

# OVARIAN CYCLE

LOW ESTROGEN AT THE END OF MENSES



FOLLICULAR PHASE

ESTROGEN



SMACK!

OVULATION!

PROGESTERONE

CORPUS LUTEUM

CORPUS ALBICANS

MENSES

LUTEAL PHASE

# UTERINE CYCLE

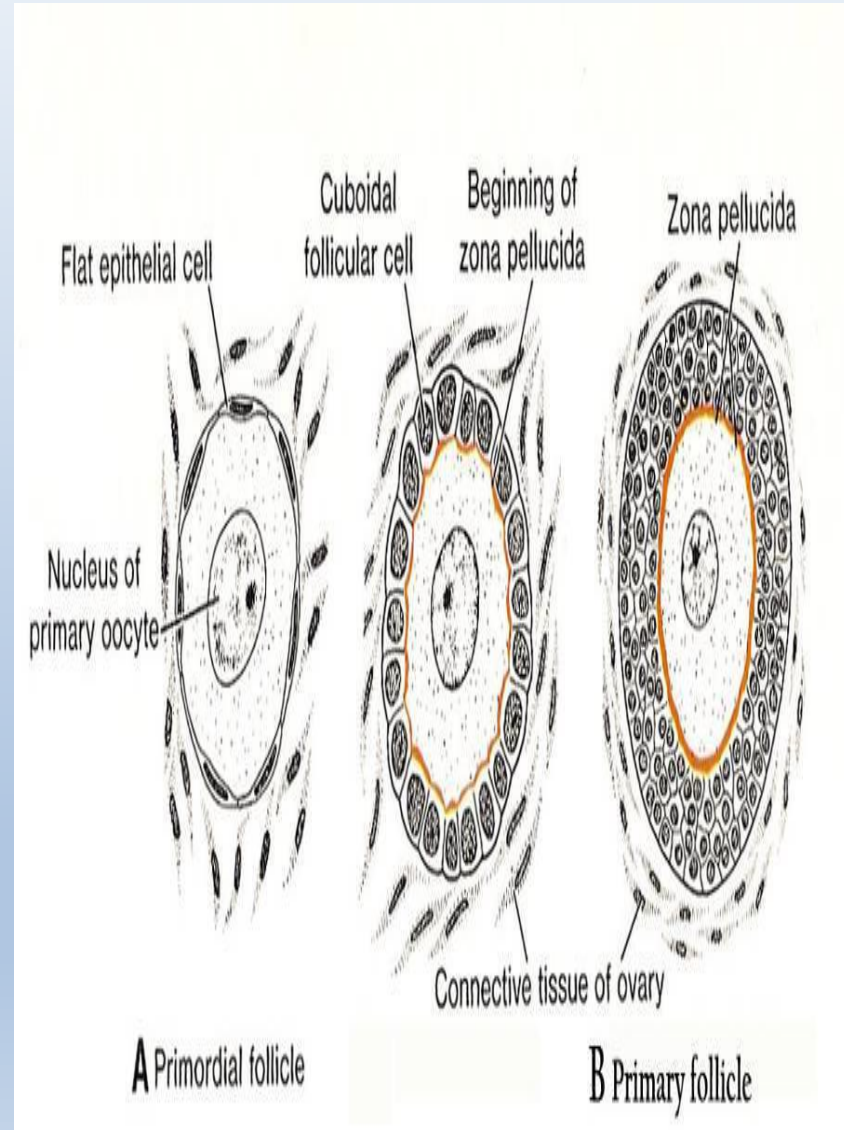
PROLIFERATIVE PHASE: INFLUENCED BY ESTROGEN, THE THICKNESS OF THE ENDOMETRIUM RAPIDLY INCREASES

SECRETORY PHASE: INFLUENCED BY PROGESTERONE, THE LINING BECOMES HIGHLY VASCULAR AND EDEMATOUS

**Cyclic changes in females**  
**DR DALIA M. BIRAM**

# Development of the follicular cells & Formation of Graafian follicle

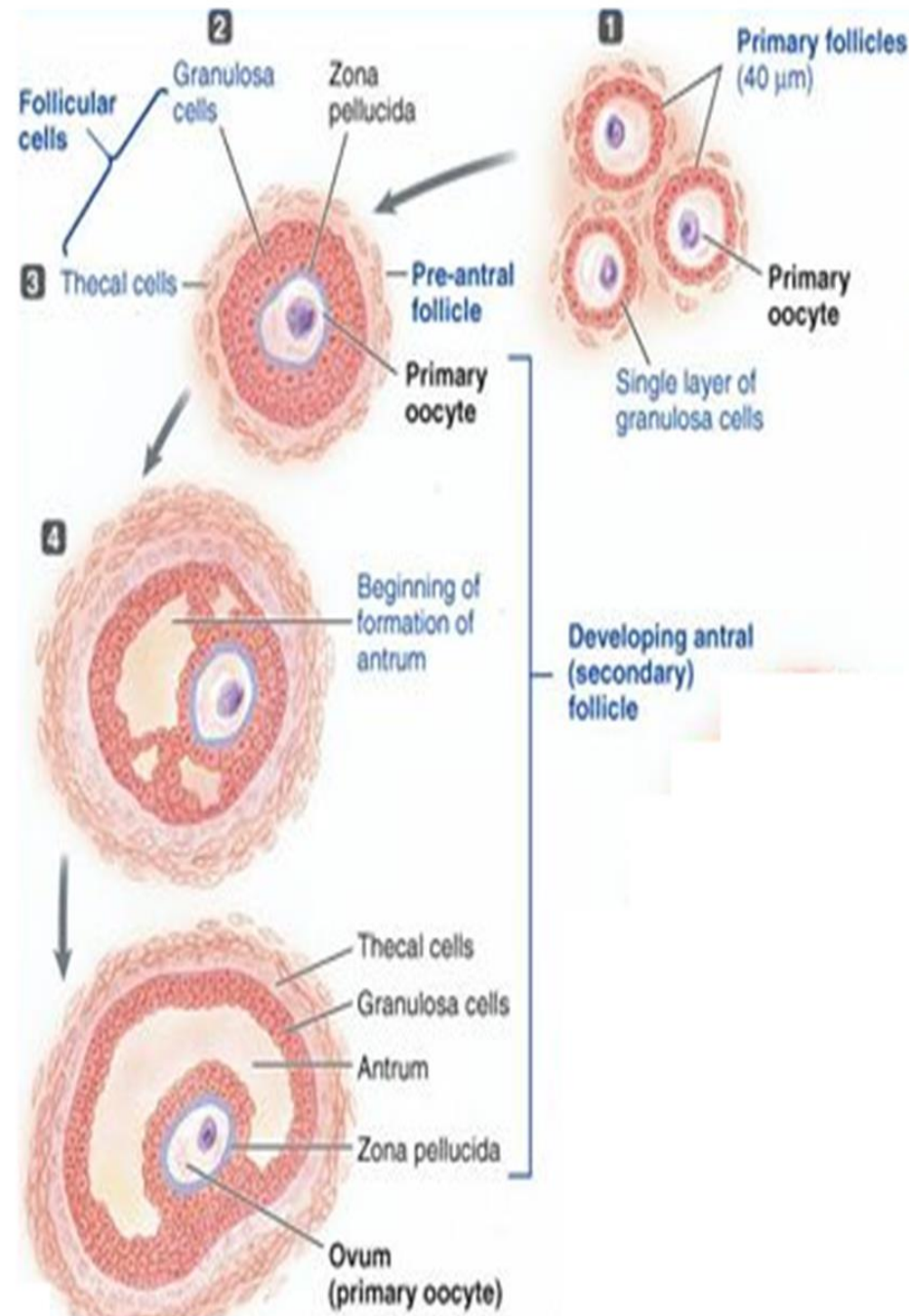
- **During intrauterine life** : Each primary oocyte becomes surrounded by one layer of flat follicular cells to form the **primordial follicle**.
- **At puberty** : Under the effect of **FSH** secreted by pituitary gland , the following changes occur :
  - The single layer of flat follicular cells around the primary oocyte change to cubical cells which proliferate forming many layers of **granulosa cells** around the primary oocyte .
  - The granulosa cells secrete **Zona pellucida** (glycoprotein shell) around the primary oocyte .
  - **Theca folliculi** cells develop around the primary follicle from the surrounding stromal cells of the ovary.
  - The primordial follicle is changed now to **the primary follicle** .



