

قال تعالى : (وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ صَلْصَالٍ مِنْ حَمَإٍ مَسْتَوِينَ)

Gametogenesis

EMBRYOLOGY 437



تمت المراجعة

غيداء آل مطوع

ب

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Important

Dr. notes

Explanation

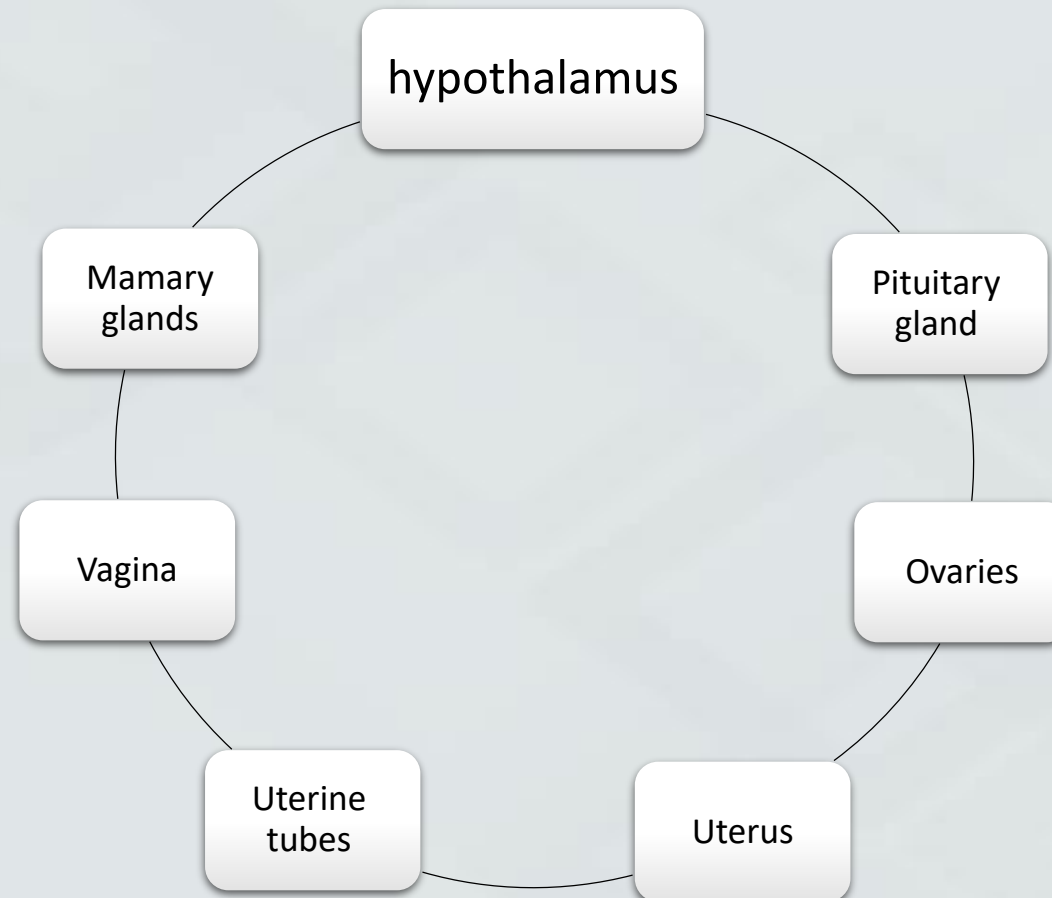


Objectives:

- 1-Describe the female cycles (ovarian – uterine).
 - 2-Define gametogenesis.
 - 3-Describe the process of spermatogenesis.
 - 4-Describe the process of oogenesis.
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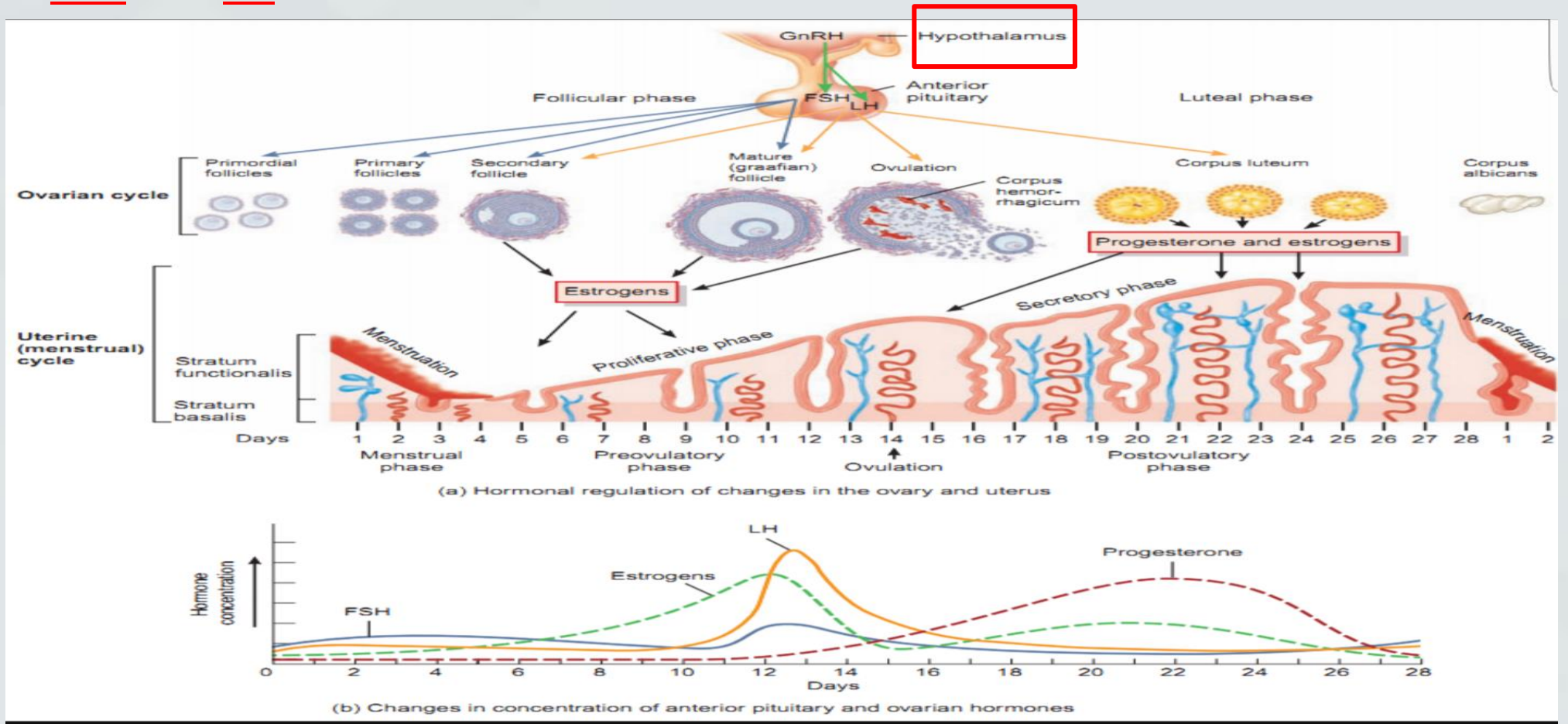
Ovarian and uterine cycles:

- starts at puberty until the menopause (سن اليأس)
- Both cycles depend upon factors to be activated and managed.



