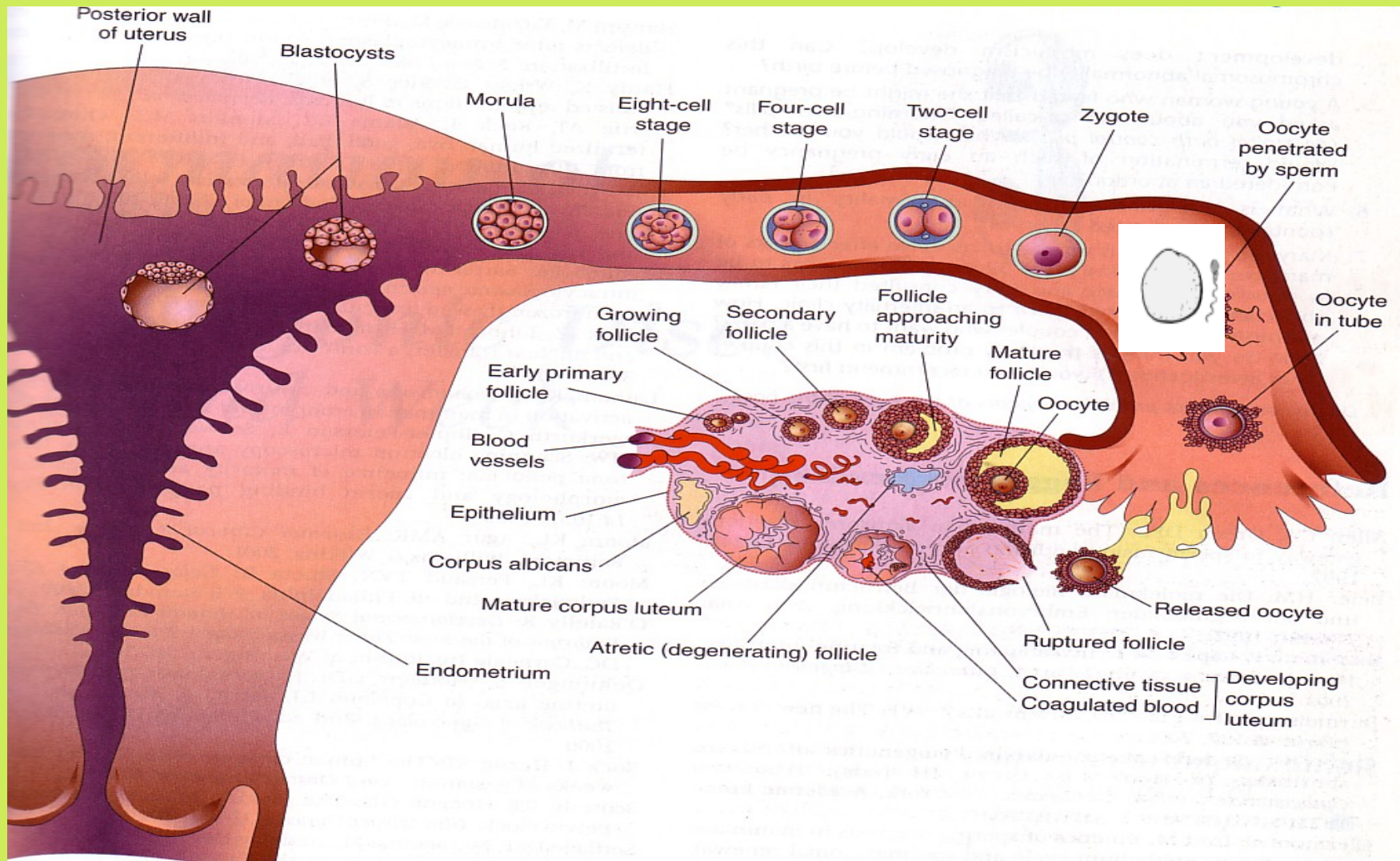


# FERTILIZATION AND IMPLANTATION

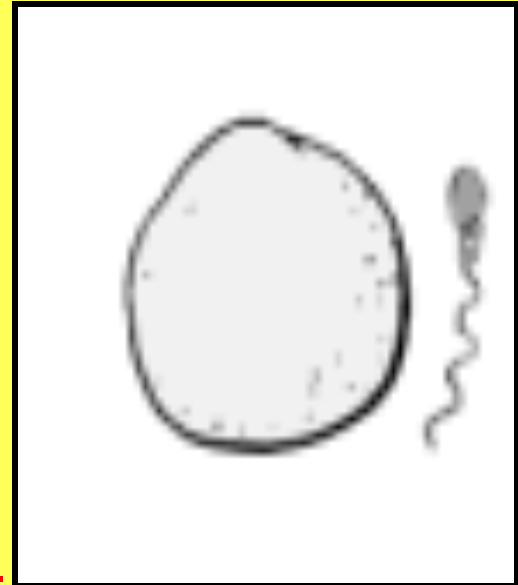


Prof. Saeed Abuel Makarem



# OBJECTIVES

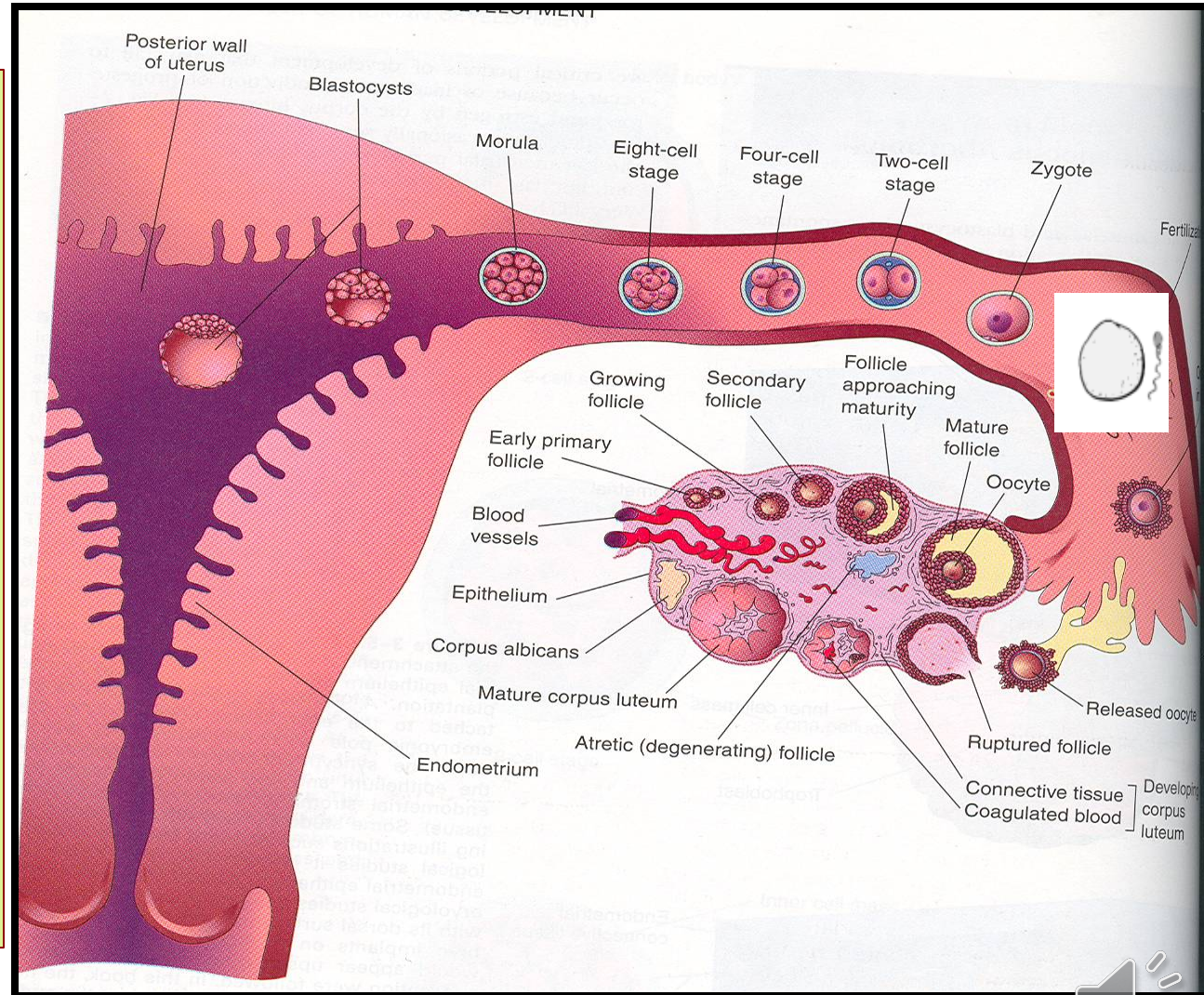
- **By the end of the lecture, you should be able to:**
- Identify fertilization and its normal site.
- List the phases of fertilization.
- Describe the results of fertilization.
- Describe the formation of **blastocyst**.
- Identify implantation and its site.
- Describe the mechanism of **implantation**.
- **List the most common sites of ectopic pregnancies.**





