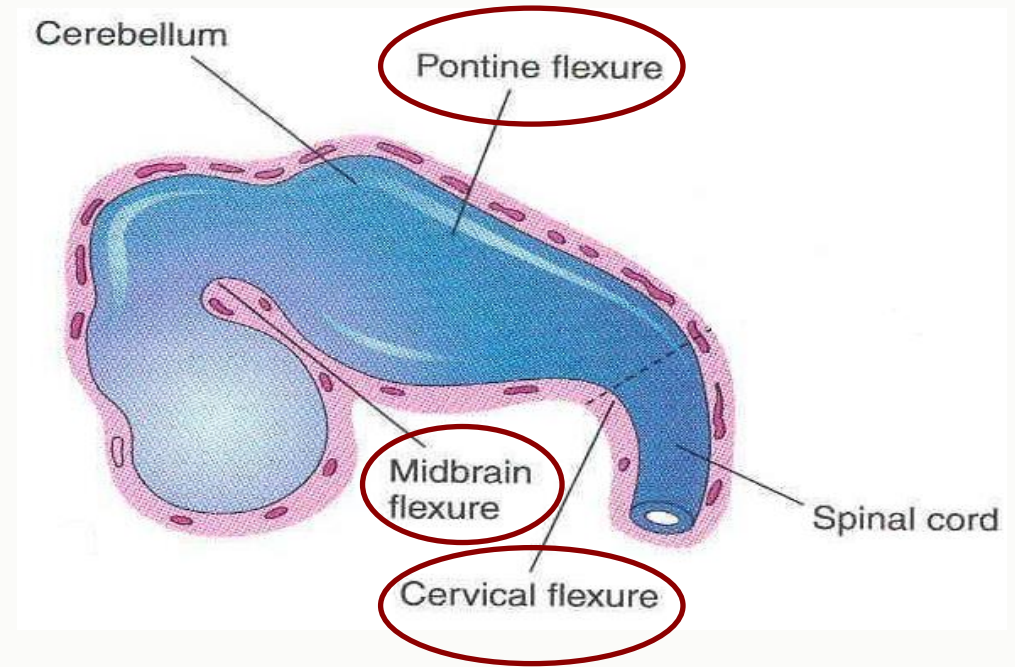


3 Brain Flexures:

By the 4th week: The neural tube grows rapidly and bends **ventrally**, producing two flexures:

- ✓ **Midbrain flexure**: between the **prosencephalon** & the **mesencephalon** (midbrain)
