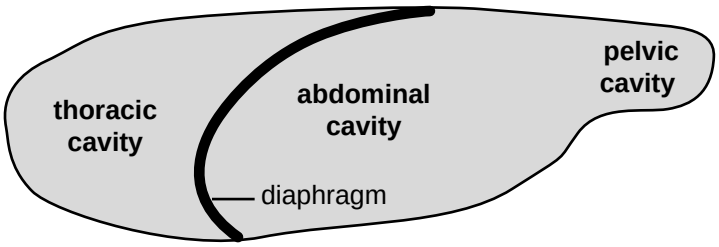
Serous Membranes & Cavities

Body Cavities



The major cavities of the body are within the trunk. They contain visceral organs and *serous membrane* cavities**:**

Thoracic cavity — is lined by endothoracic fascia.

Abdominal & pelvic cavities — are lined by transversalis fascia.

Serous Membrane Cavities

— are lined by serous membrane
— are normally empty (except for microscopic cells and a film of fluid)
— function to preclude adhesions among organs, thereby allowing organs to move freely relative to one another.

A **serous membrane** consists of a single layer of flattened mesothelial cells applied to the surface of a thin layer of collagenous tissue that attaches to underlying endothoracic/transversalis fascia. The mesothelium of the serous membrane forms the lining of a closed serous membrane cavity.

Serous membrane lining the wall of a serous cavity is designated *parietal* while that covering viscera is called *visceral*. *Connecting* serous membrane runs between parietal and visceral components.

The serous membranes are:

Peritoneum — the peritoneal cavity is found within the abdominal & pelvic body cavities.
Connecting peritoneum forms:
— mesentery
— ligament.

Pleura — two pleural cavities (separated by mediastinum) are found within the thoracic cavity.
Parietal pleura is further subdivided into:
— costal pleura
— diaphragmatic pleura
— mediastinal pleura & — pleural cupula.
Connecting pleura forms the *pulmonary ligament*.
Visceral pleura is also called *pulmonary pleura*.

Pericardium — the pericardial cavity is found within the mediastinum of the thoracic cavity.
Visceral pericardium is also called *epicardium*.

Vaginal tunics — the cavity of the vaginal process begins at the vaginal ring and extends into the scrotum around the spermatic cord & testis.
Connecting vaginal tunic forms: — mesorchium
— mesoductus deferens.

Given that viscera must move …

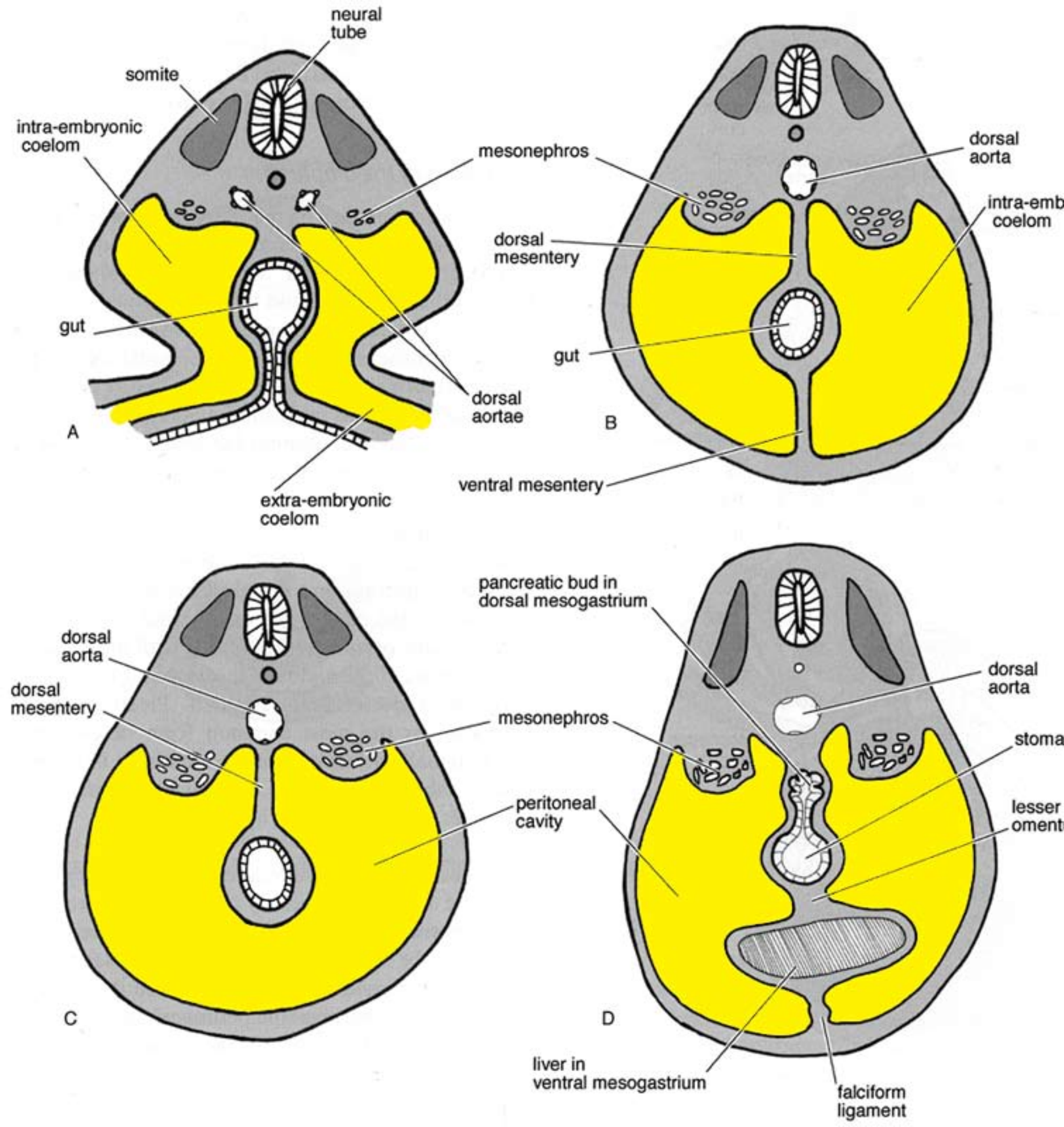
- **— the heart beats**
- **— lungs expand**
- **— stomach & intestine contract**
- **— the urinary bladder empties**

How are visceral organs separated from one another so they can move freely?

A] organ & wall surfaces are coated with anti-stick material

B] organs are surrounded by lubricant

C] organs are allowed to adhere to one another (adhesion does not affect their function)


neural tube
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gut
dorsal aortae
extra-embryonic coelom
A
mesonephros
dorsal mesentery
gut
ventral mesentery
dorsal aorta
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B
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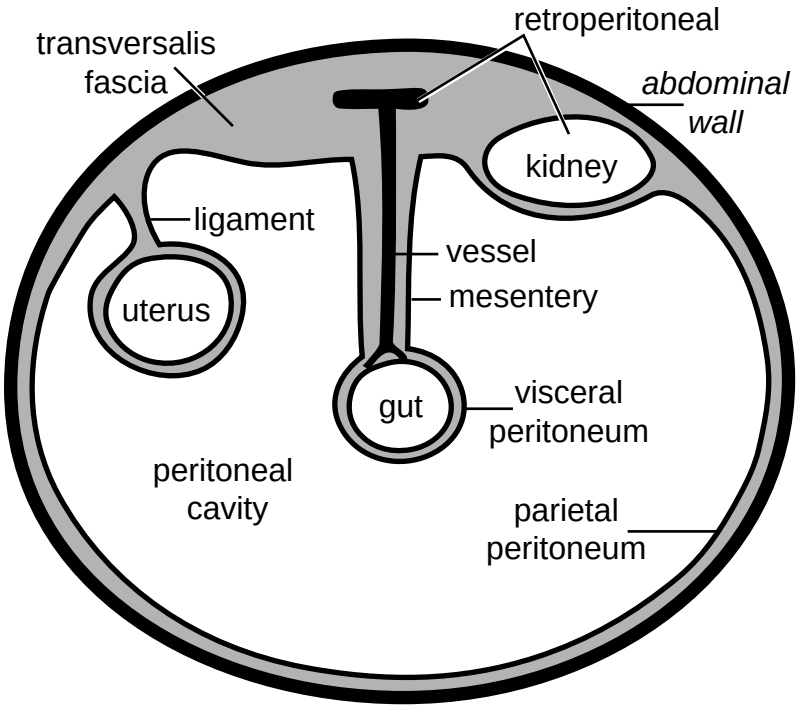
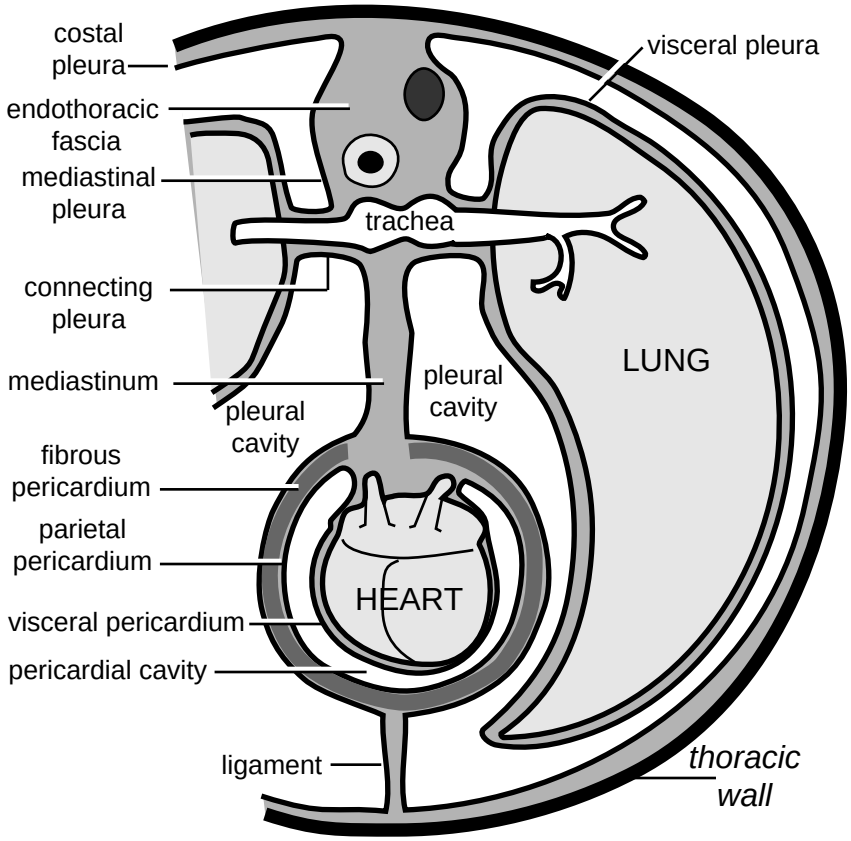
liver in ventral mesogastrium
dorsal aorta
stoma
lesser oment
falciform ligament
D

