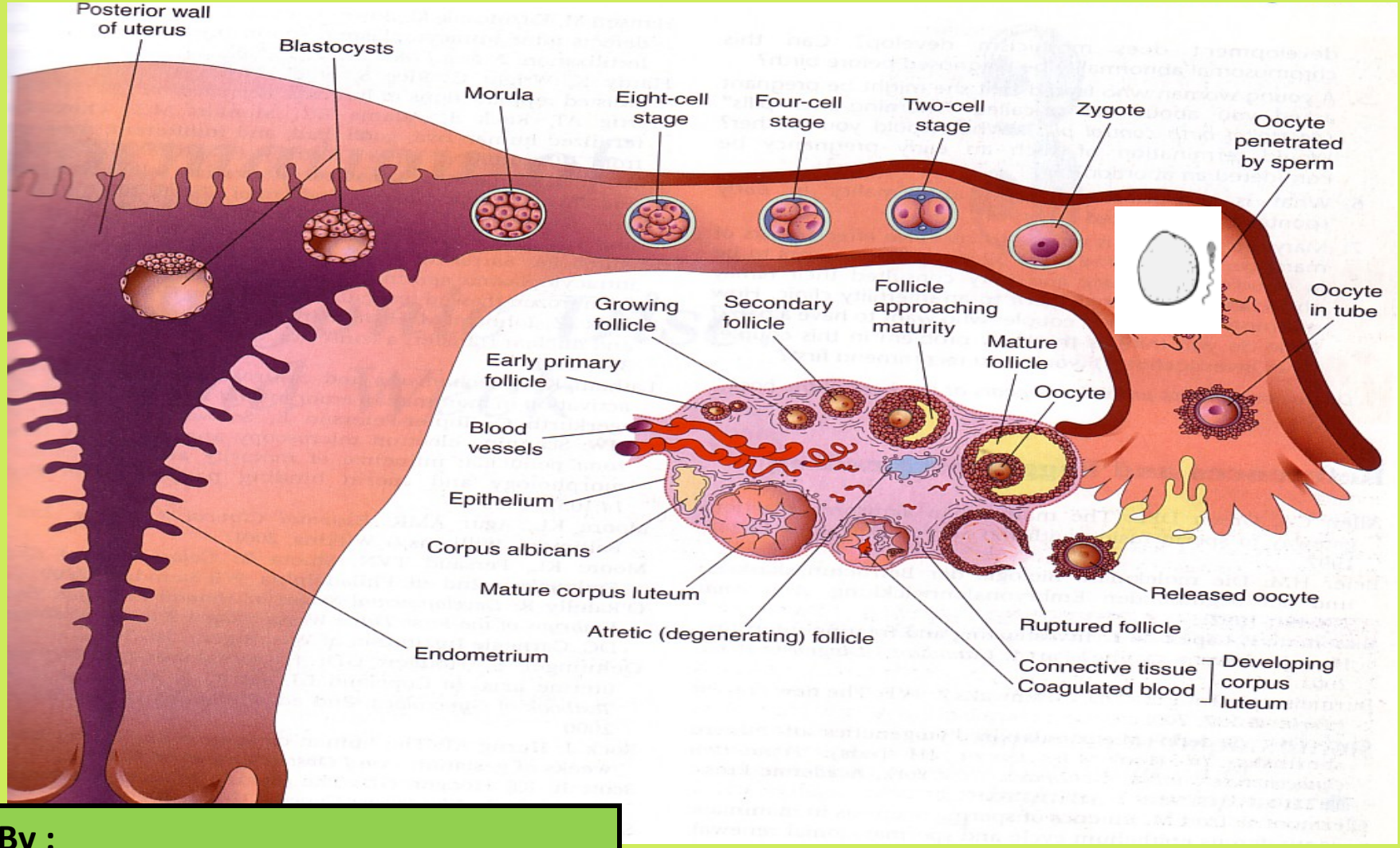
FERTILIZATION & IMPLANTATION



By :

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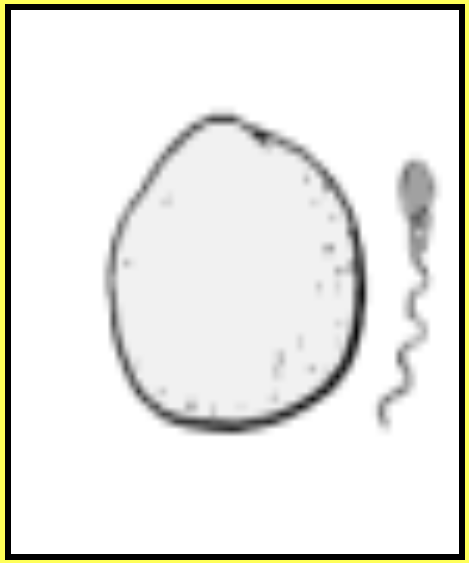
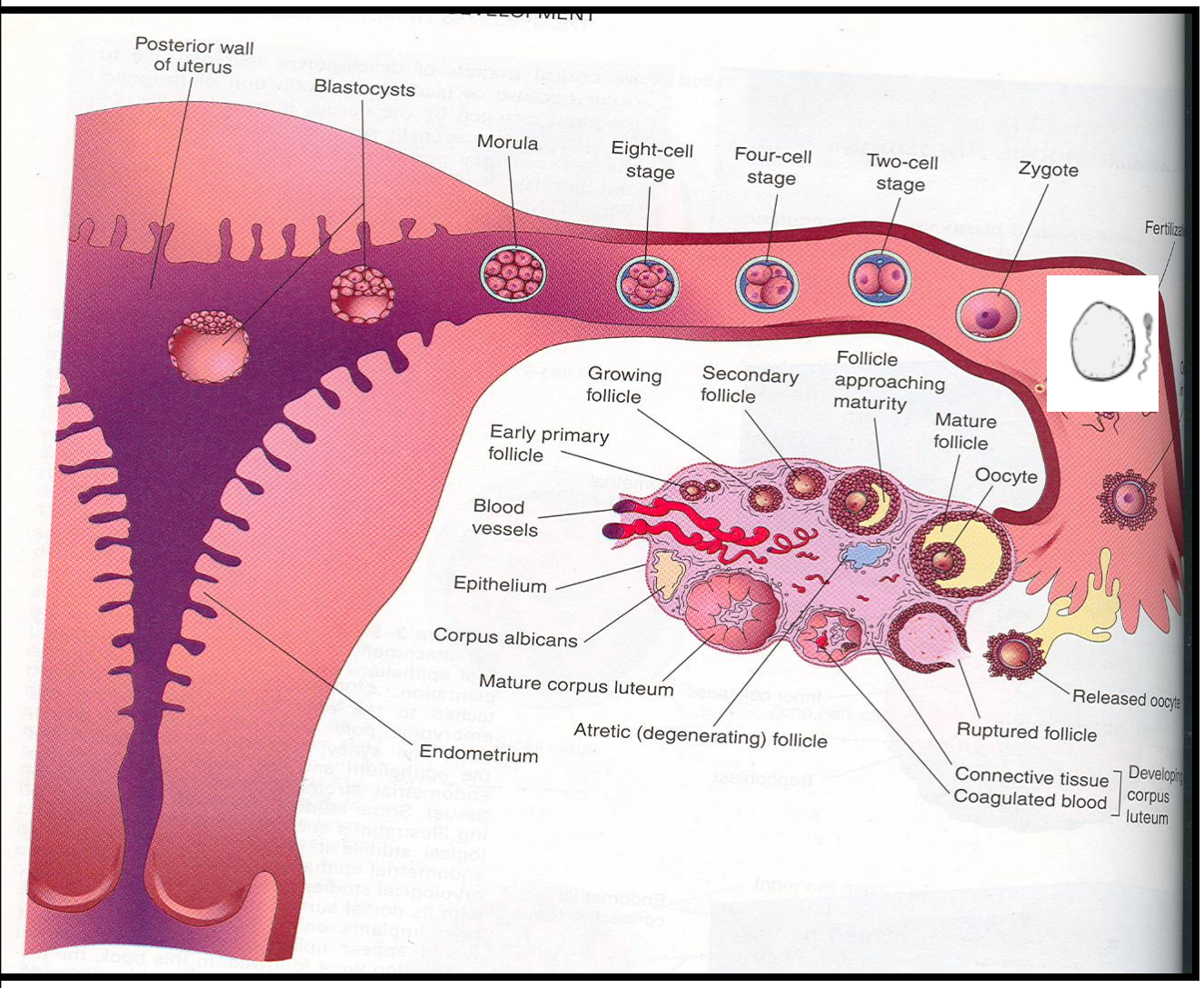
OBJECTIVES

