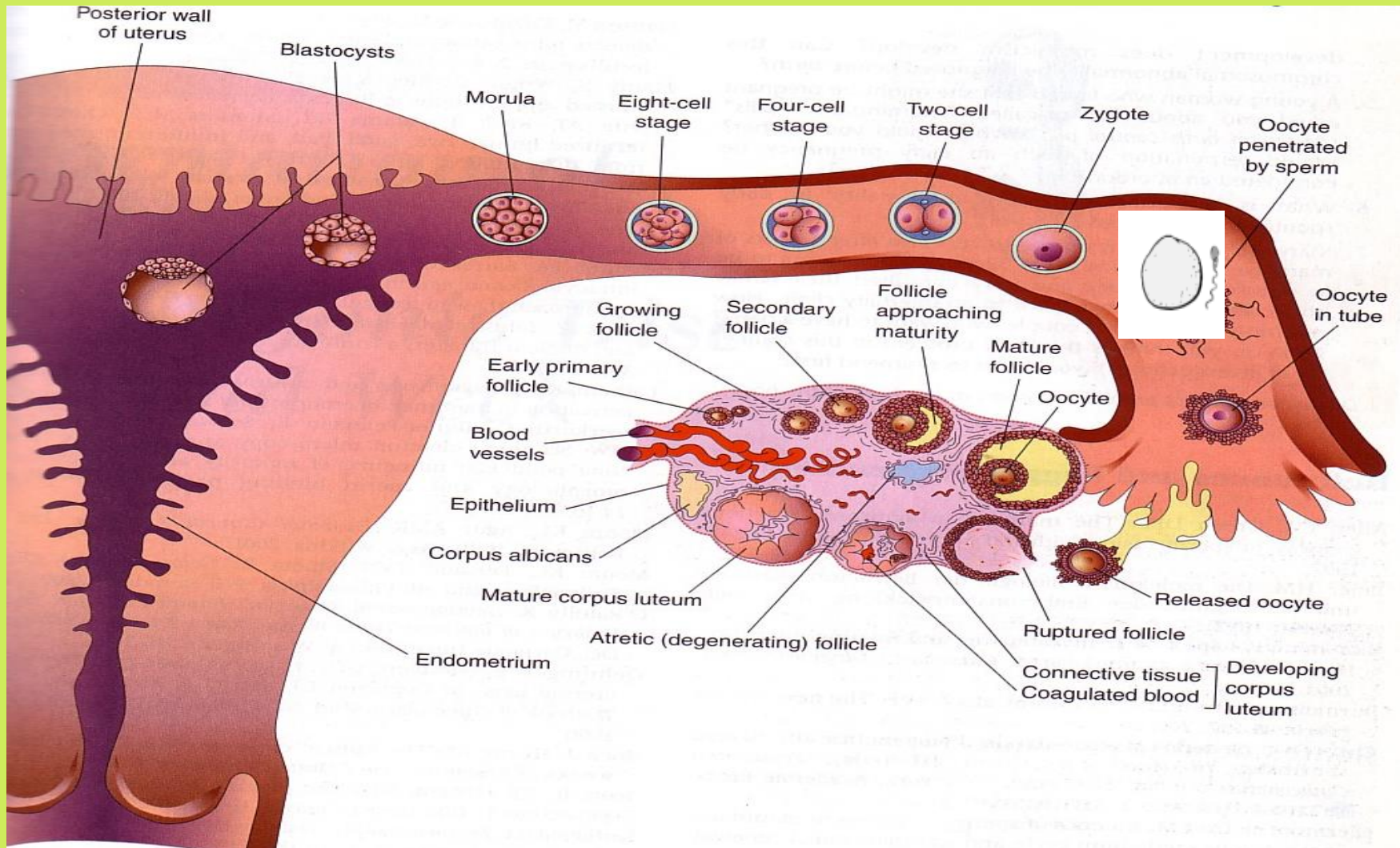


FERTILIZATION & IMPLANTATION

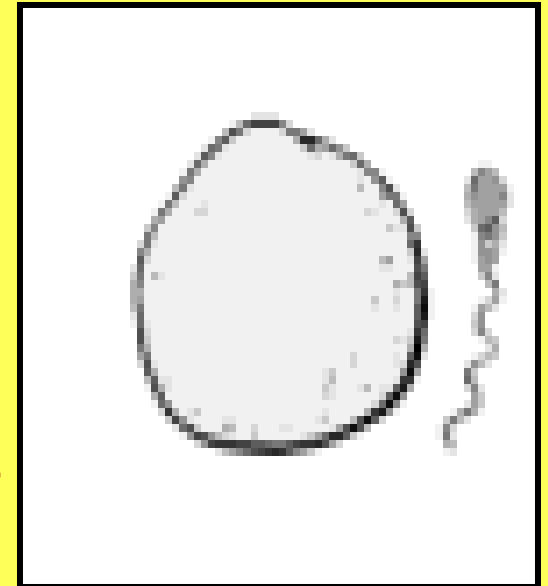


Prof. Saeed Abuel Makarem

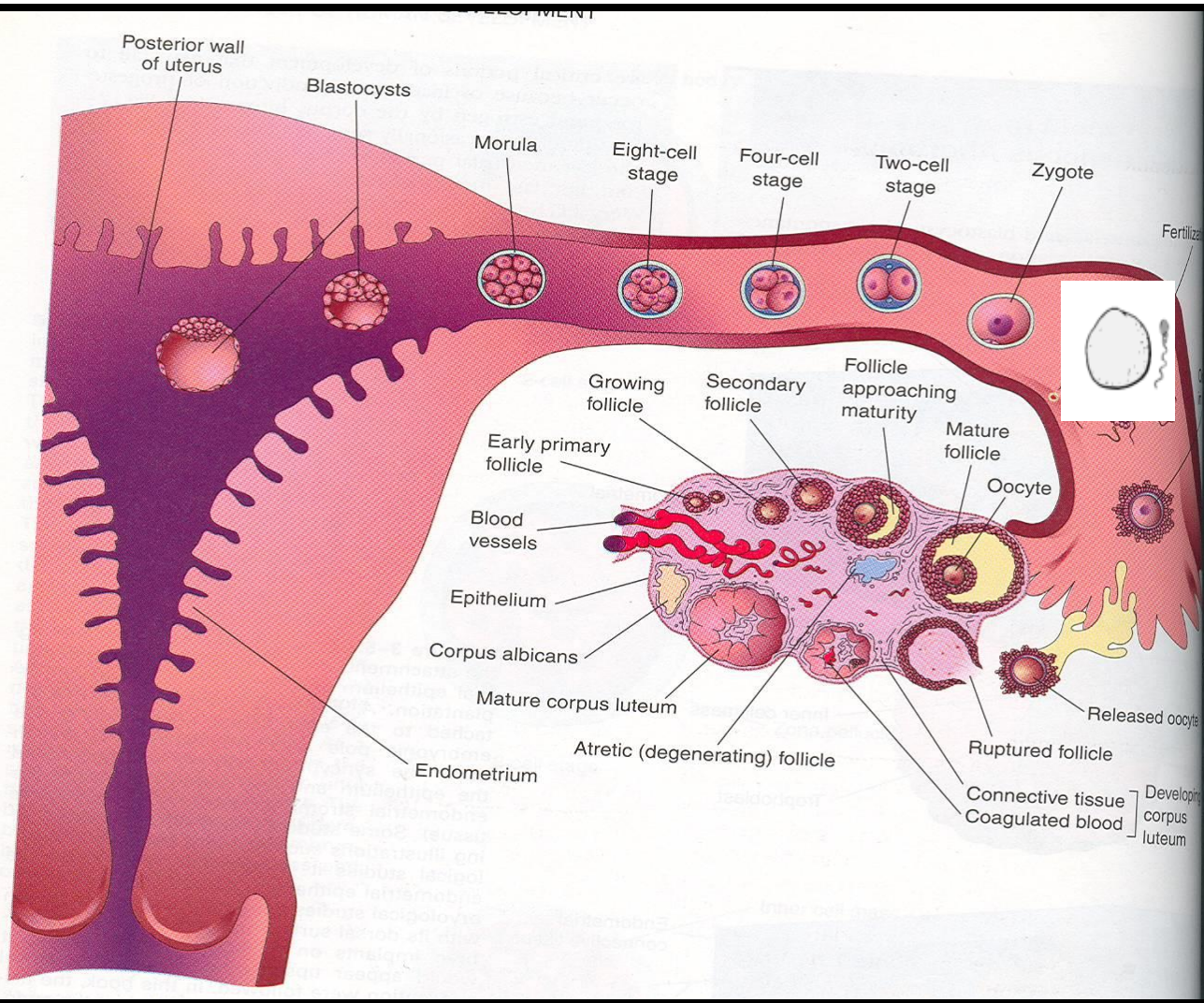
OBJECTIVES

- **By the end of the lecture, you should be able to:**

- Identify fertilization and its site.
- List the phases of fertilization.
- Describe the results of fertilization.
- Describe the formation of blastocyst.
- Identify implantation and its site.
- Describe the mechanism of implantation.
- List the common sites of ectopic pregnancies.



