

**Embryology team – 430**

**Development of cerebrum  
and cerebellum**

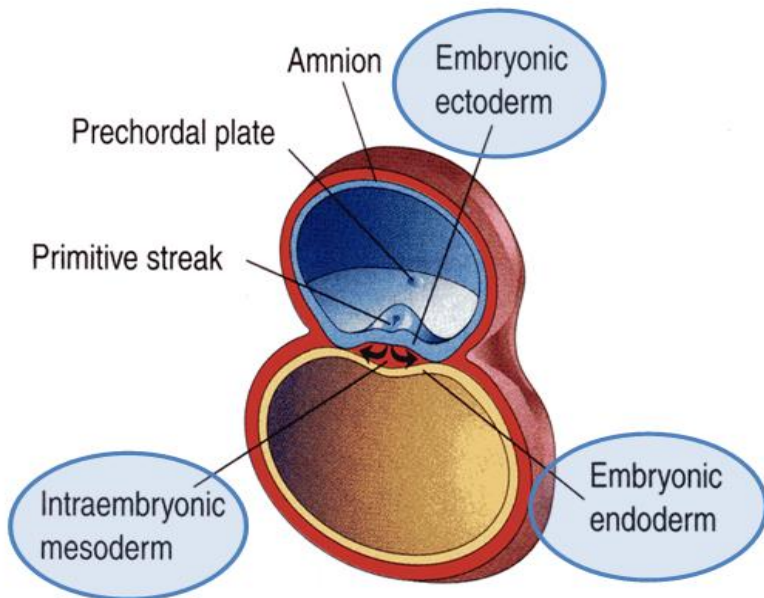


**Done by:**

**Salwa Alshibani**

**Raseel al swidan**

By the 3<sup>rd</sup> week, three germ cell layers will be formed:



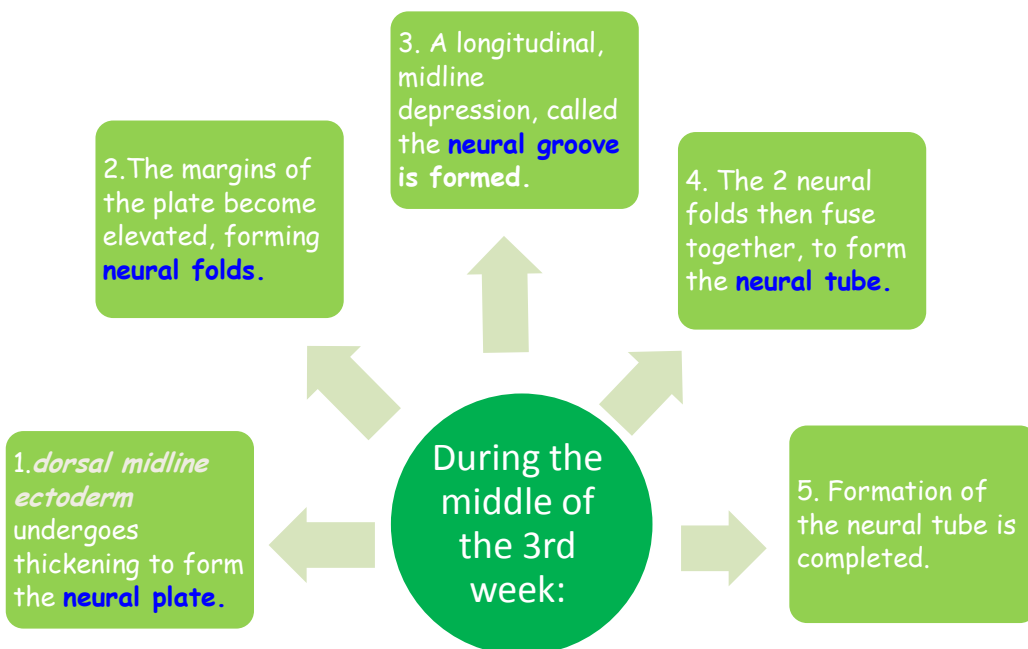
1. Ectoderm

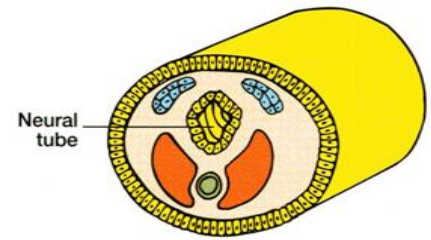
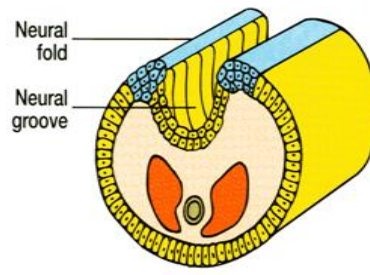
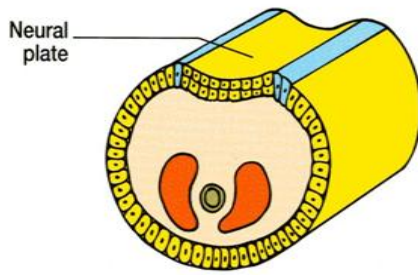
2. Mesoderm

3. Endoderm

(Each one of these layers will give rise to specific tissue and organs)

The **neural plate**: is a thickened, slipper-shaped area of the embryonic **ectoderm**





The 4<sup>th</sup> week → development of the primary brain vesicles (3 vesicle stage).

