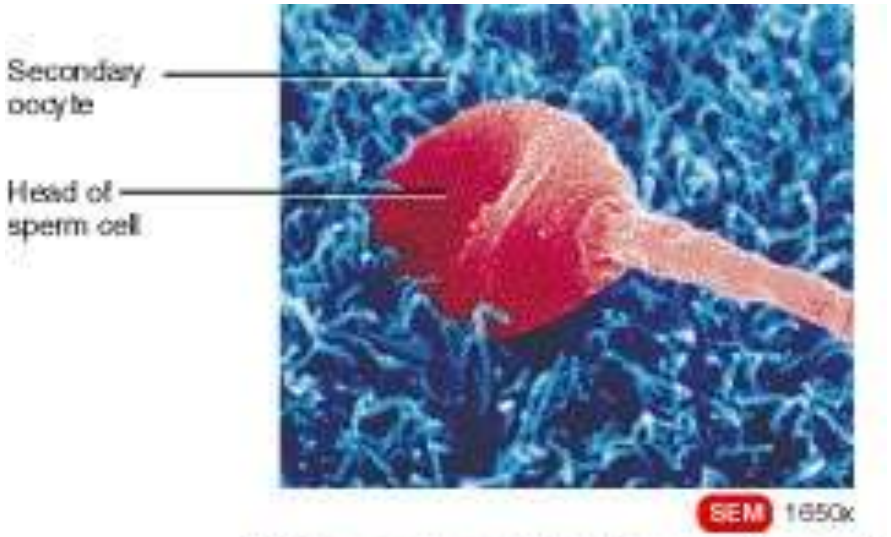
GUYTON AND HALL. 13TH EDITION

Reproductive System

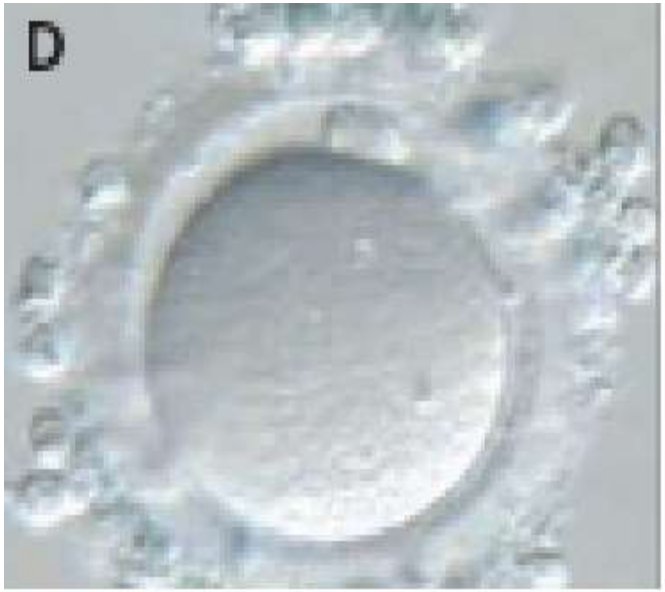
Male: P996-1021-1026, 1028-1033

Female: 1037-1051, 1055-1061, 1066-1068

Fig. 29.01b



(b) Sperm cell in contact with a secondary oocyte


D

shape and motility are important

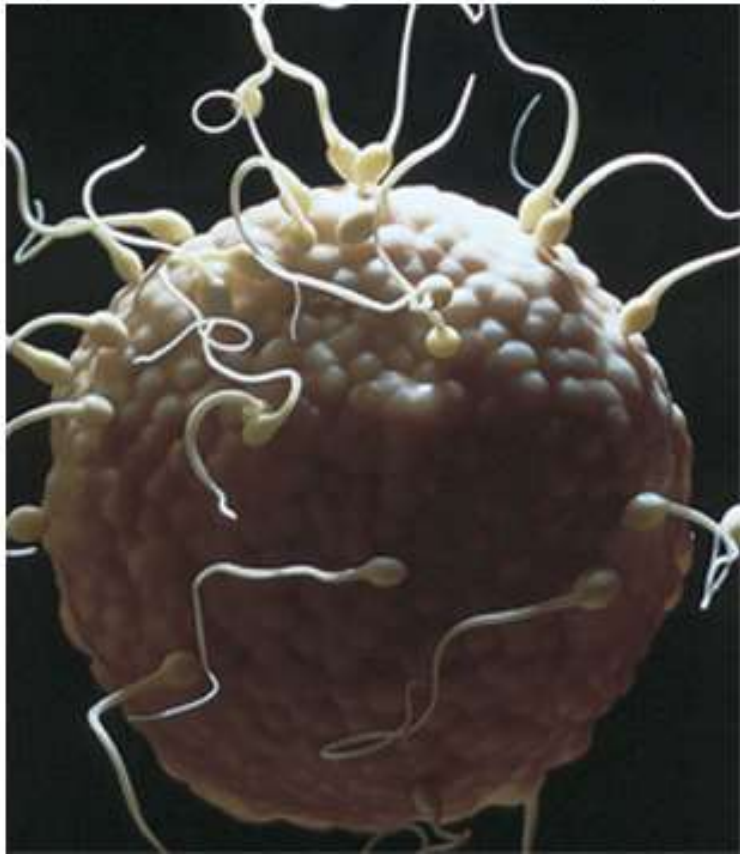
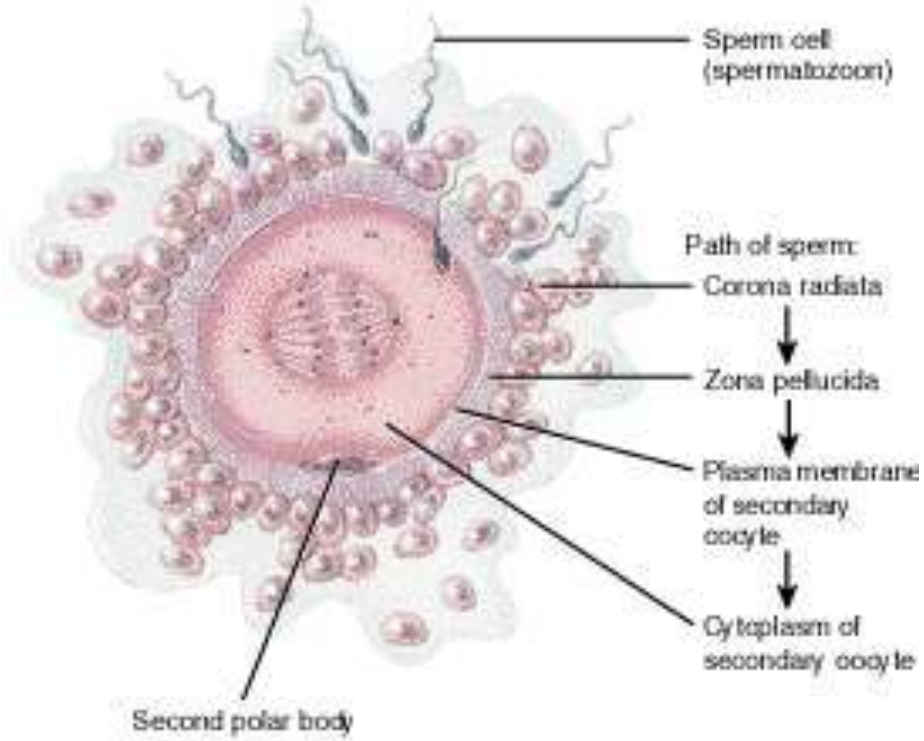


Fig. 29.01a



(a) Sperm cell penetrating a secondary oocyte

Fig. 29.01c

(c) Male and female pronuclei

Fig. 29.02

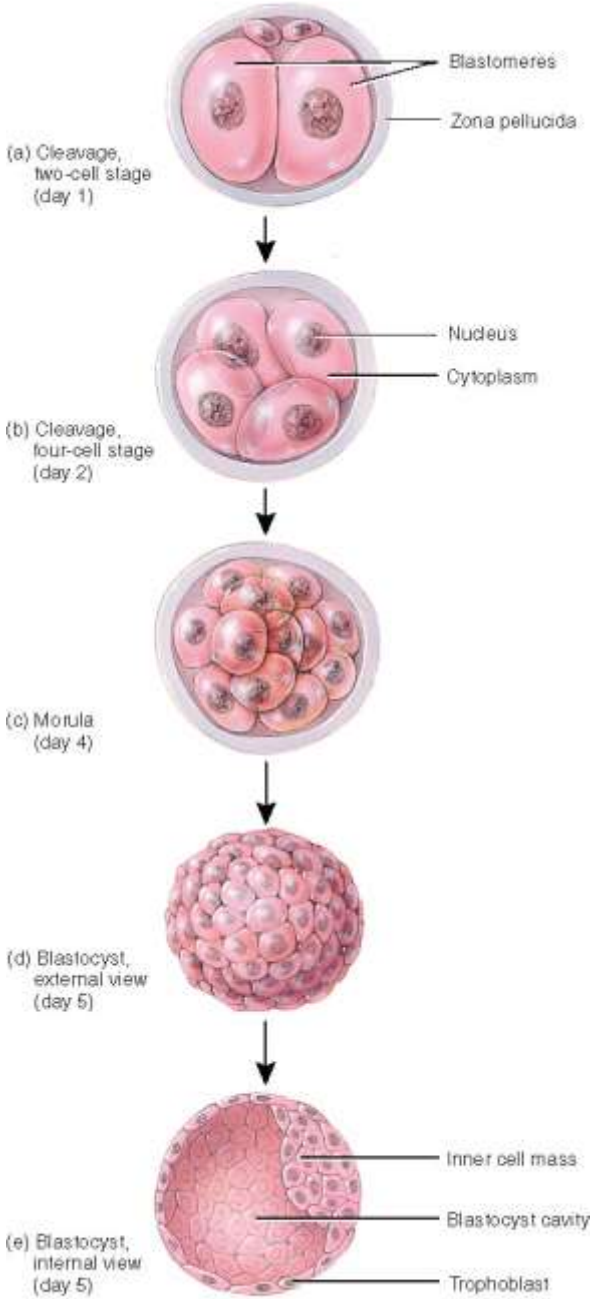
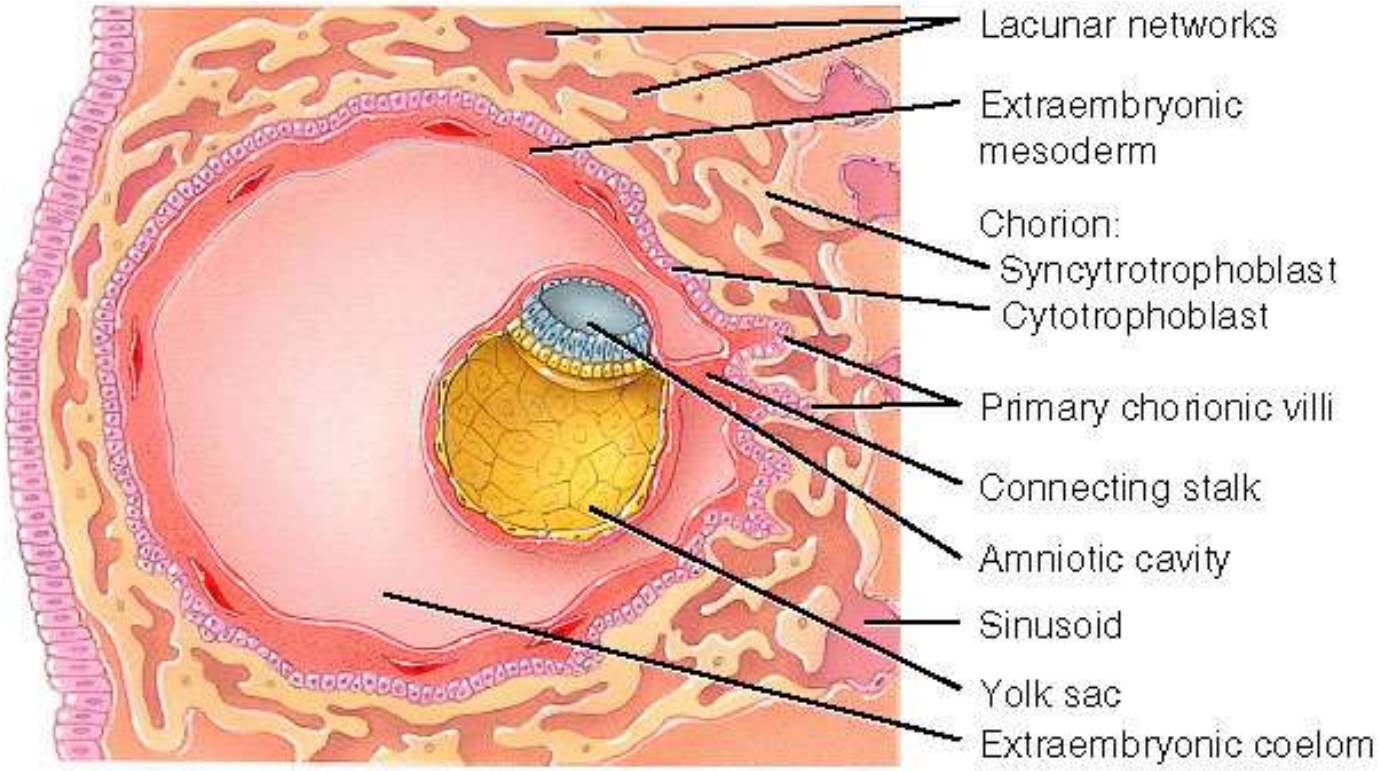

Blastomeres
Zona pellucida
(a) Cleavage, two-cell stage (day 1)
Nucleus
Cytoplasm
(b) Cleavage, four-cell stage (day 2)
(c) Morula (day 4)
(d) Blastocyst, external view (day 5)
Inner cell mass
Blastocyst cavity
Trophoblast
(e) Blastocyst, internal view (day 5)

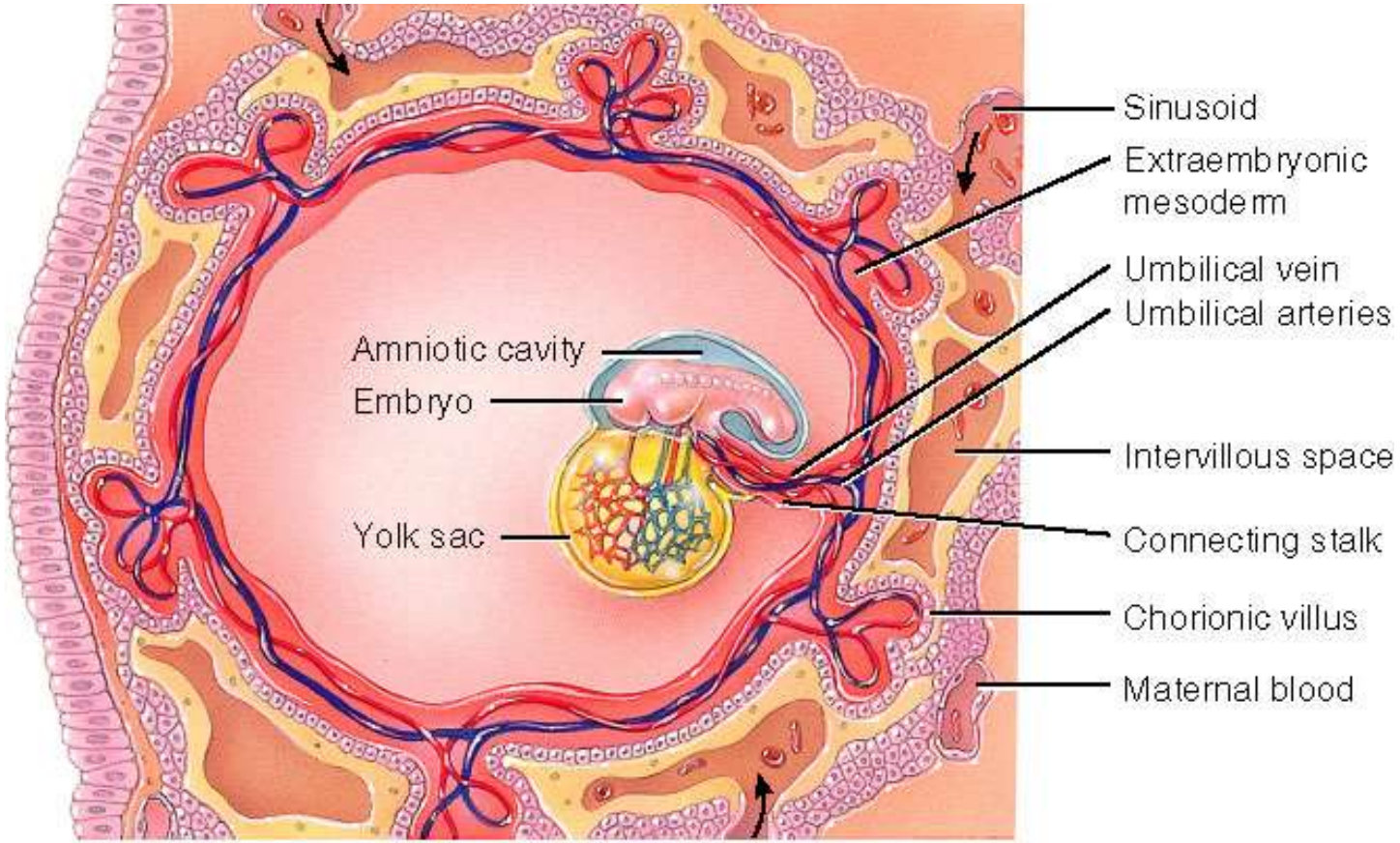
Fig. 29.10a



(a) Transverse section of blastocyst, about 13 days after fertilization

29.10a

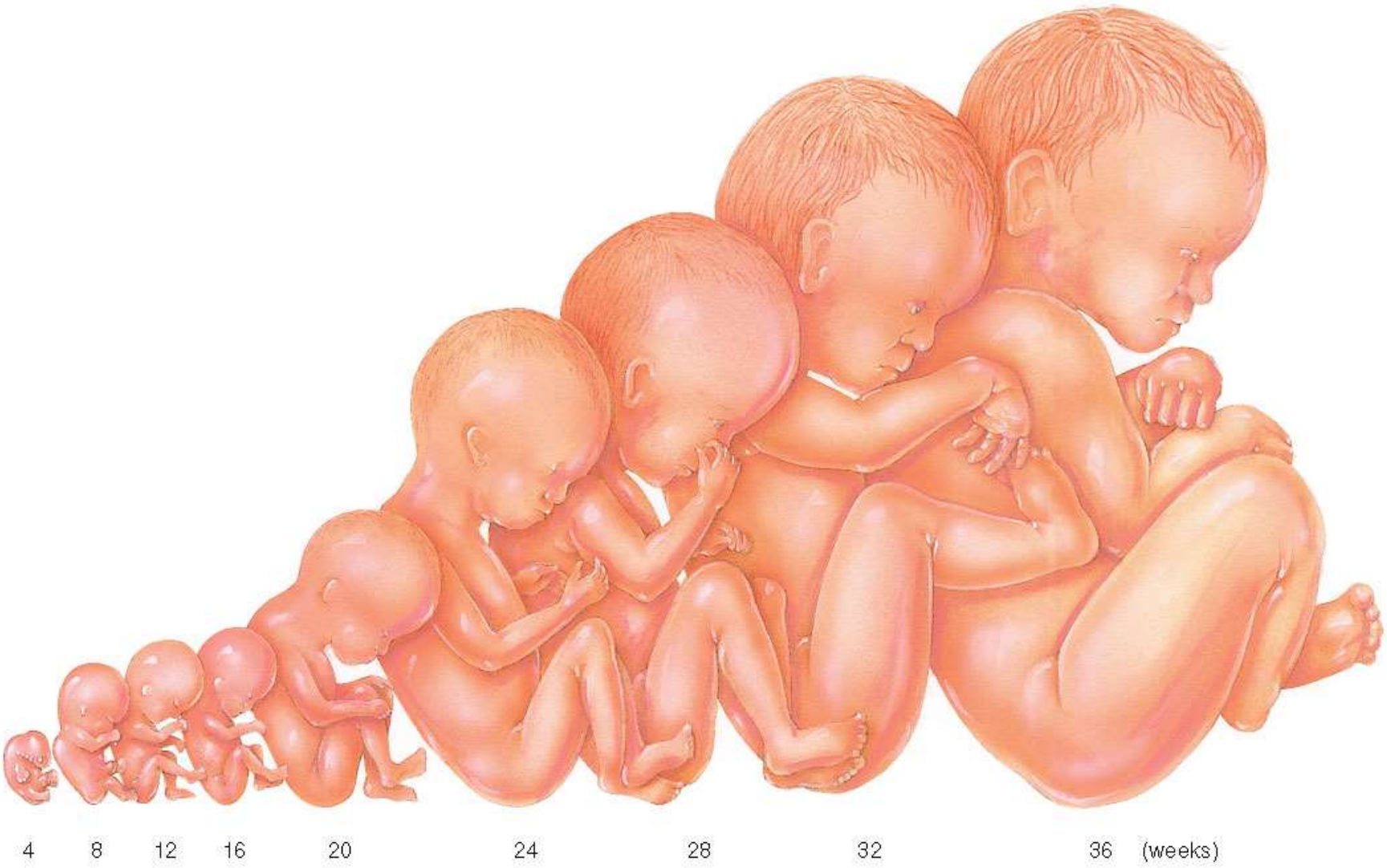
Fig. 29.10c



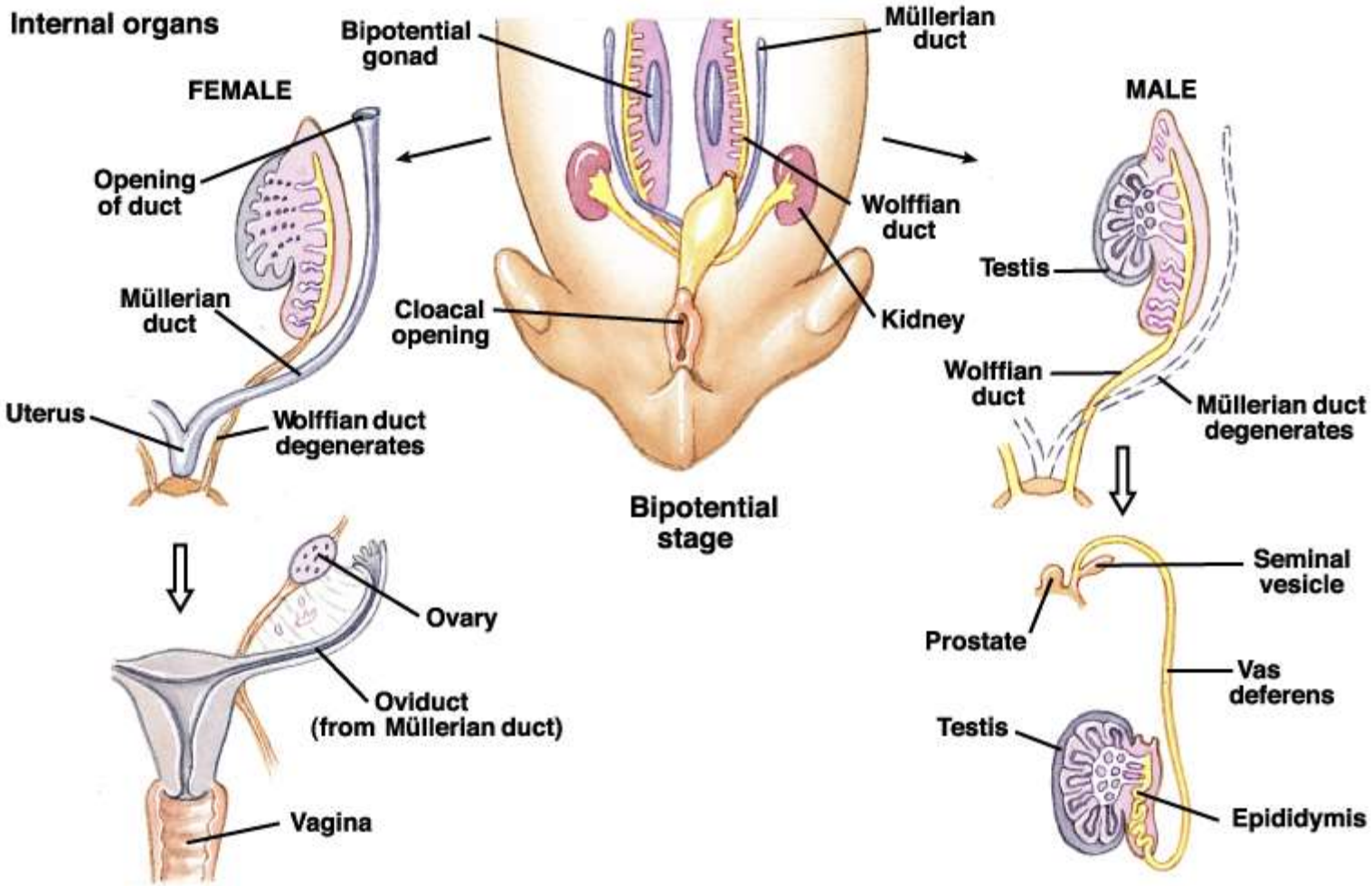
(c) Transverse section of an embryo and its vascular supply, about 21 days after fertilization

29.10c

Fig. 29.T02



29.T02


Internal organs
Bipotential gonad
Müllerian duct
FEMALE
MALE
Opening of duct
Wolffian duct
Testis
Müllerian duct
Cloacal opening
Kidney
Wolffian duct
Müllerian duct degenerates
Uterus
Wolffian duct degenerates
Bipotential stage
Seminal vesicle
Ovary
Prostate
Vas deferens
Oviduct (from Müllerian duct)
Testis
Epididymis
Vagina

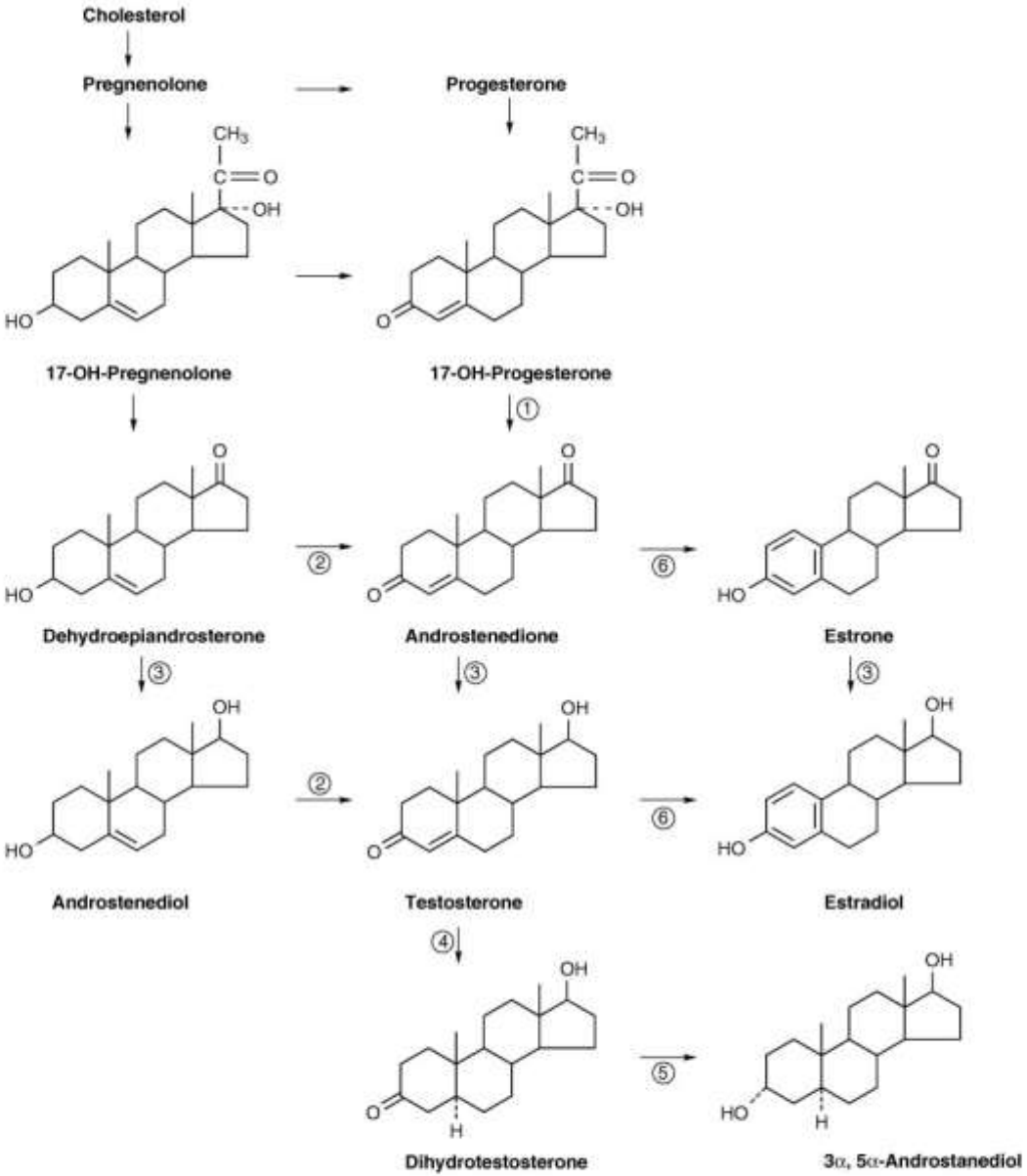
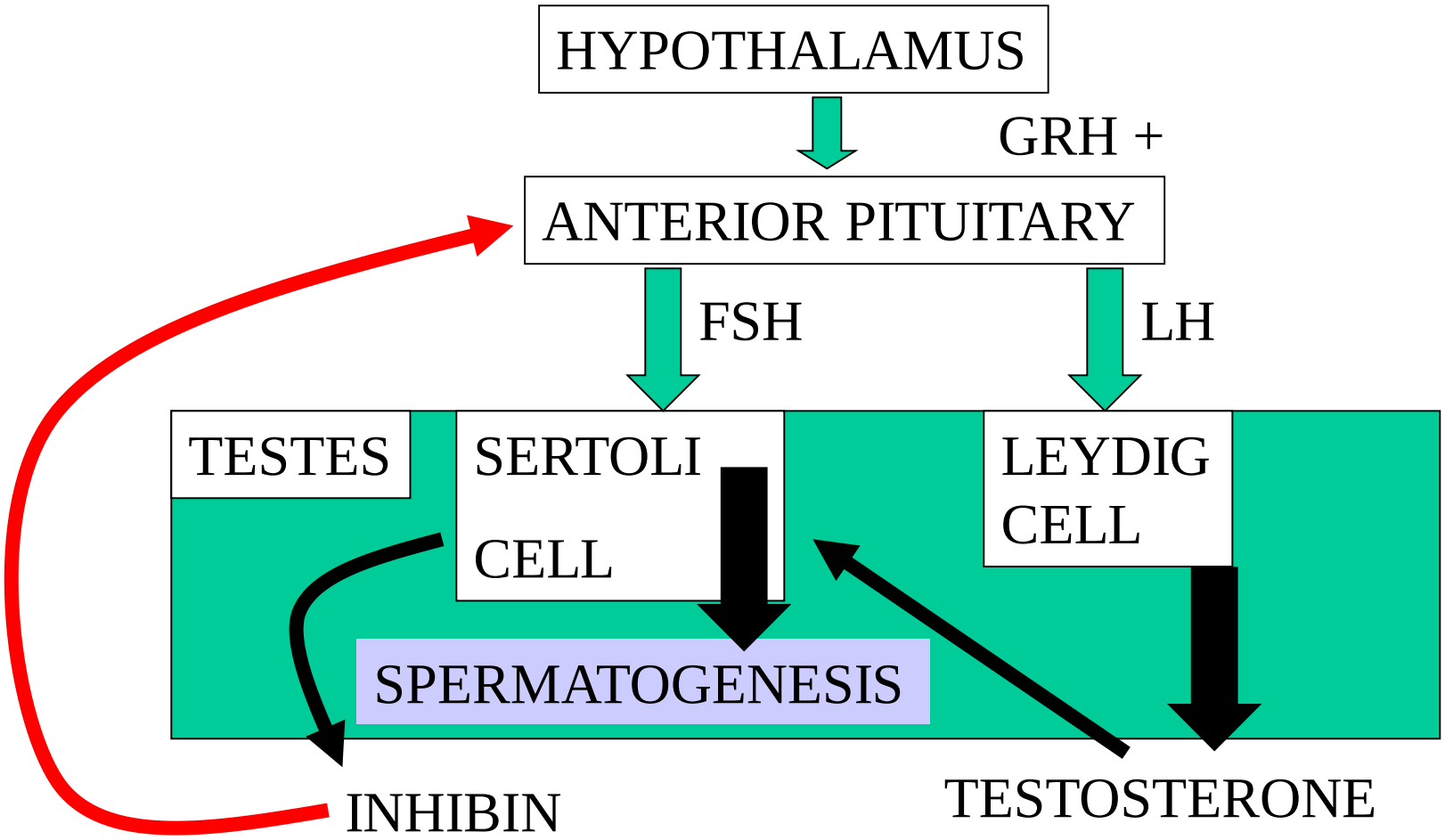
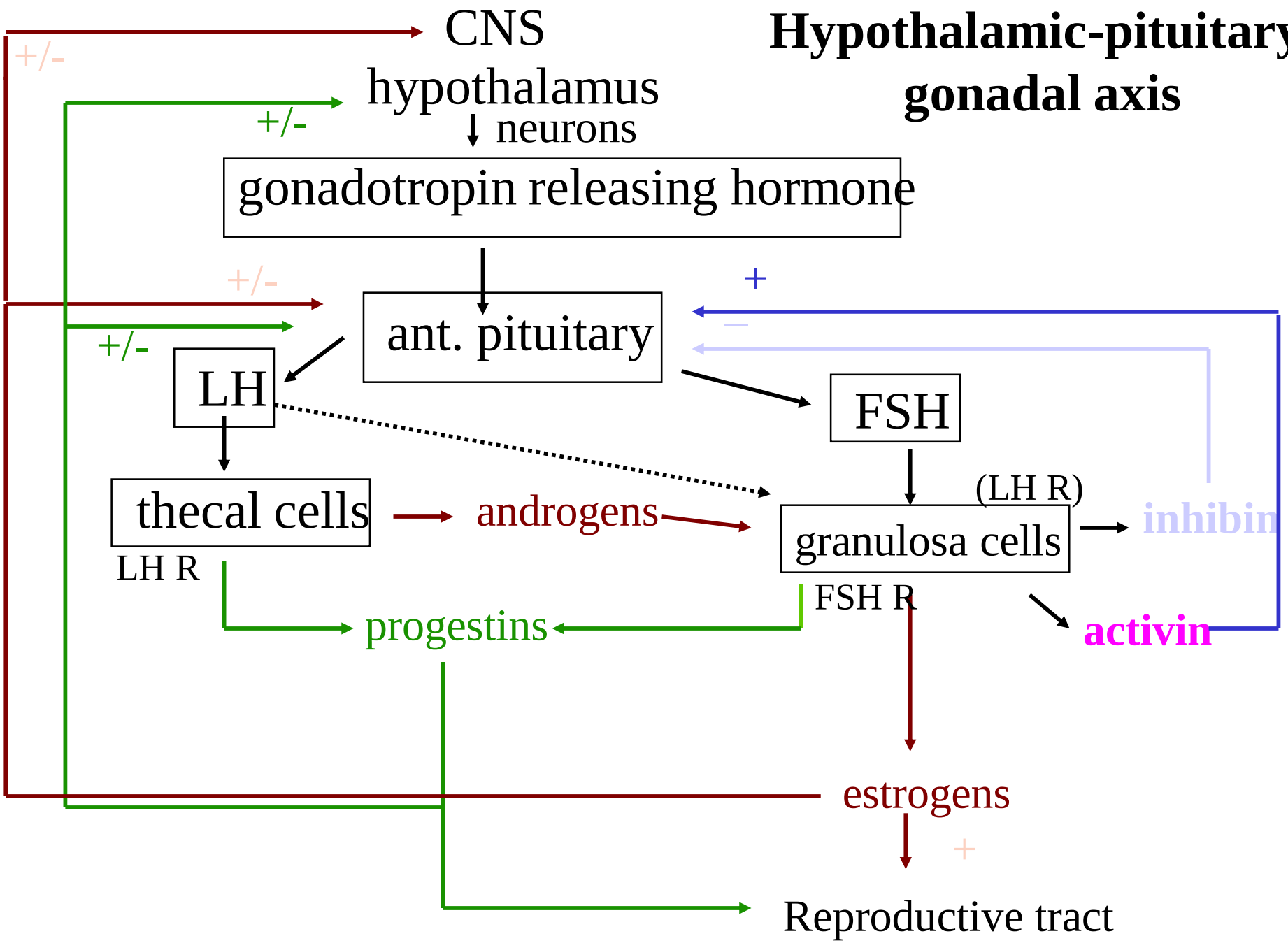


Figure 23.39. Conversion of cholesterol to sex hormones.