- **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.**



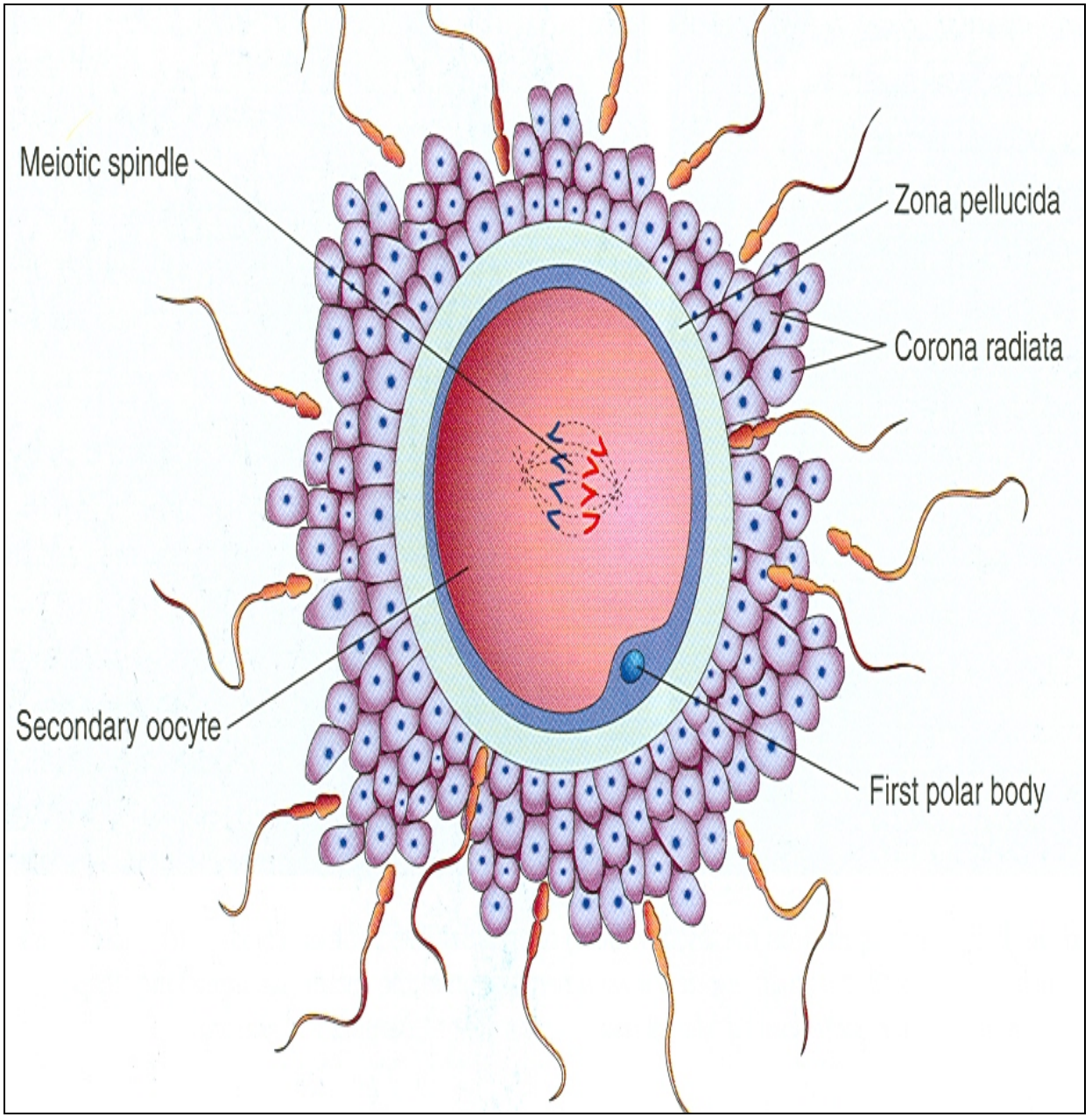
FERTILIZATION



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

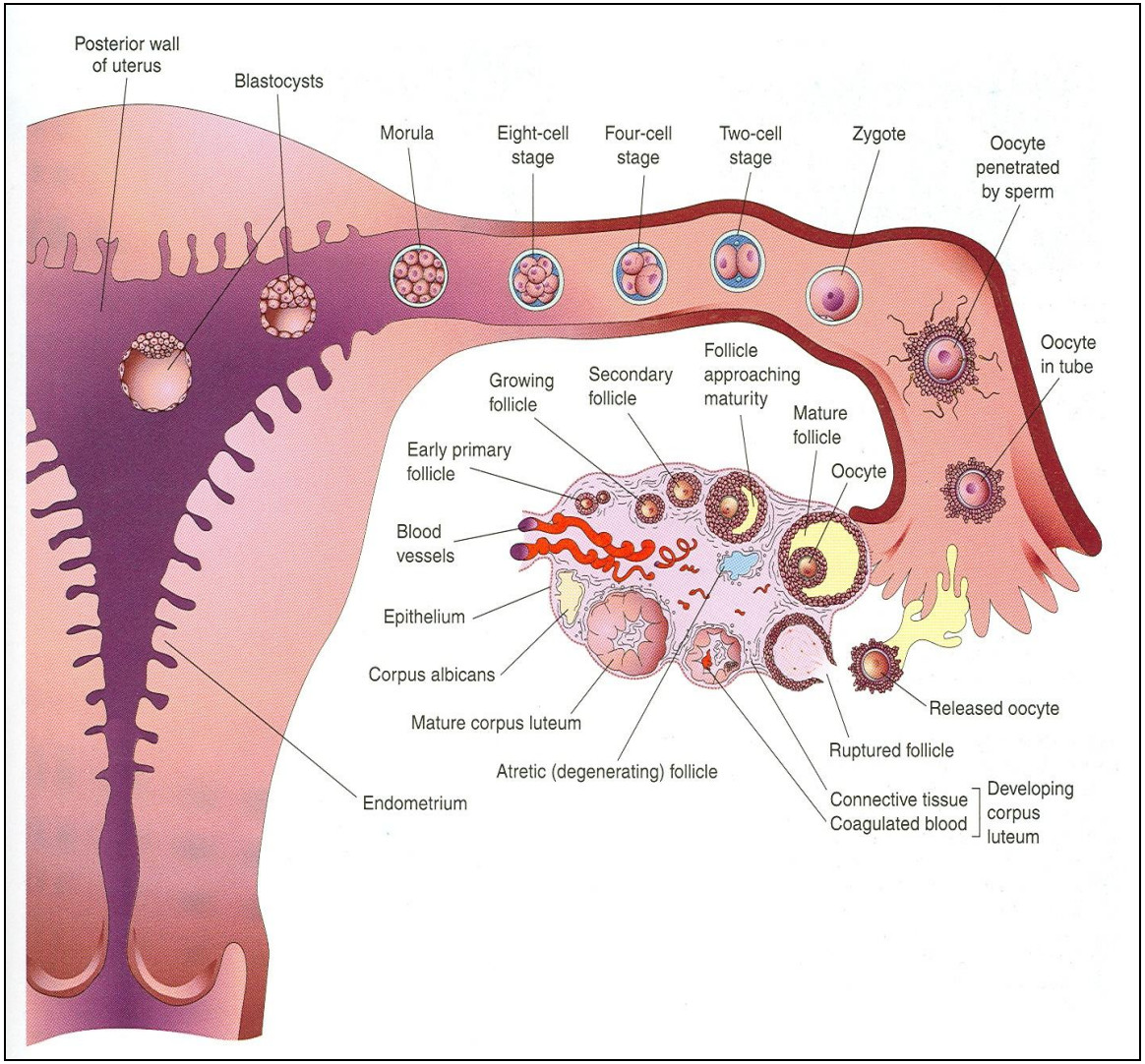
Fertilization

- 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 the tube.
- **Never occurs in the uterine cavity.**
- **Chemical signal** from oocyte attracts the sperms.



Phases of Fertilization

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

a) *Hyaluronidase enzyme* secreted by the sperms.

b) *By* movement of its tail.

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

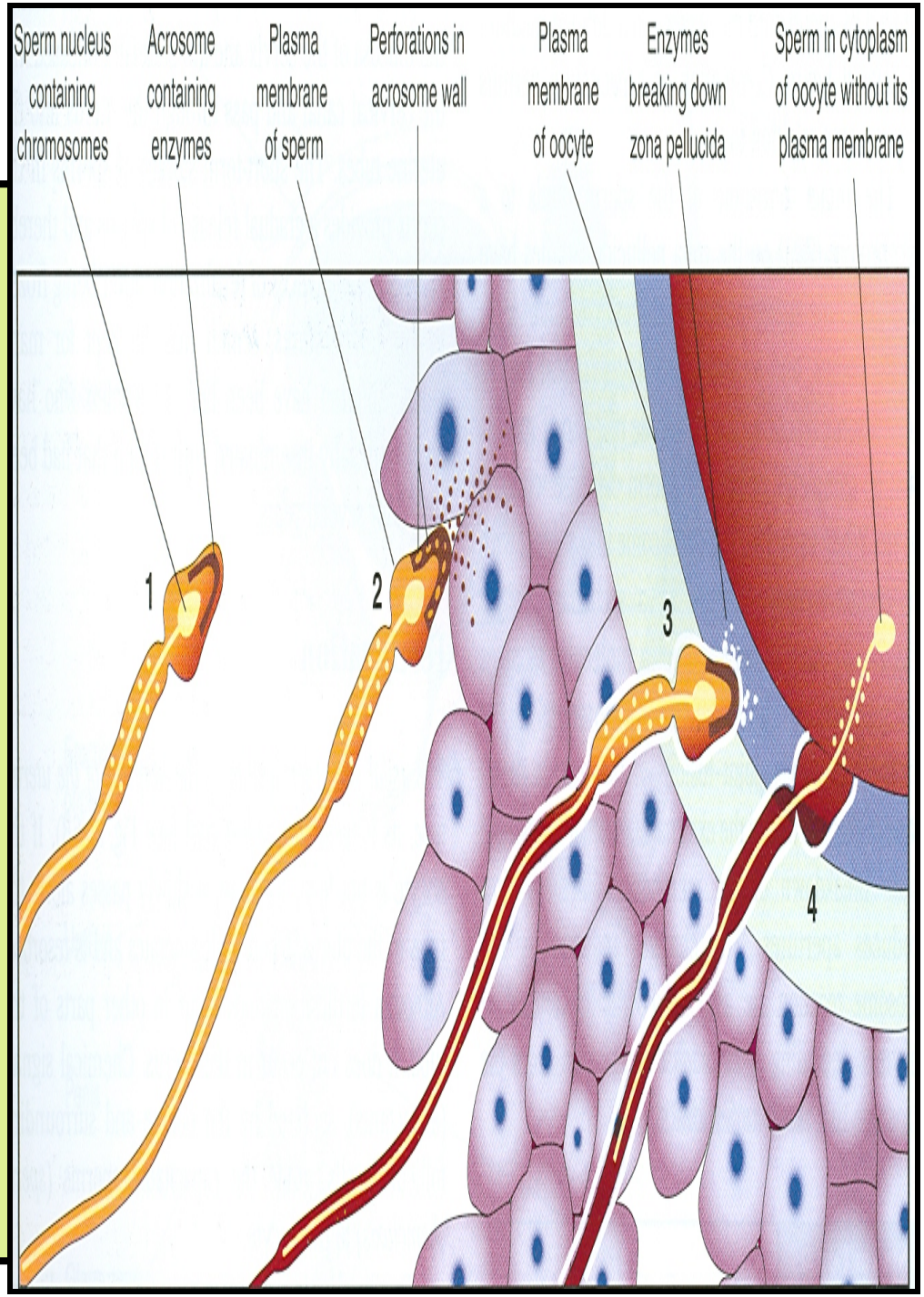
3- **Fusion** of the plasma membranes **of both** the oocyte and the sperm.