**Small irregular spaces, appear between granulosa cells , containing fluid secreted by granulosa cells .**

**These spaces later coalesce to form a single cavity called *follicular antrum* which is filled with fluid, *liquor folliculi* , containing **estrogen** hormone secreted by granulosa cells .**

**The appearance of follicular *antrum* with the theca cells differentiate into *theca interna* (cellular vascular layer) and *theca externa* (fibrous layer), changing the primary follicle into **secondary follicle.****





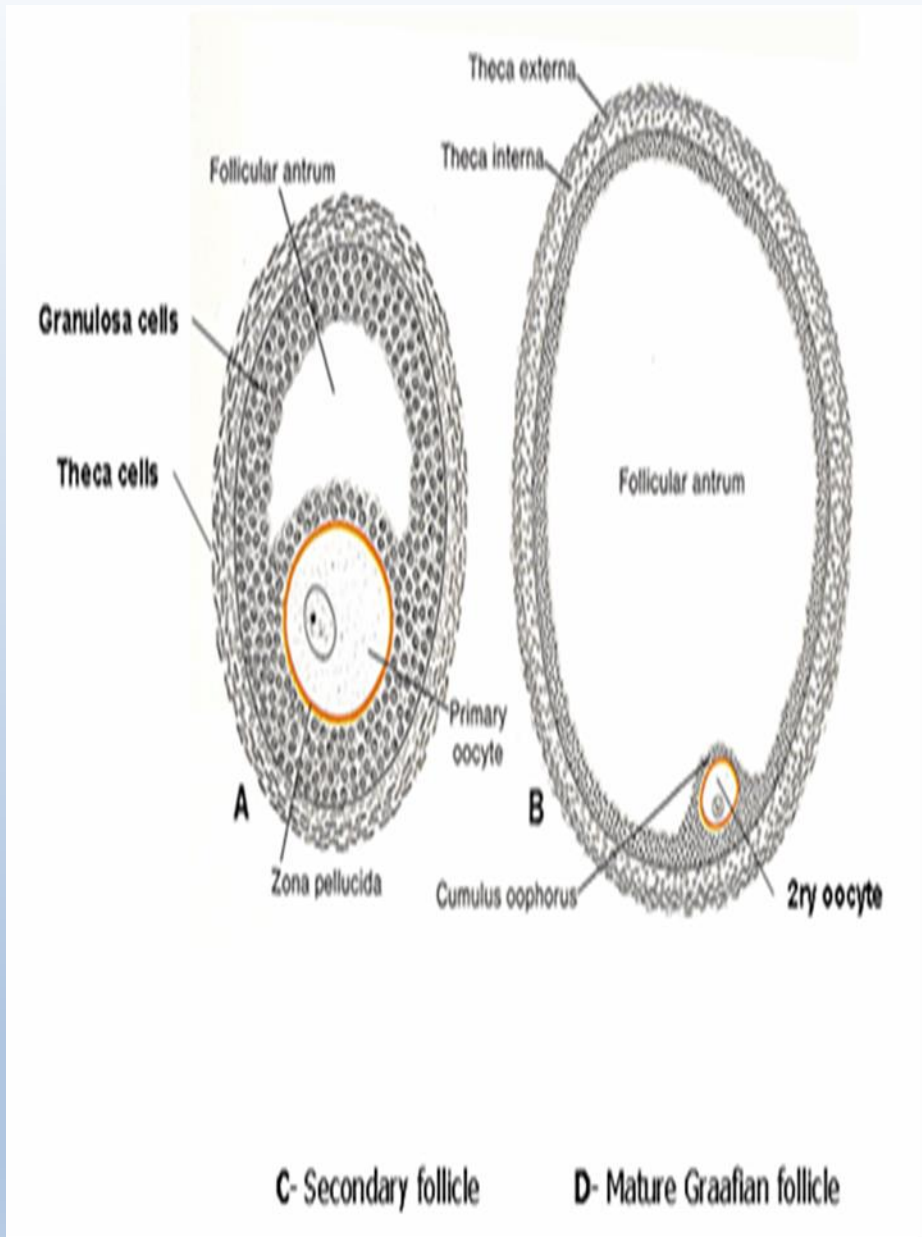
- **Enlargement of the secondary follicle** changes it to **mature Graafian follicle** which is:

**spherical vesicle bulges on the surface of the ovary. Its wall is formed of membrana granulosa (lining the antrum) , theca interna and theca externa.**

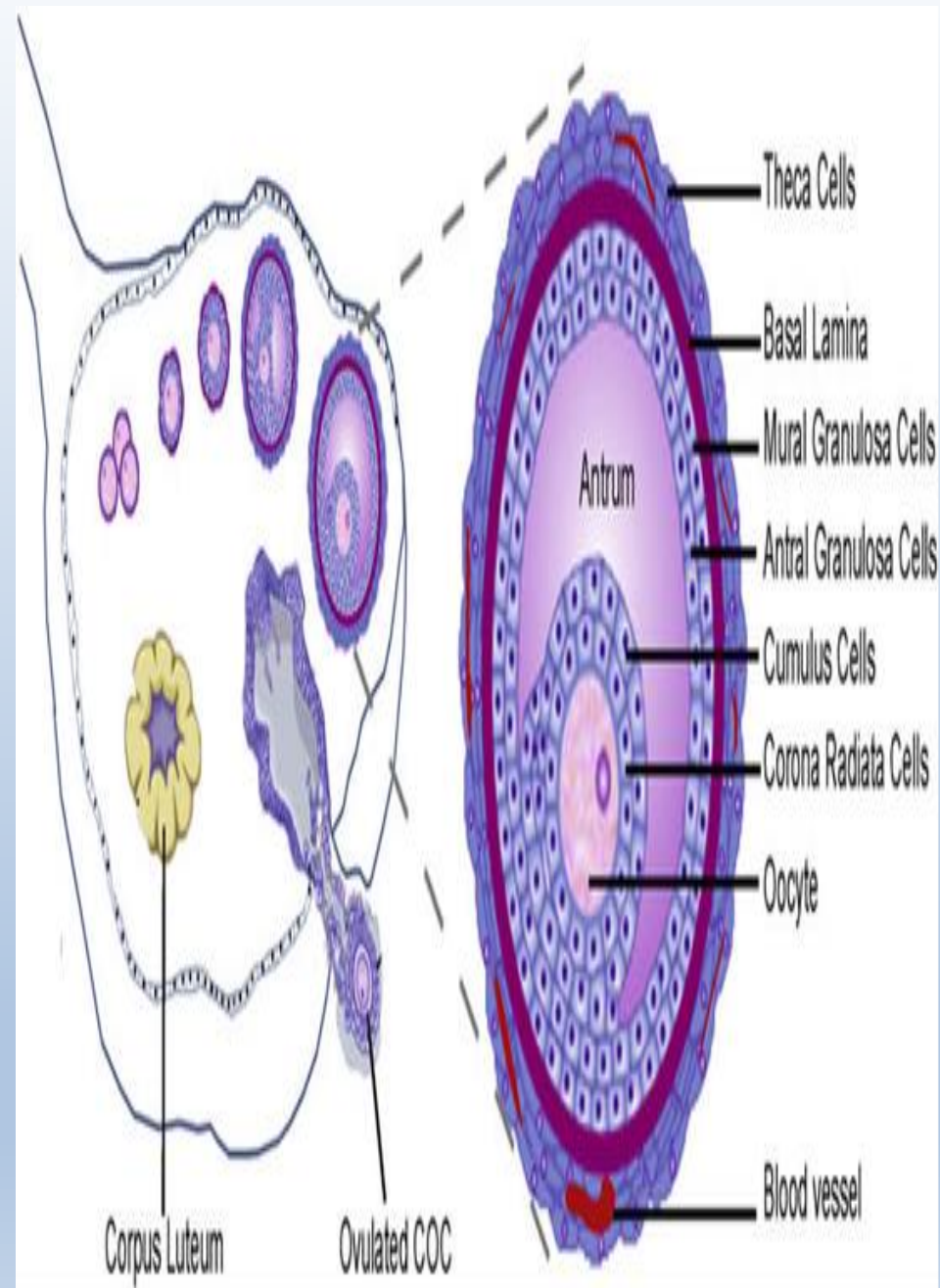
**Cumulus oophorus** are the **granulosa cells** surrounding the **oocyst** which have **eccentric position.**

