Physiology of Ovarian & Endometrial Cycle

GUYTON & HALL, Chapter 81

DR.MOHAMMED ALOTAIBI

ASSOCIATE PROFESSOR OF PHYSIOLOGY

COLLEGE OF MEDICINE

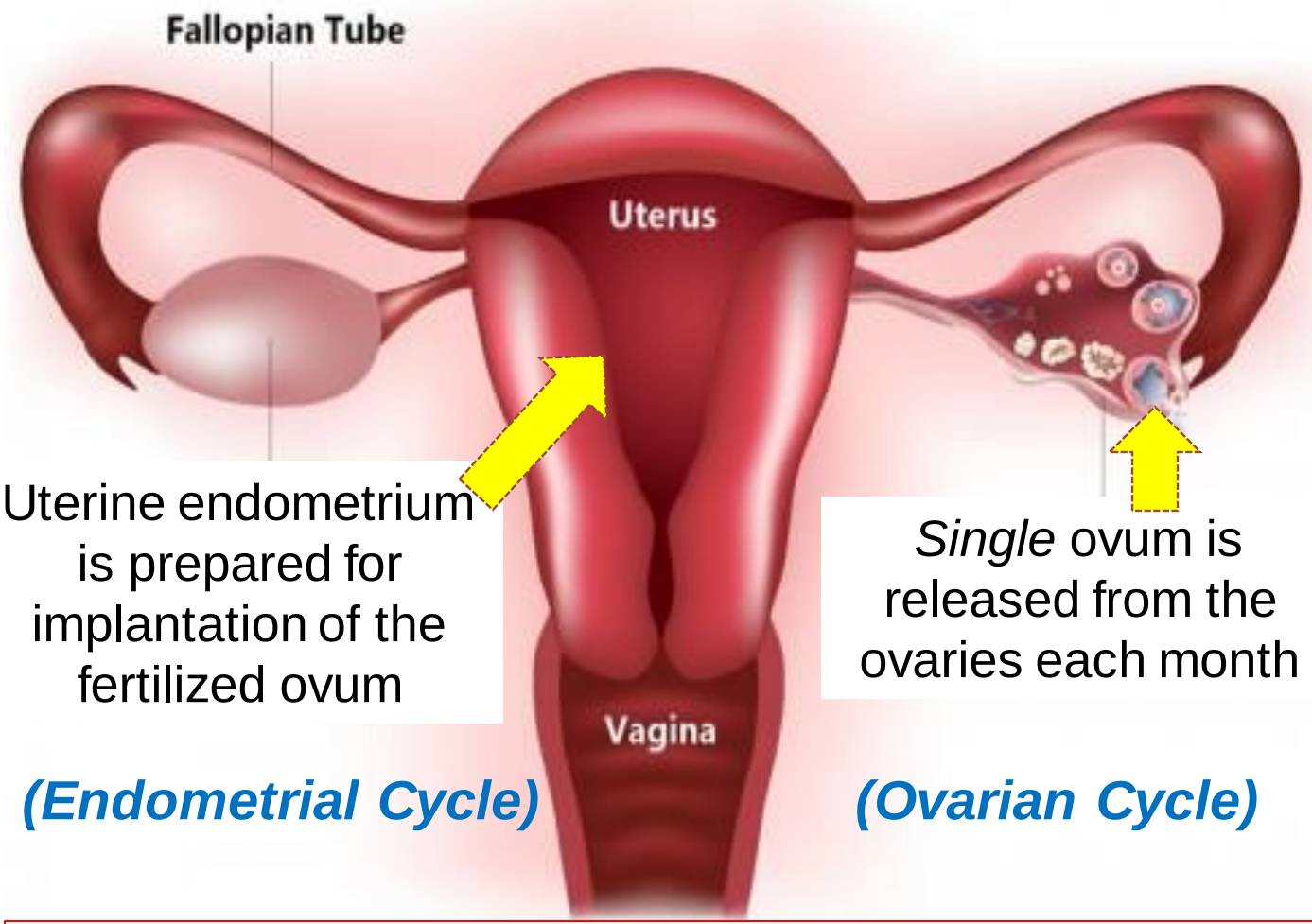
KING SAUD UNIVERSITY

Objectives

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

1. Recognize the hypothalamic-*pituitary-ovarian (HPO) axis*
2. Describe the physiological phases of ovarian and endometrial cycles
3. Describe the structural changes that occur in the ovaries and endometrium during menstrual cycle and explain how these changes are hormonally regulated
4. Describe the development and the fate of corpus luteum
5. List the female hormones and describe their physiological functions
6. Describe the physiology of menopause and the disorders of menstruation

Sexual (Menstrual) Cycle



Uterine endometrium is prepared for implantation of the fertilized ovum

(Endometrial Cycle)

Single ovum is released from the ovaries each month

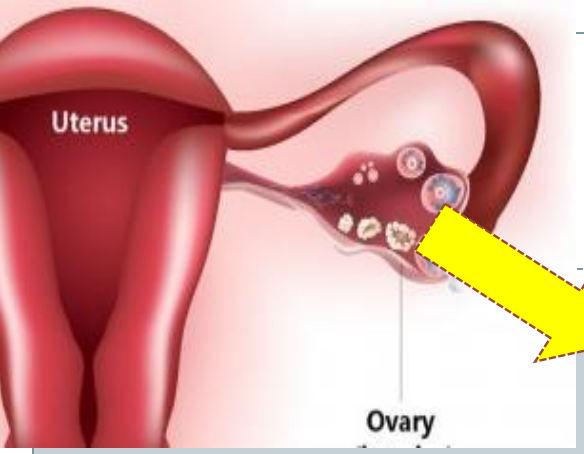
(Ovarian Cycle)

Ovary functions:

1- Oogenesis.

2- Secretion of estrogens and progesterone.

Duration of the cycle averages **28 days** (20-45 days)



Ovarian Cycle

Follicular Phase
(Preovulatory)

(Dominated by estradiol)

Ovulation

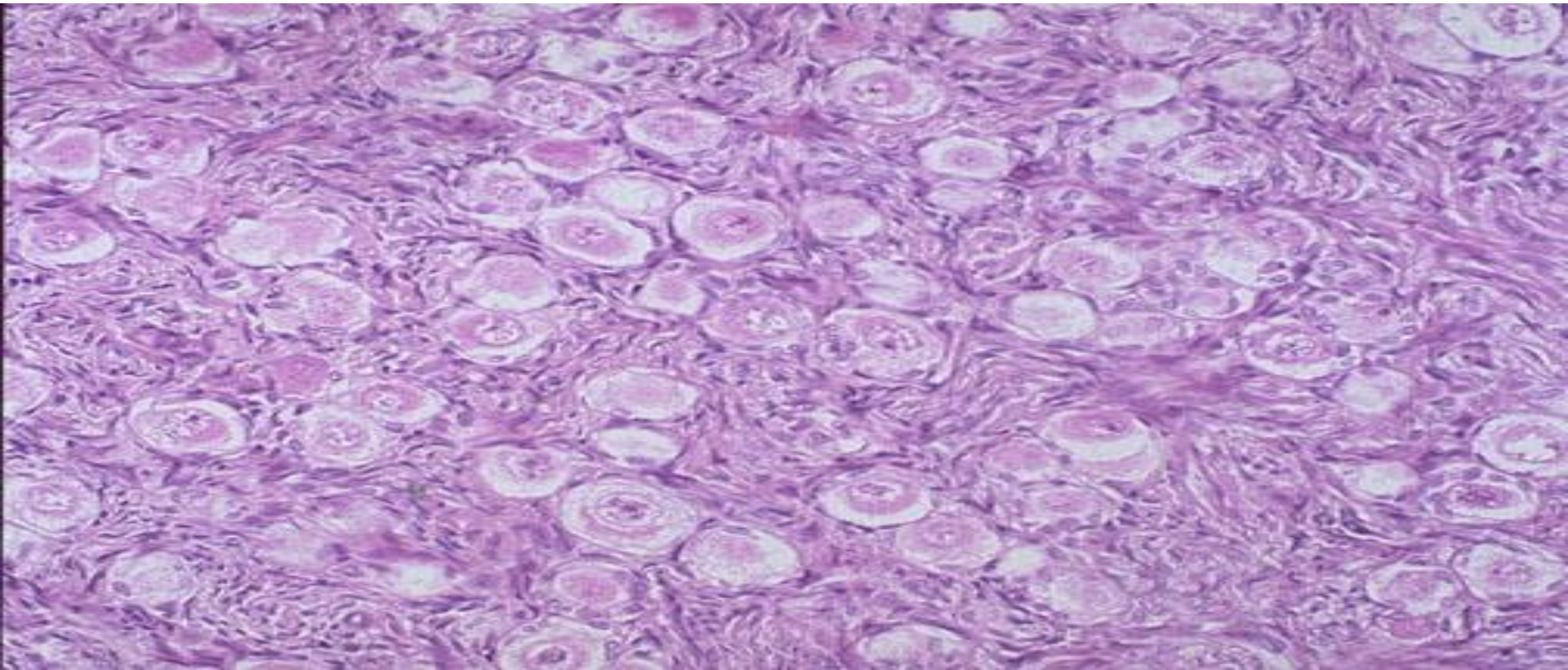
Luteal Phase
(Postovulatory)

(Dominated by progesterone)

