GAMETOGENESIS & FEMALE CYCLES

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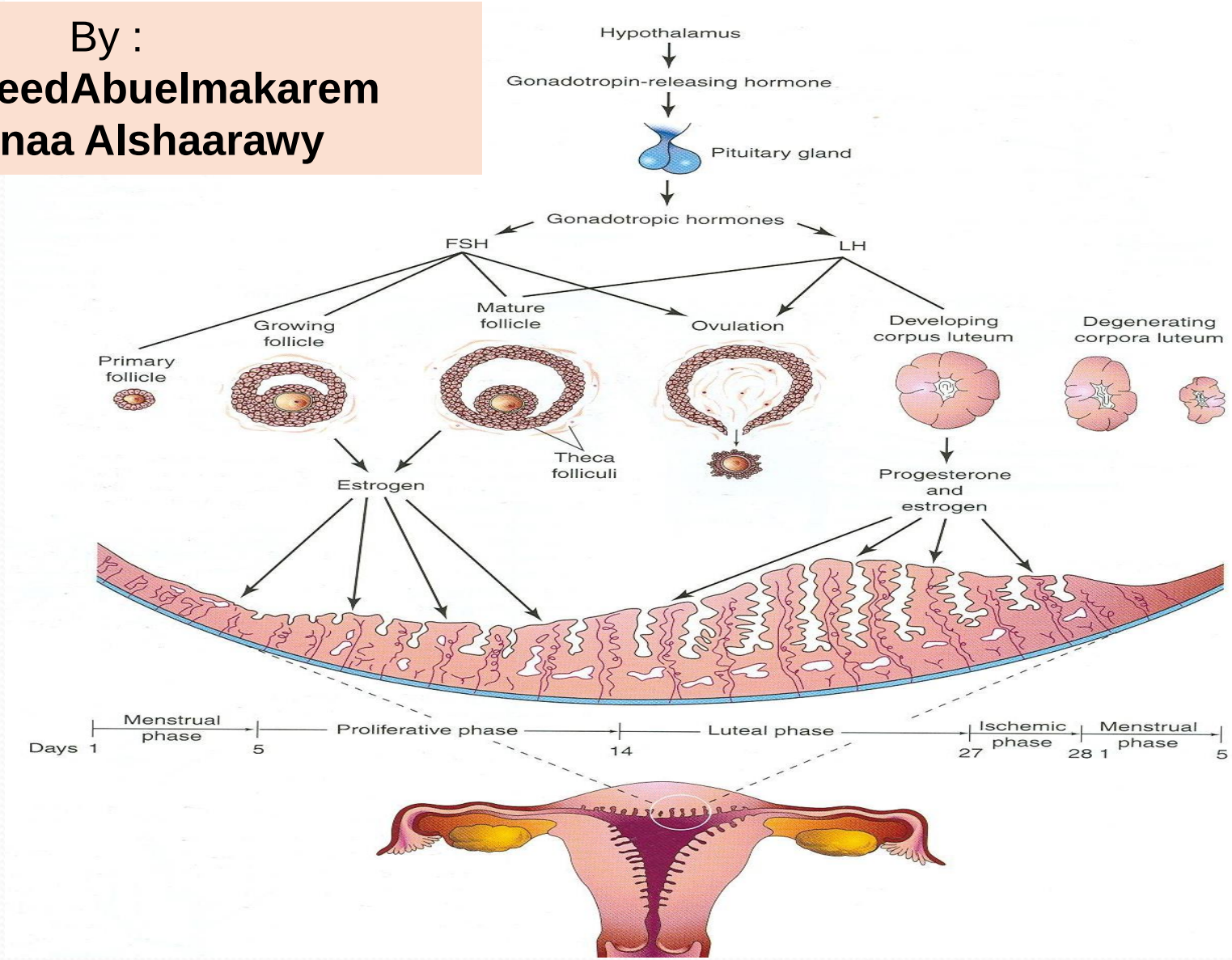


OBJECTIVES

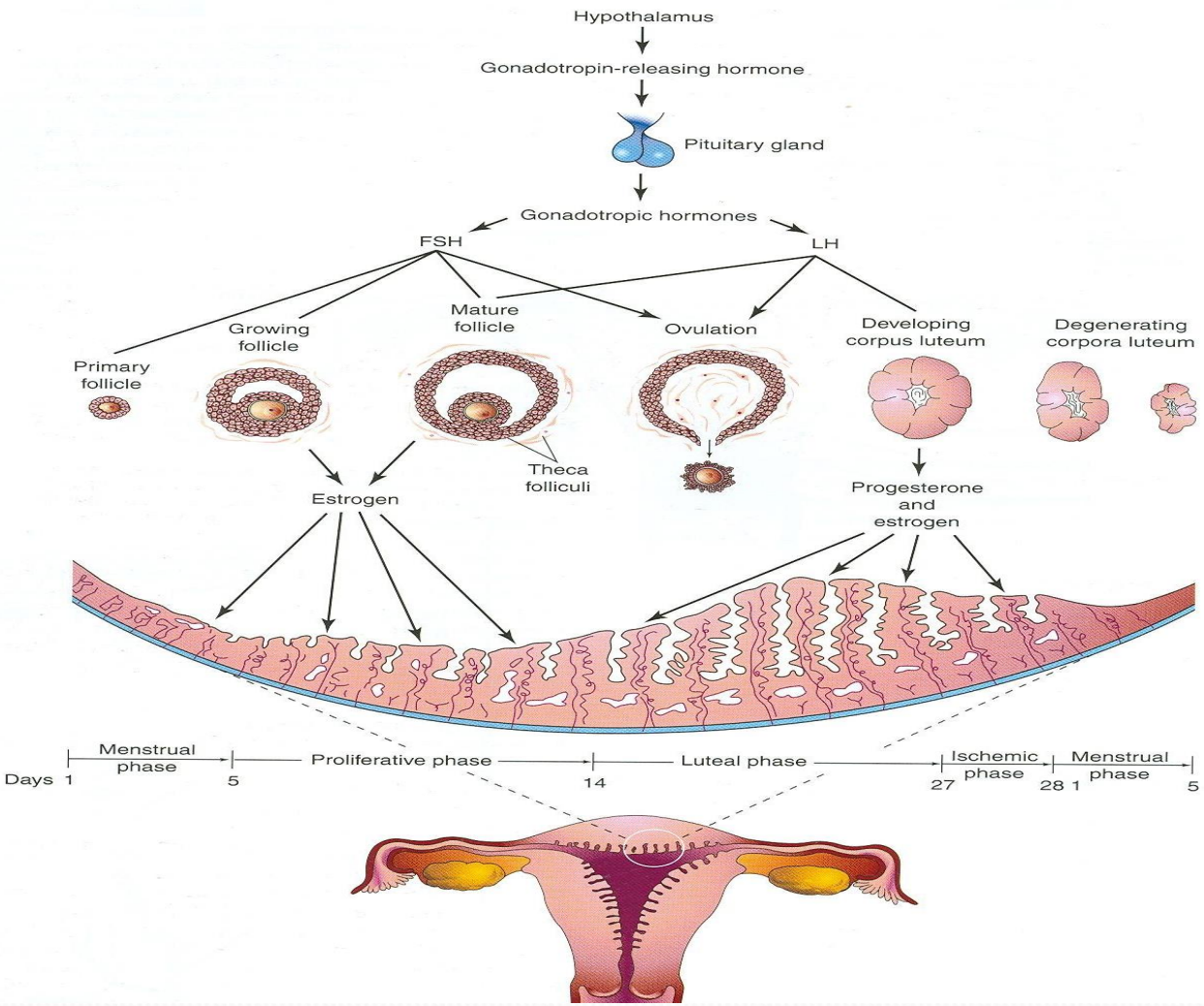
- ***By the end of the lecture, you should be able to:***
- **Describe the female cycles (Ovarian & Uterine).**
- **Define gametogenesis.**
- **Differentiate the types of gametogenesis.**
- **Describe the process of spermatogenesis.**
- **Describe the process of oogenesis.**

Female Reproductive Cycles

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

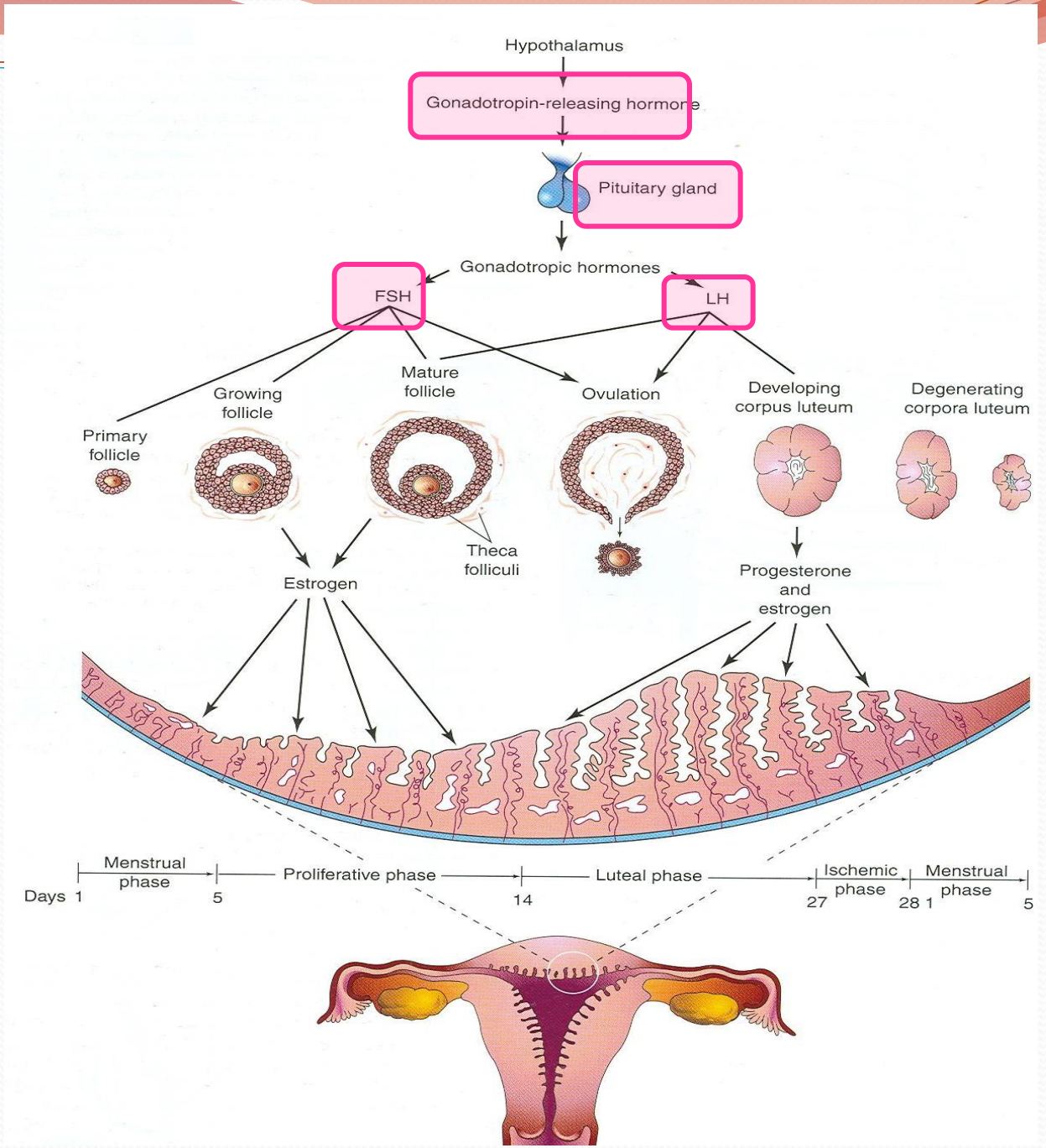
1. **Hypothalamus,**
2. **Pituitary gland,**
3. **Ovaries,**
4. **Uterus,**
5. **Uterine tubes,**
6. **Vagina and**
7. **Mammary glands.**

OVARIAN AND UTERINE CYCLES



GnRH

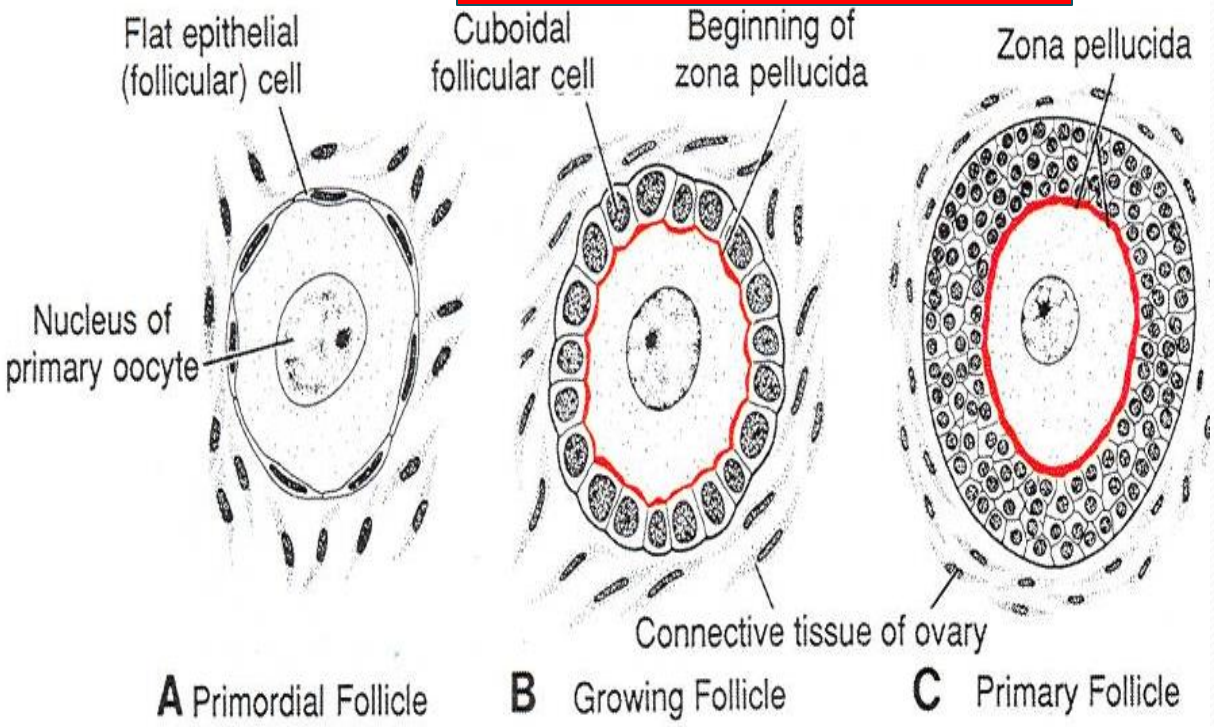
- **Gonadotrophin-releasing hormone (GnRH)** is synthesized by neurosecretory cells in the **Hypothalamus.**
- Carried to the **Pituitary gland** (anterior lobe).
- It stimulates the pituitary to release **Two *Hormones*** that act on **Ovaries (FSH & LH)**



