Oogenesis

Female Reproductive System:
Three Lectures:
1.Oogenesis
2.Fertilization and Implantation
3.Lactation and Menopause

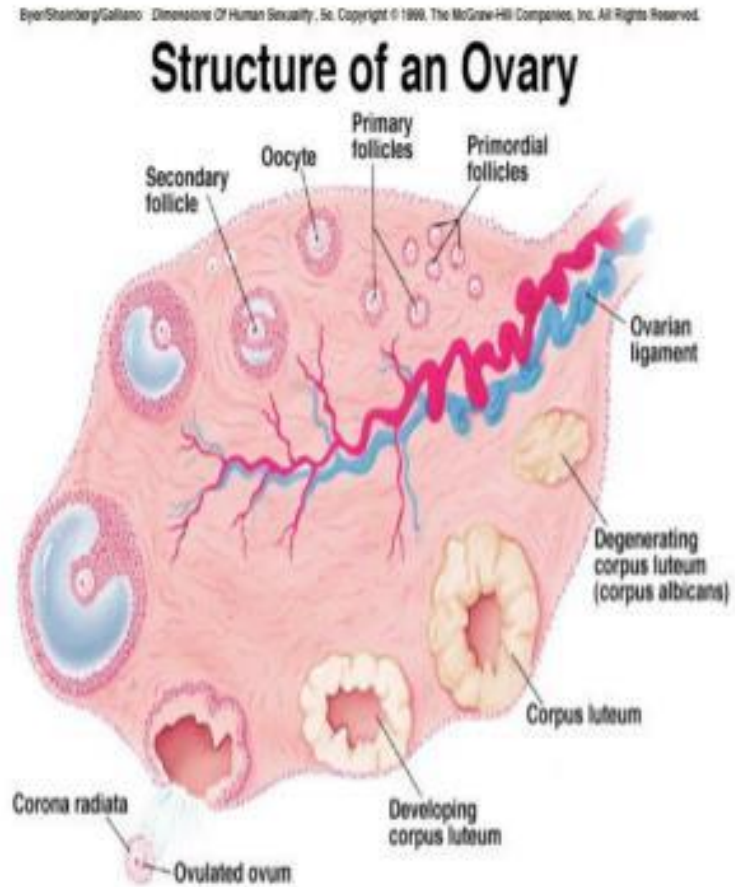
Oogenesis

- **Development of ovum (oogenesis)**
  - **Maturation of follicle**
  - **Fate of ovum and follicle**

Fundamental reproductive unit = single ovarian follicle, composed of one germ cell (oocyte), surrounded by endocrine cells

OOGENESIS

- Maturation of Oocytes Begins Before Birth
- Once primordial germ cells have arrived in the gonad of a genetic female, they differentiate into **oogonia**
- These cells undergo a number of mitotic divisions and, by the end of the third month, are arranged in clusters surrounded by a layer of flat epithelial cells
- All of the oogonia in one cluster are probably derived from a single cell,
- the flat epithelial cells, known as **follicular cells, originate from surface epithelium** covering the ovary.



Oogonium(44XX)

-In fetal ovary

Primary oocyte (44XX)

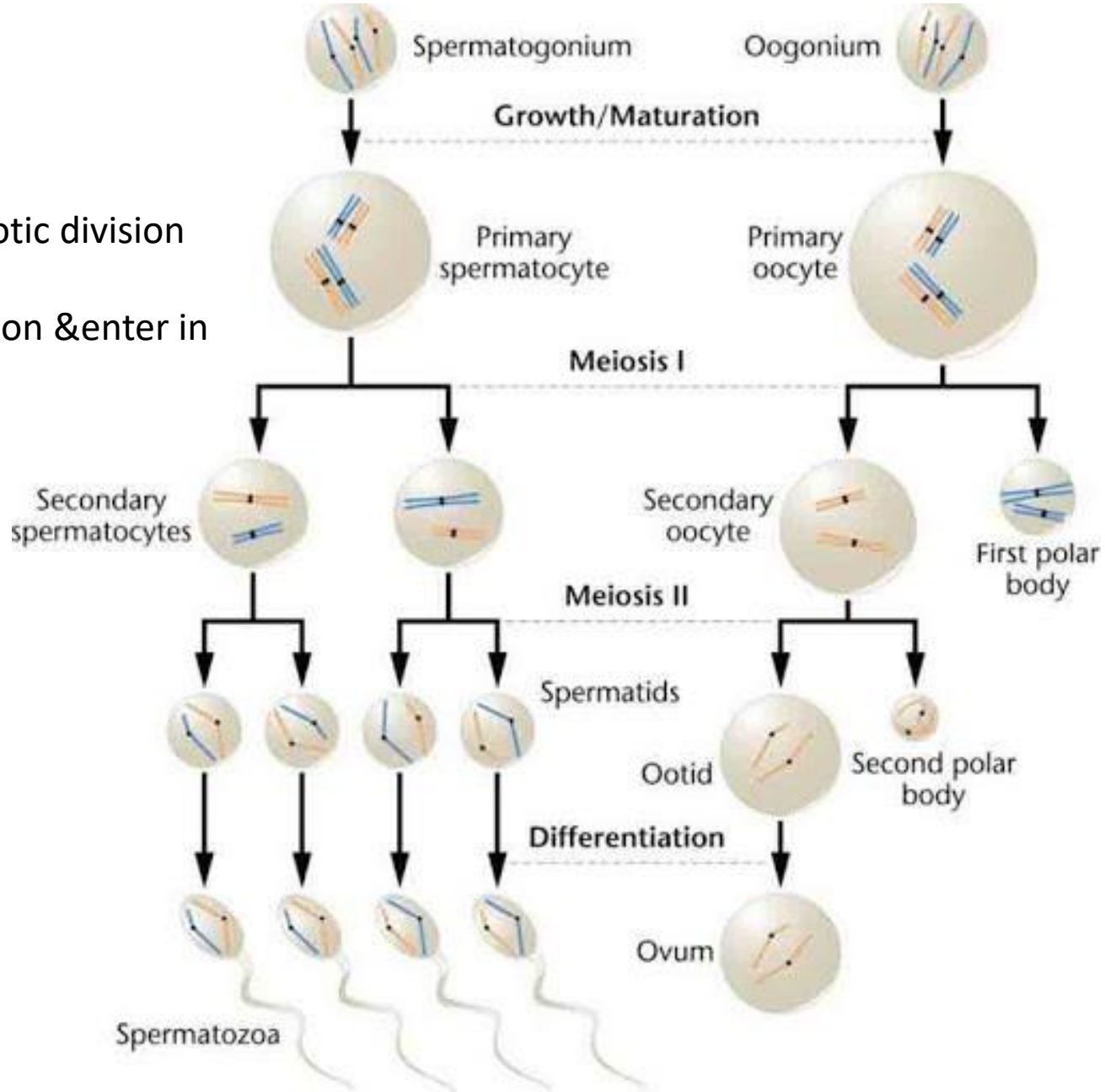
arrest till puberty in prophase of 1st phase meiotic division

