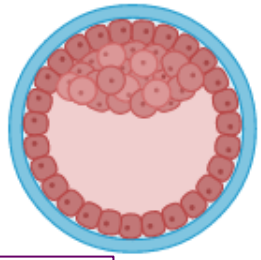
EMBRYOLOGY

EMBRYOBLAST = inner cell mass



HYPOBLAST (7th-8th day)
= primitive endoderm

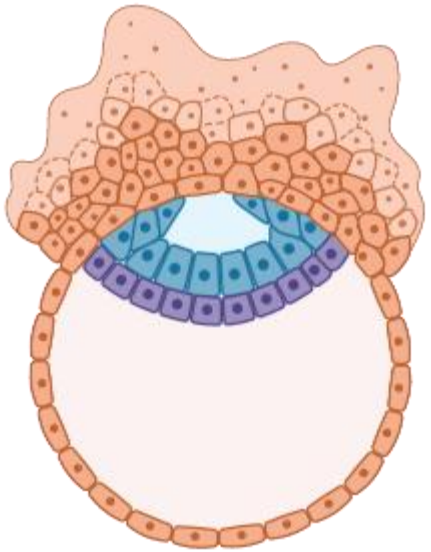
EXOCOELOMIC MEMBRANE (9th day)
= Heuser's membrane

EXOCOELOMIC CAVITY (9th day)
= primitive yolk sac

EPIBLAST (7th-8th day)

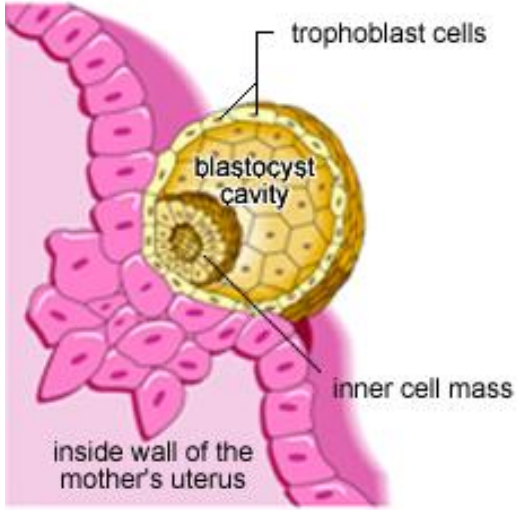
AMNIOTIC CAVITY (7th-8th day)

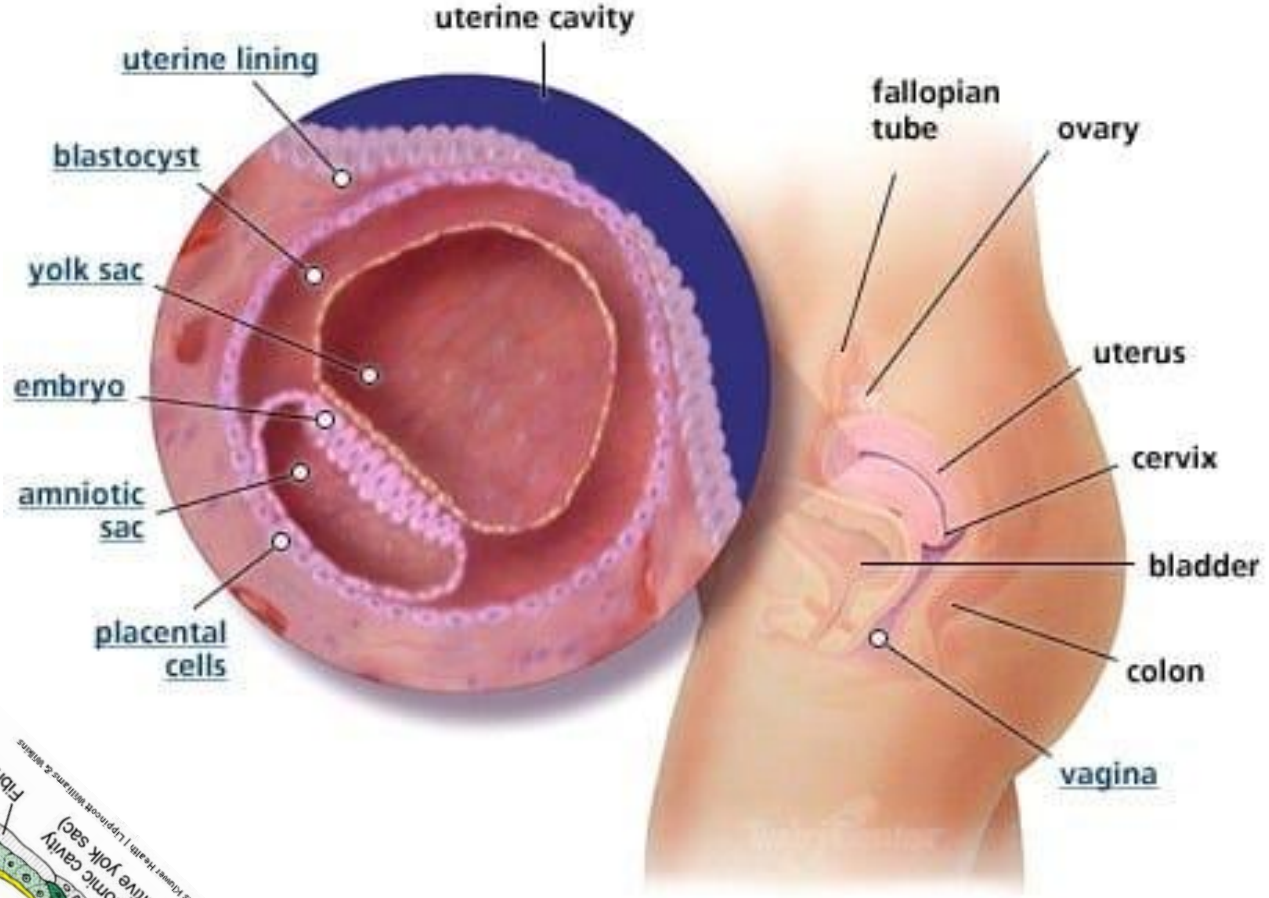
AMNIOBLASTS (7th-8th day)

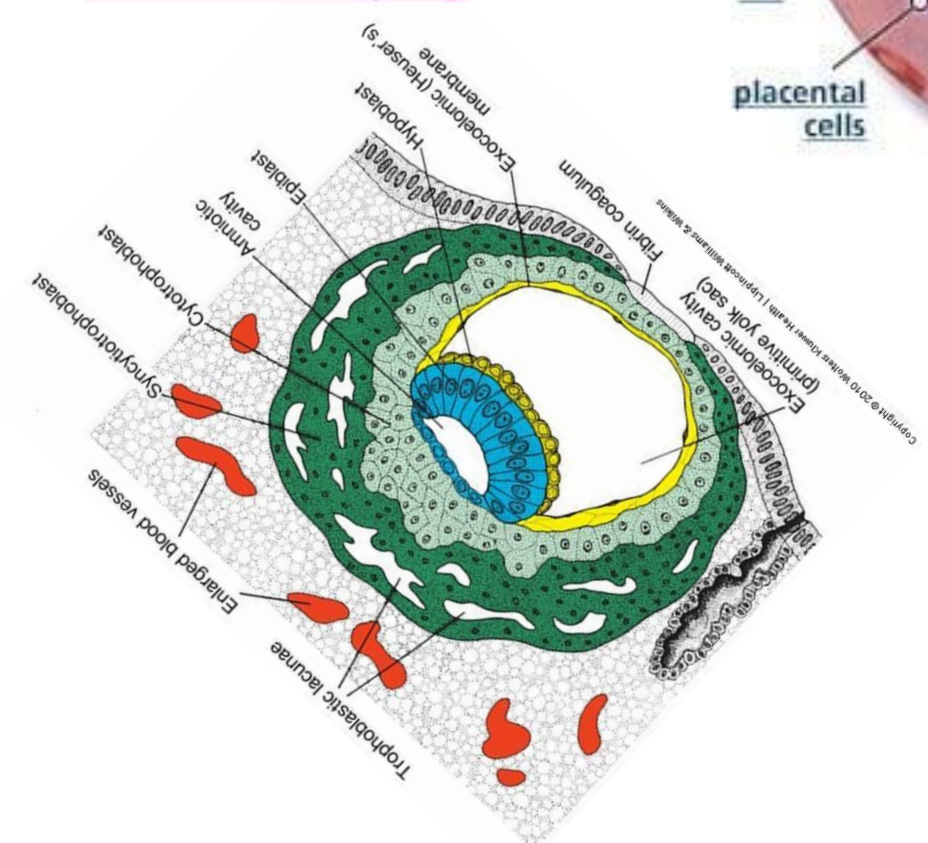


EXTRAEMBRYONIC MESODERM (11th-12th day)

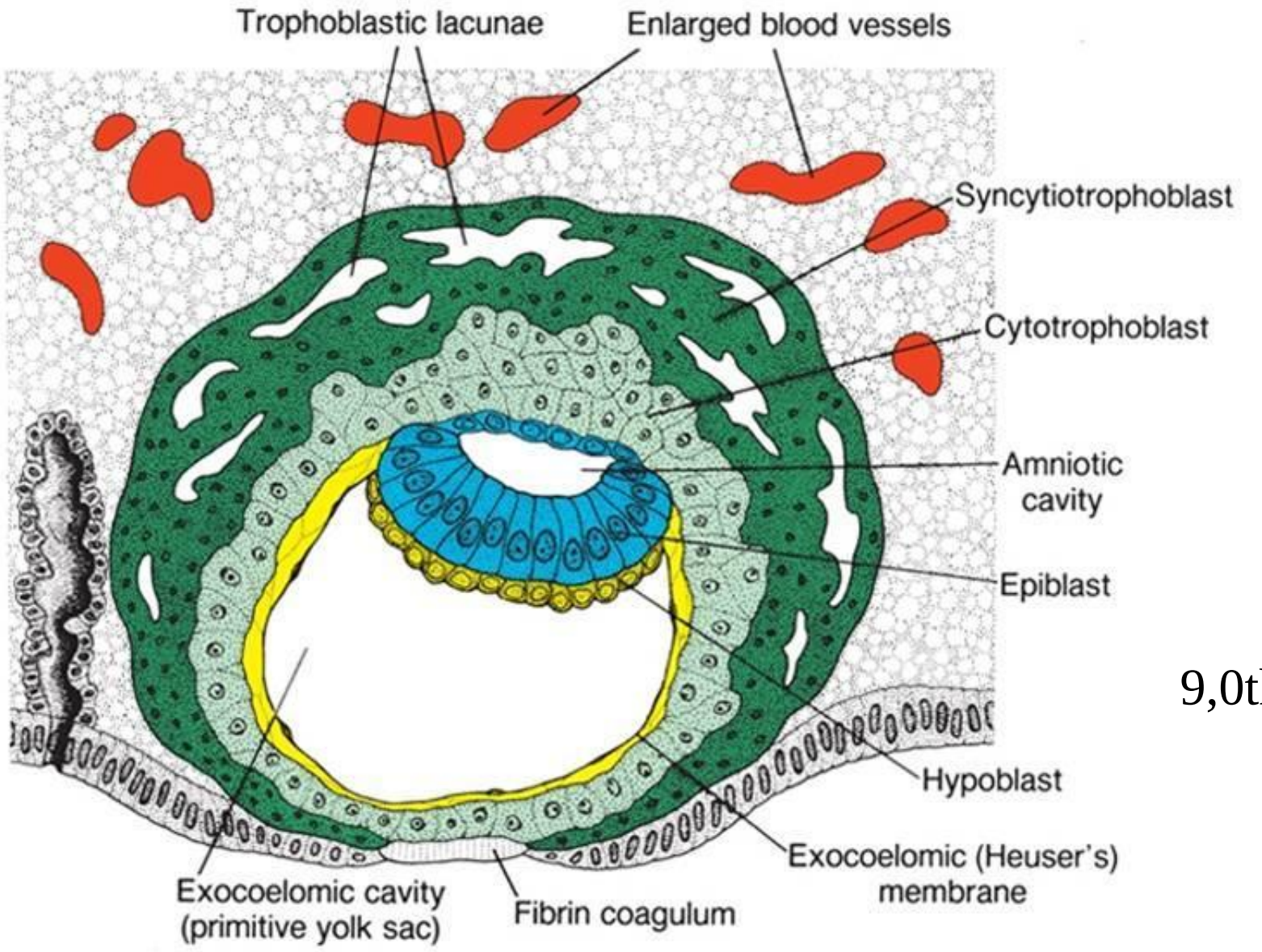
EXTRAEMBRYONIC CAOELOM (11th-12th day)
= chorionic cavity


trophoblast cells
blastocyst cavity
inner cell mass
inside wall of the mother's uterus

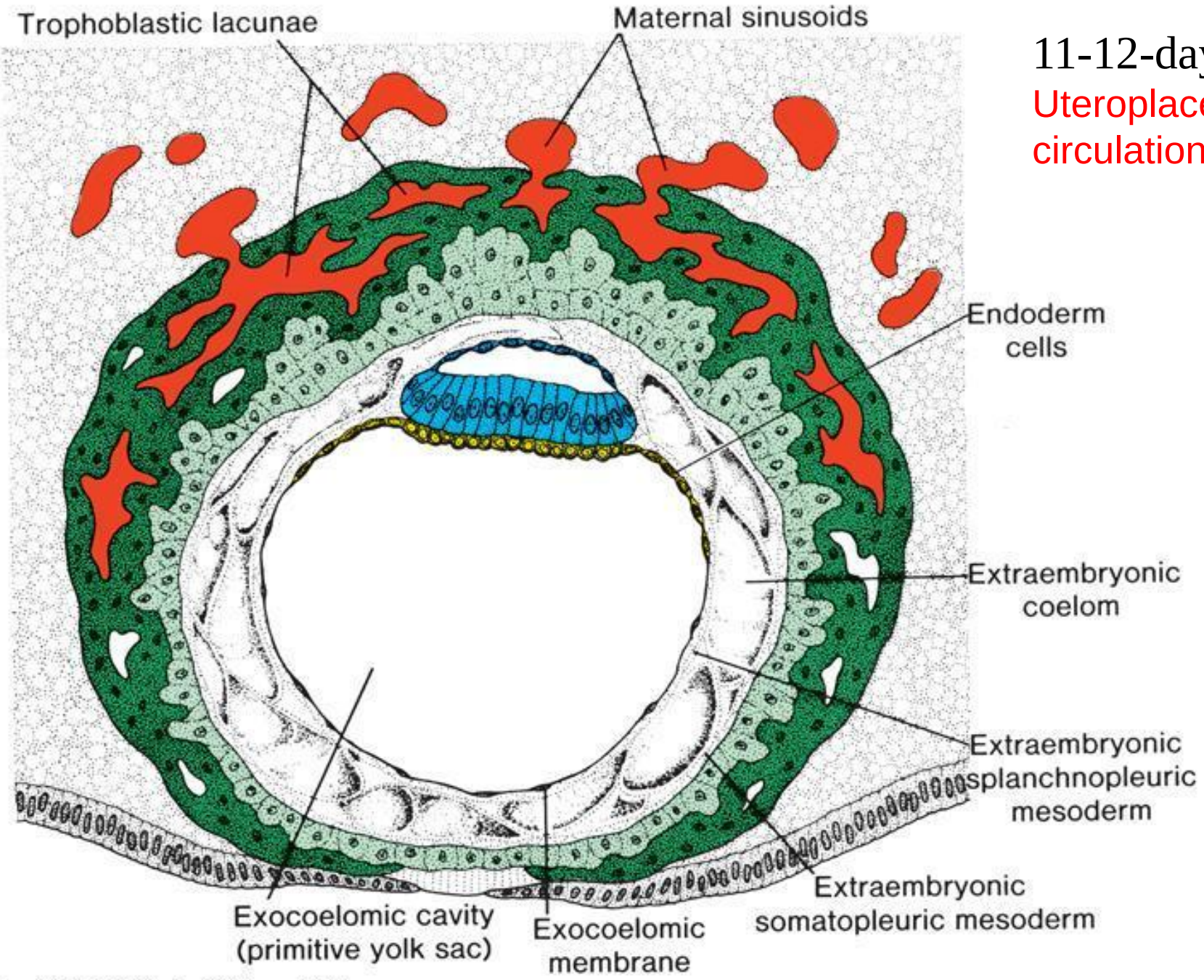

uterine cavity
uterine lining
blastocyst
yolk sac
embryo
amniotic sac
placental cells
fallopian tube
ovary
uterus
cervix
bladder
colon
vagina


Trophoblastic lacunae
Enlarged blood vessels
Syncytiotrophoblast
Cytotrophoblast
Amniotic cavity
Epiblast
Hypoblast
Exocoelomic (Heuser's) membrane
Fibrin coagulum
Exocoelomic cavity (primitive yolk sac)

Hypoblast cells **migrate** around cavity of blastocyst to create primary **yolk sac**.

