Second Week of Development

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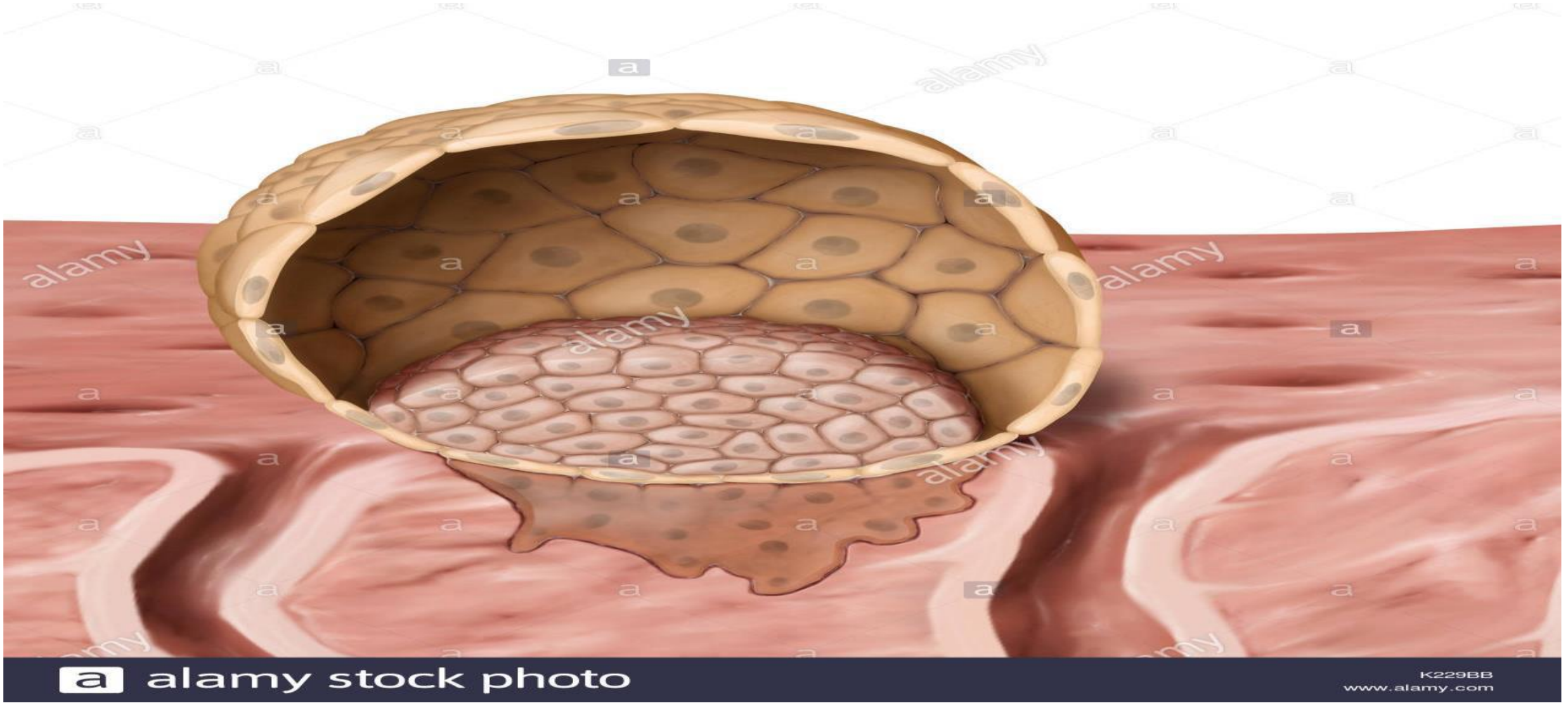
Blastocyst



Second Week of Development

The following changes occur during 2nd week of pregnancy :

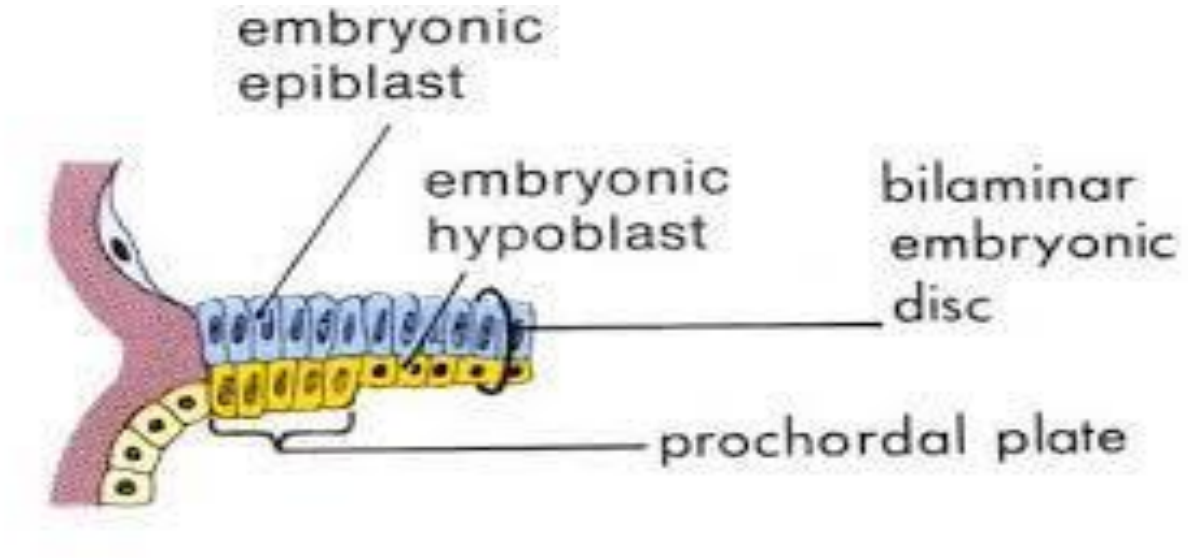
1- **Completion of implantation** by 11th or 12th day

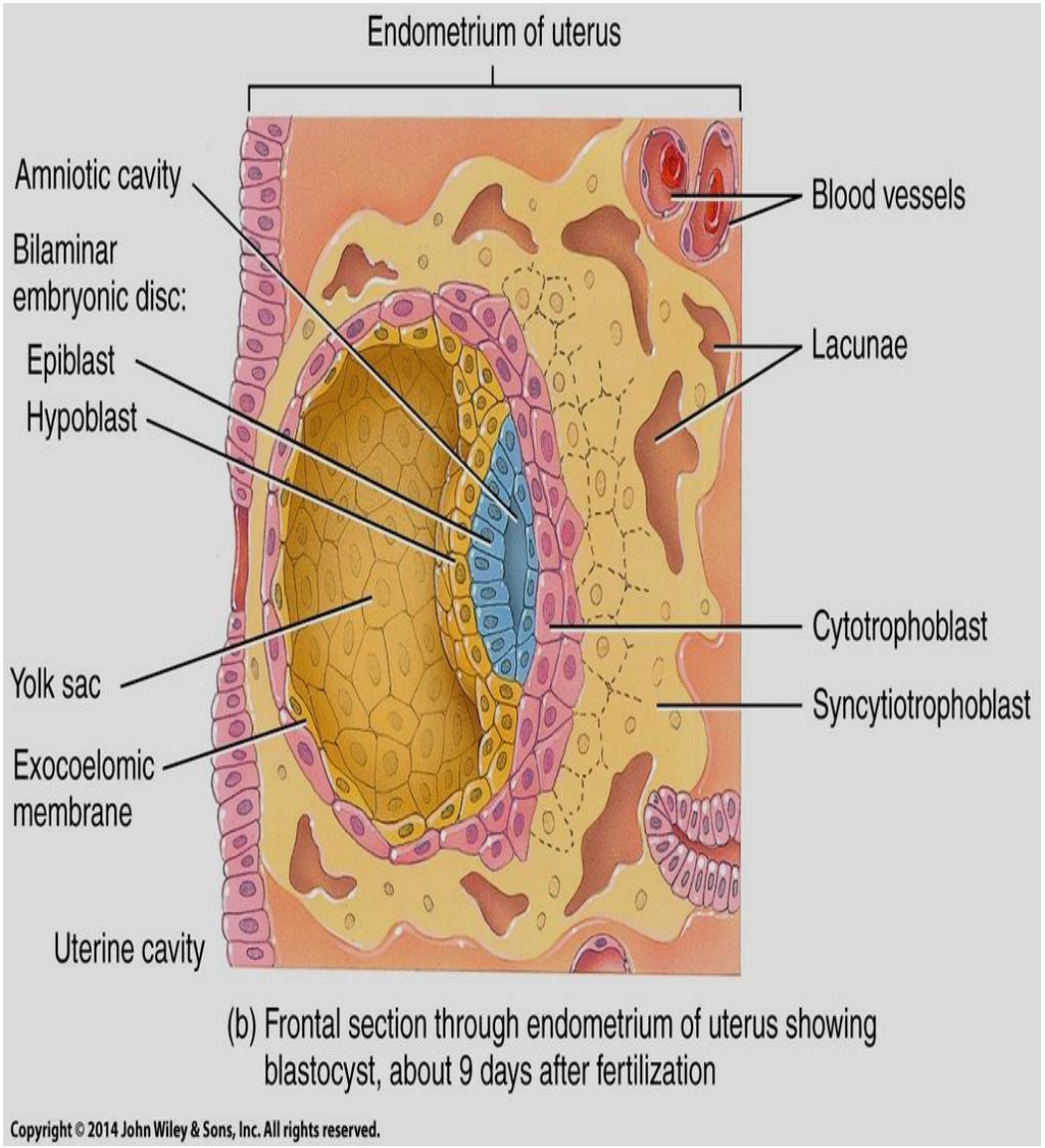
2- Changes in the embryoblast :

Formation of the **bilaminar germ disc** (**Epiblast** adjacent to the trophoblast and **Hypoblast** adjacent to the blastocele).

The germ disc is **rounded or oval** in shape .

- The epiblast and hypoblast fuse to form the **prochordal plate**, which marks the future site of the **mouth**.





3- Changes in the trophoblast :

- During 2nd. week ,the trophoblast shows rapid rate of development as compared to the slow rate of development of the bilaminar germ disc .

- The trophoblast is differentiated into an outer syncytiotrophoblast and an inner cytotrophoblast.

