

First Week of Development

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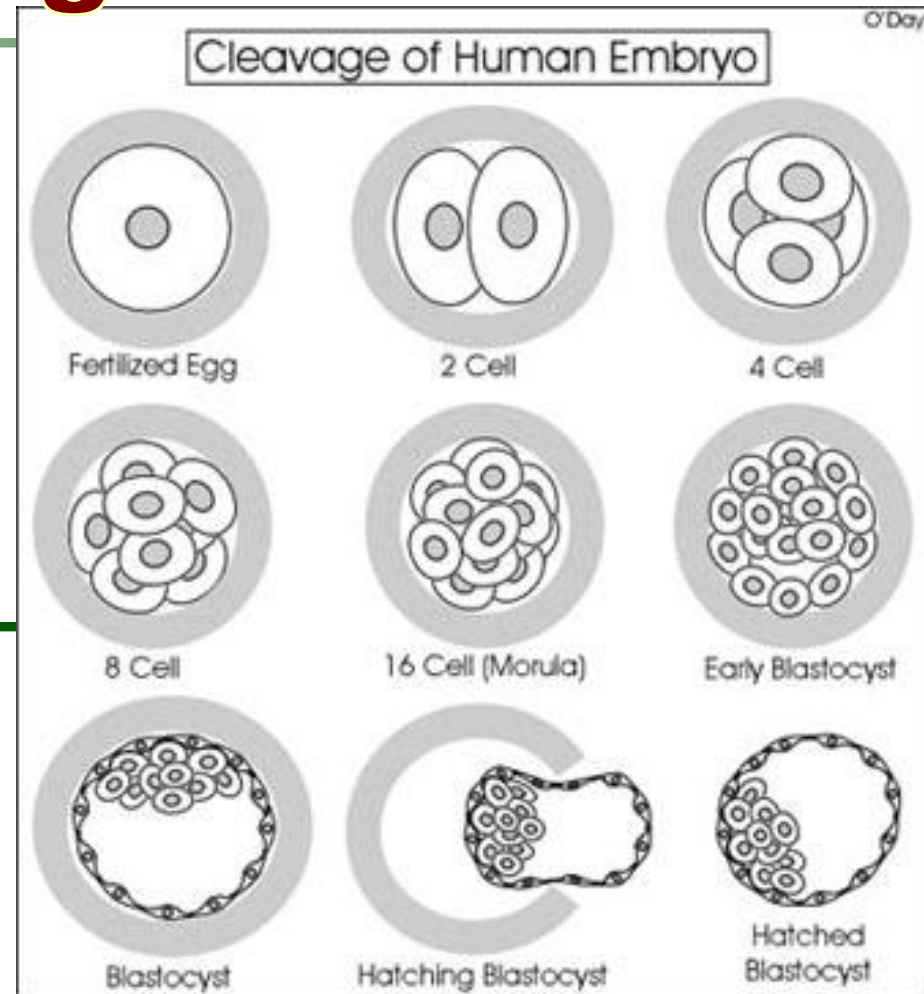
Edited by : Ahmed A. Alkhafaji

At the end of this lecture, the medical student will be able to

- Outline the changes that take place in a two cell stage zygote resulting in the formation of morula
- State the changes that occur in the morula and resulting in the formation of blastocyst and hatched blastocyst
- Discuss implantation
- outline the changes that occur during the 2nd week of development

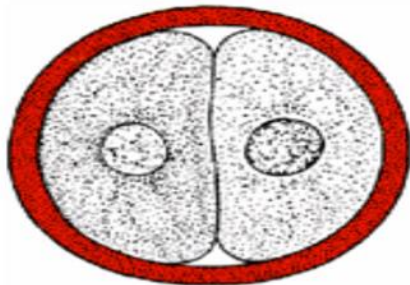
During this week , the embryo undergoes !

1. Cleavage
2. Compaction
3. Blastocyst formation
4. Hatching

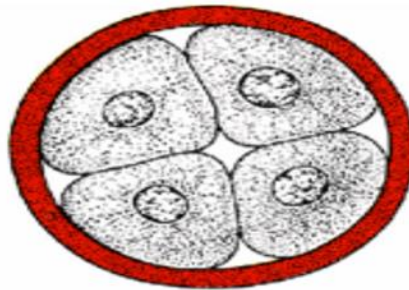


Cleavage

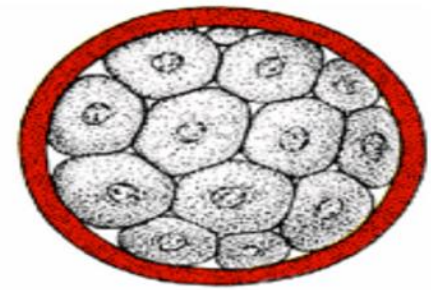
- Is a series of mitotic divisions takes place in a 2-cell stage zygote resulting in the production of a progressively larger number of increasingly smaller cells called blastomeres.



