veterinary
EMBRYOLOGY

neurulation

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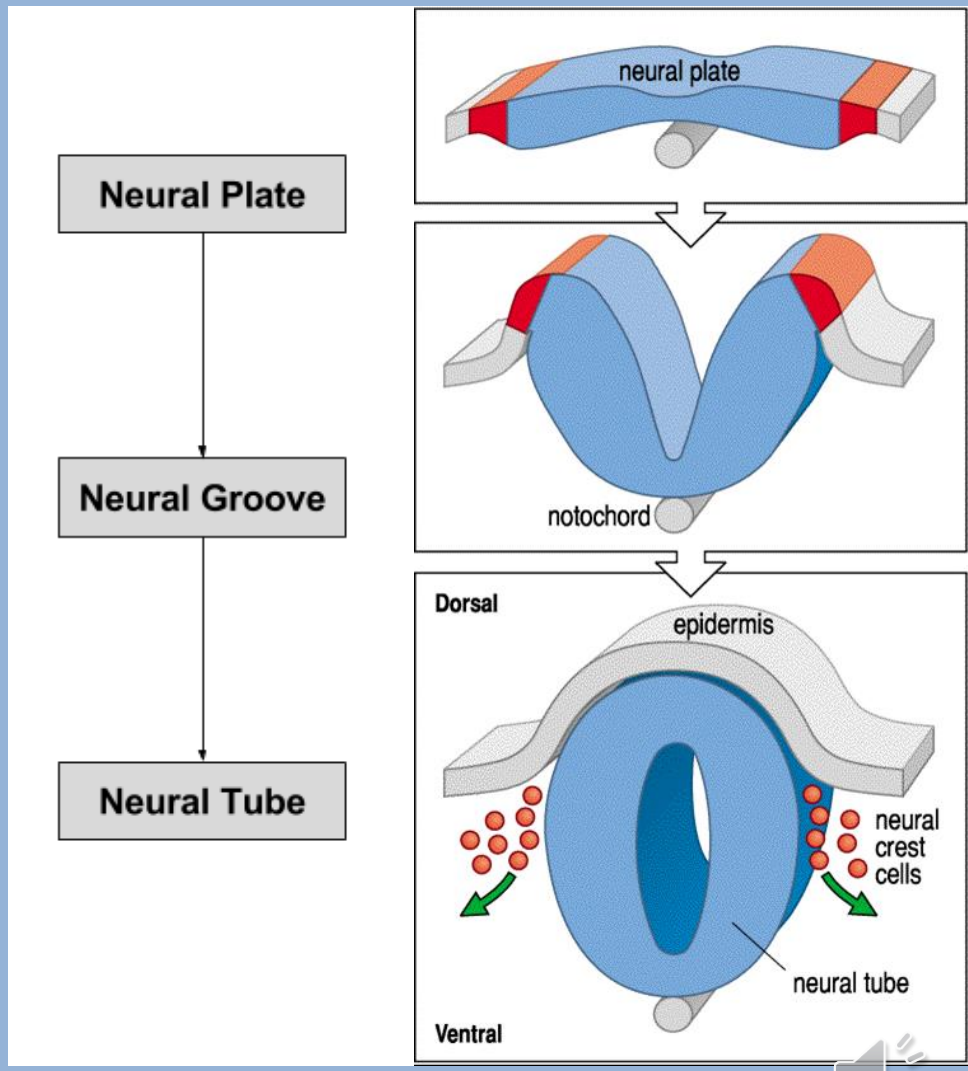
neurulation

- The formation of the **neural tube**, that presage the establishment of the central nervous system



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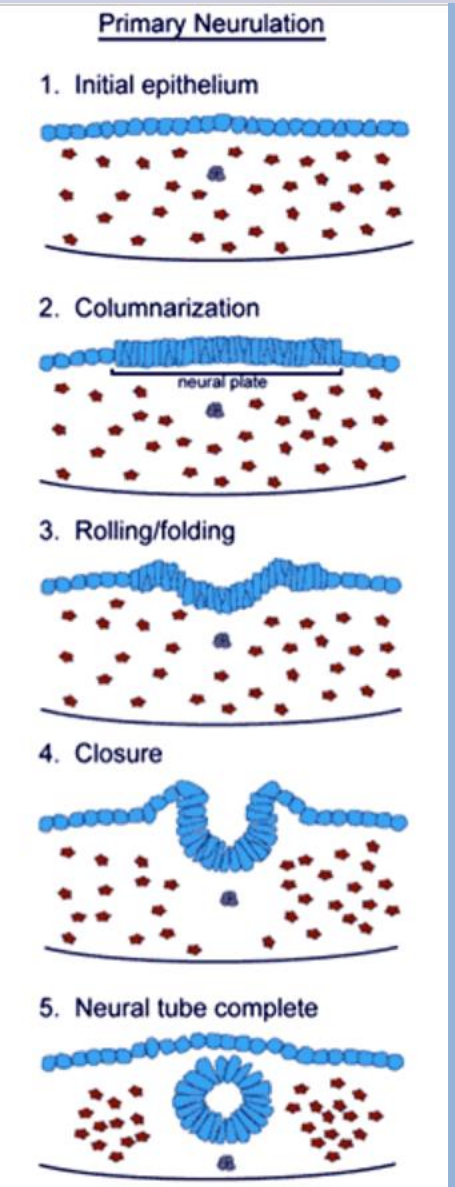

- **Two major ways of forming a neural tube:**
  - **Primary neurulation**
    - Formation of the neural tube by infolding **anteriorly.**

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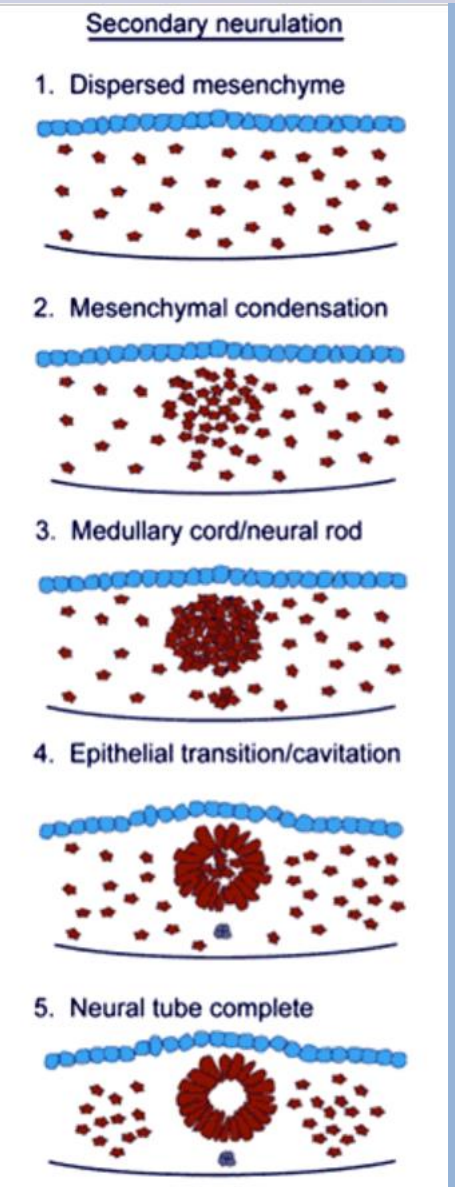

