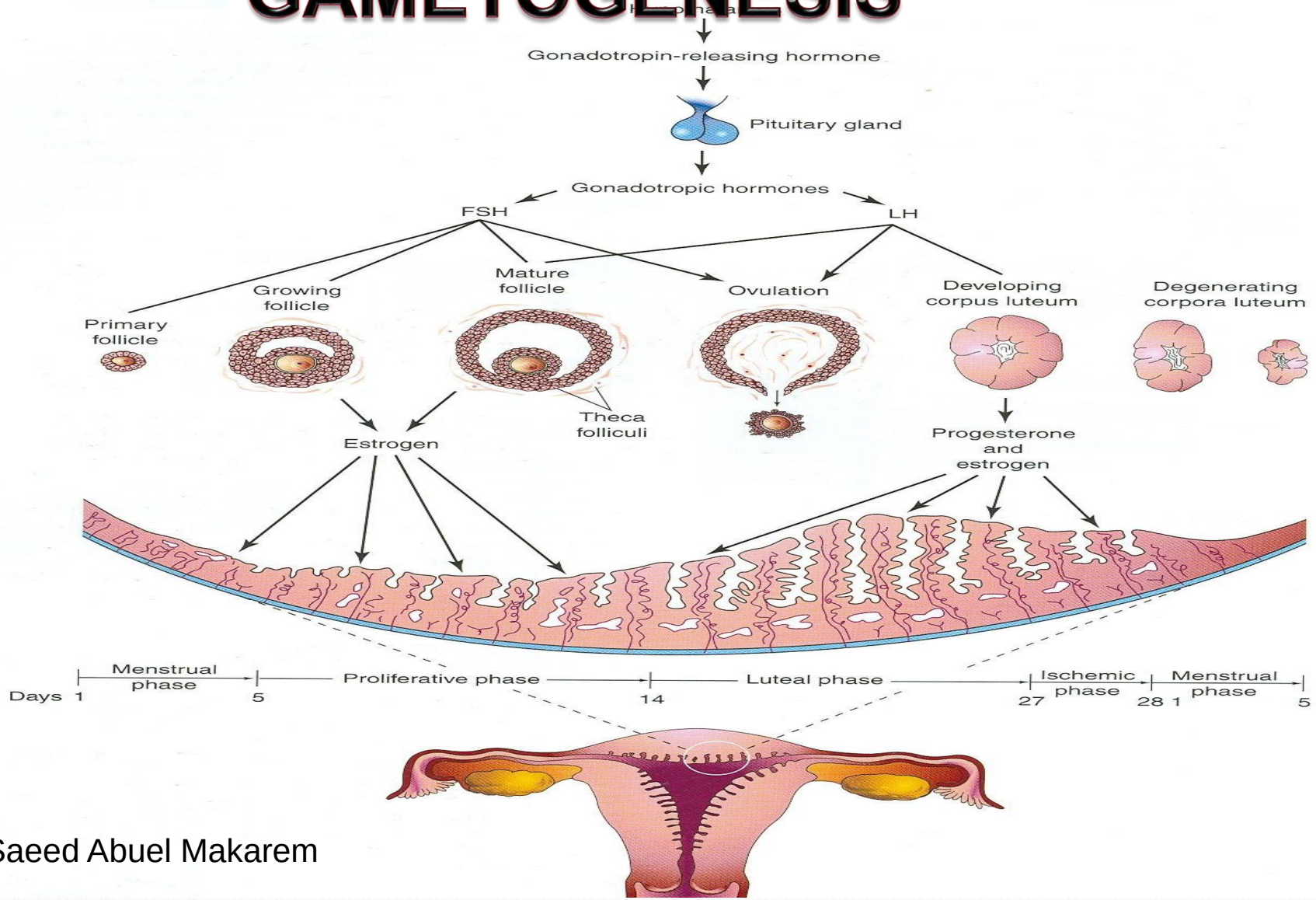
# FEMALE CYCLES & GAMETOGENESIS




Prof. Saeed Abuel Makarem

# OBJECTIVES

***By the end of the lecture, you should be able to:***

- **Describe the female cycles (Ovarian & Uterine).**
- **Define gametogenesis.**
- **Differentiate the types of gametogenesis.**
- **Describe the process of spermatogenesis.**
- **Describe the process of oogenesis.**

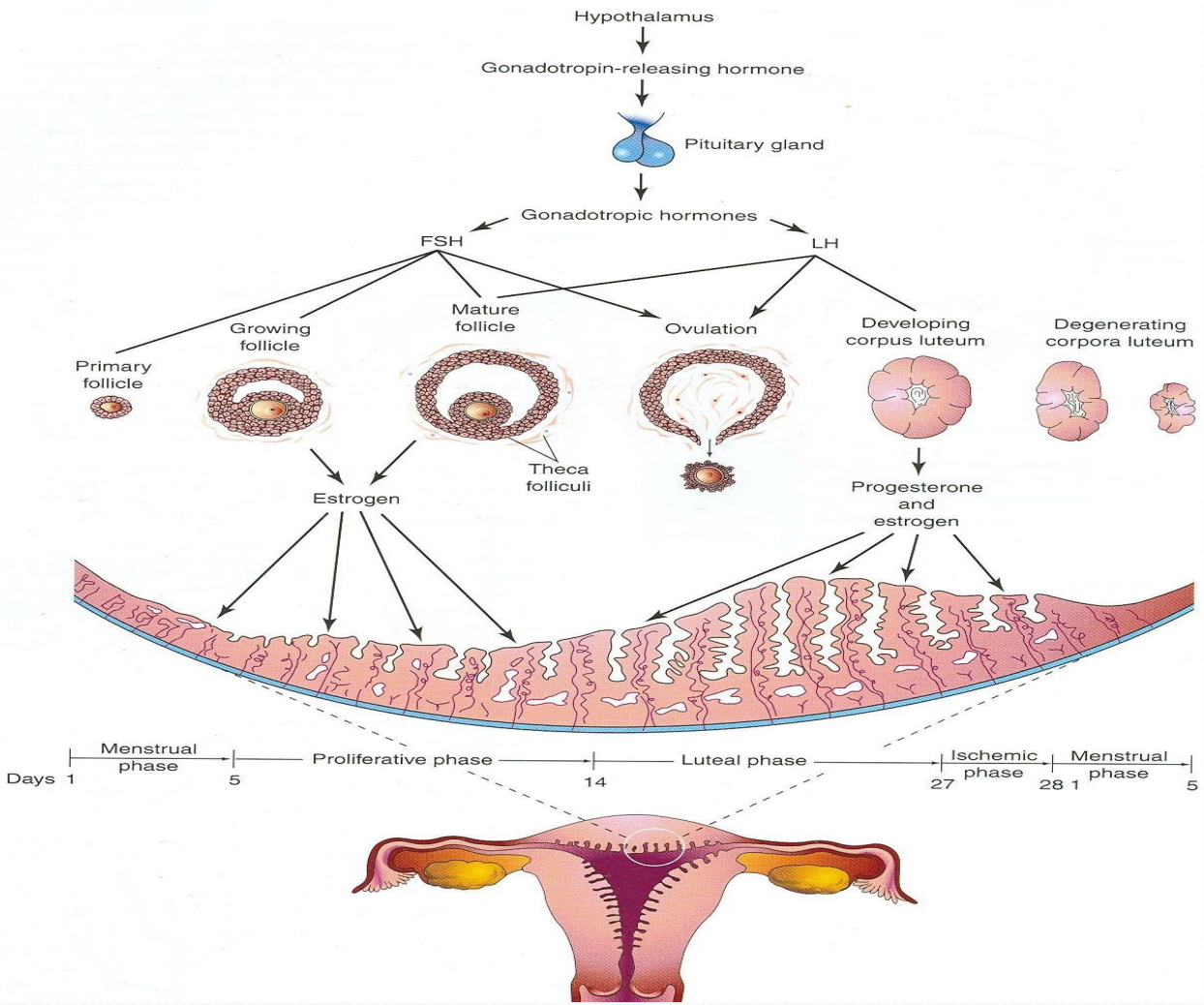
Health is a great valuable thing, we never have a true idea of its value until we lose it.

# Female Reproductive Cycles

## OVARIAN AND UTERINE CYCLES

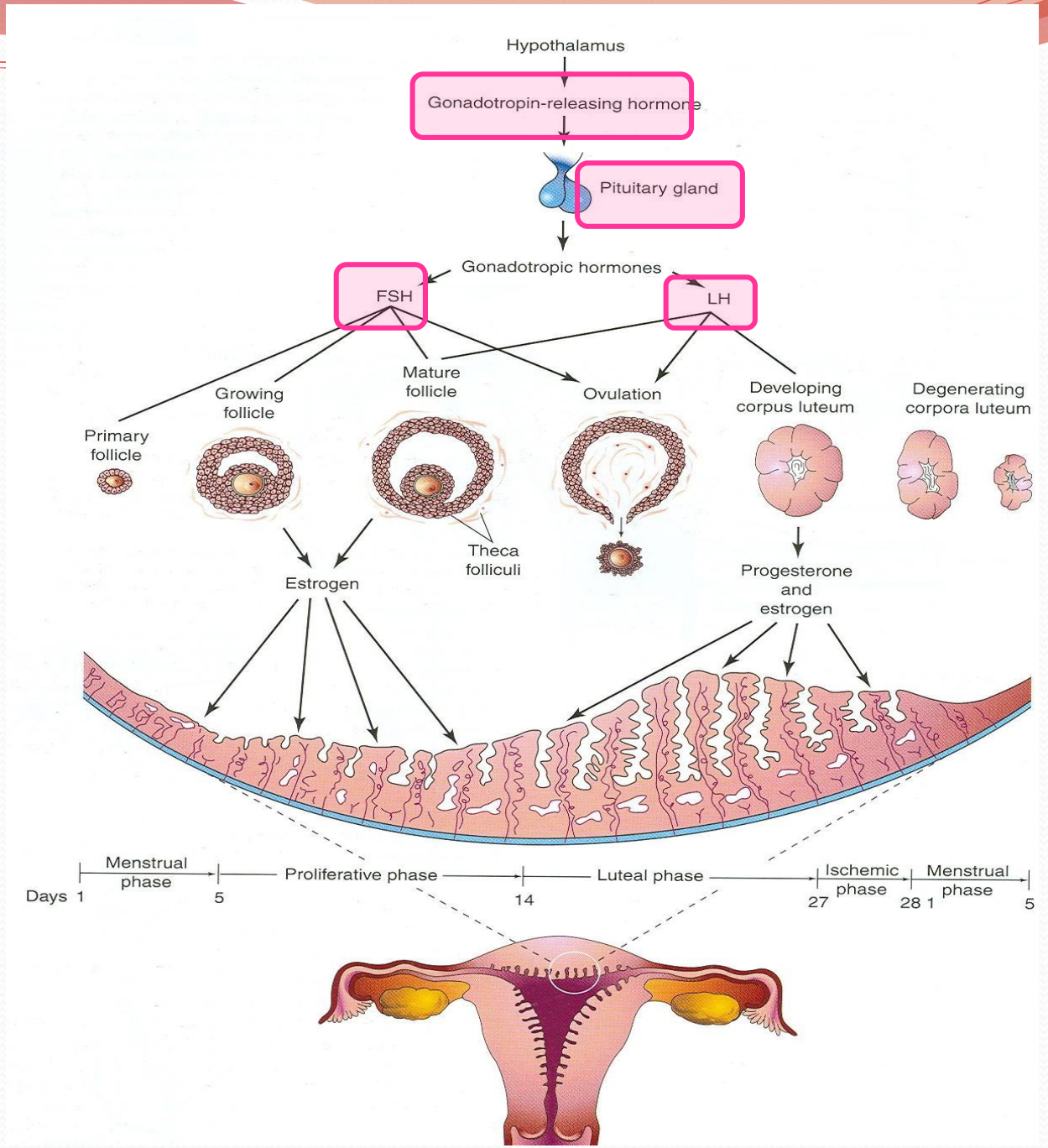
- **R**eproductive cycles start at puberty.
- Normally continues until **menopause.**
- <u>Reproductive cycles depend upon activities & coordination of:</u>

1. **Hypothalamus,**
2. **Pituitary gland,**
3. **Ovaries,**
4. **Uterus,**
5. **Uterine tubes,**
6. **Vagina and**
7. **Mammary glands.**

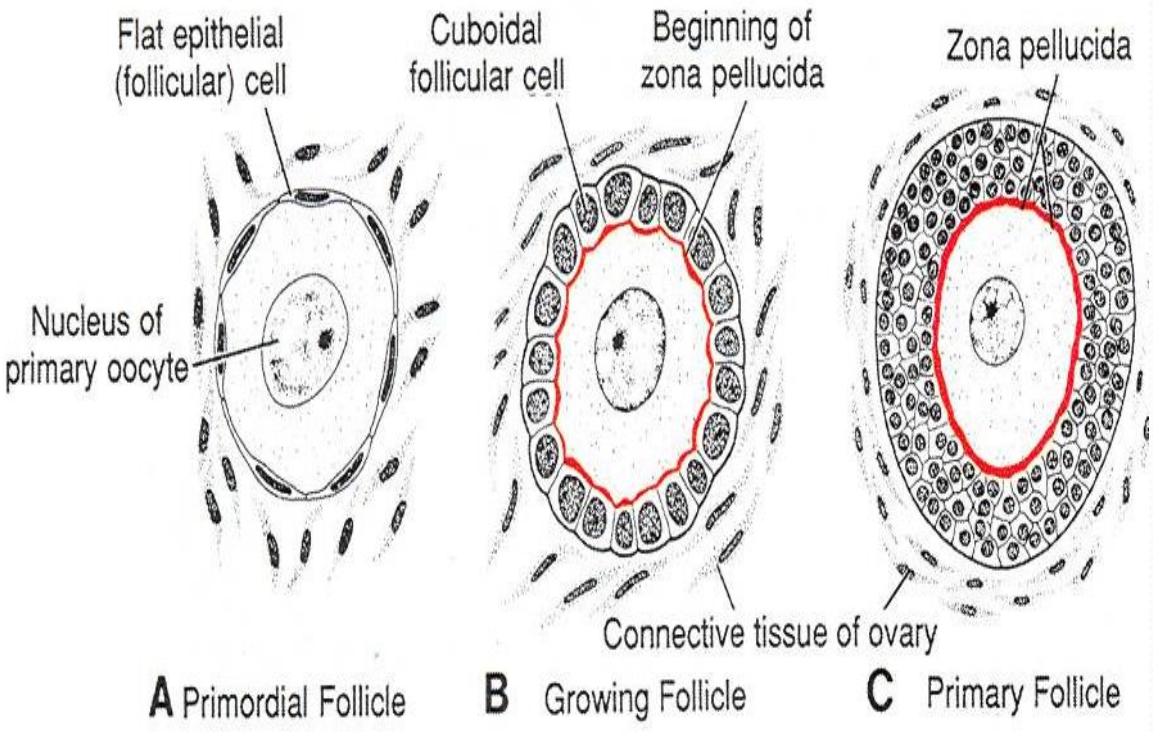


# GnRH

- **Gonadotrophin-releasing hormone (GnRH)** is synthesized by neurosecretory cells in the **Hypothalamus.**
- Carried to the **Pituitary gland** (anterior lobe).
- It stimulates the pituitary to release **Two *Hormones*** that act on **Ovaries (FSH & LH).**



# OVARIAN CYCLE




The simple flat follicular cells become cuboidal, then columnar then forming many layers around the oocyte.