- ✓ **Cervical flexure**: Between the **hind brain** & the **spinal cord**

- ✓ Later **Pontine flexure** appears in the hindbrain, in the **opposite direction**, resulting in thinning of the roof of the hindbrain.



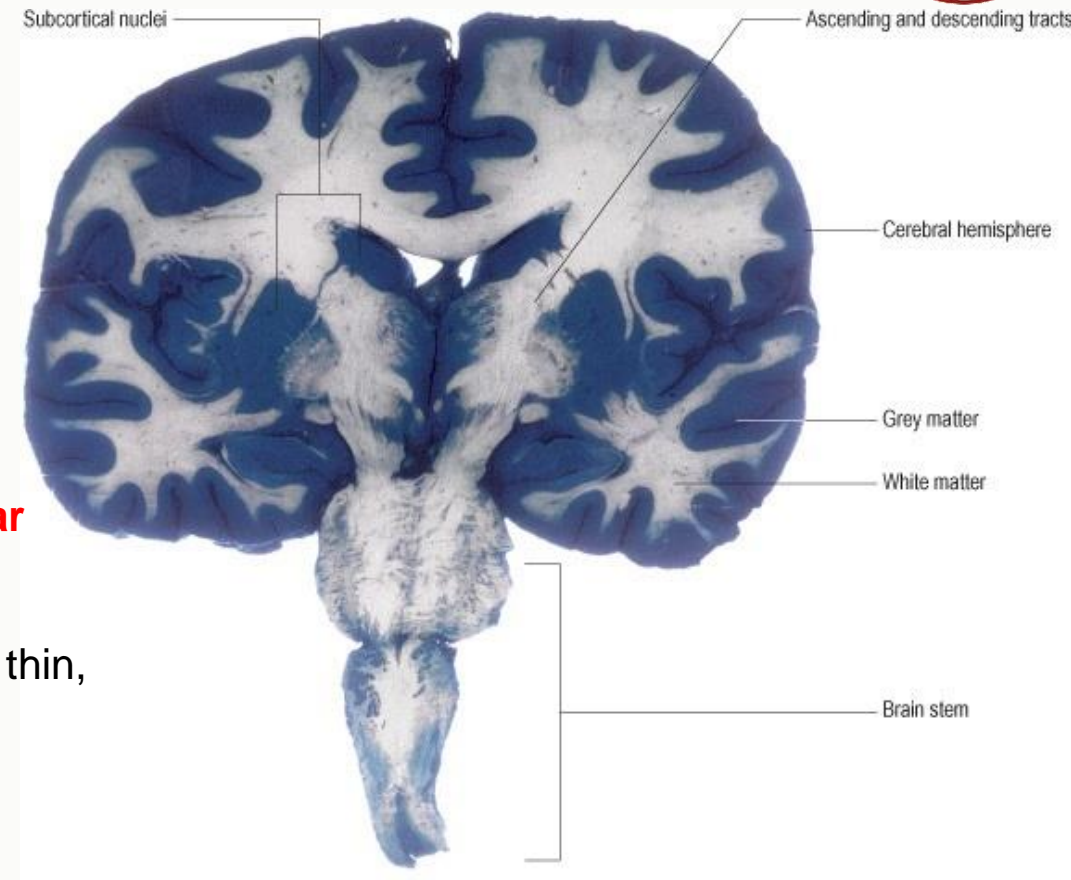
#Development of the Cerebrum:

- The cerebrum develops from the **Telencephalon**
- The (prosencephalon) or the forebrain vesicle differentiates into a:
 - 1- **Median part** (**diencephalon**).
 - 2- **Two lateral cerebral vesicles** (**telencephalic vesicles**)
- The lumen gives the **2 lateral ventricles** and the **3rd ventricle**. Both cavities communicating with each other through a wide **interventricular foramen**.

The cerebral hemispheres expand in all directions. Its medial wall becomes thin, flat and it is the site of choroid **plexus of the lateral ventricle**.

- The wall of the telencephalon is formed of 3 layers:
- 1- **Ependymal** (lining the cavity of the lateral ventricle).
 - 2- **Marginal** nerve fibers forming the **white matter**.
 - 3- **Mantel** nerve cells forming the **grey matter**

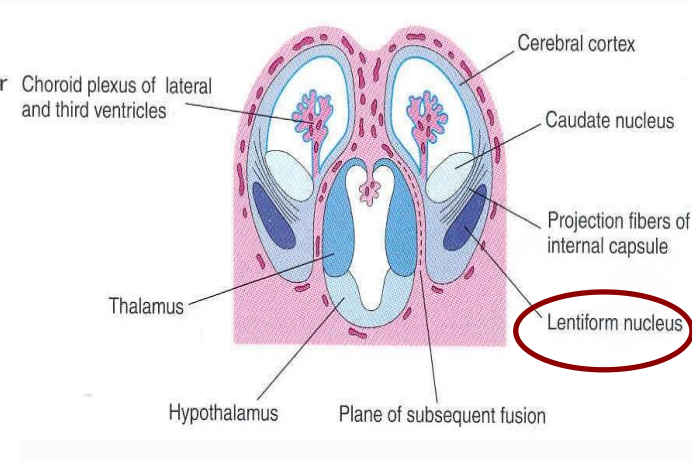
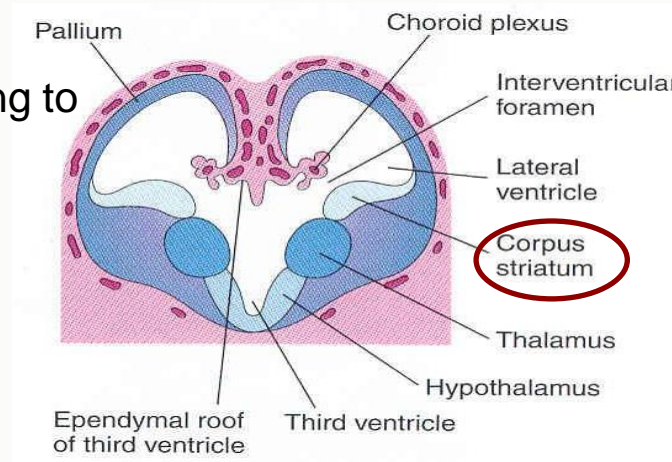
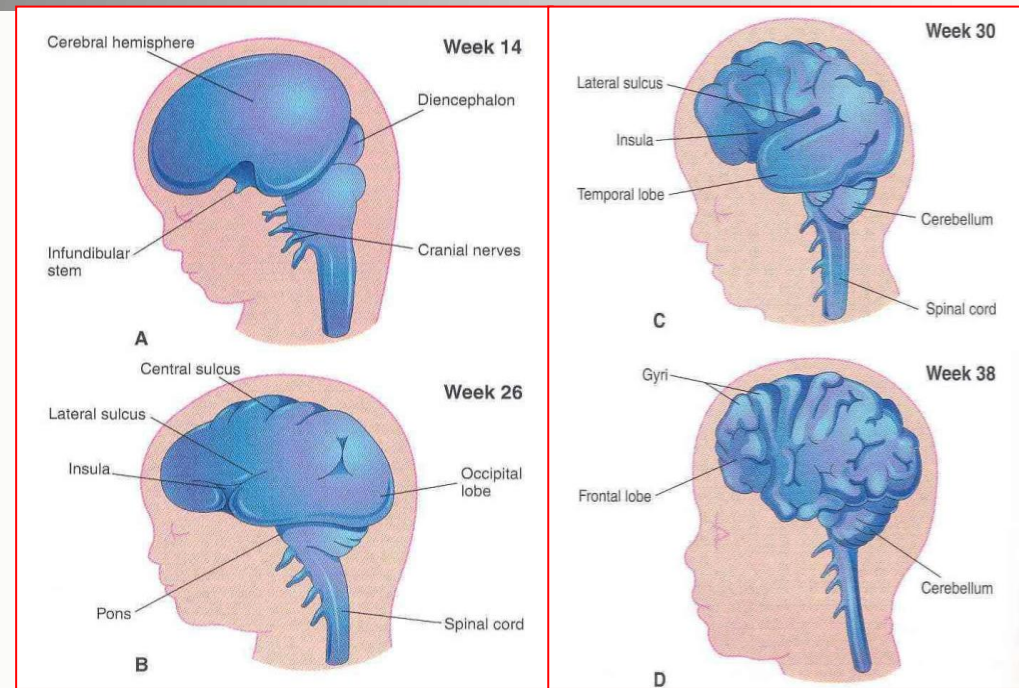
As development proceeds the Most of the nerve cells **migrate to the marginal layer** forming the cerebral cortex.
Some cells do not migrate and remains to form the **basal ganglia**.



