PHYSIOLOGY
OF
MENSTRUAL CYCLE

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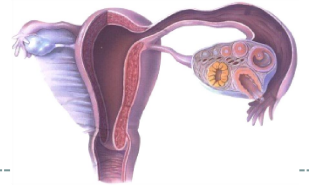
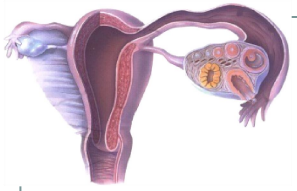
- Menstrual is a Latin word : Lunar month of 28 days.



MENSTRUAL CYCLE

Definition

- Cyclic physiological changes that take place during reproductive period in female

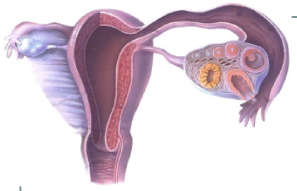


Menarche: a woman's first menstruation

- Starts typically around 11-12 years
- Depends on overall health and diet

Menopause

- End of a woman's reproductive phase
- around 45-50 years.



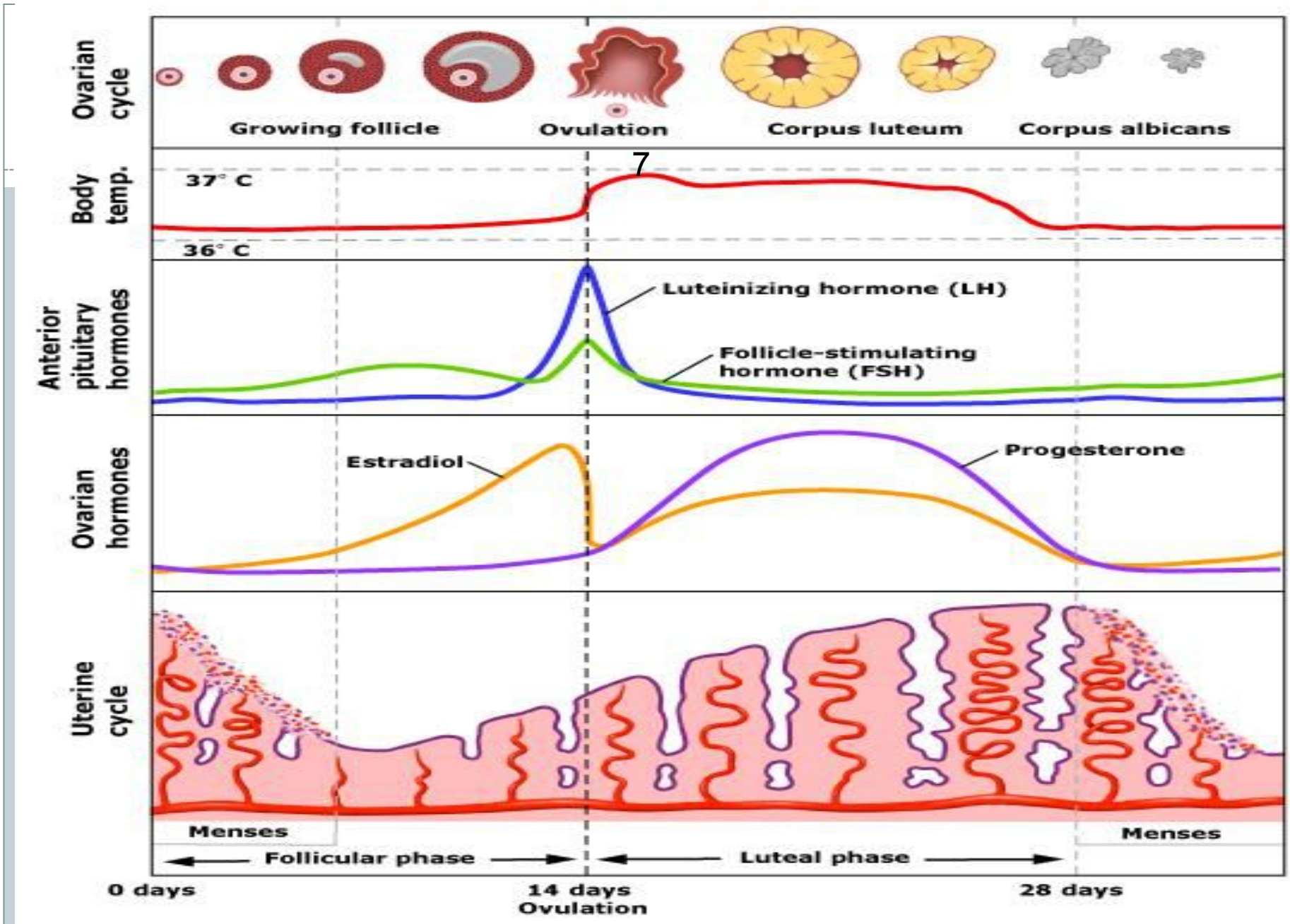
DURATION

28 days (20 to 40 days)

CHANGES DURING MENSTRUAL CYCLE

Changes in

I. Ovary
II. Uterus
III Cervix
IV. Vagina
V Fallopian tubes
VI Hormonal secretion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Growing follicle
Ovulation
Corpus luteum
Corpus albicans
Body temp.
37° C
36° C
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14 days
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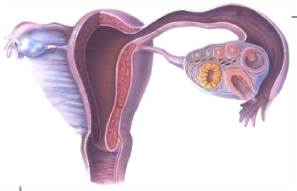
28 days



