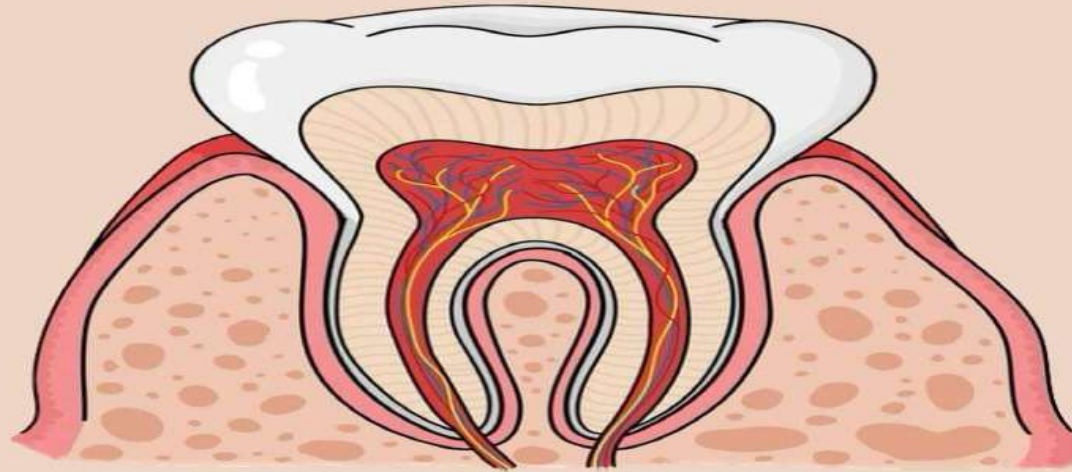




ANATOMY



LEC NO. : 20
DONE BY : Nour Al-amoush.

وَقُلْ رَبِّ زِدْنِي عِلْمًا

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

GAMETOGENESIS

في عنا قسم من Anatomy اسمه embryology و هو يهتم بدراسة تطور الجنين من لما كان sperm & oocyte لحد الولادة، وفي برضو special embryology و هاد مهتم بدراسة كل system و كسف تطوّر و هاد احنا مش طالبين فيه، السنة الجاي رح ناخذ تطوّر ال brain , skull , face و هاد يلي بهمتنا.

GAMETOGENESIS

تکوین الجامیات

Definition: The process of the formation of male & female gametes.

Site: in the gonads (testis and ovaries).
↓
males ↓
 females

Types:

A- Spermatogenesis. *in male*

B- Oogenesis. *in female*

General characters [aim]:

Prepare sex cells for fertilization.

Reduction in number of chromosomes to half [diploid number →
haploid number]
26

Changes in the shape of the sex cells. → *we will see in sperm formation.*

GAMETOGENESIS

Terminologies

البيضة

Oocyte (ovum / egg): refers to female germ or sex cells produced in the ovaries

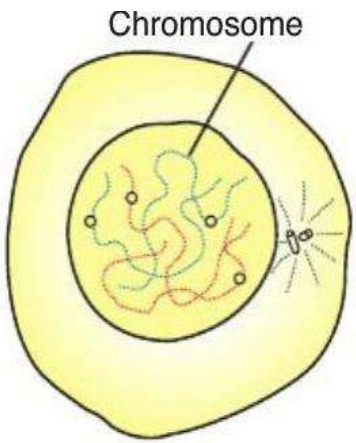
حيوان المنوي

Sperm (spermatozoon): refers to male germ cell produced in the testes (testicles)

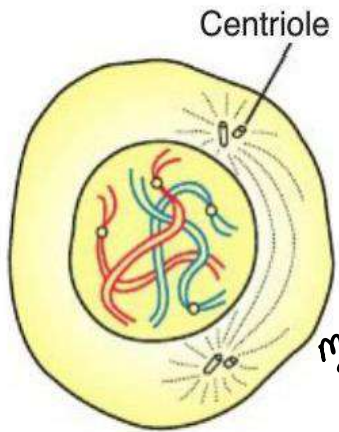
بويضة مخقبة

Zygote: results from the union of an oocyte and a sperm during fertilization.

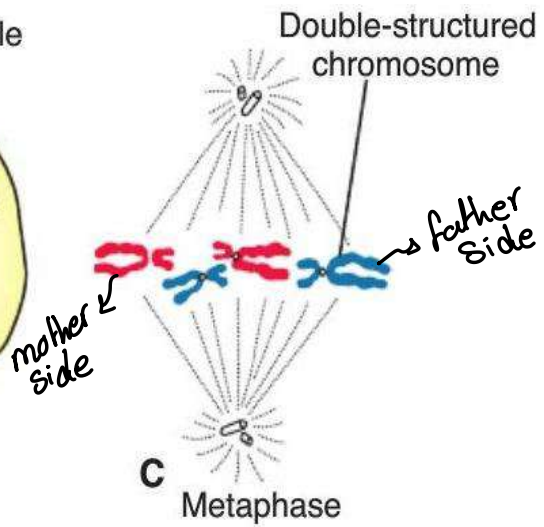
A zygote or embryo is the beginning of a new human being.



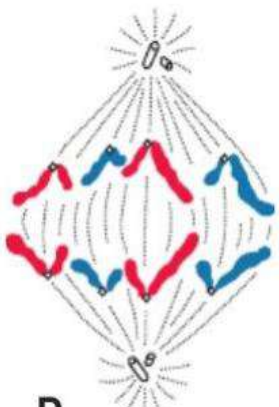
A Prophase



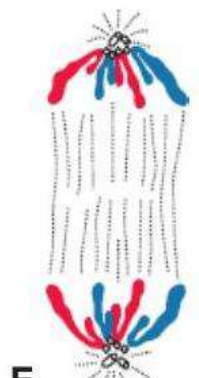
B Prometaphase



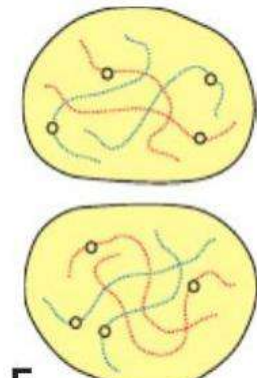
C Metaphase



D Anaphase



E Telophase



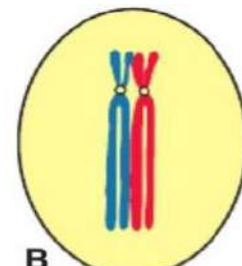
F Daughter cells

Mitotic division

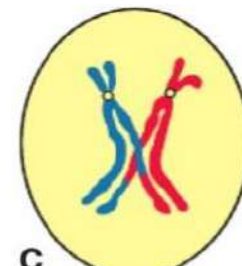
Mitosis



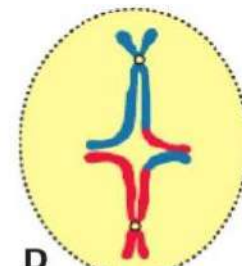
A Pairing begins



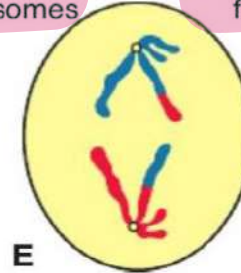
B Pairing of chromosomes



C Chiasma formation



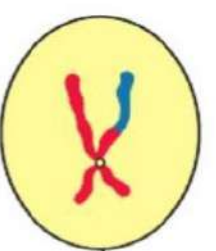
D Pulling apart of double-structured chromosomes



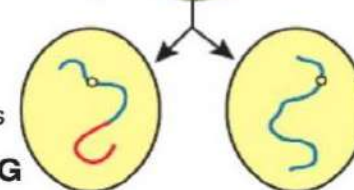
Anaphase of 1st meiotic division



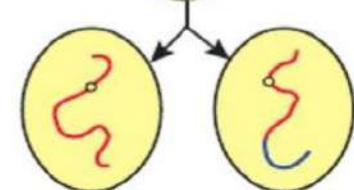
Cells contain 23 double-structured chromosomes



Cells resulting from 1st meiotic division



Cells contain 23 single chromosomes



Cells resulting from 2nd meiotic division

First and second meiotic divisions.

