



THE FUNDAMENTALS OF HUMAN EMBRYOLOGY

Lecture #1

Gametogenesis



EMBRYOLOGY

435

OBJECTIVES:

By the end of the lecture, you should be able to: •

Describe the female cycles (**Ovarian & Uterine**). •

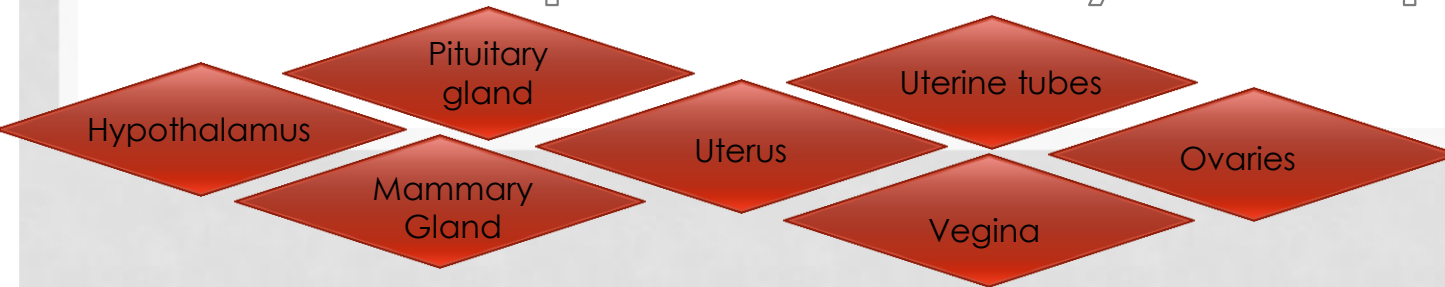
Define **gametogenesis**. •

Differentiate the types of **gametogenesis**. •

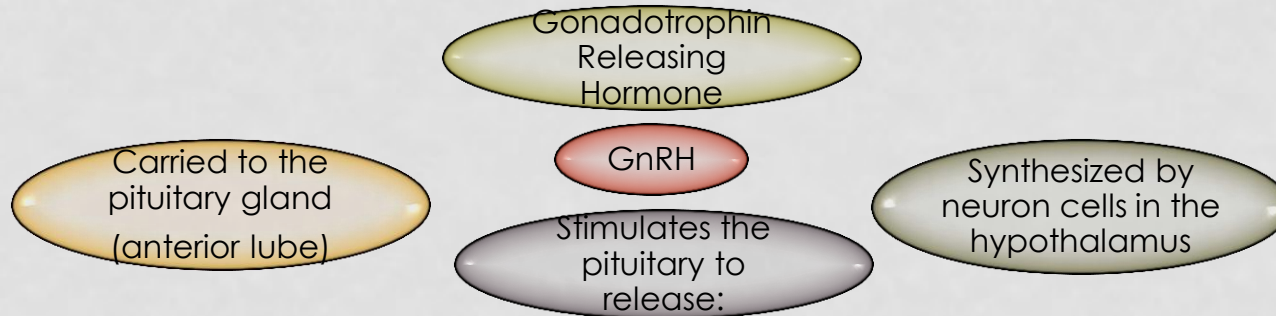
Describe the process of **spermatogenesis**. •

Describe the process of **oogenesis**. •

Female Reproductive Cycle Depends On :



Starts at
puberty
until
menopau
se



FOLLICLE STIMULATING HORMONE FSH

LUTEINIZING HORMONE LH

Both Secreted by the pituitary gland.

FUNCTIONS

It stimulates the ovarian follicles:
1- To develop & mature.
2- To produce Estrogen by its follicular cells.

1- It serves as the trigger for ovulation.
2- Stimulates the follicular cells and corpus luteum To produce Progesterone

Early development of ovarian follicle is induced by FSH.

Final stages of maturation require LH It causes ovulation (rupture of the mature follicle).

The follicle becomes enlarged until it gets full maturity. It produces swelling on the surface of the ovary.