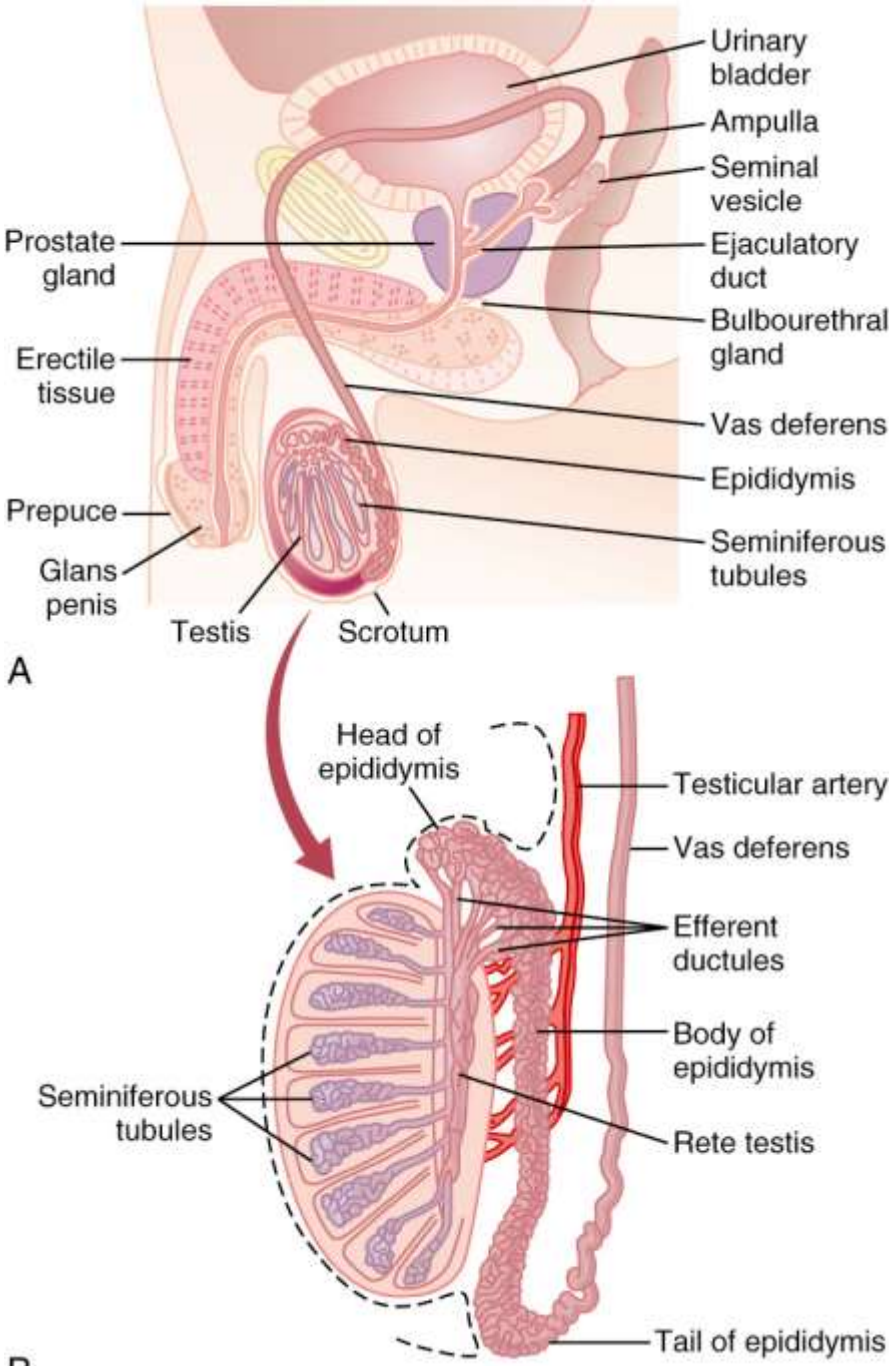
CONTROL OF TESTICULAR FUNCTION



Hypothalamic-pituitary-gonadal axis

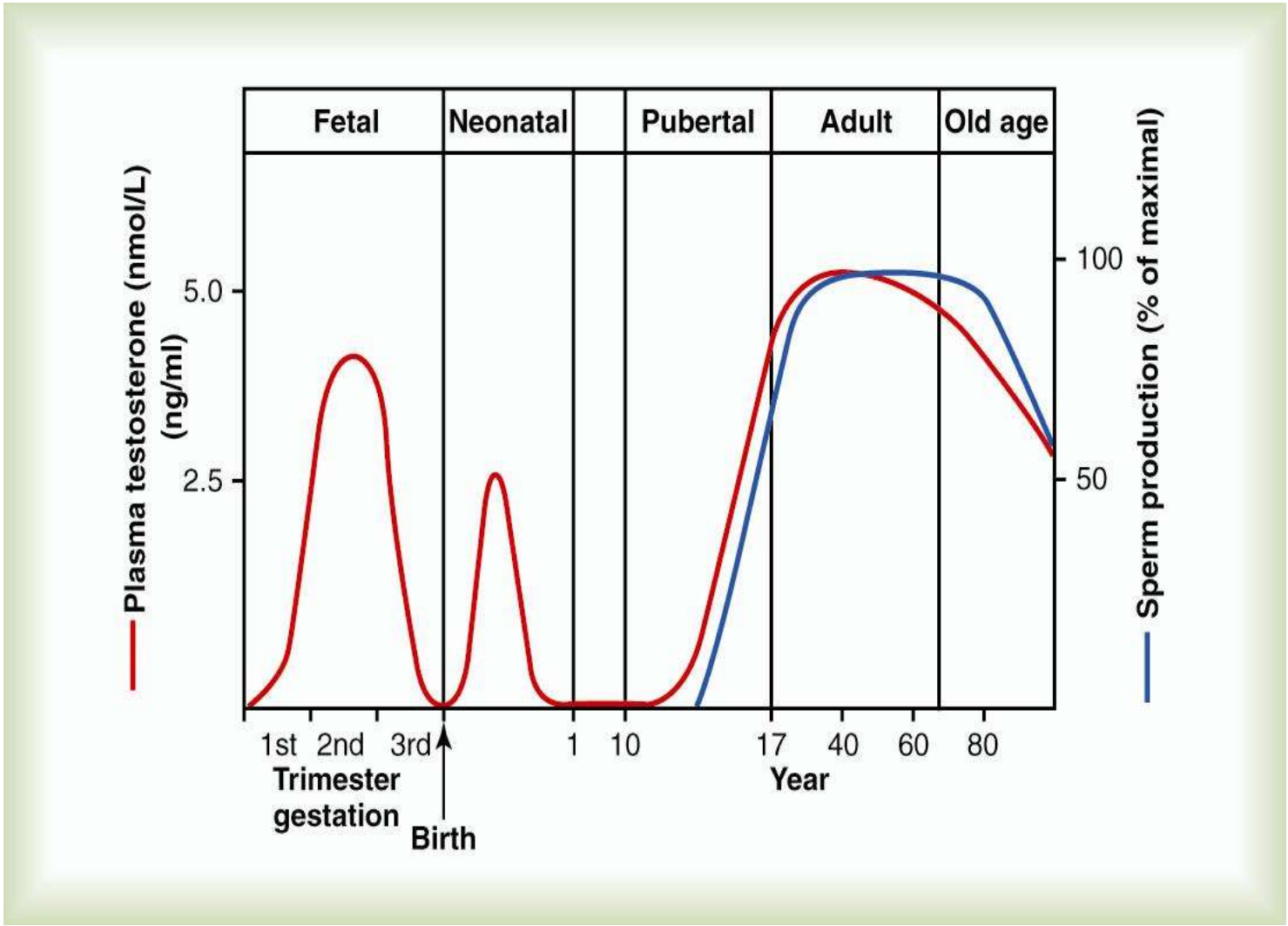


Male Reproductive System


Urinary bladder
Ampulla
Seminal vesicle
Prostate gland
Ejaculatory duct
Bulbourethral gland
Erectile tissue
Vas deferens
Epididymis
Prepuce
Seminiferous tubules
Glans penis
Testis
Scrotum
A
Head of epididymis
Testicular artery
Vas deferens
Efferent ductules
Body of epididymis
Seminiferous tubules
Rete testis
Tail of epididymis
B

HORMONES

GERM CELL


Fetal
Neonatal
Pubertal
Adult
Old age
Plasma testosterone (nmol/L)
(ng/ml)
5.0
2.5
100
50
Sperm production (% of maximal)
1st 2nd 3rd
Trimester
gestation
Birth
1 10
17 40 60 80
Year

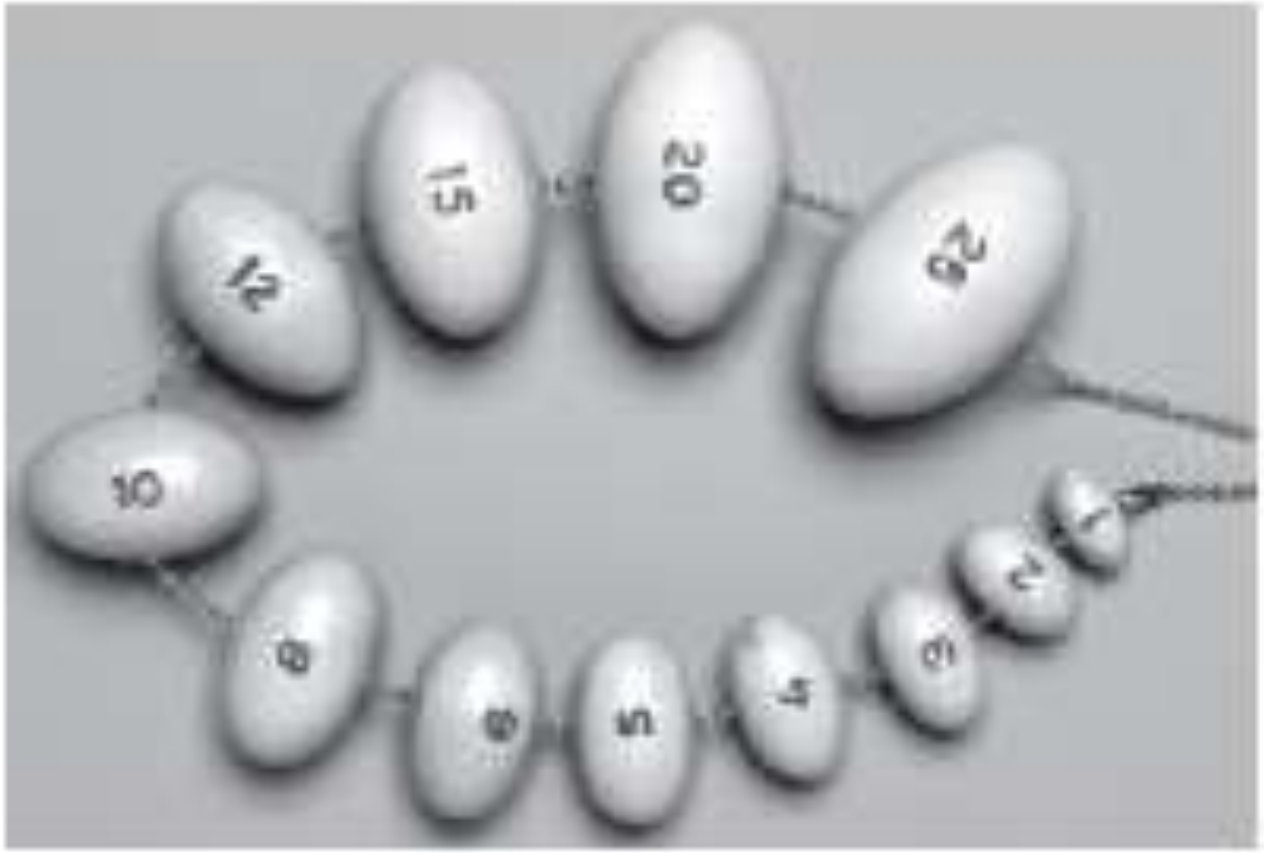
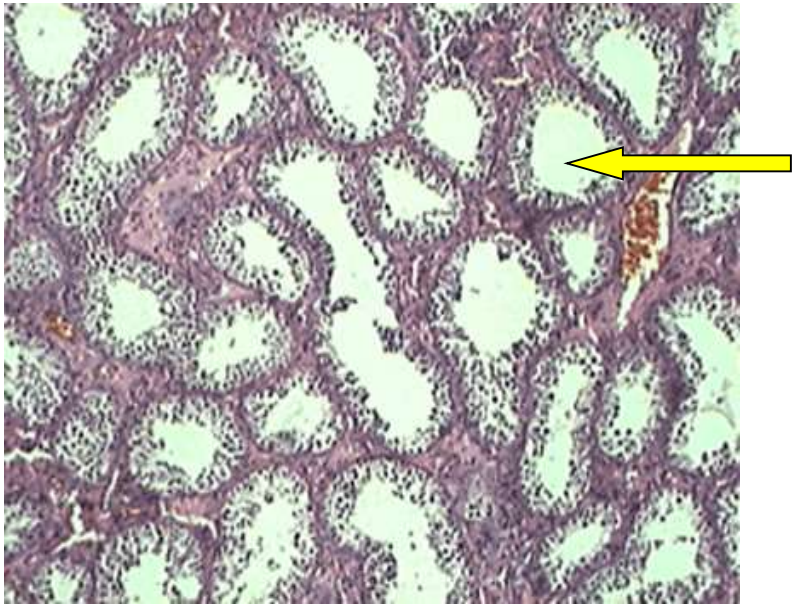
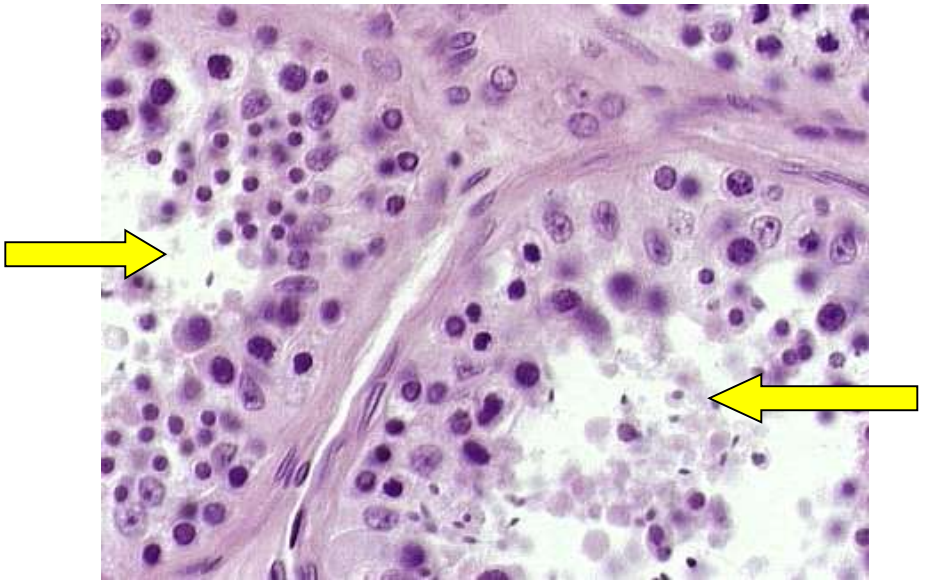
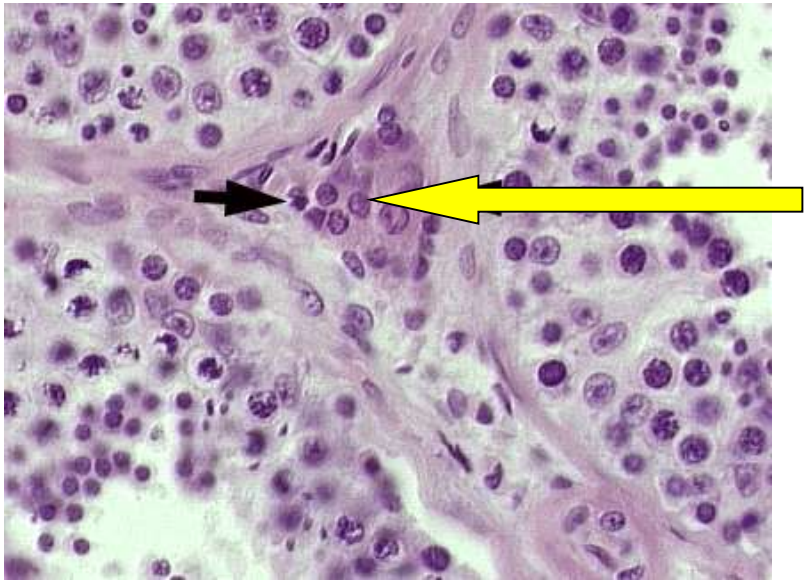


Fig. 5. A Prader orchidometer for measuring testicular volume.

Testis Cross Section

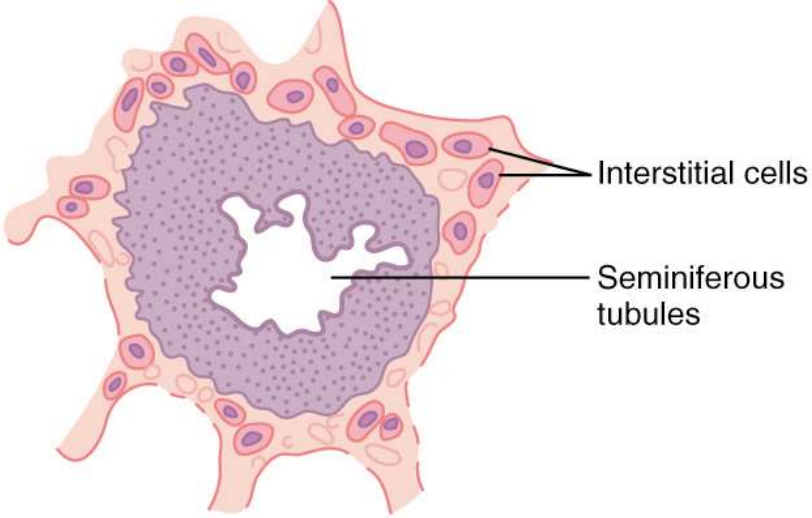




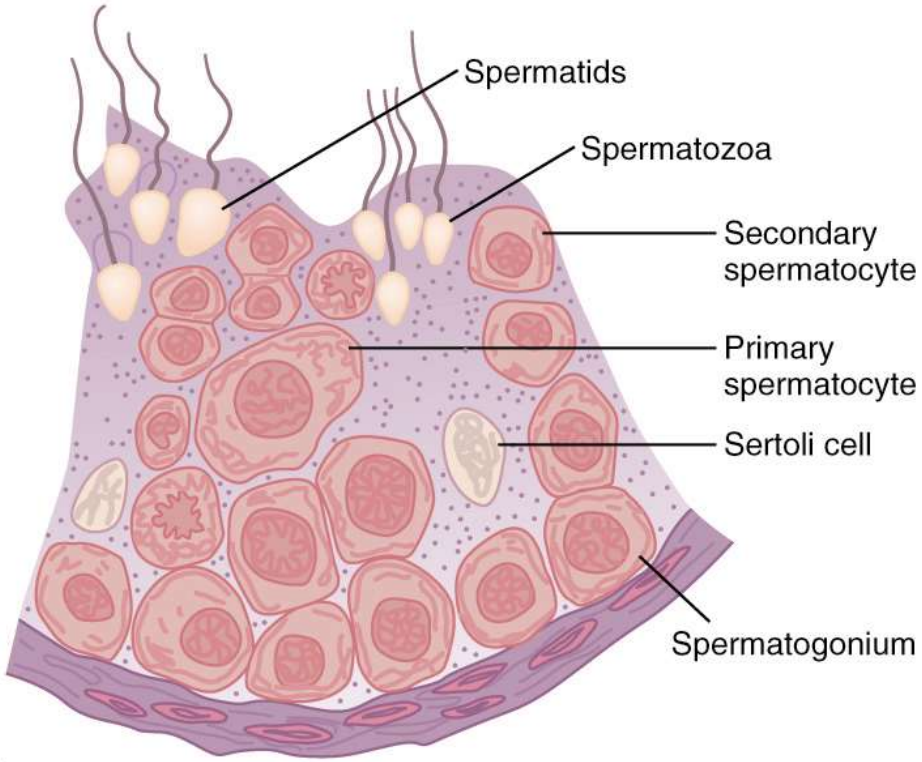


Interstitial Cells

Produce Testosterone

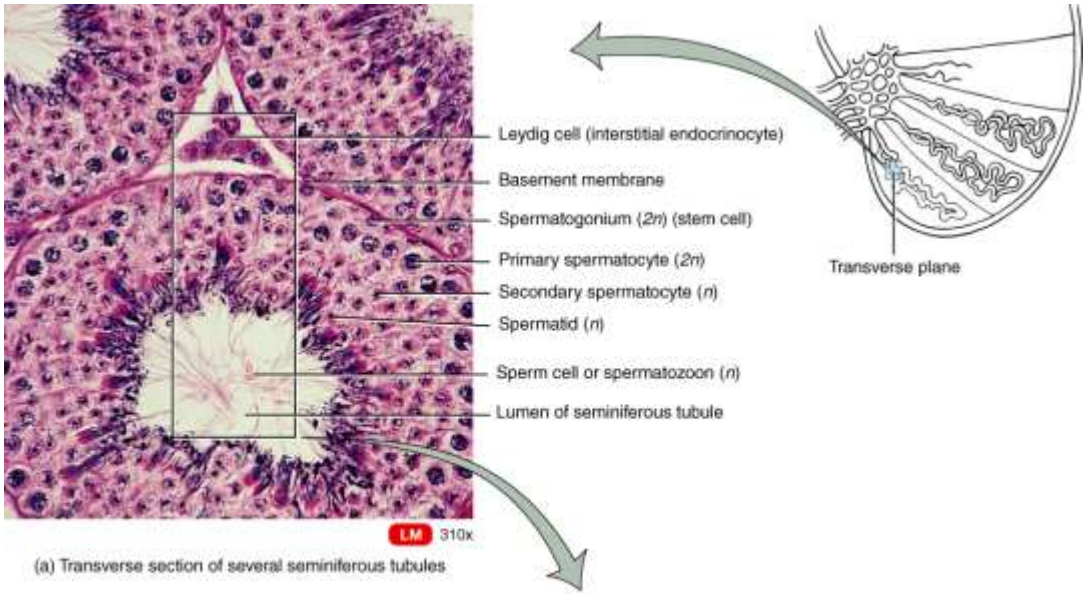

Interstitial cells
Seminiferous tubules

A

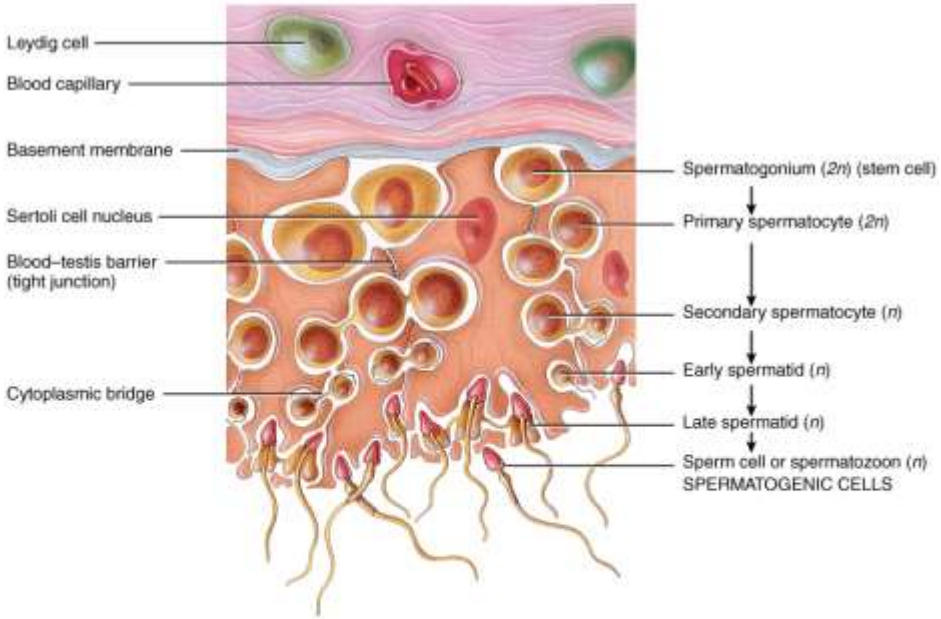

Spermatids
Spermatozoa
Secondary spermatocyte
Primary spermatocyte
Sertoli cell
Spermatogonium

B

Fig. 28.06

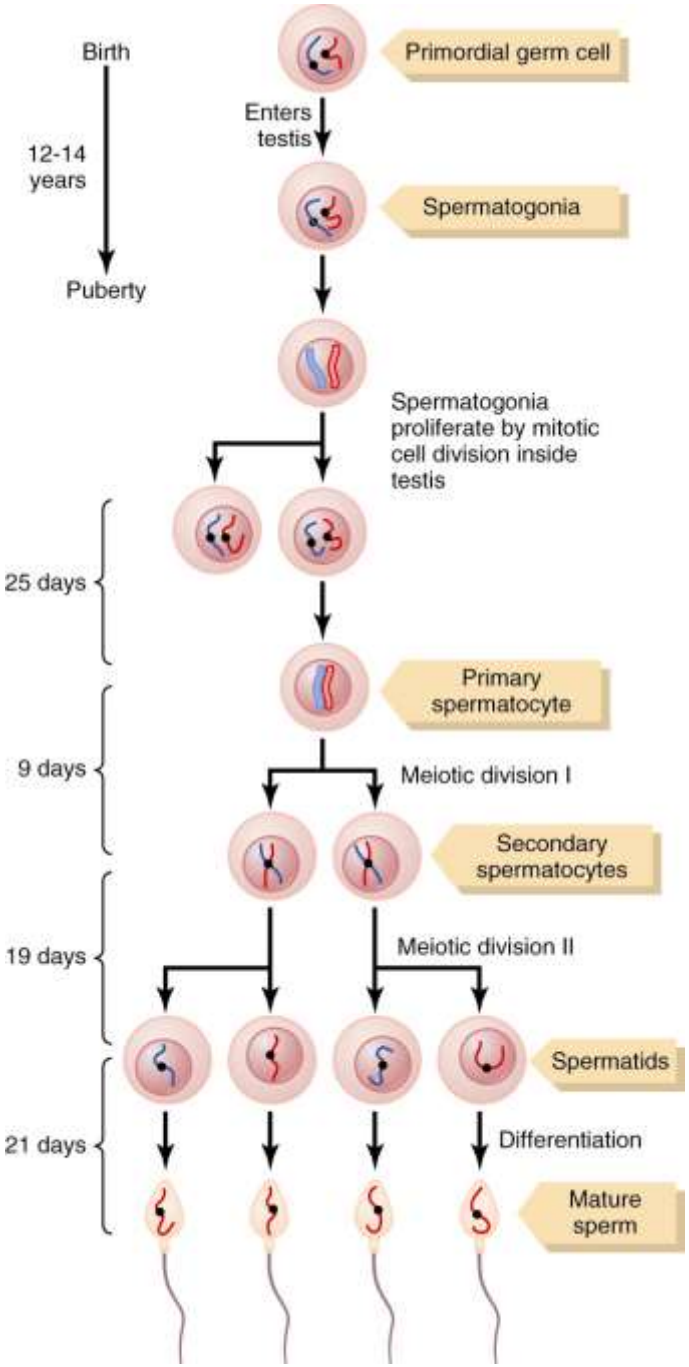


(a) Transverse section of several seminiferous tubules



(b) Transverse section of a portion of a seminiferous tubule

28.06.jpeg



Cell Divisions During Spermatogenesis

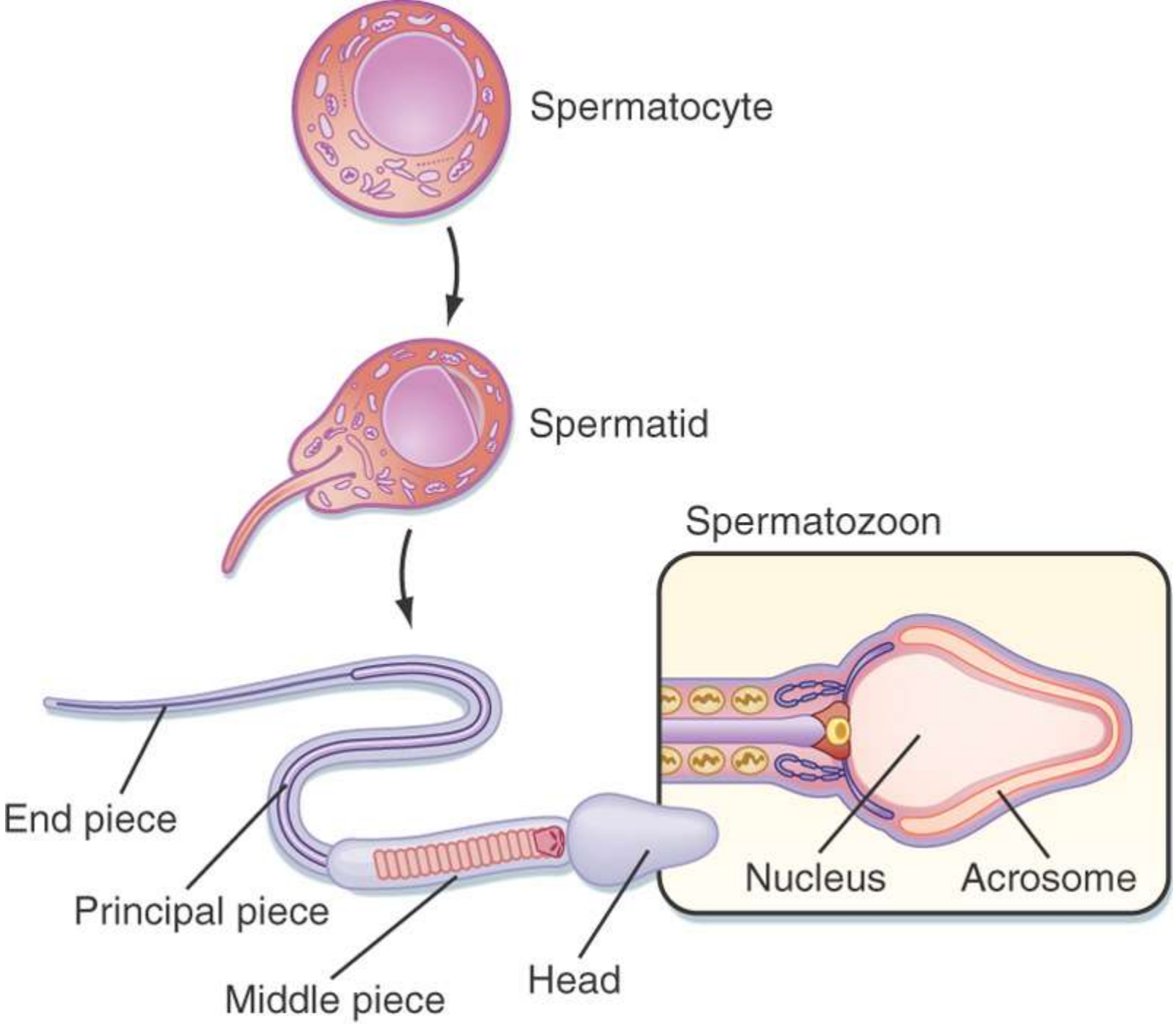
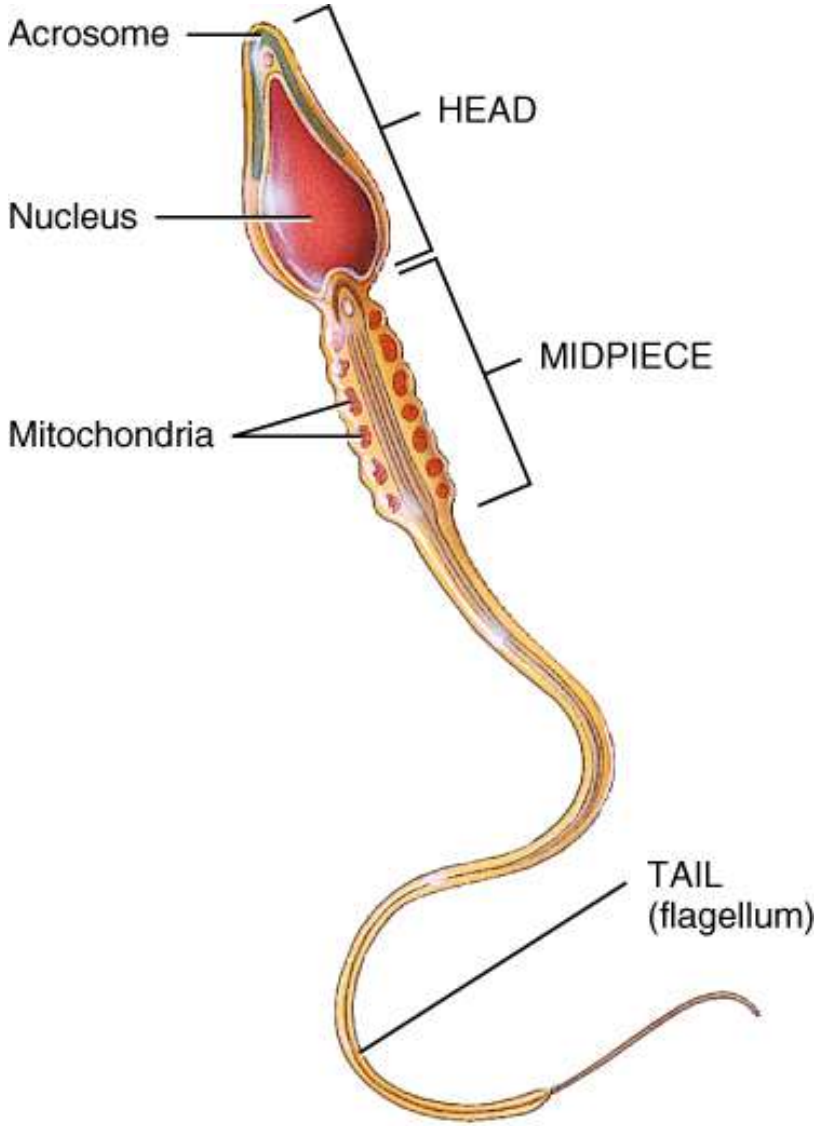


Fig. 28.08



28.08.jpeg

Morphology of Sperm

head, neck, body, tail

acrosome: cap at top of sperm head, contains hyaluronidase and proteolytic enzymes, important in penetration into ovum

mitochondria – arranged around body & tail

flagellum – outgrowth of centriole – two microtubules in center, nine around the outside

Optimal motility: pH 6-6.5

Epididymis:

Sperm maturation

Develops capability of motility

Storage ? To one month in suppressed state

Seminal vesicle:

Secretes mucoid material rich in Fructose, Citric acid, Prostaglandins, Fibrinogen.

