GENERAL EMBRYOLOGY (1ST WEEK -3RD WEEK)

TIMON KWACH
KMTC BONDO

Fertilization

Fertilization

- Fertilization
- The process of union of male & female gamate
- Site-ampullary region

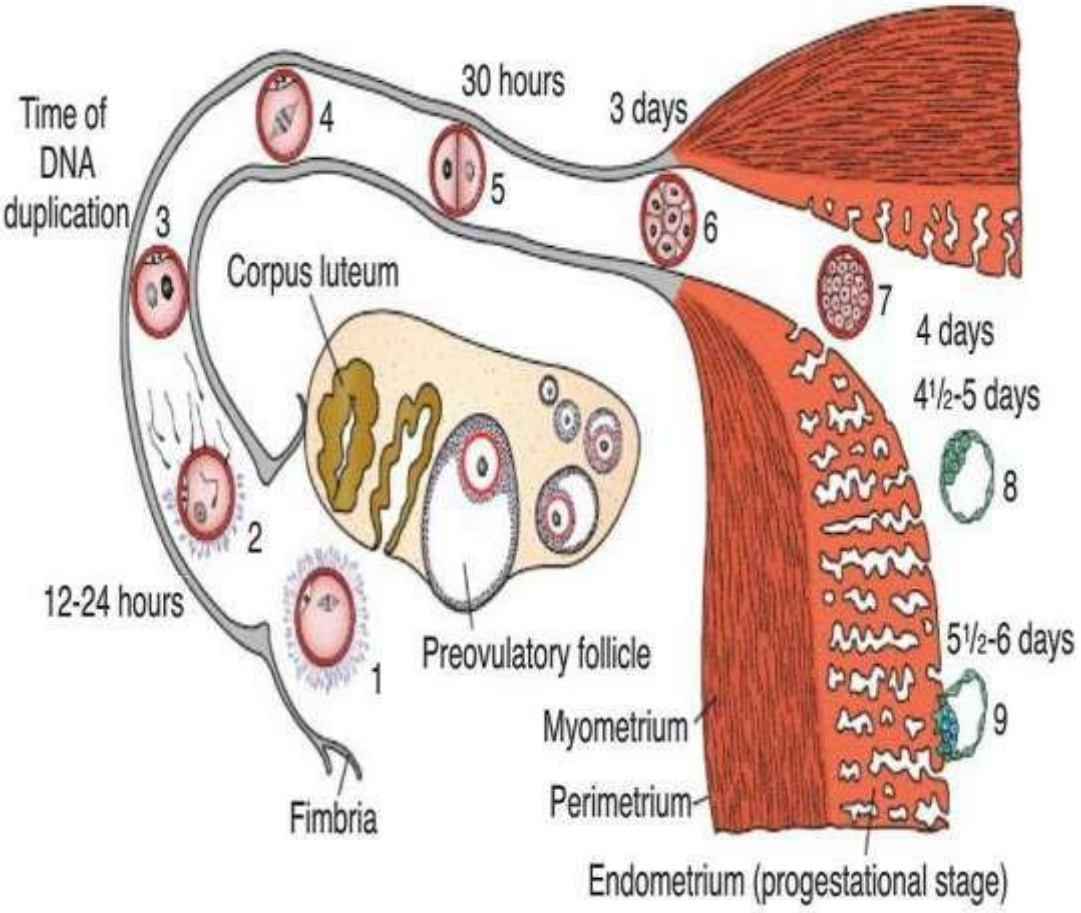


Fig: Fertilization to implantation

- Aim of fertilization
- Restoration of diploid number chromosome
- Determination of sex
- Initiation of clevage

➢ Movement of sperm from cervix to uterine tube

- Muscular contraction of uterus & uterine tube
- By own propulsion

➢ Changes in sperm before fertilization

- Capacitation
- Acrosomal reaction

➢ Capacitation

- Period of conditioning in female reproductive tract
- In uterus & uterine tube
- Epithelial interaction between sperm & uterine tube
- Can pass through corona cells & undergo acrosomal reaction

➢ Acrosomal reaction

- Mutual action
- Both sperm & follicular cell release enzyme
- Sperm penetrate zona pellucida

➢ Phases of fertilization

- Phase 1: Penetration of corona radiata
- Phase 2: Penetration of zona pellucida
- Phase 3: Fusion of oocyte & sperm cell membrane

➢ Zona reaction

- Changes on the zona pellucida that become impenetrable to other sperm
- Prevent polyspermia

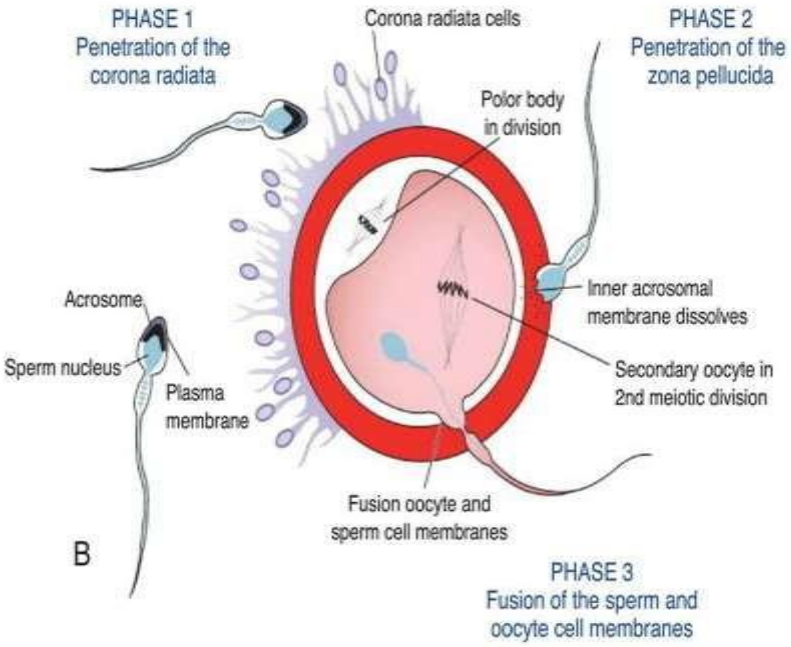


Fig-Phases of fertilization

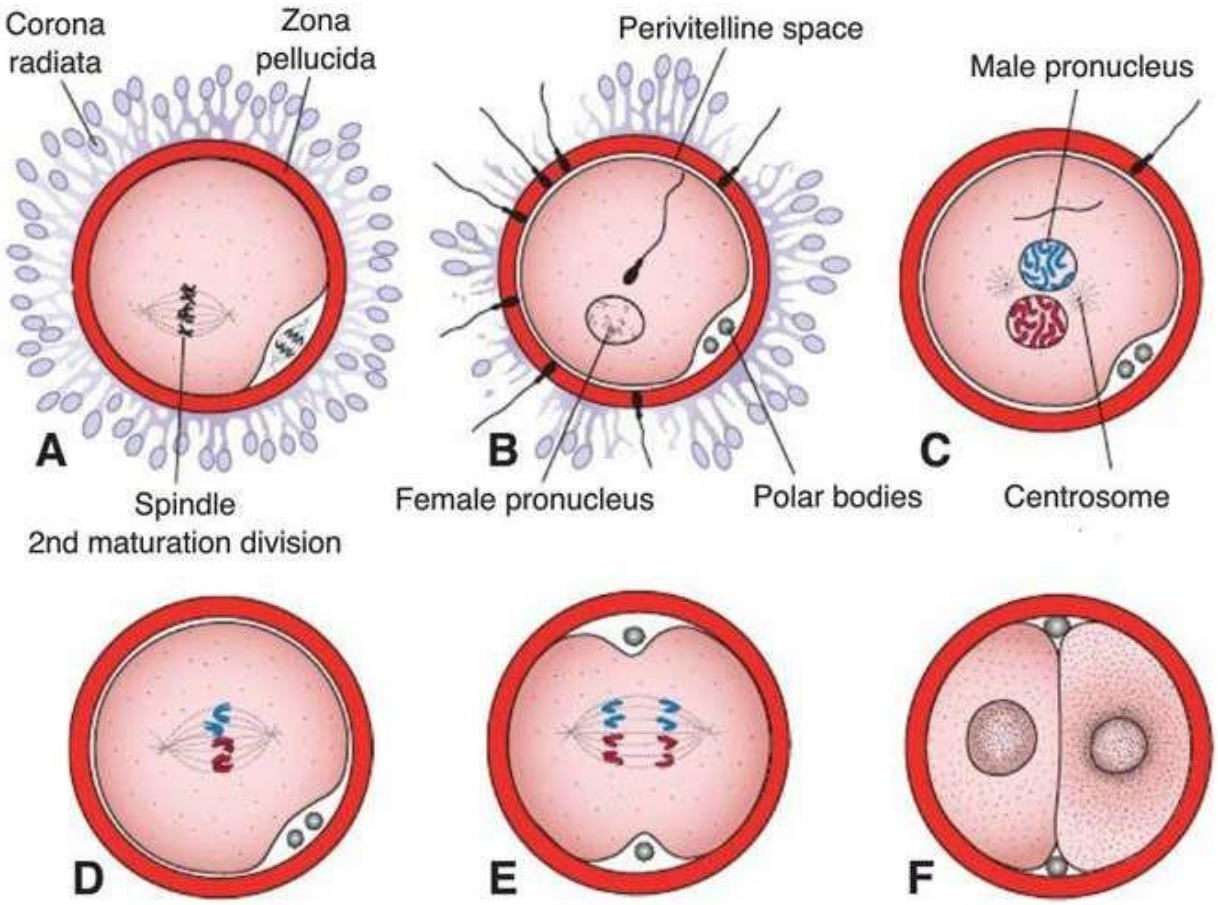


Fig-fertilization to two cell stage

Terminology

- Induction : The process where one group of cells tissues causes another set of cells or tissues to change their fate
- Inducer : Produce a signal
- Responder : Respond to a signal
- Competence : Capacity to respond to a signal
- Organiser : Localized areas of embryo induce directly tissue differentiation

  eg; primary organiser-primitive streak

  secondary organiser-notochord

  tertiary organiser-neural tube

- Totipotent : Where each cell may produce a separate embryo
- Pluripotent : Groups of cells produce specific type of tissue in early embryogenesis

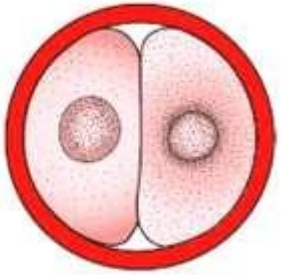
FIRST WEEK OF DEVELOPMENT

[CLEAVAGE TO IMPLANTATION]

FIRST WEEK OF DEVELOPMENT

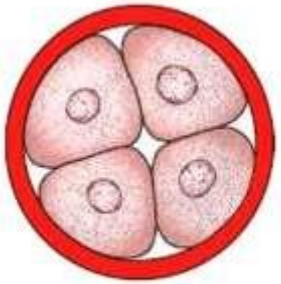
CLEAVAGE:

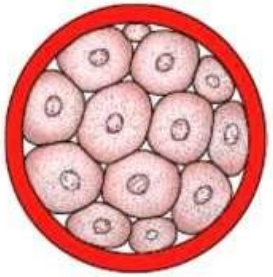
- Series of Mitotic cell division in the zygote at fallopian tube to increase the number of cells. These cells are known as Blastomeres


Two-cell stage

STAGES OF CLEAVAGE:

- **Two-cell stage**: About 30 hour after fertilization
- **Four-cell stage**: About 40 hour after fertilization
- **Twelve-cell stage:** About 72 hour after fertilization
- **Sixteen-cell stage:** About 96 hour after fertilization


Four-cell stage


Morula

COMPACTION:

- After 3rd cleavage, blastomeres maximize their contact with each other forming a compact ball of cells held together by tight junctions. This process is called compaction

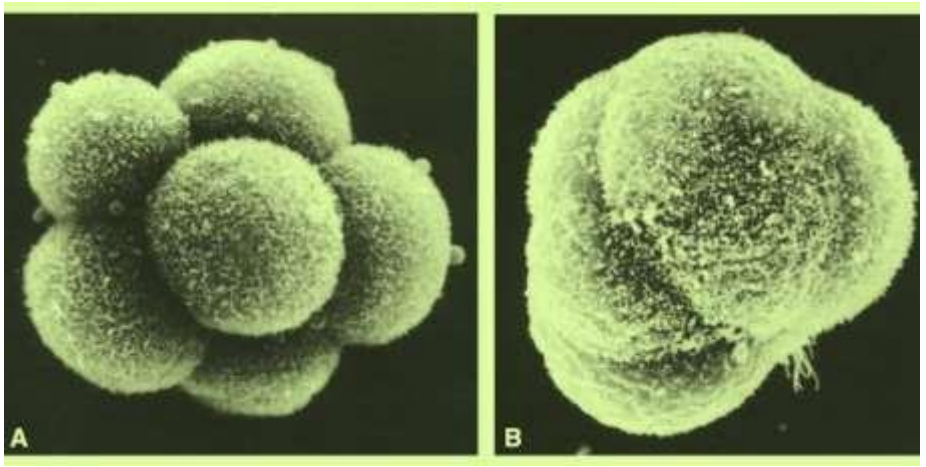
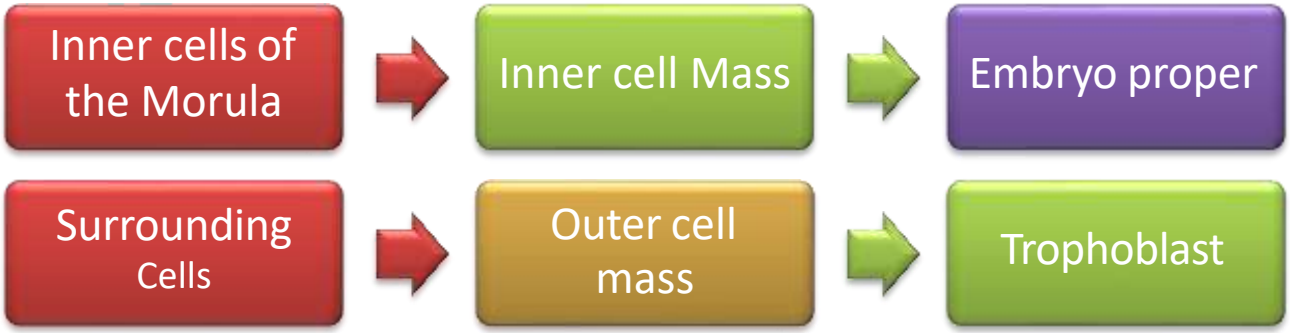
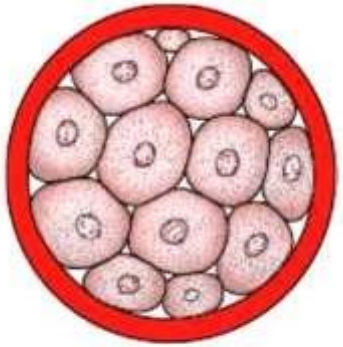


Fig: A) Uncompacted B) Compacted eight-cell mouse embryos

MORULA:

- Cells of compacted embryo divide again to form 16 cell stage which is called Morula




Morula

- Morula Still enveloped by Zona Pellucida
- Gets nutrition from secretion of Uterine tube
- Form : 3 Days after fertilization in Uterine tube

APPEARANCE:

- Mulberry in appearance.

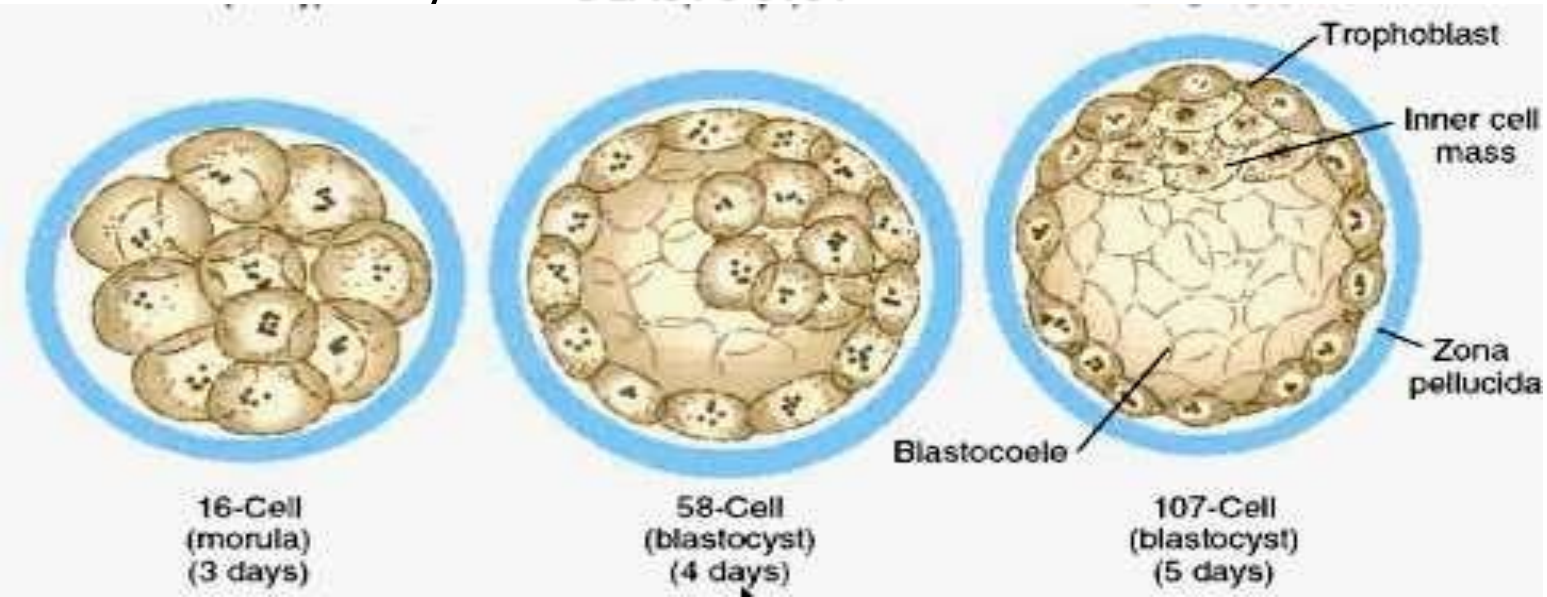
BLASTOCYST

- Morula enters Uterine cavity ⇨ Fluid begins to penetrate through the zona pellucida into the intracellular spaces of inner cell mass
- Intercellular spaces become confluent ⇨ A single cavity, **Blastocele** forms

  The fluid in the blastocystic cavity separates blastomeres into 2 parts :

  Outer Cell Mass (Trophoblast) : Form Epithelial wall of the blastocyst

  Inner Cell Mass: Form **Embryoblast** which give rise to embryo
- At this time the embryo is a **BLASTOCYST**



BLASTOCYST (Contd.)

When Forms:

- 4.5-5 days after fertilization

Where Forms:

- In Uterine Cavity

Nutrition:

- From Uterine Glandular secretion and surrounding blood vessels

Enveloped by:

- Zona Pellucida
- **Just** before implantation, Zona Pellucida disappear
- **About** 6 days after fertilization, blastocyst gets implanted

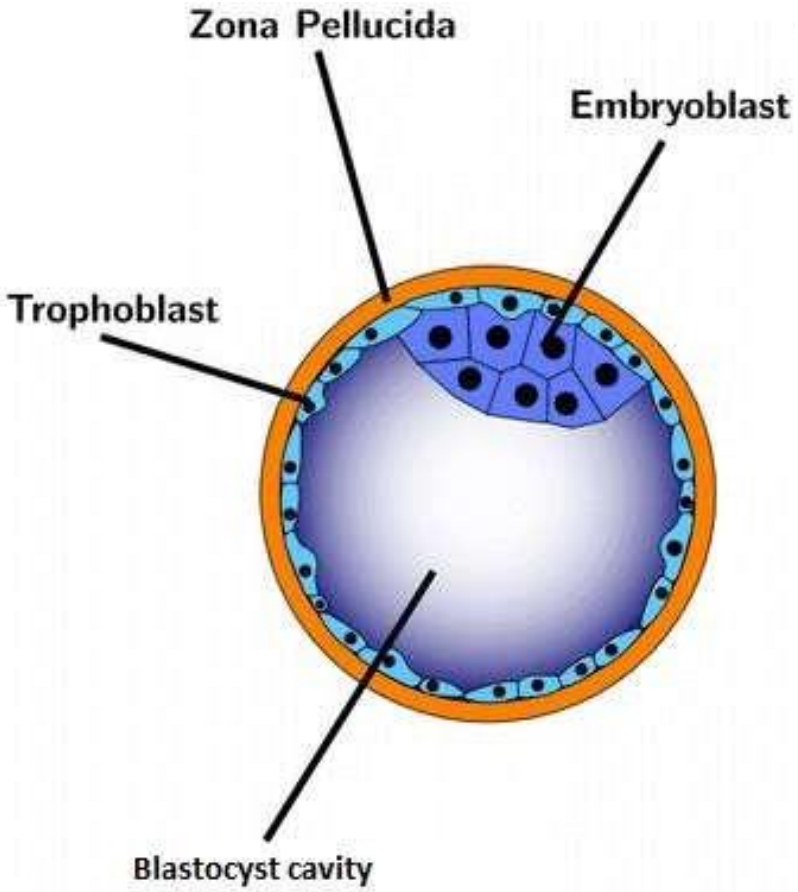


Fig: Blastocyst

IMPLANTATION:

- Embedding of Blastocyst in the anterior or posterior wall of the body near the fundus in functional layer of the Uterus,between the openings of the glands

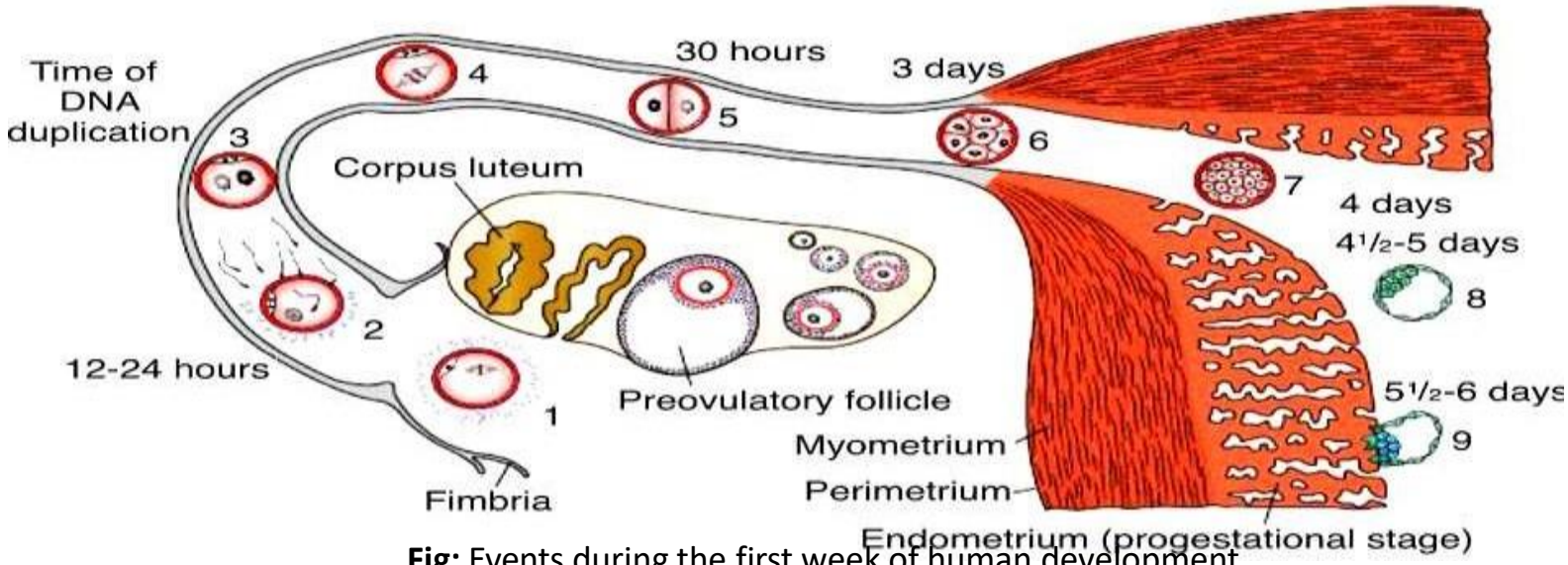


Fig: Events during the first week of human development

TIME:

- At the end of 1st Week

PHASE:

- Secretory phase of Uterus.

HOW IMPLANTATION OCCURS:

Trophoblastic Cells over embryonic pole. → **Begins to penetrate** → **Epithelial cells of Uterine Mucosa** → **With the help of Proteolytic enzymes**

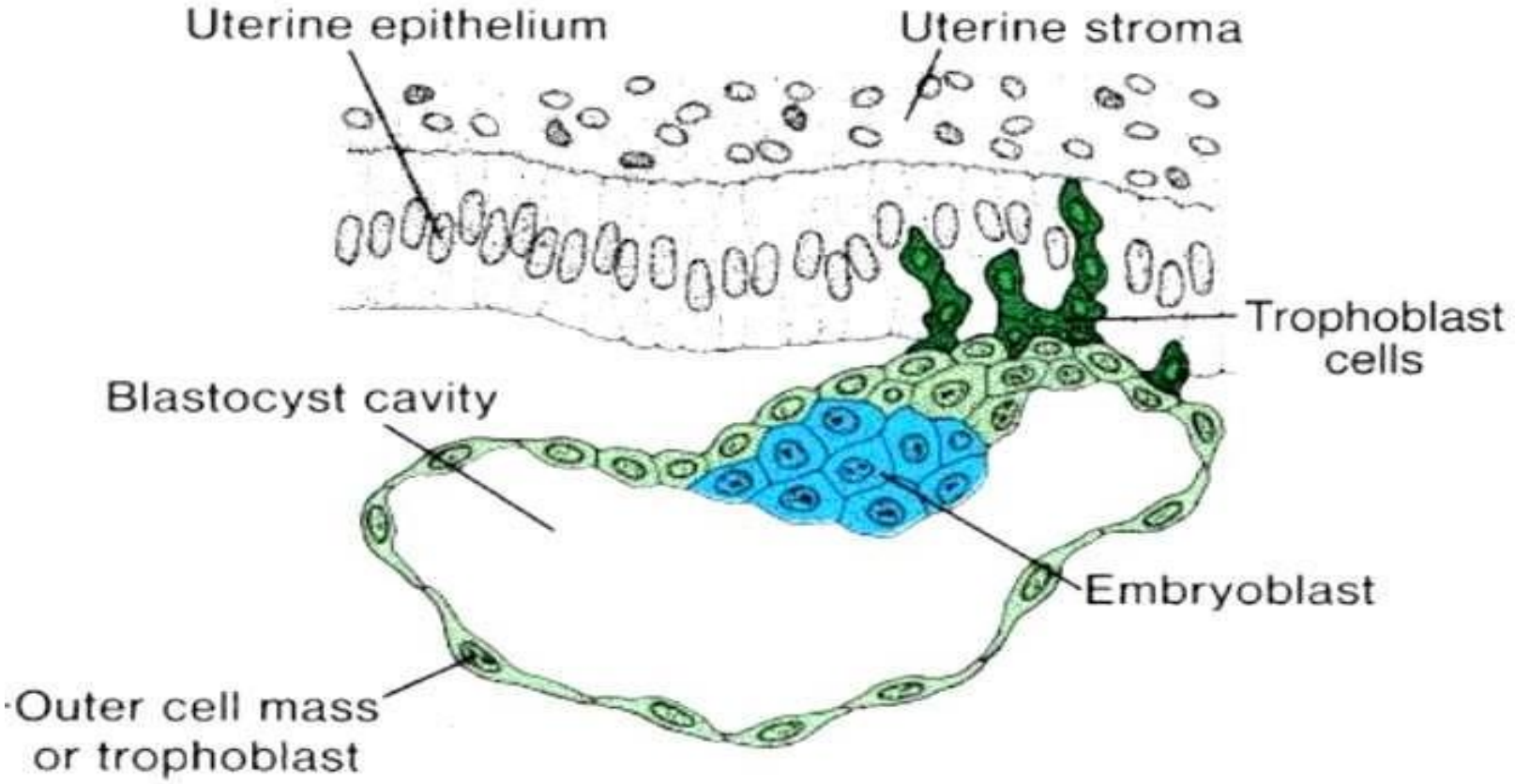


Fig: Trophoblast cells at the embryonic pole of the blastocyst penetrating the uterine mucosa

ATTACHMENT:

- By L-Selectin on Trophoblast attached with CHO receptor on uterine epithelium
- This is called Capture of blastocyst by uterine epithelium from uterine cavity
- Integrin on Trophoblast for laminin promote attachment
- Integrin for Fibronectin stimulate migration

So, Implantation is the result of mutual trophoblastic and endometrial action

UTERUS AT THE TIME OF IMPLANTATION

IN SECRETORY PHASE:

- Secretory phase begins approximately 2 to 3 days after ovulation in response to **Progesterone** produced by Corpus Luteum. **During** this phase:
  1. Increase thickness of Endometrium
  2. Uterine glands &arteries become coiled
  3. Tissue becomes succulent

As a result, 3 layers can be recognized in endometrium

1) A superficial Compact layer
2) An intermediate Spongy layer
3) A thin Basal layer

} Implantation occurs in these layers. Between the openings of glands.