Secondary oocyte(22X)+Polar body(22X)

1st phase meiotic division completed at ovulation &enter in 2nd phase

Ovum(22X)+polarbody(22X)

After fertilization



Oogenesis:

Oogonia produced by mitotic division , Then at 8-9 wks of gestation, prophase of 1st meiosis starts – becomes primary oocyte

Number of primary oocytes decreases throughout childhood from 1-2 mil to 400,000 just before puberty

– surrounded by pre-granulosa cells

– called primordial follicle – complete about 6 mos. after birth

Oogonia (primordial germ cells) expand through mitosis in fetal ovary

Oocytes when at birth enter meiosis

Primordial Follicle surrounded by layers of granulosa

Follicular Development with puberty

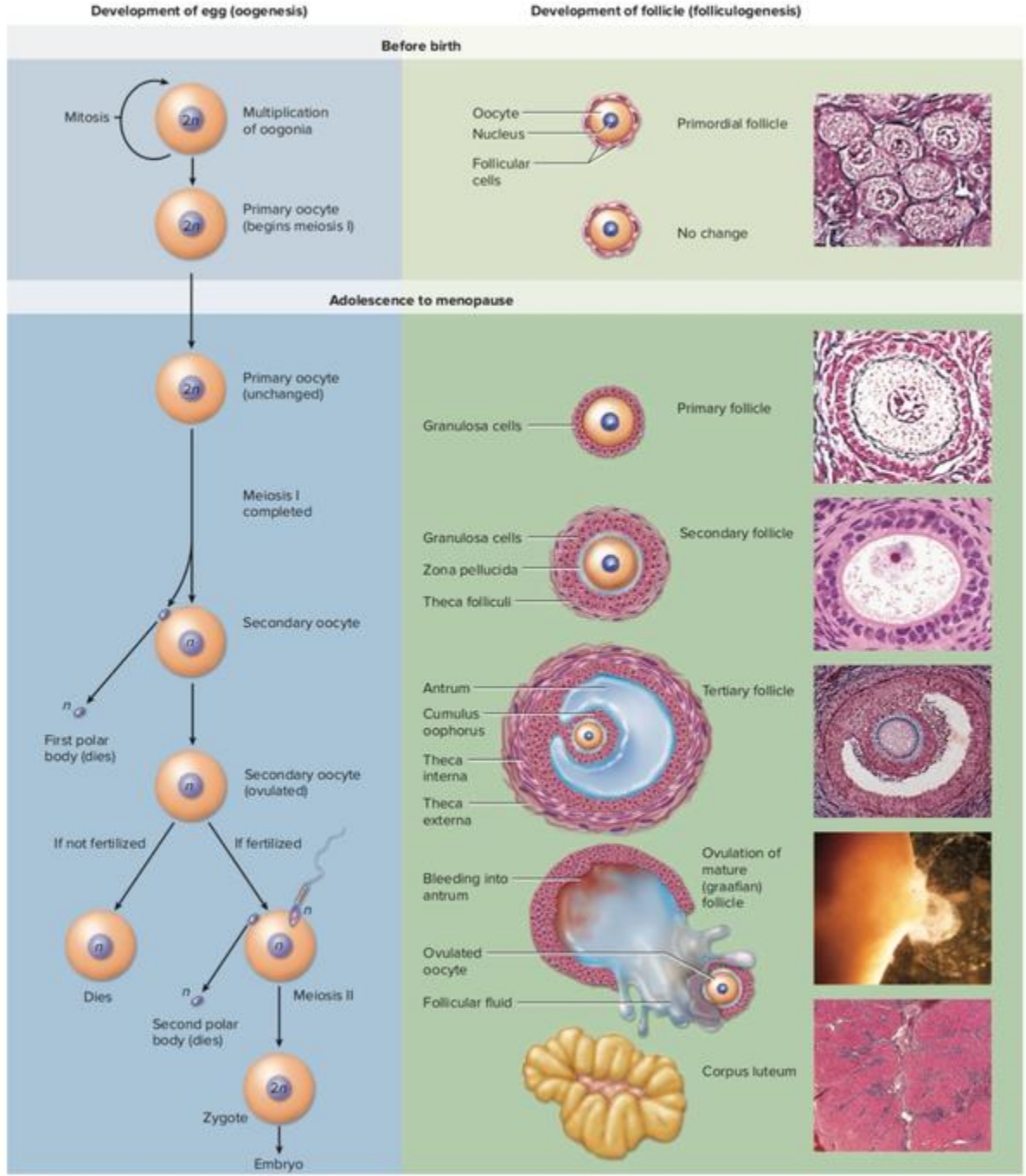
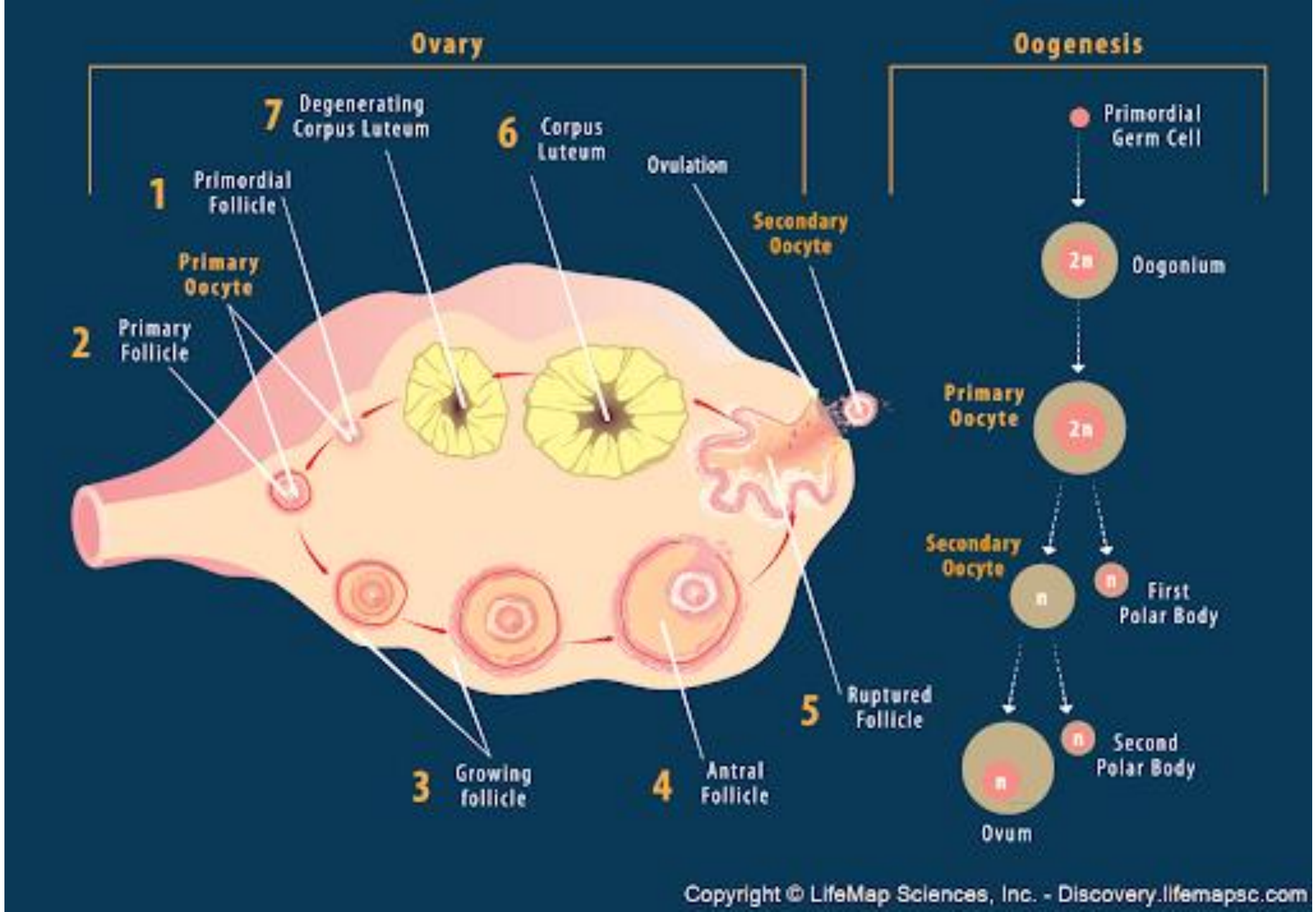


