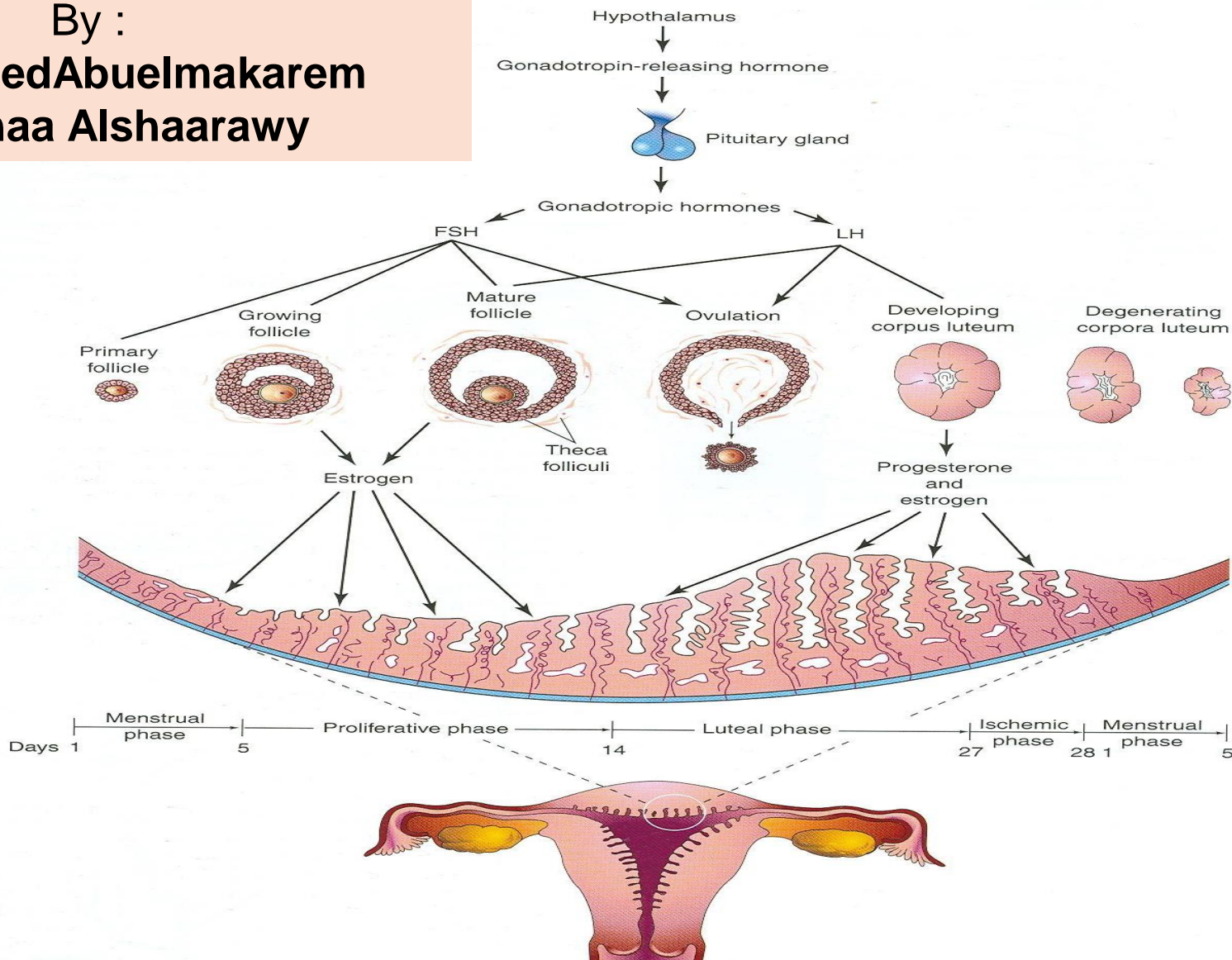


GAMETOGENESIS & FEMALE CYCLES

By :

Prof. SaeedAbuelmakarem
Dr.Sanaa Alshaarawy



OBJECTIVES

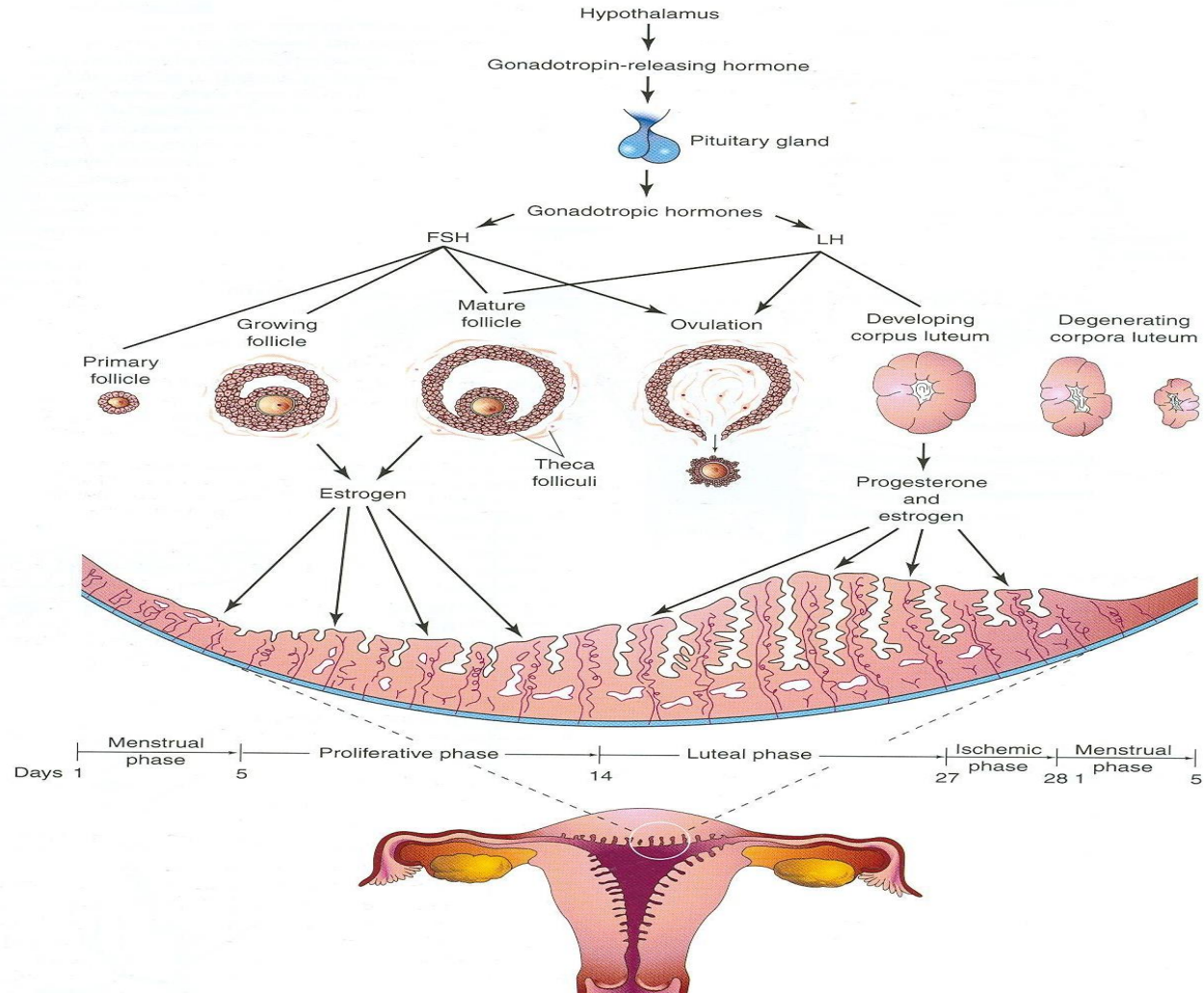
- *By the end of the lecture, you should be able to:*
- Describe the female cycles (**Ovarian & Uterine**).
- Define **gametogenesis**.
- Differentiate the types of **gametogenesis**.
- Describe the process of **spermatogenesis**.
- Describe the process of **oogenesis**.

Female Reproductive Cycles

OVARIAN AND UTERINE CYCLES

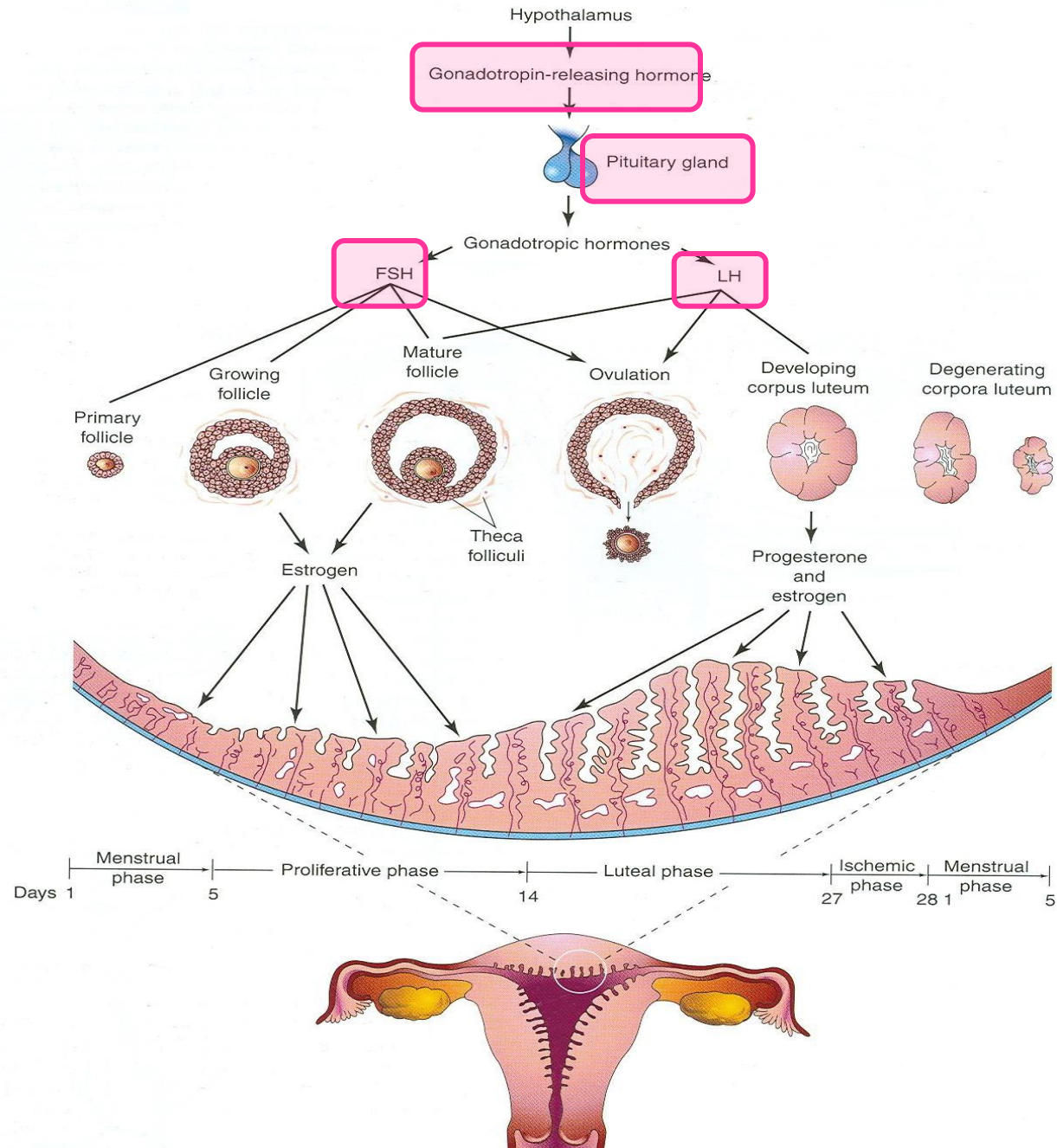
- **Start** at puberty.
- Normally continues until the **menopause**.
- Reproductive cycles depend upon activities & coordination of:

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

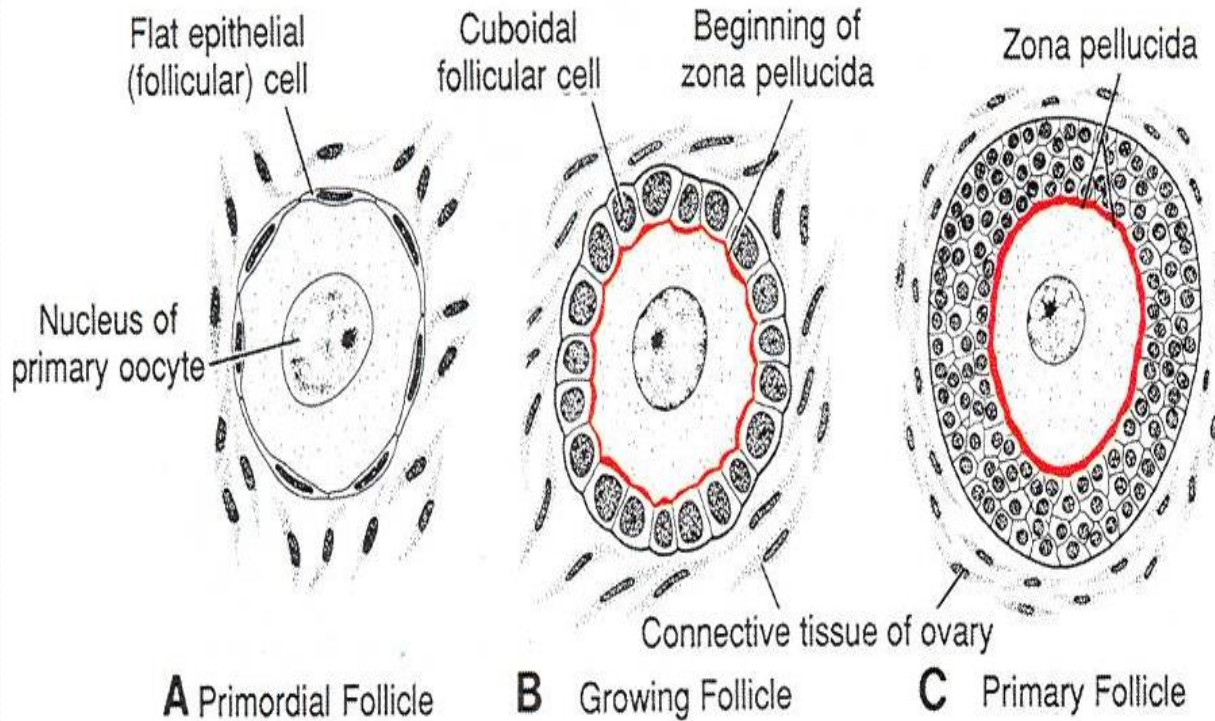


GnRH

- **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



FSH

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

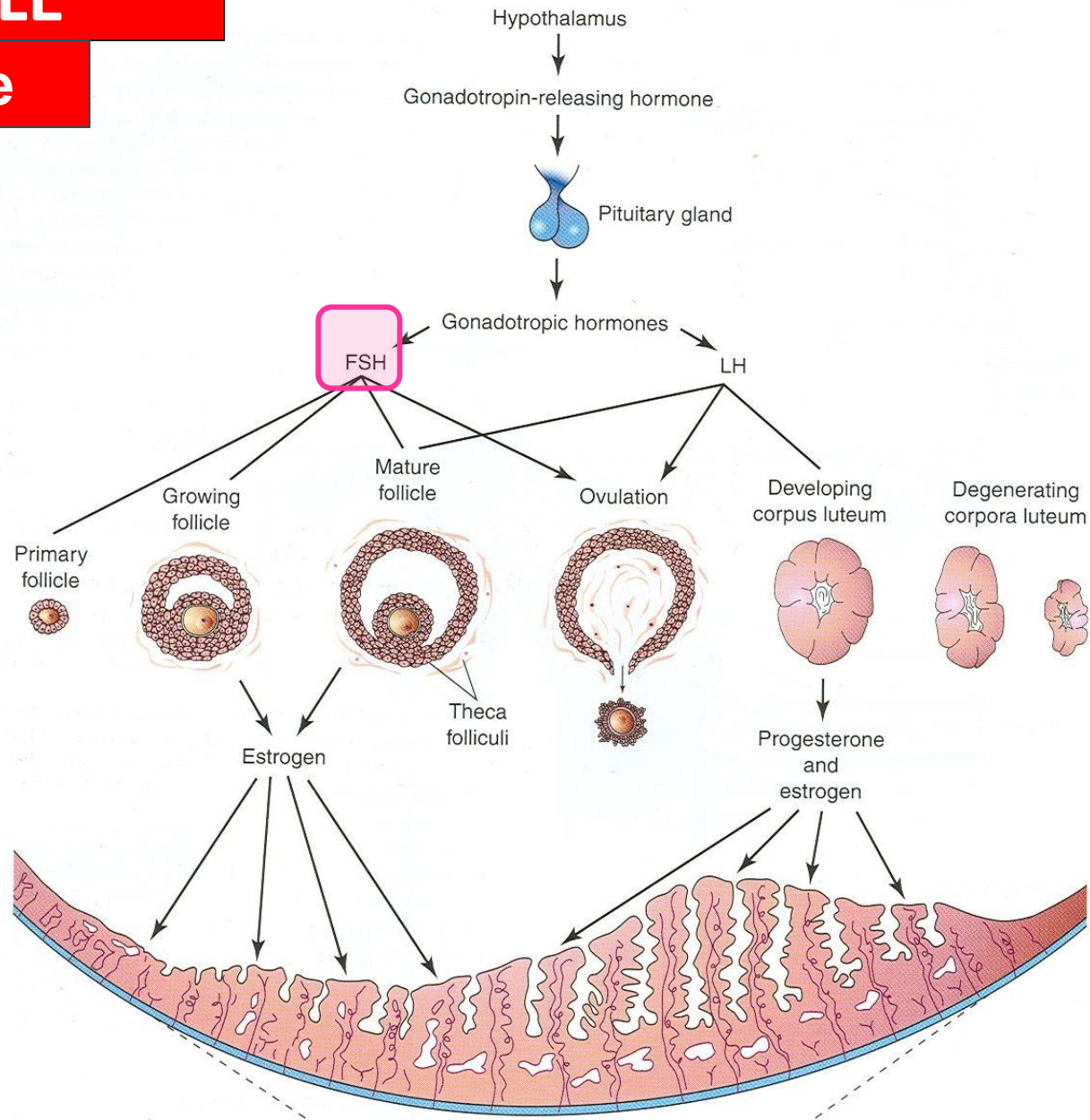
- The ovarian cycle is under the control of the **Pituitary Gland**.
- **It is divided into 3 phases: (FOL)**
- **1- Follicular, (FSH)**
- **2- Ovulatory, (LH).**
- **3- Luteal. (LH).**
- The ovarian cortex contains hundreds of thousands of **primordial follicles** (400,000 to 500,000).
- **Each consists**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

OVARIAN CYCLE

Follicular Phase

FSH

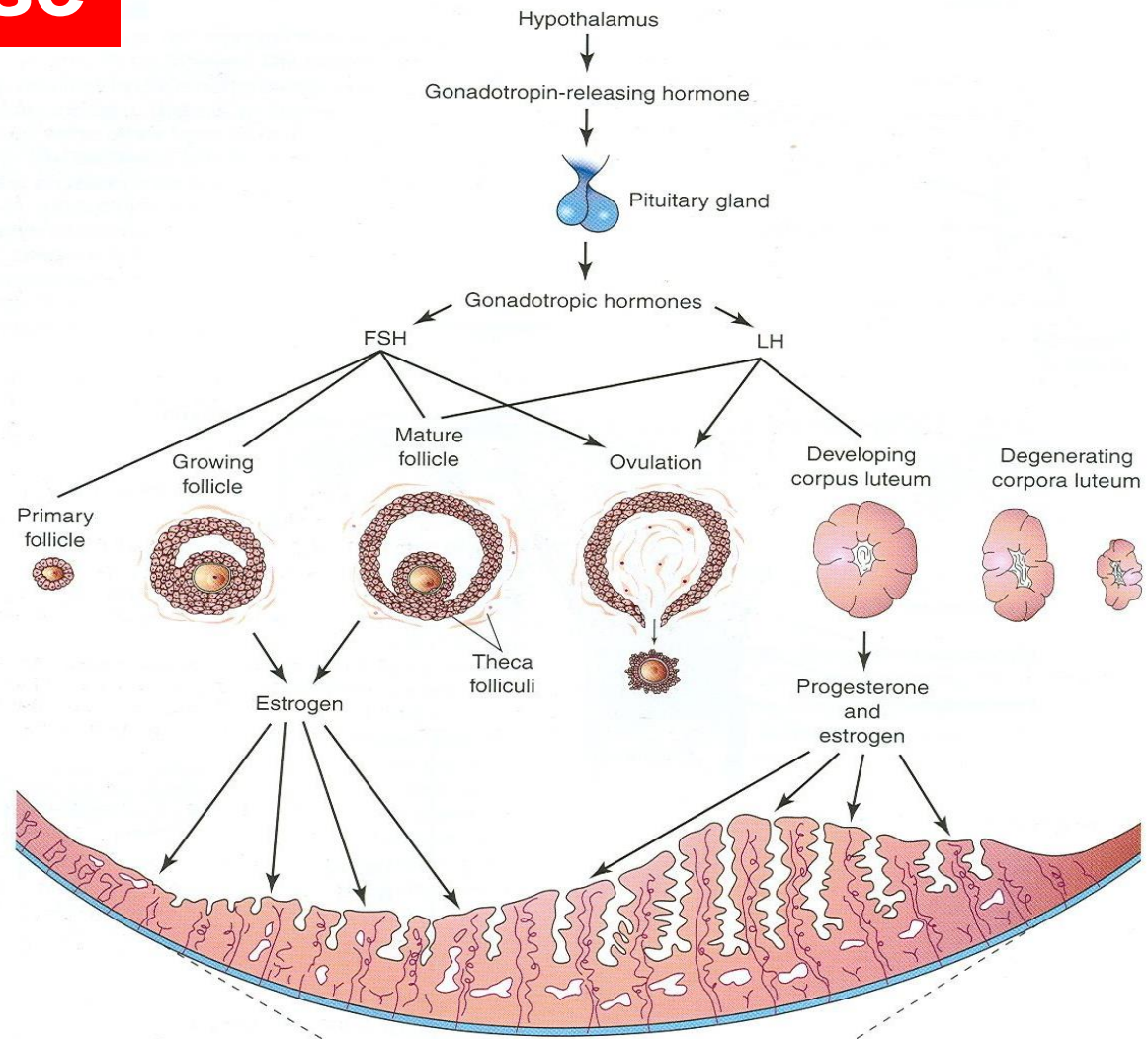
- Follicle-Stimulating Hormone .
- **FUNCTIONS:**
- 1- It stimulates the ovarian primary follicles to develop and become mature.
- 2- Production of Estrogen by the follicular cells.



Ovulatory Phase

LH

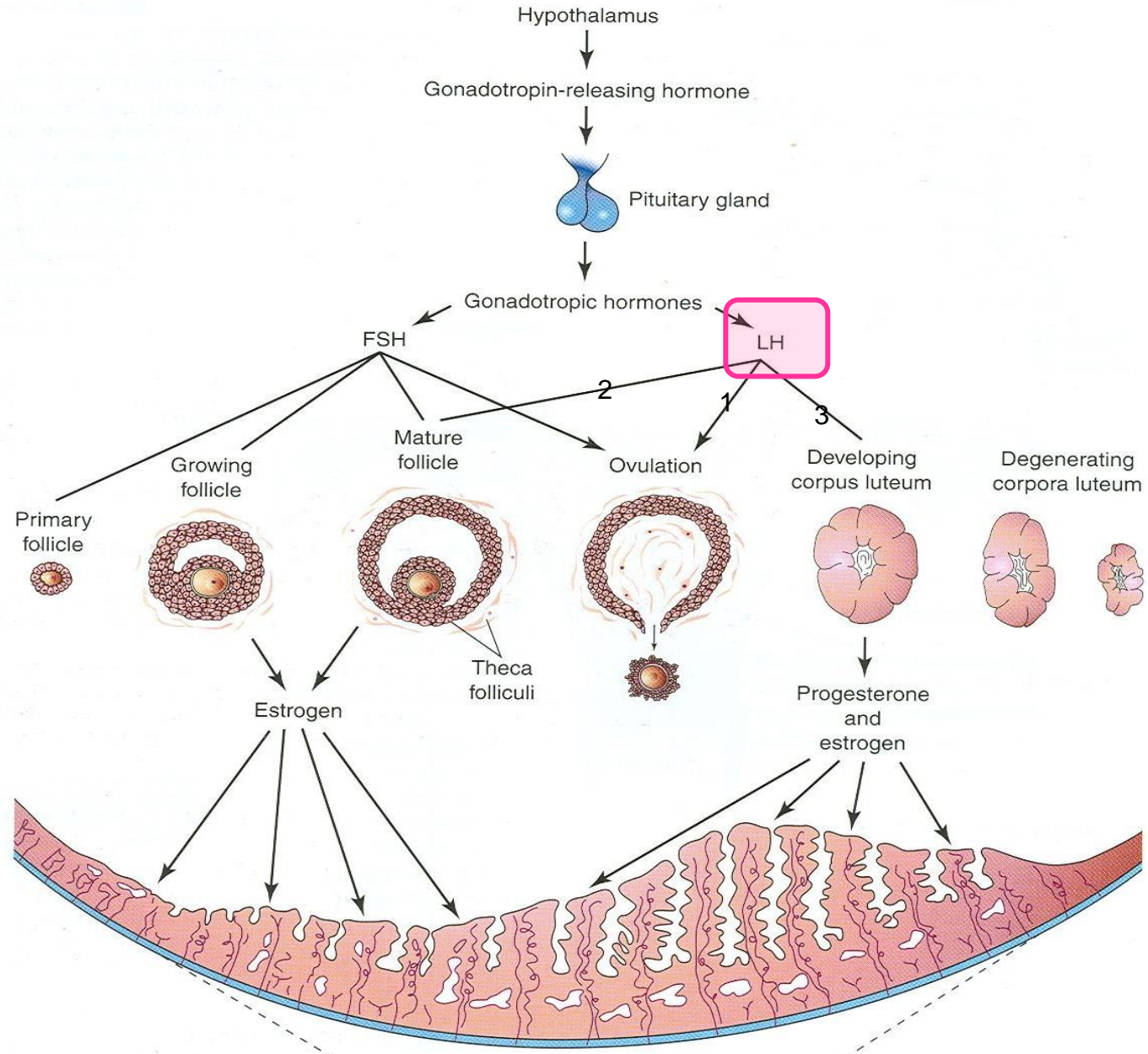
- The **follicle** becomes enlarged until it gets **maturity**.
- It produces swelling on the surface of the ovary.
- **Early development** of ovarian follicle is induced by **FSH**.
- **Final stages** of maturation require **LH**.
- **LH** causes **ovulation** (rupture of the mature follicle).



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

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.**



Luteal Phase

- The remaining of the ruptured follicle is now called **corpus luteum**.

