Female Reproductive system

四川大学组织学与胚胎学教研室

composition

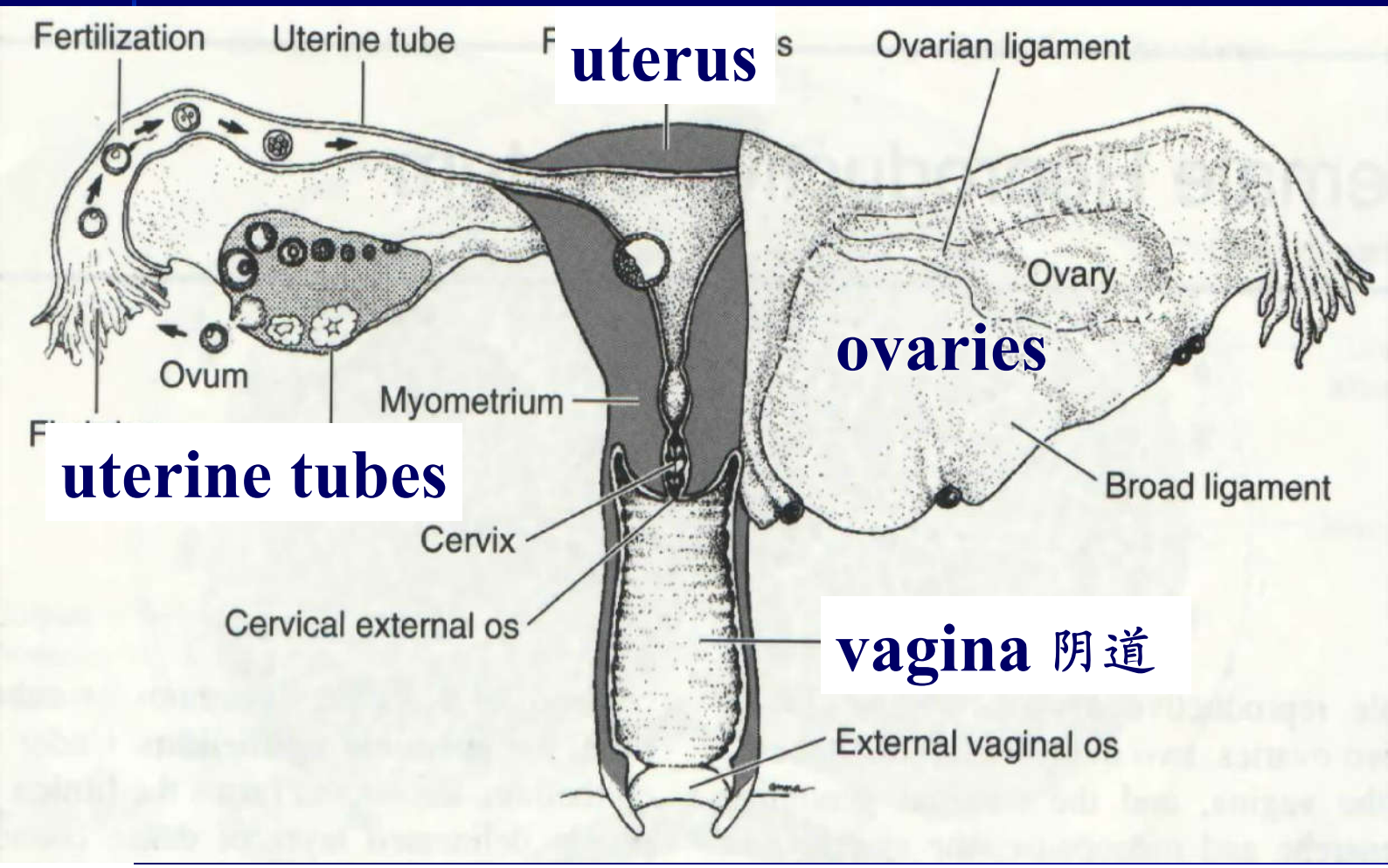
two changes

*ovary

*uterus

*endocrine interrelationships

I. Compositions



II-1 Change with age

- < 10 years old —— slow
- > 10 years old —— develop
- at puberty (13～18 y) —— develop fast

  ovaries start to ovulate

  secret sex hormones

  *menophania 月经初潮

  secondary sex characters

- fertility age
- perimenopause period (围绝经期):

  45～55 y, endocrine, somatic & mental
- postmenopause period (绝经期):

  functions of ovary

  menstruation

  reproductive organs

II-2 Cyclic changes (monthly)

between menarche and menopause

the system undergoes cyclic changes

in structure and functional activity

* uterus

III. Ovary

- superficial epithelium: simple squamous or cuboidal epi
- tunica albuginea 白膜: DCT
- cortical region: ovarian follicles & CT
- medullary region: LCT contains BVs & elastic f

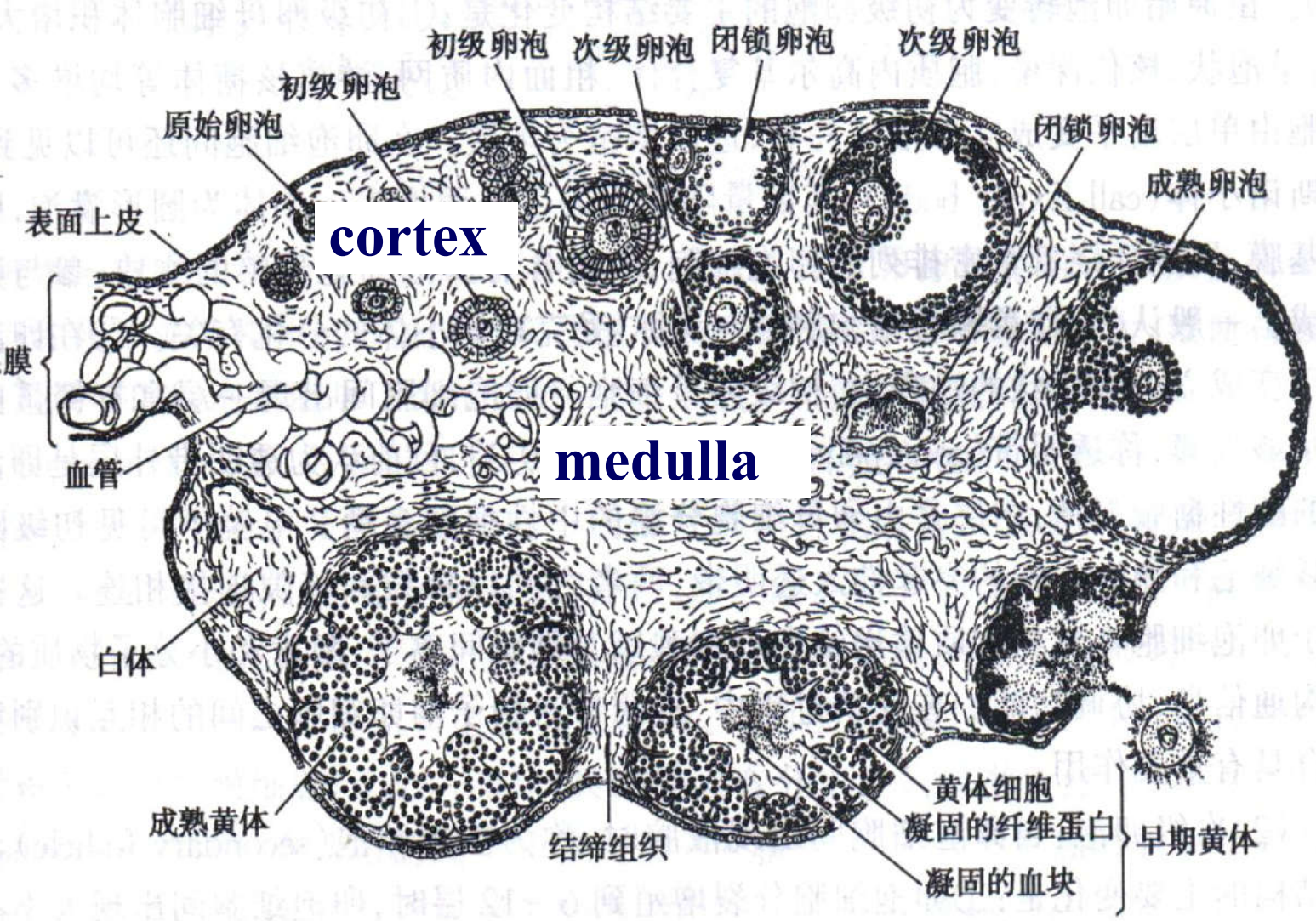


图 19-1　卵巢切面模式图

① The development and maturation of follicles

ovarian follicle
- an oocyte
- follicular cells (granulosa cells)

Before birth: all oogonia 卵原细胞 → primary oocytes → prophase of the first meiotic division 前期

