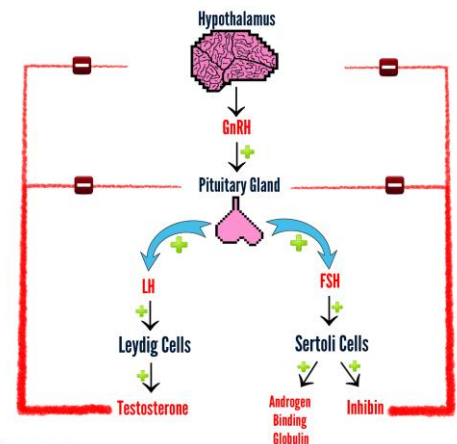
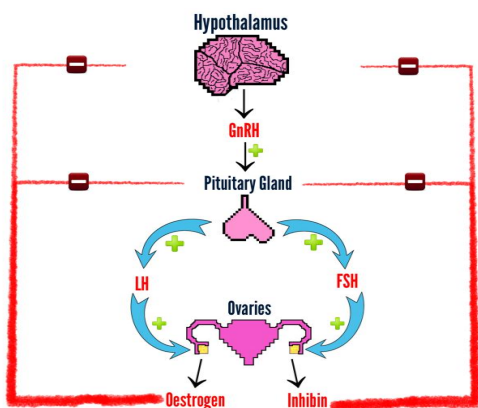