A- Syncytiotrophoblast :

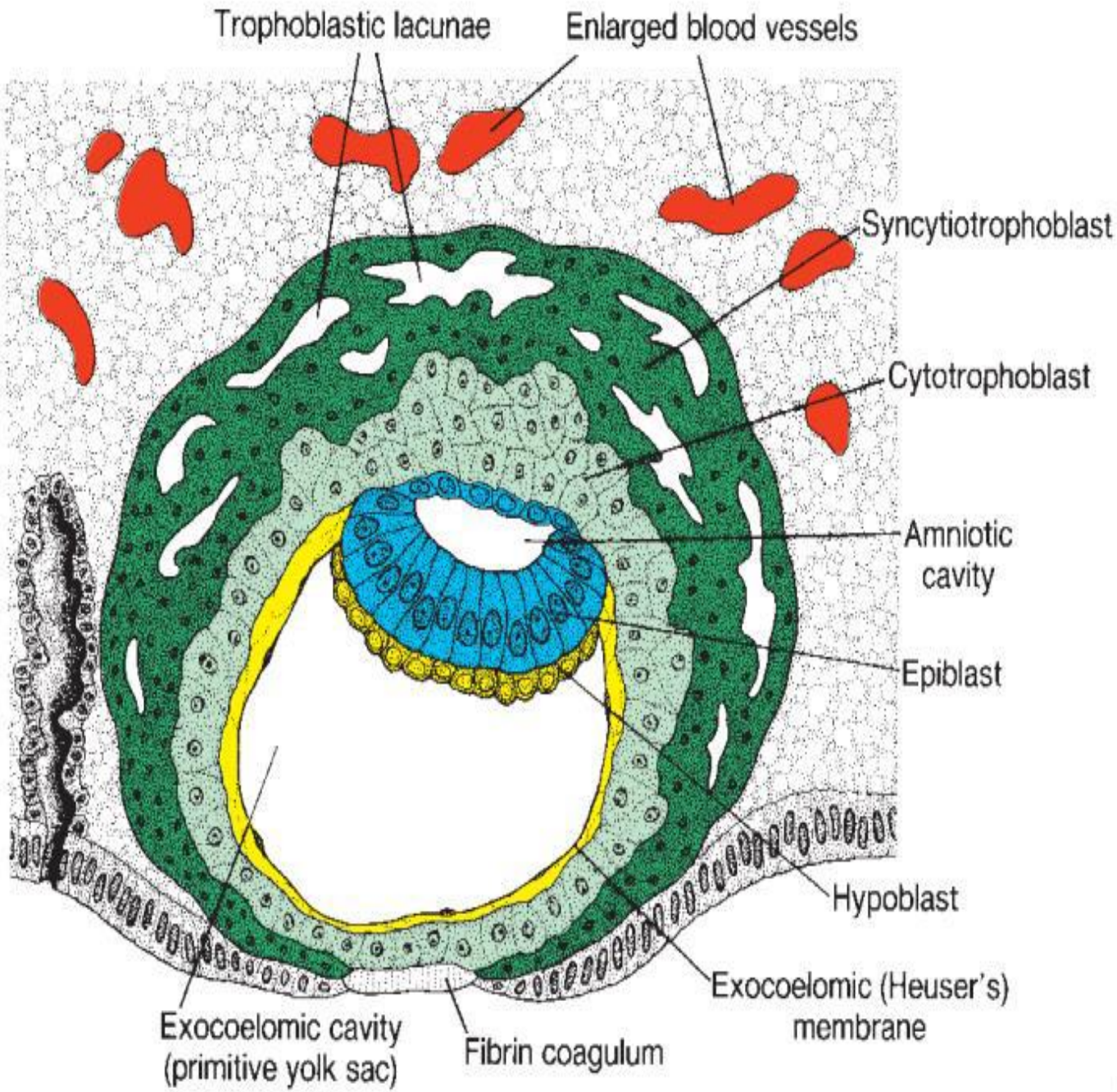
It is formed of a multinucleated zone without distinct cell boundaries.

The syncytiotrophoblast produces human chorionic gonadotropin (hCG).

Small spaces appear & coalesce (at the 9th day) in the syncytiotrophoblast , at the embryonic pole first then spread all over the syncytiotrophoblast , to form trophoblastic lacunae (lacunar stage).

At the 11th & 12th days, the syncytiotrophoblast erodes the maternal sinusoids and its lacunae are filled with maternal blood & uterine secretions which begins to flow through the trophoblastic lacunae establishing the utero-placental circulation which allow nourishment of the germ disc & change of gases & metabolites.

At the end of 2nd week , 1ry. Chorionic villi appears at the embryonic pole .



Cytotrophoblast: **Its cells maintain their cell walls.**

The syncytiotrophoblast does not divide mitotically. The cytotrophoblast does divide mitotically, adding to the growth of the syncytiotrophoblast.

HUMAN CHORIONIC GONADOTROPIN

1. hCG is a glycoprotein produced by the syncytiotrophoblast that stimulates the production

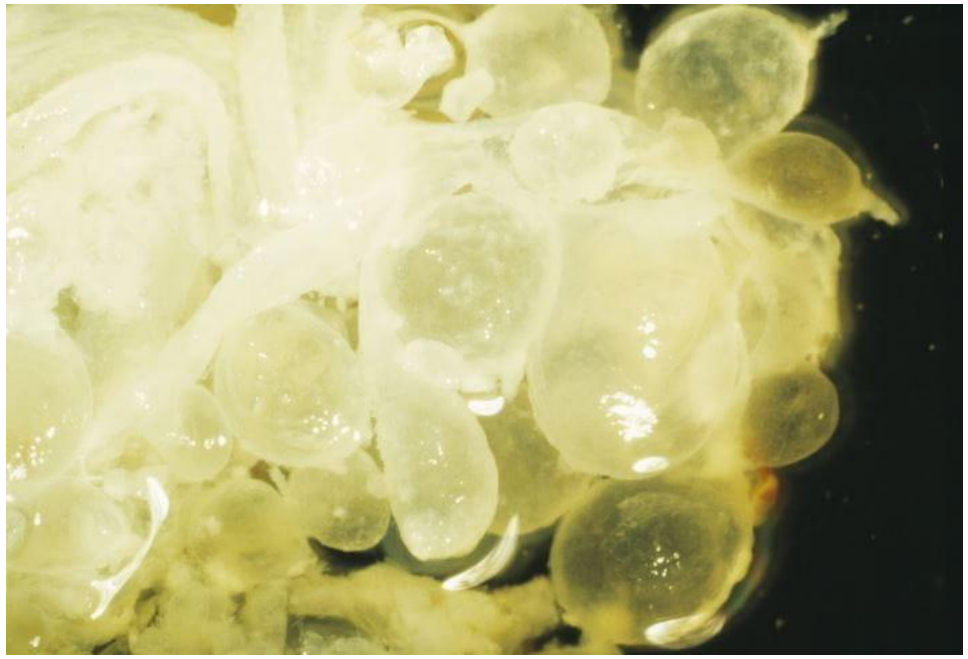
of progesterone by the corpus luteum This is clinically significant because progesterone produced by the corpus luteum is essential for the maintenance of pregnancy until week 8. The placenta then takes over progesterone production.

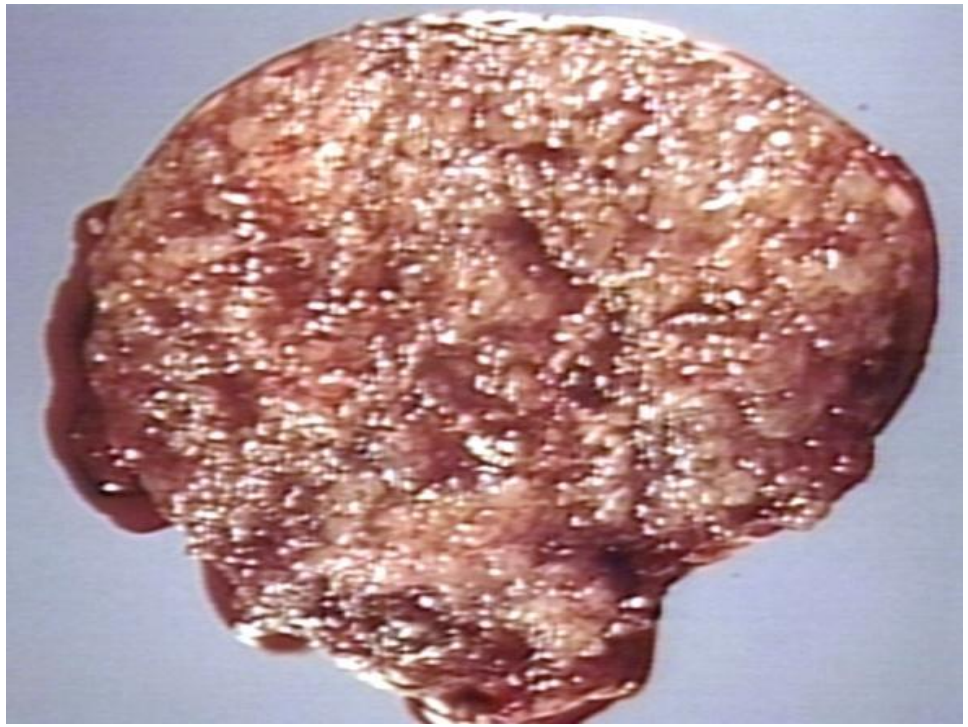
2. hCG can be assayed in maternal blood at day 8 or maternal urine at day 10 and is the basis of pregnancy testing.

4. Low hCG values may predict a spontaneous abortion or indicate an ectopic pregnancy.

5. High hCG values may indicate a multiple pregnancy, hydatidiform mole, or gestational

trophoblastic neoplasia (GTN) (such as chorioncarcinoma).





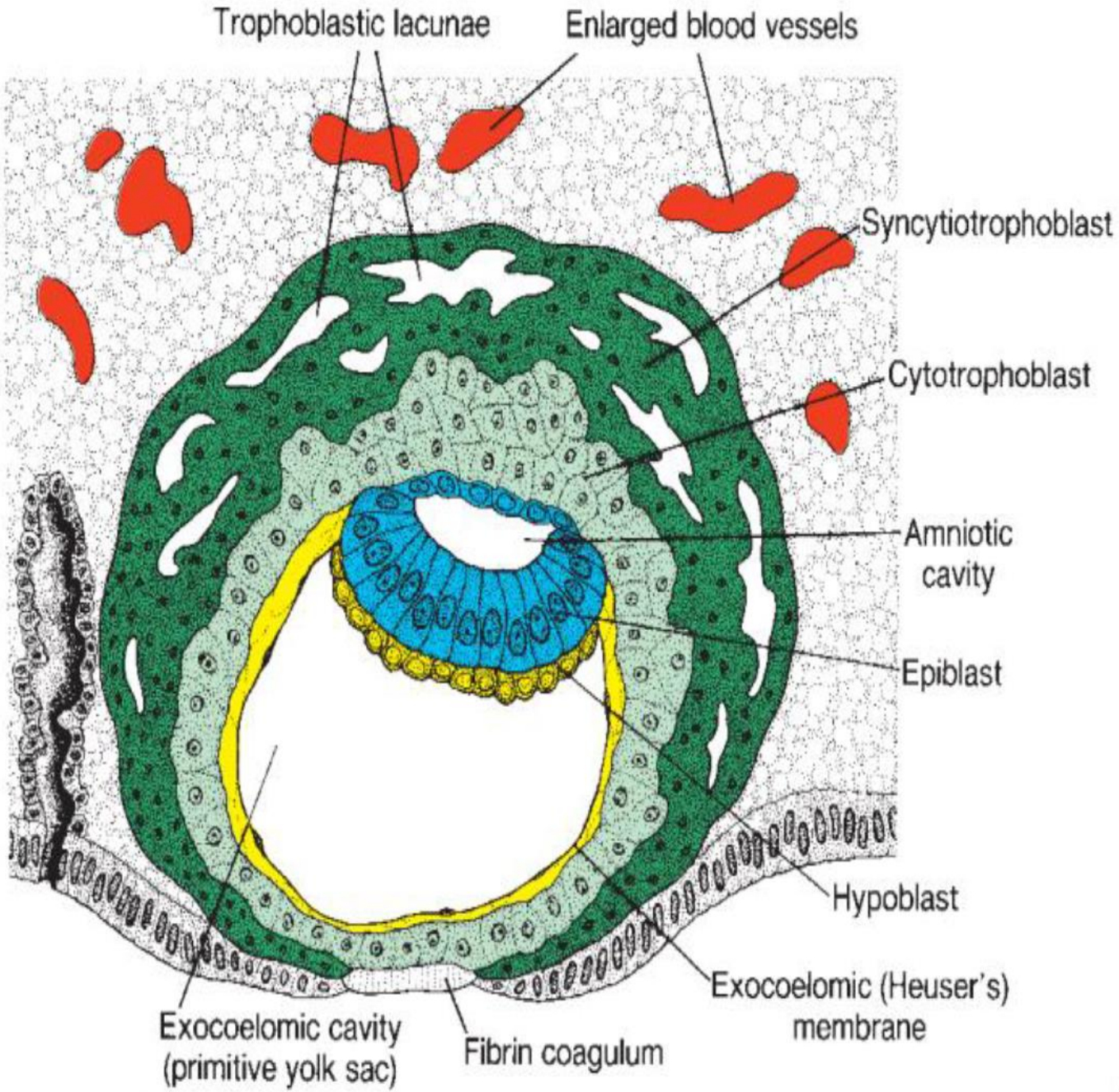
4 – Formation of 2 cavities :

a) Amniotic cavity : (8th day)

