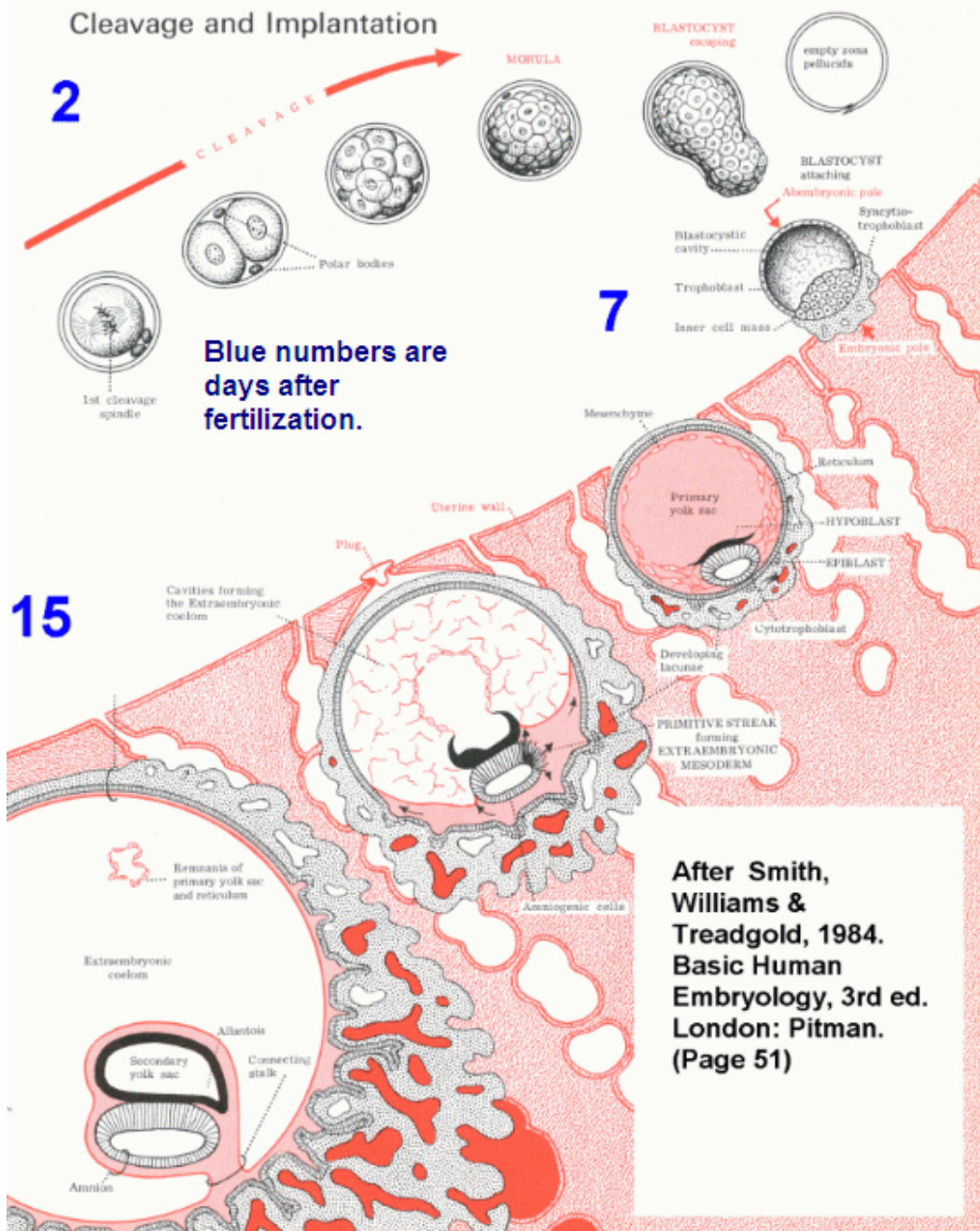
