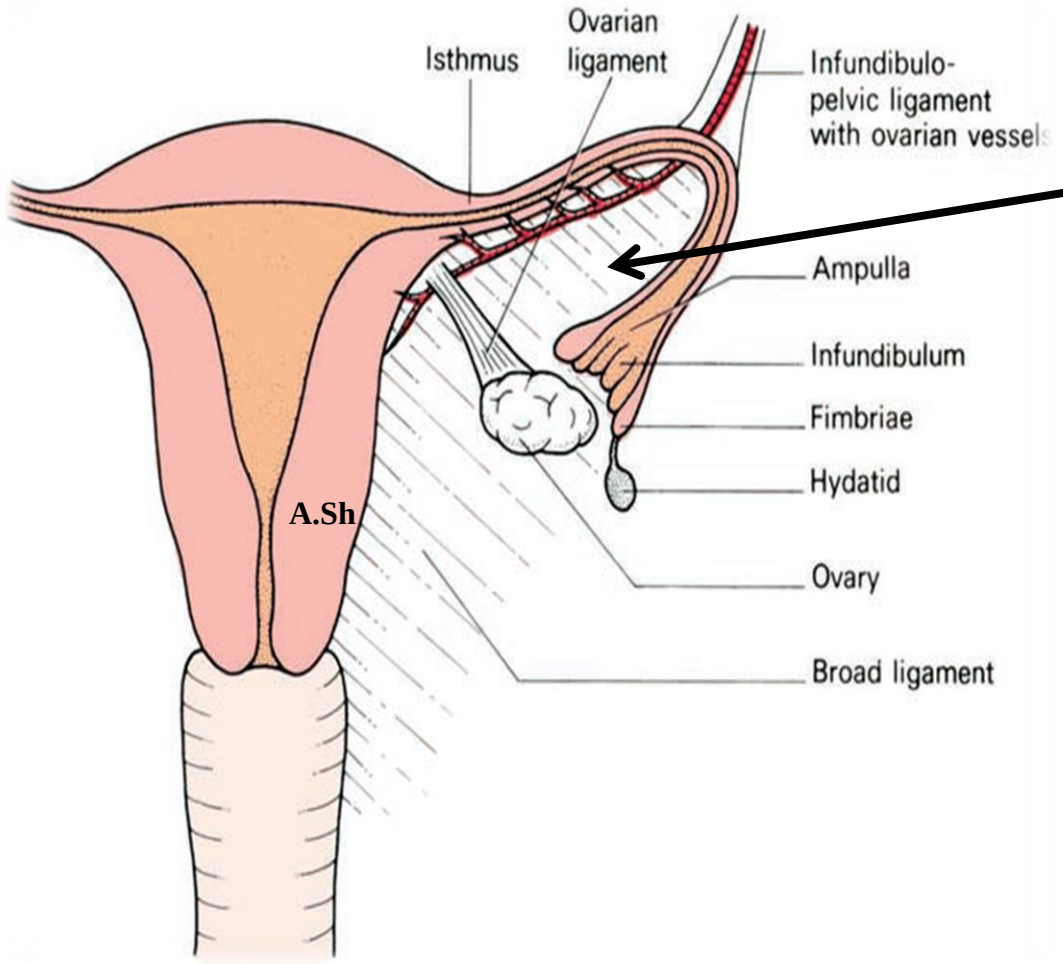
The Fallopian tubes

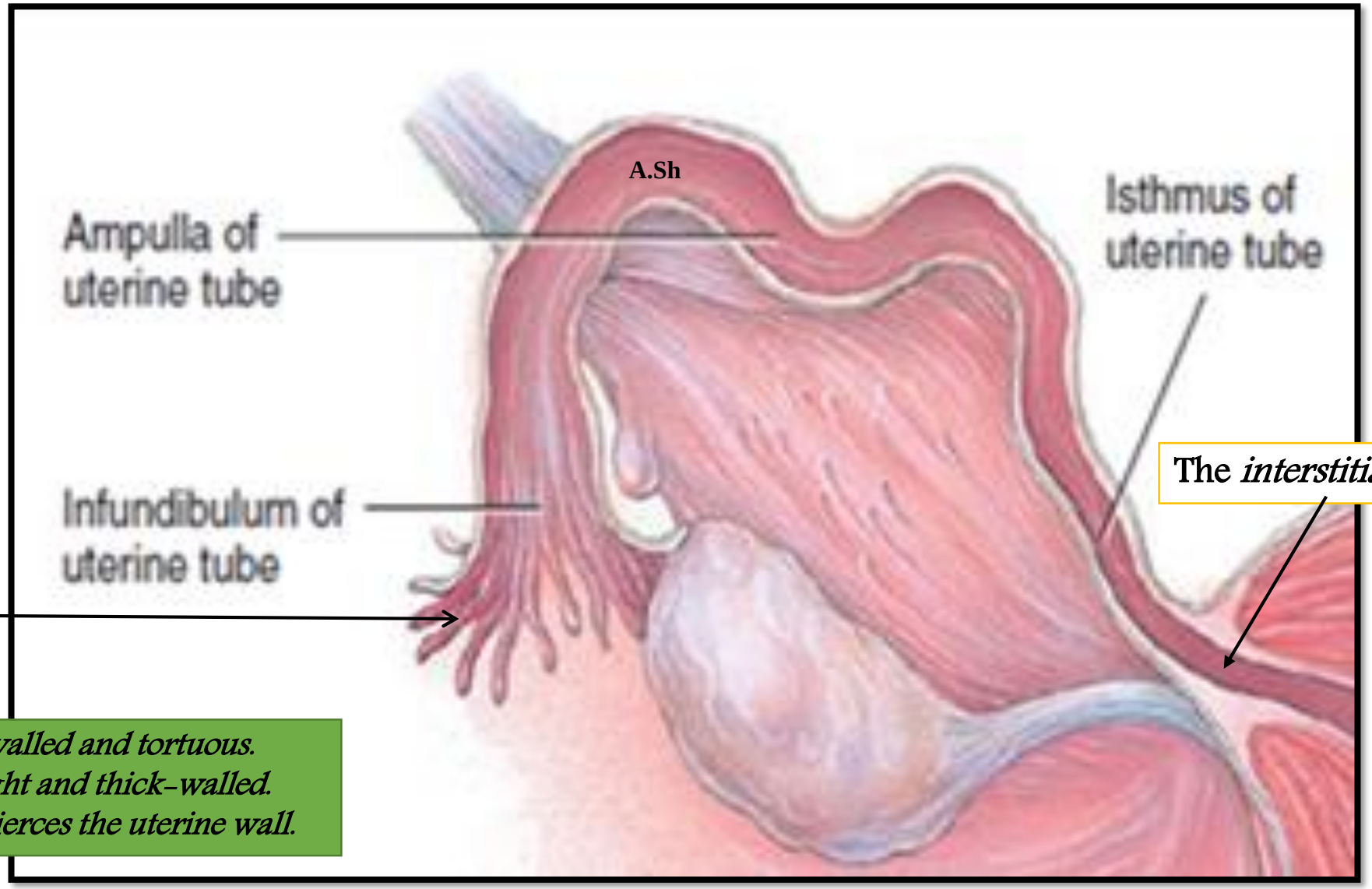


- The **uterine tubes (Fallopian) or oviducts** are about **4 in** (10 cm) long
- they lie in the ***free edge of the broad ligaments***
- open into the *cornu of the uterus*.
- They provide
- 1- **a route for sperm to reach an ovum**
- **2- Transport secondary oocytes and fertilized ova (*the dividing zygote*) from the ovaries to the uterus.**

➢Each comprises four parts.

1-The *infundibulum* — the bugle-shaped extremity extending beyond the broad ligament and opening into the peritoneal cavity by the ***ostium***.

Its mouth is fimbriated and overlies the ovary, to which one long fimbria actually adheres (*fimbria ovarica*).