# FERTILIZATION

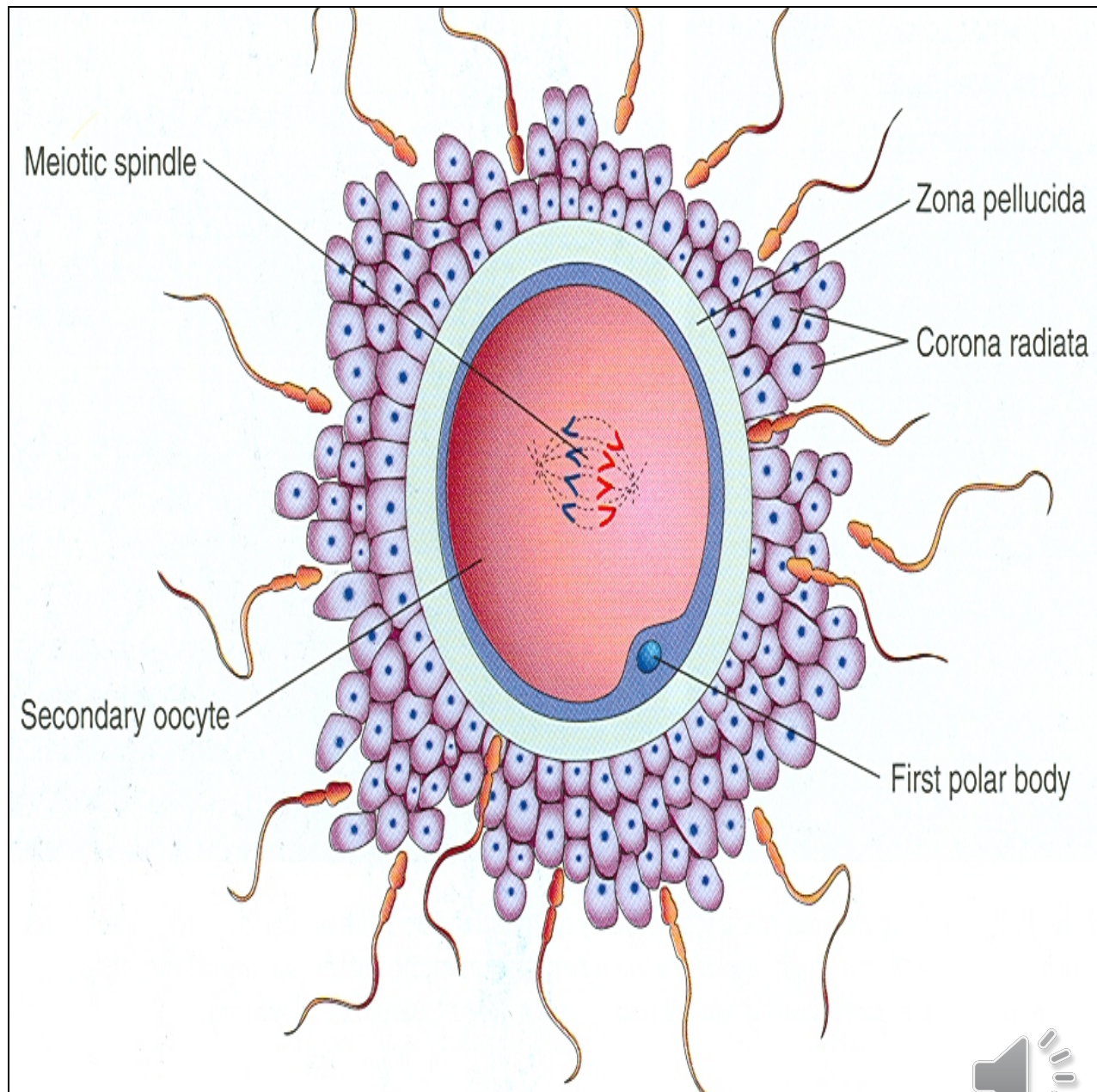
- **Definition:**
- It is the process during which a male gamete (**sperm**), and a female gamete (**oocyte**), unite together to form a single cell (**ZYGOTE**).





# Fertilization

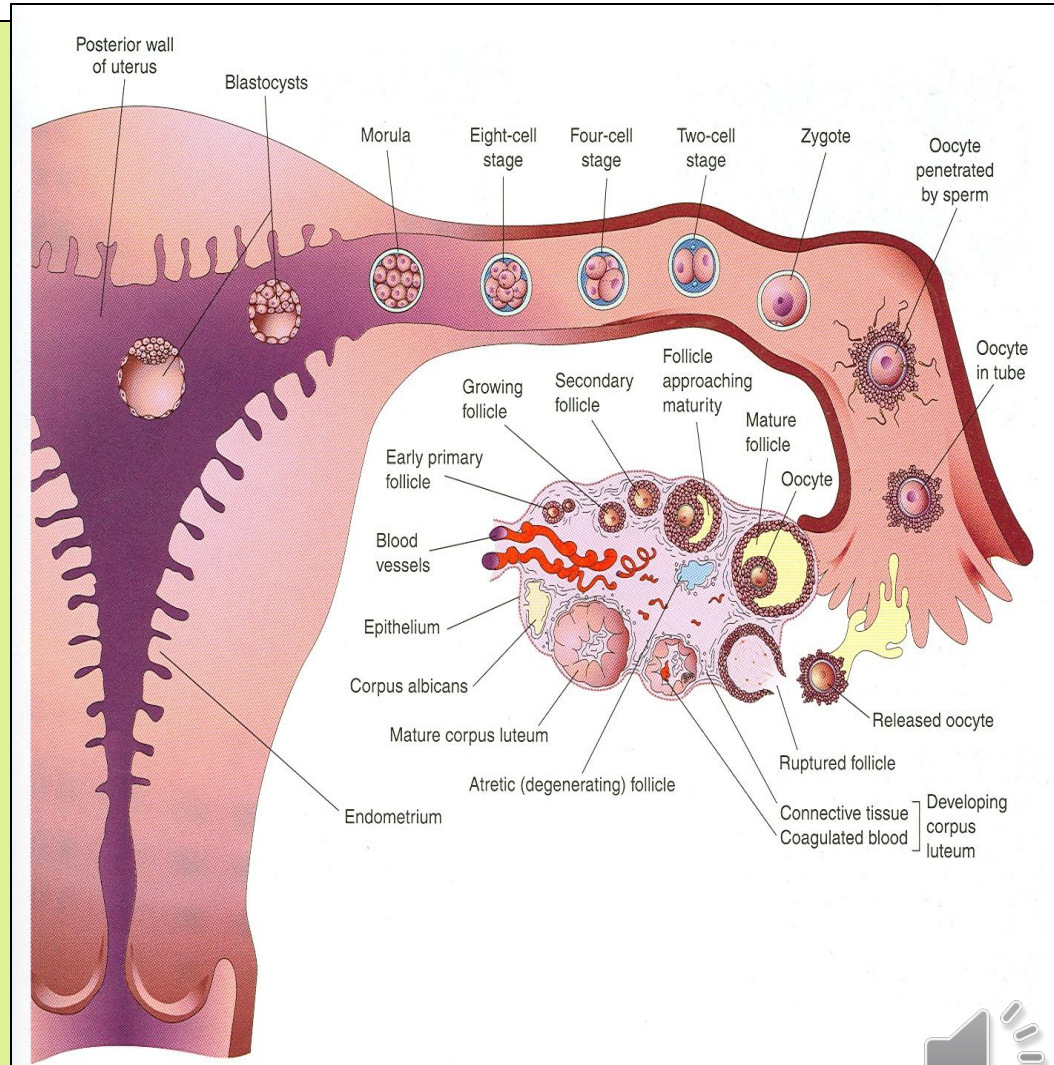
- It is a complicated process.
- It begins with a **contact** between sperm & ovum.
- It ends up with **intermingling** of the maternal and paternal chromosomes.





# Where Does Fertilization Normally Occur?

- **It usually** occurs in the ampulla of uterine tube.
- **The ampulla** is the widest part of the tube.
- **Fertilization** may occur in any other part of the tube.
- **Never occurs in the uterine cavity.**
- **Chemical signal** from oocyte attracts the sperms.
- Also 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).

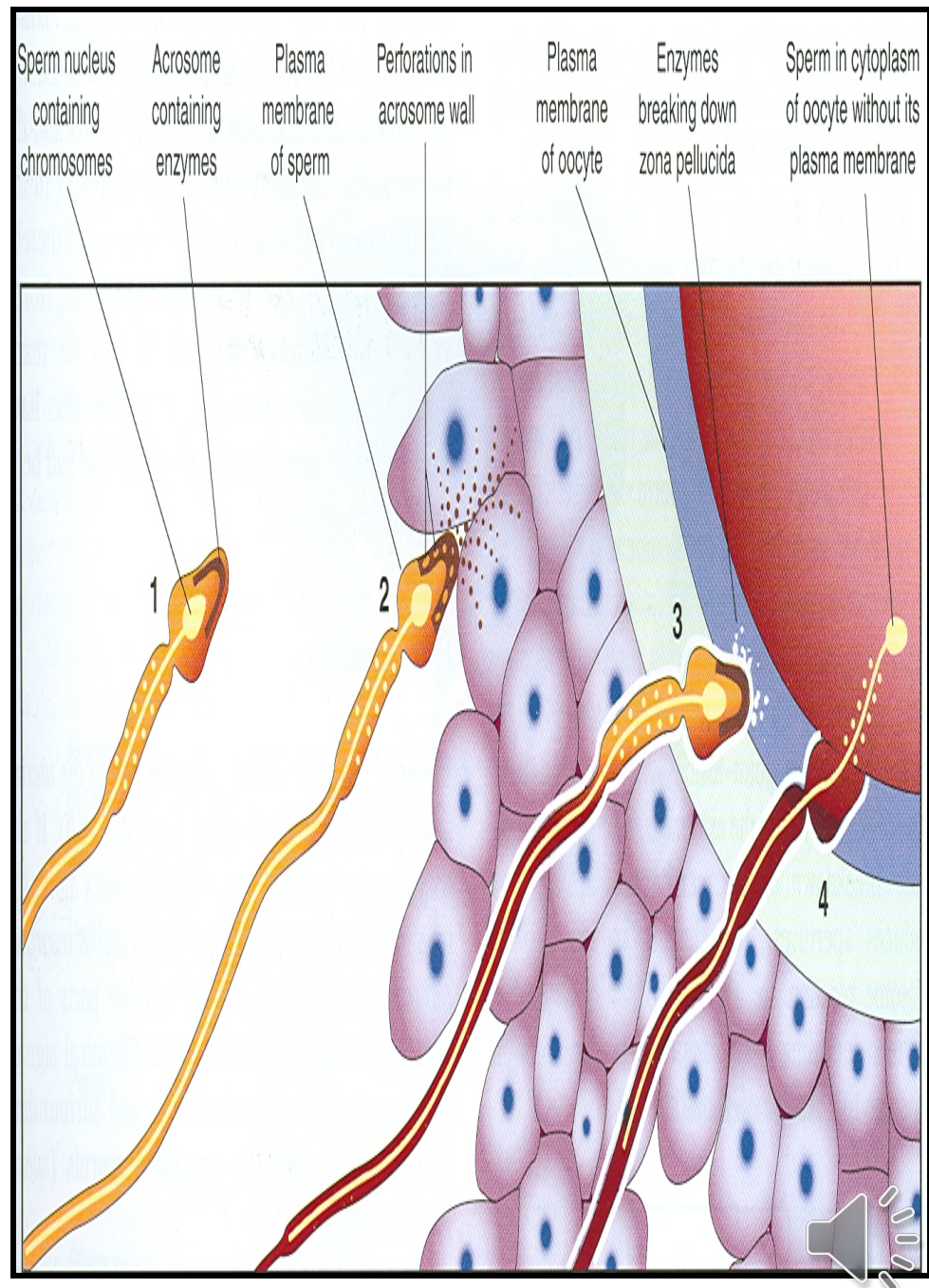
3- **Fusion** of the **plasma membranes** of the oocyte and the sperm.