- It is a space appears between the epiblast and the Cytotrophoblast
- The epiblast cells form a layer of flat cells called amnioblasts which form the roof of the amniotic cavity while its floor is formed by the epiblast .

b) Primary yolk sac : (9th day)

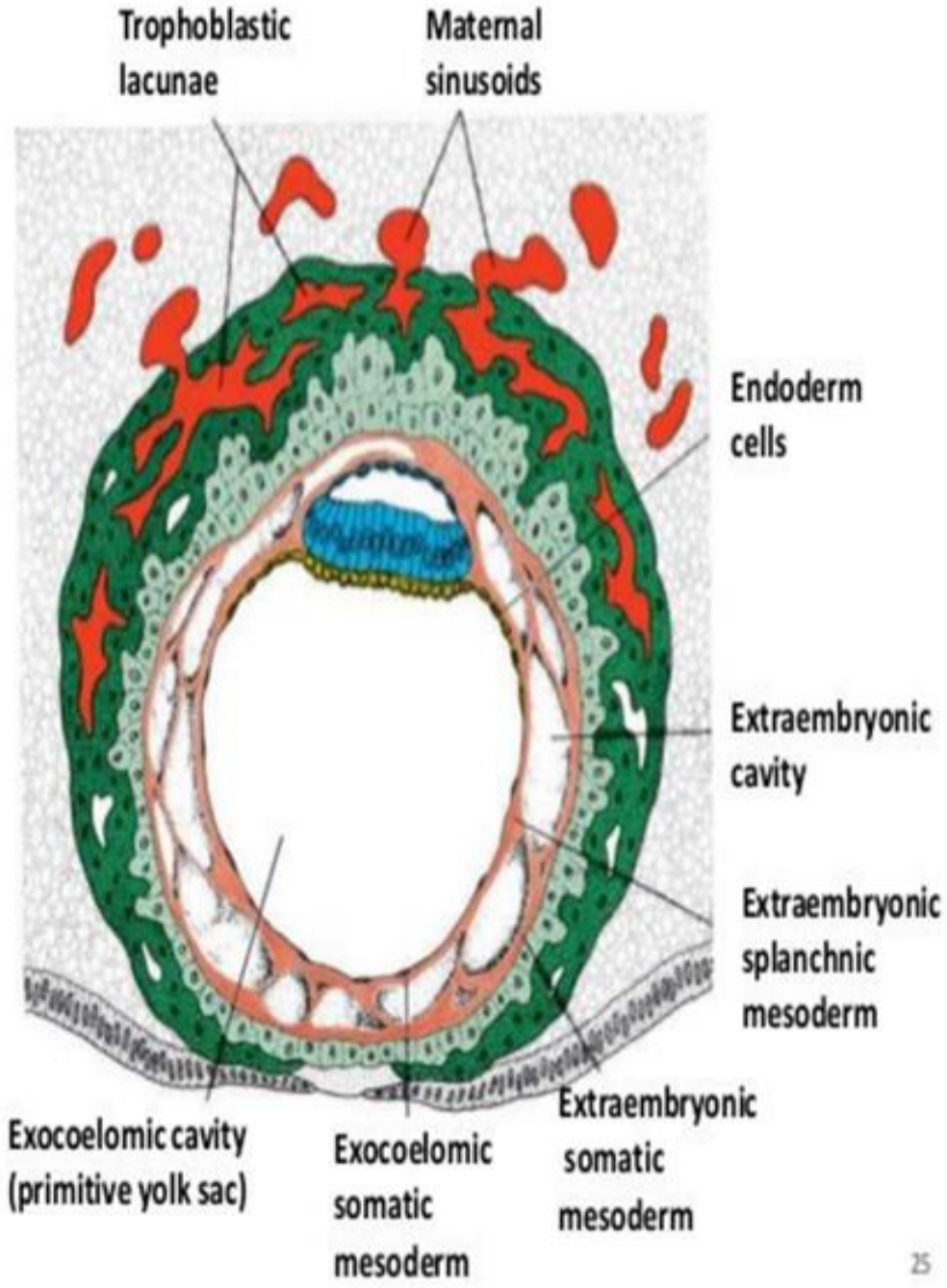
- The hypoblast cells form a layer of flat cells forming a membrane , which line the blastocele , called Hauser's membrane.
- The space between the hypoblast and the Hauser's membrane is called the 1ry yolk sac , which replaces the blastocele , with its roof is the hypoblast and the remaining part of its wall is formed of Hauser's membrane .



5-Extraembryonic mesoderm:

- **These are cells derived from the yolk sac cells appear and form very loose tissues between the cytotrophoblast externally and the the yolk sac internally.**
- **Cavities appear & coalesce , in the extra-embryonic mesoderm , forming a single large C shape cavity called the extra-embryonic coelom (or chorionic cavity).**

The hypoblast produces additional cells that migrate inside the Heuser's membrane. These cells proliferate and gradually form a new cavity known as the secondary yolk sac (day 13).



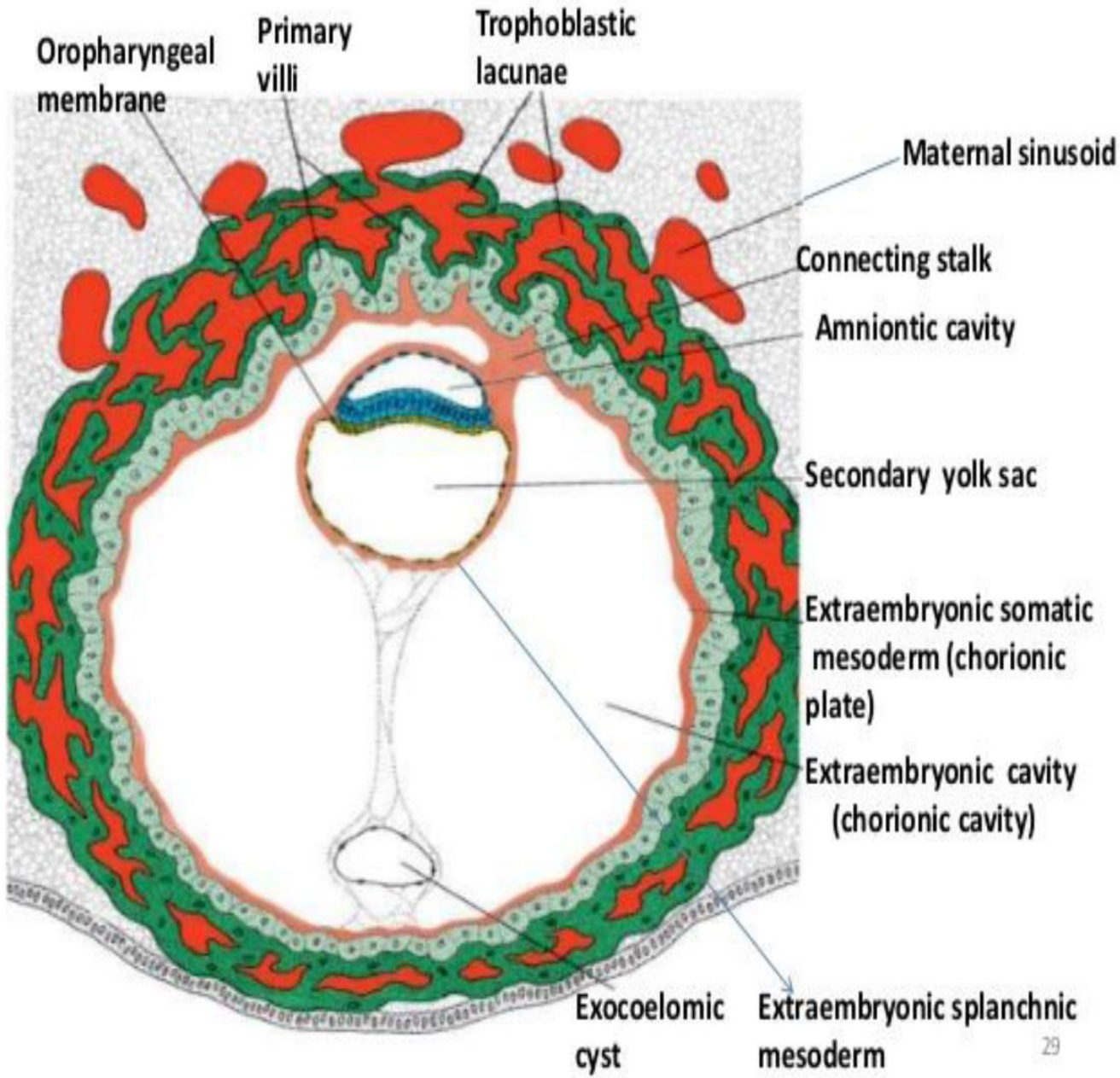
The extra-embryonic mesoderm is divided by the extra-embryonic coelom (chorionic cavity) into:

a. Extraembryonic somatopleuric mesoderm which lines the cytotrophoblast .

b. Extraembryonic splanchnopleuric mesoderm which covers the yolk sac.

c. Connecting stalk : (future umbilical cord) It is the extra-embryonic mesoderm connecting the roof of amniotic cavity with the over lying cytotrophoblast . It is found dorsal to the amniotic cavity.

• The cytotrophoblast +Syncytiotrophoblast + Extraembryonic somatopleuric mesoderm are called Chorion . The blastocyst is now called the Chorionic vesicle (at the 12th day).



Third Week of Development

The following changes occur during 3rd. week of pregnancy

A) Changes in the embryonic disc

I.Changes in shape : During 3rd. week the embryonic disc becomes pear shape because the cranial part grows at a higher rate than the caudal part .

