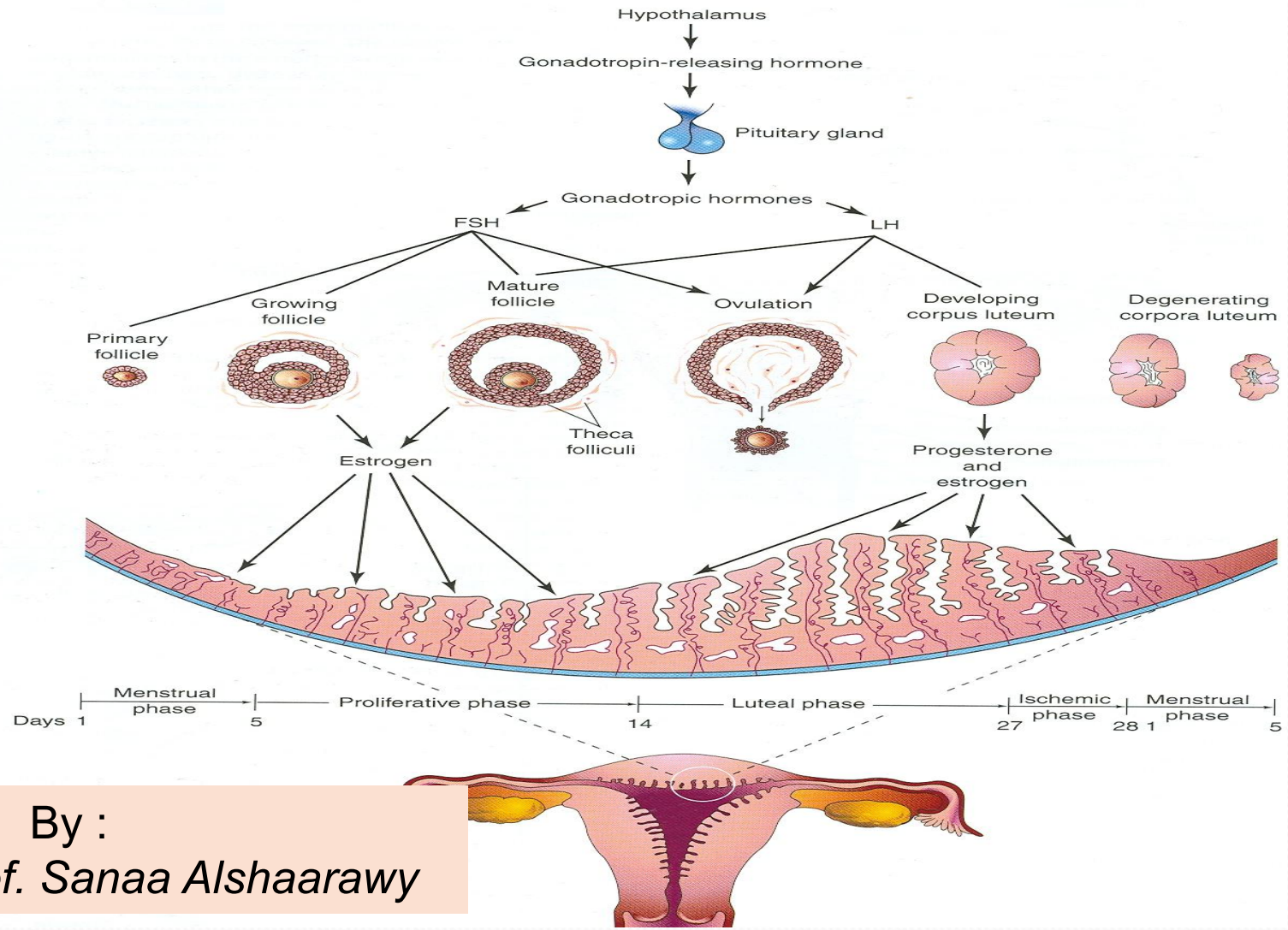
GAMETOGENESIS & FEMALE CYCLES



By :
Associate Prof. Sanaa Alshaarawy

OBJECTIVES

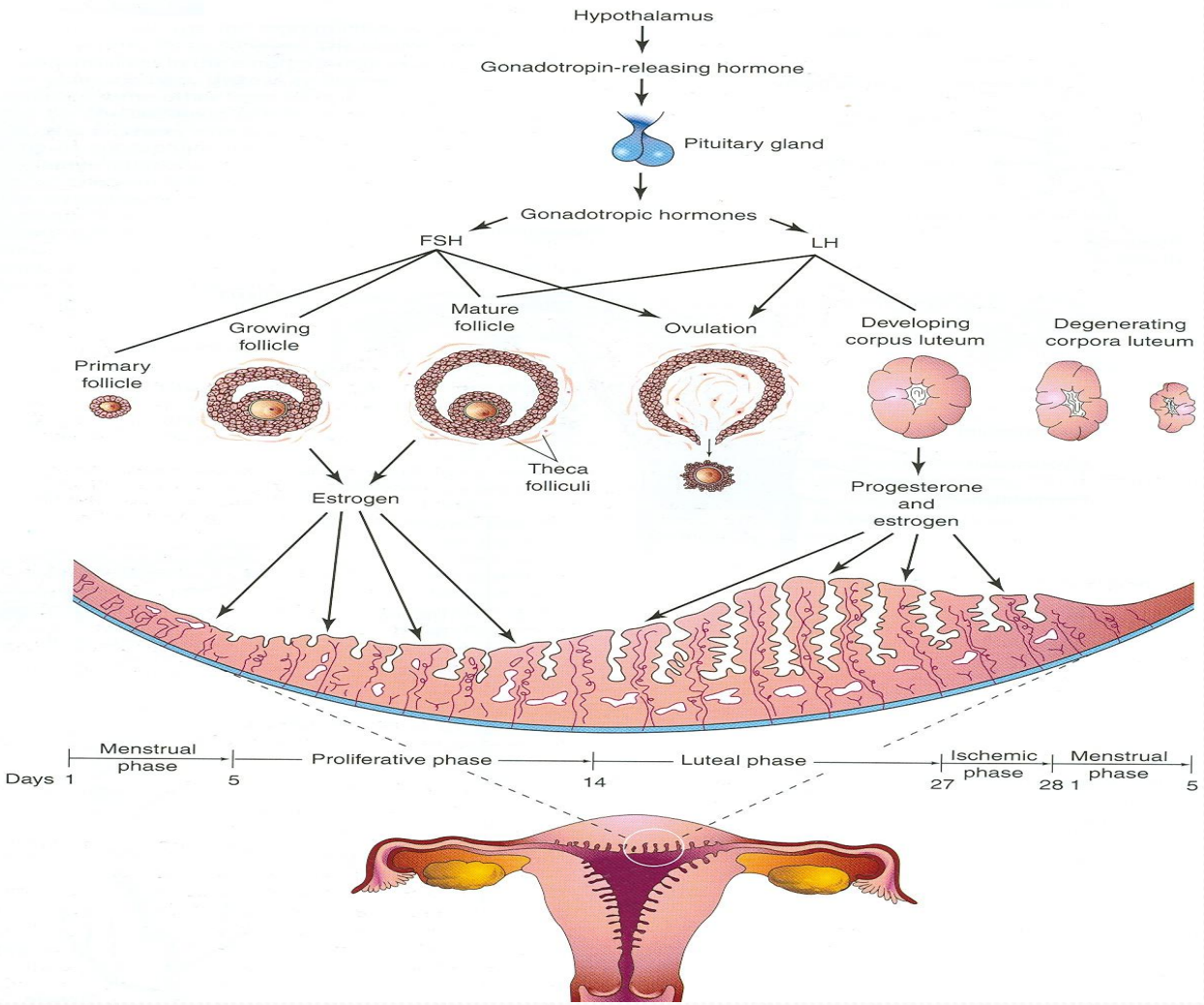
- ***By the end of the lecture, you should be able to:***
- **Describe the female cycles (Ovarian & Uterine).**
- **Define gametogenesis.**
- **Differentiate the types of gametogenesis.**
- **Describe the process of spermatogenesis.**
- **Describe the process of oogenesis.**

Female Reproductive Cycles

OVARIAN AND UTERINE CYCLES

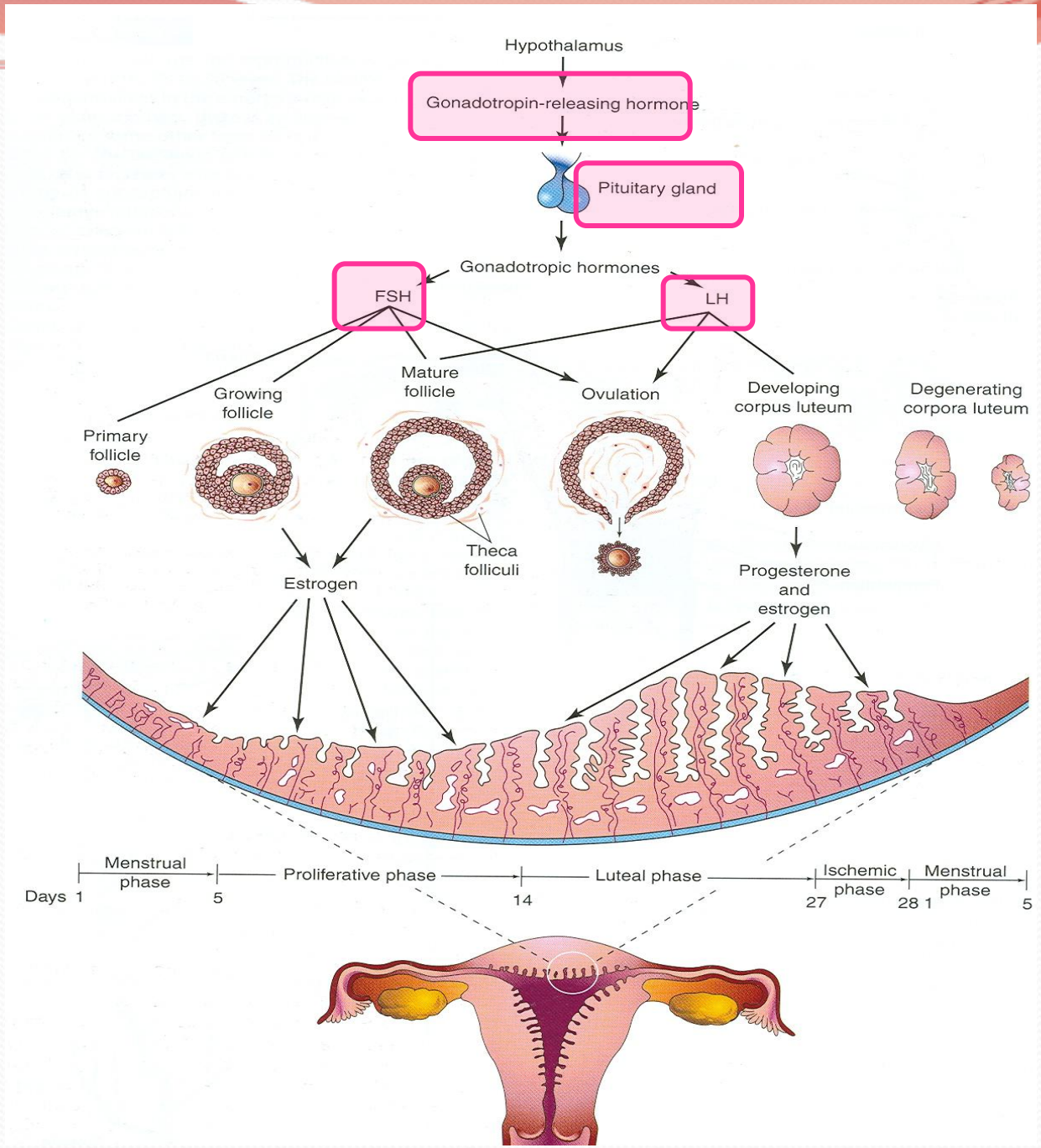
- **Start** at puberty.
- Normally continues until the **menopause.**
- Reproductive cycles depend upon activities & coordination of:

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

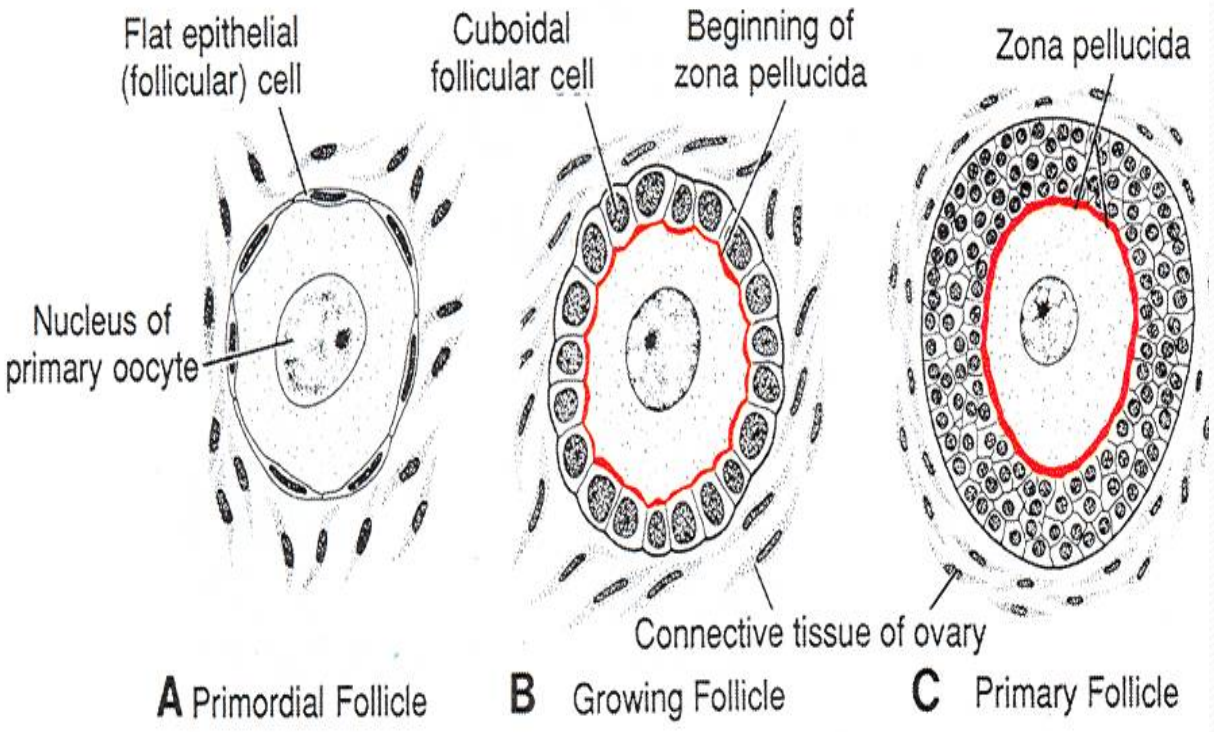


GnRH

- **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



Follicular Phase FH

Early development of ovarian follicle is induced by FSH.