The 5<sup>th</sup> week → development of the secondary brain vesicles (5 vesical stage).

## Neural tube:

Cranial part, form brain vesicle.

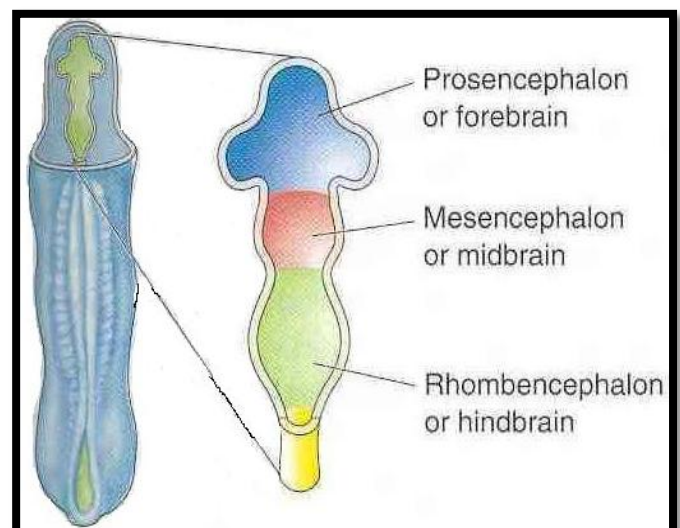
Caudal part will give the spinal cord.

grows and gives 3 dilatations (3 Primary brain vesicles)

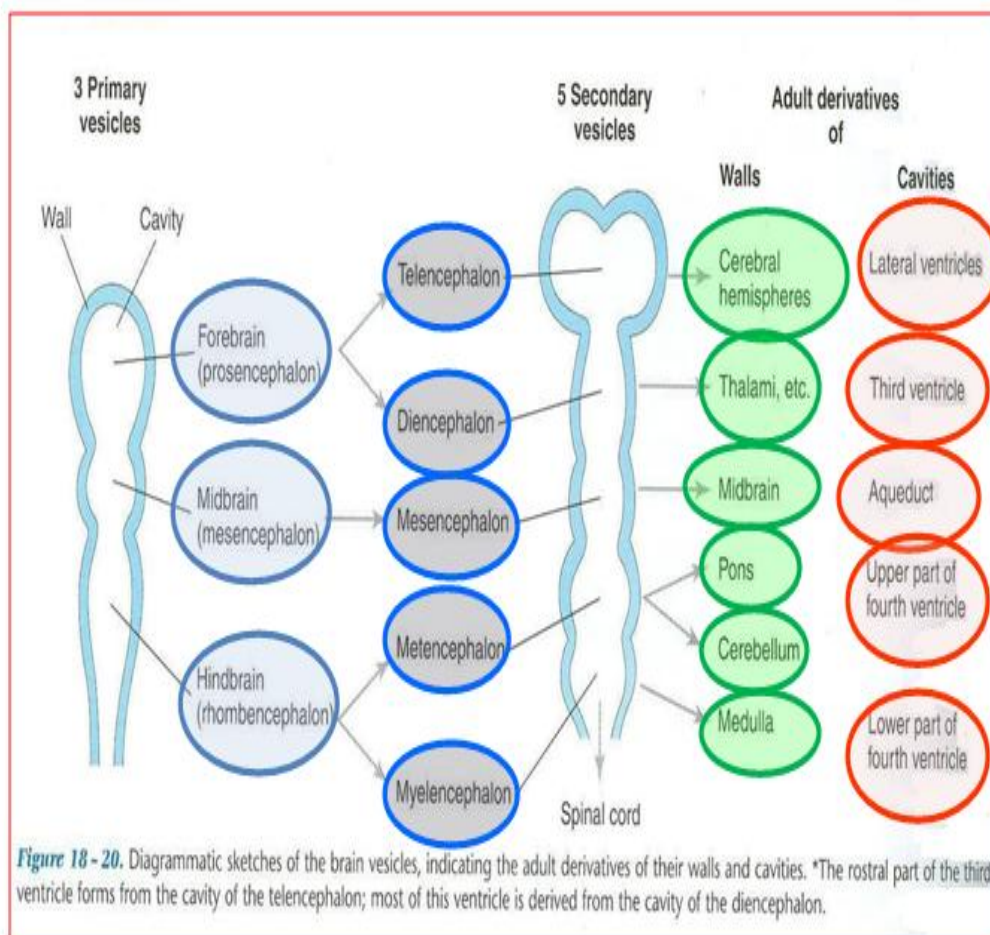
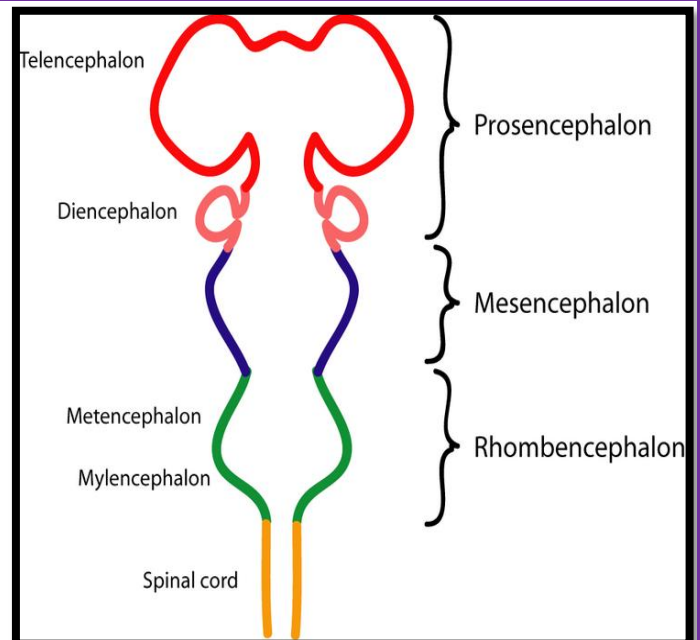
1. Prosencephalon.  
(forbrain)

