

3&4 – Physiology of Ovarian & Uterine Cycle

Reproductive Block

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[Physiology Edit File](#)

- Important
- Further explanation

Physiology Of the Ovarian & Uterine Cycle

Ovarian Cycle

Follicular Phase

Ovulatory Phase

Luteal Phase

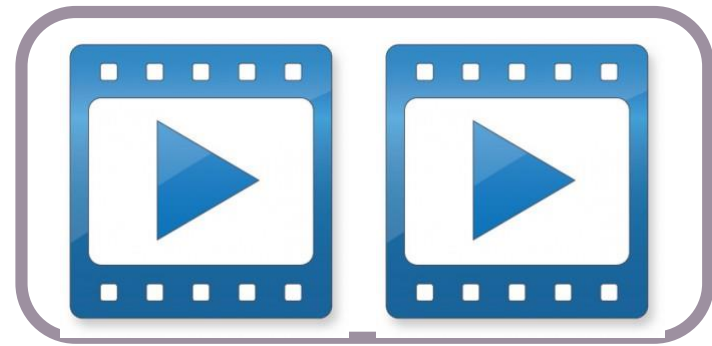
Involution of Corpus luteum and onset of new Ovarian Cycle

Uterine Cycle

Prolifertative Phase

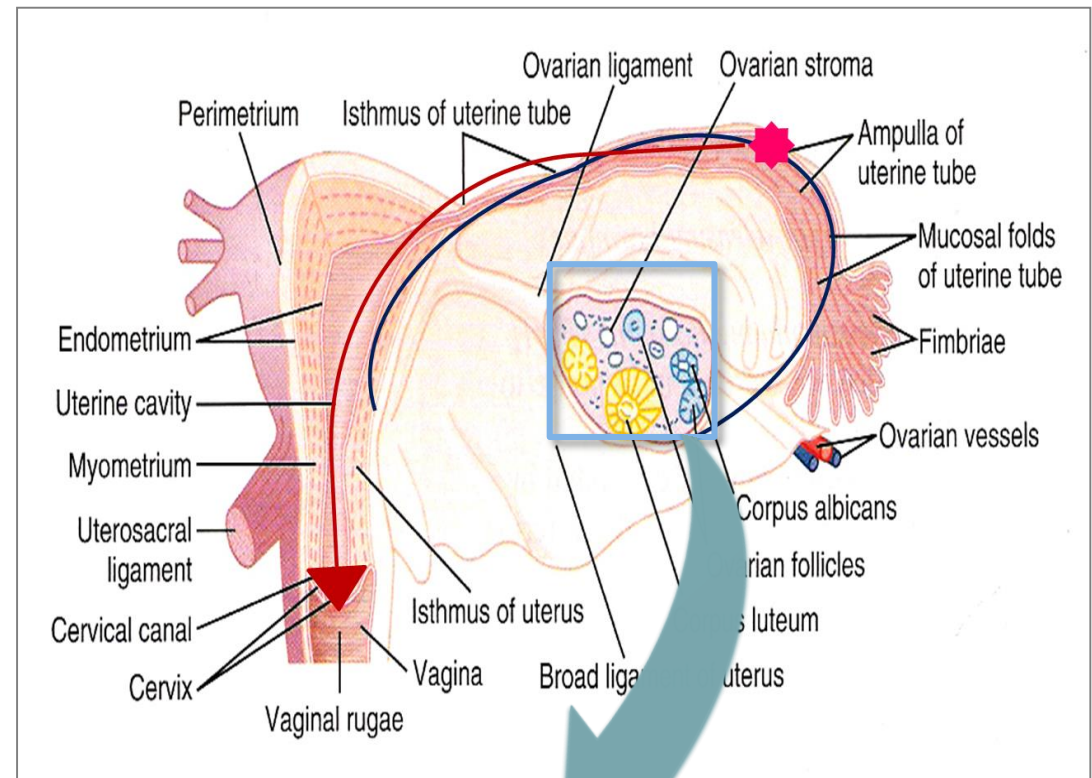
Secretory Phase

Menustration



What is The Ovarian Cycle ?

- **Monthly ovarian cycle (menstrual cycle):**
Monthly rhythmical changes in the rates of secretion of female hormones & corresponding physical changes in the ovaries & other sexual organs.
- **Duration of the cycle: average 28 days (20-45 days)**
- The cycle in which an oocyte matures (6-12 each month) ,erupts from the ovary (1-2oocyte each month) , and then travels down the oviduct to the uterus and its tightly coordinated with the uterine cycle (in which the lining of the uterus grows and prepares for an embryo implant)
- By the end of the cycle ,the oocyte has not been fertilized and an embryo has not implanted →the lining of the uterus sloughs off in process called **Menstruation**

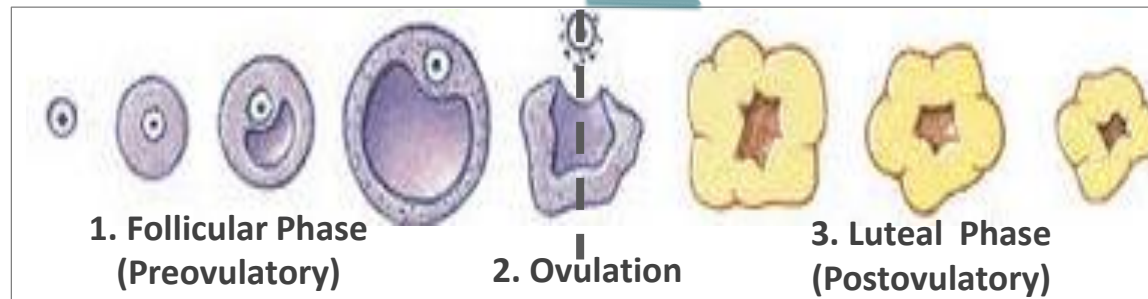


Results of the female sexual cycle

1- Single ovum is released from the ovaries each month (**Ovarian cycle**)

