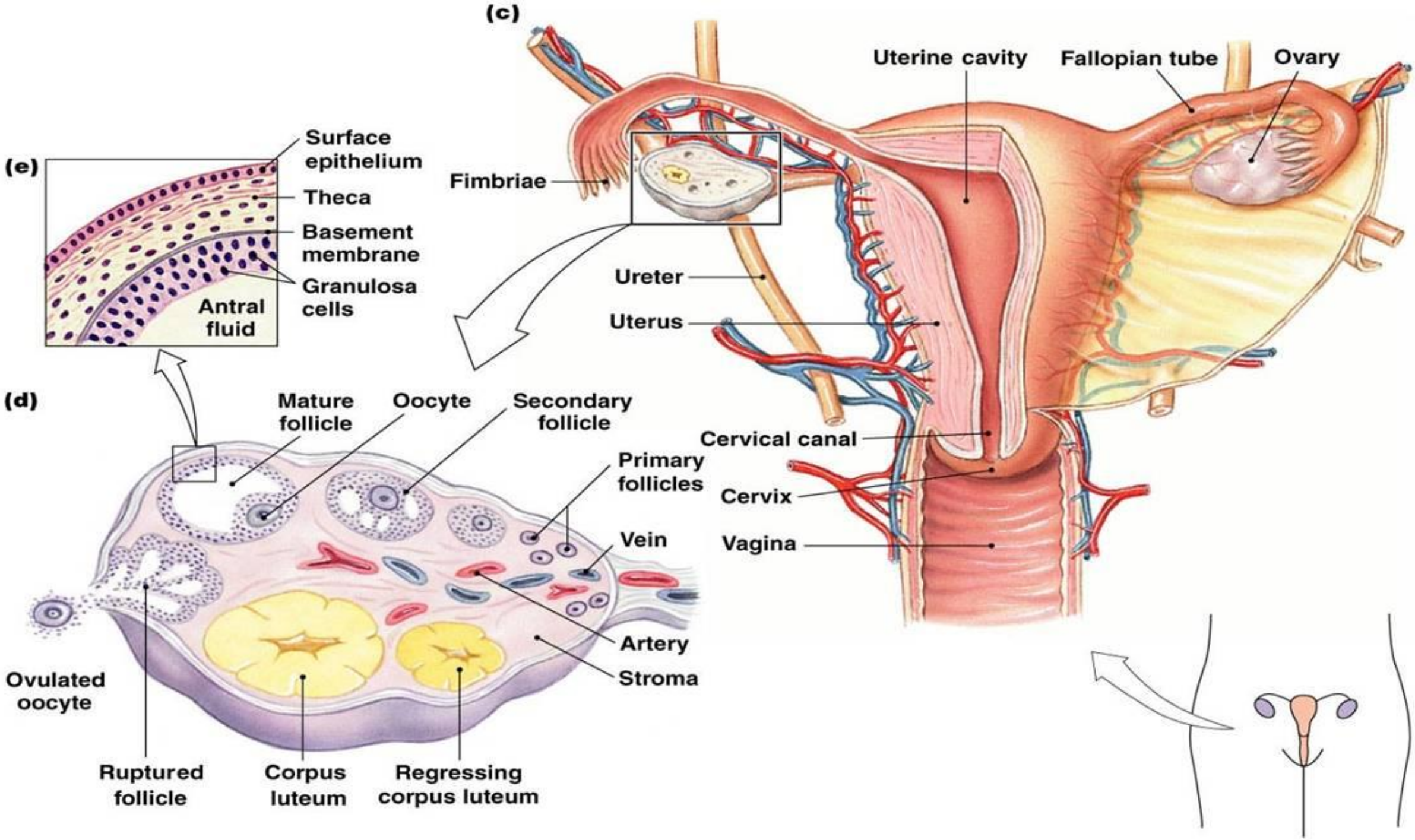
Female Reproductive System I


(c)
Uterine cavity
Fallopian tube
Ovary
Fimbriae
Ureter
Uterus
Cervical canal
Cervix
Vagina
(e)
Surface epithelium
Theca
Basement membrane
Granulosa cells
Antral fluid
(d)
Mature follicle
Oocyte
Secondary follicle
Primary follicles
Vein
Artery
Stroma
Ovulated oocyte
Ruptured follicle
Corpus luteum
Regressing corpus luteum