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

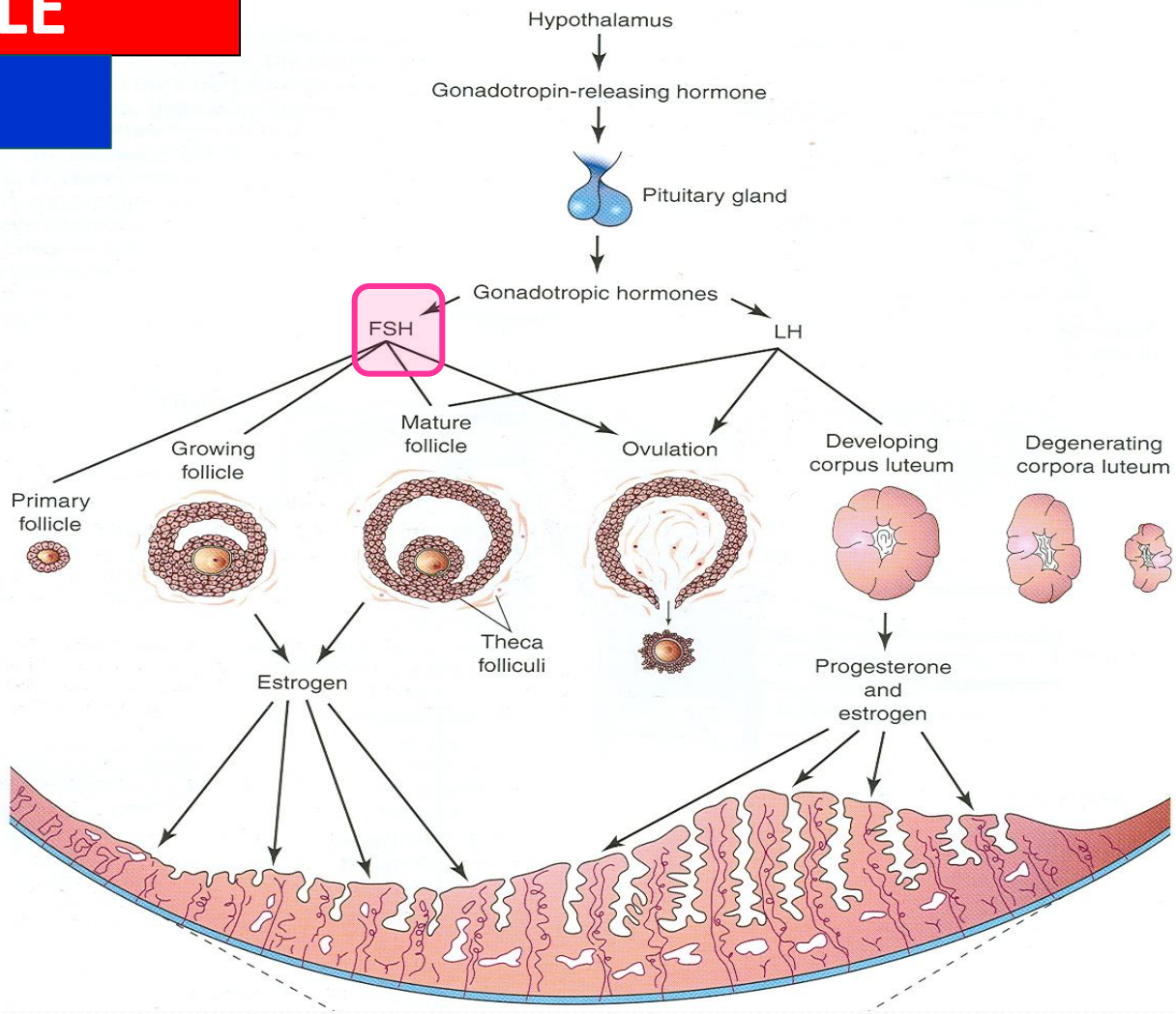
- The **ovarian cycle** is under the control of the **Pituitary Gland.**
- It is divided into 3 phases: (**FOL**)
- **1- Follicular, (FSH)**
- **2- Ovulatory, (LH).**
- **3- Luteal. (LH).**
- The ovarian cortex contains **hundreds of thousands of primordial follicles** (400,000 to 500,000).
- **Each consists** of one primary oocyte encircled by single layer of flat follicular cells.

OVARIAN CYCLE

Follicular Phase

FSH

- **FUNCTIONS:**
- **1- It stimulates the ovarian primary follicles to develop and become mature.**
- **2- Production of *Estrogen* by the follicular cells.**

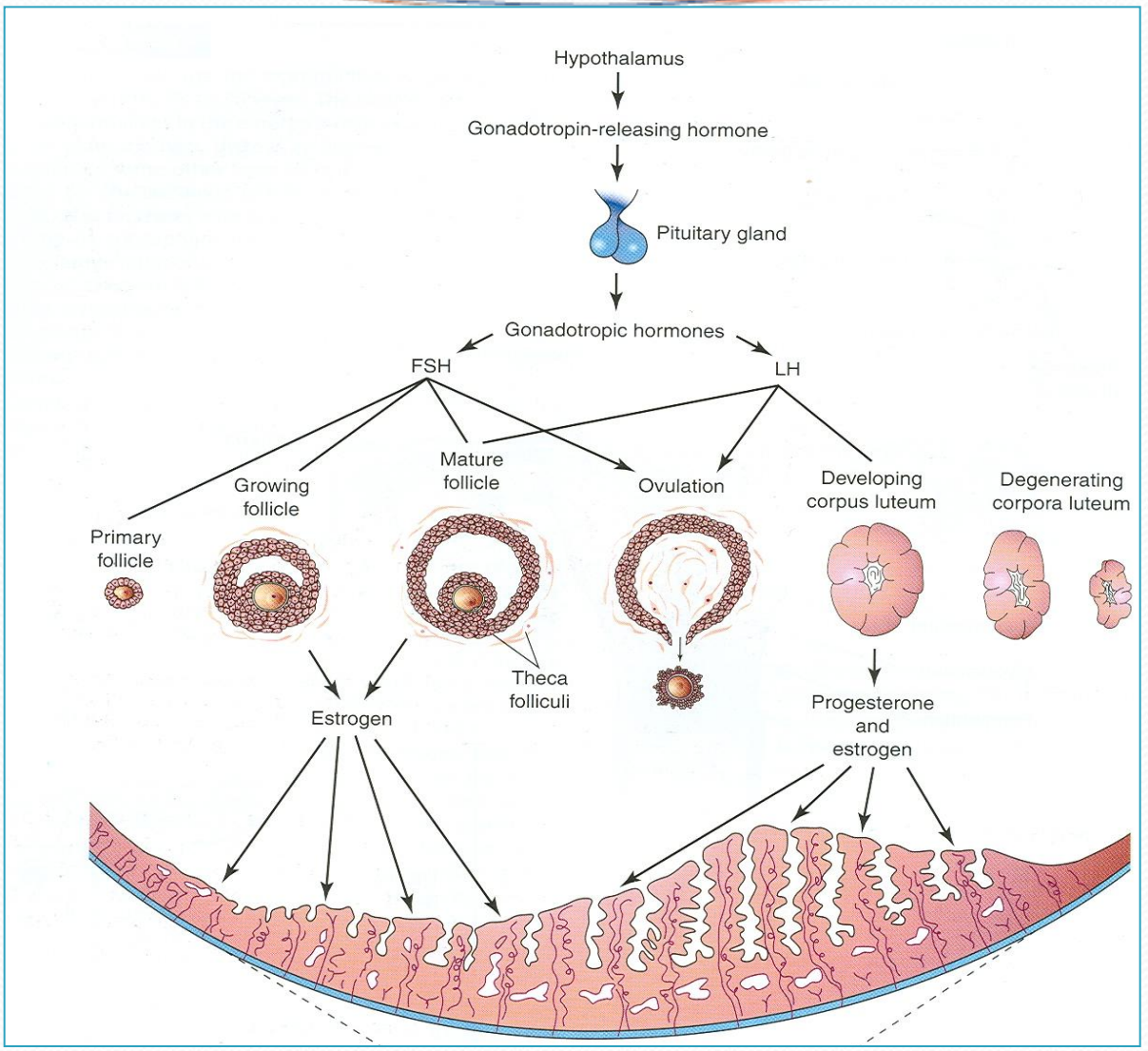


These Growing follicles produce estrogen which regulates the development and functions of the reproductive organs as breast & endometrium.

Ovulatory Phase

LH

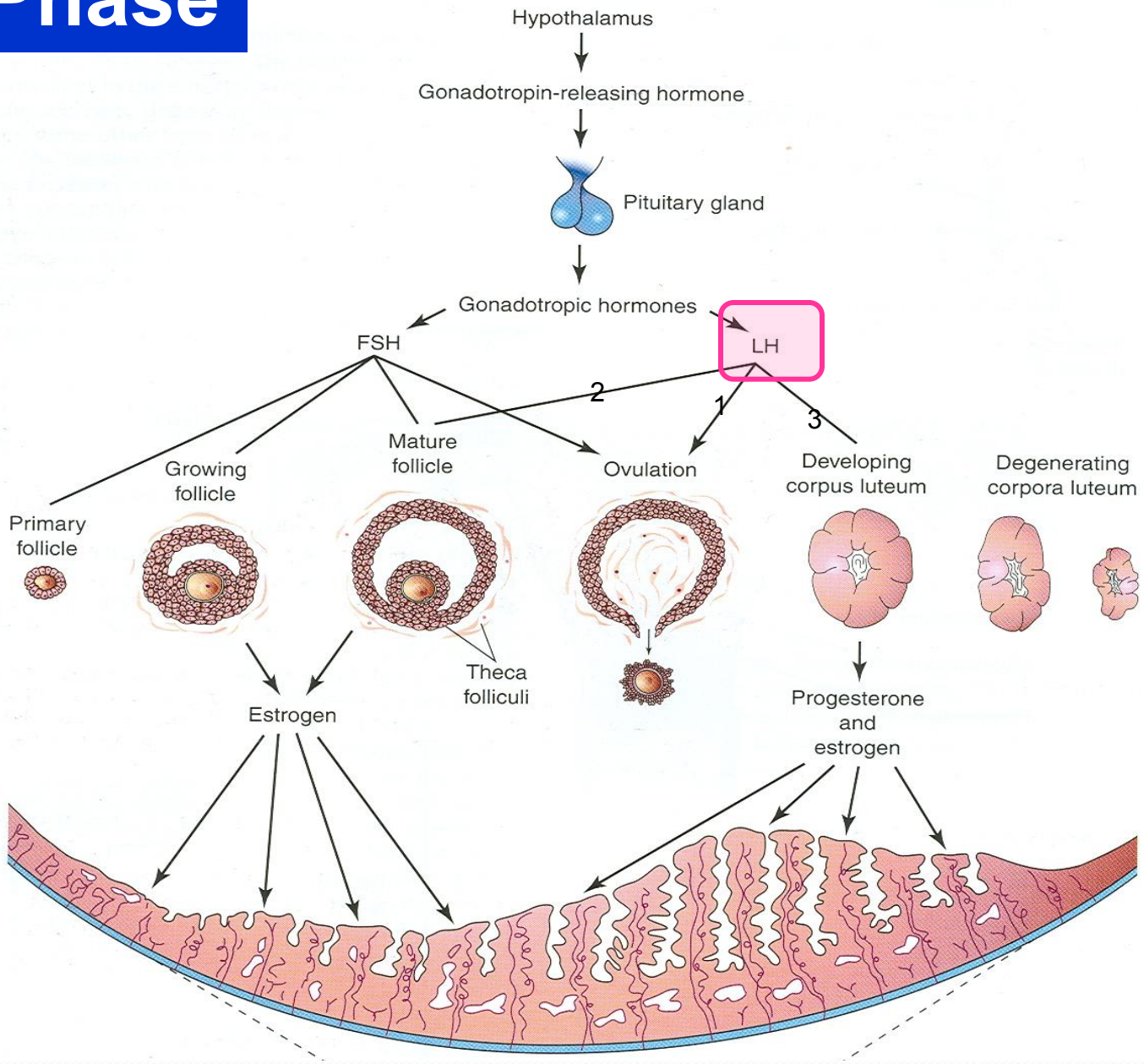
- The follicle becomes enlarged until it gets maturity.
- Early development of ovarian follicle is induced by FSH.
- Final stages of maturation require LH.
- LH. causes ovulation (rupture of the mature follicle).