- **Secondary neurulation**
  - Formation of the neural tube in the **posterior portion** without folding

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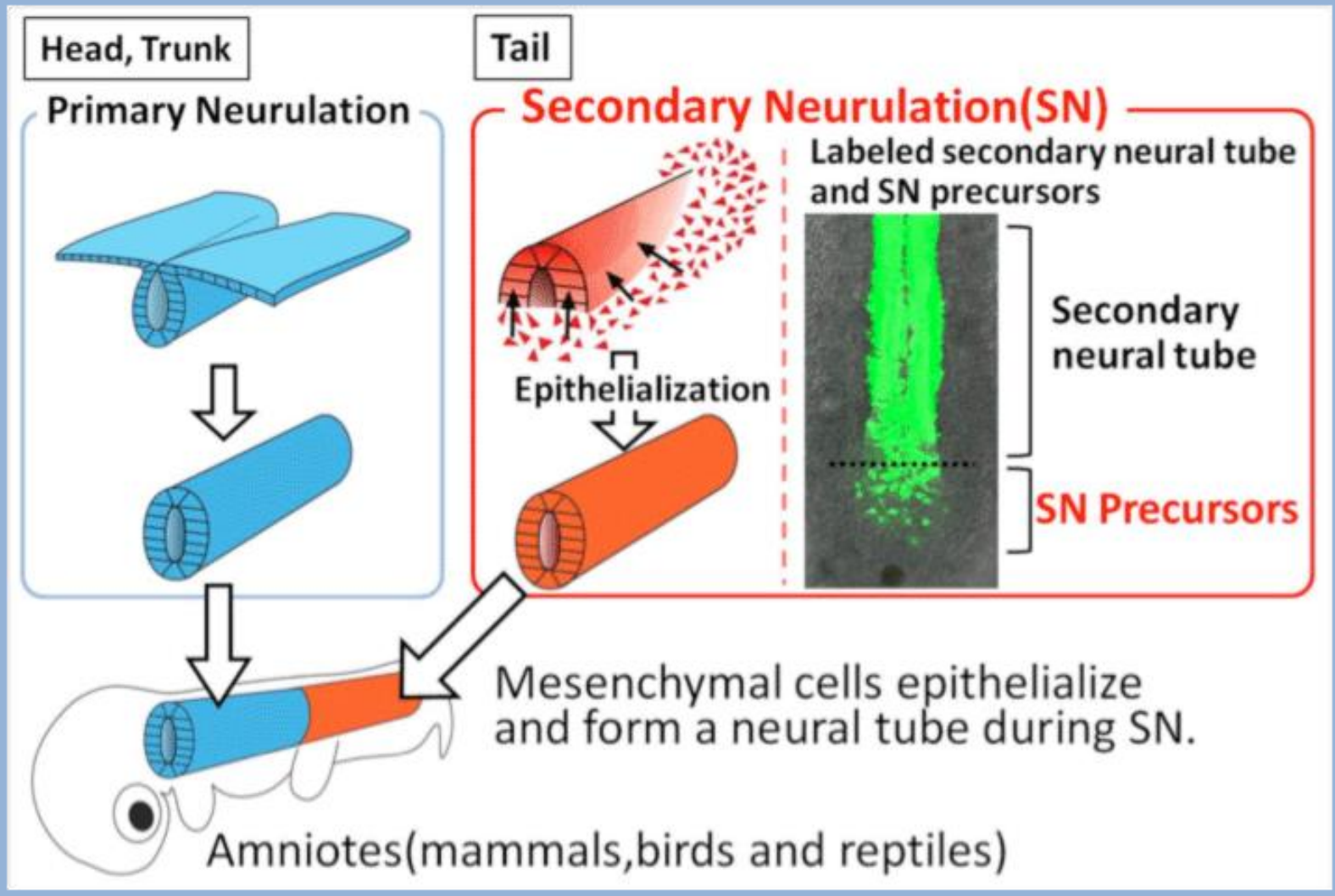

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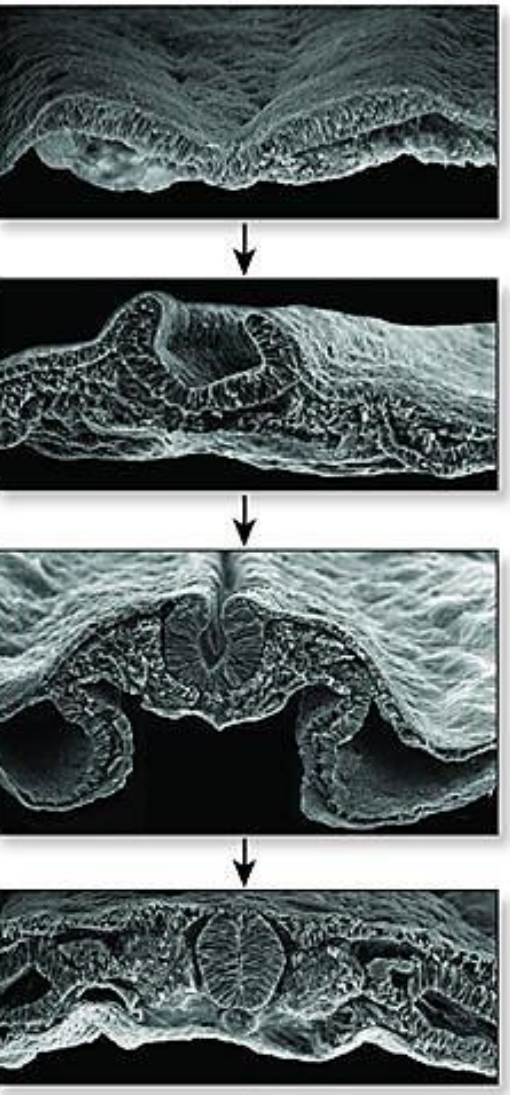