Two-cell stage



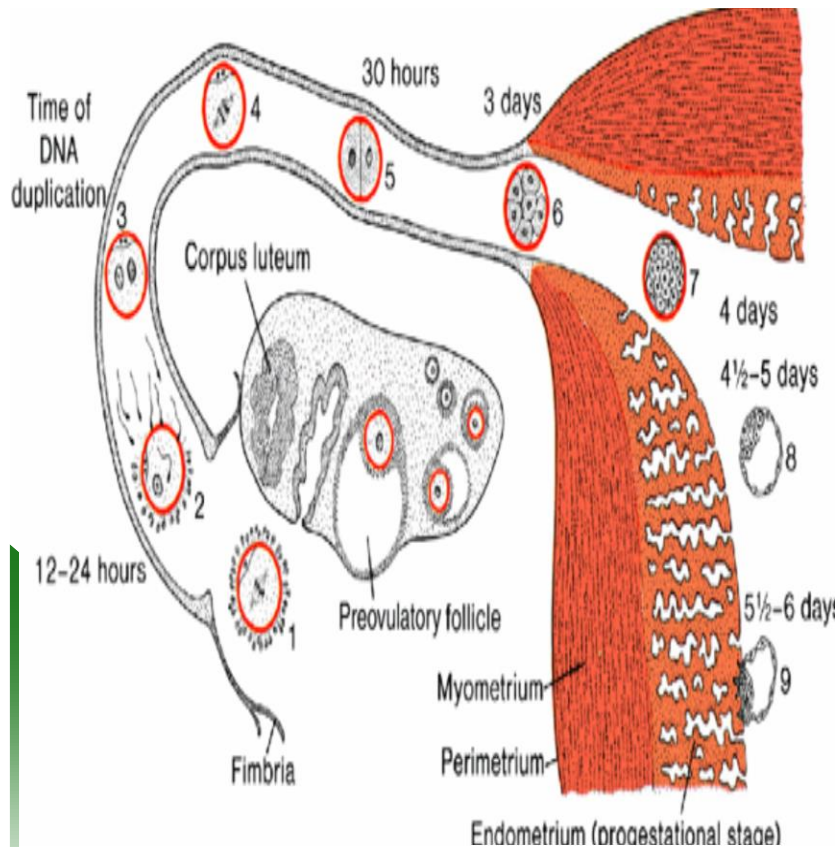
Four-cell stage



Morula

Compaction

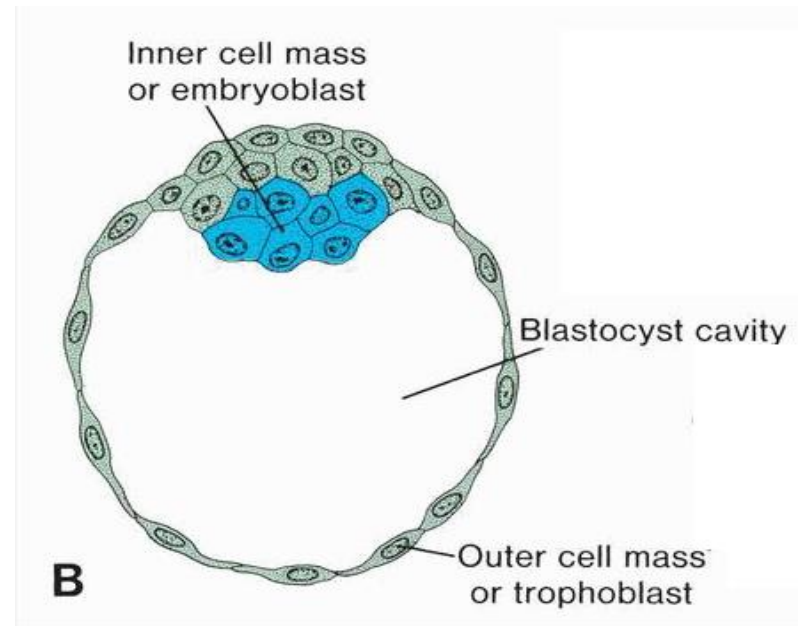
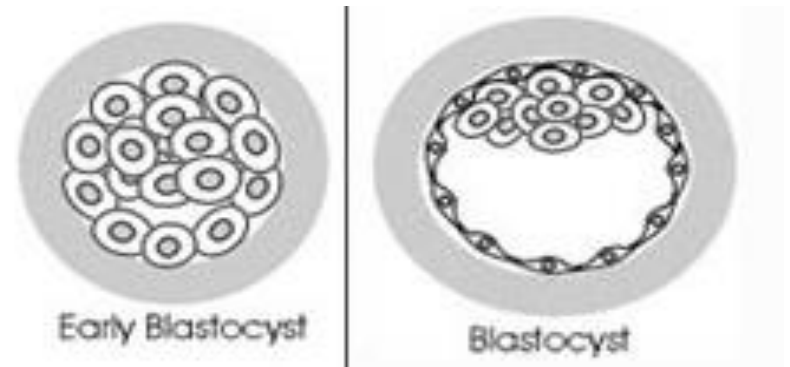
- Is the process where by the blastomeres become flattened , thereby maximizing intercellular contacts and minimizing intercellular spaces . This process results in a uniform cellular mass named morula (Latin; mulberry) which can be used for embryos when about a dozen or more cells are present and until the blastocystic cavity appears .
- Inner cells of the morula constitute the **Inner cell mass** which gives rise to tissues of the embryo proper, and surrounding cells compose the Outer cell mass which forms the Trophoblast, which later contributes to the placenta



- The cleaving embryo proceeds along the uterine tube under the influence of :
 - Tubal contractions
 - movement of cilia
- About 4 days after fertilization, the morula enters the uterine cavity

Blastocyst formation

- When the morula enters the uterine cavity, fluid begins to penetrate through the zona pellucida into the intercellular spaces of the inner cell mass
- Confluence of intercellular spaces result in the formation of a single cavity (blastocele)
- the blastocyst is formed 4.5 – 5 days after fertilization)
- The inner cell mass is known as the embryoblast are at one pole, and the outer cell mass becomes the trophoblast .

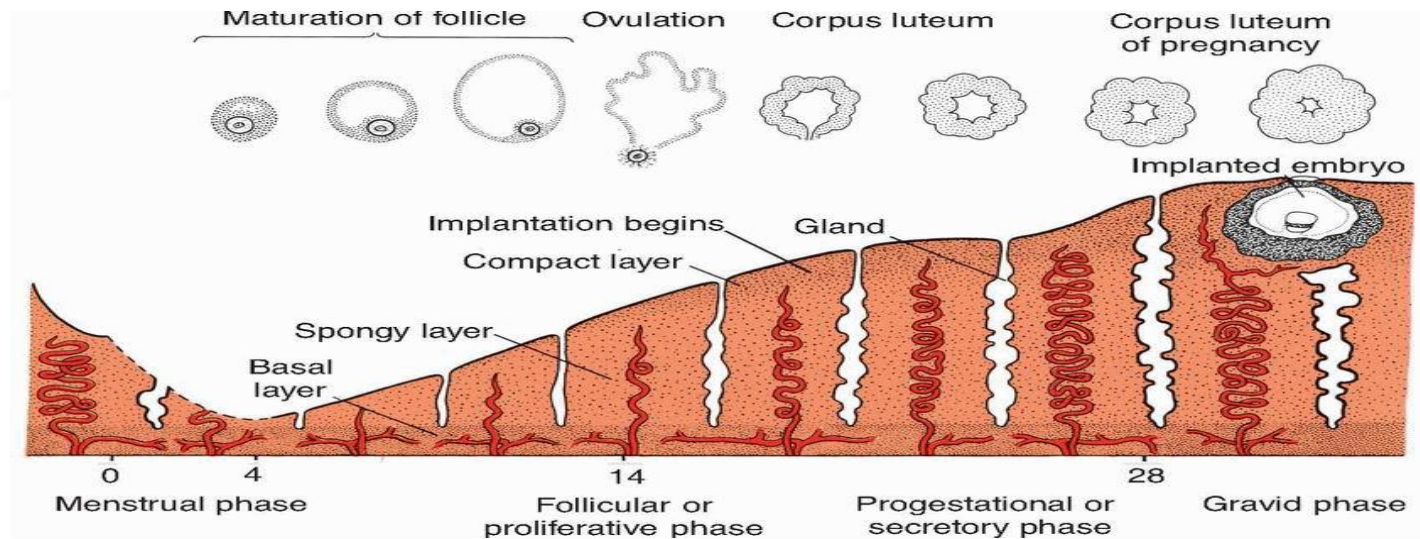


Hatching



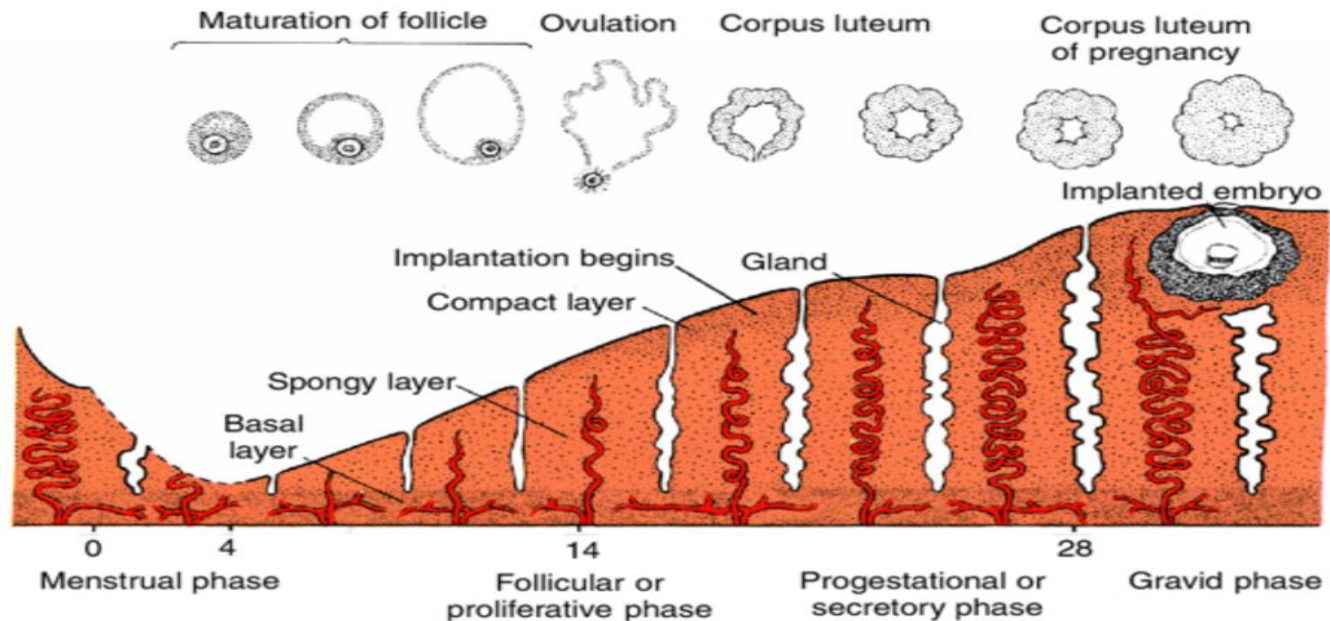
- Escape of the blastocyst from the zona pellucida . This occurs at about 6 days .
- Disappearance of zona pellucida allowing implantation to begin .