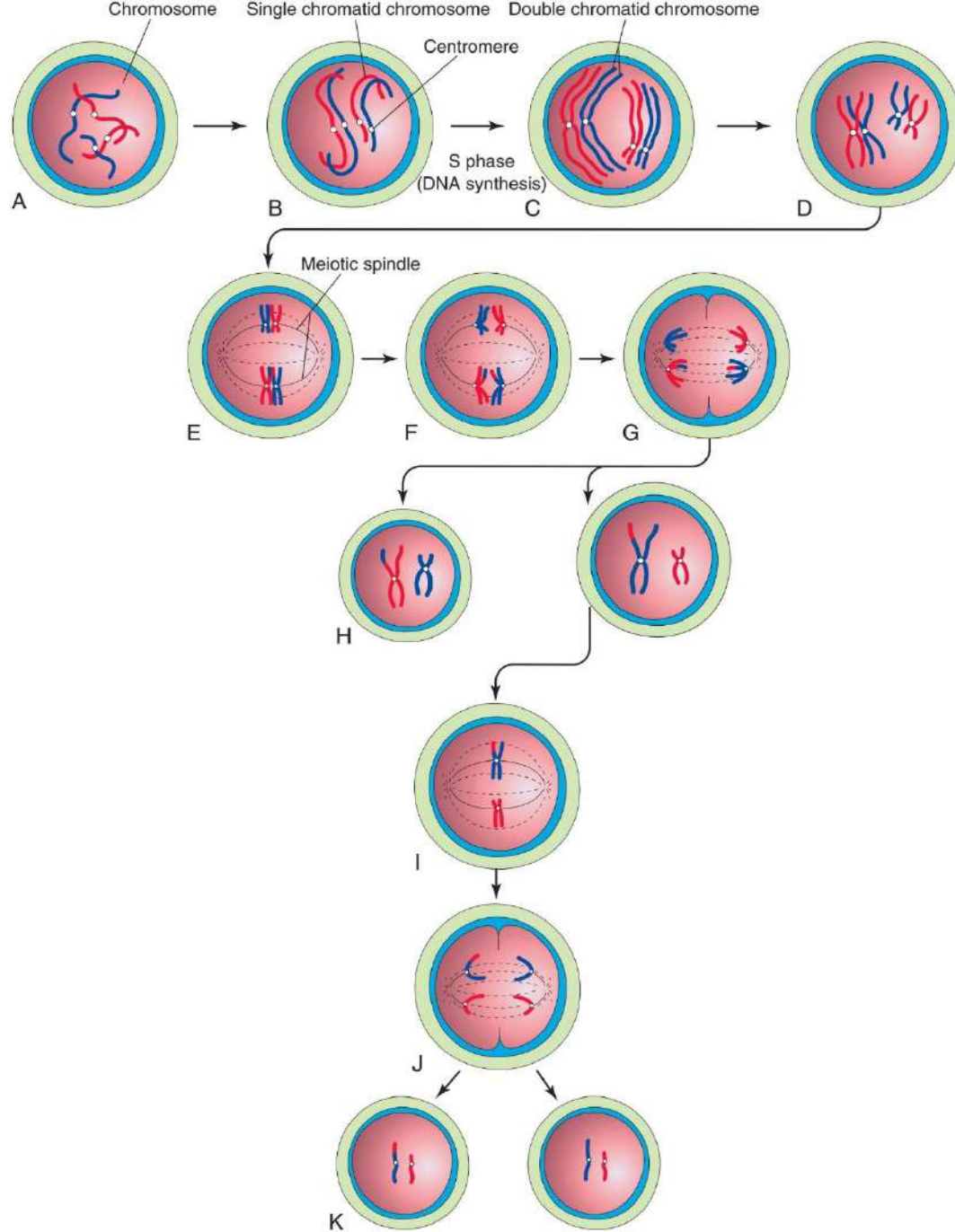
Meiosis

Miosis

بصير عنا هون تنوع نتيجة العبور الجيني بعد
هيك بصير عنا خليتين كل وحدة فيها 23
كروموسوم و بالنهاية بعطيني 4 خلايا هي
الجاميتات سواء sperm / oocyte

Mitosis & Miosis نتذكر

بالبداية الكروموسومات بتكون single strand جزء من الام و
جزء من الاب، و هدول بكونوا حاملين للجينات، في الخلية الانسانية،
كل كروموسوم بتكون من كروماتيدين بينهم centromere، لما
الخلية تنقسم هاد ال centromere بكون شادّ كثير عشان ما يسمح
بنسخ اي اشي ما بدنا اياه من الكروموسوم، بعدين بصير
للکروموسومات doublecation، بصير كل كروموسوم double
strand، بعدين بصيروا بنص الخلية على المحور بعد هيك الخيوط
المغزلية يلي هي microtubules بتشدّ الكروموسومات لعندها
على اطراف الخلية، ف بصير عندي نسختين من كل كروموسوم و
بصير عنا خليتين.



Diagrammatic representation of meiosis.

A- SPERMATOGENESIS

A- Spermatogenesis

- **Definition:** transformation of primitive male germ cells (spermatogonia) into spermatozoa.
- **Site:** Seminiferous tubules of testis.
- **Onset:** *عند البلوغ، بسبب تأثير hormones.* begins from puberty (13 – 16 years) to old age.
- **Duration:** 64 days (2 months). *Continuous process*
- **Steps:**
 1. Spermatoctogenesis
هو تكوين الخلايا الأولية
 2. Spermiogenesis.
هو تحويل بخير شكل الخلية إلى تلوونت.

A- SPERMATOGENESIS

1. Spermatocytogenesis

Stages:

1. The *in the wall of seminiferous* spermatogonia (44-XY) divide by mitosis into 2 daughter spermatogonia (44-XY) which are 2 types: (Mitotic division)

a. **Type A:** to renew itself. → Spermatogonia *سبحر دے خلیے*.

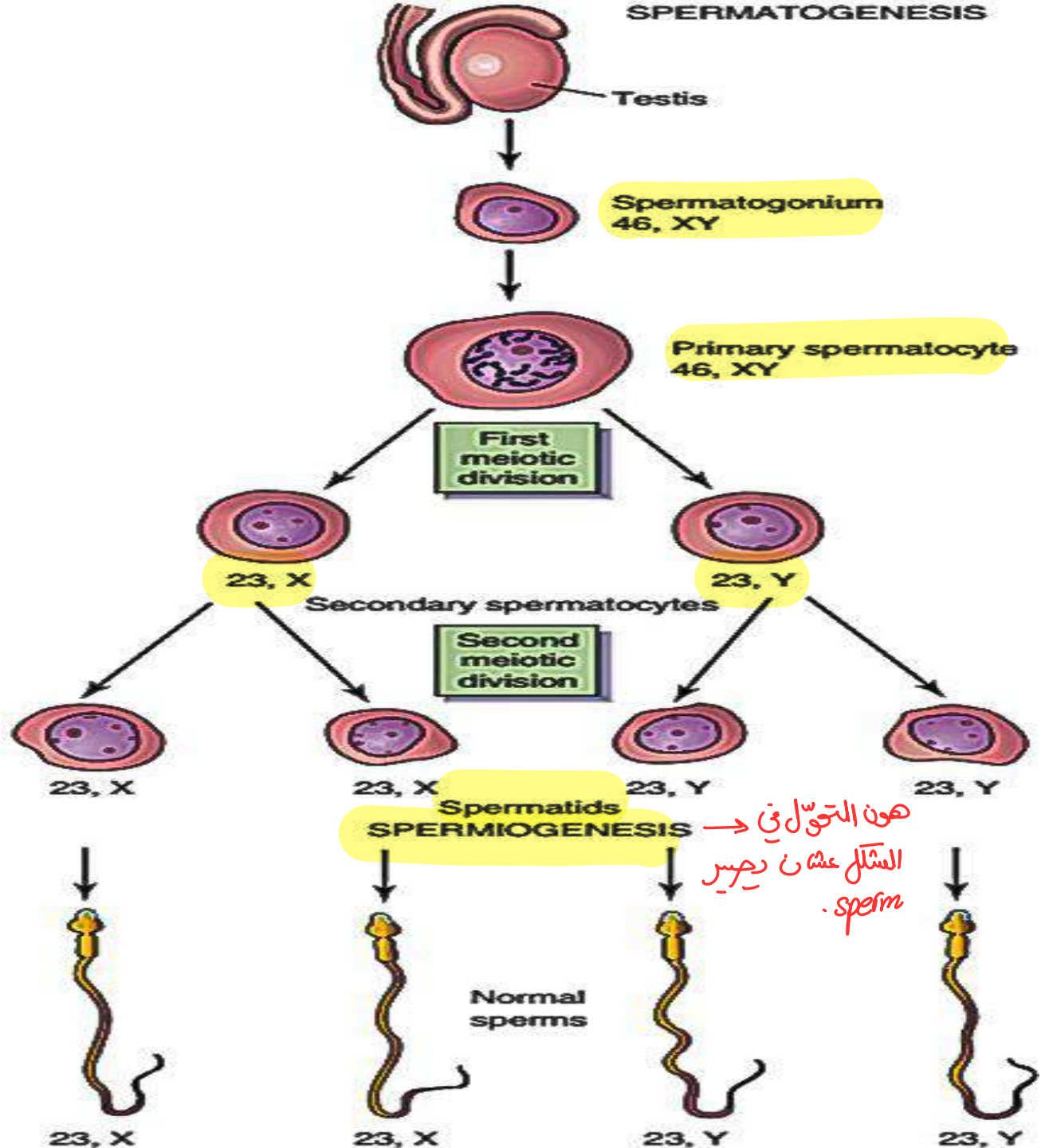
b. **Type B:** Which grow & enlarge to form (primary spermatocytes) (4n DNA).



2. Each Primary spermatocyte divides by 1st meiotic division into spermatids (haploid DNA).

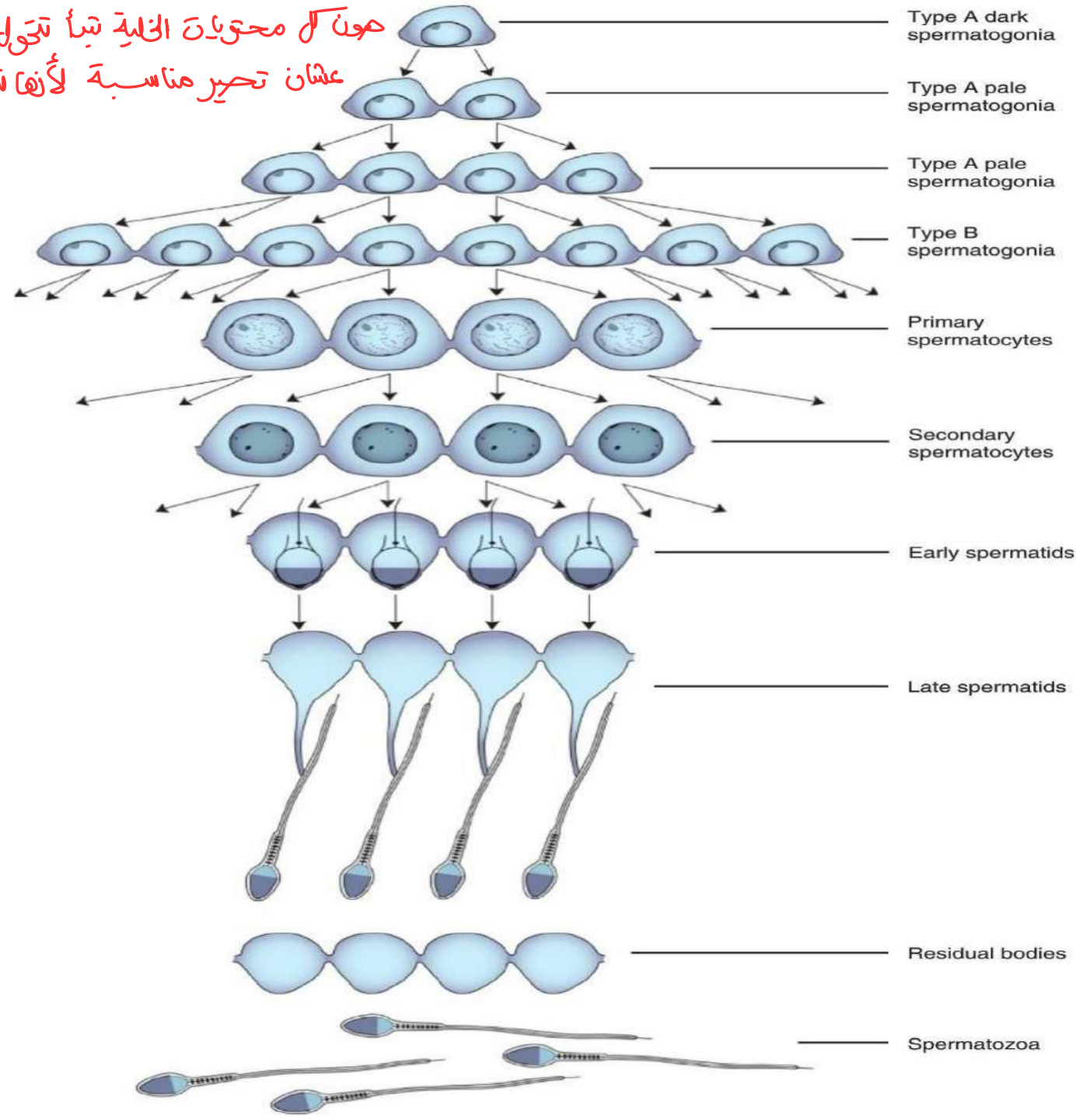
3. Each spermatid transform into a mature sperm by a process called spermiogenesis. → Sperm *سبحر*.