1 **5** **14** **28**

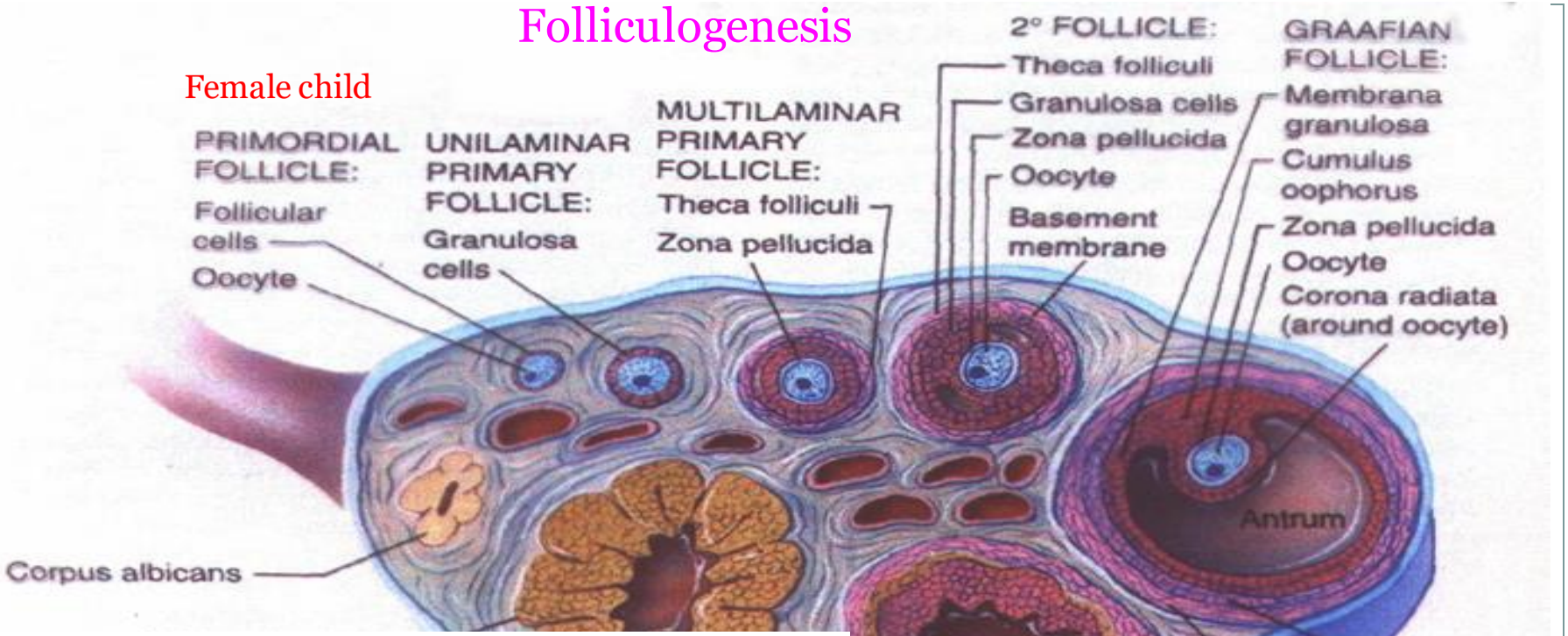
Follicular Development

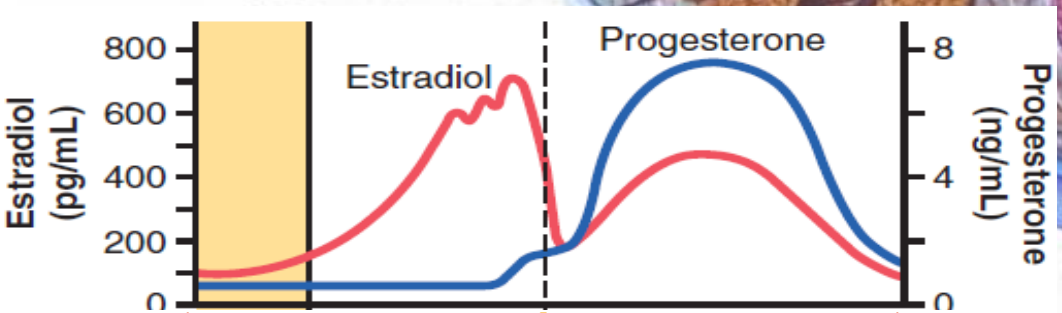
- **At birth:** 1-2 million oocytes.
- **At puberty:** 300,000 to 500,000 oocytes.
- 400-500 oocytes will normally ovulate during women's entire reproductive life.

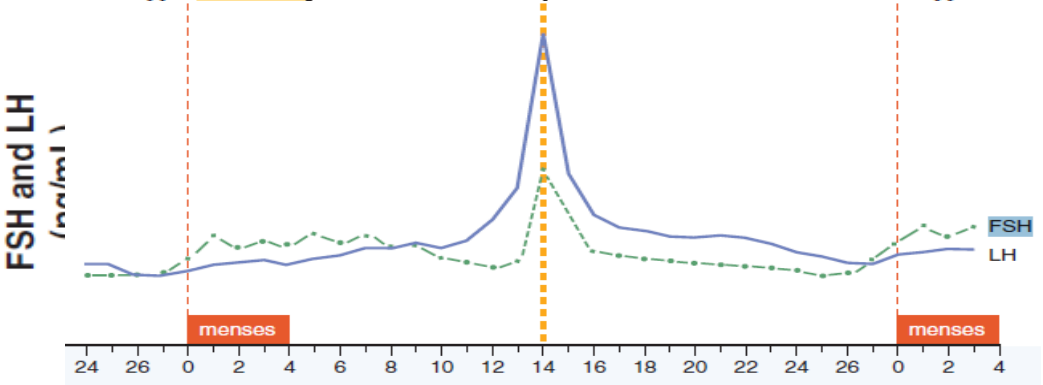


Folliculogenesis

Female child





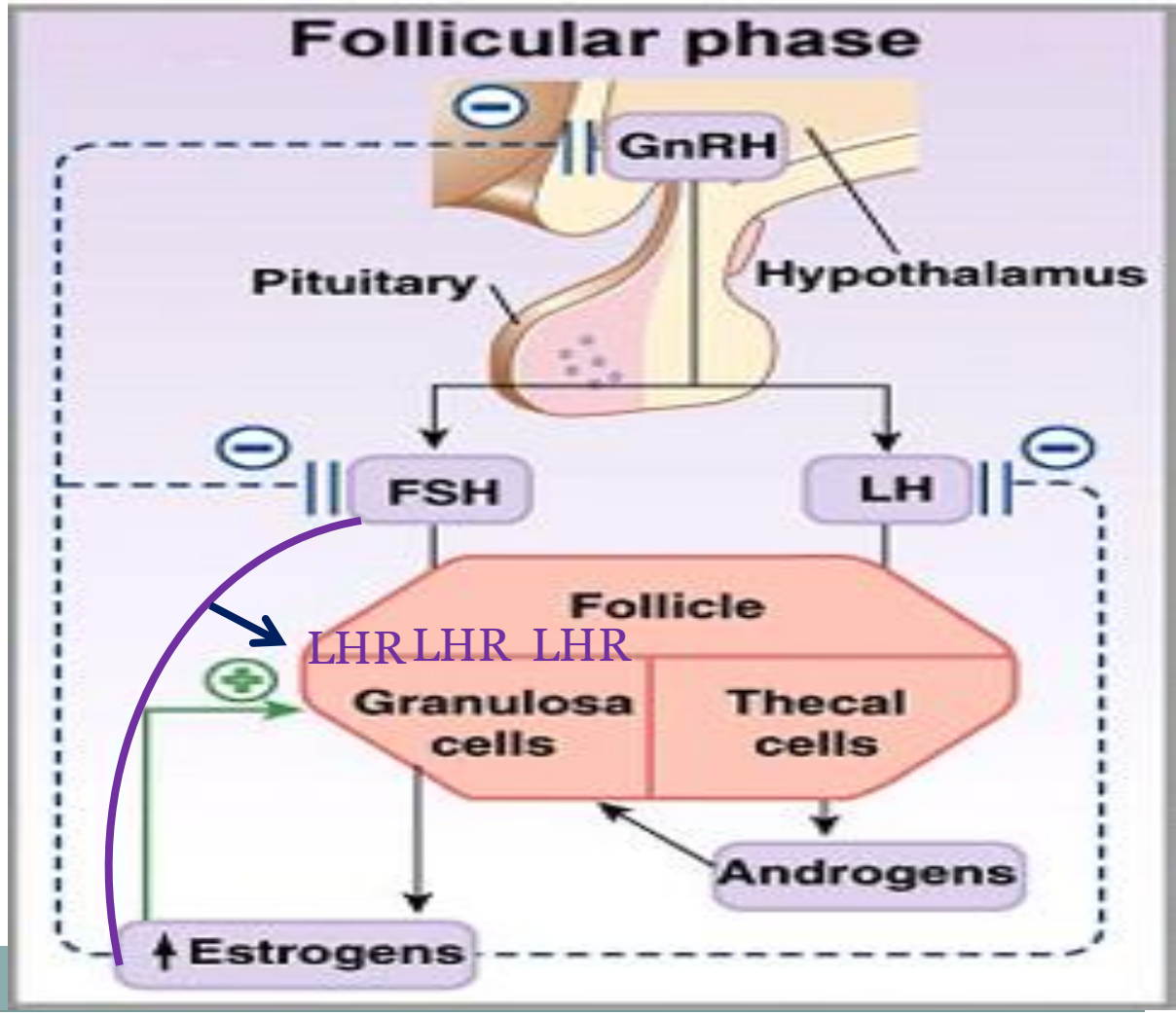


The early growth of the primary follicle up to the antral stage is under FSH stimulation only. Then there is **accelerated growth** of the follicle to larger follicle called vesicular follicle (Graffian) caused by:

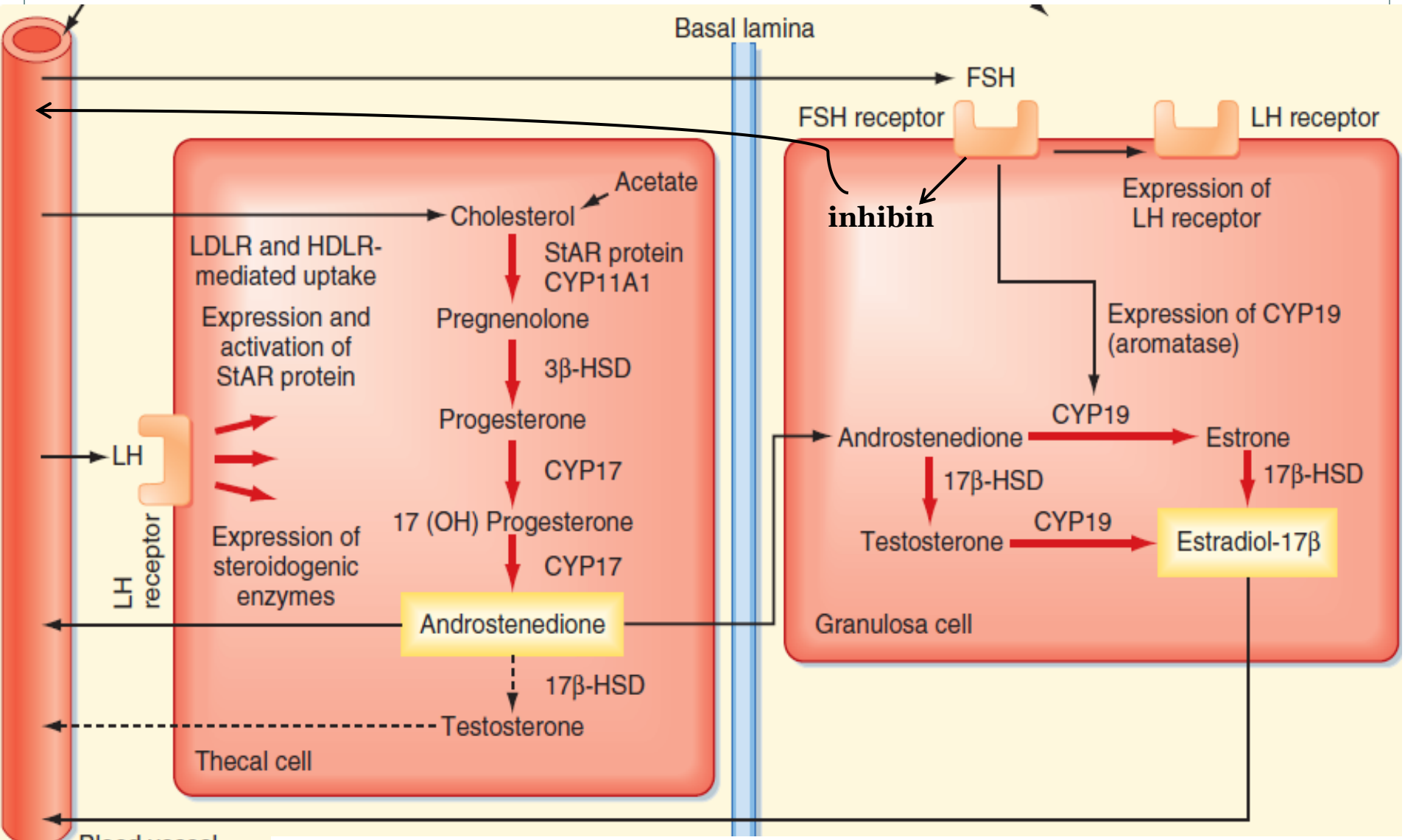
1. Estrogen ↑ FSH receptors **(positive feedback effect).**

2. Estrogen & FSH combine to promote **LH** receptors on the original granulosa cells in addition to FSH stimulation.

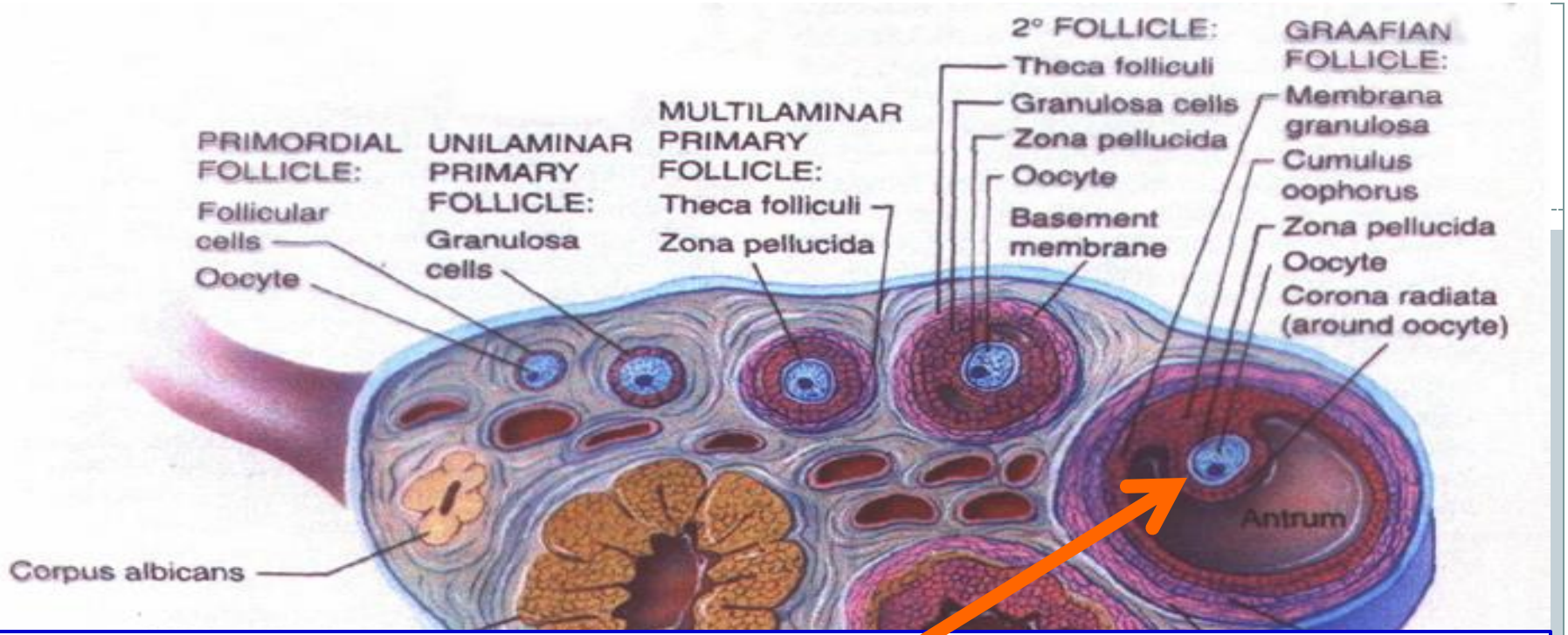
Proliferation of the follicular cells & increase their secretion.



Follicular Phase



Low levels of estrogen and inhibin negatively feed back on FSH



- The **antral follicles** begin to grow. The ovum enlarges & remains embedded at one pole of the granulosa cells of the follicle

- After a week or more of growth—but before ovulation occurs—one of the follicles begins to outgrow all the others, and the remaining 5 to 11 developing follicles **involute** (a process called ***atresia***)

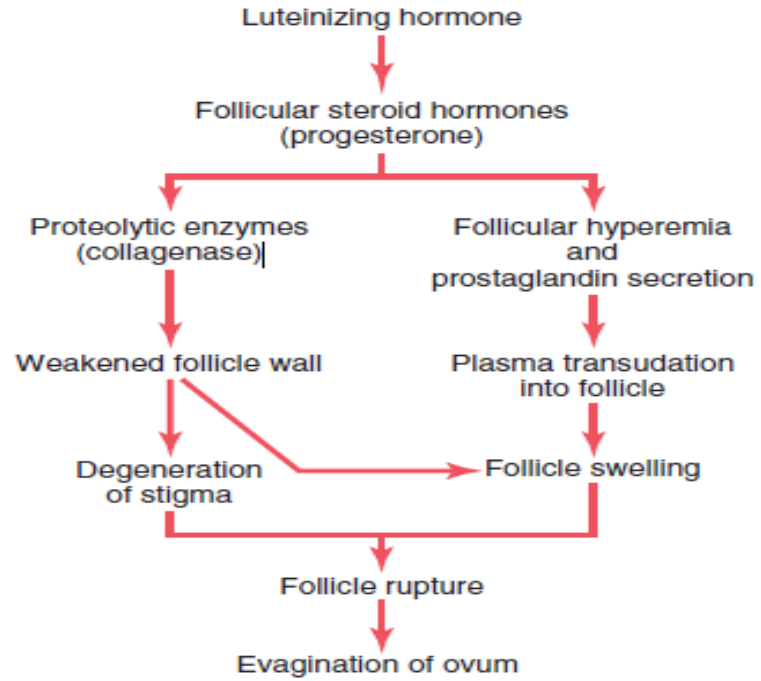
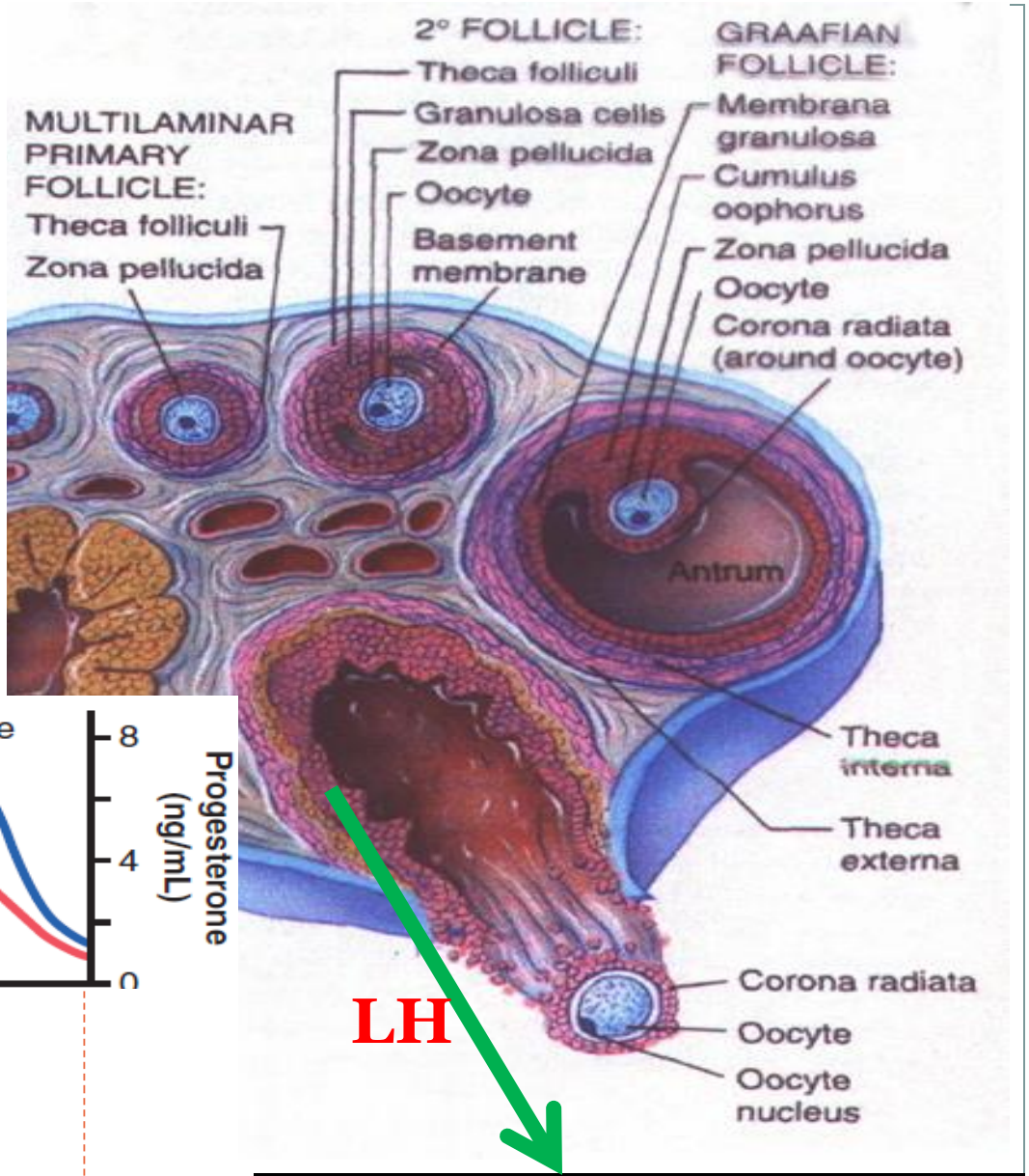
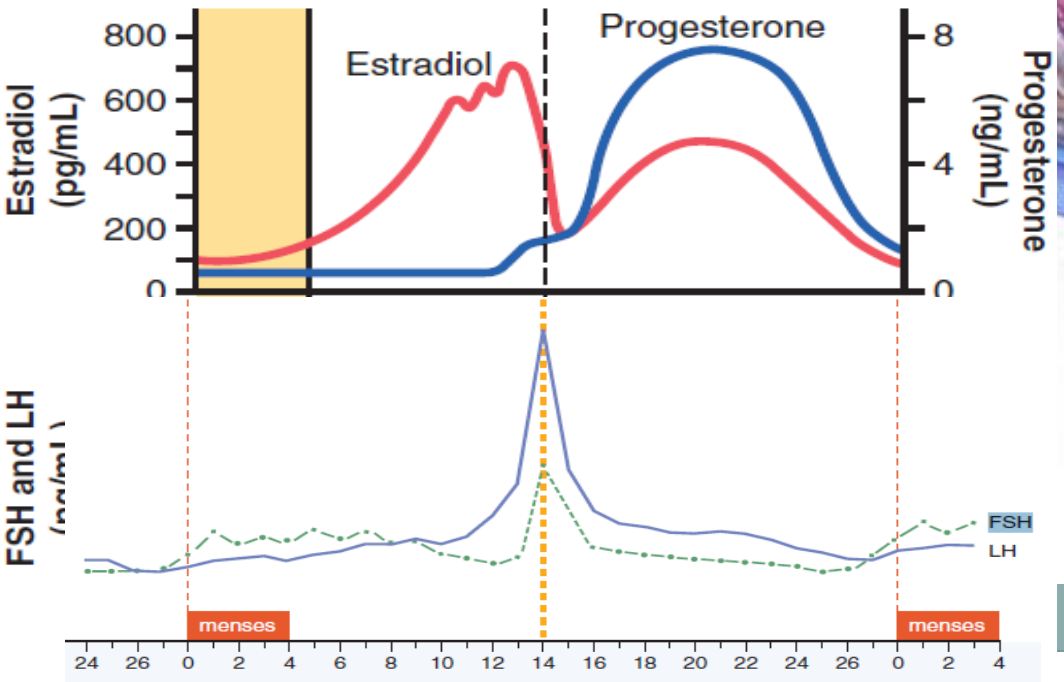