OVARIAN CYCLE

FSH

Follicular Phase



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

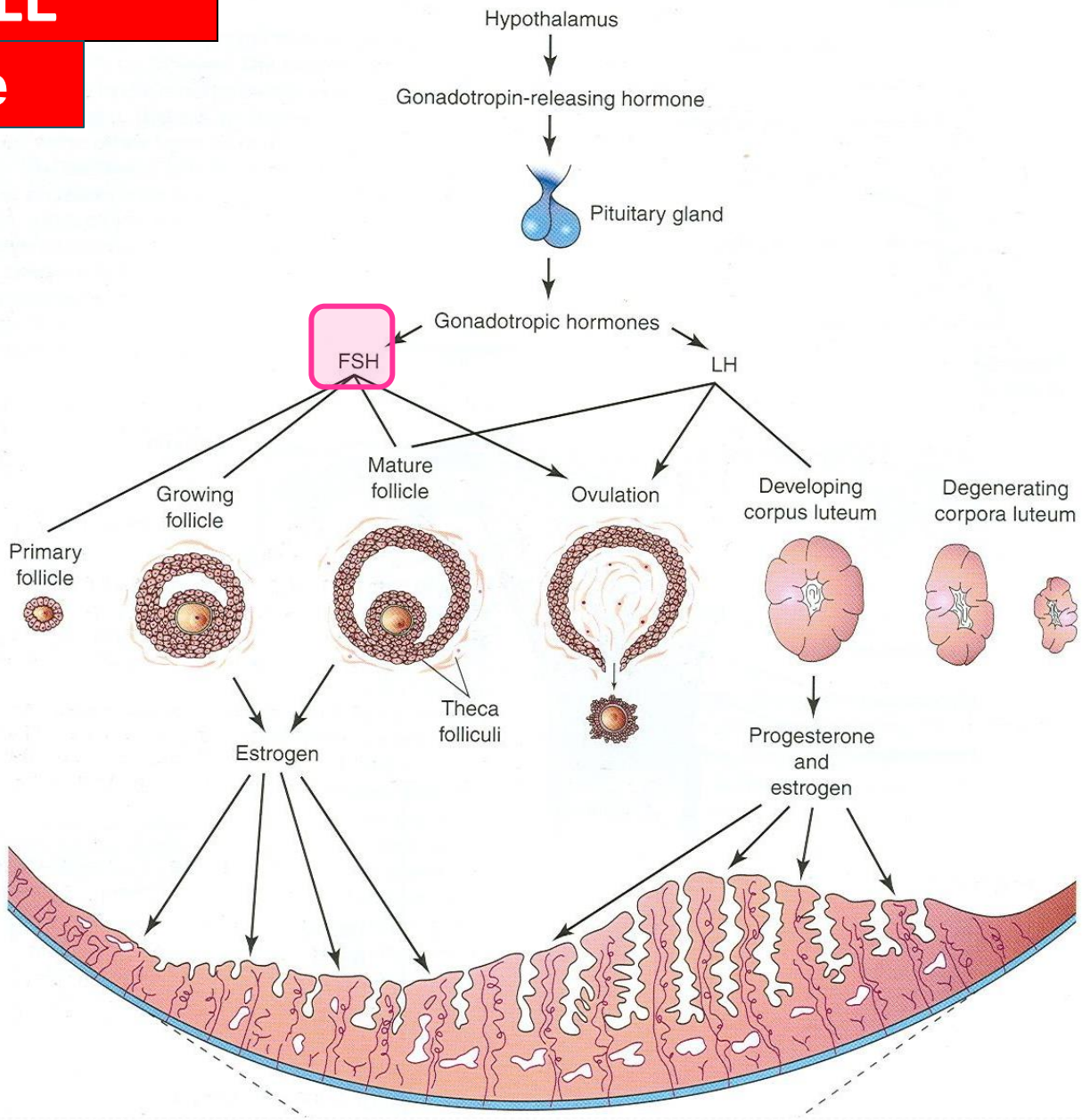
- The **ovarian cycle** is under the control of the **Pituitary Gland.**
- It is divided into 3 phases: (**FOL**)
- **1- Follicular,**
- **2- Ovulatory,**
- **3- Luteal.**
- The ovarian cortex contains hundreds of thousands of **primary follicles** (400,000 to 500,000).
- **Each consists** of one primary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

OVARIAN CYCLE

Follicular Phase

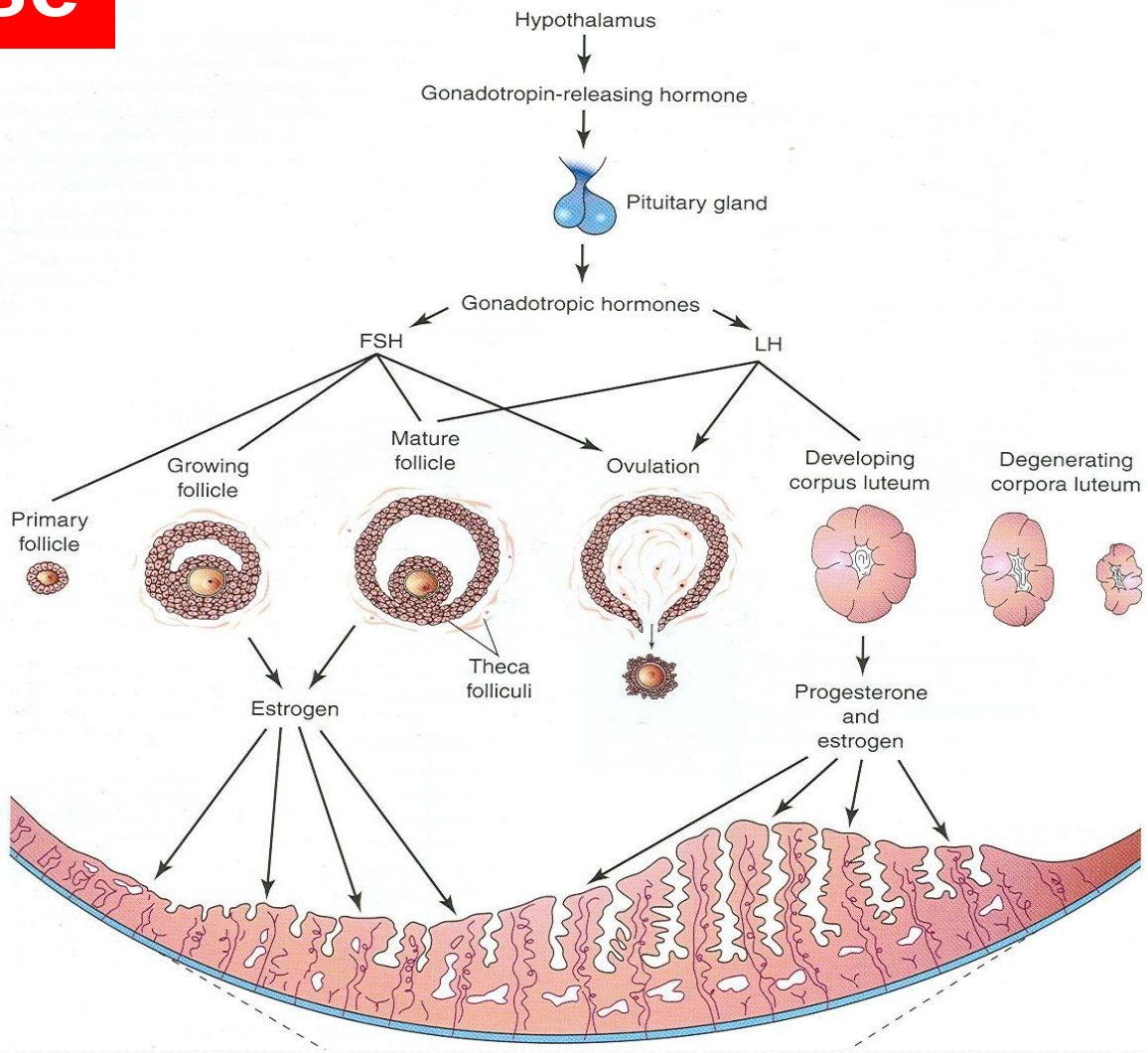
FSH

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



Ovulatory Phase

- The follicle becomes enlarged until it gets 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.
- LH. causes ovulation (rupture of the mature follicle).

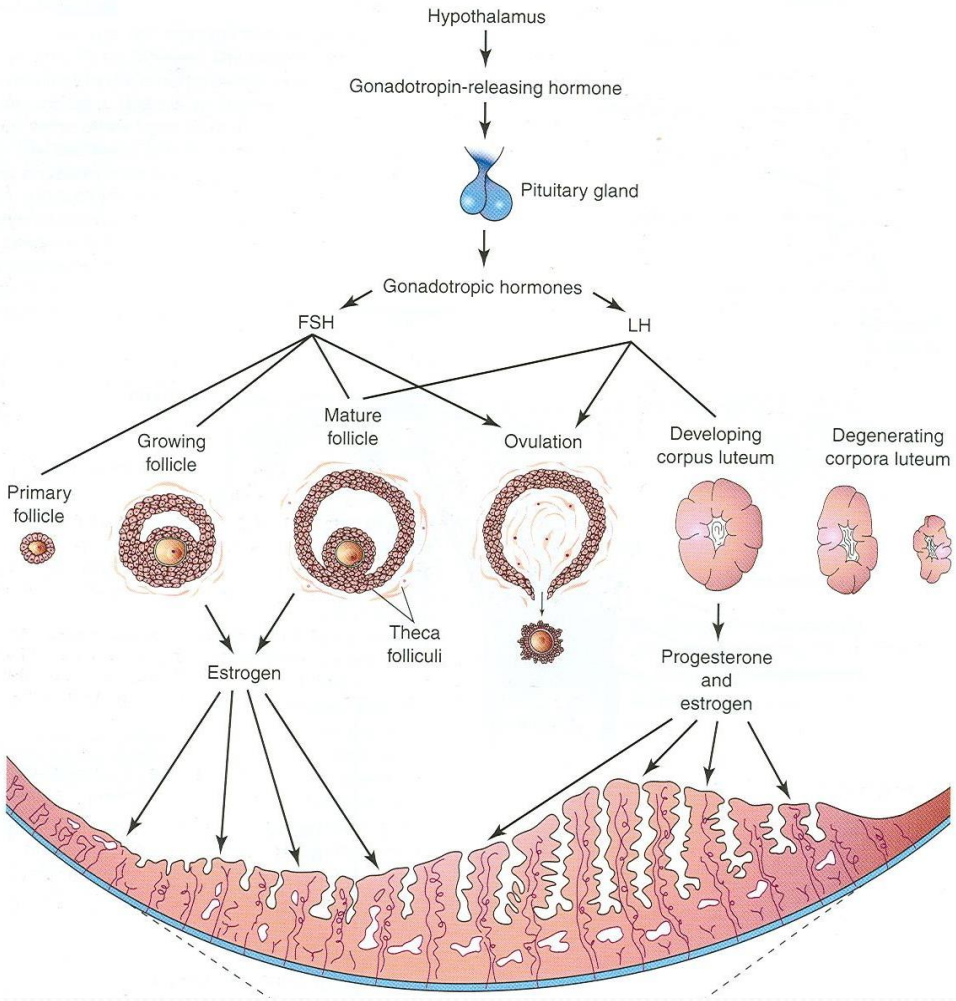


Growing follicles produce estrogen which regulates the development and functions of the reproductive organs.