- primordial
- growing (primary & secondary)
- mature

} stages

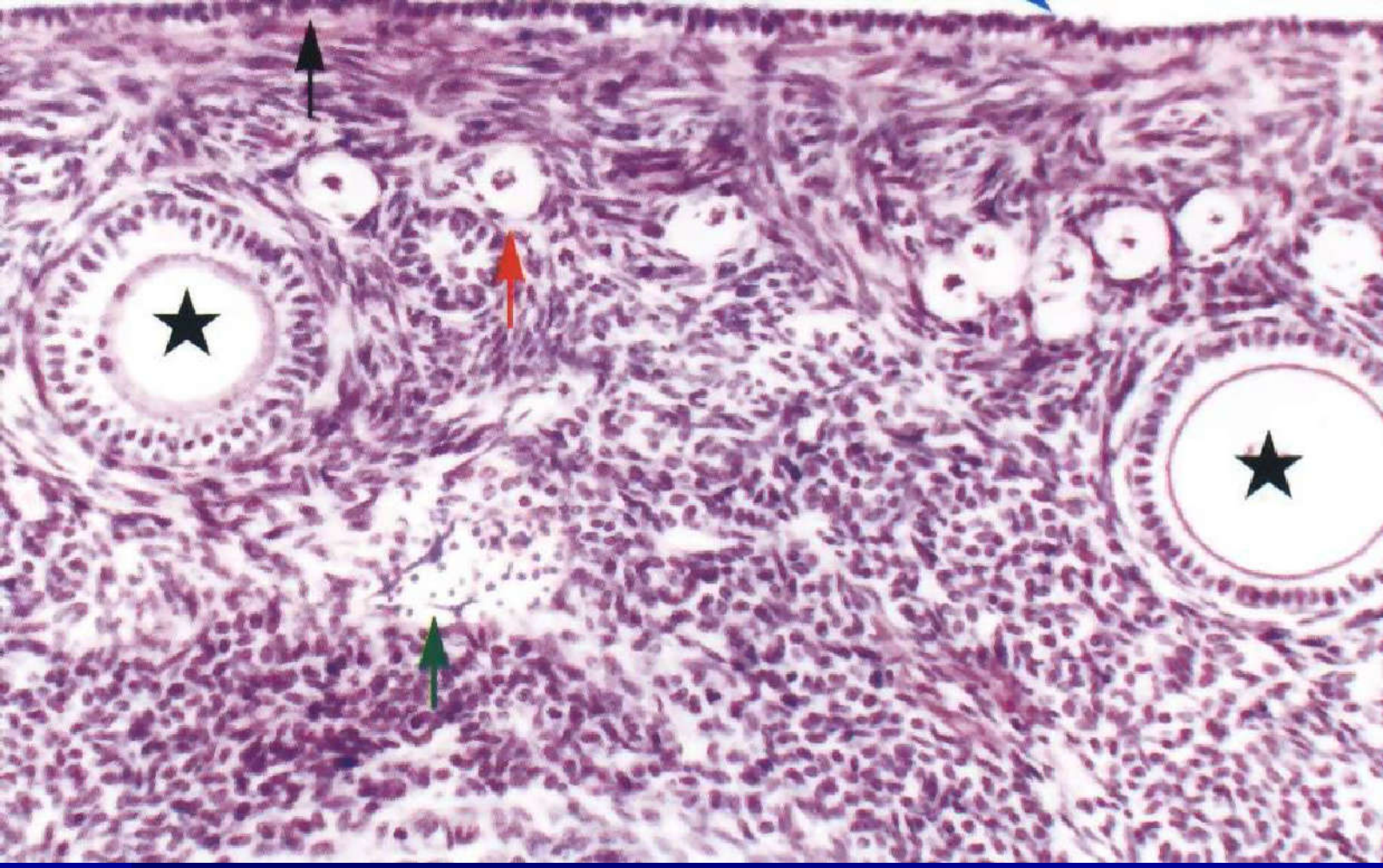
- primordial follicle

  peripheral zone, a lot of

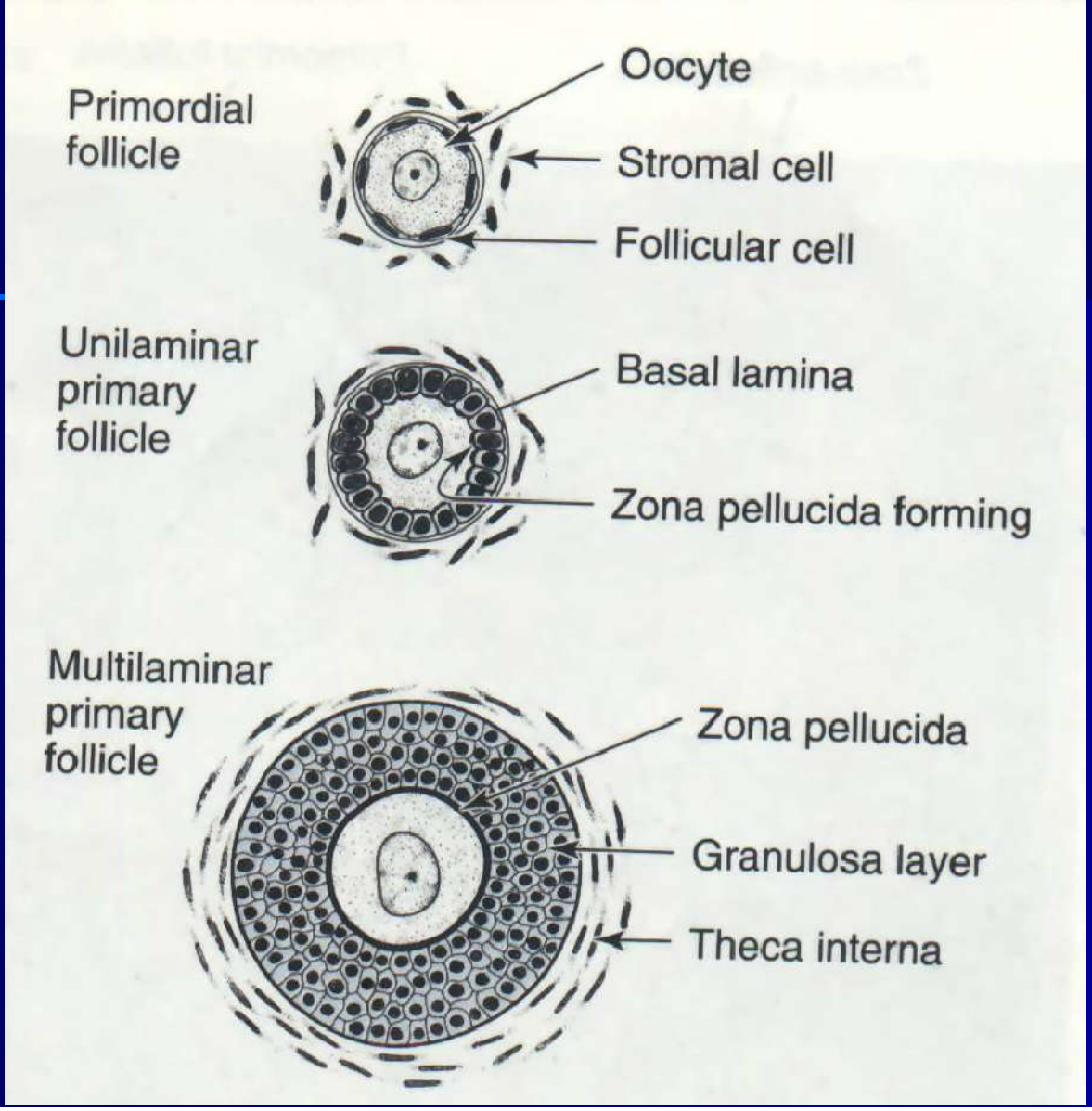
  about 40000 follicles in puberty

  a primary oocyte (large round nucleus with prominent nucleolus, pale stained cytoplasm)

  a single layer of <u>flattened</u> follicular cell



superficial epithelium → primordial follicle


Primordial follicle
Oocyte
Stromal cell
Follicular cell
Unilaminar primary follicle
Basal lamina
Zona pellucida forming
Multilaminar primary follicle
Zona pellucida
Granulosa layer
Theca interna

- **Primary follicle**

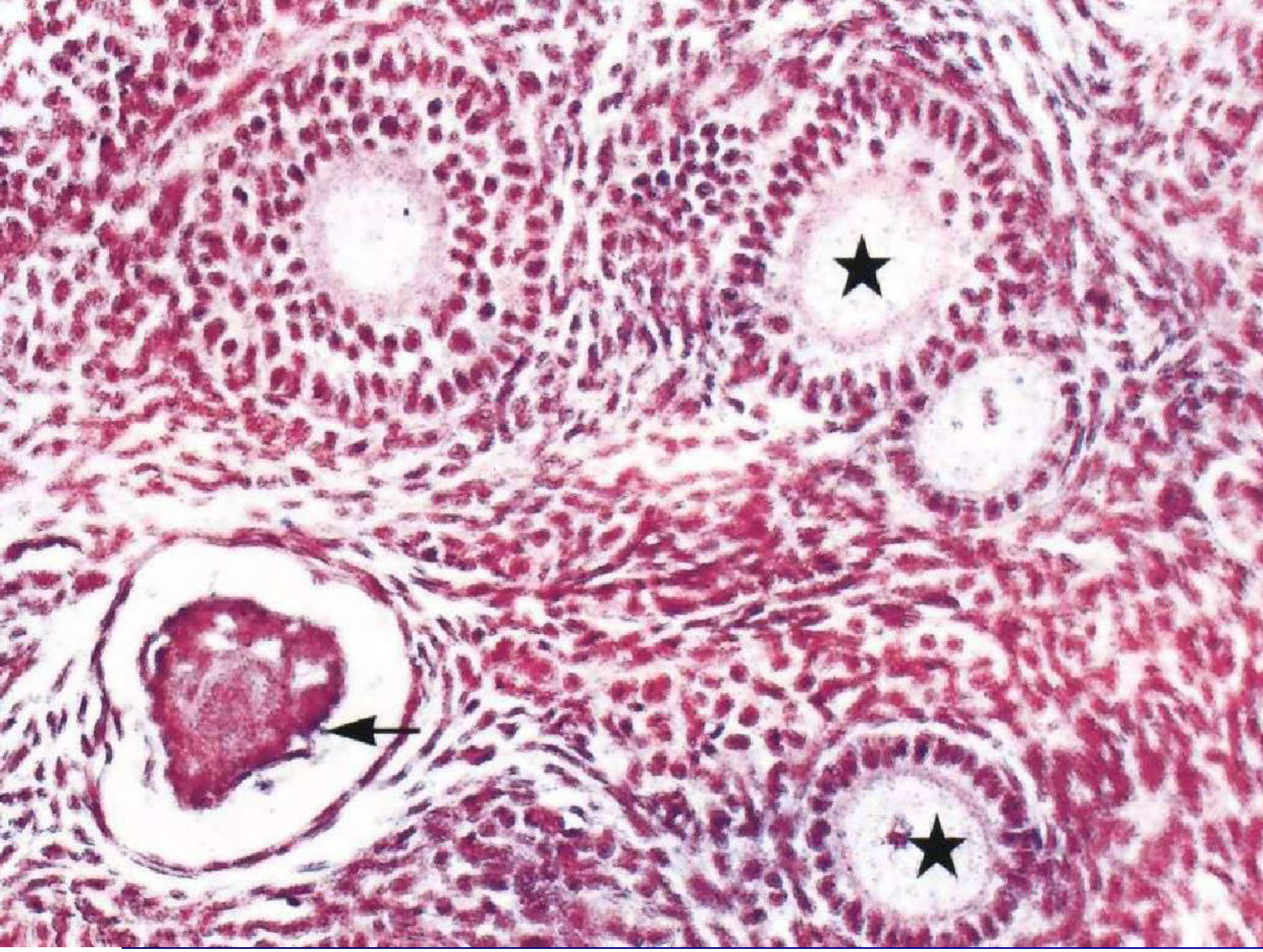
*primary oocyte enlarge, # of organelles ↑

*follicular cells:

flat → cuboidal or columnar

single layer → multiple layers

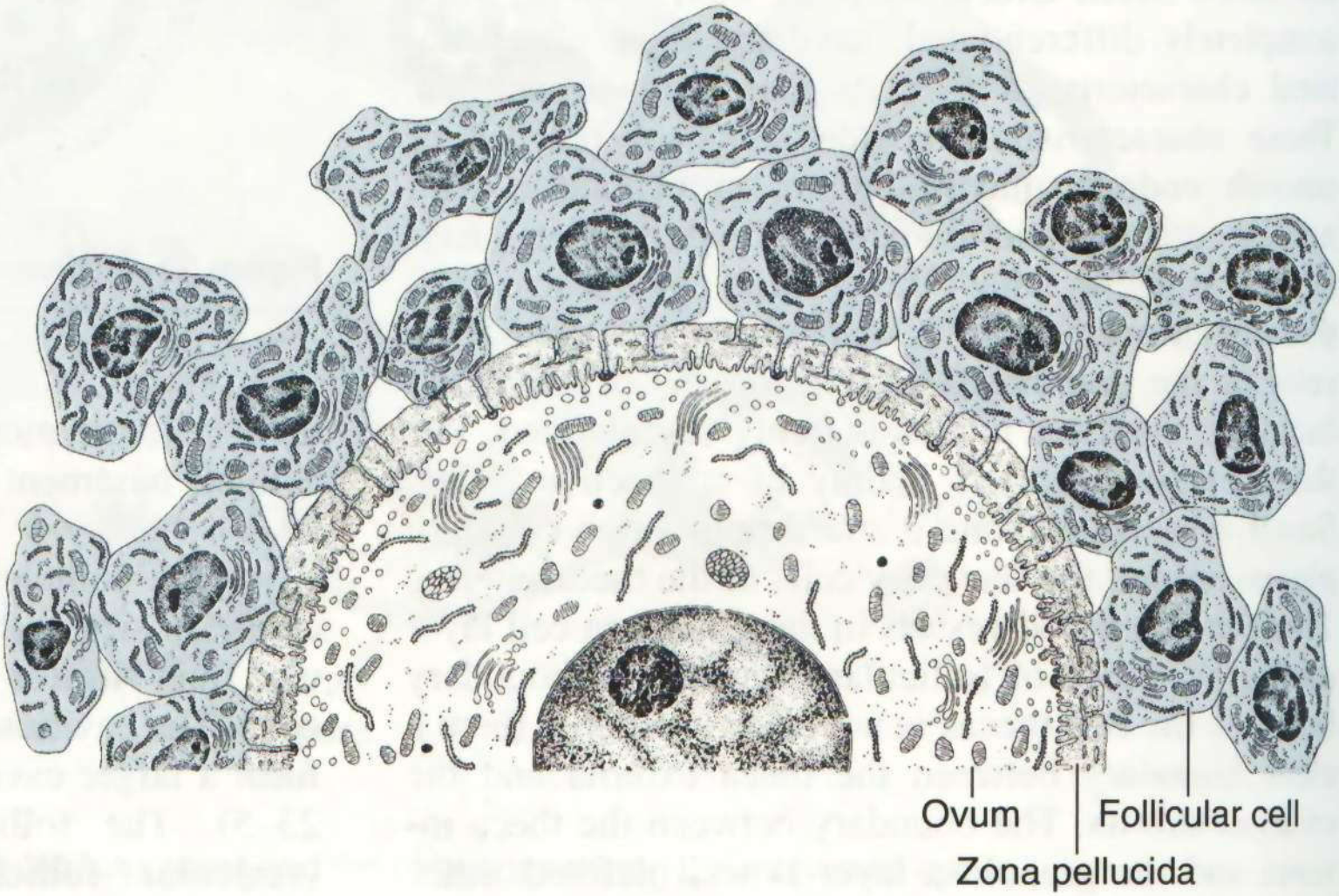
(granulosa layer)

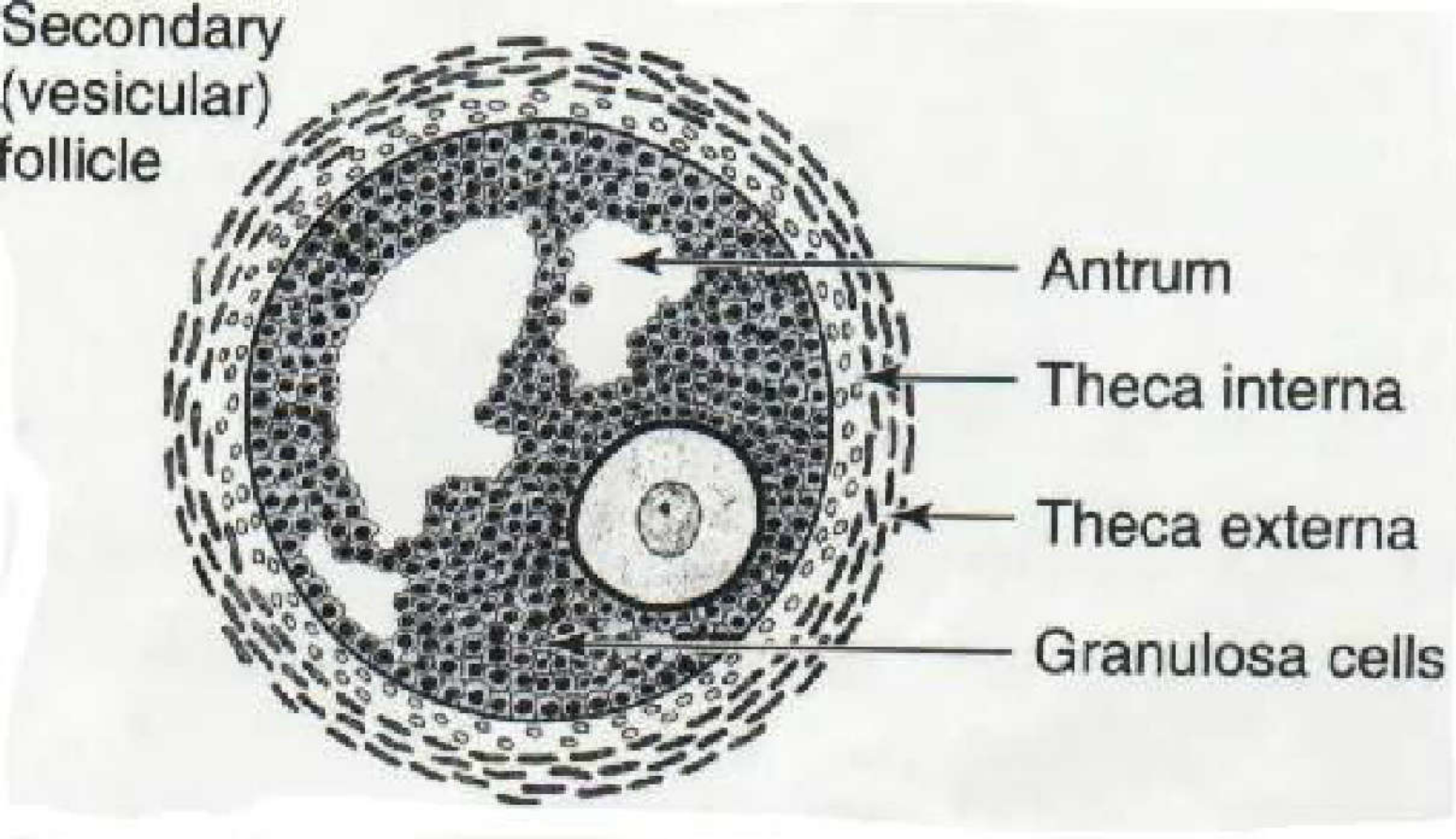


* zona pellucida

*zona pellucida 透明带：between oocyte & follicular cells

- glycoproteins
- acidophilic membrane
- synthesized by both oocyte & follicular cells