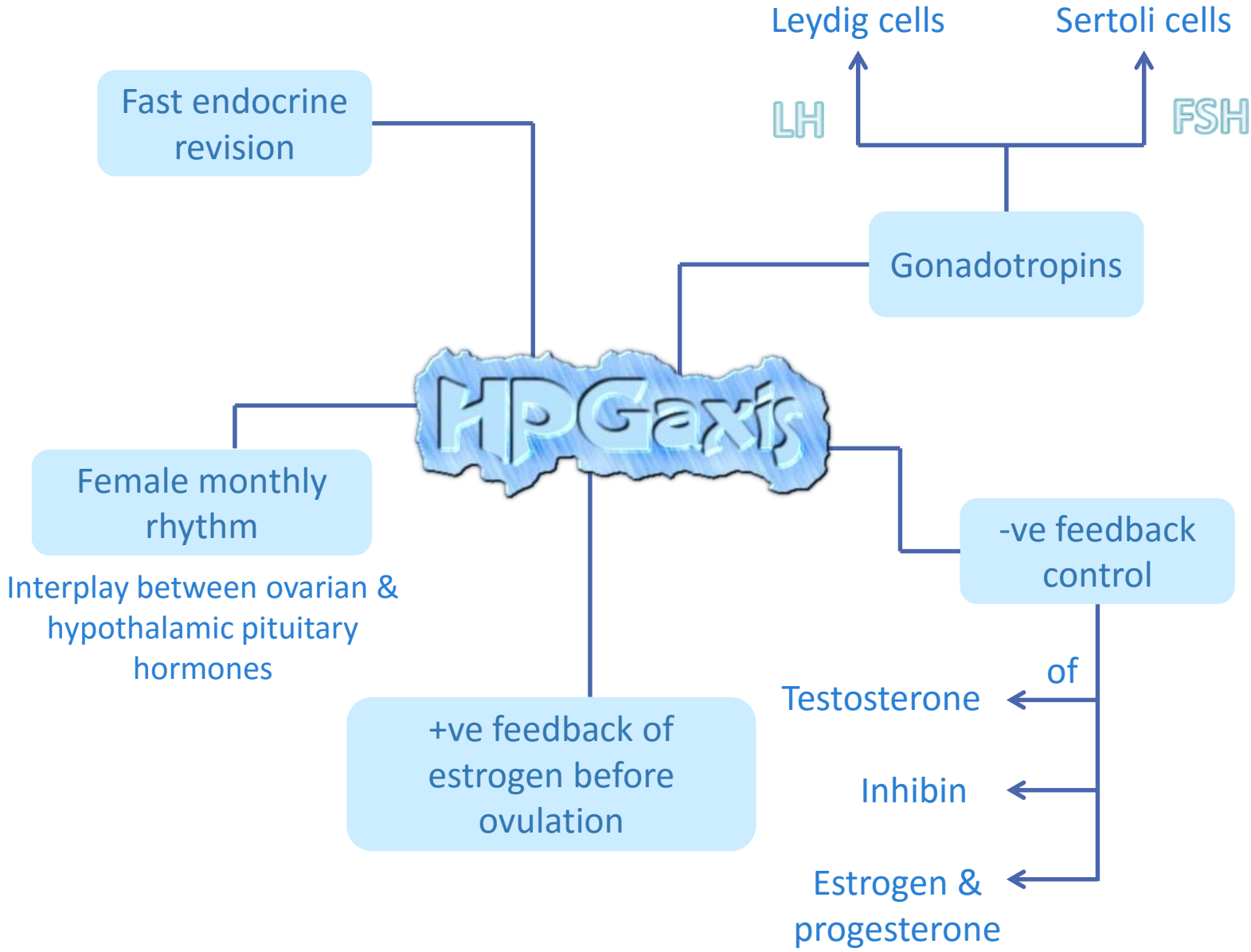
1- Hypothalamic Pituitary Gonadal Axis

Reproductive Block

Please check out this link before viewing the file to know if there are any additions/changes or corrections
[Physiology Edit File](#)



- Important
- Further explanation



Testosterone production pathway
1:40 mins

Recall from the endocrine block :')

✓ What is a hormone?

A hormone is a chemical messenger released by ductless (endocrine) glands which travels through bloodstream to target cells and binds to its receptor producing specific actions.

✓ How does the hypothalamus control the anterior pituitary gland?

Through the hypothalamic-hypophysial portal vessels

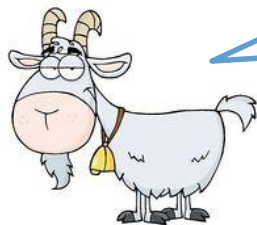
✓ How does the hypothalamus control the posterior pituitary gland?

By the hypothalamohypophysial tract between the hypothalamic nuclei (supraoptic & paraventricular nuclei) and posterior pituitary gland (neural connection)

✓ What are the hormones released by the anterior and posterior pituitary glands?

Anterior: GH, TSH, FSH, LH, ACTH, Prolactin

Posterior: Oxytocin, ADH



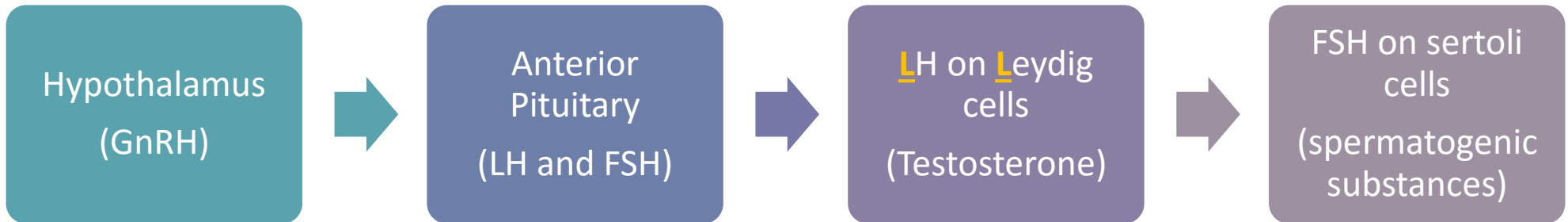
And don't forget the pituitary hormones mnemonic:

GOAT FLAP

∨
Posterior pituitary

Control of male sexual functions by hypothalamic & anterior pituitary hormones

In brief..



- ✓ Gonadotropin releasing hormone (GnRH):
 - A peptide secreted by the **arcuate nuclei** of the hypothalamus
 - Stimulates anterior pituitary gland to release gonadotropins (LH and FSH).
 - GnRH is secreted intermittently for few minutes every 1 to 3 hrs.
 - Secretion of LH by the anterior pituitary is also cyclical following the pulsatile release of GnRH.
- ✓ Testosterone is secreted by **leydig cells**, in the interstitium of the testis, by **LH stimulation** (which is released from the anterior pituitary).
- ✓ Its release is **directly proportional*** to the amount of LH.
- ✓ Mature leydig cells are found in a child's testis few weeks after birth & then disappear until puberty when it appear again.