Ovulatory Phase

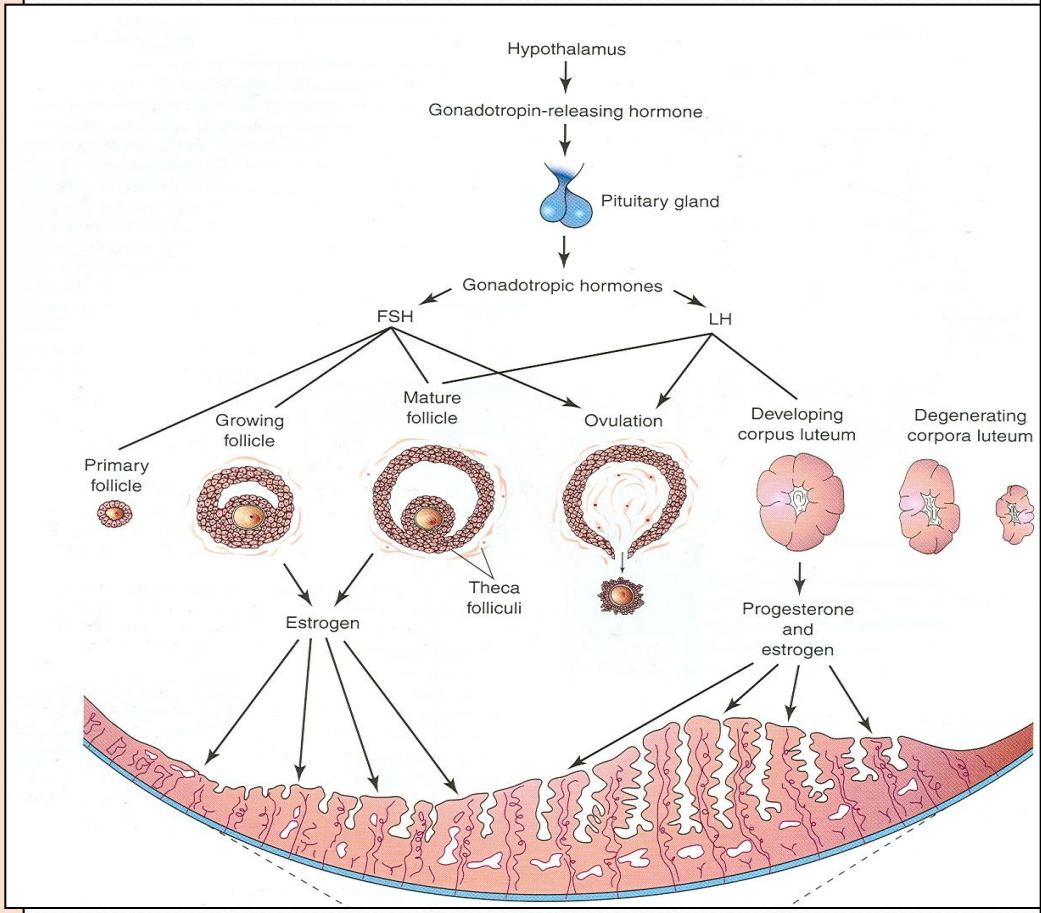
LH

- Luteinizing Hormone.
- **FUNCTIONS:**
- 1- It serves as the **trigger** for **ovulation.**
- 2- **Stimulates** the **mature follicles** to produce **Estrogen.**
- 3-**Stimulates corpus luteum** to produce **Progesterone.**



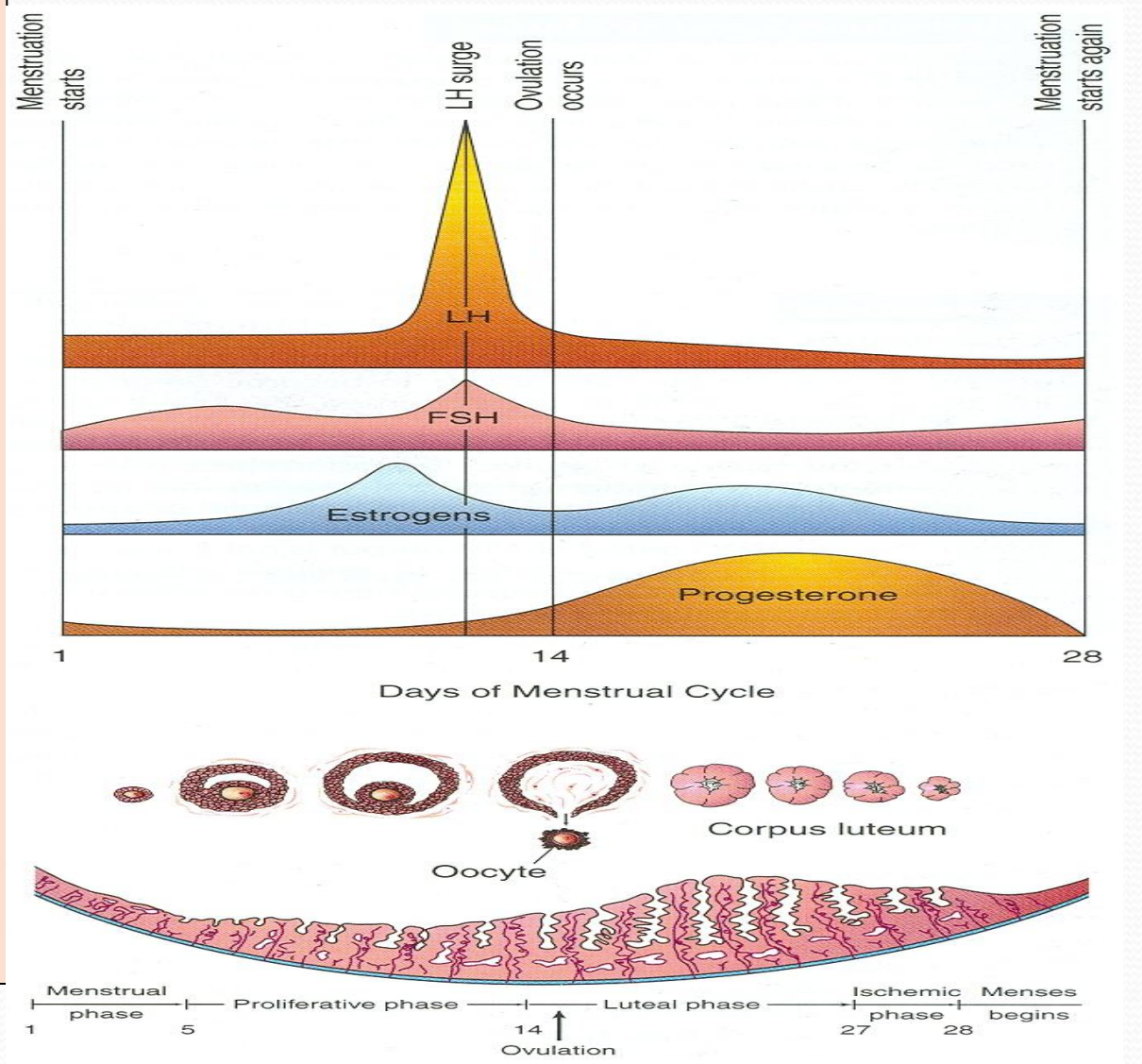
Luteal Phase & Corpus Luteum formation

- The remaining of the ruptured follicle is now called corpus luteum.
- It secretes Progesterone and small amount of Estrogen.
- These 2 hormones stimulate and prepare endometrium for implantation of fertilized Ovum (Blastocyst).
- If the oocyte is fertilized; the Corpus 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.



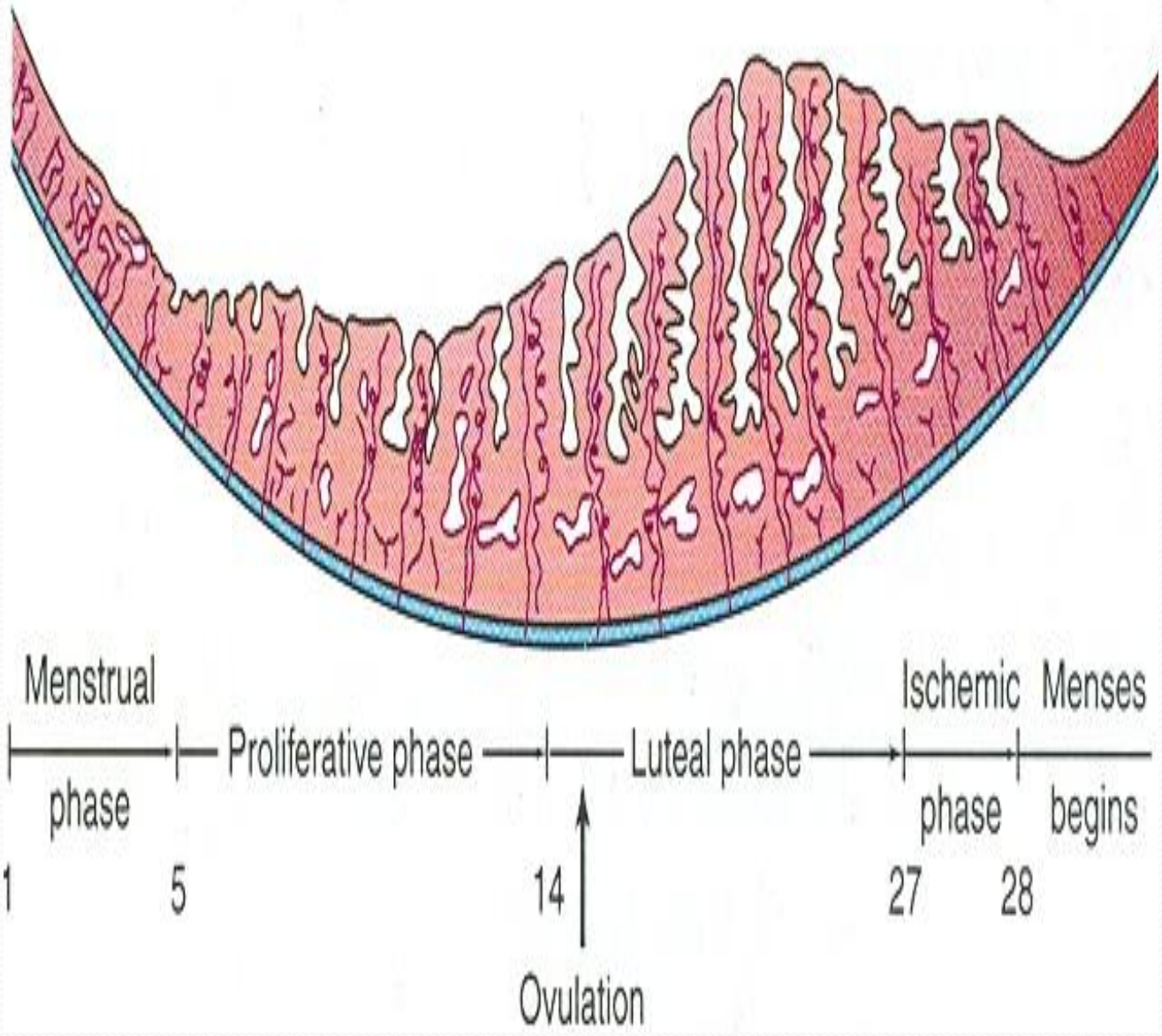
Uterine or Menstrual Cycle

- Cyclic changes in the endometrium of the uterus caused by estrogen & progesterone.
- Average menstrual cycle is 28 days.
- Day One is the day of beginning of menstrual blood flow.
- 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.



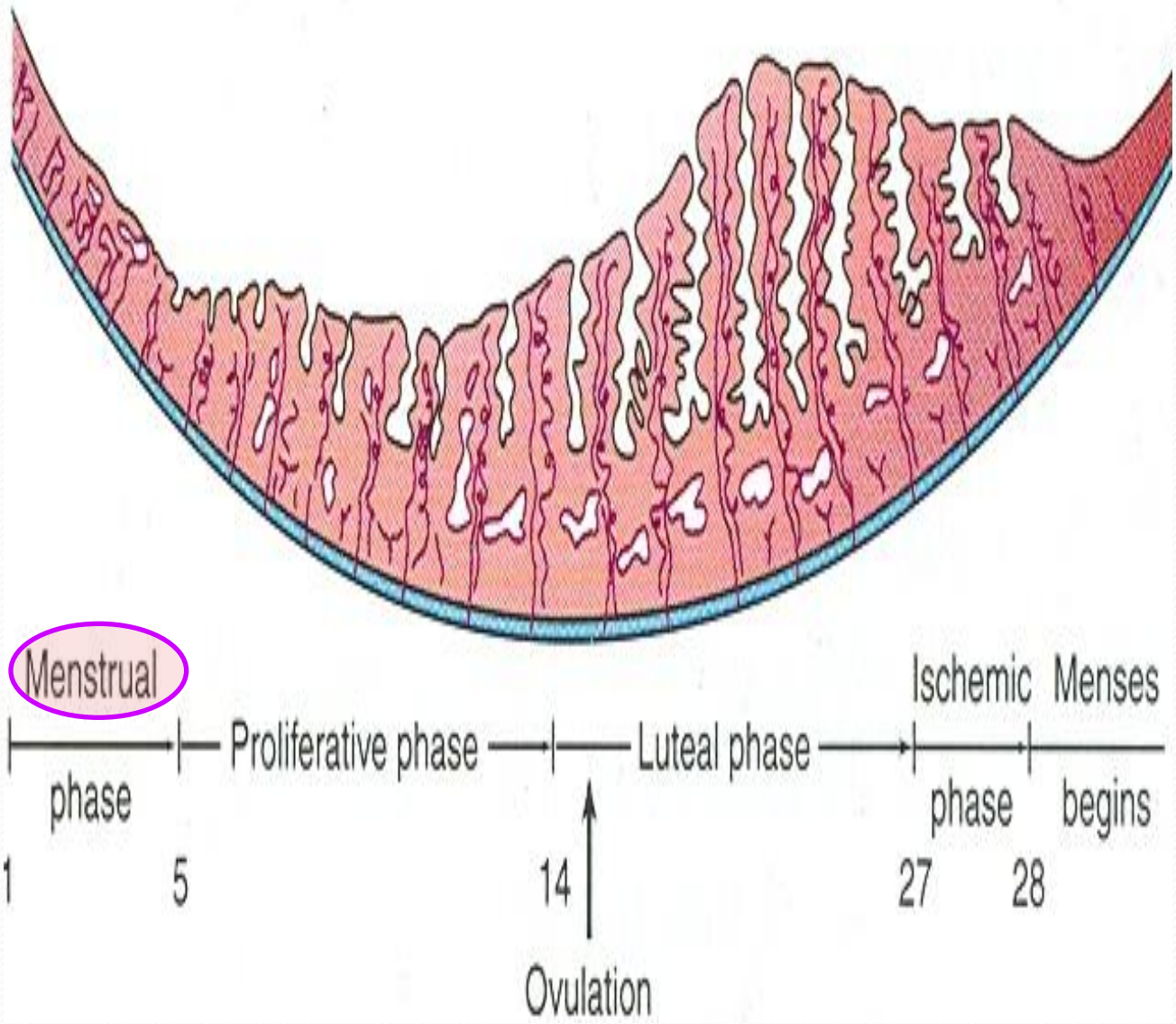
Phases of Menstrual Cycle

1. **Menstrual Phase**
2. **Proliferative or Follicular Phase**
3. **Luteal Phase**
4. **Ischemic Phase**