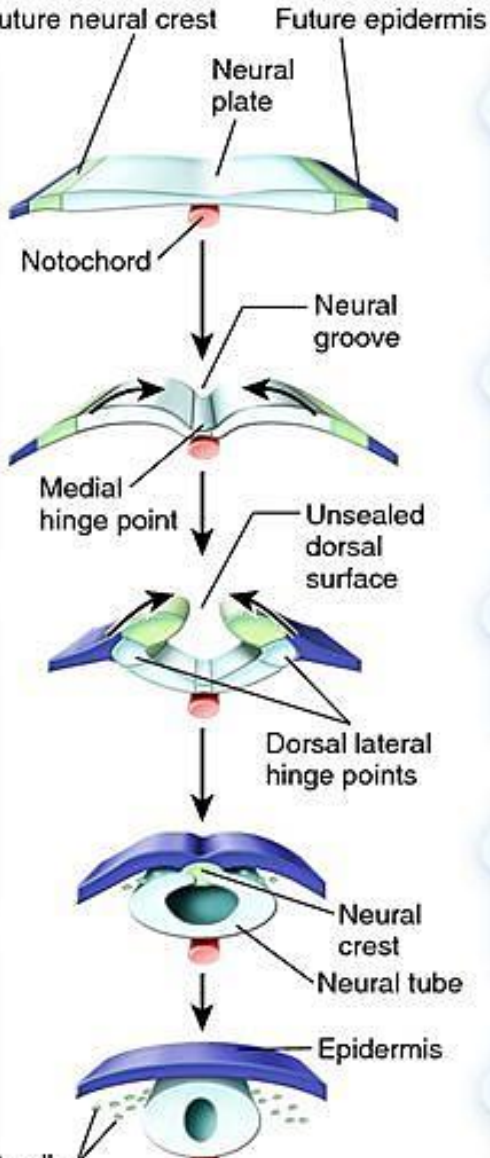

1 **Thickening and elongation:**
Ectoderm over the notochord thickens to form the neural plate, which elongates. Adjacent regions will form a neural crest and epidermis.

2 **Folding:**
Cells along the medial hinge point undergo apical constriction, causing the formation of a neural groove.

3 **Convergence:**
Two dorsal lateral hinge points undergo apical constriction to produce a tubelike structure.

4 **Fusion:**
The dorsal-most cells on each side of the neural tube begin to fuse. Epidermis also fuses dorsal to the neural tube.

5 Neural crest cells migrate away as fusion is completed.

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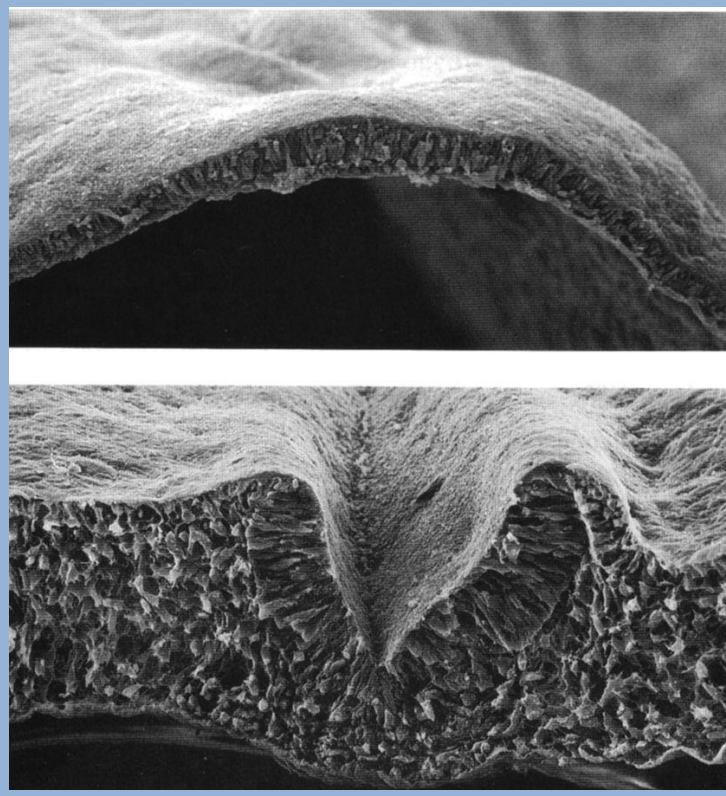
- **Neural plate**
  - First indication of neurulation.
  - The thickening of the surface ectoderm along the dorsal midline.
  - Bounded on either side by a slight elevation termed **neural folds.**



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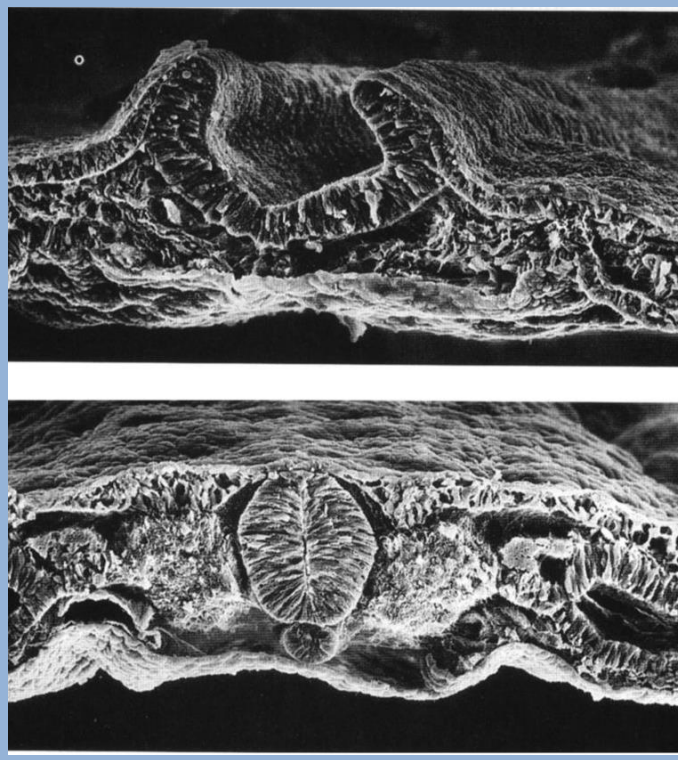
- **Neural groove**
  - The depressed midline region of the plate.
  - Becomes more elevated, subsequently converge , meet and fuse towards the dorsal midline to form the **neural tube.**