2. Mesencephalon.  
(midbrain)

3. Rhombencephalon  
(hindbrain)



- The secondary brain vesicles will divide the forebrain and the hindbrain only.
- The midbrain will not divide.





# Brain Flexures

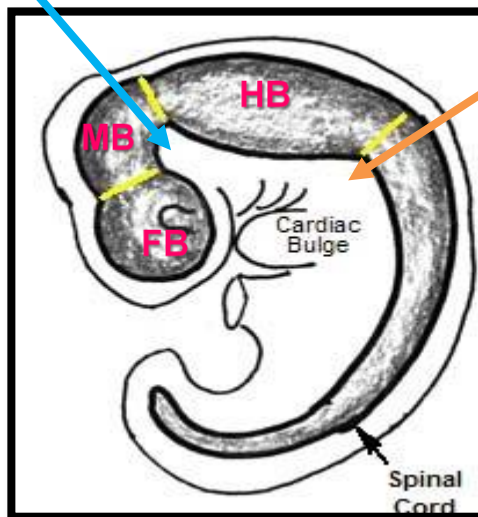
By 4th week

A **flexure** is an angular or rounded shape made by folding.

The neural tube grows rapidly and produces 2 flexures (by bending ventrally with the head fold).

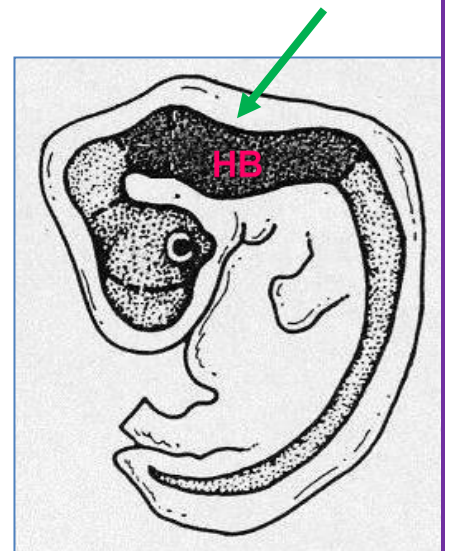
**Midbrain (cephalic) flexure:** between the forebrain & the midbrain.

