DEVELOPMENT

# of CEREBRUM & CEREBELLUM

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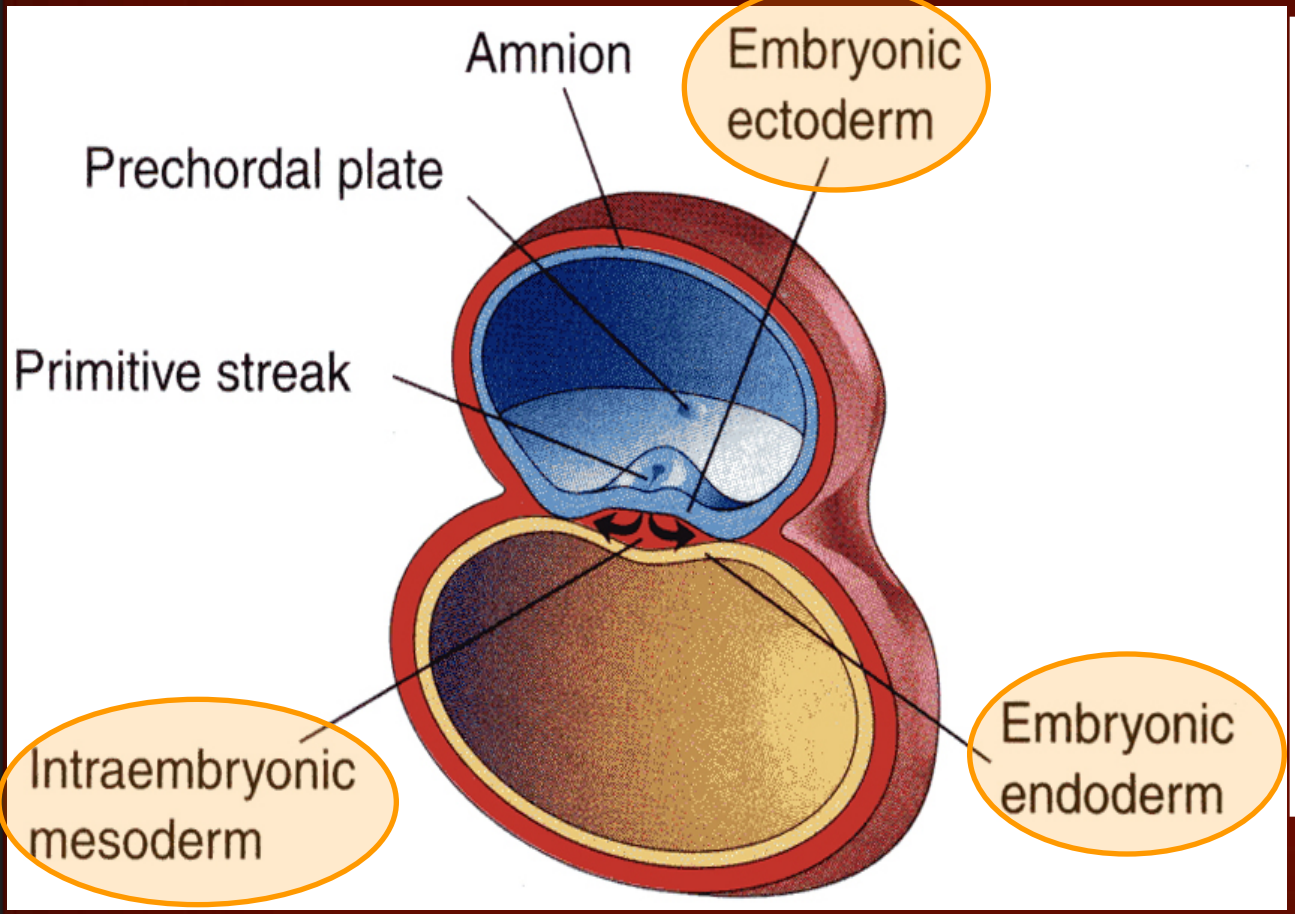
OBJECTIVES

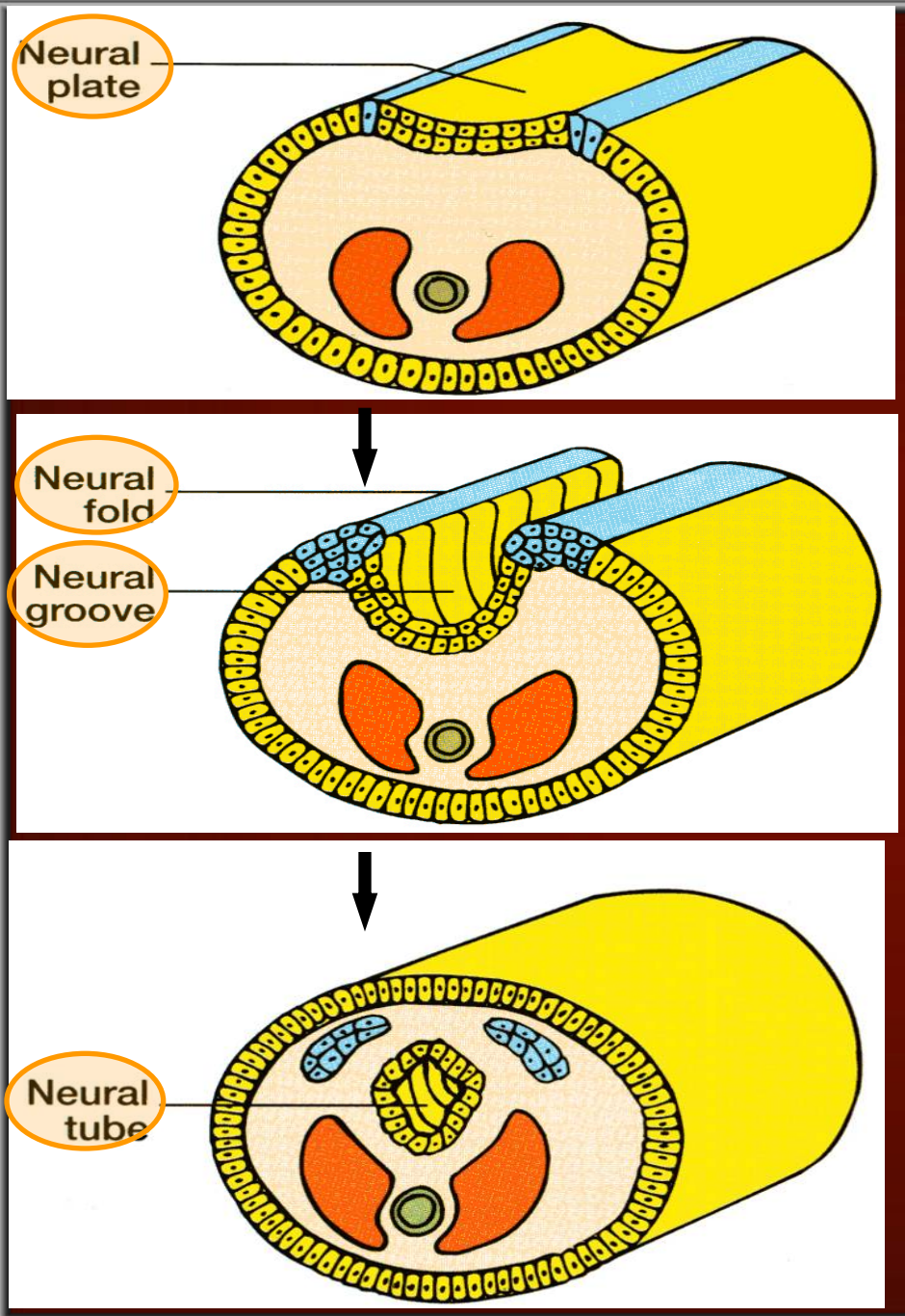
By the end of the lecture the student should be able to:

- 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.

INTRODUCTION



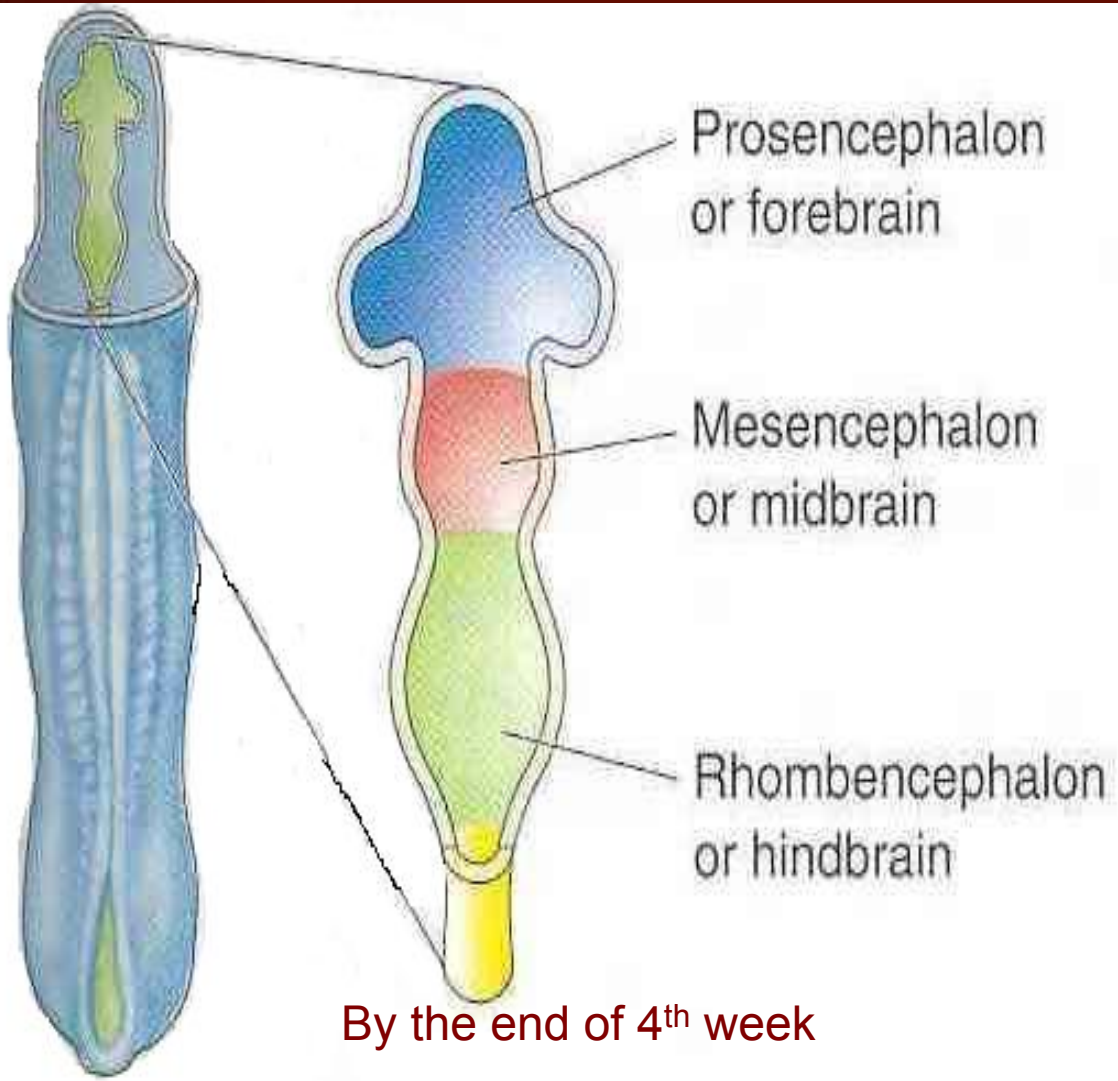
By the beginning of the 3rd week of development, three germ cell layers become established, **Ectoderm, Mesoderm** and **Endoderm.**



