Introduction to Neuroanatomy

- Structure-function relationships
  - Localization of function in the CNS
- Non-invasive brain imaging
  - CAT: structure, low resolution
  - MRI: structure, high resolution
  - PET: function, low resolution
  - fMRI: function, high resolution

Dual approach to learning neuroanatomy:

- Functional anatomy
  - Neural structures that serve particular functions; e.g., pain path from skin to cortex for perception
- Regional anatomy
  - Localization of structures in particular brain regions

Lecture objectives:

- Overview of brain structures to "demystify" anatomical content in Neural Science lectures
- Survey brain structure-function relations to provide background for first labs

First half of lecture:

- Quick review of basic CNS organization
- Use development to understand principles of structural organization of CNS

Second half: Functional localization

Introduction to Neuroanatomy I: Regional Anatomy

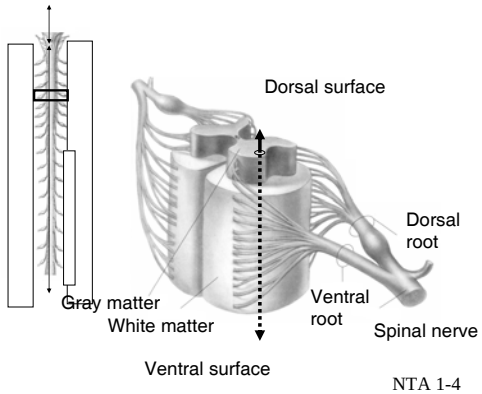
CNS Organizational Principles

- 1) Tubular organization of central nervous system
- 2) Columnar/longitudinal organization of spinal and cranial nerve nuclei
- 3) Complex C-shaped organization of cerebral cortex and deep structures

Brief Overview of Mature CNS Neuroanatomy

- Tubular organization of central nervous system
- Columnar/longitudinal organization of spinal and cranial nerve nuclei

Nuclei: locations of neuron cell bodies w/in the **central nervous system**	**Ganglia**: locations of neuron cell bodies in the **periphery**
Tracts: locations of axons w/in the **central nervous system**	**Nerves**: locations of axons in the **periphery**



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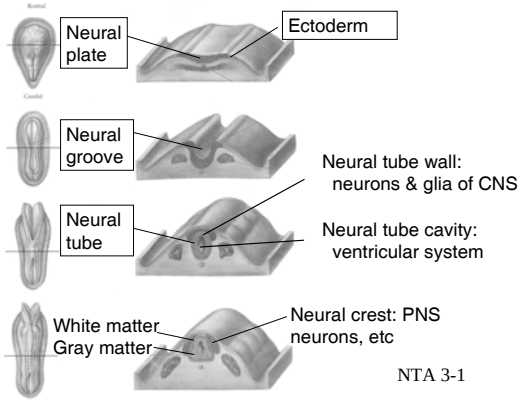
Brief Overview of Mature CNS Neuroanatomy

- 1) Tubular organization of central nervous system
- 2) Columnar/longitudinal organization of spinal and cranial nerve nuclei
- 3) Complex C-shaped organization of cerebral cortex and nuclei and structures located beneath cortex
  - Lateral ventricle
  - Basal ganglia
  - Hippocampal formation & Fornix

Neural Induction

•Portion of the **dorsal ectoderm** becomes committed to become the **nervous system**:
Neural plate



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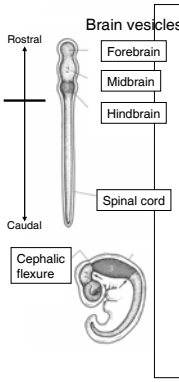

Neural Tube Development

Rostral neural tube forms the brain

Caudal neural tube forms the spinal cord

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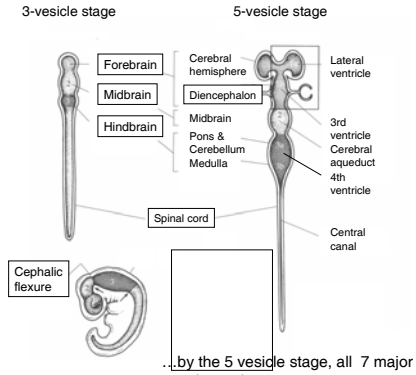

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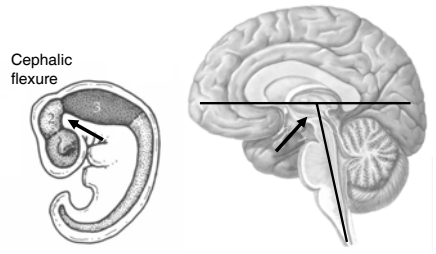
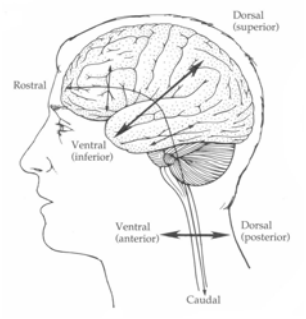
…by the 5 vesicle stage, all 7 major brain divisions are present