Ovarian cycle

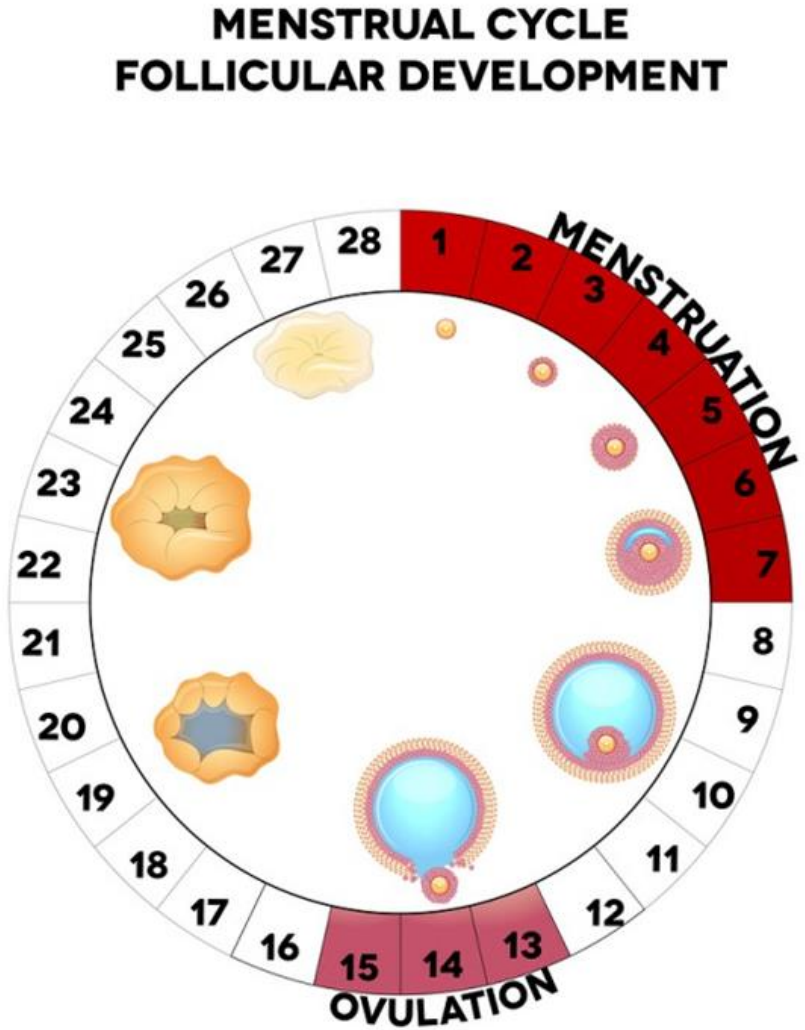
Menstrual cycle

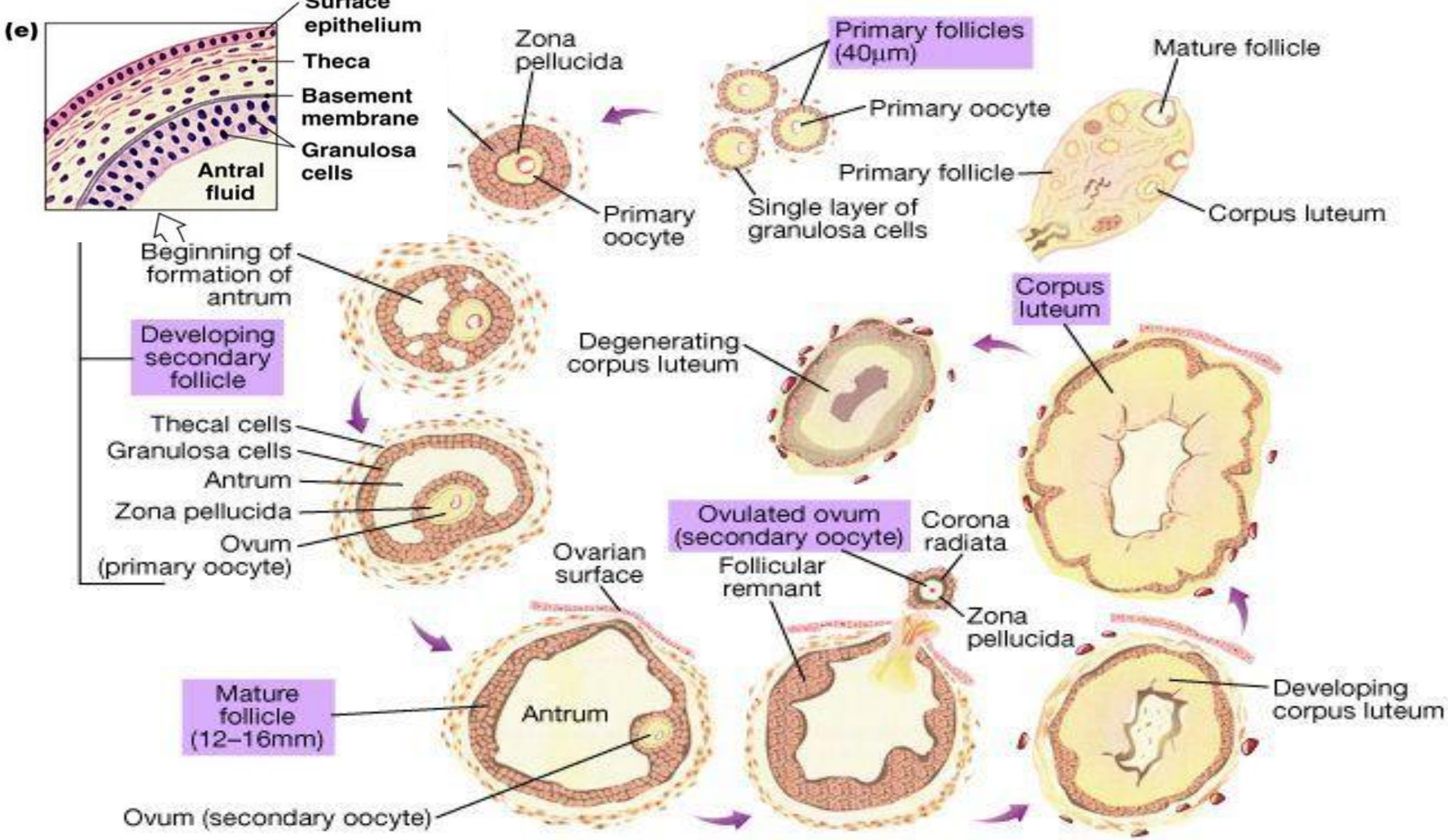
Ovarian cycle

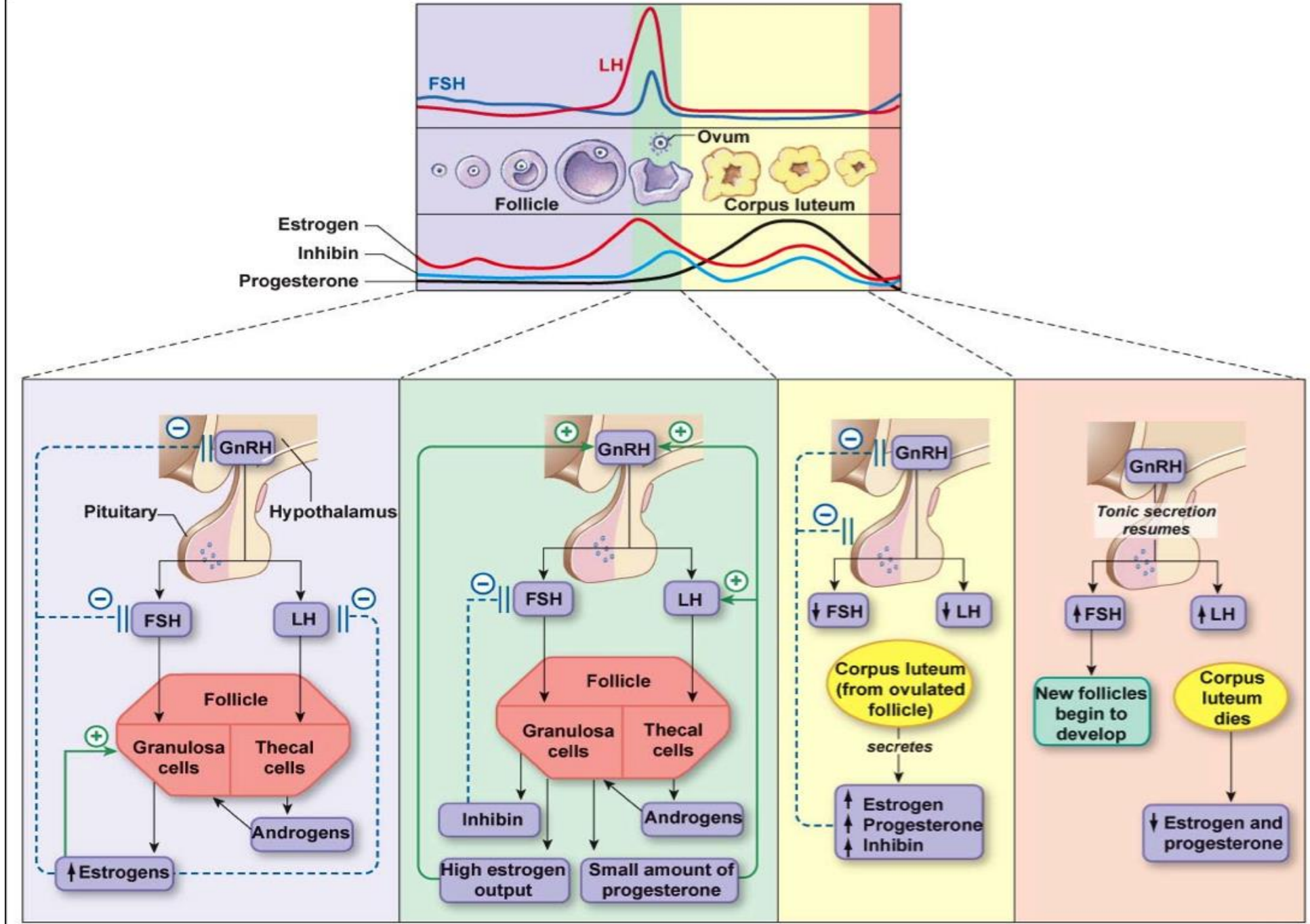
- Ovarian cycle:
- A series of events by which the ovaries prepare and release an ovum

Ovarian cycle:

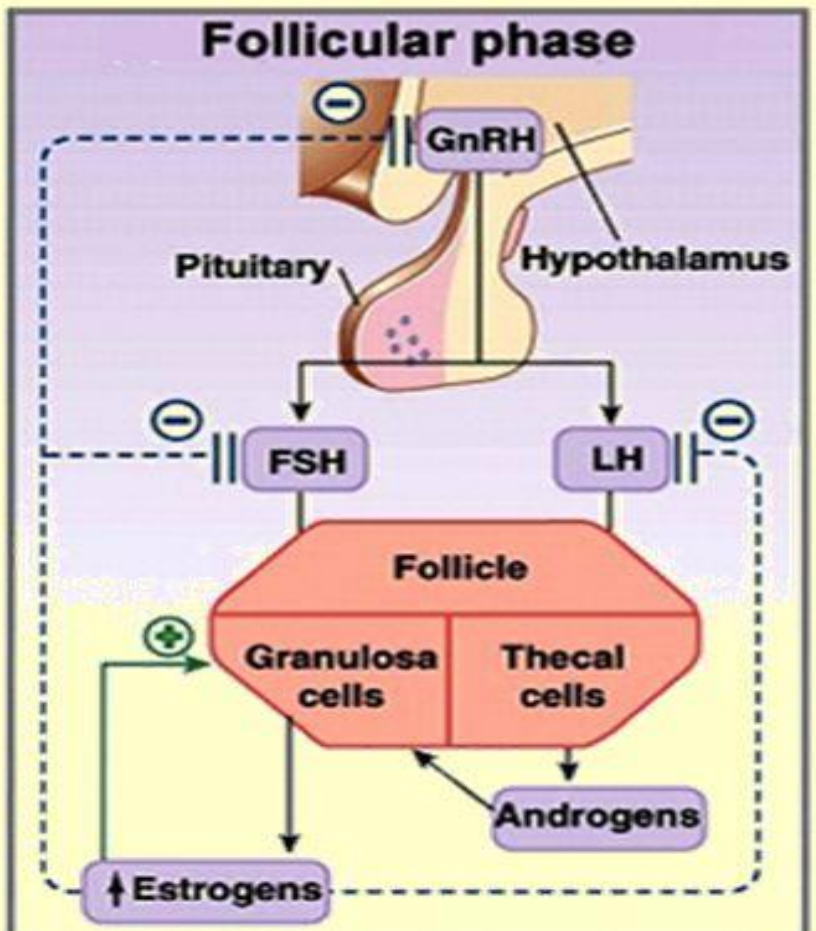
Regulated by	Duration	Begins at	Phases
FSH, LH } From pituitary gland Estrogen, Progesterone } from ovary	28 days	Puberty	Follicular Luteal

