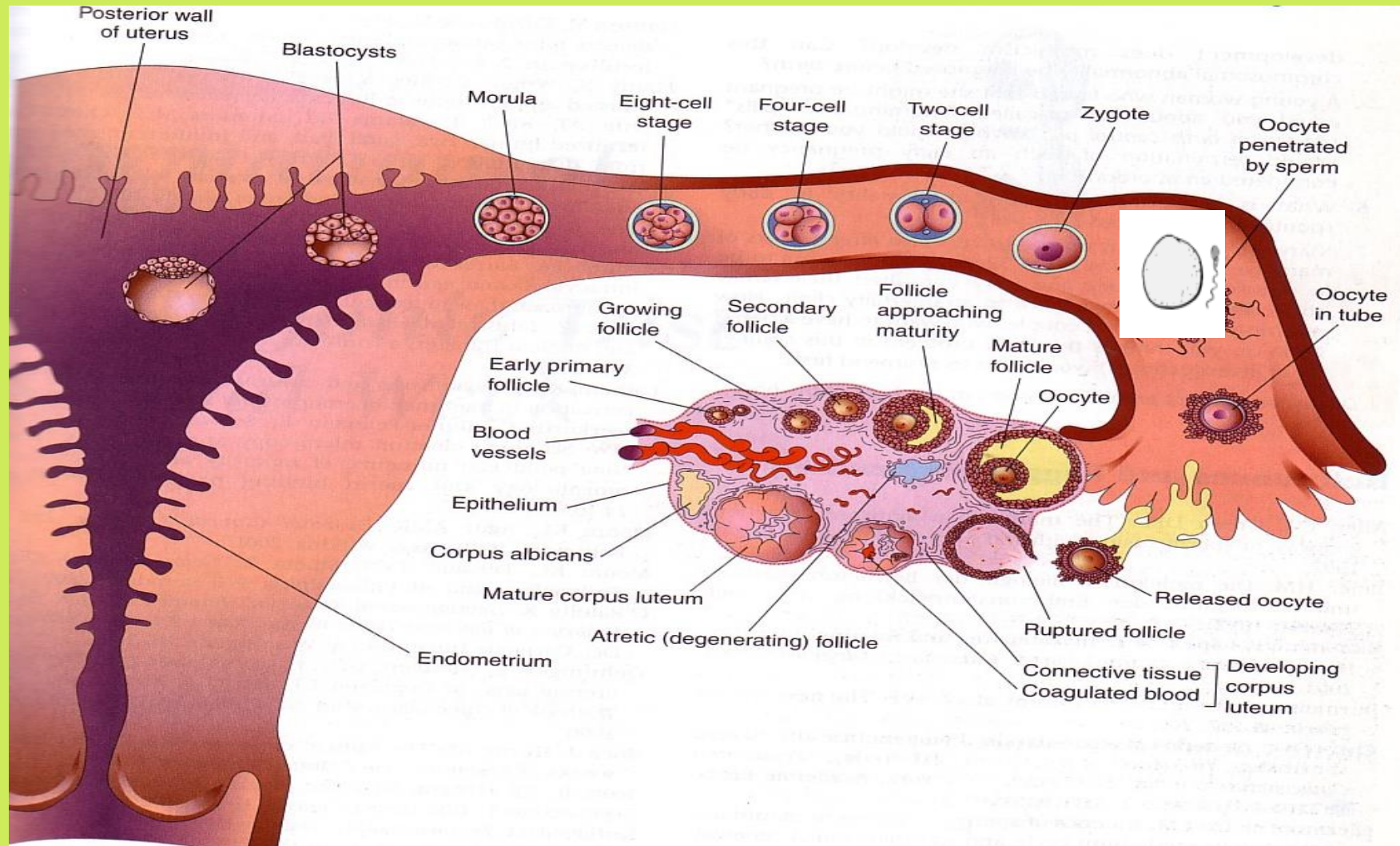


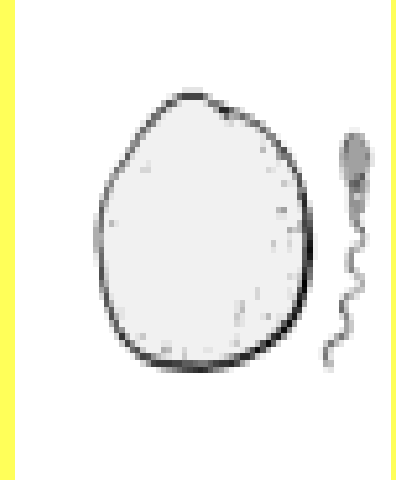
# FERTILIZATION & IMPLANTATION AND TWINNING



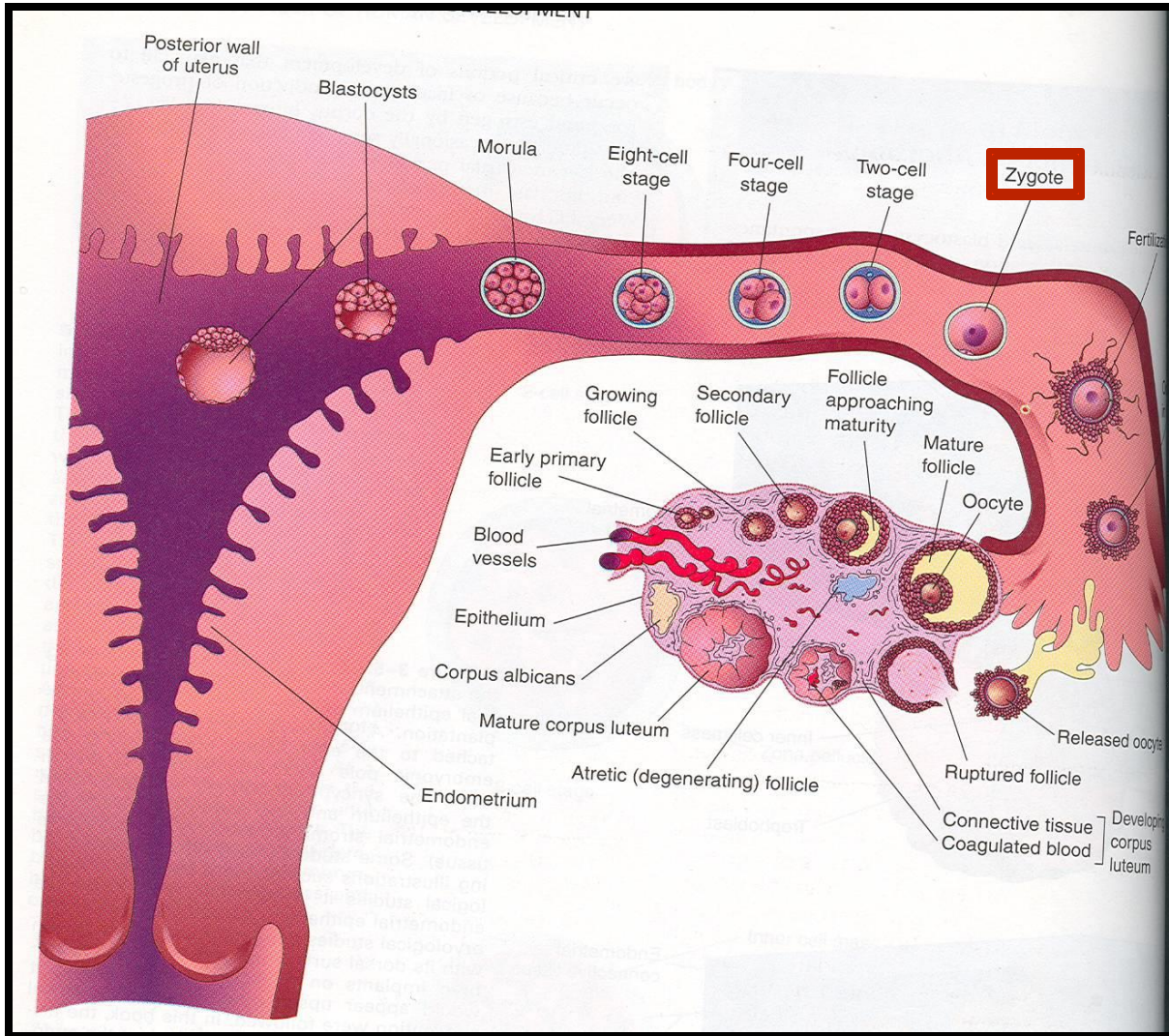
By Prof. Saeed Abuel Makarem  
& Dr. Sanaa Alshaarawi

# 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.
- Describe the **formation** of **primary chorionic villi**.
- List the **sites** of **ectopic pregnancy**.