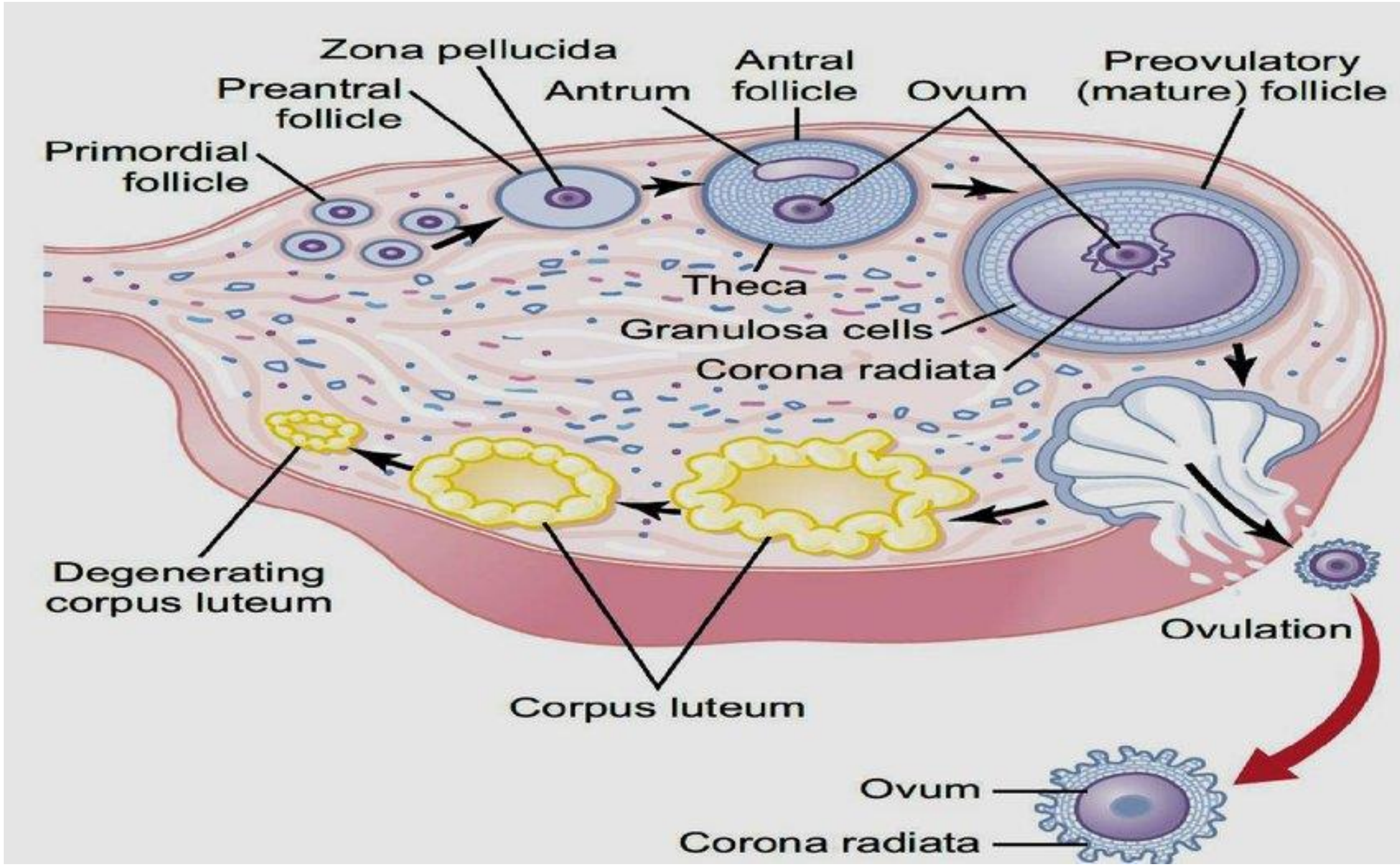
FIGURE 28.11 Oogenesis (Left) and Corresponding Development of the Follicle (Right). AP R

Follicular Development

Recruitment

Maturation




Zona pellucida
Preantral follicle
Primordial follicle
Antrum
Antral follicle
Ovum
Preovulatory (mature) follicle
Theca
Granulosa cells
Corona radiata
Degenerating corpus luteum
Corpus luteum
Ovulation
Ovum
Corona radiata

MATURATION OF FOLLICLE:

Primordial follicle

-Follicular cells

Primary follicle

-Zona pallucida

-Granulosa cells

Secondary follicle

Antrum developed

Ovarian /Graafian follicle

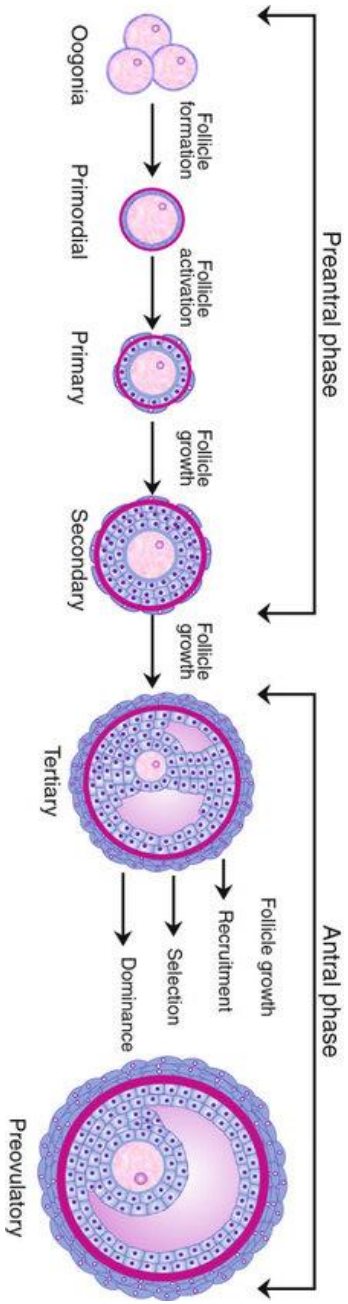
- Theca interna &externa

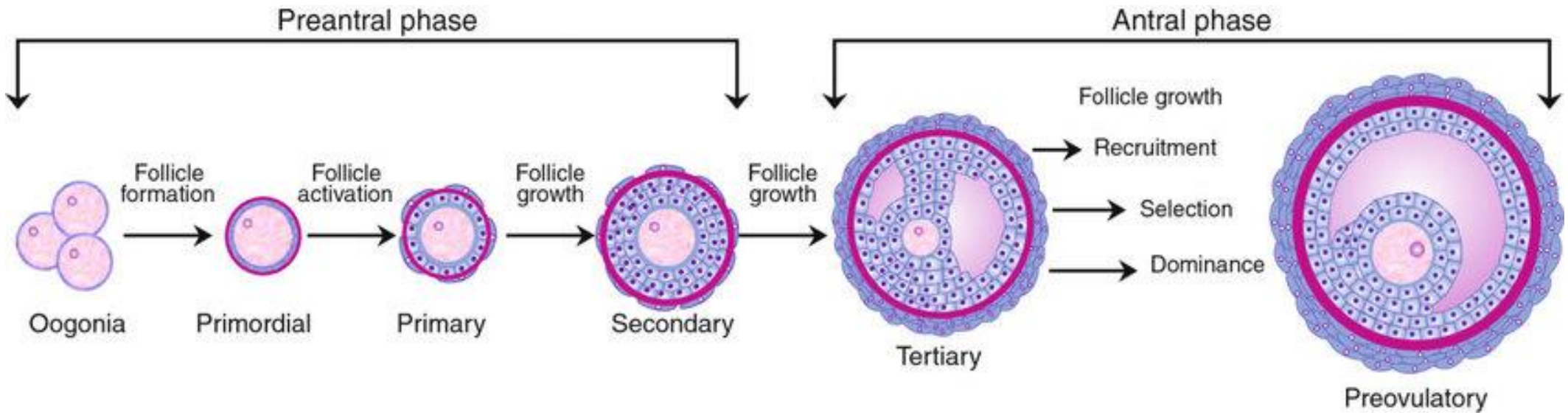
-Membrana granulosa

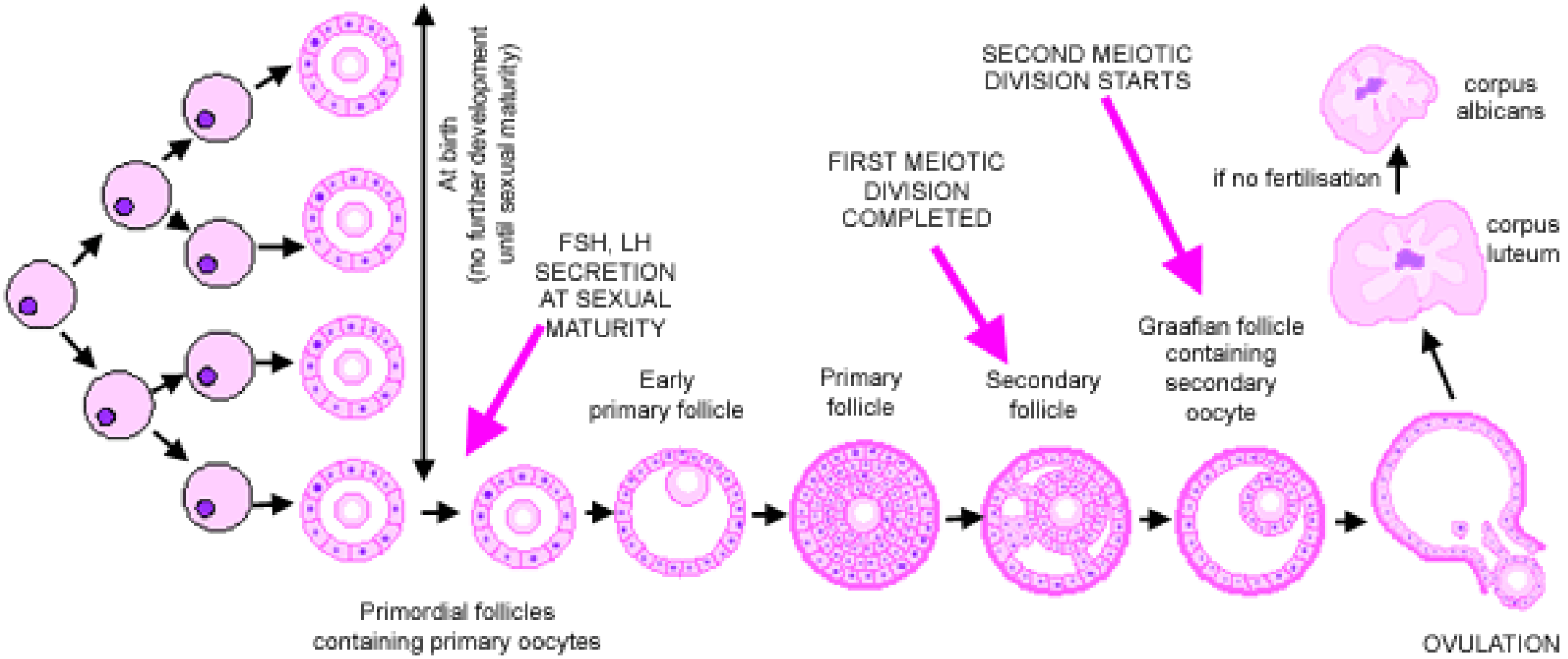
-Antrial cavity

-Discus proligerus

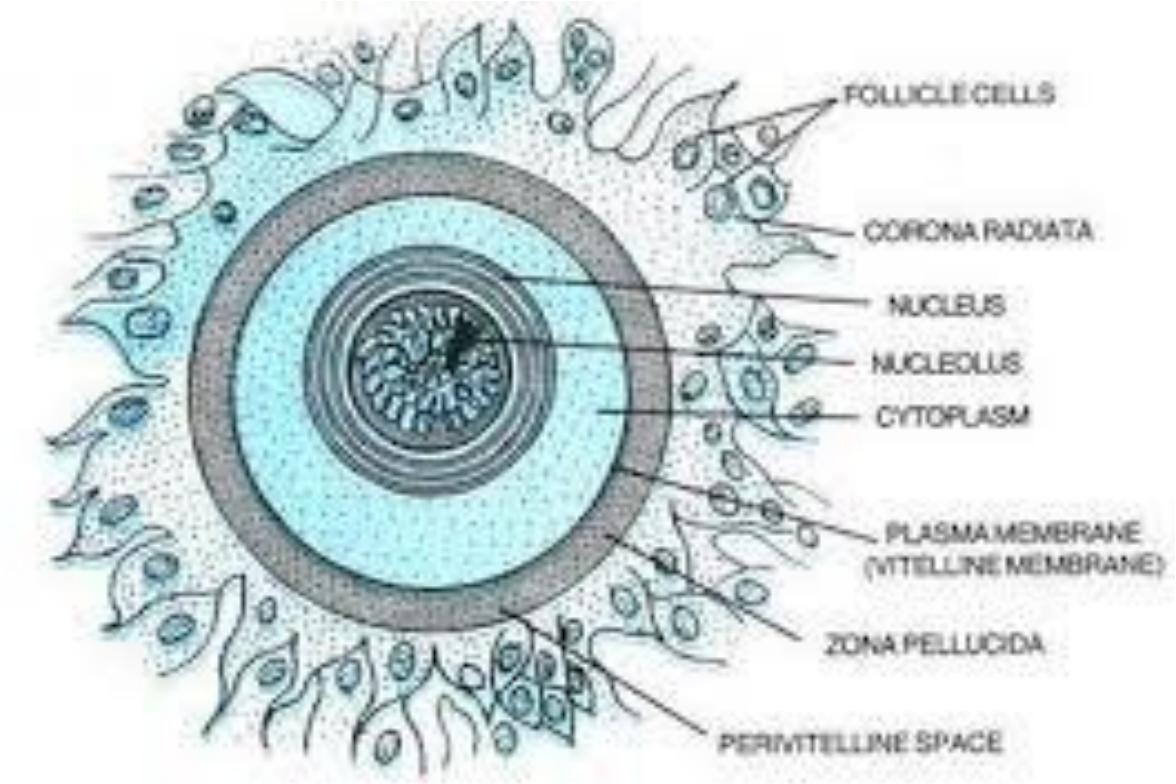
-Cumulus oophoricus




Preantral phase
Antral phase
Follicle formation
Follicle activation
Follicle growth
Follicle growth
Follicle growth
Recruitment
Selection
Dominance
Oogonia
Primordial
Primary
Secondary
Tertiary
Preovulatory


At birth
(no further development