EARLY DEVELOPMENT

- During the middle of the 3rd week, ***the dorsal midline ectoderm*** undergoes thickening to form the **neural plate (neuroectoderm).**
- The margins of the plate become elevated, forming **neural folds.**
- **So** a longitudinal, midline depression, called the **neural groove is formed.**
- **The 2 neural folds then fuse together,** thus sealing the neural groove and creating the **neural tube.**

Neural Tube Development
Three-vesicles stage (End of 4th Week)



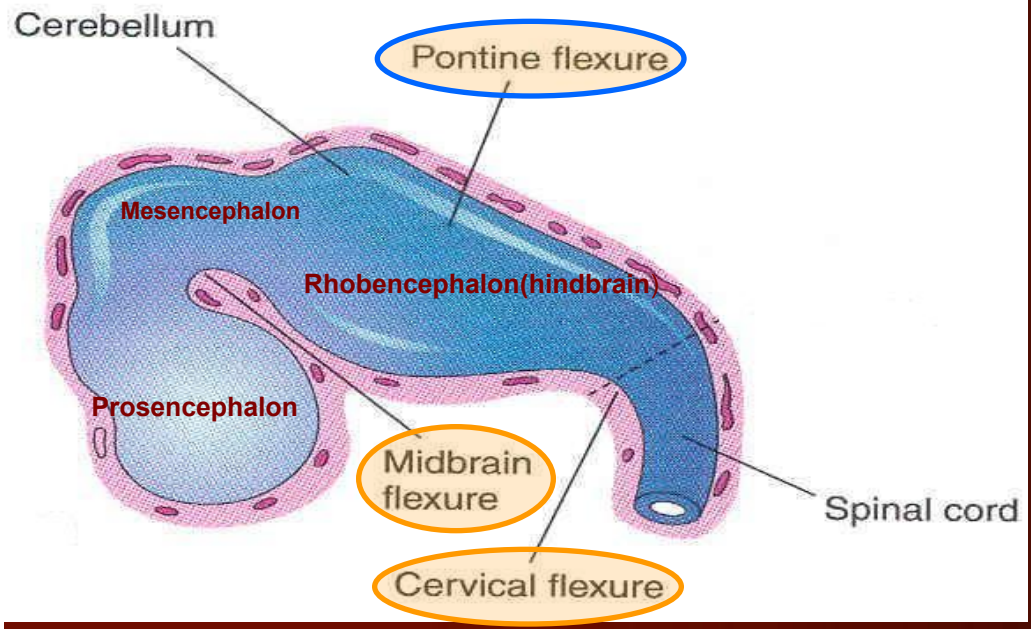
By the end of 4th week

- Formation of the neural tube is completed by the middle of the fourth week.
- **By the end of the 4th week**,

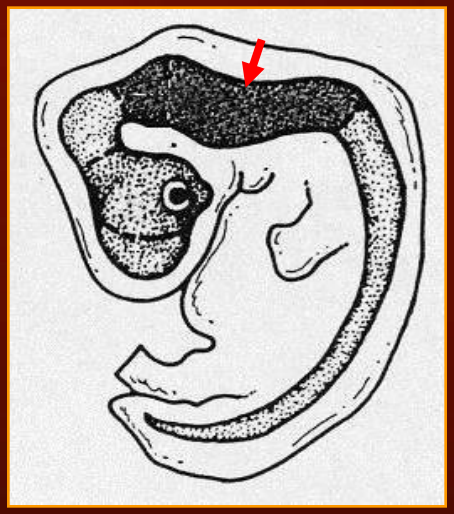
Its upper end dilates & shows 3 primary vesicles:
Prosencephalon, Mesencephalon, & Rhombencephalon.

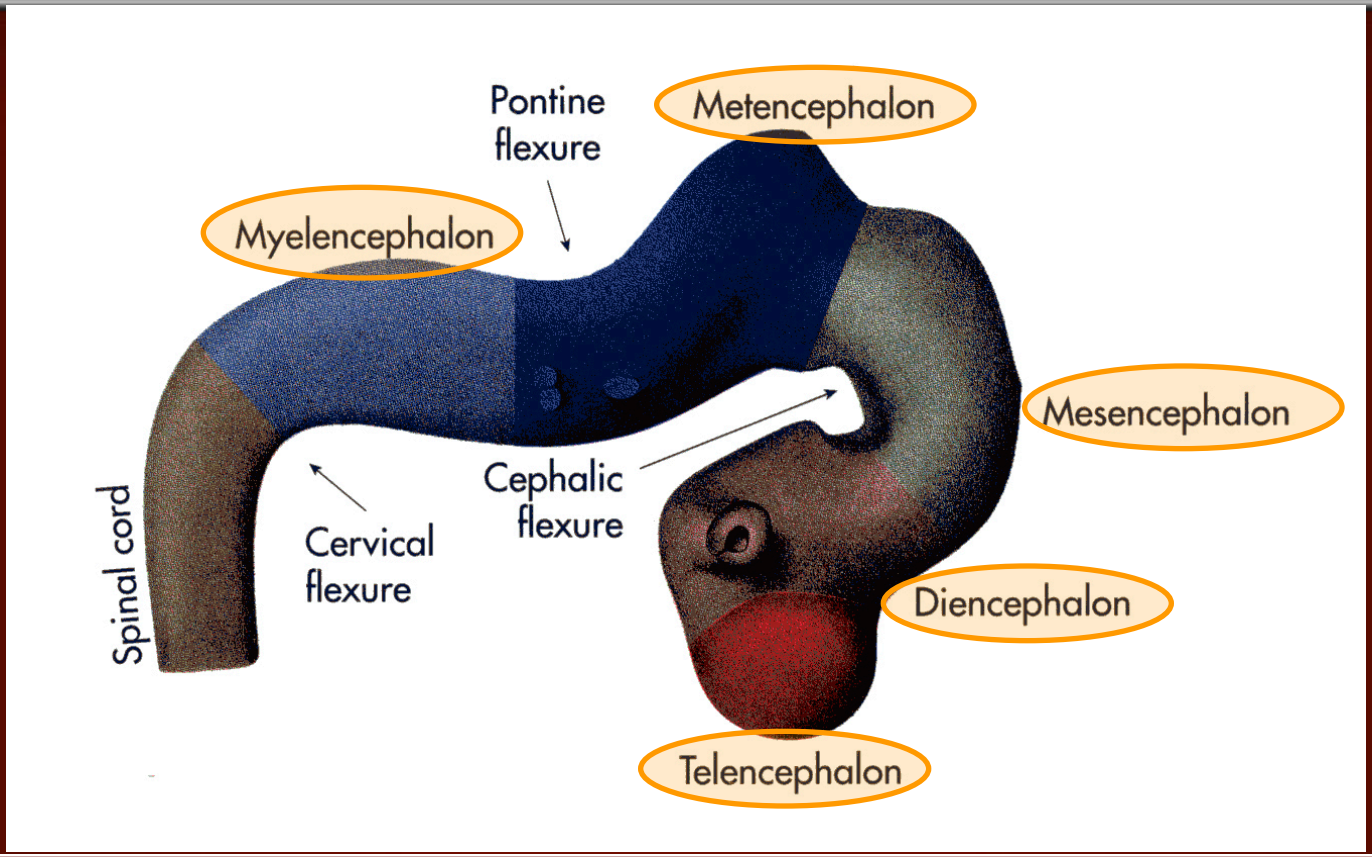
Brain Flexures

- 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.

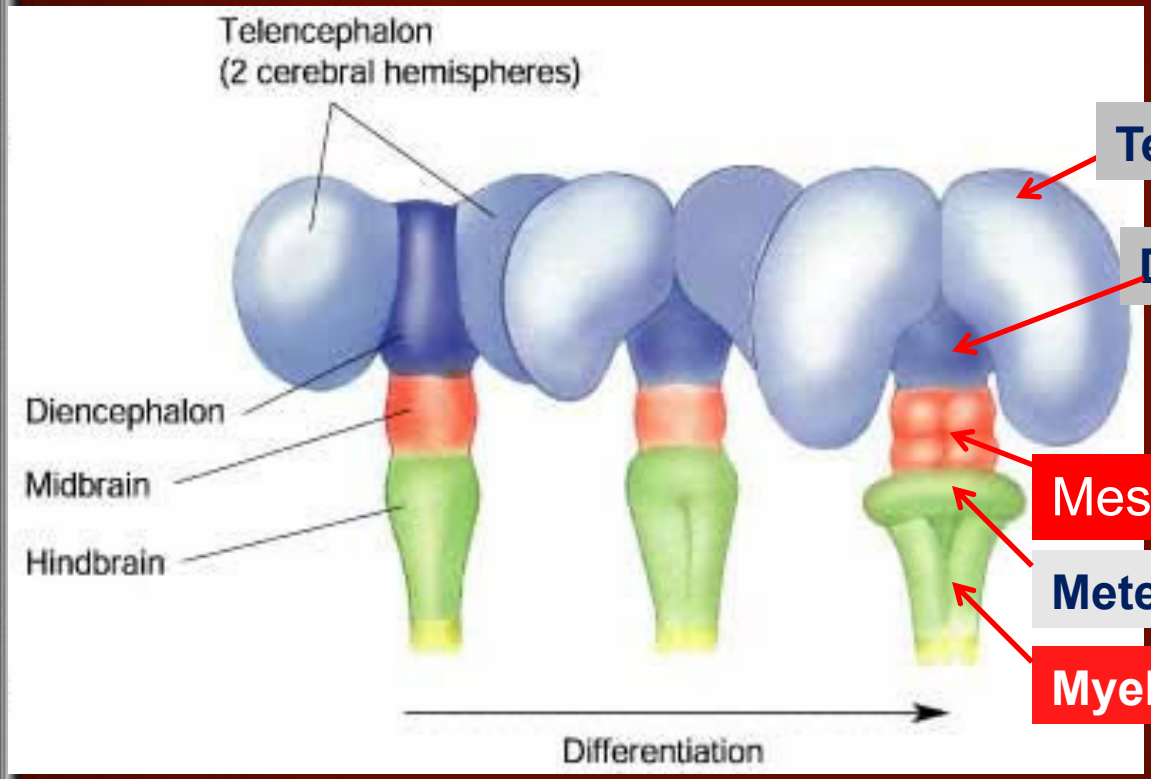




By the **5th** ***week*** further differentiation distinguishes **5** **secondary brain vesicles from the primary vesicles :**