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

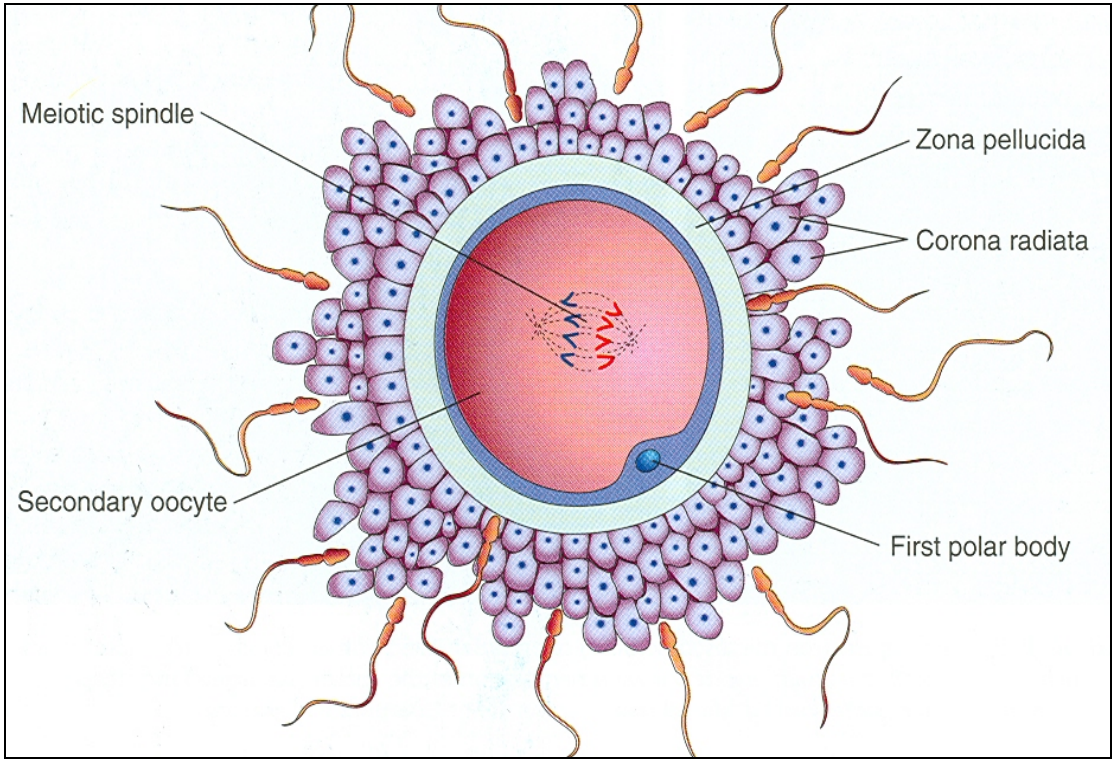
5- **Formation** of the female pronucleus

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

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



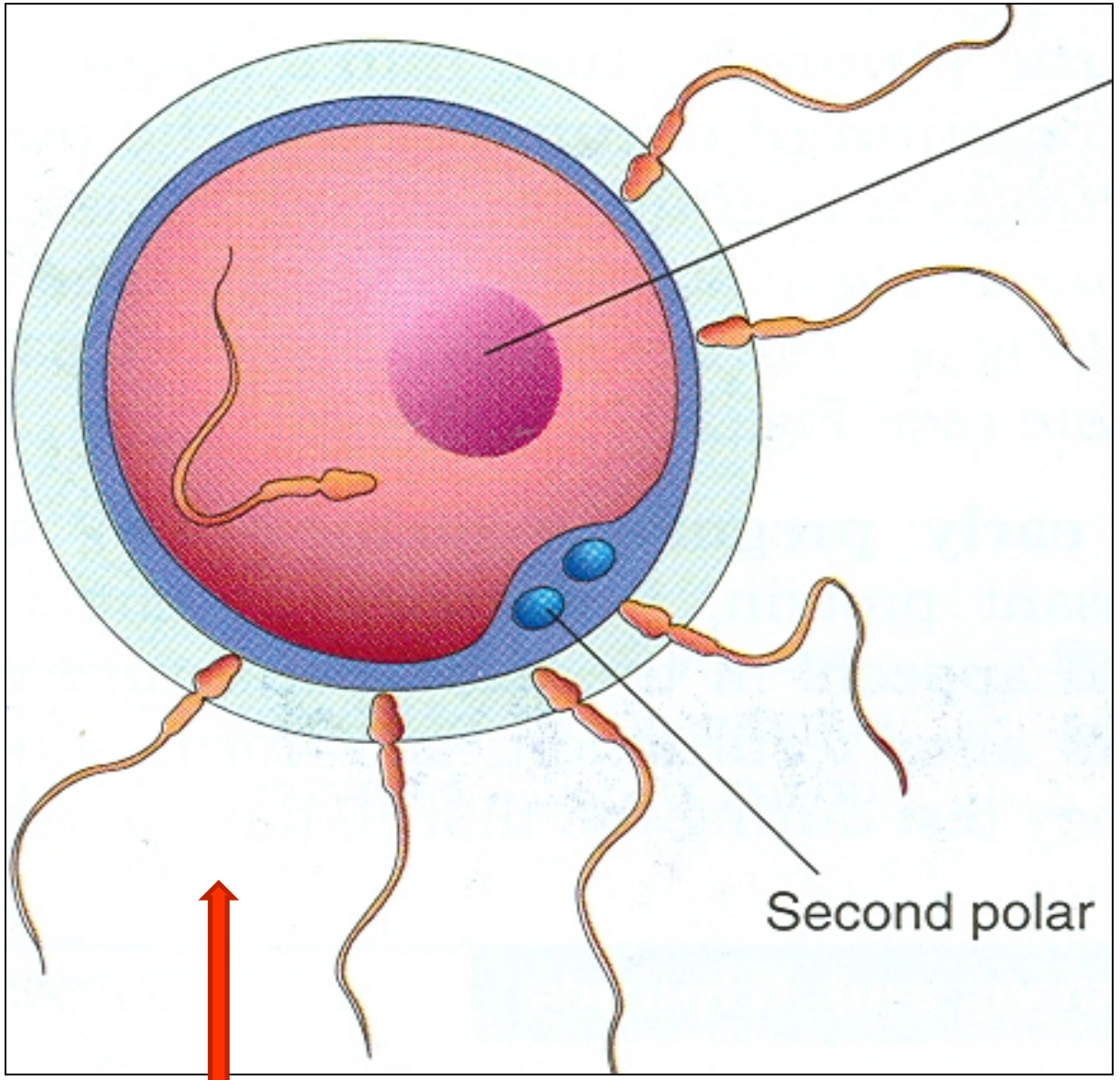
CHROMOSOMES



- **Zygote** is genetically a **unique** structure.
- **½ of chromosomes** comes from the **father** and the **other ½** 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

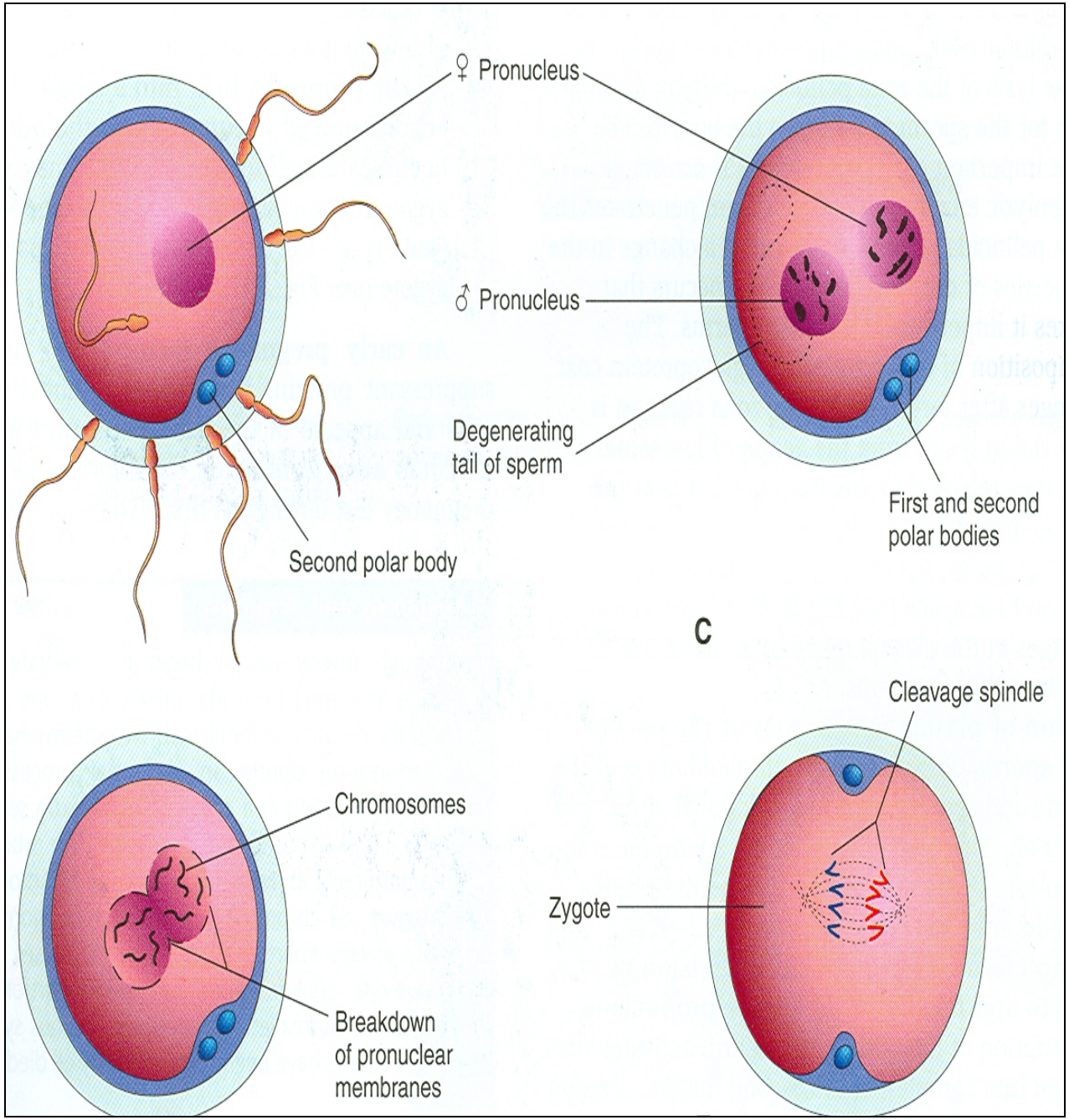
- Embryo's **chromosomal sex** is determined **at the time of fertilization.**
- **Sex** is **determined by the type of sperm** (**X or Y**) that fertilizes the oocyte.
- So, it is the **father** whose gamete **decides the sex.**