- The **ovarian cycle** is the cyclic changes which occurs in the ovary each month.
- It is under the control of the **Pituitary Gland.**
- It is divided into **3** phases: (**FOL**)

**1- Follicular,**

**2- Ovulatory,**

**3- Luteal.**

- The ovarian cortex contains hundreds of thousands of primary follicles (400,000 to 500,000).
- The primary follicle consists of one **primary oocyte** encircled by single layer of flat follicular cells.

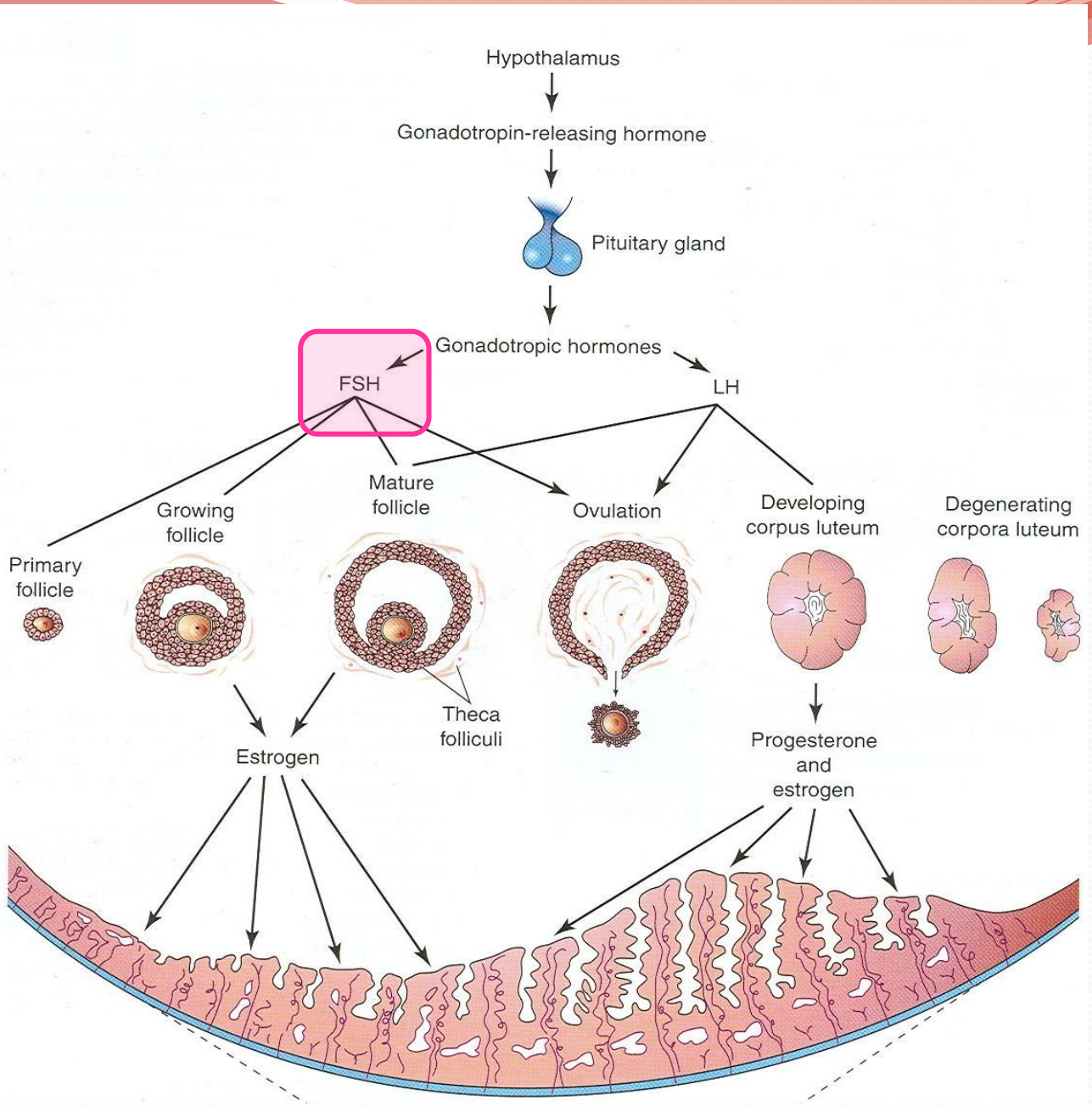
# FSH

- **Follicle-Stimulating Hormone .**
- Secreted by the pituitary gland.
- **FUNCTIONS:**

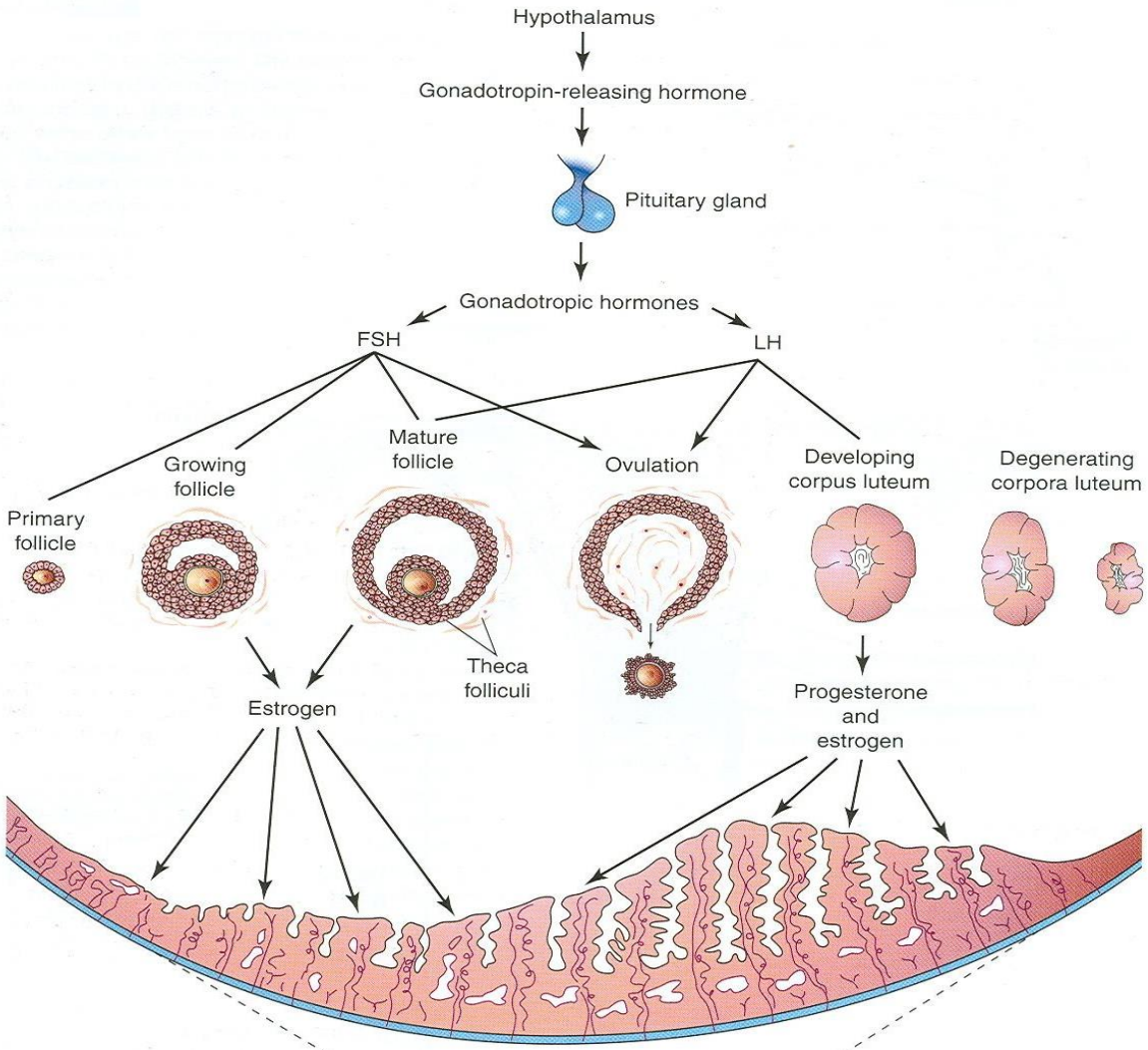
**It** stimulates the ovarian (primary) follicles:

1- To develop & mature.

2- To produce *Estrogen* by its follicular cells.



- The follicle becomes enlarged until it gets full maturity.
- It produces swelling on the surface of the ovary.
- Early development of ovarian follicle is induced by **FSH.**
- **Final** stages of maturation require **LH (luteinizing hormone).**
- **LH.** causes **ovulation** (rupture of the mature follicle).




Growing follicles produce **estrogen** which regulates the development and functions of the reproductive organs.

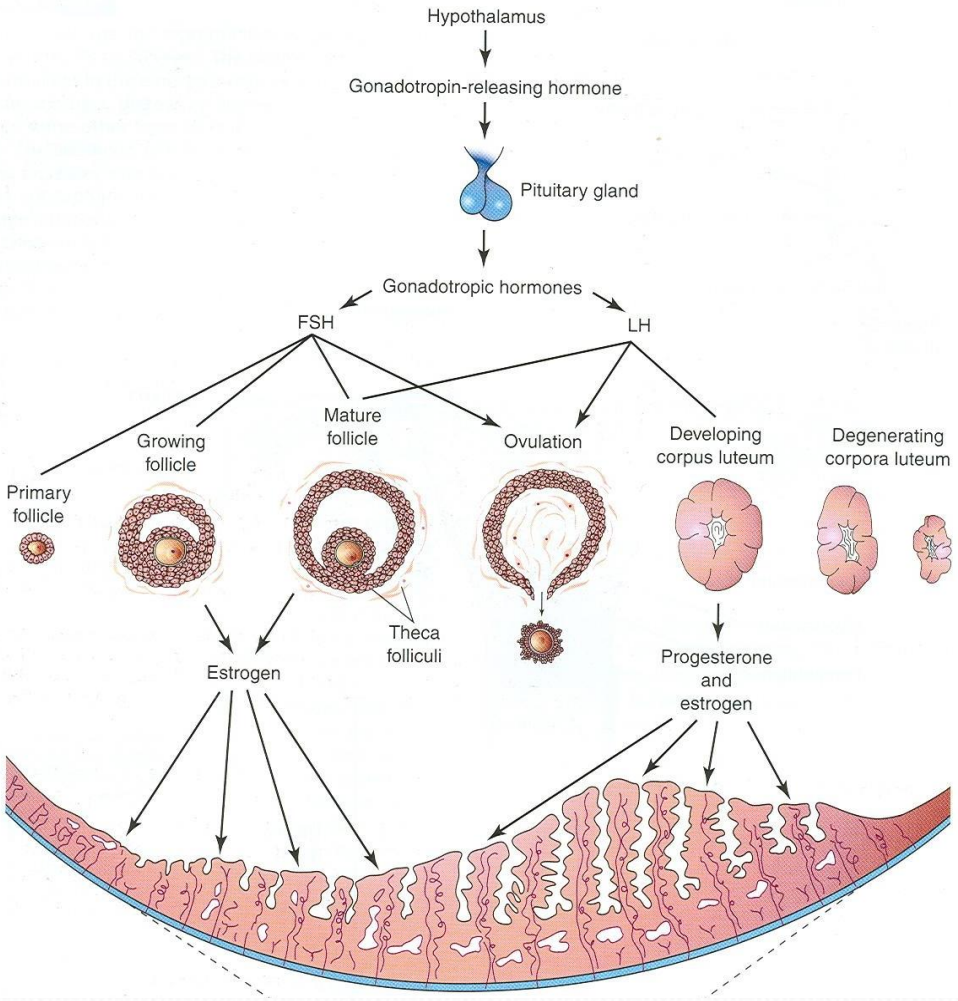
# Corpus Luteum

- When the follicle rupture its remains are called **corpus luteum**.

**The corpus luteum** secretes **Progesterone** and small amount of **Estrogen.**

- These **2 hormones** stimulate the endometrial glands to develop and prepare the endometrium for implantation of the **fertilized Ovum**.

- If the oocyte is fertilized the **C**orpus Luteum enlarges and remains till the **4th month** of pregnancy.
- If the oocyte is not fertilized the corpus luteum involutes and degenerates in ***10-12*** days and called corpus albicans.