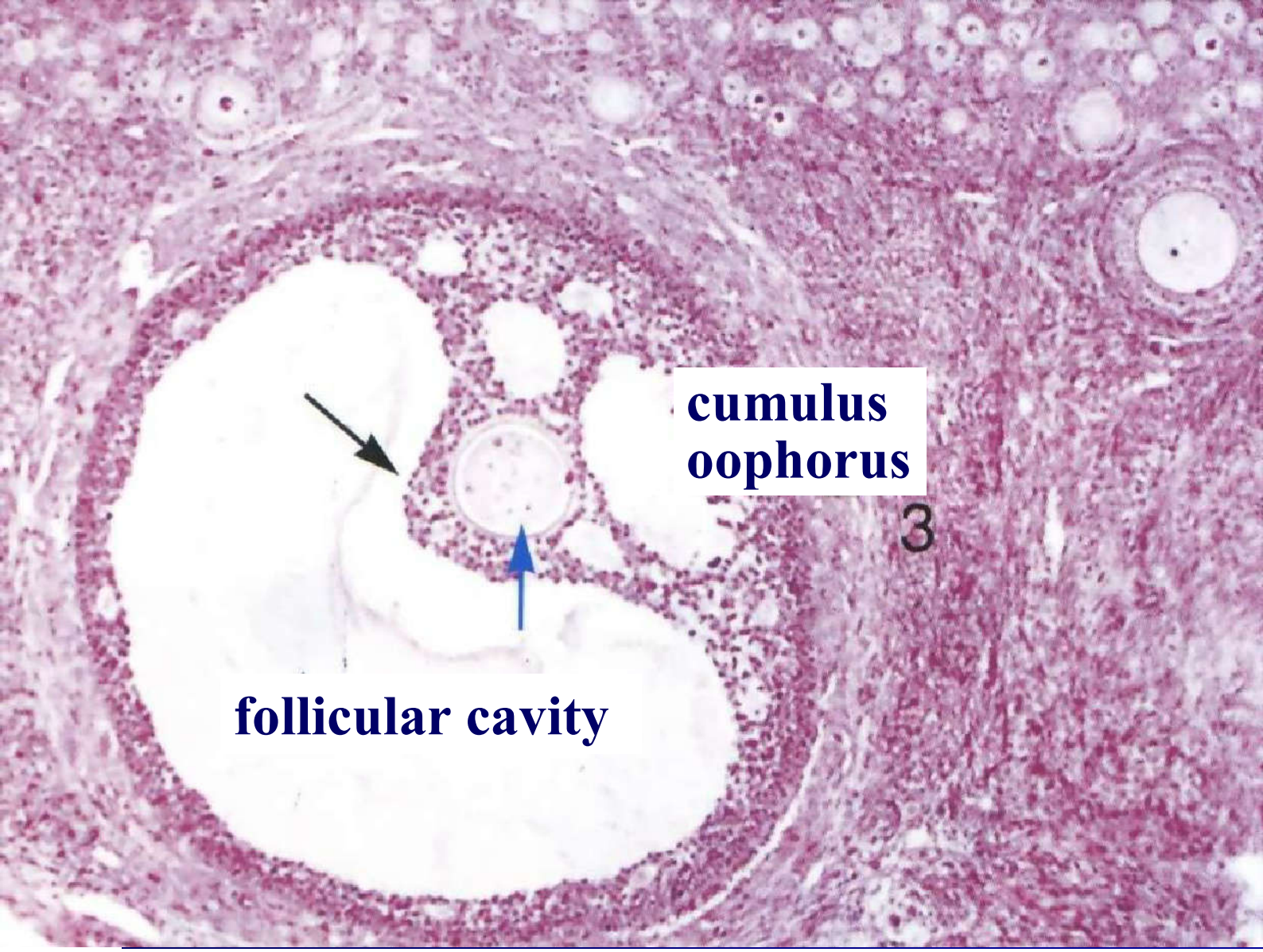

Ovum
Follicular cell
Zona pellucida

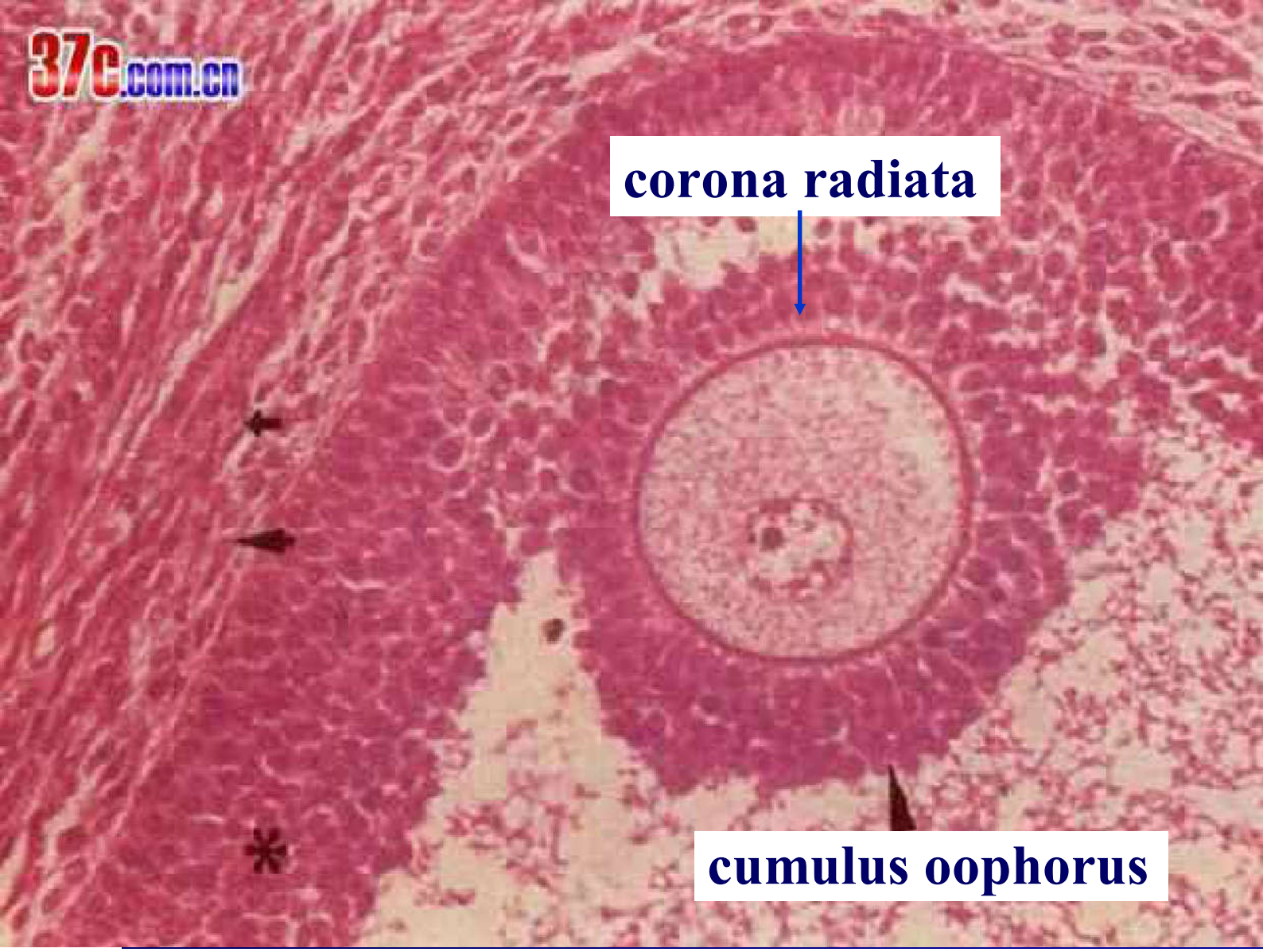


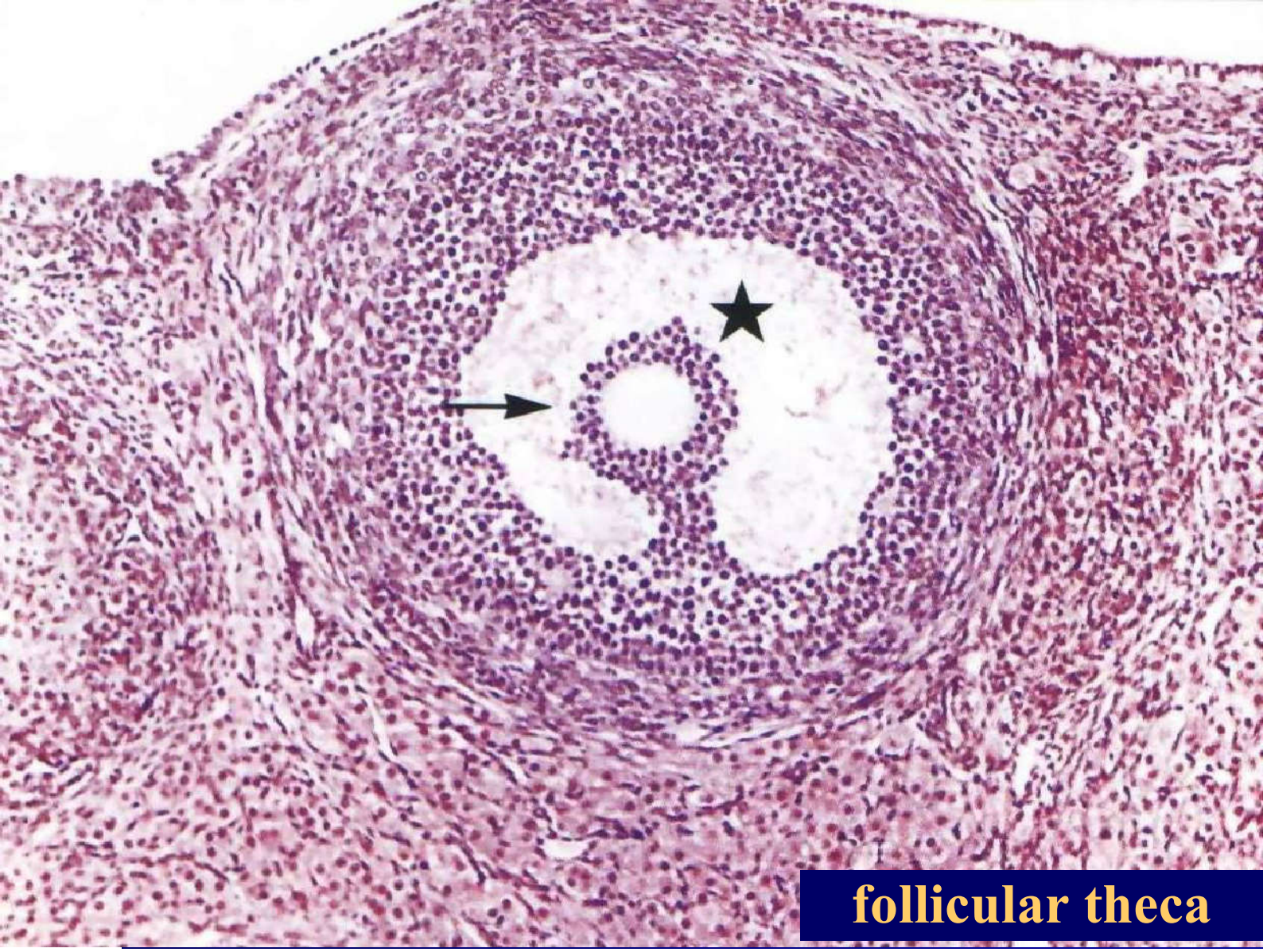
Secondary follicle

Secondary follicle

- primary oocyte reaches the maximal size
- stratum granulosum: follicular cells ↑
- follicular cavity —— follicular fluid
- cumulus oophorus 卵丘
- corona radiata 放射冠


cumulus
oophorus
3
follicular cavity


corona radiata
cumulus oophorus


follicular theca

* follicular theca 卵泡膜:

CT → theca interna 内膜层 — BVs &

theca cells - steroid-secreting cell

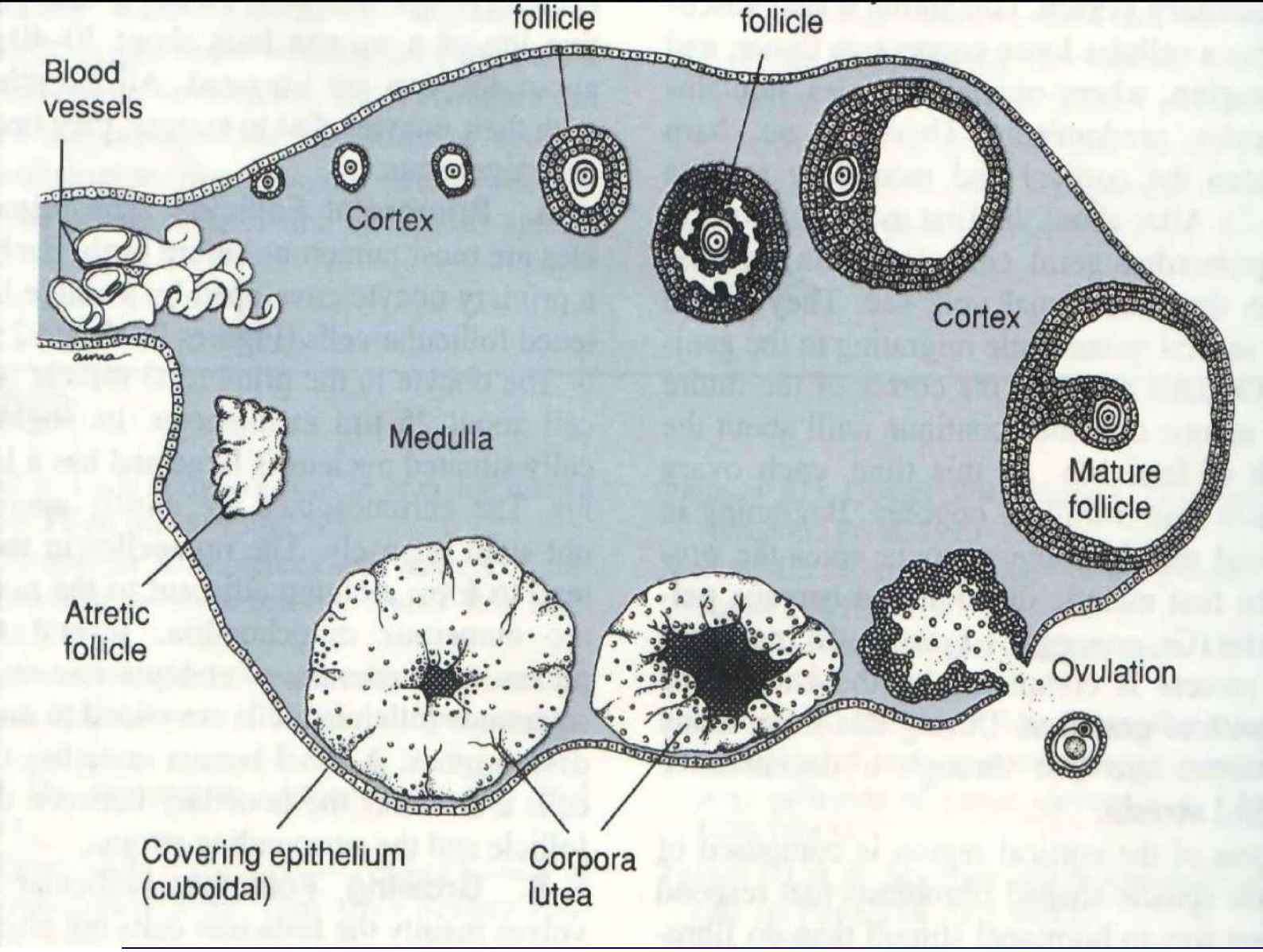
theca externa 外膜层 — more fibers

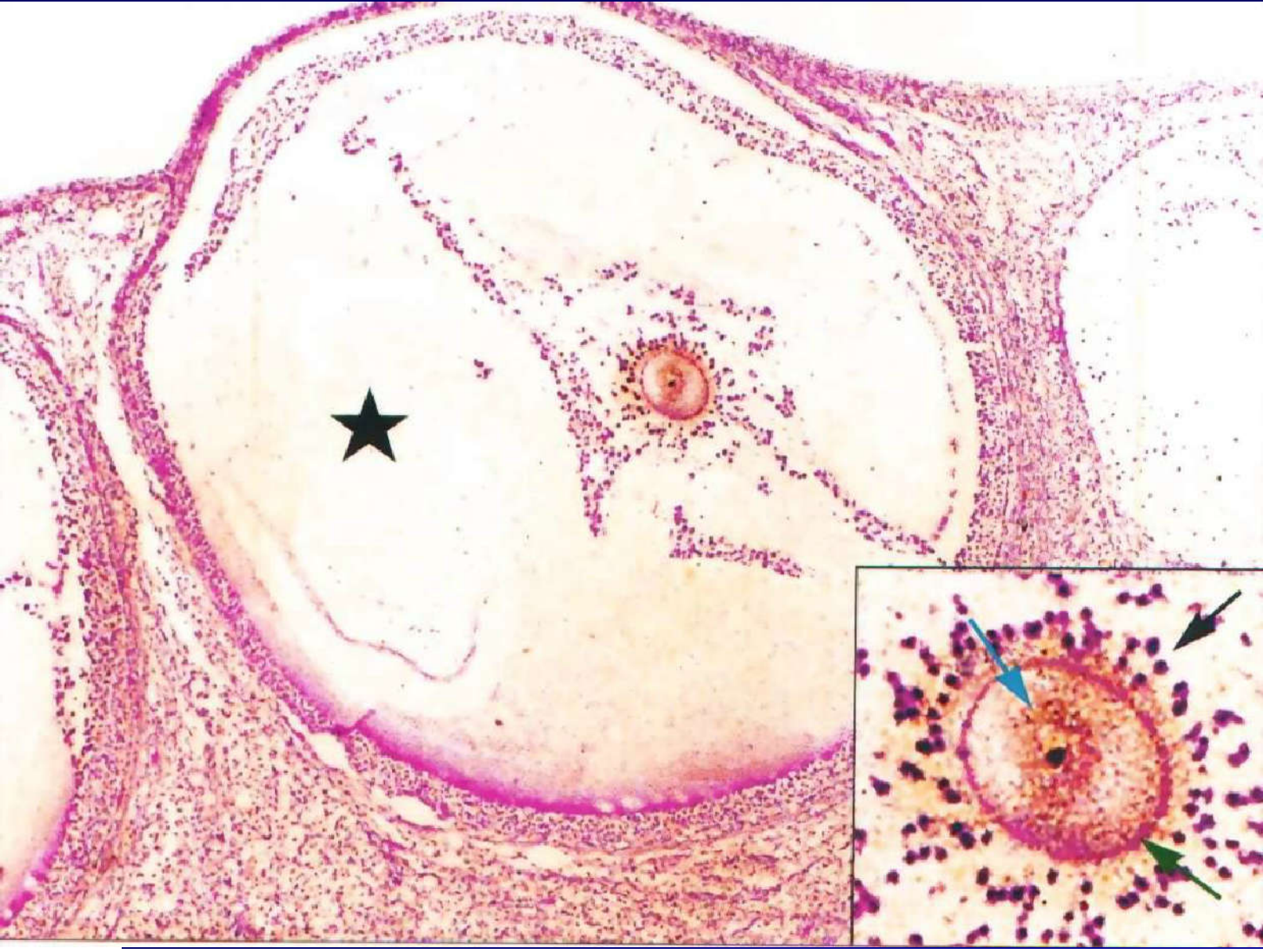
androgen 雄激素 —*enzyme*→ estrogen 雌激素

(theca cells) (granulosa)

- **Mature follicle**

* **2cm in diameter – protrudes from the surface**
* **large follicular cavity**
* **thin granulosa layer**


follicle
follicle
Blood vessels
Cortex
Cortex
Medulla
Mature follicle
Atretic follicle
Ovulation
Covering epithelium (cuboidal)
Corpora lutea



* 1st meiotic division is completed just before ovulation → secondary oocyte (23, X 2n DNA)

→ first polar body

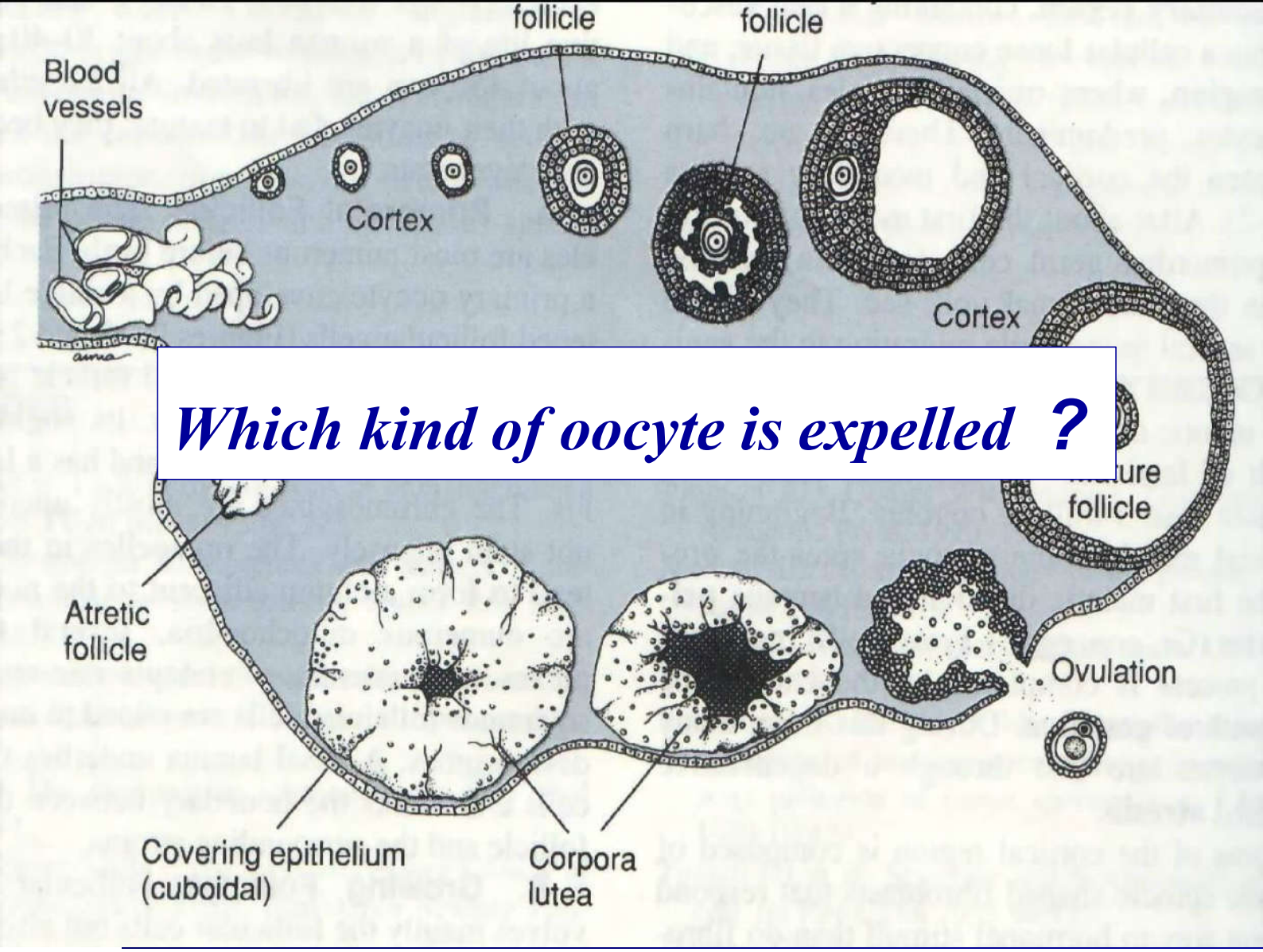
* oocyte starts the 2nd meiotic division immediately and stops in metaphase.

② Ovulation 排卵

The process:* rupture of mature follicle

* liberation of oocyte

oocyte
zona pellucida
corona radiata
} expelled from ovary



Which kind of oocyte is expelled ?

*In fertility age, one oocyte is liberated by the ovaries alternately every 28 days.