Ovarian Cycle

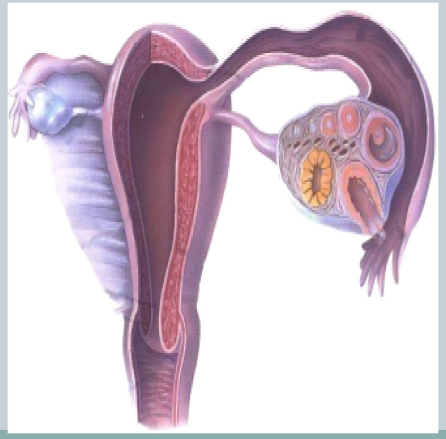
- Three phases

1. Preovulatory phase or Follicular phase
2. Ovulation
3. Postovulatory phase or Luteal phase

Preovulatory / Follicular phase

- Begins with bleeding on 1st day of menstrual cycle & ends with ovulation

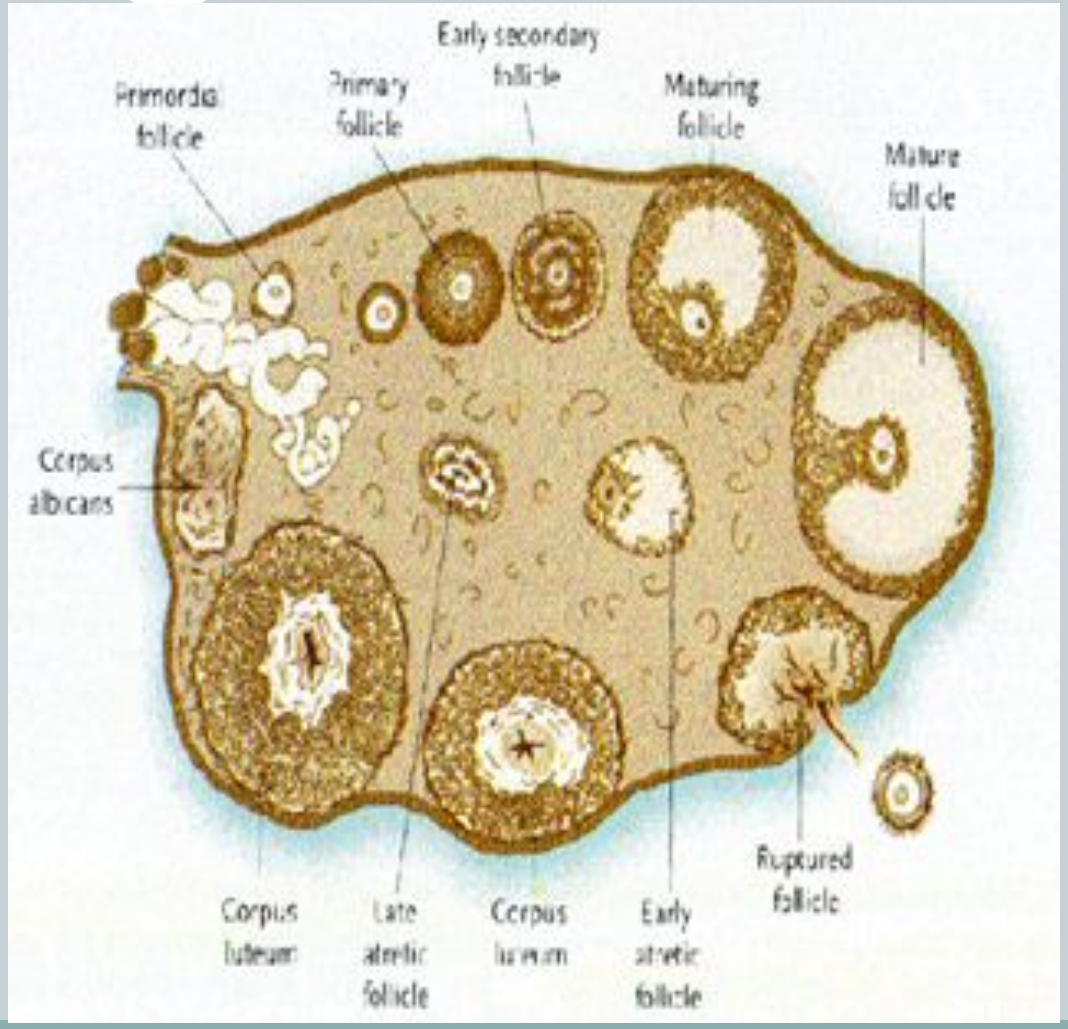
  Folliculogenesis : Maturation of ovum.



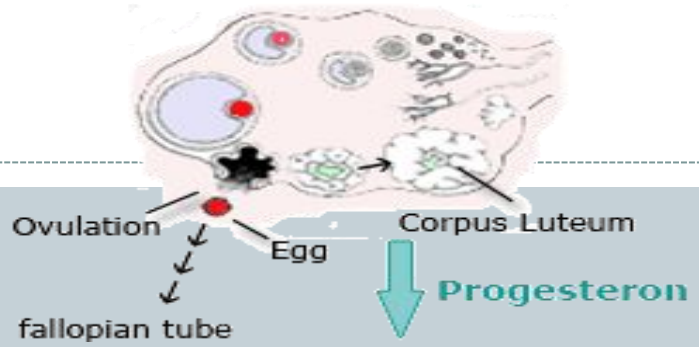
FOLLICULOGENESIS

Phases :

1. **Primordial** follicle
2. **Primary** follicle
3. **Secondary** follicle
4. **Tertiary** follicle
5. **Mature (Graffian)** follicle



FOLLICULOGENESIS



SELECTION

- 10-15 primordial follicles start maturing but only one matures to fully **dominant (Graffian) follicle** & rest undergo atrophy

♥ Selection of dominant follicle occurs day 5-7

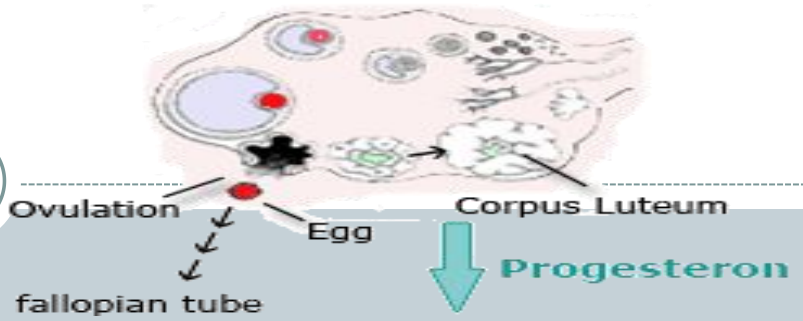
♥ It depends on

- intrinsic capacity of follicle to synthesize estrogen
- no. of FSH receptors

♥ As follicle mature ☯ ✂ estrogen ☯ ✍FSH
"-ve feed back on pituitary" ☯ follicle with highest no. of FSH receptors will continue to thrive