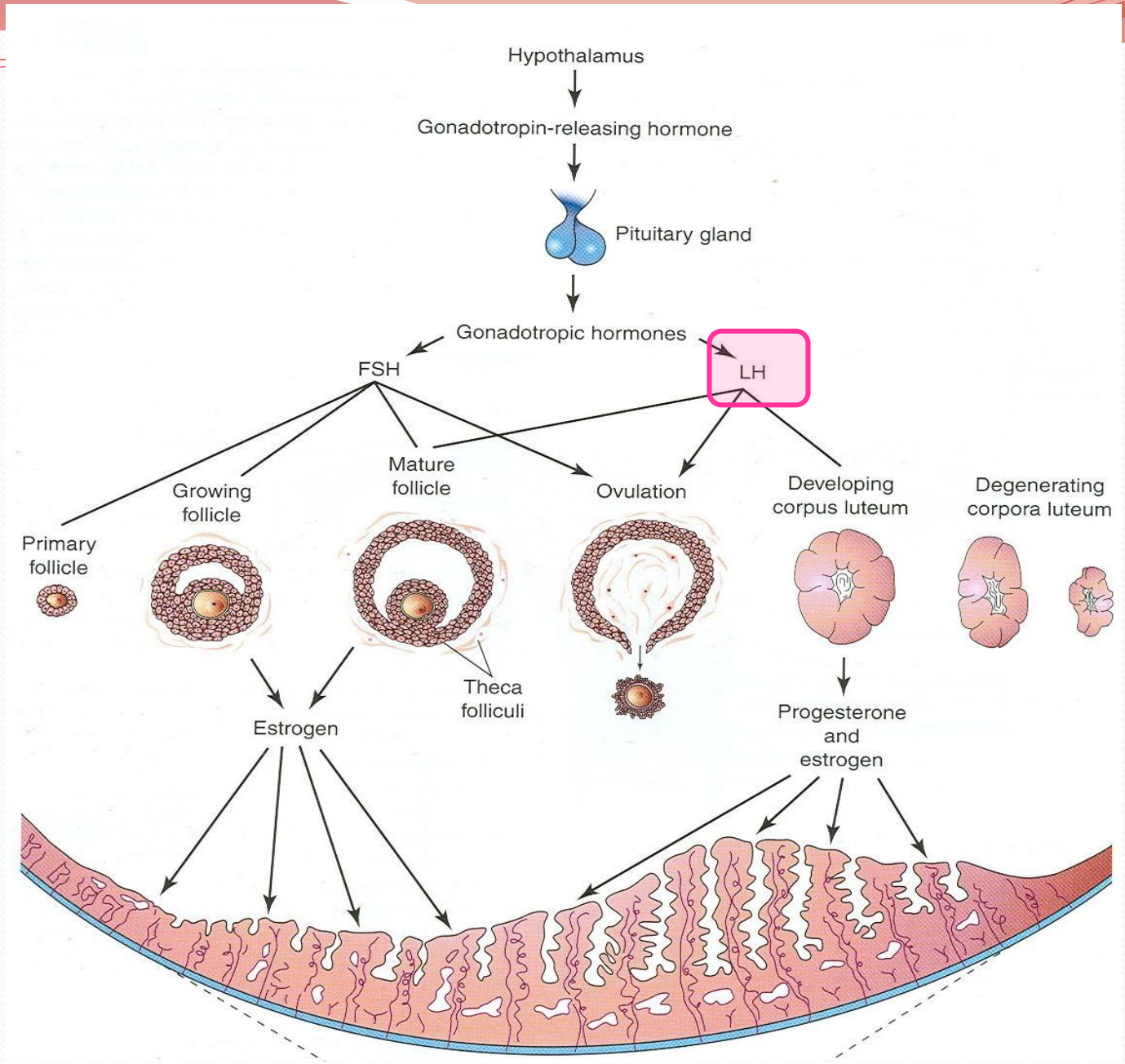
# LH

- **Luteinizing Hormone.**
- Secreted by the pituitary gland.

- **FUNCTIONS:**

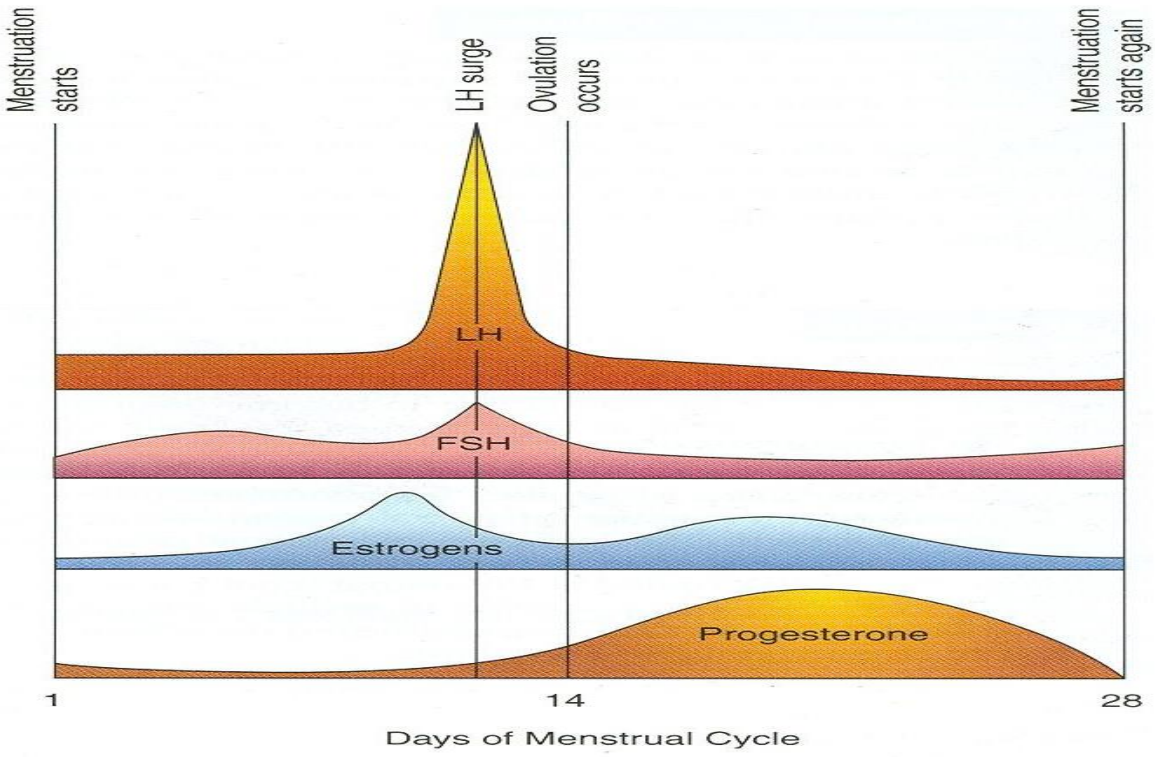
1- It serves as the trigger for **ovulation.**

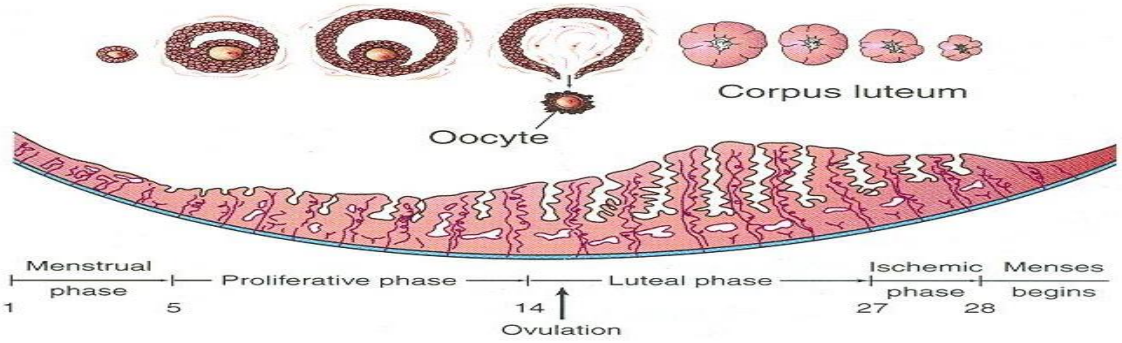
2- Stimulates the follicular cells and corpus luteum to produce **Progesterone.**



# Uterine or Menstrual Cycle

- It is the cyclic changes which occur in the endometrium of the uterus every month by the effect of **estrogen & progesterone.**
- Average menstrual cycle is about 28 days.
- **Day One is the day when menstrual blood flow begins.**
- It varies by several days in normal women.
- Ranges between **23** and **35** days in **90 %** of women.
- It sometimes varies in the same woman.

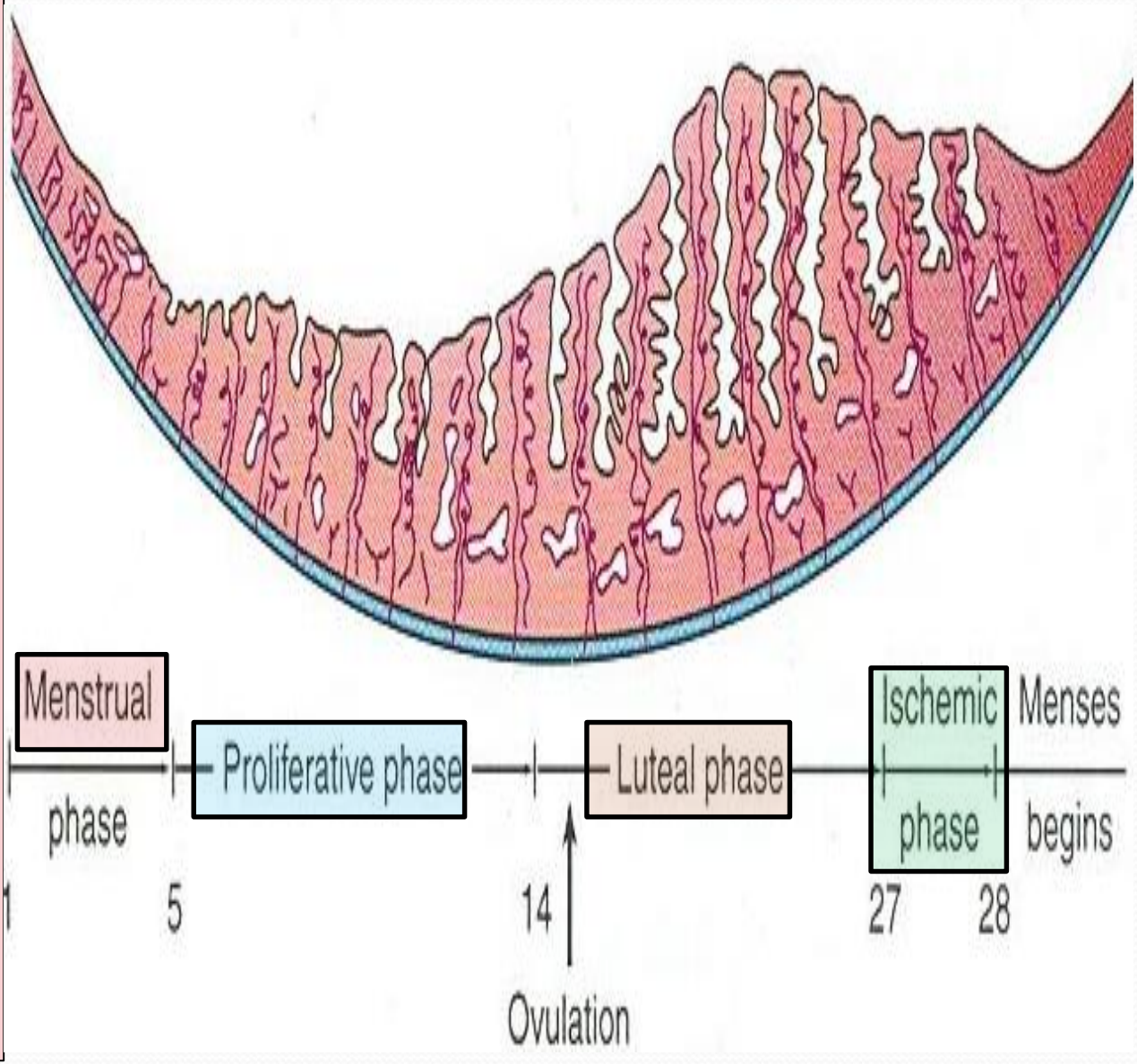


# Phases of Menstrual Cycle

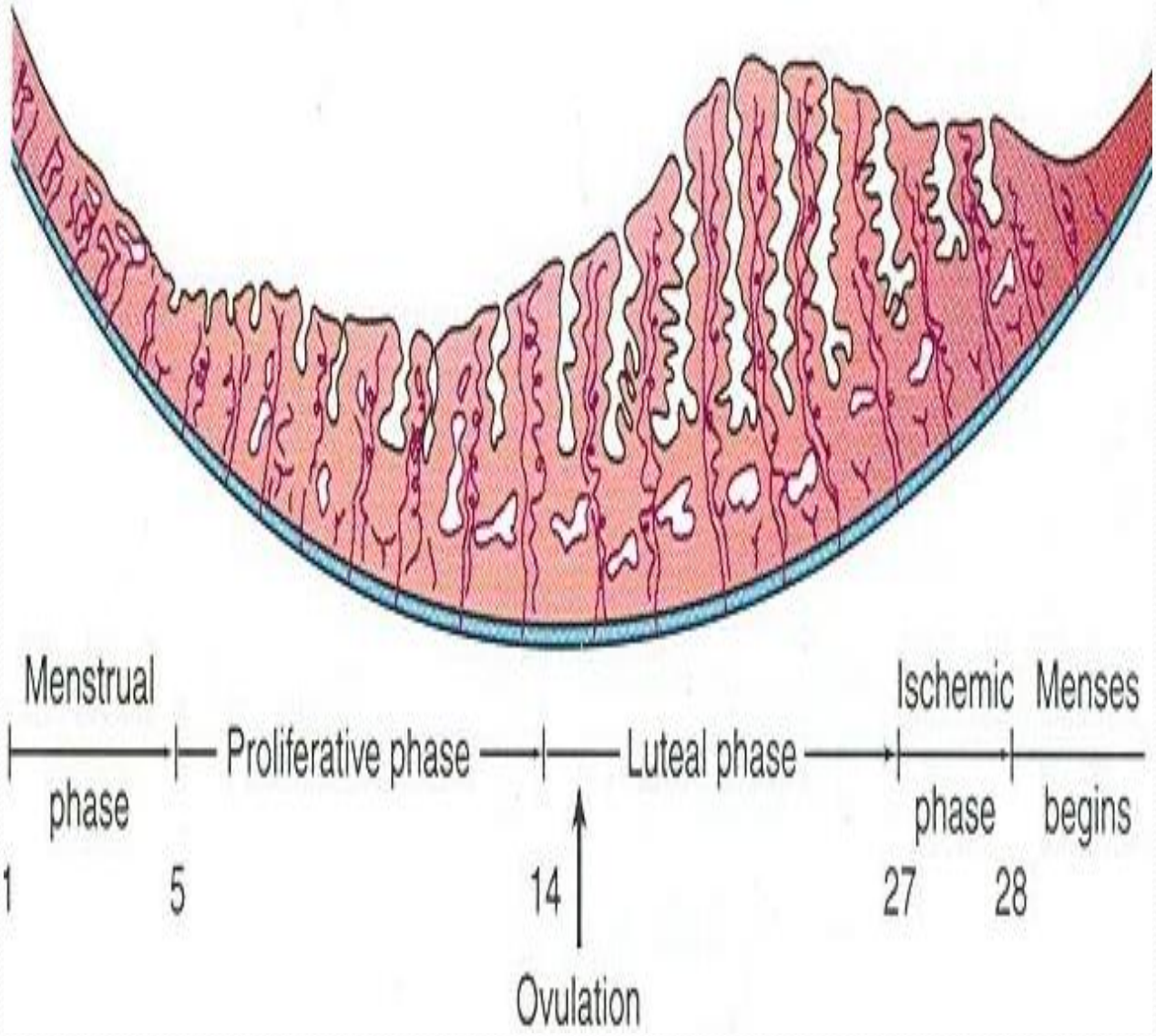
**Four phases:**

1. **Menstrual** Phase,(1-5 days)
2. **Proliferative** or **Follicular** Phase, (5-14 days).
3. **Luteal** Phase, (14-27 days).
4. **Ischemic** Phase, (27-28 days).