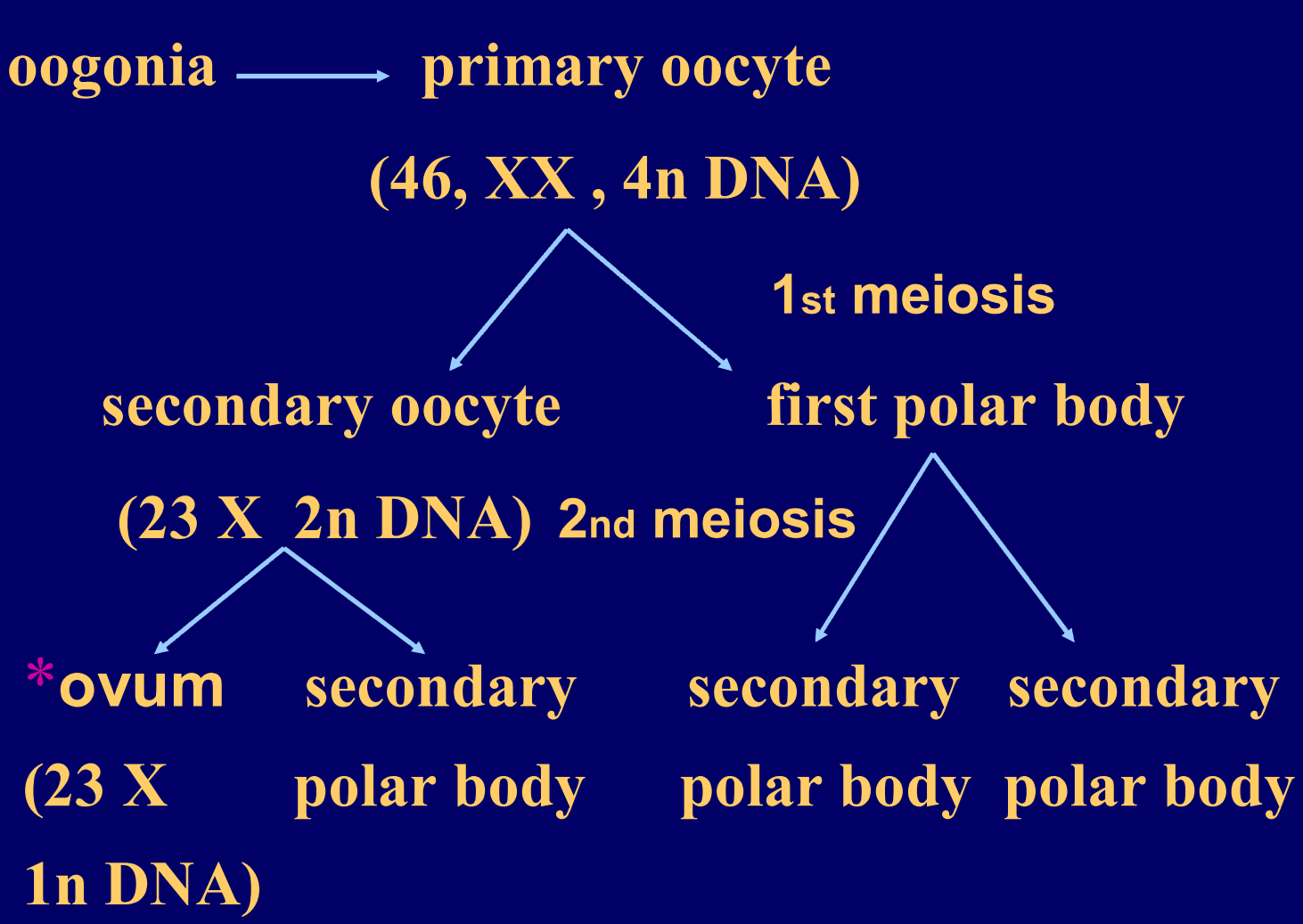
*middle of the menstrual cycle (14th day)

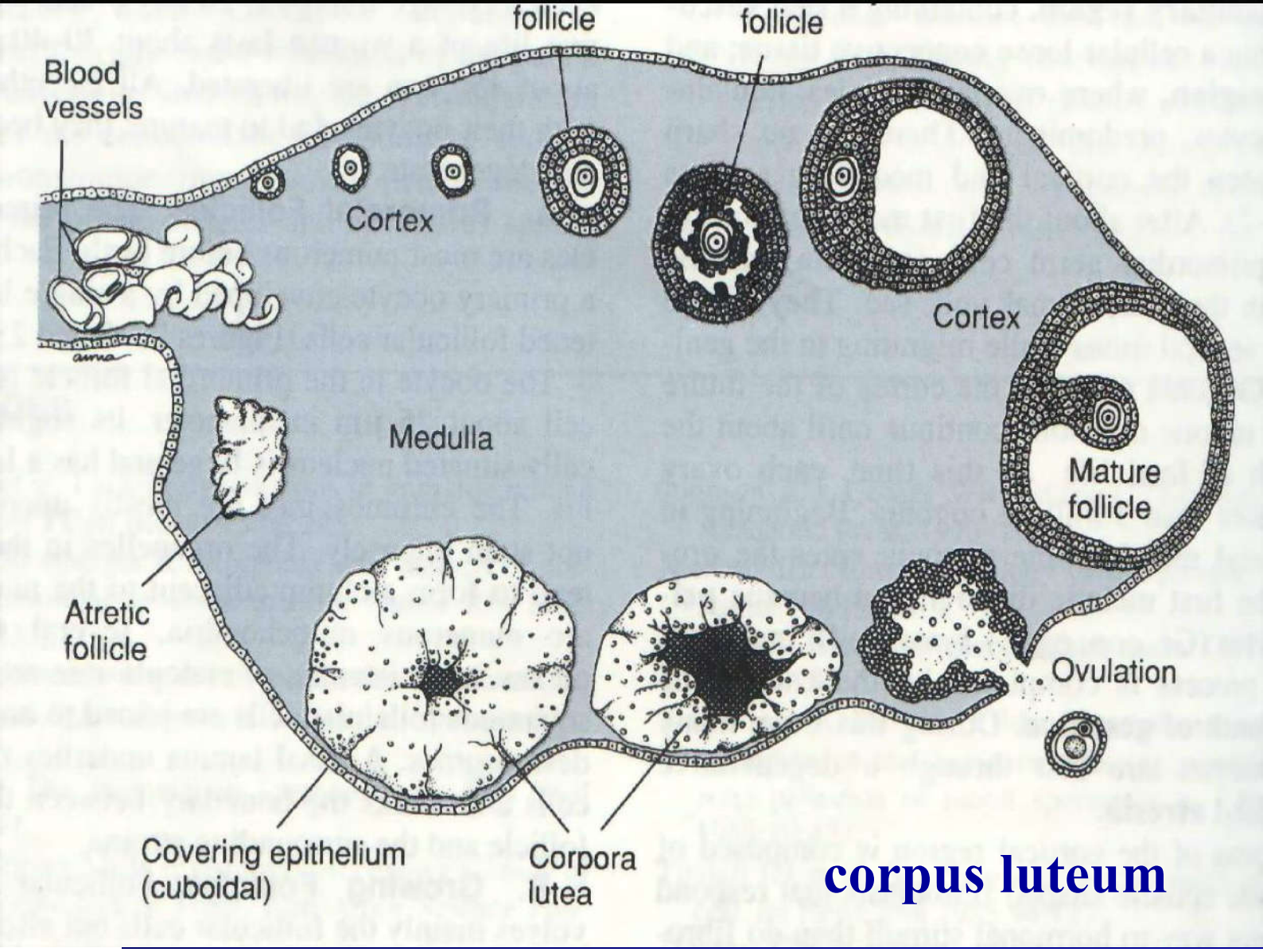
月经周期

*secondary oocyte

not fertilized → degenerate (24 hours)

fertilized → 2nd meiotic division → mature ovum


oogonia
primary oocyte
(46, XX , 4n DNA)
1st meiosis
secondary oocyte
first polar body
(23 X 2n DNA)
2nd meiosis
*ovum
(23 X
1n DNA)
secondary
polar body
secondary
polar body
secondary
polar body



corpus luteum

③ Corpus luteum 黄体

After ovulation, follicle's wall collapse to form a folded cell mass.

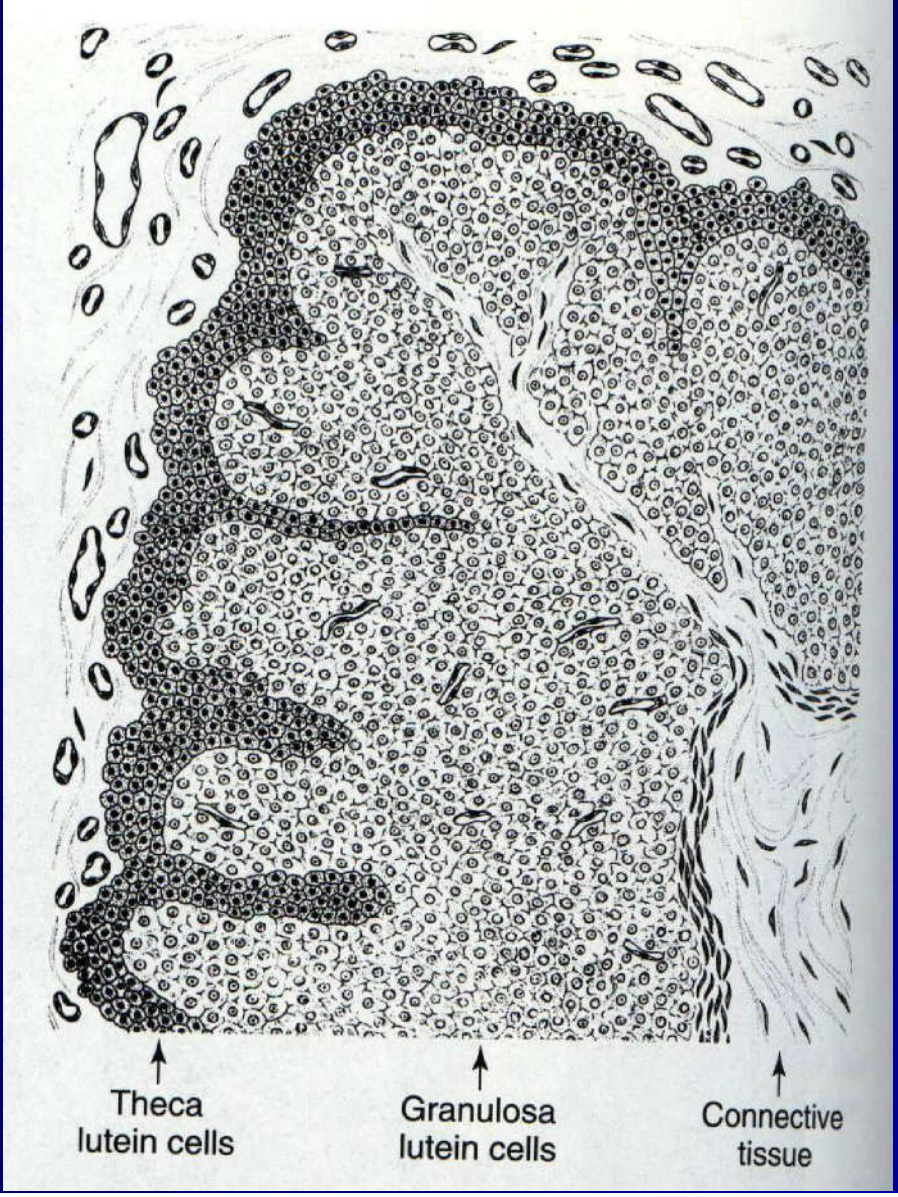
*granulosa → granulosa lutein cells

progesterone 孕激素 & relaxin

*theca interna → theca lutein cells

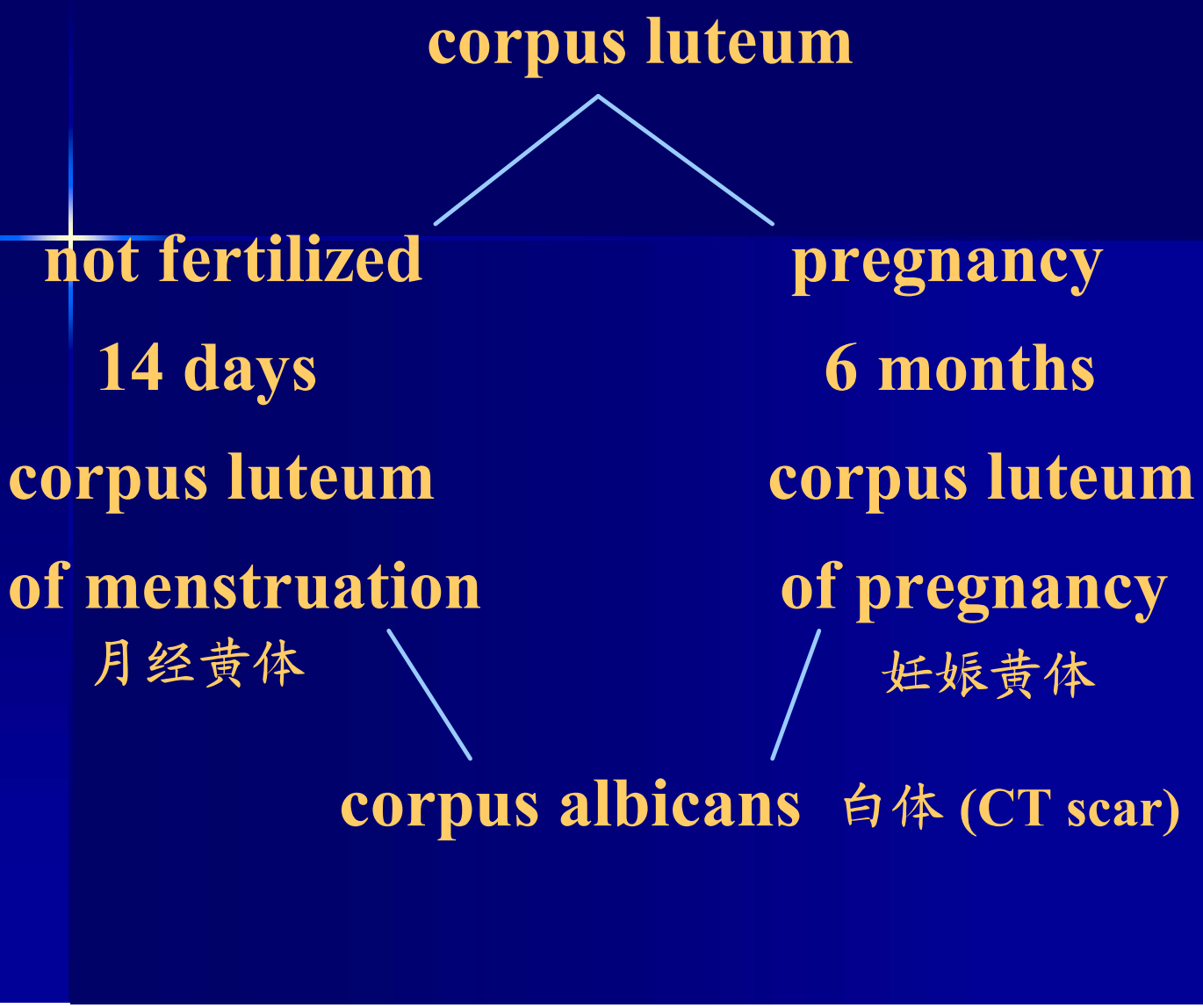
estrogen 雌激素

a endocrine gland


Theca
lutein cells
Granulosa
lutein cells
Connective
tissue

a temporary endocrine gland

*steroid secreting cells (corpus luteum)

