FEMALE REPRODUCTIVE SYSTEM

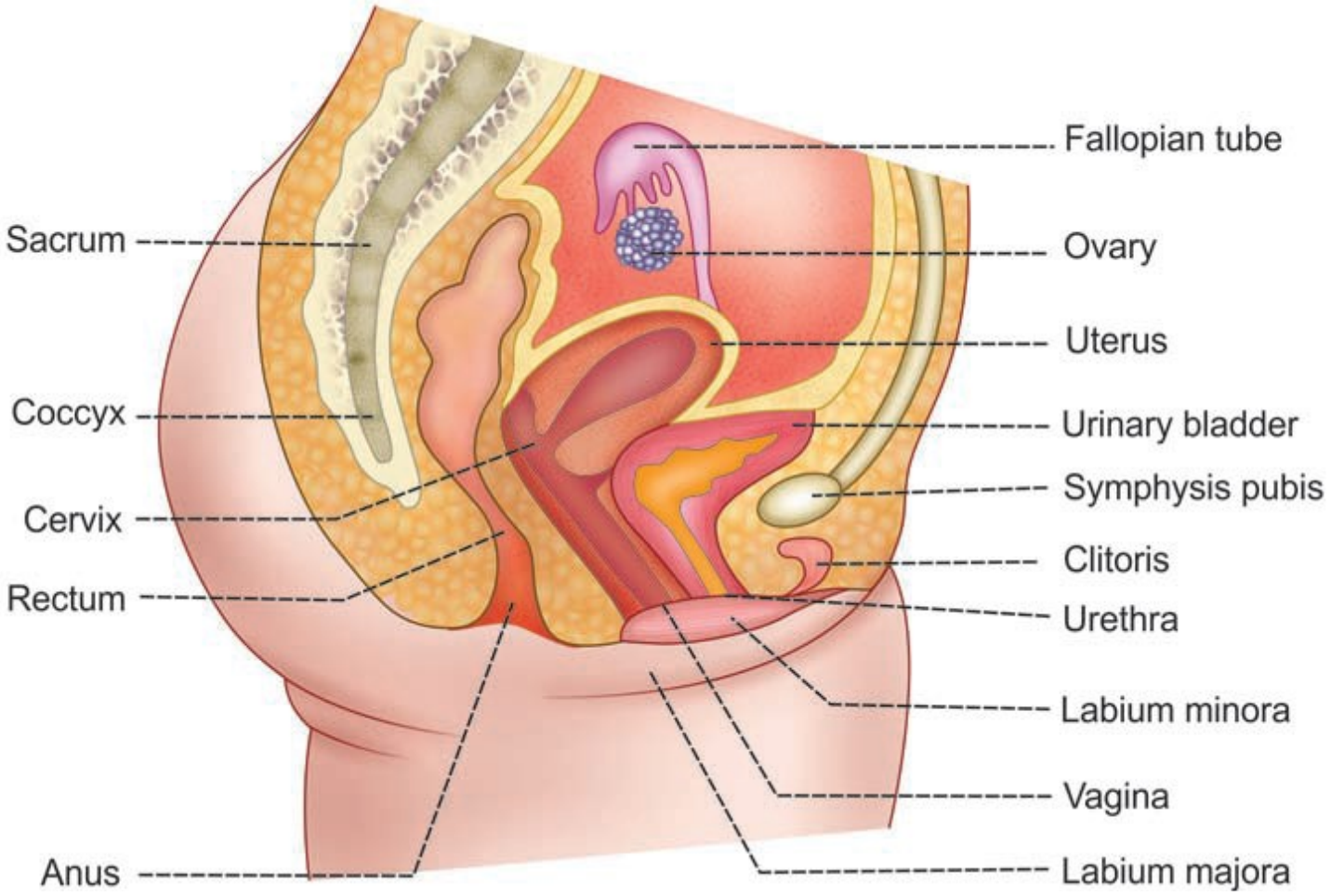
By Dr. Dinesh Chouhan

FEMALE REPRODUCTIVE ORGANS

- Female reproductive system comprises of primary sex organs and accessory sex organs.

PRIMARY SEX ORGANS

- Primary sex organs are a pair of ovaries, which produce eggs or ova and secrete female sex hormones, the estrogen and progesterone.



ACCESSORY SEX ORGANS

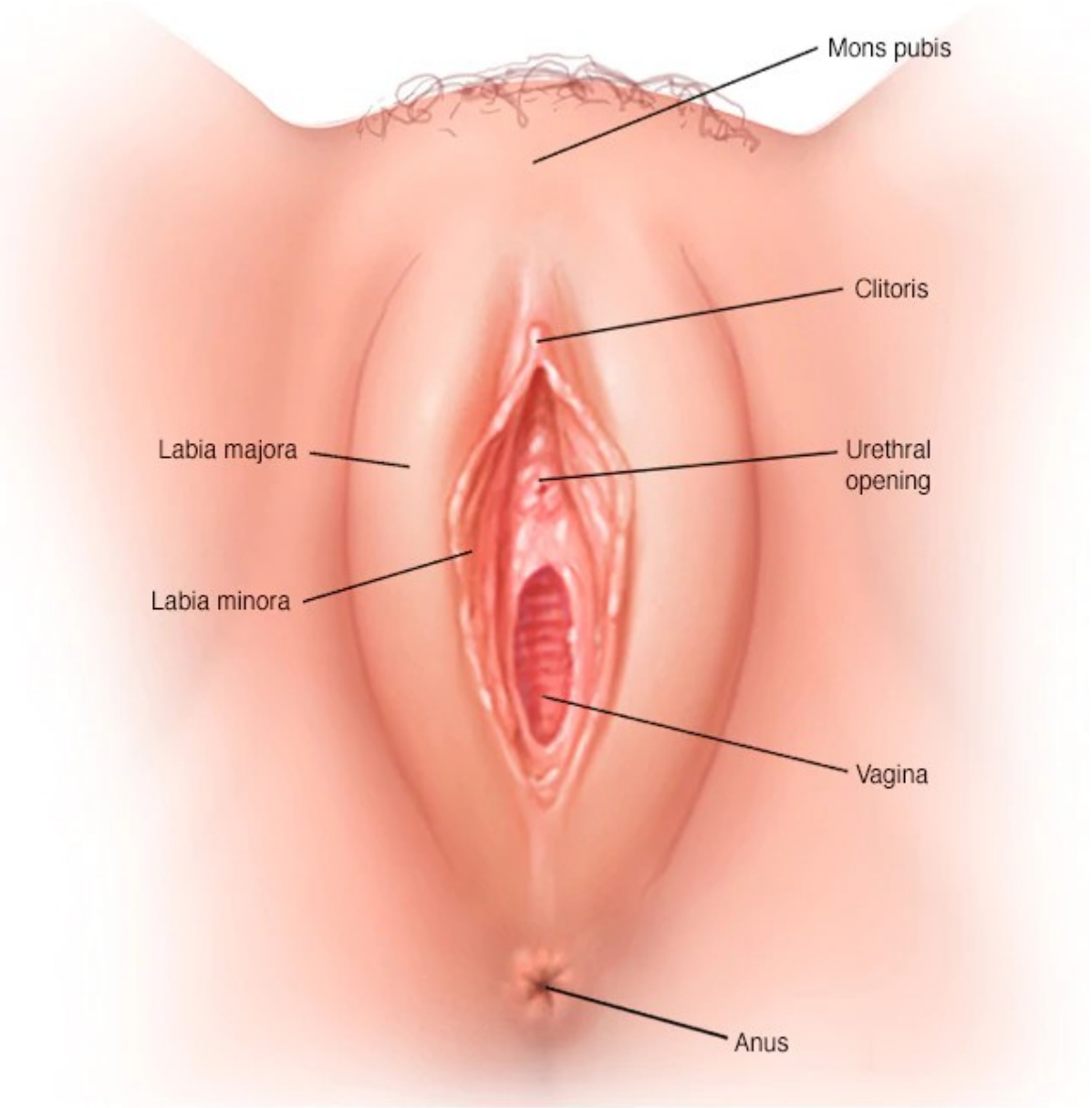
- Accessory sex organs in females are:

1. A SYSTEM OF GENITAL DUCTS

- Fallopian tubes, uterus, cervix and vagina.

2. EXTERNAL GENITALIA:

- Labia majora, labia minora and clitoris.
- Mammary glands are not the female genital organs but are the important glands of female reproductive system.