Hypothalamus :

It has neurosecretory cells that synthesize Gonadotrophin-releasing hormone (GnRH)
- The **Pituitary gland (anterior lobe)** is stimulated by GnRH to release two hormones that act on **ovaries** called FSH and LH .



The ovarian cycle:

The ovarian cortex contains (400,000 to 500,000) of primordial follicles

-Each primary follicle consists one of **primary oocyte** surrounded by single layer of flat follicular cells.

-Pituitary Gland control the ovarian cycle, ovarian cycle has three phases (FOL) :-

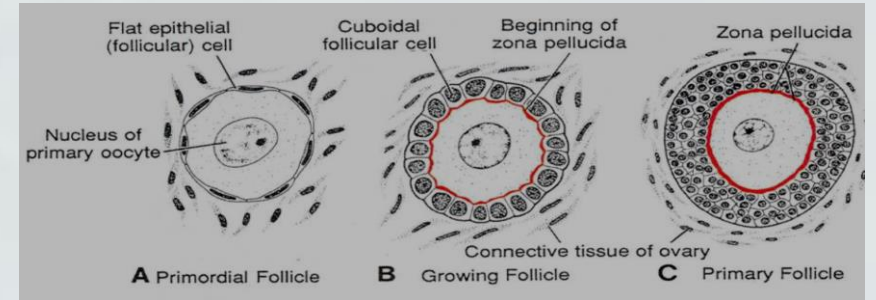
1-Follicular(FSH and little LH)

2-Ovulatory(LH and little FSH)

3-Luteal(LH)

يوجد اختلاف في الهرمونات وأيضا نسبتها إلى أي مرحلة، المهم أن تعرف أن FSH في التكوين البدائي وأن LH المسؤول عن الإباضة والمراحل النهائية .

These are follicle levels until
it becomes primary.
Growing is just description



Very Important Notes :-

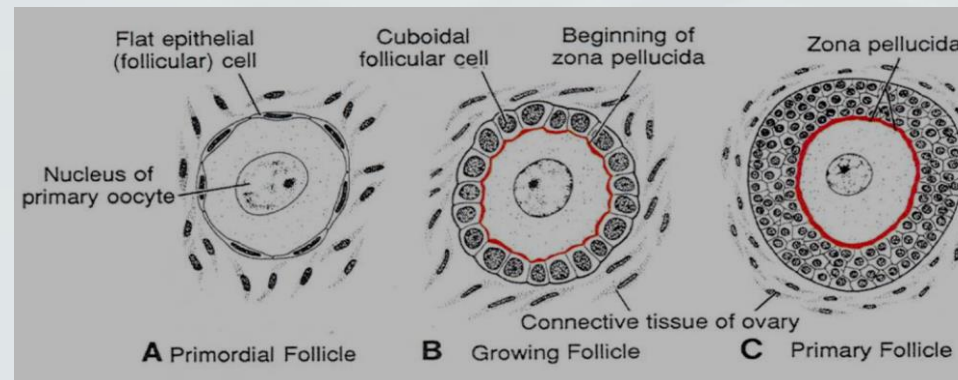
- all the primary oocytes are formed before birth , and are not made after birth .
- all primary oocytes complete the prophase and stay until puberty .
- Both FSH and LH are secreted by the pituitary gland .

• Follicular Phase :

It is the phase in which follicles gets developed and becomes mature .

Follicle-Stimulating Hormone (**FSH**) does the following (Functions):

1. Stimulates the ovarian **primary follicles** to develop and become **mature**.
 2. Production of **Estrogen** by the follicular cells.
- FSH makes the simple flat follicular cells become cuboidal, then columnar then forming many layers around the oocyte forming primary follicle.



• Ovulatory Phase :

- The follicle grows up until it gets maturity. It produces **swelling** on the surface of the ovary.
- Growing follicles produce estrogen which control the development and functions of the reproductive organ.
- Luteinizing Hormone (**LH**) does the following (Functions):
 1. Triggers **ovulation** (الإباضة)
 2. Stimulates the follicular cells to produce estrogen .
 3. Stimulate corpus luteum (الجسم الأصفر) to produce progesterone and some estrogen .

• Luteal Phase :

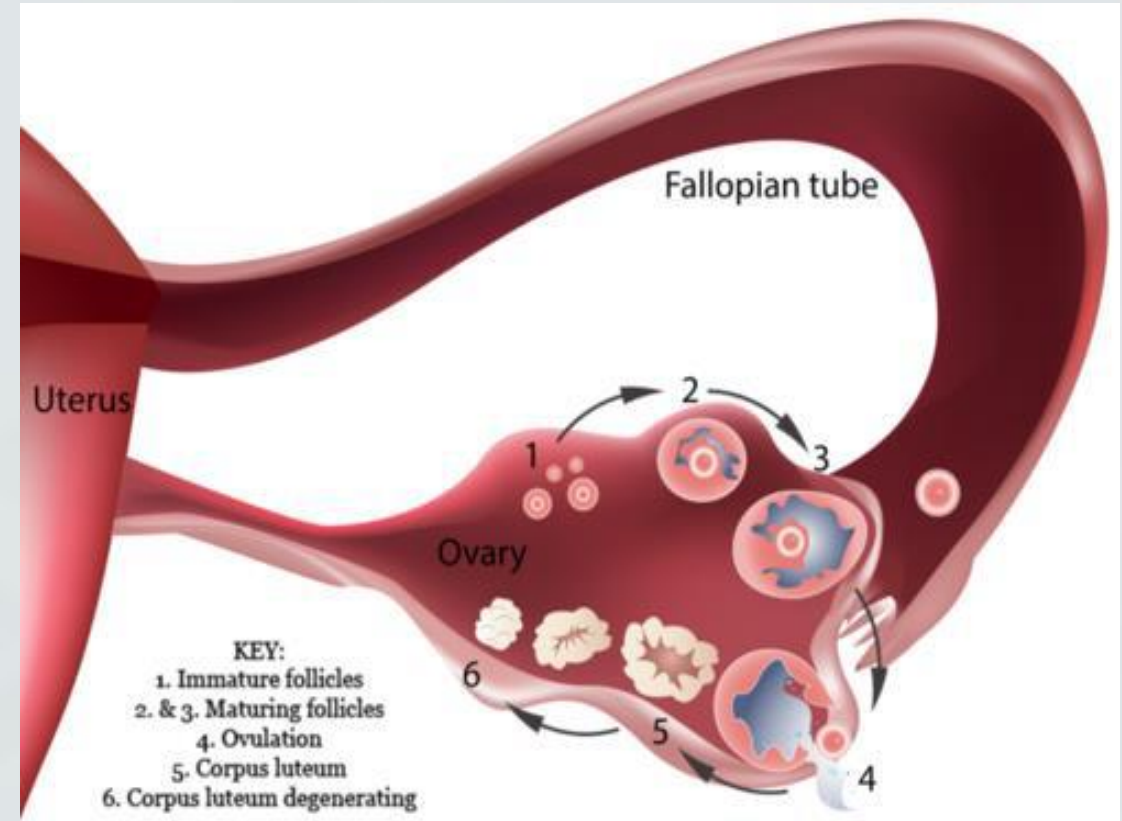
- The remaining of the ruptured follicle is now called **corpus luteum**. (الجسم الأصفر)
- It secretes **Progesterone** and small amount of **Estrogen**.
- These 2 hormones stimulate endometrial glands to secrete and prepare **endometrium** (بطانة الرحم) for planting of **fertilized ovum** [Blastocyst]
- If the oocyte is fertilized the Corpus Luteum **grow up** and remains until the **4th month** of pregnancy.
- If the oocyte is not fertilized the corpus luteum shrink and degenerates in 10-12 days.