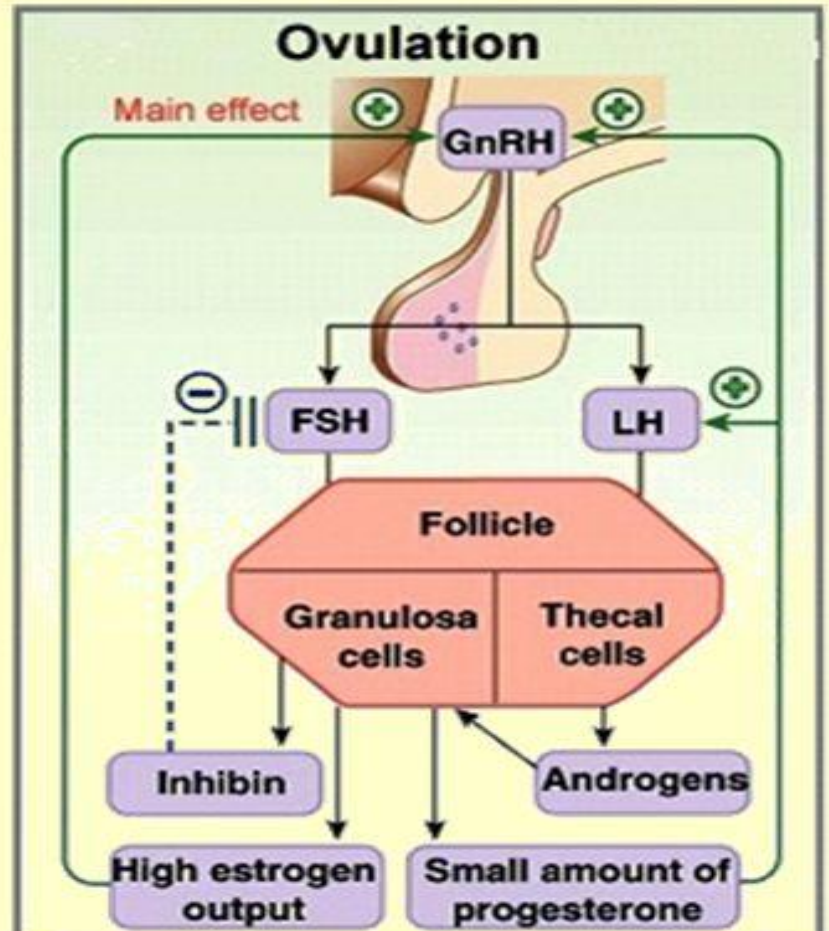


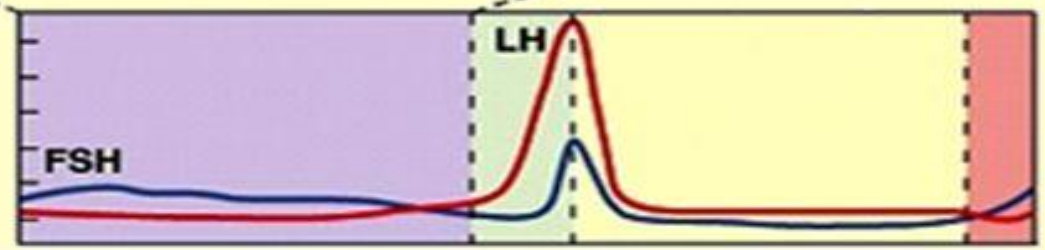

(e)
Surface epithelium
Theca
Basement membrane
Granulosa cells
Antral fluid
Zona pellucida
Primary oocyte
Primary follicles (40µm)
Primary oocyte
Primary follicle
Single layer of granulosa cells
Mature follicle
Corpus luteum
Beginning of formation of antrum
Developing secondary follicle
Thecal cells
Granulosa cells
Antrum
Zona pellucida
Ovum (primary oocyte)
Degenerating corpus luteum
Corpus luteum
Ovulated ovum (secondary oocyte)
Corona radiata
Ovarian surface
Follicular remnant
Zona pellucida
Developing corpus luteum
Mature follicle (12–16mm)
Antrum
Ovum (secondary oocyte)

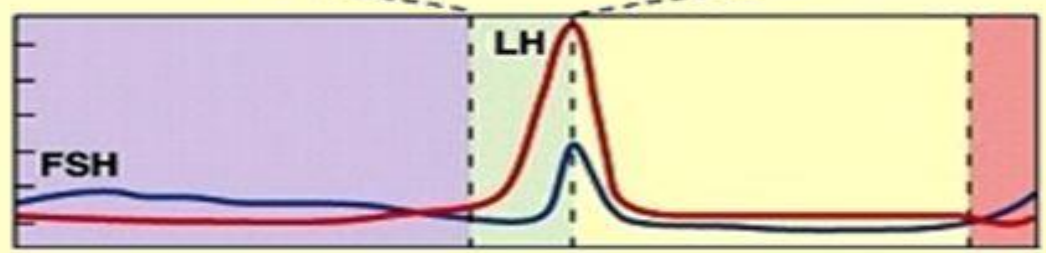

FSH
LH
Ovum
Follicle
Corpus luteum
Estrogen
Inhibin
Progesterone
GnRH
Pituitary
Hypothalamus
FSH
LH
Follicle
Granulosa cells
Thecal cells
Androgens
Estrogens
GnRH
FSH
LH
Follicle
Granulosa cells
Thecal cells
Inhibin
Androgens
High estrogen output
Small amount of progesterone
GnRH
FSH
LH
Corpus luteum (from ovulated follicle)
secretes
Estrogen
Progesterone
Inhibin
GnRH
Tonic secretion resumes
FSH
LH
New follicles begin to develop
Corpus luteum dies
Estrogen and progesterone
(a) Early to mid-follicular phase
(b) Late follicular phase and ovulation
(c) Early to mid-luteal phase
(d) Late luteal phase

