# Embryology

Lecture 2

# 3rd Week

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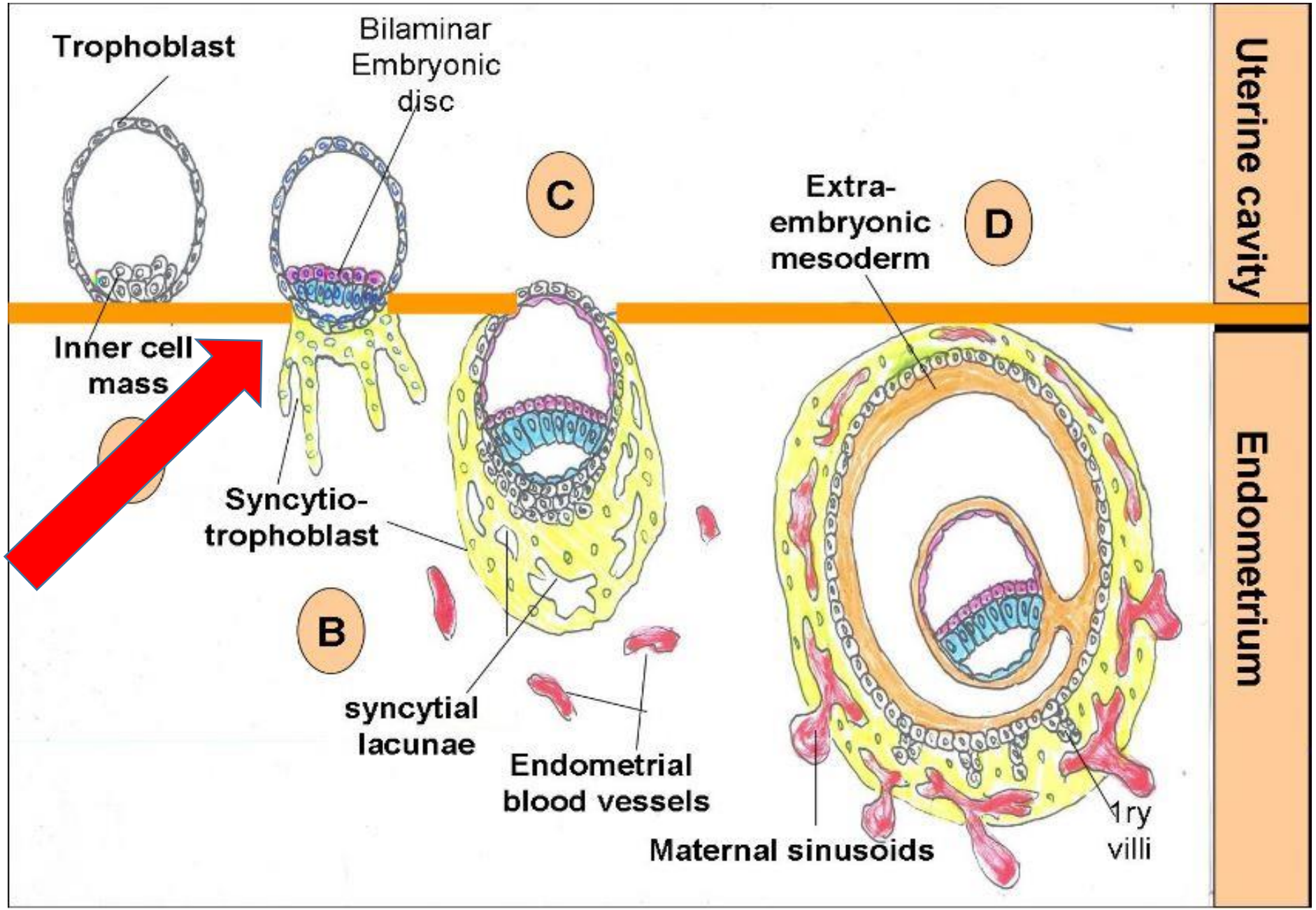
# Implantation

- ✓ The embryo is joined to the trophoblastic shell by a narrow connecting stalk that develops into the umbilical cord to attach the placenta to the embryo.

# 2nd Week


Trophoblast
Bilaminar Embryonic disc
C
Extra-embryonic mesoderm
D
Uterine cavity
Inner cell mass
Syncytio-trophoblast
B
syncytial lacunae
Endometrial blood vessels
Maternal sinusoids
1ry villi
Endometrium

# 3rd Week

- ✓ The most characteristic event occurring during the 3rd week is **gastrulation**
- ✓ Gastrulation begins with the appearance of the **primitive streak**
- ✓ **Primitive streak** has at its cephalic end the **primitive node**.

# 3rd Week

- ✓ **Gastrulation** involves: **migration**, **invagination** and **differentiation** of the epiblast
- ✓ Controlled by the **primitive streak**.

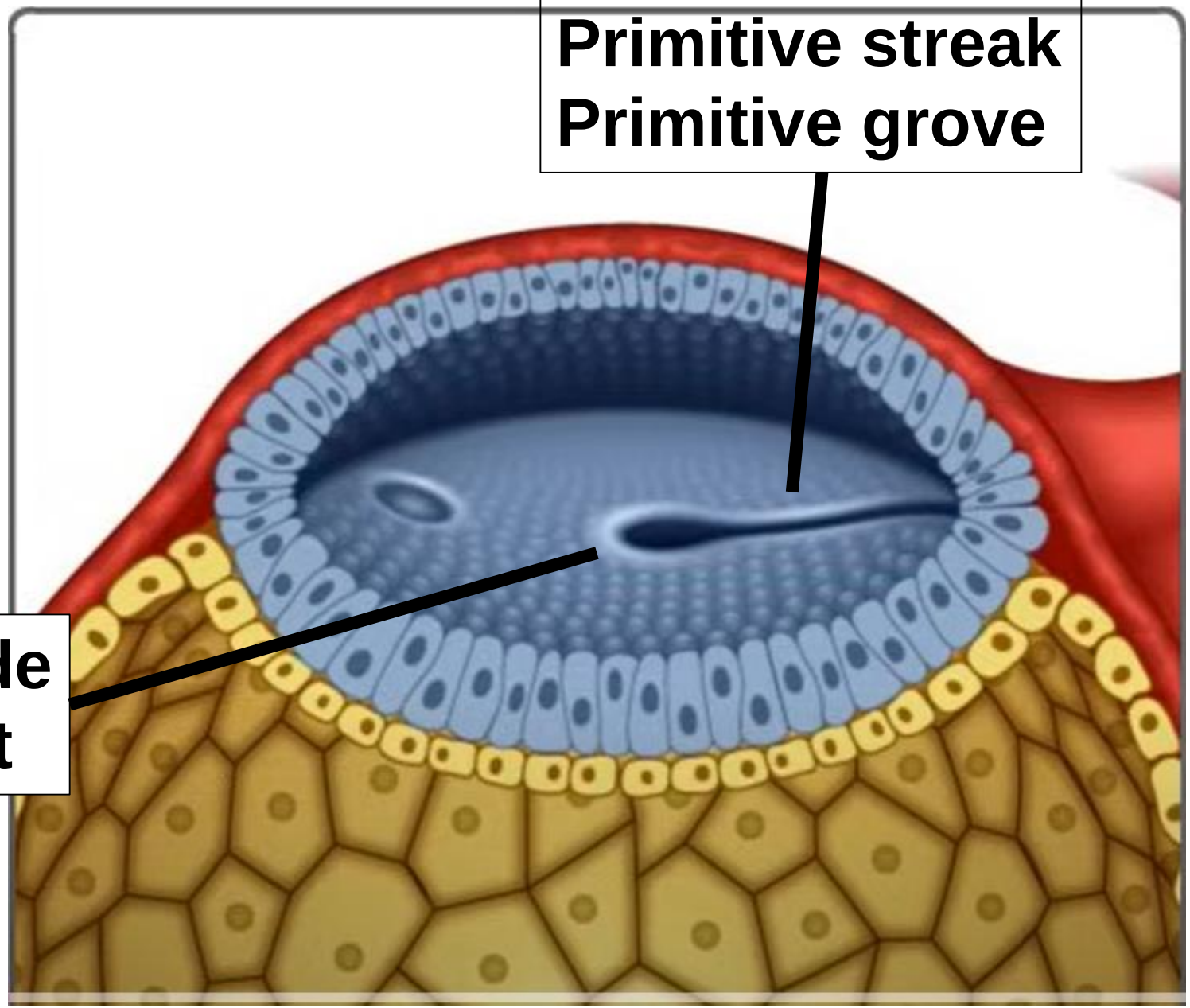
**The primitive streak:**

- ✓ A thickened linear band in the caudal end, primitive node at the cranial end
- ✓ Primitive pit and node
- ✓ Embryonic axes