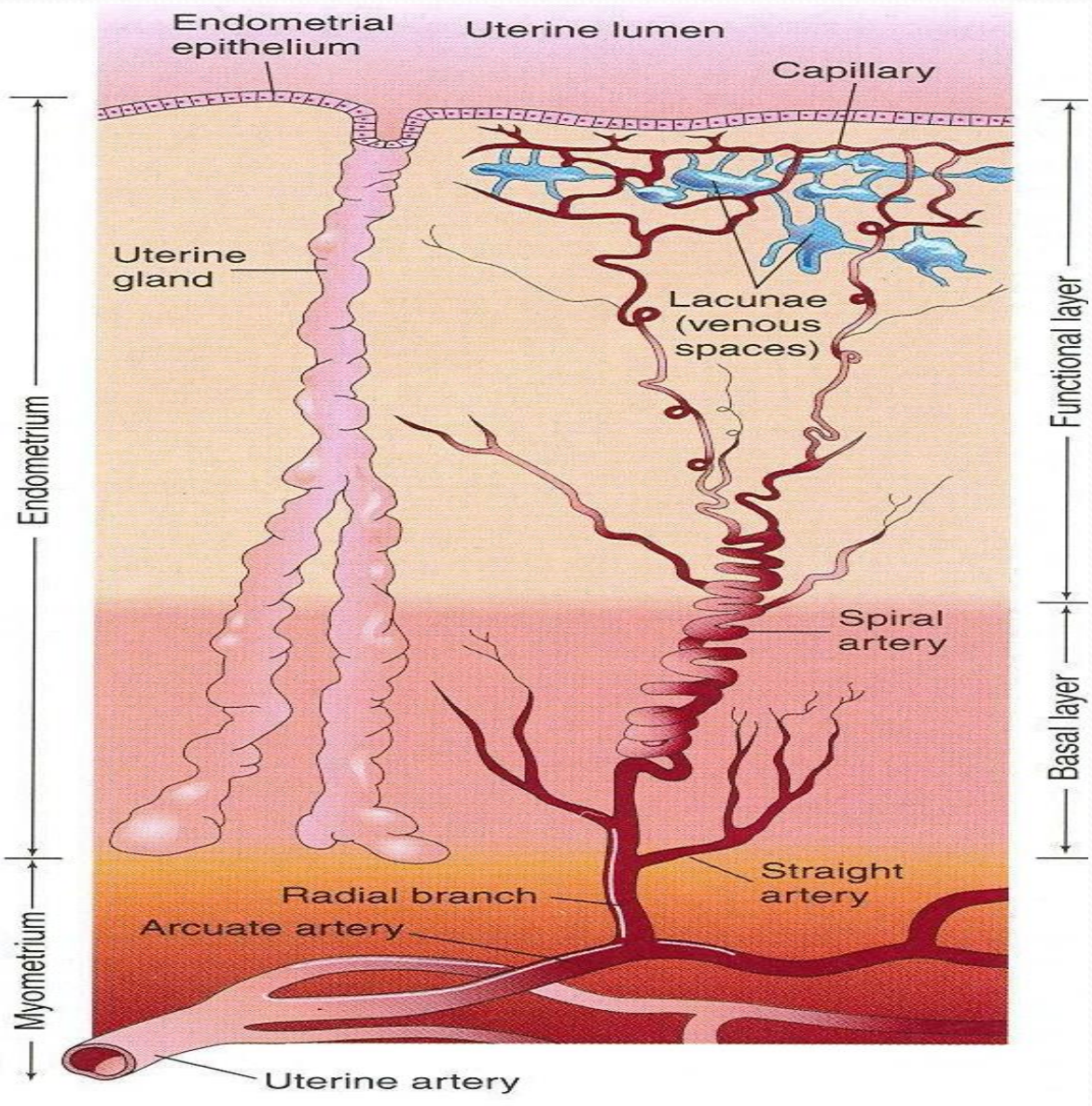
# Menstrual Phase

- Starts with the 1st day of menstruation.
- **Lasts for 4 to 5 days.**
- The functional layer of the endometrium is sloughed off and discarded with the menstrual flow.
- Blood discharge from vagina is combined with small pieces of endometrial tissue.



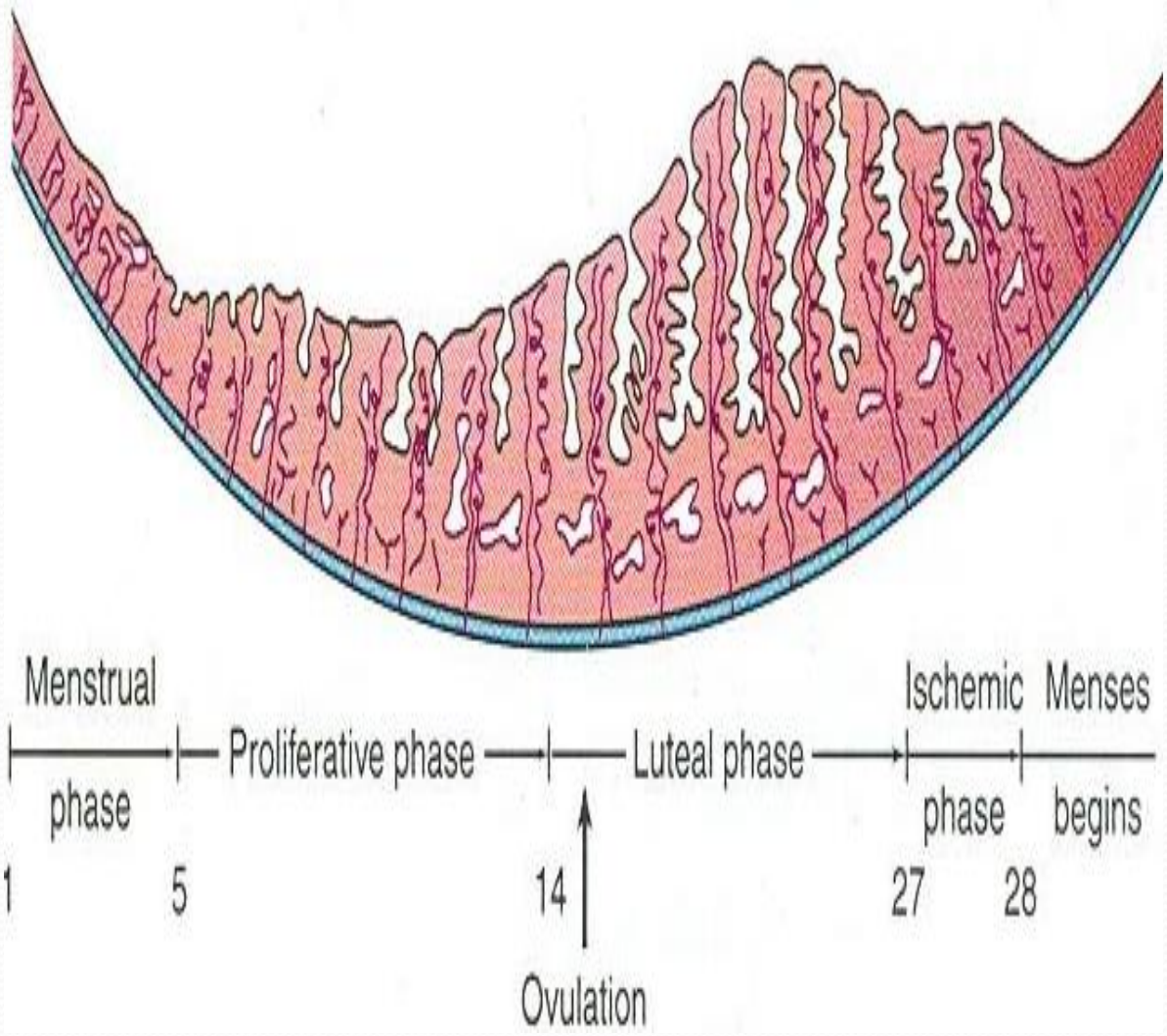
# Proliferative Phase

- **It is a phase of repair and proliferation.**
- It lasts for **9** days.
- **Coincides with growth of ovarian follicle**.
- **So it is controlled by Estrogen secreted by the follicular cells.**
- Thickness of the endometrium is increased 2-3 times.
- The glands increase in number and length and the spiral arteries elongate.



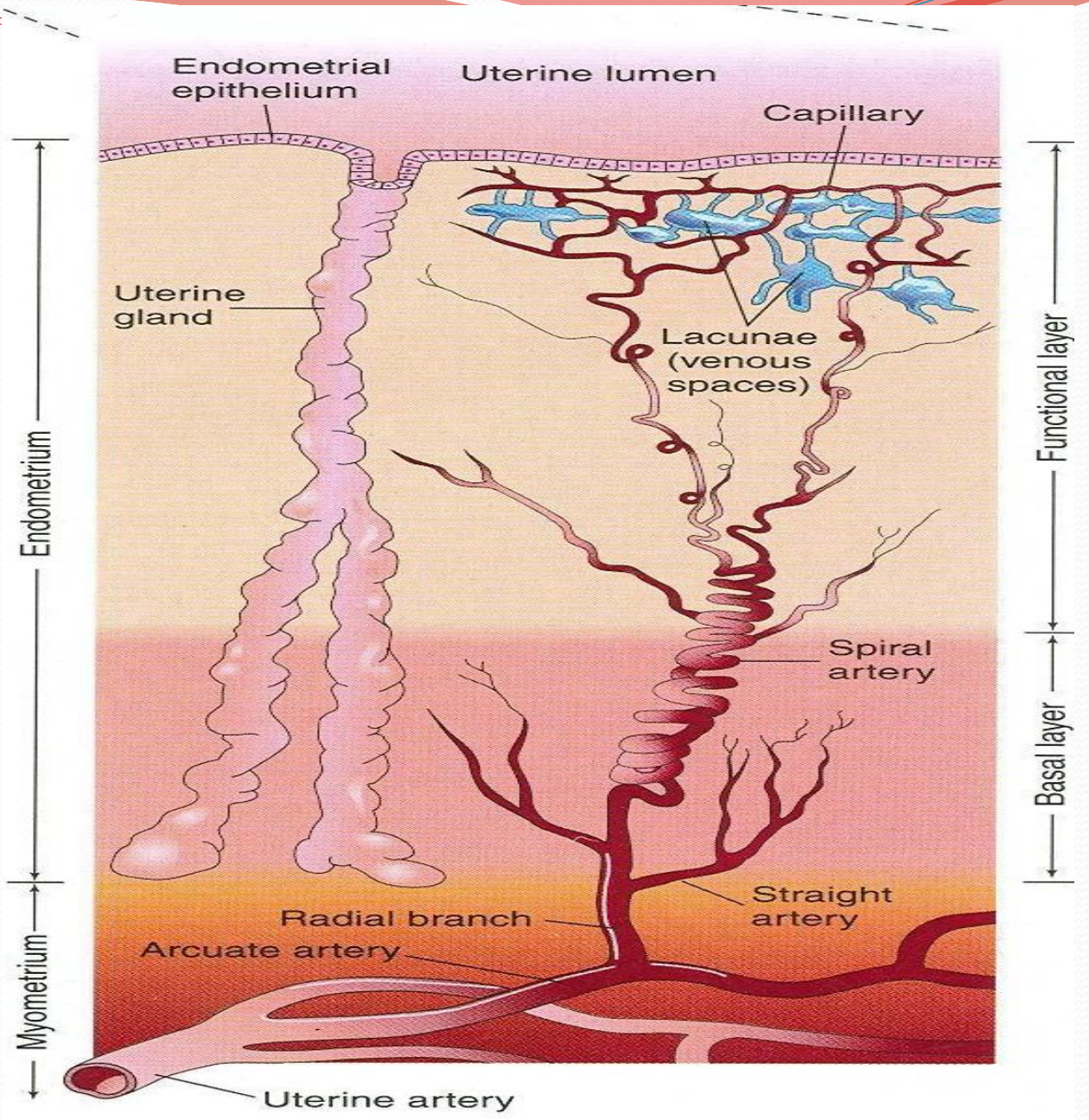
# Luteal Phase

- **It is a Secretory or <u>Progesterone phase.</u>**
- It lasts about **13** days.
- Coincides with the formation, growth and functioning of the **Corpus Luteum.**
- Glandular epithelium secrete a material rich in **glycogen.**
- Endometrium thickens under the influence of progesterone and estrogen.



