

GAMETOGENESIS

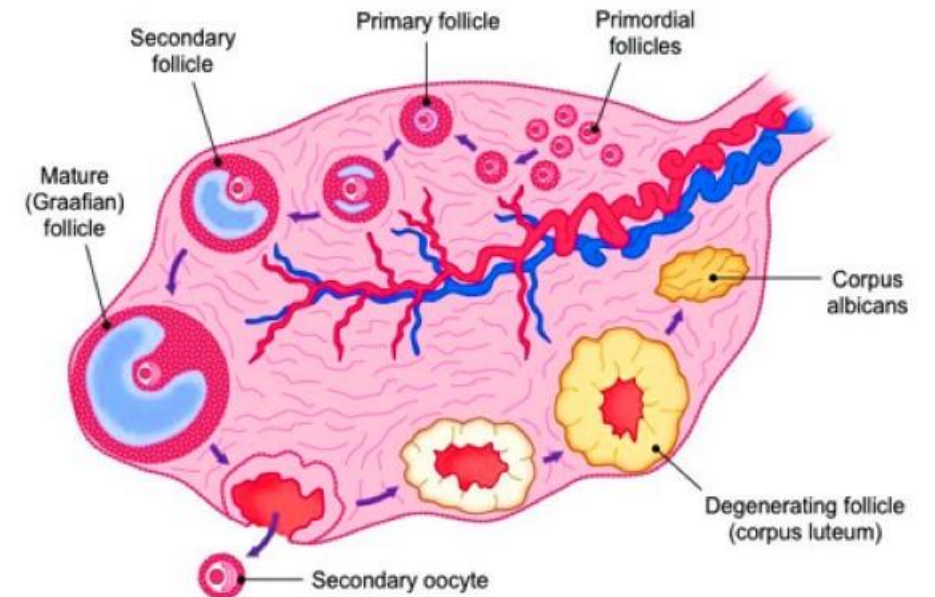
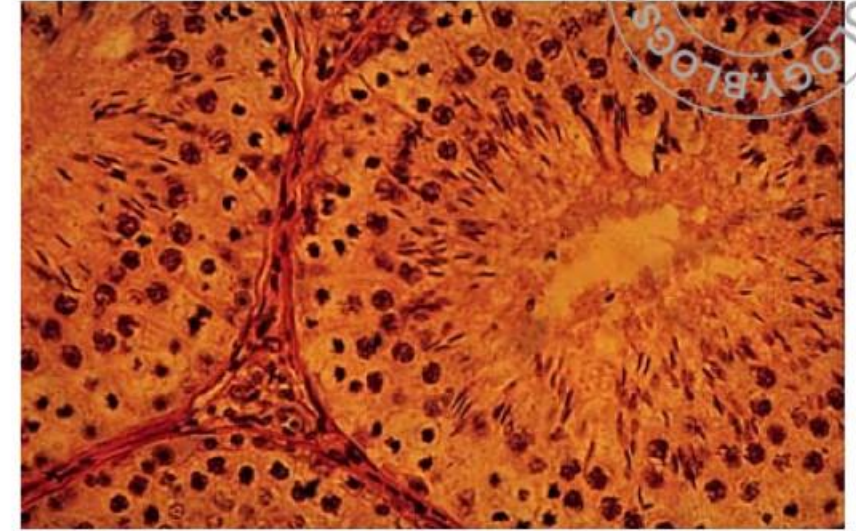
GAMETOGENESIS

It is the formation of gametes in the gonads.

TYPES OF GAMETOGENESIS

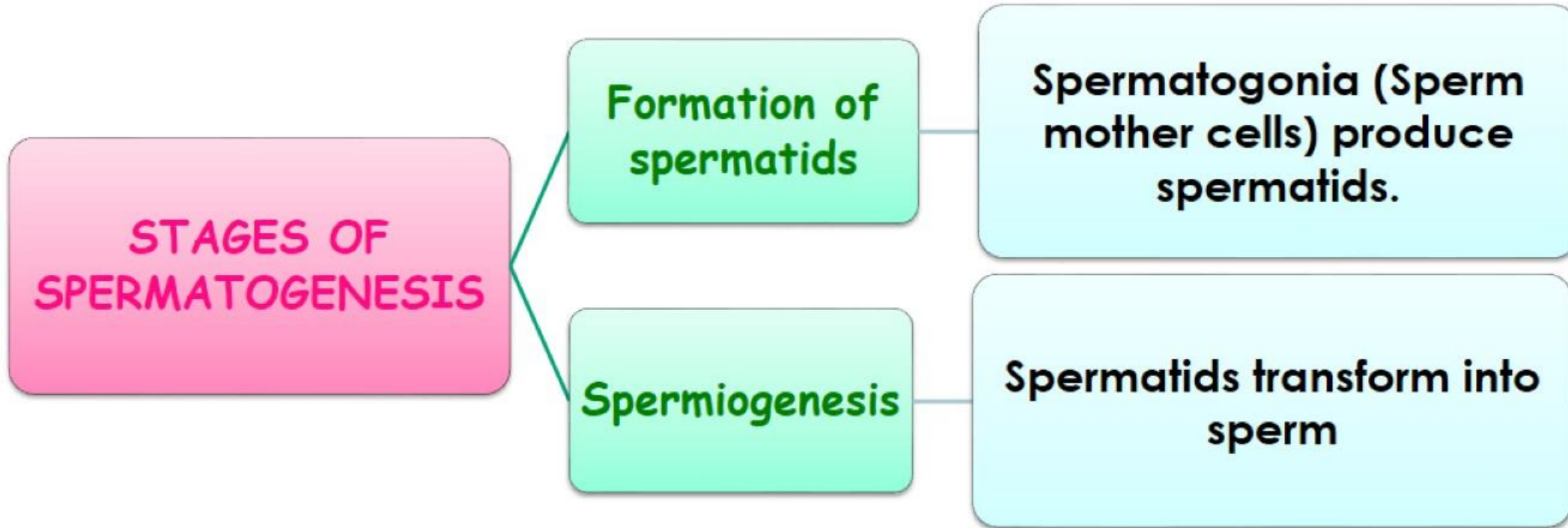
SPERMATOGENESIS
(Formation of sperms)

OOGENESIS
(Formation of ovum)



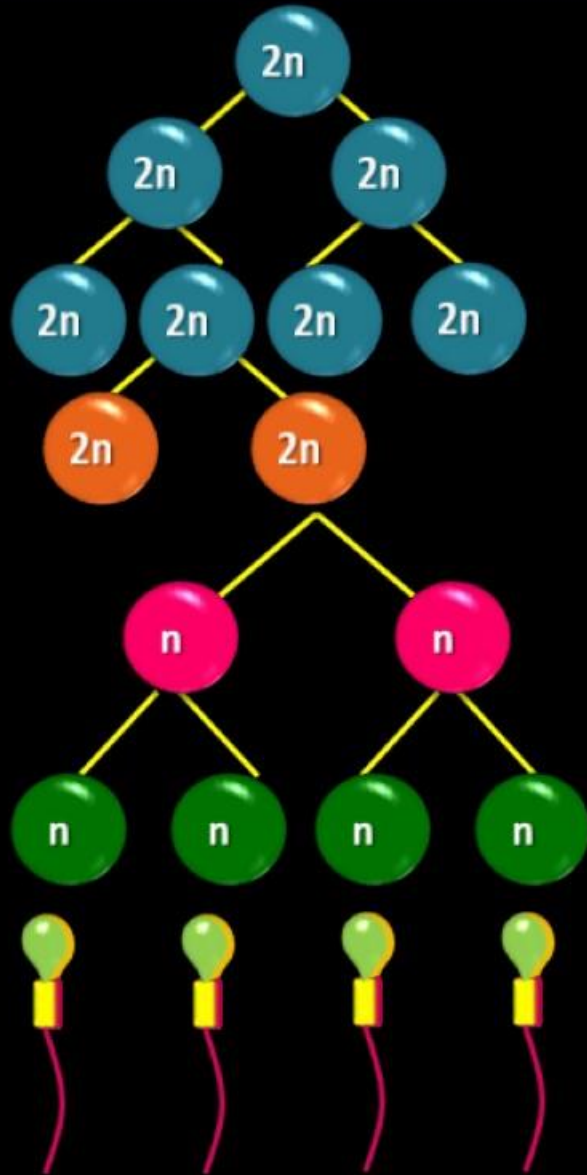


It is the process of formation of sperms (spermatozoa) in seminiferous tubules of testis.



GAMETOGENESIS

1. SPERMATOGENESIS



Spermatogonia (2n)

Mitosis

Primary spermatocytes (2n)

Meiosis I

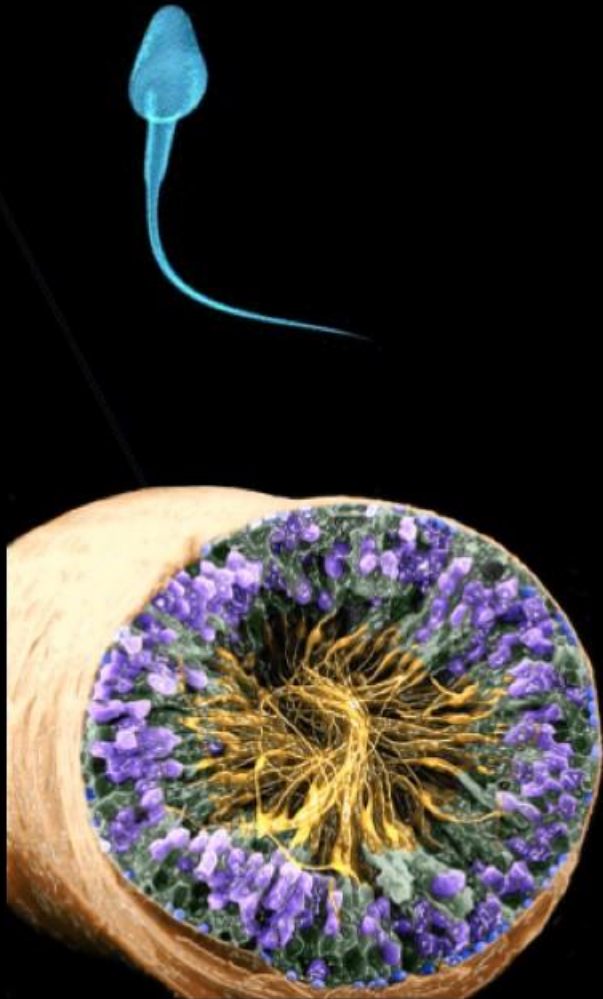
Secondary spermatocytes (n)

Meiosis II

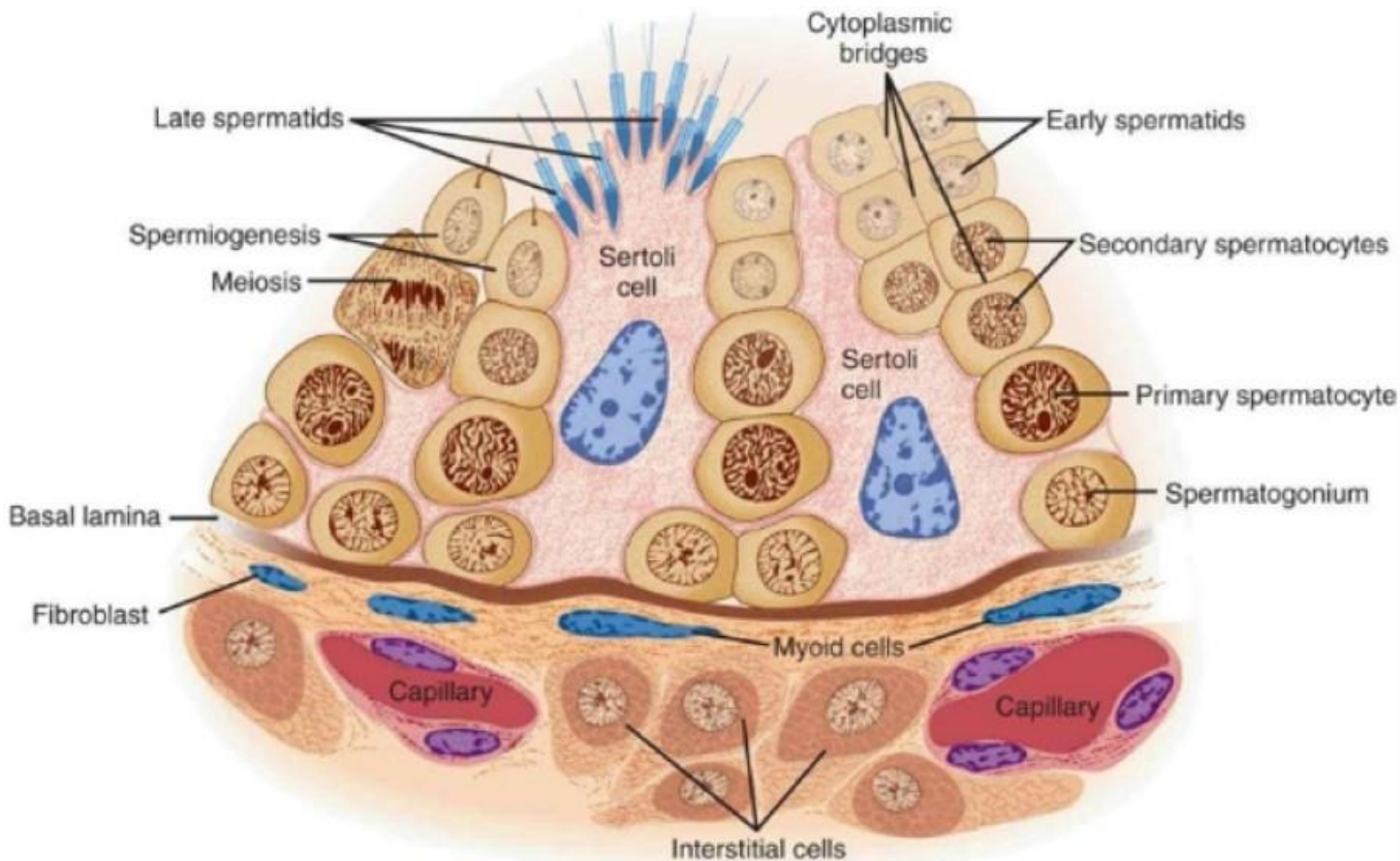
Spermatids (n)

Spermiogenesis

Spermatozoa (n)