# FERTILIZATION

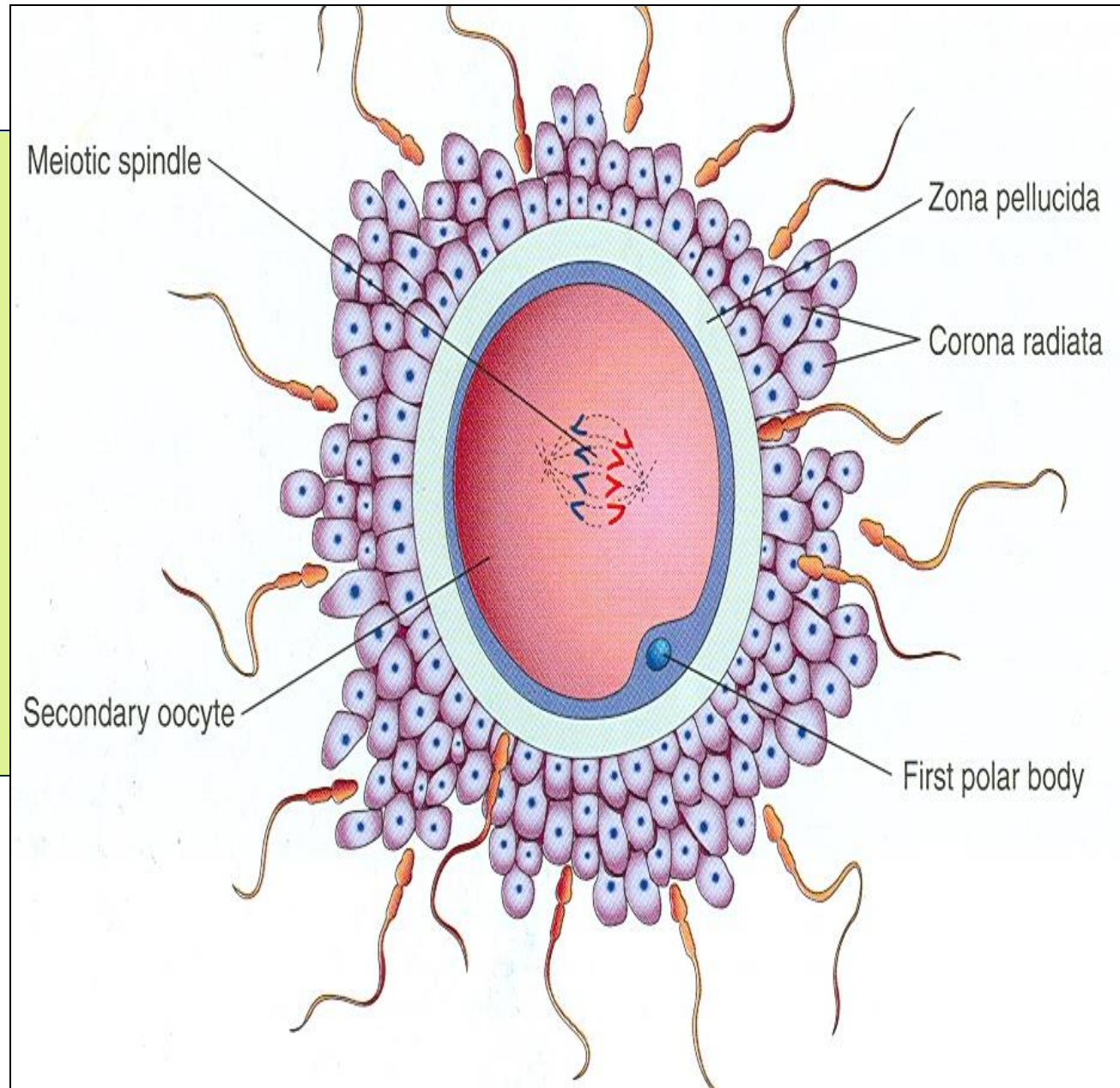


- Definition:
- It is the process during which a male gamete (**sperm**) unites with a female gamete (**oocyte**) to form a single cell (**ZYGOTE**).



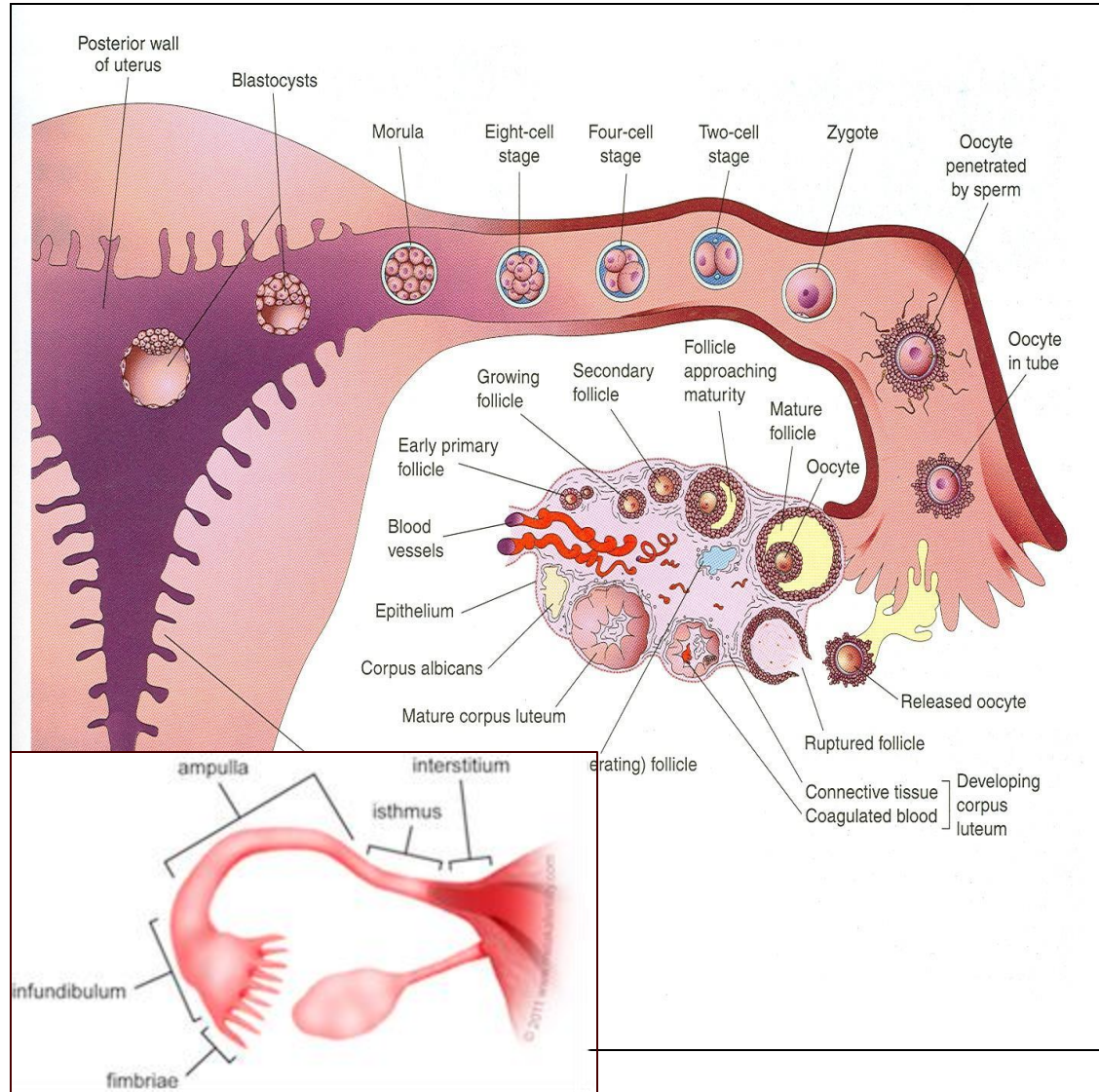
# Fertilization

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



# Site of Fertilization

- 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.