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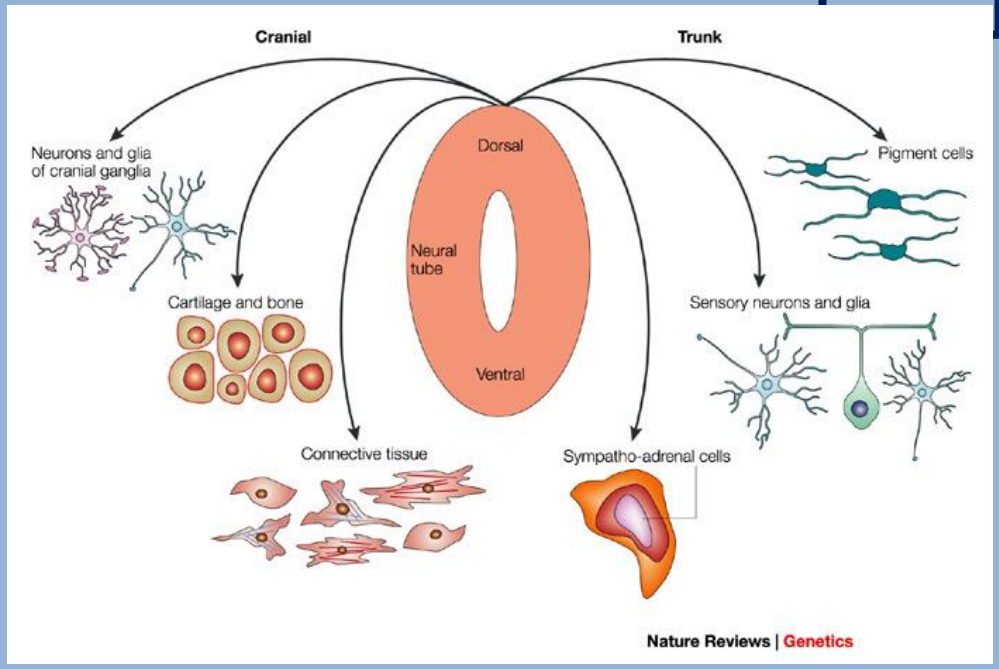
- **Neural crest**
  - Undergo an epithelio-mesenchymal transition as they leave the neuroectoderm by active migration into the underlying mesoderm.



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- **Neural crest**
  - Neural crest cell delaminate and migrate in the anterior parts of the neural tube.
  - In the midbrain and hindbrain, neural crest cells begin to detach from the apices of the neural folds and start to migrate well in advance of neural tube closure.

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- **Neural crest**
  - In the spinal cord region, migration of neural crest cells does not begin until several hours after spinal neural tube closure is complete.

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- **Neural crest**
  - In **birds**, the neural crest cells do not migrate from the dorsal region until after the neural tube has been closed at that site.

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- **Rostral and Caudal Neuropores**
  - In **chicks,** neural tube closure is initiated at the level of the future midbrain and "zips up" in both directions.
  - Neural tube closure in **mammals** is initiated at several places along the anterior-posterior axis.

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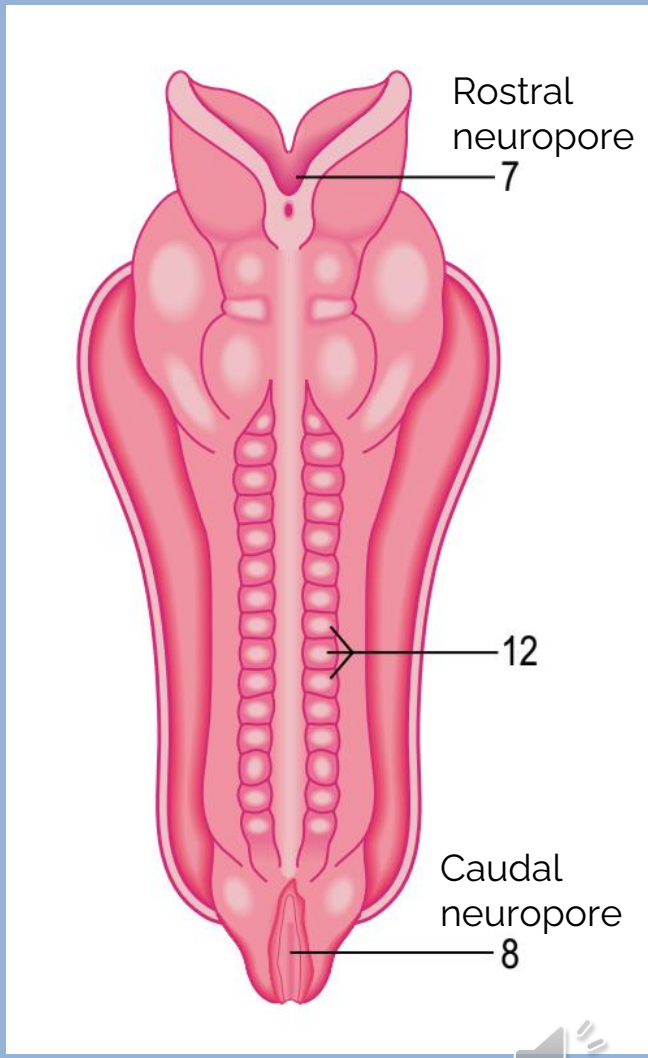
- **Rostral and Caudal Neuropores**
  - The cranial and caudal ends of the neural tube remain patent for a time.
  - For a short time prior to their closure, the neural canal communicates directly with the amniotic cavity.



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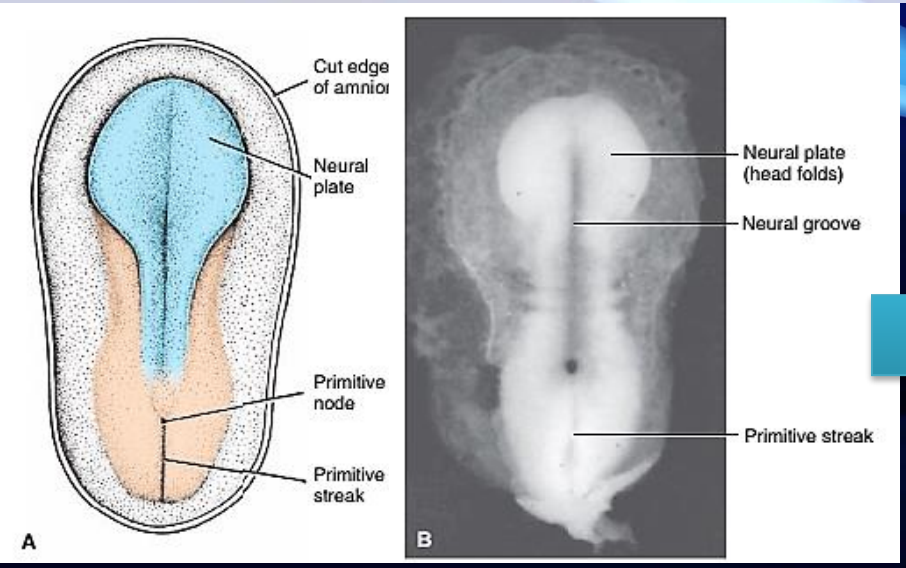