Luteal Phase

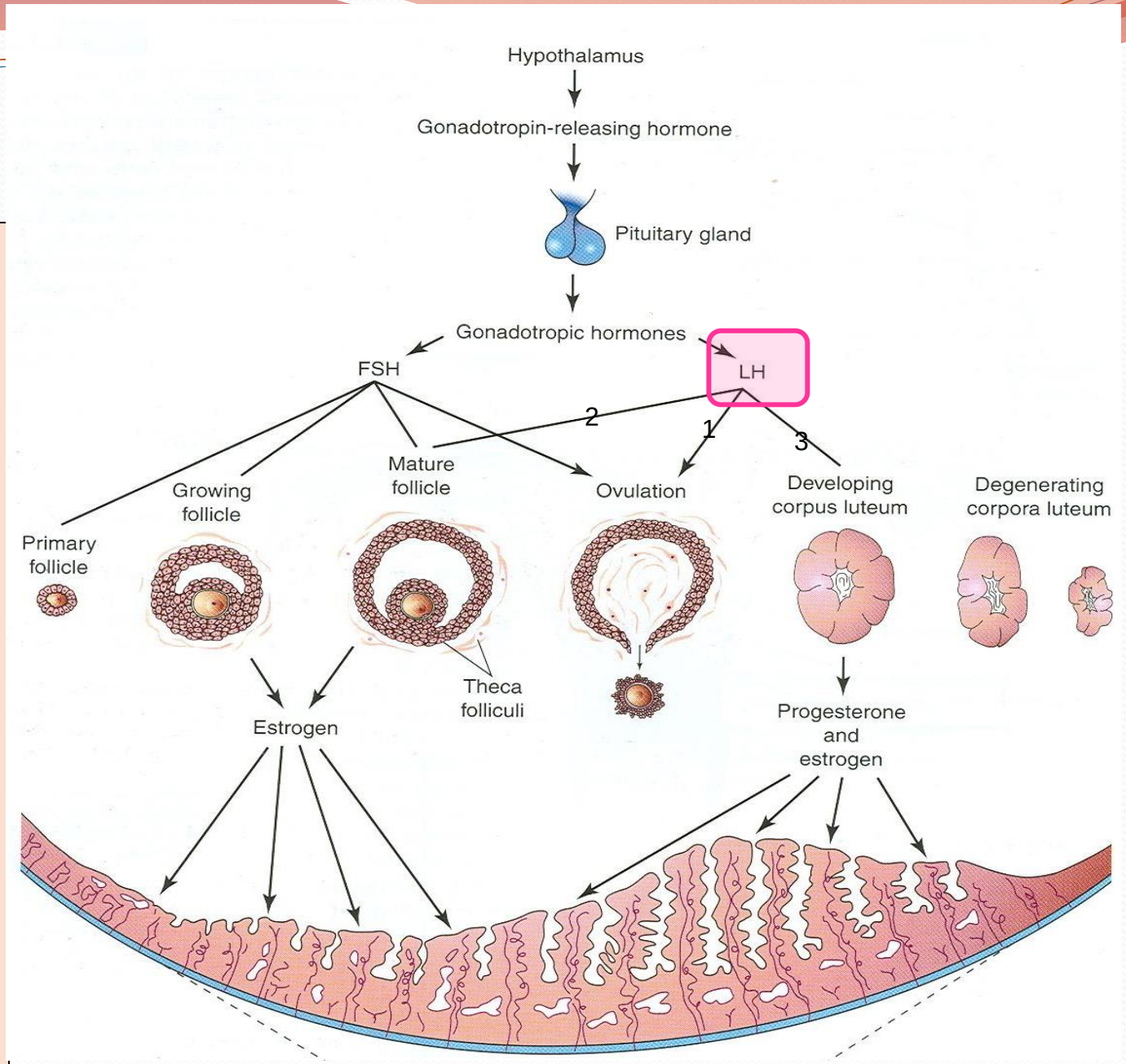
- The remaining of the ruptured follicle is now called corpus luteum.
- It secretes Progesterone and small amount of Estrogen.
- These 2 hormones stimulate endometrial glands to secrete and prepare endometrium for implantation of fertilized Ovum (Blastocyst).
- If the oocyte is fertilized the Corpus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

Corpus Luteum



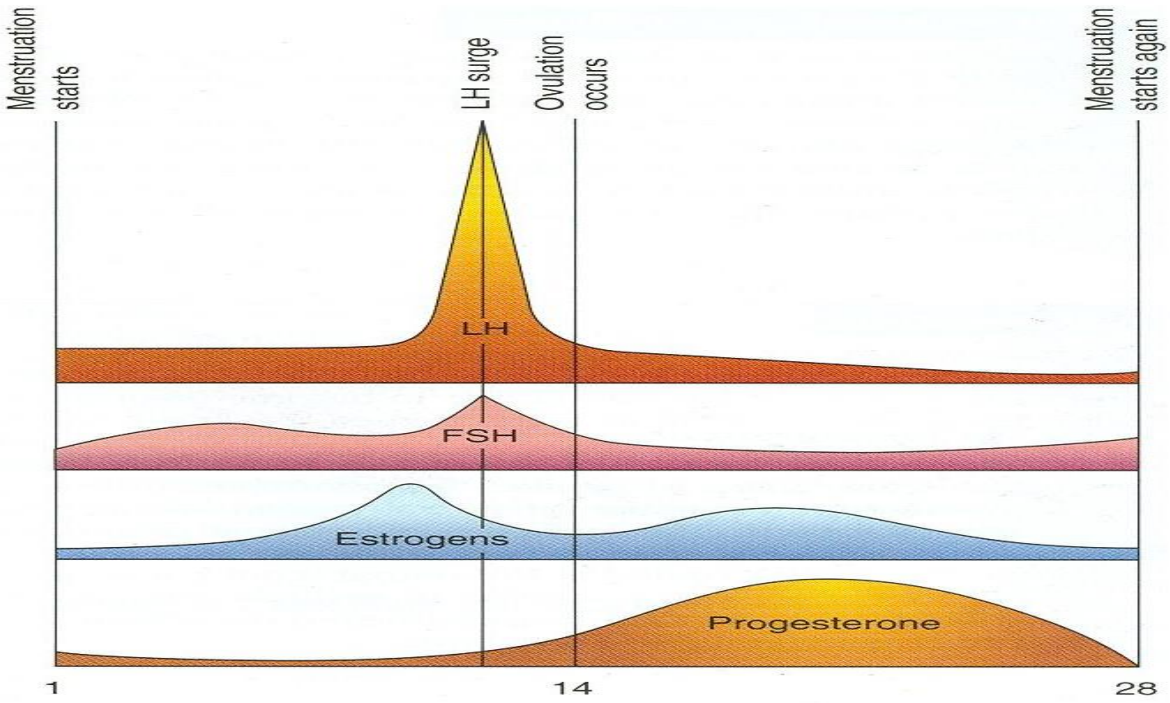
LH

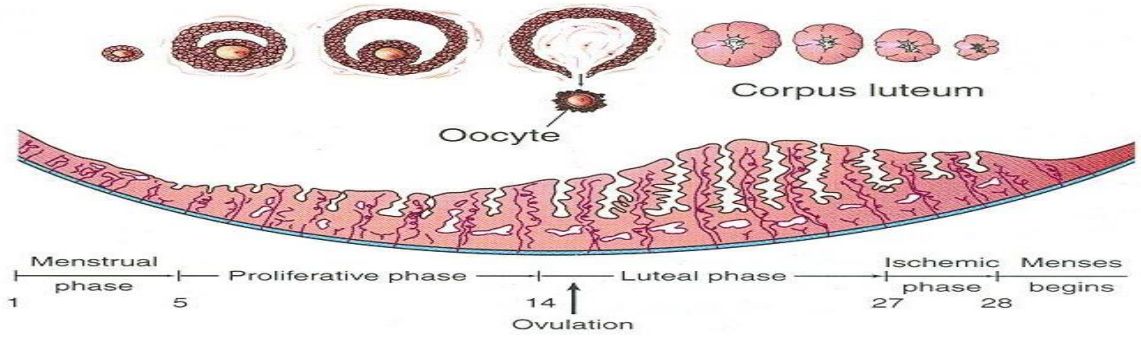
- Luteinizing Hormone.
- **FUNCTIONS:**
- 1- It serves as the trigger for ovulation.
- 2- Stimulates the follicular cells and 3-stimulate corpus luteum to produce Progesterone.



Uterine or Menstrual Cycle

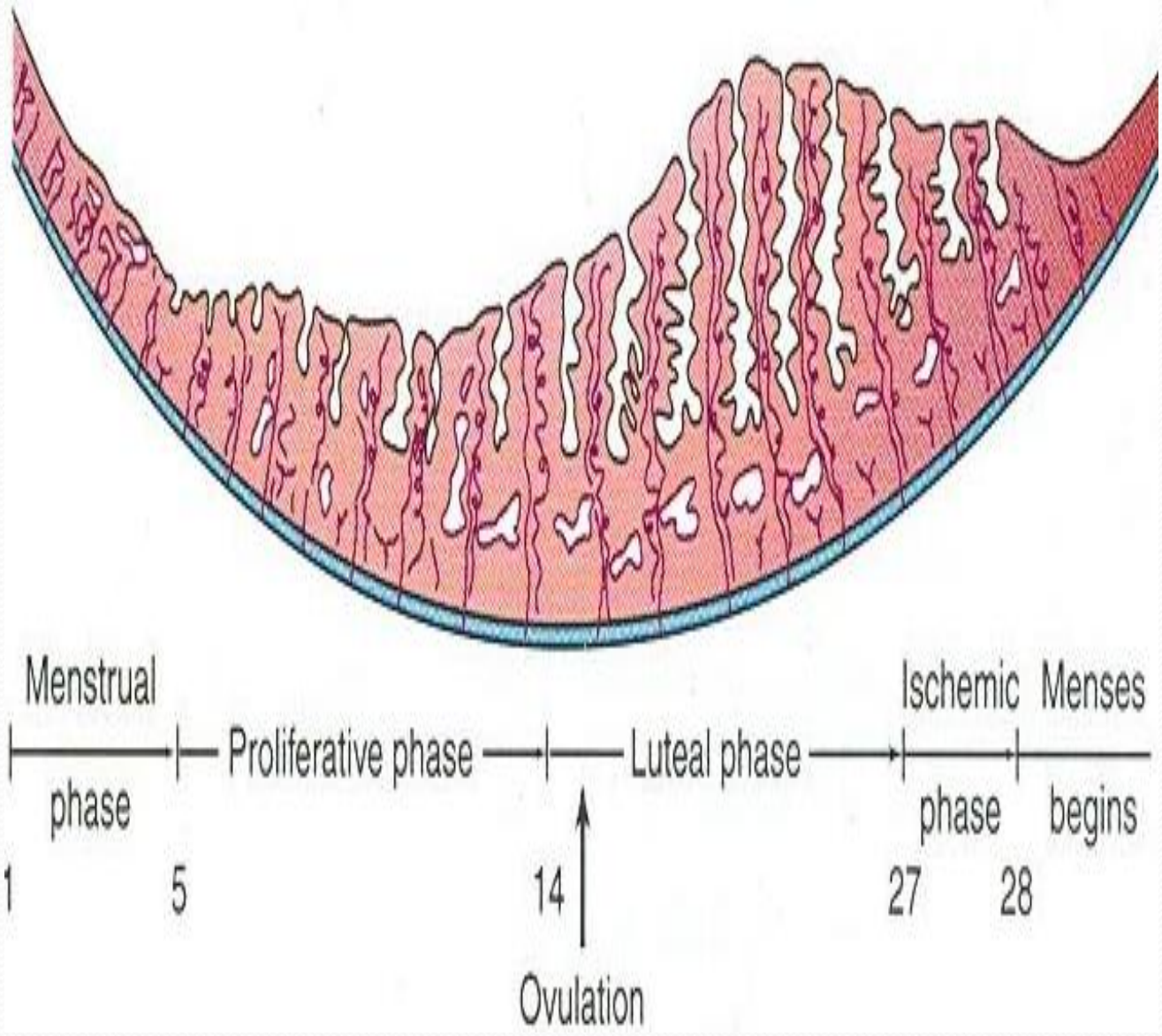
- **Cyclic changes in the endometrium of the uterus caused by estrogen & progesterone.**
- Average menstrual cycle is 28 days.
- **Day One is the day when menstrual blood flow begins.**
- **It varies by several days in normal women.**
- **Ranges between 23 and 35 days in 90% of women.**
- **It sometimes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