FSH and LH OVERVIEW :

These 2 hormones stimulate endometrial glands to secrete and prepare endometrium for **planting of fertilized ovum** [Blastocyst].

If the oocyte is fertilized the Corpus Luteum grow up and remains until the 4th month of pregnancy.

If the oocyte is not fertilized the corpus luteum shrink and degenerates in 10-12 days.



Note:

-Early development of ovarian follicle is induced by FSH.

-Final stages of maturation require LH, it causes ovulation (rupture of the mature follicle) as mentioned before .

Uterine or menstrual cycle



-What is it?	Cyclic changes in the endometrium .
-What cause it?	Caused by estrogen & progesterone .
-It's average days?	An average is 28 days , the range between 23 and 35 days in 90% of women.
What else you need to know -about menstrual cycle?	Day one is the day when menstrual blood flow begins. varies by several days in normal women and It sometimes varies in the same woman.



Phases of the menstrual cycle:

1-Menstrual Phase

- -Starts 1st day and Lasts for 4-5 days.
- Functional layer of the endometrium is **sloughed off** and thrown away with the menstrual flow.
- Blood discharge from vagina is combined with small pieces of endometrial tissue.

2-Proliferative Phase

- -Is a phase of **repair** and proliferation.
- -Lasts for 9 days.
- -Coincides with growth of ovarian follicle.
- -So it is controlled by **Estrogen** secreted by the follicular cells.
- -Thickness of the endometrium is increased into 2-3 folds.
- -The glands increase in number and length and the spiral arteries elongate.

3-Luteal Phase:

- Is a Secretory of Progesterone phase.
- -Lasts about 13 days.
- -Coincides with the formation, growth and functioning of the Corpus Luteum.
- -Glandular epithelium secretes glycogen rich material.
- -Endometrium thickens under the influence of estrogen and progesterone.
- *What happens to the endometrium in this phase?
- -The spiral arteries grow into the superficial layer of the endometrium.
- -Arteries become increasingly coiled.
- -Large venous network develops.
- -Direct arterio-venous anastomoses are the prominent features.

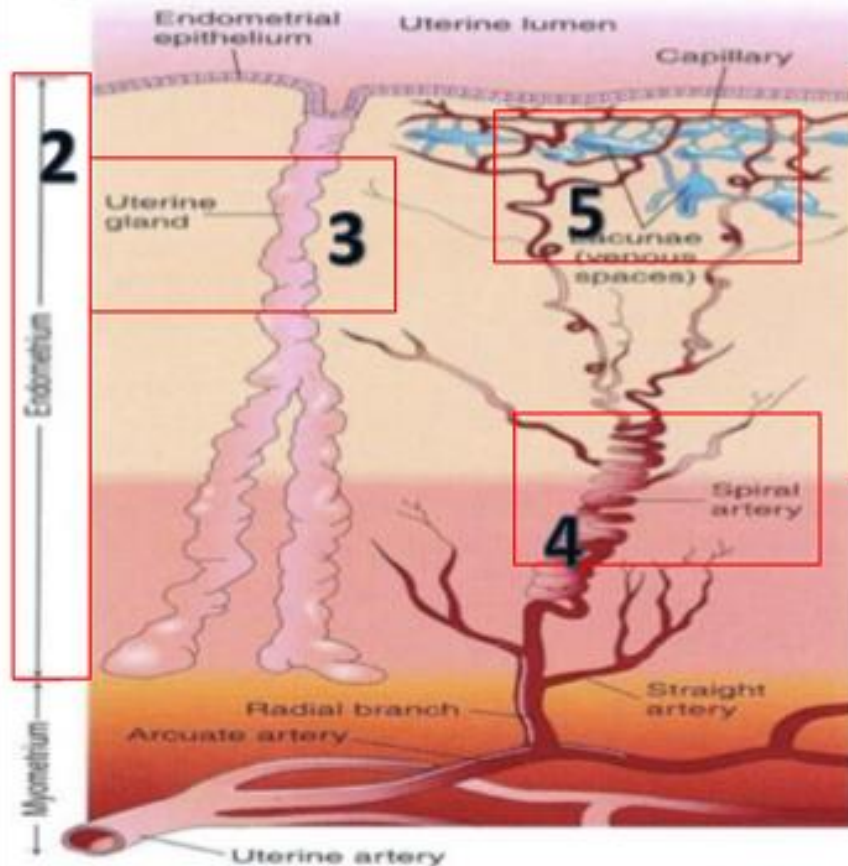
4-Ischemic Phase:

Degeneration of corpus luteum leads to decrease the levels of **estrogen & progesterone**. (نقص الاستروجين والبروجيستيرون)

- Loss of interstitial fluid.
- Marked shrinking** of endometrium.
- Spiral arteries become constricted.
- Venous stasis & Ischemic necrosis.
- Rupture of damaged vessel wall.
- Blood seeps into the surrounding connective tissues.
- Loss of 20-80 ml of blood.
- Entire compact layer and most of the spongy layer of endometrium is discarded.

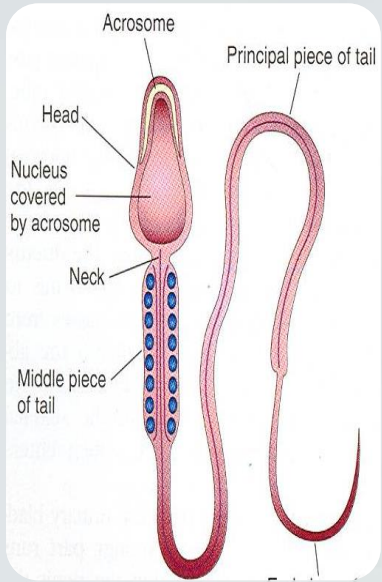
For your understanding “team 436”

FOR YOUR UNDERSTANDING:



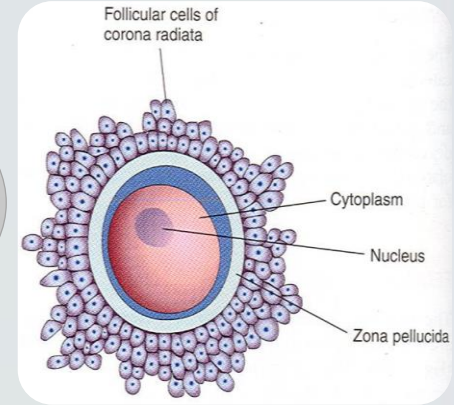
- 1** This is the functional layer of the endometrium which slough off and discarded in (**Menstrual Phase**).
- 2** This is the endometrium which **increase in thickness** during (**Proliferative Phase**). Also in (**Luteal Phase**) this endometrium **thickens** under the influence of **progesterone and estrogen**, but it **shrink** in (**Ischemic Phase**).
- 3** This is **the gland which increase in number and length** during (**Proliferative phase**)
- 4** The spiral arteries which **elongate during (Proliferative)** Also it **grow into the superficial layer** during (**Luteal Phase**). In (**Ischemic Phase**) this spiral arteries become constricted.
- 5** This is **the venous network that develops** during (**Luteal Phase**).