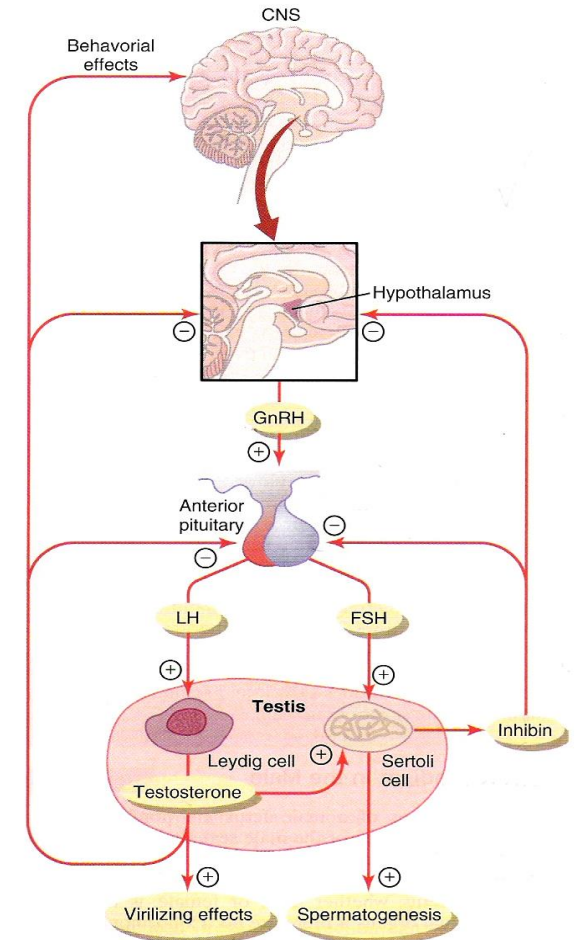
Negative Feedback Control of Testosterone

LH stimulates Testosterone secretion by the testis

Testosterone inhibits the secretion of LH

Most of the inhibitory effect results from **direct inhibition of GnRH release** from the hypothalamus

Inhibition of GnRH leads to decrease secretion of both LH & FSH.



Regulation of spermatogenesis **mainly** by FSH and testosterone

- ① FSH binds with specific FSH receptors attached to the **sertoli cells** in the seminiferous tubules → which causes these cells to grow & secrete spermatogenic substances (such as ABP*)
 - ② Also testosterone & dihydrotestosterone diffuse into the seminiferous tubules from the leydig cells and bind to ABP which enhances spermatogenesis
- Thus, both **FSH & testosterone** are necessary to initiate spermatogenesis.

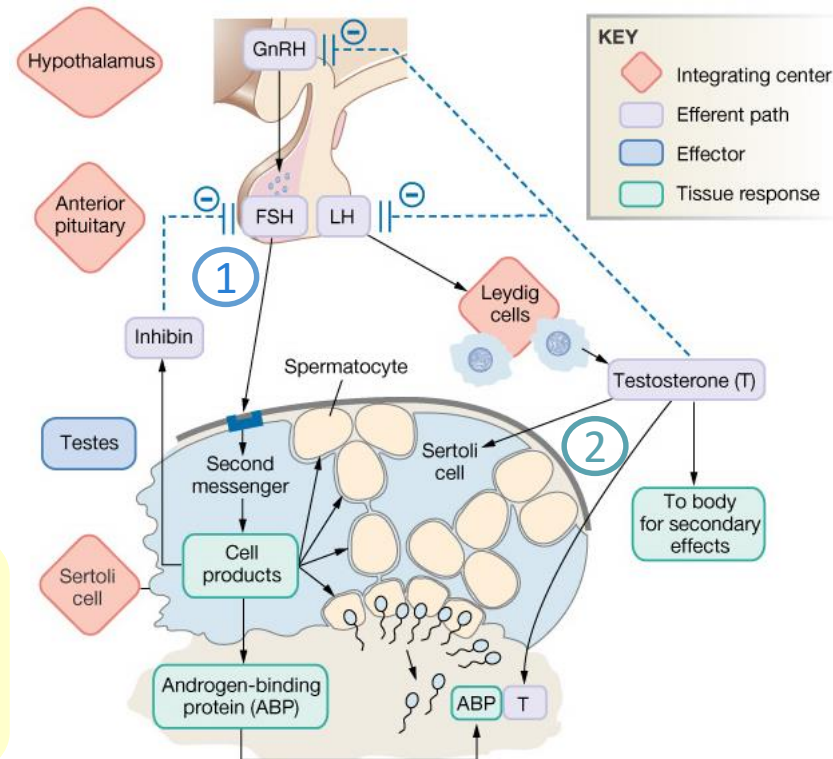
Negative feedback control of seminiferous tubule

