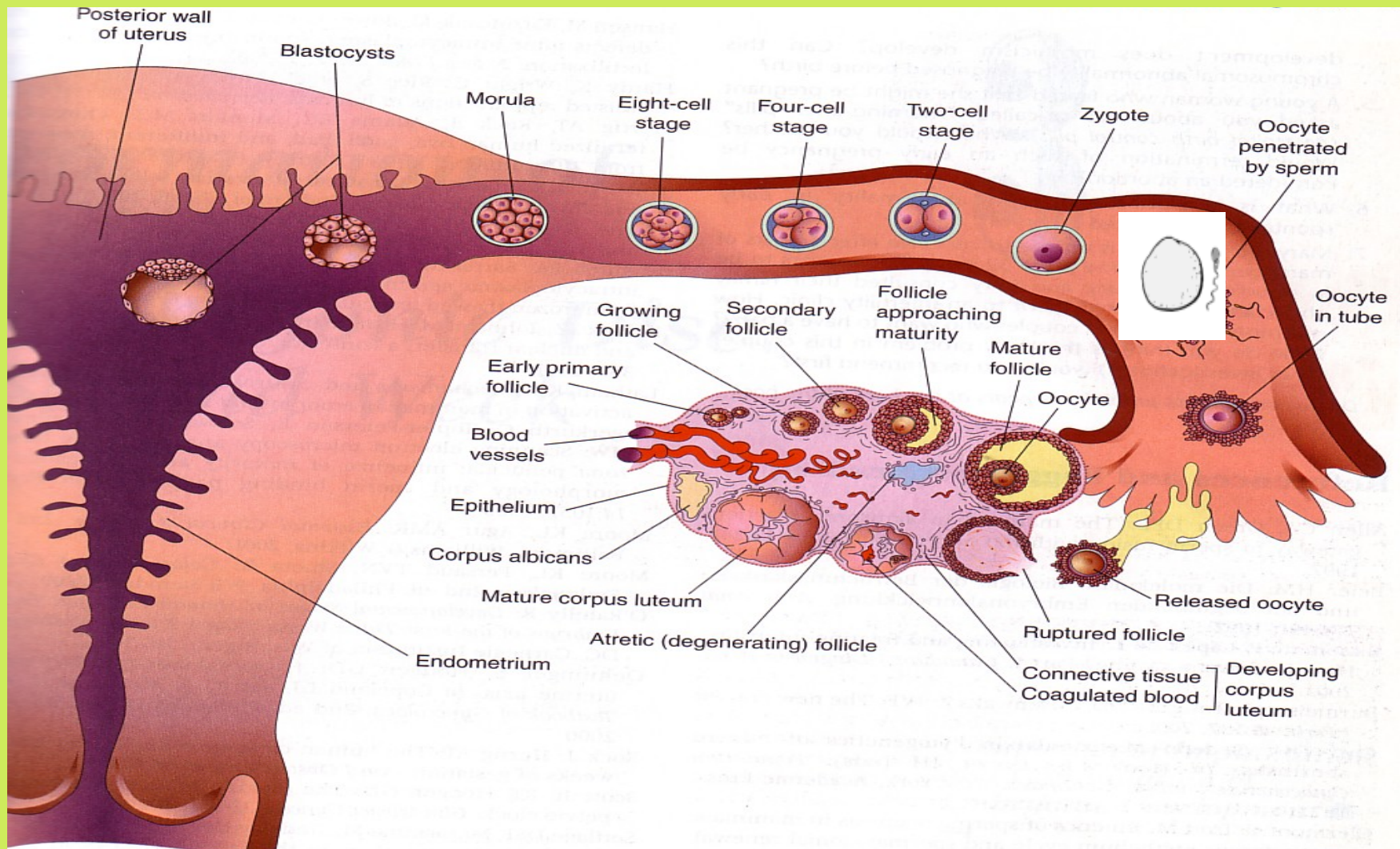


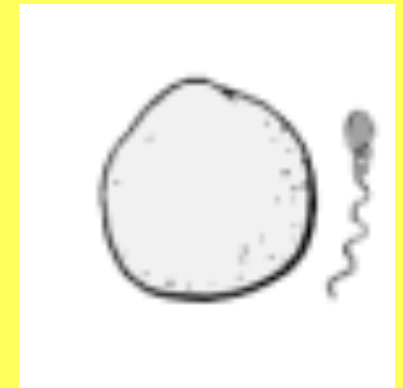
# FERTILIZATION & IMPLANTATION



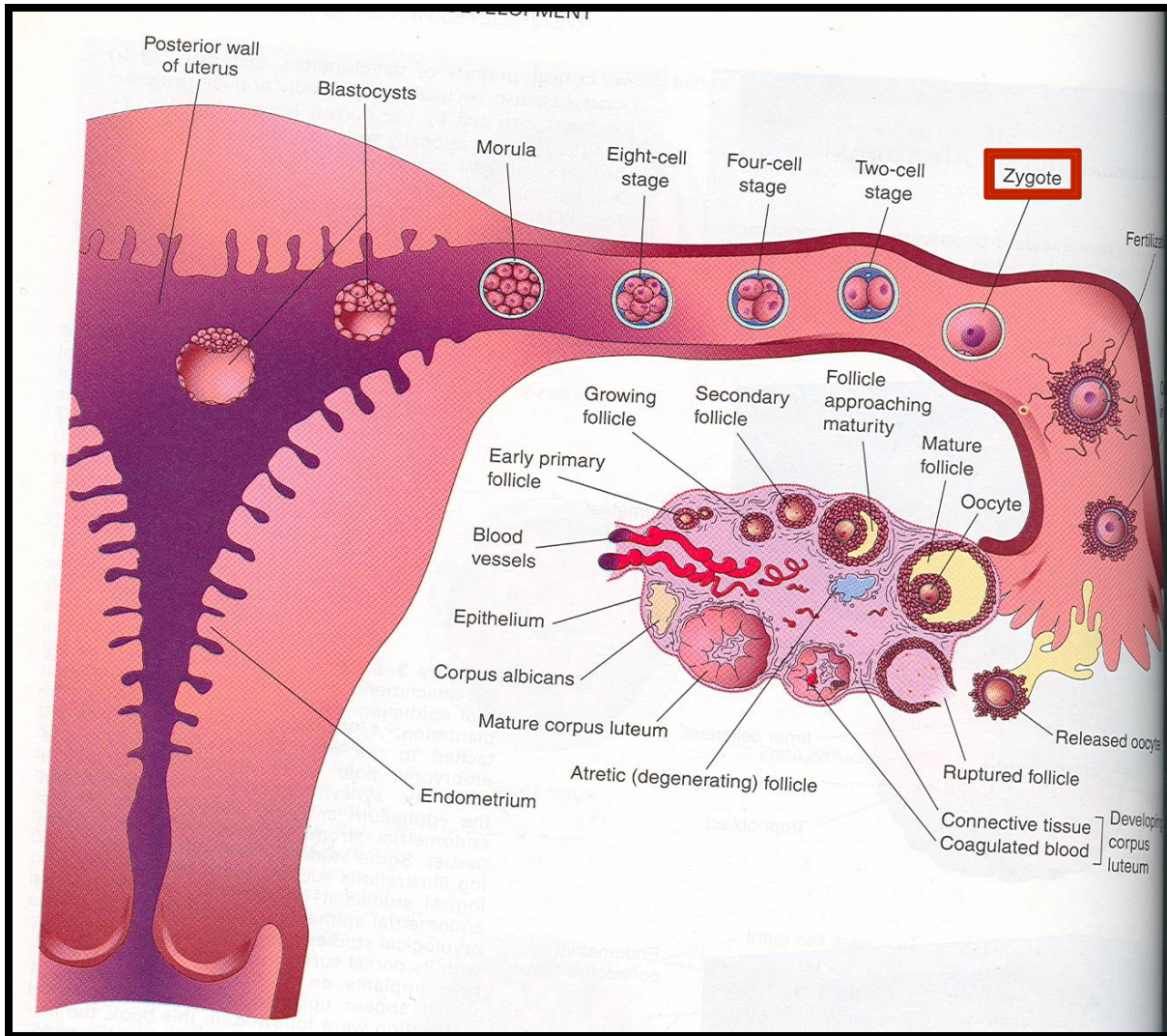
By Prof. Saeed Abuel Makarem  
& Dr. Sanaa Alshaarawi