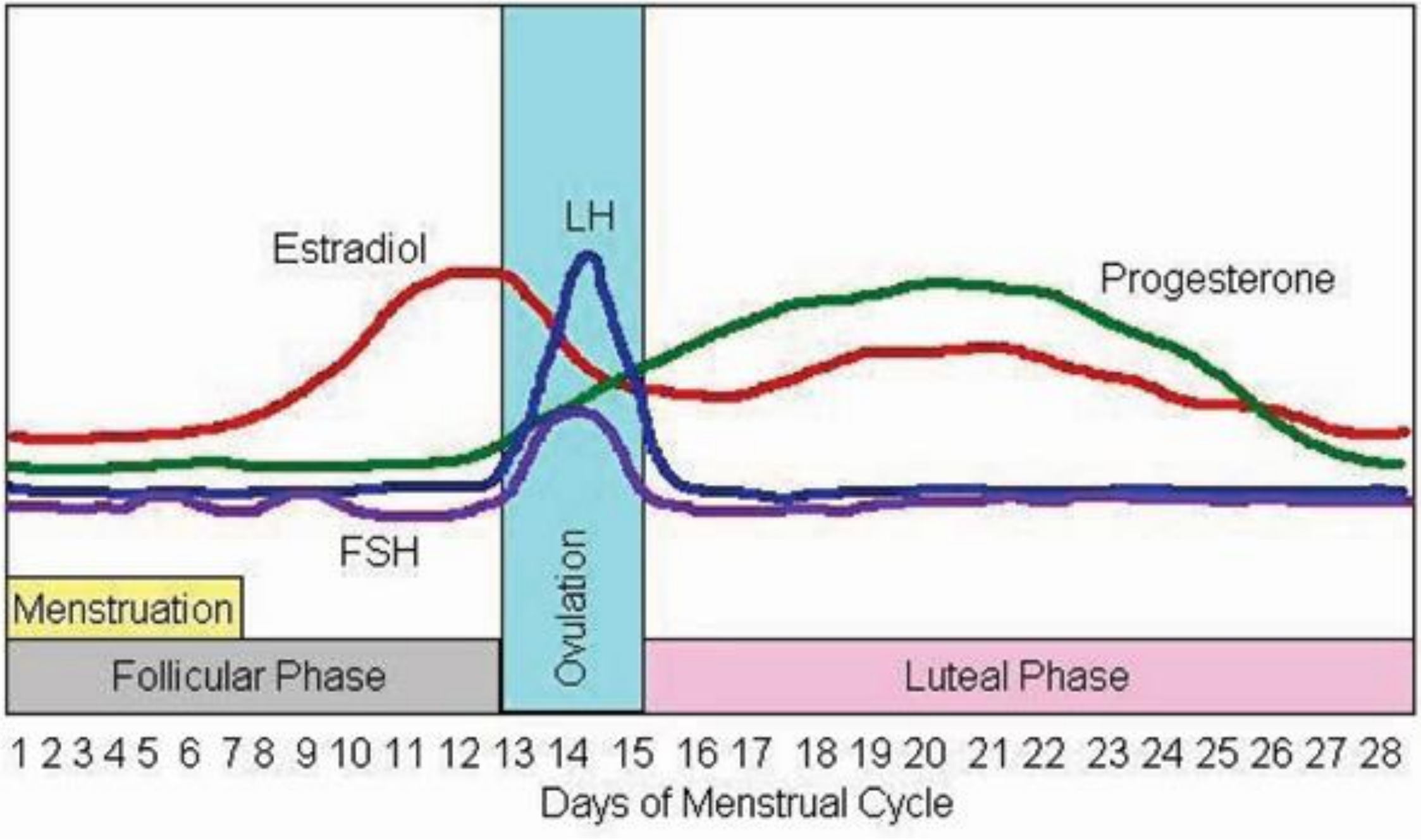
Hormonal control of the menstrual cycle



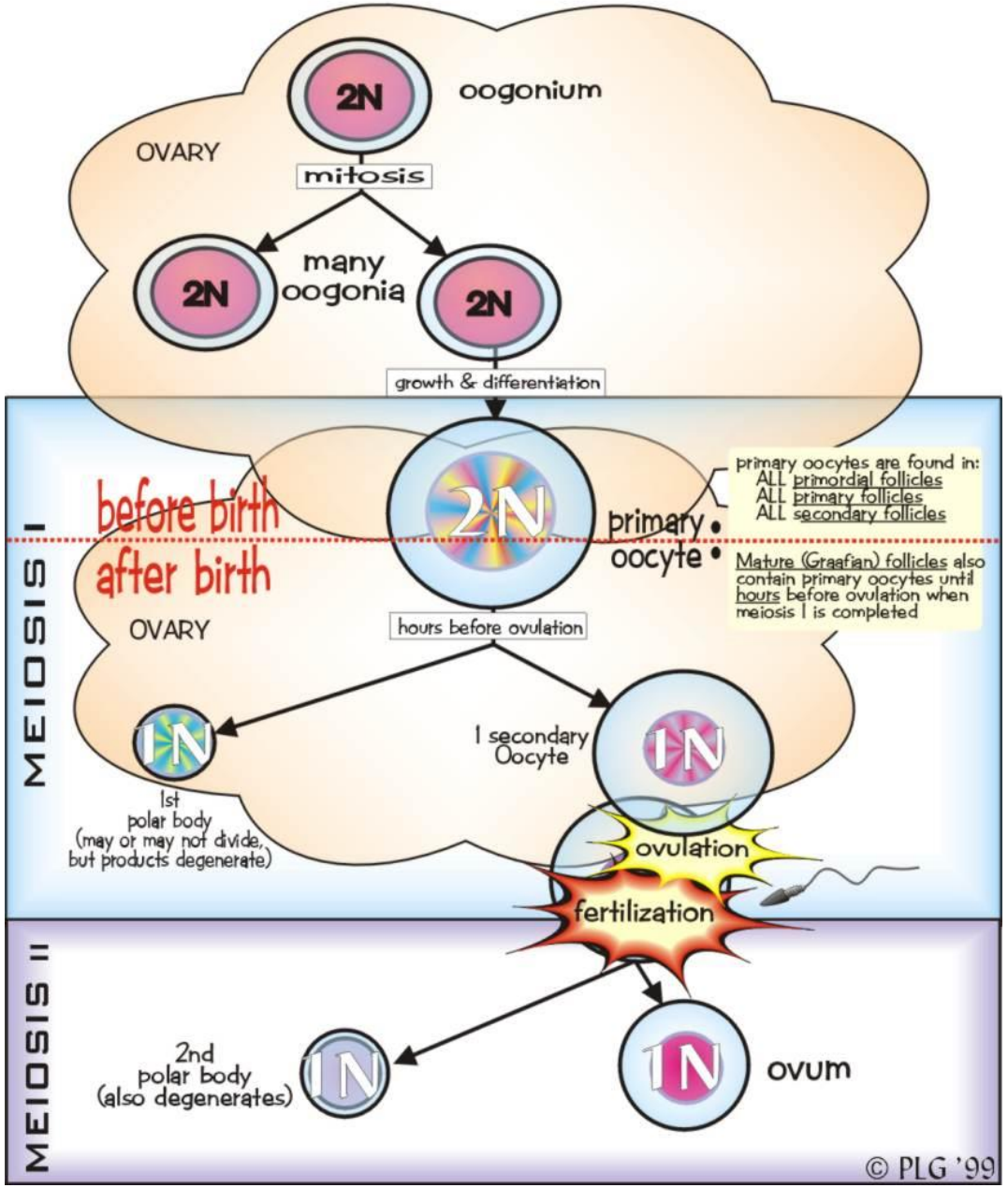


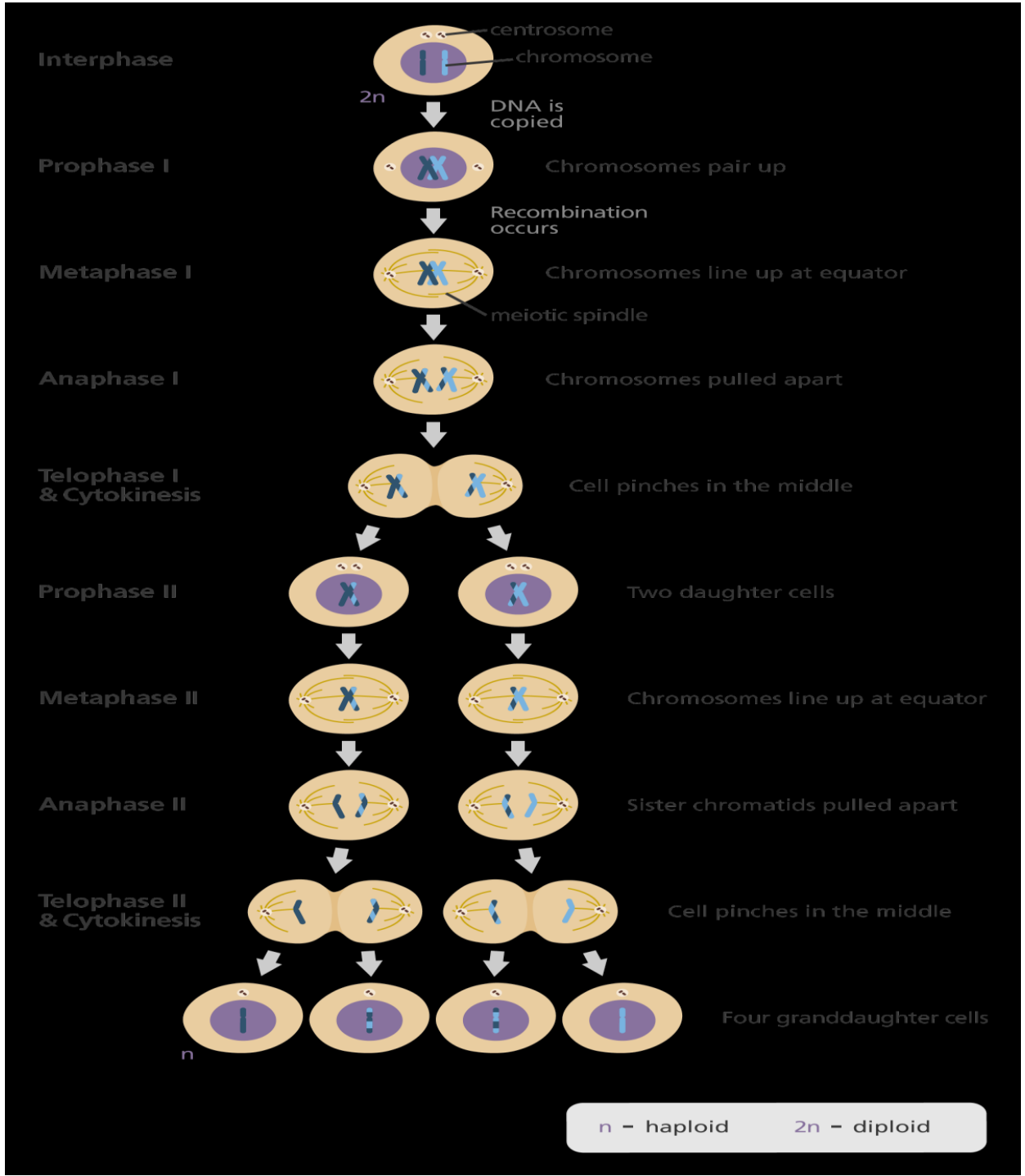





LH
Estradiol
Progesterone
FSH
Menstruation
Ovulation
Follicular Phase
Luteal Phase
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Days of Menstrual Cycle

OOGENESIS


2N
oogonium
OVARY
mitosis
2N
many oogonia
2N
growth & differentiation
2N
primary oocyte
primary oocytes are found in:
ALL primordial follicles
ALL primary follicles
ALL secondary follicles
Mature (Graafian) follicles also contain primary oocytes until hours before ovulation when meiosis I is completed
before birth
after birth
OVARY
hours before ovulation
MEIOSIS I
1N
1st polar body (may or may not divide, but products degenerate)
1 secondary Oocyte
1N
ovulation
fertilization
MEIOSIS II
2nd polar body (also degenerates)
1N
1N
ovum
© PLG '99

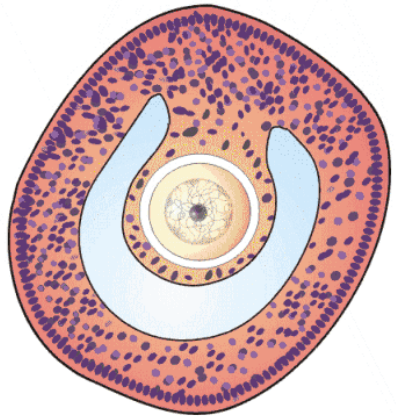

Interphase
centrosome
chromosome
2n
DNA is copied
Prophase I
Chromosomes pair up
Recombination occurs
Metaphase I
Chromosomes line up at equator
meiotic spindle
Anaphase I
Chromosomes pulled apart
Telophase I & Cytokinesis
Cell pinches in the middle
Prophase II
Two daughter cells
Metaphase II
Chromosomes line up at equator
Anaphase II
Sister chromatids pulled apart
Telophase II & Cytokinesis
Cell pinches in the middle
n
Four granddaughter cells
n – haploid
2n – diploid

Ovarian Cycle

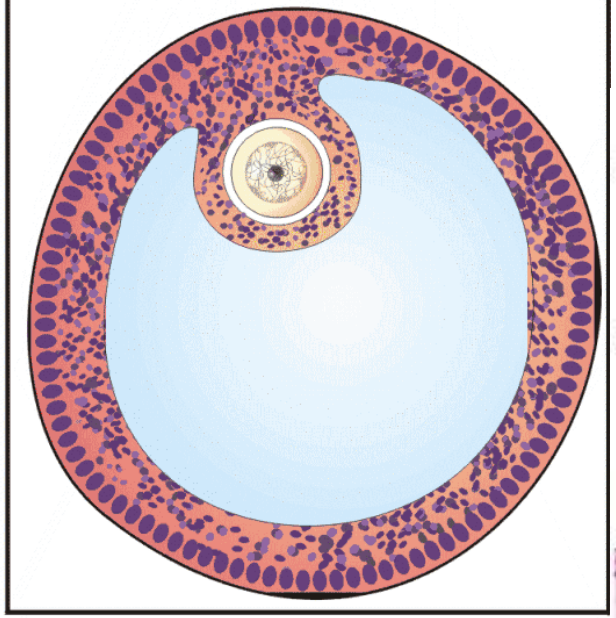
1 Primordial Follicle:
has unilamellar structure
contains a primary oocyte
--approximate size 20-30 µm

