

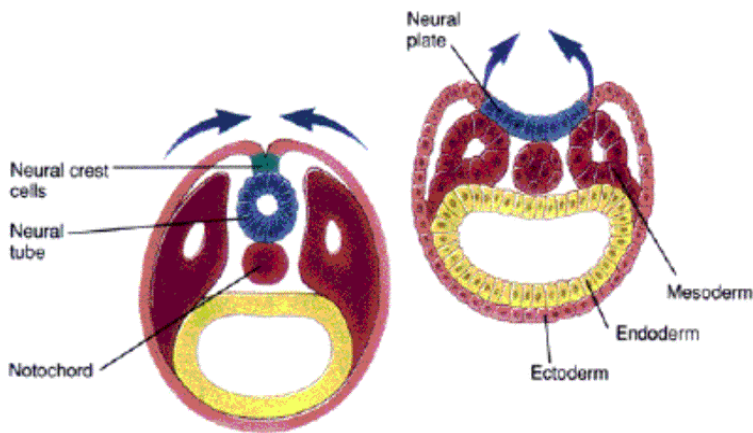
Neural Development



The incredibly important and diverse functions of the human nervous system that range from sensation, perception, learning, memory, emotion, movement, thinking, and so much more all rely on the formation, organization, and connection of different types of nerve cells.

Neural Induction

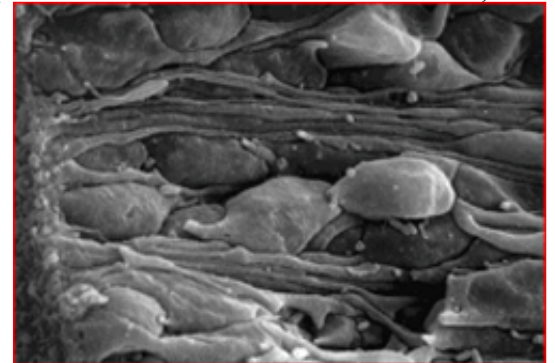
Neural induction is when signals *specify* ectodermal cells to become neural stem cells, cells of the neural plate. The *primitive streak* a transient formation on the *dorsal* side of the embryo sends signals down from the *ectoderm*. This area has a large number of molecules called bone morphogenic protein (BMP) inhibitors and fibroblast growth factors that stop the signaling properties of BMP and other factors which are expressed throughout the embryo. BMP will cause the ectoderm to become skin. However, without BMP the ectoderm will become cells of the nervous system.



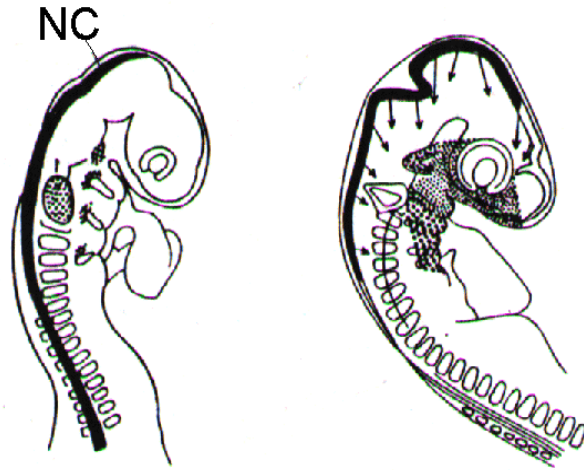
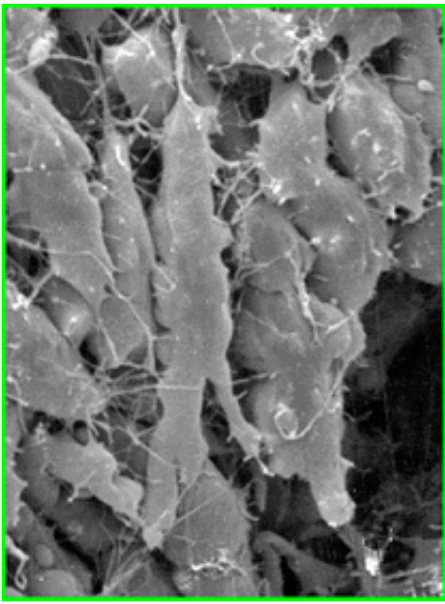
Primary Neurulation

Signals from the underlying mesoderm cause the now neural precursor cells called the *neural plate* to invaginate and form a tube called the *neural tube* [click here](#) to see a video of primary neurulation ([download QuickTime](#))

(below is a picture of the cells of the neural tube)



This hollow tube eventually becomes the central nervous system the top of the tube becoming the brain and farther down the spinal cord. When the neural tube forms the intermediate cells between the tube and the ectoderm become *neural crest cells*.