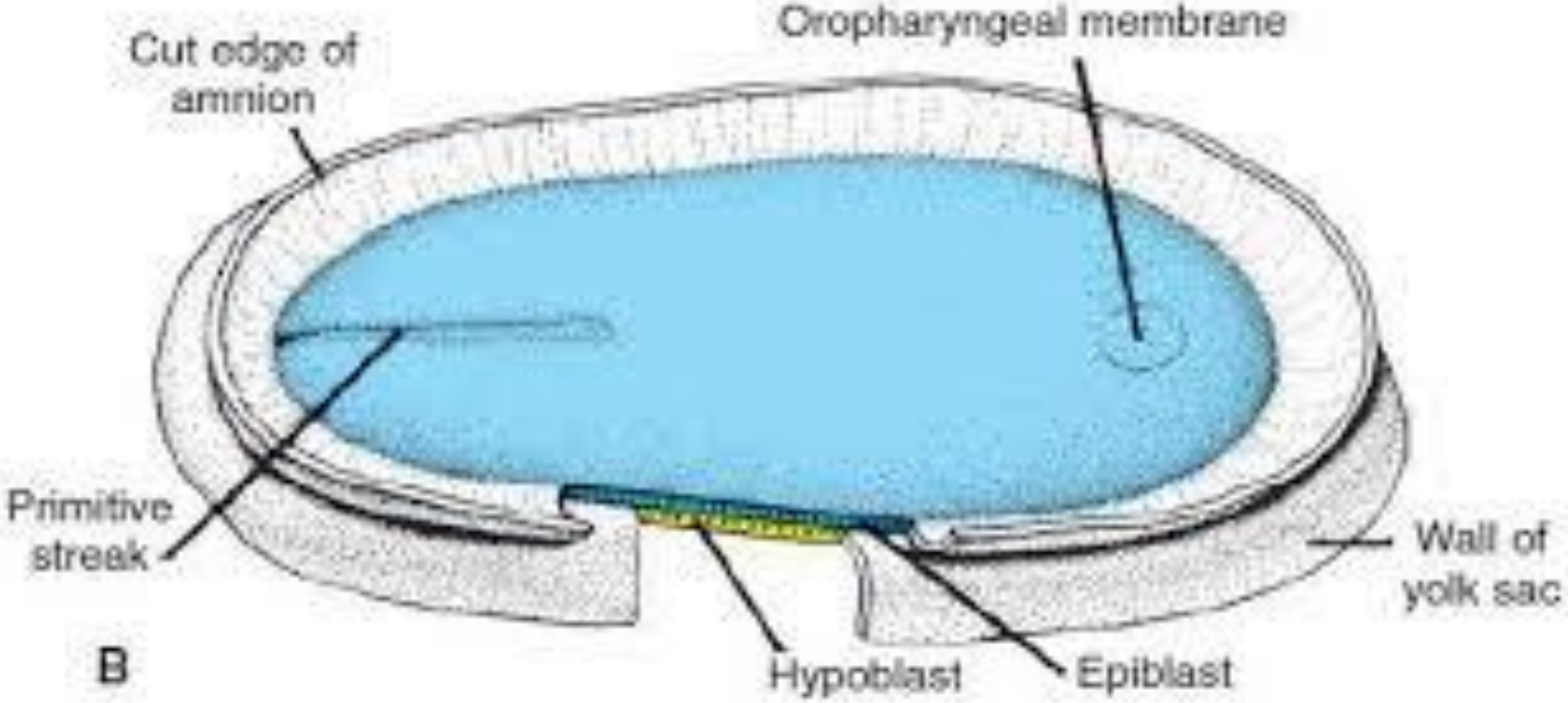
# 3rd Week

Cephalic end

Caudal end



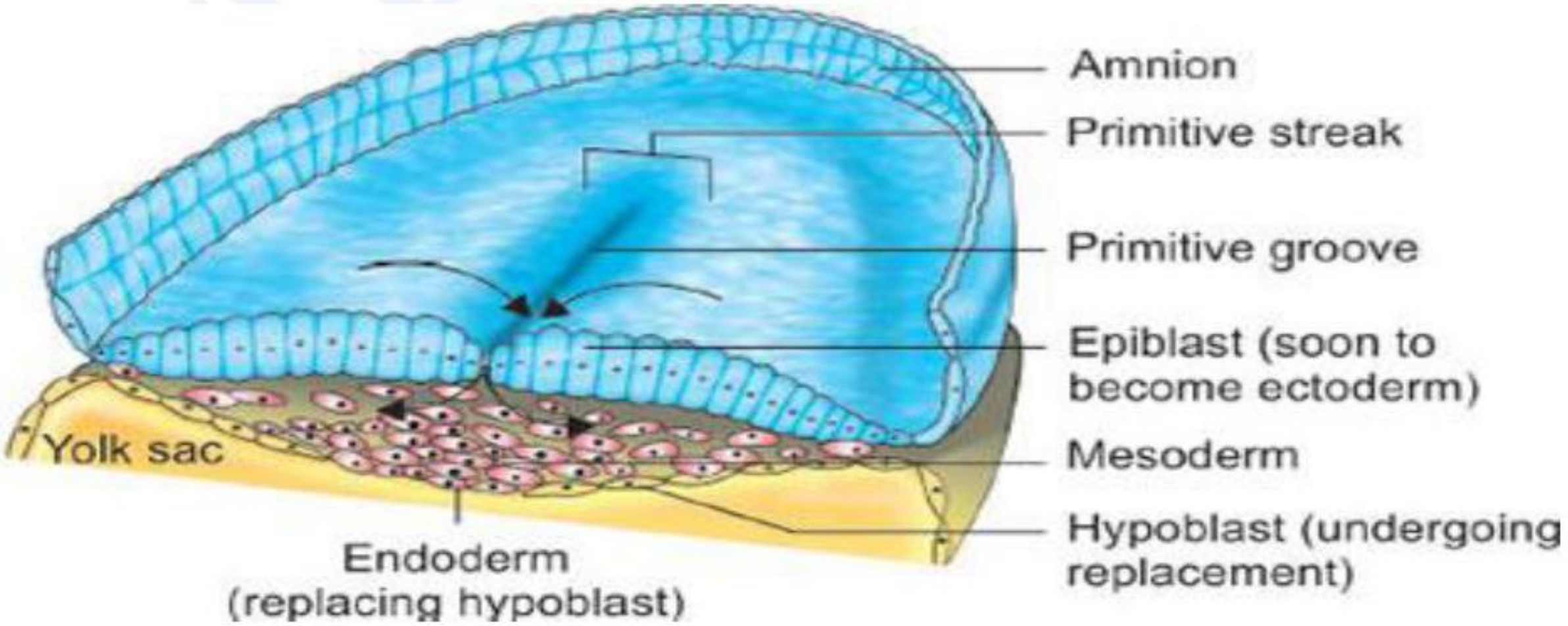
# 3rd Week


Cut edge of amnion
Oropharyngeal membrane
Primitive streak
Wall of yolk sac
B
Hypoblast
Epiblast

# 3rd Week

- ✓ In the region of the node and streak, **epiblast** cells move inward **(invaginate)** to form new cell layers, **endoderm** and **mesoderm**. Cells that do not migrate through the streak but remain in the epiblast form **ectoderm.**
- ✓ **E**piblast gives rise to all three **germ layers** in the embryo, **ectoderm, mesoderm**, and **endoderm**, and these layers form all of the tissues and organs.

# 3rd Week


Amnion
Primitive streak
Primitive groove
Epiblast (soon to become ectoderm)
Mesoderm
Hypoblast (undergoing replacement)
Yolk sac
Endoderm
(replacing hypoblast)

# 3rd Week

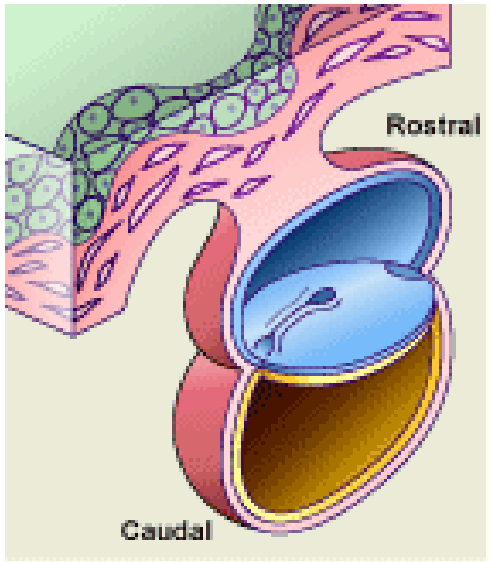
By the middle of week 3, intraembryonic mesoderm separates the ectoderm and endoderm everywhere except at:

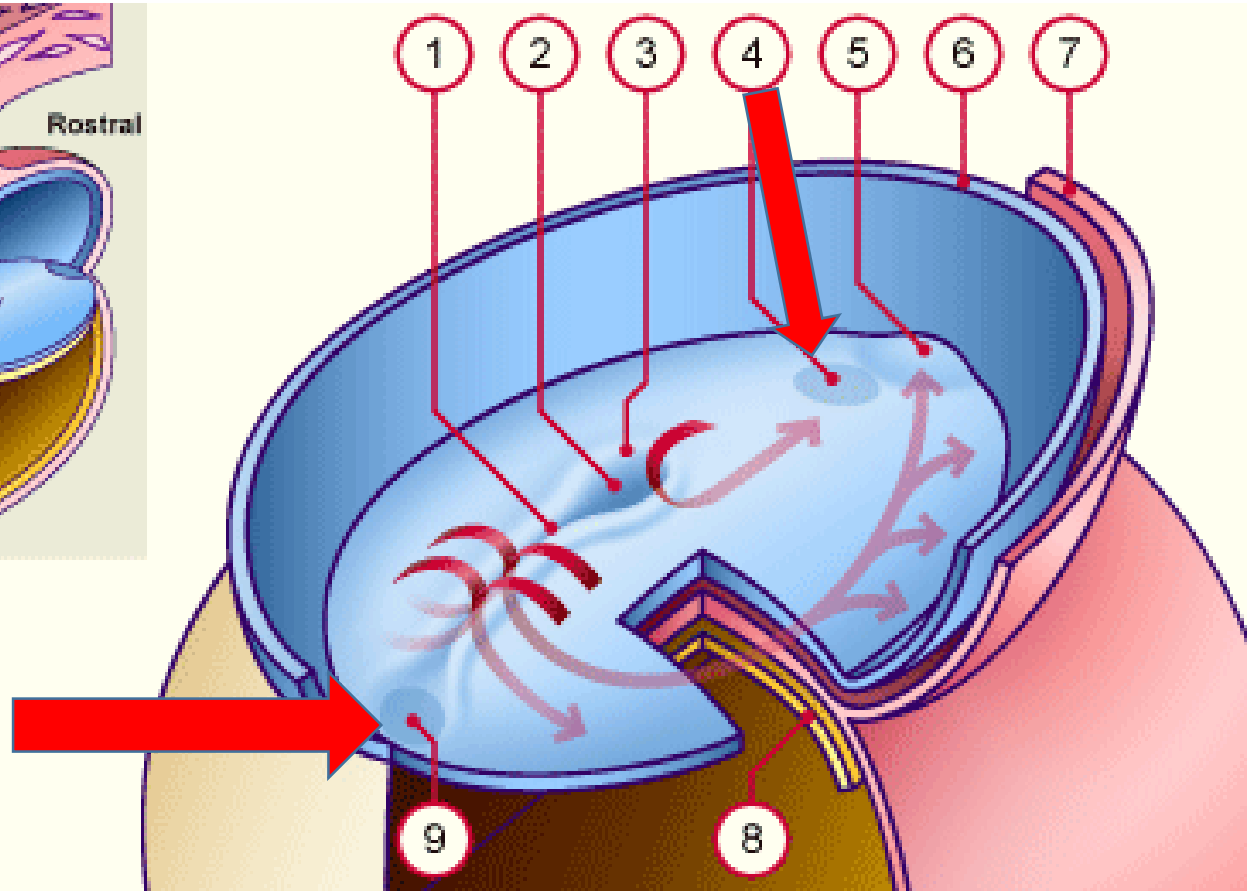
- ✓ **Oropharyngeal membrane cranially**
- ✓ **Cloacal membrane caudally**
- ✓ **In the midline, cranial to the primitive node where the notochordal process extends.**

Because embryonic ectoderm and endoderm fuse at these sites and prevent mesenchymal cells from migrating between them.

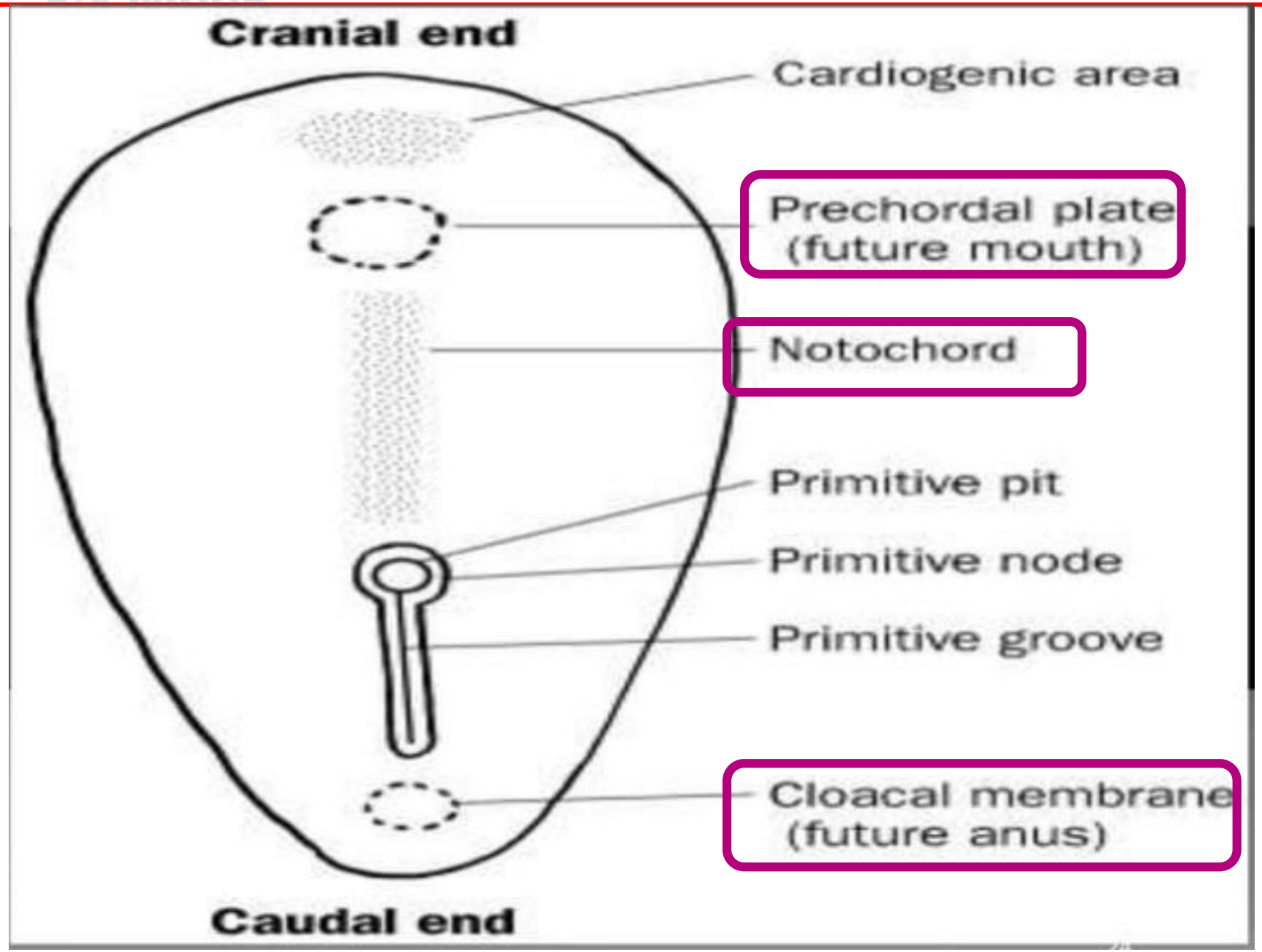
# 3rd Week

1.Primitive groove
2.Primitive pit
3.Primitive node
4.Oropharyngeal membrane
5.Cardiogenic plate
6.Sectional edge of amniotic membrane
7.Mesoderm
8.Endoderm
9.Future cloacal membrane



# 3rd Week




**No mesoderm**

# 3rd Week

- ✓ Invagination of surface cells in the primitive streak and their subsequent migration forward and laterally continues until the end of the **4th week**.