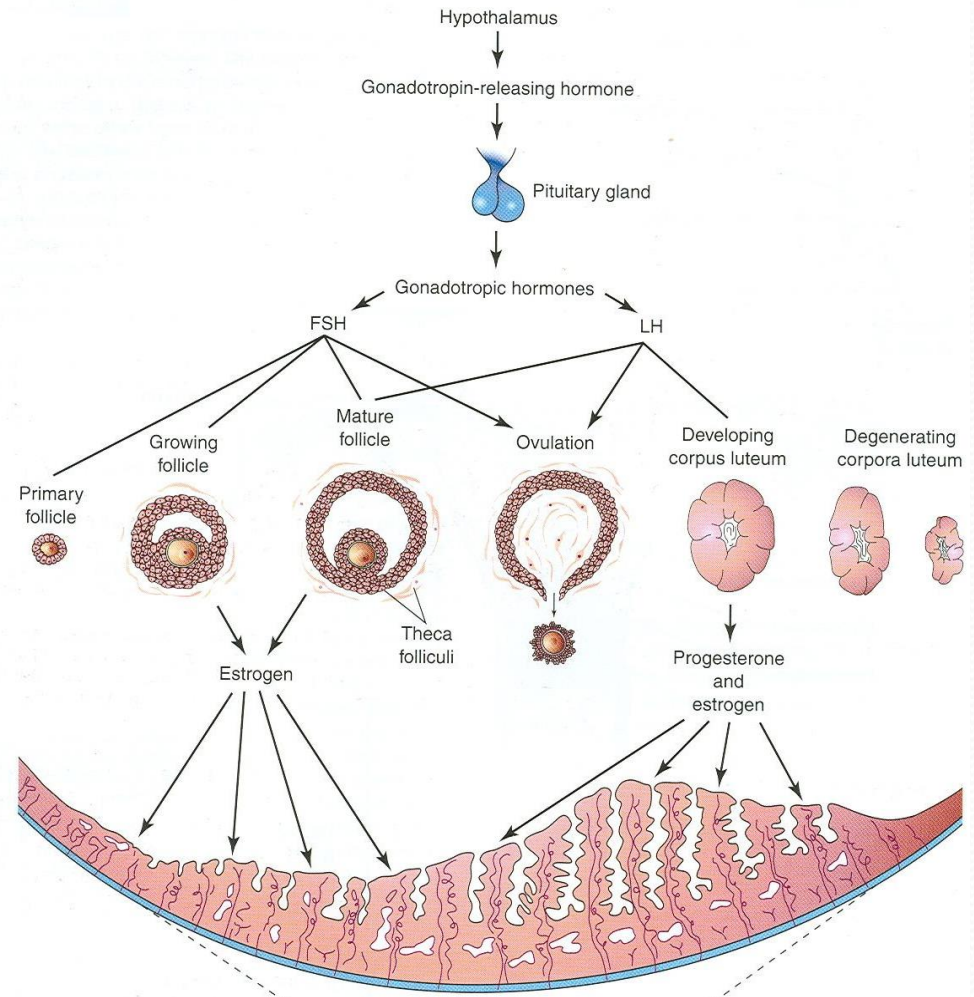
- It secretes **Progesterone** and small amount of **Estrogen**.

- 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.

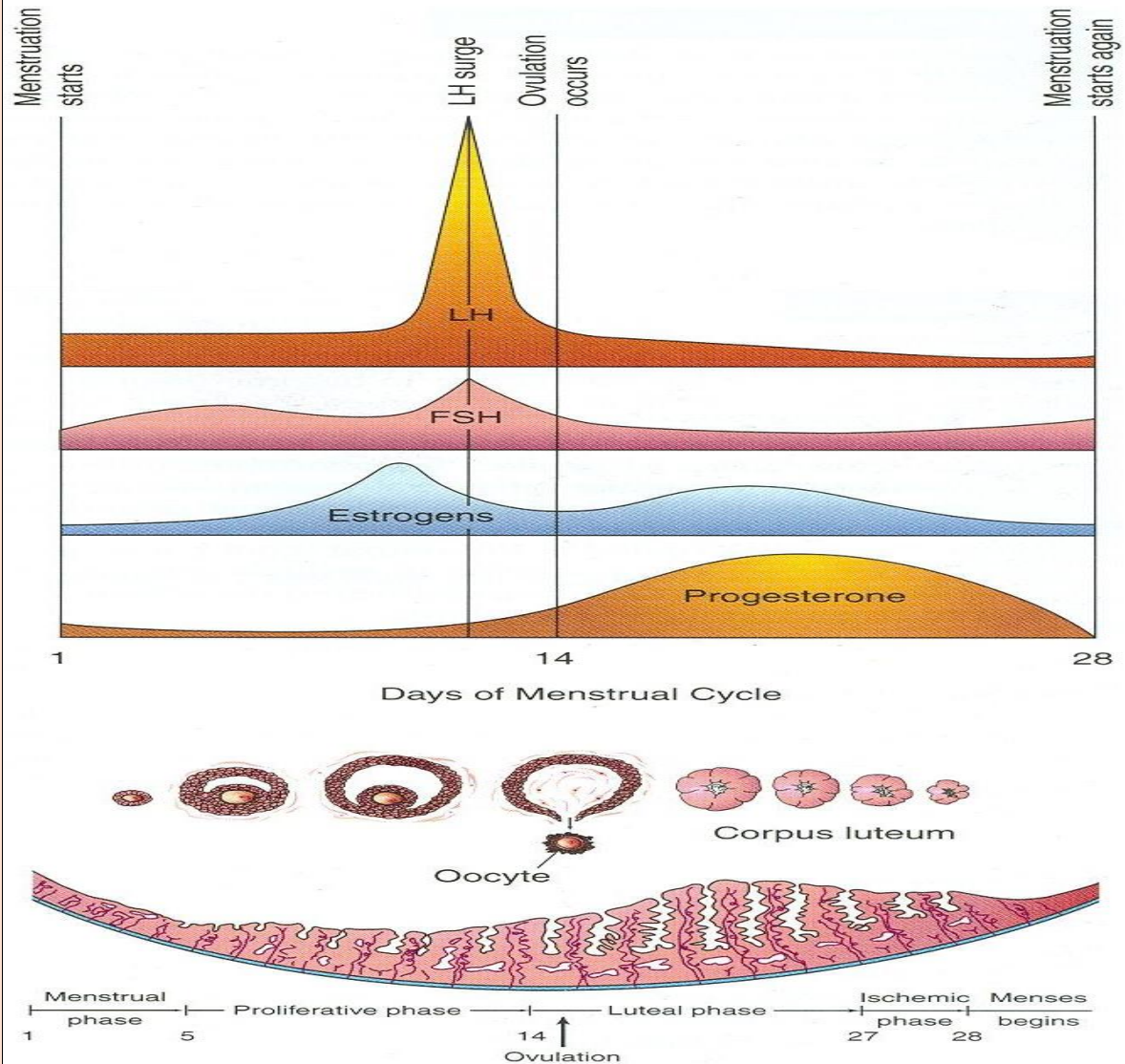
- If the oocyte is **not fertilized** the **corpus luteum** involutes and **degenerates** in 10-12 days.

Corpus Luteum



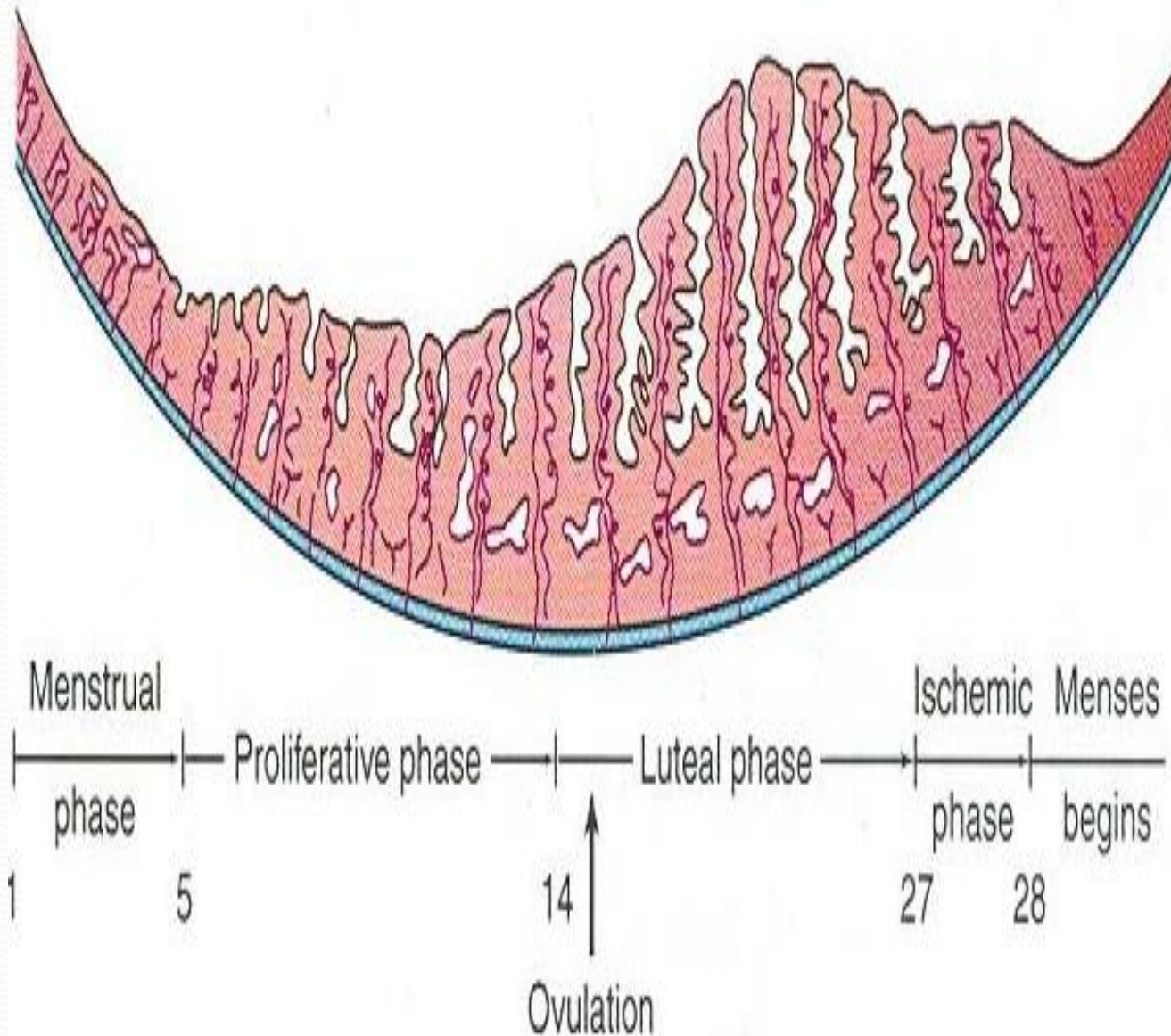
- Cyclic changes in the **endometrium of the uterus** caused by **estrogen & progesterone**.
- Average menstrual cycle is 28 days.
- Day **One** is the day when **menstrual blood** flow begins.
- It varies by several days in normal women.
- Ranges between 23 and 35 days in 90% of women.
- It sometimes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

Uterine or Menstrual Cycle



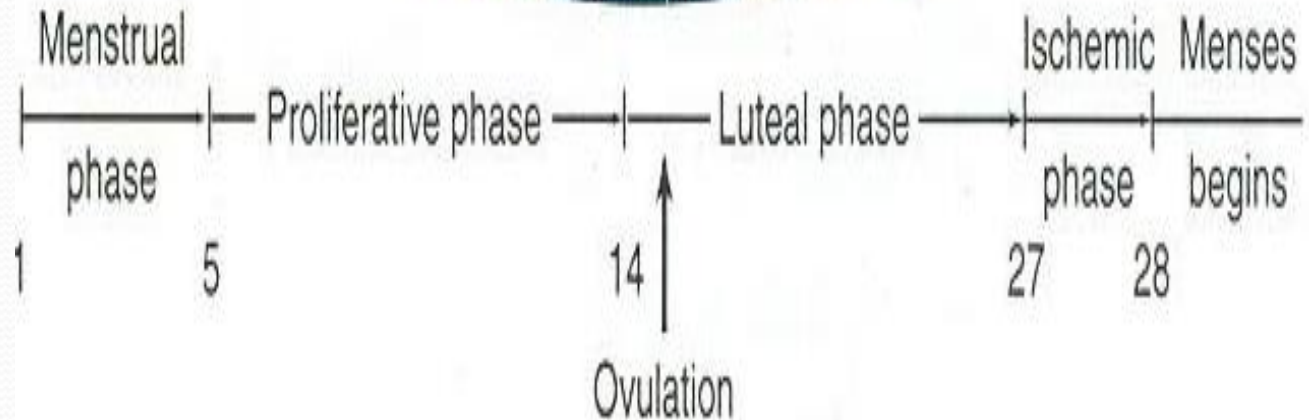
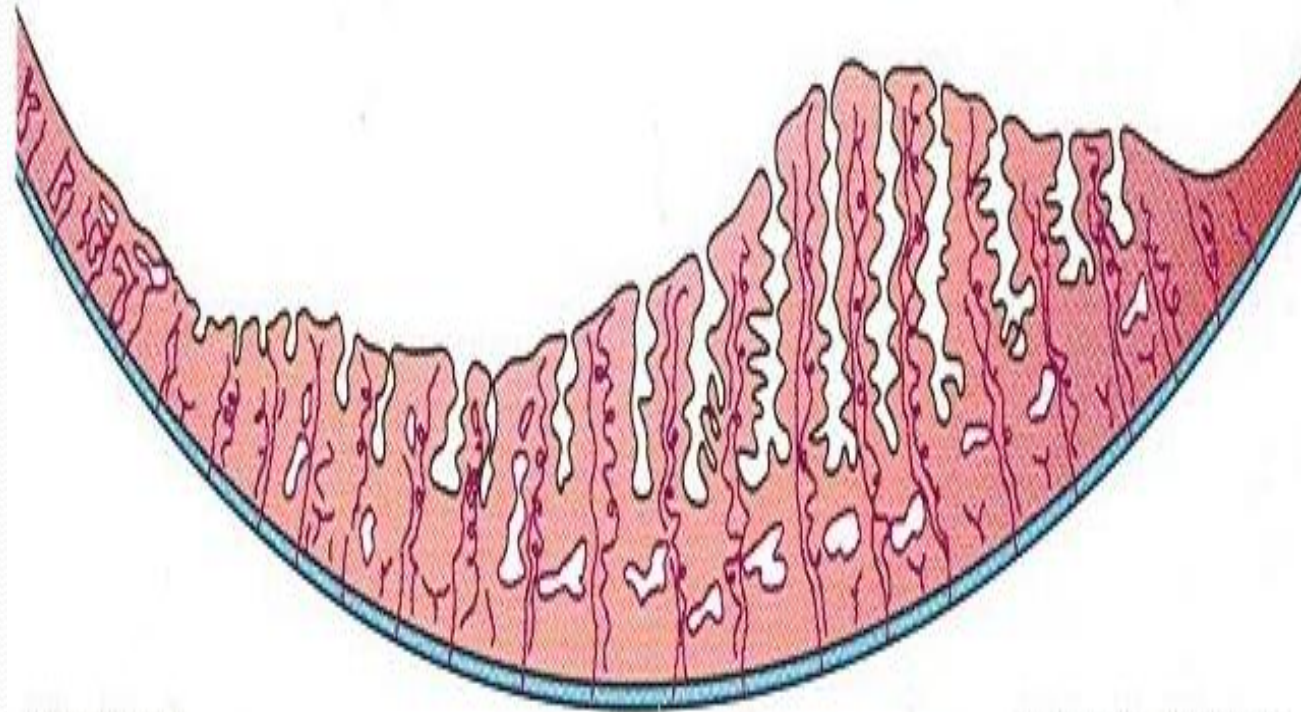
Phases of Menstrual Cycle