Gametogenesis :it is the production of mature male & female gametes (Sperms& Ova)



Spermatogenesis:
It is the series of changes by which the primitive germ cells (**spermatogonia**) are transformed into **mature sperms**.

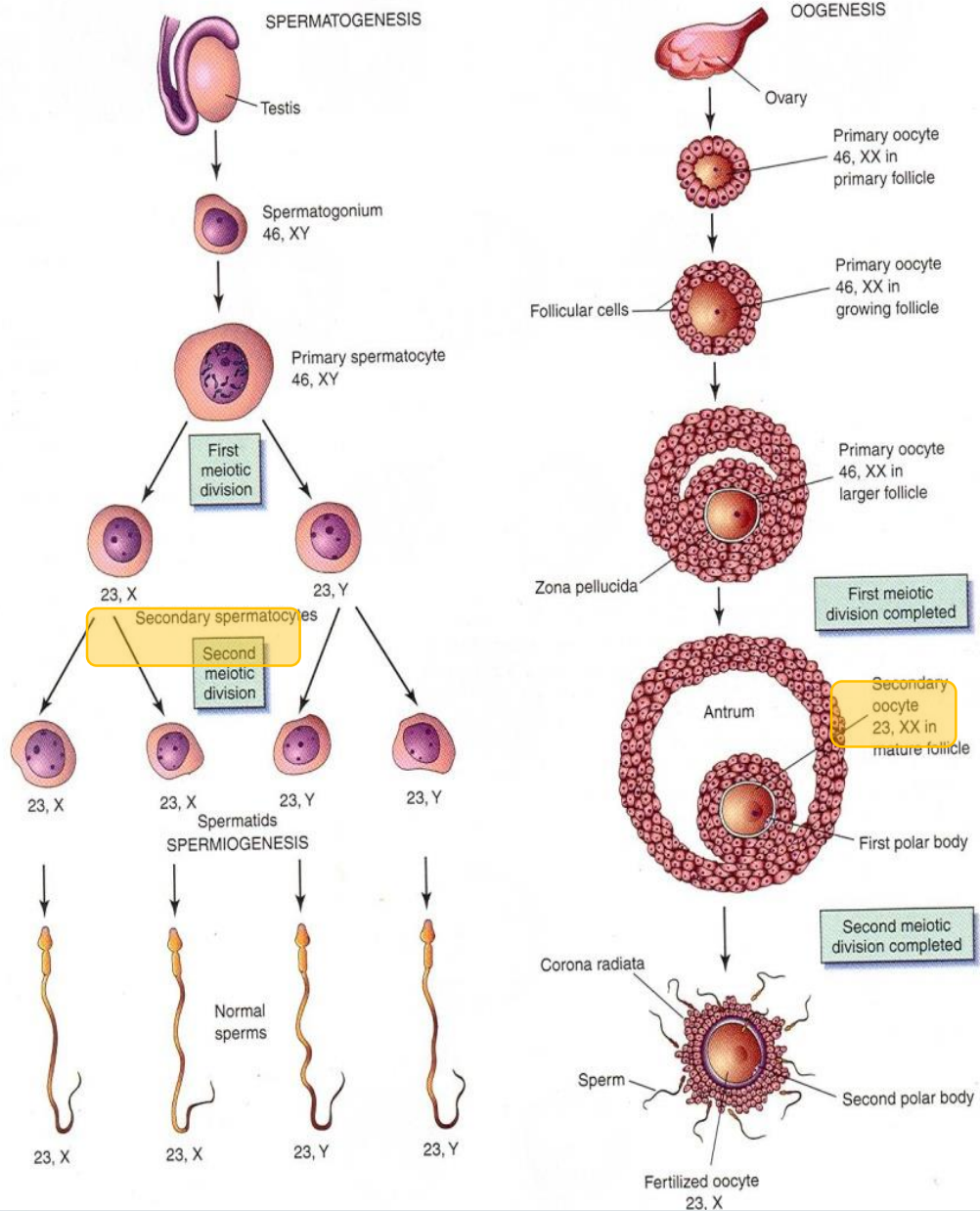
Oogenesis:
Sequence of events by which the primitive germ cells (**oogonia**) are transformed into **mature oocytes**.



Meiosis

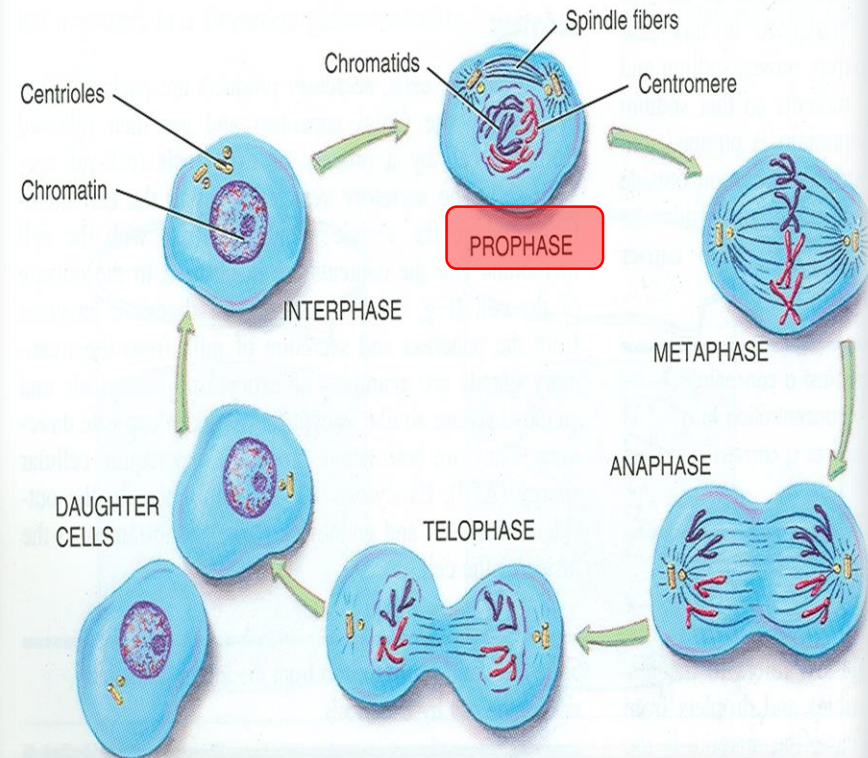
It is the cell **division** that takes place in the germ cells to produce **male & female gametes**. It consists of two cell divisions, **meiosis I & meiosis II** during which the **Diploid** number of chromosomes (46) is reduced to **Haploid** number (23).