until sexual maturity)
FSH, LH
SECRETION
AT SEXUAL
MATURITY
FIRST MEIOTIC
DIVISION
COMPLETED
SECOND MEIOTIC
DIVISION STARTS
Early
primary follicle
Primary
follicle
Secondary
follicle
Graafian follicle
containing
secondary
oocyte
if no fertilisation
corpus
albicans
corpus
luteum
Primordial follicles
containing primary oocytes
OVULATION

Ovum Structure



Fate of Ovarian Follicle

Formation of Corpus luteum

- After ovulation ovarian follicle

Ruptured and folded

Corpus luteum

- Follicular cells/granulosa cells

-Cells of membrana granulosa

-lutien pigment

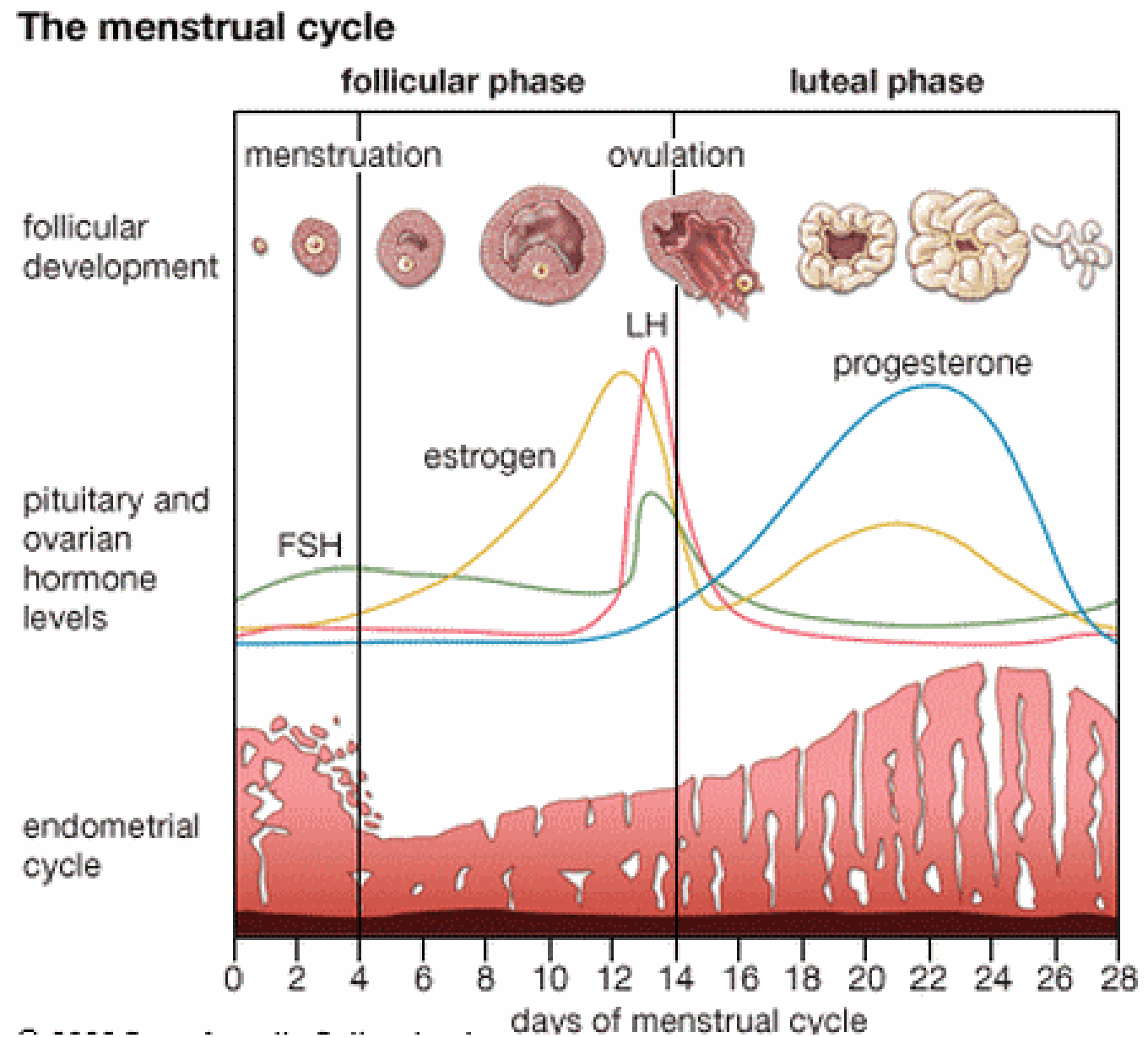
- Luteal cells
- Theacal cells

Two phase of ovulation:

1. Follicular Phase
2. Luteal Phase

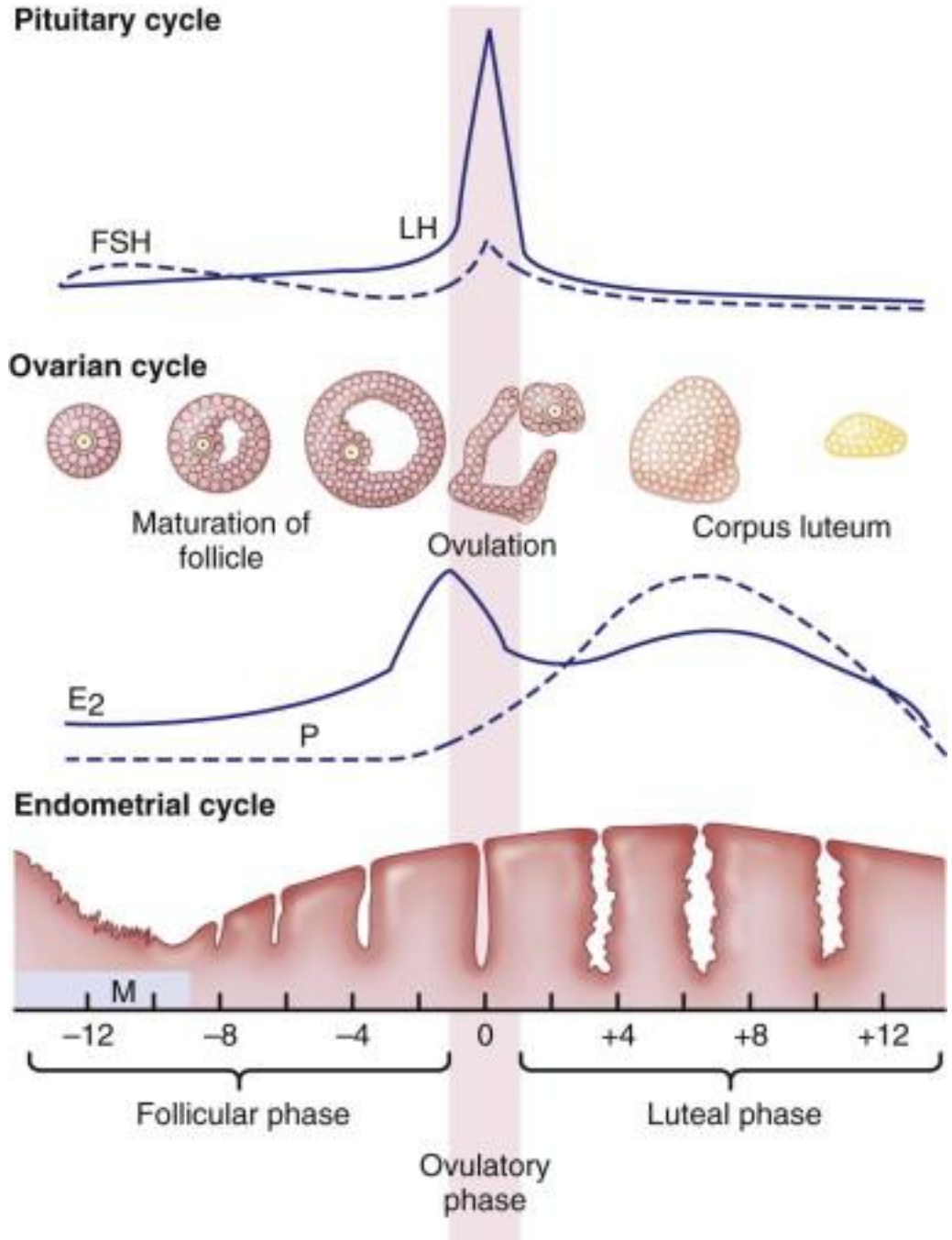
Hormones:

1. Progesterone
2. Estrogen
3. LH
4. FSH


The menstrual cycle
follicular phase
luteal phase
menstruation
ovulation
follicular development
LH
progesterone
estrogen
pituitary and ovarian hormone levels
FSH
endometrial cycle
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
days of menstrual cycle

Thecal cells – superficial – no aromatase – have only LH Receptors – can get cholesterol from LDL in blood
Granulosa cells – interior – have aromatase, but no 17□-hydroxylase (17,20-desmolase) – (Converts pregnenolone to 17□-hydroxyprenenolone to DHEA)
And progesterone to 17□-progesterone
– get cholesterol from de novo synthesis – have both LH and FSH receptors
If androgen levels high, preferentially forms DHT from Testosterone – and inhibits aromatase activity – decr. estradiol, inhibit synthesis LH R

Chemical mechanics of ovulation:
LH surge prostaglandin endoperoxide synthase in granulosa cells (sets up pseudoinflammatory response)
FSH (some LH) stimulates release of plasminogen activator from granulosa cells (converts plasminogen to plasmin)
Prostaglandins E and F release lysosomal enzymes that digest follicular wall – not completely understood
“Stigma” – form on surface of follicle, balloons out, forms vesicle and ruptures – oocyte expelled
Process facilitated by intrafollicular pressure and contraction of smooth muscle in theca


Pituitary cycle
FSH
LH
Ovarian cycle
Maturation of follicle
Ovulation
Corpus luteum
E2
P
Endometrial cycle
M
–12
–8
–4
0
+4
+8
+12
Follicular phase
Luteal phase
Ovulatory phase