SPERMATOGENESIS



هون التحوّل في
المشكل عشان نحوي
sperm

هون كل محتويات الخلية تبدأ تتحول بشكل معين
عشان تحير مناسبة لأنها تتحول لـ *sperm*



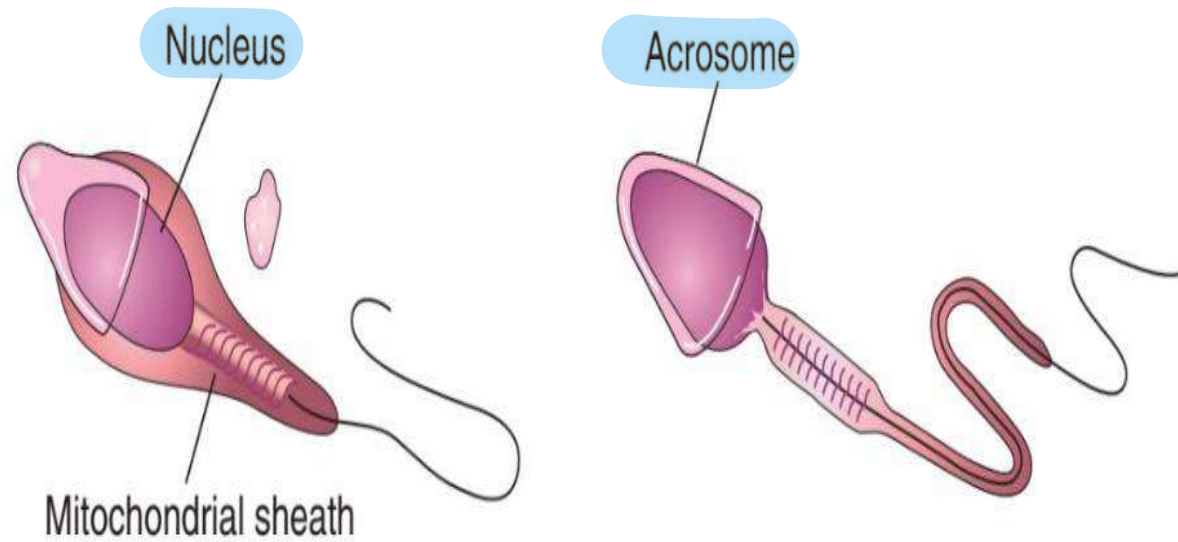
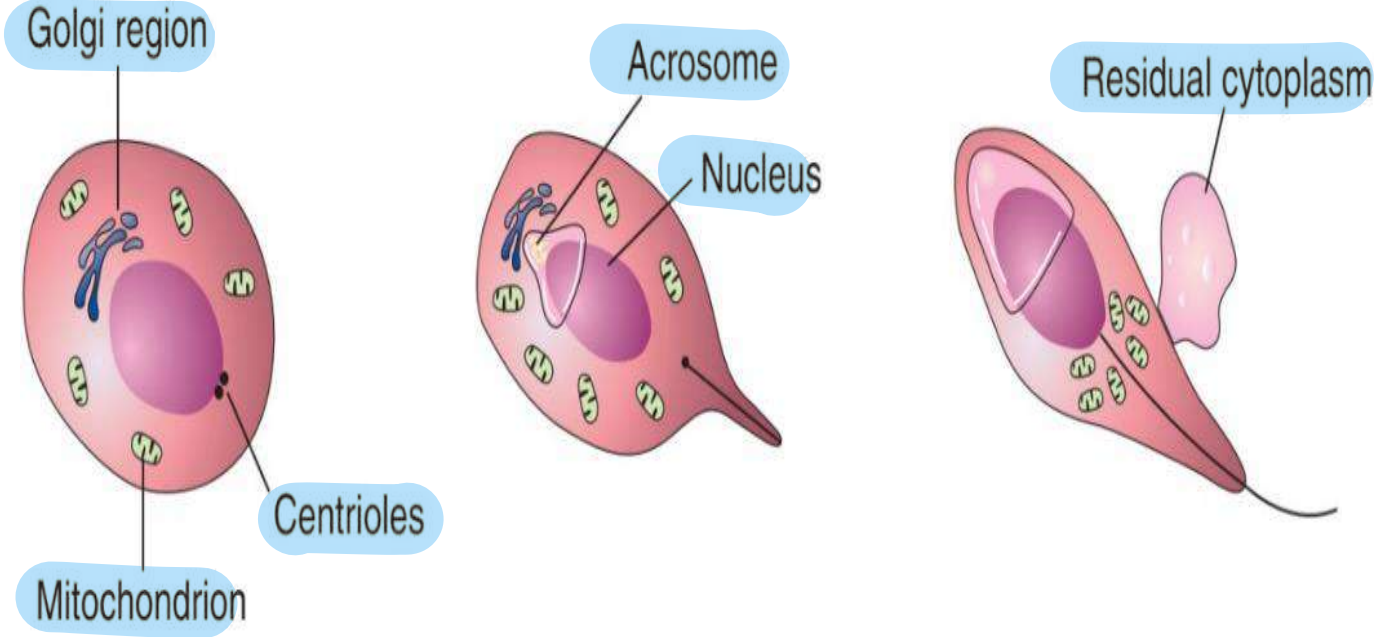
A- SPERMATOGENESIS

2. Spermiogenesis

Definition: morphological change of spermatids to mature sperms (spermatozoa).

Process:

- 1. Nucleus:** Forms most of **head** of sperm.
- 2. Golgi apparatus:** Forms **acrosomal cap** which covers anterior 2/3 of the nucleus.
- 3. Centrioles:** ^{المركزات} directed towards the opposite side of the nucleus to form the **tail** of sperm.
- 4. Mitochondria:** surround the 1st part of the tail to form **Spiral sheath** (concerned with energy production for movement).
- 5. Cytoplasm:** most of the cytoplasm of the head is removed by the **Sertoli cells**.



Illustrations of spermiogenesis, the last phase of spermatogenesis.

A- SPERMATOGENESIS

The **mature sperm** (*تقریباً ہمیشہ 48 گھنٹوں میں*)

- It consists of a **head** & **a tail** with **a neck** in between.

1. **Head:** contains the **nucleus** & **its anterior 2/3** covered by the **acrosome**.

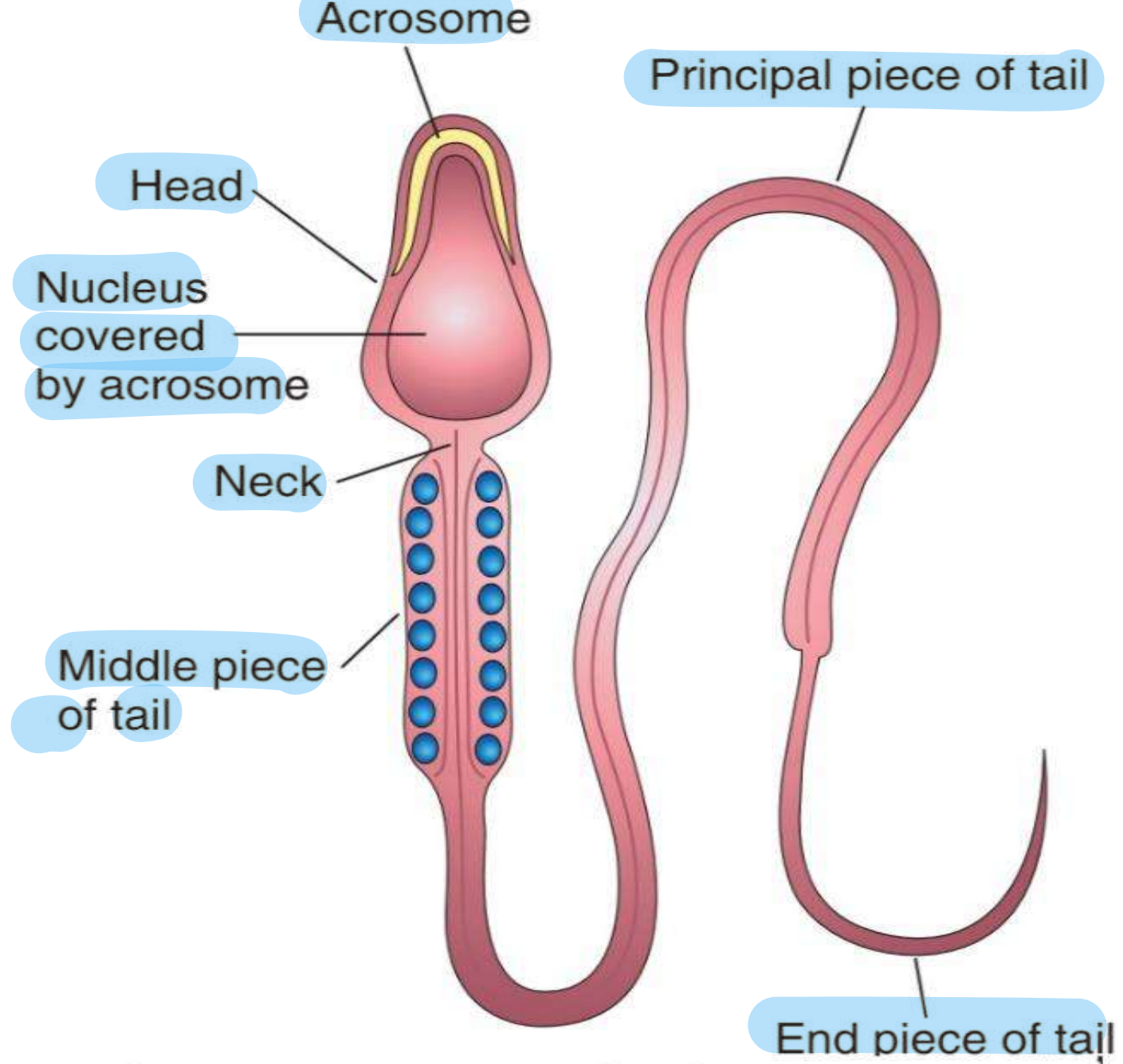
2. **Neck:** contain **centrioles**.