NORMAL GAMETOGENESIS

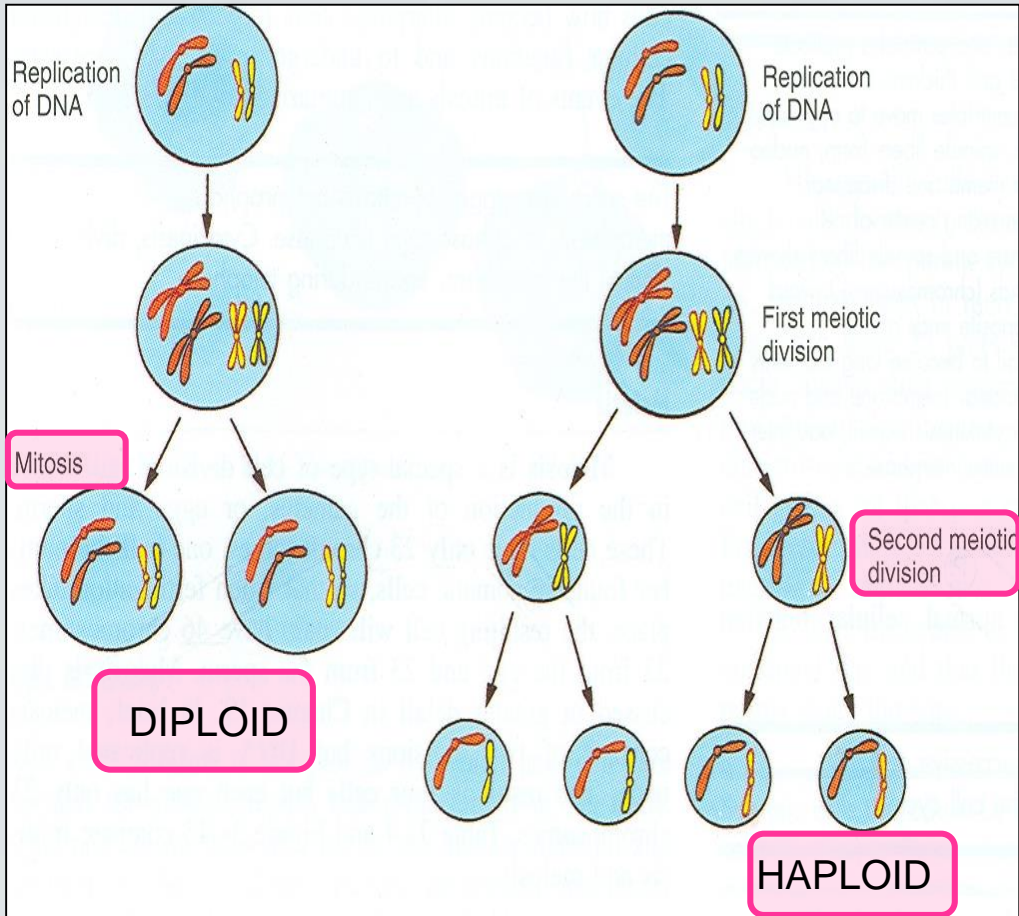


FIRST MEIOTIC DIVISION ❖

- At the beginning of 1st meiosis, (**prophase**) male & female germ cells replicate their DNA so that each of the 46 chromosomes is duplicated into sister Chromatid.
- By the end of the 1st meiotic division, each new cell formed (**Secondary Spermatocyte** or **Secondary Oocyte**) has haploid (half) number of chromosome. It is half number of chromosomes of the Primary Spermatocyte or primary Oocyte.



WHAT IS THE DIFFERENCE BETWEEN MITOSIS & MEIOSIS?



Mitosis:

The final product is diploid (has the same num. of chromosomes) and also the cells have the same size.

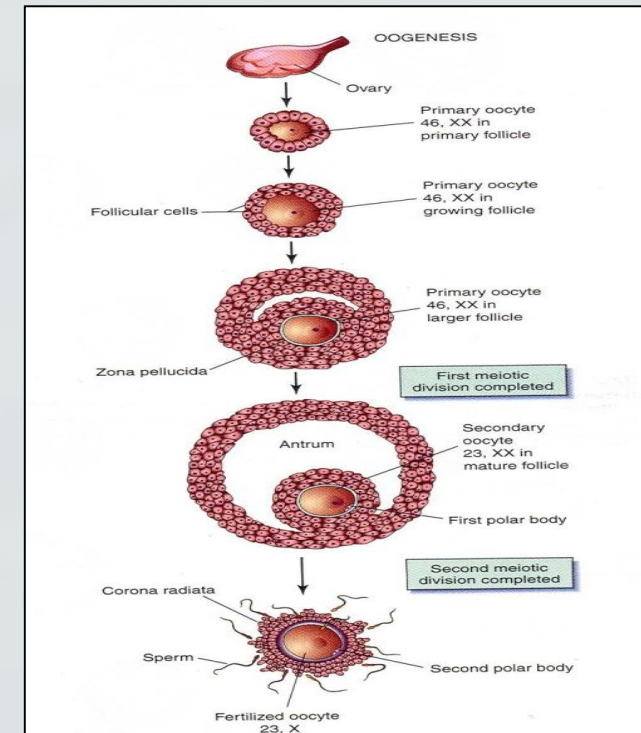
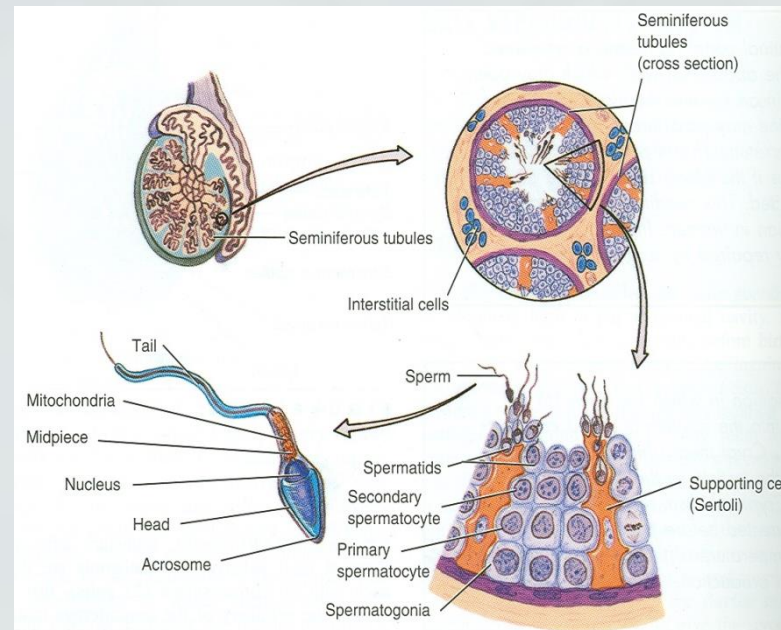
Meiosis:

The final product is haploid (has the half num. of chromosomes) and also the size of the cells become smaller.