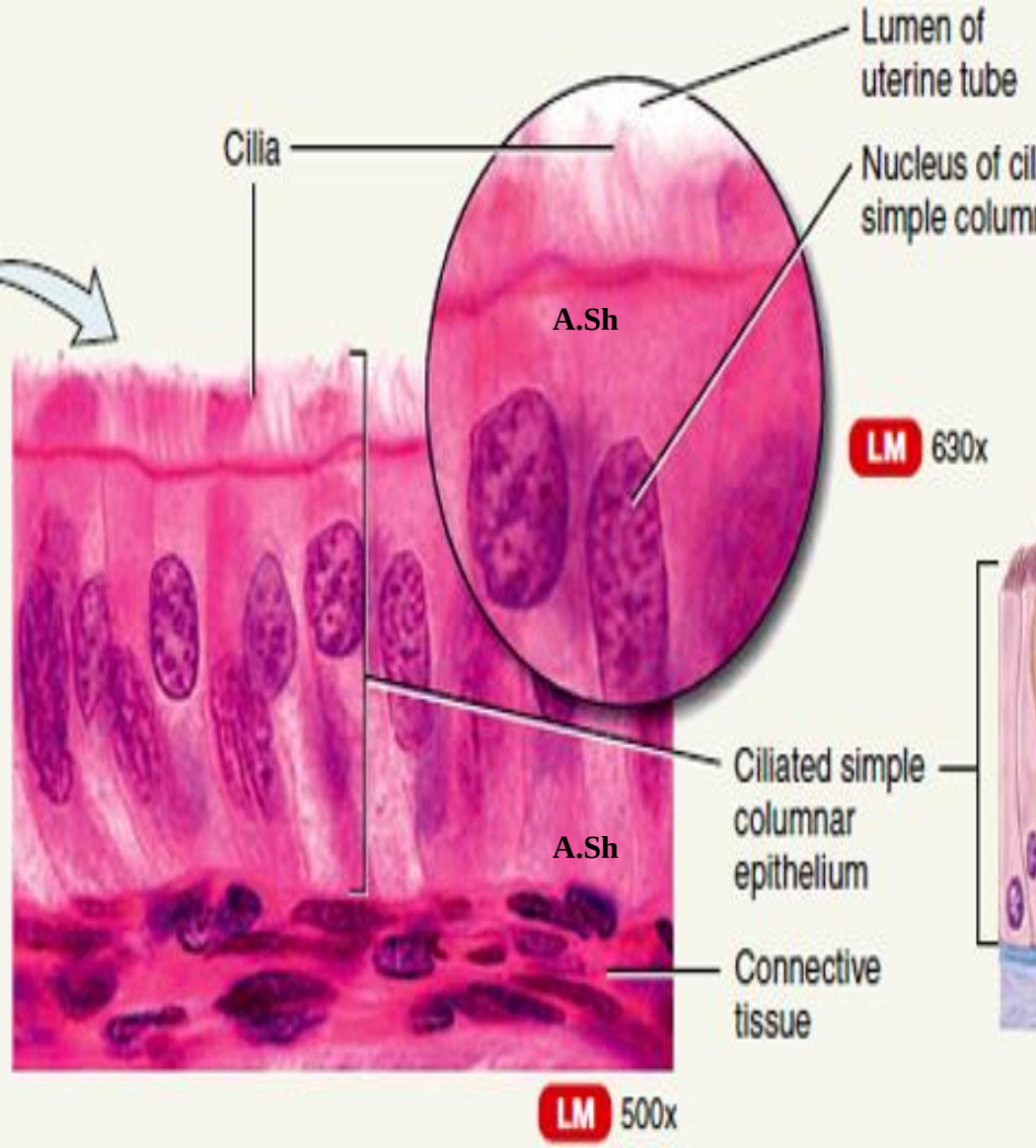
2-The *ampulla—wide, thin-walled and tortuous.*

3-The *isthmus—narrow, straight and thick-walled.*

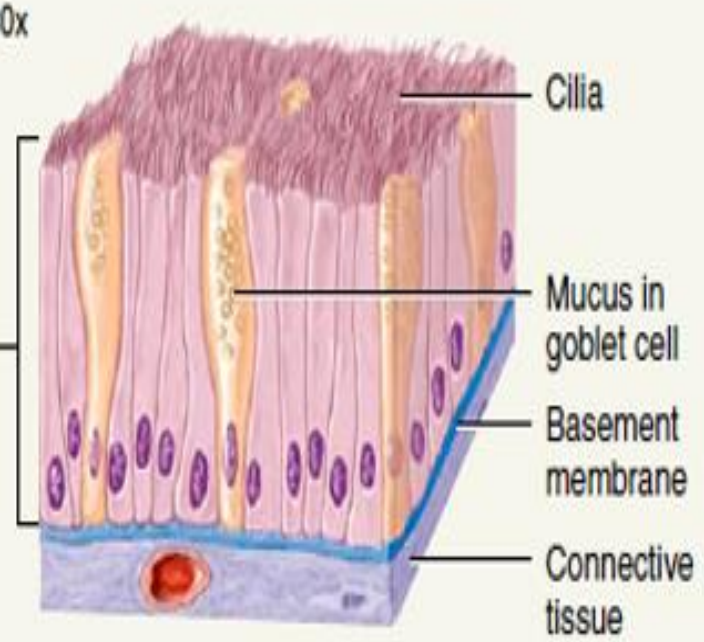
4-The *interstitial part—which pierces the uterine wall.*

Structure/Histology of the oviduct

The mucosa is formed of ***columnar,*** mainly ***ciliated cells***
The ova are propelled to the uterus along this tube, partly by ***peristalsis and partly by cilial action***

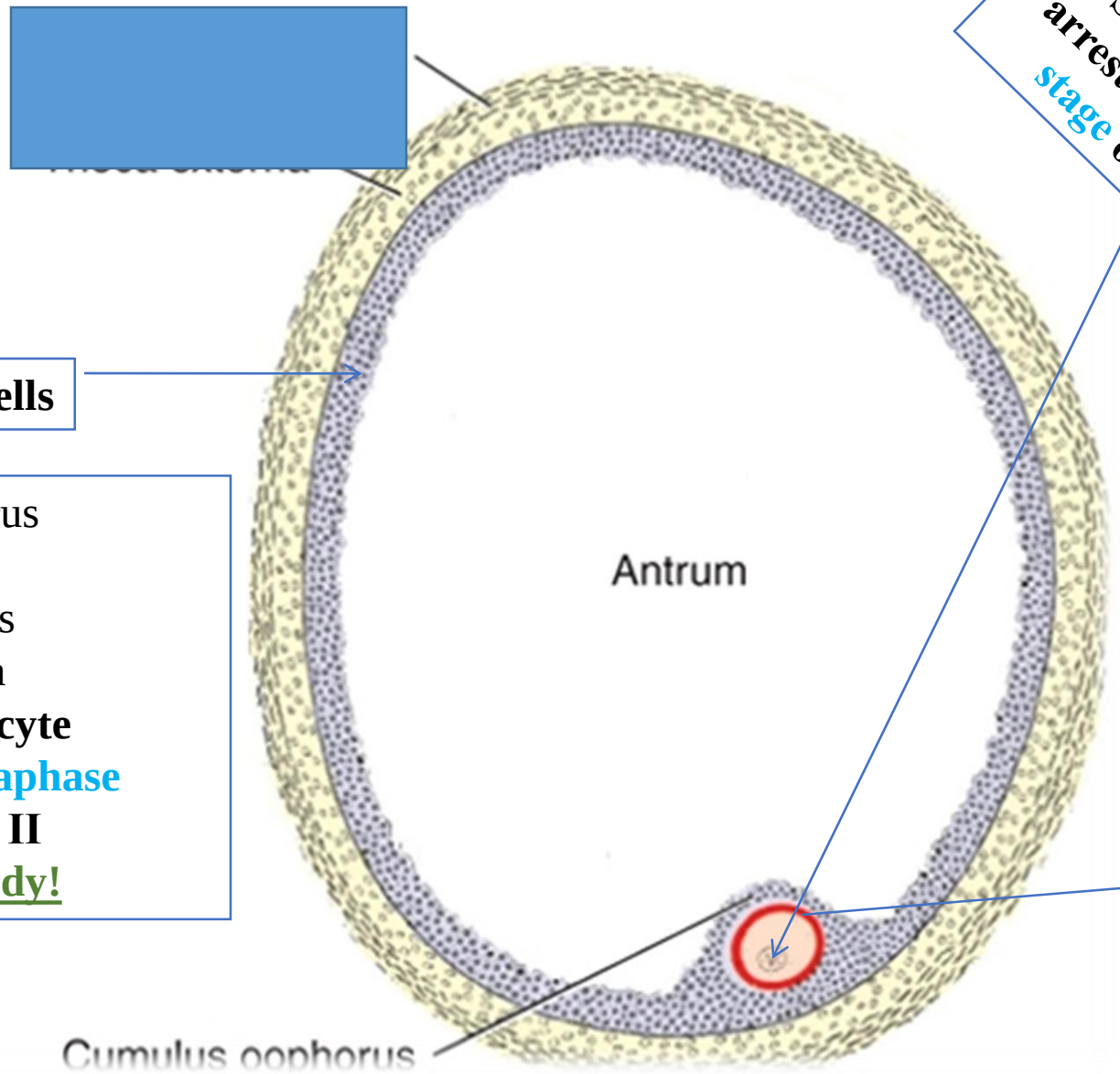


Sectional view of ciliated simple columnar epithelium of uterine tube



Ciliated simple columnar epithelium

FEATURES OF THE PREOVULATORY (GRAAFIAN FOLLICLE)



هام جدا

Secondary oocyte arrested in metaphase stage of meiosis II

Granulosa cells

Cumulus oophorus
Consists of:
1-Granulosa cells
2-Zona pellucida
3-Secondary oocyte arrested in metaphase stage of meiosis II
4-First polar body!

