

# **Female Physiology Before Pregnancy and Female Hormones-I**

Unit XIV

Chapter 82

Dr Iman Aolymat

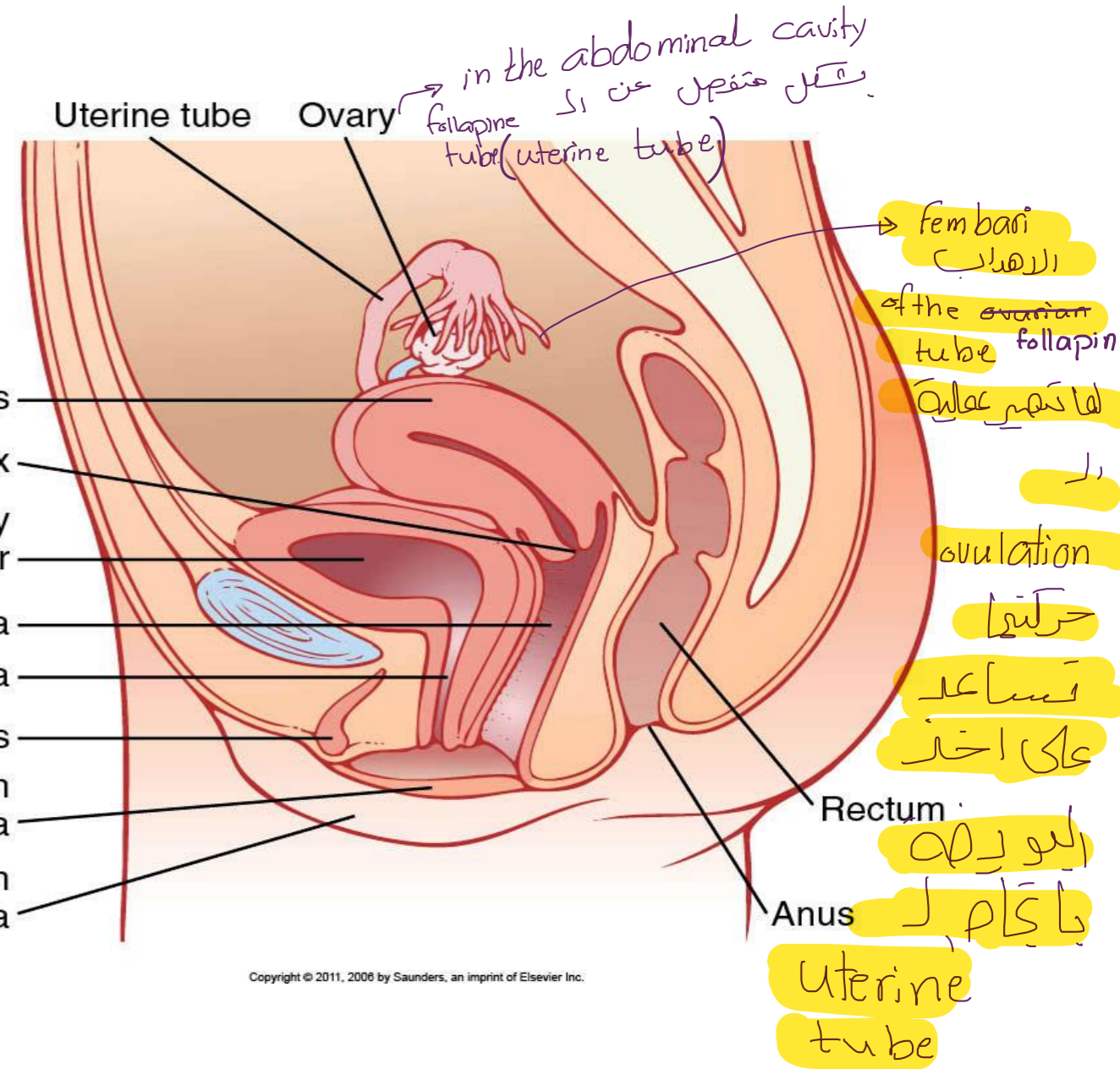
# Physiological anatomy of the female sexual organs

## Primary sex organs

➤ Ovaries have two functions:-

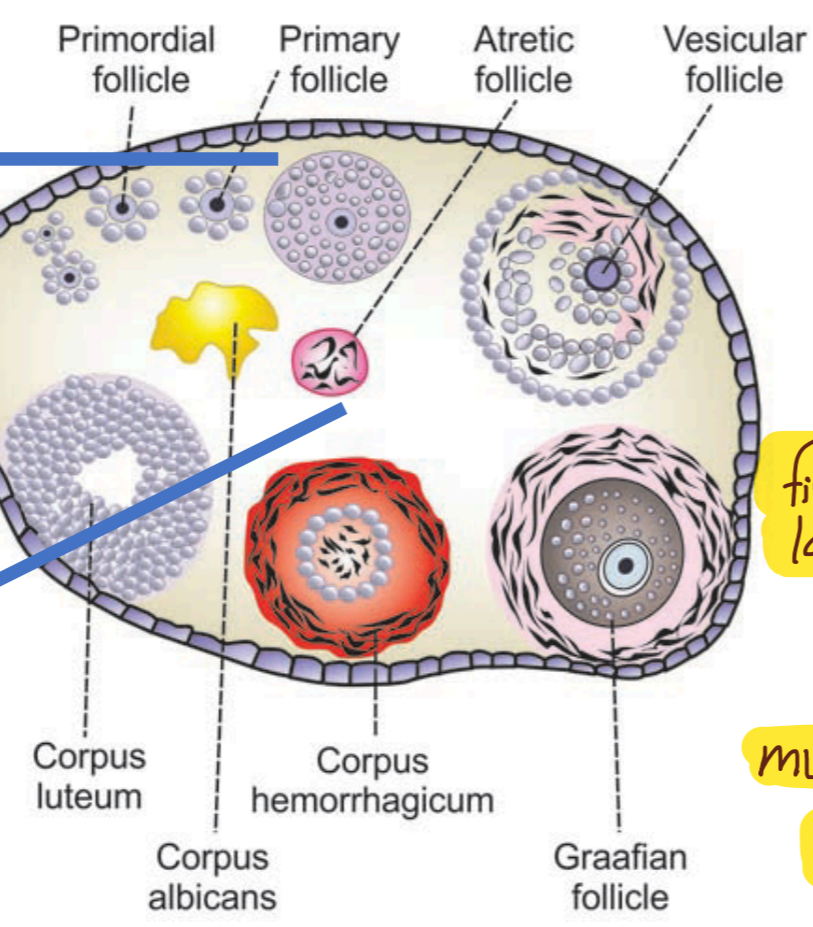
- 1 ✓ Gametogenic → site of follicular development and production of 2nd oocytes  
*formation of gametes (ovum).*
- 2 ✓ Endocrine → hormones (E&P)  
*ovaries have follicular cells secrete some hormones mainly (Estrogen and progesterone)*

*externa genitalia*



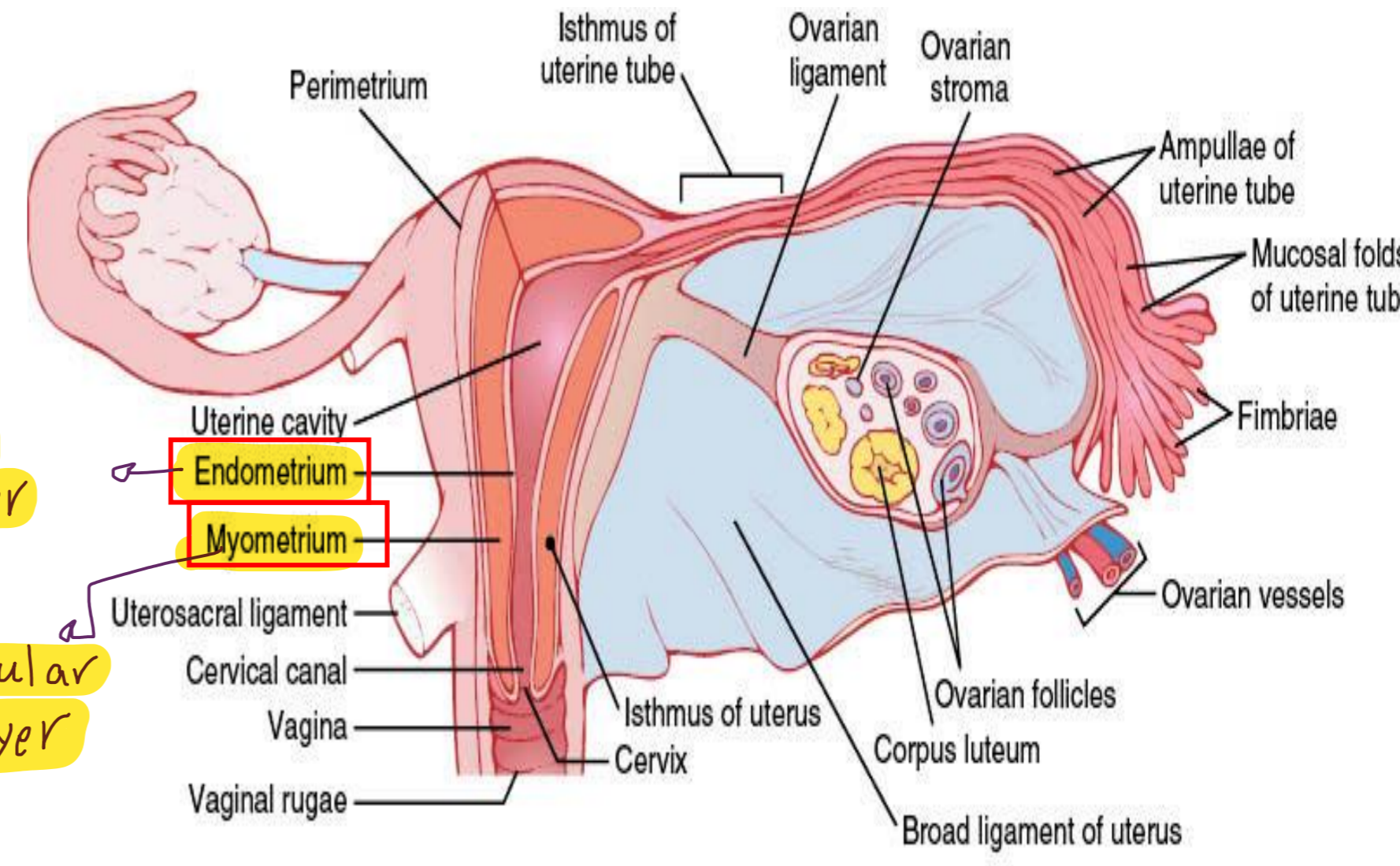
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Cortex → *outer part*  
 Lined by the **germinal epithelium** (stem cells)  
**Glandular structures** → ovarian F. at different stages  
*development of 2ry oocytes*  
**Medulla/zona vasculosa**  
 center of the ovaries (stromal tissue) → have nerves, CT, vasculature..



*first layer*

*muscular layer*



(Redrawn from Guyton AC: Physiology of the Human Body, 6th ed. Philadelphia: Saunders College Publishing, 1984.)

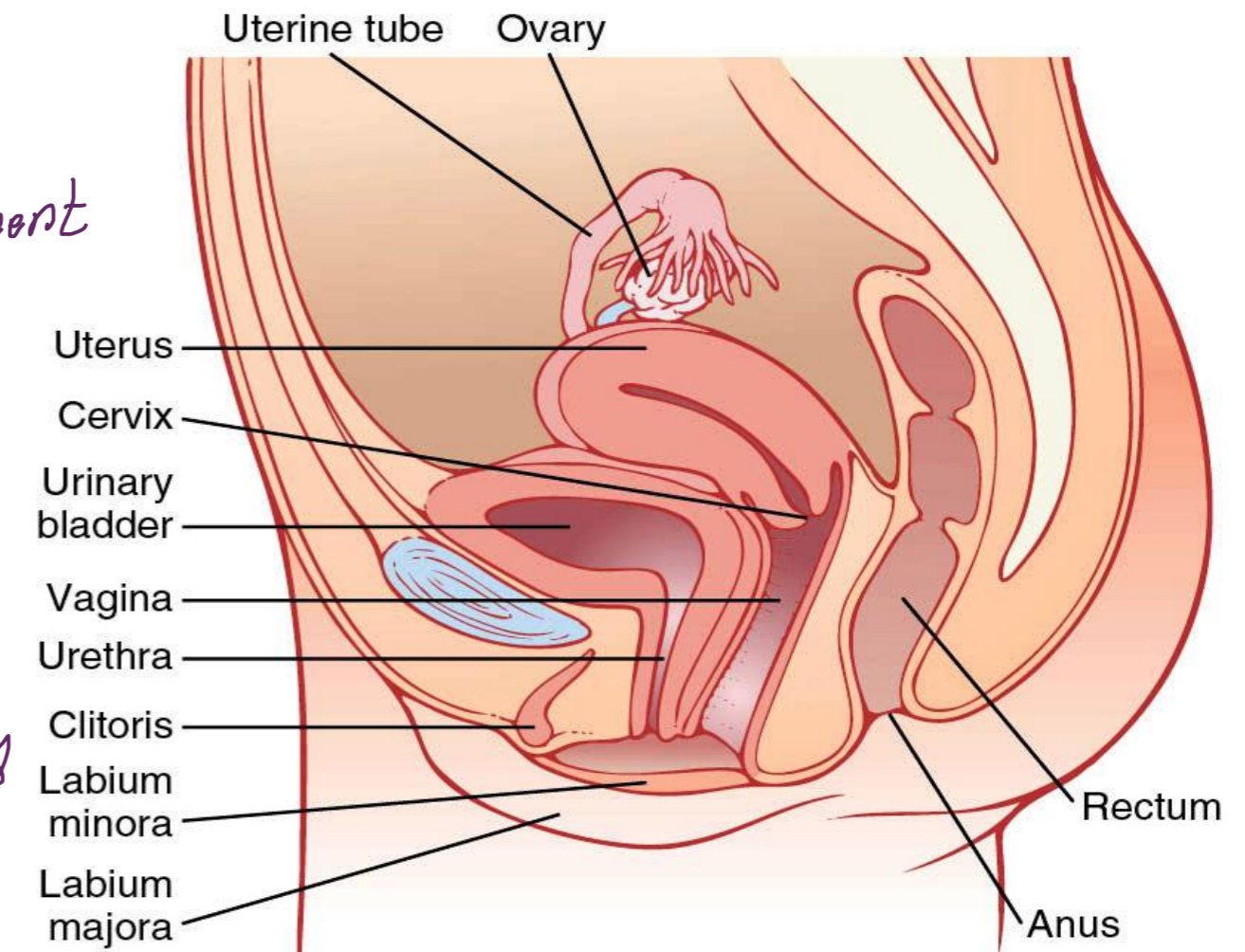


# Physiological anatomy of the female sexual organs

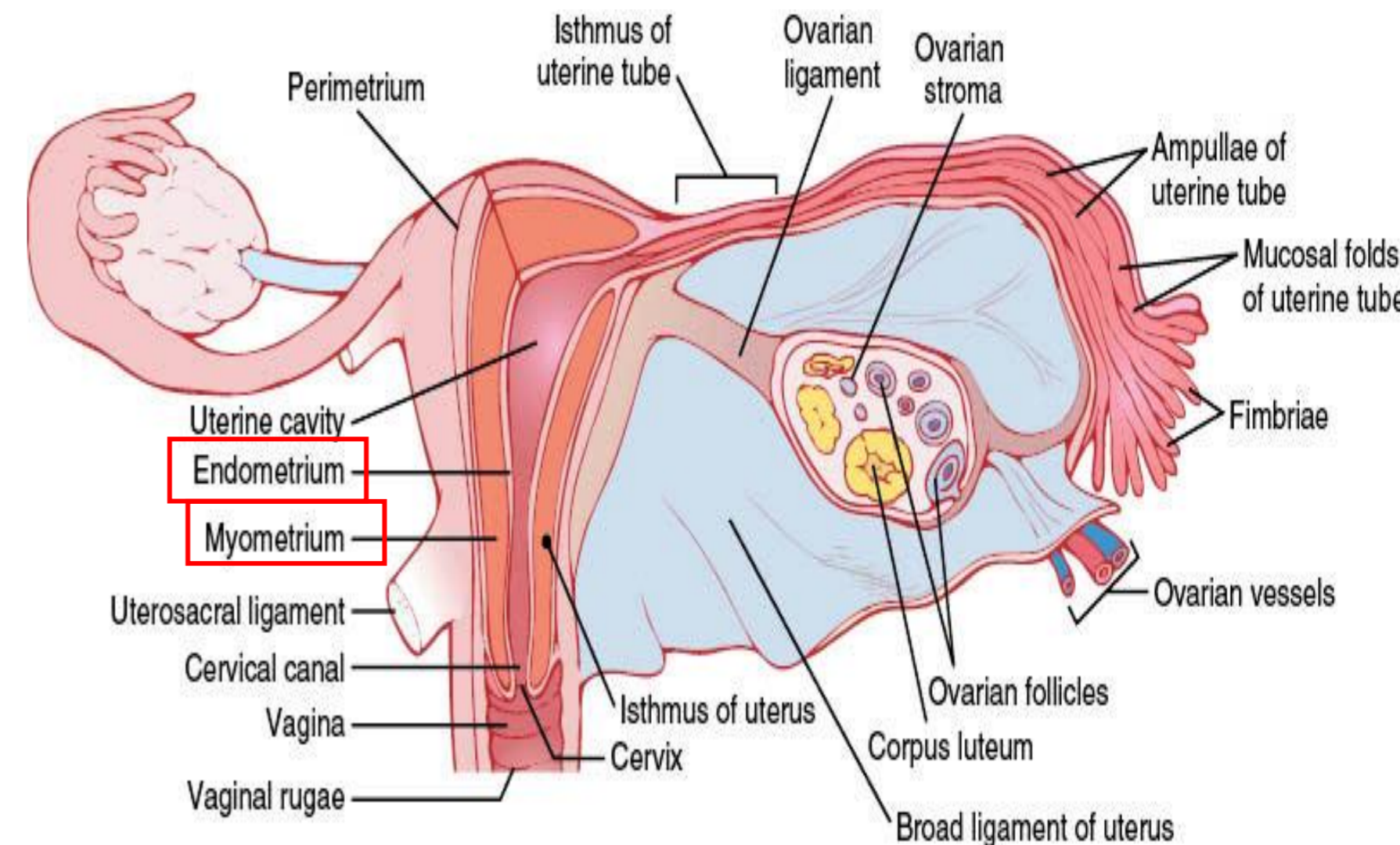
## • Accessory sex organs

*passage or pathway for movement of fertilized ovum...*

- 1 ➤ Uterine/Fallopian tubes transport fertilized ova
- 2 ➤ Uterus where fetal development occurs
- 3 ➤ Cervix (mucus secretion), Vagina (passage) *→ main site of pregnancy*  
↳ *end part of the uterus*
- 4 ➤ external genitalia constitute the vulva (L. majora, minora & clitoris)



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(Redrawn from Guyton AC: Physiology of the Human Body, 8th ed. Philadelphia: Saunders College Publishing, 1984.)

# Sexual life in females

تتم بنشاط في  
sex organs mainly (ovaries)

من الولادة حتى البلوغ

## FIRST PERIOD

- Birth-puberty
- primary and accessory sex organs do not function

من البلوغ حتى سن اليأس

## SECOND PERIOD

- puberty -menopause
- First menstrual cycle = menarche (age of menarche)
- Permanent stoppage of menstrual cycle=menopause (45 -50y).
- women menstruate and reproduce.

توقف تام ..

→ ovulation monthly  
→ she can get pregnant during this stage

## THIRD PERIOD

- Menopause-rest of life.



# Oogenesis and follicular development in the ovaries

عملية تكاثر البويضات  $\times$  قبل عملية الحمل  $\rightarrow$  early oocyte production  $\rightarrow$  before the birth

## Intrauterine life

- germinal ridges  $\rightarrow$  germinal epithelium (cortex of ovary)  $\rightarrow$  primordial ova/oogonia
- Oogonia divide to produce millions by mitosis but most degenerate (atresia) during fetal growth
- Some develop into primary oocytes & stop in prophase stage of meiosis I
- 2 million present at birth
- 300,000 remain at puberty but only 400-500 mature during a woman's life
- Each month, hormones cause meiosis I to resume in several follicles so that meiosis II is reached by ovulation
- Penetration by the sperm causes the final stages of meiosis to occur

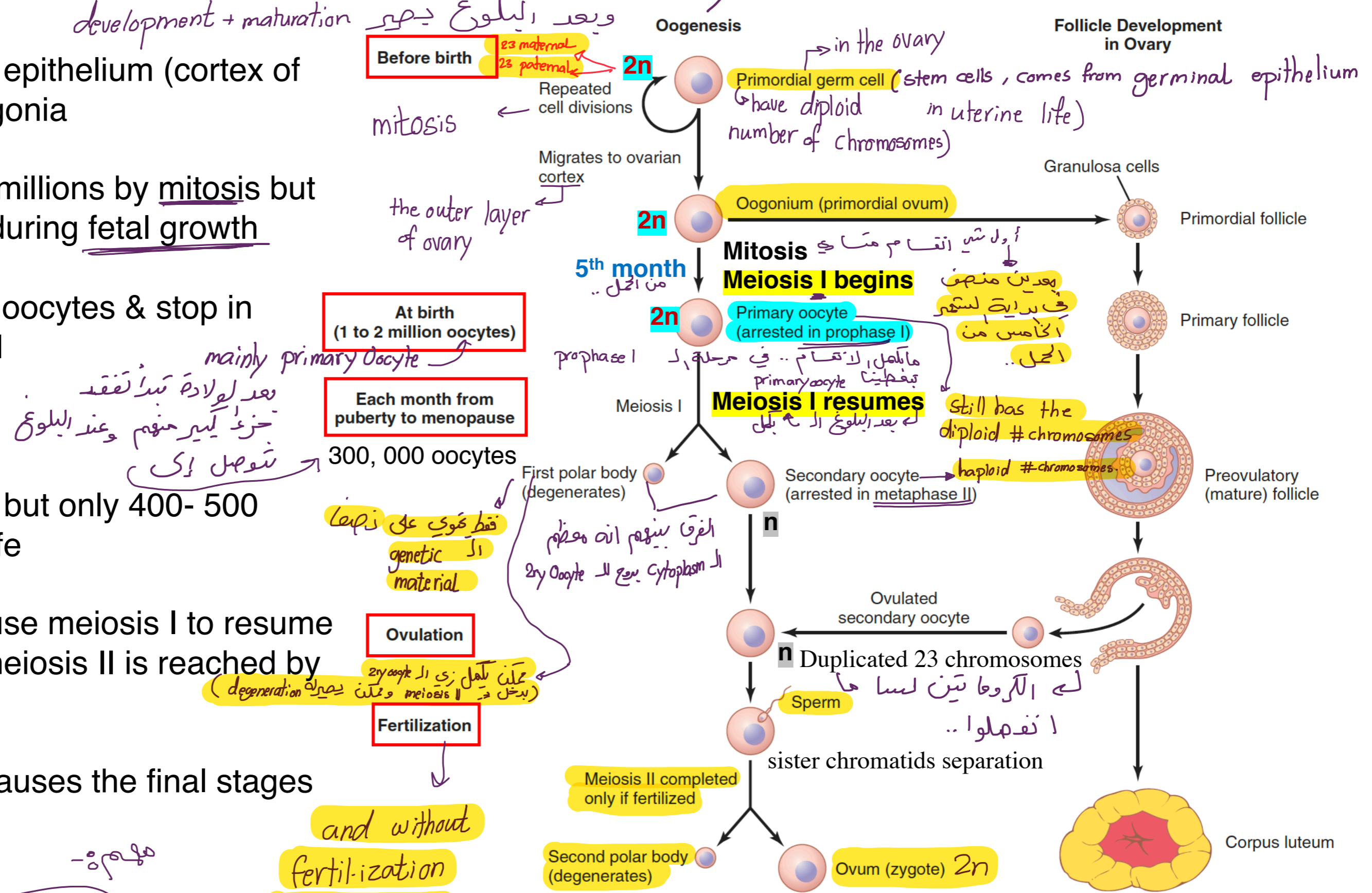


Figure 82-3. Oogenesis and follicle development.

$\times$  قبل الحمل Oocytes تكاثر البويضات  
خلال الحياة  
uterine life

and without fertilization the 2n oocyte will degenerate...

Fundamental reproductive unit = single ovarian follicle = one germ cell (oocyte) + surrounded by endocrine cells (granulosa + thecal cells)

# Monthly ovarian cycle; function of the gonadotropic hormones

➤ female monthly sexual cycle /menstrual cycle= monthly **rhythmical** changes in:

- ✓ rates of secretion of the female hormones
- ✓ ovaries and other sexual organs.

Avg 28 d (20-45 d) → **prolonged or short cycle...**  
Abnormal cycle length → decreased fertility

➤ Outcomes of female sexual cycles:

① **single ovum**/month → fetus? *one fetus*

② **prepared** uterus for **implantation** →

*fertilization في قناة فالوب  
to ovum*

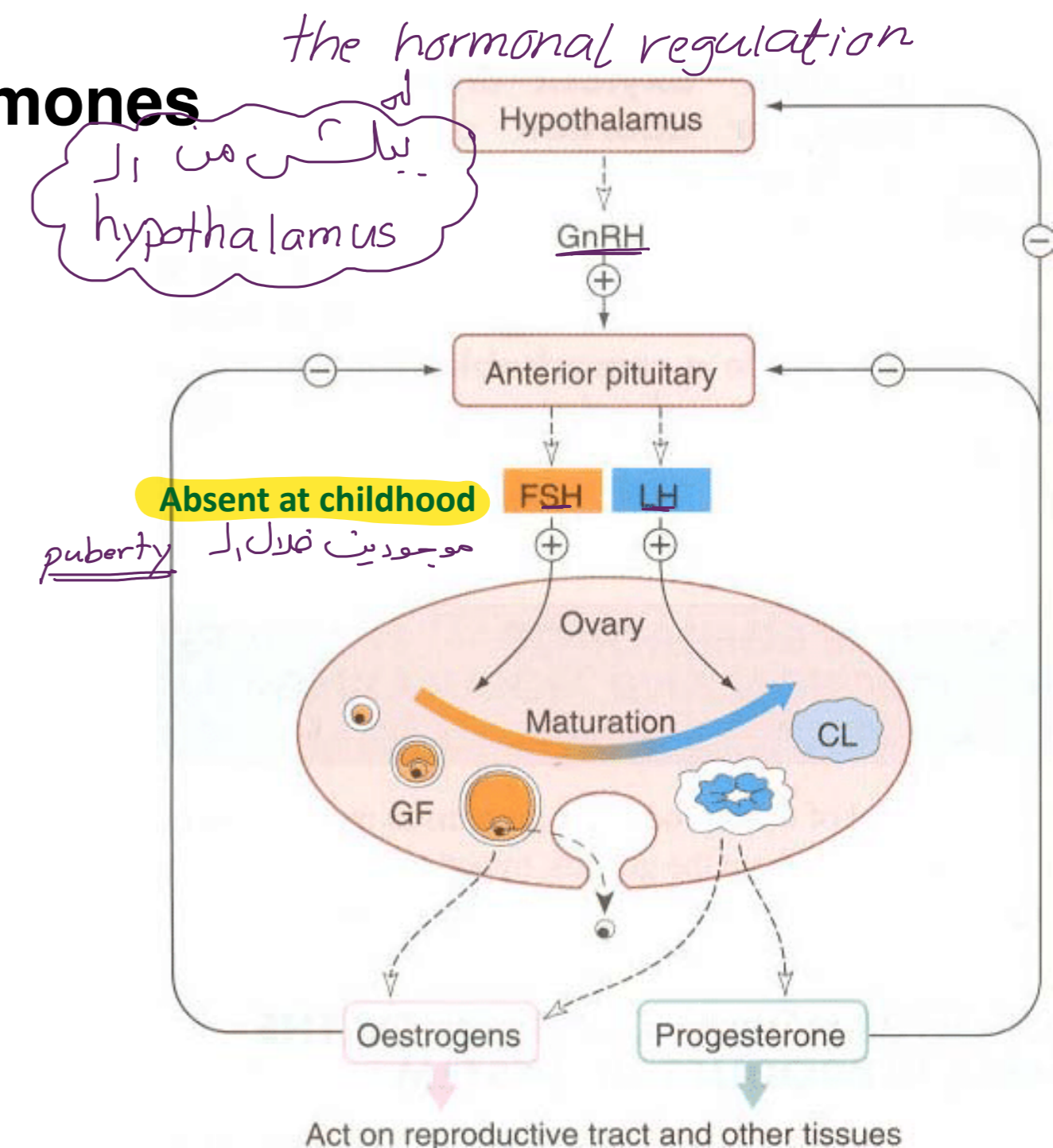
**fetus**

*← zygote في قناة فالوب*

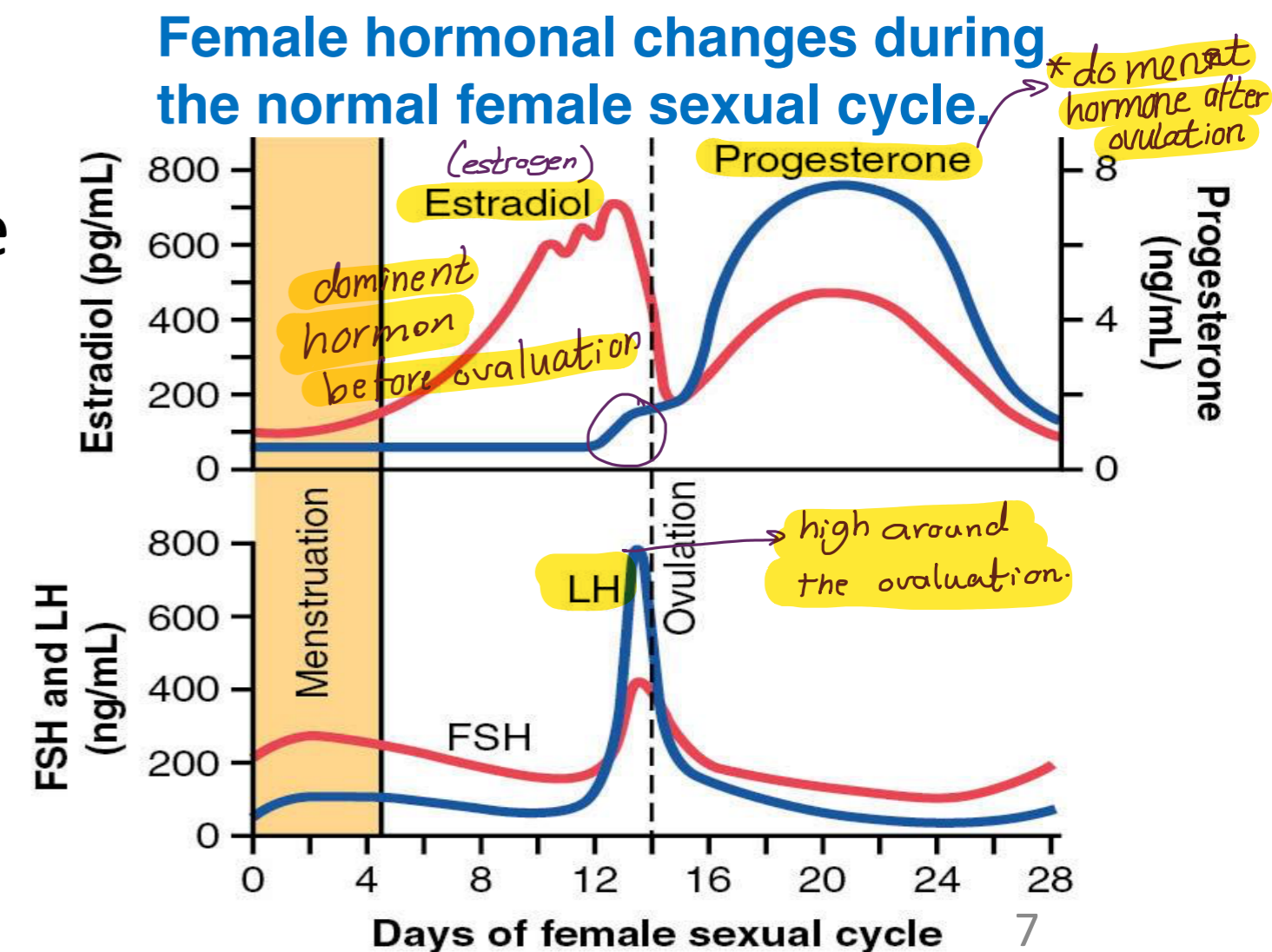


# Monthly ovarian cycle; function of the gonadotropic hormones

- Ovarian function is **completely dependent** on FSH & LH
- 9 to 12 years → pituitary begins to secrete progressively more FSH and LH → onset of monthly sexual cycles → beginning between the ages of 11 and 15 years (puberty)
- **FSH & LH** → activate receptors in ovarian target cell → increase cells' rates of secretion+growth and proliferation of cells
  - ①
  - ②
  - ③
- activation of cAMP → formation of protein kinases → phosphorylations enzymes → stimulate sex hormone synthesis