# Luteal Phase

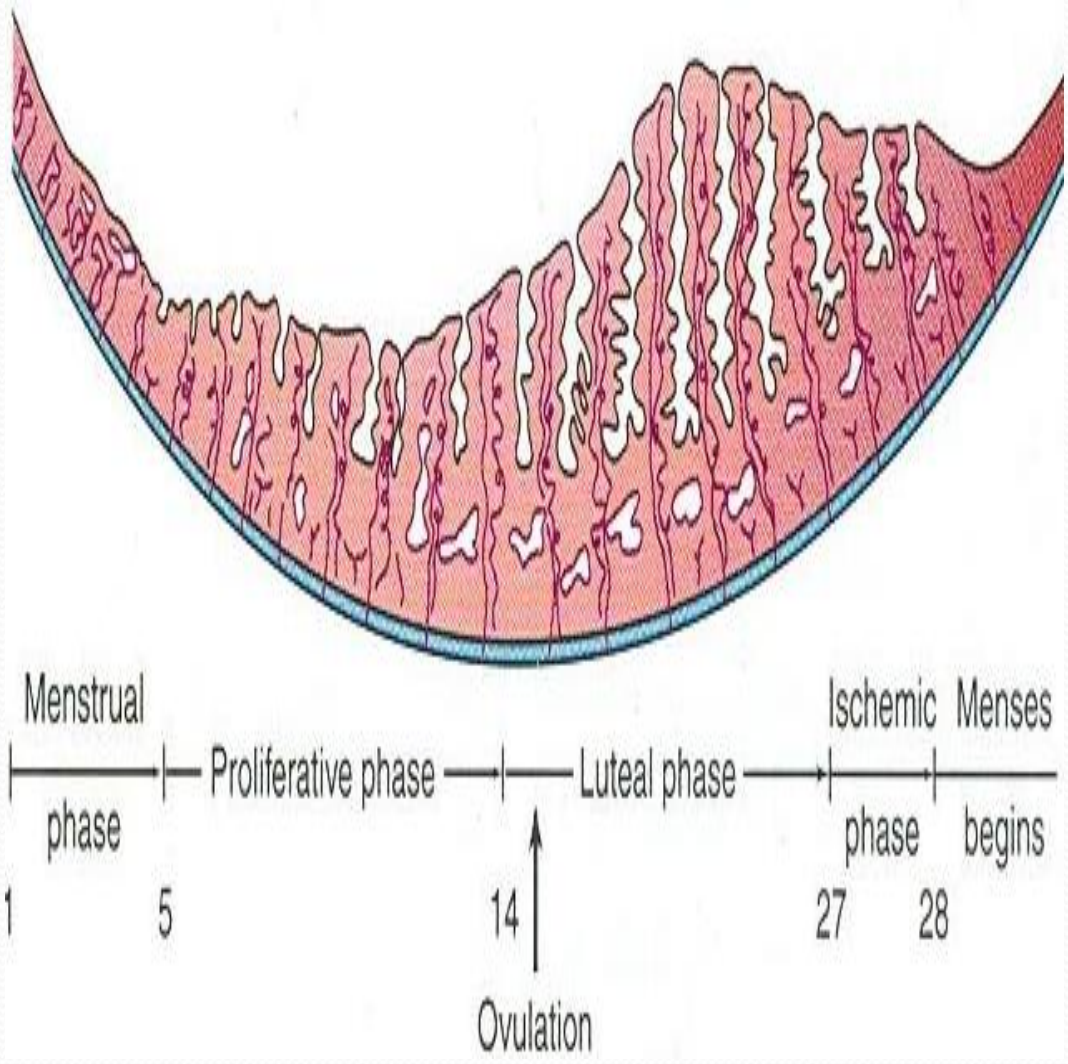
- Spiral arteries grow into the superficial layer.
- Arteries become increasingly coiled.
- Large venous network develops.
- Direct arterio-venous anastomosis is a prominent features.



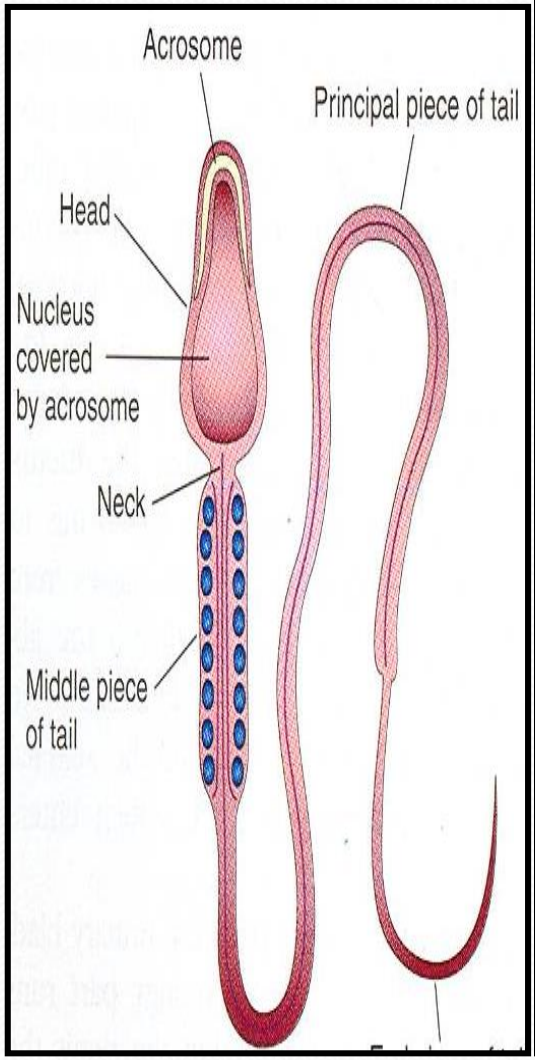
# Ischemic Phase

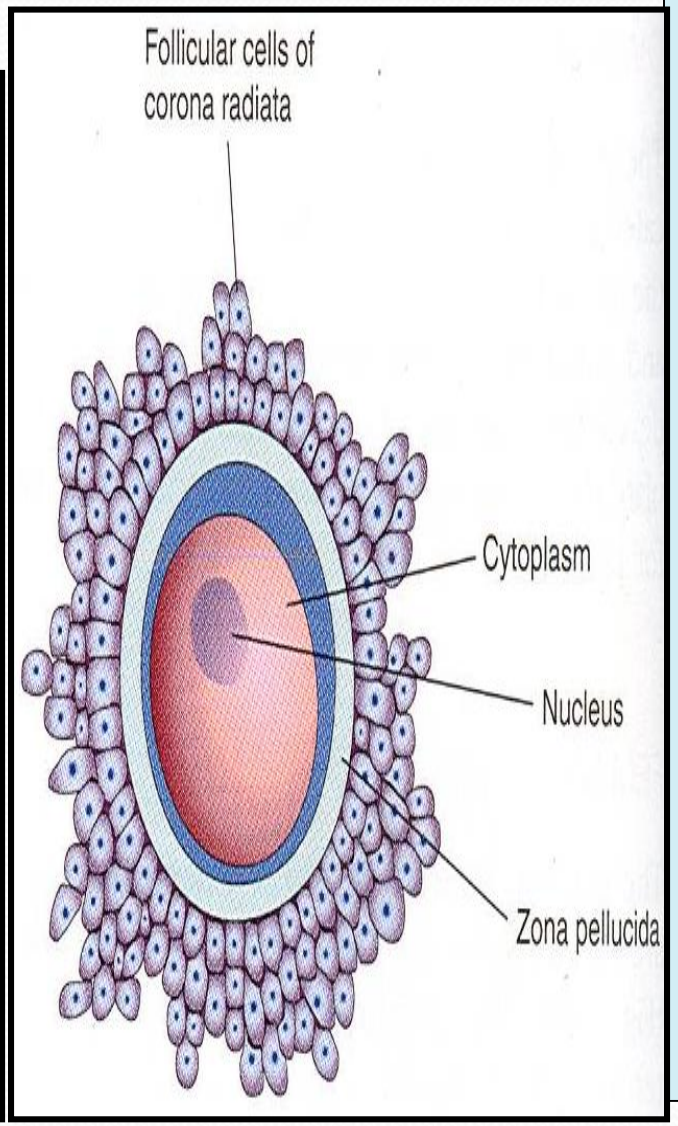
- **Degeneration** of corpus luteum leads to decrease the levels of estrogen & progesterone **<u>which lead to</u>**:

1. Loss of interstitial fluid.
2. Marked shrinking of endometrium.
3. Spiral arteries become constricted.
4. Venous stasis & Ischemic necrosis.
5. Rupture of damaged vessel wall.
6. Blood seeps into the surrounding connective tissues.
7. Loss of **<u>20-80</u>** ml of blood.
8. Entire compact layer and most of the spongy layer of endometrium is discarded.



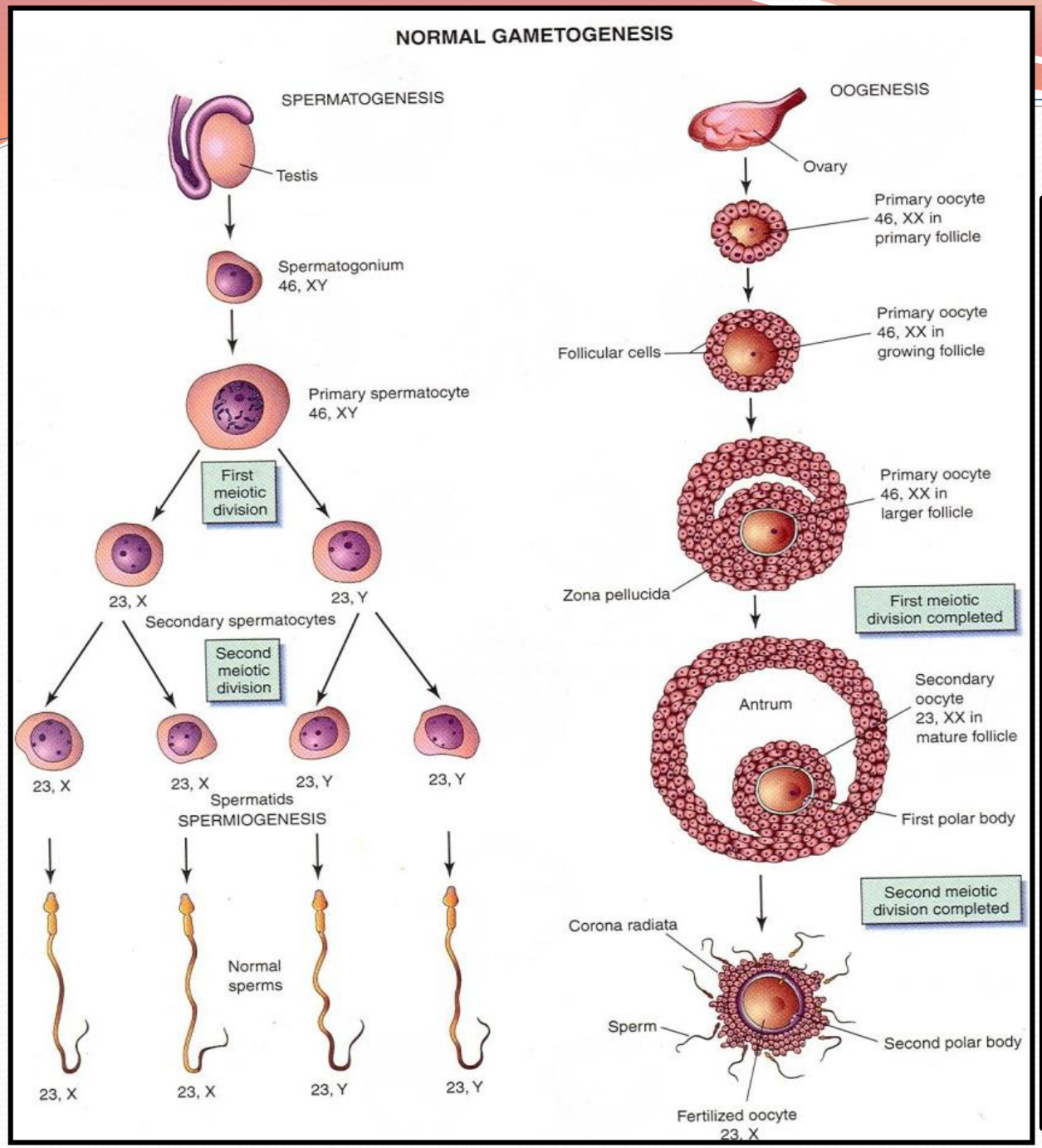
# GAMETOGENESIS
## *(Gamete Formation)*




**It is the production of mature male & female gametes (Sperms & Ova).**

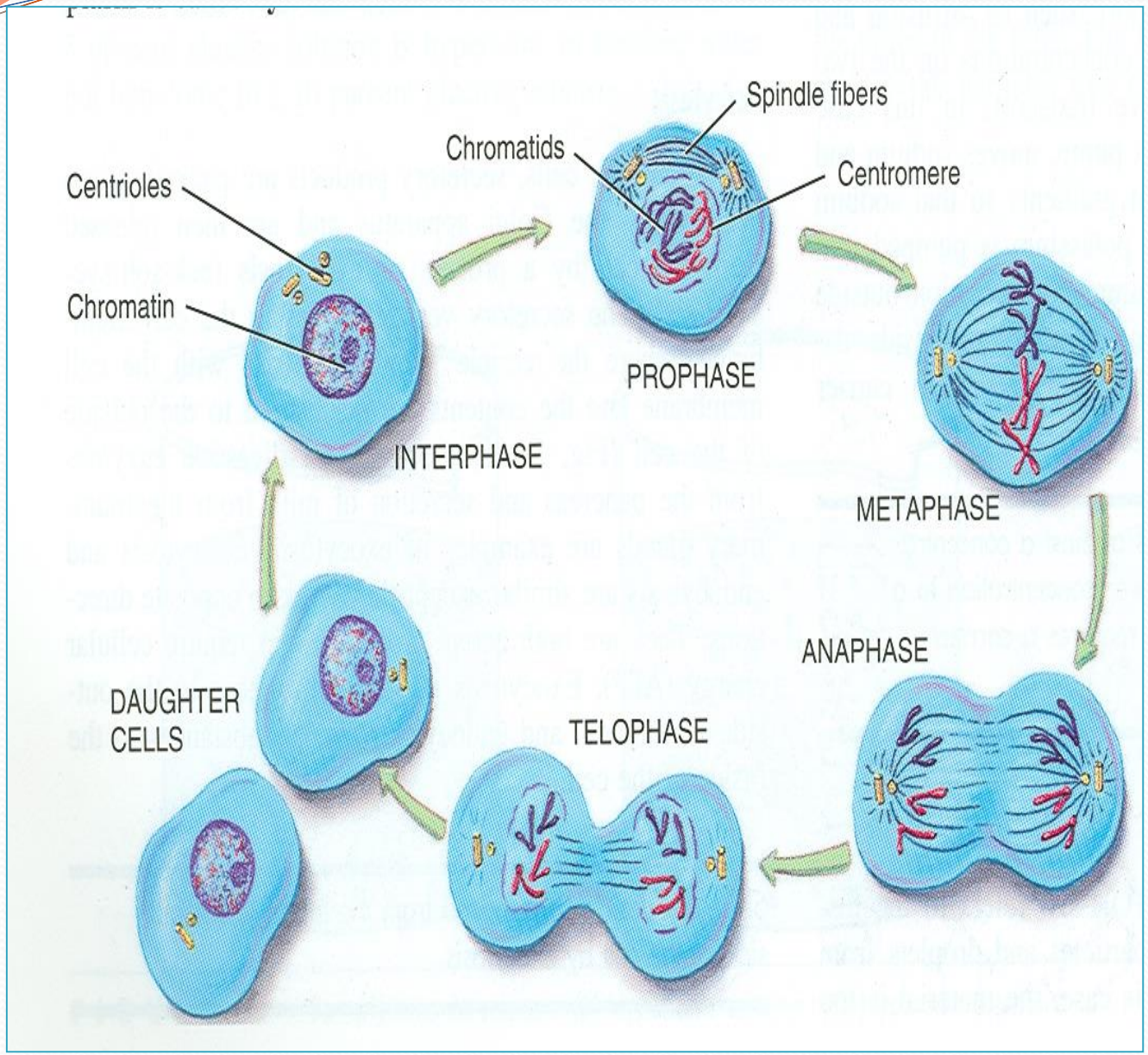
- **Spermatogenesis:**
- **It is the series of changes by which the primitive germ cells (spermatogonia) are transformed into mature sperms.**
- **Oogenesis:**
- **Sequence of events by which the primitive germ cells (oogonia) are transformed into mature oocytes.**