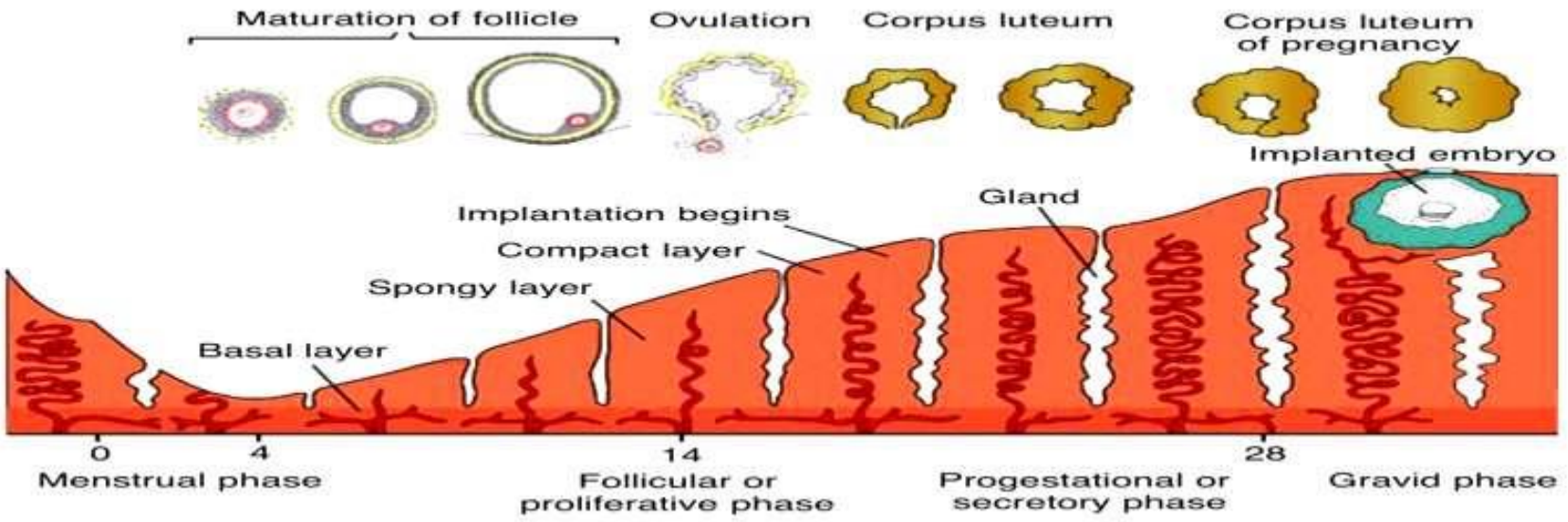


Fig: Implantation

IF FERTILIZATION DOES NOT OCCUR:

- The Corpus Luteum degenerates
- Estrogen and Progesterone levels fall
- Menstruation occurs
- Following 3 or 4 days compact& spongy layers are expelled from uterus. Basal layer is retained, functions as the regenerative layer
- Uterine lining epithelium reappears from glandular lining epithelium (simple columnar)

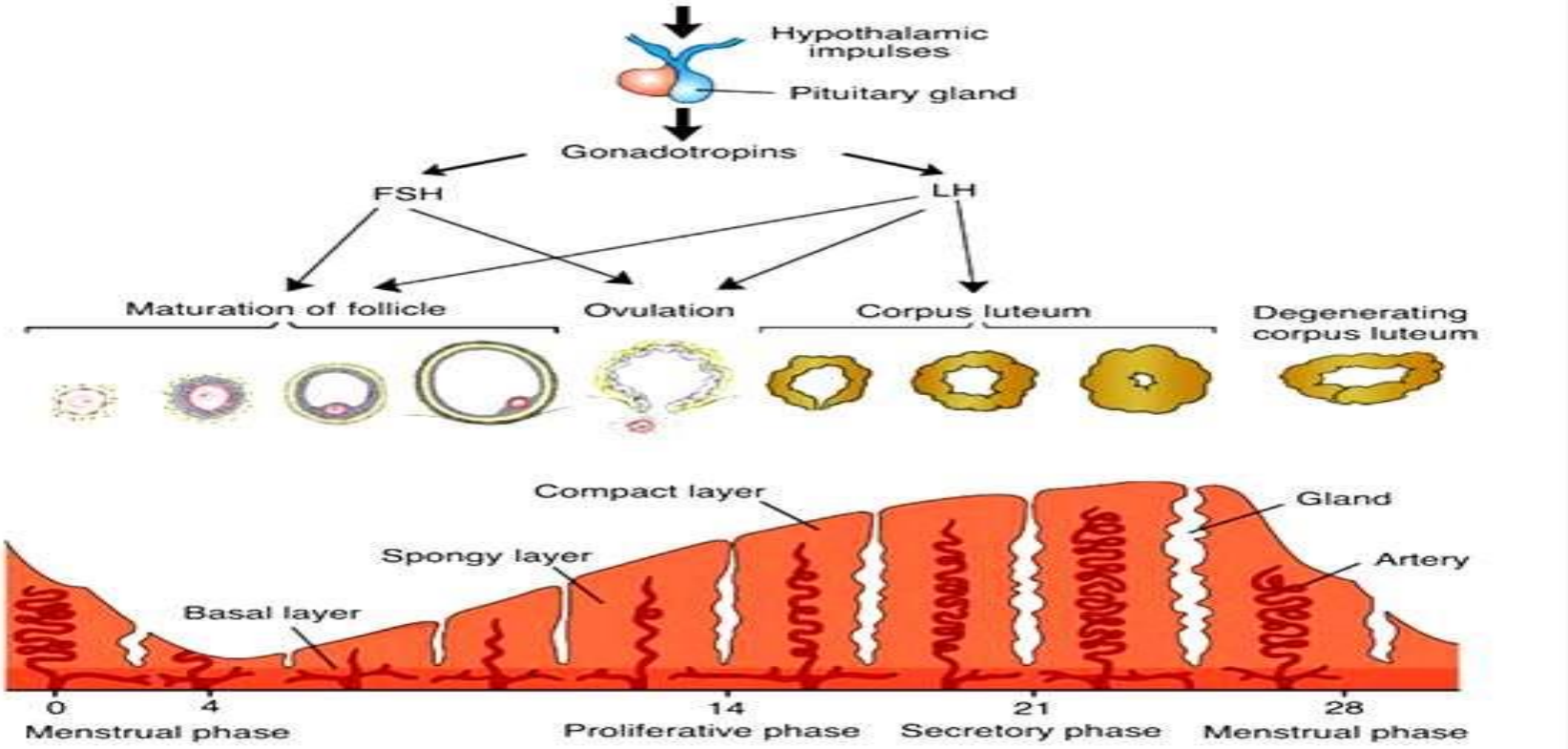


Fig: Menstrual cycle without fertilization

UTERUS AFTER IMPLANTATION

DECIDUA:

After implantation the Endometirum is known as **Decidua**.

DECIDUA REACTION:

- Cells of Endometrium becomes polyhedral
- Loaded with glycogen and lipids
- Intracellular spaces are filled with extravasate
- Tissue is edematus

This changes are known as Decidua reaction.

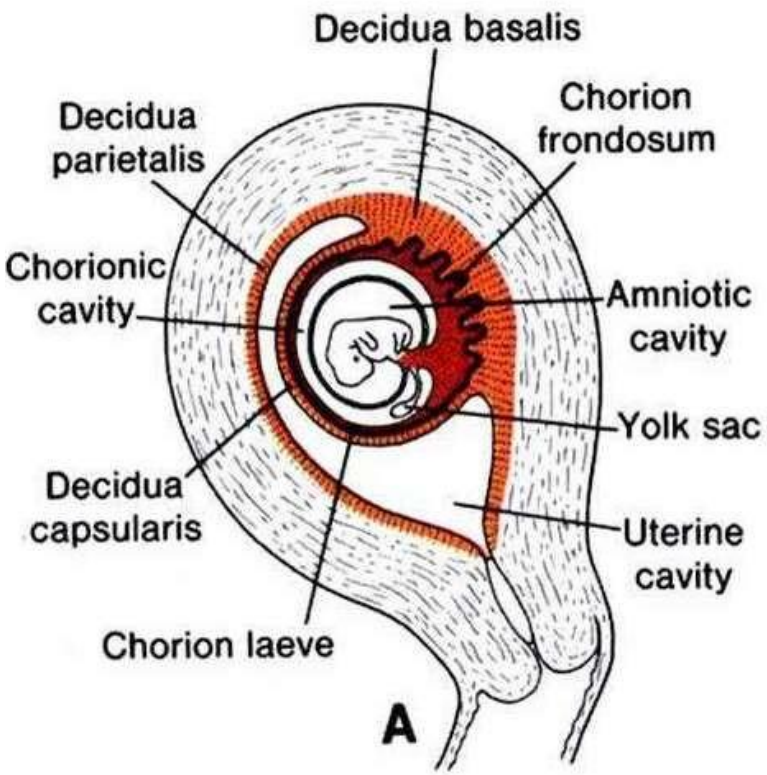


Fig: Subdivision of Decidua

TYPES:

1. Decidua Basalis
2. Decidua Capsularis
3. Decidua Parietalis

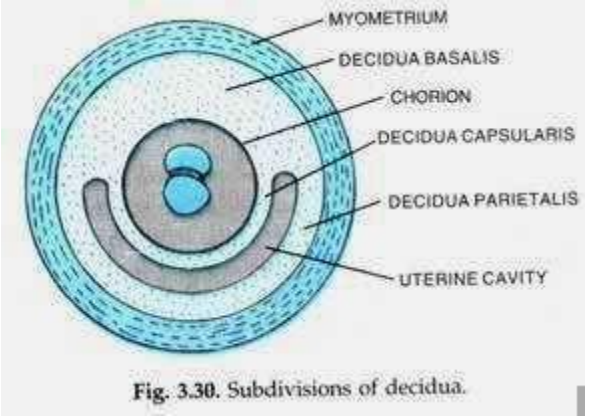


Fig. 3.30. Subdivisions of decidua.

ECTOPIC PREGNENCY:

Implantation of blastocyst takes place outside the uterus

SITE:

- Ampullary region of the tube
- Tubal implantation
- Interstitial implantation
- Implantation in the region of the internal os
- Ovarian implantation
- Abdominal cavity (rectouterine cavity)

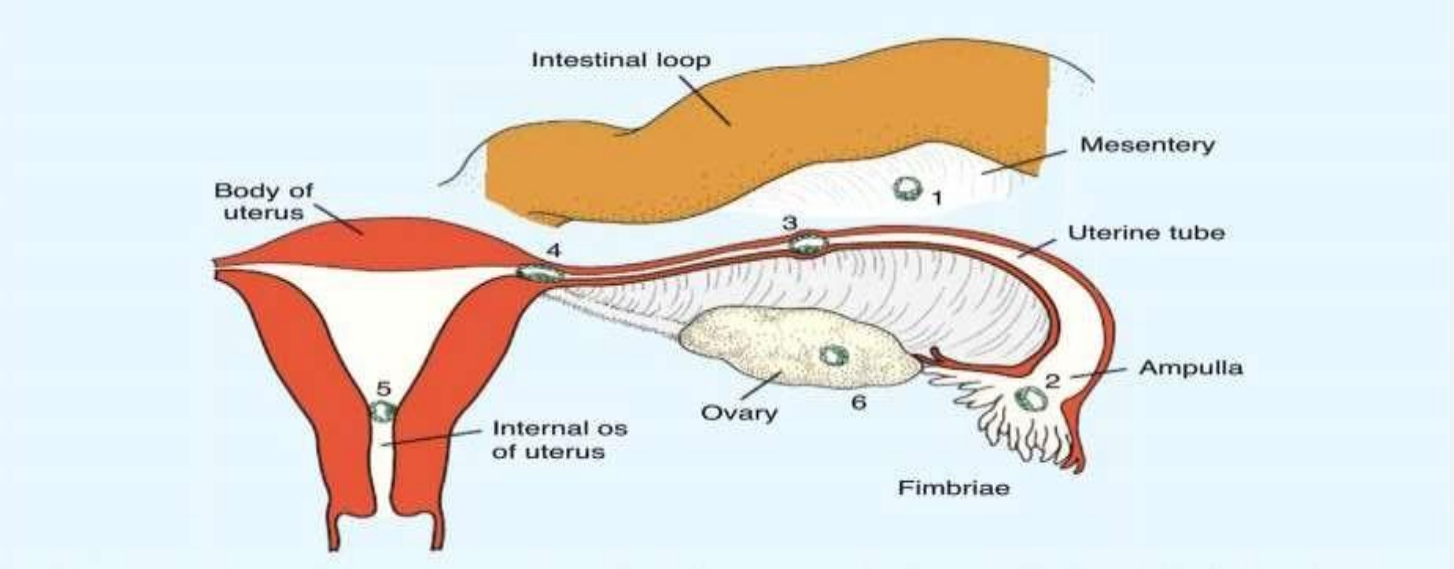


Fig: Sites of abnormal implantation

FATE OF ECTOPIC PREGNANCY:

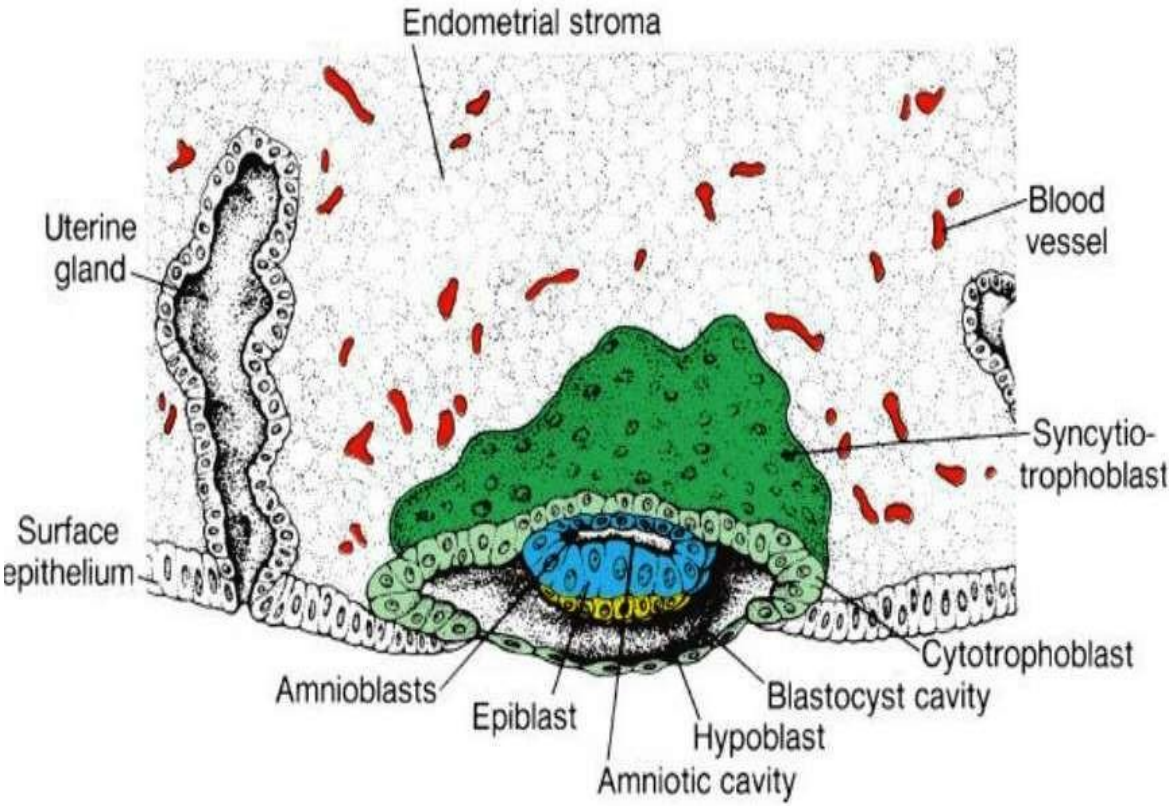
- Implantation in the region of the internal os, resulting placenta previa cause severe bleeding, In second part of the pregnancy and during delivery
- In ectopic pregnancy, embryo dies about the second month of gestation cause severe hemorrhage & abdominal pain in the mother – a surgical emergency

2nd WEEK OF DEVELOPMENT

2nd Week of Development

Day 8

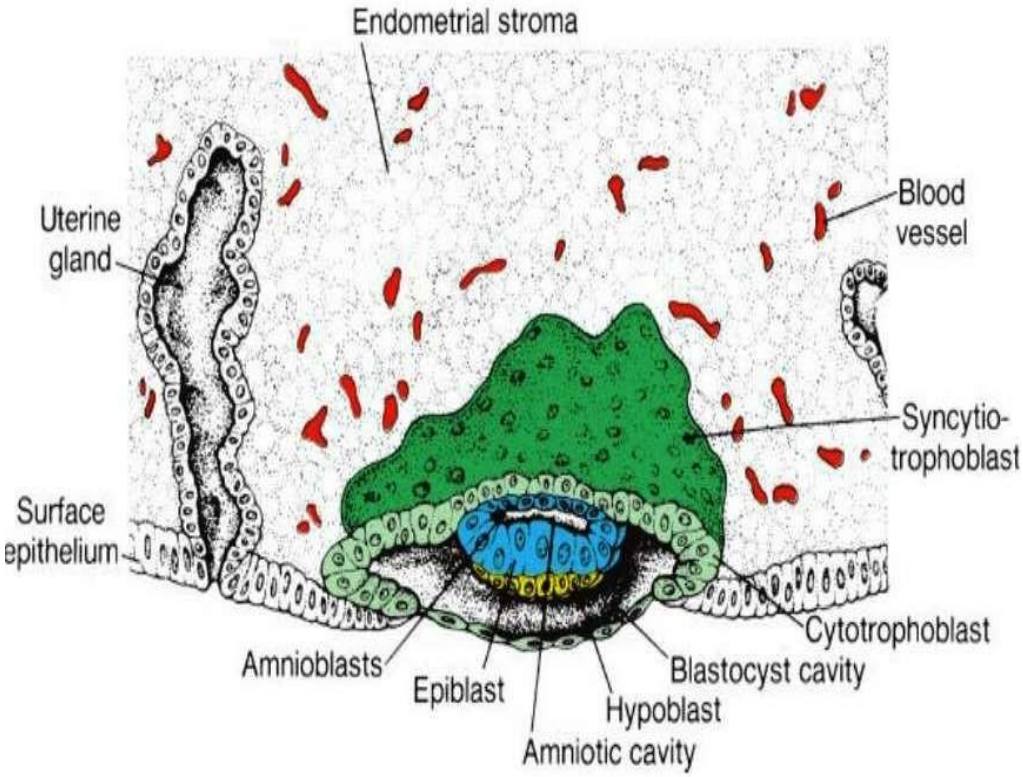
- Blastocyst partially embedded in the endometrial stroma



- Outer cell mass or trophoblast differentiate into 2 layers:

i. Cytotrophoblast: inner layer, mononucleated, mitotic figure present, actively proliferating layer

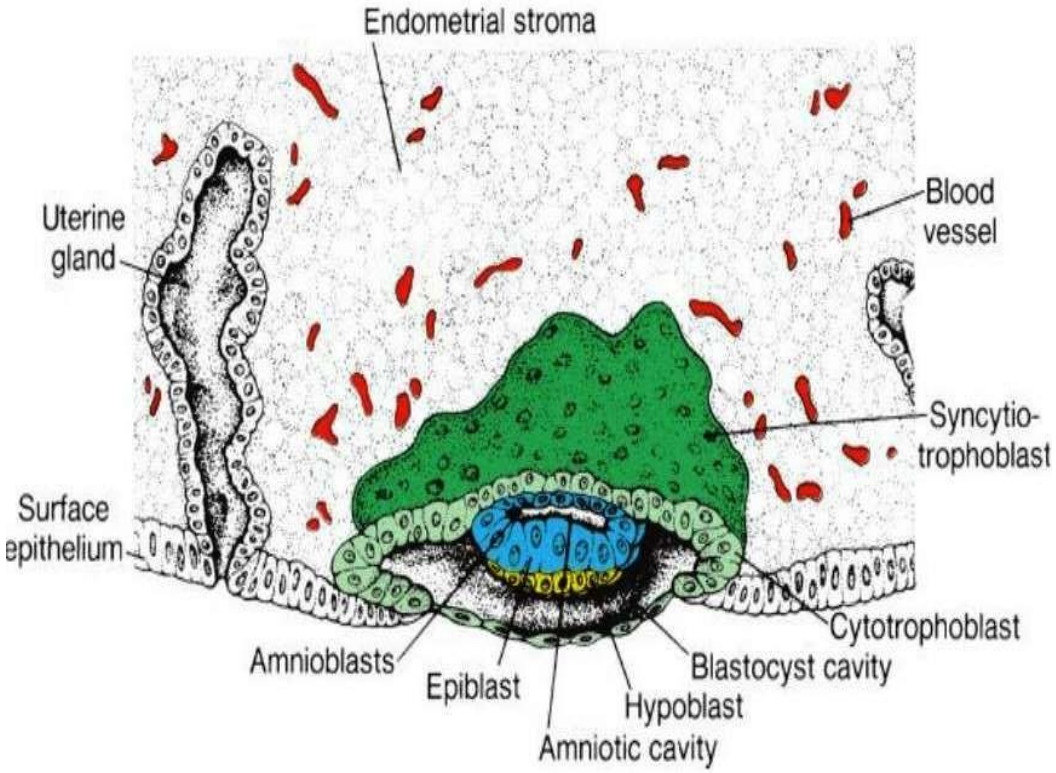
ii. Syncytiotrophoblast: outer layer, multinucleated, mitotic figure absent, erode maternal tissues



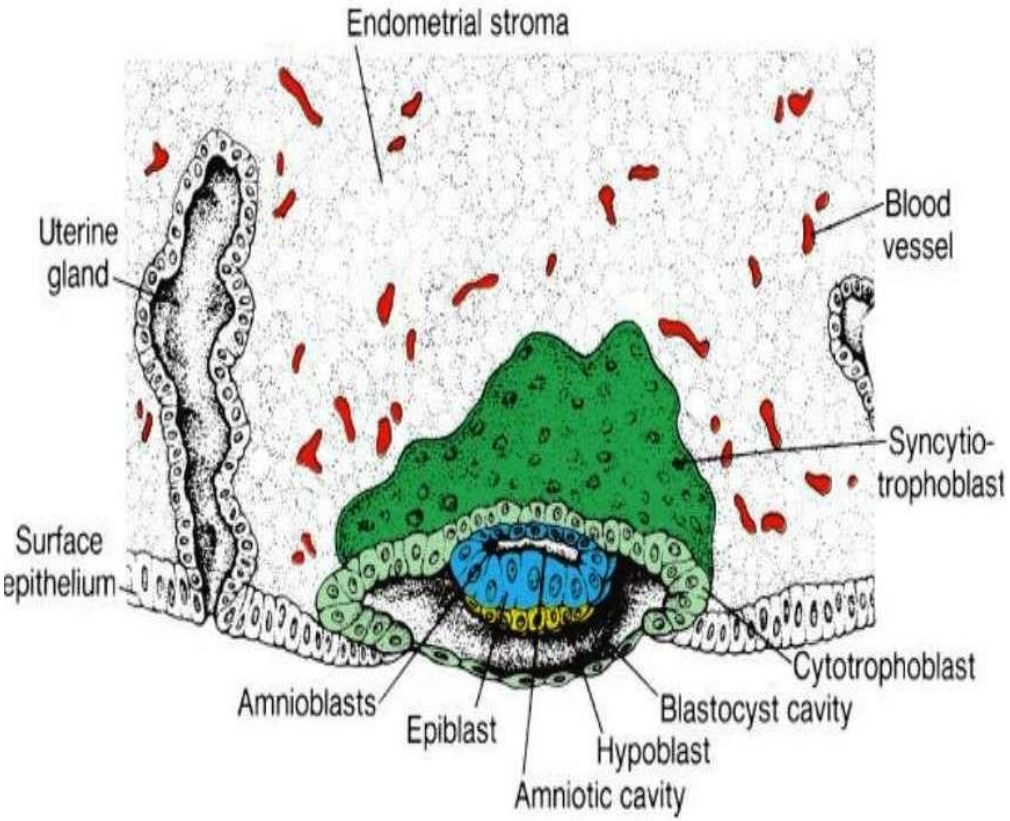
- Inner cell mass or embryoblast also forms 2layers:

i. Hypoblast: A layer of small cuboidal cells adjacent to blastocyst cavity.

ii. Epiblast: High columner cell adjacent to amniotic cavity.



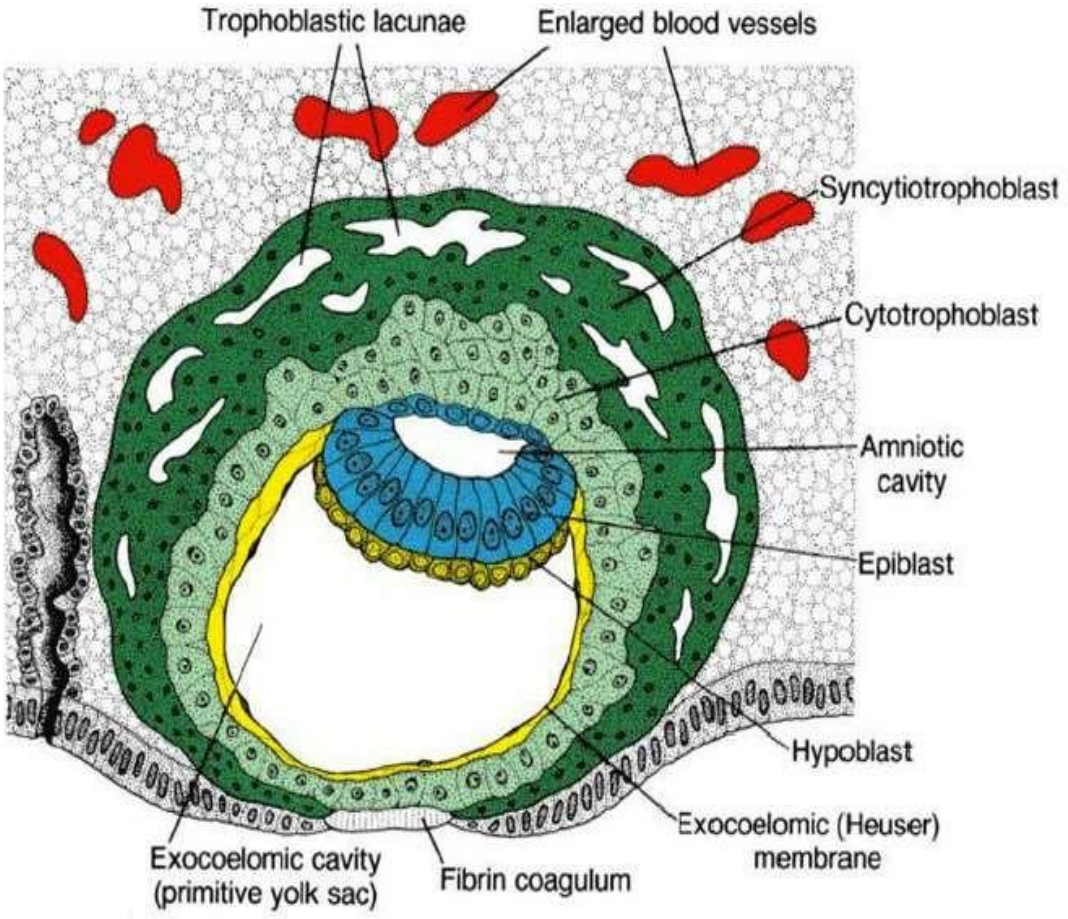
- A Small cavity appear with in the epiblast.
- The cavity enlarges to become the amniotic cavity.
- Epiblast cell adjacent to the cytotrophoblast called amnioblast
- together with the rest of the epiblast they line the amniotic cavity.