Implantation



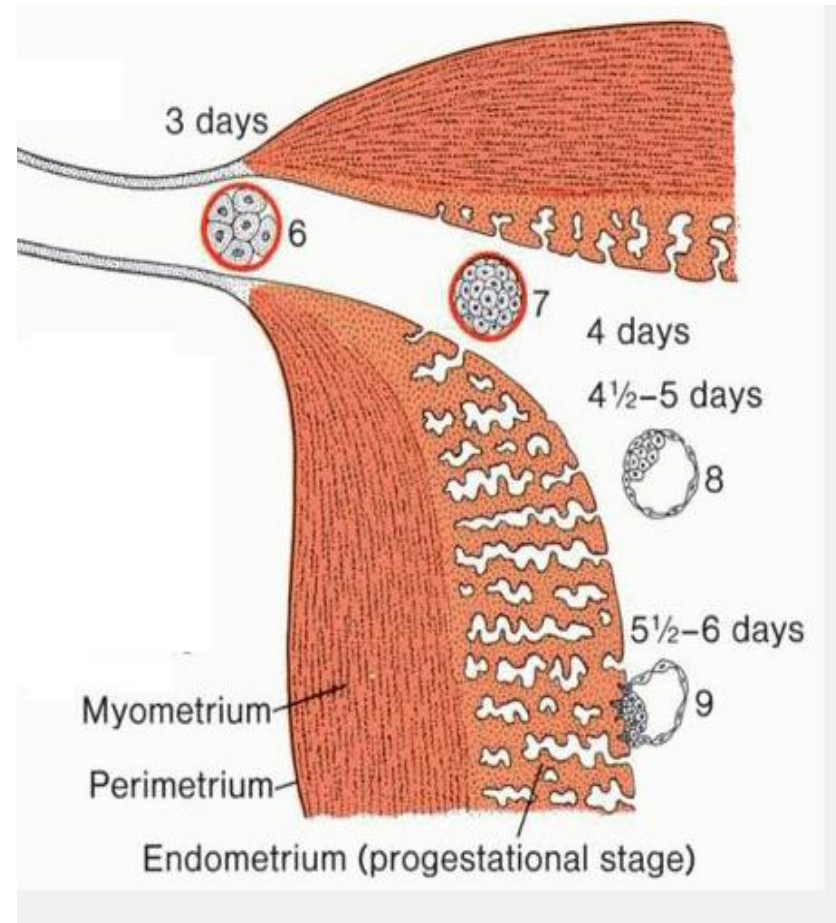
- If fertilization does not occur, shedding of the endometrium (compact and spongy layers) marks the beginning of the menstrual phase.

- If fertilization does occur, the endometrium assists in implantation and contributes to formation of the placenta.



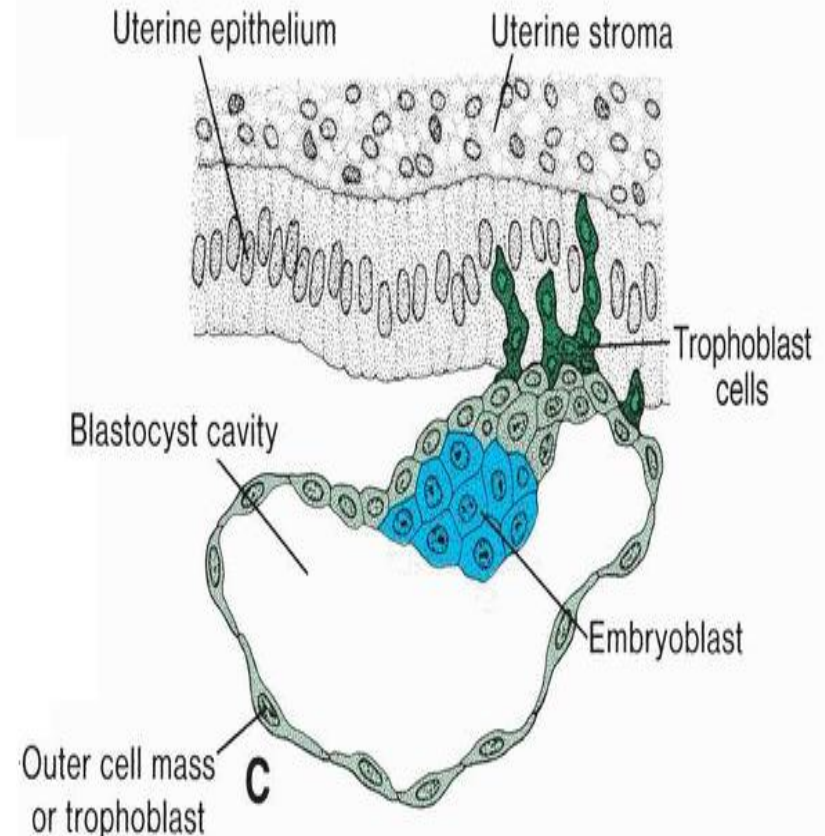
Normally , the blastocyst

- implants in the endometrium
- along the posterior or anterior wall of the body of the uterus
- becomes embedded between the openings of the glands.

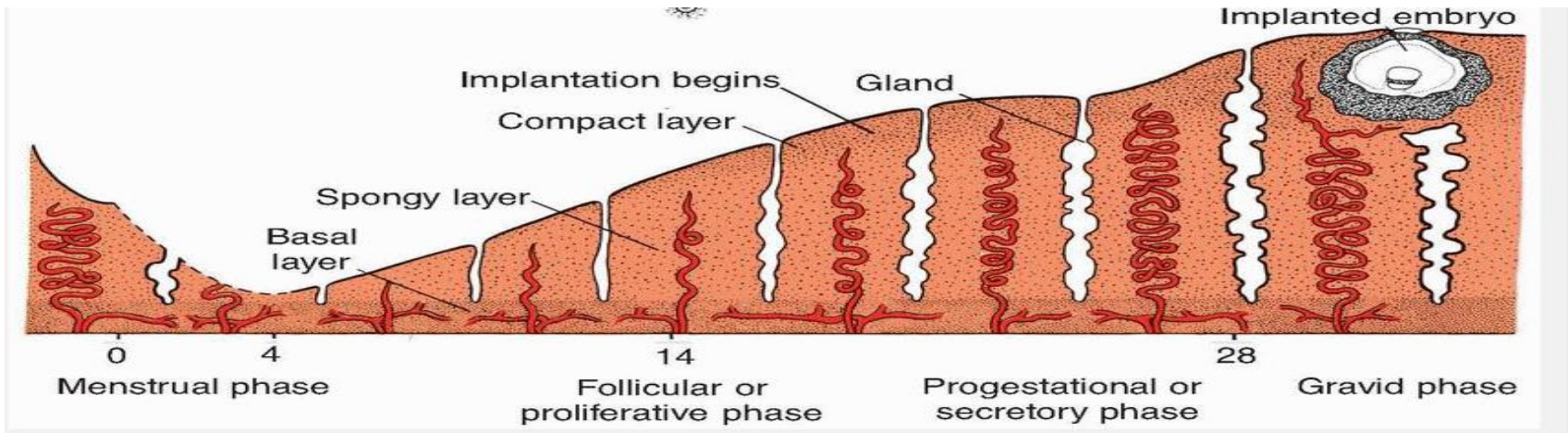


Implantation

- attaches at the embryonic pole probably around 6 days
- Is the result of mutual trophoblastic and endometrial action.
- Trophoblast cells invade the epithelium and underlying endometrial stroma with the help of proteolytic enzymes.