II.Gastrulation : (15-20 day) It includes the followings :

1. Formation of the primitive streak (15 days)

2. Invagination

3. Formation and beginning of differentiation of the intra-embryonic mesoderm .

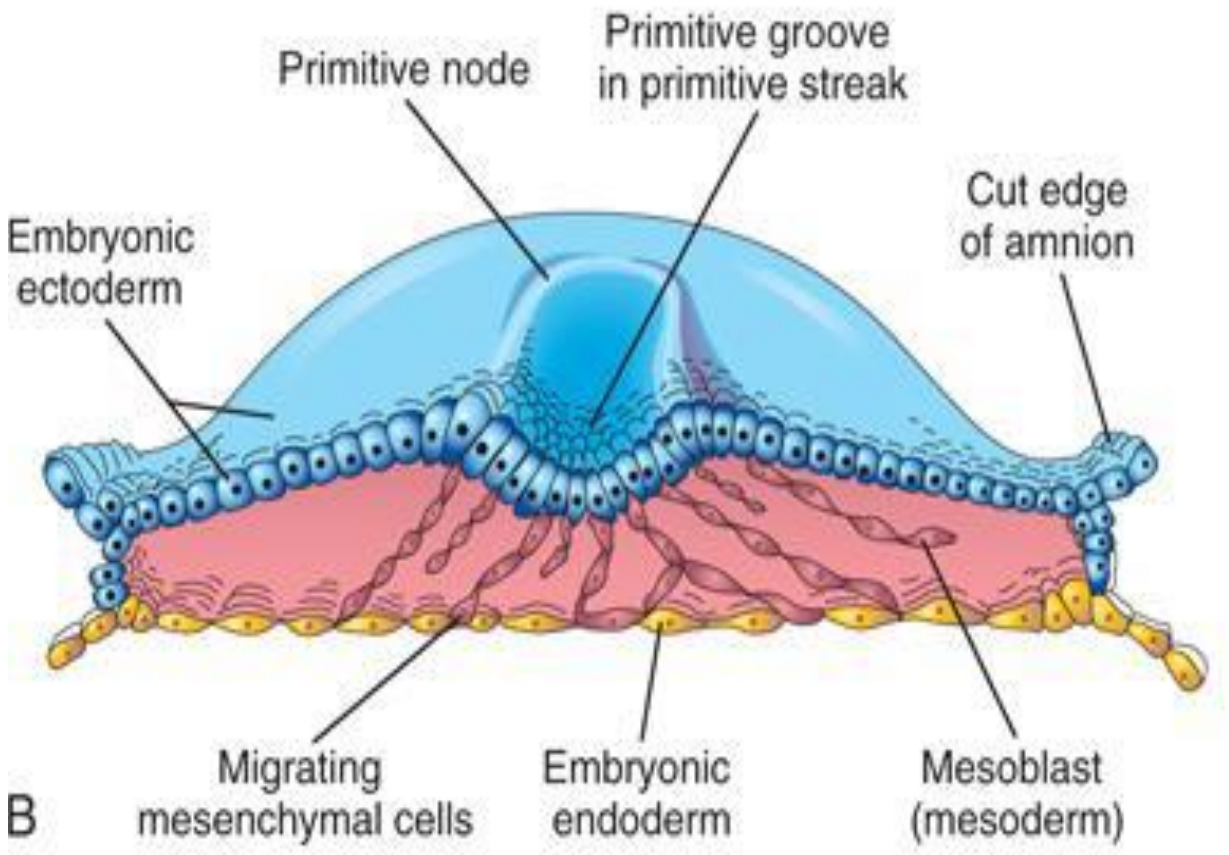
III. Formation of notochord .

IV. Neurulation (formation of neural tube) .

V. Beginning of folding of the embryonic disc (end of 3rd. week).

B) Changes in the trophoblast (chorion) :

- **3 types of chorionic villi (primary , secondary & tertiary) develop and cover the whole surface of chorionic vesicle .**



Gastrulation :

• It is the process of transformation of the bilaminar embryonic disc to form a trilaminar germ disc as follows :

1. Formation of the primitive streak: (15 days)

• The primitive streak is formed due to migration of epiblastic cells to the midline of caudal part of embryonic disc.

• It appears as a narrow groove called primitive groove with slightly bulging regions on either side.

• Its cephalic end forms a bulge called primitive node which has a central depression called primitive pit .

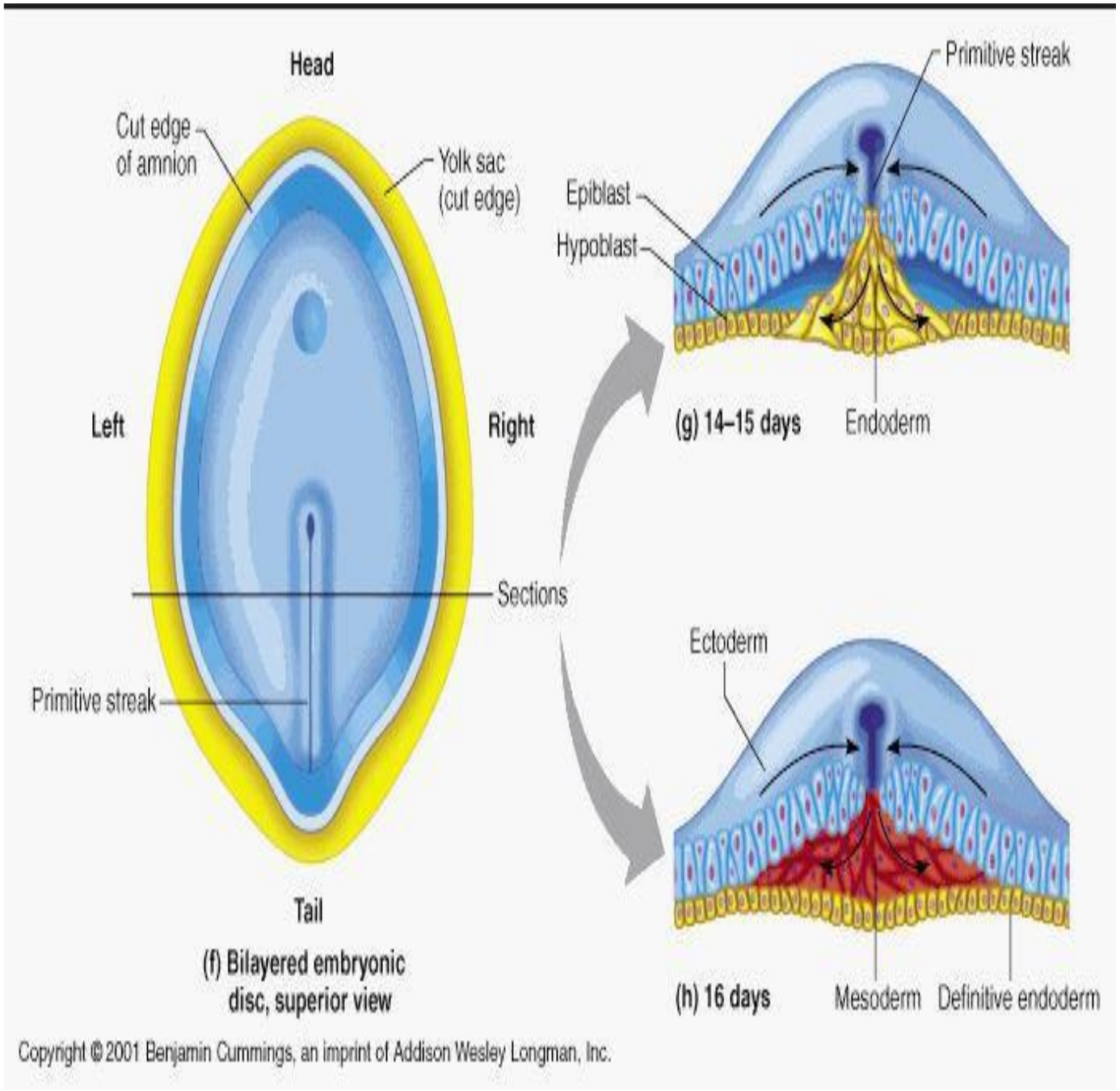
2. Invagination :

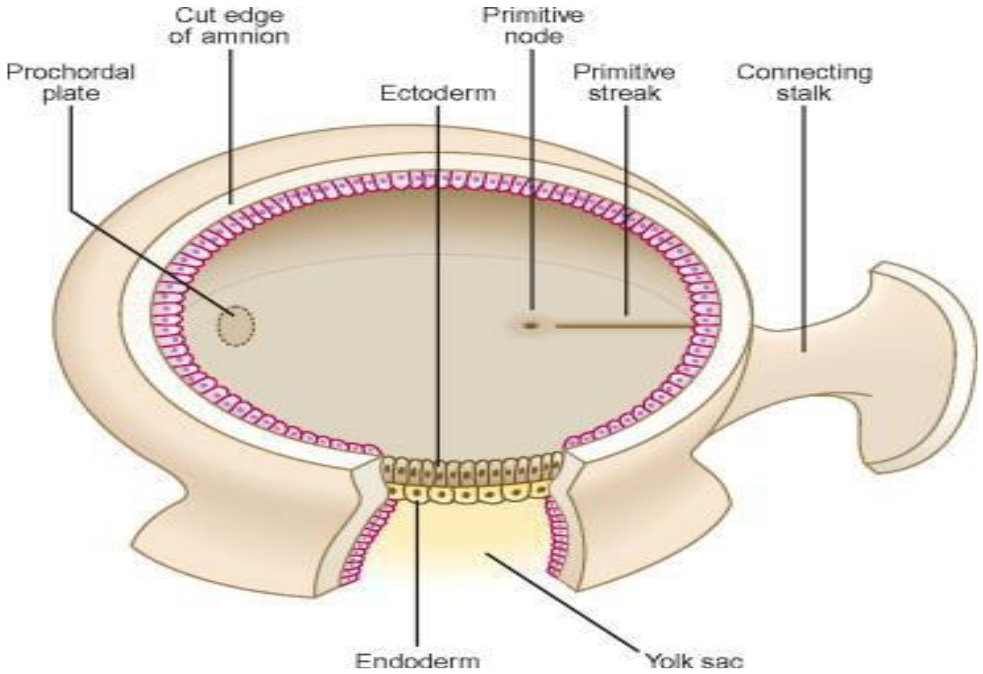
• The cells around the primitive streak , detach from the epiblast and slip beneath it into the interior of the embryonic disc to :

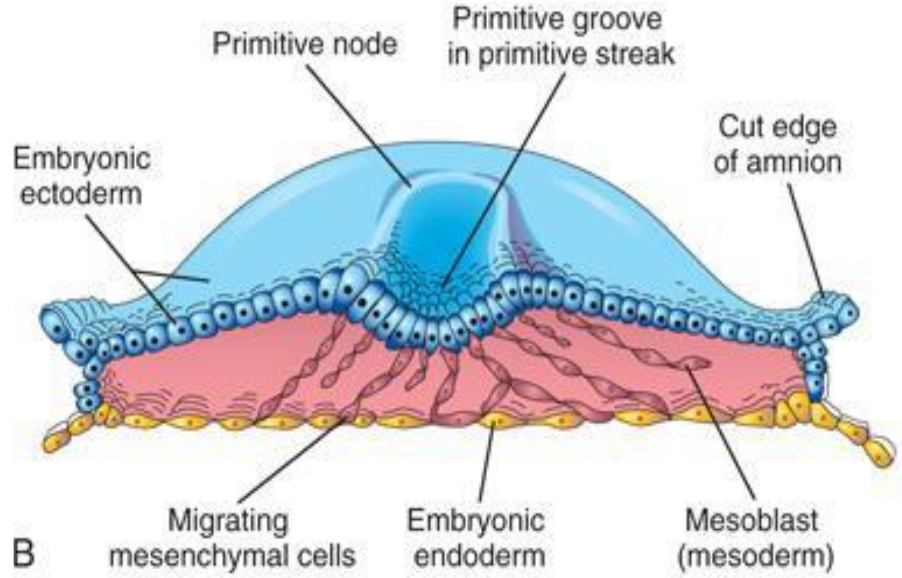
a) Invade and replaces the hypoblast to form the endoderm.

