بسم الله الرحمن الرحيم

CHANGES IN THE 1ST, 2ND, 3RD WEEK

1ST WEEK OF PREGNANCY

- **Developmental periods:**
  - **Embryonic period: from fertilization to end of 8th week (embryo).**
  - **Fetal period: from 9th week to birth (fetus).**
- **Events during the first week of pregnancy**

1) **Fertilization.**

2) **Cleavage.**

▶ Before fertilization the male and female gametes must be transported for the site of fertilization.

Fertilization

☞ **Definition: The fertilization is the process of fusion of male (spermatozoa) and female (2ry oocyte) gametes (pronuclei) to form a zygote.**

☞ **Site:** It takes place **in the most dilated part of the uterine tube- Ampulla.**

☞ **Time:** It takes place within **24 hours of ovulation.**

☞ Preparation for Fertilization:

(a) Capacitation

- It is a process of removal of plasma proteins from plasma membrane from head region (**Acrosome**) of spermatozoa in the **cervix** of uterus .
- It takes about **7 hours**. Only capacitated sperm undergoes acrosome reaction and fertilizes the ovum.

(b) Acrosomal reaction

1) In surrounding area of oocyte. (in fallopian tube)
2) During acrosomal reactions the following enzymes are needed:-

i. **Hyaluronidase** enzyme to penetrate corona radiate.

ii. **Trypsin-like-substance** and **acrosin** to penetrate zona pellucida.

☞ Movement of the sperms to the oocyte:

→ The sperms takes about 2–7 hours from the cervix to the isthmus of the tube.

→ Majority of **sperms dies within 24 hours**.

1ST WEEK OF PREGNANCY

☞ Steps of Fertilization:

1) **Penetration of the corona radiata:** by hyalurindase, tubal enzymes

2) **Penetration of the zona pellucida:** by **acrosin, esterase and neuroaminidase**, which allow sperm to reach the cell membrane.

3) **Fusion of plasma membranes of the oocyte and sperm:** The head and tail of sperm enter the cytoplasm of the oocyte, but plasma membrane of sperm remains behind.

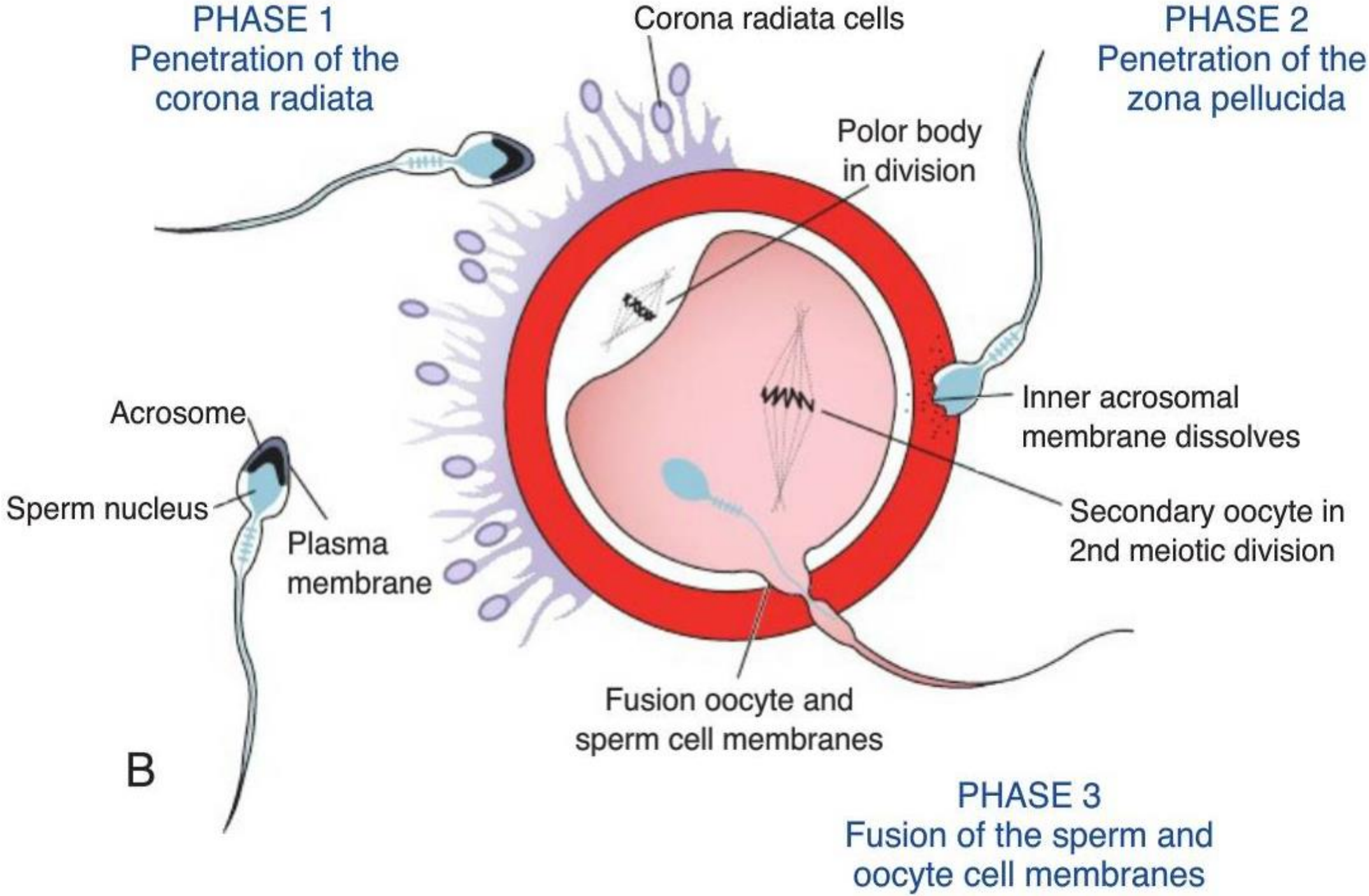
4) **Zona (cortical) reaction:**

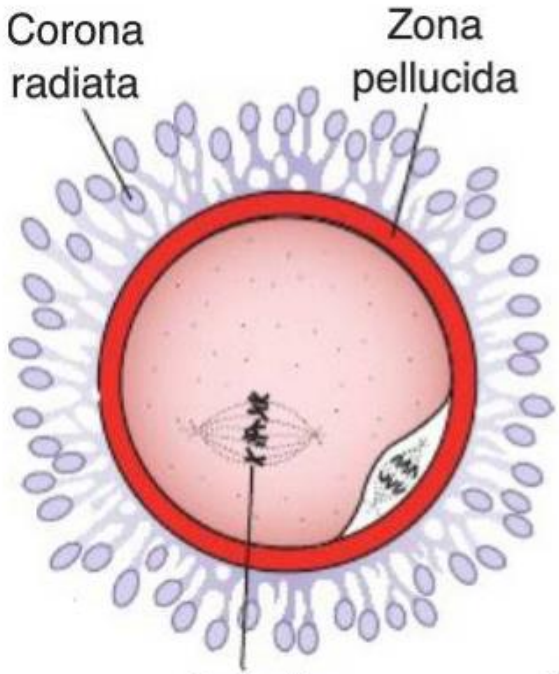
- **Definition**: structural changes at zona pellucida to prevent other sperms from penetration of the oocyte.
- These reactions prevent **polyspermy** (penetration of more than one spermatozoon into the oocyte).

5) **Completion of second meiotic** division of oocyte and formation of **female pronucleus** and the second polar body.

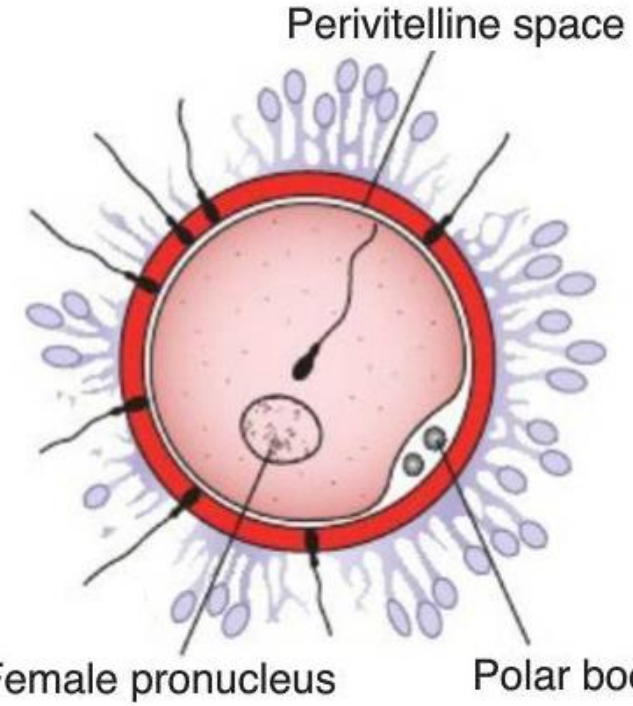
6) **Formation of male pronucleus** and the tail of the sperm degenerates.

7) **Union of the pronuclei**: this will lead to formation of **zygote with 46 chromosomes**.

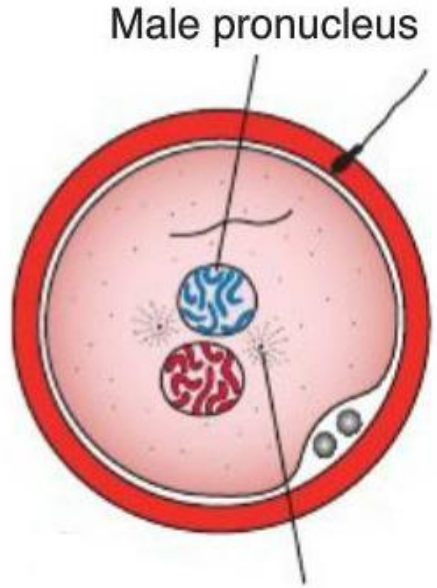

PHASE 1
Penetration of the
corona radiata
Corona radiata cells
PHASE 2
Penetration of the
zona pellucida
Polor body
in division
Acrosome
Sperm nucleus
Plasma
membrane
Inner acrosomal
membrane dissolves
Secondary oocyte in
2nd meiotic division
Fusion oocyte and
sperm cell membranes
B
PHASE 3
Fusion of the sperm and
oocyte cell membranes



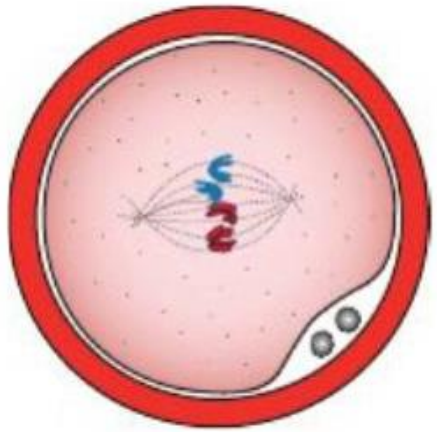
Oocyte immediately after ovulation,

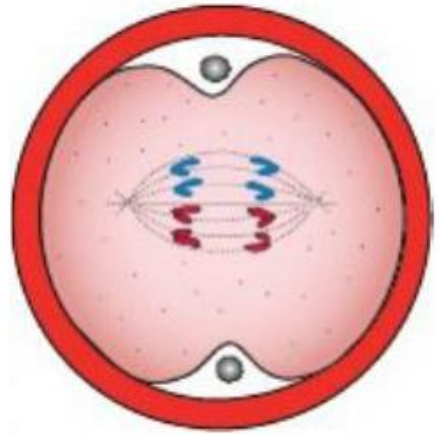


A spermatozoon has penetrated the oocyte,

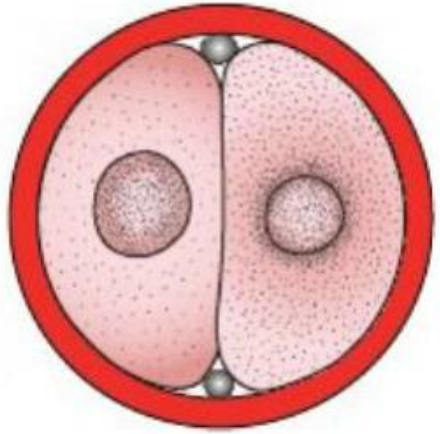


Male and female pronuclei.