♥ Other follicles undergo atrophy

OVULATION



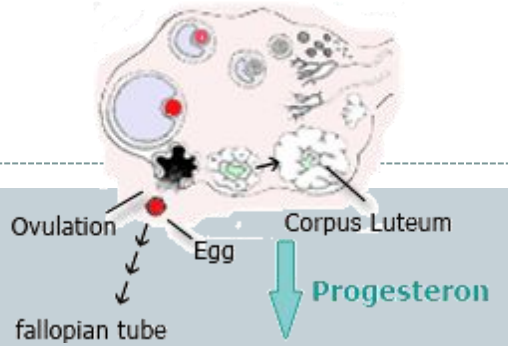
- Release of secondary oocyte from ovary (following rupture of Graffian follicle) into peritoneal cavity.
- It usually occurs 14th day (in a 28-day cycle)
- 36 hrs after mid-cycle LH surge

- During follicular phase, low level of estrogen suppresses production of LH from pituitary gland (**Negative** feedback)
- When ovum has nearly matured, estrogen levels reaches a threshold above which they stimulate production of LH , LH SURGE (**Positive** feedback)
- Also there is FSH surge
- Gonadotropin surges cause ovulation of dominant follicle after 36 hrs

POSTOVULATORY PHASE

- Remarkably constant period of about 14 days.
- During this phase corpus luteum is developed and hence it is called luteal phase.

Ovulation inside the ovary:



Ovulation

↓

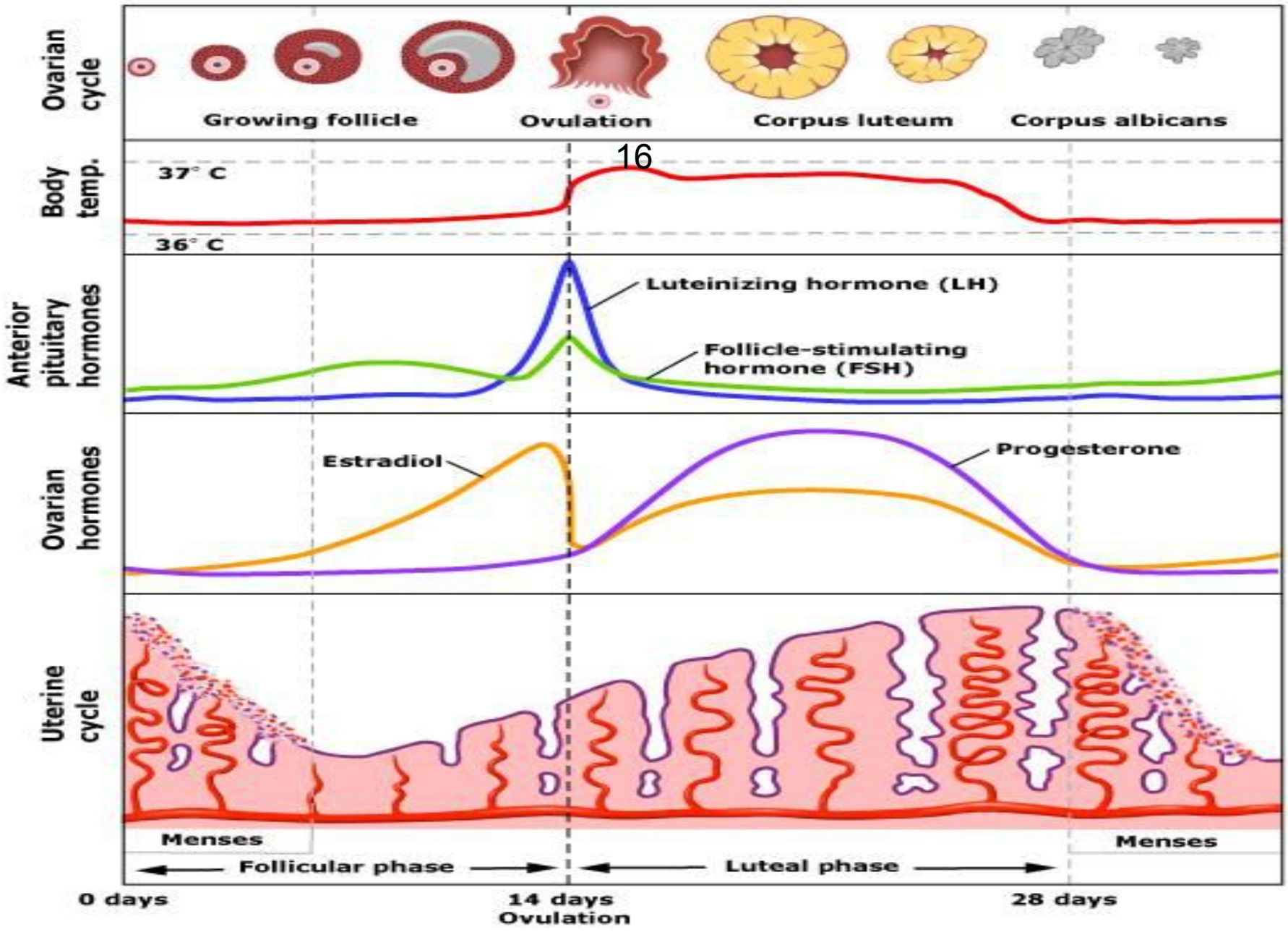
Corpus haemorrhagicum

↓

Corpus luteum

↓

1. Corpus albicans
2. Corpus luteum of pregnancy.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UTERINE CHANGES
ENDOMETRIAL CYCLE

- Endometrial cycle refers to cyclic changes occurring in the endometrium during reproductive period in females.