The cephalic flexure persists into maturity

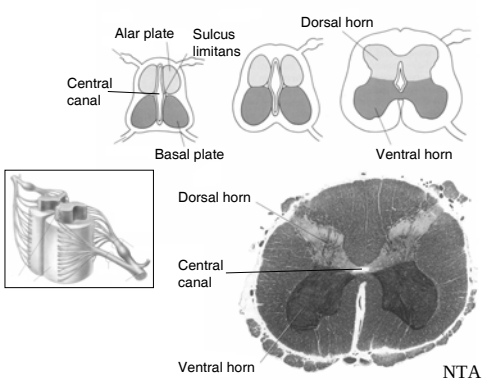




NTA 1-13

Spinal cord & brain stem have a similar developmental plan

- Segmentation
- Nuclear organization: columnar



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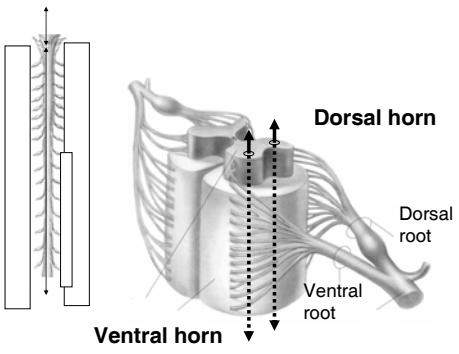
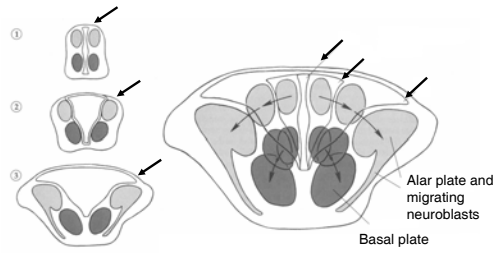


Similarities between SC and brain stem development

- Sulcus limitans separates sensory and motor nuclei
- Nuclei have columnar shape

Key differences

- 1) central canal enlargement motor medial and sensory lateral
- 2) migration away from ventricle
- 3) >> sensory and motor



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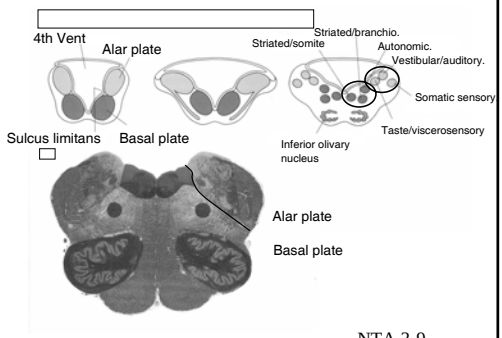
Medulla development



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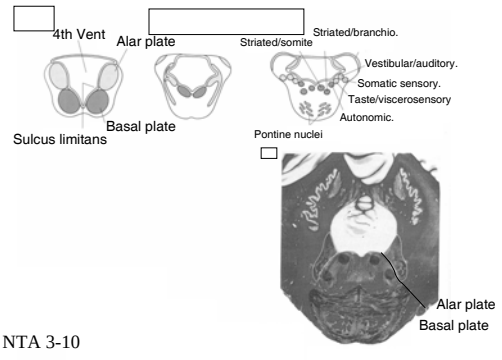
Pons development



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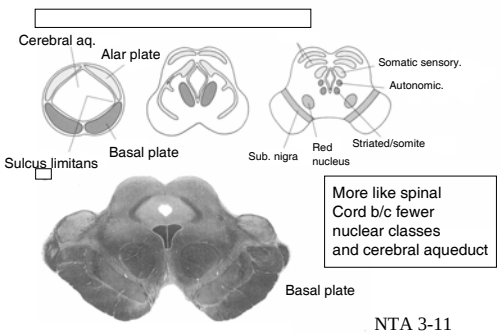
Midbrain development



NTA 3-11

Similarities between forebrain and hindbrain/spinal development

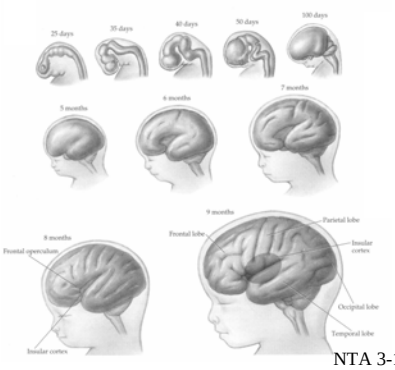
•Tubular

Key differences

- 1) CH more complex than BS/SC
- 2) Cortical gyri more complex anatomy than nuclei
- 3) Subcortical nuclei are C-shaped
  - Confusing: structure in two places on image

Diencephalon

- Thalamus
  - Gateway to cortex
- Hypothalamus
  - Control of endocrine and bodily functions
  - Circadian rhythms
  - Etc.



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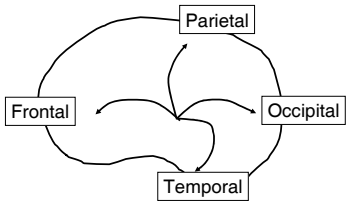
Cerebral Cortex Development



Forebrain Development & C-shaped Structures

- Cerebral cortex (NTA 3-15)
- Lateral ventricles (NTA 3-16)
- Striatum (NTA 3-16)
- Hippocampal formation and fornix (NTA 3-17)

Summary

- 7 Major components of the central nervous system & Ventricles
- All present from ~ 1st prenatal month
- Longitudinal organization of SC and BS nuclei
  - Columns
  - Anatomical and functional divisions
- C-shape organization of cerebral hemisphere structures and diencephalic
  - Cerebral cortex
  - Lateral ventricle
  - Striatum
  - Hippocampal formation and fornix