2- Uterine endometrium is prepared for implantation for the fertilized ovum

(**Uterine cycle**)



Ampulla of oviduct (Site of fertilization)  Implantation if the oocyte fertilized 
 No implantation → menstruation 

Gonadotropic Hormones and Their Effects on Ovaries:

(hypothalamic-pituitary-ovarian (gonadal) axis)

A number of hormones play roles in controlling the ovarian and uterine cycle : gonadotropin –releasing hormone (GnRH) ,luteinizing hormone(LH), follicle stimulating hormone (FSH),estrogen , progesterone

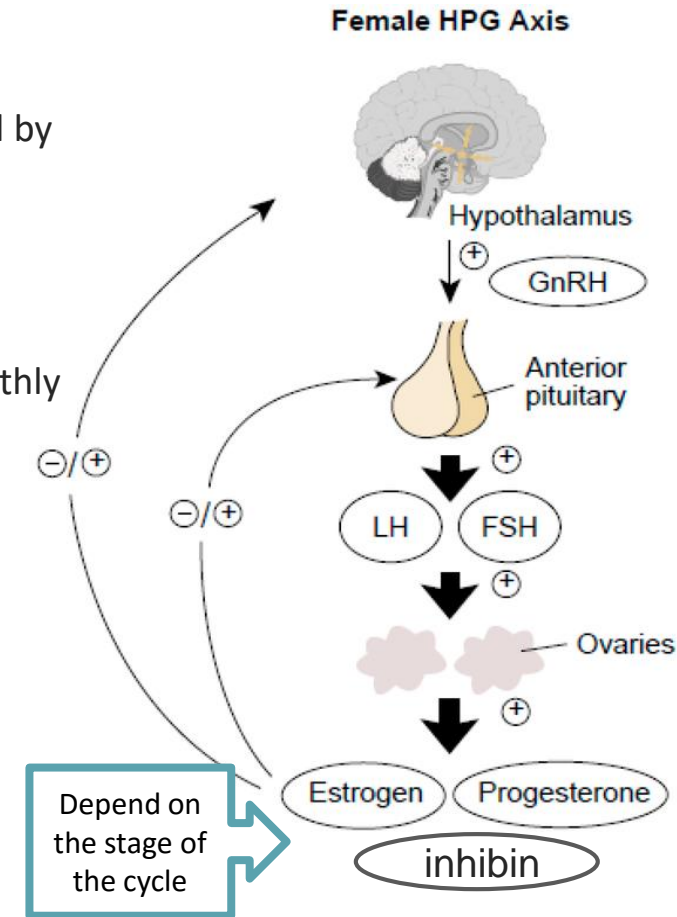
The ovarian changes during the reproductive cycle **depend on FSH & LH** secreted by AP.

In the absence of these hormones, the ovaries remain inactive throughout childhood,

At puberty the AP starts to secrete FSH & LH which lead to the beginning of monthly reproductive cycles. ,First menstrual cycle is called **Menarche**.

Both FSH and LH stimulate their ovarian target cells by combining with highly specific receptors to increase :

1. **Rates of secretion,**
2. **Growth & proliferation of the cells.**



Ovarian Follicle Growth: “Follicular” phase of the ovarian cycle (Folliculogenesis)

Start with growing of (6-12)follicle

Days

0

2

4

6

8

10

12

14

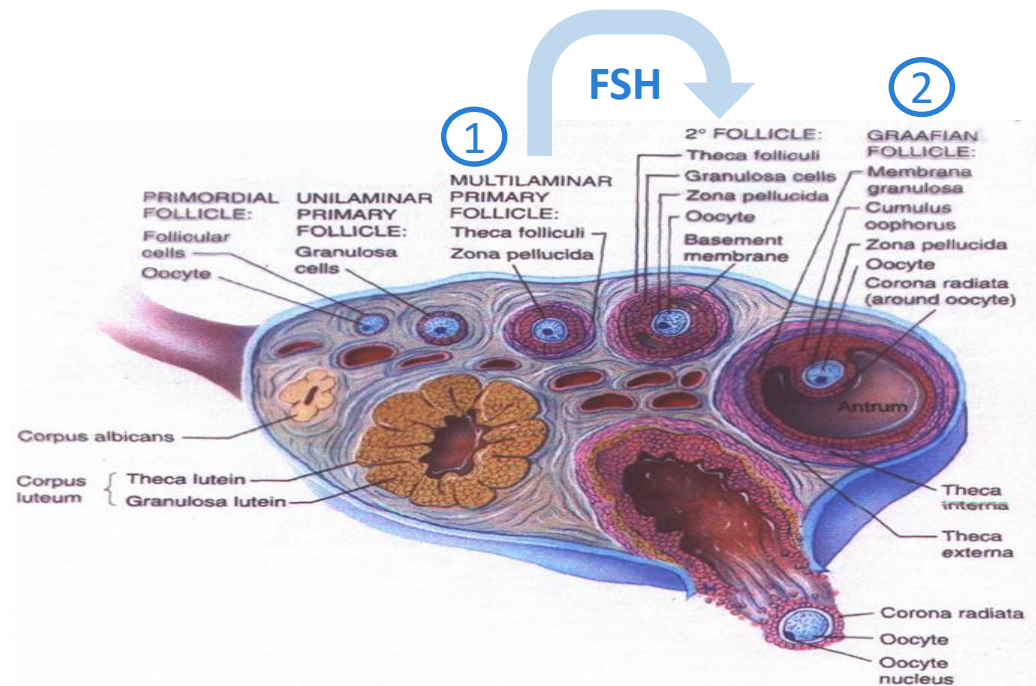
Only 1 ovum ovulated and(5-11) undergo atresia or involute