At the time of implantation, the endometrium



- Is in the secretory phase
- Uterine glands and arteries becomes coiled
- Tissue become succulent

2nd week of development

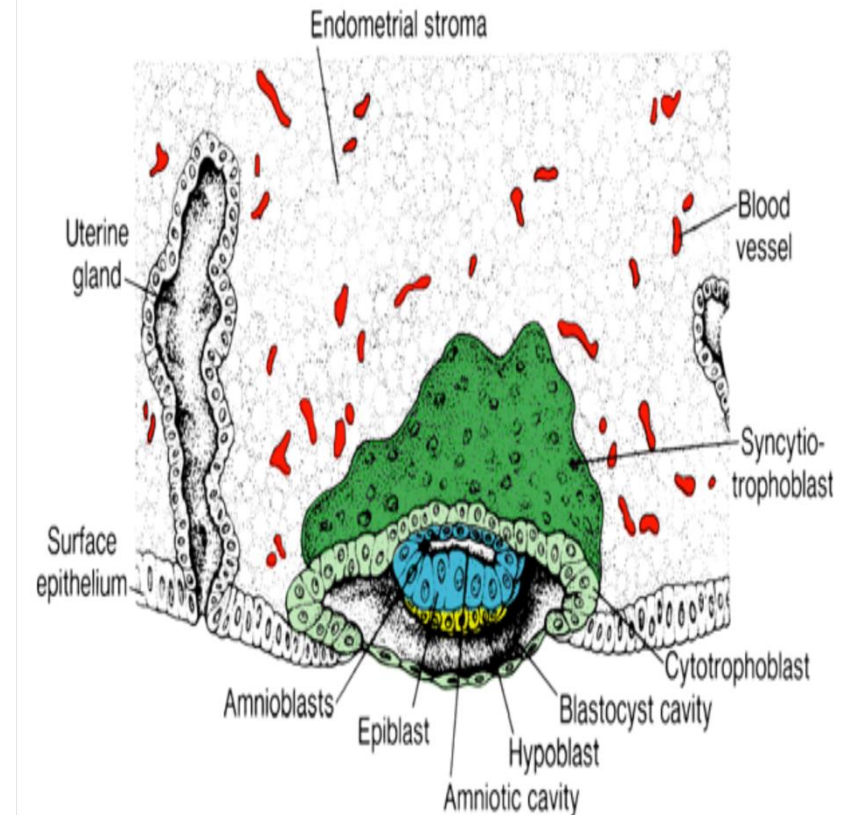
week of twos

week of twos

- The trophoblast differentiates into two layers, the **cytotrophoblast** and **syncytiotrophoblast**.
- The embryoblast forms two layers, the **epiblast** and **hypoblast**.
- The extraembryonic mesoderm splits into two layers, the **somatopleure** and **splanchnopleure**.
- Two cavities, the **amniotic** and **yolk sac cavities**, form.

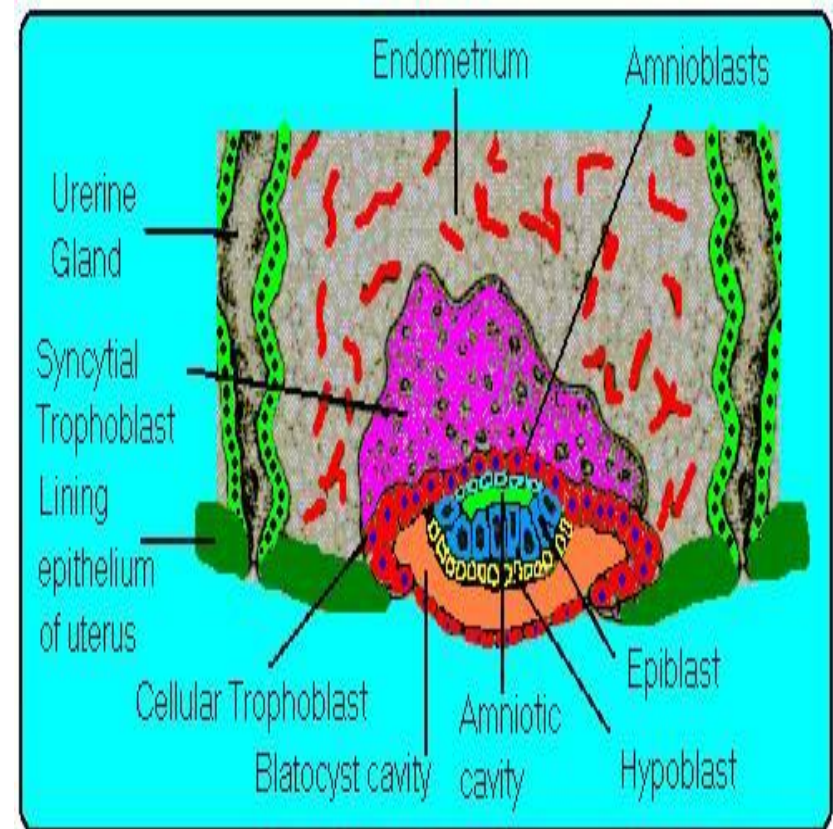
Day 7-8

- The blastocyst is partially embedded in the endometrial stroma
- The trophoblast has differentiated into two layers: (a) an inner layer of mononucleated cells, the Cytotrophoblast (shows mitotic figures) , and (b) an outer multinucleated zone without distinct cell boundaries, the Syncytiotrophoblast .
- The embryoblast differentiate into two layers: (a) hypoblast layer a layer of small cuboidal cells adjacent to the blastocyst cavity; and (b) the epiblast layer : a layer of high columnar cells adjacent to the amniotic cavity
- a small cavity appears within the epiblast. This cavity enlarges to become the amniotic cavity. Epiblast cells adjacent to the cytotrophoblast are called amnioblasts; together with the rest of the epiblast, they line the amniotic cavity .