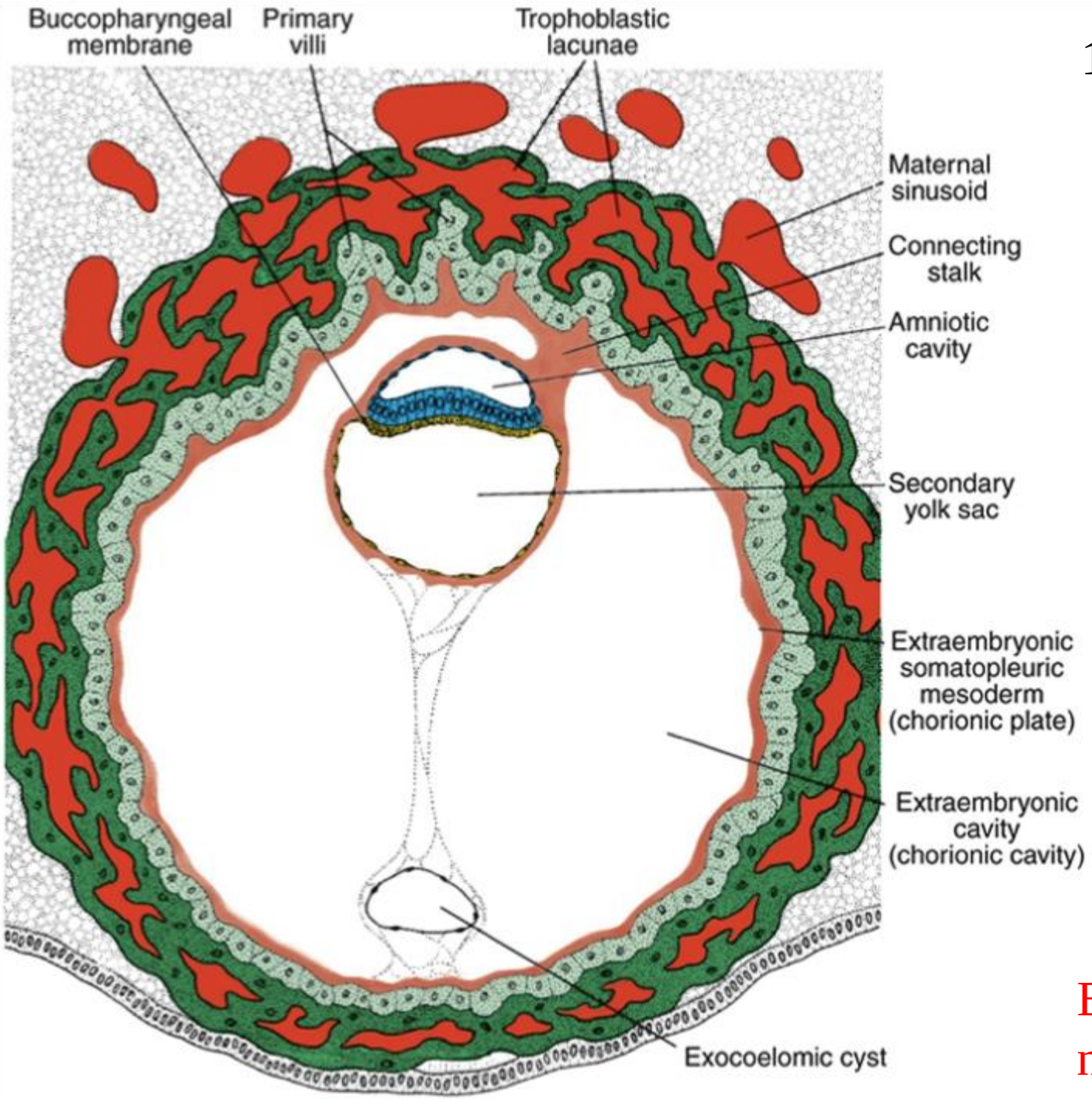


9,0th-day



11-12-day
Uteroplacental circulation

13-day



Bleeding
near 28th day

What is the correct cell lineage leading to the formation of the syncytiotrophoblast?

A.Blastomere – inner cell mass – hypoblast – trophoblast – syncytiotrophoblast

B.Inner cell mass – epiblast – cytotrophoblast – syncytiotrophoblast

C.Blastomere – trophoblast – cytotrophoblast – syncytiotrophoblast

D.Blastomere – inner cell mass – epiblast – trophoblast – syncytiotrophoblast

E.Blastomere – epiblast – trophoblast – syncytiotrophoblast

What is the correct cell lineage leading to the formation of the syncytiotrophoblast?

A. Blastomere – inner cell mass – hypoblast – trophoblast – syncytiotrophoblast

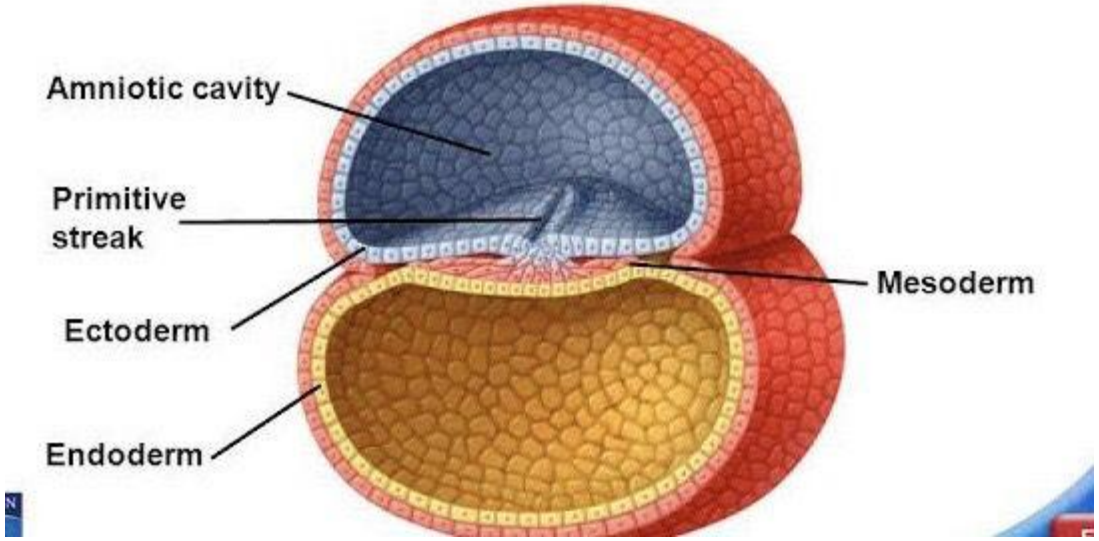
B. Inner cell mass – epiblast – cytotrophoblast – syncytiotrophoblast

C. Blastomere – trophoblast – cytotrophoblast – syncytiotrophoblast

D. Blastomere – inner cell mass – epiblast – trophoblast – syncytiotrophoblast

E. Blastomere – epiblast – trophoblast – syncytiotrophoblast

THIRD WEEK



TRILAMINAR GERM DISC

THIRD WEEK:

FORMATION OF THE TRILAMINAR GERM DISC (gastrulation)

(formation of the *intraembryonic mesoderm ectoderm and endoderm*)

FORMATION OF THE NOTOCHORD

INTRAEMBRYONIC MESODERM DEVELOPMENT

(somites, intraembryonic coelom)

NEURAL TUBE FORMATION (neurulation)

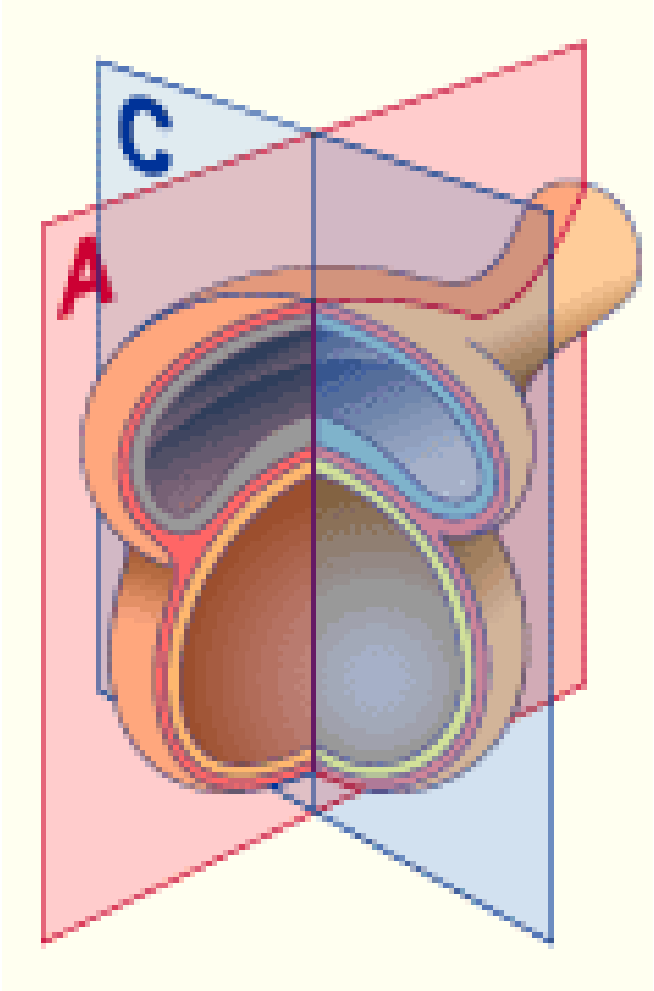
ALLANTOIS FORMATION

CARDIOVASCULAR SYSTEM DEVELOPMENT

TROPHOBLASTIC VILLI DEVELOPMENT

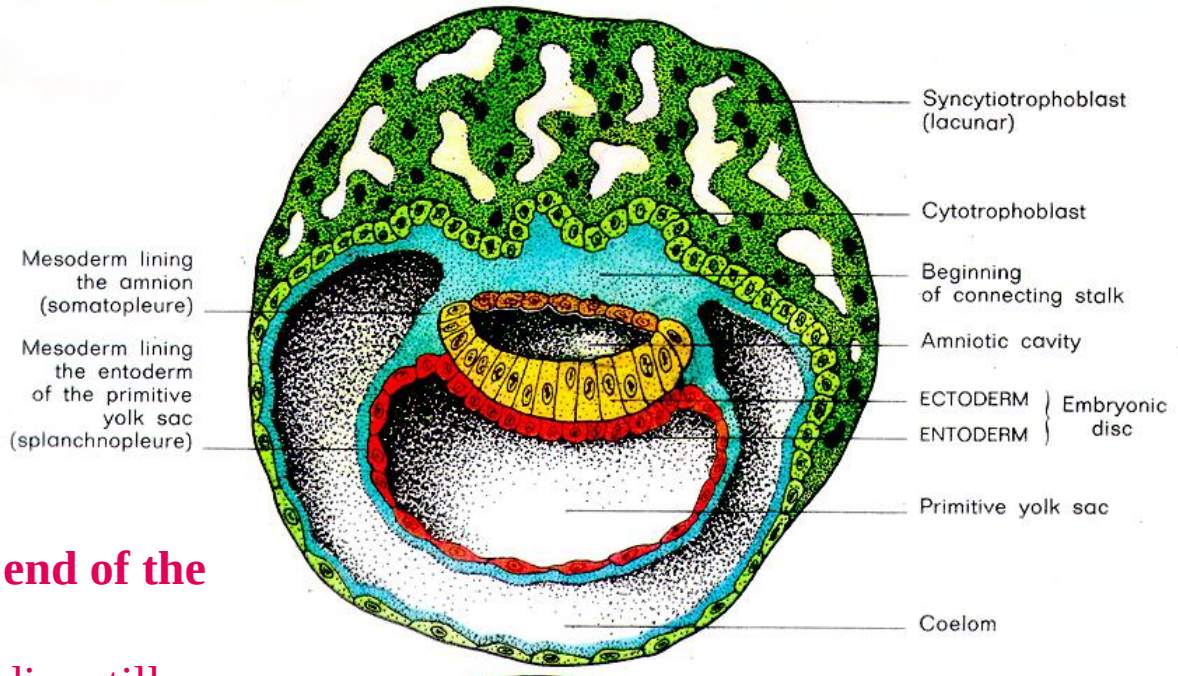
FLEXION OF THE EMBRYO

GASTRULATION



Embryo at the end of the 2nd week.

The embryonic disc still consist of only 2 layers.



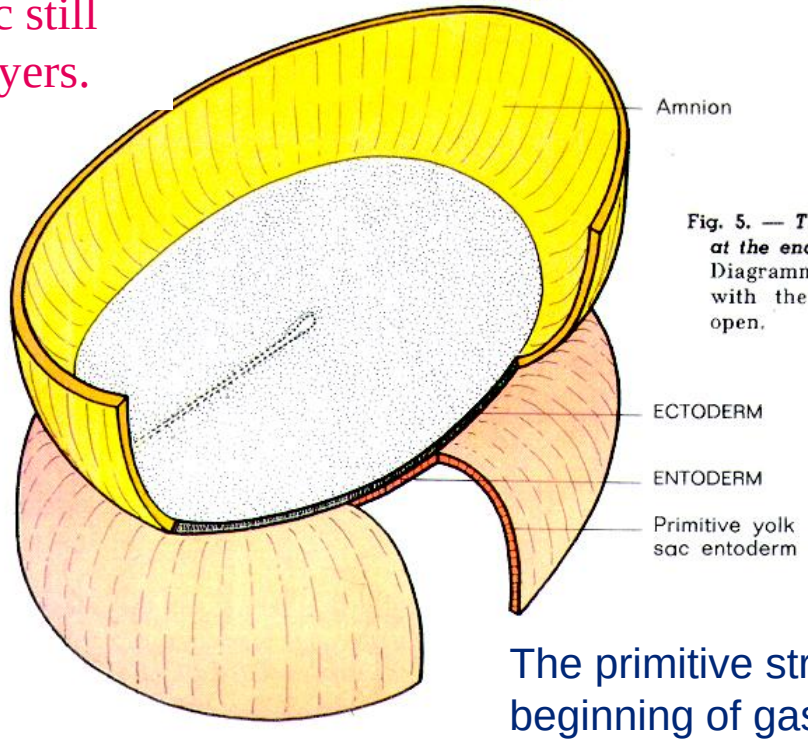


Fig. 5. — *The embryonic disc at the end of the 2nd week.* Diagrammatic dorsal view, with the amniotic cavity open.

The primitive streak appears indicating the beginning of gastrulation

THIRD WEEK

At the beginning of the 3rd week, an important process occurs : ***gastrulation,*** the formation of the third layer of the embryo, the *mesoderm*.

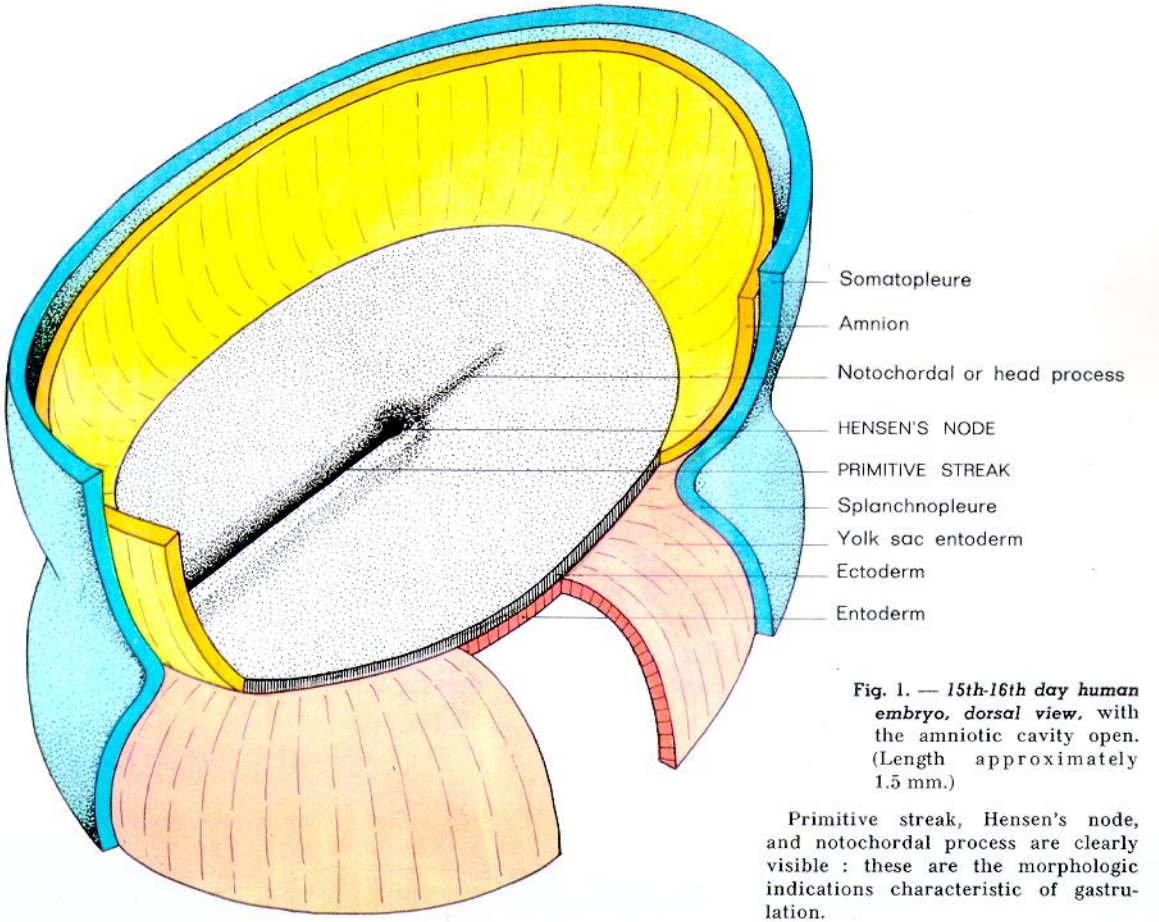


Fig. 1. — *15th-16th day human embryo, dorsal view,* with the amniotic cavity open. (Length approximately 1.5 mm.)

Primitive streak, Hensen's node, and notochordal process are clearly visible : these are the morphologic indications characteristic of gastrulation.