# 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 sites of ectopic pregnancy.



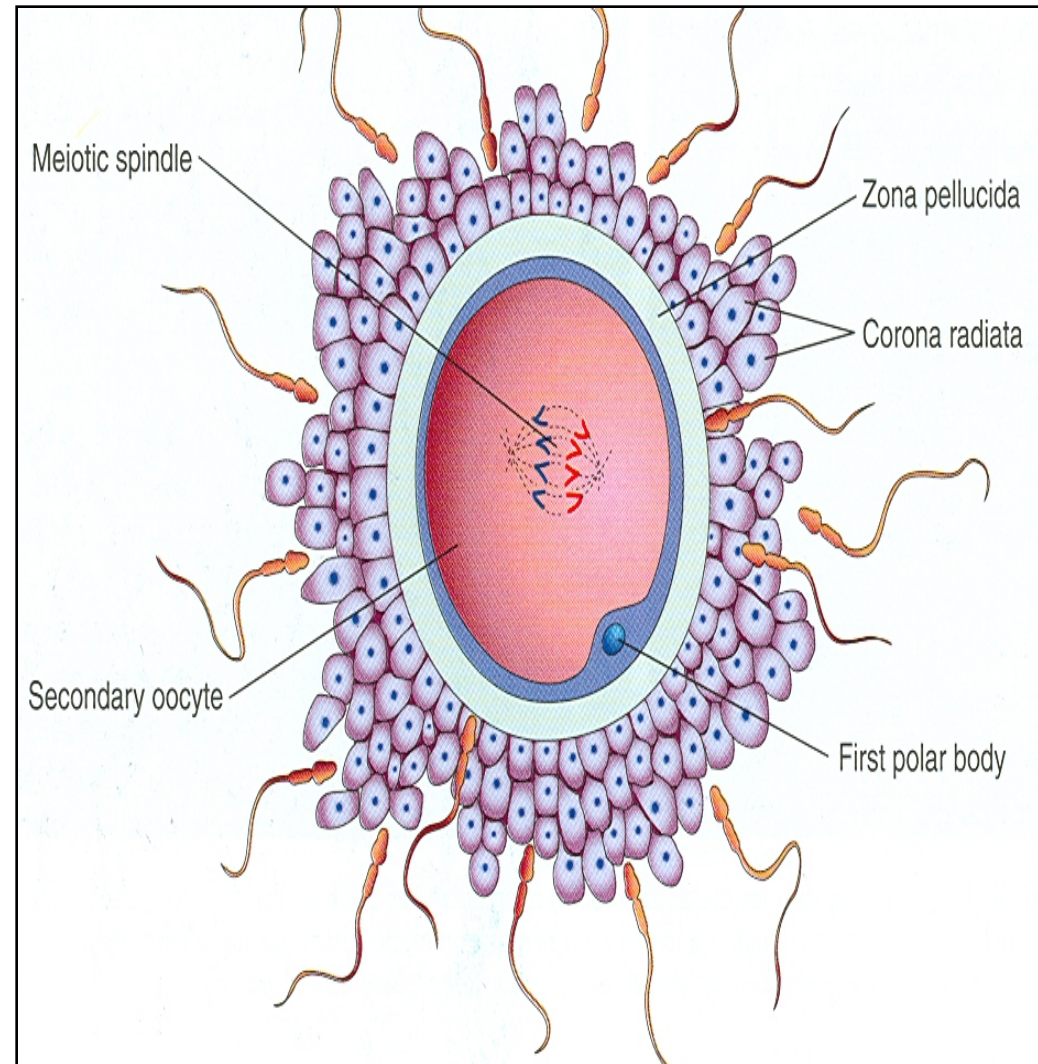
# FERTILIZATION



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

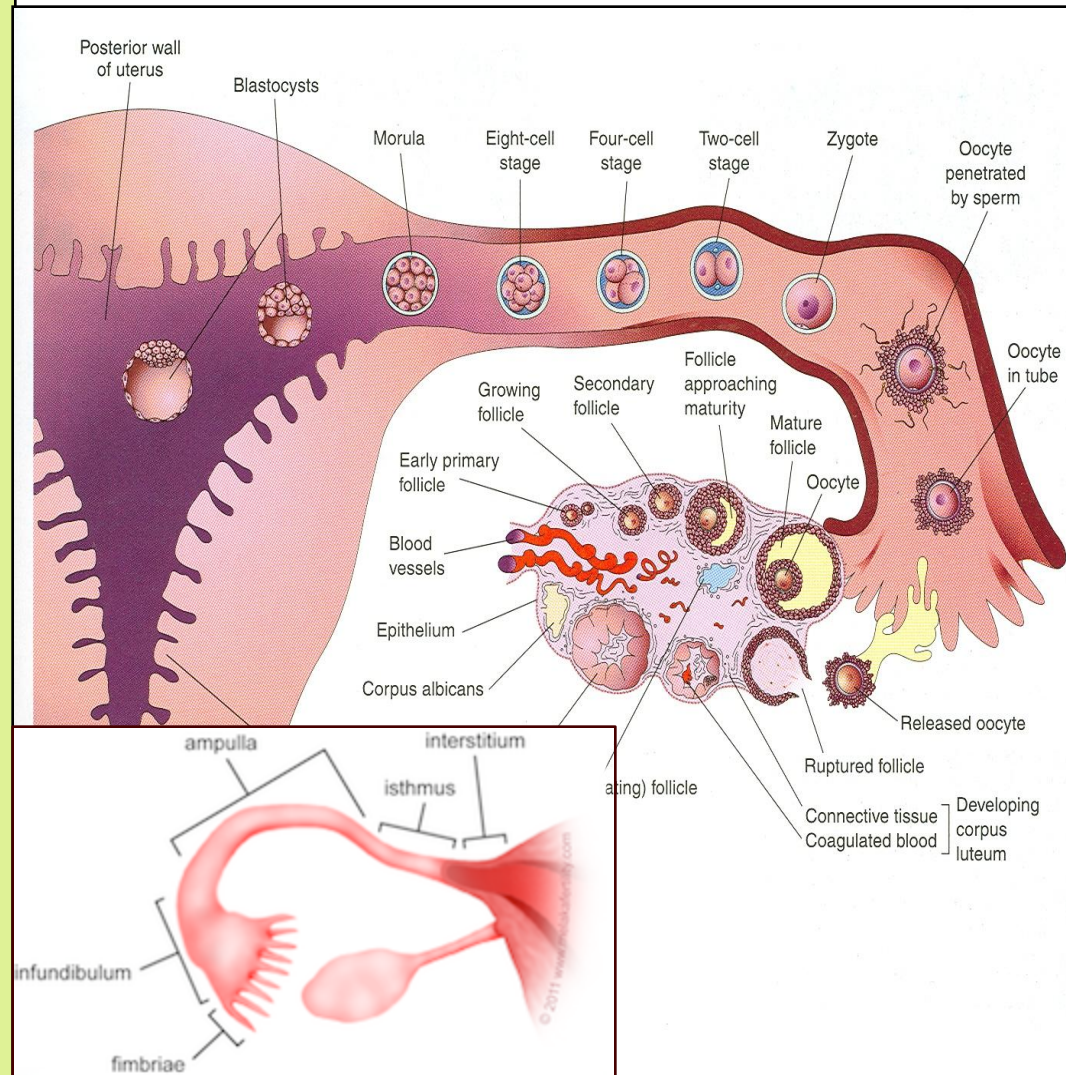
# Fertilization

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



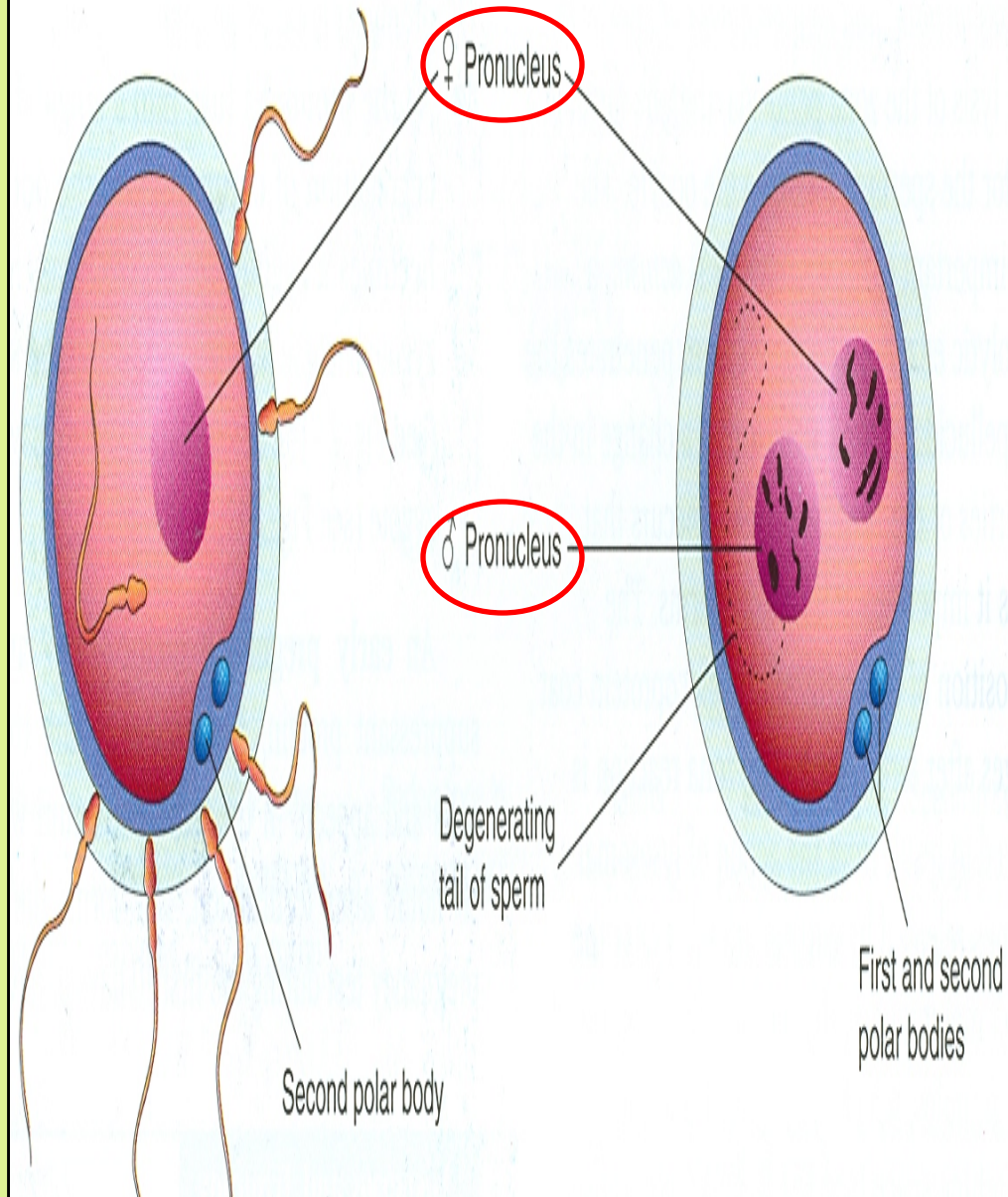
# Where Does Fertilization Normally Occur?