**estrogen** is responsible for

- 1-the changes in the endometrium in the proliferative phase
- 2- stimulate the pituitary gland to secrete LH.

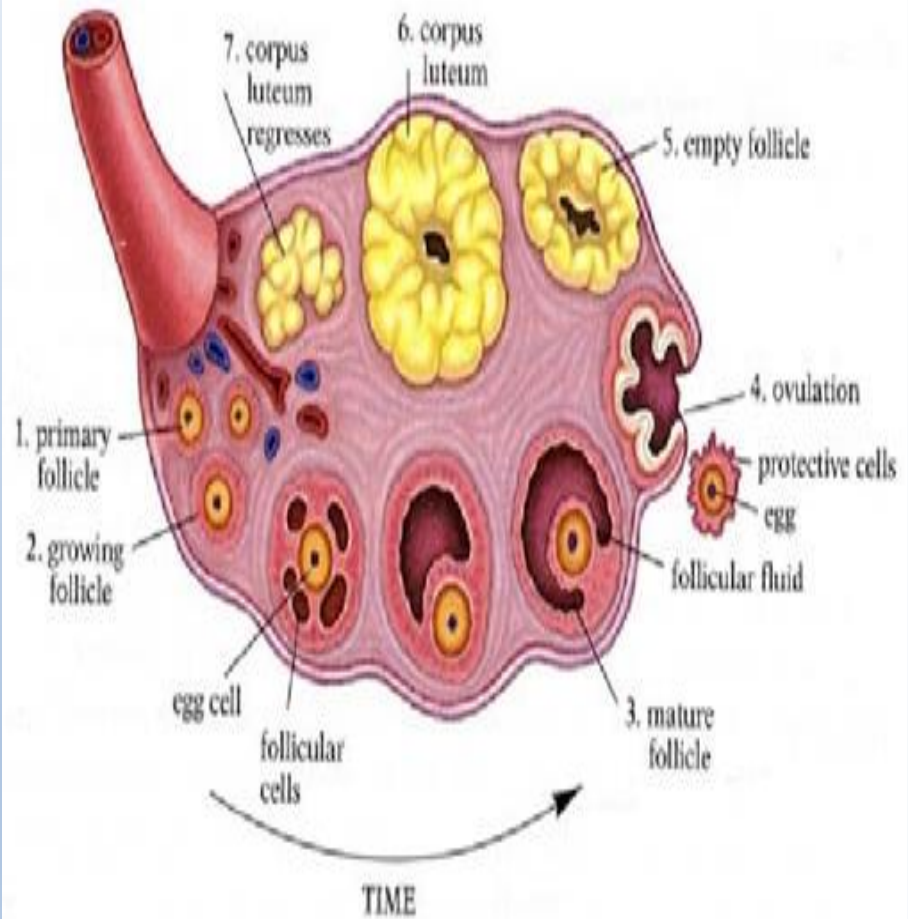


- With each cycle , many follicles in both ovaries start to develop , but only one follicle succeeds to reach full maturity , while the remainder becomes **atretic follicles** .
- **At ovulation** , the mature graafian follicle ruptures releasing the **secondary oocyte** , surrounded by the **zona pellucida & corona radiata (cells from the cumulus oophorus)** , which is sucked by uterine tube where it lies in its lateral 1/3 waiting for fertilization
- **If fertilization occurs**, second meiosis is completed in the secondary oocyte with formation of mature ovum and a zygote is formed.



- **If no fertilization occurs,** secondary oocyte **dies after 24 – 36 hours.**
- The ruptured Graafian follicle is transformed to a yellow body called **corpus luteum** , the fate of which depends on whether fertilization occurs or not .

## Follicle development



## CYCLIC CHANGES IN FEMALES

These are changes which occur every month during the fertile period of the non pregnant female.

It starts at puberty (11-14yr) and stops at menopause (45-55yr).

These changes are controlled by the hypothalamus and the pituitary gland. They affect the uterus and the ovaries.

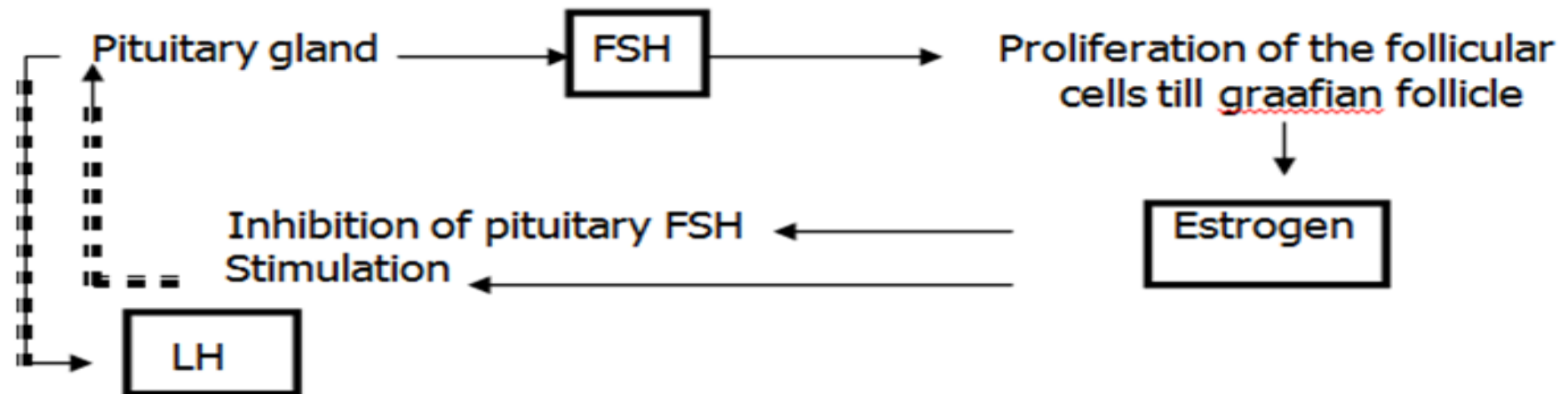
### A- THE OVARIAN CYCLE

It is the cyclic changes which occur in the **ovary** every 28 days during the fertile period of nonpregnant female.