↑ **FSH** When the seminiferous tubules fail to produce sperm

↓ **FSH** When spermatogenesis proceeds rapidly

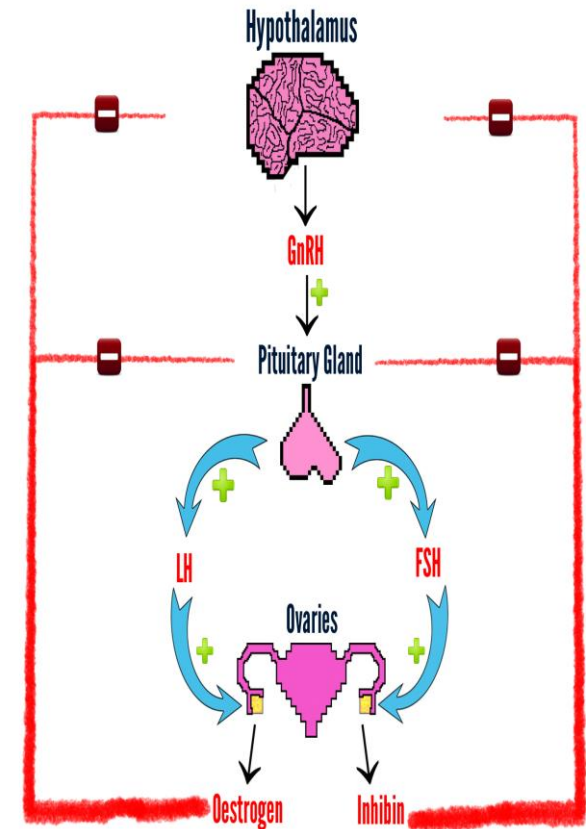
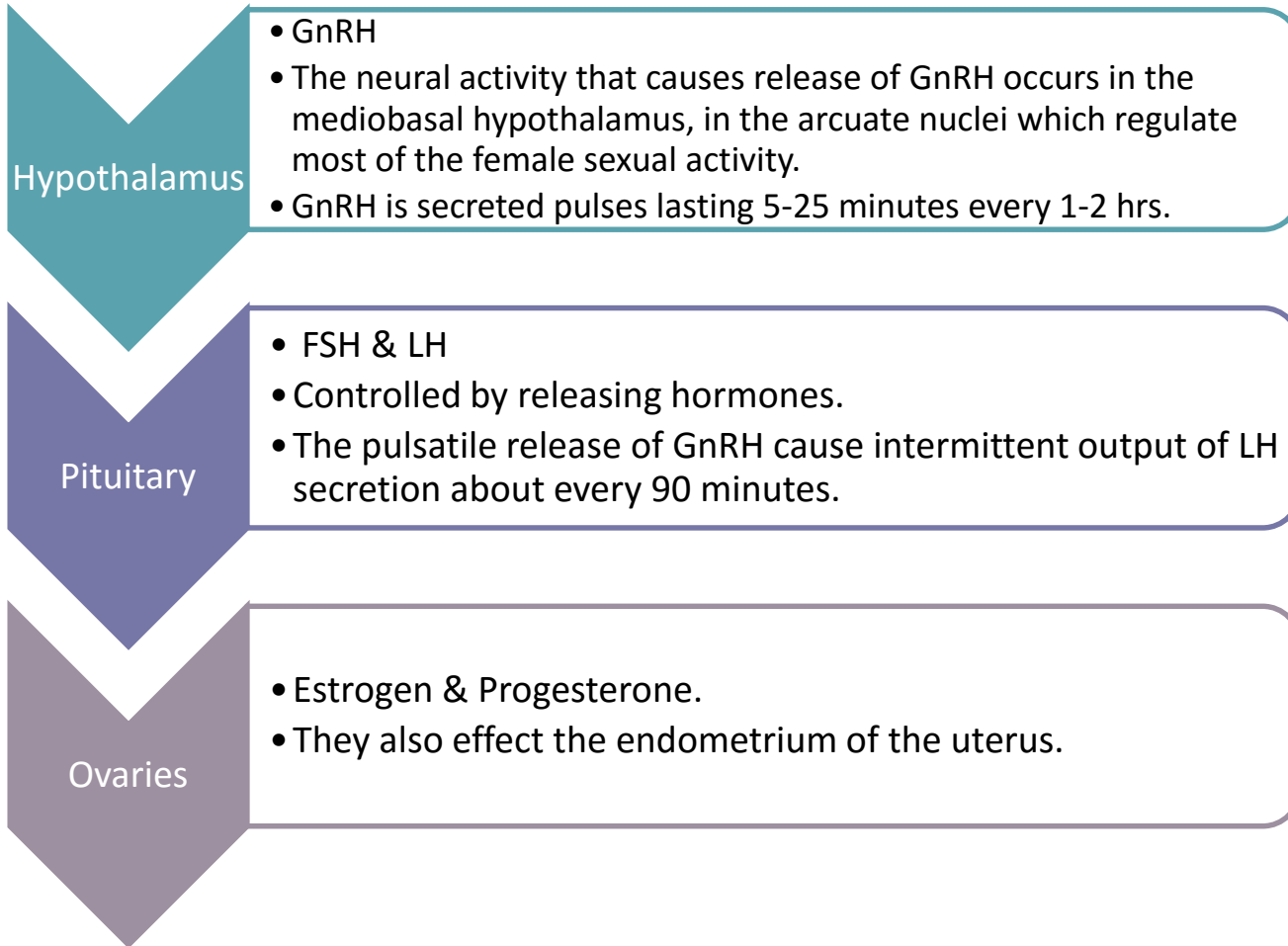
- ✓ This is due to the secretion of **inhibin** hormone from the sertoli cells which strongly inhibit the AP*- FSH
- ✓ Inhibin has slight inhibitory effect on the hypothalamus to inhibit GnRH secretion.