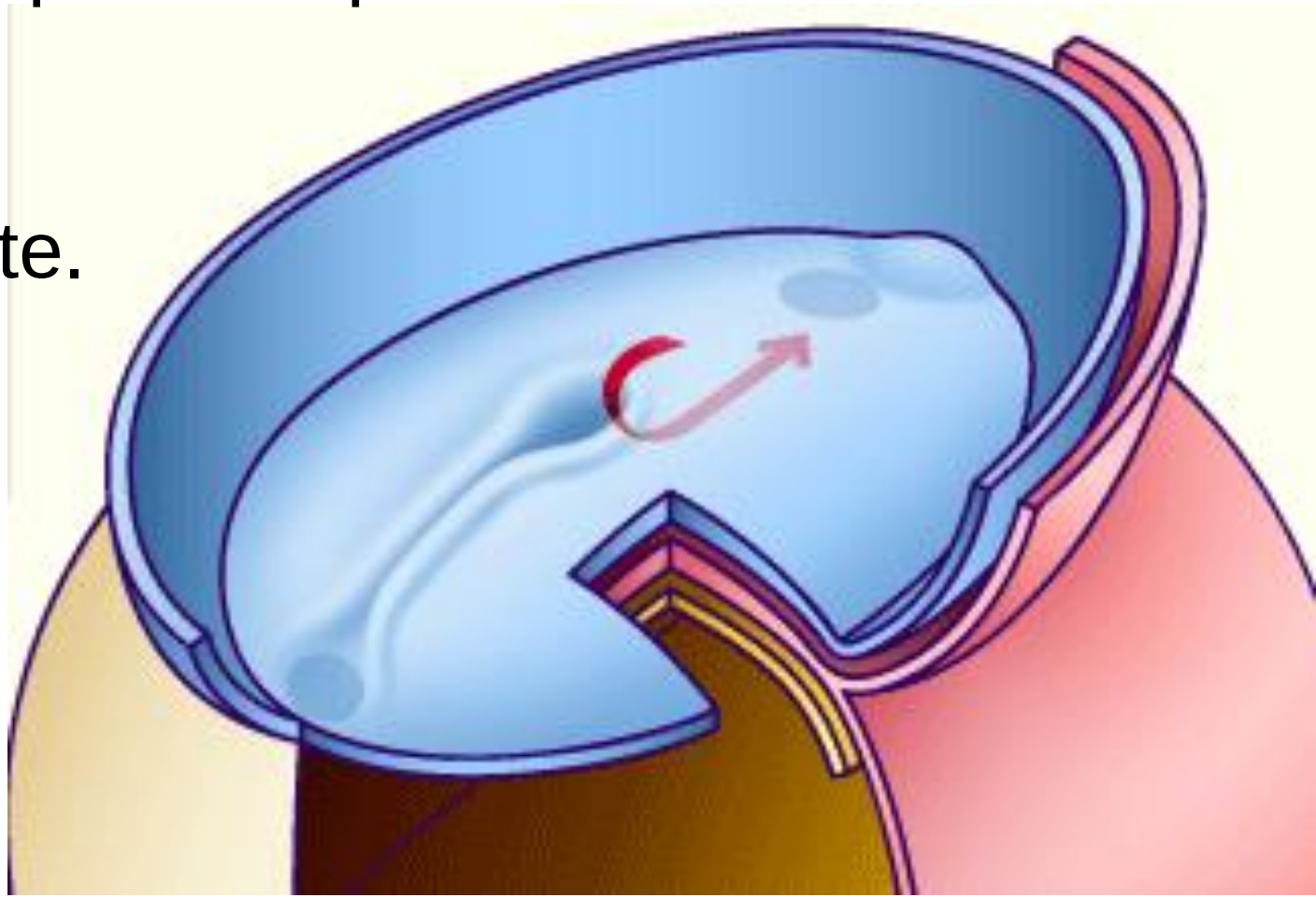
- ✓ At that stage, the primitive streak shows regressive changes, rapidly **shrinks, and soon disappears**.

# 3rd Week

- ✓ Prenotochordal cells invaginating in the primitive between ectoderm and endoderm and move forward (cranially) until they reach the prechordal plate.
- ✓ They intercalate in the endoderm as the **notochordal plate**. With further development, the plate detaches from the endoderm, and a solid cord, the **notochord**, is formed.
- ✓ It forms a midline axis, which will serve as the basis of the axial skeleton.

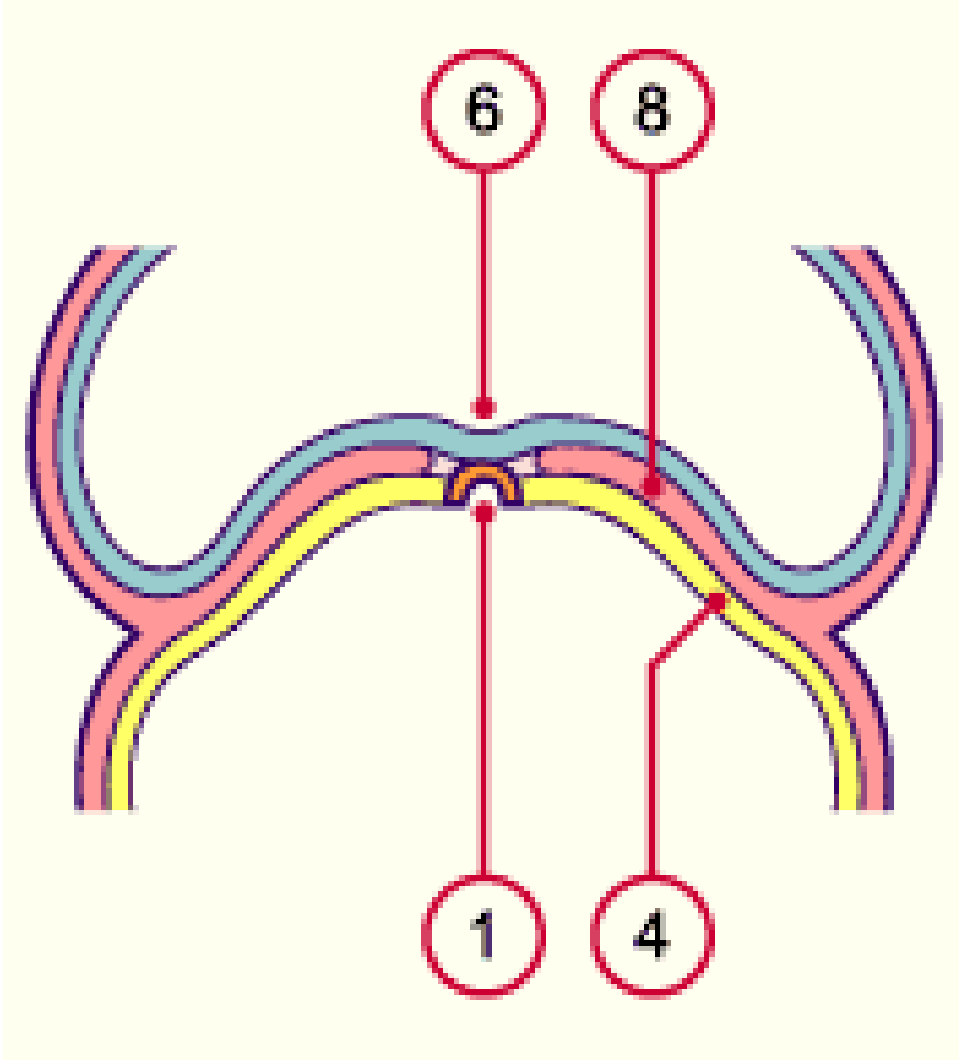
## Notochord

- ✓ Prenotochordal cells in the primitive pit
- ✓ Invaginating forward
- ✓ Stopped by prechordal plate.



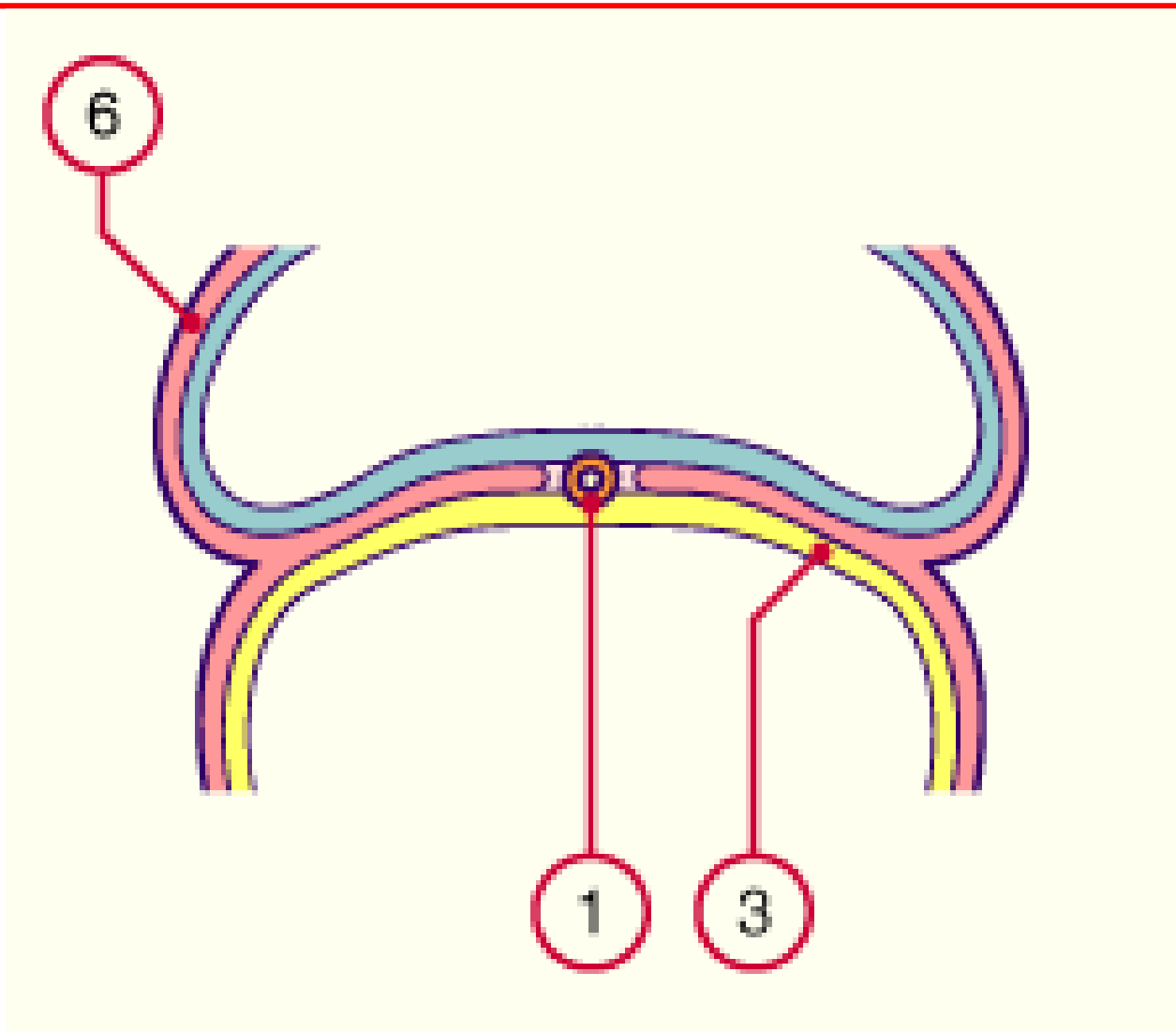
## Notochord

- ✓ They intercalate in the endoderm (4)
- ✓ As **notochordal plate** (1)