## Female hormonal changes during the normal female sexual cycle.



# Synthesis of estrogen by ovarian cells during menstrual cycle

Granulosa من داخل progesterone بجو (3)

① **Thecal cells** – superficial layer of the follicles  
 no aromatase  
 have **only LH Receptors**  
 can get cholesterol from LDL in blood

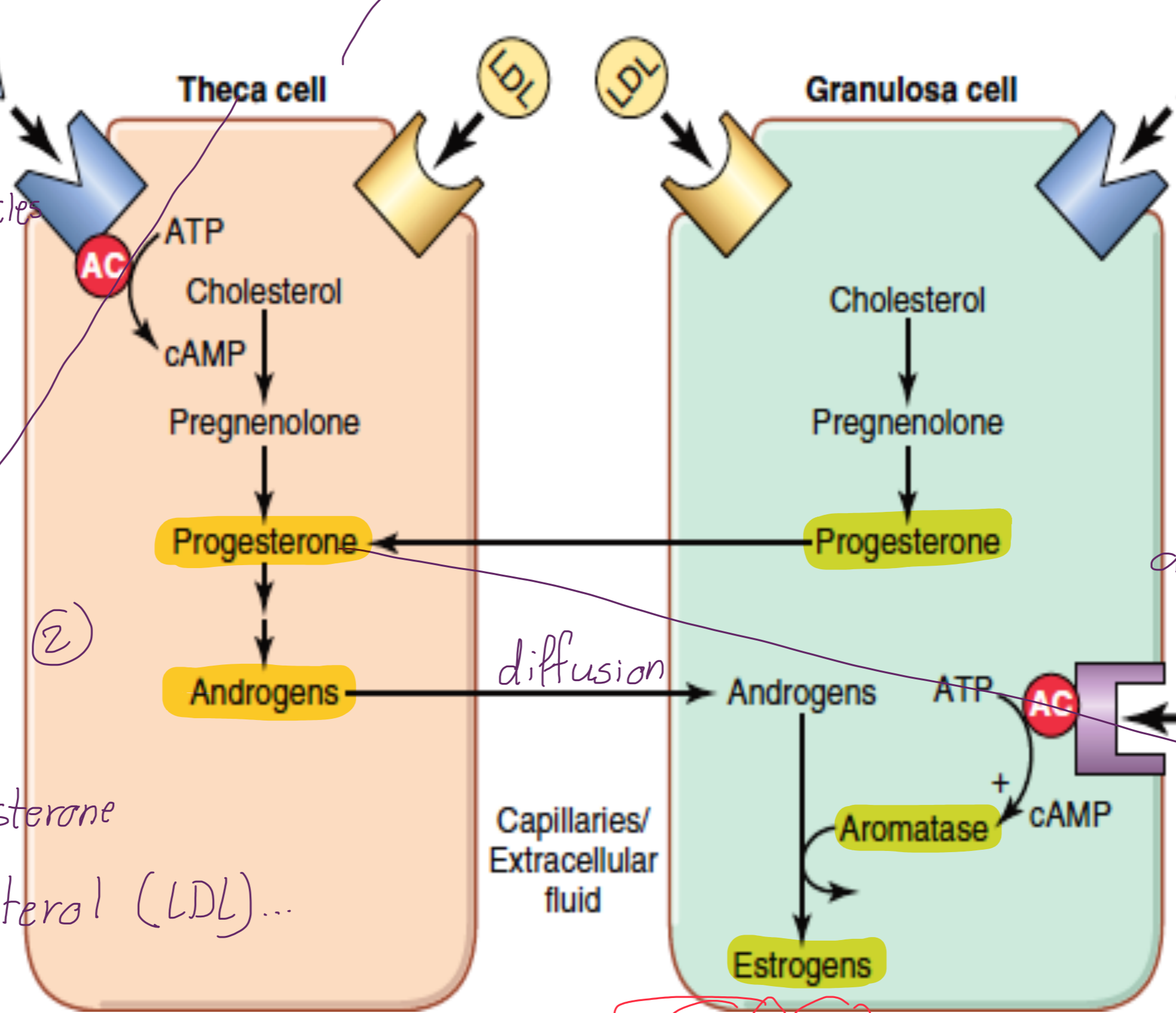
② بتون ال progesterone ال Androgens ال  
 ↳ mainly testosterone  
 From Cholesterol (LDL)...

in the inner layer of follicles  
 Granulosa cells interior  
**have aromatase**  
 have both LH and FSH receptors

\* تمام لعلية كويل ال androgen ال  
 ال estrogen ال

بقول ال androgen ال  
 ال androgen ال

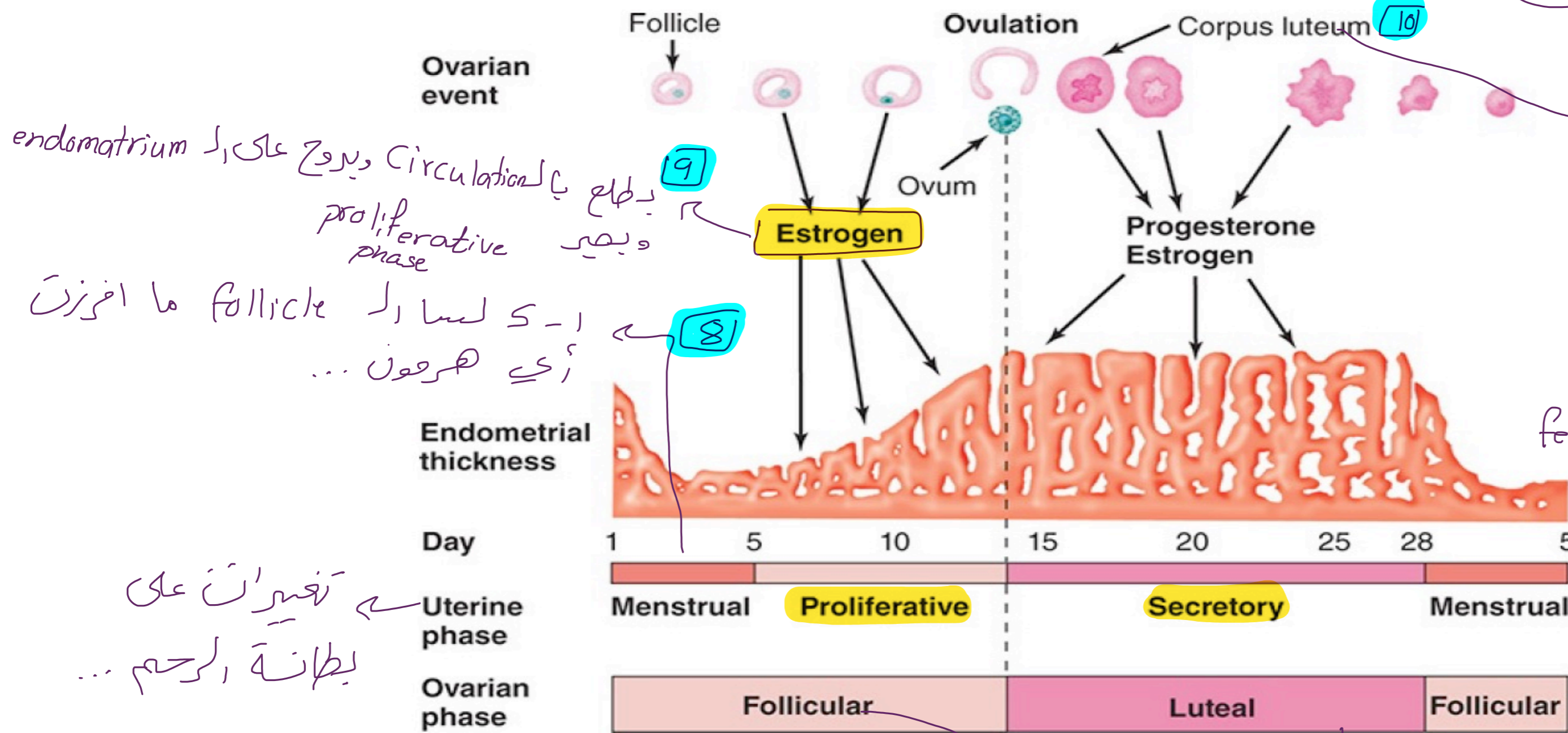
Granulosa cells ال diffusion ال  
 (FSH) (LH) receptors ال





# Female monthly sexual cycle

ovarian + uterine phase →  
 مع بعض التغييرات  
 في ال ovaries ينتج عنها تغييرات  
 في بطانة الرحم...



يكثر إفراز progesterone + estrogen  
 ويصير عناء ال secretory phase of the endometrium.  
 اذا ما صار فيه fertilization to ovum  
 شرح يصر عنها menstrual

endometrium على ال دوران ال  
 proliferation phase  
 ال ال ال follicle ما افزرت  
 ال ال ال ...

تغييرات على  
 بطانة الرحم ...

فوليكولاته ال follicles  
 ال ال ال ovaries

متغير من  
 ال ال ال length of the cycle

طول ثابت بكل ال ladies  
 (نظرة ال 14 يوم من ال cycle)

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

Endometrial cycle -- menstruation, proliferative and secretory phases

من اول يوم  
 في ال menstruation  
 ال ال ال cycle  
 قبل ال menstrual ...

in the mid cycle. → LH surge  
 يتلون ال corpus luteum  
 ال ال ال progesterone  
 under the stimulation of LH

# Female monthly sexual cycle

دوره عینی های یک ماهه

Single layer of granulosa cells

ab و ovum

عبارت عن ال

primordial follicle

1

primary follicle

بتحول الى

2

- Enlargement of the ovum
- Growth of additional layers of granulosa cells

single layer of granulosa cells

## Functions of granulosa cells:

1 Nourishment to Oocytes

2 Secretion of oocyte maturation inhibiting factor

↓  
prophase

عساکن هیت بدخل ال Oocytes  
arrested in prophase I

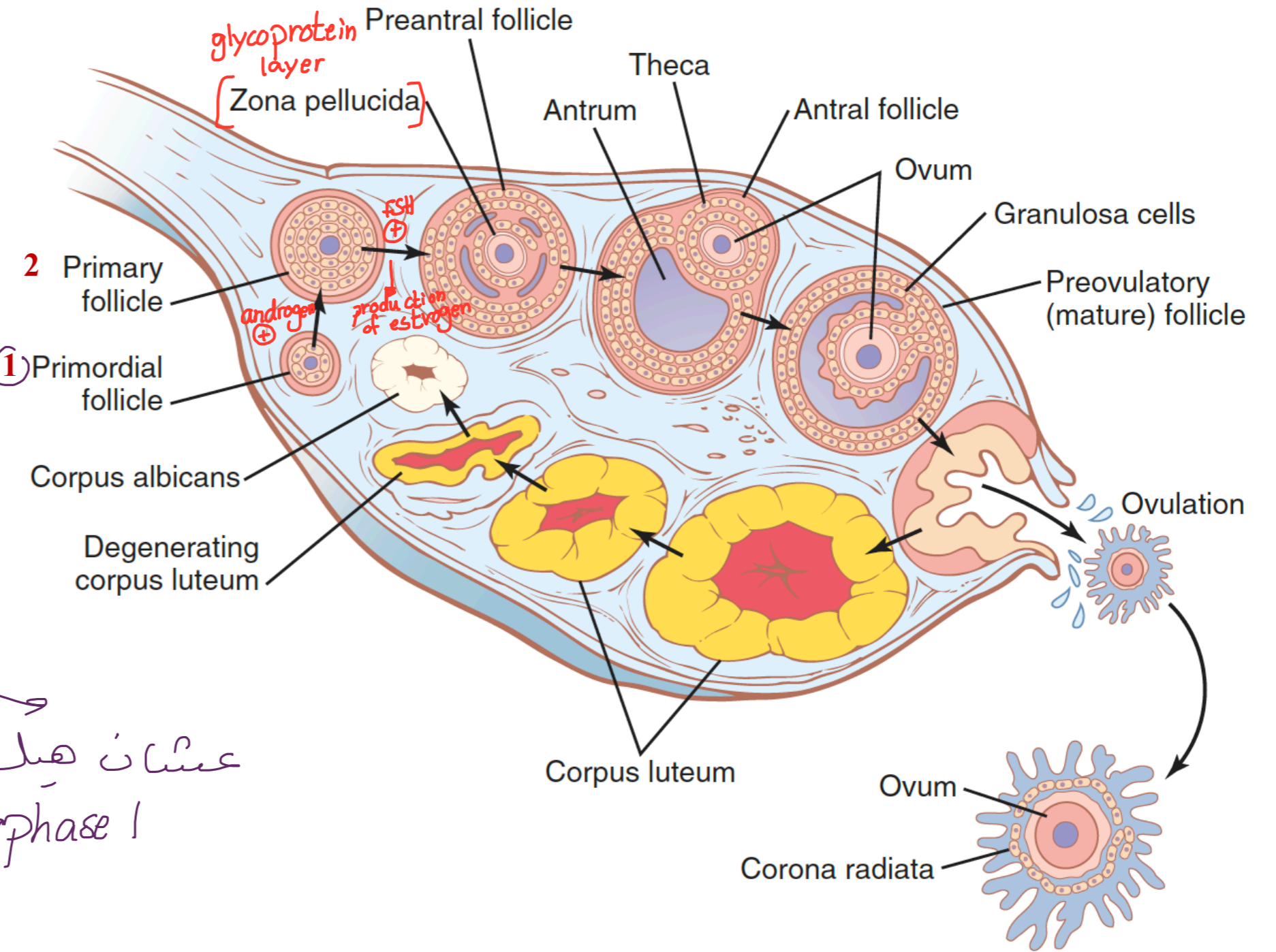


Figure 82-5. Stages of follicular growth in the ovary, also showing formation of the corpus luteum.



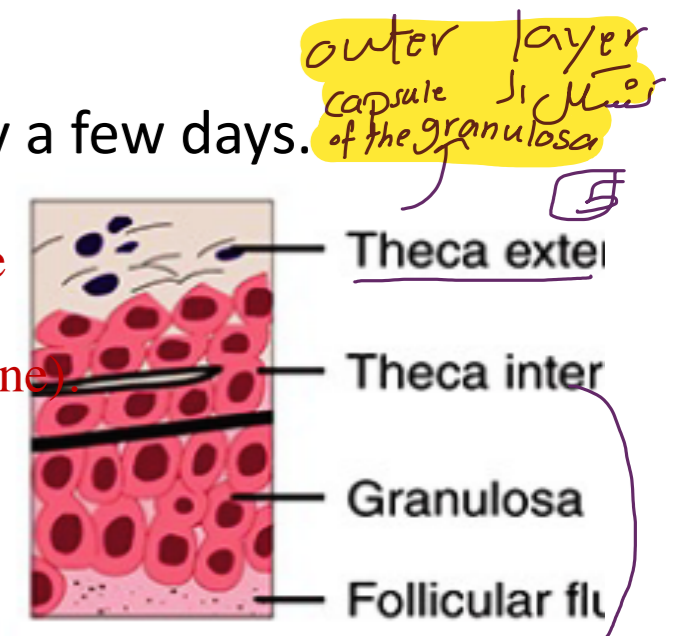
2) الهرمونات هورمونين لكن اول FSH يتبعه زيادته ابكر من ال LH...

1) 3 FSH & LH → increase slightly to moderately increase in FSH slightly greater than that of LH and preceding it by a few days.  
 These hormones (especially FSH) → cause **accelerated growth** of 6-12 primary follicles/month  
 The initial effect is **rapid proliferation** of the granulosa cells → many more layers

3) **Formation of theca cells** → in the outer layer...

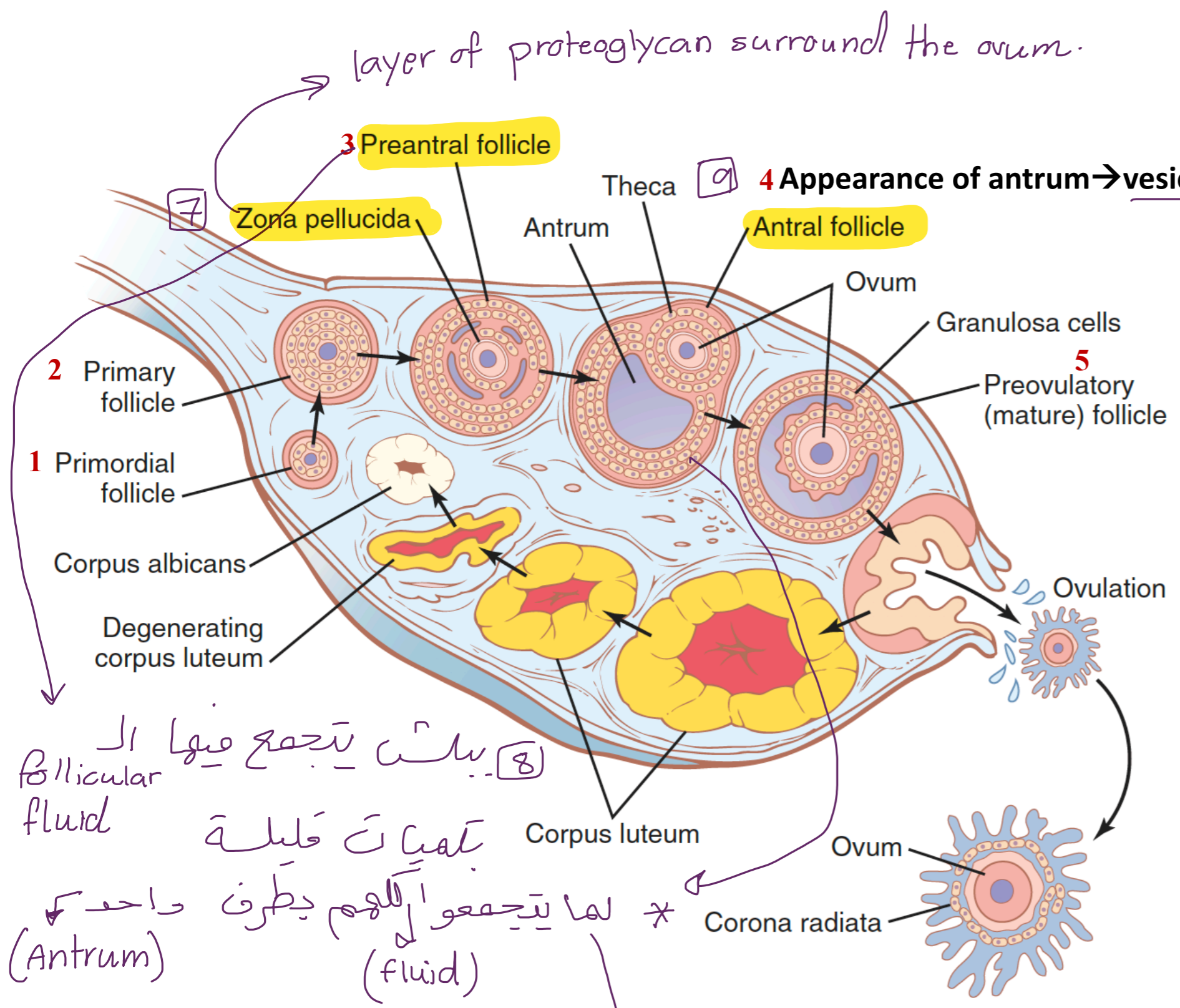
FSH → granulosa cells → secretes a **follicular fluid** containing **high concentration of estrogen** (inner layer).

growth of primary follicle



(estrogen & progesterone)

mainly involve estrogen and progesterone production.



لانه فيه fluid كثير فيسرع حركته وفعاد السائل حيان estrogen

**accelerated growth is caused by:**

1. **Estrogen** is secreted into follicle and causes the **granulosa** cells to form increasing numbers of **FSH Receptors** → positive feedback effect (makes the granulosa cells even more sensitive to FSH (intrinsic +ve FB) → so more growth of granulosa cells
2. **FSH & estrogens** combine to promote **LH receptors** on **granulosa** cells, thus allowing LH stimulation to occur in addition to FSH stimulation and creating an even more rapid increase in **follicular secretion**.
3. The increasing estrogens from follicle + ↑LH act together to cause **proliferation of the follicular thecal** cells and increase their **secretion** as well.

8) السائل يتجمع فيها ال follicular fluid  
 السائل قليله  
 \* لما يتجمعوا للوم بطرف واحد (Antrum) (fluid)

انtral follicle ال

Figure 82-5. Stages of follicular growth in the ovary, also showing formation of the corpus luteum.



١ كل شهر يصرعنا development of 6-12 primary follicles  
 لكن فقط واحدة فقط full maturation  
 يعني يتلعل ال development كامل كذا ovulation

يتكون اسرع في النمو و هي الـ Atresia  
 بتسبب عملية الـ Atresia

2 Only **One** Follicle Fully Matures (**outgrow** all the others) Each Month, and the Remainder **Undergo Atresia** → 1 fetus/preg  
 له ظهور يا في الـ primary follicle

cause → large amounts of estrogen from the most rapidly growing follicle → hypothalamus → inhibit **FSH** → blocking further growth of the less well-developed follicles.

3 the largest follicle continues to grow because of its intrinsic positive feedback effects

The single follicle reaches a diameter of 1-1.5 centimeters at the time of ovulation and is called the **mature follicle**.

إذا كان اصغر معناه فيه abnormality at the time of ovulation

or preovulatory follicle  
 or (graften)<sup>2</sup> follicle  
 ↳ (2ry oocyte)  
 [frozen in metaphase II]

نينا فيرد ..

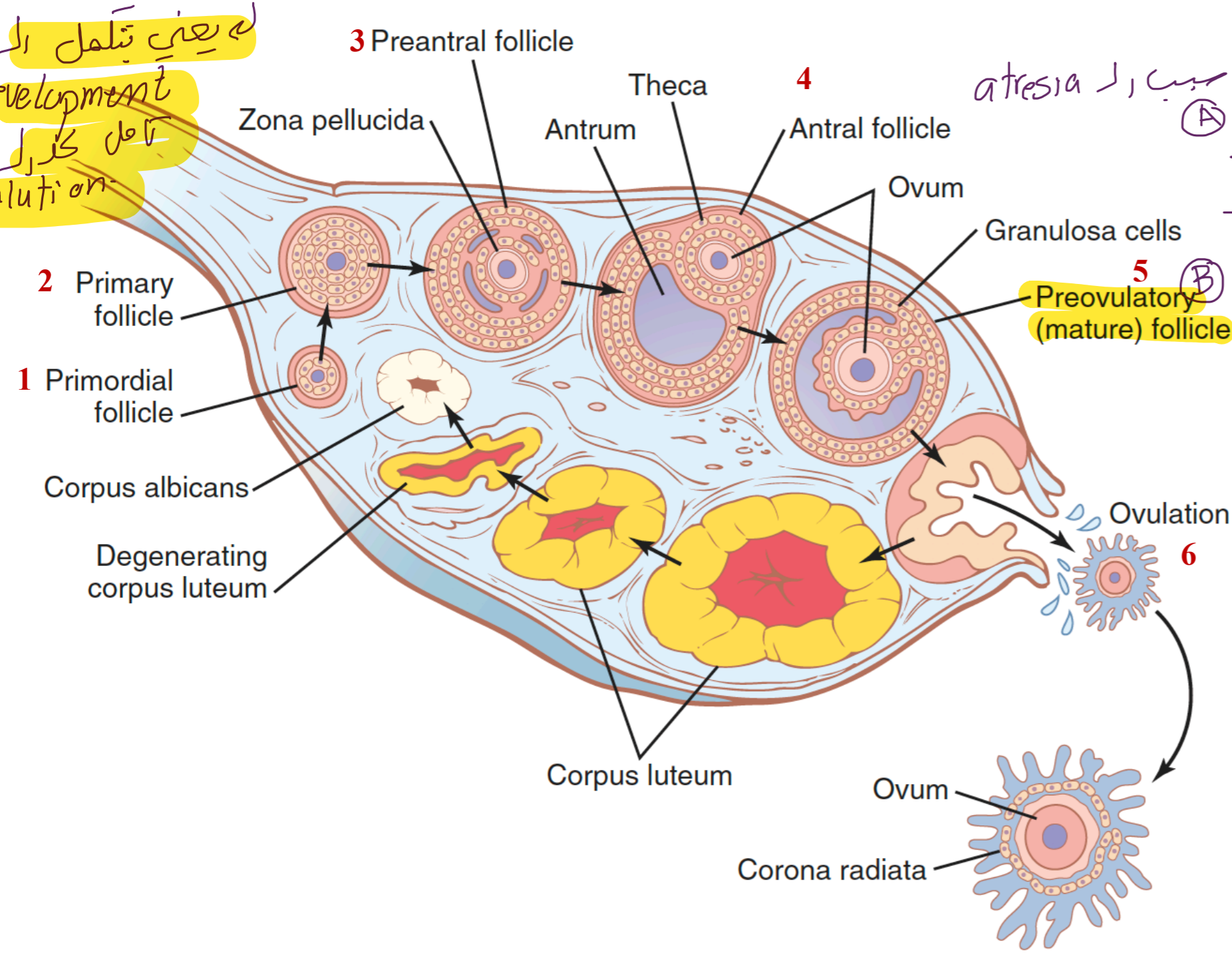


Figure 82-5. Stages of follicular growth in the ovary, also showing formation of the corpus luteum.



In the uterus (proliferative phase) *mainly under the effect of estrogen*

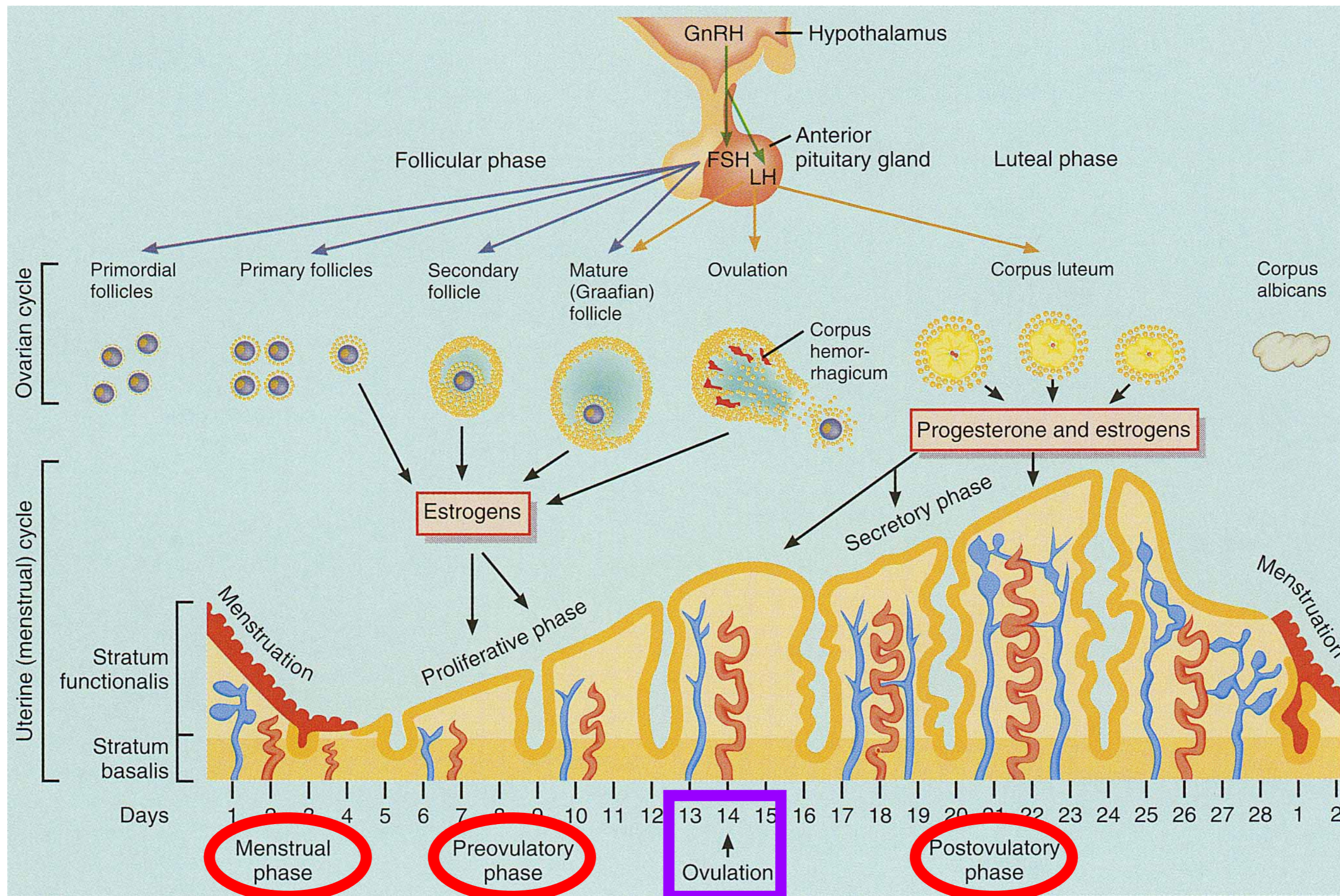
increasing estrogen levels re-epithelialize endometrial surface within 4 to 7 days after the beginning of menstruation)

After that → increase numbers of stromal cells & progressive growth of the endometrial glands and new blood vessels

