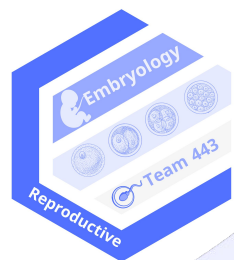


Gametogenesis & uterine cycle



Objectives



Define gametogenesis.



Differentiate the types of gametogenesis.



Describe the process of spermatogenesis.



Describe the process of oogenesis.



Define Ovarian & Uterine cycles and Describe the Uterine cycles

This lecture was presented by : [Dr.Zahid Kaimkhani](#) & [DR.Samira Shaheen](#)

[Ninja Nerd's helpful Explanation of Spermatogenesis](#)



[Click here for Ninja Nerd's board](#)

[Click here for Ninja Nerd's helpful notes](#)



[Click here for Oogenesis video by Dr matt & Dr mike](#)

Editing File

Color index :

Main text (black)

Female Slides (Pink)

Male Slides (Blue)

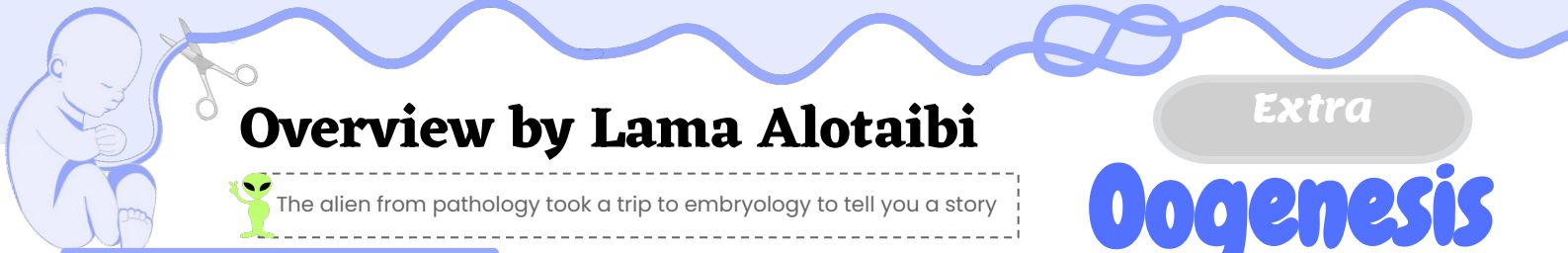
Important (Red)

Dr's note (Green)

Extra Info (Grey)