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

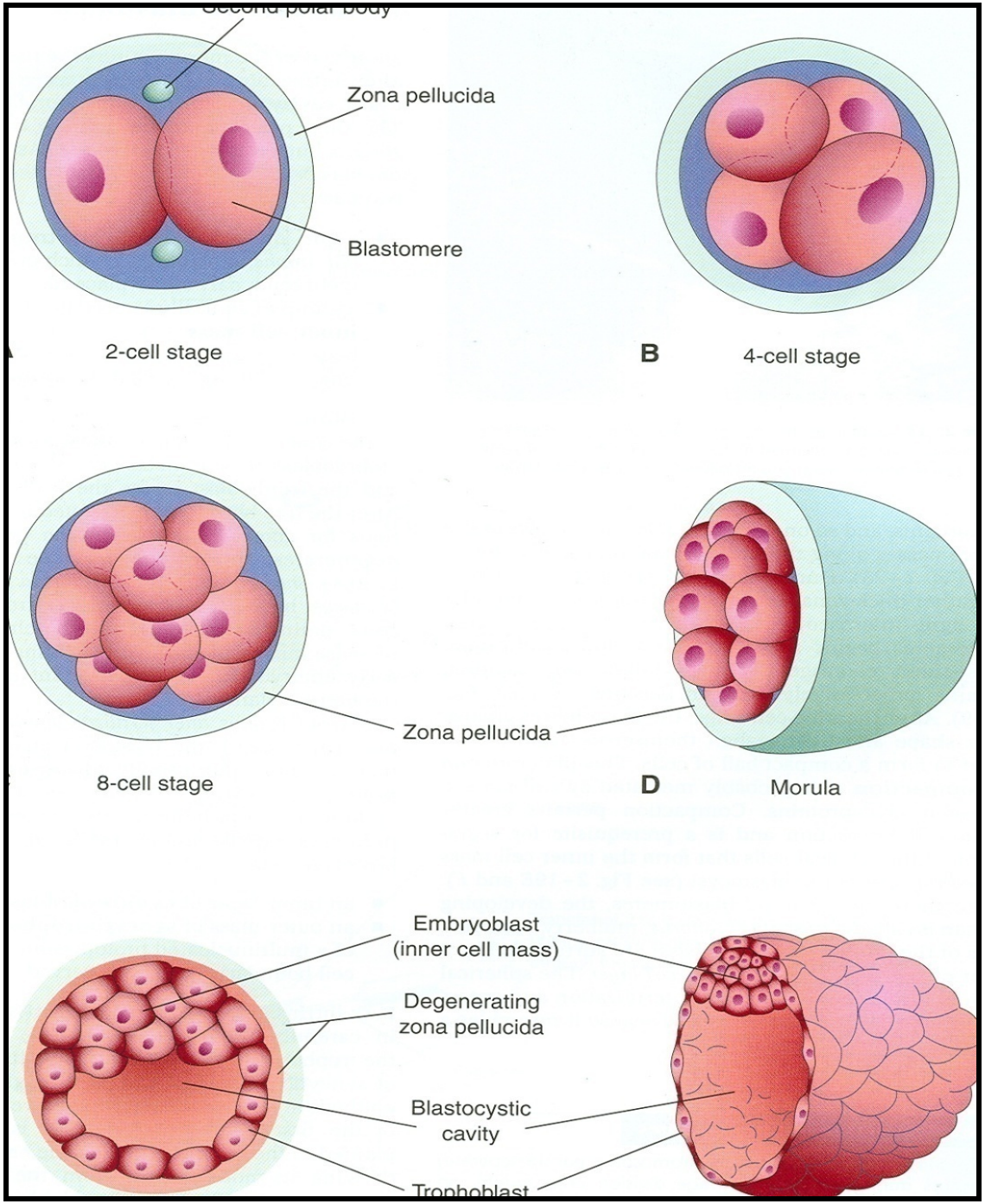
Results of Fertilization

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



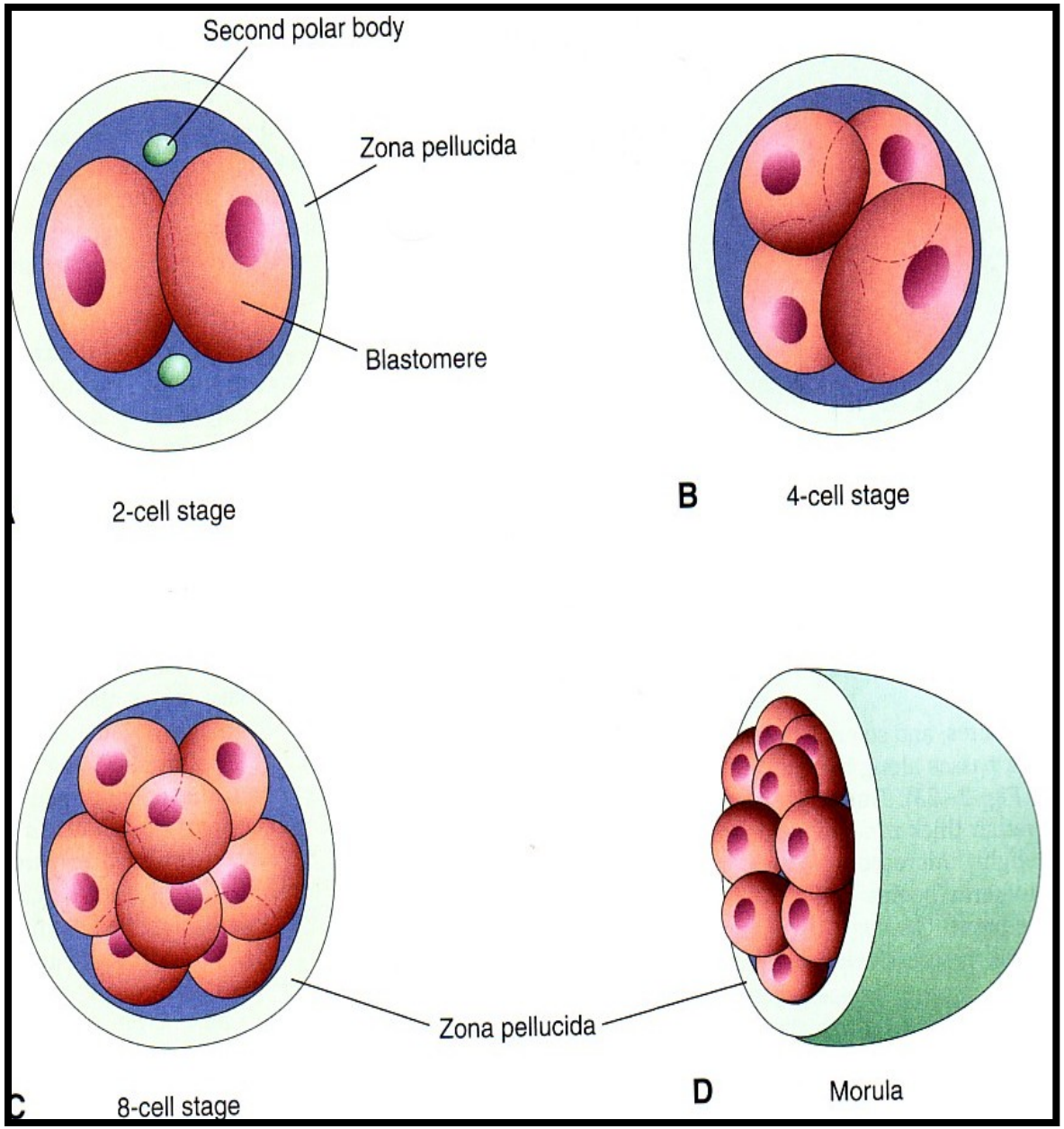
Cleavage of Zygote

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



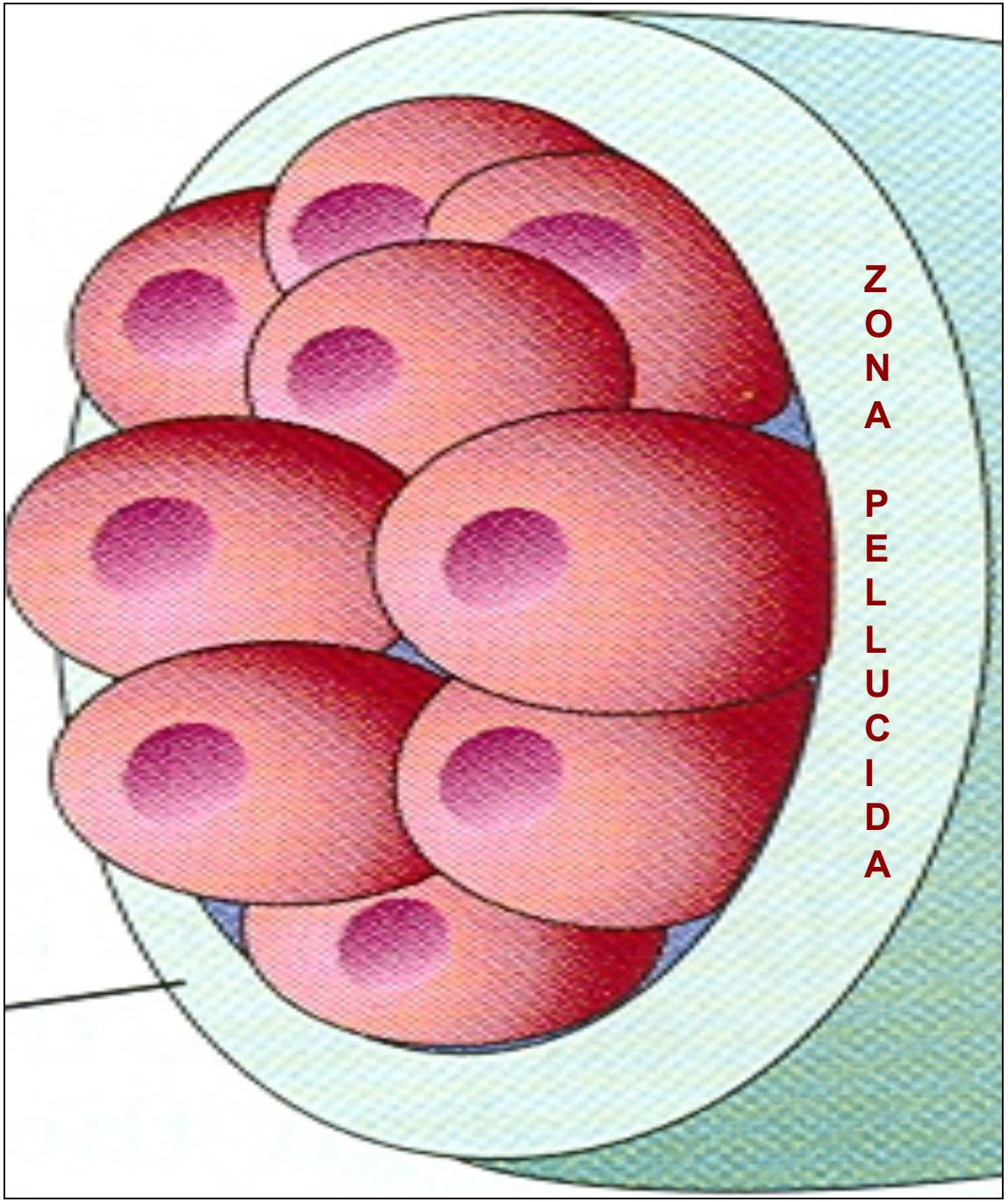
Cleavage of Zygote