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.**



- Is a phase of repair and proliferation.

- Lasts for 9 days.

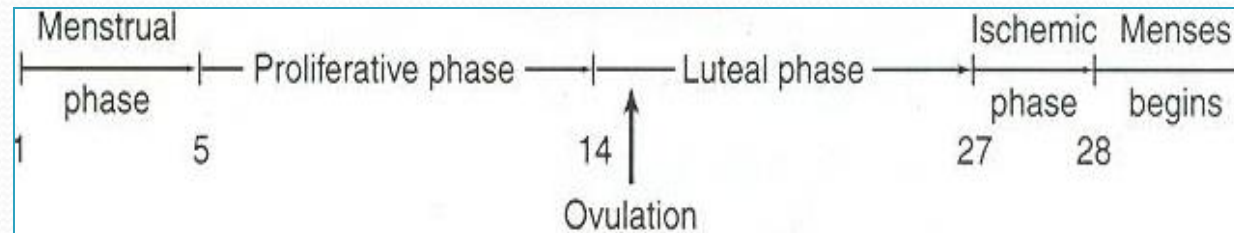
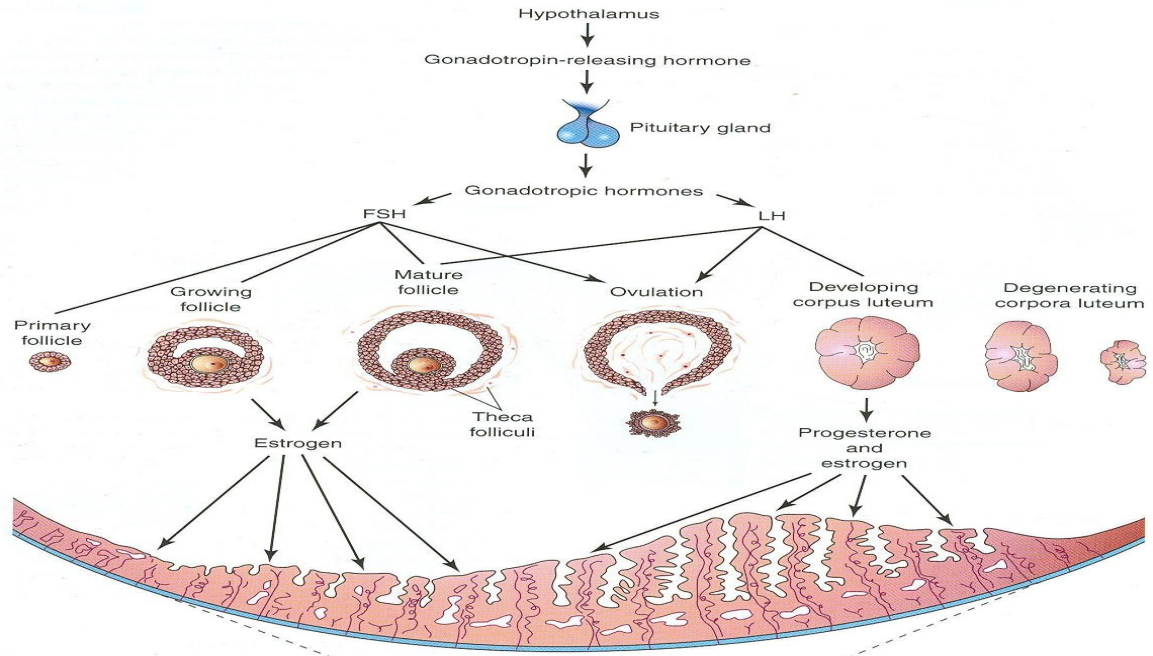
- **Coincides with growth of ovarian follicle.**

- **So it is controlled by Estrogen secreted by the follicular cells.**

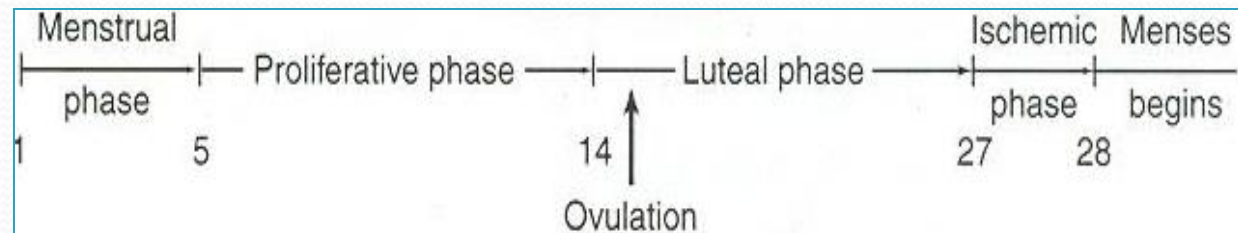
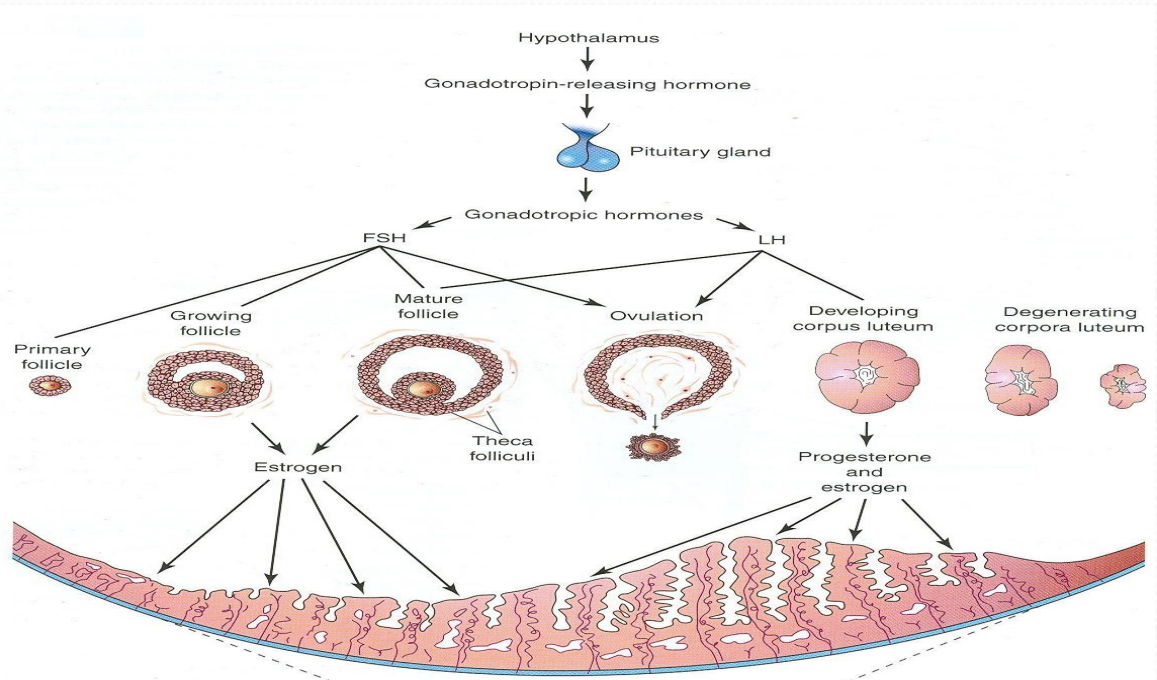
- **Thickness of the endometrium is increased into 2-3 folds.**

- **The glands increase in number and length and the spiral arteries elongate.**

Proliferative Phase



Luteal Phase



• Is a **Secretory or Progesterone phase.**

• Lasts about 13 days.

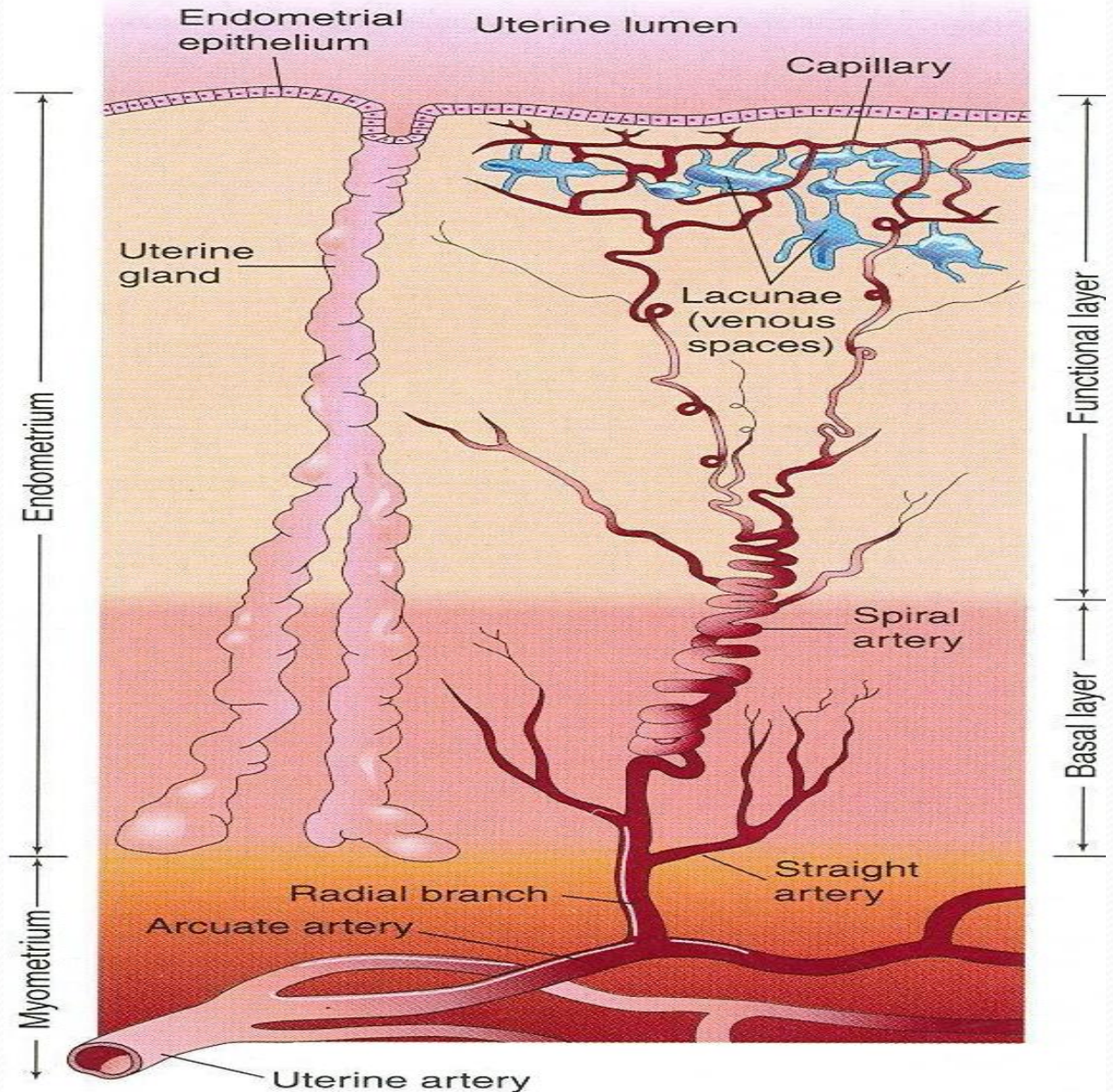
• **Coincides with** the **formation**, growth and functioning of the **Corpus Luteum.**

• **Glandular epithelium** secretes glycogen rich material.