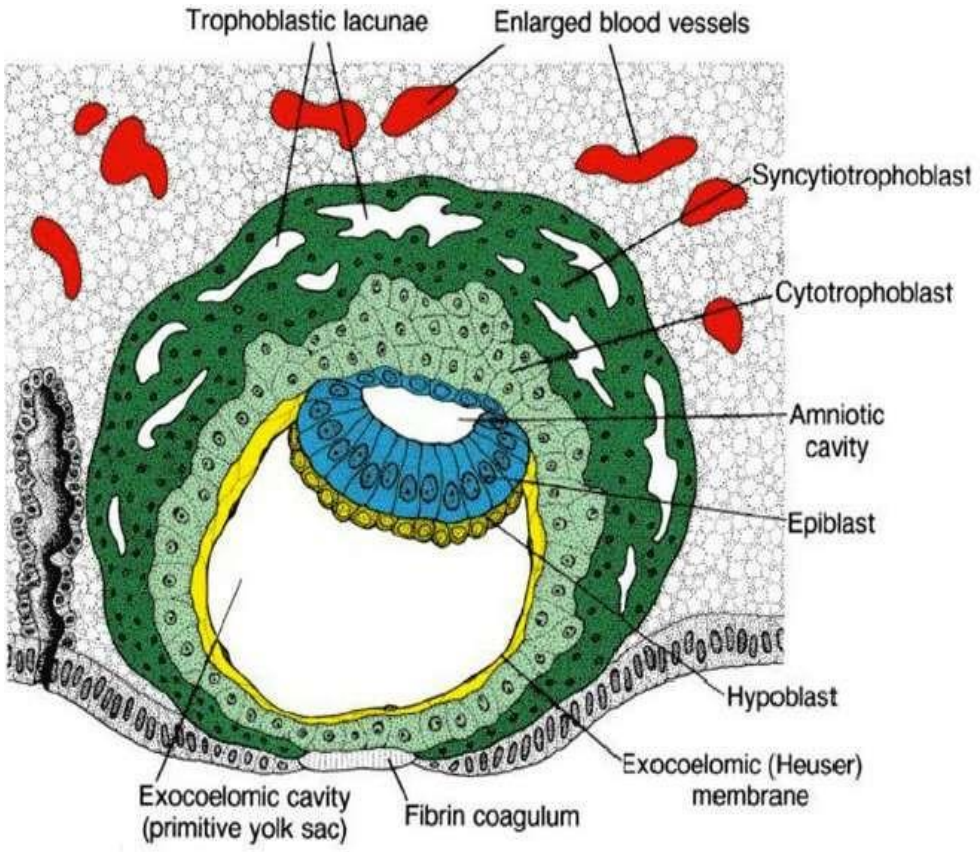
Day 9

- Blastocyst more deeply embedded in the endometrium

- At the embryonic pole ➡ vacuoles appear in syncytium ➡ vacuoles fuse and form large lacunae(**lacunar stage)**



- At the abembryonic pole, flattened cells originating from the hypoblast form a thin exocoelomic membrane that lines inner surface of the cytotrophoblast

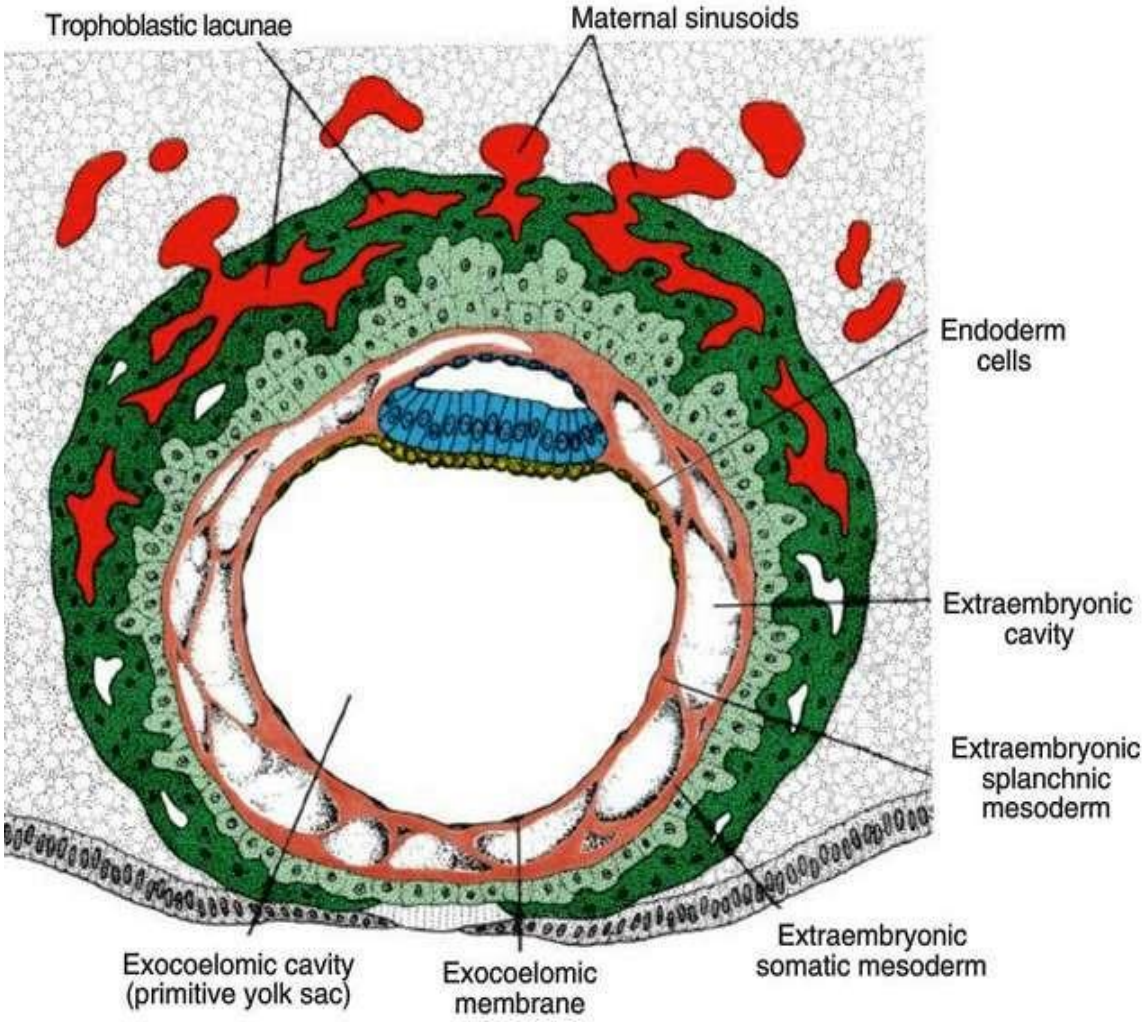


- This membrane, together with hypoblast, forms the lining of the exocoelomic cavity or primitive yolk sac.

Day 11and 12-

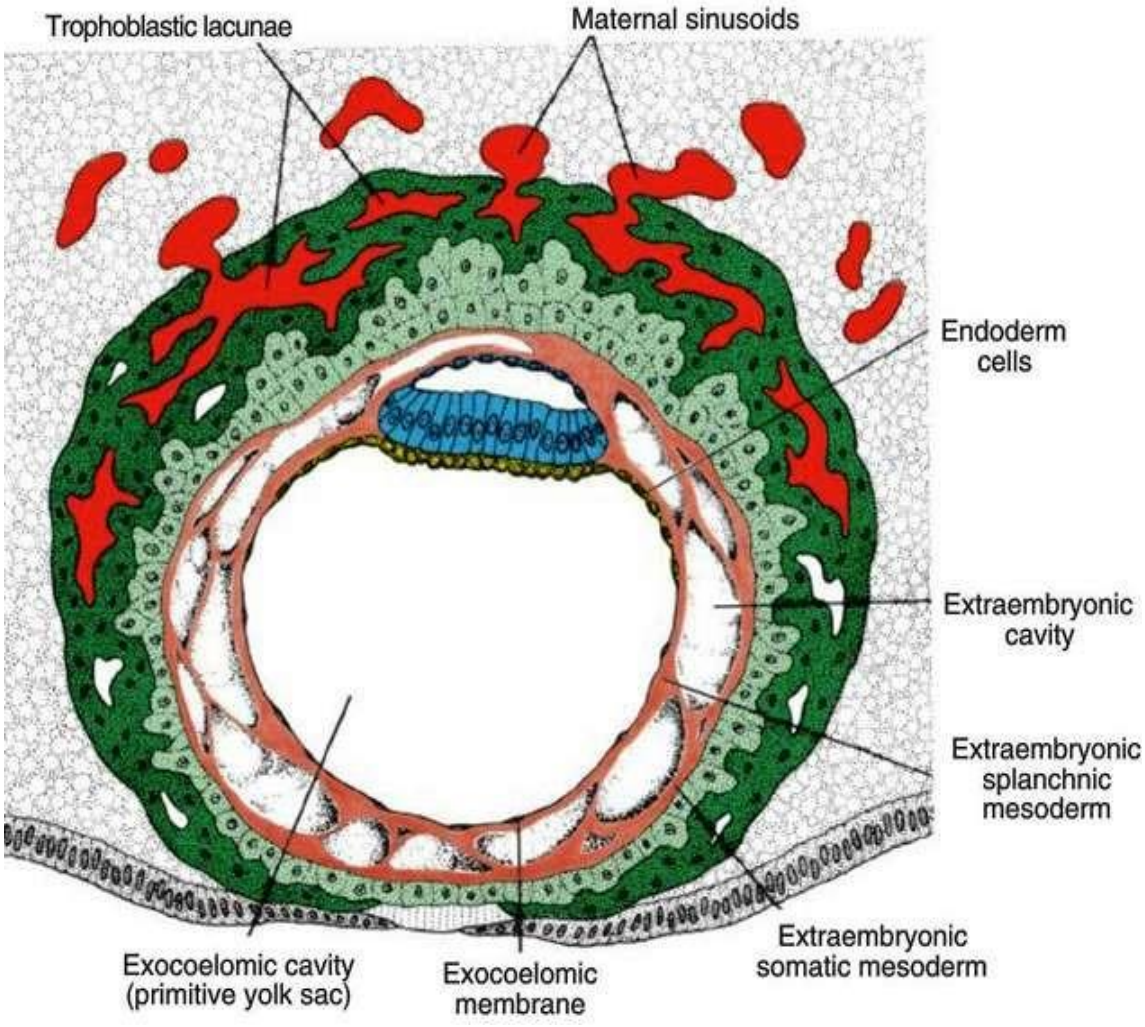
- Blastocyst completely embedded

- Inter communicating network in syncytiotrophoblast especially in embryonic pole appears



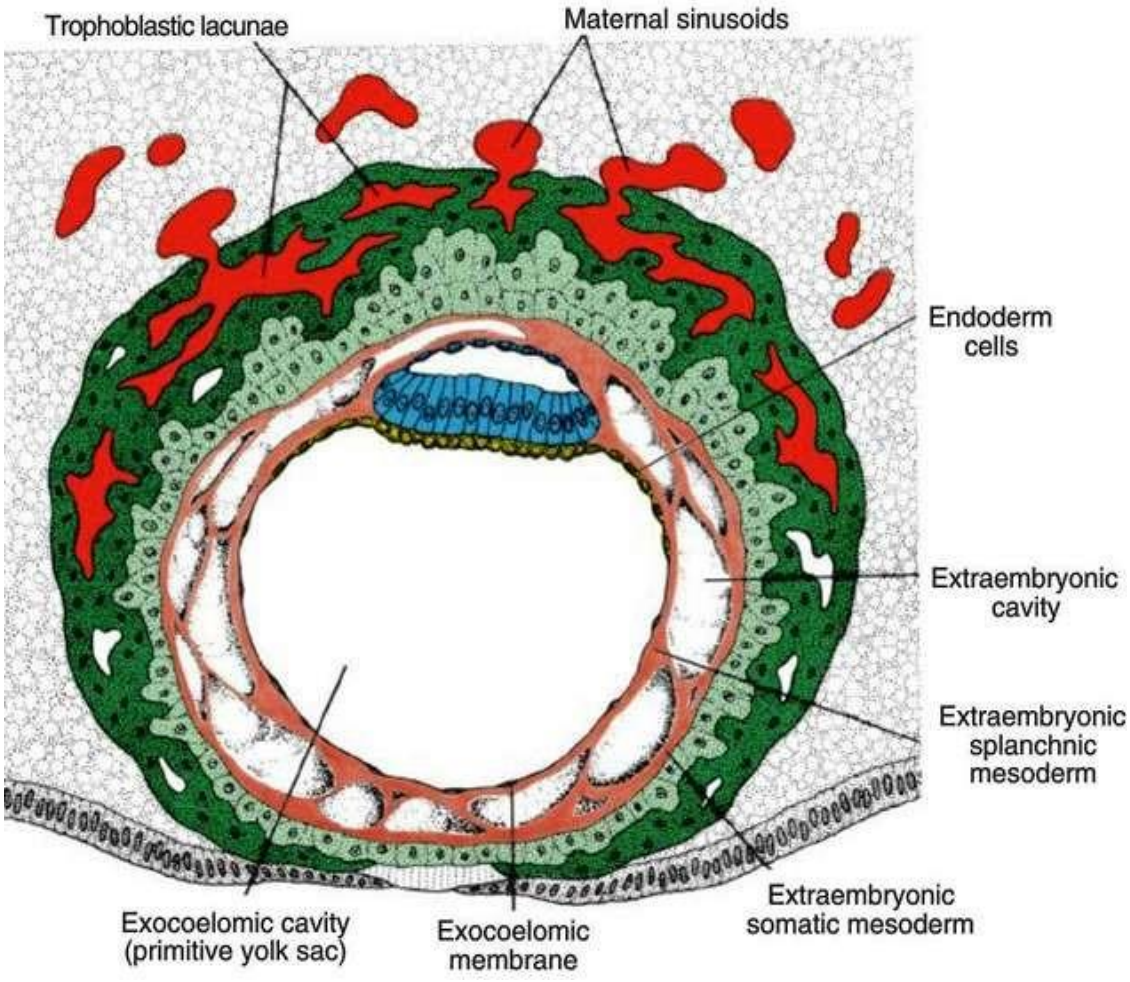
- Syncytiotrophoblast penetrate deeper in to the stroma and erode the endothalial lining of maternal capillaries.

- Congested and dilated capillaries are known as sinusoids .



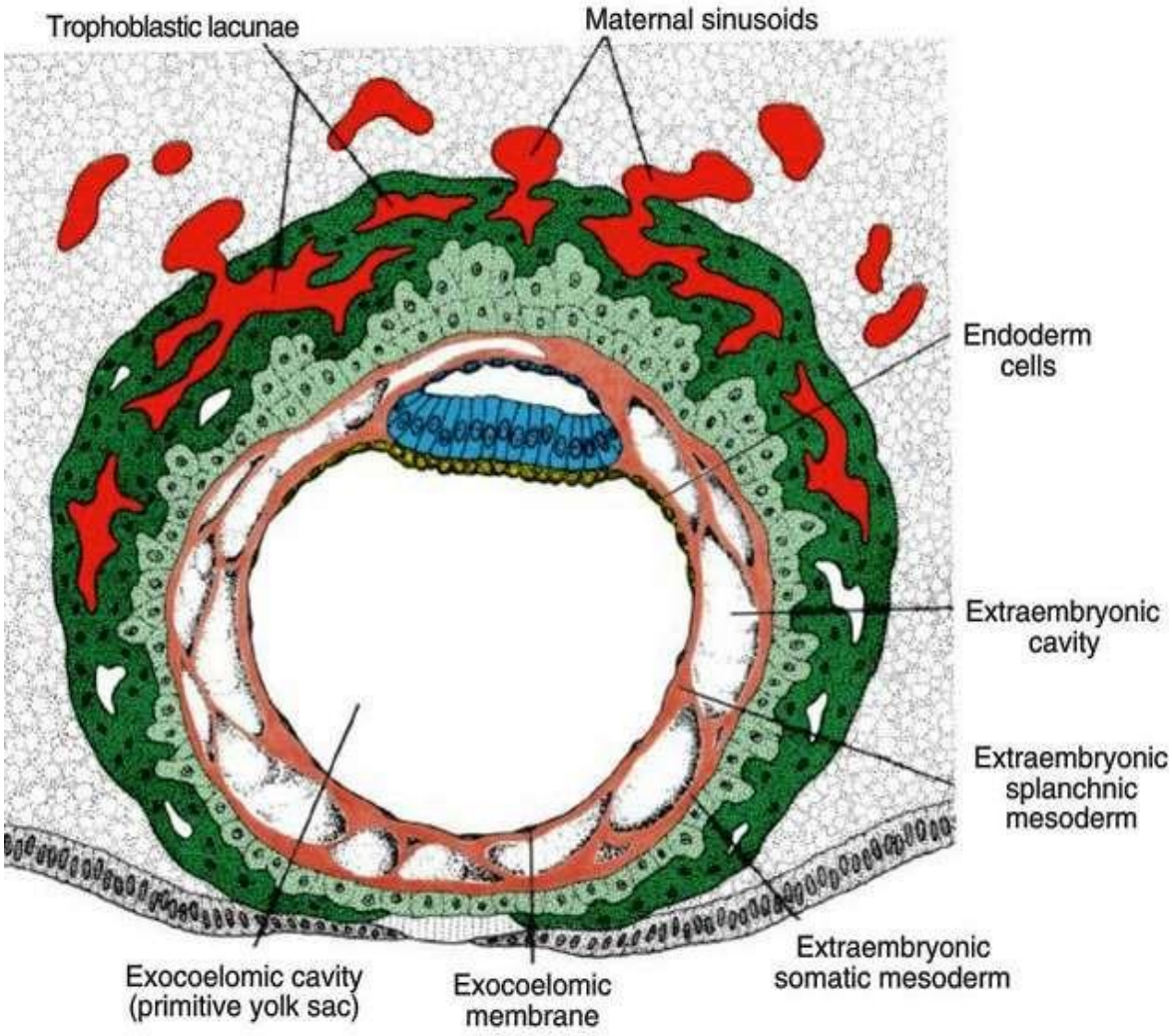
- Syncytial lacunae become continuous with the sinusoids

- Maternal blood enter in to the lacunar system(uteroplacental circulation begins)



- A new population of cells appears between the cytotrophoblast and the exocoelomic cavity

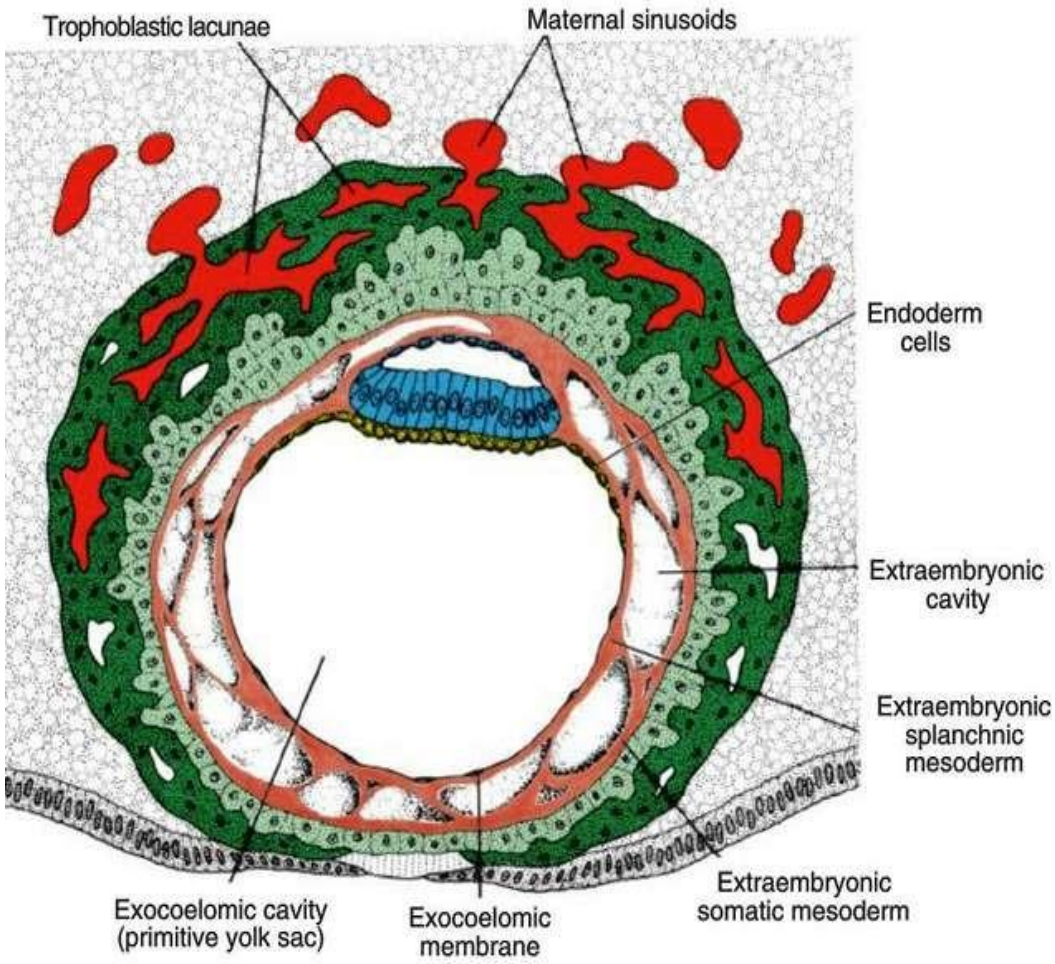
- These cells derived from yolk sac cells



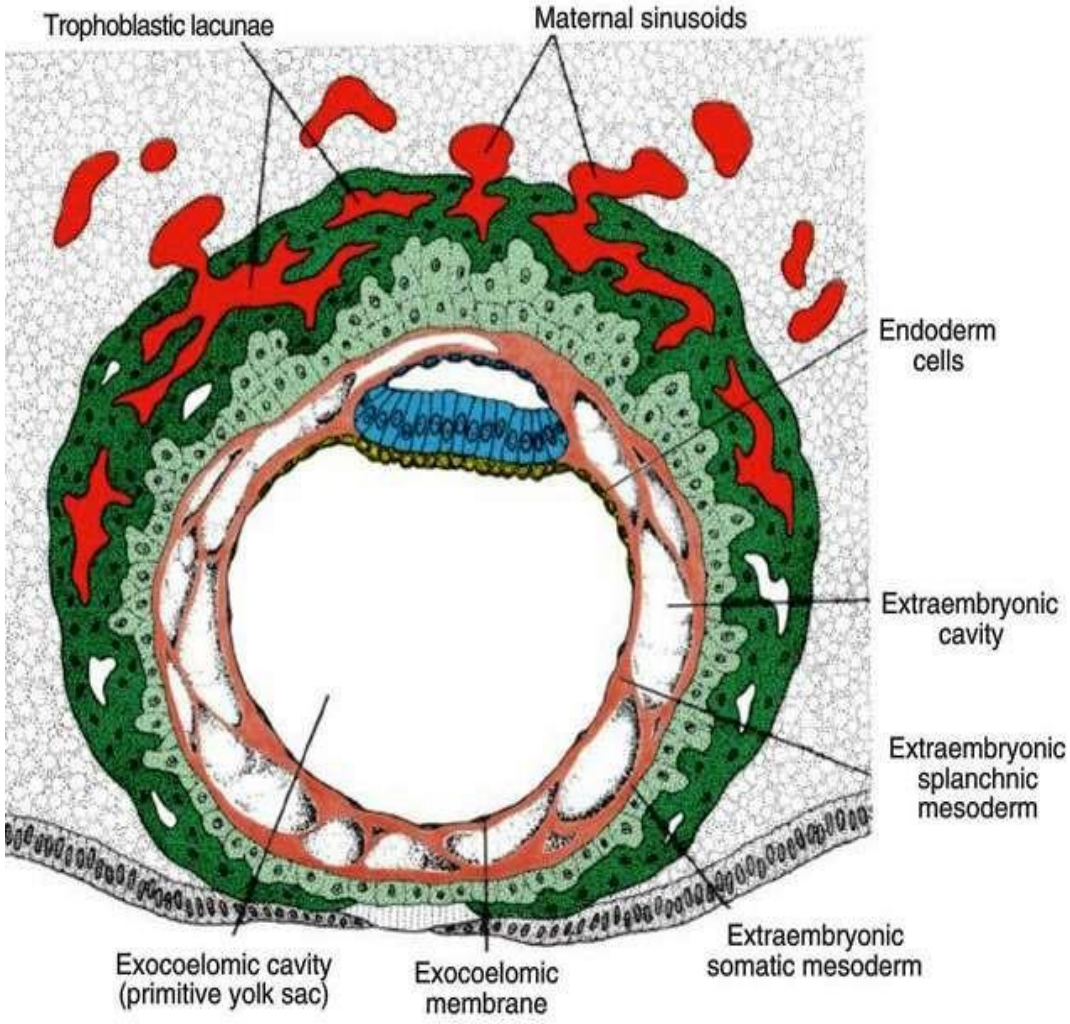
They form a fine, loose connective tissue, the extraembryonic mesoderm

i. extraembryonic somatopleuric mesoderm: lining the cytotrophoblast and amnion

ii. extraembryonic splanchnopleuric mesoderm: lining covering the yolk sac



- large cavities appears in the extraembryonic mesoderm >these cavity become confluent > extraembryonic coelom or chorionic cavity formed



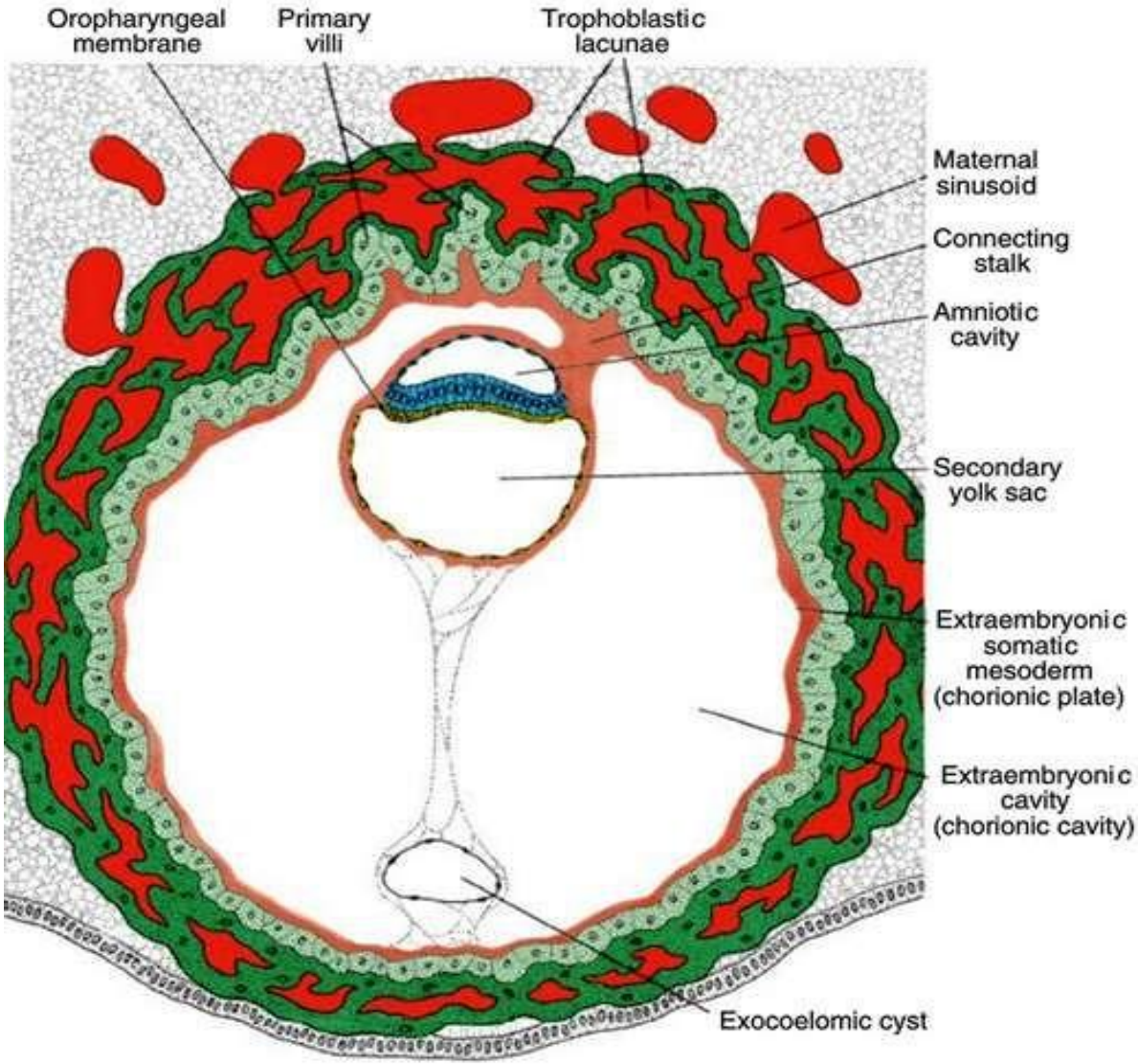
❑ Day 13-

- Surface defect in the endometrium has usually healed

- Formation of primary villi: Trophoblast is characterized by villous structures. Cells of cytotrophoblast proliferate locally and penetrate into syncytiotrophoblast forming cellular columns surrounded by syncytium are known as primary villi.

- Formation of definitive /secondary yolk sac:

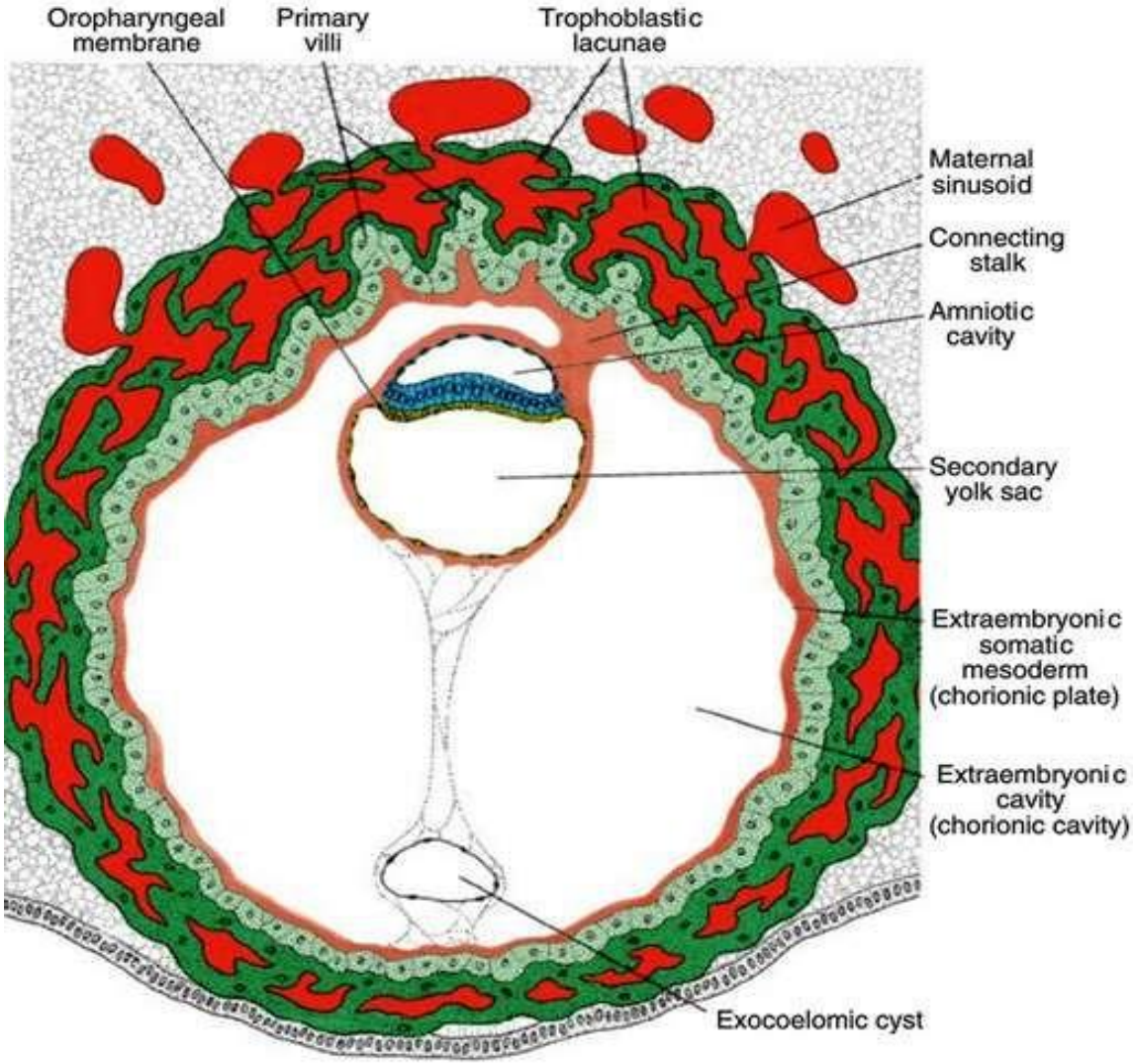
  hypoblast cells proliferate and gradually form a new cavity within the exocoelomic cavity known as secondary yolk sac.