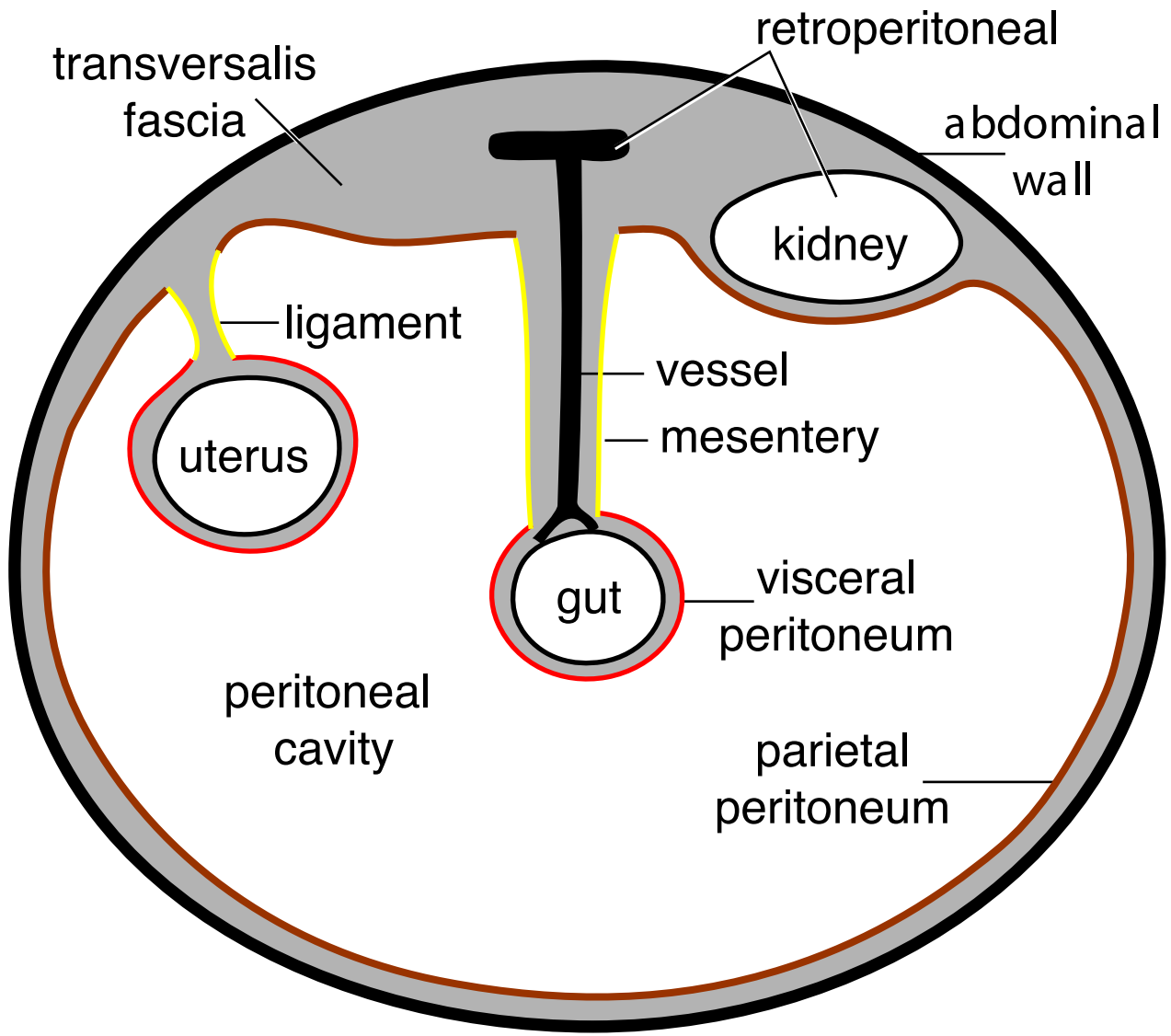
Peritoneal Cavity



Pleural (two) & Pericardial Cavities



Peritoneal Cavity



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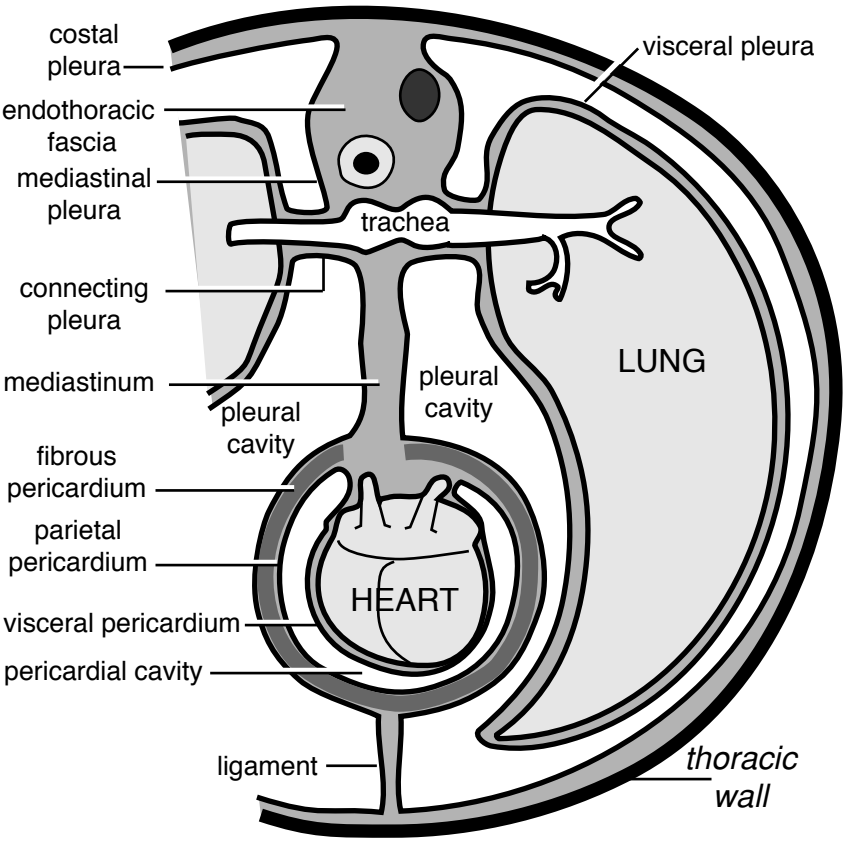
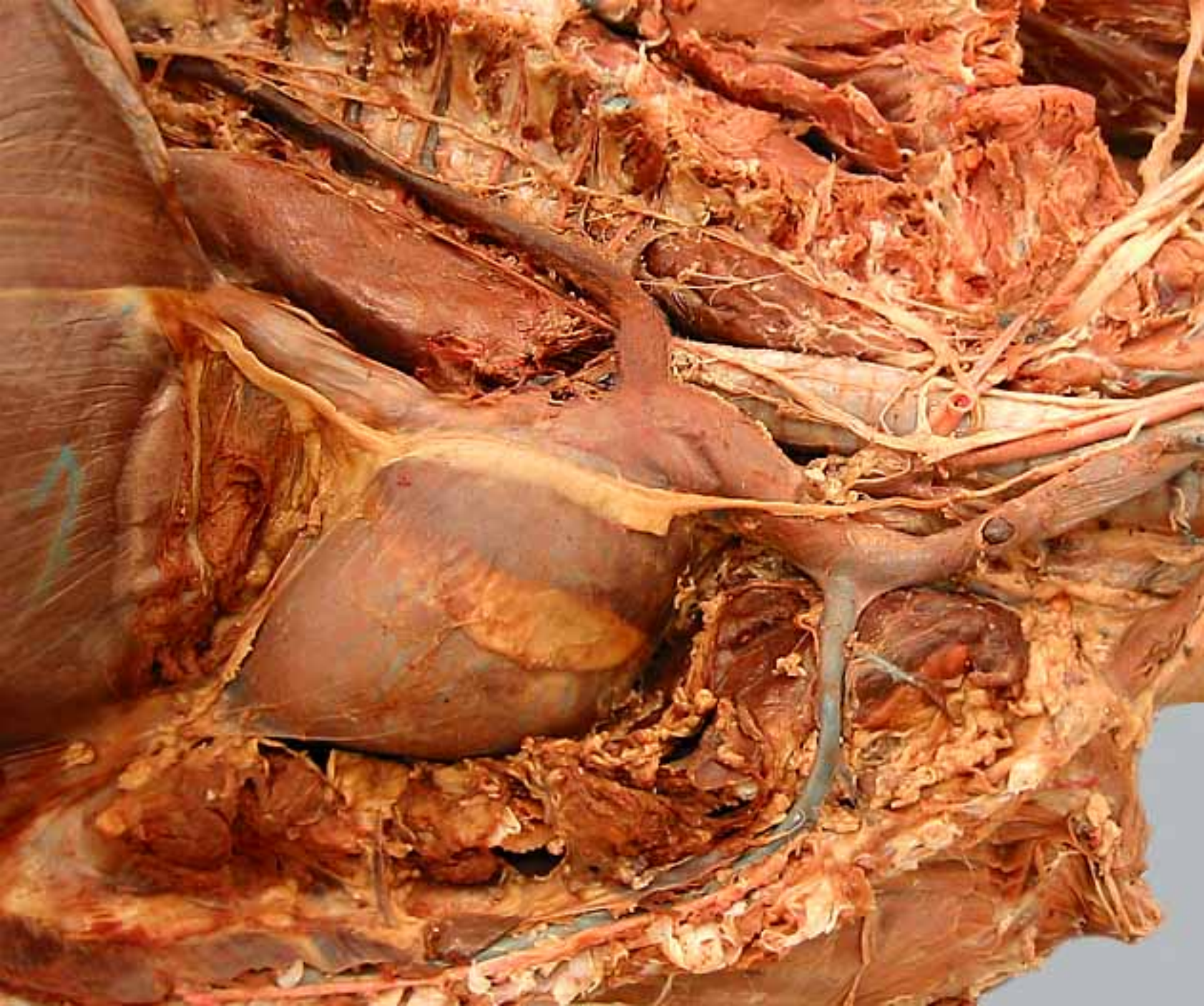
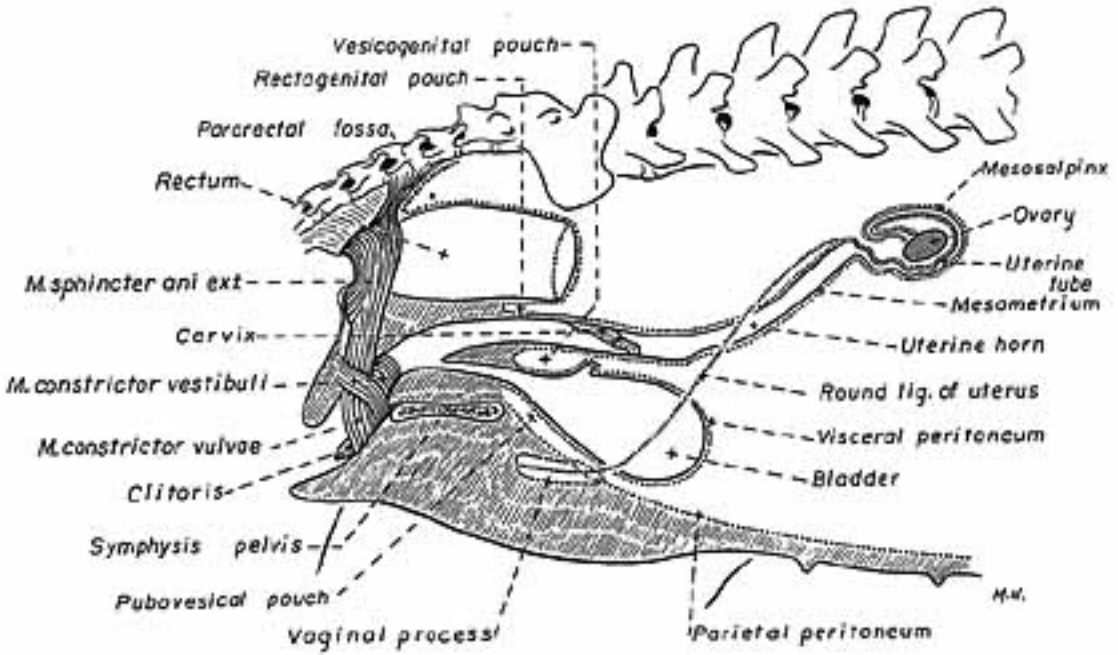
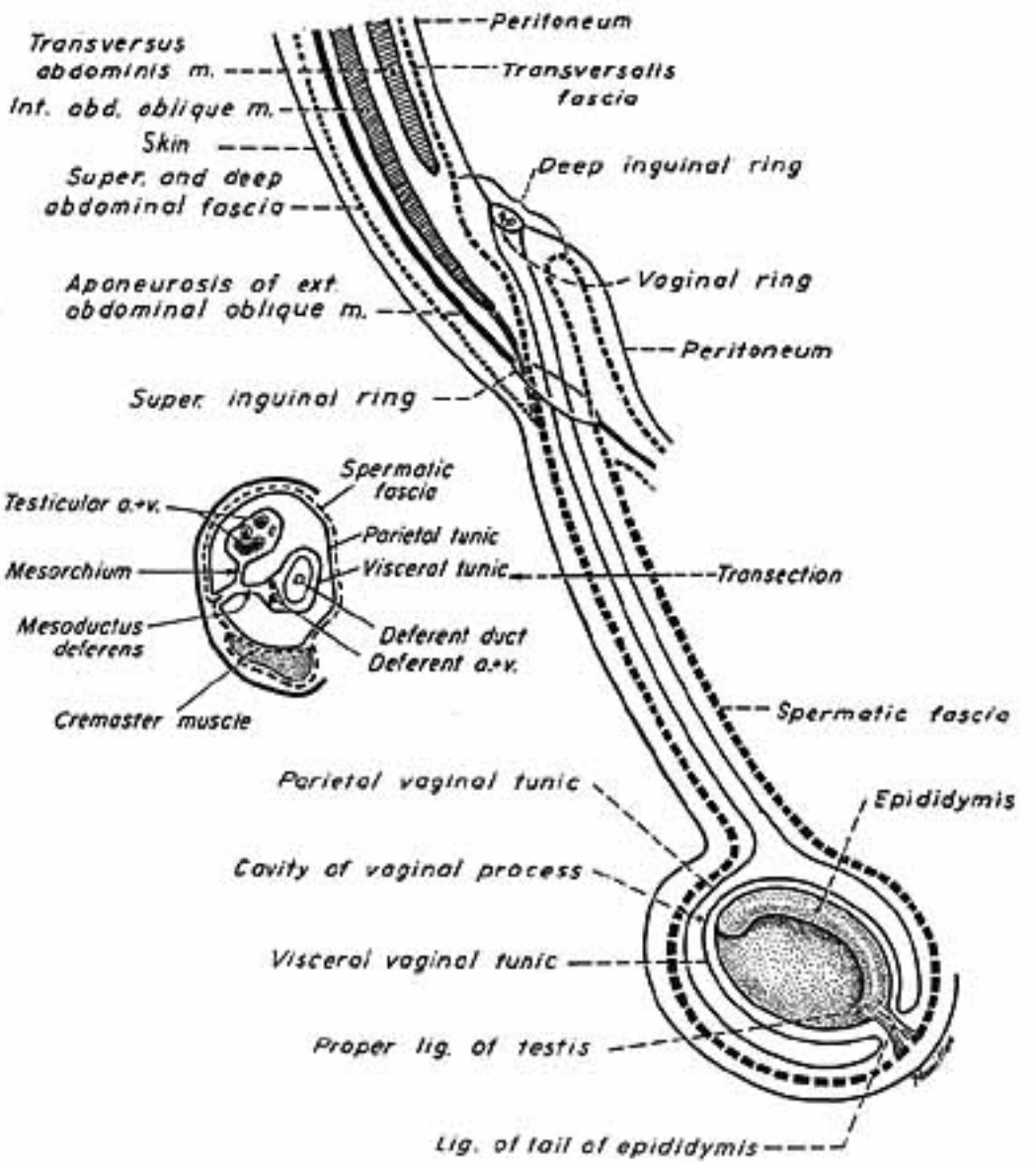
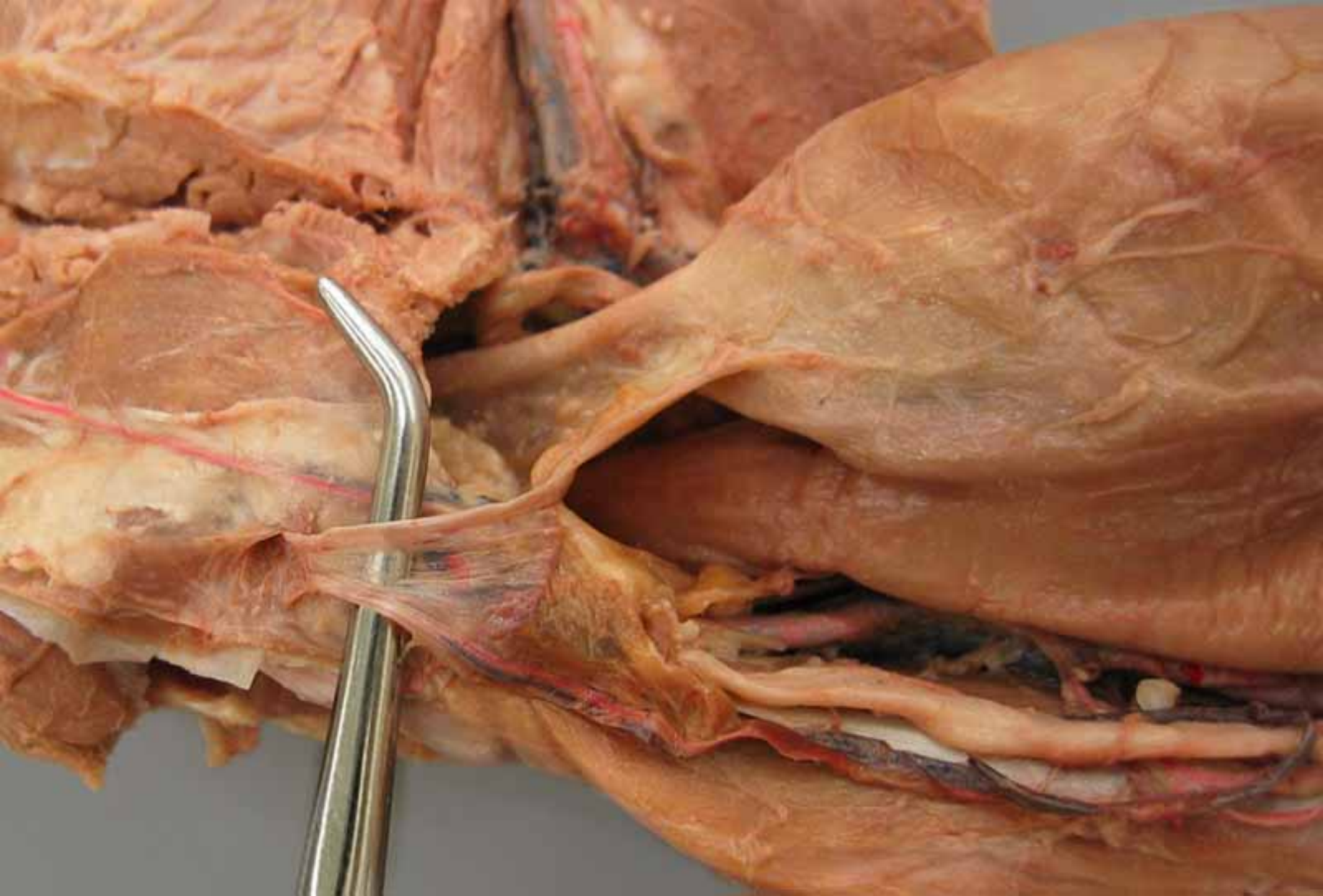
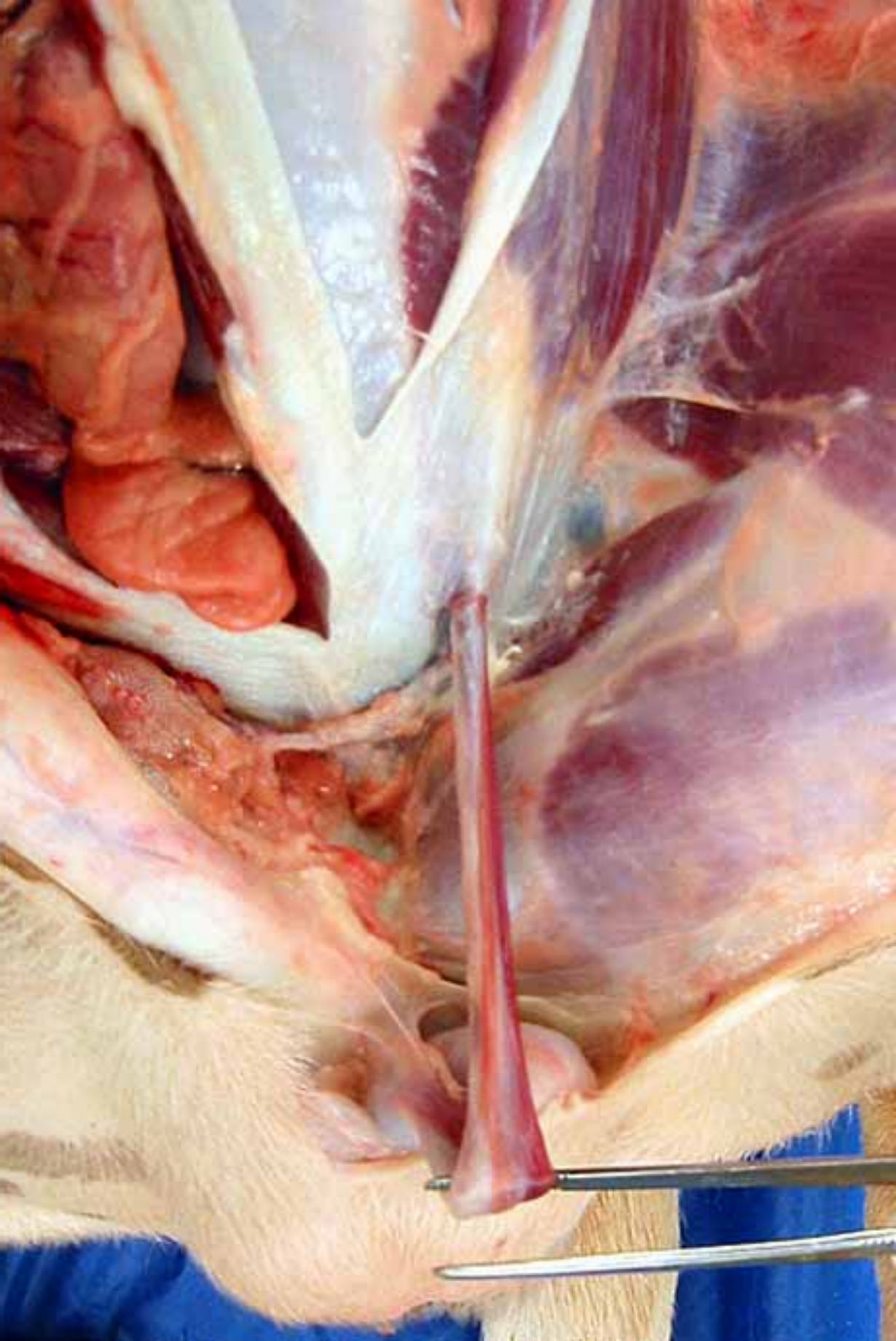