• **Endometrium thickens** under the influence of **estrogen** and **progesterone.**

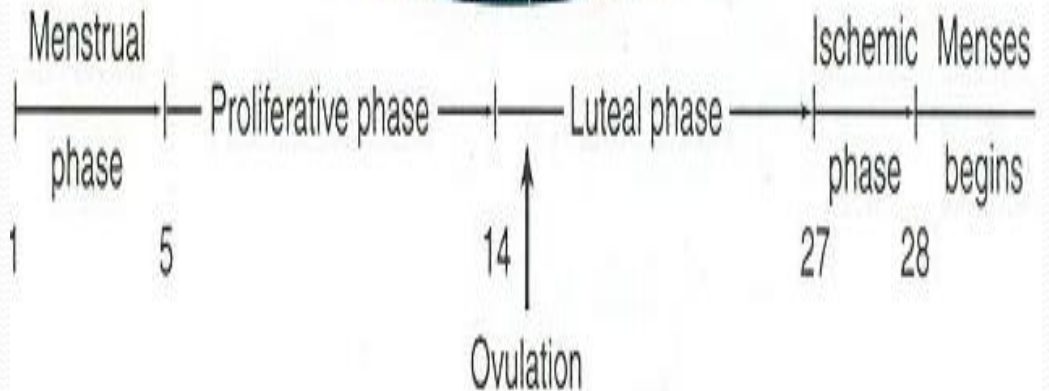
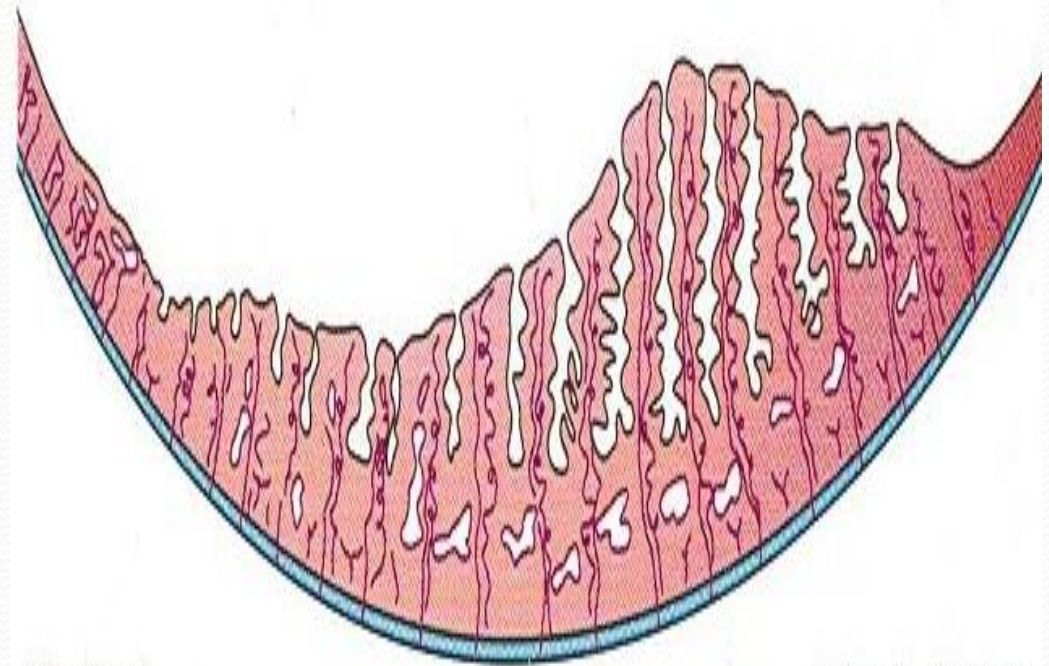
Luteal Phase

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



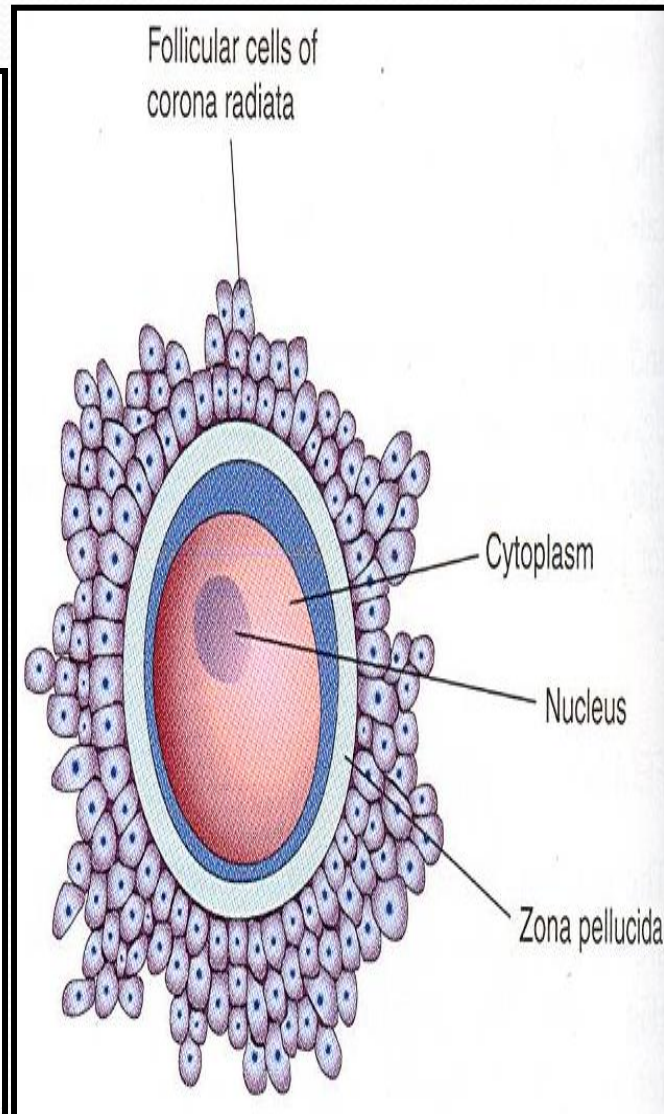
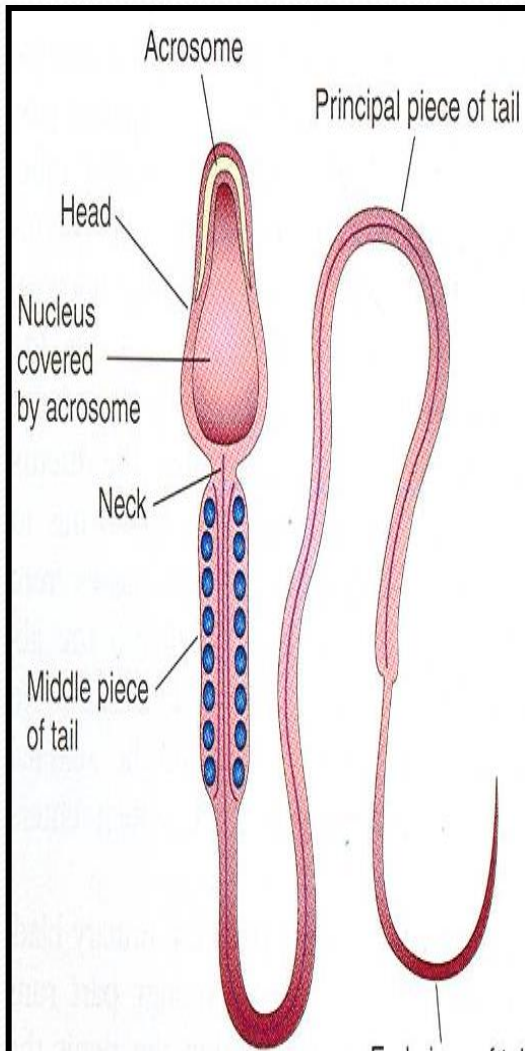
Ischemic Phase

- **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

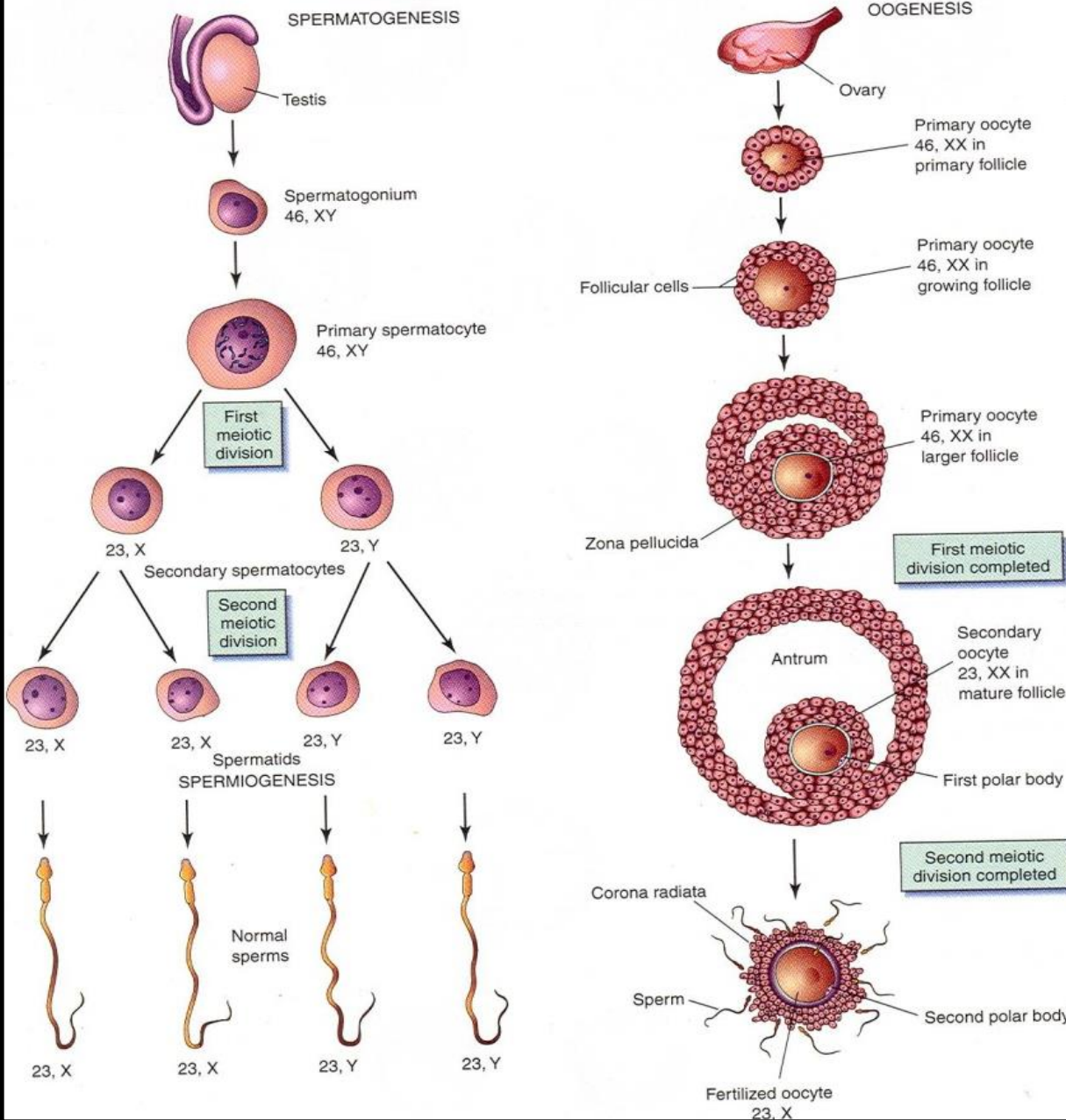
(Gamete Formation)



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.**

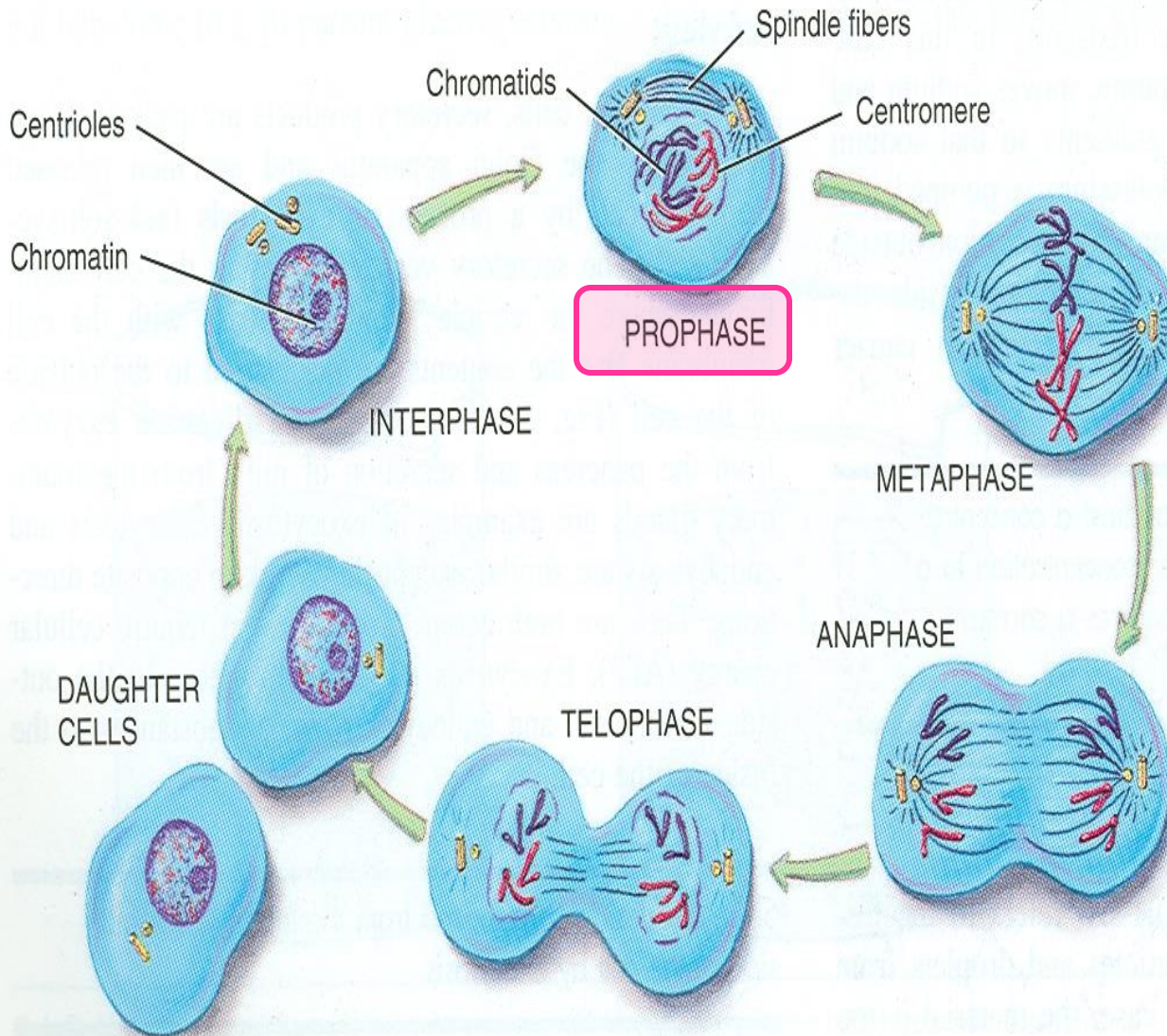
NORMAL GAMETOGENESIS



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).