- ***The prosencephalon*** divides into the two **telencephalon** and one **diencephalon** and
- ***The Rhombencephalon*** divides into **metencephalon** and **myelencephalon.**

Neural Tube Development
Five-vesicles stage (5th week)



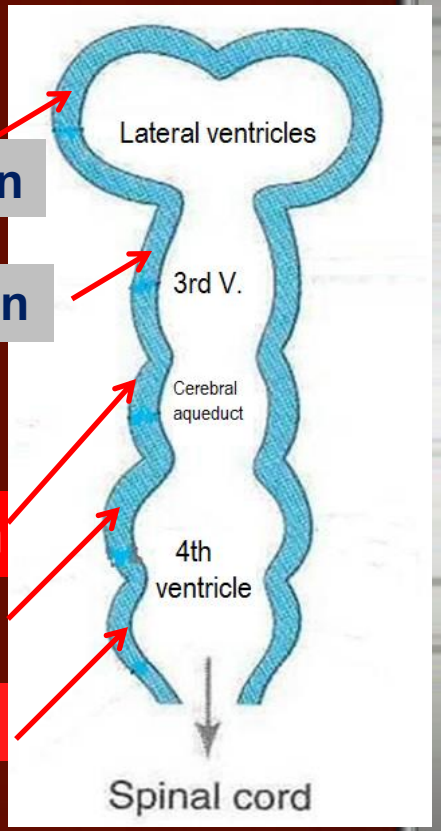
Telencephalon

Diencephalon

Mesencephalon

Metencephalon

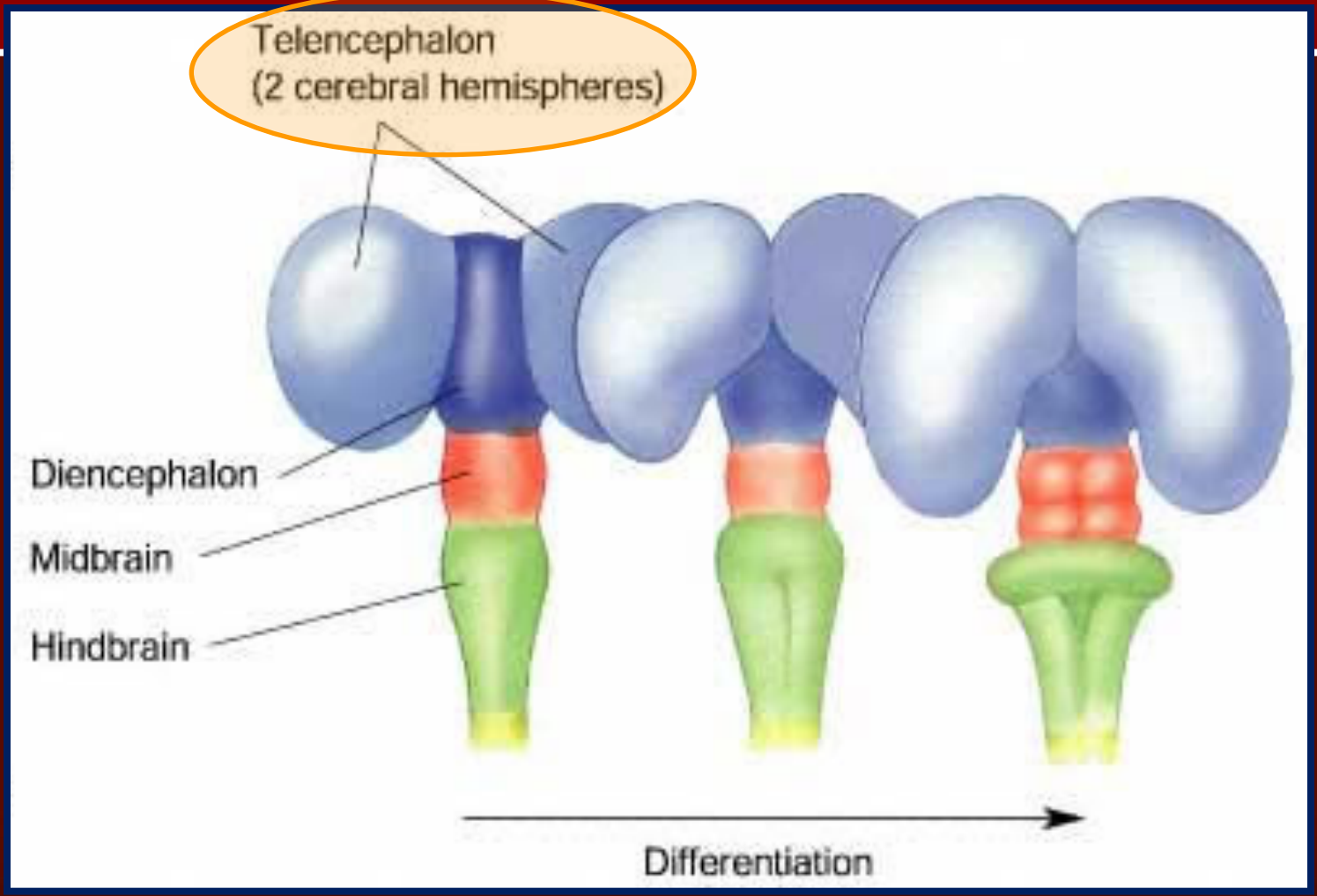
Myelencephalon



Primary brain vesicles	Secondary brain vesicles	Derivatives in mature brain
Prosencephalon (forebrain)	Telencephalon	Cerebral hemisphere
	Diencephalon	Thalamus
Mesencephalon (midbrain)	Mesencephalon	Midbrain
Rhombencephalon	Metencephalon	Pons, cerebellum
(hindbrain)	Myelencephalon	Medulla oblongata

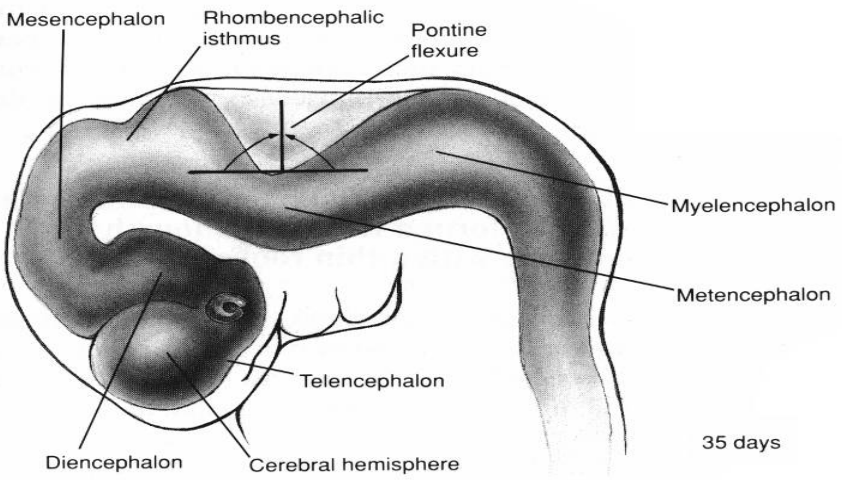
Development of the Cerebrum

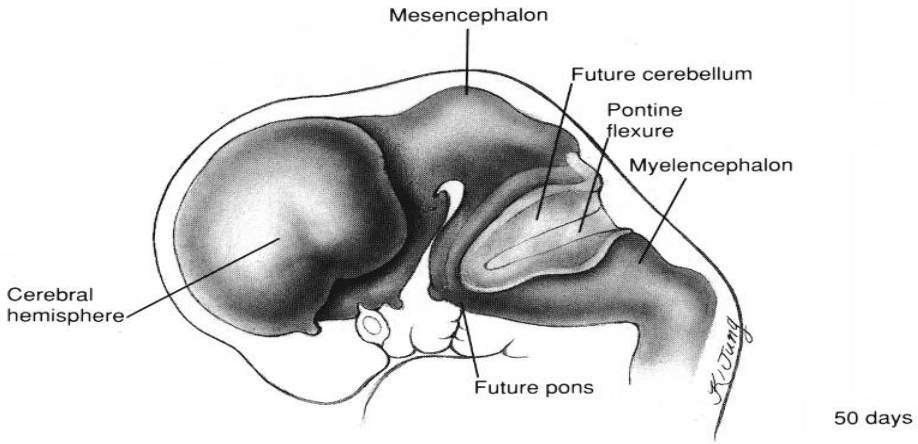
So, The cerebrum develops from the **Telencephalon**



Development of the Cerebrum

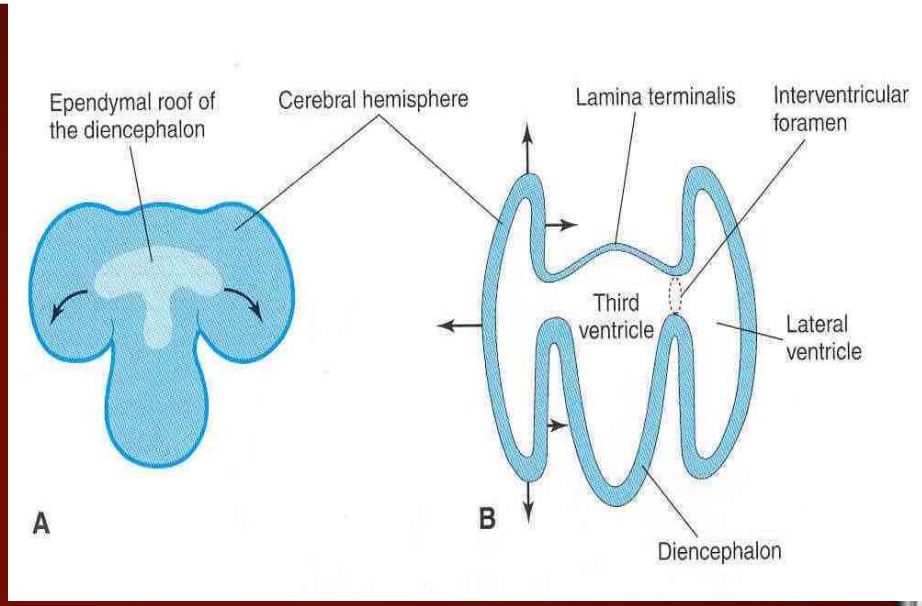
- The cerebral hemispheres first appear on the day 32 of pregnancy **(by 5th week)** as a pair of **bubble-like outgrowths** of the Telencephalon.
- By 16 weeks, the rapidly growing hemispheres are **oval** and have **expanded back** to cover the diencephalon.



