SO1: The Menstrual cycle (AMBOSS)

Menarche: start of menstruation

Menopause: cessation thereof

Menses: Bleeding (menstrual) → controlled by HPA.

Small Δ in Hormonal Balance = Menstrual irregularities

Δ's ∅ necessarily pathological

Abnormal menses = Δ's in { frequency, intensity, onset } → { AUB, Amenorrhea, Dysmenorrhea }

PMS → NB (premenstrual syndrome)

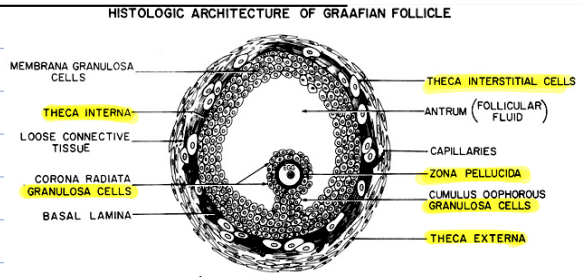
Physiology of menstrual cycle

(+) & (−) feedback loops

follicular phase

Hypothalamus = release GnRH in pulses

GnRH → Ant pit. → LH & FSH



LH & FSH → Ovaries → Graafian follicle { Theca cells → progesterone & Androstenedione; Granulosa cells → Estradiol & inhibin B }

Day before LH ↑ = one follicle becomes dominant!

Remaining follicles regress as (FSH ↓) & Estradiol peak → (+)-feedback → LH surge

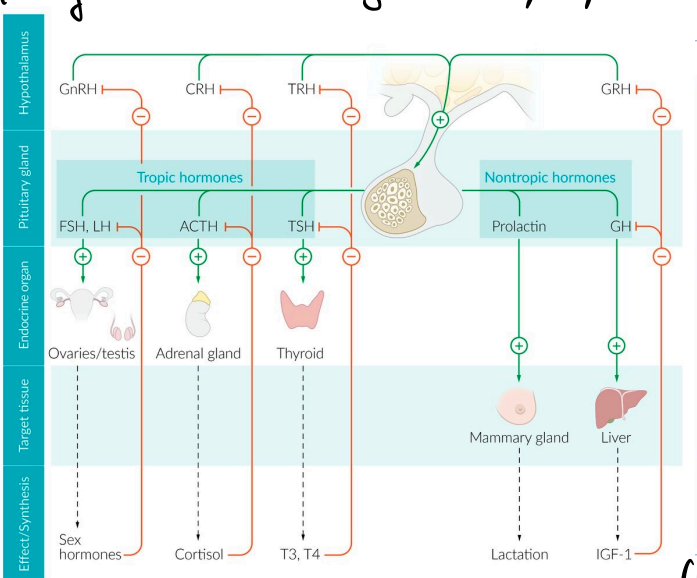
(−) -feedback → ↓ FSH Release

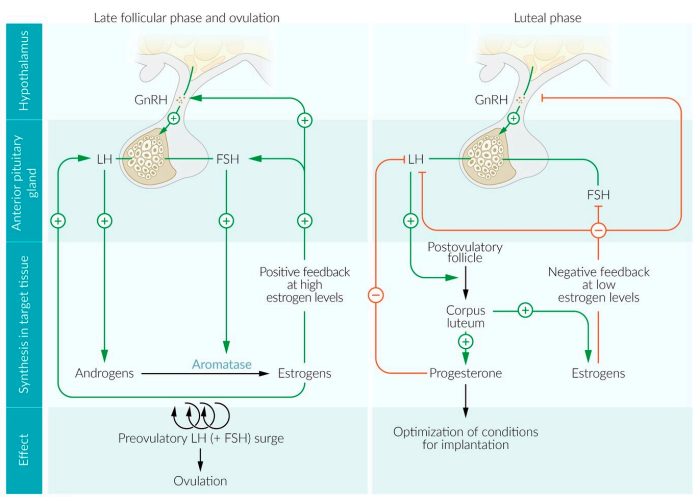
Ovulation = LH surge induces ovulation → Mature oocyte released from dominant follicle

↳ Corpus luteum prod. progesterone = LH inhibitor. [progesterone ⊣ LH]

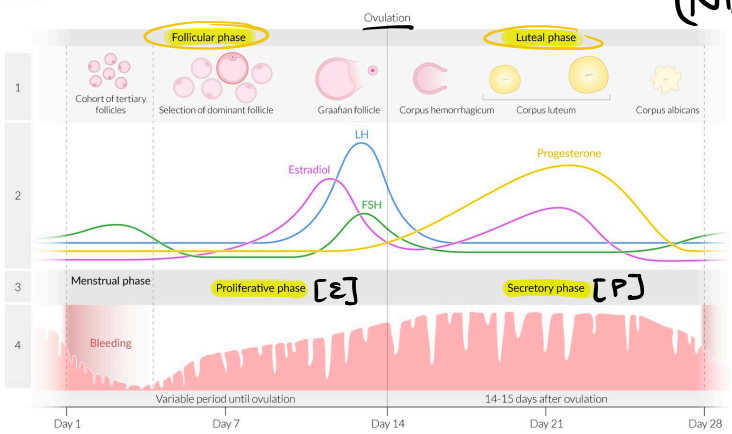
Luteal phase:

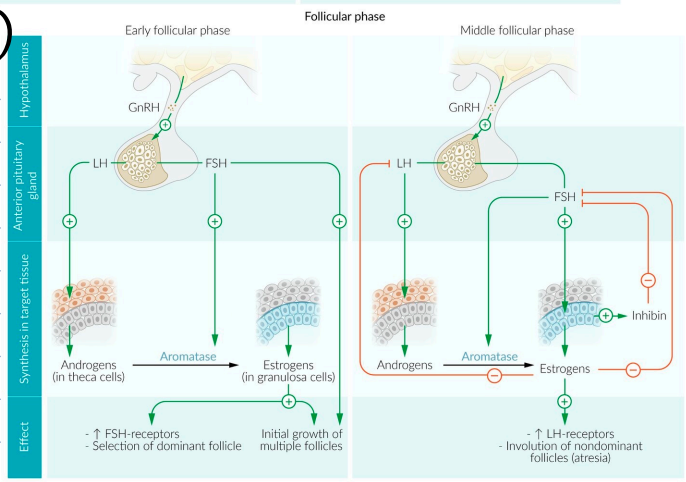
Falling LH b/c cause degeneration of corpus luteum = ↓ { progesterone, Estradiol } ∴ Endometrium ∅ maintained.





(NB)





normal menstrual cycle = 24-38 days.
Day 1 = first day of menstrual cycle.
Menses = 3-7 days (± 35-50 ml)
Menses = ↓'s in ovaries (ovarian cycle) } cycles relate to one another
= ↓'s in uterus (uterine cycle) }
Ovarian ↕'s Regulated by HPA.
Uterine ↕'s Regulated by ovaries ↕'s — Low Estradiol = FSH & LH ↓ = menstruation
— High Estradiol = ↑ FSH / LH = thickening of Endometrium.
— E & P released by corpus luteum = Development of Endometrium
— E & P ↓ secretion of FSH & LH = prevent further follicular development.

Menstrual cycle changes

Cycle	Duration	Phases	Description	Mechanism	Histological changes [2]
Ovarian cycle	• 1–14 days	• Follicular phase	• From the first day of menses to the day before the LH surge • Accounts for most of the variability in the length of the menstrual cycle • Follicle growth speeds up during the 2nd week of this phase.	• FSH stimulates the development of several follicles in the ovaries → granulosa cells of follicles produce estrogen → estrogen suppresses the release of FSH via negative feedback loop • Selection of a dominant follicle (Graafian follicle) • Positive feedback loop: high estrogen levels → FSH release → LH surge → ovulation (↑ since Granulosa cells releasing so much oestrogen. NB)	• During the secondary follicle stage, cuboidal granulosa cells continue to proliferate. • Multiple layers of thick granulosa cells surround an eccentrically located oocyte. • Most secondary follicles become atretic, but usually only one becomes a dominant follicle.
	• **14–15 days**	• Luteal phase	• From the day of the LH surge to the beginning of the next menses	• In ovulation, the Graafian follicle ruptures, releasing the oocyte. • Following ovulation, the granulosa cells produce LH receptors → LH-induced transformation of the Graafian follicle into the corpus luteum → progesterone production → inhibition of LH release (progesterone increase indicates that ovulation has occurred) • If no pregnancy occurs, the corpus luteum regresses.	• During the tertiary follicle stage, the oocyte is surrounded by the corona radiata and floats in follicular fluid. • The Graafian follicle moves to the surface of the ovary, where it ruptures and the secondary oocyte is released. The empty tertiary follicle collapses. • The corpus luteum atrophies.
Uterine cycle	• 3–7 days	• Menses	• Menstrual bleeding occurs in this phase (usually 14 days after ovulation).	• Absence of pregnancy → resolution of corpus luteum → ↓ progesterone concentration → vasospasms in the uterine spiral arteries → bleeding • To actively delay menses, administer progesterone in the second half of the menstrual cycle. (NB)	• Contraction of spiral arteries in the stratum functionalis layer → ischemia → degeneration of the functionalis layer → sloughing off of the functional layer of the endometrium
	• ~10 days	• Proliferative phase	• Characterized by the growth of the endometrium under the influence of estrogens	• Growing follicles produce estrogen (granulosa cells express aromatase, which converts androgens to estrogens) → proliferation of the endometrium	• Proliferation of endometrial epithelial cells (cells show high mitotic activity) • Endometrial glands become straight, tubular, and lined by simple columnar epithelium. • Stromal cells start to divide, enlarge, and accumulate glycogen. • Uterine spiral arteries start to regenerate and extend two-thirds of the way into the endometrium.
	• 10–14 days	• Secretory phase	• The functional layer of the endometrium is prepared for implantation under the influence of progesterone.	• Progesterone promotes endometrial differentiation → preparation of the functional layer of the endometrium for oocyte implantation • ↑ Cervical mucus secretion (prevents spermatozoids from entering uterus) • ↑ Basal body temperature • In the absence of pregnancy: ↓ progesterone levels → apoptosis of the functional layer of the endometrium → menstruation	• Intracellular subnuclear vacuoles • Increased endometrial gland tortuosity • Glycogen-rich secretions • Edematous stromal cells • Uterine spiral arteries extend the full length of the endometrium.