3. **Tail:** consists of 3 parts:

a. **Middle piece:** contains **mitochondria** which surround the 1st part of tail and it is concerned with **energy production** for movement.

b. **Principal piece:** longest part & provides **motility** of sperm.
movement

c. **End Piece.**



The main parts of a human sperm

A- SPERMATOGENESIS

The seminal fluid

Formation: من السائل المنوي

- 1.Sperms:** from testis.
- 2.Secretions:** from the accessory sex glands (seminal vesicle, prostate & bulbo-urethral glands).

Characters:

- **Nature:** Thick, white and gelatinous fluid rich in glucose & fructose..
for ATP synthesis
- **Volume:** 3-5 cc per ejaculation.
- **Odor:** Characteristic odor.
- **Reaction:** Alkaline. ^{قلوي} acidic ^{حمضي} vagina ^{عنه}
- **Number of sperms:** 200-600 million per ejaculation.
- **Motility:** More than 80% of sperms are motile.
- **Shape:** normally Less than 10% abnormal in shape.

Functions:

1. Contain fructose for sperm nutrition.
2. Contain prostaglandins for sperm motility & transport.
3. Alkaline to neutralize the vaginal acidity. ^{عشان يصبّر معادلة مع}
^{بحصن}

A- SPERMATOGENESIS

غني عن فحص بيعلوه المقبلين على الزواج لتحريير السائل المنوي و بقدروا يعرفوا الـ characters لاله ، عشان يحددوا هل بقدر فعلاً ينجب او لا ، بعض المشاكل تؤدي الى عقم ، بعض المشاكل بتكون بشكله ، حركته ، عدده لو في العدد بتكون عناهون يا اما عدد قليل من sperms او اصلاً ما في انتاج للسperms و هاد خصوصاً بصير مع التقدم بالعمر ،

Anomalies: Abnormal

1. Number:

- Azospermia: Complete absence of the sperms.
- Oligospermia: the number is less than 20 million per ejaculation.

2. Motility: ^{الكرته}

- Immotile ^{صون Tail لا يتحرك}
- Necrospermia: presence of dead sperms. → هون يتكون sperm عاهي بس في امتي خليه يموت على طول .

3. Shape:

- Dwarf sperms: very small sperms. short tail + small head.
- Giant Sperms: very big sperms.
- Sperms has 2 heads or 2 tails.

Fate: ^{مهين sperms}

site of fertilisation

- Only about 400 sperms reach the ampulla of the uterine tube after 5 minutes of their deposition.
- Their fertilization power lasts only for 24 hours.
- Only 1 sperm is allowed to enter the ovum. 23 from sperm + 23 from ovum

2 heads



2 tails



Dwarf



Giant



No head



B. OOGENESIS

- **Definition:** Transformation of the primitive female germ cells (oogonium) into mature ovum.
- **Site:** Cortex of the ovary. ^{قشرة}
- **Onset:** From intra-uterine life to menopause. ^{من الفترة الجنينية.}
- **Process:**
 1. **During intrauterine life (Prenatal maturation of oocytes):** ^{قبل الولادة}
 - Oogonia increase in number by **mitosis** daughter oogonia (44-XX).
 - Each daughter oogonium enlarges to form ^{primary} 1ry oocytes (44-XX-4n).
 - **The 1ry oocyte** begins (1st) meiotic division **before birth** but remains in the resting prophase **till puberty.** ^{البلوغ}

B. OOGENESIS

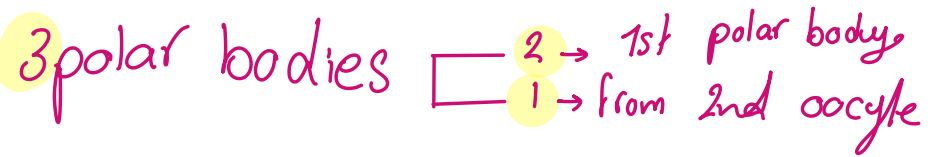
هون بعد ولادة الأنت

2. Before ovulation (Postnatal maturation of oocytes):

- **At puberty:** the 1ry oocytes begins to complete 1st meiotic division every month and gives rise to 2ry oocyte and the 1st polar body.
- **At ovulation:** the 2ry oocyte and the 1st polar body begin the 2nd meiotic division, but the division is arrested in **metaphase** till fertilization.

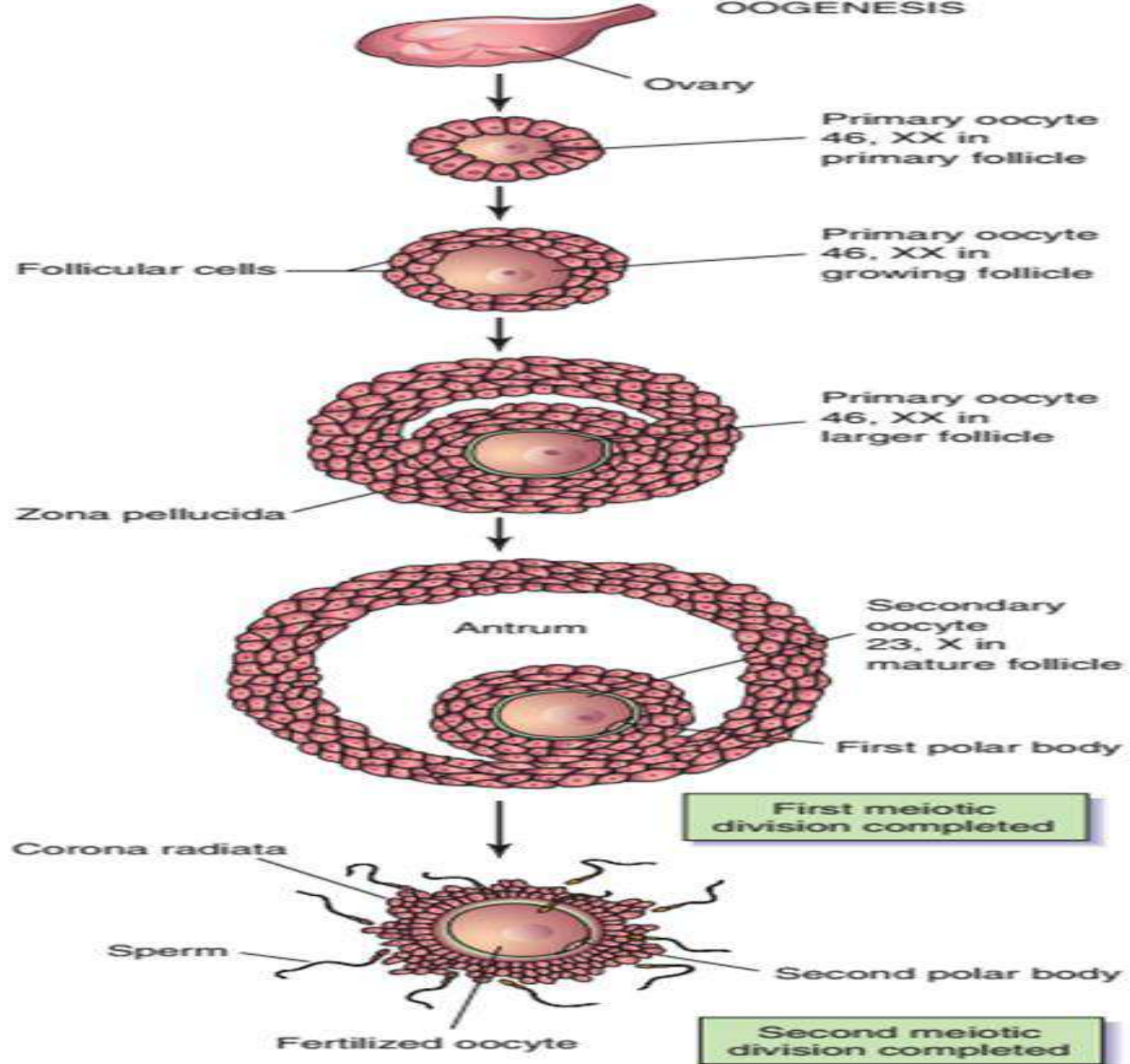
3. After ovulation:

- a. If fertilization occurs**, ^{في حالة حدوث إخصاب} the 2nd meiotic division is completed to give 2 cells: mature ovum & 2nd polar body, the 1st polar body also divides into two 2nd polar bodies.