- Exocoelomic cyst:

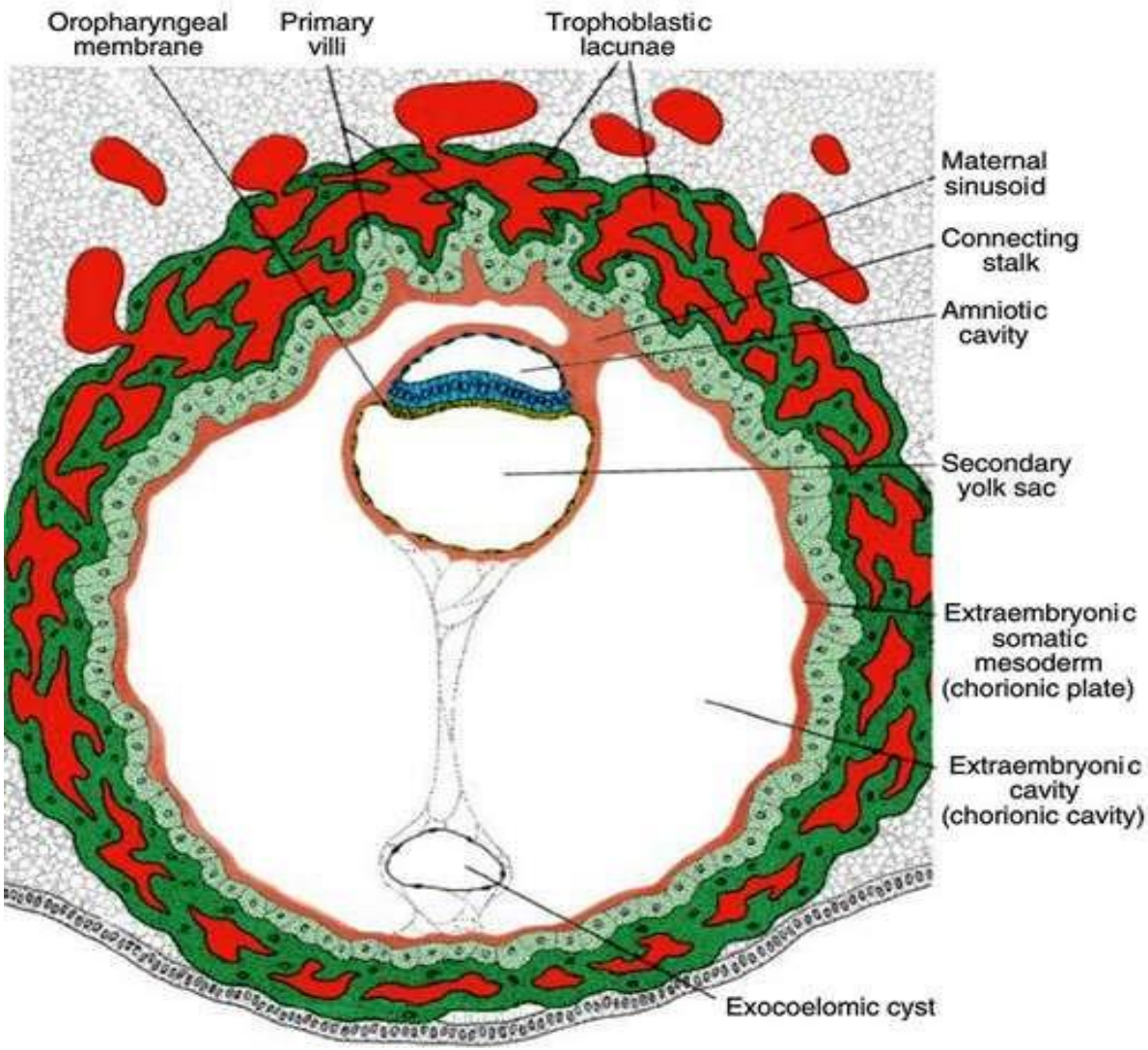
✓ Large portion of exocoelomic cavity is pinched off -Exocoelomic cyst

✓ Found in the extraembryonic coelom or chorionic cavity

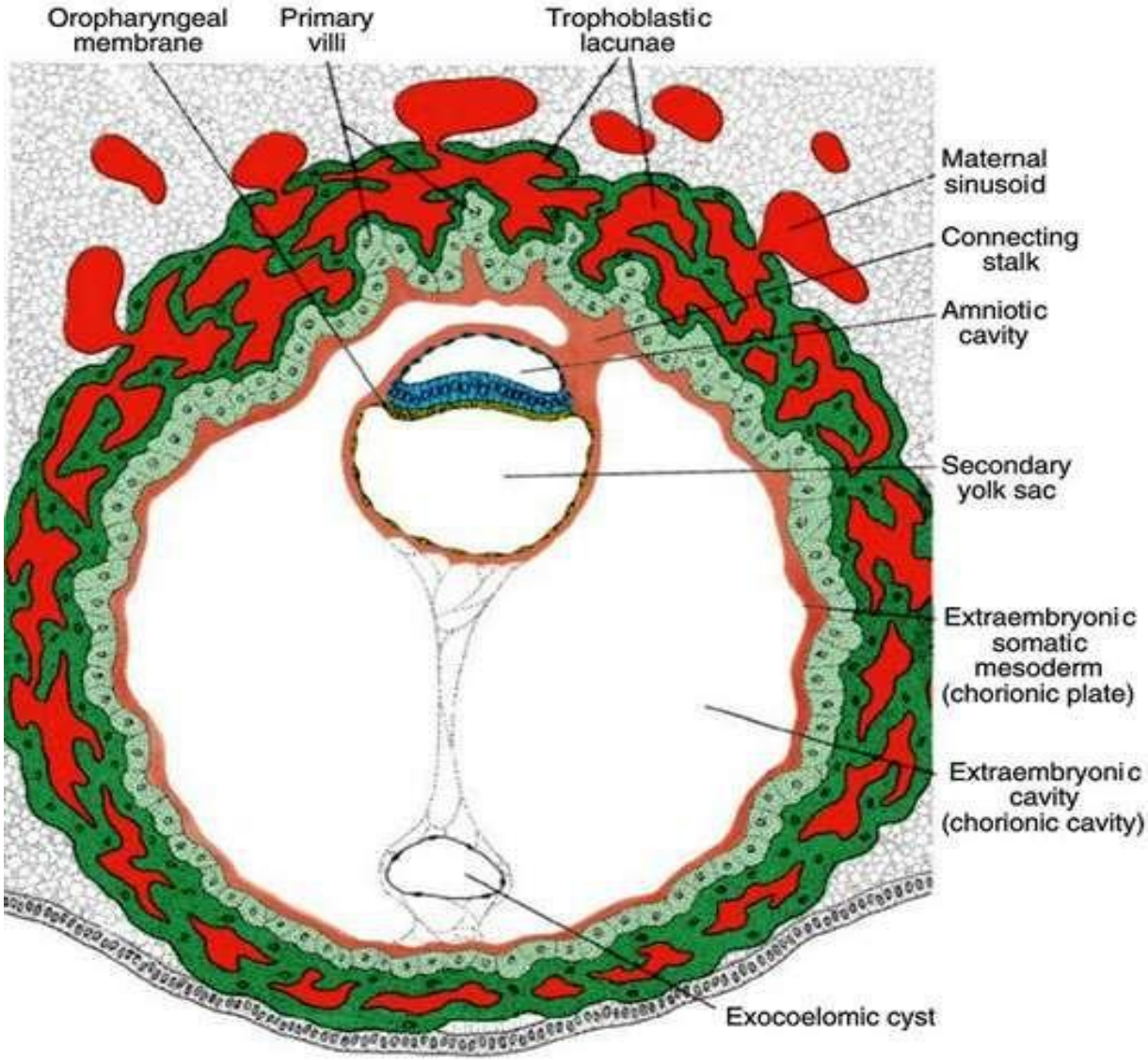


- Chorionic cavity: The extraembryonic coelom expands and form a large cavity, the chorionic cavity.

- Chorionic plate: Extraembryonic mesoderm lining the inside of the cytotrophoblast is known as chorionic plate.



- Formation of connecting stalk: The only place where extraembryonic mesoderm traverses the chorionic cavity is in the connecting stalk, the future umbilical cord.



2nd Week of Development is Known as Week of 2's:

- The trophoblast differentiate into two layers

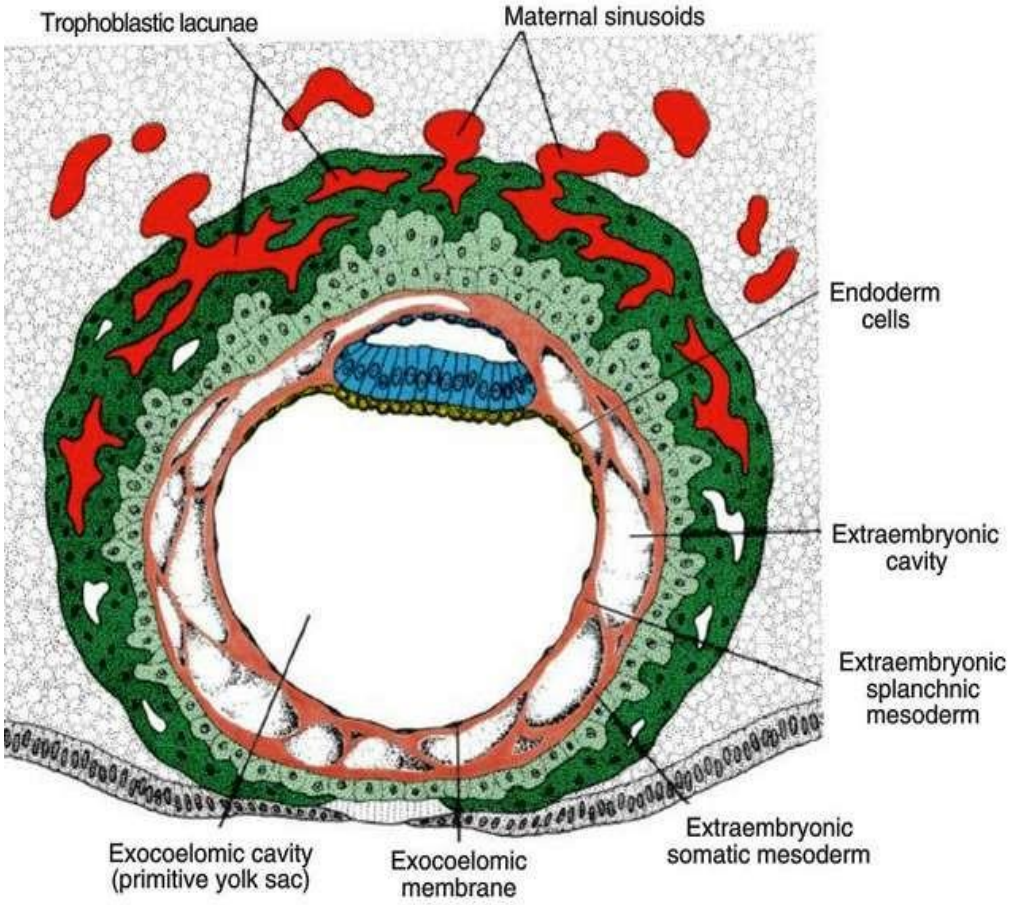
i. Cytotrophoblast

ii. Syncytiotrophoblast

- The embryoblast forms two layers

i. Epiblast

ii. Hypoblast



- The extraembryonic mesoderm split into two layers

i. Somatic layer

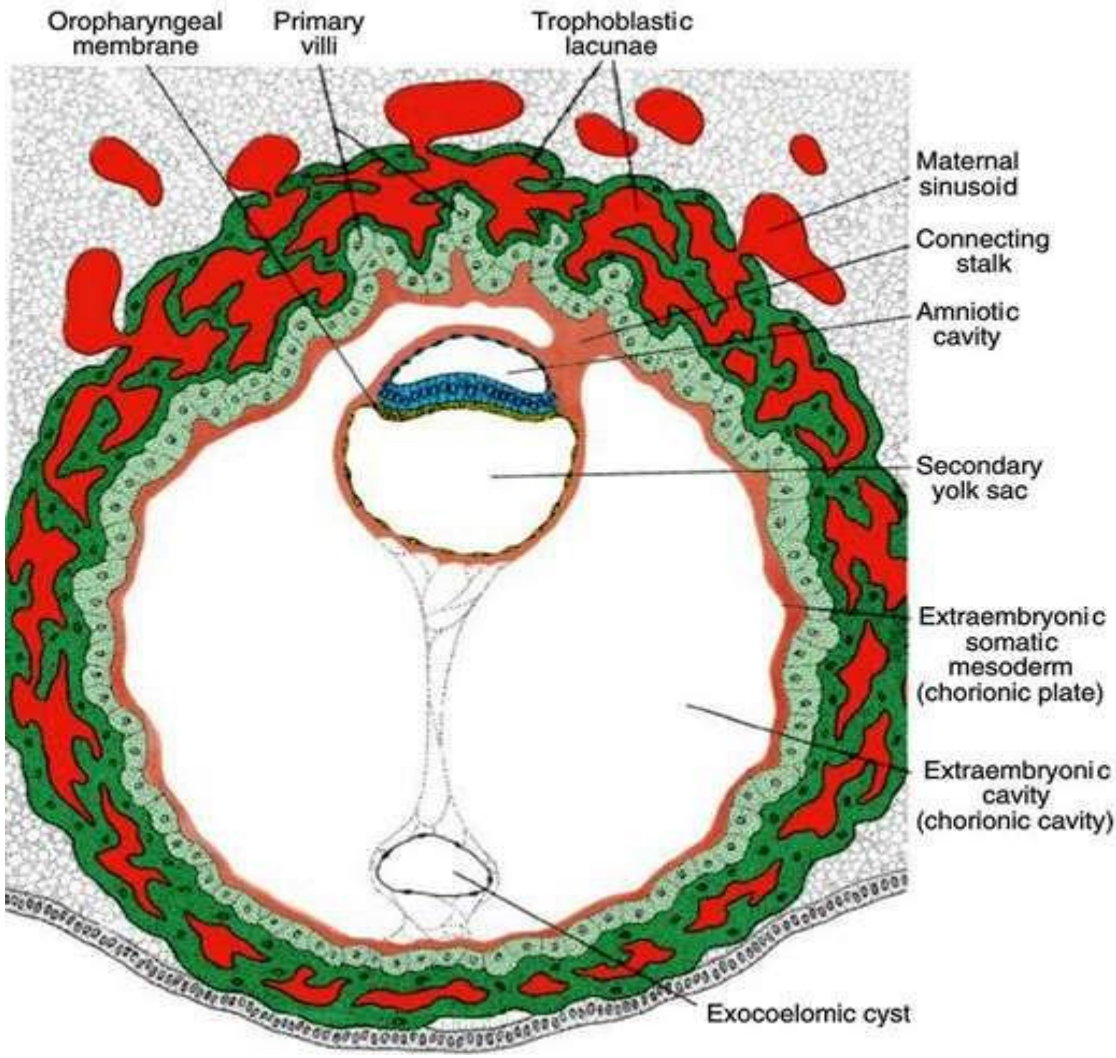
ii. Splanchnic layer

- Three cavities forms

i. Amniotic cavity

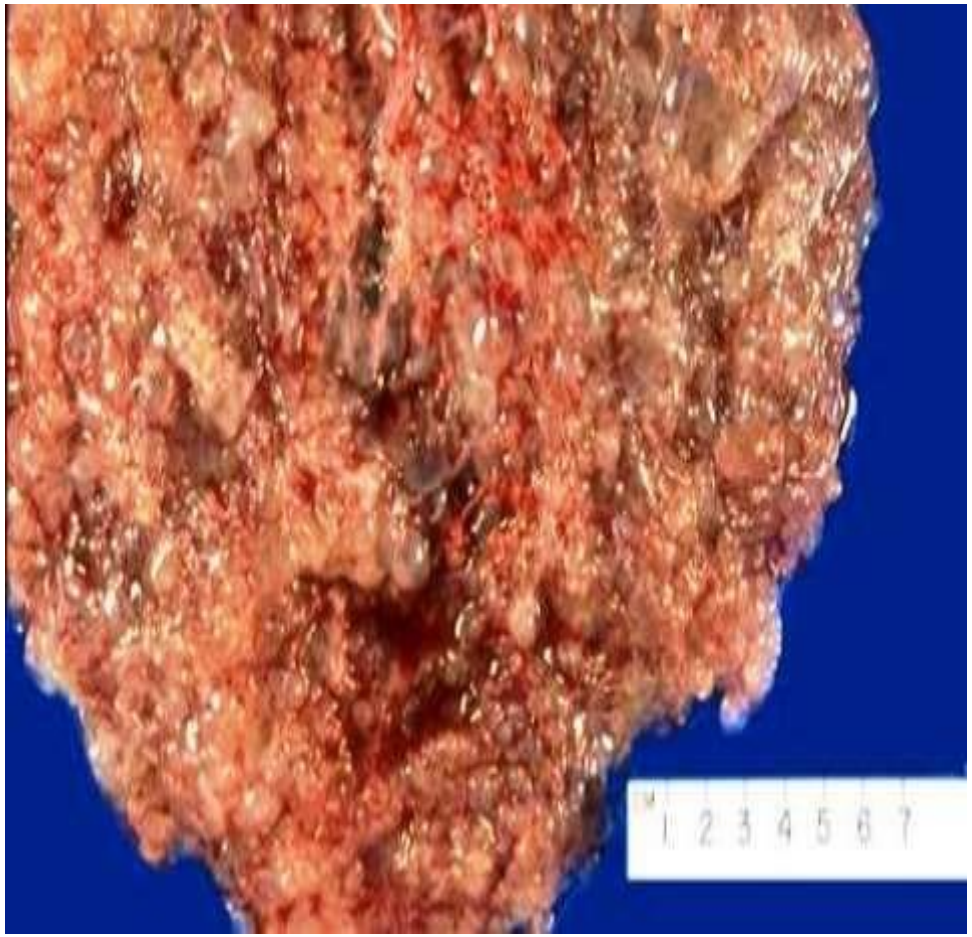
ii. Yolk sac cavity

iii. Chorionic cavity



❑ Hydatidiform mole:

- Trophoblastic tissue is the only tissue in the uterus and embryo derived cells are either absent or present in small numbers this condition is term a hydatidiform mole.



- It secretes HCG and mimics the initial stage of pregnancy.

- Most moles are aborted early in pregnancy but those containing remnant of an embryo may remain into the 2nd trimester.

- If pieces of trophoblast are left behind following spontaneous abortion or surgical removal of a mole.

- Cells may continue to proliferate and form tumors known as invasive moles or choriocarcinoma.

Third week of development

3rd week of development
Trilaminar Germ Disc

Contents:

- Some related terminologies
- Gastrulation
- Formation of the notocord
- Establishment of the body axes
- Fate map established during gastrulation
- Growth of embryonic disc
- Clinical correlates
- Further development of the trophoblast

Terminology

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- Inducer: Produce a signal
- Responder: Respond to a signal
- Competence: Capacity to respond to a signal

- Organiser : Localized areas of embryo induce directly tissue differentiation

  eg; primary organiser-primitive streak

  secondary organiser-notochord

  tertiary organiser-neural tube

- Totipotent : Where each cell may produce a separate embryo
- Pluripotent: : Groups of cells produce specific type of tissue in early embryogenesis

Gastrulation

- Process of formation of trilaminar germ disc (ectoderm, mesoderm, endoderm)in embryo
- Begins with formation of primitive streak on surface of epiblast

Primitive Streak

- At caudal end of germ disc on surface of epiblast slightly bulging region on each side of primitive groove form by aggregation of epiblast cells extend upto primitive node
- Clearly visible in 15 to 16 day embryo

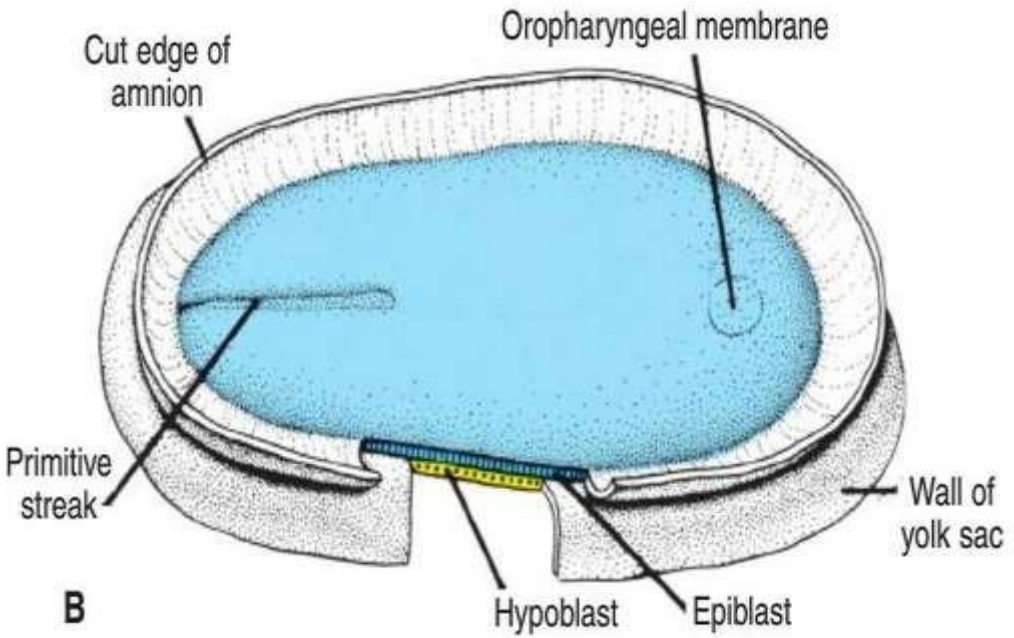


Fig:Primitive streak

Primitive Node

- Elevated region around cranial end of primitive streak by collection of epiblast cells
- Act as organizer

Primitive Pit

- Depressed area in primitive node

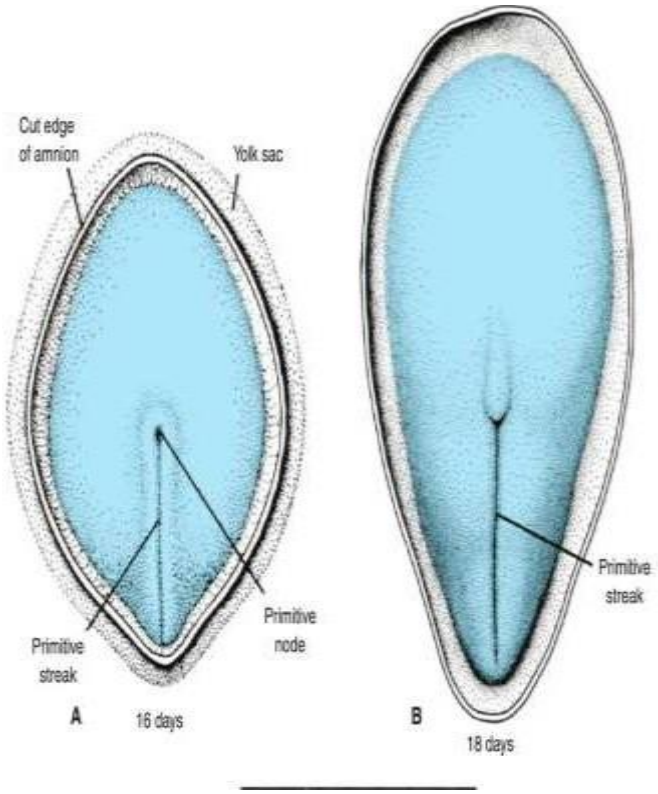


Fig: Primitive node

Process of Gastrulation

- Migration and invagination of epiblast cells towards p. groove through primitive streak
- Cells differentiate become flask shape, detached from epiblast

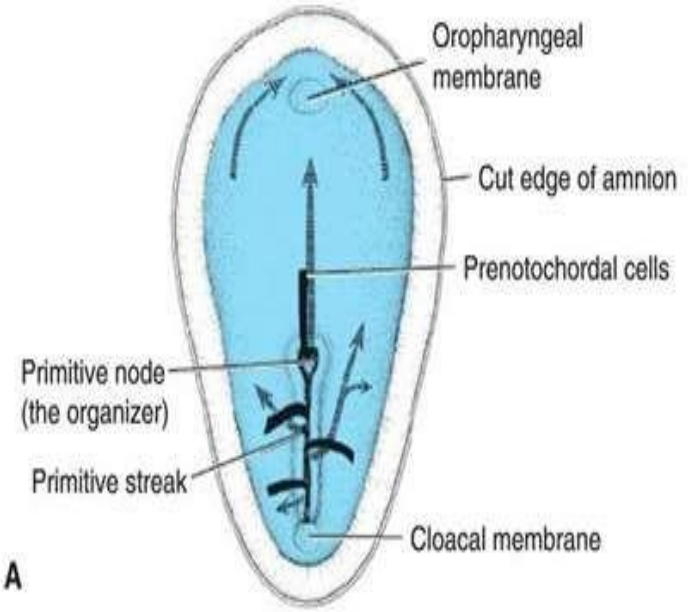


Fig: Migration of epiblast cells

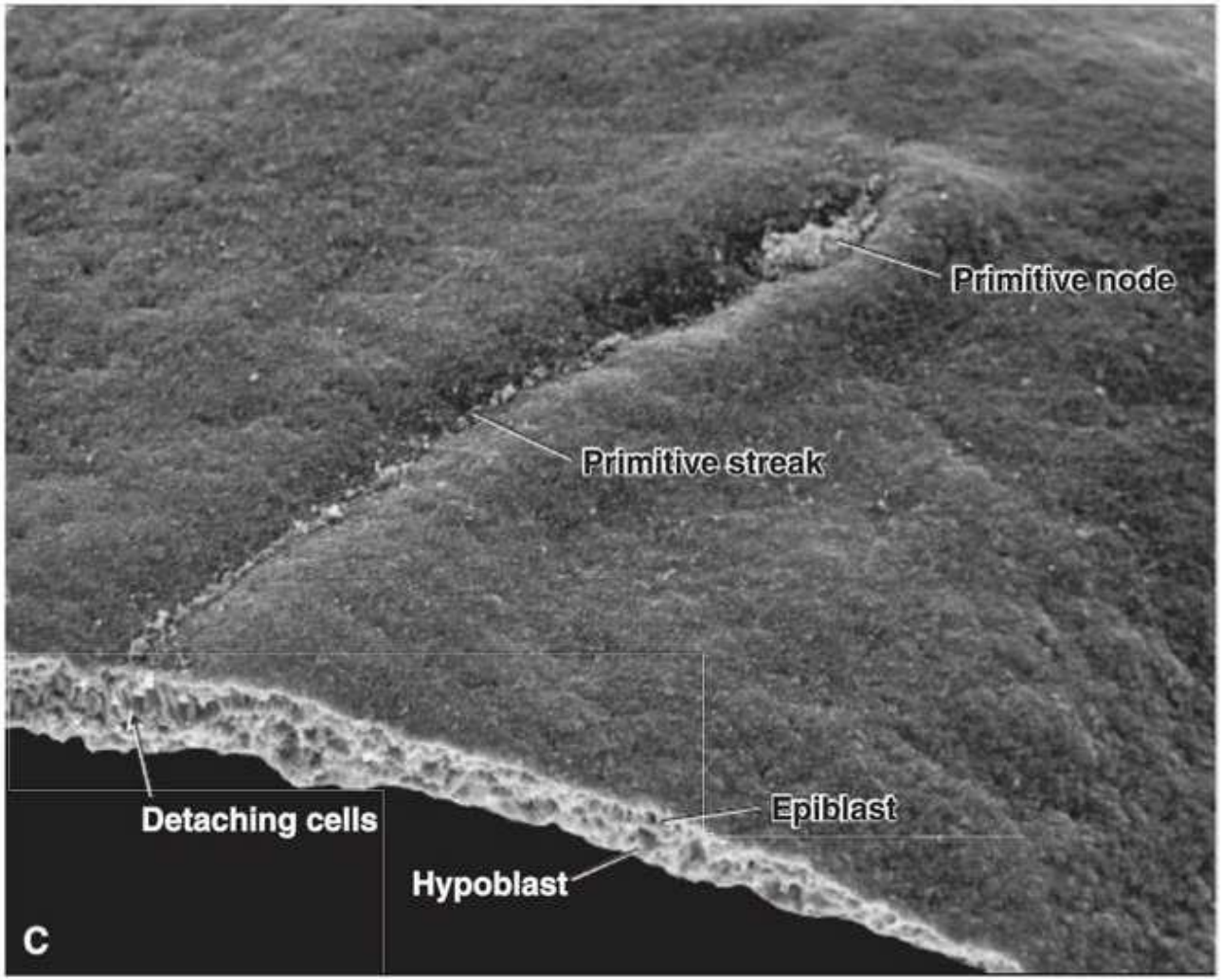
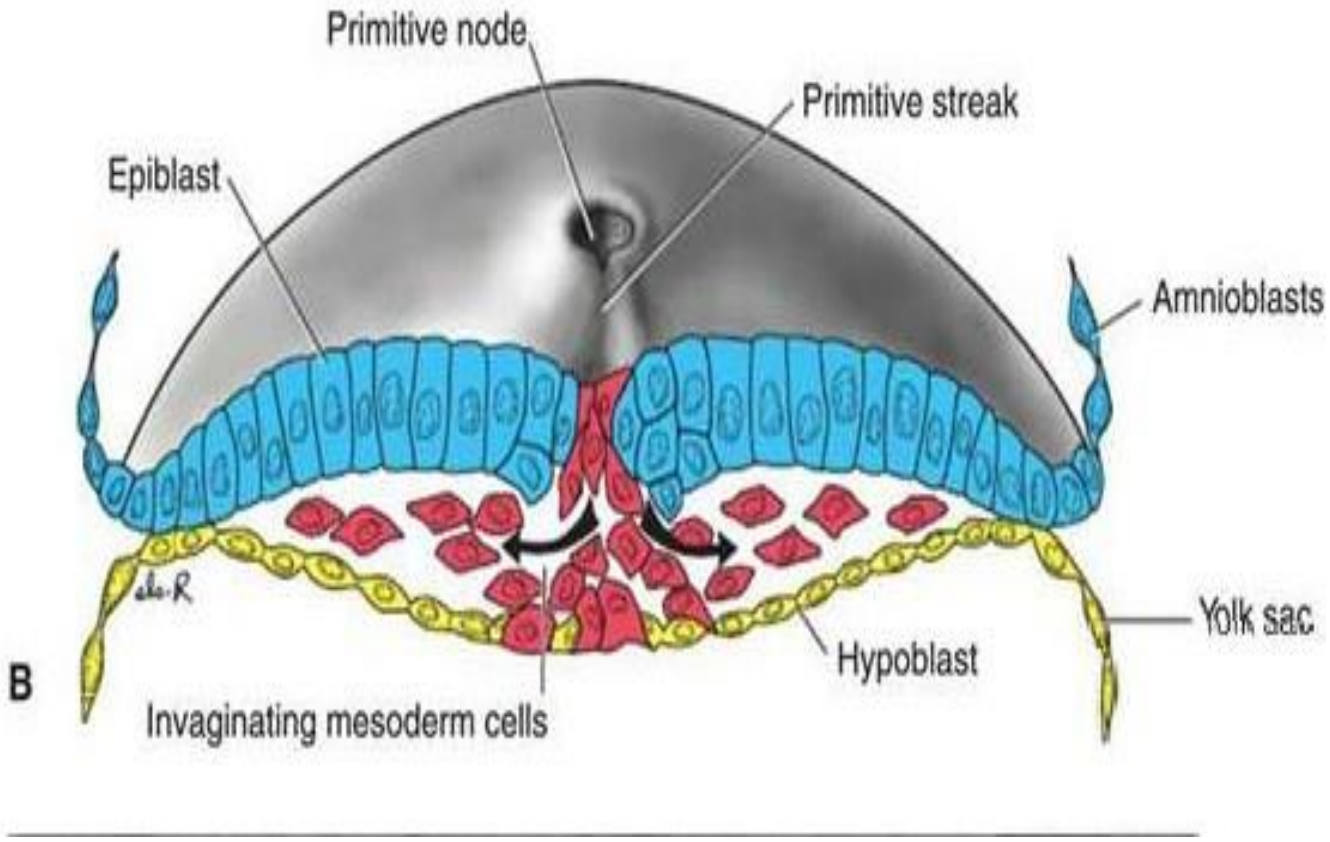