*ABP = Androgen binding protein *AP = Anterior pituitary



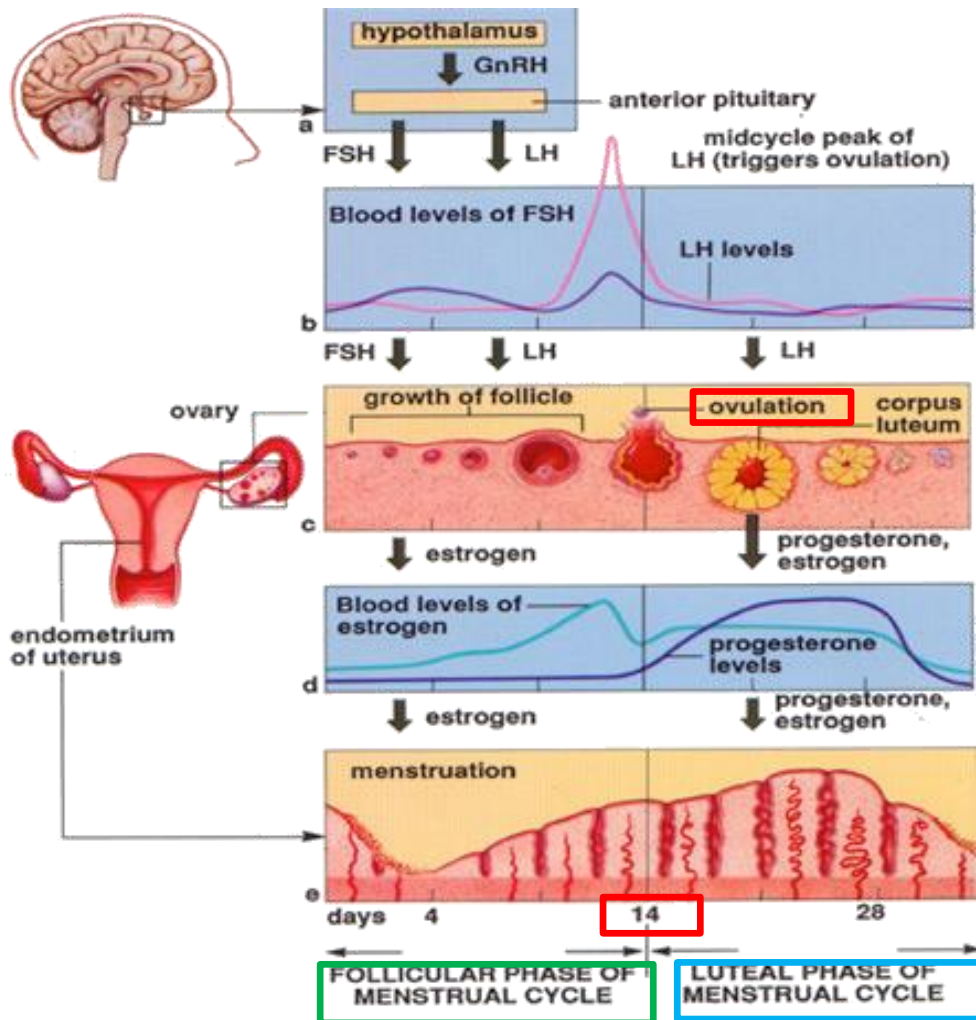
Regulation of The Female Monthly Rhythm

Interplay between the ovarian and hypothalamic-pituitary hormones



+ Positive Feedback
- Negative Feedback

Female “Menstrual” Cycle



- a. Hypothalamic-pituitary gonadal axis
- b. Blood level of LH & FSH
- c. **Ovarian Cycle:** Follicular growth, rupture (ovulation) & the corpus luteum
- d. Levels of Estrogen “**estradiol**” & Progesterone