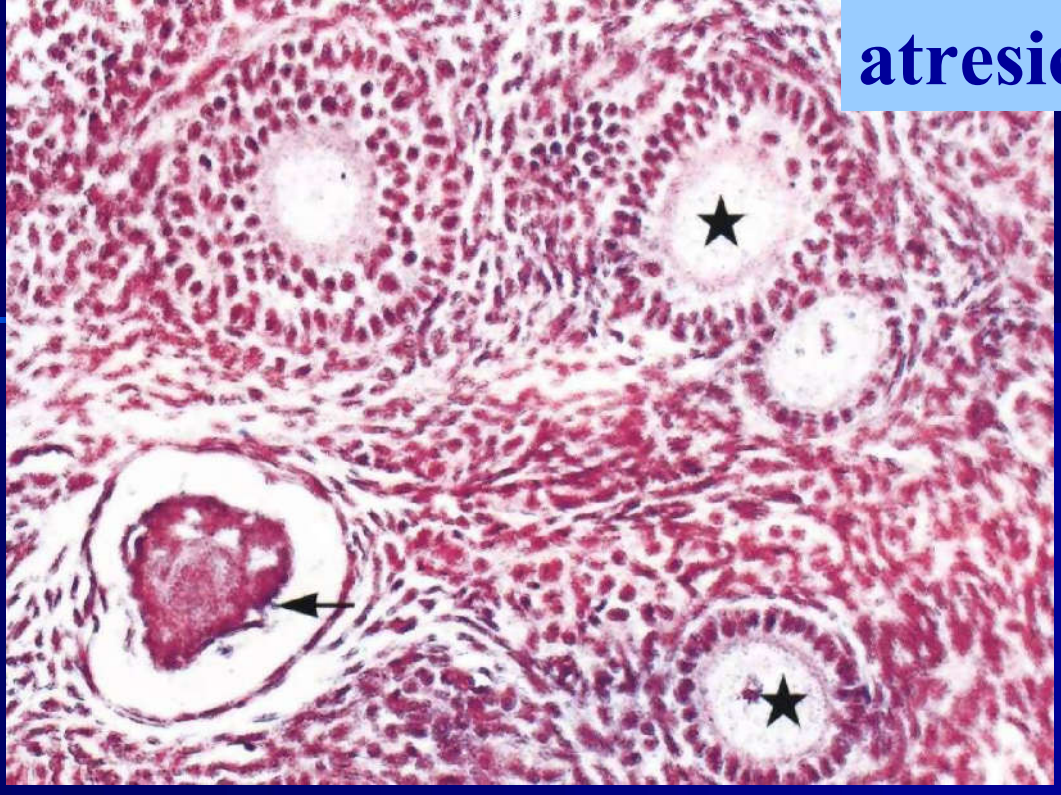

corpus luteum
not fertilized
14 days
corpus luteum
of menstruation
月经黄体
pregnancy
6 months
corpus luteum
of pregnancy
妊娠黄体
corpus albicans
白体 (CT scar)

corpus albicans

④ Atresic follicle 闭锁卵泡

* # of ovarian follicles: 40,000
* # of ova liberated: around 450
  (fertility life)
* The rest could degenerate in any developmental stage
  ——— atresic follicles

atresic follicle



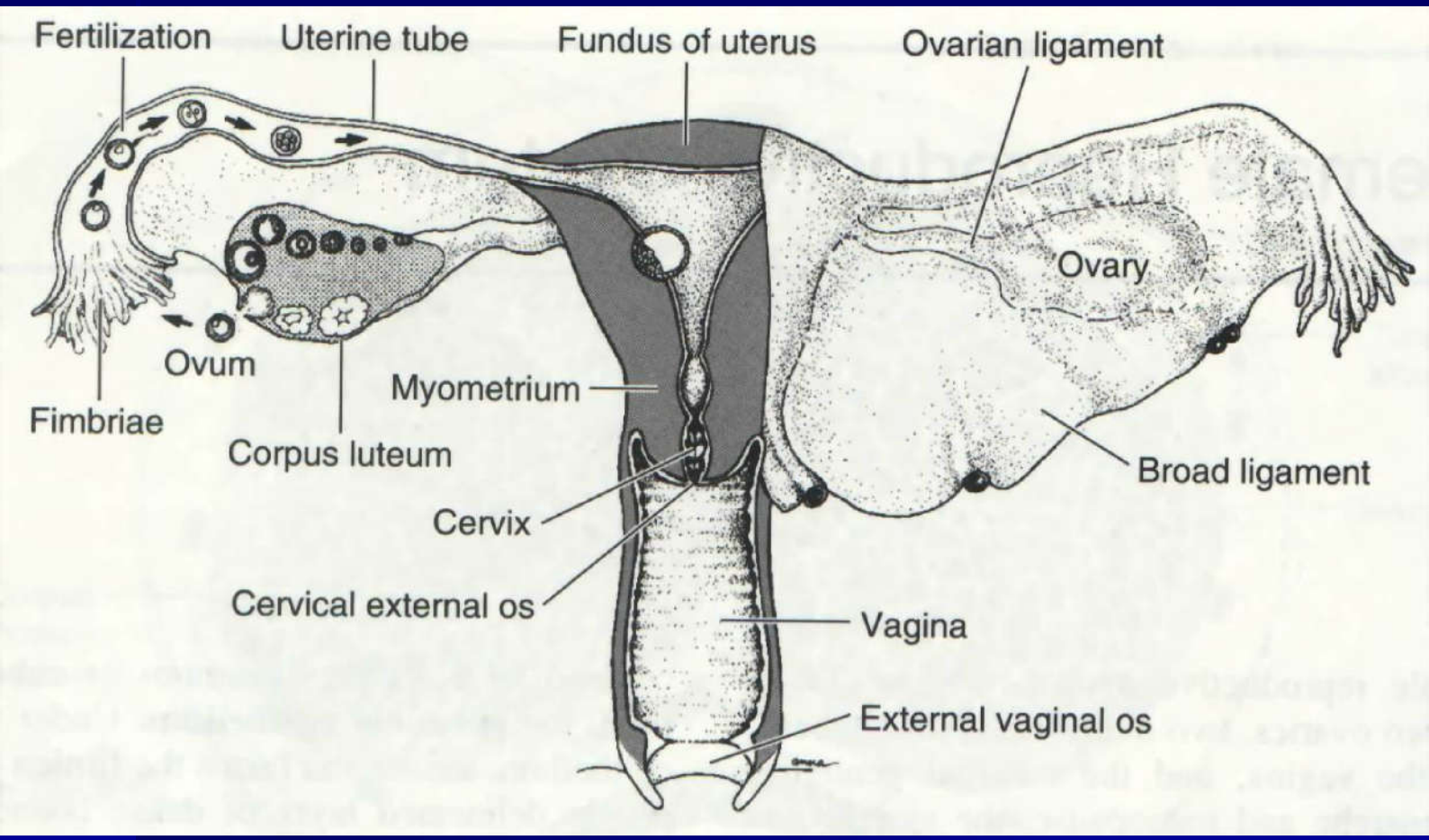
* oocyte die
* follicular cells in disorder
* zona pellucida shrink
* the wall of follicle collapse

The theca cells of large follicle will differentiate to interstitial gland

间质腺

⟶ estrogen

- The development and maturation of follicle (How does a primordial follicle develop into mature follicle?)
- Ovulation (What's ovulation? Which components are liberated? Time?)
- Corpus luteum (derivation, structure, function)
- Atresic follicle


Fertilization
Uterine tube
Fundus of uterus
Ovarian ligament
Ovary
Ovum
Myometrium
Fimbriae
Corpus luteum
Broad ligament
Cervix
Cervical external os
Vagina
External vaginal os

IV. Uterus

3 layers
- ★endometrium (mucosa)
- myometrium
- perimetrium

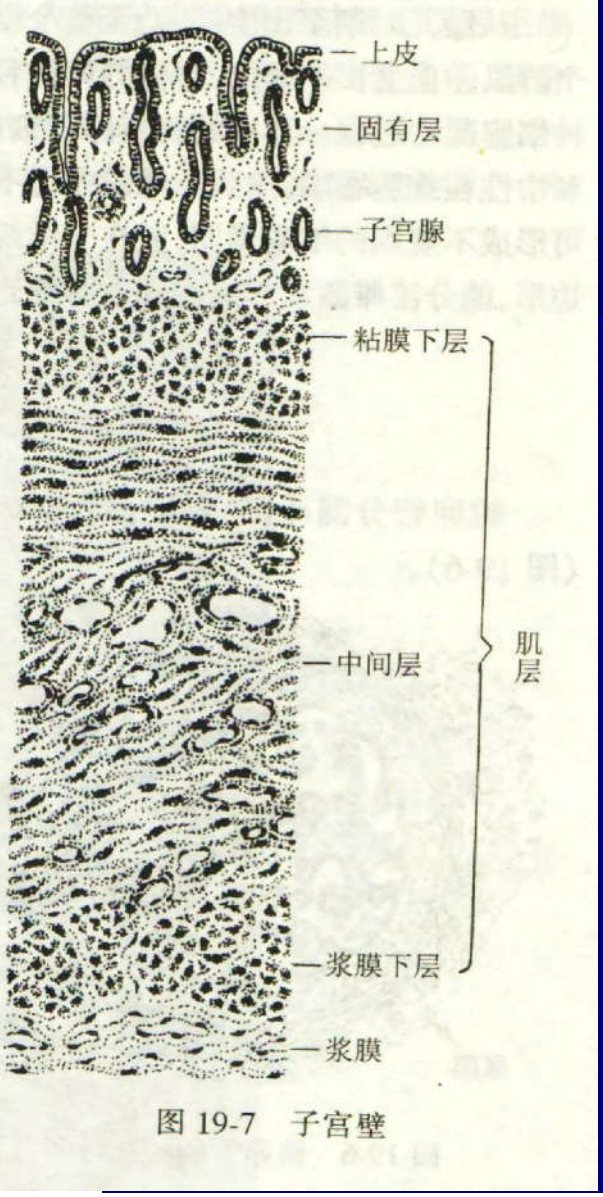


图 19-7　子宫壁

endometrium

myometrium: 3 layers

***long smooth muscle f**

***pregnancy more and longer**

perimetrium: serosa or fibrosa

① Structures of endometrium

- epithelium: simple columnar epi

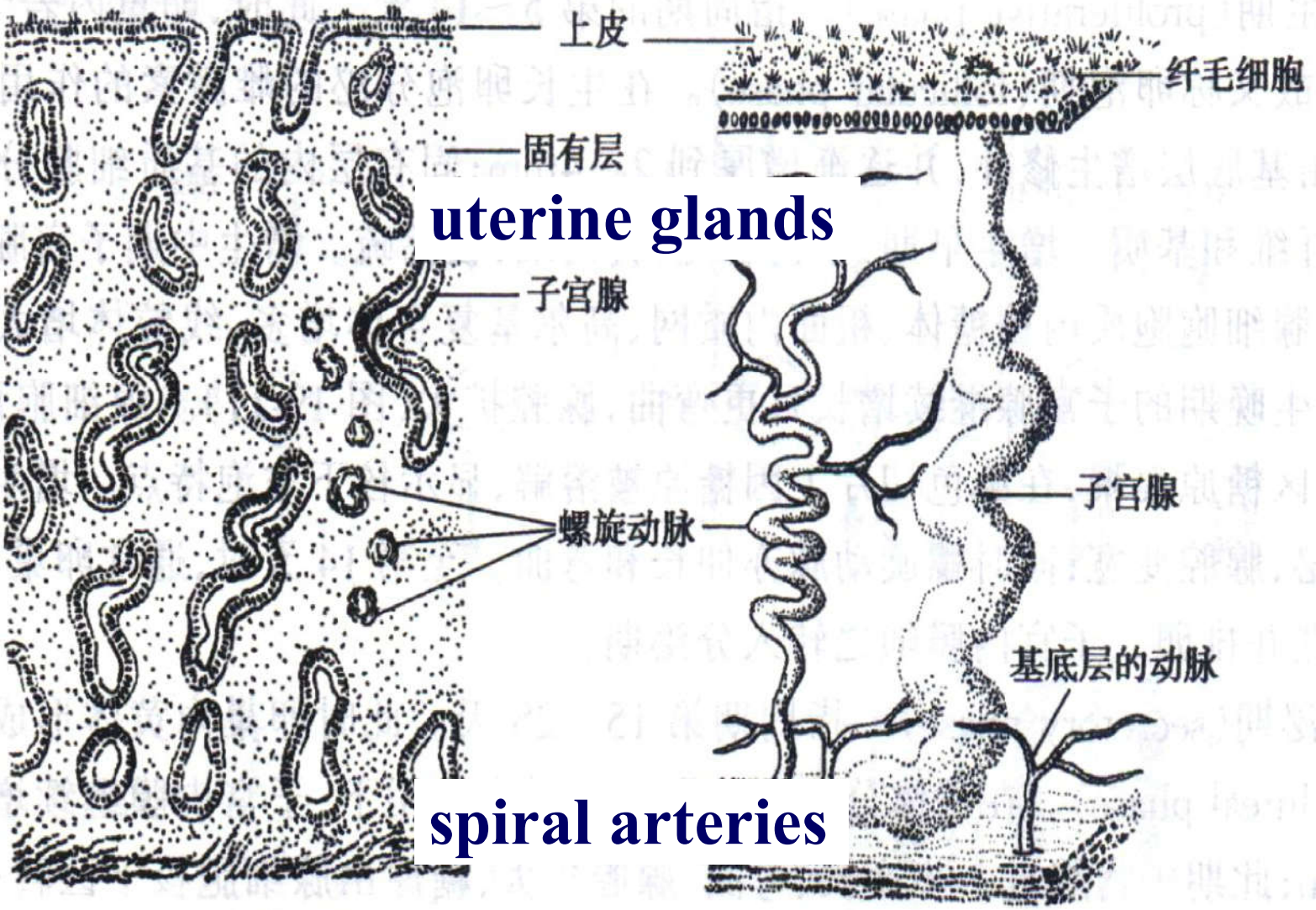
  *ciliated cells & *secretory cells

- lamina propria:

  CT with reticular f, *stroma cells & others

  *Spiral arteries

  *Uterine glands (simple tubular glands)


上皮
纤毛细胞
固有层
uterine glands
子宫腺
螺旋动脉
子宫腺
基底层的动脉
spiral arteries
A.内膜切面
B.子宫腺及螺旋动脉模式图

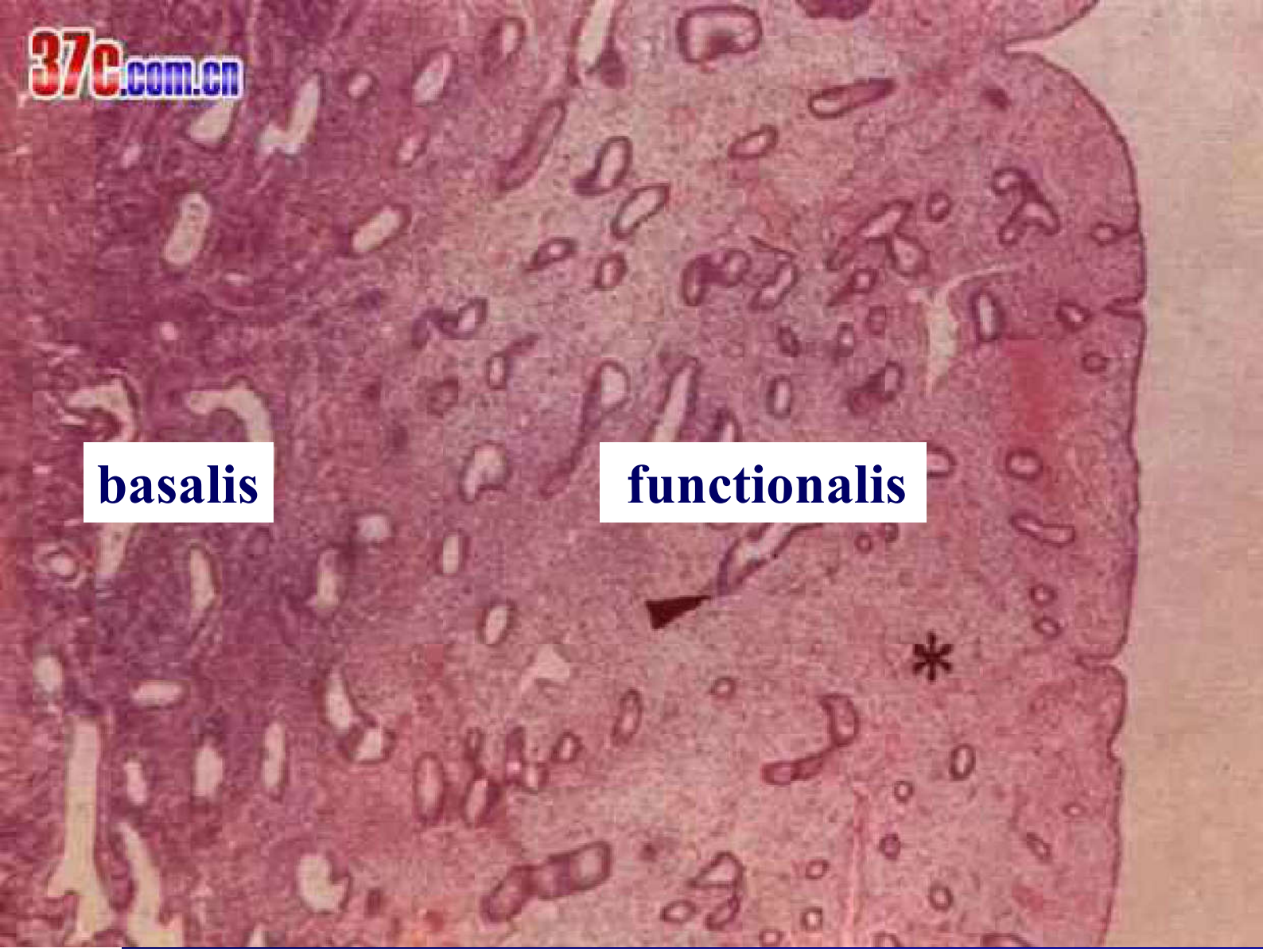
endometrium is divided into two layers

Functional layer (functionalis):

- ***peel away at menstruation**
- ***replaced during each menstrual cycle**

Basal layer (basalis):

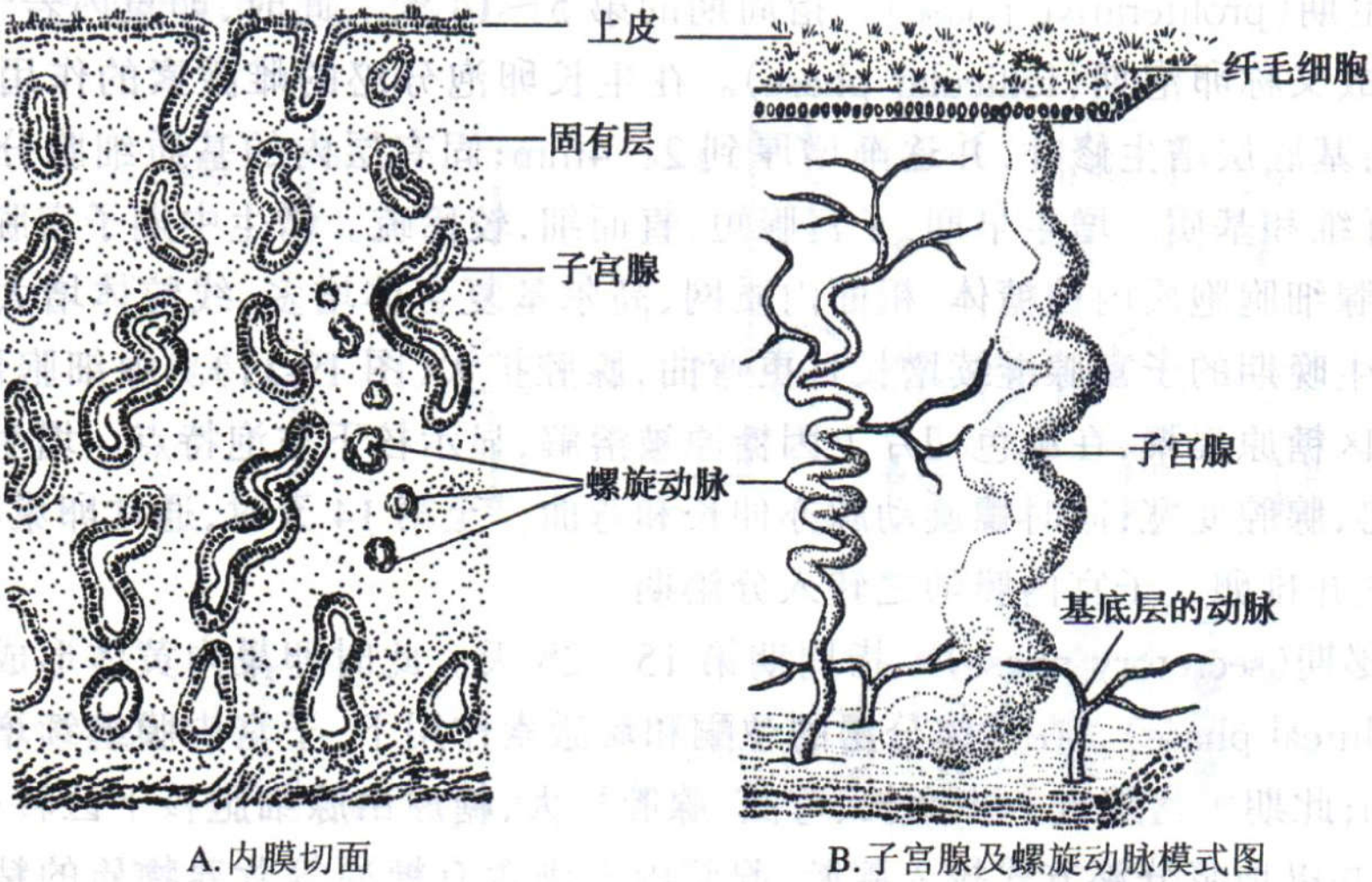
- ***doesn't peel off**
- ***proliferate and repair**


basalis
functionalis

Blood supply :

uterine A → straight A (basalis)

uterine A → spiral A (functionalis)



spiral A is sensitive to sex hormones

② The menstrual cycle 月经周期

* at about 28 days' interval, functionalis undergo structural modifications (peeling off and bleeding)
* menstruation: peeled endometrium and blood

three phases

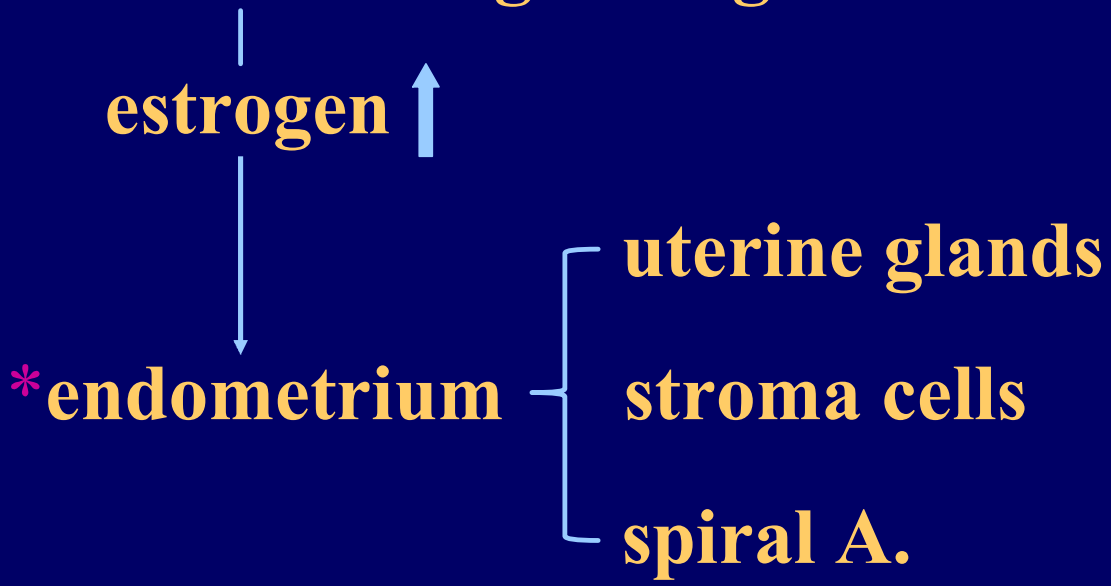
Menstrual phase: 1^{st}～4^{th} day

Proliferative phase: 5^{th}～14^{th} day

Secretory phase: 15^{th}～28^{th} day

- **proliferative phase: 5^{th}～14^{th} day**

ovarian follicles are growing



- secretory phase: 15^{th}～28^{th} day

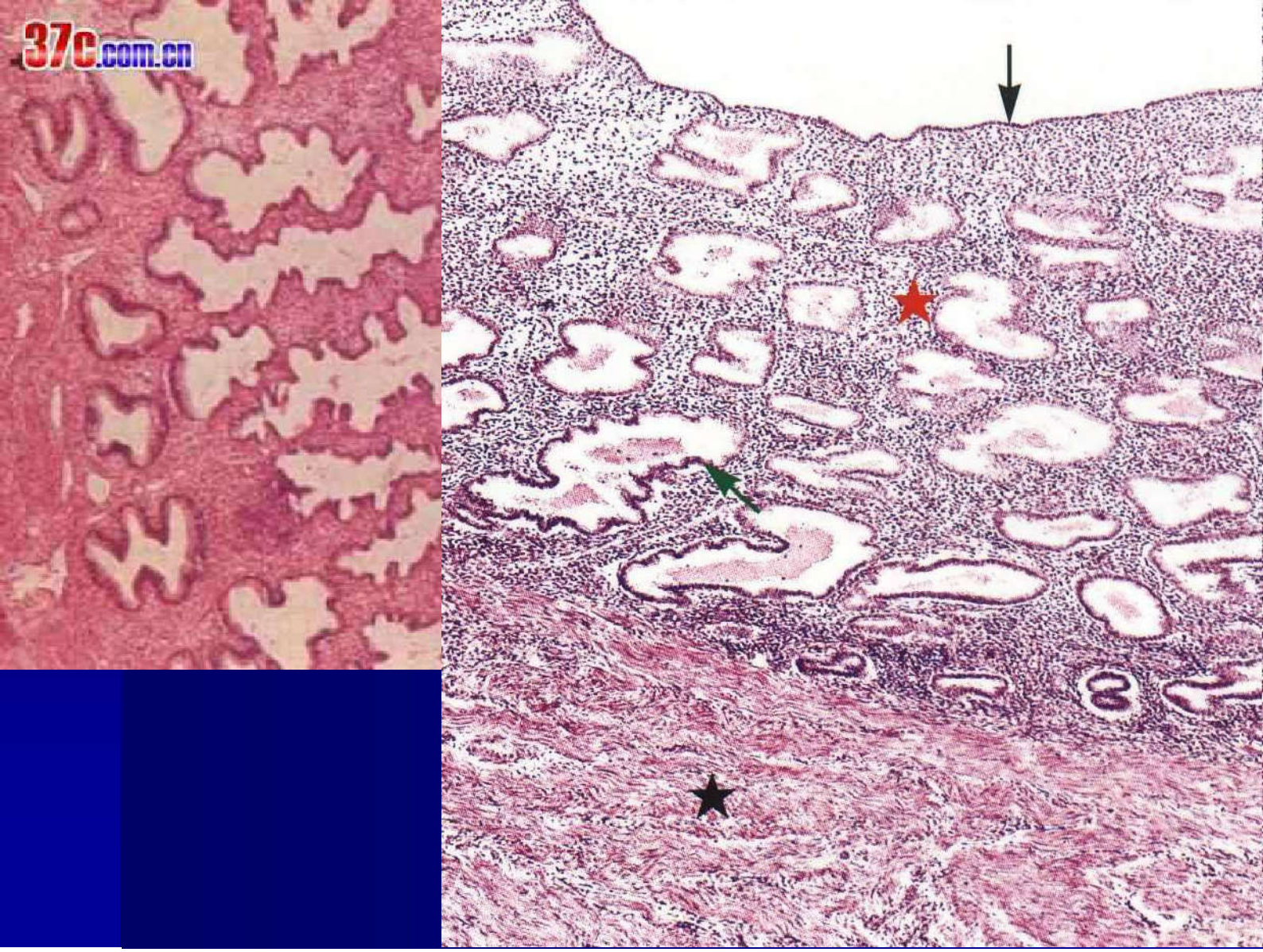
14^{th} day: ovulation

corpus luteum

sex hormones ↑

↓

endometrium
- glands: enlarge, longer, curving & secretion
- spiral A: longer & curving
- stroma cells: glycogen lipid droplet