Zona pellucida

PREOVULATORY FOLLICLE To **OVULATION**

(LH) increases

- **The surface of ovary bulges locally**
- **Digestion of collagen around the follicle**
- **Local muscular contraction In ovarian wall**

All this will help in extruding

The cumulus Oophours

BREAK FREE (ovulation) and float out of the ovary

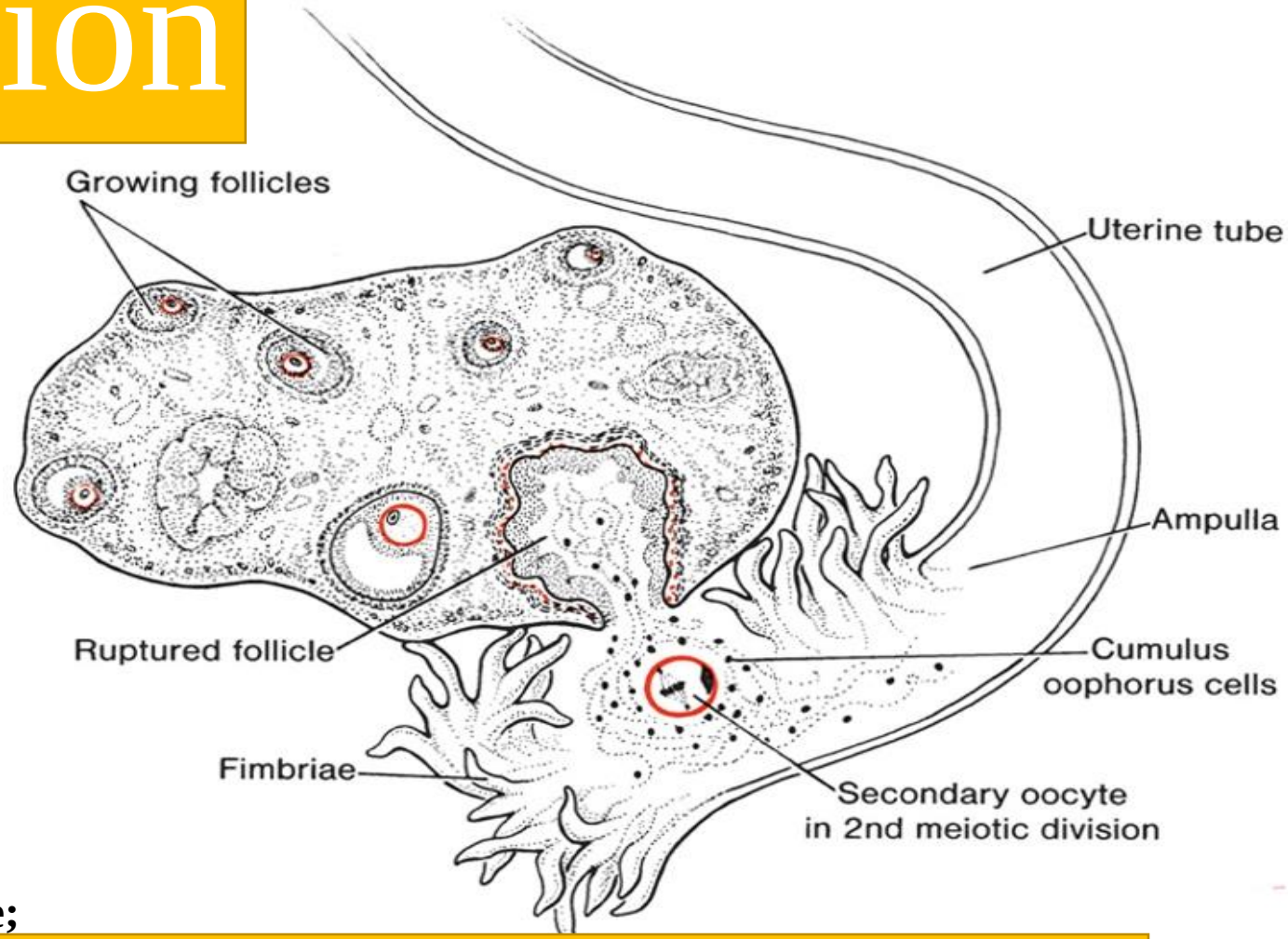
Cumulus oophorus
Consists of:
1-Granulosa cells
2-Zona pellucida
3-Secondary oocyte arrested in metaphase stage of meiosis II
4-First polar body!

Notice that only the **cumulus oophorus** is ovulated from the Preovulatory Follicle (Graafian Follicle)

Ovulation

Day 14 of a 28 days menstrual cycle

Or mid-cycle in other normal Cycles (not 28 days)



Note;

From the region of *cumulus oophorus* the oocyte with its surrounding granulosa cells breaks free (Ovulation), leaving behind them the theca interna , externa and granulosa cells

Cumulus oophorus

Consists of:

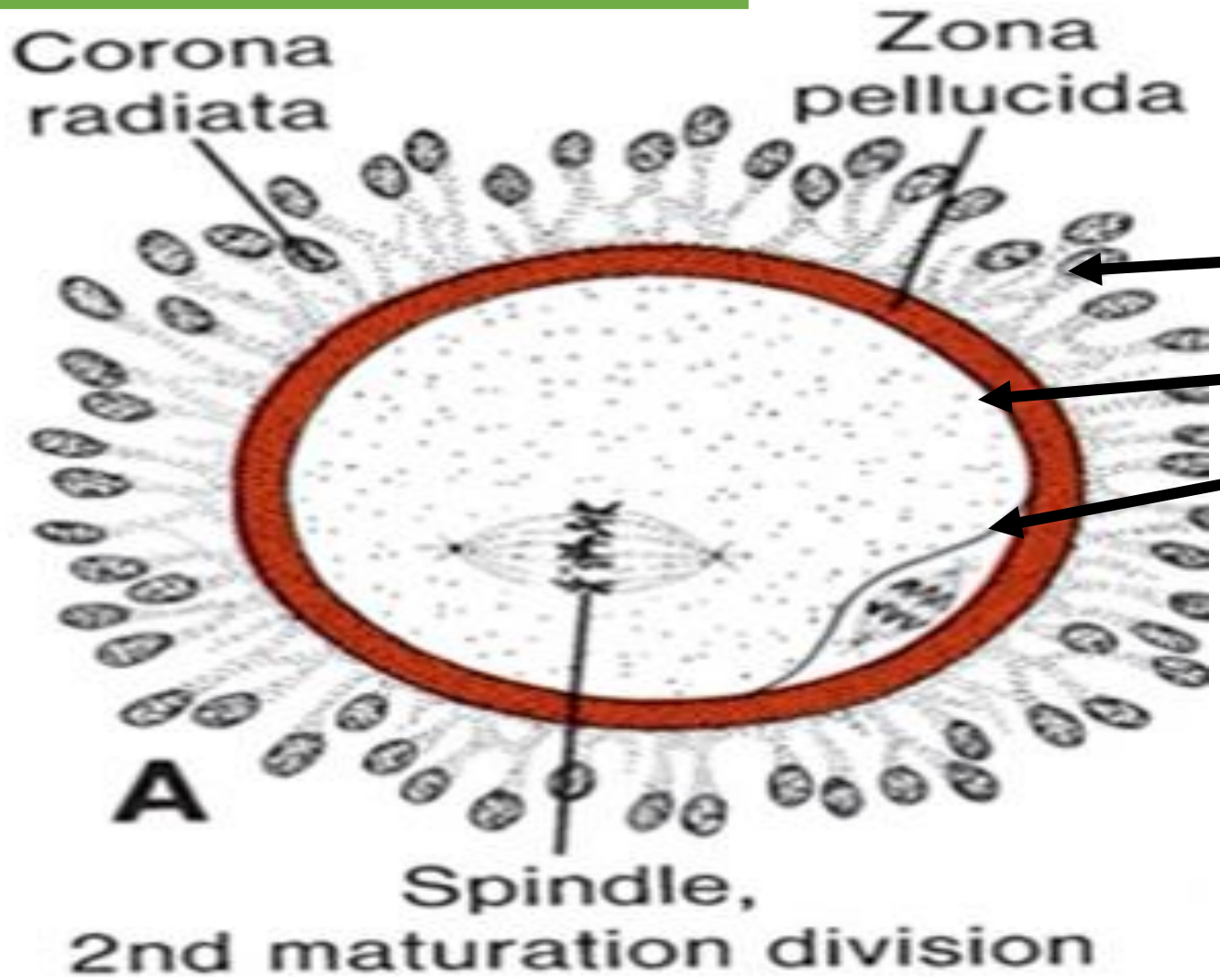
1-Granulosa cells

2-Zona pellucida

3-Secondary oocyte arrested in metaphase stage of meiosis II

4-First polar body!