Figure 82-6. The postulated mechanism of ovulation.

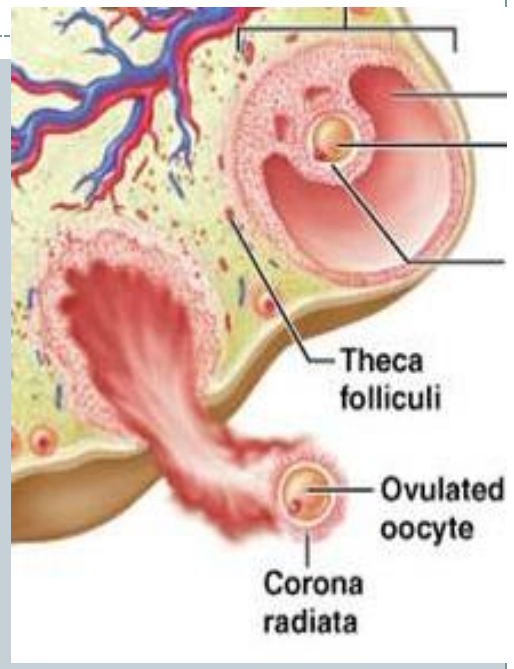


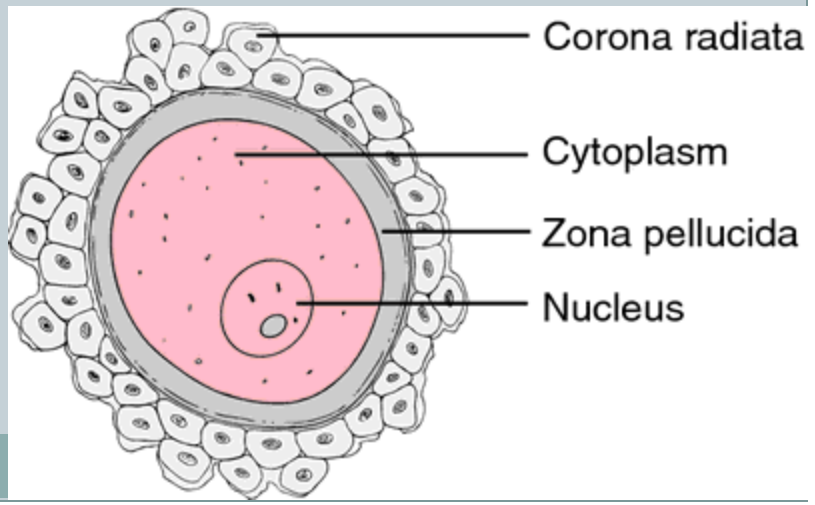


progesterone-secreting cells

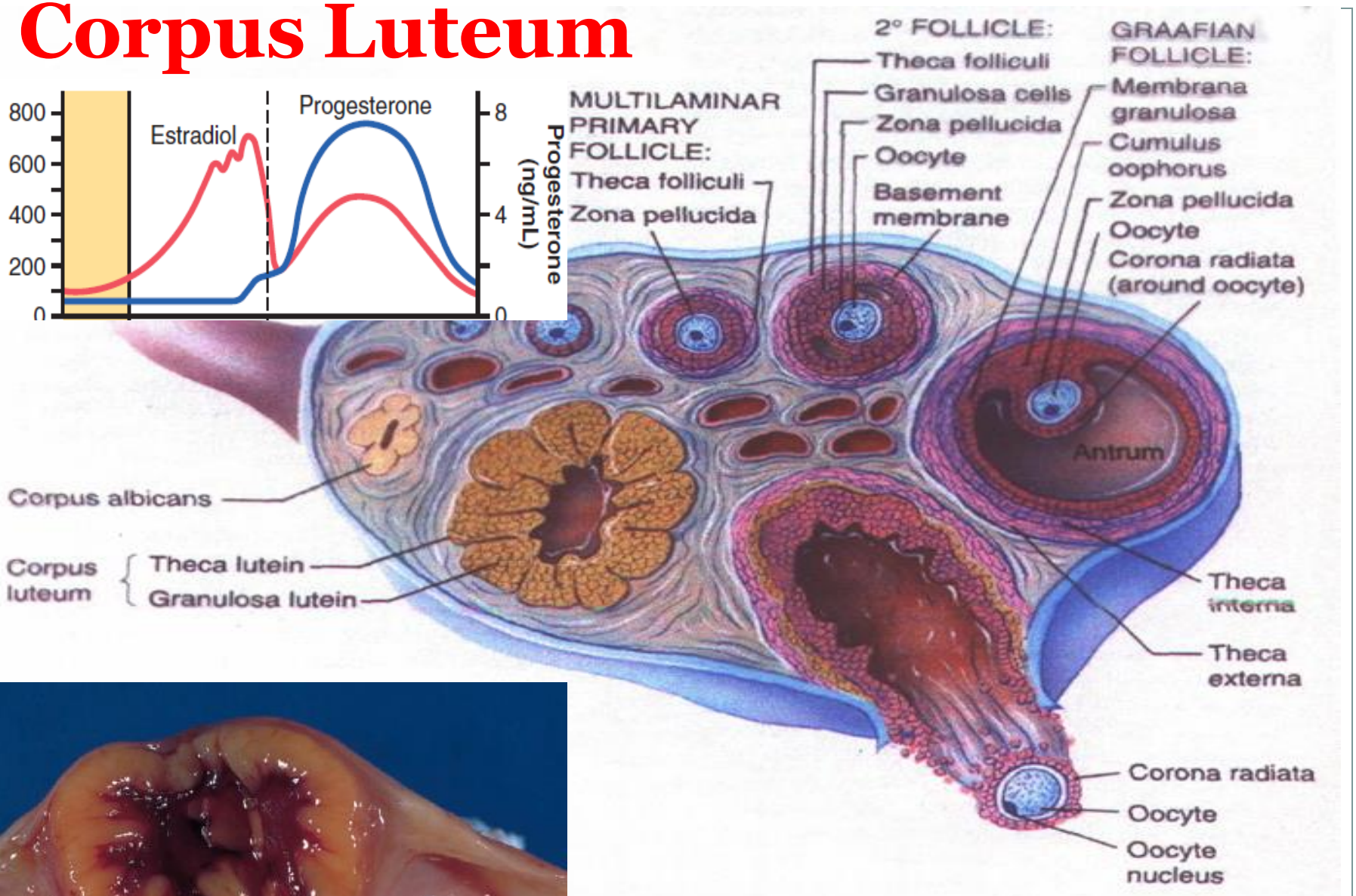
Ovulation

During ovulation, stigma protrudes & fluids ooze from the follicle & the stigma ruptures allowing more viscous fluid outward carrying with it the ovum surrounded by mass of granulosa cells called corona radiata