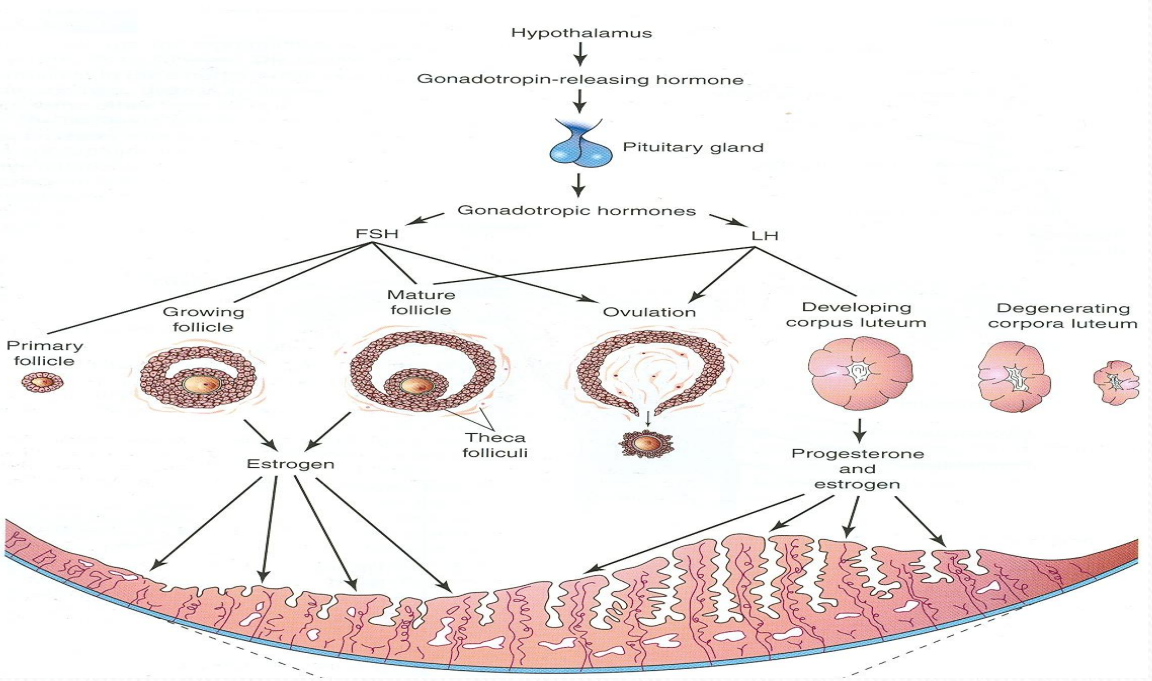
Menstrual Phase

- Starts with 1st day of menstrual cycle.
- Lasts for 4-5 days.
- Functional layer of the endometrium is sloughed off and discarded with the menstrual flow.
- So; Blood discharge from vagina is combined with small pieces of endometrial tissue.



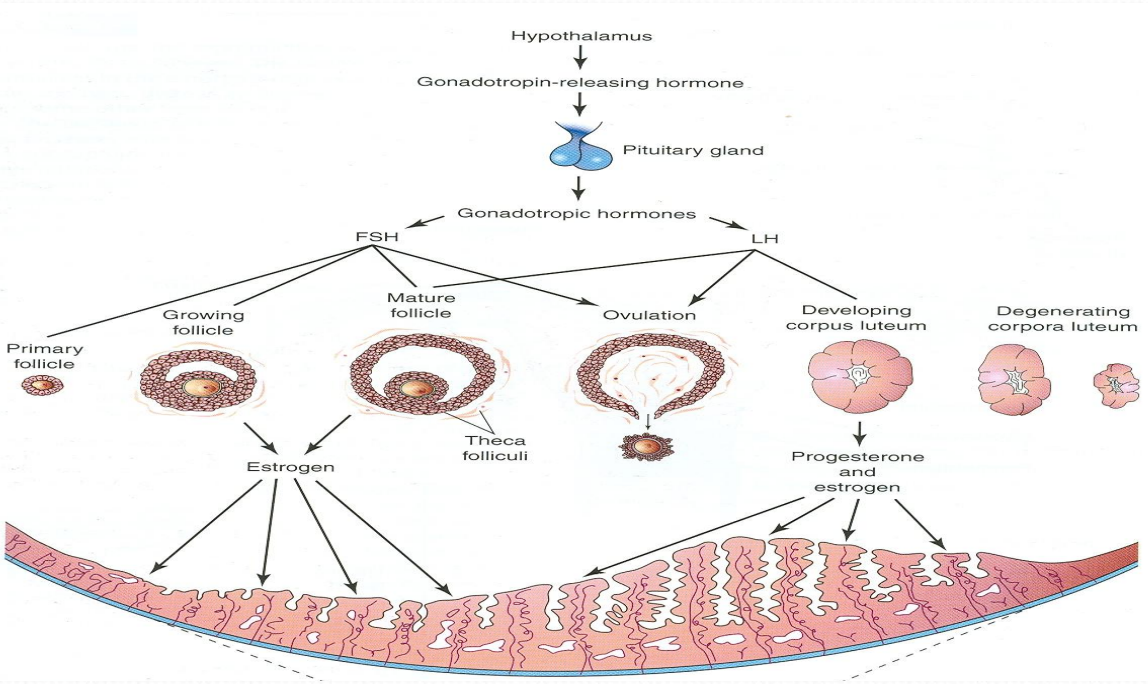
Proliferative Phase

- Is a phase of repair and proliferation.
- Lasts for 9 days.
- Coincides with growth of ovarian follicle (Follicular Phase).
- So it is controlled by Estrogen secreted by the follicular cells.
- Thickness of the endometrium is increased into 2-3 folds.
- The glands increase in number and length and the spiral arteries elongate.



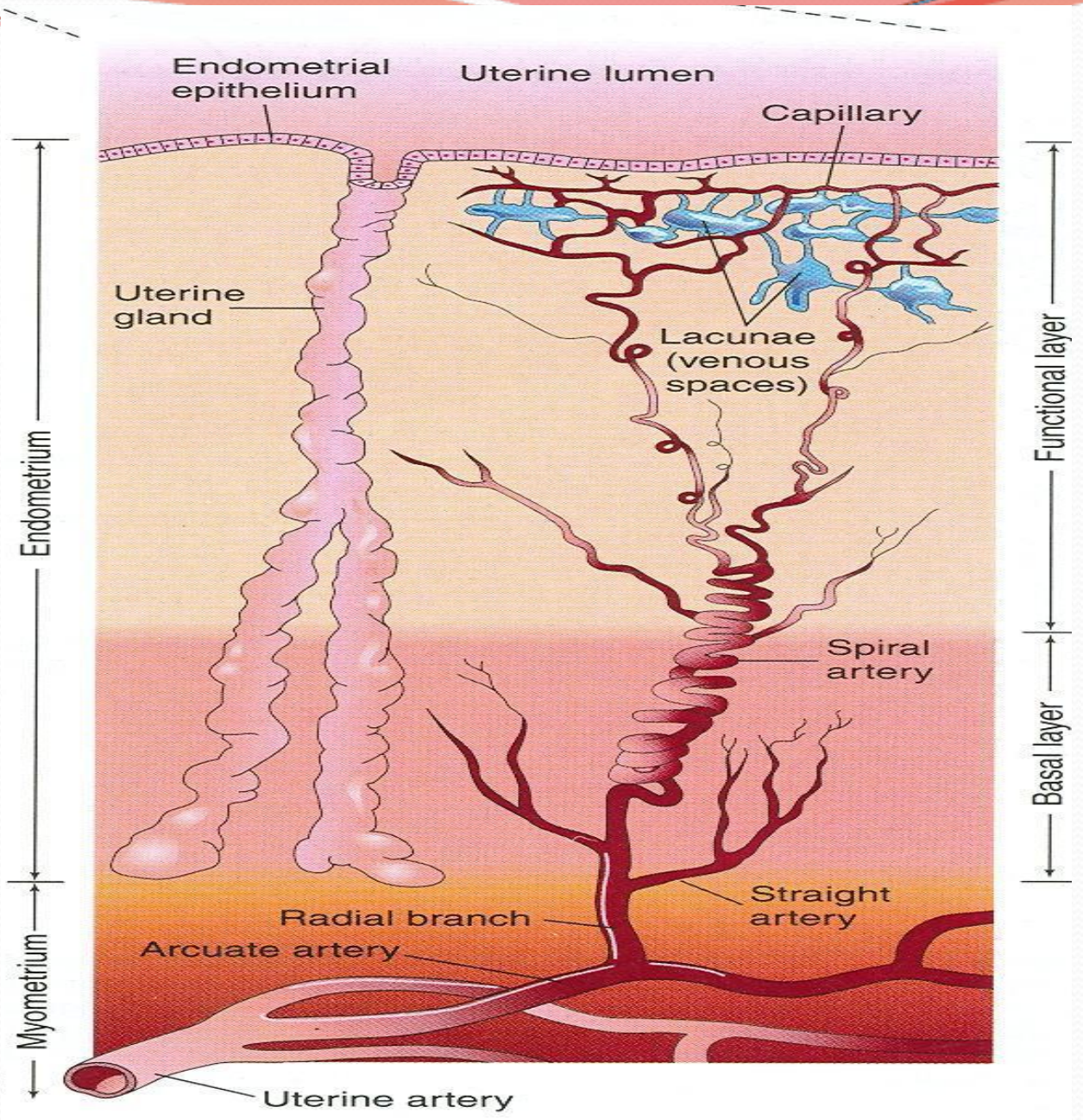
Luteal Phase

- Is a Secretory or Progesterone phase.
- Lasts about 13 days.
- Coincides with the formation, growth and functioning of the Corpus Luteum (Luteal phase of ovarian cycle).
- Glandular epithelium secretes glycogen rich material.
- Endometrium thickens under the influence of estrogen and progesterone.



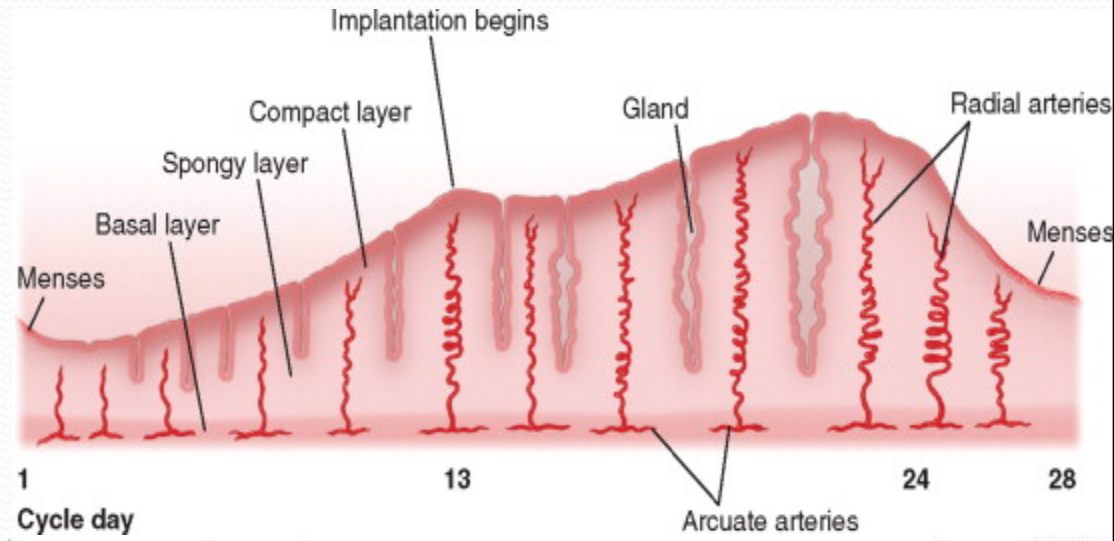
Luteal Phase

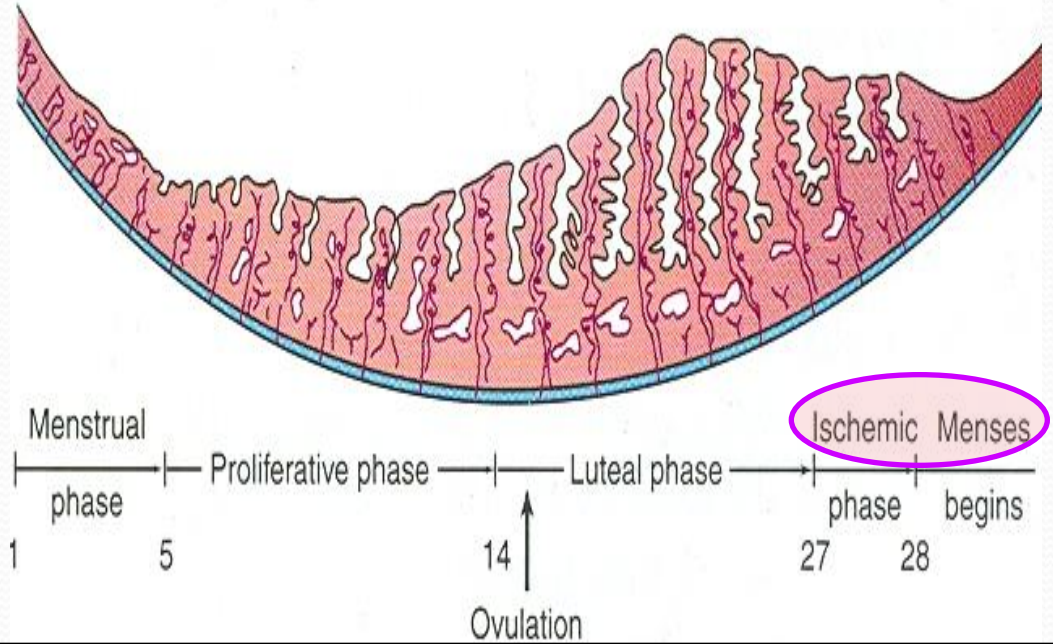
- Spiral arteries grow into the superficial layer.
- Arteries become increasingly coiled.
- Large venous network develops.
- Direct arterio-venous anastomoses are the prominent features.