PGs

i) make cervical mucus more receptive to sperm movement

ii) reverse peristaltic movement in the uterus and fallopian tubes

Prostate gland :

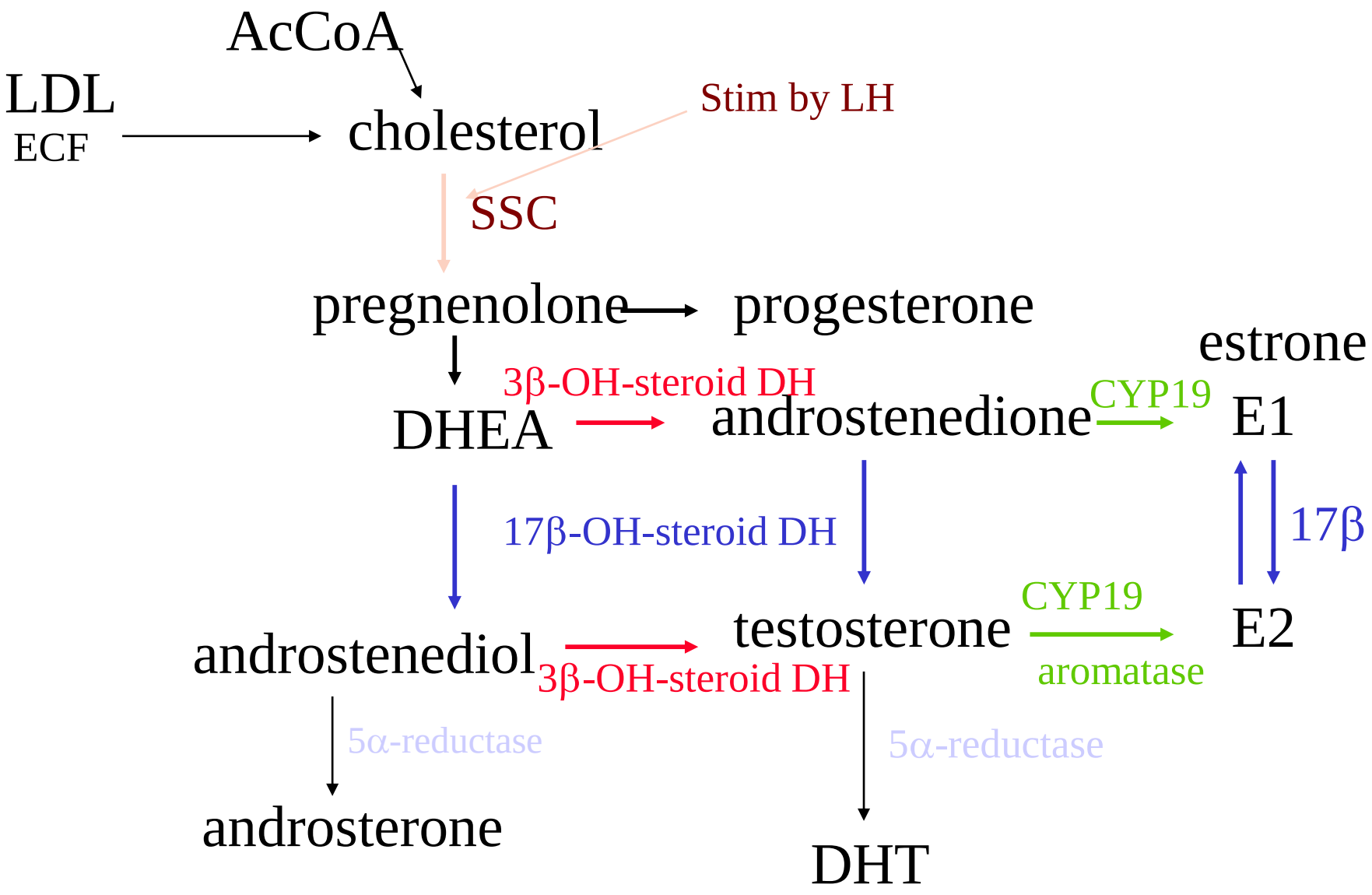
Secrete thin milky fluid contains electrolytes: Ca, Cl, HPO_3
Clotting enzymes, LMW polypeptides, proteins

pH = **Slightly alkaline**

Each ejaculation contains approximately 2-6 ml, 20-200 million sperm (< 20 million = infertile)

WHO semen reference values

Volume	2-6 ml or more
pH	7.2 or more
Conc.	$20x10^6$/ml or more
Motility	50% (T1&T2)
Morphology	15%



SSC = side chain cleavage enzyme

Androgen receptor:

found in prostate, testis (Sertoli, Leydig and myoid cells)
epididymis, seminal vesicles, neurons in CNS
anterior pituitary, thyroid, skin, adrenal cortex, liver
kidney tubules, bladder, cardiac and striated muscle
bone, vasculature

In females, also found in ovary (interstitial and granulosa cells)
mammary glands, uterus

Functions of Testosterone

– **fetal development**: present at 2nd month of embryonic life
presence or absence of testosterone determines development of genital organs and characteristics
+ testosterone = penis, scrotum
- testosterone = clitoris and vagina
also, development of prostate, seminal vesicles, vas deferens

– causes descent of testes into scrotum during last 2-3 months of pregnancy

TESTOSTERONE: BEFORE BIRTH

- Before birth: masculinizes reproductive tract and external genetalia
- Descent of testes
- Stops at birth & returns at puberty

TESTOSTERONE: AT PUBERTY

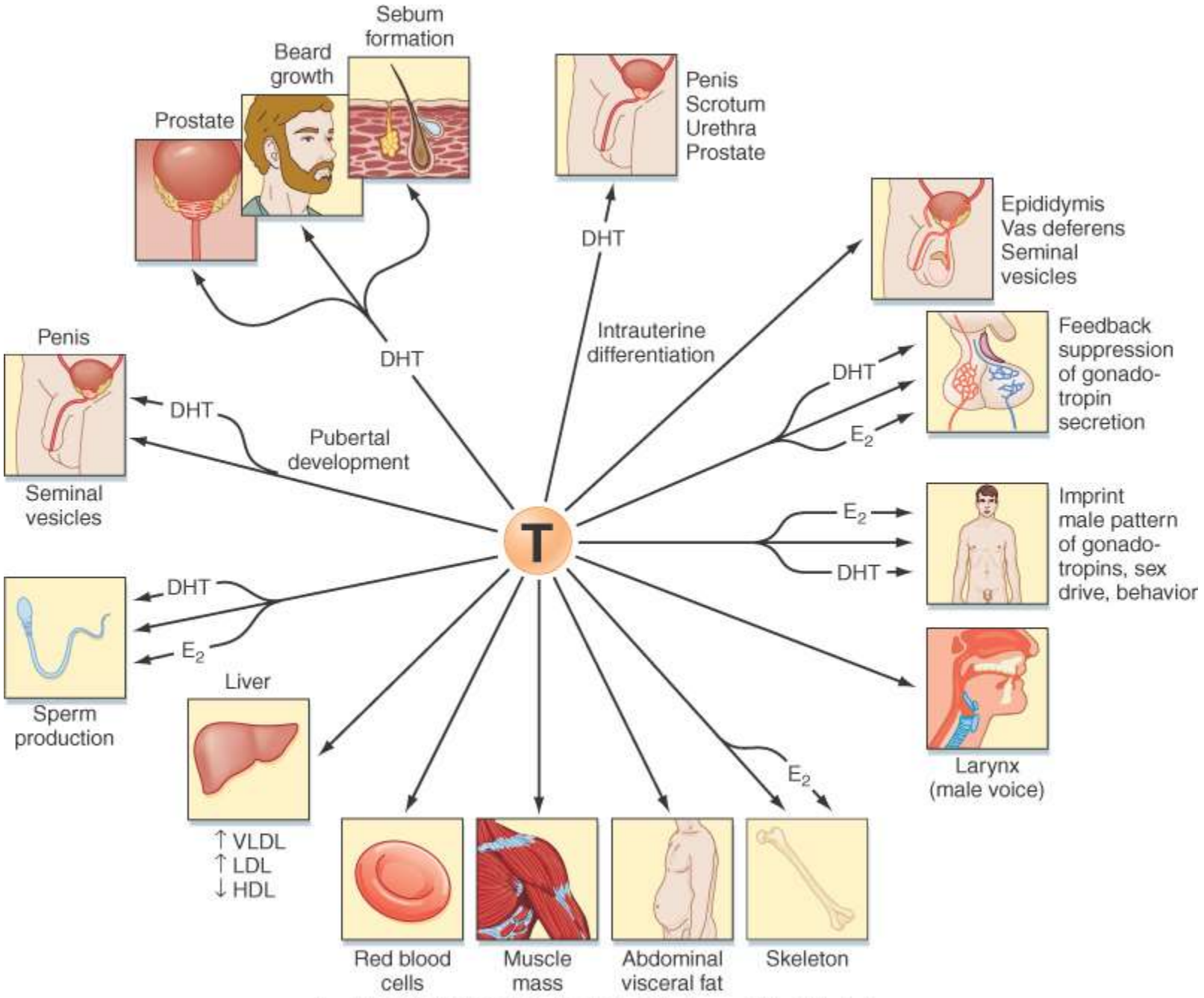
- Spermatogenesis
- Accessory sex glands enlarge and become secretory
- Penis and scrotum enlarge
- Libido

EFFECTS OF TESTOSTERONE ON SECONDARY SEX CHARACTERISTICS

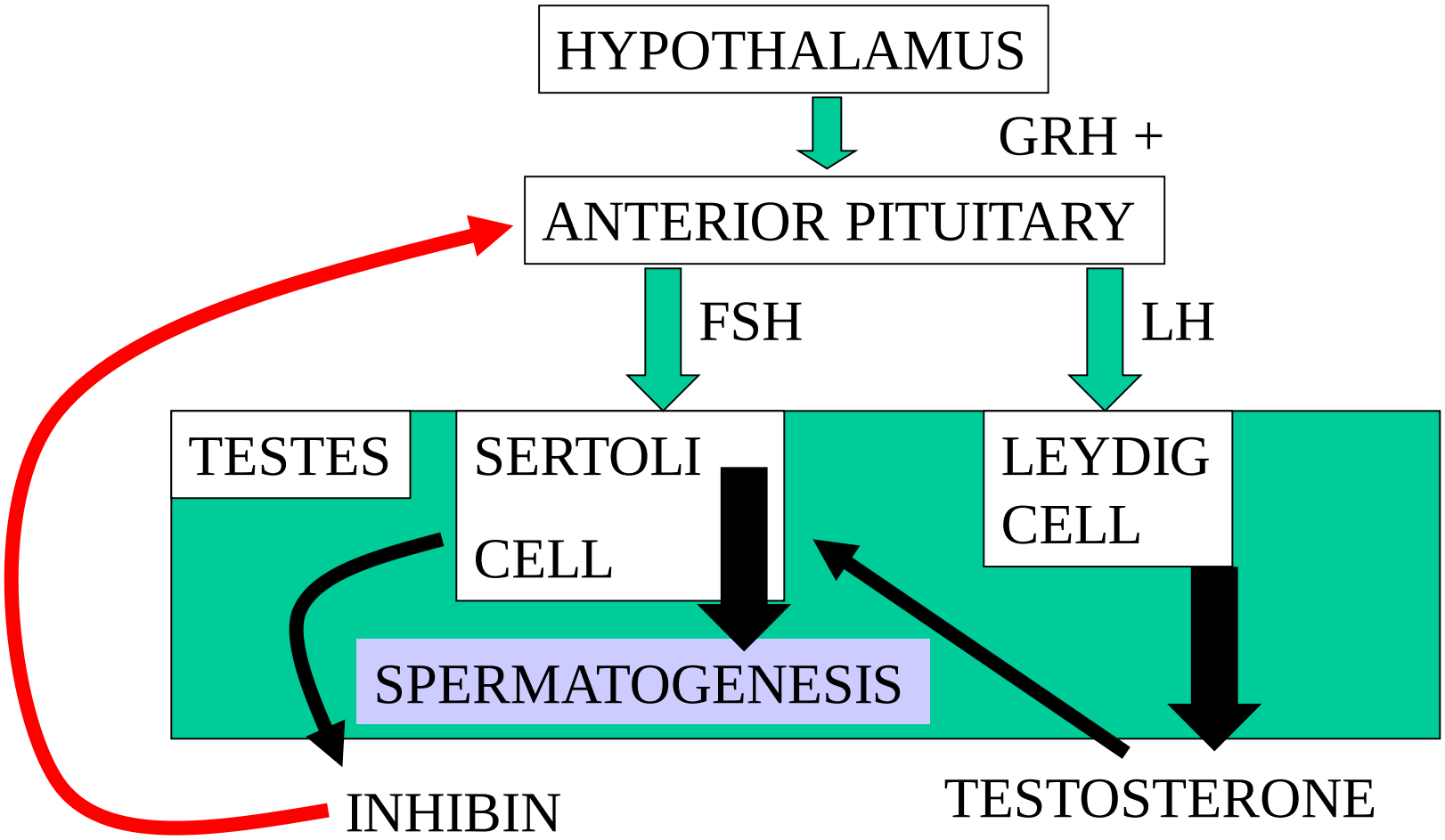
- Hair growth pattern
- Deep voice
- Thick skin
- Male body configuration

OTHER EFFECTS OF TESTOSTERONE

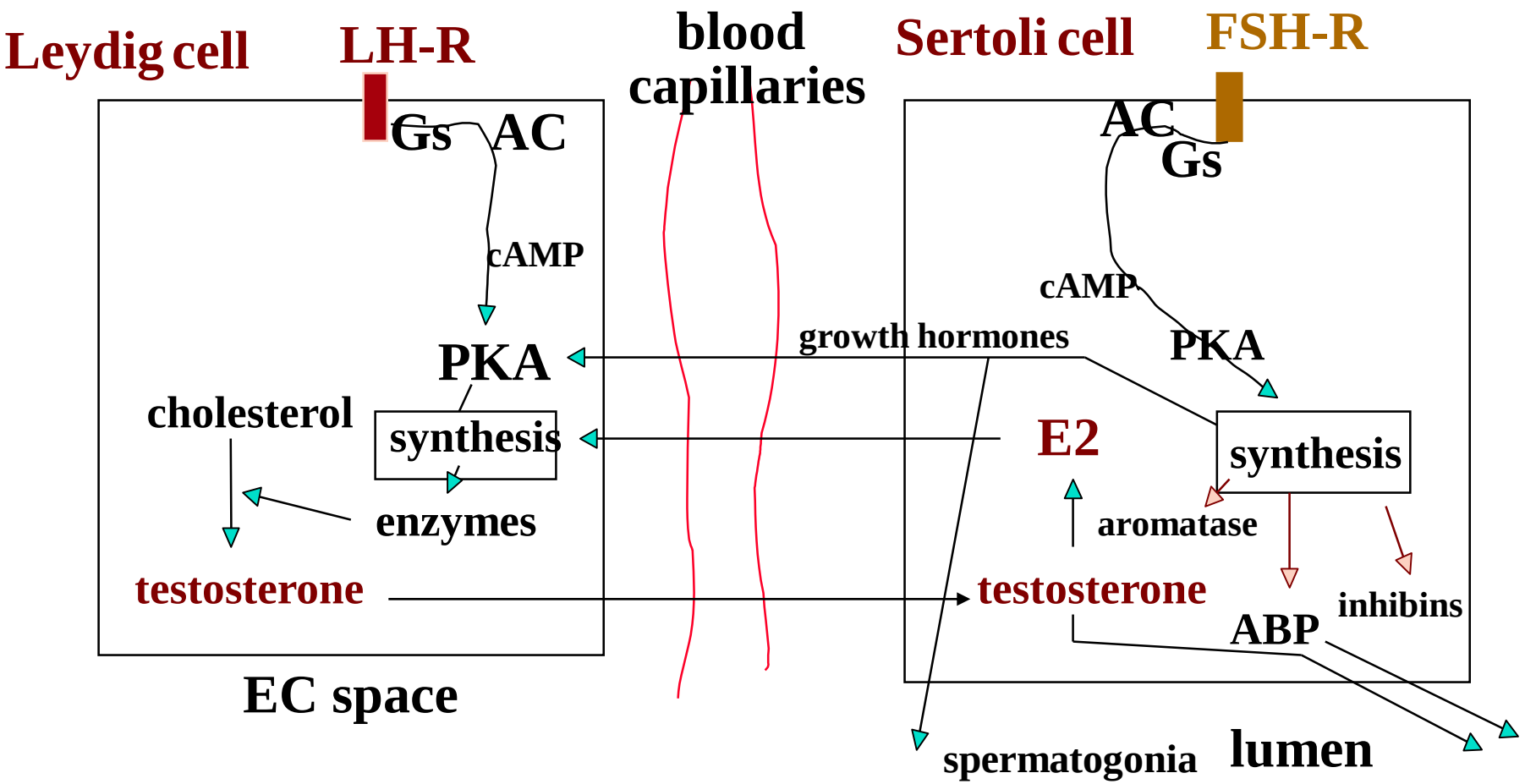
- Bone growth
- Protein anabolic effect
- Eventually stops bone growth
- Aggressive behavior (in animals)
- Male menopause



CONTROL OF TESTICULAR FUNCTION



Cells in Seminefrous tubules



Puberty: transition from quiescent reproductive endocrine system (inability to reproduce) to state of reproductive function (ability to reproduce) – begins with pulsatile GnRH/LH secretion during REM sleep

Puberty In The Male

- Usually 10-14 years old
- Endocrine,physical, and behavioral
- Leydig cells “awake” → Androgens

Puberty

Range of onset: 9-14 years of age

Completion of pubertal development: 2-4.5 yr

1st sign: enlargement of testes to greater than 2.5 cm–growth due to increase in size of seminiferous tubules, Leydig cells

Androgens from testes are driving force for secondary sex characteristics – adrenal testosterone also plays a role

Female Reproductive System

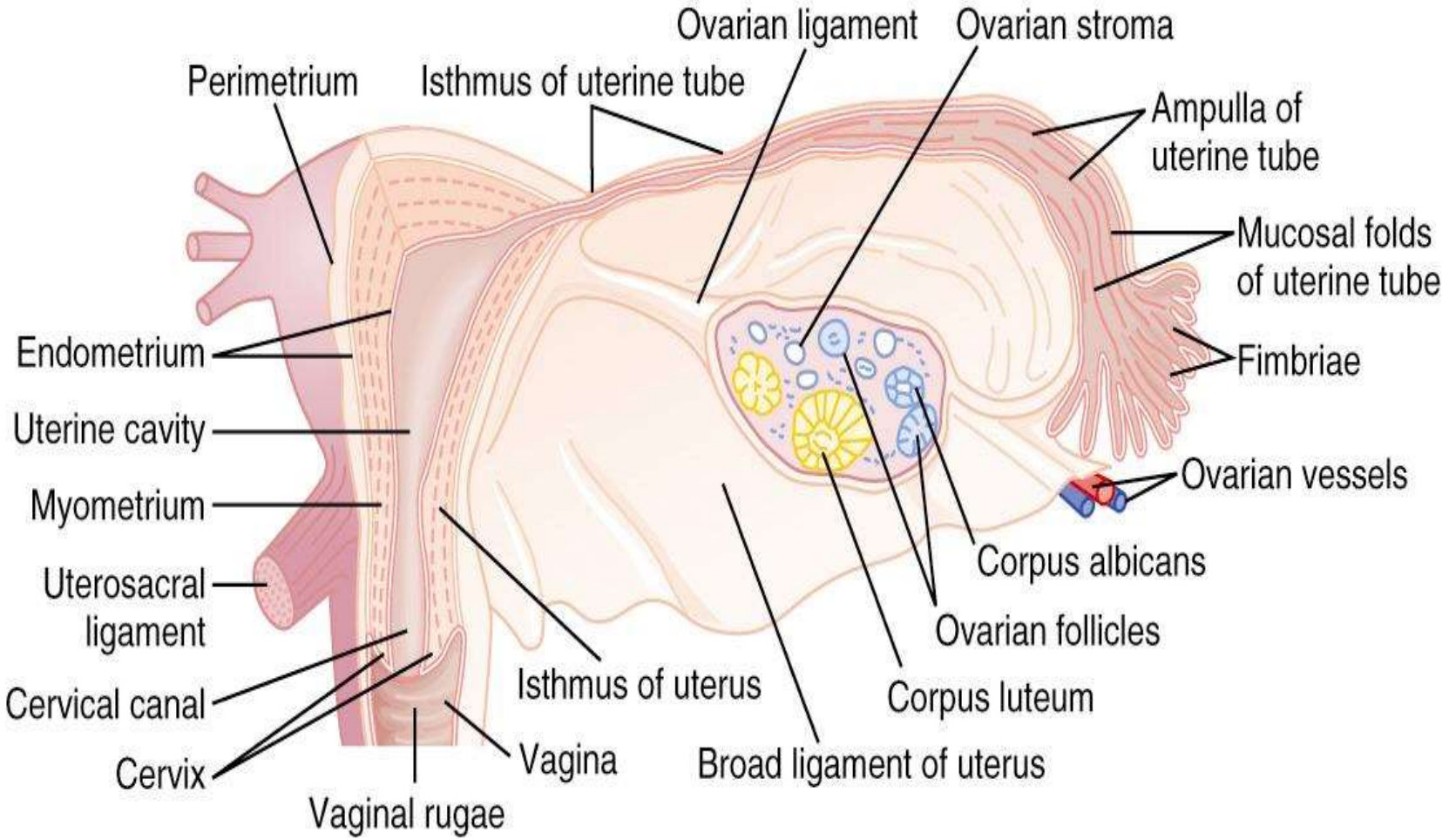
Gametogenesis:

Process through which gametes are formed

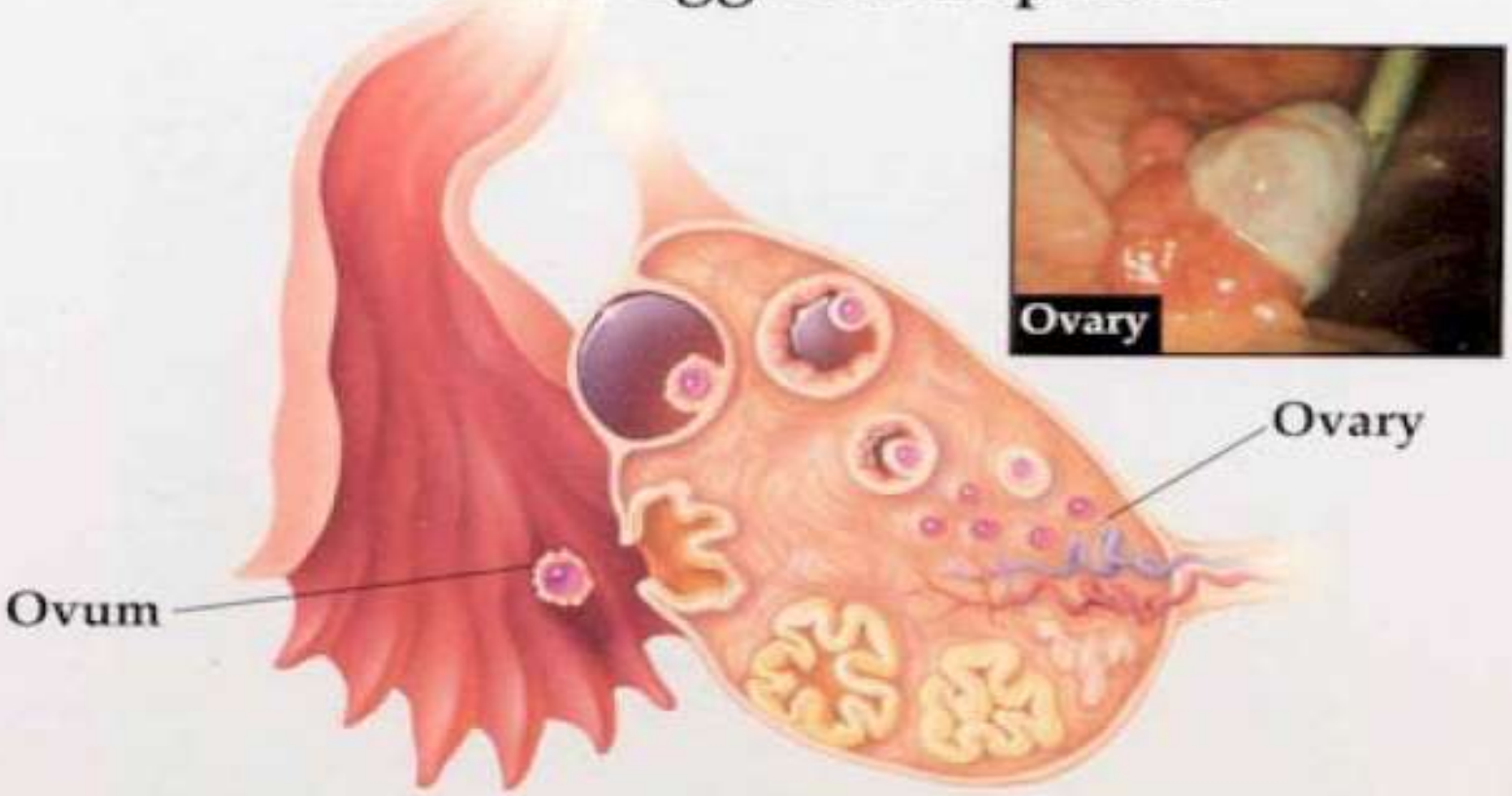
- **Spermatogenesis:**
  - produces male gametes (sperm)
  - occurs in the seminiferous tubules of the testes
  - involves meiosis
  - occurs throughout life after puberty
  - may produce 400,000,000 per day
- **Oogenesis:**
  - produces female gametes (oocytes)
  - occurs in the ovaries
  - involves meiosis
  - occurs after puberty until menopause
  - humans normally produce one oocyte during each ovarian cycle

Differences Between Spermatogenesis and Oogenesis

1. In females, mitotic proliferation of germ cells occurs prior to birth. In males, spermatogonia proliferate only after puberty.
2. In female, meiotic divisions of oocyte produces only one mature ovum. In male, meiotic divisions of primary spermatocyte produces 4 mature spermatozoa
3. In female, second meiotic division is completed only upon fertilization. In male, the products of meiosis (spermatids) undergo substantial differentiation in the maturing process.


Ovarian ligament
Ovarian stroma
Perimetrium
Isthmus of uterine tube
Ampulla of uterine tube
Mucosal folds of uterine tube
Endometrium
Fimbriae
Uterine cavity
Ovarian vessels
Myometrium
Corpus albicans
Uterosacral ligament
Ovarian follicles
Isthmus of uterus
Corpus luteum
Cervical canal
Vagina
Broad ligament of uterus
Cervix
Vaginal rugae

Normal Egg Development



Each month the ovaries release one egg, or ovum.

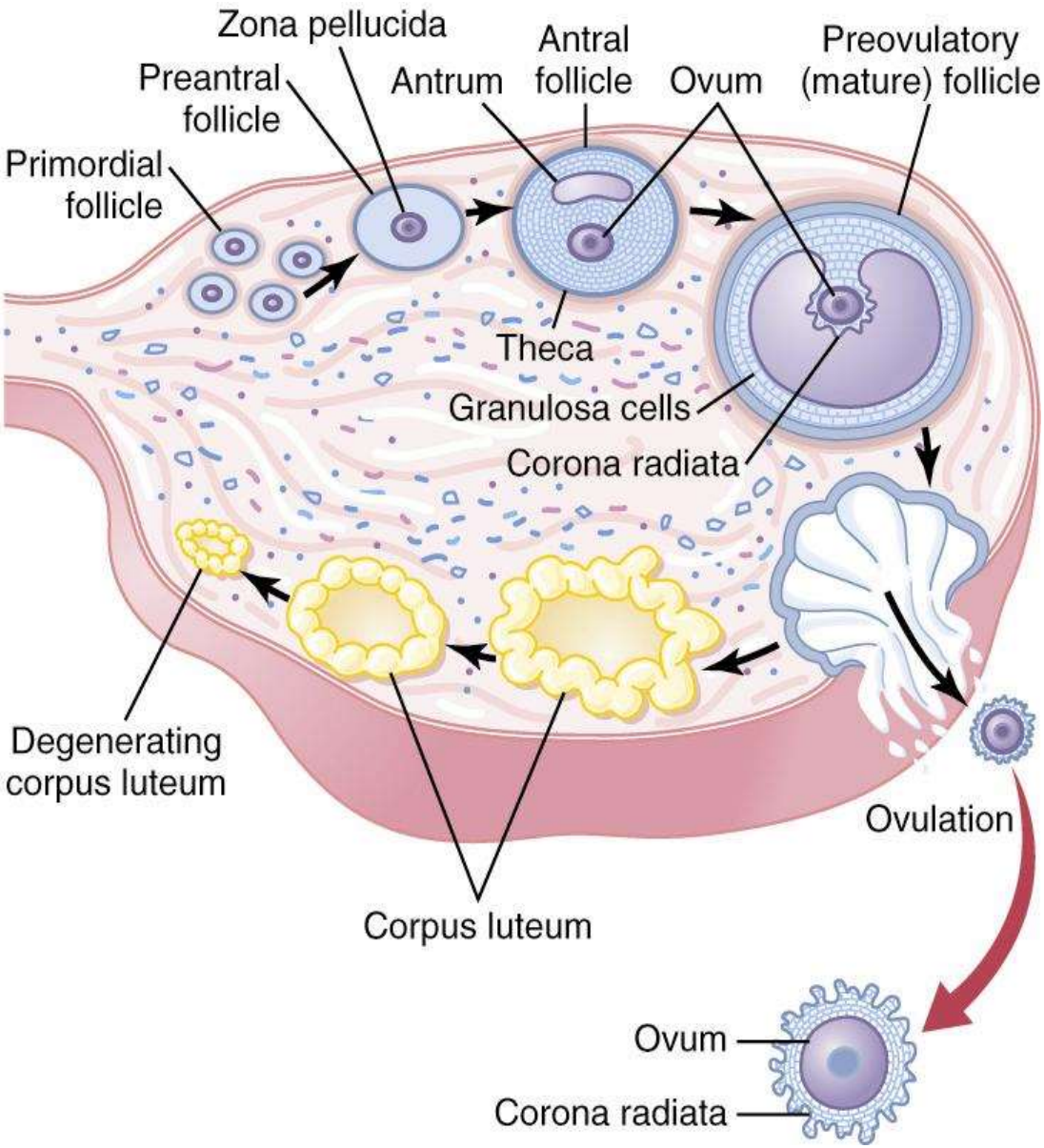
Oogenesis

Oogonia produced by mitotic division (max # = 7 mil), 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

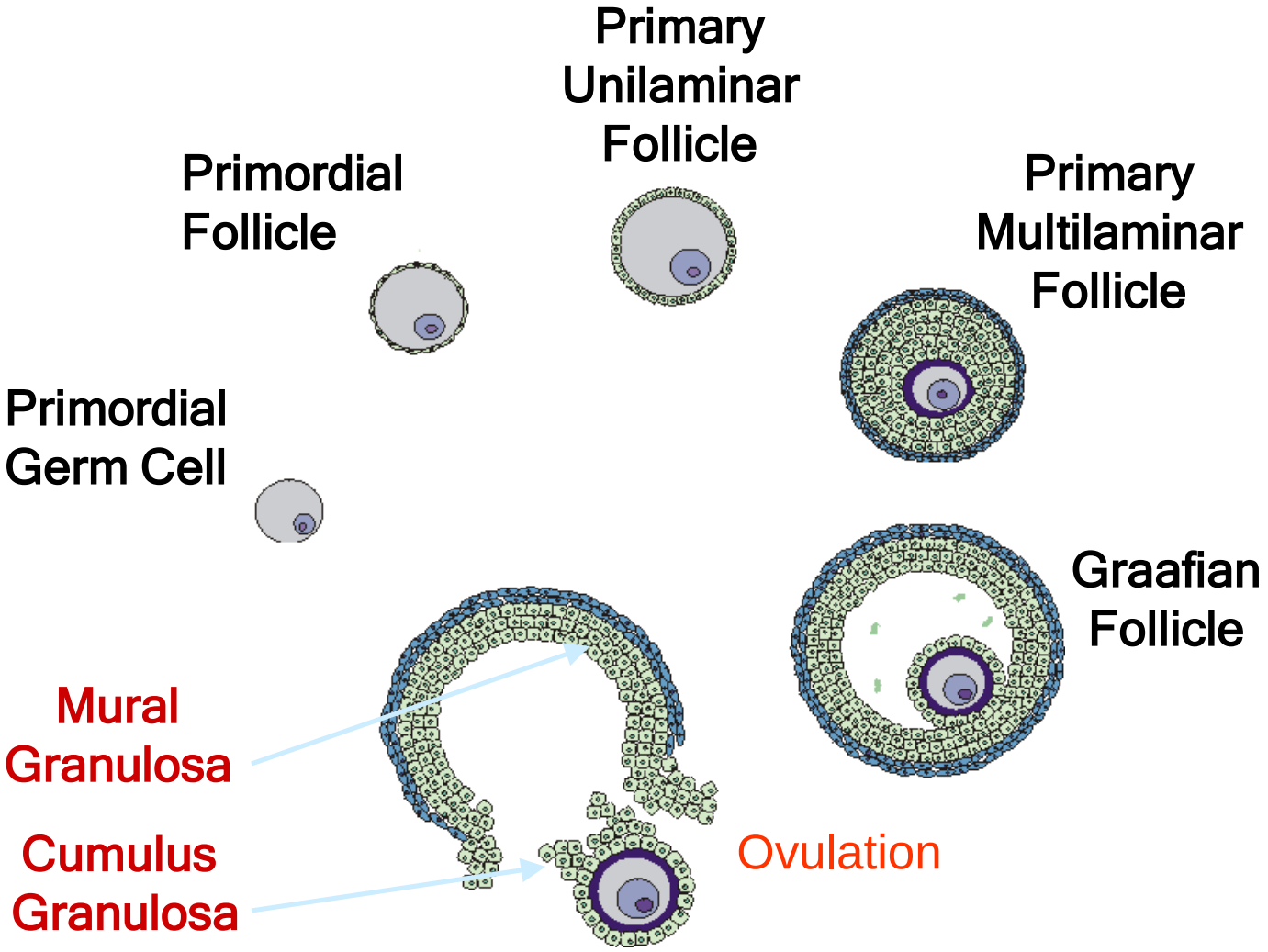
Fundamental reproductive unit = single ovarian follicle, composed of one germ cell (oocyte), surrounded by endocrine cells



Stages in follicular growth and ovulation.

Figure 81-4;
Guyton & Hall

Cumulus and Mural Granulosa cells share a common cellular origin



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

Follicular Development

- **Recruitment**
- **Maturation**

Recruitment

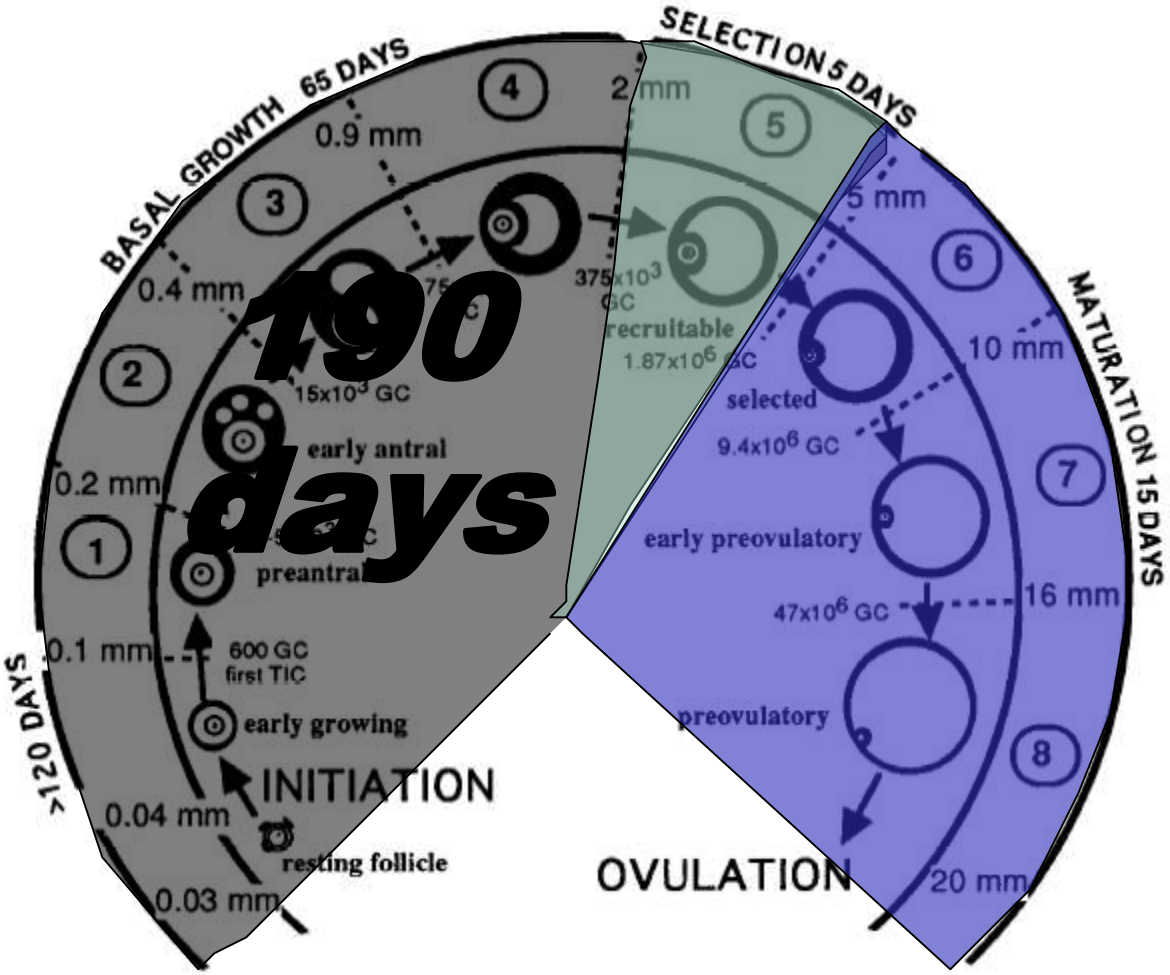
Absence of tumor suppressors gene, *PTEN*, in oocytes prematurely induces global follicular activation in mice, depleting follicular reserve, similar to POF.

Reddy et al. Science 2008; 319: 611-13.