# MEIOSIS

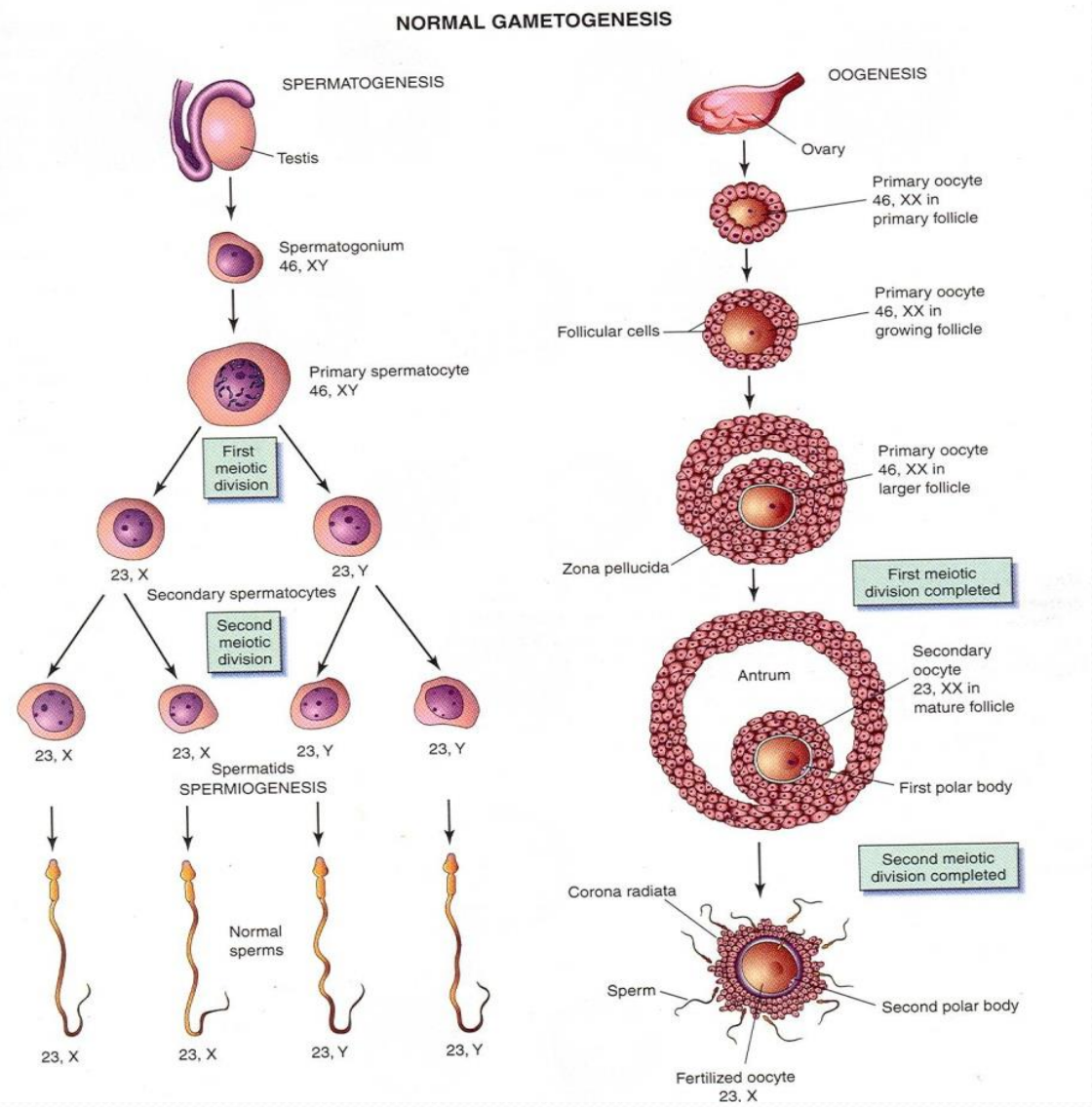
- It is reduction cell division that takes place only in the **germ cells** to produce **male & female gametes.**
- It consists of two cell divisions, **meiosis I & meiosis II,** during which the **Diploid** number of chromosomes (46) is reduced to **Haploid** number (23).

# FIRST MEIOTIC DIVISION



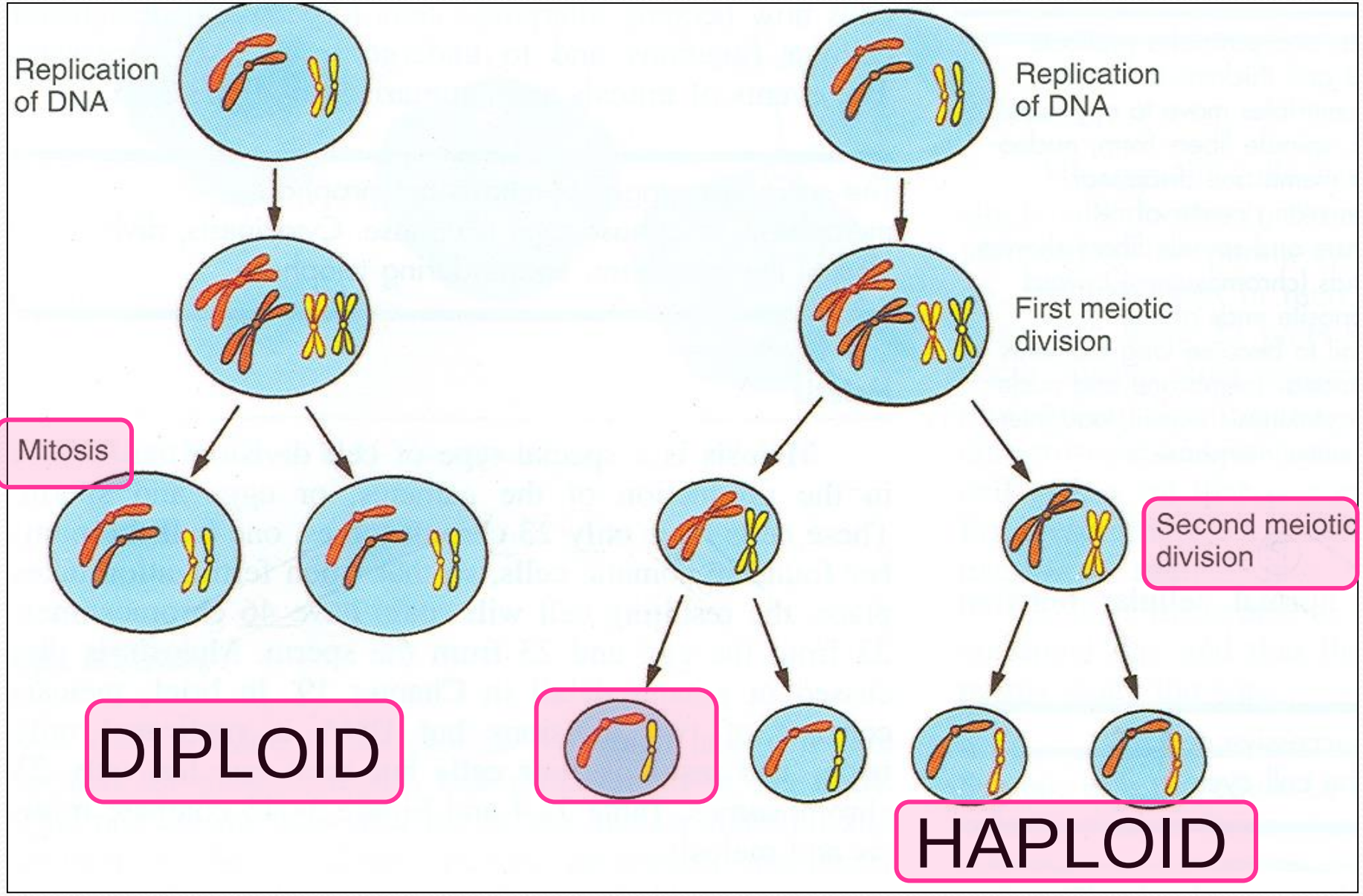

*At the beginning of meiosis, (prophase) male & female germ cells replicate their* **DNA** *so that each of the 46 chromosomes is duplicated into sister Chromatid.*

# FIRST MEIOTIC DIVISION

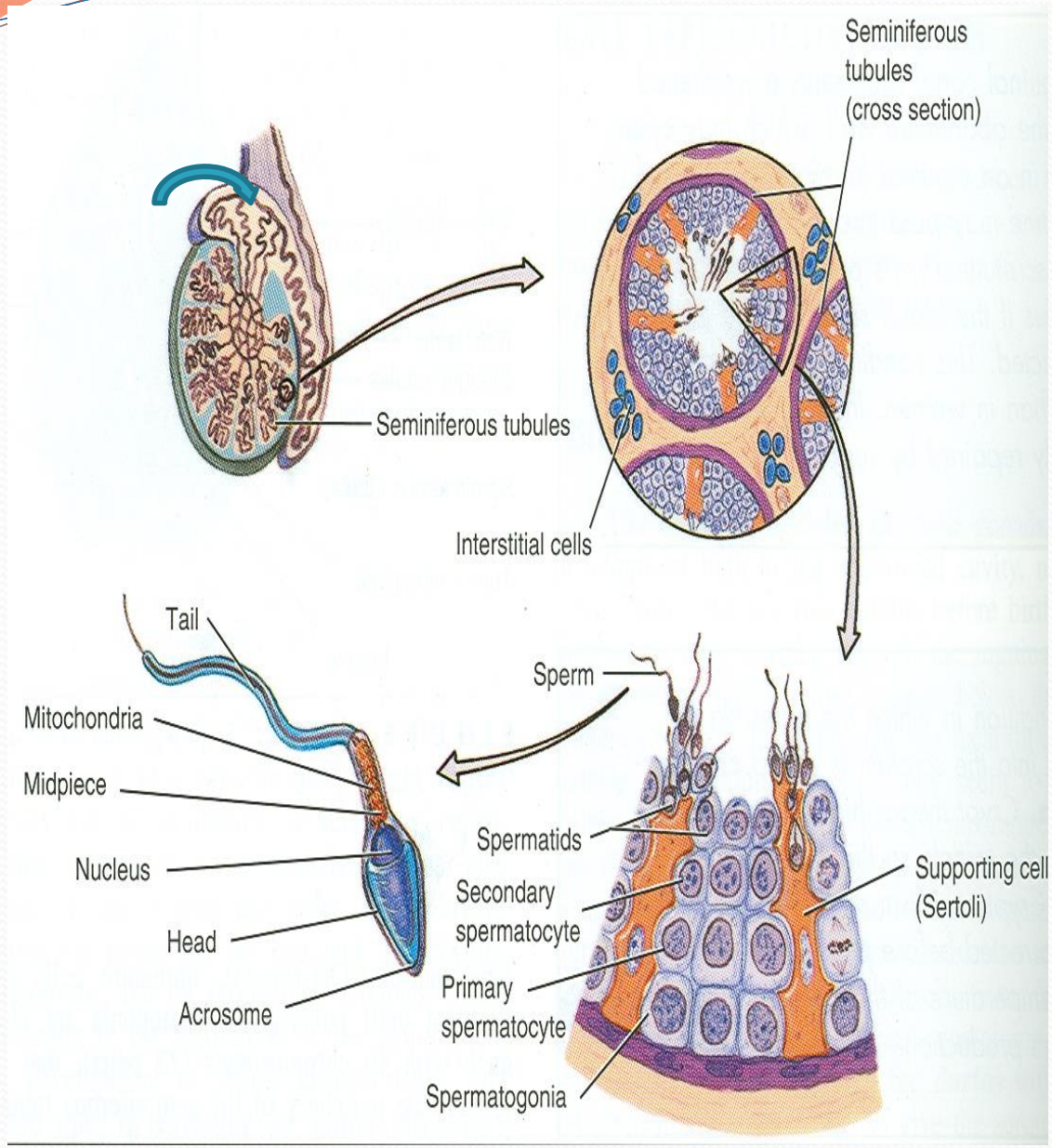



- *By the end of the first meiotic division, each new cell formed* ***(Secondary Spermatocyte or Secondary Oocyte)*** *has haploid (**half**) number of chromosome.*
- *It is half number of chromosomes of the* ***Primary Spermatocyte or primary Oocyte.***