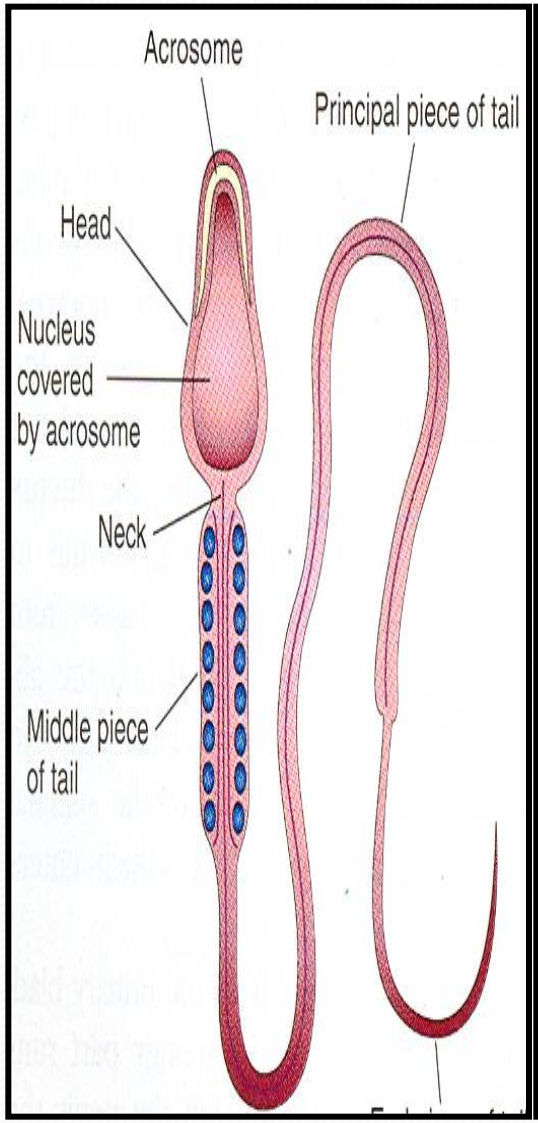
Ischemic Phase

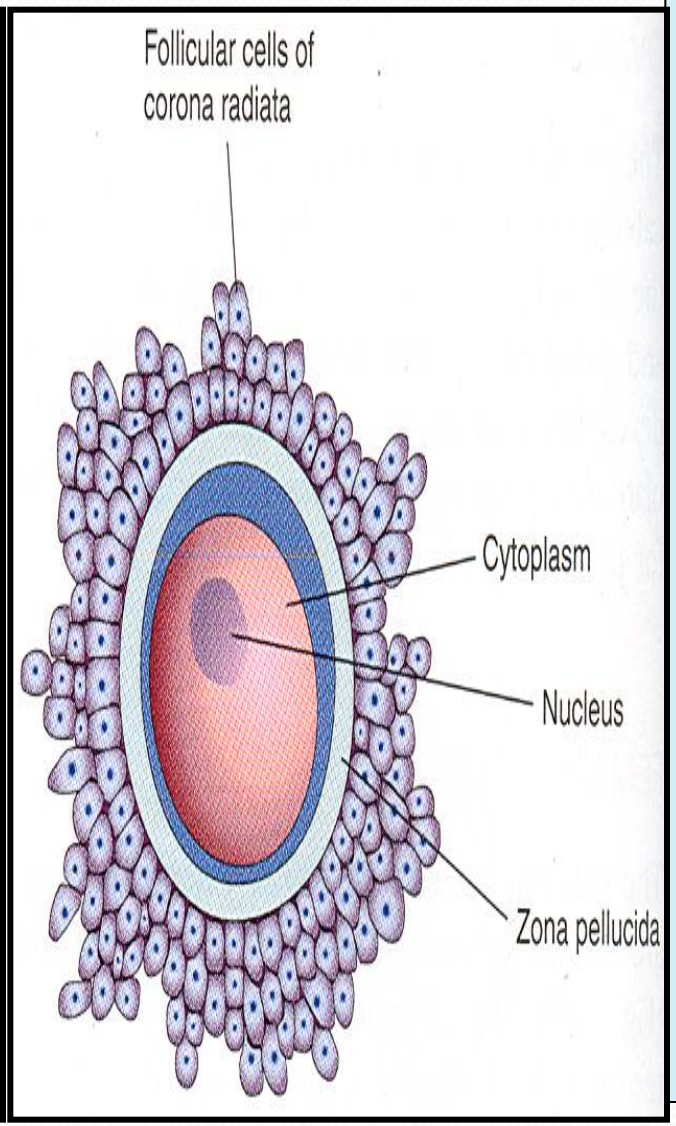
- Degeneration of corpus luteum leads to decrease the levels of estrogen & progesterone.
- Marked shrinking of endometrium.
- Spiral arteries become constricted.
- Venous stasis & Ischemic necrosis.
- Rupture of damaged vessel wall.
- Loss of 20-80 ml of blood
- Entire compact surface layer and most of the spongy layer of endometrium (middle layer filled with many vessels & glands) are discarded.





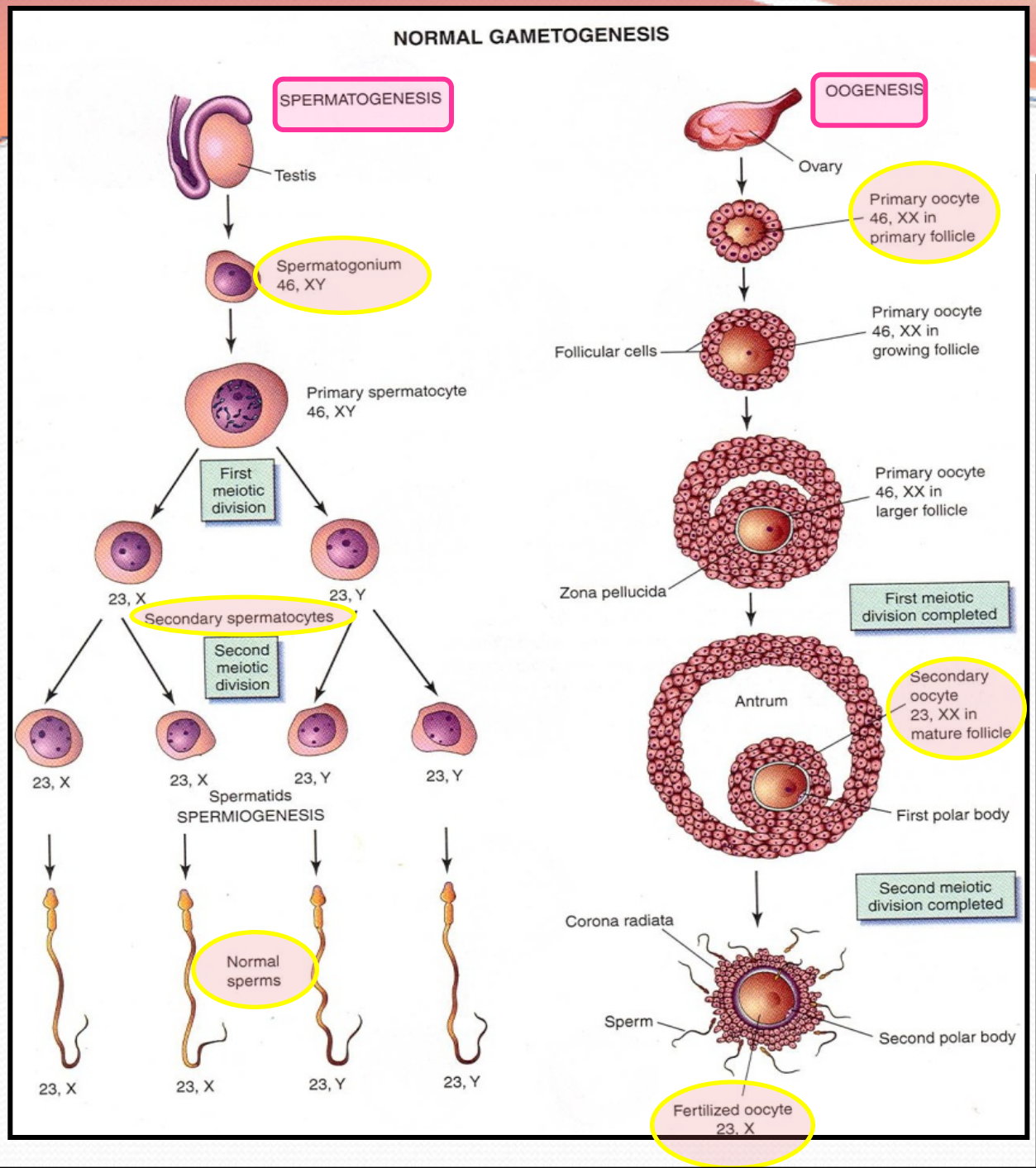
GAMETOGENESIS
(Gamete Formation)





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

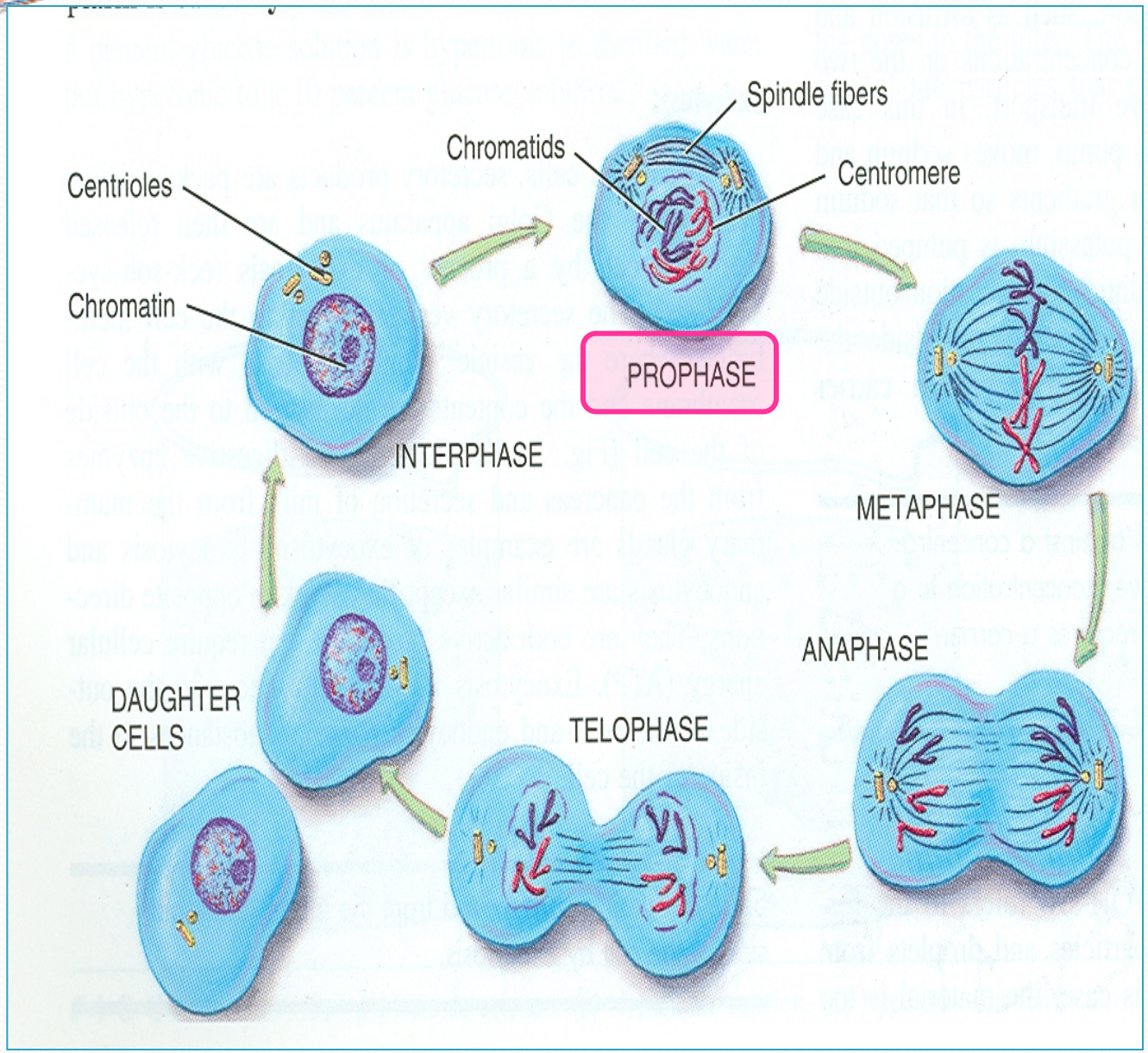
- **Spermatogenesis:**
- It is the series of changes by which the primitive germ cells (spermatogonia) are transformed into mature sperms.
- **Oogenesis:**
- Sequence of events by which the primitive germ cells (oogonia) are transformed into mature oocytes.