Vesicogenital pouch
Rectogenital pouch
Paracrectal fossa
Rectum
M. sphincter ani ext
Cervix
M. constrictor vestibuli
M. constrictor vulvae
Clitoris
Symphysis pelvis
Pubovesical pouch
Vaginal process
Mesosalpinx
Ovary
Uterine tube
Mesometrium
Uterine horn
Round lig. of uterus
Visceral peritoneum
Bladder
Parietal peritoneum
M.M.


Peritoneum
Transversus abdominis m.
Transversalis fascia
Int. obd. oblique m.
Skin
Deep inguinal ring
Super. and deep abdominal fascia
Vaginal ring
Aponeurosis of ext. abdominal oblique m.
Peritoneum
Super. inguinal ring
Spermatic fascia
Testicular a.+v.
Parietal tunic
Visceral tunic
Transection
Mesorchium
Mesoductus deferens
Deferent duct
Deferent a.+v.
Cremaster muscle
Spermatic fascia
Parietal vaginal tunic
Epididymis
Cavity of vaginal process
Visceral vaginal tunic
Proper lig. of testis
Lig. of tail of epididymis





There are four serous membranes (pericardium, pleura, peritoneum, vaginal process). Beside their names they differ in:

A] location

B] structure

C] function

D] all of the above

E] none of the above

There are four major serous membrane cavities (pericardial, peritoneal, & two pleural). The four major cavities develop . . .

A] from separate cavitations

B] from separate cavitations & common partitions

C] from a single common cavity

D] from a common cavity + separate partitions

E] common cavity + separate partitions + additional excavations

Formation of Body (Serous) Cavities

Serous cavities are cavities lined by serous membrane (mesothelium). In the adult, serous cavities are: the *pericardial* cavity, two *pleural* cavities, and the *peritoneal* cavity (including vaginal cavity extensions of the peritoneal cavity).

Acquiring a three-dimensional understanding of how serous cavities are formed is a challenging exercise. Serous cavity formation may be summarized as follows:

• all of the serous cavities develop from a common embryonic coelom and thus the cavities are continuous until partitions develop to separate them;

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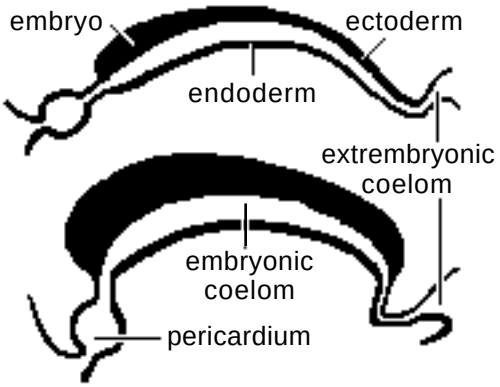
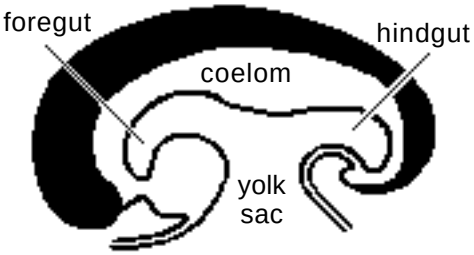


Coelom Development:

During gastrulation, the space between ectoderm and endoderm (and between trophoblast and hypoblast) is filled by inflow of primary mesenchyme that becomes mesoderm. Cavitation occurs in lateral mesoderm, establishing the **coelom** bounded by somatopleure and splanchnopleure.

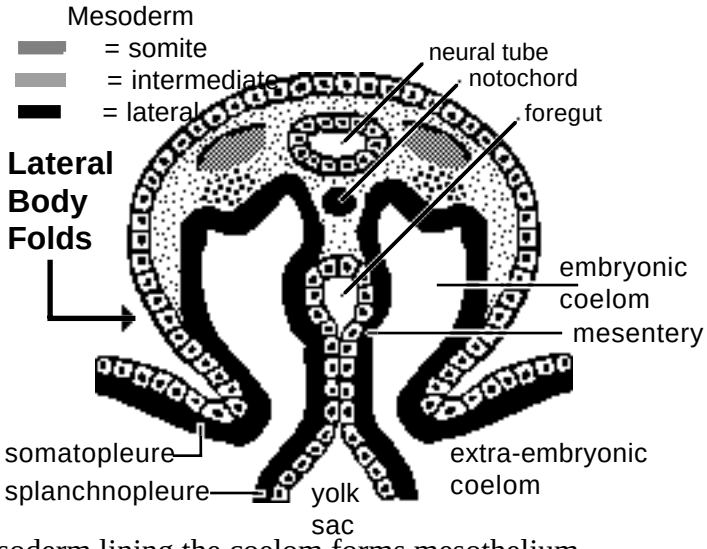


Coelom (Longitudinal View)

As head and tail processes develop and lateral body folds merge medially (except at the umbilicus), embryonic and extra-embryonic compartments of the coelom can be differentiated. The former becomes the serous cavities, the latter is filled by allantoic fetal membrane.

Formation of the head process brings the heart and pericardial coelom within the embryo, positioned ventral to the foregut. Right and left sides of the embryonic coelom are separated by gut and by dorsal and ventral mesenteries, the latter fails to develop caudal to the midgut.

Thus, the *embryonic coelom* features an anterior-ventral *pericardial* compartment, a caudal *peritoneal* compartment, and bilateral *pleural* compartments (channels) connecting the pericardial and peritoneal compartments. Mesoderm lining the coelom forms mesothelium.