**Cervical flexure:** between the hind brain & the spinal cord.



Later

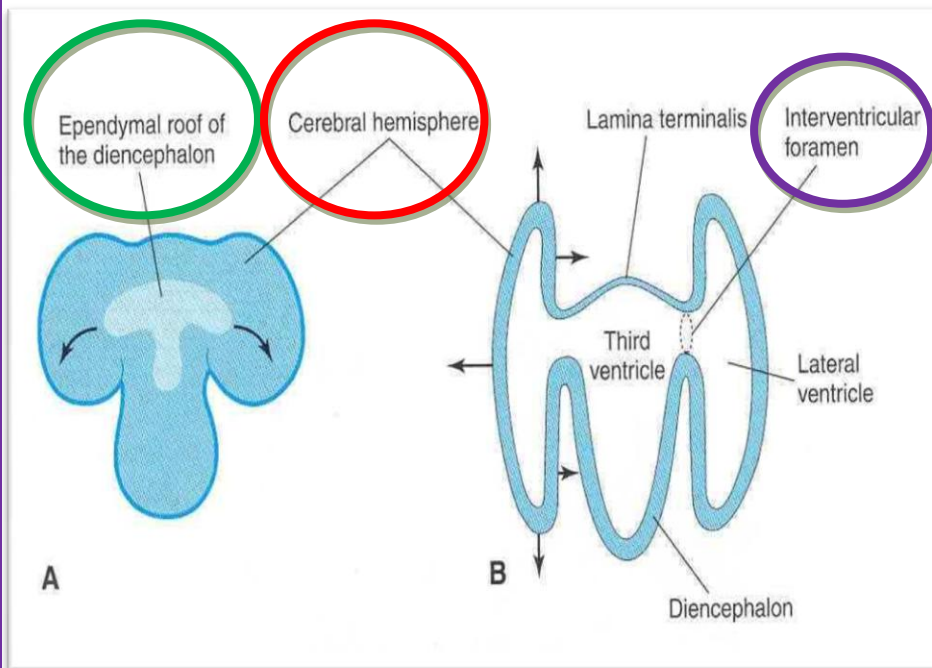
**Pontine flexure** appears in the hindbrain, in the opposite direction, resulting in stretching and thinning of the roof of the hindbrain.



The prosencephalon (Forebrain Vesicle ) will differentiate into

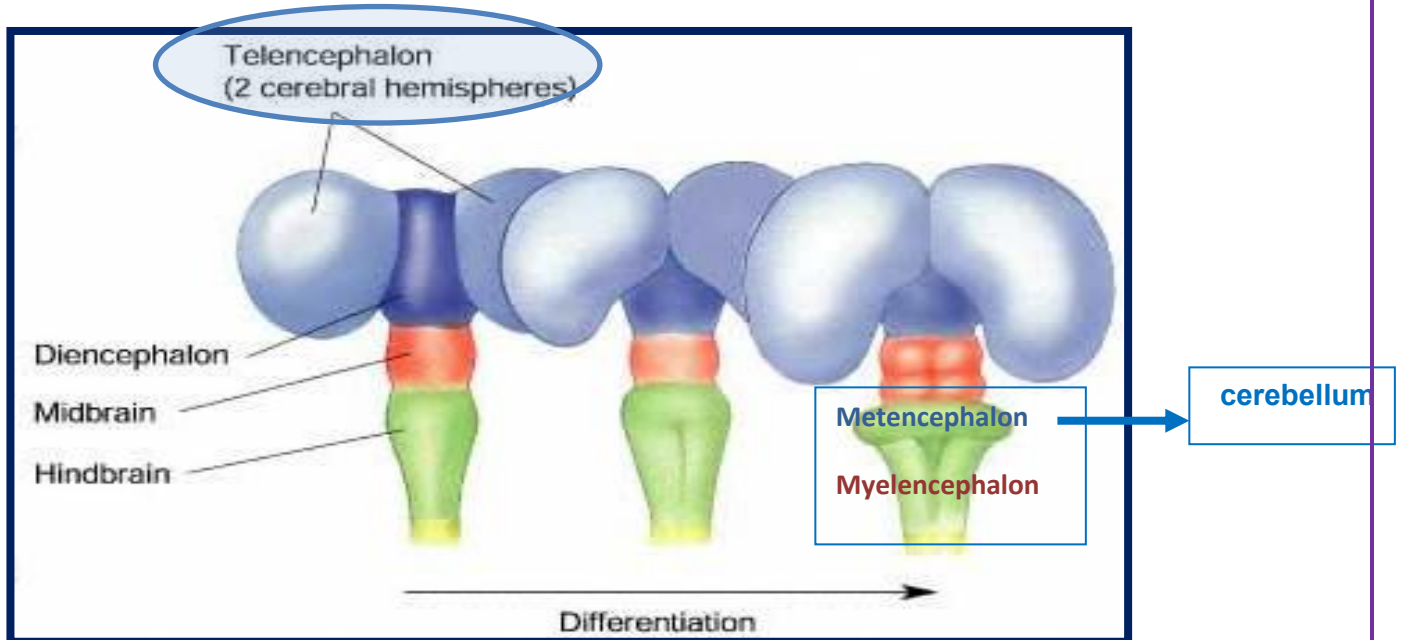
The diencephalon,  
on the medial side.