Chromosomes become arranged on the spindle, split longitudinally, and move to opposite poles.



Two-cell stage.

☞ Results of Fertilization:

1. The 2ry oocyte completes the second meiotic division.
2. Restores the normal diploid number of chromosomes (46) in the zygote (the newly formed cell).
3. Determines the sex of the embryo.
4. Initiation of cell division of zygote.

☞ Abnormalities of Normal Fertilization:

1. **Parthenogenesis:** The unfertilized oocyte starts cleavage without sperm penetration.
2. **Polyspermy including dispermy and triploidy**: Ovum fertilized by two sperms, resulting in a zygote with 69 chromosomes.

▶Cleavage and Blastocyst Formation

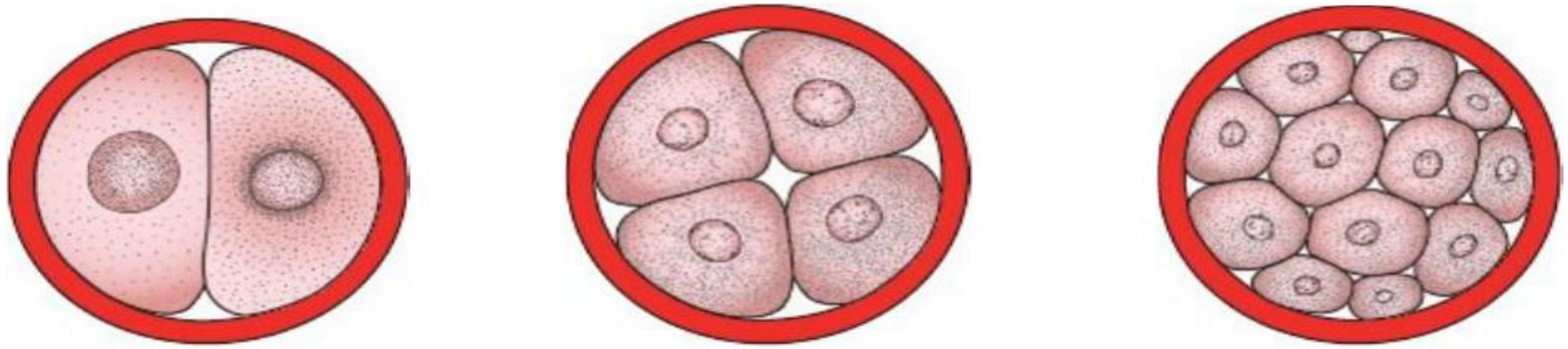
☞Cleavage

▶**Definition: Process of repeated mitotic division of zygote resulting in rapid increase in number of cells (blastomeres).**

→ 1st, zygote divides into two blastomeres then to 4 blastomeres.

→ During cleavage, zygote is within the thick zona pellucida.

→ When there are 12 to 16 blastomeres the embryo resembles a mulberry fruit and is called **morula** which formed 3 days after fertilization.



Two-cell stage Four-cell stage Morula

Development of the zygote from the two-cell stage to the late morula stage.

☞Formation of blastocyst العلقة

1. **Blastomeres** of morula undergo repeated mitotic division within zona pellucida.
2. **Zona pellucida:- Keep cells together** during cleavage and **Prevent adhesion** of these cells to uterine tube.

3. Small cavities appear between the blastomere and unite together to form **larger cavities**.

4**. Blastocele**:

➲ Appears 4 days after fertilization.

➲ It is fluid filled cavity inside morula.

➲ Source of this fluid is from uterine cavity via zona pellucida.

➲ **It divides the blastomere into two group of cells:-**

1ST WEEK OF PREGNANCY

1) **Outer cell mass [trophoblast] (tropho=related to nutrition).**
2) It will gives rise to Trophoblast layer which is responsible for nutrition and protction.
3) Give embryonic part of the placenta.

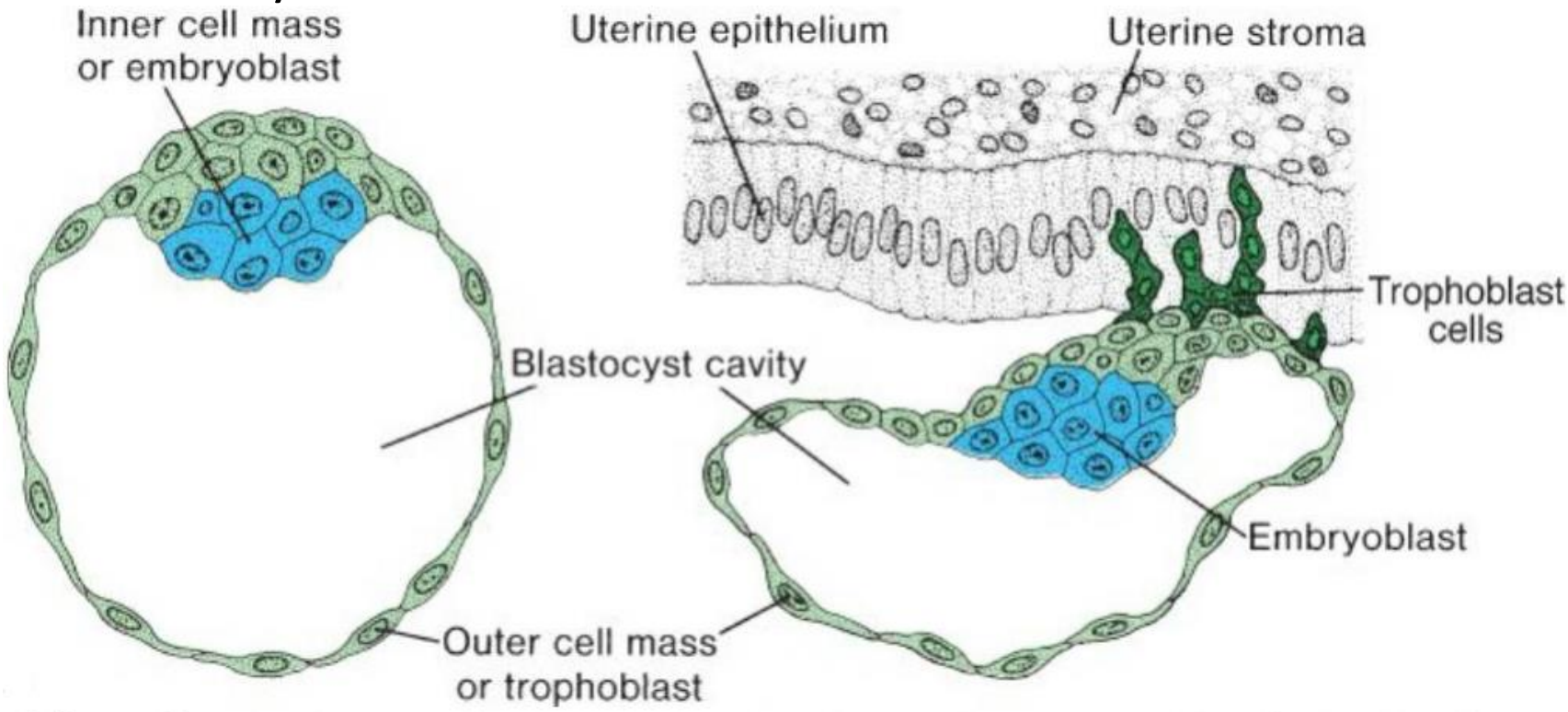
2) **Inner cell mass (embryoblast):-**

3) Projects in the form of a mass into the cavity of blastocyst.
4) Will develop into the tissues of the embryo.

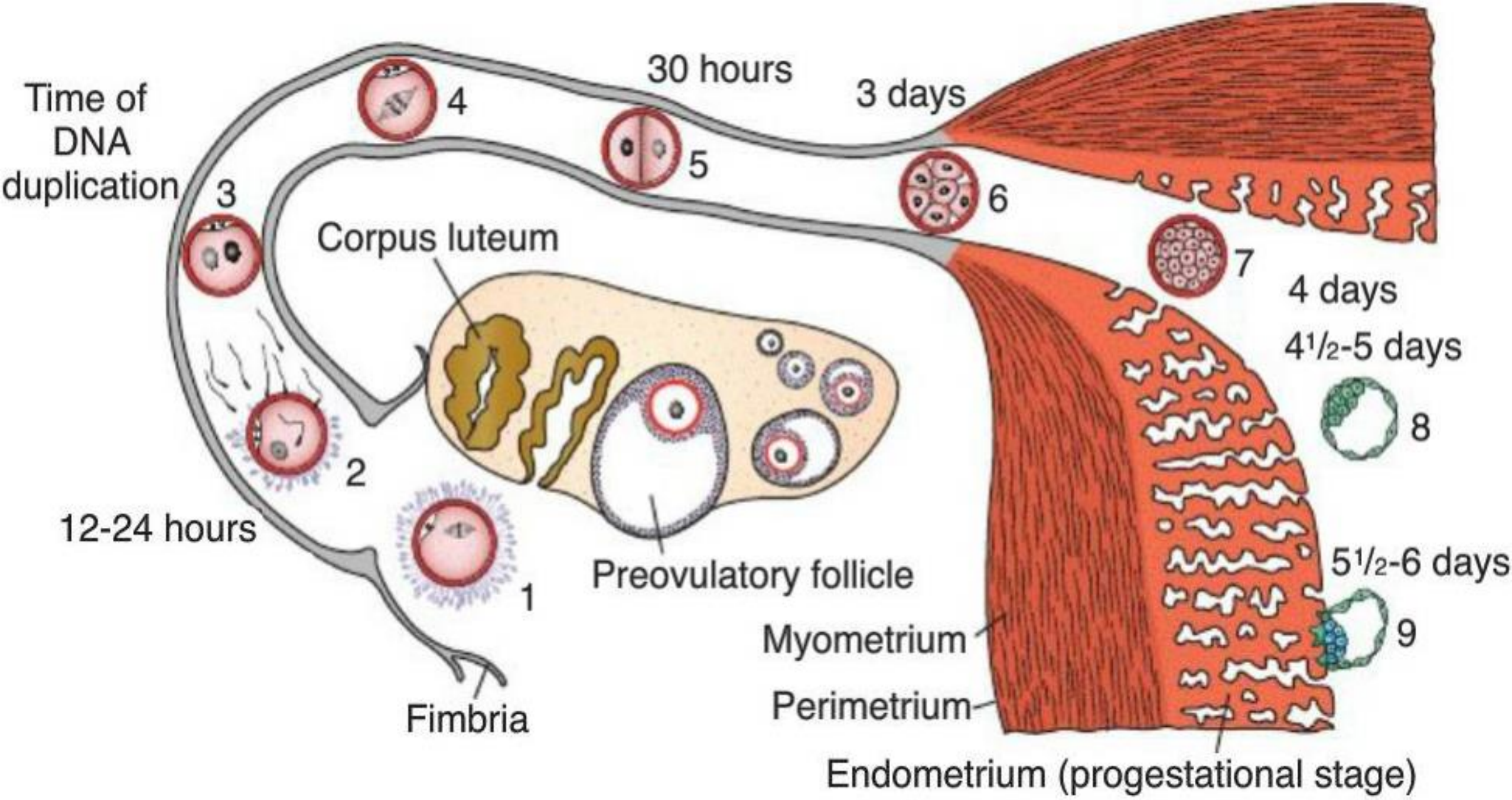
Embryonic poles:

➲ The blastocele now has 2 poles:

1. **Embryonic pole (implantation pole) :** towards the endometruim of the uterus.
2. **Abembryonic pole**: towards the cavity of the uterus.



Schematic of a human blastocyst showing inner cell mass and trophoblast cells.



Events during the first week of human development.