PHASES OF ENDOMETRIAL CYCLE

1st day of bleeding is considered as first day of cycle

- Three phases
- Menstrual phase
- Proliferative / Follicular (Estrogen) phase
- Secretory / Luteal phase (Progesterone) phase

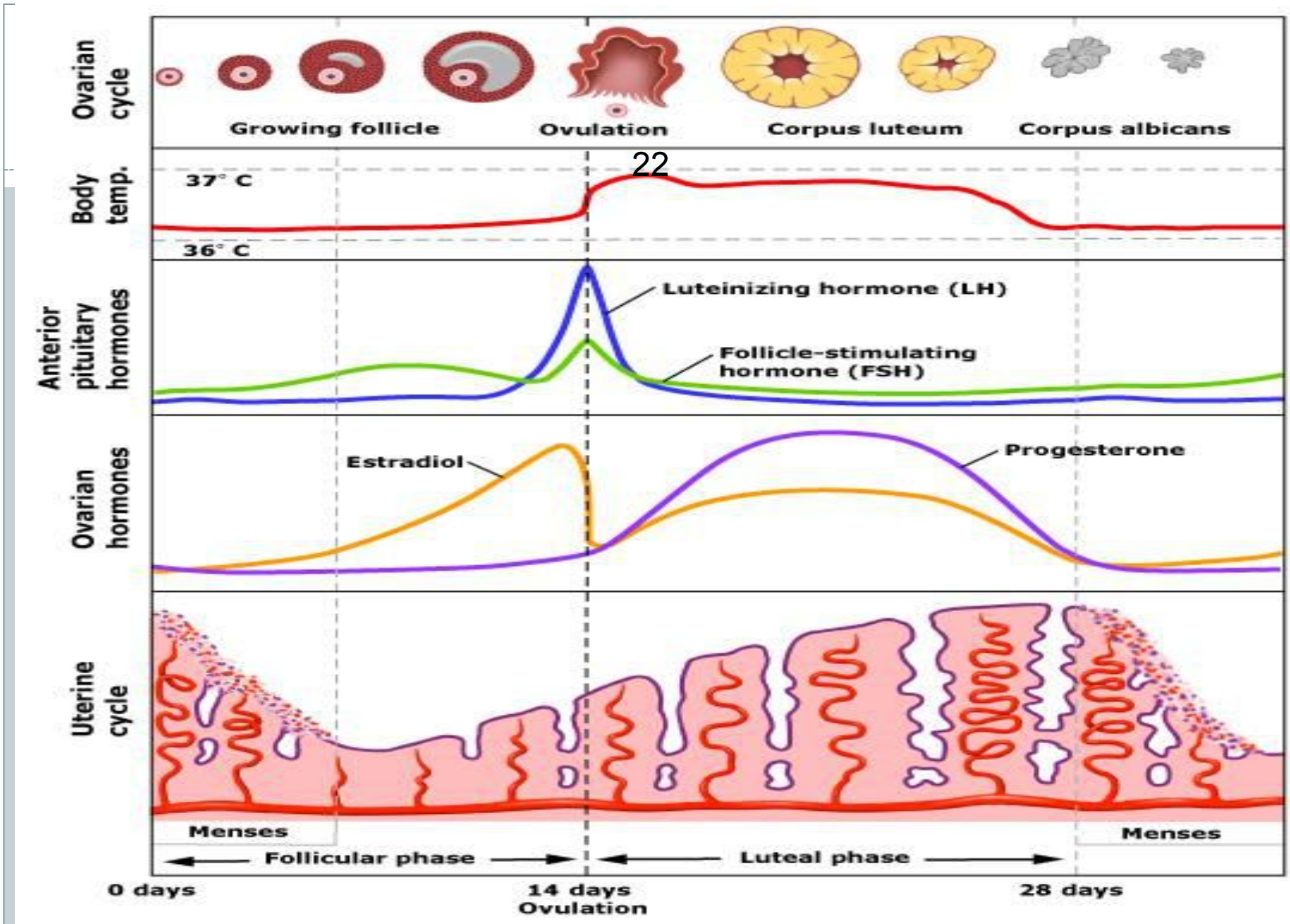
- Menstrual phase : 1st - 5th day
- Proliferative phase : 6th - 14th day
- Secretory phase : 15th - 28th day

Proliferative phase

- Also known as Preovulatory phase
- 6^{th} to 14^{th} day.
- It follows phase of menstruation, after which only a thin basal layer of endometrium is left.
- Changes are due to oestrogen secreted by graafian follicle in the ovary.
- Thus, it coincides with follicular phase of ovarian cycle.

- Changes in endometrium:
- **Re epithelialise** endometrium.

  Thickness of endometrium, ↑ from 1 mm to 3-4 mm
- **Angiogenesis** leads to proliferation of blood vessels which become the spiral arterioles
- Endometrial **glands grow**. They contain glycogen but are nonsecretory.
- At the end of this phase ovulation occurs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0 days
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28 days

Secretory phase

- Syn : Postovulatory phase .
- 15th to 28th day.
- Changes are due to both estrogens & progesterone secreted by corpus luteum .
- This coincides with luteal phase of ovarian cycle.