SPERMATOGENESIS vs. OOGENESIS

SPERMATOGENESIS		OOGENESIS
Formation of <u>mature sperms</u> with <u>haploid number</u> of chromosomes.	AIM	Formation of <u>secondary oocytes</u> with <u>haploid number</u> of chromosomes
Seminiferous tubules of the <u>testis</u> .	SITE	Cortex of the ovary
From puberty till old age.	TIME	<ul style="list-style-type: none"> Starts during <u>fetal life</u> becomes completed <u>after puberty</u> & continues until <u>menopause</u>.
<ul style="list-style-type: none"> About two months 	DURATION	It occurs monthly <u>Except</u> during pregnancy.

NOTE → **Sperms are stored and become functionally mature in the Epididymis.**



SPERMATOGENESIS

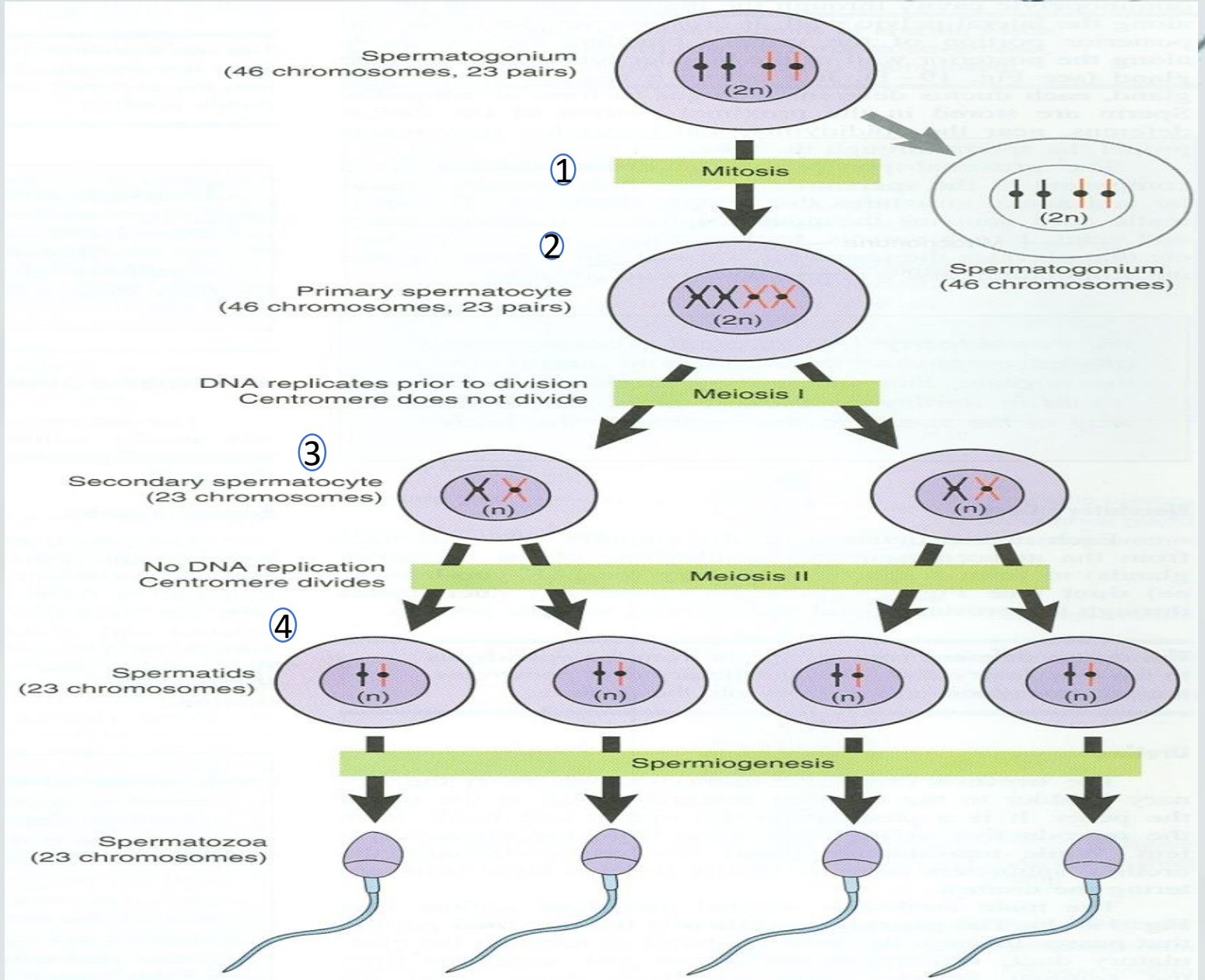
1-Each spermatogonium divides by mitosis into 2 daughter spermatogonia .

2- Each daughter Spermatogonia grows to give primary spermatocyte (46).

3- Primary spermatocyte undergoes meiotic division to give 2 secondary spermatocyte (22+ x) or (22+y).

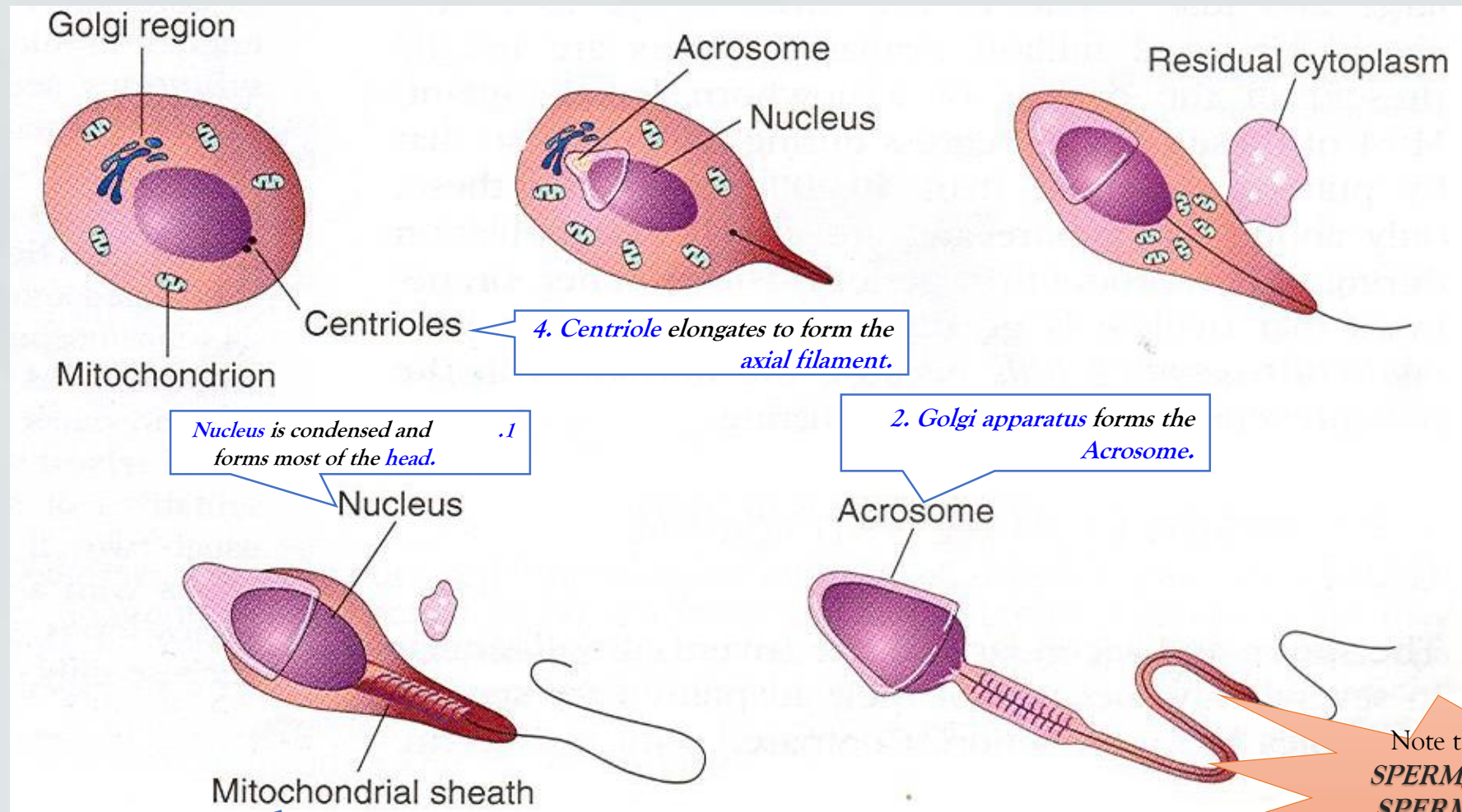
4- Secondary spermatocytes undergo 2nd meiotic division to form 4 haploid spermatids (half size).