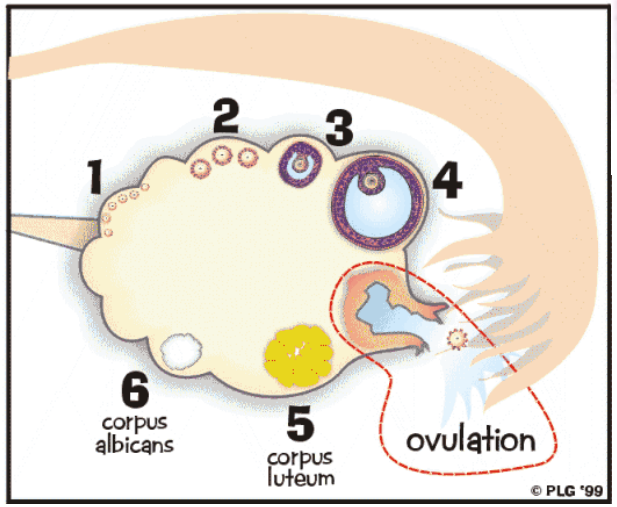
2 Early Primary Follicle:
has multilamellar structure
has a zona pellucida
contains a primary oocyte
--approximate size 45 µm

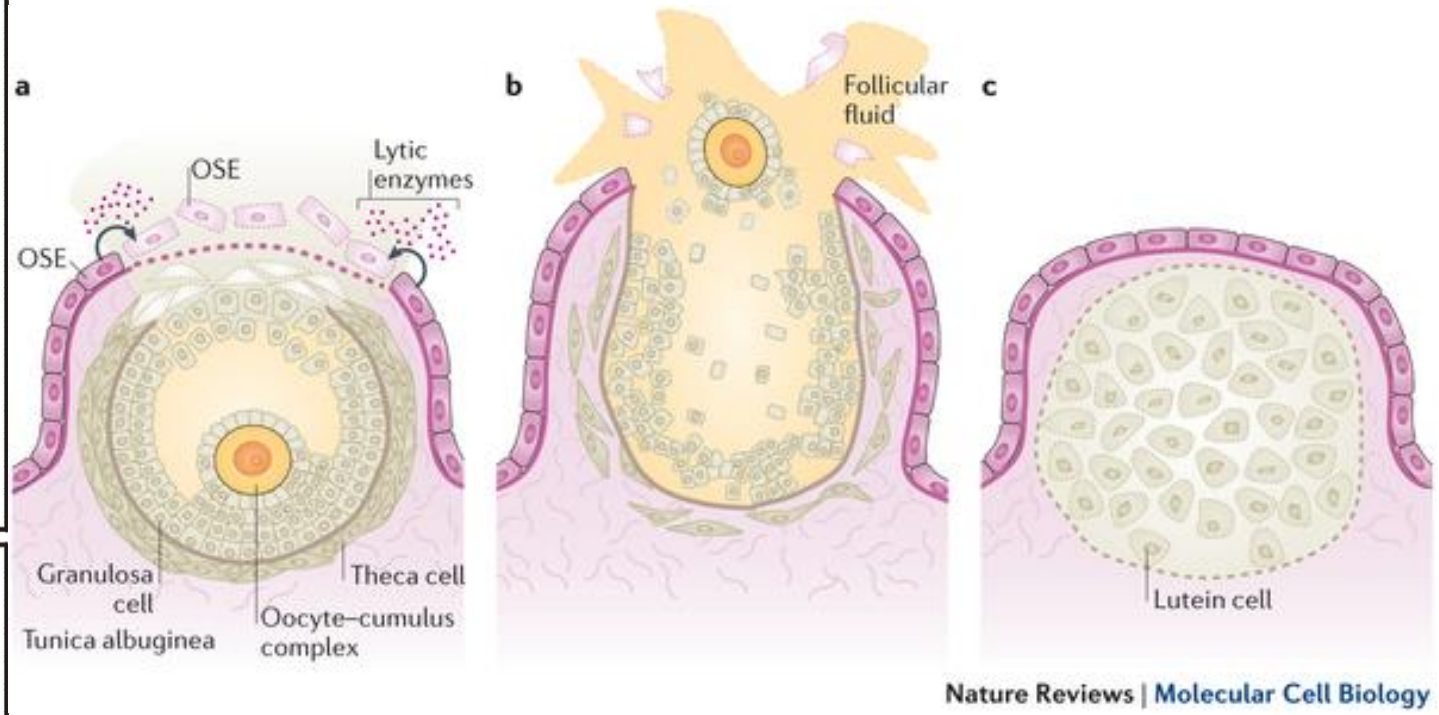
3 Secondary Follicle:
has an antrum
contains a primary oocyte
--approximate size 125-150 µm



4 Mature (Graafian) Follicle
contains a primary oocyte
(approximate size 125-150 µm)
until hours before ovulation
when meiosis I is completed
presence of first polar body
indicates secondary oocyte