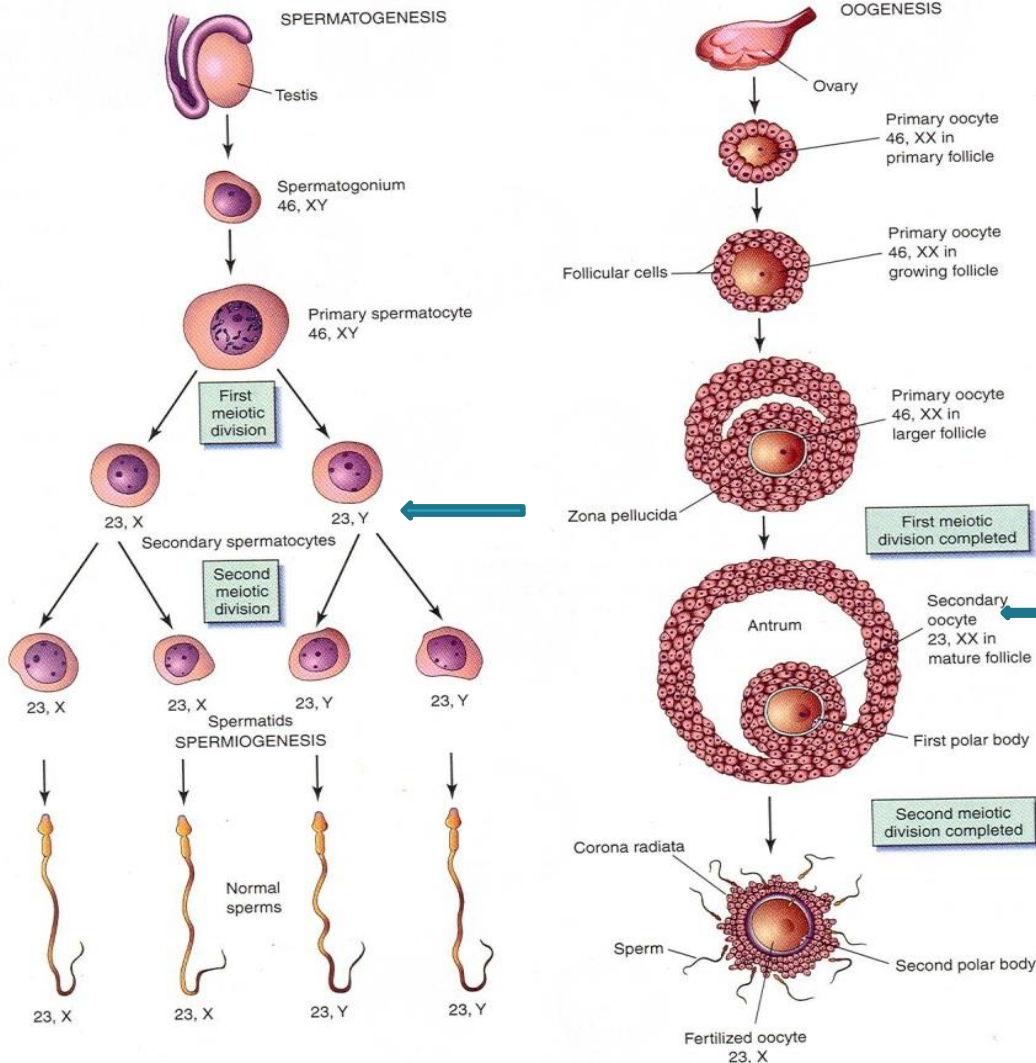
FIRST MEIOTIC DIVISION



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

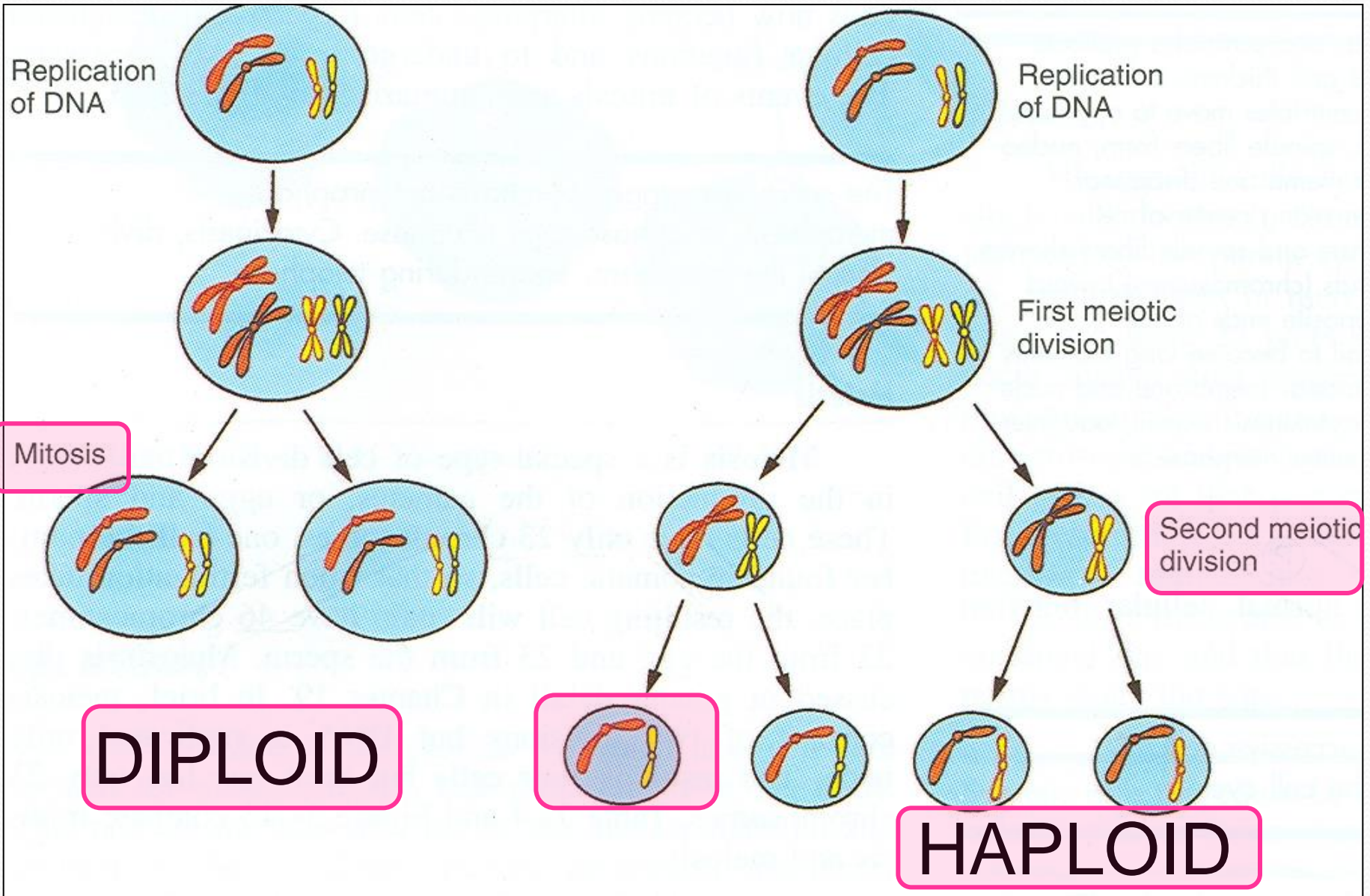
FIRST MEIOTIC DIVISION

NORMAL GAMETOGENESIS

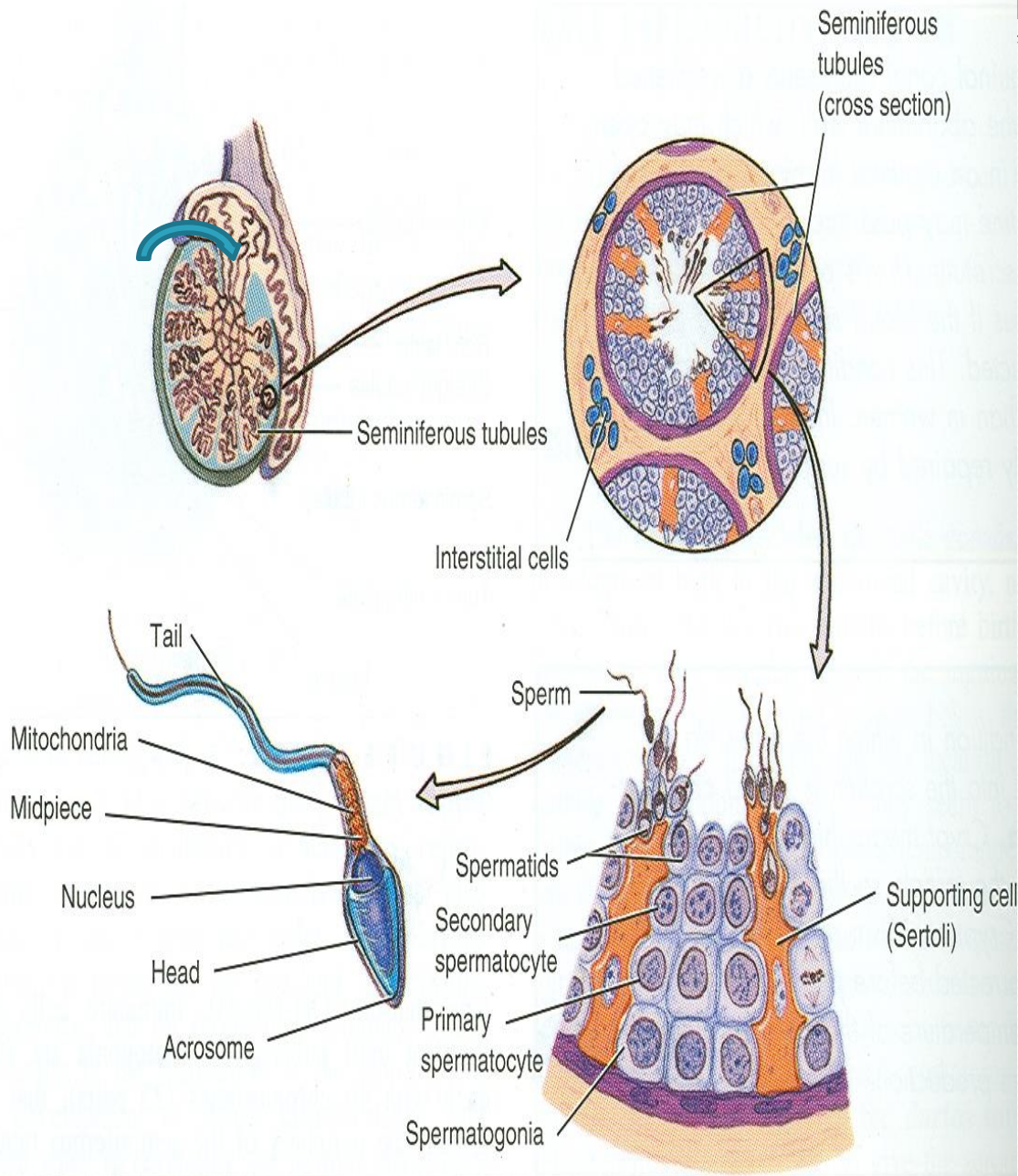


- By the end of the first meiotic division, each new cell formed (**Secondary Spermatocyte** or **Secondary Oocyte**) has haploid (half) number of chromosome.
- It is half number of chromosomes of the **Primary Spermatocyte** or **primary Oocyte**.

WHAT IS THE DIFFERENCE BETWEEN MITOSIS & MEIOSIS?