Some of the granulosa cells will arrange themselves around the zona pellucida to form Corona radiata

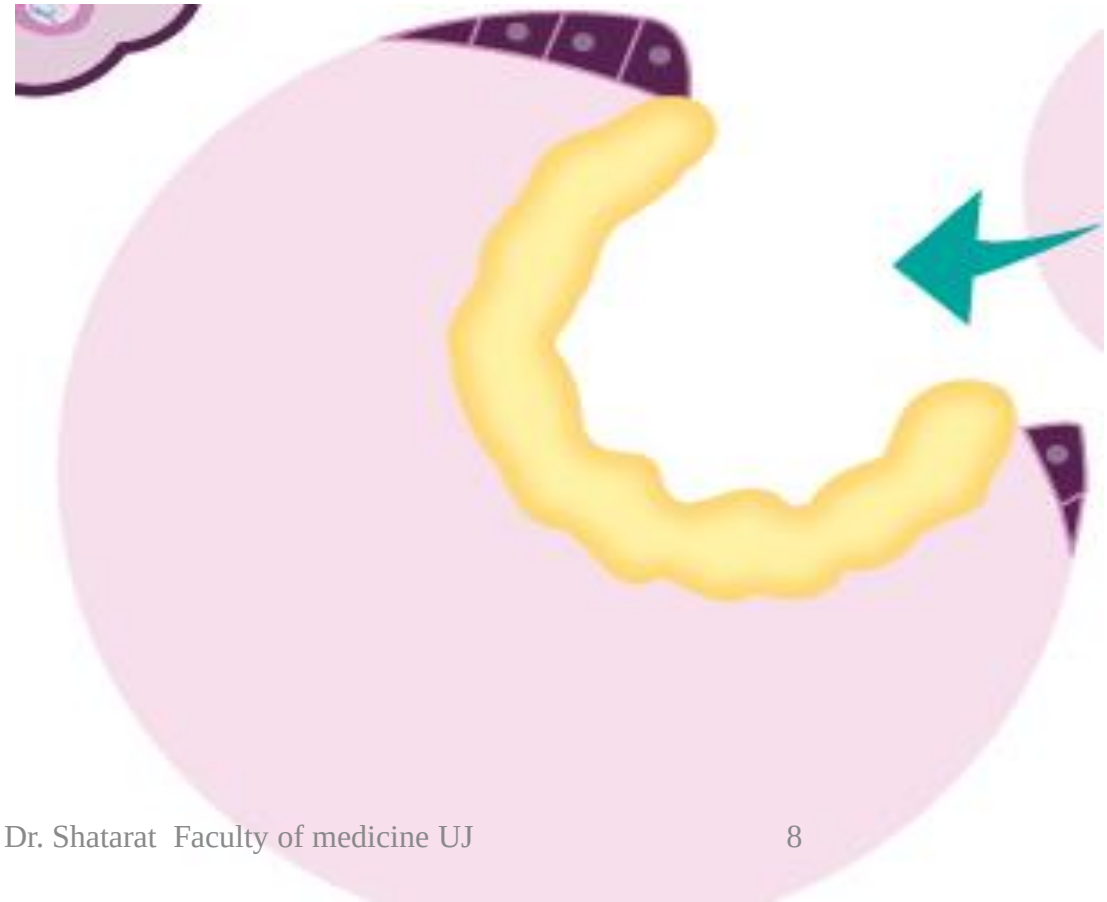


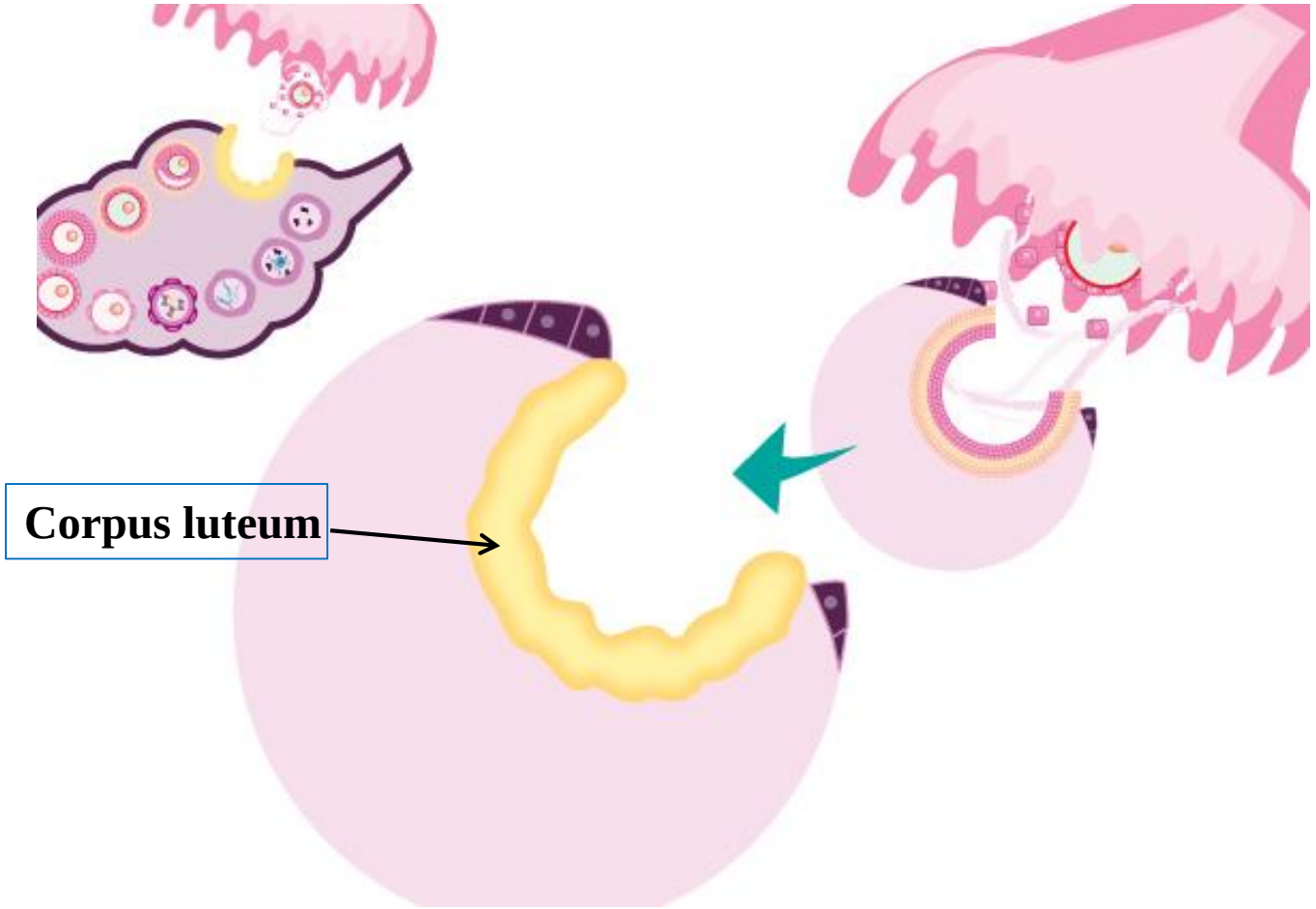
1-Granulosa cells (Corona radiata)
2-Zona pellucida
3-Secondary oocyte arrested in metaphase stage of meiosis II
4-First polar body!

CORPUS LUTEUM

After ovulation, granulosa cells remaining in the wall of the ruptured follicle, together with cells from the theca interna, are vascularized by surrounding vessels. Under the influence of LH, these cells develop a yellowish pigment and change into lutein cells, which form the corpus luteum and secrete estrogens and progesterone

Progesterone, together with some **estrogen**, causes the uterine mucosa to enter the progestational or secretory stage in preparation for implantation of the embryo.