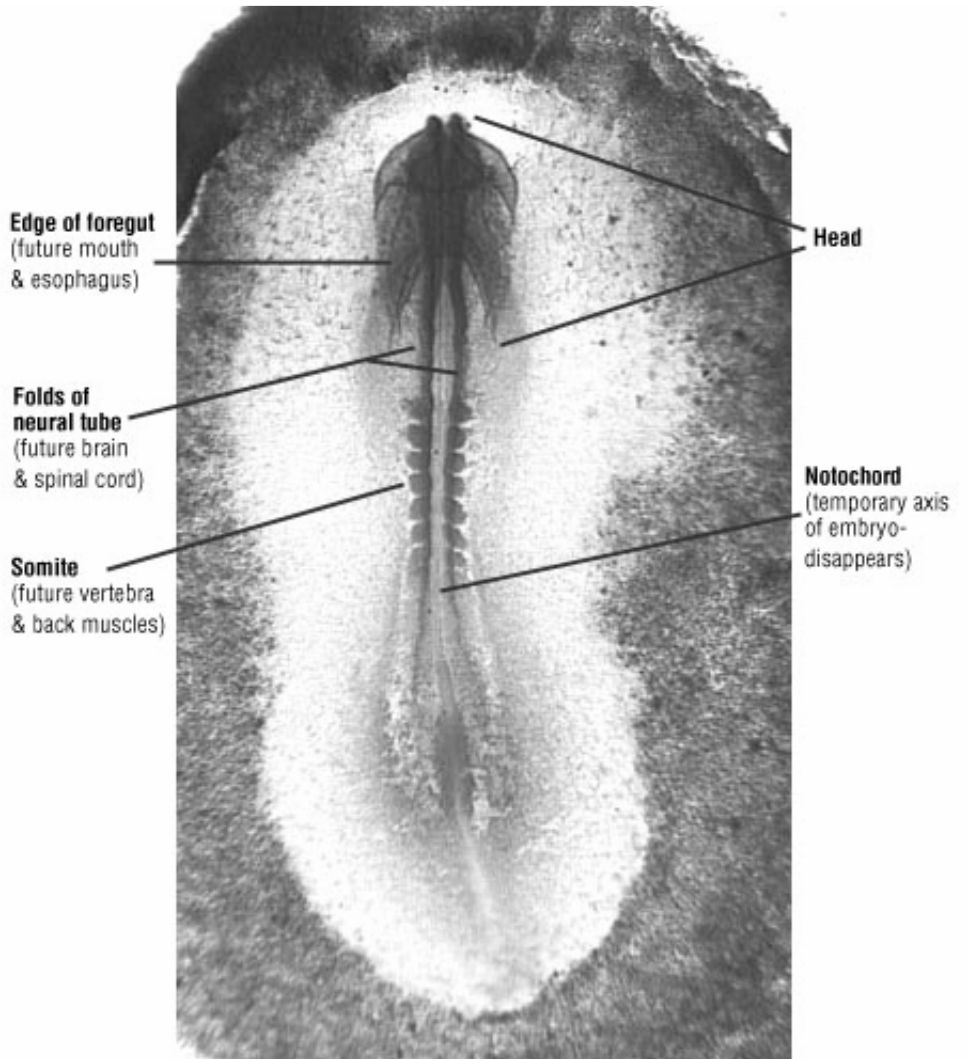


Secondary Neurulation

[click here](#) to see a video of secondary neurulation ([download QuickTime](#))

Somitogenesis

[click here](#) to see what happens to the somites ([download QuickTime](#))



Differentiation of the Neural Tube

forms the spinal cord and brain

Spinal cord

BMP4 and BMP7 in dorsal ectoderm sends dorsalizing signals

SHH from notochord and floorplate of neural tube send ventralizing signals

the neural tube and its lumen expand and constrict to form chambers of spinal cord and brain

Brain

The 3 primary vesicles

1) Forebrain (Prosencephalon) 2) Midbrain (Mesencephalon) 3) Hindbrain (Rhombencephalon)

and 5 secondary vesicles

Prosencephalon--Telencephalon and diencephalon

Mesencephalon

Rhombencephalon--Metencephalon and Myelencephalon

And adult derivatives

Telencephalon-olfactory lobes, hippocampus, and cerebrum

diencephalon-thalamus and hypothalamus (retina and epithalamus (pineal gland))

