SIKLUS OVARIUM

Kuliah 6

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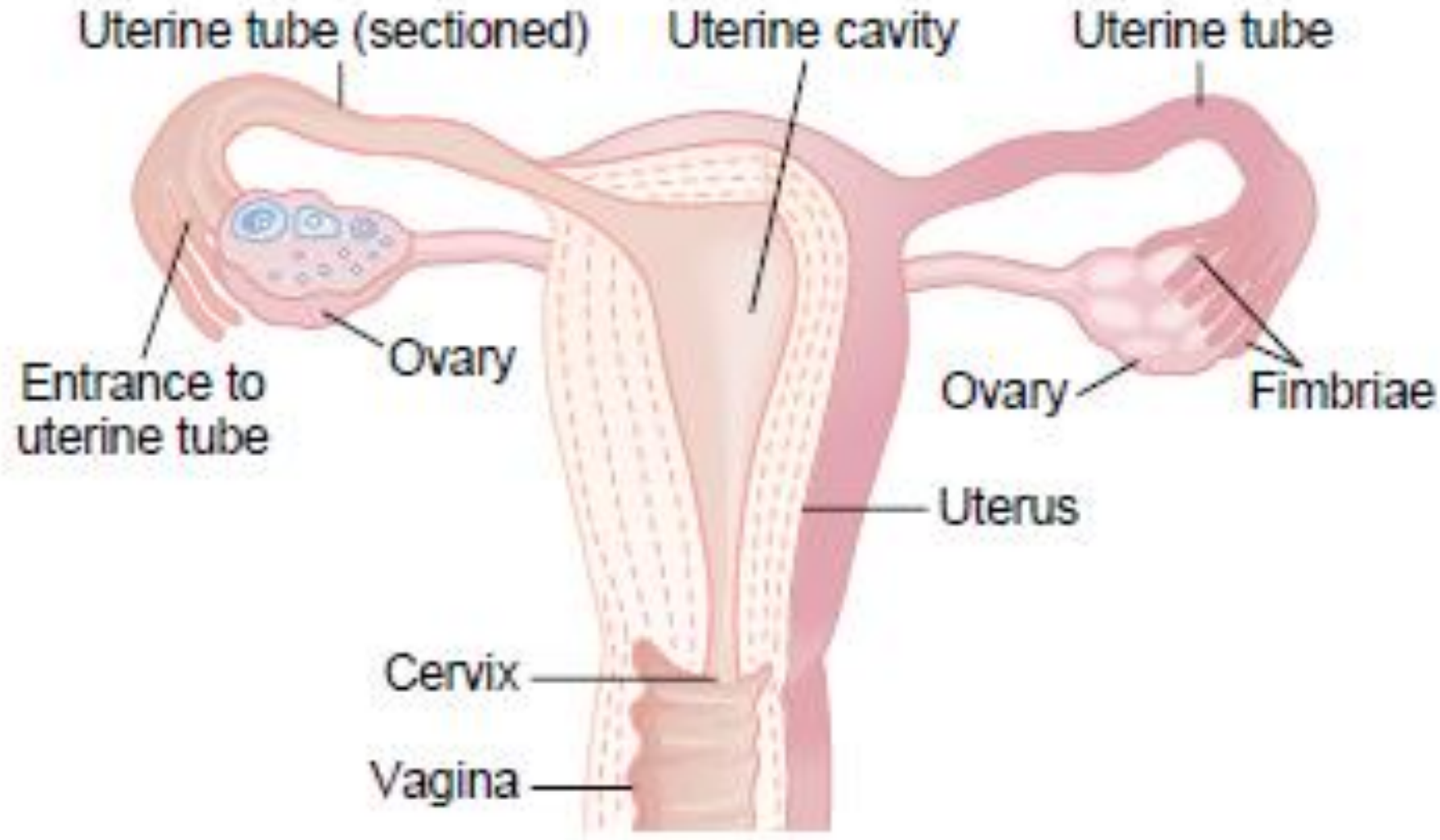
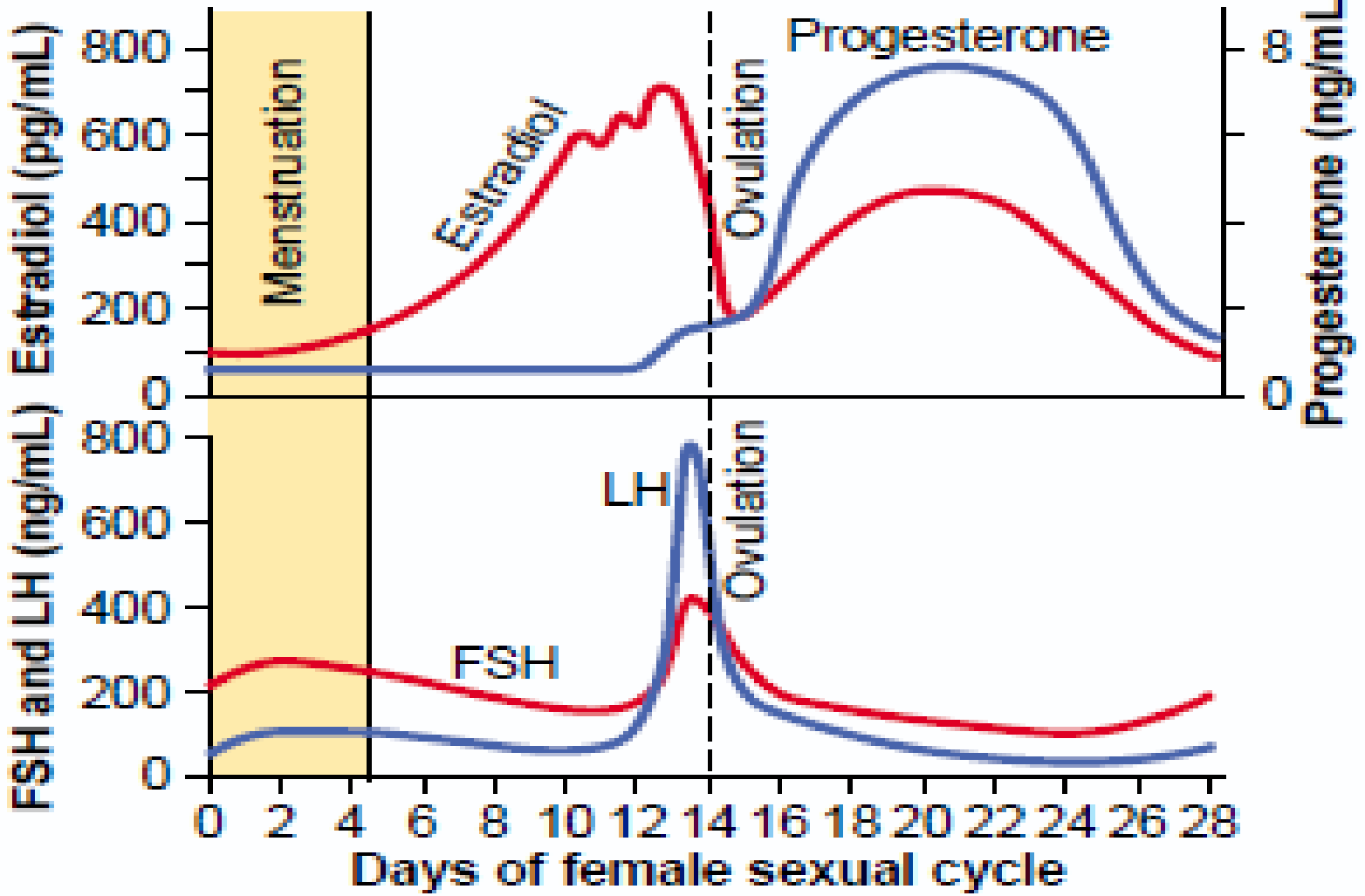