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

5- **Formation** of the **female** pronucleus

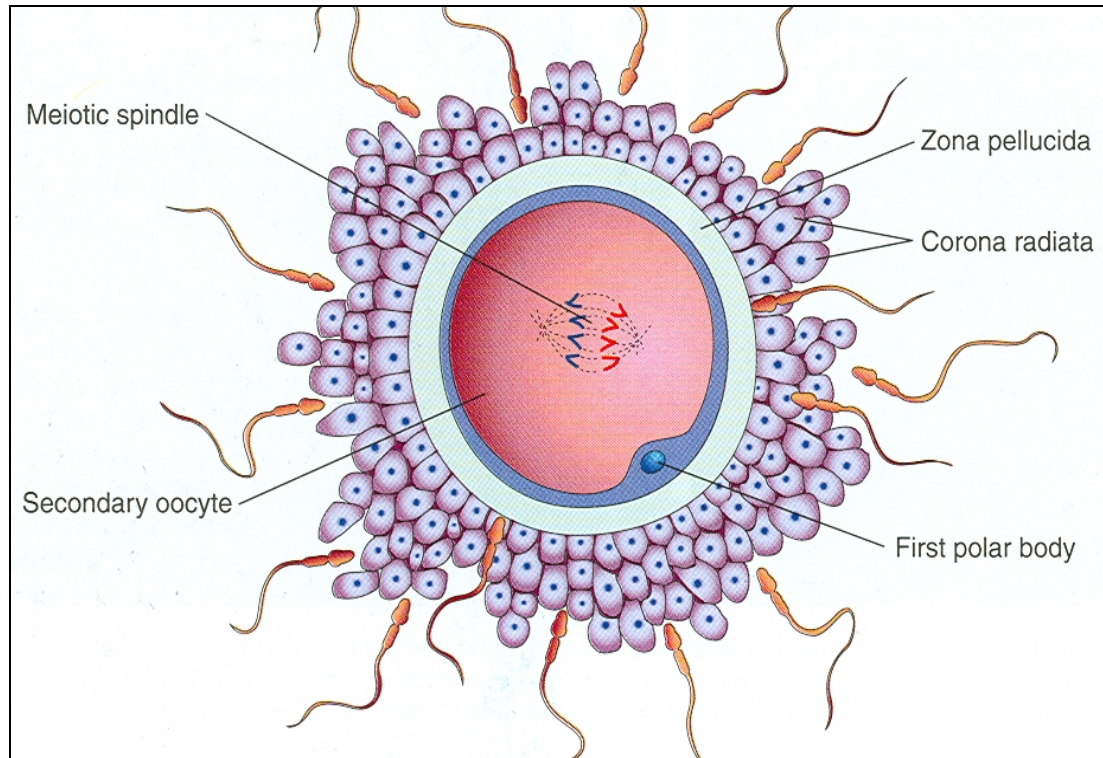
6- **Formation** of the **male** pronucleus.

7- **Union** of the 2 pronucleii.





# CHROMOSOMES

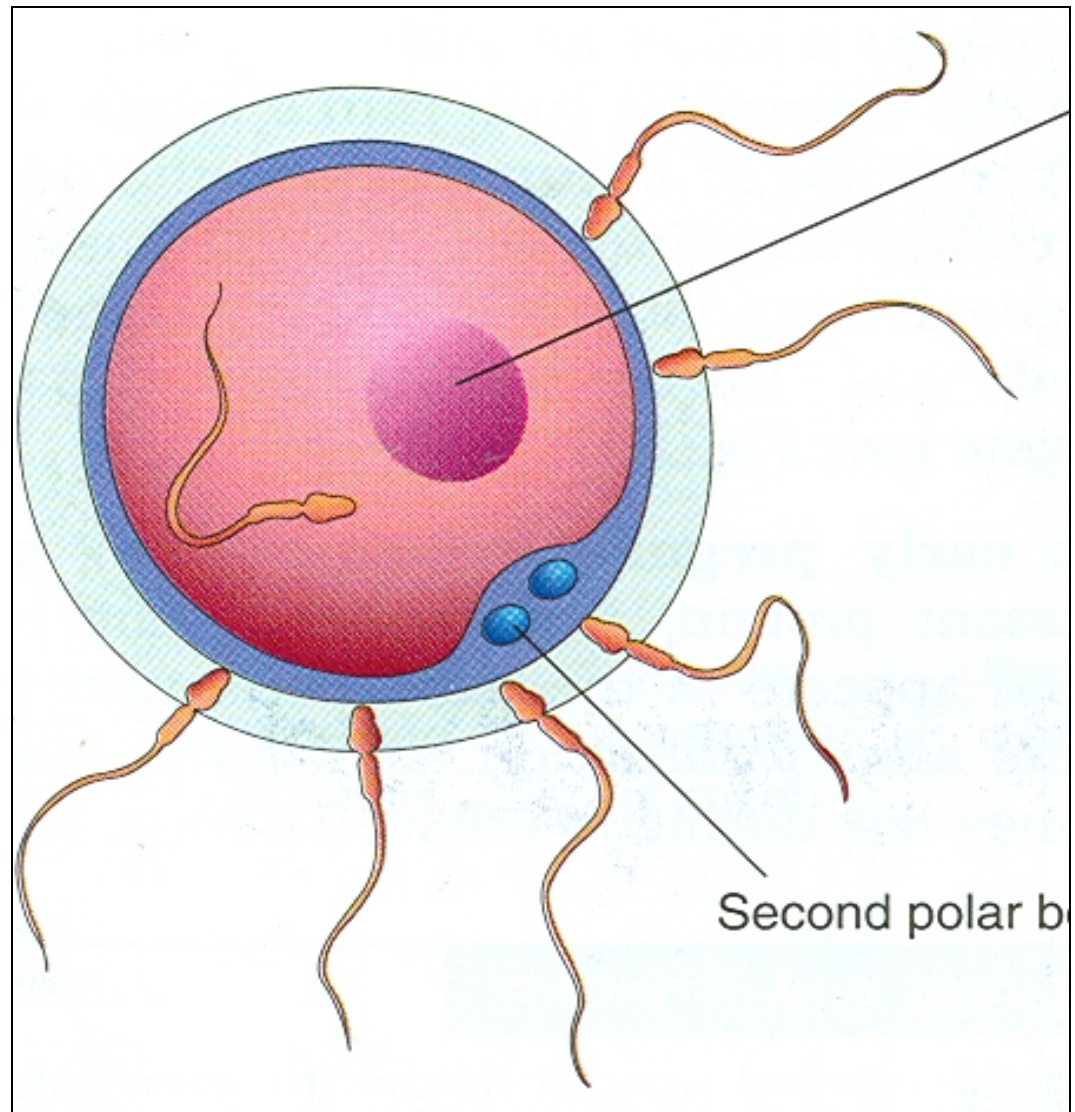


- **Zygote** is genetically a **unique** structure.
- Half of its **chromosomes** comes from the **father** and the other half comes from the **mother**.
- New combination is formed which is different from either of the parents.
- This mechanism forms **biparental inheritance** and leads to variation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