- Usually in the **ampulla** of **uterine tube**.
- **Ampulla** is the longest and 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.

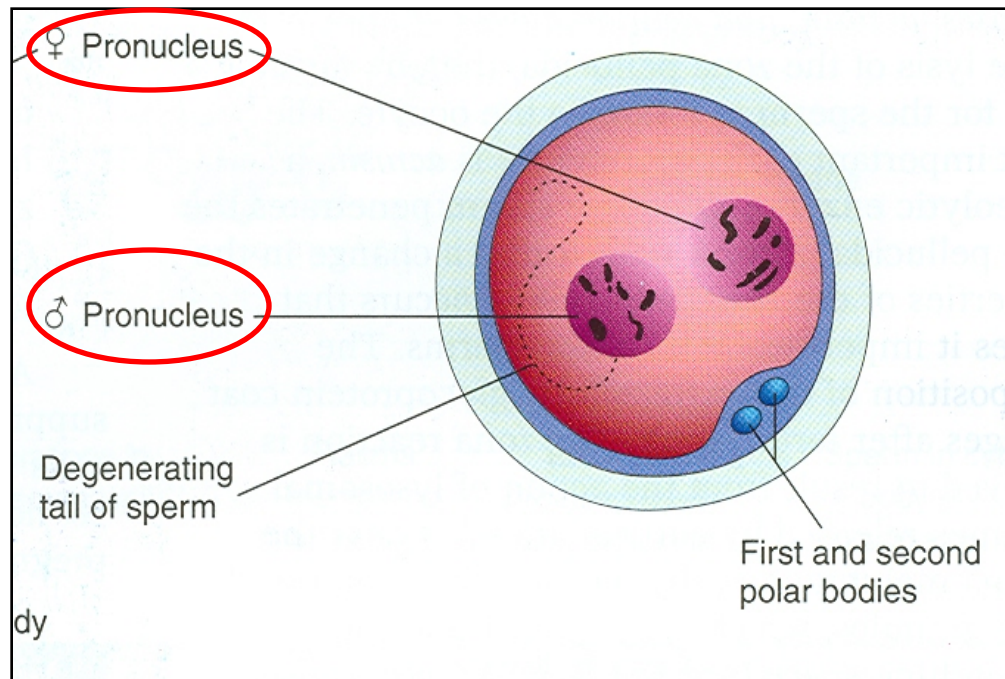


# Phases of Fertilization

- 1&2- Passage of the sperm through the cells of the corona radiata by the effect of:
  - a) Hyaluronidase enzyme secreted from the acrosome of the sperm.
  - b) By movement of its tail.
- 3- Penetration of the zona pellucida by acrosine E. (a substance secreted from acrosomal cap).
- 4- Fusion of the plasma membranes of the oocyte and the sperm.
- 5- Completion of the **second meiotic division of the oocyte**, which was arrested at (**metaphase**).
- 6- Formation of the female pronucleus.
- 7- Formation of the male pronucleus.
- 8- Union of the 2 pronuclei.



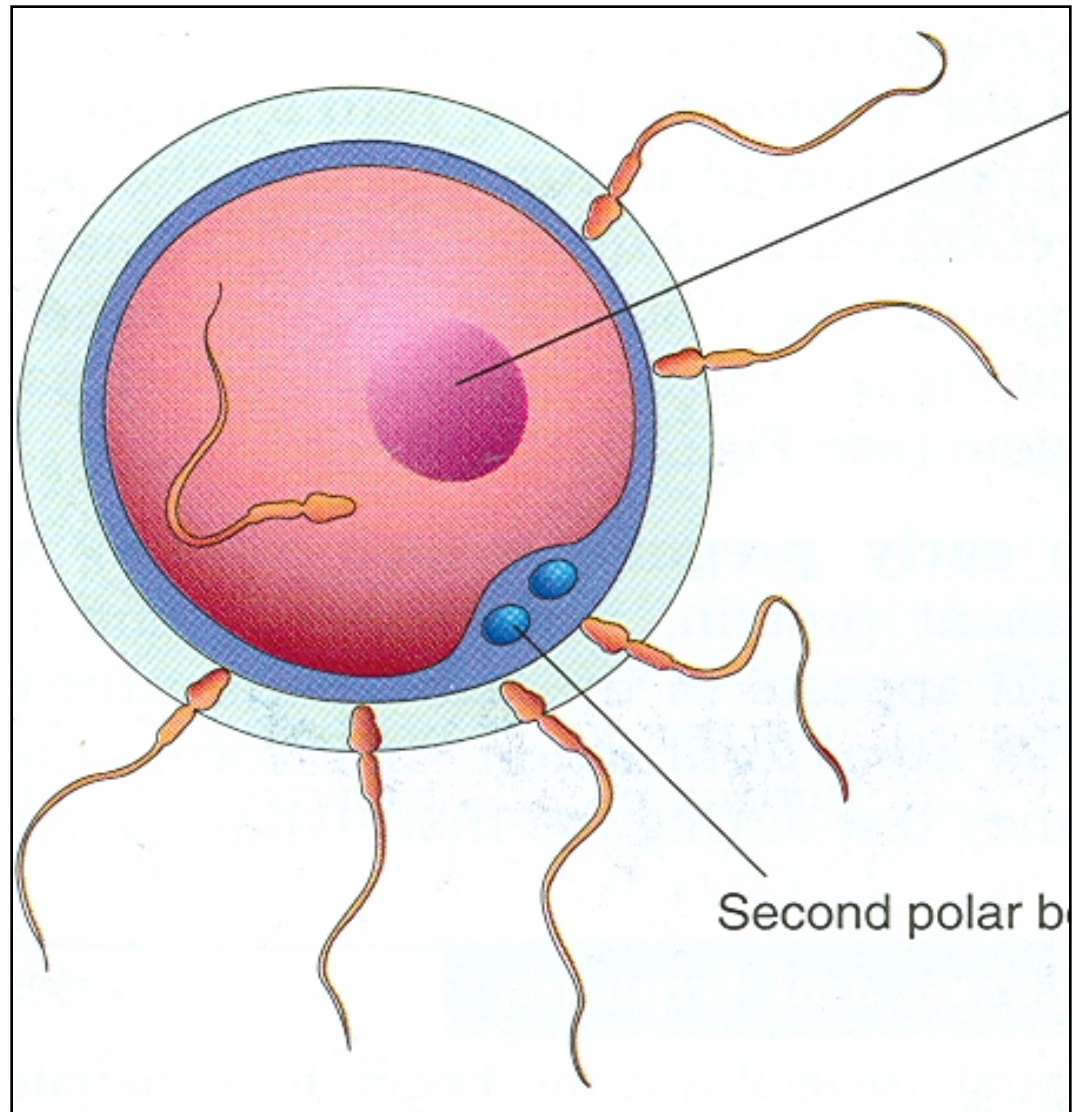
# CHROMOSOMES IN THE ZYGOTE



- **Zygote** is genetically **unique**.
- **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 by genetic studies.
- 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.