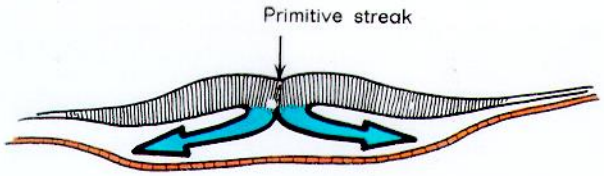
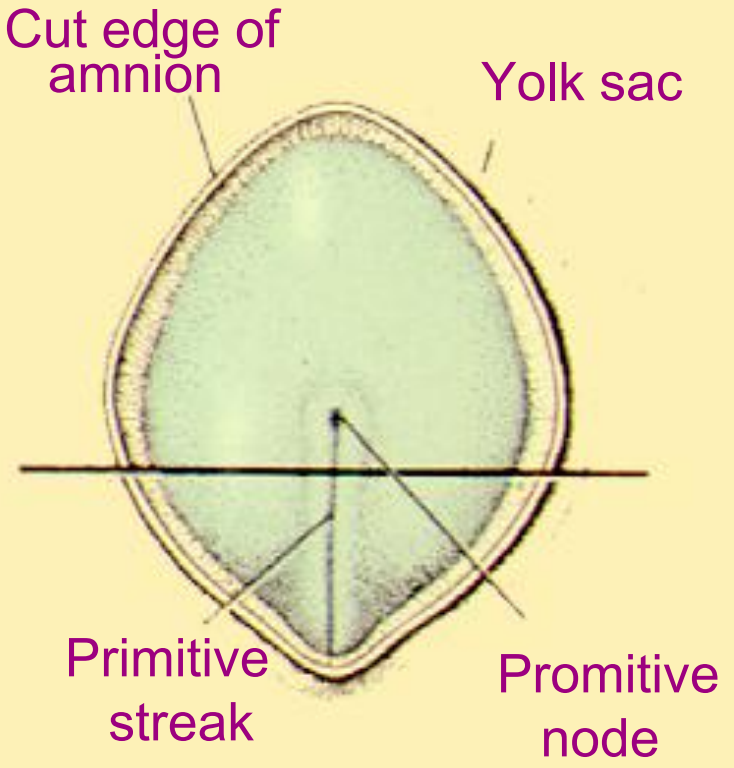
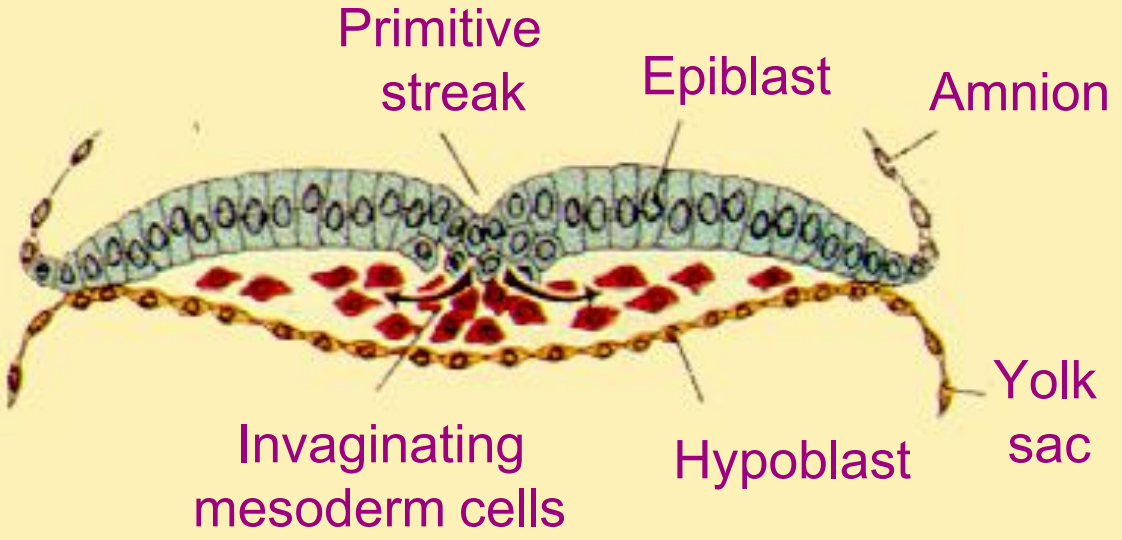


Fig. 2. — Cellular movements at the level of the primitive streak. *(Cross section.)*

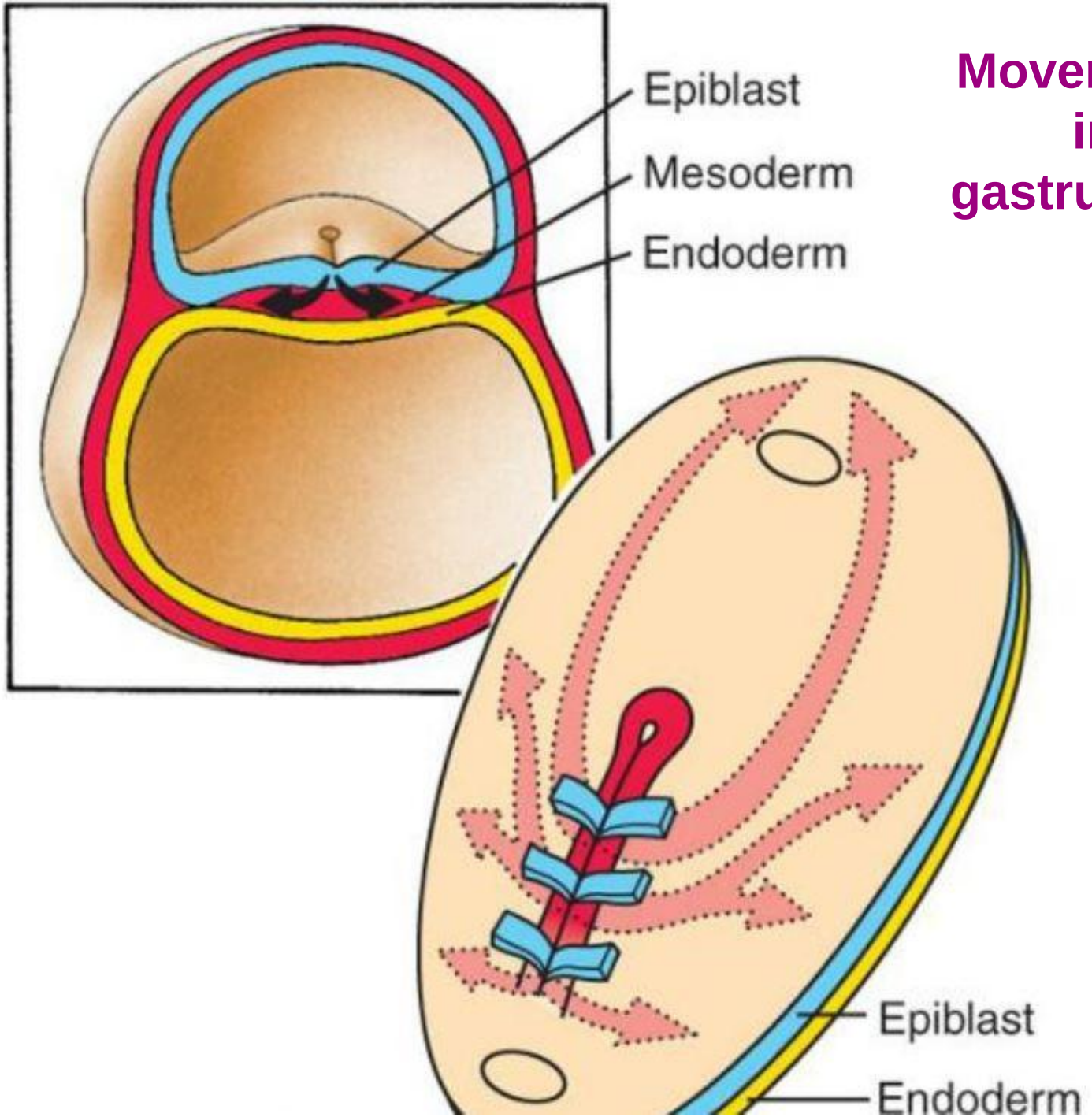
Formation of the mesoderm occurs through a process of cellular migration: ectodermal cells glide downward at the level of the primitive streak

Dorsal side of a 16-day presomite embryo
Transverse section through the region of the primitive streak

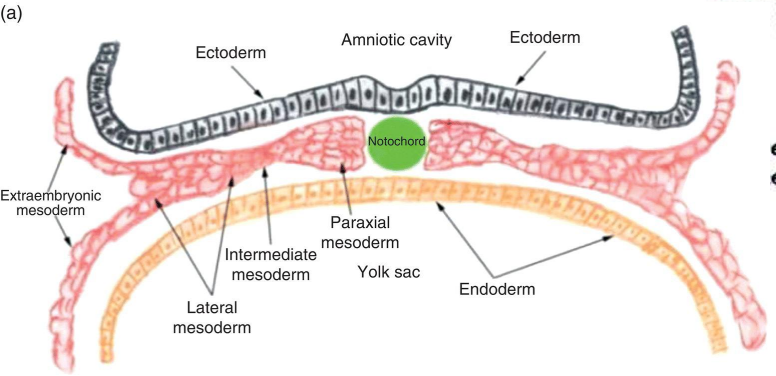




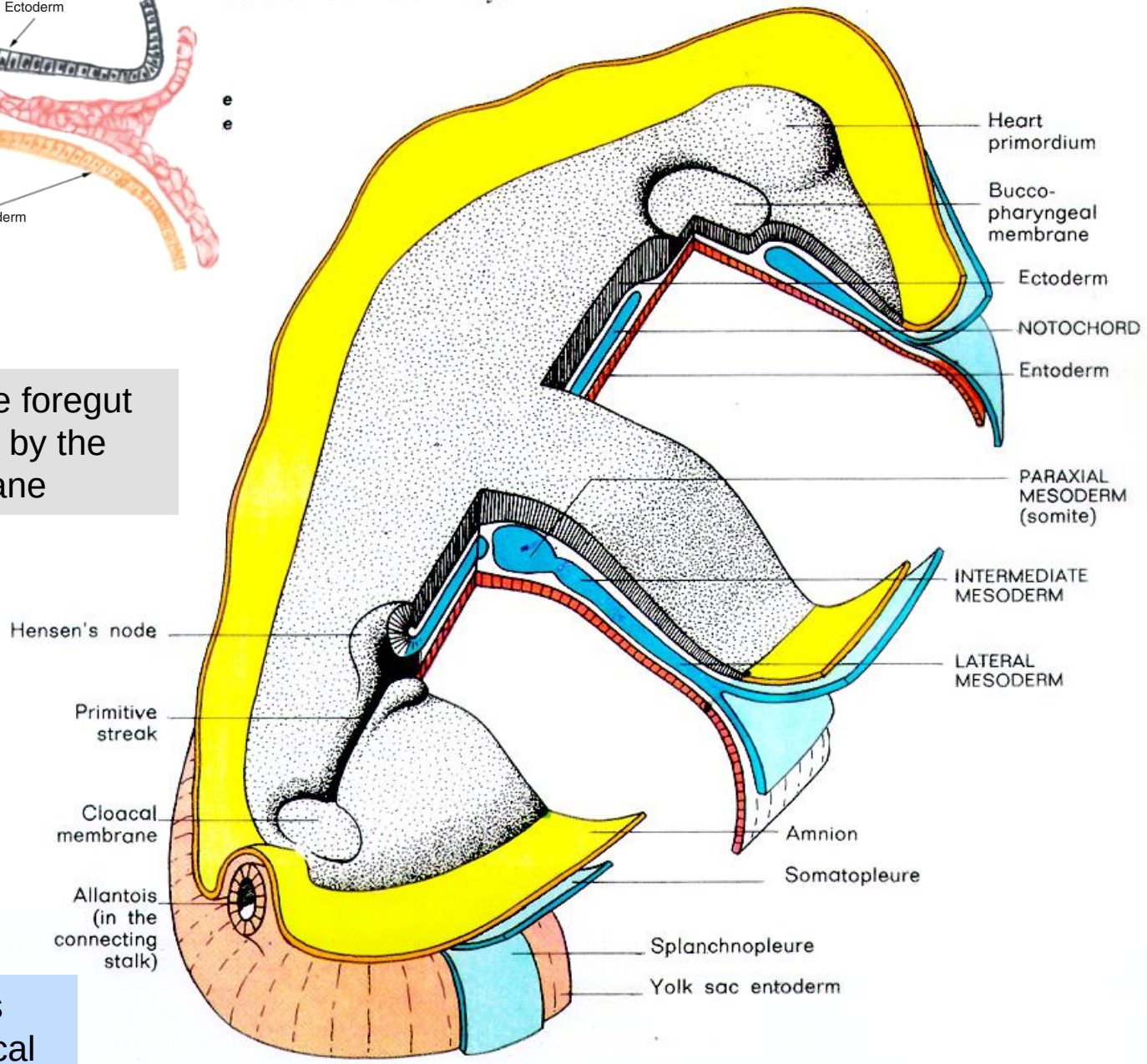
Movements in gastrulation



gives rise to the somites, and the intermediate and lateral mesoderm
be studied successively.



At the cephalic end, the foregut is temporarily bounded by the oropharyngeal membrane



The hindgut terminates temporarily at the cloacal membrane .

THIRD WEEK: FORMATION OF THE TRILAMINAR GERM DISC (GASTRULATION)

PRIMITIVE STREAK (14-16)

PRIMITIVE NODE (Hensen's node)

(primitive pit)

EPIBLAST CELLS MIGRATION

(formation of the *mesoderm and intraembryonic endoderm*)

(three germ layers)

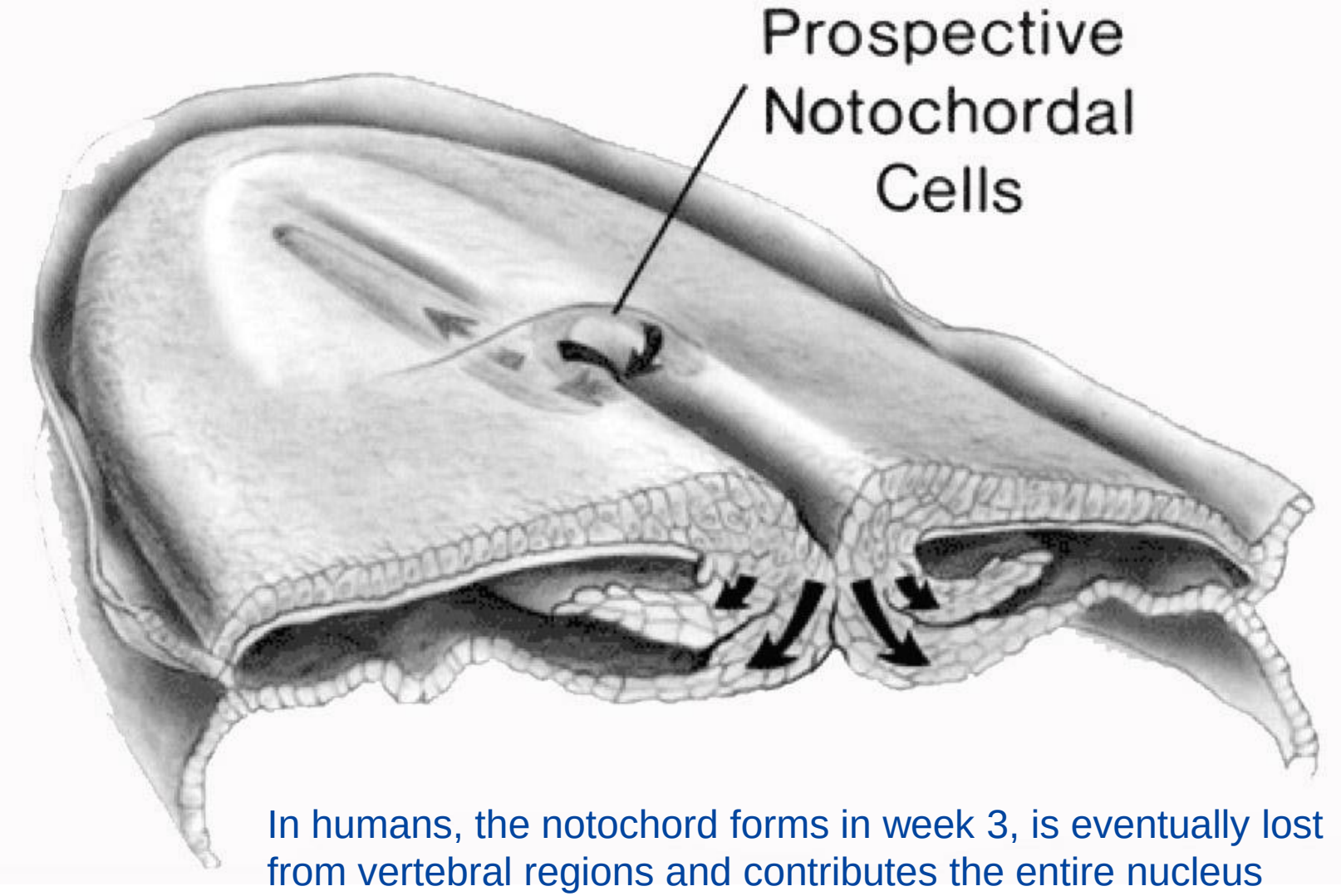
FORMATION OF THE NOTOCHORD (16-20)

NOTOCHORDAL (head) PROCESS (17)

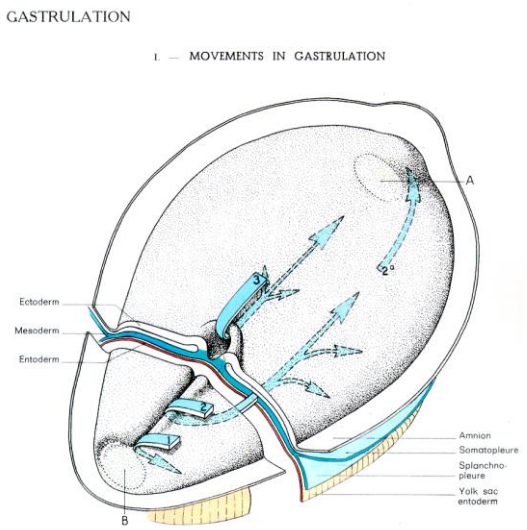
NOTOCHORDAL PLATE (19)

DEFINITIVE NOTOCHORD (20)

NOTOCHORD FORMATION



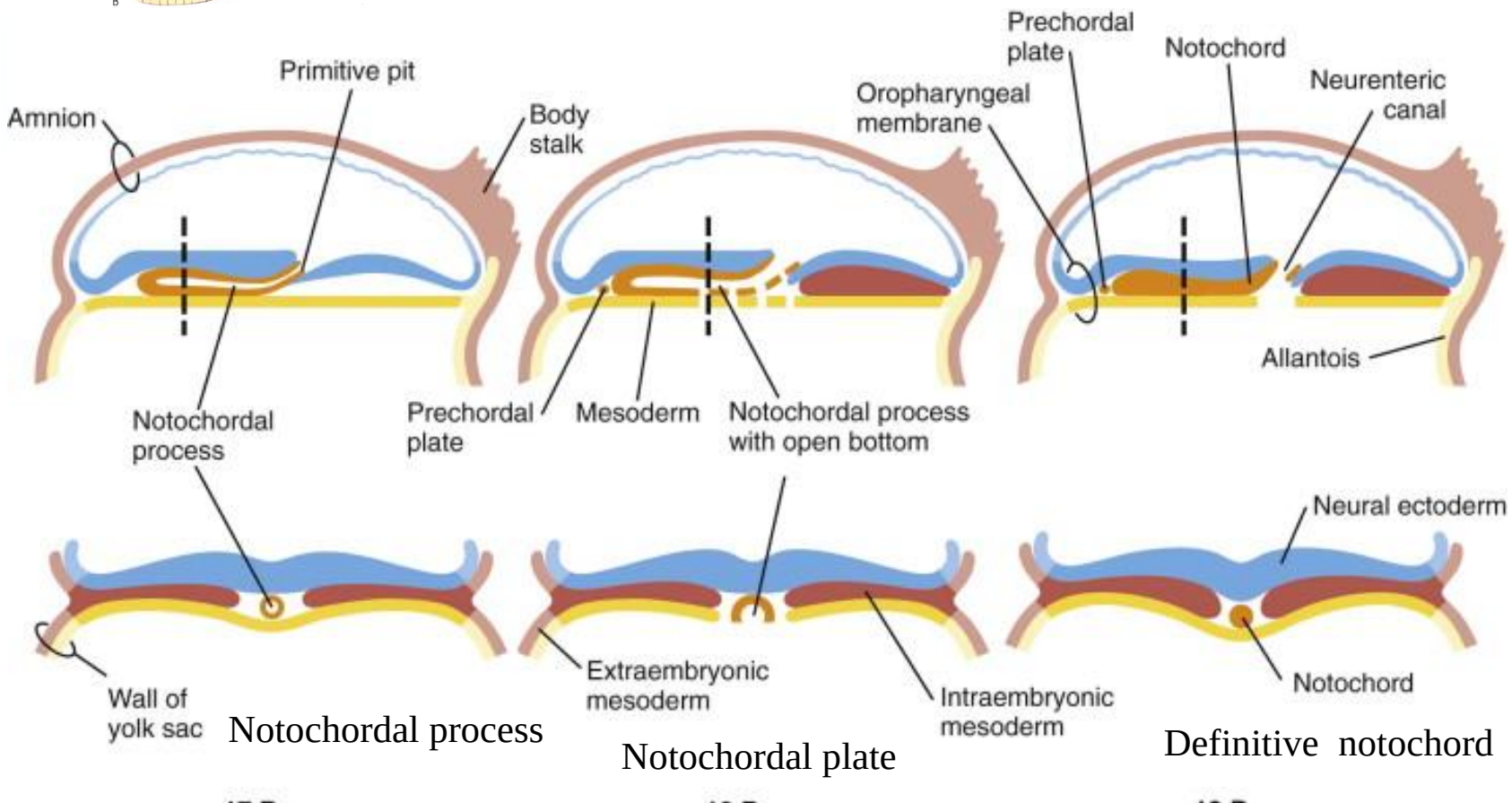
In humans, the notochord forms in week 3, is eventually lost from vertebral regions and contributes the entire nucleus pulposus of the intervertebral disc during the formation of the vertebral column.



