The ectoderm: neurulation, neural tube, neural crest

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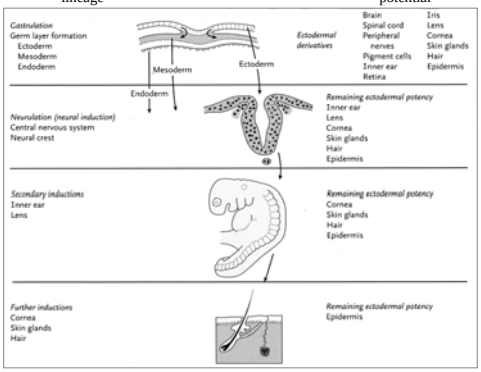
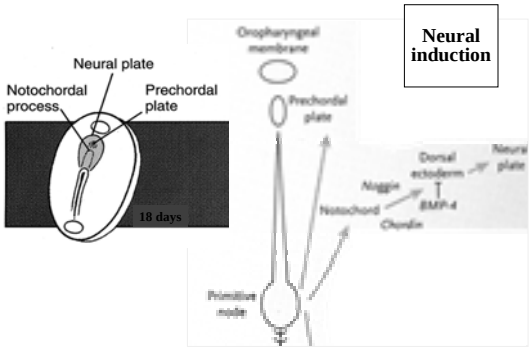
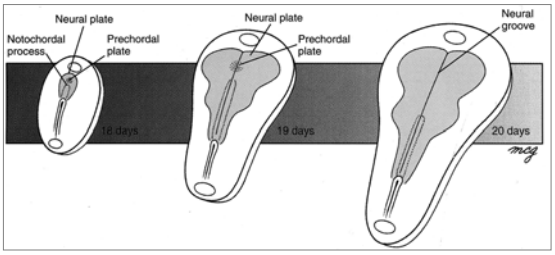
Events that remove cells from the epidermal lineage

Progressive restriction of developmental potential





Shaping the neural plate



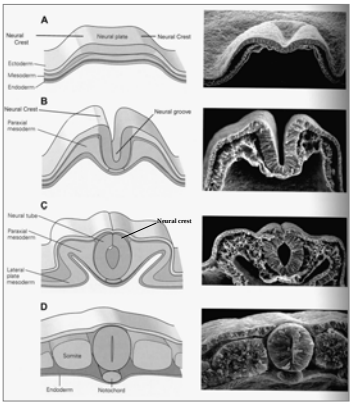
PRIMARY NEURULATION

Neural induction, formation of the neural plate

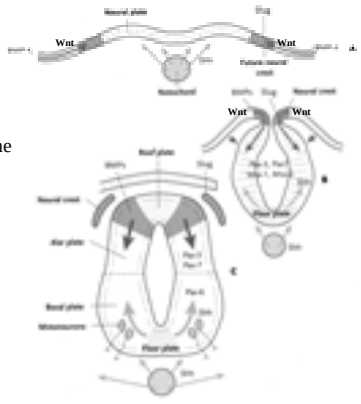
Formation of of the neural groove and neural folds

Closure of neural folds, formation of neural tube and neural crest

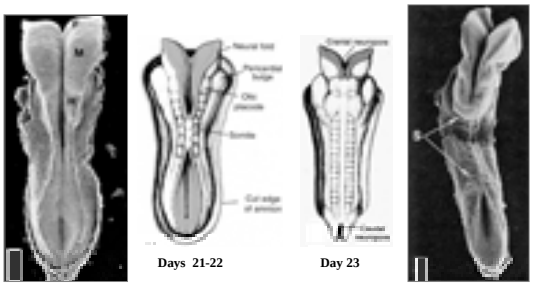
Initially, the neural tube is composed of a single layer of neuroepithelial cells



Dorsal and ventral signaling in the spinal cord

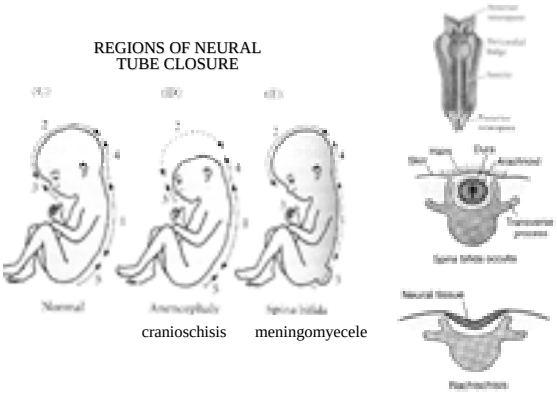


Dorsal view: Neurulating embryos



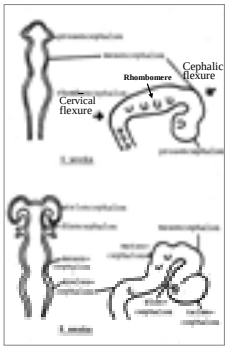
Days 21-22 Day 23

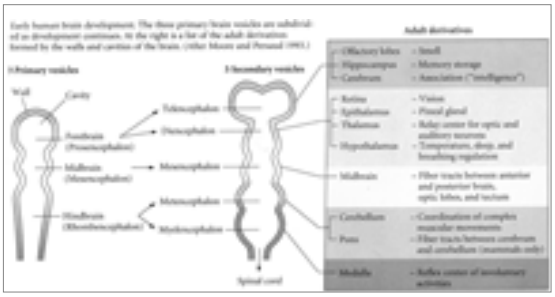
REGIONS OF NEURAL TUBE CLOSURE



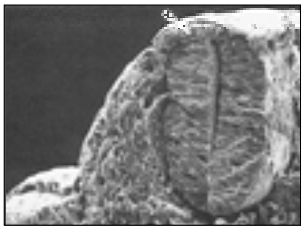
cranioschisis meningomyecele

REGIONALIZATION OF THE CNS
PRIMARY AND SECONDARY VESICLES AND FLEXURES



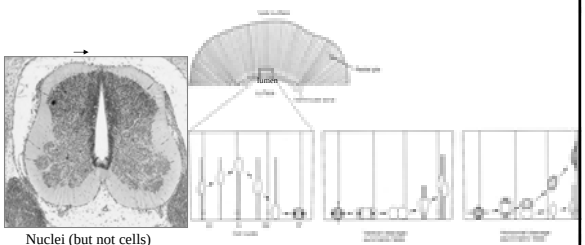


How are billions of CNS cells (neurons and glia) generated?