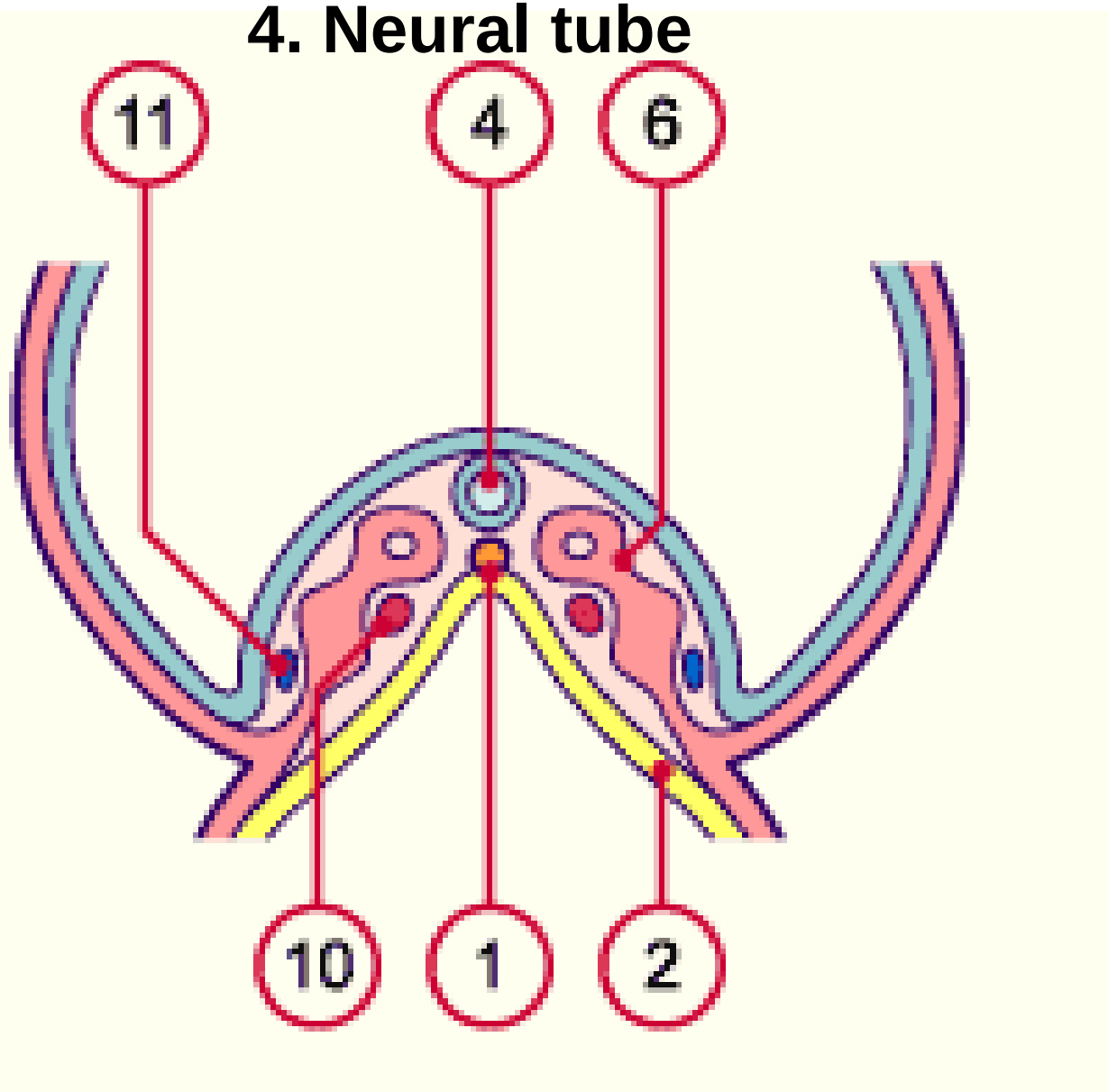
## Notochord

- ✓ Detaches from the endoderm
- ✓ **Notochord**, is formed (1)



## Notochord

- ✓ Basis of the axial skeleton. 1



## Neurulation:

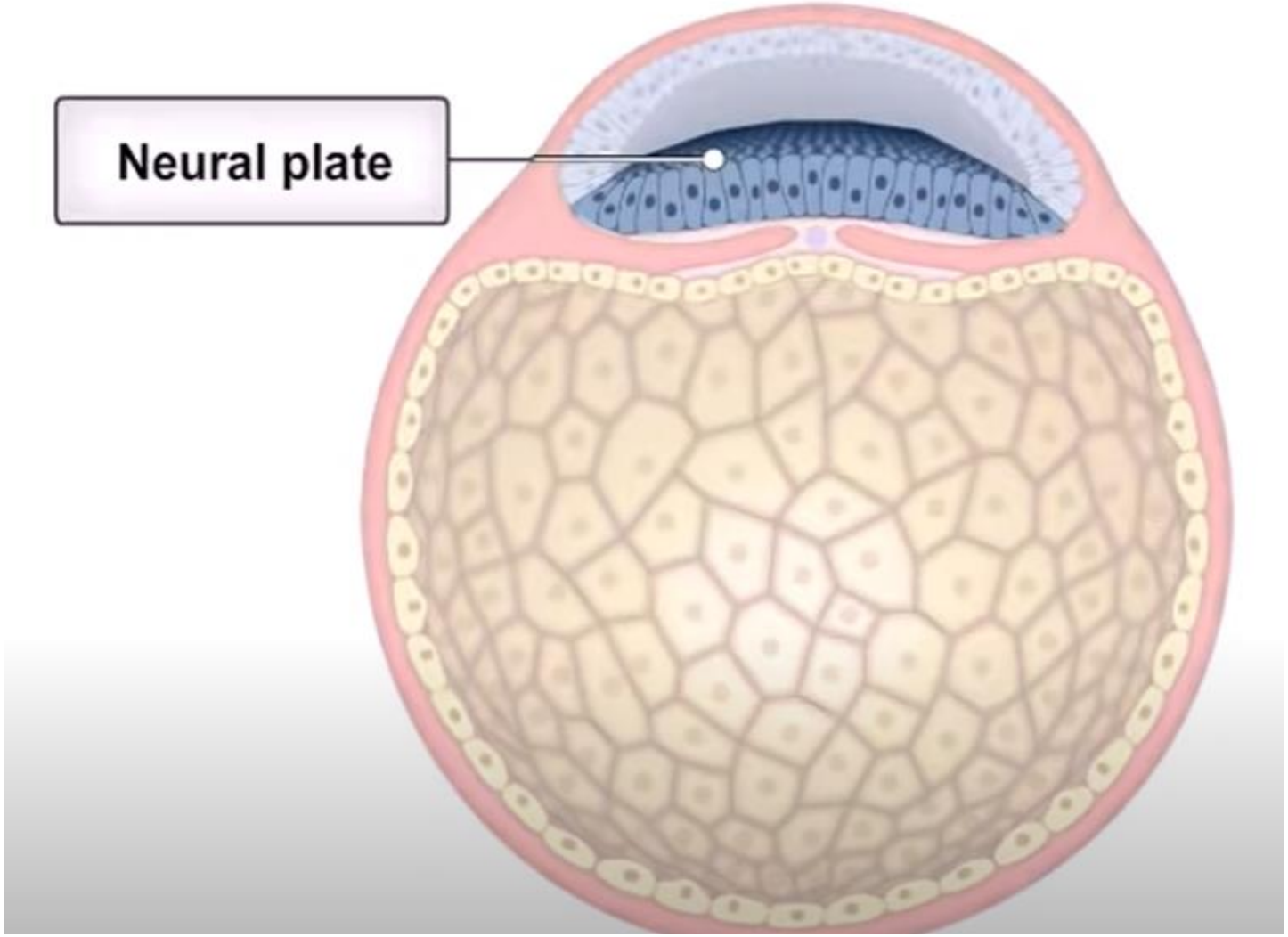
- ✓ The events that occur during neurulation mark the beginning of the formation of the central nervous system.
- ✓ The first event in neurulation is the formation of a thickened area of cells in the ectoderm, called the neural plate.
- ✓ The cranial end of the neural plate indicates the region of the eventual brain, and the narrower caudal end represents the eventual region of the spinal cord.
- ✓ The lateral edges of the neural plate become elevated, and fold to form the neural fold.
- ✓ The groove created by the folding of the neural plate is called the neural groove.

# 3rd Week

- ✓ Gradually, the two neural folds approach each other, and fuse together, and the neural plate transforms into the neural tube
- ✓ The neural tube is the precursor to the central nervous system. Fusion of the neural tube usually begins in the cervical region, extending in both cranial and caudal directions.
- ✓ The openings that are formed at the cranial and caudal ends of the embryo are called cranial and caudal neuropores.

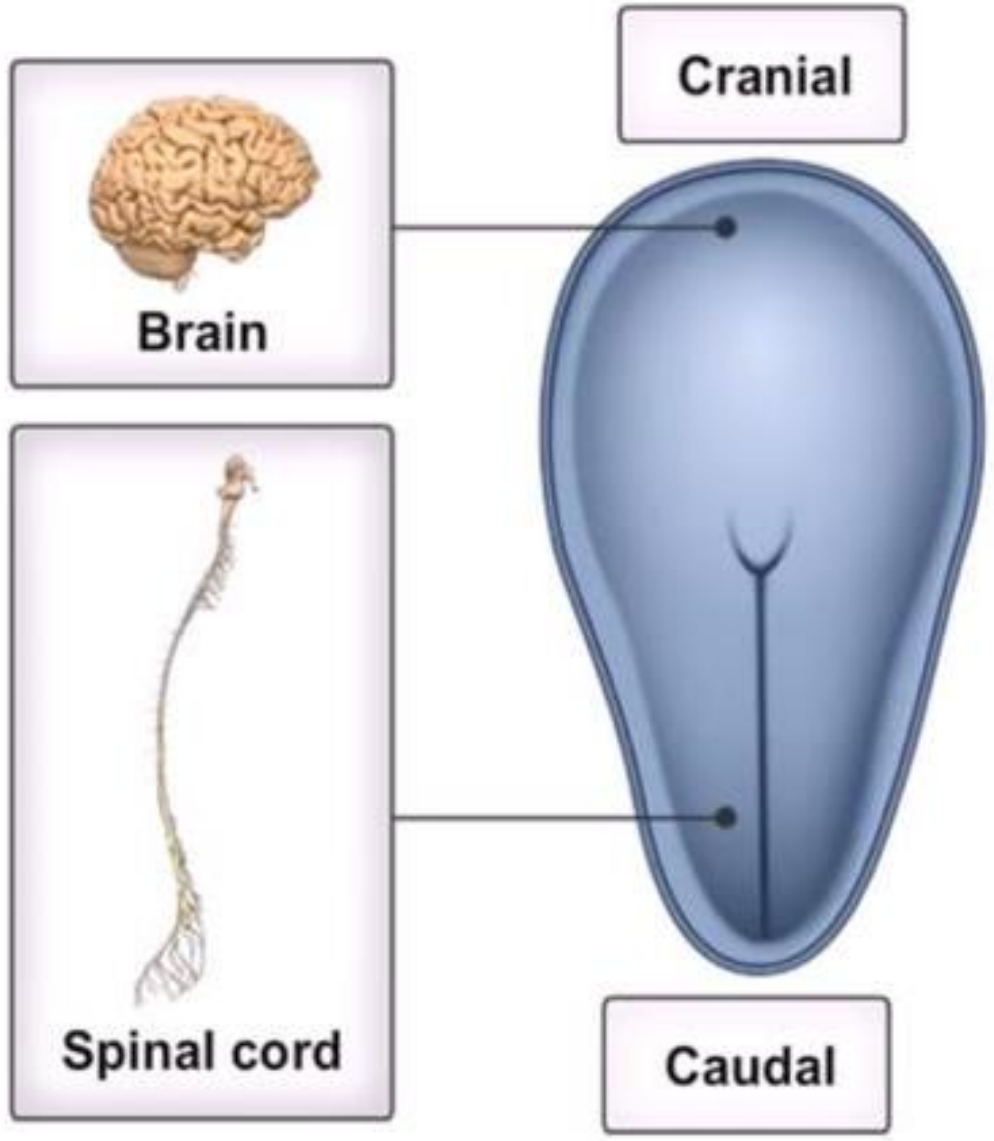
# Neurulation:

- ✓ The 1st event is the formation of a thickened area of cells in the ectoderm called neural plate