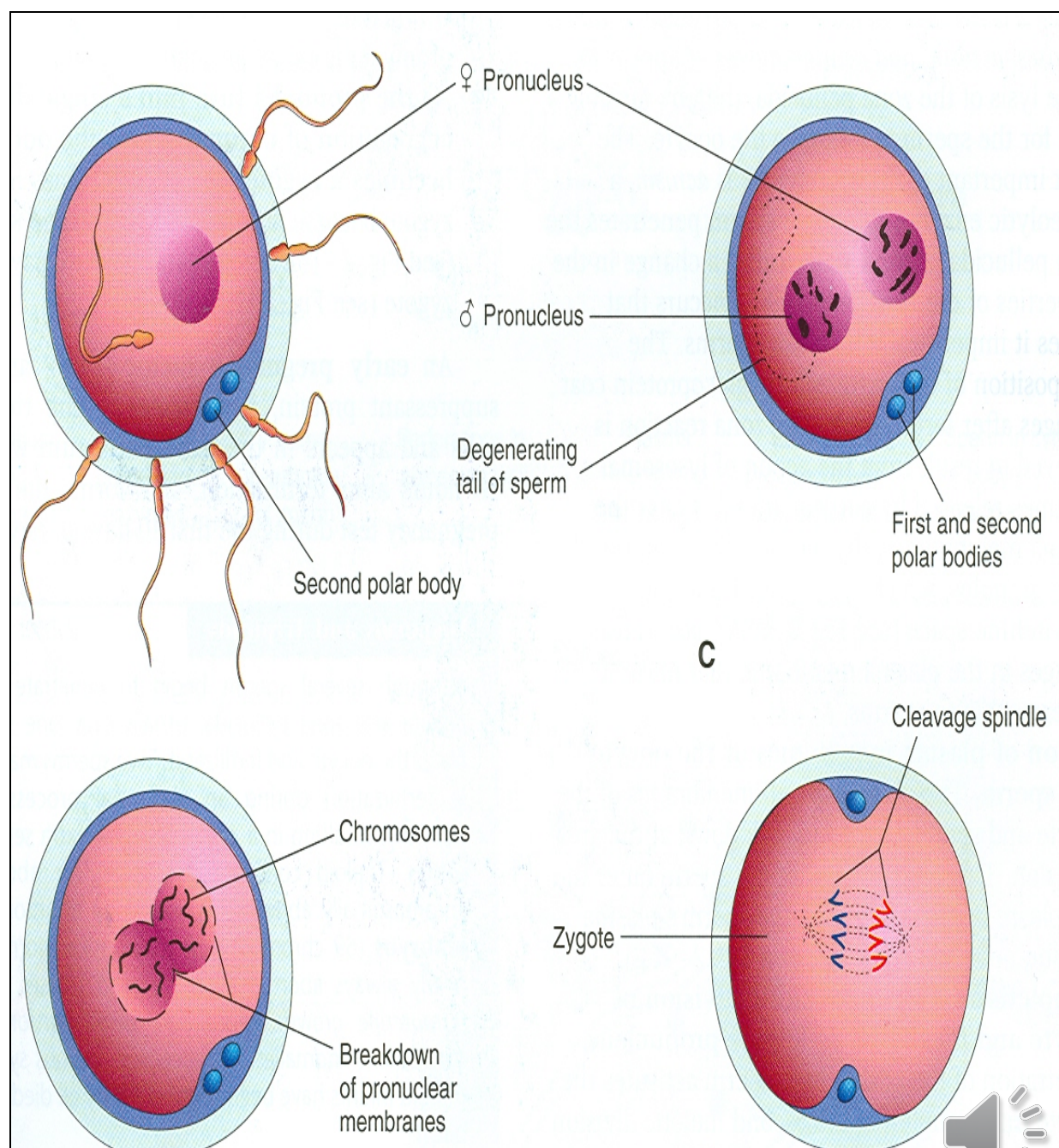
❖ **Zonal reaction**: It is a change in properties of zona pellucida that makes it **impermeable** to other sperms.





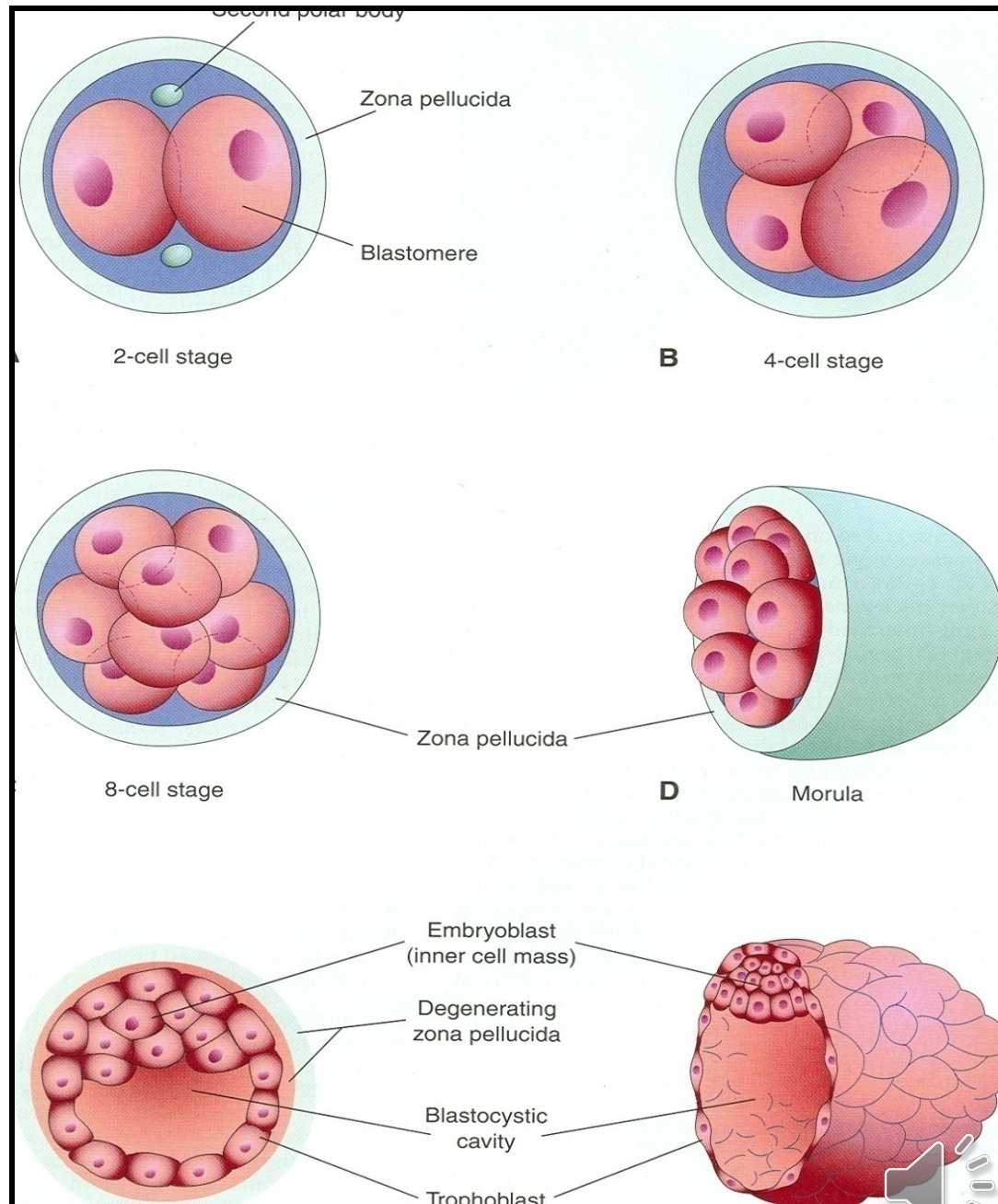
# Results of Fertilization

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



# Cleavage of Zygote

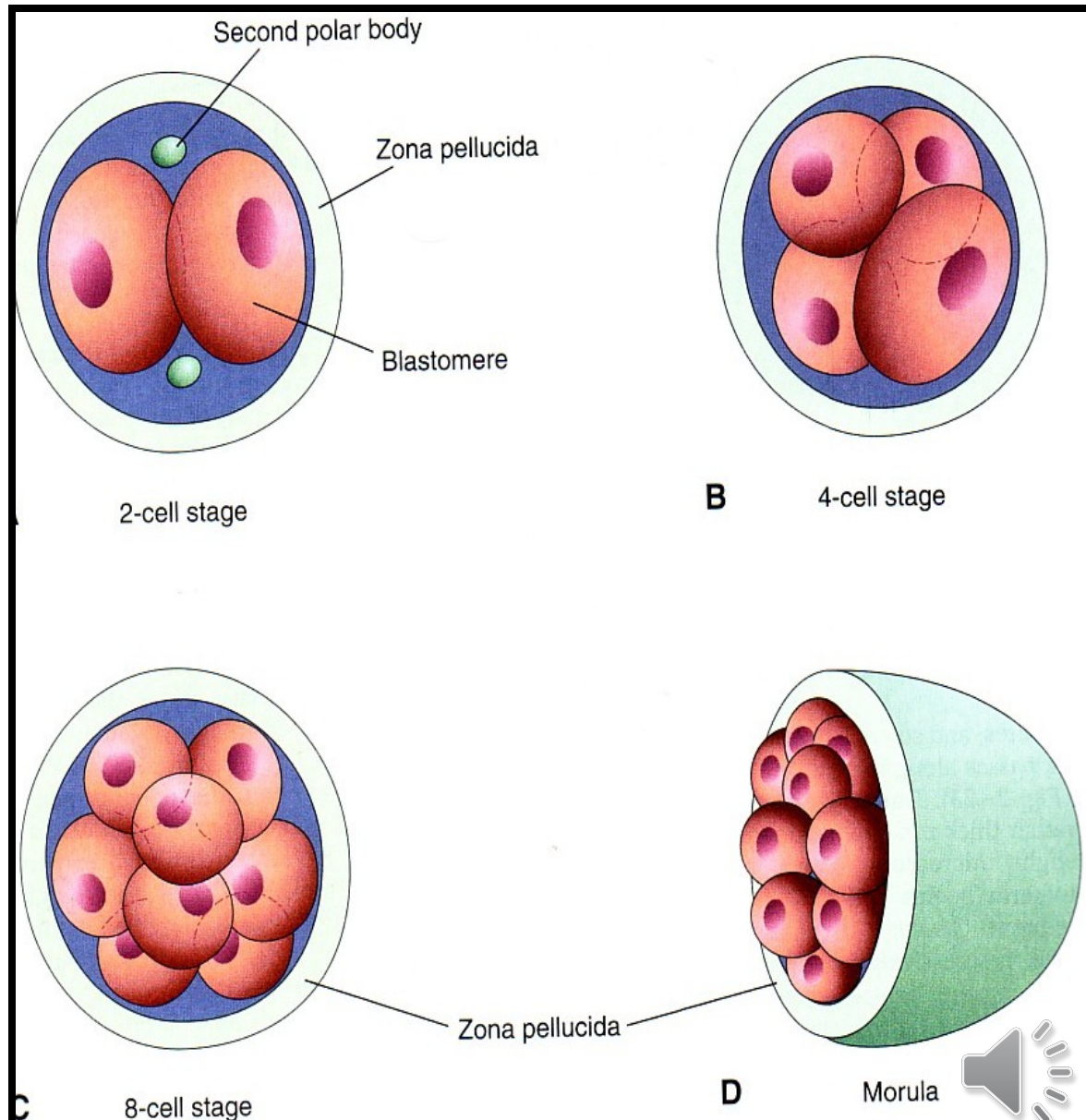
- It is the repeated **mitotic** divisions of the zygote.
- Normally occurs in the uterine tube.
- Rapid increase in the number of the cells.
- These smaller embryonic cells are now called, **Blastomeres**.