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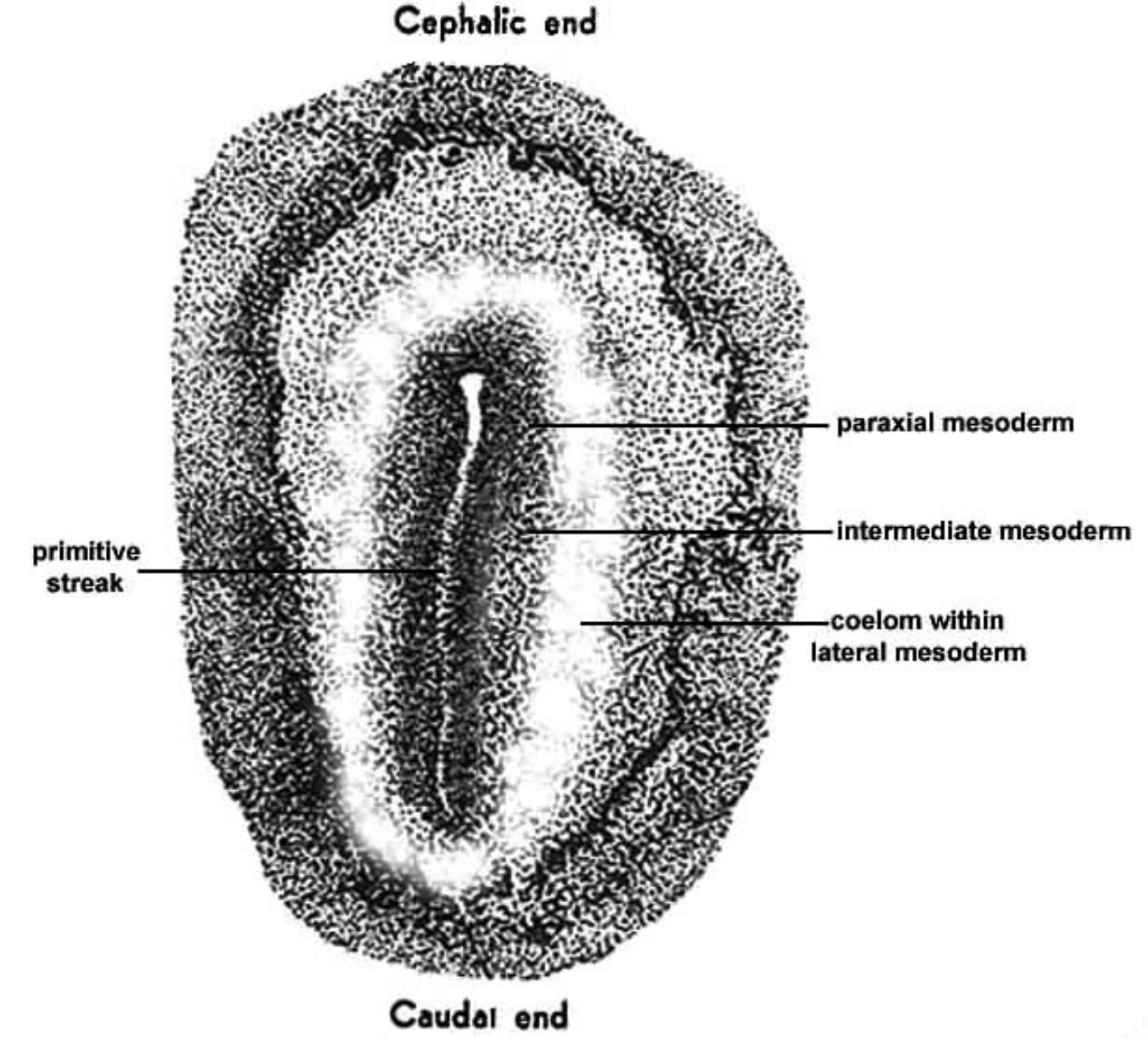
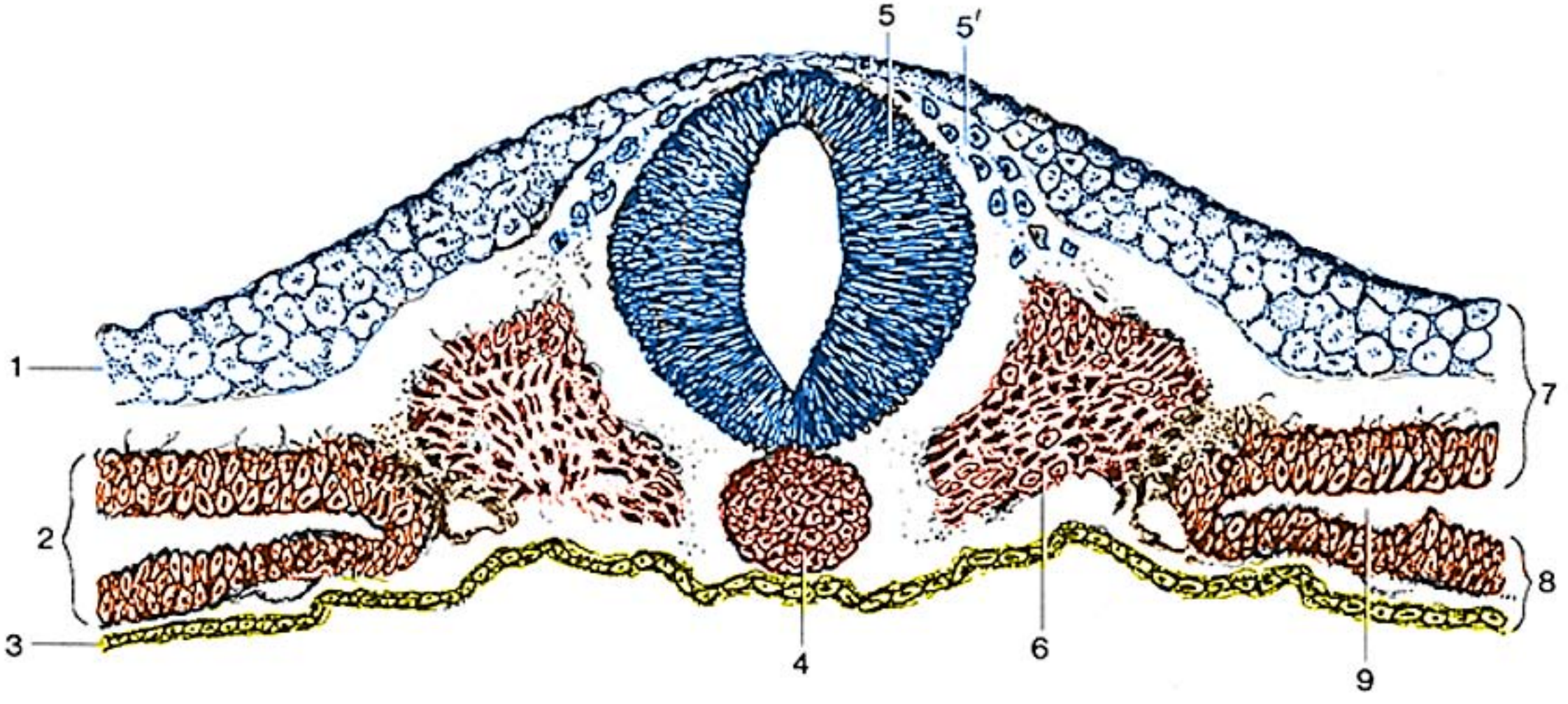

Cephalic end
paraxial mesoderm
intermediate mesoderm
primitive streak
coelom within lateral mesoderm
Caudal end


5
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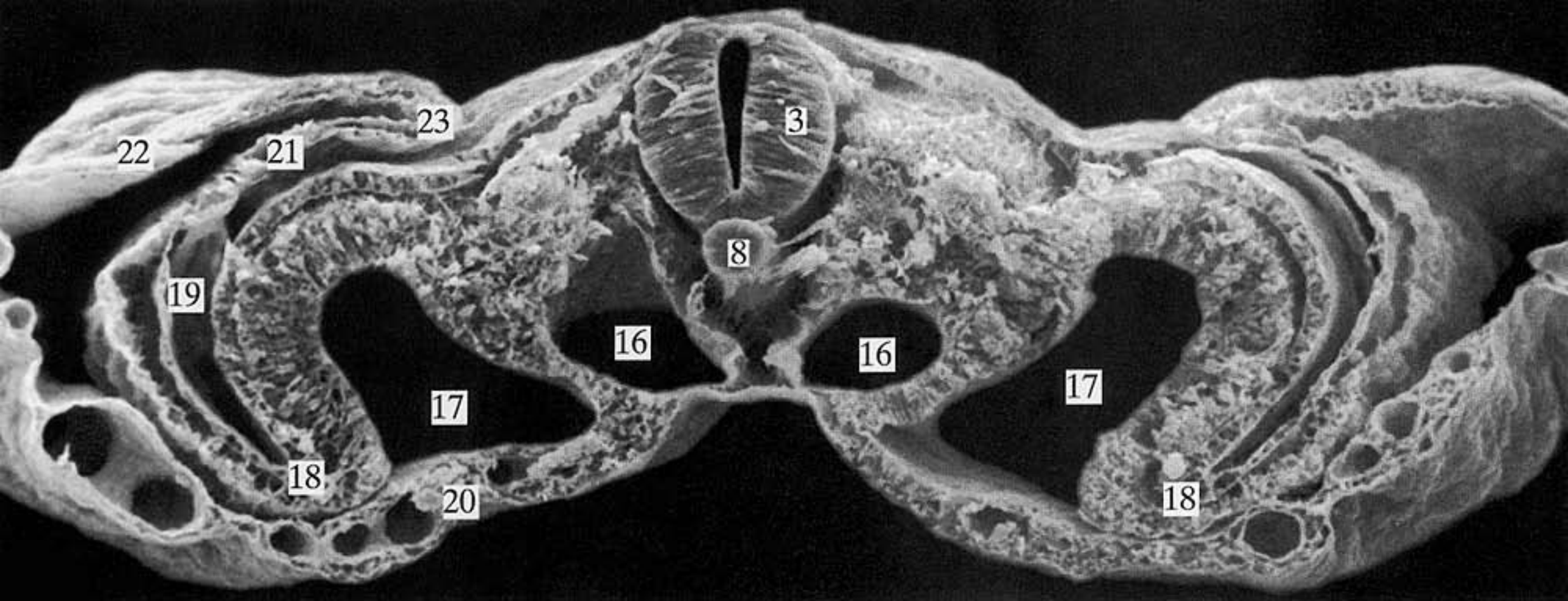
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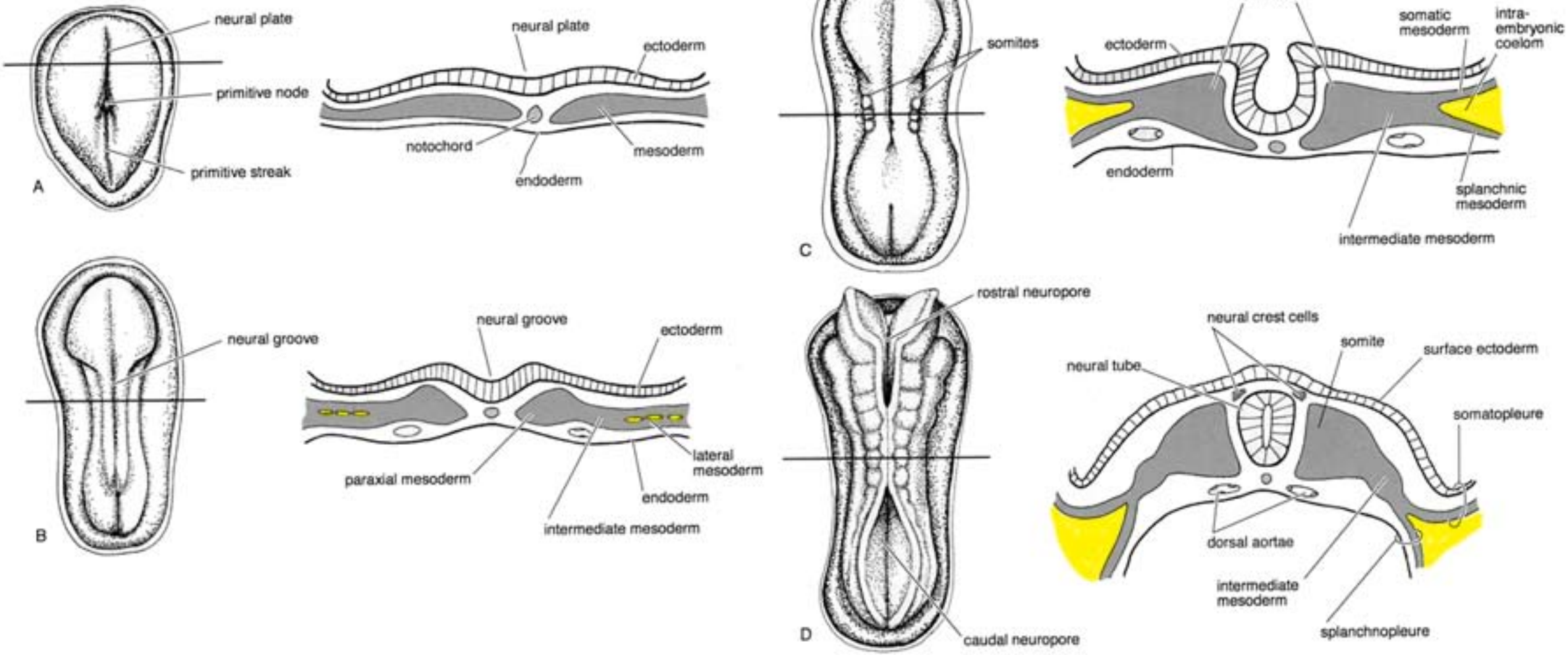
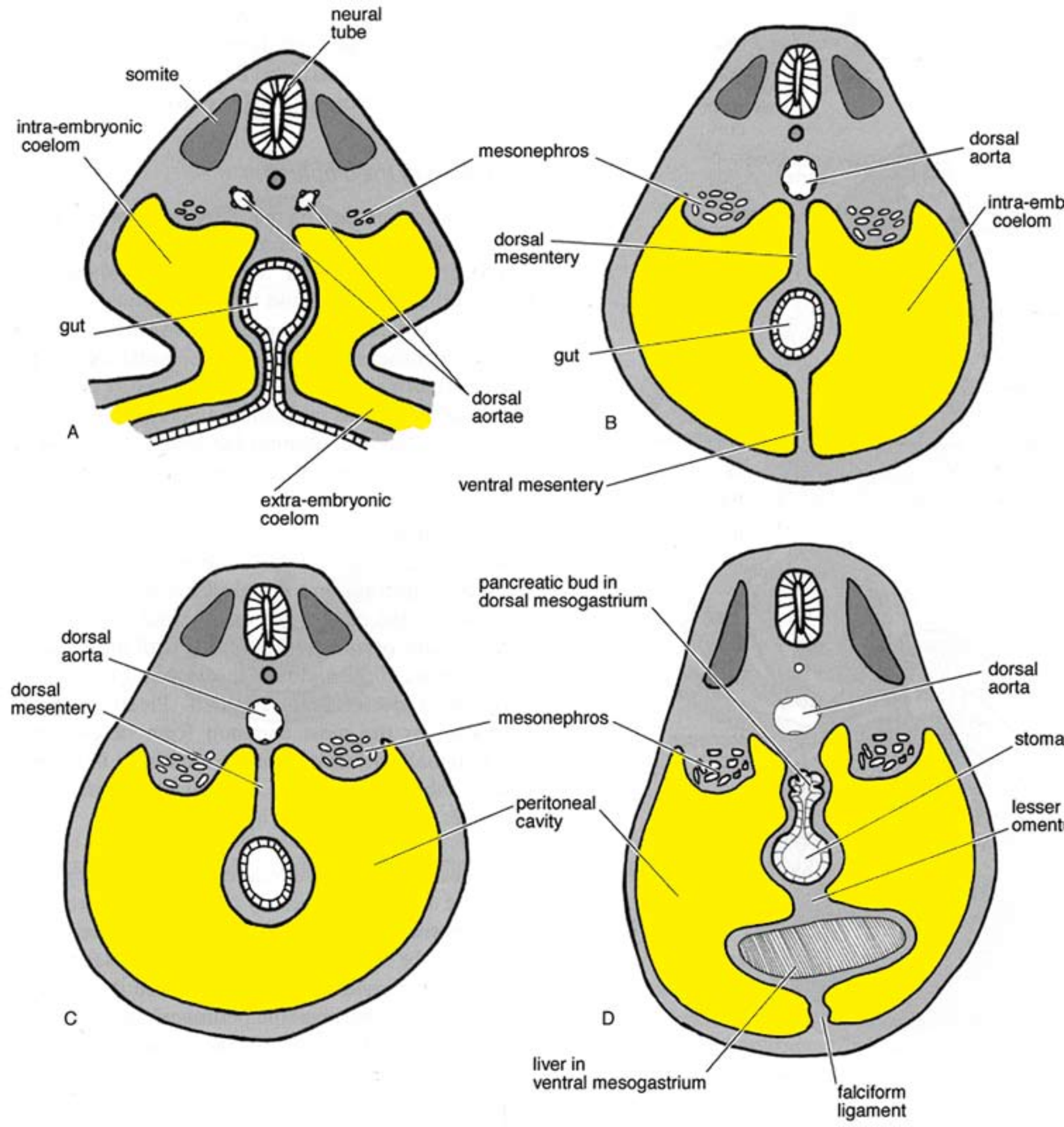

