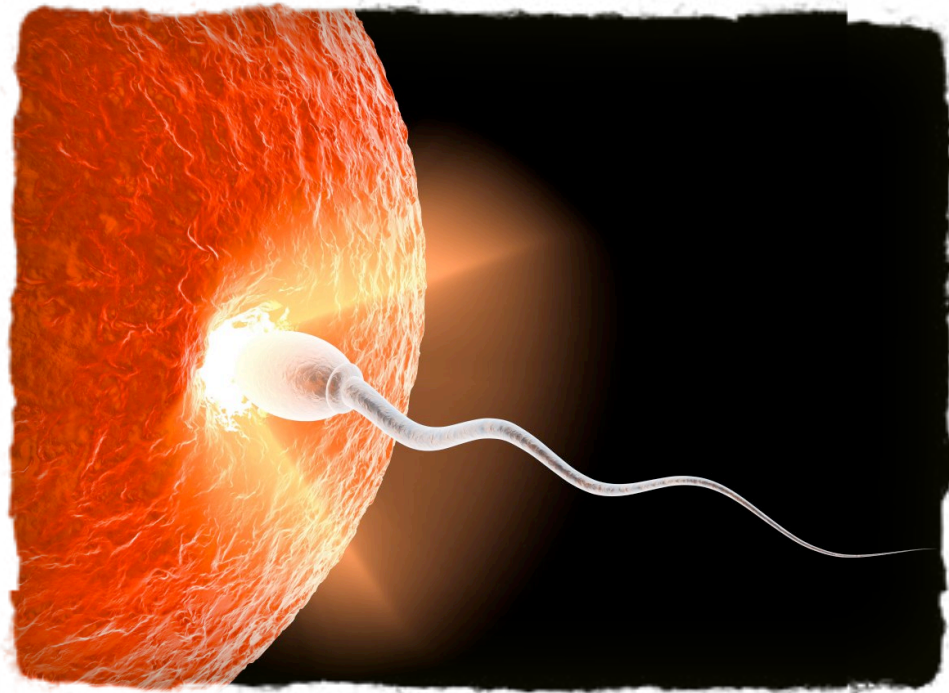


# EMBRYOLOGY FOUNDATION BLOCK



## Second lecture Fertilization and Implantation

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# Fertilization:

- Fusion of male **sperm** and female **oocyte** to form zygote.
- It begins with contact between sperm and ovum where **chemical signals** from the oocyte attracts sperms. Oocyte: cannot be fertilized after **24** hours ,Sperm: does not survive for more than **48** hours.
- Ends up with intermingling of maternal and paternal chromosomes.
- **Site:** It usually occurs in the **ampulla** of uterine tube Ampulla (the widest part of the uterine tube) or it may occur in another part of the tube. **Never** occurs in the uterine cavity.

## Stages:

- 1) Passage of sperm through corona radiata: The sperms passes first through cells of **corona radiata** by the effect of **hyaluronidase enzyme** + the movement of its tail.
- 2) Penetration of Zona Pellucida: Acrosomal enzymes allow only one sperm to create a tract through the zona pellucida.
  - **Zonal reaction:** it is a change in properties of zona pellucida that makes it **impermeable** to *other* sperms after fertilization.
- 3) Fusion of plasma membranes of the ovum and sperm: Sperm content enters into the oocyte. Sperm undergoes morphological changes.
- 4) Completion of 2nd mitotic division and formation of pronucleus.
- 5) Formation of male pronucleus.
- 6) Fusion of the two pronuclei.