OVARIAN CYCLE :

Follicular

Ovulatory

Luteal

under the
control of
the :
Pituitary
Gland

NOTE :

Growing follicles produce estrogen which regulates the development and functions of the reproductive organs.

The primary follicle consists of one **primary oocyte**

Corpus Luteum

When the follicle ruptures its remains are called **corpus luteum**.

- 1- The corpus luteum secretes **Progesterone** and small amount of **Estrogen**
- 2- These **2 hormones** stimulate the endometrial glands for implantation of the **fertilized Ovum**.
- 3- If the oocyte is fertilized the Corpus Luteum enlarges and remains till the **4th month** of pregnancy.
- 4- If the oocyte is **not** fertilized the corpus luteum involutes and degenerates in **10-12** days and called **corpus albicans**.
- 5- The **simple flat follicular cells** become **cuboidal**, then **columnar** then forming many layers around the **oocyte**.

UTERINE OR MENSTRUAL CYCLE

UTERINE OR MENSTRUAL CYCLE

It has 4 main phases

• 1. Menstrual

• 2. Proliferative

• 4. Ischemic

• 3. Luteal

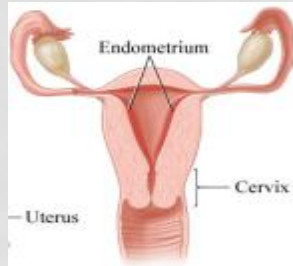
• It is the cyclic changes which occur in the endometrium of the uterus every month by the effect of estrogen & progesterone.

Average menstrual cycle is 28 days.

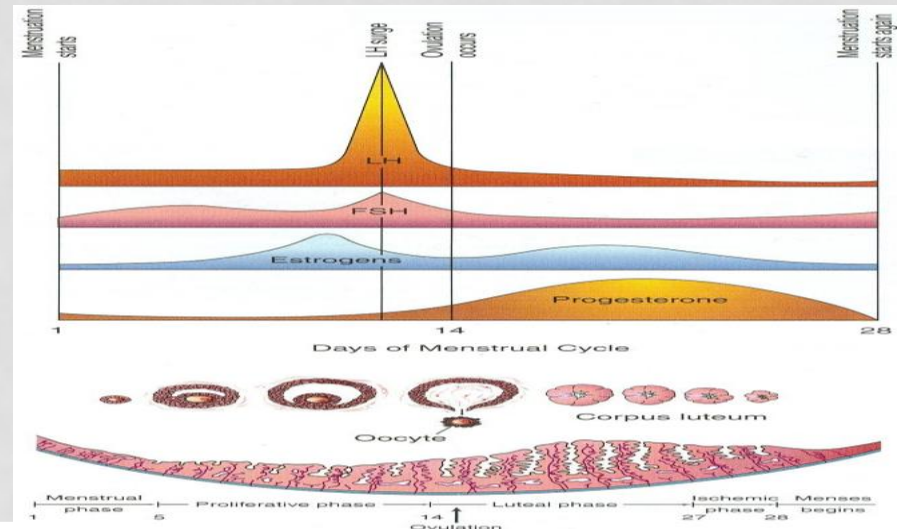
Day One : the day when menstrual blood flow begins

It varies by several days in normal women. And It sometimes varies in the same woman.

Ranges between 23 and 35 days in 90 % of women.



Menstrual Phase	Proliferative Phase	Luteal Phase	Ischemic Phase
1-5 days	5-14 days	14-27 days	27-28 days



<ul style="list-style-type: none"> - Starts with the first day of menstrual cycle . - What happens in this phase? <p>1- Function layer of the endometrium sloughed Off and Discarded with the menstrual flow .</p> <p>2- Blood discharge from vagina is combined with small pieces of endometrial tissues .</p>	<ul style="list-style-type: none"> - It is a phase of repair and proliferation. - It 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 2-3 times. - The glands increase in number and length and the spiral arteries elongate. 	<ul style="list-style-type: none"> - This phase coincides with the formation and function of the corpus luteum <p>Changes in this phase:</p> <ol style="list-style-type: none"> 1-Glandular epithelium secrete glycogen rich material . 2-Endometrium thickness under the influence of Estrogen and Progesterone . 3- Spiral arteries grow into the superficial layer . 4- Arteries become increasingly coiled. 5- Layer venous network develops 6- Direct arterio – venous anastomoses are the prominent features .
Menstrual Phase	Proliferative Phase	Luteal Phase (Progesterone Phase)