embryologymed443@gmail.com



Overview by Lama Alotaibi



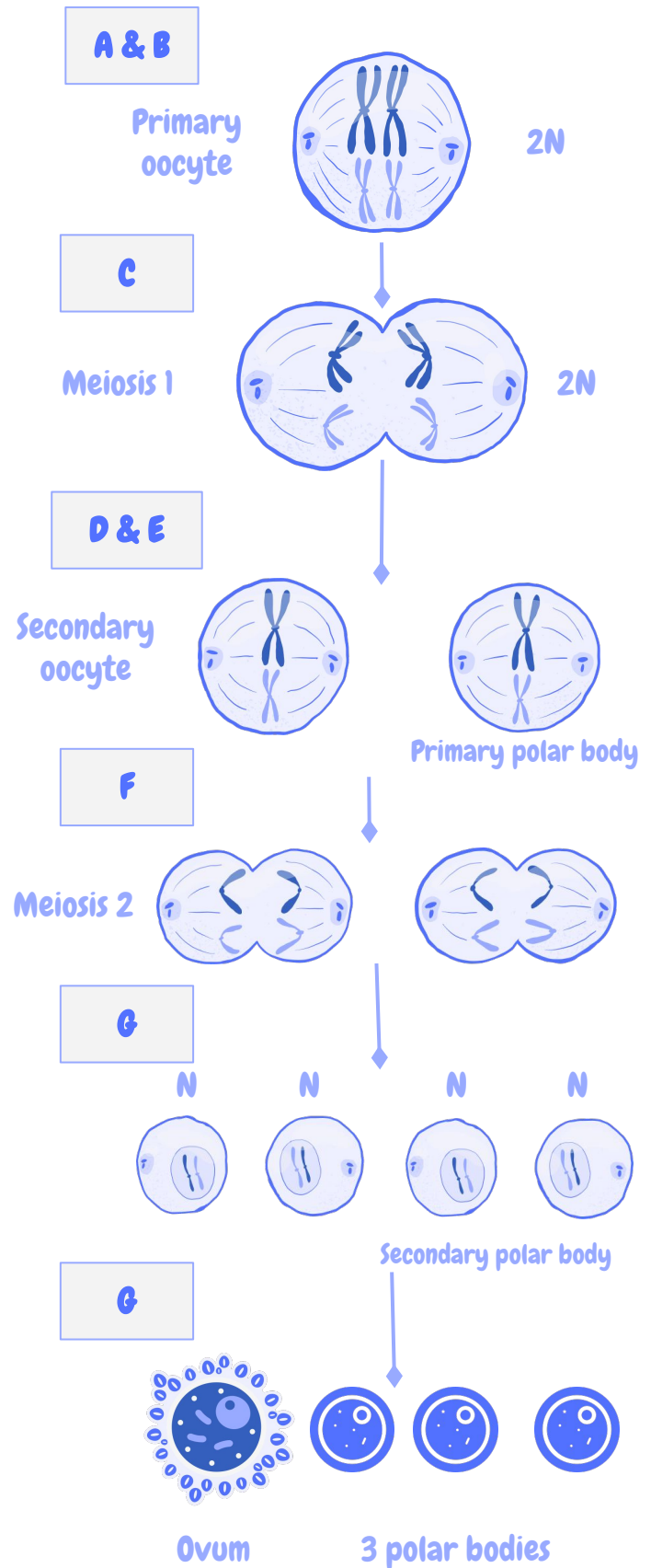
The alien from pathology took a trip to embryology to tell you a story

Extra

Oogenesis

Overview

- A. Primitive oogenia proliferate by mitotic division & DNA giving primary oocytes
- B. Primary oocyte is enclosed with single layer to form primordial follicle & **stop till puberty**
- C. After puberty primary oocyte undergo meiosis 1 & divided into 2 cells :
- D. One gets most of DNA & cytoplasm called secondary oocyte
- E. Other one gets little DNA & cytoplasm called **primary polar body** (which will degenerate later)
- F. At ovulation secondary oocyte begins meiosis 2 **but gets arrested at metaphase** (waiting for sperm)
- G. If fertilisation occurs second meiosis will be completed & form 1 ovum & 3 polar bodies