Seminiferous tubule: Cross section



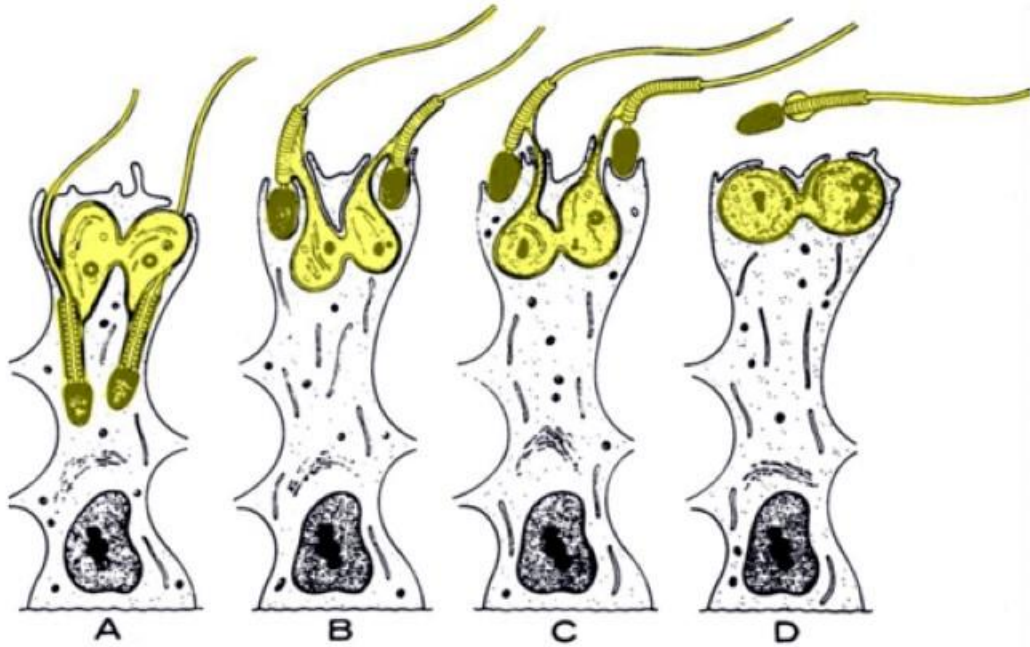
A portion of Seminiferous tubule

**A primary spermatocyte →
2 sec. spermatocytes (n).**

**A sec. spermatocyte →
2 spermatids (n).**

Thus

**A primary spermatocyte
↓
4 spermatids/4 sperms**

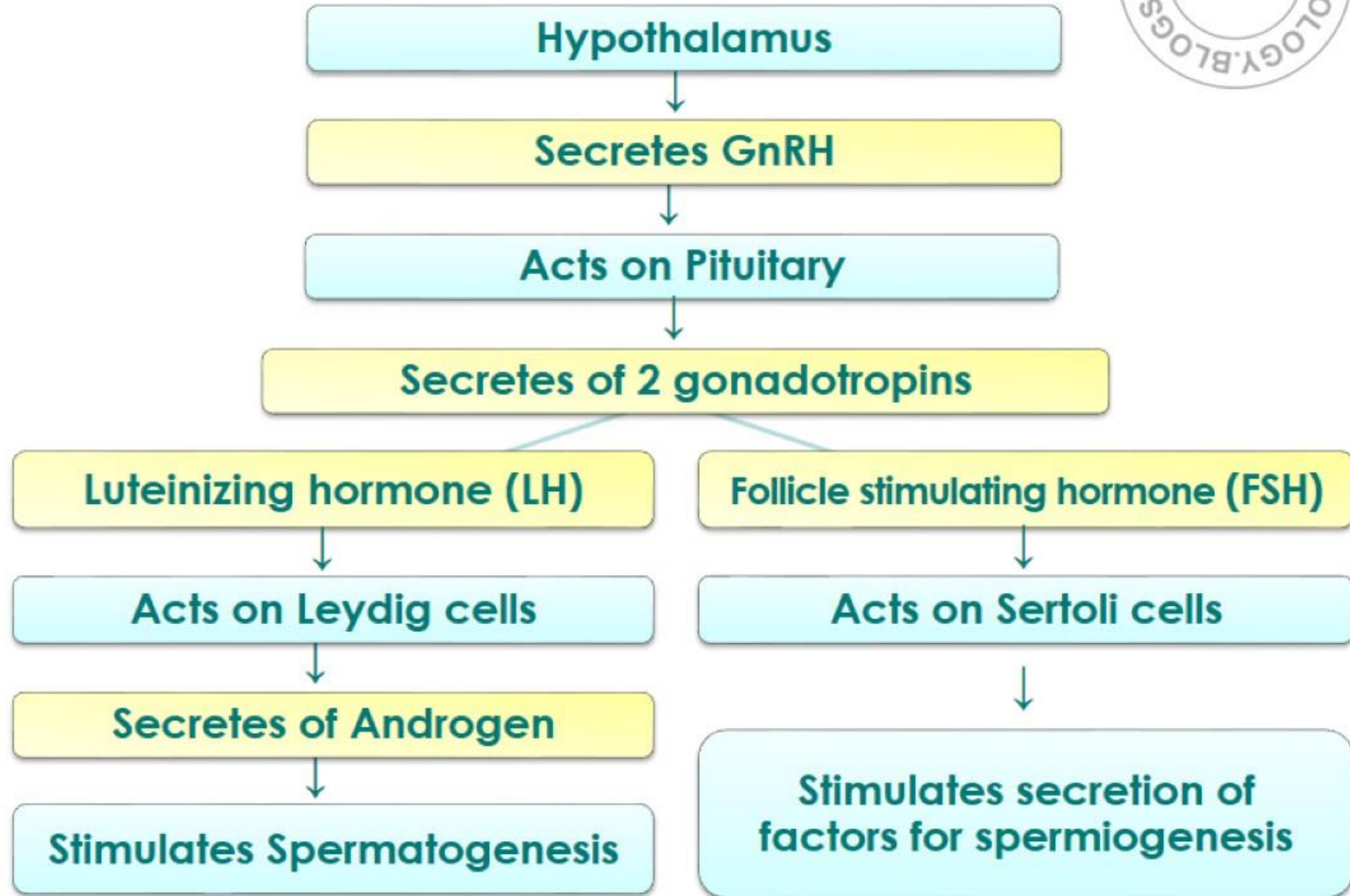


SPERMATION

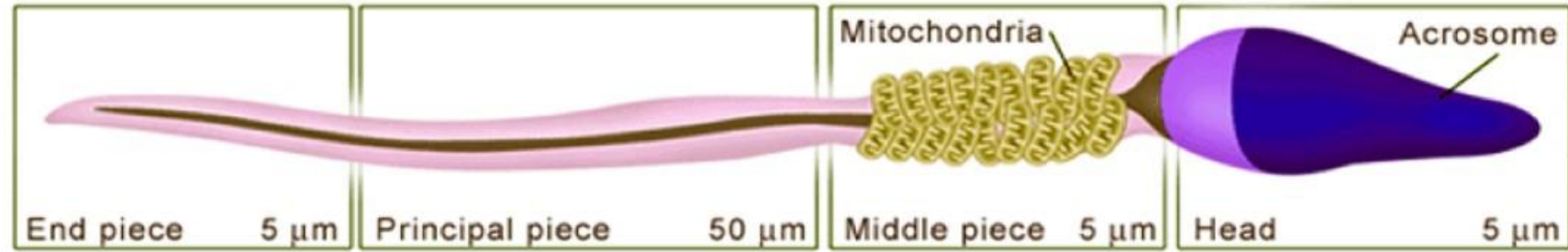
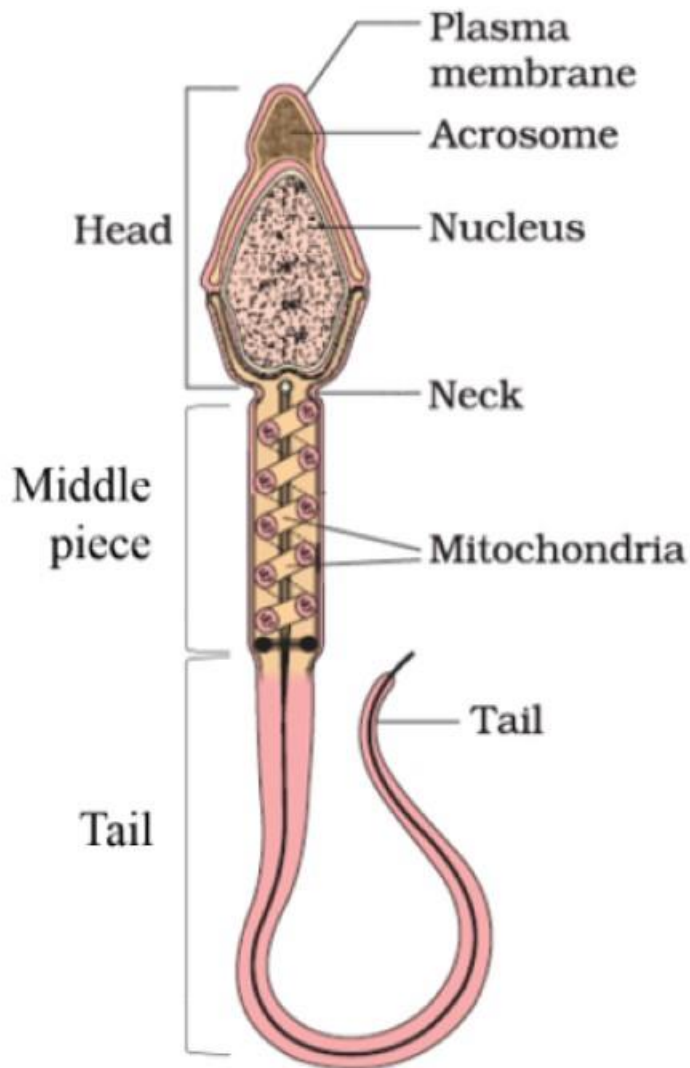


- After spermiogenesis, sperm heads are embedded in the Sertoli cells to get nourishment. Then they are released to lumen of seminiferous tubules. It is called **spermiation**.

Role of Hormones in Spermatogenesis

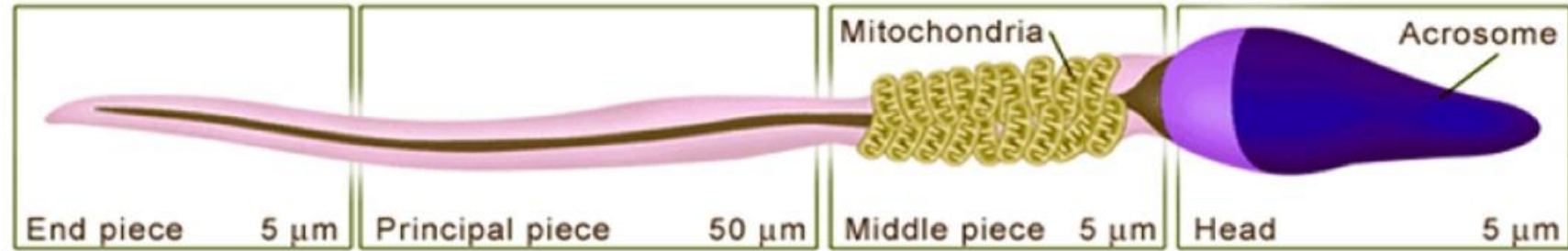
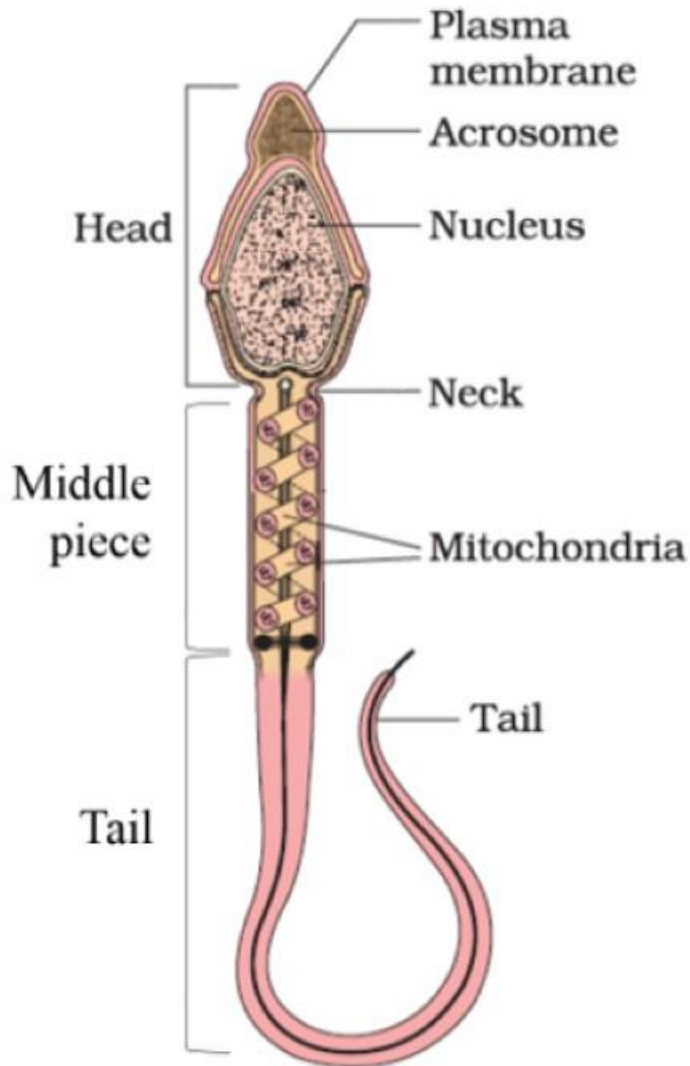


Structure of spermatozoa (Sperm)



- ❑ A mature sperm is about **60 μ (0.06 mm) long.**
- ❑ Sperm is enveloped by a plasma membrane.
- ❑ A sperm has 3 regions:
 - ❑ **Head**
 - ❑ **Middle piece**
 - ❑ **Tail**

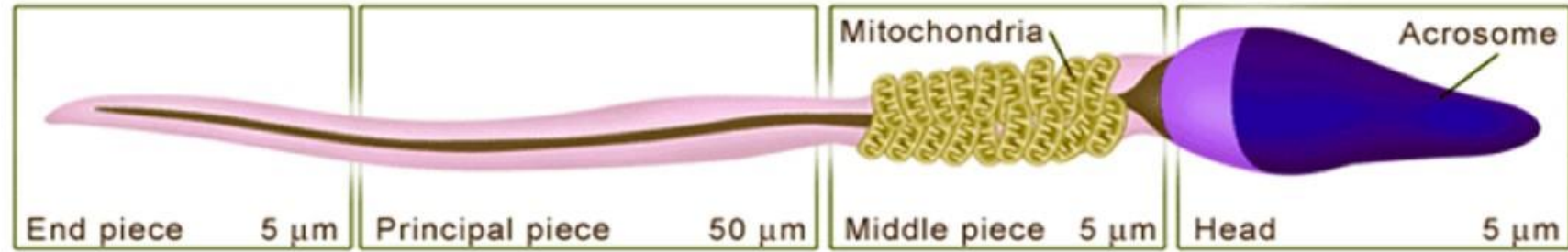
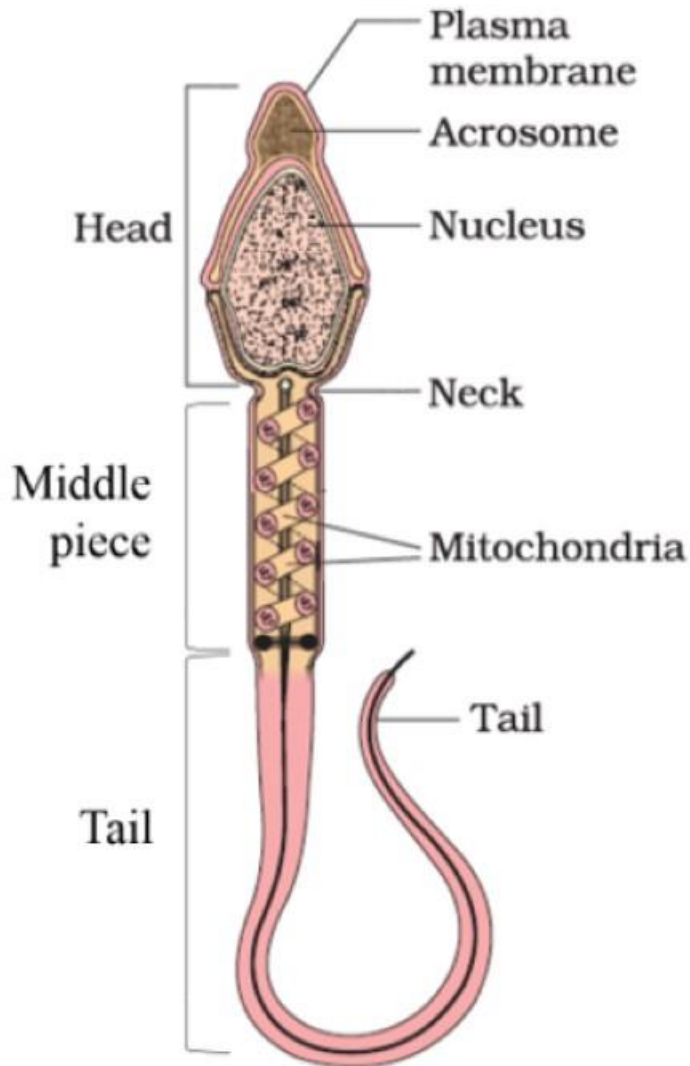
Structure of spermatozoa (Sperm)



Head

- ❑ Oval shaped.
- ❑ Formed of **nucleus & acrosome**.
- ❑ **Acrosome** is formed from **Golgi complex**. It contains **lytic enzymes**.
- ❑ Behind the head is a neck.