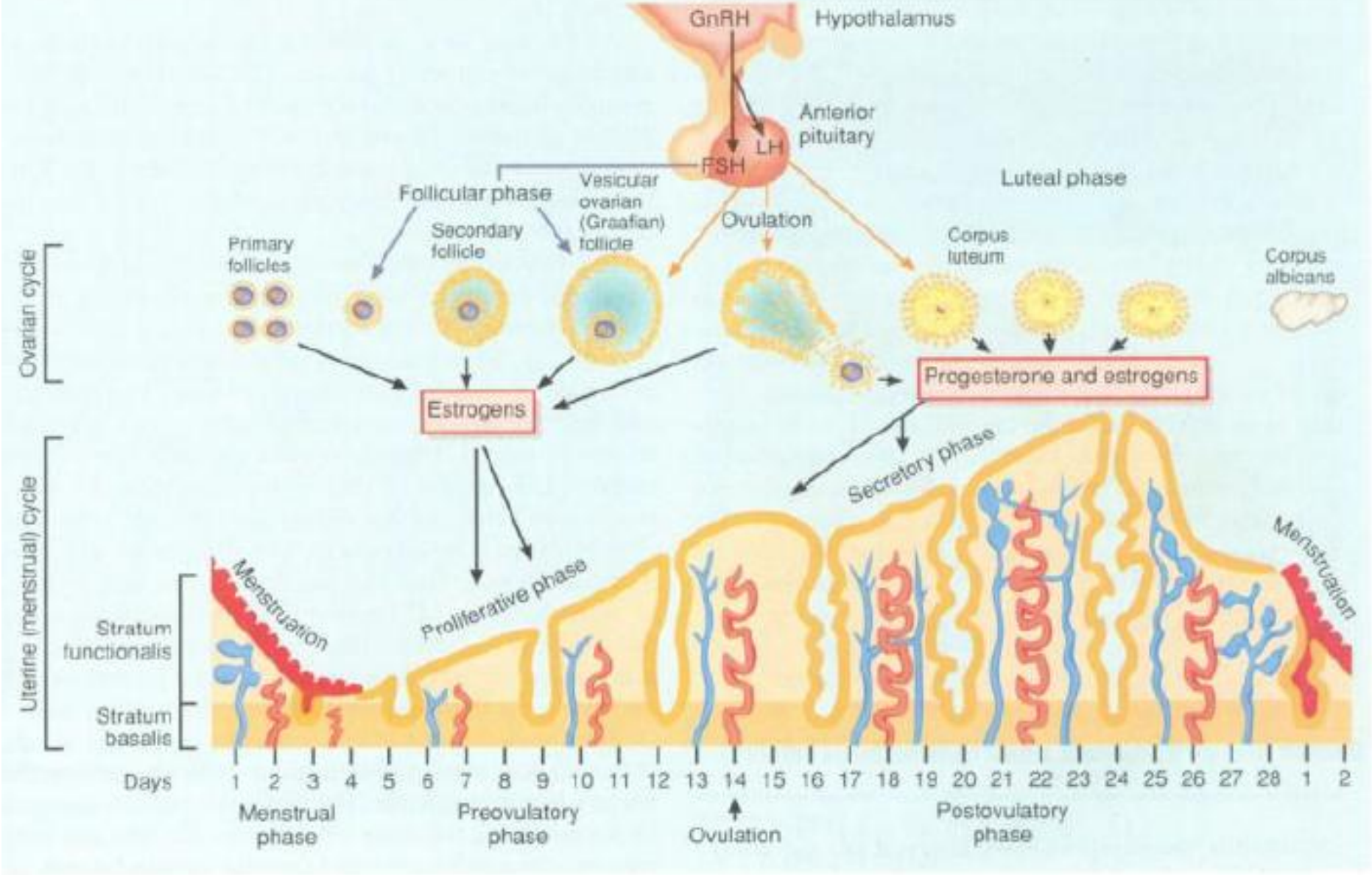
Female reproductive organs

Female Monthly Sexual Cycle (Menstrual Cycle)

- **Normal reproductive years of female are characterized by monthly rhythmical changes in the rates of secretion of female hormones and corresponding physical changes in ovaries and other sexual organs**
- **Duration of the cycle average 28 days (20-45 days)**
- **Abnormal cycle length is frequently associated with decreased fertility**
- **Two significant results:**
  - **Only single ovum is normally released → ovarian cycle**
  - **Uterine endometrium is prepared in advance for implantation of fertilized ovum → endometrial cycle**



Plasma concentrations of gonadotropins and ovarian hormones during the normal female sexual cycle



Correlation of ovarian and uterine cycles with the hypothalamic and anterior pituitary gland hormones.