- 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 **thick translucent membrane.**



Morula

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

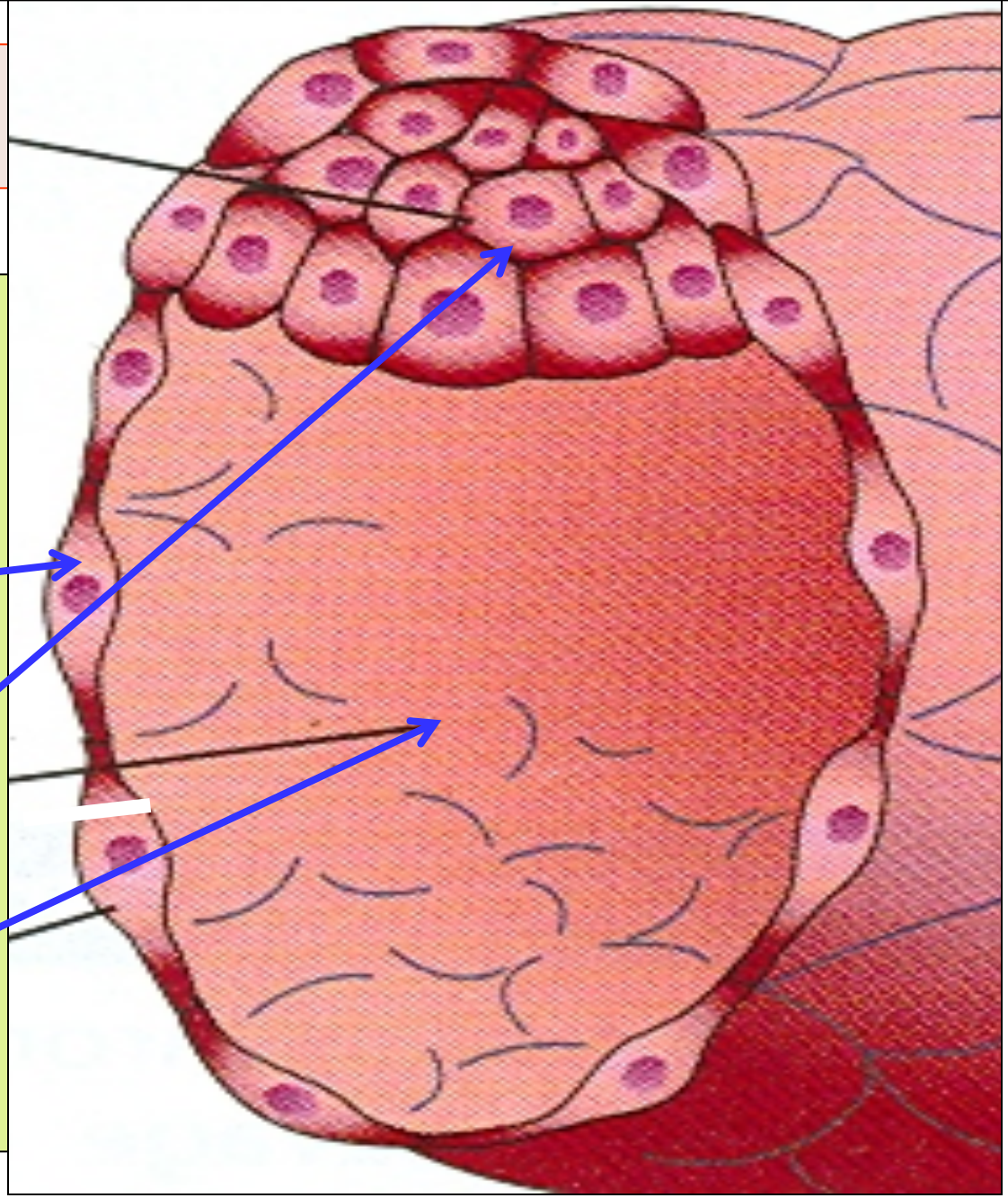


BLASTOCYST

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

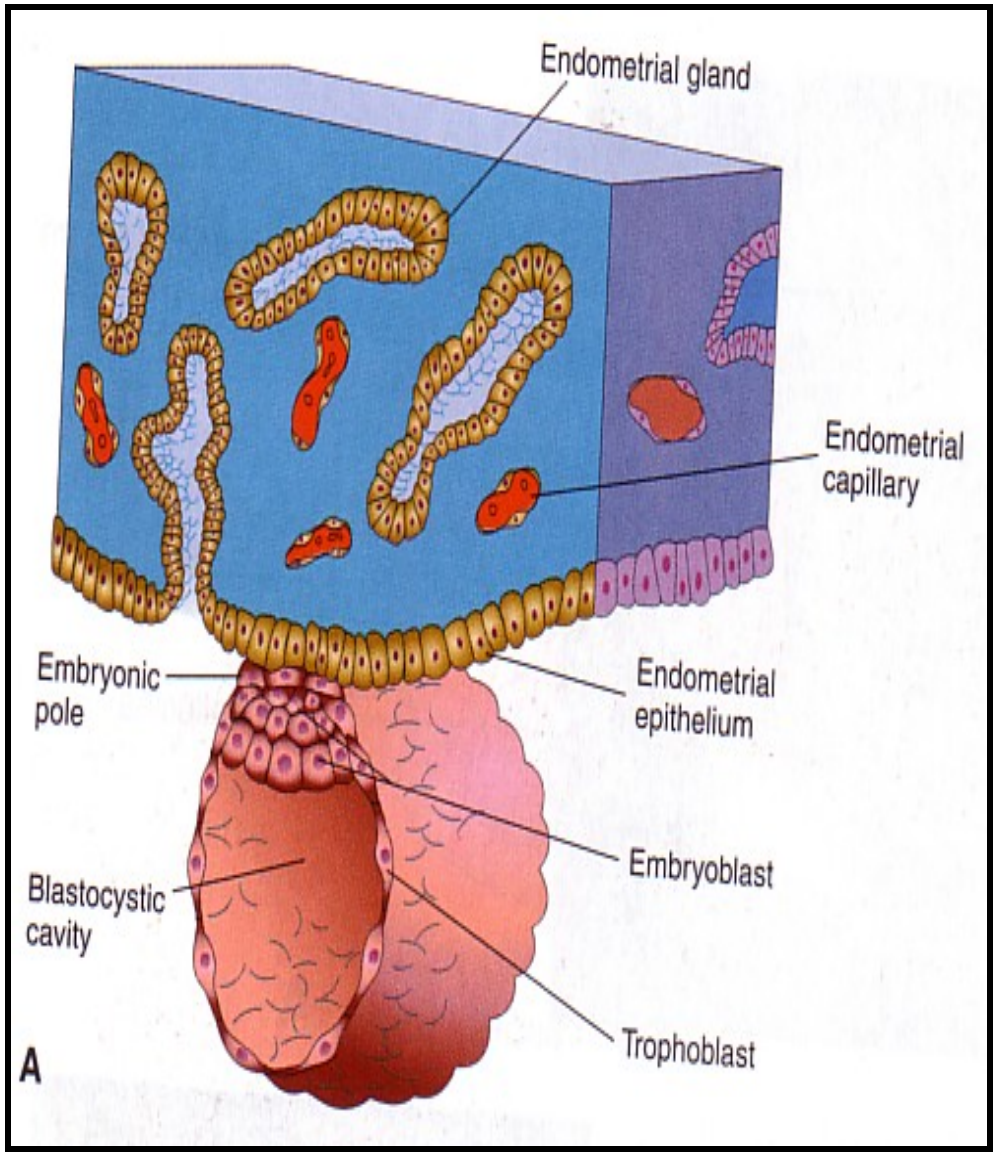
1. Outer cell layer called **trophoblast.**
2. Inner cell layer (mass); called **Embryoblast** attached to one of the poles of the blastocyst.