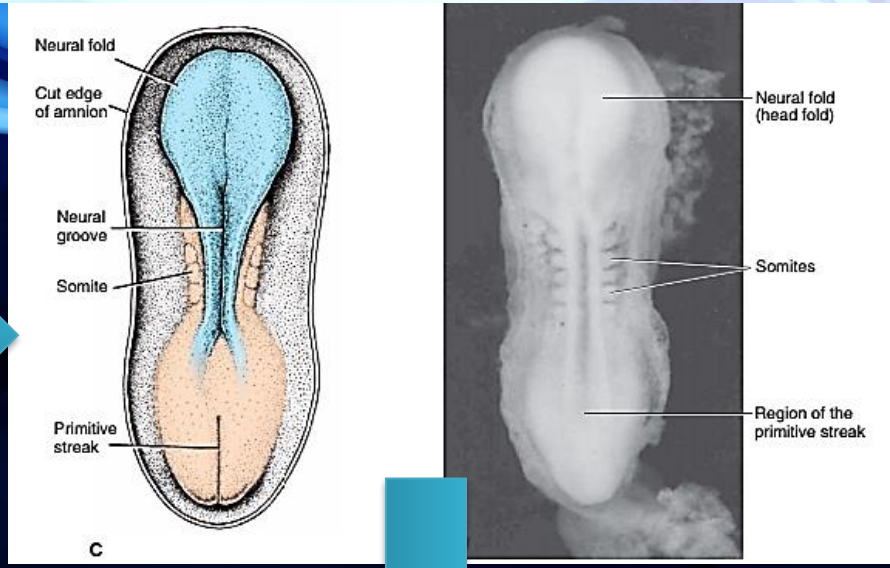

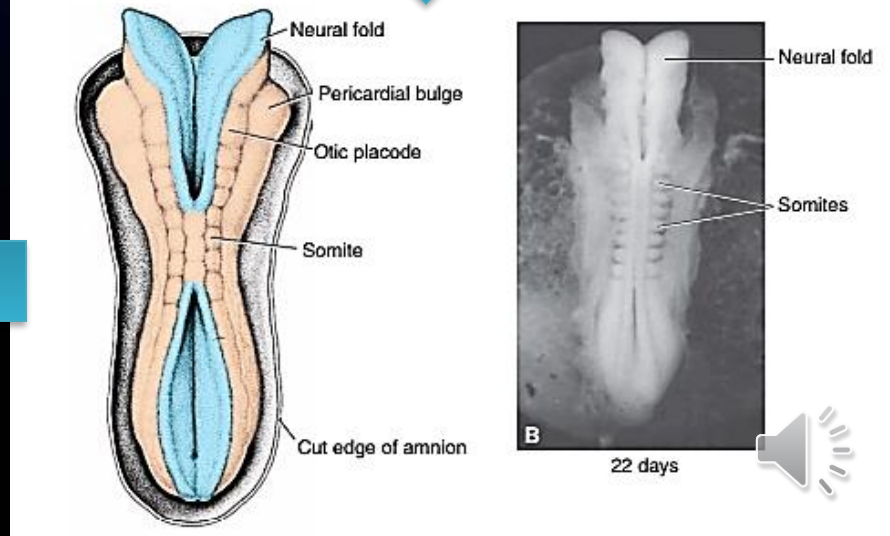

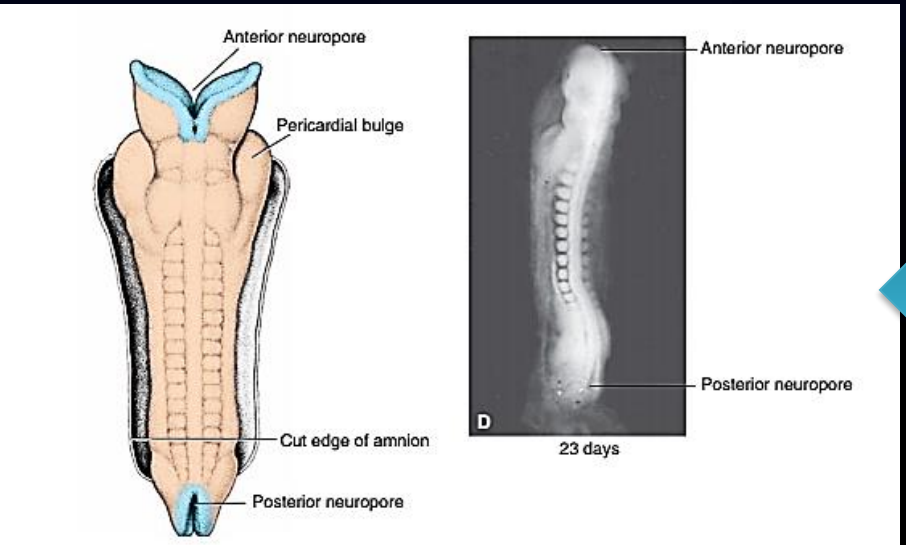

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Major derivatives of the cranial and circumpharyngeal neural crest

Sensory nervous system	Ganglia of trigeminal nerve (V), facial nerve (VII), glossopharyngeal nerve (superior ganglion), vagus nerve (jugular ganglion)
Autonomic nervous system	Parasympathetic ganglia: ciliary, ethmoidal, sphenopalatine, submandibular, visceral Satellite cells of sensory ganglia, Schwann cells of peripheral nerves, leptomeninges of prosencephalon and part of mesencephalon
Endocrine cells	Carotid body, parafollicular cells of thyroid
Pigment cells	Melanocytes
Mesectodermal cells	Cranial vault (squamosum and part of os frontale), nasal and orbital bones, part of the otic capsule, palate, maxilla, visceral cartilage, part of external ear cartilage
Connective tissue	Dermis and adipocytes of the skin, cornea of the eye, odontoblasts, stroma of glands (thyroid, parathyroid, thymus, salivary, lachrymal), outflow tract of heart, cardiac semilunar valves, walls of aorta and aortic-arch derived arteries
Muscle	Ciliary muscle; dermal smooth muscles, vascular smooth muscle

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Table 8-2: M rivatives of the trunk neural crest