Functioning of Ovaries

- **During fetal life:**
  - stimulated by chorionic gonadotropin (hCG)
- **A few weeks after birth until puberty (prepubertal period / childhood):**
  - dormant
- **Productive period:**
  - stimulated by - gonadotropic hormone (GnH)
  - ovarian hormones
- **Menopause**

Ovarian Cycle

1. **The follicular phase:**
   - **ovarian follicle growth**
   - **ovulation**

2. **The luteal phase:**
   - **development of corpus luteum**

1. The Follicular Phase

Follicle Growth

- From the time of birth, there are many primordial follicles containing 1 primary oocyte
- Progression of some primordial follicles to preantral and early antral stages occurs
  - throughout infancy and childhood, and
  - then during the entire menstrual cycle
- Therefore, although most of follicles in ovaries are still primordial, there are also always present a relatively constant few number of preantral and early antral follicles

Follicle Growth…..

- At the start of each cycle, 10-25 the follicles begin to develop into larger follicles
- In humans, usually one of the larger follicles in one ovary starts to grow rapidly on ± the 6thday, becomes the dominant follicle
- The dominant follicle continues to develop, and others (in both ovaries) regress and become a degenerative process called atresia (an example of programmed cell death, or apoptosis)
- The eggs in the degenerating follicles also die

Follicle Growth…..

- As dominant follicle enlarges, mainly as result of expanding antrum (increase in fluid), granulosa cell layers surrounding the egg form a mound that projects into the antrum: **cumulus oophorus**
- As time of ovulation approaches, primary oocyte emerges from meiotic arrest and completes its first meiotic division to become secondary oocyte
- Cumulus separates from follicle wall, so that it and oocyte float free in antral fluid

Ovulation

- Mature follicle (Graafian follicle): ± 1,5 cm in diameter, that it balloons out on ovary's surface
- Ovulation occurs when the thin walls of follicle and ovary at site where they are joined rupture because of enzymatic digestion
- Secondary oocyte surrounded by its tightly adhering zona pellucida and granulosa cells, as well as cumulus, is carried out of ovary and onto ovarian surface by antral fluid
- All this happens on ± day 14 of menstrual cycle

Ovulation…..

- Occasionally, 2 or more follicles reach maturity and more than 1 egg may be ovulated
- This is the most common of cause of multiple births
- In such cases, siblings are fraternal, not identical, because the eggs carry different sets of genes

1. The follicular phase…..

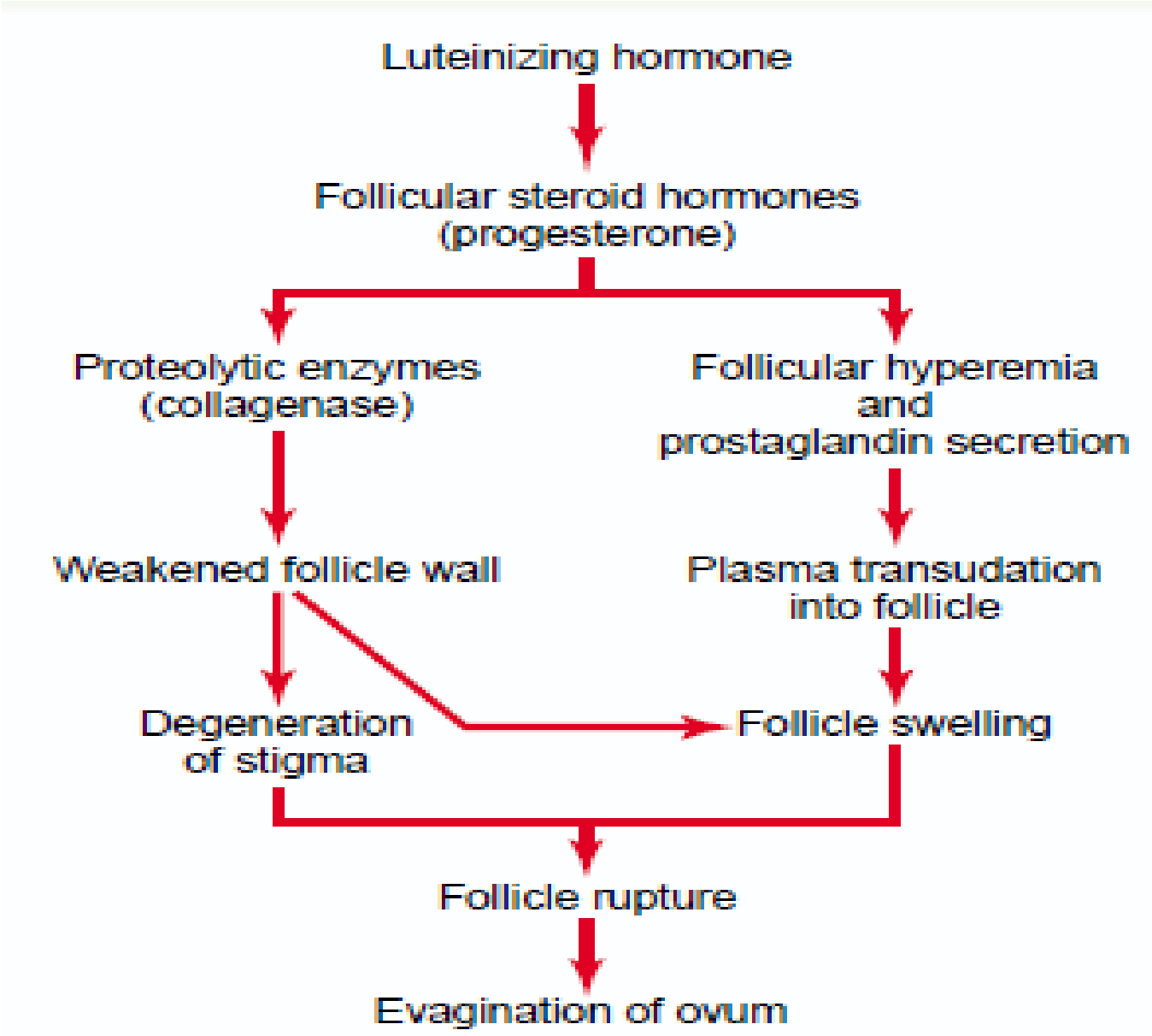
- **Ovulation**
  - protruding outer wall ⇒ stigma
  - oozing of fluid into the stigma ⇒ rupture
  - the viscous fluid outward into abdomen carrying ovum with granulosa cells (corona radiata)
  - occasionally > 1 follicles reach maturity ⇒ fraternal multiple births