Stage		① Primordial follicle	② Primary follicle	③ Secondary follicle (Antral)	④ Tertiary follicle (Graafian follicle, vesicular or mature or dominant)	⑤ Ovulating follicle
note		• In female child	• After puberty			
Physiological stimulus and changes		No FSH and LH	AP secrete FSH and LH which cause stimulation of the ovaries lead to growth of some follicles.		FSH, LH,estrogene	
Histological changes and Characteristics		surrounded by single Granulosa cell sheath	1)increase in size of the ovum 2)growth of additional layers of granulosa cells of some follicles 3)Occur of zona pellucida (thick glycoprotein layer between oocyte and granulosa cells)	1)proliferation of the granulosa cells to many layers 2)ovary interstitium collects in several layers outside the granulosa cells to form a second mass of cells called theca (Greek for "box")	1) ovum enlarges 2)theca dividei nto 2 layers: theca interna & externa 3)granulosa cells secrete follicular fluids that contain estrogen that will accumulates to form antrum (caused by stimulation of FSH receptors)	
Hormonal changes	Gonadotropic hormones	During the first few days of the monthly female sexual cycle there is an increase secretion of FSH and LH ,FSH increase is slightly more & earlier than LH which causes the acceleration of growth of many primary follicles each month				
	ovarian hormone levels					

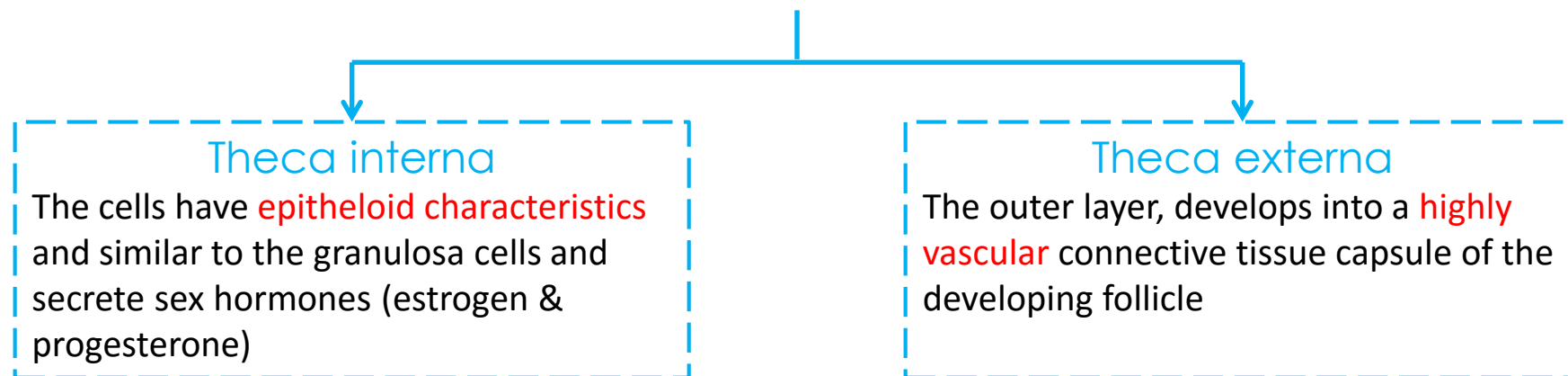
- ① The early growth of the primary follicle up to the antral (secondary) stage is under FSH stimulation only.
- ② Then there is accelerated growth of the follicle to larger follicle called Graafian follicle (vesicular or mature or dominant) caused by:
 1. Estrogen secreted into the follicle caused the granulosa cells to increase FSH receptors which causes positive feedback effect
 2. Both estrogen & FSH combine to promote LH receptors on the original granulosa cells in addition to FSH stimulation, allowing more rapid increase in follicular secretion
 3. The increasing estrogen from the follicle plus increasing LH from the AP causes proliferation of the follicular theca cells & increase their secretion

Did you know?

During all the reproductive years of adult life, between about 13 and 46 years of age, 400 to 500 of the primordial follicles develop enough to expel their ova (one each month). The remaining follicles that start develop but didn't reach the mature stage (5 to 11 each month) undergo atresia or involute



The Theca is divided into 2 layers in Graafian Follicle:



The main effect of each hormone during the Follicular phase

Rising
↑ Estrogen

- **-ve feedback centrally** on the AP → less FSH and LH secretion at the beginning
- while in the final stages it has a positive feedback by upregulating GnRH receptors, that will trigger the ovulation
- **+ve feedback locally** on the receptors

Declining
↓ FSH

- Withdraw growth support
- Atresia in lesser follicles

During childhood, the granulosa cells Provide:

- nourishment for the ovum
- Secrete oocyte maturation inhibiting factor which keeps the ovum in its primordial state.

Ovulation Phase

Day: 14.

“The Big Picture”

High levels of LH → Follicular swelling + stigma¹ formation → oozing of the fluid at first → followed by rupture of the stigma widely allowing more fluid to come out.

So, what does this fluid contain?