The ovarian cycle is divided into three phases:

1. **Preovulatory (follicular) phase.**
2. **Ovulation.**
3. **Postovulatory (Luteal phase).**

### PREOVULATORY (FOLLICULAR) PHASE:

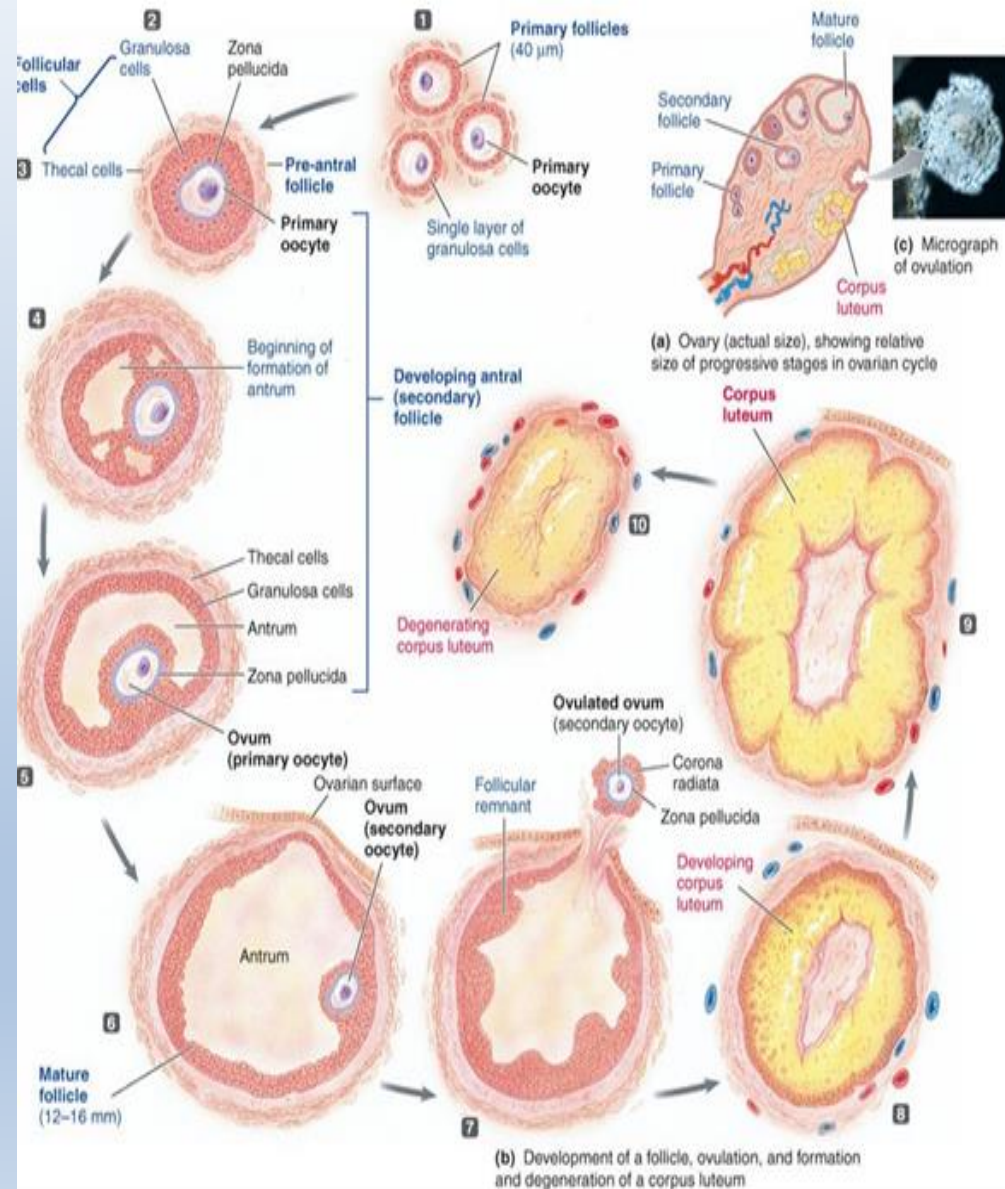




# 1-PRE-OVULATORY Follicular phase (1-14)

- At the beginning of each ovarian cycle, the anterior lobe of pituitary gland secretes **FSH** which stimulates a number of primordial follicles to develop.
- Only one follicle reaches maturity and secretes **estrogen** which
- 1- **inhibit** secretion of FSH by pituitary gland
- 2- **stimulate** secretion of luteinizing hormone
- The estrogen secreted in this phase is responsible for the **proliferative phase of the uterine cycle**.

## Development of the Follicle, Ovulation, and Formation and Degeneration of the Corpus Luteum



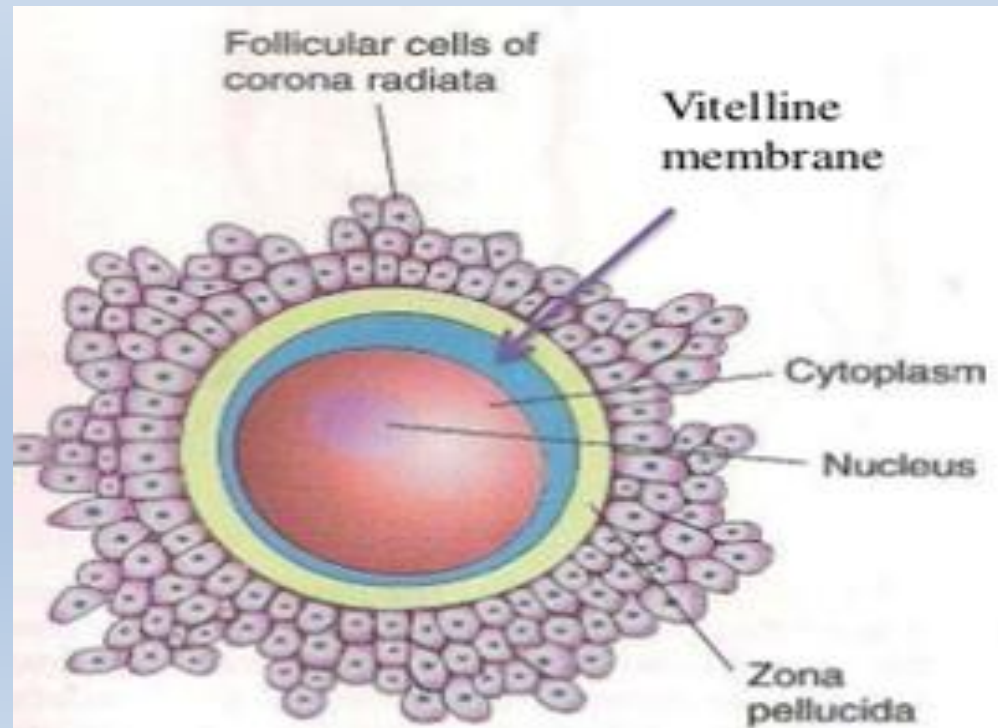
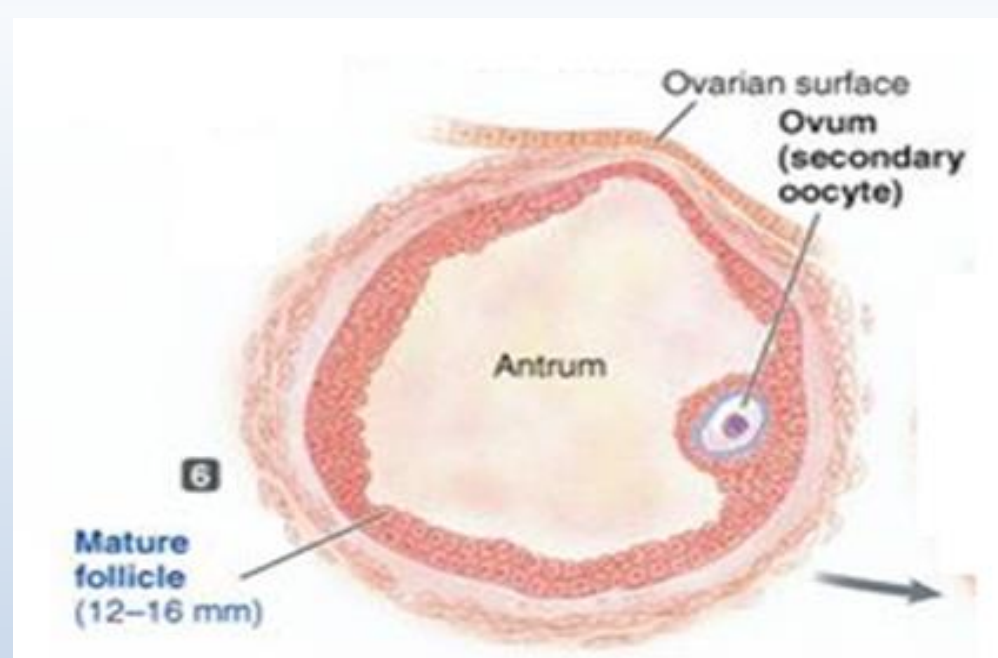