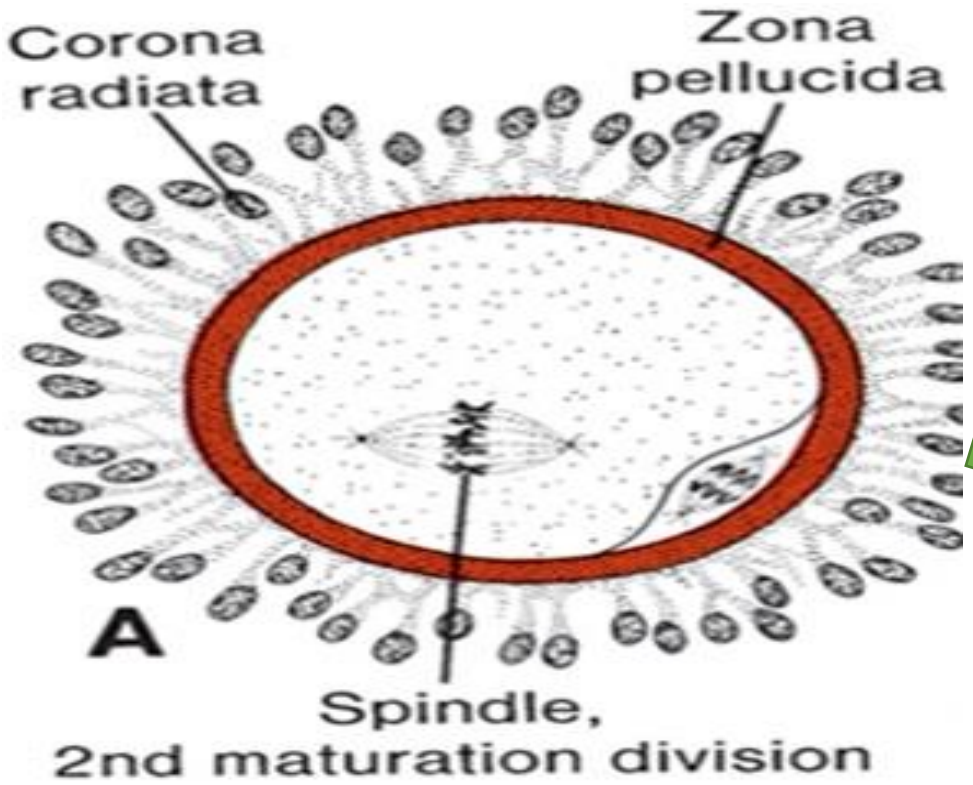



Corpus luteum

What is the destiny of

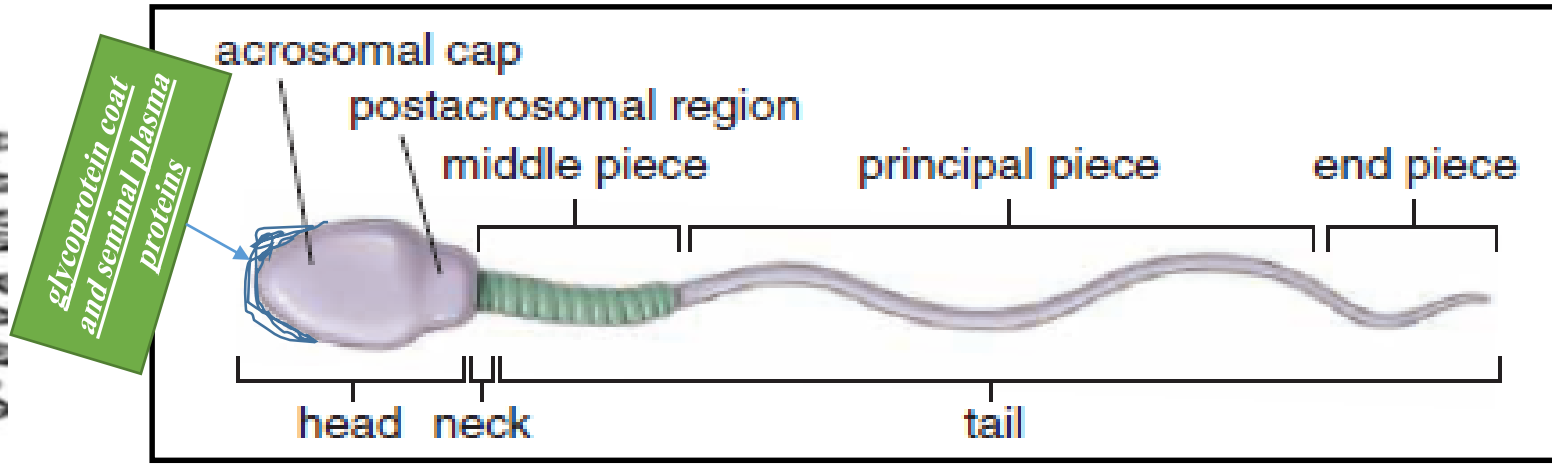
The ovulated Secondary oocyte (arrested in metaphase stage of meiosis II) with its First polar body which are covered by zona pellucida and corona radiata???

SO .....WHAT WE HAVE BEFORE FERTILIZATION



An ovulated egg Made of:

1-Secondary oocyte arrested in metaphase stage of meiosis II
2- First polar body arrested in metaphase stage of meiosis II
3-Zona pellucida
4- Corona radiata



A Sperm

that carries **23 chromosomes**

and an **acrosome**

Is it arrested at any stage???!! no

But it has !!!!!!!!!

glycoprotein coat and seminal plasma proteins

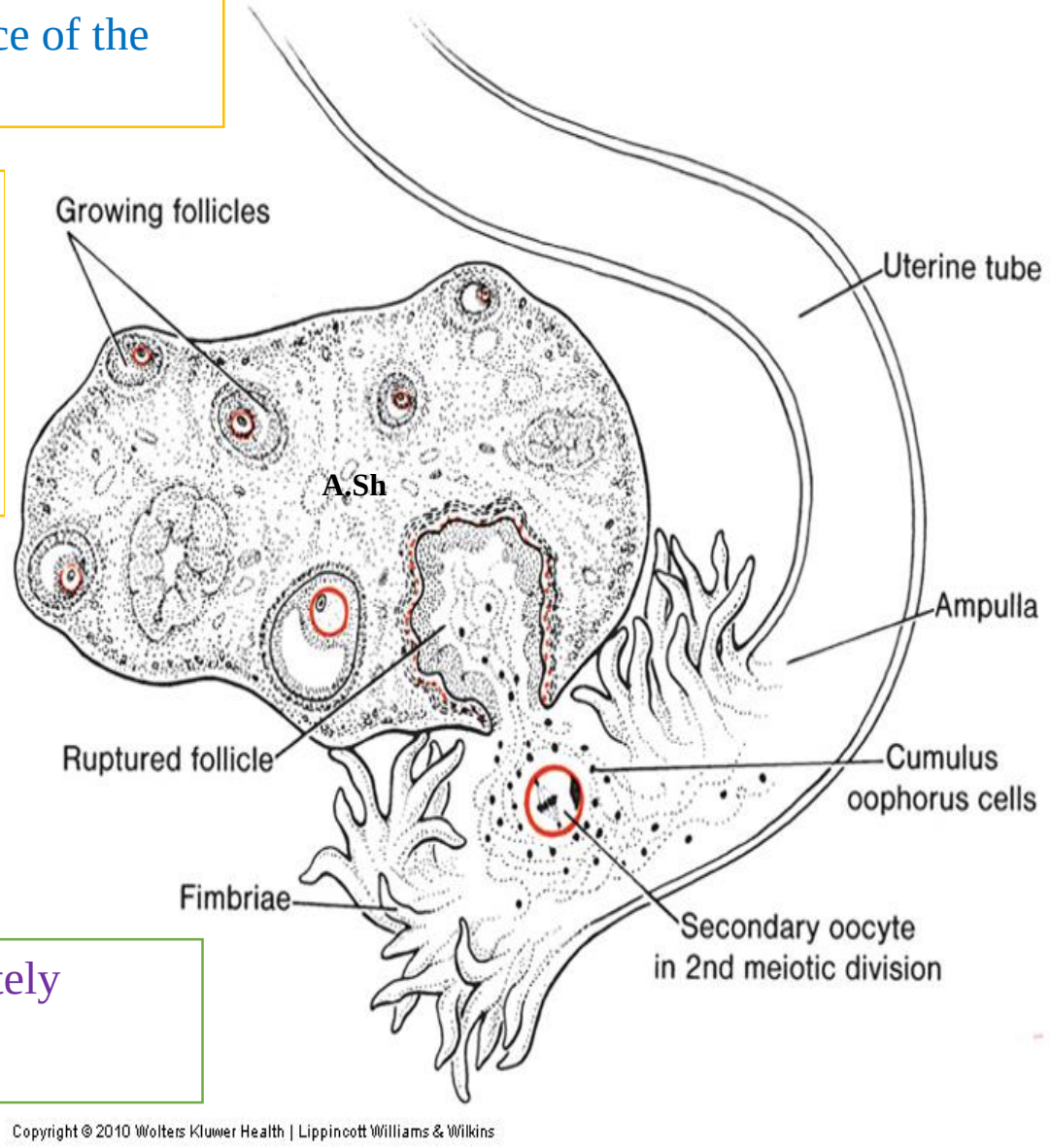
They will prevent penetration through corona radita, what to do?

➢**Before ovulation, fimbriae** of the uterine tube **sweep over** the surface of the ovary, and the tube itself begins to **contract rhythmically**

Oocyte Transport

➢These **sweeping movements** of the fimbriae and **motion of cilia** on the epithelial lining **carry** the oocyte to the uterine tube

Once the oocyte is in the uterine tube, it is **propelled by peristaltic muscular contractions** of the tube and **by cilia in the tubal mucosa**



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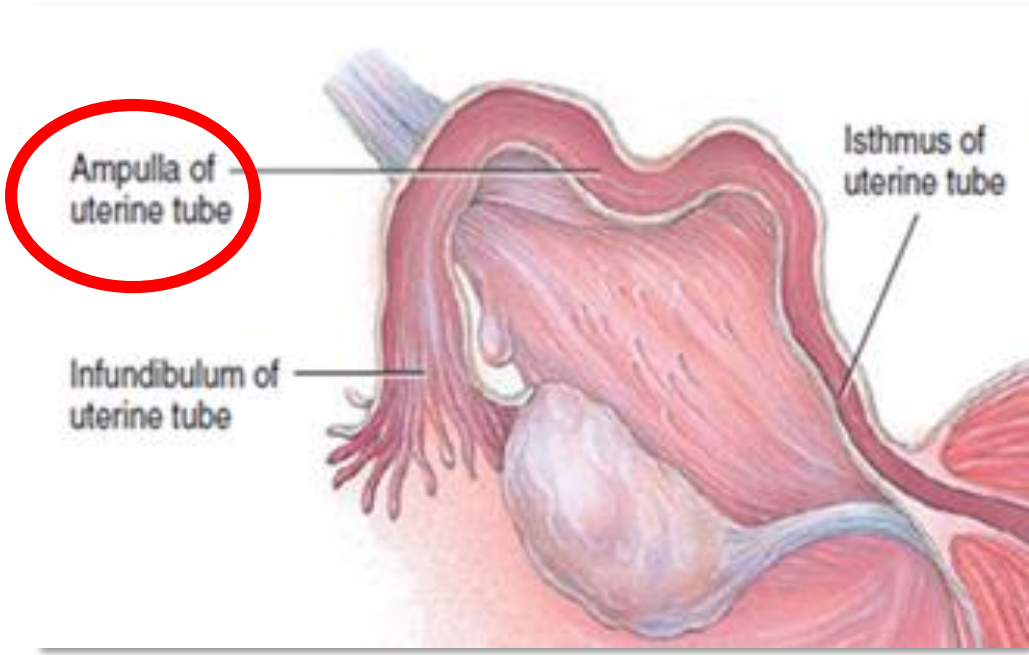
➢In humans, the fertilized oocyte reaches the uterine lumen in approximately **3 to 4 day**.