This fluid contains the ovum and a mass of granulosa cells known as *Corona Radiata*

➤ Now the detailed picture:

- 2 days before ovulation, the rate of LH secretion from anterior pituitary is increased *markedly* to **6-16 folds** and peaks **16 hrs** before ovulation.
- FSH also increases by 2-3 folds and acts synergistically with LH to cause *swelling* of the follicle before ovulation.
- LH has a *specific effect* on granulosa & theca cells converting them into *progesterone-secreting cells* (rather than estrogen-secreting cells) **so estrogen secretion falls about 1 day before ovulation while progesterone secretion goes up.**

¹Stigma: small area in the center of the follicle.

All of this requires **INITIATION OF OVULATION:**

High LH from anterior pituitary → secretion of lots of progesterone. This will ultimately have 2 effects:

- ✓ Theca externa secretes proteolytic enzymes → weakens follicle wall → degeneration of stigma.
- ✓ Follicular hyperemia & prostaglandin secretion → plasma transudation & follicular swelling.

Luteal Phase

After the expulsion of ovum, the remaining parts of the follicle (**granulosa remnants +theca interna**) change to *luteal cells* which become filled with lipid & are hence called **Corpus Luteum**.

Corpus Luteum: persists for 12 days except in pregnancy.

It's composed of:

- ✓ *Granulosa cells* secreting estrogen & progesterone
- ✓ *Theca interna* secreting mainly androgens that are converted to estrogen in granulosa cells.
- After 12 days it involutes (dies out) and forms corpus albicans & is replaced by connective tissue & absorbed.

➤ Luteinizing function of LH

- A local hormone in the follicular fluid called *lutinization-inhibiting factor* hold the luetinization process until after ovulation.
- After extrusion of ovum from follicle the following changes occur:
 1. *Conversion of granulosa and theca interna cells into lutein cells.*
 2. *Secretion of progesterone & estrogen from corpus luteum.*

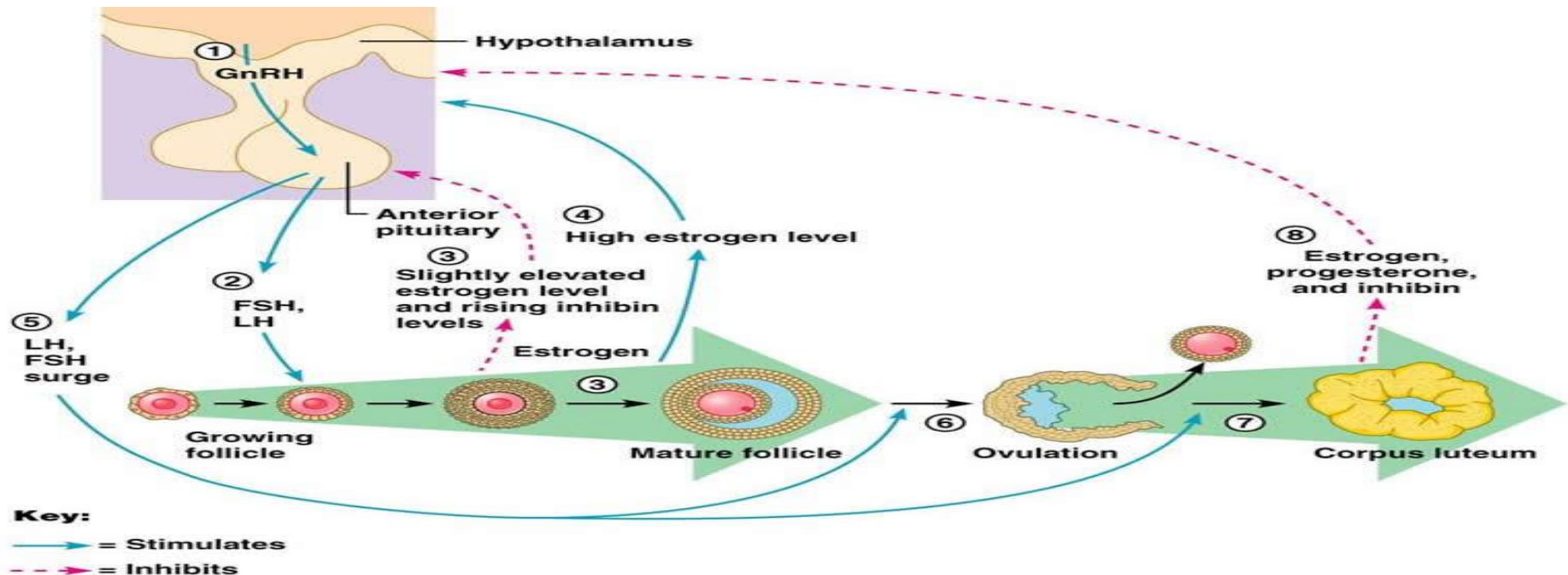
If pregnancy occurs (blastocyst implants in the uterine lining) , **hCG** (similer in structure to LH) from placenta prolongs the life of corpus luteum for 2-4 months so it will continue releasing estrogen and progestron that will continue in inhibiting AP releasing of FSH and LH →no ovulation

