

Gametogenesis and uterine cycles

Objectives:

- Describe the female cycles (Ovarian & Uterine)
- Define gametogenesis
- Differentiate the types of gametogenesis
- Describe the process of spermatogenesis
- Describe the process of oogenesis.

Done by:

- **Team leaders:** Meaad Alnofaie - Fahad Alnahabi



- Important
- Extra
- Notes



Female Reproductive Cycles



❖ OVARIAN AND UTERINE CYCLES

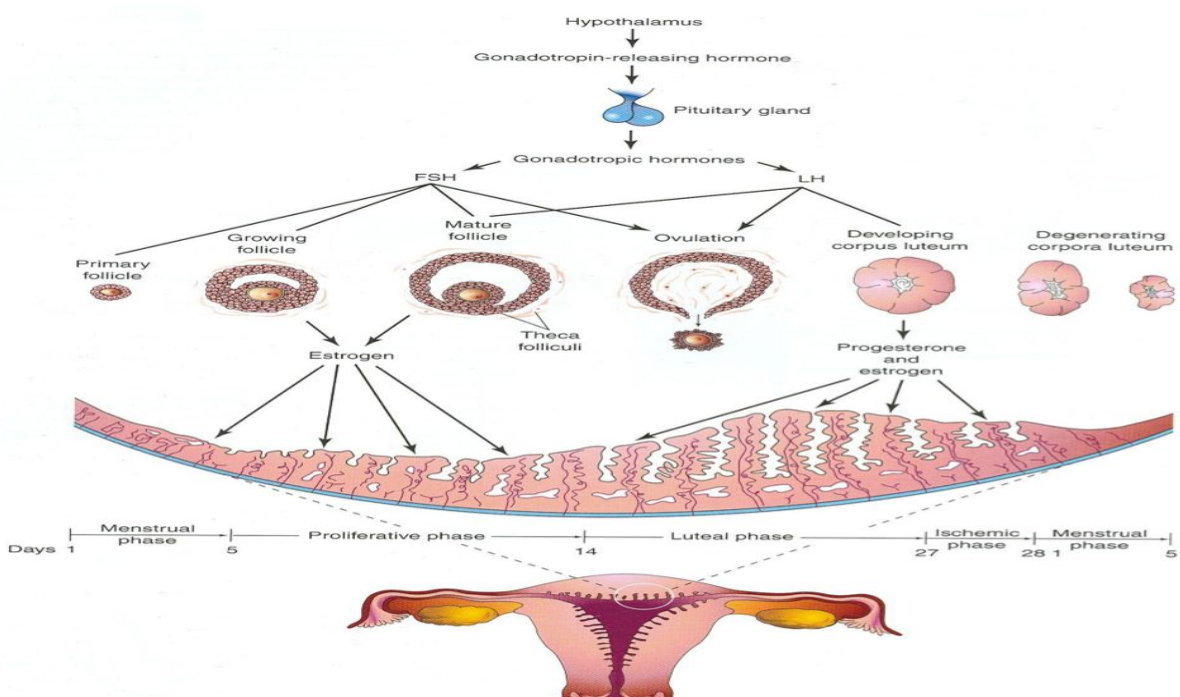
- Start at puberty
- Normally continues until the menopause

❖ Reproductive cycles depend upon activities & coordination of:

1. Hypothalamus
2. Pituitary gland
3. Ovaries
4. Uterus
5. Uterine tubes
6. Vagina and
7. Mammary glands

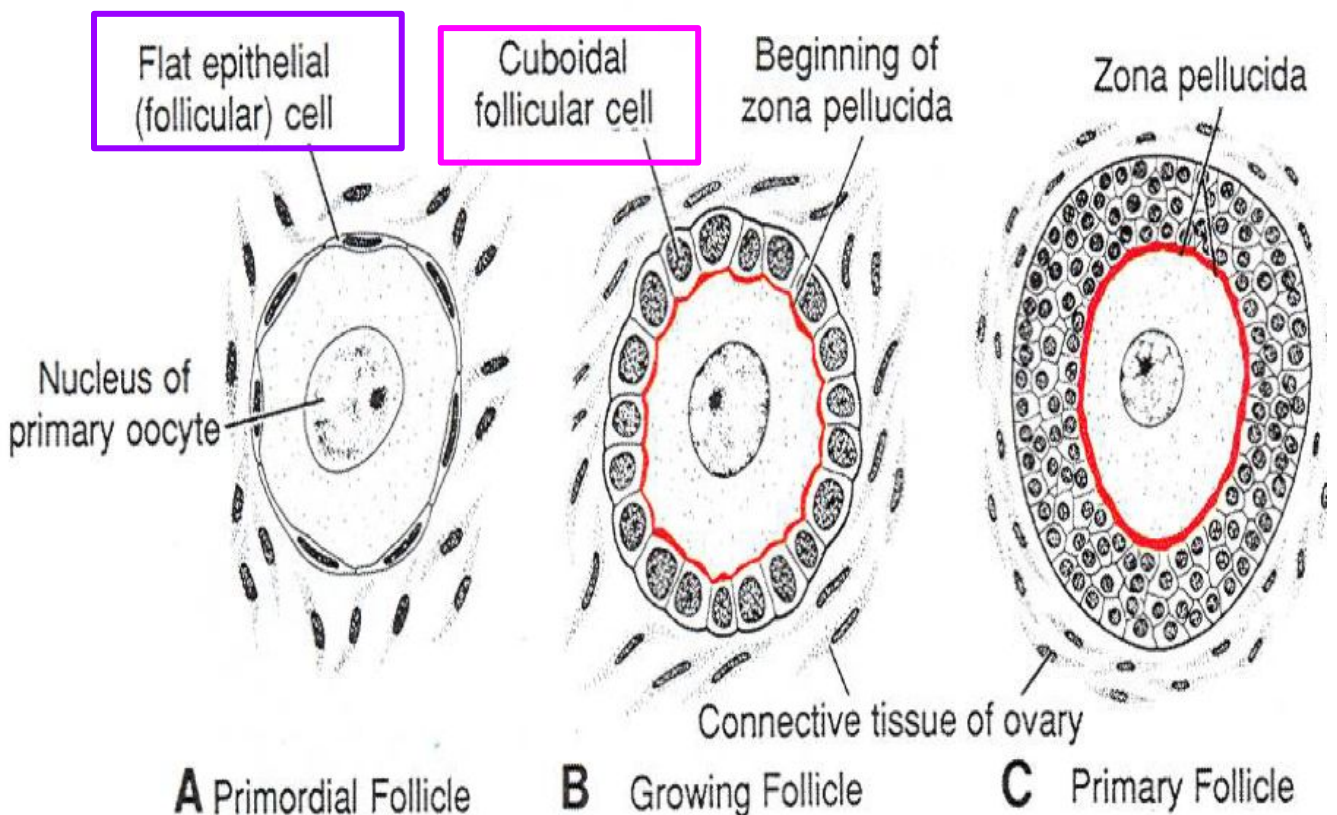
❖ GnRH:

- Gonadotropin-releasing hormone (GnRH) is synthesized by neurosecretory cells in the Hypothalamus
- Carried to the Pituitary gland (anterior lobe)
- It stimulates the pituitary to release Two Hormones that act on Ovaries (FSH & LH)



Ovarian Cycle

- The ovarian cycle is under the control of the Pituitary Gland
 - It is divided into 3 phases: (FOL)
 - 1- Follicular, (FSH) (preovulatory)
 - 2- Ovulatory, (LH)
 - 3- Luteal. (LH) (Postovulatory)
 - The ovarian cortex contains hundreds of thousands of primordial follicles (400,000 to 500,000)
 - Each consists of one primary encircled by single flat follicular cells
- ❖ **FSH**
- Early development of ovarian follicle induced by FSH
 - At the beginning of each ovarian cycle 15 to 20 primary follicles are stimulated to grow by FSH
 - The simple flat follicular cells become cuboidal, then columnar then forming many layers cells around the oocyte forming primary follicle



Ovarian Cycle

❖ Follicular Phase

➤ Follicle-Stimulating Hormone

➤ **FUNCTIONS:**

1. It stimulates the ovarian primary follicles to develop and become mature
2. Production of Estrogen by the follicular cells