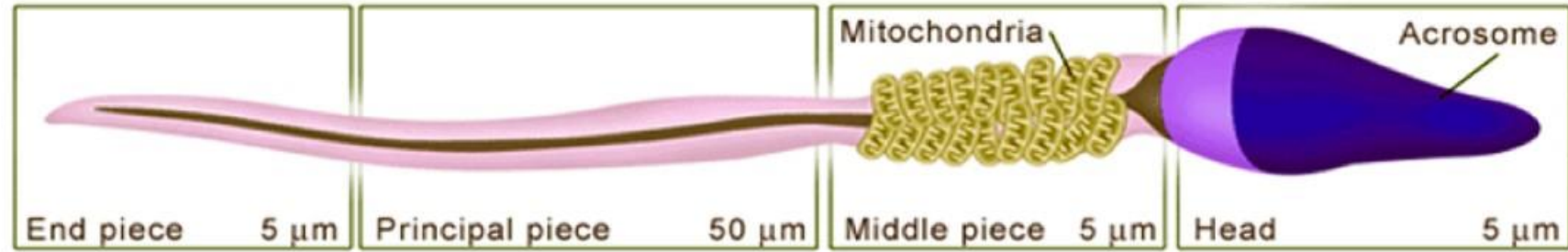
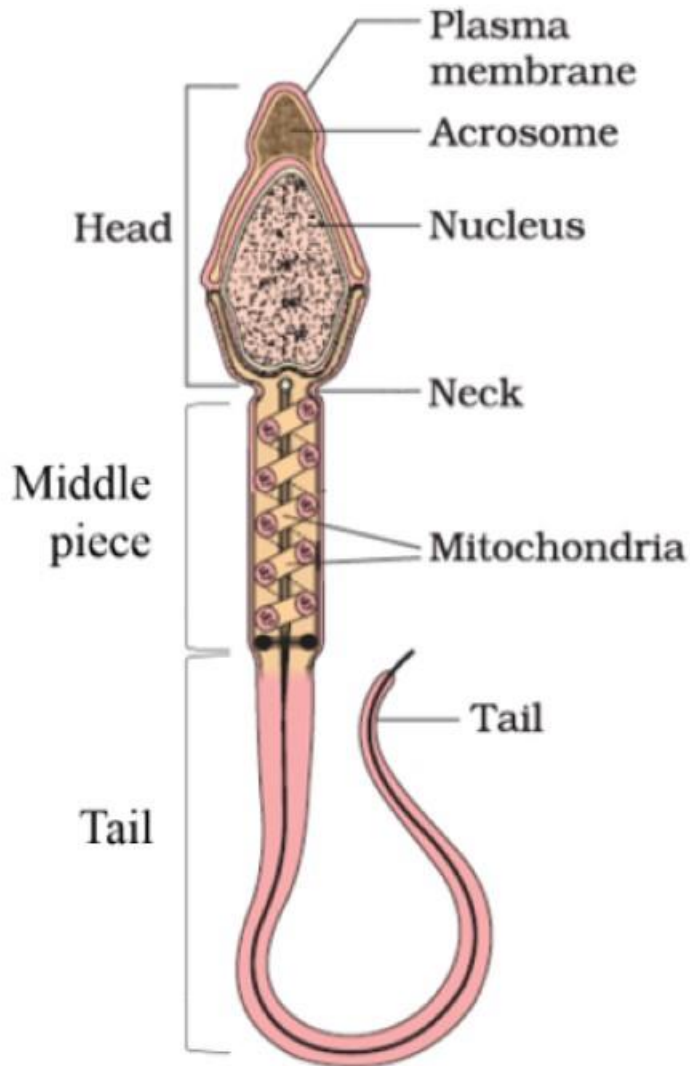
Structure of spermatozoa (Sperm)



Middle piece

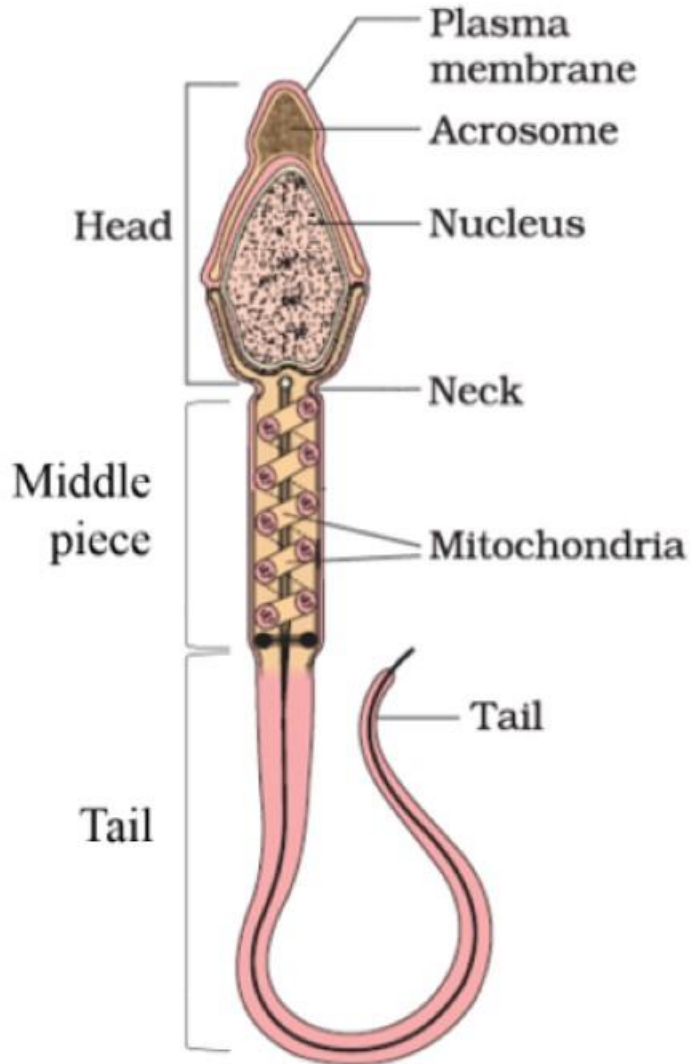
- ❑ Composed of **axial filament** surrounded by **mitochondria & cytoplasm**.
- ❑ Mitochondria produce **energy** for the **sperm motility**.

Structure of spermatozoa (Sperm)

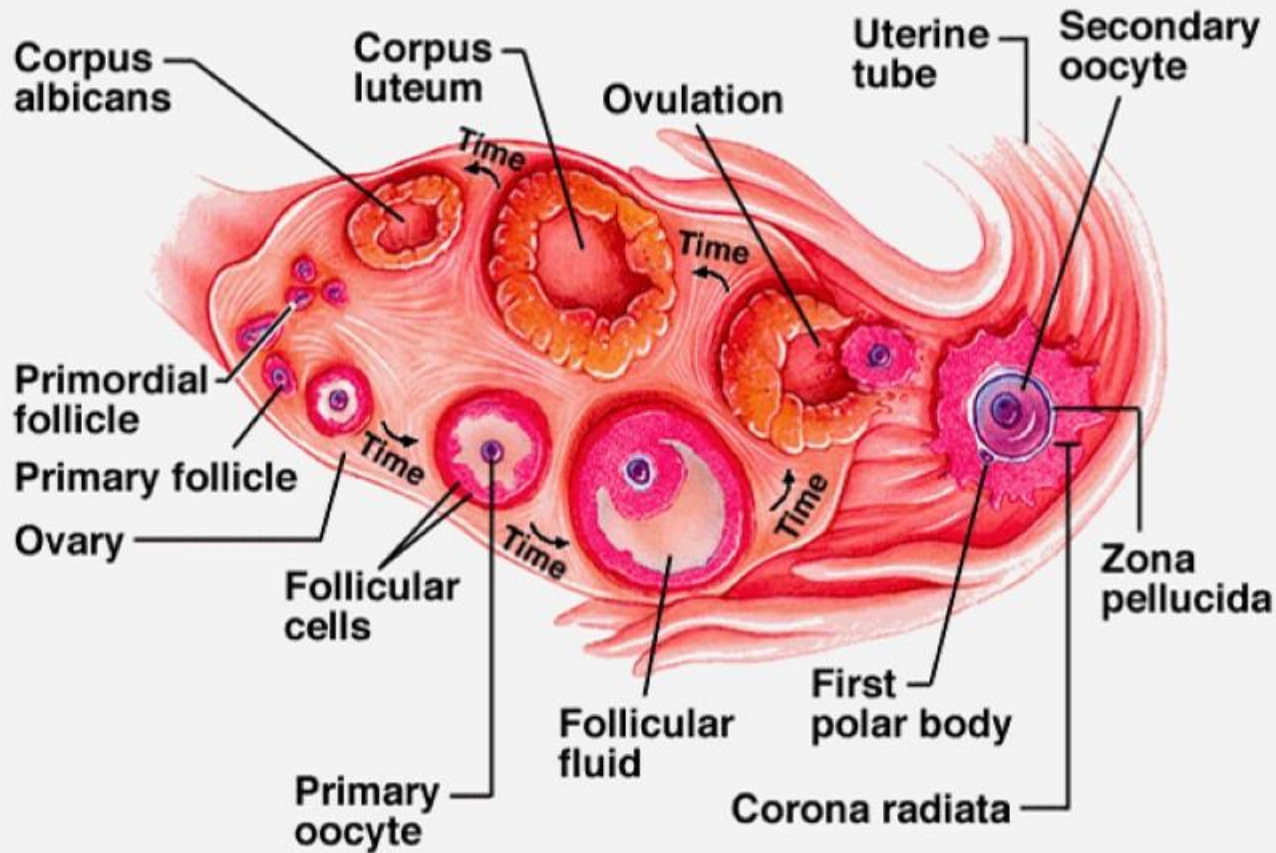


Tail

- ❑ Consists of a **central axial filament**.
- ❑ The sperm moves in fluid medium and female genital tract by the undulating movement of the tail.



- ✓ The human male ejaculates about **200-300 million sperms** during a coitus.
- ✓ For normal fertility, at least **60% sperms** must have normal shape and size. **40%** of them must show vigorous motility.



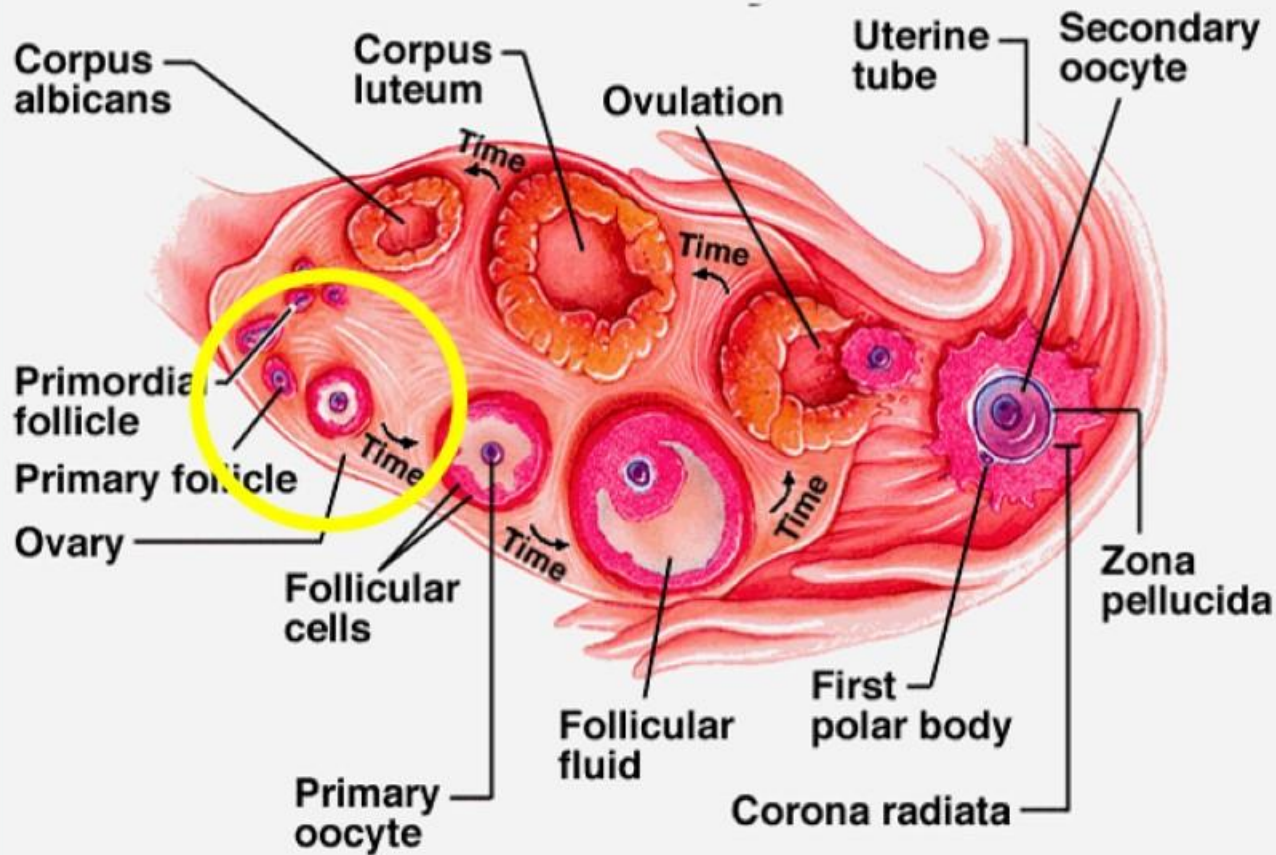
- It is the formation & maturation of **ovum**.