Fertilization

A process by which haploid male gamete fuse with female gamete to give single diploid nucleus.



➢Occurs **in the ampullary region** of the **uterine tube**.

➢This is the widest part of the tube and is close to the ovary.

➢Spermatozoa may remain **viable** in the **female reproductive tract for several days**!!!!!!!

➢**Only 1% of sperm** deposited in the vagina **enter the cervix**, where they may survive for **many hours.** .

➢The trip from cervix to oviduct requires a minimum

of 2 to 7 hours.

➢Spermatozoa are ***not able to fertilize*** the oocyte immediately upon arrival in the female genital tract but must undergo:

(1) Capacitation
(2) Acrosome reaction

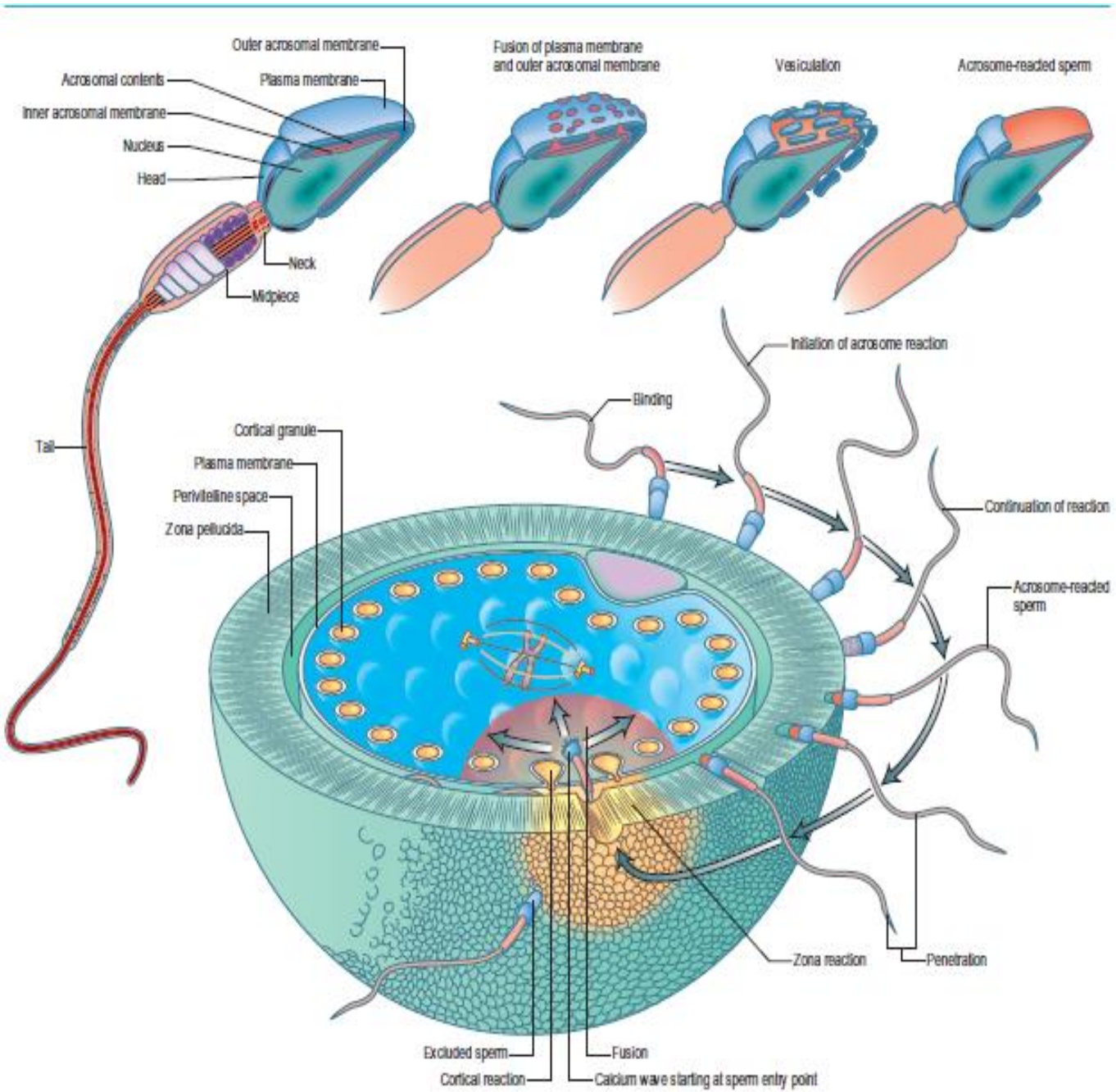
1-Capacitation

- is a period of conditioning ***in the female reproductive tract***
- in the human **lasts approximately 7 hours**
- **It** Includes; ***REMOVAL of the glycoprotein coat and seminal plasma proteins*** from the plasma membrane ***that overlies the acrosomal*** region of the spermatozoa.

Only capacitated sperm can pass through the corona cells and undergo the acrosome reaction.

➢ The acrosome reaction

Occurs after binding to **the zona pellucida**, is induced by zona proteins. Includes the release of **enzymes** needed to penetrate the zona pellucida, **including acrosin- and trypsin-like substances**



The phases of fertilization

Phase 1: Penetration of the Corona Radiata

Capacitated sperm pass freely through **the corona radiata**

Phase 2: Penetration of the Zona Pellucida

The zona **is a glycoprotein shell surrounding** the egg that **facilitates and maintains** sperm **binding** and induces **the acrosome reaction.**

FROM THE SPERM

- Both binding and the acrosome reaction are mediated by the **ligand ZP3, a zona protein**
- **Release of acrosomal enzymes** (acrosin) allows sperm to penetrate the zona.
- Permeability of the zona pellucida changes when **the head of the sperm comes in contact with the oocyte surface,** This contact results in **release of**:

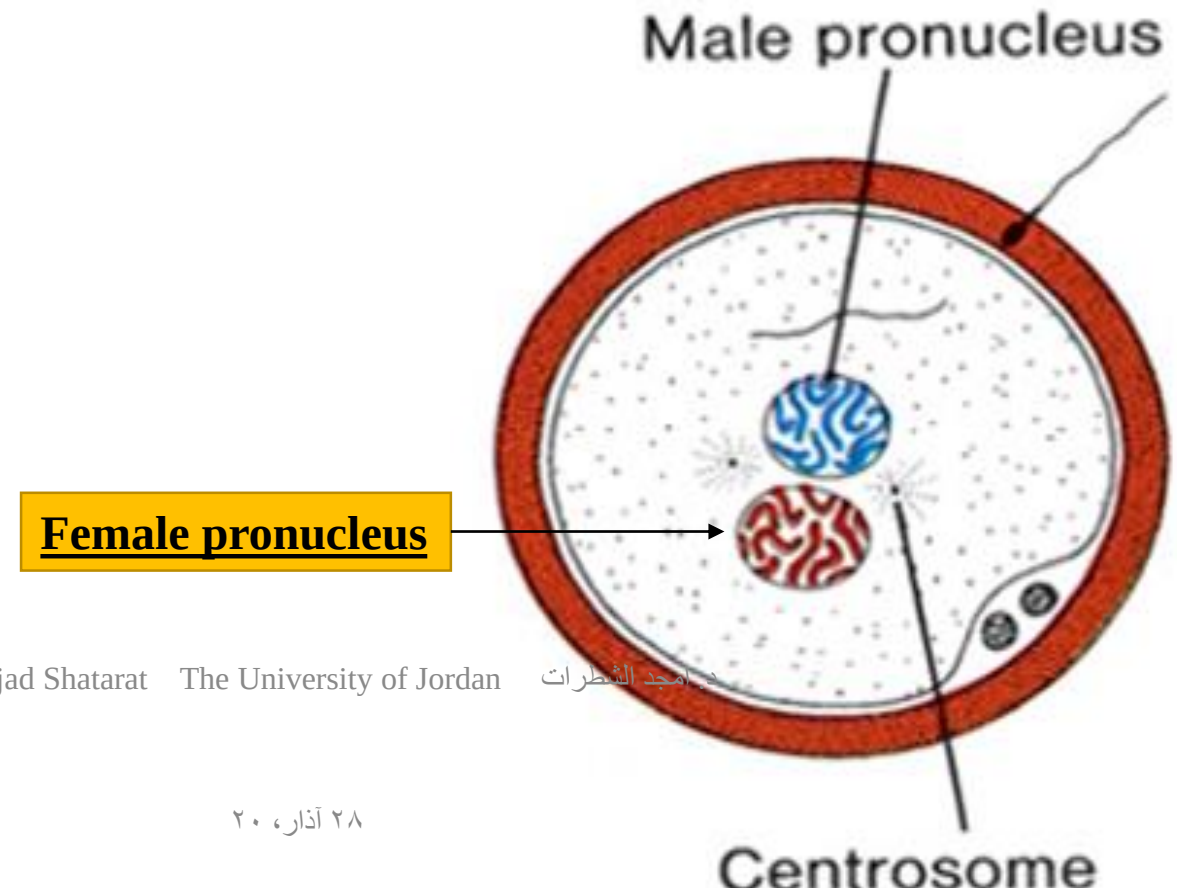
FROM THE OOCYTE

lysosomal enzymes from **cortical granules lining the plasma membrane of the oocyte.**