FUNCTIONAL ANATOMY OFACCESSORY SEX ORGANS

UTERUS

- Uterus is otherwise known as **womb.**
- It lies in the pelvic cavity, in between the rectum and urinary bladder.
- Uterus is a hollow muscular organ with a thick wall.
- It has a central cavity, which opens into vagina through cervix.
- On either side at its upper part, the fallopian tubes open.
- Uterus communicates with peritoneal cavity through fallopian tubes.
- Virgin uterus is pyriform in shape and is flattened anteroposteriorly.
- It measures about 7.5 cm in length, 5 cm in breadth at its upper part and about 2.5 cm in thickness.
- There is a constriction almost at the middle of uterus called **isthmus.**

DIVISIONS OF UTERUS

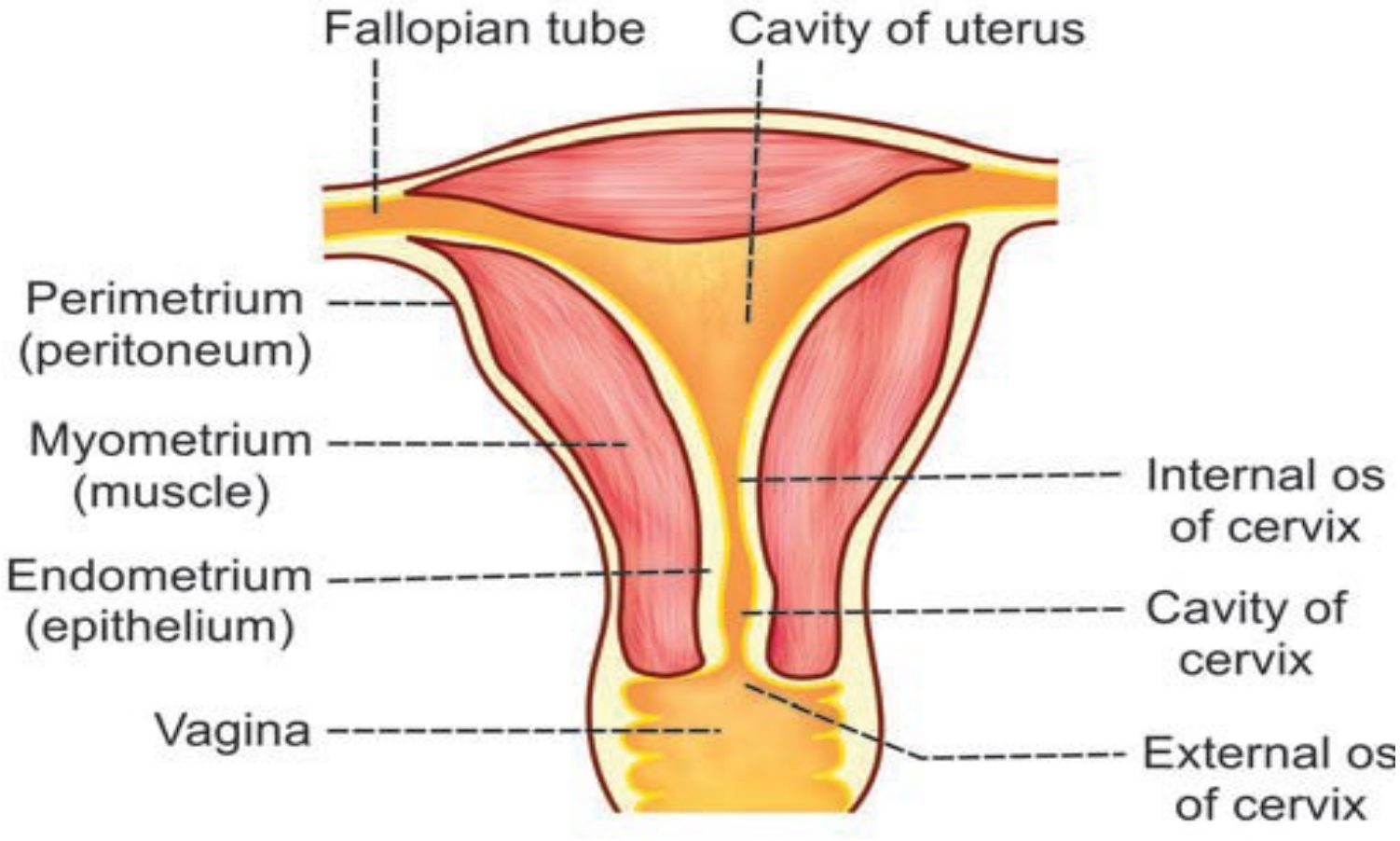
- Uterus is divided into three portions:

1. Fundus (above the entrance points of fallopian tubes)
2. Body (between fundus and isthmus)
3. Cervix (below isthmus).

STRUCTURE OF UTERUS

- Uterus is made up of three layers:

1. Serous or outer layer
2. Myometrium or middle muscular layer
3. Endometrium or inner mucus layer



1. SEROUS OR OUTER LAYER

- Serous or outer layer is the covering of uterus derived from peritoneum.
- Anteriorly, it covers the uterus completely, but posteriorly it covers only up to the isthmus.

2. MYOMETRIUM OR MIDDLE MUSCULAR LAYER

- Myometrium is the thickest layer of uterus and it is made up of smooth muscle fibers.
- Muscular layer is interdisposed with blood vessels, nerve fibers, lymphatic vessels and areolar tissues.

3. ENDOMETRIUM OR INNER MUCUS LAYER

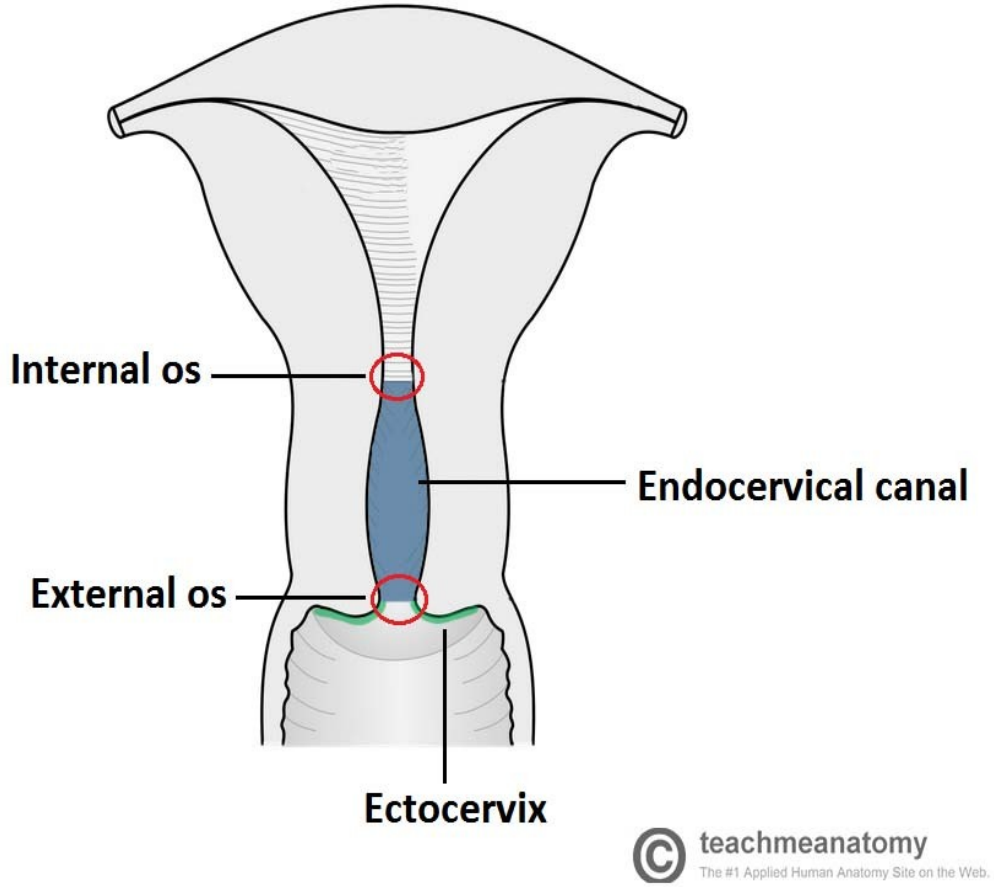
- Endometrium is smooth and soft with pale red color.
- It is made up of ciliated columnar epithelial cells.
- Endometrium also contains connective tissue in which the uterine glands are present.
- Uterine glands are lined by ciliated columnar epithelial cells.

CHANGES IN UTERUS

- Uterus changes its size, structure and function in different phases of sexual life.
- Just before menstruation, uterus is enlarged, becomes more vascular.
- The endometrium thickens with more blood supply.
- This layer is desquamated during menstruation and reformed after menstrual period.
- During pregnancy, uterus is enlarged very much with increase in weight.
- After parturition (delivery), it comes back to its original size but the cavity remains larger.
- In old age, uterus is atrophied.

CERVIX

- Cervix is the lower constricted part of uterus.
- It is divided into two portions:



1. UPPER SUPRAVAGINAL PORTION

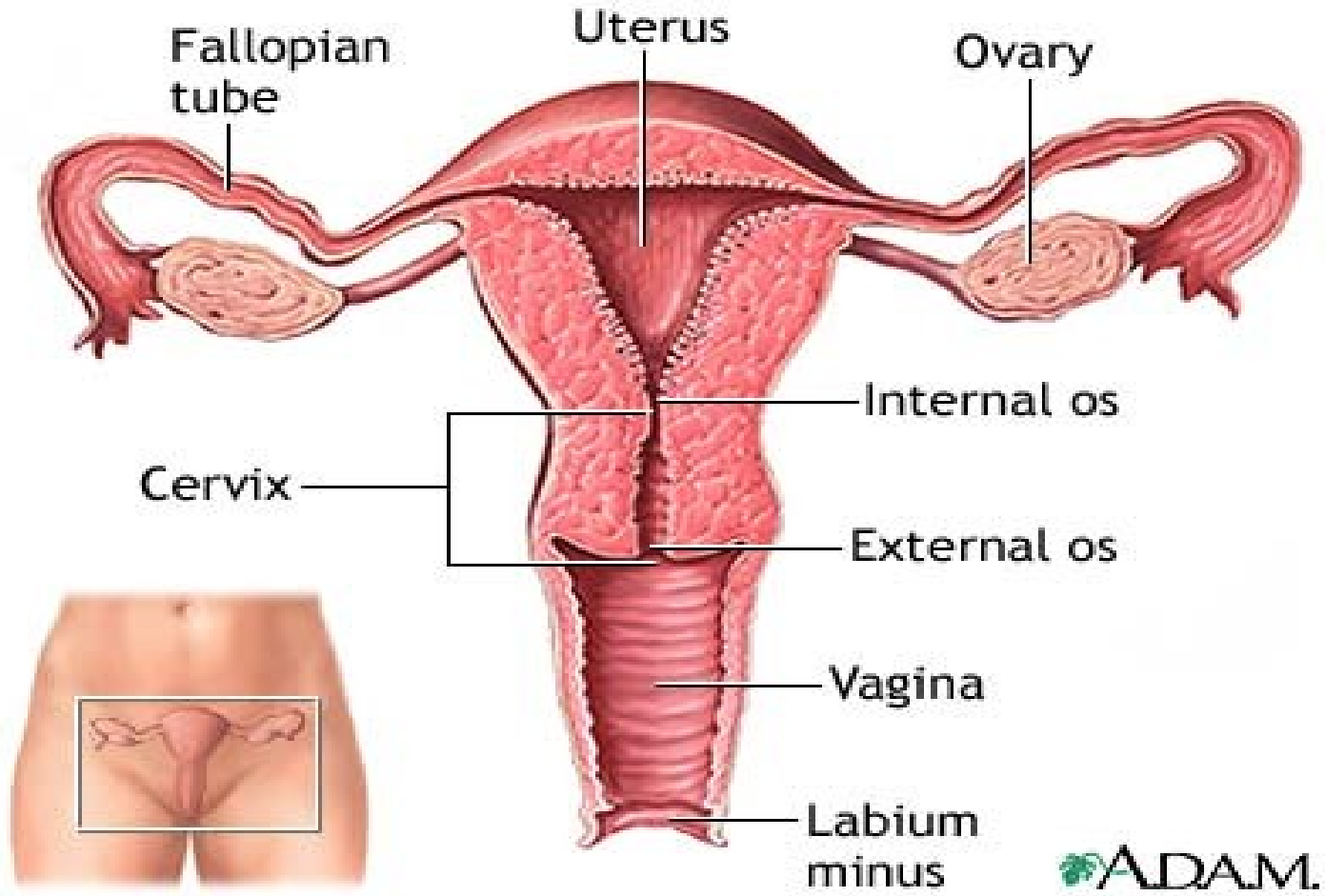
- It communicates with body of uterus through **internal os** (orifice) of cervix.
- Mucus membrane of this portion has glandular follicles, which secrete mucus.

2. LOWER VAGINAL PORTION

- It projects into the anterior wall of the vagina and it communicates with vagina through external os (orifice) of cervix.
- Mucus membrane of this portion is formed by stratified epithelial cells.

VAGINA

- Vagina is a short tubular organ.
- It is lined by mucus membrane, which is formed by stratified epithelial cells.



SEXUAL LIFE IN FEMALES

- Lifespan of a female is divided into three periods.

FIRST PERIOD

- First period extends from birth to puberty.
- During this period, primary and accessory sex organs do not function.
- Puberty occurs at the age of 12 to 15 years.

SECOND PERIOD

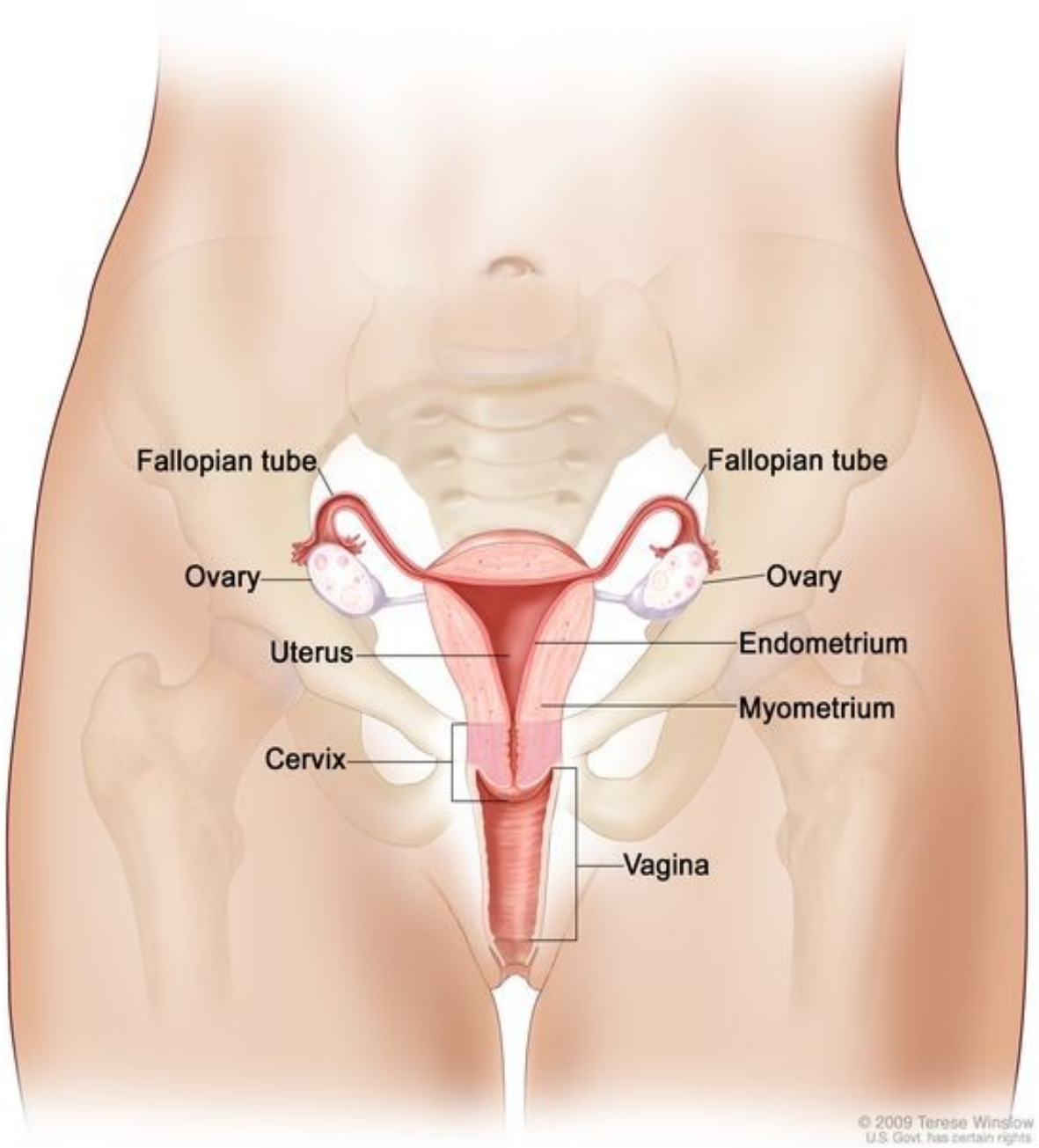
- Second period extends from onset of puberty to the onset of menopause.
- First menstrual cycle is known as **menarche.**
- Permanent stoppage of the menstrual cycle in old age is called **menopause,** which occurs at the age of about 45 to 50 years.
- During the period between menarche and menopause, women menstruate and reproduce.

THIRD PERIOD

- Third period extends after menopause to the rest of the life.

OVARY

- Ovary is the gonad or **primary sex organs** in females.
- A woman has two ovaries.
- Ovaries have two functions, gametogenic and endocrine functions. Gametogenic function is the production and release of **ovum** or egg, which is the **female gamete** (reproductive cell).
- Endocrine function of ovaries is the secretion of female sex hormones.