Maturation

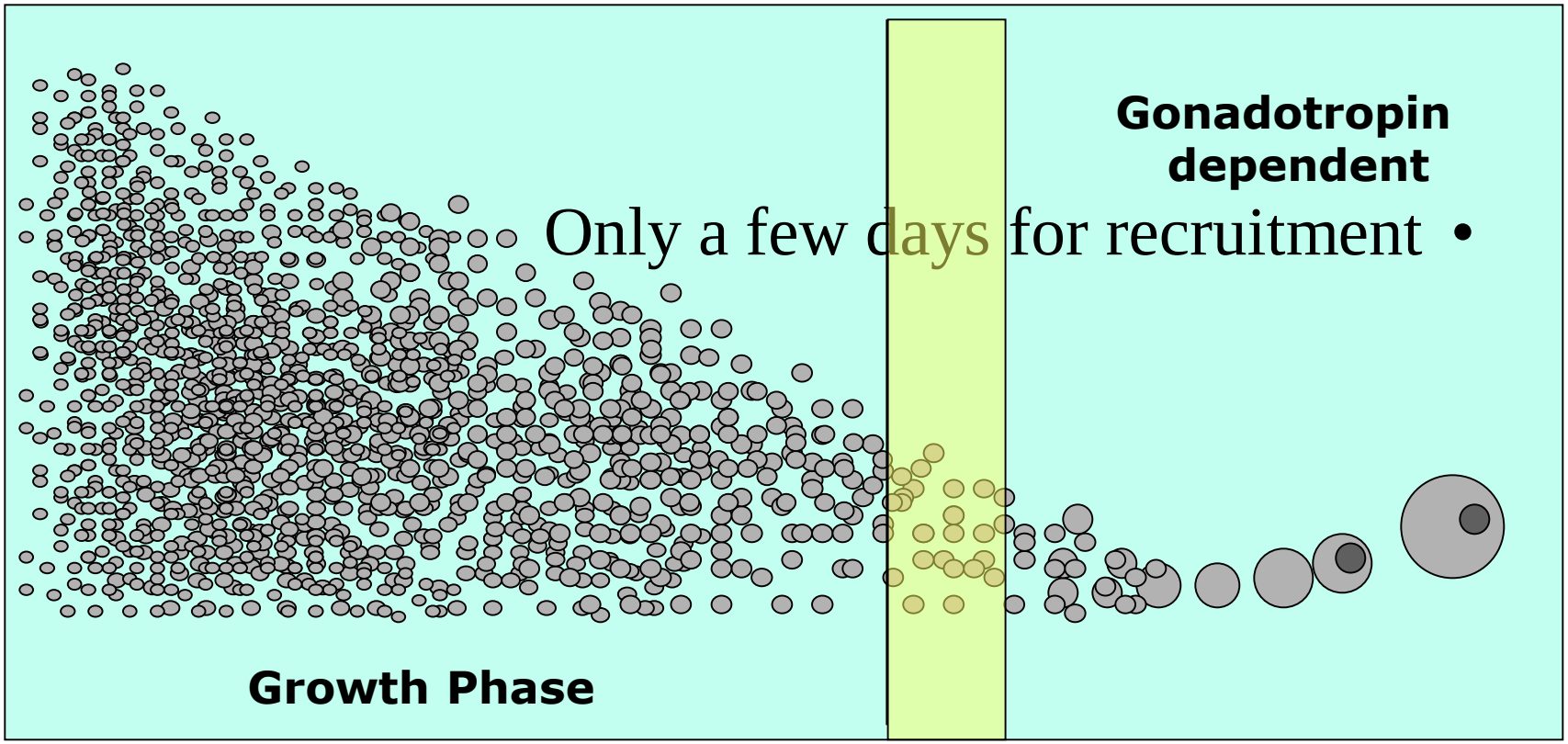
Bidirectional communications between germ cells (oocytes) and somatic cells (granulosa) are critical to oocyte maturation, follicle growth and ovulation.

Daikoku and Dey. Nature Medicine 2008; 14: 1192-3.

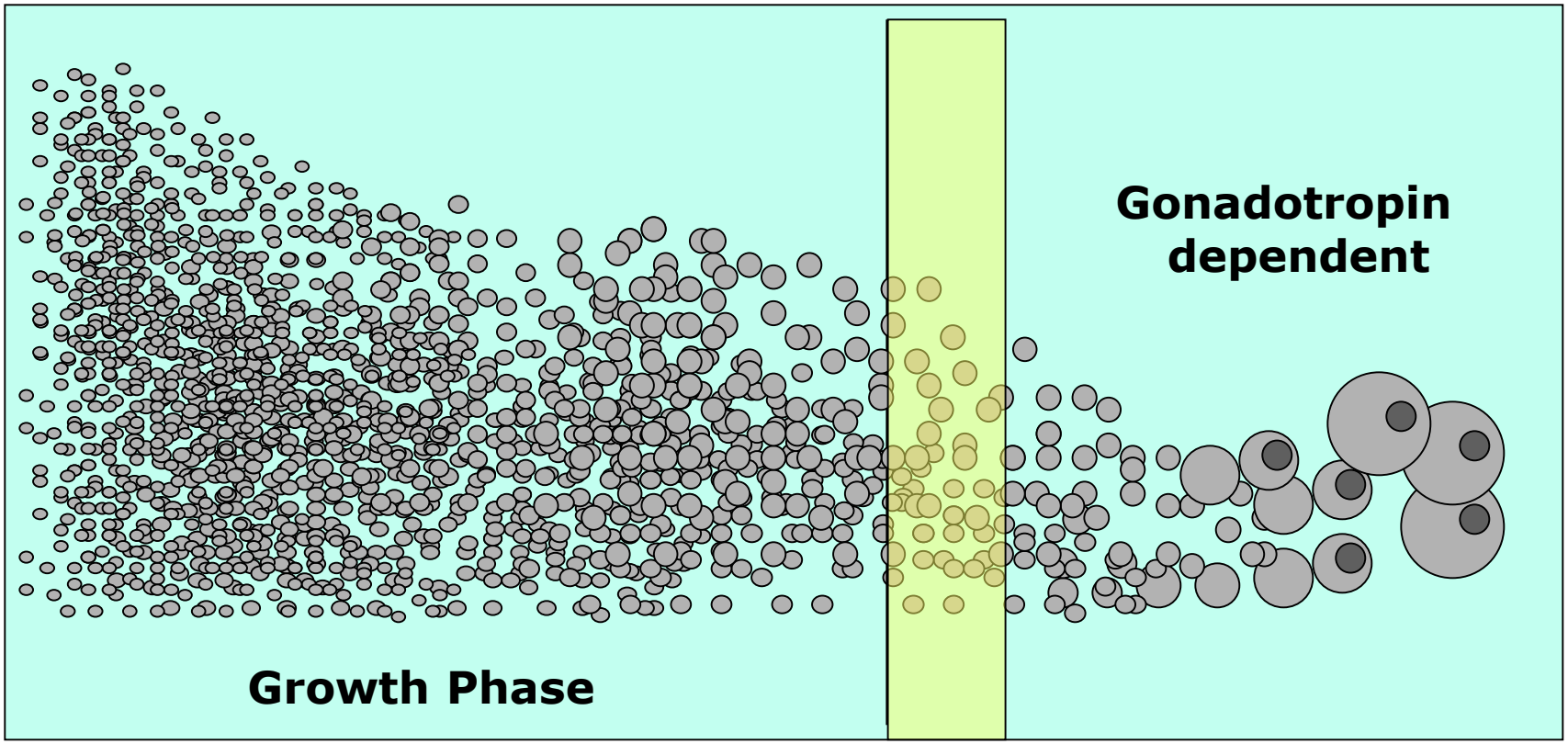


Gougeon, A. Endocrine Reviews 17:121 1996

Follicle Growth



Follicle Growth



AMH

- Secreted by granulosa cells of small follicles
- FSH independent
- Stable under various conditions:
  - OCP
  - Pregnancy
  - Menstrual cycle

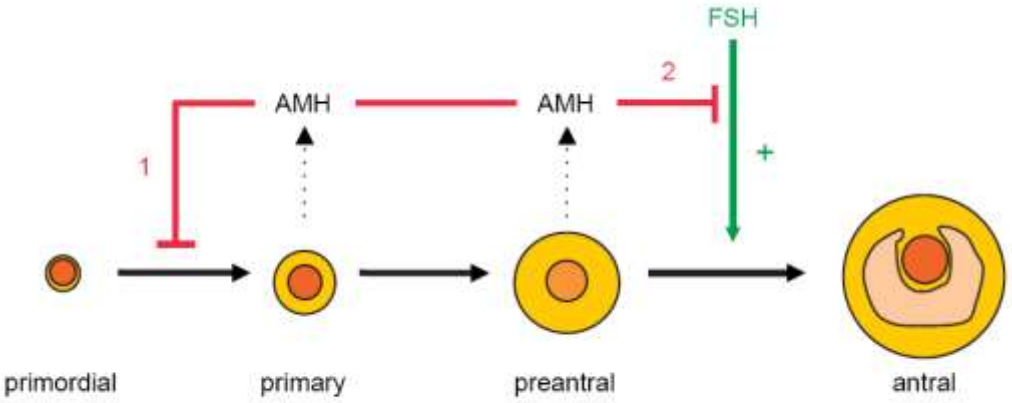
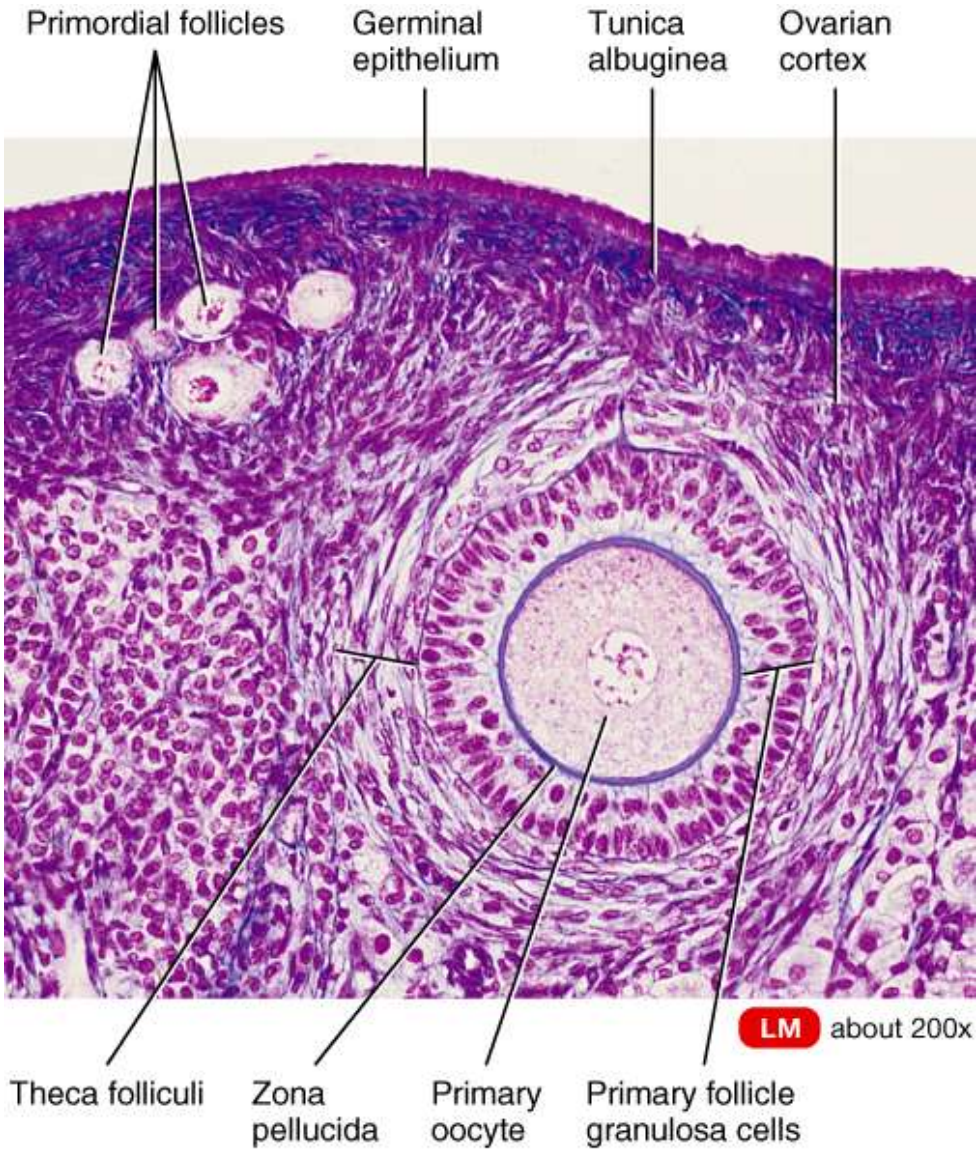


Figure 2 Model of AMH action in the ovary. Progressing stages of folliculogenesis are depicted. AMH is produced by the small growing (primary and preantral) follicles in the postnatal ovary and has two sites of action. It inhibits initial follicle recruitment (1) and inhibits FSH-dependent growth and selection of preantral and small antral follicles (2).

Visser J (2006) Reproduction
www.reproduction-online.org

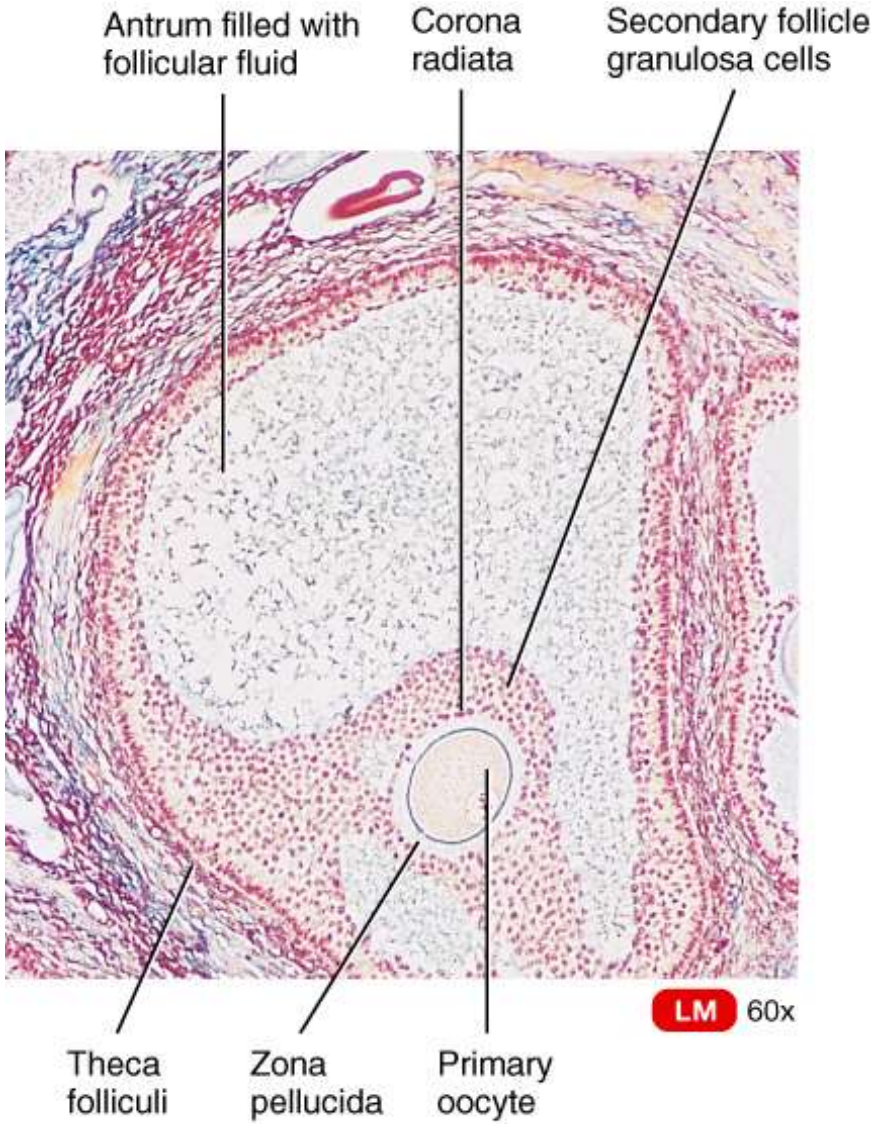
Fig. 28.16a



(a) Ovarian cortex

28.16a.jpeg

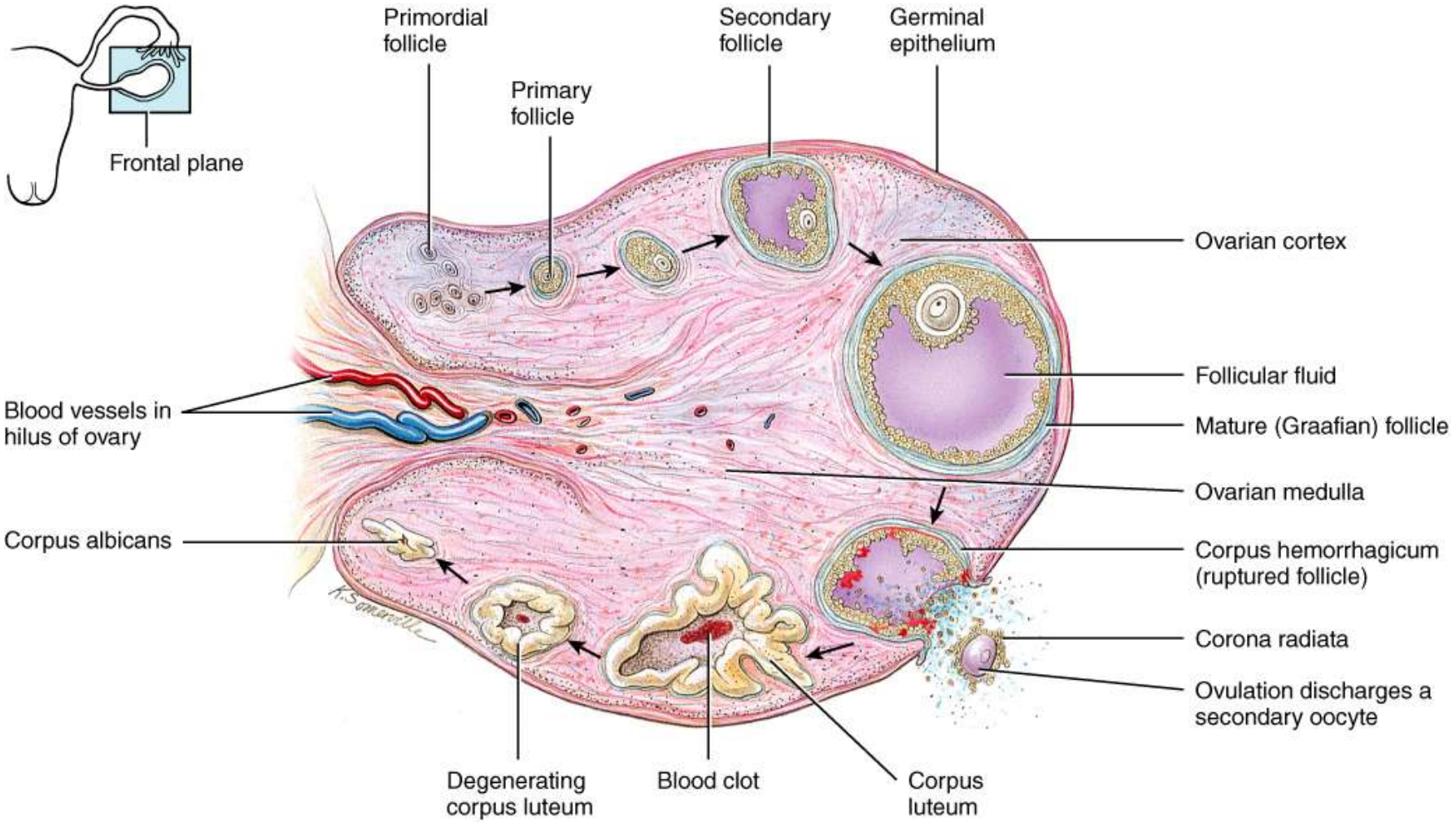
Fig. 28.16b



(b) Secondary follicle

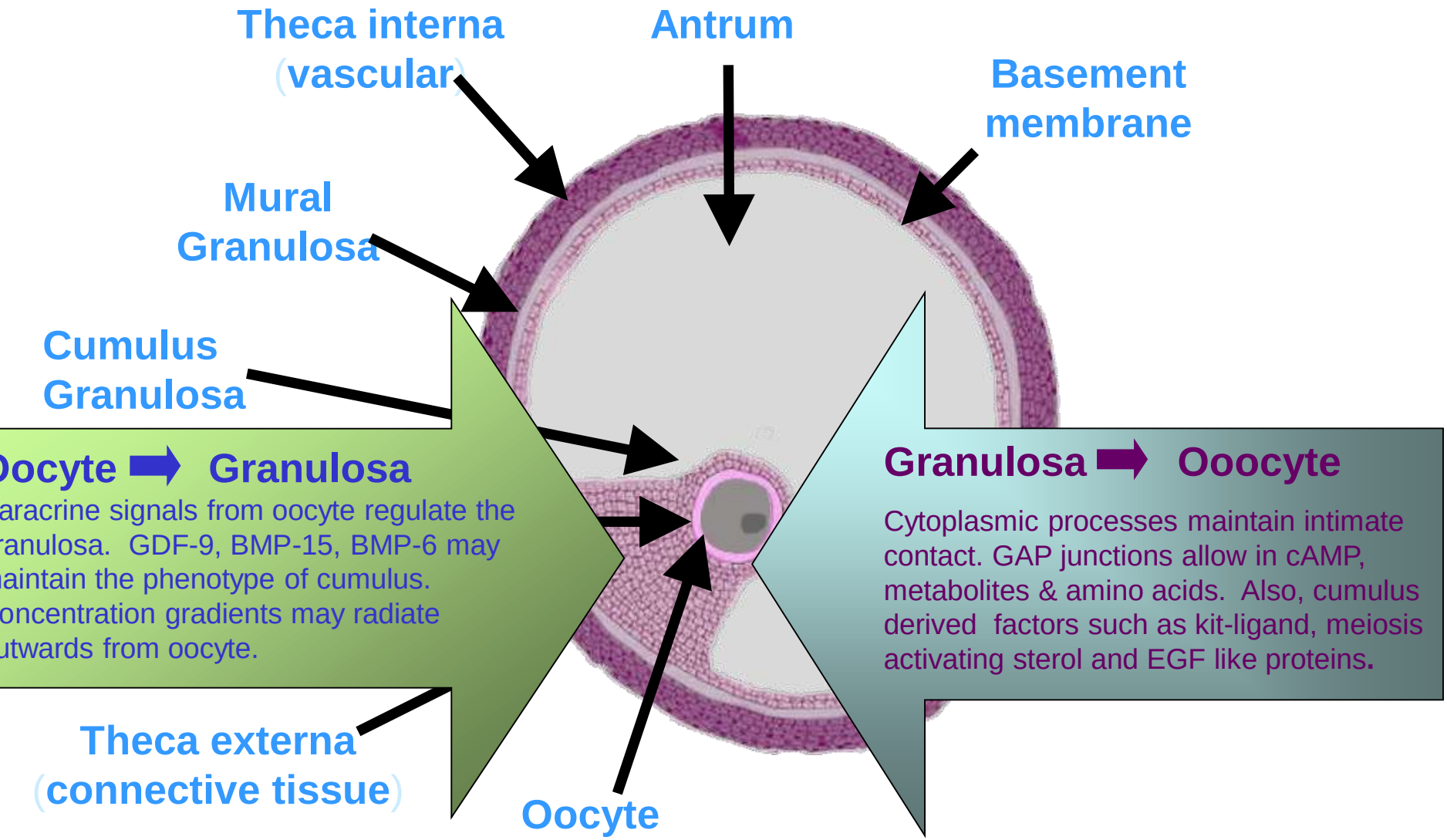
28.16b.jpeg

Fig. 28.15



28.15.jpeg

Granulosa & Oocyte are reciprocally regulated.



Thecal cells – superficial – no aromatase – have only LH Receptors – can get cholesterol from LDL in blood

Granulosa cells – interior – have aromatase, but no 17α-hydroxylase (17,20-desmolase) –

(Converts pregnenolone to 17α-hydroxyprenenolone to DHEA)

– get cholesterol from de novo synthesis

– have both LH and FSH receptors

And progesterone to 17α-progesterone

If androgen levels high, preferentially forms DHT from Testosterone – and inhibits aromatase activity

– decr. estradiol, inhibit synthesis LH R

Negative feedback of steroids on gonadotropin release

-- in child, low levels of steroid blocks release of gonadotropins
-- in adult, much higher levels of steroids, same level of inhibition of release of gonadotropins

Reduced sensitivity to steroids with age

Age dependence of feedback sensitivity:
high sensitivity in childhood; low sensitivity in adulthood

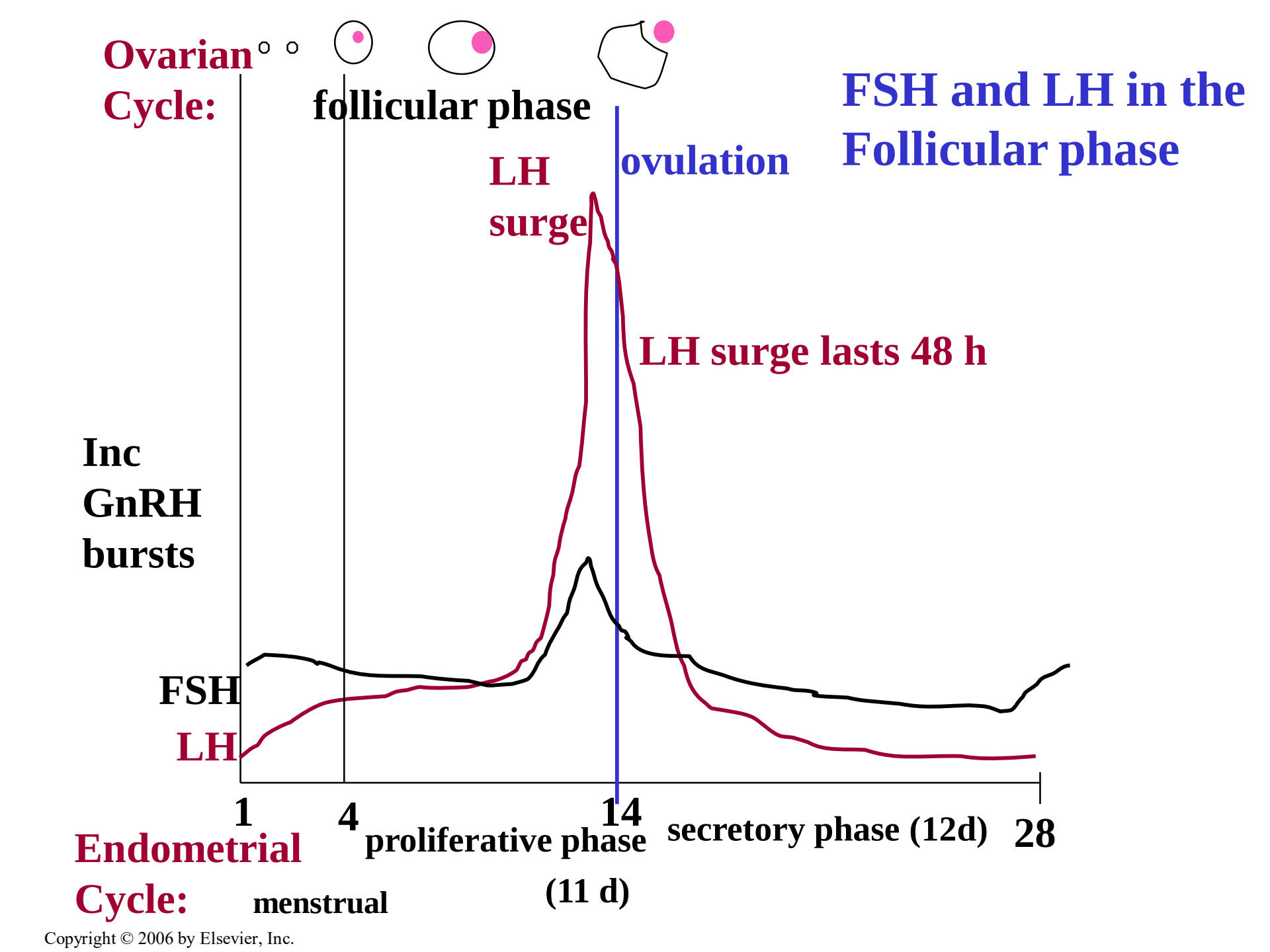
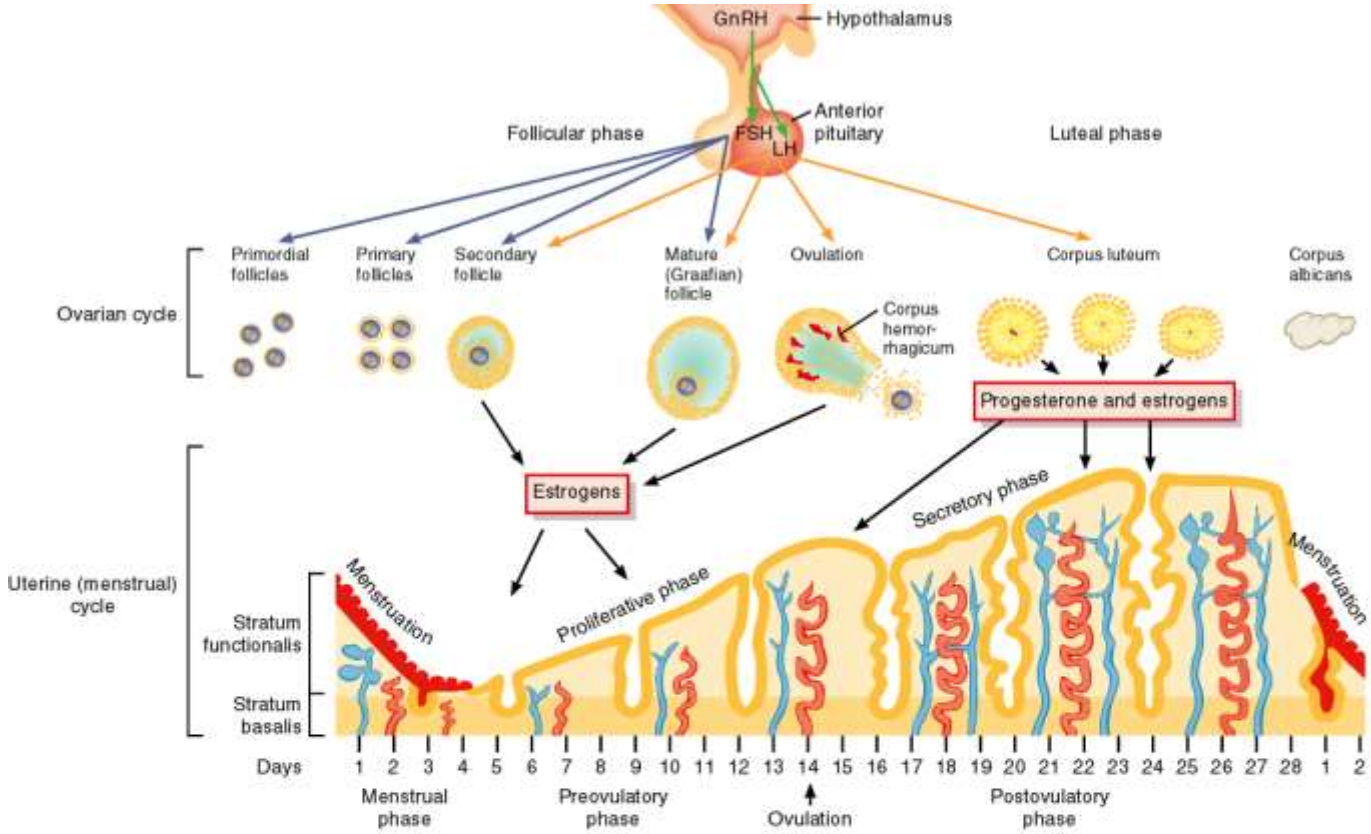
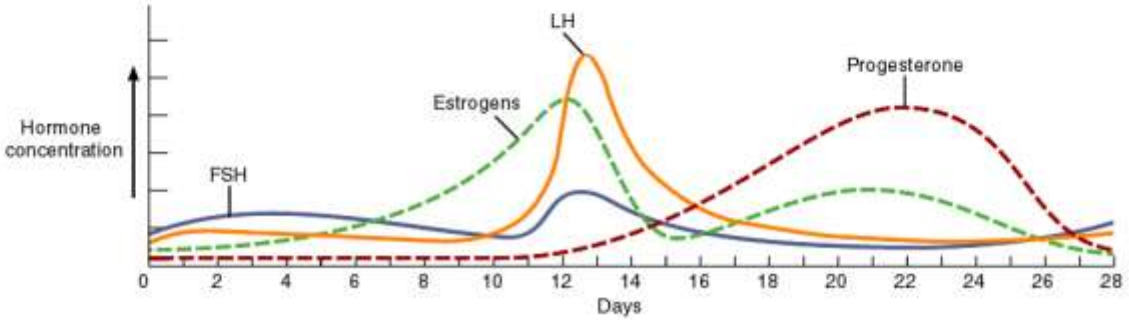


Fig. 28.26



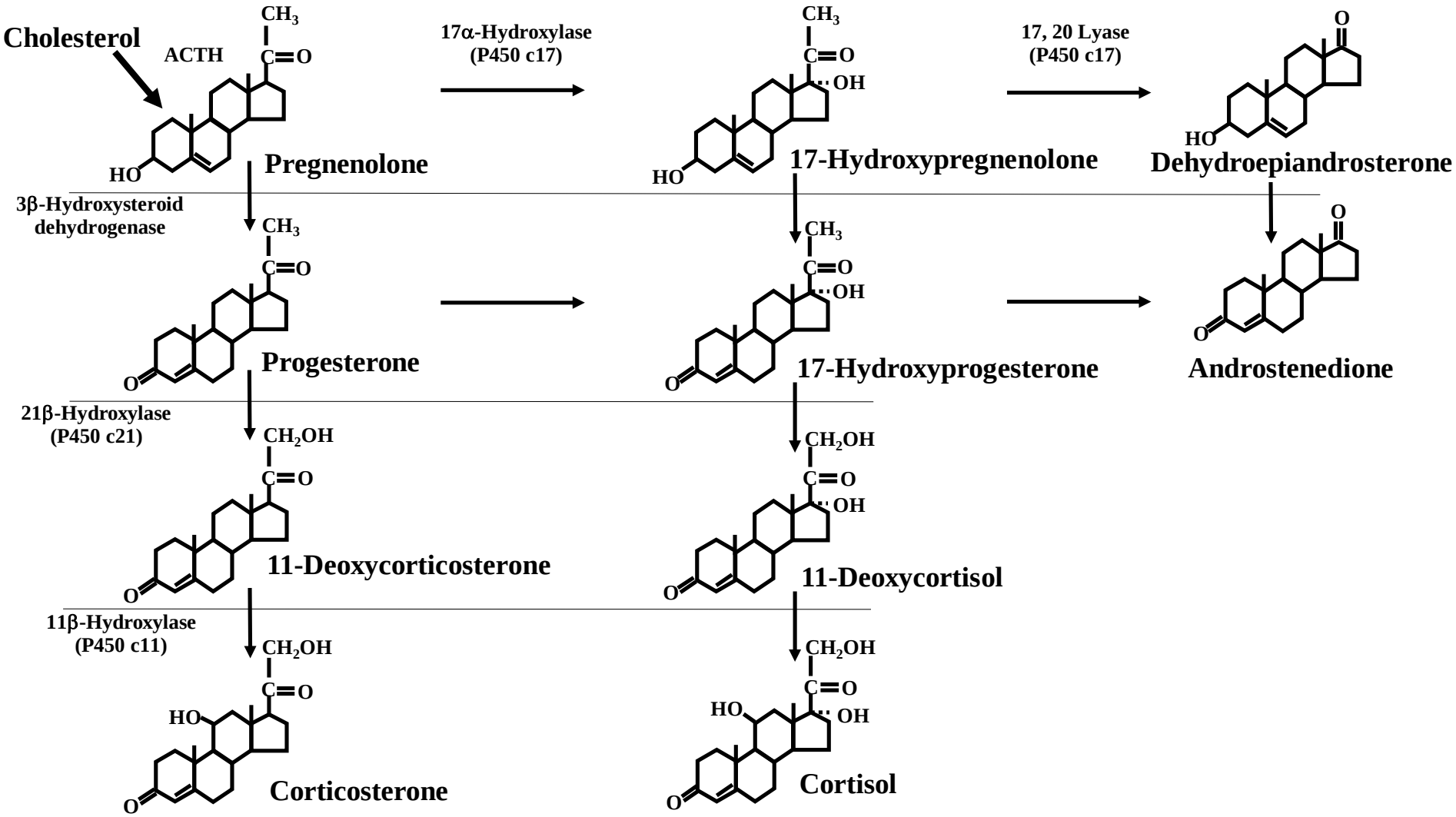
(a) Hormonal regulation of changes in the ovary and uterus