The neuroepithelium is a single layer of rapidly dividing stem cells

NEUROGENESIS IN THE NEUROEPITHELIUM



Nuclei (but <u>not</u> cells) migrate during the cell cycle

The plane of division of progenitor cells in the ventricular zone influences their fate

At least half the neurons that are generated undergo apoptosis and die.

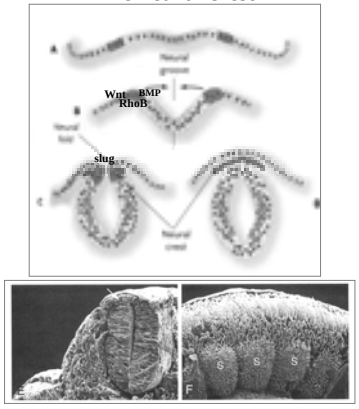
Neuronal survival depends upon recognition of target related trophic signals.

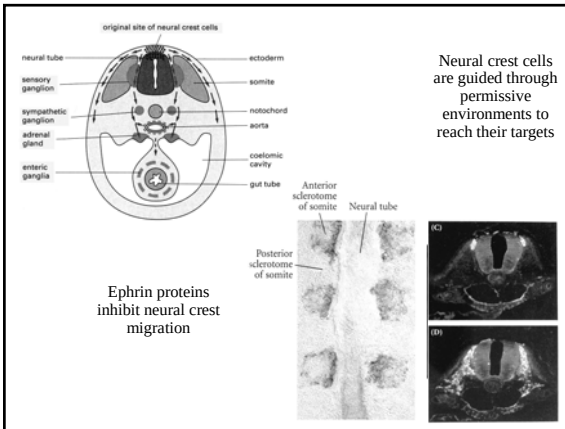
Table 13.1 Some derivatives of the neural crest

Derivative	Cell type or structure derived
Peripheral nervous system (PNS)	Neurons, including sensory ganglia, sympathetic and parasympathetic ganglia, and plexuses Neuroglial cells Schwann cells
Endocrine and paraendocrine derivatives	Adrenal medulla Calcitonin-secreting cells Carotid body type I cells
Pigment cells	Epidermal pigment cells
Ectomesenchyme	
Facial cartilage and bone	Facial and anterior ventral skull cartilage and bones
Connective tissue	Corneal endothelium and stroma Tooth papillae Dermis, smooth muscle, and adipose tissue of skin of head and neck Connective tissue of salivary, lachrymal, thymus, thyroid, and pituitary glands Connective tissue and smooth muscle in arteries of aortic arch origin

Source: After Jacobson 1991, based on multiple sources.

The neural crest

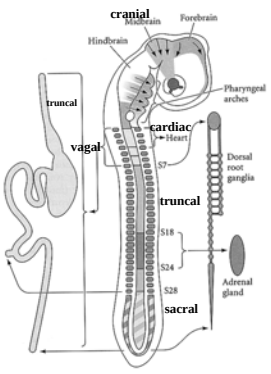




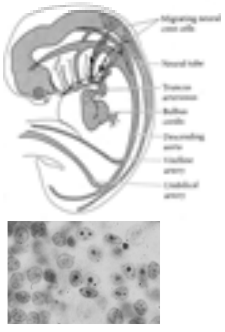
Neural crest cells are guided through permissive environments to reach their targets

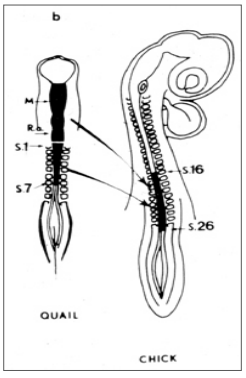
Ephrin proteins inhibit neural crest migration

THE REGION OF THE NEURAXIS FROM WHICH A CREST CELL MIGRATES DETERMINES THE TARGET REACHED BY ITS DERIVATIVES



circumpharyngeal neural crest





Genetic potential, developmental restriction and differentiation

•Some neural crest cells appear to be pluripotent. They can generate a remarkable number of differentiated cell types, but express only those phenotypes that are appropriate for the region they colonize.

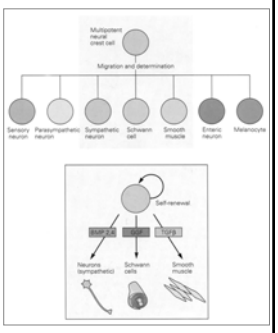
•*Example: Cranial neural crest*

•The genetic potential of other crest-derived cells is more restricted. There are a limited number of options in their genetic repertoire.

•*Example: truncal neural crest*

•Finally, some pre-migratory crest cells appear to be programmed for a specific developmental fate or if they are not committed to one before leaving the crest, there developmental options are severely restricted during their migration.

•*Example: cardiac neural crest*



ectoderm:
neurulation, neural tube, neural crest
The end

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