1. Follicular Phase

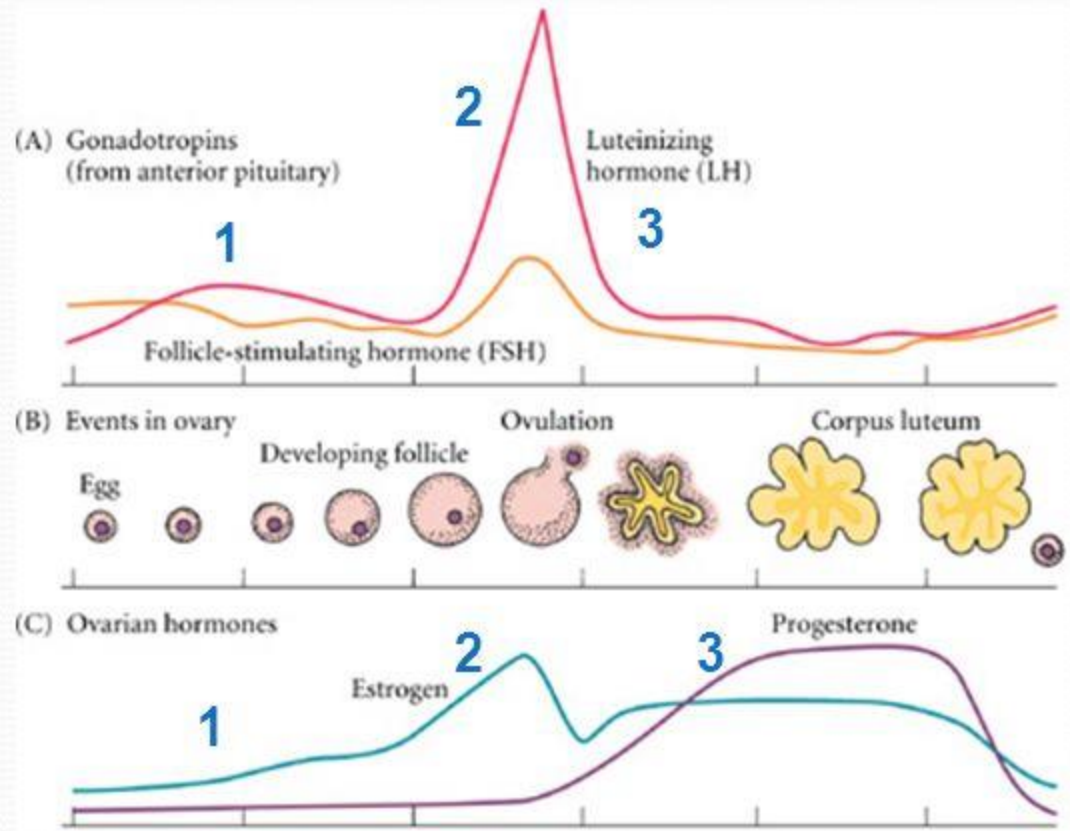
- Low level of estrogen inhibits production of LH and FSH (keeping their levels low)
  - Inhibits AP to prevent ovulation

2. Ovulation

- High estrogen stimulates LH and FSH production (more effect on LH than FSH)
  - Stimulates AP to cause ovulation

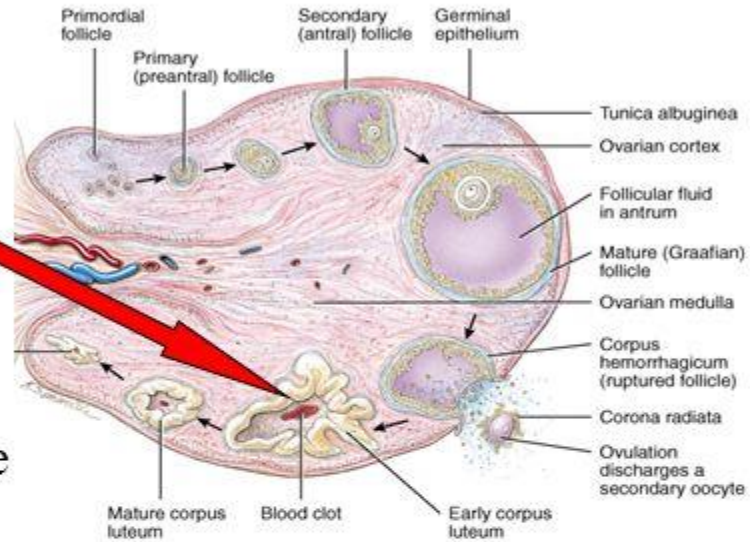
3. Luteal Phase

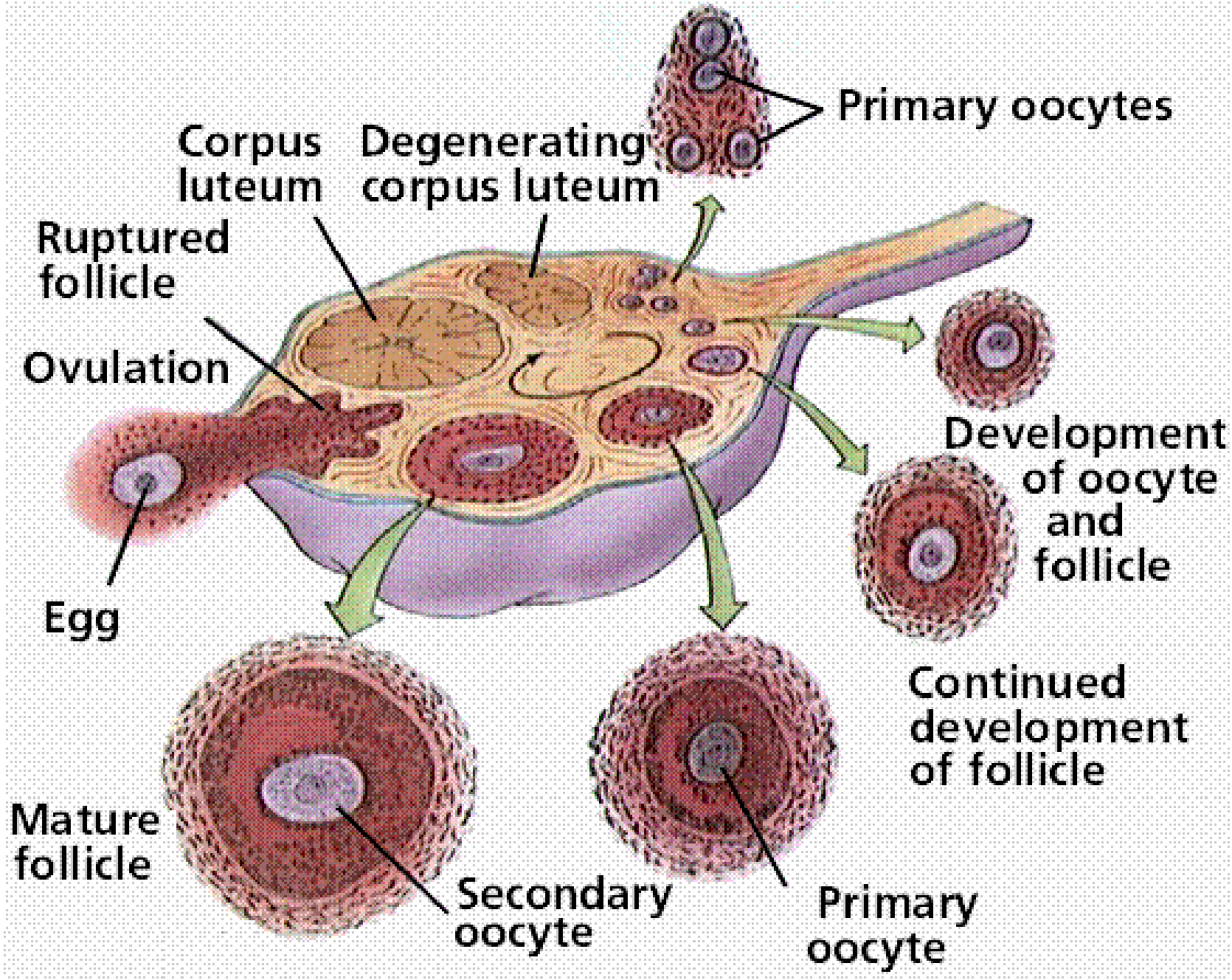
- High levels of progesterone and estrogen inhibits LH and FSH production
  - Inhibit AP and Hypothalamus



Corpus Luteum

- After ovulation, empty follicle becomes a corpus luteum
  - Corpus Luteum secretes:-
    - Progesterone – completes the preparation of uterine lining
    - Estrogens – work with progesterone
    - Relaxin – relaxes uterine muscles and pubic symphysis
    - Inhibin – decreases secretion of FSH and LH
- Corpus albicans is a white scar tissue left after the corpus luteum dies.