## 2-Ovulation phase

It is the rupture of the mature Graafian follicle liberating the ovum

**LH will produce the following changes:**

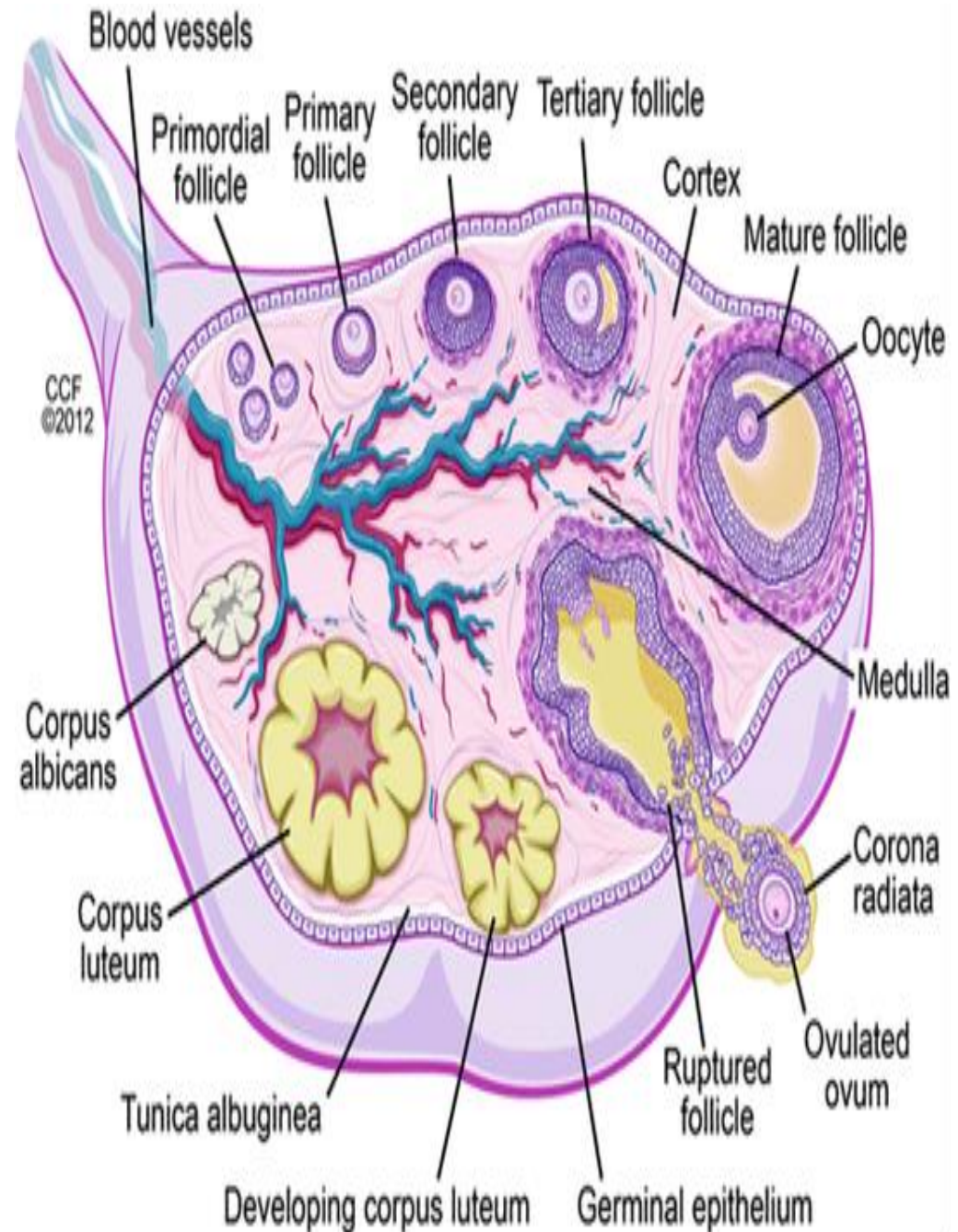
1. Stimulate collagenase enzyme resulting in digestion of collagen fibers surrounding the mature Graafian follicle.
2. Stimulate prostaglandins resulting in ovarian contraction.
3. Complete 1st meiotic division of primary oocyte to form 2dry oocyte (23 ch) and 1st polar body and start 2nd meiotic division.
4. Ovulation.
5. Formation of corpus luteum inside the ovary from the ruptured Graafian follicle.



**At the time of ovulation, the **body temperature** is slightly elevated, and the female feel pain in the iliac fossa ( mid-cycle pain ) . If this pain occurs on the right side , it may be miss diagnosed as acute appendicitis .**

**✦ Ovulation occur once every lunar month , approximately 14 days ( plus or minus one day ) before the beginning of next menstruation .**