1. The follicular phase…..

- **Estrogen:**
  - Depresses secretion of FSH ⇒
    - Block further growth of less well developed follicles → atresia
    - The largest follicle continue to grow → full mature
  - Increasing number of FSH receptors
  - FSH + estrogen ⇒ promote LH receptors
  - LH + estrogen ⇒
    - proliferation of theca cells ⇒ increase progesterone secretion
    - enlargement of ovum (10X)

Effects of LH Surge on Ovarian Function

- Primary oocyte completes its first meiosis mediated by messengers released from granulosa cells in response to LH
- Antrum and blood flow to follicle increase markedly
- Granulosa cells begin releasing progesterone and decrease the release of estrogen
- Enzymes and prostaglandin synthesized by granulosa cells breakdown of follicular membrane
- Remaining granulosa cells of the ruptured follicle (along with theca cells) are transformed into CL which begin to release progesterone and estrogen



Postulated mechanism of ovulation

2. The luteal phase

Development of corpus luteum

- Granulosa cells & theca interna cells rapidly change into lutein cells (luteinization)
- Granulosa cells develop endoplasmic reticulum $\Rightarrow$ form progesterone > estrogen
- Theca cells form androgens $\rightarrow$ converted by granulosa cells $\Rightarrow$ estrogens
- Secretion of inhibin

2. The luteal phase.....

- **Involution of corpus luteum**

  Onset of next ovarian cycle

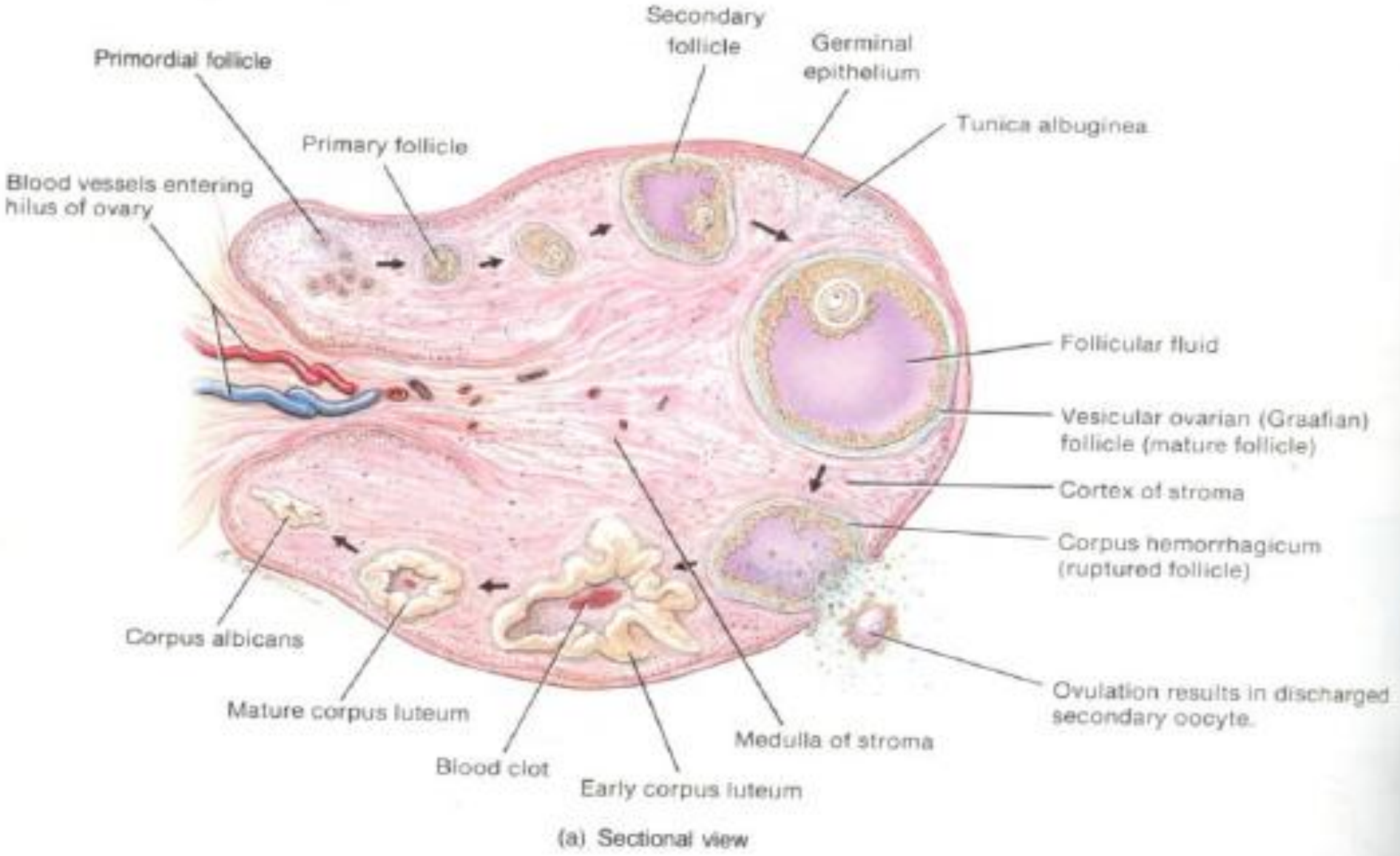
  1. Estrogen, progesterone & inhibin ↑ ⇒