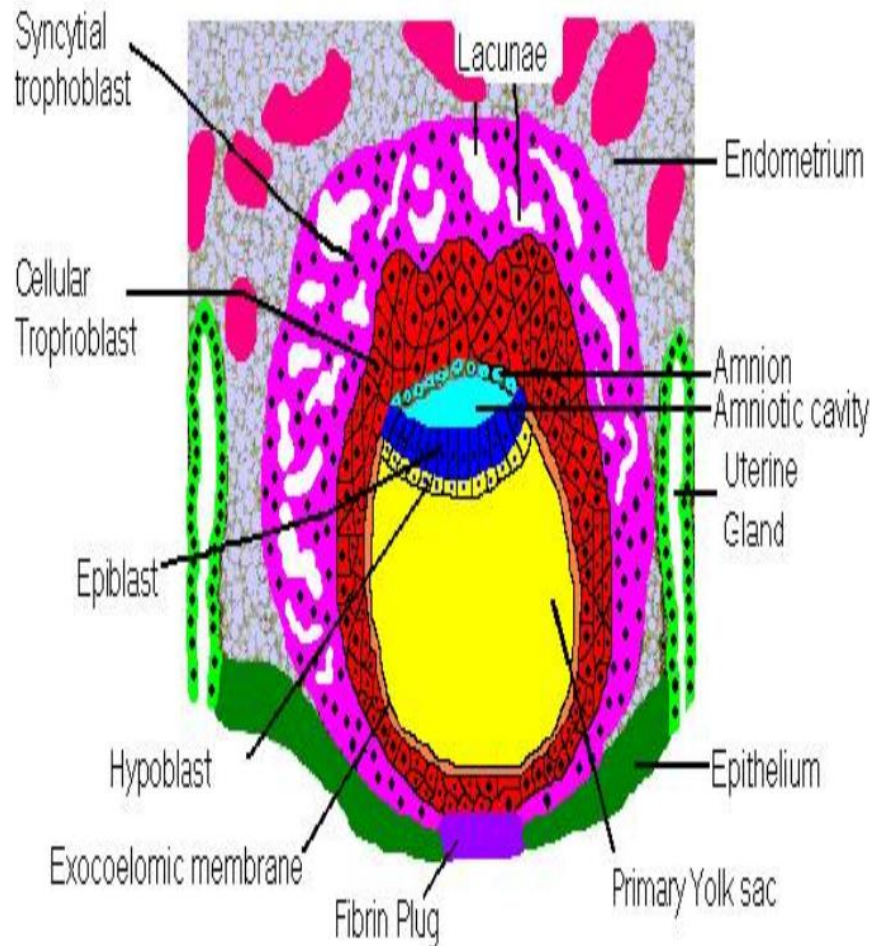


Day 7-8

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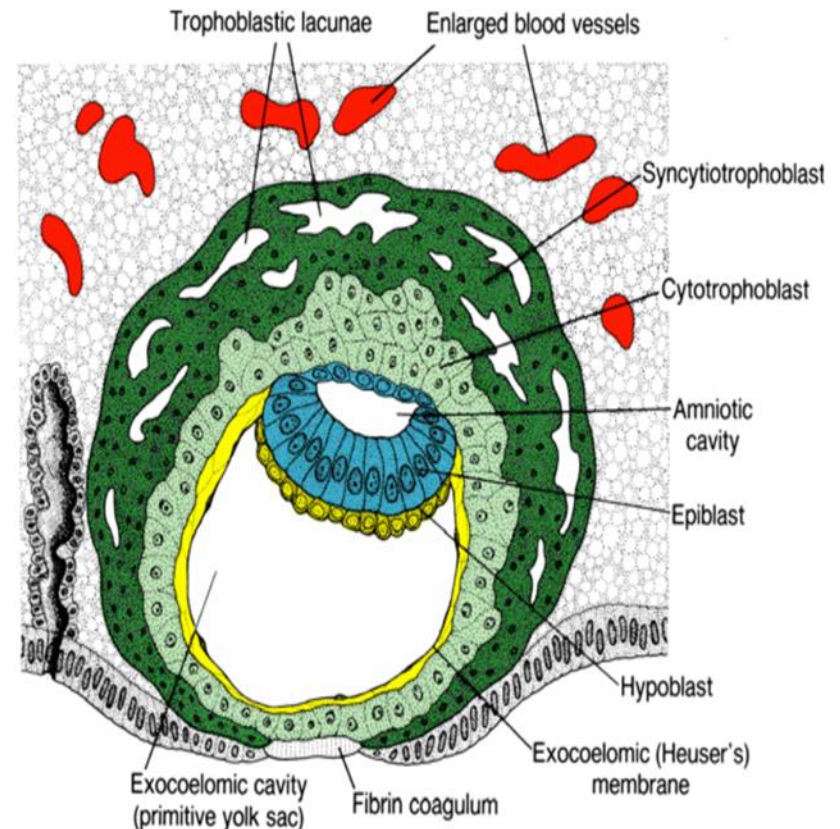
Day 9



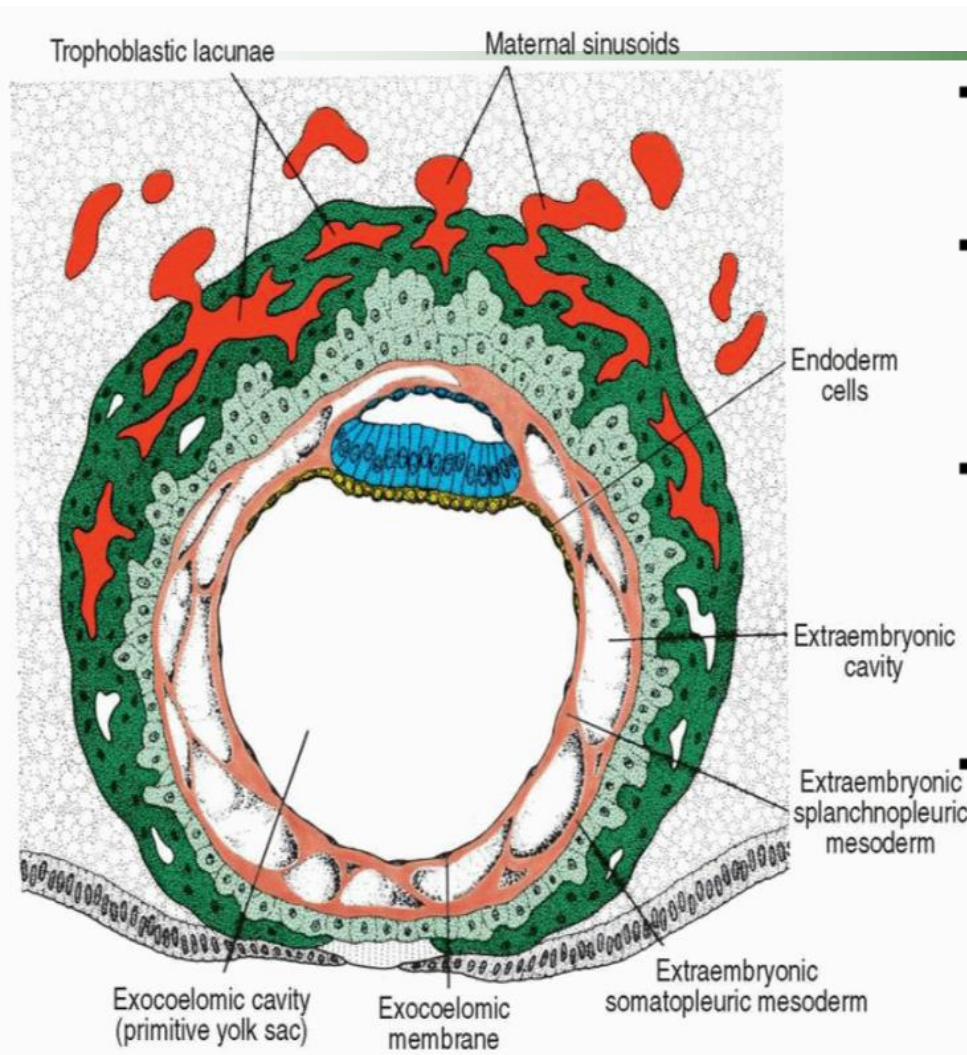
- The blastocyst is more deeply embedded in the endometrium, and the penetration defect is closed by a fibrin coagulum
- The trophoblast (lacunar stage) : vacuoles, appearing in the syncytium, fuse and form large lacunae.
- Embryoblast – bilaminar germ disc : epiblast (columnar) and hypoblast (cuboidal)
- Exocoelomic (Heuser's) membrane : flattened cells probably originating from the hypoblast form this membrane, that lines the inner surface of the cytotrophoblast . This membrane, together with the hypoblast, forms the lining of the exocoelomic cavity, or primitive yolk sac.