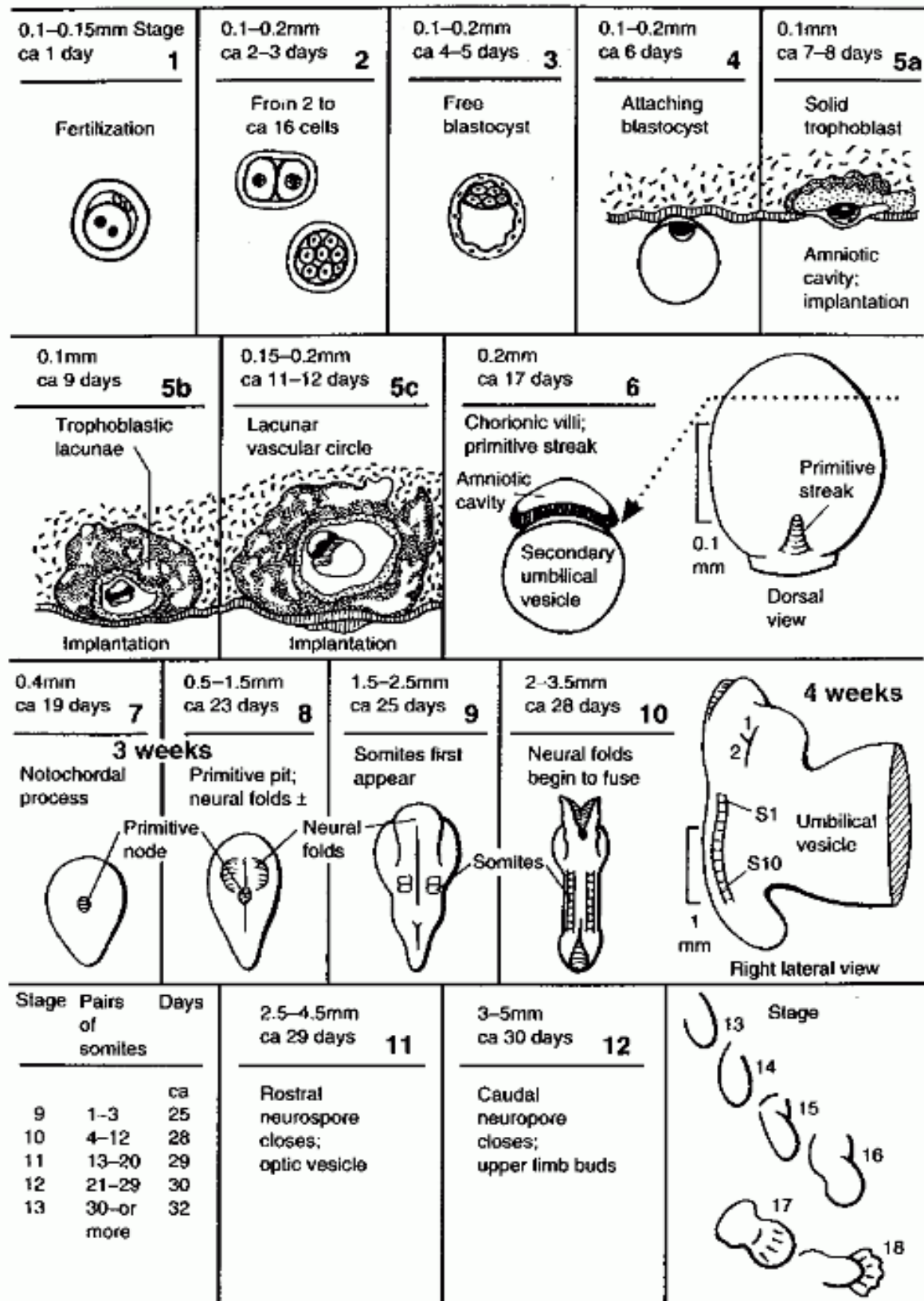