Secretory phase

- Characteristic Changes

1. Prominent corkscrew-shaped glands

2. Increased vascularity

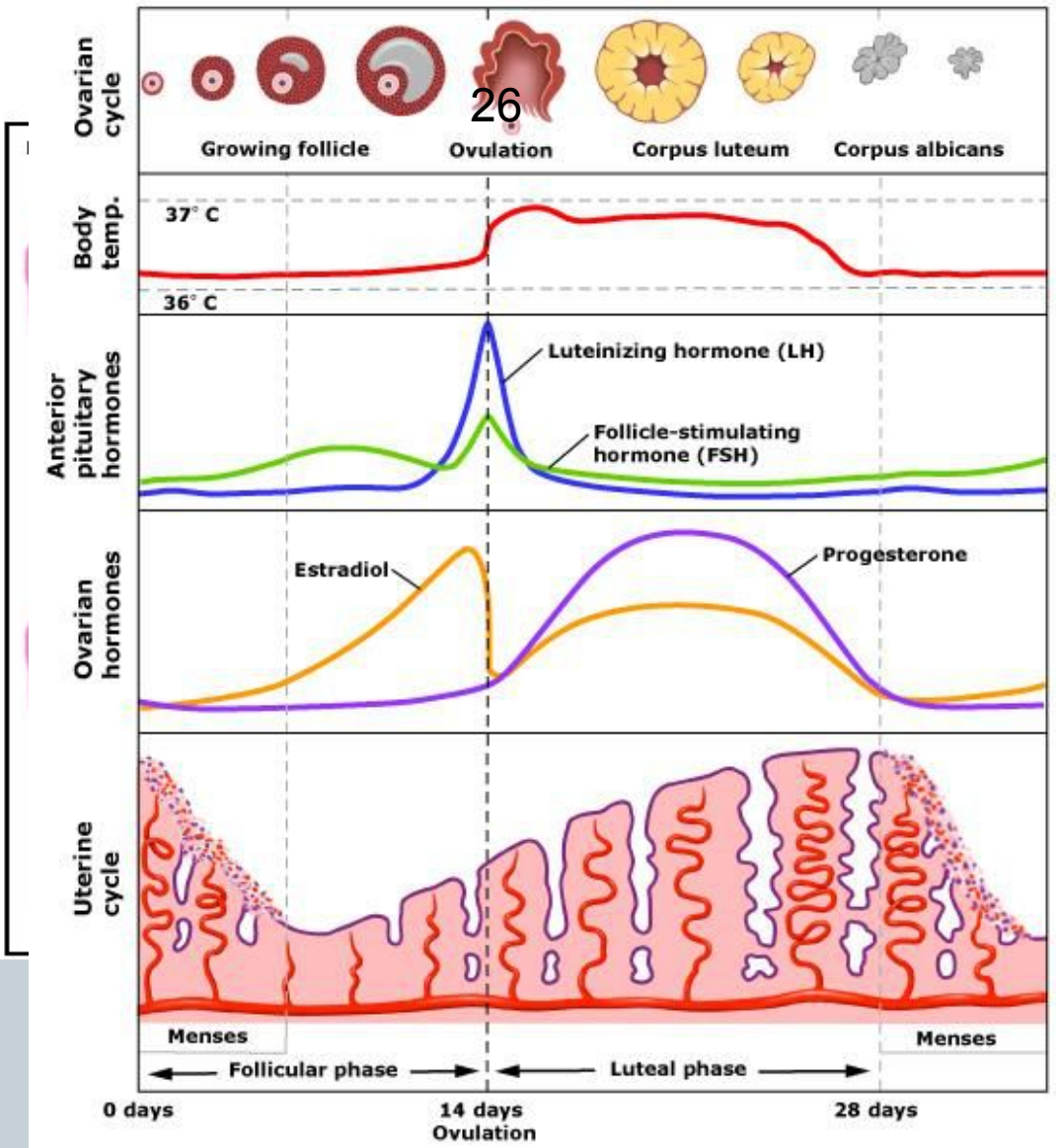
Secretory phase cont…

- Endometrial glands increases in size & exceeds thickness of endometrium. So, they become tortuous

  They secrete thick viscous fluid containing glycogen.

- Blood supply of endometrium further increases
- Thickness of endometrium ↑ to 5-6 mm.
- These changes provide appropriate conditions for implantation.

- If fertilization does not occur, corpus luteum involutes & on 26th day oestrogen & progesterone level falls & mark end of secretory phase.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Menstrual phase

- Average duration is 3-5 days .

- On 26^{th} or 27^{th} day of previous cycle, there is sudden reduction in estrogen & progesterone from ovary. This is responsible for menstruation.

Menstrual phase

Mechanism:

Local production of leukotrienes & prostaglandins

↓

Intense spasm of sprial arteries & contractions of myometrium.

↓

Ischaemia

↓

Hypoxia

↓

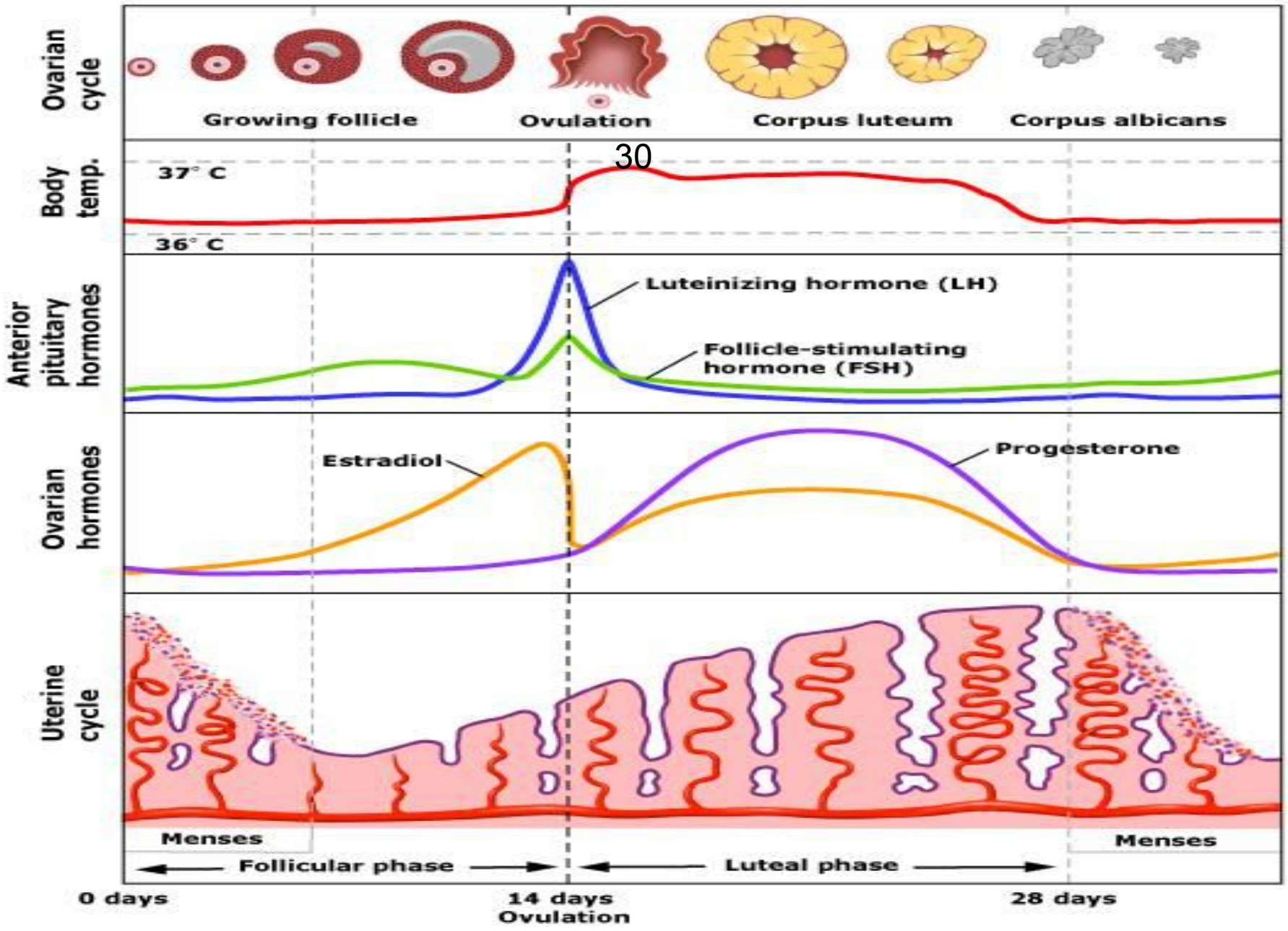
Necrosis of stratum functionale

↓

Rupture blood vessels & blood oozes out (Average 30 ml)