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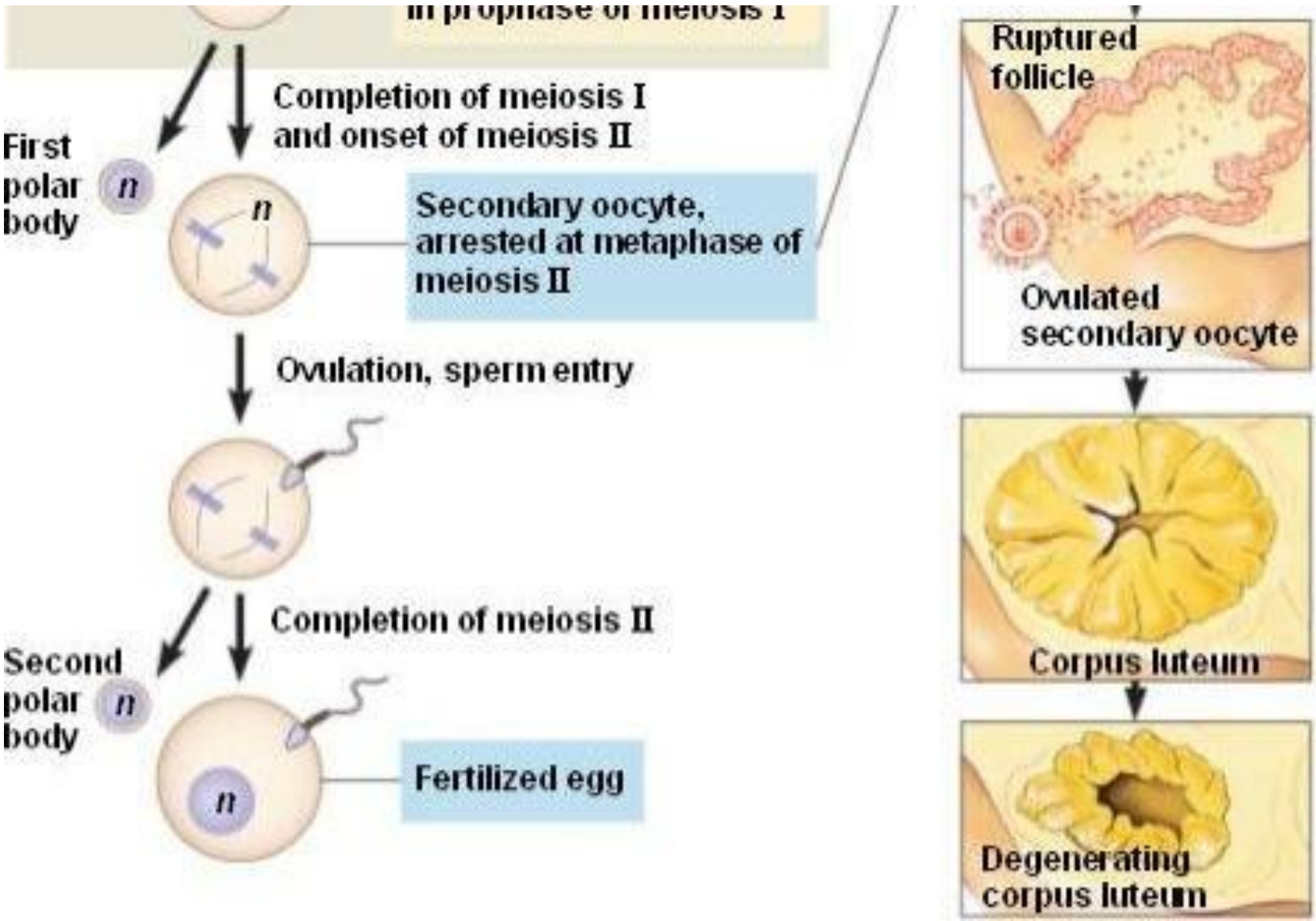
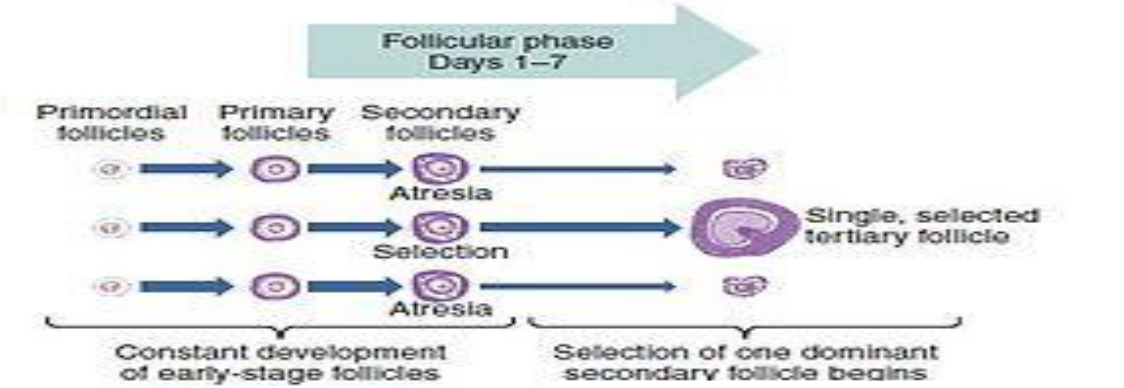
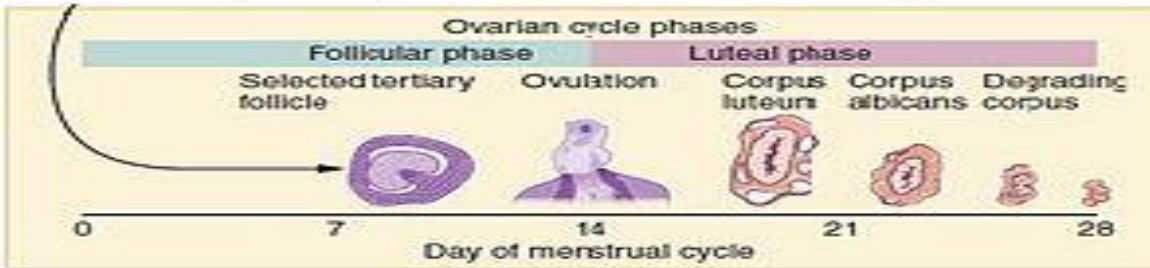
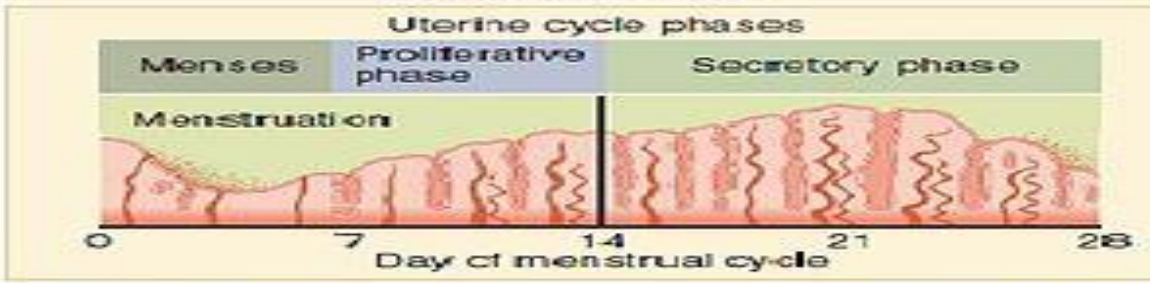
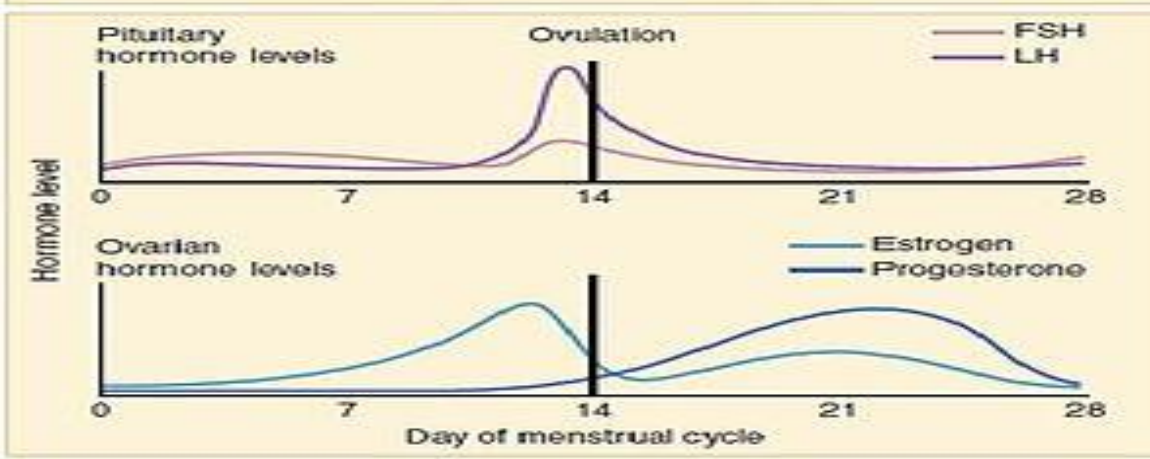
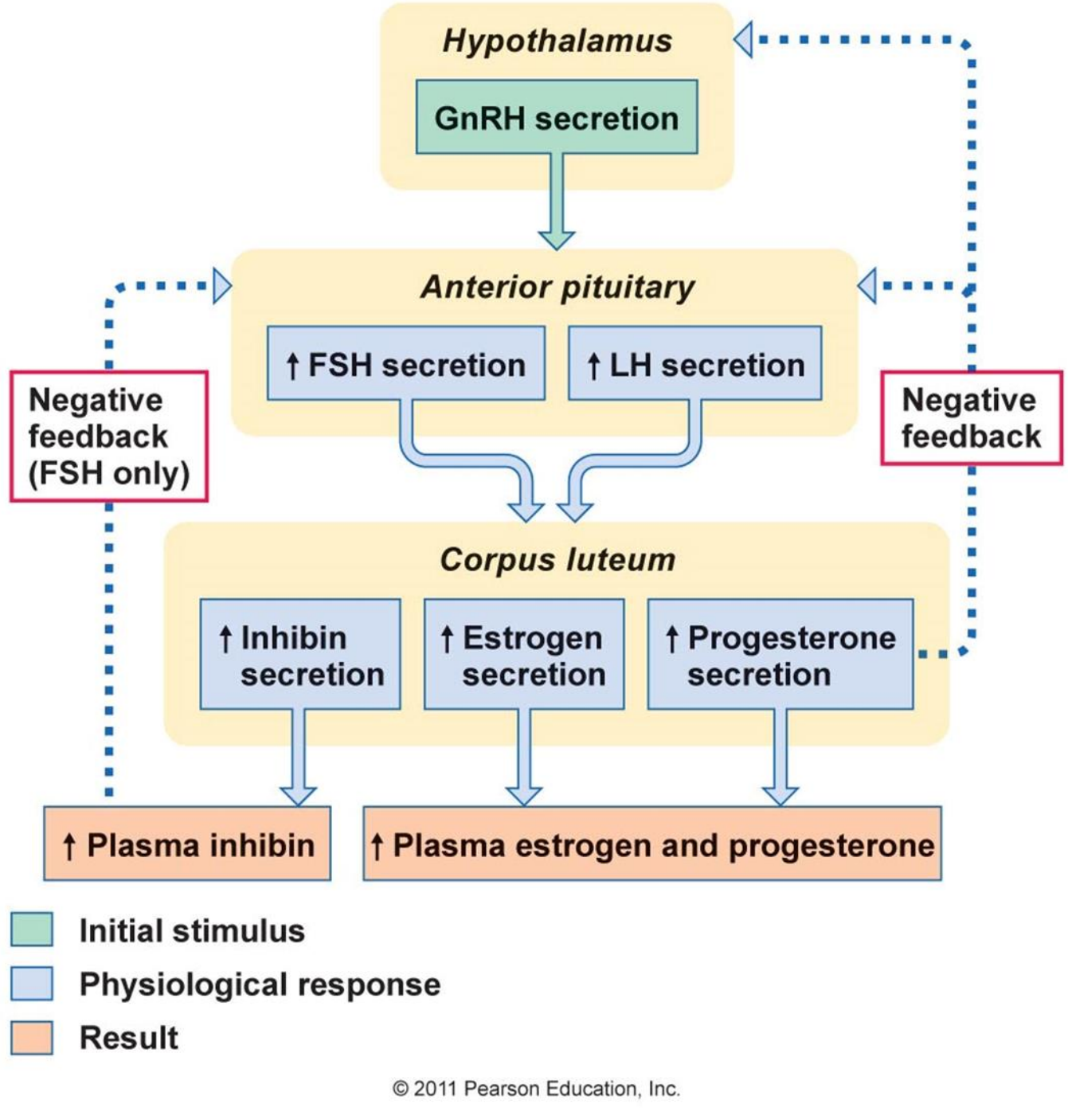

in prophase of meiosis I
Completion of meiosis I
and onset of meiosis II
First
polar
body
n
n
Secondary oocyte,
arrested at metaphase of
meiosis II
Ovulation, sperm entry
Completion of meiosis II
Second
polar
body
n
n
Fertilized egg
Ruptured
follicle
Ovulated
secondary oocyte
Corpus luteum
Degenerating
corpus luteum