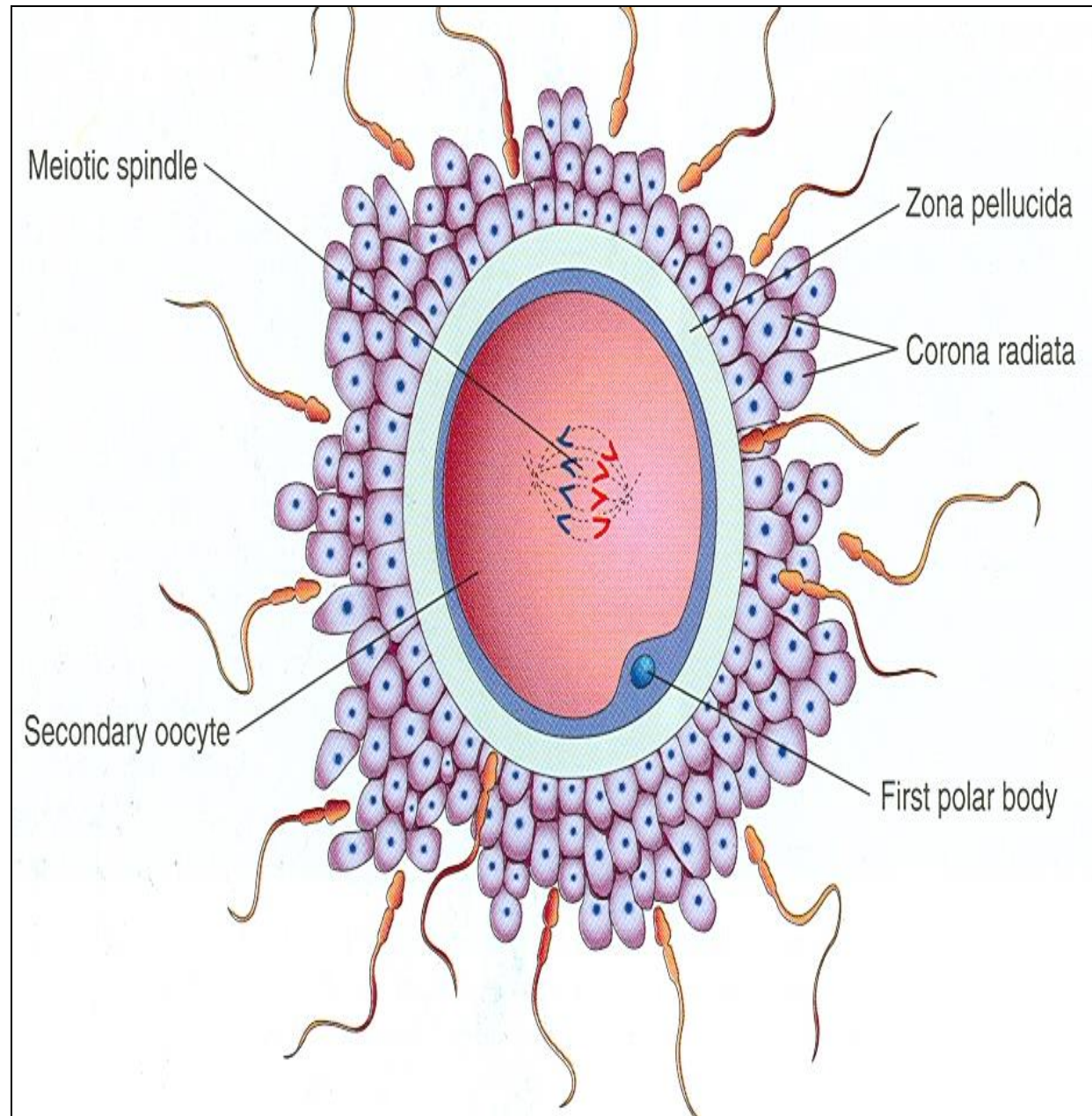
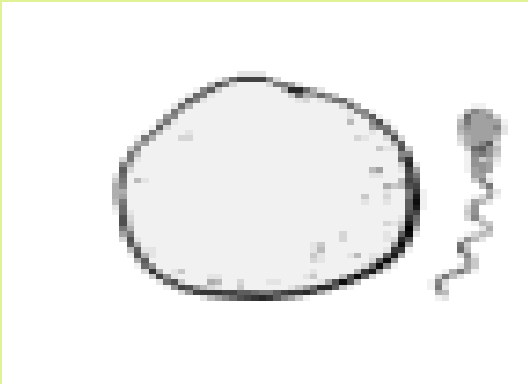
FERTILIZATION



- **Definition:**
- It is the process during which a male gamete (**sperm**), and a female gamete (**oocyte**), unite together to form a single cell (**ZYGOTE**).

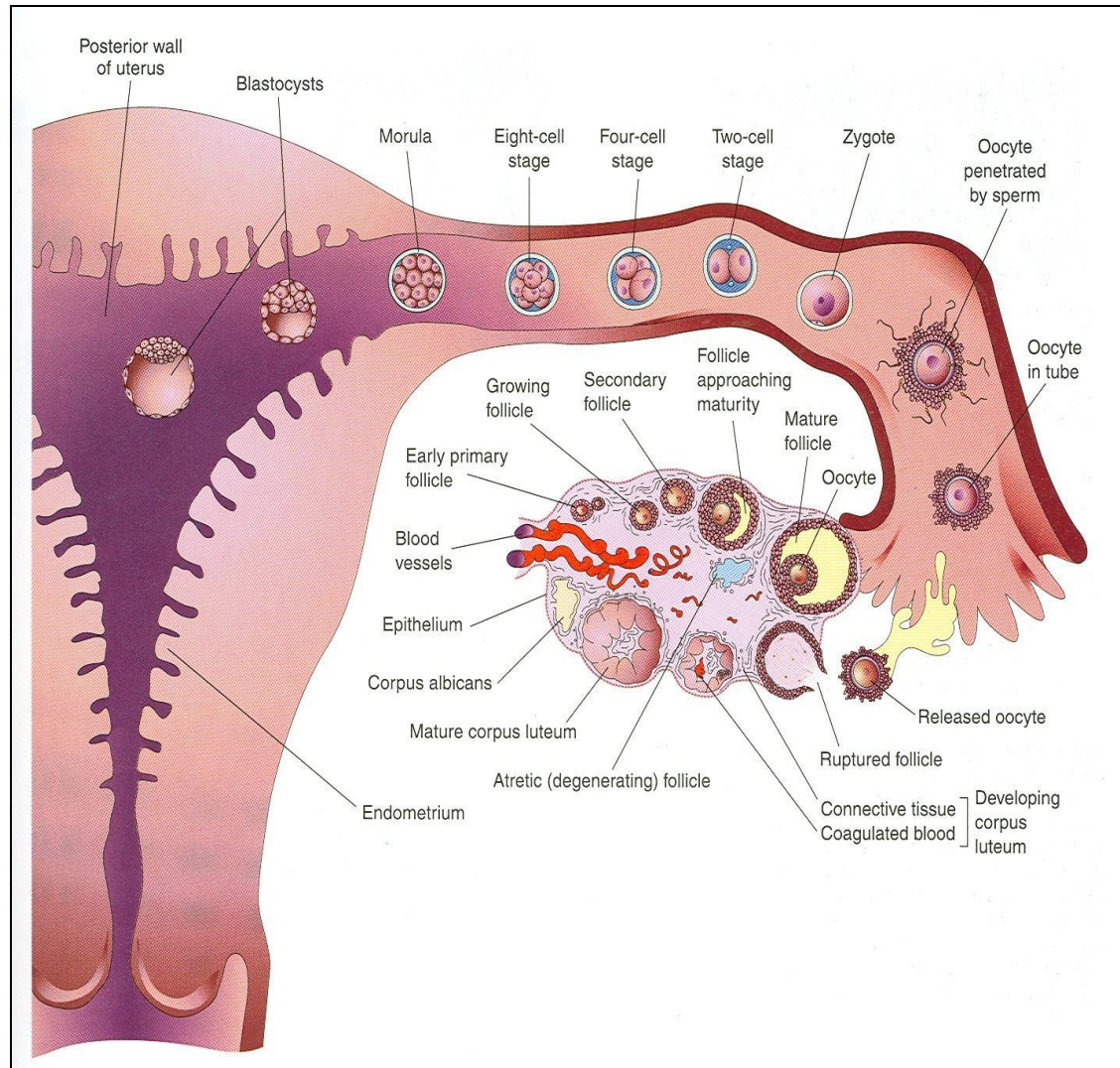
Fertilization

- It is a complex process.
- It begins with a **contact** between sperm & ovum.
- Ends up with **intermingling** of the maternal and paternal chromosomes.



Where Does Fertilization Normally Occur?

- **Usually** in the ampulla of uterine tube.
- **Ampulla** is the widest part of the tube.
- **Fertilization** may occur in any other part of tube.
- **Never occurs in the uterine cavity.**
- **Chemical signal** from oocyte attracts the sperms.
- Peristaltic movement of the tube from medial to lateral.



Phases of Fertilization

1- Passage of the sperm through the cells of the **corona radiata** by **the effect of:**

- a) Hyaluronidase enzyme secreted from the sperms.
- b) By movement of its tail.

2- Penetration of the **zona pellucida** by **acrosine** (a substance secreted from **acrosomal cap**).

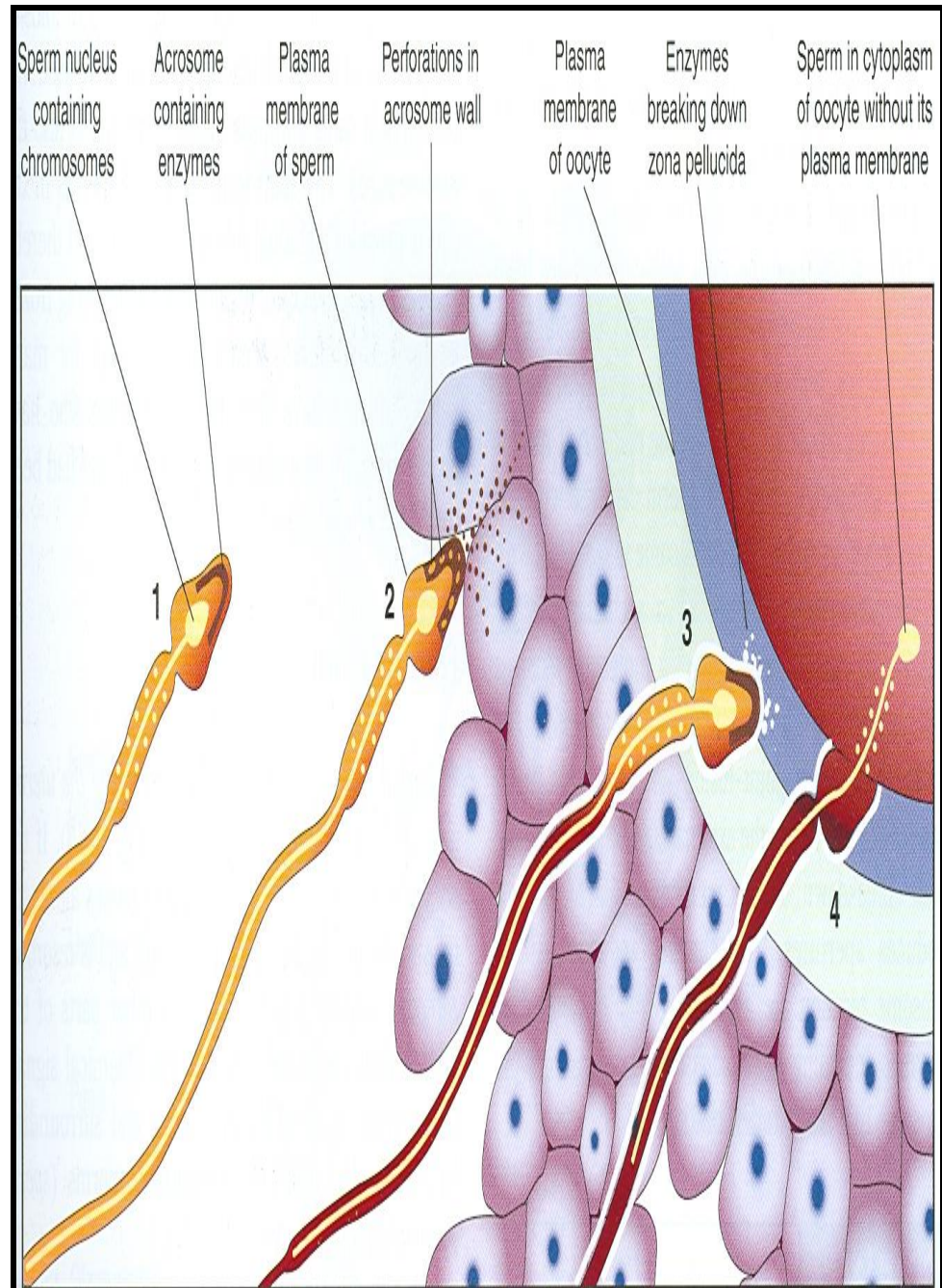
3- Fusion of the plasma membranes of both the oocyte and the sperm.