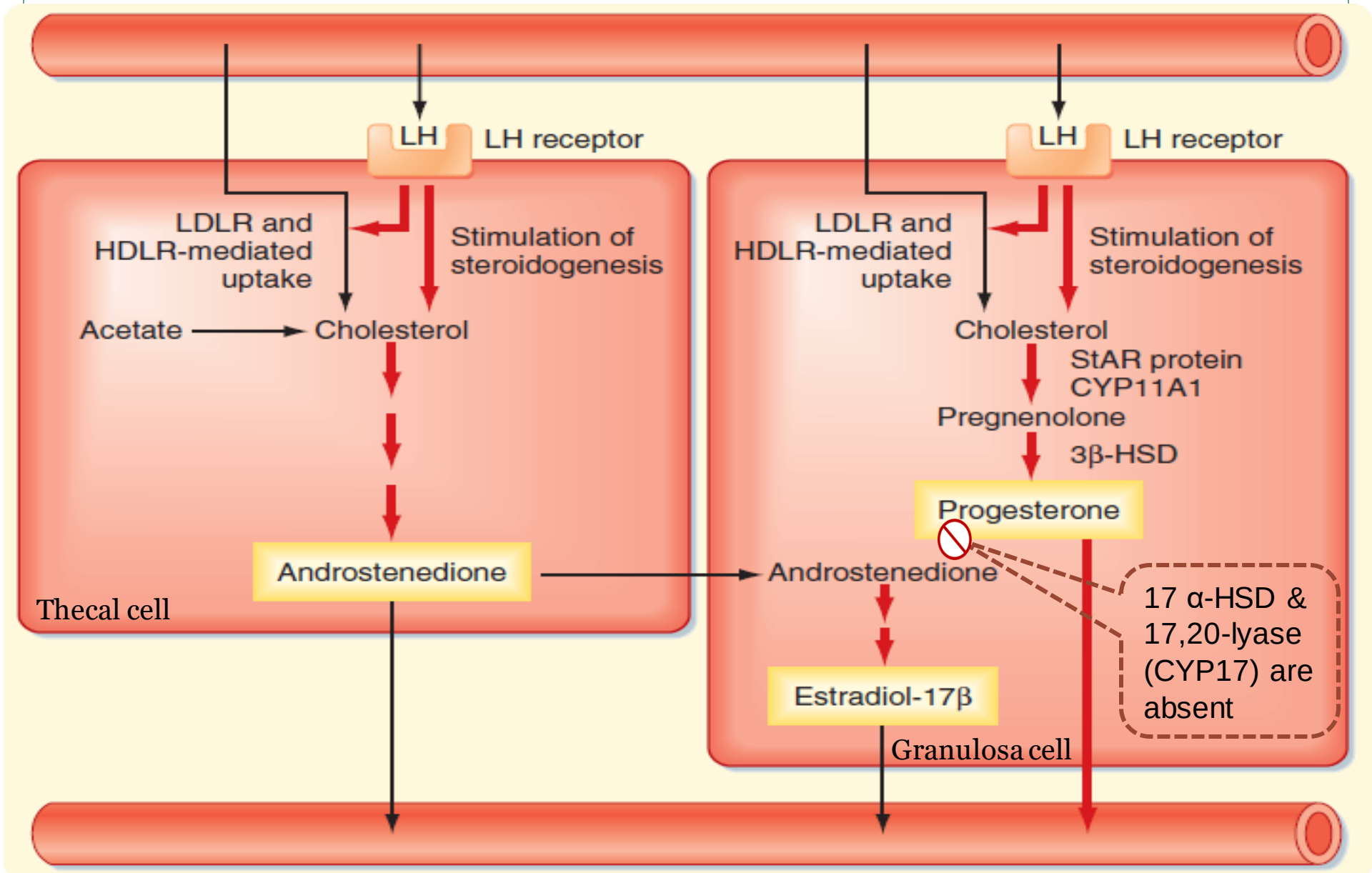


Corpus Luteum



Luteal Phase

Vascularization of the *corpus luteum* makes low LDL available to the granulosa-lutein cells



Corpus Luteum

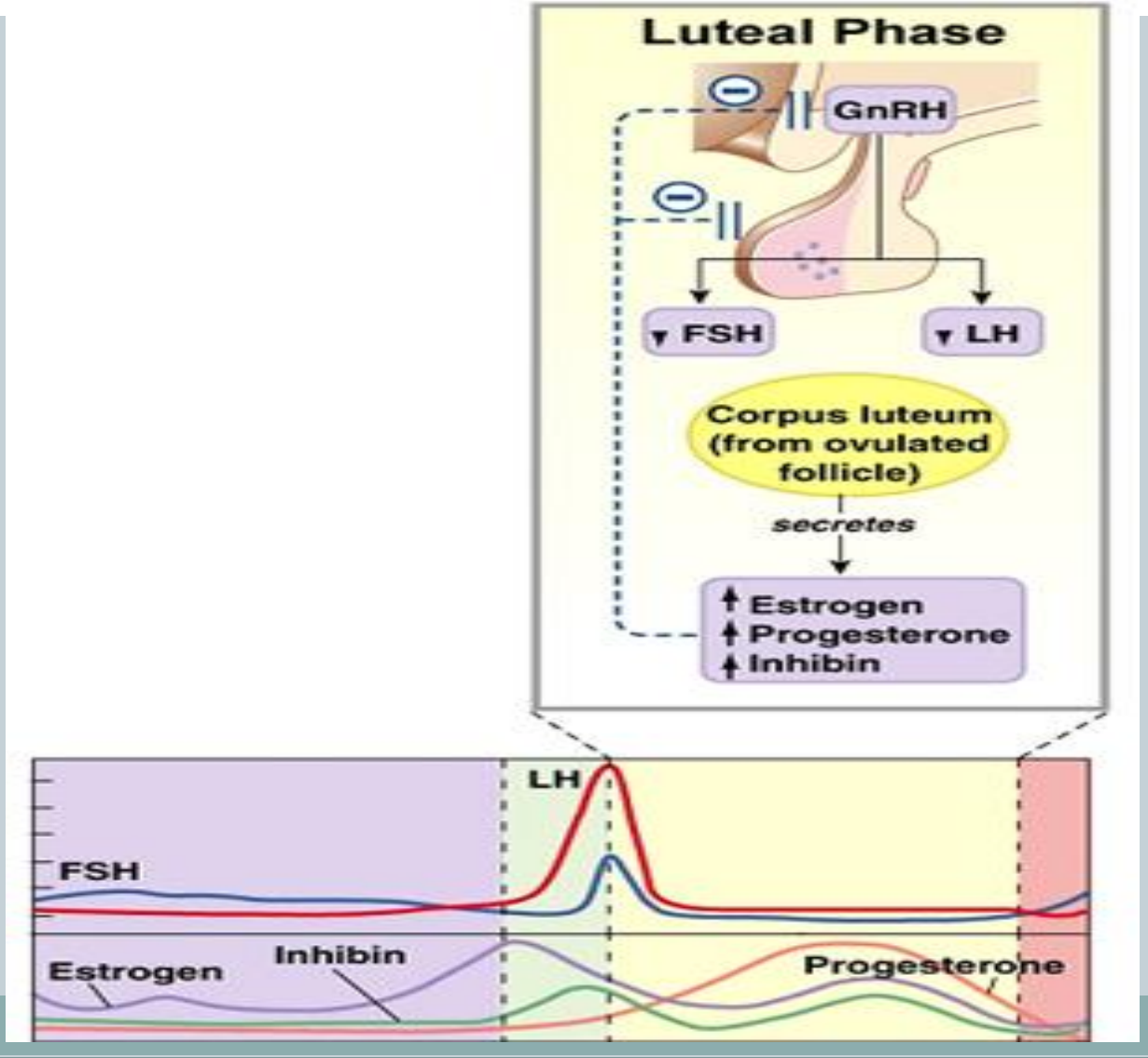
Function of LH:

1- Causes ***ovulation***.

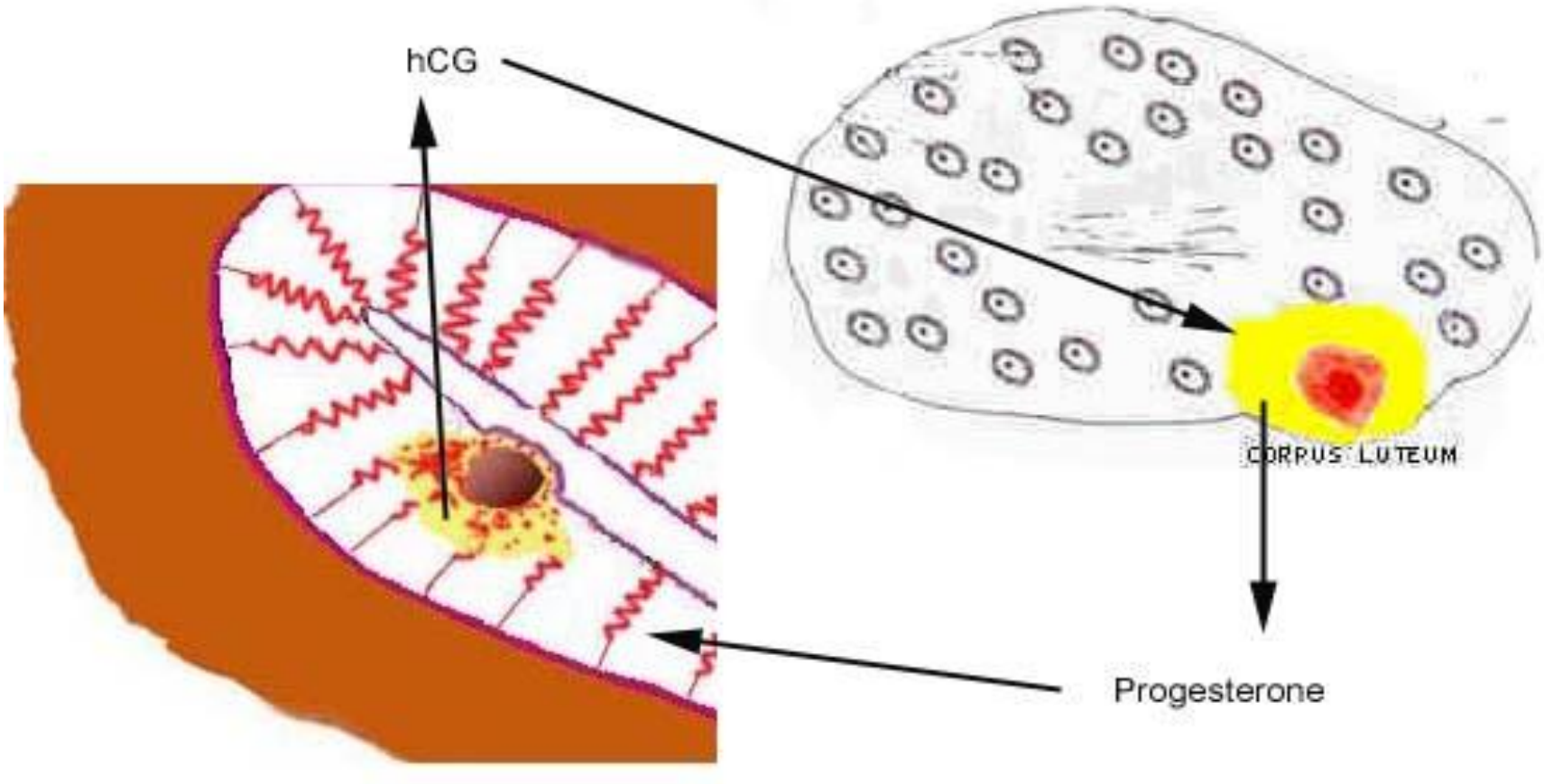
2 -Causes ***luteinization*** (changes the granulosa and theca cells into lutein cells.