Degeneration of corpus luteum leads to decrease the levels of estrogen & progesterone which lead to:

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



Explanation of the Ovarian and Uterine Cycle

[HTTPS://WWW.YOUTUBE.COM/WATC](https://www.youtube.com/watch?v=9-mujskp_g4)
[H?V=9-MUJSKP_G4](https://www.youtube.com/watch?v=9-mujskp_g4)

GAMETOGENESIS (*Gamete Formation*)

It is the production of mature male & female gametes (Sperms & Ova)

A- Spermatogenesis

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

MEIOSIS

- It is reduction cell division that takes place only 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).

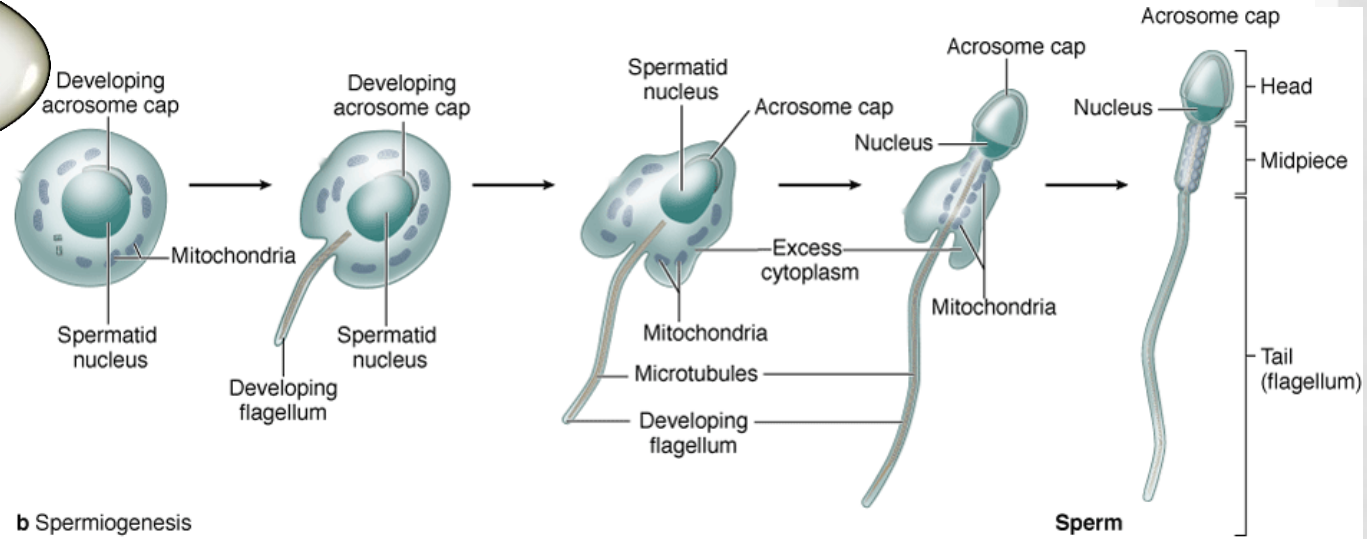
B- Oogenesis:

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

FIRST MEIOTIC DIVISION

- At the beginning of 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 first 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**.

A- Spermatogenesis



• AIM:

• Formation of sperms with haploid number of chromosomes.

• SITE:

• Seminiferous tubules of the testis.

• TIME:

• From puberty till old age.

• DURATION:

• About two months.

• **N.B. Sperms are stored and become functionally mature in the Epididymis.**

• Each **spermatogonium** divides by mitosis into 2 daughter Spermatogonia .