- It takes place in **Graafian follicles**.

- Oogenesis is initiated in embryonic stage when millions of **egg mother cells (oogonia)** are formed within ovary.

- No more oogonia are formed and added after birth.

- Oogonia multiply to form **primary oocytes**. They enter **prophase-I** of the meiosis and get temporarily arrested at that stage.



- Each primary oocyte gets surrounded by a layer of **granulosa cells** to form **primary follicle**.

- Many primary follicles degenerate during the phase from birth to puberty. Therefore, at puberty, only **60,000-80,000** primary follicles are left in each ovary.

Development of ovarian follicle

Primary follicle



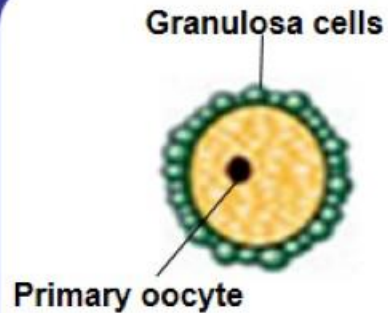
Secondary follicle



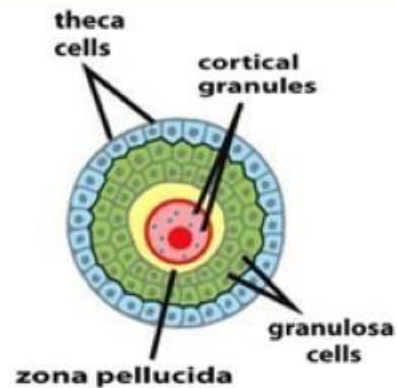
Tertiary follicle



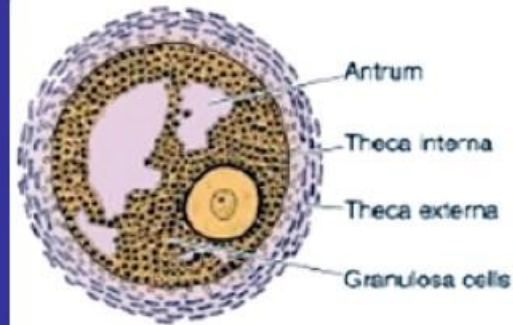
Graafian follicle



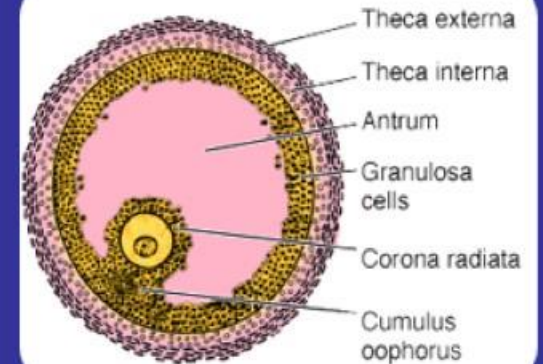
A layer of granulosa cells surrounding a primary oocyte.



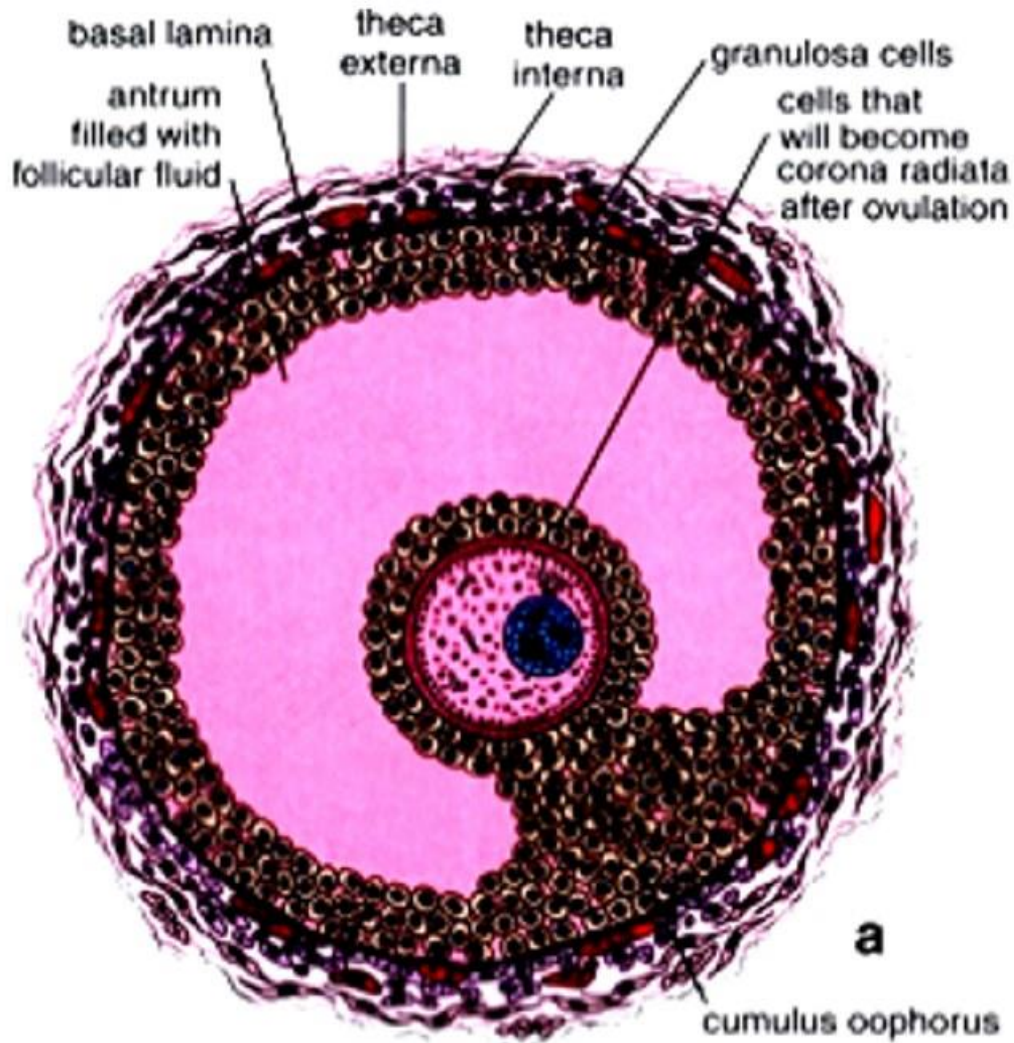
More layers of granulosa cells and a new theca surrounding a primary oocyte.



Fluid filled cavity (antrum) develops. Theca layer forms inner theca interna & outer theca externa.

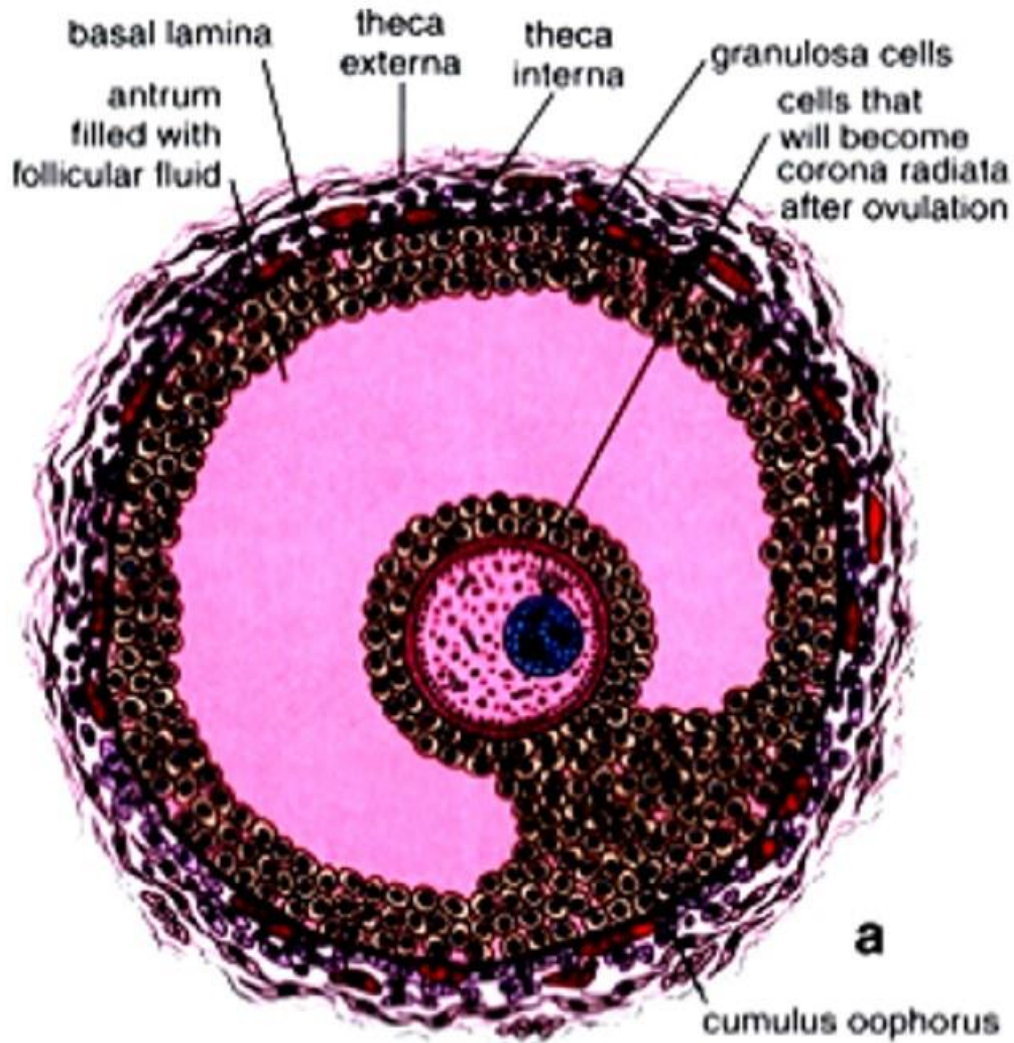


Fully matured follicle



MATURE GRAAFIAN FOLLICLE

- The primary oocyte in tertiary follicle grows and undergoes first unequal meiotic division to form a large **haploid secondary oocyte** and a tiny **first polar body**.
- So, secondary oocyte retains the nutrient rich cytoplasm of the primary oocyte.
- It is unknown that whether the first polar body divides further or degenerates.



MATURE GRAAFIAN FOLLICLE

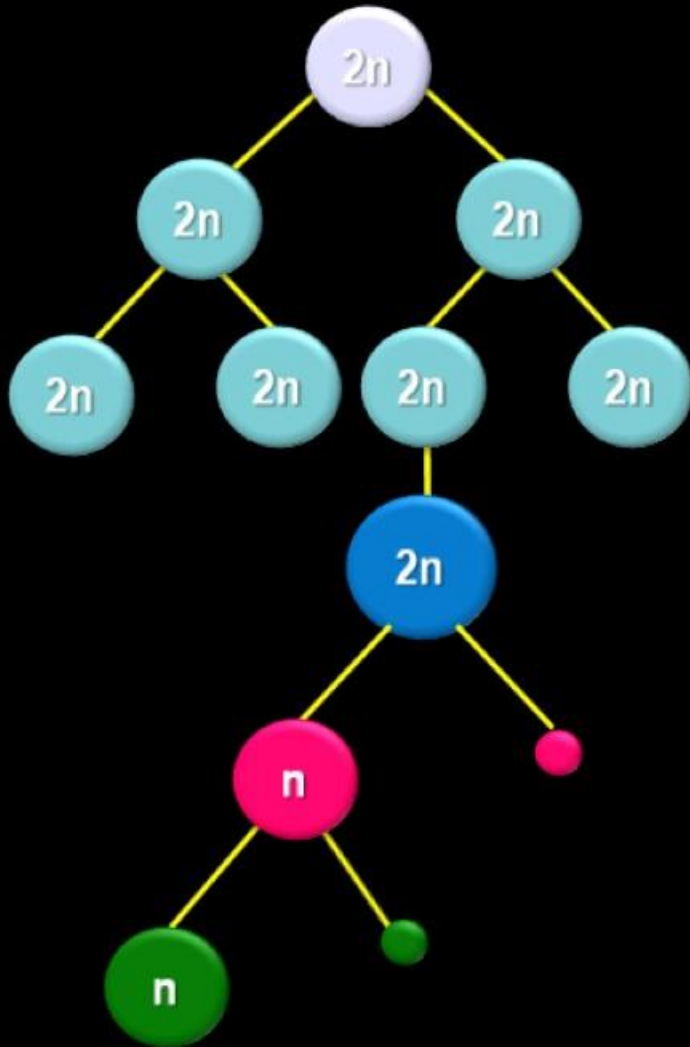
- The tertiary follicle further changes into the **mature follicle (Graafian follicle)**.

- Secondary oocyte forms a new membrane (**zona pellucida**).

- Graafian follicle now ruptures to release the **secondary oocyte (ovum)** from the ovary. This is called **ovulation**.