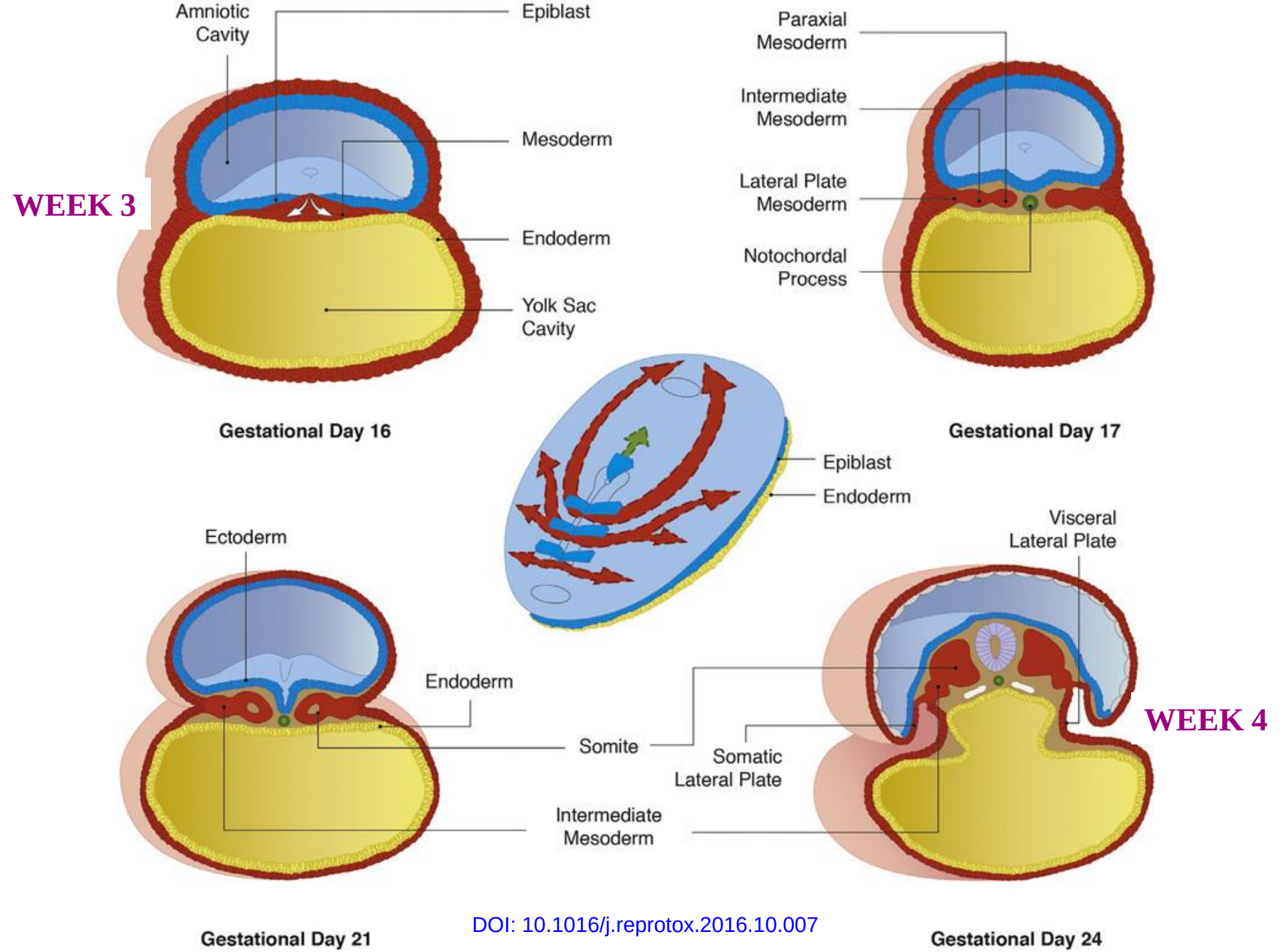
The notochord formation

The progenitor **notochord** is derived from cells migrating from the primitive node and pit. The **notochord** forms during gastrulation and soon after induces the **formation** of the neural plate (neurulation), synchronizing the **development** of the neural tube.

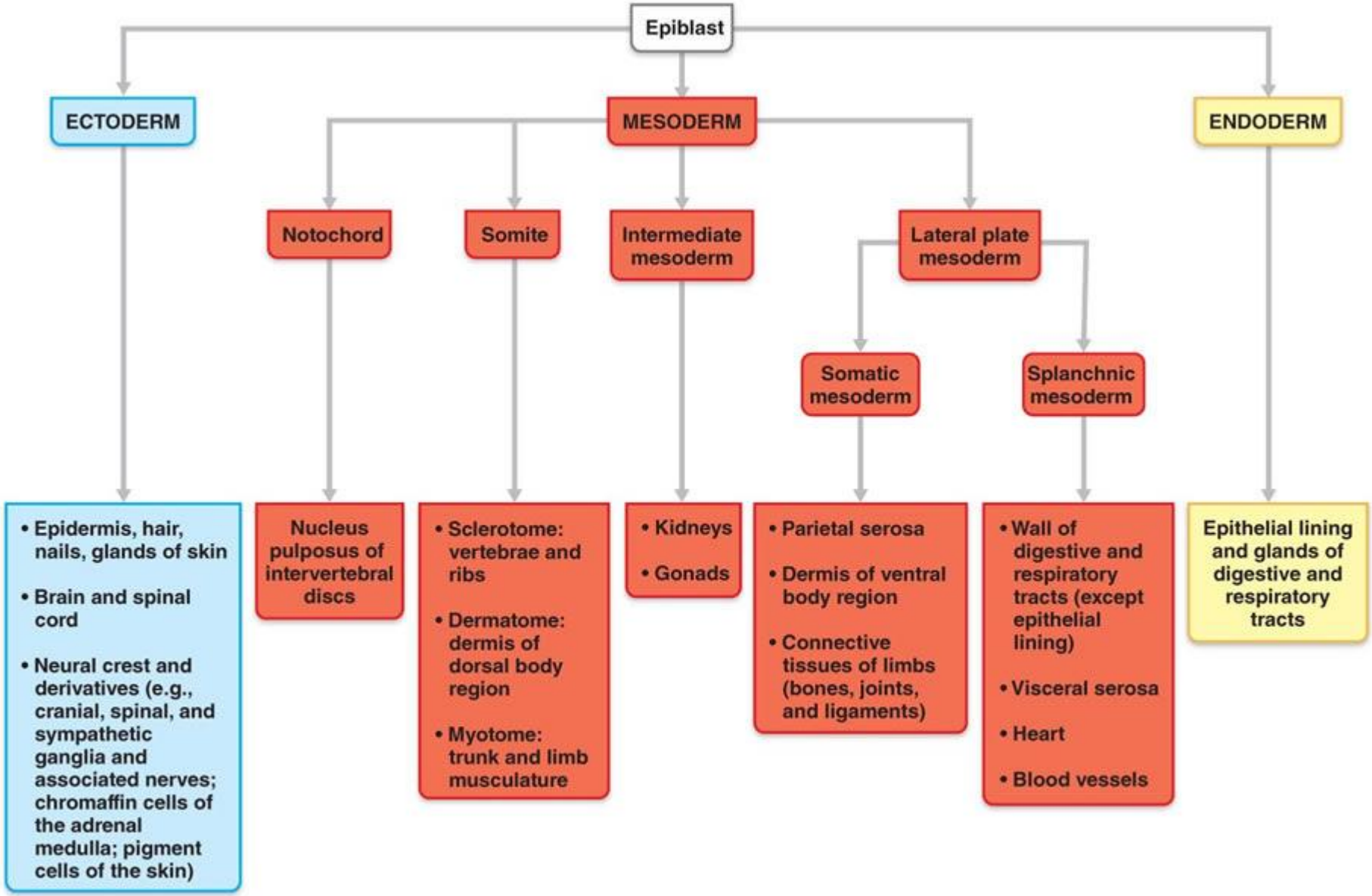
The neurenteric canal temporarily connects the amniotic and yolk sac cavities



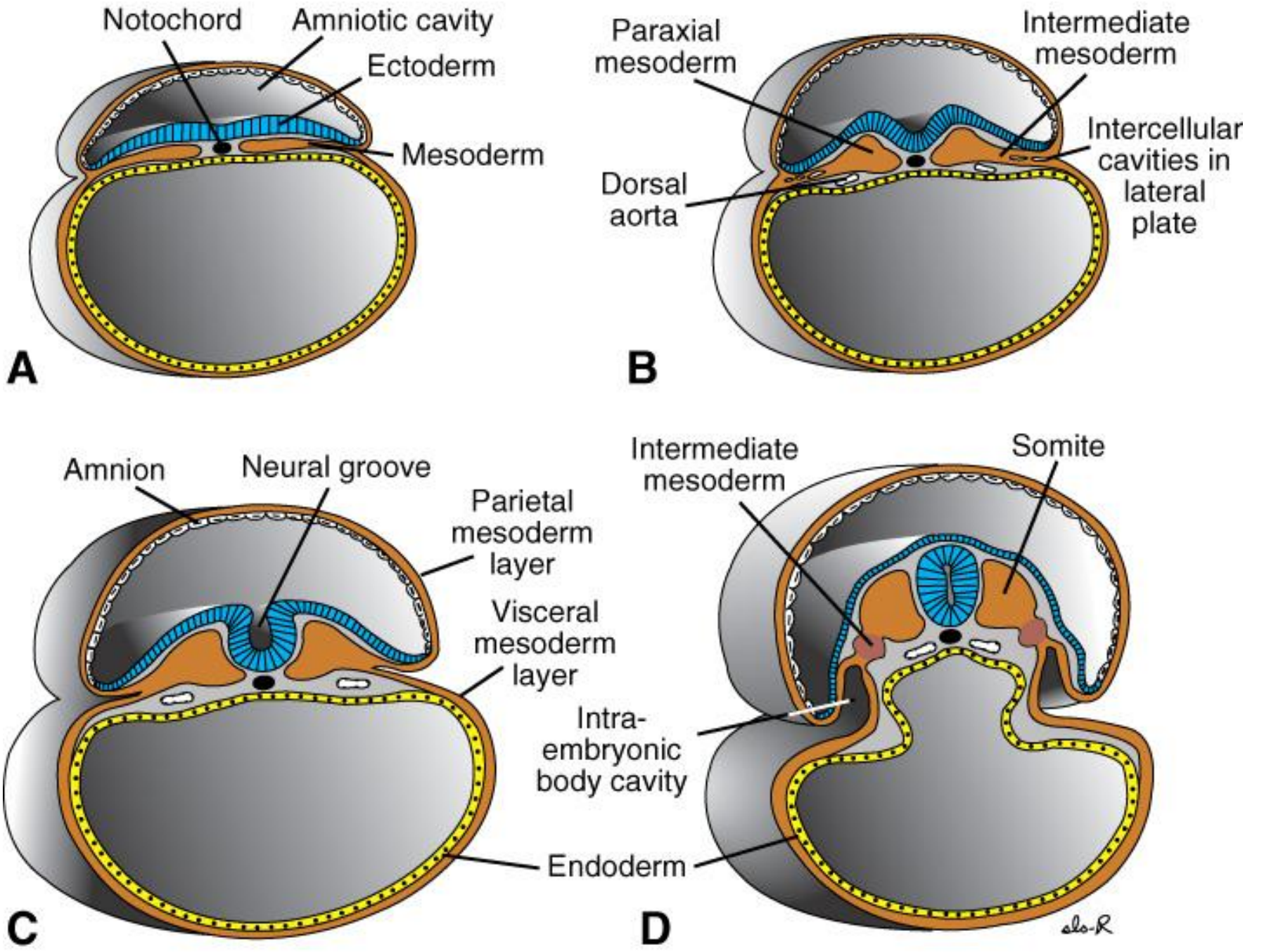
The primitive streak usually disappears without a trace. Occasionally remnants may persist in the sacrococcygeal region of the embryo to give rise to a tumor called a TERATOMA. These tumors are more common in females than in males and may become malignant. The tumor appears as an external mass at the base of the spine. Because the primitive streak contains pluripotent cells, these tumors often contain tissue derivatives of all three germ layers. (Note: Teratomas may also result from abnormal migration of primitive germ cells.)