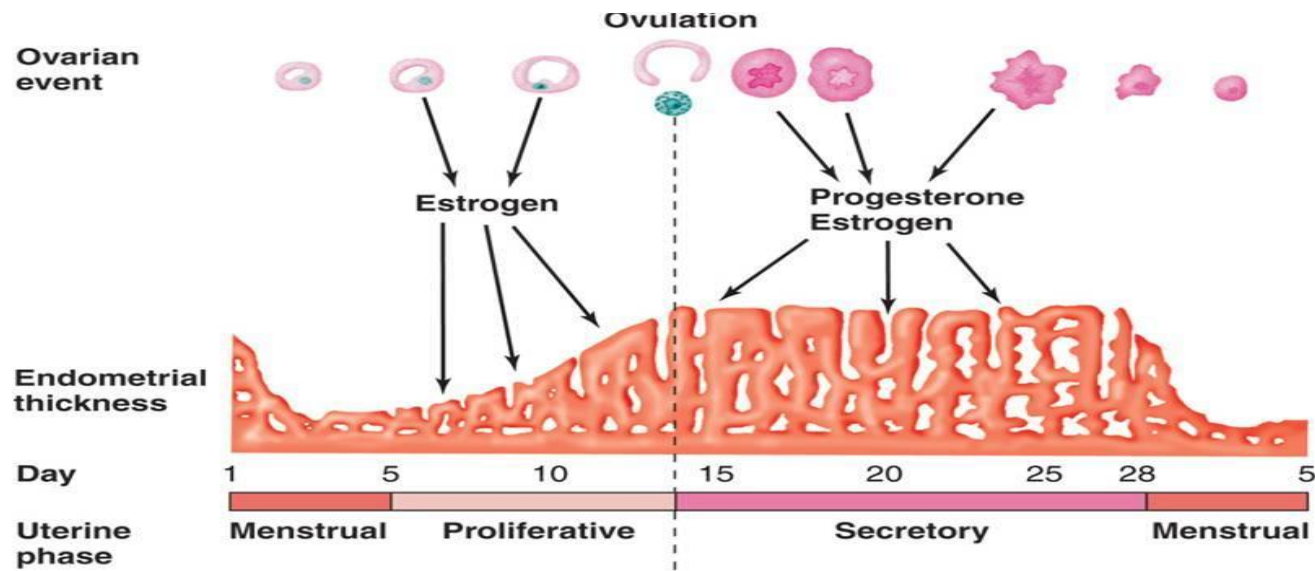
INVOLUTION OF CORPUS LUTEUM & ONSET OF NEXT OVARIAN CYCLE

Lutein cells of corpus luteum secrete:

- Progesterone & estrogen (causing negative feedback on anterior pituitary → low levels of **LH & FSH**).
- Inhibin hormone which inhibits **FSH**.

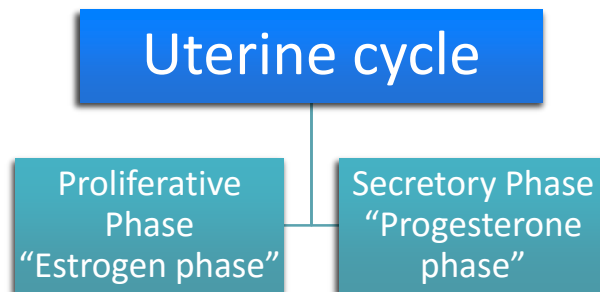
So, we can consider that the corpus luteum ends its own life due to the low levels of FSH & LH causing cessation of secretion of estrogen, progesterone, & inhibin. This will ultimately remove the feedback inhibition on the anterior pituitary & allowing increase secretion of FSH & LH again 😊





Uterine Cycle

It is associated with the monthly cyclical production of estrogens & progesterone by the ovaries in the lining of the uterus **“It is correlated with the ovarian cycle”**



1- Proliferative Phase “Estrogen Phase”

This phase is also called = Preovulation phase because it occurs prior to ovulation.

Steps of Proliferative Phase

At the beginning of each cycle, most of the endometrium has been desquamated by menstruation, and only a thin layer of **endometrial stroma** and **few glands** are present.



Under the influence of the **estrogen** coming from the ovaries the endometrial stroma and glands and blood vessels start to proliferate rapidly.



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



The endometrial surface re-epithelialized within 4-7 days after the beginning of menstruation

2- Secretory Phase “Progesterone Phase”

Estrogen & progesterone are secreted in the later part of the monthly cycle **by the corpus luteum.**



Progesterone causes marked swelling & secretory development of the endometrium.



The glands increase in tortuosity, excess secretory substances accumulate in the glands.



The secretory changes prepare the endometrium (stored nutrients) for implantation of the fertilized ovum .



Blood supply to the endometrium increases and become more tortuous.



Stromal cells cytoplasm increases because lipid & glycogen deposits in the stromal cells

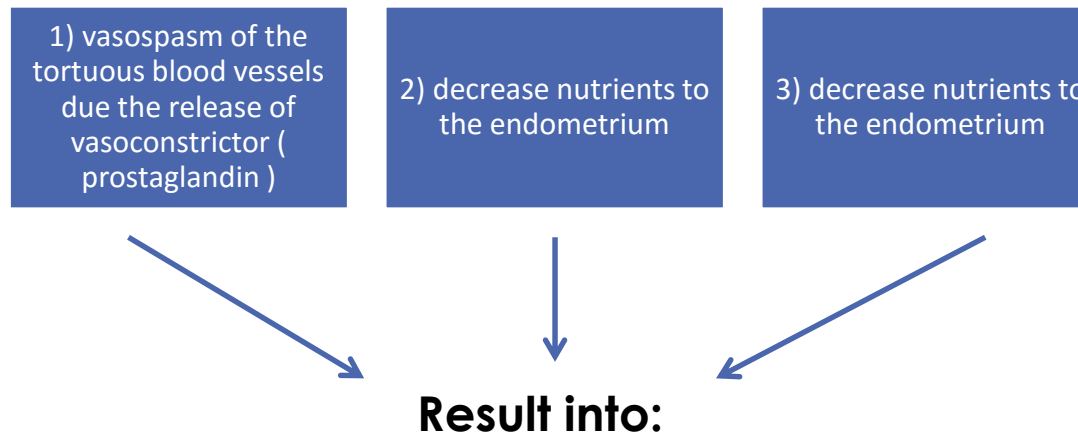


Uterine secretions called **“uterine milk”** provide nutrition for the diving ovum.