  FSH & LH ↓ ⇒ involution of corpus luteum

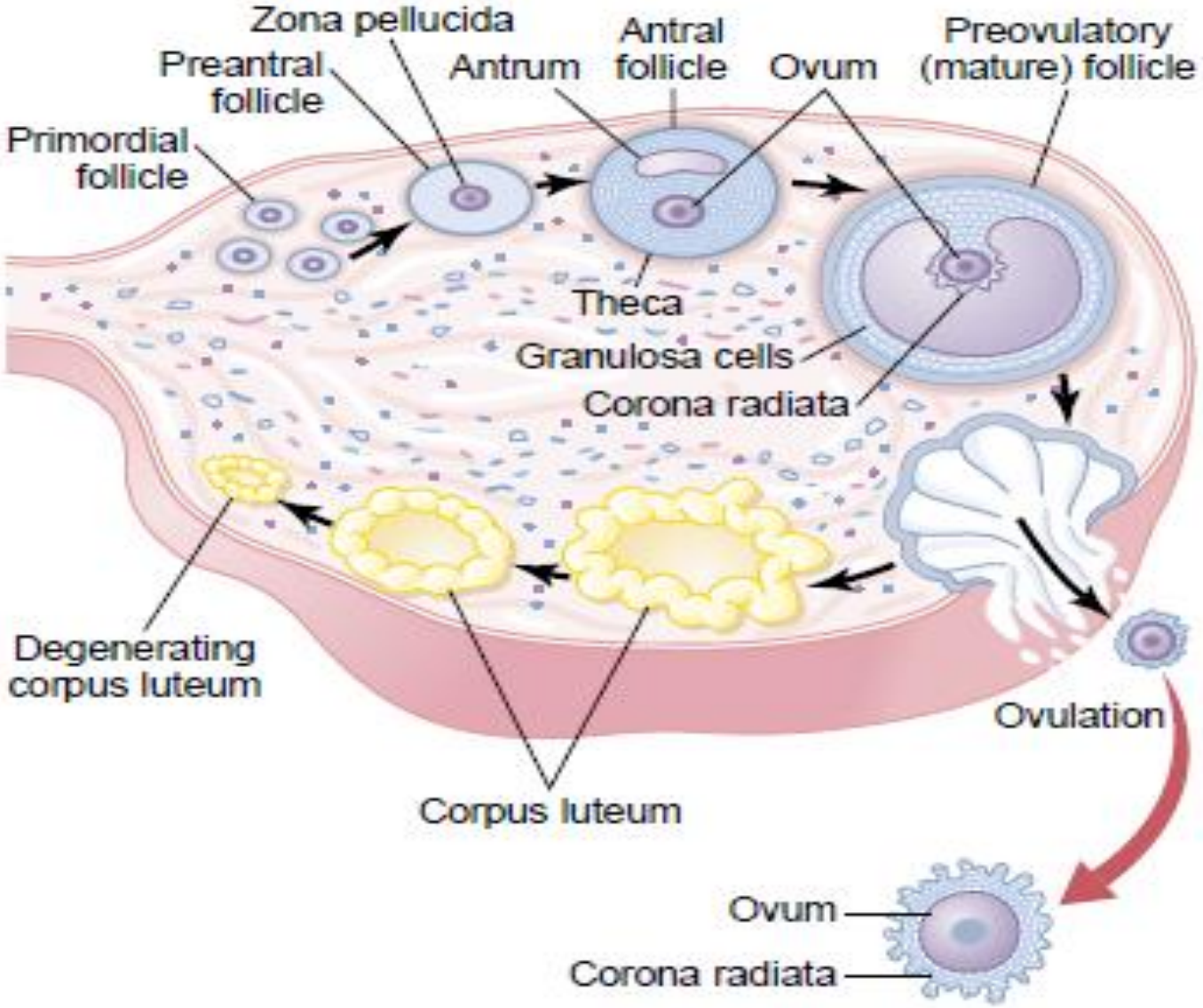
  2. Estrogen & progesterone ↓ ⇒

  - **menstruation**
  - **FSH ↑ followed by secretion of LH**

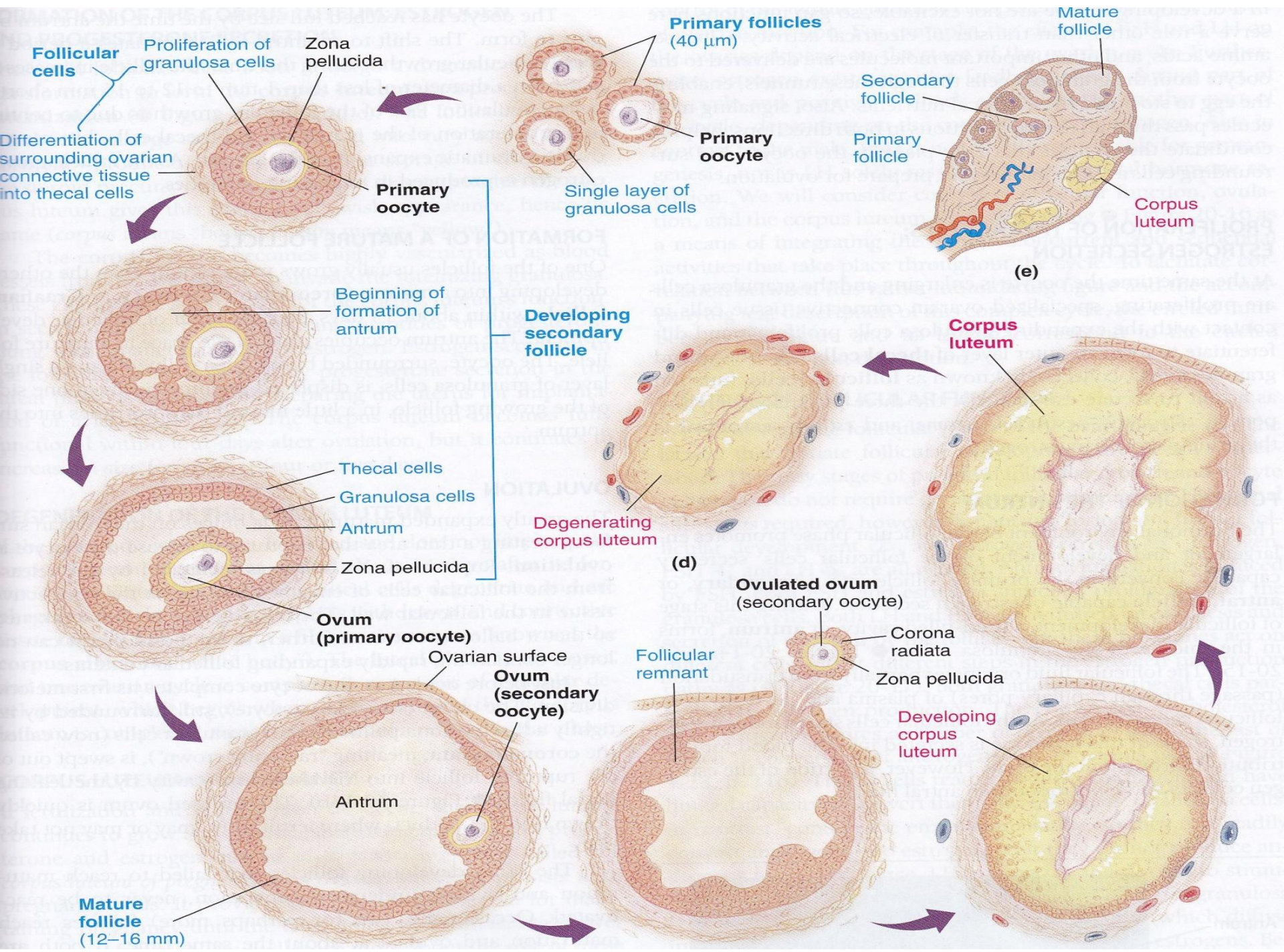
  3. Initiate growth of new follicle ⇒ new ovarian cycle