# 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 sperms.**

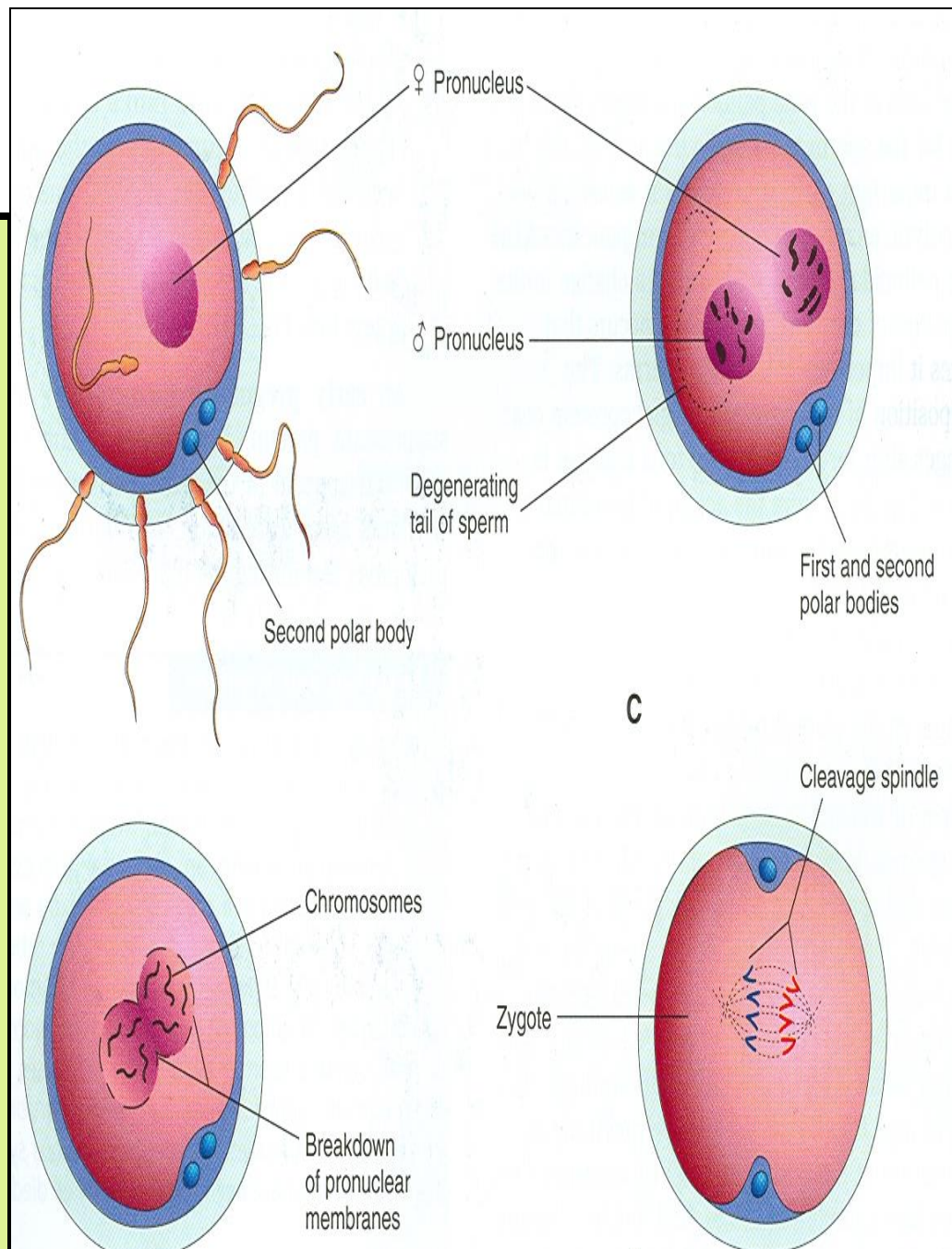
**b) By movement of its tail.**

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

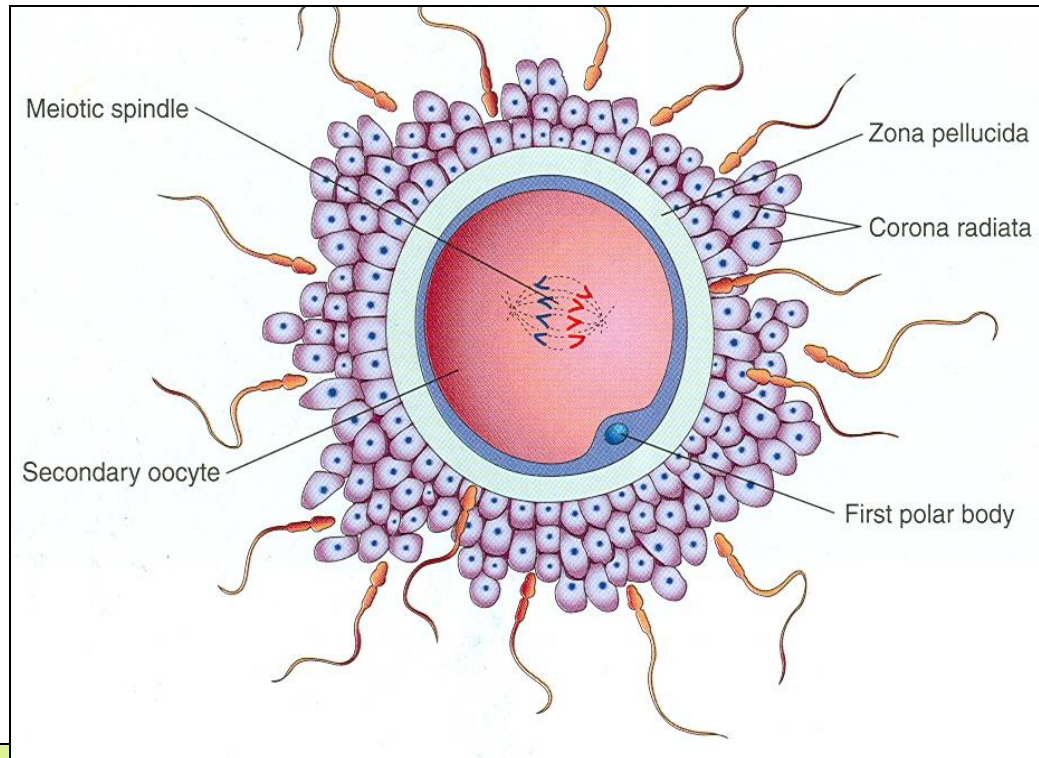
**4- Fusion of the plasma membranes of the oocyte and the sperm.**

**5- Completion of the second meiotic division of the oocyte & formation of the female pronucleus.**

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



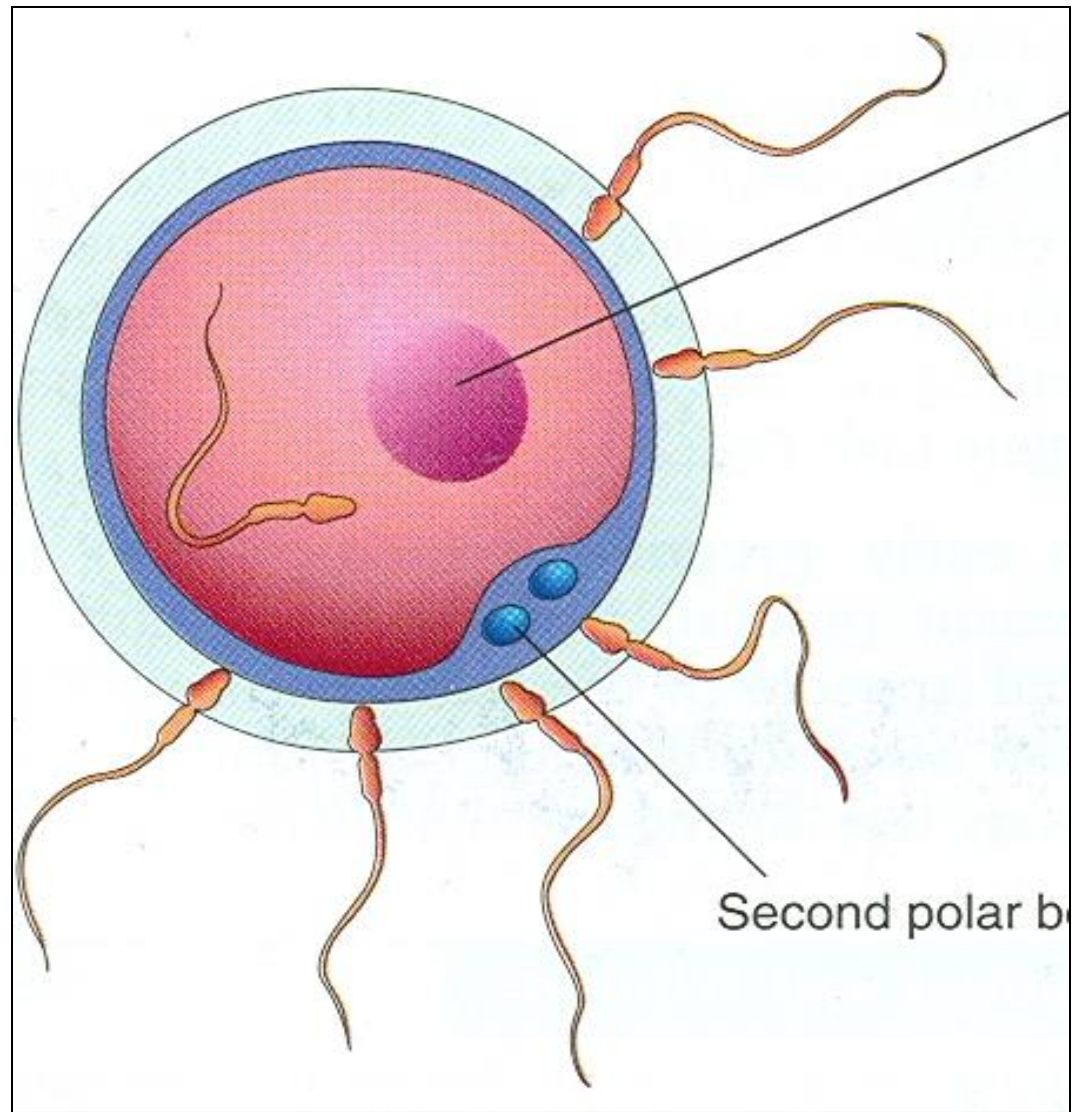
# CHROMOSOMES IN THE ZYGOTE



- **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.

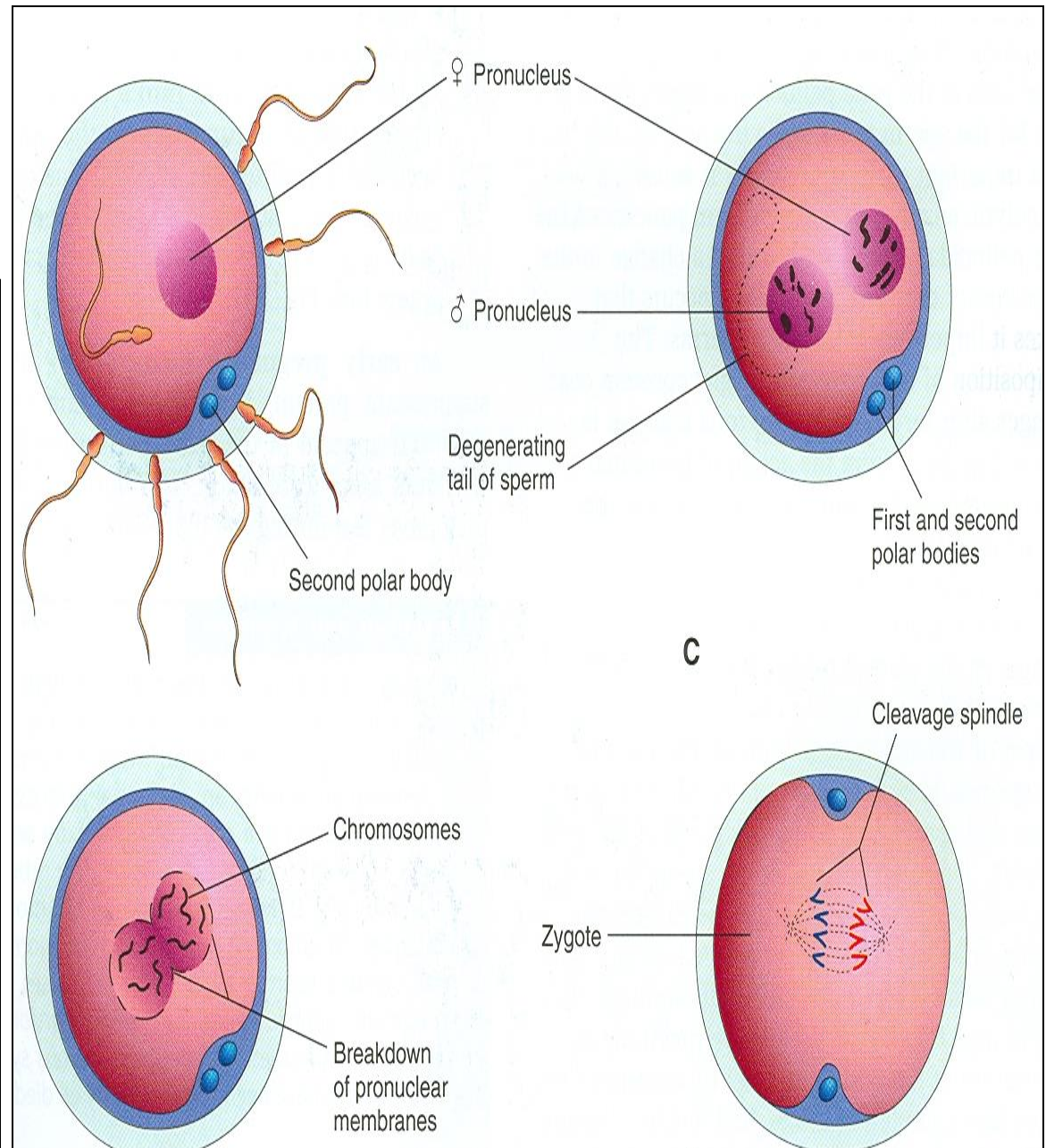


❖ **Zonal reaction** : it is a change in properties of zona pellucida that makes it **impermeable** to other sperms.