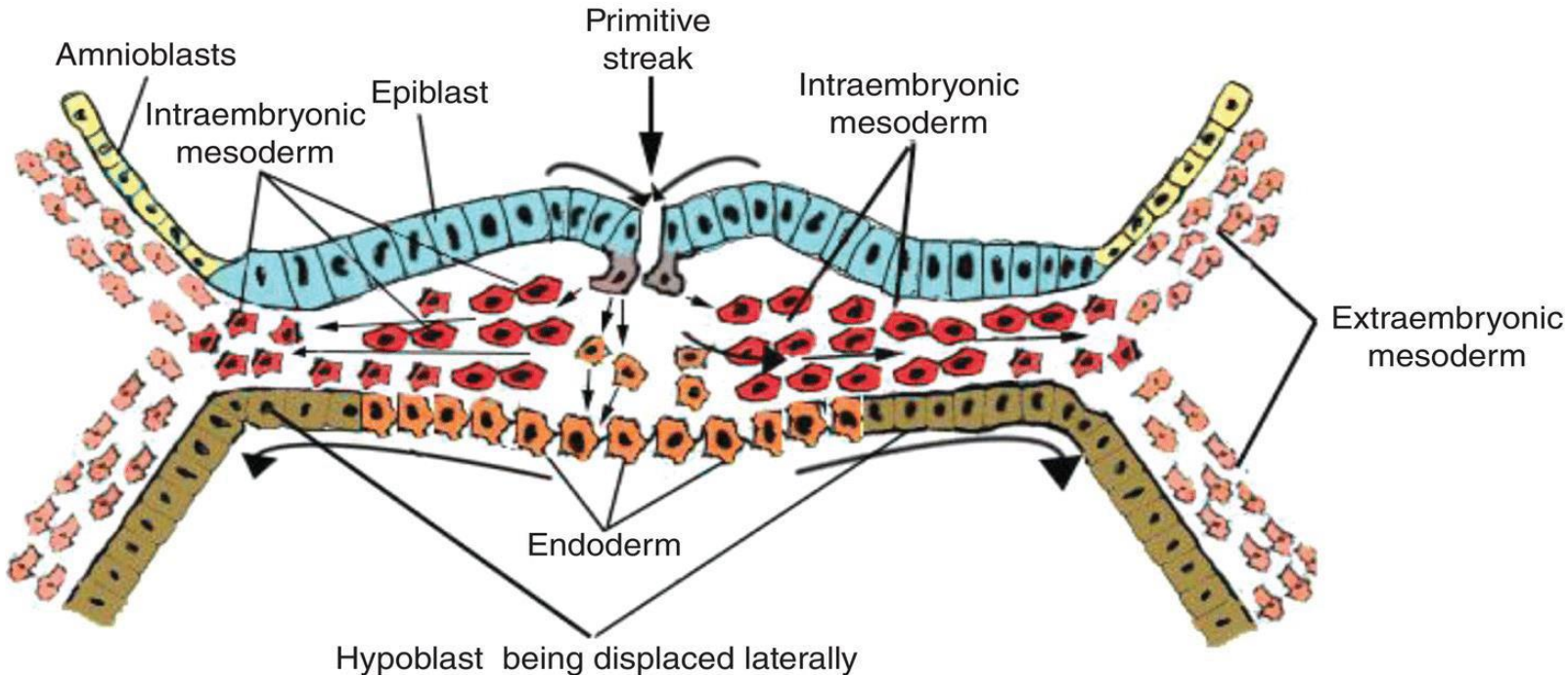
b) The remaining part of the epiblast forms the ectoderm; it is attached to the amnioblast at the amnio-ectodermal junction.

c) Some of the invaginated epiblast cells remain and migrate in all directions in between the ectoderm and the endoderm to form intra-embryonic mesoderm .



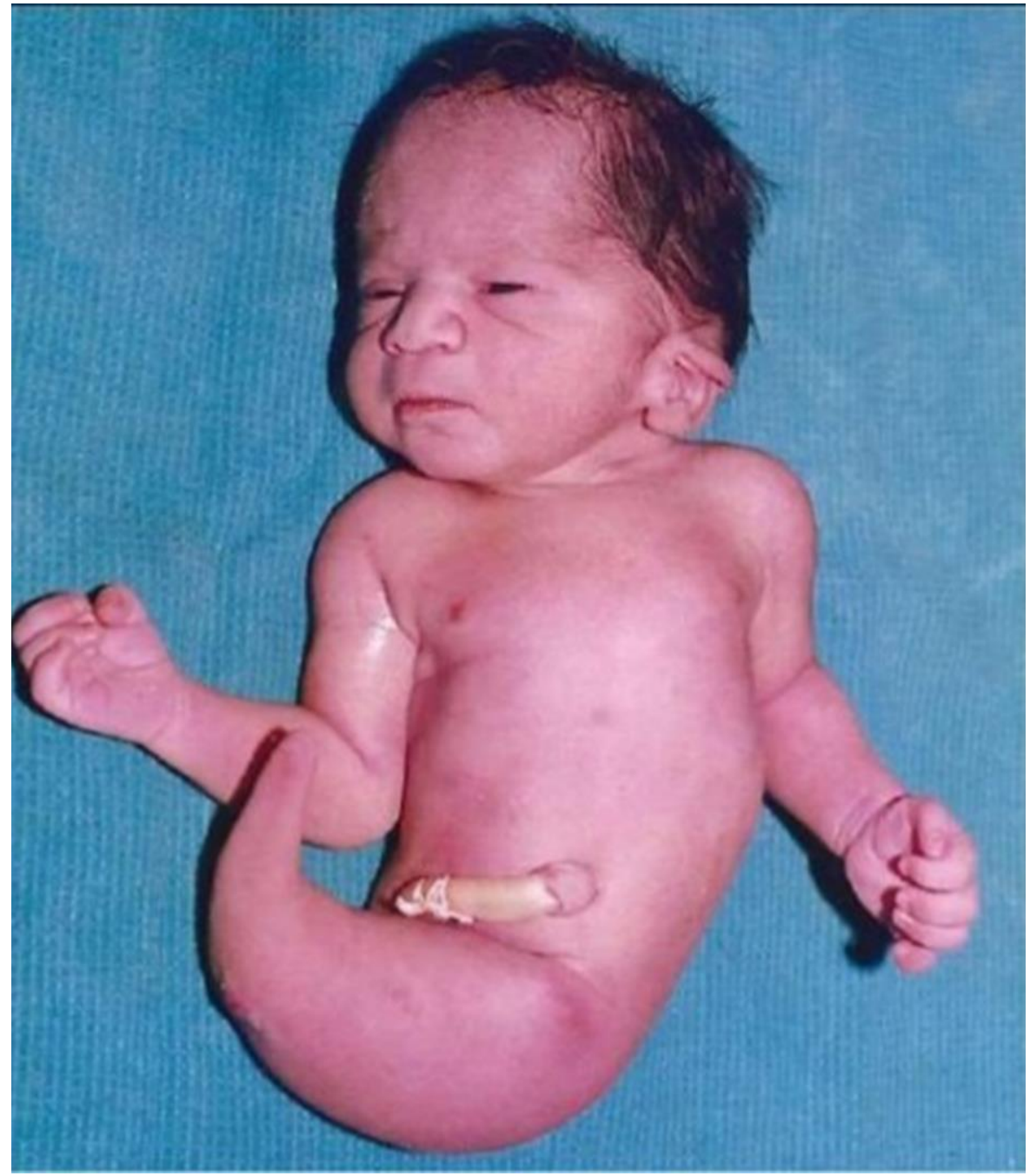






Clinical Correlates

- Gastrulation itself may be disrupted by genetic abnormalities, toxic insults and maternal diabetes
- In caudal dysgenesis (sirenomelia), insufficient mesoderm is formed in the caudalmost region of the embryo. Because this mesoderm contributes to formation of the lower limbs, urogenital system (intermediate mesoderm), and lumbosacral vertebrae, abnormalities in these structures ensue.

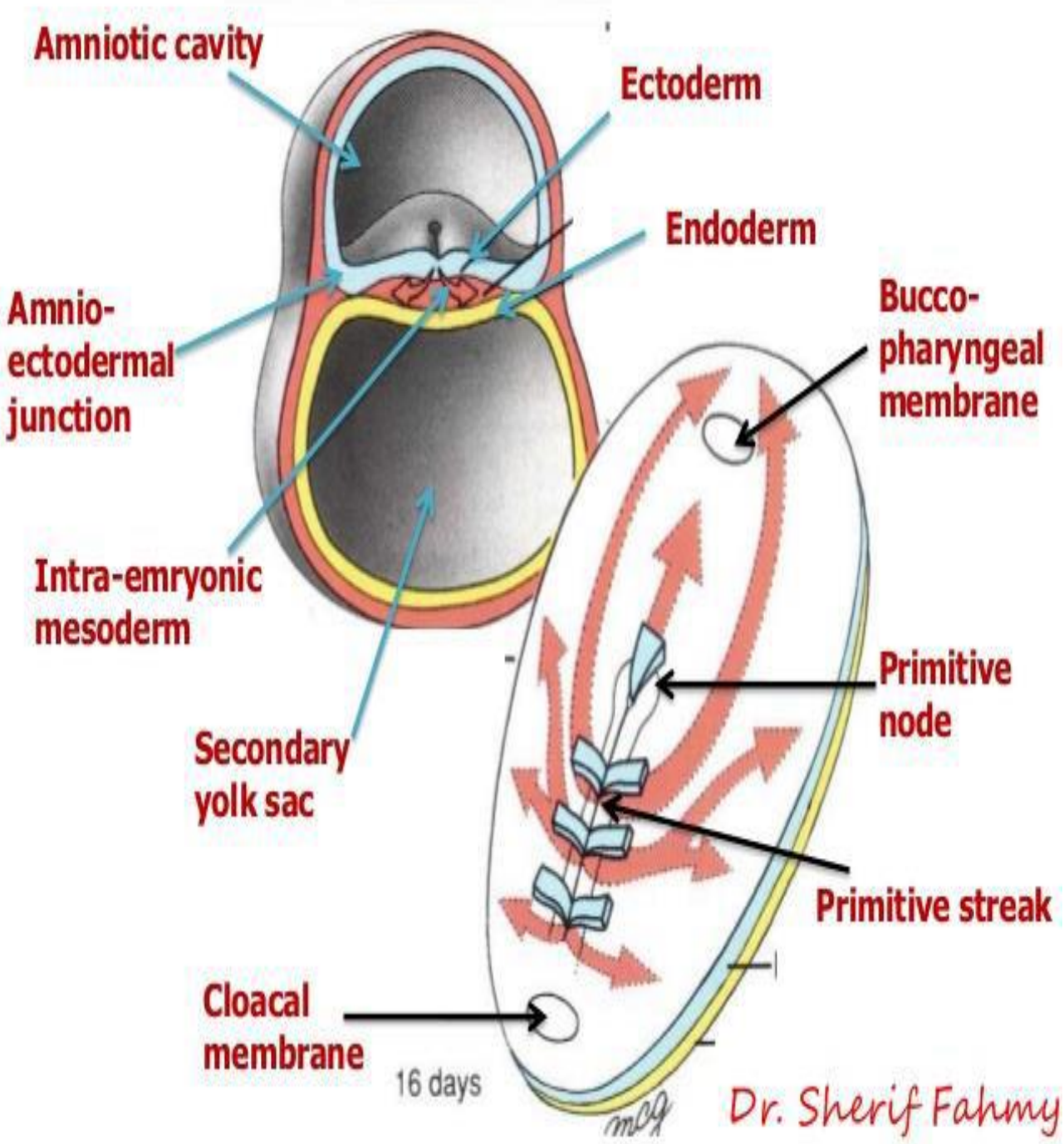


Tumors Associated With Gastrulation

- Sometimes, remnants of the primitive streak persist in the sacrococcygeal region. These clusters of pluripotent cells proliferate and form tumors, known as sacrococcygeal teratomas, that commonly contain tissues derived from all three germ layers. This is the most common tumor in newborns, occurring with a frequency of one in 37,000. These tumors may also arise from primordial germ cells that fail to migrate to the gonadal ridge