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 **6th day** after fertilization.
- It is **completed** by the **11th** or **12th** day.



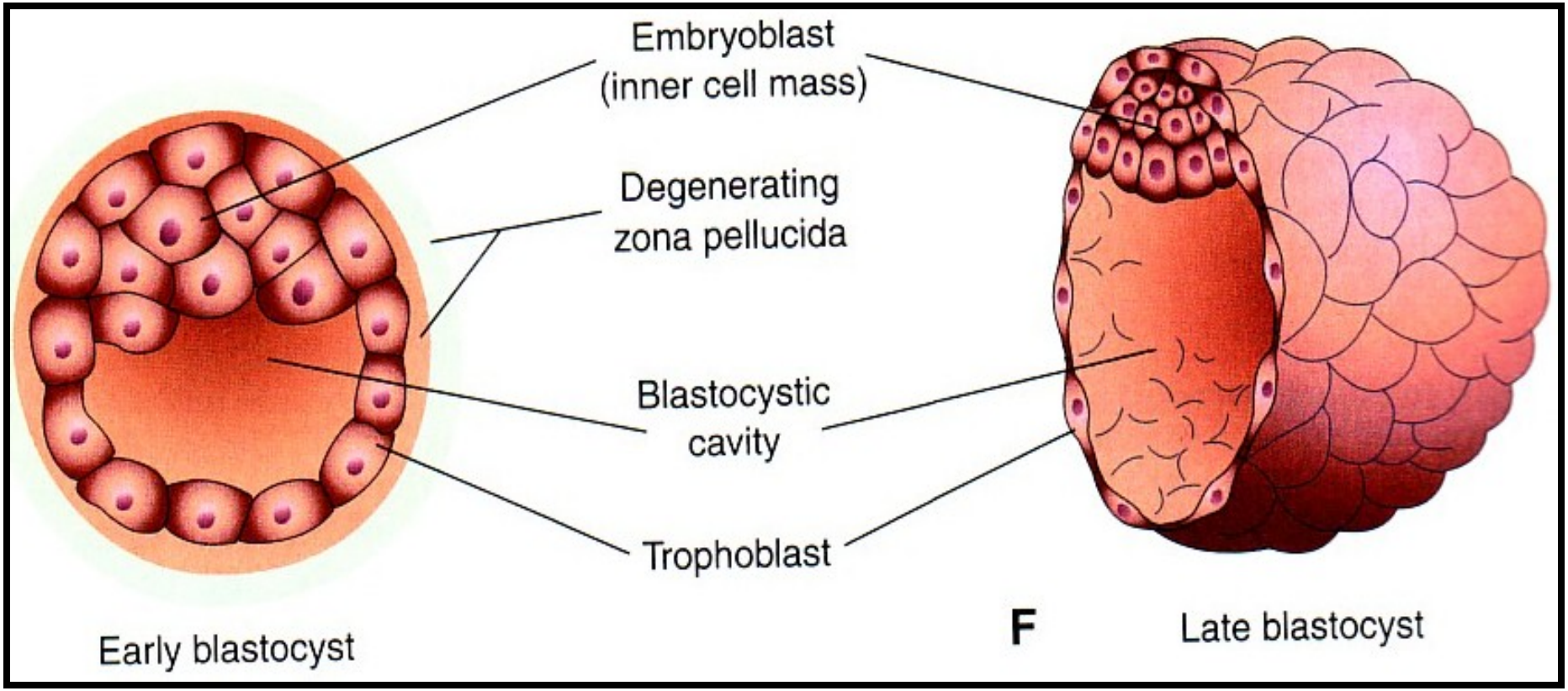
- **Mechanism:**

➢ The Morula reaches the uterine cavity by the 4th day.

➢ It remains **free** within the uterine cavity for **one or two** days.

➢ **Fluid** passes from uterine cavity to the Morula.

➢ Now the **Morula** is transformed into ***Blastocyst***, its cavity is called **blastocystic cavity** or blastocele, and **its cells** divided into **Embryoblast & Trophoblast**.



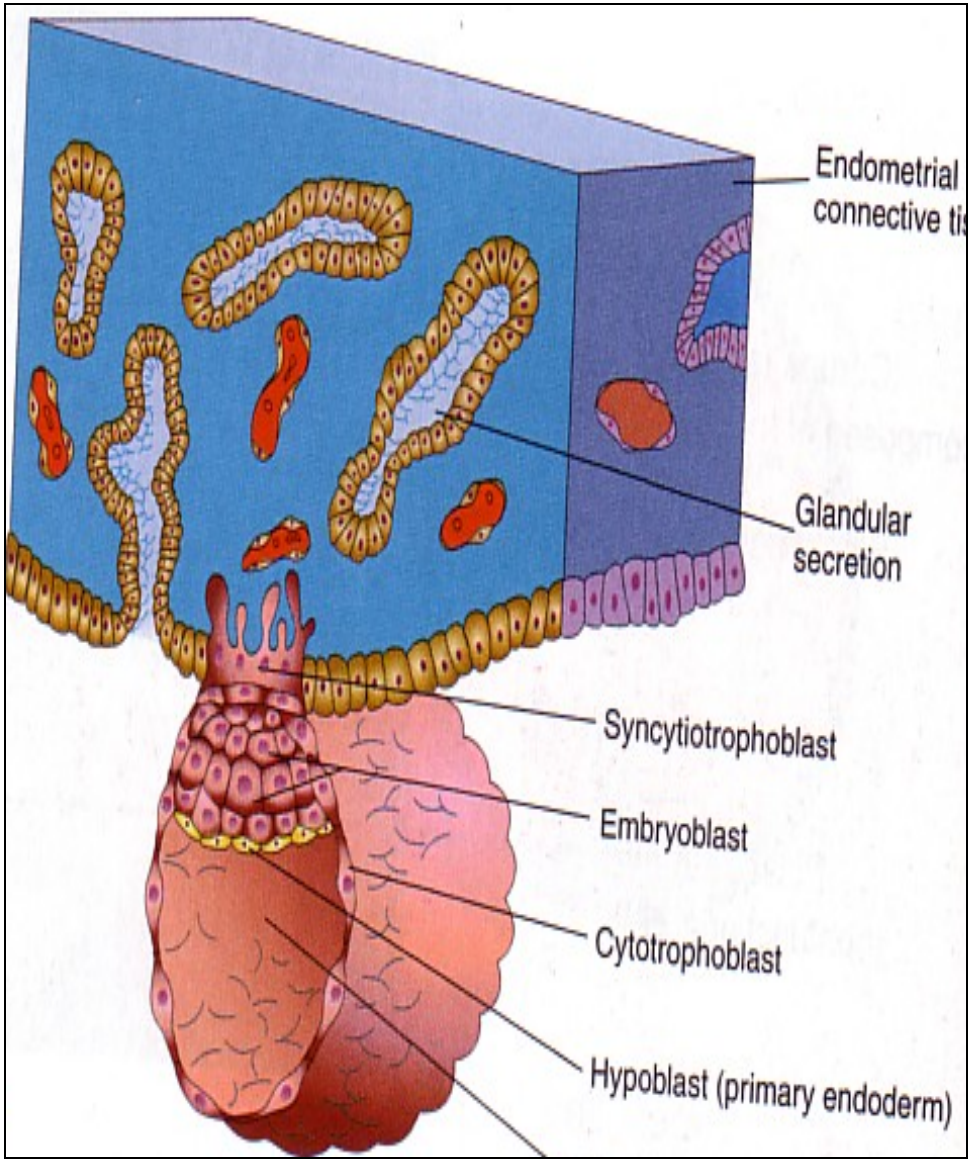
Implantation

- **Zona pellucida** degenerates & disappears by the **5th** day to allows the **blastocyst** to increase in size and penetrates 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,** T*rophoblast* differentiated into **2 layers:**

Syncytiotrophoblast;
outer multinucleated cytoplasmic mass, with *indistinct* cell boundary.

Cytotrophoblast
inner layer, mitotically active.