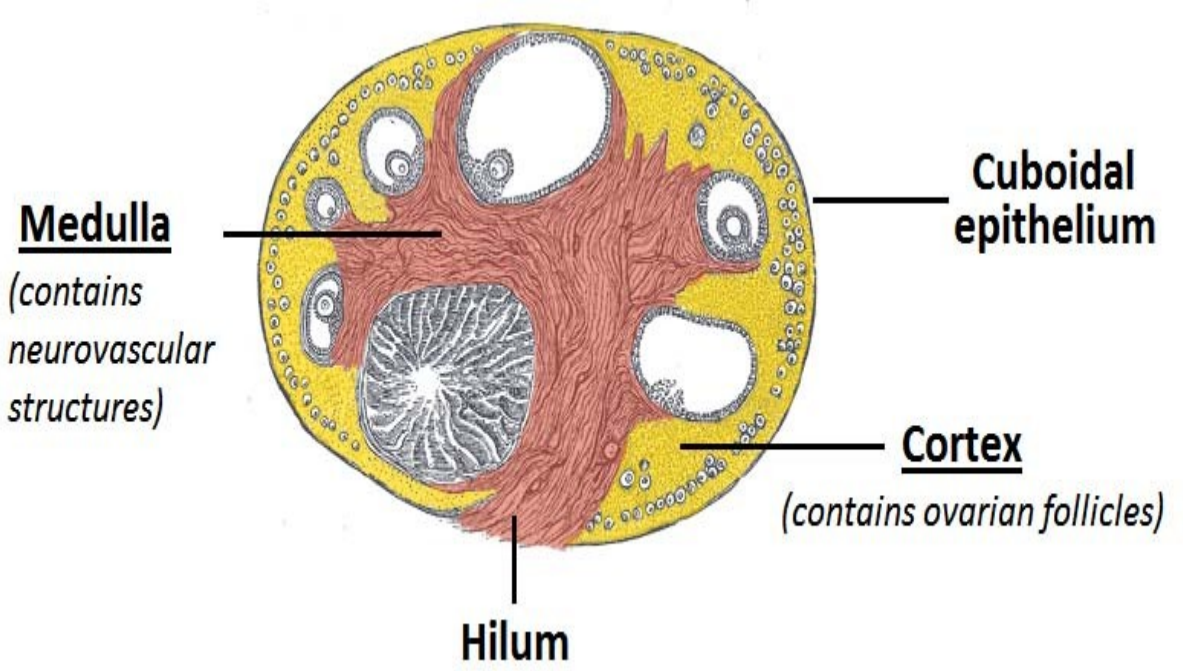


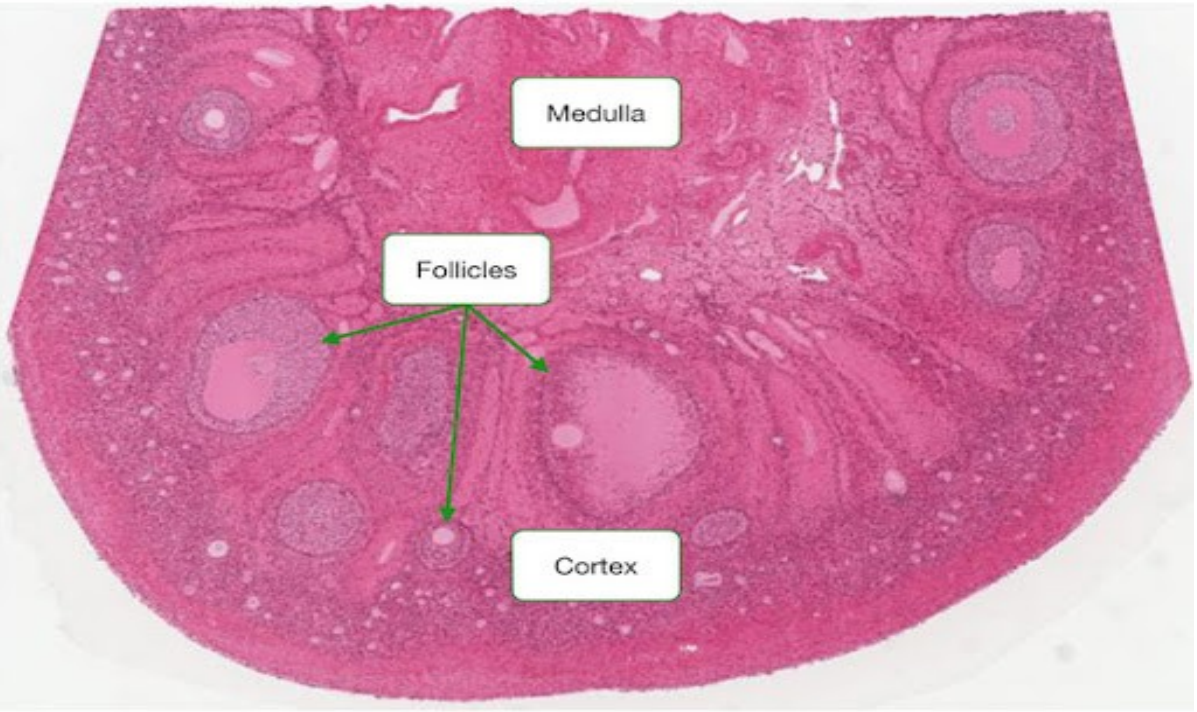
FUNCTIONAL ANATOMY OF OVARY

- Ovaries are flattened ovoid bodies, with dimensions of 4 cm in length, 2 cm in width and 1 cm in thickness.
- Each ovary is attached at hilum to the broad ligament, by means of mesovarium and ovarian ligament.

- Each ovary has two portions:

1. **MEDULLA**
2. **CORTEX**





MEDULLA

- Medulla or zona vasculosa is the central deeper portion of the ovary.
- It has the stroma of loose connective tissues.
- It contains blood vessels, lymphatics, nerve fibers and bundles of smooth muscle fibers near the hilum.

CORTEX

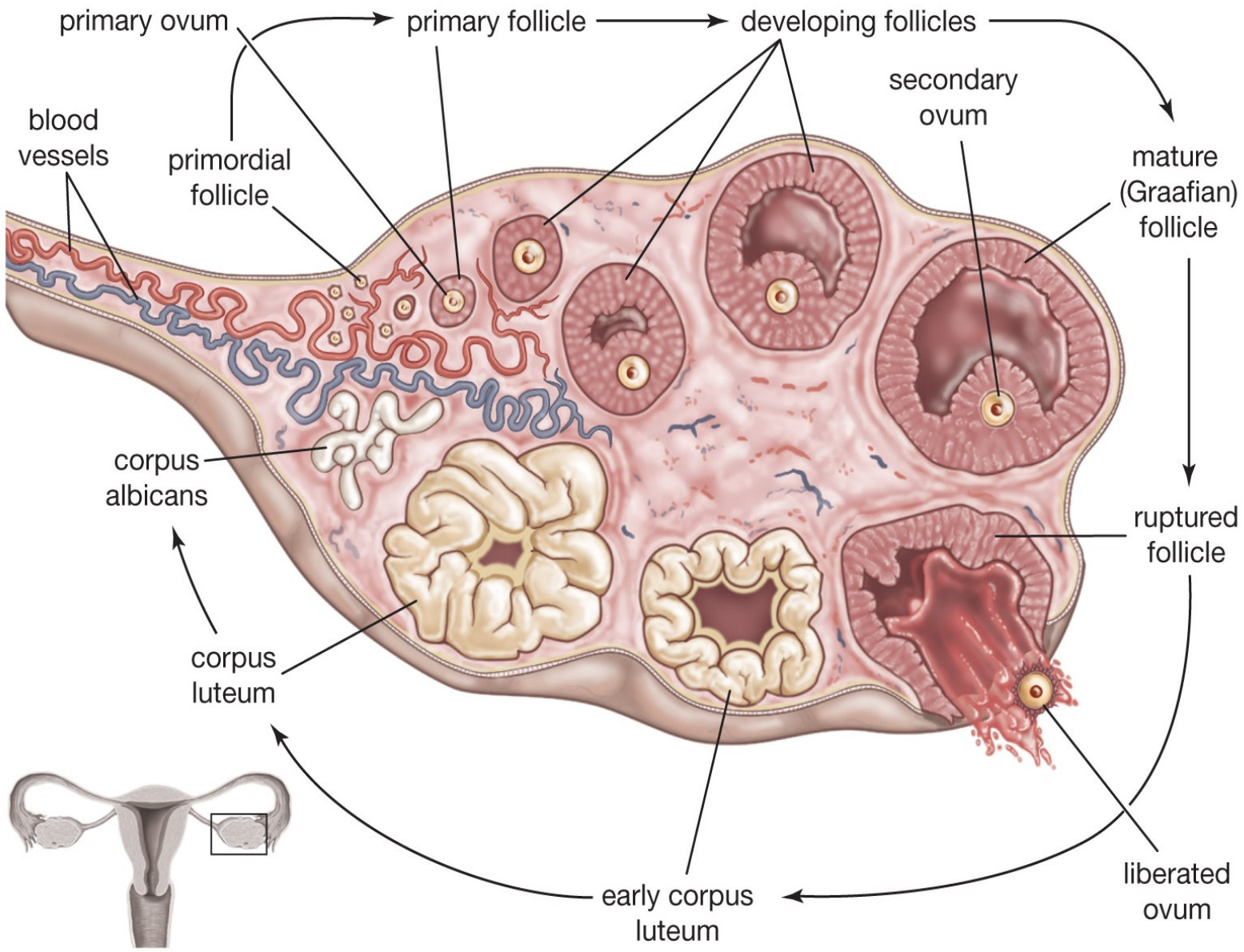
- Cortex is the outer broader portion.
- Cortex is lined by the germinal epithelium underneath a fibrous layer known as **'tunica albuginea'.**
- Cortex consists of the following structures:

i. Glandular structures, which represent ovarian follicles at different stages.
ii. Connective tissue cells
iii. Interstitial cells, which are clusters of epithelial cells with fine lipid granules formed mainly from theca interna.

OVARIAN FOLLICLES

- In the intrauterine life, outer part of cortex contains the **germinal epithelium.**
- When fetus develops, the germinal epithelium gives rise to a number of primordial ova.
- The primordial ova move towards the inner substance of cortex.
- A layer of spindle cells called **granulose cells** from the ovarian stroma surround the ova.
- Primordial ovum along with granulosa cells is called the **primordial follicle**.
- In 7th or 8th month of intrauterine life, about 6 million primordial follicles are found in the ovary.
- At the time of birth, only 1 million primordial follicles remains and the rest of the follicles degenerate.
- At onset of puberty, the number decreases further to about 300,000 to 400,000.
- After menarche, during every menstrual cycle, one of the follicles matures.

- During every menstrual cycle, only one ovum is released from any one of the ovaries.
- During every cycle, many of the follicles degenerate.
- The degeneration of the follicles is called the **corpus fibrosa (Atretic follicle).**
- Usually, the degenerated follicles disappear without leaving any scar.



FUNCTIONS OF OVARIES

- Ovaries are the primary sex organs in females. Functions of ovaries are:

1. Secretion of female sex hormones
2. Oogenesis
3. Menstrual cycle

OVARIAN HORMONES

- Ovary secretes the female sex hormones estrogen and progesterone.
- Ovary also secretes few more hormones, namely inhibin, relaxin and small quantities of androgens.

ESTROGEN

- In a normal non-pregnant woman, estrogen is secreted in large quantity by theca interna cells of ovarian follicles and in small quantity by corpus luteum of the ovaries.
- Estrogen is derived from androgens, particularly Androstenedione.
- In pregnant woman, a large amount of estrogen is secreted by the placenta.

FUNCTIONS OF ESTROGEN

- Major function is to promote cellular proliferation and tissue growth in the sexual organs.
- In childhood, secreted in small quantity.
- During puberty, the secretion increases sharply, resulting in changes in the sexual organs.