- b. If fertilization does not occur**, ^{في حالة عدم حدوث إخصاب} the 2ry oocyte degenerates after 24 hours.

OOGENESIS



B. OOGENESIS

N.B: The number of oocyte in females;

1. 2 million 1ry oocytes in the ovaries of the newborn females.

2. 40000 1ry oocytes during adolescence.

3. 480 become 2ry oocytes used by ovulation during reproductive life.

$$\frac{480}{12} = 40 \text{ (فترة الإخصاب للأنت)}$$

Gametogenesis

formation of male and female gametes

spermatogenesis (male)

Spermatocytogenesis : we have spermatogonium

hormone changes
↓
primary spermatocyte
mitotic division
← 2nd secondary spermatocyte
2nd division
4 cells (spermatids) 22% + 22%

Spermiogenesis : changing of the shape for maturation

oogenesis (female)

intraovarian life : we have oogenia → primary oocyte
قبل الولادة

Before ovulation : primary oocyte $\xrightarrow{1st\ division}$ secondary oocyte + 1st polar body
عند البلوغ
2nd division
موت بوقت مبكر وبيننا متوقف في إخصاب اولاد
2nd polar body

After ovulation

fertilisation : secondary oocyte $\xrightarrow{2nd\ division}$ mature ovum + 2nd polar body
No fertilisation

Sperm transport

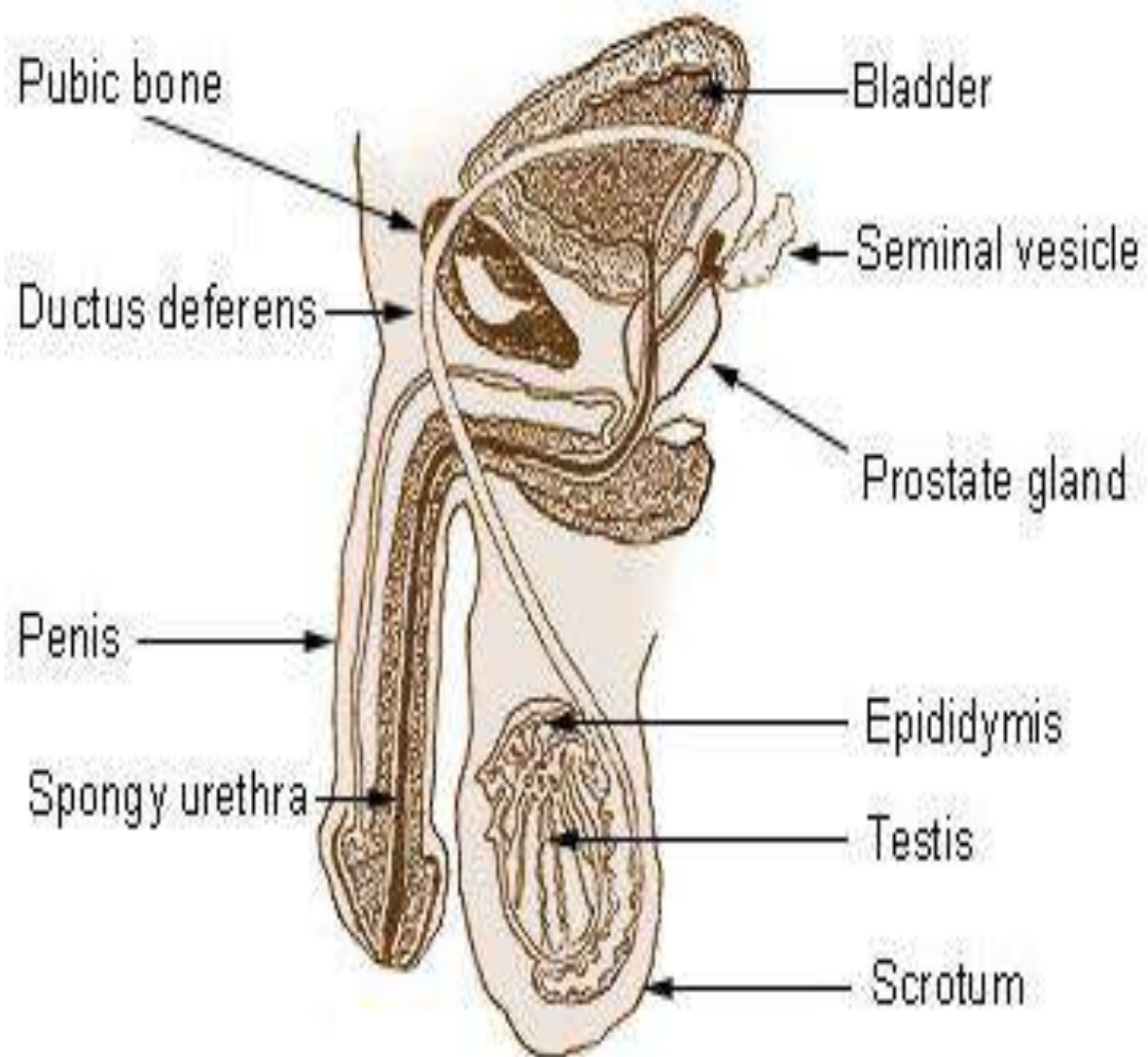
1. In male:

- From the (epididymis) to (urethra) through **Vas deference**.
- As the sperms pass through the male ducts secretions from the accessory sex glands are added to it to form the seminal fluid.

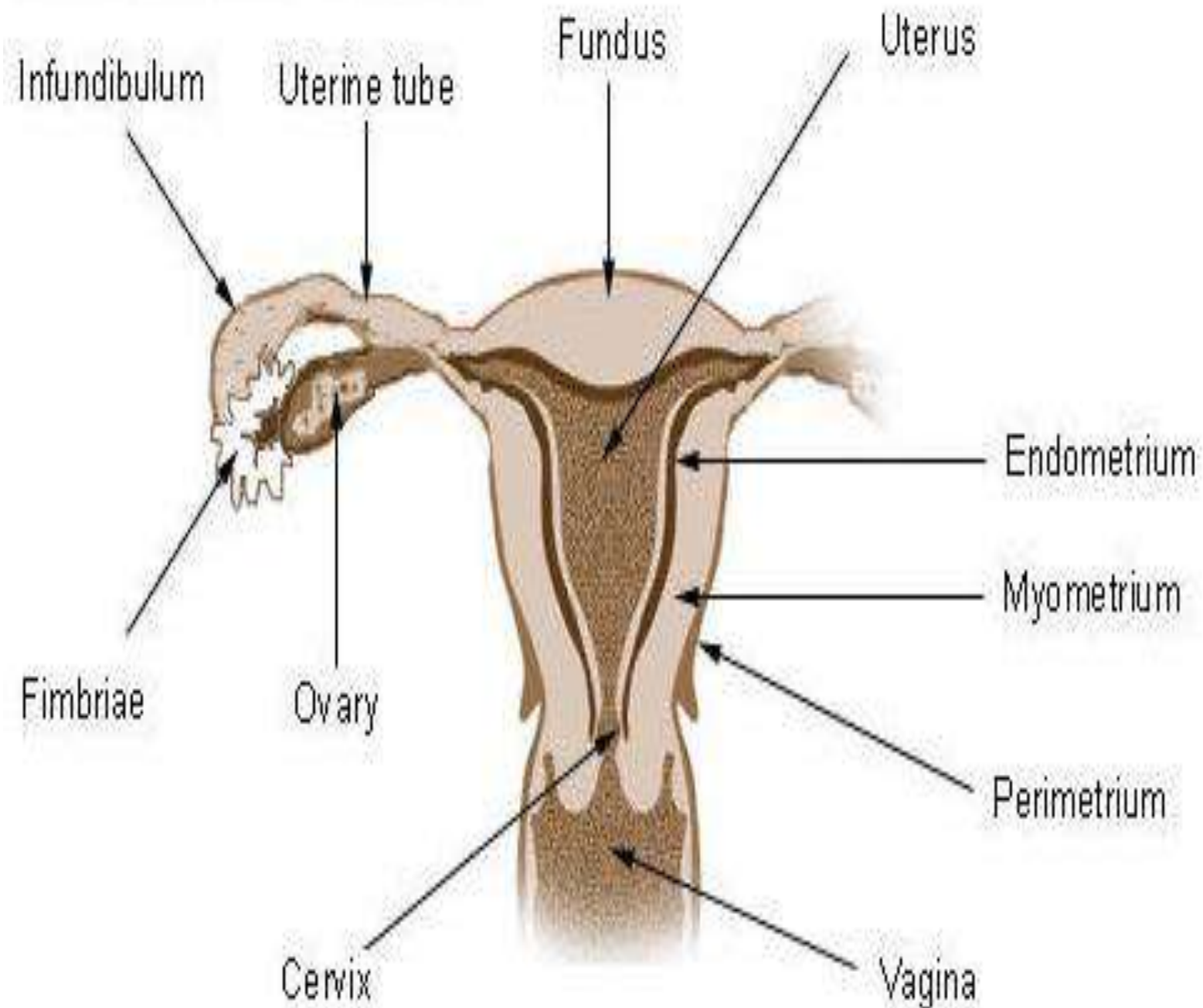
2. In female:

- During sexual intercourse from **200 – 600 million** sperms deposited around **Posterior fornix of vagina**.
- The sperms pass through **the cervical canal** by the movement of its tail to reach **uterus**.
- Then passes through uterus to reach **uterine tube**. (RT + LT) →

در مالتا
oocyte
عنا ترتبط فيها



Uterus and Uterine tubes



COMPARISON

Male gametes

The sperm is highly motile.

The sperm have a little cytoplasm.

The cytoplasm of the sperm contains no yolk granules. ^{المُح}

There are two types of normal sperm: $22 + X$ and $22 + Y$.