• Each daughter spermatogonia grows to give rise to **primary spermatocyte (46)**.

• Primary spermatocyte undergoes **meiosis** to give rise to **secondary spermatocyte (22+ x) or (22+y)**.

• Each **secondary** spermatocyte divides & redivides to give **spermatid (23)**.

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

1. **Nucleus** is condensed and forms most of the head.
2. **Golgi apparatus** forms the Acrosome, (acrosomal cap).
3. **Mitochondria** forms a spiral sheath.
4. **Centriole** elongates to form the axial filament.

•**AIM:**

•Formation of secondary oocytes with haploid number of chromosomes.

•**SITE:**

Cortex of the ovary

•**TIME:**

Starts very early during fetal life becomes completed after puberty & continues until menopause.

- NB. It occurs monthly Except during pregnancy.

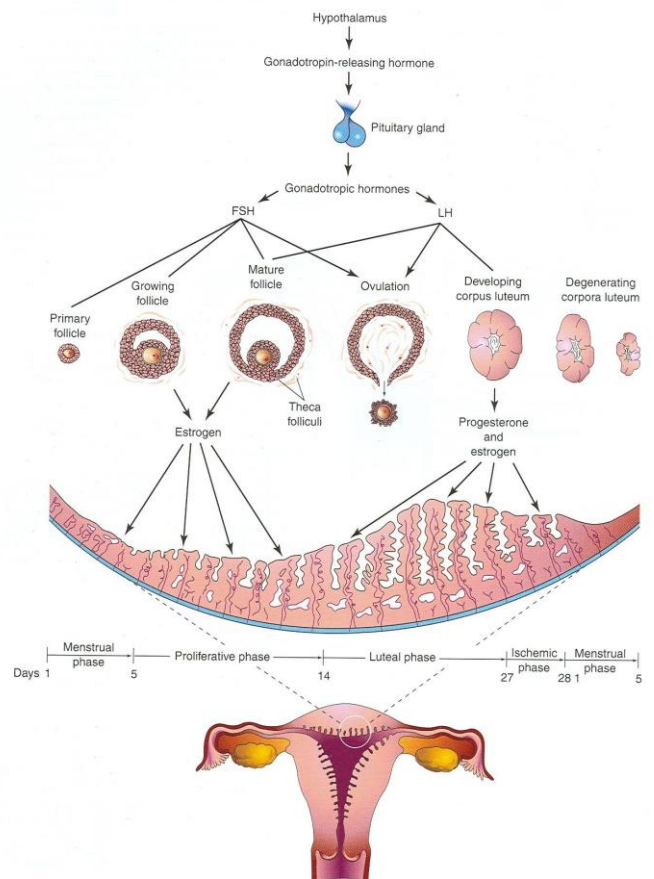
B- Oogenesis:

<u>Before Birth:</u>	<u>At Birth:</u>	<u>After Puberty :</u>
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During early fetal life, primitive ova (Oogonia) proliferate by mitotic division and enlarge to form **Primary Oocytes (46)** (Slide# 6).

All primary oocytes have completed the **prophase of the 1st meiotic division** and remain arrested at **prophase** and do not finish their first meiotic division until puberty (Slide#6).

Shortly before ovulation, the **Primary Oocyte** completes its first 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 cytoplasm. The 1st polar body is a small nonfunctional cell that soon degenerates.