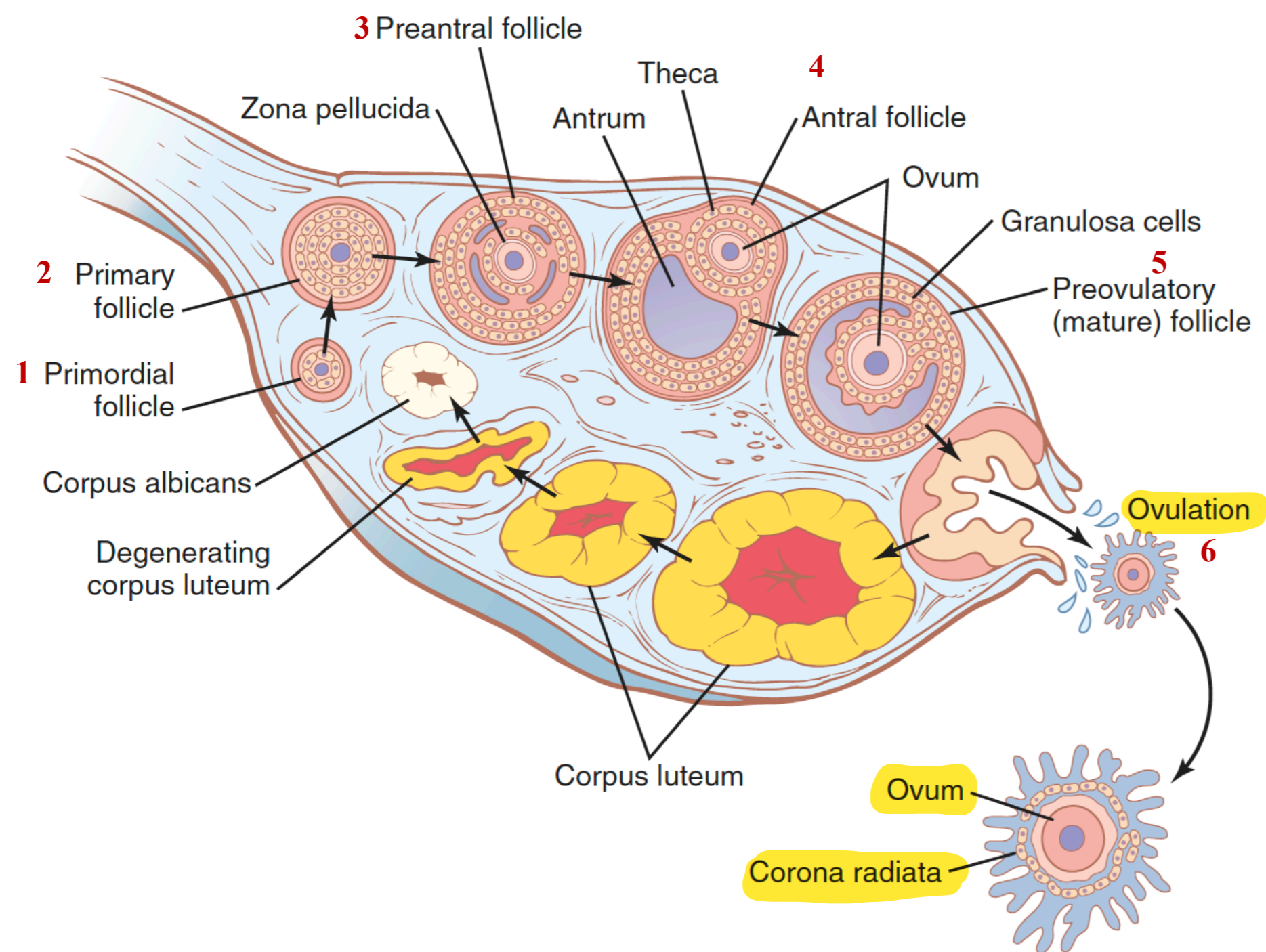
1

2

3







**Figure 82-5.** Stages of follicular growth in the ovary, also showing formation of the corpus luteum.

**6-Ovulation** in the mid cycle.

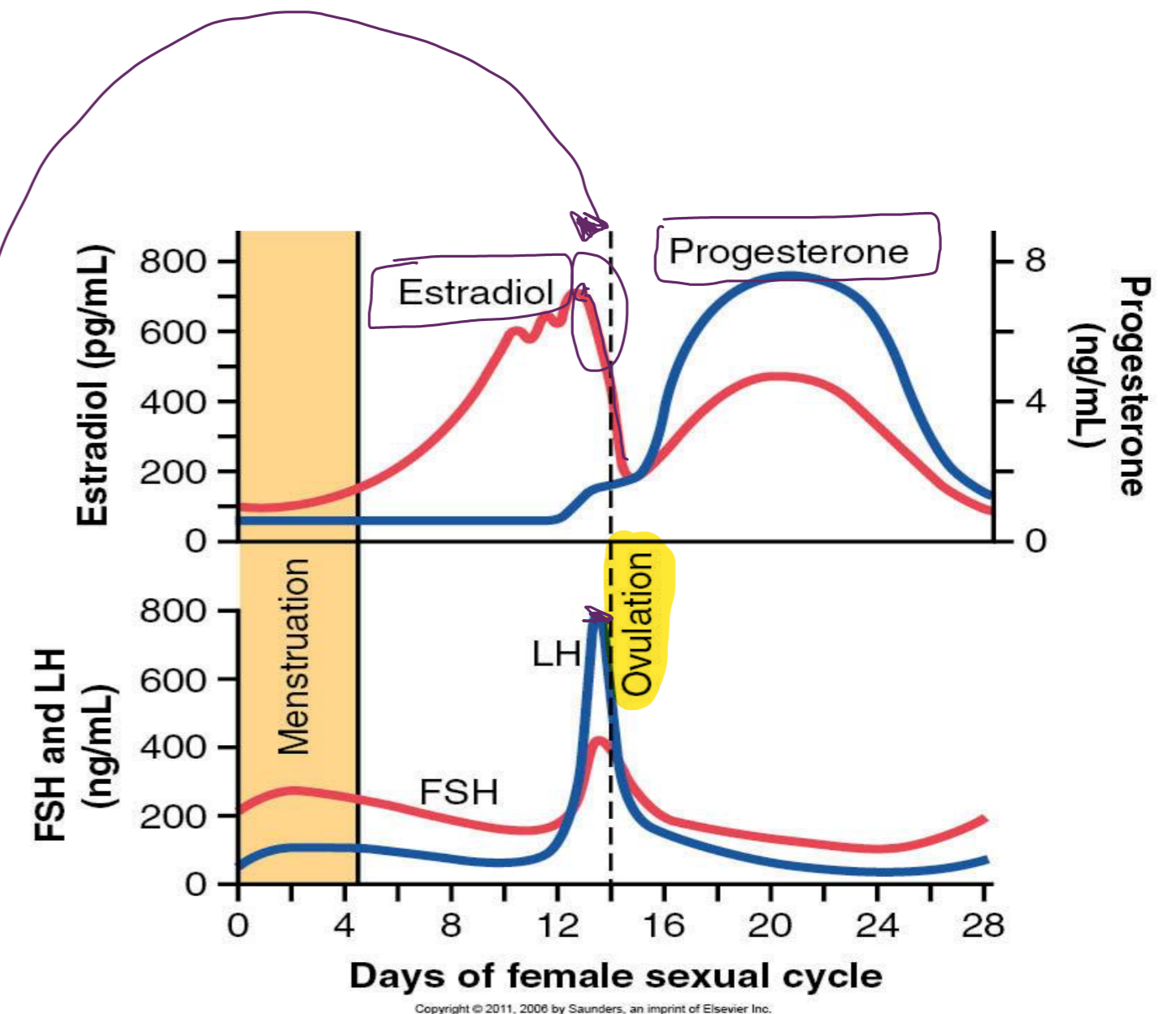
In 28-day cycle → ovulation 14 days after onset of menstruation  
 small area in the center of the follicular capsule (**stigma**) → ruptures → ovum surrounded by a granulosa cells → called the **corona radiata**

... زي التاج ...



# Ovulation

- A Surge of LH Is Necessary for Ovulation.
- LH is necessary for **final follicular growth** and **ovulation**. *↗*
- 2 days before ovulation → rate of secretion of LH **increases markedly**, 6-10-fold, peaking 16h before ovulation. *and then drop*
- FSH also increases 2-3 fold at the same time
- FSH & LH act synergistically to **cause rapid swelling of the follicle before ovulation**. *↗*
- LH converts **granulosa and theca** cells to mainly **progesterone** secreting cells. *↗*
- rate of secretion of estrogen begins to fall about 1 day before ovulation



# Signs of Ovulation

- ① • Increase in basal body temperature
- ② • Changes in cervical mucus
- ③ • Cervix softens
- ④ • Mittelschmerz---pain



# Postovulatory Phase

- lasts 14 days
- In the ovary → (luteal phase)
  - LH → luteinization → granulosa & theca **interna** cells change rapidly into **lutein** cells → filled with lipid → **c. corpus luteum** → P&E → low FSH&LH
  - Lutein cells → **inhibin** → inhibit FSH
- Involution of CL
  - No fertilization → **corpus albicans** is formed
    - as hormone levels drop, secretion of GnRH, FSH & LH rise
- if fertilization did occur, developing embryo secretes **human chorionic gonadotropin (hCG)** which maintains health of **corpus luteum** & its hormone secretions

yellow

mainly progesterone

لحمية تتكون من البطانة

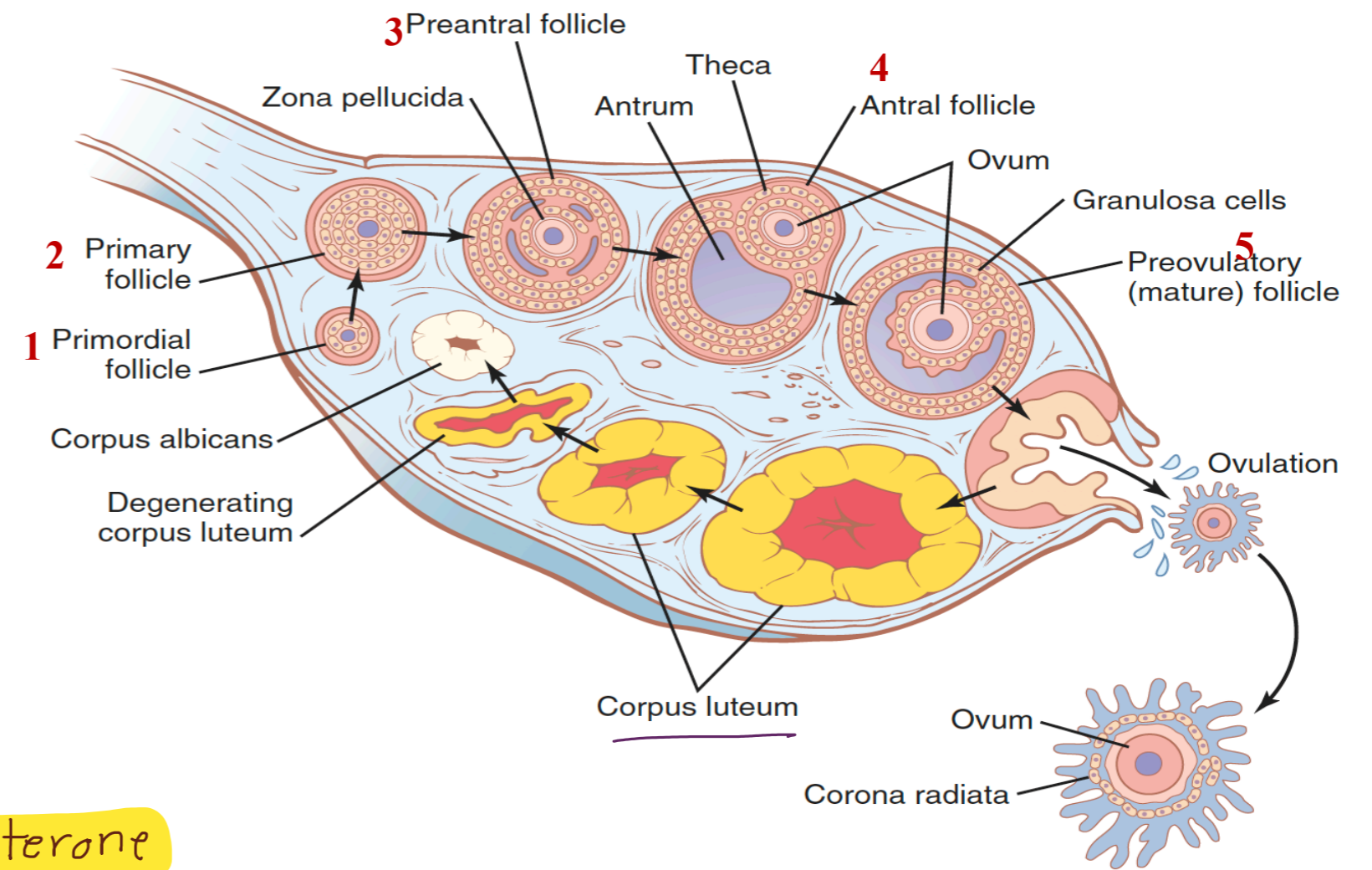
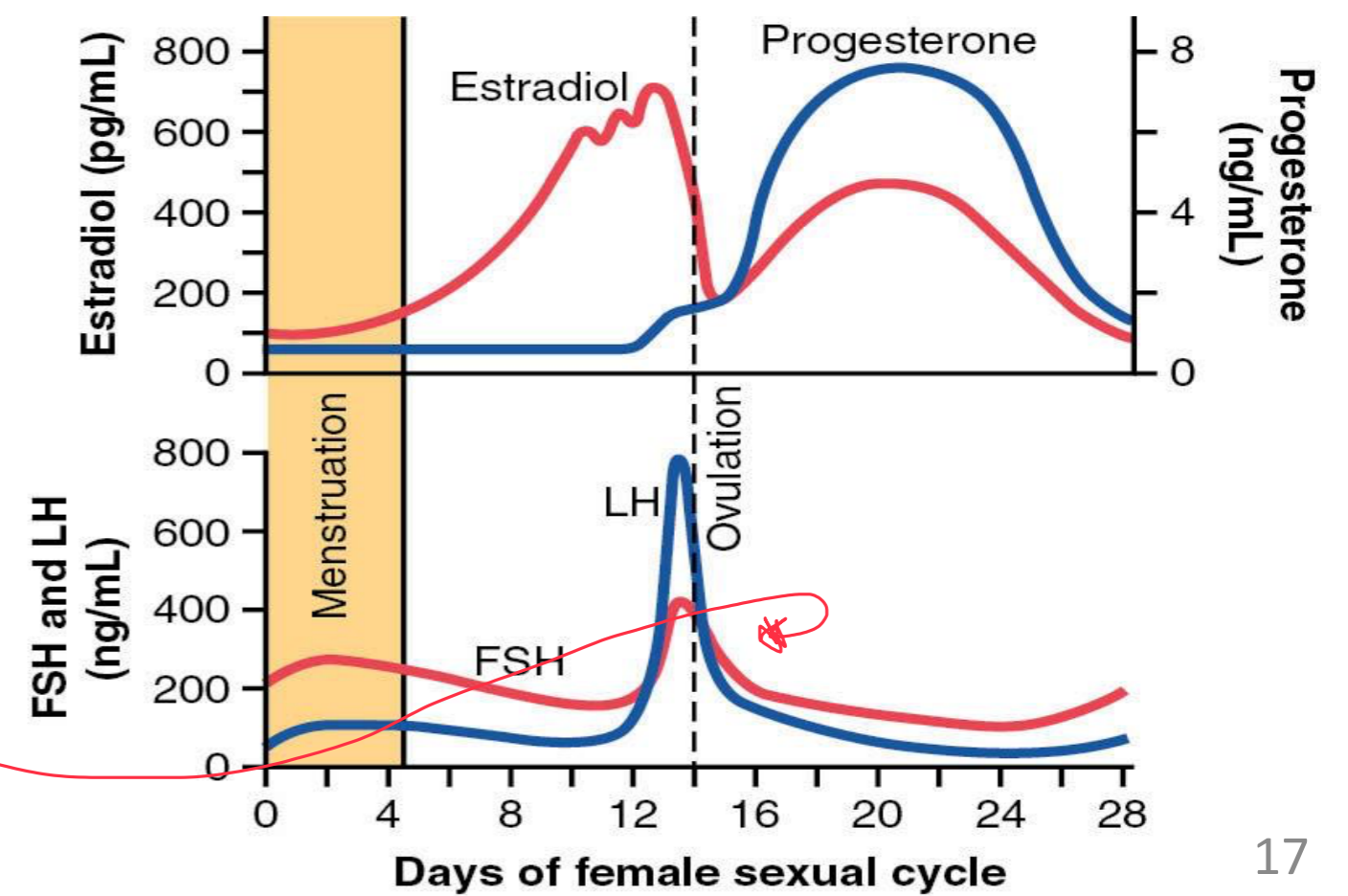
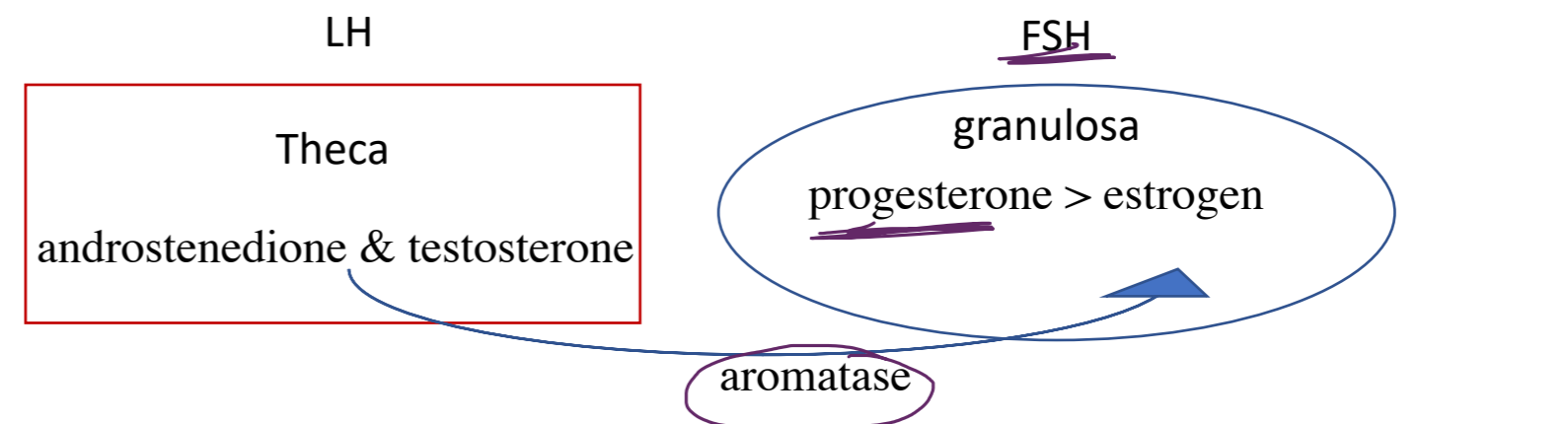


Figure 82-5. Stages of follicular growth in the ovary, also showing formation of the corpus luteum.



# Postovulatory Phase

- In the uterus (secretory phase/progestational phase)
  - Hormones (**progesterone mainly**) from corpus luteum promote marked swelling and secretory development of endometrium → provide appropriate conditions for implantation of a fertilized ovum

## Glands →

- increase in tortuosity
- excess of secretory substances accumulates in the glandular epithelial cells

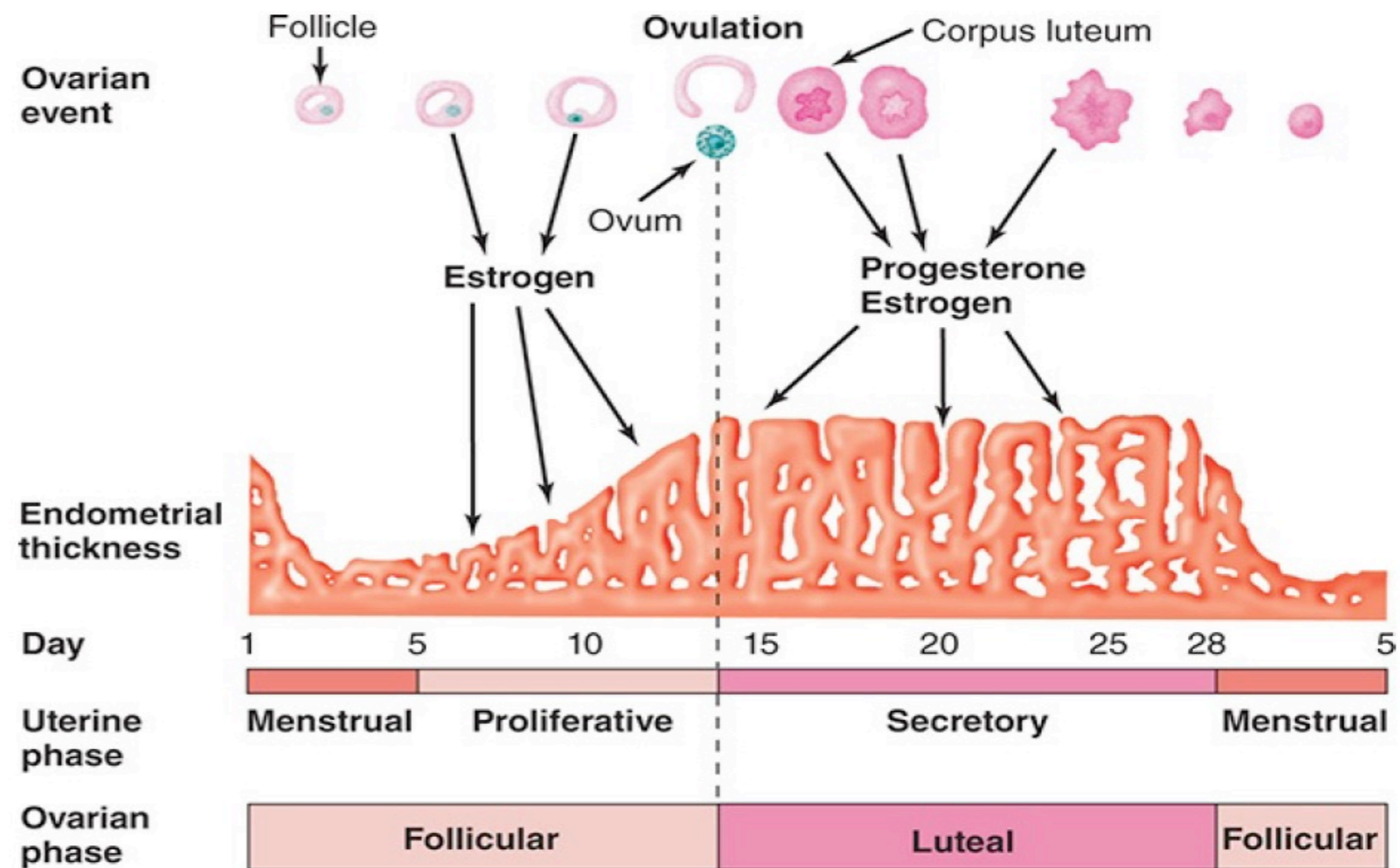
## stromal cells →

- Cytoplasm increases
- lipid and glycogen deposits

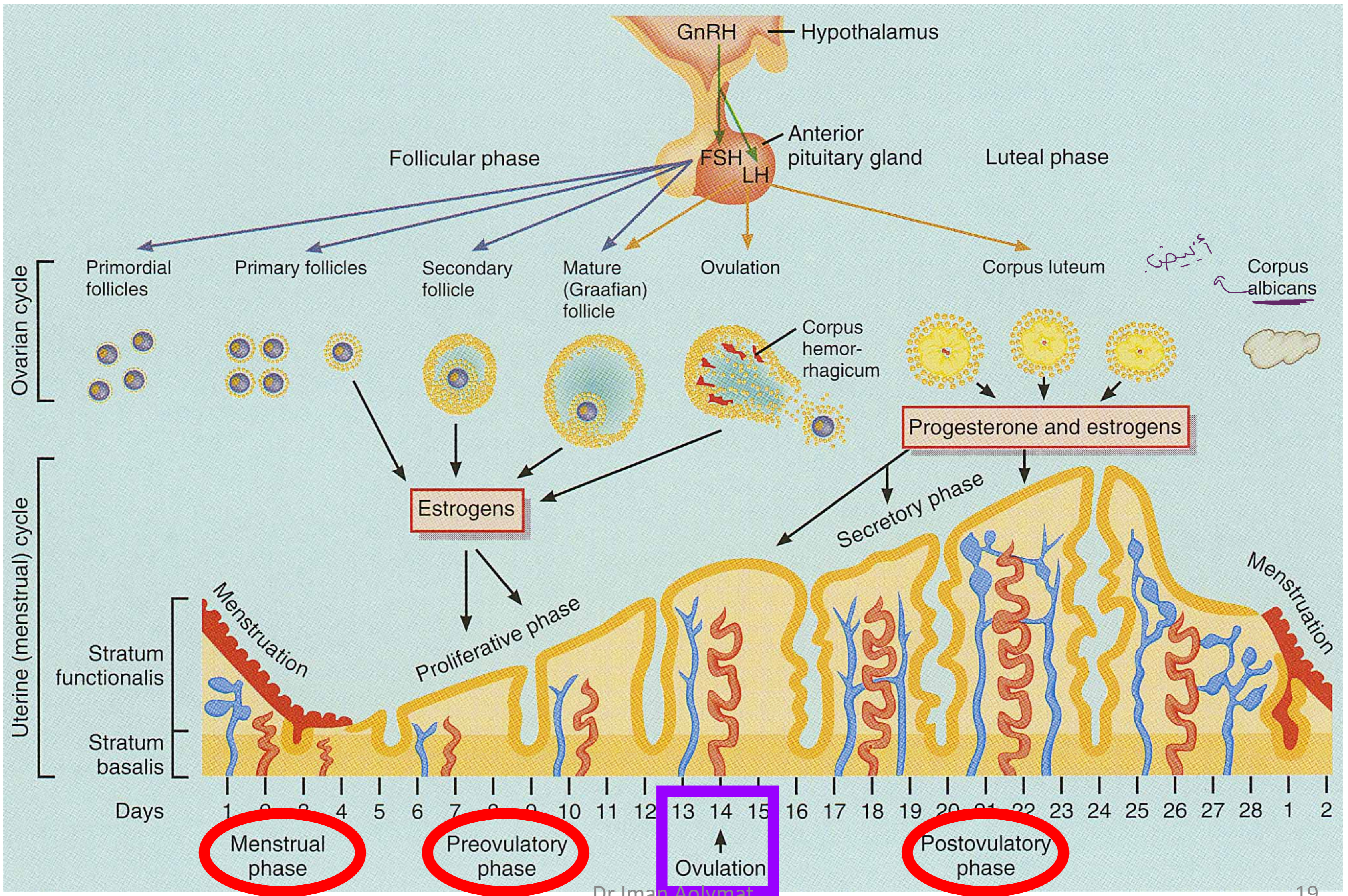
- Increase blood supply to the endometrium
  - blood vessels becoming **highly tortuous**.

- **“uterine milk,”** provide nutrition for the early dividing ovum

if no fertilization occurs, **menstrual** phase will **begin**









# Menstrual Phase

- Menstruation lasts for **5** days
- First day is considered beginning of 28 day cycle
- In ovary
  - • **Early follicular growth**
- In uterus
  - 1 • declining levels of progesterone (mainly) & estrogen
  - 2 • caused spiral arteries to constrict – ischemia & necrosis → glandular tissue dies
  - 3 • stratum [functionalis layer] is sloughed off along with 40 ml of blood, 35 ml serous fluid  
↳ *superficial layer*
  - 4 • **The menstrual fluid is nonclotting** → because a fibrinolysin is released along with the necrotic endometrial material. excessive bleeding → not enough fibrinolysin → clotting → *abnormal sign...*
- Within 4 to 7 days after menstruation starts, the loss of blood ceases because, by this time, the endometrium has become **[re-epithelialized]**



The end

# **Female Physiology Before Pregnancy and Female Hormones-II**

Unit XIV

Chapter 82

Dr Iman Aolymat



# Functions of the ovarian hormones

## Two types of ovarian sex hormones:

### 1- Estrogens

- promote proliferation and growth of specific cells in the body that are responsible for the development of most **secondary sexual characteristics** of the female
- mainly from ovary (in non-pregnant) and very little from the adrenal cortex.
- In pregnancy the placenta secretes very large amount.

uterus, vagina, breast

- **Three estrogens.** → main estrogen in the body, and its action stronger than other estrogens

1 •  $\beta$ -estradiol (the principle one and most potent )

2 • Estrone: most of this is formed in the peripheral tissues from androgens secreted by the adrenal cortices

3 • Estriol: weak, Increase in pregnancy

# Functions of the ovarian hormones

## Two types of ovarian sex hormones:

### 2-progestins

- the most important progesterone
- little of 17- $\alpha$ - hydroxyprogesterone.
- In non-pregnant progesterone is secreted mainly from **corpus luteum**.
- In pregnancy, large amount by **placenta** especially **after 4th month of pregnancy**
- to **prepare the uterus** for pregnancy and the **breasts** for lactation.

الجسم الأصفر

↑ thickness of the uterus  
secretory changes in the endometrial cavity  
to be ready for the pregnancy and fetus implantation

development of ducts and alveoli  
to be ready for lactation  
هو ما يعمل  
milk

\* **Estrogens and Progesterone Are Transported in the Blood Bound to Plasma Proteins (albumin and with specific estrogen and progesterone-binding globulins)**

Lipophilic  
Substances

So in the circulation they will not  
be dissolved in the blood and they need to be  
carried with plasma protein mainly albumin

Dr Iman Aolymat

إعداد prolactin هو المسؤول عن  
preparing the glandular  
tissue of the breast  
for the process of lactation.  
التي تنتج  
milk



(Zero) قبل البلوغ Female sex hormones

# Functions of estrogen

of all of the genital tract organs from infant size to adult size.

- **External female sex organs:** at puberty, increase in size of ovaries, fallopian tubes, uterus and vagina, external genitalia  
 ① promotion of female 2ry characteristic by enlargement the size of the female sexual organs

deposition of fat in mons pubis

it is very important in adult stage of life because it's

- ② • **change vaginal epithelia** from cuboidal to stratified type → more resistant to trauma & infection  
 ↳ because the female at sexual life, she will be more prone to the trauma by sexual intercourse

- ③ • **endometrium:** proliferation of stroma and endometrial glands (important in nutrition of fertilized ovum)  
 ↳ very important for preparation of uterine environment for the fertilized ovum

↳ very important for increase the amount of secretions (help if the female get pregnant)

- ③ • **Fallopian Tubes:** proliferation of glandular tissues of this lining to proliferate, and especially important, increase number of ciliated epithelial cells that line the fallopian tubes  
 ↳ very important for the movement of the ovum

Increase activity of the cilia - cilia always beat toward the uterus → helps propel the fertilized ovum in that direction.

هي دائما تتحرك باتجاه uterus  
(تقودها fertilized ovum وتحركها باتجاه uterus)

- ④ • **Breasts:** fat deposition, development of stromal cells, growth of ducts  
 (progesterone (mainly), prolactin important in milk production. estrogen influence growth of alveoli & lobules)

\* الستيرويدات كمان يستعمل على ال breast لكن ال main hormone هو ال progesterone

# Functions of estrogen

so, the female have more vasculature within the skin →

عشان هيك اذا انجرحت دلاشي فهي  
معرضة انها تنزف اكثر من الـ  
male

- 5) **Skin:** increase vascularization of skin and development of soft skin → male يكون الـ Skin الـ ← course and ragi ?
- 6) **Hair:** little effect -pubic & axillary hair → adrenal androgens  
عكس الـ male الـ T
- 7) **Bones:** estrogen inhibits osteoclastic activity → + increase at puberty  
osteoprotegerin/osteoclastogenesis inhibitory factor, so height increases after puberty, but epiphyses and shafts of bones unite early and growth stops  
لو قارتنا الـ puberty الـ male الـ female بين الـ

↑ strength of bone

## Menopause → osteoporosis

بيت نقصان الـ استروجن  
او توقف اتاجه

لـ بتأخر لكن الـ growth عنده يطول  
لأن فترة الـ puberty الـ effect of the T الـ  
لأنه الـ closure of epi- الـ وتأخر  
بتكون اضعف على الـ

- 8) **Estrogens slightly increase protein deposition** (more in males)
- 9) **Sodium and water retention by the kidney.** Slight effect but during pregnancy the tremendous formation of estrogens by the placenta may contribute to **body fluid retention**  
in normal conditions (non pregnant women) → Na<sup>+</sup>/H<sub>2</sub>O retention  
بتكون خفيف جداً الـ  
لأن في الحوامل الـ بصير الـ production of large amount of estrogen  
فبصير عندهم body fluid retention الـ الـ بياخد الـ contraception
- 10) **Estrogens increase body metabolism and fat deposition** (subcutaneous tissues, breasts, buttocks and thighs)  
فبصير عندهم increase in the weight

## More subcutaneous fat in women than men

رؤو ما الـ تأثير على الـ hair في الـ sexual areas...