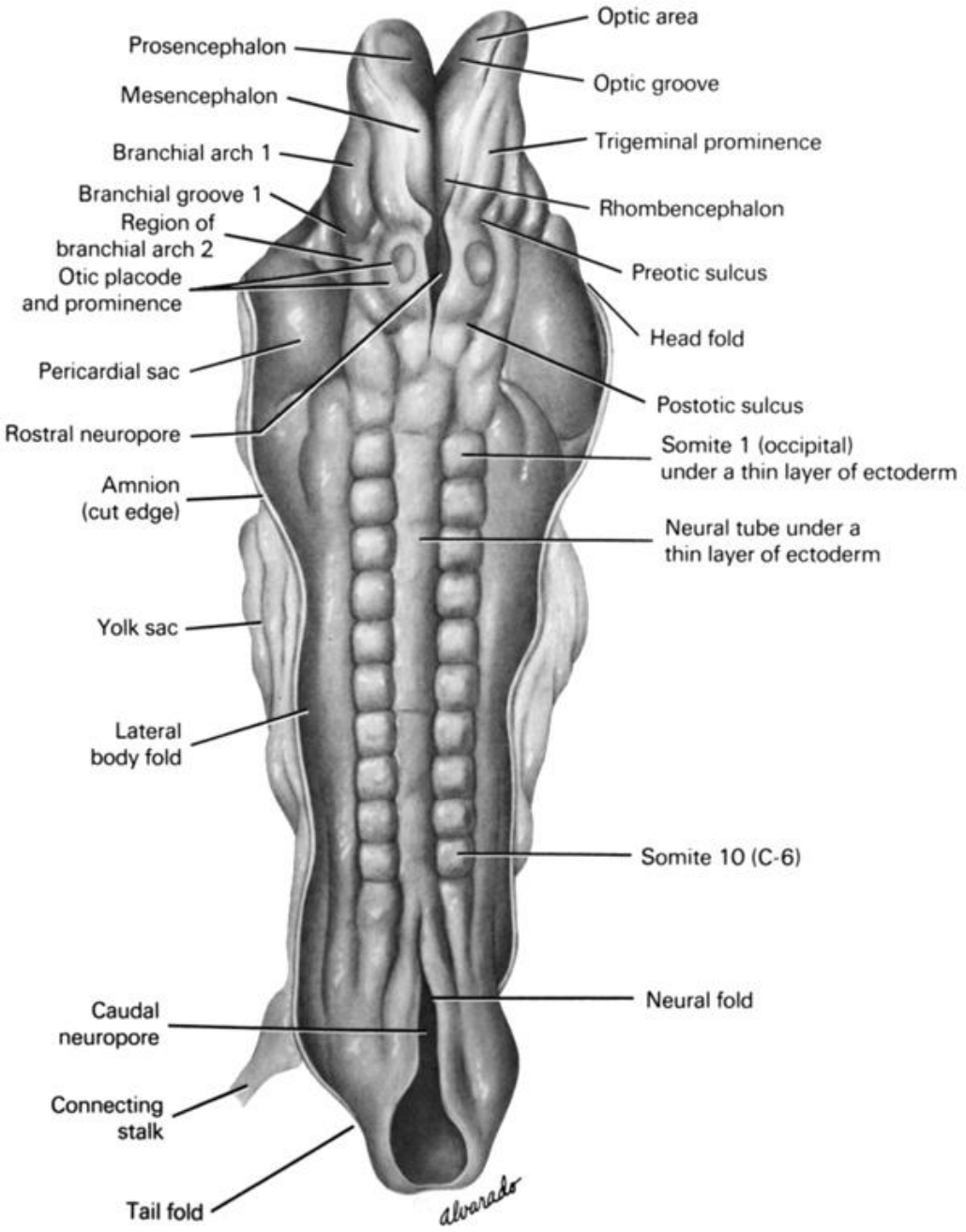


DOI: 10.1016/j.reprotox.2016.10.007



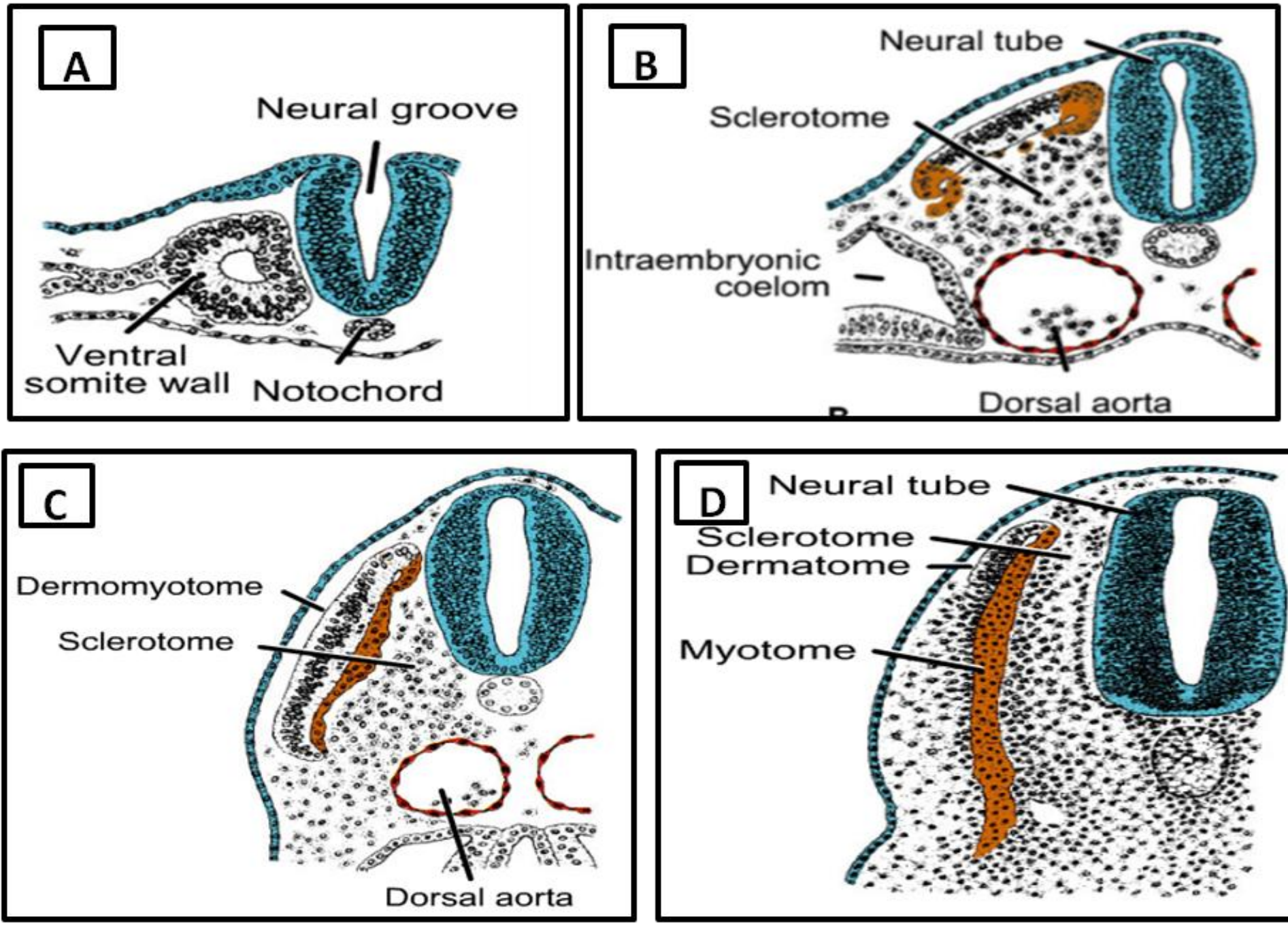
Endoderm	Mesoderm	Ectoderm
Gastrointestinal tract from pharynx to upper rectum	Muscles	Neural crest:
Liver	Bone and connective tissue (except in head)	Melanocytes
Pancreas	Urinary system	Ganglia of cranial nerves and spinal dorsal root
Respiratory epithelium	Reproductive system	Major part of autonomic nervous system
Middle ear epithelium	Circulatory system	Schwann and glial cells
Urinary bladder epithelium	Dermis (except in head and neck)	Adrenal medulla
Thyroid		Bone and connective tissue of head
Parathyroid		Dermis in head and neck
		Nervous system (see neural crest above)
		Sensory epithelium of eye, ear and nose
		Oral epithelium
		Epidermis
		Mammary gland

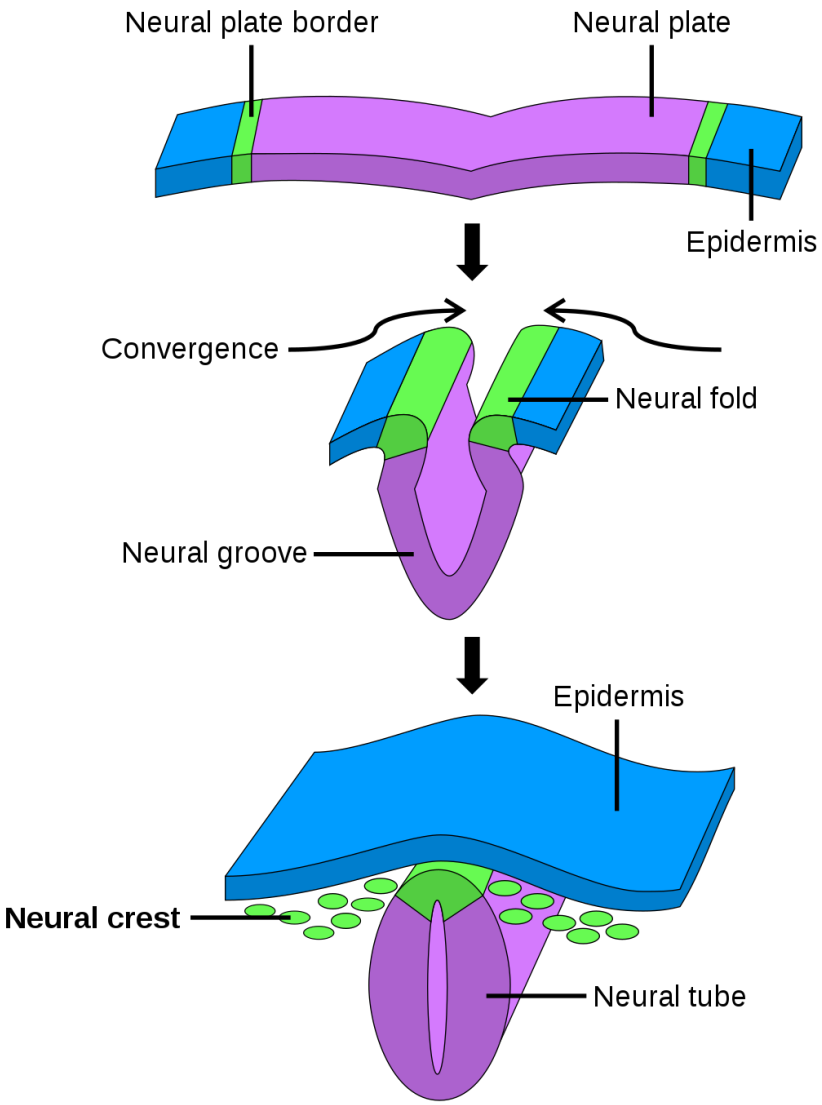

Notochord
Amniotic cavity
Ectoderm
Mesoderm
A
Paraxial mesoderm
Intermediate mesoderm
Intercellular cavities in lateral plate
Dorsal aorta
B
Amnion
Neural groove
Parietal mesoderm layer
Visceral mesoderm layer
Endoderm
C
Intermediate mesoderm
Somite
Intra-embryonic body cavity
D
slo-R



The term **somitogenesis** is used to describe the process of segmentation of the **paraxial mesoderm** within the trilaminar embryo body to form pairs of **somites**, or balls of mesoderm. In humans, the **first** somite pair appears at **day 20** and adds caudally at 1 somite pair/90 minutes until on average 44 pairs eventually form.


somites


A
Neural groove
Ventral somite wall
Notochord
B
Neural tube
Sclerotome
Intraembryonic coelom
Dorsal aorta
C
Dermomyotome
Sclerotome
Dorsal aorta
D
Neural tube
Sclerotome
Dermatome
Myotome



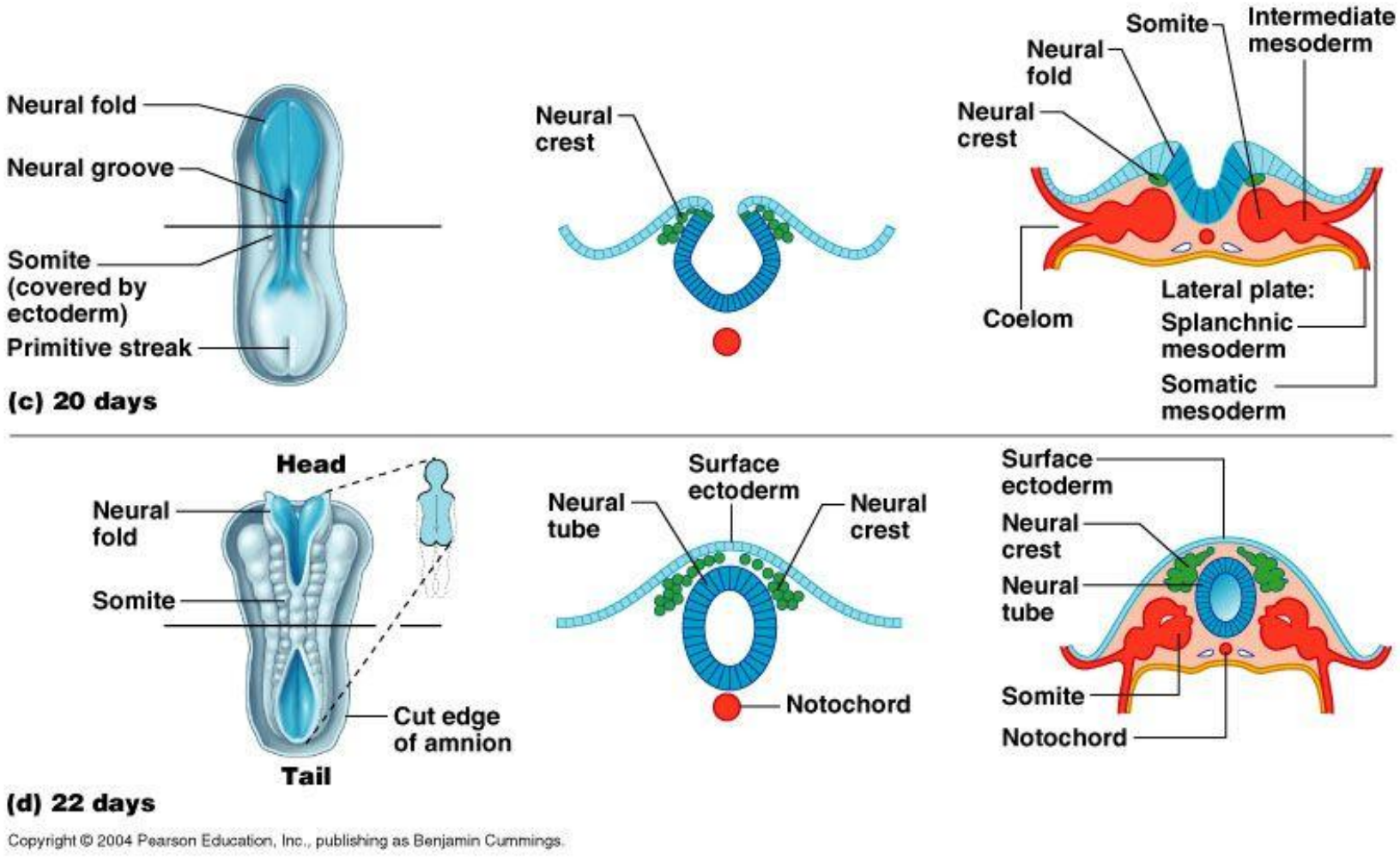
Neural plate formation: in this step the neural plate formation occurs inside the embryo by division of cells.

Neural plate Shaping/Modelling: in this step the neural plate formed takes a definite shape or remodels to form a definite shape.

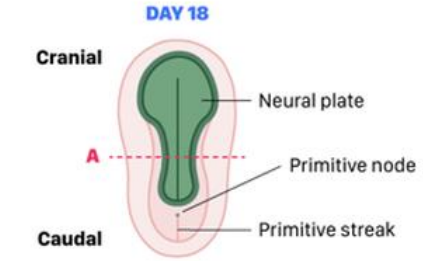
The neural plate is bent to form **neural grooves**: in this step, the neural plate is bent to form grooves.

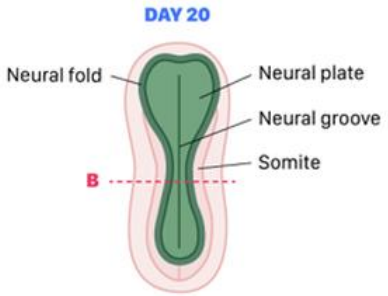
Neural grooves are closed to form **neural tubes:** in this step, the neural grooves close to form a tube that is a neural tube.