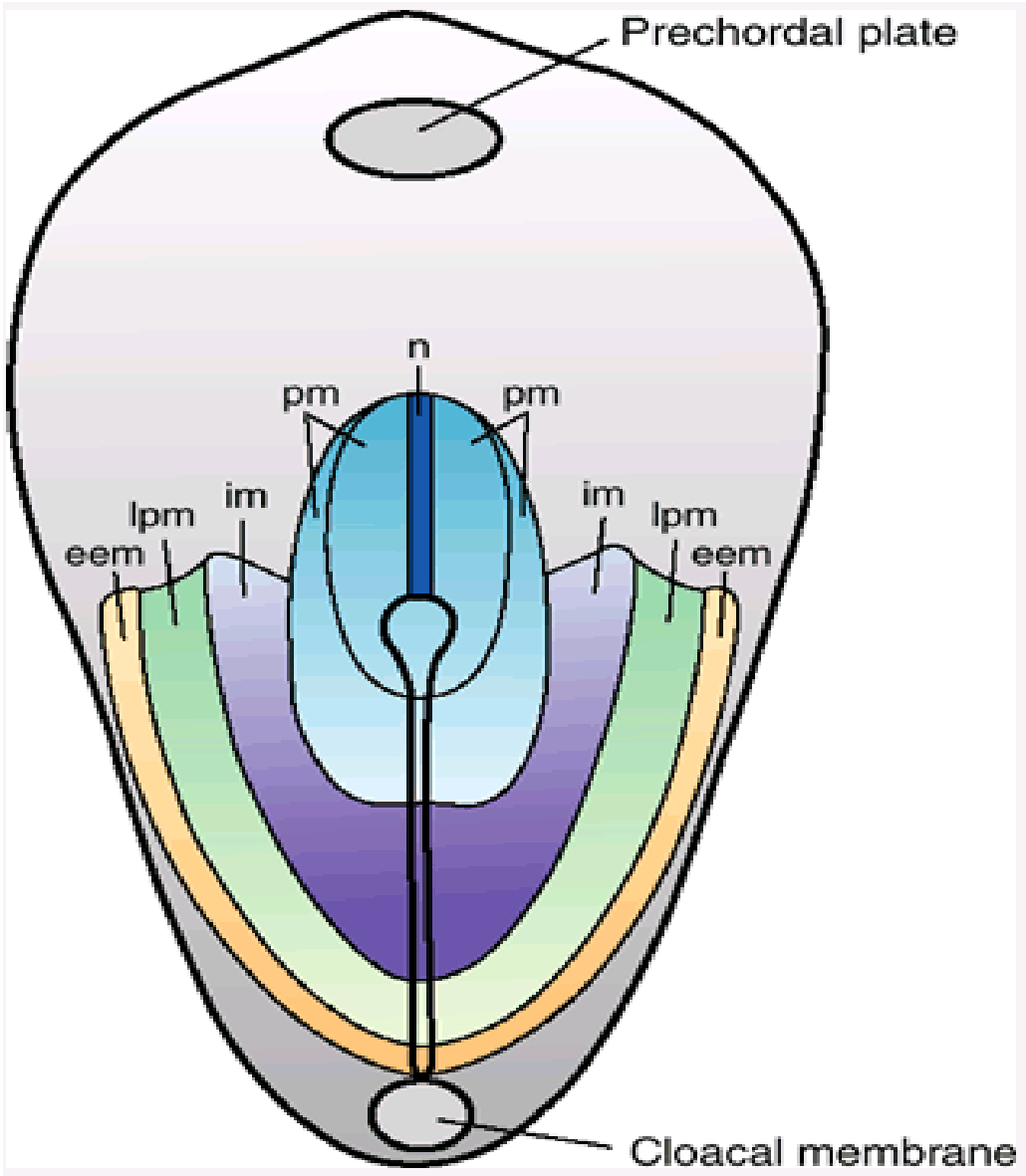
Figure 4-6 Female infant with a large sacrococcygeal teratoma that developed from remnants of the primitive streak. The tumor, a neoplasm made up of several different types of tissue, was surgically removed. (Courtesy of A.E. Chudley, MD, Section of Genetics and Metabolism, Department of Pediatrics and Child Health, Children's Hospital and University of Manitoba, Winnipeg, Manitoba, Canada.)

- **3. Formation & beginning of differentiation of the intra-embryonic mesoderm : It migrates & spreads between the ectoderm and endoderm except in three region:**
- 1) **Prochordal plate** : near the cephalic end of the embryonic disc . The prochordal plate later on will become the oro-pharyngeal membrane .
- 2) **Cloacal membrane** : immediately behind the caudal end of the primitive streak .
- 3) **Midline region** of the embryonic disc between primitive node and Prochordal plate that will form the notochord.



Fate Map

- Cells from specific regions of Epiblast , later on form specific part or structure of the embryo
- Cells invaginate through the primitive node --- notochord
- Cells from lateral side of the node and cranial part of primitive streak --- paraxial mesoderm
- Cells migrating through mid streak --- intermediate mesoderm
- Cells migrating through caudal part of the streak ----- lateral mesoderm



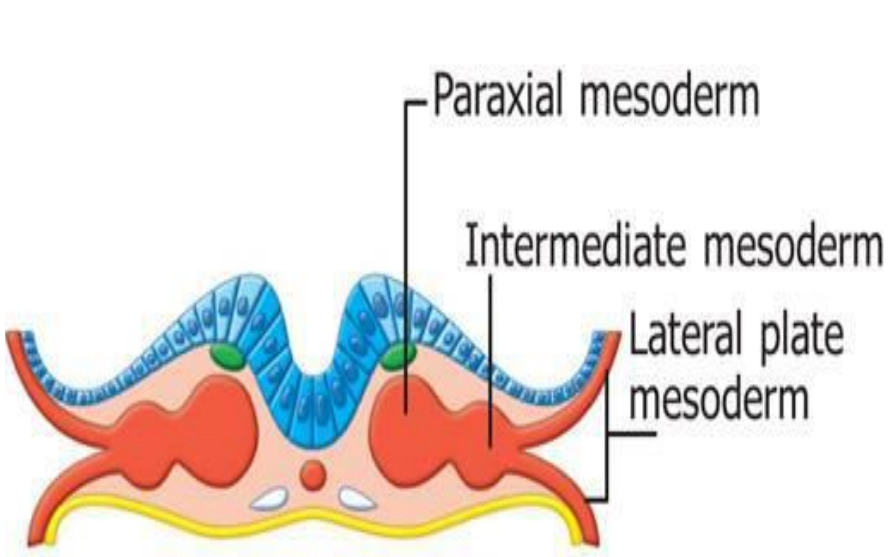
At the 17th day , the intra-embryonic mesoderm is formed as a sheet of loose tissue between the ectoderm and endoderm on either side of the notochord (except in the previous 3 areas) .

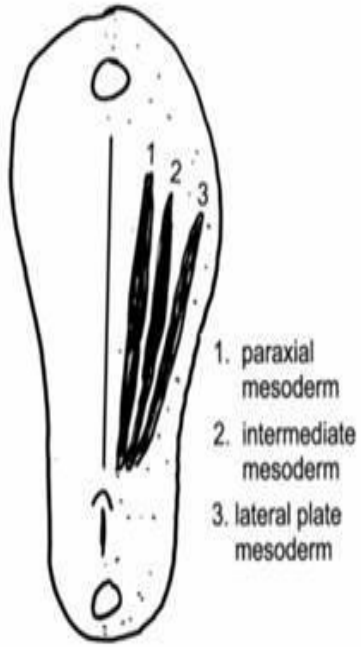
- **It establishes contact with the extra-embryonic mesoderm at the margins of the embryonic disc.**
- **As development proceeds , 2 longitudinal grooves appear in the intra-embryonic mesoderm on either sides of the notochord dividing it into 3 parts :**

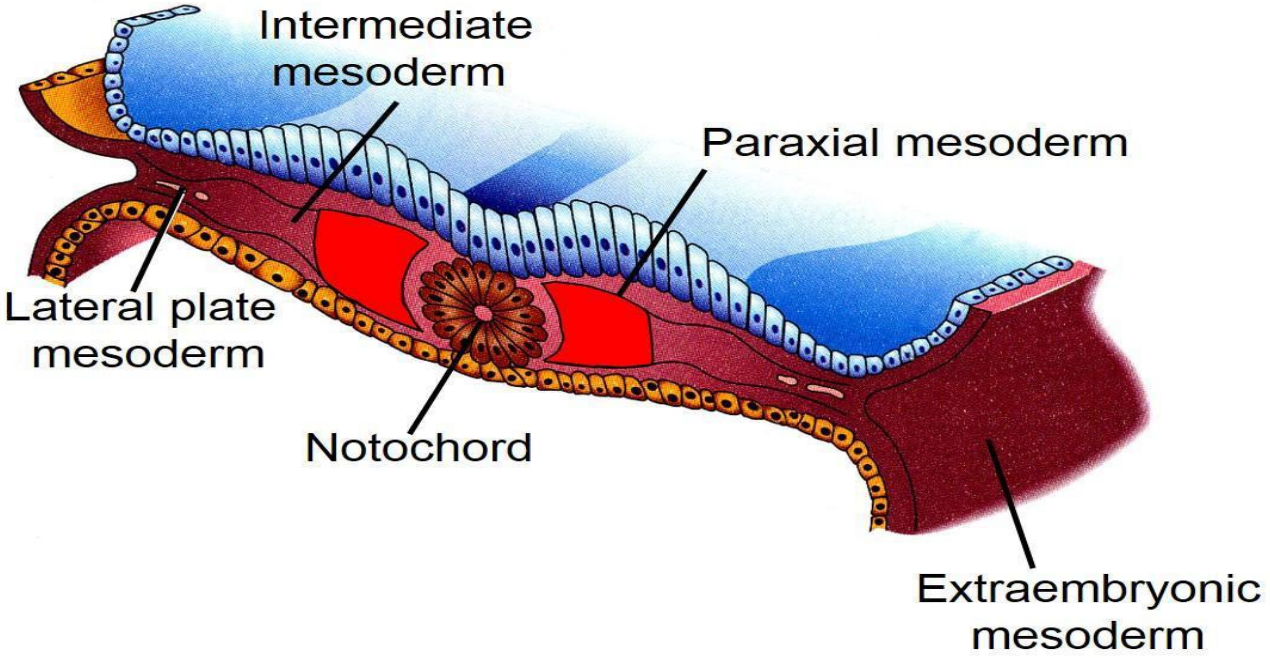
a) Paraxial mesoderm : on each sides and parallel to the notochord

b) Intermediate mesoderm lateral to the paraxial mesoderm.

c) Lateral plate mesoderm most laterally near the edge of the embryonic disc and it extends in the cephalic region of the disc cranial to the buccopharyngeal membrane.