# DEVELOPMENT OF THE CENTRAL NERVOUS SYSTEM

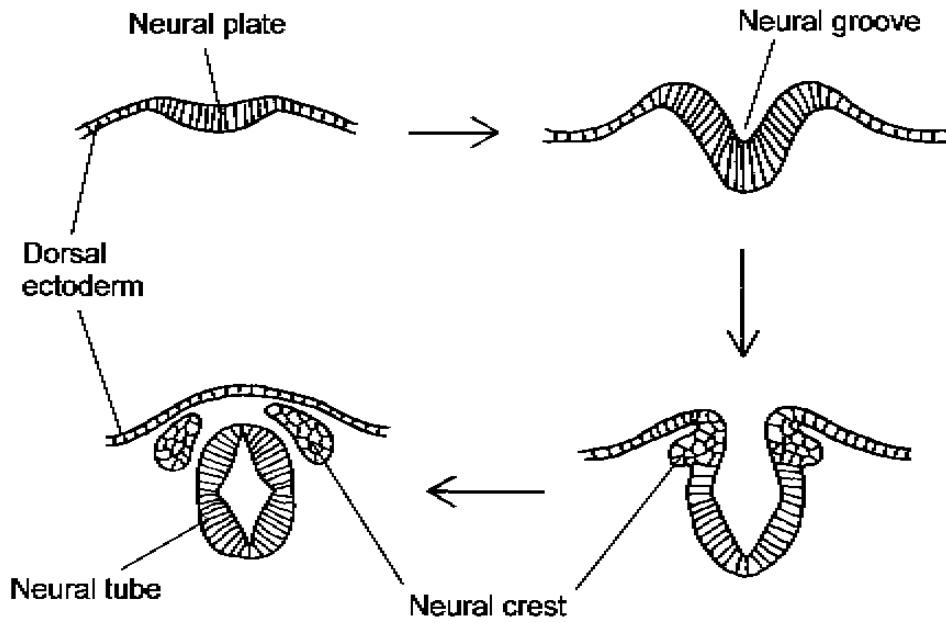
## EARLY HUMAN DEVELOPMENT



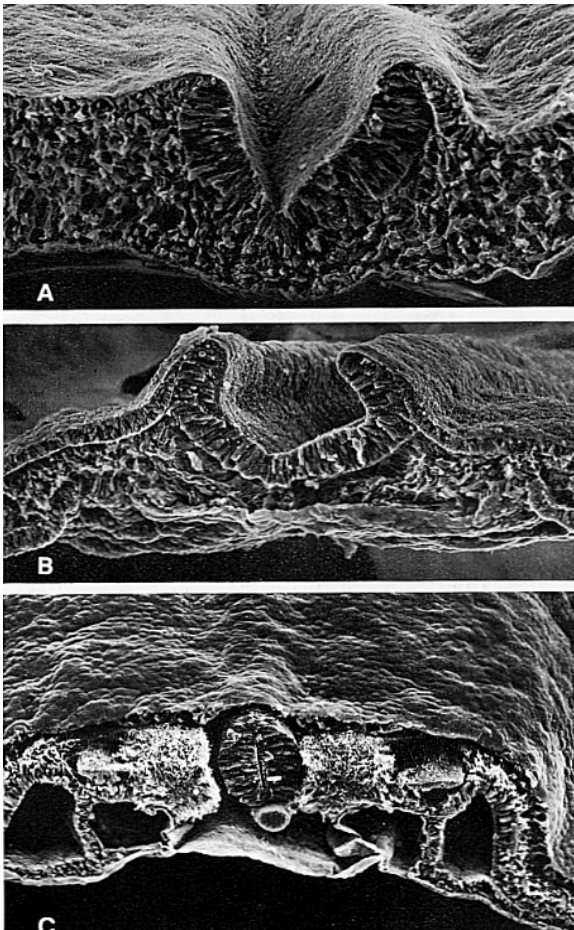


**Figure A: Stages 1–12**

O'Rahilly & Muller 2006



Transverse sections through the dorsal parts of a series of embryos, to show how the neural plate gives rise to the neural tube and neural crest