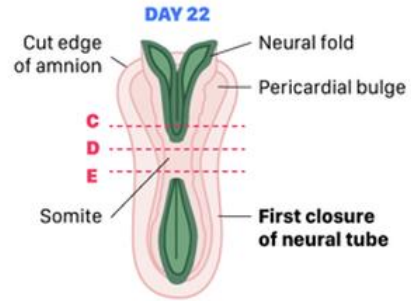
WEEK 3

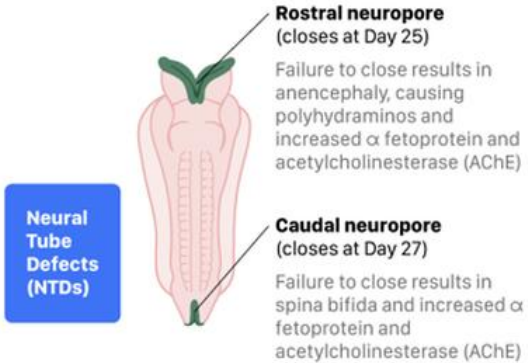


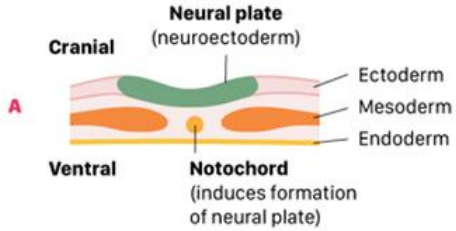
WEEK 4

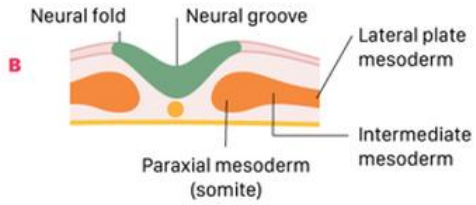


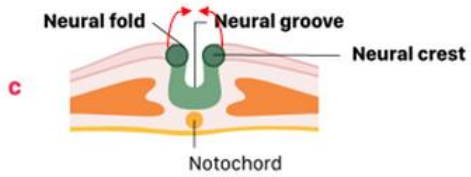


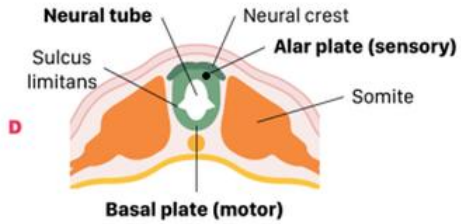


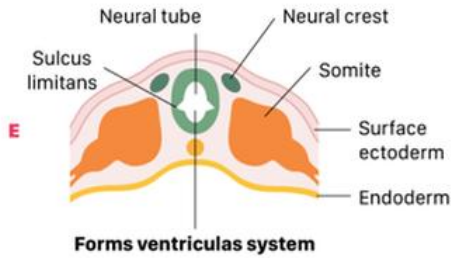




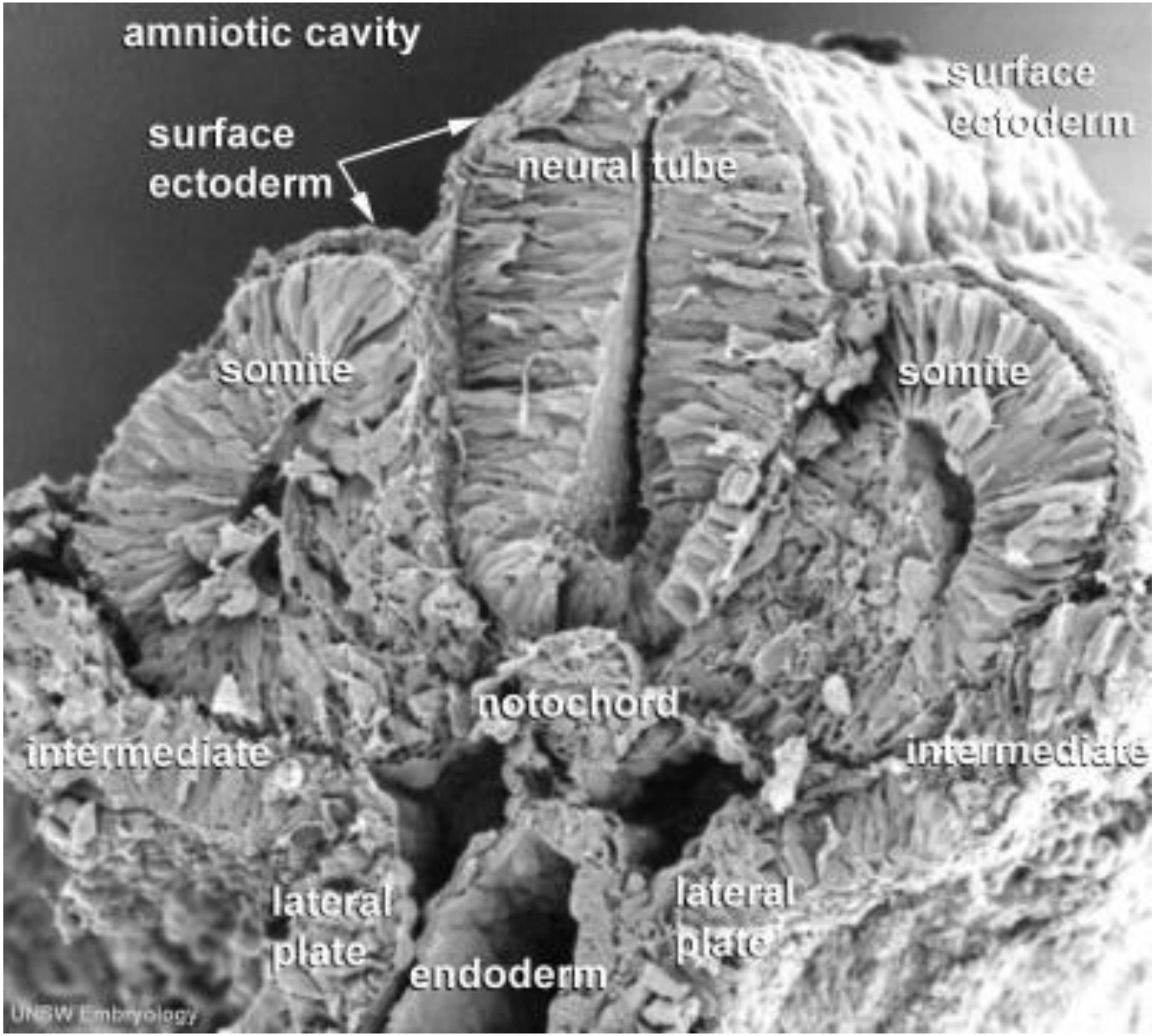






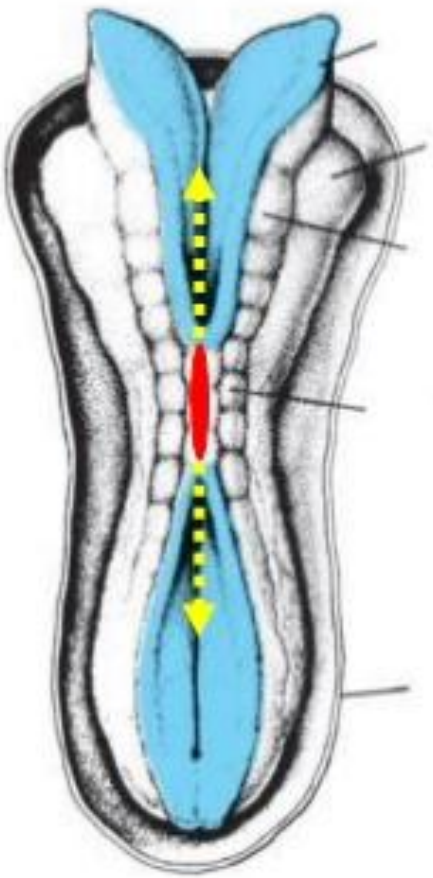


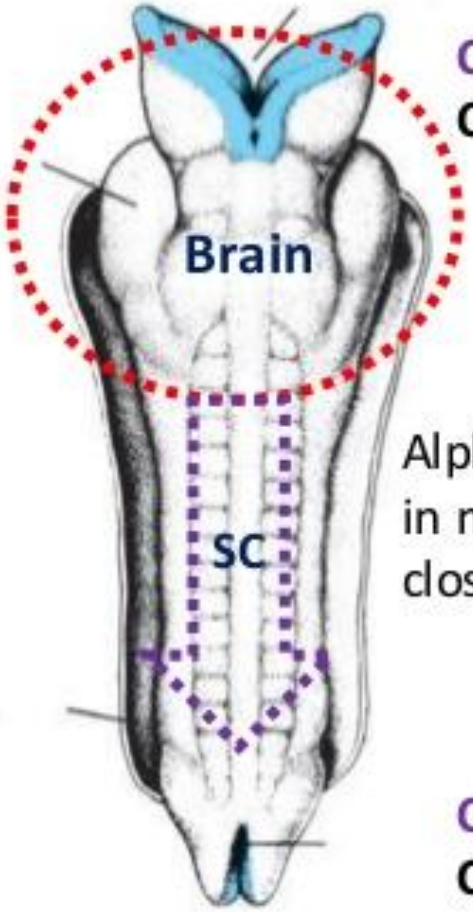
Week 4



Human embryo 25 days, 19 somite pairs Scanning EM. (Carnegie stage 11)

ectoderm

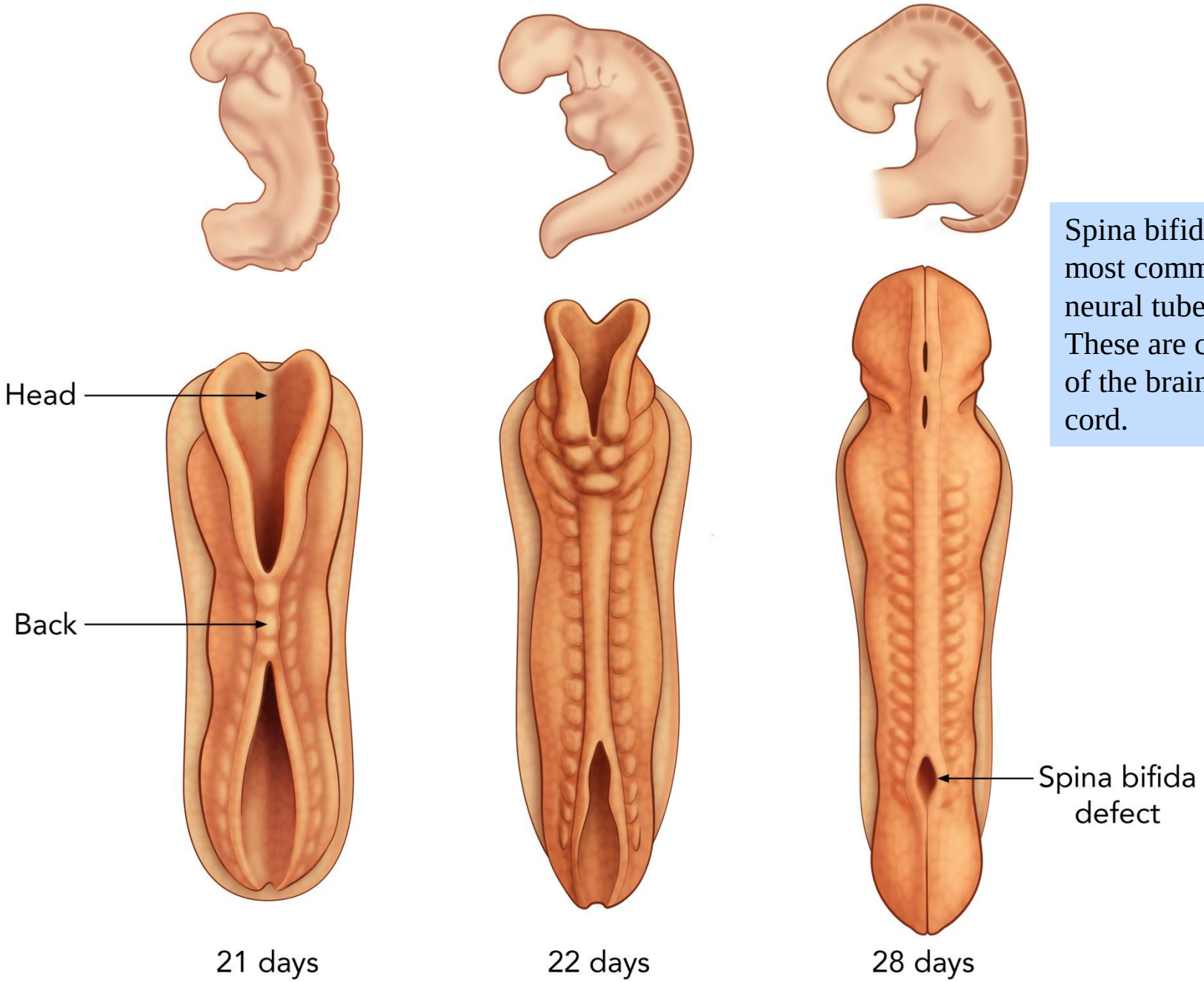




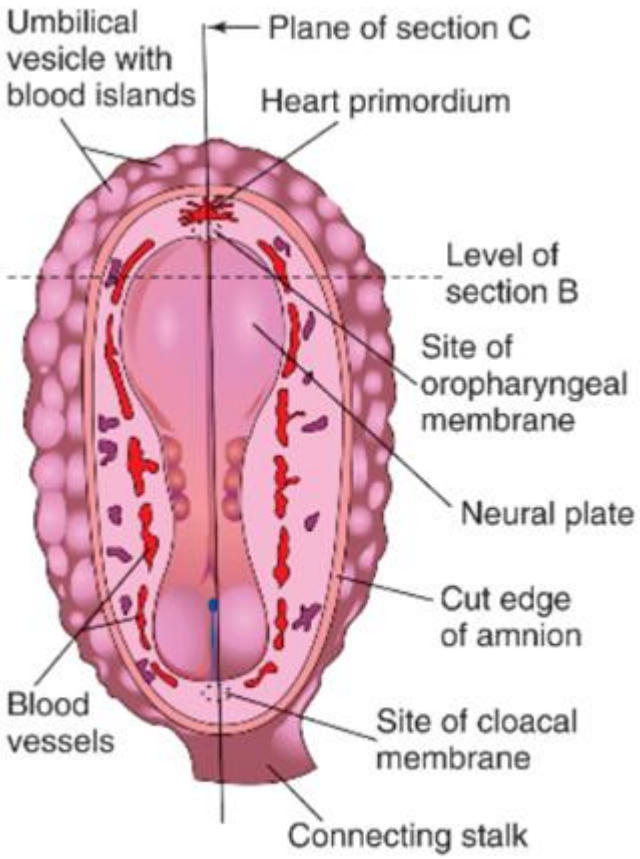
Cranial neuropore
Closure at 25th day

Alpha feto protein (AFP) increases in maternal AF if neuropores fail to close (neural tube defects).

Caudal neuropore
Closure at 27th day

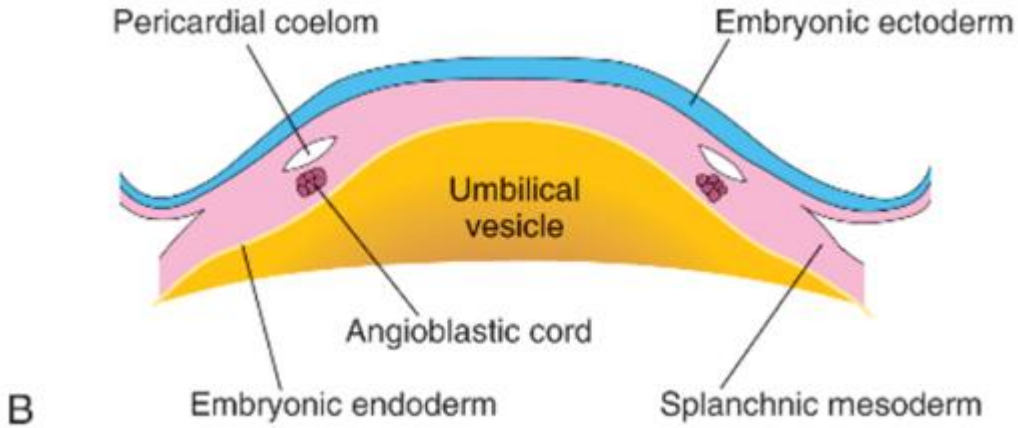


Spina bifida is the most common kind of neural tube defect. These are conditions of the brain and spinal cord.

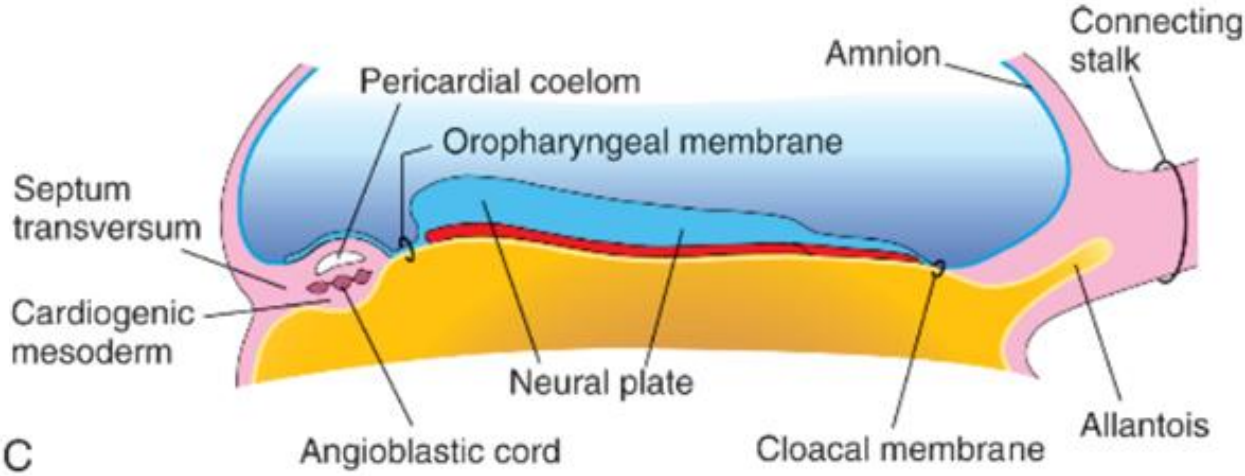

Umbilical vesicle with blood islands
Plane of section C
Heart primordium
Level of section B
Site of oropharyngeal membrane
Neural plate
Cut edge of amnion
Blood vessels
Site of cloacal membrane
Connecting stalk

A

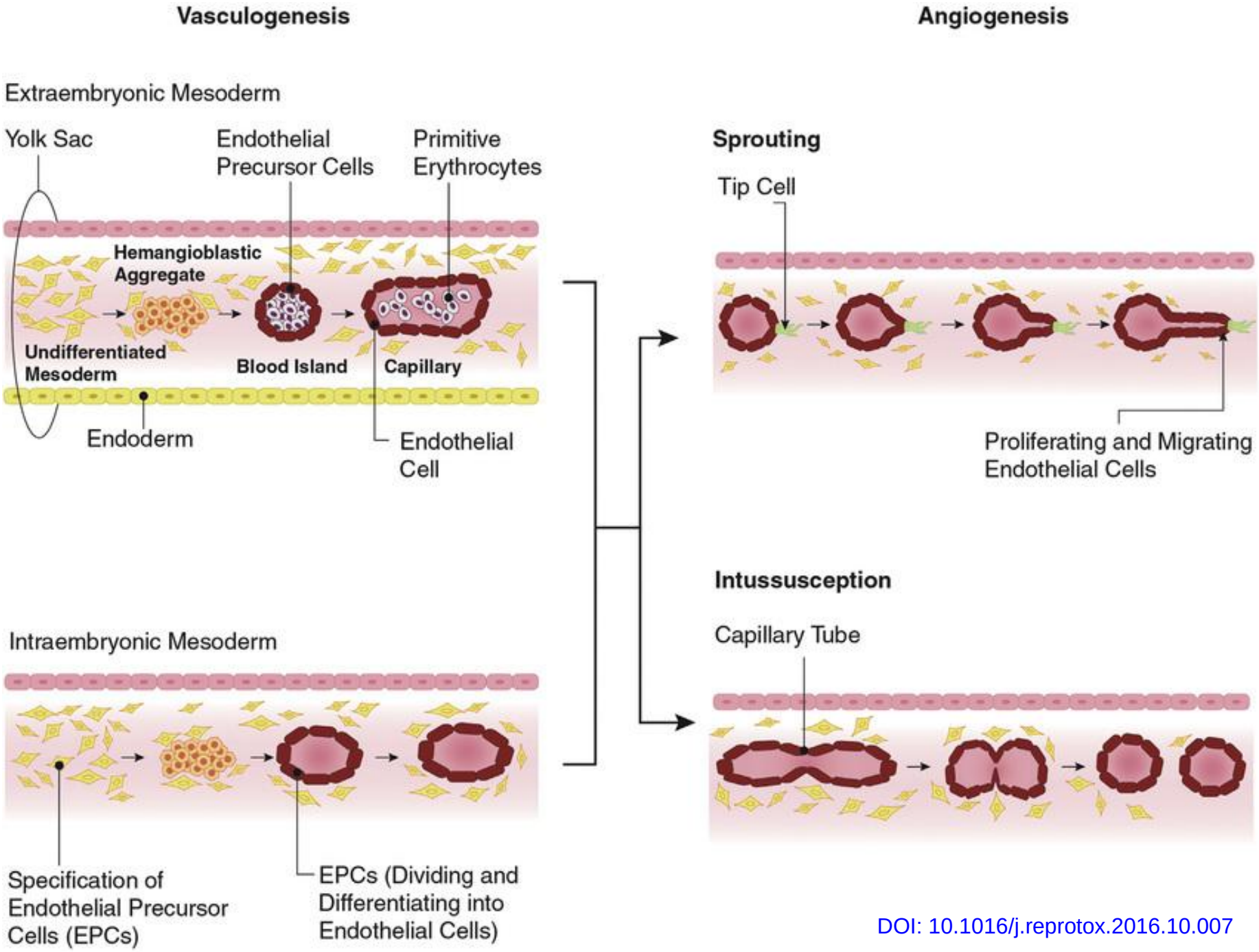
Day 18


Pericardial coelom
Embryonic ectoderm
Umbilical vesicle
Angioblastic cord
Embryonic endoderm
Splanchnic mesoderm

B


Amnion
Connecting stalk
Pericardial coelom
Oropharyngeal membrane
Septum transversum
Cardiogenic mesoderm
Neural plate
Angioblastic cord
Cloacal membrane
Allantois

