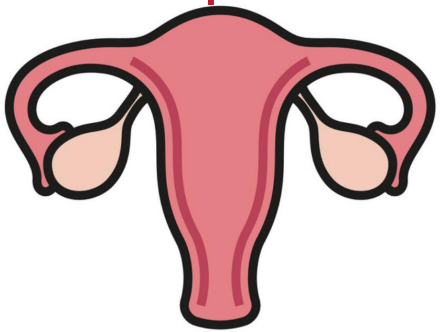

Gametogenesis and uterine cycles

Reproductive block-Embryology -Lecture 2

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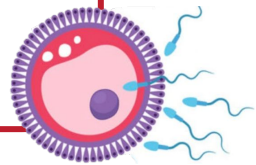


Color index:

- Girls' slides
- Boys' slides
- Main content
- Extra
- Important
- Drs' notes

Objectives

At the end of the lecture, students should be able to:

- Describe the female cycles (Ovarian & Uterine).
- Define and differentiate the types of gametogenesis.
- Describe briefly the process of spermatogenesis.
- Describe briefly the process of oogenesis.
- Do people seriously read these?

Female Reproductive Cycles

- The reproductive cycle start at **puberty** normally continues until the menopause
- Reproductive cycles depend upon activities & coordination of:

Hypothalamus	Pituitary gland	Ovaries	Uterine tubes	Uterus	Vagina	Mammary glands

1- GnRH (Gonadotropin-releasing hormone)

- The cycle starts by the release of GnRH by neurosecretory cells of the **hypothalamus**
- It is carried to the Anterior Pituitary gland to stimulate the release of two Hormones that act on **Ovaries** (FSH and LH)

2- FSH (Follicle-Stimulating Hormone)

- It is secreted by the anterior pituitary gland

Functions:

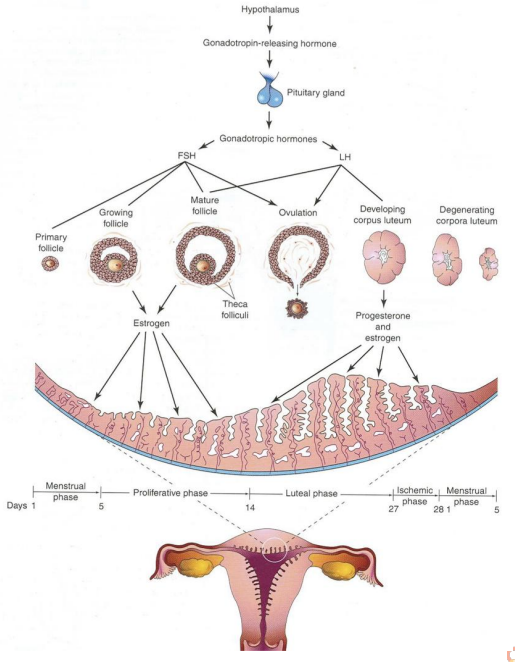
1. It stimulates the ovarian primary follicle to become mature (Follicular Phase)
2. It stimulate the follicular cells (cells surrounding the oocyte) to produce estrogen which regulate the development and functions of the reproductive organs as breasts and endometrium

3- LH (Luteinizing Hormone)

- It is secreted by the anterior pituitary gland

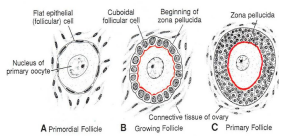
Functions:

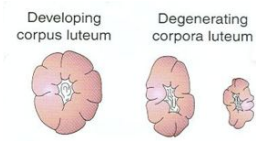
1. It serves as a trigger for ovulation
2. Stimulates the corpus luteum after ovulation to produce progesterone large amounts
3. Stimulates the mature follicles to produce Estrogen small amounts

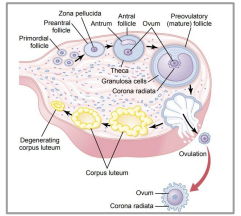


Ovarian Cycle

- The ovarian cortex contains 400,000-500,000 primary follicle (or primordial follicles) aka primitive ovarian follicle
- Each primary follicle consist of one primary oocyte which is encircled by a single layer of flat follicular cells
- The ovarian cycle is under the control of the **pituitary gland** and is divided into 3 phases (FOL)
- FSH stimulates a number of primary follicles to develop into mature Graafian follicle







1- Follicular Phase

- After puberty the simple flat follicular cells become cuboidal, then columnar then forming many layers around the oocyte forming **primary ovarian follicle**
- Early development of the follicle is induced by FSH