# WHAT IS THE DIFFERENCE BETWEEN MITOSIS & MEIOSIS?

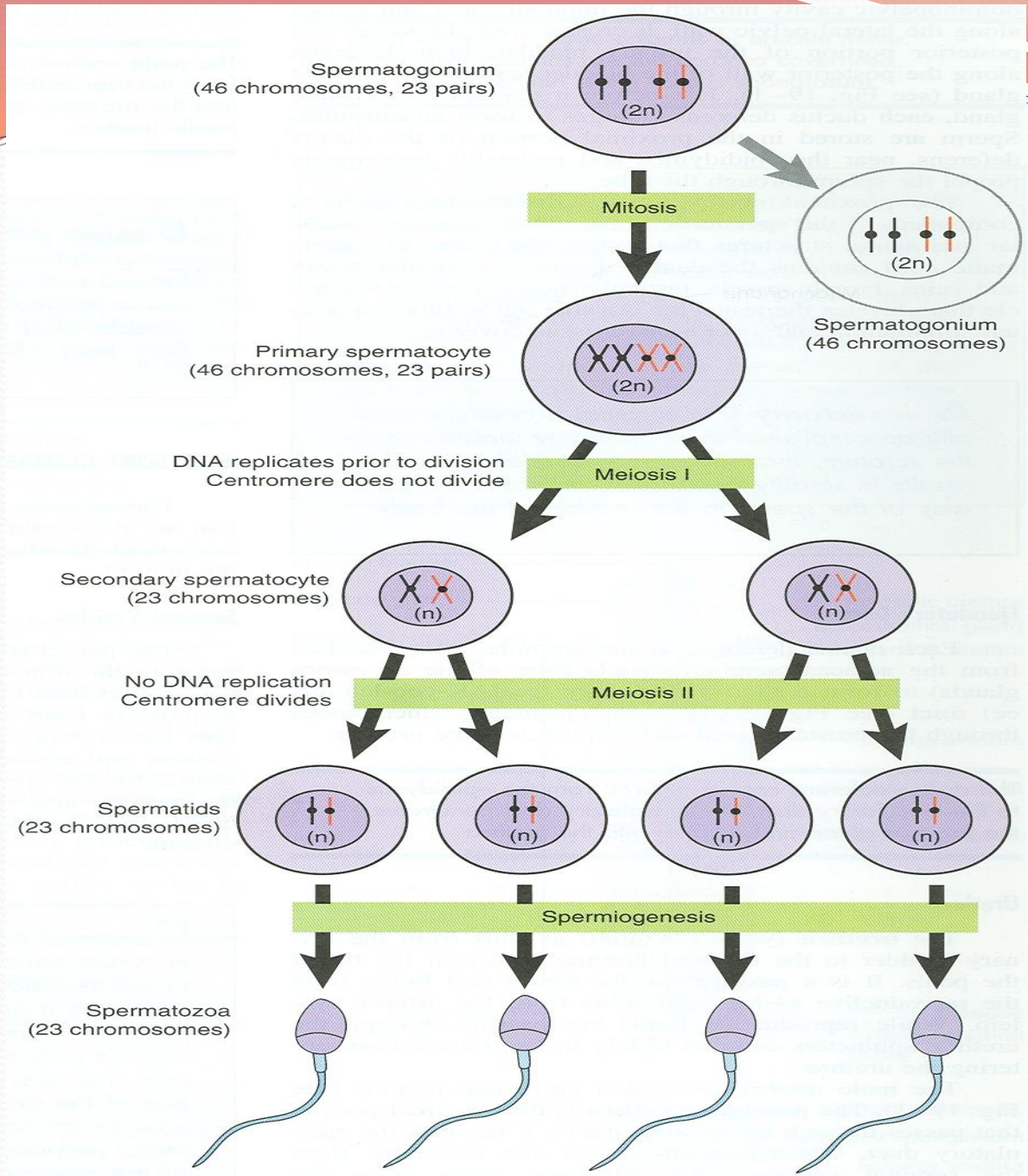


# SPERMATOGENESIS



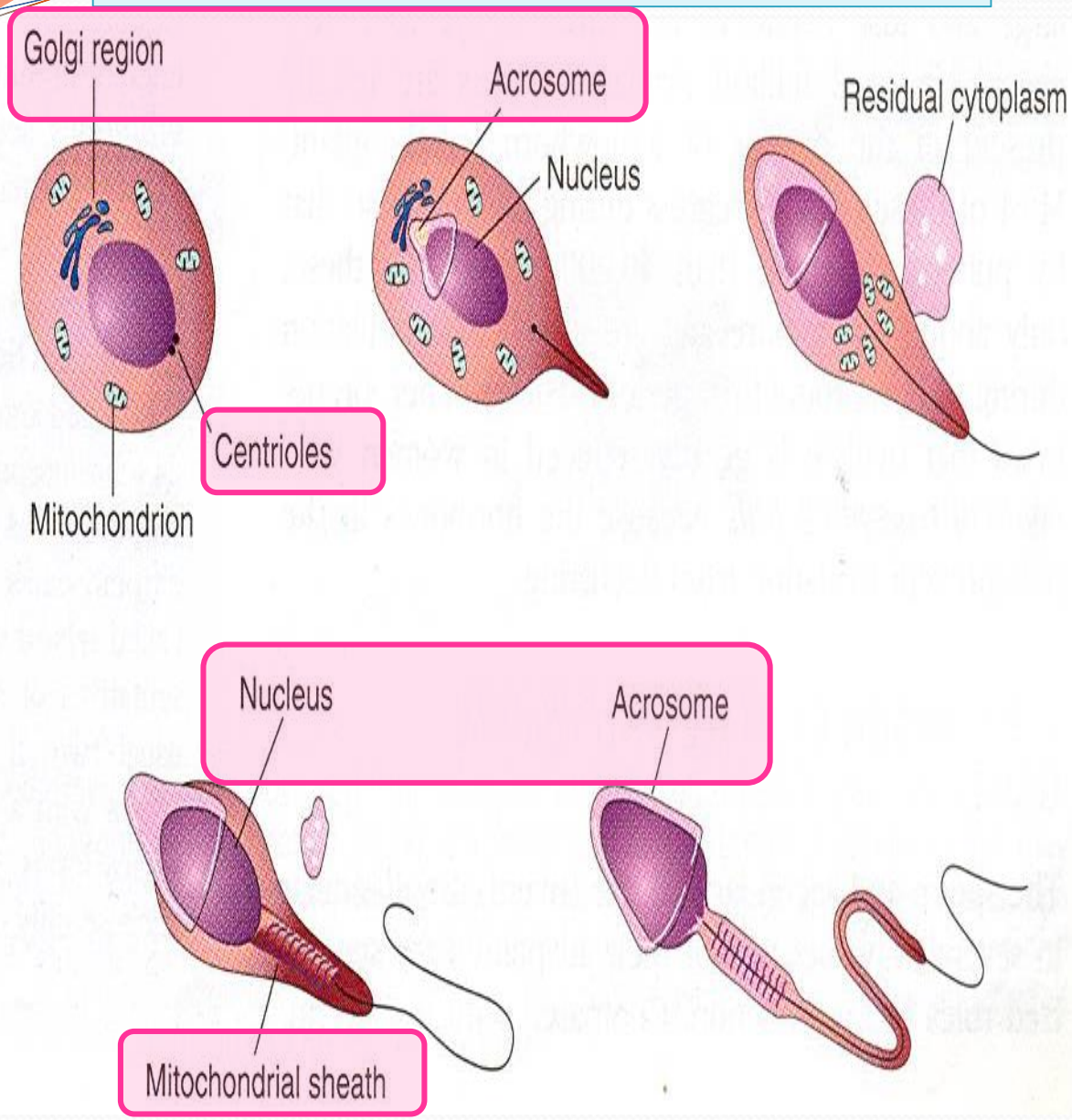

- **AIM:**
- Formation of sperms with haploid number of chromosomes.
- **SITE:**
- Seminiferous tubules of the testis.
- **TIME:**
- From puberty till old age.
- **DURATION:**
- **About two months.**
- **N.B. Sperms are stored and become functionally mature in the Epididymis.**

# SPERMATOGENESIS




- Each spermatogonium divides by mitosis into 2 daughter Spermatogonia .
- Each daughter spermatogonia grows to give rise to **primary spermatocyte (46).**
- ----------
- Primary spermatocyte undergoes ***meiosis*** to give rise to **secondary spermatocyte (22+ x) or (22+y).**
- Each **secondary** spermatocyte divides & redivides to give **spermatid (23).**

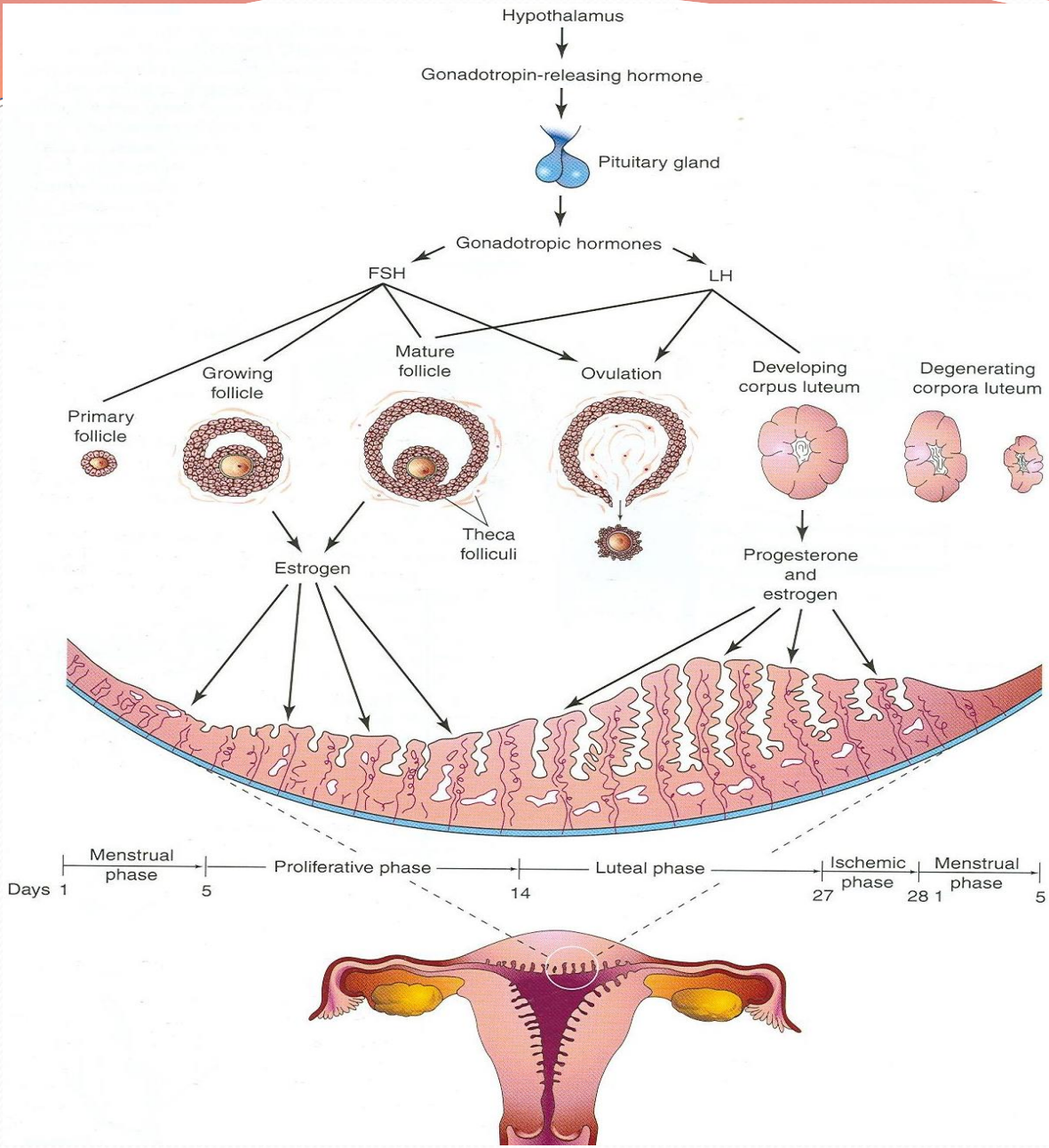
# SPERMIOGENESIS




- *It is* ***change in shape*** *(****metamorphosis****) through which the Spermatids are transformed into mature Sperms:*

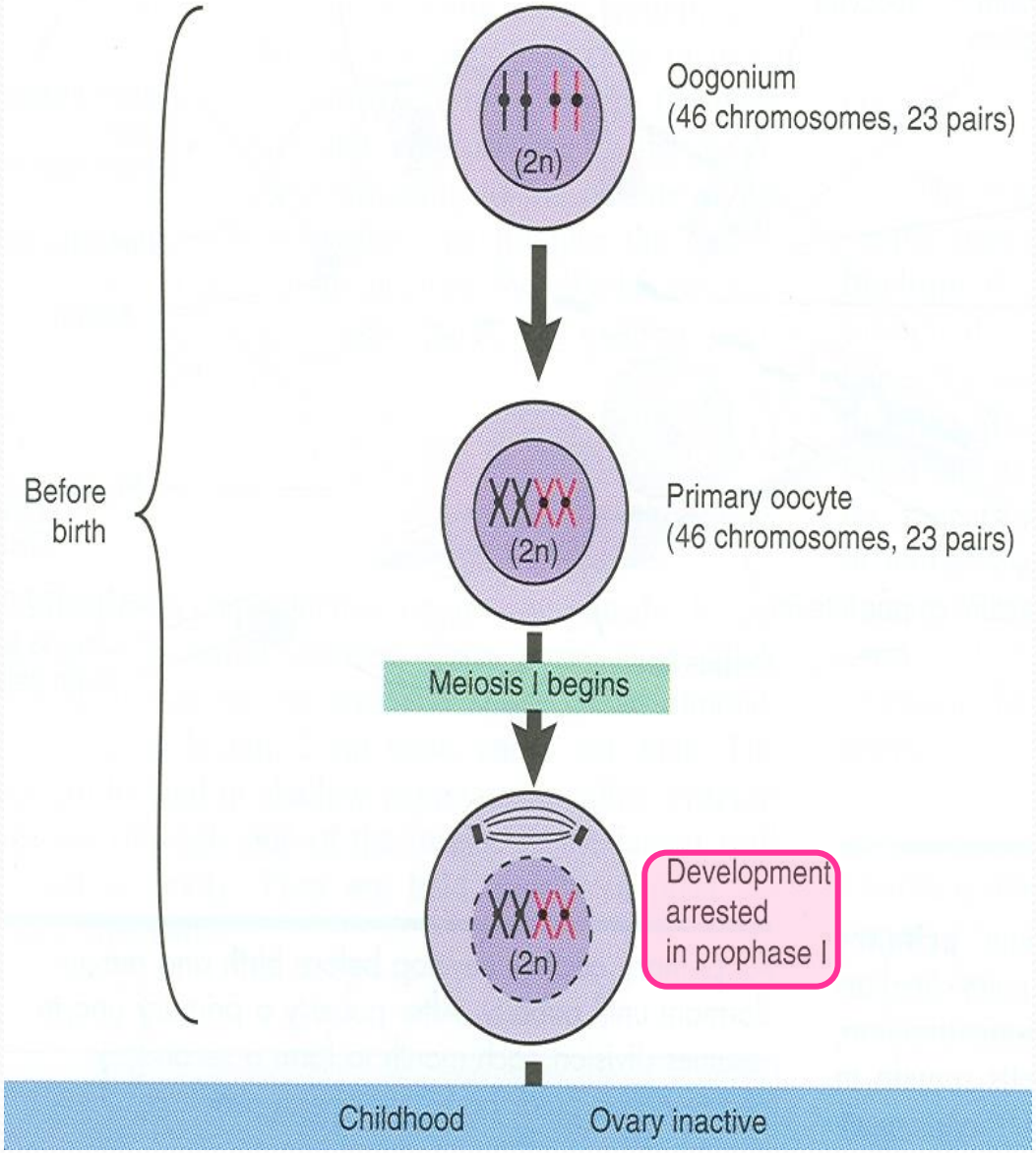
1. ***Nucleus*** *is condensed and forms most of the head.*
2. ***Golgi apparatus*** *forms the Acrosome, (acrosomal cap).*
3. ***Mitochondria*** *forms a spiral sheath.*
4. ***Centriole*** *elongates to form the axial filament.*