3 - Maintains secretion of progesterone & estrogen from the corpus luteum.

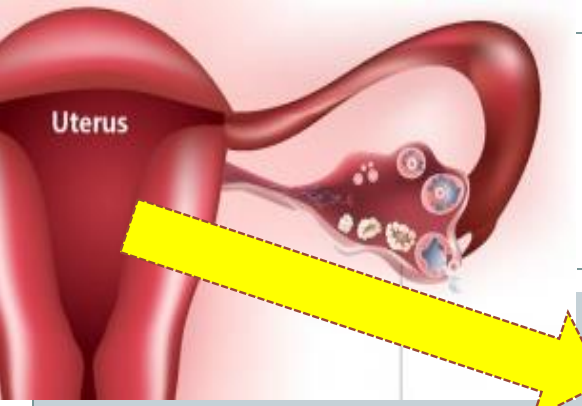
Involution of the corpus luteum and onset of the next ovarian cycle



Rescue of Corpus Luteum



- <u>If pregnancy occurs</u>, the hCG from the Trophoblast acts on the corpus luteum to prolong its life for 2 to 4 months of pregnancy



Uterine Cycle

Proliferative phase
(Preovulatory)

(Dominated by estradiol)

Ovulation

Secretory phase
(Postovulatory)

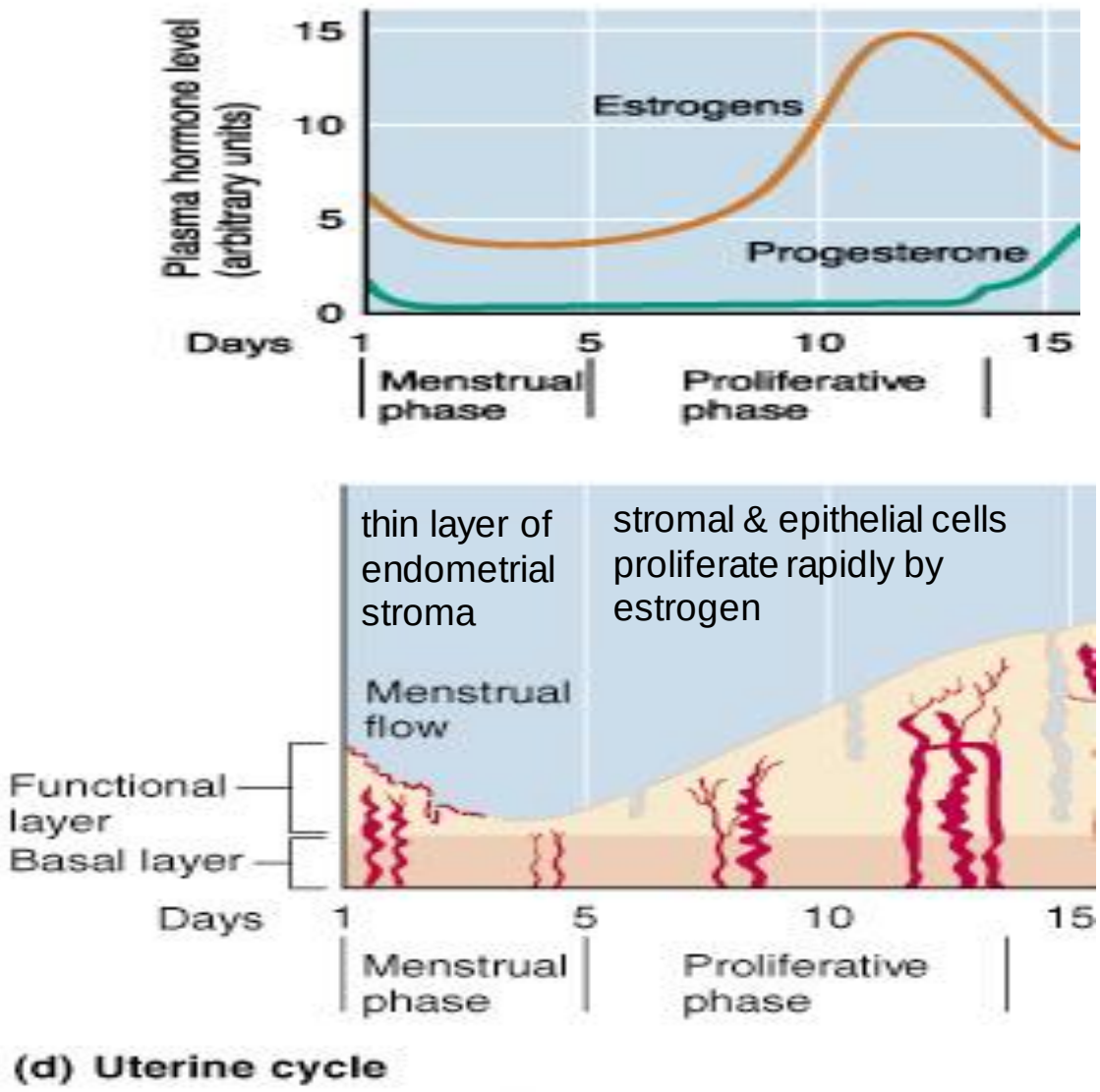
(Dominated by progesterone)

1 **5** **14** **28**

Proliferative phase (estrogen phase)

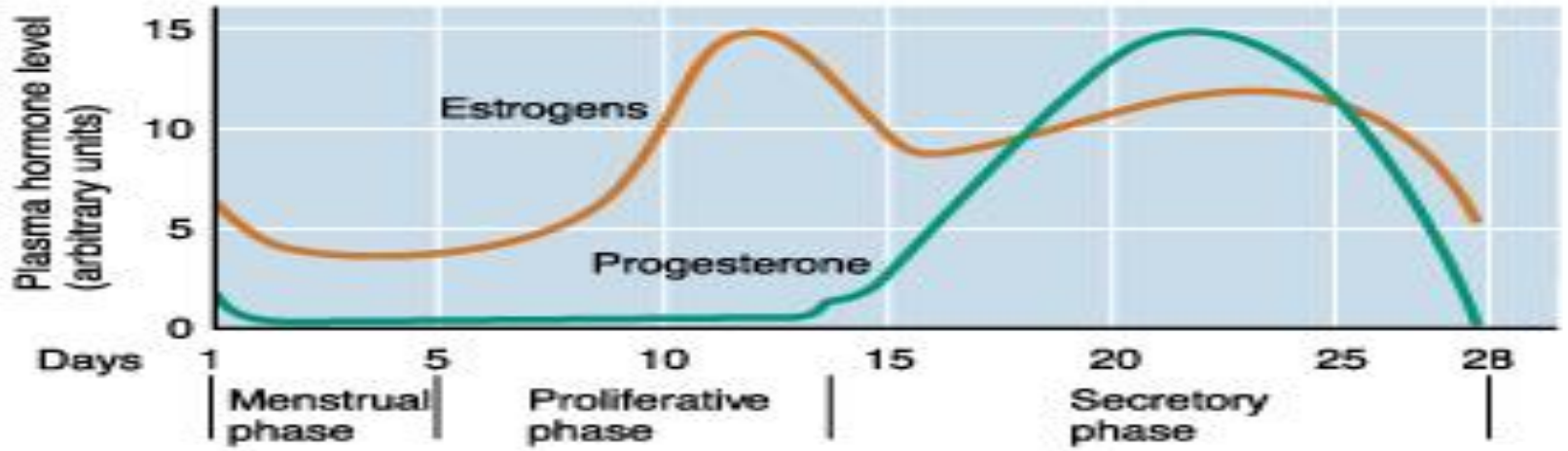
The endometrial surface re-epitheliazed within 4-7 days after the beginning of menstruation. The endometrium thickness increases, due to increase numbers of stromal cells &progressive growth of the glands & new blood vessels.

At the time of ovulation, the endometrium is **3-5 mm thick**. The endometrial glands and cervical region secrete a thin, stringy mucus which helps to guide sperm in the proper direction from the vagina into the uterus.