Effects of estrogen are:

1. EFFECT ON OVARIAN FOLLICLES

- It promotes the growth of ovarian follicles by increasing the proliferation of the follicular cells.

2. EFFECT ON UTERUS

- It enlarge uterus to about double of its childhood size along with Increase in the blood supply to endometrium
- Increase in the contractility of the uterine muscles.

3. EFFECT ON FALLOPIAN TUBES

- It increases the activity of the cilia, so that the movement of ovum in the fallopian tube is facilitated
- Enhances the proliferation of glandular tissues in fallopian tubes.

4. EFFECT ON VAGINA

- Changes the vaginal epithelium into stratified epithelium, it is more resistant to trauma and infection.
- Increases the layers of the vaginal epithelium.
- Reduces the pH of vagina, making it more acidic.
- All these changes are necessary for the prevention of vaginal infections such as **gonorrheal Vaginitis.**

5. EFFECT ON SECONDARY SEXUAL CHARACTERS

- Estrogen is responsible for the development of secondary sexual characters in females.
- **Like;** Hair develops in the pubic region and axilla, Skin becomes soft and smooth, Shoulders become narrow, Broaden hips, Fat deposition in breasts and Buttocks and Broadening of pelvis etc.

6. EFFECT ON METABOLISM

i. On protein metabolism

- Estrogen induces anabolism of proteins, by which it increases the total body protein.

ii. On fat metabolism

- Estrogen causes deposition of fat in the subcutaneous tissues, breasts, buttocks and thighs.

PROGESTERONE

- In non-pregnant woman, a small quantity of progesterone is secreted by theca interna cells during follicular stage.
- But, a large quantity of progesterone is secreted during secretory phase by the corpus luteum.
- In pregnant woman, large amount of progesterone is secreted by the corpus luteum.

FUNCTIONS OF PROGESTERONE

- Progesterone is concerned mainly with the final preparation of the uterus for pregnancy and the breasts for lactation.
- The effects of progesterone are:

1. EFFECT ON FALLOPIAN TUBES

- Progesterone promotes the secretory activities of mucosal lining its necessary for nutrition of the fertilized ovum, while it is in fallopian tube before implantation.

2. EFFECT ON THE UTERUS

- Progesterone promotes the secretory activities of uterine **endometrium** during the secretory phase of the menstrual cycle.
- Thus, the uterus is prepared for implantation of the fertilized ovum.

3. EFFECT ON CERVIX

- Progesterone increases the thickness of cervical mucosa and thereby inhibits the transport of sperm into uterus.
- This effect is utilized in the contraceptive actions of minipills.

4. EFFECT ON THE MAMMARY GLANDS

- Progesterone promotes the development of lobules and alveoli of mammary glands by proliferating and enlarging the alveolar cells.
- It makes the breasts to swell by increasing the secretory activity and fluid accumulation in the subcutaneous tissue.

5. EFFECT ON HYPOTHALAMUS

- Progesterone inhibits the release of LH from hypothalamus through feedback effect.
- This effect is utilized for its contraceptive action.

6. THERMOGENIC EFFECT

- Progesterone increases the body temperature after ovulation.
- The mechanism of thermogenic action is not known.
- It is suggested that progesterone increases the body temperature by acting on hypothalamic centers for temperature regulation.

7. EFFECT ON RESPIRATION

- During luteal phase of menstrual cycle and during pregnancy, progesterone increases the ventilation via respiratory center.
- This decreases the partial pressure of carbon dioxide in the alveoli.

MENSTRUAL CYCLE

INTRODUCTION

- Menstrual cycle is defined as cyclic events that take place in a rhythmic way during the reproductive period of a woman's life.
- Menstrual cycle starts at the age of 12 to 15 years, which marks the onset of puberty.
- The commencement of menstrual cycle is called **menarche.**
- Menstrual cycle ceases at the age of 45 to 50 years.
- Permanent cessation of menstrual cycle in old age is called **menopause.**

DURATION OF MENSTRUAL CYCLE

- Duration of menstrual cycle is usually 28 days.
- But, under physiological conditions, it may vary between 20 and 40 days.

CHANGES DURING MENSTRUAL CYCLE

- During each menstrual cycle, series of changes occur in ovary and accessory sex organs.
- These changes are divided into 4 groups:

1. Ovarian changes
2. Uterine changes
3. Vaginal changes
4. Changes in cervix.

- All these changes take place simultaneously.

OVARIAN CHANGES DURING MENSTRUAL CYCLE

- Changes in the ovary during each menstrual cycle occur in two phases:

A. Follicular phase
B. Luteal phase.

- Ovulation occurs in between these two phases.

FOLLICULAR PHASE

- Follicular phase extends from the 5th day of the cycle until the time of ovulation, which takes place on 14th day.
- Maturation of ovum with development of ovarian follicles takes place during this phase.

OVARIAN FOLLICLES

- Ovarian follicles are glandular structures present in the cortex of ovary.
- Each follicle consists of the ovum surrounded by epithelial cells, namely **granulosa cells.**
- The follicles gradually grow into a matured follicle through various stages.

DIFFERENT FOLLICLES:

1. PRIMORDIAL FOLLICLE

- At the time of puberty, both the ovaries contain about 400,000 primordial follicles which was dovelopes in intra uterine life.
- Each primordial follicle has an ovum, which is incompletely surrounded by the granulosa cells.
- These cells provide nutrition to the ovum during childhood.
- At the onset of puberty, under the influence of FSH and LH the primordial follicles start growing through various stages.

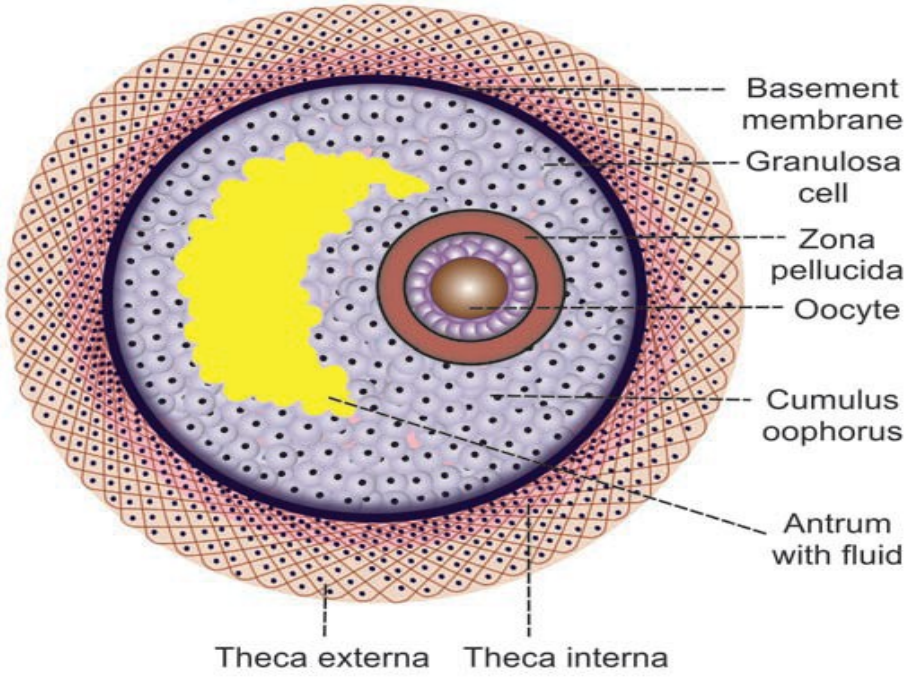
2. PRIMARY FOLLICLE

- Primordial follicle becomes the primary follicle, when ovum is completely surrounded by the granulosa cells.
- Proliferation of granulosa cells and increase in size of the follicle along with Increase in size of the ovum.

3. VESICULAR FOLLICLE

- Under the influence of FSH, about 6 to 12 primary follicles start growing and develop into vesicular follicles.
- First, the proliferation of granulosa cells occurs than the ovum increases in size and its diameter increases up to 100 to 150 μ.
- Thick membrane is formed around the ovum, which is called zona pellucida.
- **Spindle cells** from the stroma of ovarian cortex are modified and form a covering sheath around the follicle.
- The covering sheath is known as **follicular sheath** or **theca folliculi.**
- Theca folliculi divides into two layers:

a) Theca interna
b) Theca externa.



A. THECA INTERNA

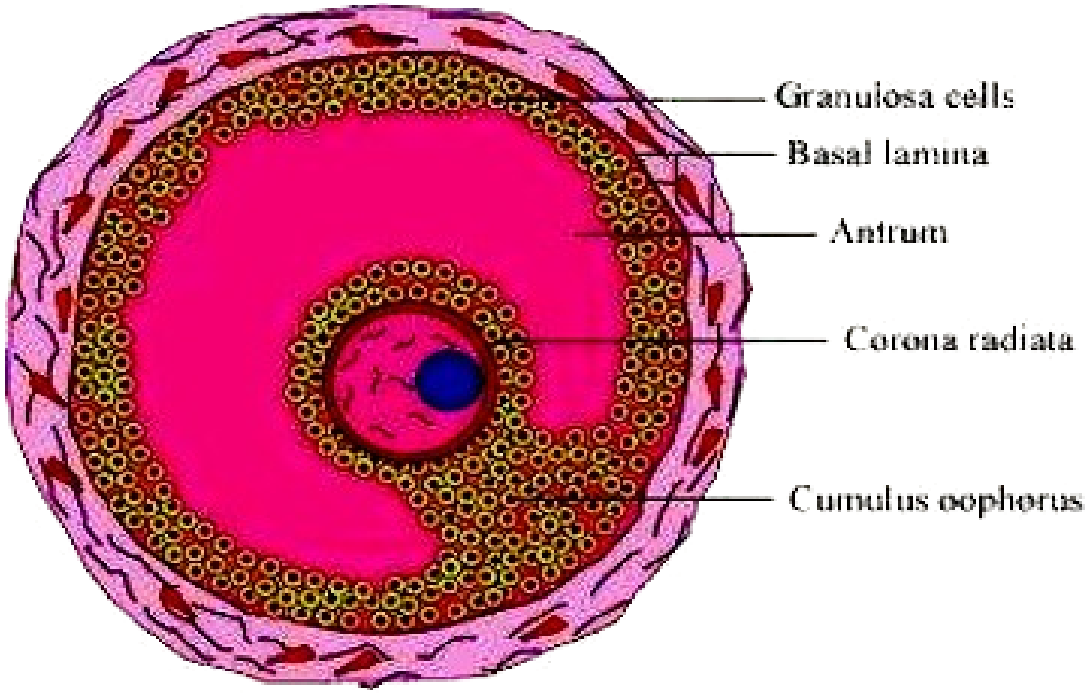
- Theca interna is the inner vascular layer with loose connective tissue.
- It was secretory in nature and secreting the female sex hormones, especially estrogen.