The telencephalic  
vesicles (which will  
form the lateral  
cerebral hemispheres)



The lumen gives the 3<sup>rd</sup> ventricle and the 2 lateral ventricles that will communicate with each other by ( the interventricular foramen )

## Development of the Cerebrum and cerebellum

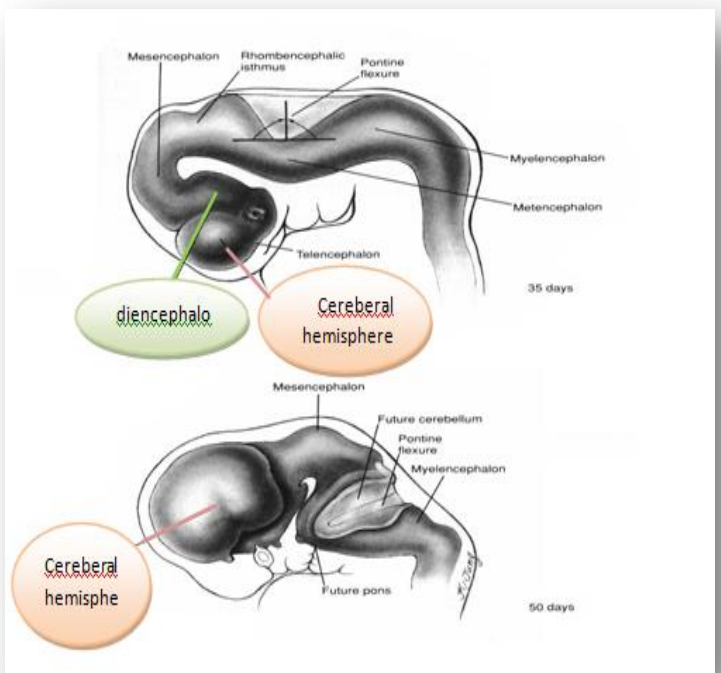


## The cerebral hemispheres

### The beginning of the cerebral hemispheres:

➡ **on the day 32,** (the cells are proliferating rapidly, stretching the wall) it will form a pair of **bubble-like** outgrowths of the telencephalon.

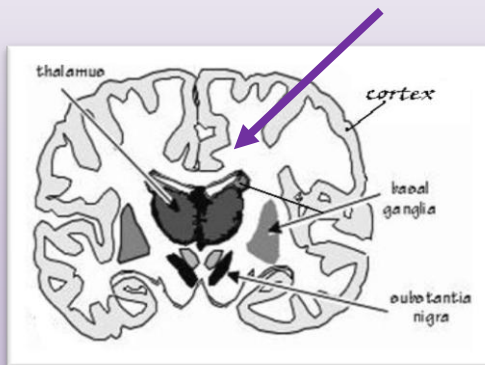
➡ **By 16 weeks,** the hemispheres will cover all the aspect of the diencephalon.



The cerebral hemispheres will keep growing in all directions.

As it grows, the walls are becoming thinner and thinner.

Its **medial wall** becomes the site of **choroid plexus of the lateral ventricle**.



On the **3<sup>rd</sup> month**, the surface of the cerebral is **smooth**.

On the **4<sup>th</sup> month**, gyri separated by sulci will appear in the cortex, because the gray matter grows much faster than the white matter.

The gyri and sulci effectively increase the surface area of the brain, and they differ from one person to another.

Initially the **Corpus striatum (basal nuclei)** will appear in the **6<sup>th</sup> week** as one mass, on the floor of each cerebral hemisphere.

Then the cortex will develop their fibers to the white matter, so they will push the basal nuclei (corpus striatum) and divide it into **caudate nucleus & lentiform nucleus**.

These fibers are called: **the internal capsule**.

The wall of the telencephalon is formed of 3 layers:

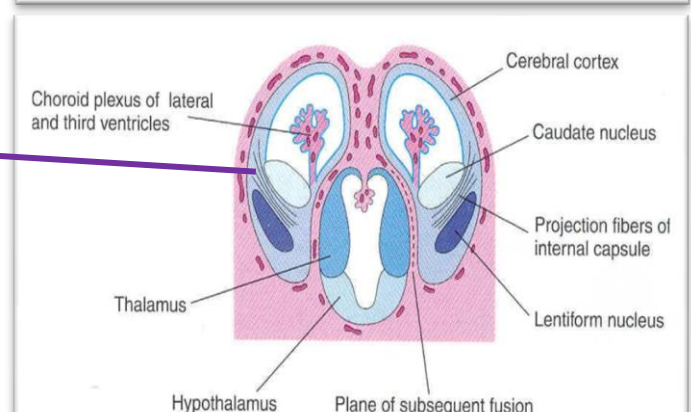
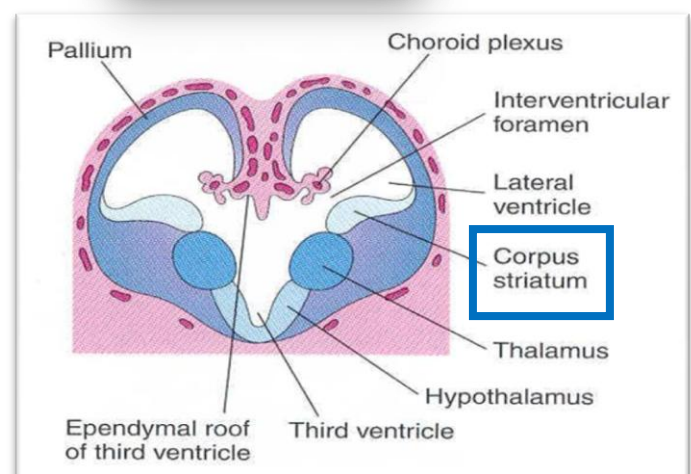
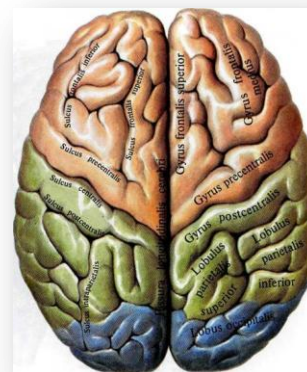
**Ependyma:** (the inner) lines the cavity of the lateral ventricle.

**Mantle layer:** Intermediate layer contains nerve cells (grey matter).

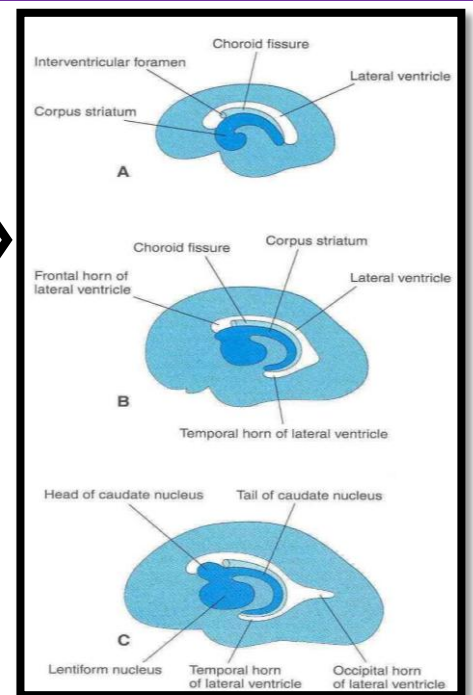
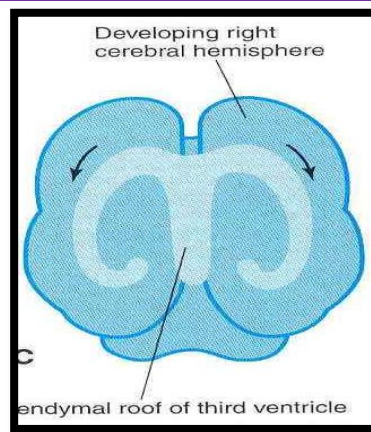
**Marginal layer:** Outer layer contains nerve fibers (white matter).

Once the 3 layers are formed, most of the nerve cells in the mantle layer migrate (move) to the marginal layer to form the **cerebral cortex**.

The remaining cells (which do not migrate) form **the basal ganglia**.



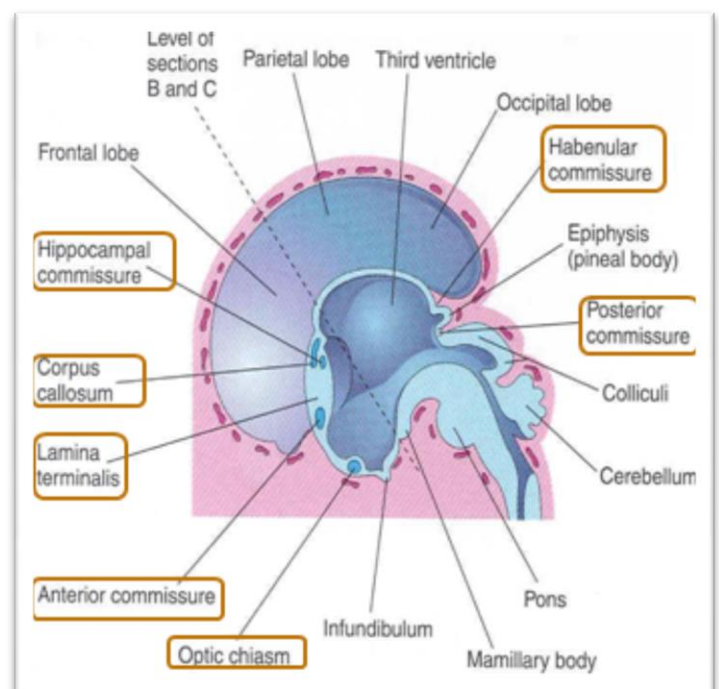




Further expansion of cerebral hemisphere, gives **C-shape to the hemisphere** as well as the **lateral ventricle** and the **caudate nucleus**.