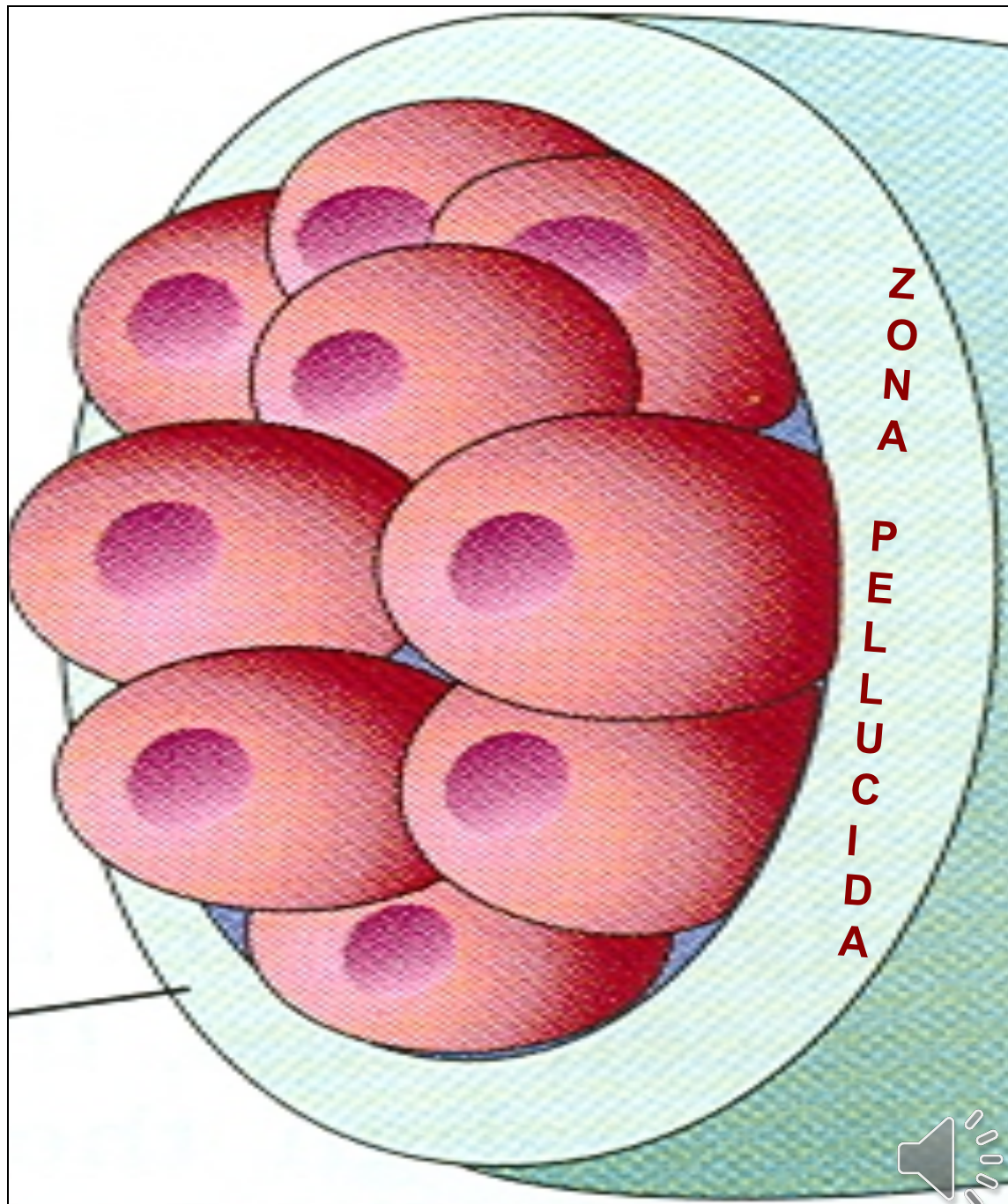
# Cleavage of Zygote

- 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.
- The **zona pellucida** is a thick translucent membrane under the microscope.



# 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 **3<sup>rd</sup>** day after fertilization.
- It resembles mulberry or blackberry.
- It reaches the uterine cavity by the **4<sup>th</sup>** day.