2- Ovulation

- The follicle becomes enlarged until it gets mature.
- Early development of ovarian follicle is induced by **FSH**
- Final stages of maturation requires LH
- LH causes **ovulation** which is the rupture of the mature follicle

3- Luteal Phase

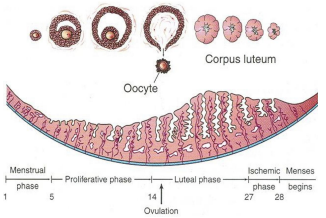
- Now the remaining part of the ruptured follicle is called corpus luteum which secretes progesterone and small amount of estrogen
- The 2 hormones stimulate the endometrial glands to secrete and prepare endometrium for implantation of the fertilized ovum (Blastocyst)
- By the 14th day of menstrual cycle the (LH) of the pituitary gland stimulates the rupture of the mature follicle which changes into corpus luteum

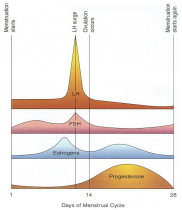
IF the oocyte is fertilized the corpus luteum enlarges and remains until the 4th month of pregnancy

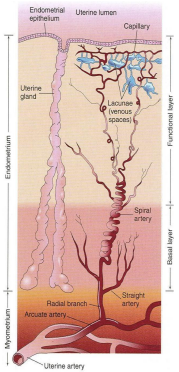
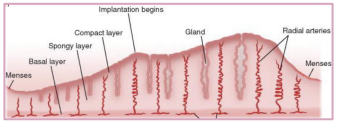
IF the oocyte is not fertilized then the corpus luteum will involute and degenerate into a corpus albican in 10-12 days It will leave a white scar on the endometrium of the uterus

Menstrual (Uterine) Cycle

- It is a cyclic change that occurs in the endometrium of the uterus due to the effect of estrogen and progesterone
- The menstrual cycle ranges from 23-35 days in 90% of women and the average is about 28 days It sometimes varies in the same woman.
- It is divided into 4 phases:





Phase	Menstrual	Proliferative (Follicular)	Luteal	Ischemic
Start	1st day	5th day	14th day	27th day
Duration	Lasts for 4-5 days	Lasts for 9 days	Lasts for 13 days	Lasts for ONE day
Description	• The functional layer of the endometrium is sloughed off and discarded with the menstrual flow. • Blood is discharged from the vagina with small pieces of endometrial tissue.	• Is a phase of repair and proliferation. ★ Coincides with the growth of the ovarian follicle (Follicular phase)(MCQ) ★ It is controlled by Estrogen (MCQ) secreted by follicular cells which increases the thickness of the endometrium into 2-3 folds. • The glands increase in number and length and the spiral arteries elongate.	★ It is also called **secretory** of progesterone phase ★ Coincides with the growth of the corpus luteum (luteal phase) (MCQ) • Endometrium increases in thickness under the influence of estrogen and progesterone mostly. • Glandular epithelium secretes glycogen rich material. • Spiral arteries grow into superficial layer (functional & basal) and become increasing coiled • Large venous network develop and direct arterio-venous anastomoses are the prominent features. 	Degeneration of the corpus luteum leads to a decrease level of estrogen and progesterone which will lead to: 1. Loss of interstitial fluid 2. Marked shrinkage of the endometrium 3. Spiral arteries constricts 4. Venous stasis 5. Ischemic necrosis due to ruptured vessels 6. Blood spreads to the connective tissue 7. Loss of 20-80 / 60 - 80 ml of blood 8. Entire compact and most of the spongy layer of the endometrium is discarded 

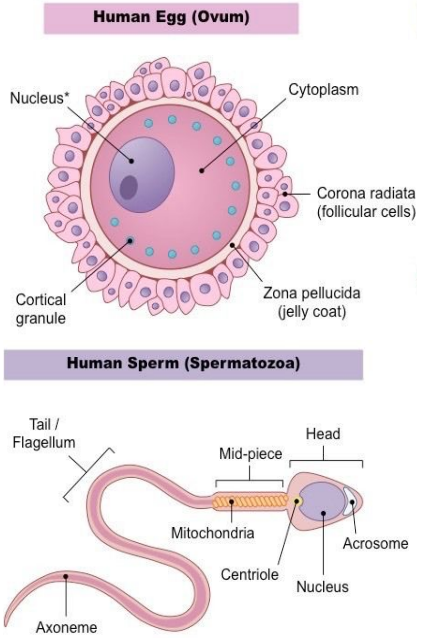
Only in boys slides

Gametogenesis introduction

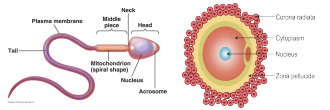
- The sustenance of any species is dependent on its ability to reproduce.
- While some organisms replicate via asexual reproduction, humans and other mammals are dependent on sexual reproduction for the propagation of their species.
- In order for their genetic code to be passed on from parents to their offspring, specialized sex cells are produced to facilitate this process.

what is gametogenesis?