Sensory nervous system	Spinal ganglia
Autonomic nervous system	Ganglia of the sympathetic chain, coeliac and mesenteric ganglia, visceral and pelvic plexuses, Schwann cells of peripheral nerves Satellite cells of sensory ganglia, enteric glial cells
Endocrine cells	Adrenal medulla, neurosecretory cells of heart and lung
Pigment cells	Melanocytes
Mesectodermal cells	None
Connective tissue	None
Muscle	None

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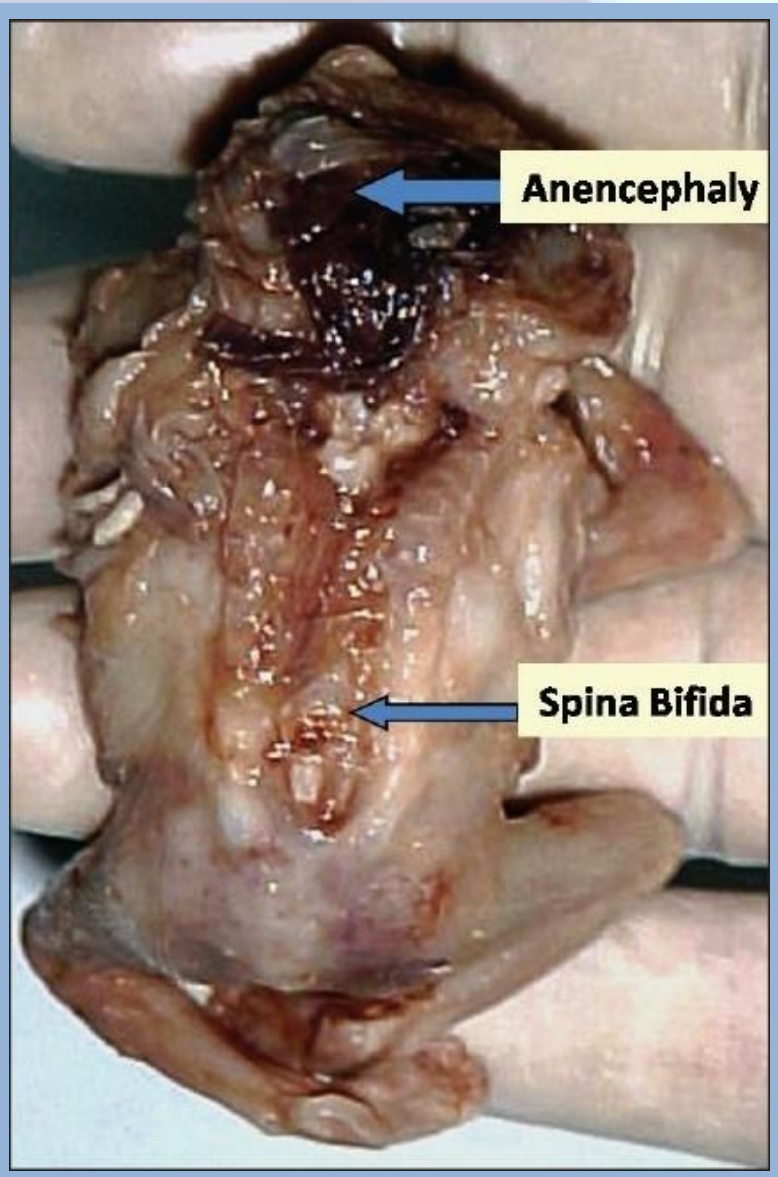
NEURAL TUBE DEFECTS



- **Cranioschisis**
  - A closure defect of the brain
- **Rachioschisis**
  - A closure defect of the spinal cord

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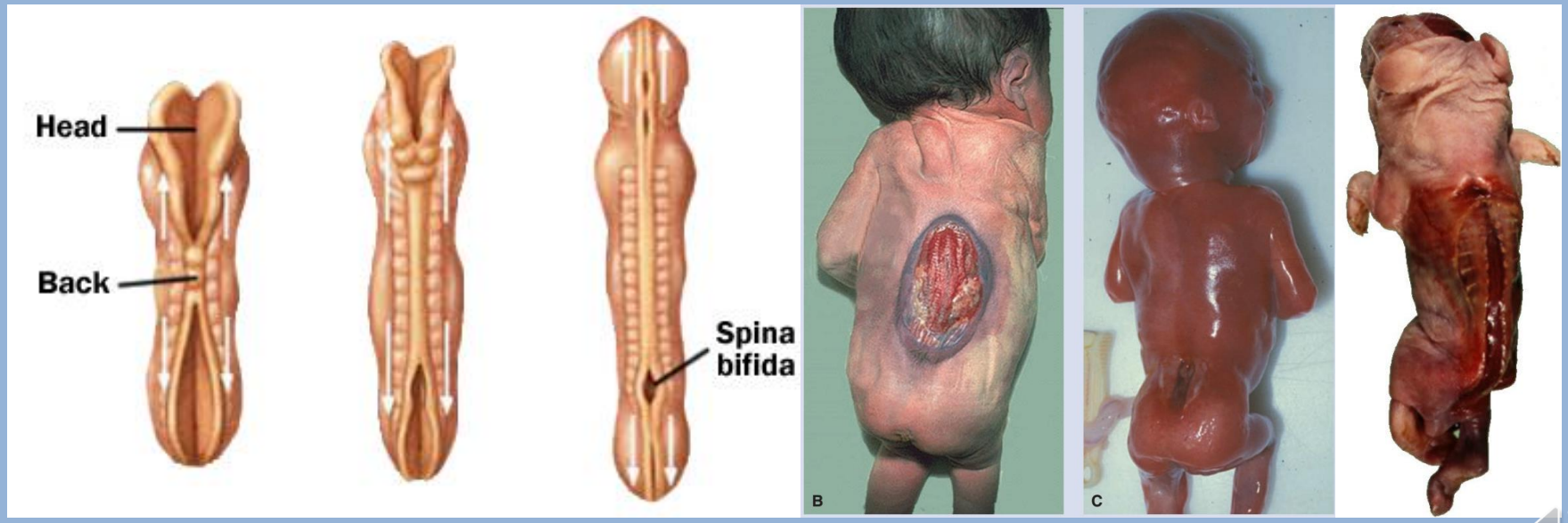
NEURAL TUBE DEFECTS

- **Spina bifida**
  - All abnormalities in which the vertebral arches fail to close dorsal to the spinal cord to form the vertebral canal.