2ND WEEK OF PREGNANCY

- **Events during the second week of pregnancy**

1) **Implantation of the blastocyst.**
2) **Decidua formation.**
3) **Blastocyst changes in 2nd week of pregnancy.**

2ND WEEK OF PREGNANCY

1) Implantation

- **Definition**: process of embedding of blastocyst in the endometrium.
- **Time**:- **Begins:** at the end of 1st week. **Ends:** by the end of 2nd week.
- **Normal site of implantation:-**

1) Endometrium of **Upper part of the Body of Uterus [near fundus]**
2) On the **Posterior wall** more than anterior wall **3) Near Middle line**.

- **Processes:**

1) **Zona pellucida surrounding blastocyst** Degenerates resulting in: Enlargement of blastocyst and Exposure of **trophoblast** that is differentiated into:
    - **outer syn-cytio-trophoblast.**
    - **inner cyto-trophoblast.**

2ND WEEK OF PREGNANCY

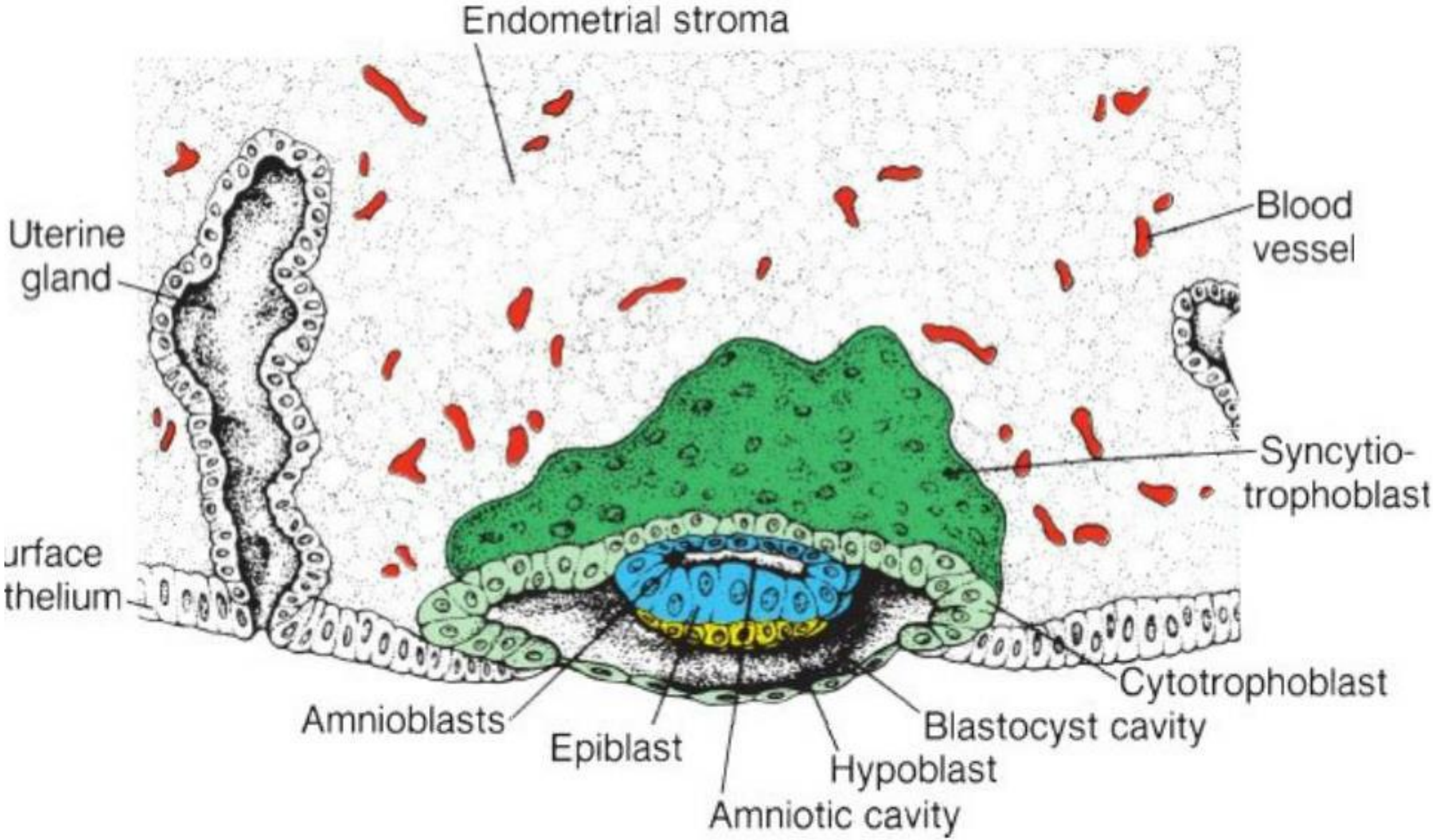
- Exposure of trophoblast has two functions:-
  a. **Adhesive power**: makes blastocyst adheres to endometruim.
  b. **Histolytic power;** produced by proteolytic enzymes released from syncytiotrophoblast and promote lysis of endometrial tissue leading to:
     a. **Lysis of glands and c.t.**→ formation of defect in the endometrium→ blastocyst gradually embeds in enderom.
     b. **lysis of blood capillaries** → oozing of blood to fill lacunae in syncytiotrophoblast.

- **Blastocyst:**

a. Implants in the endometrium at its embryonic pole.

b. The defect in the endometrium is filled by fibrin clot.

c. The defect in the endometrial epithelium gradually disappears as the endometrium epithelium is repaired.



A 7.5-day human blastocyst, partially embedded in the endometrial stroma.

2ND WEEK OF PREGNANCY

- **Abnormal sites of implantation**

A. **In uterus: Placenta Praevia**

- **Definition**: implantation of a blastocyst in the inferior segment of the uterus. near the internal os of cervix.
- **Types**:

▶ **Placenta previa lateralis:** not related to internal os of cervix.

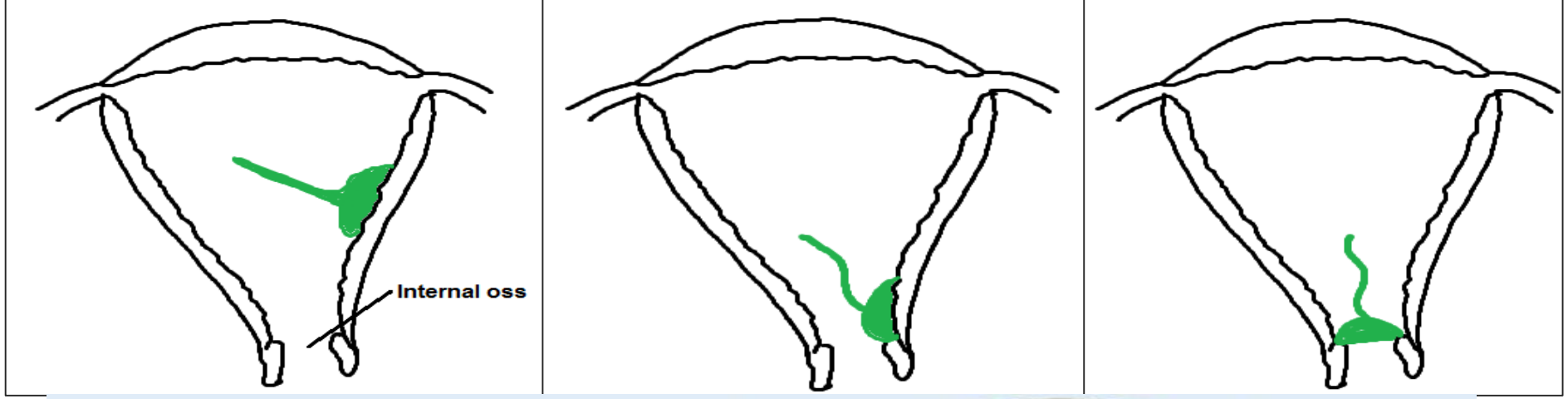
▶ **Placenta previa marginalis:** partially covers internal os of cervix.

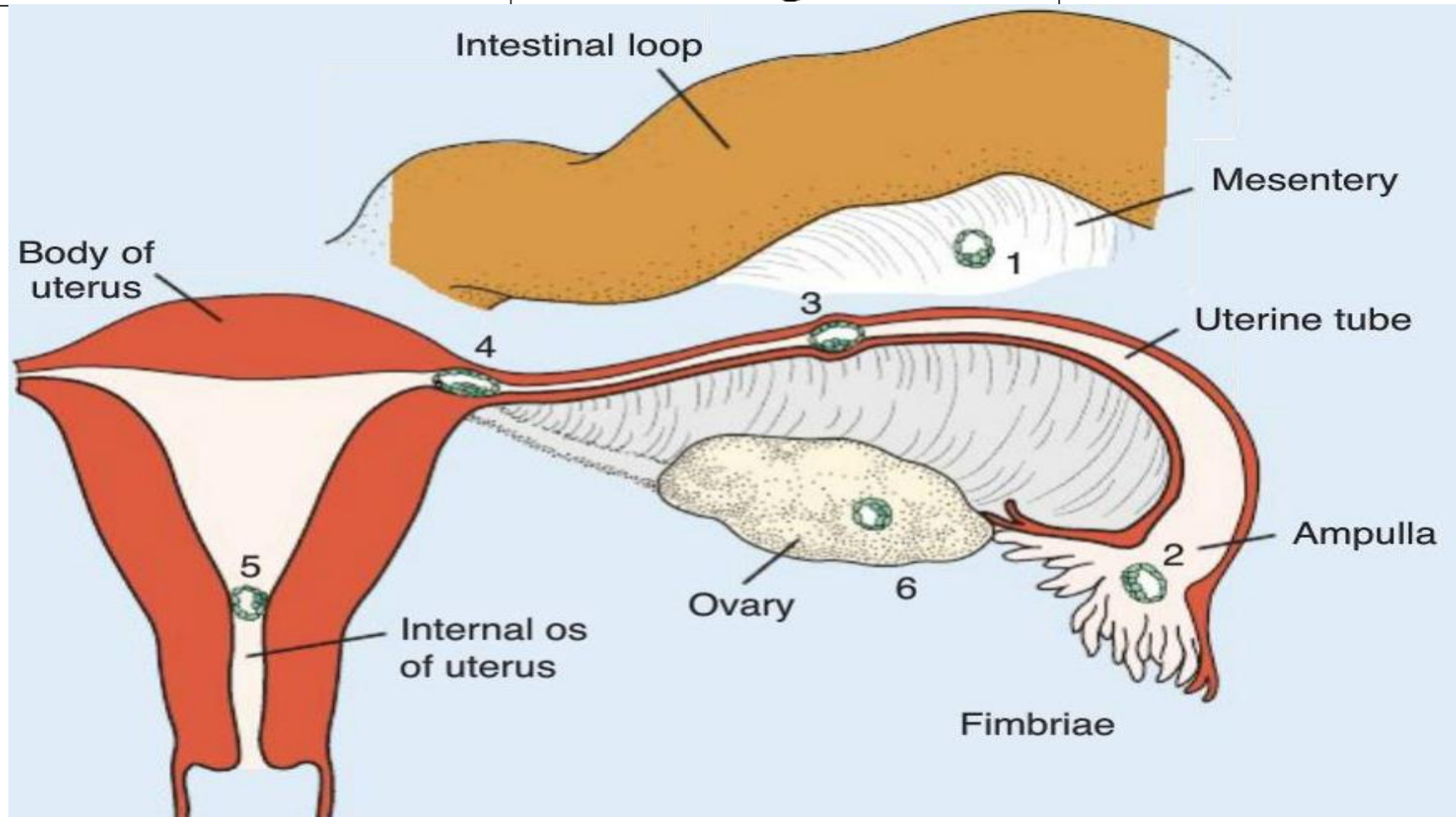
▶ **Placenta previa centralis:** completely covers internal os of cervix.

A. **Extrauterine:- Ectopic Pregnancy**

- **Definition**:-blastocyst implant outside the uterus.
- **Types**:-

1) **Ovarian pregnancy:** The fertilized ovum is implanted on the ovary
2) **Tubal pregnancy:** Commonly in ampulla and isthmus of the uterine tube.
3) **Abdominal (peritoneal) pregnancy:-** Commonly over the surfaces of abdominal viscera.