B. THECA EXTERNA

- It is the outer layer and consists of thickly packed fibers and spindle shaped cells.
- After about 7th day of menstrual cycle, one of the vesicular follicles becomes the dominant follicle.
- It develops further to form graafian follicle. Other vesicular follicles degenerated.

4. GRAAFIAN FOLLICLE

- Graafian follicle is the matured ovarian follicle with maturing ovum.
- It is named after the Dutch physician and anatomist, **Regnier De Graaf.**
- Size of the follicle increases up to about 10 to 12 mm.



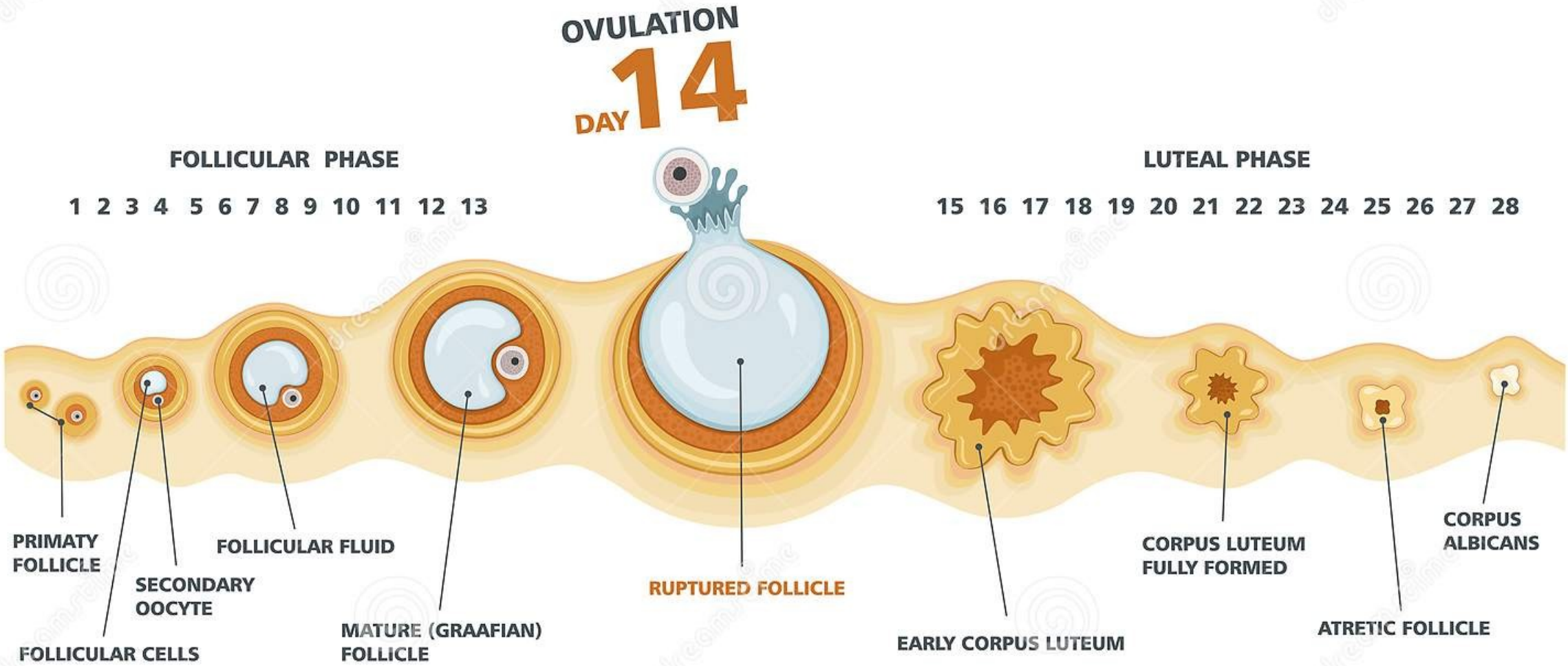
Structure of the Graafian follicle

- Follicular cavity becomes larger and Ovum attains maximum size.
- Zona pellucida becomes thick and Theca interna becomes prominent. it thickened about double with the formation of rich capillary network.
- On the 14th day of menstrual cycle, graafian follicle is ready for the process of ovulation.

OVULATION

- Ovulation is the process by which the graafian follicle ruptures with consequent **discharge of ovum** into the abdominal cavity.
- It is influenced by LH.
- Ovulation occurs on 14th day of menstrual cycle in a normal cycle of 28 days.
- The ovum enters the fallopian tube.
- Stages of ovulation:
  1. Rupture of graafian follicles takes place at the stigma.
  2. Follicular fluid oozes out.
  3. Ovum is expelled out into the abdominal cavity along with some amount of fluid and granulosa cells.
  4. From abdominal cavity, the ovum enters the fallopian tube through the fimbriated end.
- After ovulation, the ovum is viable only for 24 to 48 hours. So it must be fertilized within that time. If fertilization does not occur, ovum degenerates.

MENSTRUAL CYCLE



LUTEAL PHASE

- Luteal phase extends between 15th and 28th day of menstrual cycle.
- During this phase, corpus luteum is developed and hence this phase is called luteal phase.

CORPUS LUTEUM

- it is a glandular yellow body, developed from the ruptured graafian follicle after the release of ovum. It is also called **yellow body.**

DEVELOPMENT OF CORPUS LUTEUM

- Soon after the rupture of graafian follicle and release of ovum, the follicle is filled with **blood.**
- Now the follicle is called **corpus hemorrhagicum,** The blood clots slowly.
- Blood clot is gradually replaced by a **serousfluid** containing fibrin.
- It is transformed into corpus luteum and obtains a diameter of 15 mm and remains in the ovary till the end of the cycle.

FUNCTIONS OF CORPUS LUTEUM

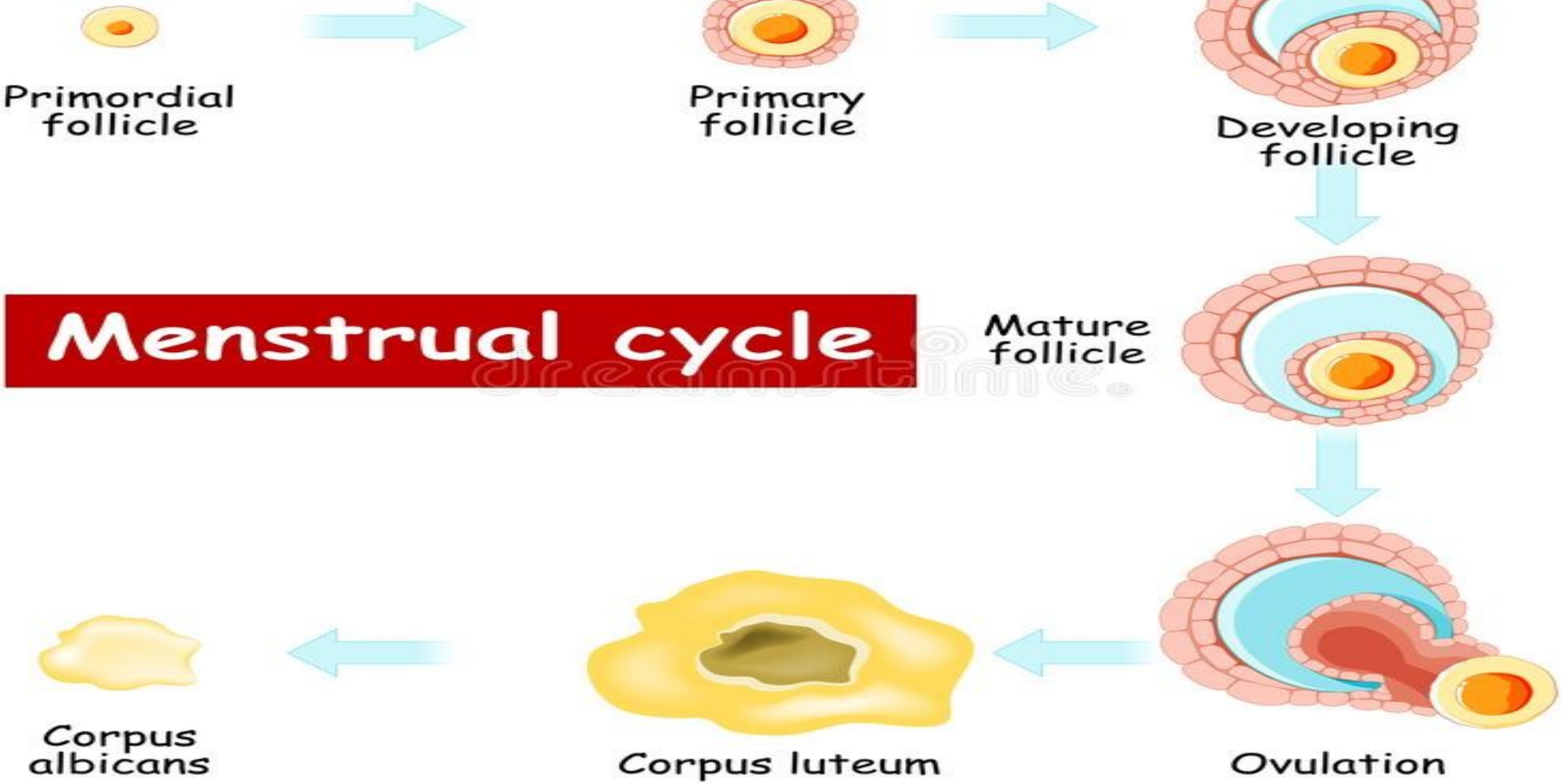
1. SECRETION OF HORMONES

- Corpus luteum acts as a **temporary endocrine gland.**
- It secretes large quantity of progesterone and small amount of estrogen.
- LH influences the secretion of these two hormones.