6) الـ استروجين على الـ hair distribution تأثير قليل ... الـ hair الـ الـ بياشر عليه mainly adrenal androgen الـ الـ بريدوا

عند البلوغ ... يختلف عن الـ الـ الـ Dr Iman Aolymat  
development of male hair الـ الـ الـ pattern



for preparing the uterus for the implantation of fetus. **هي عملية في جدار الرحم** preparation of the uterus for the pregnancy **يكون في النصف الأول** dominant in the first half

# Functions of Progesterone

Secretory changes in the uterus **E** حتى يصرح **بعد الاغتناف** ovulation ← mainly in the 2nd half of the cycle

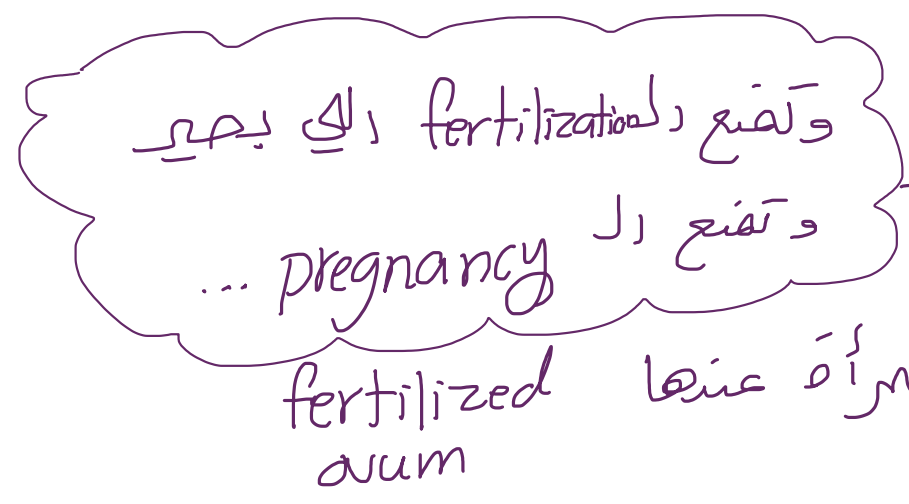
**Promotes secretory changes in the uterus during the latter half of the monthly female sexual cycle** suitable for implantation of an embryo (secretory phase).

**2. Decreases contraction of uterine tubes and myometrium** (decreases expulsion of implanted ovum). **تخفف من تقلص** relaxation effect on

**3. Stimulates breast growth, and swelling** particularly glandular tissue. **النساء الذي يتخذون Progesteron pills (حوامع الحمل التي تحتوي على P) هي النقطة التي تمنعها في contraception** **تحسين** improvement of fallopian tube and myometrium **حتى تضع انتقال البويضة** mainly fallopian **لشرحها في البروستات** swelling of the breast

**4. Increase mucosal secretions of the fallopian tubes** to provide nutrition to the fertilized dividing ovum which traverses the tubes towards the uterus body.

**5. Changes the cervix mucus into thick and sticky** (cervical plug). → **شرحها بالسلايد (28)**



**2** \* هي العملية مهمة في النساء الذي يتخذون **contraction** ← **لأنه تقييد** contraceptive **مهم جدا حتى ما يصر فيه** **abortion** **عندما المرأة عنها** **عندما يصر فيه** **abortion** (Dr Iman Aolymat)

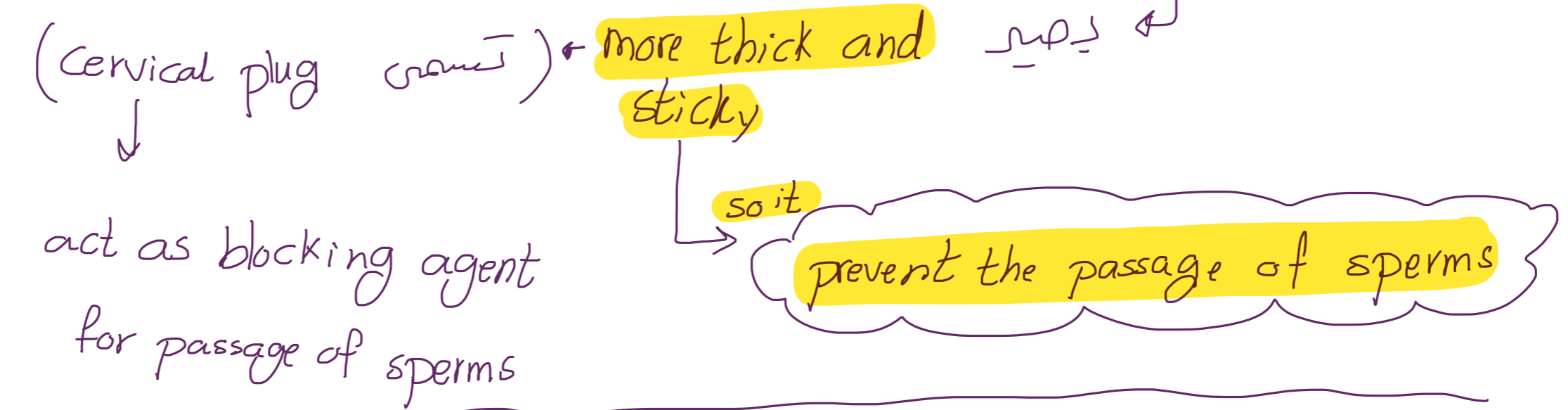
نقطة (3)

عشان هيك الادات عندهم اسني اسمه cyclic breast pain بغير نتيجة التغيير في الهرمونات في ال 2nd half of menstrual cycle بزيد ال progesterone

فالعينات بسو بـ enlargement, pain in the brest نتيجة ال effect of progesterone

(cyclic breast pain due to hormonal changes, usually come bilaterally)

نقطة (5) الزيادة في ال cervical mucus يعتمد عليها في ال contraceptive



very important point

Combined E+P inhibition for milk production

ما ينطوي لانه يسهل ال milk production

ال E+P ال ينطوي

the progesterone → ↓ motility

→ ↑ thickening of the cervical plug

so, it used in contraception

× في ال P contraceptive يعطوهم فقط في ال lactating ladies (breast feeding women)

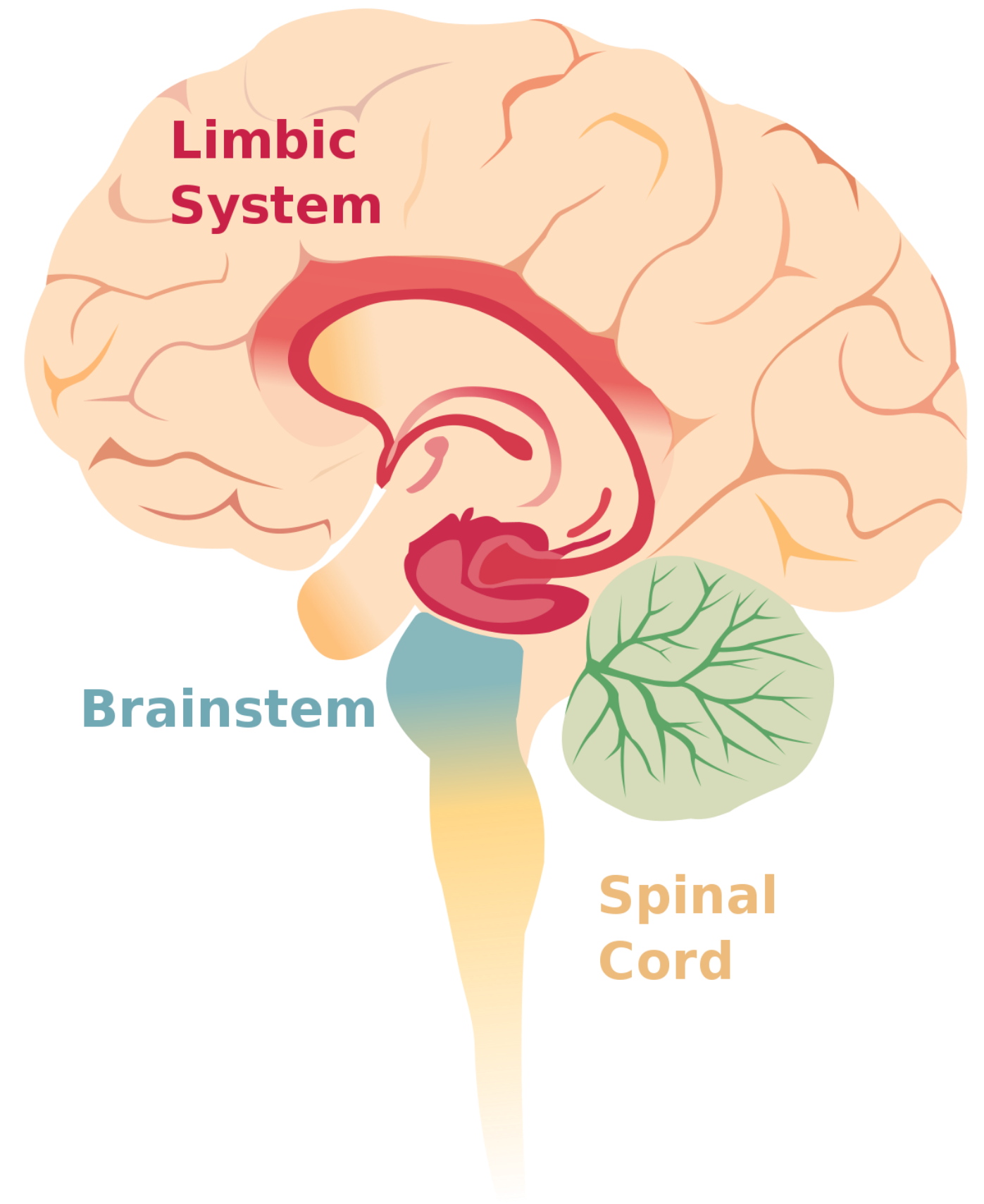
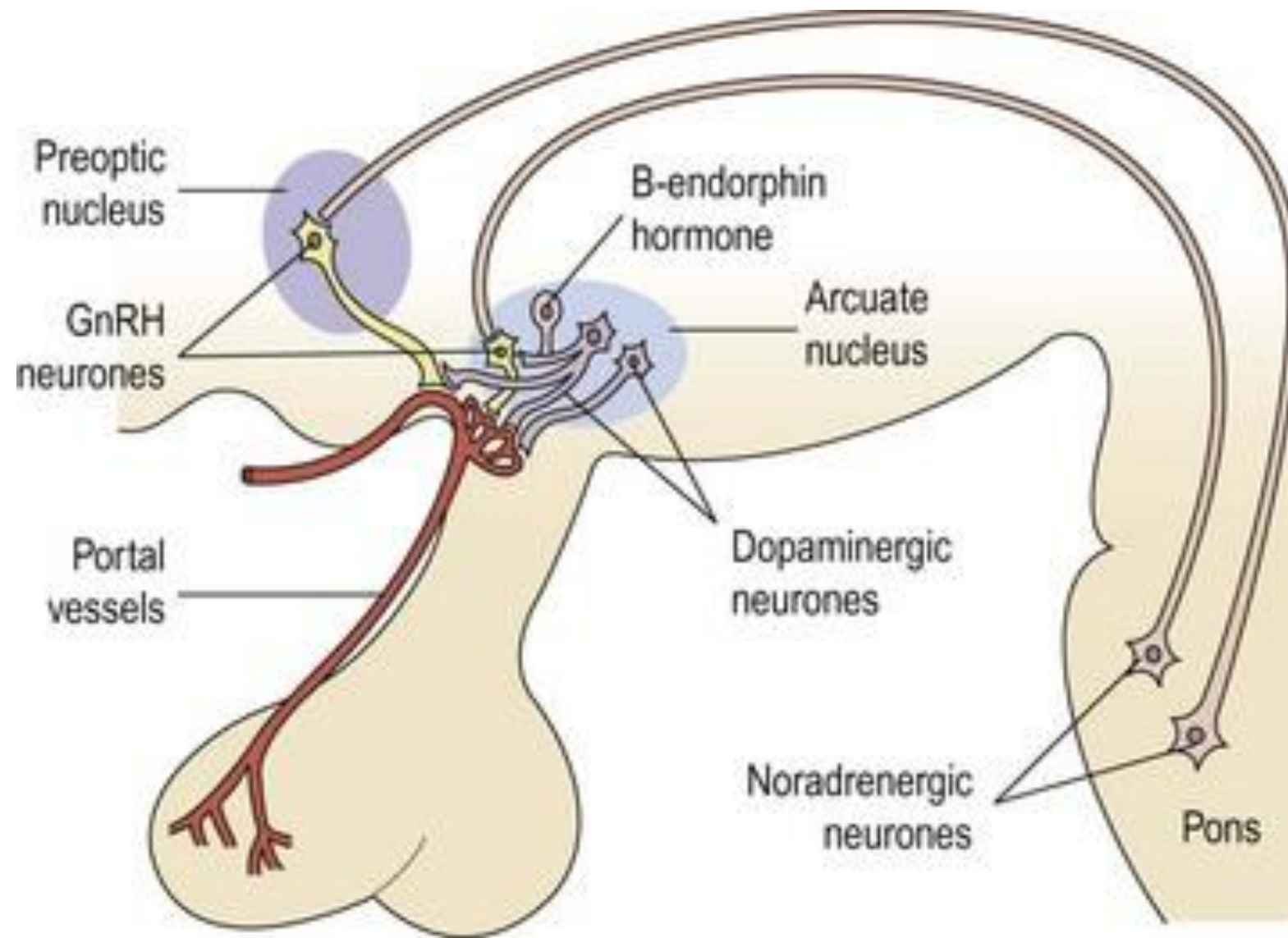
لانه لو اعطوا ال pills الي فيها E+P مع بغير فيه inhibition for milk production

بالتي ال P دجوا انه ما له effect على ال milk production لذلك ينطوي only for the lactating ladies



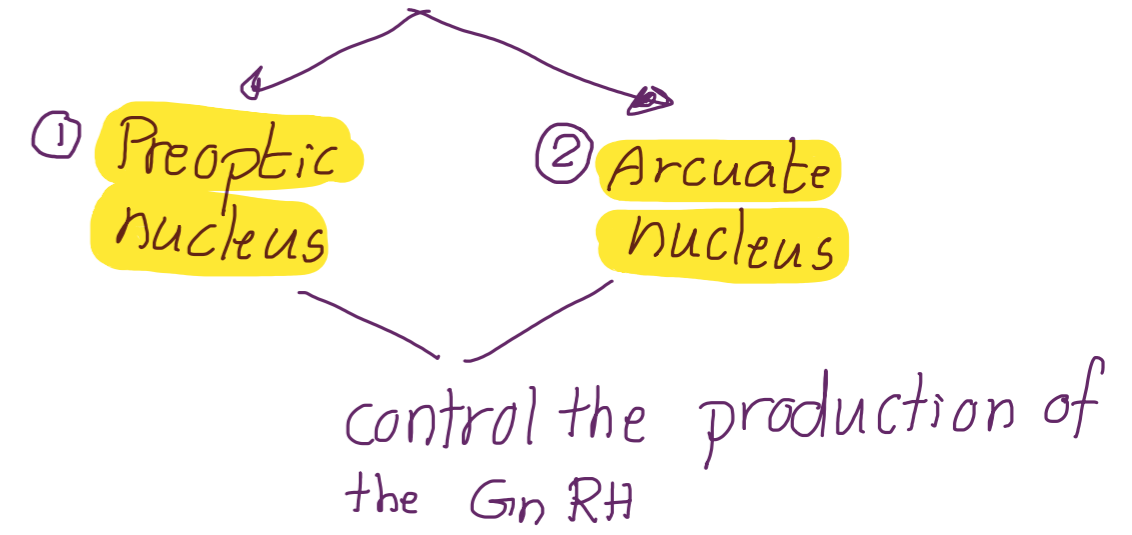
# Overview of Hormonal Regulation

نفس الهرمون ممتد يعمل positive feedback أو negative feedback في ظروف معينة وفي أوقات معينة من الـ circulation





1] تثبيط عملية الـ regulation في الـ hypothalamus ← هون الـ gonadotrophs بتفرز الـ GnRH  
 في عنا two main areas يتحلوا في الـ hypothalamus



لغوي يبلت secretion لوقن  
 معين بعدين بتوقف -  
 بترد تغير نفس الـ cycle  
 \*عنا يصير  
 Continuous secretion

production of GnRH لما يصير عنا  
 hypothalamic-hypophyseal portal system. بنزل عن طريق الـ  
 anterior pituitary الـ

it is not effective in the stimulation of anterior pituitary  
 وبالتالي بتوقف الـ production of LH and FSH

IN PULSTAIL manar ← production of GnRH  
 عملية الـ

بها انعم بتفرزو في pulstail manar تقريباً كل (5-20 min every 1-2 hours)

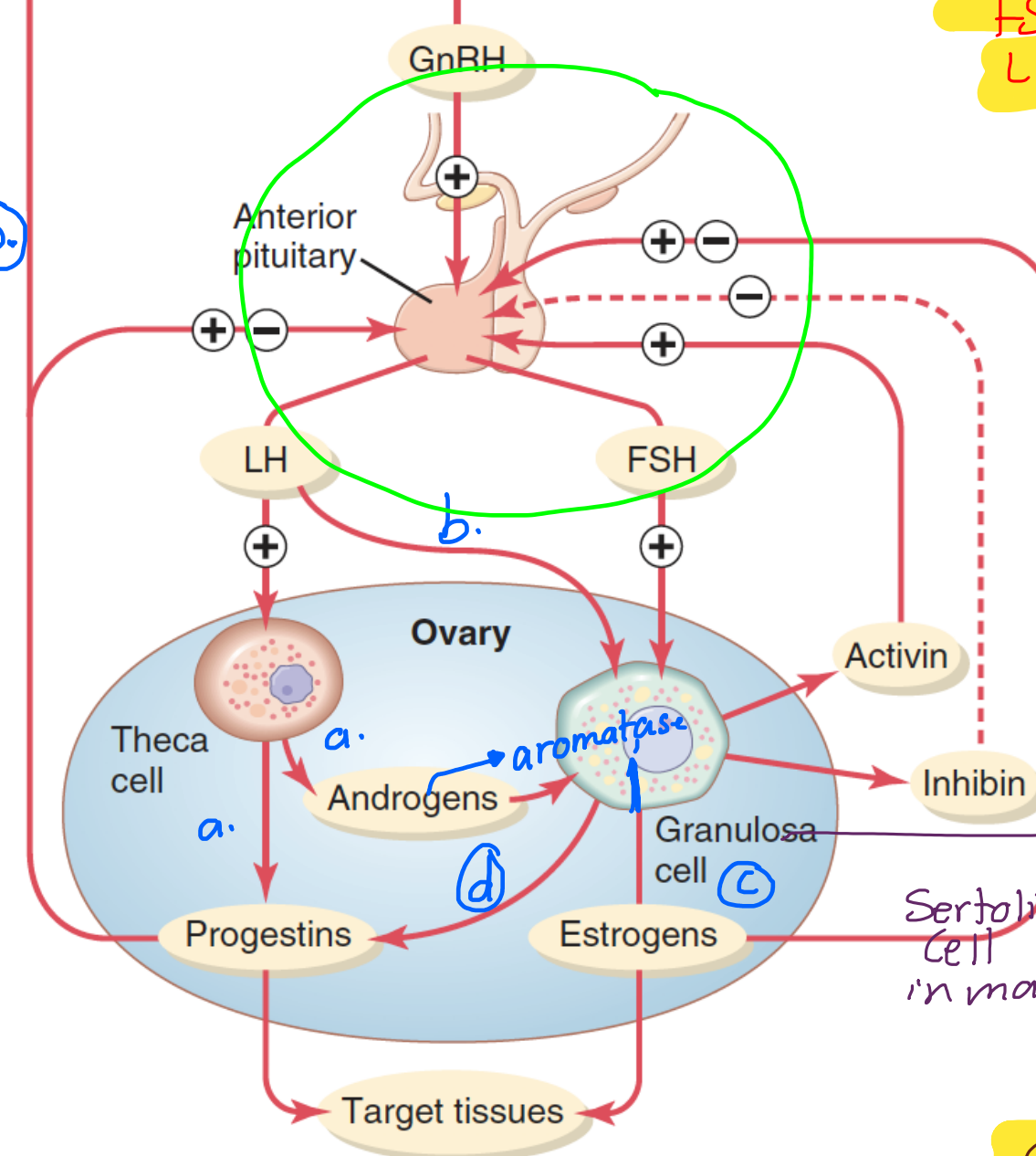
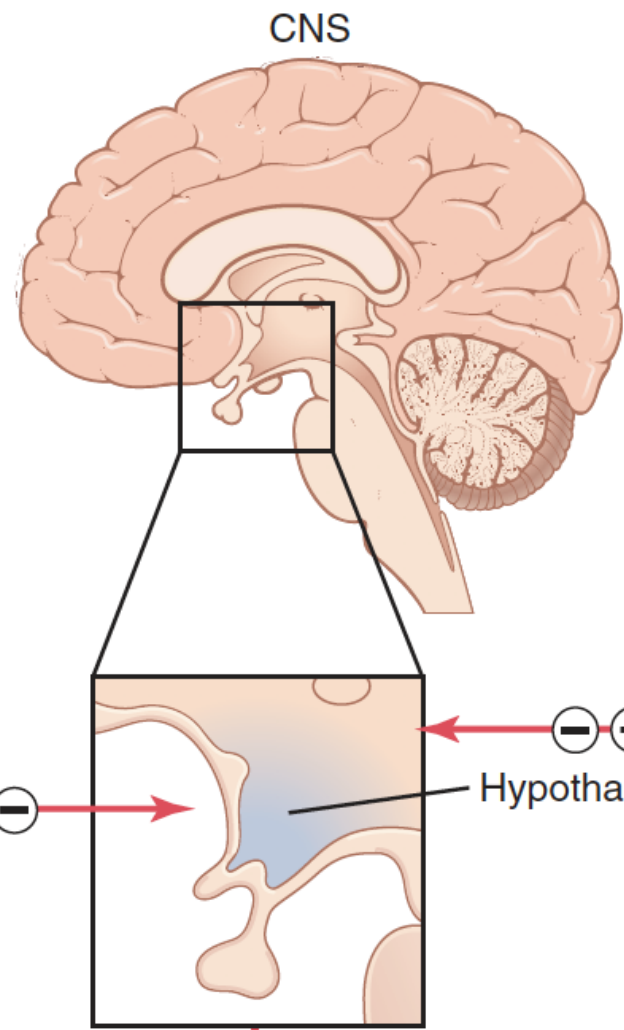
GnRH in children is absent

2] في عنا الـ limbic system ← هون مدراً عشان psychic control of behaviors

بعضو يعمل Control mainly on arcuate nucleus في الـ GnRH  
 معناه انه ياتر → So, any psychic emotions or psychology → Female sexual act

3] رلان بعد ما صار فيه GnRH من الـ hypothalamus وراغ الـ anterior pituitary ← هون يصير فيه release of FSH and LH  
 LH → released mainly in pulstail manar like GnRH but it released every 90 min

# Overview of Hormonal Regulation



[4] هجرد ها صار Secretion of GnRH دراج لا  
stimulation of 2 anterior pituitary hormones

FSH  
mainly act on  
granulosa cells

theca cells  
تفرز يستغل على لا  
a. production لغت يهر عن  
of androgens  
and progesterons

c. حقت يهر فيه  
production of  
estrogen

d. ولمان يهر  
production of  
progesterone

واينما يهر فيه  
كويل لا  
androgens  
عن طريقه  
aromatase  
لاكي  
estrogens

b. لنفس الوقت لا  
يهر stimulation على لا  
granulosa  
cells

end of the cycle \* لا inhibin هجمه جديا بال  
P + E لما يهره ال

LH + FSH فلو يهر ال  
at the end of the cycle  
(2nd half of the cycle)

يفي ال inhibin يستغل على لا  
FSH + LH  
تكن mainly on  
FSH

وهو يستغل على ال LH  
to a lesser extent

ال granulosa cells بال لا  
لا P + E تفرز  
two other hormones زي ال

activin

Inhibin

positive feedback  
activation of FSH

negative feedback  
inhibition of FSH



↑ feed back ( negative أو positive ) ← P + E ↓ \*

\* The feedback mechanisms in the female is complicated

① the negative feedback of Estrogen and progesterone on LH and FSH production :-

mainly on anterior pituitary → ↓ FSH + ↓ LH secretion

Small amount of estrogen → negative feedback inhibition (LH + FSH)

البيروستيرون ← قليل ، لتأثير تبعه على الـ -ve feedback

لكن اذا وُجد ← progesterone + small amount of E ← -ve feedback effect  
mainly on anterior pituitary

له يستعمل على الـ hypothalamus لكن

Strongest effect  
on anterior pituitary  
hormones

Small amount of Estrogen  
تتصرف اذا انوجد

2 Positive feedback of Estrogen (slide 34)

in the lower part of the graph

the LH surge → starts 1-2 days before the ovulation

24h - 44h - sharp increase in the LH

the increase in the concentration of LH before the ovulation...  
 ← تصريحا من 7-10 ساعات

بنفس الوقت يجبرنا small FSH surge

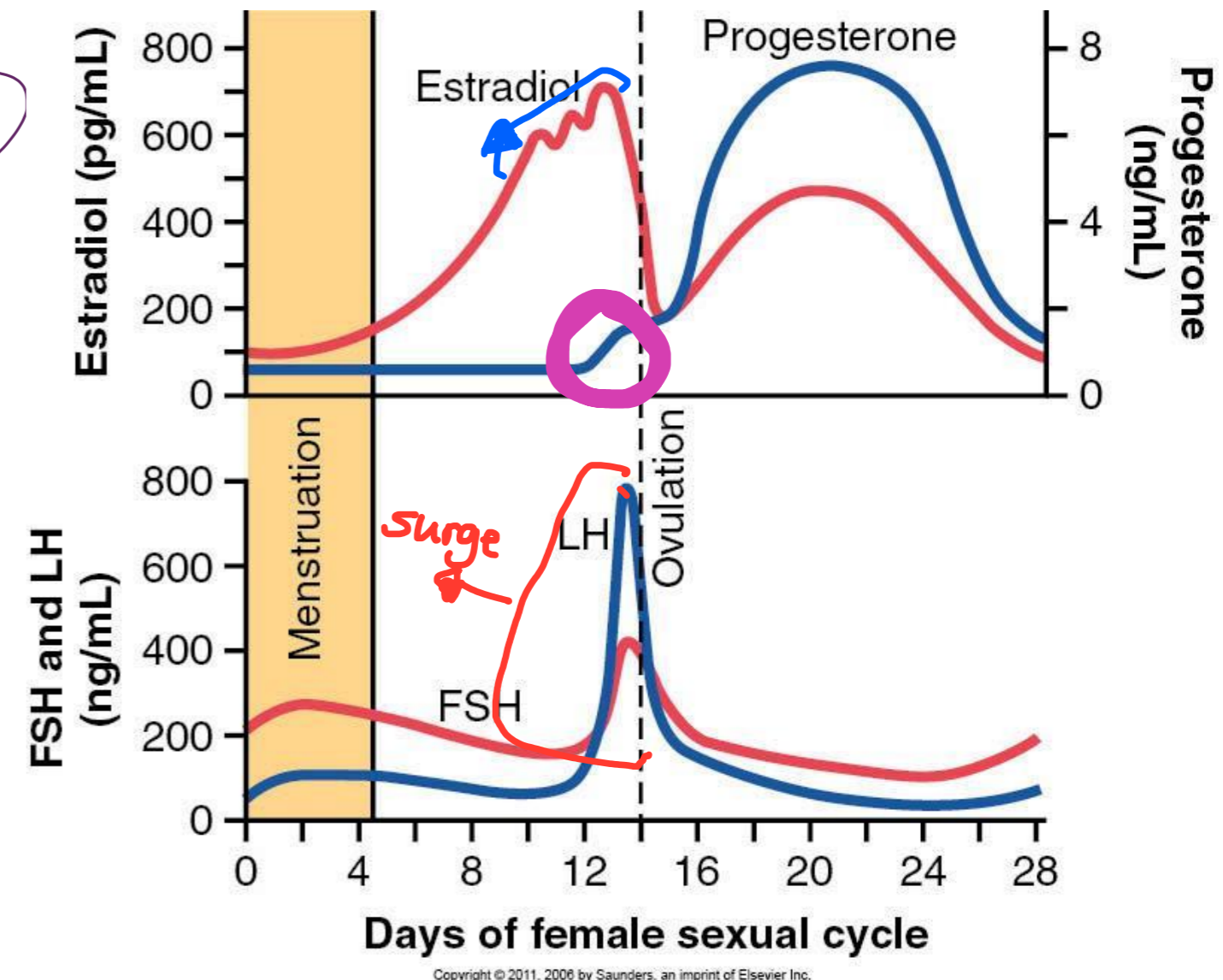
2-3 folds increase in the FSH at the same time of ↑LH

سبب زيادة الـ LH surge والـ FSH هس معروف بسبب

سبب الزيادة الليبره في الـ E في هذه المرحله من الـ cycle

قبل الـ ovulation هي التي بتعمل +ve feedback عنها ينتج الـ LH surge activation of the surge of LH

مع انه الـ E باوقات اخرى من الـ cycle ← بعمل -ve feedback

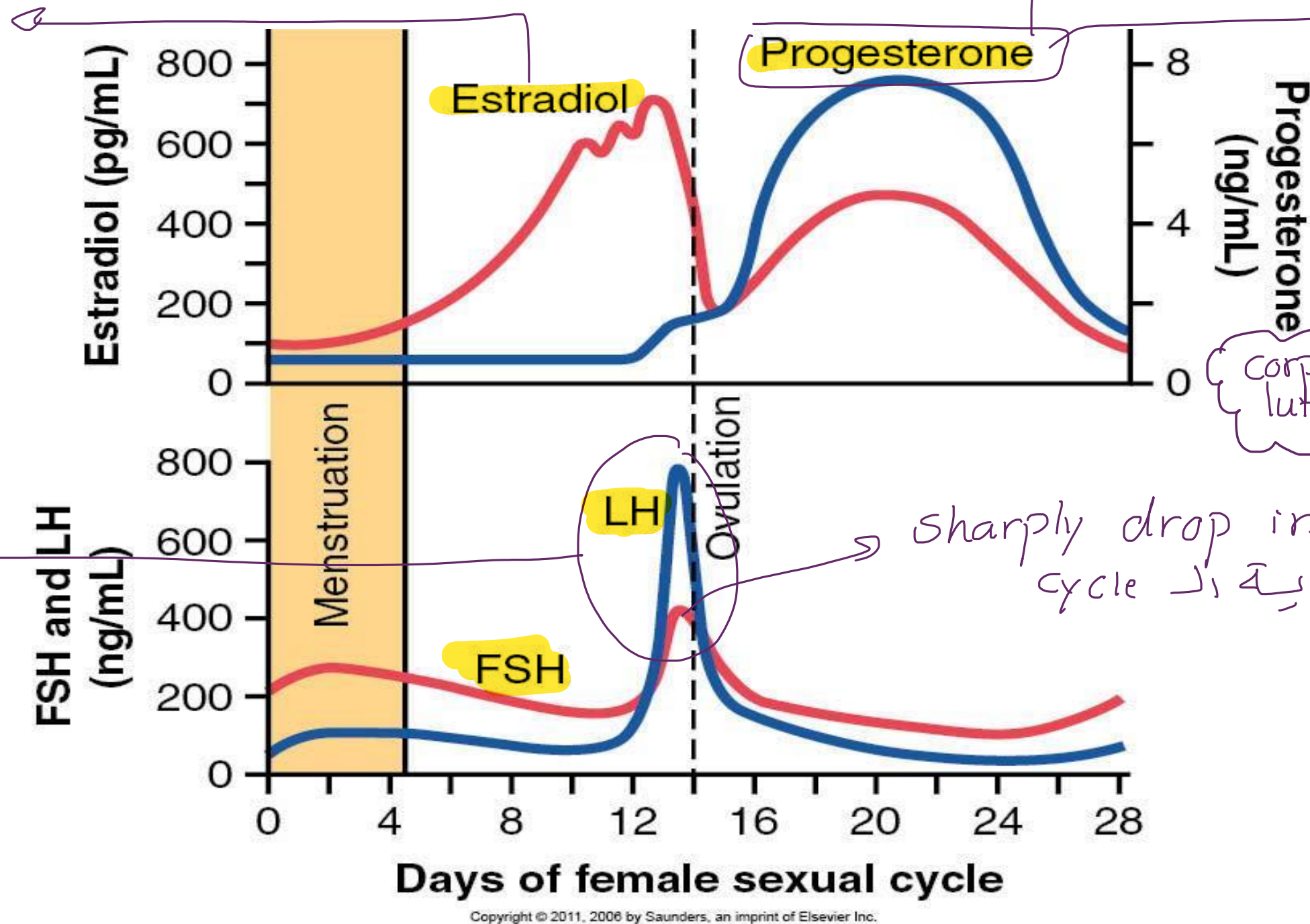


2 قبل الـ ovulation في عا زيادة في الـ P secretion من الـ granulosa cells وهاي الزيادة بتلعب دور في الـ LH surge



# Feedback oscillation of the hypothalamic-pituitary-ovarian system

dominant in the 1st half



dominant in the 2nd half of the cycle...

in the 2nd half of the cycle → drop in Estradiol before the day of ovulation

Corpus luteum.