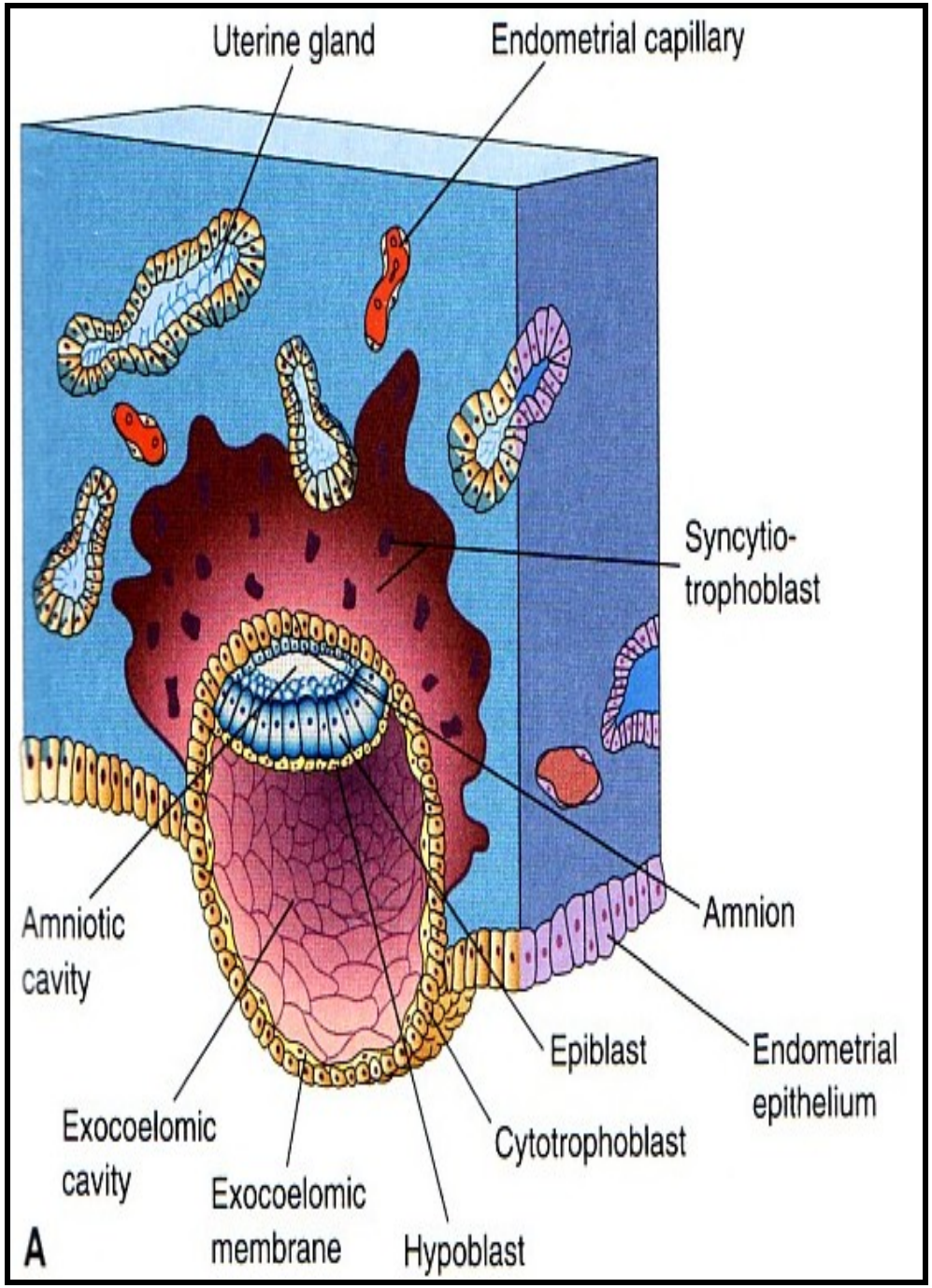
- **By 8th day** the blastocyst is superficially embedded in the compact layer of the endometrium.



- **Blood-filled Lacunae** appear within 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 **facilitates invasion** of endometrium **by** the **Syncytiotrophoblast.**

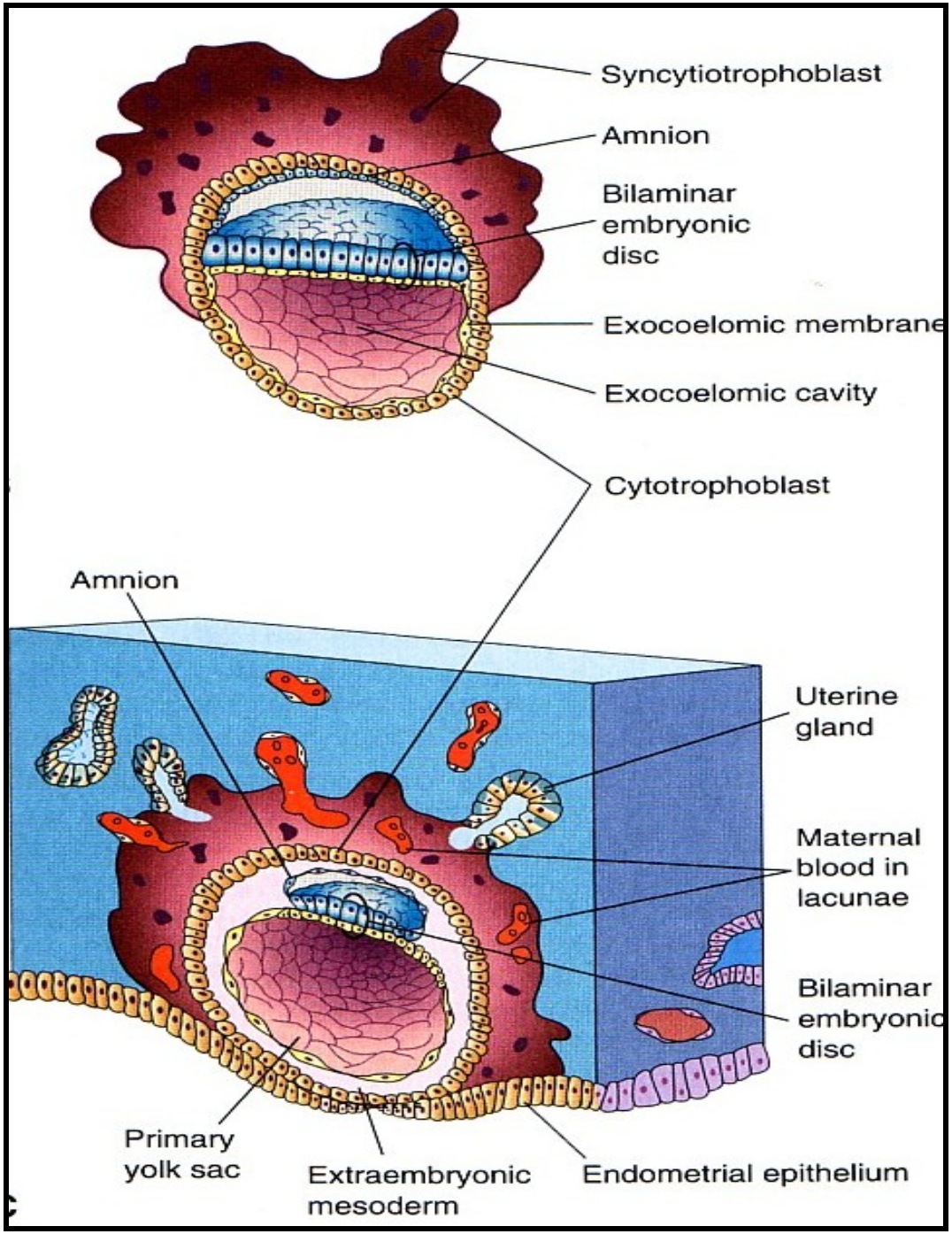
Syncytiotrophoblast engulf these degenerated cells for nutrition of the embryo.

Implantation

can be **detected** by:

1- **Ultrasonography.**

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

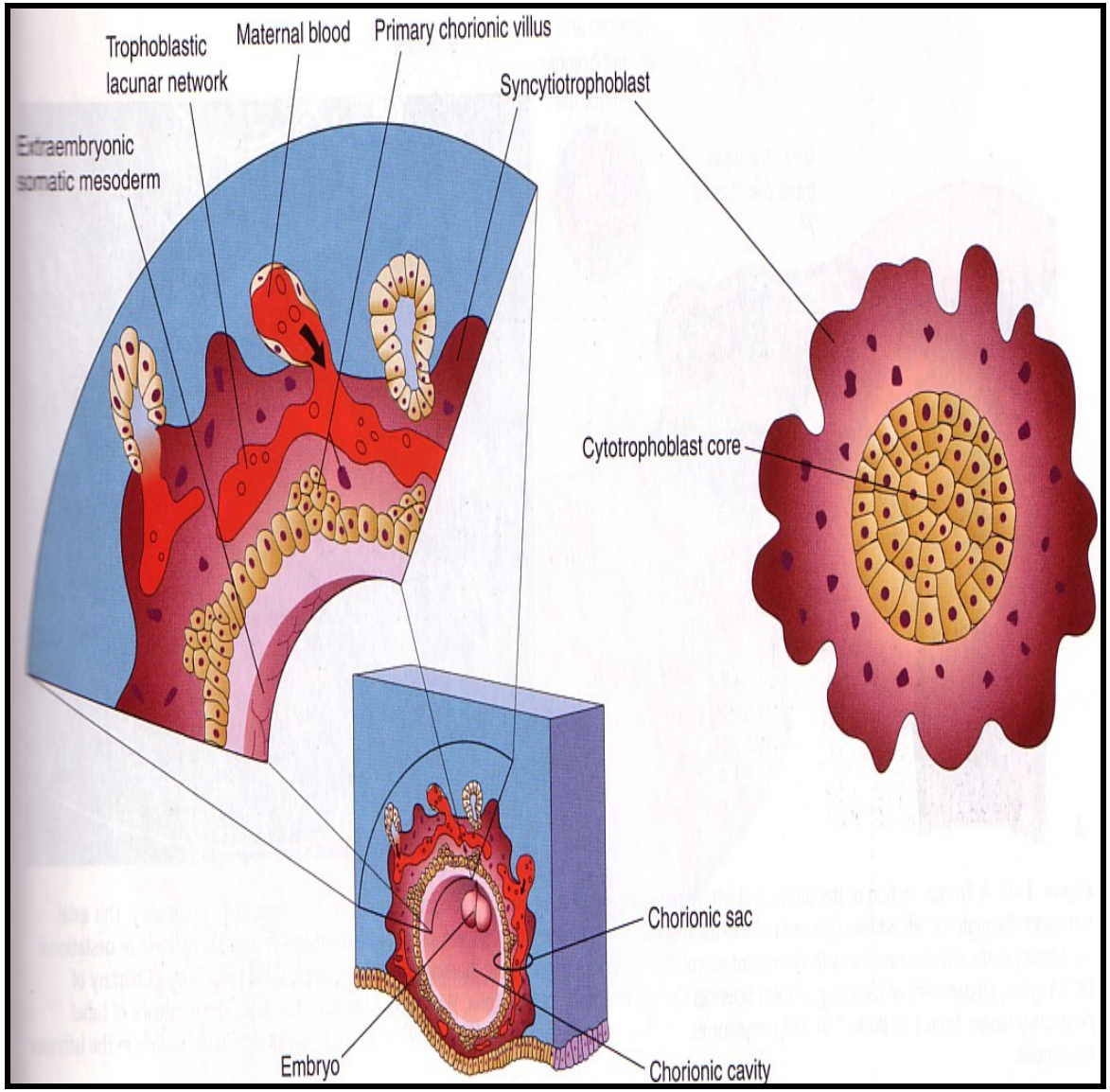


Early Pregnancy Factor

- 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.