- **Gametogenesis** is a complicated process that involves numerous biochemical pathways and morphological changes for the formation and development of specialized generative cells, known as gametes; sex cells, Sperms for males ,and Ova for females.
- These sex cells are produced by a specialized type of cell replication known as meiosis that occurs during gametogenesis.
- The subsequent gametes contain half the genetic information as their parent cells, and are also unique when compared with both the parent cells and among each other.
- It involves the chromosomes and the cytoplasm of the gametes, preparing them for fertilization.
- During gametogenesis the gametes contain half the number of chromosomes (haploid number) that is present in the somatic cells



Gametogenesis (Gamete formation)

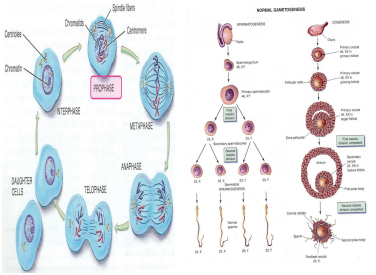


- Gametogenesis is the production of mature male & female gametes (Sperms & Ova).
- Gametes are direct descendant of primordial germ cells.
- Primordial germ cells are first observed in the wall of the yolk sac the 4th week. then it migrate into the future gonad region.

divided according to the gendar to :

♂ **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.



Types of cell division happen in gametogenesis:

1	2
Mitosis: a type of cell division that results in two daughter cells each having the same number(Diploid) as the parent nucleus	**Meiosis:** takes place in the germ cells to produce 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).

Meiosis 1: At the beginning, (prophase) germ cells replicate their DNA so that each of the 46 chromosomes is duplicated into sister Chromatid.
By the end, each new cell formed (Secondary Spermatocyte or Secondary Oocyte) has a haploid (half) number and each one of half number of chromosome of the Primary Spermatocyte or primary Oocyte.

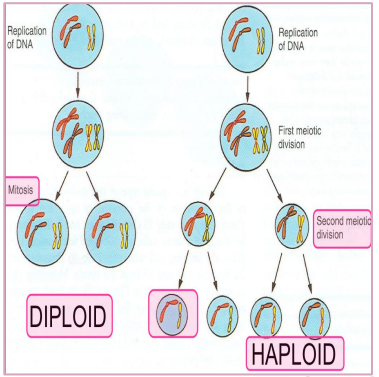
Importance of meiosis : Boys slides

1.Provides constancy of chromosome number between generations with reduction of the number of chromosome from Diploid to Haploid, and production of haploid gametes.

2. Allow random assortment of maternal & paternal chromosomes between the gametes.

3. Relocate segments from maternal & paternal chromosomes by crossing over of chromosomes that produces a recombination of genetic material

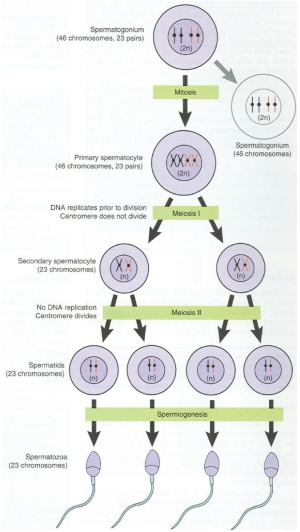
Female Dr: WHAT IS THE DIFFERENCE BETWEEN MITOSIS & MEIOSIS?

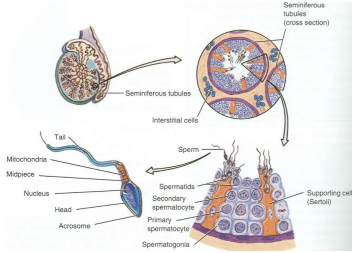


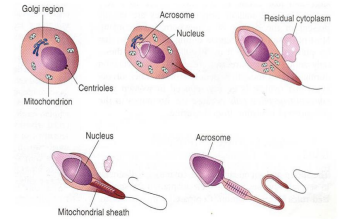
Spermatogenesis:

Aim	Site	Time	Duration	Store
Formation of sperms with haploid number of chromosomes.	Seminiferous tubules of the testis.	From puberty till old age	About two months.	Sperms are transformed passively from seminiferous tubules to epididymis and stored and become functionally mature in the Epididymis

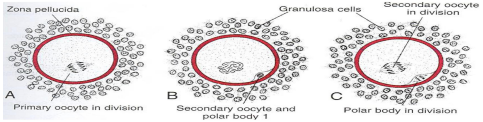
1. Each spermatogonium divides by mitosis into 2 daughter Spermatogonia
2. Each daughter spermatogonia grows to give rise to primary spermatocyte (46).
3. Primary spermatocyte undergoes meiosis I to give rise to secondary spermatocyte (22+ x) or (22+y).
4. Each secondary spermatocyte undergoes meiosis II to form 4 haploid spermatids (half size 23).
5. Spermatids are transformed into 4 mature sperms by a process called spermiogenesis
6. Change in shape (metamorphosis) through which the Spermatids are transformed into mature motile 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.