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

28.26.jpeg

Steroid Hormone Biosynthesis



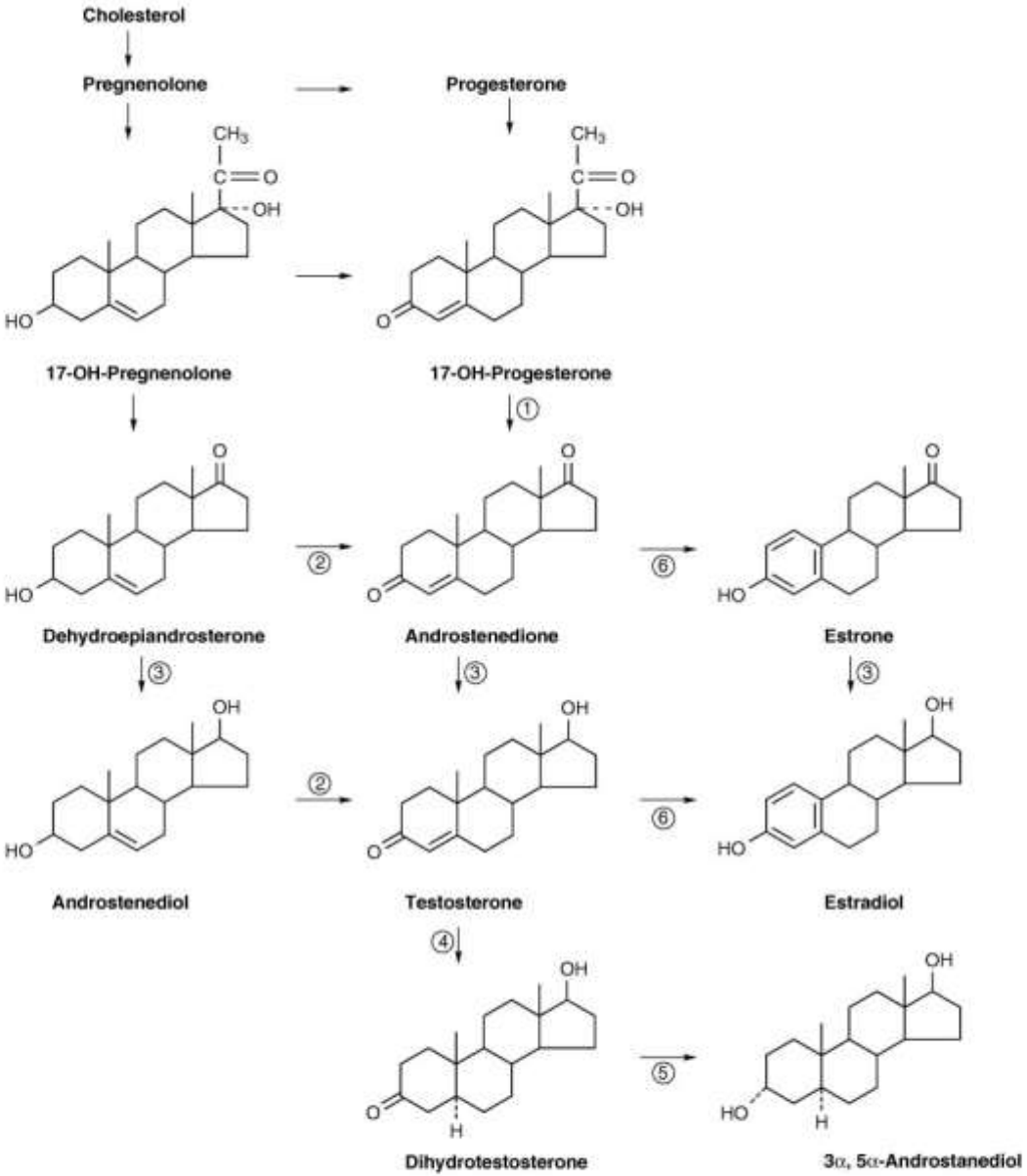
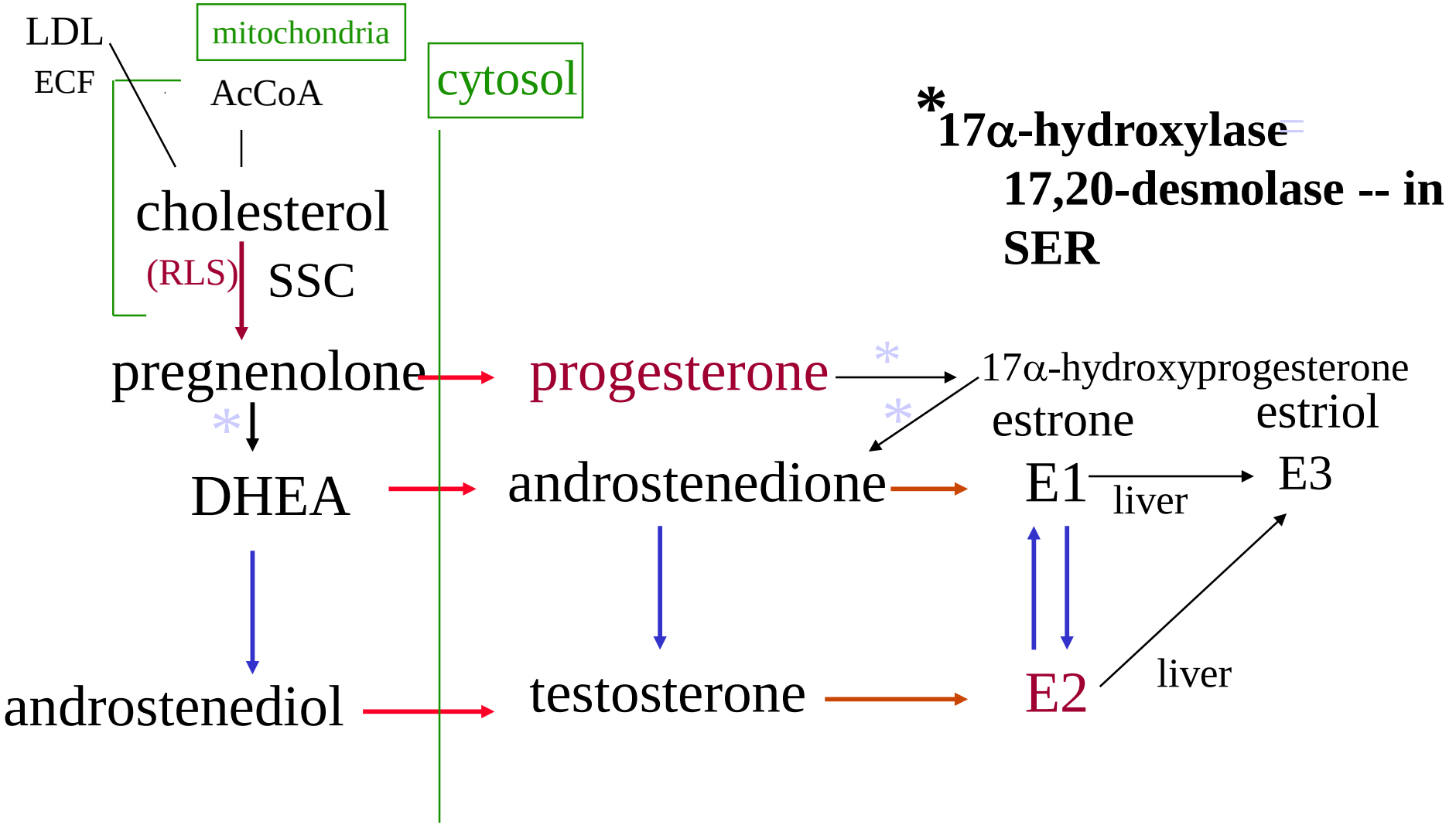


Figure 23.39. Conversion of cholesterol to sex hormones.



Synthesis of steroid hormones

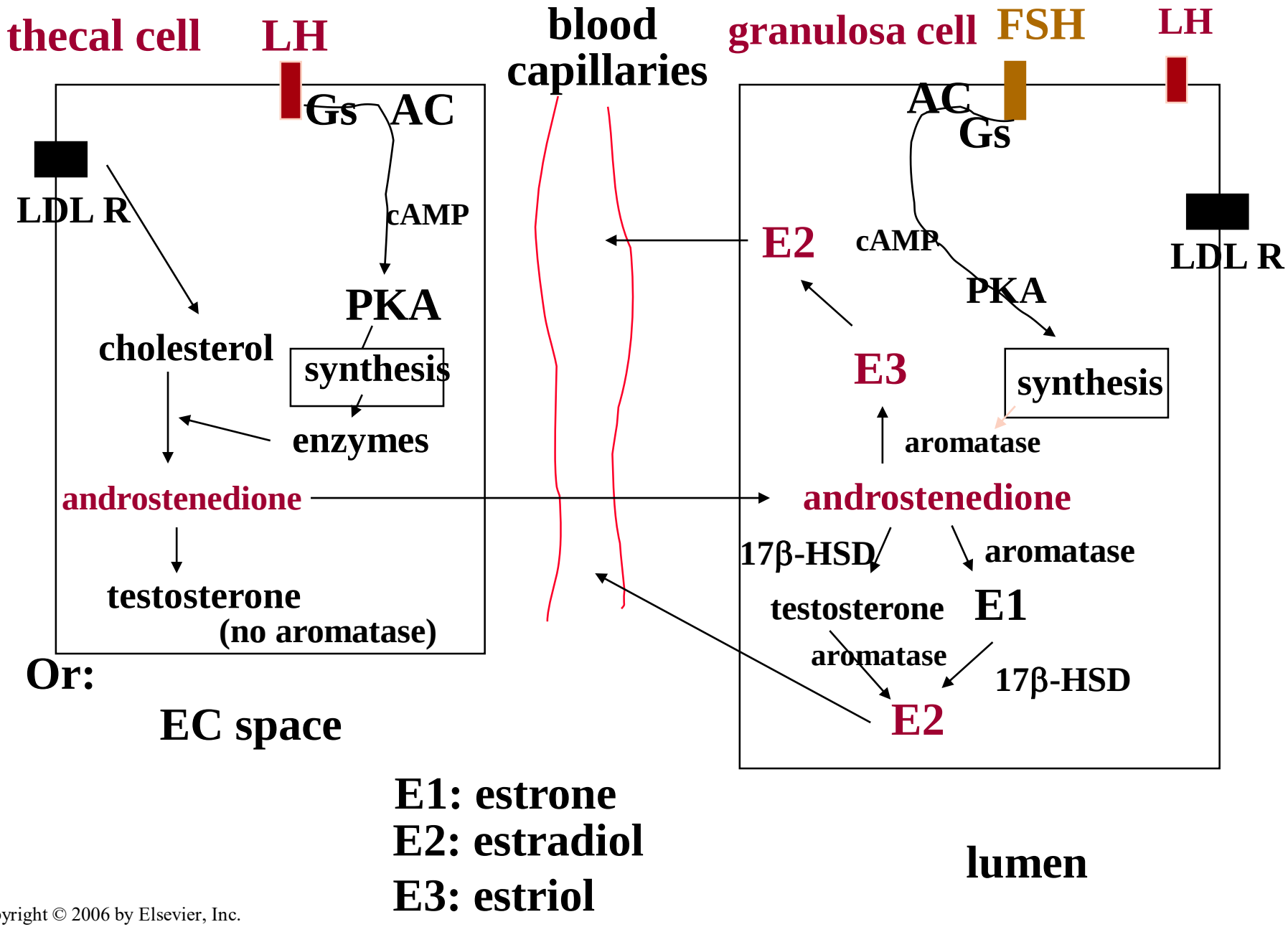
3β-hydroxysteroid DH (in cytosol)

Aromatase (in cytosol)

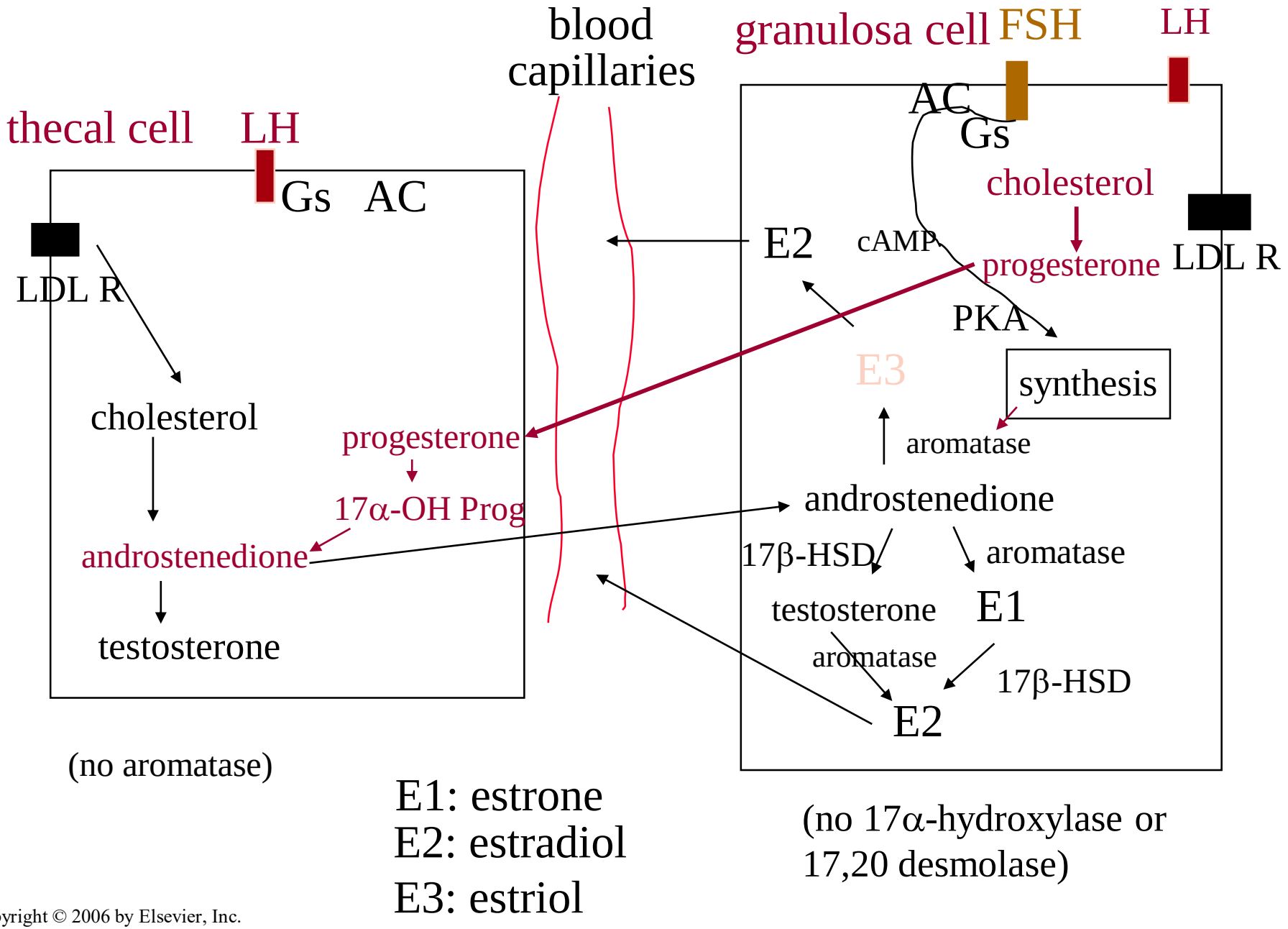
17β-hydroxysteroid DH (in SER)

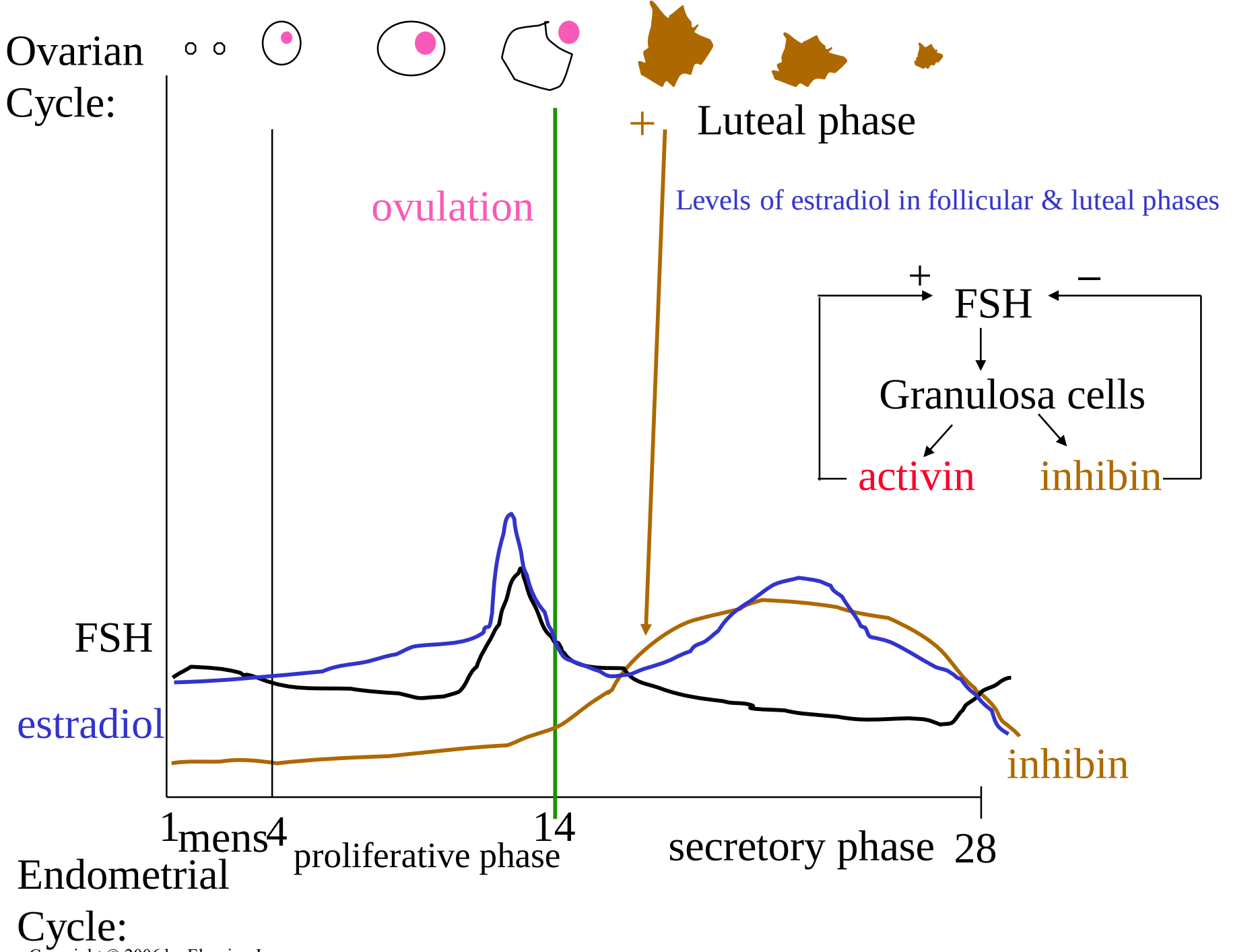
SSC = side chain cleavage enzyme (in mitochondria)

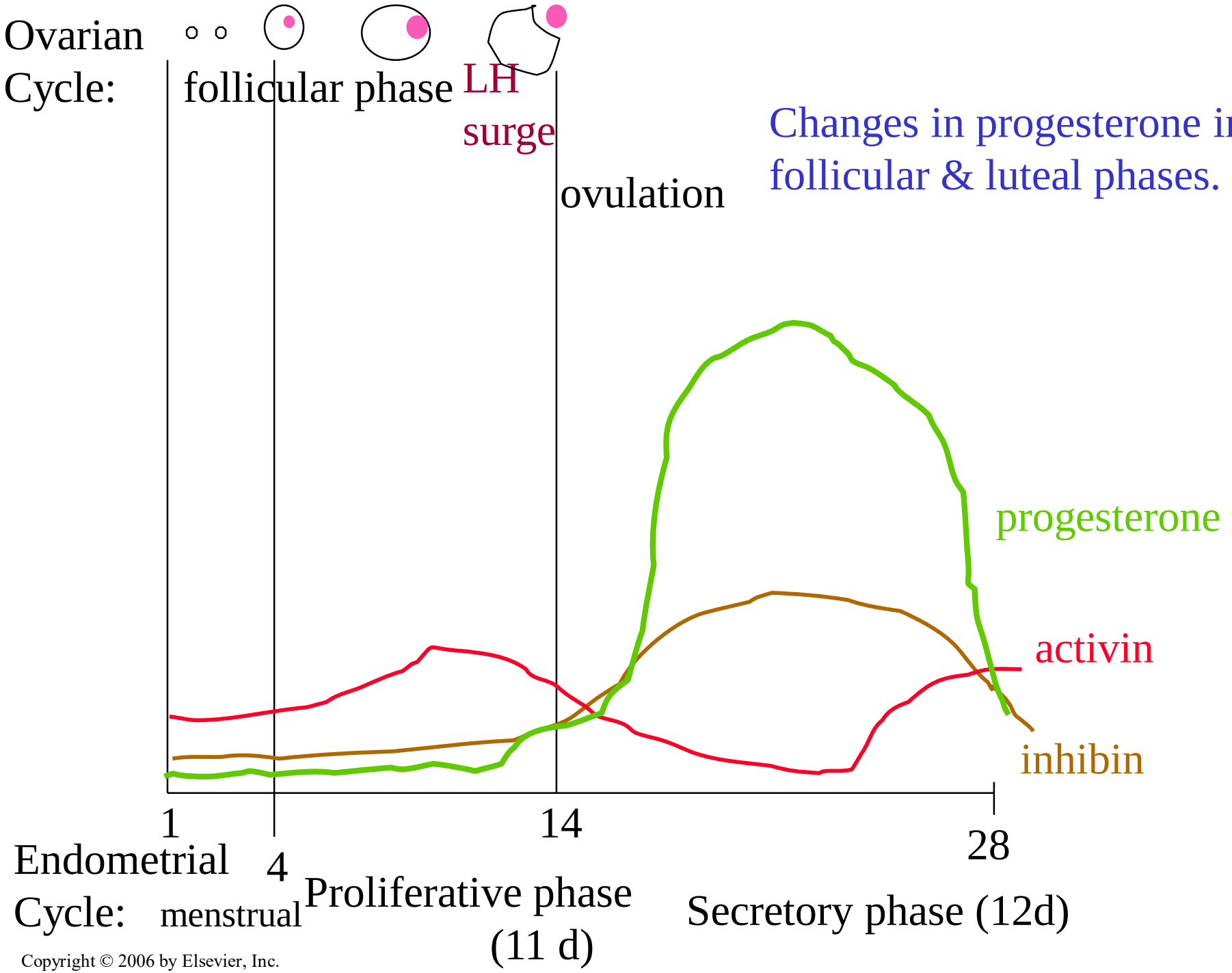
Steroid synthesis in follicular phase

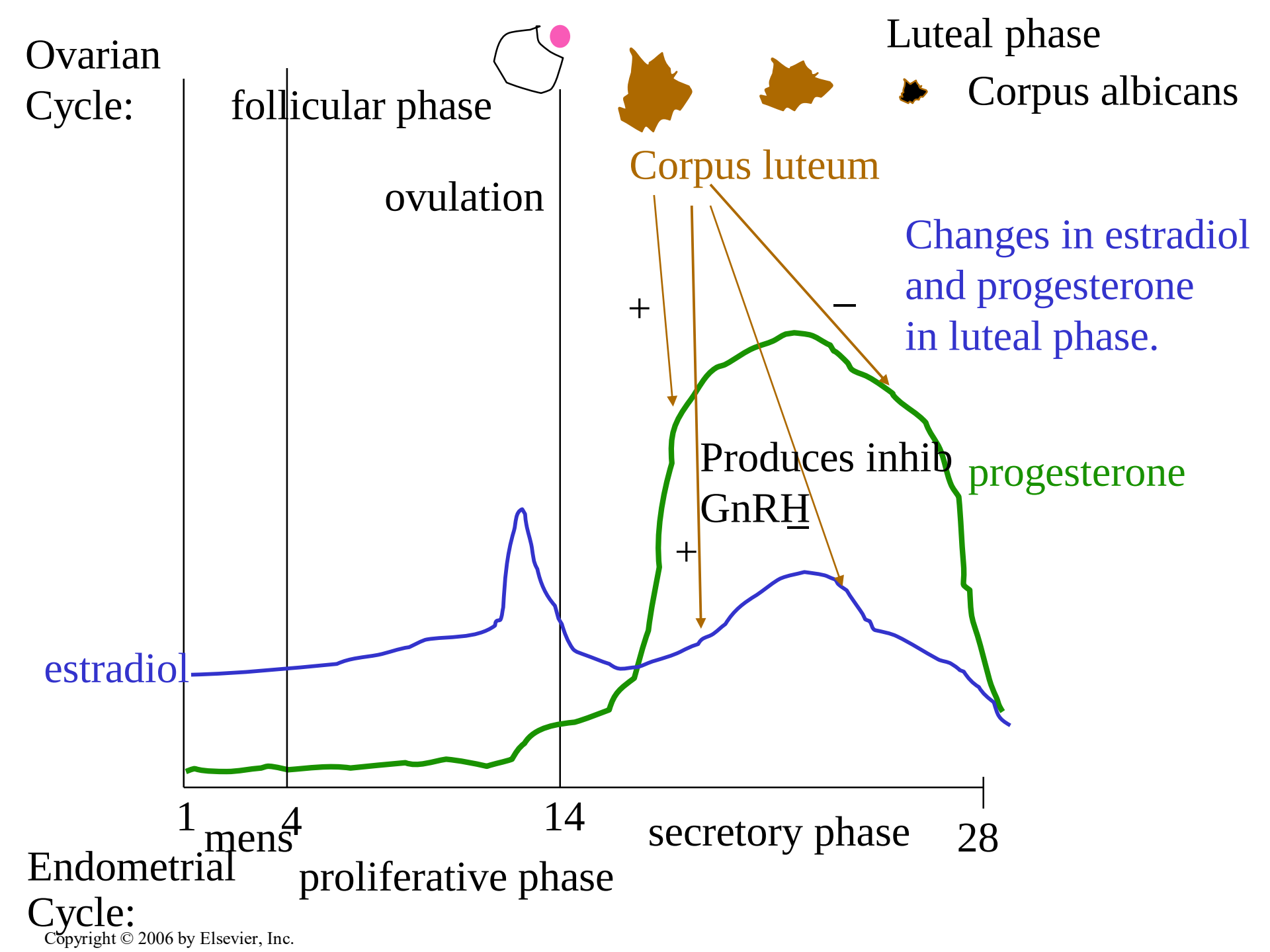


Steroid synthesis in luteal phase







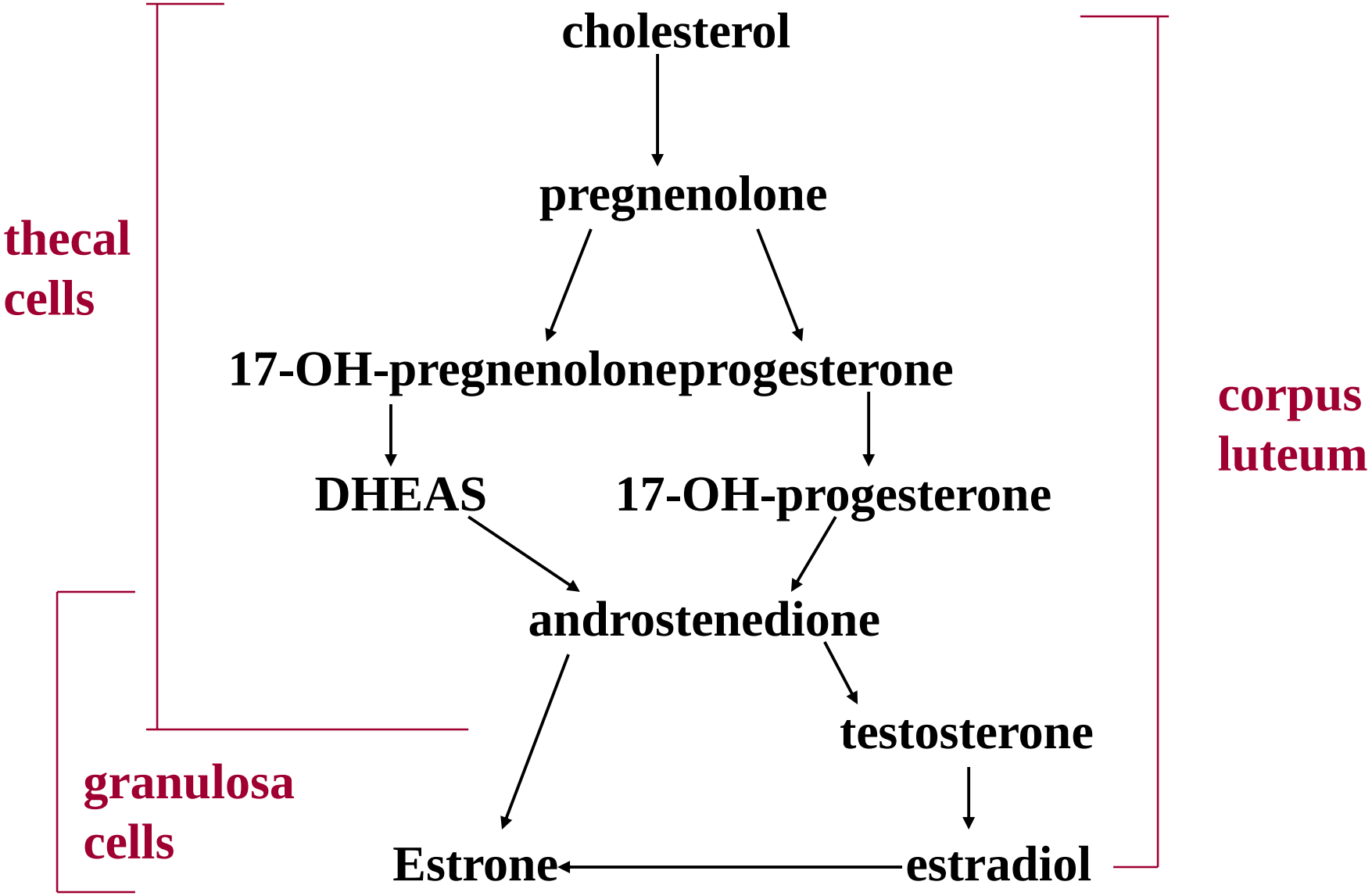


Corpus luteum

- 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


cholesterol
pregnenolone
17-OH-pregnenoloneprogesterone
DHEAS
17-OH-progesterone
androstenedione
testosterone
Estrone
estradiol
thecal cells
granulosa cells
corpus luteum

Hypothalamic-pituitary-gonadal axis

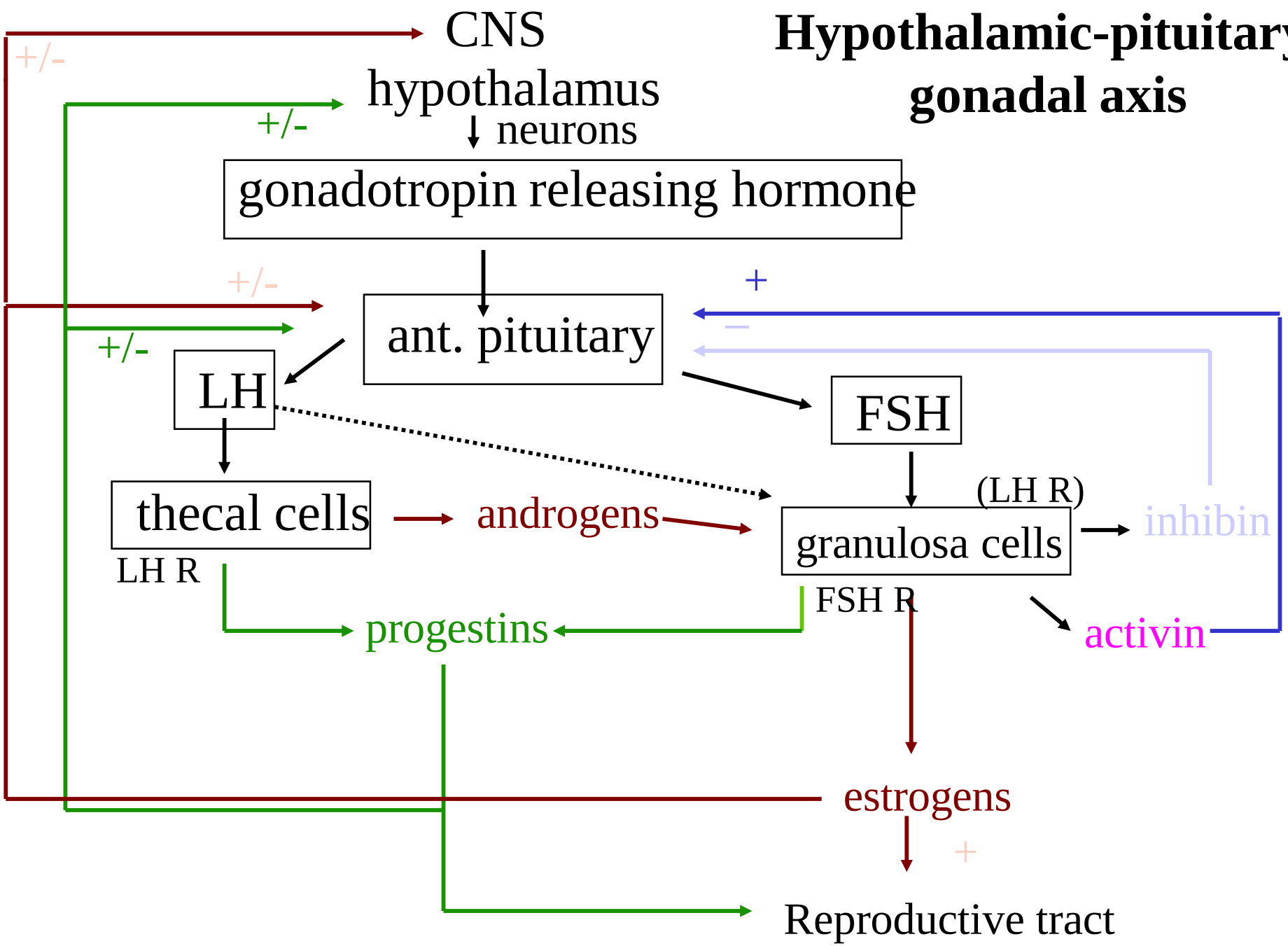
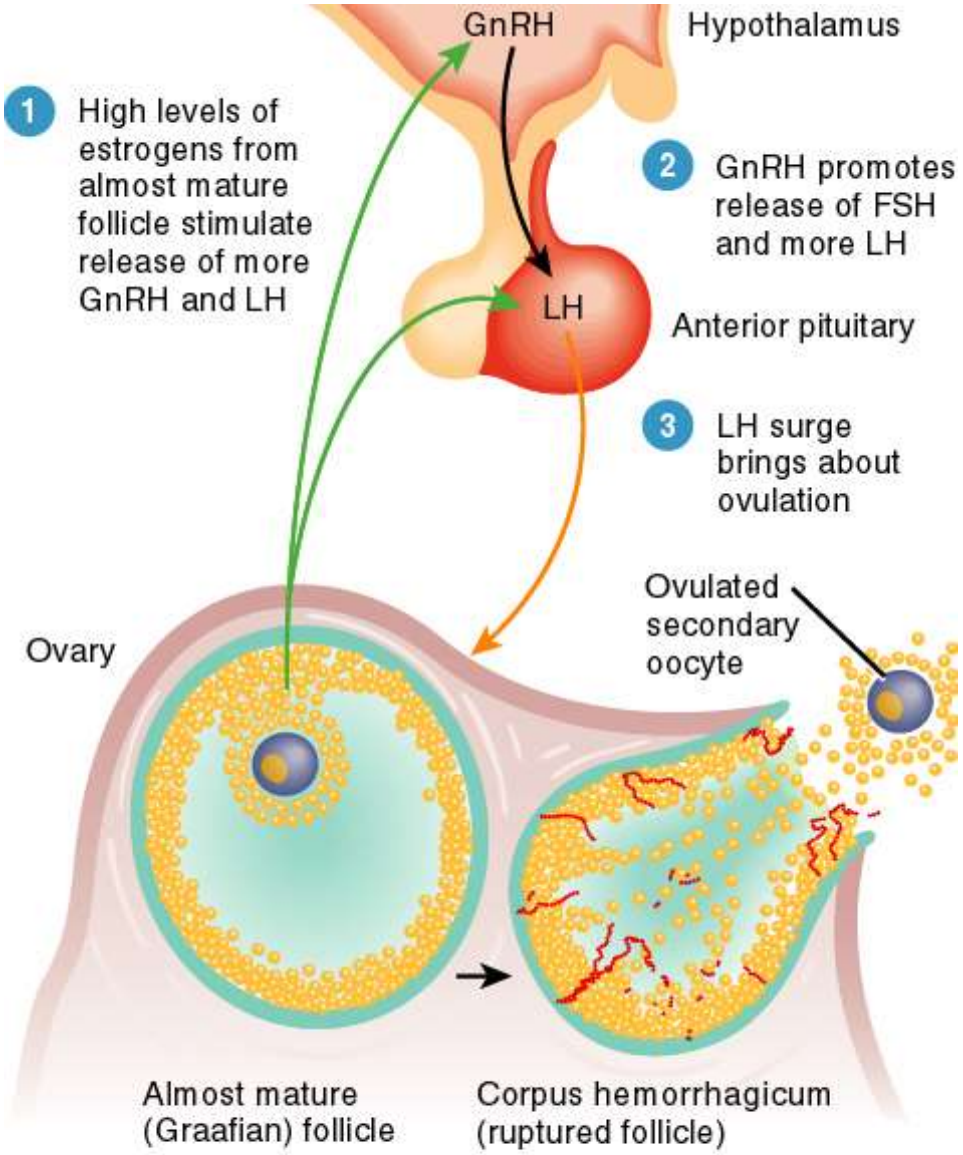
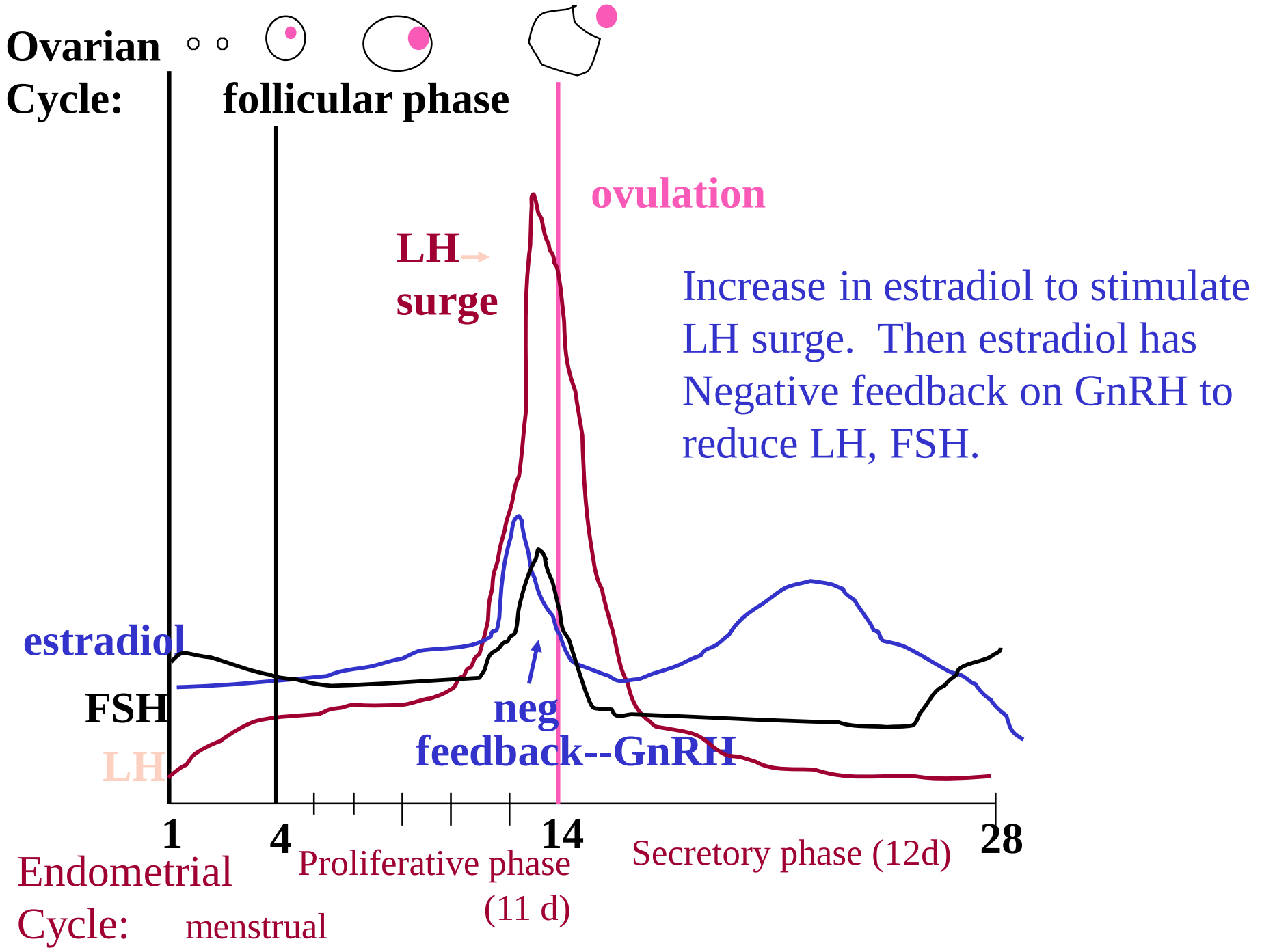