Menstrual phase

- It immediately gets clotted in uterus but soon gets liquefied by fibrolysins present in endometrial debris.
- Therefore menstrual blood does not contain blood clots unless flow is excessive.
- During this phase about 2/3rd of endometrium is sloughed off & only a thin basal layer is left .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CYCLIC CHANGES IN CERVIX

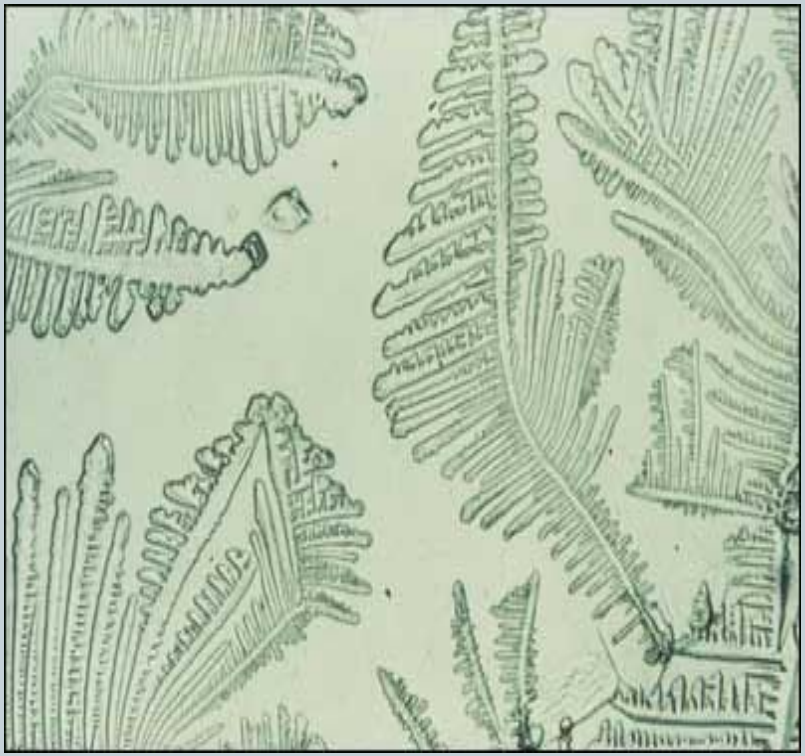
- **Menstruation phase**

  No shedding off mucosa

CYCLIC CHANGES IN CERVIX

- **Proliferative phase**

  Cervical secretions become thin watery and alkaline.
- At ovulation , cervical mucus is thinnest and its elasticity is maximum. It can be stretched like a long, thin elastic thread upto 8-12 cm (**spinnbarkeit** effect).
- This favours transport of sperms in female genital tract
- When a drop of Mucus is spread on glass slide , it produces a characteristic fern-like pattern
- **Fern test**: Normally Fern pattern disappears after ovulation in secretory phase.



CYCLIC CHANGES IN CERVIX

- **Secretory phase**

Cervical secretions decrease in quantity & becomes thick.

These changes make a plug and prevent entry of sperm through cervical canal.

CYCLIC CHANGES IN VAGINA

- Proliferative phase

  Epithelium becomes thickened & cornified. They accumulate glycogen.

- Secretory phase

  Epithelium proliferates & gets infiltrated with leucocytes

  Secretions become thick and viscid.

  These changes increases resistance to infection.

Changes in fallopian tubes

i. During follicular phase:

- ↑ number & rate of beating of cilia
- ↑ number of secretory epithelial cells
- ↑ vascularization of fimbria.

ii. At time of ovulation, motility of fallopian tubes increases.

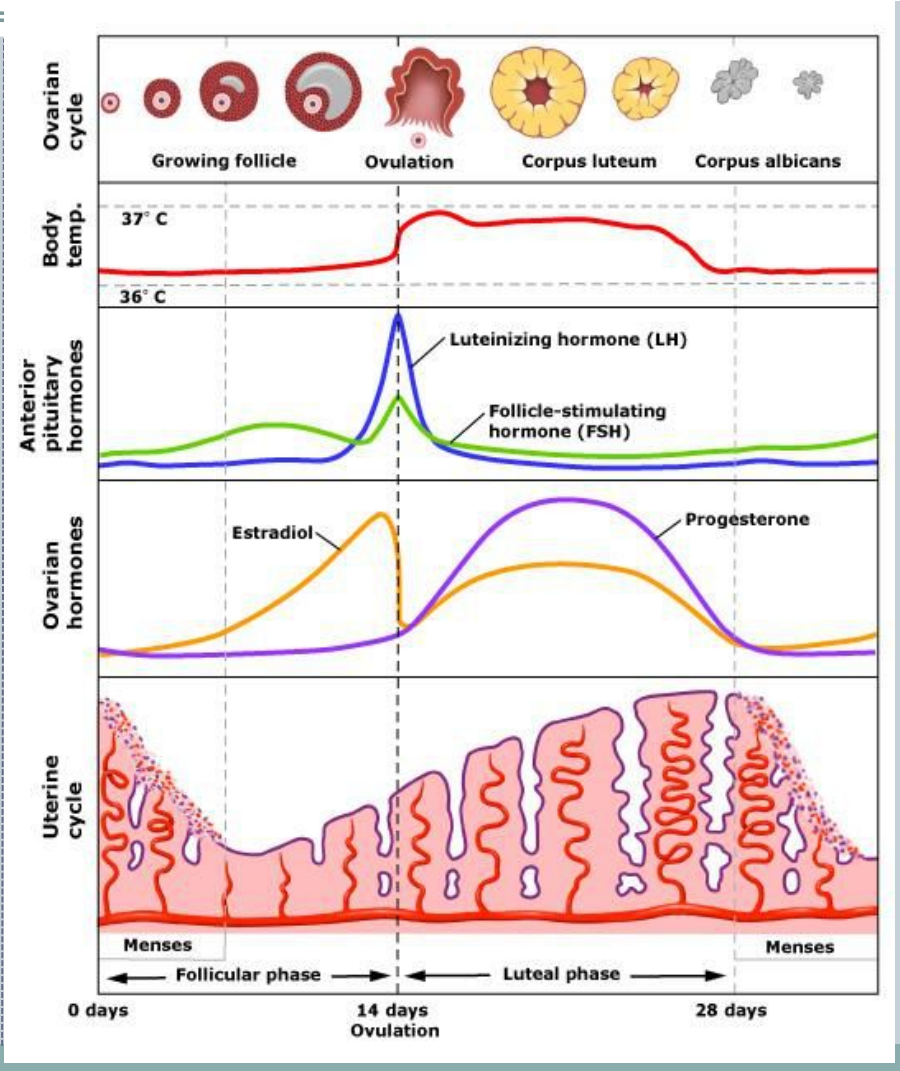
iii. During luteal phase, ↑ secretion of epithelial cells. This provides nutrition to ovum, sperm & zygote if fertilization occurs.