Oogenesis:



Aim	Site	Time	Duration
Formation of secondary oocytes with haploid number of chromosomes.	Cortex of the ovary	• Starts very early during fetal life • Completed after puberty and ends at menopause.	It occurs monthly Except during pregnancy and after menopause

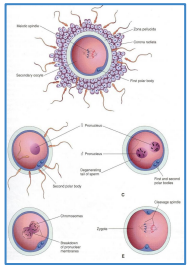
1. **Before Birth (During early fetal life):** primitive ova (Oogonium, Oogonia) proliferate by mitotic division into 2 daughter oogonium and enlarge to form **Primary Oocytes** with diploid number of chromosome, (44+XX) =(46).

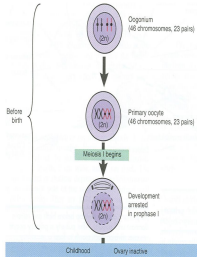
2. **At (before) Birth:** all primary oocytes have completed the prophase of the 1st meiotic division and remain arrested at prophase

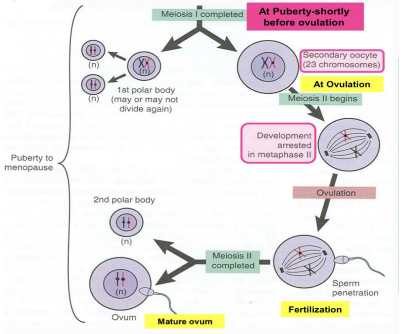
3. **After Puberty:** Shortly before ovulation, A reduction division by which Primary Oocyte completes its first meiotic division (which was arrested at prophase) and give rise to Secondary oocyte (22+X)= (23) & First Polar Body.
   — The Secondary Oocyte receives almost all the cytoplasm.
   — The First Polar Body It is small nonfunctional cell that soon degenerates and receives very little amount of cytoplasm.

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

5. **If the secondary oocyte is fertilized:** the second meiotic division is completed as the sperm penetrates the zona pellucida. otherwise it degenerates in 24 hours after ovulation. The secondary oocyte divides into mature ovum and 2nd polar body which degenerates.
   —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
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	**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.	**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

Errors in Meiosis

- Errors in gametogenesis can lead to a number of chromosomal abnormalities including non-disjunction or polyploidies.
- Non-disjunction occurs when chromosomes fail to separate appropriately.
- Polyploidy occurs when there are more than 2 copies of a homologous chromosome in a cell.

Errors in gametogenesis can lead to:

- Trisomy
- Down's Syndrome – trisomy 21
- Edward's Syndrome – trisomy 18
- Monosomy as Turner syndrome
- Obstetricians can aid parents to screen for chromosomal abnormalities antenatally.

Answers: [Q1:D] [Q2:B] [Q3:B] [Q4:A] [Q5:C] [Q6:A] [Q7:B] [Q8:A]

QUIZ

Q1: How many sperms are produced from primary spermatocyte?

A. 1 Sperm

B. 2 Sperm

C. 3 Sperm

D. 4 Sperm

Q2: what is the fate of secondary oocyte if it is not get fertilized

A. re enter the cycle

B. degenerates

C. become polar body

D. get out with the Menstrual Cycle bleeding

Q3: Which hormone will be released at ovulation?

A. Progesterone

B. LH

C. GnRH

D. FSH

Q4: : When does the primary oocyte complete its first meiotic division?

A. Shortly before ovulation

B. After fertilization

C. after birth

D. Before puberty

Q5: : In which phase does the secondary oocyte arrest in?

A. Anaphase

B. Telophase

C.Metaphase

D. Prophase

Q6: Menstruation is caused by decline in the level of?

A. FSH

B. LH

C.Progesterone

D.Estrogen

Q7: site of the Oogenesis

A.Cortex of the uterus

B. Cortex of the ovary

C. medulla of the ovary

D. medulla of the uterus

Q8: Luteal phase lasts for

A. 13 days

B. 14 days

C. 9 days

D. 2-3 days

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