❖ Ovulatory Phase

➤ LH

➤ The follicle becomes enlarged until it gets maturity

➤ It produces swelling on the surface of the ovary

➤ Early development of ovarian follicle is induced by FSH

➤ Final stages of maturation require LH

➤ **LH causes:**

➤ ovulation (rupture of the mature follicle)

➤ These Growing follicles produce estrogen which regulates the development and of the mature functions of the reproductive organs

➤ Luteinizing Hormone

➤ **FUNCTIONS:**

1- It serves as the trigger for ovulation (rupture of the mature follicle) at the middle of the cycle.

2- Stimulates the mature follicles to produce Estrogen which regulates the development and functions of the reproductive organs especially the endometrium.

3- Stimulates corpus luteum to produce Progesterone small amount Of estrogen.

❖ Luteal Phase

➤ The remaining of the ruptured follicle is now called corpus luteum

➤ It secretes **Progesterone** and small amount of **Estrogen**

➤ These 2 hormones stimulate endometrial glands to secrete and prepare endometrium for implantation of fertilized Ovum (**Blastocyst**)

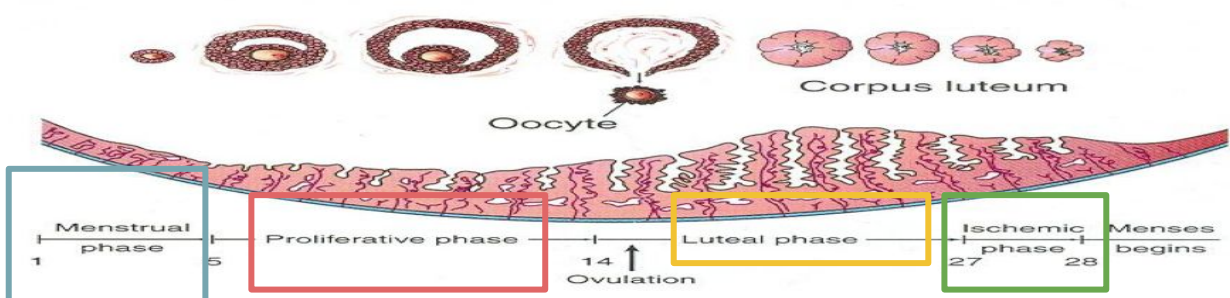
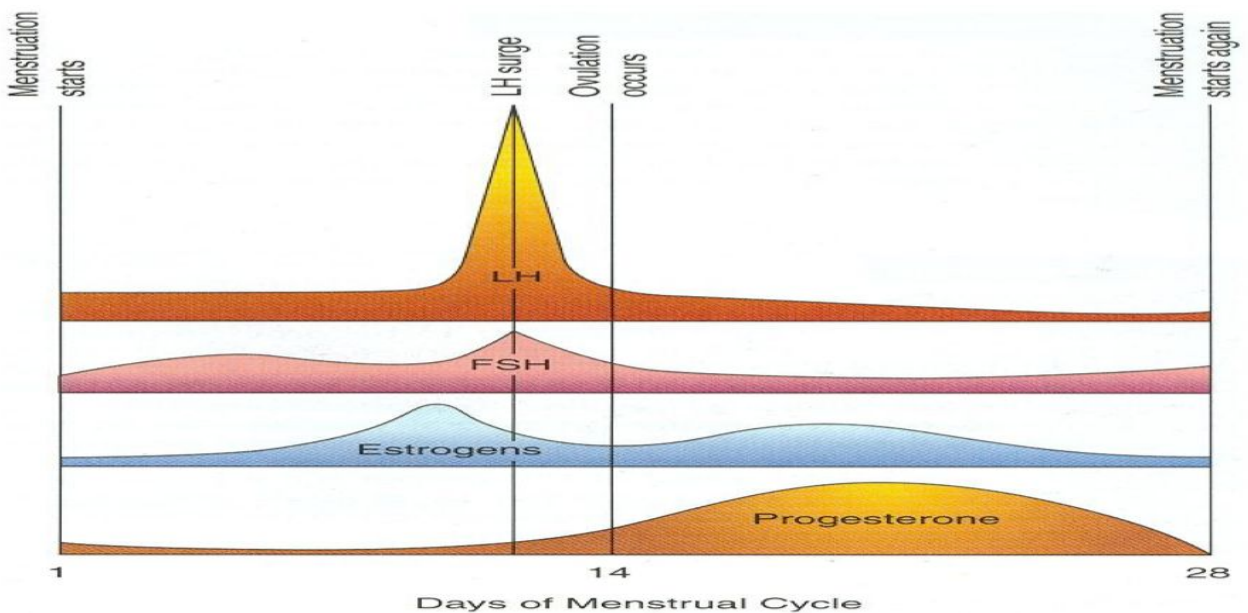
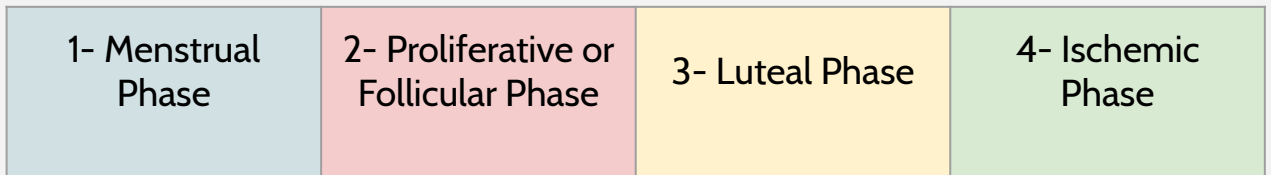
➤ If the oocyte is fertilized the Corpus Luteum **enlarges and remains till the 4th month of pregnancy**