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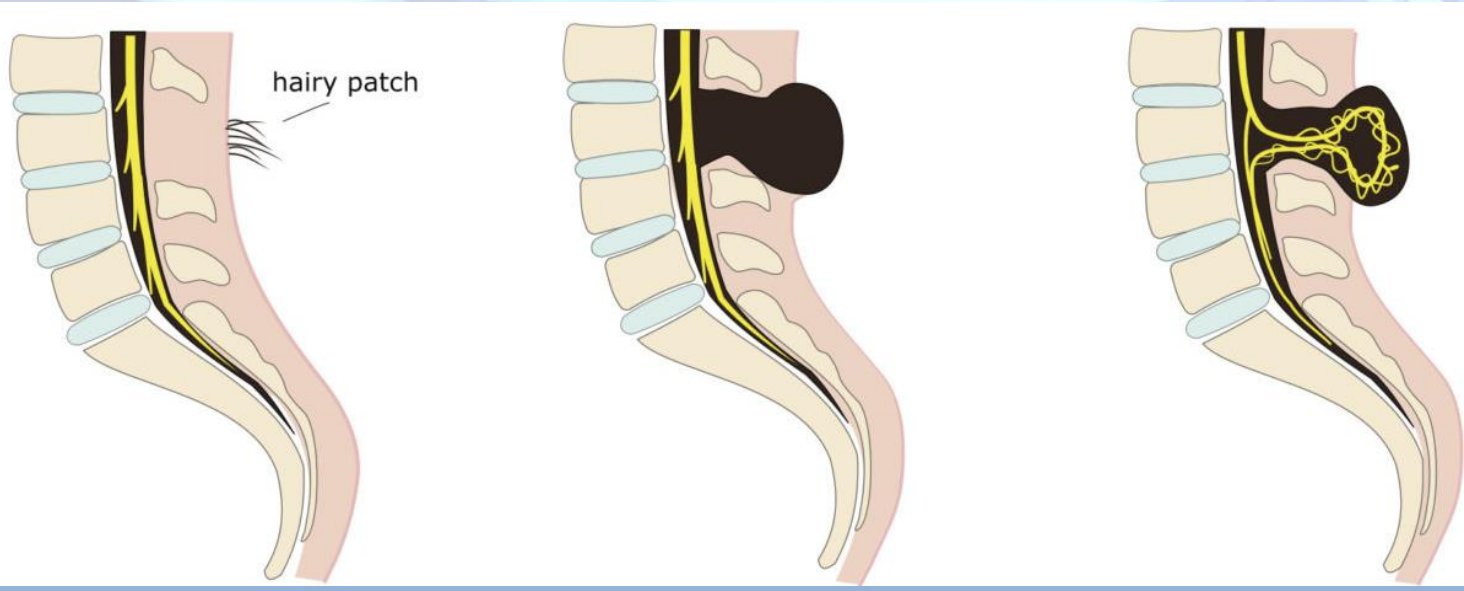
NEURAL TUBE DEFECTS



- **Spina bifida occulta**
  - The spinal cord and meninges remain in place but the vertebral arch of one or more vertebrae is incomplete.
- **Spina bifida cystica**
  - The meninges is distended by fluid.

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NEURAL TUBE DEFECTS

- **Dysraphia**
  - The cranial neuropore fails to fuse properly or even remains open.
    - **Meningocoele**
      - Meninges herniate and become distended by fluid accumulation.
    - **Meningoencephalocoele**
      - The protrusion involves both meningeal and brain tissue.
    - **Meningohydroencephalocoele**
      - The brain tissue containing part of the ventricular system

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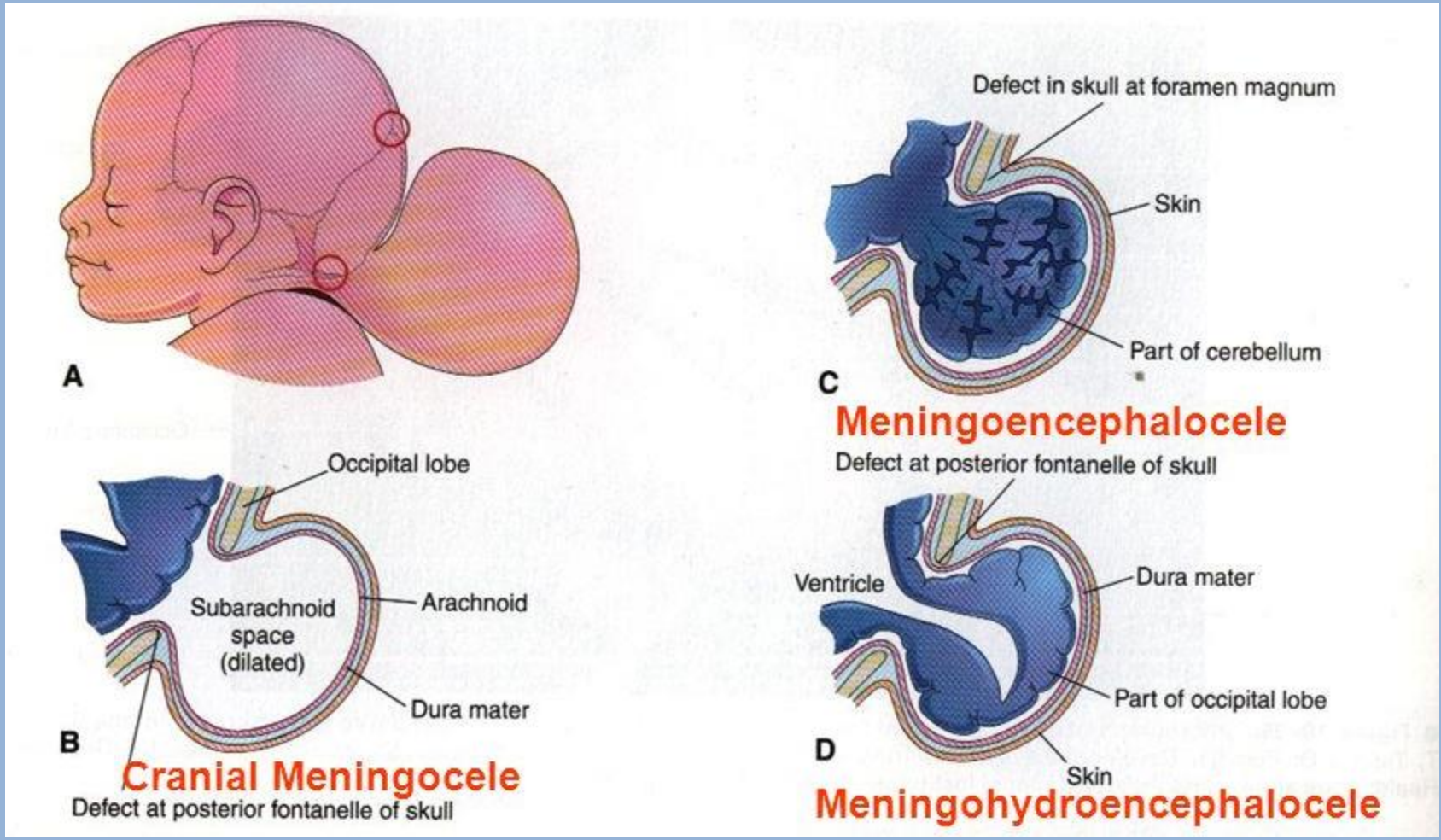
NEURAL TUBE DEFECTS