Primary oocytes
Corpus luteum
Degenerating corpus luteum
Ruptured follicle
Ovulation
Egg
Development of oocyte and follicle
Continued development of follicle
Mature follicle
Secondary oocyte
Primary oocyte

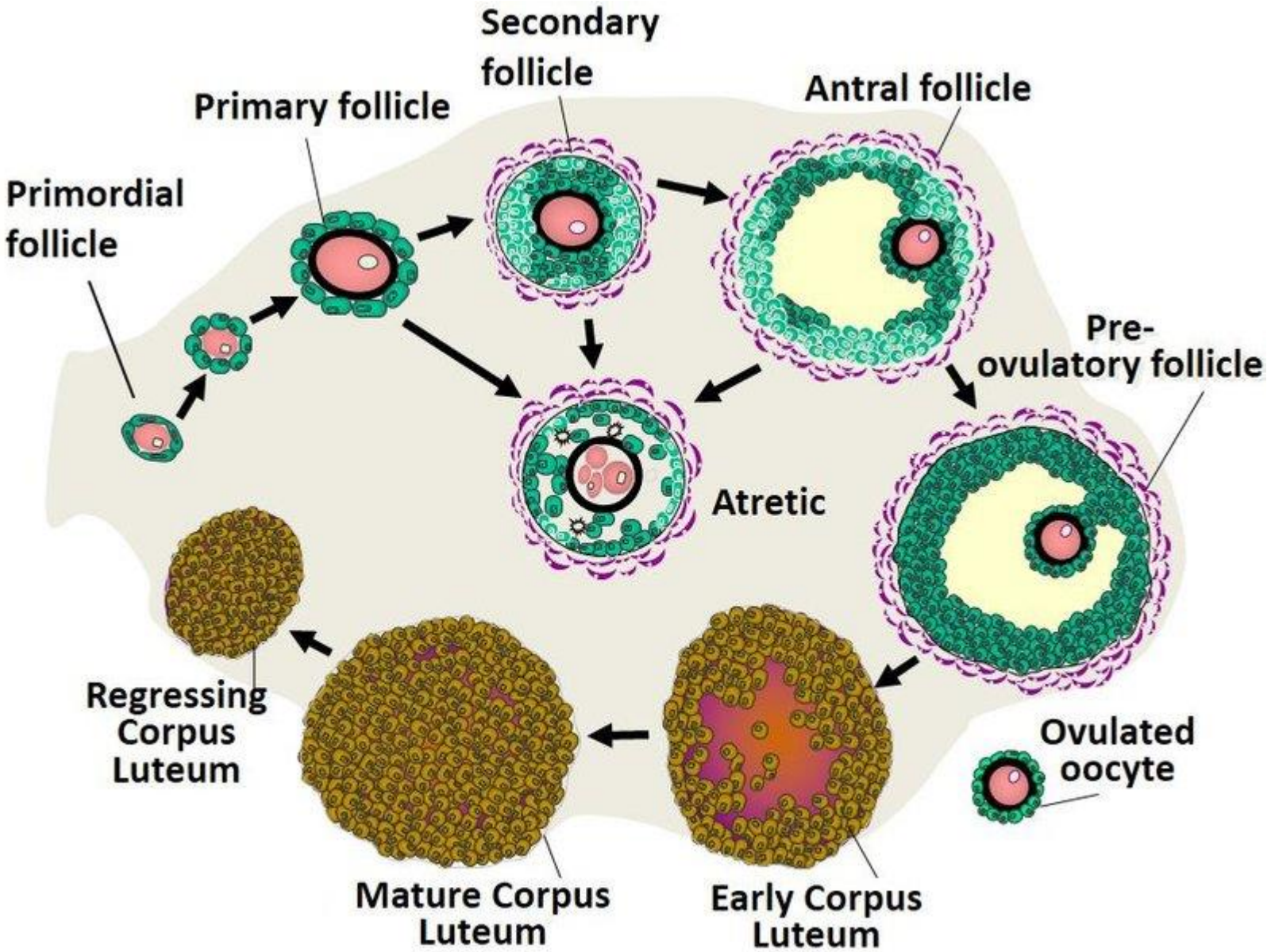
Fate of follicle

- **Corpus luteum**

  -Corpus albicans

- **Corpora atretica**

 -interstitial gland



Corpus luteum

- Provides necessary hormones for implantation of ovum and maintenance of zygote until placenta can take over 80% granulosa cells, 20% thecal cells

If no fertilization, it will regress in about 14 d

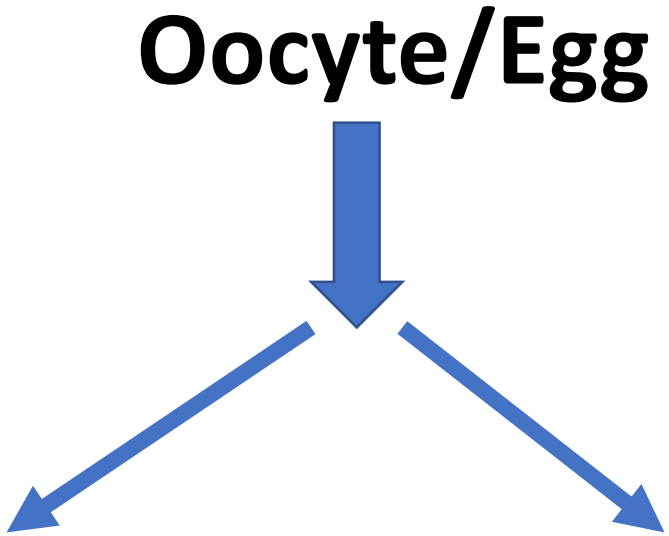
Avascular scar = corpus albicans

Ovarian cycle – follicular phase – avg 15 d (range, 9-23 days) ovulatory phase – 1-3 d – culminates with ovulation luteal phase – 13 d – less variable than follicular

Endometrial cycle– menstruation, proliferative and secretory

Phase

Menstrual Cycle controlled by gonadotropin and gonadal hormone



Corpus luteum

- Corpus luteum of pregnancy

- Corpus luteum of menstruation

Next Lecture on Fertilization and Implantation…