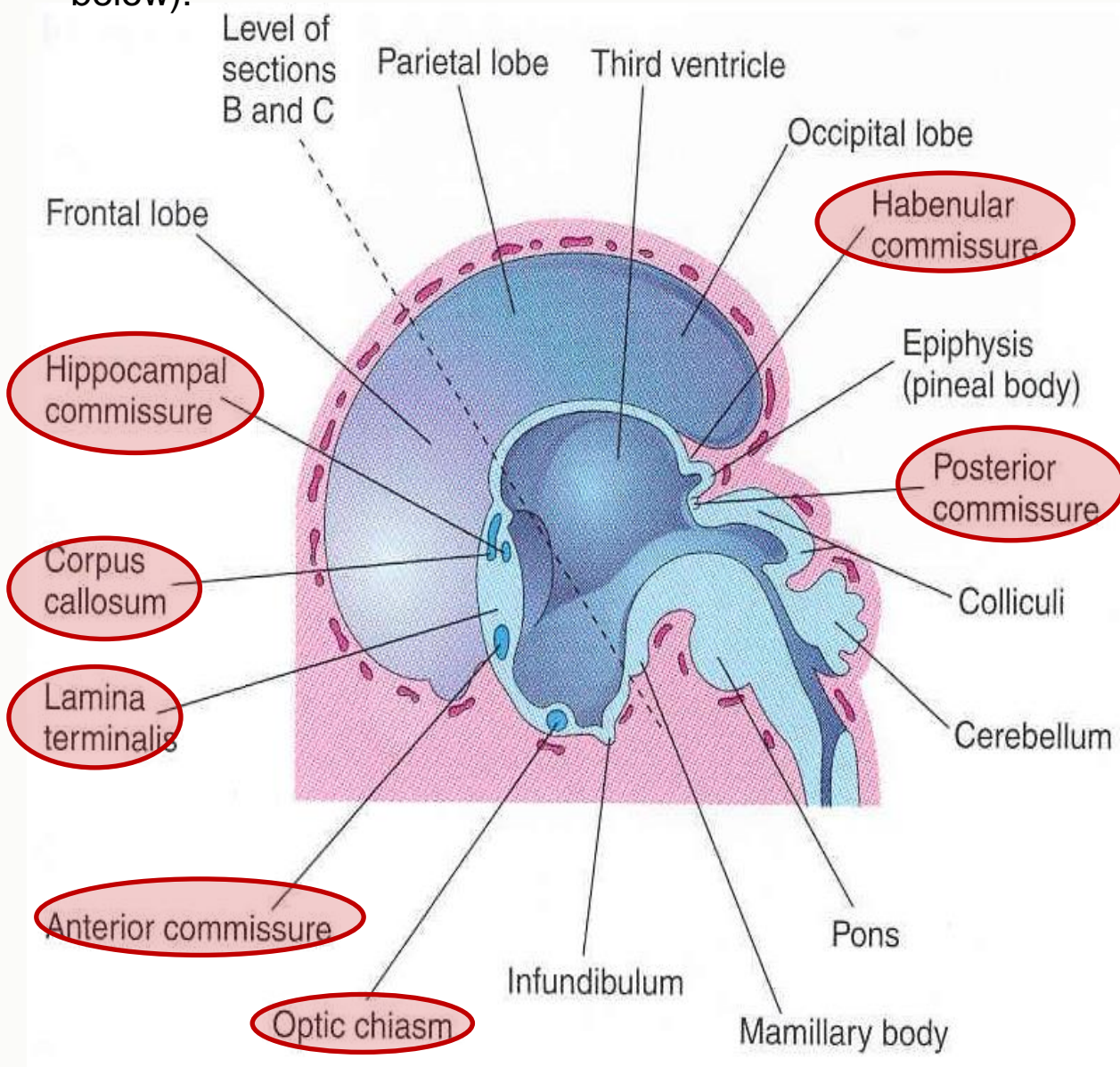
- The cerebral hemispheres first appear on the **day 32** as a pair of bubble-like outgrowths of the Telencephalon, By **16 weeks**, the rapidly growing hemispheres are oval and have expanded back to cover the diencephalon.
- By the end of the **3rd month** the surfaces of the cerebral hemispheres are smooth. By the **4th month** the grey matter grows faster than the white matter, so, the cortex becomes folded into gyri separated by sulci. The gyri and sulci effectively increase the surface area of the brain.

❖ Corpus striatum:

- It appears in **6th week** in the **floor** of each **cerebral hemisphere**.
- As the cerebral cortex differentiates and the fibers passing to and from it, pass through the **corpus striatum**, The corpus striatum now is divided into **caudate nucleus & lentiform nucleus**. This fiber pathway forms the **internal capsule**.
- Further expansion of cerebral hemisphere give **C-shape appearance** to the **hemisphere** itself as well as its cavity (**lateral ventricle**).
- Also the **caudate nucleus** elongates and assumes the shape of the lateral ventricle and remains related to it.



- ❖ As the cerebral cortex develops, group of fibers, (commissures), connect the corresponding regions of the cortex the 7 commissures are (marked below):

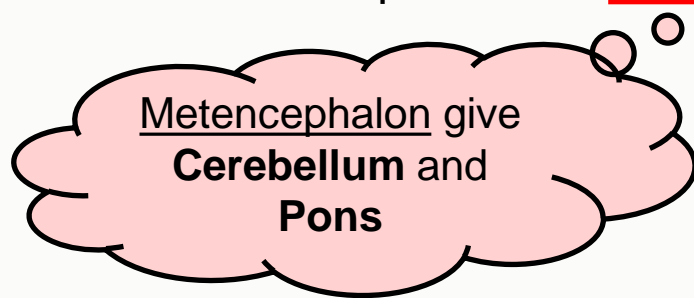


❖ Insula:

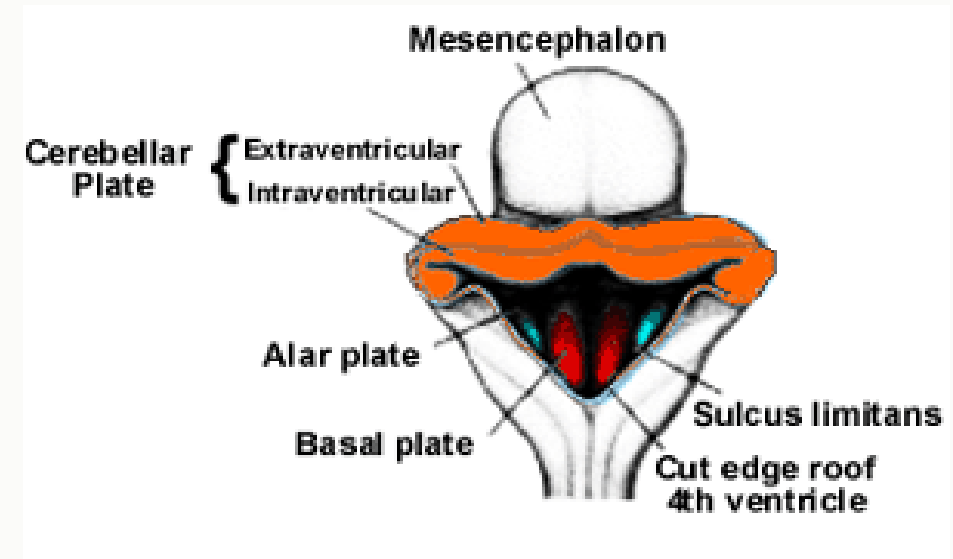
The cortex covering the surface of the corpus striatum: grows relatively **slower than the other cortices**, so it is overgrown by the rest of the hemisphere and **lies in the depth of the lateral sulcus**. This is called **the insula**.

Development of the Cerebellum:

- It develops from the dorsal part of the **Metencephalon**

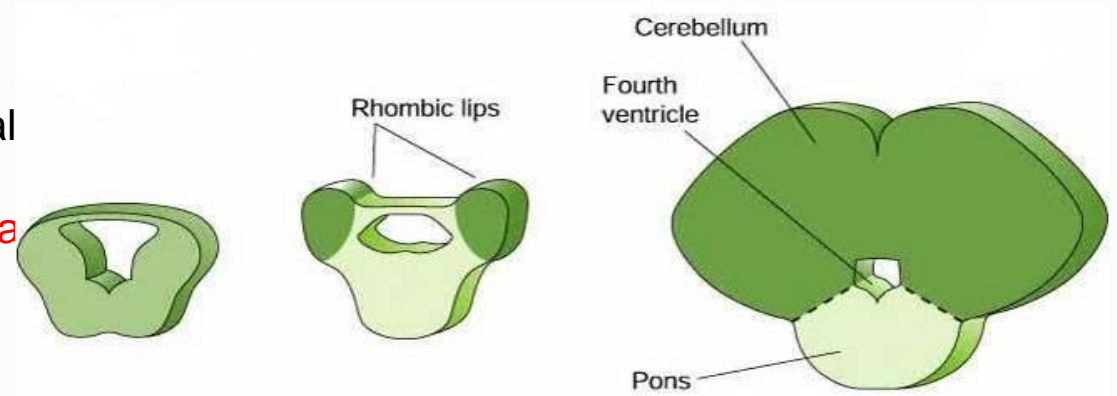


- Pontine flexure results in: (slide 5)
 1. **Moving the 2 alar plates** laterally then pending medially.
 2. **Stretching and thinning** of the roof plate.
 3. **Widening** of the cavity to form the 4th ventricle.



❖ Metencephalon: Changes in Alar plates

- ✓ The **dorsal parts** thicken to form **Rhombic lips**, – that will give rise to the **cerebellum**.
- ✓ Some **neuroblasts** migrate from the **mantel layer** to the marginal layer and form the – **cerebellar cortex**.
- ✓ Others remains in the mantel layer and give rise to the **cerebellar nuclei**. –
- ✓ The **cerebellar peduncles** develop later as the axons of the neurones of the cerebellar nuclei – grows out to reach the brain stem.