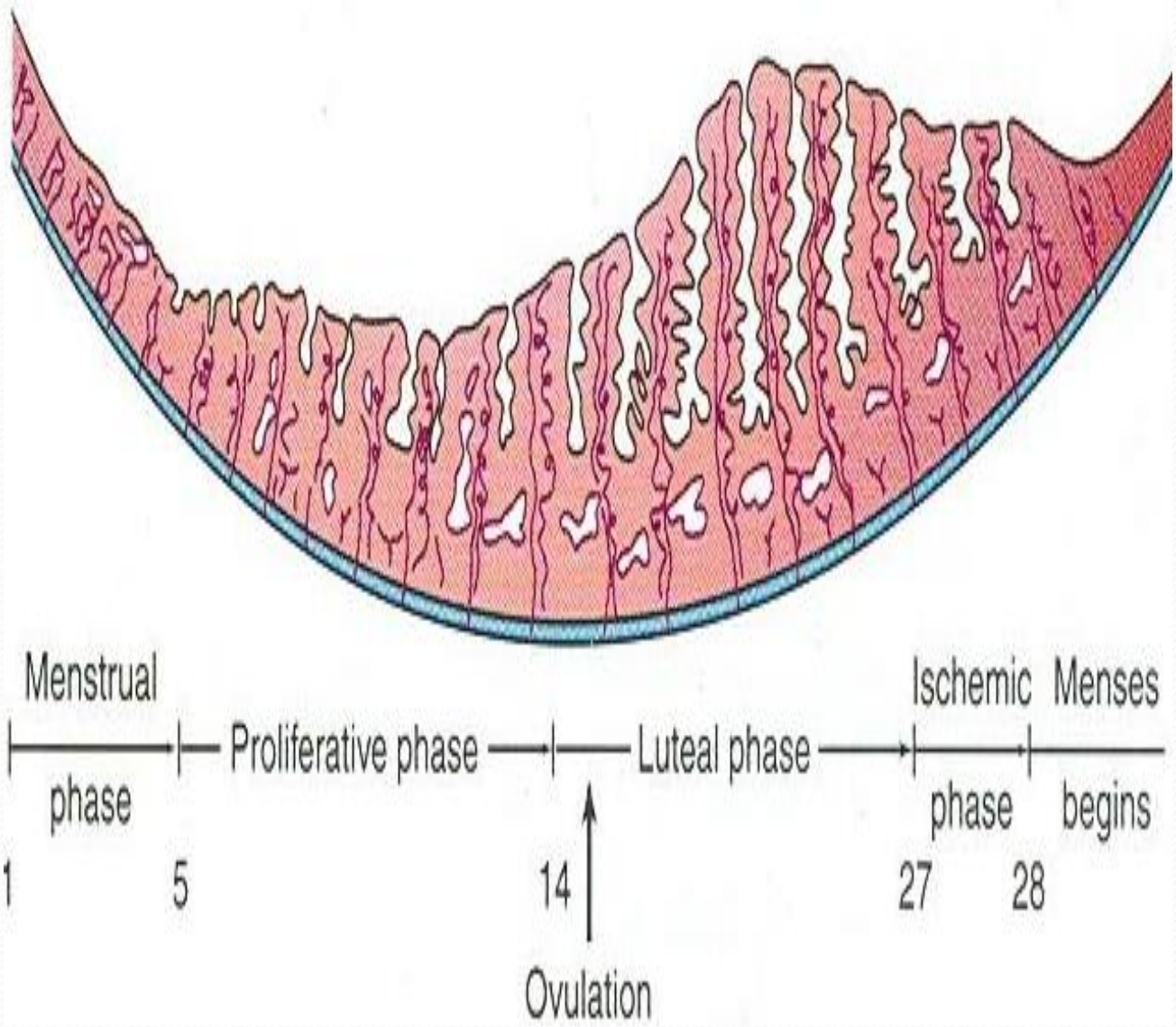
Phases of Menstrual Cycle

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



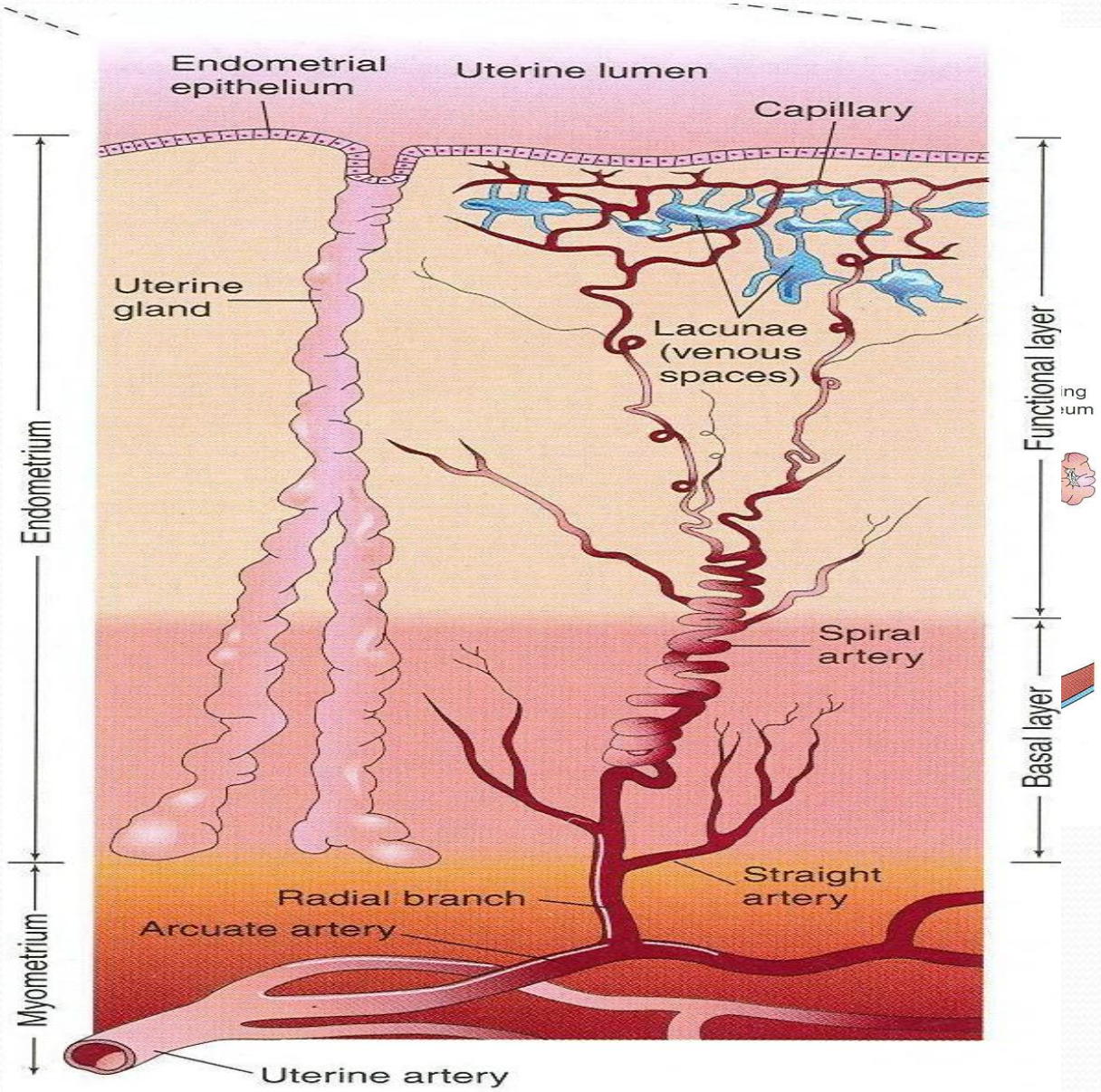
Menstrual Phase

- 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.
- Blood discharge from vagina is combined with small pieces of endometrial tissue.



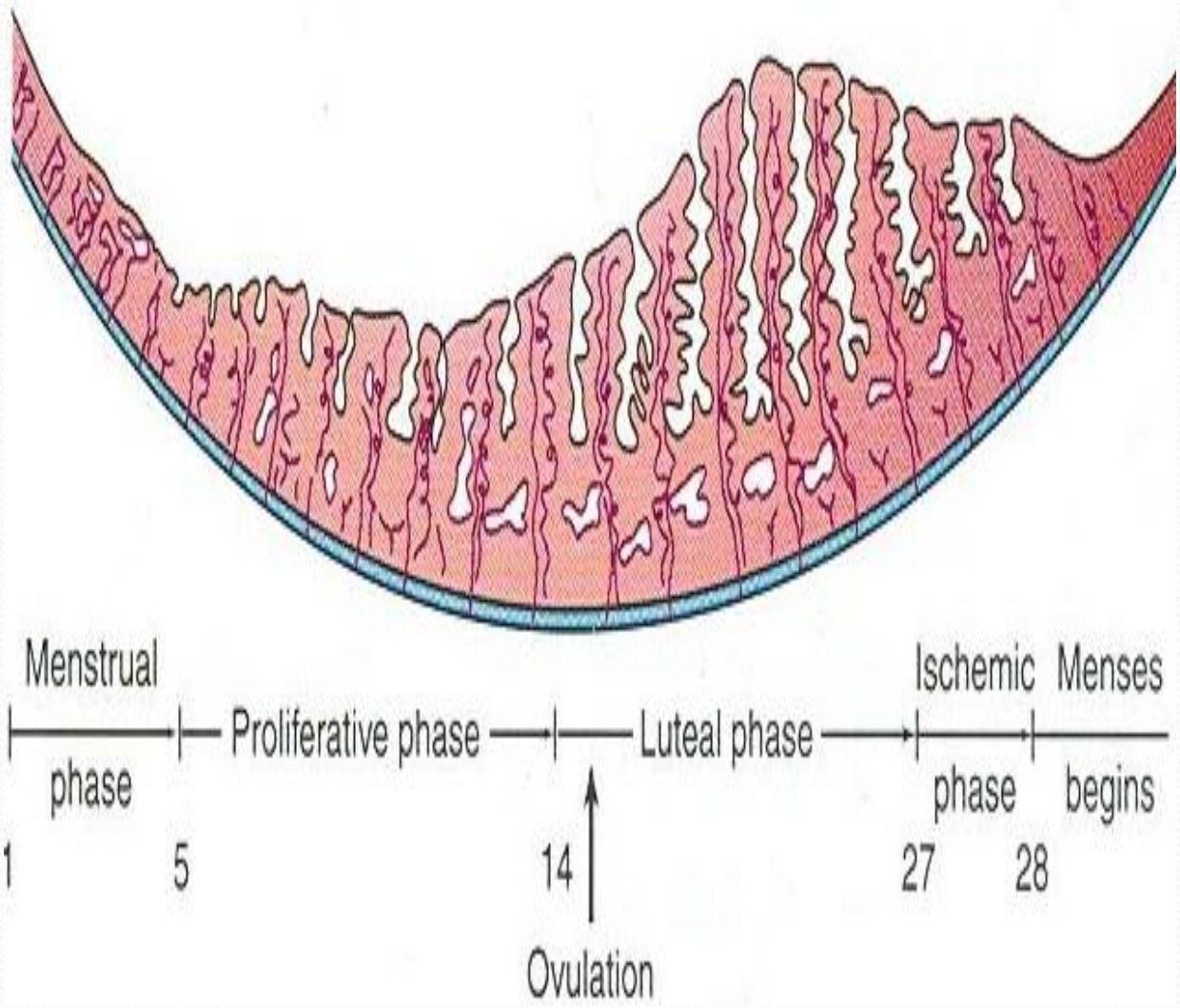
Proliferative Phase

- Is a phase of repair and proliferation.
- Lasts for 9 days.
- Coincides with growth of ovarian follicle.
- 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.