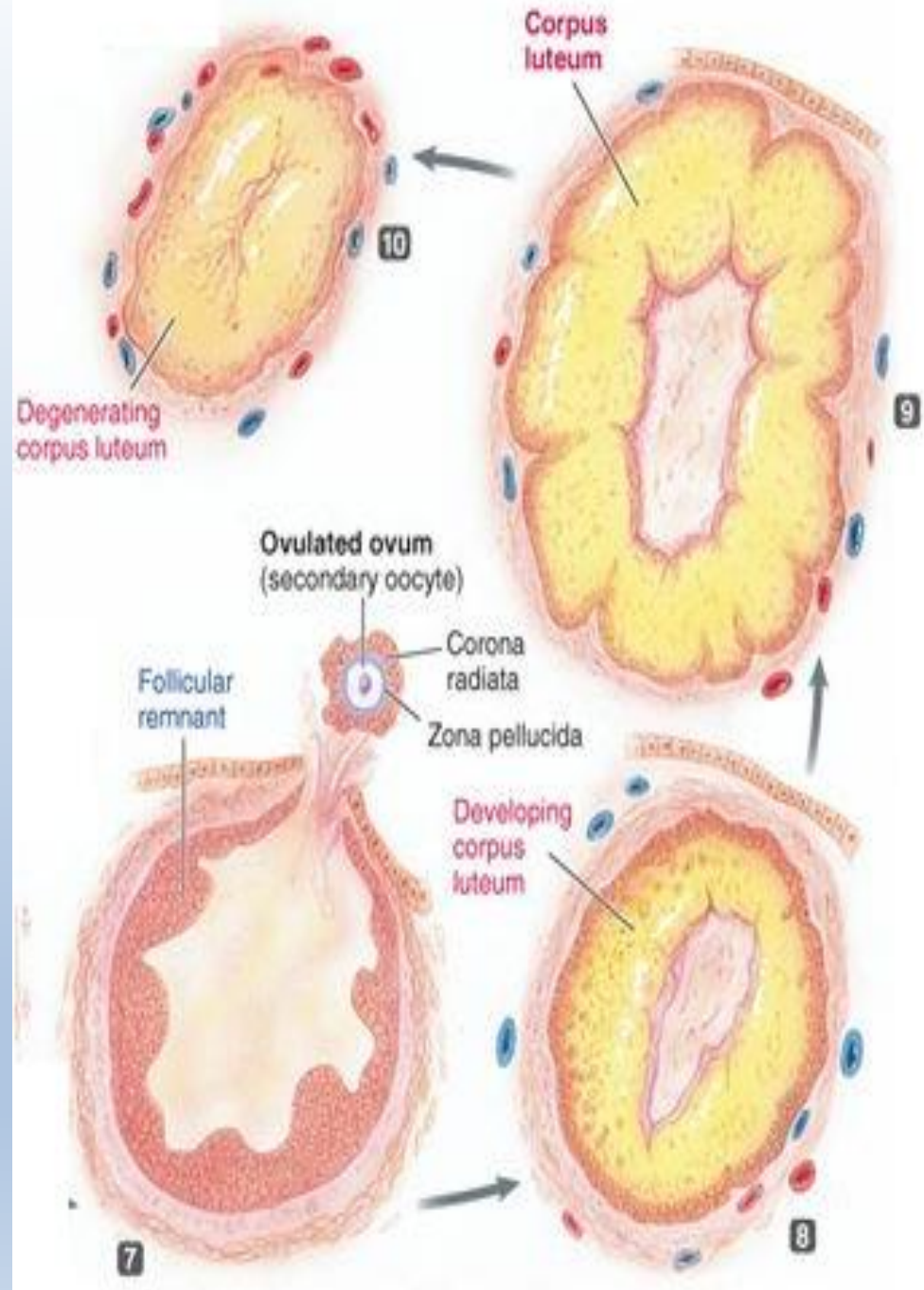
**✦ Ovulation does not occur during pregnancy and occurs to less extend during lactation .**





### **3-POST OVULATORY (LUTEAL) PHASE:**

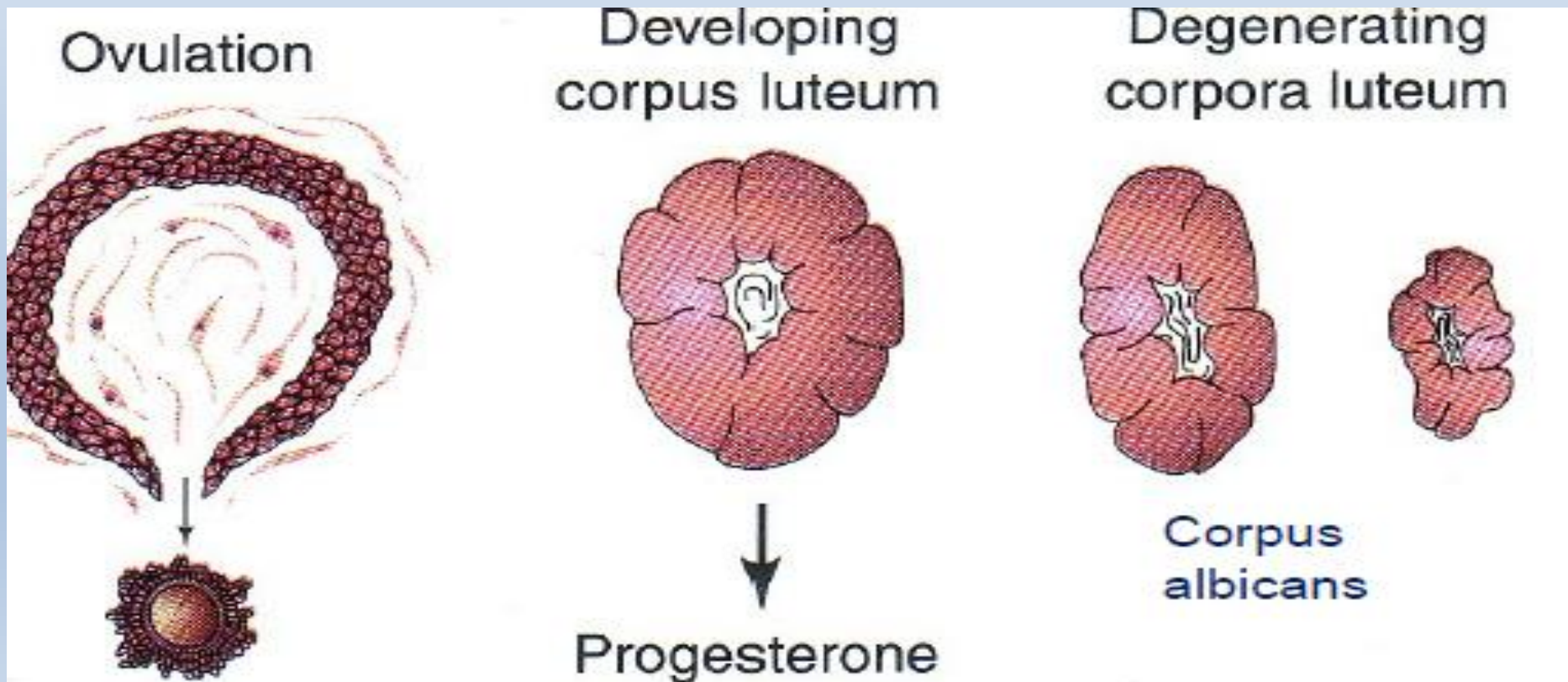
- Following ovulation, the granulosa cells of the ruptured follicle and the theca interna cells become polyhedral
  - Under the effect of LH, these cells contain yellowish pigment and change into luteal cells forming the *corpus luteum* (corpus =body & luteum = yellow)
  - The corpus luteum secretes **progesterone** hormone mainly and little estrogen.
- Progesterone hormone controls the **secretory phase** of the menstrual cycle





## Corpus Luteum

- It is the luteinized Graafian follicle under the effect of luteinizing hormone (L.H.). This occurs in the second half of ovarian cycle (luteal phase). Yellow pigments are deposited in granulosa and theca interna cells.
- - **Fate of corpus luteum:**
  - **No fertilization**, it lives for 10 days and the transformed into fibrous tissue called corpus albicans and stop secreting progesterone.
  - **With fertilization**, it stays till the 4th month as *corpus luteum of pregnancy* to keep endometrium intact. is under the effect of **the human chorionic gonadotrophin (hCG)** secreted by trophoblast of the developing embryo.



## **B- UTERINE (MENSTRUAL) CYCLE:**

It is the monthly changes which take place in the **endometrium** of the uterus from puberty till menopause in the non pregnant female.

It is repeated every 28 days.

It is affected by the ovarian cycle and the ovarian hormones.