GAMETOGENESIS

2. OOGENESIS: STEPS



Oogonia (2n) (Diploid, 46 chromosomes)

Mitosis (embryonic stage)

Primary oocyte (2n)

Grow in size

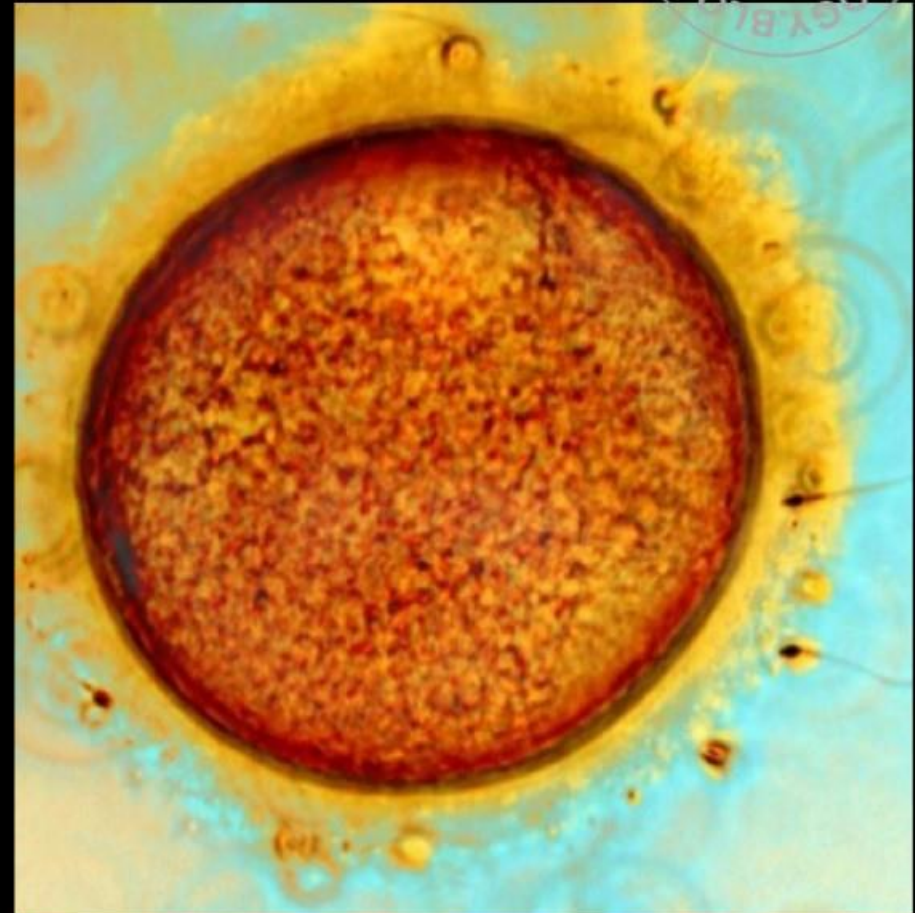
Primary oocyte (2n)

Meiosis I ↓ (prior to ovulation)

Secondary oocytes (n) & first polar body (n)

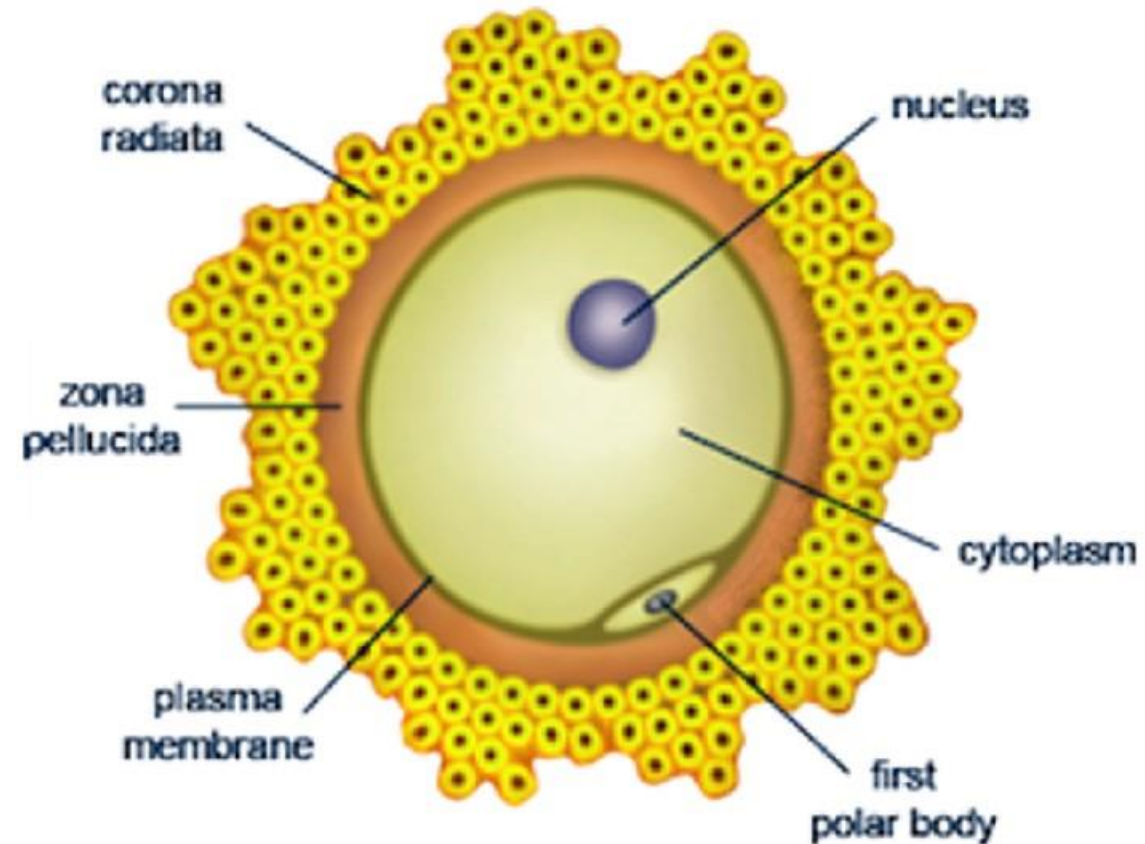
Meiosis II ↓ (During fertilization)

Ootid (ovum-n) & second polar body (n)

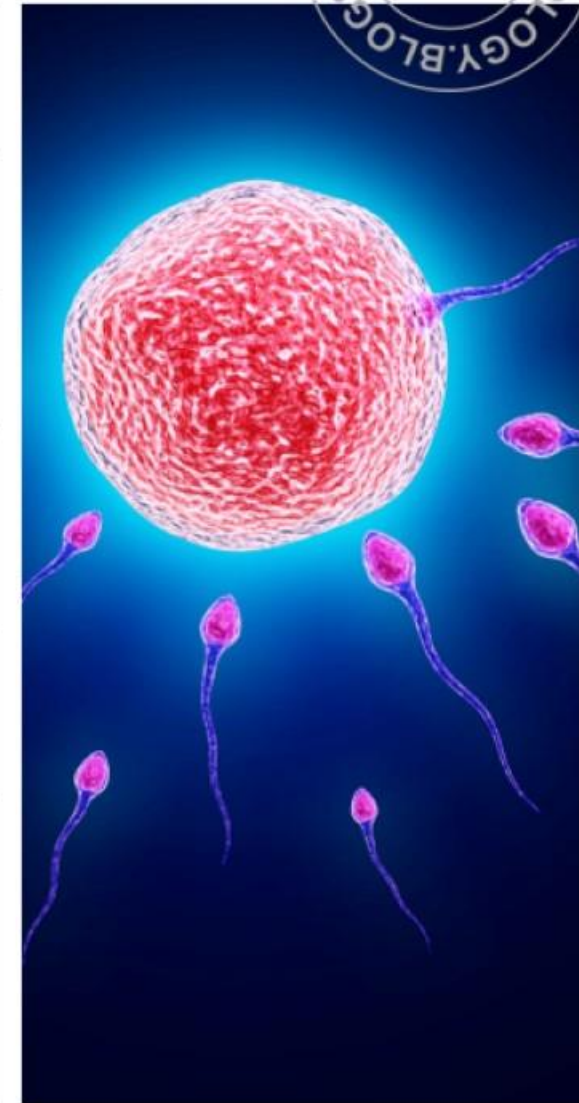


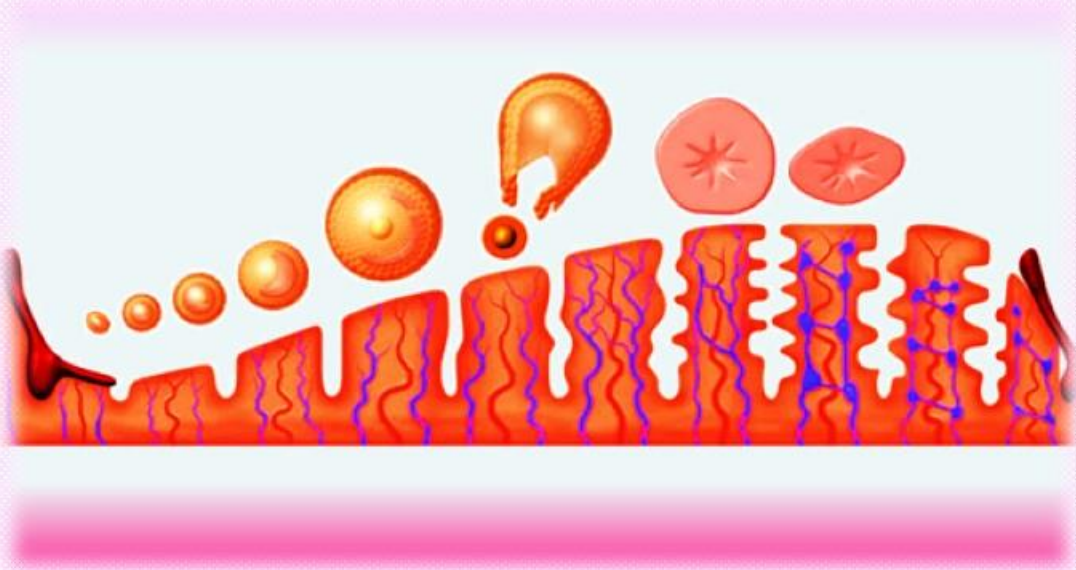
Ovum

- Spherical and **non-motile**.
- **Size:** About **0.2 mm** in diameter.
- Ovum has 3 membranes:
 - ❖ **Plasma membrane (Oolemma):** Innermost layer.
 - ❖ **Zona pellucida:** Outer to the plasma membrane.
 - ❖ **Corona radiata:** Outer layer formed of **follicle cells**.



Spermatogenesis	Oogenesis
Occurs in testis.	Occurs in ovary.
Limited growth phase.	Elaborated growth phase.
Each primary spermatocyte gives 4 sperms.	Each primary oocyte gives only one ovum.
No polar body formation.	Polar bodies are formed.
Begins at puberty and extends up to senility.	Begins at embryonic stage but suspends up to the puberty. It ceases around the age of 50.





MENSTRUAL CYCLE

MENSTRUAL CYCLE (REPRODUCTIVE CYCLE)



It is the cyclic events starting from one **menstruation** till the next during **reproductive period** (puberty to menopause) of a woman's life.

MENSTRUAL CYCLE (REPRODUCTIVE CYCLE)



**Duration of Menstrual
cycle is
28 or 29 days.**



MENSTRUAL CYCLE (REPRODUCTIVE CYCLE)



Menstrual cycle is also seen in other **primates**.



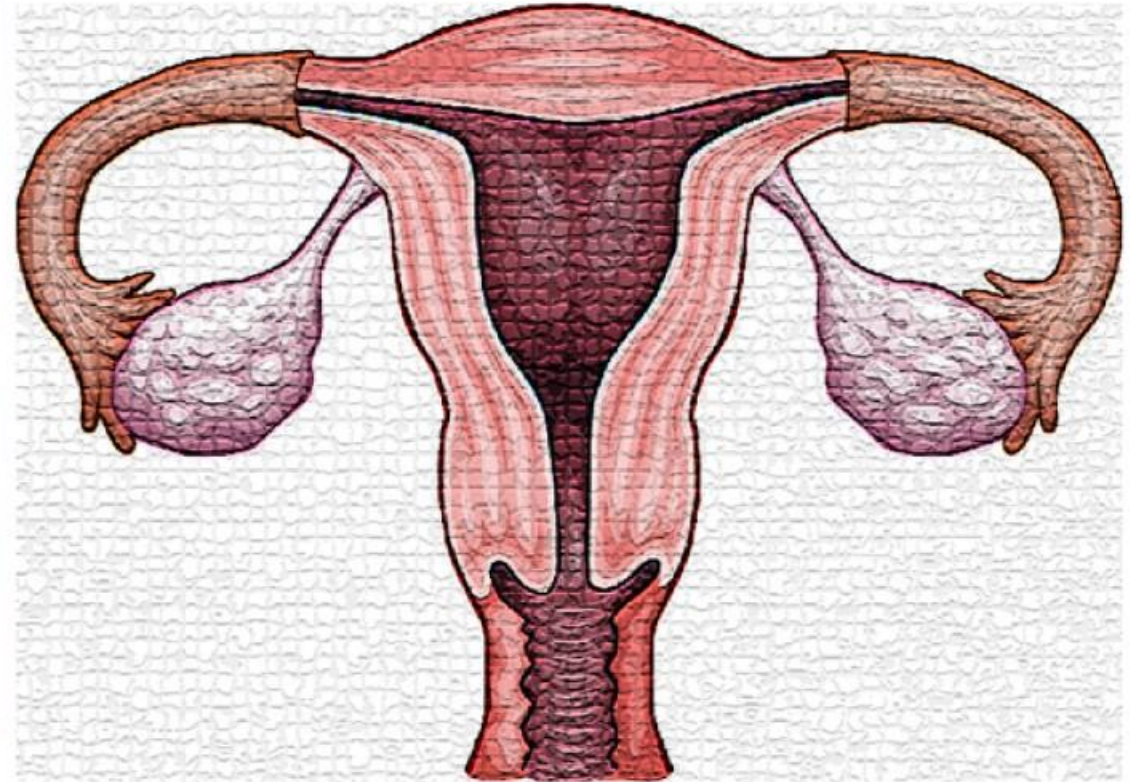
MENSTRUAL CYCLE (REPRODUCTIVE CYCLE)



Events of Menstrual cycle

Ovarian cycle:
Changes in ovary

Uterine cycle:
Changes in uterus,
oviduct and vagina



MENSTRUAL CYCLE (REPRODUCTIVE CYCLE)