- e. **Uterine Cycle:** events happening in the endometrium wall

Follicular Phase

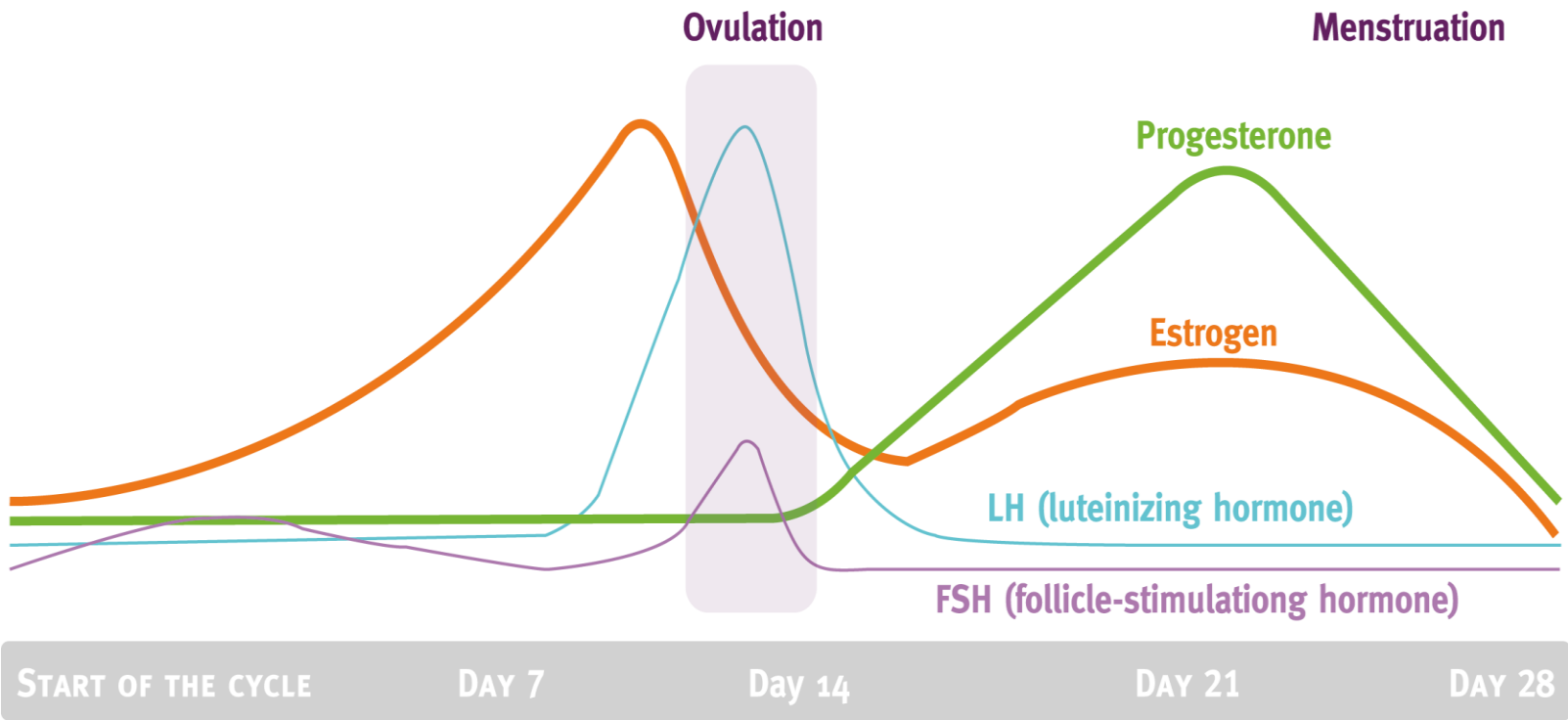
- After menstruation the level of FSH & LH increases
- Mainly FSH accelerates growth of few follicles (6-12 follicles).
- The growing follicle secretes increasing amounts of **Estrogen**

Ovulation

- 14 days after the menstruation.
- 2 days before ovulation LH secretion will increase markedly and FSH also increases, they work synergistically to cause rapid swelling of the follicle during the last few days before ovulation.