Internal oss


Intestinal loop
Mesentery
Body of uterus
1
3
Uterine tube
4
Ampulla
2
5
6
Ovary
Internal os of uterus
Fimbriae

2) Decidua formation

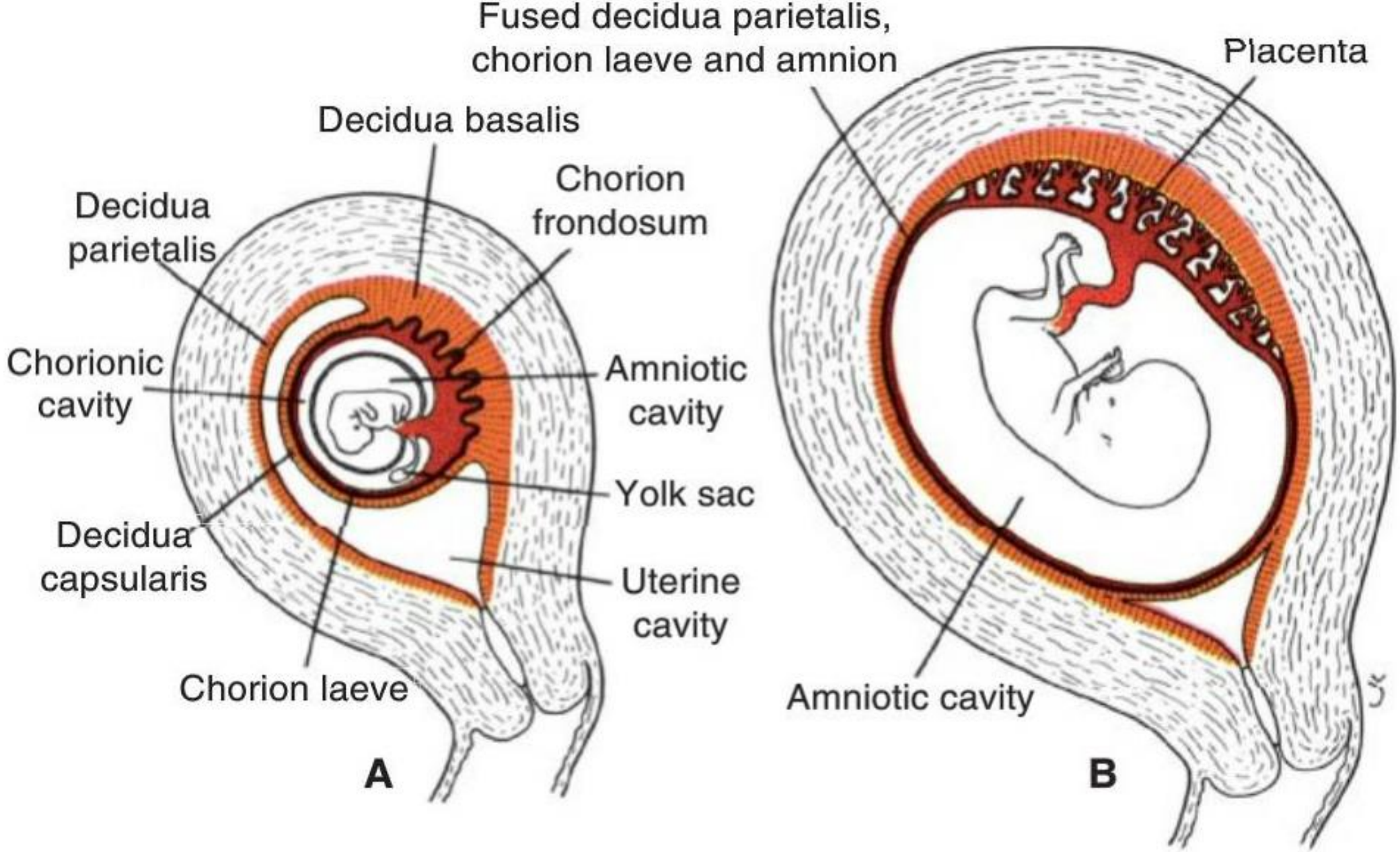
- **Definition**: is the endometrium of the pregnant uterus.
- **Parts**: formed of three parts:-

1) **Decidua basalis:** Part of endometrium lies between foetus and myometrium.
2) **Decidua capsularis:** Part of endometrium covers foetus.
3) **Decidua parietalis:** Part of endometrium lines the rest of uterine cavity.

- **Fate**:

1) **Decidua basalis:** becomes **hypertrophy** to form the **maternal** part of **placenta**.
2) **Decidua capsularis & parietalis:-**

- Growth of embryo leads to opposition and fusion of deciduas capsularis and parietalis. resulting in obliteration of uterine cavity and reduction of blood supply to deciduas capsularis and parietalis leads to **degeneration** and **disappear**.



Relation of fetal membranes to wall of the uterus. A. End of the second month. B. End of the third

2ND WEEK OF PREGNANCY

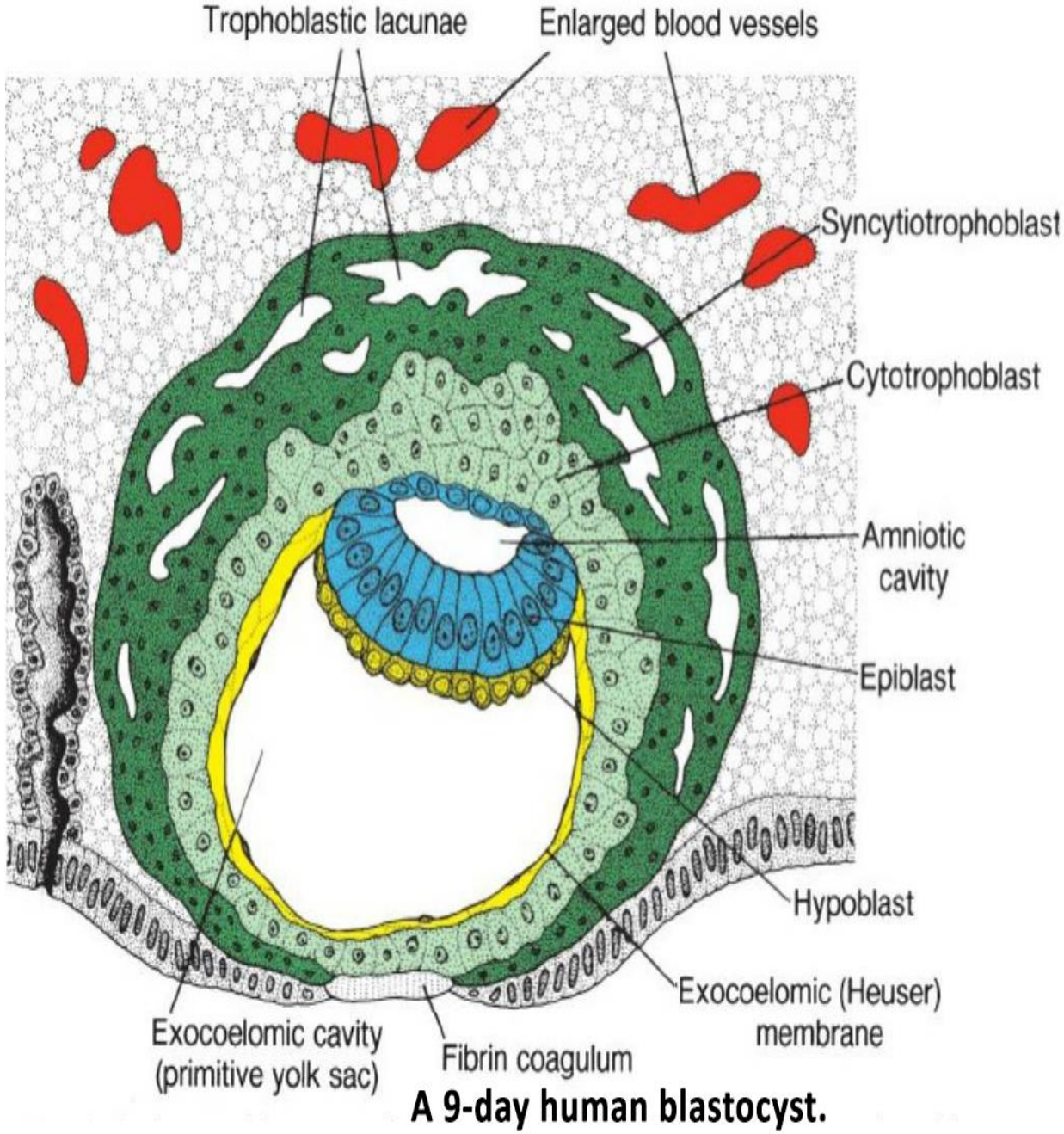
3) Changes in Blastocyst

(a) Changes in embryonic disc (2)
(b) Changes in the cavities: (2)
(c) Changes in wall (2)

a) Changes in embryonic disc

Inner cell mass is changed into two layers:-

a. **Epi-blast [primary ectoderm]**
   i. upper thicker layer.
   ii. high columnar cells.
   iii. related to amniotic cavity.
b. **Hypo-blast [primary endoderm]**
   i. lower thin layer.
   ii. small cuboidal cells.
   iii. related to primary yolk sac.



A 9-day human blastocyst.

b) Changes in the cavities: formation of

1) Amniotic cavity:

- New smaller & dorsal cavity appears in inner cell mass.
- **Floor**:- formed of epiblast.
- **Roof** & **sides**: formed of flat cells called amnioblastic cells derived from epiblast cells.

2) Primary yolk sac:

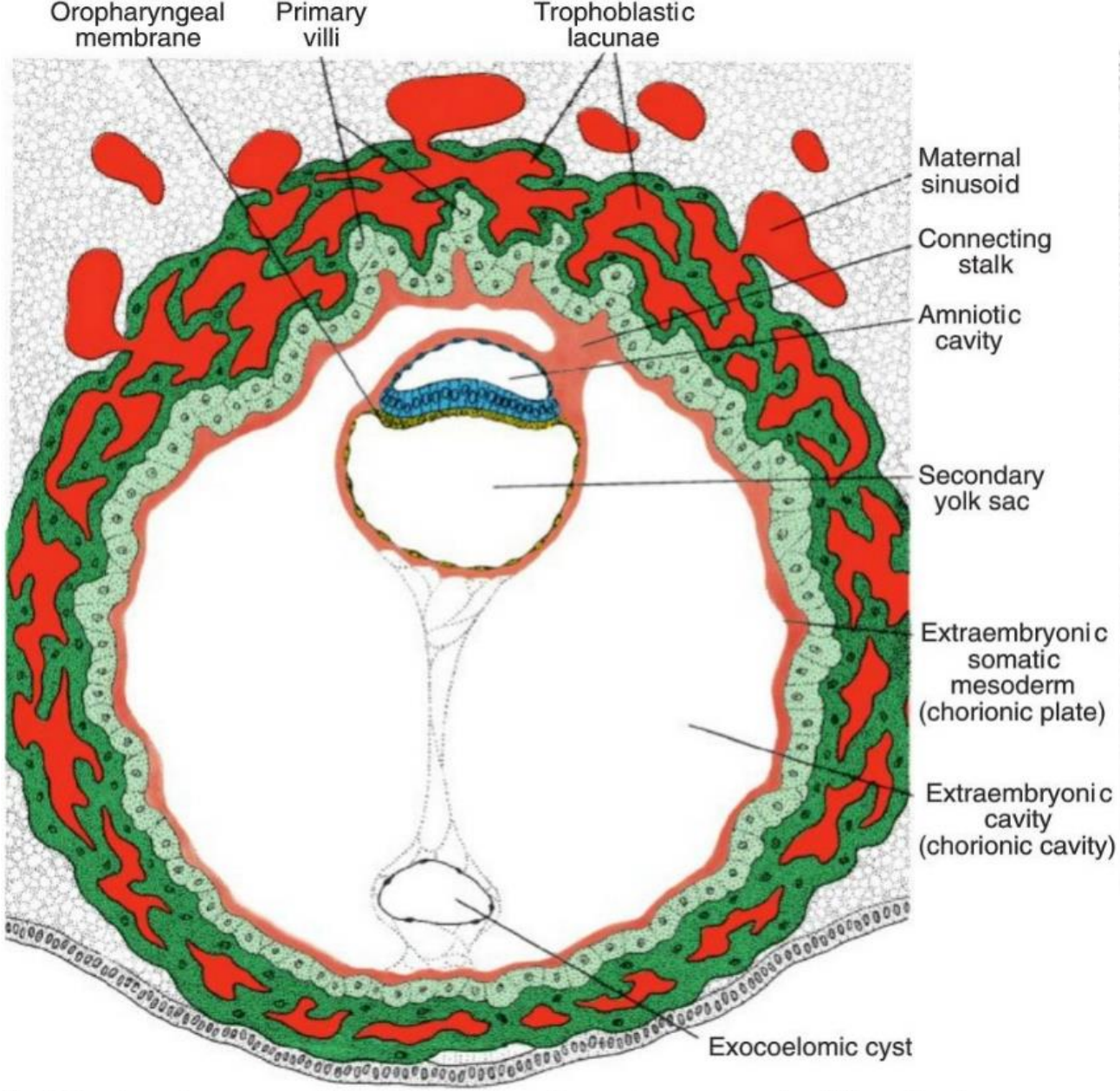
- **Blastocele** cavity → primary yolk sac.
- **Roof:** formed of hypoblast
- **Floor** & **sides** : formed of flat cells (exocoelomic "Heuser" membrane) derived from hypoblast cells.