Menstruation

if the ovum is not fertilized, two days before the monthly cycle ,the corpus luteum involutes and progesterone & estrogen level decreases ,decreasing endometrial stimulation and followed by endometrial involution to 65% of its previous thickness.

During the 24 hours preceding the menstruation there is:



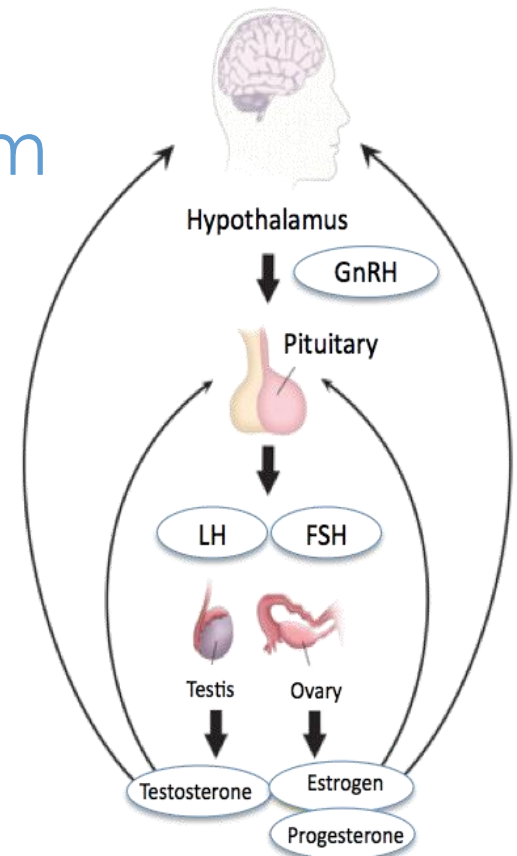
- Gradual necrosis of the outer layer of the endometrium leads to separation from the uterus at the site of the hemorrhages
- Within 48 hrs, all the superficial layers of the endometrium desquamated in the uterine cavity.
- The mass of desquamated tissue & blood plus the contractile effects of prostaglandins initiate contractions which expel the uterine contents.
- Normally, 40ml of blood + 35ml of serous fluid are lost.
- The menstrual blood is usually non-clotting due to the presence of fibrinolysin.
- Within 4 to 7 days after menstruation the loss of blood ceases and the endometrium become re-epithelialized.

Leukorrhea During Menstruation

Leukocytes are released with the necrotic material and blood so that the uterus is highly resistant to infection. “Discharge from the vagina of a white or yellowish viscid fluid containing mucus and pus cells.”

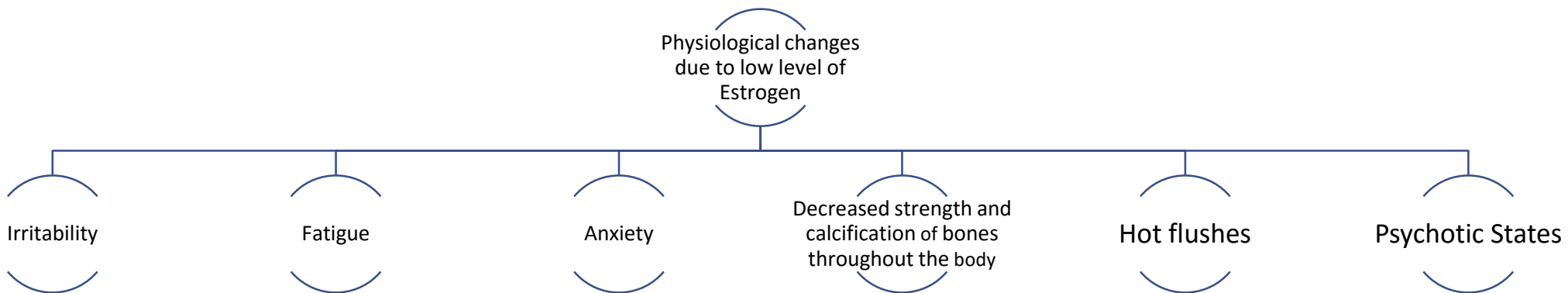
Feedback Oscillation of The Hypothalamic-Pituitary-Ovarian System

- During the postovulatory phase (between ovulation and the beginning of the menstruation) the corpus luteum secrete large amounts of progesterone , estrogen and inhibin which all together cause negative feedback effect on anterior pituitary and hypothalamus to inhibit both FSH & LH.
- Lowest levels of FSH and LH occurs 3-4 days before the menstruation onset.



Menopause

- The period during which the cycles cease and the female sex hormones diminish to almost none.
- It is due to the low level of estrogen in the blood due to decline in the number of primordial follicles in the ovaries, so the ovaries are unresponsive to FSH and LH.
- The reproductive cycles become irregular , ovulation fails to occur and the cycle ceases.
- The uterus and vagina atrophy
- It occur between the age of 40-50 years.