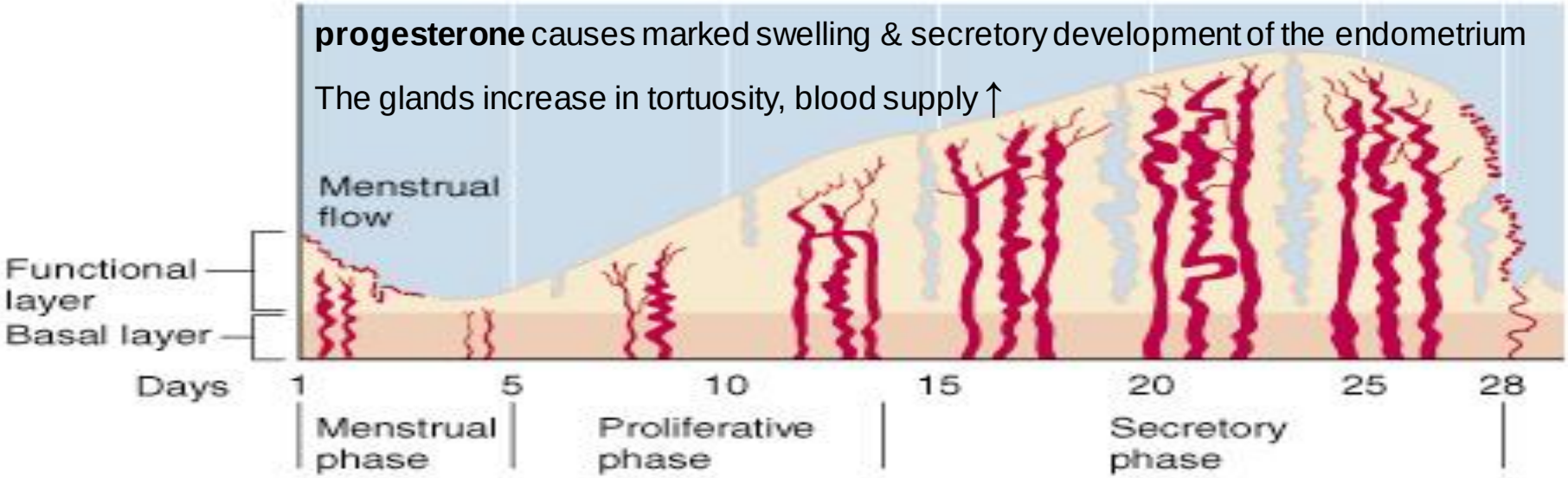
(d) Uterine cycle

Secretory phase (progestational phase)



progesterone causes marked swelling & secretory development of the endometrium

The glands increase in tortuosity, blood supply ↑



Stromal cells cytoplasm increase lipid &glycogen deposits, 1 week after ovulation, endometrium thickness is 5-6 mm . Uterine secretions called **"uterine milk"** provide nutrition for the dividing ovum.

Menstruation

- -If the ovum is not fertilized, about 2 days before the end of the monthly cycle, the corpus luteum in the ovary suddenly involutes and the ovarian hormones (estrogens and progesterone) decrease to low levels of secretion,

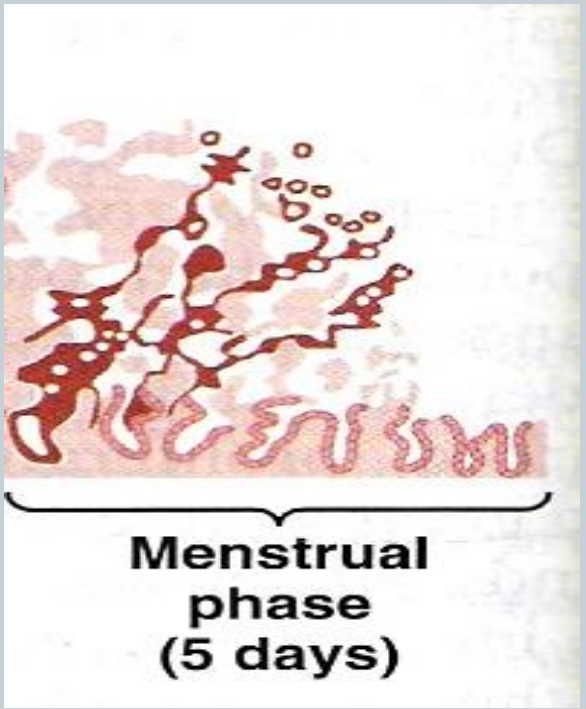
- Necrosis is initiated in the endometrial blood vessels, due to:

1) vasospasm

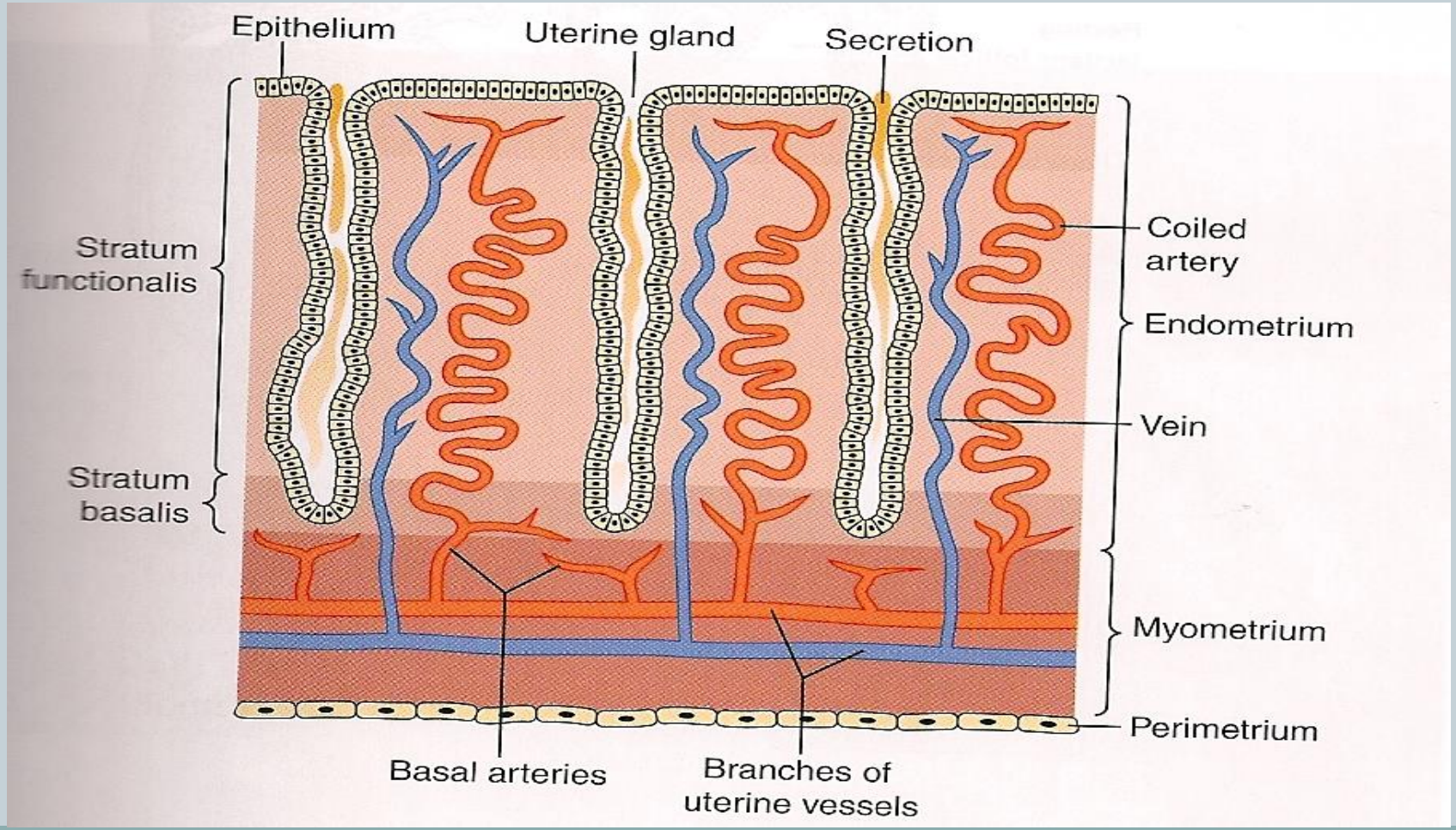
2) decrease nutrients to the endometrium

3) loss of the hormonal stimulation

- The mass of desquamated tissue & blood plus the contractile effects of prostaglandins all initiate contractions which expel the uterine contents.