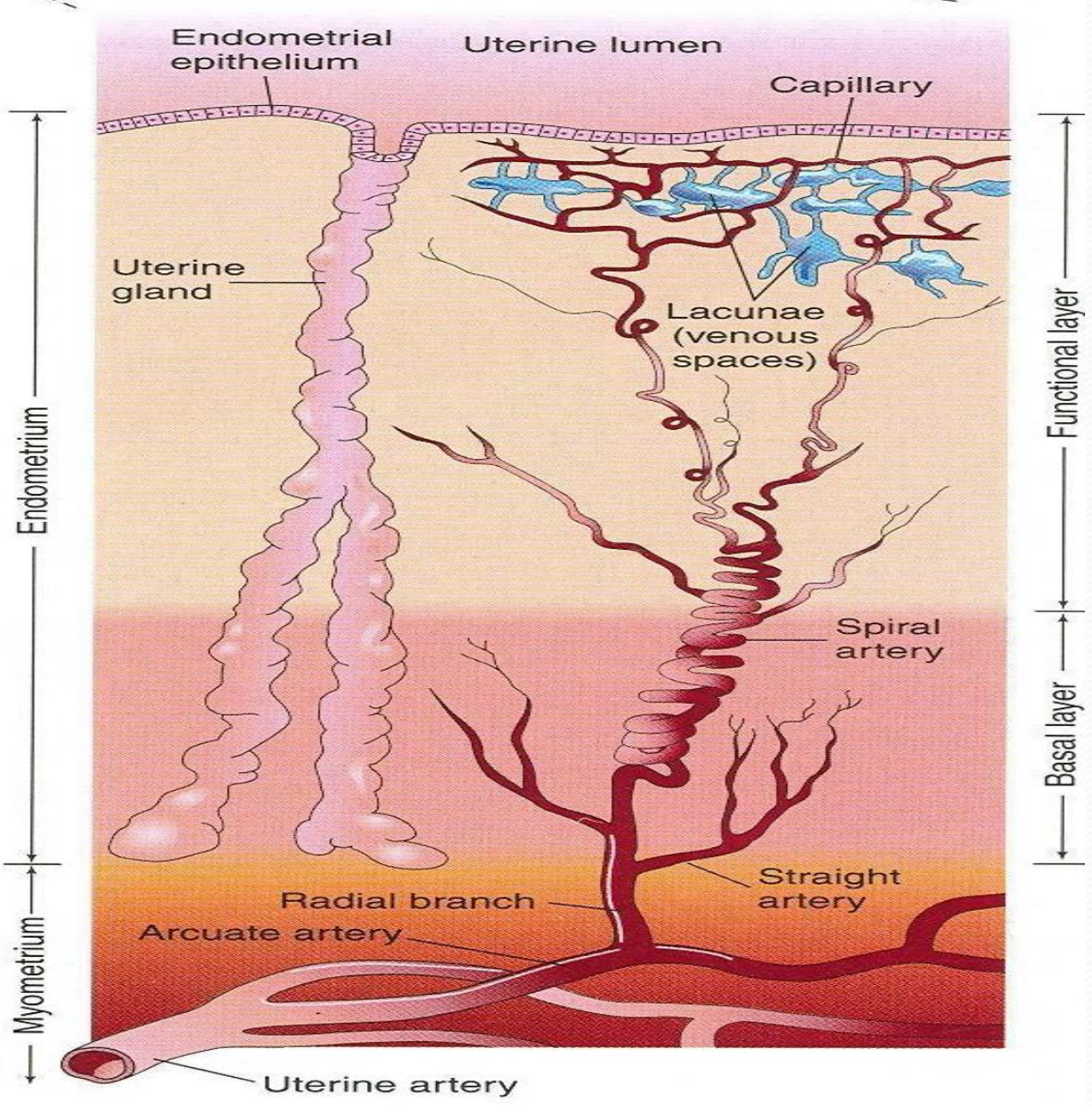
Luteal Phase

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



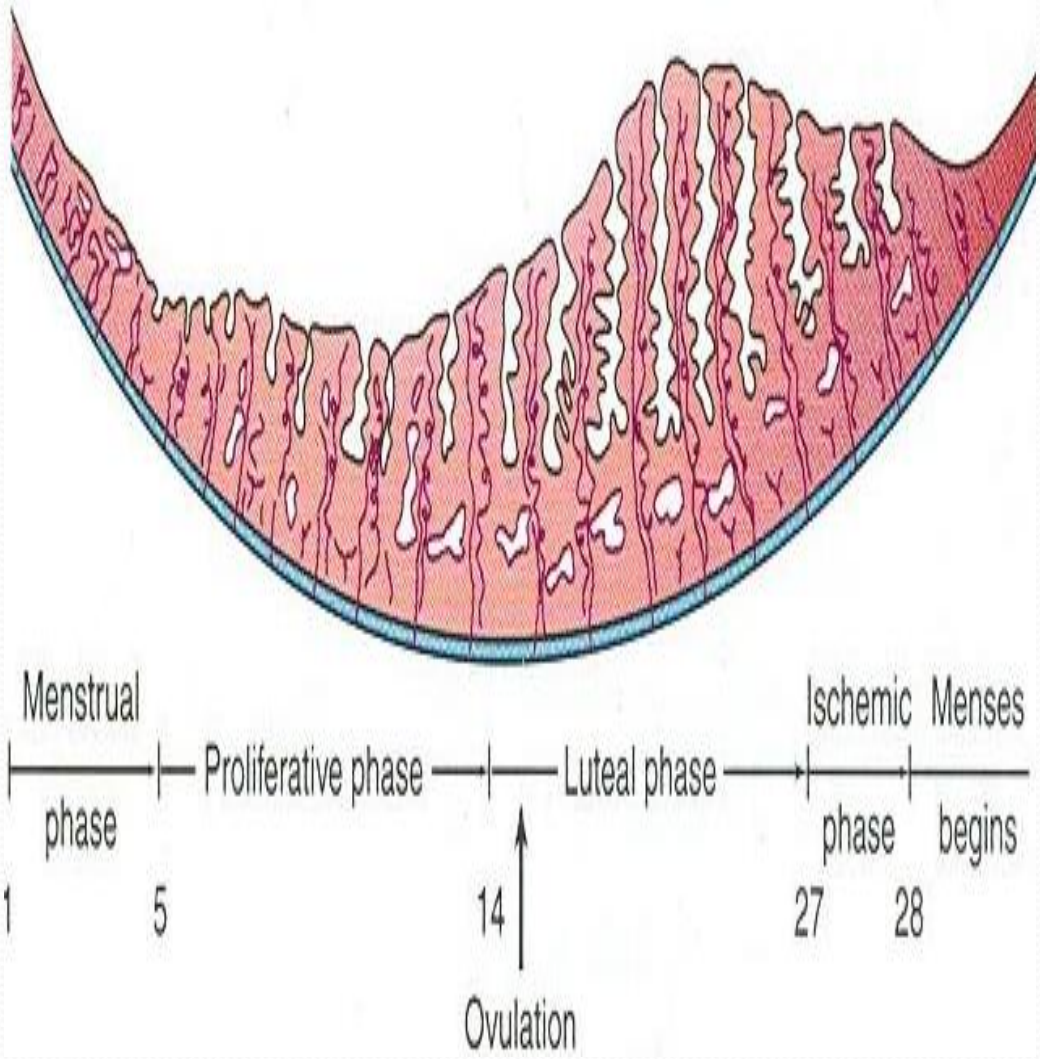
Luteal Phase

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

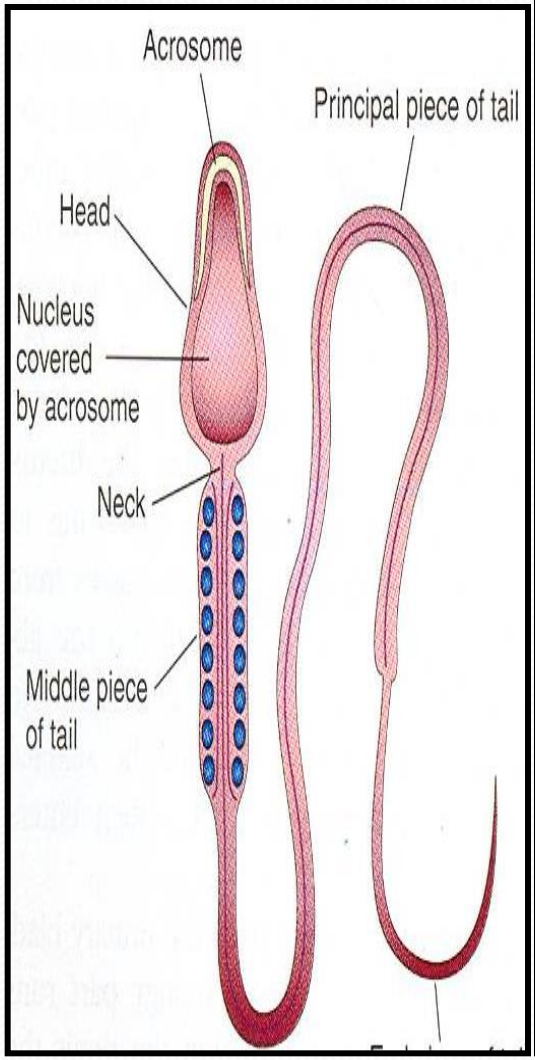


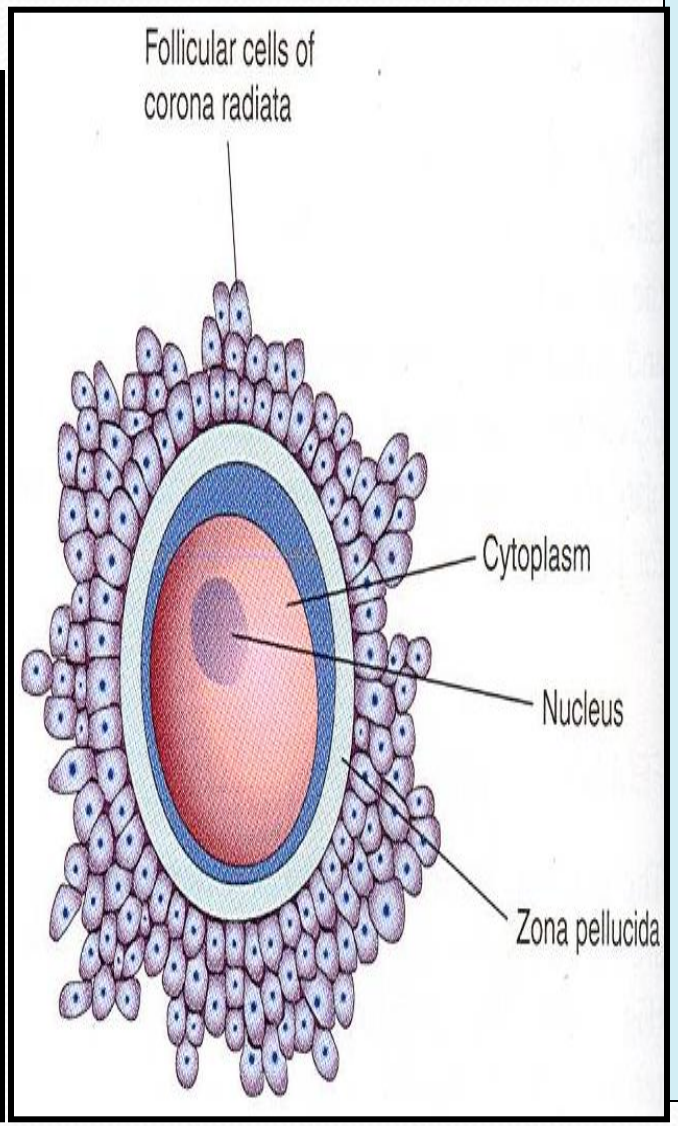
Ischemic Phase

- Degeneration of corpus luteum leads to decrease the levels of estrogen & progesterone.
- Loss of interstitial fluid.
- Marked shrinking of endometrium.
- Spiral arteries become constricted.
- Venous stasis & Ischemic necrosis.
- Rupture of damaged vessel wall.
- Blood seeps into the surrounding connective tissues.
- Loss of 20-80 ml of blood
- Entire compact layer and most of the spongy layer of endometrium is discarded.



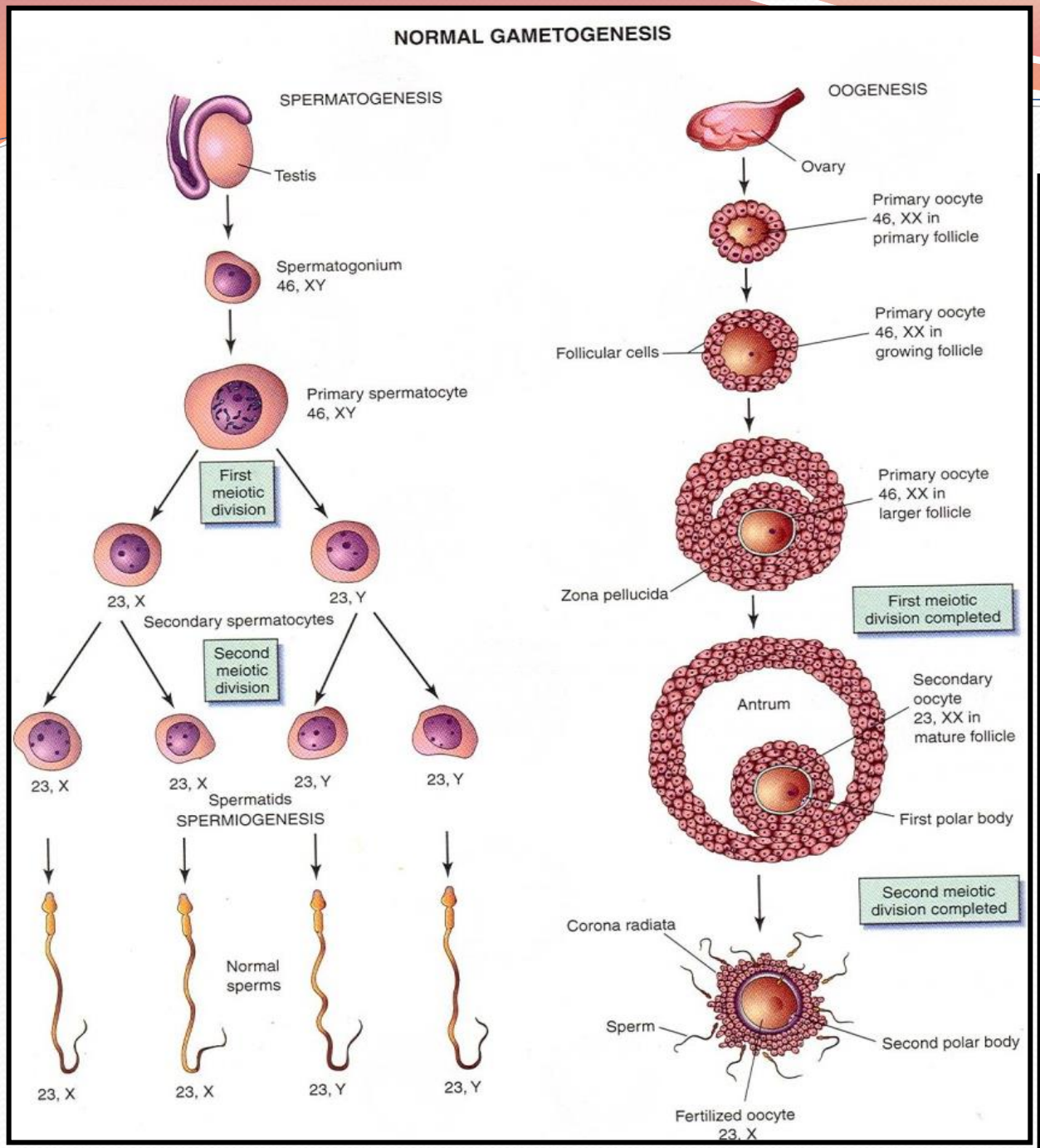
GAMETOGENESIS
(Gamete Formation)





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

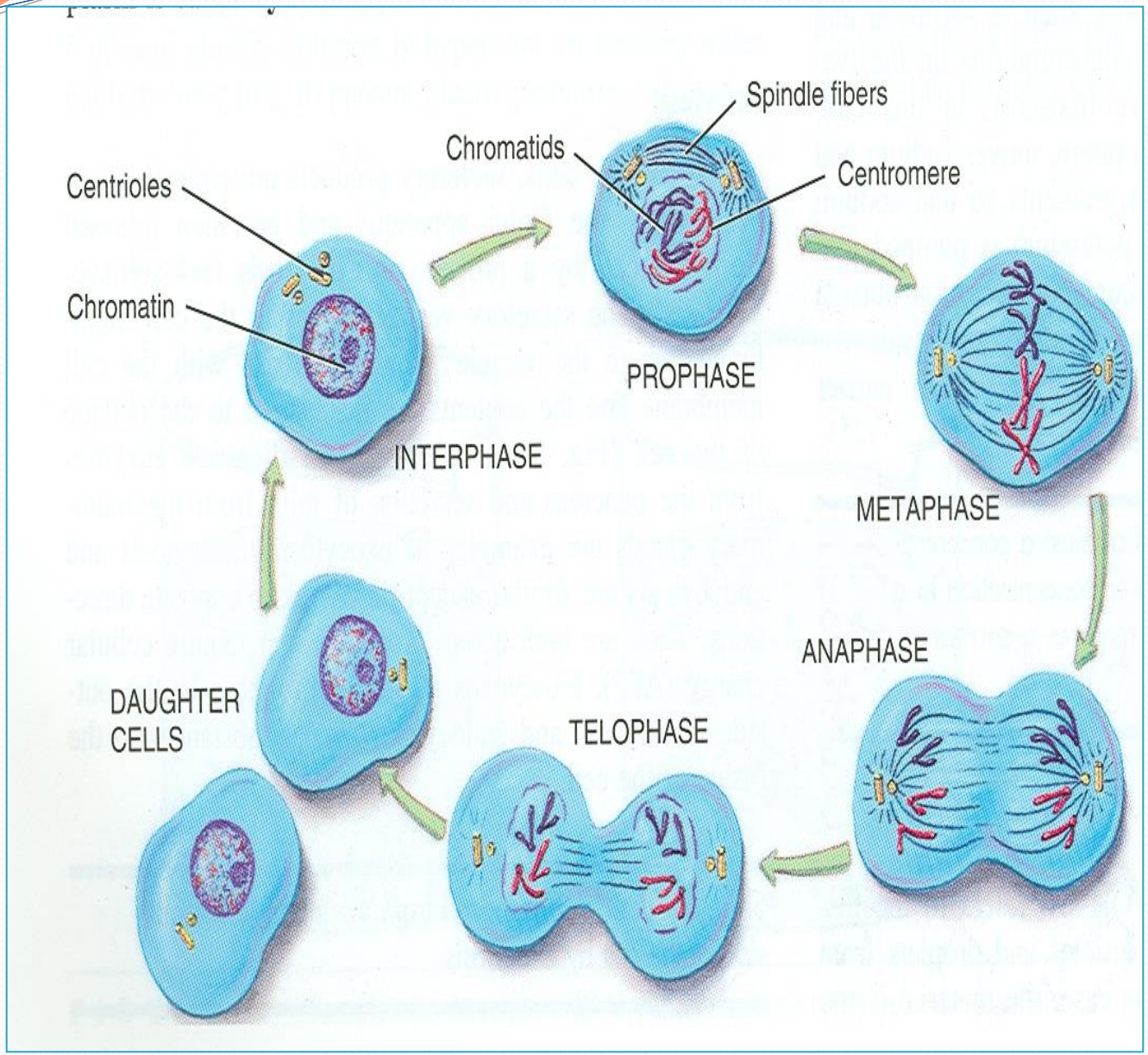
- **Spermatogenesis:**
- **It is the series of changes by which the primitive germ cells (spermatogonia) are transformed into mature sperms.**
- **Oogenesis:**
- **Sequence of events by which the primitive germ cells (oogonia) are transformed into mature oocytes.**