neural plate
primitive node
primitive streak
A
neural plate
ectoderm
notochord
mesoderm
endoderm
somites
C
somites
somatic mesoderm
intra-embryonic coelom
ectoderm
endoderm
splanchnic mesoderm
intermediate mesoderm
neural groove
B
neural groove
ectoderm
paraxial mesoderm
lateral mesoderm
endoderm
intermediate mesoderm
rostral neuropore
D
caudal neuropore
neural crest cells
somite
surface ectoderm
neural tube
somatopleure
dorsal aortae
intermediate mesoderm
splanchnopleure


neural tube
somite
intra-embryonic coelom
gut
dorsal aortae
extra-embryonic coelom
A
mesonephros
dorsal mesentery
gut
ventral mesentery
dorsal aorta
intra-emb coelom
B
dorsal aorta
dorsal mesentery
peritoneal cavity
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pancreatic bud in dorsal mesogastrium
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liver in ventral mesogastrium
dorsal aorta
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falciform ligament
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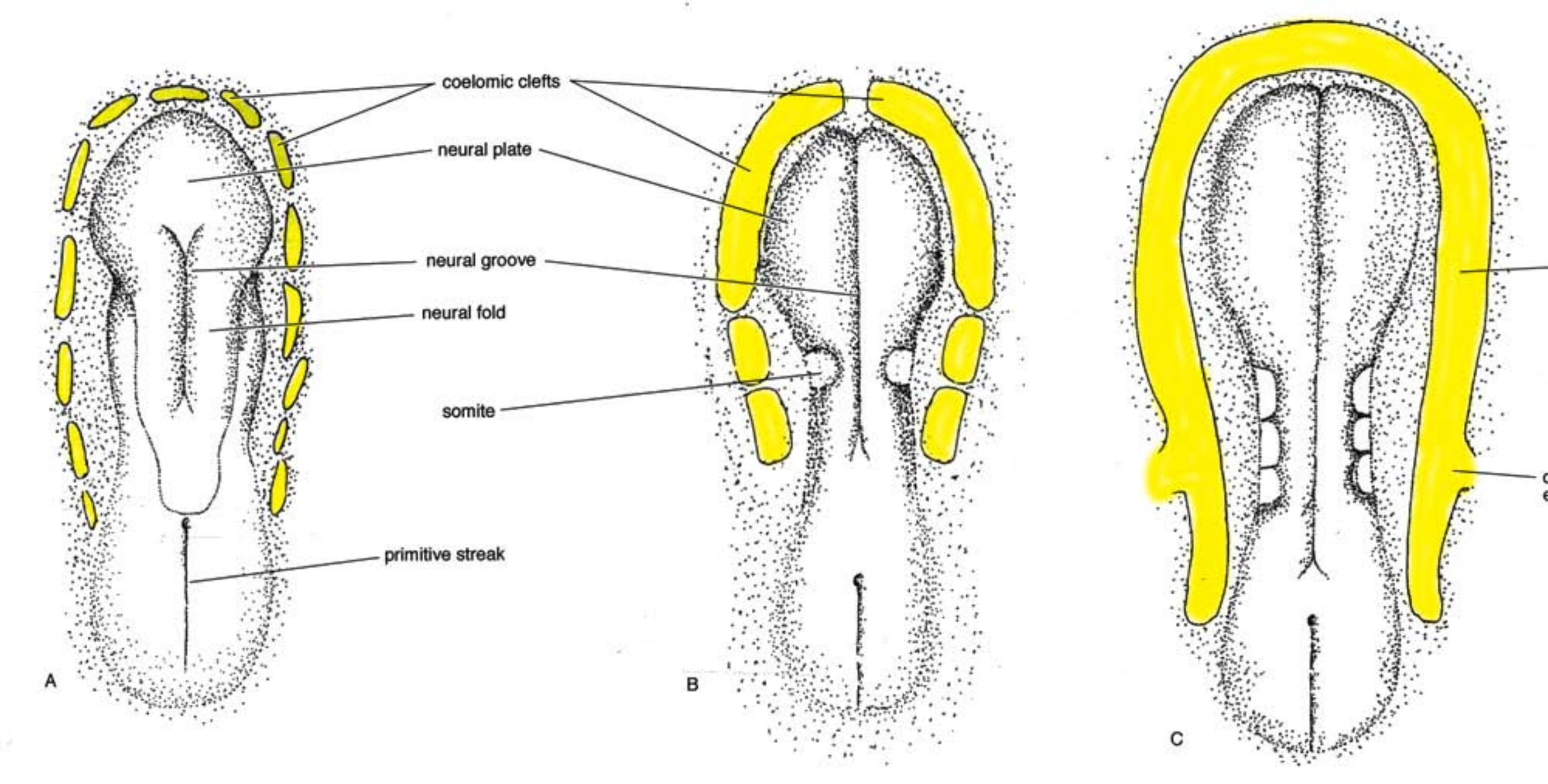
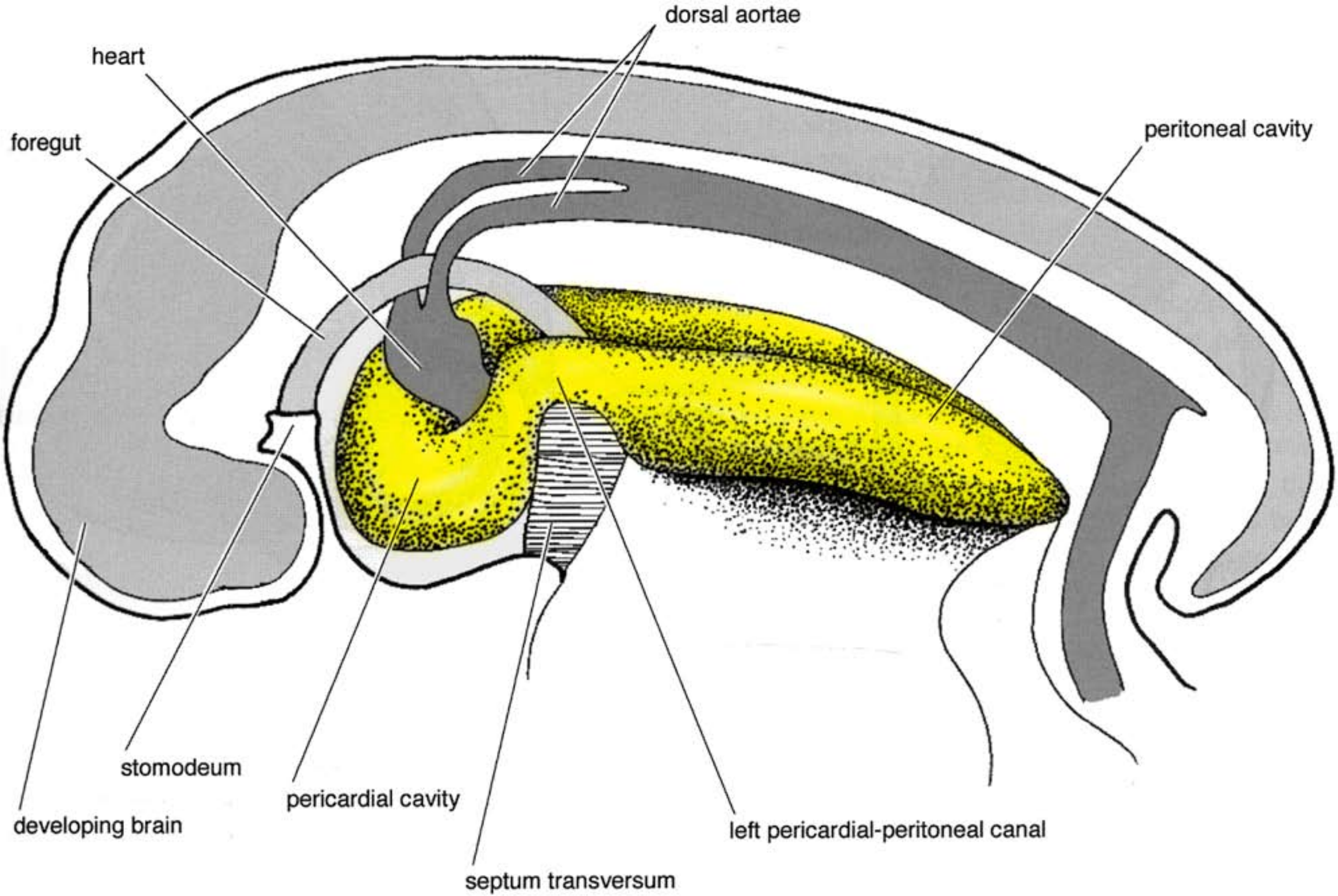
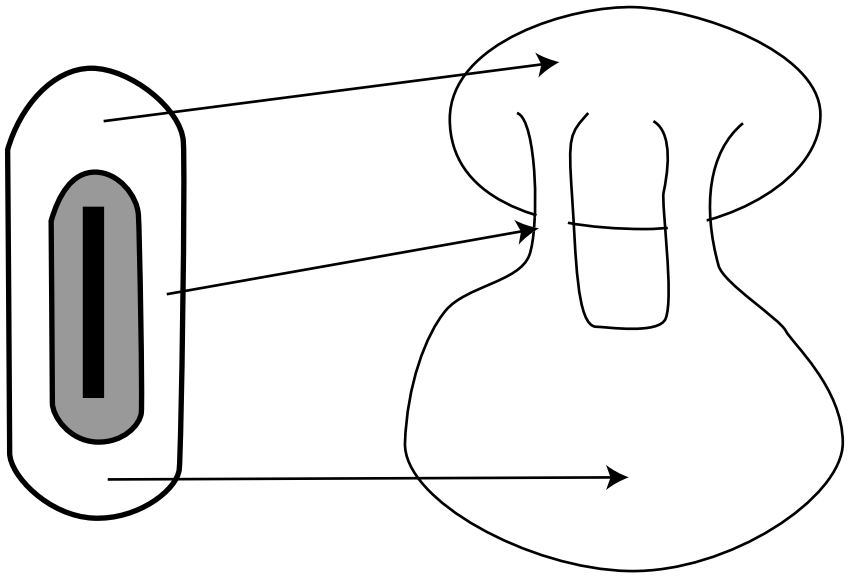
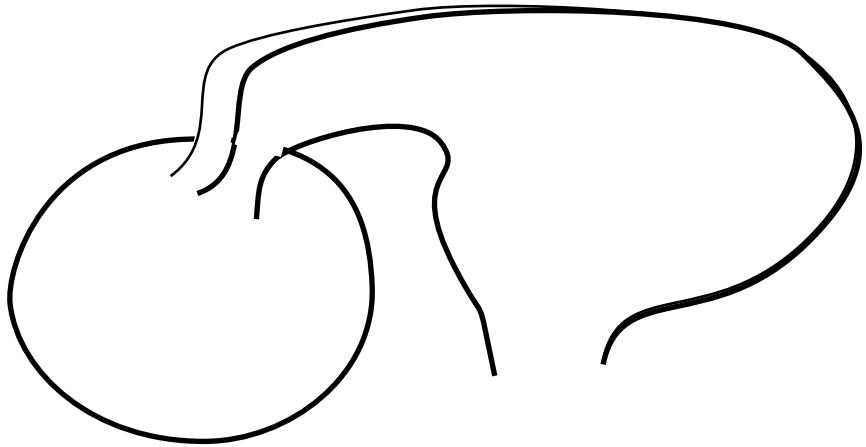

coelomic clefts
neural plate
neural groove
neural fold
somite
primitive streak
A
B
C


dorsal aortae
heart
foregut
peritoneal cavity
stomodeum
developing brain
pericardial cavity
septum transversum
left pericardial-peritoneal canal