Abnormalities of The Menstrual Cycles

- **Amenorrhea:** is the absence of menstrual period
- **Primary amenorrhea:** menstrual period has never occurred
- **Secondary amenorrhea:** cessation of cycles in a women with previously normal period, due:

Pregnancy

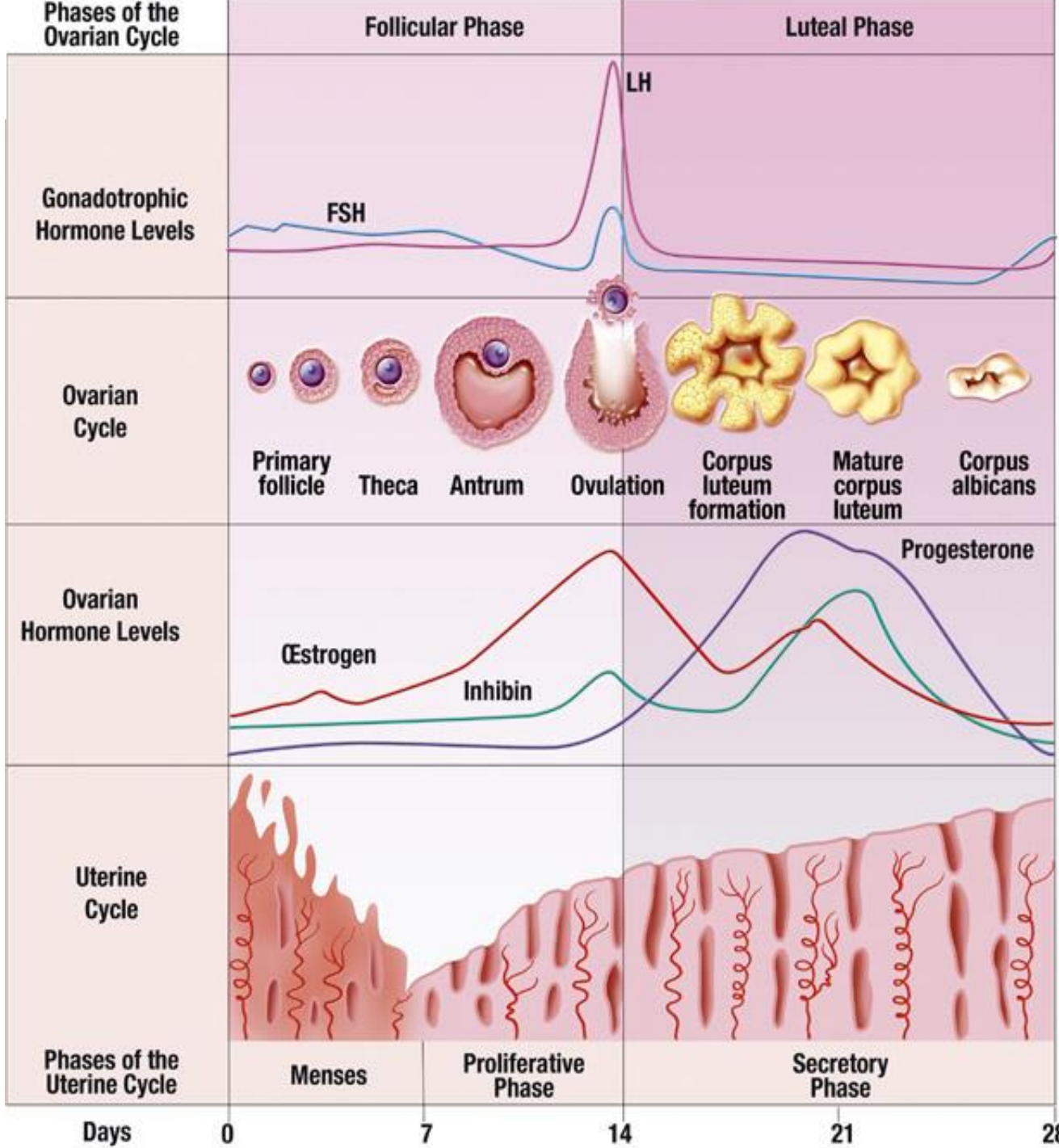
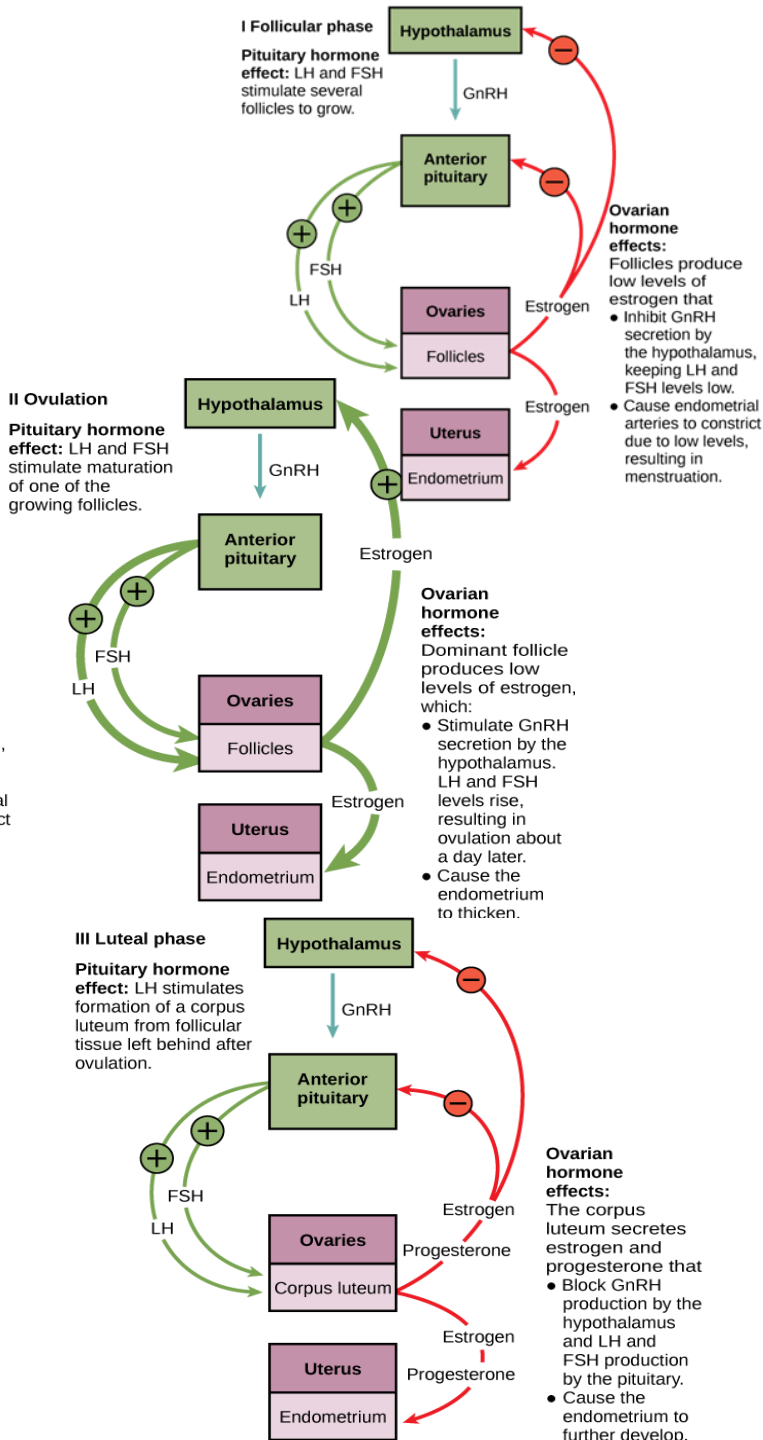
Emotional stimuli
and changes in the
environment