As the cerebellar hemispheres develops they undergo a complicated process of transverse **folding** and form closely packed, **leaf-like** transverse **gyri** called **folia**.

These processes of **fissure formation** and **foliation** continue throughout **embryonic**, **fetal**, and **postnatal** life, and they increase the **surface area of the cerebellar cortex**.

#Congenital Anomalies of The Brain:

- ✓ Hydrocephalus.
- ✓ Microcephaly.
- ✓ Mental retardation.
- ✓ Seizures.
- ✓ Cerebral palsy.
- ✓ Cranium bifidum (with or without meningocele & meningoencephalo-cele).
- ✓ Agenesis of corpus callosum.
- ✓ Arnold-Chiari malformation.

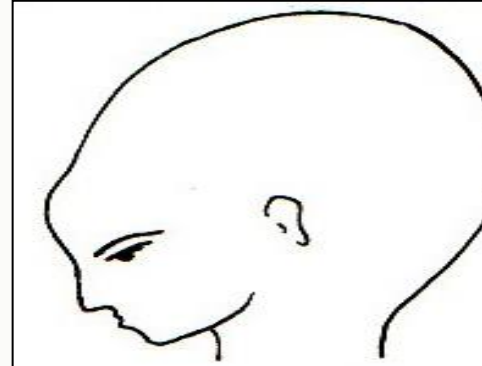
-**Meningocele:** herniation of meninges.
-**Meningoencephalocele:** herniation of meninges and brain

✓ ANENCEPHALY:

the **brain** and **skull** are minute (very small) and the infant does not usually survive.

It is due to failure of closure of the cranial **neuropore of the neural tube**.

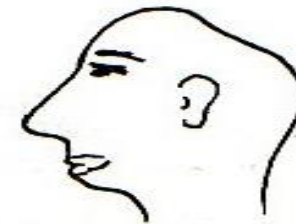
The frequency of this case **1:1000**.



Hydrocephaly



Anencephaly



Microcephaly



#Timeline summery:



Week 3

- Early: Germ cells layer.
- Middle: Neuronal plate

Week 4

- 1- Appearance of flexures.
- 2- (Middle) complete neuronal tube.
- 3-(End) the 3 vesicles appearance.

Week 5

- 1-(Day32) day 32 appearance of cerebral bubble.
- 2-the 5 secondary brain vesicles appearance

Week 6

- appearance of **Corpus striatum**

Week 16

- cerebral growing is oval

Month 3

- cerebral hemisphere smooth

Month 4

- gray matter of cerebral grow faster than white



❖ MULTIPLE CHOICES QUESTIONS

1-Which of the follow is NOT a primary vesicle:

- a-Prosencephalo
- b-Mesencephalon
- c-Rhombencephalon
- d-Metencephalon

2-Cerebrum Develop from:

- a-Telencephalon
- b-Mesencephalon
- c-Hindbrain
- d-Mylencephalon

3-First appearance of cerebral hemisphere:

- a-6th week.
- b-16th week.
- c-16th Day.
- d- Day 32.

4- Pontine flexure results in:

- a- Moving the 2 alar plates Medially then pending Laterally.
- b- Stretching and thinning of the roof plate.
- c- Widening of the cavity to form the 3rd ventricle.
- d- Narrowing of the cavity to form the 3rd ventricle.

5- Which statement is correct regarding ANENCEPHALY:

- a-Infant usually survives.
- b-Brain and skull are minute.
- c- failure of closure of the cranial neuropore of the neural tube
- d-B&C.



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

❖ SHORT ANSWERS QUESTIONS

- **Mention the stages of formation of the neural tube:**

- 1-Neural plate. (dorsal plate)
- 2-Neural Folds.
- 3-Neural groove.
- 4-Neural tube.

- **Mention the 3 brain flexures:**

- 1- Midbrain flexure.
- 2-Cervical flexure.
- 3-Pontine flexure.

- **Mention 4 Congenital Anomalies of The Brain:**

- 1-Hydrocephalus.
- 2-Microcephaly.
- 3-Mental retardation.

- **Mention 4 commissure that can be seen in development of cerebral cortex:**

- 1-Anterior commissure.
- 2-Posterior commissure
- 3-Corpus callosum.
- 4-Lamina terminalis.

❖ Helpful links:

[Embryology Of The Brain 1/2](#)
[Embryology Of The Brain 2/2](#)



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