MEIOSIS

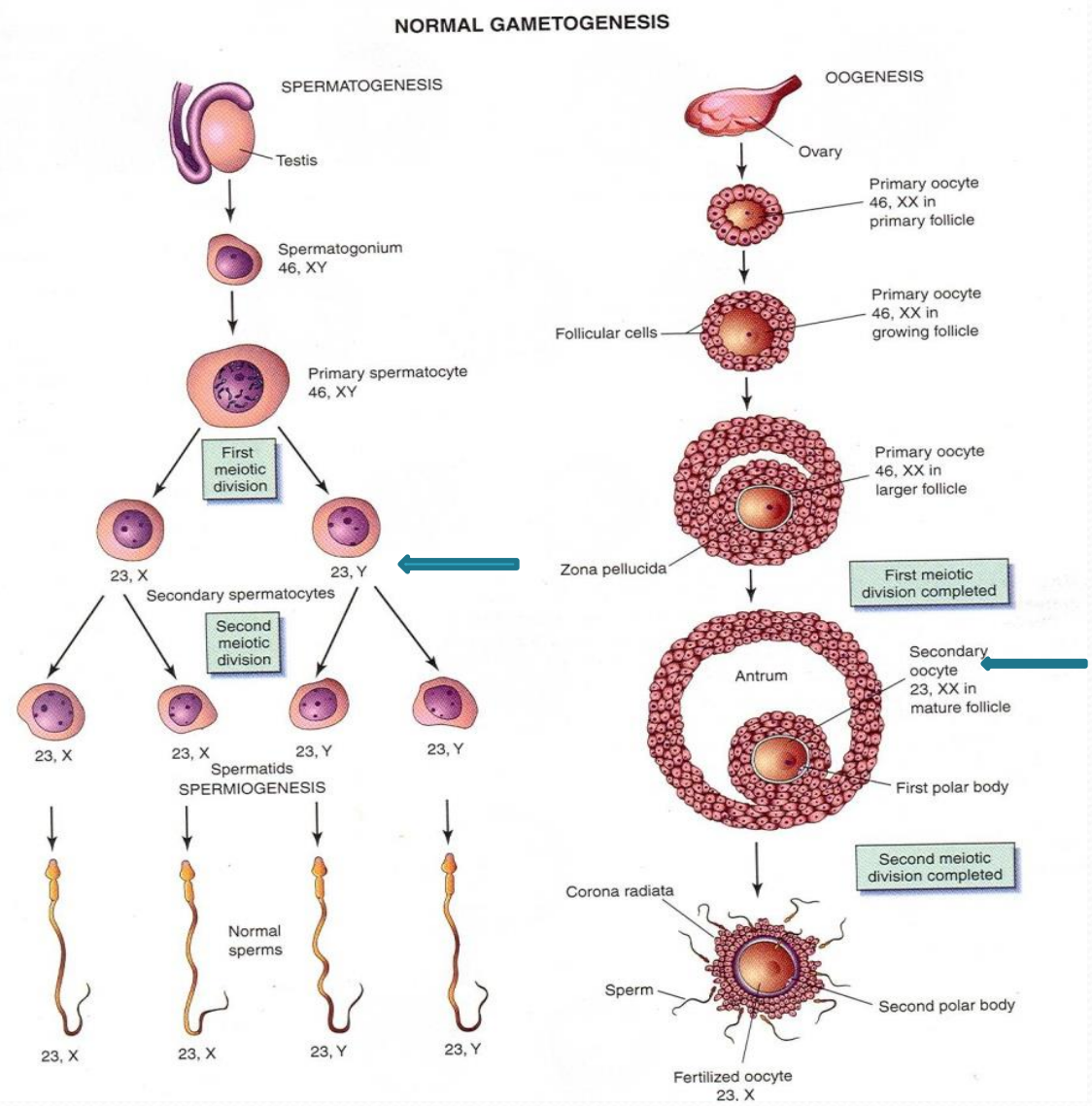
- ***It is the <u>cell division</u> that takes place <u>in</u> the <u>germ cells</u> to produce male & female gametes.***
- ***It consists of two cell divisions, meiosis I & meiosis II during which the Diploid number of chromosomes (46) is reduced to Haploid number (23).***

FIRST MEIOTIC DIVISION



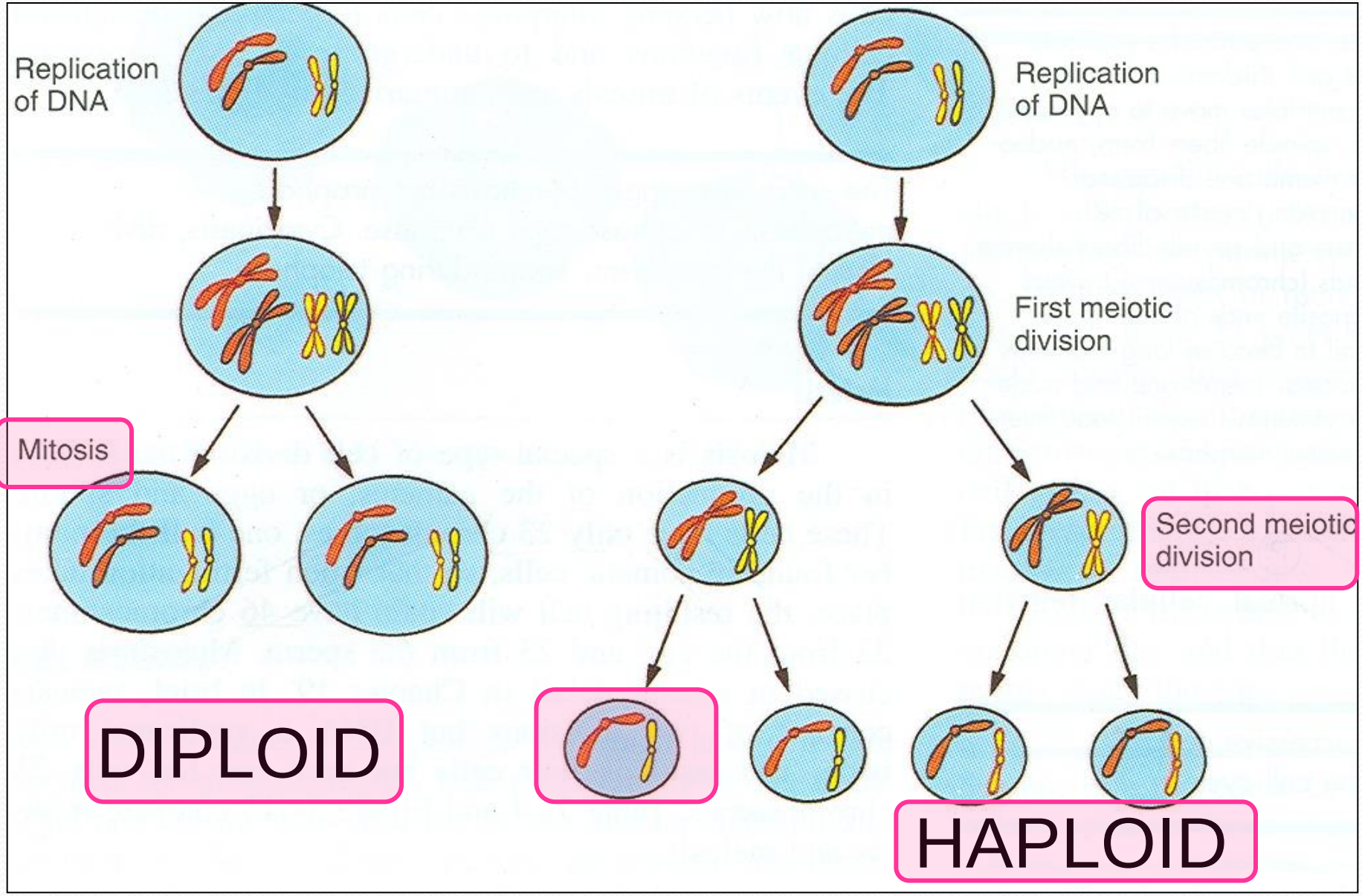
- ***At the <u>beginning of meiosis I</u>, (prophase) male & female germ cells <u>replicate their DNA</u> so that***
- ***each of the 46 chromosomes is duplicated into sister Chromatid.***

FIRST MEIOTIC DIVISION

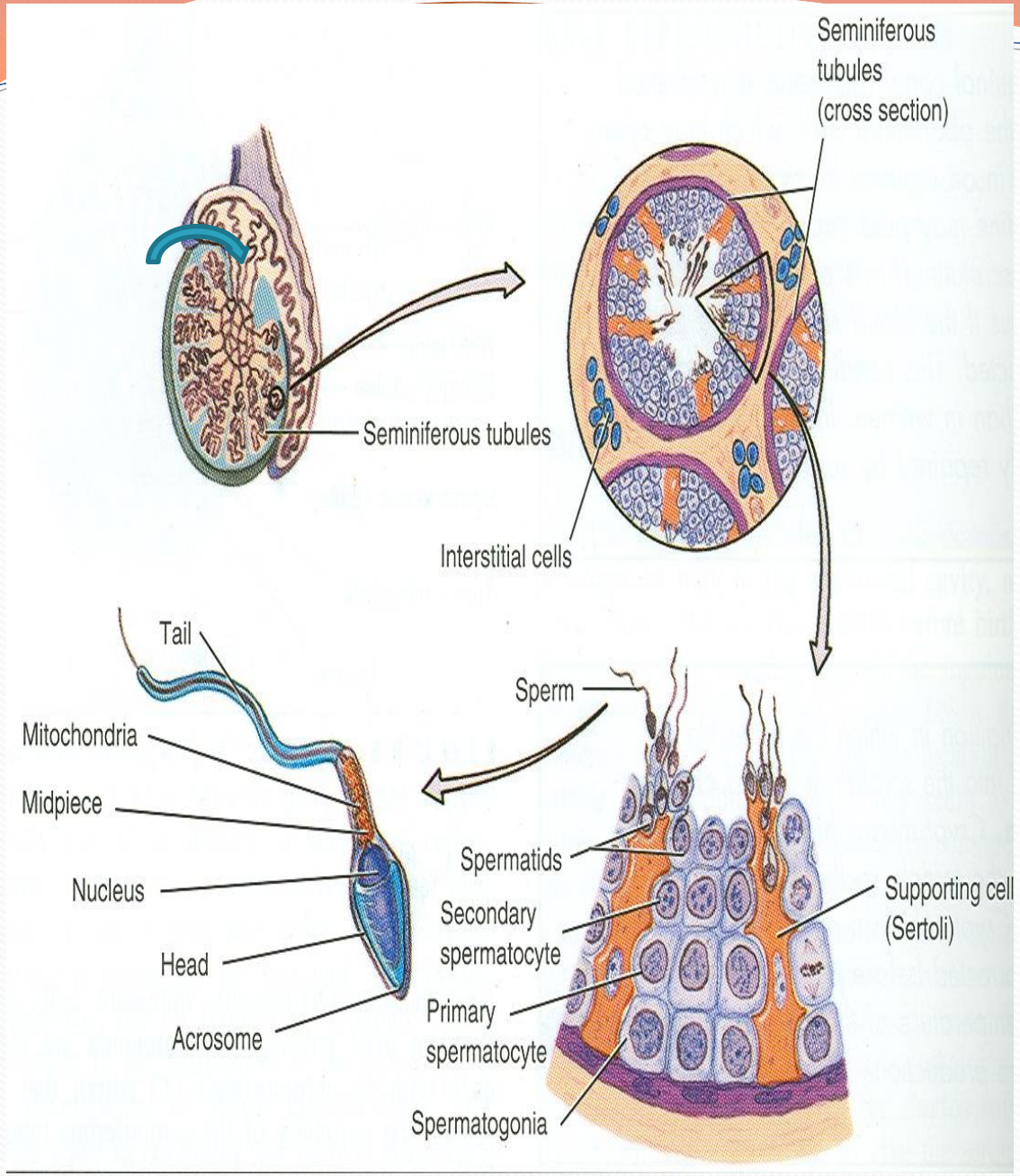


- ***By the end of the first meiotic division, each new cell formed (Secondary Spermatocyte or Secondary Oocyte) has haploid (half) number of chromosome.***
- ***It is half number of chromosomes of the Primary Spermatocyte or primary Oocyte.***

WHAT IS THE DIFFERENCE BETWEEN MITOSIS & MEIOSIS?