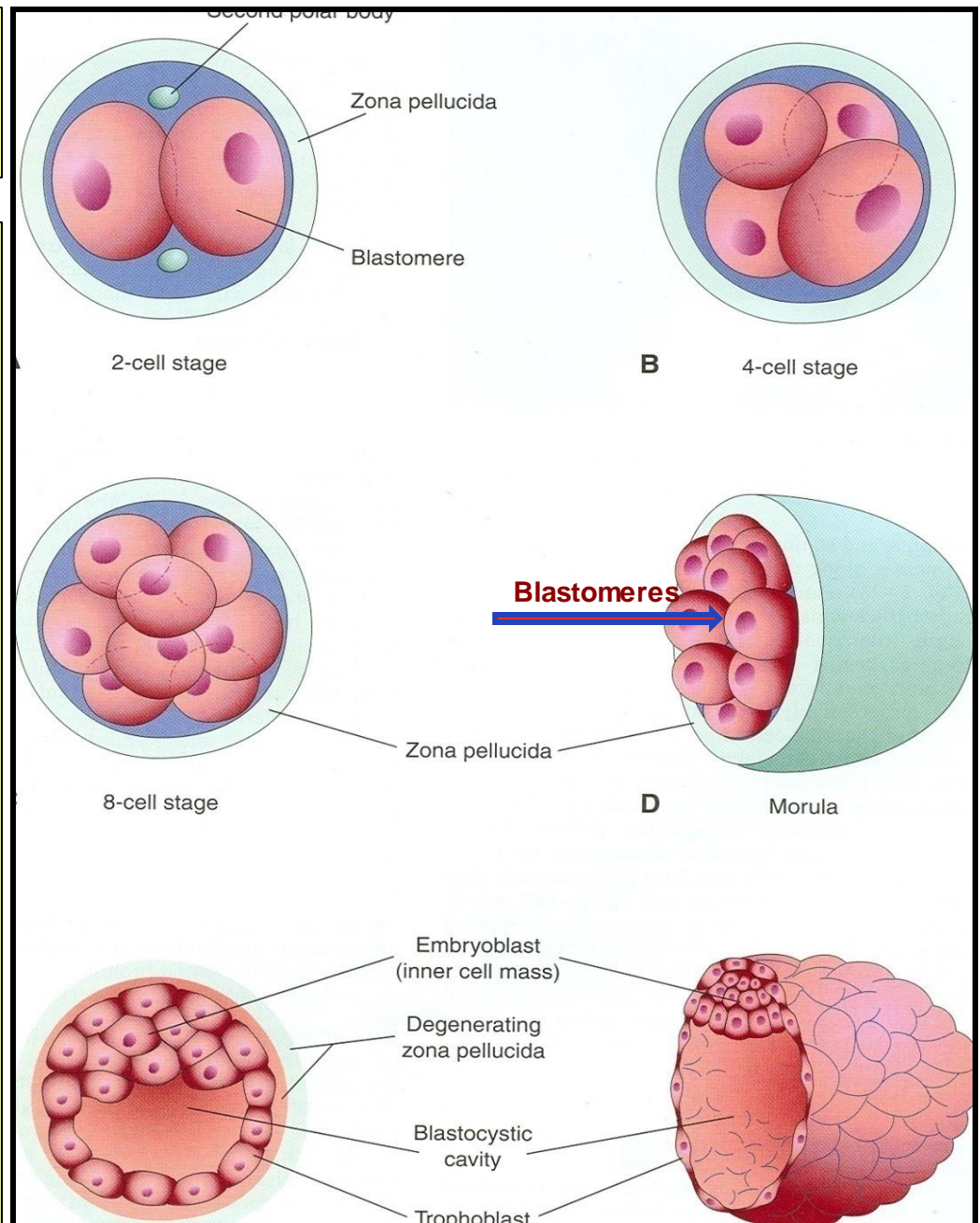
# Results of Fertilization

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.**



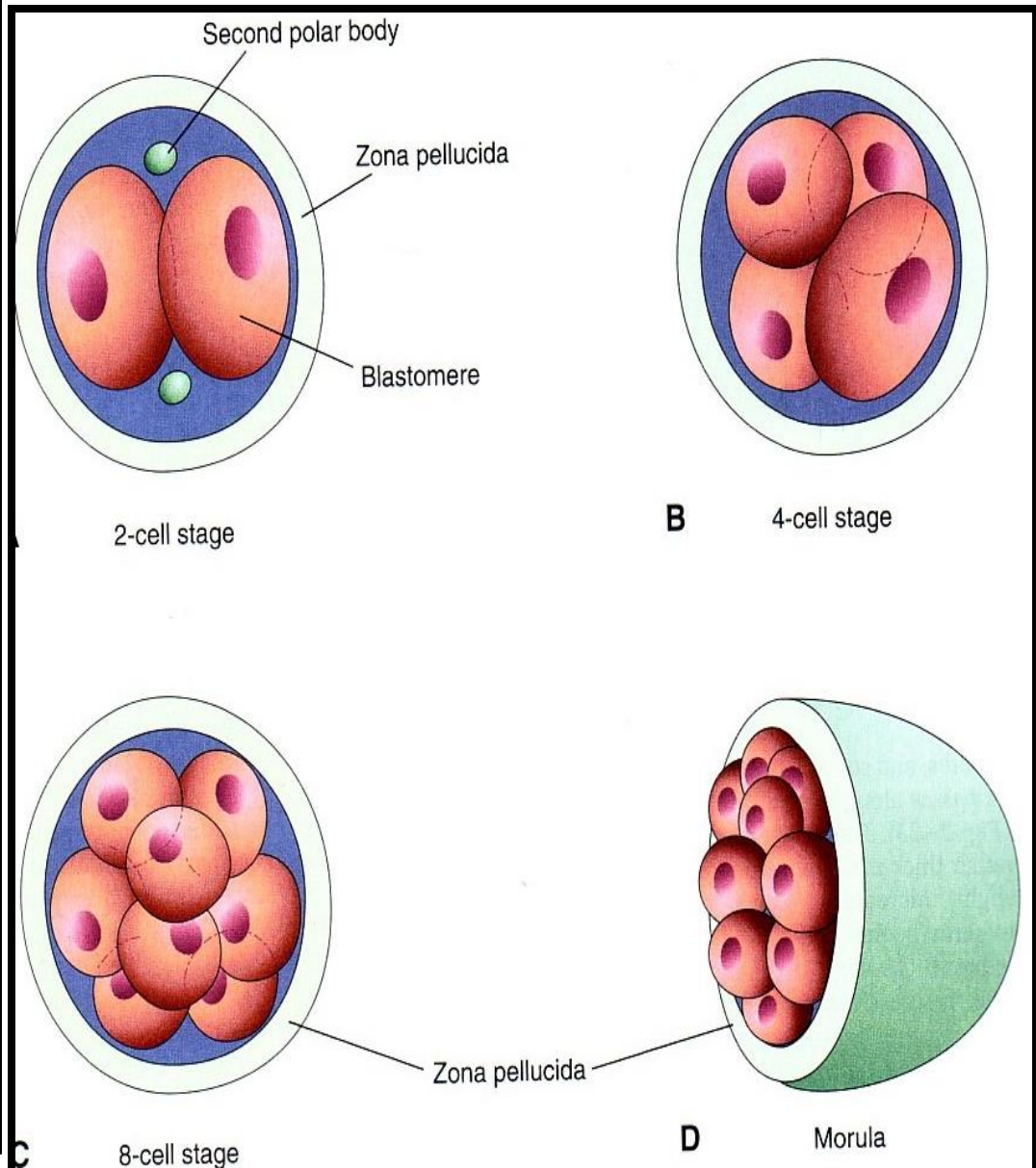
# Cleavage of Zygote

- 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

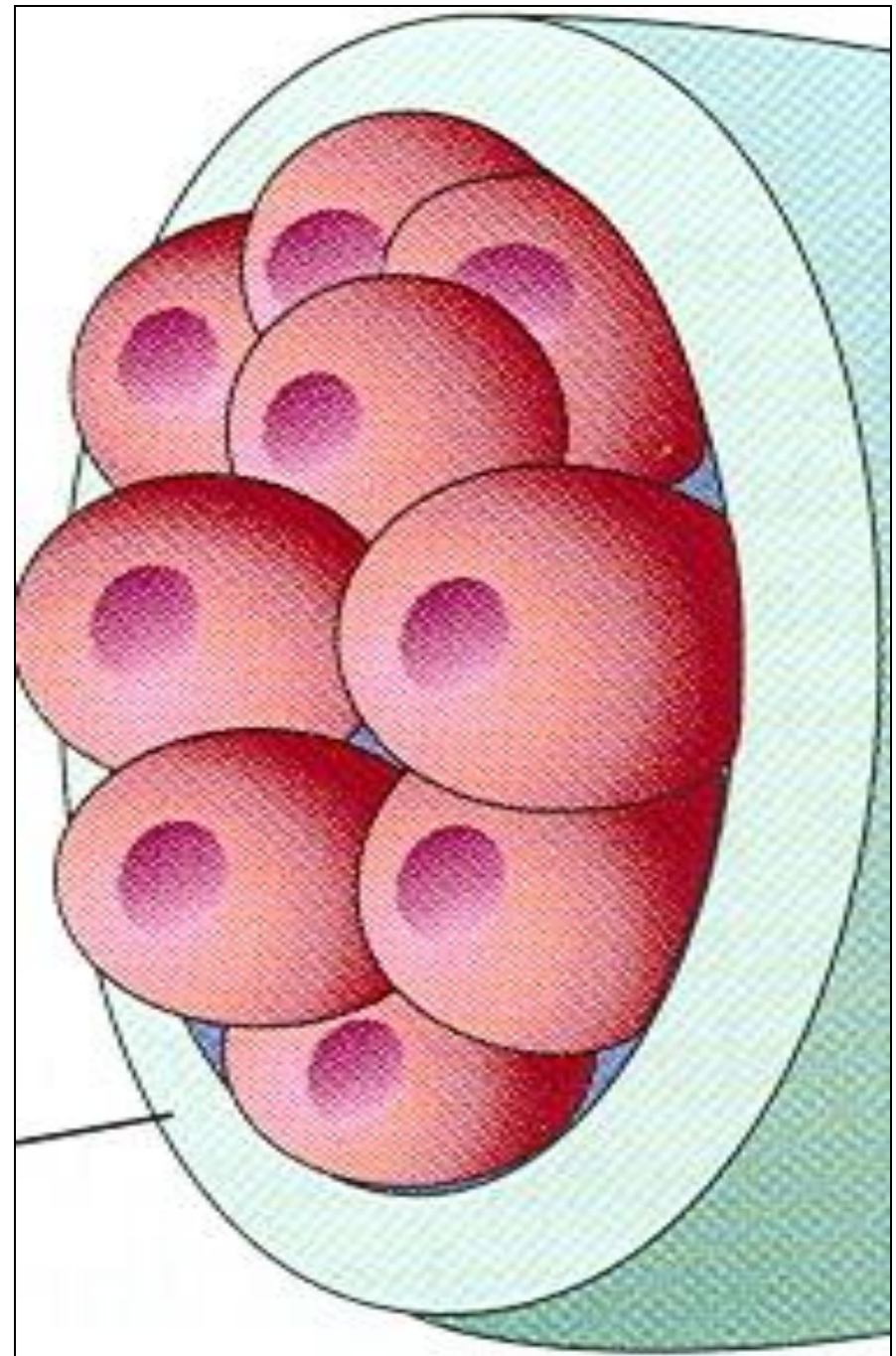
- It begins about 30 hours after fertilization.
- Zygote divides into 2, then 4, then 8, then 16 cells.
- Zygote lies within the thick **zona pellucida** during cleavage.
- Zygote migrates **in the uterine tube** during cleavage from lateral to medial.
- Under the microscope, the **zona pellucida** is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