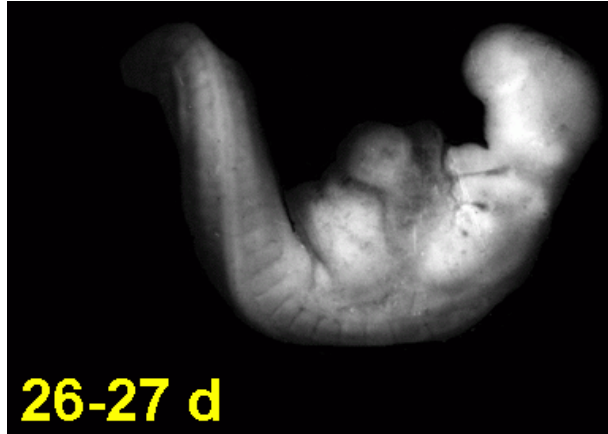
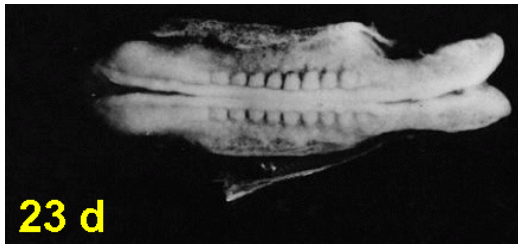
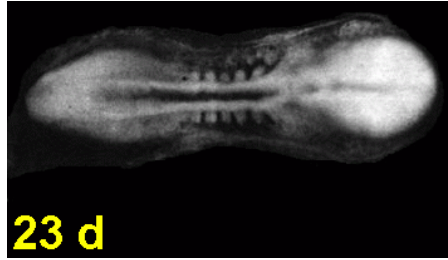
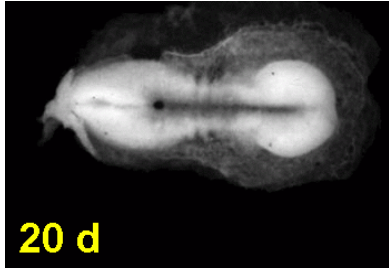
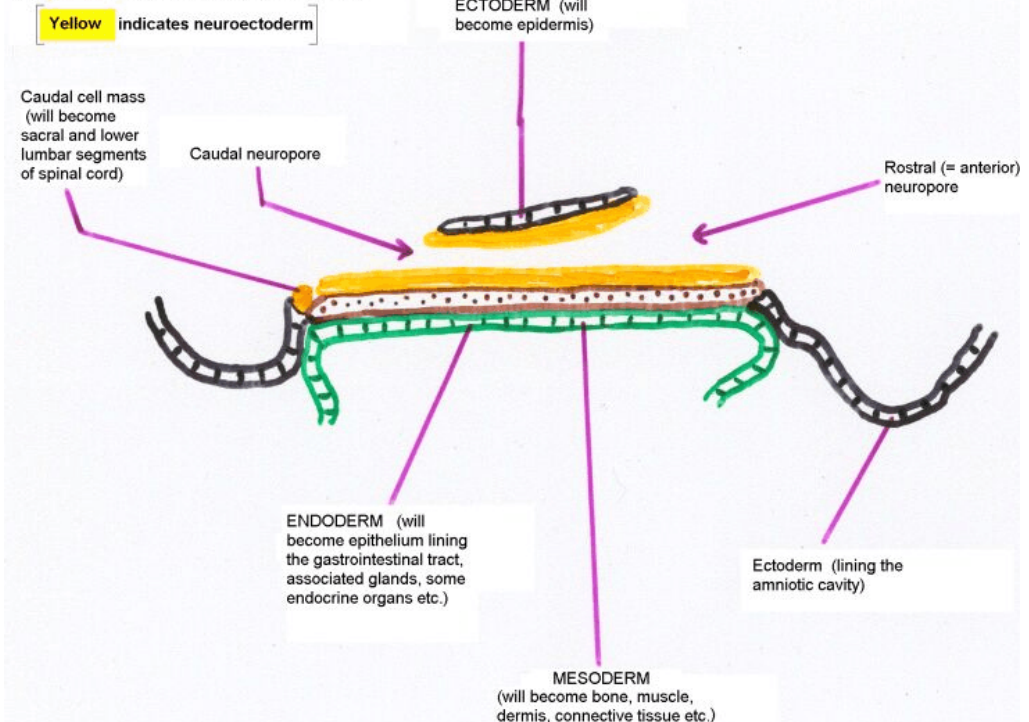


Diagram of longitudinal section of a human embryo 22-23 days after fertilization, showing the partly closed neural tube and the neuropores.