Fig. 28.27



28.27.jpeg



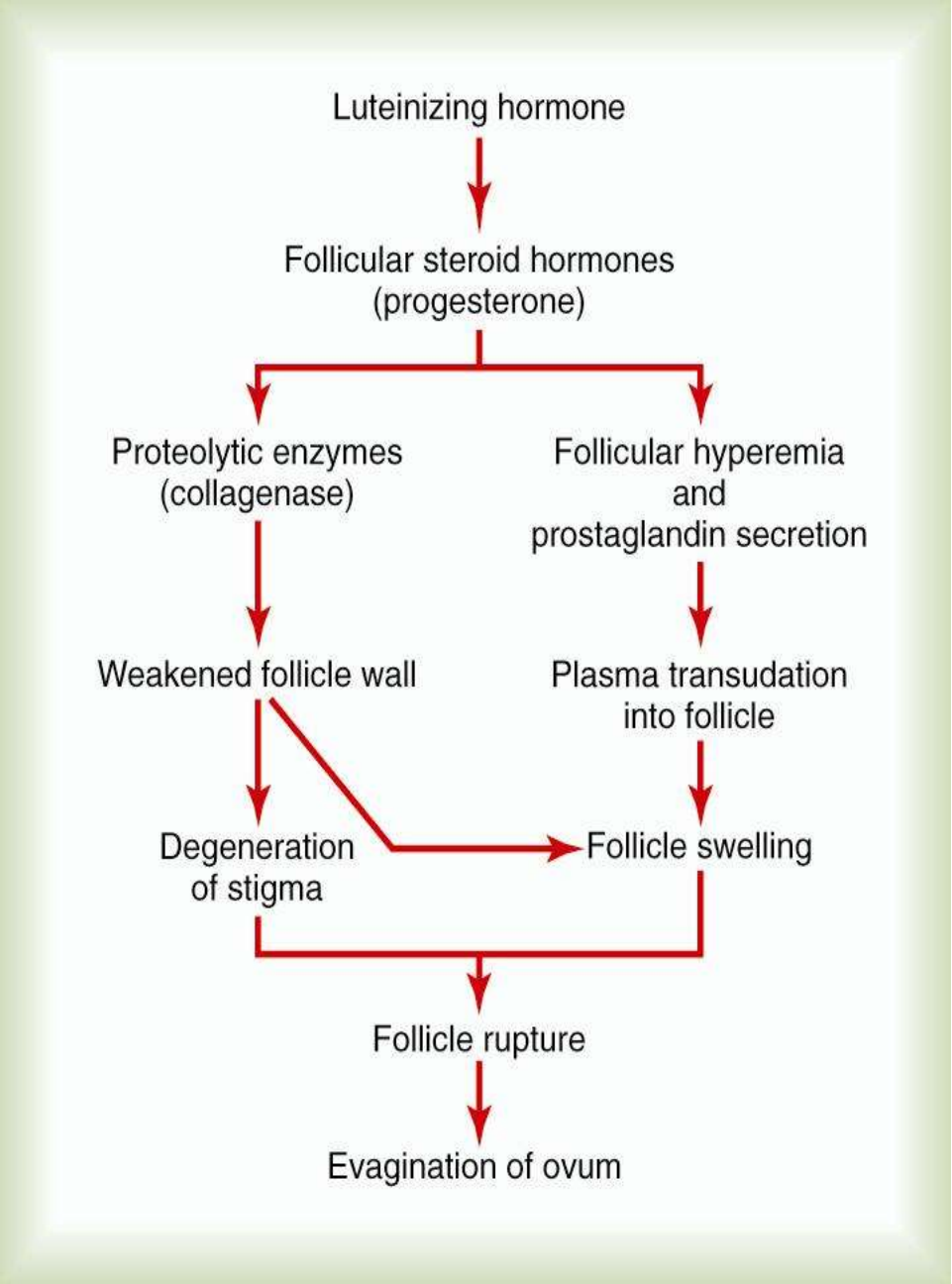
Chemical mechanics of ovulation:
LH surge → prostaglandin endoperoxide synthase in granulosa cells (sets up pseudoinflammatory response)

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



Postulated mechanisms responsible for ovulation

Figure 81-5;
Guyton & Hall

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 phases

Menstrual cycle – controlled by gonadotropins, gonadal hormones

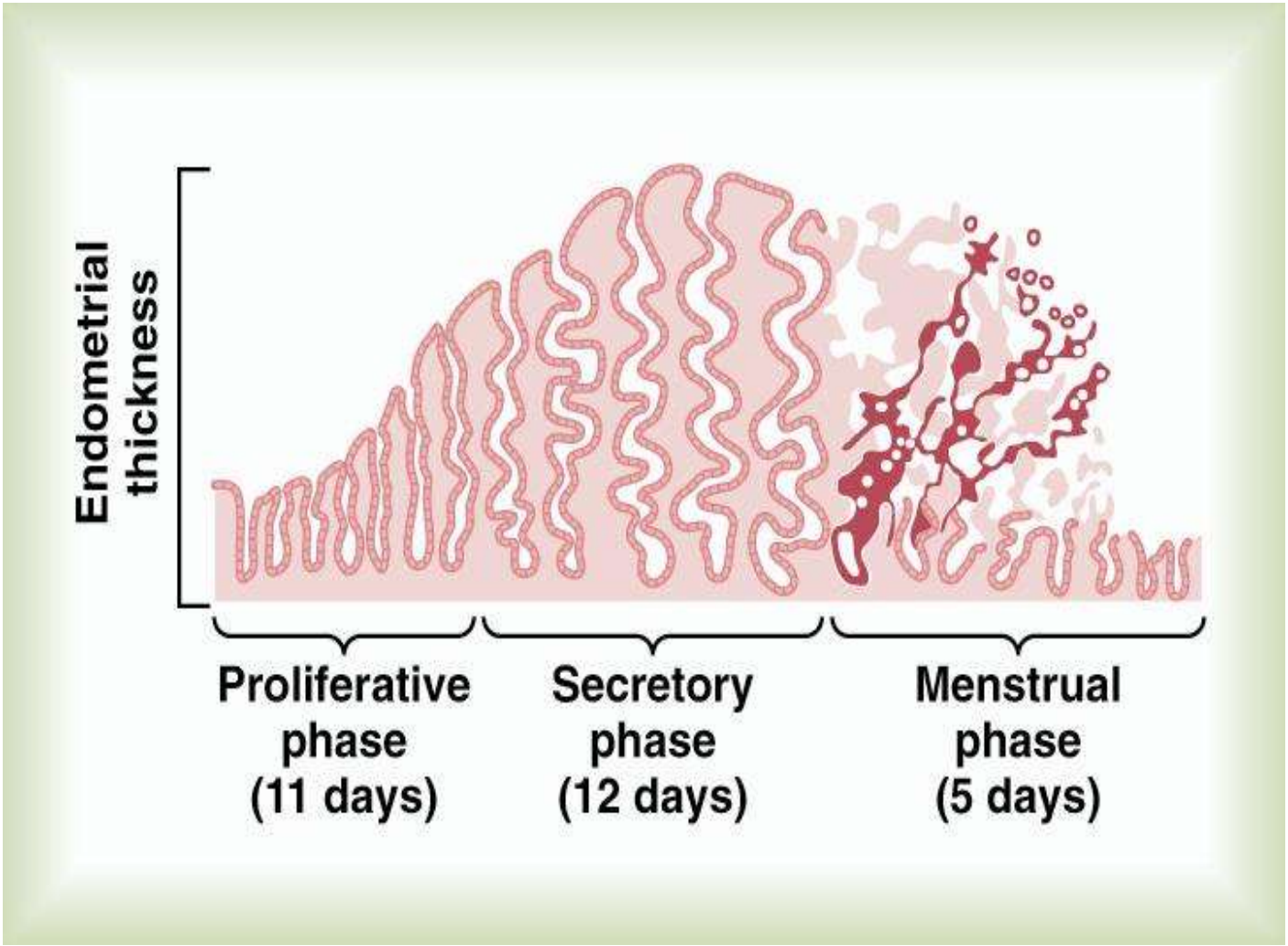
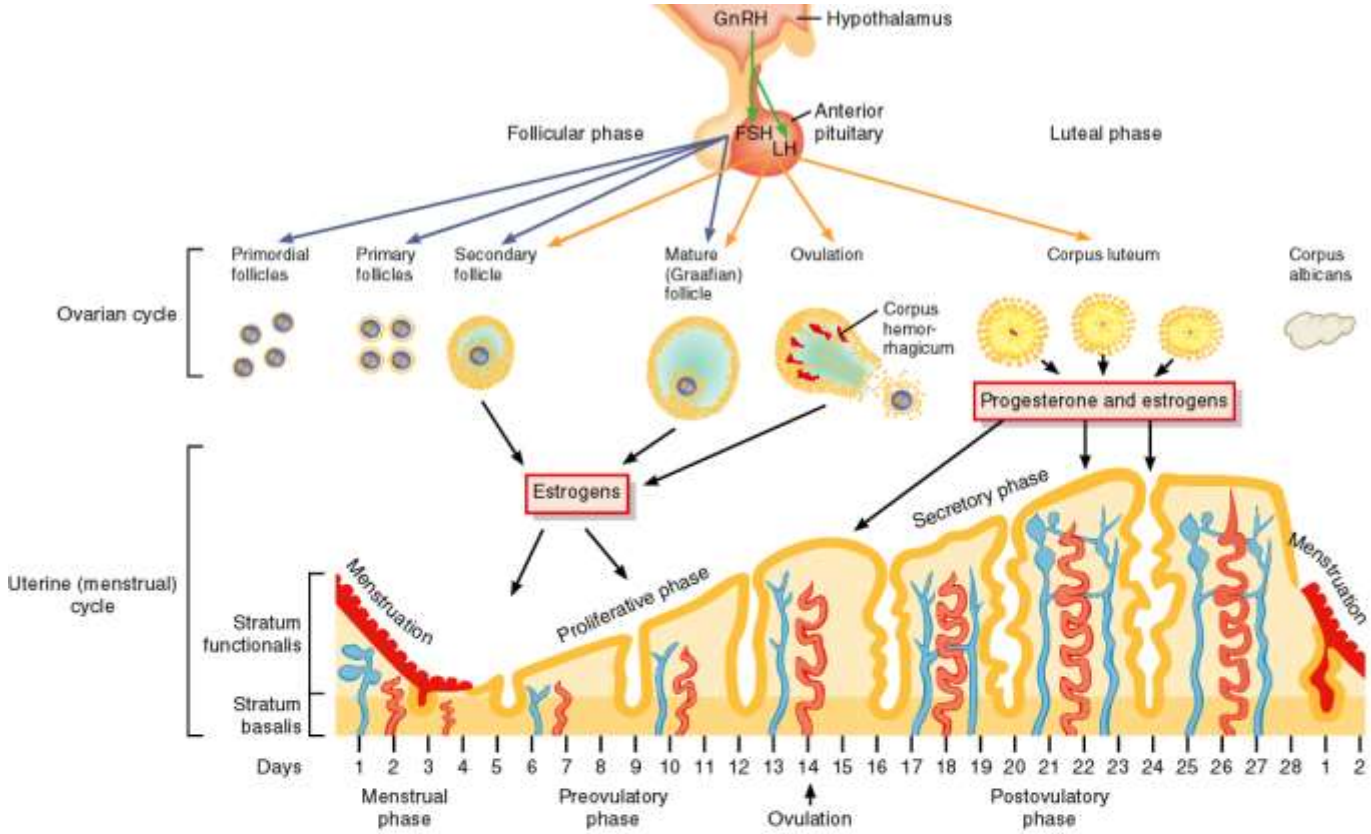
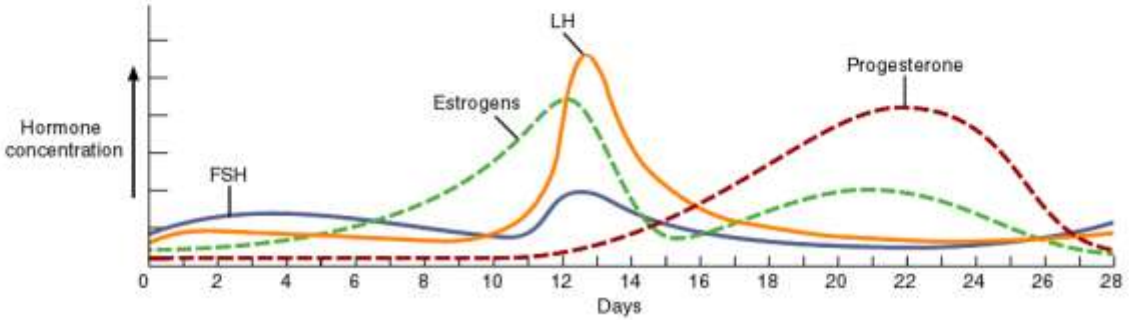


Figure 81-7; Guyton & Hall

Fig. 28.26



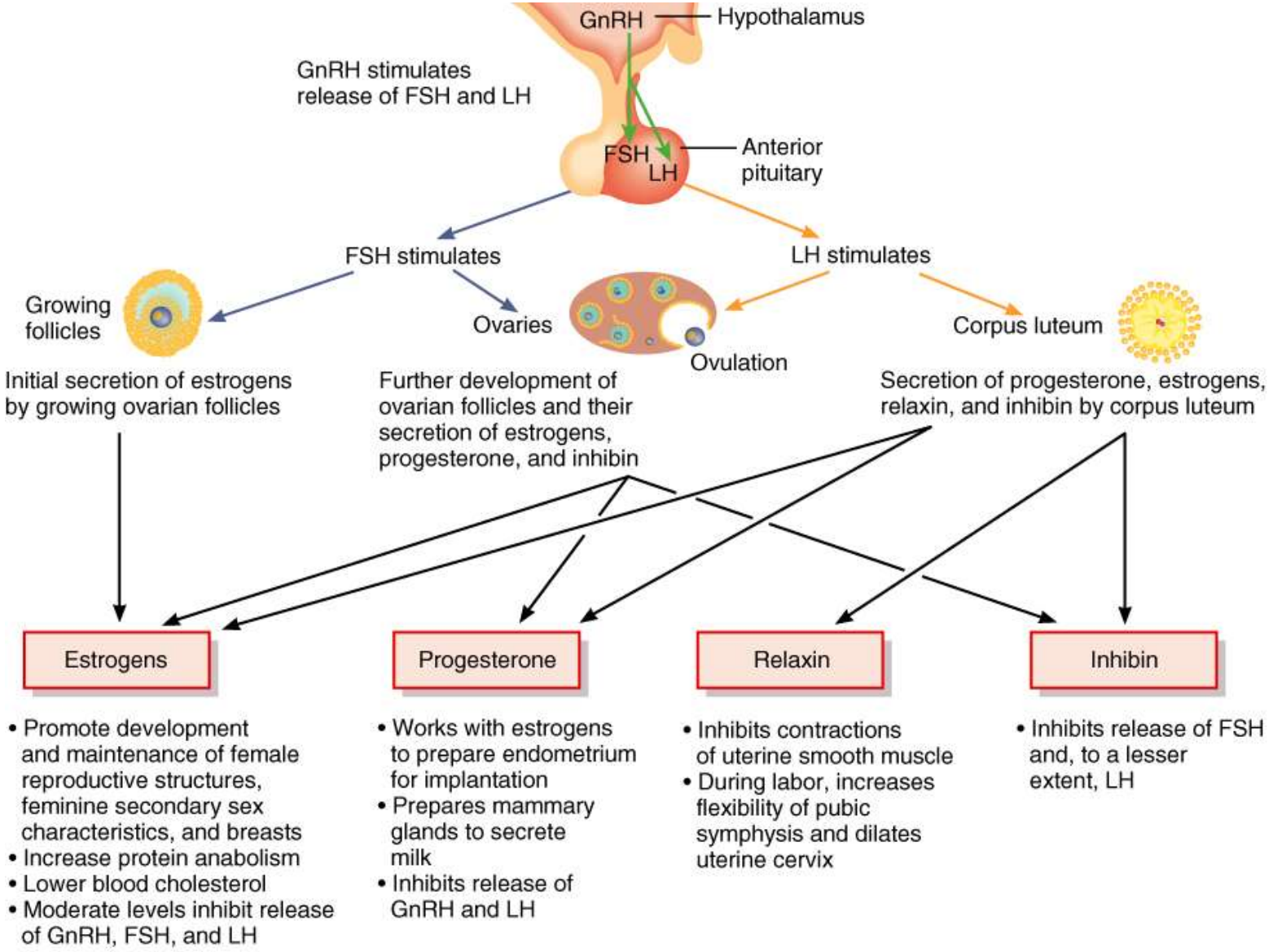
(a) Hormonal regulation of changes in the ovary and uterus



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

28.26.jpeg

Fig. 28.25



28.25.jpeg

Differences Between Spermatogenesis and Oogenesis

1. In female, mitotic proliferation of oogonia occurs prior to birth. In males, spermatogonia proliferate only after puberty.
2. In female, meiotic divisions of oocyte produces only one mature ovum. In male, meiotic divisions of primary spermatocyte produces 4 mature spermatozoa
3. In female, second meiotic division is completed only upon fertilization. In male, the products of meiosis (spermatids) undergo substantial differentiation in the maturing process.

Estradiol – nuclear receptor (α and β)

– genomic effects:

–there may be membrane receptor as well

–acute effects:

increase IC Ca, vasodilation

–upregulates synthesis of ER and PR

–antioxidant

Functions of Estradiol

External female sex organs: at puberty, increase in size of
fallopian tubes, uterus and vagina, external genitalia
deposition of fat in mons pubis
change vaginal epithelia from cuboidal to stratified type
endometrium: proliferation of cells and endometrial glands
(important in nutrition of fertilized ovum)

Breasts: fat deposition, development of stromal cells, ducts
(progesterone, prolactin important in milk production)

Bones: estrogen causes osteoclastic activity, so height increases after puberty, but epiphyses and shafts of bones unite early and growth stops

Functions of Estradiol

Fat deposition: more subcutaneous fat in women than men
Women: estrogens: hips and thighs fat deposition
(prior to menopause) then more abdominal

(Men: androgens: abdominal fat deposition)

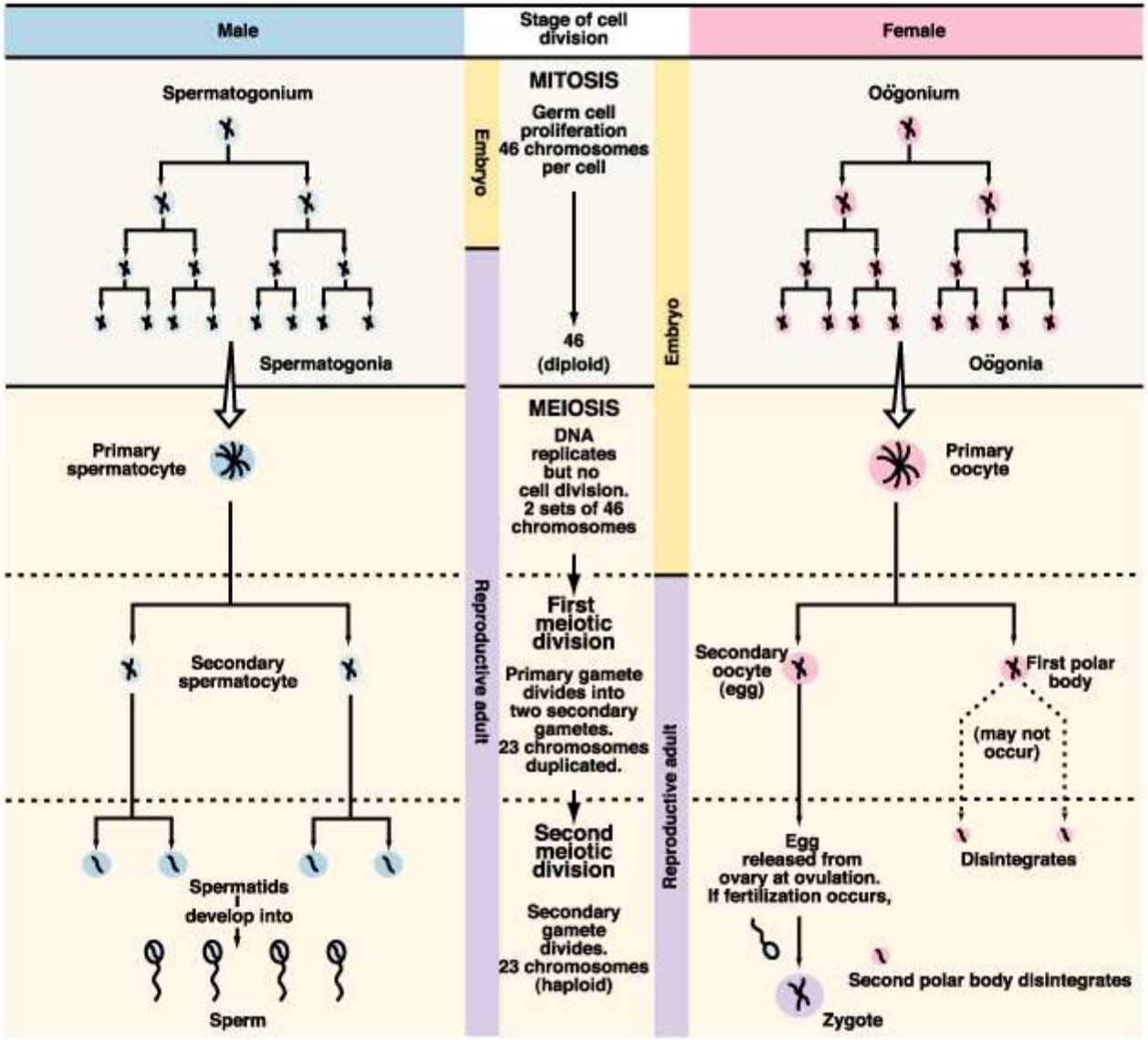
Skin: increase vascularization of skin

Progesterone
Nuclear receptor – interacts with progesterone regulatory elements on DNA

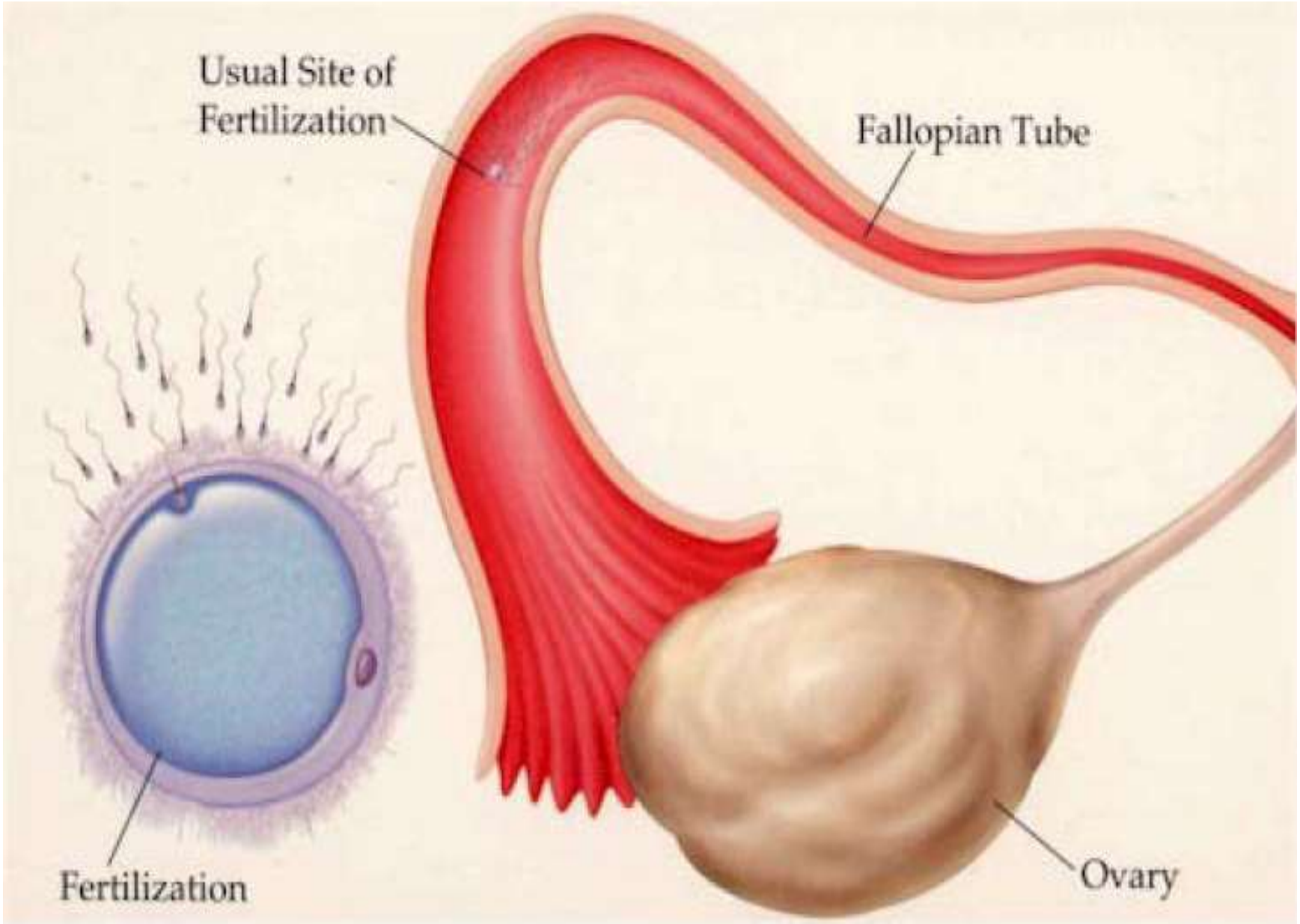
Progesterone receptor antagonist: mifepristone causes abortion and also inhibits hyperhydrocortisolism

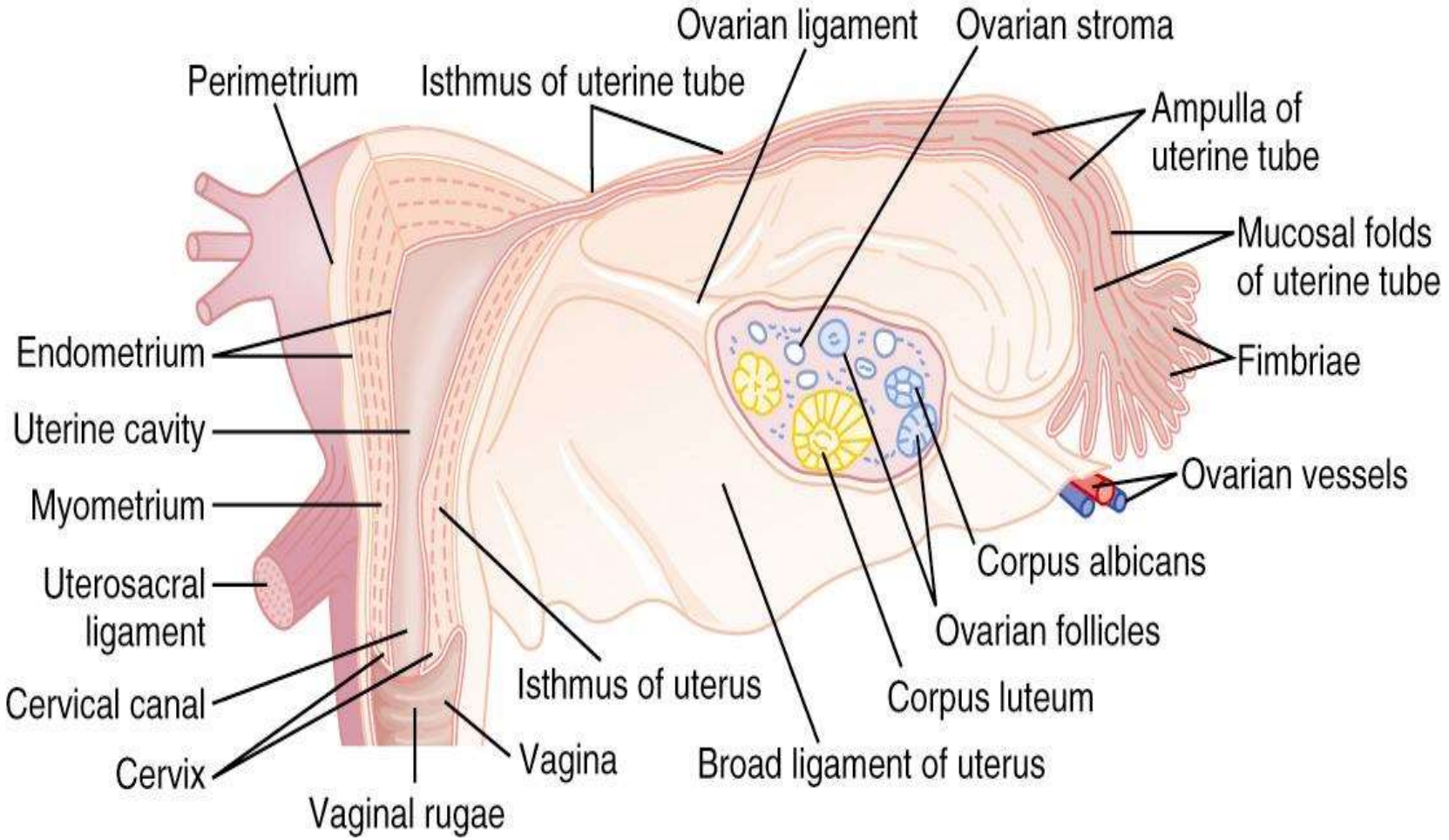
Inhibits estrogen receptor synthesis
Causes endometrial proliferation during luteal phase

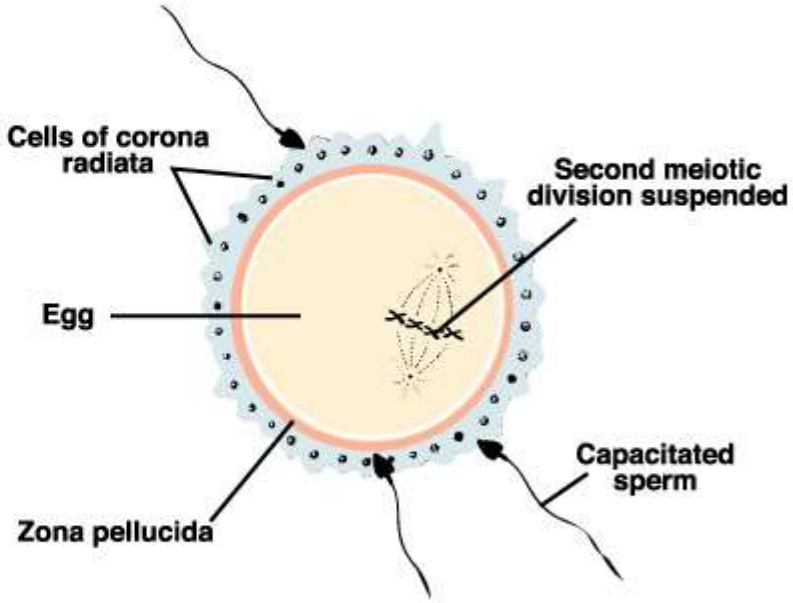
Puberty: transition from noncyclic, relatively quiescent reproductive endocrine system to state of cyclic reproductive function – begins with pulsatile GnRH/LH secretion during REM sleep

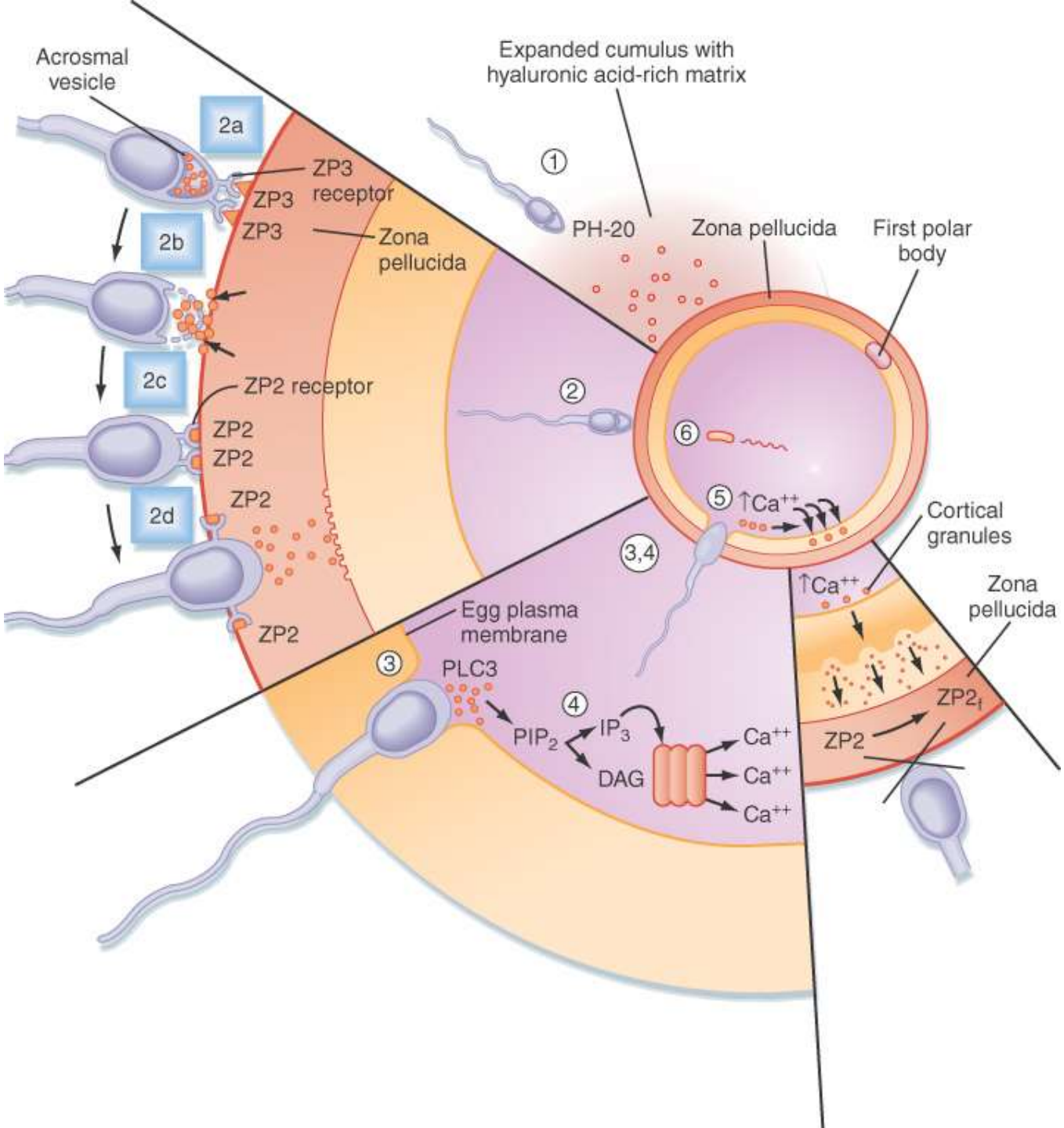

Male
Stage of cell division
Female
Spermatogonium
MITOSIS
Germ cell proliferation
46 chromosomes per cell
Embryo
Oögonium
Spermatogonia
46
(diploid)
Oögonia
MEIOSIS
DNA replicates but no cell division.
2 sets of 46 chromosomes
Primary spermatocyte
Primary oocyte
First meiotic division
Primary gamete divides into two secondary gametes.
23 chromosomes duplicated.
Secondary spermatocyte
Secondary oocyte (egg)
First polar body
(may not occur)
Second meiotic division
Secondary gamete divides.
23 chromosomes (haploid)
Spermatids develop into
Sperm
Egg released from ovary at ovulation. If fertilization occurs,
Disintegrates
Second polar body disintegrates
Zygote
Reproductive adult
Reproductive adult
Embryo