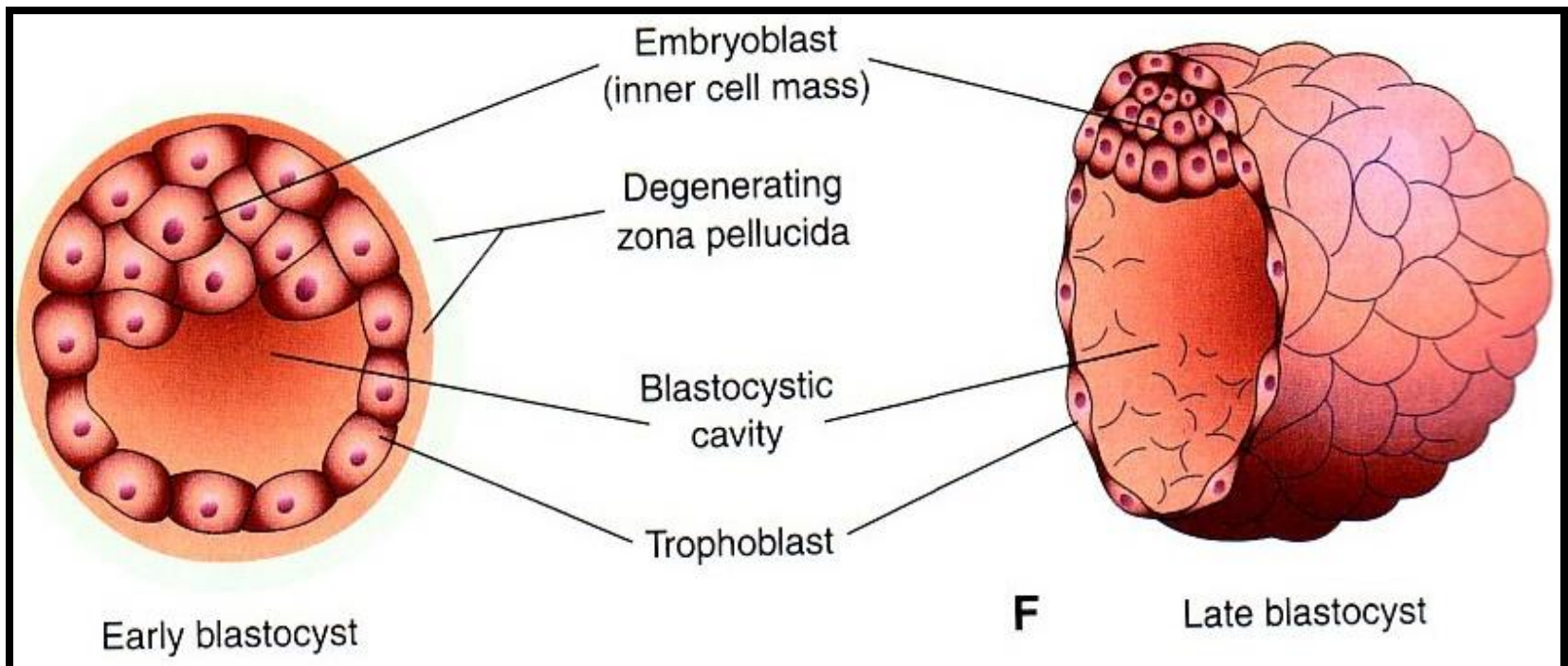


# Morula

- 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**.



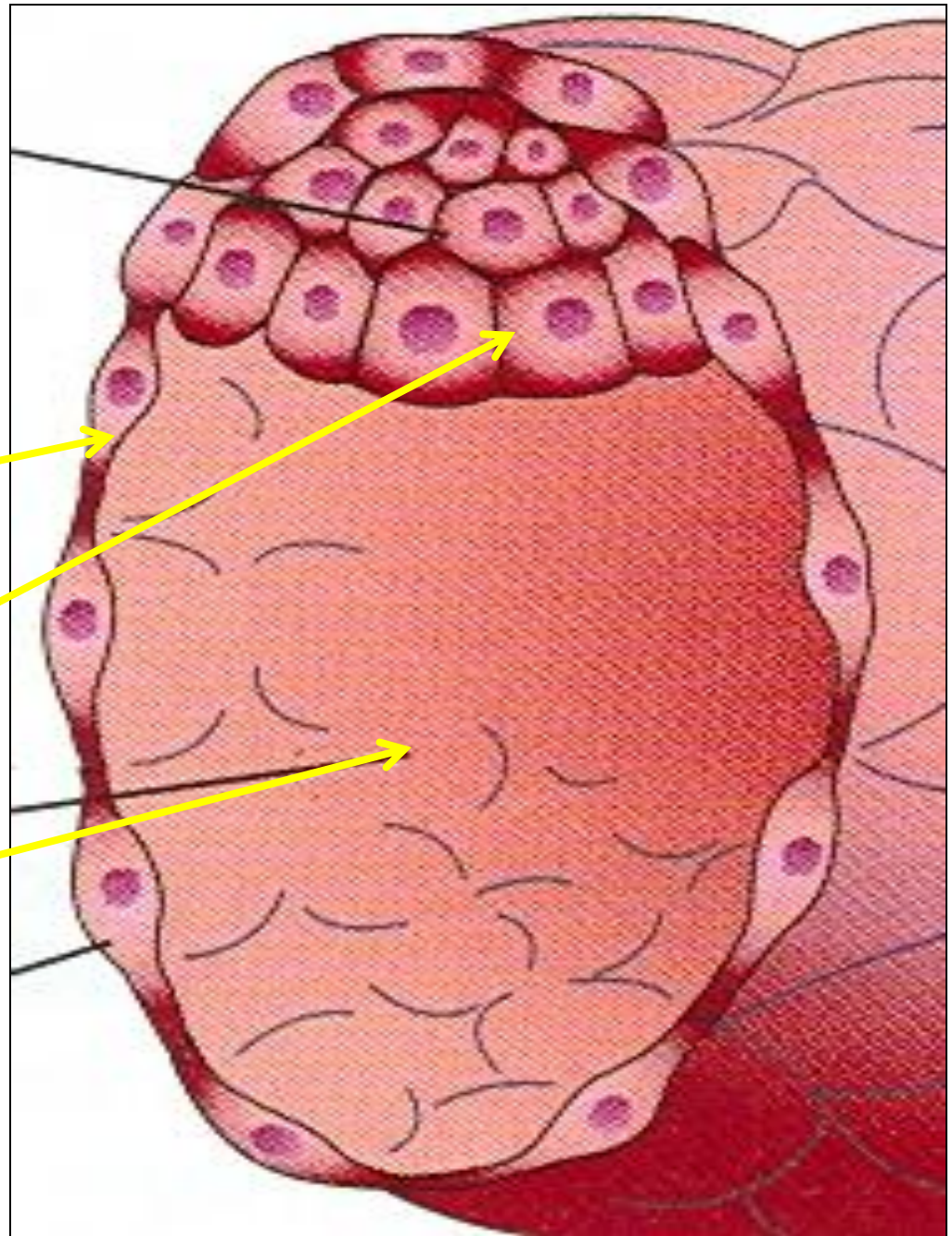


# BLASTOCYST

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.