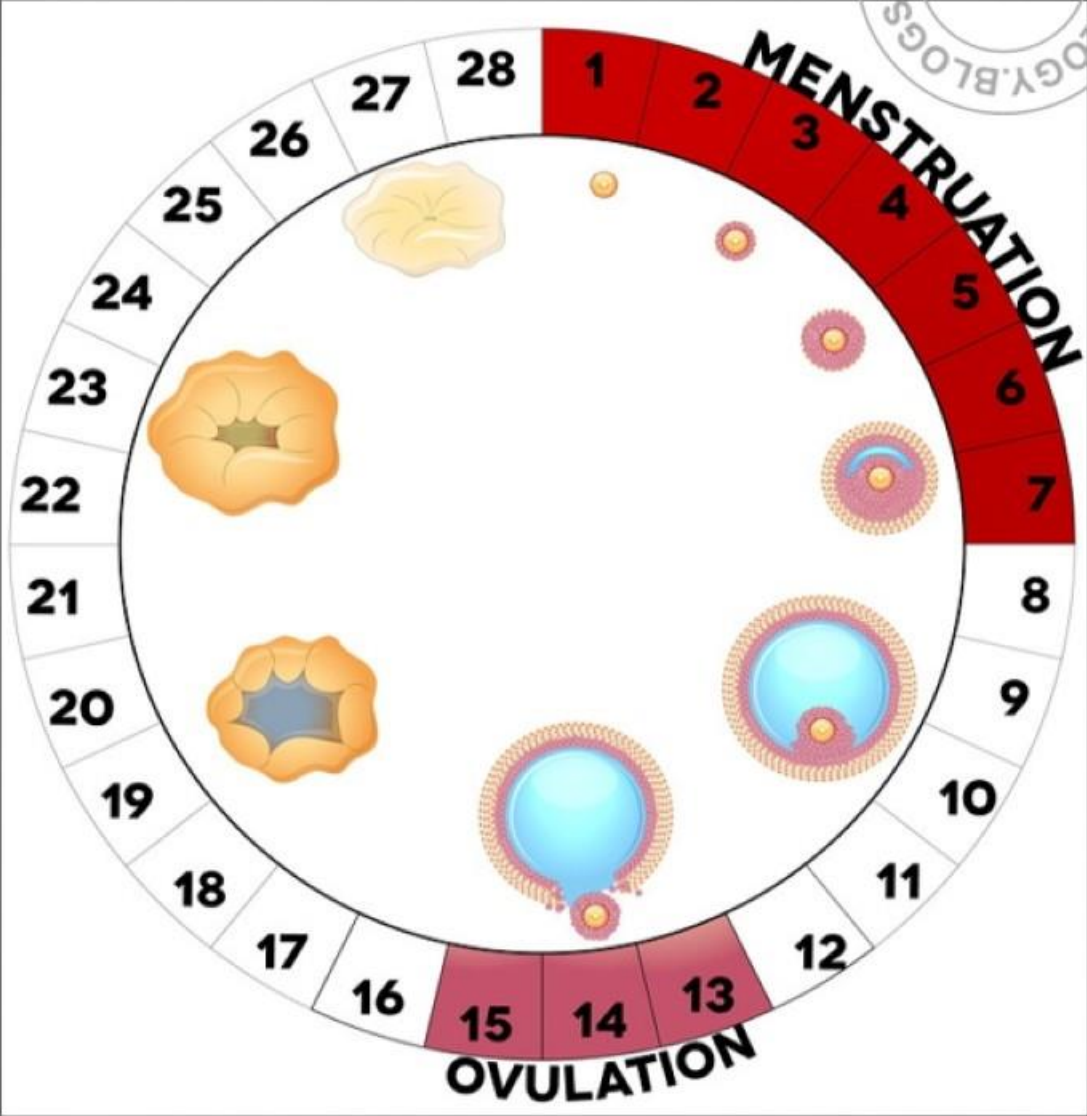
Phases of Menstrual Cycle

Menstrual phase:
1-5th day

Follicular (Proliferative) phase:
5-13th day

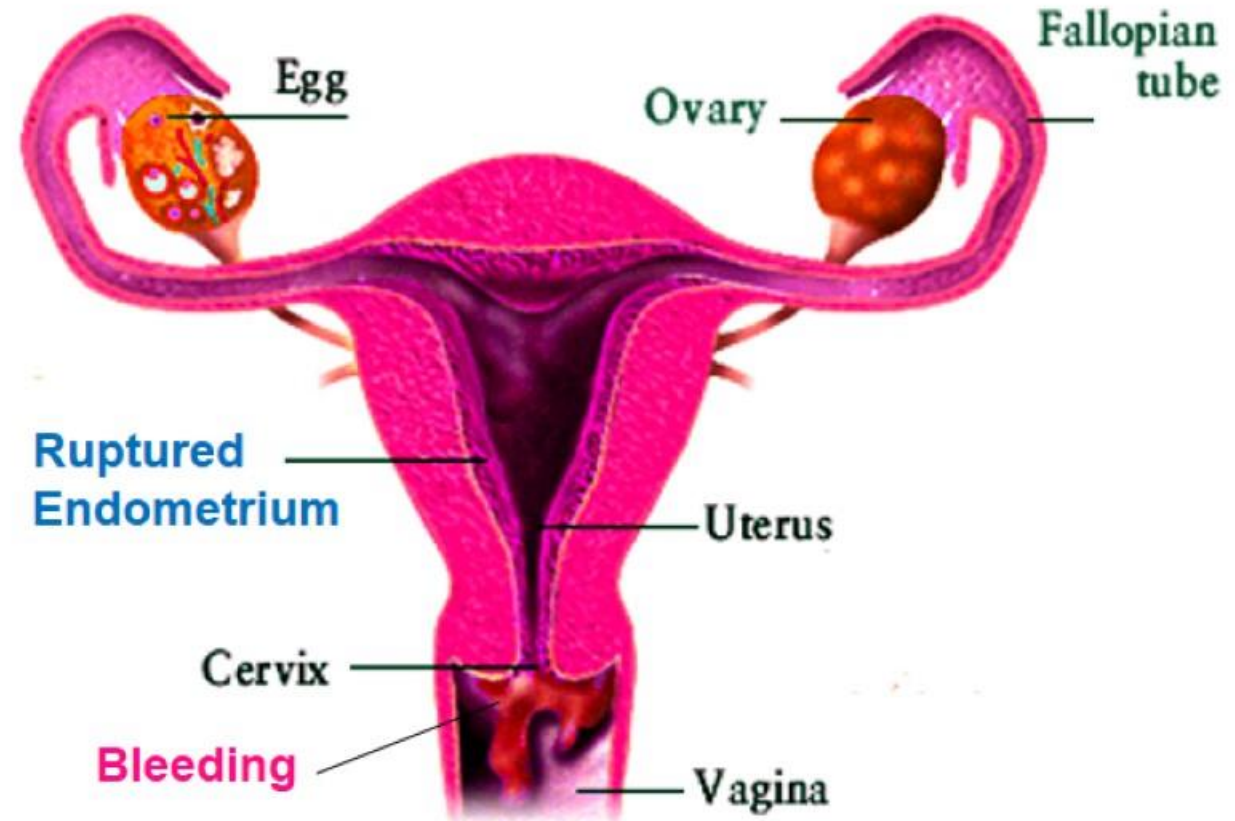
Ovulatory phase:
14th day

Secretory (Luteal) phase:
15-28th day



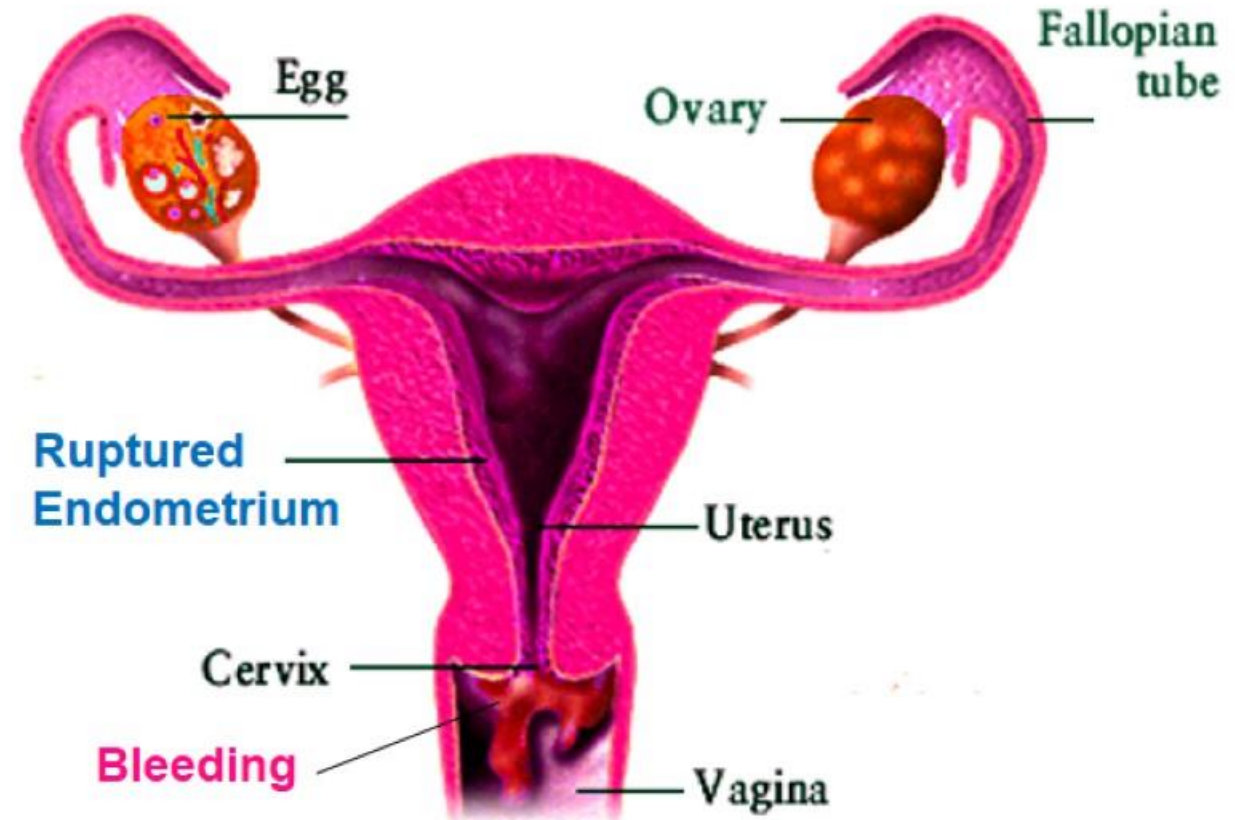
1-5th
day

- The cycle starts with **menstrual flow (bleeding)**.
- It lasts for **3-5 days**.



1-5th
day

- Menstruation occurs if the released ovum is not fertilized. It results in **breakdown of endometrial lining and uterine blood vessels** that comes out through vagina.



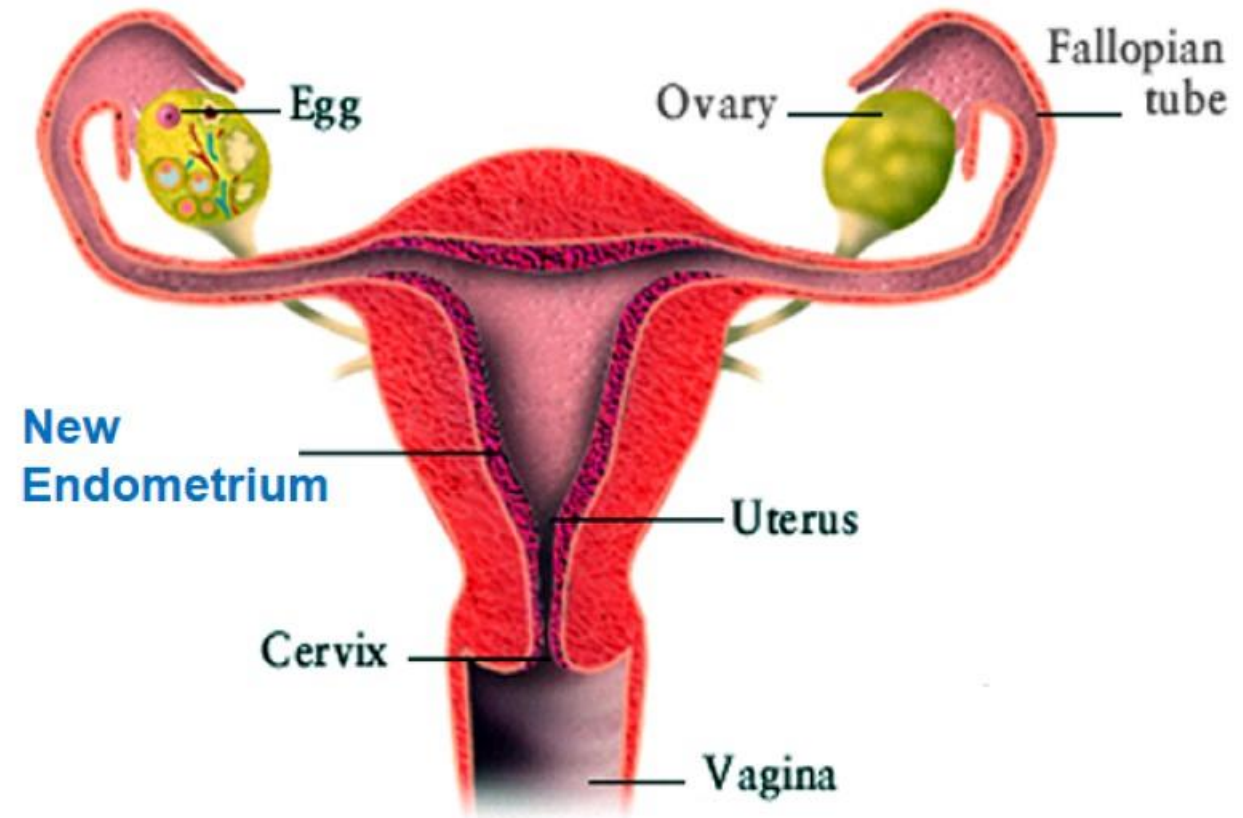
1-5th
day

- Lack of menstruation indicates **pregnancy**.
- It may also be caused due to **stress, poor health etc.**



**5-13th
day**

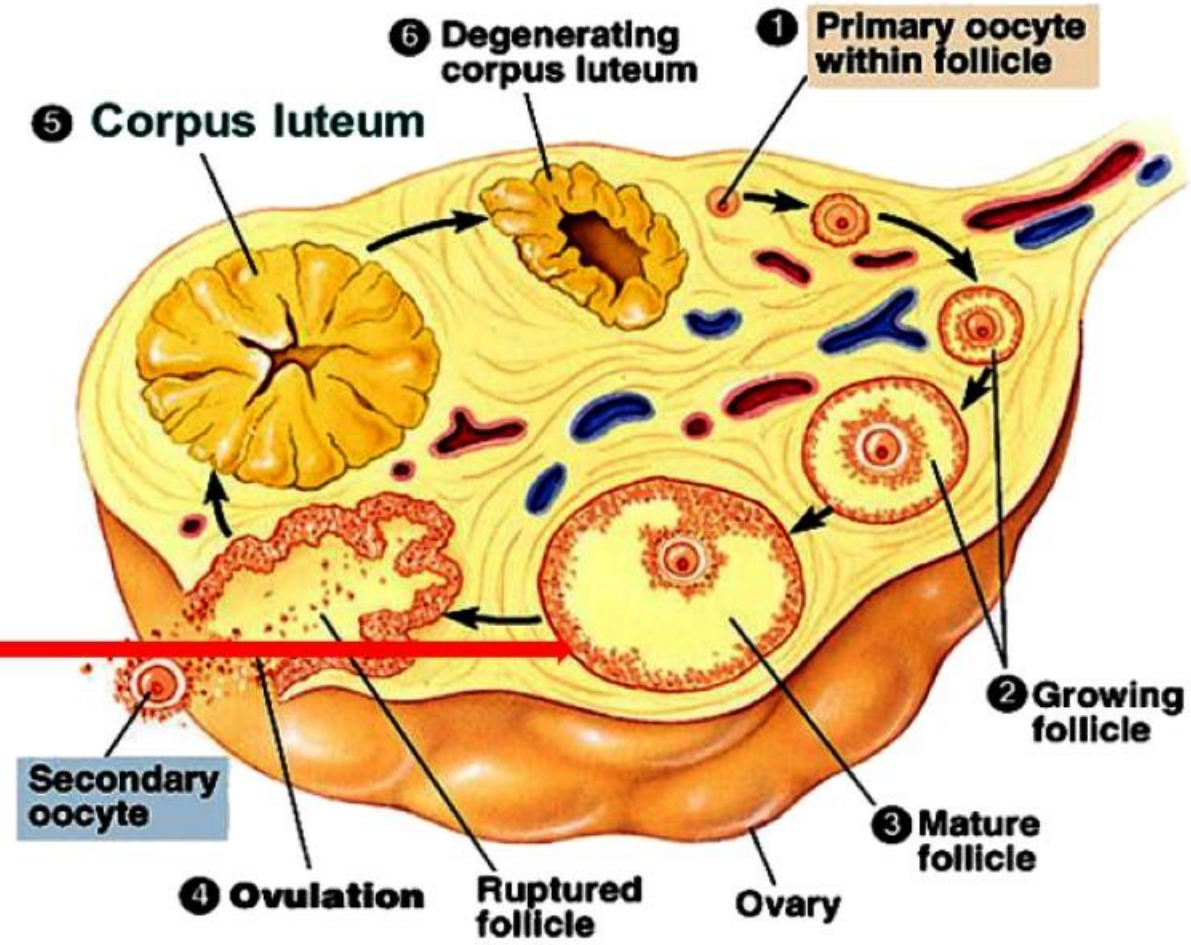
- It starts from **5th day** after menstruation and completed within **8-12 days**.
- In this phase, action of **gonadotropins (FSH & LH)** from pituitary occurs.