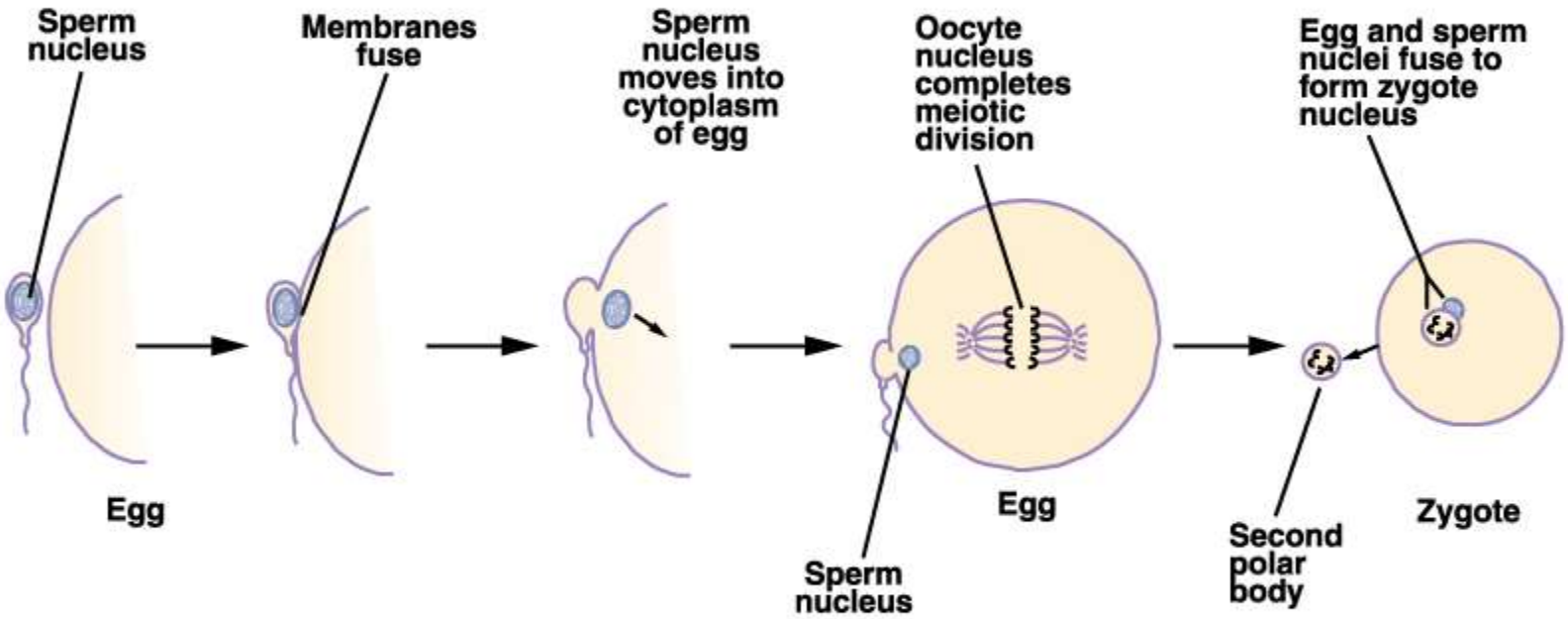
Fertilization & Implantation


Usual Site of
Fertilization
Fallopian Tube
Fertilization
Ovary


Ovarian ligament
Ovarian stroma
Perimetrium
Isthmus of uterine tube
Ampulla of uterine tube
Mucosal folds of uterine tube
Endometrium
Fimbriae
Uterine cavity
Ovarian vessels
Myometrium
Corpus albicans
Uterosacral ligament
Ovarian follicles
Isthmus of uterus
Corpus luteum
Cervical canal
Vagina
Broad ligament of uterus
Cervix
Vaginal rugae


Cells of corona radiata
Second meiotic division suspended
Egg
Capacitated sperm
Zona pellucida


Acrosmal vesicle
2a
2b
2c
2d
ZP3 receptor
ZP3
ZP3
Zona pellucida
ZP2 receptor
ZP2
ZP2
ZP2
ZP2
Expanded cumulus with hyaluronic acid-rich matrix
①
PH-20
Zona pellucida
First polar body
②
⑥
⑤ ↑Ca++
Cortical granules
3,4
↑Ca++
Zona pellucida
Egg plasma membrane
③
PLC3
④
PIP2
IP3
DAG
Ca++
Ca++
Ca++
ZP2f
ZP2


Sperm nucleus
Membranes fuse
Sperm nucleus moves into cytoplasm of egg
Oocyte nucleus completes meiotic division
Egg and sperm nuclei fuse to form zygote nucleus
Egg
Sperm nucleus
Egg
Second polar body
Zygote

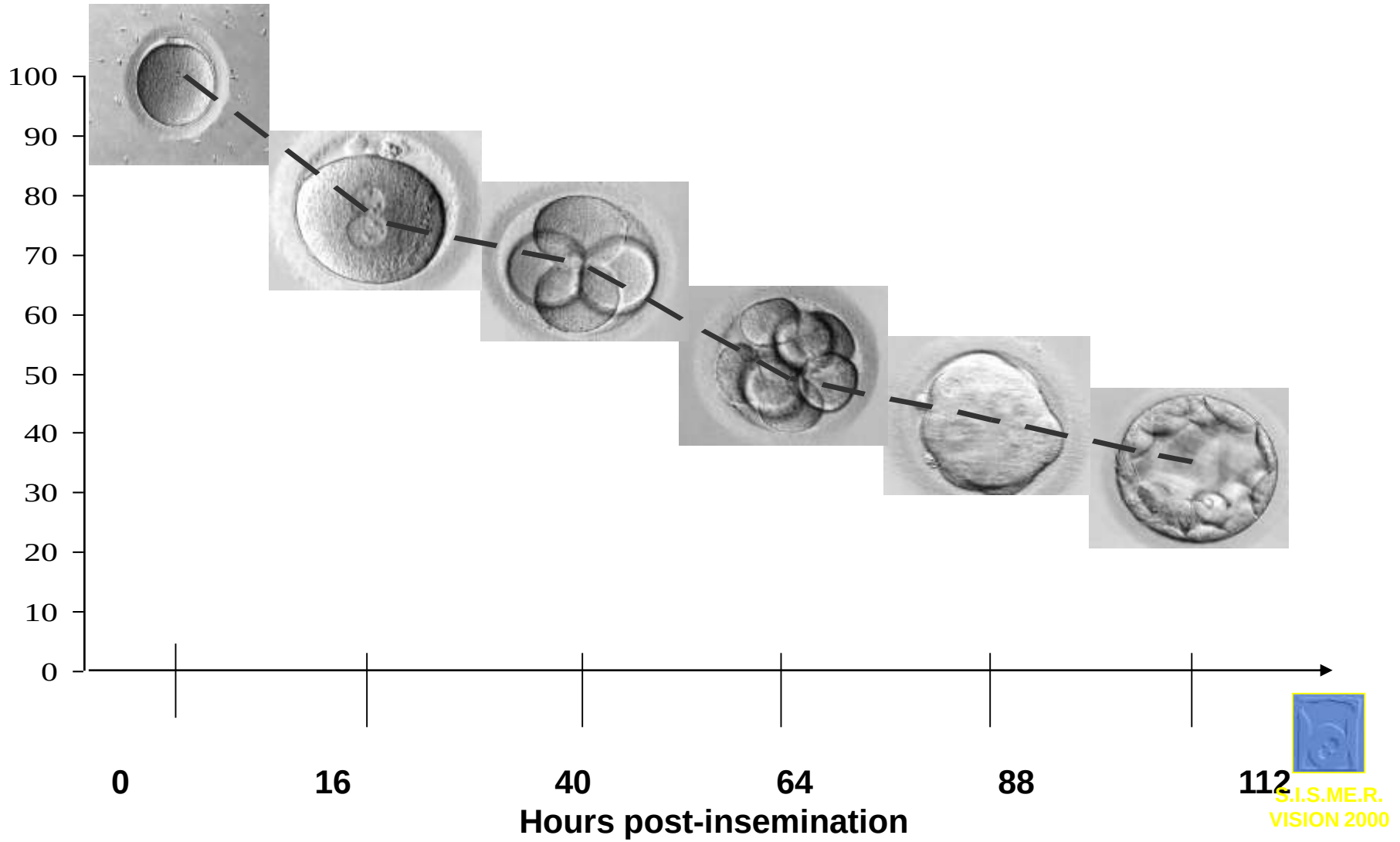
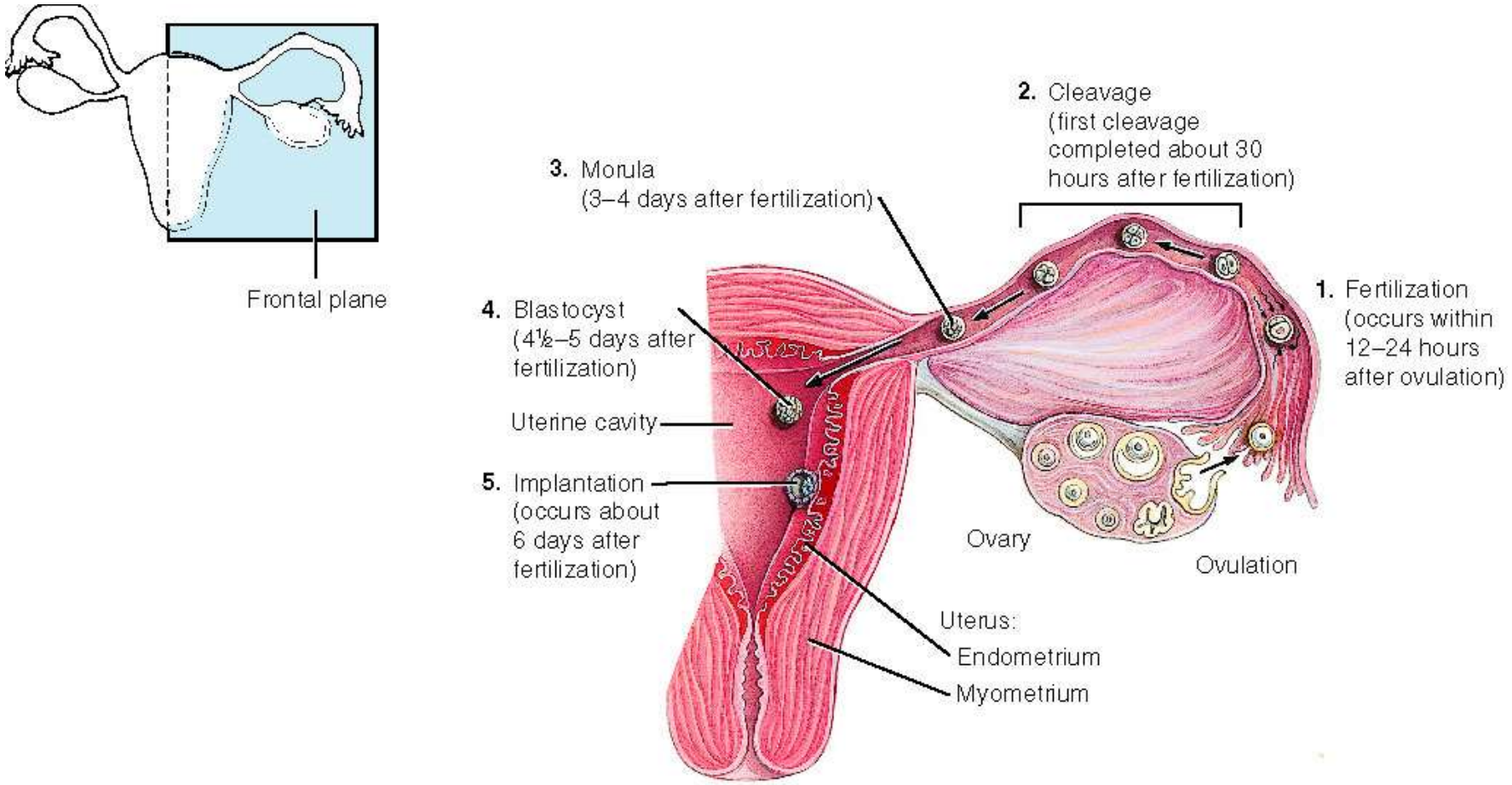

Maternal transcripts
Embryonic transcrip
100
90
80
70
60
50
40
30
20
10
0
0
16
40
64
88
112
Hours post-insemination
S.I.S.ME.R.
VISION 2000

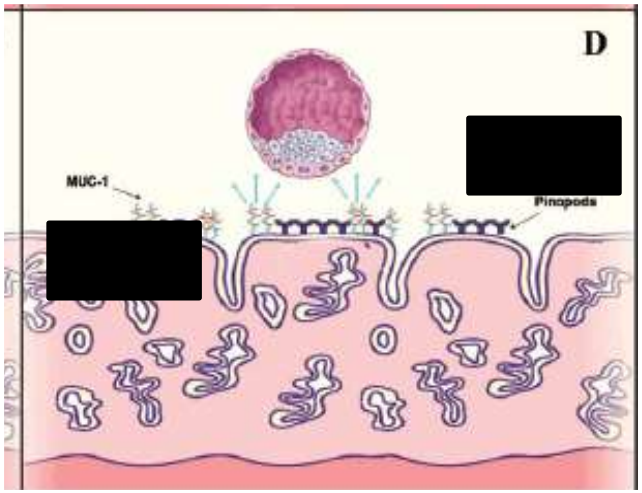
Fig. 29.05



Frontal section through uterus, uterine tube, and ovary

Requirements for implantation

- a receptive endometrium
- a functionally normal blastocyst
- an adequate cross-communication



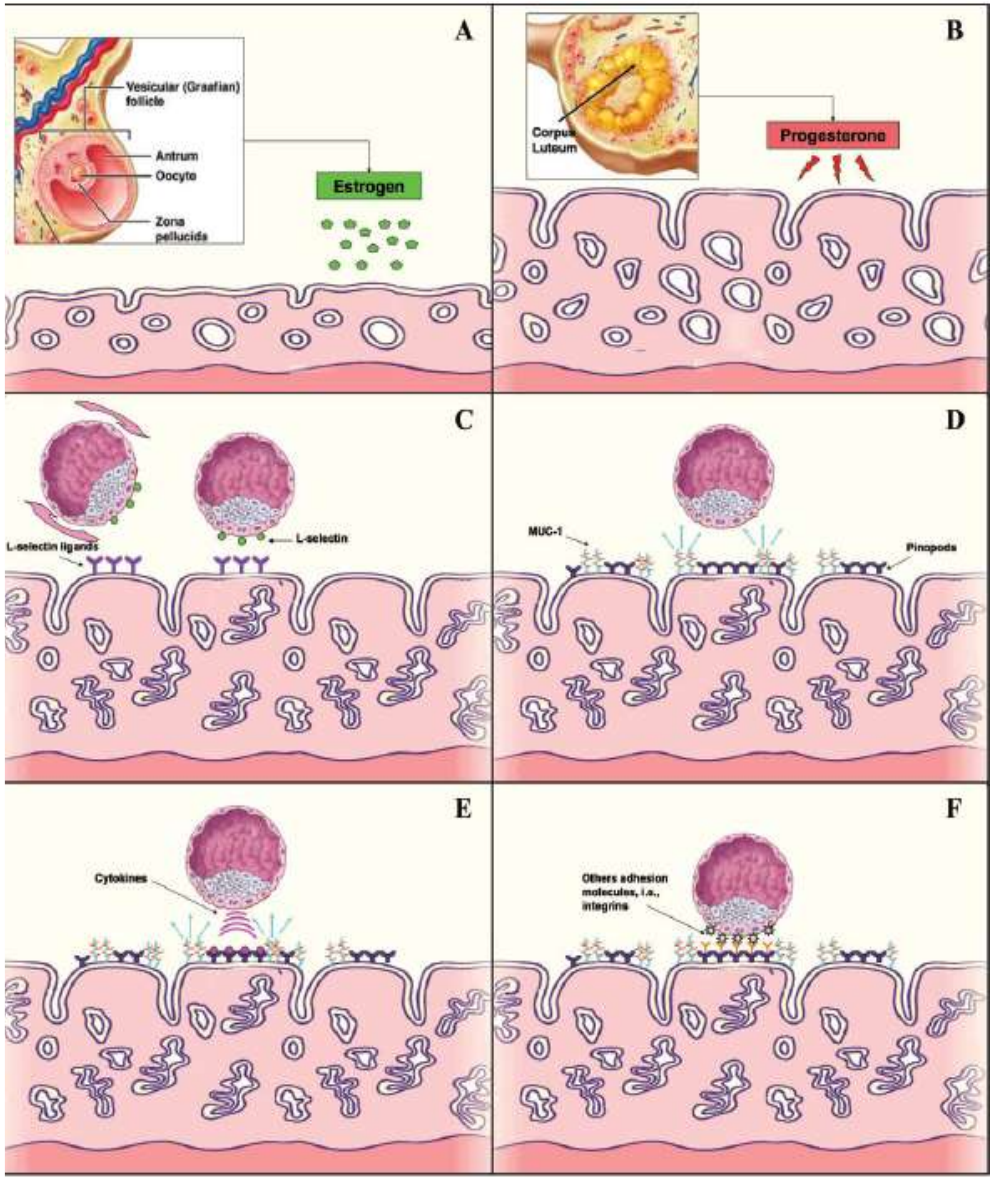
Markers of implantation

- Endometrium:

Integrin molecules, L-selectin ligands, mucin-1
Heparin-binding EGF

- Embryo:

cytokines and growth factor interleukins; prostaglandins, VEGF receptor for endometrial signals
LIF receptor,insulin-like GF and heparin-binding epidermal growth factor receptor

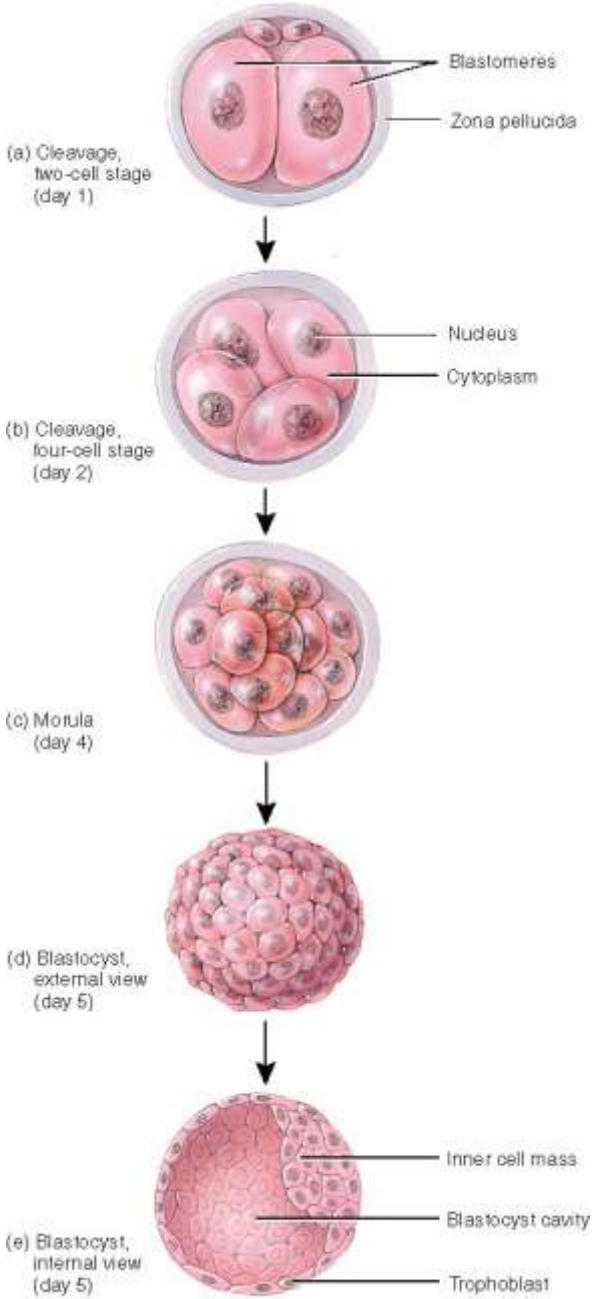


Hoozemans et al, 2004

The implantation window

- LH day +6 to +10
- Phases:
  signaling, apposition, attachment, invasion
- Key associated findings:
  luminal epithelial pinopodes;
  expression of adhesion molecules
  and novel cytokines profile

Fig. 29.02


Blastomeres
Zona pellucida
(a) Cleavage, two-cell stage (day 1)
Nucleus
Cytoplasm
(b) Cleavage, four-cell stage (day 2)
(c) Morula (day 4)
(d) Blastocyst, external view (day 5)
Inner cell mass
Blastocyst cavity
Trophoblast
(e) Blastocyst, internal view (day 5)

Early invasion phase

Human Conceptus

uPA + tPA

MMP 2, 9

TI MMP

PAI

Endometrium

Late invasion phase

Human Conceptus

IL-6
IL-10

TH_2 reaction

Blocking antibodies

cytotoxic cells

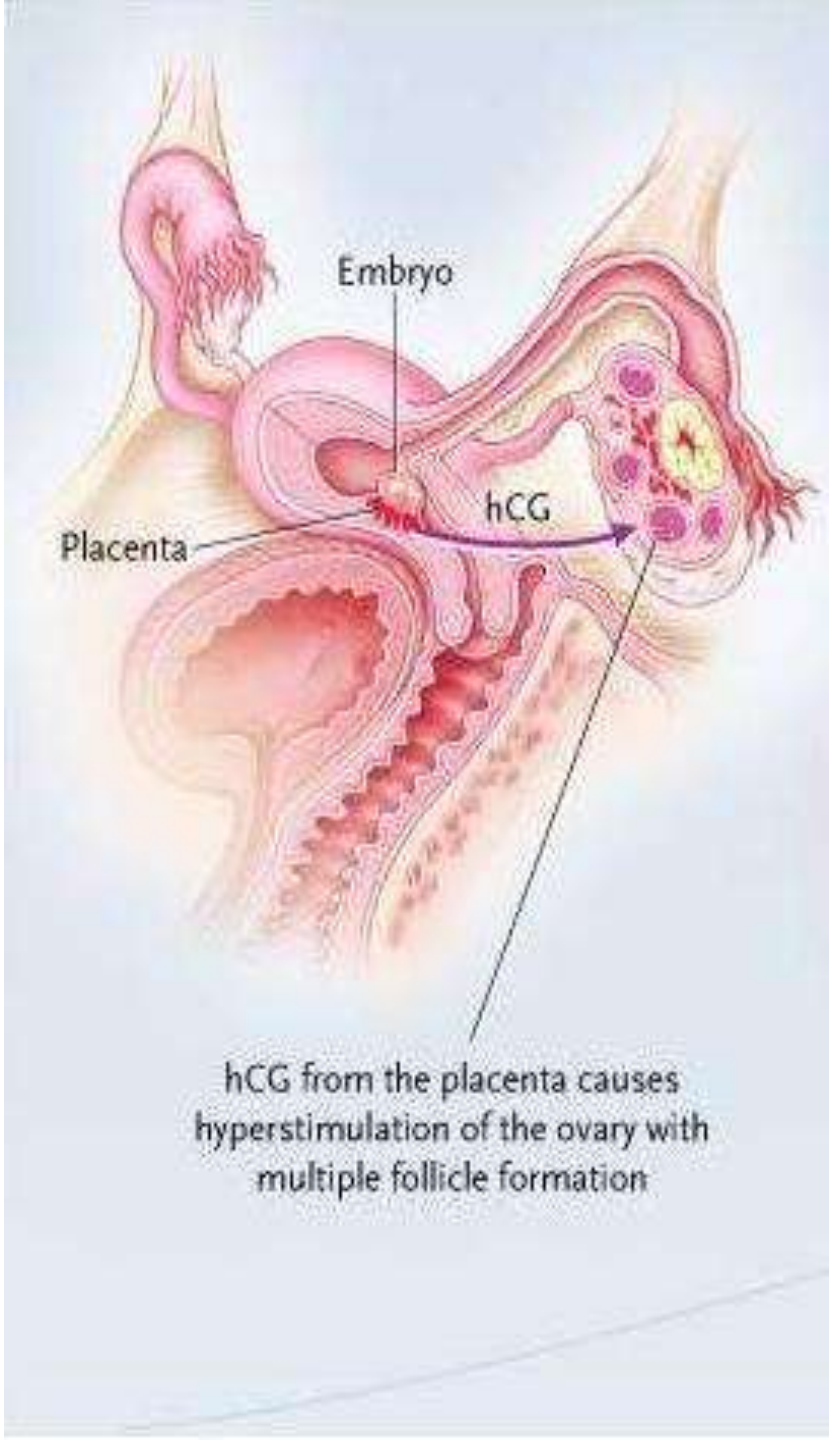
TH_1 reaction

TNF- β
IFNγ

Endometrium

T1 and T2 helper cells in implantation

T1 helper cells	T2 helper cells
Favours rejection	Favours implantation
IFN-γ	IL-4
IL-2	IL-5
IL-12	IL-6
TNF-α	IL-9
	IL-10
	IL-13


Embryo
hCG
Placenta
hCG from the placenta causes
hyperstimulation of the ovary with
multiple follicle formation

Implantation failure

In normal fertile women, 78 to 83 %

of embryos **fail** to implant (Wilcox et al, 1988; Ellish et al, 1996)

In infertile women, 85 % of embryos **fail** to implant (Edwards et al, 1995)

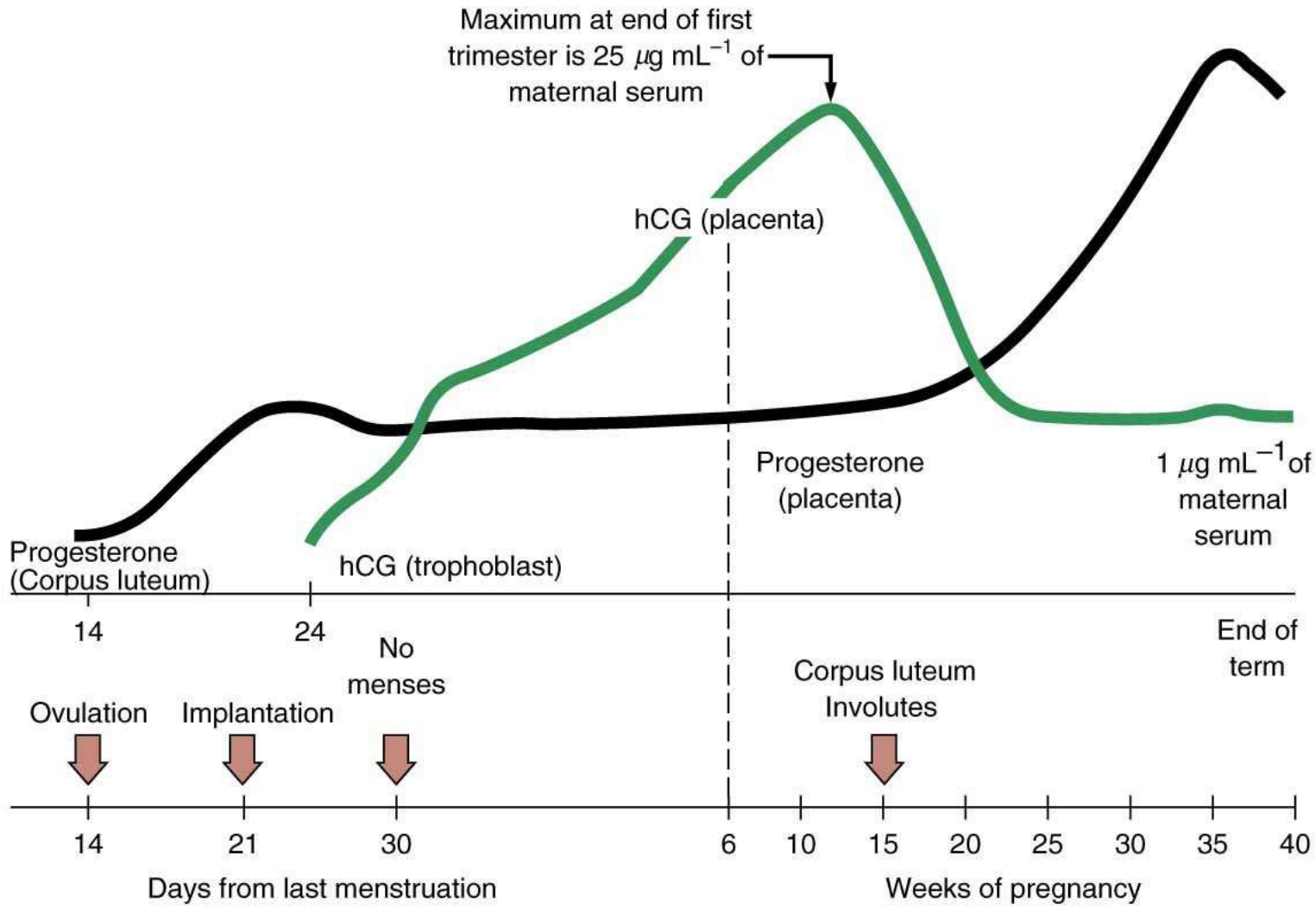
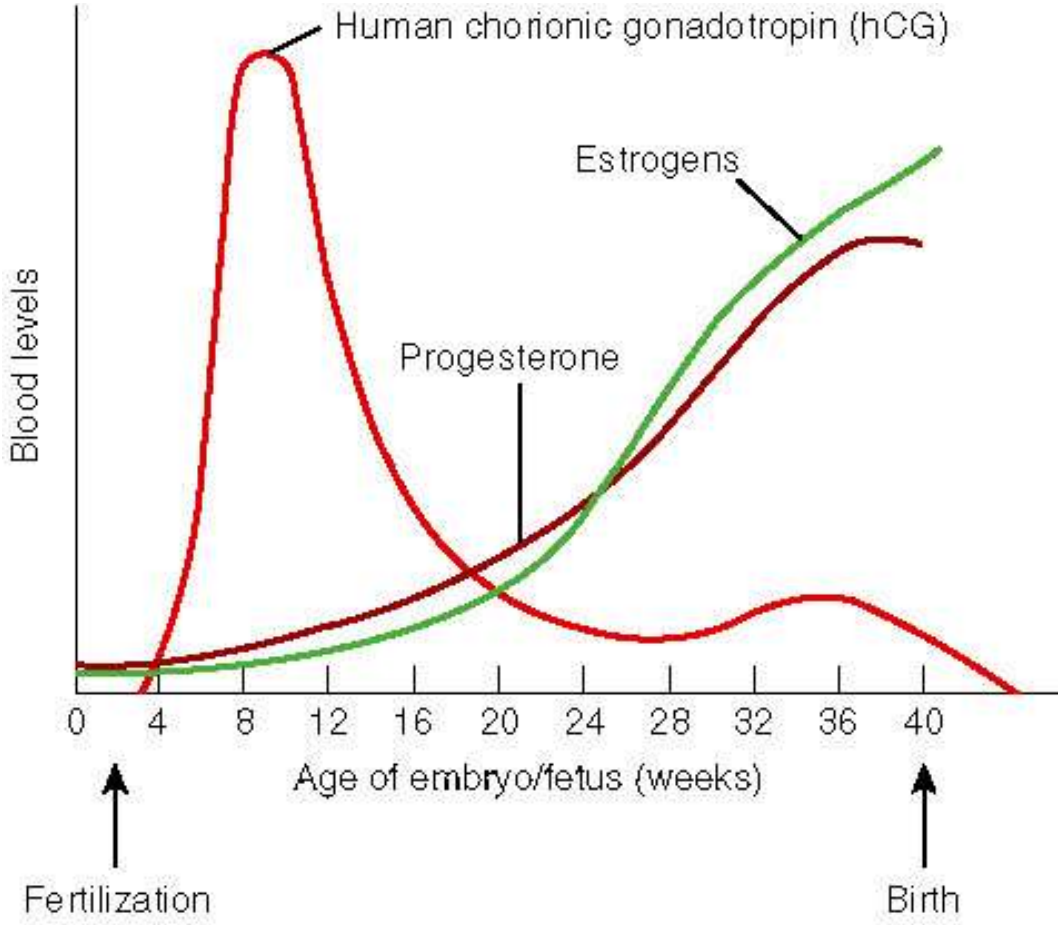


Figure 23.20. Effect of fertilization on ovarian cycle in terms of secretion of progesterone and human chorionic gonadotropin (hCG).