بعد ذلك يرجع يرتفع من الـ

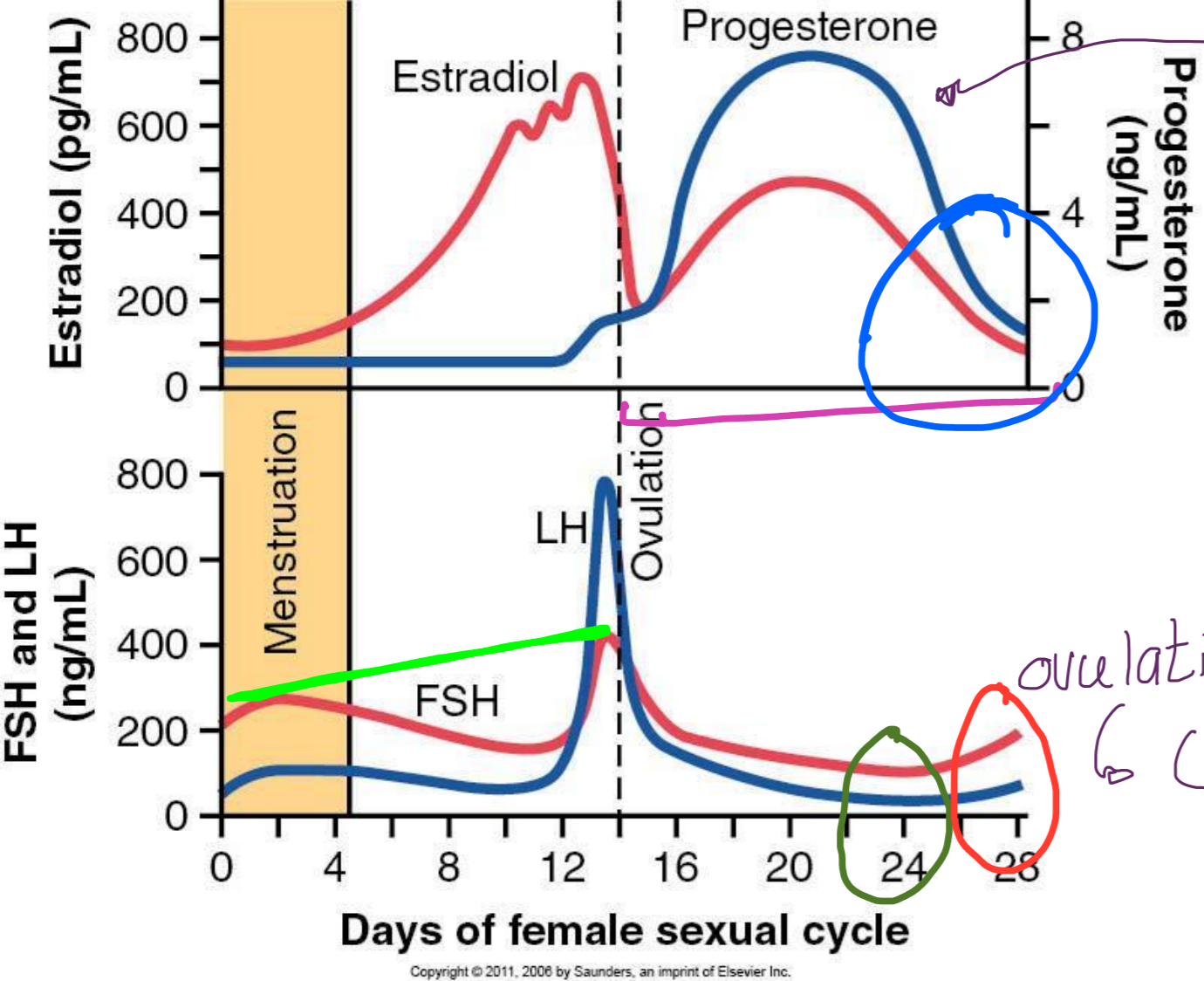
↑LH + ↑FSH near ovulation

Sharply drop in LH + FSH cycle كد تقريباً نهاية الـ

\* the +ve feedback of LH and FSH in the mid of the cycle لها علاقة بـ

① Sharp increase of E before the ovulation  
↳ +ve feedback on LH surge

② ↑ progesterone from granulosa cells  
↳ activation of the LH surge



\* من الـ ovulation إلى الـ menstruation يهبط عننا زيادة في الـ P والـ E من الـ corpus luteum ولما كان فيه معاهم زيادة في الـ inhibin

فاي الزيادة في الـ E + P ← بتراجع تعمل -ve feedback

\* الـ +ve feedback في منتصف الـ cycle حتى يهبط عننا ovulation  
 (high E → +ve feedback → LH + FSH surge)

\* عند ذلك الـ E بعمل -ve feedback

ولما يزيد الـ P + E في الـ 2nd half of cycle ← result in Sharp decrease in LH + FSH  
 (-ve feedback on anterior pituitary and the hypothalamus result in inhibition of LH and FSH secretion)  
 ومعاهم الـ inhibin

أقل مستوى لـ LH + FSH يكون في 3-4 days before the menstruation

\* قبل الـ menstruation رجع يهبط فيه involution of the corpus luteum بيليش يهبط في نهاية الـ cycle  
 وبما انه صار فيه involution ← رجع ينزل الـ E والـ P والـ inhibin نزلو لهم بهاي الفترة رجع يهبط الـ -ve feedback  
 فيلش الـ LH حرك الـ FSH يزدادوا

\* عند بداية الـ menstruation في زيادة في الـ FSH تقريباً موازية للزيادة في منتصف الـ cycle وپرضو الـ LH  
 نزداد لكن بكميات أقل



له ليشت ال FSH وال LH يرجعوا يزيديا ؟!

لانه ح تبتس عنا ال follicular phase ← فال LH + FSH مهمين عشان ال follicular growth



بالتاك يجهر عنا زياده  
في E من ال follicles

\* زياده ال estrogen ح يزيدي progressively

وال peak ← 16 h before the ovulation ( يعني باليوم 12.5 - 13 من ال cycle )

هاي الزيادة ح تعقل +ve feedback on FSH

So, the estrogen → mainly result in -ve feedback

but in the mid of the cycle

↳ result in +ve feedback

→ No ovulation (mainly in puberty)

## Anovulatory Cycles—Sexual Cycles at Puberty

موقع في عملية الـ ovulation  
around the mid cycle

preovulatory surge of LH is not sufficient → anovulatory cycle

### Consequences

- failure of development of corpus luteum
- no secretion of **progesterone** during the latter portion of the cycle
- cycle is shortened

تكون normal (menarche)

The first few cycles after the onset of puberty are usually anovulatory, as are the cycles occurring several months to years before menopause

لأنه جسمها لم يسهل بها هنز الحمل

لأنه كل ما كبرت المرأة  
تتزداد نسبة هرمون التستوسترون  
في المبيضات... فهذا يؤدي  
تورمال عندها حتى لا يحدث  
حمل.



عشان هيك ارتفاع ال LH و FSH في ال female [5]

indication for ovarian failure  
It's a bad sign in reproductive age

# PUBERTY AND MENARCHE

[1] The period of **puberty** is caused by a **gradual increase in GnRH** by the pituitary beginning in about the **eighth year of life**, and usually culminating in the onset of puberty and menstruation between ages **11 and 16** years in girls (average, 13 years).

[6] لكن في ال old ages يكون normal

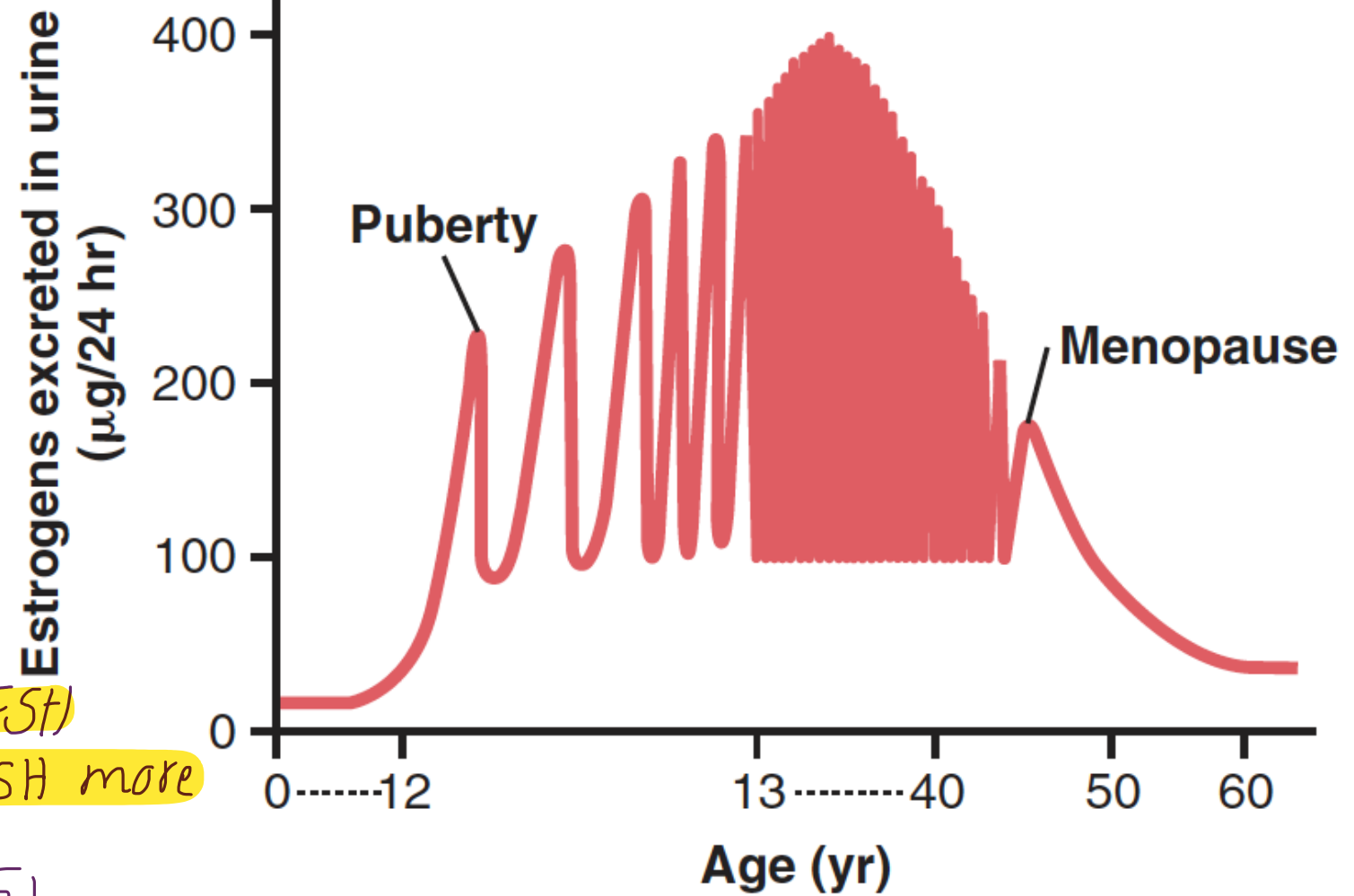
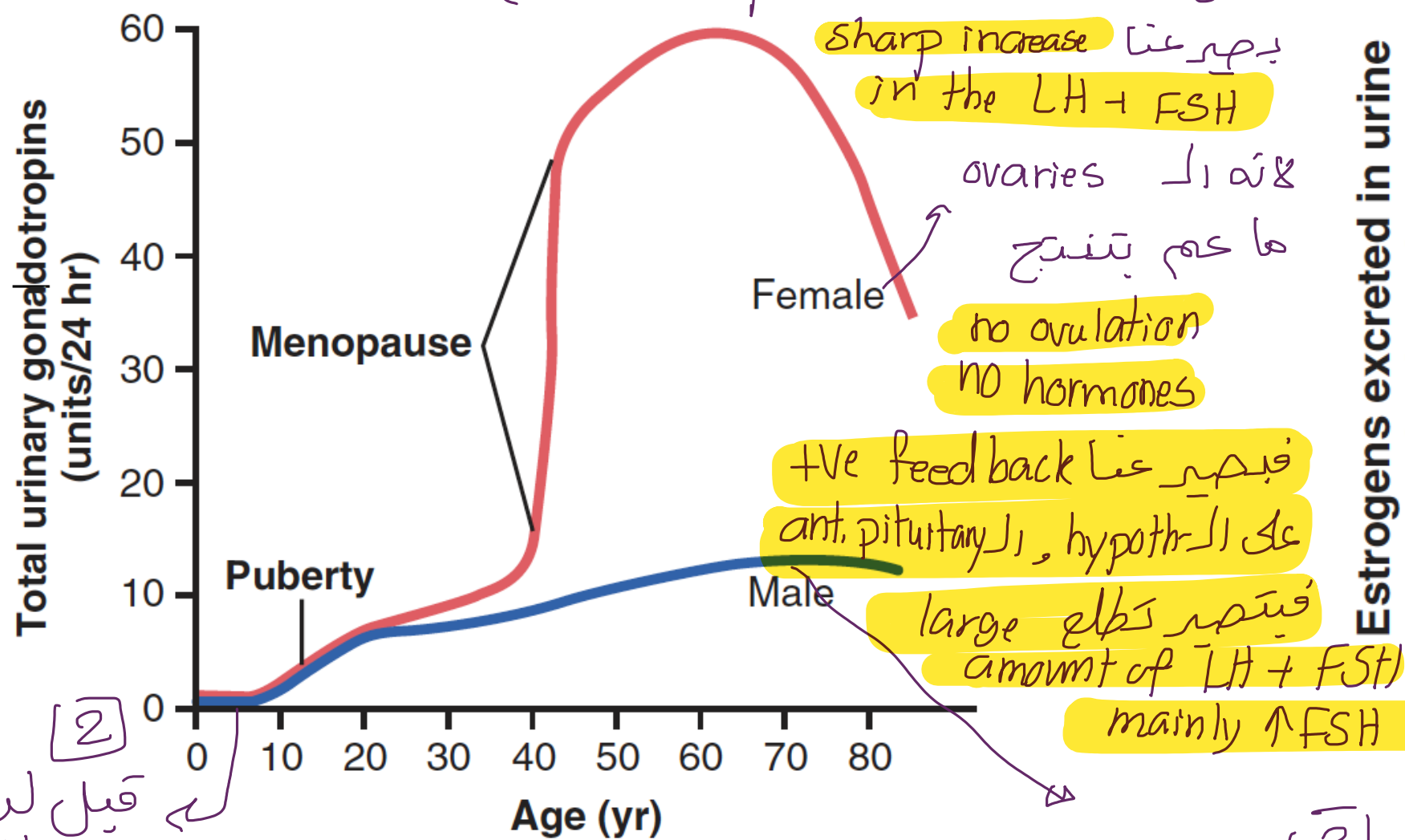
لانه هاني ovulation

لجهر Sharp increase in FSH+LH

the hypothalamus does not secrete significant quantities of GnRH during childhood.

لحد عمر ال 65 وبعد هيك بيكس ينزل ...

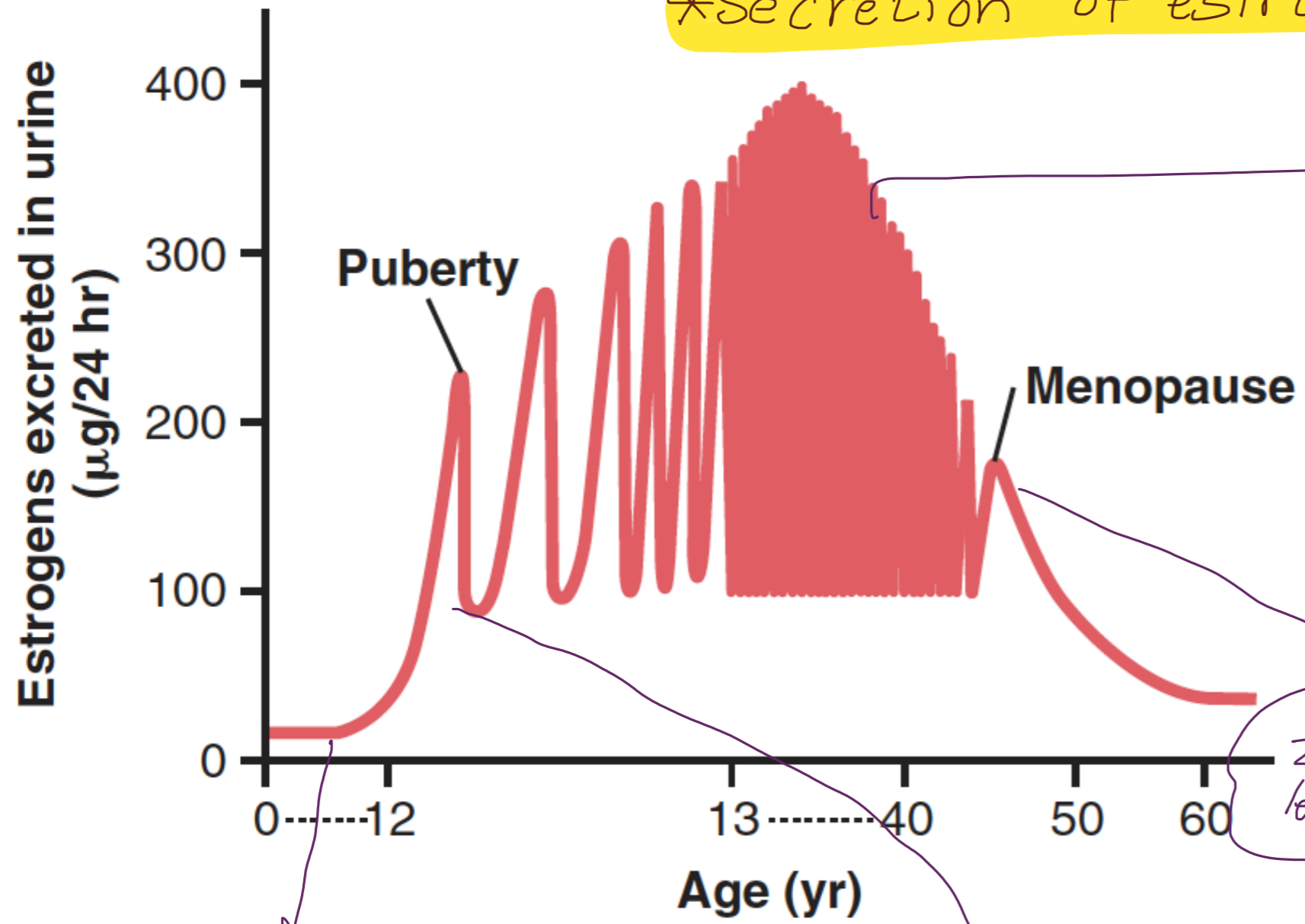
[4] لكن في ال female بيكس ال GnRH بعد ديلووع و قريب من عمر ال menopause (40)



[2] قبل ليلووع كادهما ال male + female يكون عندهم low amount of GnRH

[3] بيكس ال GnRH يرتفع بعد ليلووع continuous ديسل during the male life

\*Secretion of estrogen during the female life---



③ monthly sexual cycle من  
from reproductive age (13-45 y)  
the cycle become more intense  
cyclical variation in the estrogen

④ بعد هيك بيك يتناقص قريب  
على عدد الـ menopause حتى يوصل تقريباً  
zero level in menopause

① قبل البلوغ  
estrogen level is very low

② cyclic secretion الـ بعد البلوغ بيك الـ  
of estrogen with menstrual cycle  
في بداية الـ puberty بتكون  
less cyclical secretion of variation



# Menopause

دول سي بيبي ال irregularity بعدين تتوقف ال cycle  
ليسي ؟ لانه ال female sexual H بتخف بشكل كبير لكن ال LH و FSH  
بتلدا كميات كبيرة (mainly FSH)

At age 40 to 50 years, the sexual cycle usually becomes **irregular** and **ovulation often fails to occur**.

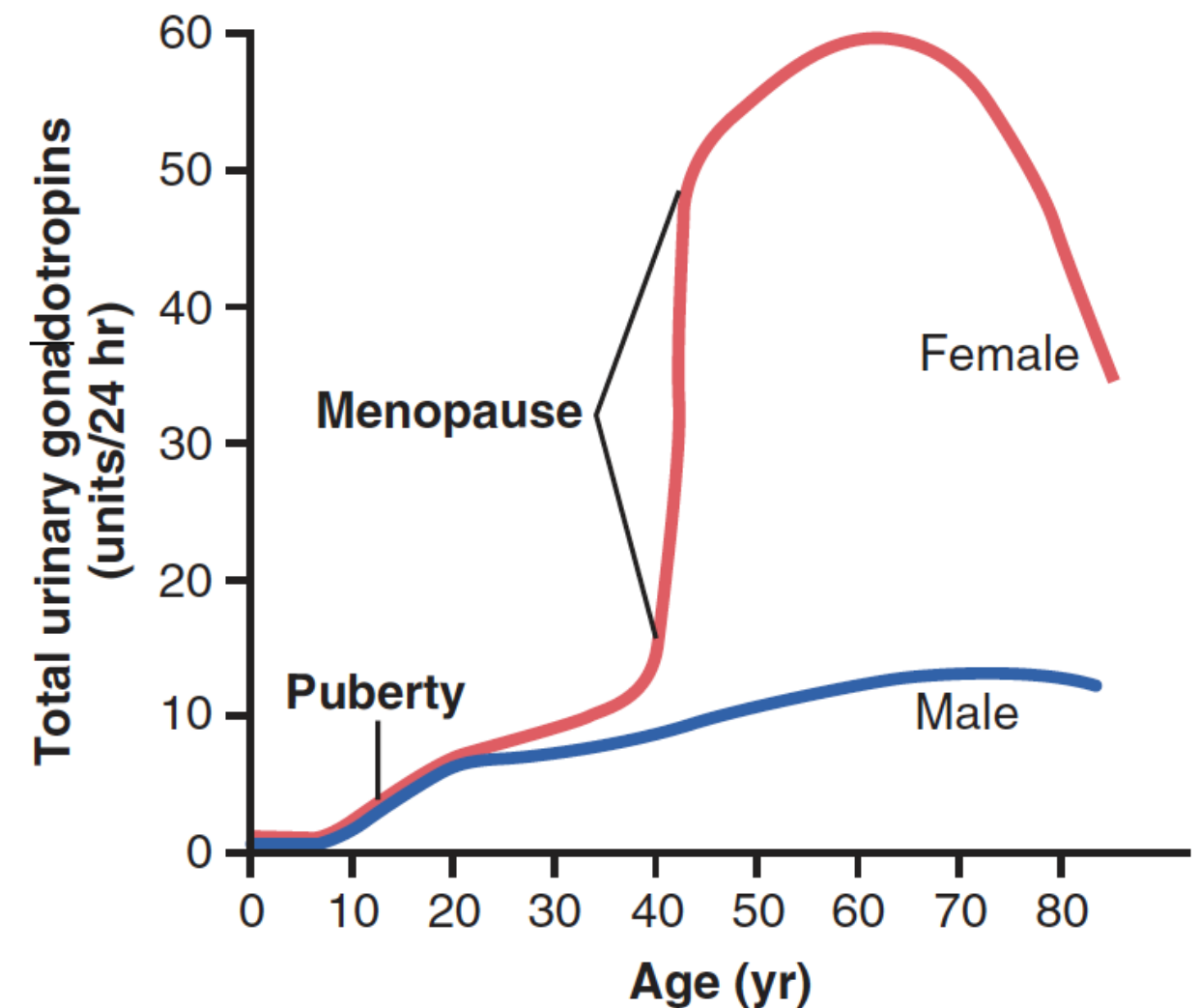
لكل ال E بتون Zero

After a few months to a few years, the cycle ceases

The period during which the **cycle ceases** and the **female sex hormones diminish** to almost none is called **menopause**

estrogens can no longer inhibit FSH and LH

FSH and LH (mainly FSH) are produced after menopause **in large** and continuous quantities



# Menopause

the production of estrogens by the ovaries falls virtually to zero.

The loss of estrogens :

- (1) “hot flushes” characterized by extreme flushing of the skin
- (2) psychic sensations of dyspnea
- (3) Irritability
- (4) Fatigue
- (5) anxiety
- (6) Decreased strength and calcification of bones throughout the body *→ osteoporosis*

Administration of estrogen (HRT) after menopause → ▼ symptoms of menopause, may increase the risk for cardiovascular disease



# Female sexual response

- **Stimulation of the Female Sexual Act.**

- psychic stimulation, local sexual stimulation & thoughts.

*by stimulation of the sexual part*

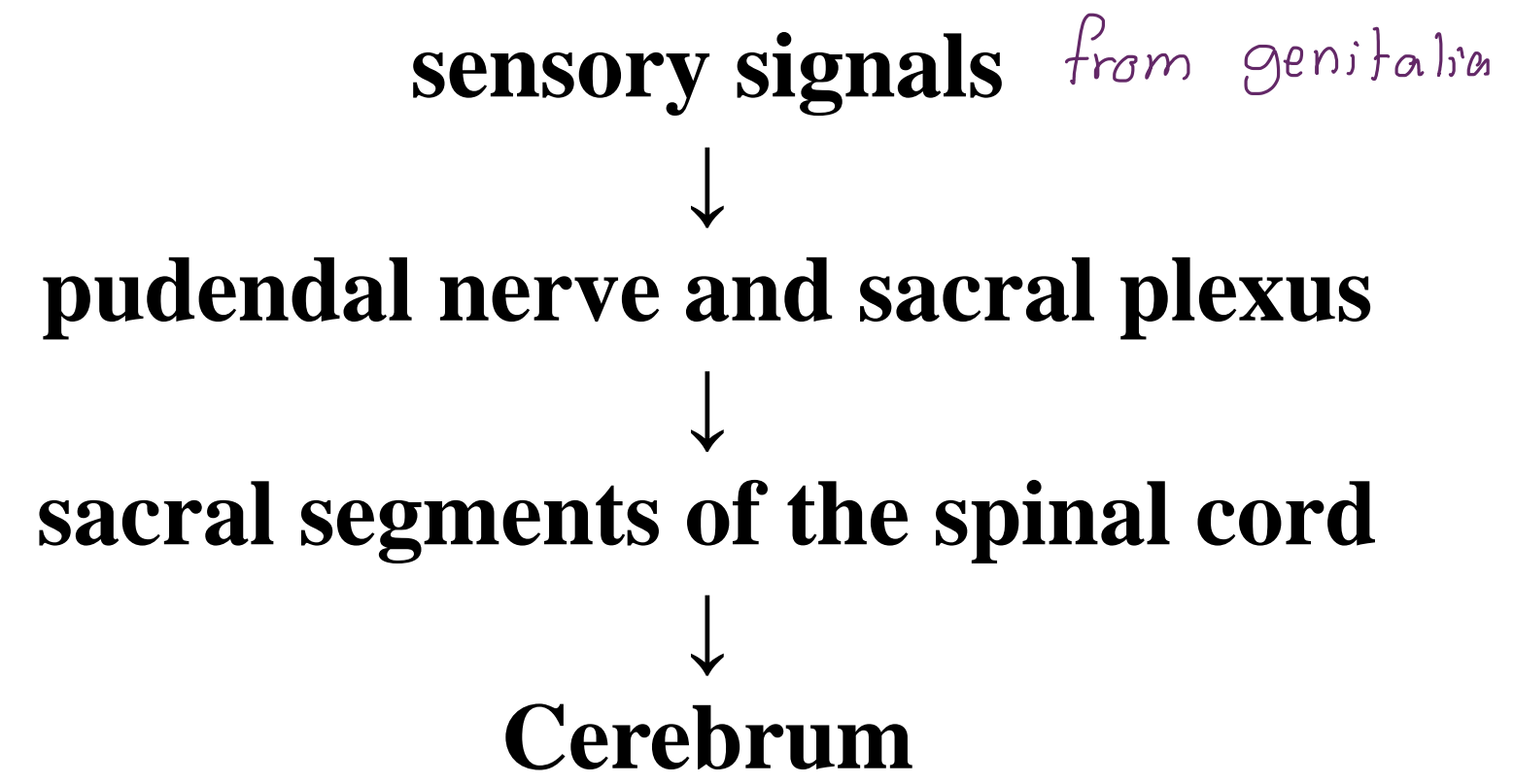
- **Sexual desire** is based on **psychological and physiological drive**

- sexual desire does increase in proportion to the level of sex hormones

- Desire also changes during the monthly sexual cycle, reaching a **peak** near the time of **ovulation**, probably because of the **high levels of estrogen** secretion **during the preovulatory period**.