Uterine (endometrial) Cycle



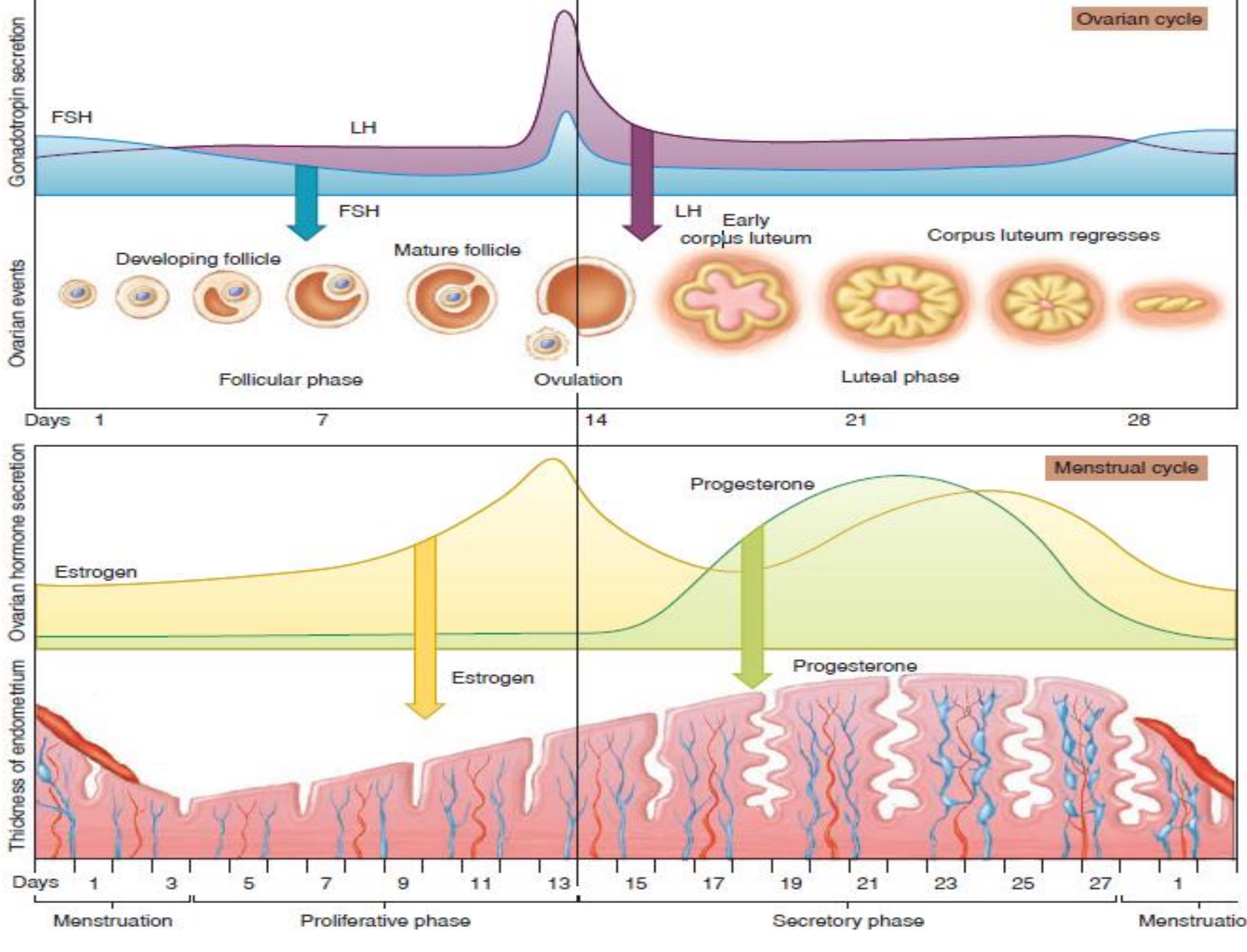
Menstruation

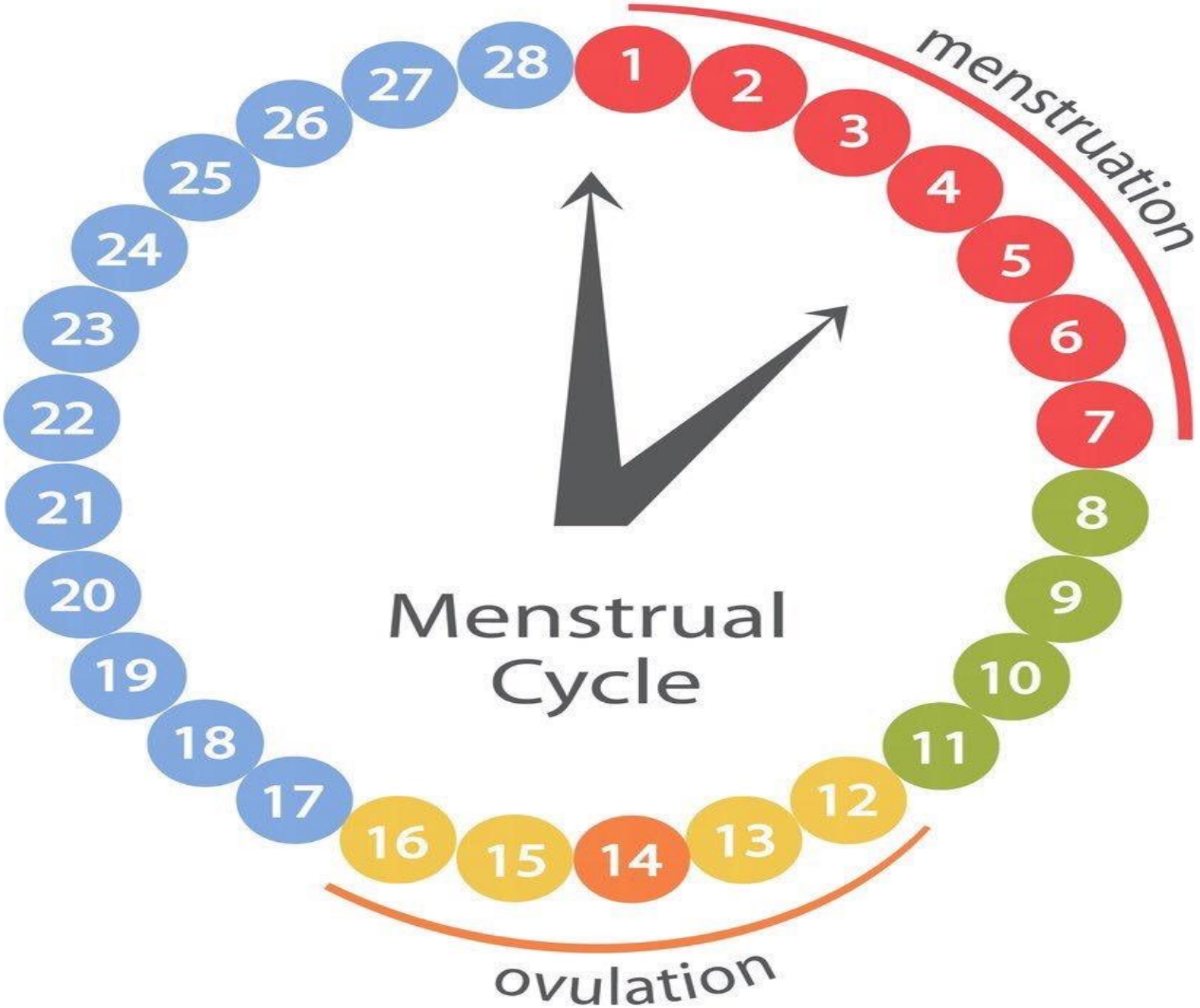
- **In normal menstruation**, about 40 ml of blood + 35 ml of serous fluid are lost. The menstrual blood is normally non-clotting due to the presence of fibrinolysin.

-Within 4 to 7 days after menstruation, the loss of blood ceases & the endometrium become re-epithelialized.

Leukorrhea during menstruation:

During menstruation, leukocytes are released with the necrotic material & blood so the uterus is highly resistant to infection during menstruation as protective mechanism.


Ovarian cycle
Gonadotropin secretion
FSH
LH
FSH
LH
Early corpus luteum
Corpus luteum regresses
Ovarian events
Developing follicle
Mature follicle
Follicular phase
Ovulation
Luteal phase
Days 1 7 14 21 28
Menstrual cycle
Ovarian hormone secretion
Progesterone
Estrogen
Estrogen
Progesterone
Thickness of endometrium
Days 1 3 5 7 9 11 13 15 17 19 21 23 25 27 1
Menstruation
Proliferative phase
Secretory phase
Menstruation


menstruation
1
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Menstrual
Cycle
ovulation

Functions of Estrogens

- Estrogens increase the size of ovaries, fallopian tubes, uterus, and external genitalia.
- Estrogens cause marked proliferation of the endometrial stroma and greatly increased development of the endometrial glands.
- Estrogens cause (1) development of the stromal tissues of the breasts, (2) growth of an extensive ductile system, and (3) deposition of fat in the breasts.
- Estrogens stimulate bone growth and slightly increase protein deposition.
- Estrogens increase body metabolism and fat deposition.
- Estrogens cause sodium and water retention by the kidney tubules.

Functions of progesterone

- Progesterone promotes the secretory changes in the uterine endometrium.
- Progesterone promotes increased secretion by the mucosal lining of the fallopian tubes.
- Progesterone promotes development of the lobules and alveoli of the breasts, causing the alveolar cells to proliferate, enlarge, and become secretory.
- Progesterone decreases the frequency and intensity of uterine contractions.

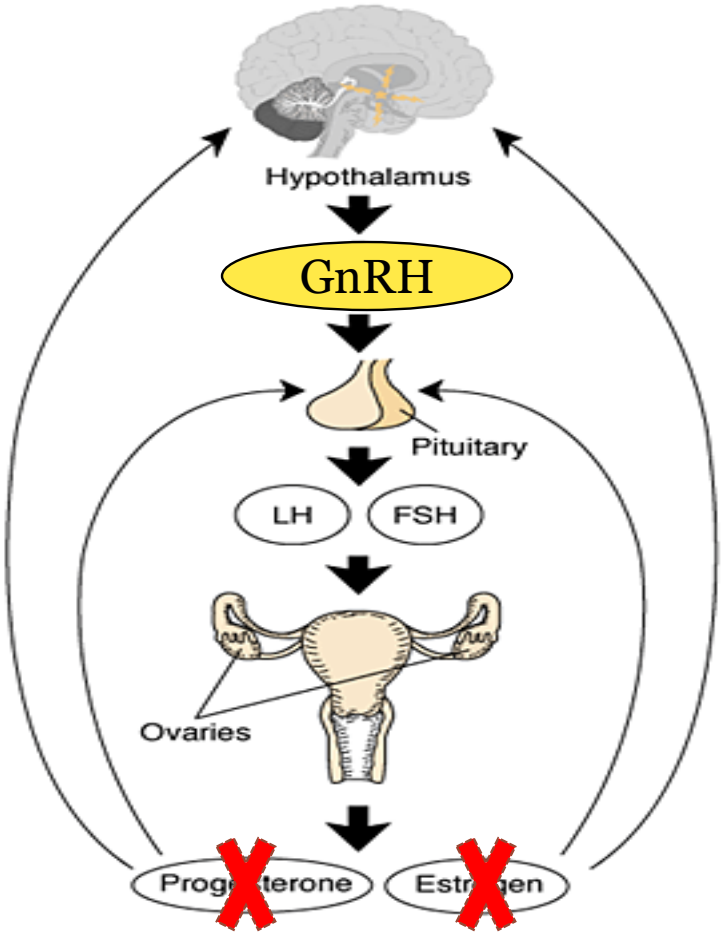
Menopause and the Disorders of Menstruation

Menopause

At the age of 45 to 51 years, the sexual cycle becomes irregular, ovulation fails to occur & the cycle ceases

The loss of estrogens causes marked physiological changes in the function of the body including:

"hot flushes" characterized by extreme flushing of the skin, psychic sensations and dyspnea, Irritability, fatigue, anxiety, occasionally various psychotic states, decreased strength and calcification of bones throughout the body.



Disorders of Menstruation

Amenorrhea: Is absence of menstrual period either

- Primary amenorrhea in which menstrual bleeding has never occurred.
- Secondary amenorrhea cessation of cycles in a woman with previously normal periods, caused by:
  - Pregnancy (is the most common cause)
  - Emotional stimuli and changes in the environment.
  - Hypothalamic or pituitary diseases (↓ GnRH,FSH, LH pulses)
  - Hypothyroidism (TRH stimulates prolactin which ↓ GnRH)
  - Primary ovarian disorders and various systemic disease.

Menorrhagia: Refer to abnormally heavy or prolonged bleeding.

Hypomenorrhea: Refer to scanty flow.

Oligomenorrhea: Refer to infrequent menstrual periods.

Dysmenorrhea: Painful menstruation (cramps due to accumulation of prostaglandins in the uterus).

The End

Thank You