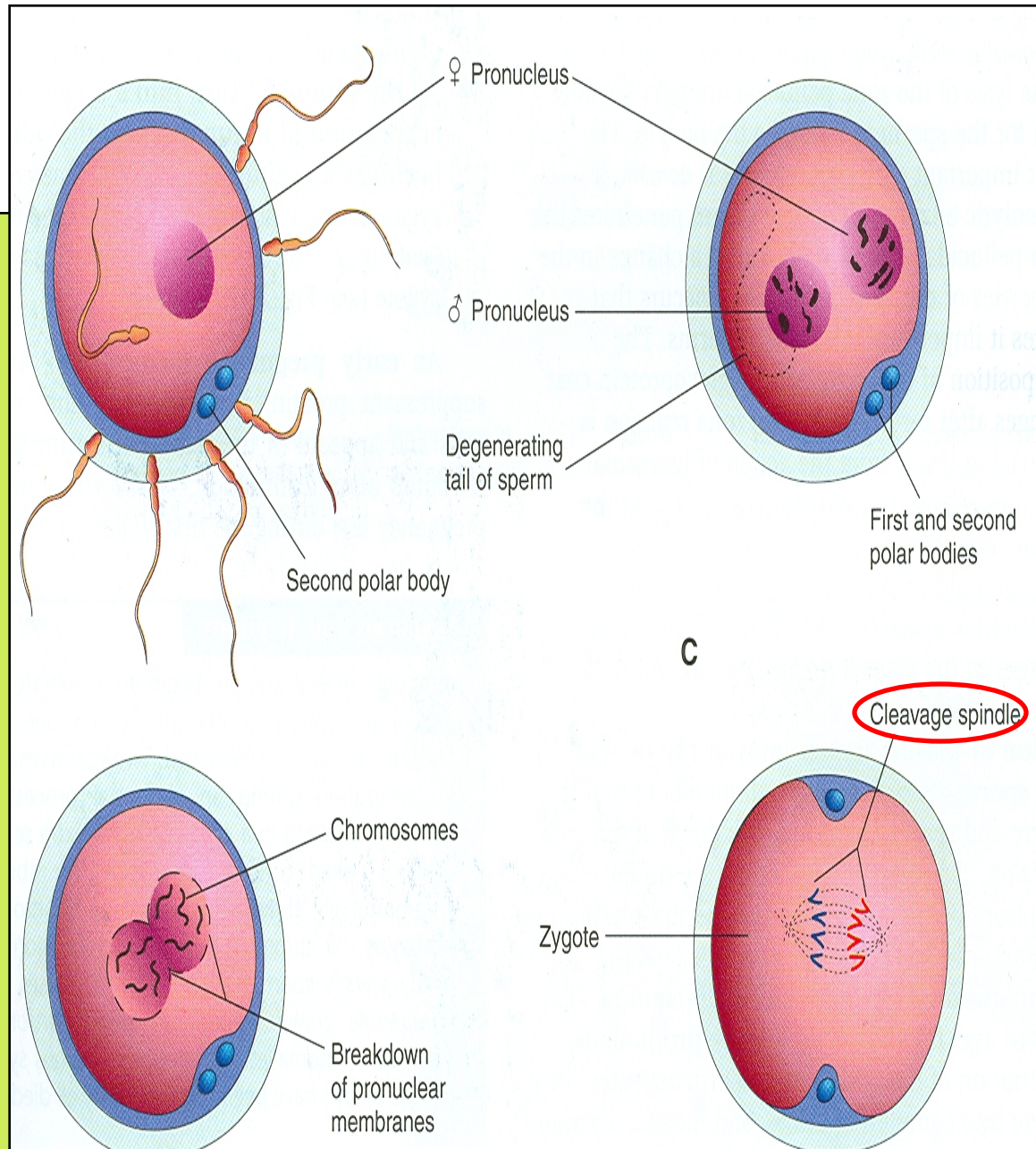


❖ **Zonal reaction** : it is a change in properties of zona pellucida that makes it impermeable to other sperms.



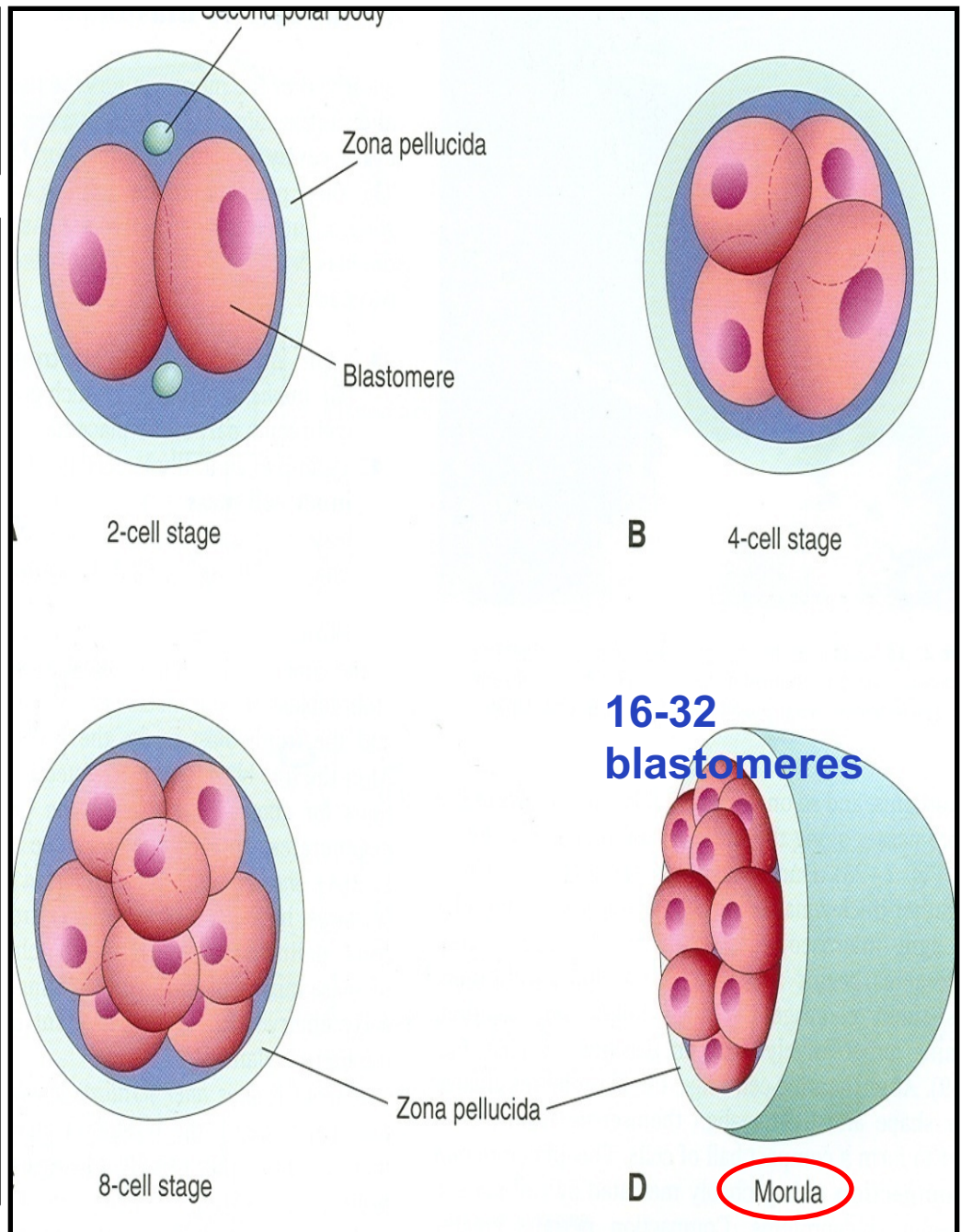
# Results of Fertilization

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



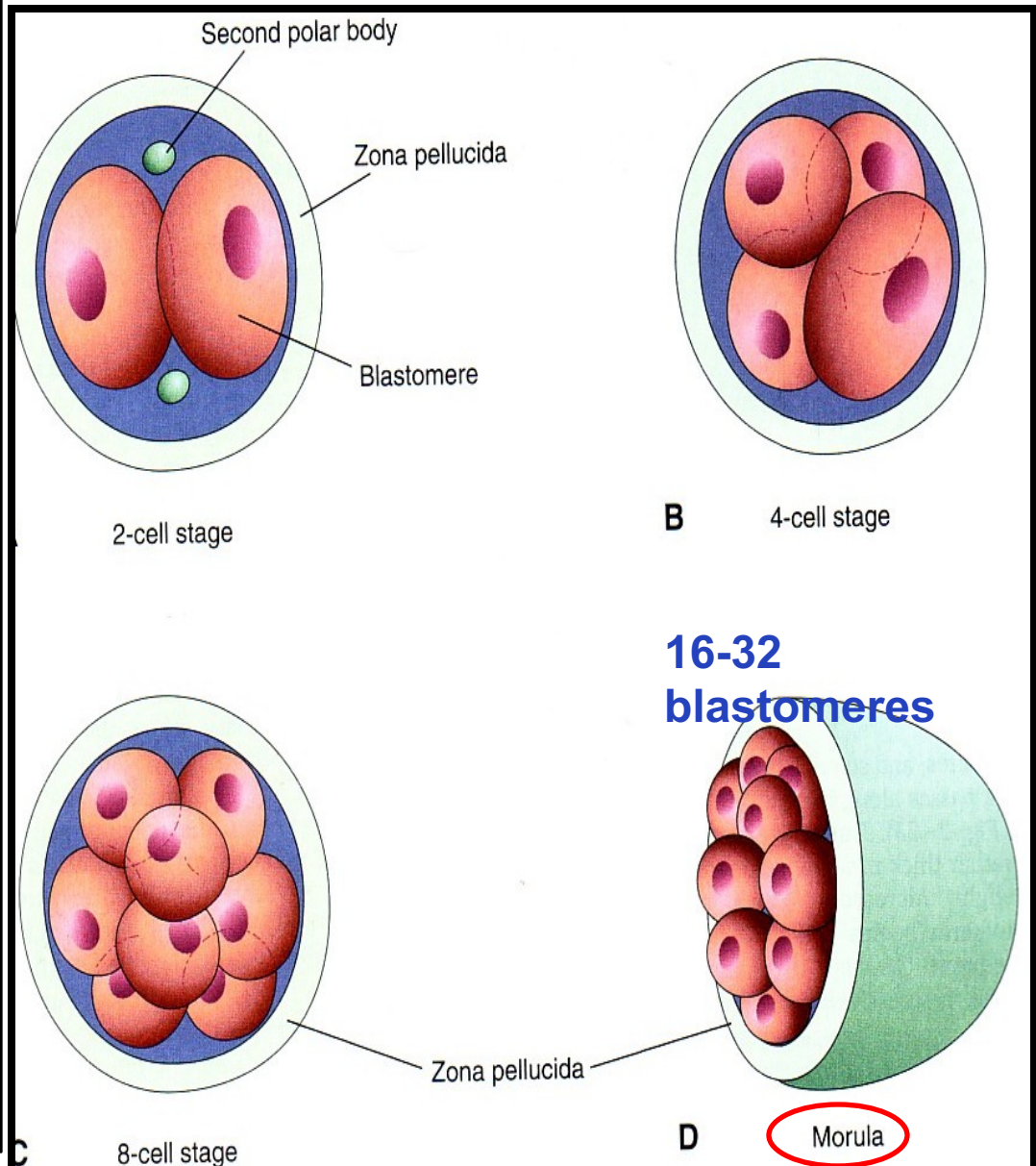
# Cleavage of Zygote

- 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**.