MEIOSIS

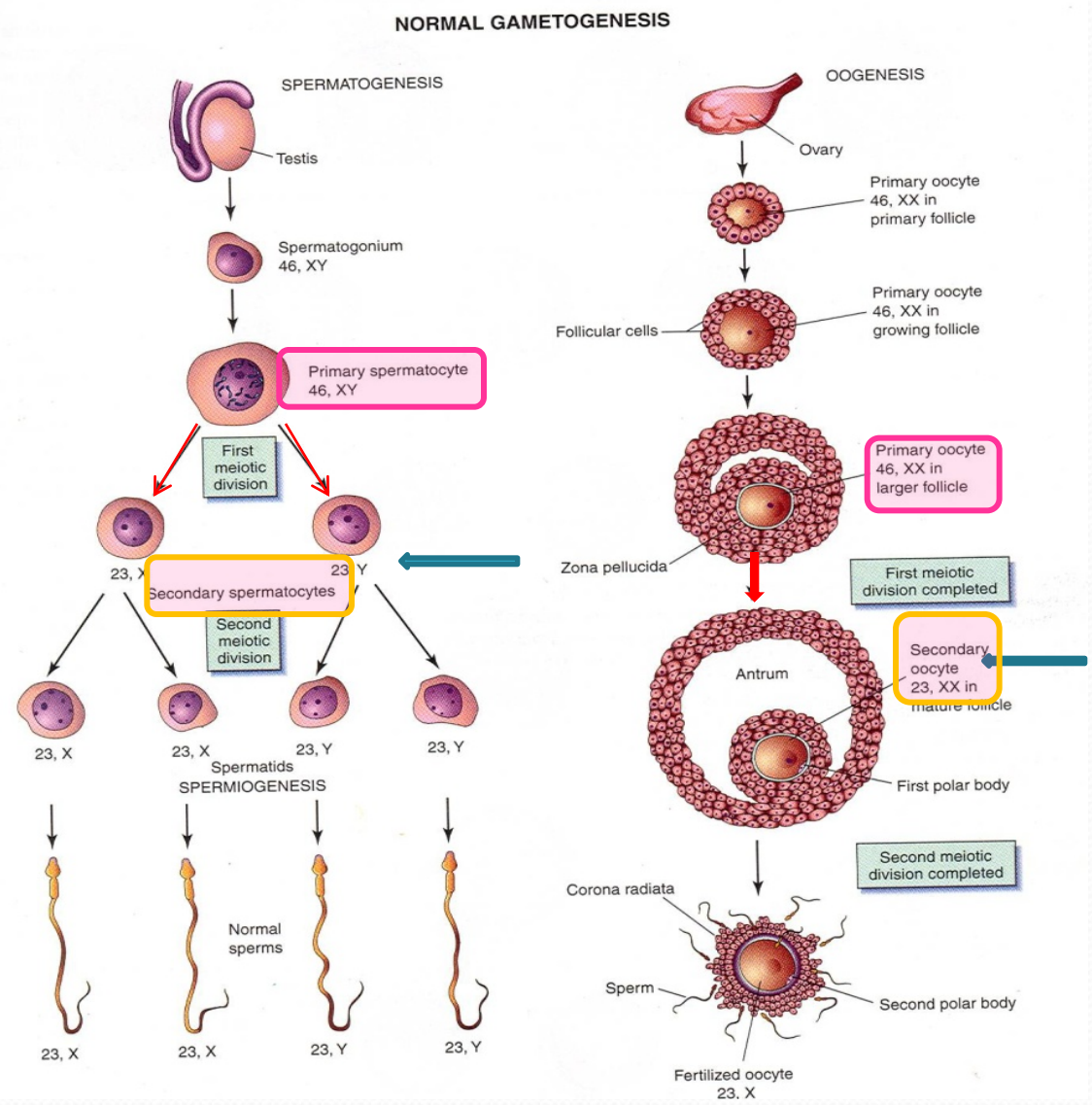
- *It is the cell division that takes place in the germ cells to produce male & female gametes.*
- *It consists of two cell divisions, meiosis I & meiosis II during which the Diploid number of chromosomes (46) is reduced to Haploid number (23).*

FIRST MEIOTIC DIVISION



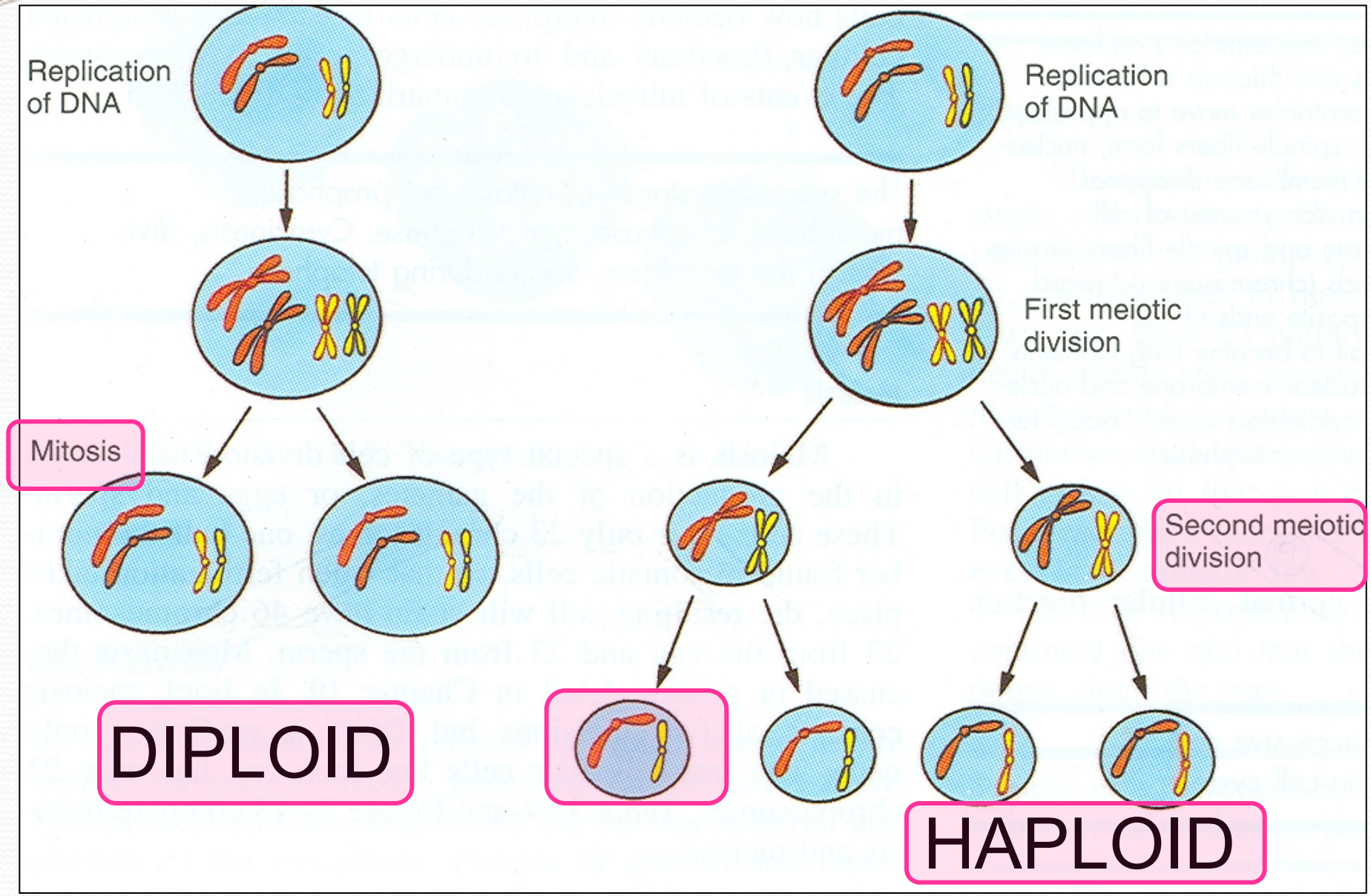
- ***At the beginning of meiosis I, at (prophase) male & female germ cells replicate their DNA so that***
- ***each of the 46 chromosomes is duplicated into sister Chromatids.***

FIRST MEIOTIC DIVISION

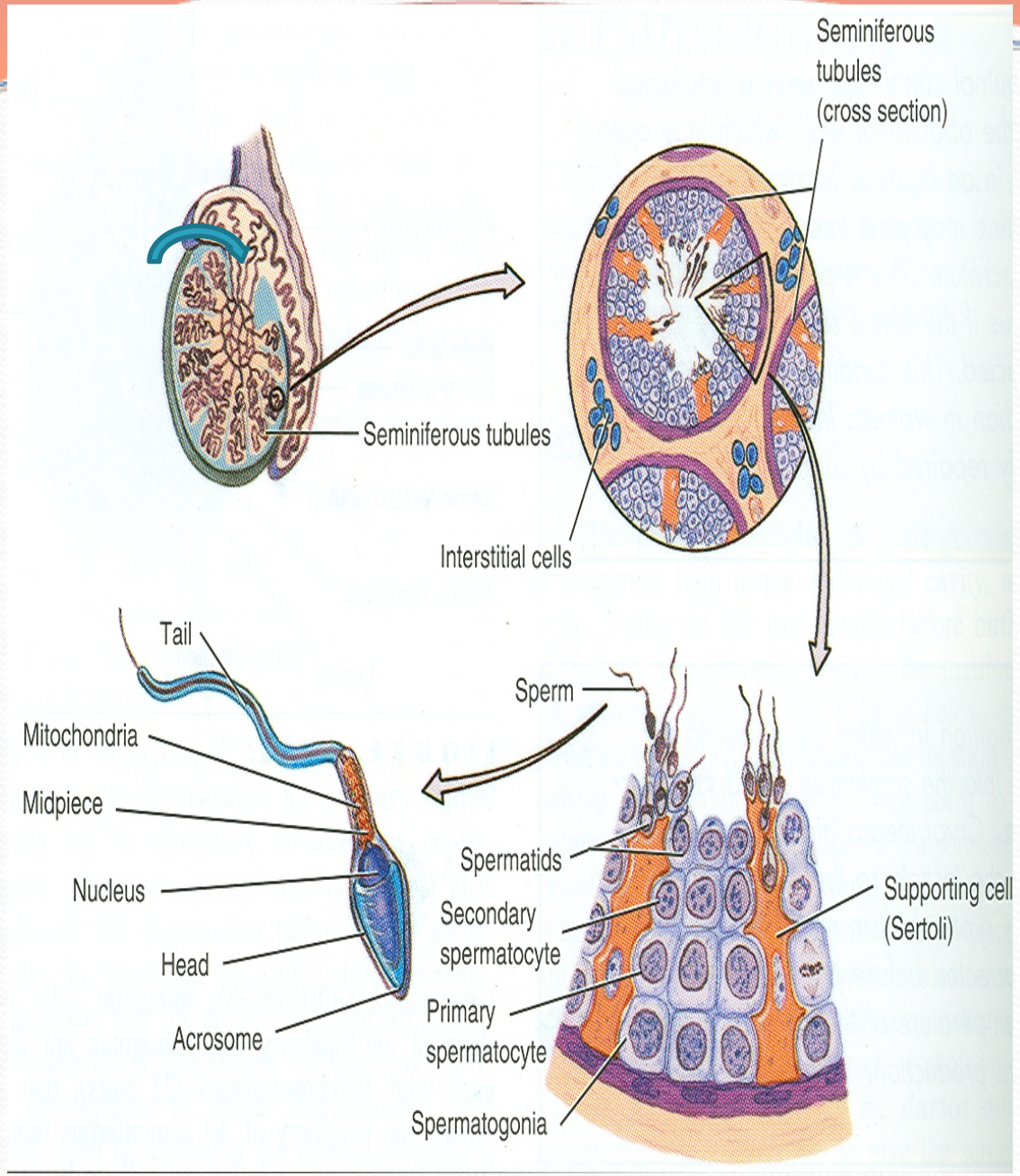


- ***By the end of the 1st meiotic division, each new cell formed (Secondary Spermatocyte or Secondary Oocyte) has haploid (half) number of chromosome.***
- ***It is ½ number of chromosomes of the Primary Spermatocyte or primary Oocyte.***

WHAT IS THE DIFFERENCE BETWEEN MITOSIS & MEIOSIS?