4- Completion of the second meiotic division of the oocyte, which was arrested at (metaphase).

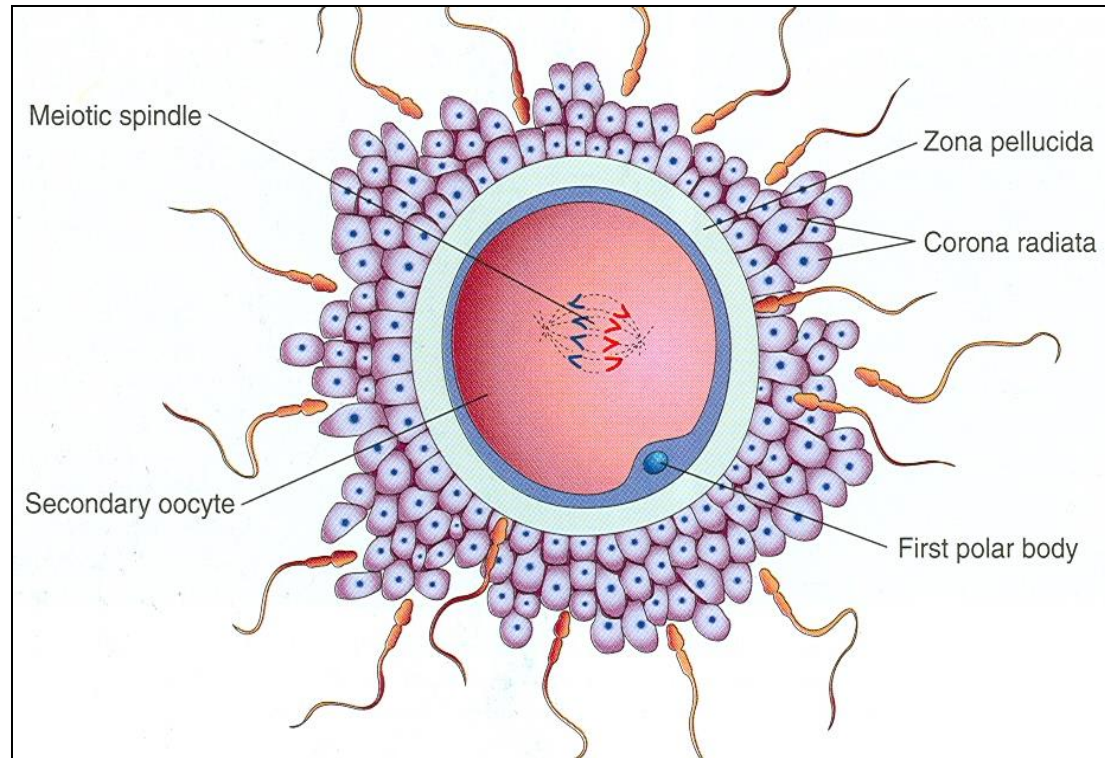
5- Formation of the female pronucleus

6- Formation of the **male** pronucleus.

7- Union of the 2 pronucleii.



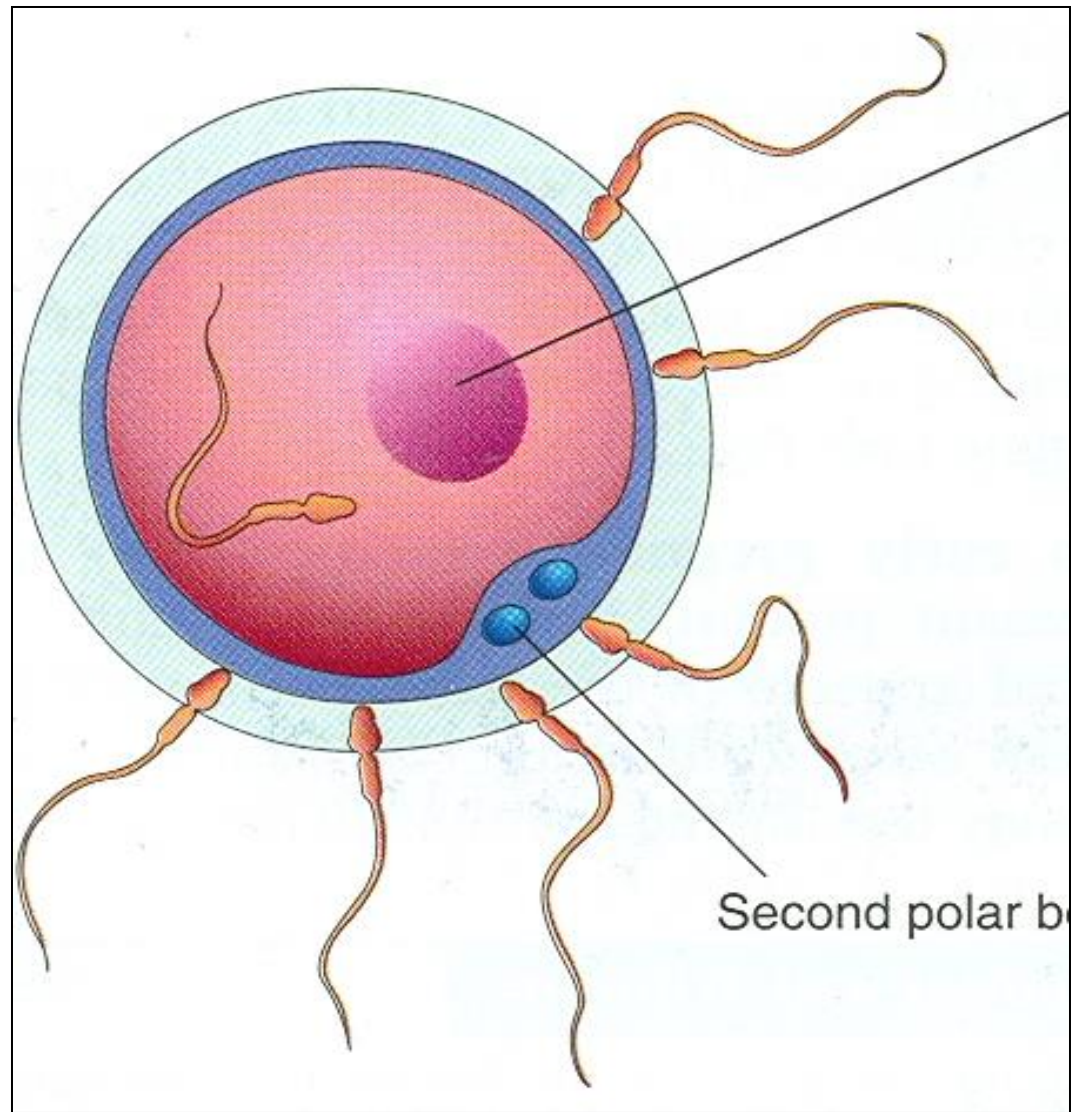
CHROMOSOMES



- **Zygote** is genetically a **unique** structure.
- Half of its **chromosomes** comes from the **father** and the other half comes from the **mother**.
- New combination is formed which is different from either of the parents.
- This mechanism forms **biparental inheritance** and leads to variation of the human species.