C



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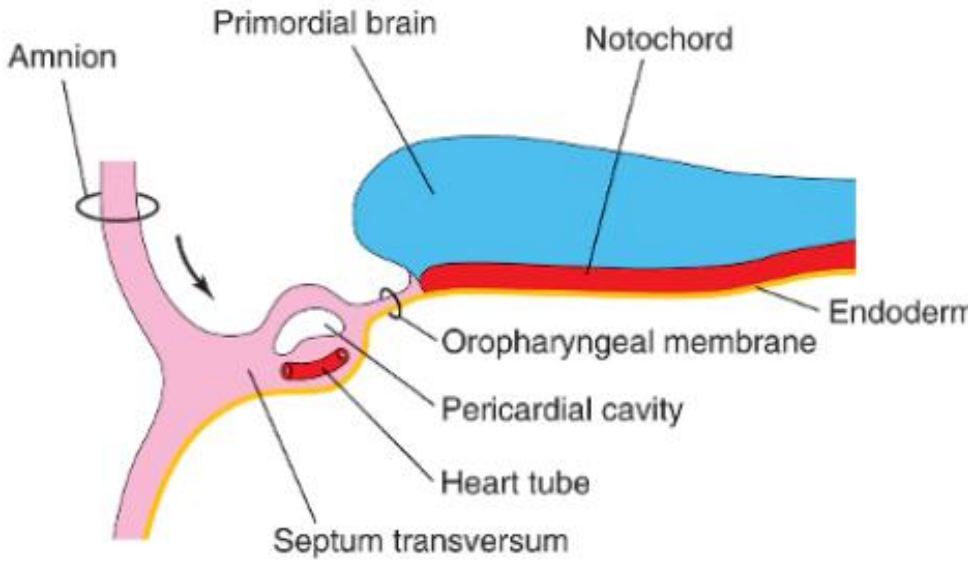
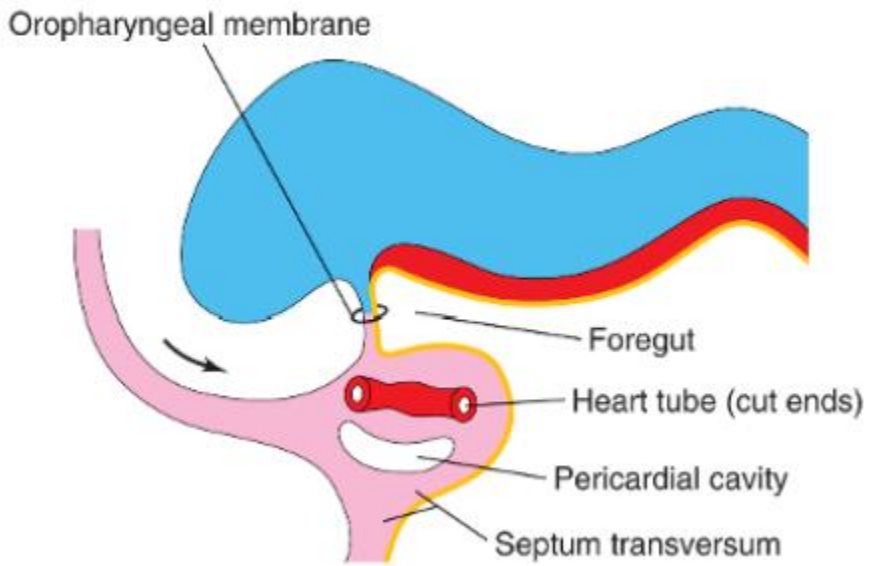
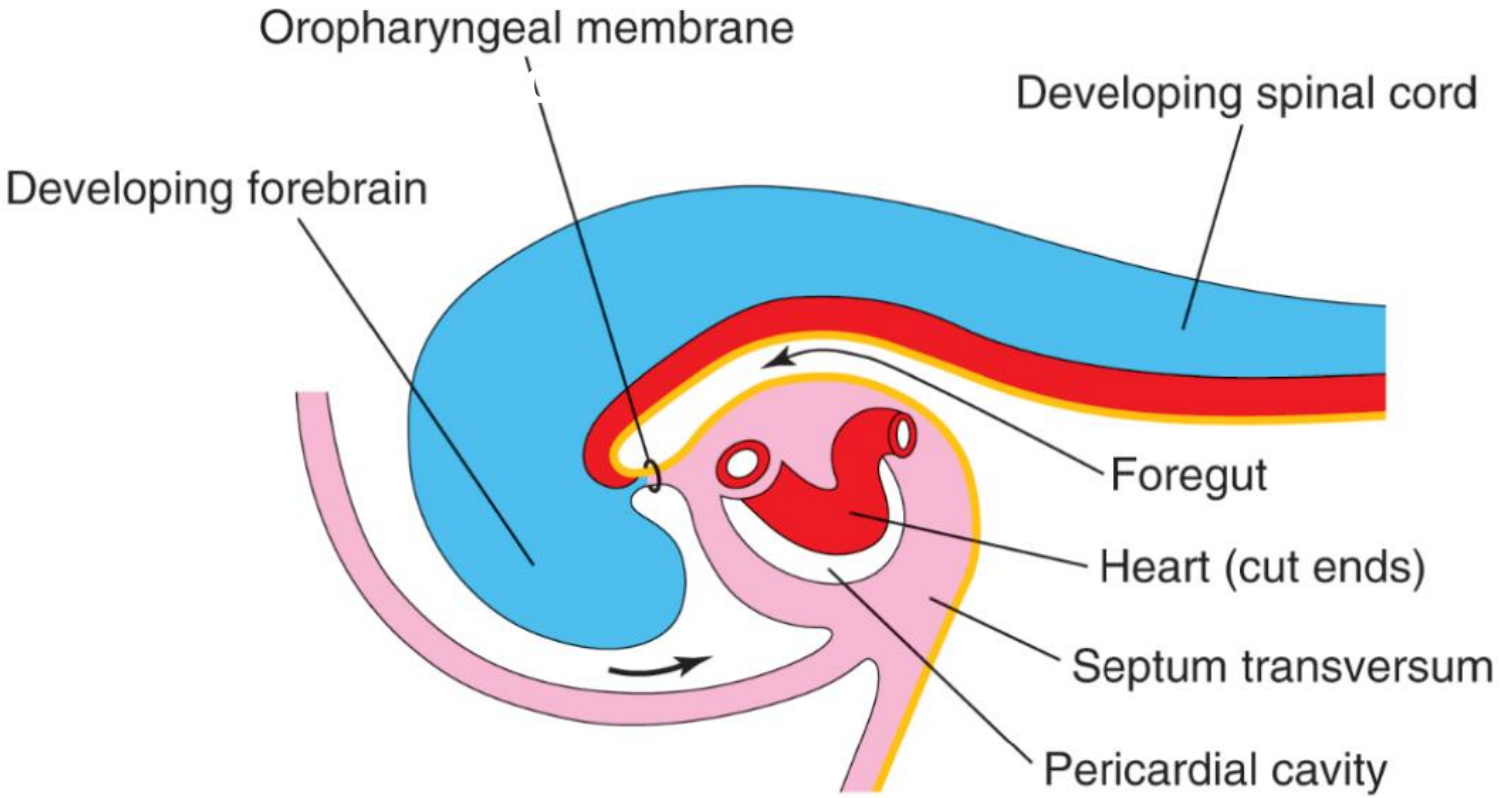
Longitudinal sections through the cranial half of human embryos during the **fourth week** of development.



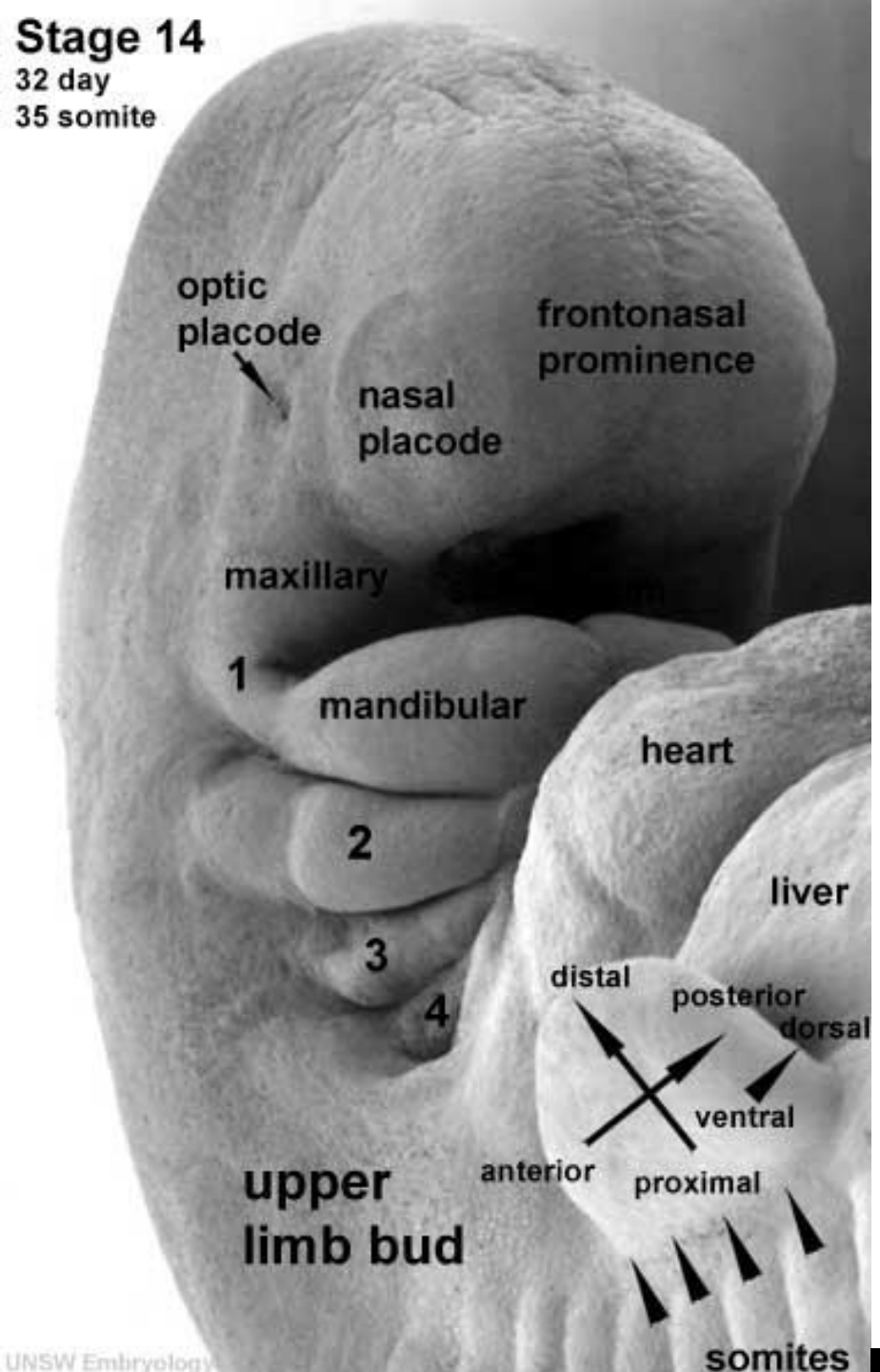


The effect of the head fold (*arrows*) on the position of the heart and other structures is shown. **A** and **B,** As the head fold develops, the heart tube and the pericardial cavity come to lie ventral to the foregut and caudal to the oropharyngeal membrane.

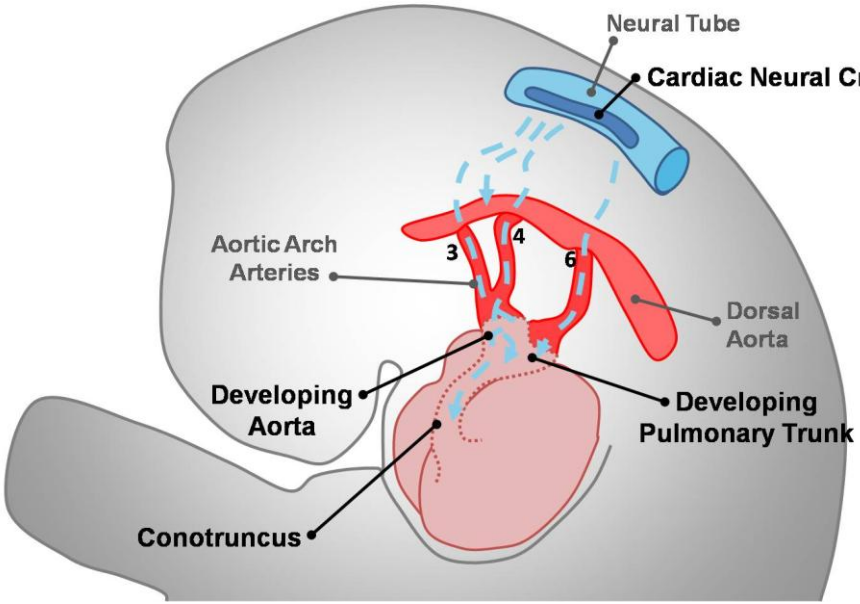


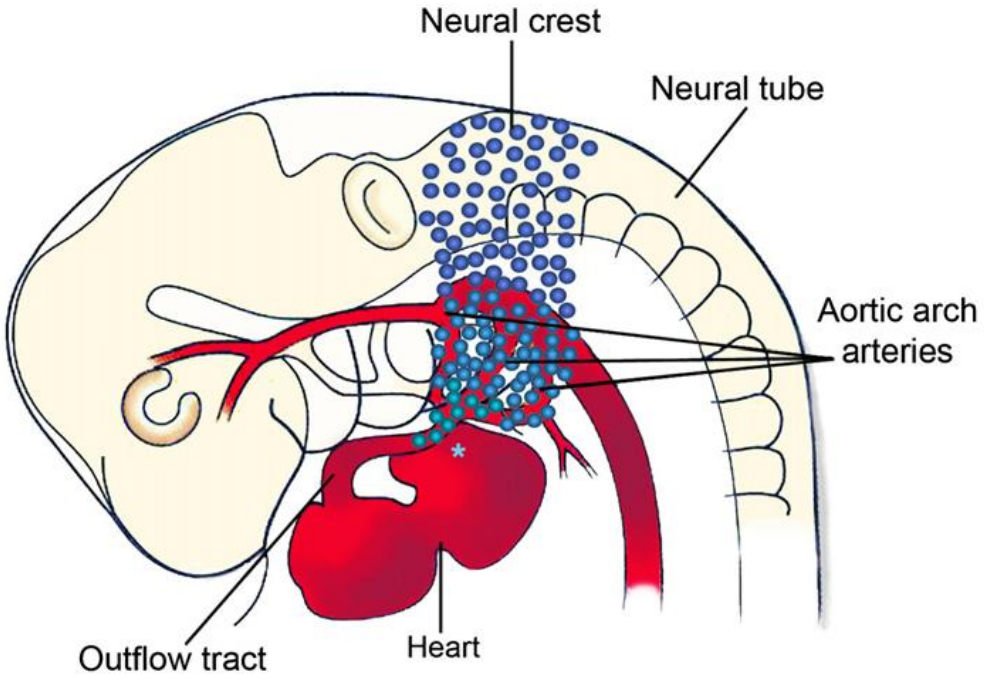
C

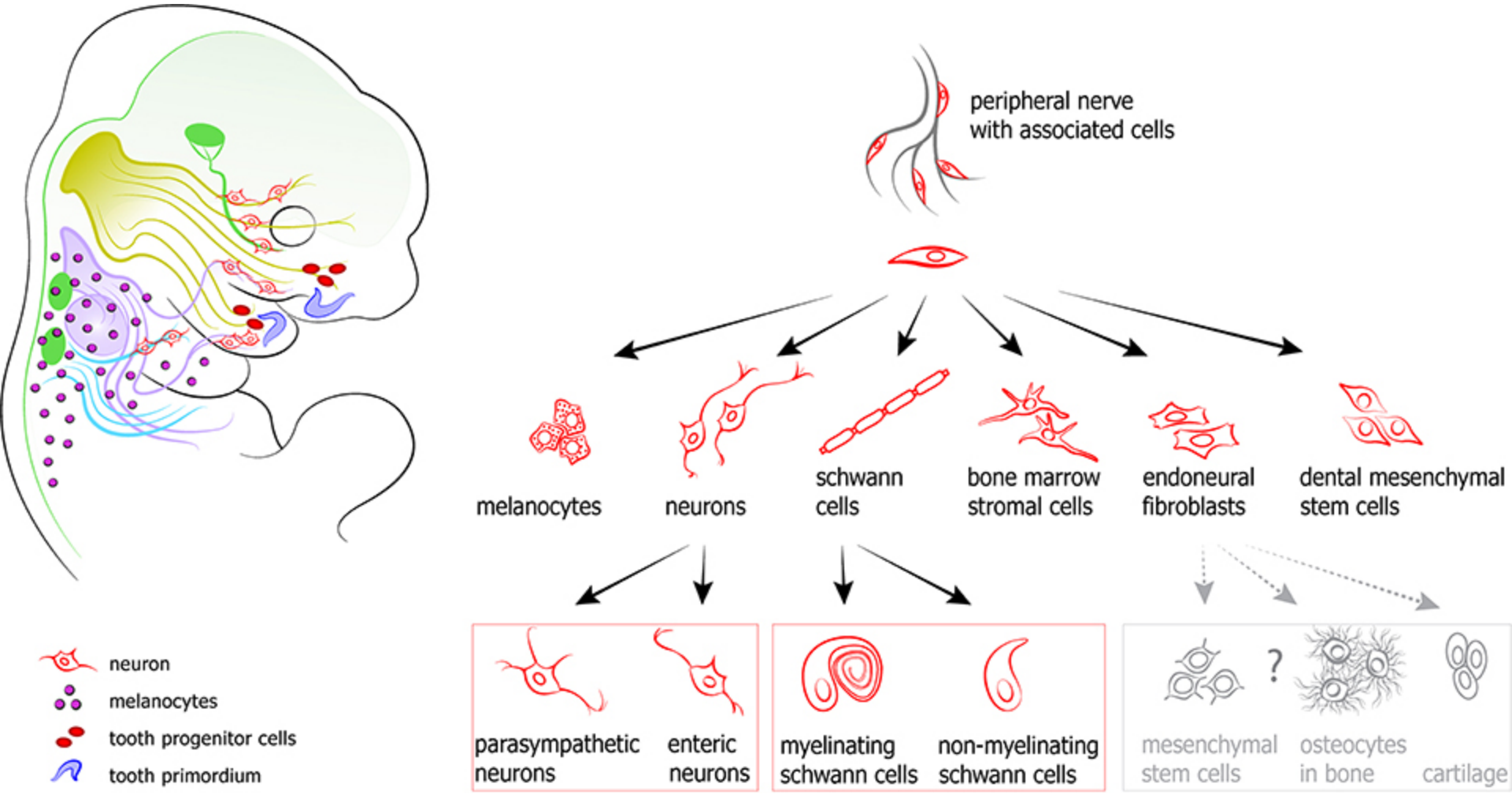
The positions of the pericardial cavity and the septum transversum have reversed with respect to each other. The **septum transversum** now lies posterior to the pericardial cavity, where it will form the central tendon of the diaphragm.