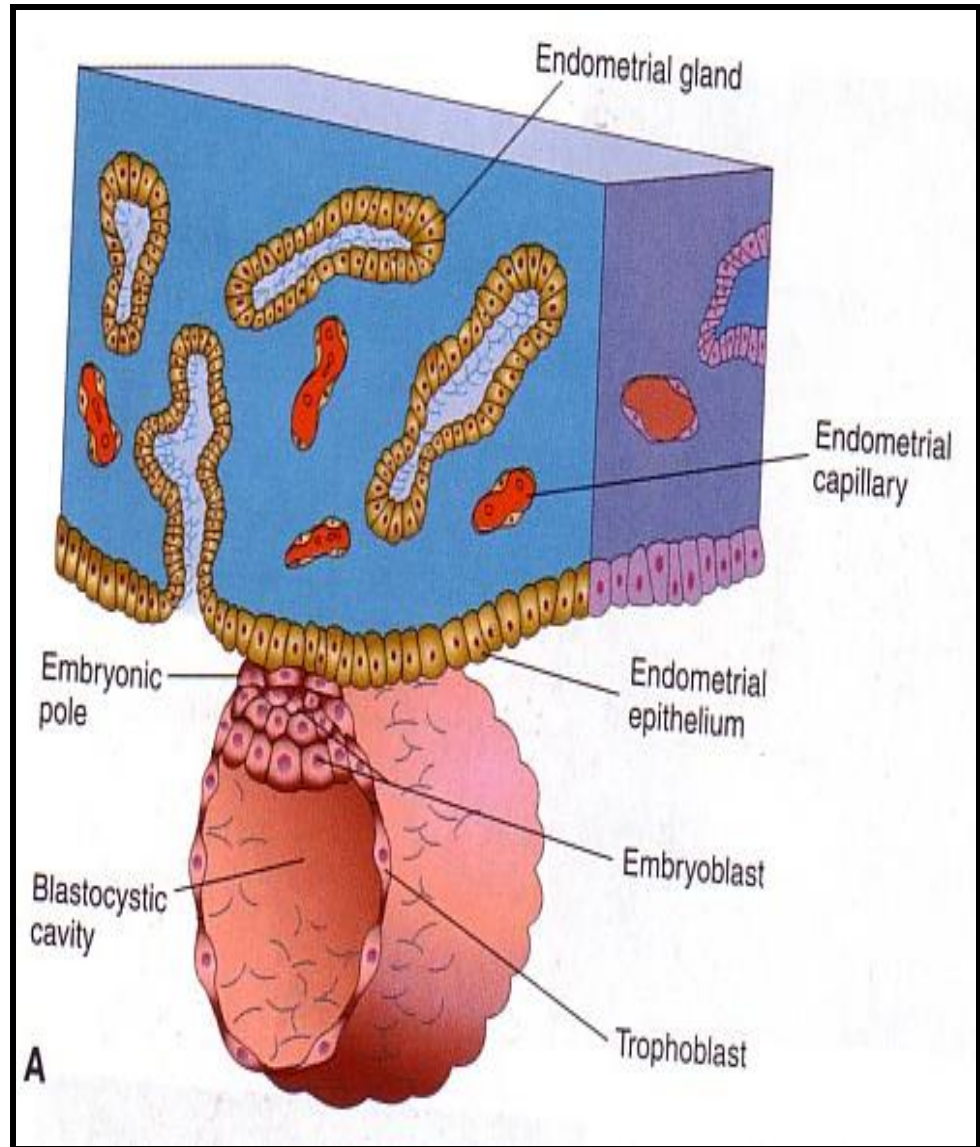
The cavity is called **blastocystic cavity** or **blastocoele**.





- 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 **11th or 12th day.**

# IMPLANTATION



- By the 5<sup>th</sup> day the Zona pellucida degenerates.
- **Blastocyst** begins implantation by the 6<sup>th</sup> day.
- **Trophoblast cells** at the embryonic pole of the blastocyst begin to penetrate the **epithelium** of the **endometrium (uterine mucosa)** at the **6<sup>th</sup> day of development**.
- **Penetration** results from **proteolytic enzymes** (eg. COX-2) produced by the trophoblast.

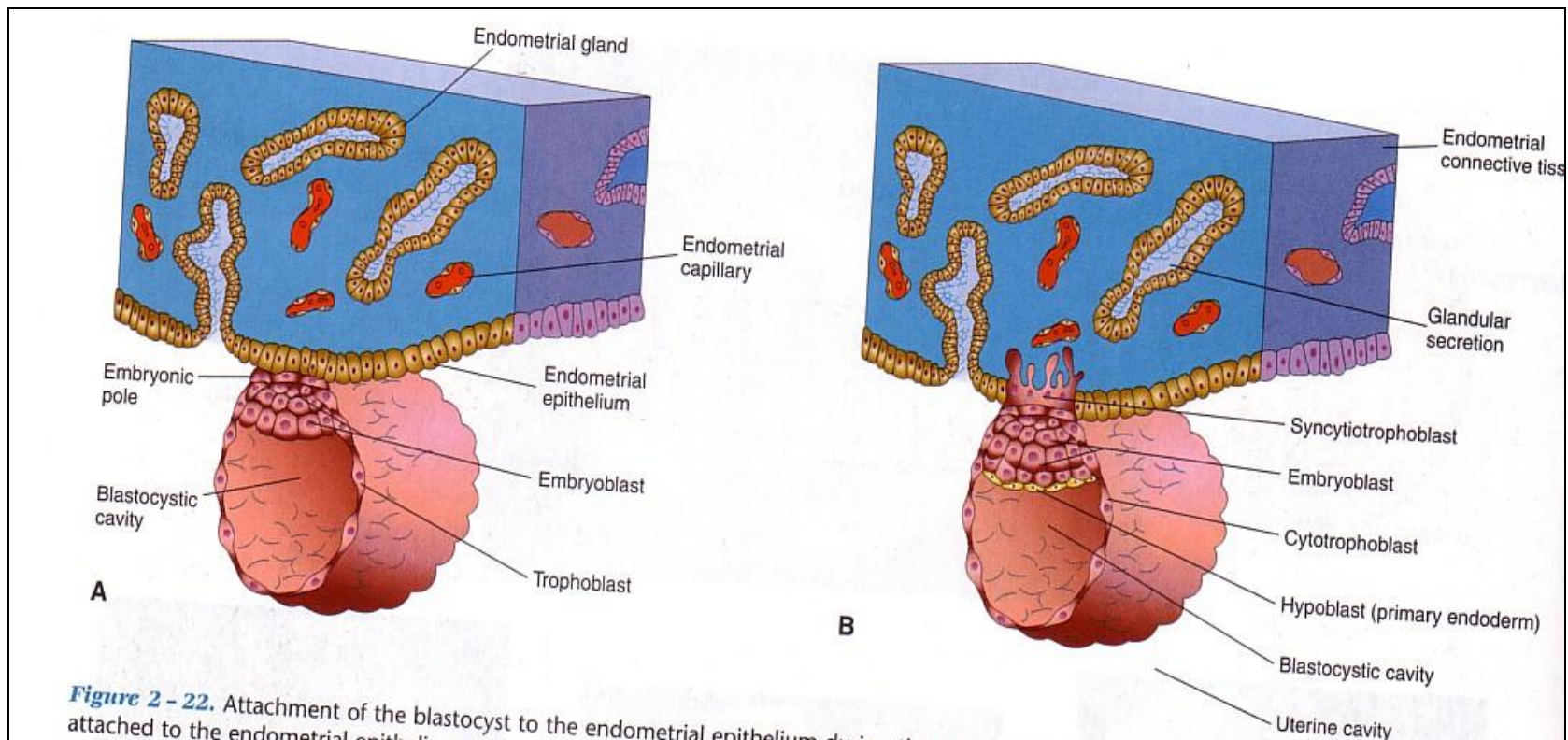


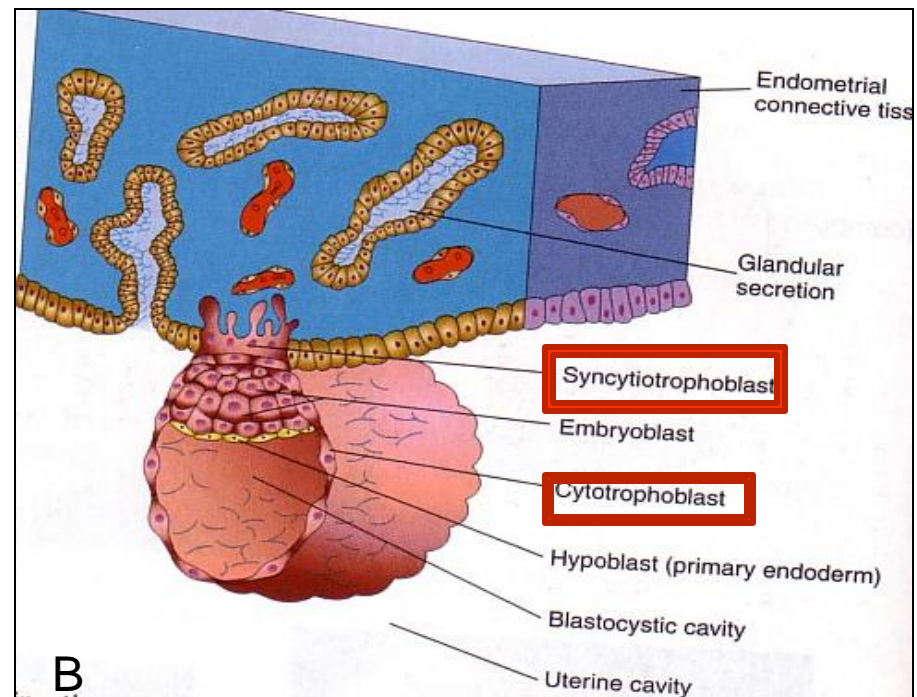
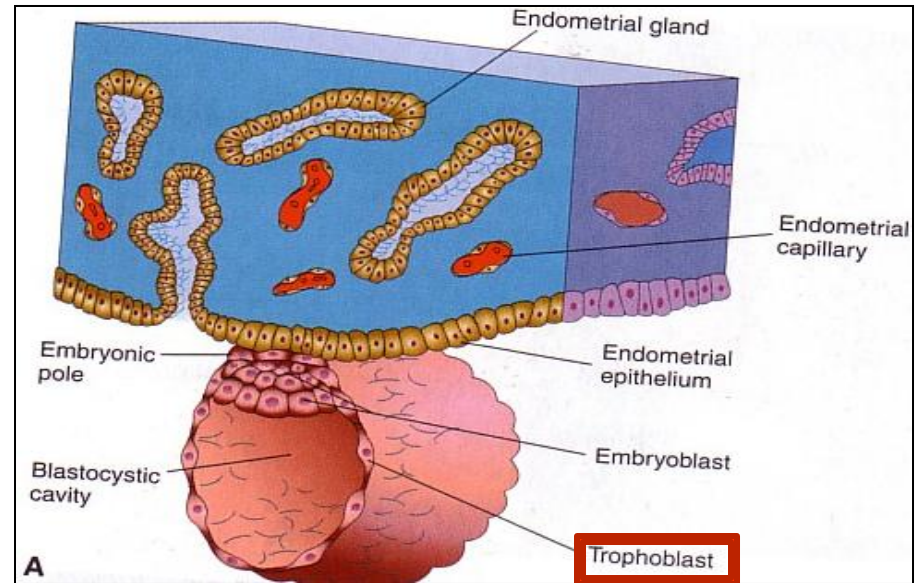
Figure 2 - 22. Attachment of the blastocyst to the endometrial epithelium during implantation.