2. MAINTENANCE OF PREGNANCY

- If pregnancy occurs, corpus luteum remains active for about 3 months, i.e. until placenta develops.
- Secretes hormone during this period for maintain the pregnancy.
- Abortion occurs if corpus luteum becomes inactive or removed before third month.

Menstrual cycle



FATE OF CORPUS LUTEUM

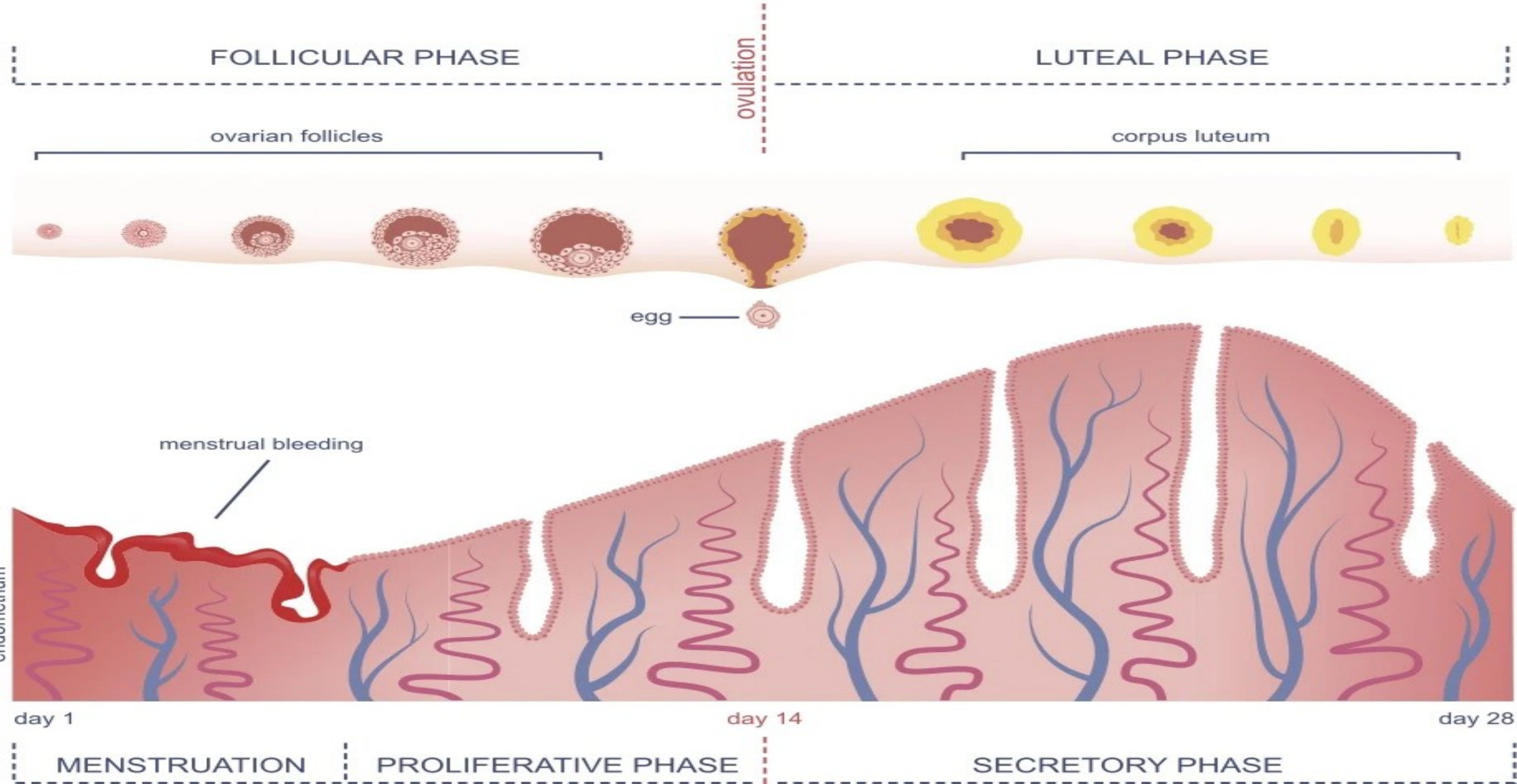
- Fate of corpus luteum depends upon whether ovum is fertilized or not.

1. IF THE OVUM IS NOT FERTILIZED

- Than it reaches the maximum size about one week after ovulation.
- And degenerates into the **corpus luteum menstrualis** or **spurium.**
- Afterwards, the corpus luteum menstrualis is transformed into a whitish scar called **corpus albicans.**

2. IF OVUM IS FERTILIZED

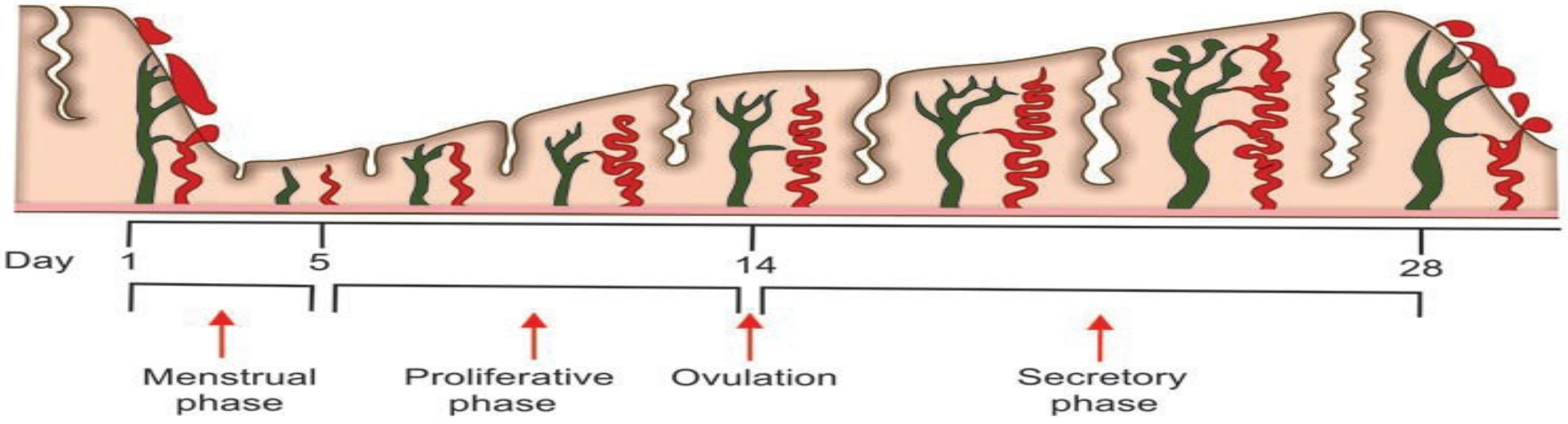
- If ovum is fertilized and pregnancy occurs, the corpus luteum persists and increases in size.
- It attains a diameter of 20 to 30 mm and it is transformed into **corpus luteum graviditatis (verum)** or **corpus luteum of pregnancy.**
- It remains in the ovary for 3 to 4 months. During this period, it secretes large amount hormone which are essential for the maintenance of pregnancy.
- After 3 to 4 months, placenta starts secreting these hormones and corpus luteum degenerates.


FOLLICULAR PHASE
ovulation
LUTEAL PHASE
ovarian follicles
corpus luteum
egg
menstrual bleeding
endometrium
day 1
day 14
day 28
MENSTRUATION
PROLIFERATIVE PHASE
SECRETORY PHASE

UTERINE CHANGES DURING MENSTRUAL CYCLE

- During each menstrual cycle, along with ovarian changes, uterine changes also occur simultaneously.
- Uterine changes occur in three phases:

1. **MENSTRUAL PHASE**
2. **PROLIFERATIVE PHASE**
3. **SECRETORY PHASE**



1. MENSTRUAL PHASE

- After ovulation, if pregnancy does not occur, the thickened **endometrium** is shed or **desquamated.**
- This desquamated endometrium is expelled out through vagina along with blood and tissue fluid.
- The process of shedding and exit of uterine lining is called **menstruation** or **menstrual bleeding** and that period is called menstrual phase or **menstrual period.**
- It is also called **menses, emmenia** or **catamenia.**
- It lasts for about 4 to 5 days.
- The day when bleeding starts is considered as the first day of the menstrual cycle.
- At the 26th or 27th day of the previous cycle, there is a sudden reduction in the release of estrogen and progesterone from ovary.
- Decreased level of these two hormones is responsible for menstruation.