c) Changes in wall:

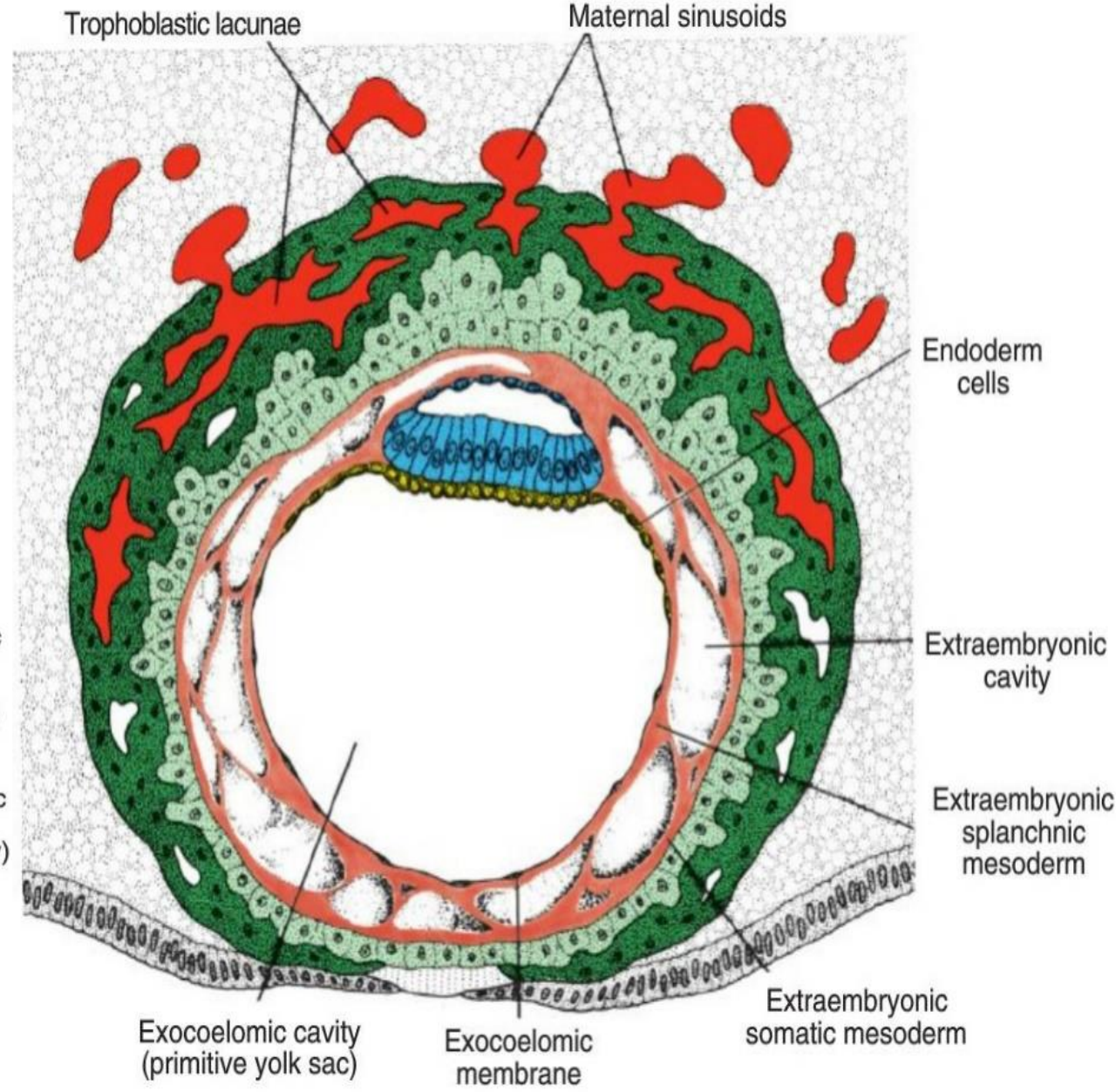
Development of extra-embryonic mesoderm & extra-embryonic coelom (EEM & EEC)

The exocoelomic "Heuser" membrane **Increases in thickness** and **Isolated spaces** appear within it.

These Spaces rapidly fuses together to form a large cavity called extra-embryonic coelom



A 13-day human blastocyst. showing trophoblastic lacunae at the embryonic as well as the abembryonic pole, the primary villi and the extraembryonic coelom or chorionic cavity. The secondary yolk sac is entirely lined with endoderm.



Human blastocyst of approximately 12 days. Extraembryonic mesoderm proliferates and filis the space between the exocoelomic membrane and the inner aspect of the trophoblast.

2ND WEEK OF PREGNANCY

As a result of formation of the ceolom, the extra embryonic mesoderm is divided into two layers:-

a. Extra-embryonic SOMATIC mesoderm:-it is the part of the (EEM) that is:

1- line trophoblast. 2- cover the amniotic cavity.

b. Extra-embryonic SPLANCHNIC mesoderm:-it is the part of the (EEM) that is cover the primary yolk sac.

Division of (EEM) is not complete: mesodermal mass remains connecting the two layers at caudal end of embryonic disc called **connecting stalk** (**future umbilical cord**).

Division of Trophoblast

- Trophoblast differentiate into two layers:

Outer syncytiotrophoblast: multinucleated cytoplasmic mass without boundaries

Inner cytotrophoblast: mononucleated cells.

- **Function:**

1- isolated cavities [LACUNEA]appear. become filled with mixture of maternal blood from ruptured endometrial capillaries. The adjacent lacunae fuse to form lacunar network which are primordial for intervillous space of placenta.

2- produce H.C.G. which enters maternal blood

Changes in 3rd week includes:

1. Changes in the structure of the bilaminar embryonic plate
2. Changes in the trophoplast (chorion)

Gastrulation is the formative process by which the three germ layers, which are precursors of all embryonic tissues, and axial orientation are established in embryos.

During gastrulation, the bilaminar embryonic disc is converted into a trilaminar embryonic disc.

Gastrulation is the beginning of morphogenesis (development of body form) and is the significant event occurring during the third week.

3RD WEEK OF PREGNANCY

1. Development of prechordal plate:

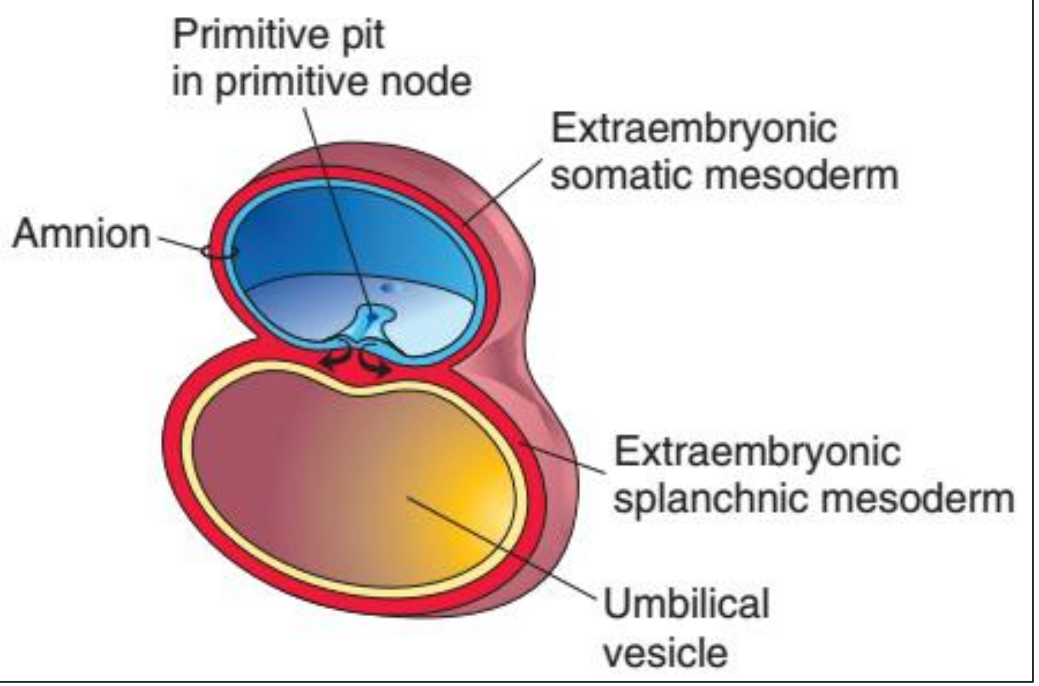
- On the 14th day, cranially in the middle line the prechordal plate is formed (future mouth).

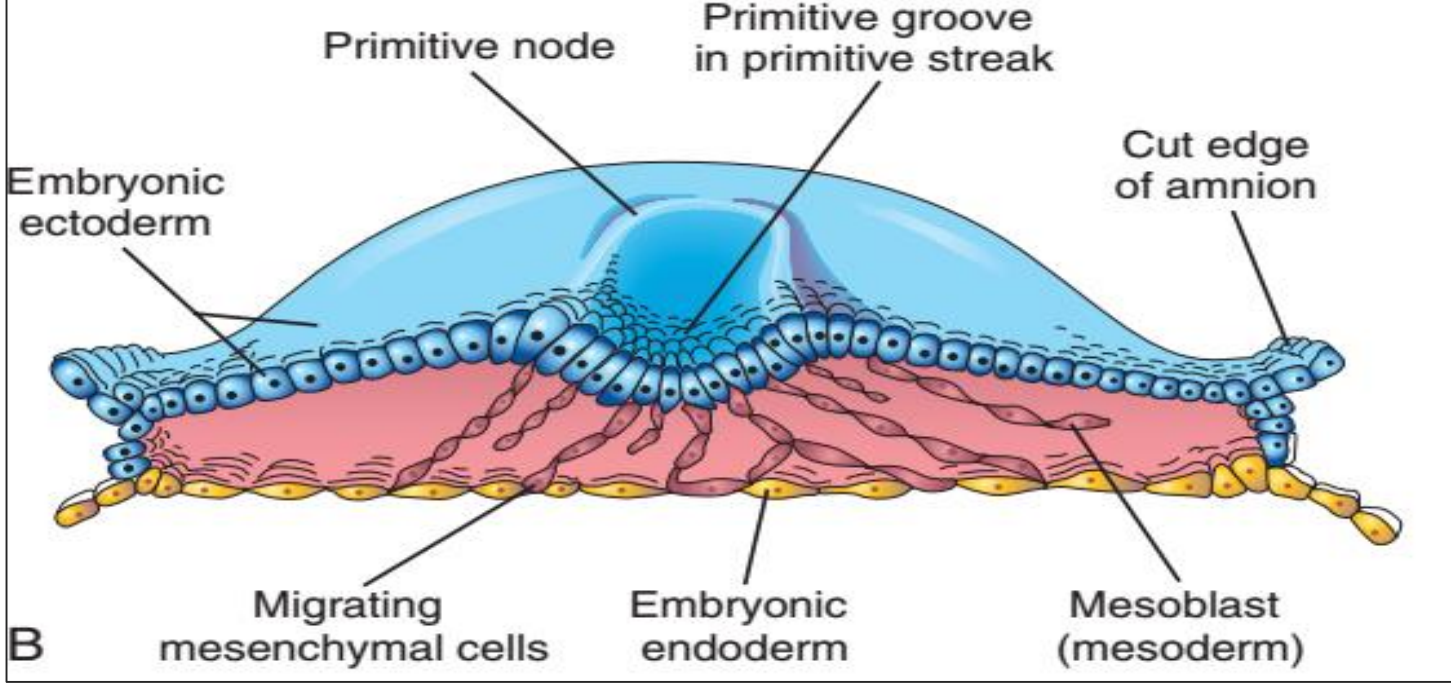
2. Development of primitive streak:

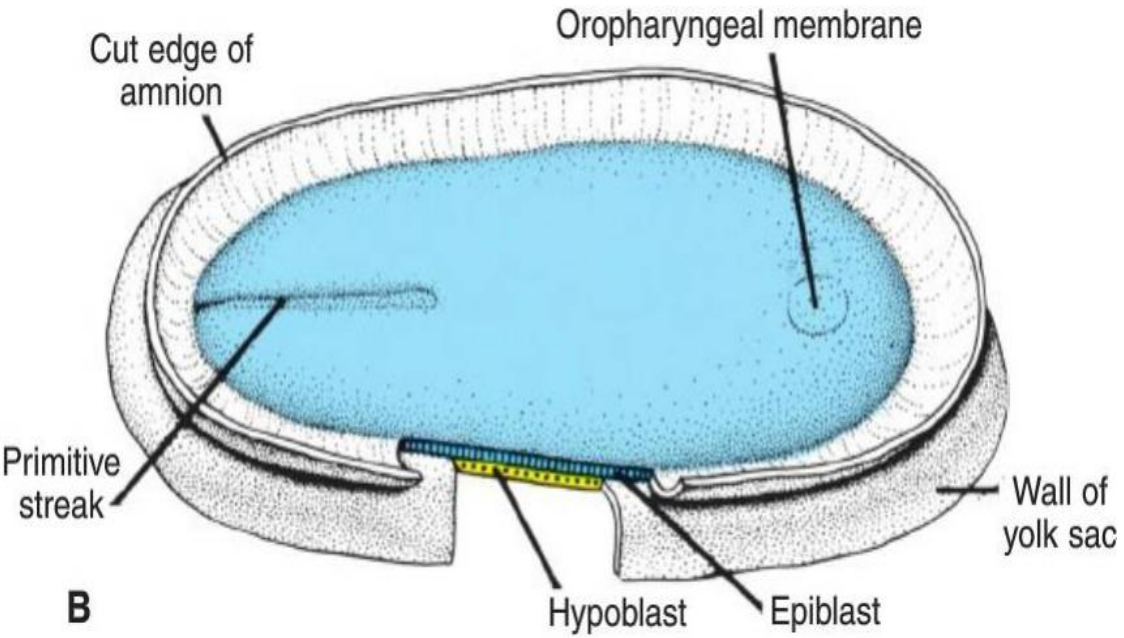
- On the 15th & 16th days, the epiblast cells at the caudal end migrate to the median plane towards cranial end forming the primitive streak which proliferates to form **a primitive node** & small depression in the primitive node appears called the **primitive pit**.

Function of the primitive streak in the developing embryo:

1. Formation of **the 3 layers** (**ectoderm, endoderm and mesoderm**) → ???.
2. Formation of the **notochord**.
3. Determination of the **axises of embryo** (cranio-caudal, dorso-ventral & right-left) axises.
4. Stimulate the appearance of **the nervous system**.


Primitive pit
in primitive node
Extraembryonic
somatic mesoderm
Amnion
Extraembryonic
splanchnic mesoderm
Umbilical
vesicle


Primitive node
Primitive groove
in primitive streak
Cut edge
of amnion
Embryonic
ectoderm
Migrating
mesenchymal cells
Embryonic
endoderm
Mesoblast
(mesoderm)
B


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

3RD WEEK OF PREGNANCY

1. Formation of ectoderm, mesoderm & endoderm (Gastrulation):

Epiblastic cells near the primitive streak proliferate & migrate through the **primitive streak**.

1. Some cells migrate **to replace the hypoblast** and form **endoderm** on 14th & 15th days.
2. The next cells to migrate pass between the **epiblast and the hypoblast** to form **intra-embryonic mesoderm**.
3. The rest of the cells of **the epiblast will form the ectoderm**.
4. Now the embryonic disc contains 3 layers **(ectoderm, endoderm & mesoderm)**.

2. Development of notochord

- Cells that migrate through the **primitive pit** in the midline between the ectoderm & endoderm will **form the notochord**.

- This newly formed notochord will be the **core around** it the **vertebral column** will be formed.

3RD WEEK OF PREGNANCY

Stages of development:

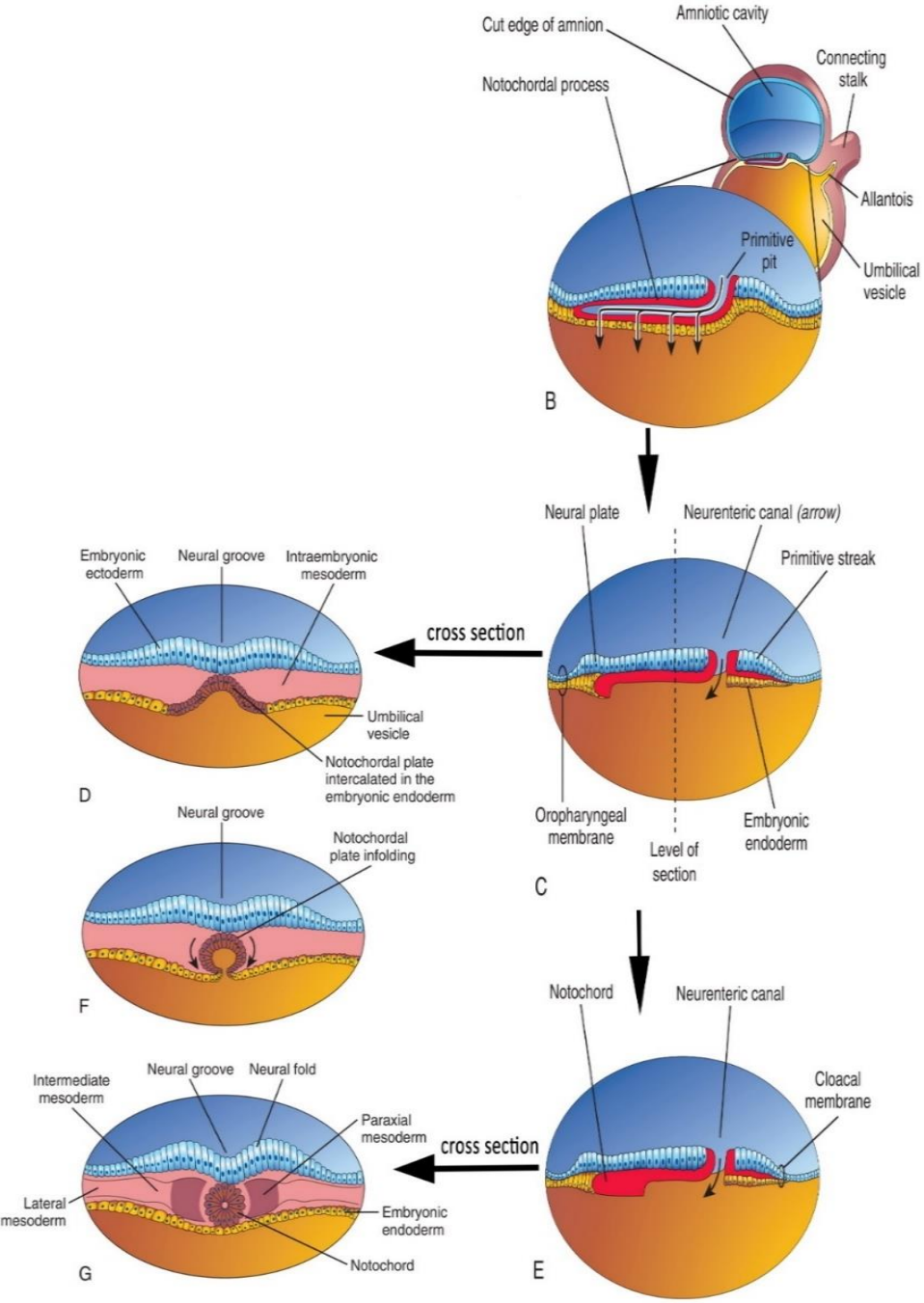
Notochordal process on the 17th day→ **Notochordal canal** on the 18th day → **Neurenteric canal** (transient communication between amniotic fluid & yolk sac cavities through neurenteric canal)on the 19th day → **Notochordal plate** → **Notochord** on 20th day.

Fate of notochord:

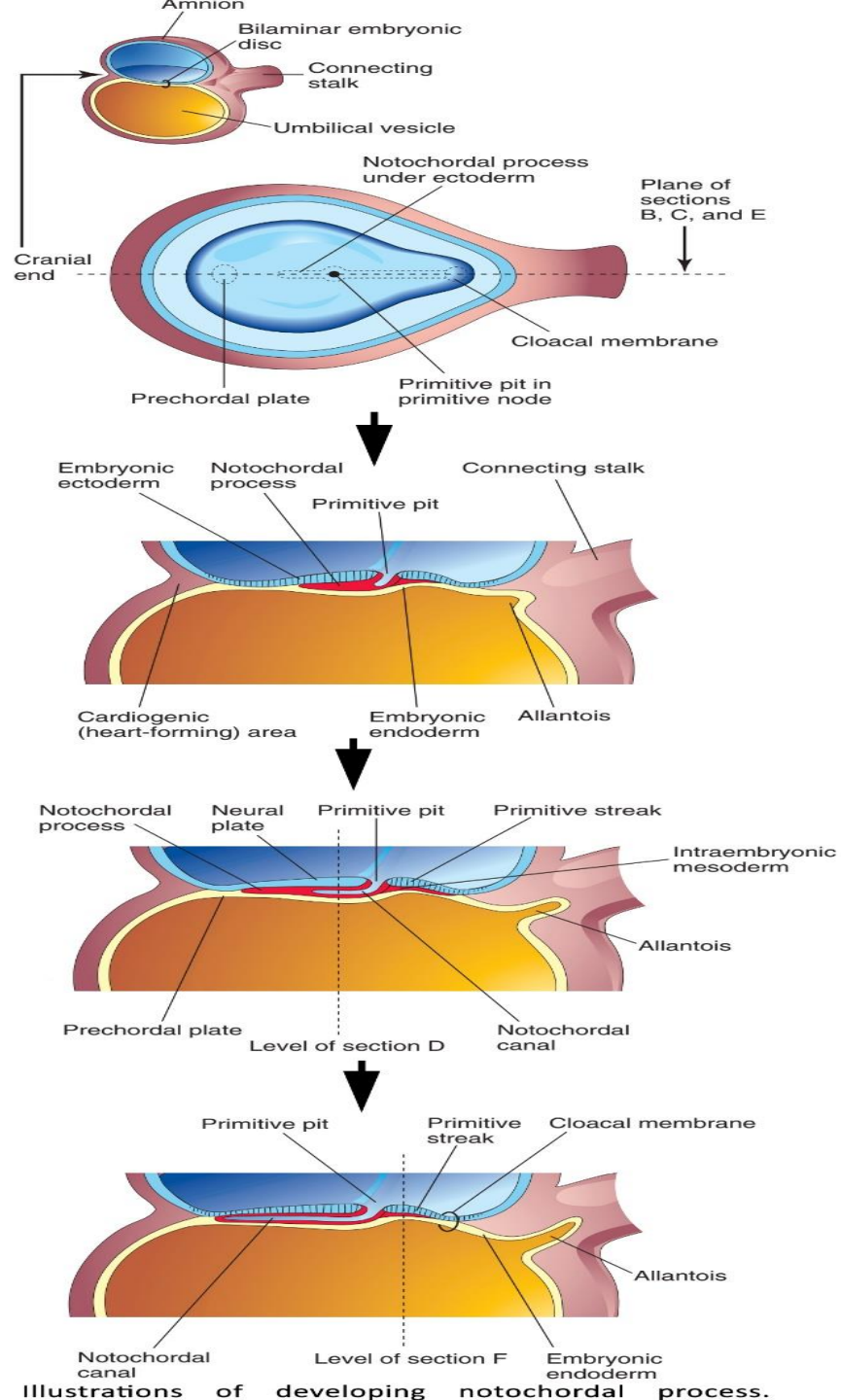
1.Cranial part: forms → basilar part of occipital bone & a part of body of sphenoid.