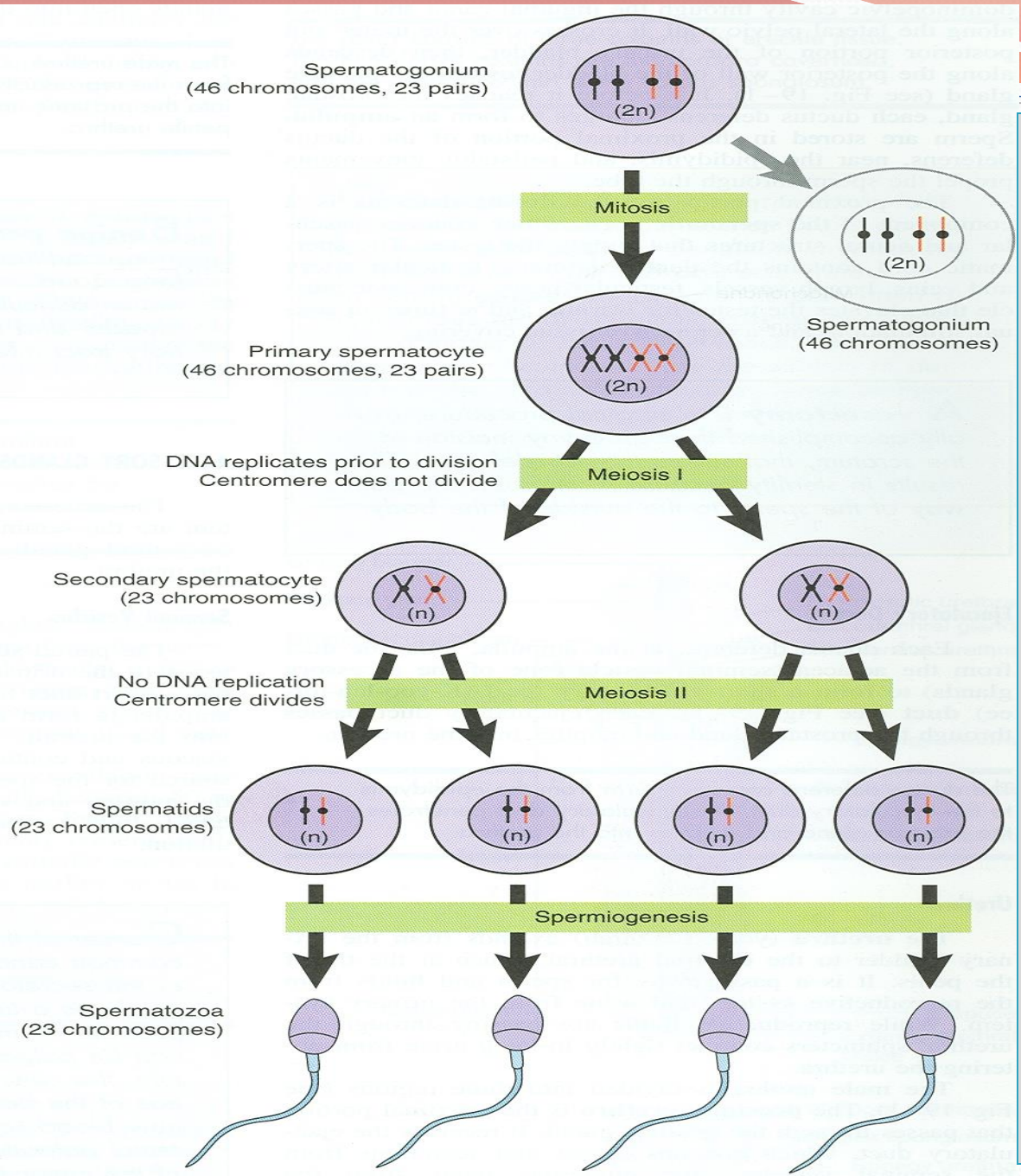


SPERMATOGENESIS



- **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

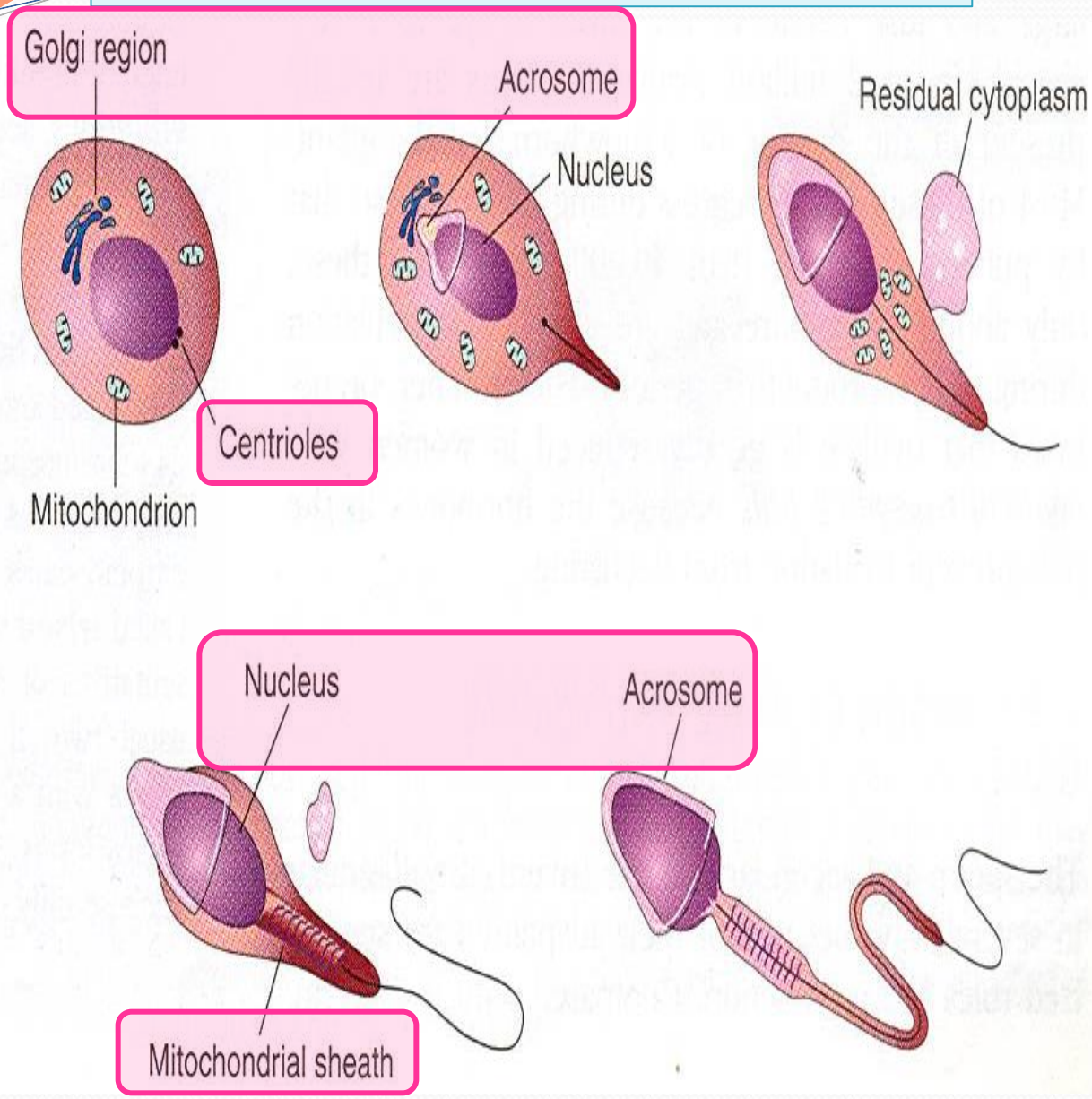


- Each **daughter Spermatogonia** grows to give **primary spermatocyte (46).**
- **Primary spermatocyte** undergoes ***meiotic*** division to give

  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.**

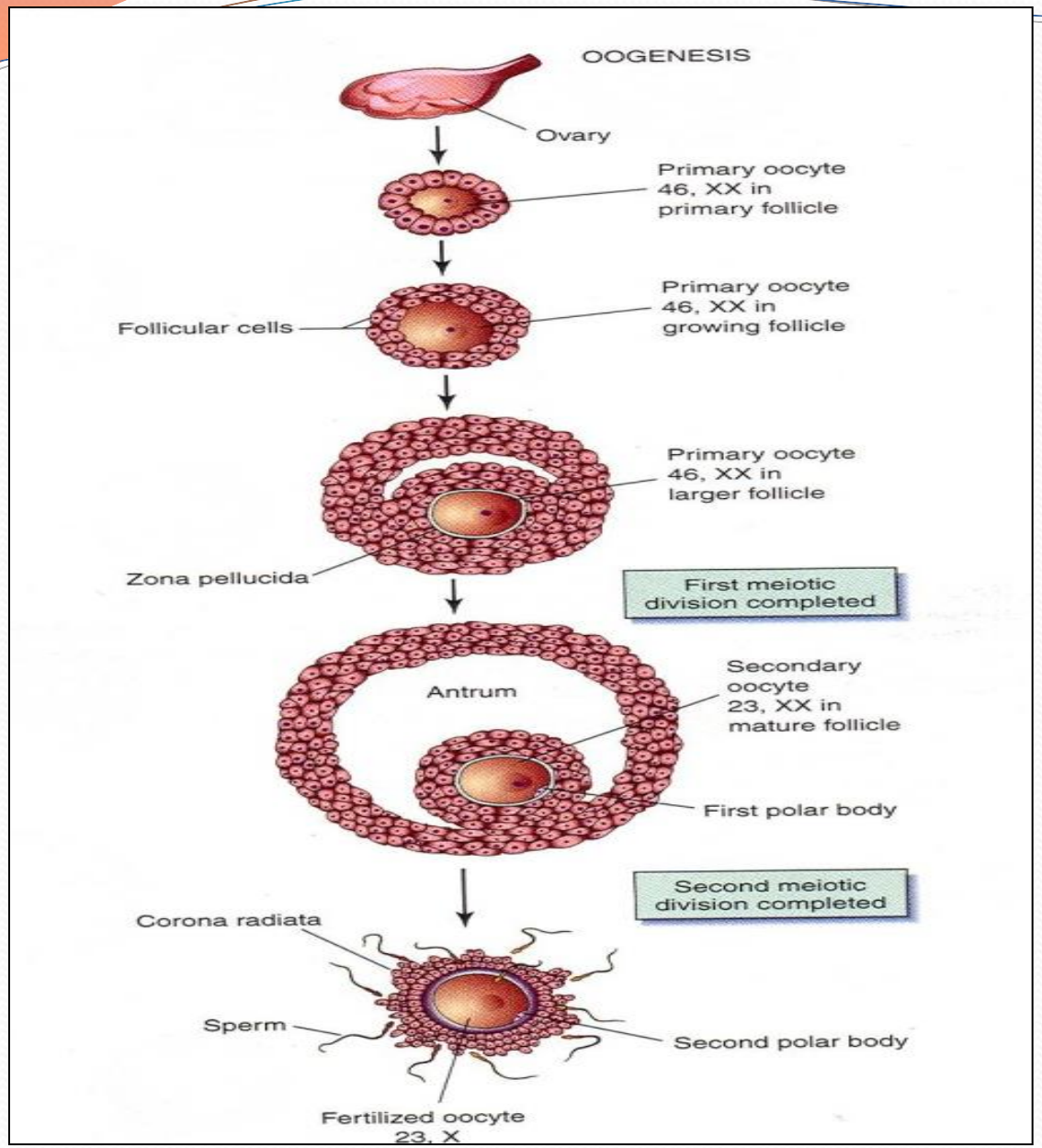
SPERMIOGENESIS



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

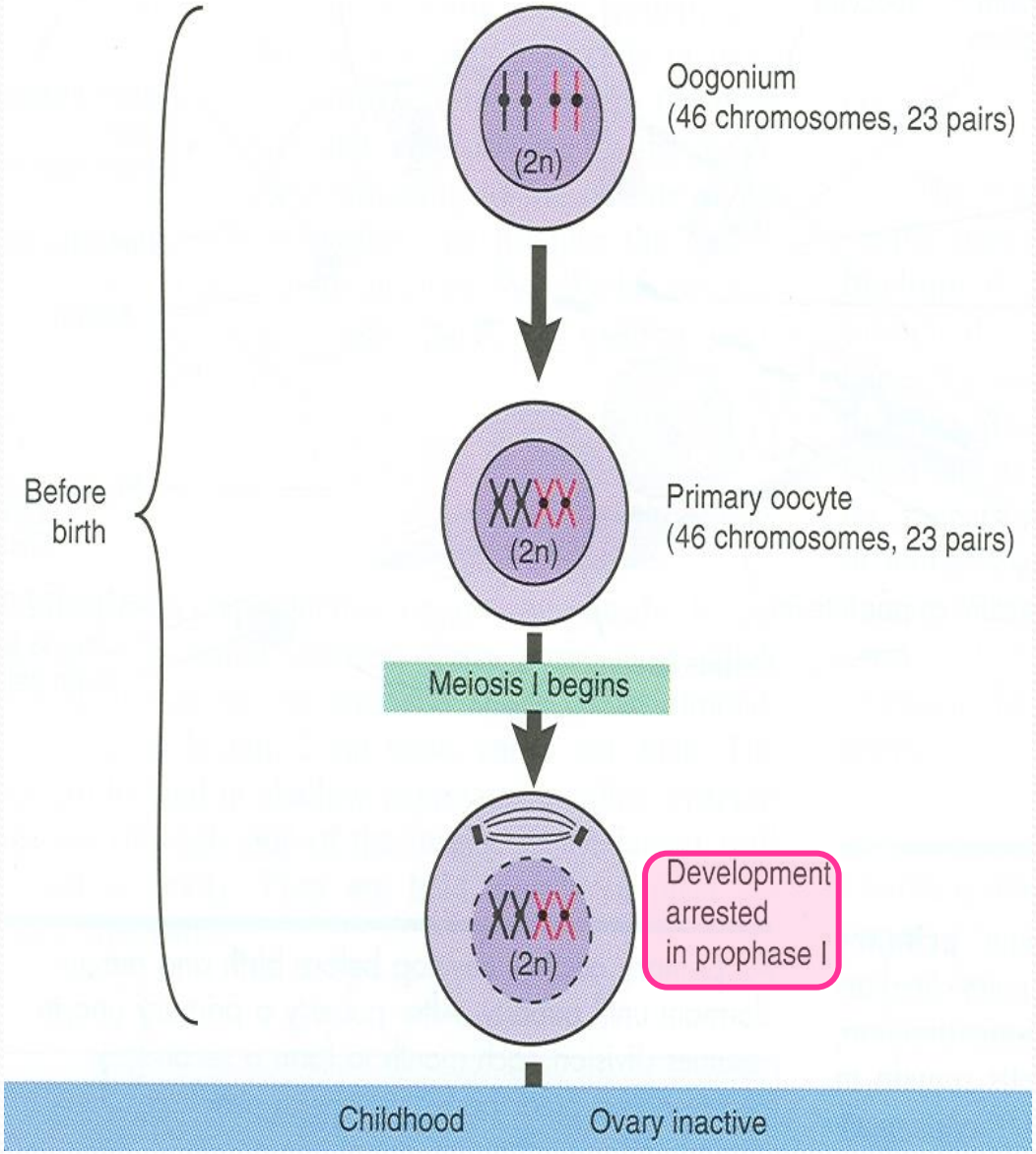
1. ***Nucleus is condensed and forms most of the head.***
2. ***Golgi apparatus forms the Acrosome.***
3. ***Mitochondria forms a spiral sheath.***
4. ***Centriole elongates to form the axial filament.***

