

Neural Development:

- Explain embryonic and foetal brain development
- Describe the development of the brain vesicles
- Describe the process of cell proliferation
- Describe the impact of incomplete neural tube development and brain damage in early life
- Provide examples of neural tube defects

Cell Proliferation

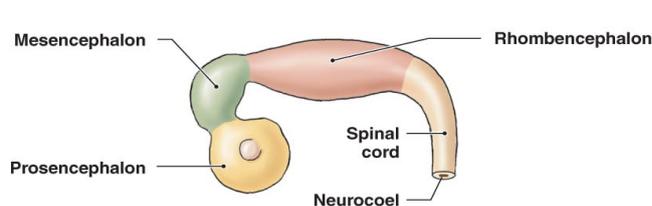
Cell proliferation is the process that results in an increase of the number of cells, and is defined by the balance between cell divisions and cell loss through cell death or differentiation.

- The brain develops from the walls of the 5 fluid filled vesicles
- The fluid filled spaces remain in the adult and become the ventricular system
- Neural stem cells are formed in the walls of the ventricles
- Are formed by single cells copying their DNA and dividing in 2 and making more cells
- Other cells migrate to take up a position in the cortex
- Occurs when the normal inhibition of cell division is lost

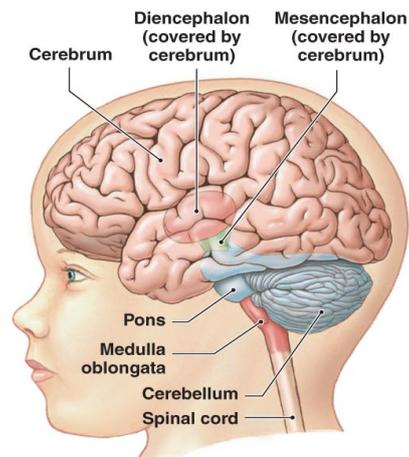
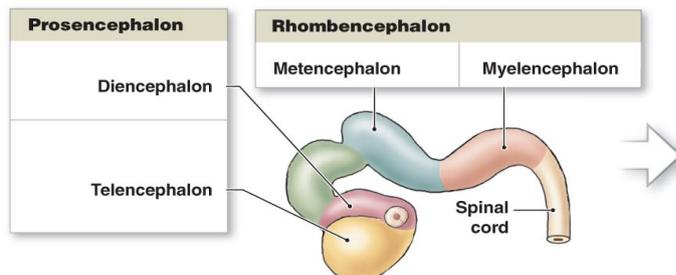
Brain vesicles

- 3 swelling primary vesicles at the front end (anterior part) of the neural tube
- The brain develops from the vesicles which are:-
 - **1. Prosencephalon:** Forebrain, anterior most section (covered by cerebrum), it differentiates to form 3 vesicles.
 - **2. Mesencephalon:** Midbrain
 - **3. Rhombencephalon:** Hindbrain

A lateral view of the brain of an embryo after 4 weeks of development showing the neural tube



A lateral view of the brain of a 5-week-old embryo



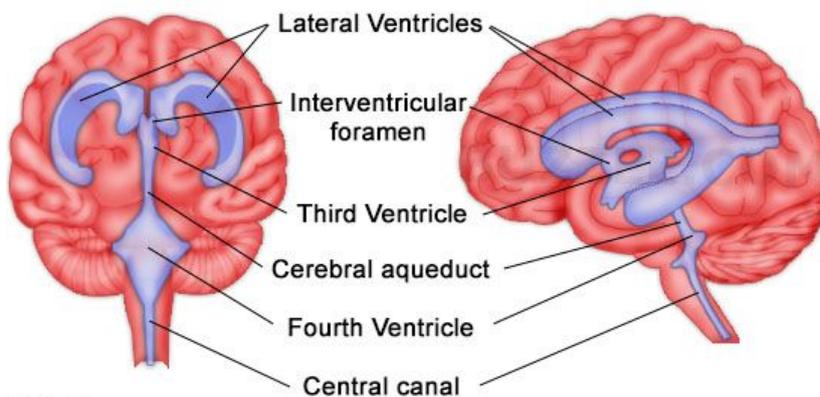
Brain development in a child, showing the cerebrum covering other portions of the brain

- By the end of the 6th week the brain development of the 5 brain vesicles is complete
- By the 8th week the frontal lobes, parietal, temporal and occipital lobes have began to form
- The limbic system is developed

Brain vesicles

- Contains CSF
- The neurocoel within the cerebral hemispheres expand to form the ventricles
- Each cerebral hemisphere contains a large lateral ventricle, not connected but communicate through the 3rd ventricle (interventricular foramen)