## Results:

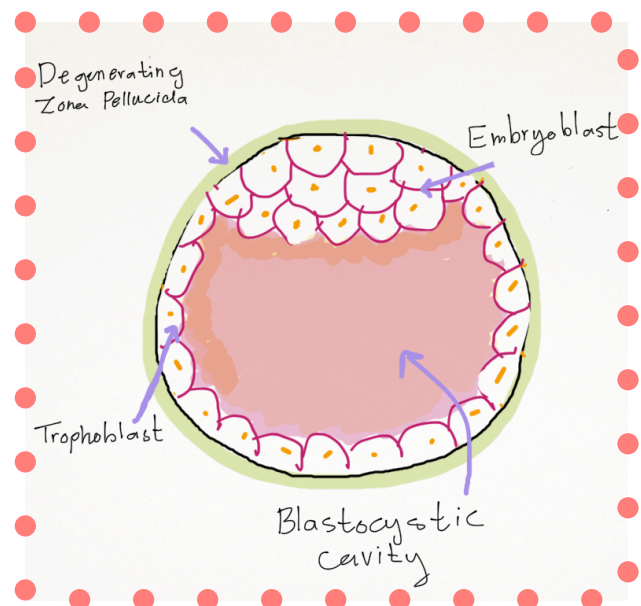
A) The diploid number of chromosomes is restored.

B) Embryo's sex is determined at the time of fertilization depending on the type of sperm from the **father** (X or Y).

C) Cleavage initiation.

- **Cleavage:** Repeated mitotic divisions of the zygote. Begins 30 hours after fertilization. During cleavage, zygote is still within the zona pellucida. Normally occurs in the uterine tube with rapid increase in the number of the cells. Resulting in smaller embryonic cells are now called **Blastomeres**.
- Zygote is genetically unique. This is because of the new combination formed. This **biparental** inheritance leads to genetic variation.
- After the 8 cell stage, cells are compactly arranged (**compaction**).
- Spherical **Morula** (12-32 blastomeres) is formed **3 days** after fertilization.
- After the **5<sup>th</sup>** day of fertilization zona pellucida degenerates.

- **Blastocyst stage:** Morula develops into **blastocyst** with a (1) blastocystic cavity (**blastocoele**) + (2) outer cell layer (**Trophoblast**) and (3) inner cell layer mass (**embryoblast**) or the embryonic pole.
- It is nourished by the secretions of the uterine wall. Now it is ready for implantation.



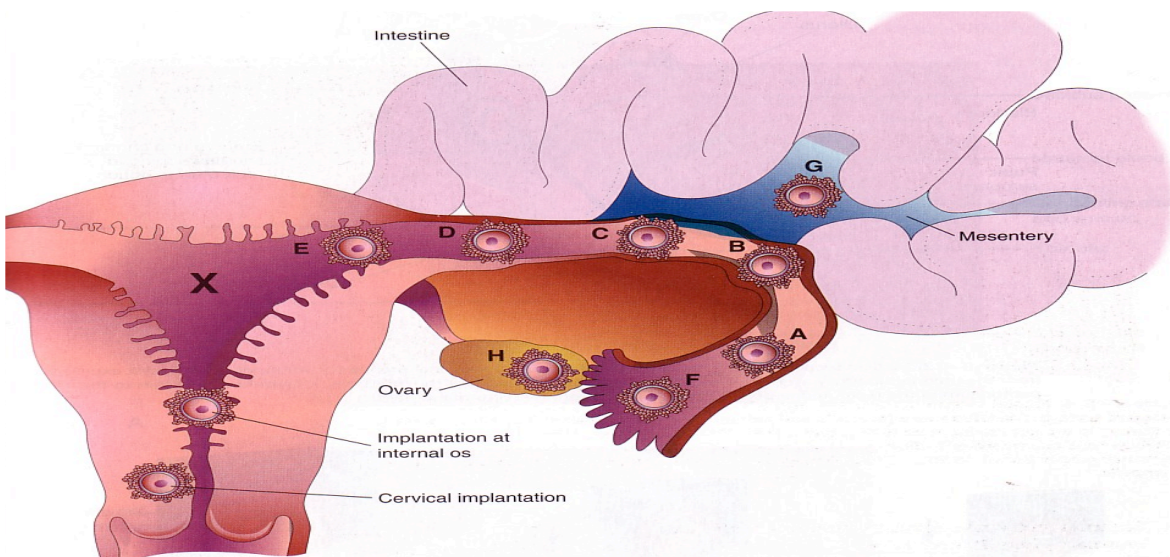
## IMPLANTATION:

- It occurs at **6<sup>th</sup> day till 12<sup>th</sup> day** in the posterior wall of the uterus, near the **fundus**. Blastocyst (usually from the embryonic pole) penetrates endometrium using proteolytic enzyme. It is implanted in the **superficial compact layer** of the endometrium.
- 7<sup>th</sup> day: Now the **Trophoblast** is differentiated into 2 layers:
  - a) **Cytotrophoblast**, inner layer, mitotically active.
  - B) **Syncytiotrophoblast** (outer multinucleated mass, with indistinct cell boundary) It **erodes** the **endothelial lining** of the **maternal capillaries** which are known as **sinusoids** with finger-like processes. At day 12, the defect in the endometrial epithelium is filled by a **closing plug** ( a blood clot).
- **Blood-filled Lacunae** appears in the **Syncytiotrophoblast** which **communicate** forming a network by the **10<sup>th</sup> or 11<sup>th</sup> day**. Now blood of **maternal capillaries** reaches the **lacunae** so **Primitive uteroplacental circulation** is established by **11<sup>th</sup> or 12<sup>th</sup> day**.
- **Endometrial cells** undergo **apoptosis** (programmed cell death)
- **Implantation** is detected **ultra sound & hCG** secreted by the **Syncytiotrophoblast** about the **end** of 2<sup>nd</sup> week.

## Possible implantation sites and corresponding condition:

- Normally occurs in *posterior wall* of **endometrium of uterus**.
- **Placenta Praevia**: implantation occurs in the lower uterine segment.
- **Extrauterine(Ectopic)**: ectopic pregnancy in (ovary-abdomen-cervical). **95% to 97%** occurs in the **uterine tube** especially in the **ampulla** and **isthmus**.
- **Early pregnancy factor**:
  - a) An immunosuppressant protein.
  - b) Secreted by trophoblast cells.
  - c) Appears in the maternal serum within 24-48 hours.

- It is the basis of EPT in the first 10 days of development.
- **On the graph below:**
- Normal site (X)
- The approximate order of pregnancy of ectopic implantations is indicated **alphabetically** (A, most common, H, least common).  
A to F, **Tubal pregnancies**. G, **Abdominal pregnancy**. H, **Ovarian pregnancy**. Tubal pregnancies are the most common type of ectopic pregnancy. Although appropriately included with uterine pregnancy site, a cervical pregnancy is often considered to be an ectopic pregnancy.



3 - 10. Implantation sites of blastocysts. The usual site in the posterior wall of the uterus is indicated by an X. The approximate order of frequency of ectopic implantations is indicated alphabetically (A, most common, H, least common). A to F, Tubal pregnancies. G, Abdominal pregnancy. H, Ovarian pregnancy. Tubal pregnancies are the most common type of ectopic pregnancy. Although appropriately included with uterine pregnancy sites, a cervical pregnancy is often considered to be an ectopic pregnancy.

**Check point! Can you:**

- Define terms “fertilization” and “implantation”?
- Describe phases and outcome of fertilization?
- Describe cleavage and at which stage implantation occurs?
- Define the normal and abnormal sites for implantation?





- **Where does fertilization occur ?** Ampulla of the uterine tube.
- **Which one of the following is the result of fertilization ?** Initiation of cleavage.
- **Where does implantation occur ?** Posterior wall of the body of uterus.
- **Implantation begins ?** 6 days after fertilization.
- **Fertilization begins ?** 12 hours after ovulation.
- **Implantation happens at which stage?** Blastocyst.
- **Which cell layer is concerned with implantation?** Syncytiotrophoblast.

*Timeline:*

*Fertilization & Implantation*

*30 hours - Cleavage*

*3<sup>rd</sup> day - Morula*

*5<sup>th</sup> day - ZP degeneration*

*6<sup>th</sup> day - Implantation*

*7<sup>th</sup> day - Trophoblast differentiated*

*8<sup>th</sup> day - The blastocyst is embedded in the compact layer of the endometrium.*

*12<sup>th</sup> day - Uteroplacental circulation formed*

*13<sup>th</sup> day - Proliferation of Cytotrophoblast cells*

*14<sup>th</sup> day - HCG detection*