Mesencephalon-Midbrain

Metencephalon-cerebellum and pons

Myelencephalon-medulla

Proliferation of cells in neural tube

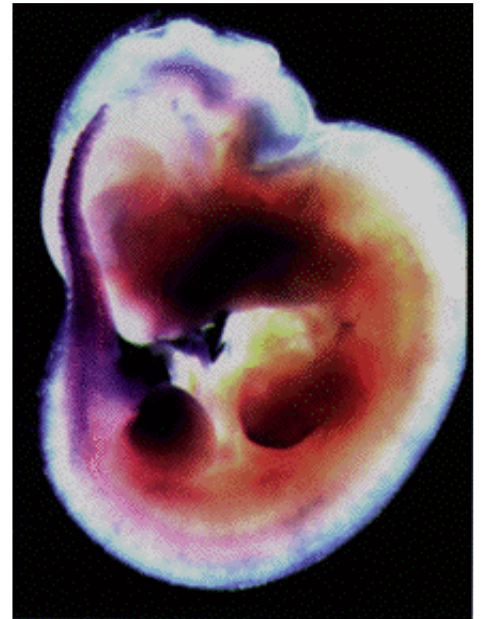
cells shape during cell cycle and their birthday

Migration of cells from neural tube

role of growth factors in cell growth and migration

Neural Crest Cells

4 functional groups of cells



1) cranial cephalic neural crest makes bones of the face and some of the skull

migration pathways

2) trunk neural crest cells

migration pathways

a) melanocytes

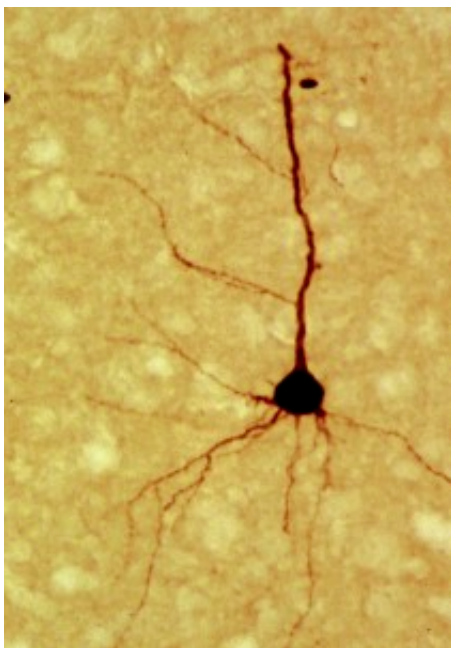
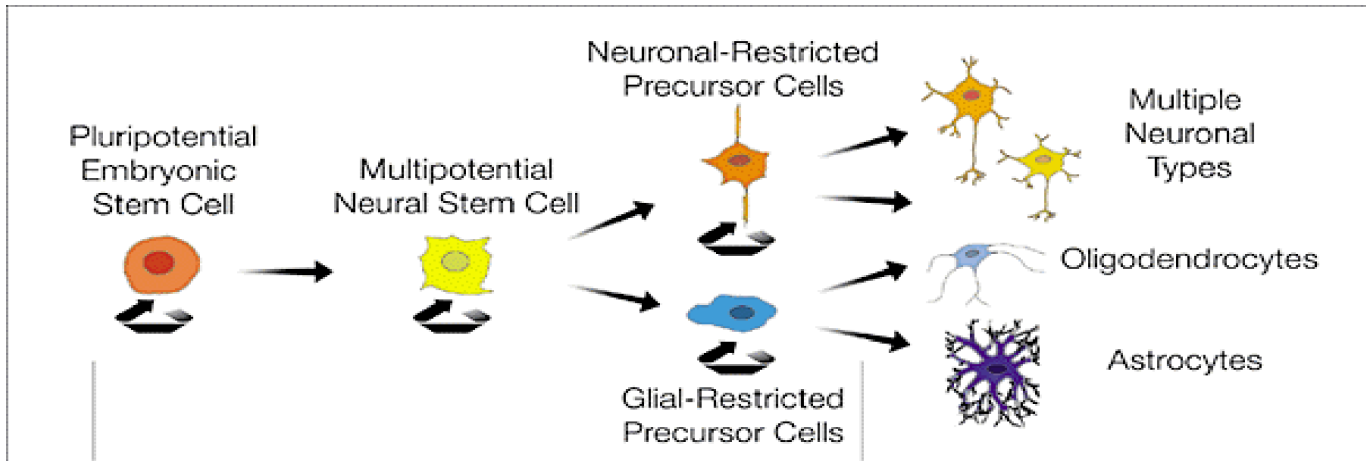
b) dorsal root ganglia

3) vagal and sacral neural crest cells-parasympathetic ganglia of gut

migration pathways

4) cardiac neural crest cells-musculo connective tissue, wall of arteries, and others

migration pathways



Elongation and synapse formation

the growth cone and role of glial cells in elongation

Netrins and neuron outgrowth