5-13th
day

FSH stimulates

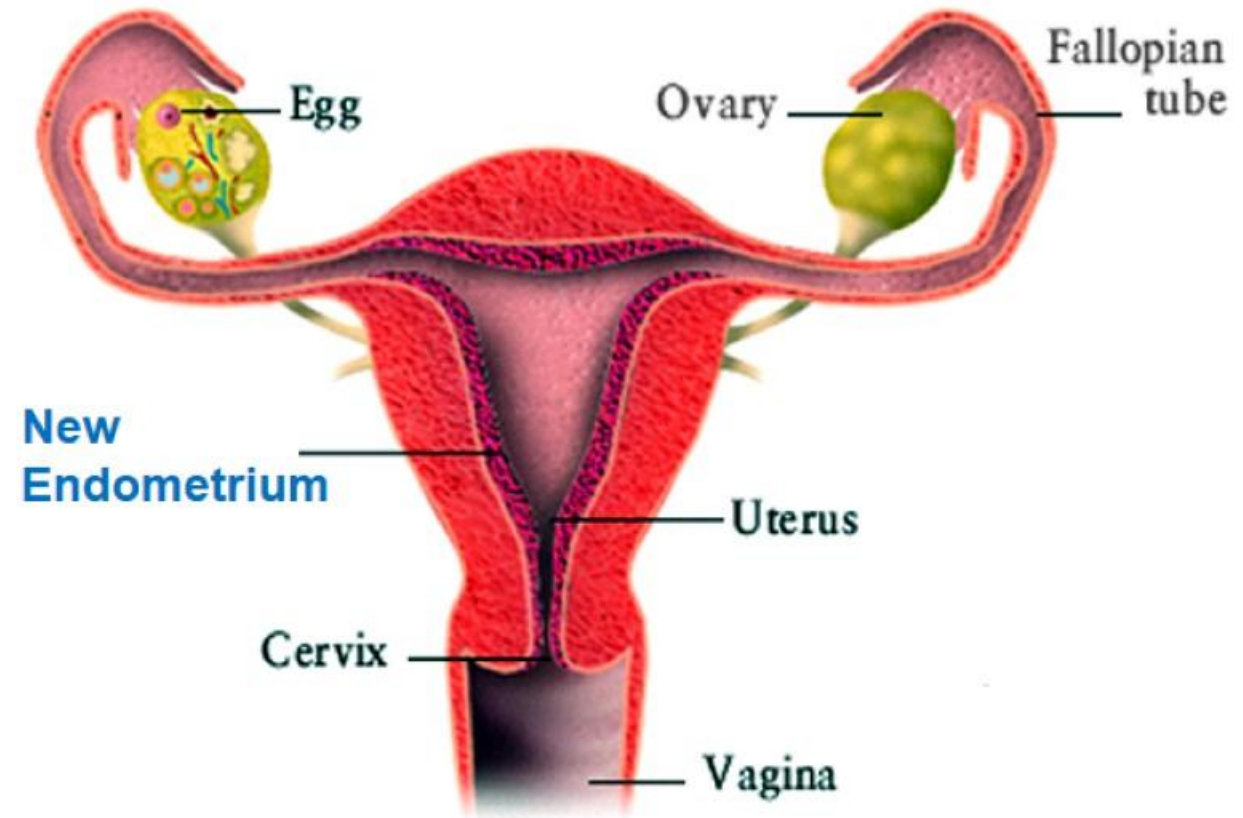
- Development of primary follicles into **Graafian follicles**.
- Secretion of **oestrogens** by **Graafian follicles**.



5-13th
day

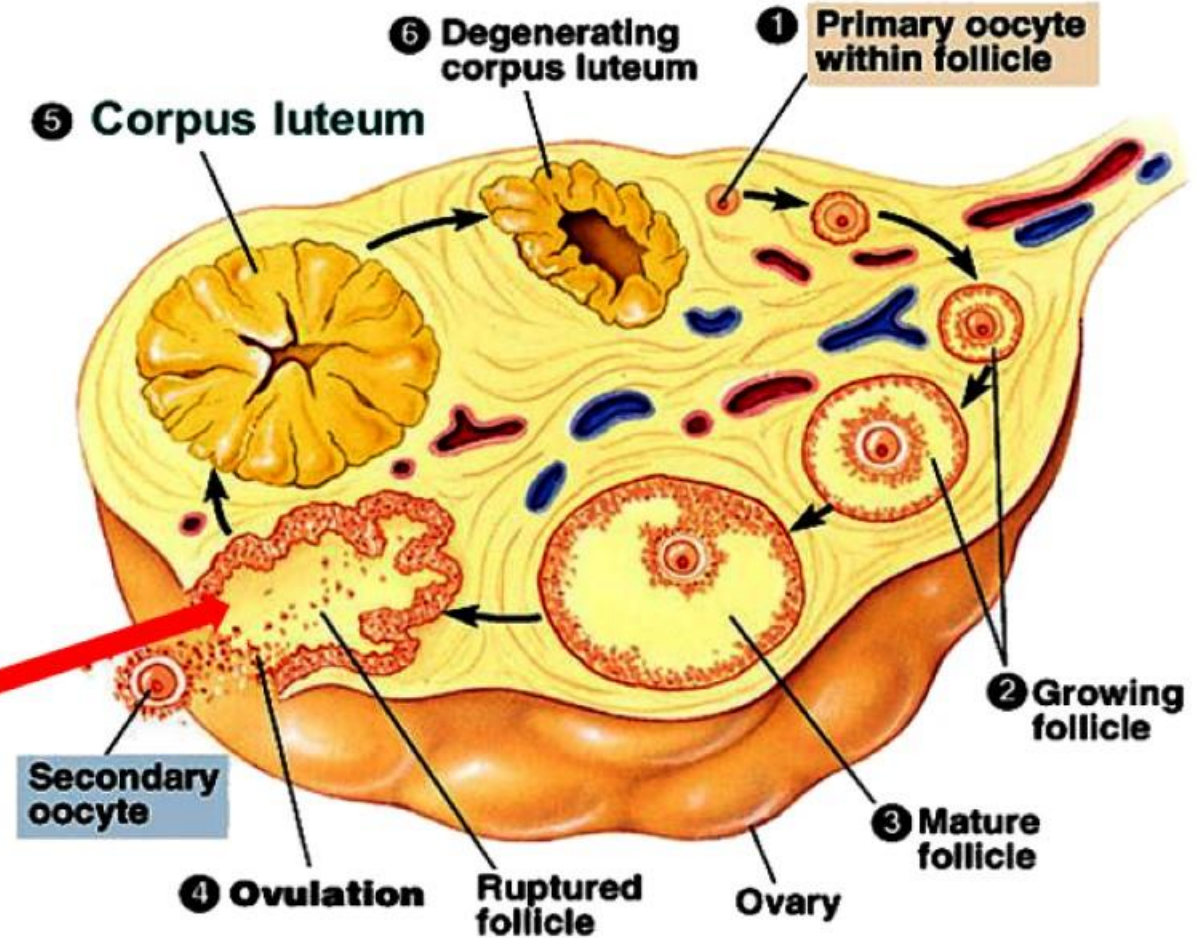
Oestrogens stimulate

- Proliferation of **ruptured uterine endometrium** and mucus lining of **oviduct & vagina**.
- Development of secondary sexual characters.
- Suppression of FSH secretion.
- Secretion of **LH (Luteinizing hormone)**.



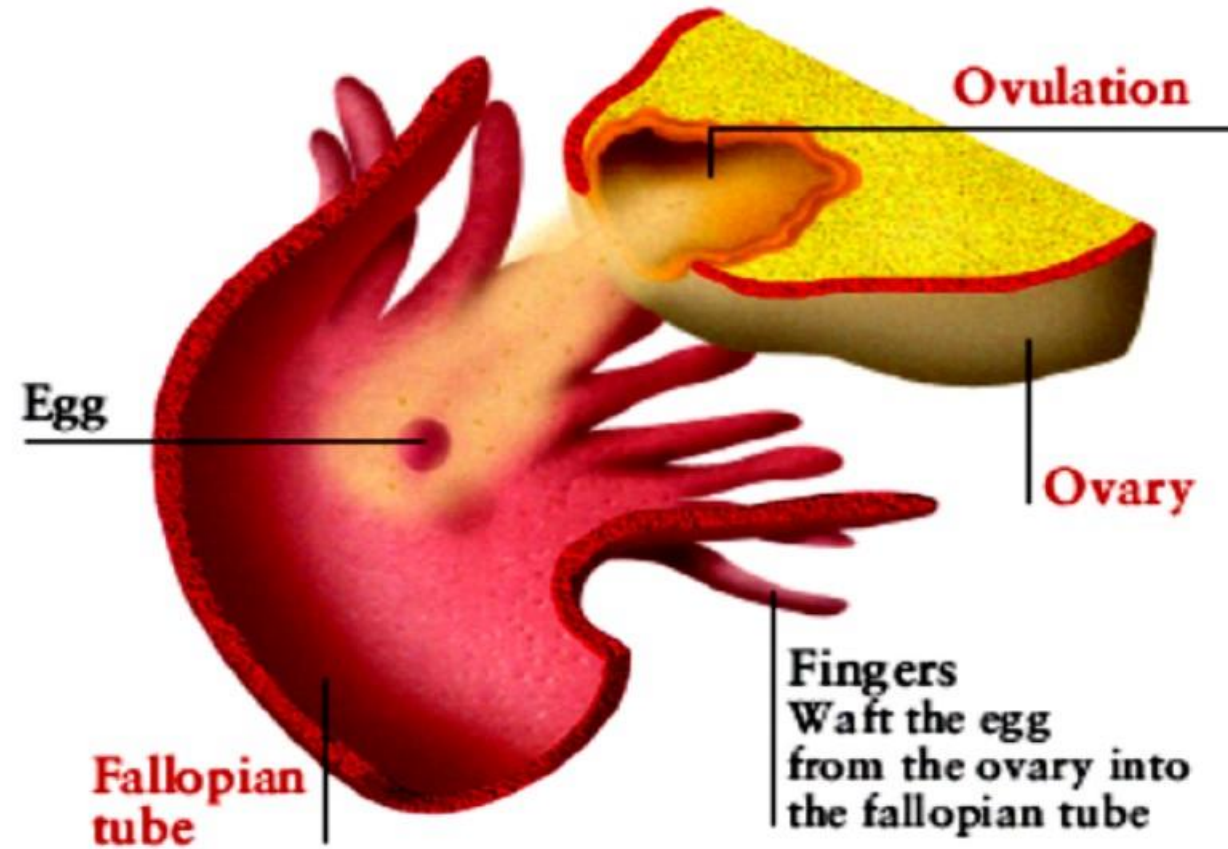
14th
day

- LH & FSH attain a peak level in the middle of cycle.
- Rapid secretion of LH (LH surge) induces rupture of Graafian follicle and thereby ovulation (on 14th day).



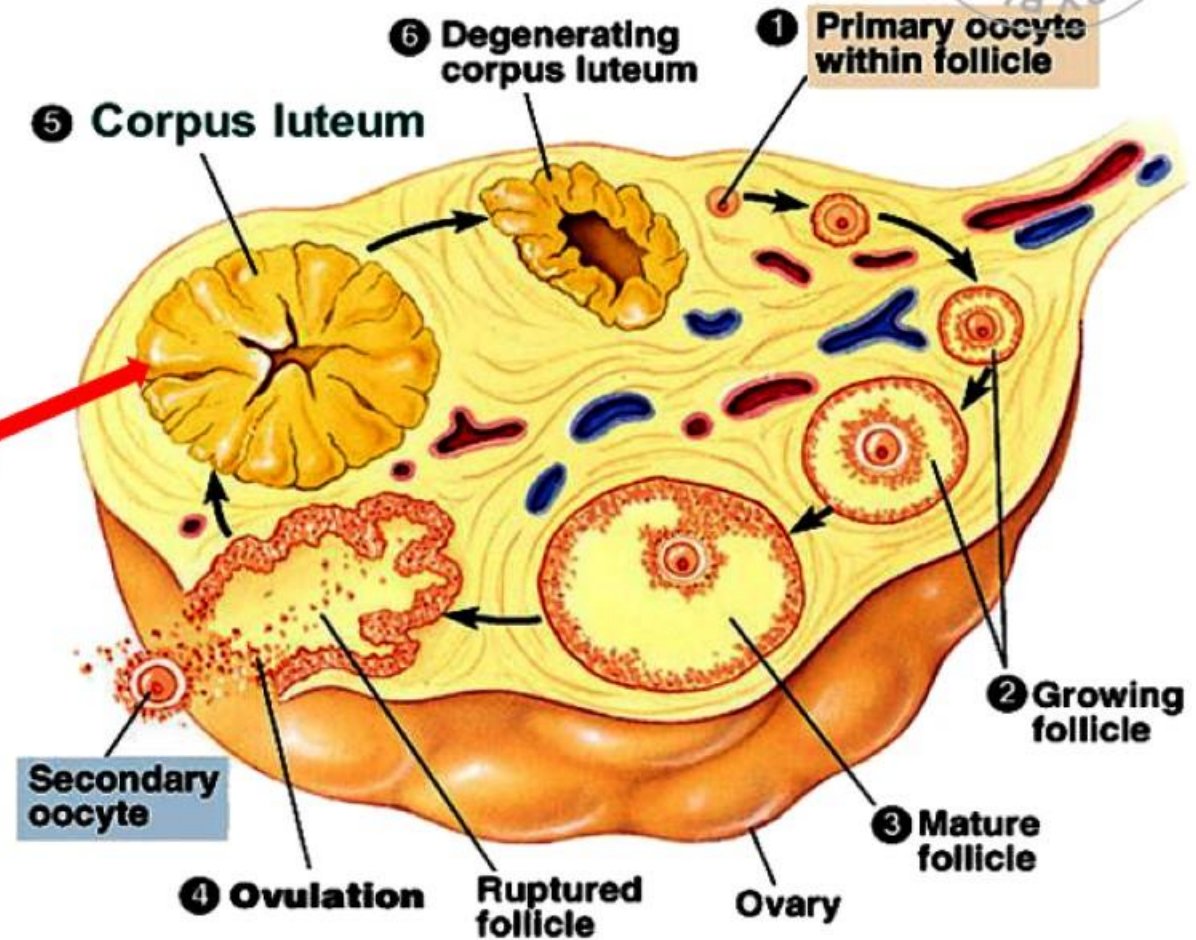
14th
day

- LH & FSH attain a peak level in the middle of cycle.
- Rapid secretion of LH (LH surge) induces rupture of Graafian follicle and thereby ovulation (on 14th day).