5- Spermatids are transformed into 4 mature sperms by a process called spermiogenesis.



SPERMIOGENESIS :

It is change in shape (**metamorphosis**) through which **Spermatids** are transformed into **mature Sperms**.



1. Nucleus is condensed and forms most of the head.

2. Golgi apparatus forms the Acrosome.

3. Mitochondria forms a spiral sheath.

4. Centriole elongates to form the axial filament.

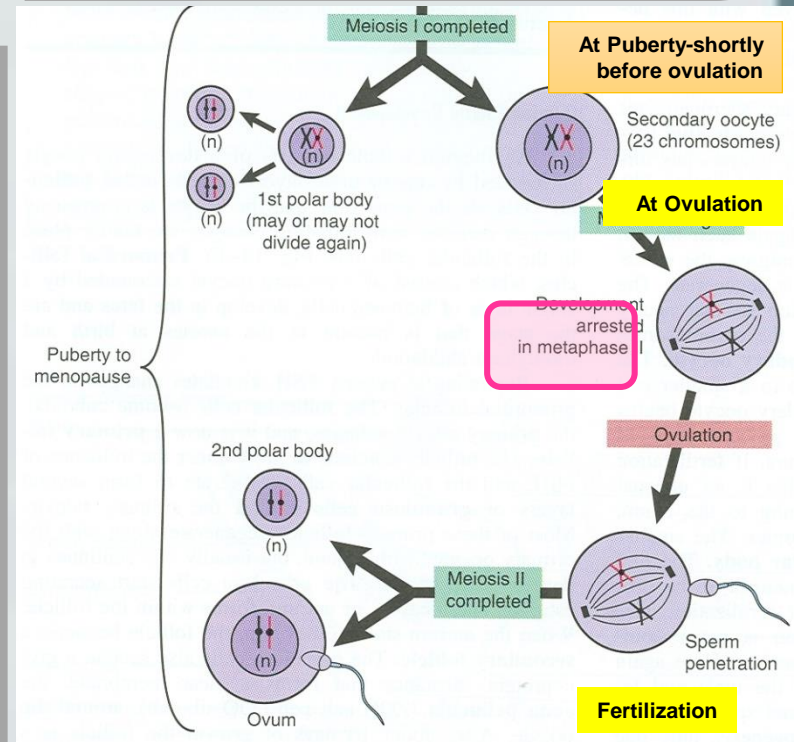
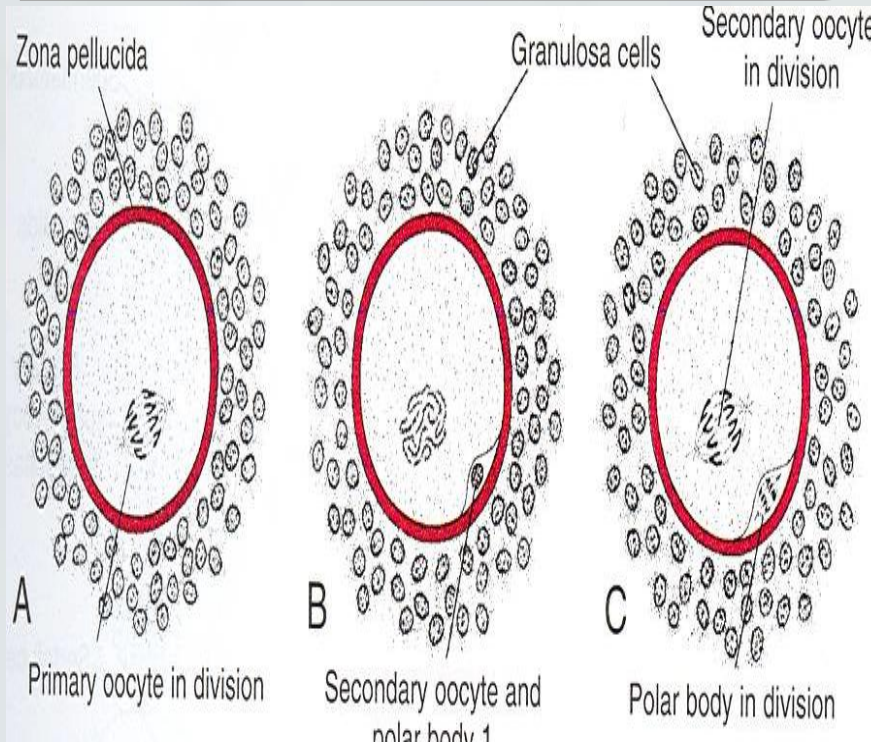
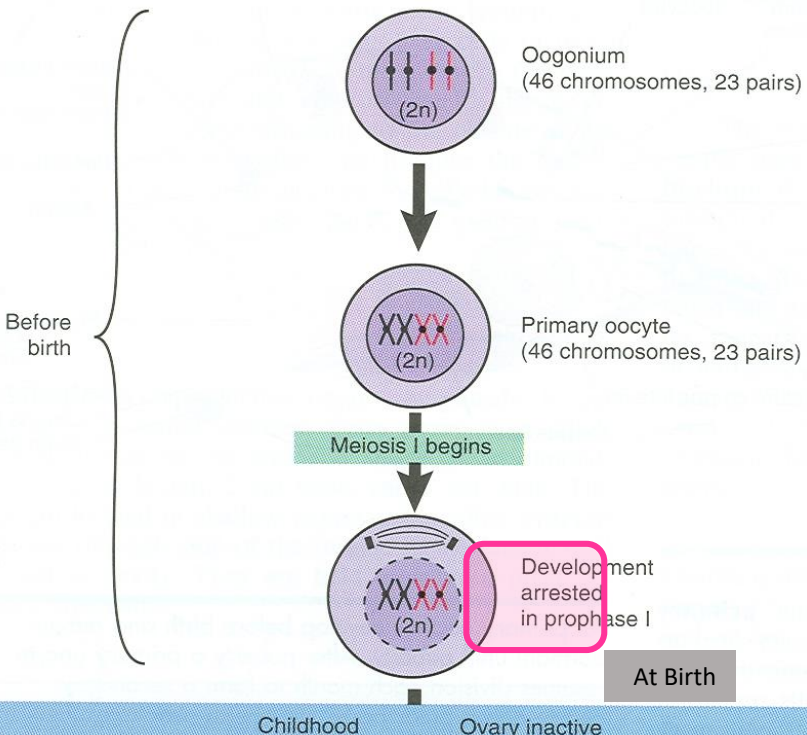
Note the difference:
SPERMATOGENESIS
SPERMIOGENESIS