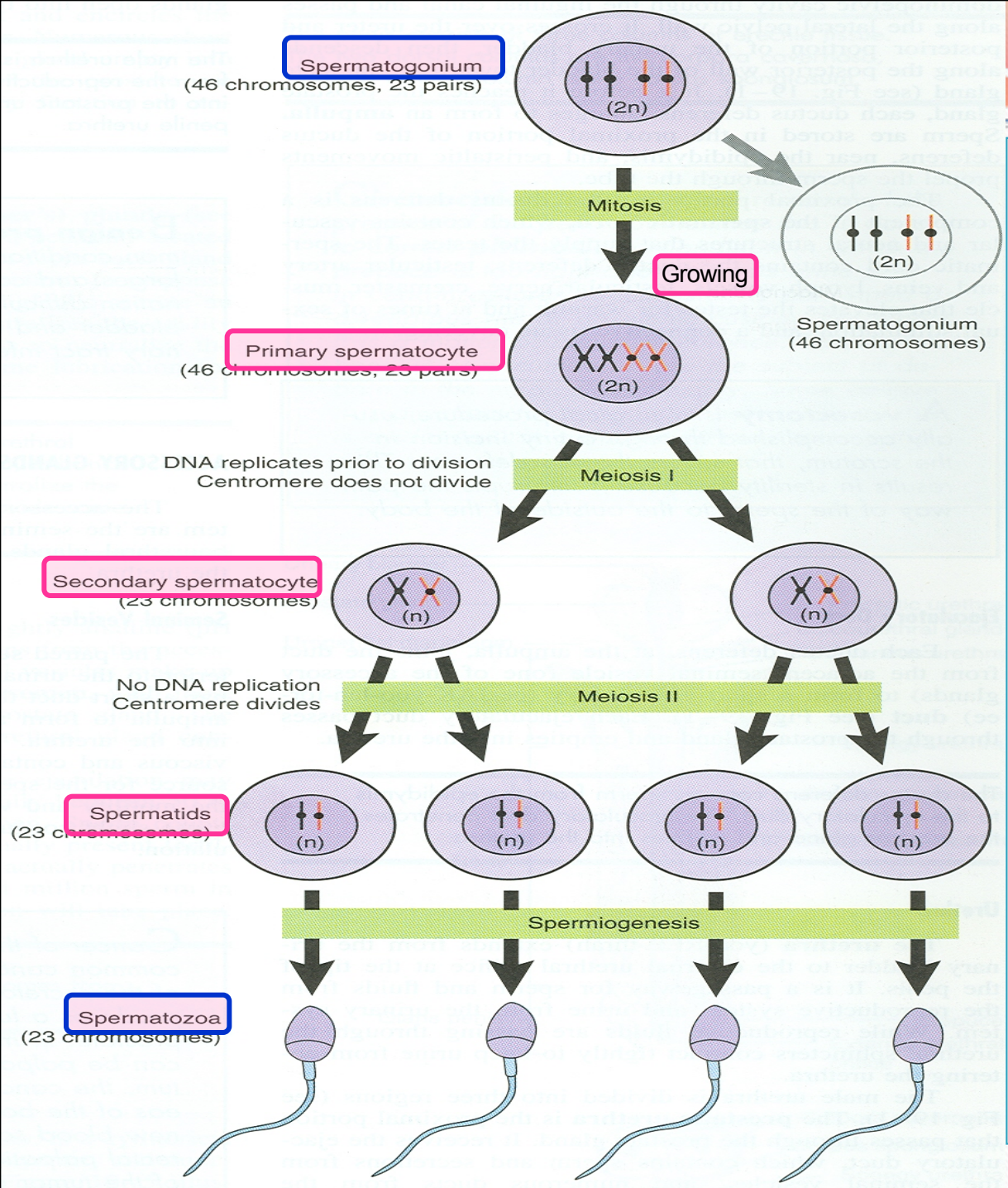


SPERMATOGENESIS



- **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

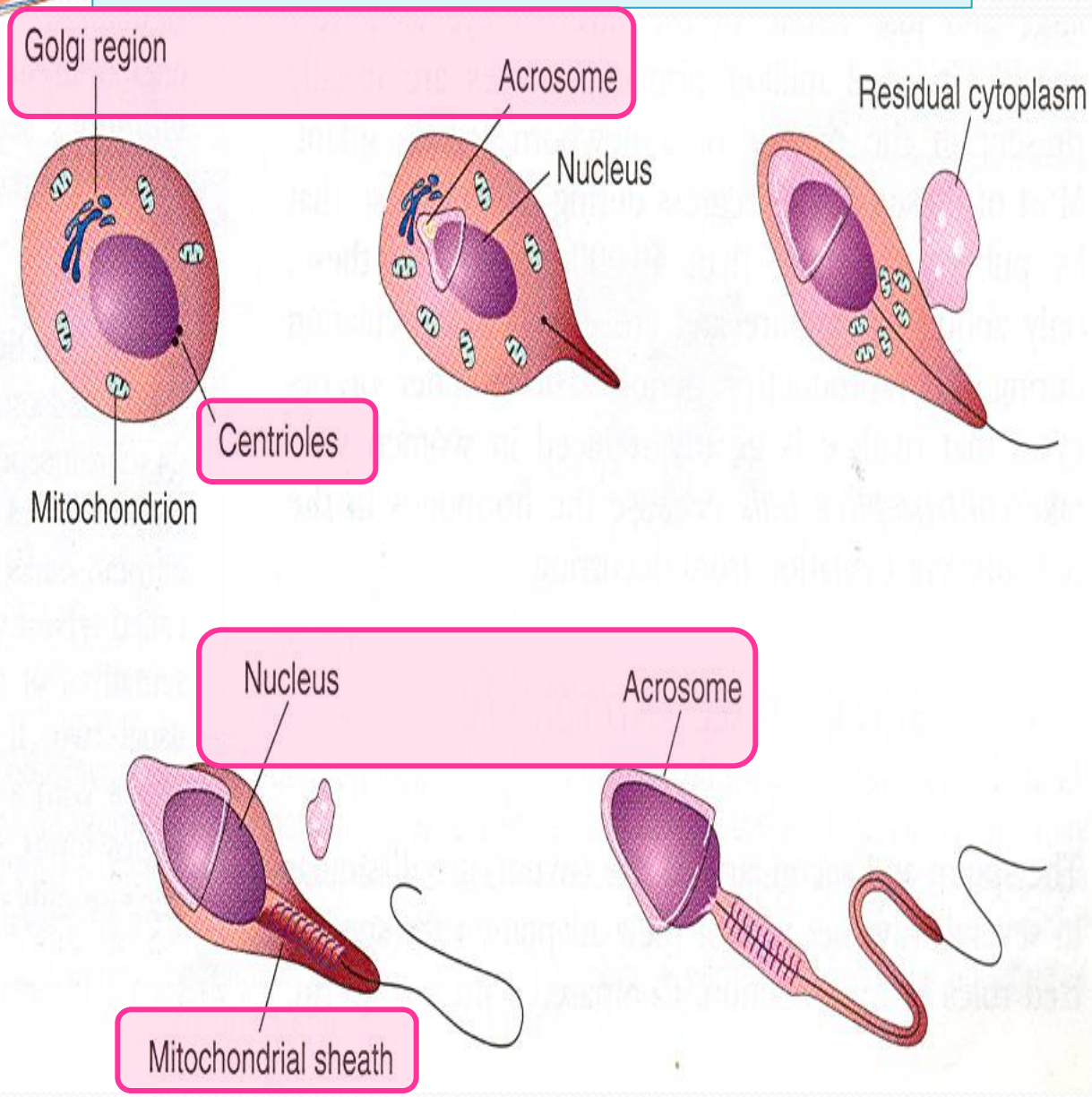


- Each **daughter Spermatogonia** grows to give **primary spermatocyte (46).**
- **Primary spermatocyte** undergoes ***meiotic*** division to give

  2 secondary spermatocyte (22+ x) or (22+y).

- **Secondary spermatocytes** undergo **2nd meiotic division** to form 4 haploid **spermatids** (half size).
- **Spermatids** are transformed into **4 mature sperms** by a process called **spermiogenesis.**

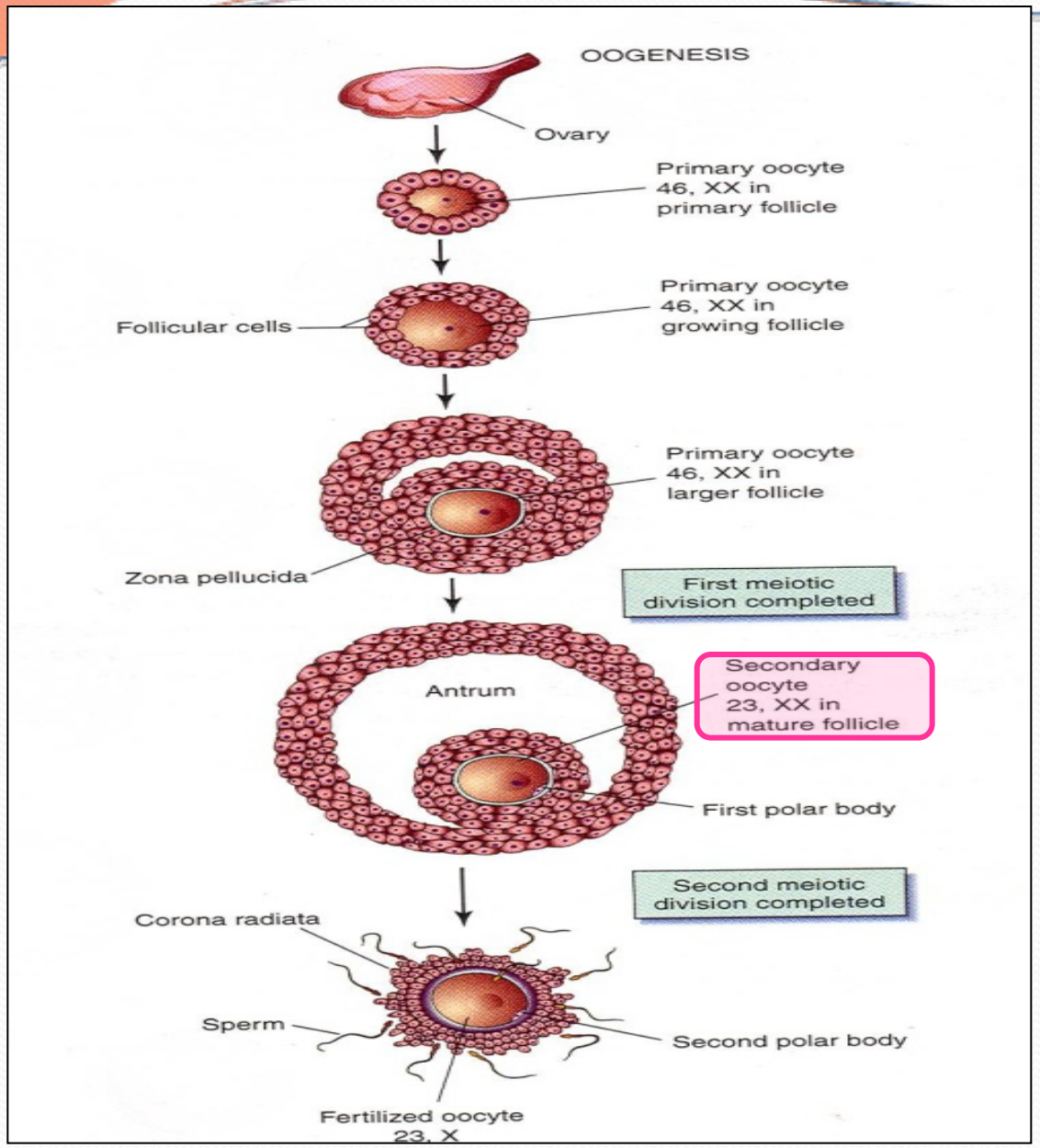
SPERMIOGENESIS



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

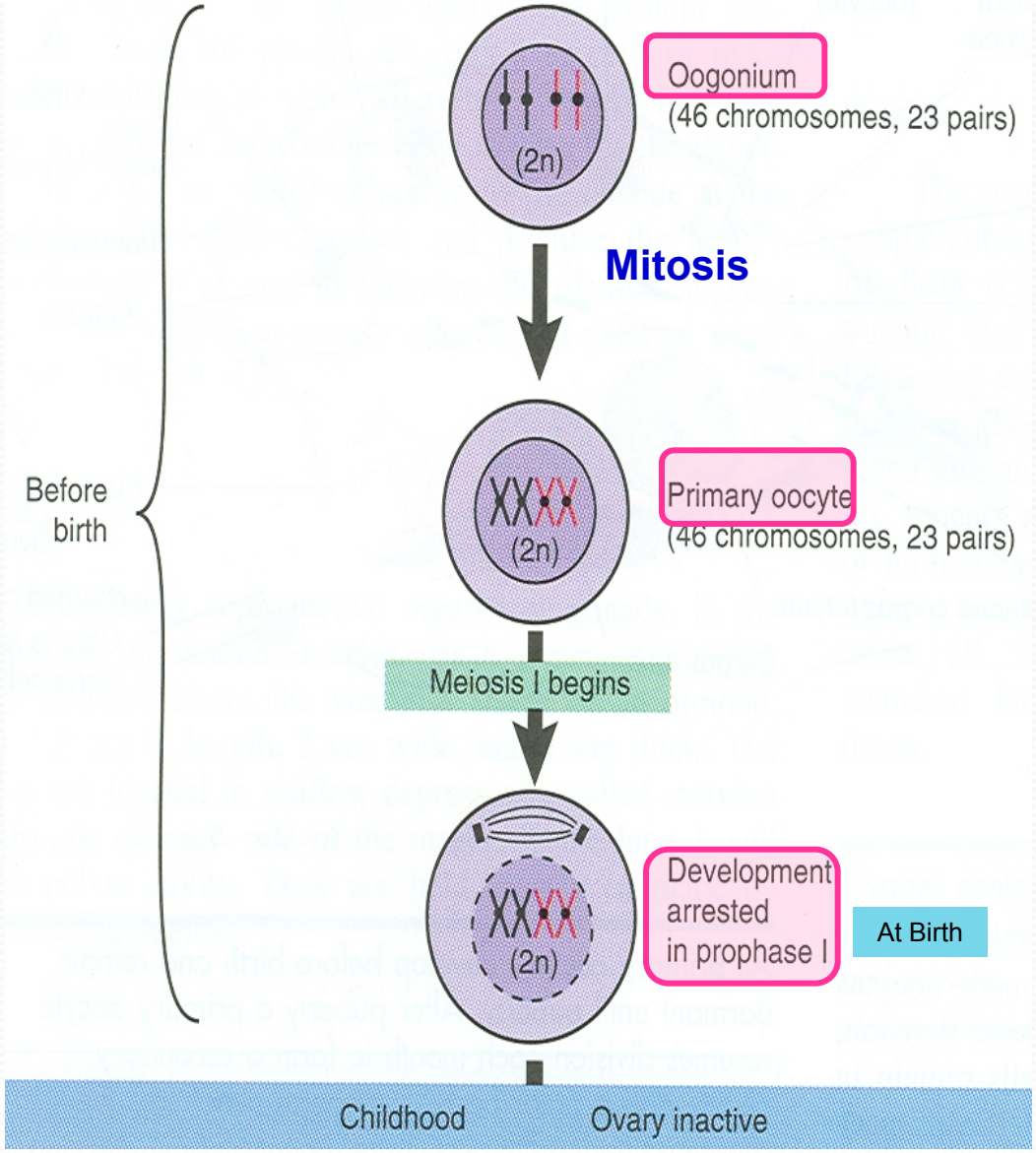
1. ***Nucleus is condensed and forms most of the head.***
2. ***Golgi apparatus forms the Acrosome.***
3. ***Mitochondria forms a spiral sheath.***
4. ***Centriole elongates to form the axial filament.***