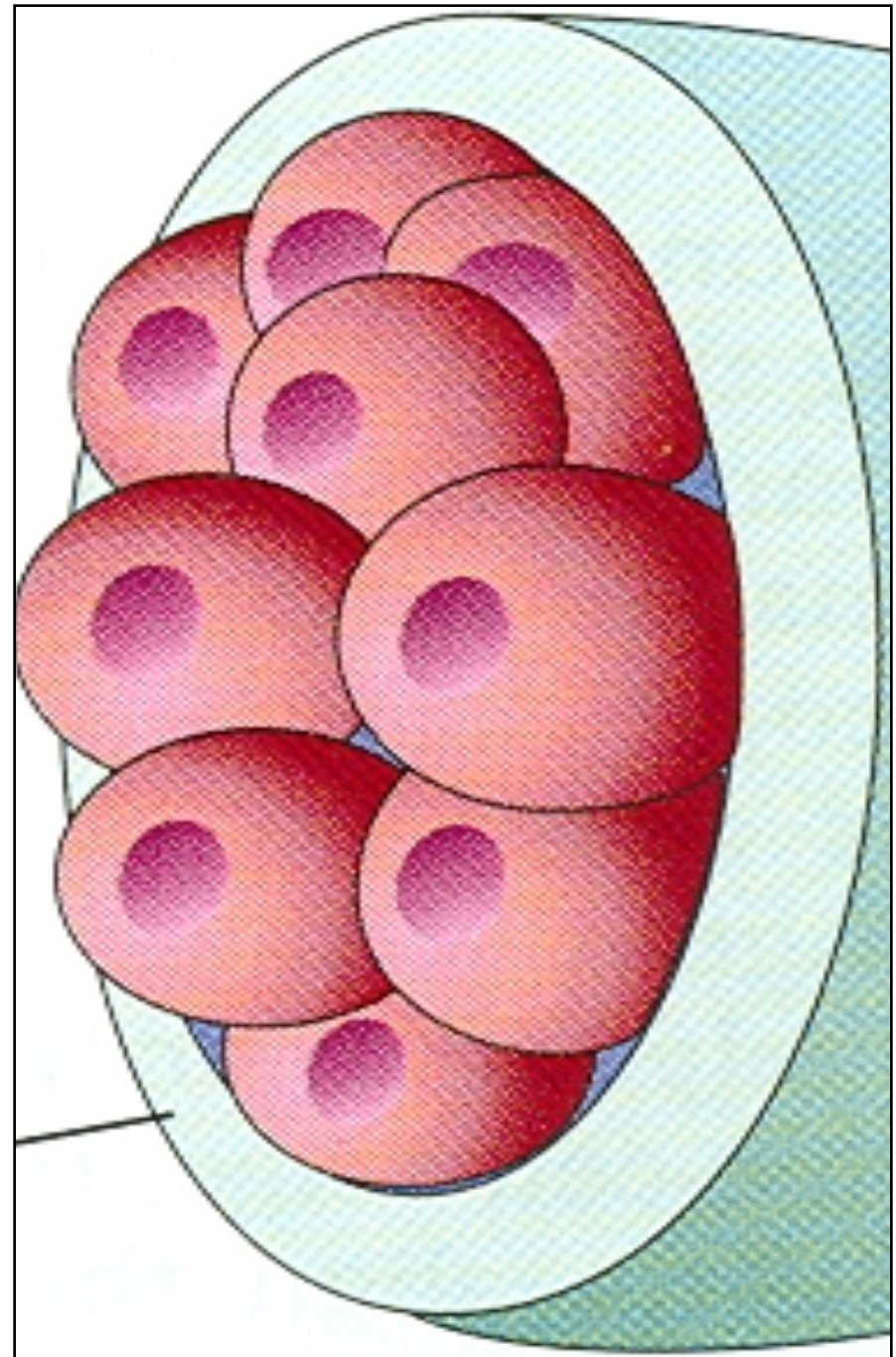
# Cleavage of Zygote

- It 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 lateral to medial.
- Under the microscope, the **zona pellucida** is a translucent membrane

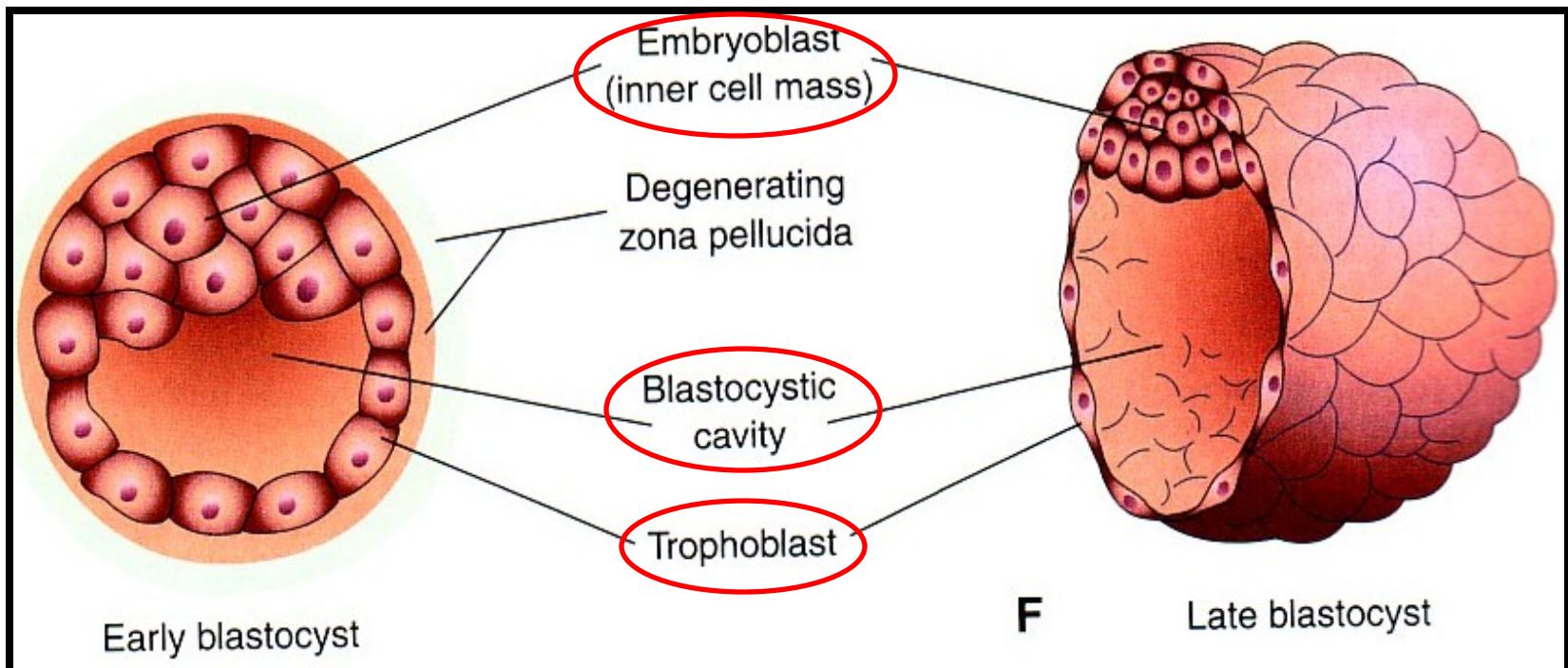


# Morula

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



- **Mechanism of Blastocyst Formation :**
- The **Morula** reaches the **uterine cavity by the 4<sup>th</sup> day after fertilization**, & remains free 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**, its **cells** divided into **Embryoblast & Trophoblast**.