Dorsal View



Lateral View



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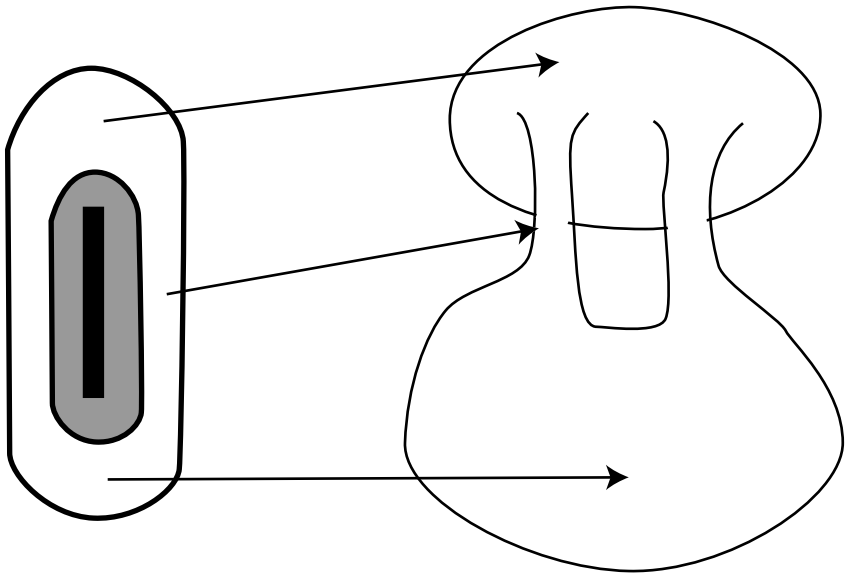
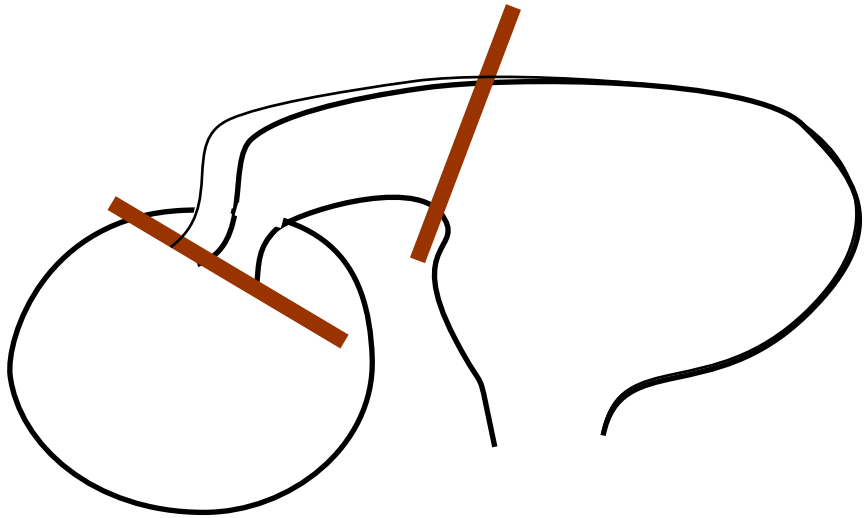


Lateral View



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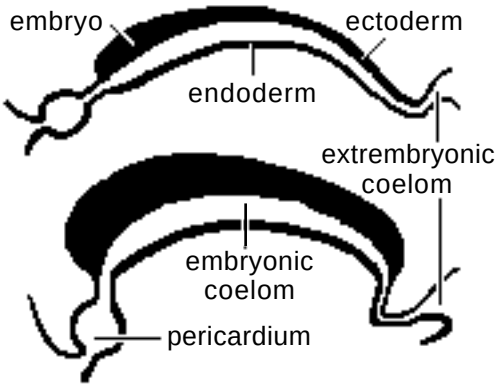

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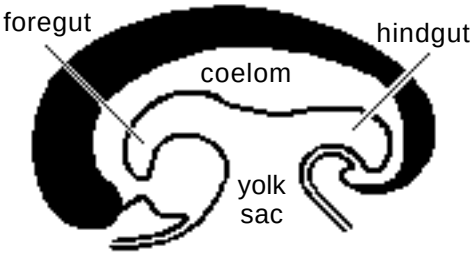

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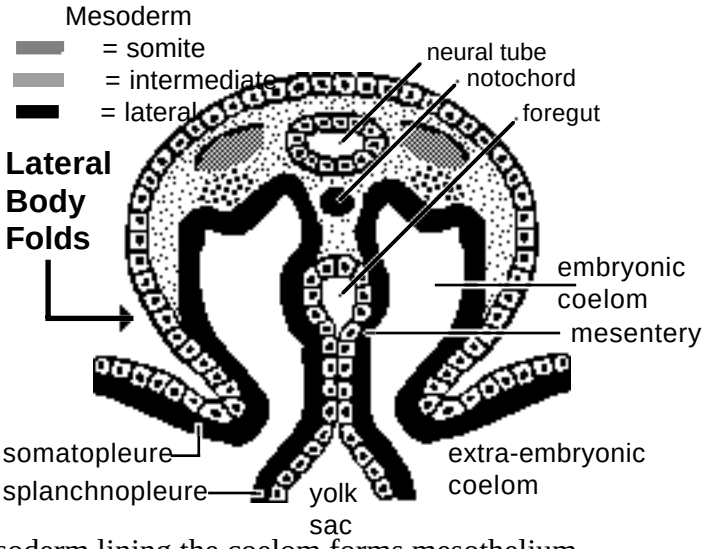

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Separation of Peritoneal and Pleural Cavities:

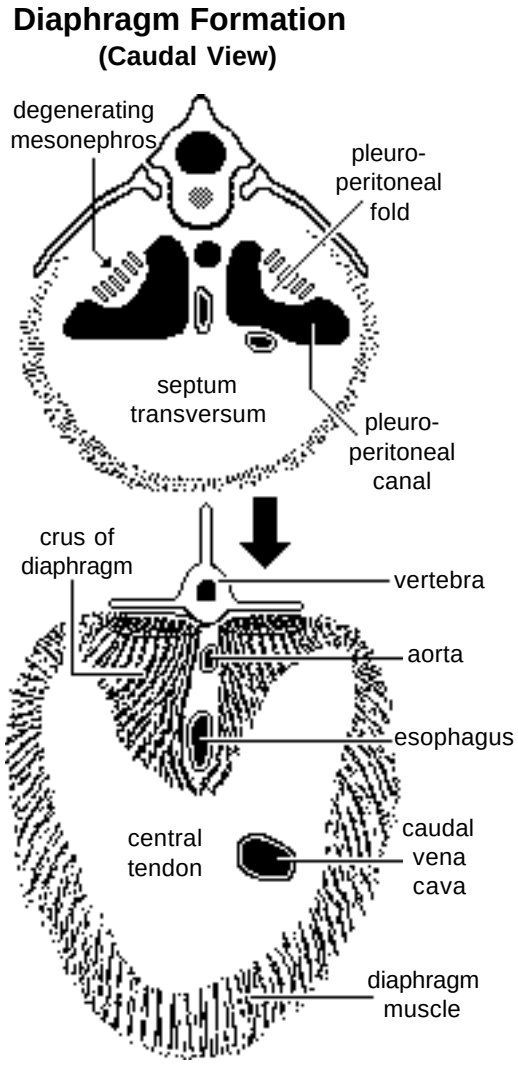
In the adult, peritoneal and pleural cavities are separated by the diaphragm. The diaphragm is formed by a *septum transversum*, paired *pleuroperitoneal folds*, and somatic mesoderm. Diaphragmatic musculature is derived from somites in the cervical region ($C_{5, 6, 7}$), where the diaphragm is initially formed.

Details of diaphragm formation include:

— the septum transversum originates as mesoderm in front of the heart; as the heart shifts ventral to the foregut, the septum becomes incorporated into the ventral body wall and ventral mesentery caudal to the heart; it grows dorsally and forms a transverse partition ventral to the level of the gut

— dorsal to the gut, bilateral pleuroperitoneal folds grow medially and meet at the dorsal mesentery

— subsequent growth of the pleural cavity into somatic mesoderm (mesenchyme) will result in body wall mesoderm forming the marginal regions of the diaphragm (diaphragm musculature).



Separation of Pericardial and Pleural Cavities:

In the adult, pericardial and pleural cavities are separated by fibrous pericardium.

Originally in the embryo, the pericardial coelomic cavity communicated with two dorsally positioned pleural cavities (canals). Subsequently, the cavities become partitioned by paired *pleuropericardial folds* and then somatic mesoderm. Details of the separation include:

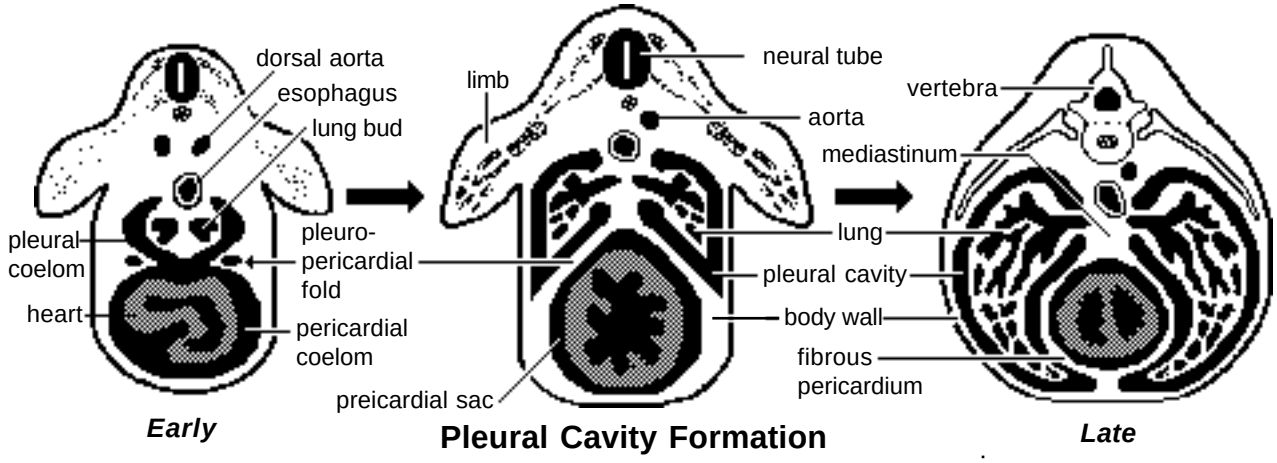
— bilateral pleuropericardial folds (membranes), which accompany common cardinal veins as they join the heart, converge medially to unite with the mediastinum (ventral mesentery) and partition the ventral pericardial cavity from the dorsal pleural canals;

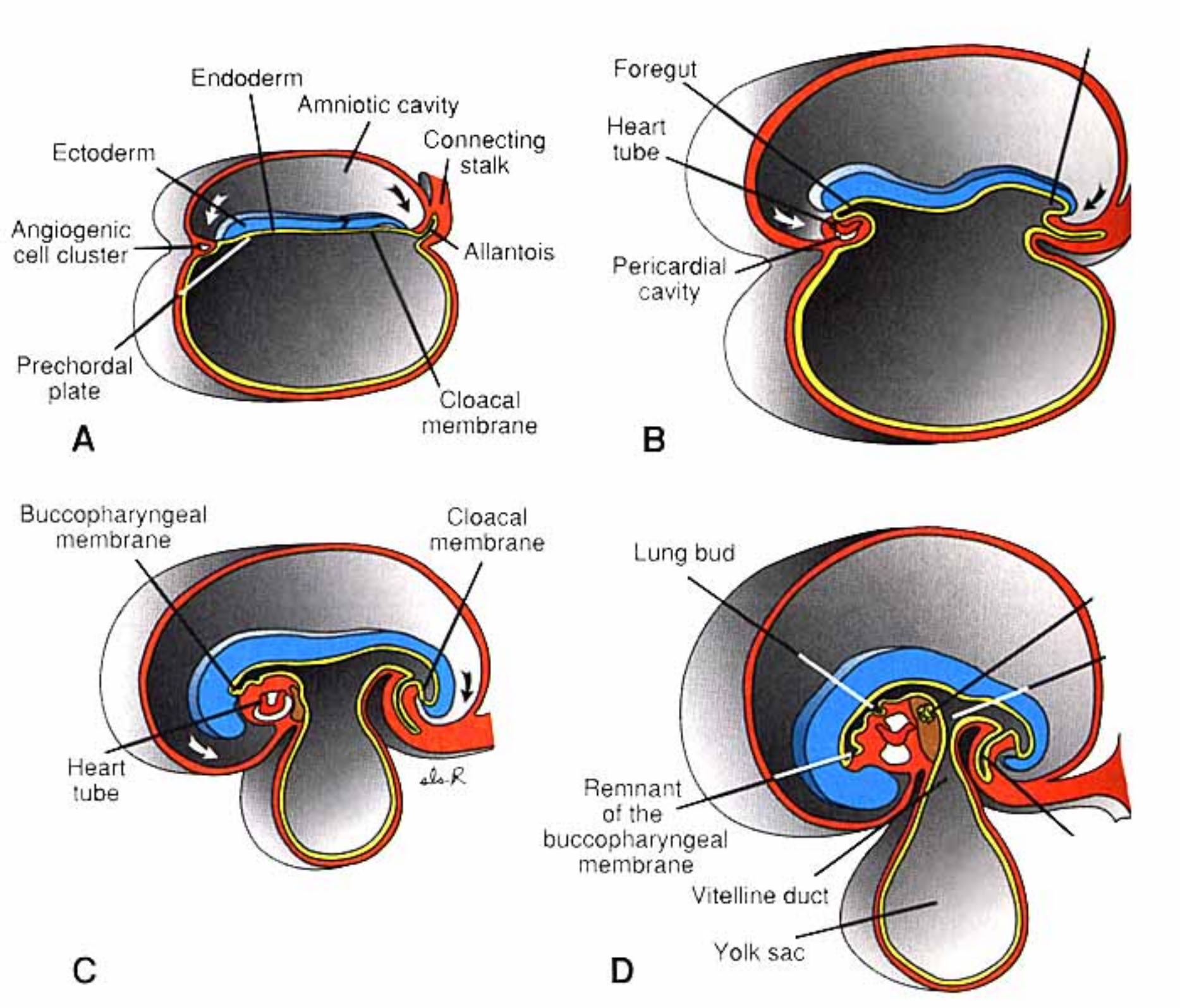
— subsequent ventrolateral growth of the pleural cavities into the body wall incorporates somatic mesoderm (mesenchyme) into the future fibrous pericardium.