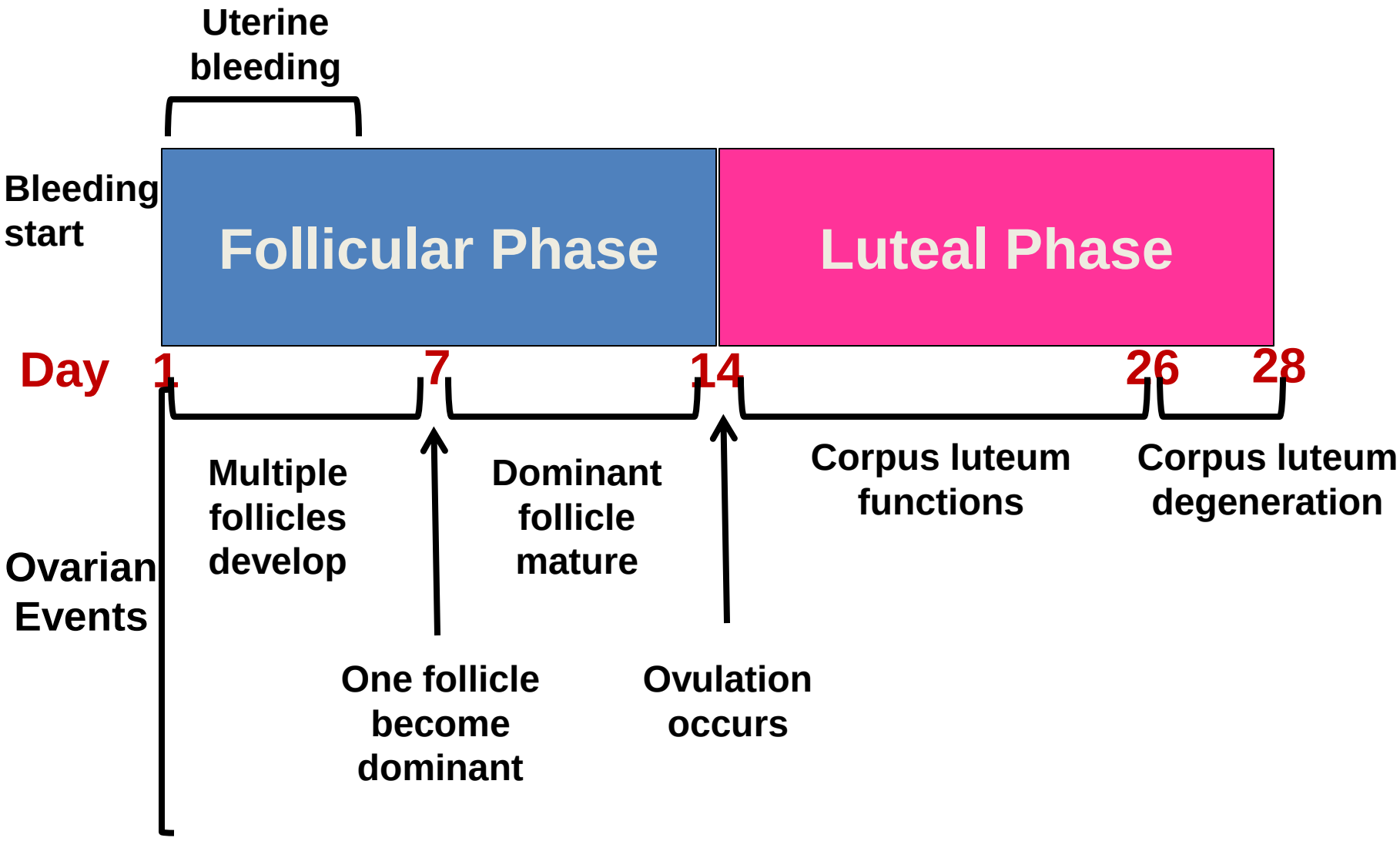
Histology of the ovary. The arrows indicate the sequence of developmental stages that occur as part of ovarian cycle