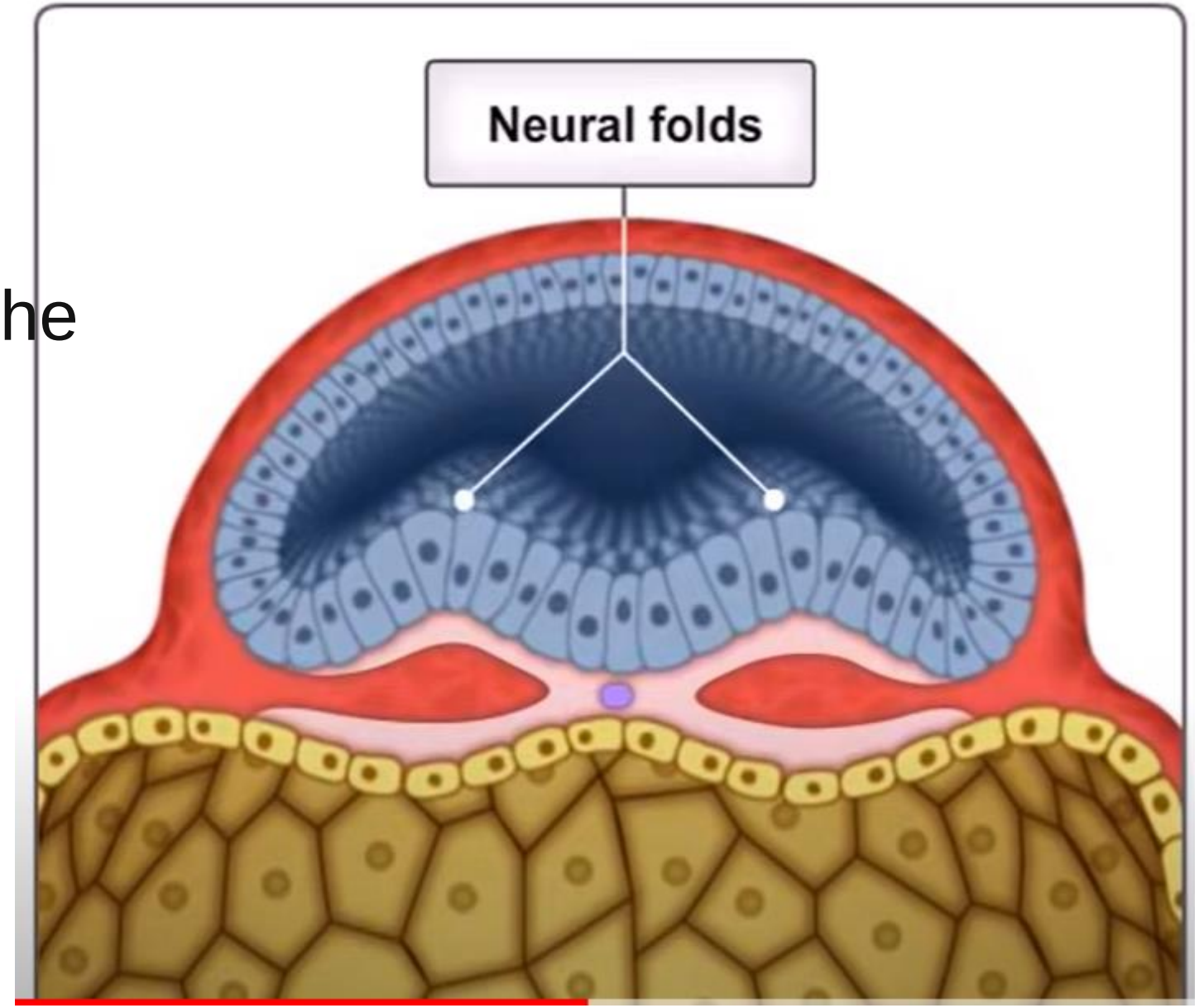
# Neurulation:

- ✓ The cranial end of the neural plate indicates the region of the eventual brain, and the narrower caudal end represents the eventual region of the spinal cord.



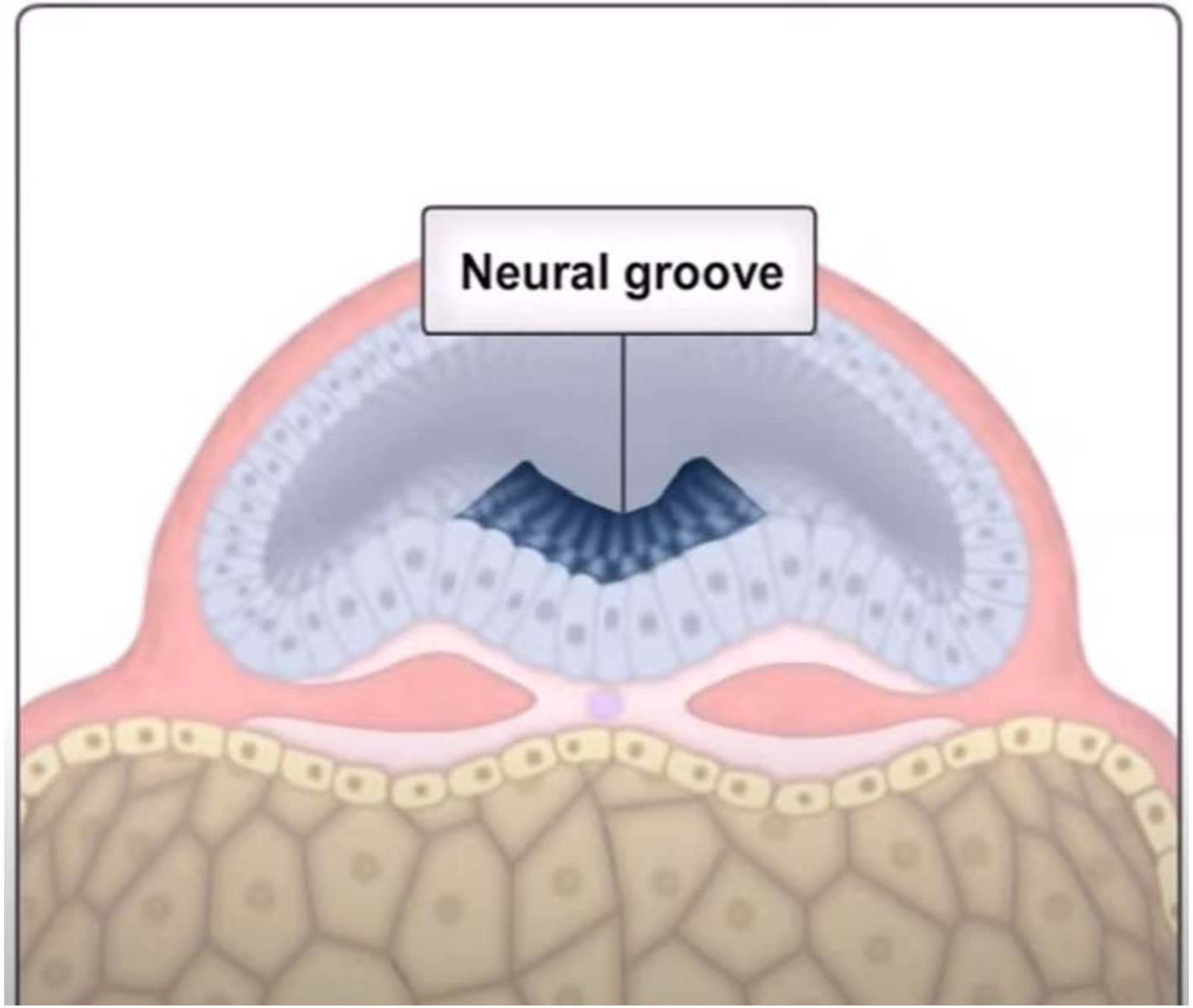
# Neurulation:

- ✓ The lateral edges of the neural plate become elevated, and fold to form the neural fold



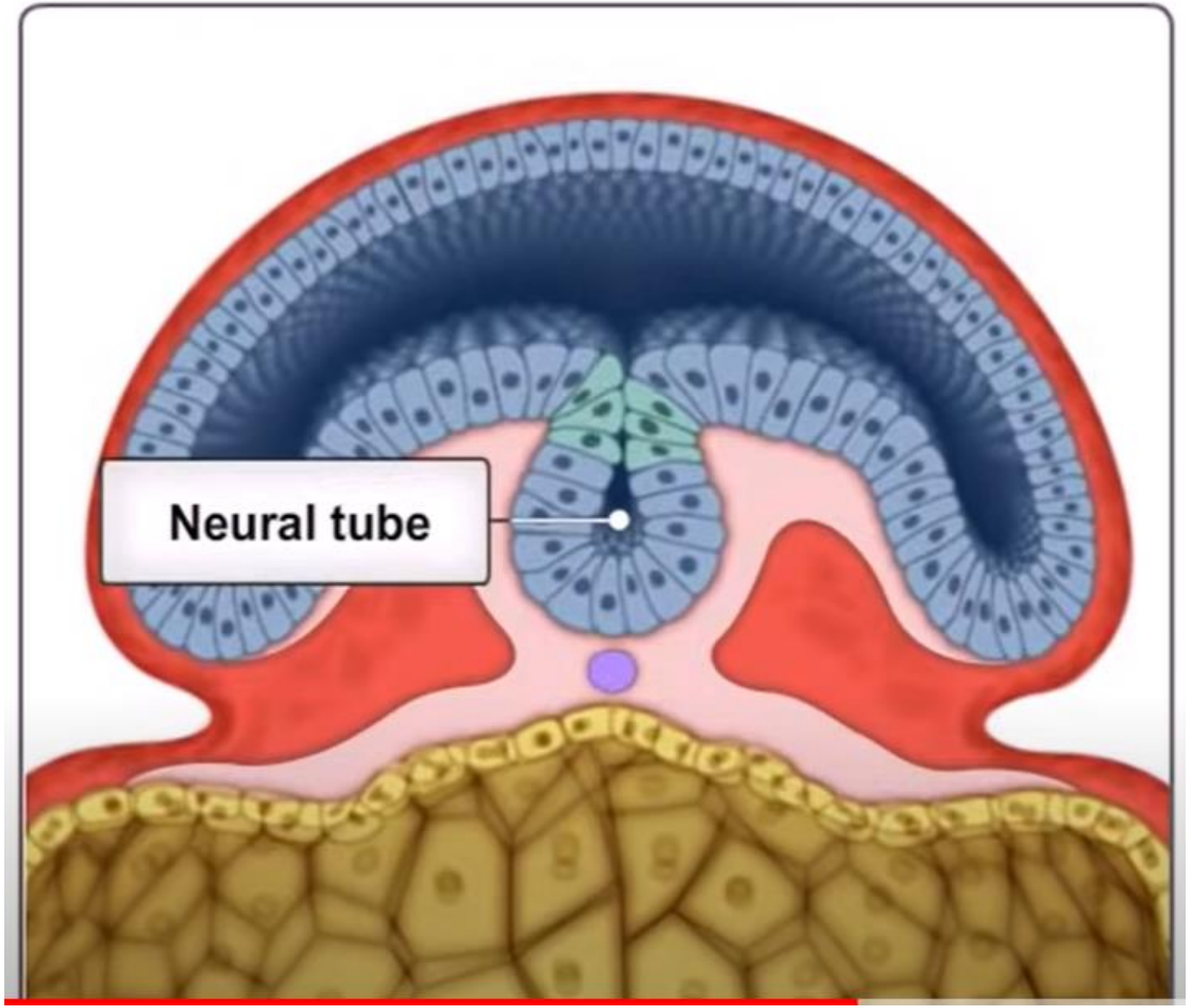
# Neurulation:

- ✓ The groove created by the folding of the neural plate is called the neural groove.