➤ If the oocyte is not fertilized the **corpus luteum involutes and degenerates in 10-12 days and called corpus albicans**

Uterine or Menstrual Cycle

- Cyclic changes in the endometrium of the uterus caused by estrogen & progesterone
- Average menstrual cycle is 28 days
- Day One is the day when menstrual blood flow begins
- It varies by several days in normal women
- Ranges between 23 and 35 days in 90% of women
- It sometimes varies in the same woman

❖ Phases of Menstrual Cycle



Phases of Menstrual Cycle

❖ Menstrual Phase

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

❖ Proliferative Phase

- Is a phase of repair and proliferation
- **Lasts for 9 days**
- Coincides with growth of ovarian follicle (Follicular Phase)
- 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

❖ Luteal Phase

- Is a Secretory or 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
- 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

❖ Ischemic Phase (1 day)

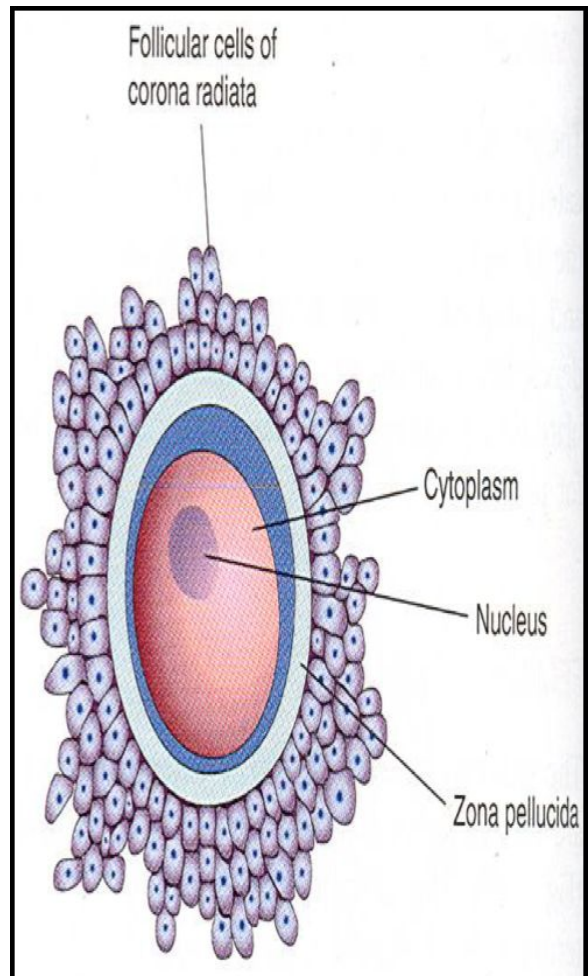
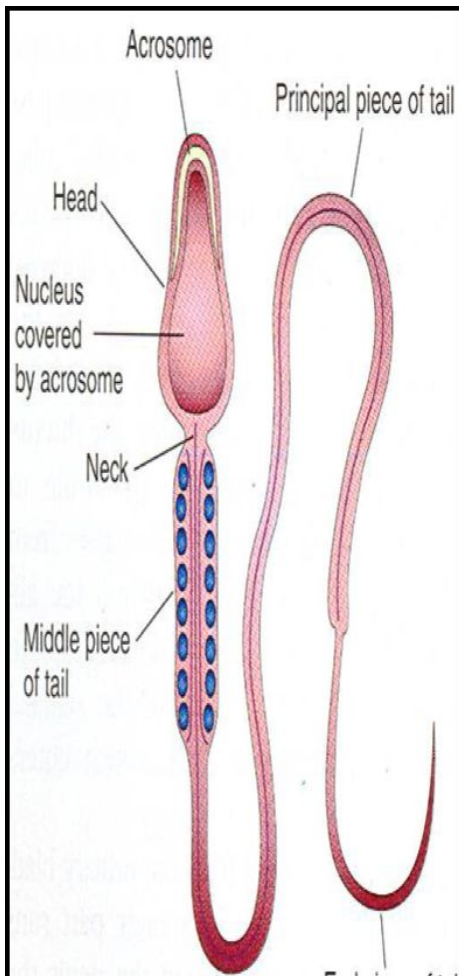
- Degeneration of corpus luteum leads to decrease the levels of estrogen & progesterone
- Loss of interstitial fluid
- Marked shrinking of endometrium
- Spiral arteries become constricted
- Venous stasis & Ischemic necrosis
- Rupture of damaged vessel wall
- Loss of 20-80 ml of blood
- Blood sweeps into the surrounding connective tissues
- Entire compact layer and most of the spongy layer of endometrium is discarded



Gametogenesis

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

Spermatogenesis	Oogenesis
It is the series of changes by which the primitive germ cells (spermatogonia) are transformed into mature sperms.	Sequence of events by which the primitive germ cells (oogonia) are transformed into mature oocytes.

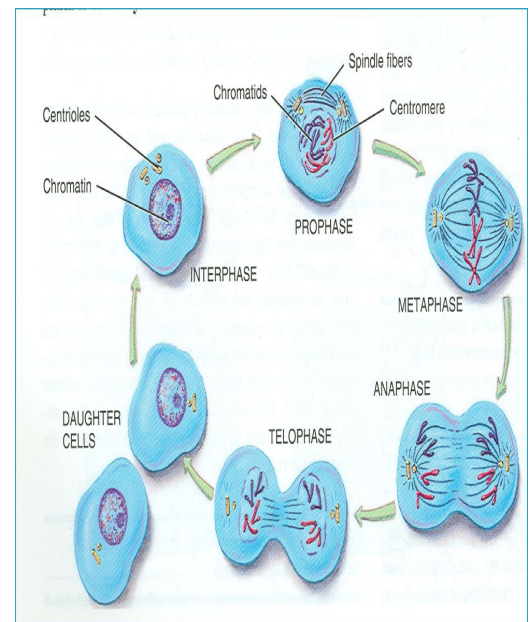
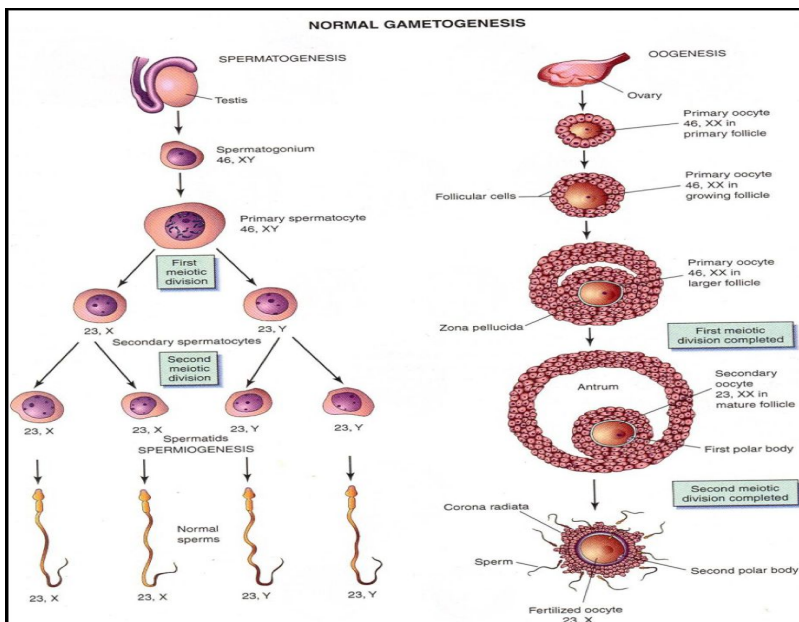