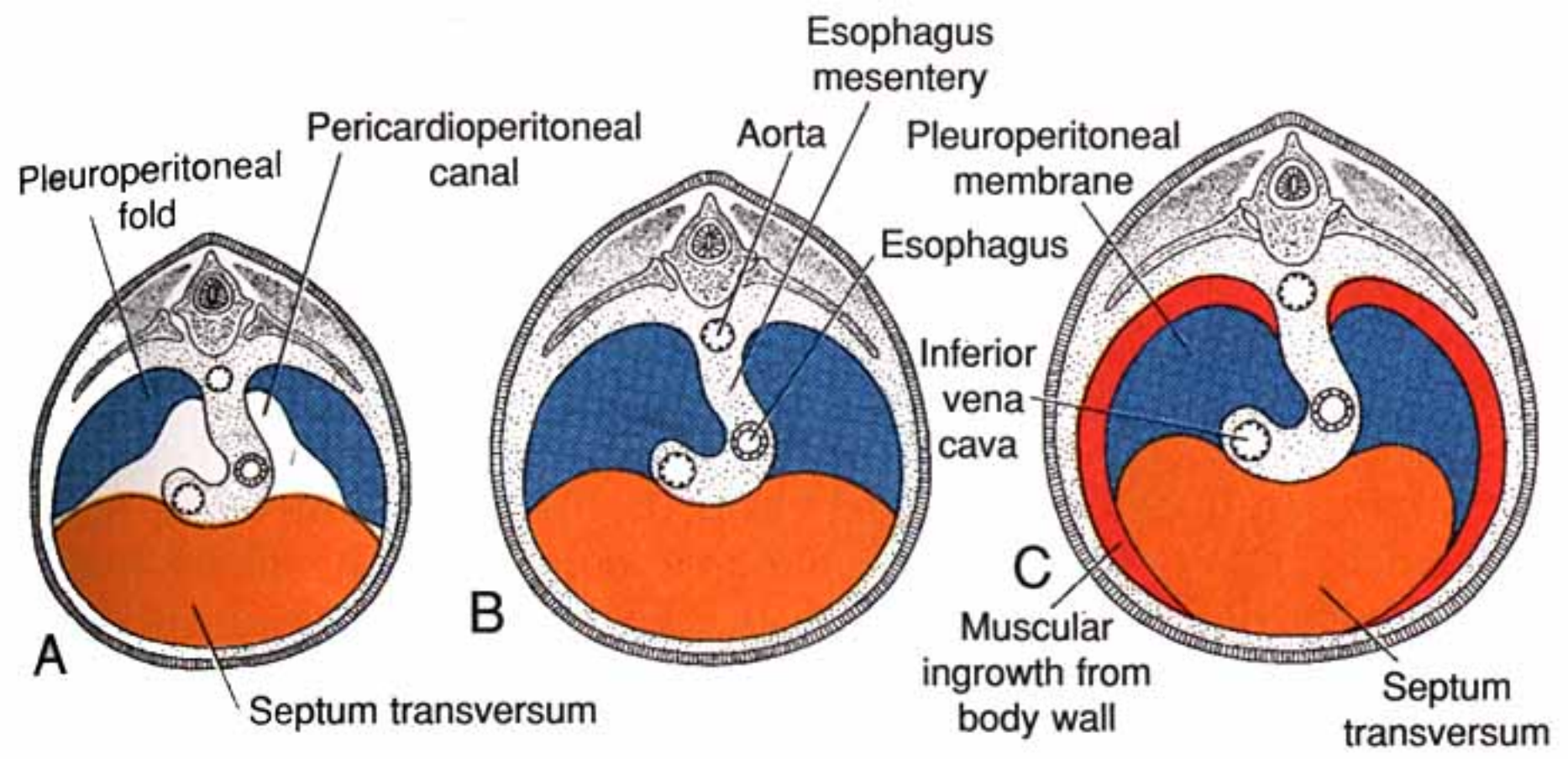
NOTE: Mediastinum is formed initially by dorsal and ventral mesenteries of the esophagus.

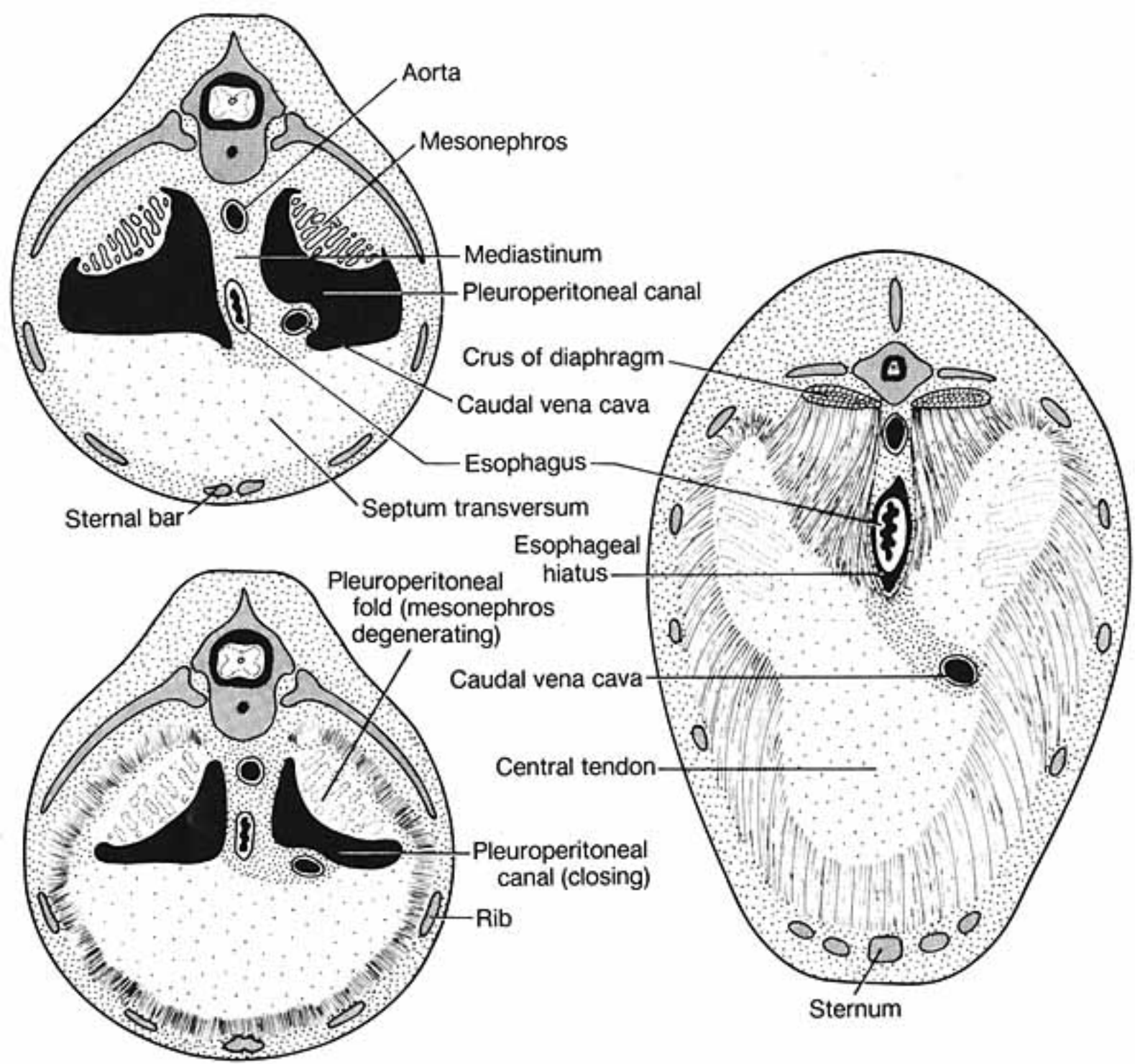
Growth of Pleural Cavities:

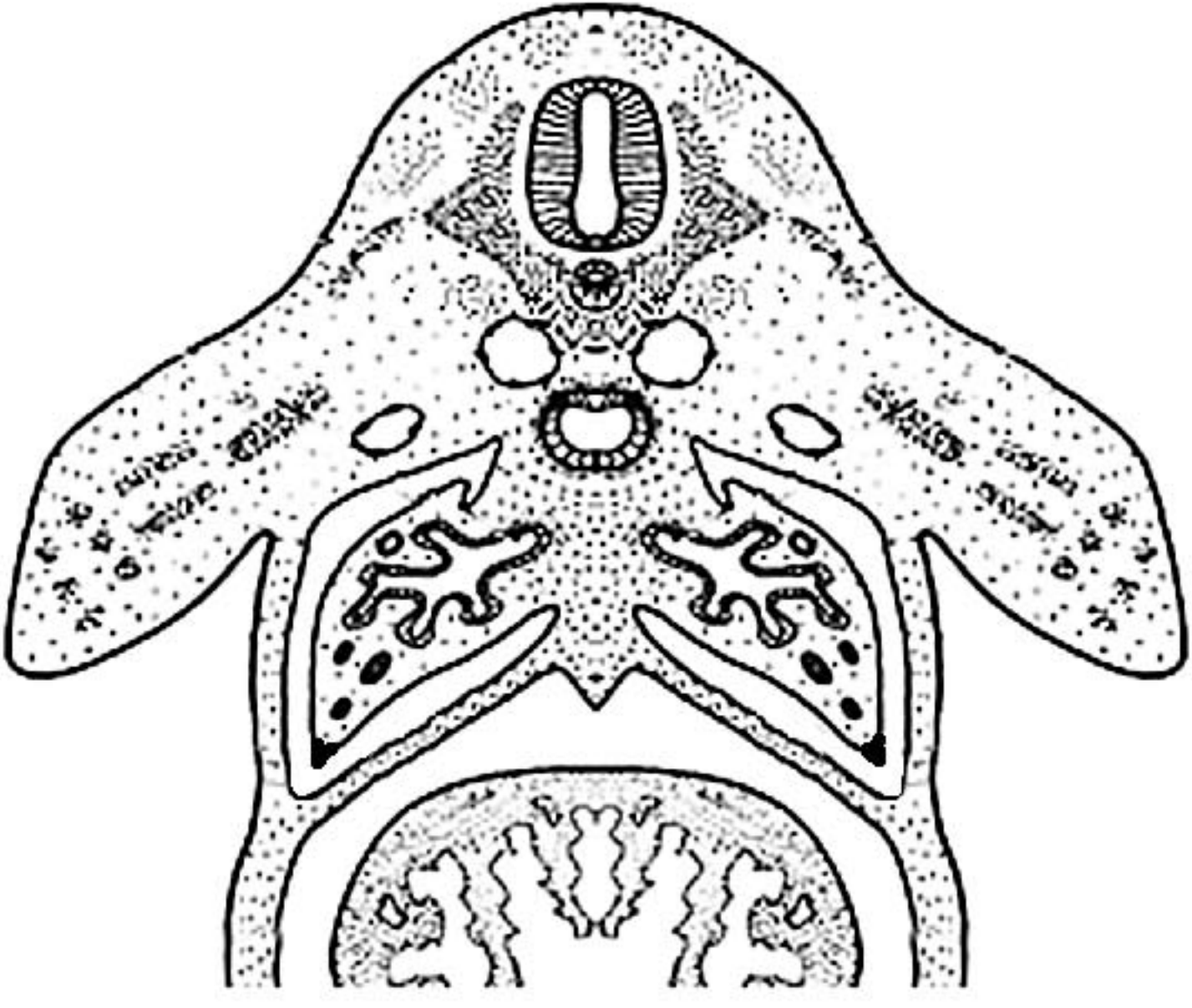
Initially the pleural cavities are small canals into which the lung buds project. As the lungs grow, the pleural cavities enlarge and appear to carve into the body wall (into somatic mesoderm/ mesenchyme). As a result, somatic mesoderm forms partitions (fibrous pericardium and diaphragm) that wall off the pleural cavities.