Production of 1ry spermatocytes after puberty _{بعد البلوغ}

Female gametes

The mature oocyte is immotile. ^{غير متحركة}

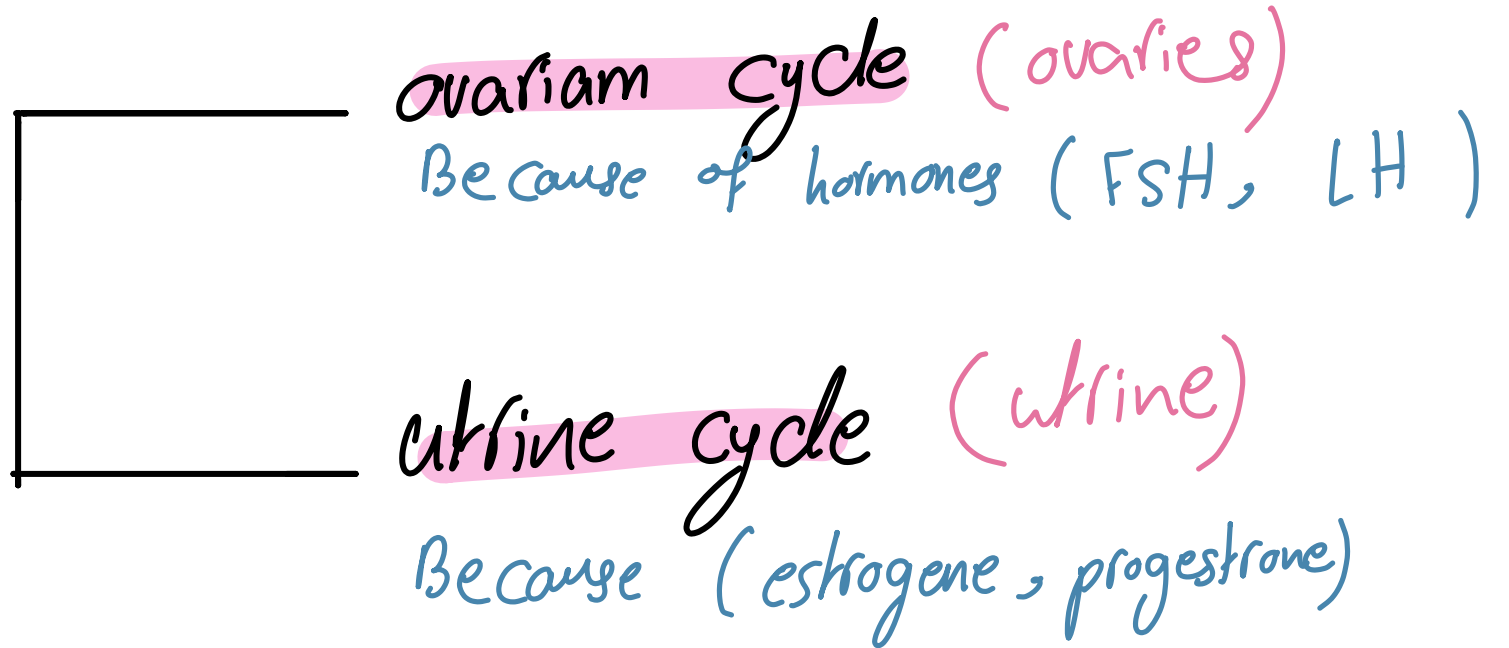
The mature oocyte is a massive cell.

The cytoplasm of the mature oocyte contains ^{cytoplasm هون اللمة أكبر} yolk granules which provide nutrition to the dividing zygote during the first week after fertilization.

There is one type of ovum: $22 + X$.

No primary oocytes after birth _{before birth}

FEMALE REPRODUCTIVE CYCLES



CYCLIC CHANGES

A. Ovarian Cycle *every month.*

- **Definition:** cyclic changes that occurs in the ovaries.
- **Time:** Begins at ^{عند البلوغ} puberty (8-14 year) and **ends** at menopause (45-55 year), and stops during pregnancy. ^① ^②
- **Duration:** 28 days (lunar month). *(26-35 days) من ثابتة بين*
- **Cause:** FSH and LH.
- **Phases:** three phases:
 - 1) **Follicular phase (preovulatory phase).** *قبل الإباضة*
 - 2) **Ovulation.** *الإباضة*
 - 3) **Luteal phase (postovulatory phase).** *بعد الإباضة*

CYCLIC CHANGES

1) Follicular Phase:

a) **Primordial follicles:** Time: from 1st day to day 13 *بمساعدة oocyte*

1ry oocyte surrounded by a single layer of follicular cells which are at first flat cells (before birth), but later they become cuboidal (during puberty).

internal وحدة + external وحدة ← Theca zone
بغمر طبقة حوالين oocyte ← Granulosa

في عناء FSH يؤمن عليهم الخلايا تكسر و تعطير

b) **Growing follicle:** The primary follicle gradually increases in size due to:

(a) **Ovum:** increase in size.

(b) **Two membranes** are added by the follicular cells:

① **Zona pellucida:** around the ovum (amorphous, acellular glycoprotein material).

↳ (Carbohydrates + protein)

② **Basement membrane:** around the follicular cells

CYCLIC CHANGES

(c) **Follicular cells:** proliferate and become many layers (called granulosa cells). They secrete estrogen. →

(d) **The follicular cells:** secrete fluid in the inter follicular spaces. These spaces enlarge and fuse together to form one large cavity called the follicular cavity filled with the follicular fluid.

(e) **Theca:** arrangement of connective tissue around the growing follicle and differentiate into two layers:

a. Theca interna: internal vascular layer.

b. Theca externa: external fibrous layer.

□ When all these changes occur, the growing follicle called mature Graafian follicle.

CYCLIC CHANGES

c) Mature Graafian Follicle:

تحت تأثير FSH بتطوع
للـ cortex

- **Site:** in the cortex of the ovary.
- **Time:** at 14th day (midcycle). → جاهزة للانفجار
- **Shape:** rounded.
- **Size:** 2 cm in diameter.
- **Function:** Secrets estrogen and protects oocyte.
- **Fate:** The Graafian follicle ruptures and gives 2ry oocyte and corpus luteum.
يحزني تنفجر
- **Structure:** from outside inwards:

(a) **Theca externa.**

(b) **Theca interna.**

CYCLIC CHANGES

(c) Granulosa (follicular) cells: many layers of follicular cells surrounding follicular cavity and classified into:

- 1) Corona radiate: few layers of cells surrounding the ovum.
- 2) Cumulus oophorus: follicular cells connecting corona radiate with granulosa cells.
- 3) Granulosa (follicular) cells: all around the follicle.

(d) The follicular cavity: filled with the follicular fluid, and contains estrogen.

(e) zona pellucida: becomes more thick.

(f) Ovum: increase in size (500 micron) and immediately before ovulation it completed its 1st meiotic division and becomes 2ry oocyte:

CYCLIC CHANGES

2) Ovulation: مرحلة الإباضة وهي تكون البويضة

- **Definition:** rupture of the mature Graafian follicle and liberation of the ovum which is surrounded by the zona pellucida and corona radiata.

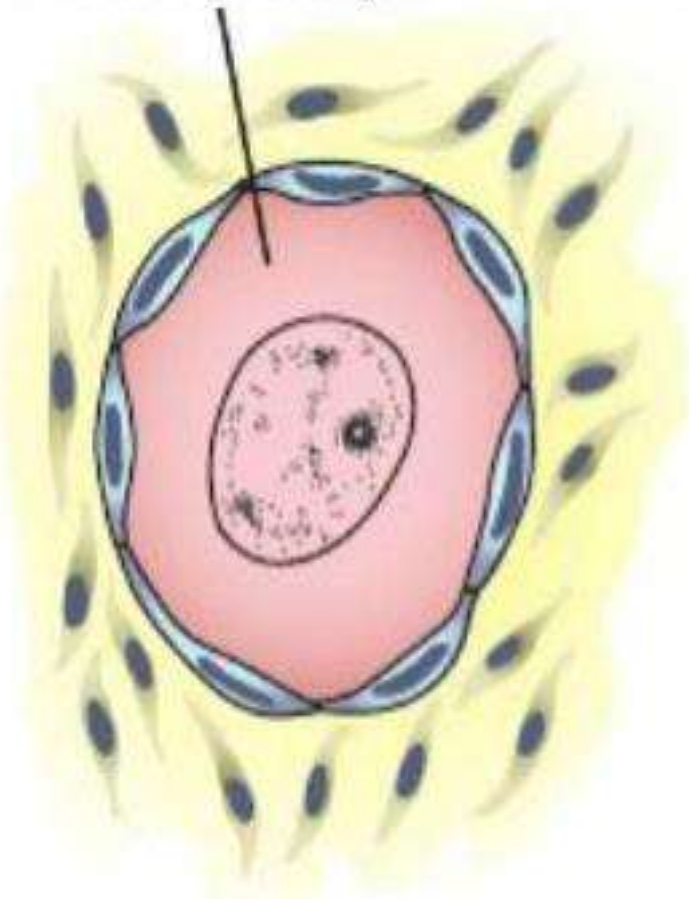
1 + 2 + 3 → ياتي بطلعوا معها
و يروحوا مع uterine tube

- **Fate:** it enters the uterine tube where it is either fertilized or discharged from the uterus during the menstrual period.

- **Time:** midcycle (14 days in an average 28-day menstrual cycle).