OOGENESIS

Before Birth: During early fetal life, primitive ova (**Oogonia**), proliferate by mitotic division and enlarge to form **Primary Oocytes (46)**
At Birth all primary oocytes have completed the **prophase** of the **1st meiotic division** and **remain arrested** and do not finish their first meiotic division until at **puberty**.

At Puberty : Shortly before ovulation, the Primary Oocyte completes its **1st meiotic division** to give Secondary oocyte (23) & First Polar Body.
 The Secondary Oocyte receives almost all the cytoplasm.
 The First Polar Body receives very little.
 It is small nonfunctional cell that soon degenerates.

At ovulation, the secondary oocyte begins the second meiotic division but progresses only to **metaphase** where division is **arrested**.

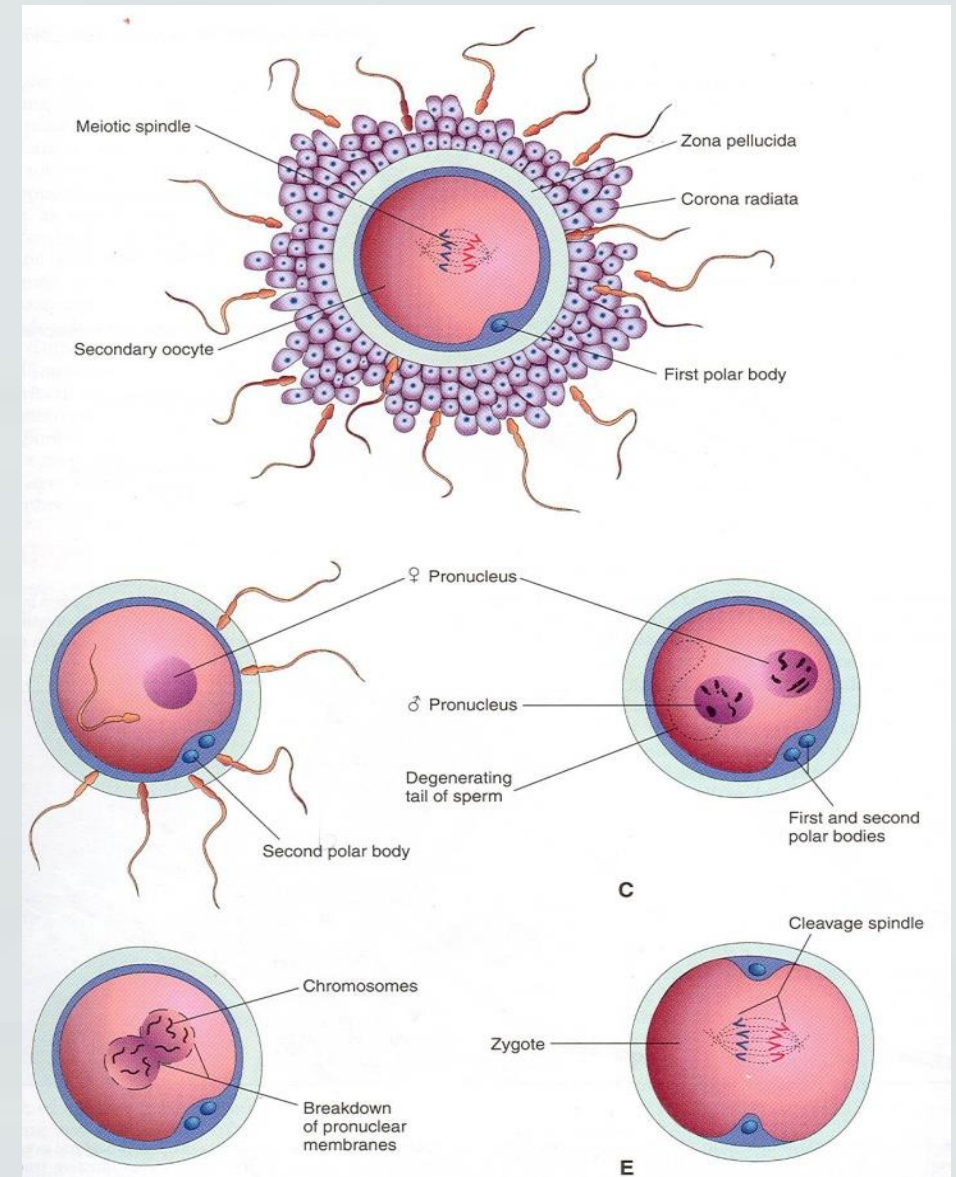


OOGENESIS

If the secondary oocyte is **fertilized**, the second meiotic division is completed otherwise it **degenerates** 24 hours after ovulation.
 Most of the cytoplasm is retained by the Mature Oocyte (Fertilized Oocyte).
 The rest is in the **2nd Polar Body** which soon degenerates.

DURING FETAL LIFE	AFTER PUBERTY DURING EACH OVARIAN CYCLE	AFTER FERTILIZATION
<p>Proliferation: each oogonium divides by mitosis into 2 daughter oogonia (with diploid number of chromosomes: (44 + XX))</p> <p>Growth: oogonium enlarges to form primary oocyte (with diploid number).</p> <p>Primary oocytes begin 1st meiotic division which stops at prophase</p>	<p>1st meiotic division is completed: (shortly before ovulation): a reduction division by which a primary oocyte divides into one secondary oocyte (haploid number of chromosomes: (22 + X) & 1st polar body (degenerates)</p> <p>2nd meiotic division begins: begins at ovulation, progresses only to metaphase and becomes arrested.</p>	<p>2nd meiotic division is completed: 2n y oocyte divides into a mature ovum (haploid number) & 2nd polar body (degenerates).</p>

N.B.: NO PRIMARY OOCYTES FORM AFTER BIRTH





Some videos for enriching what has been read :-

[Ovulation](#)

[Spermatogenesis and Oogenesis](#)

Quick quiz :-

[Gametogenesis & Female cycles](#)





Embryology⁴³⁷

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