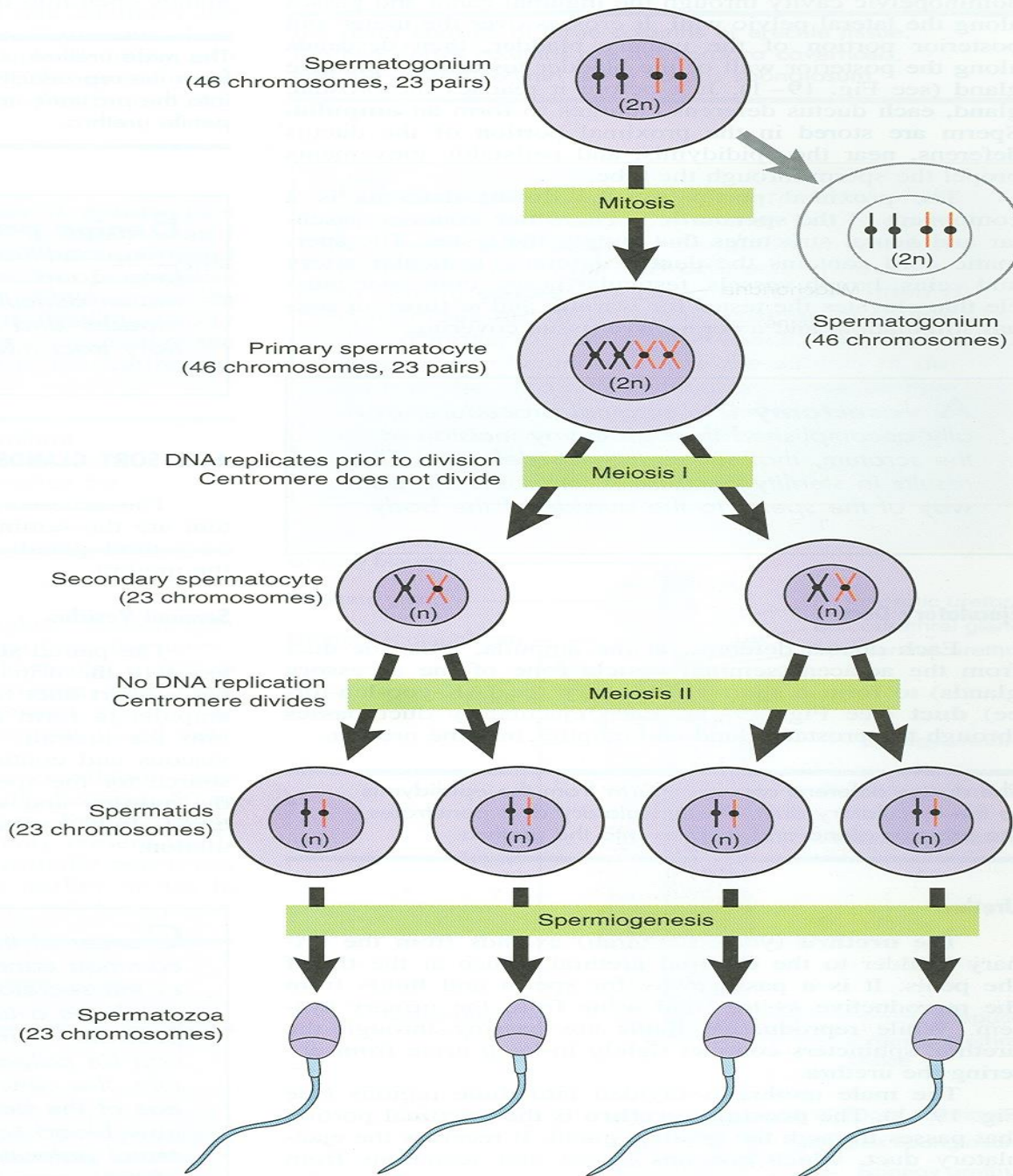


SPERMATOGENESIS



- **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

Golgi region

Acrosome

Residual cytoplasm

Nucleus

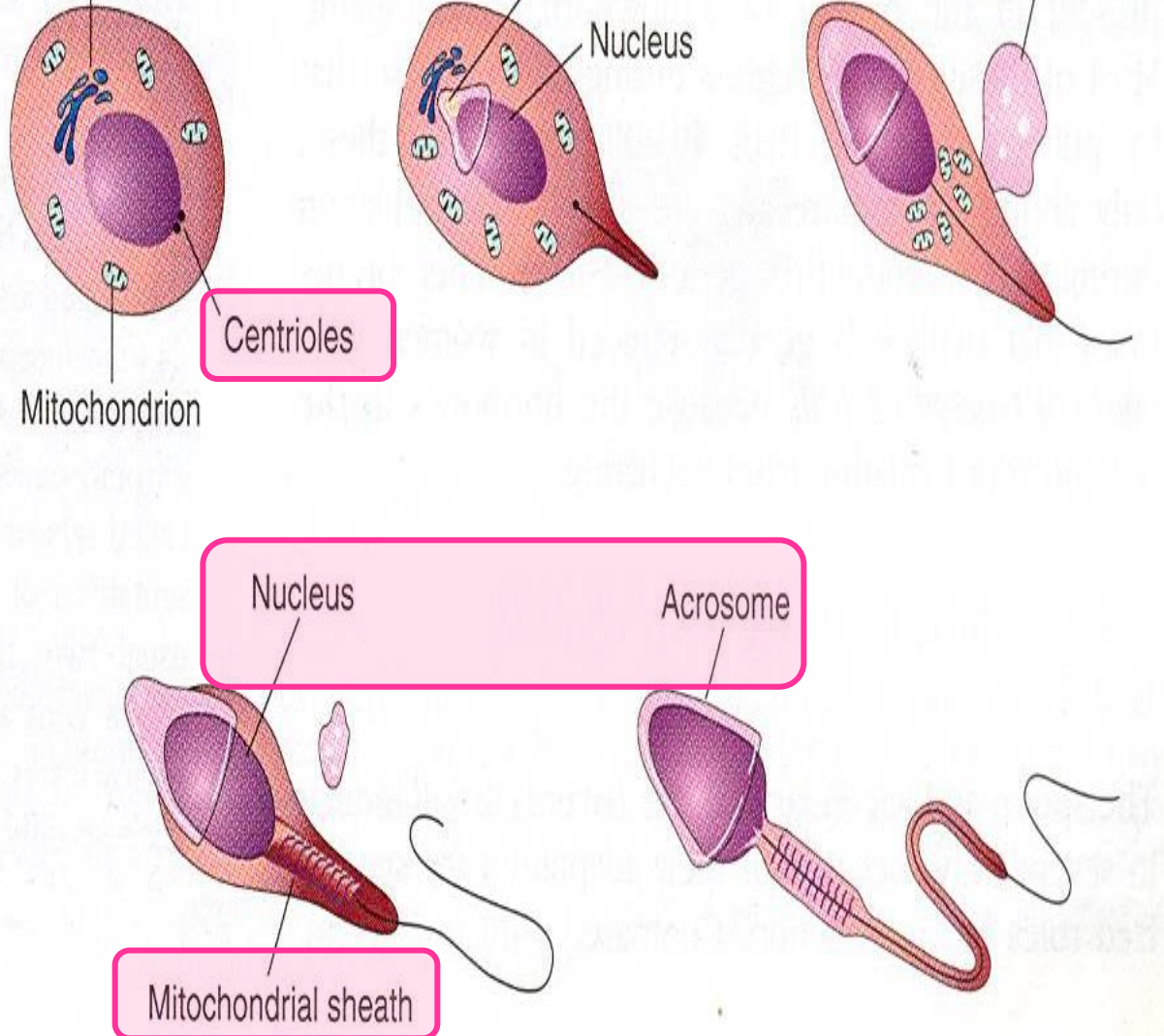
Centrioles

Mitochondrion

Nucleus

Acrosome

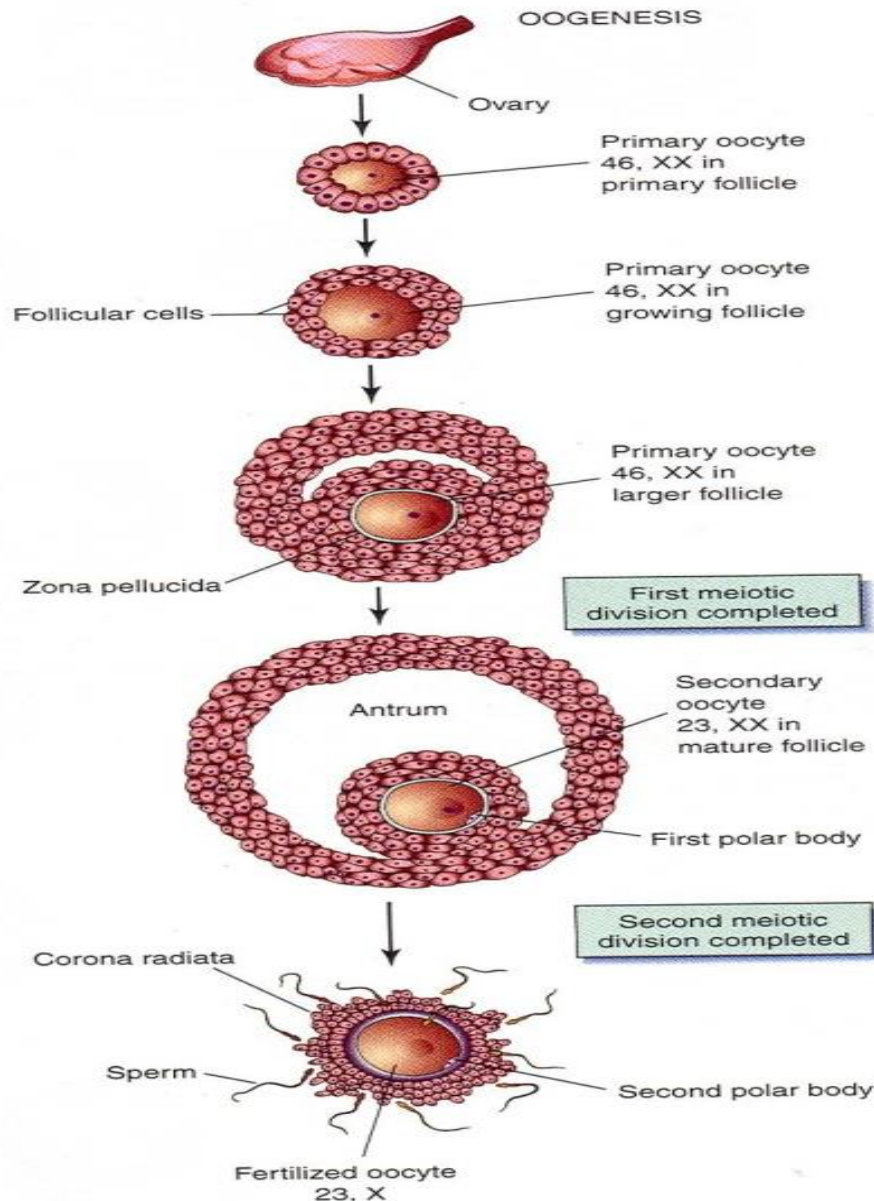
Mitochondrial sheath



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

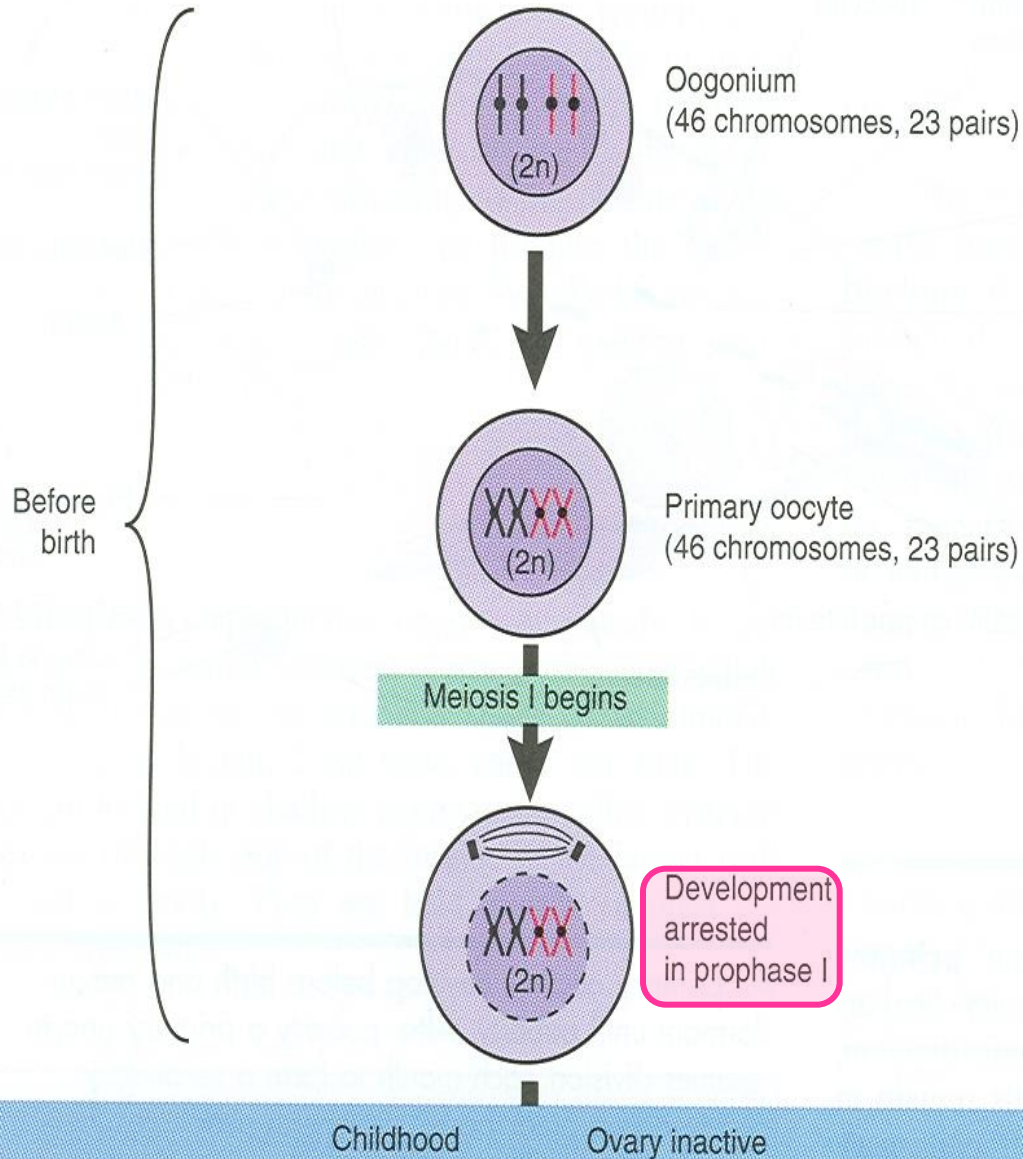
1. **Nucleus** is condensed and forms most of the **head**.
2. **Golgi apparatus** forms the **Acrosome**.
3. **Mitochondria** forms a **spiral sheath**.
4. **Centriole** elongates to form the **axial filament**.