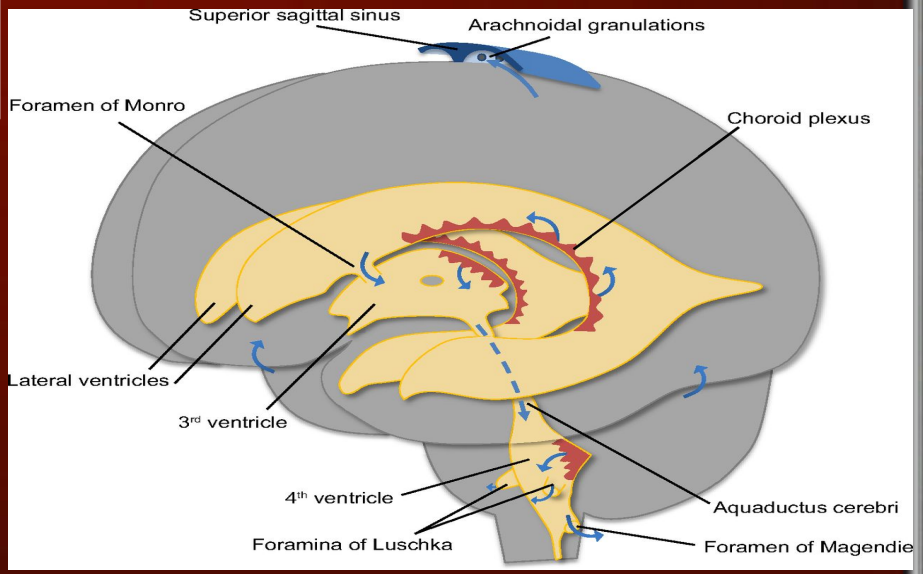


Differentiation of Forebrain Vesicle
(prosencephalon)

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

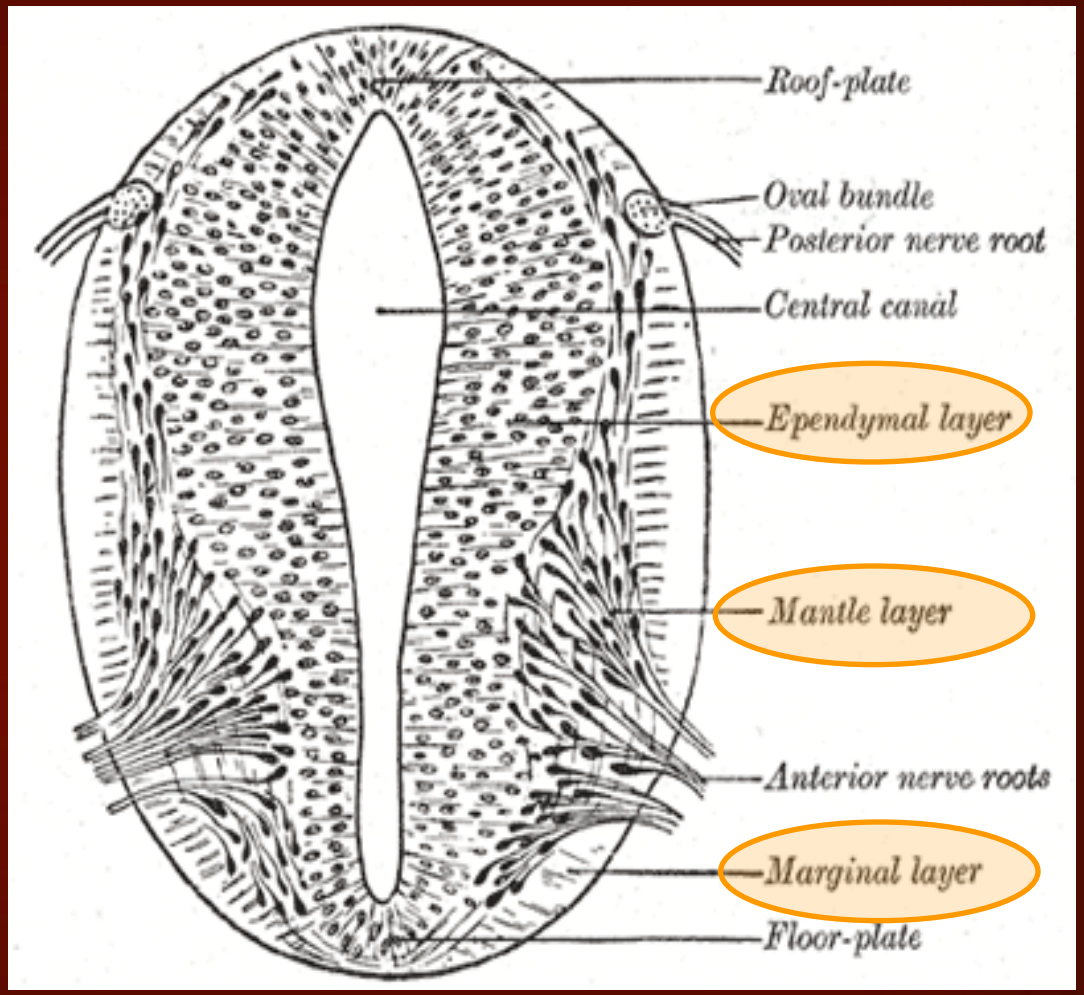


- The cerebral hemispheres expand in all directions.
- Its medial wall becomes thin, flat and it is **the site of development of** choroid plexus in the lateral ventricle.

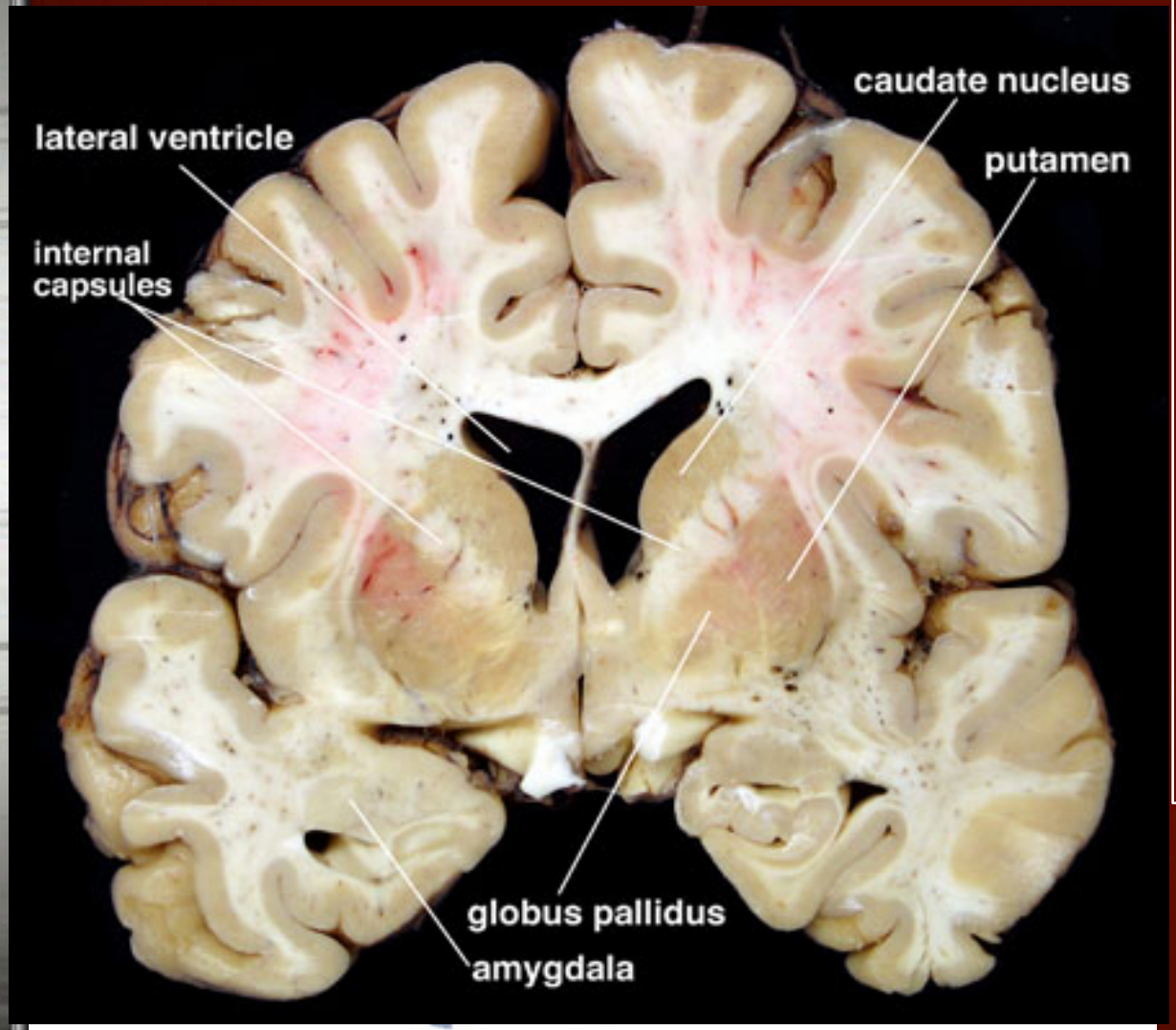


Development of the Cerebrum

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



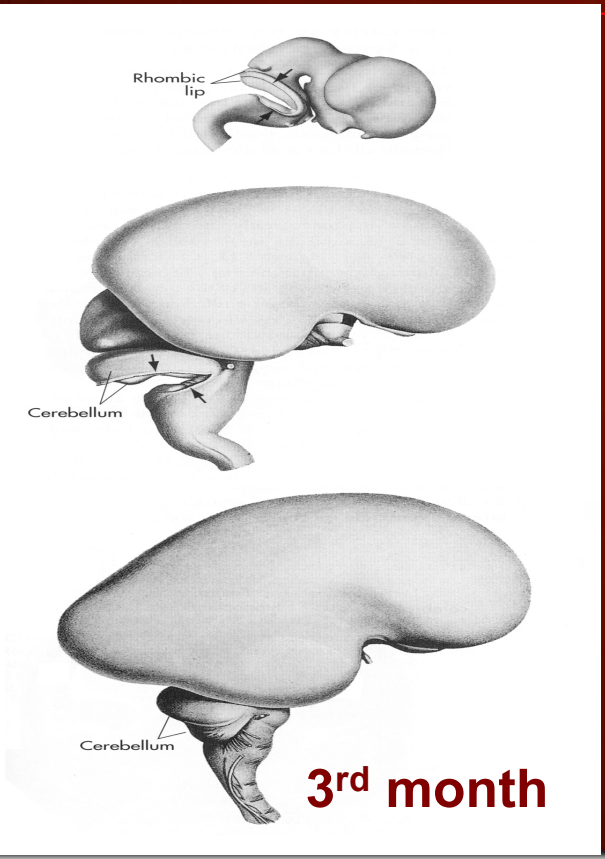
As development proceeds, the following changes occur:



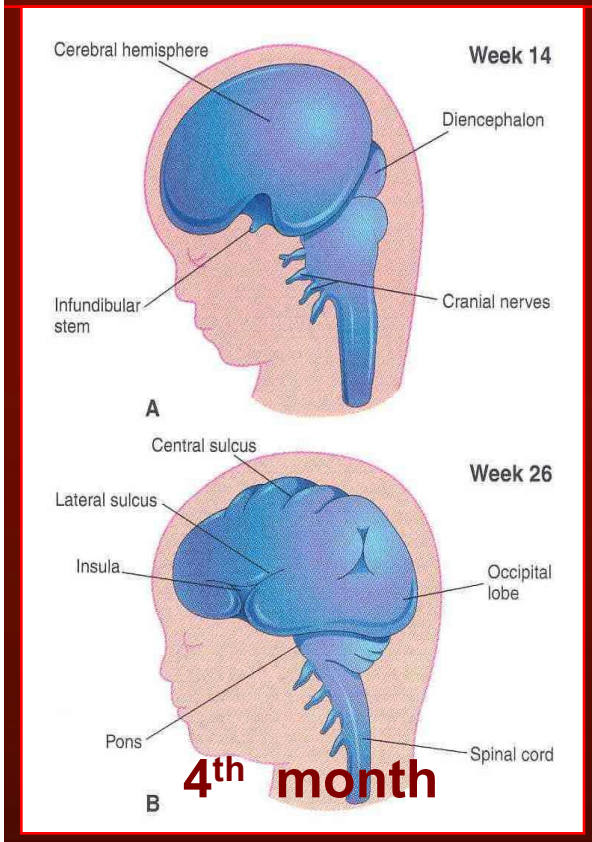
Most of the nerve cells in mantel layer migrate to the site of marginal layer forming the cerebral cortex.

Some cells do not migrate and remains to form the basal ganglia.

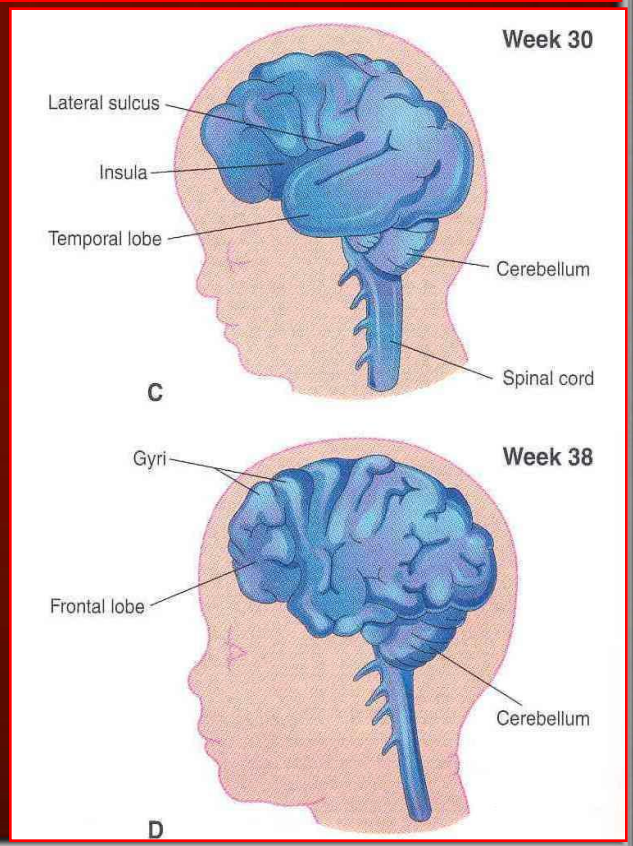
- **By the end of the 3rd month** the surfaces of the cerebral hemispheres are smooth.
- **By the 4th month** the grey matter grows faster than the white matter, so, the **cortex** becomes folded into gyri separated by sulci ; The gyri and sulci effectively increase the surface area of the brain.
- The detailed pattern of gyri & sulci varies somewhat from individual to individual.



3rd month

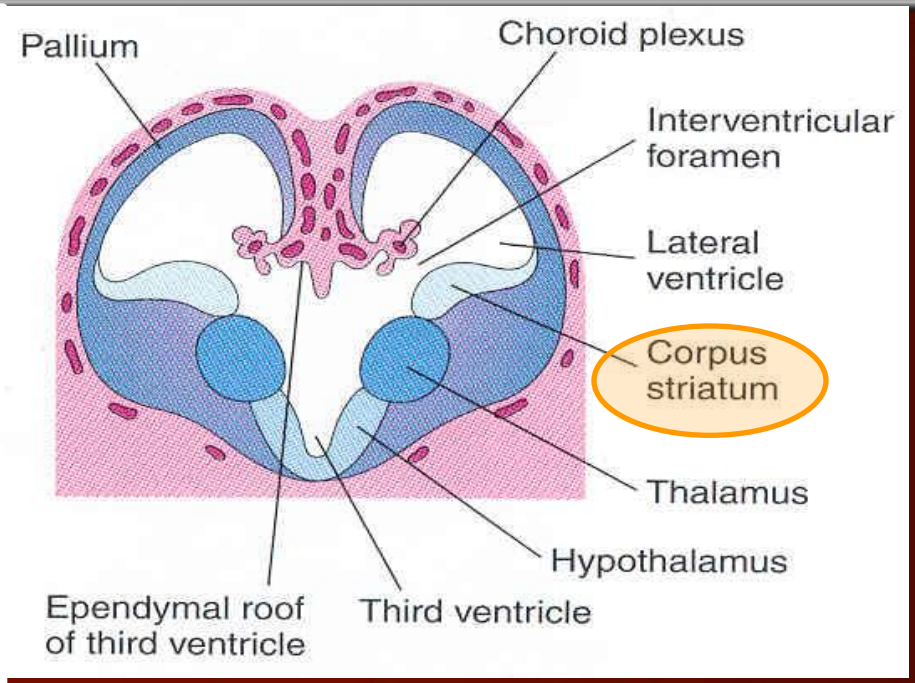


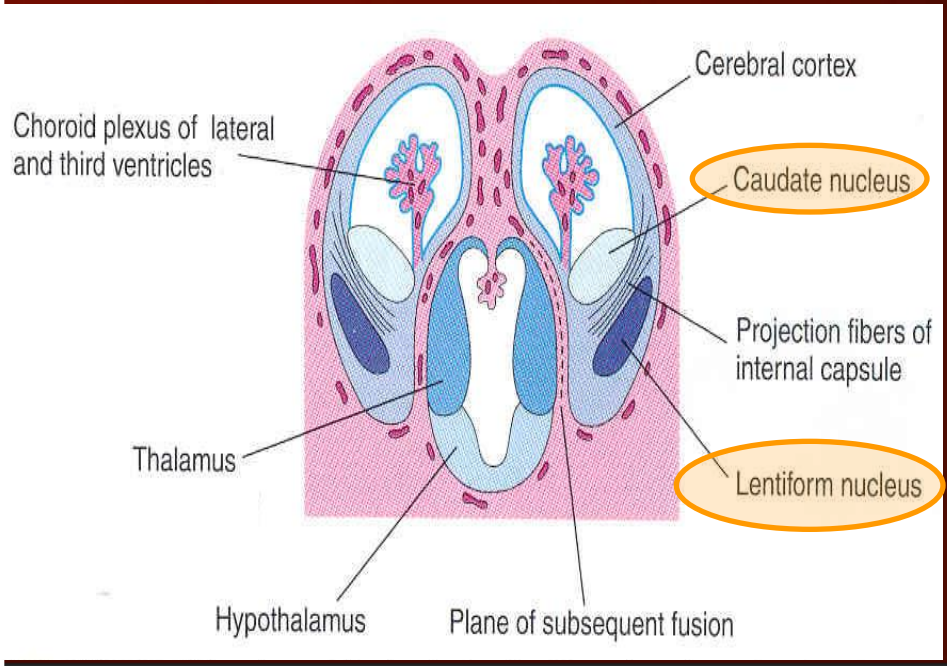
4th month



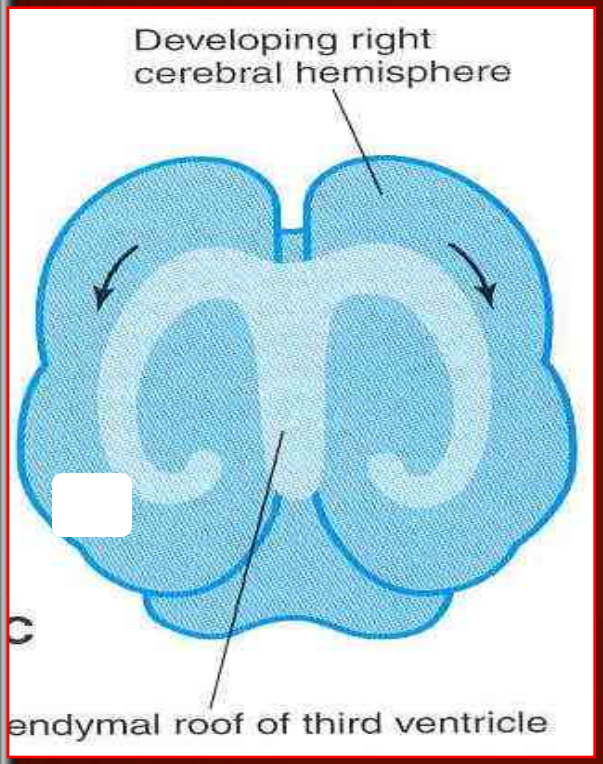
Corpus striatum:

- It is the basal ganglia nuclei in the cerebral hemisphere
- 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, they pass through the corpus striatum,
- The corpus striatum now divides into caudate nucleus & lentiform nucleus.
- This fiber pathway forms the internal capsule.