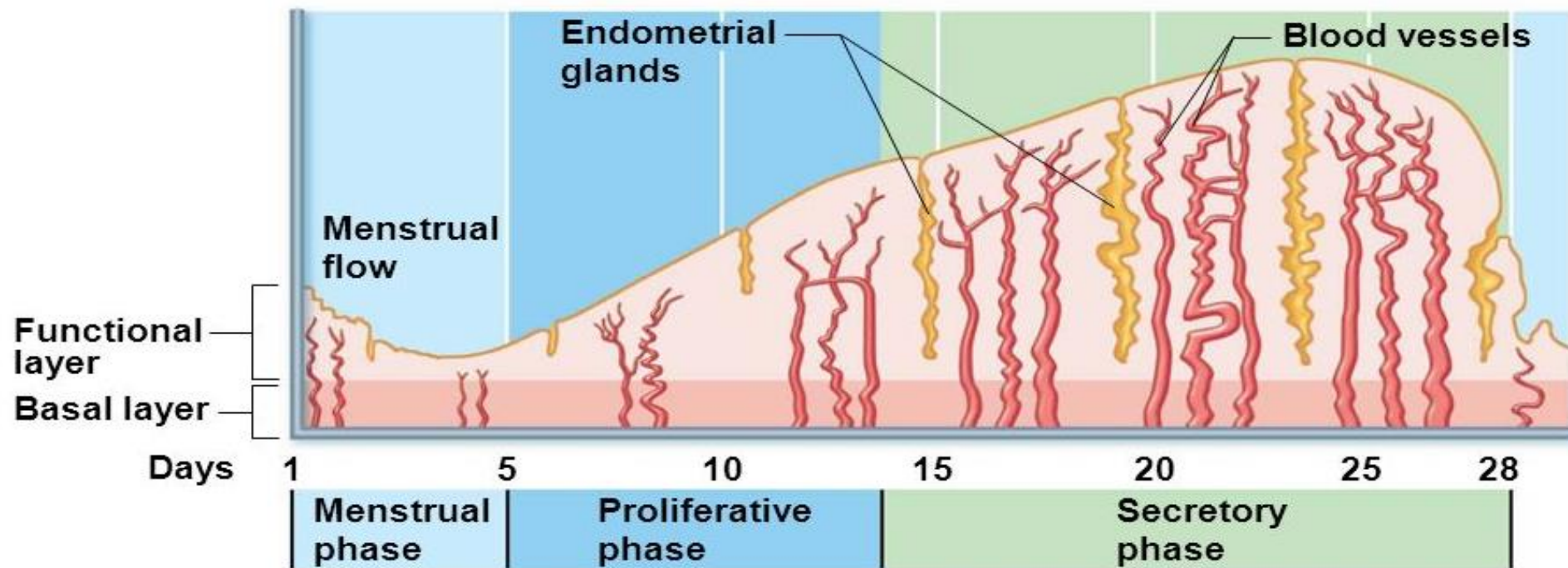
It passes through three phases.

### **1. Menstrual phase (4 days)**

It corresponds to the beginning of the pre-ovulatory phase of the ovarian cycle.

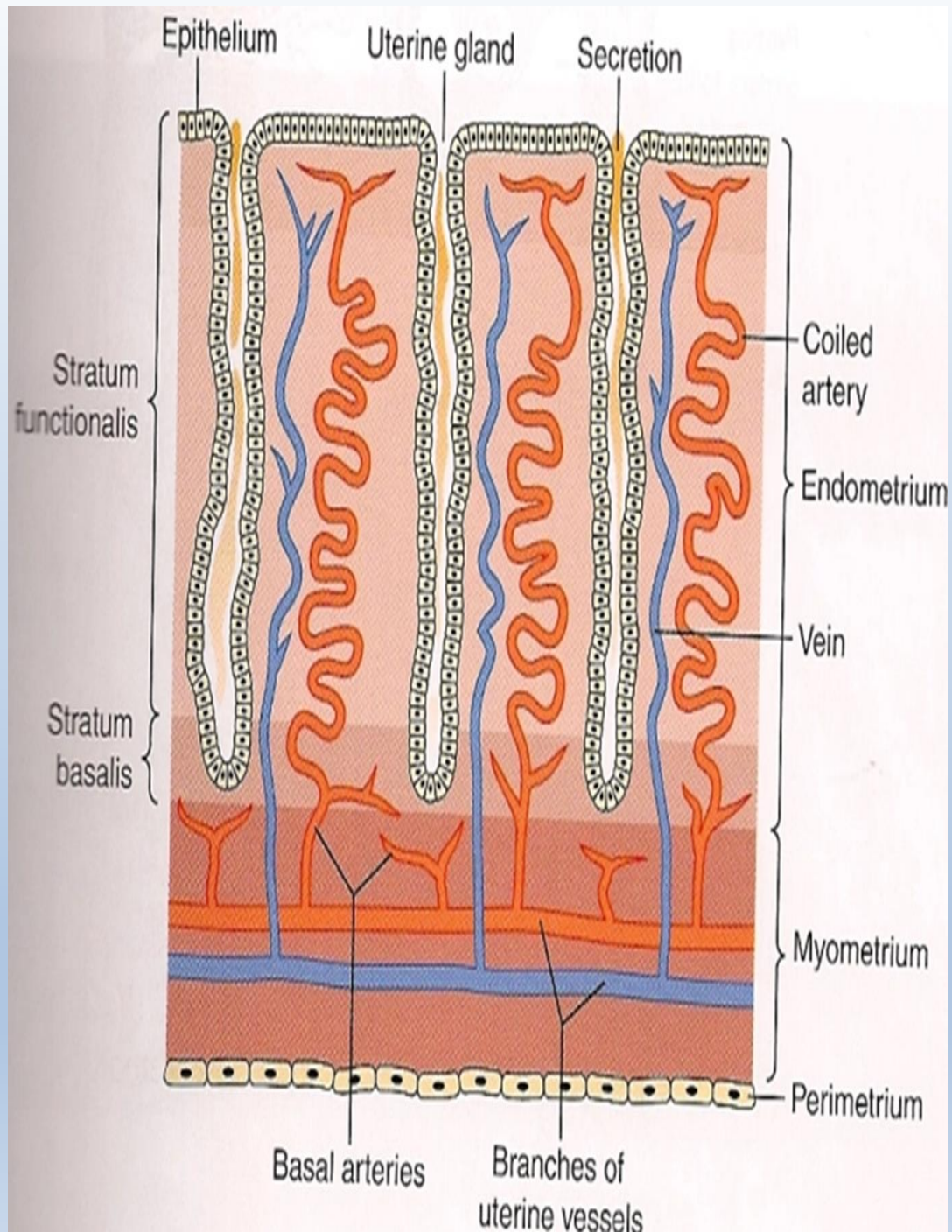
-1st day of the cycle is the 1st day of menstruation.-It is completed within 3 to 4 days.

-It occurs due to spasm of endometrial arterioles because of **degeneration of corpus luteum and drop in level of progesterone**





- The superficial part of endometrium degenerates and expelled with mucous & 50-60 cc of unclotted blood ( due to presence of proteolytic enzymes ) from the ulcerated uterus .
- At the end of this phase the endometrium is reduced to 1/5 to 1/10 its maximal thickness .
- The **basal layer** of the endometrium is not affected because it is supplied by the **basal arteries**, and it is the site of endometrial regeneration.