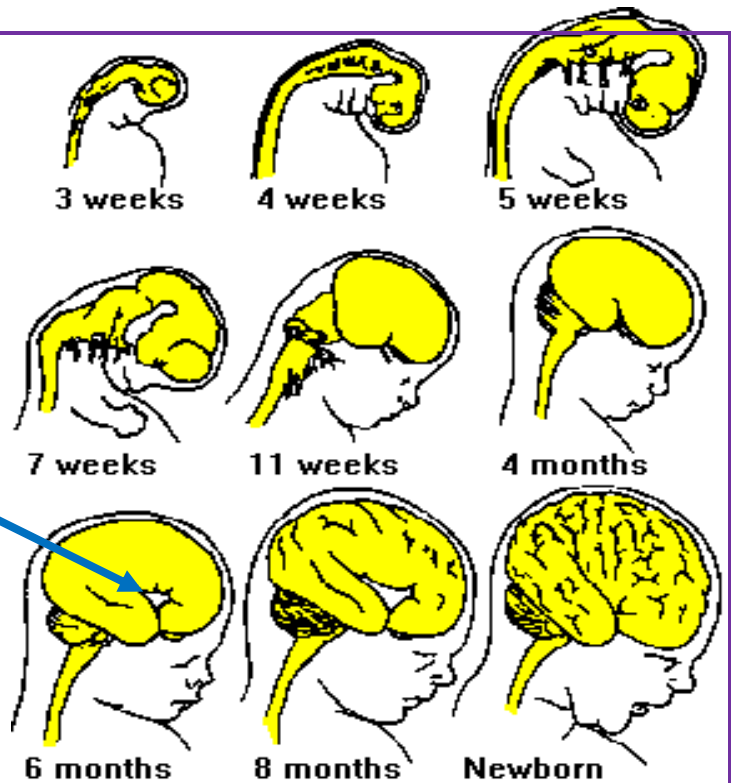
**The Cerebral Commissures** that connect one hemisphere to the other, are:

- **Lamina terminalis.**
- **Optic chiasma.**
- **Anterior commissure.**
- **Posterior commissure.**
- **Hippocampal commissure.**
- **Corpus callosum.**
- **Habenular commissure.**
- **Corpus callosum.**



All the parts of the cerebral hemispheres will grow so fast, except a small part of the gyrus which is called (**insula**)

Insula lies in the depth of the lateral sulcus and it will grow relatively slow, so it is overgrown by the rest of the hemisphere