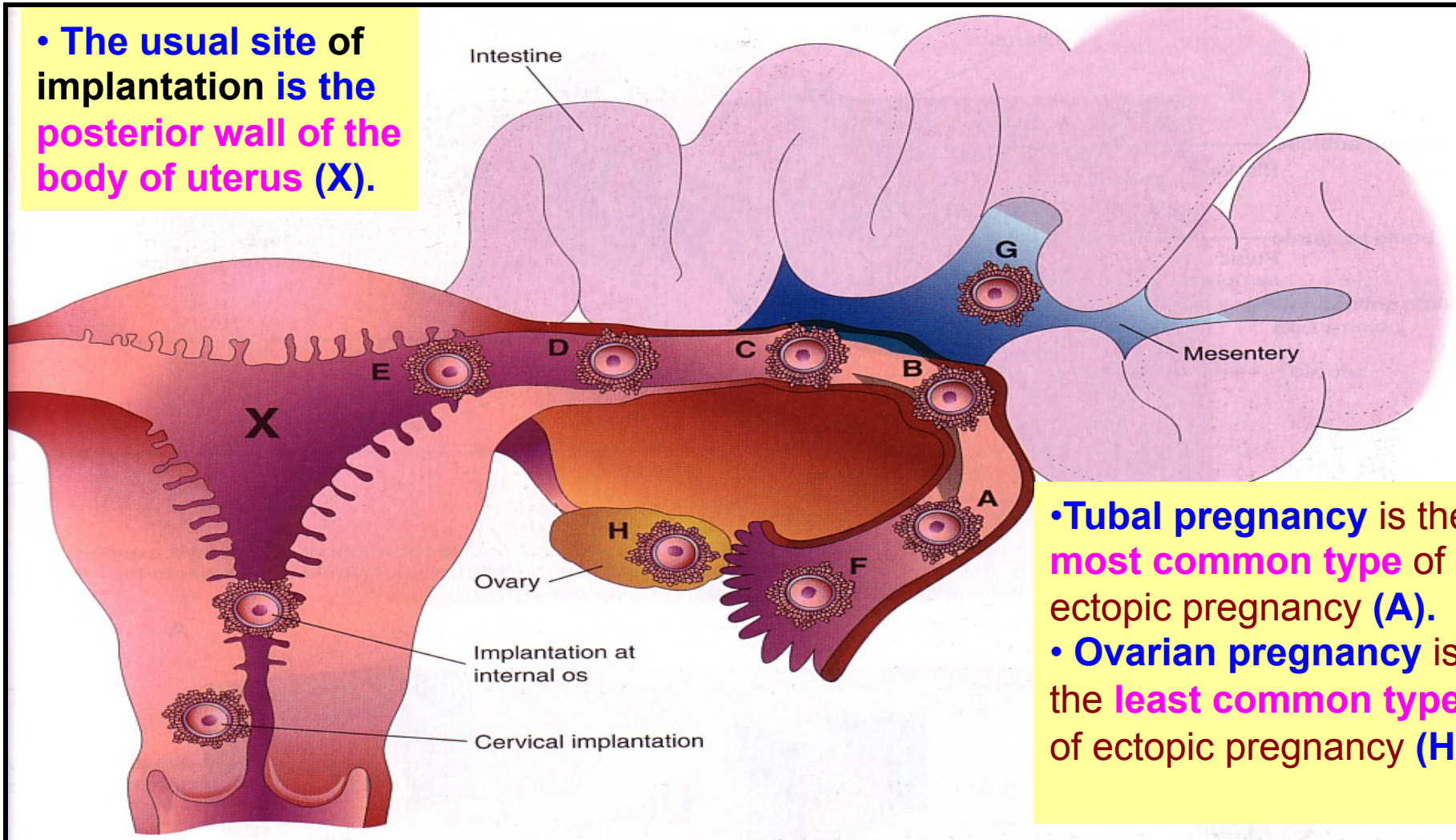
Formation of The Primary Chorionic villi

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



Ectopic Implantation (Pregnancy)

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



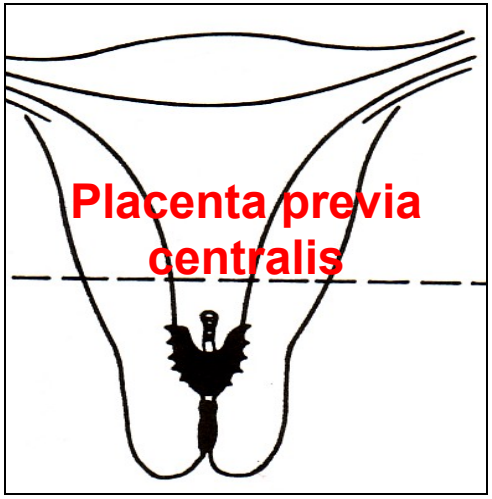
•**Tubal pregnancy** is the **most common type** of ectopic pregnancy **(A).**

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

e 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 ncy of ectopic implantations is indicated alphabetically (*A*, most common, *H*, least common). *A* to *F*, Tubal pregnancies. *G*, Abdominal ancy. *H*, Ovarian pregnancy. Tubal pregnancies are the most common type of ectopic pregnancy. Although appropriately included with uterine ancy sites, a cervical pregnancy is often considered to be an ectopic pregnancy.

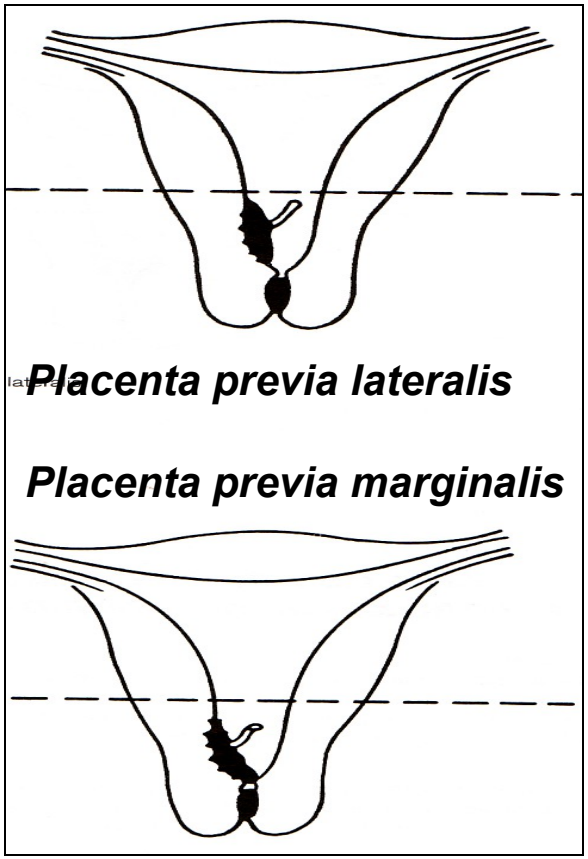
Ectopic Pregnancy

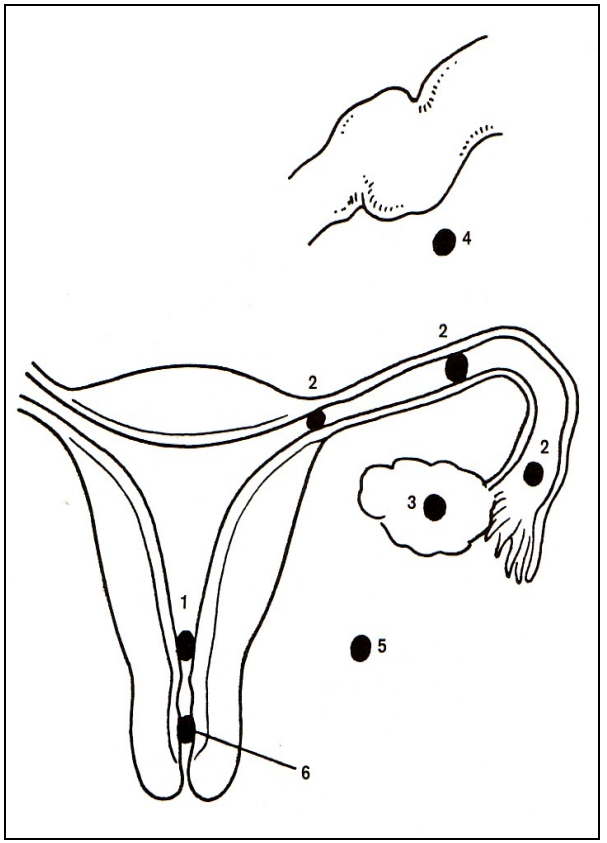
- **It means** implantation **outside the uterine cavity.**
- **95 to 97%** of ectopic pregnancies **occurs in the uterine tube.**
- **Most** are in the **ampulla** & isthmus.
- **Placenta previa:**
- **Implantation** occurs in the **lower uterine segment.**



Ectopic Pregnancy:

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





GOOD LUCK