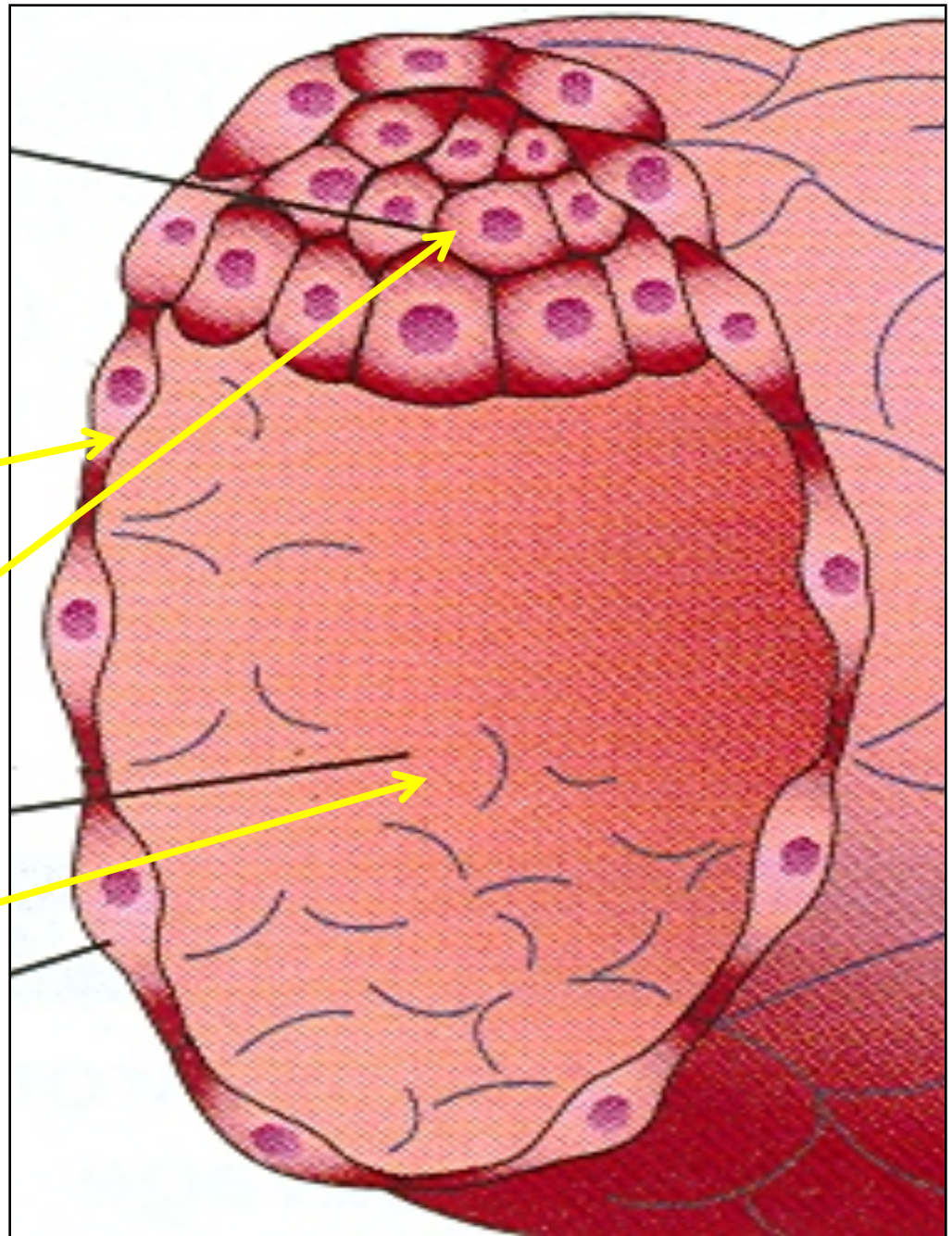


# BLASTOCYST

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

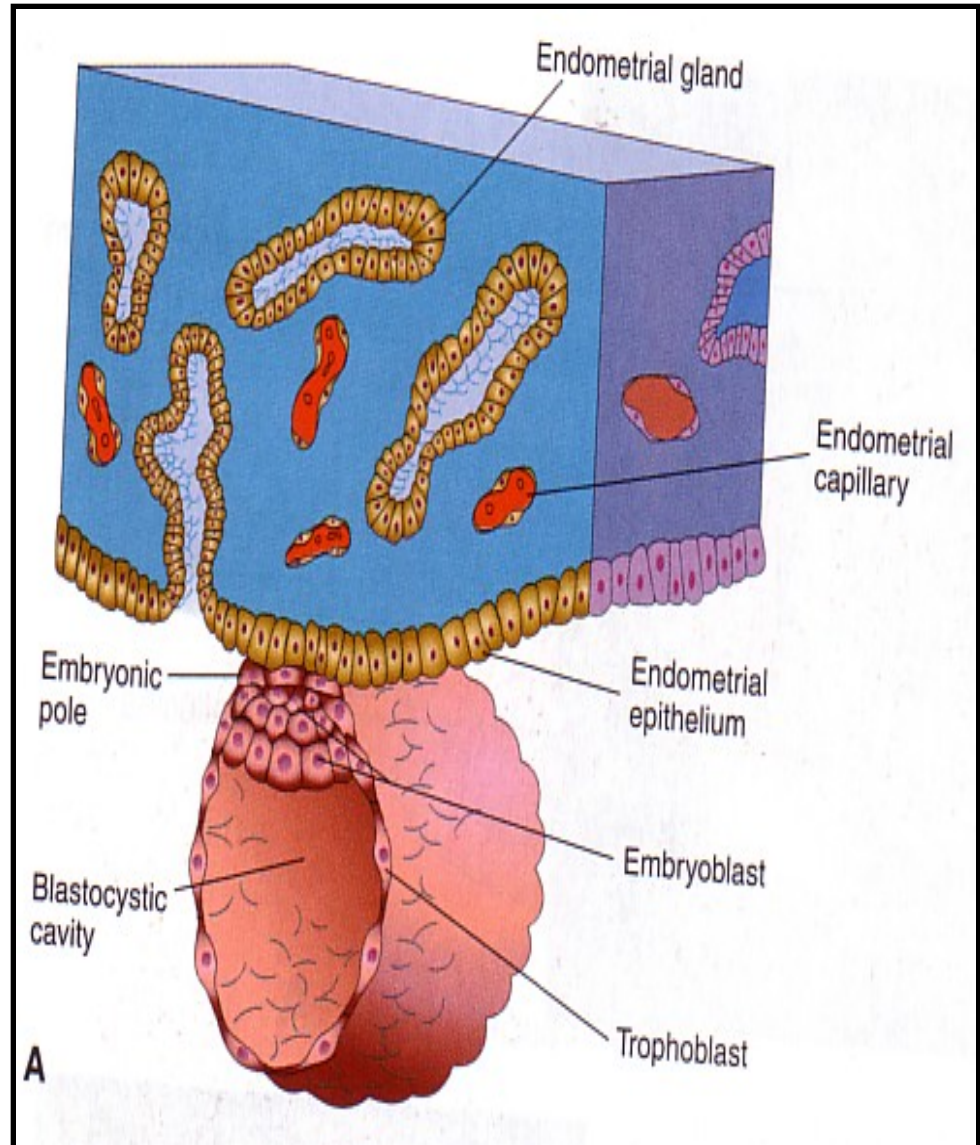
1. Outer cell layer called trophoblast.
2. Inner cell layer (mass) called Embryoblast attached to one of the poles of the blastocyst.

The cavity is called blastocystic cavity or blastocoel.

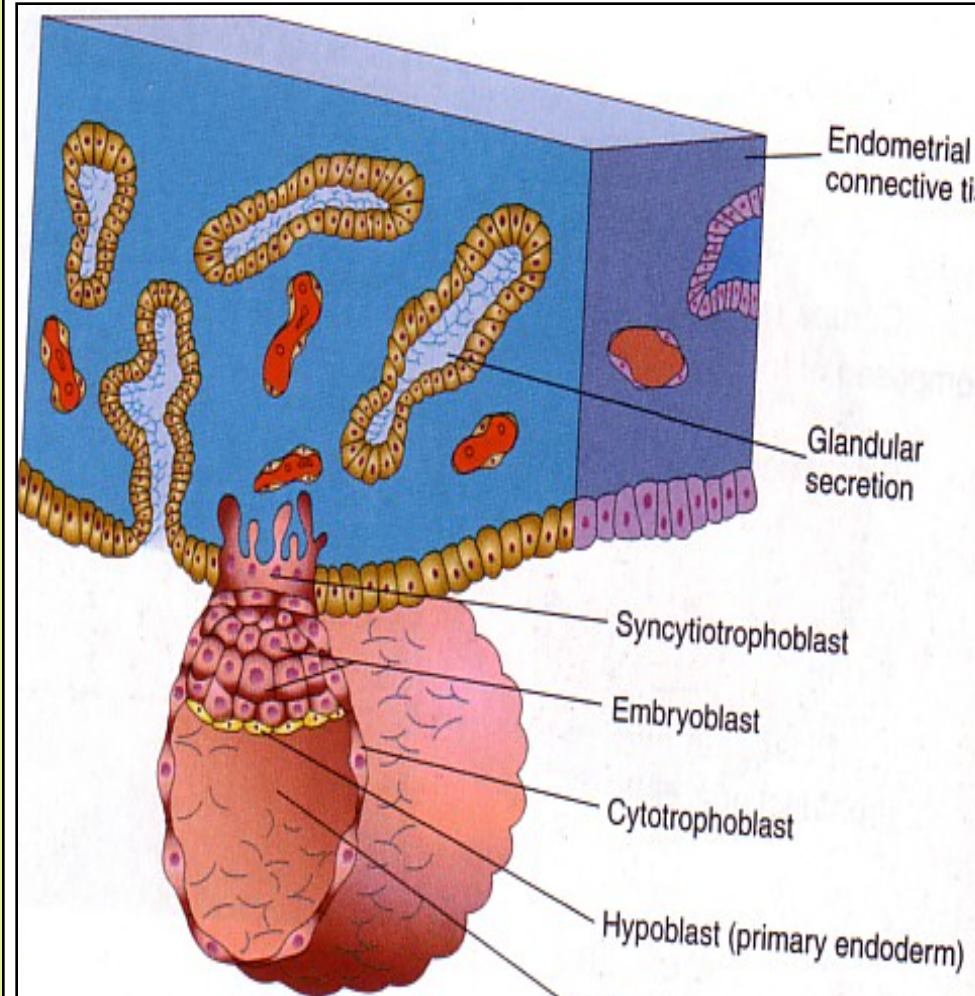


- Definition :
- It is the process by which the **Blastocyst** penetrates the **superficial (Compact) layer of the endometrium** of the uterus.
- Site:
- The normal site of implantation is the posterior wall of the body of the uterus near the fundus.
- Time:
- It begins about the **6<sup>th</sup> day**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

# IMPLANTATION



## Mechanism of Implantation (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 (beginning of implantation).
- By **7<sup>th</sup> day**, Trophoblast differentiated into **2 layers**:
  - **Syncytiotrophoblast** which invades the endometrium; (It is outer multinucleated cytoplasmic 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.