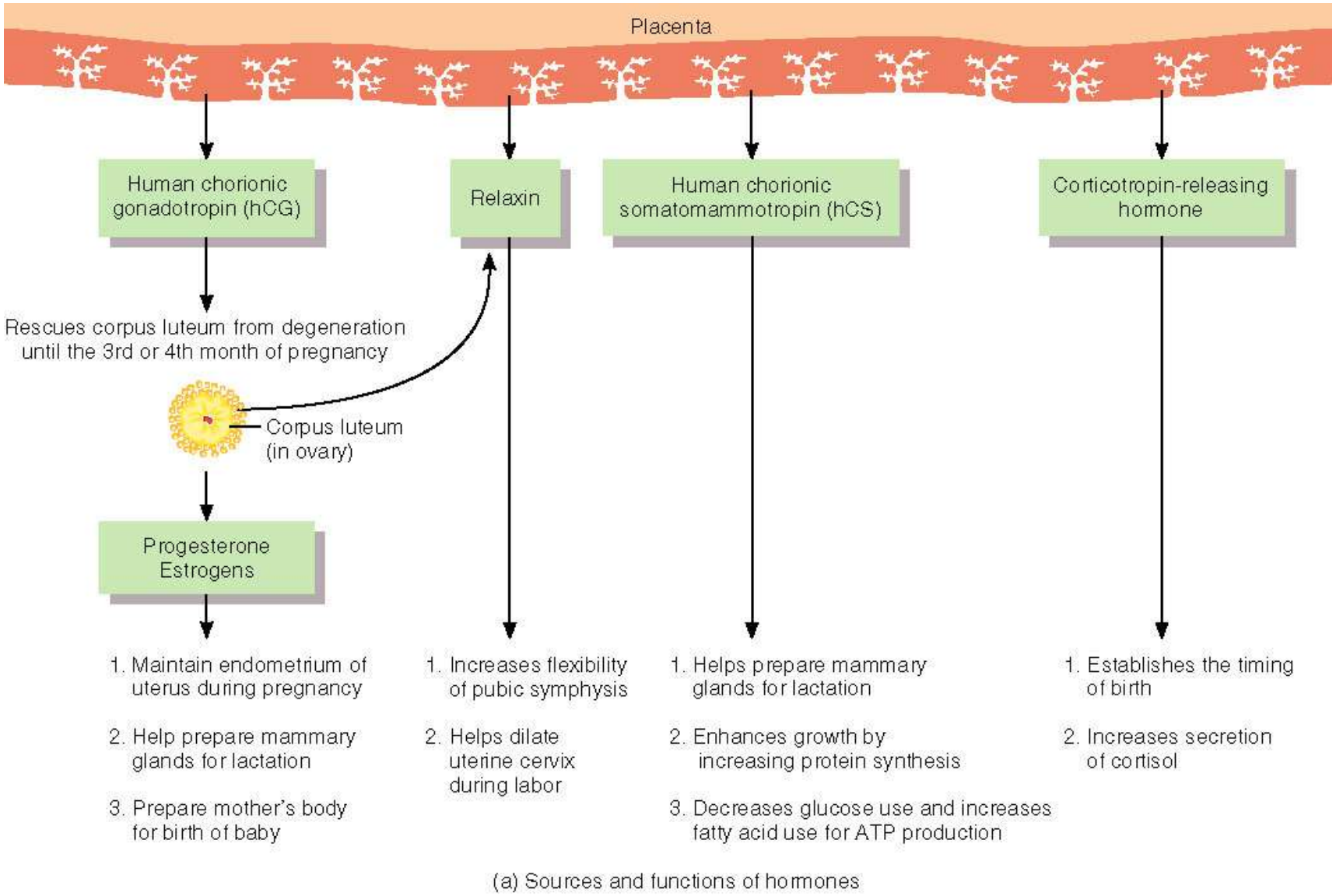
Fig. 29.16b



(b) Blood levels of hormones during pregnancy

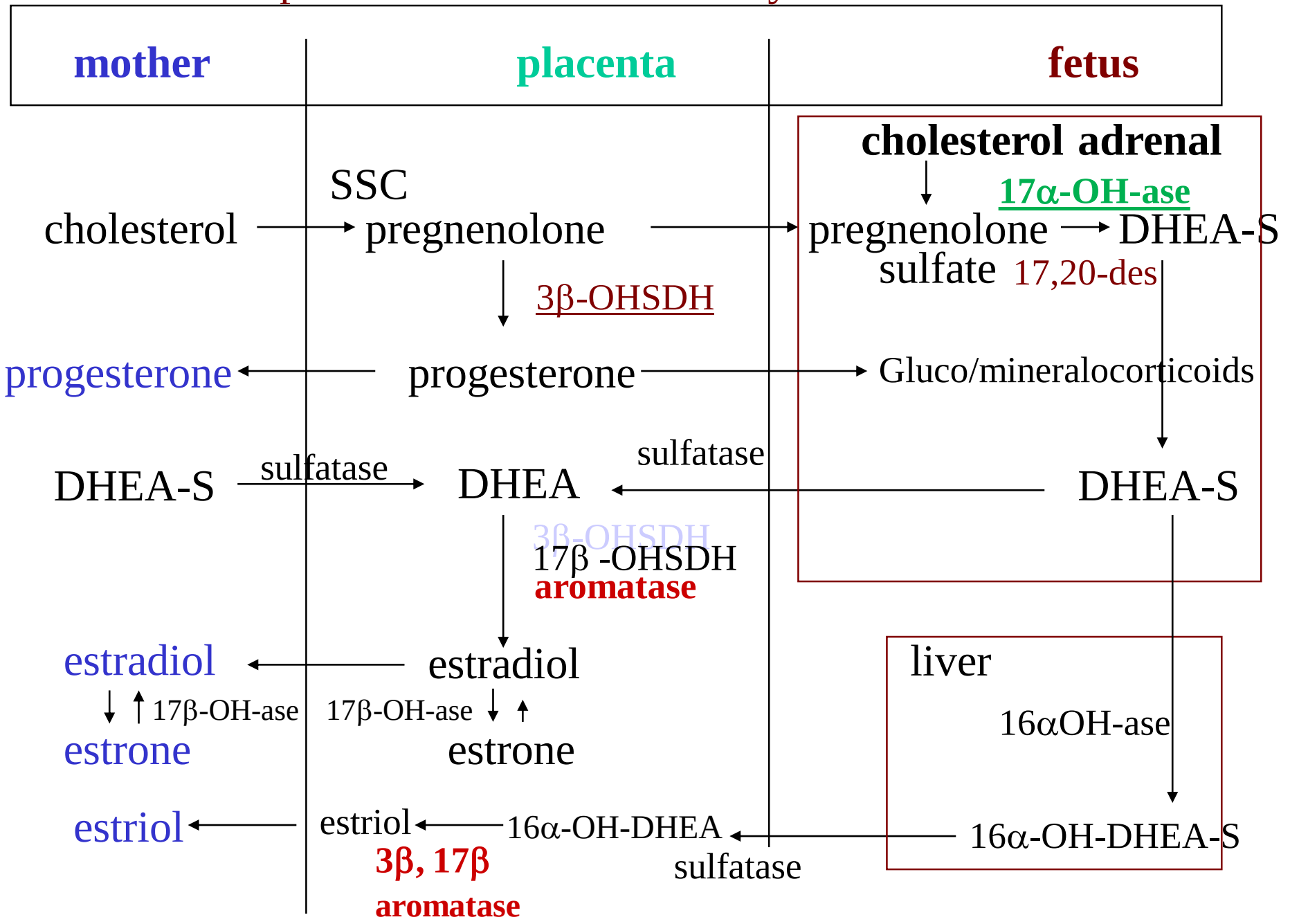
29.16b

Fig. 29.16a



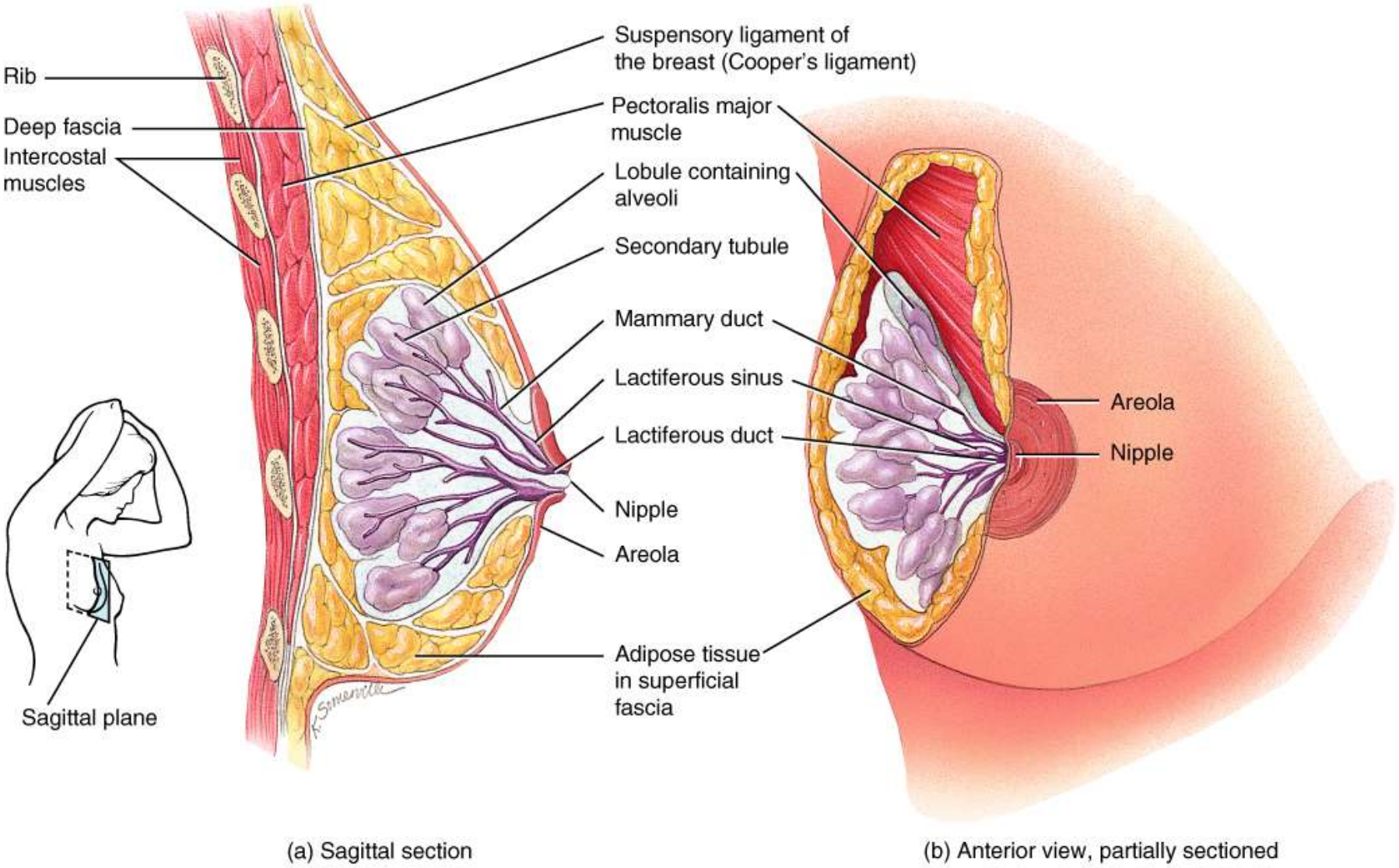
(a) Sources and functions of hormones

Maternal-feto-placental steroid hormone synthesis

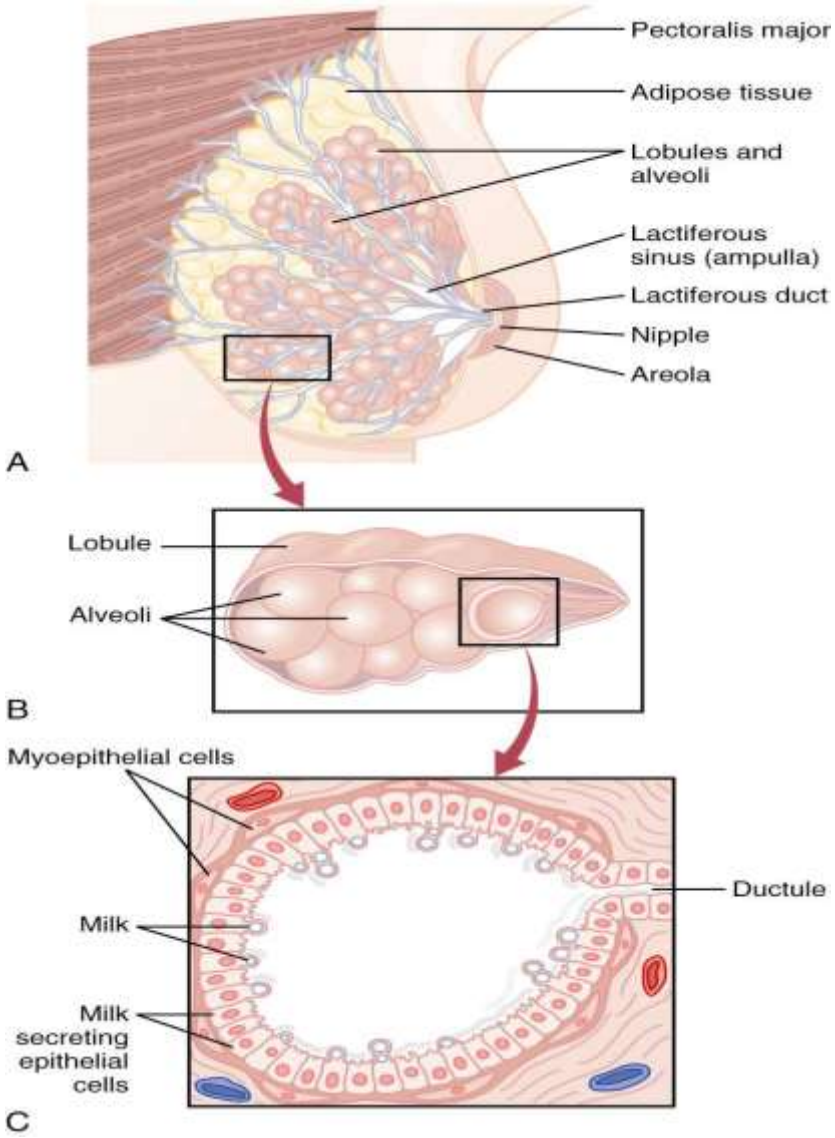


Lactation

Fig. 28.24



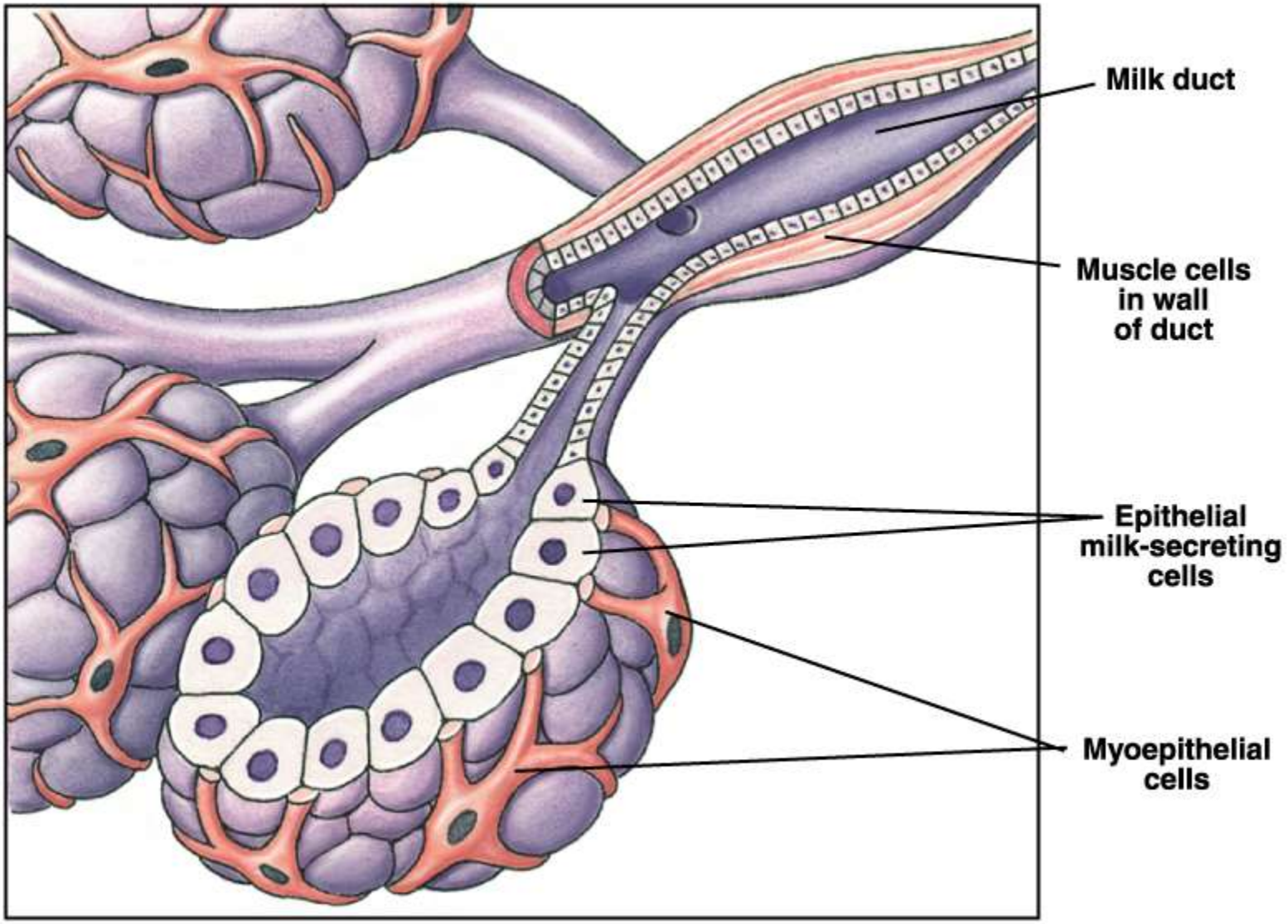
28.24.jpeg

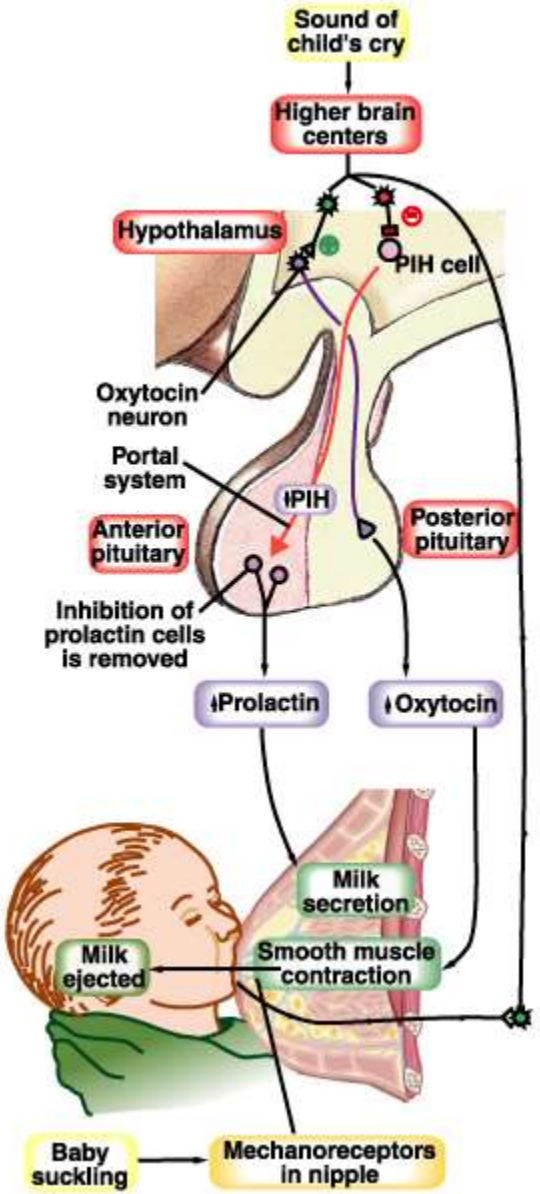

Pectoralis major
Adipose tissue
Lobules and alveoli
Lactiferous sinus (ampulla)
Lactiferous duct
Nipple
Areola
A
Lobule
Alveoli
B
Myoepithelial cells
Ductule
Milk
Milk secreting epithelial cells
C

Regulation of Prolactin secretion

Stimulation	Inhibition
Pregnancy	Dopamine
Estrogen	Dopamine agonist
Nursing-breast manipulation	Somatostatin
Sleep	GnRH associated peptide
Stress	Prolactin
TRH	
Dopamine antagonist	

1. Growth and development of the mammary glands - primarily
2. Milk production - requires prolactin, insulin and glucocorticoids
3. Neuroendocrine mechanisms - sucking causes prolactin and oxytocin release
4. Milk let-down reflex - necessary for the infant to obtain milk
5. Control of prolactin secretion - suckling releases prolactin, the more the infant is nursed, the more milk is produced
6. Lactation and resumption of ovarian cycles


Milk duct
Muscle cells in wall of duct
Epithelial milk-secreting cells
Myoepithelial cells


Sound of child's cry
Higher brain centers
Hypothalamus
PIH cell
Oxytocin neuron
Portal system
PIH
Anterior pituitary
Posterior pituitary
Inhibition of prolactin cells is removed
Prolactin
Oxytocin
Milk secretion
Milk ejected
Smooth muscle contraction
Baby suckling
Mechanoreceptors in nipple

Puberty: transition from quiescent reproductive endocrine system (inability to reproduce) to state of reproductive function (ability to reproduce) – begins with pulsatile GnRH/LH secretion during REM sleep

What determines age at puberty:

- genetics
- nutrition
- geographic location
- exposure to light
- body composition, fat deposition
- exercise

Menarche has been occurring **earlier** in past few decades in US and Europe

Distance from equator, higher altitudes

Puberty

Range of onset: 9-14 years of age

Completion of pubertal development: 2-4.5 yr

1st sign: enlargement of testes to greater than 2.5 cm–growth due to increase in size of seminiferous tubules, Leydig cells

Androgens from testes are driving force for secondary sex characteristics – adrenal testosterone also plays a role

Menopause- Andropause

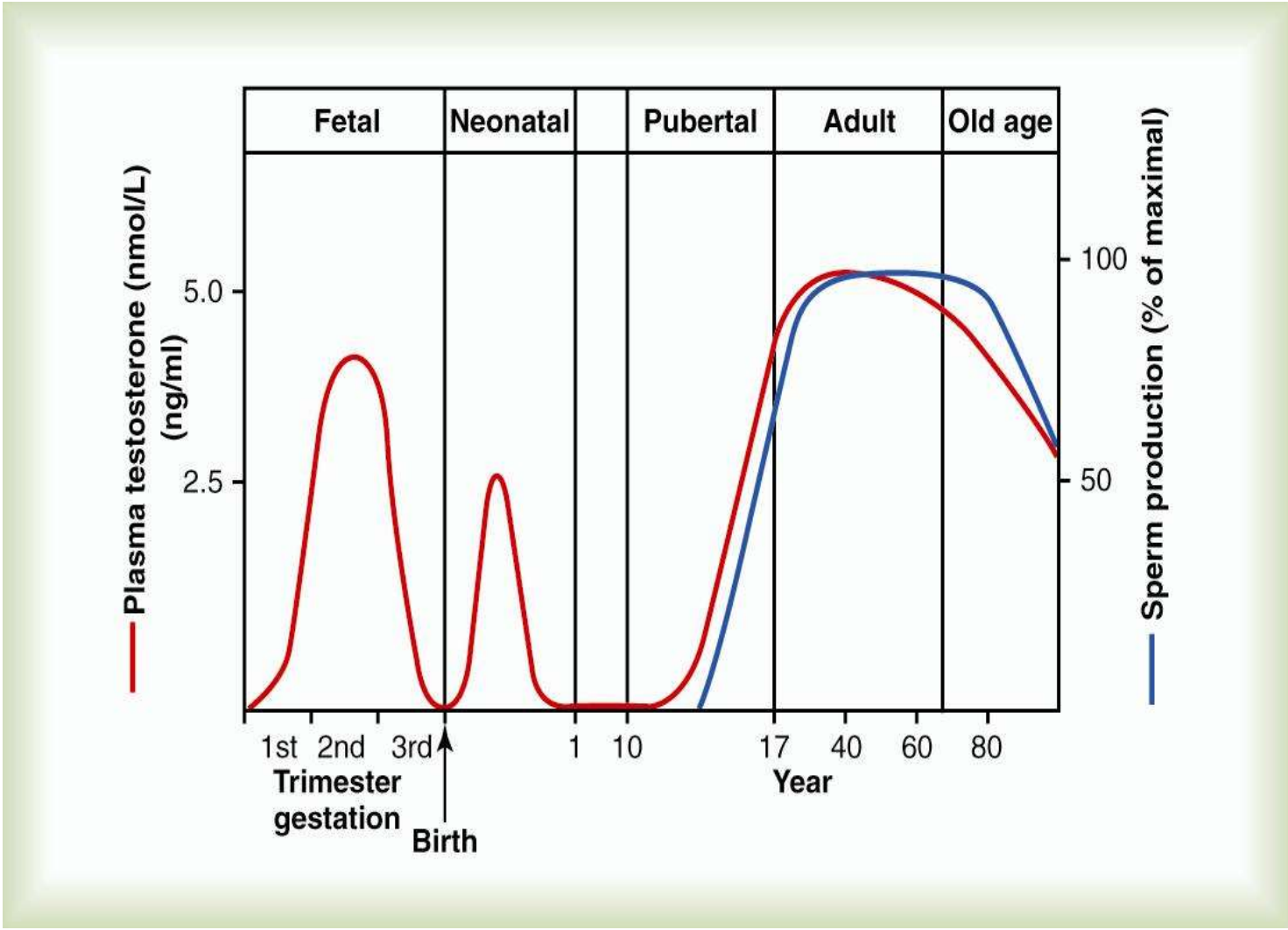


Figure 80-9; Guyton & Hall

Menopause

Defn: obsolescence of ovaries, no estradiol production, ova only occasional secondary follicle, few primary follicles

Occurs at ≈ 50 yr of age (average)

Due to reduction in estrogen, low levels of inhibin, no negative feedback of LH and FSH; therefore, high levels LH and FSH

Can occur naturally, due to surgery or as a result of chemotherapy

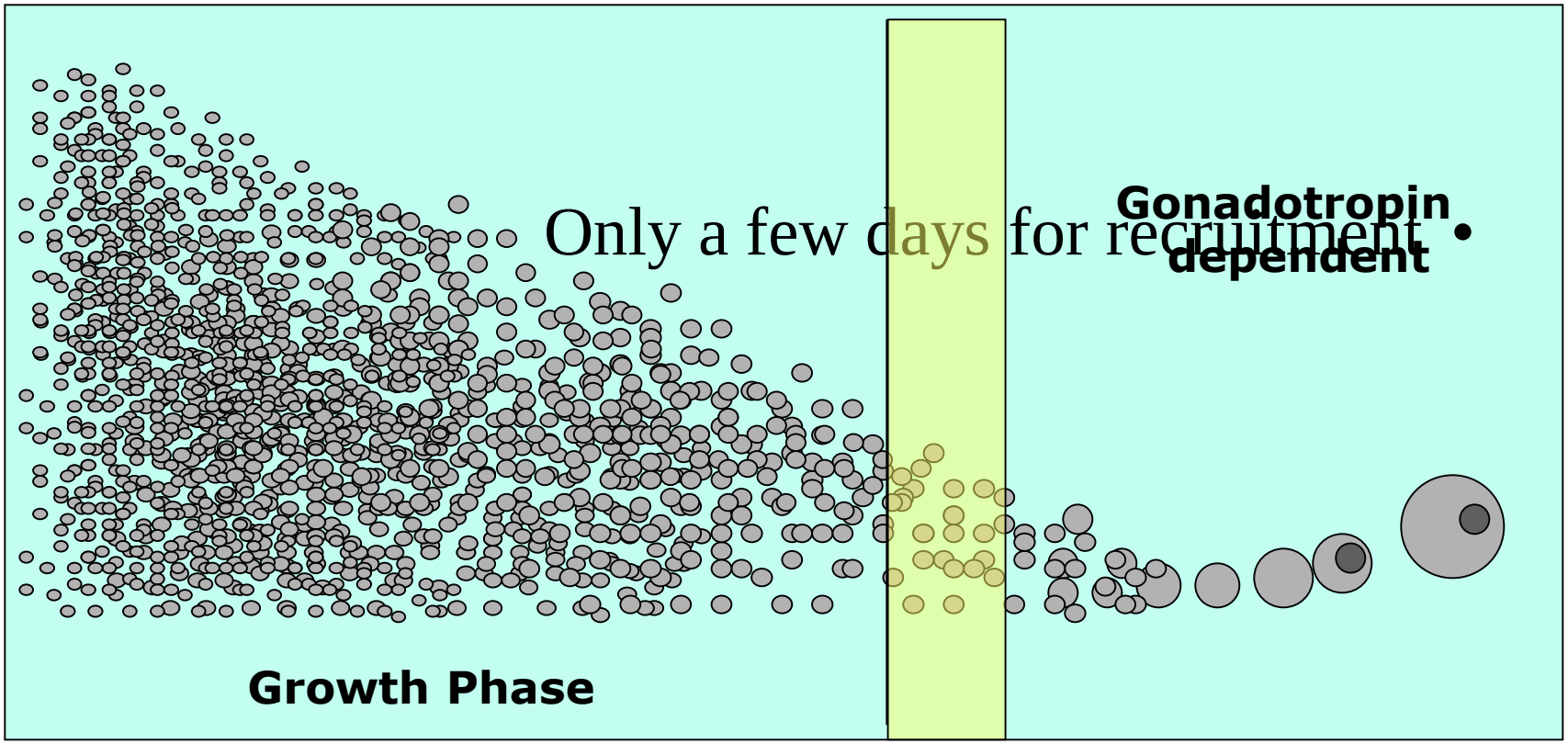
Ovarian Aging

- Physiologic
- Premature

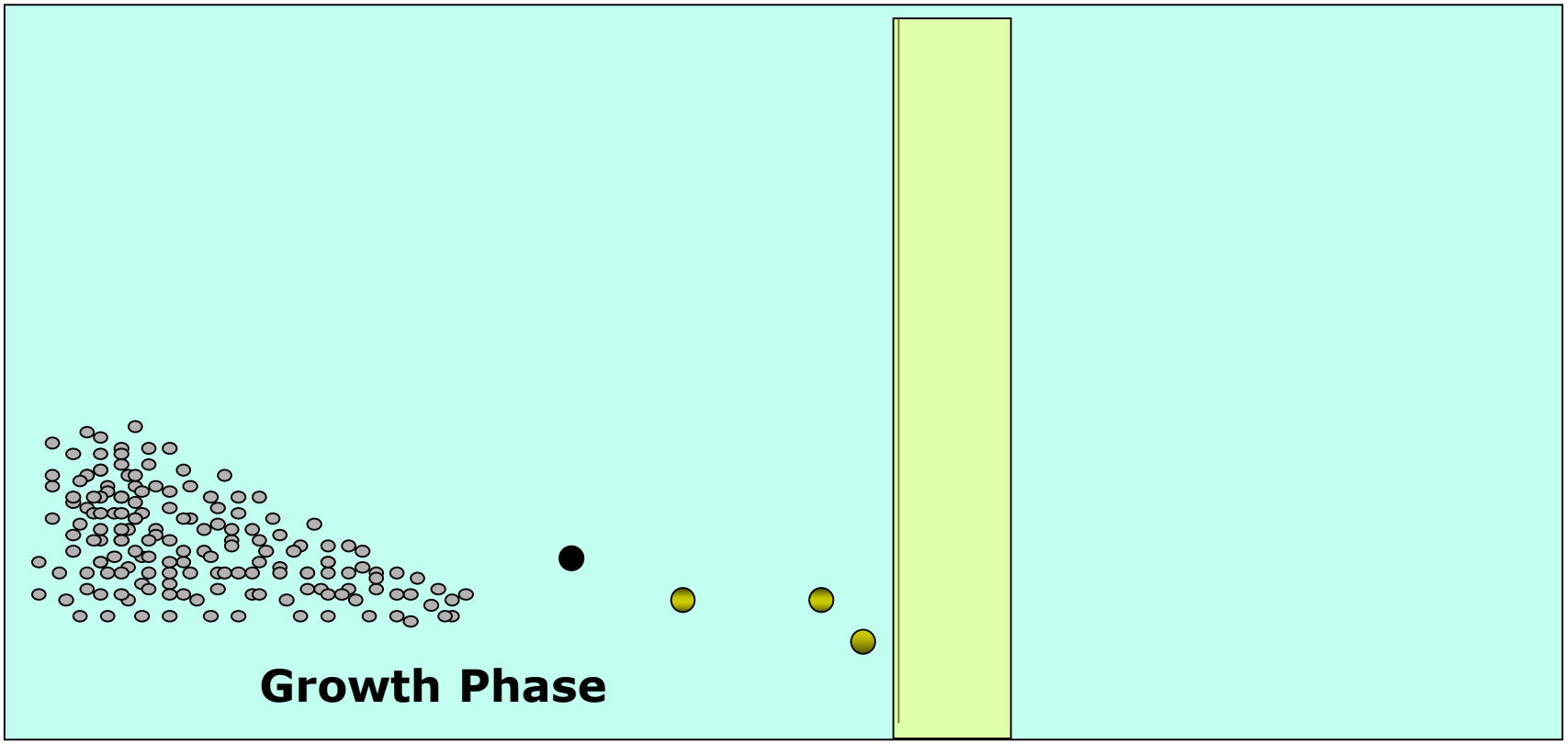
RECRUITMENT AND MATURATION IS AFFECTED BY AGE

FEMALE FERTILITY DECLINES

Follicle Growth



Follicle Growth



AMH

Termellen KP et al: Australian NZ J Obstet Gynecol 2005; 45:20-24

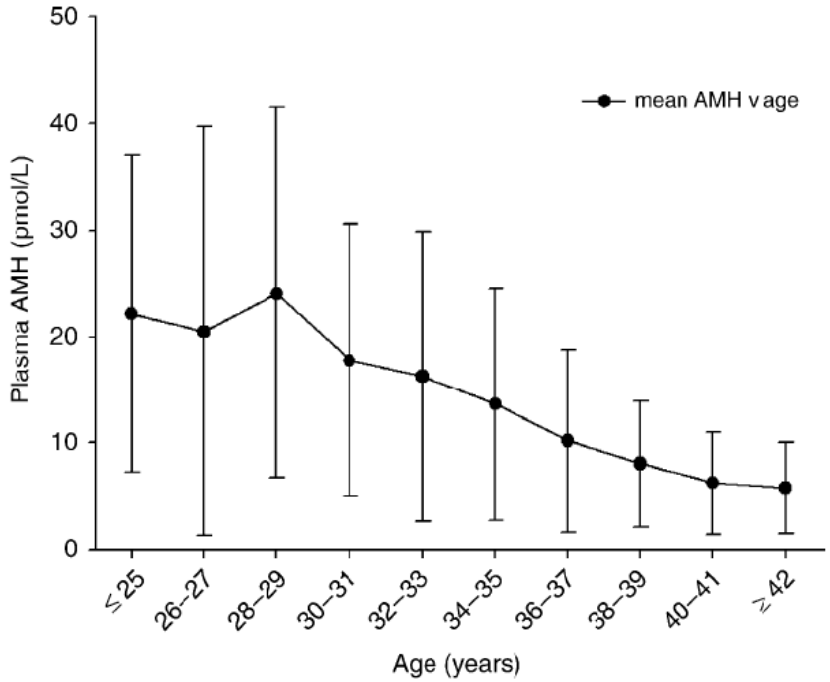
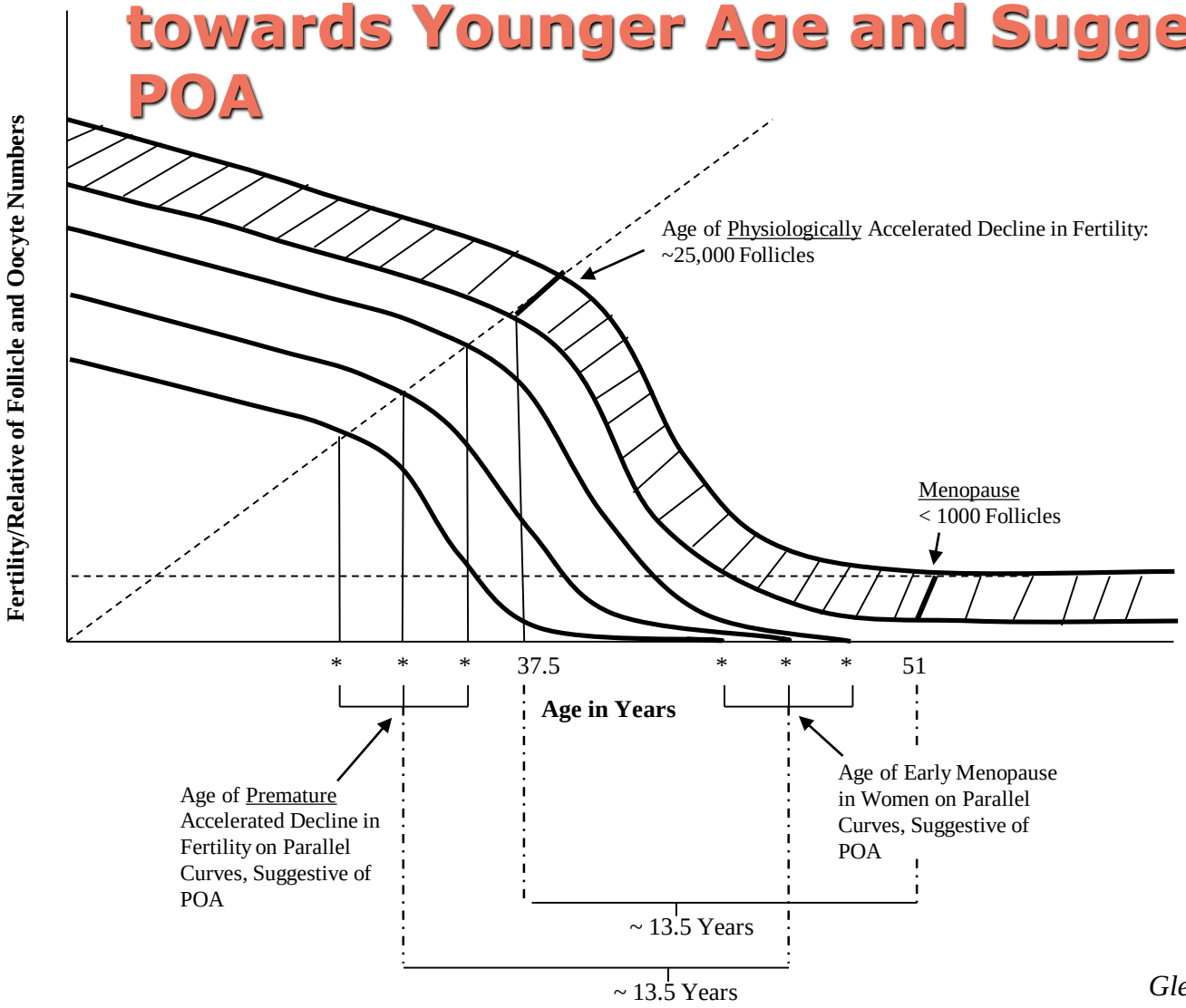


Figure 1 Early follicular phase (day 3–5) anti-müllerian hormone (AMH) over the reproductive age range. Mean ± standard deviation plotted.

AMH decreases with age

Physiological Age-Related Fertility Curve (Range) and Parallel Curves Shifted towards Younger Age and Suggestive of POA



Gleicher N. Contemp Ob/gyn 2004