OOGENESIS



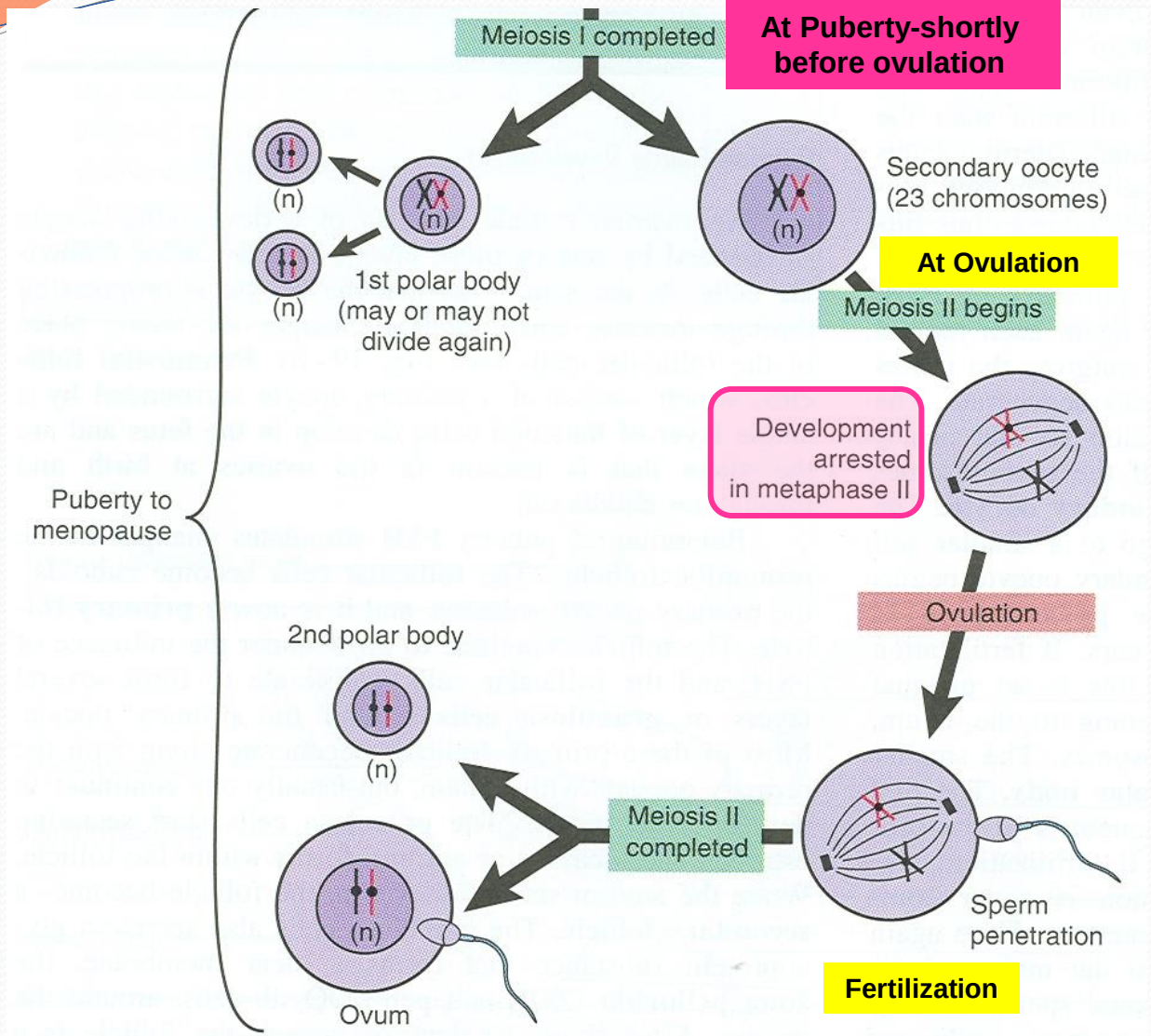
- **AIM:**
- **Formation of secondary oocytes with haploid number of chromosomes.**
- **SITE:**
- **Cortex of the ovary**
- **TIME:**
- **Starts during fetal life becomes completed after puberty & continues until menopause.**
- ***It occurs monthly Except during pregnancy.***

OOGENESIS



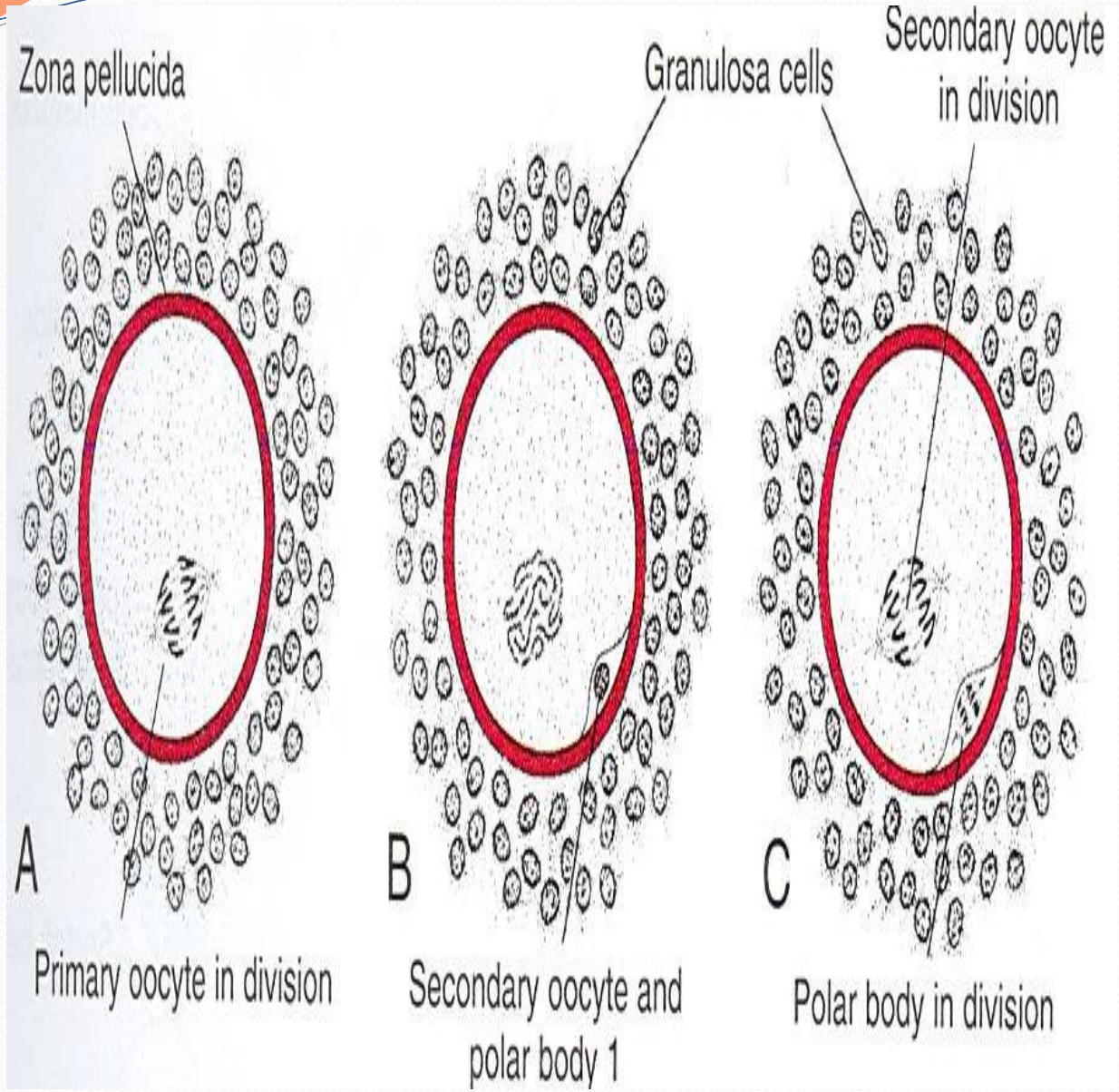
- ***Before Birth:*** *During early fetal life, primitive ova (**Oogonia**). proliferate by mitotic division and enlarge to form **Primary Oocytes (46)***
- ***At Birth all primary oocytes** have completed the **prophase of the 1st meiotic division** and **remain arrested** and do **not finish** their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

OOGENESIS



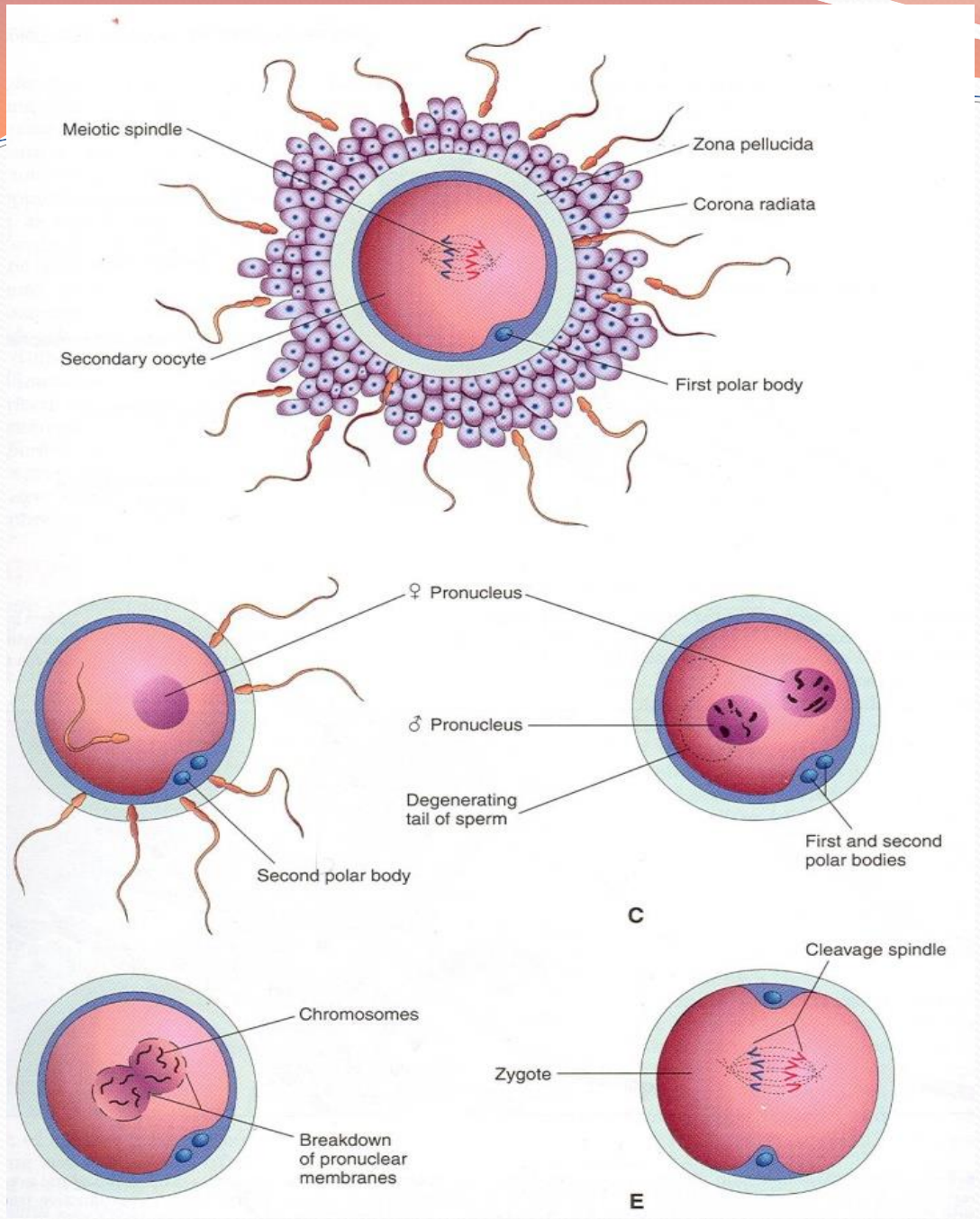
- ***At ovulation, the secondary oocyte begins the second meiotic division but progresses only to metaphase where division is arrested.***

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.***
- ***It is small nonfunctional cell that soon degenerates.***

OOGENESIS



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

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