Luteal Phase

- During the first hours after the rupture the remaining granulosa and theca cells will change rapidly to Lutein cells and the structure itself is called **Corpus luteum**
- It is highly secretory organ secreting large amount of estrogen and progesterone.



Female Reproductive System - Menstrual Cycle, Hormones and Regulation
15 mins

Pre-Ovulatory LH Surge

AP secretes **increased amount of LH** and **FSH in much smaller amount** for 1-2 days before ovulation

The possible causes of LH secretion could be:

- **Estrogen** secreted in large amount has special positive feedback effect of stimulating pituitary secretion of LH & to a lesser extent on FSH
- The **granulosa cells** of the follicle begin to secrete small increasing amount of progesterone about 1 day before ovulation which stimulate LH secretion.

Post-Ovulation

Feedback oscillation of the hypothalamic-pituitary-ovarian system:

During the postovulatory phase the **corpus luteum** secrete large quantities of both **progesterone ,estrogen & inhibin.**

All together cause **negative feedback** effect on anterior pituitary and hypothalamus to inhibit both FSH & LH secretion and lowest level of these hormones is 3-4 days before the onset of menstruation

Follicular Growth Phase

2 -3 days before menstruation, corpus luteum regress & secretion of estrogen, progesterone & inhibin decrease.

No more negative feedback effect on AP hormones.

Therefore a day after menstruation FSH secretion begins to increase (2 folds) while LH secretion is low.

These hormones causes growth of a new follicle -begin of new cycle –

During the first 11 to 12 days of the follicular growth the rate of secretion of FSH & LH decrease due to the negative

*For more understanding, go to the figure in next slide.

Hormonal Feedback

Negative feedback effects of estrogen and progesterone

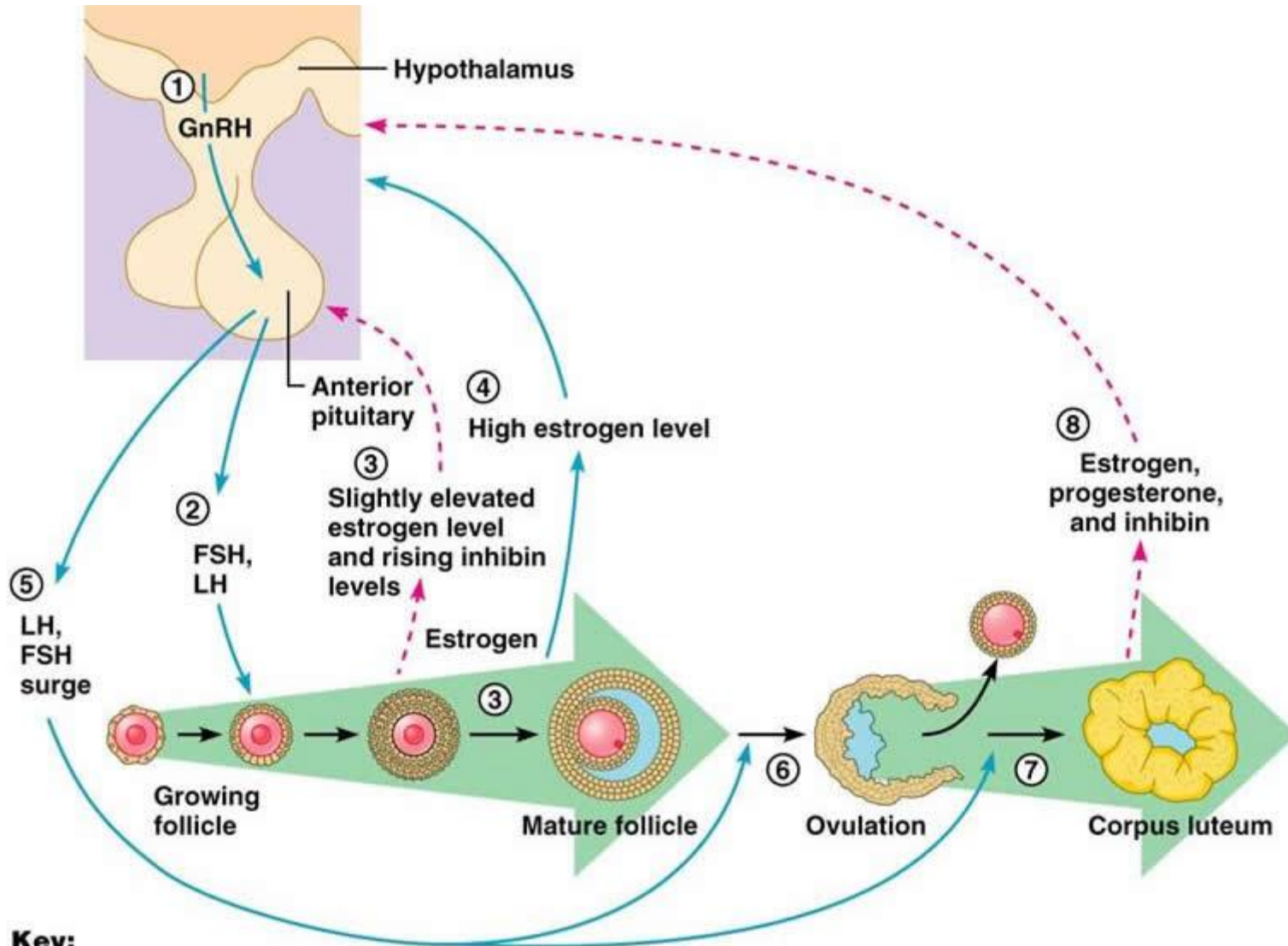
Estrogen **in small amounts** has strong effect to inhibit the production of LH & FSH and this inhibitory effect of estrogen is increased when progesterone is available.