Fig: Migration and invagination of epiblast cells

- After invagination some cells displace hypoblast creating embryonic endoderm
- Others lie between epiblast and newly created endoderm form mesoderm
- Cells remaining in epiblast form ectoderm

Gastrulation



- So Epiblast is the source of all germ layers
- Give rise to all of the tissues and organs in embryo

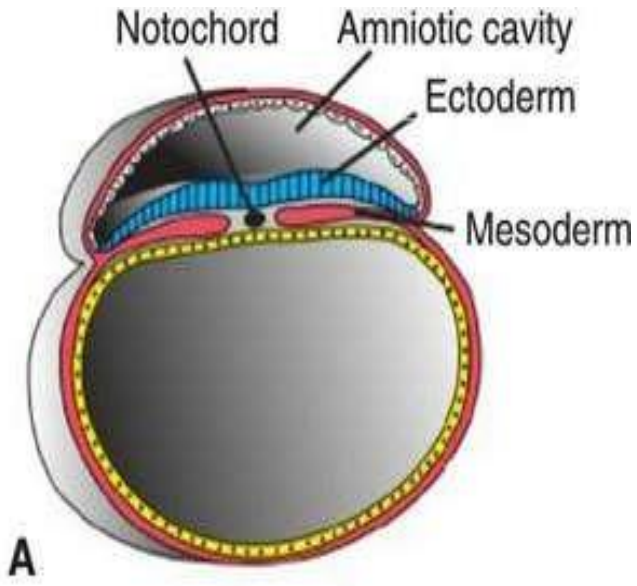


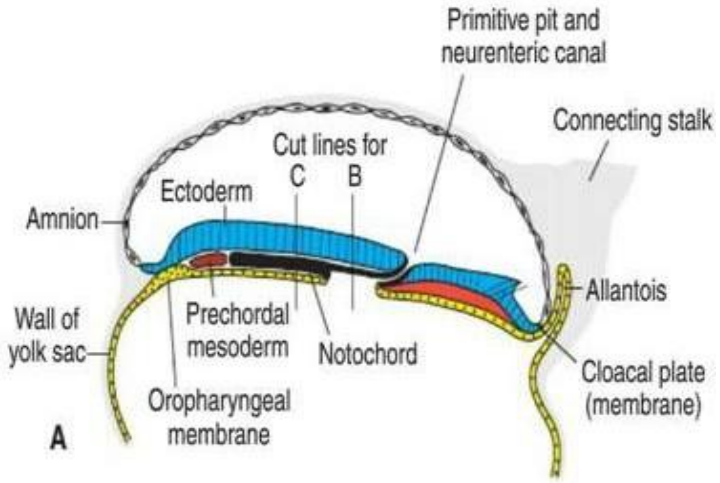
Fig: Trilaminar germ disc embryo

Oropharyngeal membrane

- A small region of tightly adherent ectoderm and endoderm cells at the cranial end of disc with no intervening mesoderm
- Future opening of oral cavity

Cloacal membrane

- Form at caudal end of disc by tightly adherent ectoderm and endoderm with no intervening mesoderm



Notochord

- Midline structure develops from epiblastic cell lying between ectoderm and endoderm
- Act as the basis of axial skeleton
- Induce formation of neural tube
- Form nervous system and vertebral column

Formation of notochord

- Epiblast cells invaginating in primitive node move forward until reach prochordal plate form notochordal process
- Canal form within notochordal process
- Cells of notochordal process intercalate with endoderm cell

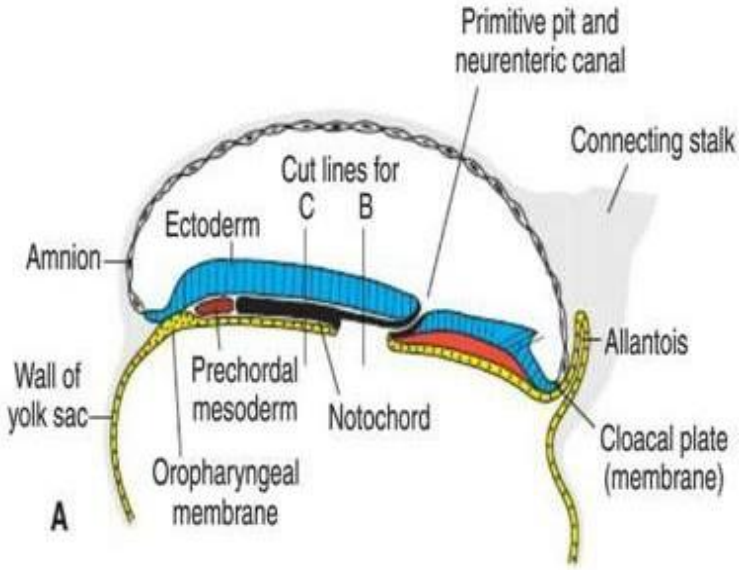


Fig: Notochordal process

- A neuroenteric canal form temporarily connect amniotic cavity to yolk sac
- Cells detach from endoderm and proliferate to form a solid cord known the definitive notochord

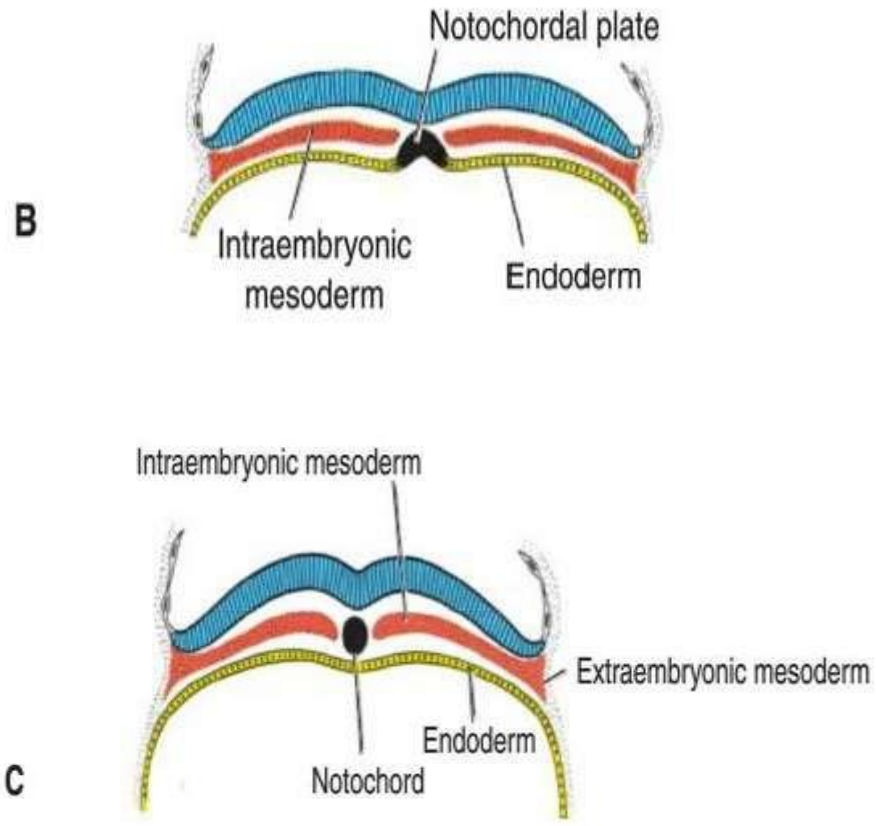
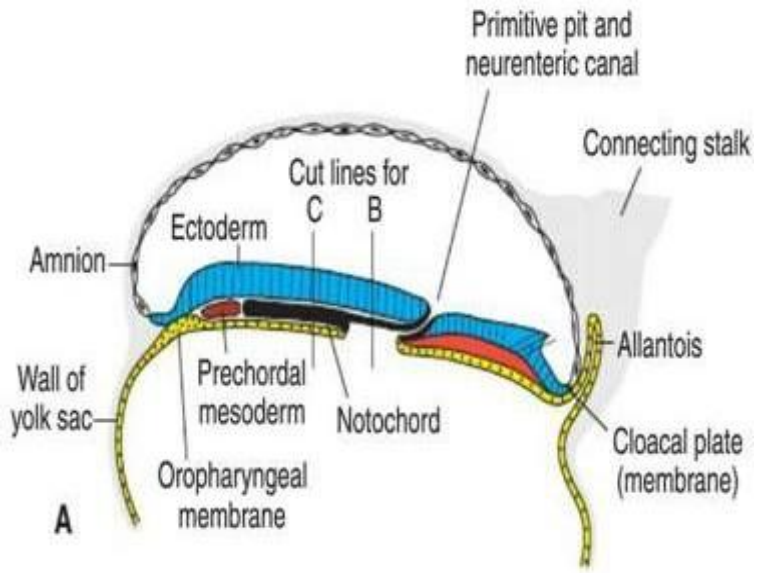


Fig: Formation of notochord

Allantois or allantoenteric diverticulum

- Posterior wall of yolk sac extend into connecting stalk as a diverticulum known allantiois
- In human remain rudimentary



Establishment of body axes

1. Anterior posterior (craniocaudal)

- Cells in hypoblast form AVE at cranial end express gene for head formation
- Nodal actvate initiate and maintain node and strek

1. Dorso ventral (d-v)

- BMP4,FGF2 ventralize mesoderm form intermediate and lateral plate mesoderm
- Antagonize BMP4 activity dorsalize mesoderm cranially
- Middle and caudal region dorsal mesoderm controll by BRACHYURY gene

- Middle and caudal region dorsal mesoderm controll by BRACHYURY gene

- Left-right axis
- FGF8 induces nodal expression restricted to left side by accumulation of serotonin

- Laterality defect
- Situs inversus,dextrocardia

Fate map

Cells of cranial most part of node	Notocord
Lateral edge of node and cranial end of streak	Paraxial mesoderm
Through midstreak region	Intermediate mesoderm
More caudal part of streak	Lateral plate mesoderm
Caudal most part of streak	Extraembryonic mesoderm

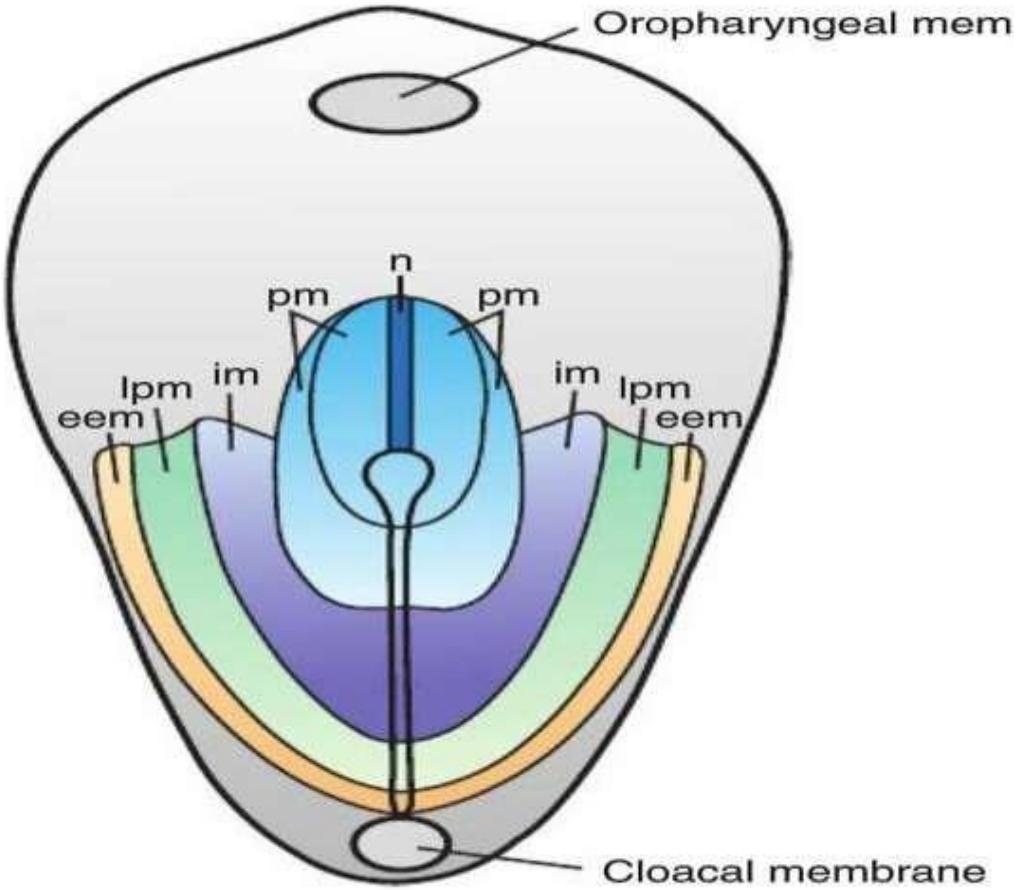


Fig: Fate map for epiblast cells

Growth of embryonic disc

- Embryo develop cephalocaudally
- Initially flat and almost round
- Gradually elongated broad cephalic and narrow caudal end
- Invagination and migration cells continue until end of fourth week
- Primitive streak disappear at the end of fourth week

Clinical correlation

1. Insufficient mesoderm in caudal most region resulting caudal dysgenesis (sirenomelia)
2. Sometimes remnants of primitive streak persist in sacrococcygeal region and form sacrococcygeal Teratoma
3. Situs inversus in which abdominal and thoracic viscera become inverse

Fetal membrane and placenta

FETAL MEMBRANE

- **Fetal membrane**: structures derived from zygote other than embryo
- **Names of the fetal memebranes:**

  Trophoblast

  Amnion

  Chorion

  Allantois

  Connecting stalk

  Fetal part of placenta

  Yolksac

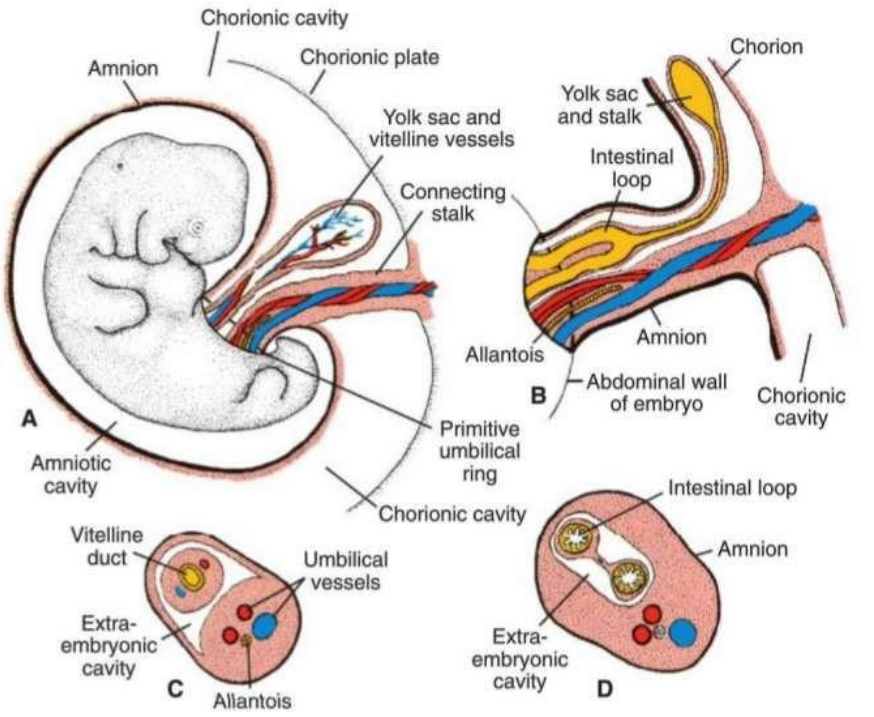


Fig: Fetal membranes

- **TROPHOBLAST**:Outer cell layer surrounding blasocyst from which placental tissues derived

- **AllANTOIS**:A diverticulum from posterior wall of yolk sac that extends into connecting stalk

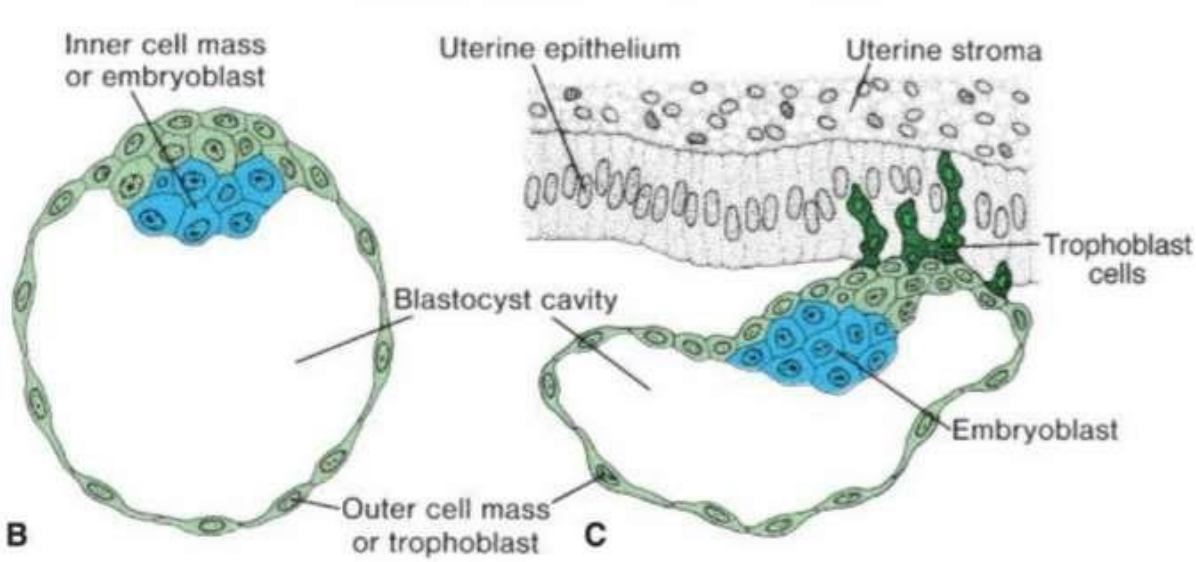
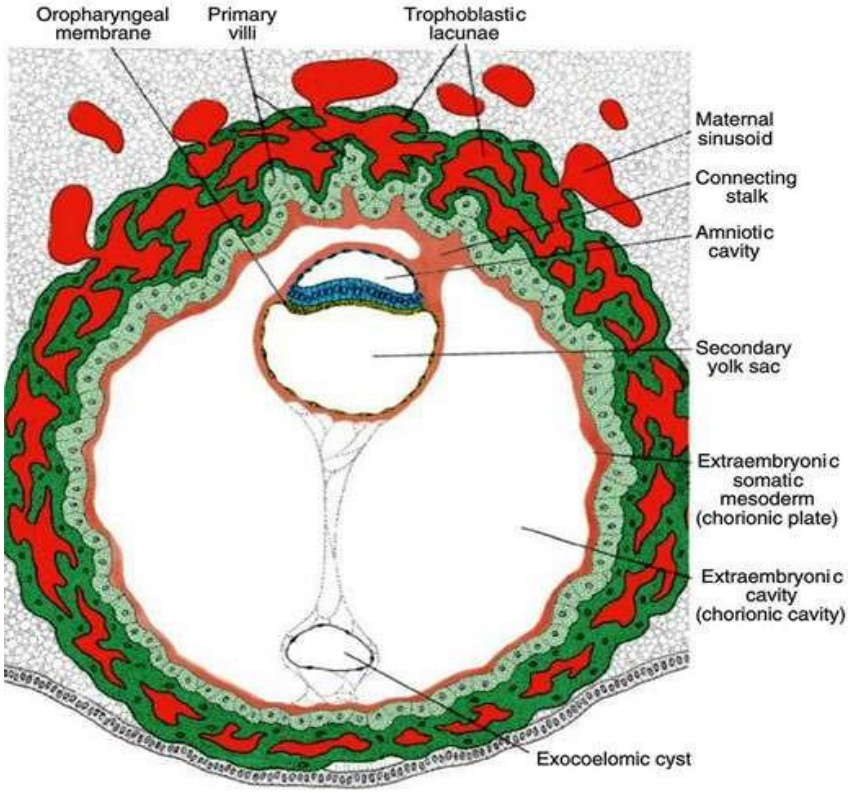


Fig: Trophoblast

- **AMNION**: Membrane derived from epiblast which surrounds amniotic cavity
- **CHORION**:Multilayered structure consisting of somatic layer extraembryonic mesoderm,cytotrophoblast & syncytiotrophoblast
- **CONNECTING STALK**:Unsplitted part of extraembryonic mesoderm ,connects embryo with trophoblast



PLACENTA

- It is the organ that facilitates nutrient and gas exchange between the maternal and fetal compartments
- 2 components

➢ Fetal portion –**chorionic frondosum**

➢ Maternal portion-**decidua basalis**

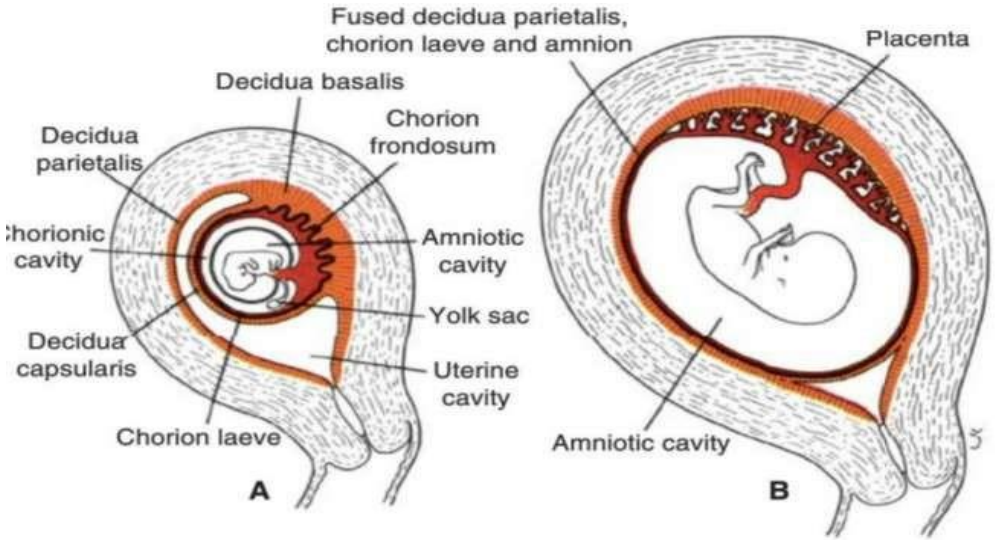
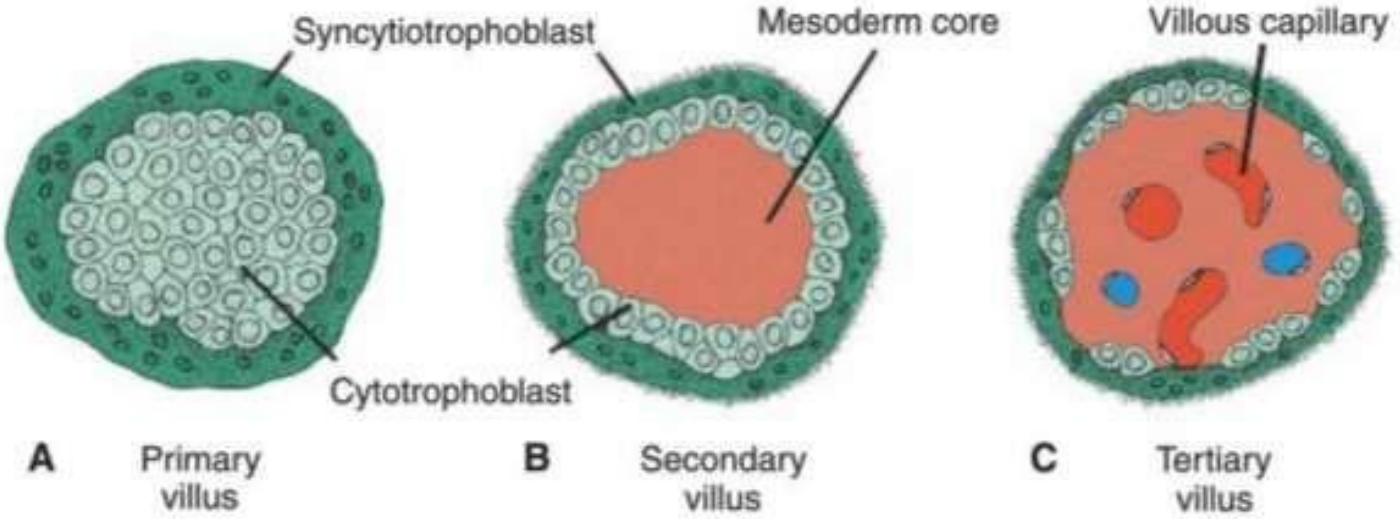


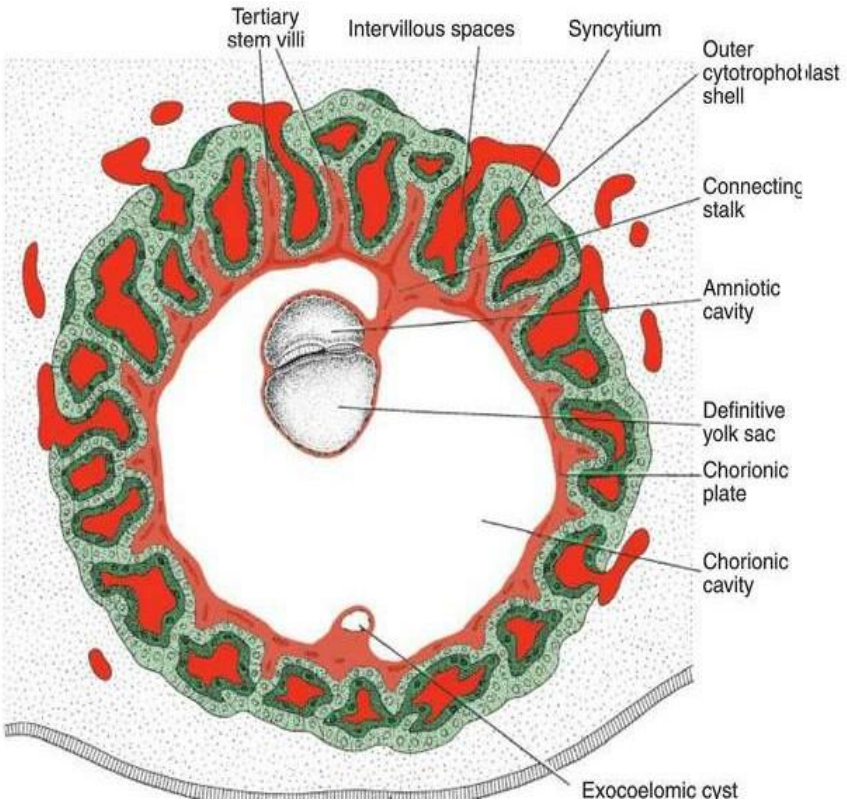
Fig: Placental components

FORMATION OF CHORION FRONDOSUM

- **Primary villi**: cytotrophoblastic core covered by syncytial layer
- **Secondary villi**: mesodermal cells penetrate the core of primary villi
- **Tertiary villi**:when blood vessels appear

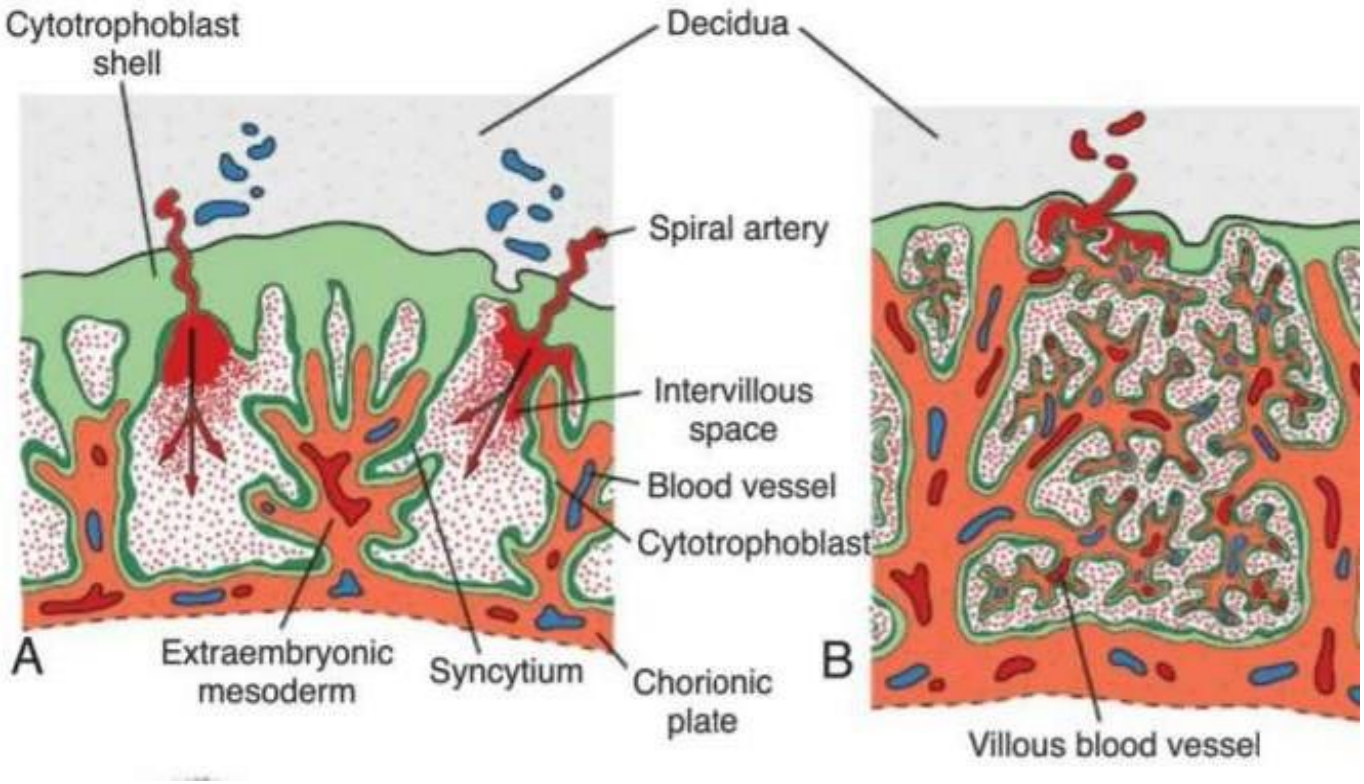


•**Outer cytotrophoblastic shell**: Cytotrophoblastic cells penetrate progressively into syncytium & reach endometrium. & establish contact with neighbouring villous stems, forming a thin outer cytotrophoblastic shell.