Hypothalamic
disease (GnRH
pulses)

Pituitary disorders

Primary ovarian
disorders and
various systemic
disease

- **Menorrhagia:** refer to abnormally profuse flow during regular periods
- **Hypomenorrhea:** refer to scanty flow
- **Dysmenorrhea:** painful menstruation: Cramps due the accumulation of **prostaglandins** in the uterus can be treated with inhibitors of prostaglandin synthesis.



1- in which stage of the follicular phase theca cells start to appear :

- a. Primordial follicle
- b. secondary follicle
- c. Graffian follicle

2- Which of the following is NOT secreted by corpus luteum?

- a. FSH
- b. Estrogen
- c. Inhibin

3- Which of the following cell layers doesn't take part in formation of corpus luteum?

- a. Theca interna
- b. Granulosa cells
- c. Theca externa

4- ovulation occurs approximately at which day over the 28days of ovarian cycle ?

- a. 6
- b. 10
- c. 20
- d. 14

5- Complication of lack of estrogen?

- a. headache
- b. bone fracture
- c. tachycardia
- d. loss of vision

6-What is the definition of amenorrhea:

- a. scanty flow of blood
- b. painful menstruation
- c. abnormally profuse flow
- d. absence of menstrual period

7- What is the predominate hormone in the secretory phase?

- a. Progesterone
- b. Estrogen
- c. Inhibin
- d. FSH

8- Dysmenorrhea occurs due to accumulation of ?

- a. Leukotrienes
- b. Prostaglandins
- c. Nitric oxide
- d. Progesterone

Answers:

- 1-b
- 2-a
- 3-c
- 4-d
- 5- b
- 6- d
- 7- a
- 8- b

Q1: what is the main trigger for growing of the primary follicle until reach the secondary follicle stage?

FSH (follicle stimulating hormone)

Q2: write the correct time duration over the cycle 28 cycle in normal female ?

1) **menstruation: 0 -7th day**

2) **Follicular phase: day 0-14th**

3) **Ovulation: day 14th**

4) **Luteal phase: 12 days day 15th -27th**

Q3: Mention 4 histological features could be seen in follicles of different stages ?

Theca cells (externa and interna), antrum, granulosa cell sheath, zona pellucida layer

Q4: Mention the hormones secreted by the corpus luteum?

progesterone, inhibin, and estrogen.

Q5: Describe the fate of corpus luteum?

Pregnancy occur: maintained and continue to release estrogen and progesterone for 2-4 months until the placenta take place then it will involutes

No pregnancy :After 12 days of growth and secretion it undergoes involution due to low levels of FSH and LH.

Q6: What is corpus luteum composed of?

Granulosa cells secreting estrogen and progesterone and theca interna cells secreting androgens that are further converted into estrogens in granulosa cells.

Q7: What are the symptoms of menopause?

Ans: Irritability, Osteoporosis, Fatigue, Hot flushes, anxiety

Q8: Write the three changes occur to the endometrium before menstruation

Ans:

1. vasospasm of the tortuous blood vessels.
2. decrease nutrients to the endometrium.
3. decrease nutrients to the endometrium

Q9: Secondary amenorrhea occurs due to:

Ans: Pregnancy, Hypothalamic disease (GnRH pulses), Pituitary disorders, Primary ovarian disorders and various systemic disease

Q10: The definition of Menorrhagia?

Ans: refer to abnormally profuse flow during regular periods

Q11: What is the ovarian hormone that is elevated before ovulation?

Ans: Estrogen

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Thank you for checking our work

Best Wishes..