14-28th
day

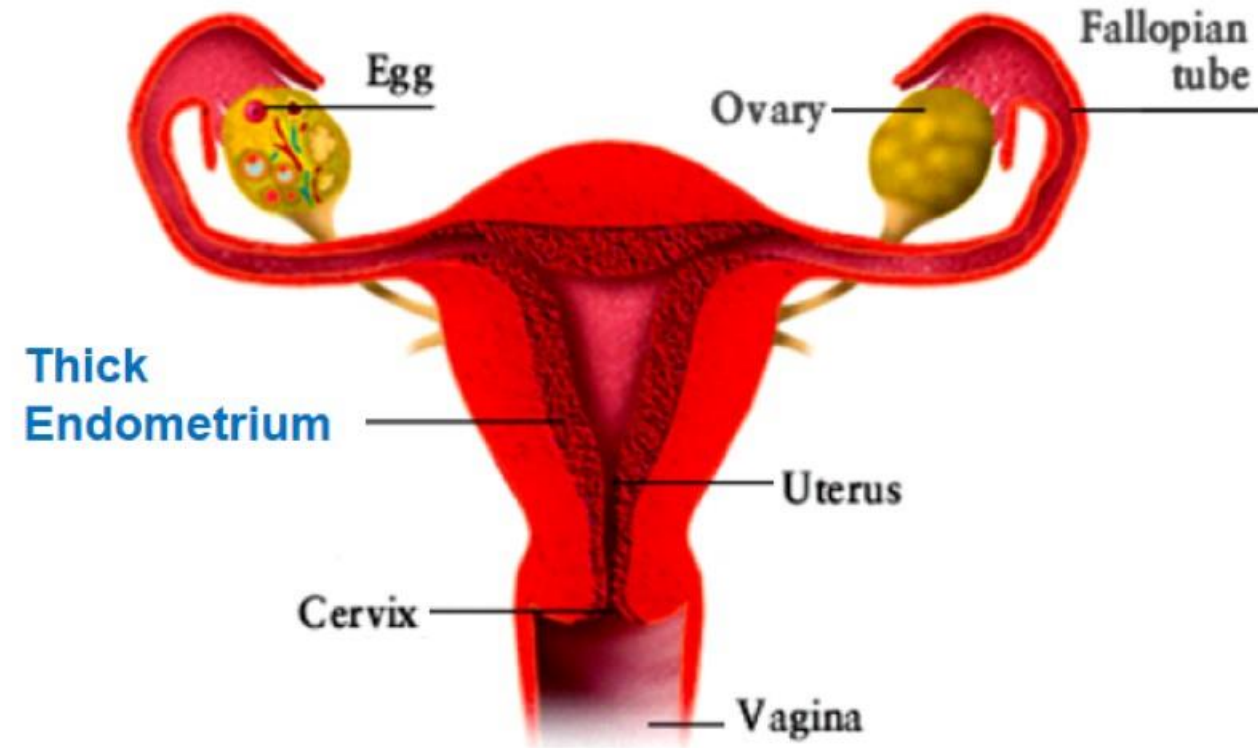
- After ovulation, **Graafian follicle** is transformed into a yellow endocrine mass called **Corpus luteum**.
- **Corpus luteum** secretes **progesterone**.



14-28th
day

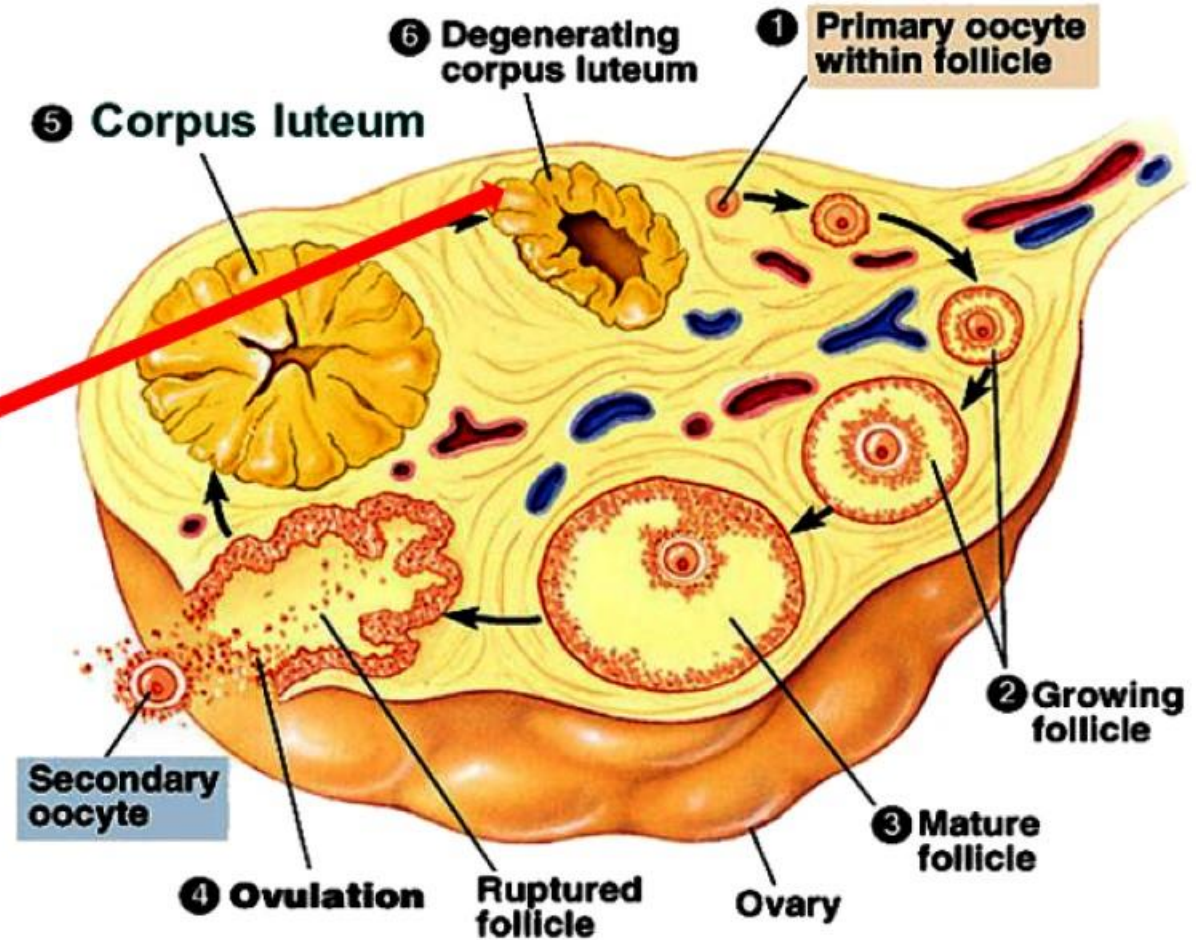
Functions of progesterone:

- ✓ Makes the endometrium **maximum vascular, thick and soft**. Thus the uterus gets ready for implantation.
- ✓ Inhibits the **FSH secretion** to prevent development of a second ovarian follicle.



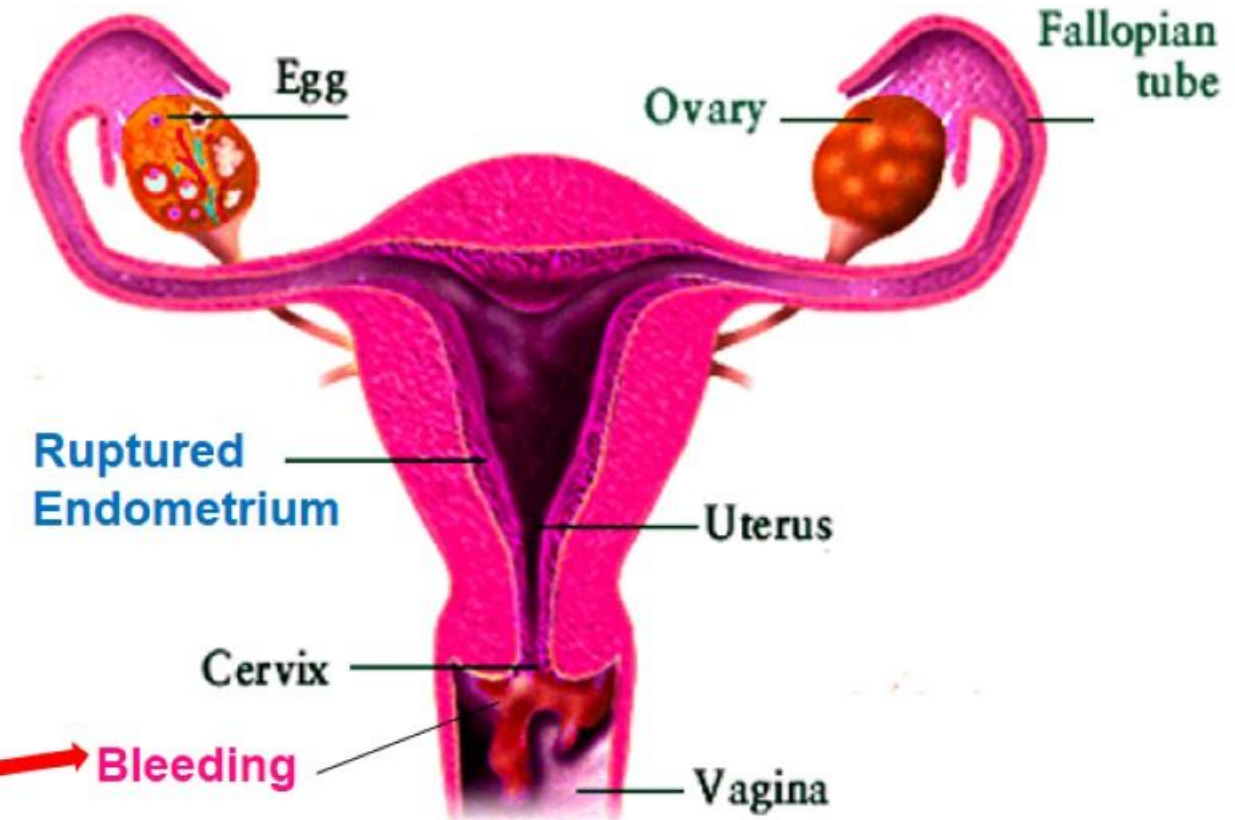
14-28th
day

- If fertilization does not occur, corpus luteum degenerates.
- It causes disintegration of endometrium. It leads to next **menstruation** and new cycle.



14-28th
day

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- It causes disintegration of endometrium. It leads to next **menstruation** and new cycle.



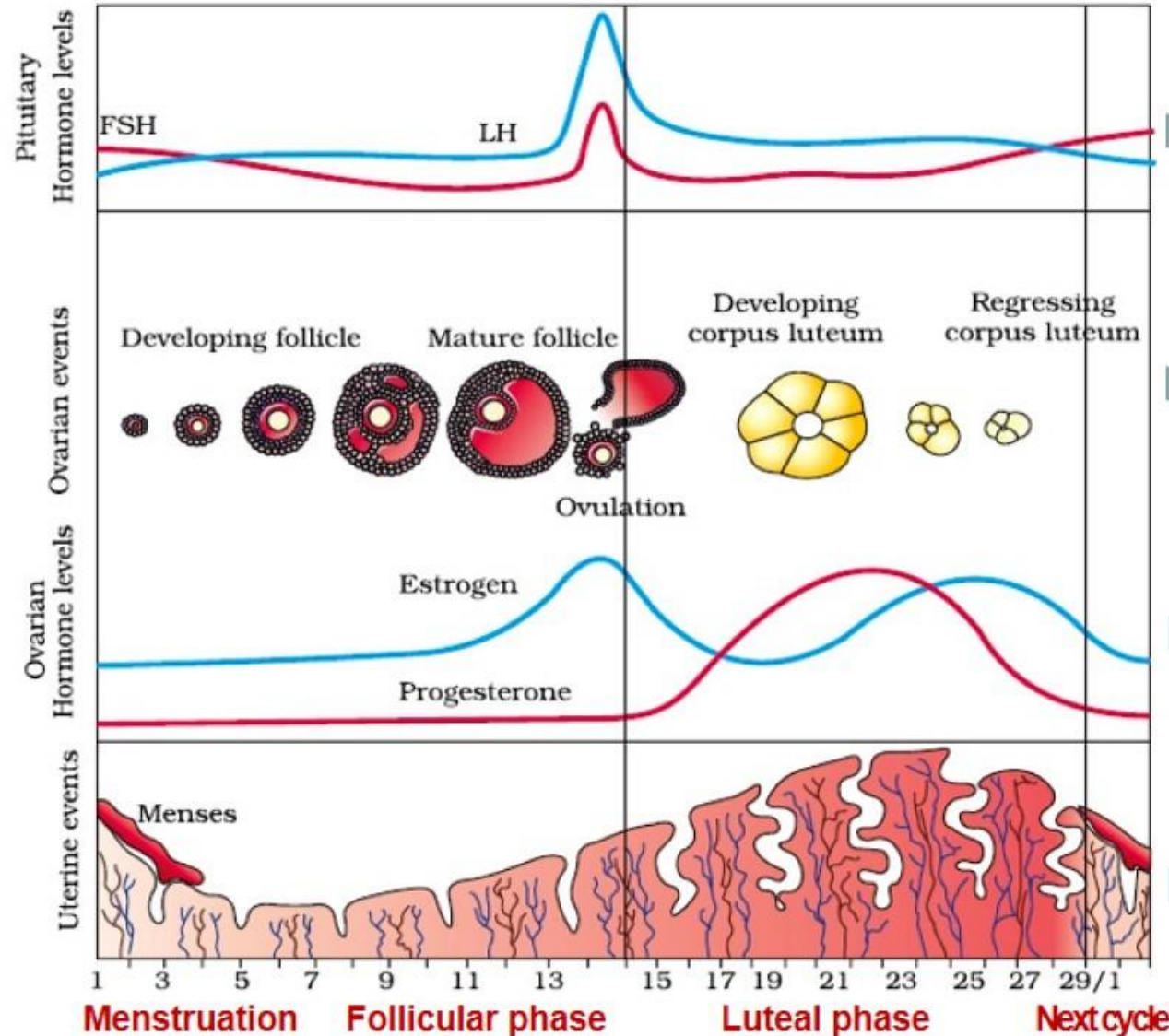
**14-28th
day**

- During pregnancy, all events of menstrual cycle stop and there is no menstruation.



MENSTRUAL CYCLE

Overall changes



Change in Pituitary hormone (FSH & LH) levels

Changes in Ovary (Ovarian events)

Change in Ovarian hormone (Estrogen & Progesterone) levels

Changes in uterus (Uterine events)

MENSTRUAL CYCLE



Menarche: The first menstruation during puberty.

Menopause: Stopping of menstrual cycle (at about 50 yrs of age).

Reproductive Phases of Human Life

Menarche
11-12 years



Menstruation
12-50 years



Menopause
50 years - death