Meiosis

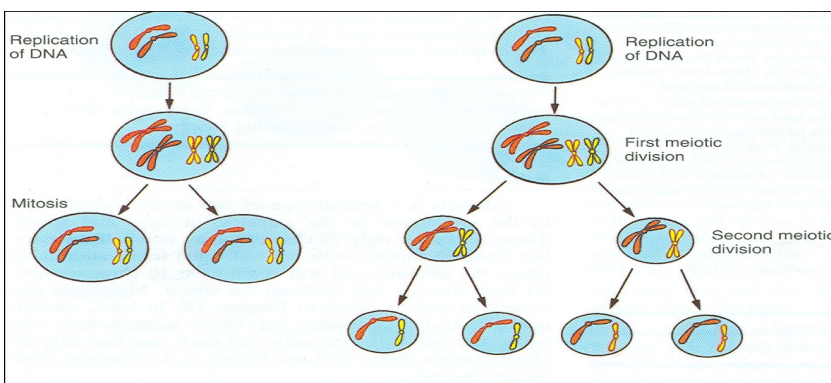
- It is the cell division that takes place in the germ cells to produce male & female gametes
- It consists of two cell divisions, meiosis I & meiosis II during which the Diploid number of chromosomes (46) is reduced to Haploid number (23)

❖ First meiotic division

- At the beginning of meiosis I, (prophase) male & female germ cells replicate their DNA so that each of the 46 chromosomes is duplicated into sister Chromatids
- 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 ?

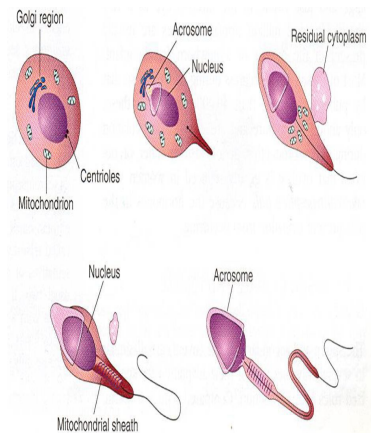
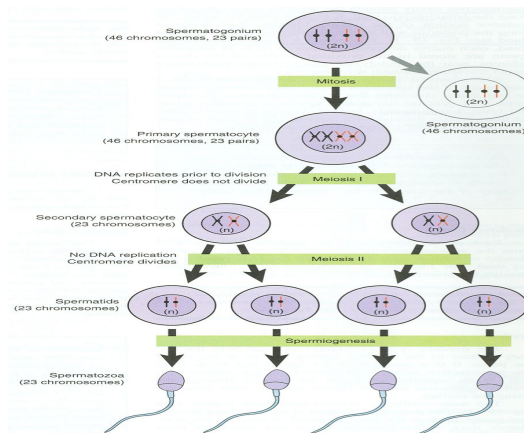
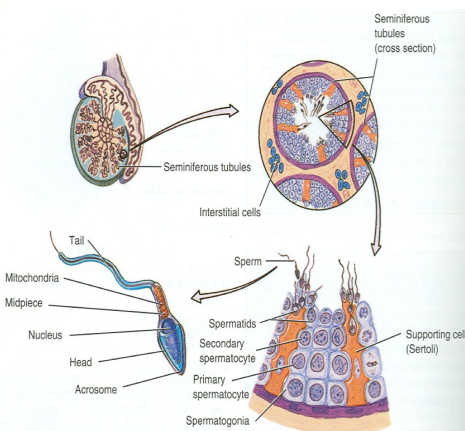