2. The central part of notochord: degenerates.

3. Part of notochord in the intervertebral disc: → from nucleus bulbosus.



Illustrations of notochord development by transformation of the notochordal process.



Illustrations of developing notochordal process.

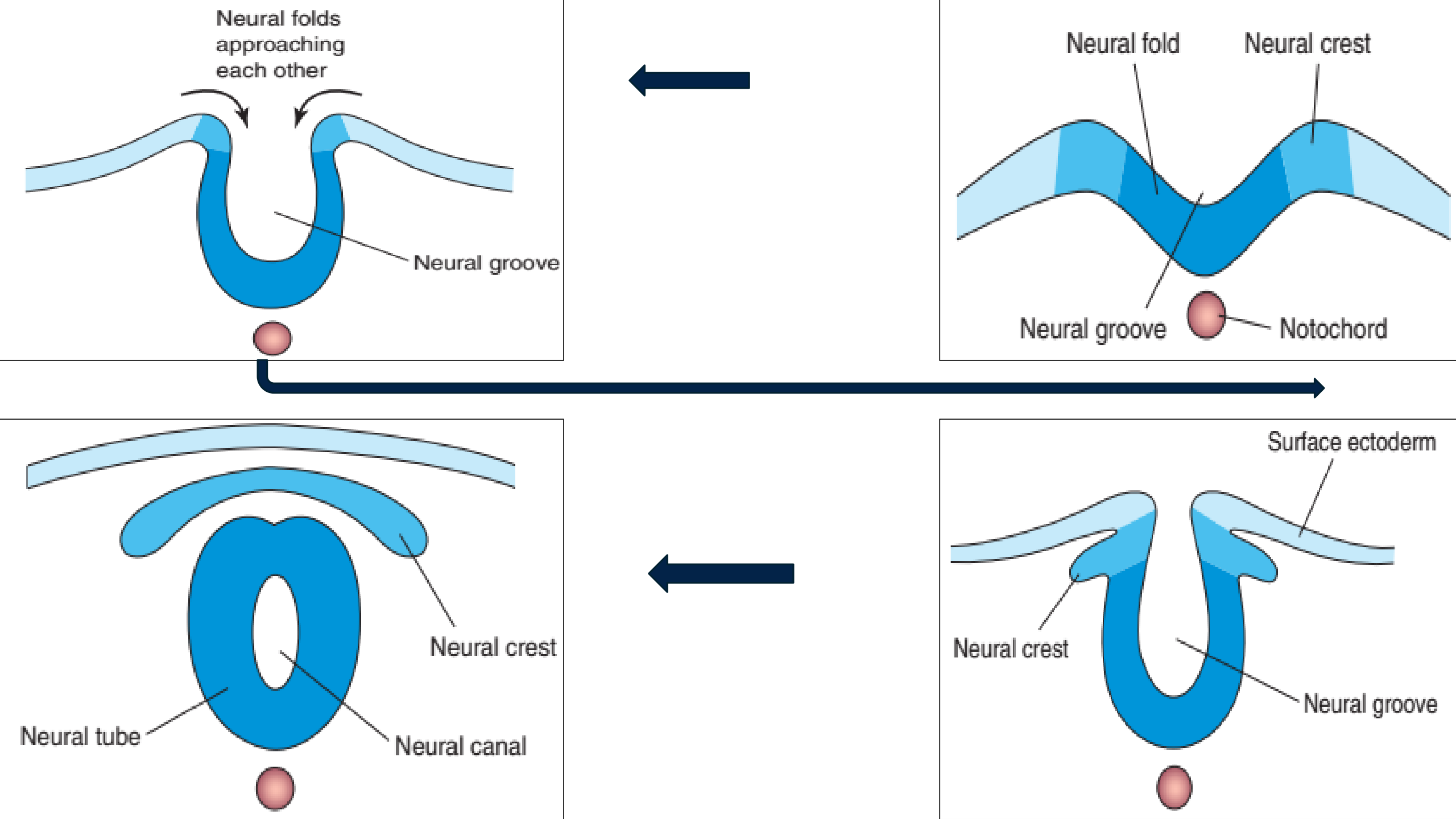
3RD WEEK OF PREGNANCY

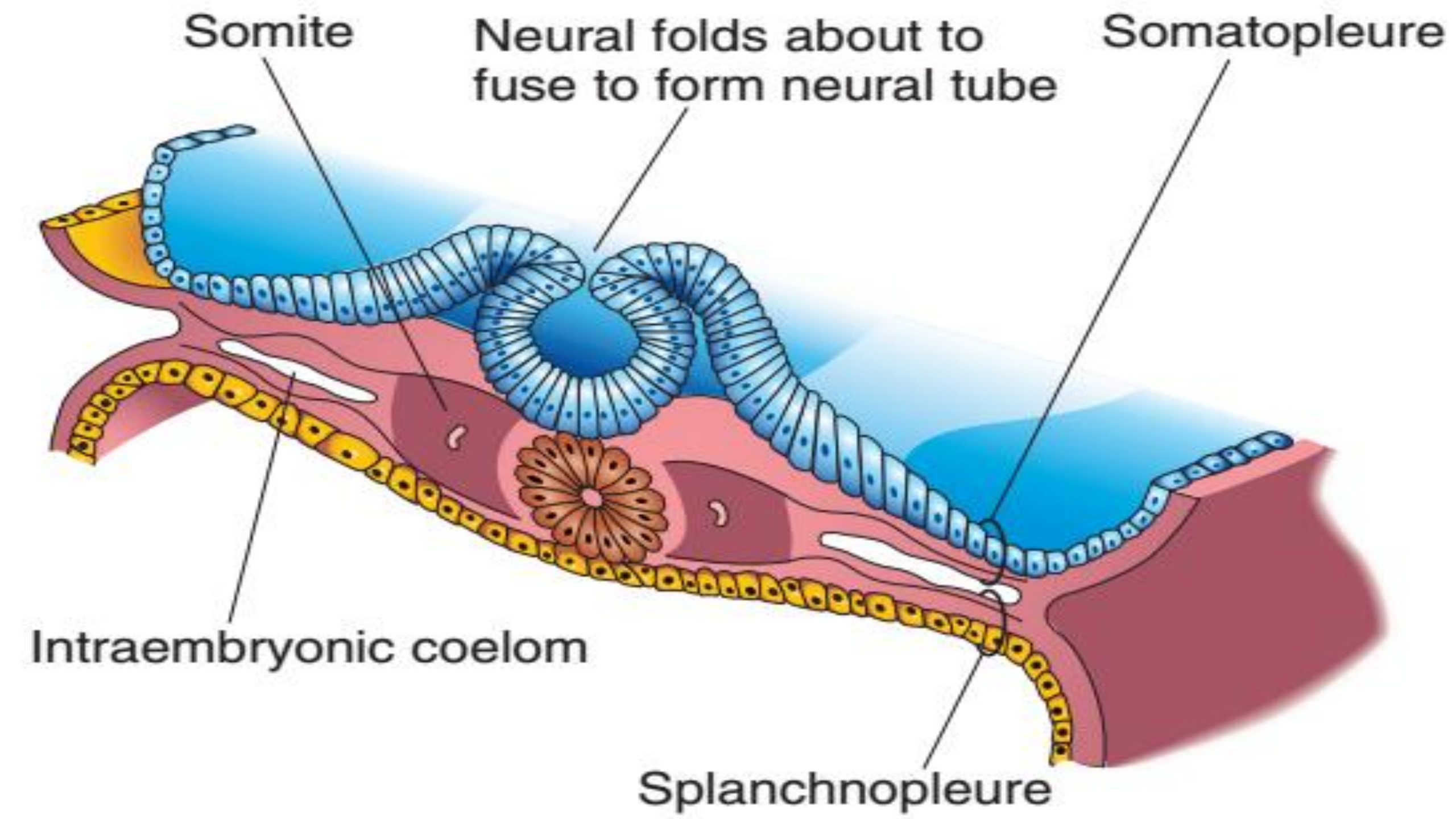
Development of neural tube(Neurilation).

Time: At the 3rd week.

Stages:

1. On 17th day, the ectoderm over the notochord forms an elongated thick plate called neural plate.
2. On 18th day, the neural plate invaginated to form neural groove.
3. The neural groove has neural folds on each side.
4. The neural folds approximate to each other and fuse to form the neural tube.
5. The neural tube then separates from the surface ectoderm.
6. During the separation of the neural tube some cells fall on both sides of it to form the neural crest cells.
7. The cranial end of the tube dilates to form the brain vesicle & the remaining part forms the spinal cord.


Neural folds approaching each other
Neural groove
Neural fold
Neural crest
Neural groove
Notochord
Surface ectoderm
Neural crest
Neural groove
Neural crest
Neural tube
Neural canal


Somite
Neural folds about to fuse to form neural tube
Somatopleure
Intraembryonic coelom
Splanchnopleure

3RD WEEK OF PREGNANCY

Neural crest

Origin: Group of cells that fall on both sides of neural tube.

Derivatives:

a. Neuroblasts: these cells give rise to:

1. Nerve cells of dorsal root ganglia.
2. Nerve cells of sympathetic ganglia.
3. Nerve cells of parasympathetic ganglia of some cranial nerve (3rd, 7th, 9th & 10th).
4. Nerve cells of sensory ganglia of some cranial nerve (5th, 7th, 8th & 10th).

b. Spongioblasts: these cells give rise to:

1. Pia and arachnoid maters.
2. Schwann cells.

c. Chromaffin cells: these cells give rise to:

1. Suprarenal medulla.
2. Cells of carotid and aortic bodies.

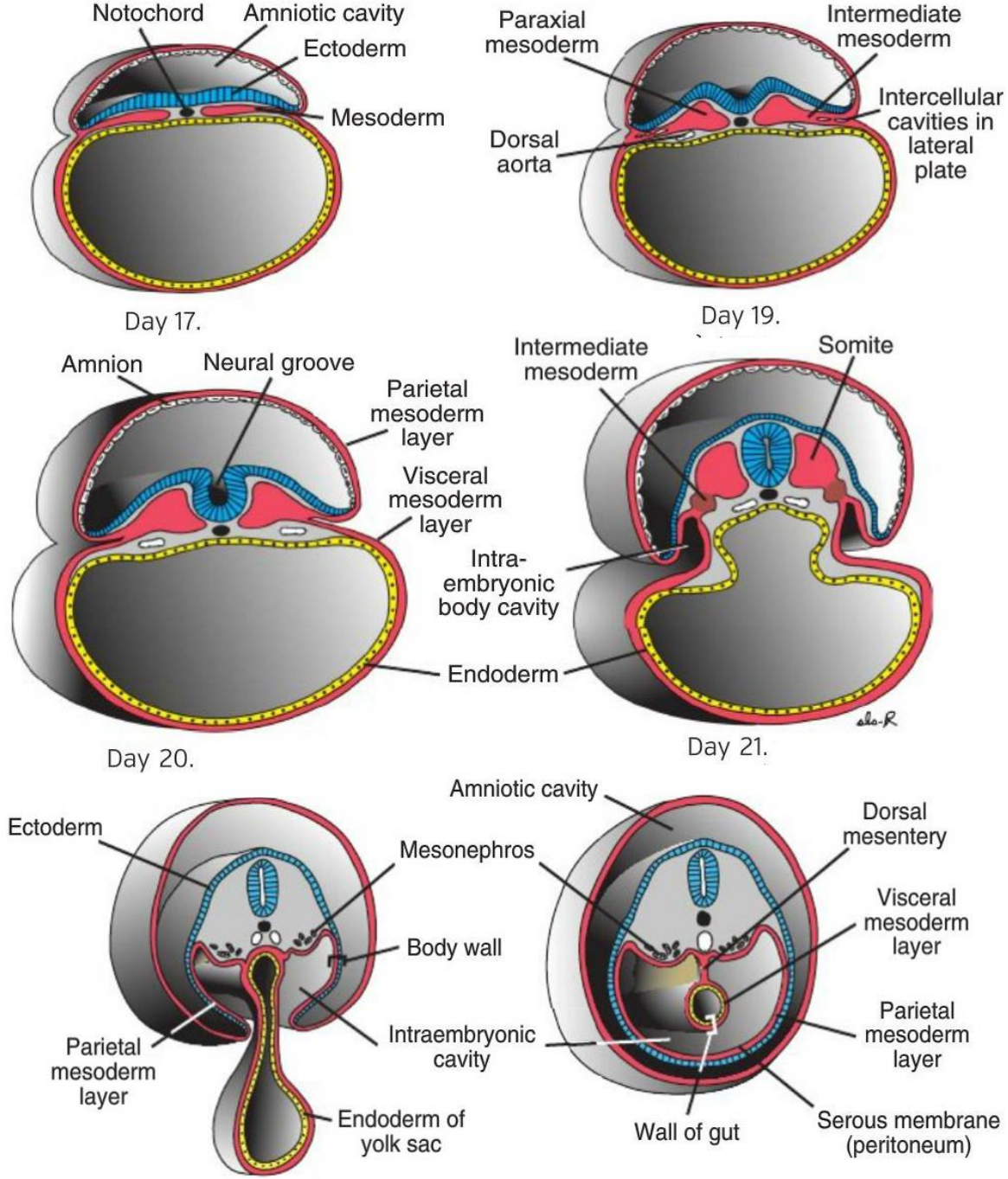
d. Melanocytes: Pigment cells of the skin.

e. Some bones of the face.

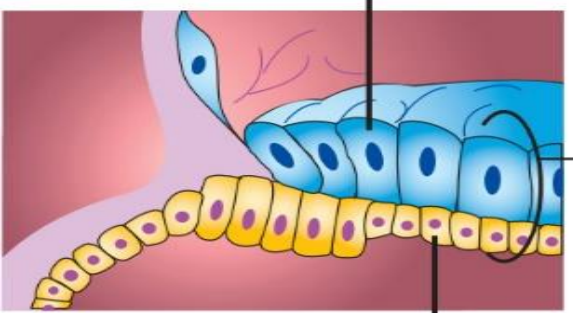
Intra-embryonic mesoderm

- It is continuous with **extra-embryonic mesoderm** covering amnion and yolk sac at the margin of embryonic disc.
- By the middle of 3rd week, I.E.M. separate the ectoderm and endoderm every where ***EXCEPT***:
  - Cranially: **at prochordal plate.**
  - In the median plane: **at notochordal process**
  - Caudally: **at cloacal membrane.**
- Development: A longitudinal groove appears on each side of the notochord dividing the intra embryonic mesoderm into:

1- **paraxial mesoderm:** on each side of notochord.
2- **Intermediate cell mass:** in the floor of the groove.
3- **Lateral plate mesoderm:** Lateral to the groove.



Transverse sections showing development of the mesodermal germ layer.



Bilaminar embryonic disc

Epiblast

Ectoderm of amnion

Embryonic ectoderm

Primitive streak

Extraembryonic mesoderm

Embryonic mesoderm

Notochordal process

Embryonic endoderm

Hypoblast

Endoderm of umbilical vesicle

Extraembryonic mesoderm

Origin of embryonic tissues.

3RD WEEK OF PREGNANCY

Differentiation Of Three Germ Layers

1) Derivatives of Ectoderm

1- Central and peripheral nervous system.
2- Sensory epithelium of the eye, ear and nose.
3- Epidermis of the skin and it is appendage(hair, nails and the sweet, sebaceous and mammary glands).
4- The pia and arachnoid mater.
5- Suprarenal medulla and chromaffin tissue.
6- The external auditory meatus and the outer layer of tympanic membrane.
7- Enamel of teeth.
8- The epithelium of nasal cavity and the paranasal sinuses.
9- The anterior part of the buccal cavity, gums, salivary glands, pituitary glands, lower half of anal canal and the terminal part of male urethra.
10- The conjunctiva, outer layer of cornea and muscle of the iris.

2) Derivatives of endoderm

1- Epithelial lining of:

a. Gastro-Intestinal Tract.

b. Respiratory Tract.

c. Urinary Bladder and urethra.

d. Tympanic cavity, antrum and auditory tube in the ear.

2- Parenchyma of tonsil, thyroid, parathyroid glands, thymus, liver and pancreas.

3RD WEEK OF PREGNANCY

3) Derivatives of Intraembryonic mesoderm

A. Paraxial mesoderm: divides into Number: 42-44 pairs of somites

Fate: somites divided into two parts:

1. Ventromedial part: form Sclerotome which gives axial skeleton (vertebral column and ribs).
2. Dorsilateral part: form Dermo-myotome.
   - Dermatome: superficial part and gives dermis of skin and fascia.
   - Myotome: deep part and gives skeletal muscles.

B. Intermediate cell mass

Definition: part of intraembryonic mesoderm in floor of longitudinal groove.

Fate: gives urogenital system:

1. Male and female duct system
2. Kidney
3. Testis or ovary
4. Cortex of suprarenal gland.

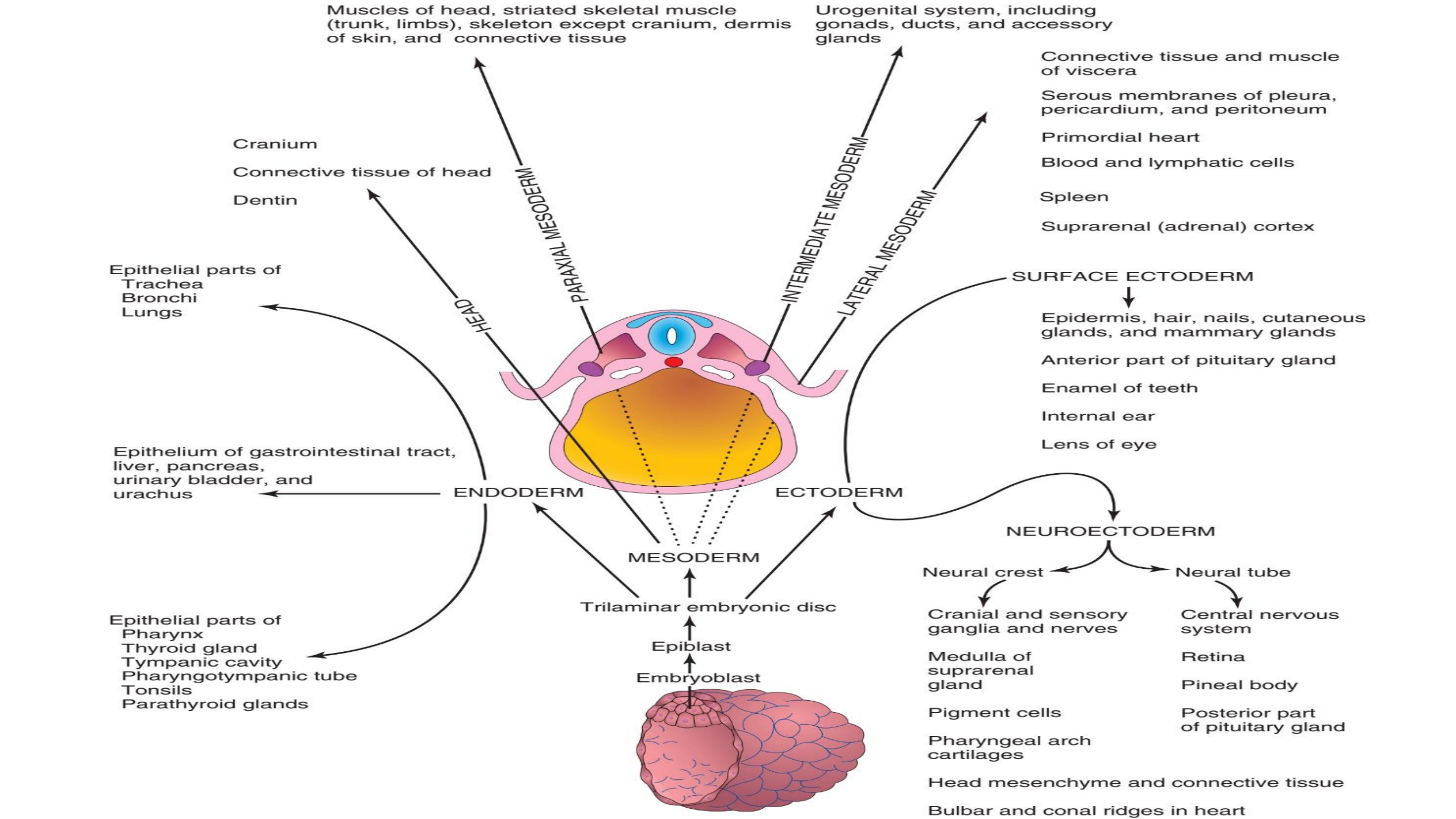
C. Lateral plate mesoderm

Definition: part of intraembryonic mesoderm lateral to longitudinal groove.

Development:

- Small cavities appear in lateral plate mesoderm.
- These cavities unite to form single horse shoe cavity (intraembryonic coelom) that divides lateral plate mesoderm into:
  1. Somatic (parietal) layer
  2. Visceral (splanchnic) layer
  3. Intraembryonic coelom

1. Somatic (parietal) layer: gives
   a) Muscles of abdominal wall and chest wall.
   b) Parietal layer of pleura, peritoneum and pericardium.
2. Visceral (splanchnic) layer: gives
   a) Muscles of heart, smooth muscles of bronchial tree and gut.
   b) Visceral layer of pleura, peritoneum and pericardium.
3. Intraembryonic coelom: divided into pleural, peritoneal and pericardial cavities.


Muscles of head, striated skeletal muscle (trunk, limbs), skeleton except cranium, dermis of skin, and connective tissue
Urogenital system, including gonads, ducts, and accessory glands
Connective tissue and muscle of viscera
Serous membranes of pleura, pericardium, and peritoneum
Primordial heart
Blood and lymphatic cells
Spleen
Suprarenal (adrenal) cortex
Cranium
Connective tissue of head
Dentin
HEAD
PARAXIAL MESODERM
INTERMEDIATE MESODERM
LATERAL MESODERM
Epithelial parts of
Trachea
Bronchi
Lungs
SURFACE ECTODERM
Epidermis, hair, nails, cutaneous glands, and mammary glands
Anterior part of pituitary gland
Enamel of teeth
Internal ear
Lens of eye
Epithelium of gastrointestinal tract, liver, pancreas, urinary bladder, and urachus
ENDODERM
ECTODERM
NEUROECTODERM
MESODERM
Neural crest
Neural tube
Trilaminar embryonic disc
Cranial and sensory ganglia and nerves
Central nervous system
Epiblast
Medulla of suprarenal gland
Retina
Embryoblast
Pineal body
Pigment cells
Posterior part of pituitary gland
Epithelial parts of
Pharynx
Thyroid gland
Tympanic cavity
Pharyngotympanic tube
Tonsils
Parathyroid glands
Pharyngeal arch cartilages
Head mesenchyme and connective tissue
Bulbar and conal ridges in heart

شکرا