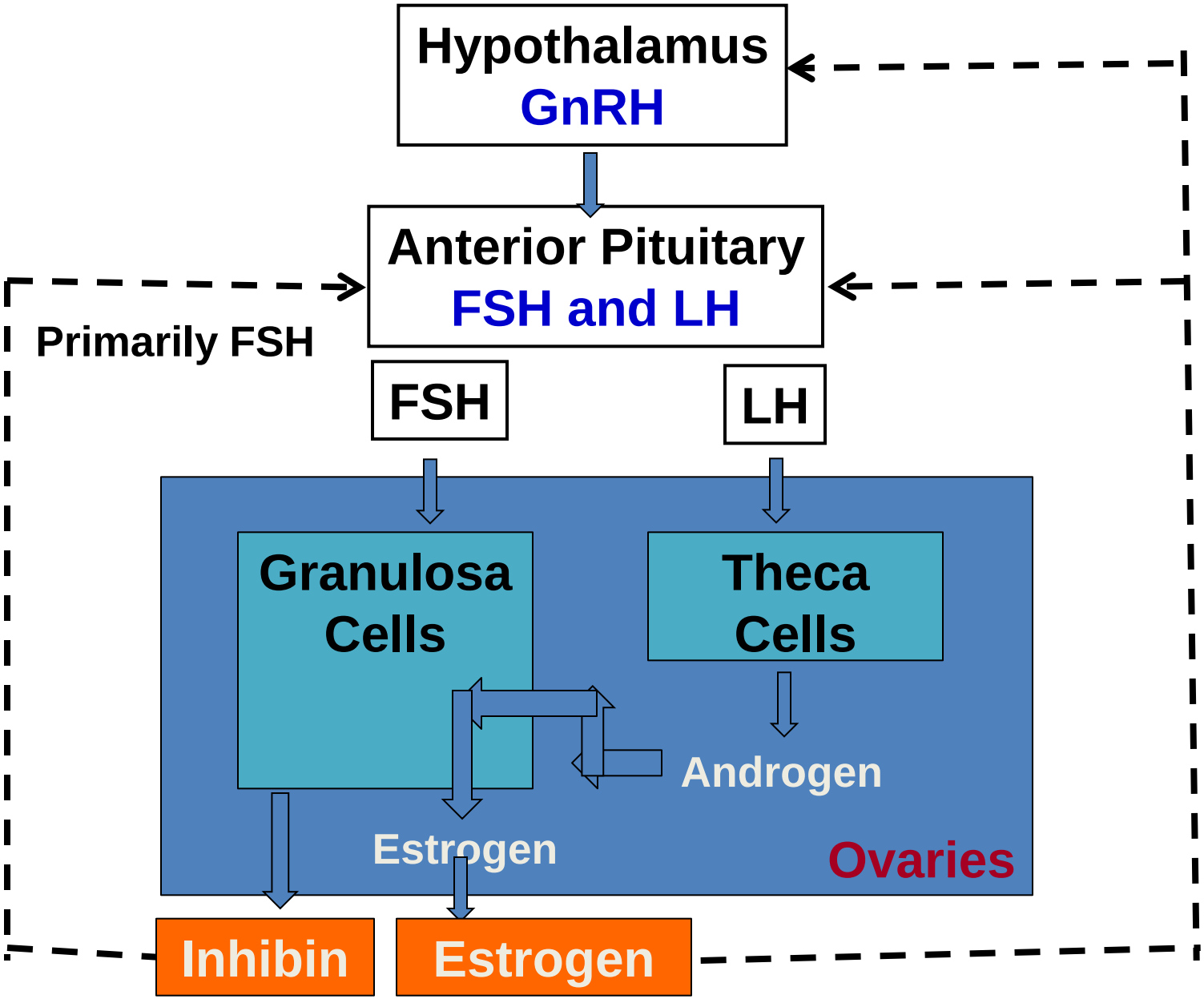
Stages of follicular growth in the ovary


Primary follicles
(40 μm)
Follicular cells
Proliferation of granulosa cells
Zona pellucida
Differentiation of surrounding ovarian connective tissue into thecal cells
Primary oocyte
Single layer of granulosa cells
Primary oocyte
Mature follicle
Secondary follicle
Primary follicle
Corpus luteum
(e)
Beginning of formation of antrum
Developing secondary follicle
Thecal cells
Granulosa cells
Antrum
Zona pellucida
Ovum (primary oocyte)
Degenerating corpus luteum
(d)
Corpus luteum
Ovulated ovum (secondary oocyte)
Corona radiata
Zona pellucida
Ovarian surface
Ovum (secondary oocyte)
Follicular remnant
Antrum
Developing corpus luteum
Mature follicle (12–16 mm)

Summary of Ovarian Events



Hormonal Control of Ovarian Function



Summary of Major Feedback Effects of Estrogen, Progesterone, Inhibin

Estrogen

In low plasma concentration:

- **Negative feedback inhibition of FSH and LH secretion during early and middle follicular phase**

When increasing dramatically:

- **Positive feedback stimulation of LH surge which triggers ovulation**

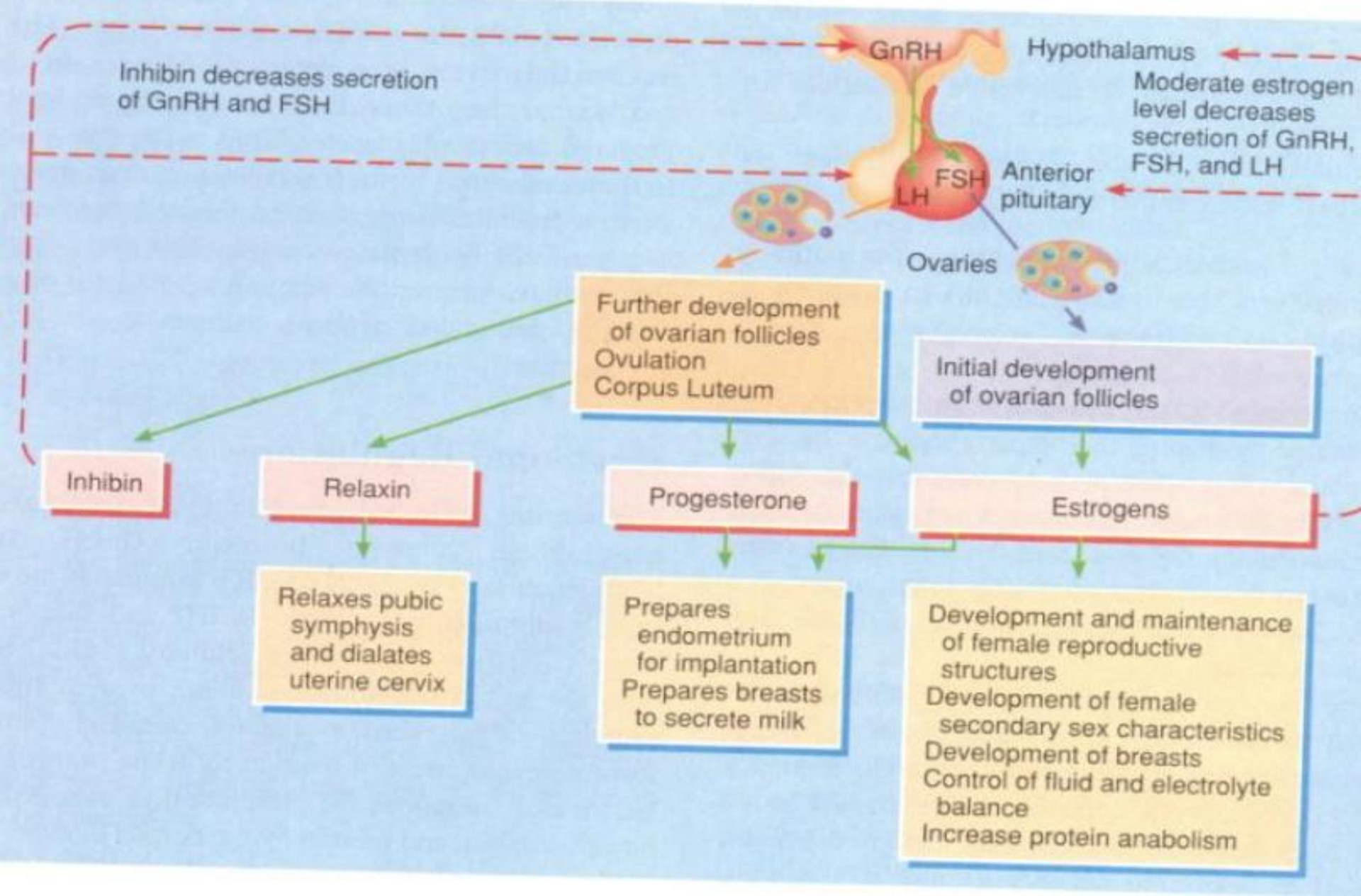
Summary of Major Feedback Effects of Estrogen, Progesterone, Inhibin