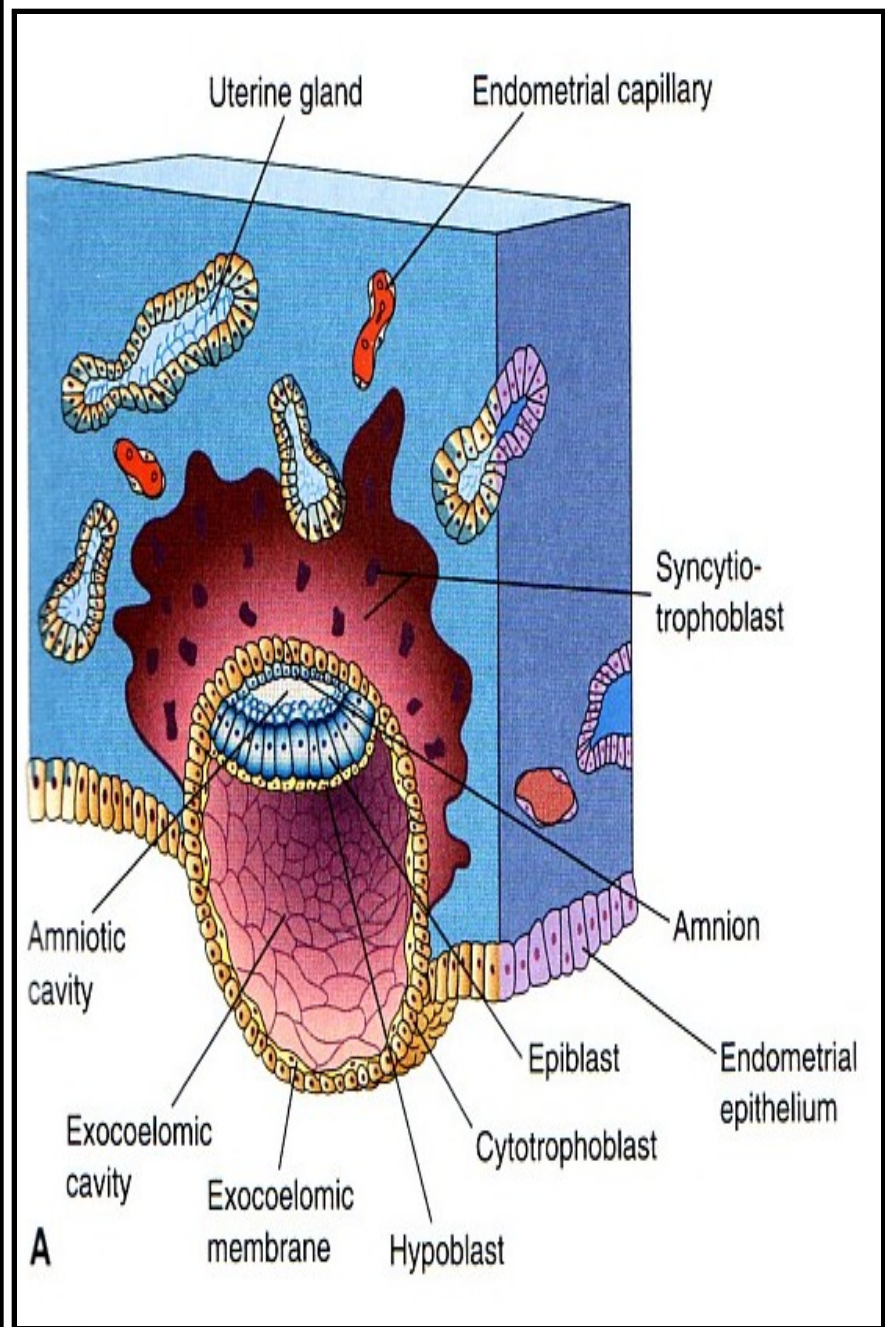
- **Blood-filled Lacunae** appear in the **Syncytiotrophoblast** which communicate forming a lacunar network by the 10<sup>th</sup> or 11<sup>th</sup> day.

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

**Now** blood of maternal capillaries reaches the lacunae so,

**Uteroplacental circulation**

is established 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**.

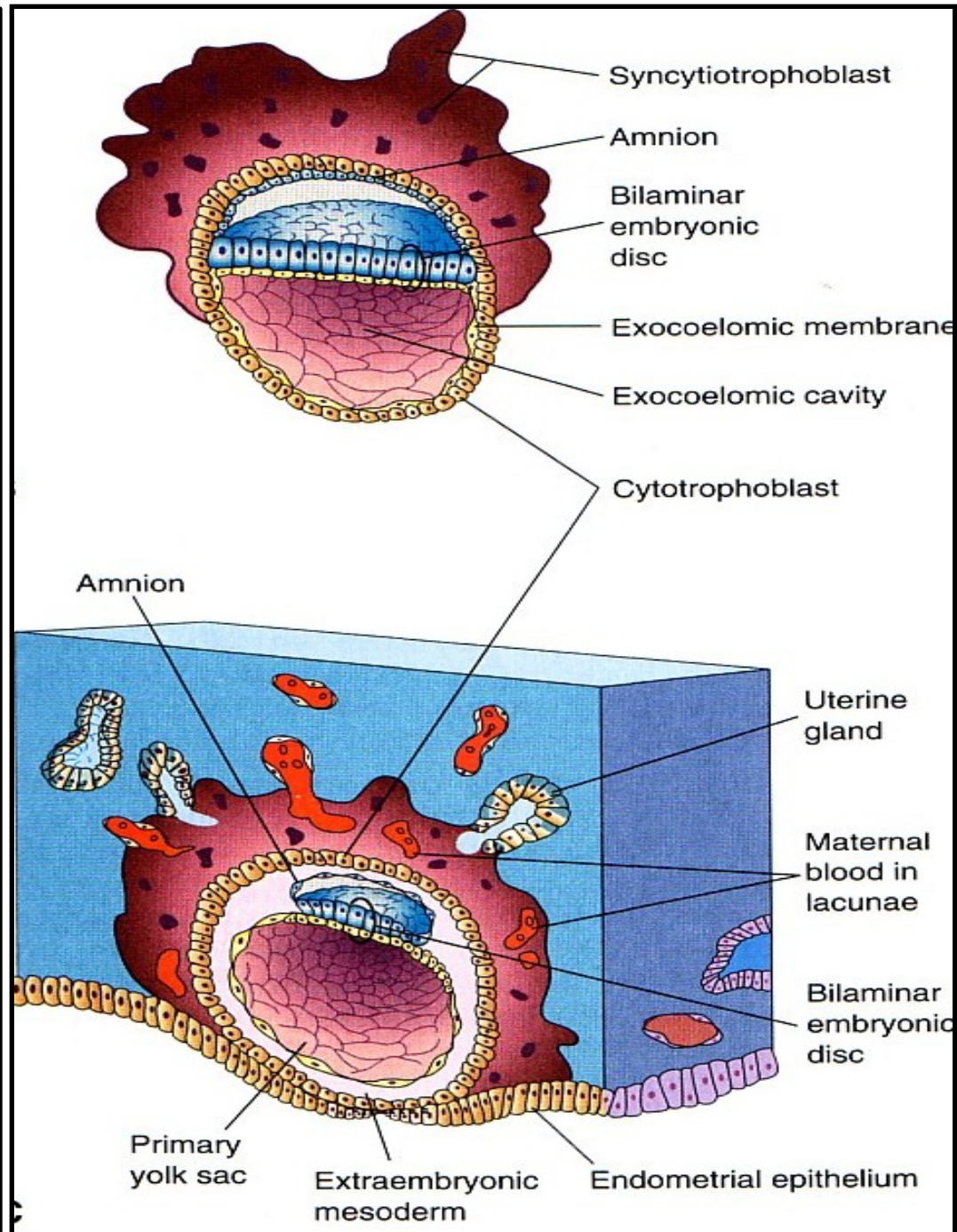
**Syncytiotrophoblast engulf** these degenerated cells for nutrition of the embryo.

### **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 (**Home Pregnancy Test**):

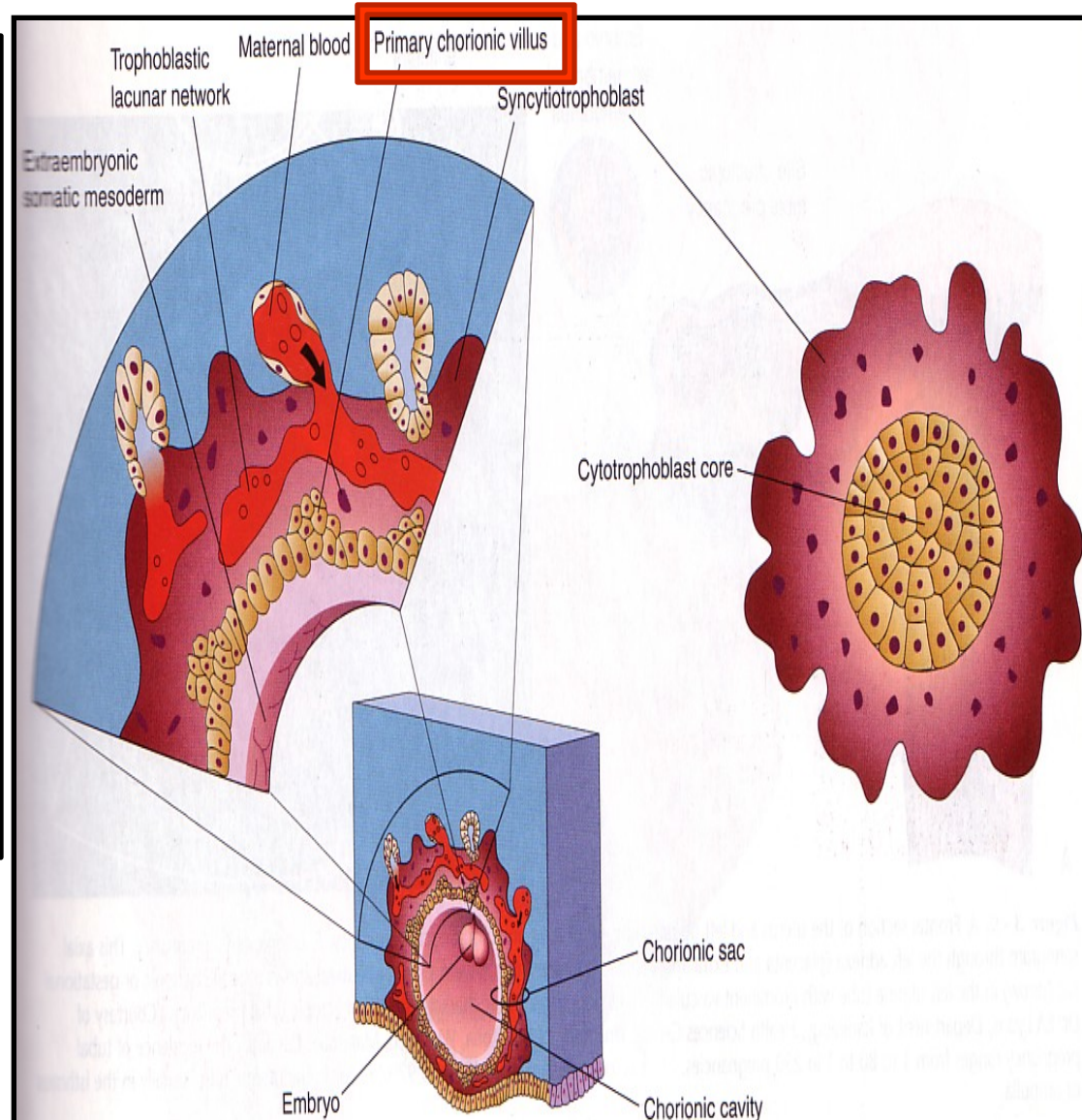


# Early Pregnancy Factor (EPF)

- 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.