CHANGES IN ENDOMETRIUM DURING MENSTRUAL PHASE

- Lack of estrogen and progesterone leads to reduction in the thickness of endometrium, up to 65% of original thickness.
- During the next 24 hours, the tortuous blood vessels in the endometrium undergo severe constriction.
- Vasoconstriction leads to **hypoxia,** which results in **necrosis** of the endometrium.
- Necrosis causes rupture of Outer layer of the **endometrium**.
- This process is continued for about 24 to 36 hours.
- Within 48 hours after the reduction in the secretion of estrogen and progesterone, the superficial layers of endometrium are completely desquamated.
- Uterine contractions expel the blood along with desquamated uterine tissues to the exterior through vagina.
- During normal menstruation, about 35 mL of **blood** along with 35 mL of **serous fluid** is expelled.
- Menstruation stops between 3rd to 7th day of menstrual cycle.
- At the end of menstrual phase, the thickness of endometrium is only about 1 mm.

2. PROLIFERATIVE PHASE

- Proliferative phase extends usually from 5th to 14th day of menstruation, i.e. between the day when menstruation stops and the day of ovulation.
- It corresponds to the follicular phase of ovarian cycle.
- At the end of menstrual phase, only a thin layer (1 mm) of endometrium remains, as most of the endometrial stroma is desquamated.

CHANGES IN ENDOMETRIUM DURING PROLIFERATIVE PHASE

- Endometrial cells proliferate rapidly and epithelium reappears within the first 4 to 7 days.
- Uterine glands and blood vessels start developing within the endometrial stroma.
- Endometrium reaches the thickness of 3 to 4 mm at the end of proliferative phase.
- All these uterine changes during proliferative phase occur because of the influence of estrogen released from ovary.
- On 14th day, ovulation occurs under the influence of LH.

SECRETORY PHASE

- Secretory phase extends between 15th to 28th day of the menstrual cycle.
- After ovulation, corpus luteum is developed in the ovary.
- It secretes a large quantity of progesterone along with a small amount of estrogen.
- Estrogen causes further proliferation of cells in uterus, so that the endometrium becomes more thick. Progesterone causes further enlargement of endometrial stroma and growth of glands.
- Under the influence of progesterone, the endometrial glands commence their secretory function.

CHANGES IN ENDOMETRIUM DURING SECRETORY PHASE

- Endometrial glands increase in size.
- Cytoplasm of stromal cells increases.

- Many new blood vessels appear within endometrial Stroma so blood supply to endometrium increases.
- Thickness of endometrium increases up to 6 mm.
- Actually, secretory phase is the preparatory period, during which the uterus is prepared for implantation of ovum.
- If a fertilized ovum is implanted during this phase and if the implanted ovum starts developing into a fetus, then further changes occur in the uterus for the survival of the developing fetus.
- If the implanted ovum is unfertilized or if pregnancy does not occur, menstruation occurs after this phase and a new cycle begins.

CHANGES IN CERVIX AND VAGINA DURING MENSTRUAL CYCLE

CHANGES IN CERVIX DURING MENSTRUAL CYCLE

- Mucus membrane of the cervix also shows cyclic changes during menstrual cycle.

1. PROLIFERATIVE PHASE

- During proliferative phase, the mucus membrane of cervix becomes thinner and more alkaline due to the influence of estrogen. It helps in the survival and motility of spermatozoa.

2. SECRETORY PHASE

- During secretory phase, the mucus membrane of cervix becomes more thick and adhesive because of actions of progesterone.

VAGINAL CHANGES DURING MENSTRUAL CYCLE

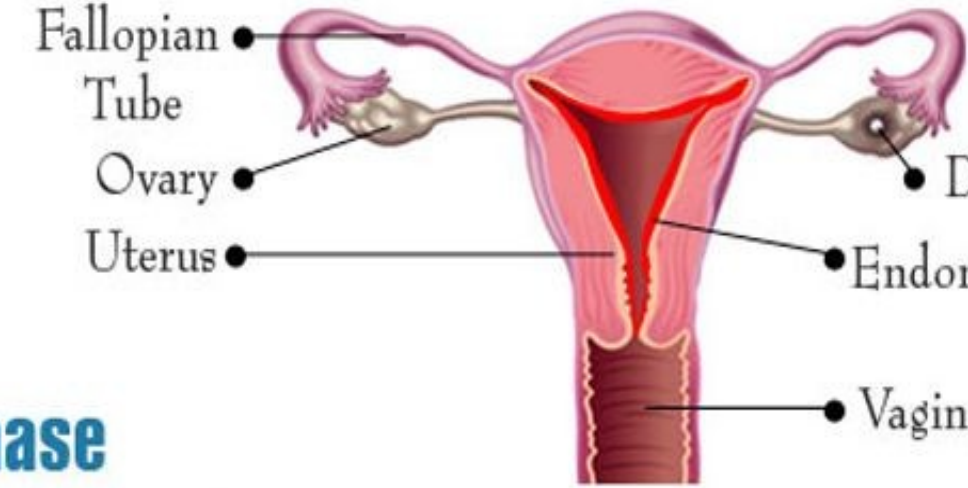
1. PROLIFERATIVE PHASE

- Epithelial cells of vagina are cornified.
- Estrogen is responsible for this.

2. SECRETORY PHASE

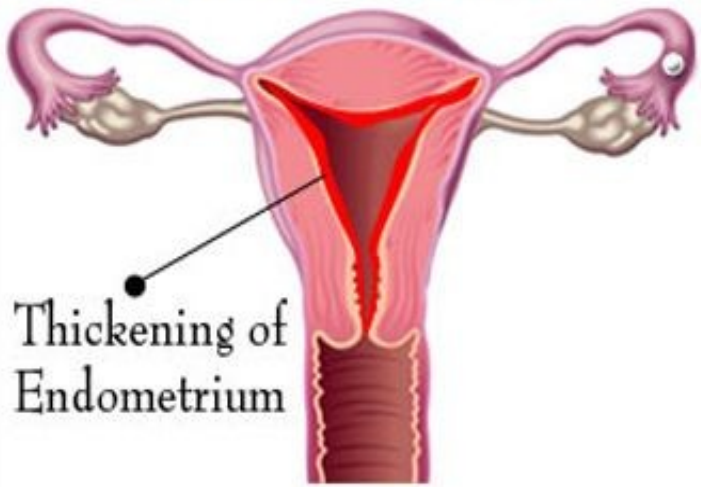
- Vaginal epithelium proliferates due to the actions of progesterone.
- It is also infiltrated with leukocytes.
- These two changes increase the resistance of vagina for infection.

Menstrual Cycle



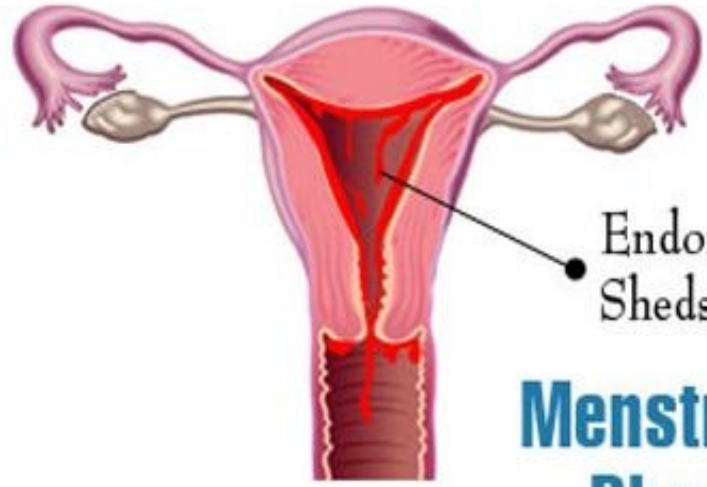
Follicular Phase

Developing Egg



Ovulation Phase

Luteal Phase



Menstrual Phase

APPLIED PHYSIOLOGY – ABNORMAL MENSTRUATION

MENSTRUAL SYMPTOMS

- Menstrual symptoms are the unpleasant symptoms with discomfort, which appear in many women during menstruation.
- These symptoms are due to hormonal withdrawal, leading to cramps in uterine muscle before or during menstruation.

COMMON MENSTRUAL SYMPTOMS

- Abdominal pain, Dysmenorrhea (menstrual pain), Headache, Occasional nausea and vomiting, Irritability, Depression, **Migraine** (neurological disorder, characterized by intense headache causing disability).

PREMENSTRUAL SYNDROME

- Premenstrual syndrome (PMS) is the symptom of stress that appears before the onset of menstruation. It is also called **premenstrual stress syndrome, premenstrual stress** or **premenstrual tension.**
- It lasts for about 4 to 5 days prior to menstruation.
- Symptoms appear due to salt and water retention caused by estrogen.

COMMON FEATURES

- Mood swings, Anxiety, Irritability, Emotional instability, Headache, Depression, Constipation, Abdominal cramping, Bloating (abdominal swelling)

ABNORMAL MENSTRUATION

1. **AMENORRHEA:** Absence of menstruation.
2. **HYPOMENORRHEA:** Decreased menstrual bleeding.
3. **MENORRHAGIA:** Excess menstrual bleeding.
4. **OLIGOMENORRHEA:** Decreased frequency of menstrual bleeding.
5. **POLYMENORRHEA:** Increased frequency of menstruation.
6. **DYSMENORRHEA:** Menstruation with pain.
7. **METRORRHAGIA:** Uterine bleeding in between menstruations.

THANK YOU