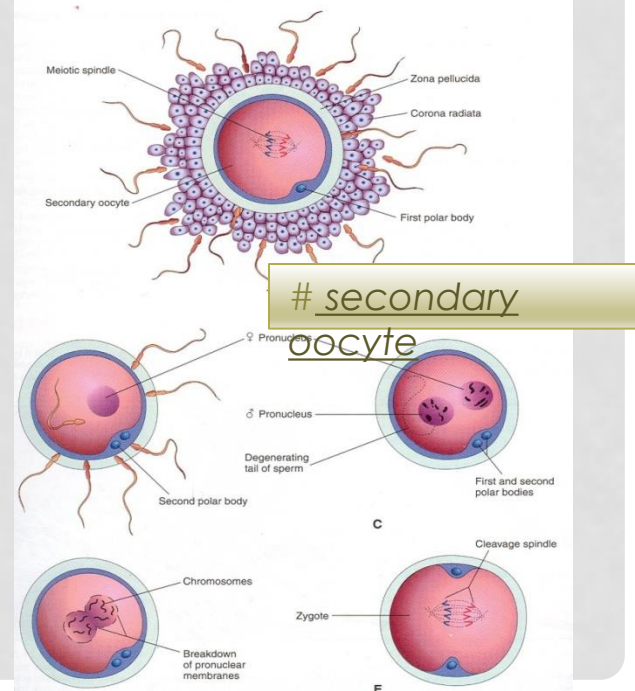
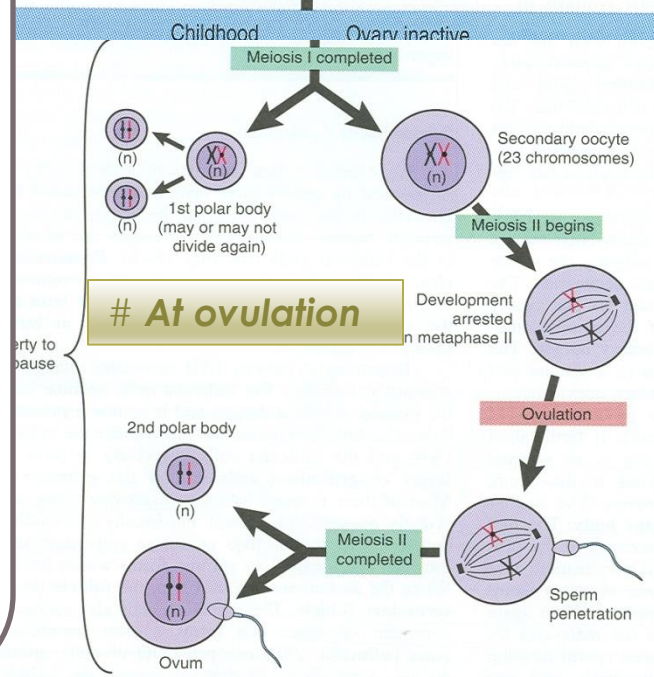
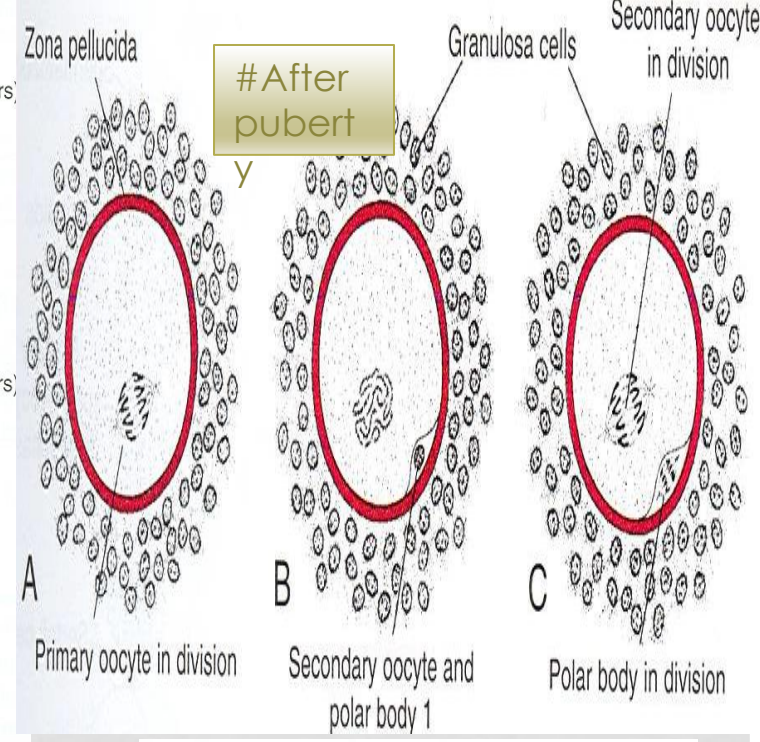
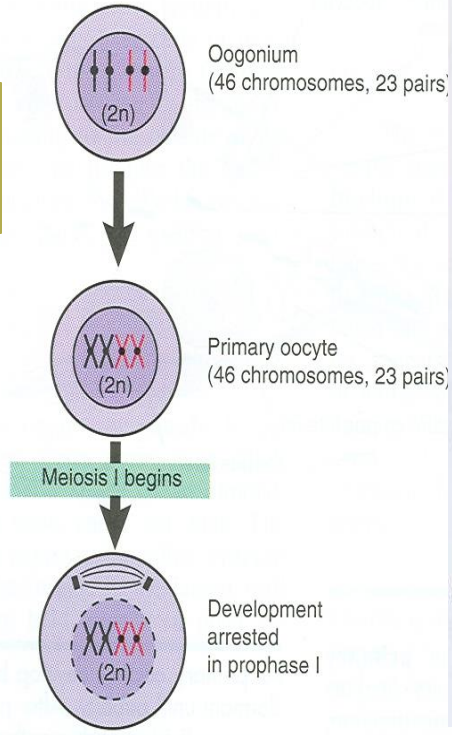
B- Oogenesis:

Before Birth

Before birth

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

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



DURING FETAL LIFE

Proliferation:

each oogonium divides by **mitosis** into 2 daughter oogonia (with **diploid** number of chromosomes: $(44 + XX)$)

Growth:

oogonium enlarges to form primary oocyte (with **diploid** number).

Primary oocytes begin 1st meiotic division which stops at **prophase**

AFTER PUBERTY DURING EACH OVARIAN CYCLE

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)

2nd meiotic division begins: begins at ovulation, progresses only to **metaphase** and becomes arrested.

AFTER FERTILIZATION

2nd meiotic division is completed:

2ry oocyte divides into a mature ovum (**haploid** number) & 2nd polar body (degenerates).

N.B.: NO PRIMARY OOCYTES FORM AFTER BIRTH

Notes

1) meiosis II, during which the Diploid number of chromosomes (46) is reduced to Haploid number (23).

2)Spermatogenesis:

It is the series of changes by which the primitive germ cells (spermatogonia) are transformed into.

3) GnRH is synthesized by neurosecretory in the hypothalamus

4) FSH and LH are secreted by pituitary glands.

5) LH hormone makes ovulation.

6) Growing follicles produce (estrogen).

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Some important notes :

1- If the secondary oocyte is **fertilized**, the second meiotic division is completed .

2- spermatogenesis **is the series of changes by which the primitive germ cells (spermatogonia) are transformed into mature sperms .**

3- At ovulation *the nucleus of the secondary oocyte begins the **second meiotic division .***

Some important notes

1- All primary oocytes have completed the prophase .

2- each of the 46 chromosomes is duplicated into sister Chromatid.

3- Early development of ovarian follicle is induced by FSH.

QUIZ!

1- Luteal Phase lasts for :

A) 5 days B) 9 days C) 11 days D) 13 days

2- GnRH stimulates the pituitary to release :

A) LH B) FSH C) A&C D) Neither A or C.

3- The Mitochondria helps Spermatids to form :

A) The head B) *Acrosome* C) *Axial filament* D) *Spiral sheath*

4- At Birth All primary oocytes have completed of the 1st meiotic division.

A) Prophase. B) Metaphase. C) Anaphase. D) Telophase.

Answers :
1) D
2) C
3) D
4) A

KEY WORDS

***Ovulation:** when a mature egg is released from the ovary and is available to be fertilized.

***sister chromatid:** Two identical copies (chromatids) formed by the replication of a single chromosome.

EMBRYOLOGY

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