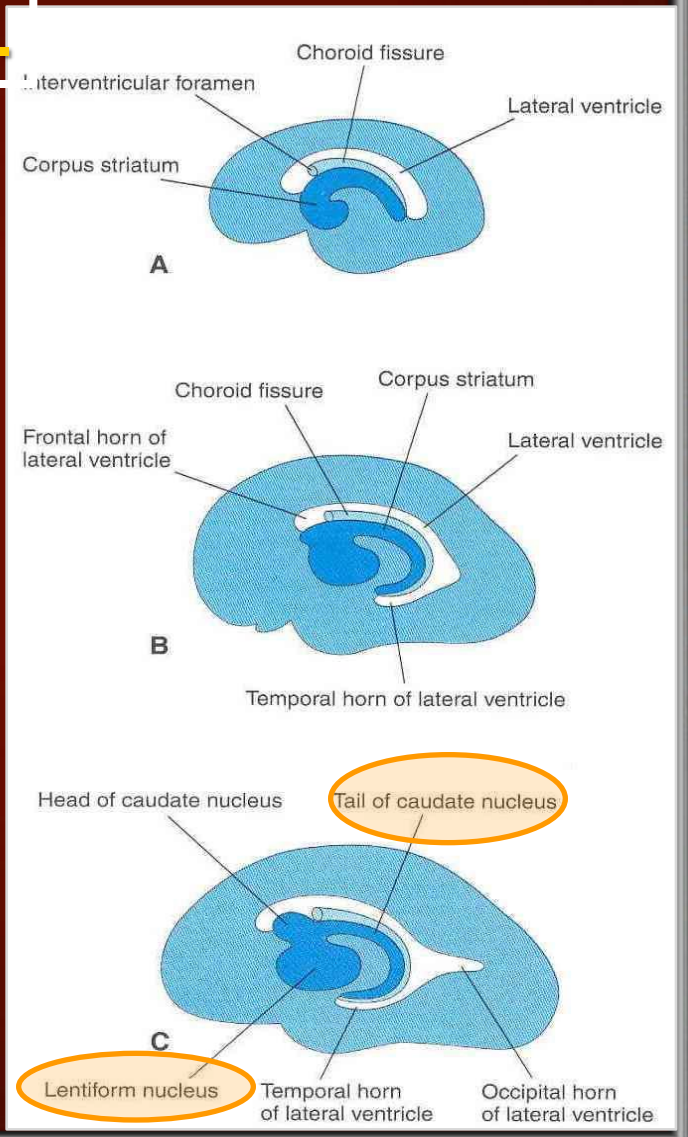




Further expansion of cerebral hemisphere gives C-shape appearance to the hemisphere itself as well as its cavity (lateral ventricle).

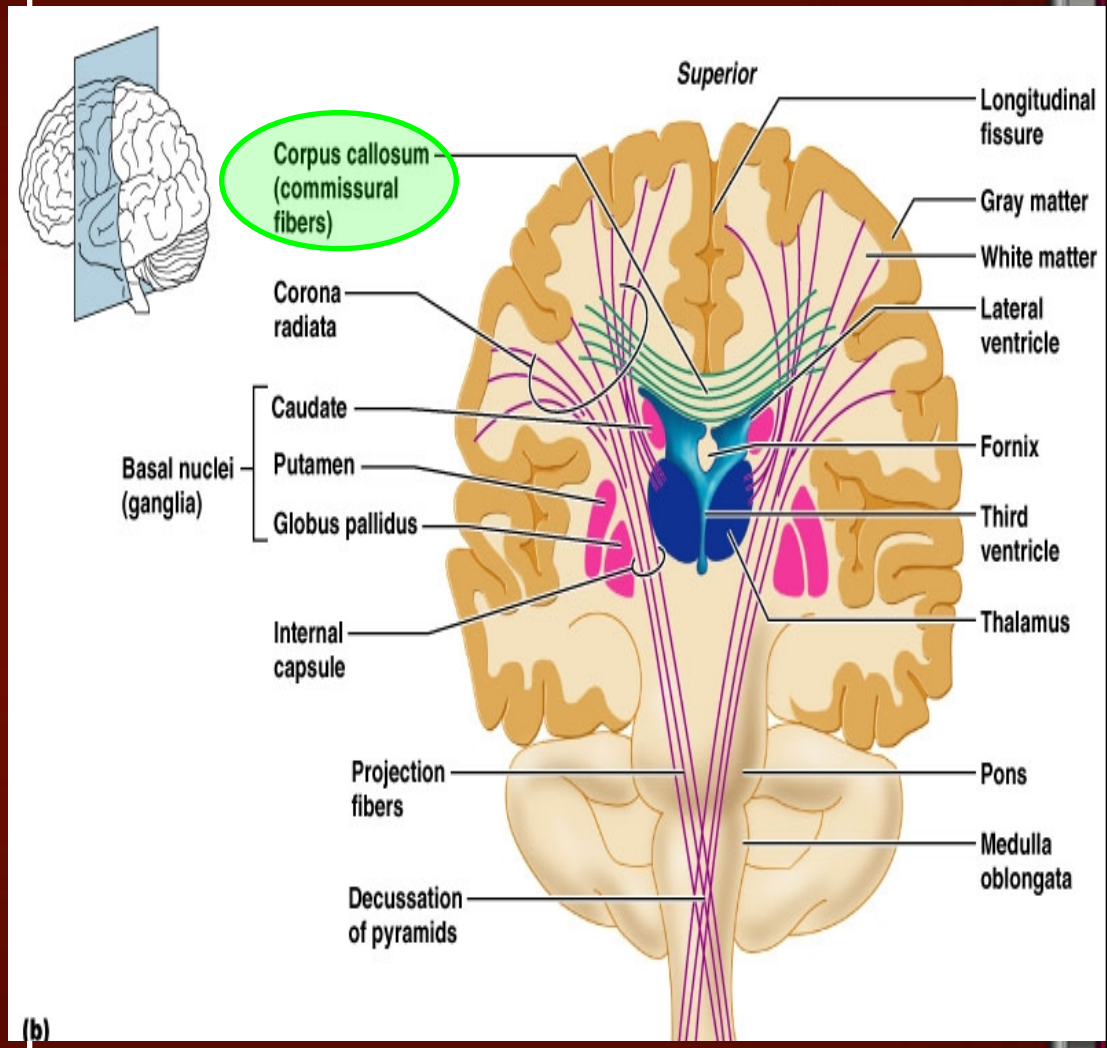


- Also the caudate nucleus elongates and assumes the shape of the lateral ventricle and remains related to it.



Development of the Cerebral Commissures

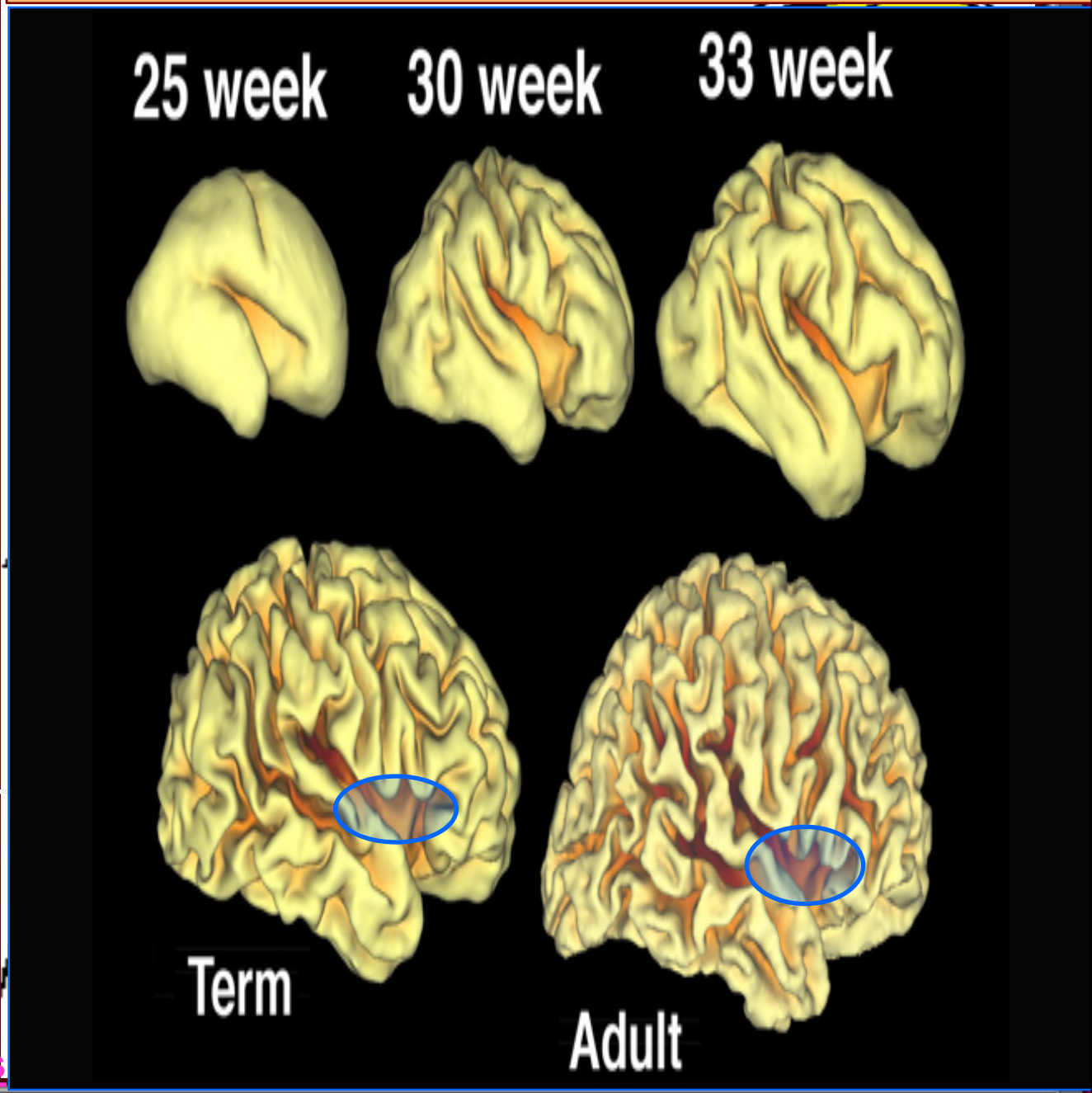
- **As the cerebral cortex develops, group of fibers, (commissures), connect the corresponding regions of the cortex.**
- These are:
- Lamina terminalis.
- Optic chiasma.
- Anterior commissure.
- Posterior commissure.
- Hippocampal commissure.
- Habenular commissure.
- **Corpus callosum** (is a major commissural fibres that connect the two cerebral hemispheres).