- **menstrual phase: 1^{st}～4^{th} day**

corpus luteum degenerate

sex hormones ↓

endometrium

spiral A contracts

ischemia & necrosis of functionalis

spiral A dilates & bleed

menstruation

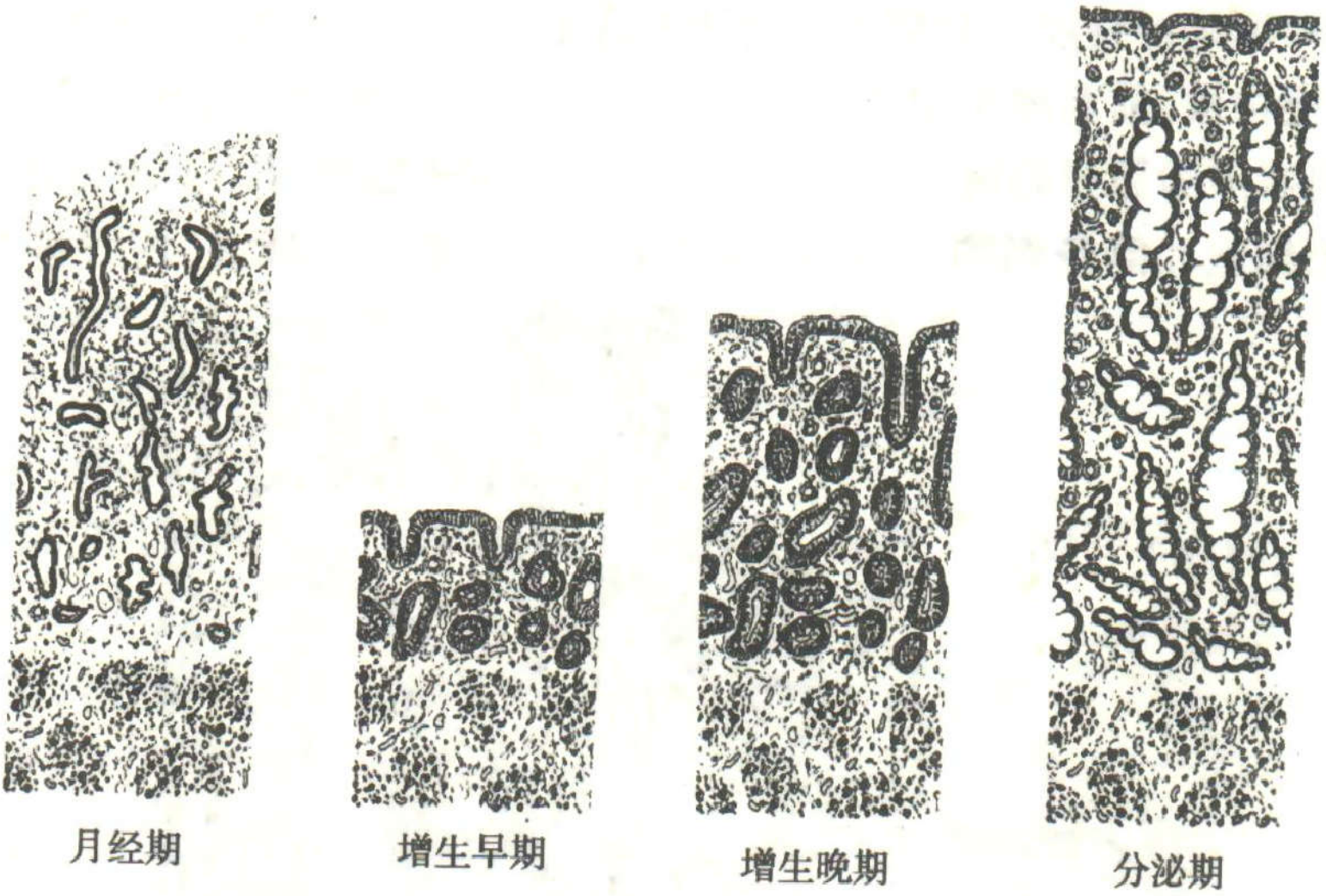


图 19-9　子宫内膜周期性变化示意图

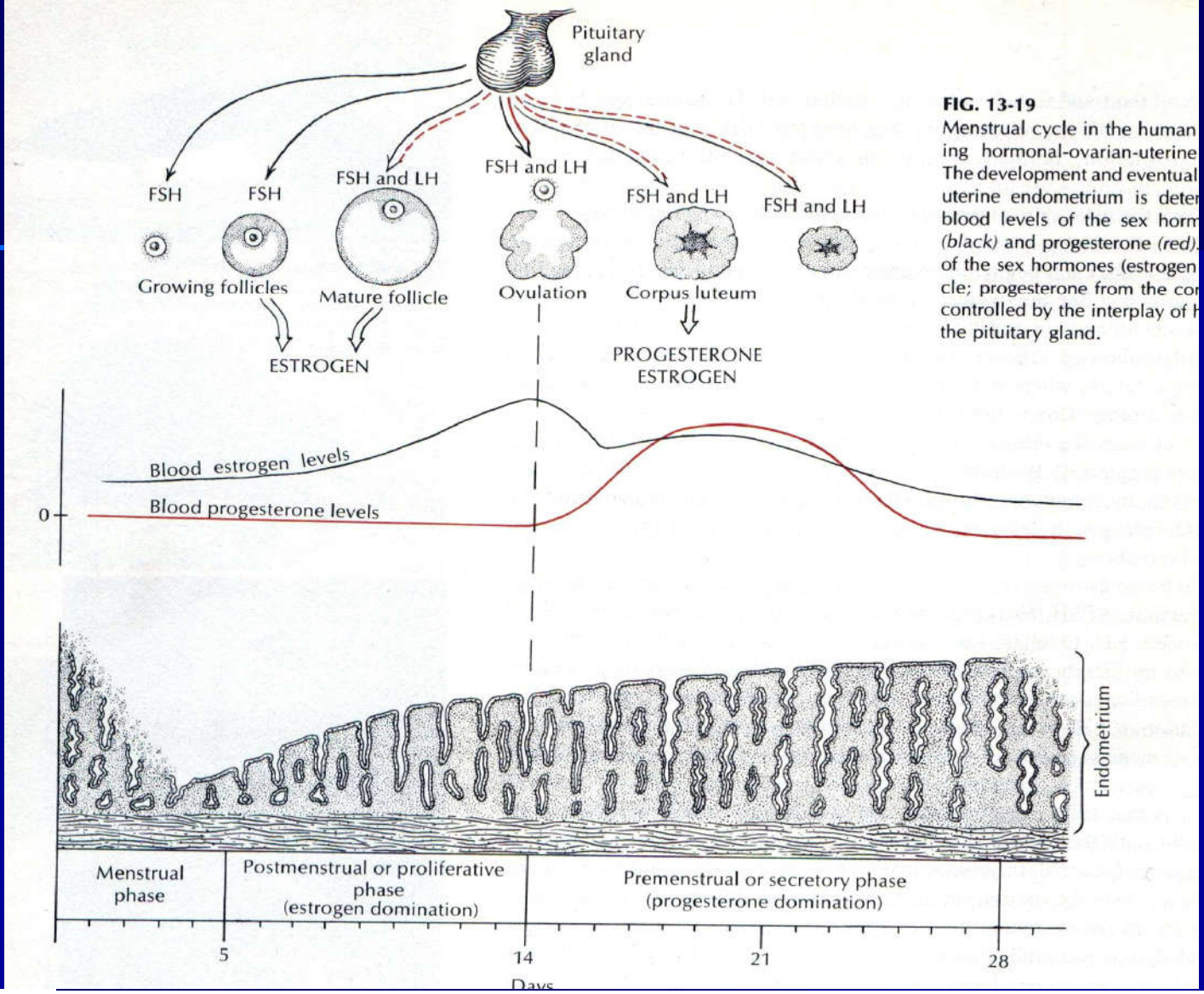
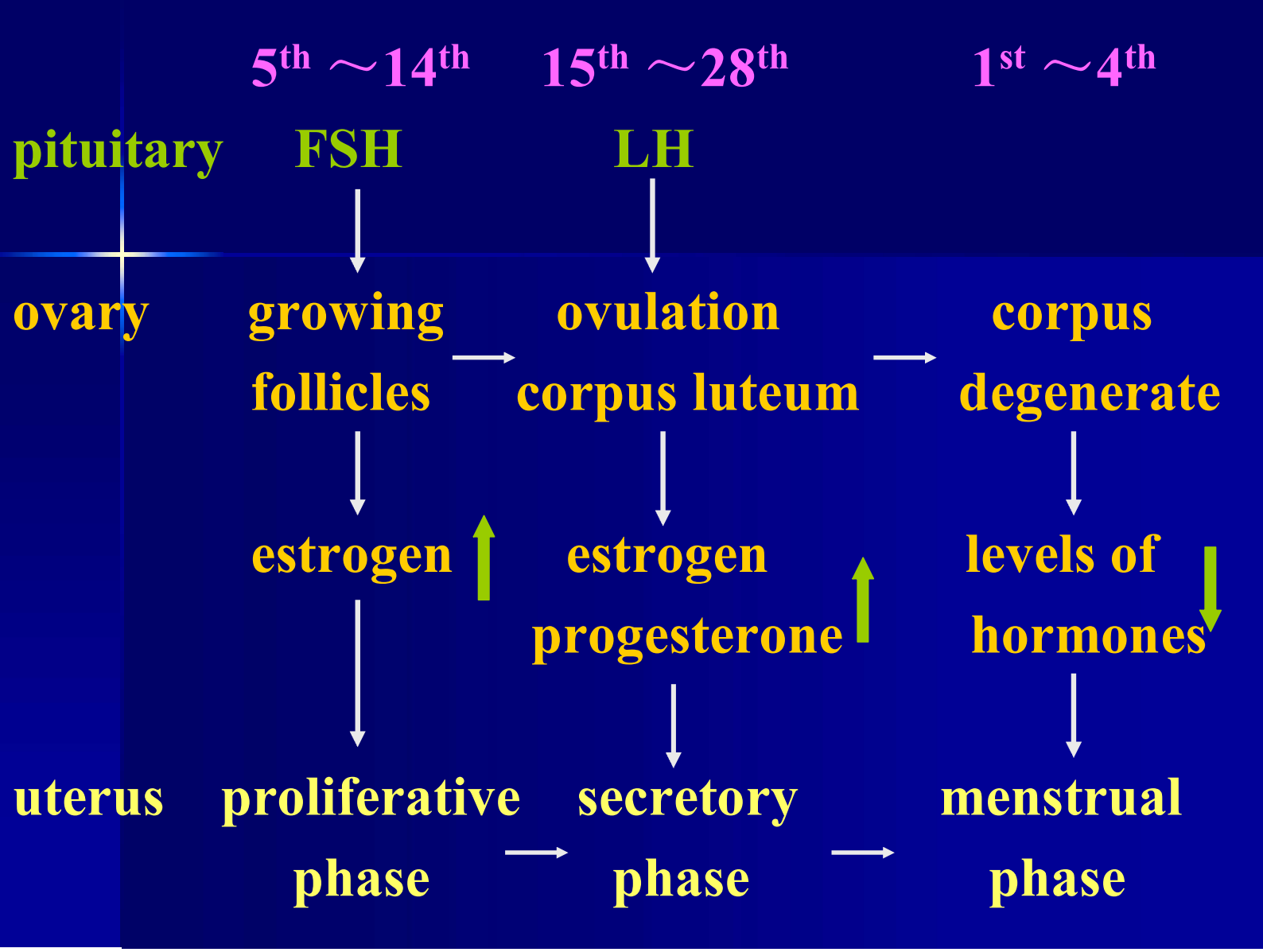


FIG. 13-19
Menstrual cycle in the human
ing hormonal-ovarian-uterine
The development and eventual
uterine endometrium is deter
blood levels of the sex horm
(black) and progesterone *(red)*.
of the sex hormones (estrogen
cle; progesterone from the cor
controlled by the interplay of h
the pituitary gland.


5th ～14th
15th ～28th
1st ～4th
pituitary
FSH
LH
ovary
growing follicles
ovulation
corpus luteum
corpus degenerate
estrogen
estrogen
progesterone
levels of hormones
uterus
proliferative phase
secretory phase
menstrual phase