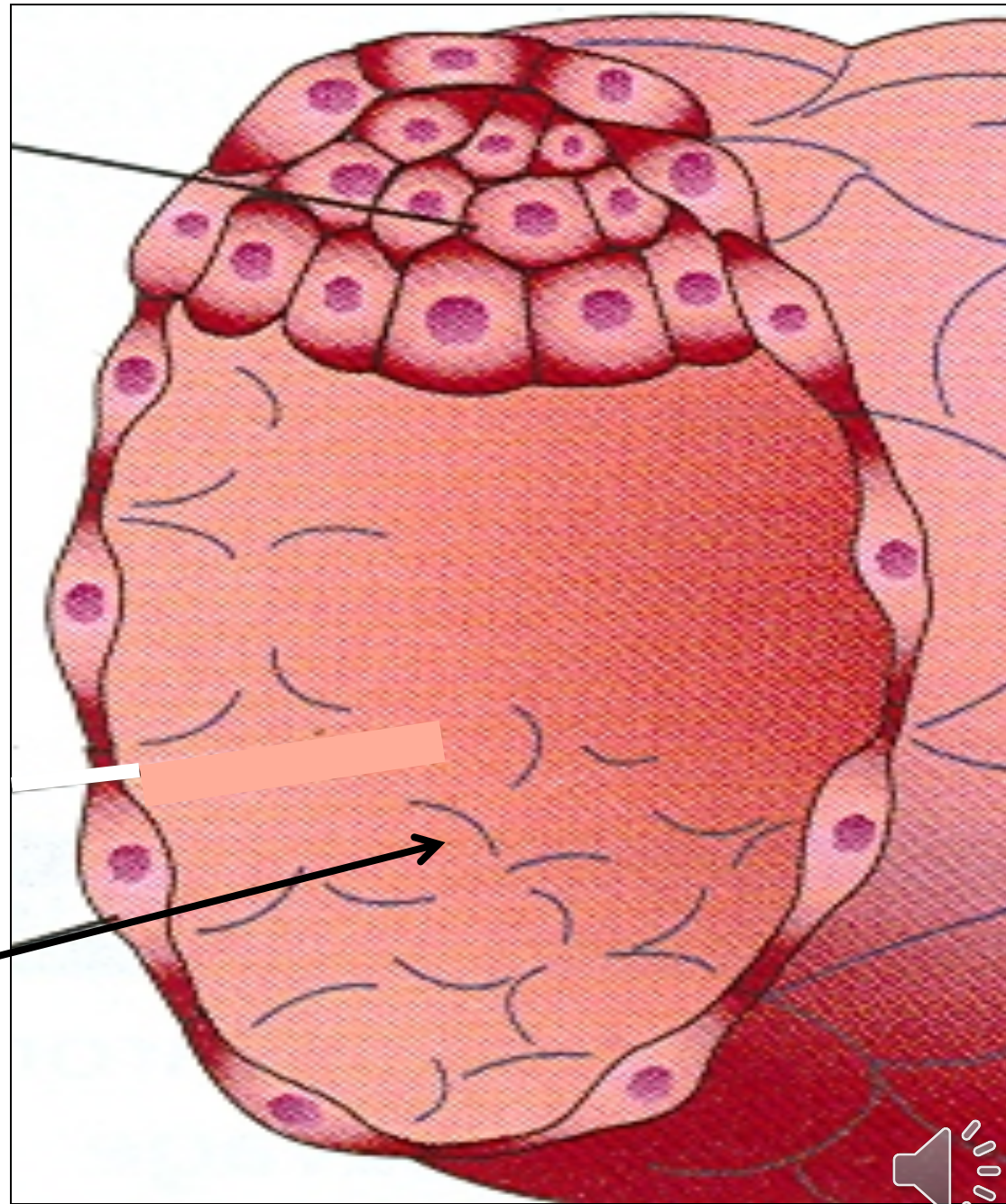


# BLASTOCYST

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

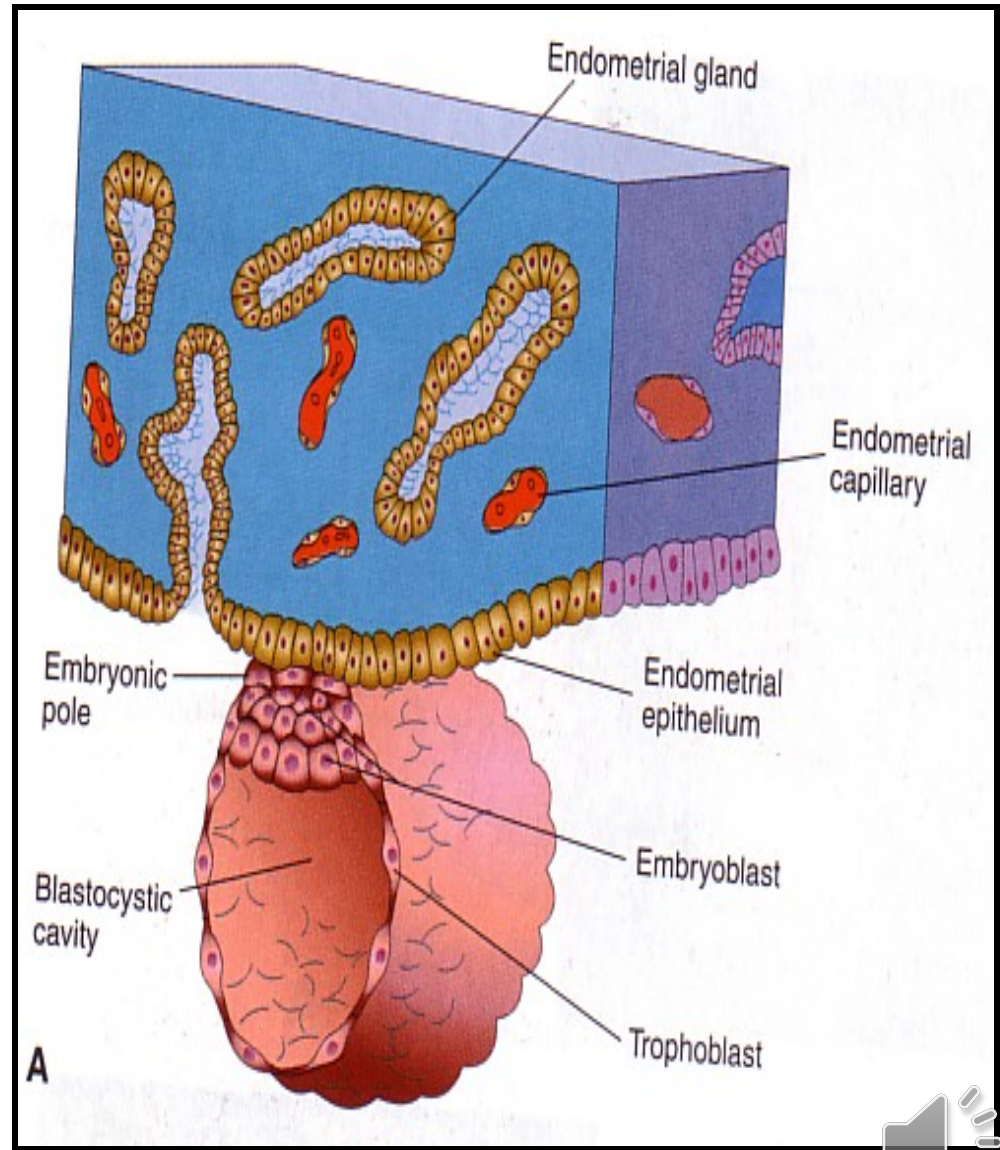
1. Outer cell layer called **trophoblast**.
2. Inner cell layer (mass) attached to one of the poles of the blastocyst.

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



# IMPLANTATION

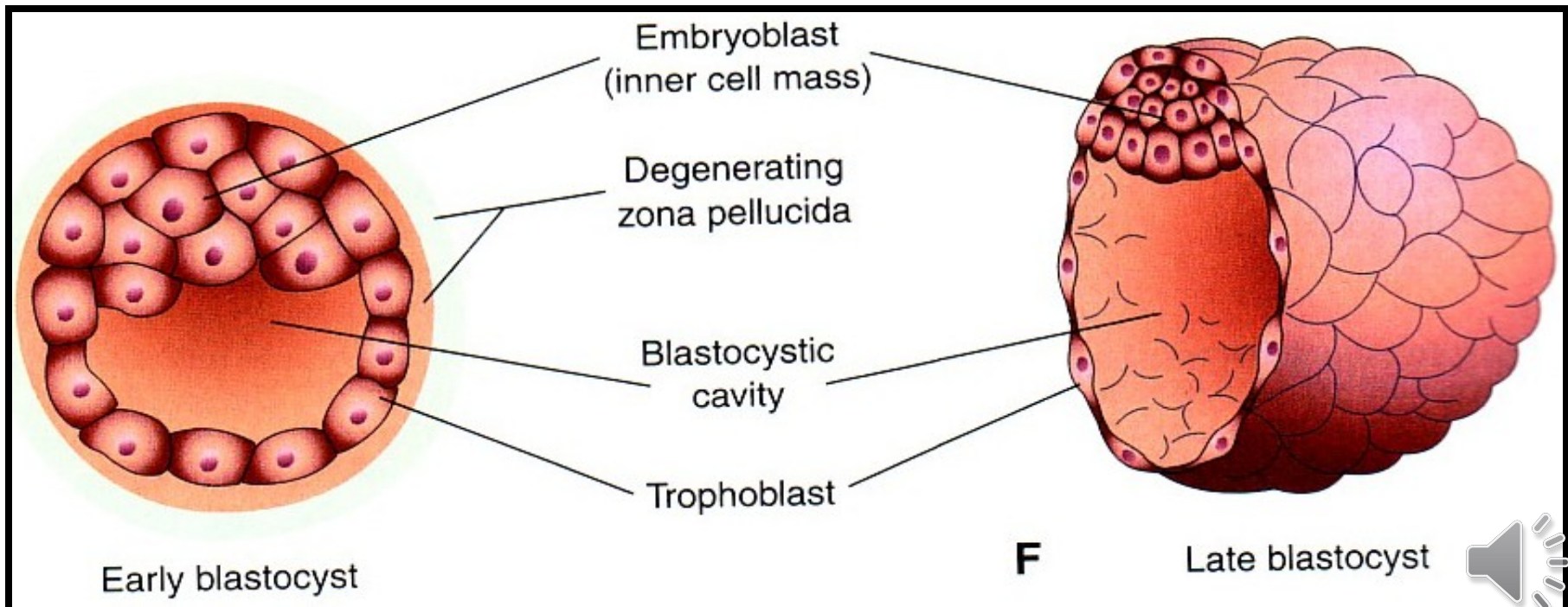
- **Definition:**
- It is the process by which the **Blastocyst** penetrates the **superficial** (compact) layer of the endometrium of the uterus.
- **Site: (what is the normal site of implantation?)**
- The normal site of **implantation** is the **POSTERIOR WALL OF THE BODY OF THE UTERUS NEAR THE FUNDUS.**
- **Time:**
- It **begins** about the **6<sup>th</sup> day** after fertilization.
- It is **completed** by the **11<sup>th</sup>** or **12<sup>th</sup>** day.





- **Mechanism:**

- The Morula reaches the uterine cavity by the 4<sup>th</sup> 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**.



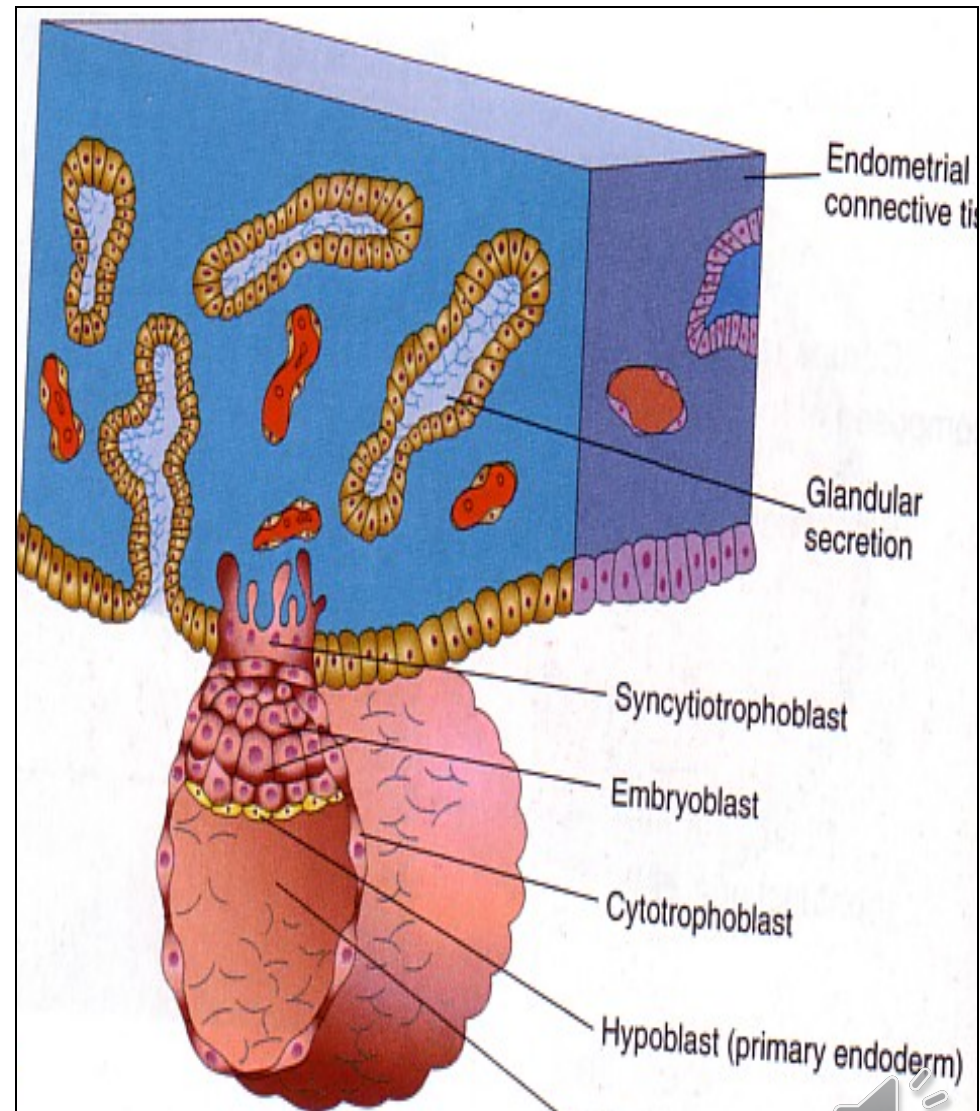
# Summary

- **Zona pellucida** degenerates & disappears by the **5<sup>th</sup>** 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 **6<sup>th</sup>** day the blastocyst adheres to the endometrium
- By **7<sup>th</sup>** day, the **Trophoblast** differentiates into **2 layers**:

**Syncytiotrophoblast** (outer multinucleated mass, with indistinct cell boundary.

**Cytotrophoblast**, inner layer, mitotically active.

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



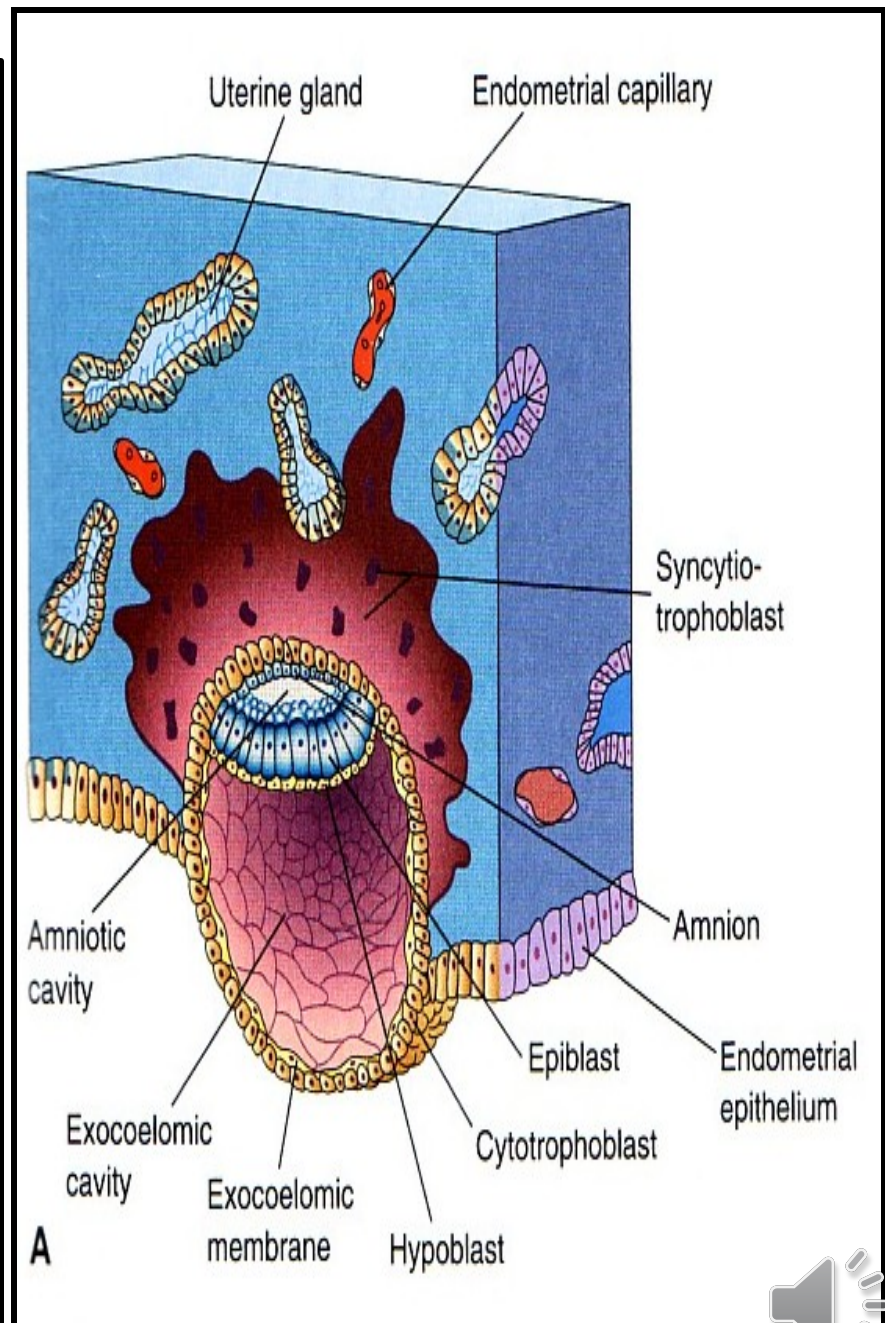


- Blood-filled Lacunae appear in the **Syncytiotrophoblast** which communicate with each other forming a network by the 10<sup>th</sup> or 11<sup>th</sup> day.

- **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 **11<sup>th</sup> or 12<sup>th</sup> day**.



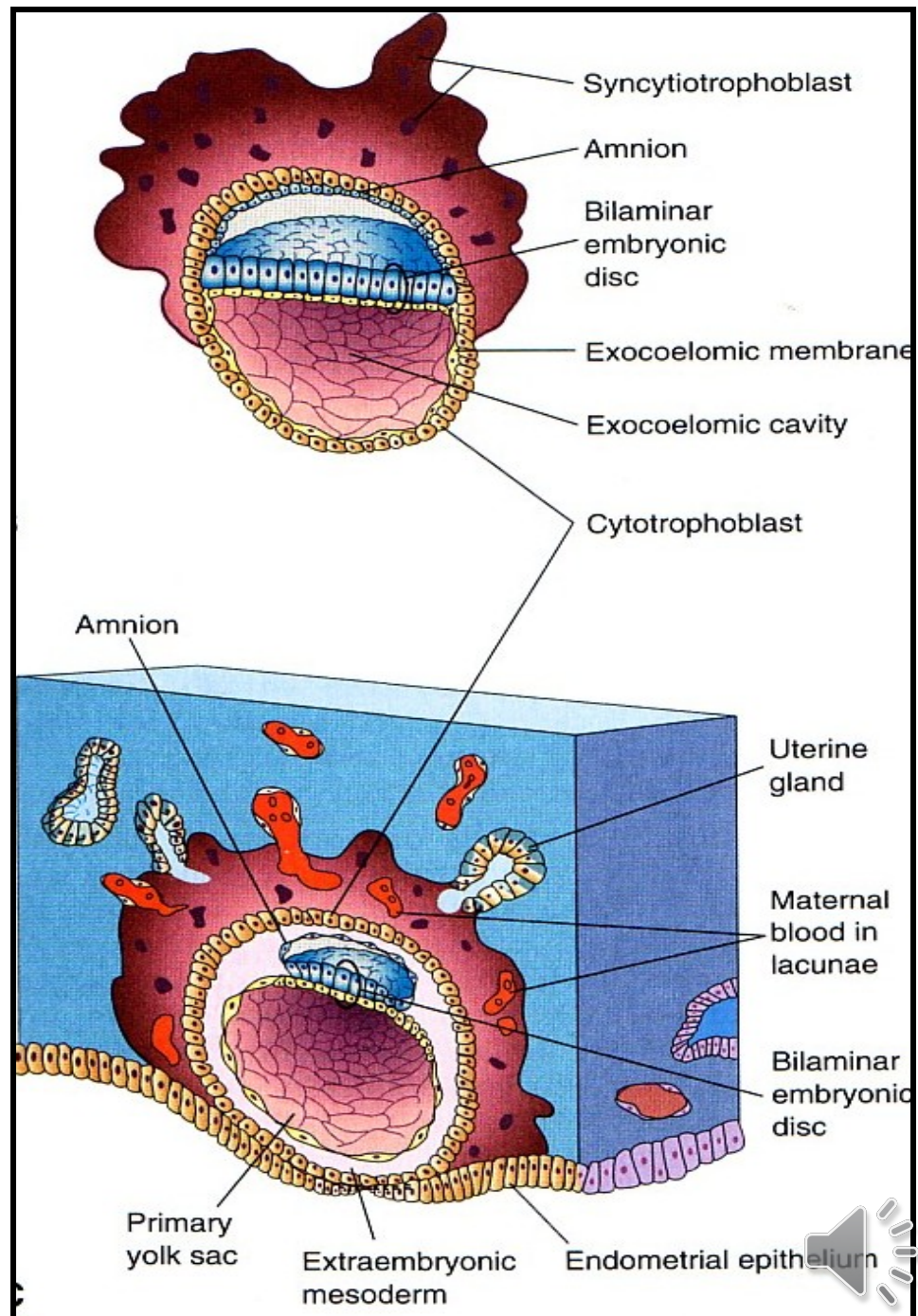
***Endometrial cells*** undergo a process called apoptosis (programmed cell death) to facilitate invasion of endometrium by the **Syncytiotrophoblast**.