Development of the trophoblast during 3rd. week :

- The trophoblastic lacunae are surrounded by **trophoblastic (chorionic) villi** as following:
- **The primary villi :** (syncytiotrophoblast + cytotrophoblast) the cytotrophoblast penetrates into the syncytiotrophoblast in between the lacunae to form the primary villi .
- **The secondary villi :** (cytotrophoblast + syncytiotrophoblast + core of mesoderm**):** a core of extraembryonic mesoderm which lines the cytotrophoblast enters into the primary villi to form the secondary villi .
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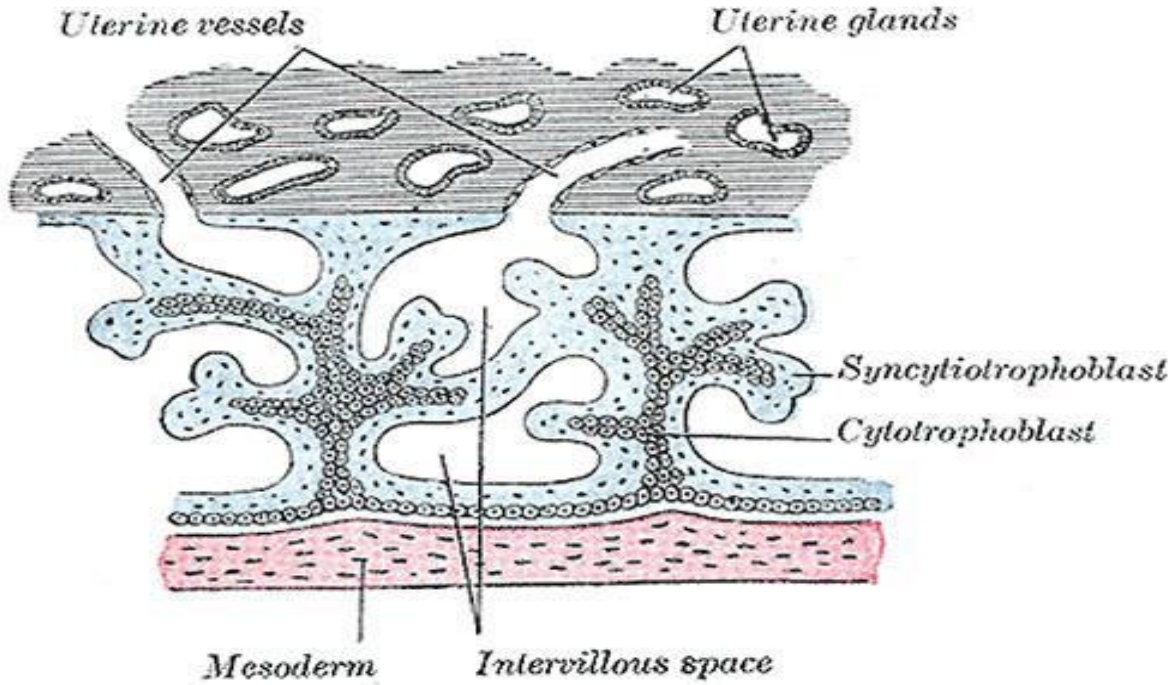
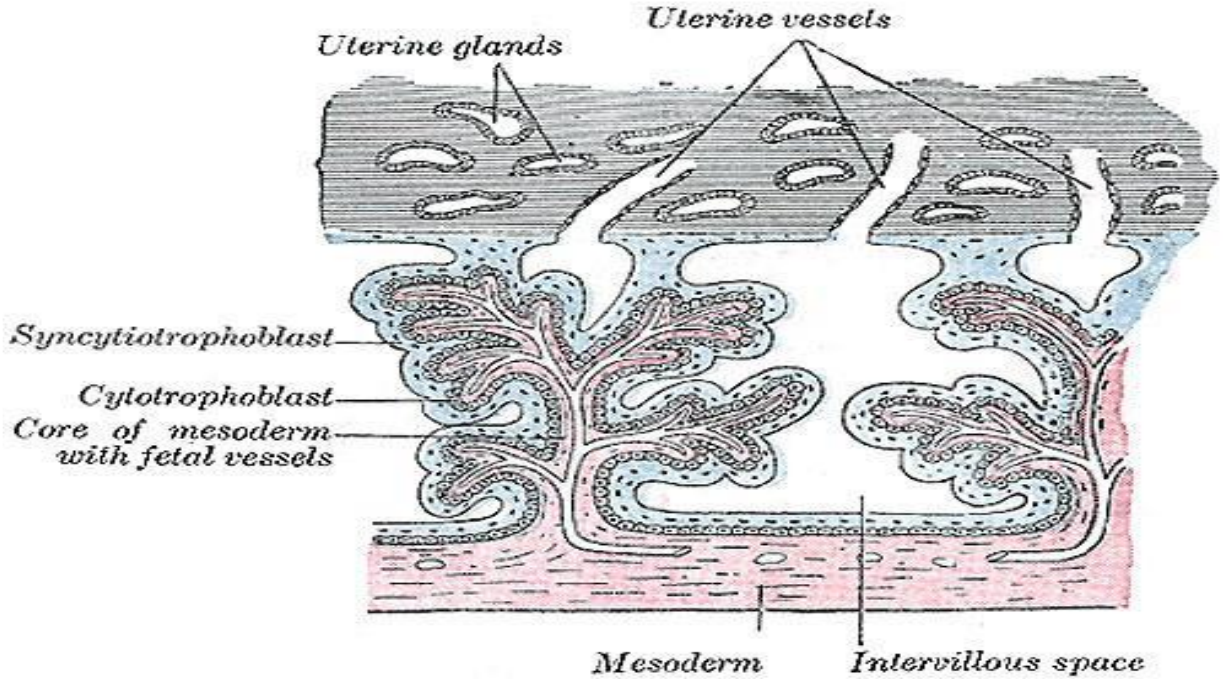
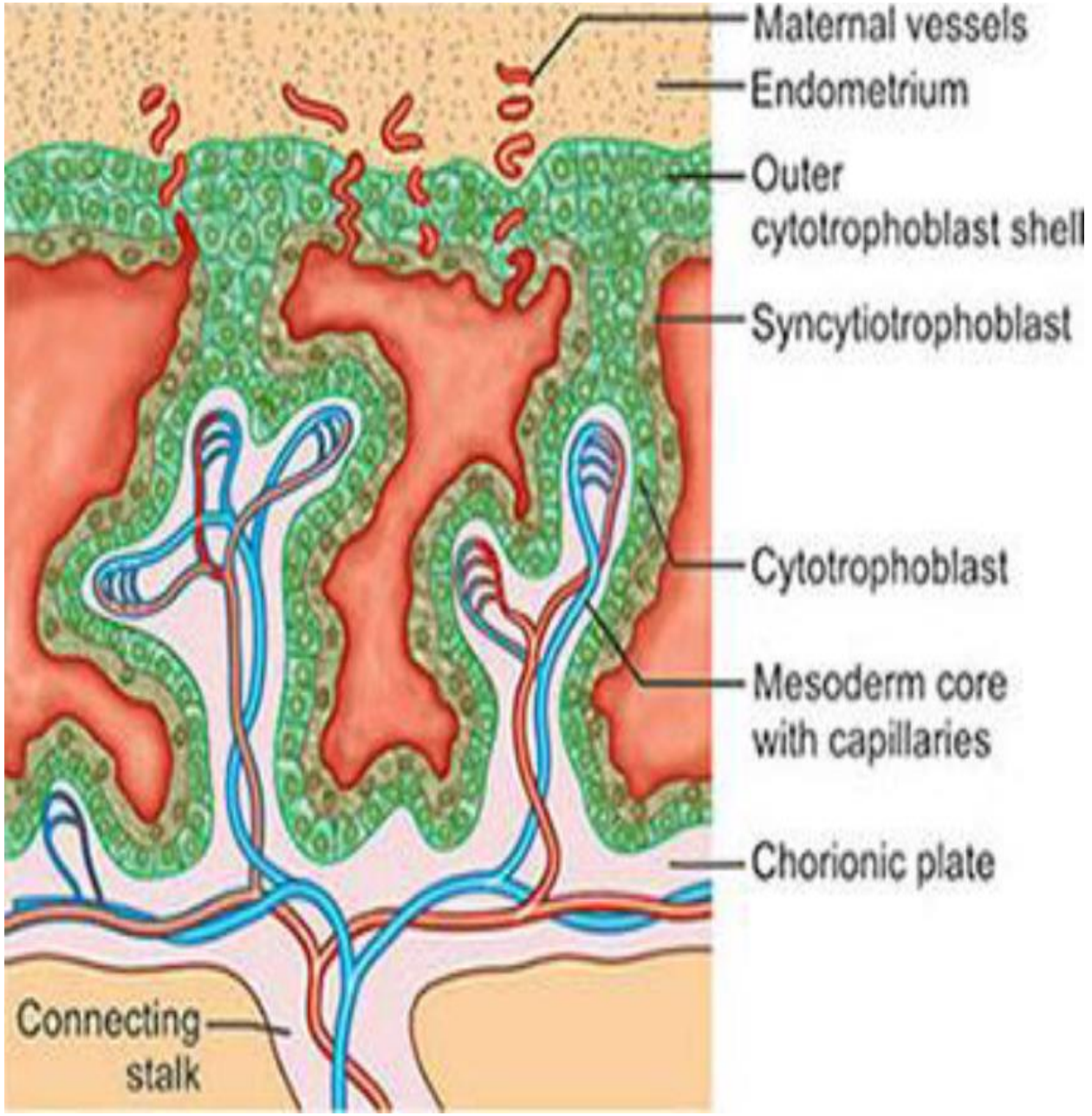




The tertiary or definitive villi:
(syncytiotrophoblast + cytotrophoblast + core of mesoderm + blood capillaries)

- Blood capillaries are formed in the extraembryonic mesoderm of the secondary villi to change them into tertiary villi.