Sex of the Embryo

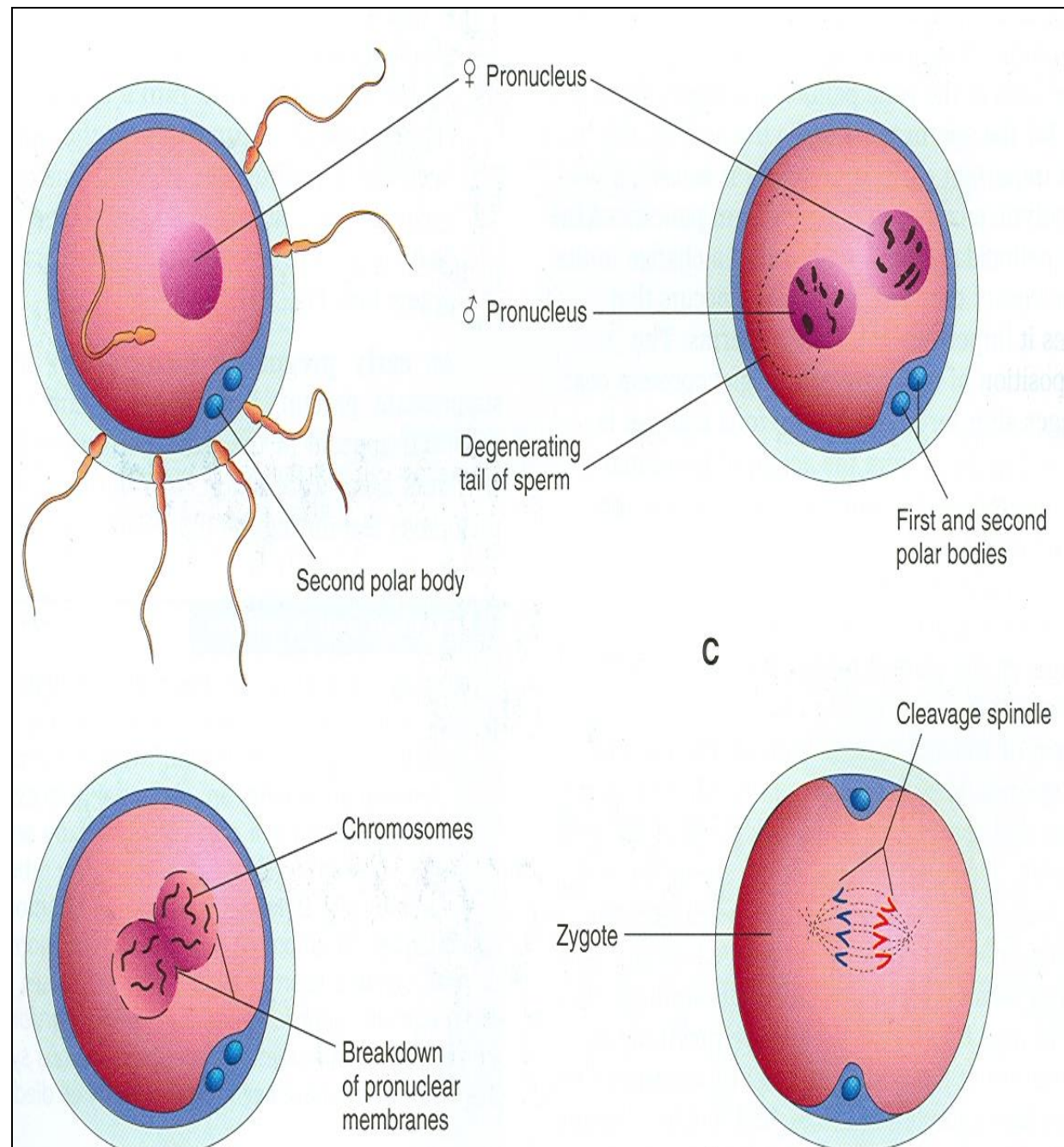
- Embryo's **chromosomal sex** is determined at the time of fertilization.
- Sex is determined by the type of sperm (**X or Y**) that fertilizes the oocyte.
- So, it is the **father** whose gamete decides the sex.



❖ Zonal reaction : it is a change in properties of zona pellucida that makes it impermeable to other sperms.

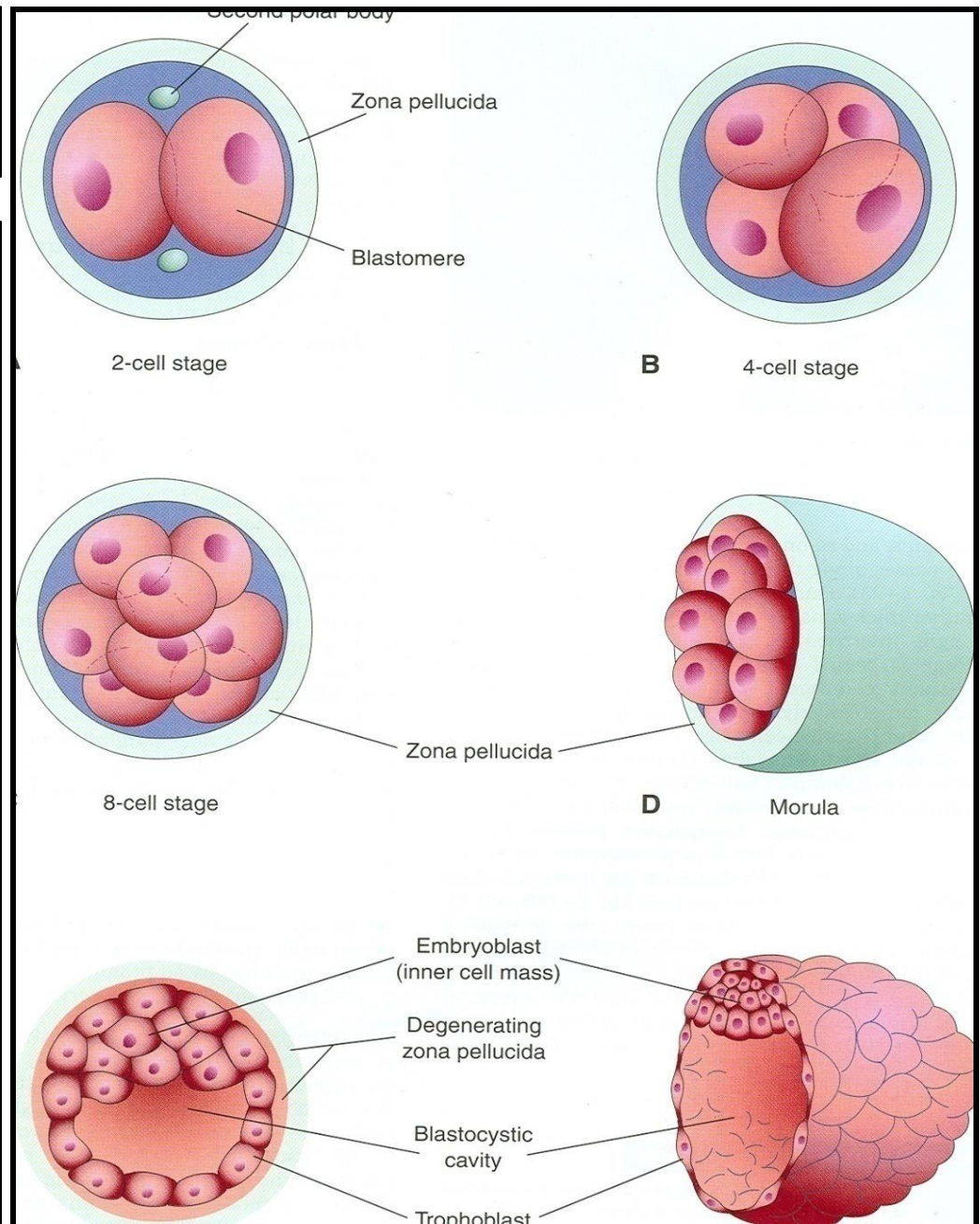
Results of Fertilization

1. Stimulates the penetrated oocyte to complete its **2nd meiotic** division.
2. Restores the normal **diploid** number of chromosomes.
3. Determines the sex of the embryo.
4. Initiates cleavage of the zygote (**cell division**).



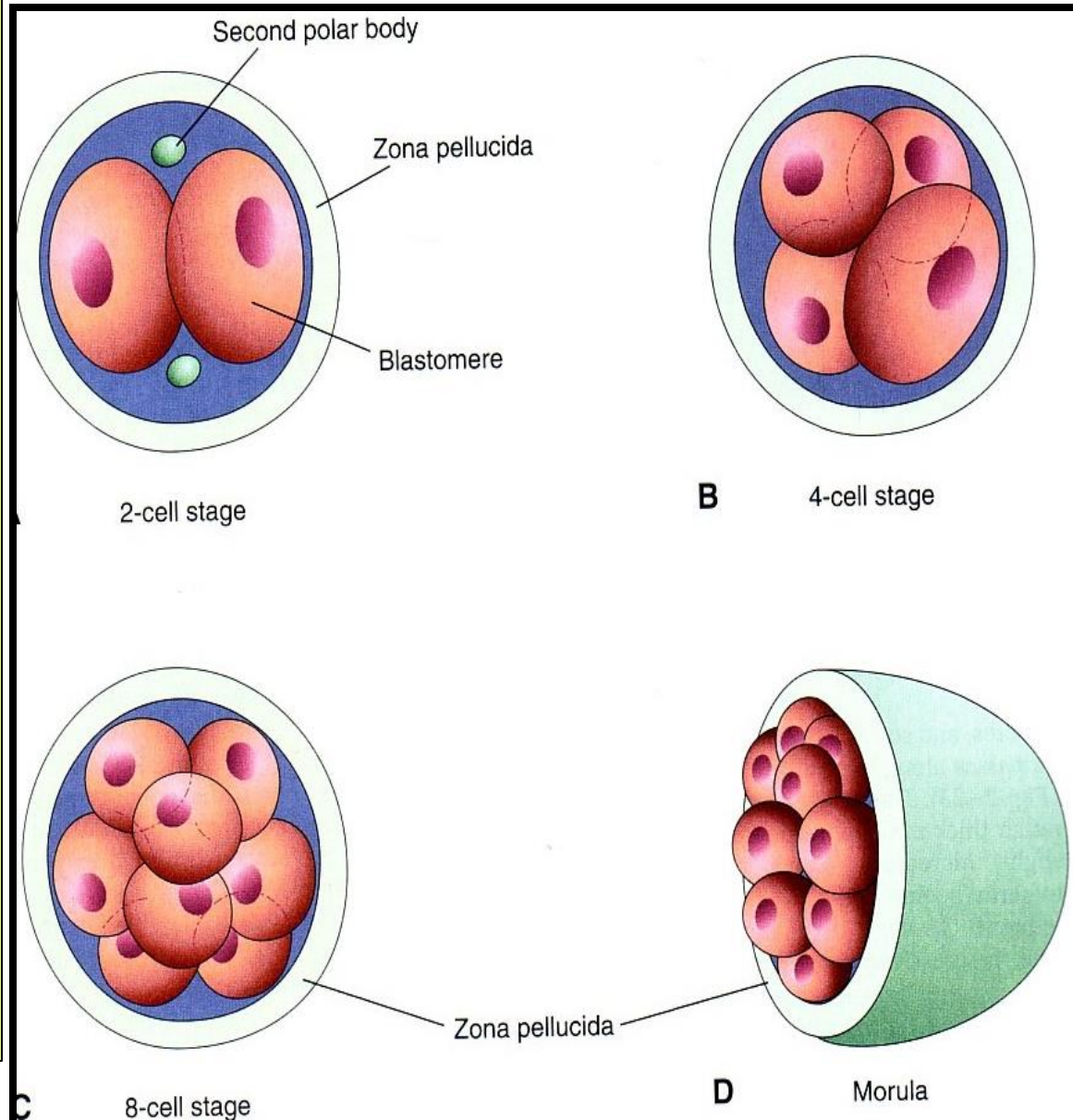
Cleavage of Zygote

- It is the repeated **mitotic** divisions of the zygote.
- Normally occurs in the uterine tube.
- Rapid increase in the number of the cells.
- These smaller embryonic cells are now called, **Blastomeres**.