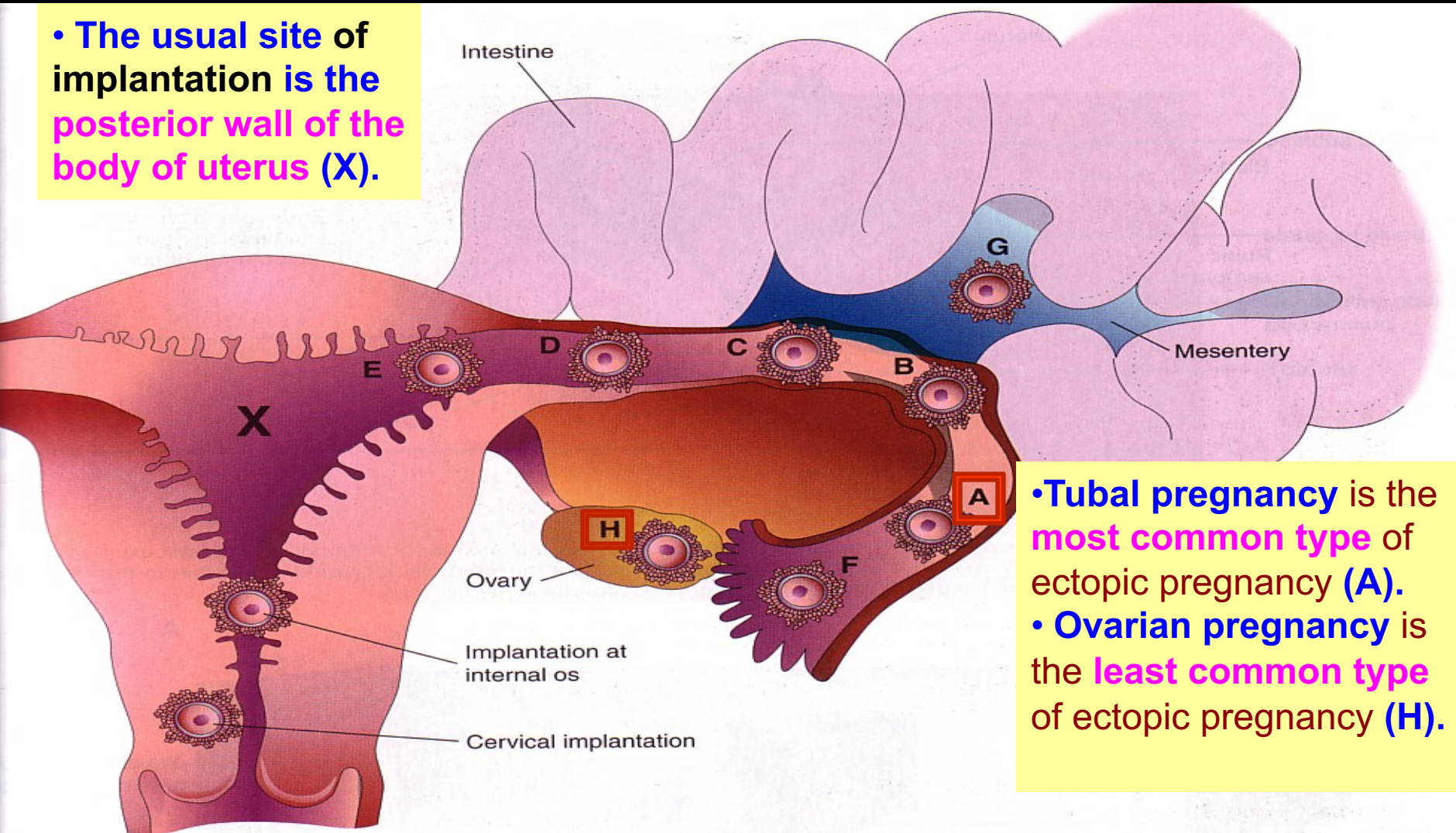
# Formation of The Primary Chorionic villi

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



# Ectopic Implantation (Pregnancy)

• The usual site of implantation is the posterior wall of the body of uterus (X).



• Tubal pregnancy is the most common type of ectopic pregnancy (A).

• Ovarian pregnancy is the least common type of ectopic pregnancy (H).

Fig 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.

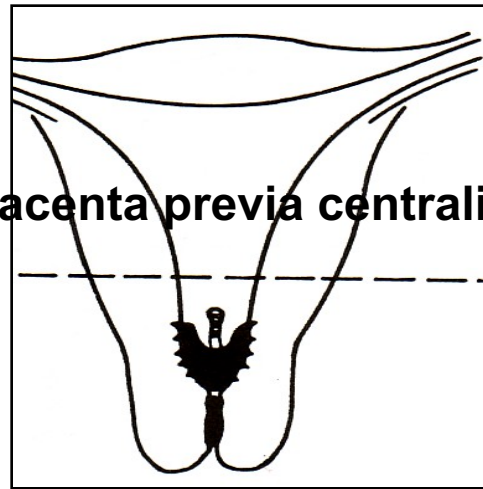
1. 95 to 97% of ectopic pregnancies occurs in the uterine tube.

- Most are in the **ampulla** & isthmus.

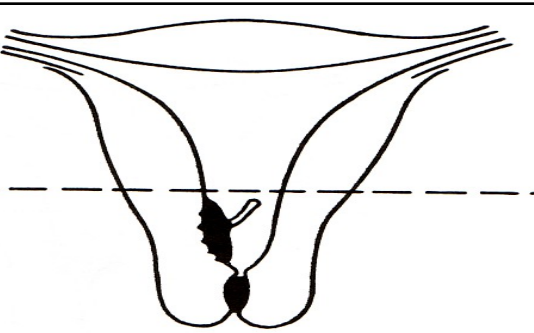
## 2. Placenta previa:

- Implantation occurs in the lower uterine segment.

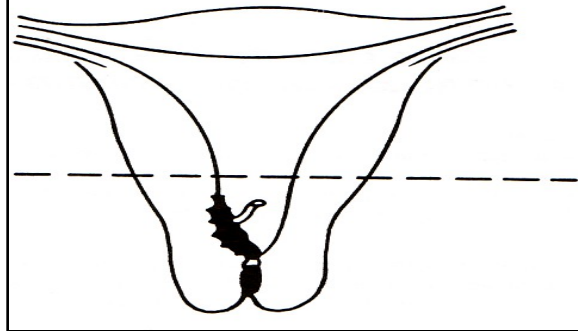
Placenta previa centralis



Placenta previa lateralis

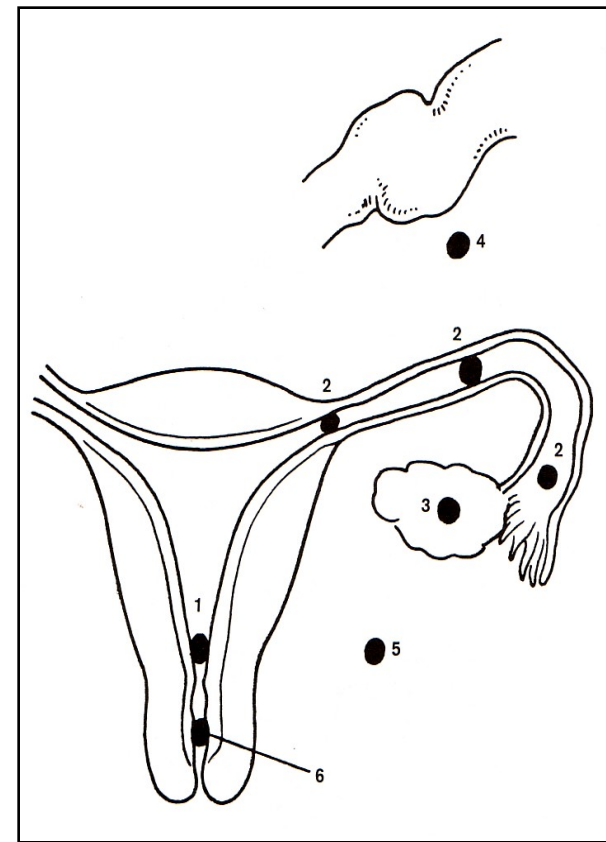


Placenta previa marginalis



## Ectopic Pregnancy:

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



GOOD

LUCK