## FURTHER DEVELOPMENT, and major divisions of the brain.

**BLUE:** Hindbrain = rhombencephalon, comprising medulla, pons and cerebellum (darker blue).

**GREEN:** Midbrain = mesencephalon, comprising tectum and cerebral peduncles.

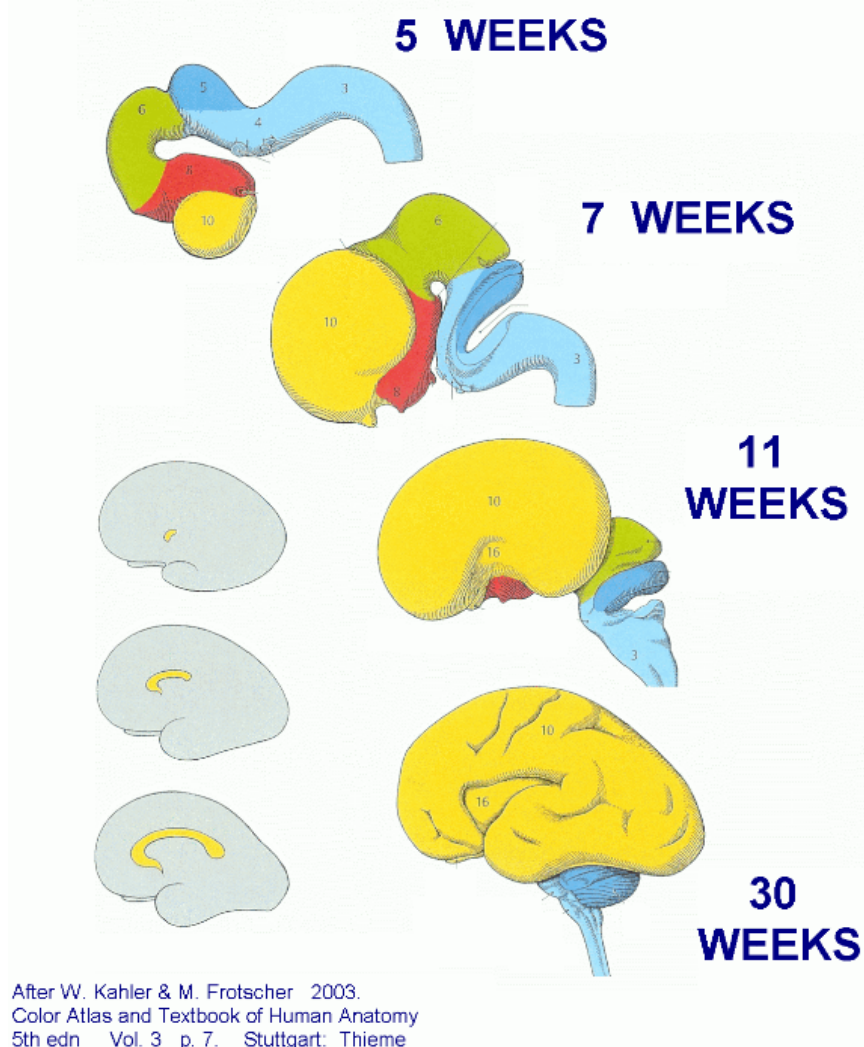
**RED:** Diencephalon, comprising thalamus, hypothalamus etc.