Progesterone

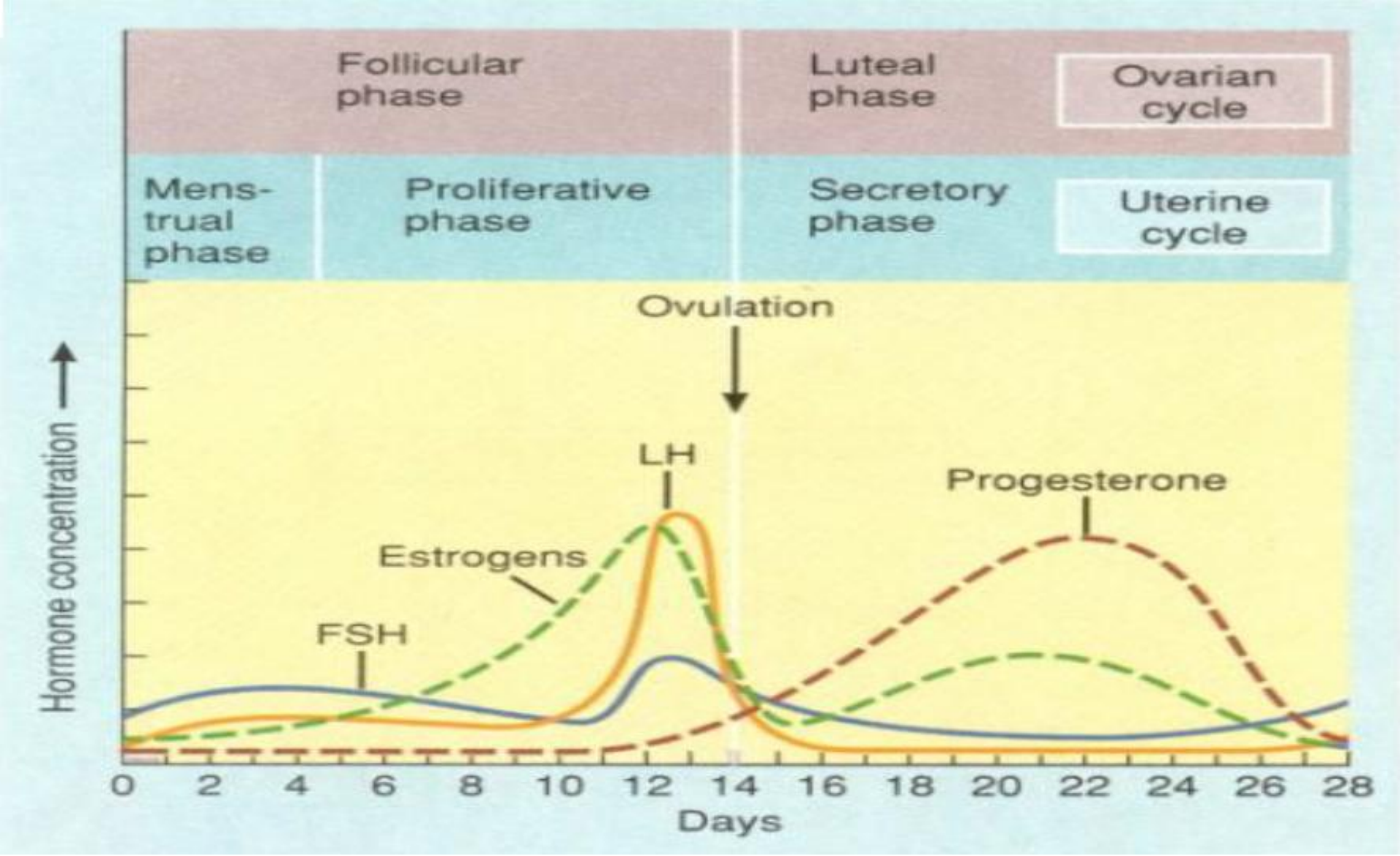
- Negative feedback inhibition of FSH and LH secretion, and
- Prevention of LH surge during luteal phase and pregnancy

Inhibin

- Negative feedback inhibition of FSH and LH secretion throughout the cycle



Secretion and physiological effects of estrogen, progesterone, relaxin, and inhibin



Relative concentrations of anterior pituitary gland hormones (FSH – LH) and ovarian Hormones (estrogen – progesterone) during a normal female sexual cycle. Note the relationship of the hormones to the ovarian and uterine cycles

Functions of Granulosa cells

- Nourish oocytes
- Secrete chemical messengers that influence oocytes and theca cells
- Secrete antral fluid
- Site of action for estrogen and FSH in the control of follicle development during early and middle follicular phases
- Express aromatase which convert androgen (from theca cells) to estrogen
- Secrete inhibin
- Site of action for LH induction of changes in oocytes and follicle culminating in ovulation and formation of CL

Menopause

- Few primordial follicles remain
- Production of estrogen fall
- Postmenopausal syndrome:
  - ‘hot flushes’
  - psychic sensation of dyspnea
  - irritability
  - fatigue
  - anxiety
  - occasionally various psychotic states
  - decreased strength and calcification of bones

Thank You

Tugas

1. Kerjasama sel granulosa dan sel theca terhadap sekresi hormon wanita
2. Mekanisme kerja pil KB
3. Pada kehamilan: corpus luteum berfungsi mensintesis estrogen dan progesteron dan apa pengganti bila CL mati