HORMONAL REGULATION

1) Proliferative Phase :
   Estrogens

2) Secretory Phase :
   Progesterone

3) Menstrual
   Phase :commences as hormone production by corpus luteum declines



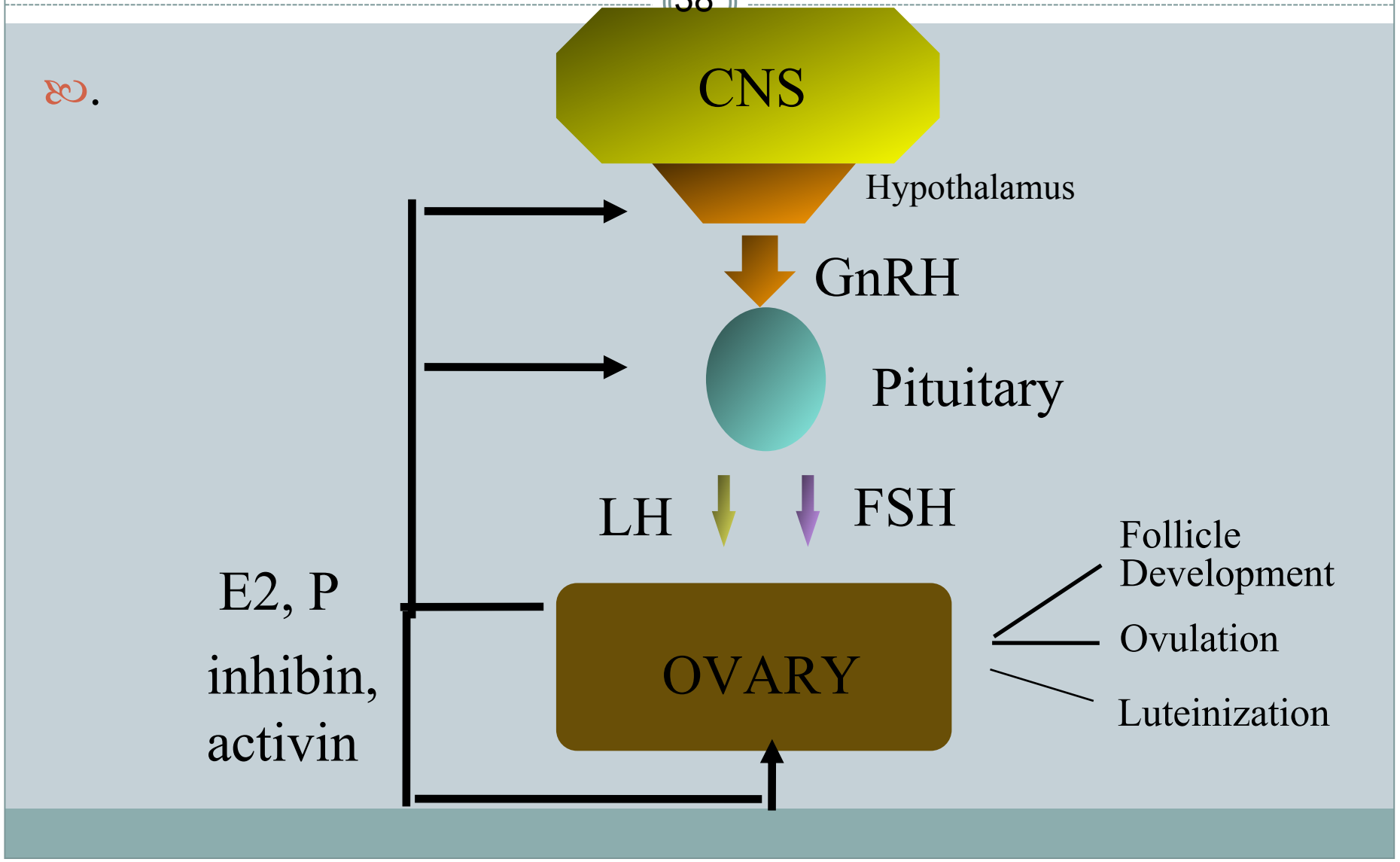
HORMONAL CONTROL OF MENSTRUAL CYCLE

HPO Axis

- Hormones involved are:

1. Hypothalamic hormone - GnRH
2. Anterior pituitary hormones - FSH and LH
3. Ovarian hormones - Estrogen and progesterone.

HPO axis


CNS
Hypothalamus
GnRH
Pituitary
LH
FSH
E2, P
inhibin,
activin
OVARY
Follicle
Development
Ovulation
Luteinization

Hypothalamic Hormone

- GnRH is also known as luteinizing hormone releasing hormone (LHRH)
- It stimulates secretion of FSH & LH from anterior pituitary.