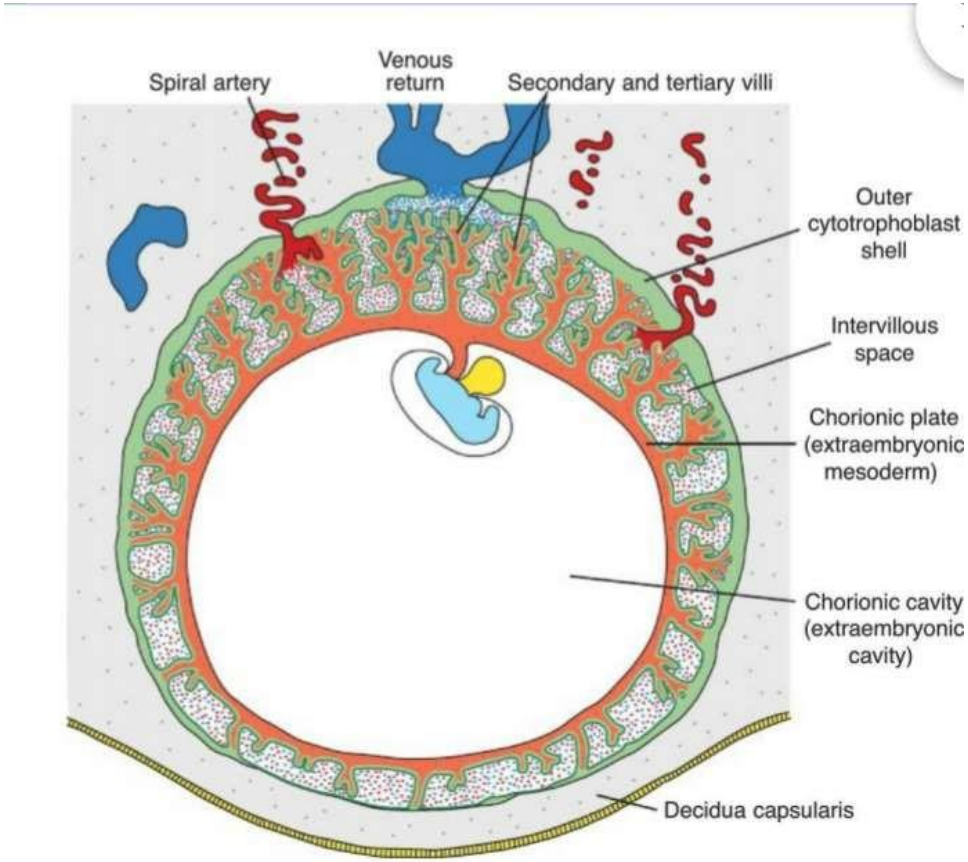


- **Anchoring villi**: Villi that extend from the chorionic plate to the decidua basalis

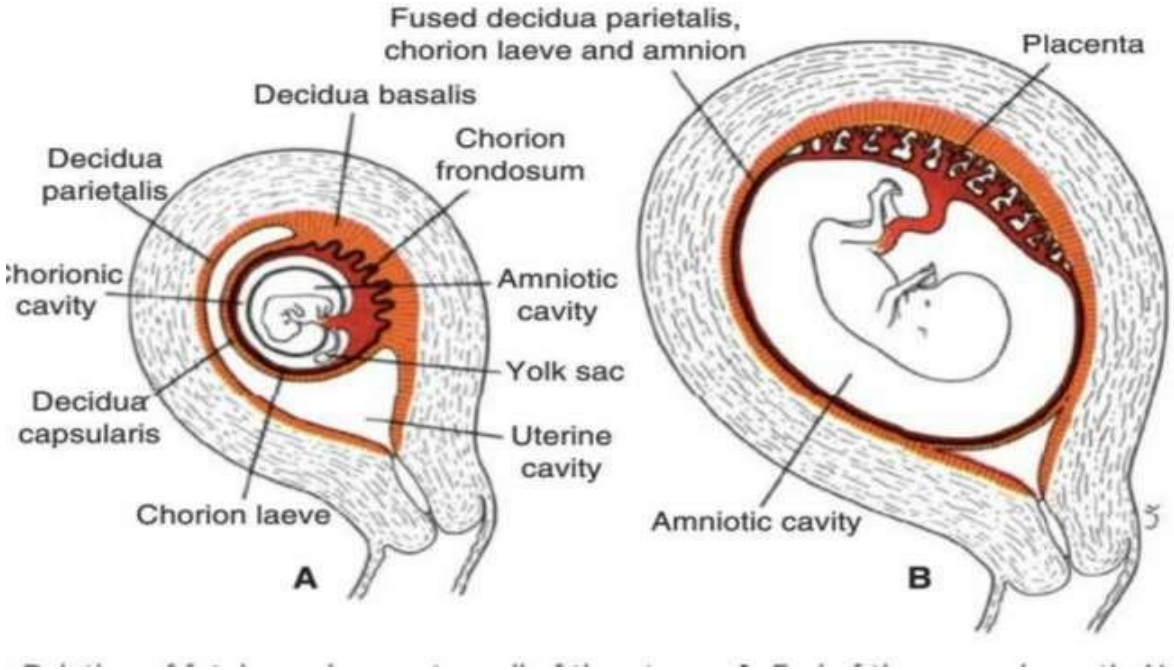
- **Terminal villi**:Villi that branch from the sides of stem villi



- Villi on embryonic pole continue to grow & expand ,giving rise to **chorion frondosum**
- **Chorion leave**: villi on abembryonic pole



- **Decidua**:after implantation uterine endometrium,functional layer of endometrium
- **Decidua basalis**:over chorion frondosum
- **Decidua capsularis** :over abembryonic pole
- **Decidua parietalis**:lining rest of uterus

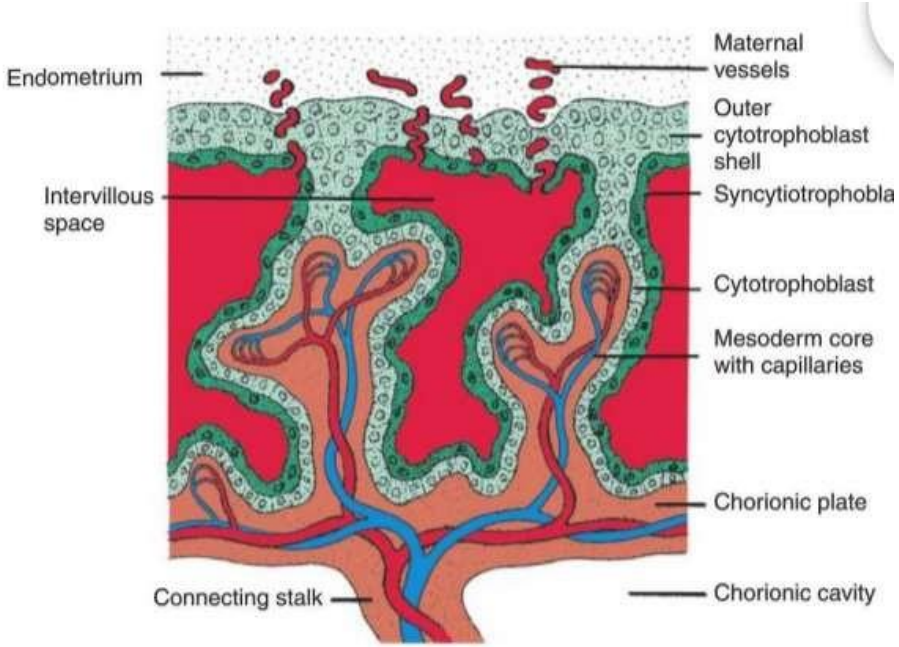


STRUCTURE OF PLACENTA

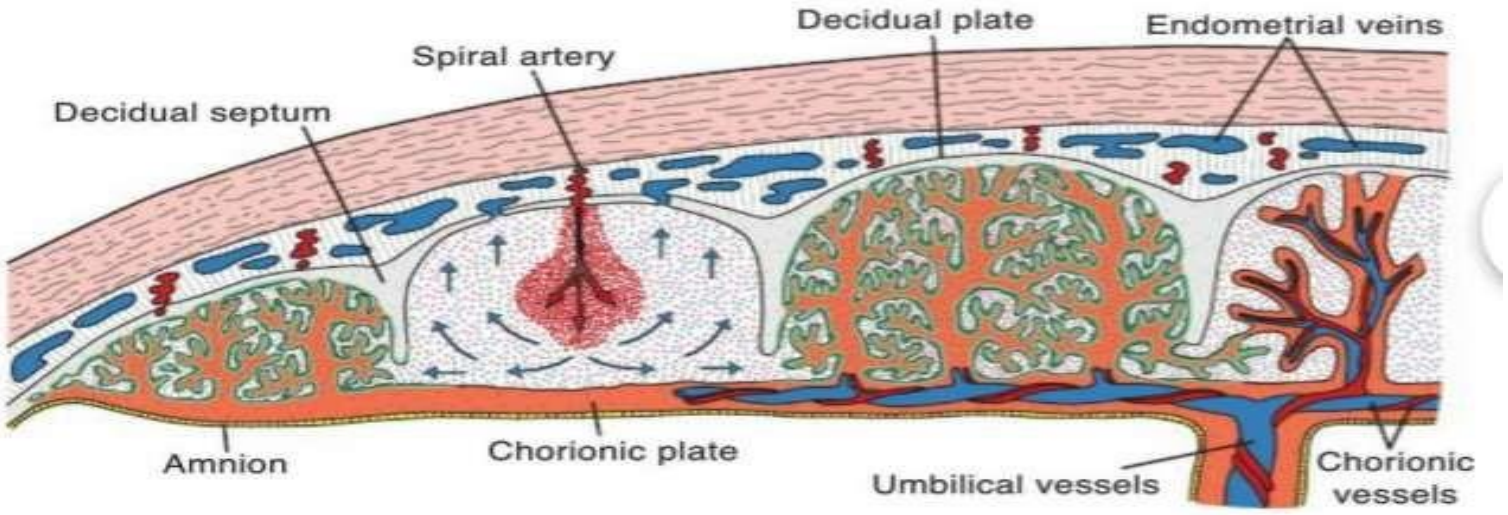
- On fetal side placenta bordered by **chorionic plate**
- On maternal side by **decidual plate**
- In between –**intervillous spaces**,filled with maternal blood
- **Decidual septa** formed
- Placenta divides into **cotyledons**

PLACENTAL CIRCULATION

- **Extraembryonic vascular system**:Capillaries in tertiary villi make contact with capillaries in chorionic plate and in the connecting stalk.
- Cotyledons receive blood through **spiral artery**

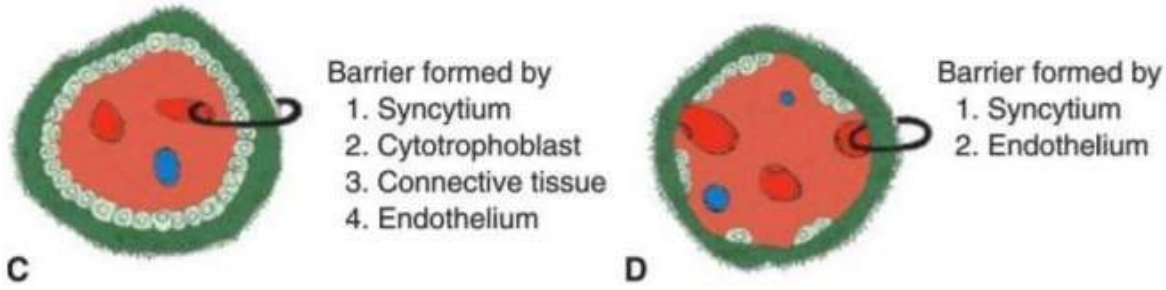


- Arteries pierce decidual plate & enters intervillous space
- Pressure in arteries force blood deep into intervillous space
- As pressure decreases blood flows back & enters **endometrial veins**
- Contains 150 ml blood.



PLACENTAL BARRIER

- **Initially 4 layer**
  - ➢ Endothelial linining of fetal vessels
  - ➢ Connective tissue in villous core
  - ➢ Cytotrophoblastic layer
  - ➢ Syncytium
- **From 4 months**
  - ➢ Endothelium
  - ➢ Syncytium



FUNCTION OF PLACENTA

- Exchange of gases
- Exchange of nutrient & electrolyte
- Transmission of maternal antibodies
- Hormone production

Clinical correlates

- Placenta accreta
- Placenta percreta
- Placenta increta
- Amniotic bands
- Long cord
- Short cord
- Polyhydramnios
- Oligohydramnios

Embryonic period & derivatives of the Ectodermal germ layer

Embryonic period

- Embryonic period: Third to eight weeks of development

- Also known as period of organogenesis

- Three germ layer gives rise to number of specific tissue and organs

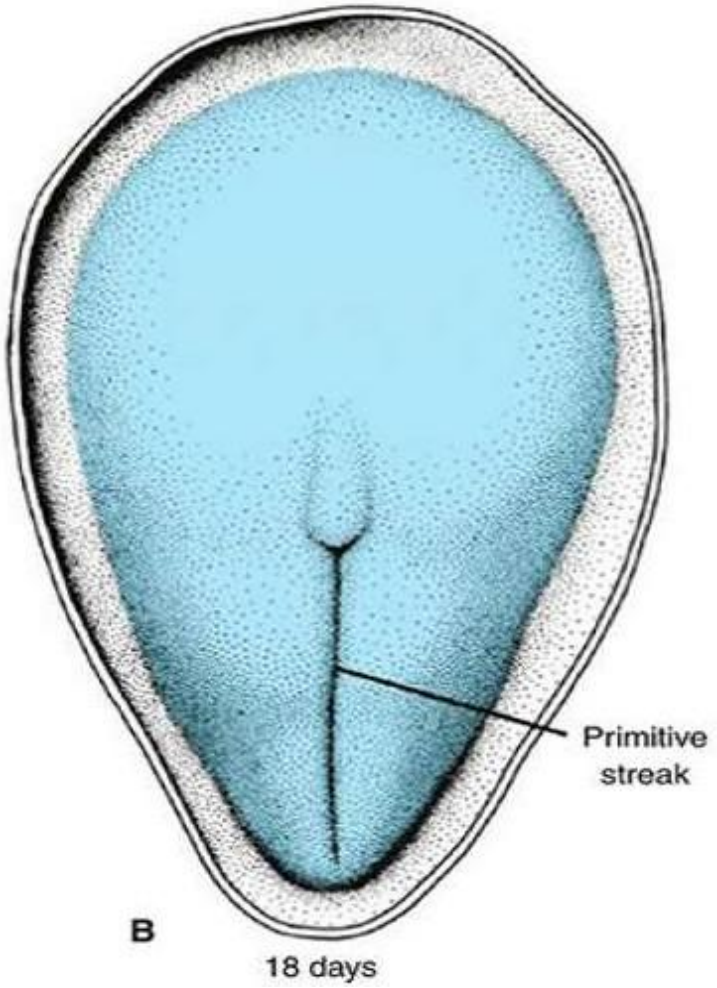


Figure: Embryonic disc with broader cephalic end and narrow caudal end.

Derivatives of the Ectodermal germ layer

Parts of ectoderm

- Neuroectoderm
- Neural crest
- Surface ectoderm
- Ectodermal placodes
  - Lens placode
  - Otic placode

- Neural plate: Appearance of notochord induce overlying ectodem to thicken

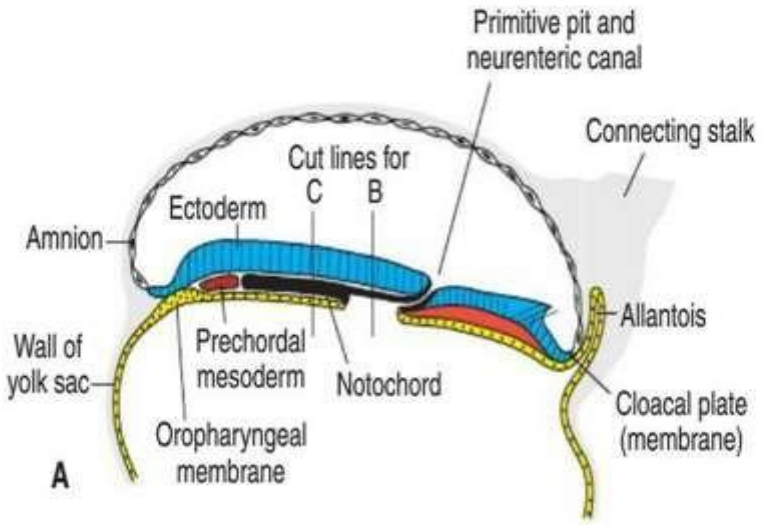


Figure:Notochord induce overlying ectoderm to thicken

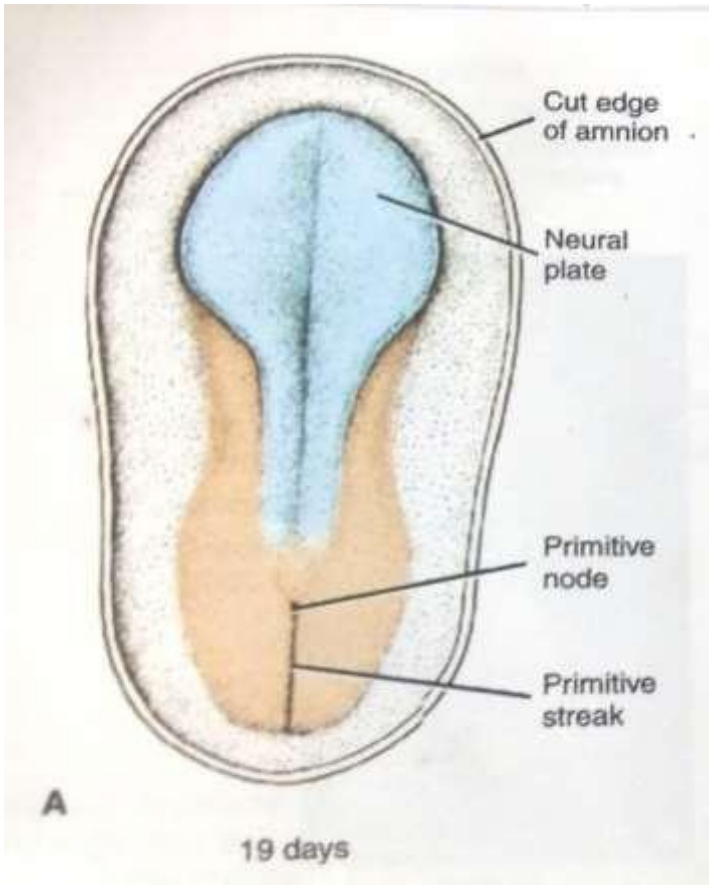


Figure: Neural plate formation

- **Neurulation** : Process where neural plate forms neural tube

- Neural fold: Neural plate lengthens and its lateral edges elevate

- Neural groove: Depressed midregoin of neural plate

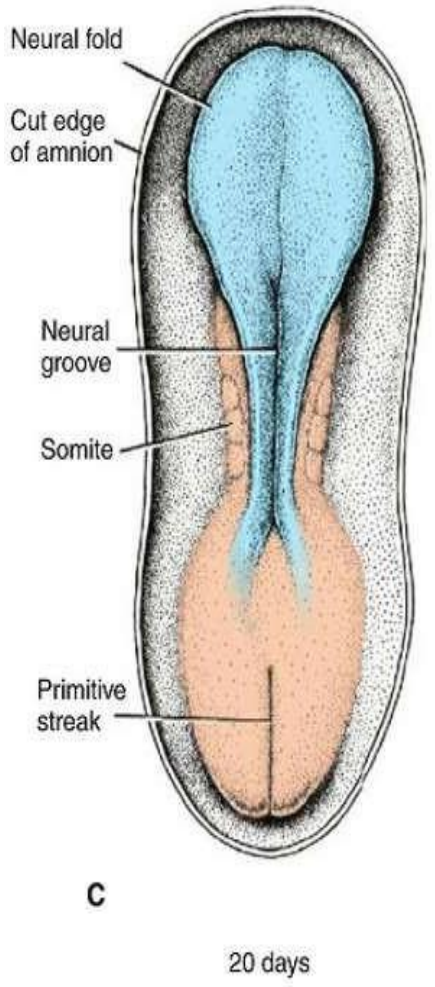


Figure:Neural fold and neural groove fomation

- **Neural tube**: Neural fold approach each other in mid line

- Anterior neuropore:Cephalic end of neural tube

- Posterior neuropore: Caudal end of neural tube

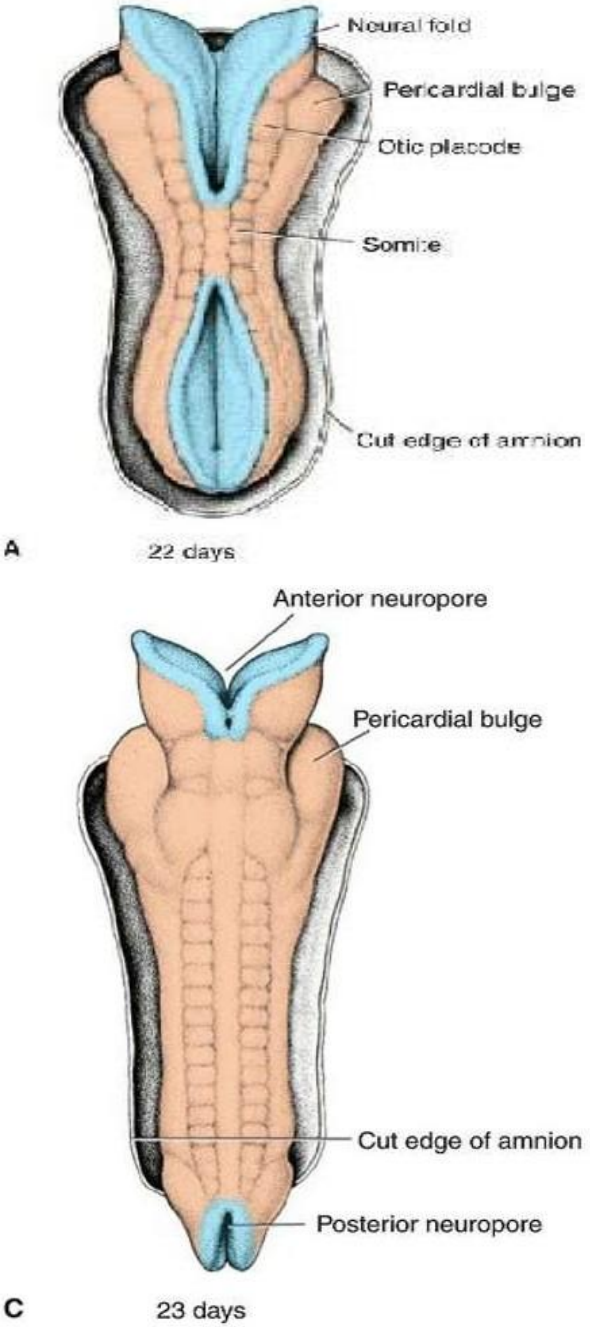


Figure: Neural tube formation

- **Neural crest cell:**

➢ Neural plate on each side bounded by neural crest cell

➢ Neural crest cells dissociate from their neighbours

- Crest cells undergo epithelial to mesenchymal transition

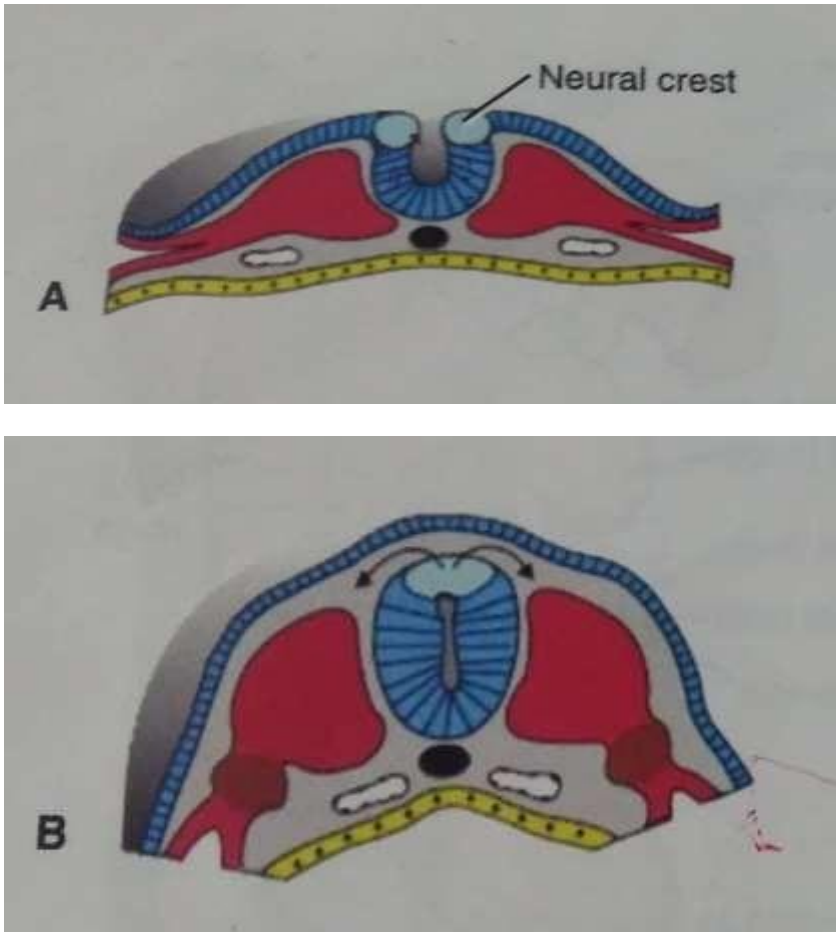


Figure:Neural crest cells at lateral border of neuroectoderm

Migration of neural crest cell

- **After closure** of neural tube crest cells from **trunk region** migrate one of two pathways:

✓ Dorsal pathway through dermis to form melanocytes of skin and hair follicles

✓ Ventral pathway through anterior half of each somite to form sensory ganlia,sympathetic and enteric neurons,Schwann cells and cells of the adrenal medulla

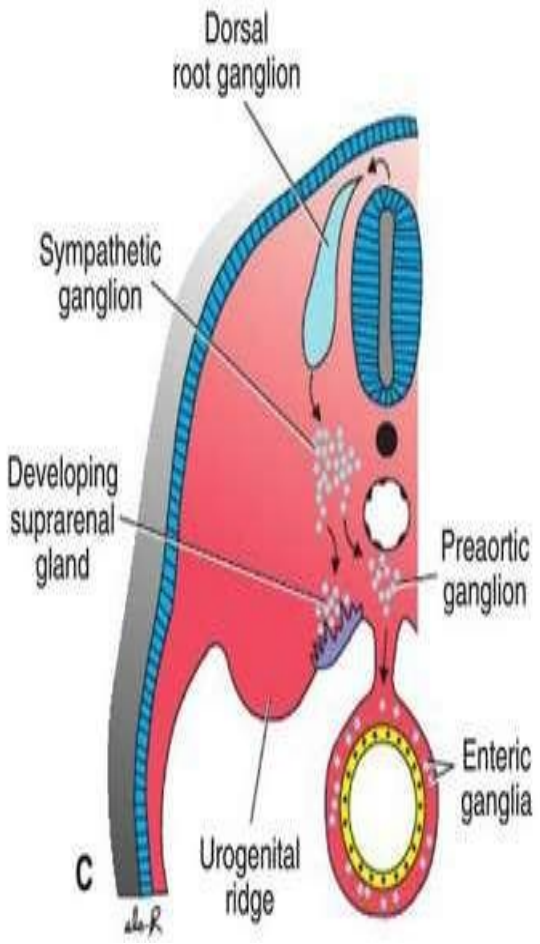


Figure:Migration of neural crest cells

- **Before closure** of neural tube crest cells from **cranial region** migrate to form craniofacial skeleton as neuron for cranial ganglia, glial cells,melanocytes