# Female sexual act

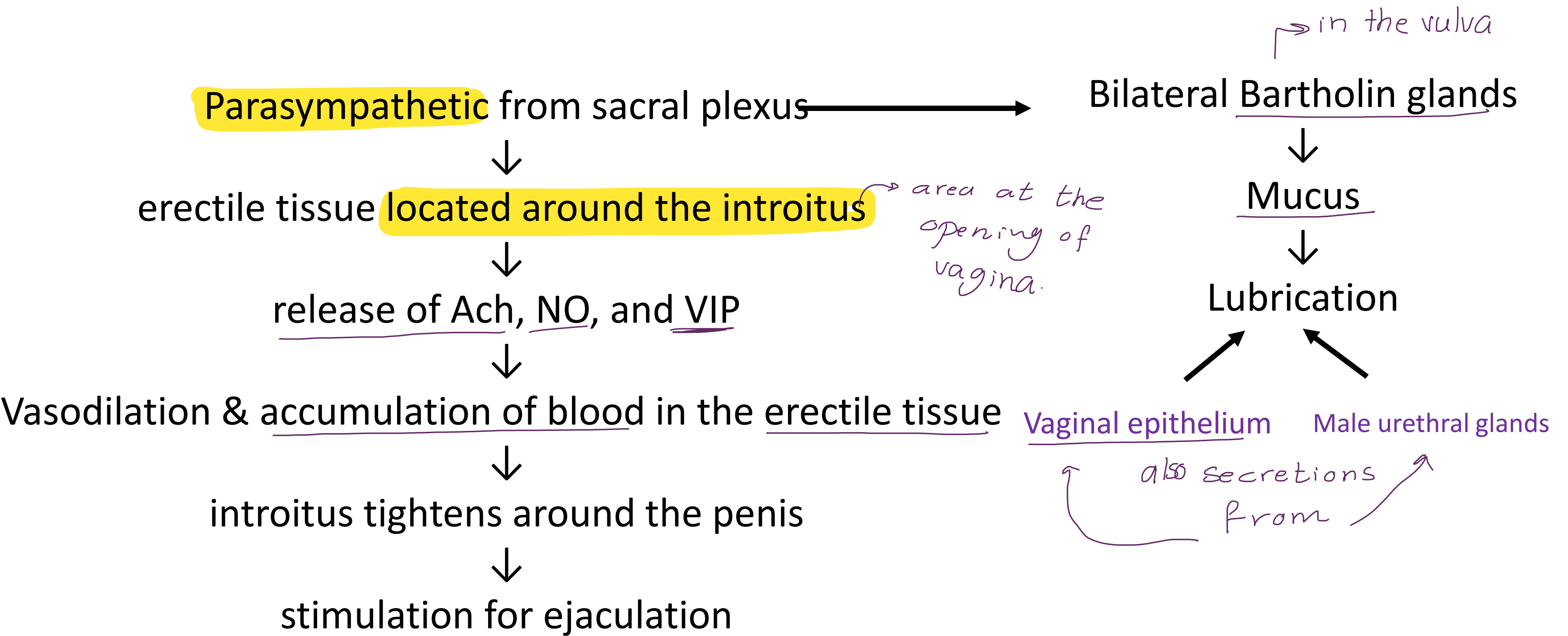
- Sexual stimulation in women is initiated by stimulation of the vulva, vagina, and other perineal regions can create sexual sensations.
- The glans of the clitoris is very sensitive to sexual stimulation





# Female Erection and Lubrication.

*not dominant like the male* → *mainly in the area around introitus*



# Female Orgasm

Female Orgasm (female climax ) : happens when maximal sexual sensation is reached.

This is supported by **psychic conditioning signals** from the cerebrum

female orgasm is analogous to **emission and ejaculation** in the male, and it may help promote fertilization of the ovum.



Process is similar in males and females:

- 1) **Excitement phase**: caused by psychological or physical stimulation; engorgement and erection of clitoris, vaginal congestion -- parasympathetic nerves
- 2) **Plateau phase**: intensification of these responses, increased HR, BP, respiratory rate, muscle tension
- 3) **Orgasmic phase**: culmination of sexual excitement, intense physical pleasure → *in the male or female*
- 4) **Resolution phase**: returns genitalia and body systems to pre-arousal state

## Male and female sexual response

the male after the ejaculation  
process → period of يدخل في  
refraction  
(refractory period)

### Differences:

Sexual act لا يدخل في إلا بعد فترة معينة ويتخلف من male لاخر  
again

- ① Women don't require refractory time before beginning excitation again
- ② No ejaculation in the female



# Fertile Period of Each Sexual Cycle.

The ovum remains viable and capable of being fertilized → 24 hours after it is expelled from the ovary.

for 1 day

لوقت يوم  
sexual intercourse

عشان نصح حتى يوم فيه fertilization

for people who are thinking about pregnancy

↑ around the time of ovulation

Therefore, sperm must be available soon after ovulation if fertilization is to take place.

A few sperm can remain fertile in the female reproductive tract for up to **5 days**.

average 3 days

Therefore, for fertilization to take place, intercourse must occur sometime between **4 and 5 days before ovulation up to a few hours after ovulation.**

Thus, the period of female fertility during each month is short—about 4 to 5 days.

Concept of contraception →

الانثى راي ال period عندها very regular

وتعرف متى ال timing of ovulation

ففي الوقت راي هتوقعه يوم فيه ال ovulation قبل وبعد

ما يصرف فيه sexual intercourse و external ejaculation

لحتى ما يصرف فيه حمل ...

The end



# Pregnancy and Lactation-1

Chapter 83  
Unit X1V

Dr Iman Aolymat

# Maturation and fertilization of the ovum

Secondary oocyte + granulosa cell (corona radiata)



Ovulation



Peritoneal cavity



Cilia activation by estrogen



Beating toward ostium of FT



Ova enters fimbriated end of one of FT



Secondary oocyte at ampullae of FT



fertilization

كامل في منبقة  
ampullae  
of FT

\* ال Ovary متصل مباشرة مع ال fallopian tube  
في بينهم مسافة

\* وال fimbrii of the fallopian tube  
متصلة مع ال Ovary لكن اعلى  
ال ovulation يتدفع على ال peritoneal cavity

(we have two ovaries and two FT)  
\* كل شهر one ovary هو الذي ينتج منه ال Oocyte  
ال ovaries يتناوبوا...

**Sperm**

the sperms are ejaculated in the vagina

**transport of sperm is aided by:**

- 1) contractions of the uterus and FT → PG in seminal fluid
- 2) oxytocin during female orgasm

والذي يساعد على  
contractions of  
the uterus and FT

تعمل negative pressure

تساعد على ال movement of  
Sperms toward ampullae of FT  
والذي يعمل هاهنا ال Contractions  
هي ال 2 PG الذي في ال Seminal fluid

الذي موجود في ال fallopian tube

هاد يساعد

take of ovum from peritoneal cavity into FT

هنا ال per/ ejaculation فيه ملايين من ال sperms لكن عدد ال sperms الذي كقدر توصل ال ampullae of FT Very low



# Fertilization

layer surrounding the ovum

**2** Bind to & penetrate zona pellucida  
release acrosomal enzymes, hyaluronidase and proteolytic enzymes

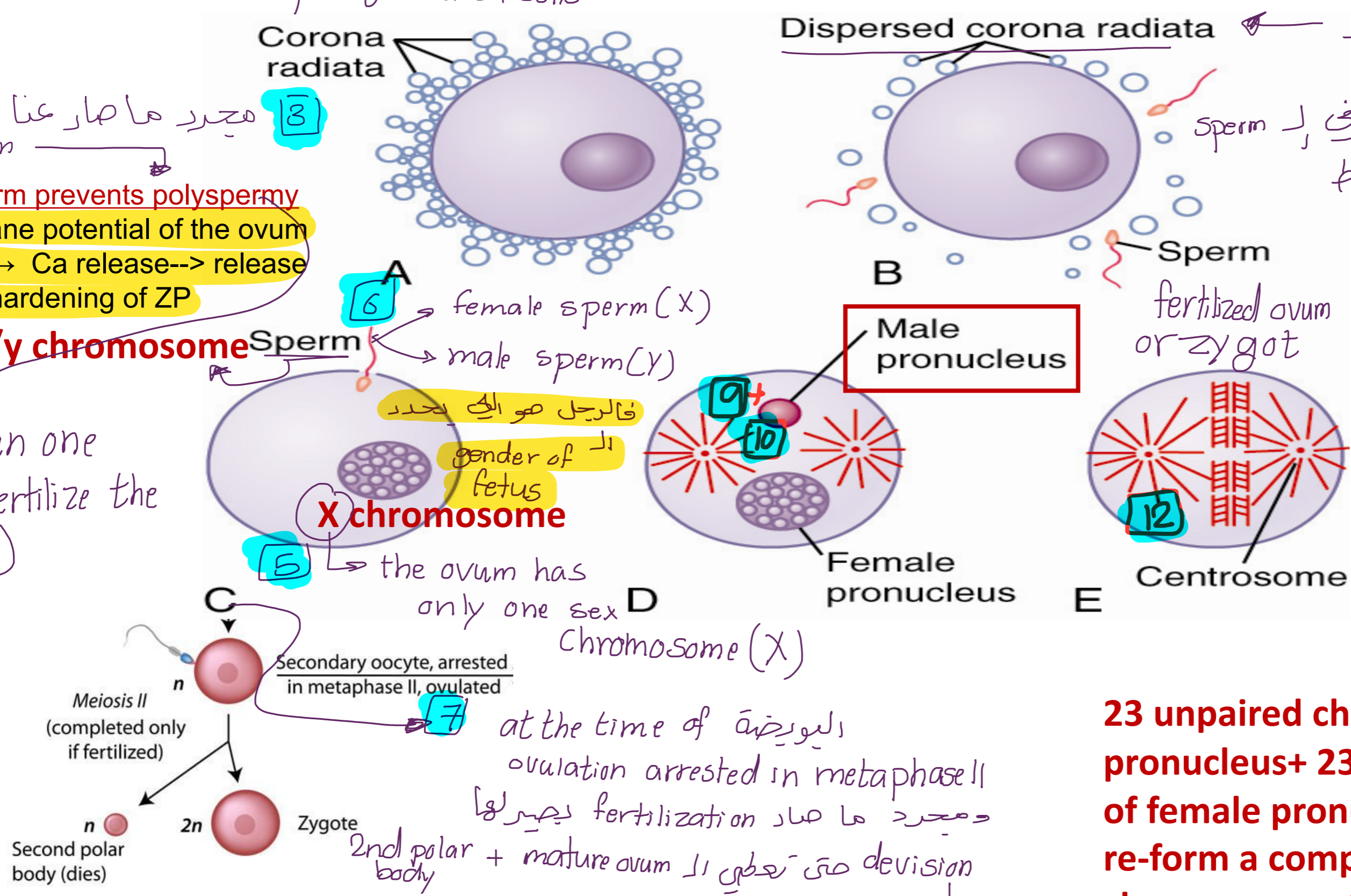
the ovum surrounded by multiple layers of granulosa cells

penetration of one sperm  
هجرة ما صار عننا **3**

**Fusion of 1 sperm prevents polyspermy**  
↓ in the membrane potential of the ovum  
↑ IP3 in ovum → Ca release → release of enzymes → hardening of ZP

**X/y chromosome**

(more than one Sperm fertilize the ovum)



**1** يوجد ال Sperm يهبط

**10** يرضو بهر فيه تغييرات في ال Sperm  
بخفي ال tail ويضل فقط  
ال male pronucleus

fertilized ovum = Sperm + ovum **11**

**12** بعد هيك ال كروموسومات  
من ال male + female  
(paternal + maternal)

يصرفهم alignment  
مع بعض حتى يعطوا ال  
full set of chromosomes  
in the fertilized zygote  
(46 chromosomes)

**23 unpaired chromosomes of male pronucleus + 23 unpaired chromosomes of female pronucleus align themselves → re-form a complete complement of 46 chromosomes (23 pairs) in the fertilized ovum or zygote**

**Once a sperm has entered the → the oocyte divides to form mature ovum + second polar body**

**8** بهر عننا تغييرات  
بستركز المادة الوراثية

المature ovum ال cytoplasm يبقى لي ال  
Dr Iman Aolymat  
ال ال 2nd polar يتخلص من نصف المادة الوراثية

**9** بعد هاي التغييرات بهر عننا  
Female pronucleus  
genetic material ← فيها

# Transport of fertilized ovum

from the site of fertilization (ampullae of FT) into uterine cavity ...

- 3 - 5 days after fertilization → ovum is transported to U cavity

## Aided by:

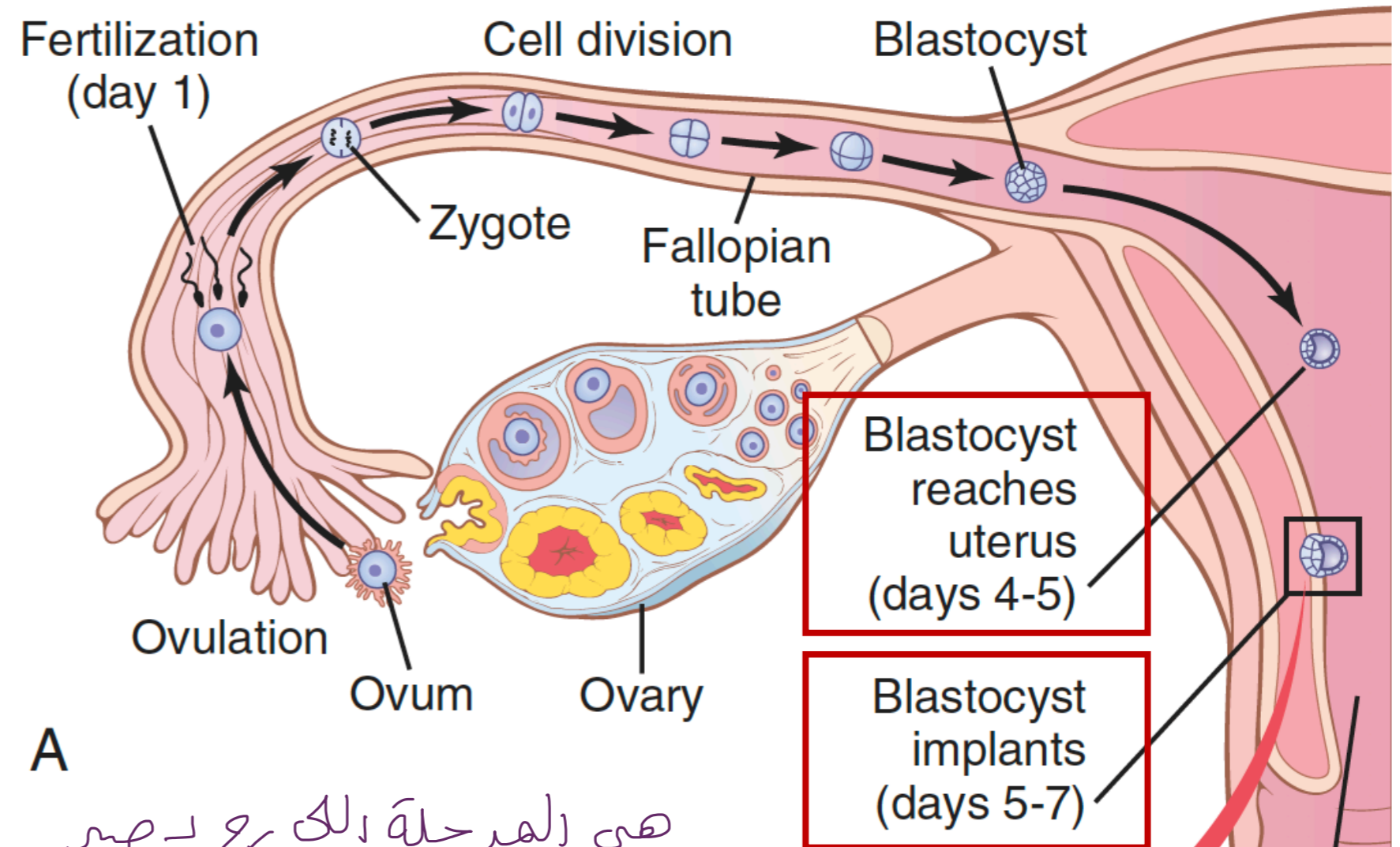
1. Epithelial secretions *from FT*
2. Cilia action
3. Weak contractions of fallopian tube

قناة حركة ال fertilized ovum من ال ampullae في ال U cavity

Several division of the developing embryo take place before implantation (blastomere → morula → blastocyst)

2 cells      16-32 cells      50-100 cells

و بعد 5-7 يوم بعد (fertilization) ← تتفقد يوصف (يعني في اليوم 5-7 بعد (fertilization))  
و بعد 5-7 يوم بعد (يعني في اليوم 5-7 بعد (fertilization))



A

هي المرحلة التي بعد  
فيها ال implantation  
تدخل على ال uterine cavity  
4-5 days after fertilization

و ما يهر لها implantation مباشرة



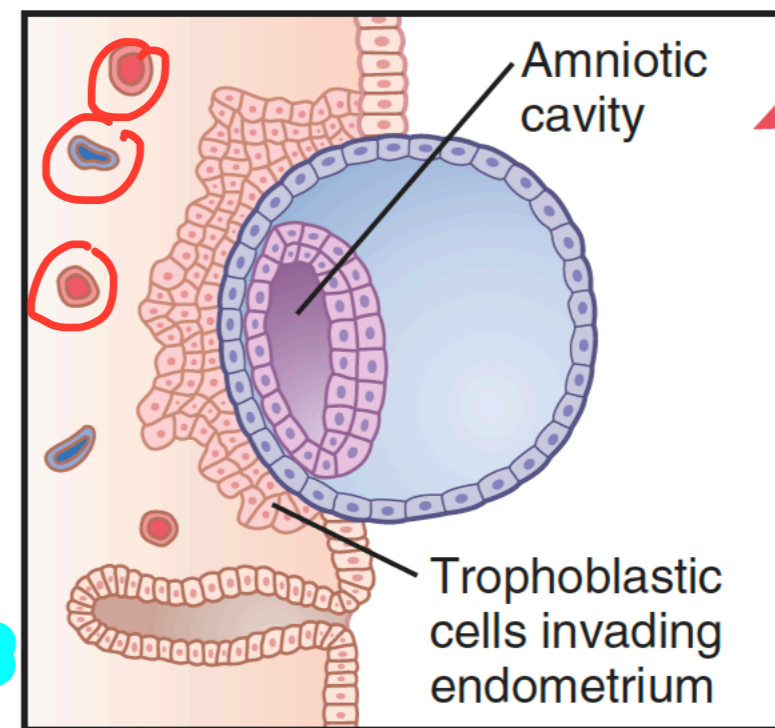
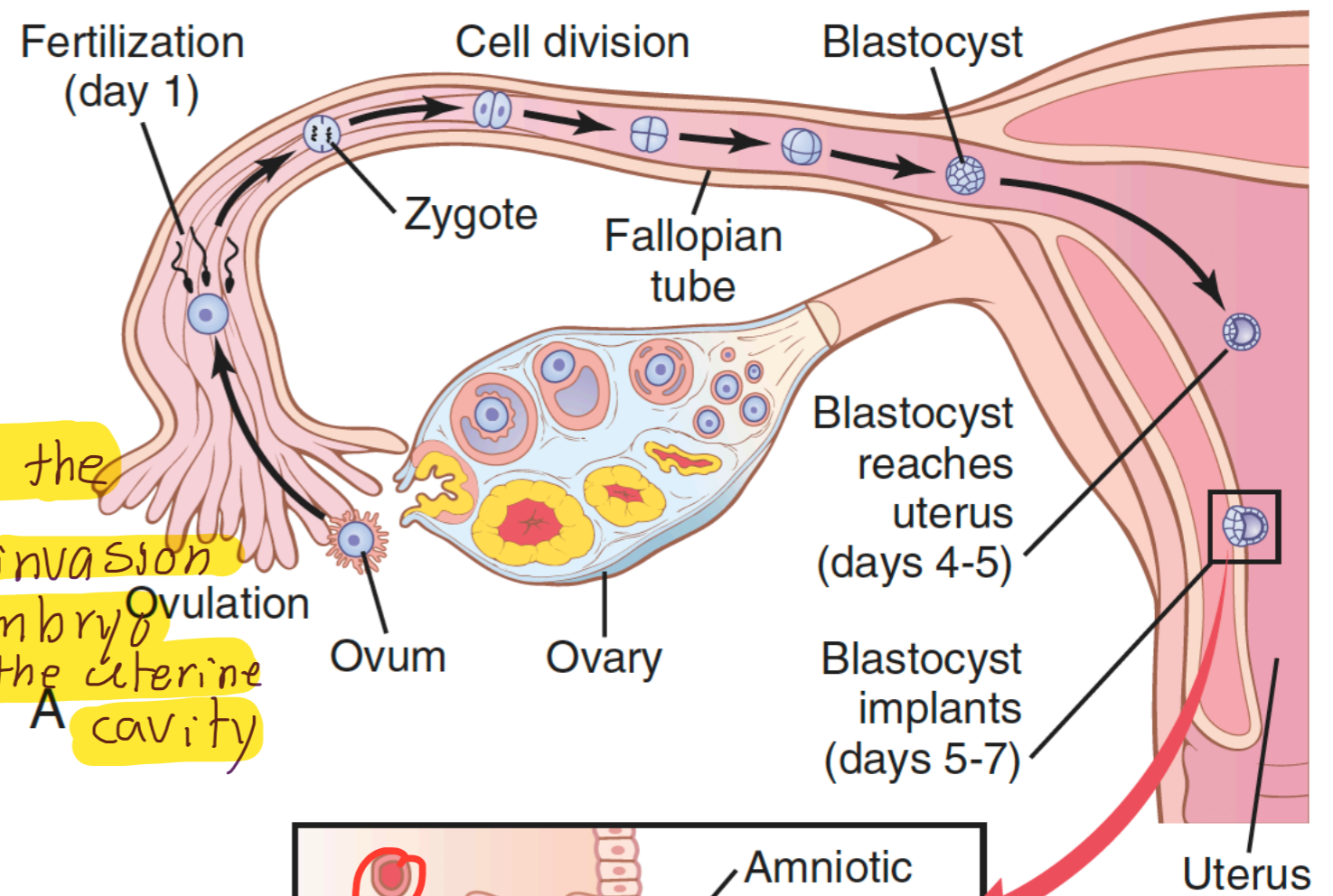
# Implantation of fertilized ovum

حتى يصير لنا implantation ← ال fertilized ovum لازم  
 تخترق جدار ال endometrium  
 لكي يسهل عملية الاختراق  
 يسهلوا عملية ال invasion of blastocyst

Mediated by **trophoblast** on surface of the blastocyst → Proteolytic enzymes → degradation of the endometrium cavity

- 1 Invasion results in fluid secretion → nutrient
- 2 trophoblast & blastocyst (foetus) + endometrium (mother) → **placenta**

degradation of the endometrium cavity → invasion of embryo in the uterine cavity



عملية ال invasion لها فائدتين :-  
 مجرد ما ال proteolytic enzyme تعمل destruction to endometrium

(البيروميترون يحضر ال endometrium بال secretory phase ال pregnancy)

بالتالي عملية ال invasion يصرفي secretion of these substances

بالتالي يزود ال fetus بال nutrient

① مجرد ما صار عننا  
 nutrition لازم يتوفره embryo  
 قدام ال pregnancy

② دعملية ال nutrition بتوفز من اول لحظة  
 من ال fertilization من ال FT كد ما يوصل  
 ال endometrium ديصره ال Implantation

# Nutrition during pregnancy

⑤ 2nd half of the cycle → prepare the endometrium cavity by secretory phase

↳ ↑ secretory materials of endometrium (uterine milk)

## ③ nutrition

- ① • FT → FT secretions
- ② • Uterine cavity

④ Before imp. the progesterone that secreted in the 2nd

- uterine endometrial secretions "uterine milk" ⑥ because it includes a lot of nutrition substances for the embryo

After imp.

- decidual cells/decidua : glycogen, proteins, lipids & minerals

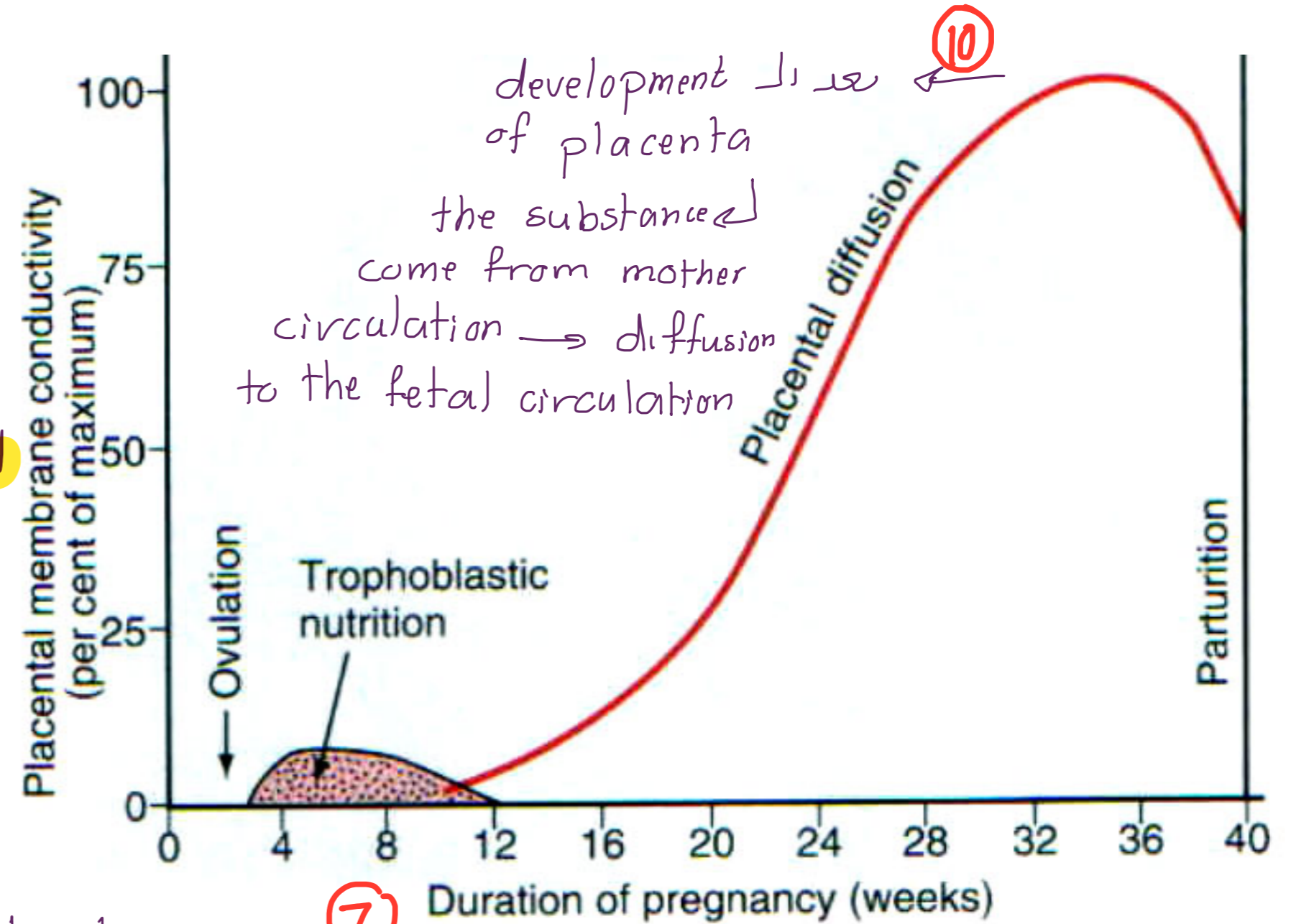
## Progesterone effect

⑨ essential substances for the growth of the fetus

⑦ مجرد ما صار فيه ال implantation  
 يكون ال P already prepare the endometrium

(the cells of endometrium → swollen and full of glycogen, proteins, lipid, minerals) ⑧

decidua ال decidual cells





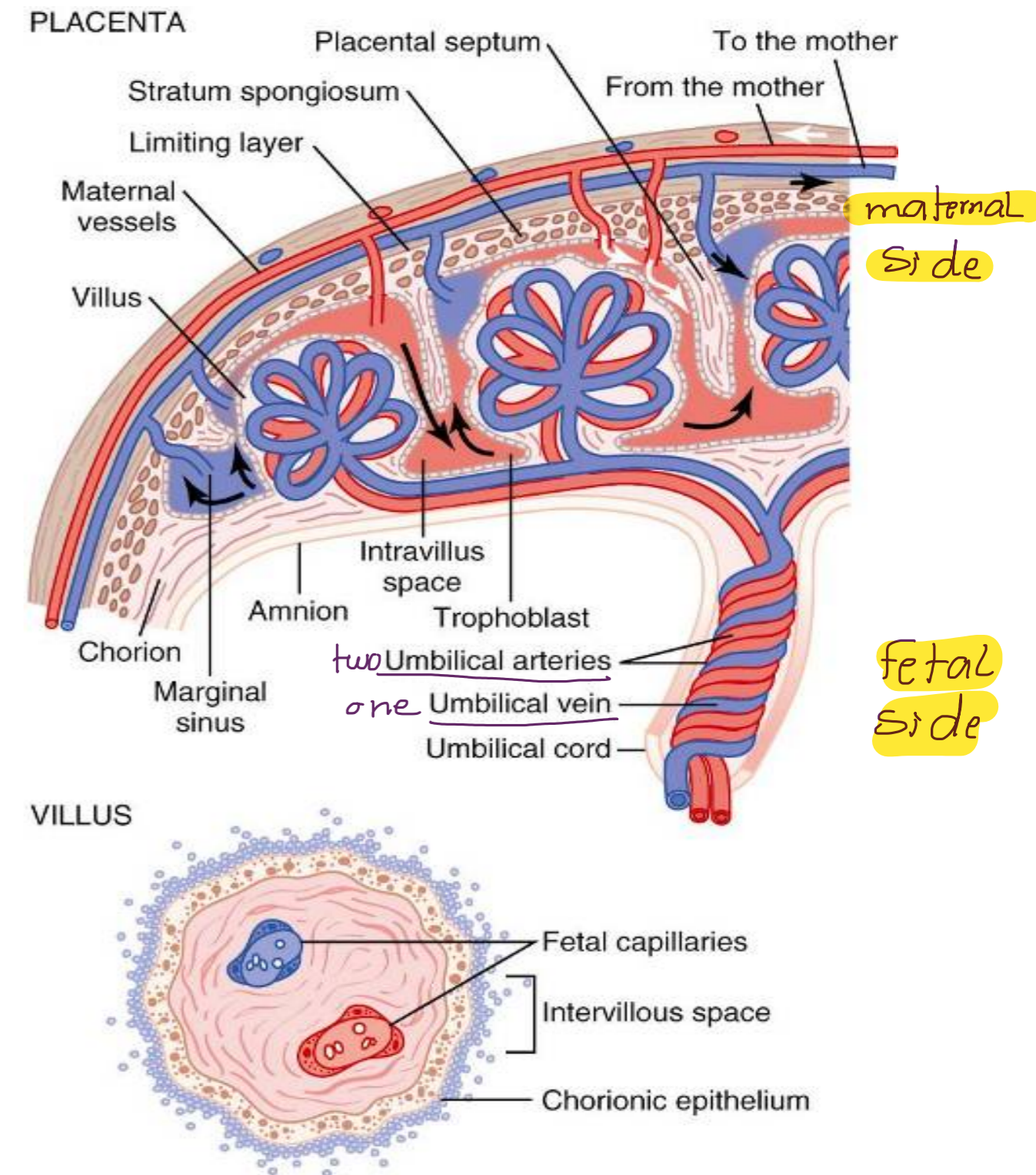
# Functions of the placenta

## major function:

- providing food & oxygen from the mother's blood into the fetus's blood
- diffusion of excretory products from the fetus back into the mother

early months of pregnancy → ↓ placental permeability → <sup>because</sup> thick placental membrane & ↓ surface area

later months of pregnancy → <sup>because</sup> ↑ placental permeability & ↑ surface area



## 1 \* Circulation of the placenta

2 umbilical arteries + one umbilical vein connected capillaries called chorionic villi

لے یعنی ای سٹی نہ علاقہ یا ل placenta

## 2 \* Exchange between chorionic villi & maternal sinuses of uterine artery

uterine A لے تیرجی ال substance عن طریق ال

diffusion of gases (O<sub>2</sub>, nutritional substances) ..

maternal circulation لے ven

وتبرج عن طریق ال

3

# Diffusion of gases through placenta

- **Diffusion of oxygen** → dissolved in maternal blood ... and transported to fetal circulation
- Oxygen is transported by **simple diffusion** ← by
- Maternal PO<sub>2</sub> 50-60 mmHg
- Fetal PO<sub>2</sub> 20-30 mmHg → very low...
- **Mean pressure gradient 20 mmHg**

low PO<sub>2</sub> in the foetus capillary

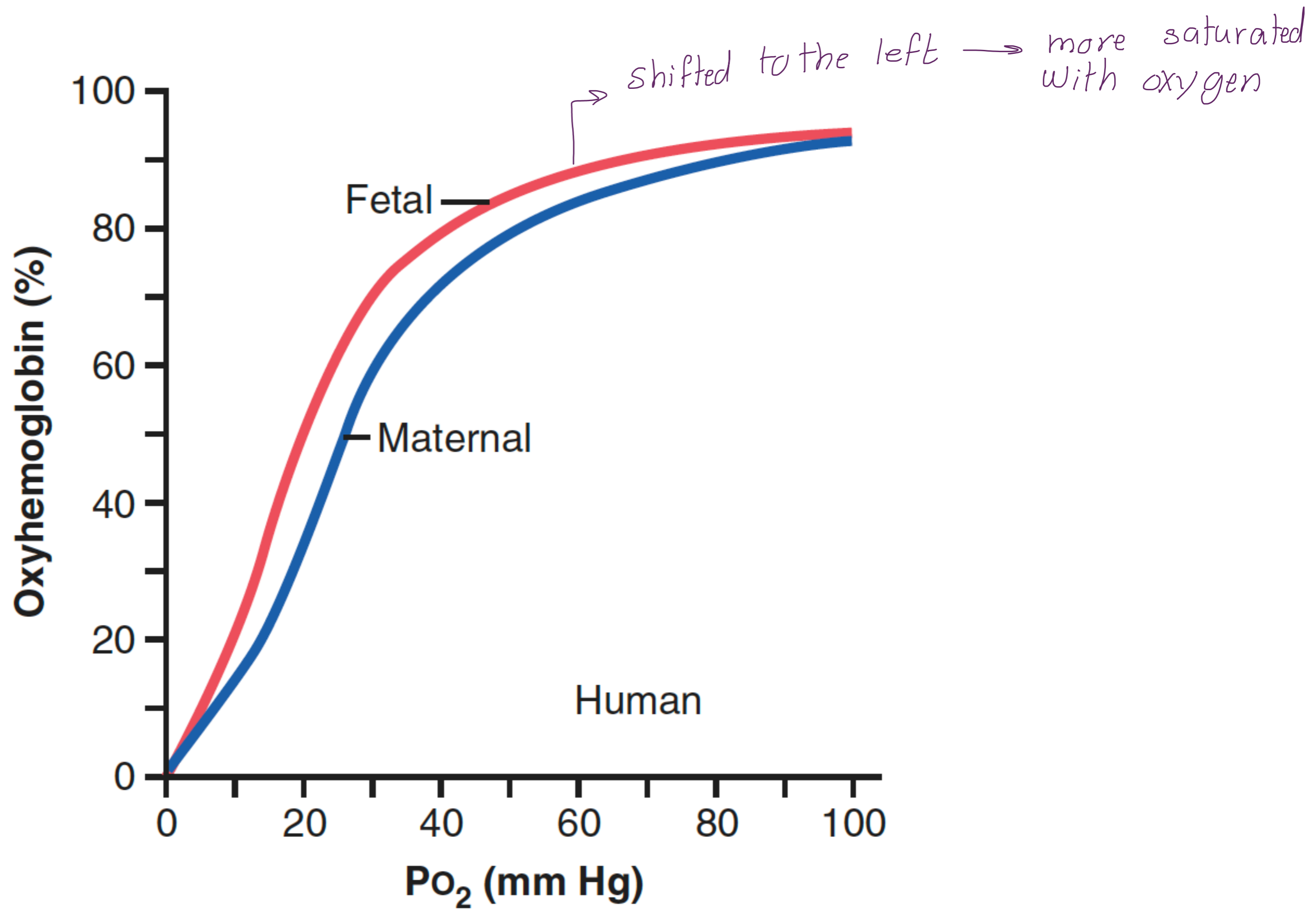
Low oxygen transport!!!  
Not the case 😊  
Why?