- It's secretion depends on :

1. External factors like psychosocial events which act on hypothalamus via cortex and other brain centers
2. Feedback via ovarian hormones.

HYPOTHALAMIC ROLE IN THE MENSTRUAL CYCLE

- The hypothalamus secretes GnRH in a pulsatile fashion
- GnRH activity is first evident at puberty
- Follicular phase GnRH pulses occur hourly
- Luteal phase GnRH pulses occur every 90 minutes
- Loss of pulsatility [down regulation of pituitary receptors [∃ secretion of gonadotropins
- Release of GnRH is modulated by –ve feedback by:

  steroids

  gonadotropins
- Release of GnRH is modulated by external neural signals

Anterior Pituitary Hormones

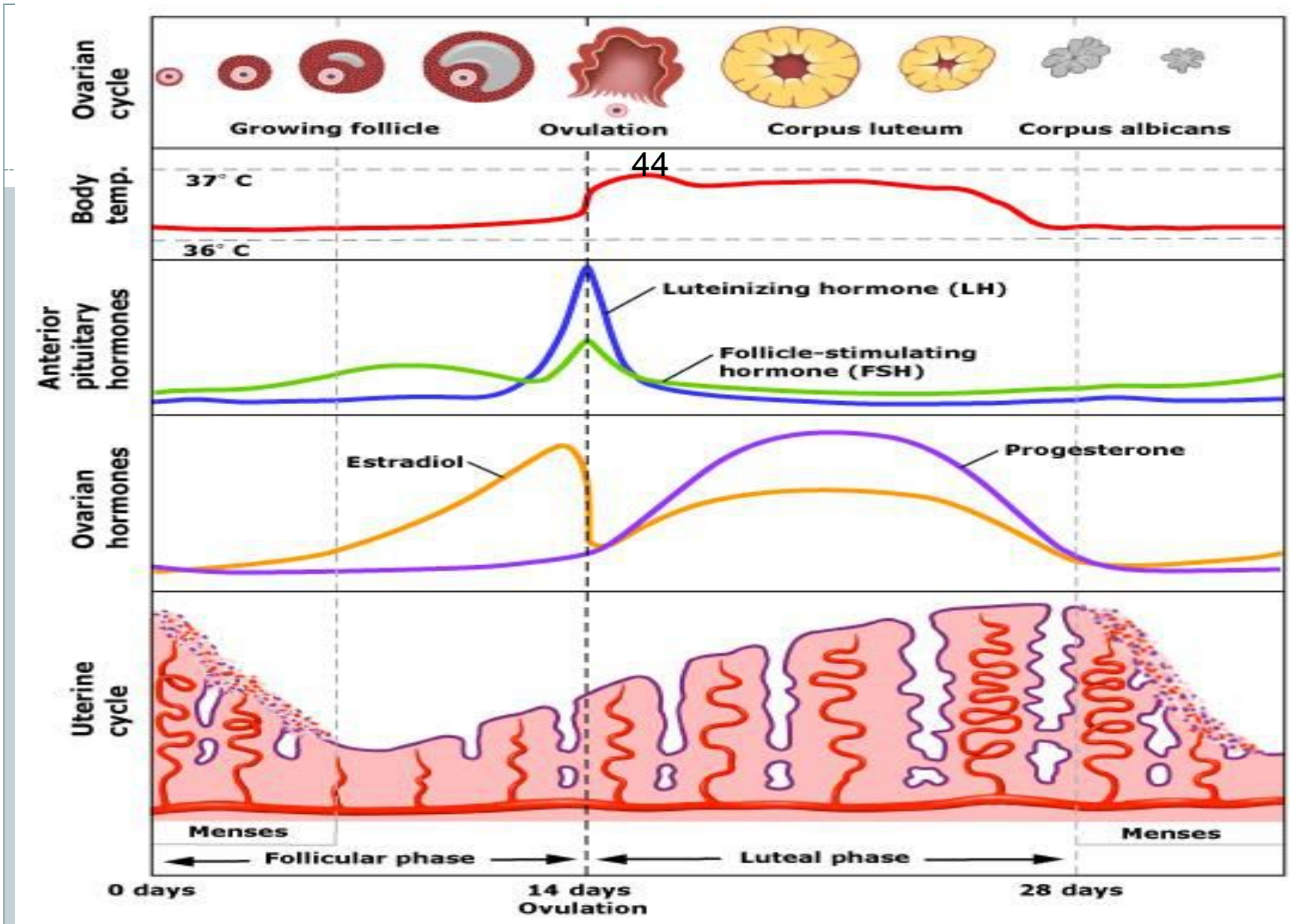
- FSH & LH
- FSH stimulates recruitment & growth of immature ovarian follicles.
- LH triggers ovulation & sustains corpus luteum.

Anterior Pituitary Hormones

- Depending on their plasma levels, effect may be positive , negative or both.
- Oestrogen, in high conentration, (just before ovulation) inhibits FSH secretion (**Negative** feedback) and promotes LH secretion (by **Positive** feedback).
- High levels of gonadal hormones in mid luteal phase inhibit secretion of both FSH & LH (**Negative** feedback).
- Low levels of gonadal hormones (during menstruation phase) increase secretion of both FSH & LH (**Positive** feedback).

Ovarian hormones

- Estrogen & progesterone
- Ovarian follicle secretes estrogen and corpus luteum secretes progesterone.
- Estrogen is responsible for growth of follicles.
- Both hormones act together to produce changes in uterus, cervix and vagina.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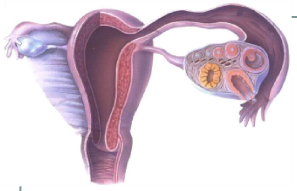
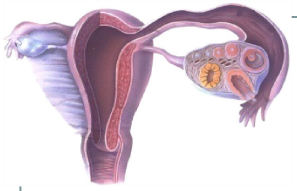


APPLIED PHYSIOLOGY

- Safe Period
- Follicular study
- IUI
- 36 hrs after mid-cycle LH surge (LH surge kit)
- IVF : Retrival of ovum
- Blood clot means excessive blood loss



APPLIED PHYSIOLOGY

- Abnormalities of menustrual cycle
- Abnormalities of ovarian functions
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THANK YOU