Ventricles of the Brain

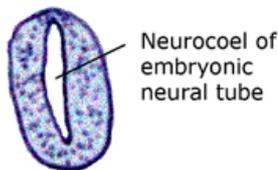


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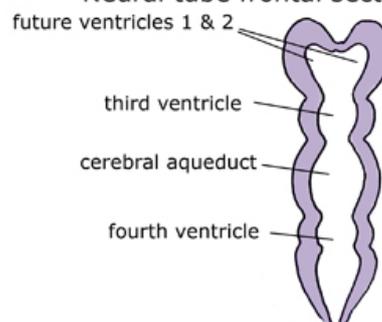
3rd ventricle:- in the diencephalon
-The aqueduct of the midbrain in

mesencephalon is a passageway that connects the 3rd to the 4th ventricle

Neural tube cross section



Neural tube frontal section



Postnatal Brain development

- 300g newborn brain
- Growth occurs through the increase in size of neurons and increased number of supporting cells, Glia cells, development of neural processes and synapses, laying down of myelin sheaths

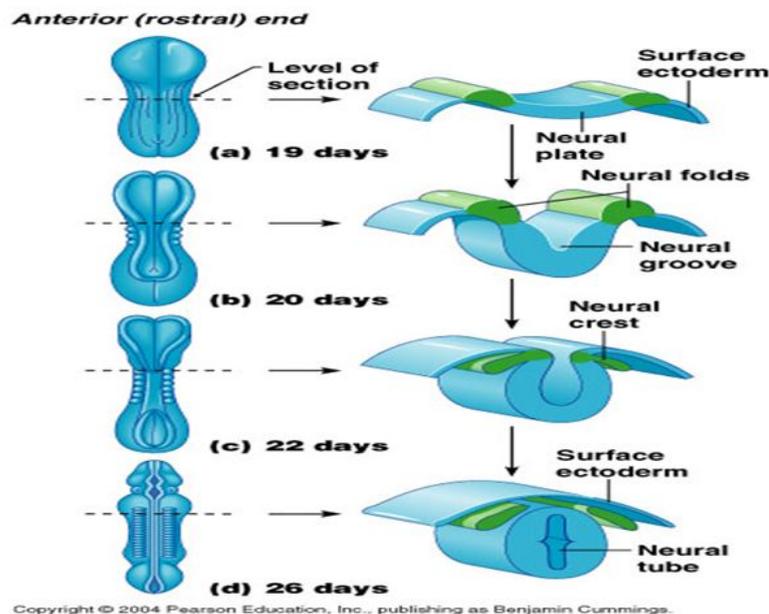
Neural tube

- The CNS develops from the neural tube
- Neural tube = Fluid filled tube that is formed early in the embryonic development
- Embryonic period= the first 8 weeks after implantations
- - egg + sperm (both haploid cells) when fertilized becomes a zygote (into a diploid cell)
- Duplicates to 32 cells to become a Blastocyst.
- Implantation in uterine wall = 6 days after fertilisation
- Remaining 30 weeks of gestation are used to grow, refine, develop organs and systems and tissues.

Formation of the neural tube

- During the 3rd week of gestation the brain consists of a flat sheet of cells
- The embryo starts as a flat disc with 3 layers of cell (gastrula / trilaminar)
- **Endoderm**= develops into the lining of many internal organs
- **Mesoderm**= develops into the bones of the skeleton and the muscles
- **Ectoderm**= Develops into the nervous system and the skin.
- **Neural plate**= Develops from the ectoderm, the the neural plate into nervous system.

NEURAL TUBE



Day 18:- The groove appears in the neural plate walls of groove move together forming the neural tube- develops into brain and spinal cord

Day 22-28:- The end of the tube closes

- Does Not close = neural tube defect
- The top of the neural tube becomes the brain the rest the spinal cord.

Neural crest

- The neural folds come together and some neural ectoderm is pinched off and lies outside
- Neurons with all bodies in the peripheral nervous system come from the neural crest
- Develops in association with the underlying mesoderm
- Mesoderm bulges called Somites

Neural precursor cells

- Have the potential to generate most of the different types of neurons and Glia found in the brain
- Neurons are created in areas of the brain that are rich in neural precursor cells
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- Usually a precursor cell is a stem cell which has the capacity to differentiate into only one cell type

Apoptosis- programmed cell death- when absent or incomplete- can cause synclacty

- Or can cause serious anatomical malformations but can also result in minimal consequences depending on the gene targeted, neuronal population, and stage of development.

Attenuated - (weakened) synapse development or reduced programmed cell death

- Learning disorders
- Developmental cognitive disorders and linguistic functions

Necrosis- Cell damage by external force