Mitosis: The final product is diploid (has the same number of chromosomes), end with 2 cells

Meiosis: The final product is haploid (has the half number of chromosomes), end with 4 cells

Spermatogenesis

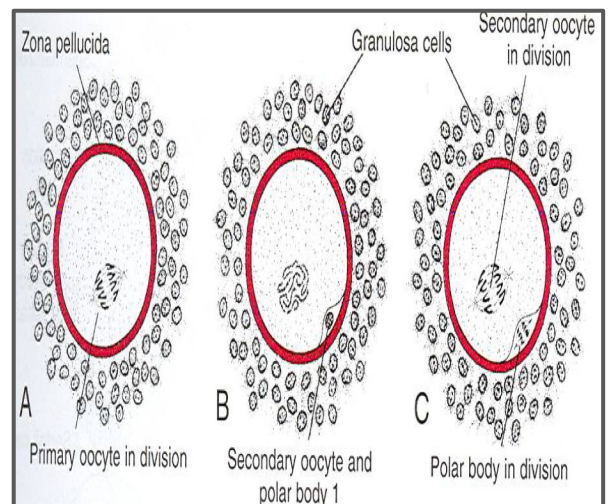
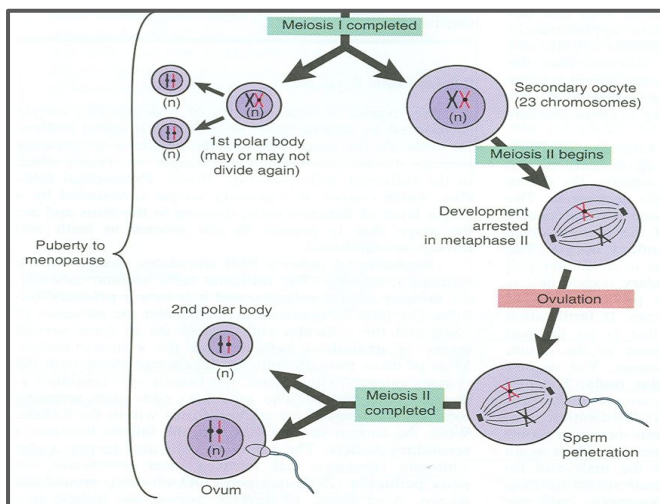
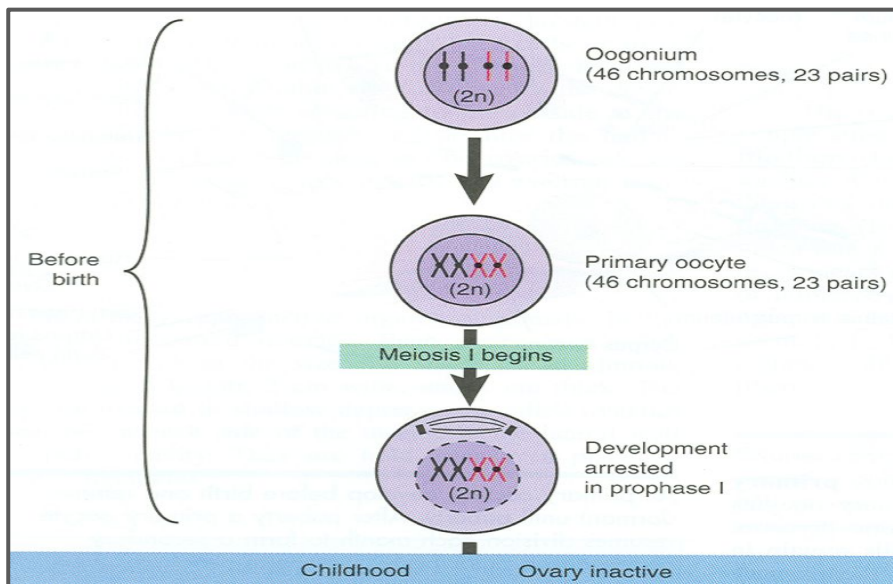
Aim	<ul style="list-style-type: none"> ➤ Formation of sperms with haploid number of chromosomes
Site	<ul style="list-style-type: none"> ➤ Seminiferous tubules of the testis
Time	<ul style="list-style-type: none"> ➤ From puberty till old age
Duration	<ul style="list-style-type: none"> ➤ About two months □ (64) days ➤ N.B. Sperms are stored and become functionally mature in the Epididymis
Spermatogenesis	<ul style="list-style-type: none"> ➤ Each spermatogonium divides by mitosis into 2 daughter Spermatogonia ➤ Each daughter Spermatogonia grows to give primary spermatocyte (46) Primary spermatocyte undergoes meiotic division to give 2 secondary spermatocyte (22+ x) or (22+y) ➤ Secondary spermatocytes undergo 2nd meiotic division to form 4 haploid spermatids (half size) ➤ Spermatids are transformed into 4 mature sperms by a process called spermiogenesis
Spermiogenesis Notice the difference between SPERMATOGENESIS and SPERMIOGENESIS	<ul style="list-style-type: none"> ➤ It is change in shape (metamorphosis) through which Spermatids are transformed into mature Sperms: <ol style="list-style-type: none"> 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