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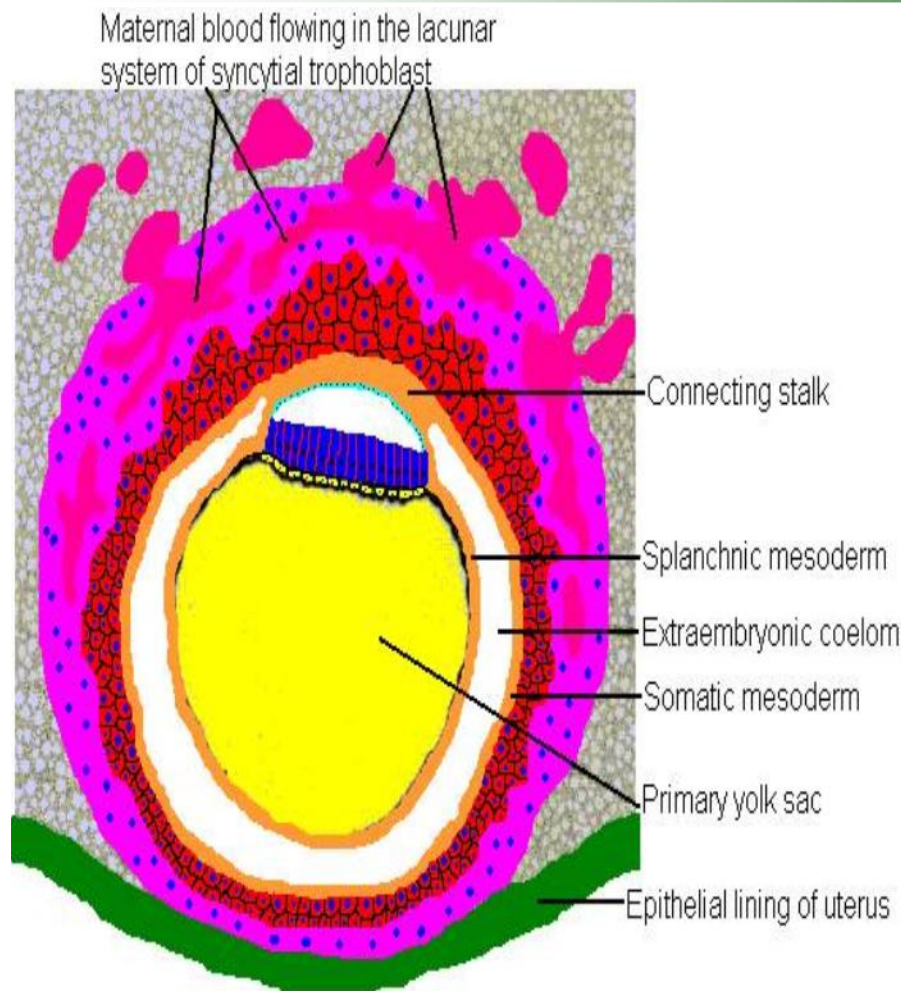


Days 11 and 12



- The blastocyst is completely embedded in the endometrial stroma, and the surface epithelium almost entirely covers the original defect in the uterine wall
- lacunar spaces in the syncytium form an intercommunicating network which is particularly evident at the embryonic pole; at the abembryonic pole, the trophoblast still consists mainly of cytotrophoblastic cells
- Cells of the syncytiotrophoblast penetrate deeper into the stroma and erode the endothelial lining of the maternal capillaries which are congested and dilated, (sinusoids). The syncytial lacunae become continuous with the sinusoids, and maternal blood enters the lacunar system establishing the uteroplacental circulation
- Growth of Bilaminar germ layer is relatively slow compared with that of the trophoblast

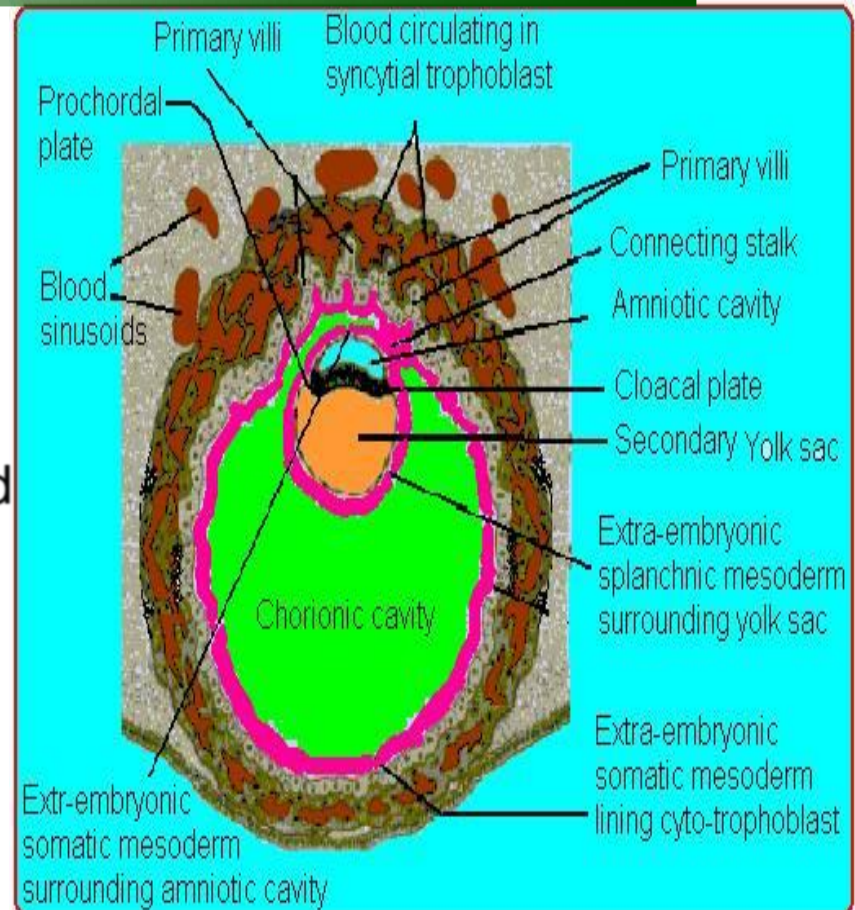
Days 11 and 12



- a new population of cells appears between the inner surface of the cytotrophoblast and the outer surface of the exocoelomic cavity. These cells, derived from yolk sac cells, form a fine, loose connective tissue, the extraembryonic mesoderm, which eventually fills all of the space between the trophoblast externally and the amnion and exocoelomic membrane internally.
- Soon, large cavities develop in the extraembryonic mesoderm, and when these become confluent, they form a new space known as the extraembryonic coelom, or chorionic cavity. This space surrounds the primitive yolk sac and amniotic cavity, except where the germ disc is connected to the trophoblast by the connecting stalk.
- The extraembryonic mesoderm lining the cytotrophoblast and amnion is called the extraembryonic somatopleuric mesoderm;
- The extraembryonic mesoderm covering the yolk sac is known as the extraembryonic splanchnopleuric mesoderm.