- Neural crest cell contributes to so many organs and tissues that sometimes they are referred as the **fourth germ layer**

Derivatives of neural crest

- Connective tissue and bones of the face and skull
- Cranial nerve ganglia
- C cells of the thyroid gland
- Conotruncal septum in the heart
- Odontoblasts
- Dermis in face and neck
- Spinal [dorsal root] ganglia
- Sympathetic chain and preaortic ganglia
- Parasympathetic ganglia of the gastrointestinal tract
- Adrenal medulla
- Schwann cells
- Glial cells
- Meninges [forebrain]
- Melanocytes
- Smooth muscle cells to blood vessels of the face and forebrain

Surface ectoderm: After closure of neural tube remaining ectoderm

Derivatives of surface ectoderm

- Epidermis
- Hair and hair follicle
- Nail
- Mammary gland
- Sebaceous gland
- Sweat gland

Ectodermal Placode

- Otic placode
- Lens placode

- Otic placode invaginate to form otic vesicle which will form internal ear
- Lens placode invaginate to form lenses of eye

Derivatives of Ectodermal placode

- Internal ear
- Lenses of eyes

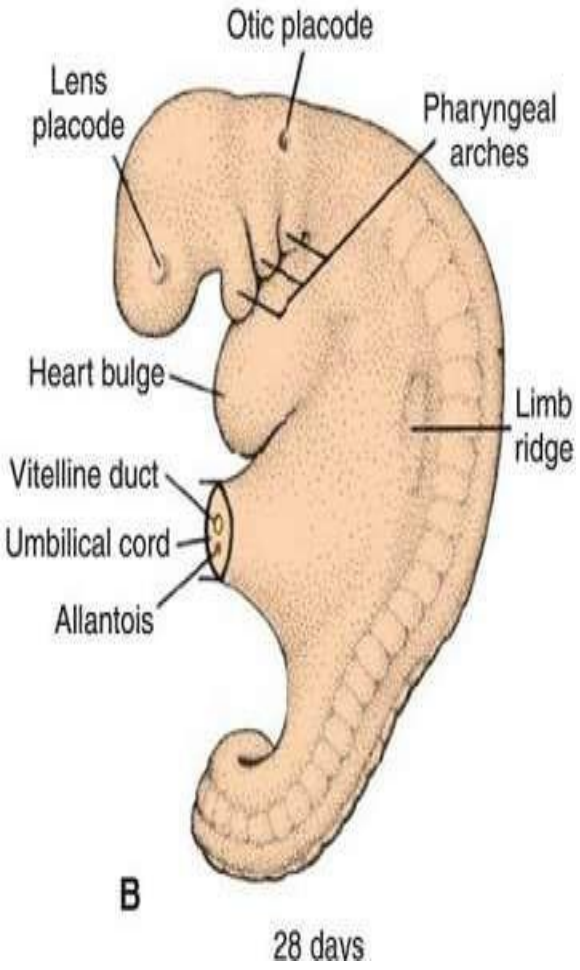


Figure:Embryo showing lens placode and otic placode

So Derivatives of Ectodermal germ layer

- Neural plate form neural tube which form central nervous system
- Neural crest cells form peripheral nervous system
- Surface ectoderm form epidermis with its appendages
- Ectodermal lens placode form lenses of eyes
- Ectodermal otic placode form internal ear

- Neural tube defects: Failure of closure of Neural tube

❑ Anencephaly: Failure of closure of neural tube in cranial region

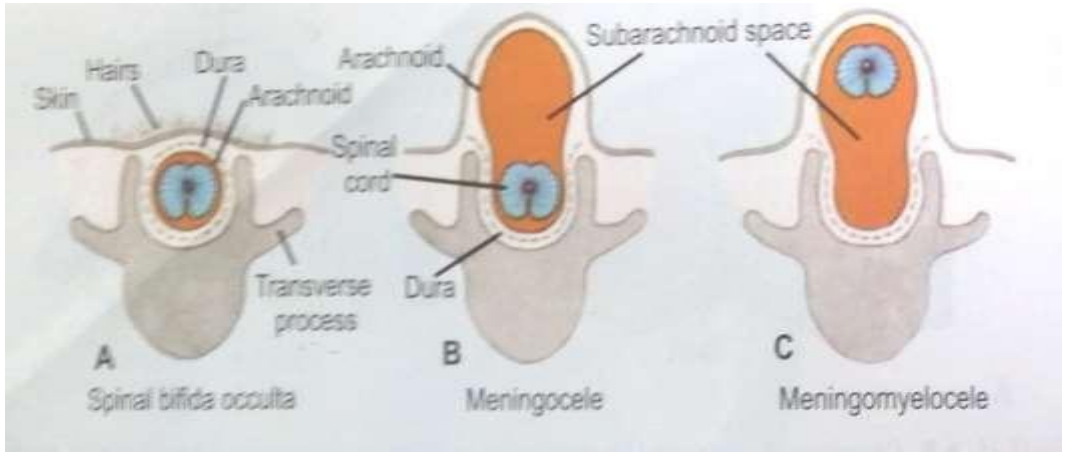
Figure:Anencephaly

- Spina bifida: Failure of closure of neural tube from cervical to caudal region

Figure: Spina bifida at lumbosacral region

Types of spina bifida

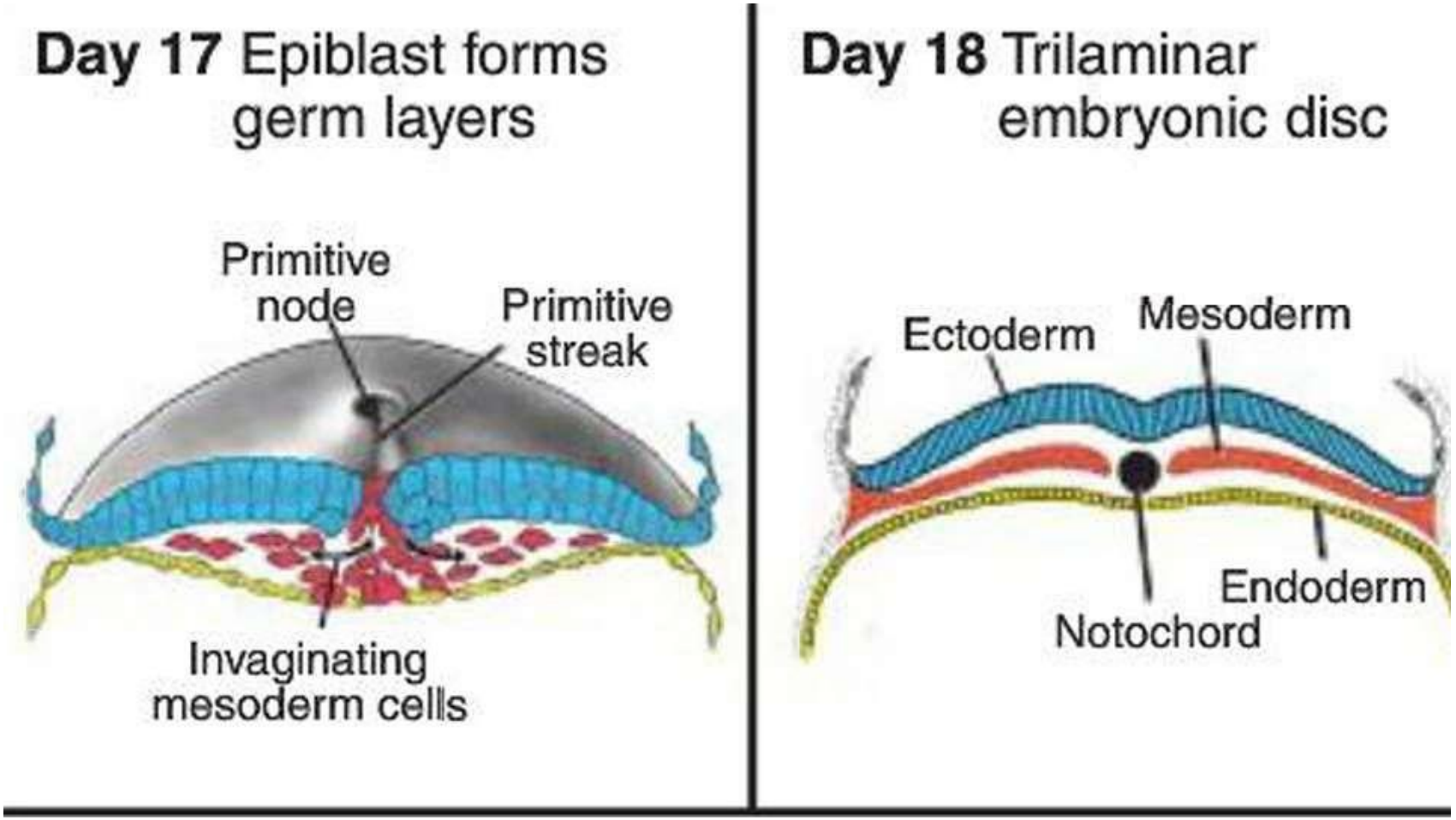
- Spina bifida occulta
- Meningocele
- Meningomyelocele
- Rachischisis



- Prevention of neural tube defect by Folic acid administration

DERIVATIVES OF MESODERMAL GERM LAYER

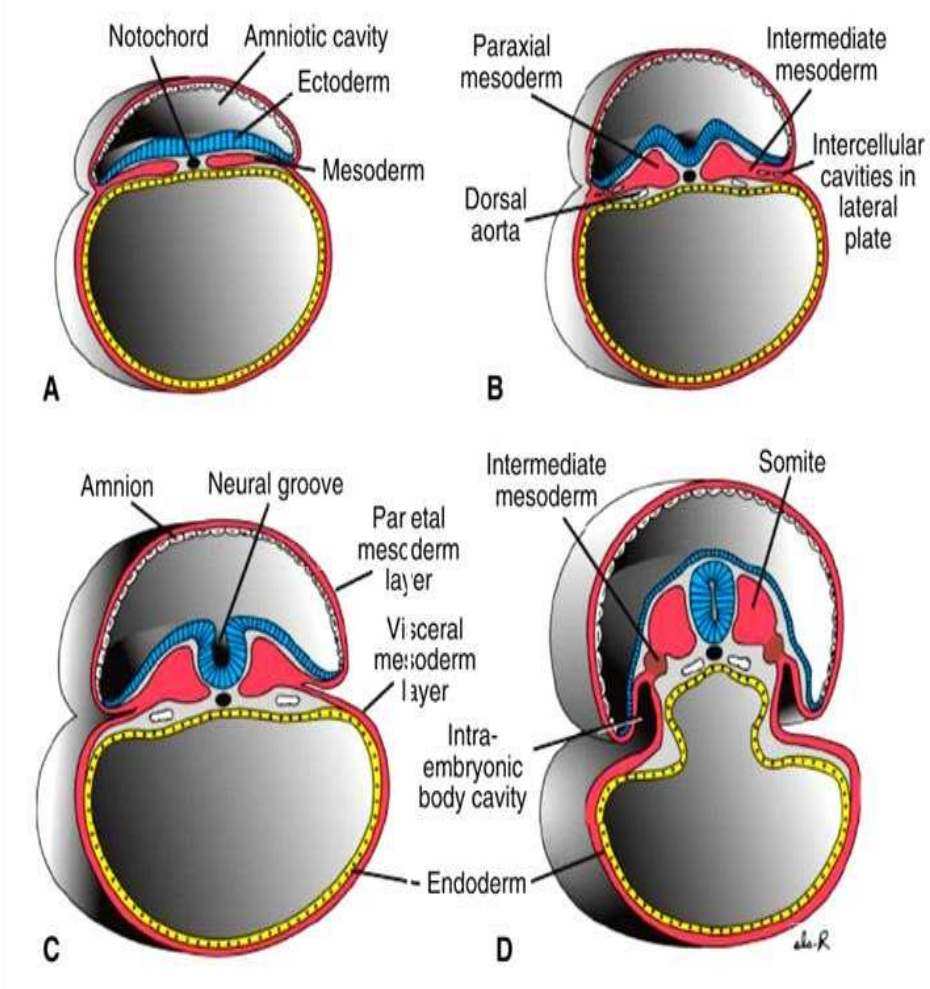
It is the middle layer of trilaminar germ layer



Epiblast to Trilaminar germ disc formation by gastrulation

DERIVATIVES OF MESODERMAL GERM LAYER

- Initially **it** form **thin sheet** on each side of midline
- Cells close to midline - **proliferate and thickened – paraxial mesoderm**
- More laterally remain as- **lateral plate mesoderm**
- Between paraxial and lateral plate mesoderm -**intermediate mesoderm**

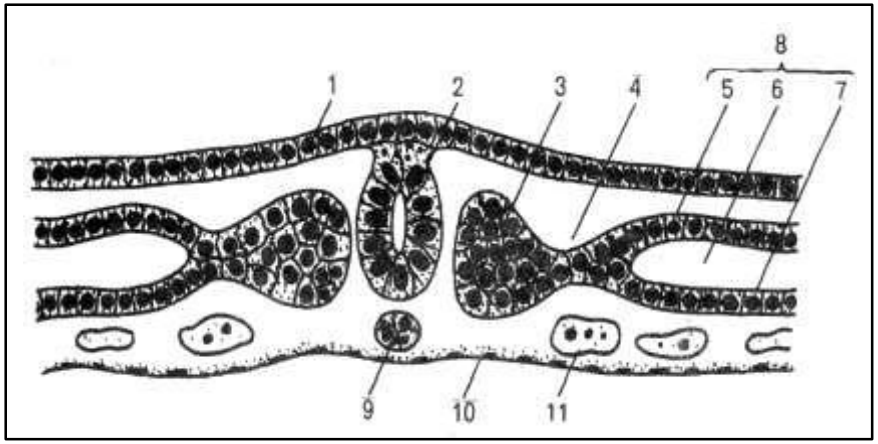


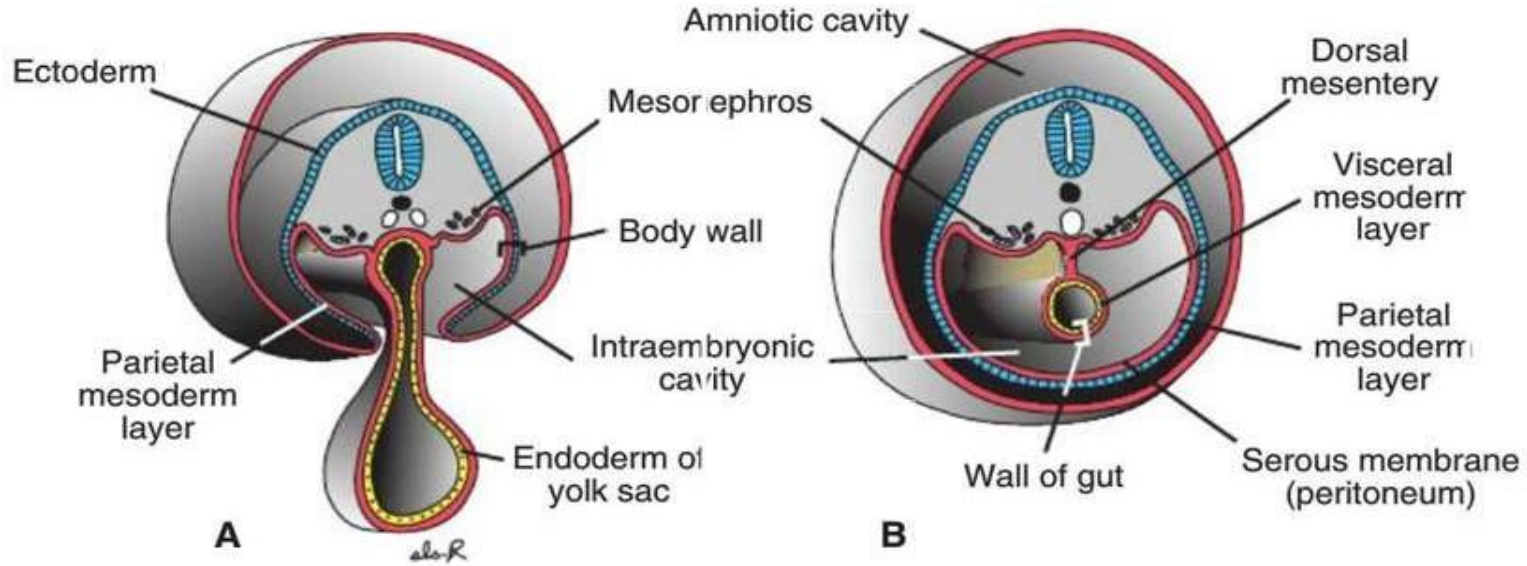
Transverse section showing development of mesodermal germ layer.A-17D,B-19D,C-20D,D-21D

MESODERM

- Paraxial mesoderm
- Intermediate mesoderm
- Lateral plate mesoderm:

  - Somatic or parietal -mesoderm covering amnion
  - Splanchnic or visceral –mesoderm covering yolk sac





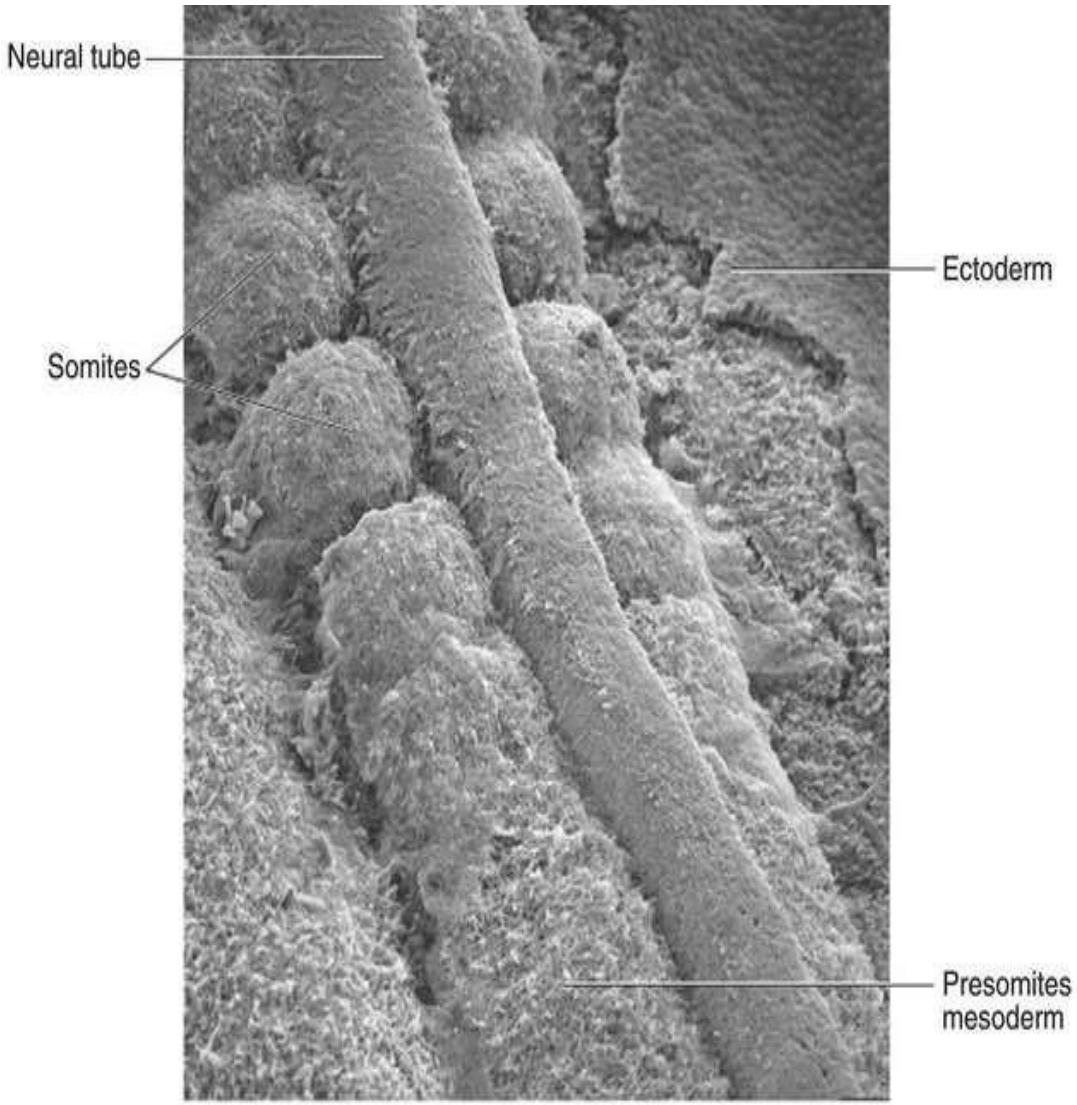
A.Tranverse section through 21d embryo at the region of mesonephrone, showing parietal and visceral layers.**B.parital** mesoderm and overlying ectoderm form the ventral and lateral body wall

Paraxial mesoderm

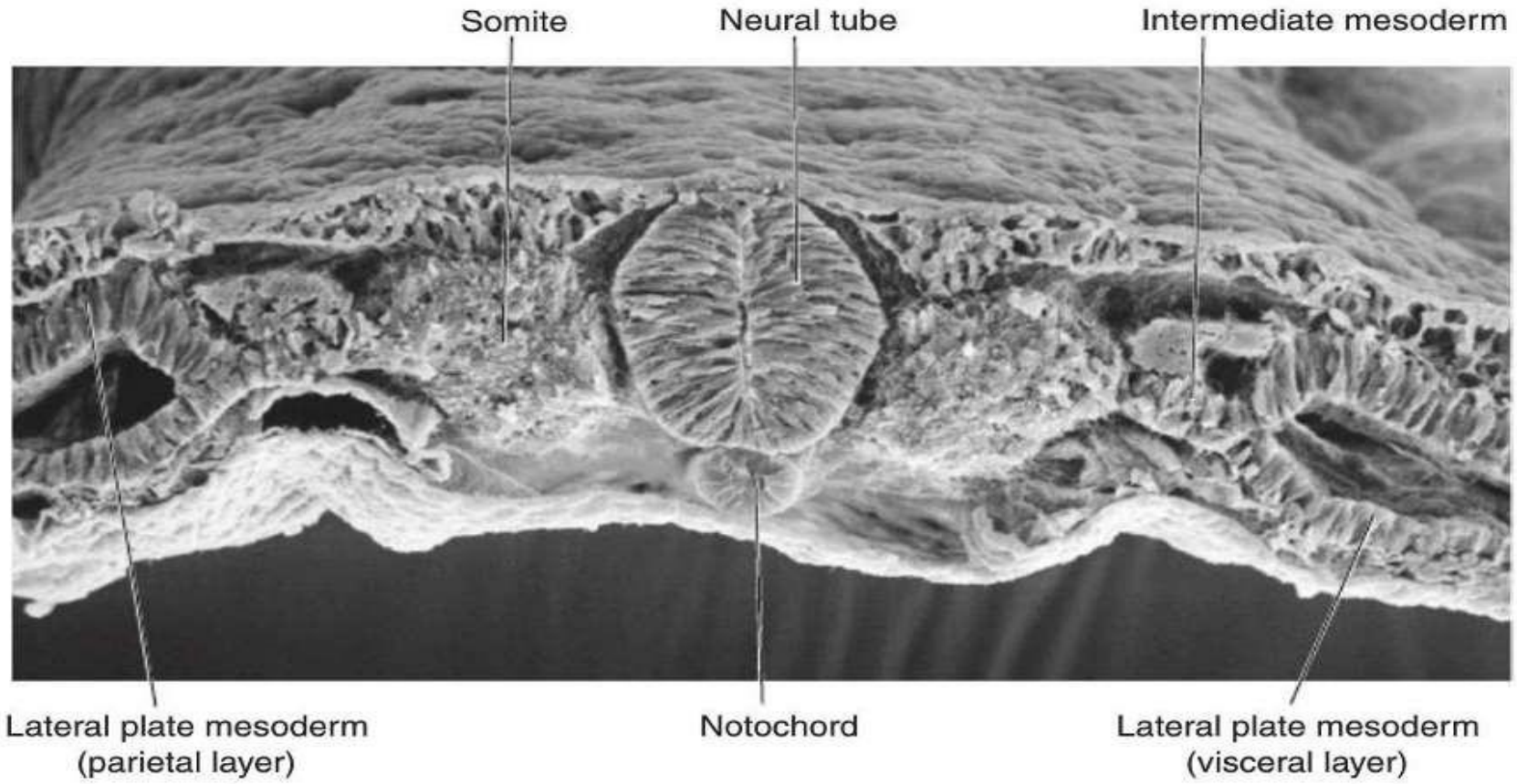
- **Start of 3rd wk** paraxial mesoderm start to organized into segment-called **somitomeres**
- **First at cephal region** ,then proceed caudally
- Head region-somitomere and neural plate form Neuromers
- **From occipital to caudal region**, somitomers further organized to form Somites.
- At 20 th day **first pair of somites arise at occipital** region, and proceed caudally. At a rate of 3 pair /day
- At the end of **5th wks 42-44 pair somites** developed

NUMBER OF SOMITES IN DIFFERENT REGION

Occipital region	4
Cervical region	8
Thoracic	12
Lumber	5
Sacral	5
Coccygeal	8-10



SOMITES



Cross section through **somites** and **neural tube**

Age determination by counting somites

TABLE 6.2 Number of Somites Correlated to Approximate Age in Days

Approximate Age (d)	Number of Somites
20	1–4
21	4–7
22	7–10
23	10–13
24	13–17
25	17–20
26	20–23
27	23–26
28	26–29
30	34–35

STAGES OF DEVELOPMENT OF SOMITES

A. Paraxial mesoderm cell arranged around a cavity

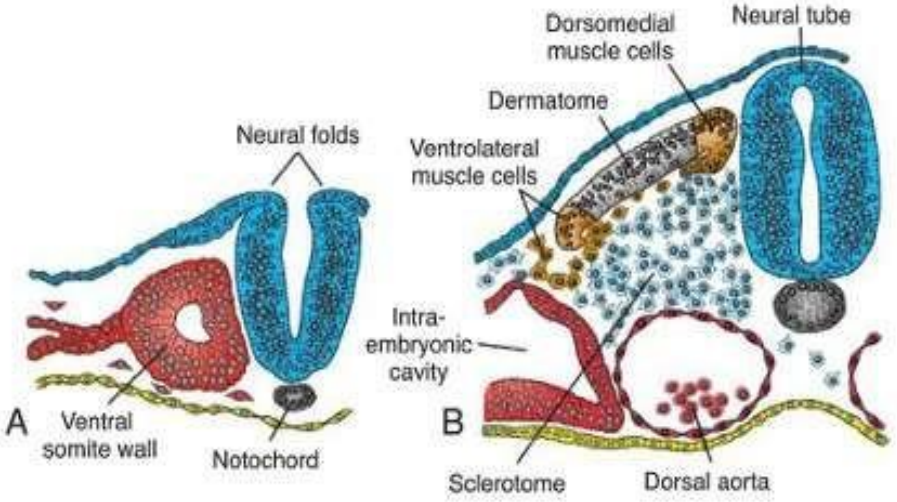
B. Cells from **ventral and medial wall** migrate around the nural tube and notocord-form vertebra and rib.

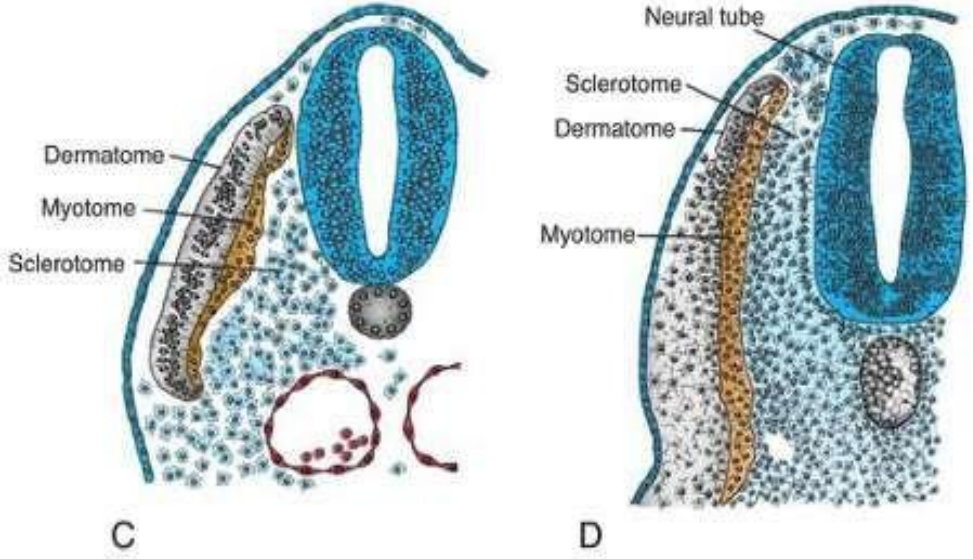
C. Cells of the **dorso-medial and ventro-lateral** form muscle precursor cell

(BC)Cells between these group form

dermatoms

D. Cells from **ventrolateral edges** migrate into parital layer of LPM –form most musculature of body wall



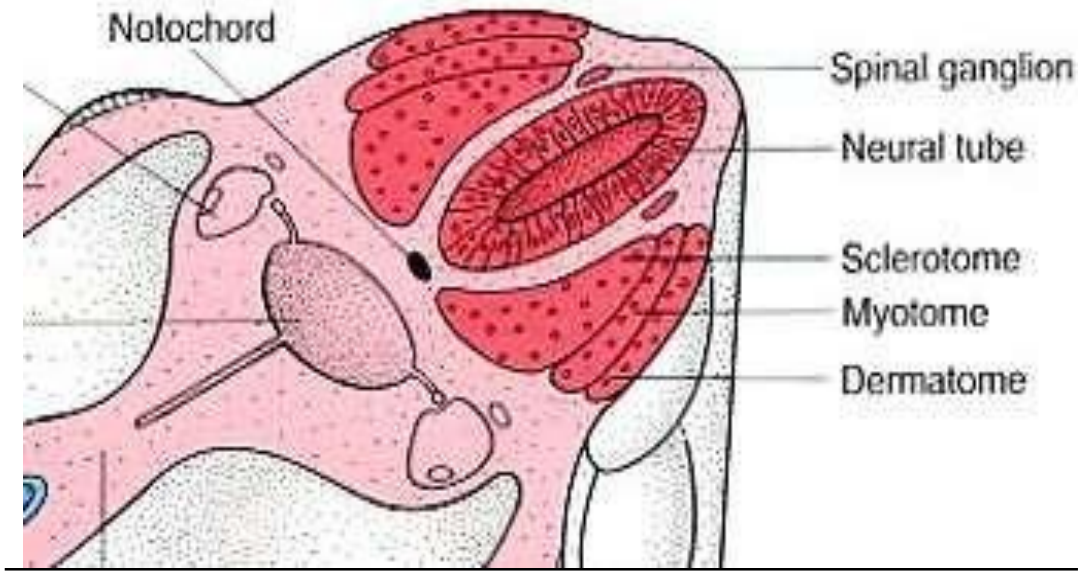


SOMITES DIFFERENTIATION

- Initially **somites** exist as a **ball of mesoderm(fibroblast) cell around a small lumen**
- **Start of 4th *wk-cells of* ventral and medial** wall migrate to **surround the nural tube and notocord-form vertebra and rib**
- Cells of **dorsomedial and ventrolateral edge** form precursors of muscle cell
- Cells between these group form dermatoms
- Cells from **ventrolateral edges** migrate into parital layer of LPM –form most musculature of body wall

Cont……

- Cells of **dermatomyotoms** forms-
  - Dermis of skin of back
  - Muscle of back
  - Body wall
  - Some limb muscle



- **Each smites form-**
  - Its own sclerotomes-Tendon ,cartilage ,bone
  - Its myotoms-Segmental muscle
  - Its dermatoms-dermis of back

  Each myotoms and dermatoms has its own segmental nerve component

LATERAL PLATE MESODERM

❑ Parietal(somatic)-

- Surround the intra embryonic cavity,
- Form thin membrane(mesothelium) line the –peritoneal, pleural, pericardial cavity
- **Mesoderm of parietal layer** together with **overlying ectoderm** form the lateral body wall fold
- These fold with **head and tail fold** close the body wall.
- **Parietal layer of LPM-**

  i. Dermis of the skin of body wall and limb

  ii. The bones and Connective tissue of limb and sternum

- **Sclerotome and muscular precursor** cell migrate into parietal layer- costal cartilage , limb muscle, and most of the body wal muscle

❑Visceral(splanchnic)-

- surround the organ, form thin membrane around each organ
- **Visceral layer of LPM** with embryonic endoderm form the wall of gut tube.