Development of Insula & lateral fissure

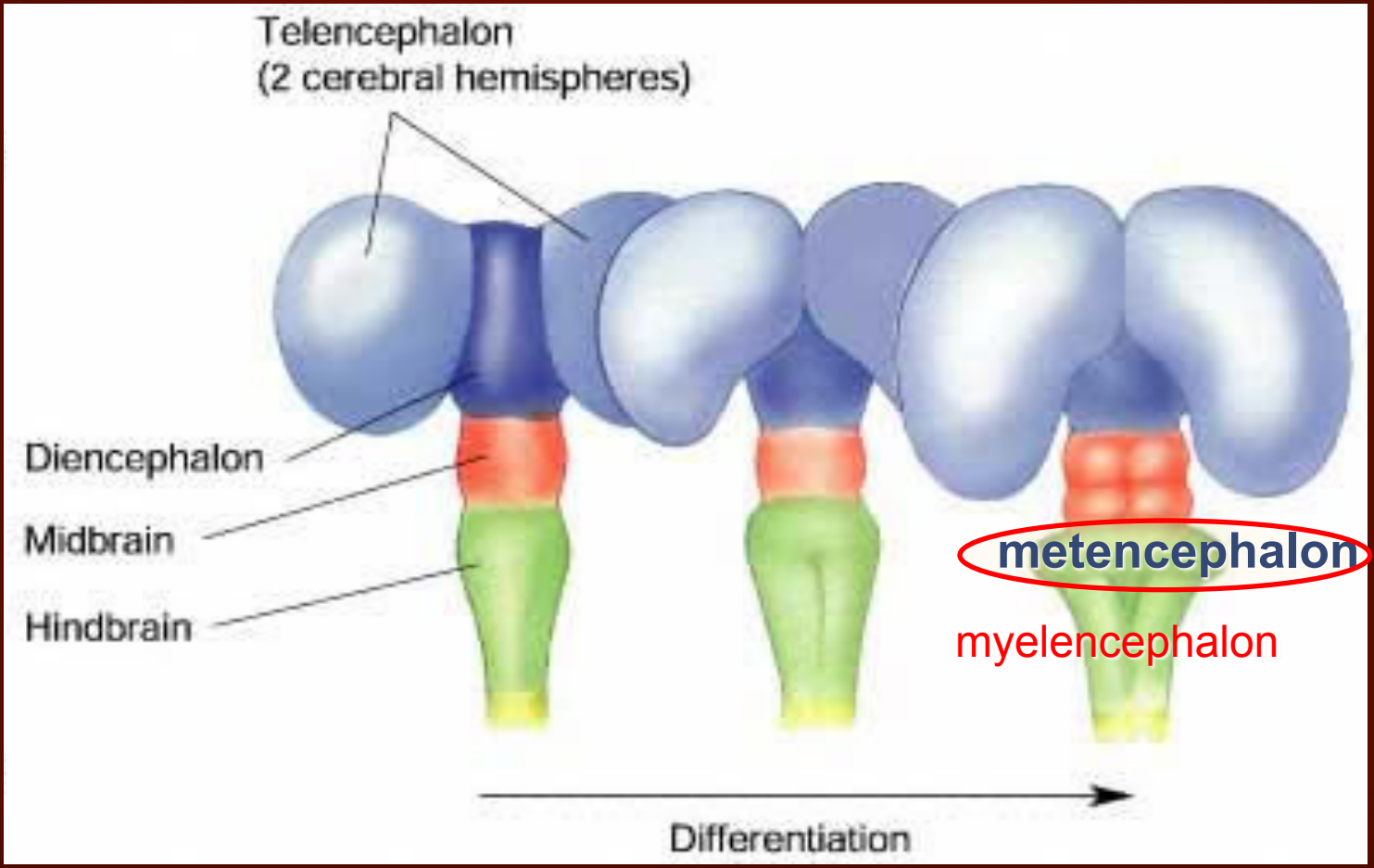
The cortex covering the surface of the corpus striatum: grows relatively slower than the other cortices, so it is overgrown by the rest of the hemisphere and lies in the depth of the lateral sulcus. This is called the insula.

So, the insular lobe is a portion of cerebral cortex covering the corpus striatum that invaginated to lie deep within the lateral sulcus

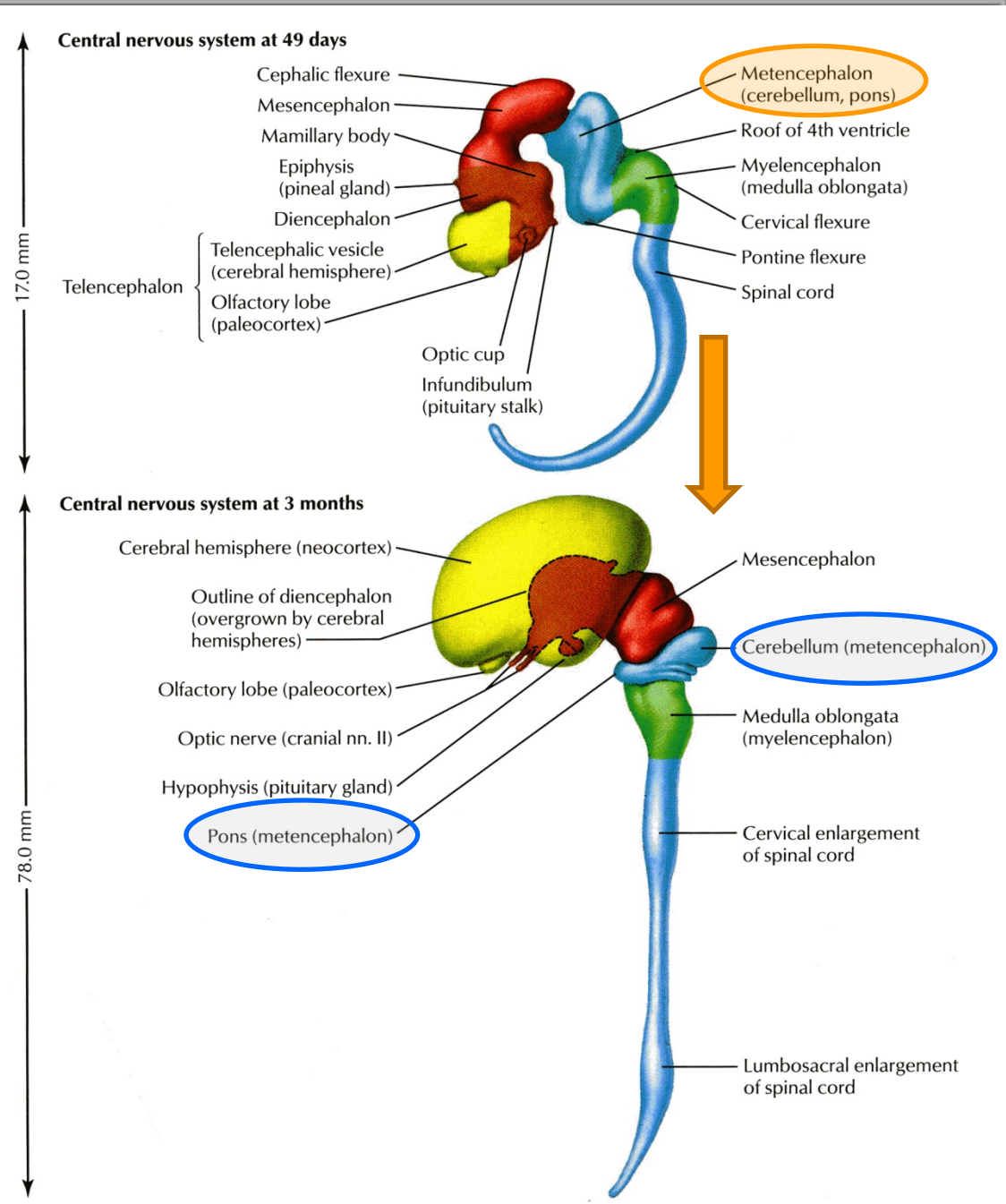


Development of the Cerebellum

It develops from the dorsal part of the Metencephalon

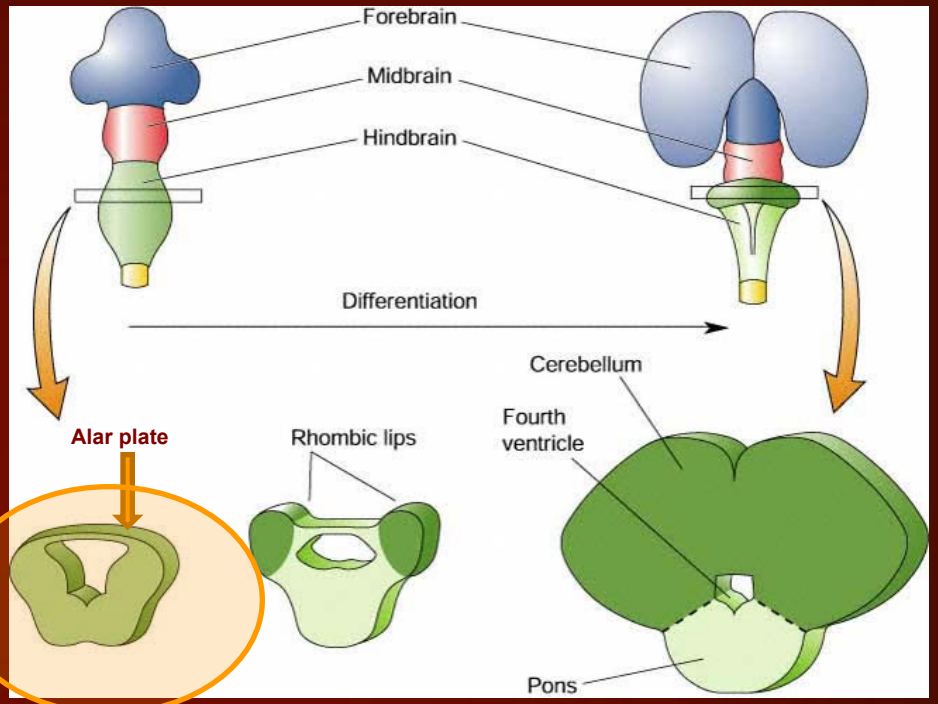


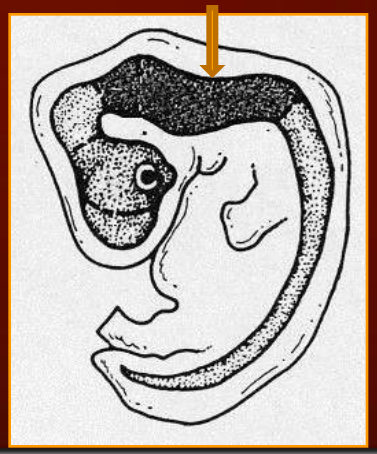
The metencephalon develops into the ***pons*** and overlying ***cerebellum.***