This inhibitory effects **more on the anterior pituitary directly** & to lesser extent on the hypothalamus to inhibit the secretion of GnRH.

Hormone inhibin

from the corpus luteum secreted by the granulosa cells inhibit the secretion of **FSH** & to lesser extent LH .

Summary



Key:
—→ = Stimulates
- - -→ = Inhibits

MCQs

1-Most of the testosterone inhibitory effect results from?

- A. Direct inhibition of Leydig cells
- B. Direct inhibition of GnRH release
- C. Direct inhibition of anterior pituitary
- D. Indirect inhibition of GnRH release

2-Where does the GnRH get released?

- A. Supraoptic nuclei
- B. Paraventricular nuclei
- C. Mammillary body
- D. Arcuate nuclei

3-Which hormones are necessary to initiate spermatogenesis?

- A. FSH
- B. LH
- C. Testosterone
- D. A&C

4-GnRH is secreted in pulses (intermittently) every other?

- A. 1-3h
- B. 1-2 days
- C. 5-25min
- D. 5h

5-When does the corpus luteum regress?

- A. after ovulation
- B. 2-3days before menstruation.
- C. 2-3days after menstruation.
- D. before ovulation.

6-During the first 11 to 12 days of the follicular growth the rate FSH&LH:

- A. Only LH will decrease
- B. Only FSH will decrease
- C. FSH & LH decrease

Answers: 1-B 2-D 3-D 4-A 5-B 6-C

Q1: In which stages of a male's life mature leydig cells are found?

Ans: few weeks after birth & they appear again in puberty.

Q2: What's the relation between spermatogenesis & FSH release?

Ans: when spermatogenesis increases rapidly → pituitary secretion of FSH diminishes, but when the seminiferous tubules fail to produce sperm → secretion of FSH from the AP increases

Q3: What are the possible causes of LH surge in the pre-ovulatory phase?

- 1) Estrogen secreted in large amount has special positive feedback effect
- 2) the secretion of small increasing amount of progesterone about 1 day before ovulation which stimulate LH secretion

Q4: Mention the dominant hormone in each phase of the cycle.

Ans: the first half of the cycle estrogen is the dominant and in the other half it is progesterone

Q5: Compare between leydig cells' -ve feedback and seminiferous tubule's -ve feedback on gonadal hormones secretion:

	Leydig cells	Seminiferous tubules (sertoli cells)
Hormone responsible	Testosterone	Inhibin
Effects	direct inhibition of GnRH release from the hypothalamus	<ul style="list-style-type: none"> • strongly inhibits the AP- FSH • Inhibin has slight inhibitory effect on the hypothalamus

Done By

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You deserve a rest..

Thank you for checking our work

Best Wishes..