**YELLOW:** Cerebral hemispheres = telencephalon, comprising cerebral cortex, subcortical white matter, corpus striatum.

### Some more words:

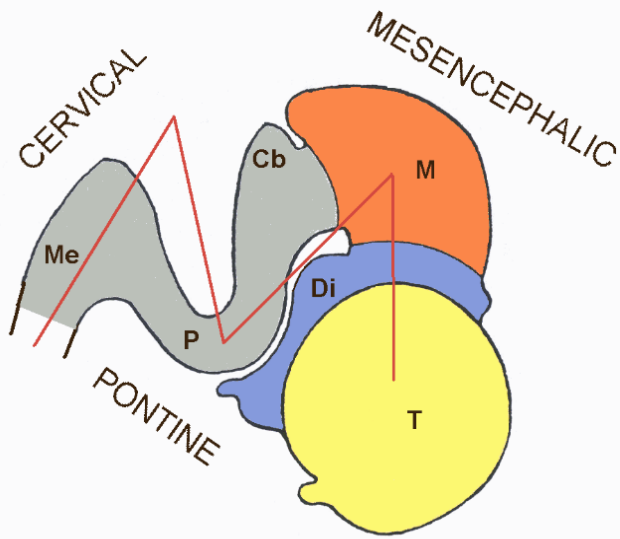
Metencephalon = pons + cerebellum

Forebrain = prosencephalon = diencephalon + telencephalon



The three diagrams on the left show the growth of the corpus callosum.

## FLEXURES

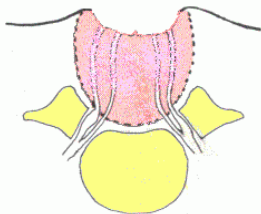


Me = Medulla  
 P = Pons  
 Cb = Cerebellum  
 M = Midbrain (mesencephalon)  
 Di = Diencephalon  
 T = Telencephalon

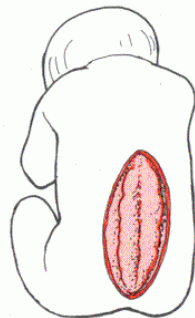
Folding a tube with variably thickened walls, to fit inside the cranium.

## DEVELOPMENTAL ABNORMALITIES ASSOCIATED WITH DEFECTIVE NEURAL TUBE CLOSURE OR FAILURE TO FORM ASSOCIATED SKELETAL ELEMENTS.

### MYELOSCHISIS



Missing: Roof plate  
 Vertebral arch  
 Skin



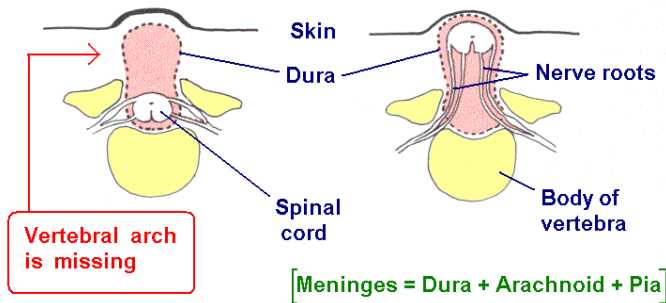
Posterior neuropore does not close.  
 Overlying structures do not develop.  
 Neurocoele is exposed.

# CYSTIC SPINA BIFIDA

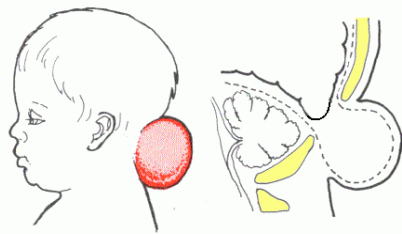


# MENINGOCOELE

# MENINGOMYELOCOELE

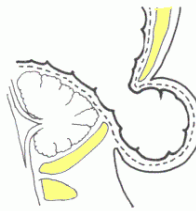


# CRANIAL MENINGOCOELE



Meninges and CSF in herniating cyst

# MENINGOENCEPHALOCOELE



Brain (in this case, occipital lobes of the cerebrum) in cyst

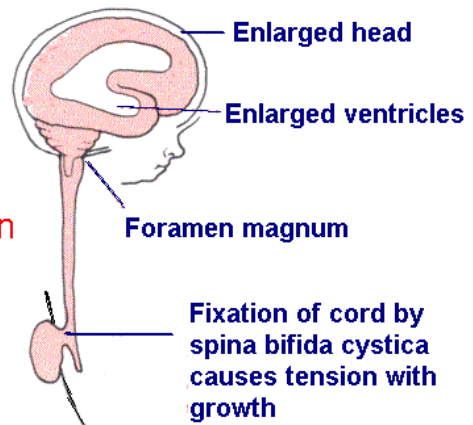
# HYDROCEPHALY (HYDROCEPHALUS)