## Reasons for enhanced oxygen transport

- ① fetal haemoglobin has a **higher affinity** for O<sub>2</sub> (20- 50% more oxygen than maternal haemoglobin)
- ② **50% greater concentration of haemoglobin** in the foetal blood > maternal blood
- ③ Bohr effect: haemoglobin carry more O<sub>2</sub> at low PCO<sub>2</sub>
  - **CO<sub>2</sub> diffuses out** from foetal blood → maternal blood → loss of CO<sub>2</sub> makes foetal blood **alkaline** one maternal blood **is acidic** → this **increases the capacity of foetal blood to combine with oxygen & decreases the maternal capacity to combine with oxygen** → more oxygen is delivered to the foetus

highly soluble





## Diffusion of gases through placenta

- **Diffusion of CO<sub>2</sub>** *main waste product*

Pco<sub>2</sub> fetal blood is 2-3 mmHg >maternal blood → simple diffusion of CO<sub>2</sub>

High solubility of CO<sub>2</sub> 20 times > as rapidly as oxygen → enhance CO<sub>2</sub> diffusion  
*from fetus to mother*



# Diffusion of nutrients

## Glucose

- Placenta stores glycogen
- by facilitated diffusion (carrier molecules)
- 20 to 30% lower glucose in the fetal blood than maternal blood

دونه دلبيبي  
metabolic active  
فيستولك glucose  
آلتر بكثر من الامم

## Fatty acids

- High solubility
- diffuse slowly simple diffusion

## Proteins

- active transport

## Minerals

- potassium, sodium and chloride → diffuse easily

## Excretion of waste products

- CO<sub>2</sub> → diffusion
- excretory products (urea, uric acid and creatinine) → diffusion
- [Urea] is just slightly greater in fetal blood → easily diffuse
- [Creatinine] higher in fetal blood → does not diffuse easily

لے فتر اتم فی ال fetal circulation  
و بلون مرتفع اکثر فی ال fetal من ال mother  
circulation

## Protective function of the placenta

- • Mainly after 3 months
- • Impermeable to toxins and bacteria
- • Permeable to antitoxins some immunoglobulins, viruses and drugs- malformation



# Hormonal functions of the placenta

- 1 • Human chorionic gonadotropin
- 2 • Estrogen
- 3 • Progesterone
- 4 • Human chorionic somatomammotropin

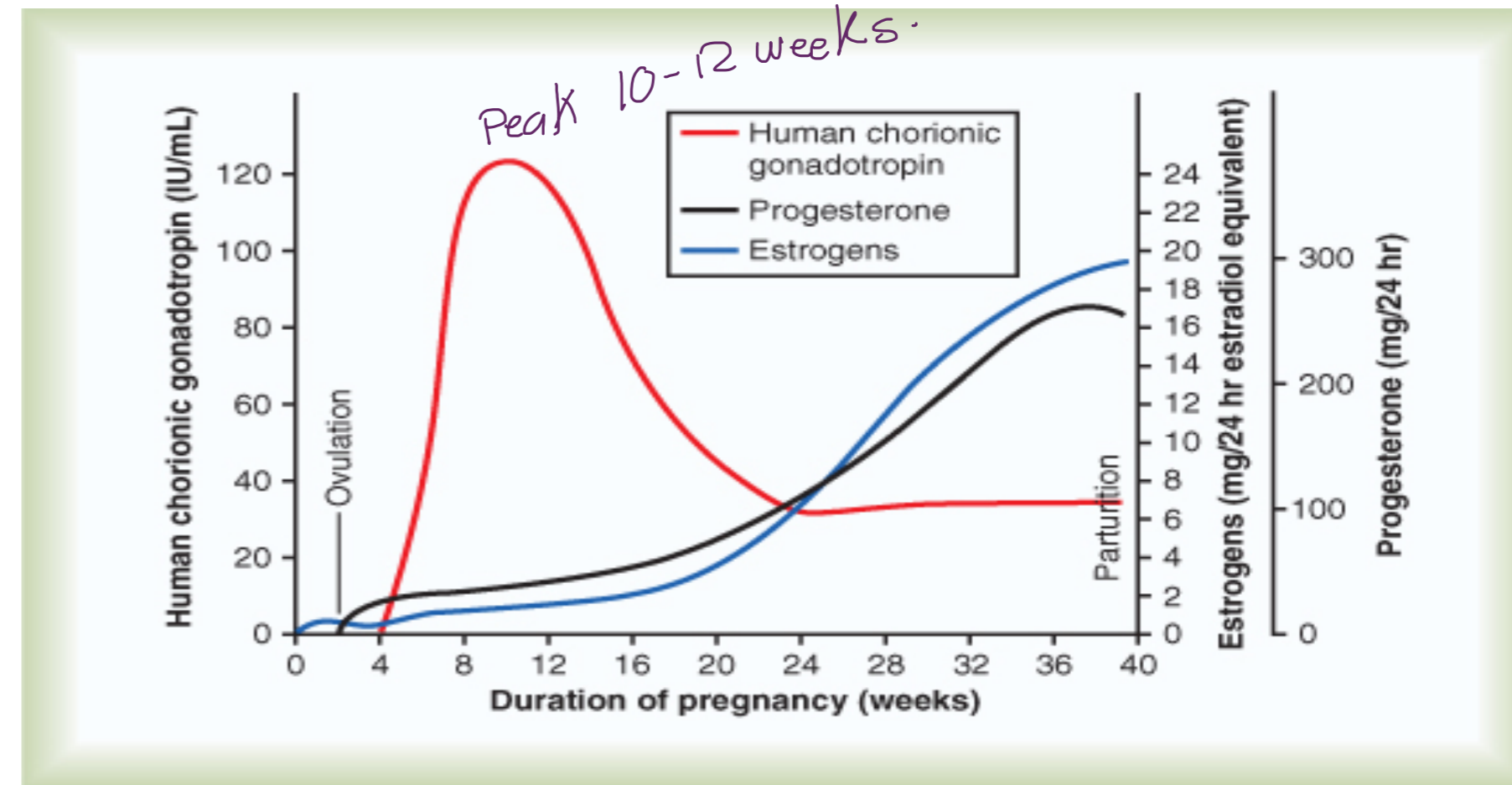
# Hormonal functions of the placenta

يتم الكشف عن الحمل بفحص هذا الهرمون

## human chorionic gonadotropin (hCG)

- Glycoprotein
- Similar structure and function as luteinizing hormone
- secreted by syncytial trophoblast cells
- detected in the blood 8-9 days after ovulation
- maximum secretion 10-12 weeks of pregnancy
- decreases back to a lower level by 16-20 weeks for the remainder of the pregnancy

← ويصل ثابت بعد ذلك level  
till the end of pregnancy.



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# Hormonal functions of the placenta

## human chorionic gonadotropin

### Functions of human chorionic gonadotropin

- 1 • Persistence of the corpus luteum → duplication in CL size → secrete large quantities of progesterone and estrogen →
- ① **prevent menstruation** to prevent sloughing of the implanted fetus
- ② **Growing of the endometrium & storage of nutrients** → development of the decidual cells

مهم جداً لاستمرار الحمل

**corpus luteum is very essential for pregnancy**

**after 12 week → placenta takes the role**

**involute slowly after the 13th to the 17th week of gestation**

first 3 months

# Hormonal functions of the placenta

## human chorionic gonadotropin

### Functions of human chorionic gonadotropin

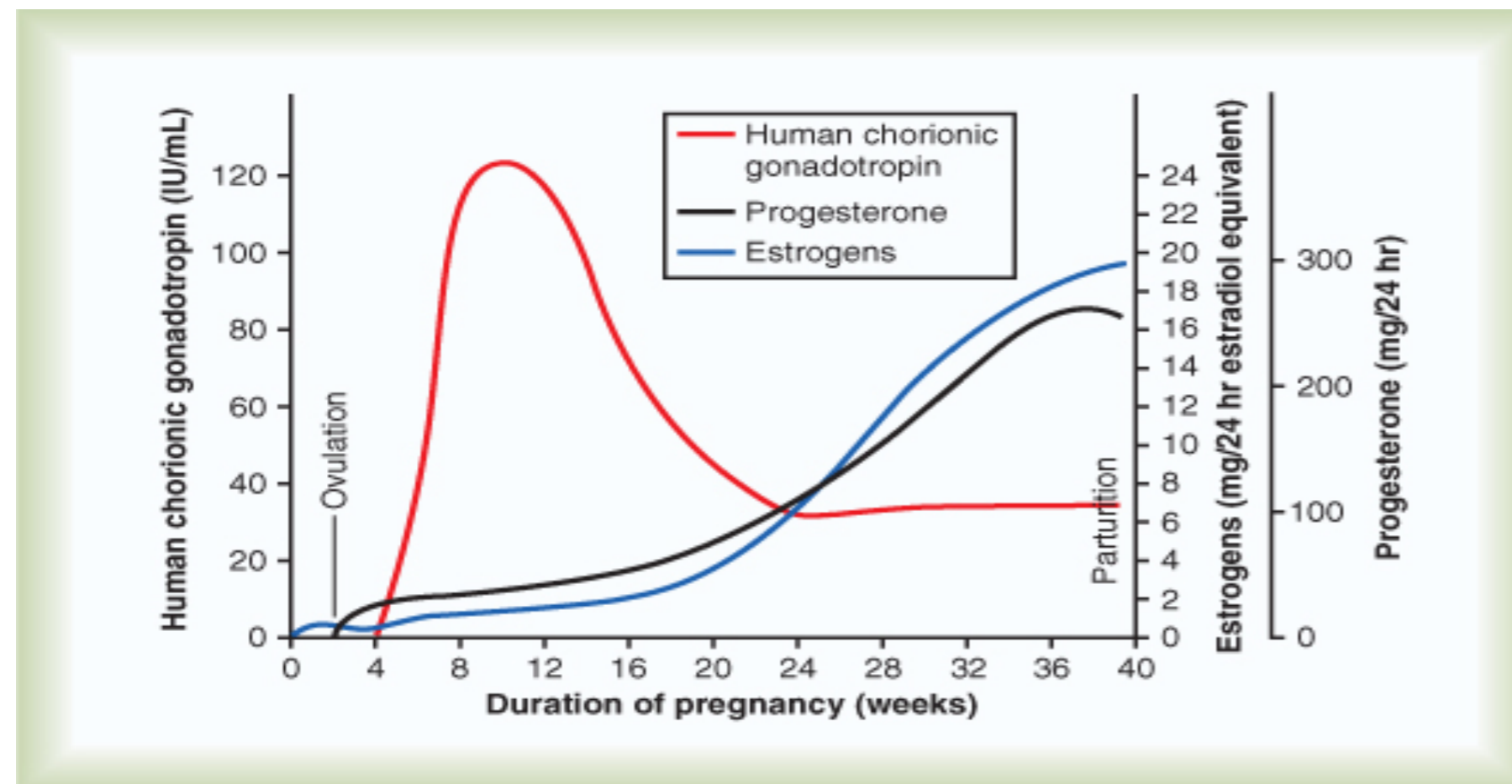
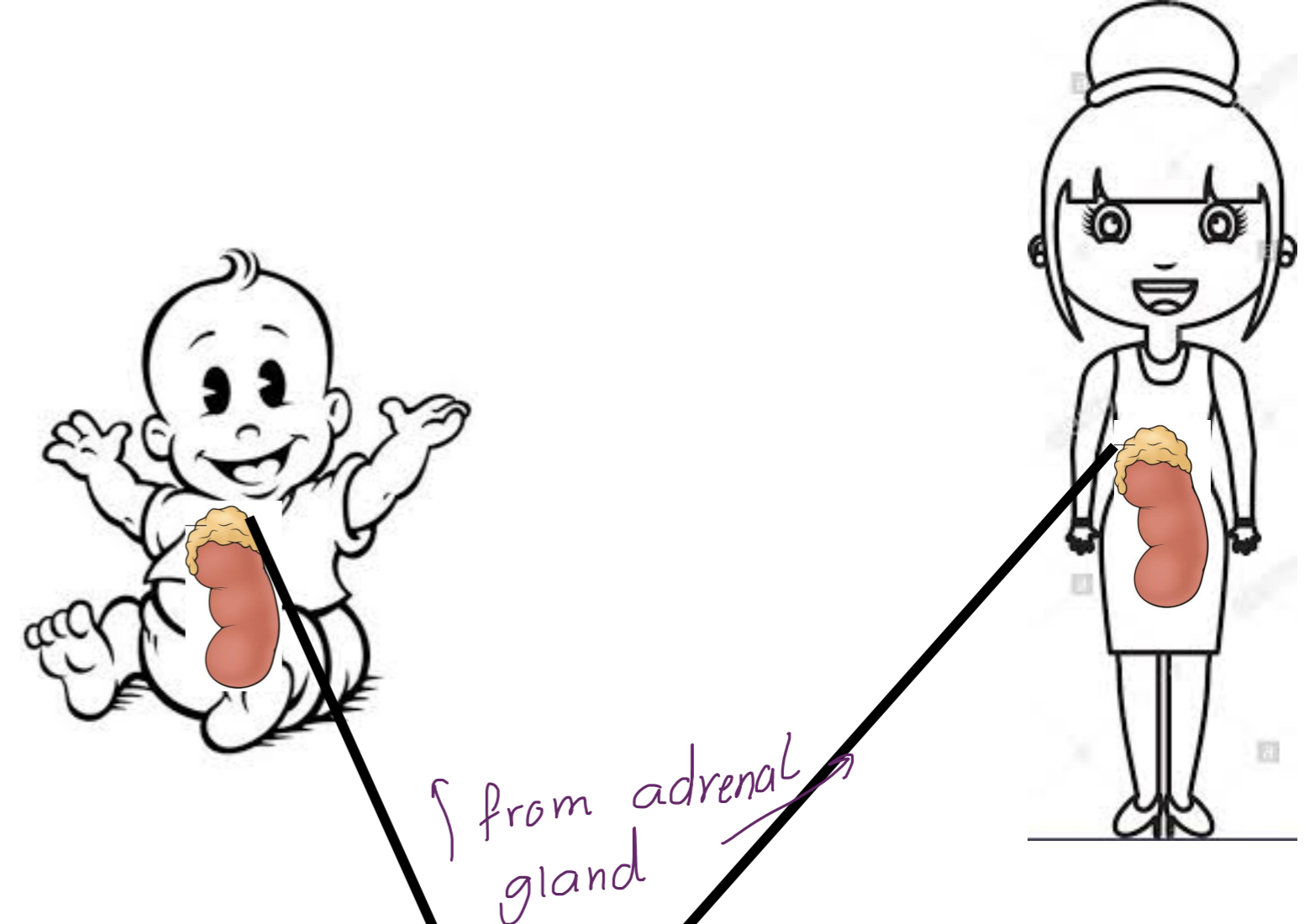
*If the woman pregnant with a male baby →*

- Stimulate the male fetal distance to produce testosterone
- Development of male fetal sexual organs
- Descend of the testicles to the scrotum

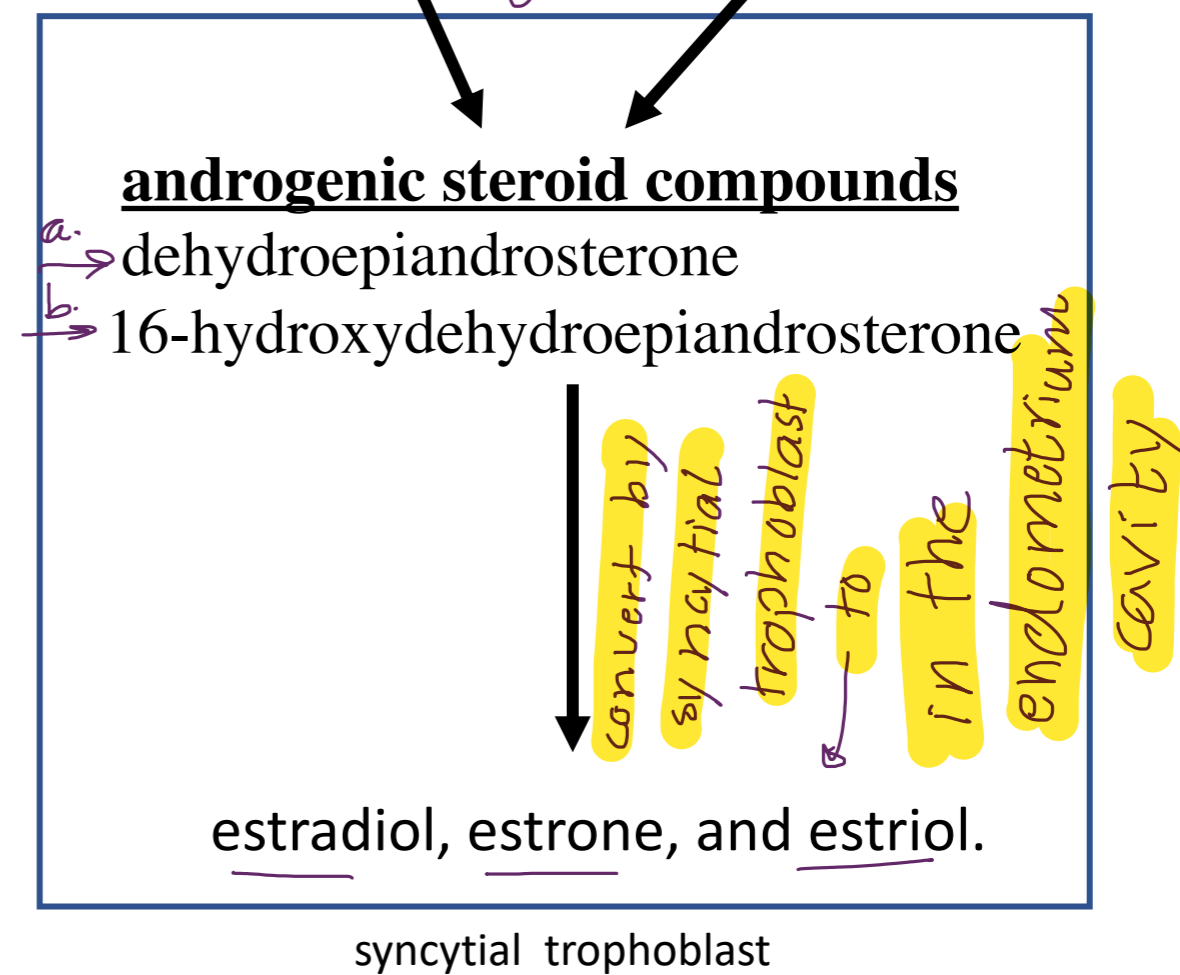
# Hormonal functions of the placenta

## Estrogen

- Secreted by the syncytial trophoblast
- Towards the end of pregnancy estrogen production increases up to 30 times



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# Functions of estrogens

- ① • Enlargement of uterus (myometrium)
- ② • Enlargement of breast and growth of **duct** system of the breast
- ③ • Enlargement of female external genital organs
- ④ • Relax pelvic ligaments and symphysis pubis of pelvic bone  
→ allowing better accommodation for expanding fetus and easy passage through birth canal

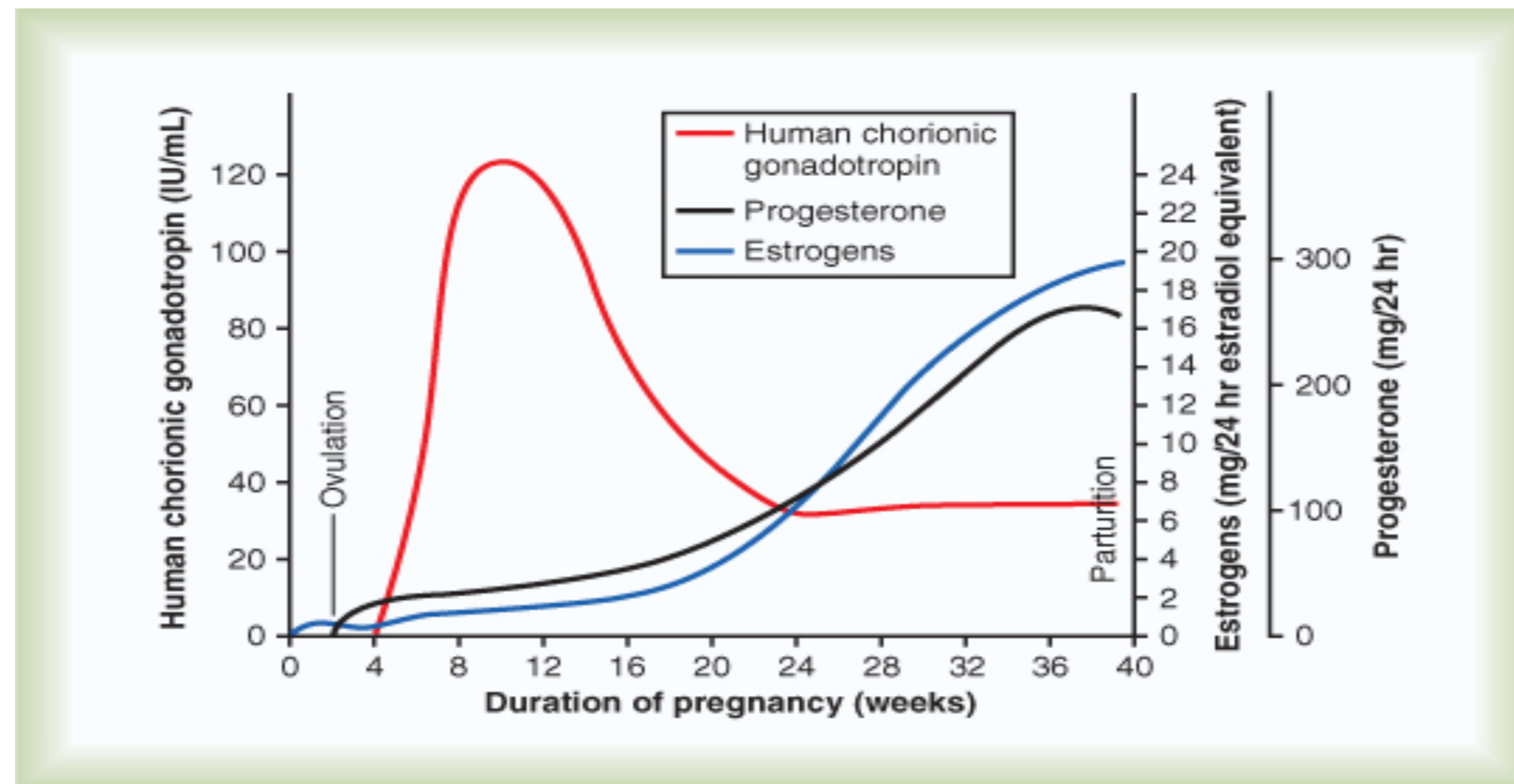
# Functions of estrogens

- ⑤ • Increase cholesterol uptake by placenta to augment the synthesis of **progesterone**
- ⑥ • Increase formation of oxytocin receptors
- ⑦ • Both estrogen and progesterone inhibits the action of prolactin on mammary gland , thus no milk synthesis during pregnancy
- ⑧ • fetal development during pregnancy → by affecting the rate of cell reproduction in the early embryo

# Hormonal functions of the placenta

## Progesterone

- Towards the end of pregnancy, progesterone production increases tremendously



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# Hormonal functions of the placenta

## Progesterone

### Functions of progesterone

- 1- development of decidual cells → nutrition of early embryo
- 2- decreases contractility of the uterus by inhibiting synthesis of PG and by decreasing uterus sensitivity to oxytocin → prevent abortion

# Hormonal functions of the placenta

## Progesterone

### Functions of progesterone

- 3- development of the <sup>(embryo, fetus)</sup> conceptus before implantation → increase the secretions of mother FT and uterus → nutrient
- 4- Affects cleavage of early embryo
- 5- Development of **alveolar pouches** of mammary glands and increase their capacity to secrete milk
- 6- Stimulates respiratory centers in mother to increase ventilation

# Human chorionic somatomammotropin (HCS)

- Secretion is directly proportional to the weight of placenta
- Can be detected 5 weeks after gestation

## Functions

- 1 • Has a similar action to **growth hormone** and **increases protein synthesis**
- 2 • development of breasts & causes lactation (similar function to prolactin) → also called **human placental lactogen (HPL)**



# Human chorionic somatomammotropin (HCS)

- 3 • antagonize insulin action on carbohydrates increasing maternal blood glucose levels → more glucose available to the fetus
- 4 • Stimulates maternal lipolysis → Source of energy for mother

# Other hormonal factors in pregnancy

## 1- increased pituitary secretion

- anterior pituitary enlarge by 50%
- increased corticotropin, thyrotropin & prolactin
- decrease LH and FSH (inhibited by E & P)

## 2- increase corticosteroid secretions

- moderate increase in glucocorticoids → mobilize amino acids from mother's tissue → used for synthesis of tissues in the fetus
- <sup>↑ mineralocorticoid</sup> 2 fold increase in aldosterone → with estrogen → fluid retention by excessive sodium absorption → pregnancy induced hypertension

## 3- increased insulin

# Other hormonal factors in pregnancy

## 4- increased thyroid gland secretion

- 50% increase in thyroid gland size
- increase thyroxine <sup>T<sub>3</sub>+T<sub>4</sub></sup> → stimulated by hCG & human chorionic thyrotropin (secreted by placenta)

## 5-increased parathyroid gland secretion

- parathyroid gland increase in size
- increase calcium absorption from the mother's bone → used by fetus for bone ossification

## 6-secretion of relaxin by the ovaries and placenta

- stimulated by hCG
- with estrogen → relaxation of pelvic ligaments
- softening of the cervix at the time of delivery
- vasodilator → increase blood flow increase venous return and cardiac output



**The end**

# Pregnancy and Lactation-II

Chapter 83

Unit X1V

Dr Iman Aolymat

# Response of the mother's body to pregnancy

- mainly due to **higher** levels of hormones of pregnancy

## **ENLARGMENT OF SEXUAL ORGANS**

- Uterus
- Ovaries
- Vagina → introitus opens more widely
- Breast

## **APPEARANCE**

- Edema
- Acne
- Pigmentation
- Masculine or acromegalic features

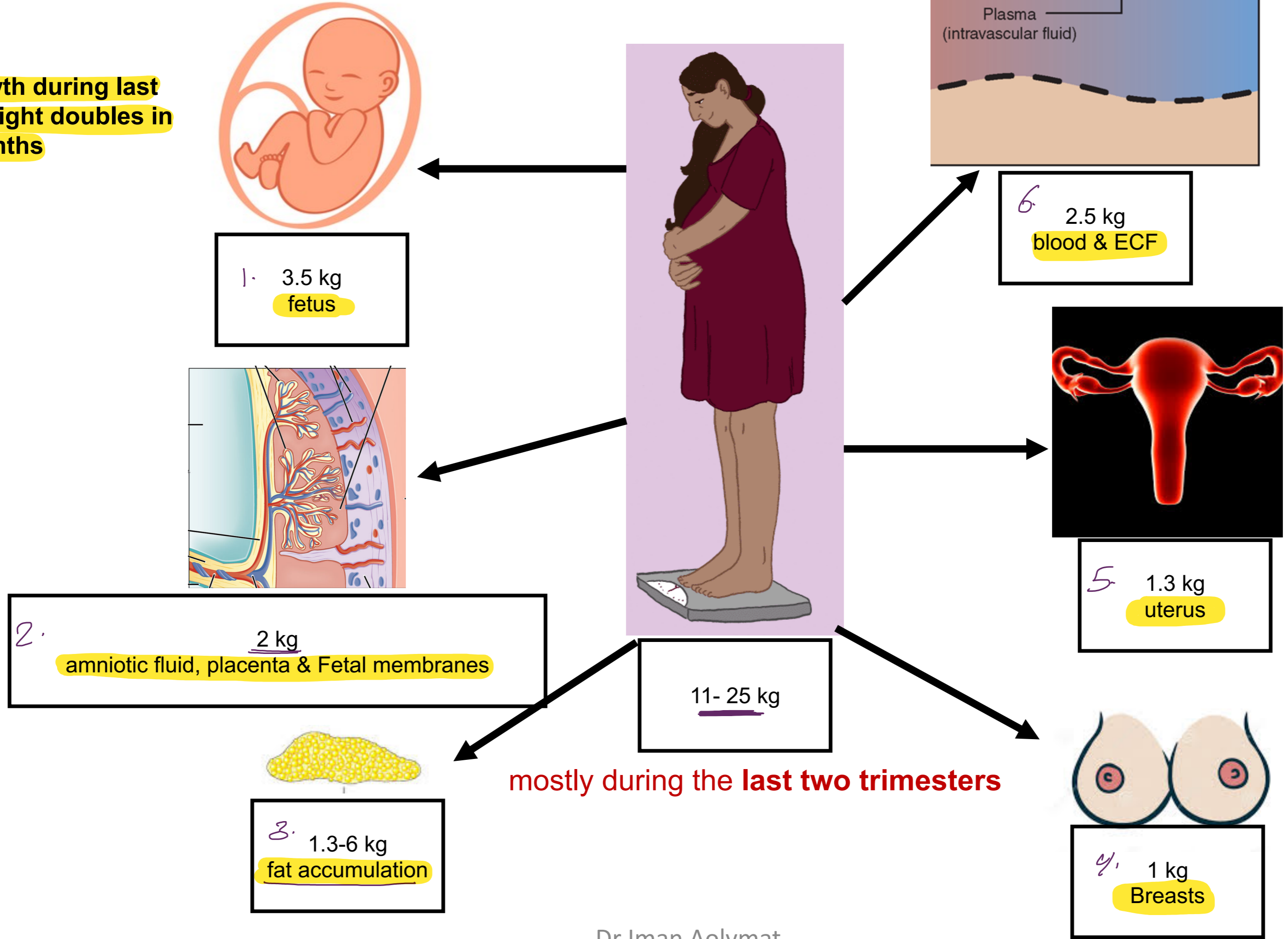


# Response of the mother's body to pregnancy

## Weight gain

greatest growth during last trimester, weight doubles in the last 2 months

extra fluid → excreted in the urine during few days after birth → due to loss of fluid-retaining hormone from the placenta



mostly during the last two trimesters

# Response of the mother's body to pregnancy

## Nutrition during pregnancy

it is very important because the baby need a lot of nutrition substances especially in the early period of pregnancy

- Increased desire for food due to increase in the hormones of the pregnancy..
- mother → less absorption of protein, calcium, phosphate, and iron → supply to the fetus

↓  
circulation الـ و يروحوا لـ fetus

period of organogenesis

- Nutritional and dietary needs change (need more iron, calcium, phosphates, vit D, vit K)

vit-K clotting factor

- vitamin K → prothrombin → to prevent hemorrhage (brain hemorrhage)

- Iron deficiency → hypochromic anaemia (physiological anemia)

cerebral hemorrhage  
prothrombin الـ  
delivery process الـ  
[ Stretching for head ]

→ very important for clotting factor...