Intermediate mesoderm: Differentiated into urogenital system

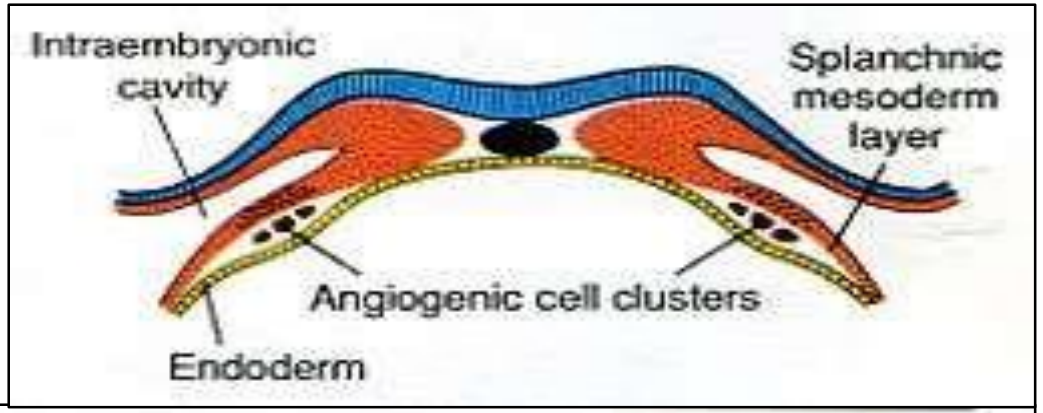
- **Cervical and upper thoracic region-** segmented cell cluster(future-nephrotoms)
- **Caudally**-unsegmented mass-neohrogenic cord
- **Excretory unit of Urinary system** and gonad –developed from partially segmented and partially unsegmented intermediate mesoderm

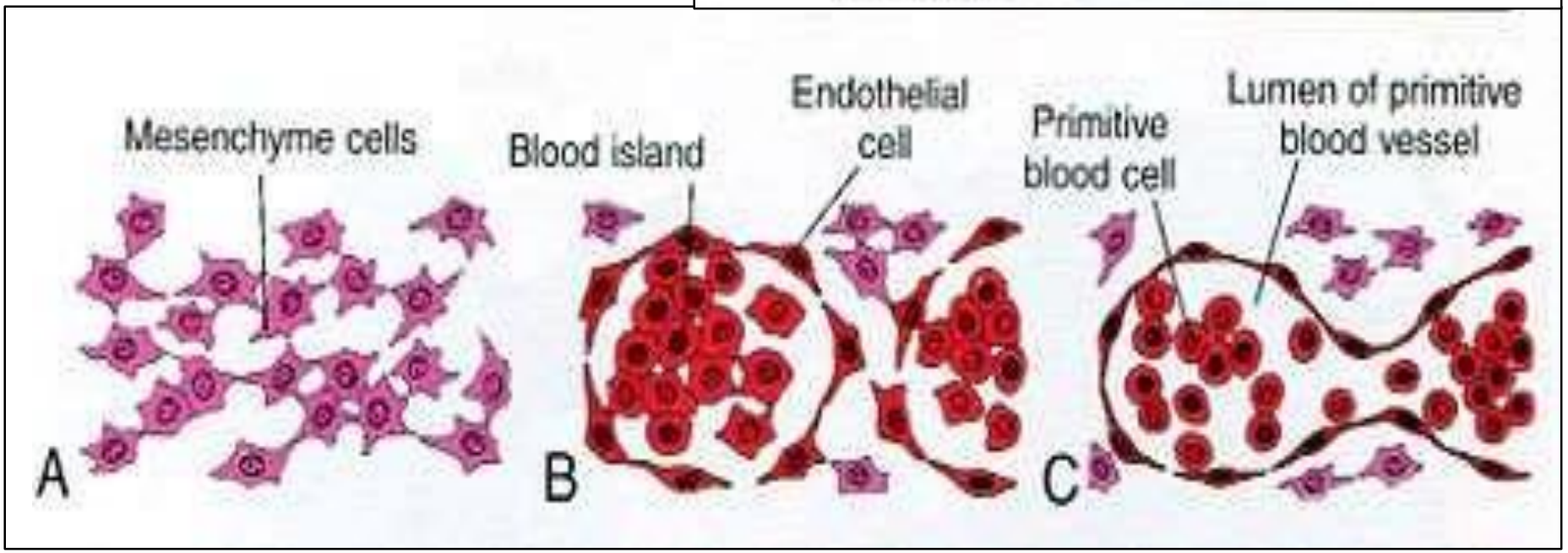
Angiogenesis and hemopoiesis occur concurrently

- Primitive blood cells
  - differentiate from mesenchyme
  - inside the embryonic vessels

⇓

intravascular hemopoiesis





Blood and blood vessels

- **Blood vessels forms in 2 way**:
  - Vasculogenesis-vesells arise from blood island
  - Angiogenesis:sprouting from existing blood vessels
- **First blood island apear** in mesoderm surrounding the wall of the **yolk sac at 3rd wk** ,
- later lateral plate mesoderm and other region
- Island arise from mesodermal cells –induced to form **hem-angioblast-**commom precoursure of vessels and blood cell.
- Definitive haemopoitic stem call are drive from mesoderm surrounding the aorta
- Then **cell colonize to liver** – major haemopoitic organ for 2nd to 7th months.
- **Stem cells of liver colonized –bone marrow at the 7th months** of gastation and liver loss its haemopoetic function.

IN SUMMARY: following tissue and organ developed from mesoderm

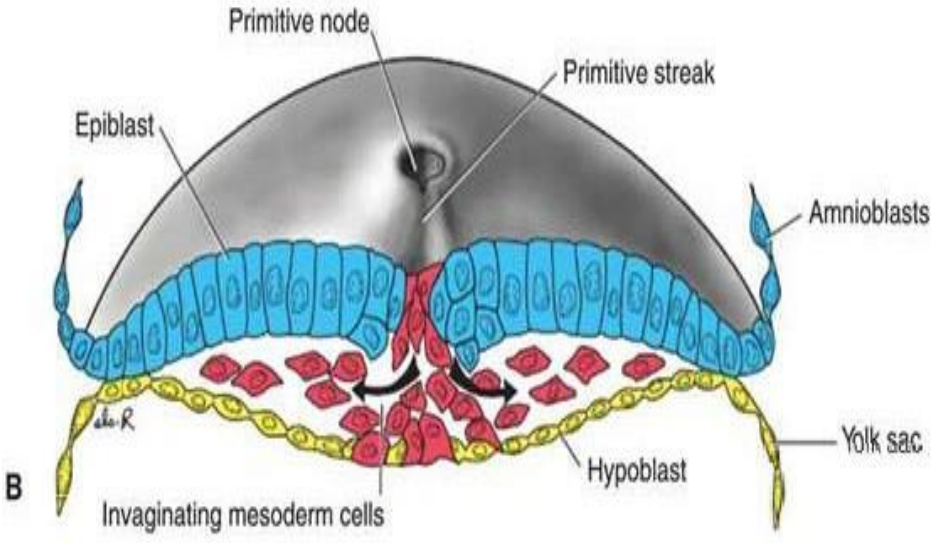
- **Supporting tissue**-connective tissue, cartilage and bones
- **Striated and smooth** muscle
- **Vascular system**-The heart, arteries, vain, lymph vessels, and all blood and lymph cells
- **Urogenital system**-Kidney gonad and their corrosponding duct (except UB)
- The cortical portion of suprarenal gland and spleen

DERIVATIVES OF ENDODERM

Endoderm

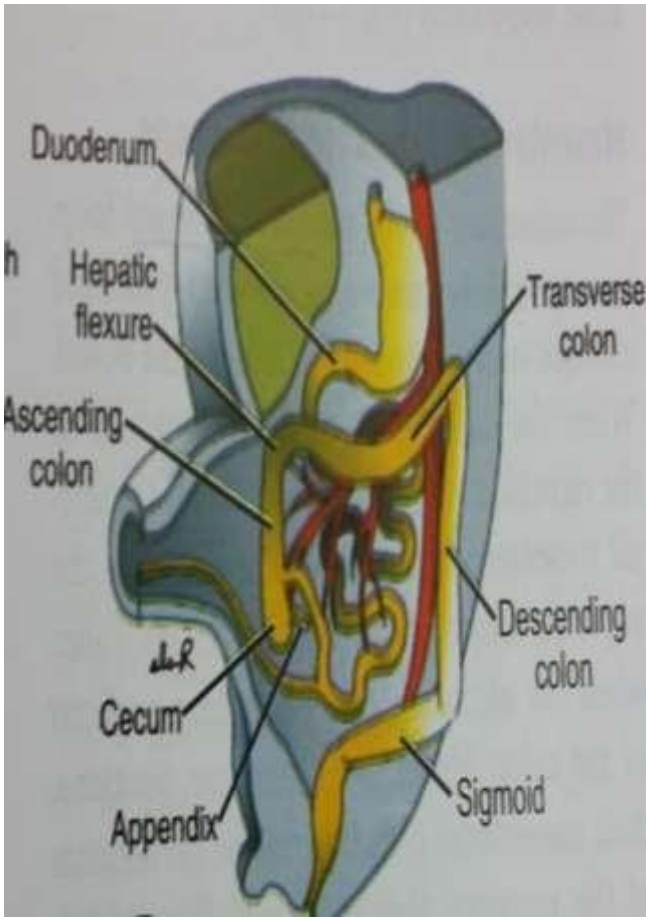
- Epiblast cell migrate through Primitive streak, invaginated and differentiated

- some displace the hypoblast, form endoderm germ layer

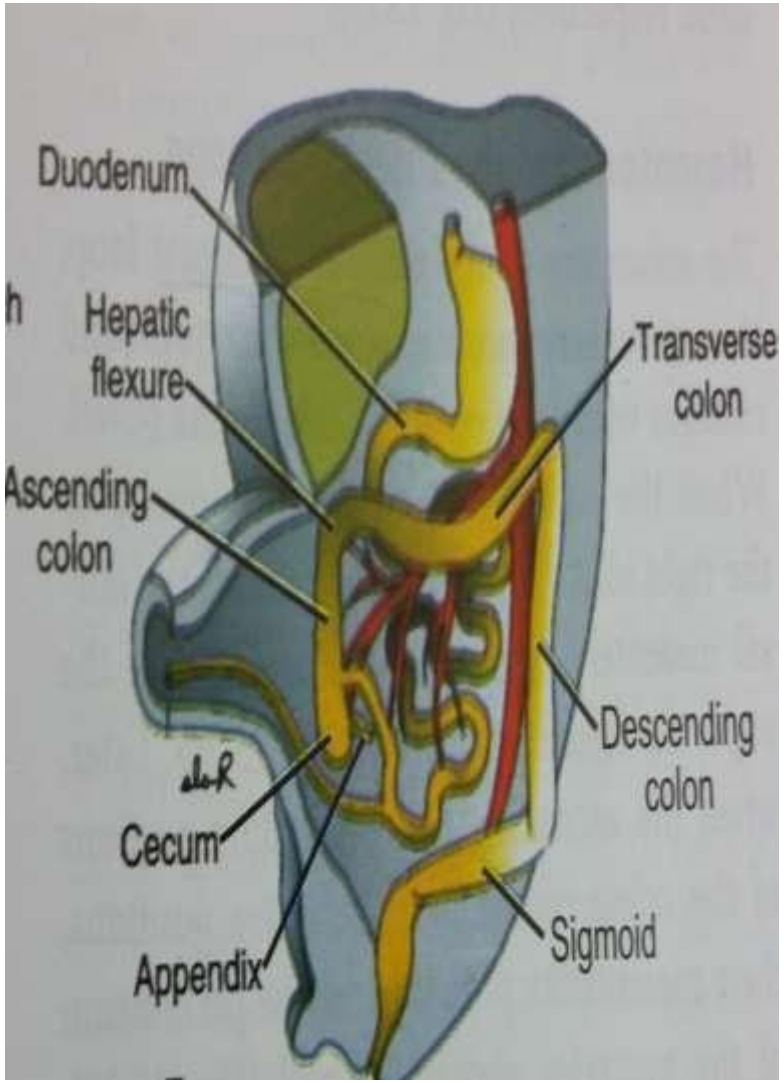


Derivatives of endoderm

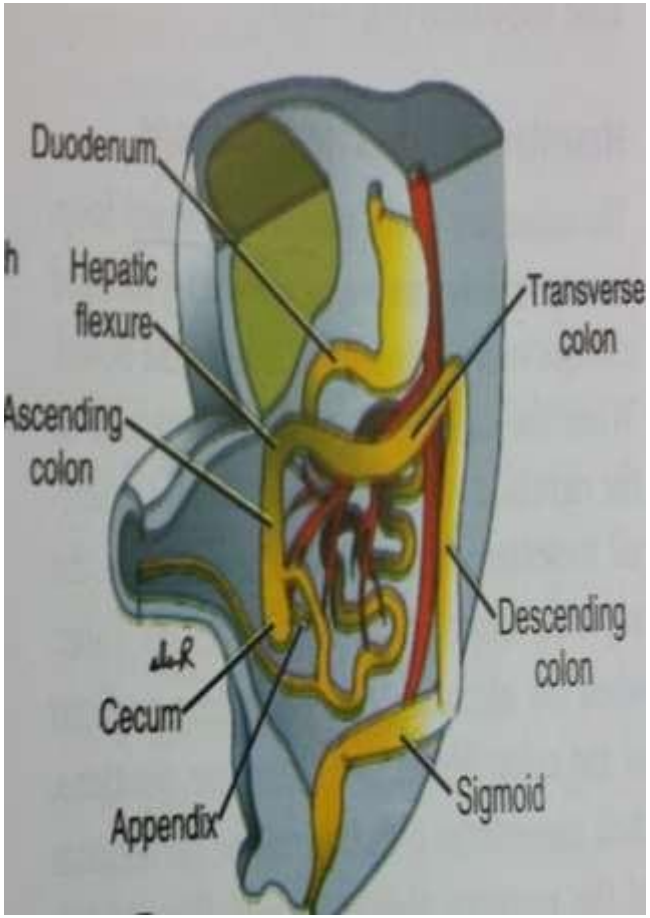
Pharyng eal gut	➢ The epithelial lining of the tympanic cavity and the auditory tube,inner lining of tympanic membrane ➢ The reticular stroma of the tonsils and the thymus. ➢ Parts of the floor of the mouth including the tongue,pharynx ➢ Parenchyma of thyroid and parathyroid gland



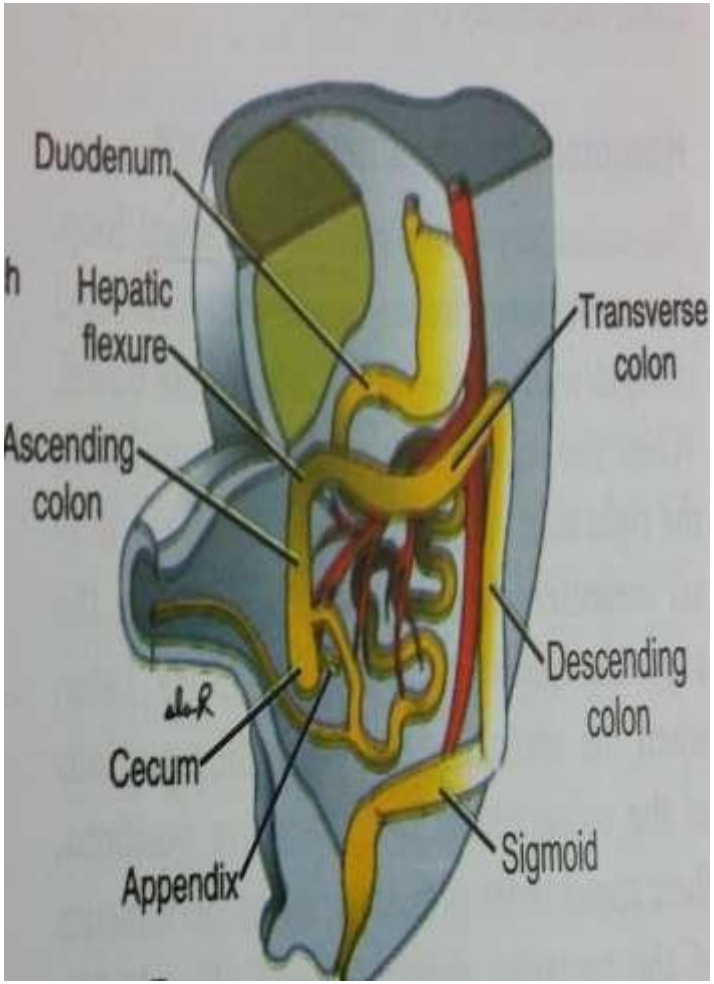
Foregut	➢ Lining Epithelium and glands of oesophagus, stomach, 2nd part of duodenum up to opening of bile duct. ➢ Liver, gall bladder, Pancreas ➢ Lining epithelium of trachea, bronchi, lung



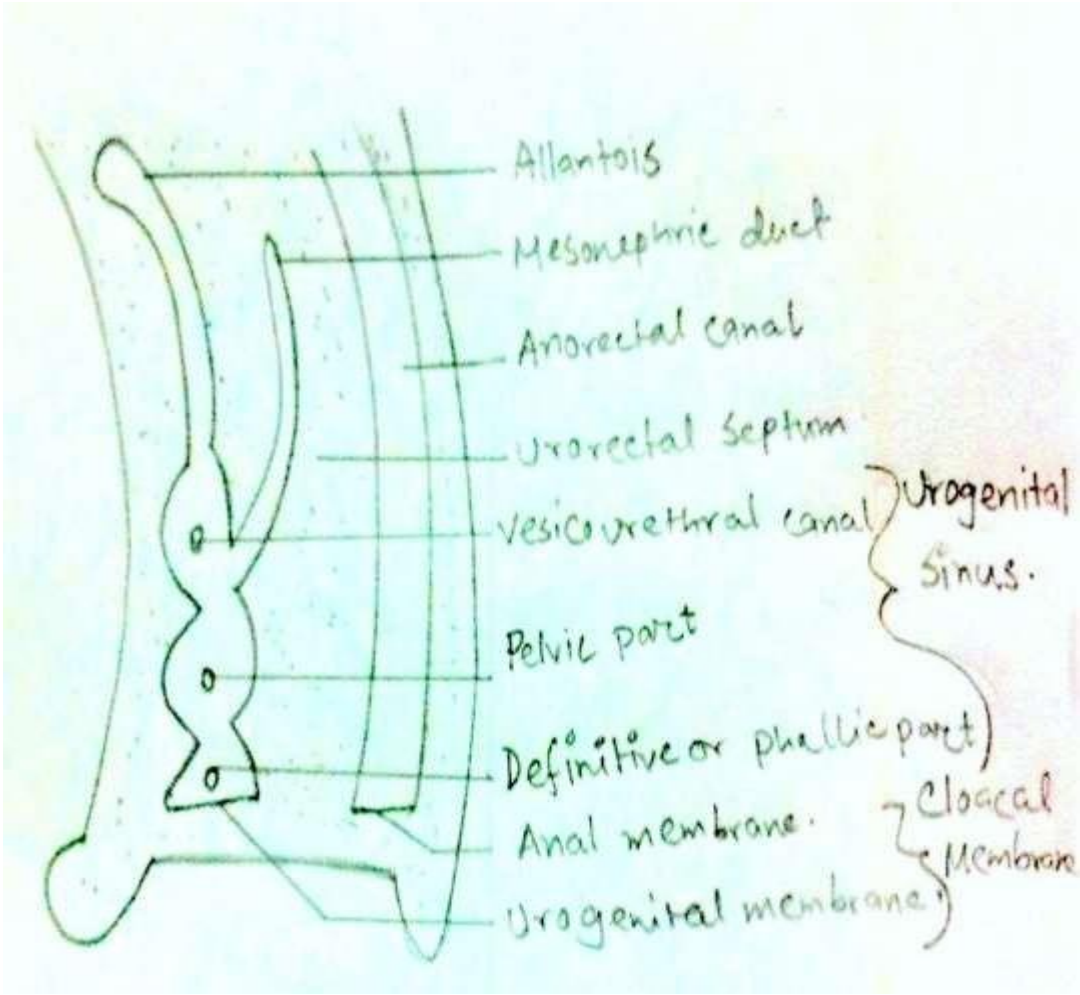
Midgut	➢ Lining Epithelium and glands of duodenum below the opening of bile duct ➢ Jejunum, ilium, appendix, ceacum ➢ Ascending colon, Right 2/3 of transverse colon



Hindgut	➢ Lining epithelium and glands of Left 1/3 of transverse colon,Descending colon, Sigmoid colon ➢ Rectum up to middle transverse fold



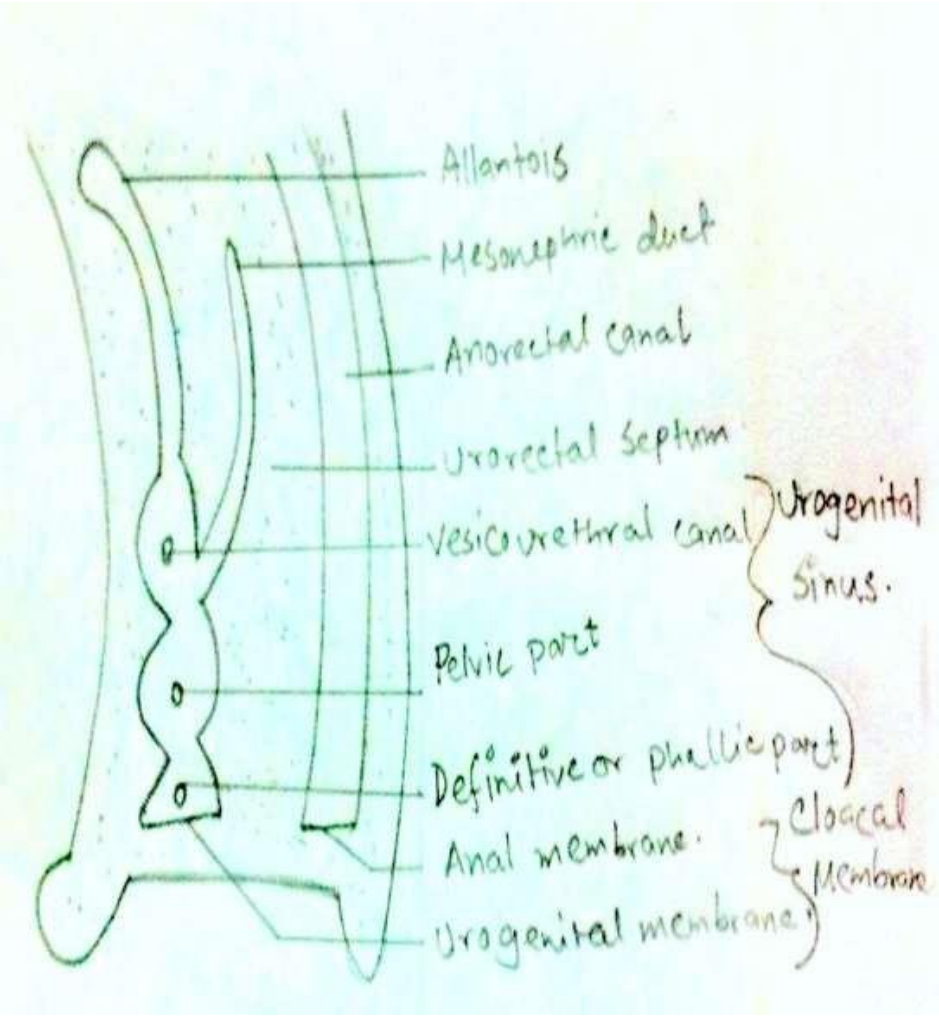
- **Cloaca:** It is a distal dilated part of hindgut, endoderm lined cavity.



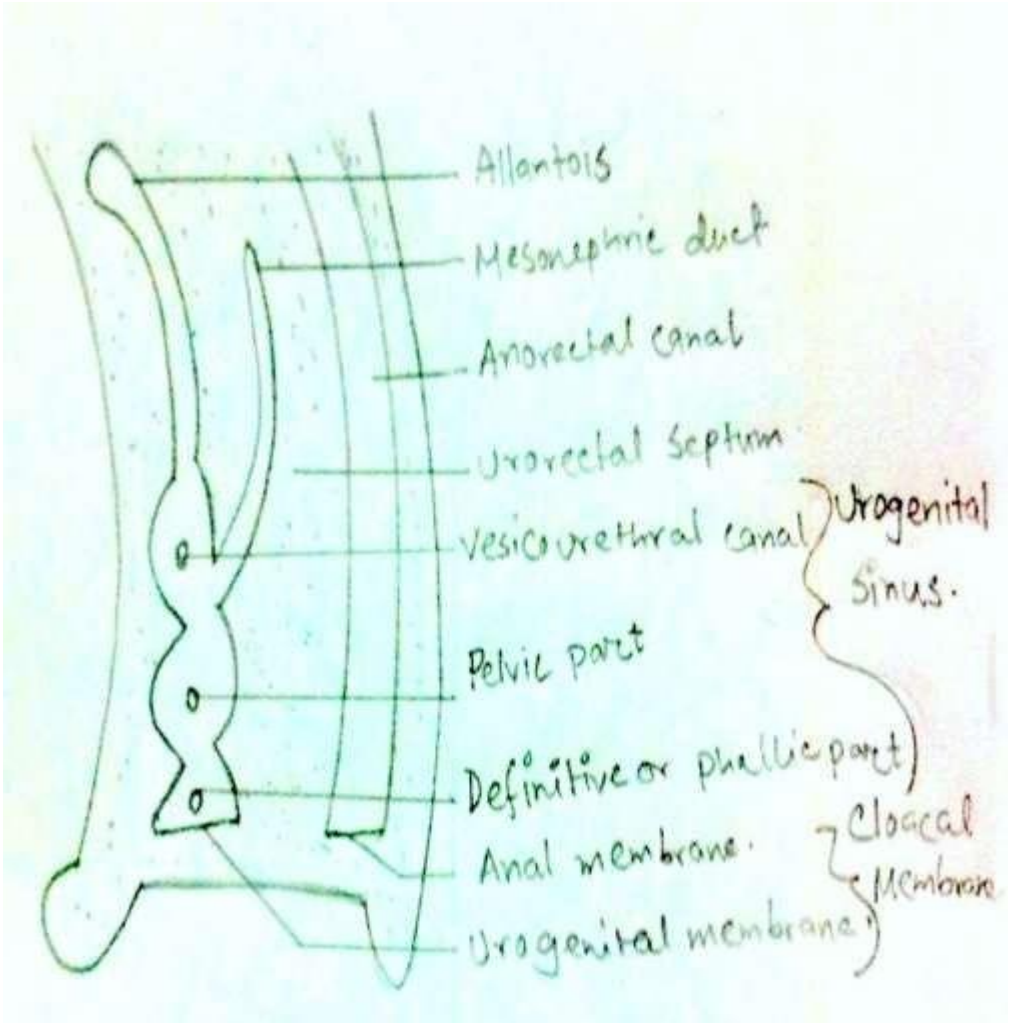
Derivatives of cloaca:

- Ventral part(primitive urogenital sinus):
- Upper Part(vesicourethral canal):lining epithelium of urinary bladder except trigone

- Middle(pelvic part): lining epithelium of
- In male- prostatic and membranous part of urethra, Part of ejaculatory duct,
- glandular part of prostate
- In female-whole urethra
- Lower part: lining epithelium of
- Phallic part(in male)-penile urethra
- Definitive urogenital sinus(in female)-lower portion of vagina



- Dorsal part(anorectal canal):
- Lining epithelium of lower part of rectum, anal canal upto pectinate line



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THANK YOU