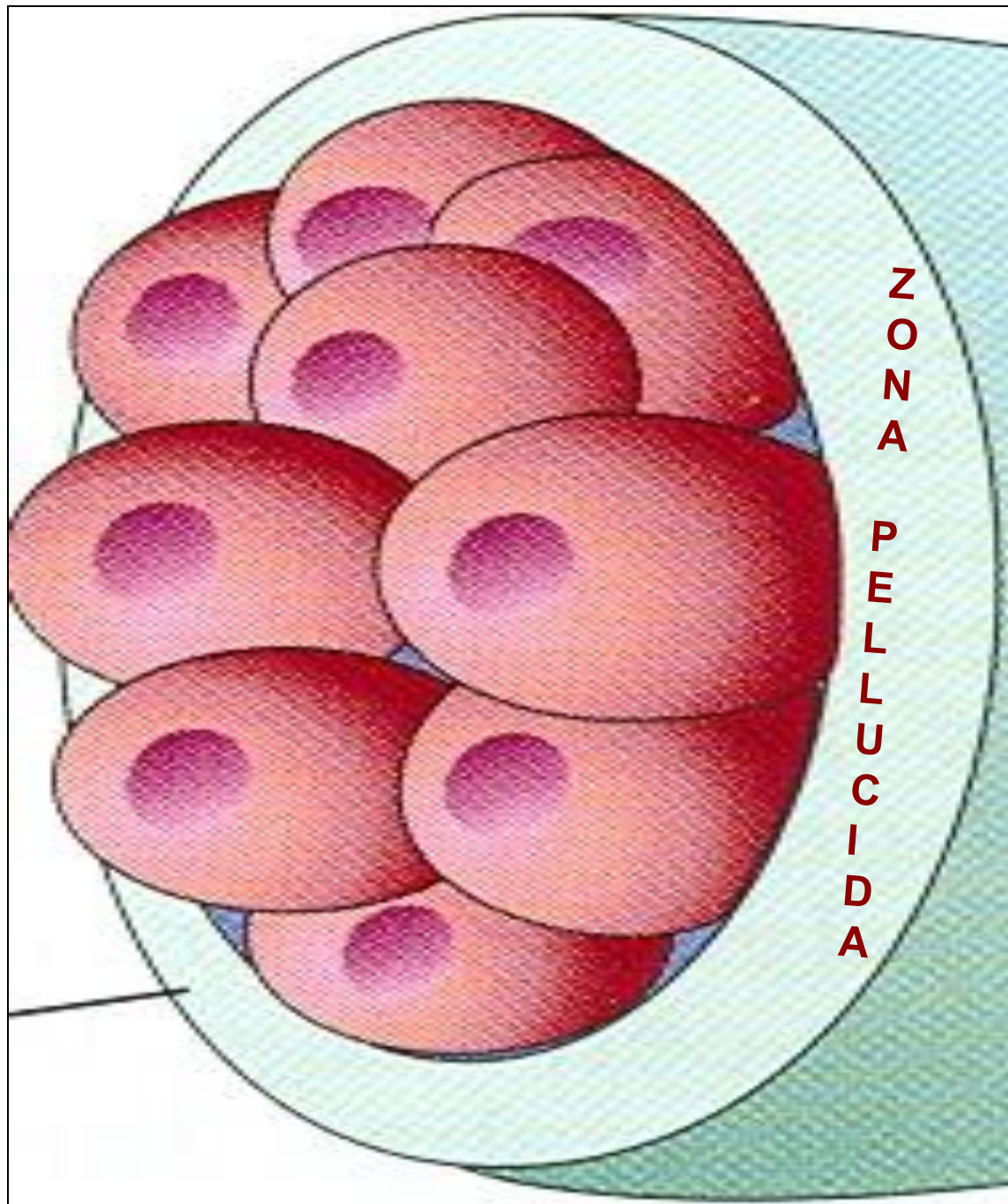
Cleavage of Zygote

- Cleavage begins about **30 hours** after fertilization.
- Zygote divides into **2**, then **4**, then **8**, then **16** cells.
- Zygote lies within the thick **zona pellucida** during cleavage.
- Zygote migrates in the uterine tube during cleavage from its lateral end to its medial end.
- Under the microscope, the zona pellucida is a translucent membrane.



Morula

- When there are 16 to 32 blastomeres the developing human is called **MORULA**.
- The **Morula** reaches the uterine cavity at this stage.
- Spherical **Morula** is **formed** about the **3rd** day after fertilization.
- It resembles mulberry or blackberry.
- It reaches the uterine cavity by the **4th** day.

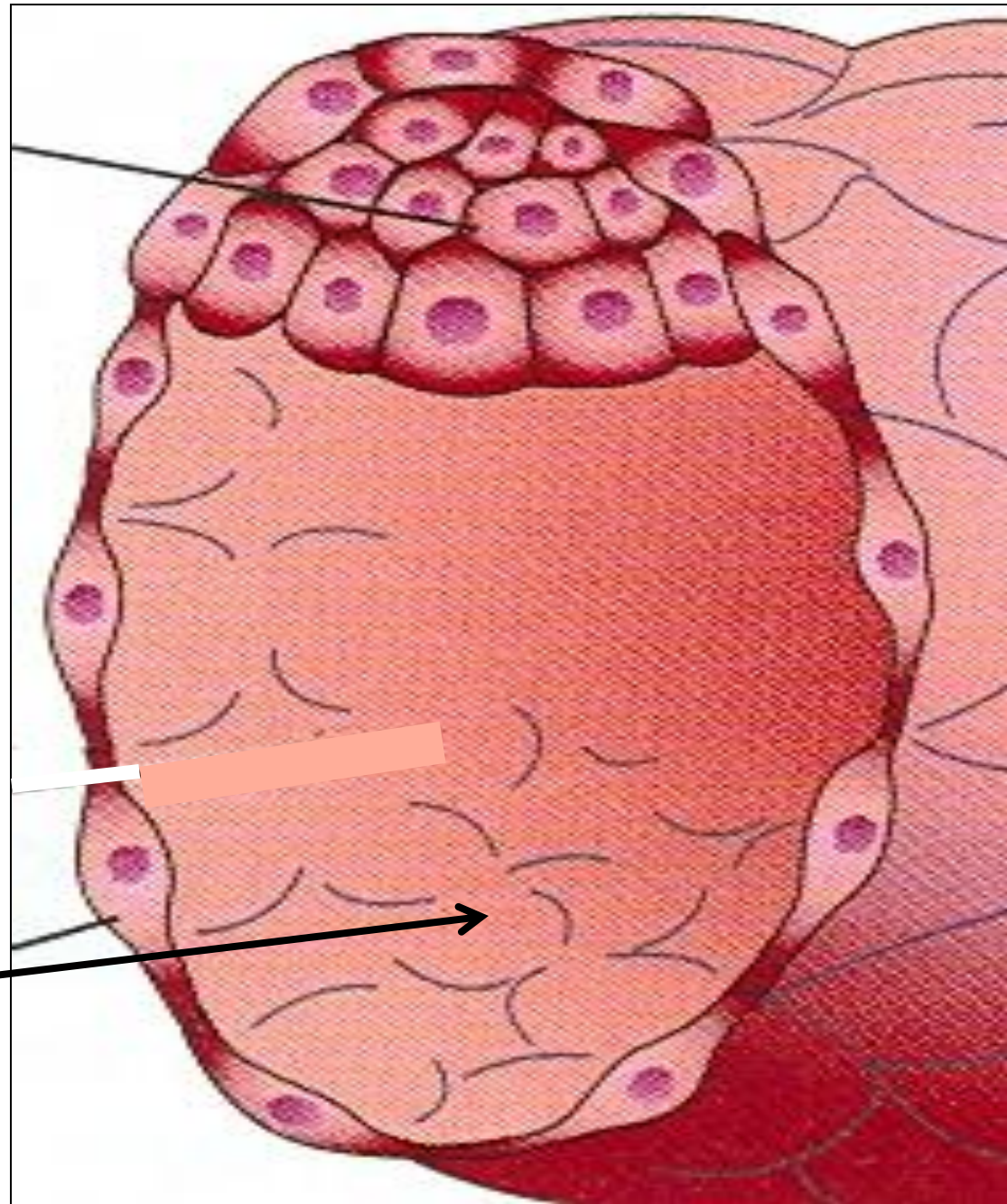


BLASTOCYST

A **cavity** appears within the morula dividing its cells into 2 groups:

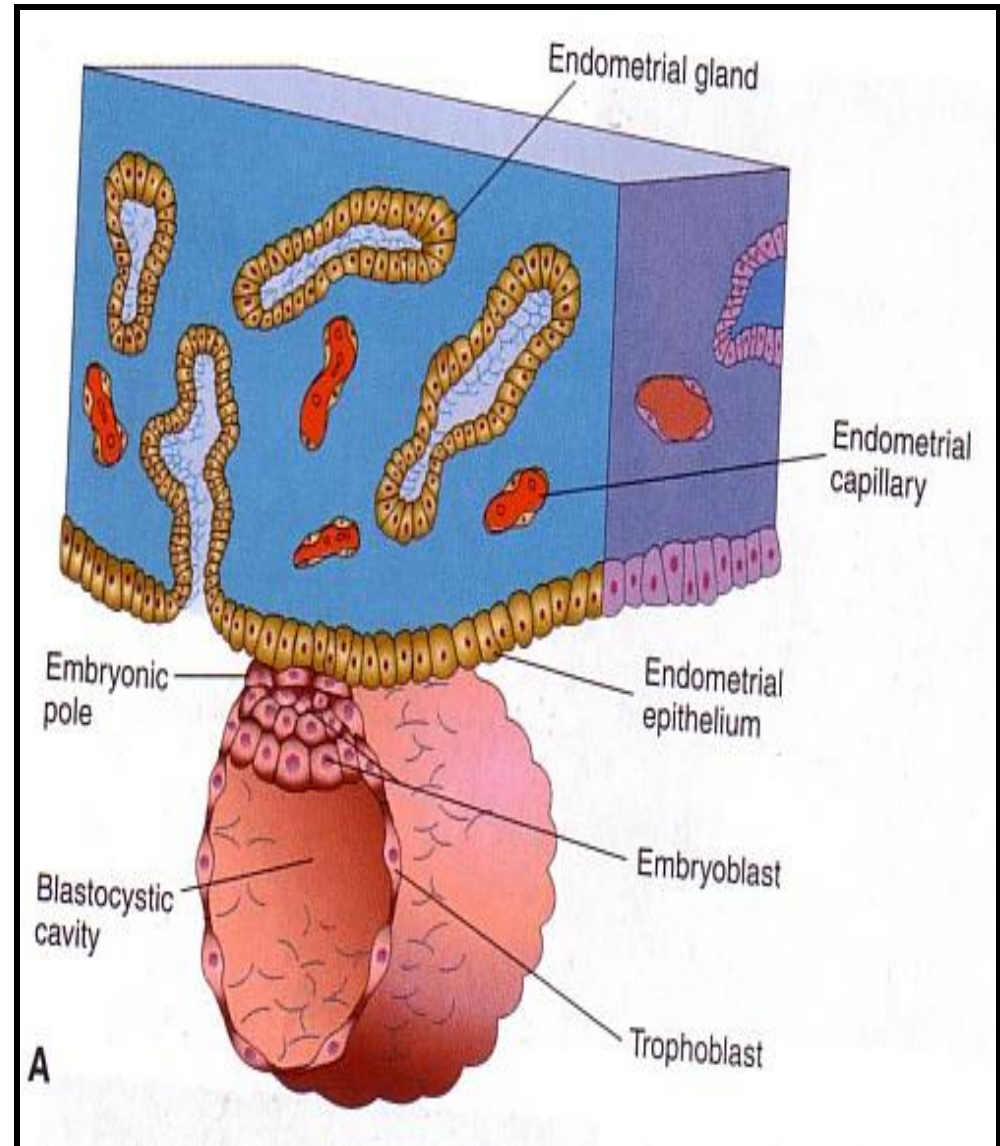
1. Outer cell layer called **trophoblast**.
2. Inner cell layer (mass) attached to one of the poles of the blastocyst.

The cavity is called **blastocystic** cavity or blastocele.



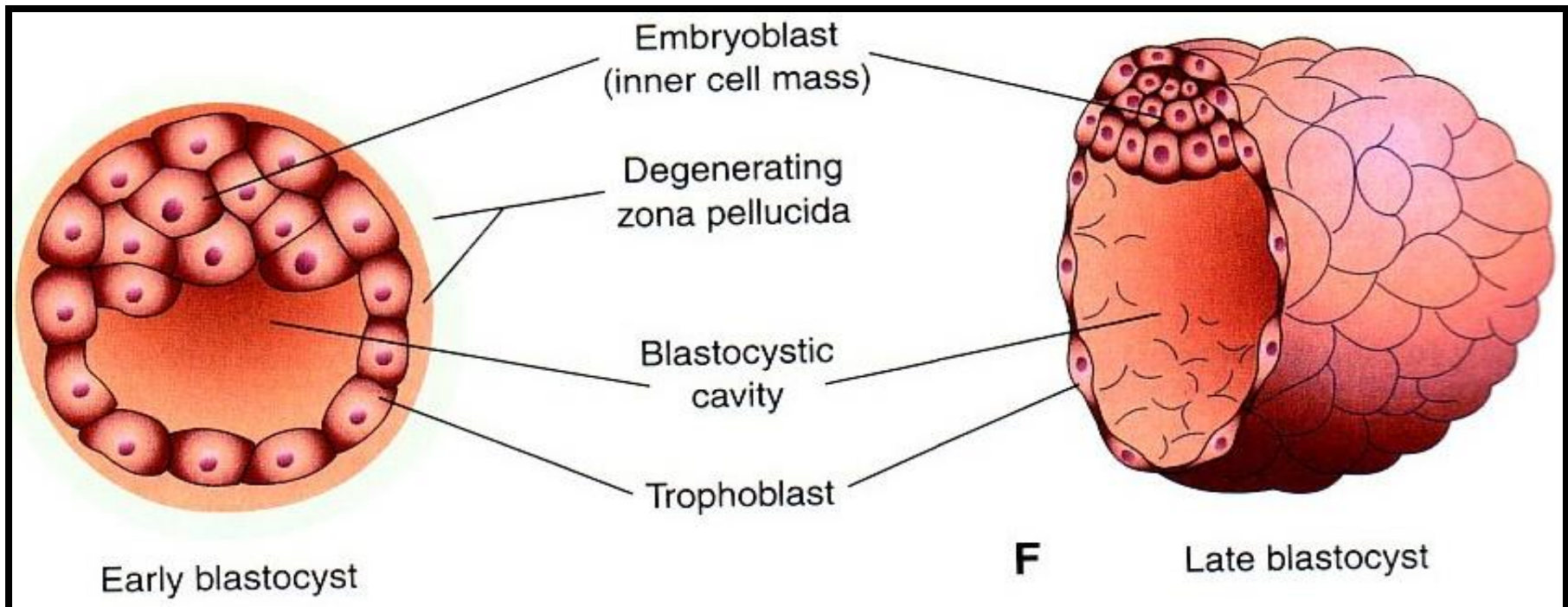
- **Definition:**
- It is the process by which the **Blastocyst** penetrates the **superficial** (compact) layer of the endometrium of the uterus.
- **Site: (what is the normal site of implantation?)**
- The normal site of **implantation** is the **posterior wall of the body of the uterus near the fundus.**
- **Time:**
- It **begins** about the **6th day** after fertilization.
- It is **completed** by the **11th** or **12th** day.

IMPLANTATION



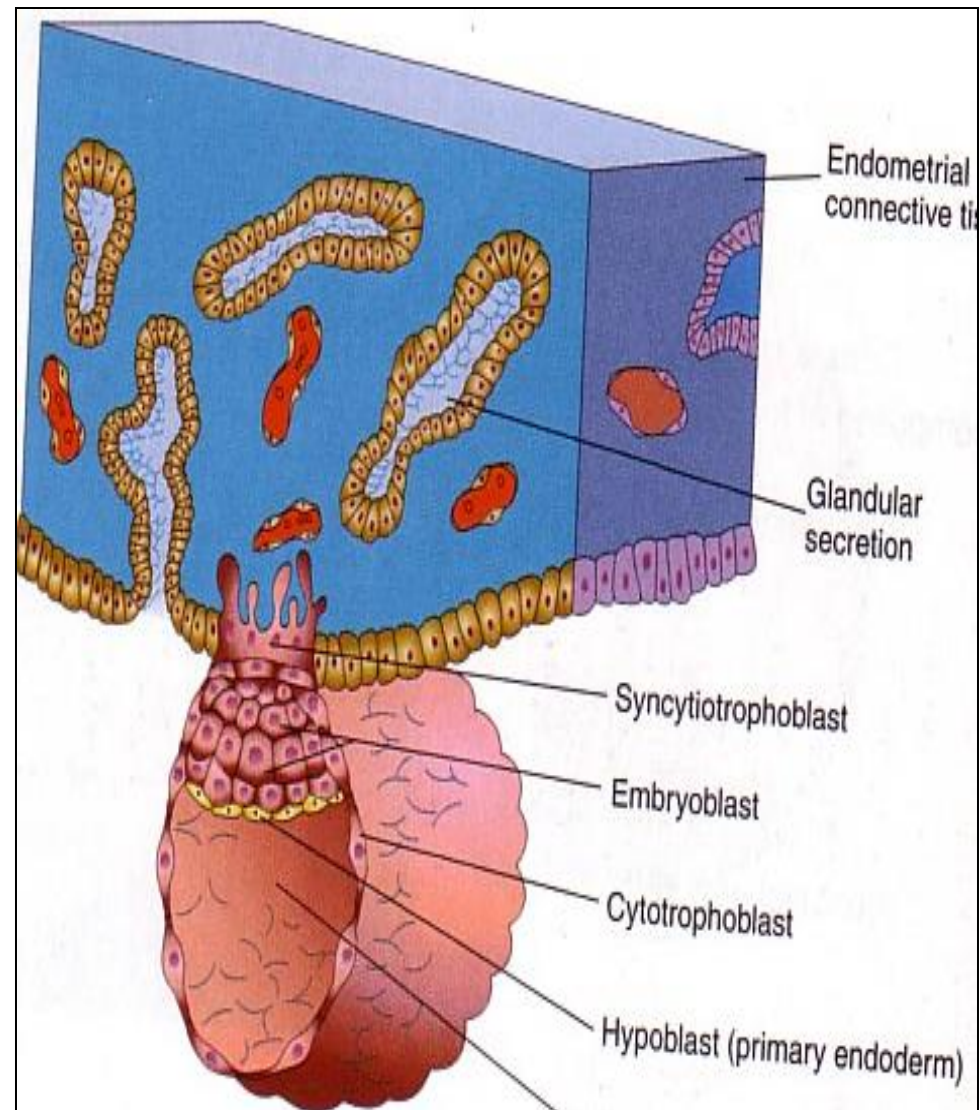
- **Mechanism:**

- The Morula reaches the uterine cavity by the 4th day after fertilization.
- It remains **free** within the uterine cavity for **one or two** days.
- **Fluid** passes from uterine cavity to the Morula.
- Now the Morula is called **Blastocyst**, its cavity is called blastocystic cavity or blastocele, and its cells divided into **Embryoblast & Trophoblast**.



Summary

- **Zona pellucida** degenerates & disappears by the **5th** day to allow the **blastocyst** to increase in size and penetrate the endometrium.
 - The **embryoblast** projects into the blastocystic cavity, while the trophoblast forms the wall of the blastocyst.
 - By **6th** day the blastocyst adheres to the endometrium
 - By **7th** day, Trophoblast differentiated into **2 layers**:
Syncytiotrophoblast (outer multinucleated mass, with indistinct cell boundary.
Cytotrophoblast, inner layer, mitotically active.
- By **8th** day the blastocyst is superficially embedded in the compact layer of the endometrium.