- These enzymes alter properties of the zona pellucida(**zona reaction**) to prevent sperm penetration and inactivate **species-specific receptor sites for spermatozoa on the zona surface**

Phase 3: Fusion of the Oocyte and Sperm Cell Membranes.

Actual fusion between the oocyte membrane and the membrane that covers the sperm head is
accomplished at the acrosomal reaction
when the plasma membrane covering the head cap disappears during the acrosome reaction.



The egg responses to the entrance of the spermatozoon in three ways:

A) Cortical and zona reactions

As a result of the release of cortical oocyte granules

(1) The oocyte membrane becomes **impenetrable** to other spermatozoa.
(2) the zona pellucida alters its structure and composition to prevent **sperm binding and penetration**. These reactions prevent **polyspermy** (penetration of more than one spermatozoon into the oocyte

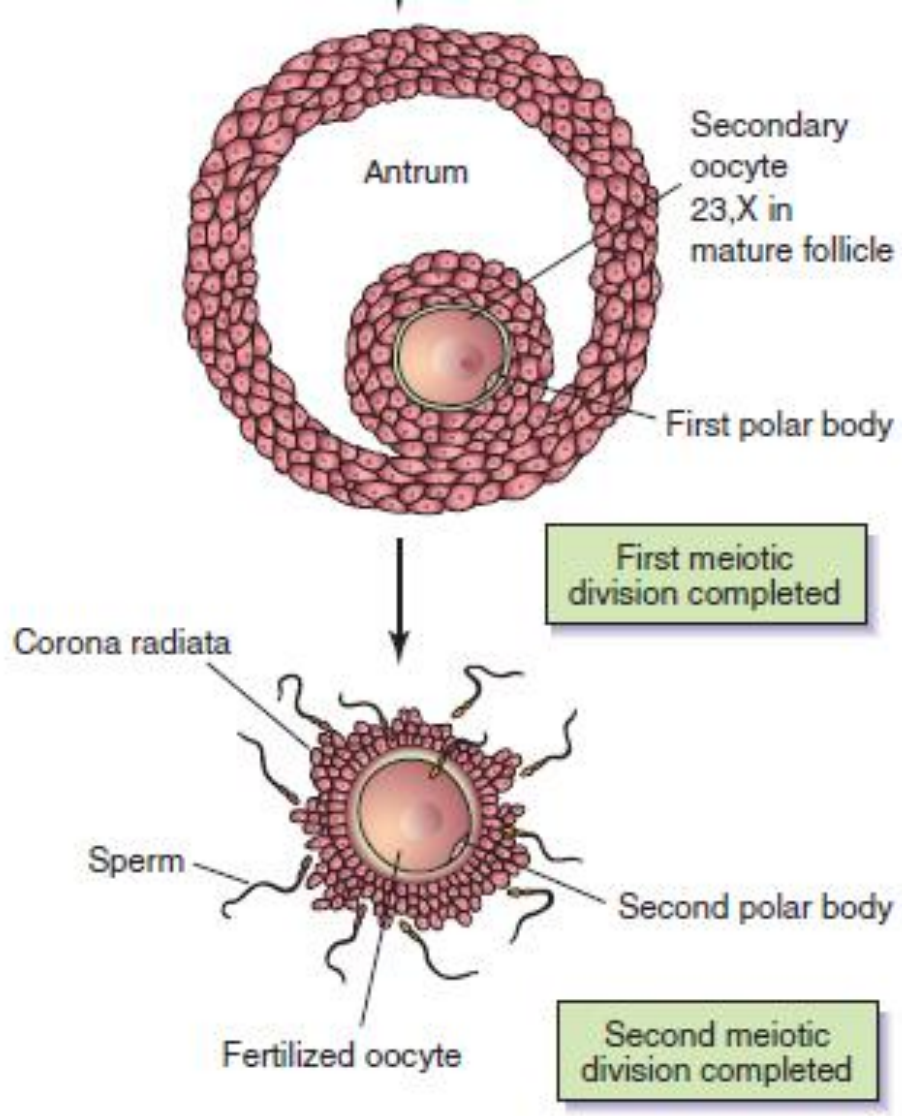
B) Resumption of the second meiotic division

➢The oocyte **finishes its second meiotic division.**

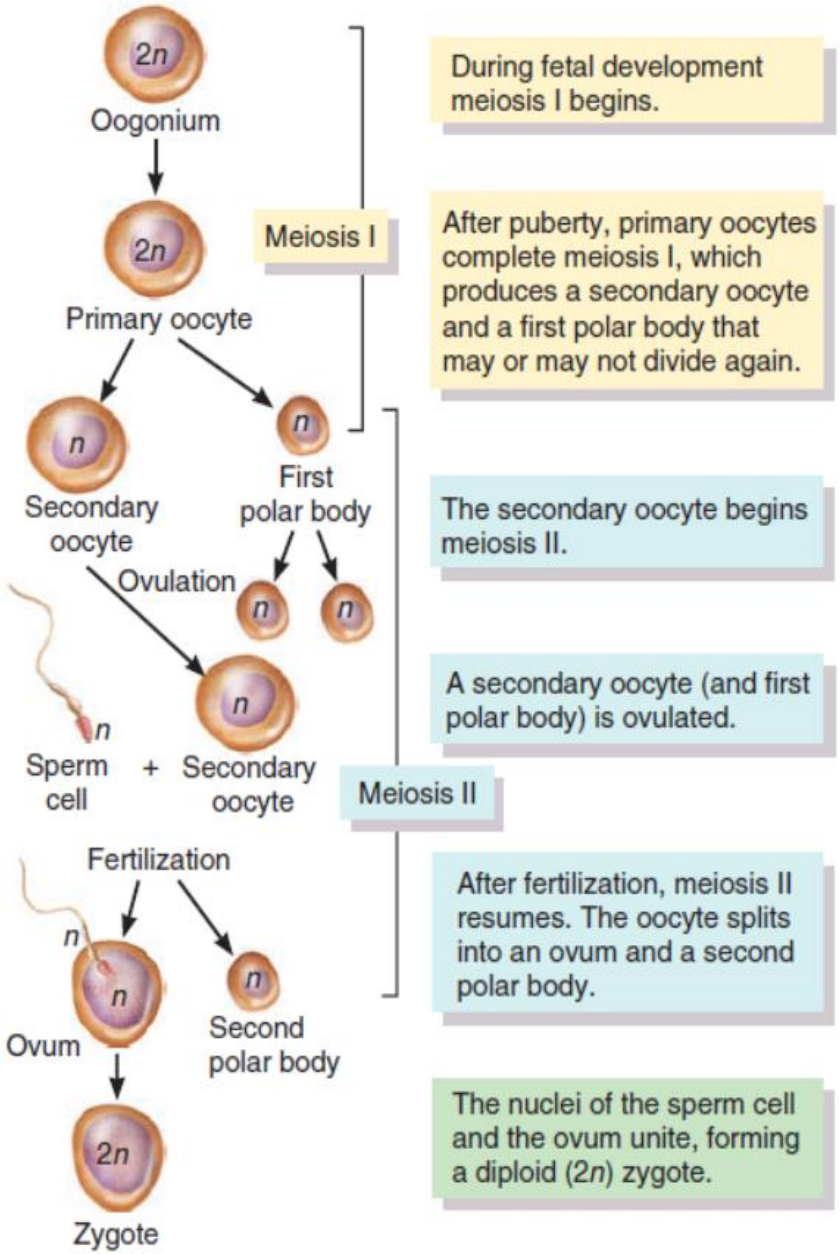
➢One of the daughter cells, receives hardly any cytoplasm, is known as the **second polar body**; the other daughter cell is the definitive oocyte.