**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 2<sup>nd</sup> week.





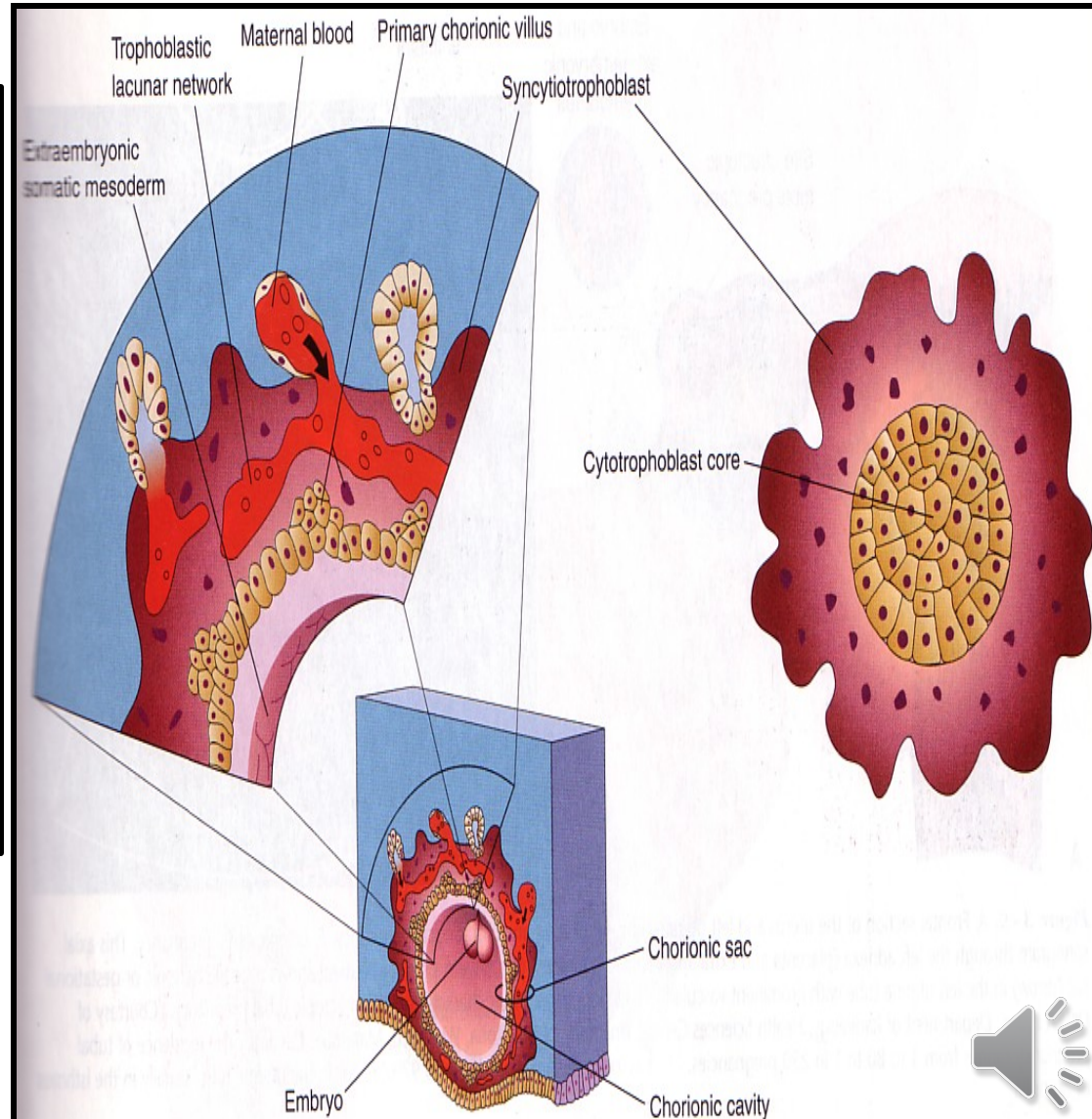
# Early Pregnancy Factor

- 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.



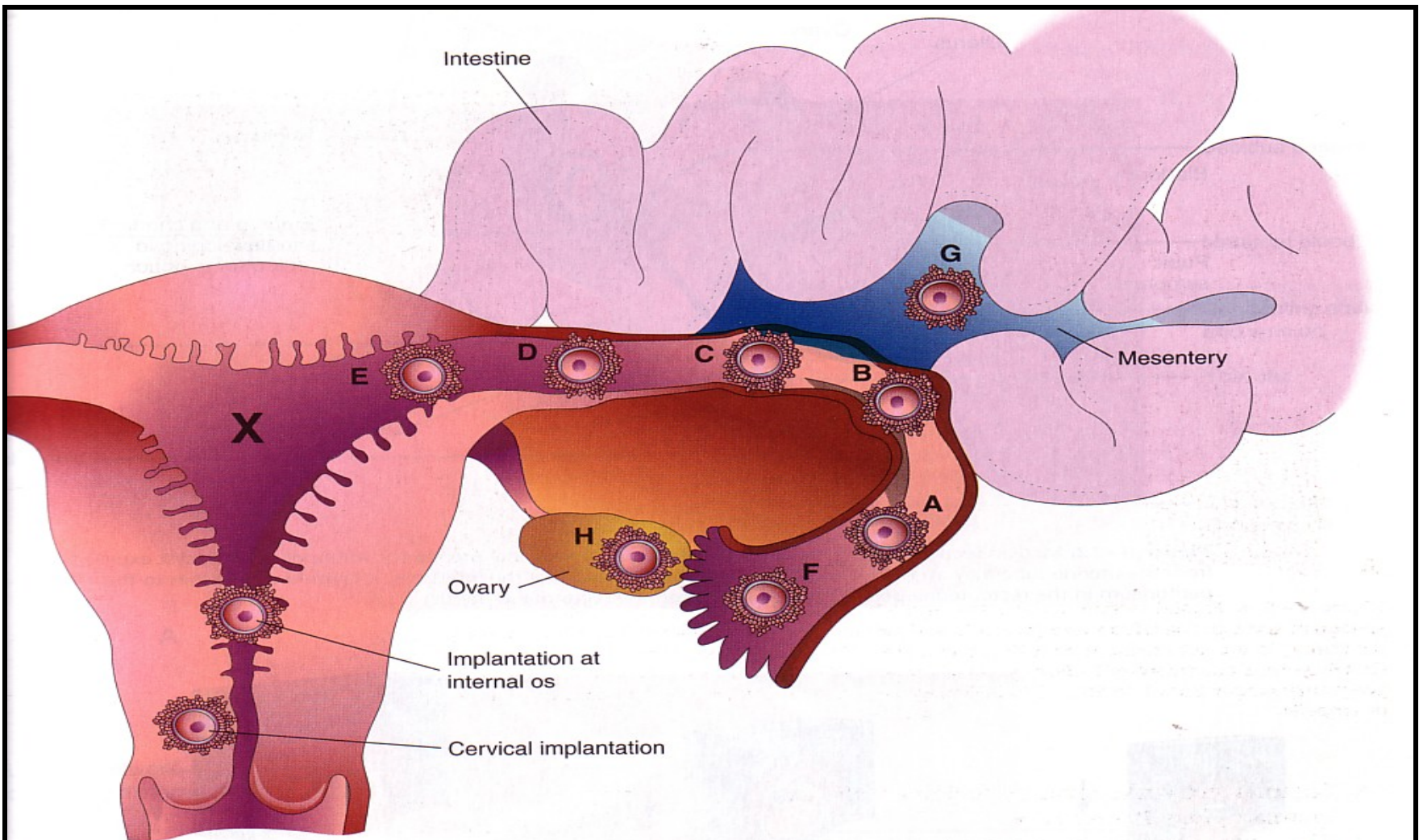
# Formation of The Primary Chorionic villi

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





# Ectopic Implantation (Pregnancy)

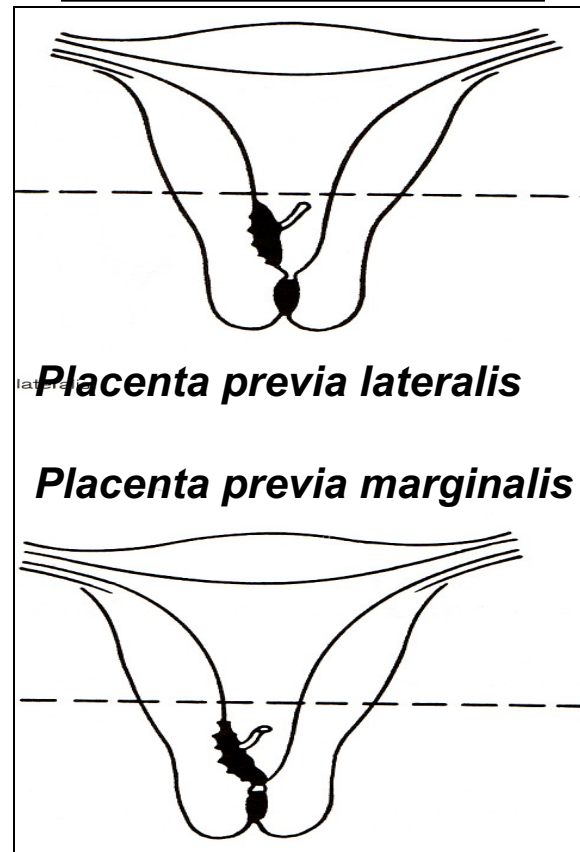
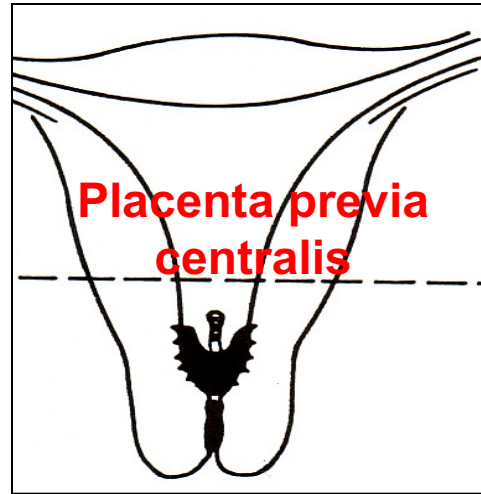


**Figure 3-10.** Implantation sites of blastocysts. The usual site in the posterior wall of the uterus is indicated by an X. The approximate order of frequency of ectopic implantations is indicated alphabetically (A, most common, H, least common). A to F, Tubal pregnancies. G, Abdominal pregnancy. H,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



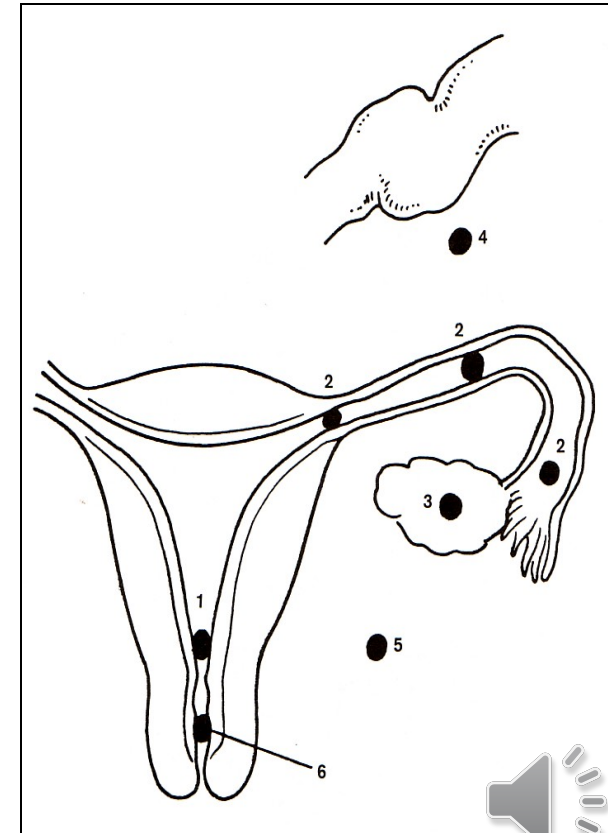
# Ectopic Pregnancy

- 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**