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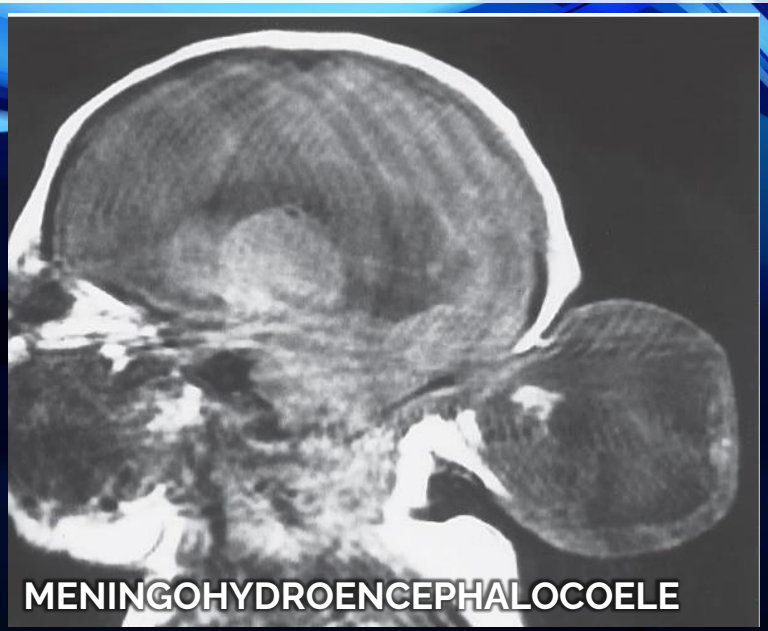


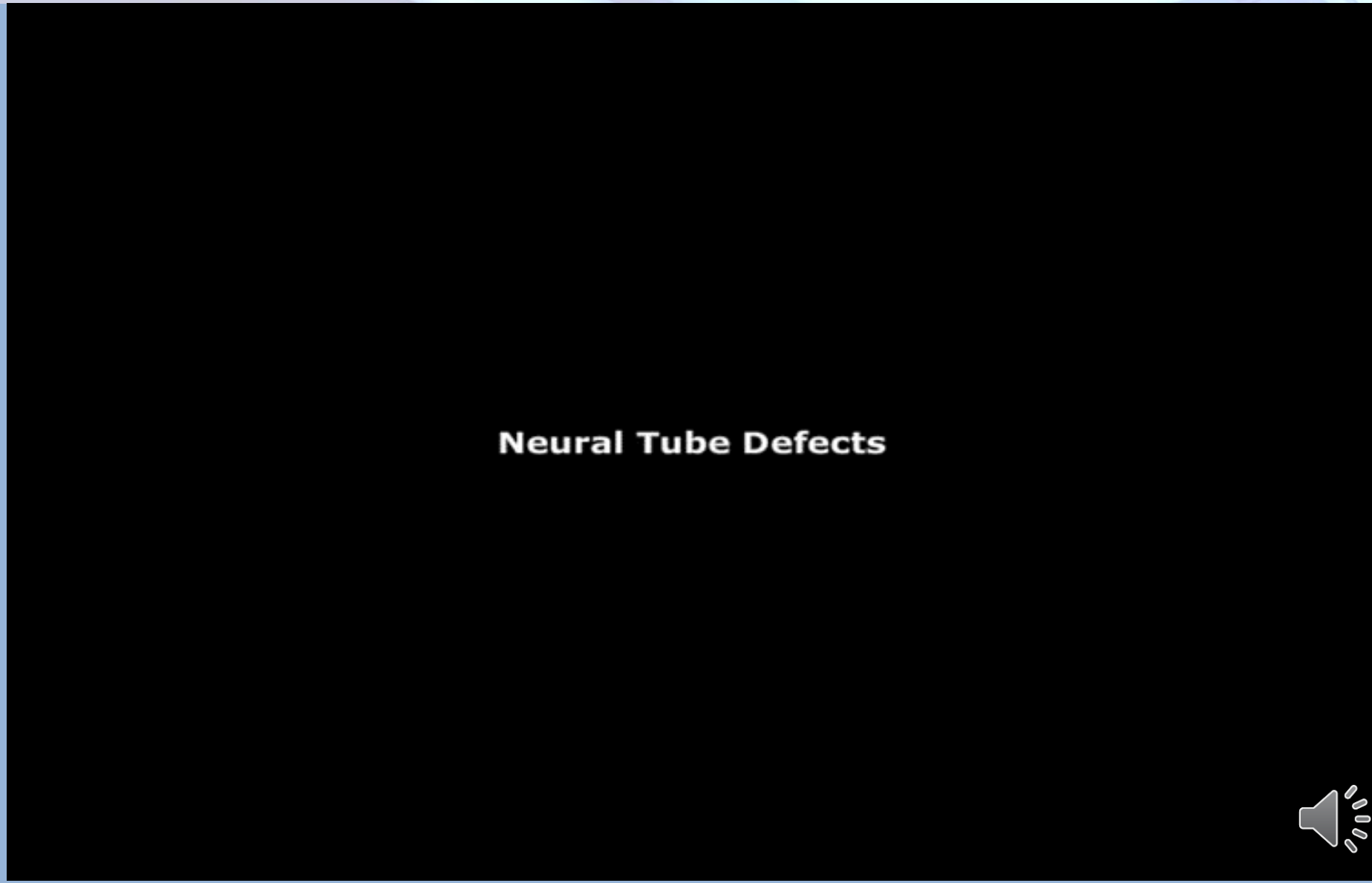
NEURAL TUBE DEFECTS

- **Exencephaly**
  - A complete failure of the cephalic part of the neural tube to close.
  - In this condition, the vault of the skull does not form, leaving the malformed brain exposed.

NEURAL TUBE DEFECTS

- **Anencephaly**
  - Absence of the telencephalon and much of the diencephalon, although the brainstem remains intact.

NEURAL TUBE DEFECTS



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