# OOGENESIS



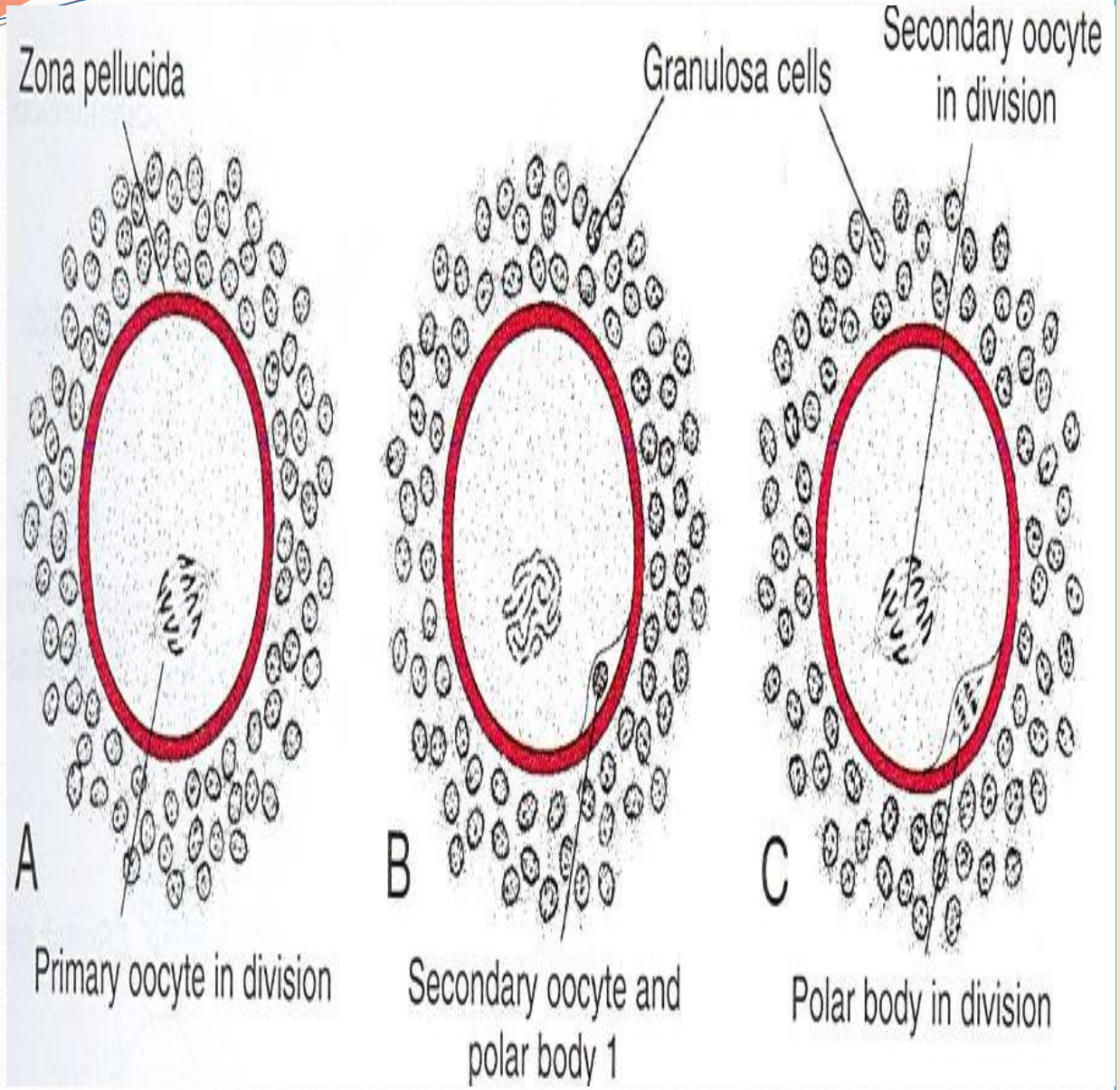

- **AIM:**
- **Formation of secondary oocytes with haploid number of chromosomes.**
- **SITE:**
- **Cortex of the ovary**
- **TIME:**
- **Starts very early during fetal life becomes completed after puberty & continues until menopause.**
- **NB. It occurs monthly Except during pregnancy.**

# OOGENESIS



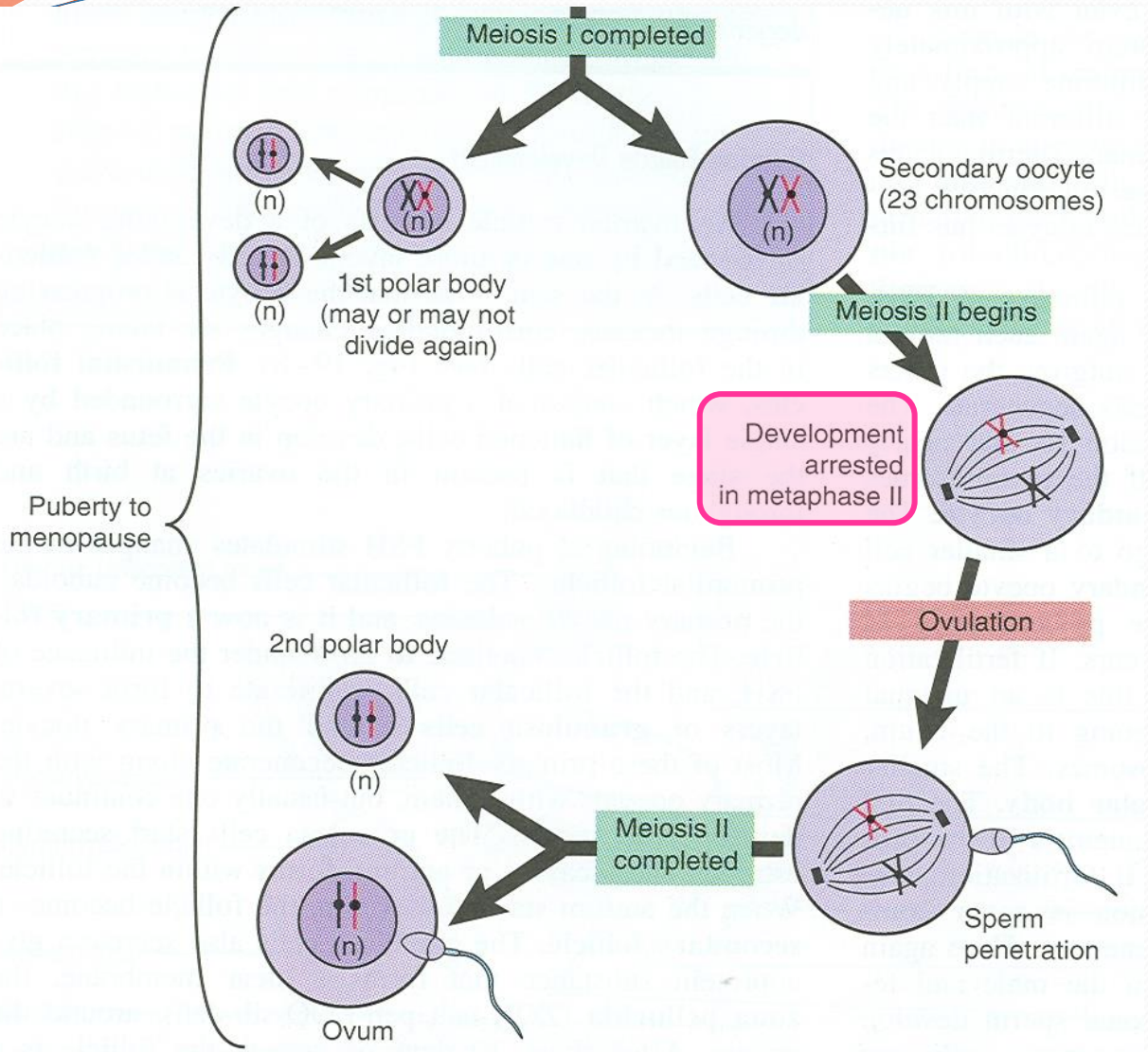

- ***Before Birth*:**
- *During early fetal life, primitive ova (Oogonia) proliferate by mitotic division and enlarge to form **Primary Oocytes (46).***
- ***At Birth:***
- *All primary oocytes have completed the **prophase of the 1st meiotic division** and remain arrested at **prophase** and do not finish their first meiotic division until puberty.*

# OOGENESIS



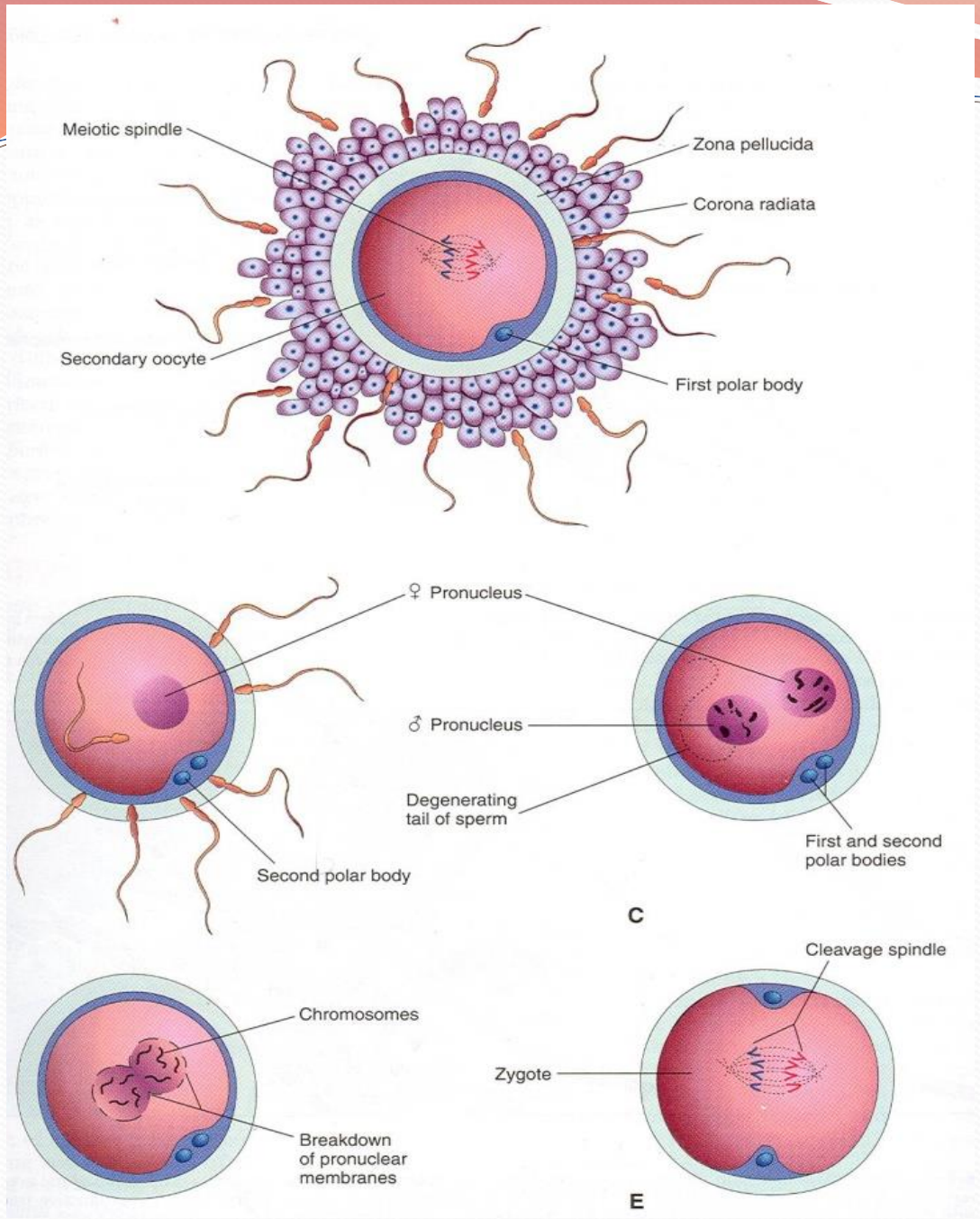

- ***After Puberty :***
- *Shortly before ovulation, the Primary Oocyte completes its first meiotic division to give Secondary oocyte (23) & First Polar Body.*
- *The Secondary Oocyte receives almost all the cytoplasm.*
- *The First Polar Body receives very little cytoplasm.*
- *The 1st polar body is a small nonfunctional cell that soon degenerates.*

# OOGENESIS




- ***At ovulation,*** *the nucleus of the secondary oocyte begins the* ***second meiotic division*** *but progresses only to* ***metaphase*** ***where division is arrested.***

# OOGENESIS




- *If the secondary oocyte is **fertilized,** the second meiotic division is completed otherwise it degenerates in 24 hours after ovulation.*
- *Most of the cytoplasm is retained by the **Mature Oocyte** (Fertilized Oocyte).*
- *The rest is called the 2nd **Polar Body** which soon degenerates.*

| DURING FETAL LIFE | AFTER PUBERTY DURING EACH OVARIAN CYCLE | AFTER FERTILIZATION |
|---|---|---|
| **Proliferation:**<br>each oogonium divides by mitosis into 2 daughter oogonia (with diploid number of chromosomes: (44 + XX)<br>**Growth:**<br>oogonium enlarges to form primary oocyte (with diploid number).<br><br>Primary oocytes begin 1st meiotic division which stops at **prophase** | 1st meiotic division is completed: (shortly before ovulation):<br>a reduction division by which a primary oocyte divides into one secondary oocyte (haploid number of chromosomes: (22 + X) & 1st polar body (degenerates)<br><br>2nd meiotic division begins: begins at ovulation, progresses only to **metaphase** and becomes arrested. | 2nd meiotic division is completed:<br>2ry oocyte divides into a mature ovum (haploid number) & 2nd polar body (degenerates). |

**N.B.: NO PRIMARY OOCYTES FORM AFTER BIRTH**

# GOOD LUCK