# Neurulation:

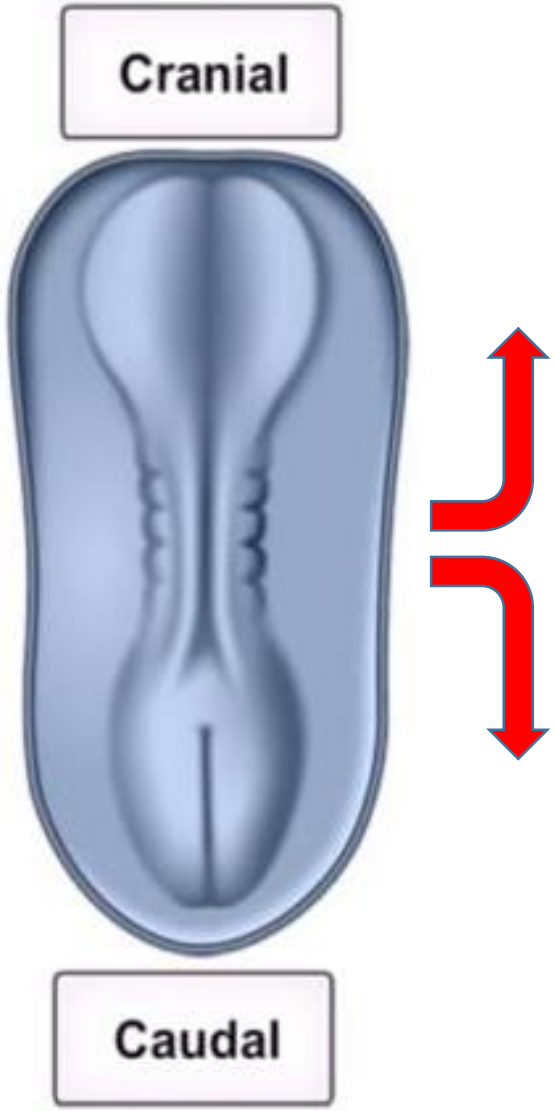
- ✓ Gradually, the two neural folds approach each other, and fuse together, and the neural plate transforms into the neural tube



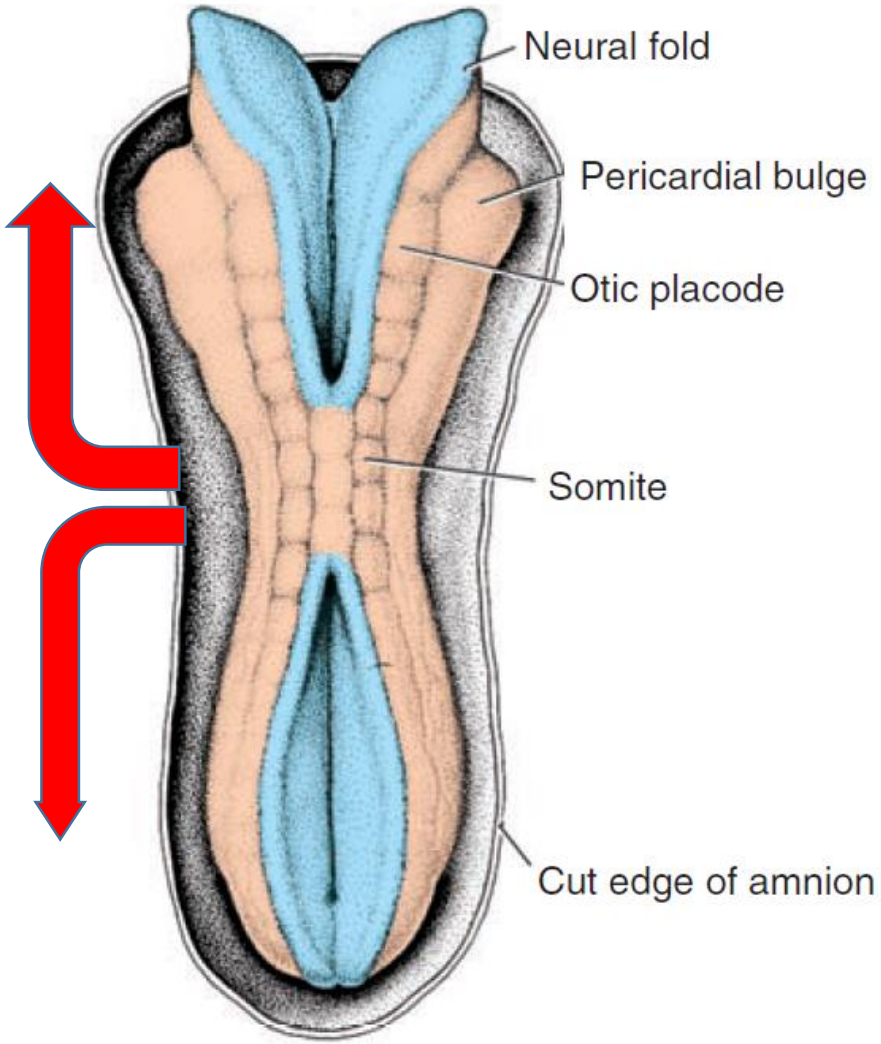
# Neurulation:

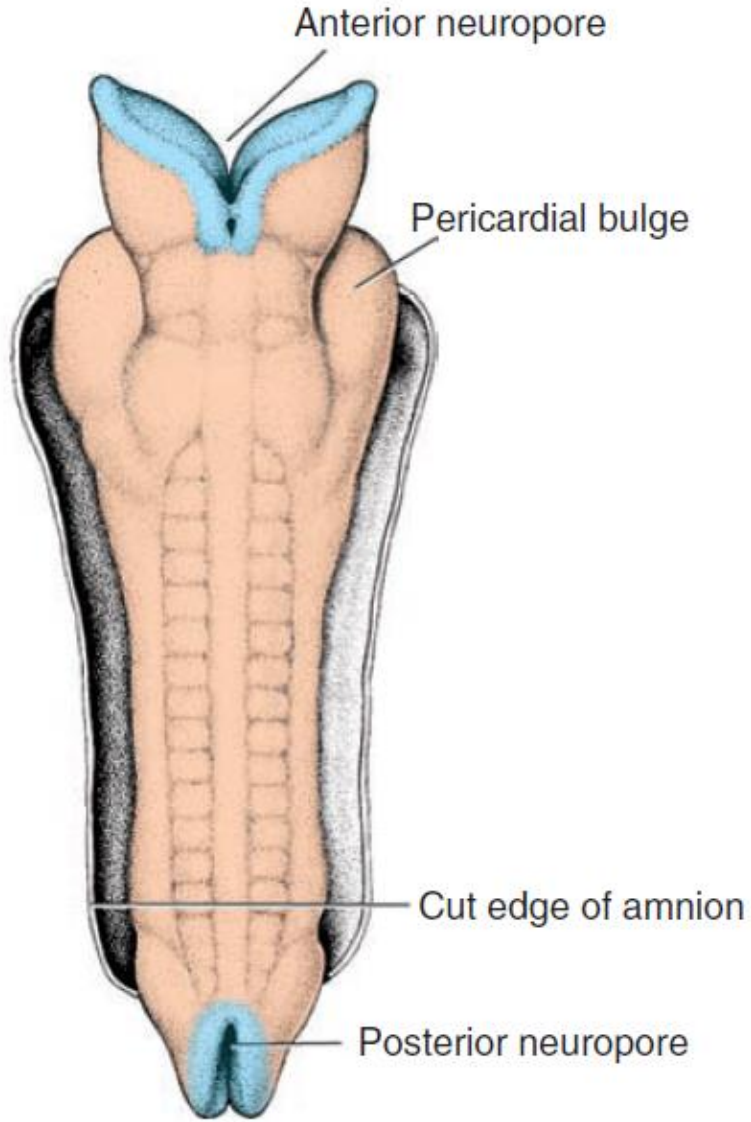
- ✓ Fusion of the neural tube usually begins in the cervical region, extending in both cranial and caudal directions.

- ✓ The openings that are formed at the cranial and caudal ends of the embryo are called **cranial and caudal neuropores.**



# Neurulation:



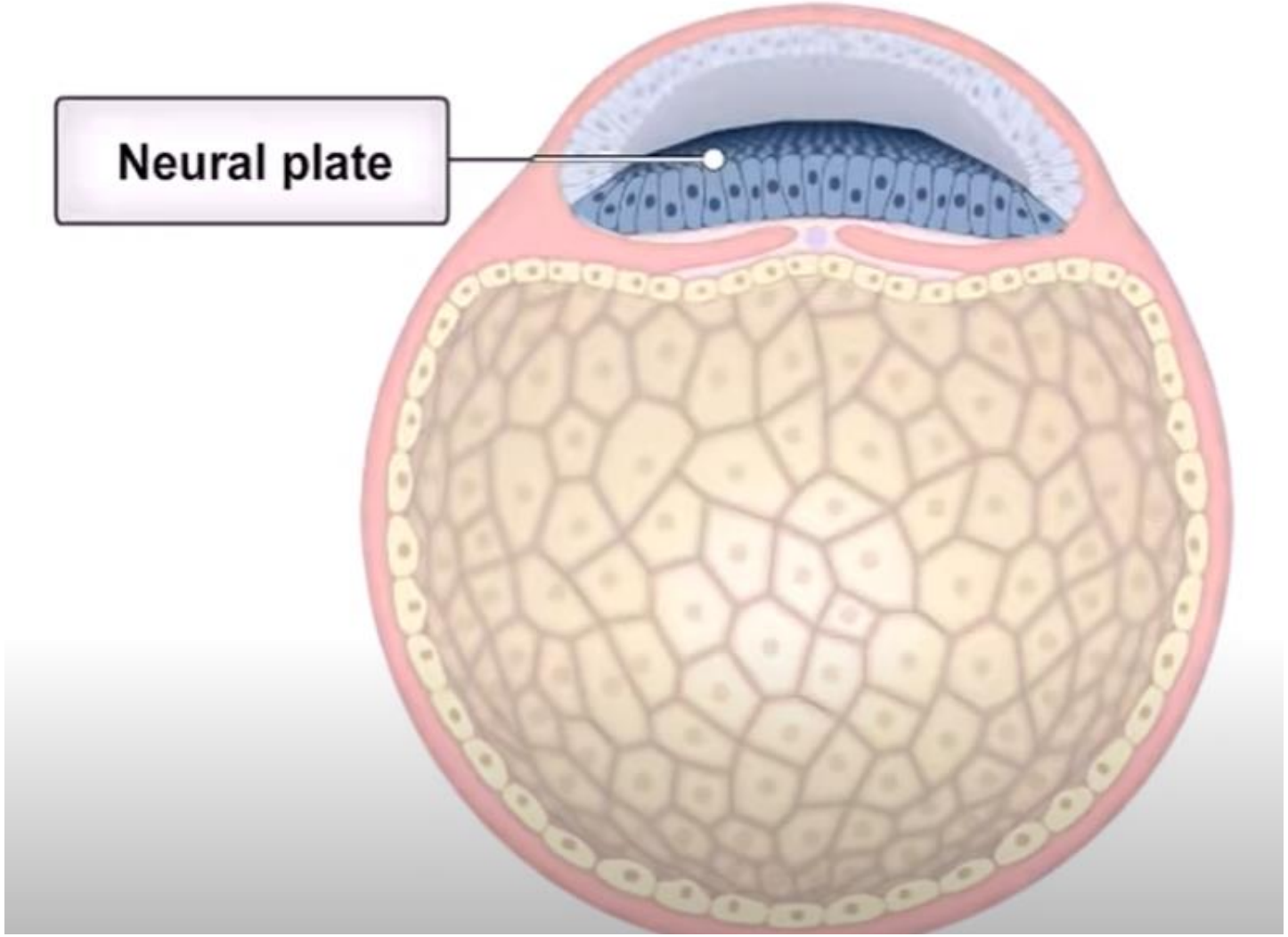
# Neurulation:

- ✓ Once the neural tube has **completely fused**, the process of **neurulation is complete**

- ✓ And the central nervous system (CNS) is represented by a **closed tubular** structure with a narrow caudal portion, -the spinal cord, and a much broader cephalic portion

# Neurulation:

- ✓ The 1st event is the formation of a thickened area of cells in the ectoderm called neural plate

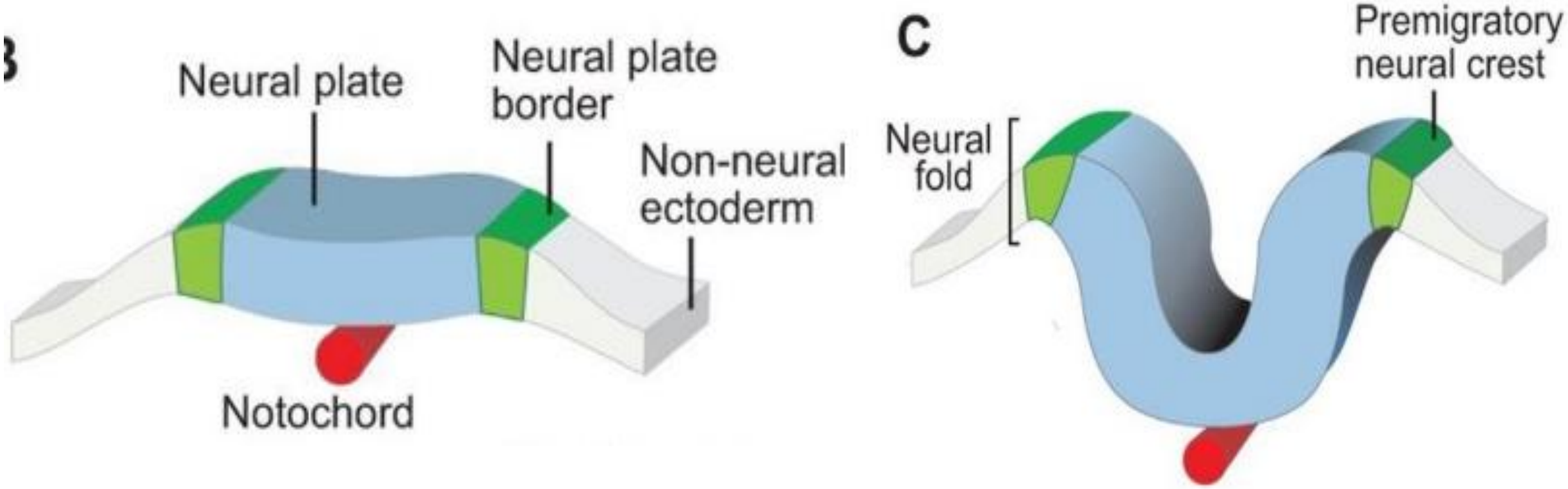


# Neural Crest Cells

- ✓ During the closure of the neural tube, cells on the lateral side of the neural plate detach forming a new cell population, called the neural crest.
- ✓ The neural crest cells, will undergo an epithelial-to-mesenchymal transition by active migration and displacement to enter the underlying mesoderm.
- ✓ These cells contribute to the formation of the peripheral nervous system.