- By **6<sup>th</sup>** day the **blastocyst adheres** to the endometrium (A) and **beginning of penetration**.
- By **7<sup>th</sup>** day, **Trophoblast differentiated into 2 layers: (B)**

**Cytotrophblast**, inner layer, mitotically active.

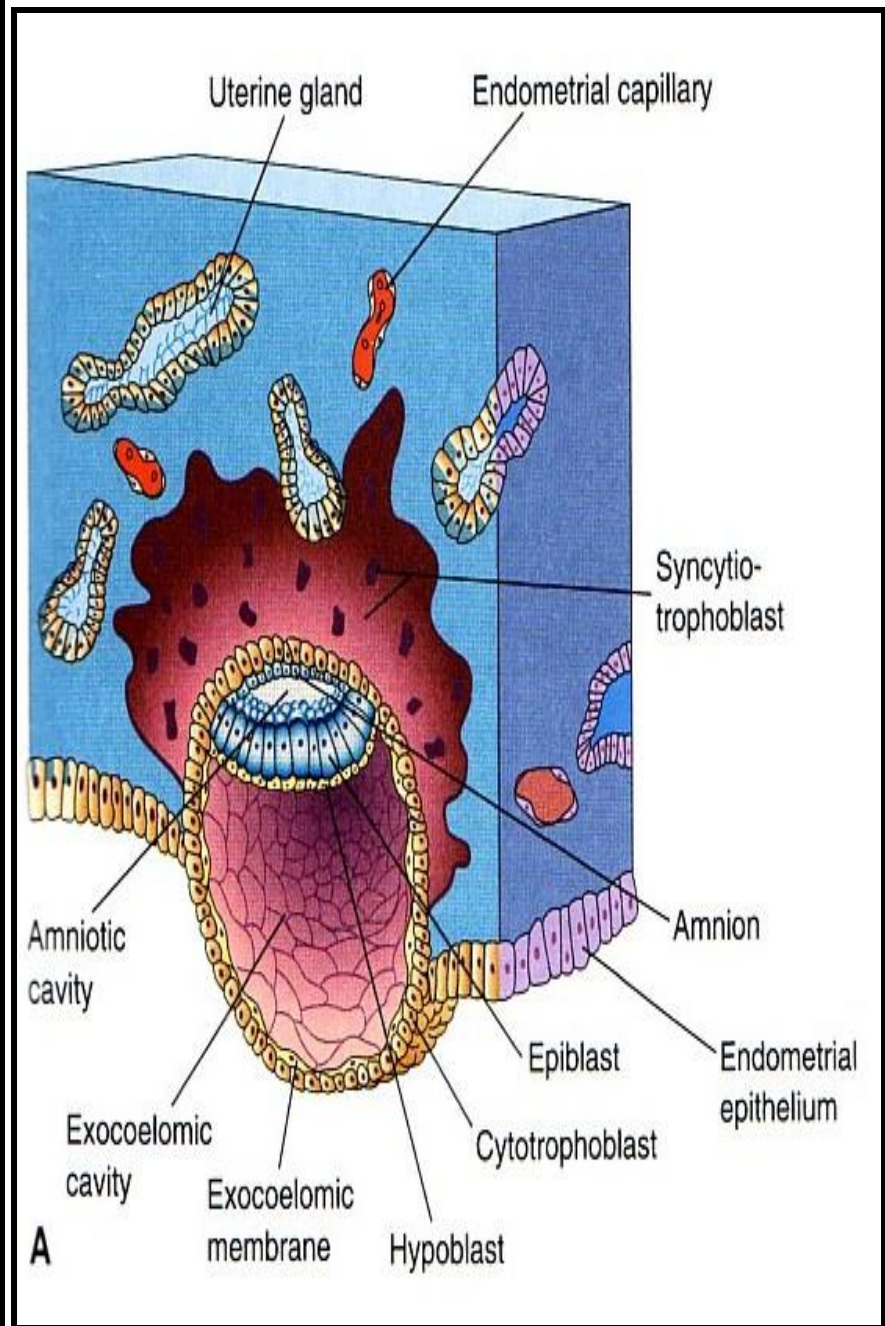
**Syncytiotrophblast** (outer multinucleated mass, with *indistinct* cell boundary; **Invasion of endometrium continues with the syncytiotrophblasts**)

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 **facilitates invasion** of endometrium **by the Syncytiotrophoblast**.

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

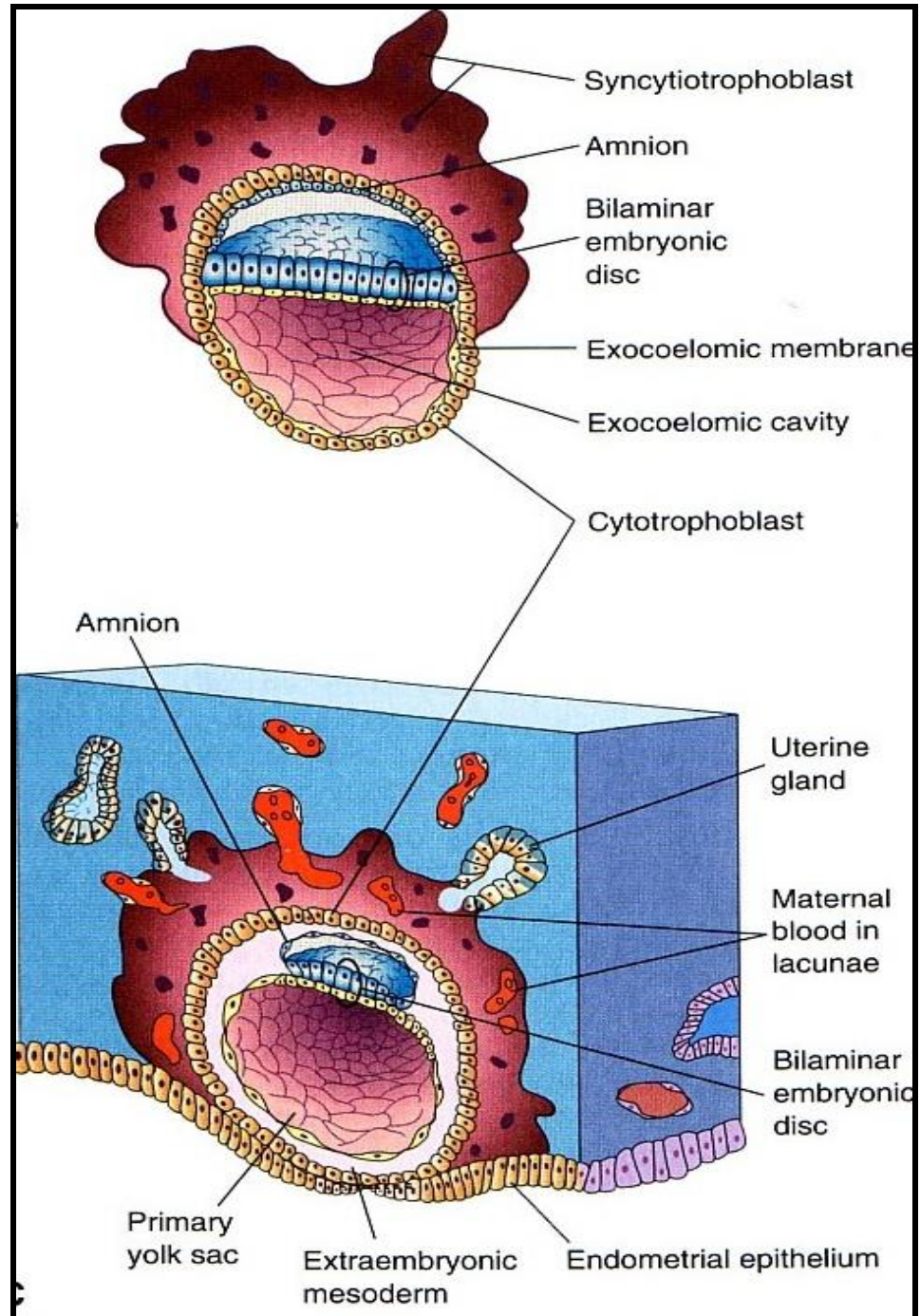
### **Implantation**

**can be detected by:**

1- **Ultrasonography**.

2- **Pregnancy test hCG** :

(human chorionic gonadotrophin) a hormone which is **secreted by** the **Syncytiotrophoblast** about the **end** of 2<sup>nd</sup> week (HCG can be measured in **both the blood and urine** to determine if a woman is pregnant).