CYCLIC CHANGES

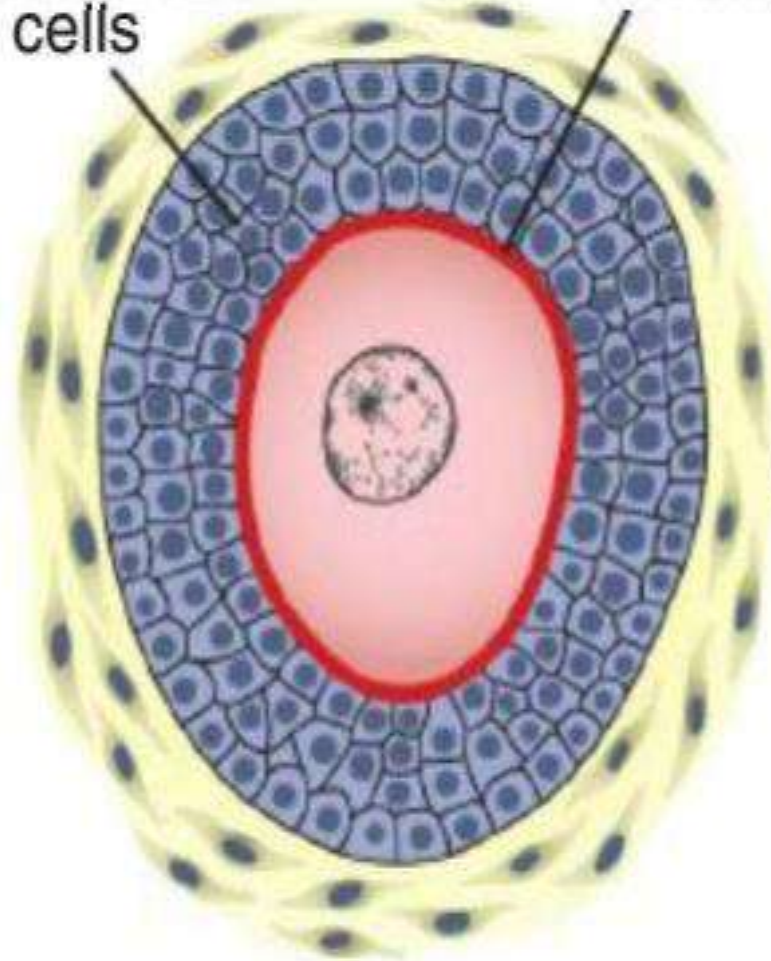
Primary oocyte



A Primordial follicle

Granulosa cells

Zona pellucida

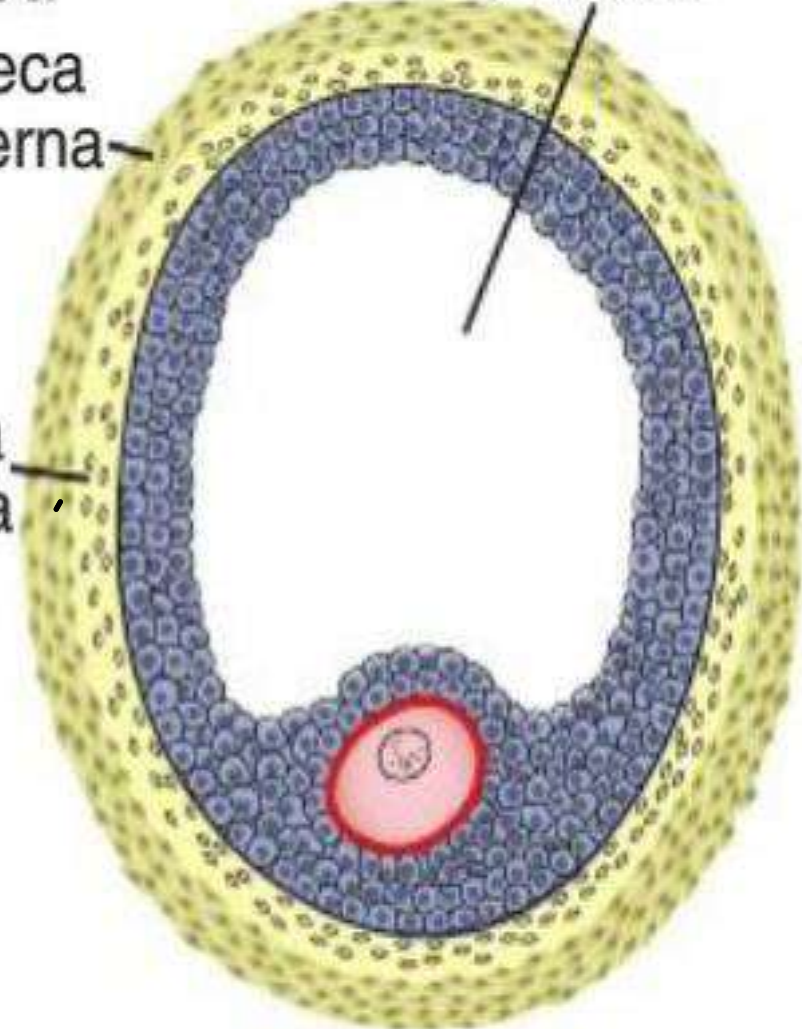


B Growing follicle

Theca externa

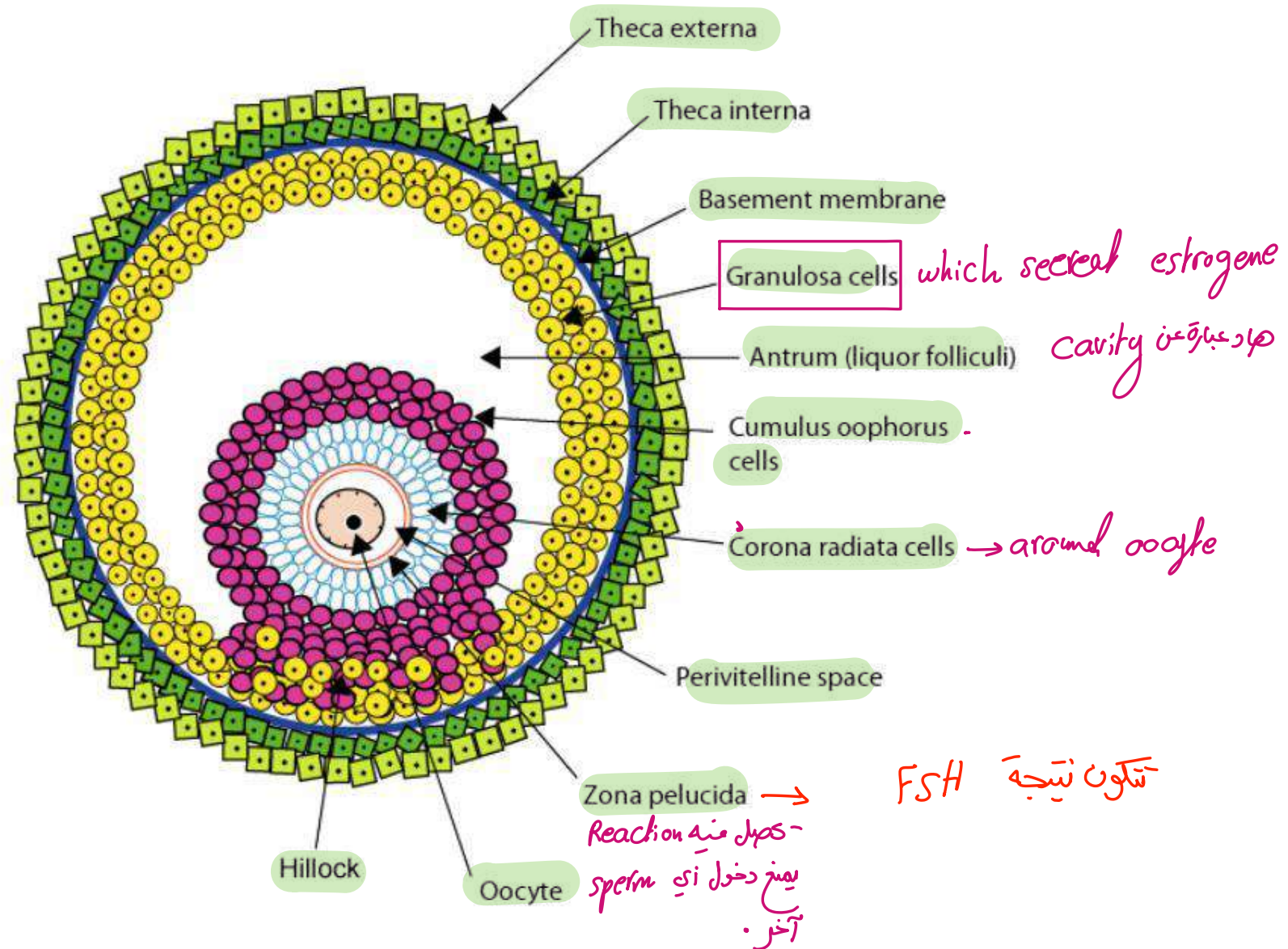
Antrum

Theca interna



C Vesicular follicle

Anatomy of a Graafian Follicle



CYCLIC CHANGES

- Causes:

1. **FSH and LH hormones.** *Repture كَقْر-*
2. **Prostaglandins:** produces contraction of the smooth muscles in the theca externa. *→ fibrous tissues
↳ smooth muscles*
3. **The high osmotic pressure** of the fluid inside follicular cavity due to high levels of LH.

CYCLIC CHANGES

3) Luteal phase:

- After ovulation, the wall of the Graafian follicle **collapse**.
- The follicular cavity becomes filled with **blood** and forms the **corpus haemorrhagicum**. (الكيسم الأظفر) ^{تدع مثل الآرة}
- Three days later, the bleeding stop and the granulosa cells enlarge and become distended with the **yellow pigment (lipochrome)** and transformed into a **yellow body**, known as the **corpus luteum**.
- **The corpus luteum:** secretes **progesterone** from **theca interna** cells and secretes **estrogen** by **follicular cells**.
- It lives for **9 days** then **degenerate** if pregnancy doesn't occur.