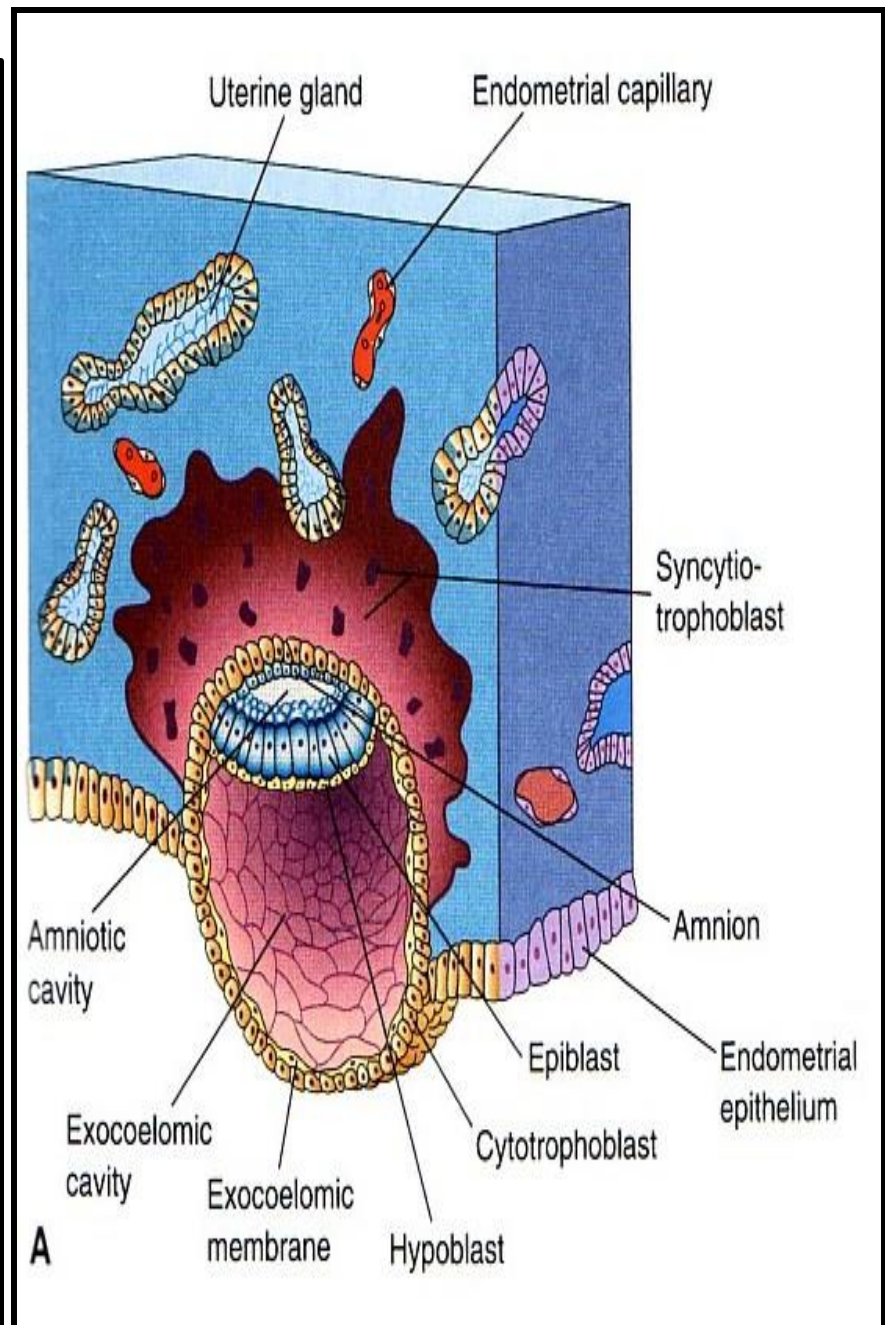


- Blood-filled Lacunae appear in the **Syncytiotrophoblast** which communicate with each other forming a network by the 10th or 11th day.

- **Syncytiotrophoblast** **erodes** the endothelial lining of the maternal capillaries which known as sinusoids.

Now blood of maternal capillaries reaches the lacunae so

Uteroplacental circulation begins by **11th or 12th day**.



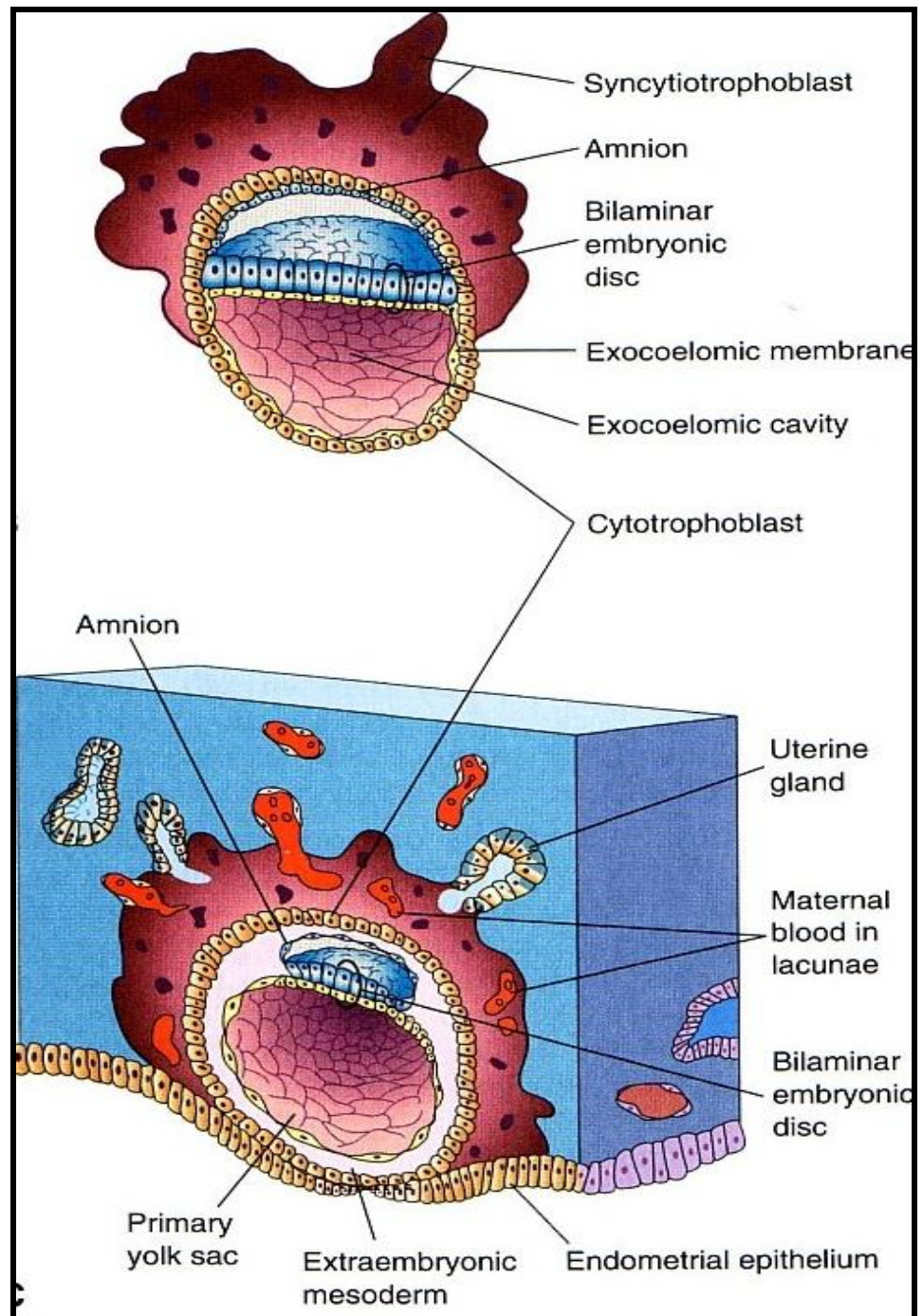
Endometrial cells undergo a process called apoptosis (programmed cell death) to facilitate invasion of endometrium by the **Syncytiotrophoblast**.

Syncytiotrophoblast engulf these degenerated cells for nutrition of the embryo.

Implantation

can be **detected** by:

- 1- Ultrasonography.
- 2- hCG (human chorionic gonadotrophin which is secreted by the Syncytiotrophoblast) about the **end** of 2nd week.