OOGENESIS



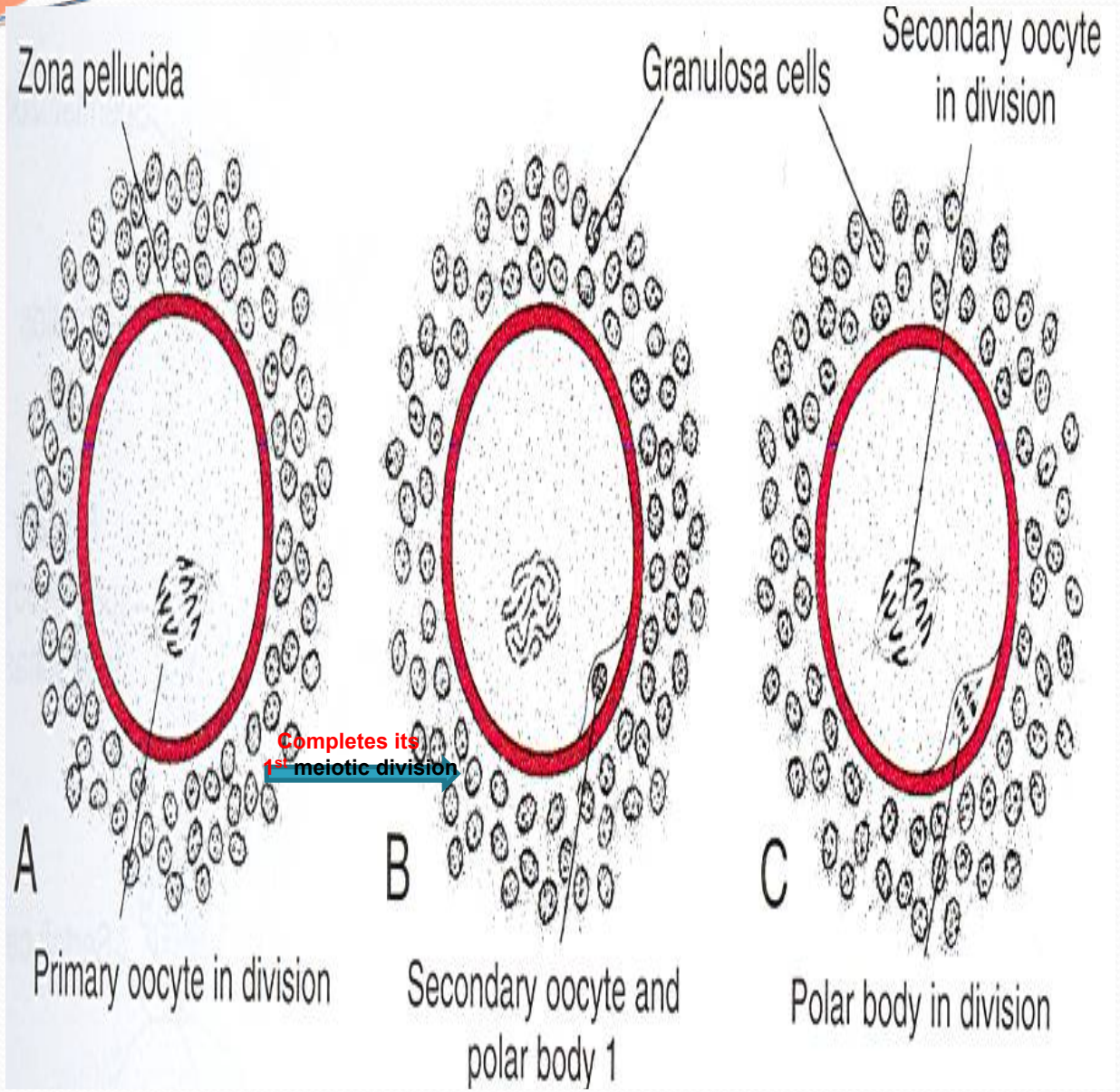
- **AIM:**
- **Formation of secondary oocytes with haploid number of chromosomes.**
- **SITE:**
- **Cortex of the ovary**
- **TIME:**
- **Starts during fetal life becomes completed after puberty & continues until menopause.**
- ***It occurs monthly Except during pregnancy.***

OOGENESIS



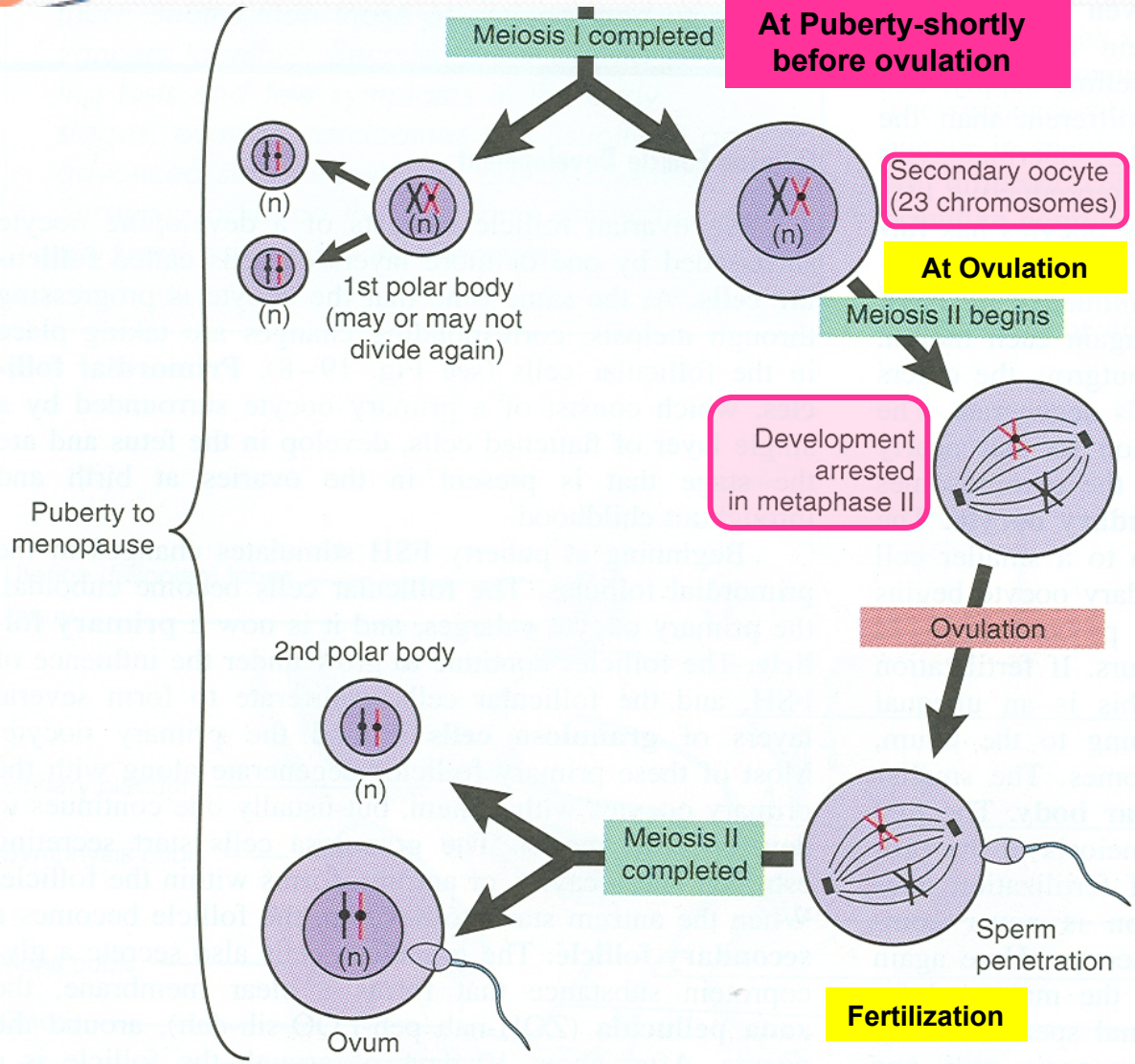
- ***Before Birth:*** ***(During fetal life)*** *, primitive ova (**Oogonia**). proliferate by mitotic division and enlarge to form **Primary Oocytes (46)***
- ***Before birth &At Birth : all primary oocytes remain arrested in prophase I of the 1st meiotic division.***
- *And do not finish their first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

OOGENESIS



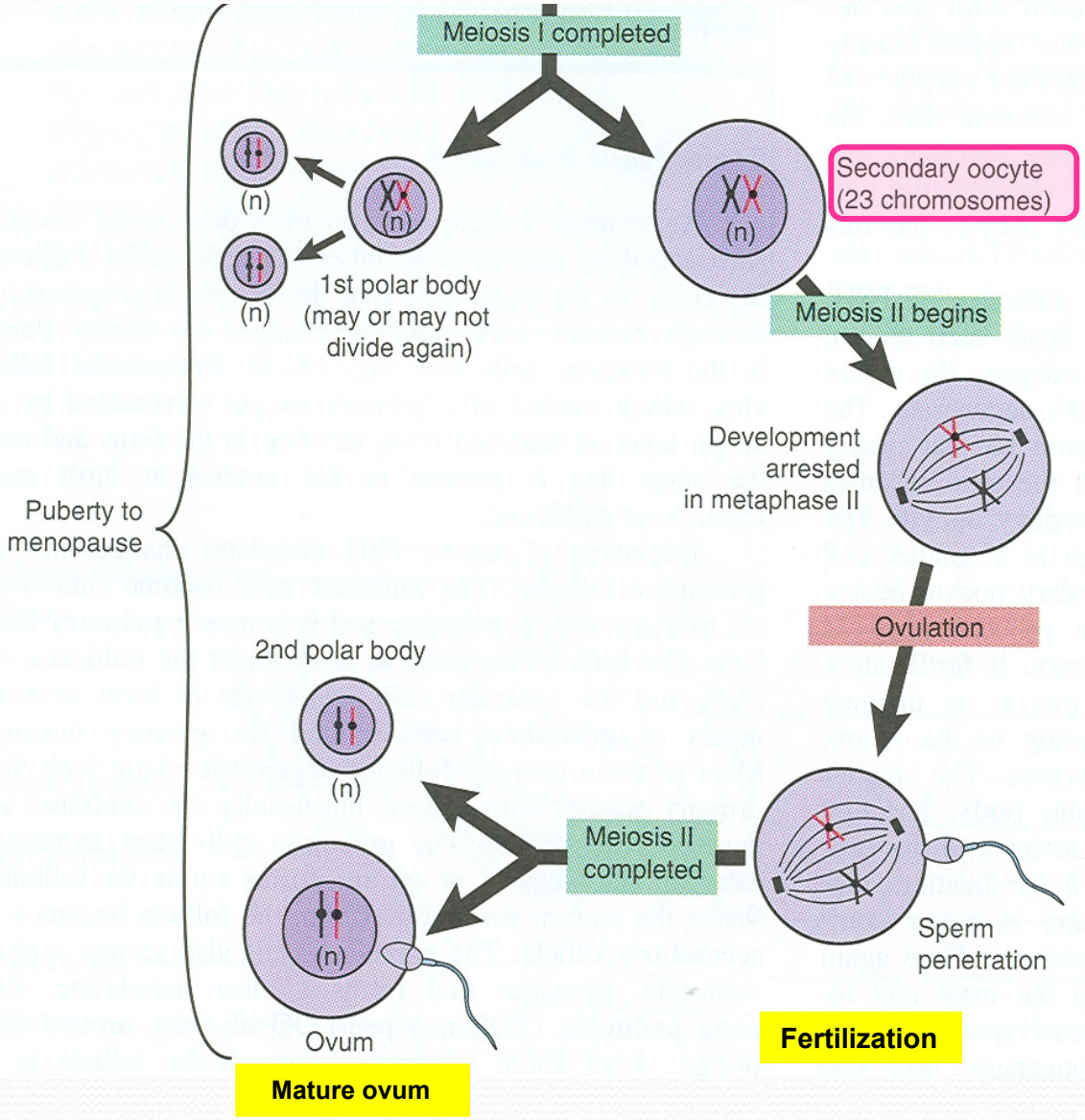
- ***At Puberty***
- ***Shortly before ovulation;*** ***Primary Oocyte*** ***completes*** ***its*** ***first meiotic division*** ***to give*** ***Secondary oocyte*** ***(23) & First Polar Body.***
- ***The Secondary Oocyte receives almost all the cytoplasm.***
- ***The First Polar Body receives very little.***
- ***It is small nonfunctional cell that soon degenerates.***

OOGENESIS



- ***At ovulation :*** ***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 24 hours after ovulation.*
- *Most of the cytoplasm is retained by the Mature Oocyte*
- *The rest is in the 2nd Polar Body which soon degenerates.*

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

N.B.: NO PRIMARY OOCYTES FORM AFTER BIRTH

GOOD LUCK