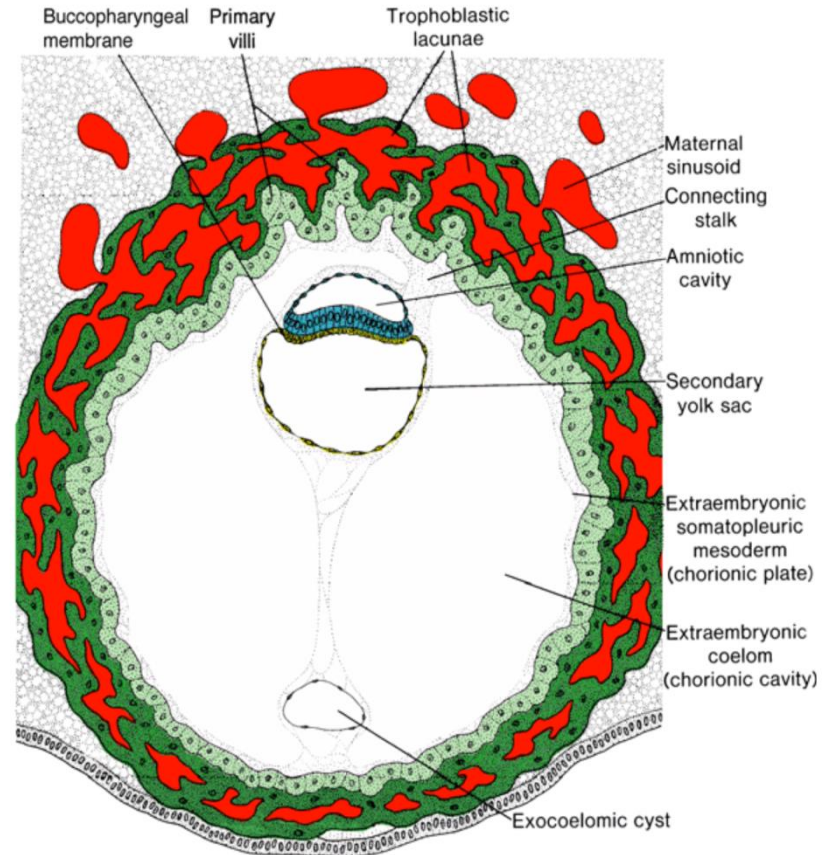
Day 13

- The surface defect in the endometrium has usually healed .
- The trophoblast is characterized by villous structures (primary villi) which are cellular columns of cytotrophoblast surrounded by syncytium . is represented
- The germ disc by 2 apposed discs : hypoblast and epiblast



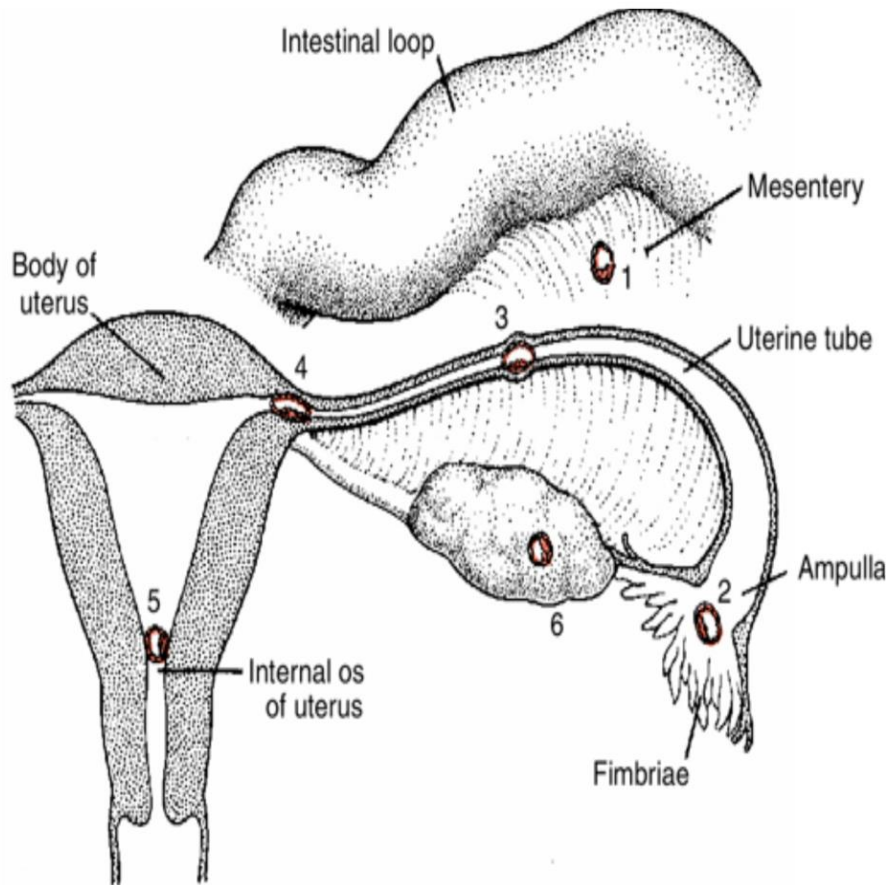
Day 13

- the hypoblast produces additional cells that migrate along the inside of the exocoelomic membrane. These cells proliferate and gradually form a new cavity within the exocoelomic cavity. This new cavity is known as the secondary yolk sac or definitive yolk sac. This yolk sac is much smaller than the original exocoelomic cavity, or primitive yolk sac.
- Exocoelomic cysts : large portions of the exocoelomic cavity are pinched off during the formation of the secondary yolk sac. These portions are found in the extraembryonic coelom or chorionic cavity.
- the extraembryonic coelom expands and forms a large cavity, the chorionic cavity.
- The extraembryonic mesoderm lining the inside of the cytotrophoblast is then known as the chorionic plate.
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- With development of blood vessels, the stalk becomes the umbilical cord.
- The only place where extraembryonic mesoderm traverses the chorionic cavity is in the connecting stalk . With development of blood vessels, the stalk becomes the umbilical cord.