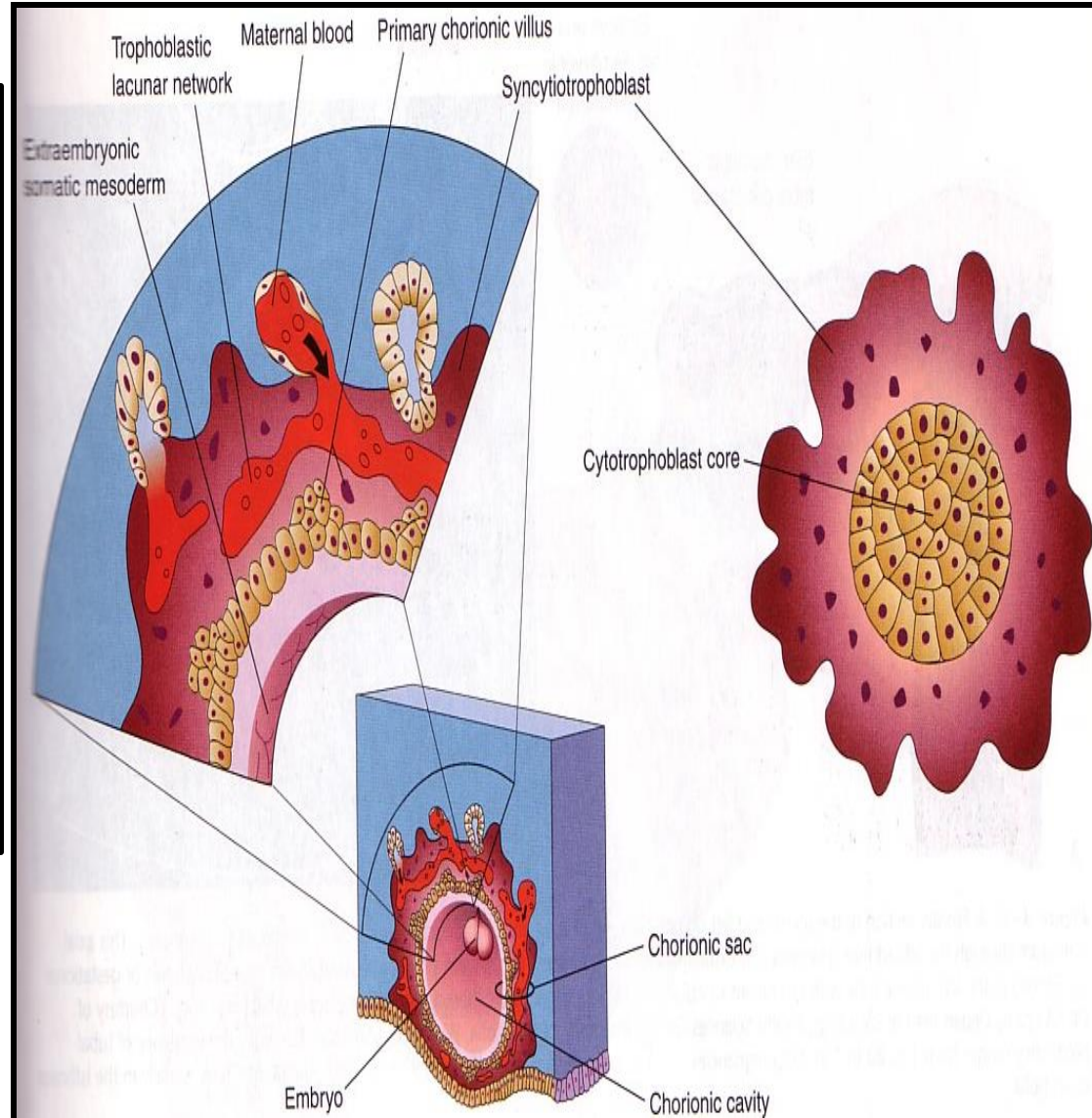


Early Pregnancy Factor

- Is an immunosuppressant protein.
- Secreted by trophoblast cells.
- Appears in maternal serum within 24--48 hrs., after implantation.
- It is the basis for **EPT** (Early pregnancy test) in the first **10 days** of development.

Formation of The Primary Chorionic villi

- By the 13th day *Proliferation* of Cytotrophblast cells produce extension within the **Syncytiotrophoblast** to form the primary chorionic villi.



Ectopic Implantation (Pregnancy)

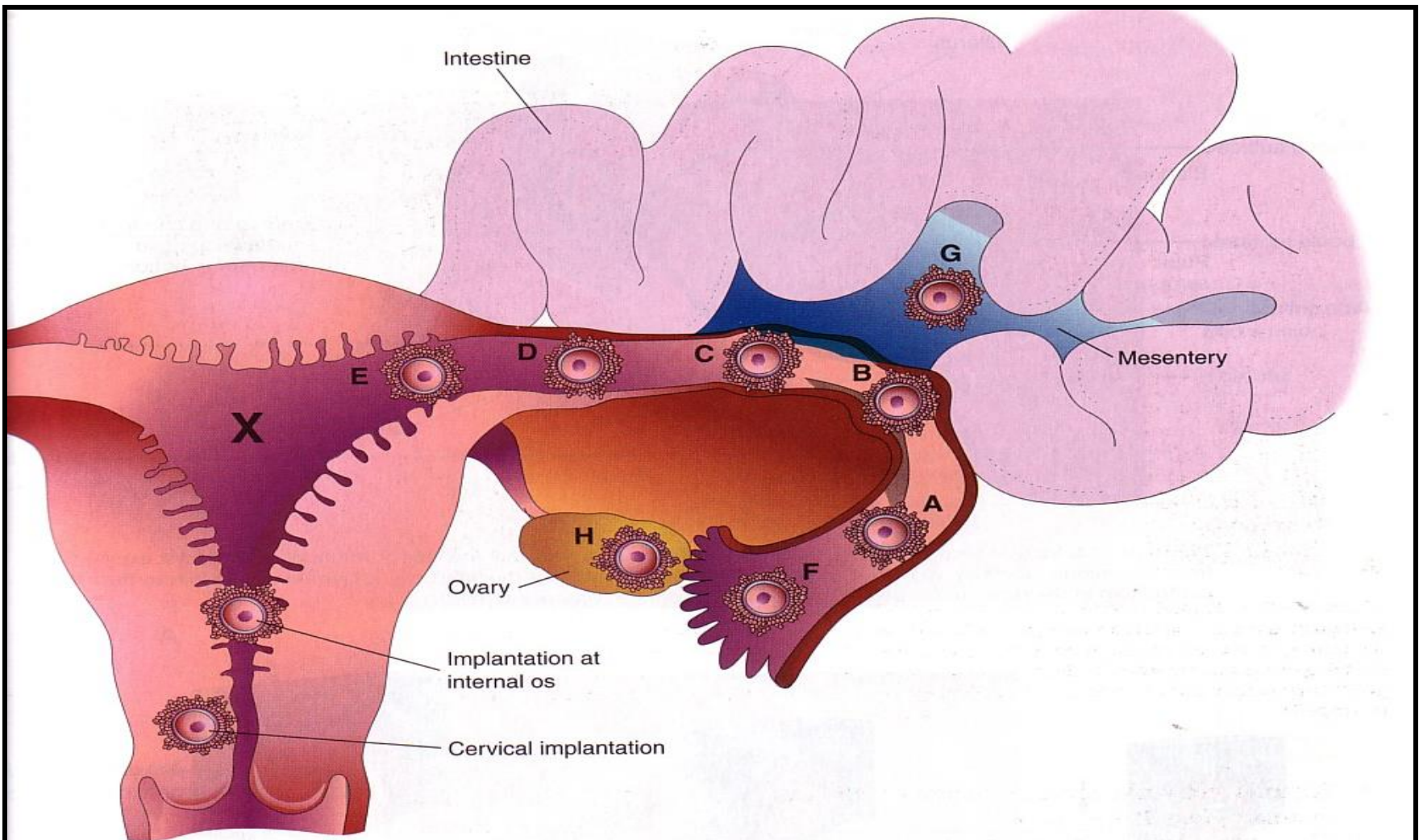
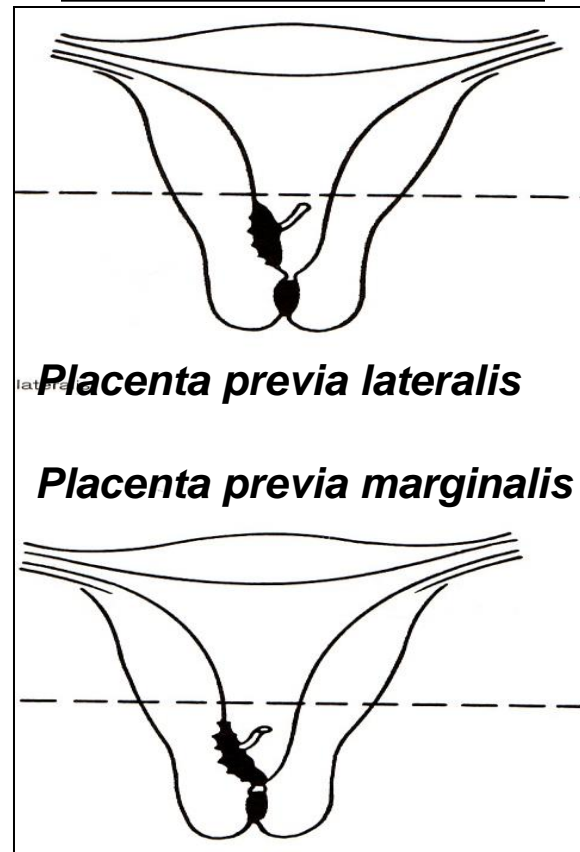
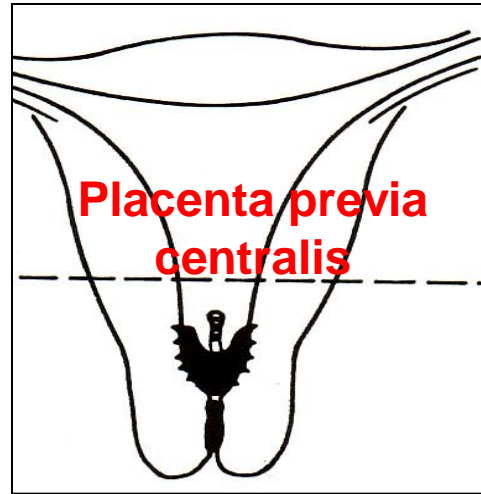


Figure 3-10. Implantation sites of blastocysts. The usual site in the posterior wall of the uterus is indicated by an X. The approximate order of frequency of ectopic implantations is indicated alphabetically (A, most common, H, least common). A to F, Tubal pregnancies. G, Abdominal pregnancy. H, Ovarian 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.

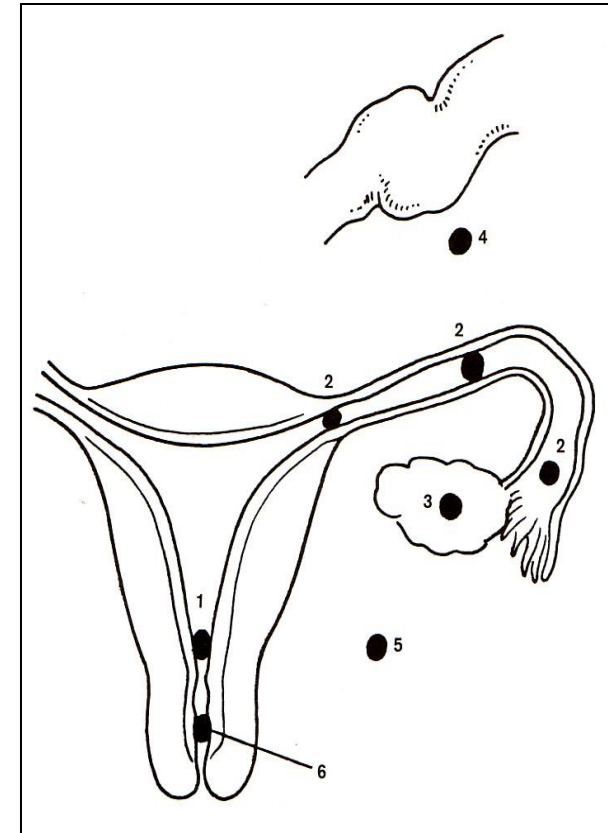
Ectopic Pregnancy

- It means implantation outside the uterine cavity.
- 95 to 97% of ectopic pregnancies occurs in the uterine tube.
- Most are in the ampulla & isthmus.
- Placenta previa:
- Implantation occurs in the lower uterine segment.



Ectopic Pregnancy:

- 1- Placenta Previa.
- 2- Tubal.
- 3- Ovarian.
- 4- Abdominal.
- 5- Pelvic.
- 6- Cervical.



GOOD LUCK