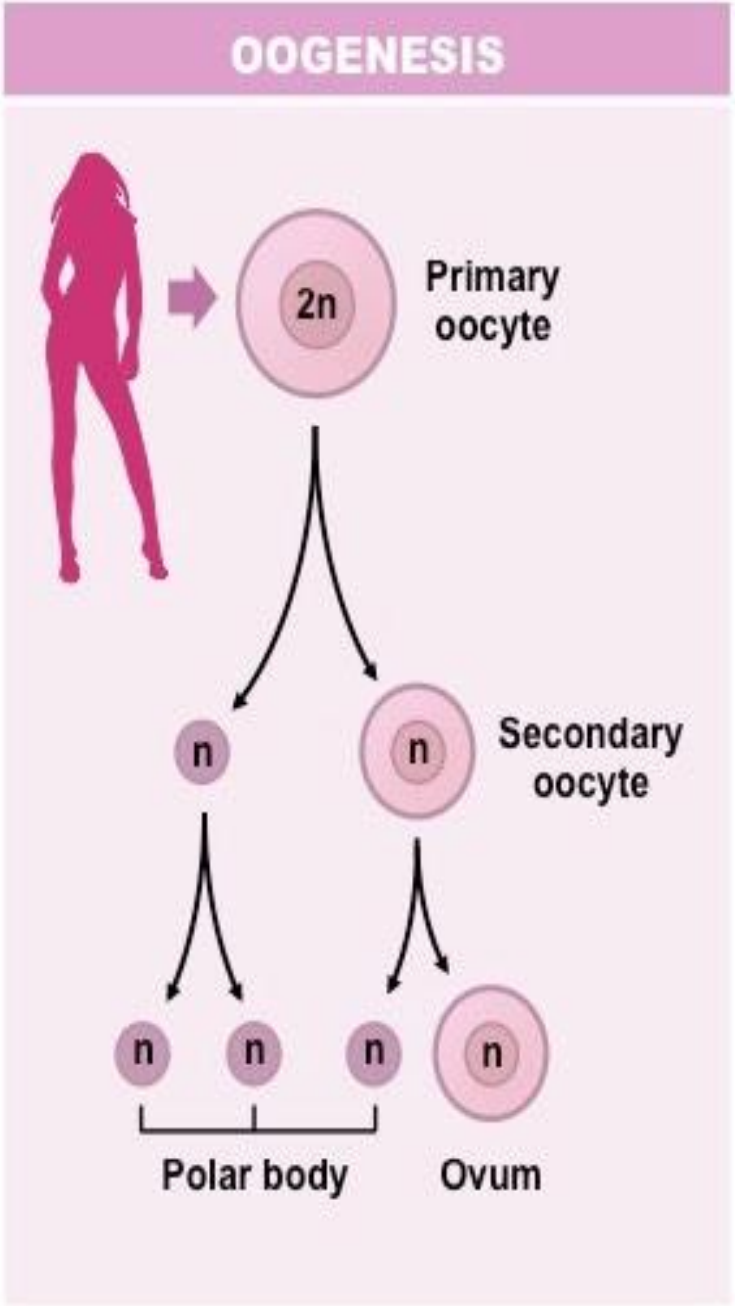
➢ Its chromosomes **(22plus X)** arrange themselves in a vesicular nucleus known as the **female pronucleus**.

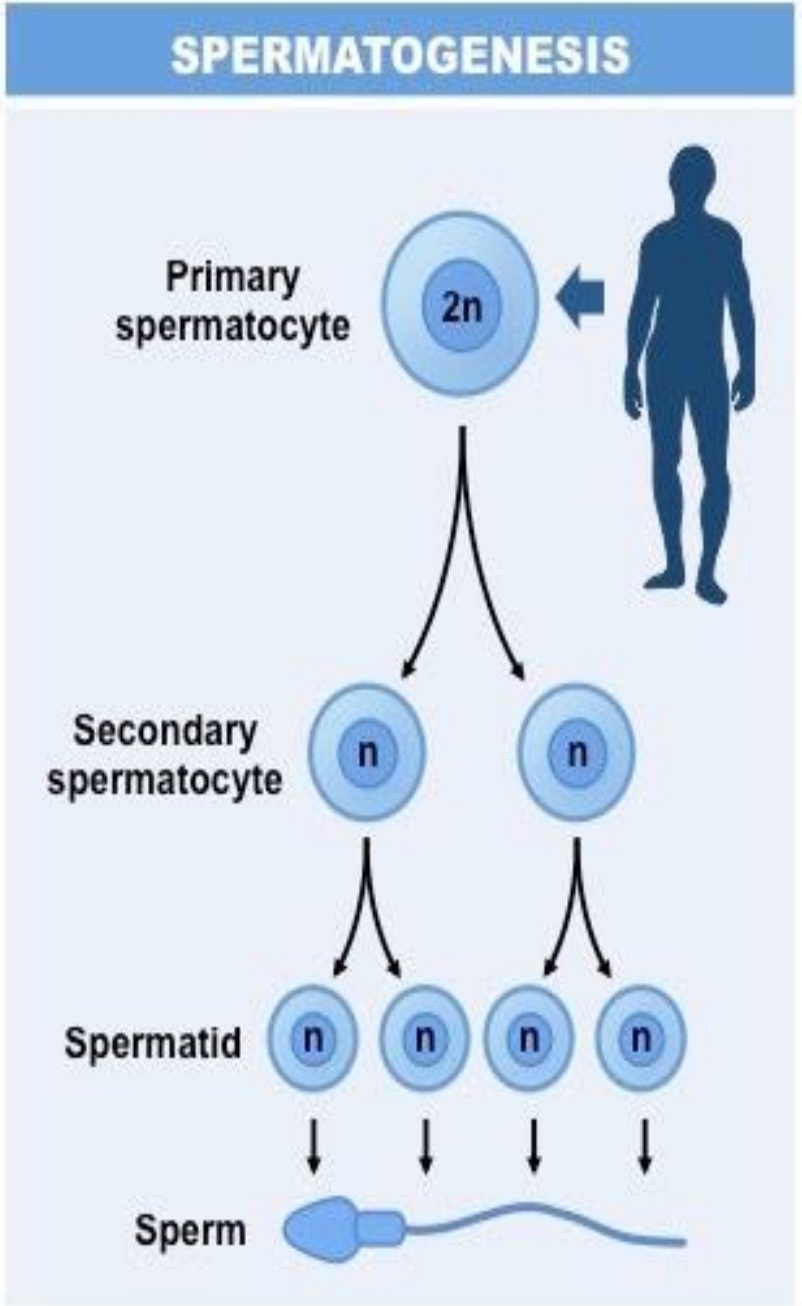
➢The spermatozoon, meanwhile, moves forward until it lies close to the female pronucleus. Its nucleus becomes swollen and forms the **male pronucleus**.



Only now the oogenesis of this oocyte has come to its end


2n
Oogonium
2n
Primary oocyte
Meiosis I
n
Secondary oocyte
n
First polar body
Ovulation
n
n
n
Sperm cell
+
Secondary oocyte
Meiosis II
Fertilization
n
n
Ovum
n
Second polar body
2n
Zygote
During fetal development meiosis I begins.
After puberty, primary oocytes complete meiosis I, which produces a secondary oocyte and a first polar body that may or may not divide again.
The secondary oocyte begins meiosis II.
A secondary oocyte (and first polar body) is ovulated.
After fertilization, meiosis II resumes. The oocyte splits into an ovum and a second polar body.
The nuclei of the sperm cell and the ovum unite, forming a diploid (2n) zygote.


OOGENESIS
2n
Primary oocyte
n
n
Secondary oocyte
n
n
n
n
Polar body
Ovum


SPERMATOGENESIS
Primary spermatocyte
2n
Secondary spermatocyte
n
n
Spermatid
n
n
n
n
Sperm

C) Metabolic activation of the egg

- The activating factor is probably carried by the spermatozoon

- Activation encompasses the initial cellular and molecular events associated with early embryogenesis.

The main results of fertilization are as follows:

➢ ***Restoration of the diploid number of chromosomes***, half from the father and half from the mother. Hence, the zygote contains a new combination of chromosomes different from both parents.

➢ ***Determination of the sex of the new individual***.
An X-carrying sperm produces a female (XX) embryo, and a Y-carrying sperm produces a male (XY) embryo. Therefore, the chromosomal sex of the embryo is determined at fertilization

Initiation of cleavage.
Without fertilization, the oocyte usually degenerates 24 hours after ovulation.

IF No sperm

oocyte is NOT fertilized;

the cell degenerates approximately 24 hours after ovulation.

OOGENESIS

- Primordial germ cells arrive in the indifferent gonad at week 4 and differentiate into oogonia.
- Oogonia enter meiosis I to form **primary oocytes**. All primary oocytes are formed by **month 5 of fetal life** and are **arrested the first time in prophase (diplotene) of meiosis I** and remain arrested until puberty.
- Primary oocyte arrested in meiosis I are present at birth.
- When a girl reaches puberty, during each monthly cycle a primary oocyte becomes unarrested and completes meiosis I to form a secondary oocyte and polar body.
- The secondary oocyte becomes **arrested the second time in metaphase of meiosis II** and is ovulated.
- At fertilization within the uterine tube, the secondary oocyte completes meiosis II to form a **mature oocyte** and **polar body.**