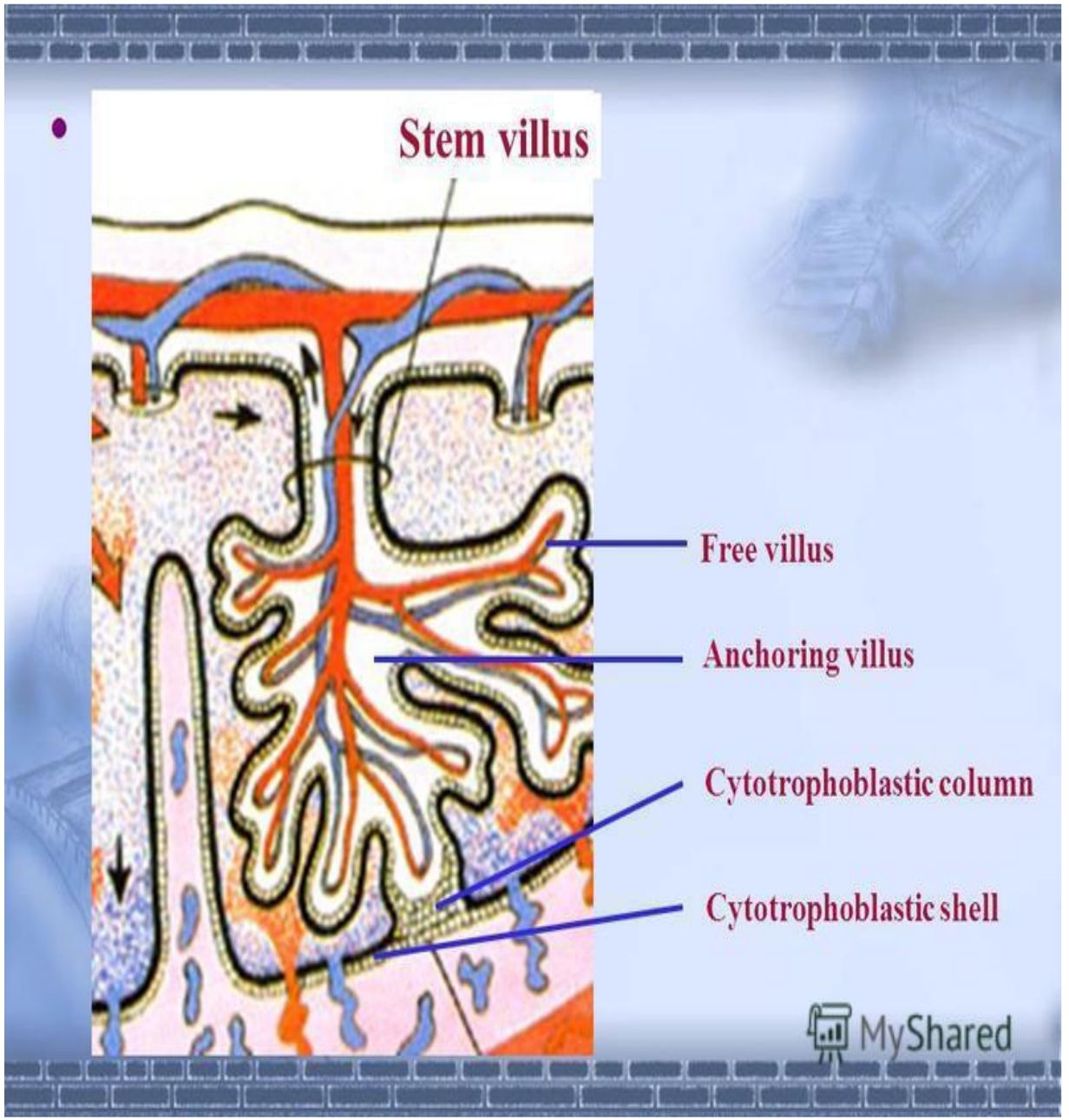


These capillaries will be connected to the vessels in the chorionic plate and connecting stalk thus will be connected to umbilical vessels

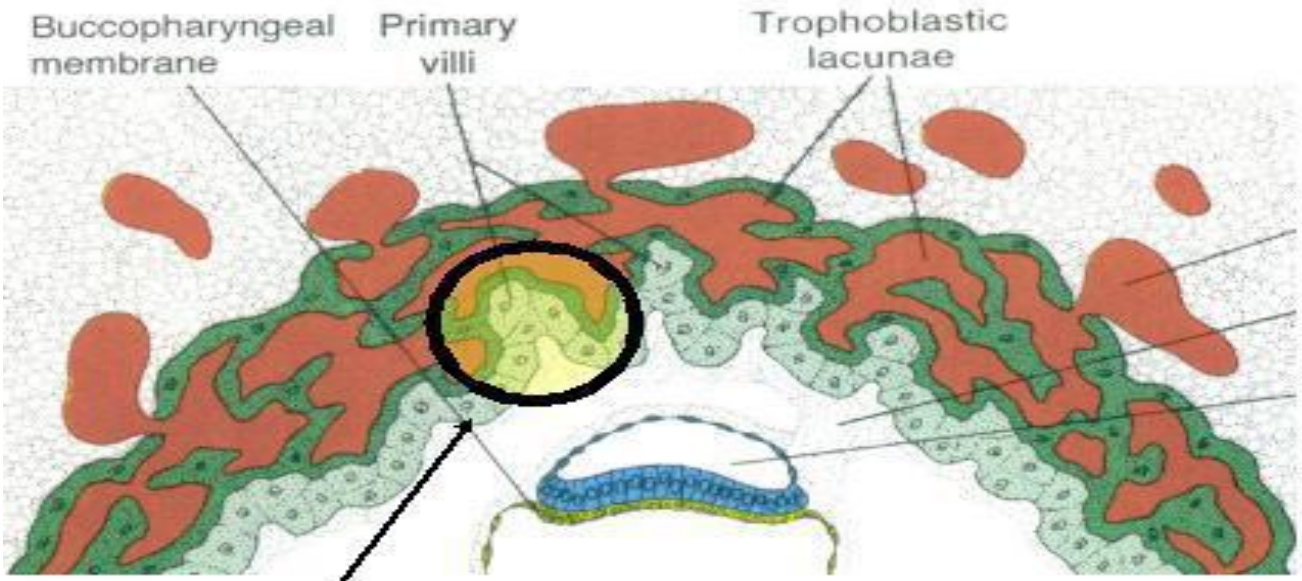
- **Outer cytotrophoblastic shell** is formed by penetration of the cytotrophoblast into the overlying syncytium until it reaches the maternal endometrium . The cytotrophoblastic cells of one villous establish contact with similar extensions of the neighboring villi forming the cytotrophoblastic shell.
- **Stem villi** are those attached to the chorionic plate .
- **Anchoring villi** are those which extend to the **decidua basalis** (endometrium forming the maternal part of the placenta) to fix the chorionic vesicle to the uterine wall .
- **Free , floating or absorbing villi** :

▪ Those are the side branches from the stem villi and float freely within maternal blood in the intervellous spaces .

▪ At these villi exchange of nutrients and other factors will occur.

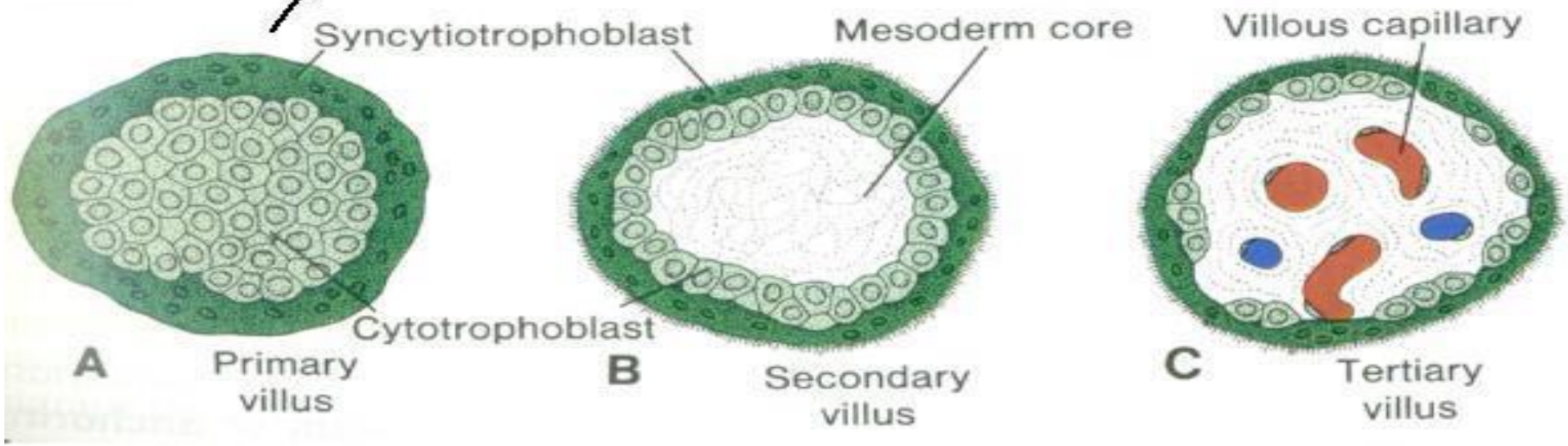


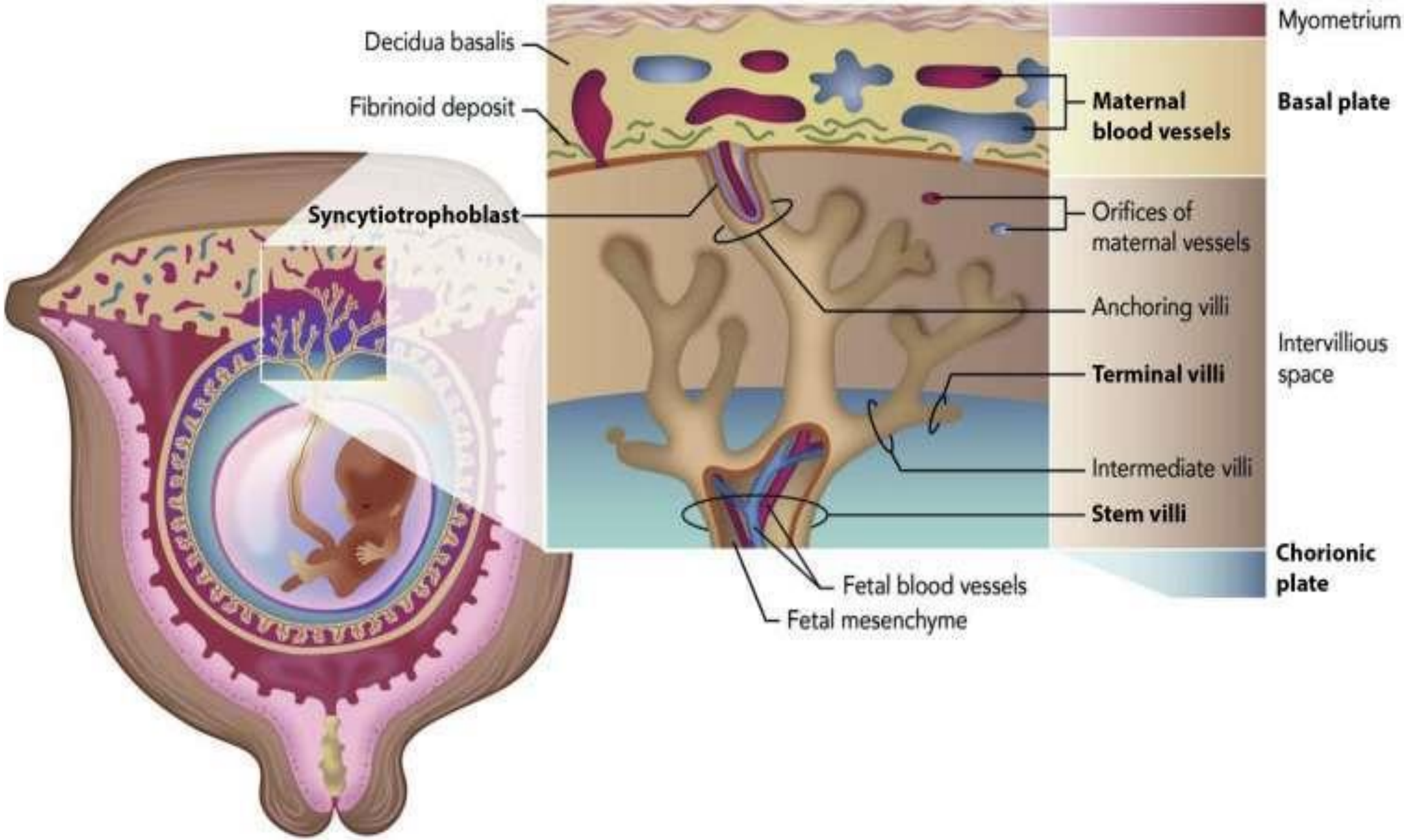
Trophoblast Development in the 3rd Week



At the end of the 3rd week mesoderm invades the primary villus and those cells differentiate into small blood vessels.

Blood vessels in the villus will make contact with blood vessels that develop in the chorionic plate (the outer shell of the chorionic cavity).




Decidua basalis
Fibrinoid deposit
Syncytiotrophoblast
Myometrium
Basal plate
Maternal blood vessels
Orifices of maternal vessels
Anchoring villi
Intervillious space
Terminal villi
Intermediate villi
Stem villi
Chorionic plate
Fetal blood vessels
Fetal mesenchyme