OÖGENESIS



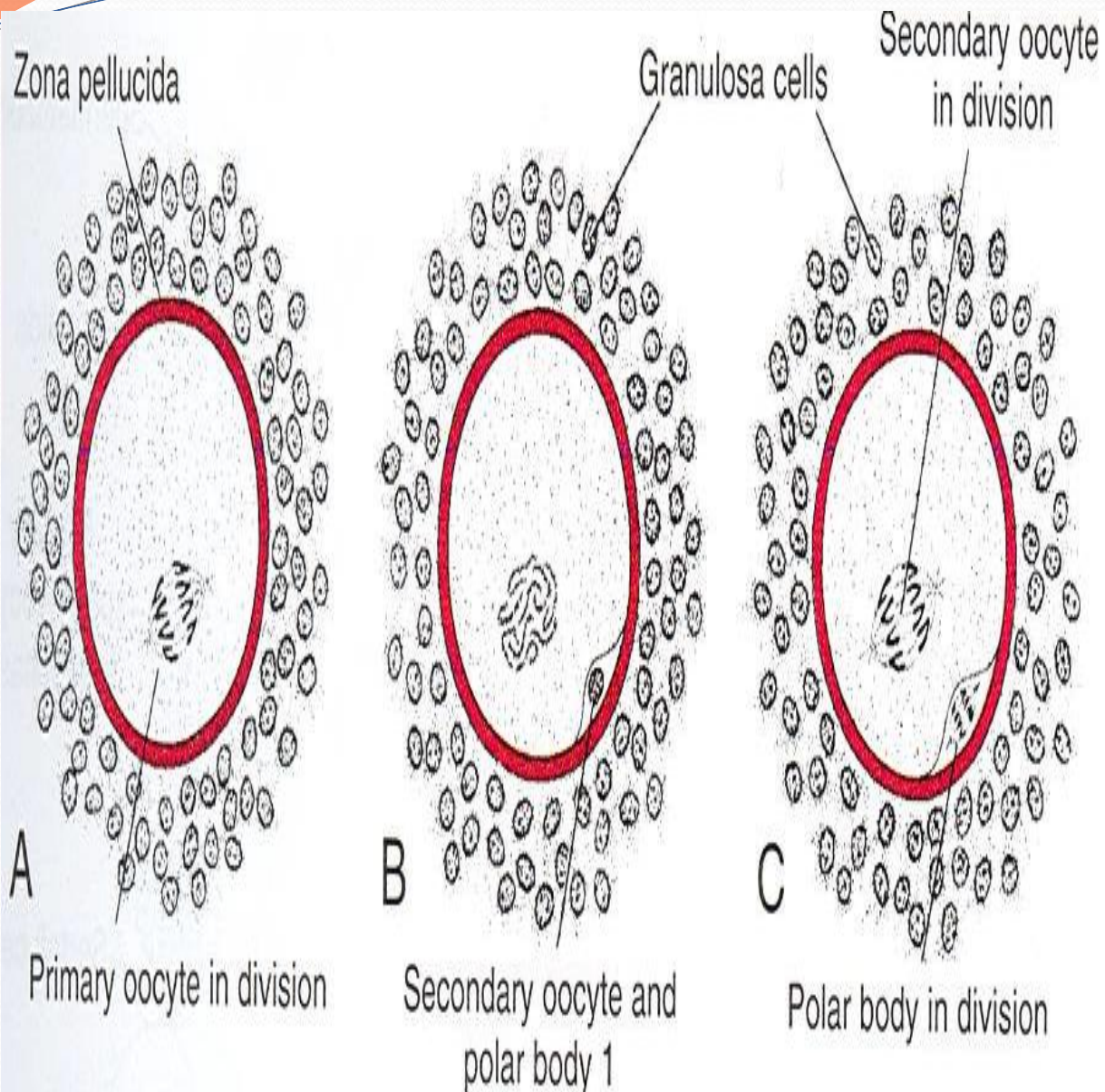
- **AIM:**
- Formation of secondary oocytes with haploid number of chromosomes.
- **SITE:**
- Cortex of the **ovary**
- **TIME:**
- Starts during fetal life becomes completed after puberty & continues until menopause.
- *It occurs monthly* Except *during pregnancy.*

OOGENESIS



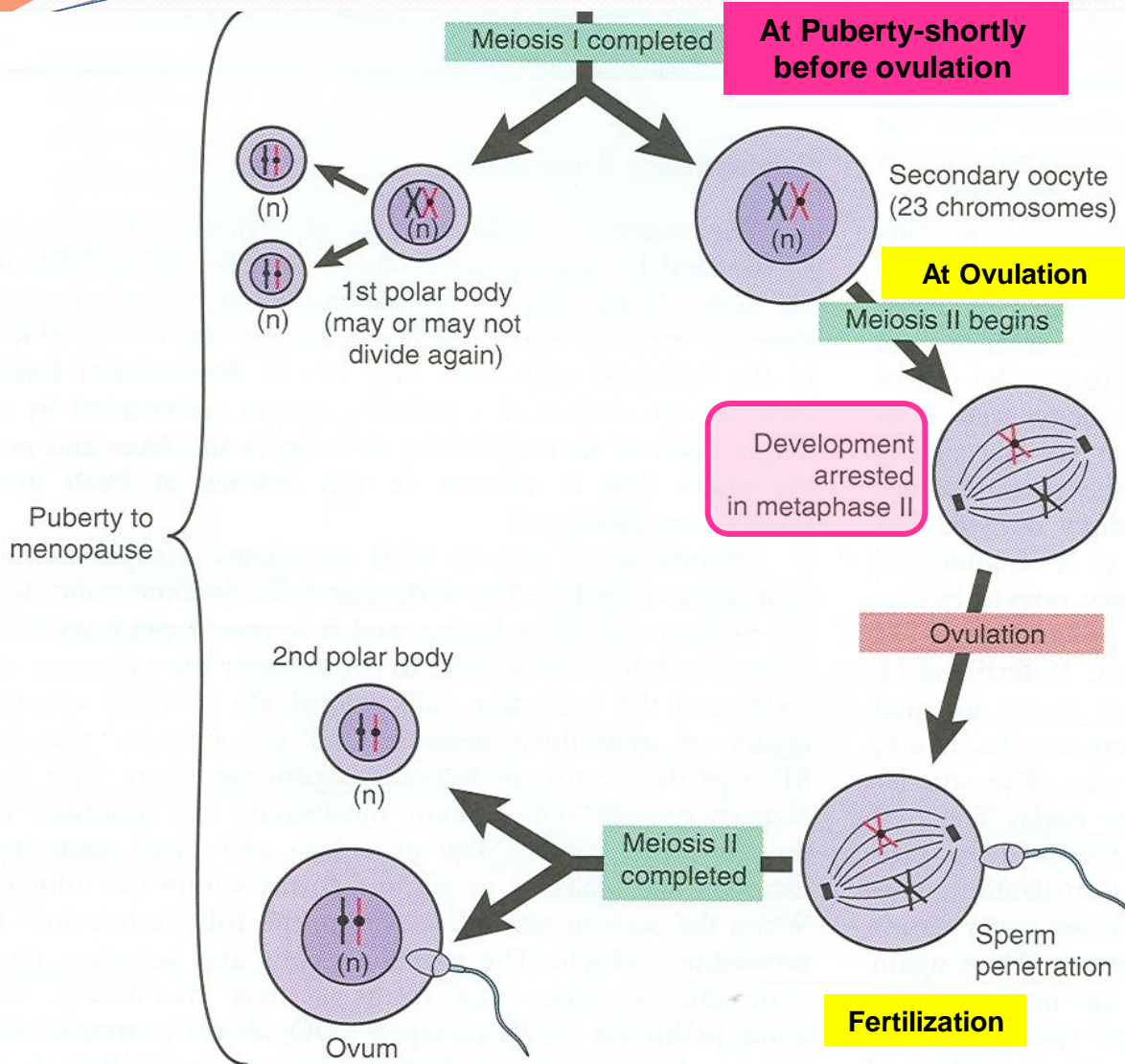
- **Before Birth:** During early fetal life, primitive ova (**Oogonia**) proliferate by mitotic division and enlarge to form **Primary Oocytes (46)**
- **At Birth** all primary oocytes have completed the prophase of the 1st meiotic division and **remain arrested** and do **not finish** their first meiotic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

O O G E N E S I S



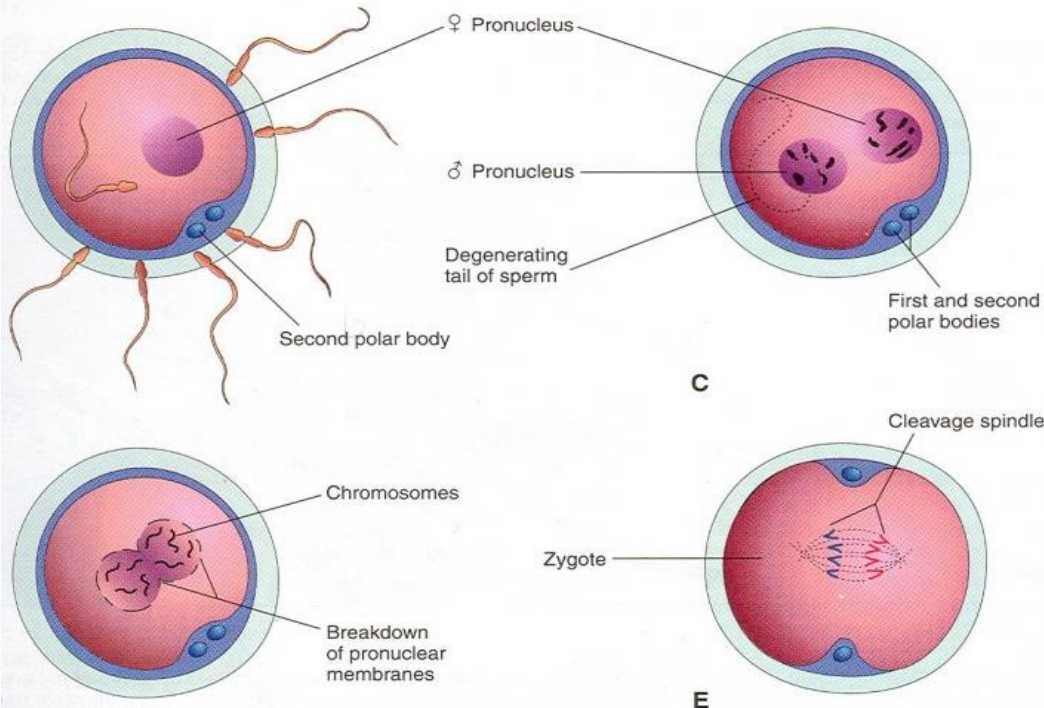
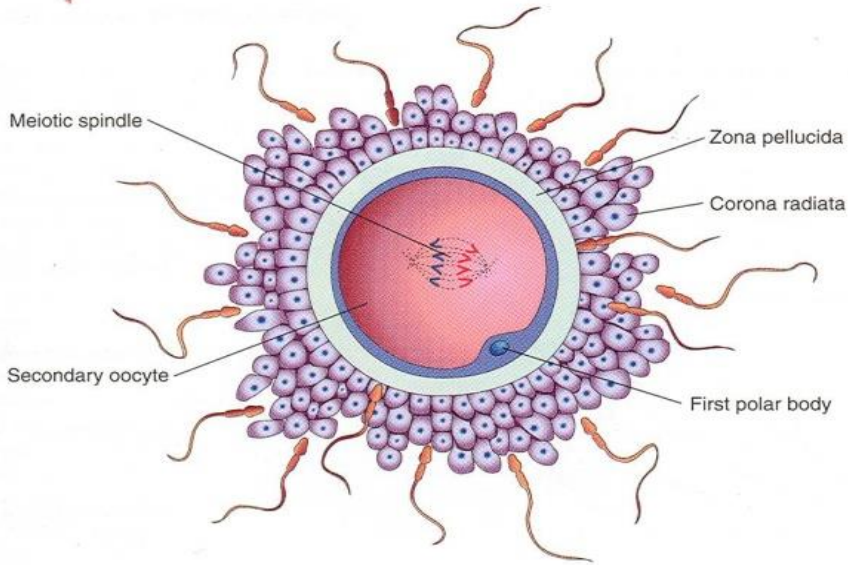
- After Puberty
- Shortly before ovulation, the Primary Oocyte completes its first meiotic division to give Secondary oocyte (23) & First Polar Body.
- The Secondary Oocyte receives almost all the cytoplasm.
- The First Polar Body receives very little.
- It is small nonfunctional cell that soon degenerates.

OOGENESIS



- *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 (Fertilized Oocyte)**.
- The rest is in the **2nd Polar Body** which soon **degenerates**.

DURING FETAL LIFE

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**

AFTER PUBERTY DURING EACH OVARIAN CYCLE

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.

AFTER FERTILIZATION

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