Oogenesis

Aim	➤ Formation of secondary oocytes with haploid number of chromosomes
Site	➤ Cortex of the ovary
Time	<ul style="list-style-type: none"> ➤ Starts during fetal (10th week) life ➤ Stops in the middle, (Birth to puberty) ➤ Restarts And completed after puberty (11-13 years) ➤ continues until menopause (45-55 years) ➤ It occurs monthly Except during pregnancy
Before Birth:	➤ During early fetal life, primitive ova (Oogonia) proliferate by mitotic division and enlarge to form Primary Oocytes (46)
Before and at Birth:	➤ all primary oocytes completed the prophase of the 1st meiotic division and <input type="checkbox"/> remain arrested and do not finish their first meiotic division until puberty
At Puberty:	<ul style="list-style-type: none"> ➤ 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, It is small nonfunctional cell that soon degenerates
At Ovulation:	<ul style="list-style-type: none"> ➤ 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 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.

A women reached puberty at age of 10 and menopause at 50, she had regular cycle her entire life and never been married what is the number of fully mature oocyte she had her entire life?
 she will have one each month so 12 each year and she has been fertile for 40 years so the total number is $40 * 12 = 480$ oocytes



DURING FETAL LIFE	AFTER PUBERTY DURING EACH OVARIAN CYCLE	AFTER FERTILIZATION
<p>Proliferation:</p> <p>each oogonium divides by mitosis into 2 daughter oogonia (with diploid number of chromosomes: $(44 + XX)$)</p> <p>Growth:</p> <p>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):</p> <p>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:</p> <p>begins at ovulation, progresses only to metaphase and becomes arrested.</p>	<p>2nd meiotic division is completed:</p> <p>2n oocyte divides into a mature ovum (haploid number) & 2nd polar body (degenerates).</p>

N.B.: NO PRIMARY OOCYTES FORM AFTER BIRTH

MCQ's

1. Reproductive cycles depend upon activities		2. Ovarian Cycle divide into				
A.	Pituitary	A.	3 Phases			
B.	Hypothalamus	B.	4 Phases			
C.	Vagina	C.	5 phases			
D.	All above	D.	6 phases			
3. Remaining of ruptured follicles is		4. Corpus luteum mainly secretes				
A.	Corpus luteum	A.	Estrogen			
B.	Ovam	B.	Progesterone			
C.	Cuboidal cells	C.	FSH			
5. Day 1 of menstrual Cycle is		6. Is a Secretary or Progesterone phase				
A.	Ischemic Phase	A.	Proliferative Phase			
B.	Menstrual Phase	B.	Luteal Phase			
C.	Luteal Phase	C.	Menstrual Phase			
Q	1	2	3	4	5	6
Answers	D	A	A	B	B	B