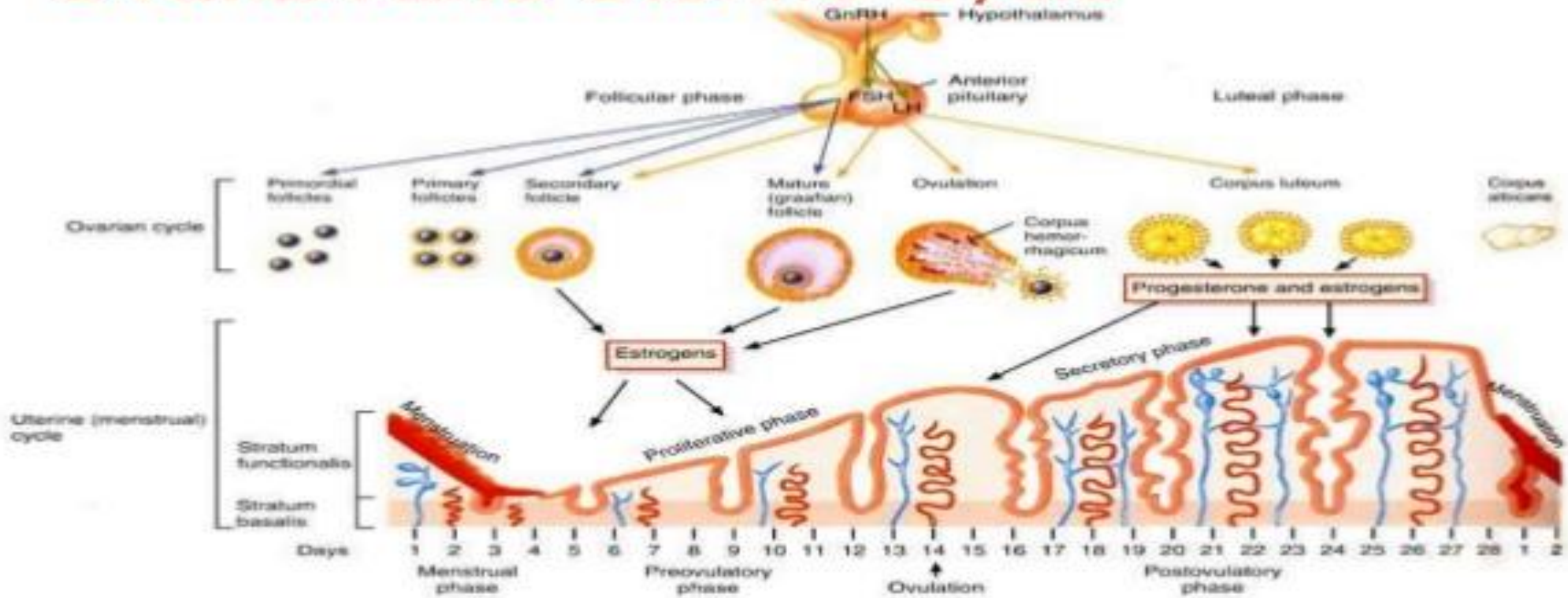




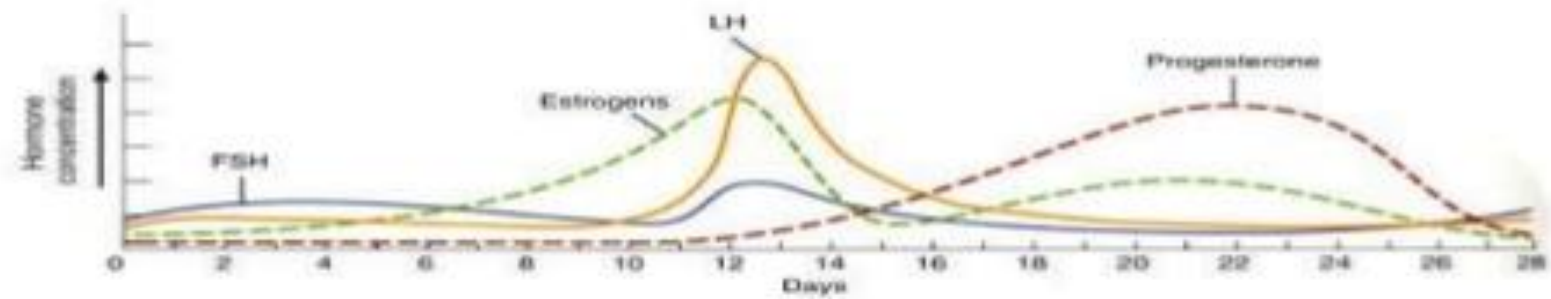




Ovarian and Uterine Cycle

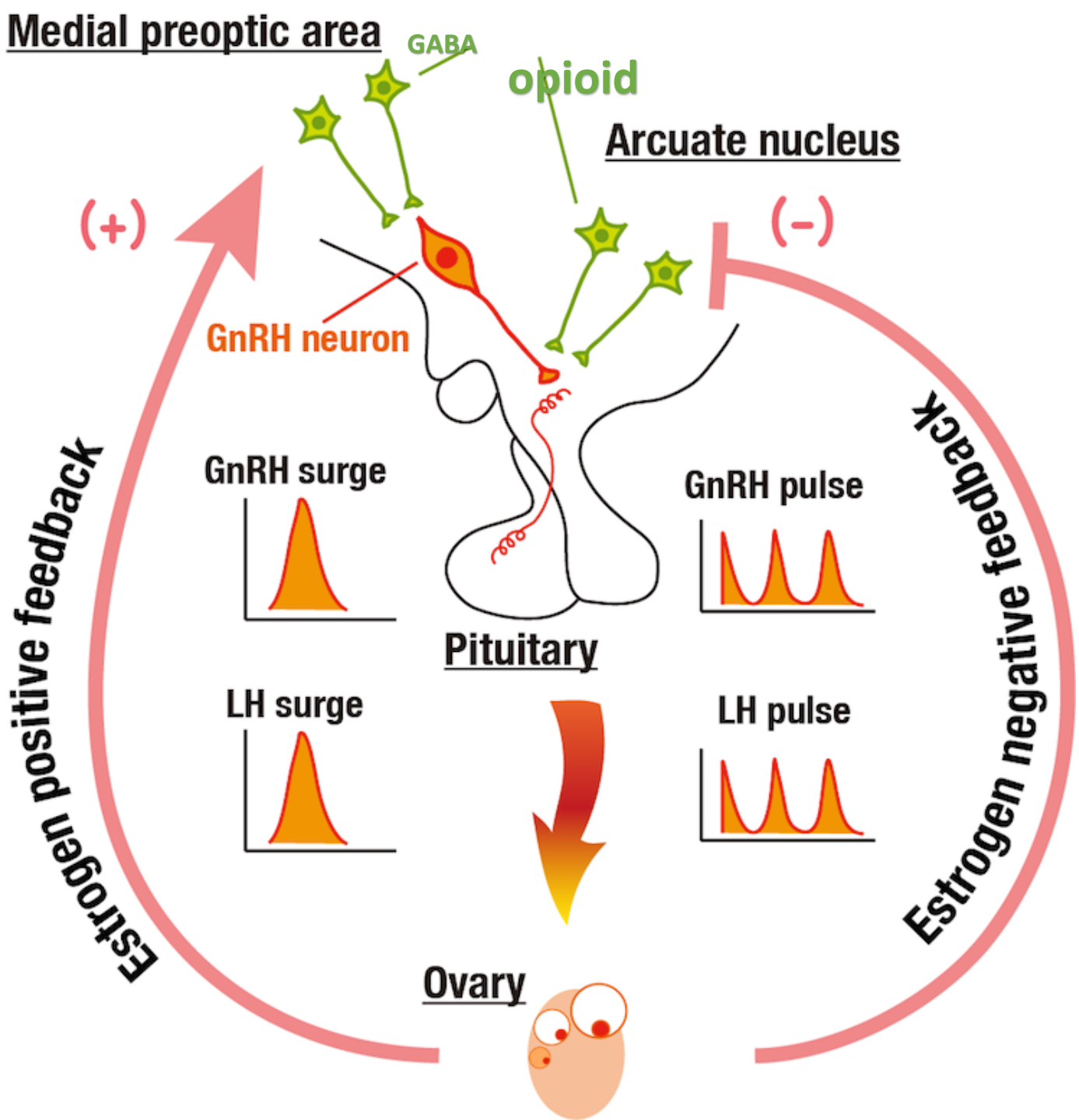


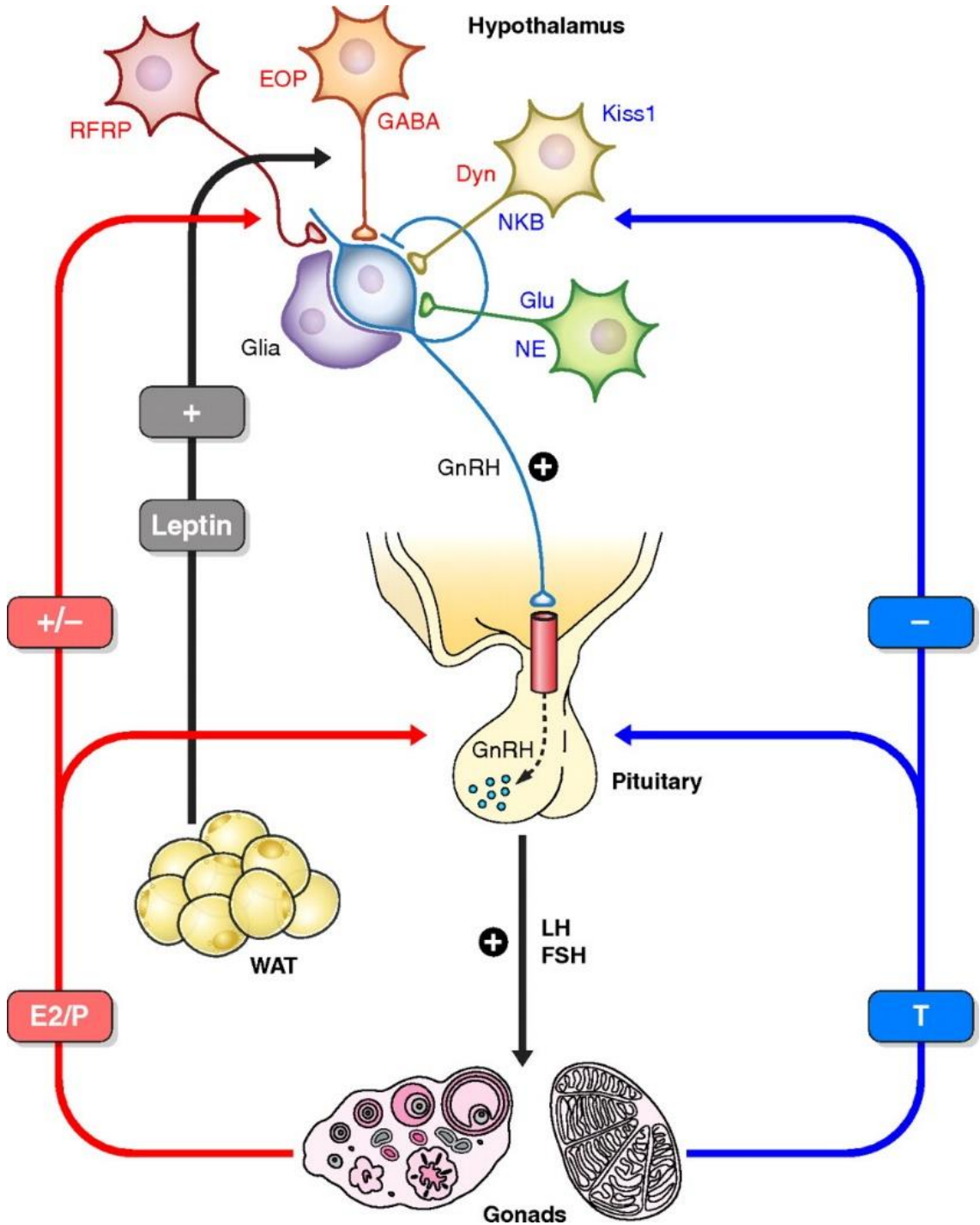
(a) Hormonal regulation of changes in the ovary and uterus



(b) Changes in concentration of anterior pituitary and ovarian hormones

- During the proliferative phase, estradiol stimulates the development of Golgi complex-derived primary lysosomes, many of which contain acid phosphatase, a potent lytic enzyme
- During the first half of the luteal phase, lytic enzymes, including acid phosphatase, are confined to membrane-bound lysosomes. Their release is presumably inhibited by the membrane-stabilizer effect of progesterone. The sudden decrease in estradiol and progesterone levels causes a failure in the membrane integrity of acid phosphatase-containing lysosomes.
- PGF2α and PGE2 increase significantly in the secretory endometrium by the 25th day of the cycle and reach maximum concentrations during the menstrual period, but PGF2α increases to a much greater degree than does PGE2. It has been speculated that the high levels of the potent vasoconstrictors endothelin, which acts on spiral arterioles, and PGF2α, which is seen during menstruation, may stimulate the onset of bleeding via vasoconstriction of spiral arterioles at the endometrial-myometrial junction and the expulsion of degenerated endometrium through myometrial contractions, respectively.

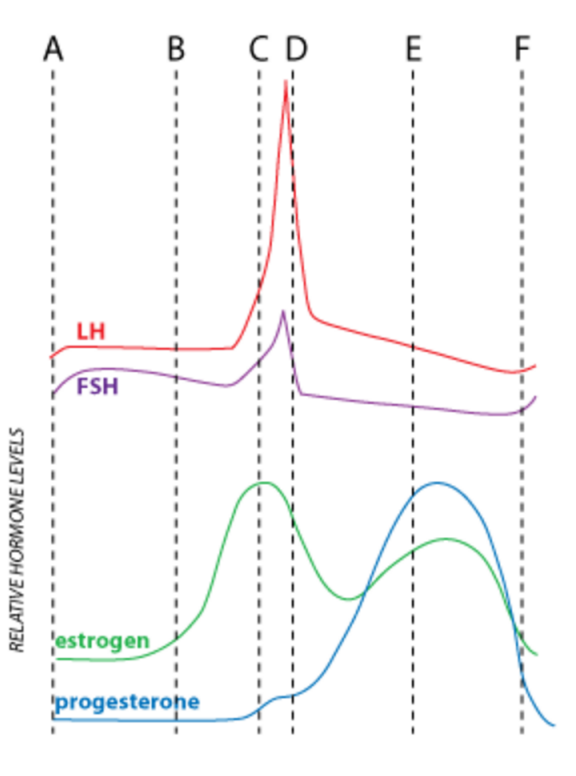

Medial preoptic area
GABA
opioid
Arcuate nucleus
(+)
(–)
GnRH neuron
GnRH surge
GnRH pulse
Pituitary
LH surge
LH pulse
Ovary
Estrogen positive feedback
Estrogen negative feedback


Hypothalamus
EOP
RFRP
GABA
Kiss1
Dyn
NKB
Glu
NE
Glia
+
GnRH
Leptin
+/–
–
GnRH
Pituitary
WAT
LH
FSH
E2/P
T
Gonads

Quiz: Female Cycle

Refer to the figure at right. The dotted lines marked with letters represent particular times during the cycle. Type in the letter for the time that best matches the descriptions below. Note that letters may be used more than once (or in some cases, there may be more than one correct answer).

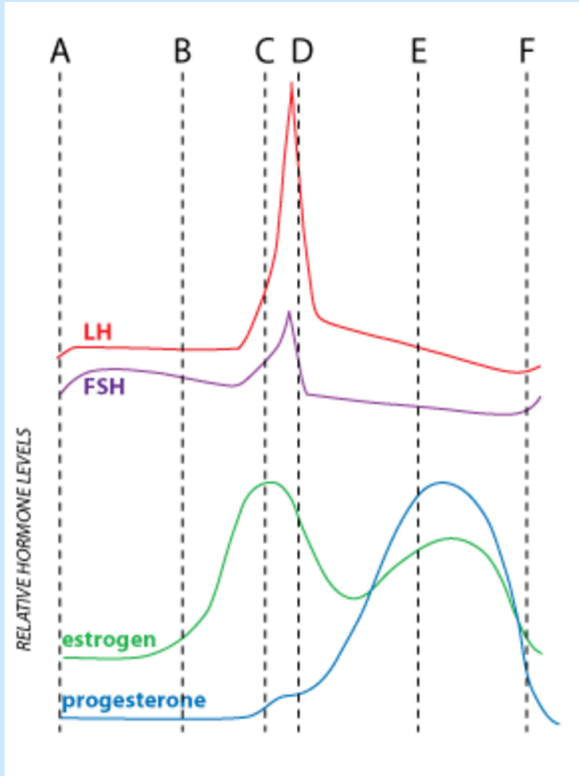