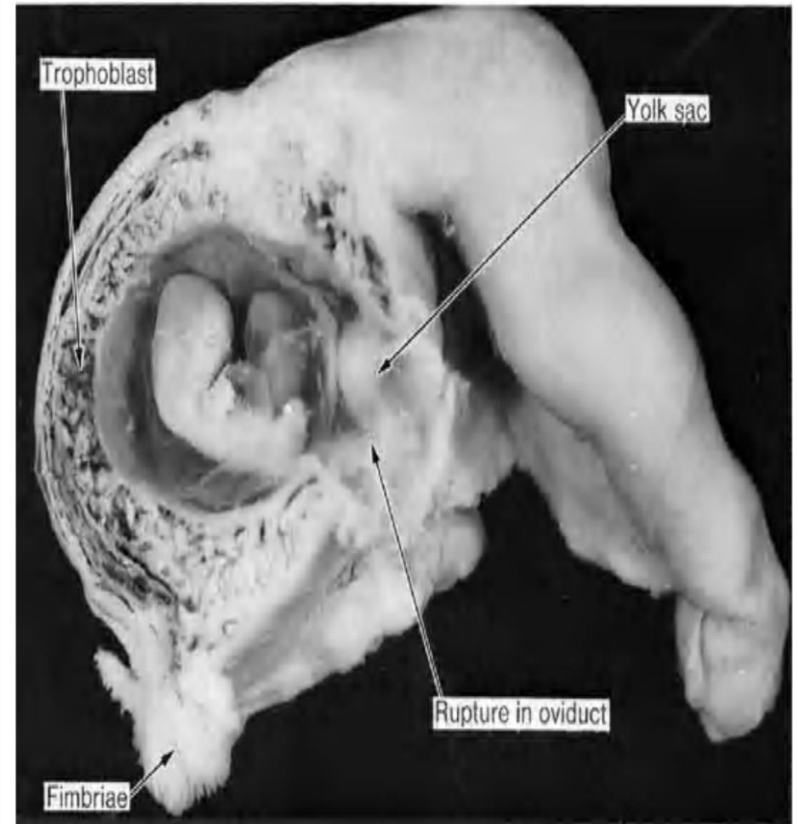
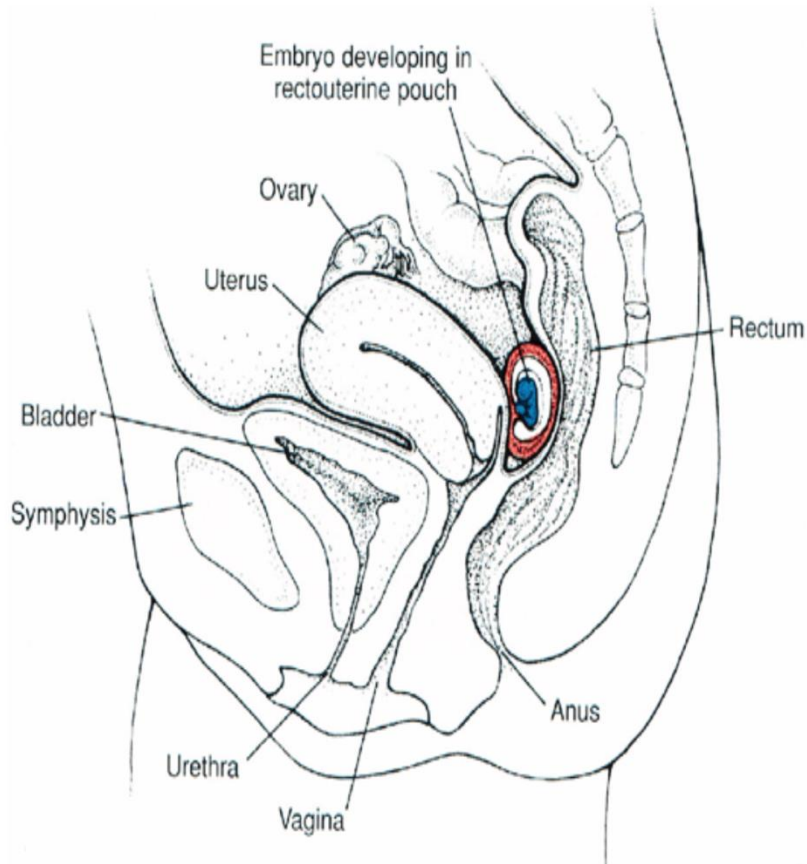
Clinical Correlates

Abnormal Implantation of the blastocyst



- 1. implantation in the abdominal cavity [the ovum most frequently implants in the rectouterine cavity (Douglas pouch) but may implant at any place covered by peritoneum];
- 2. implantation in the ampullary region of the tube;
- 3. subabdominal implantation;
- 4. interstitial implantation, e.g., in the narrow portion of the uterine tube;
- 5. implantation in the region of the internal os, frequently resulting in placenta previa; and
- 6. ovarian implantation.

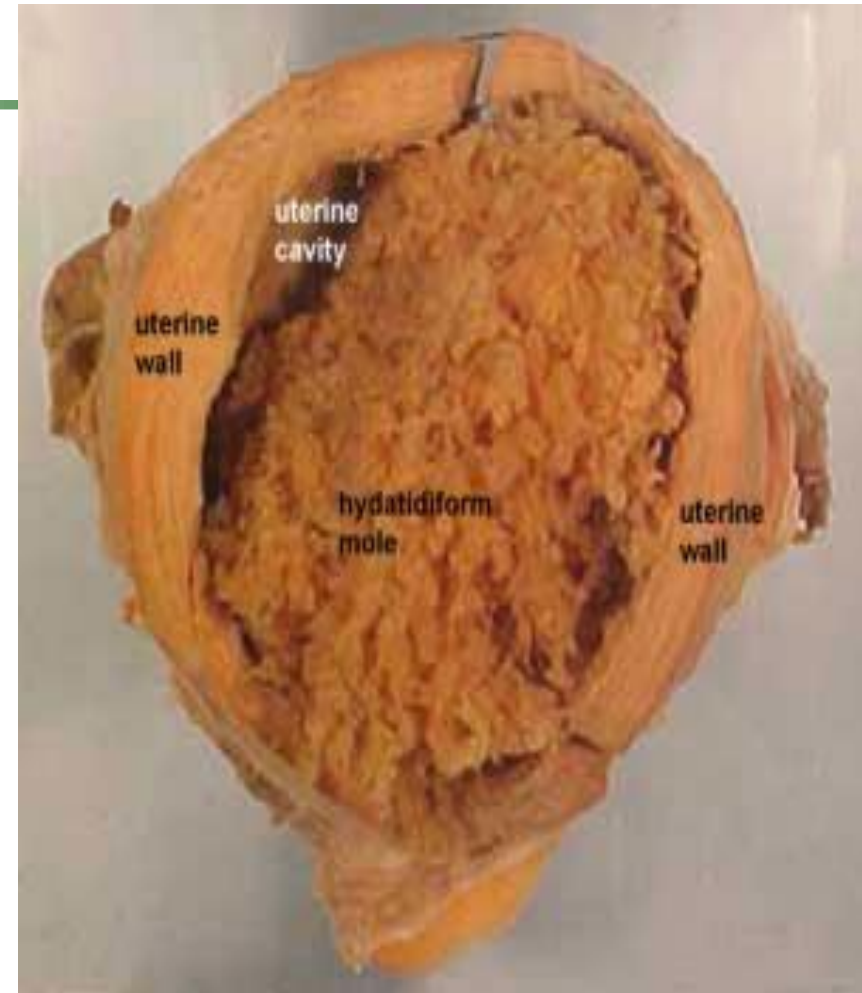
Abnormal implantation sites



hydatidiform mole

mole

- the trophoblast develops and forms placental membranes with little or no embryonic tissue . Such a condition is known as a hydatidiform mole.
- Moles secrete high levels of hCG and may produce benign or malignant (invasive mole, choriocarcinoma) tumors.

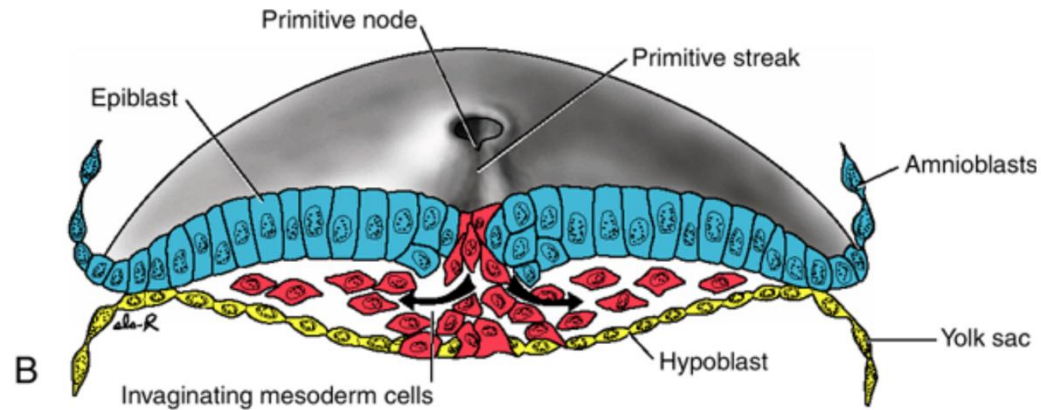


hydatidiform mole

mole

- most moles arise from fertilization of an oocyte lacking a nucleus followed by duplication of the male chromosomes to restore the diploid number .
- These results suggest that **paternal genes** regulate most of the development of the trophoblast .
- male and female pronuclei may be genetically equivalent but they may be different functionally.

Thank you



- Next lecture: Third week of Development

SNipER