Development of the Cerebellum

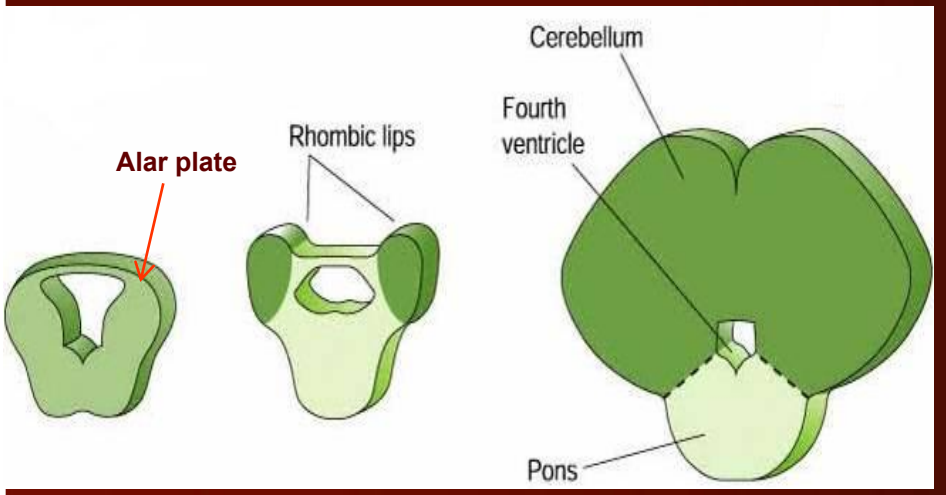
- **Pontine flexure results in:**
  1. Moving the alar plates (It is part of dorsal side of neural tube) of the neural tube laterally then pending medially.
  2. Stretching and thinning of the roof plate.
  3. Widening of the cavity to form the 4th ventricle.

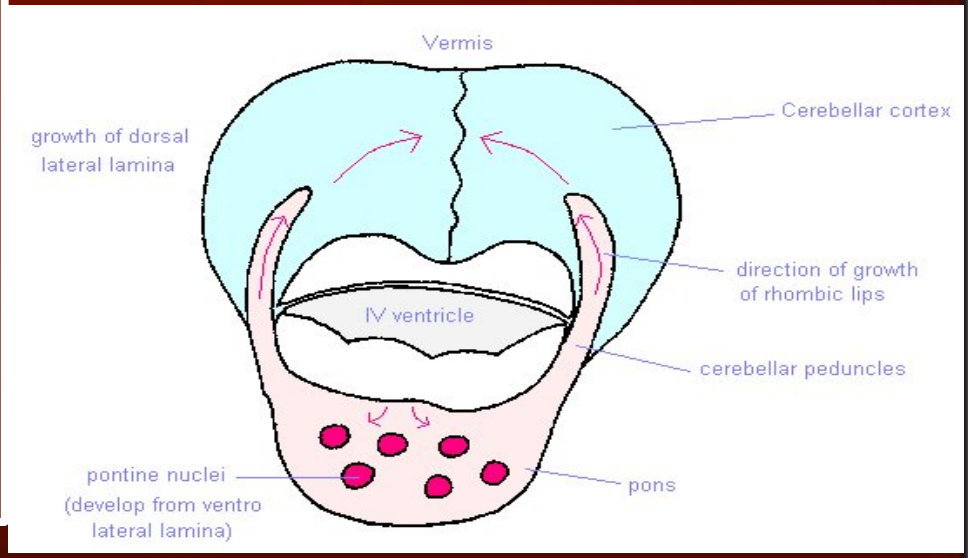




Metencephalon: Changes in Alar plates

- The dorsal parts of alar plate thicken to form Rhombic lips, that will **give rise** to the cerebellum.
- **Some neuroblasts** migrate from the mantle layer to the marginal layer to 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 these cerebellar nuclei** grow out to reach the brain stem.





The surface of the cerebellum

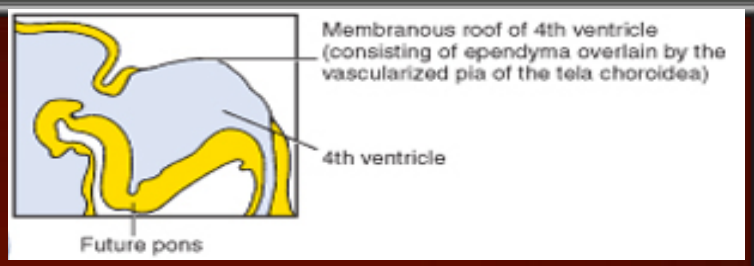
- As the **cerebellar hemispheres** develops; they **undergo a complicated process of transverse folding** to **form** closely packed, leaf-like **transverse gyri** **called folia & fissures.**
- **These processes of fissure formation and foliation** continue throughout embryonic, fetal, and postnatal life, and they **increase the surface area of the cerebellar cortex.**

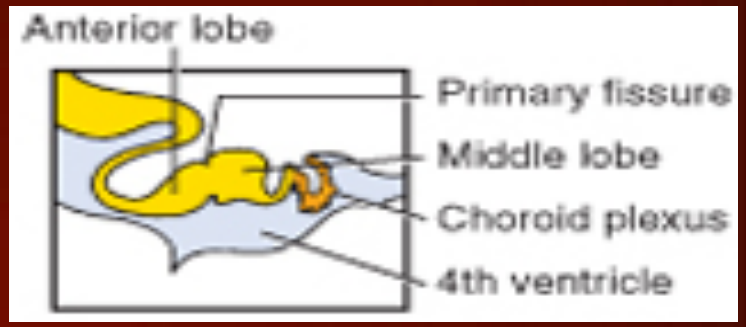
35 d

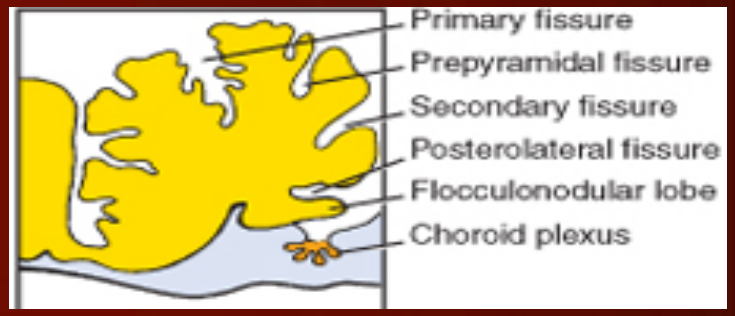
50 d

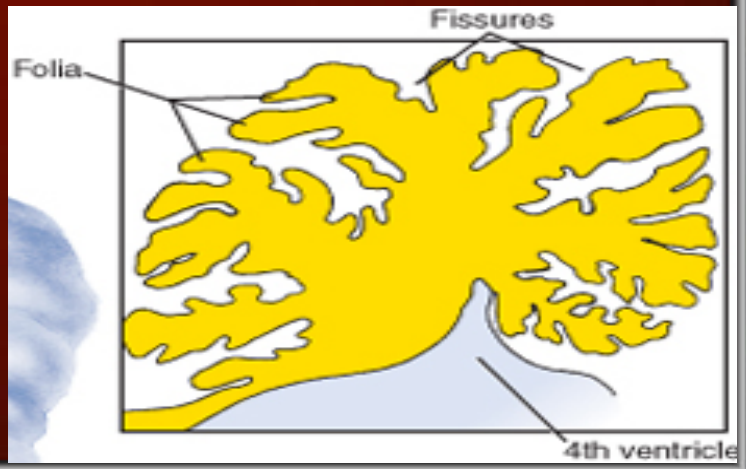
90 d

150 d



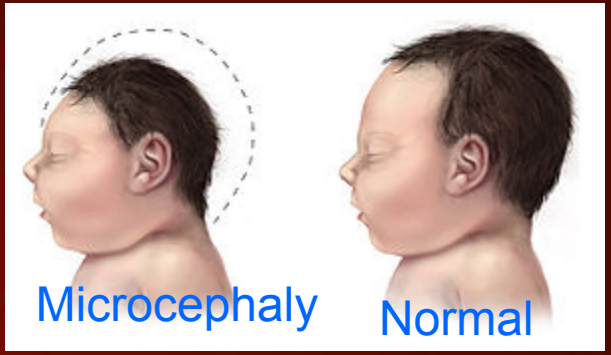


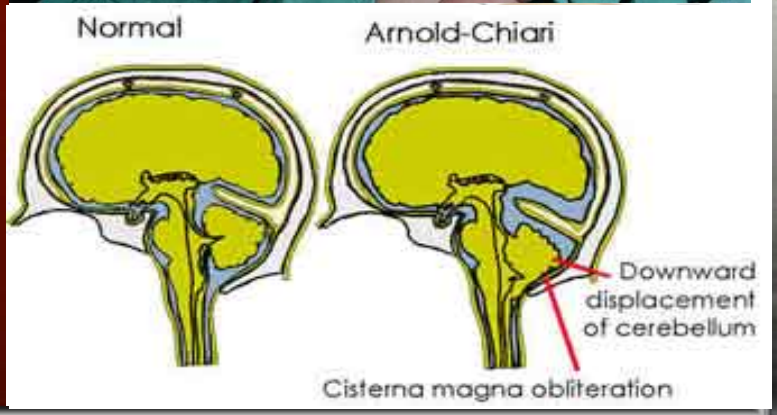




Congenital Anomalies of The Brain

- Mental retardation.
- Seizures (changes in electrical activity).
- Cerebral palsy.
- Cranium bifidum with or without meningocele & meningo-encephalocele.
- Agenesis of corpus callosum.
- Microcephaly (abnormal smallness of the head, a congenital condition associated with incomplete brain development).
- Hydrocephalus :
- **The most common cause** is a flow obstruction, hindering the free passage of CSF through the ventricular system and subarachnoid space.
- Arnold-Chiari malformation (herniated part of cerebellum through the foramen magnum leading to CSF obstruction ,so hydrocephalus results), also in **aqueductal stenosis** and in **brain tumours.**
- Anencephaly.





ANENCEPHALY

In anencephaly, the brain and skull are minute and the infant does not usually survive.


THANK YOU