	Fill in choice	Correct	False	Correct Answer
1. Estrogen is inhibiting gonadotropin secretion (negative feedback effect).				
2. Estrogen stimulates gonadotropin secretion (positive feedback effect).				
3. This time corresponds to dominant follicle selection.				
4. This time corresponds to the first day of menstruation.				
5. Granulosa cells proliferate in response to FSH **only**, not LH.				
6. Granulosa cells respond to **both** FSH and LH.				
7. Negative feedback by **both** estrogen and progesterone prevents ovulation.				
8. Corpus luteum is degenerating.				
9. Gonadotropin levels rise due to release from negative feedback inhibition.				
10. **Progesterone** promotes **secretion** by endometrial glands.				
11. **Estrogen** promotes **proliferation** in the endometrium.				
12. This time corresponds to rupture of the dominant follicle.				



Quiz: Female Cycle

Refer to the figure at right. The dotted lines marked with letters represent particular times during the cycle. Type in the letter for the time that best matches the descriptions below. Note that letters may be used more than once (or in some cases, there may be more than one correct answer).

	Fill in choice	Correct	False	Correct Answer
1. Estrogen is inhibiting gonadotropin secretion (negative feedback effect).	E&B	☐	☑	B (also E)
2. Estrogen stimulates gonadotropin secretion (positive feedback effect).	C	☑	☐	C
3. This time corresponds to dominant follicle selection.	B	☑	☐	B
4. This time corresponds to the first day of menstruation.	A	☑	☐	A
5. Granulosa cells proliferate in response to FSH **only**, not LH.	A	☑	☐	B (also A)
6. Granulosa cells respond to **both** FSH and LH.	C	☑	☐	C
7. Negative feedback by **both** estrogen and progesterone prevents ovulation.	E	☑	☐	E
8. Corpus luteum is degenerating.	F	☑	☐	F
9. Gonadotropin levels rise due to release from negative feedback inhibition.	A	☑	☐	A and F
10. **Progesterone** promotes **secretion** by endometrial glands.	E	☑	☐	E
11. **Estrogen** promotes **proliferation** in the endometrium.	B	☑	☐	B and C
12. This time corresponds to rupture of the dominant follicle.	D	☑	☐	D




TO BE
CONTINUED