# ANENCEPHALY

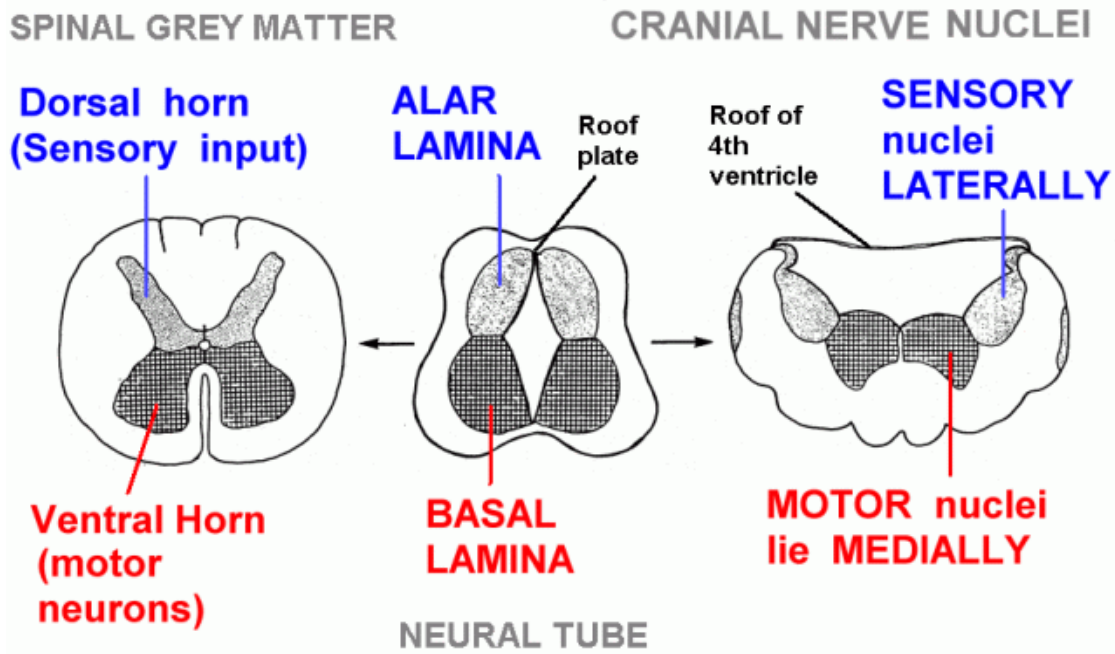


Exposed, open, undeveloped cerebrum. Brain stem and its functions preserved

# Chiari malformation

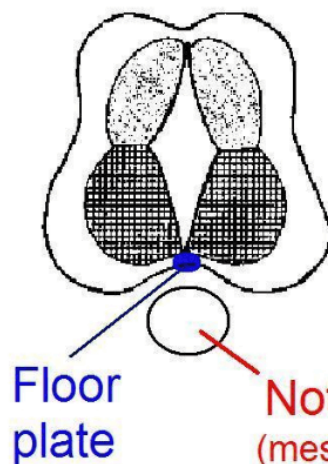


SEPARATION OF **MOTOR** AND **SENSORY** REGIONS OF GREY MATTER IN THE SPINAL CORD AND BRAIN STEM.



## INDUCTION

Substance(s) secreted by cells affect the differentiation of other cells. The effect depends on concentration of the inducing molecules, which decreases with distance from the source.



Floor plate cells also secrete **Shh**, which induces motor neuron formation in the ventral part of the neural tube

Secretes **Shh**, which induces the floor plate of the neural tube

<http://www.nature.com/milestones/development/milestones/full/milestone21.html>

\* See this web site for more information \*