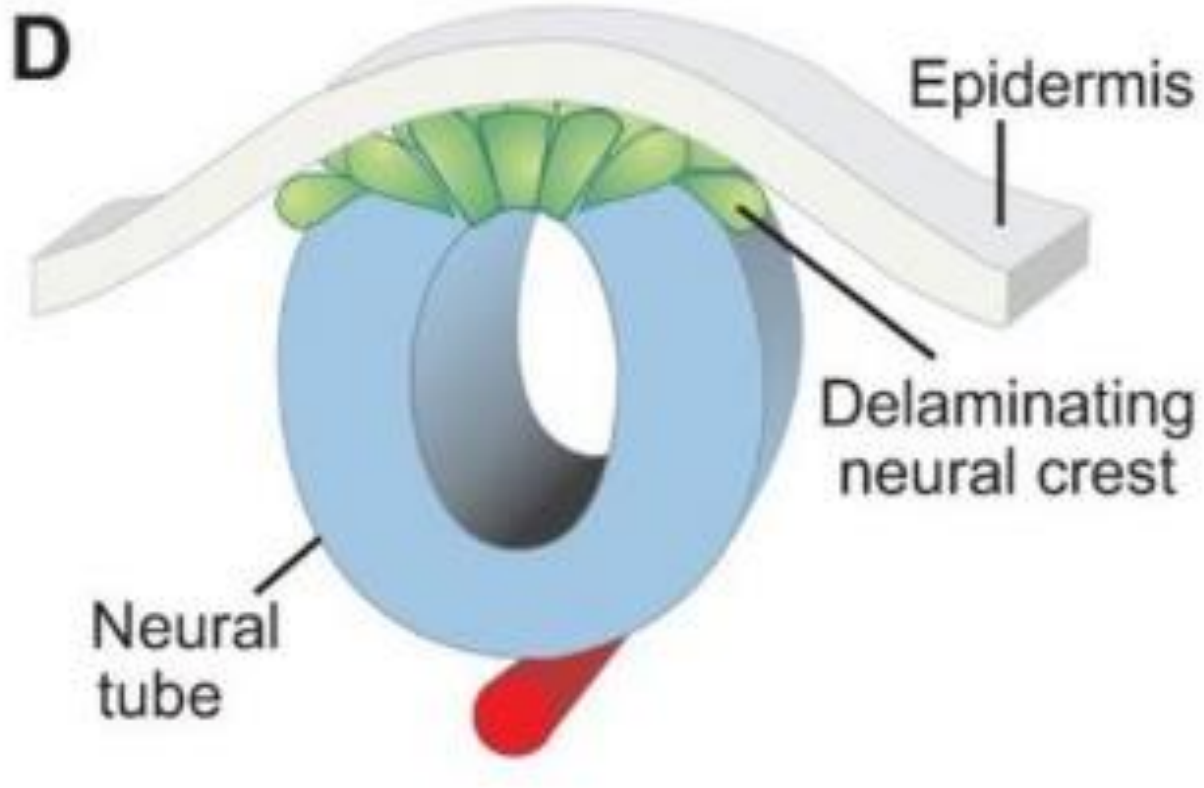
# Neural Crest Cells

- ✓ As the neural folds elevate and fuse, cells at the lateral border or **crest of the neuroectoderm** begin to dissociate from their neighbours.



# Neural Crest Cells

- ✓ This cell population, the neural crest, will undergo an **epithelial-to-mesenchymal transition** as it leaves the neuroectoderm by active migration and displacement to enter the underlying mesoderm.

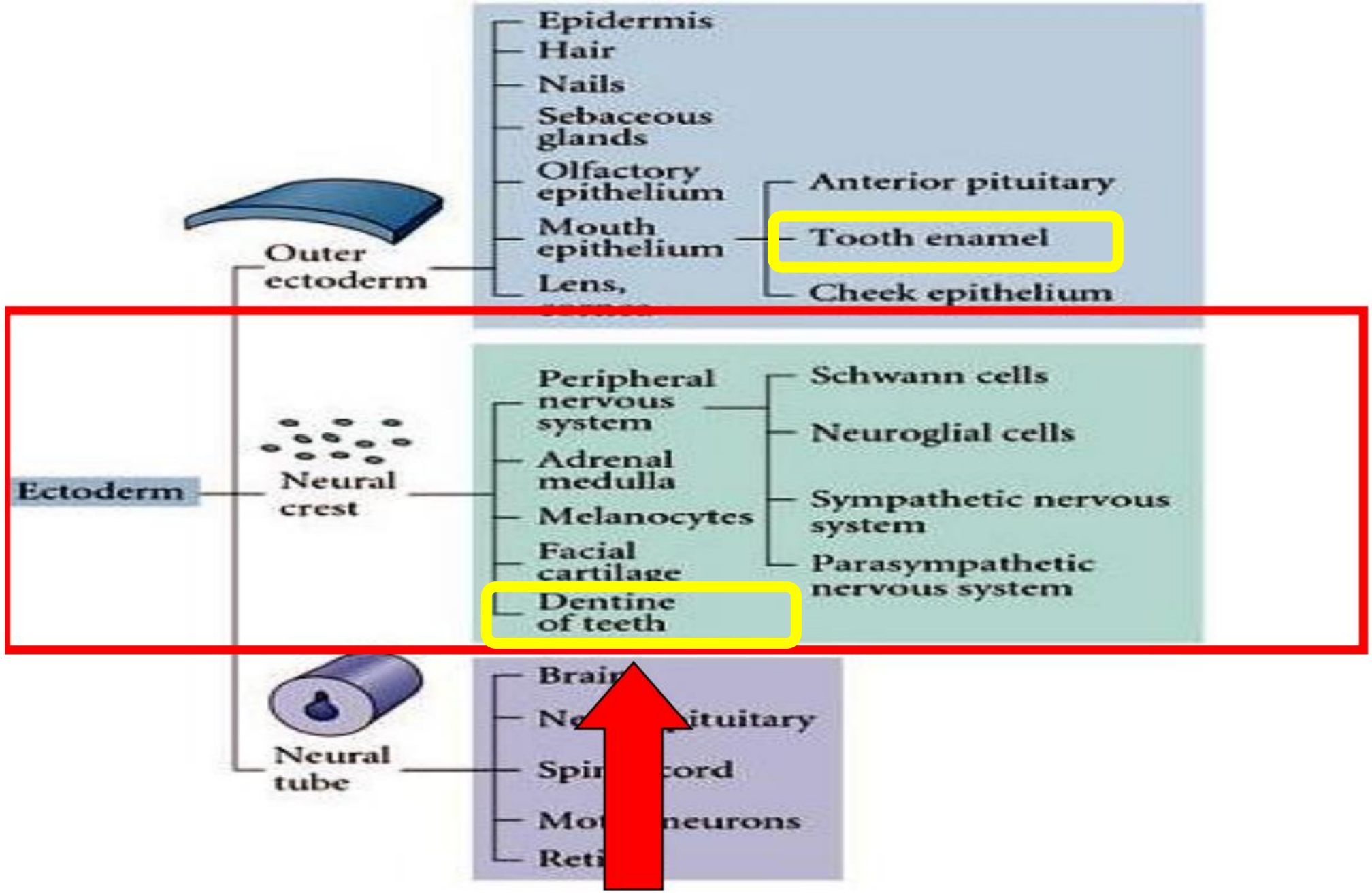


# Neural Crest Cells

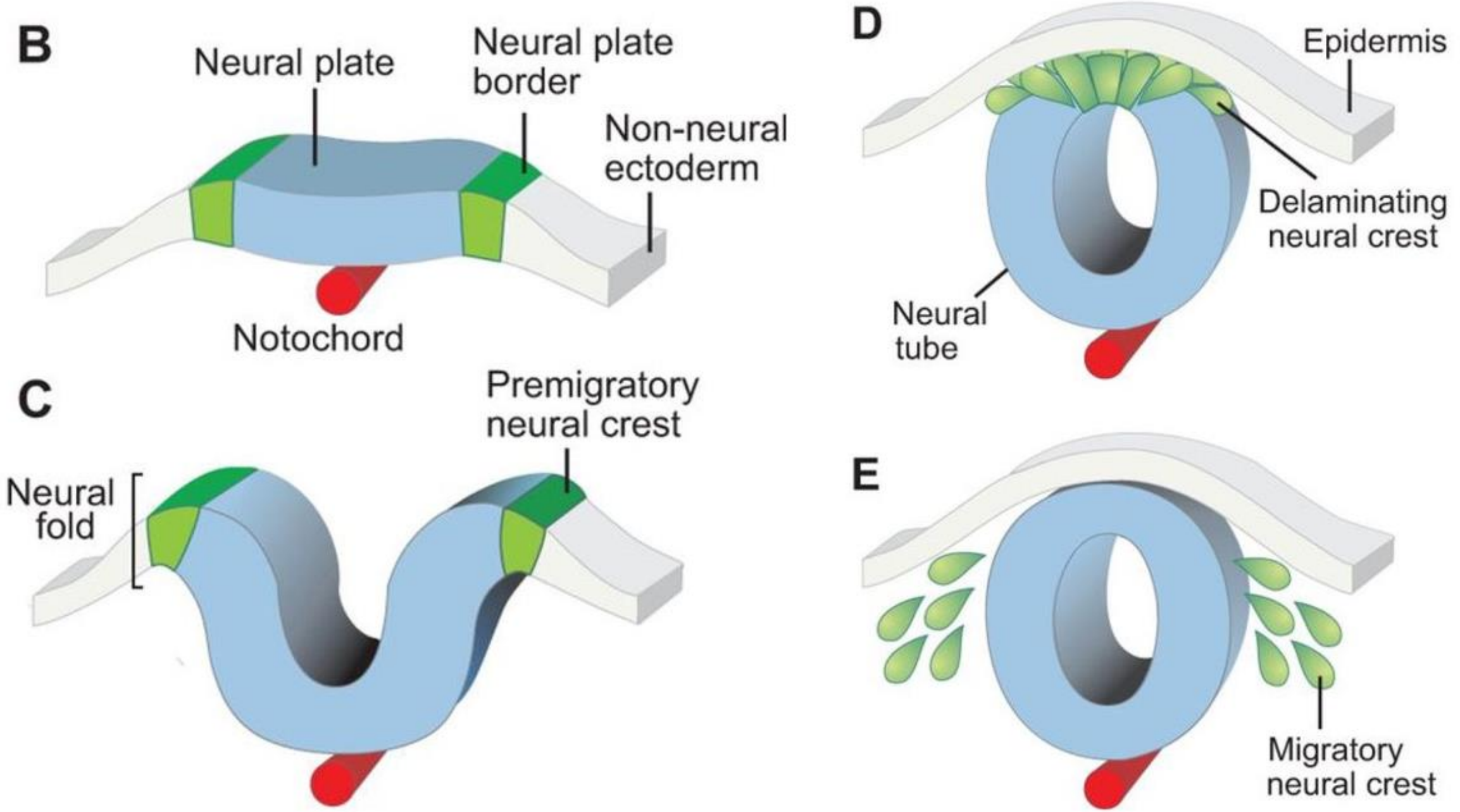
- ✓ These cells contribute to the formation of the **peripheral nervous system**

- ✓ Neural crest cells are so fundamentally important and contribute to so many organs and tissues that they are sometimes referred to as **The Fourth Germ Layer**.