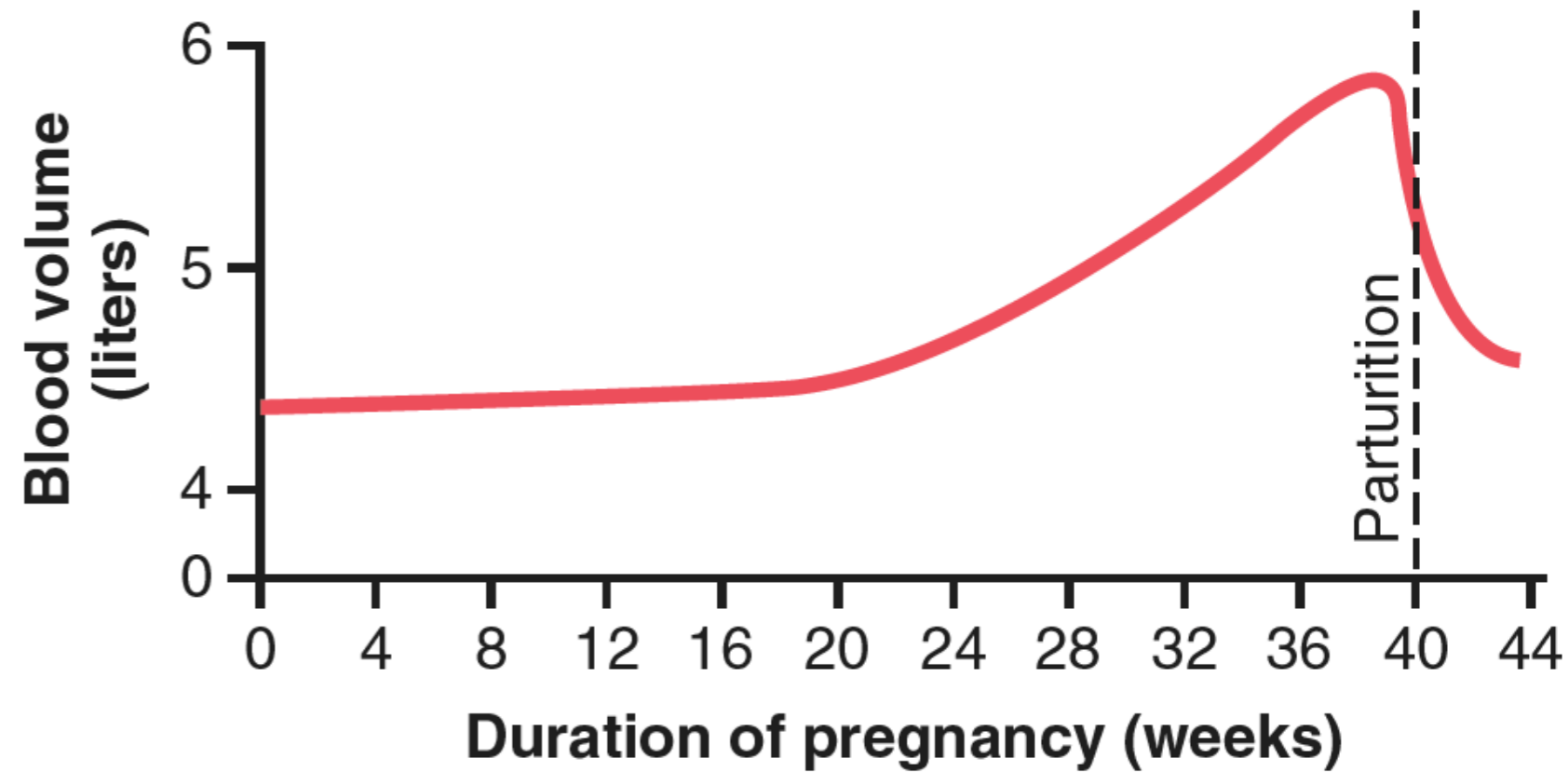
# metabolism during pregnancy

- result in
- increased thyroxine, adrenocortical hormones, and sex hormones
  - increased basal metabolic rate 15% → [second half of pregnancy]
  - extra load → more muscle activity → more energy
  - Increased insulin secretion
  - Increased insulin resistance → [more glucose available]

← يرفع على الـ fetal circulation  
حتى تغذي عليه الجبسي .



# Changes in maternal circulation



فقد مهم لأنه بعد الـ delivery مع يسهل عندها

post bleeding ← فقد تعويض (تزداد حجم)

الـ circulation للحامل حتى وقت الولادة يكون عندها extra BV (حتى تنسى)

والتخلص من النفايات الغذائية... waste product... nutritional substances

➤ Increased **blood flow** through the placenta → 625 ml/min

➤ Increased maternal **cardiac output** → 30-40% (by 27th wk)

➤ The last 8 wks → cardiac output **falls** just above normal level

➤ Maternal blood volume is increased by 30% → mostly during the second half of pregnancy →

1- ↑ aldosterone & E → fluid retention (↑ Na<sup>+</sup> + H<sub>2</sub>O reabsorption)

2- Increased bone marrow activity → (حتى يفرج RBC more)

1-2 L extra blood → **1/4 lost through bleeding during delivery** (spare blood volume during delivery) ①

➤ Edema due to increase in **venous pressure** in lower limbs → compression of the inferior vena cava by the uterus and the pressure of the fetal on the common iliac veins & Decrease plasma protein concentration ②

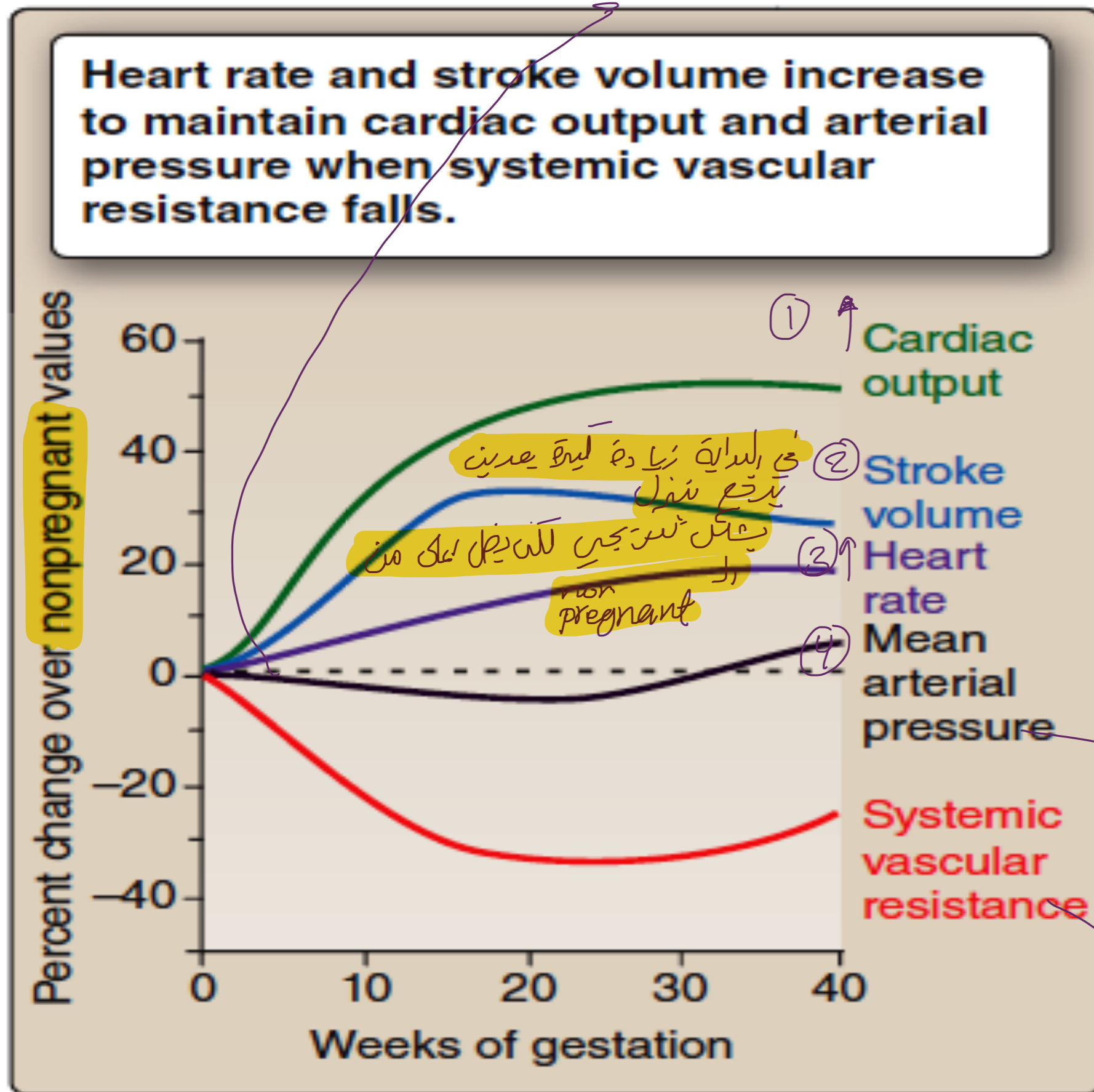
due to obstruction of venous return

① enlargement of the uterus

② the baby compress the common iliac veins

# Changes in maternal circulation

preference line for nonpregnant.



- ❖ Systemic arterial pressure declines slightly during pregnancy
- ❖ fall is greater for (diastolic) than for systolic pressures (physiological)
- ❖ mean arterial pressure increase to pre-pregnancy levels by about 36 weeks.
- ❖ Systemic vascular resistance decreases due to release of NO and ednotheline

تتناقص في بداية الحمل  
 وبالأخص في الأخرى يرجع إلى  
 أعلى مستوى من الـ non pregnant

تقل بشكل كبير مع تقدم الحمل

# Changes in maternal plasma volume and Hematocrit during pregnancy

تعبئة [2] سلايد [82]

blood volume يزيد لكن الـ hematocrit يقل

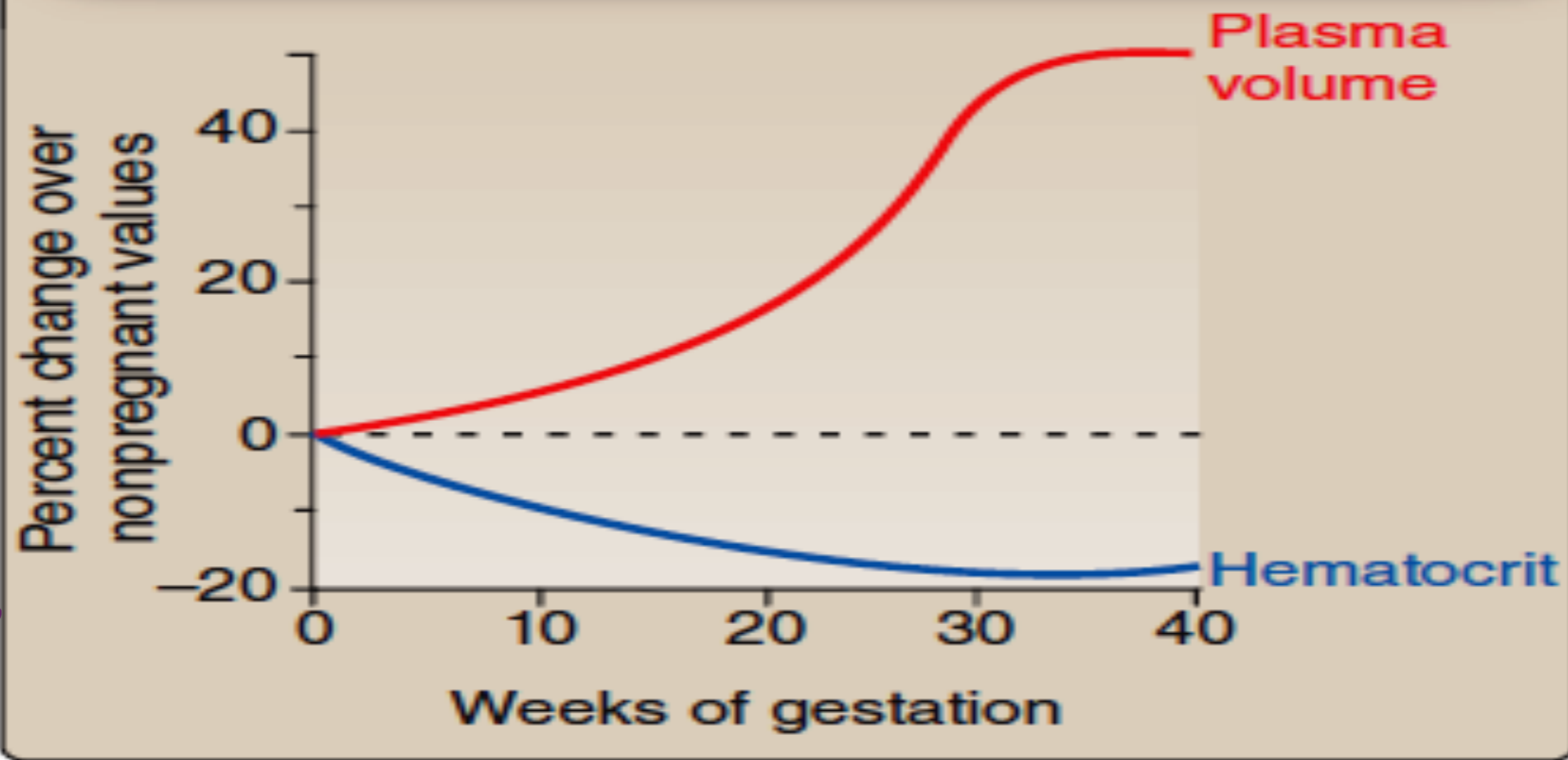
يعني سبب ما حاول الـ bone marrow انه يمنع blood cells خارج كواكب الزيادة في الـ blood volume

عشان صحت

ليهي عند

الكامل

**The inability of red blood cell production to keep pace with increasing plasma volume causes hematocrit to fall during pregnancy.**



physiological

anemia

(hematocrit ↓)

due to

dilutional effect

↑ plasma volume

↓ hematocrit



# Respiration

- Increased alveolar ventilation → due to progesterone
- Increased tidal volume (40%) → causes dec in maternal plasma

CO<sub>2</sub> -- slight alkalosis

هامة جداً حتى تغير نحل  
O<sub>2</sub> ليس يزداد في الـ hyperventilation  
more washing of CO<sub>2</sub> يخل →

بالتالي  
maternal circulation  
more alkalosis

so the affinity  
of the maternal blood  
for O<sub>2</sub> decreased  
and the affinity of the  
fetal blood for O<sub>2</sub>  
will increase

# Maternal kidney function

- Increased urine formation *(more in last trimester)*
  - ① due to ↑ fluid retention
  - ② enlargement of uterus compresses the bladder and ↓ capacity of the bladder
- Increased tubular reabsorption → sodium, chloride and water by 50% *due to aldosterone and E*
- Increased renal blood flow and GFR by 50% → renal vasodilation
- Causes of renal vasodilation
  - ①-NO
  - ②-Relaxin

# Morning sickness

- 70% of pregnancies
- Onset 4-8 wks gestation أول شهرين
- improvement before 14-16 wks
- Mechanisms: السبب غير معروف ولادئ ... لكن مهلة تكون يسبب
- ① Relaxation of smooth muscle of stomach
- ② ? Inc hCG
- Higher frequency of female fetus -- 56%



# Pre-eclampsia

- Idiopathic **multisystem** disorder specific to human pregnancy

- Characterized by:

1- maternal hypertension

2- proteinuria

3- generalized edema

- Disease of the placenta

- Failure of trophoblast invasion of spiral arteries → Supply of both nutrients and oxygen to the placenta **is disturbed**

- Decreased RBF & GFR → في الوضع الطبيعي نرى تضيقاً في الوعاء الدموي → *vasodilation.*
- Leading cause of maternal and perinatal mortality

# Pre-eclampsia

BP normalizes following delivery → faster with Caesarean section and D/C

**cause:** unknown; thought to be:

limited blood supply to uterine arteries → causing ischemia and endothelial damage with release of:

## 1- cytokine

A-tumor necrosis factor- $\alpha$

B- interleukin-6

## 2-Placental factors that impede angiogenesis

A-soluble fms-related tyrosine kinase1(s-Flt1)

B- soluble endoglin

→  
عِلَّةُ نِسْبَةِ إِسْخِمِيَا فِي الْبَلْعَانِ  
ischemia in placenta

# Eclampsia *more severe form*

fatal severe preeclampsia with :

- ① • Seizure
- ② • Coma
- ③ • Decreased kidney output
- ③ • Liver malfunction
- ④ • Extreme hypertension



# Parturition/ labor /delivery

➤ Strong **rhythmical** uterine contraction

*regulated by +ve feedback mechanism*

## ➤ Stages of labor

**stage 1:** labor →

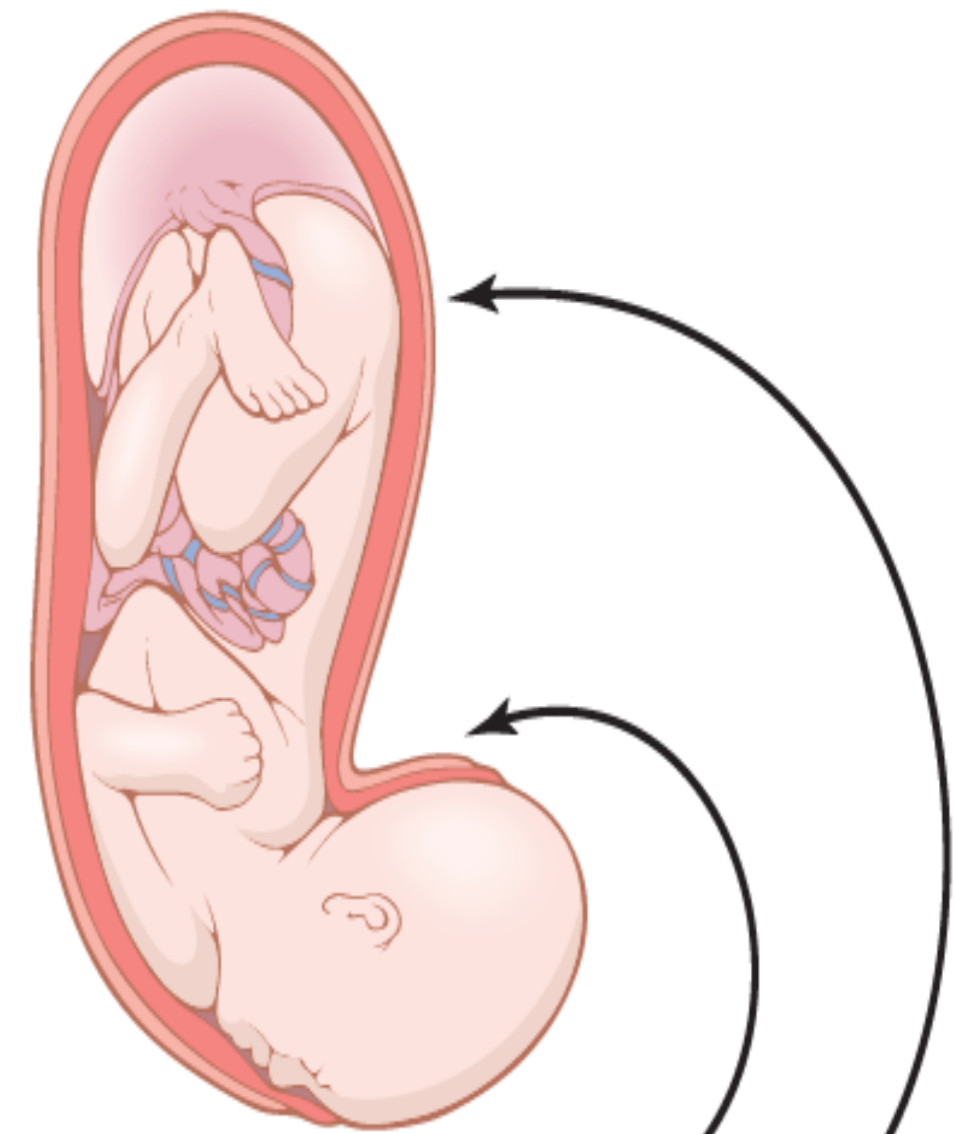
contractions → dilatation of the cervix and opening of vaginal canal

uterine → (stimulates more contractions positive feedback)

cervical → head stretching → more uterine contractions

*contraction in the uterus*

*more stimulation of the contraction in the fundus*



1. Baby's head stretches cervix
2. Cervical stretch excites fundic contraction
3. Fundic contraction pushes baby down and stretches cervix some more
4. Cycle repeats over and over again

**stage 2:** baby delivery

**stage 3:** placental detachment

# Parturition/ labor /delivery

## Hormonal factors

### Maternal

Oxytocin

PG

Catecholamines

Cortisol

Relaxin

### Fetal

Oxytocin

Cortisol

PG

### Placental

Estrogen

Progesterone

PG

# Hormonal factors

## 1- E & P

↑↑ E (toward end of pregnancy)

Sudden ↓↓ P at end of pregnancy

P inhibits prostaglandin E2 → inhibit-  
contraction.

↑ E/P ratio →

+ contraction

+ synthesis and sensitivity of oxytocin  
receptors

+ PG

## 2- Oxytocin

+ uterine contraction

+ PG from decidua

## 3- Relaxin

secreted by placenta & mammary  
glands

Softening cervix

Relaxation of symphysis pubis  
ligaments

Dilatation of the cervix

+ oxytocin receptors

- inhibitory action of progesterone

↓  
[↑ contraction.]



## Hormonal factors

### 4- PGE2

from the decidua → + Calcium concentration

### 5-Catecholamines

adrenaline and noradrenaline  
+ uterine contraction

### 6- cortisol

- ① + uterine contraction
- ② stress tolerance

## Mechanical factors

stretch of uterine muscles  
stretch of the cervix →  
↑ contraction

# lactation

## Estrogen effect on the breast:

- ①- growth of ductal system
- 2- + stroma
- 3- fat deposition

## Progesterone effect on the breast

growth of lobule-alveolar system

E & P → inhibit prolactin

## Stages of breast development

### 1- puberty

- A-growth of mammary glands
- B-fat deposition

### 2- during pregnancy

- Ⓐ-high estrogen
- Ⓑ-complete development of glandular tissue

# lactation

- **Prolactin**

- ❖ secreted by anterior pituitary gland
- ❖ + from the 5th week of pregnancy
- ❖ increases 10-20 times by delivery
- ❖ decreases after 7 to 9 months

تعالج العرضيات الـ prolactin

amorrhea ← menstrual cycle  
بضع الـ

unovulatory ← cycle الـ أو يتلون الـ

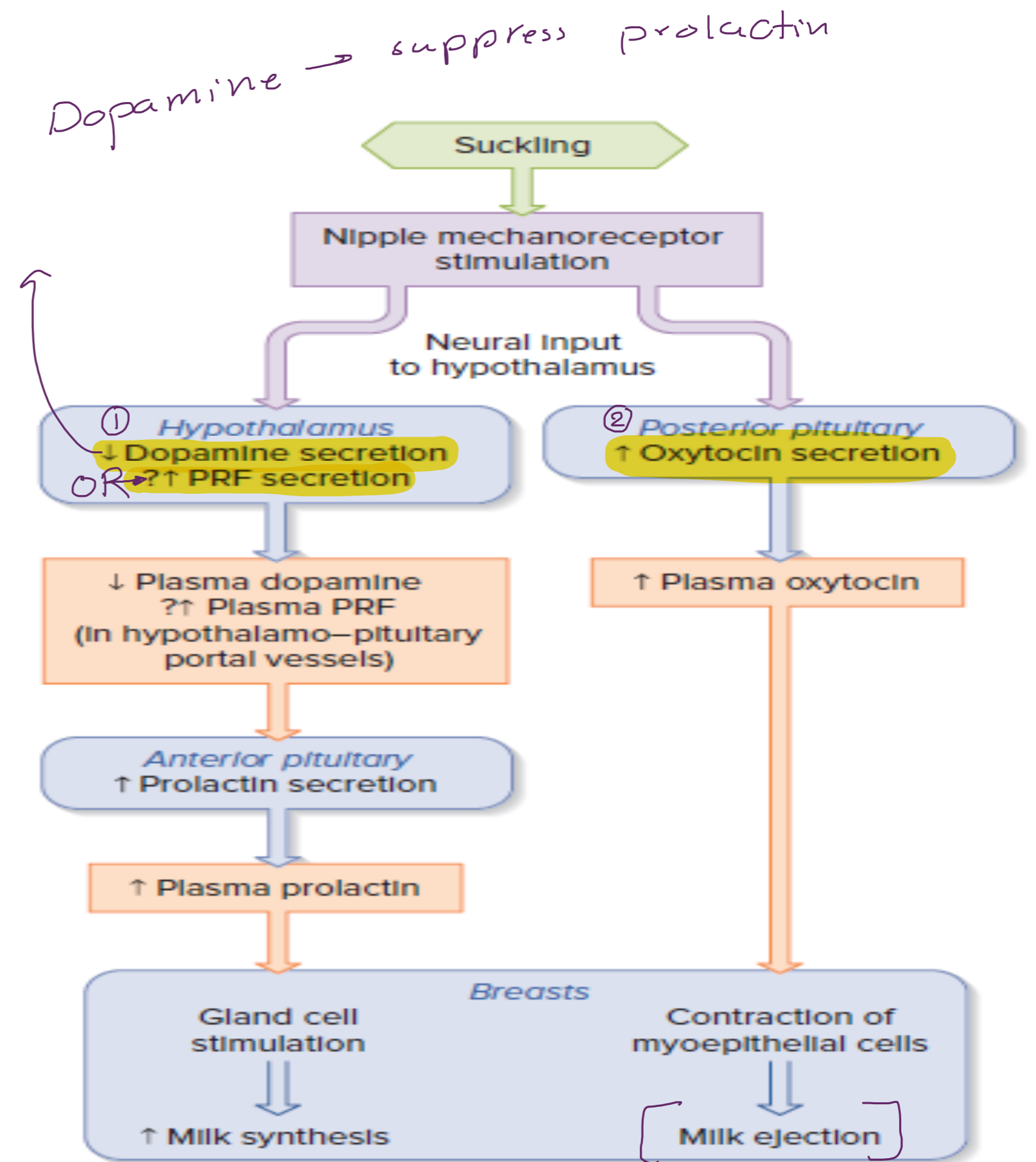
لذلك الرضاعة الطبيعية هي امر وسائل منع الحمل.

- Human chorionic somatomammotropin → lactogenic effect
- First few days (1-7) → colostrum (very small amount) → Protein and lactose almost no fat
- Up to 1.5 L of milk/day- higher in twins- high energy consumption
- Milk formation requires increase in growth hormone, cortisol, parathyroid hormone and insulin → to increase amino acids, fatty acids, glucose and calcium



# lactation

- suckling → hypothalamus → prolactin surge
- milk ejection from alveoli to ducts is caused by oxytocin
- Prolactin secretion is inhibited by the hypothalamus → prolactin inhibitory Factor
- Dopamine inhibits prolactin secretion
- Prolactin inhibits LH and FSH → inhibits menstruation for several months
- Enlargement of parathyroid gland to supply needed calcium and phosphate + bone decalcification



# lactation

Table 83-1 Composition of Milk

Constituent	Human Milk (%)	Cow's Milk (%)
Water	88.5	87.0
Fat	3.3	3.5
Lactose	6.8	4.8
Casein	0.9	2.7
Lactalbumin and other proteins	0.4	0.7
Ash	0.2	0.7

50% higher

2-3 higher

Calcium & other minerals

milk provides nutrients, antibodies & WBCs

**The end**