Embryo – Week 5: Migration of the Cardiac Neural Crest

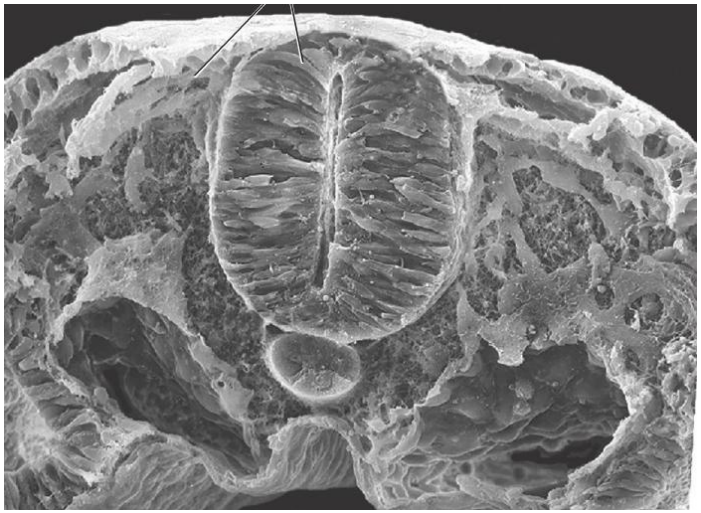


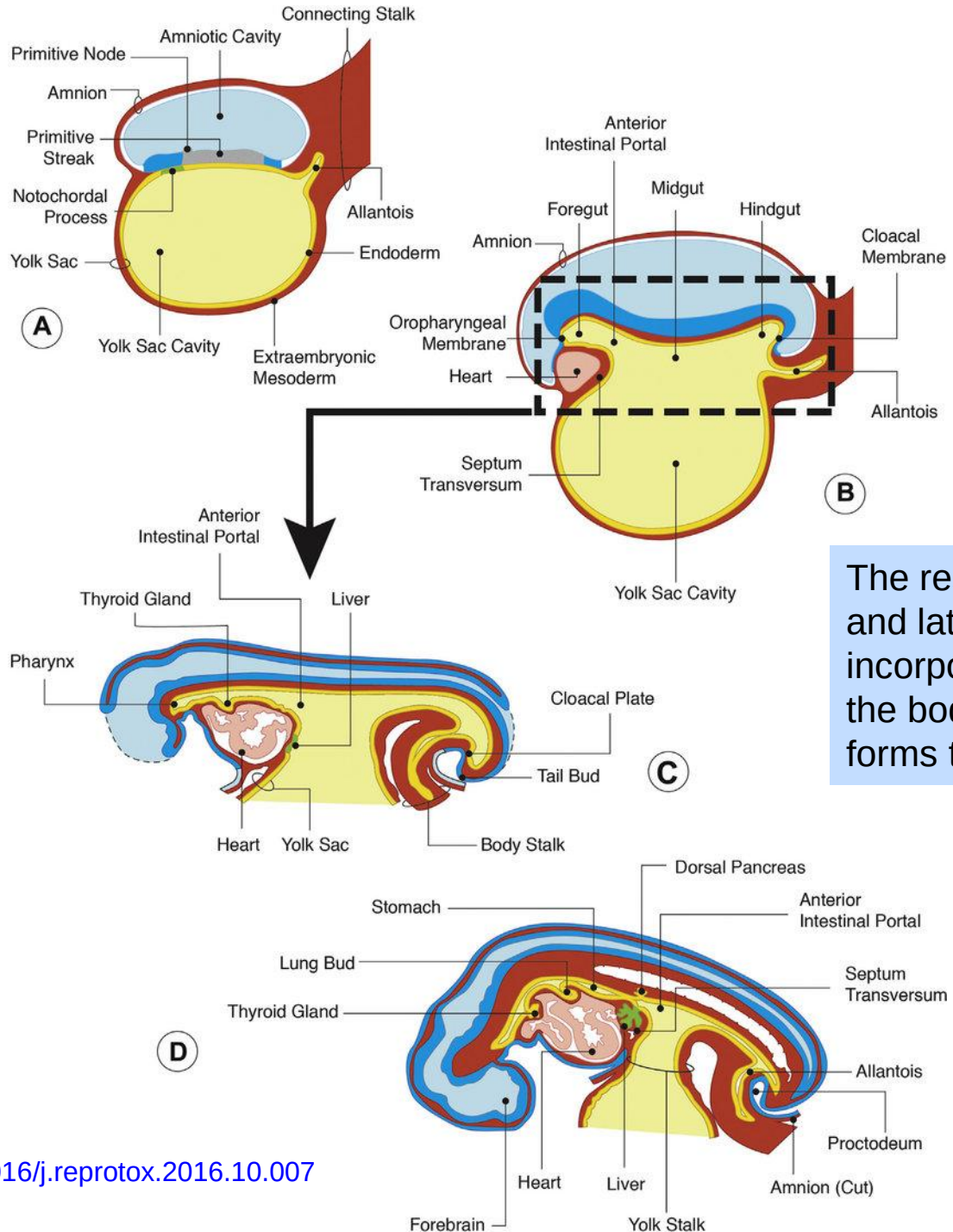



peripheral nerve
with associated cells
melanocytes
neurons
schwann
cells
bone marrow
stromal cells
endoneural
fibroblasts
dental mesenchymal
stem cells
parasympathetic
neurons
enteric
neurons
myelinating
schwann cells
non-myelinating
schwann cells
?
mesenchymal
stem cells
osteocytes
in bone
cartilage
neuron
melanocytes
tooth progenitor cells
tooth primordium

Neural crest cells

- Sometimes referred as a fourth germ layer
- Neural crest cells of the cranial neural folds leave the neural tube before closure
- Neural crest cells in the trunk region
- In the head region they form:
  - Craniofacial skeleton
  - Dermis of face and neck
  - Melanocytes
  - Cranial ganglia
  - C cells of thyroid gland
  - Odontoblasts and cementoblasts
  - Glial cells
  - Mesenchyme of thymus
  - Mesenchyme of parathyroid gland
  -





The result of cephalocaudal growth and lateral folding is partial incorporation of the allantois into the body of the embryo where it forms the cloaca.

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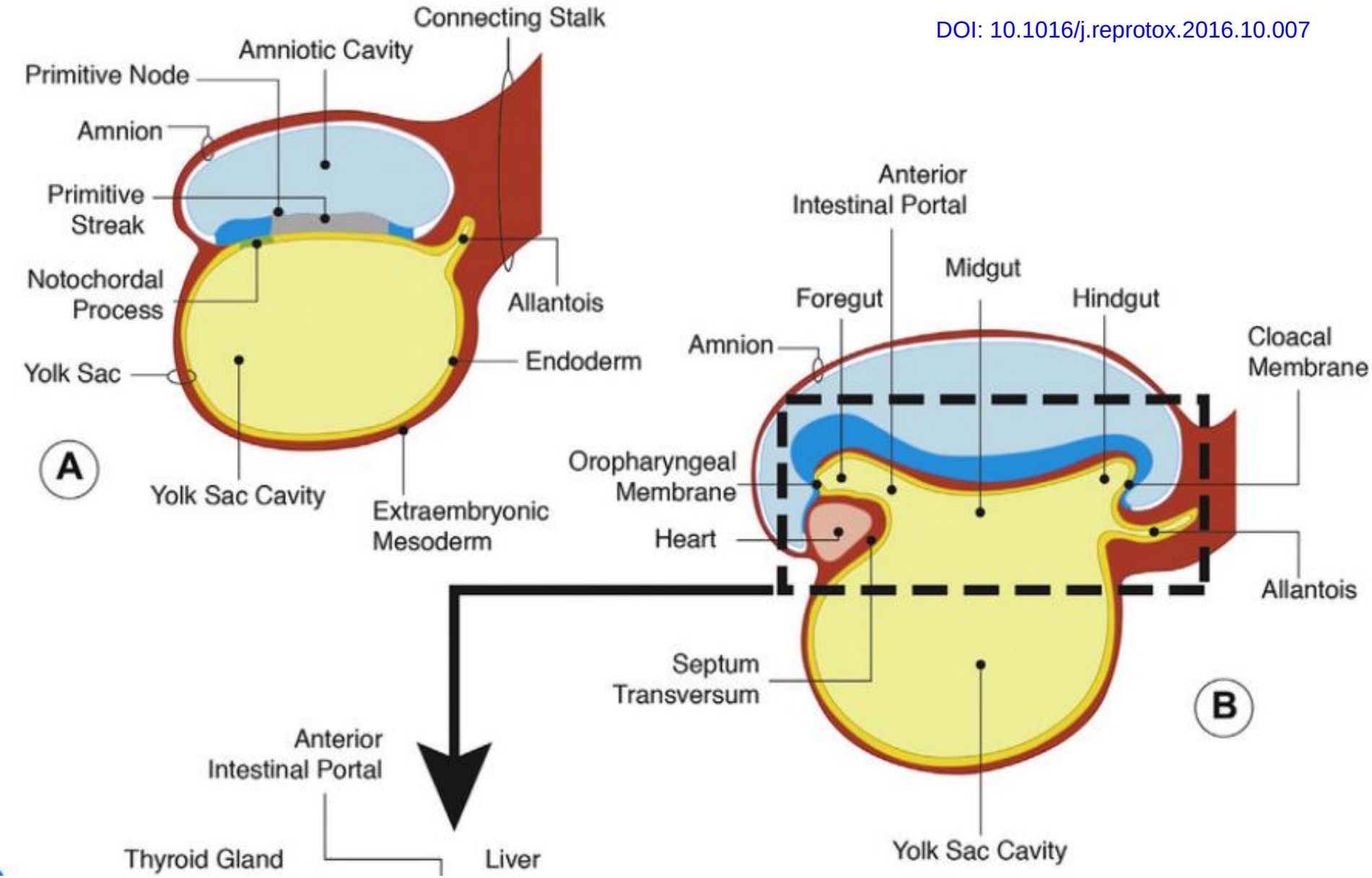
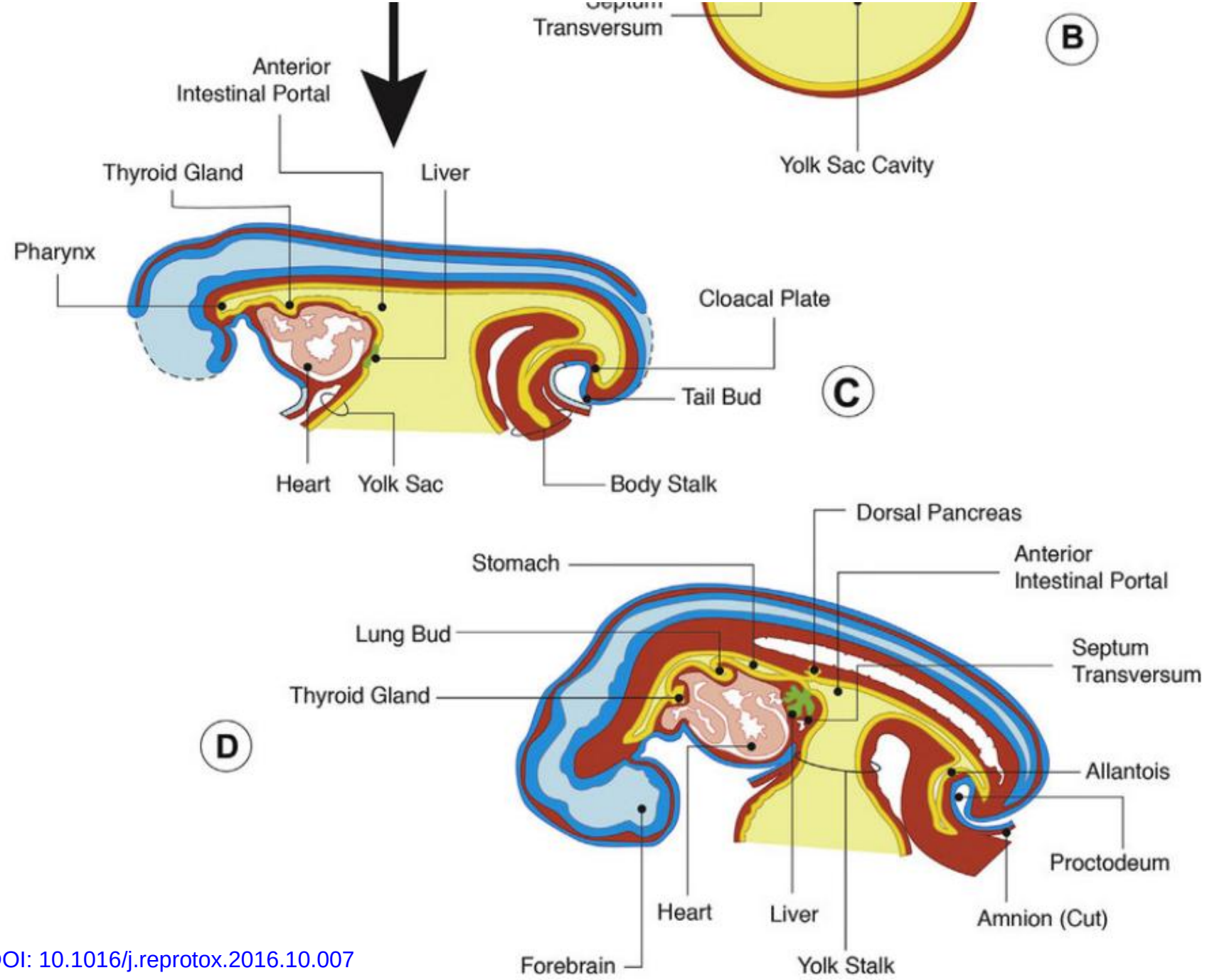


When the cloacal membrane appears, the posterior wall of the yolk sac forms a small diverticulum that extends into the connecting stalk. This diverticulum, **the allantoenteric diverticulum**, or **allantois**, appears around the **16th** day of development.



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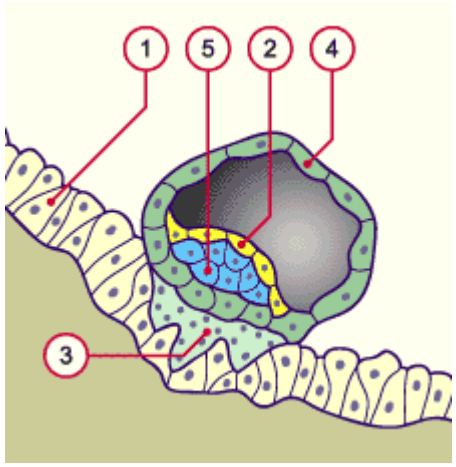
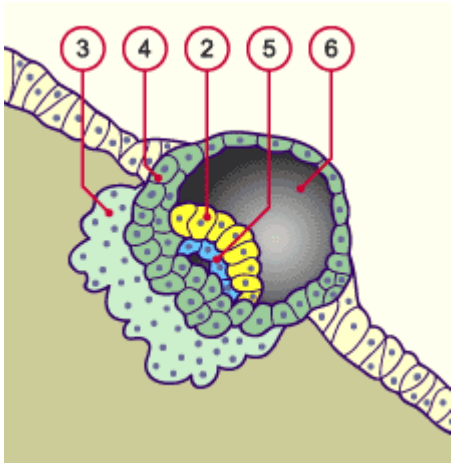
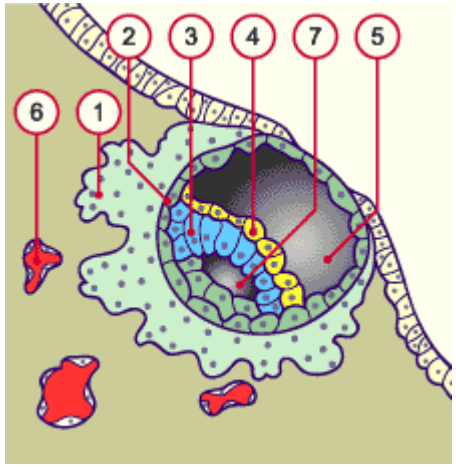
Implantation 6th-7th day



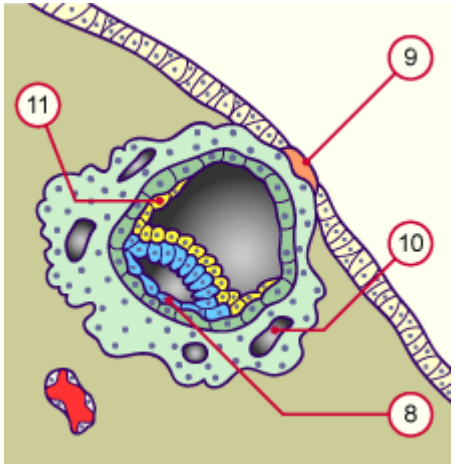
Implantation 7th-8th day



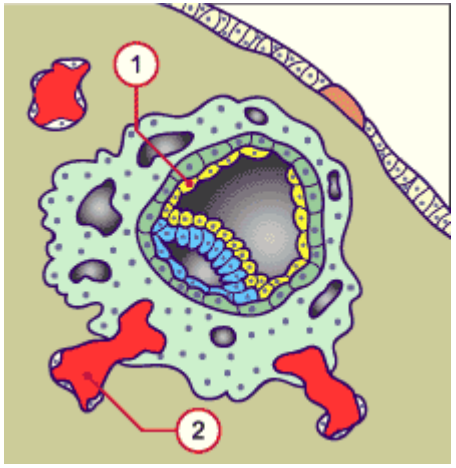
Implantation 8th day



Implantation 9th day



Implantation 9th-10th day



Implantation 10th-11th day