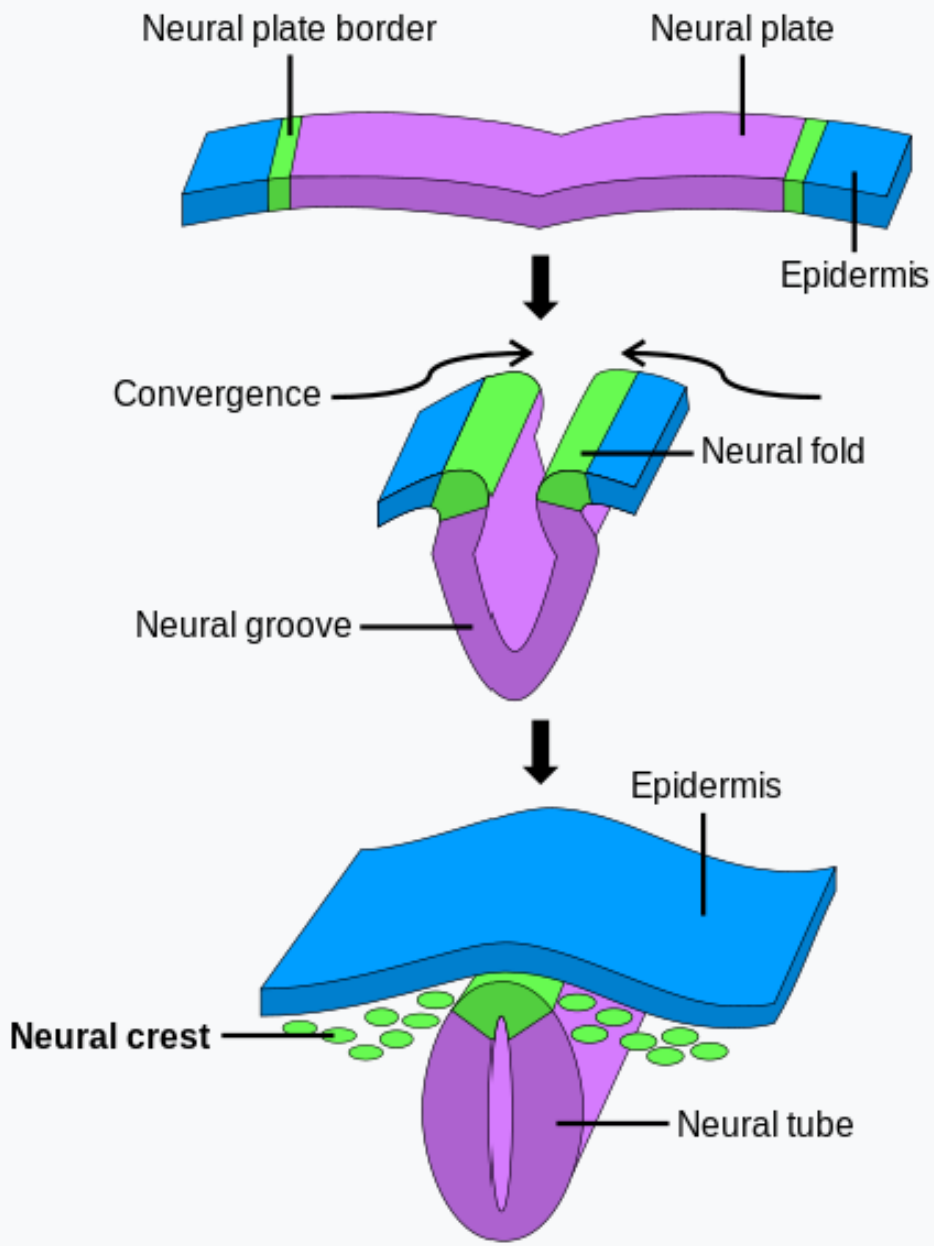
# Neural Crest Cells



# Neural Crest Cells

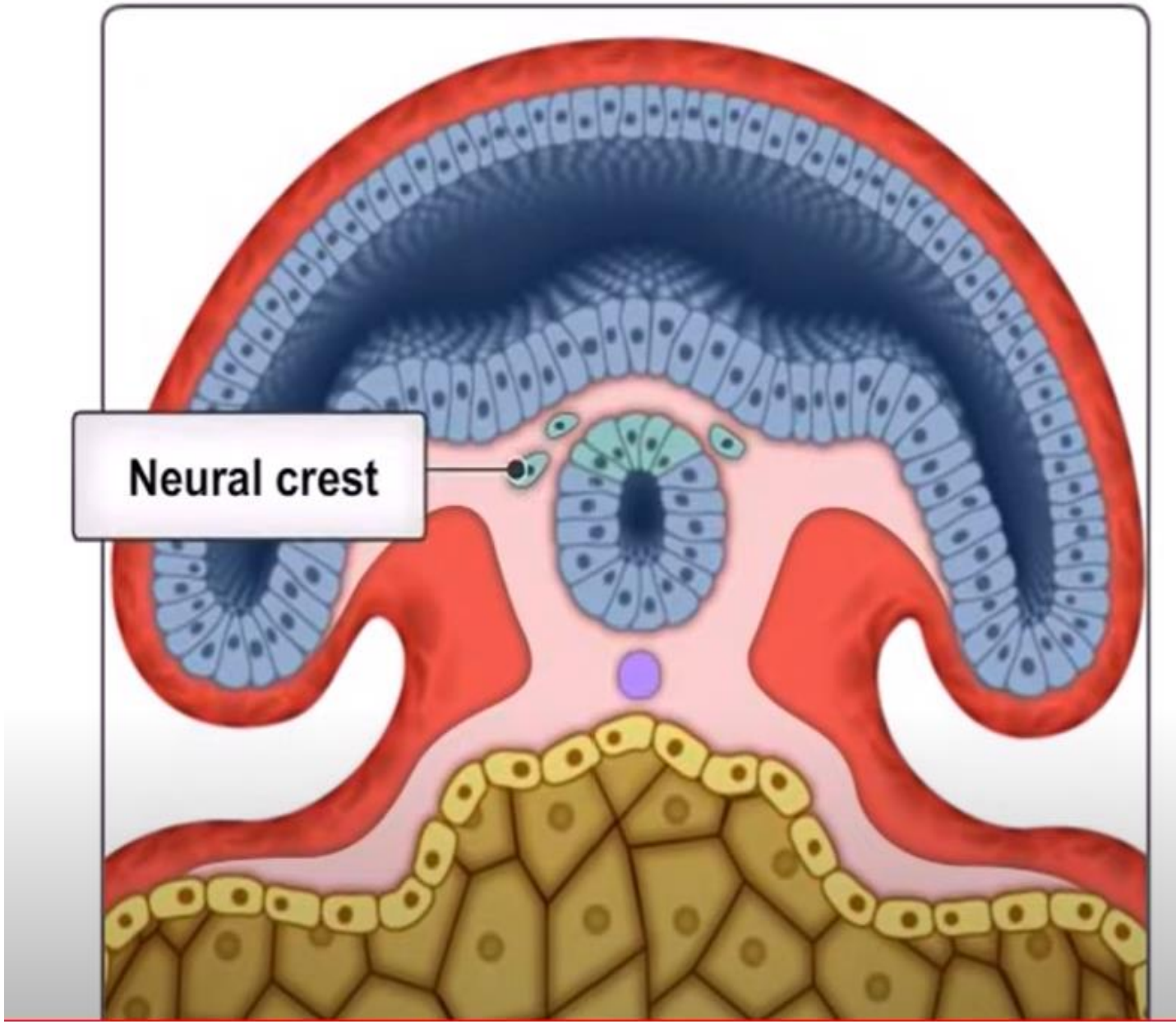


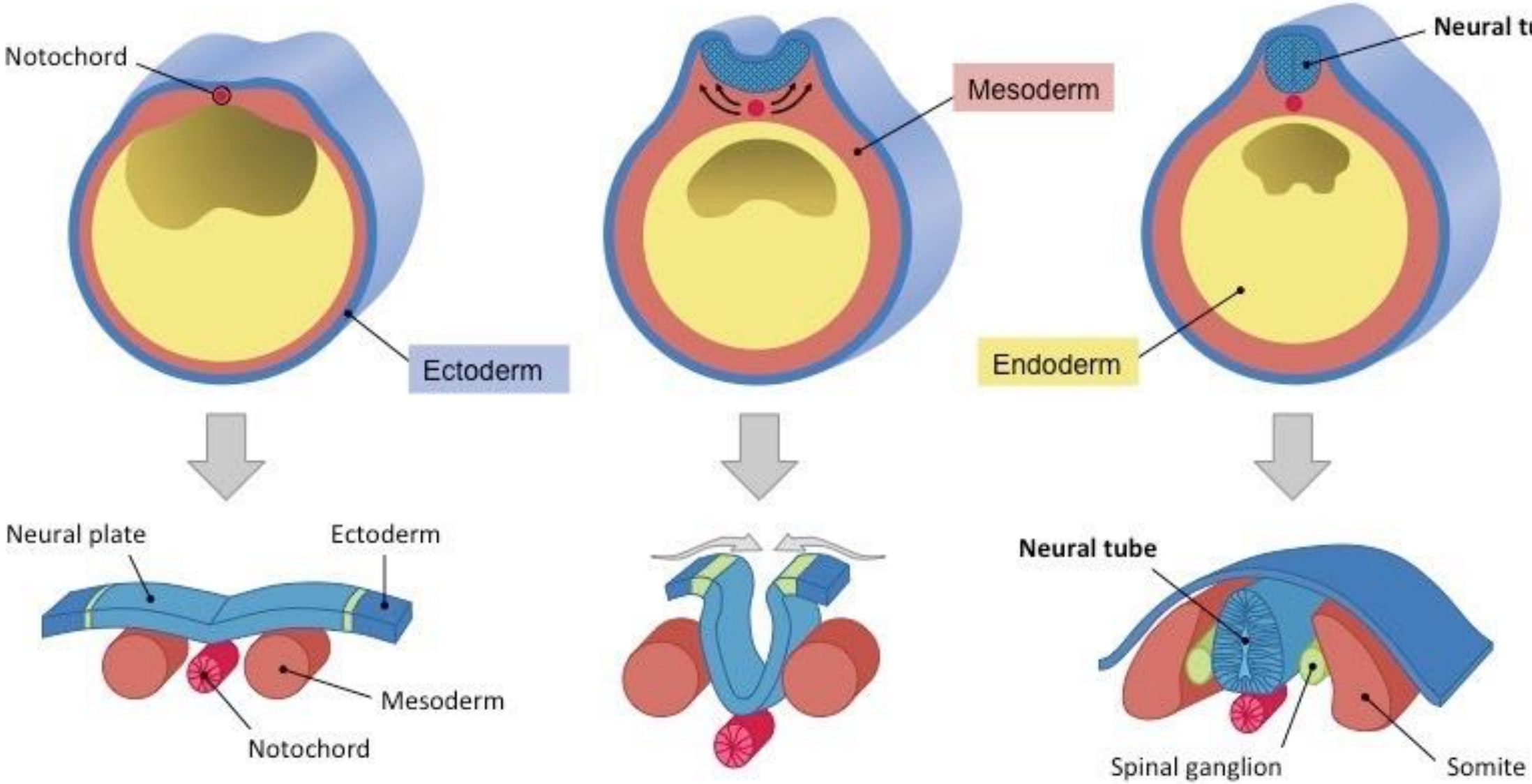
# Neural crest



# Neural Crest:

These cells contribute to the formation of the peripheral nervous system






**1.** Notochord forms from mesoderm cells soon after gastrulation is complete

**2.** Signals from notochord cause inward folding of ectoderm at the neural plate

**3.** Ends of neural plate fuse and disconnect to form an autonomous neural tube