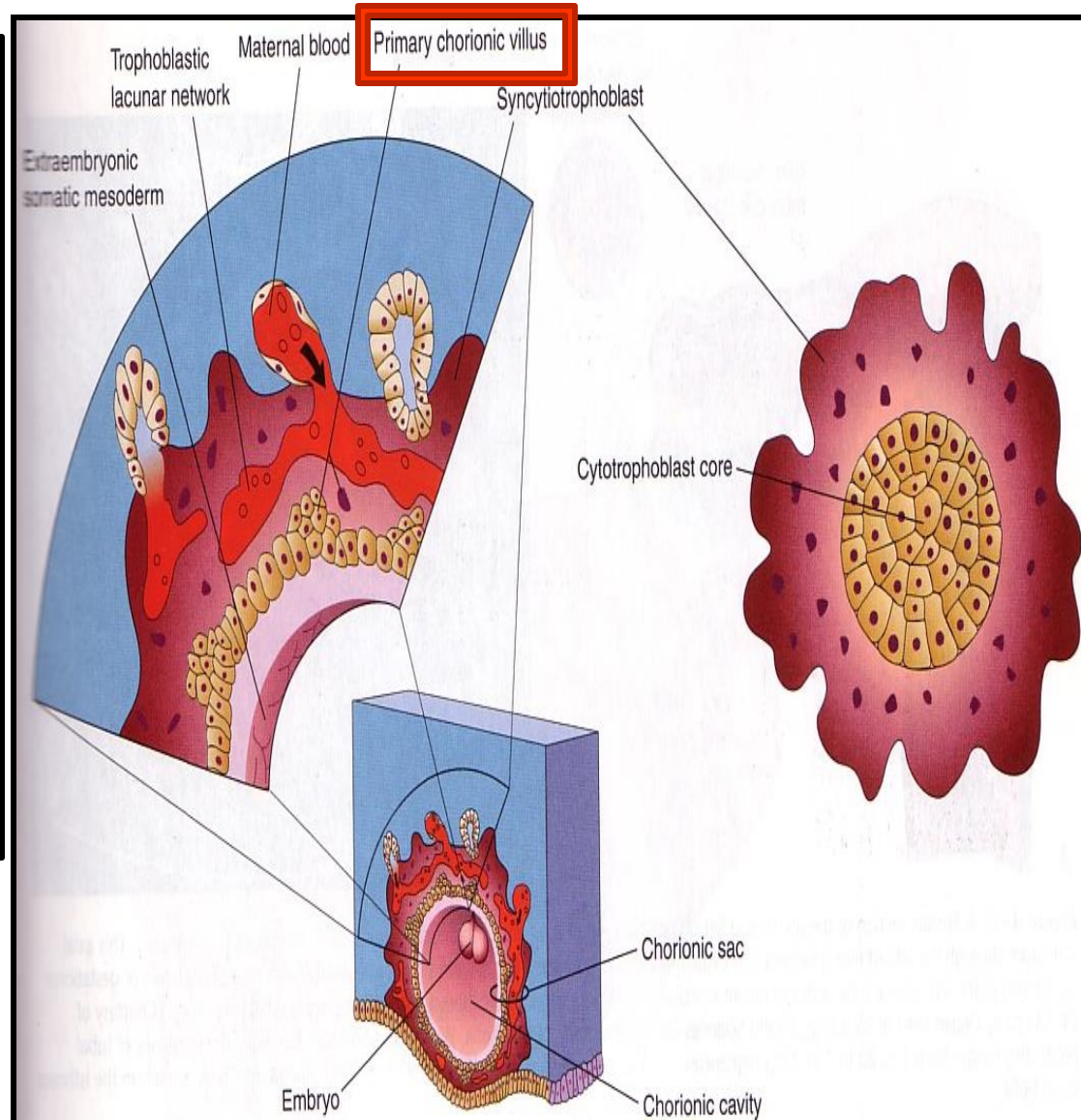
# Early Pregnancy Factor

- Is an **immunosuppressant protein**.
- **Its function** is to prevent the immune system from attacking the new embryo.
- **Secreted** by **trophoblast cells**.
- **Appears in** maternal serum within **24--48 hrs., after fertilization**.
- It is the basis for **EPT** (Early pregnancy test) in the **first 10 days of development**.



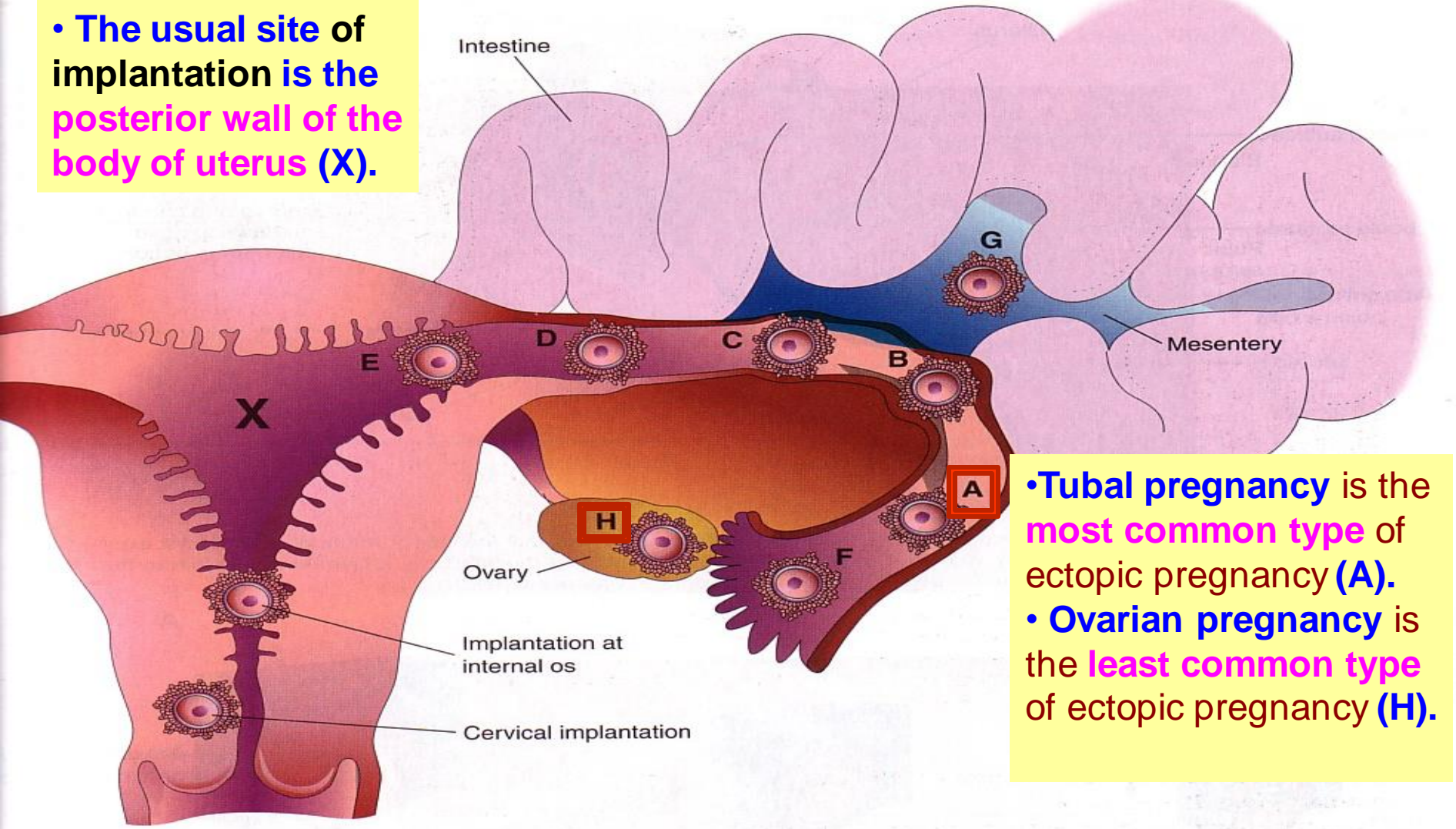
# Formation of The Primary Chorionic villi

- **By the 13<sup>th</sup> day**  
*Proliferation of Cytotrophoblast 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.

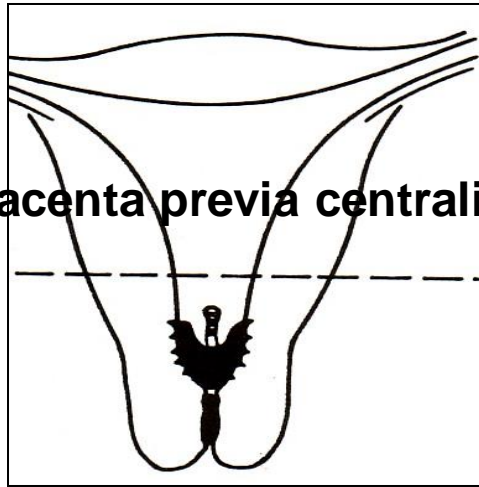
1. 95 to 97% of ectopic pregnancies occurs in the uterine tube.

- Most are in the ampulla & isthmus.

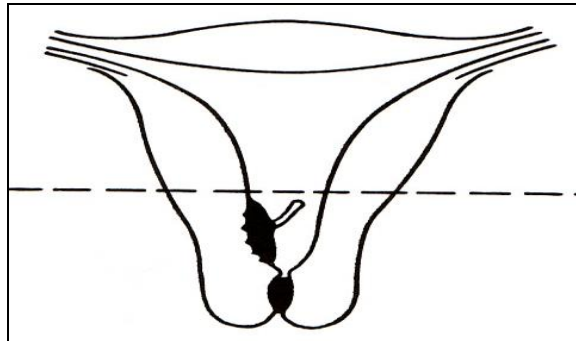
## 2. Placenta previa:

- Implantation occurs in the lower uterine segment.

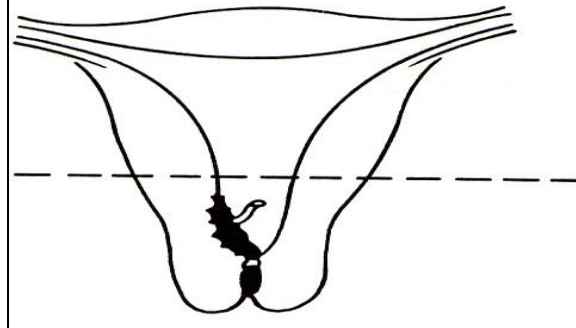
Placenta previa centralis



Placenta previa lateralis

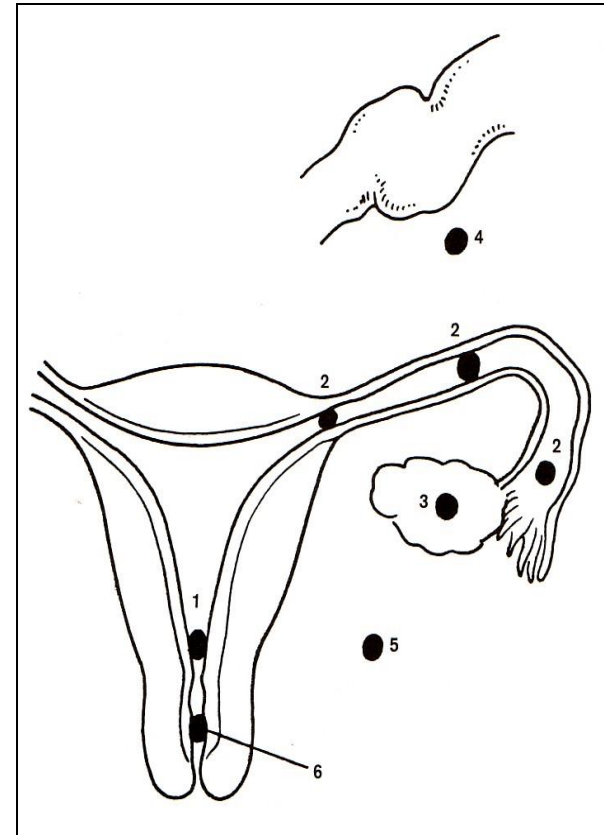


Placenta previa marginalis



## Ectopic Pregnancy:

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





***THANK YOU***