Endoderm
Amniotic cavity
Ectoderm
Connecting stalk
Angiogenic cell cluster
Allantois
Prechordal plate
Cloacal membrane
A
Foregut
Heart tube
Pericardial cavity
B
Buccopharyngeal membrane
Cloacal membrane
Heart tube
C
Lung bud
Remnant of the buccopharyngeal membrane
Vitelline duct
Yolk sac
D


Pleuroperitoneal fold
Pericardioperitoneal canal
Septum transversum
A
Esophagus mesentery
Aorta
Esophagus
B
Pleuroperitoneal membrane
Inferior vena cava
C
Muscular ingrowth from body wall
Septum transversum


Aorta
Mesonephros
Mediastinum
Pleuroperitoneal canal
Crus of diaphragm
Caudal vena cava
Esophagus
Septum transversum
Sternal bar
Esophageal hiatus
Pleuroperitoneal fold (mesonephros degenerating)
Caudal vena cava
Central tendon
Pleuroperitoneal canal (closing)
Rib
Sternum



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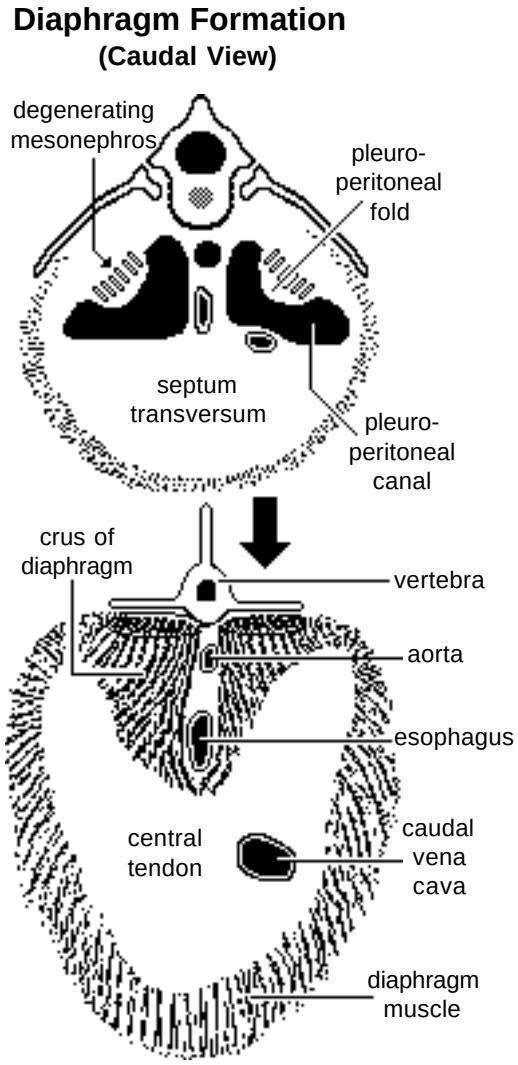
— dorsal to the gut, bilateral pleuroperitoneal folds grow medially and meet at the dorsal mesentery

— subsequent growth of the pleural cavity into somatic mesoderm (mesenchyme) will result in body wall mesoderm forming the marginal regions of the diaphragm (diaphragm musculature).



Separation of Pericardial and Pleural Cavities:

In the adult, pericardial and pleural cavities are separated by fibrous pericardium.

Originally in the embryo, the pericardial coelomic cavity communicated with two dorsally positioned pleural cavities (canals). Subsequently, the cavities become partitioned by paired *pleuropericardial folds* and then somatic mesoderm. Details of the separation include:

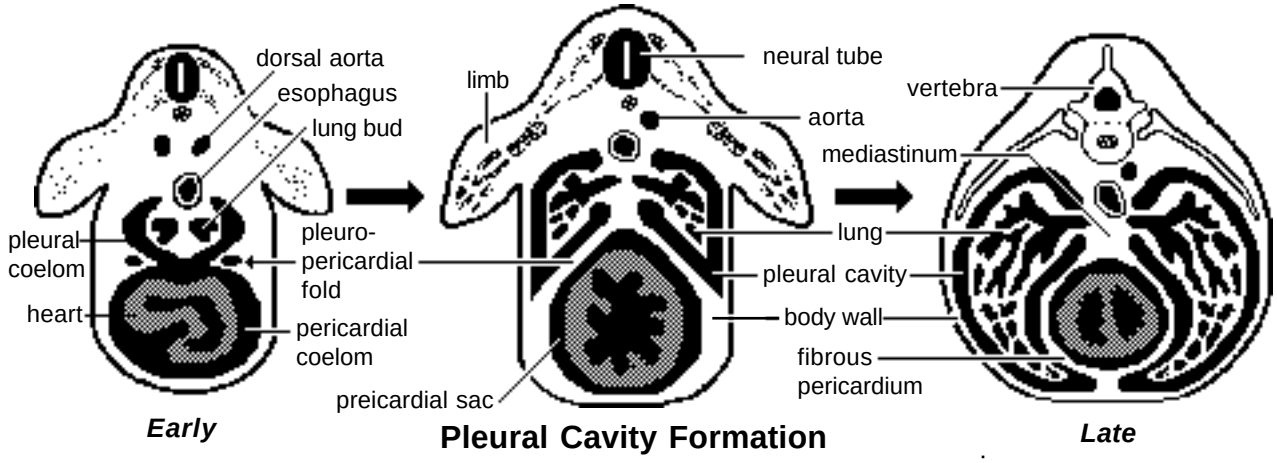
— bilateral pleuropericardial folds (membranes), which accompany common cardinal veins as they join the heart, converge medially to unite with the mediastinum (ventral mesentery) and partition the ventral pericardial cavity from the dorsal pleural canals;

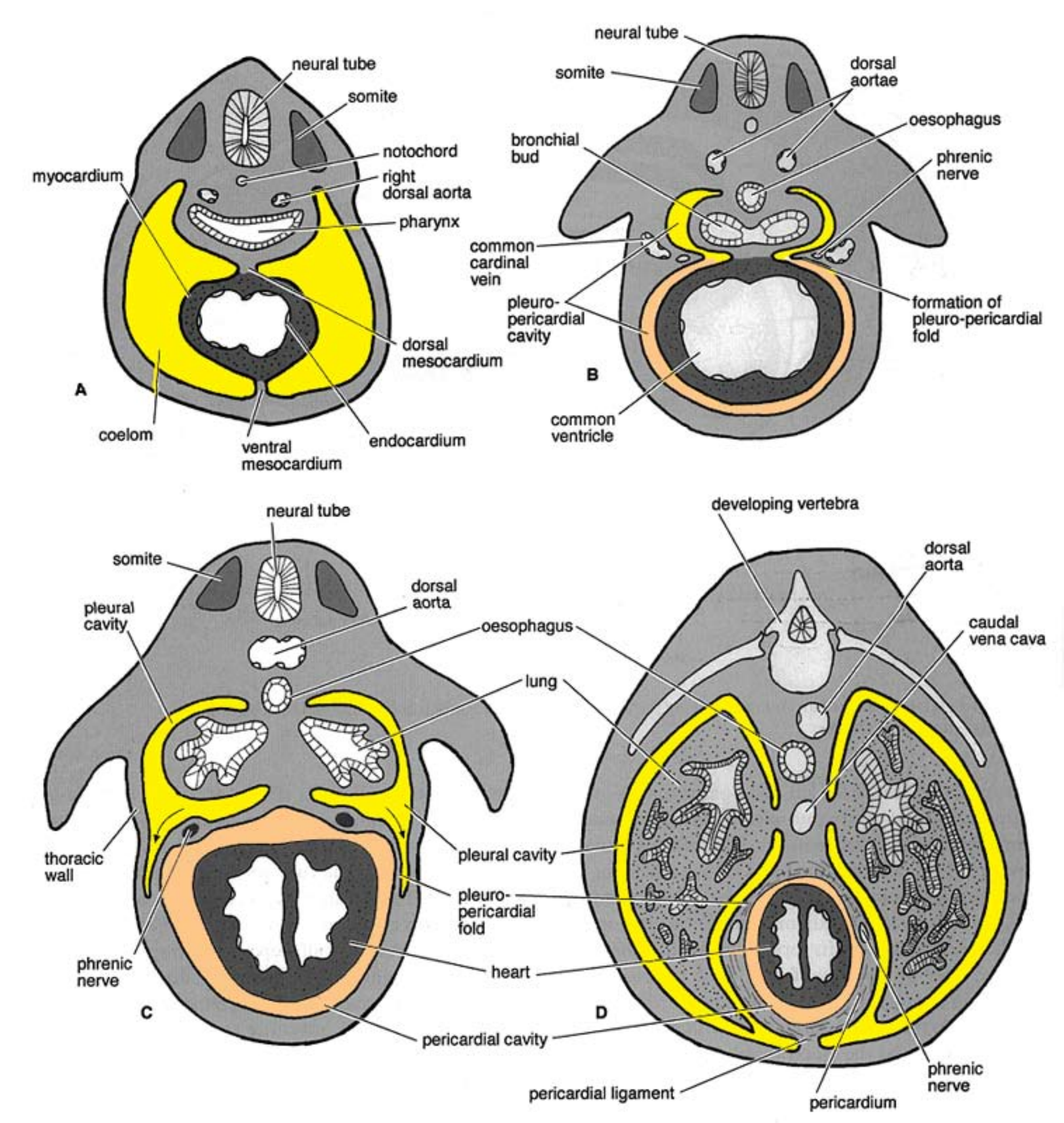
— subsequent ventrolateral growth of the pleural cavities into the body wall incorporates somatic mesoderm (mesenchyme) into the future fibrous pericardium.

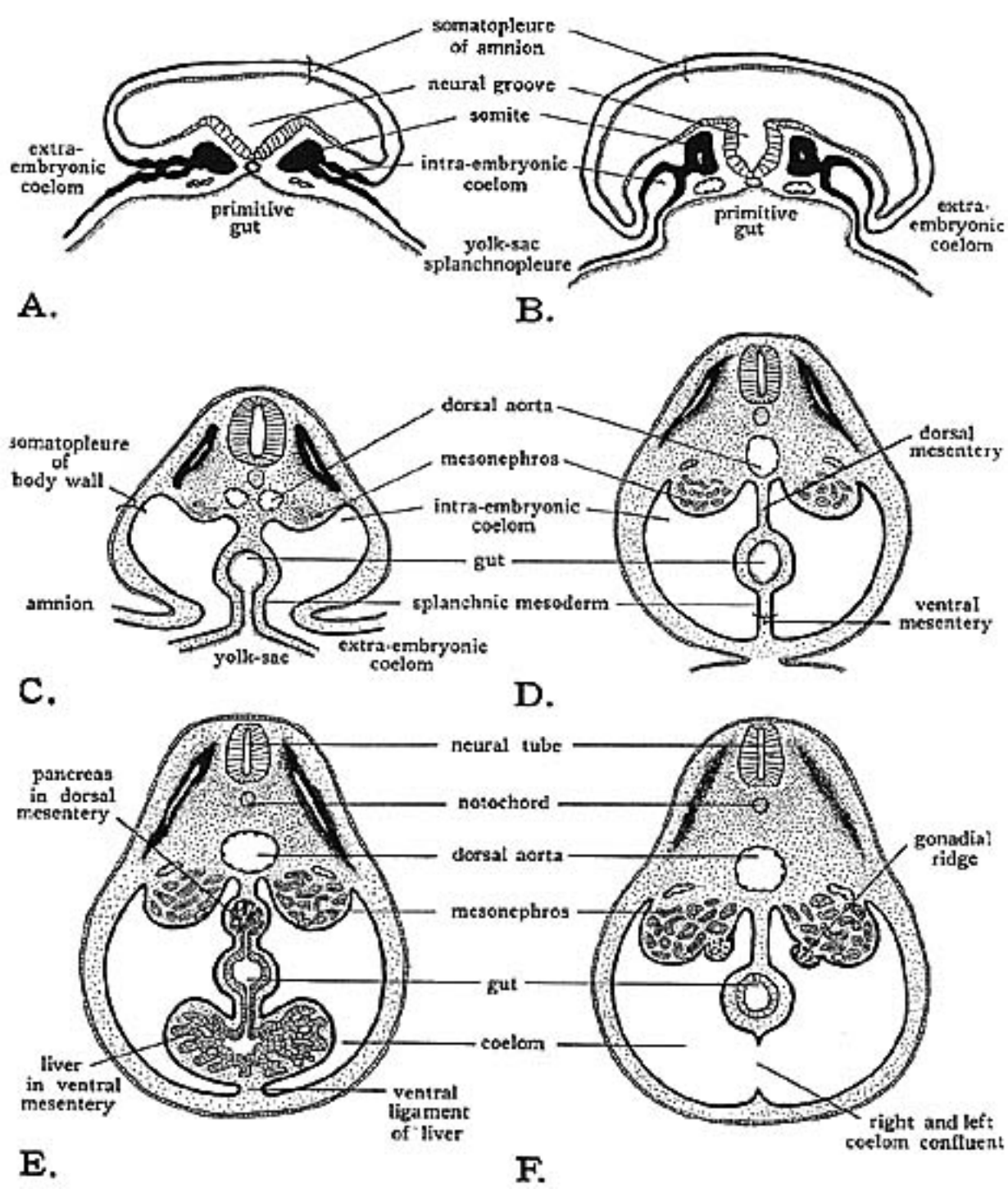
NOTE: Mediastinum is formed initially by dorsal and ventral mesenteries of the esophagus.

Growth of Pleural Cavities:

Initially the pleural cavities are small canals into which the lung buds project. As the lungs grow, the pleural cavities enlarge and appear to carve into the body wall (into somatic mesoderm/ mesenchyme). As a result, somatic mesoderm forms partitions (fibrous pericardium and diaphragm) that wall off the pleural cavities.




neural tube
somite
notochord
myocardium
right dorsal aorta
pharynx
dorsal mesocardium
A
coelom
ventral mesocardium
endocardium
neural tube
somite
dorsal aortae
oesophagus
bronchial bud
phrenic nerve
common cardinal vein
pleuro-pericardial cavity
formation of pleuro-pericardial fold
B
common ventricle
neural tube
somite
dorsal aorta
pleural cavity
oesophagus
lung
thoracic wall
pleural cavity
pleuro-pericardial fold
phrenic nerve
heart
C
pericardial cavity
developing vertebra
dorsal aorta
caudal vena cava
D
phrenic nerve
pericardial ligament
pericardium


somatopleure of amnion
neural groove
somite
extra-embryonic coelom
intra-embryonic coelom
primitive gut
yolk-sac splanchnopleure
primitive gut
extra-embryonic coelom
A.
B.
dorsal aorta
dorsal mesentery
somatopleure of body wall
mesonephros
intra-embryonic coelom
gut
amnion
splanchnic mesoderm
ventral mesentery
yolk-sac
extra-embryonic coelom
C.
D.
neural tube
pancreas in dorsal mesentery
notochord
dorsal aorta
gonadial ridge
mesonephros
gut
coelom
liver in ventral mesentery
ventral ligament of liver
right and left coelom confluent
E.
F.