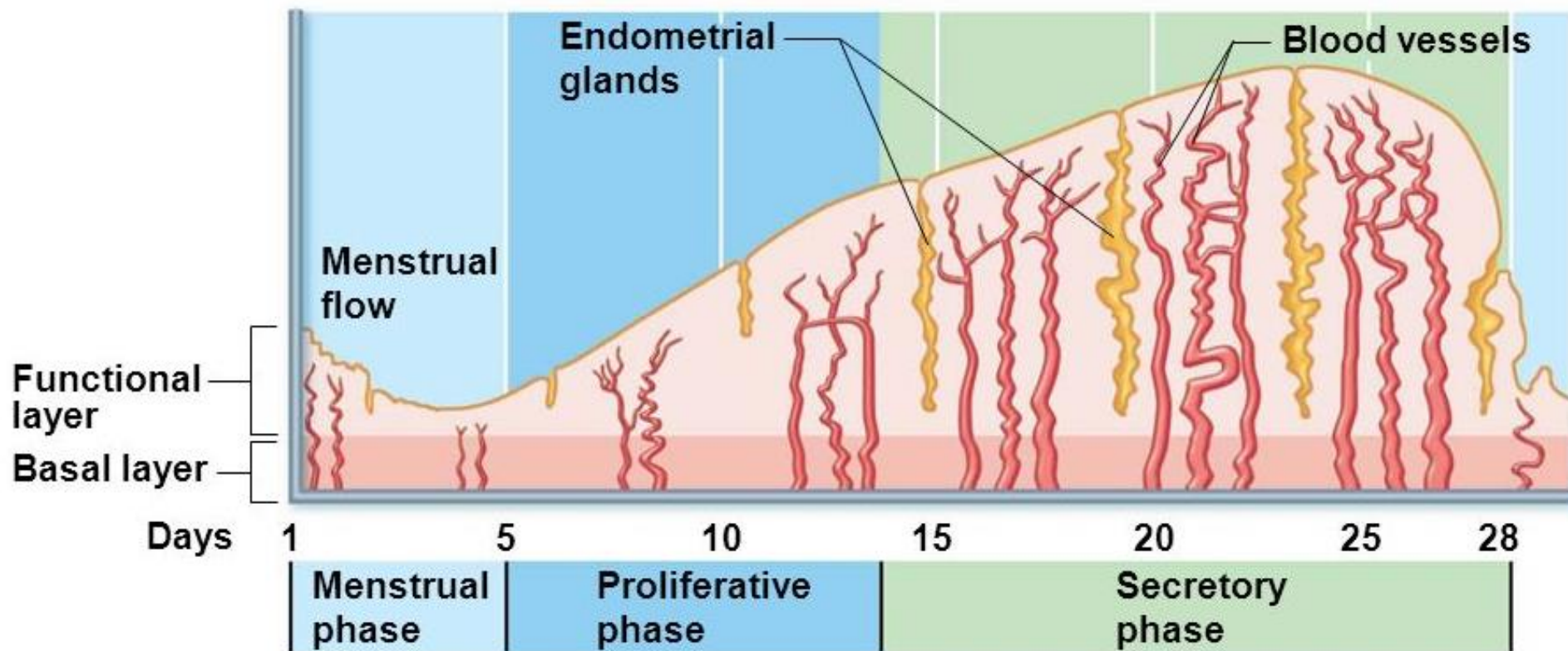
## 2. Proliferative (estrogenic) (postmenstrual) phase (10 days)

- It lasts for **10 days**.

- It begins at the end of the menstrual phase. It is under the influence of **estrogen hormone** secreted by the follicular cells

It coincides with growth of the ovarian follicles.

- The endometrium increases in thickness (up to 3 mm) and its epithelium becomes columnar. The uterine glands become large and rich of mucin and glycogen therefore this phase is also called the **phase of repair**.



### 3. Secretory (premenstrual) (progestational) phase (14 days)

It corresponds to the postovulatory phase of the ovarian cycle

-Blood vessels and glands become spiral.

-mucous glands become long, tortuous & distended with secretion

-Endometrium becomes differentiated into **superficial compact, middle spongy & basal layers**

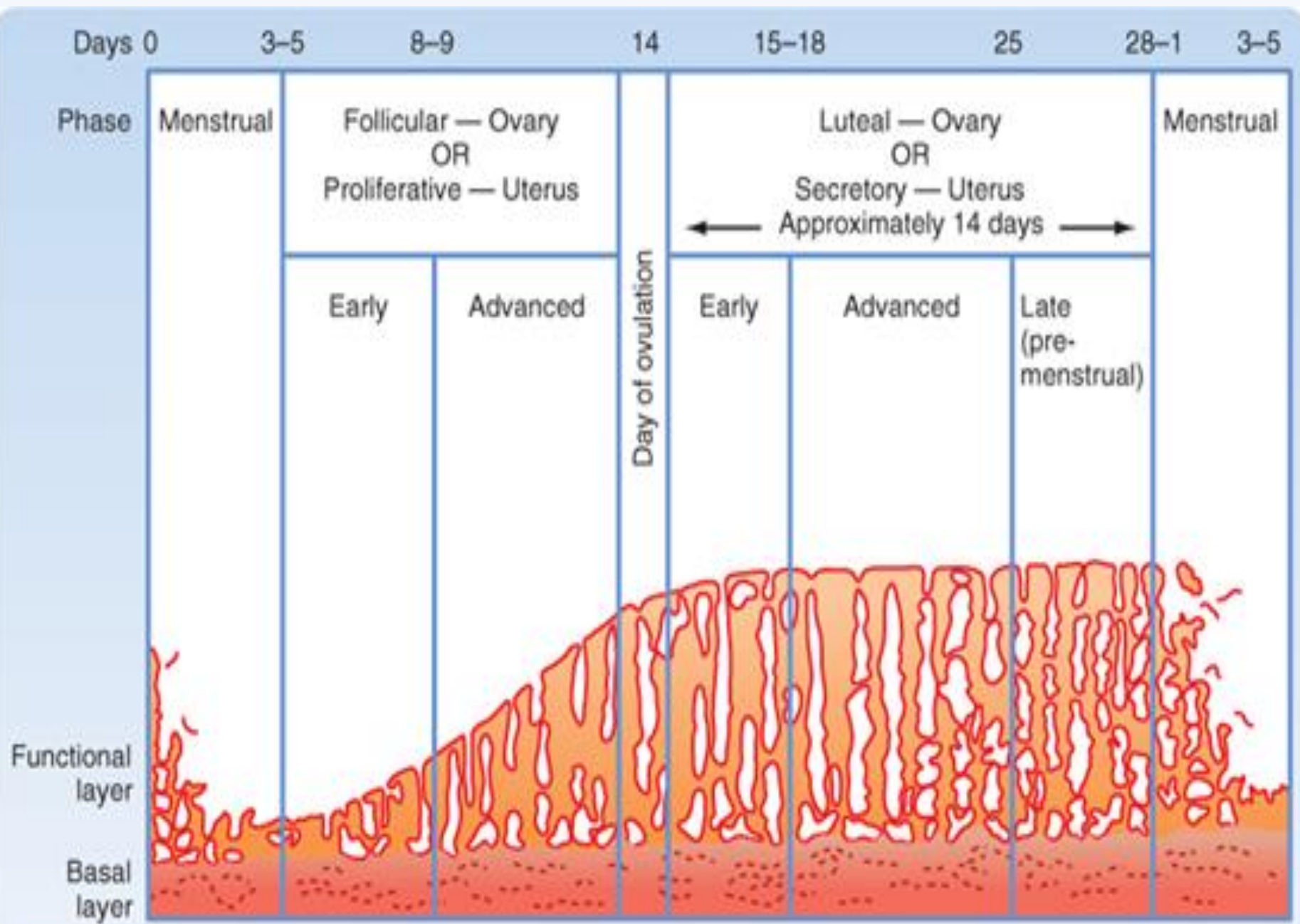
-This phase is under effect of **progesterone** and small amount of estrogen produced by corpus luteum.

-It lasts for **14** days.

These changes in the endometrium can be regarded as the preparation of the endometrium for the reception and nourishment of the suspected blastocyst if fertilization occurs.

• **If fertilization of the ovum does not occur:** the corpus luteum degenerates, progesterone levels fall, and the secretory endometrium enters an **ischemic phase** during the last day of the secretory phase and so menstruation occurs.

• **If fertilization occurs** cleavage of the zygote and formation of the blastocyst follows. The fetal yolk sac produces hCG (*human chorionic gonadotrophic hormone*) which keeps the corpus luteum secreting progesterone. As a result of progesterone secretion, the secretory phase continues as pregnancy. This is why menstruation does not occur.



Koepfen & Stanton: Berne and Levy Physiology, 6th Edition.  
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