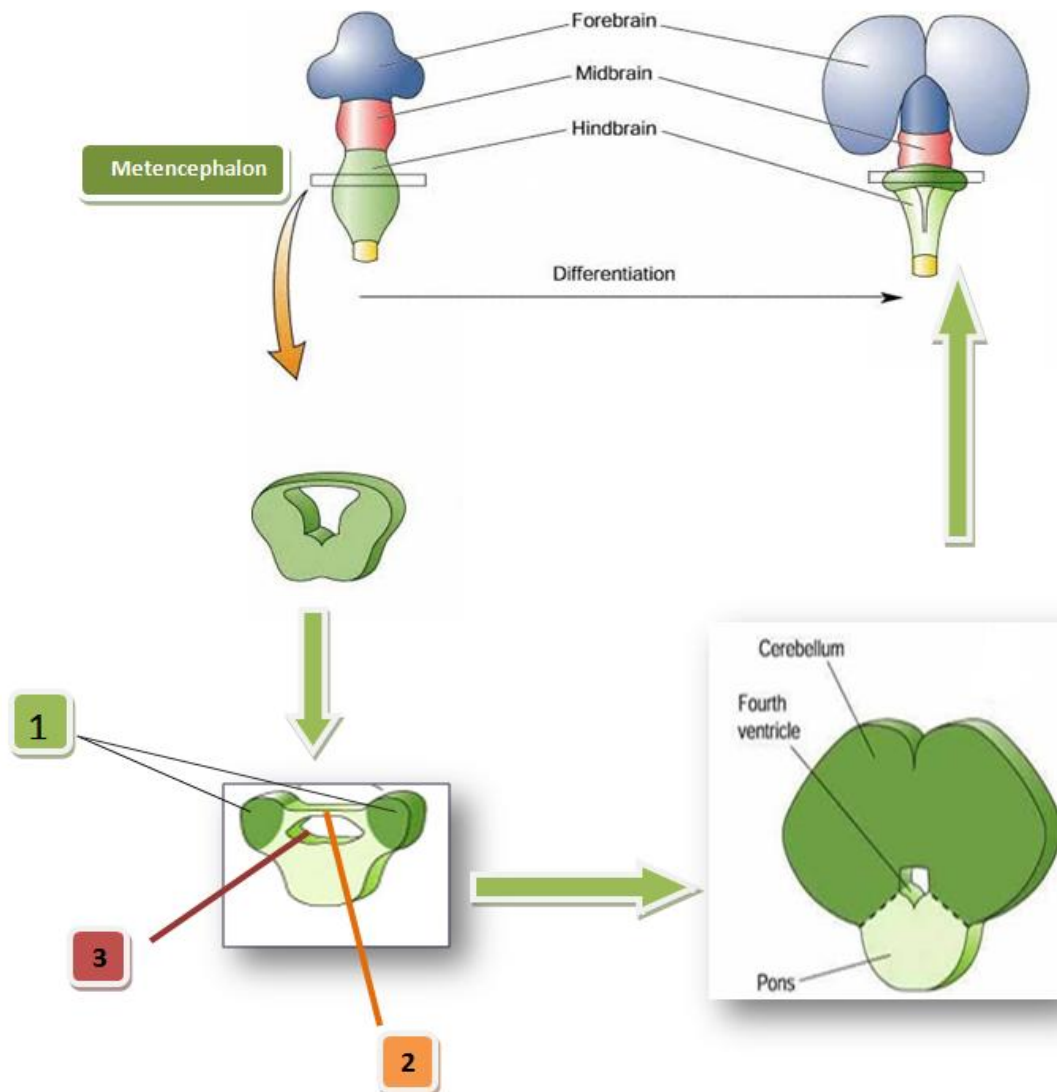
## The cerebellum

- It develops from the dorsal part of the **alar plate** of the **Metencephalon**
- The metencephalon develops into **pons** and **cerebellum**
- **When the pontine flexure develop, three things will happen.**
  - 1) Pushing the **alar plates** more laterally.
  - 2) The central part is stretching and the **roof plate is thinning.**
  - 3) Widening of the cavity to **form the 4<sup>th</sup> ventricle.**

After that, The **alar plates** will grow rapidly and will 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**.

the remaining cells in the mantle layer will give rise to the **cerebellar nuclei**, that will give axons to form the **cerebellar peduncles** that reach the brain stem.



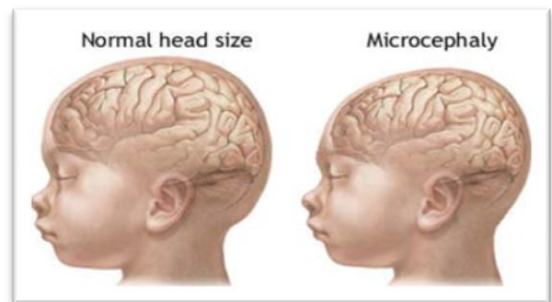
The cerebellar hemispheres undergo a complicated process of transverse folding and form closely packed, leaf-like transverse gyri called **folia**.

They increase the surface area of the cerebellar cortex by increasing with time.

These processes of fissure formation and foliation continue throughout **embryonic, fetal, and postnatal life**.

## \*Common congenital Anomalies of Brain\*

- Mental retardation.
- Seizures.
- Cerebral palsy.
- Cranium bifidum with or without meningocele (defect in the bone, and the meninges are coming out from it) & meningoencephalocele. (meninges + brain tissue are coming out)
- Meroanencephaly.
- Microcephaly.
- Agenesis of corpus callosum.



- Hydrocephalus.

(the cranial cavity is very large, accumulation of the CSF)

- Arnold-Chiari malformation. (the brain stem is pushed down into the foramen magnum)
- Anencephaly. (the skull is not developed at all)





# Test Yourself!

Q1: The nucleus that has the same shape of the lateral ventricle and the cerebral hemisphere is:

- a) Basal nuclei
- b) Caudate nucleus
- c) Lentiform nucleus
- d) Gracilis nuclei

The answer is ( B )

Q2: the area that grows slowly in the cerebral hemisphere is:

- a) Corpus callosum
- b) Insula
- c) Internal capsule

The answer is (b)

Q3: the cerebellum develops from:

- a) Ventral part of the basal plate
- b) Dorsal part of the basal plate
- c) Ventral part of the alar plate
- d) Dorsal part of the alar plate

The answer is (D)

# Thank you!