بستان على بعضه

لو حصل ، بستان ويتكلم

CYCLIC CHANGES

□ Fate of corpus luteum:

- ▶ □ If fertilization occur: the corpus luteum enlarges and continues to secrete progesterone till 4th month of pregnancy and called corpus luteum of pregnancy. عشان تستاعدى بقوة بطانة الرحم
- ▶ □ If fertilization doesn't occur: the corpus luteum begins to degenerate about 10 to 12 days after ovulation and transformed into white fibrous tissue in the ovary called the corpus albicans. white

CYCLIC CHANGES

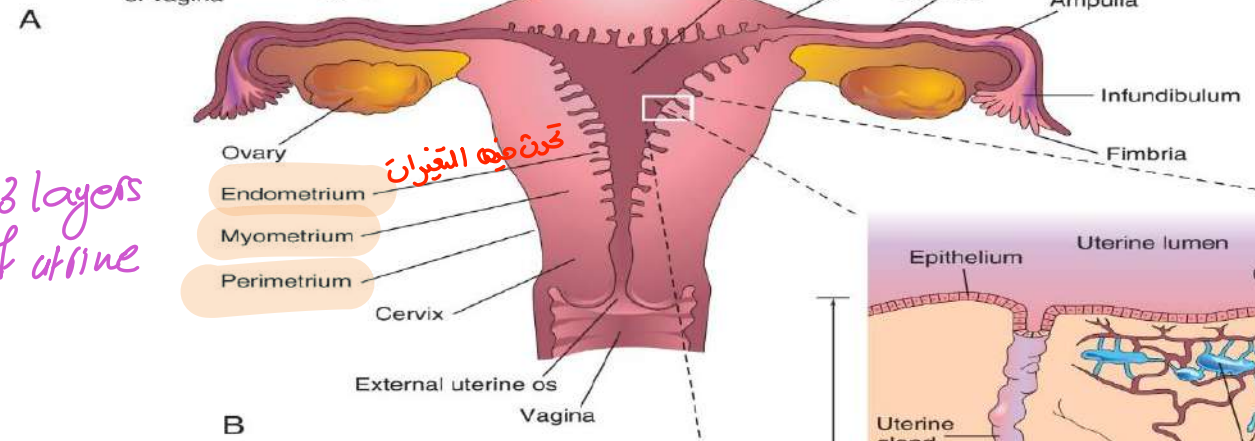
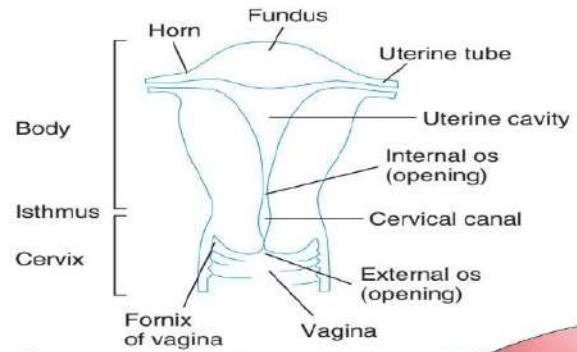
B. Menstrual (Uterine) cycle

- **Definition:** Cyclic and structural changes in the endometrium of the uterus every 28 days (Lunar month).
- **Onset:** from ^{من البلوغ} puberty till menopause.
- **Cause:** estrogen and progesterone.
- **Phases:** three main phases.

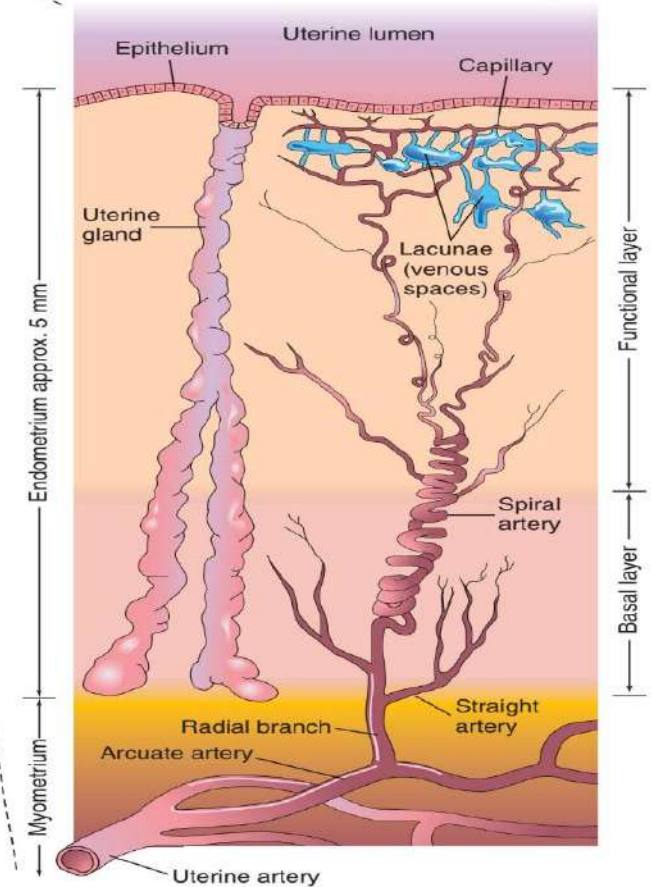
1) Menstrual (bleeding) phase.

2) Proliferative (estrogenic) phase.

3) Secretory (luteal, progestronic) phase.



3 layers of uterine



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CYCLIC CHANGES

1) Menstrual (bleeding) phase:

- **Duration:** usually lasts 4 to 5 days

N.B.: The 1st day of menstruation is the beginning of the cycle.

- **Cause:**

- Degeneration of the corpus luteum causes sudden falling of progesterone level.

2) Proliferative (estrogenic) phase:

- **Duration:** about 9 days (from the end of the menstrual phase till 14th day of the cycle).
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N.B.: proliferative phase coincides with the growth of ovarian follicles.

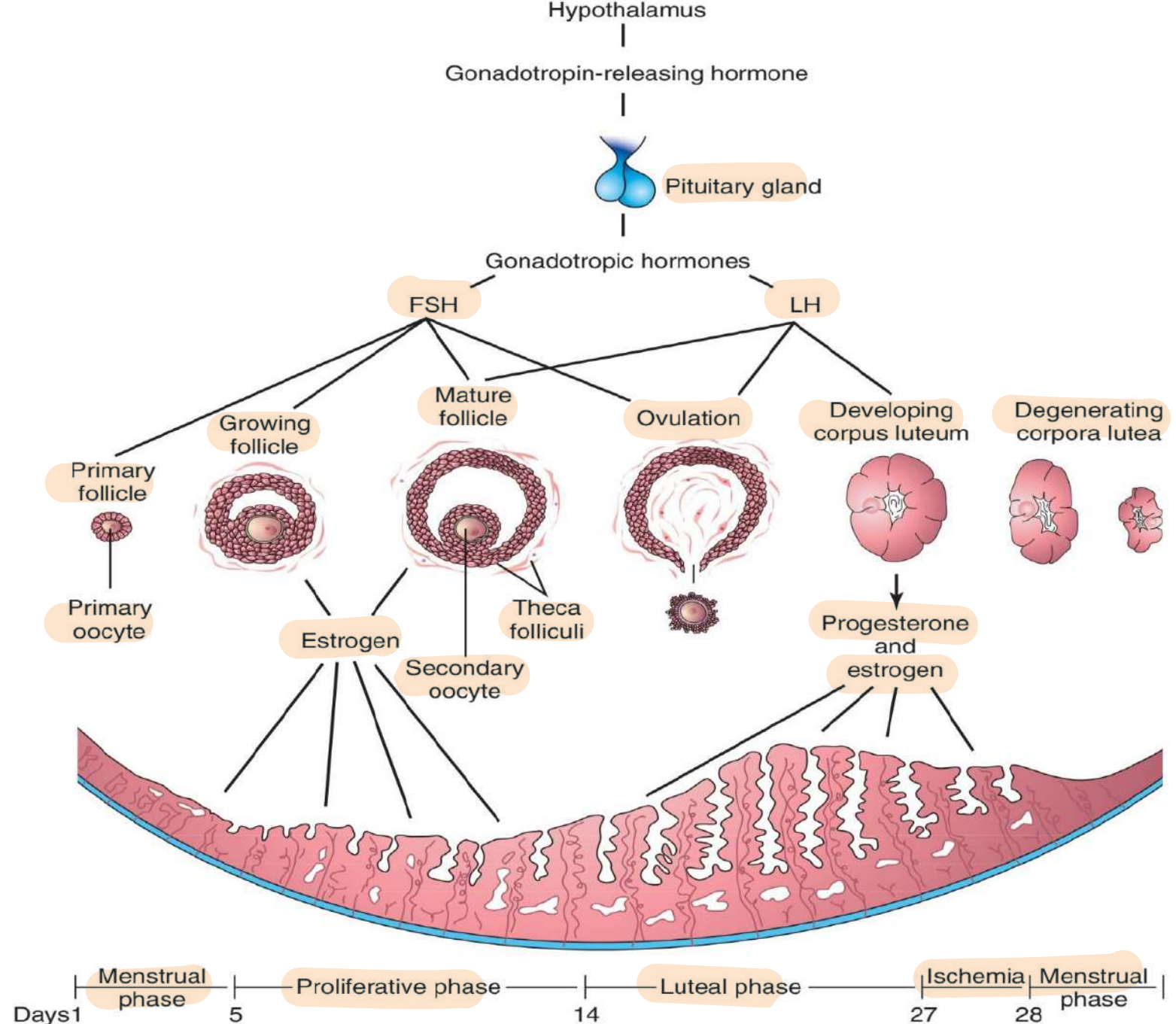
- **Cause:** estrogen secreted by growing follicles.

3) Secretory (luteal, progestronic) phase:

- **Duration:** about 14 days Extends from the time of ovulation.

N.B.: It coincides with the formation and growth of the corpus luteum.

- **Cause:** progesterone and estrogen hormones produced by corpus luteum.



Interrelations of the hypothalamus of the brain, pituitary gland, ovaries, and endometrium.

CYCLIC CHANGES

- Characters of menstrual phase:

- **Menstrual blood:** is the bleeding from vagina.
- **Amount:** 50-60 c.c.
- **Time:** from 3 to 7 days
- **Contents:**
 - i. Unclotted blood.
 - ii. 2ry oocyte and its surrounding (zona pellucida and corona radiate).
 - iii. Superficial layer of endometrium (stratum compactum and stratum spongiosum)

Thank you

Thank you