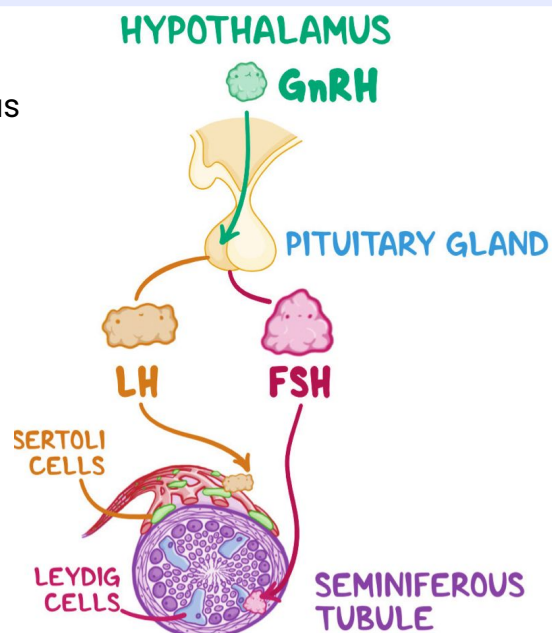


Extra

Spermatogenesis

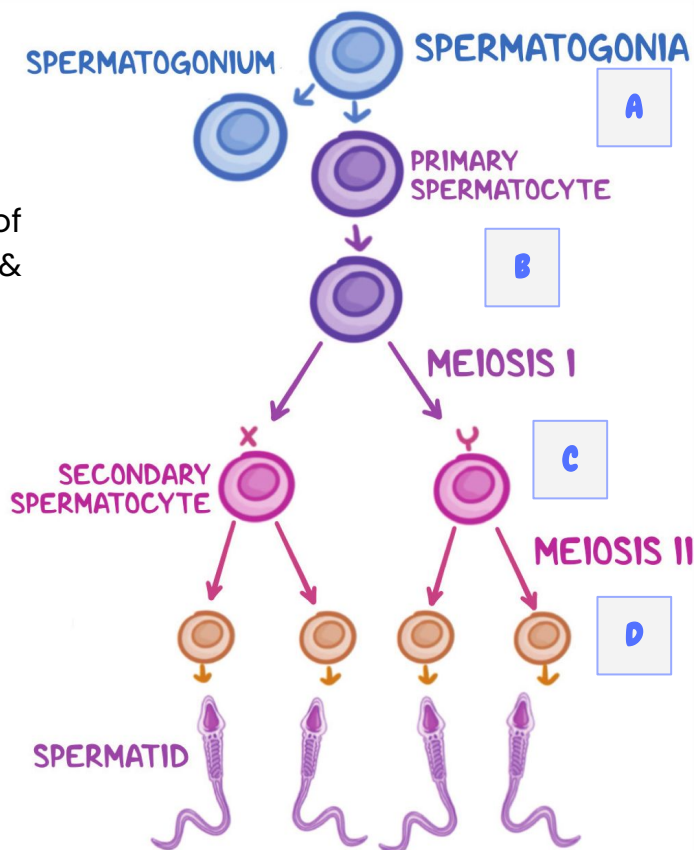
Step 1 "initiation"

- A. spermatogenesis starts at puberty under hypothalamus stimulation by GnRH
- B. GnRH stimulates pituitary glands to secrete LH & FSH
 - before puberty: GnRH, LH, FSH : secreted in low constant levels
 - After Puberty: Secretion becomes pulsatile
- C. LH binds to Leydig cells to stimulate testosterone synthesis
- D. FSH binds to Sertoli cells to produce androgen binding protein (allow testosterone to cross blood testis barrier) in seminiferous tubules



Step 2 "spermatogenesis"

- A. spermatogonia (diploid cell) undergo mitosis to give: one spermatogonium (so the number of spermatogonia in the testes doesn't decrease) & one primary spermatocyte.
- B. Primary spermatocyte moves to the lumen of seminiferous tubules & enters meiosis I
- C. Then it gives 23-chromosome cells with X & Y chromosomes called secondary spermatocytes
- D. Secondary spermatocytes enter meiosis II & give 23-chromosome cells but with only one chromatid called spermatid



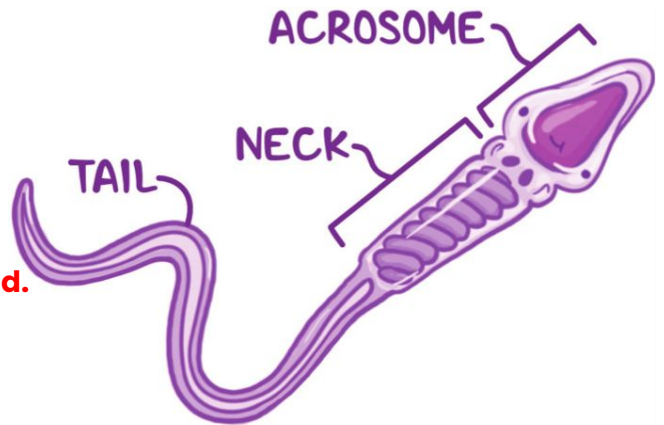
Step 3 “ sperms “

Spermatids enter the lumen of seminiferous tubules & undergo Spermiogenesis

Where : the Spermatids are transformed into mature motile sperms

By :

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.**



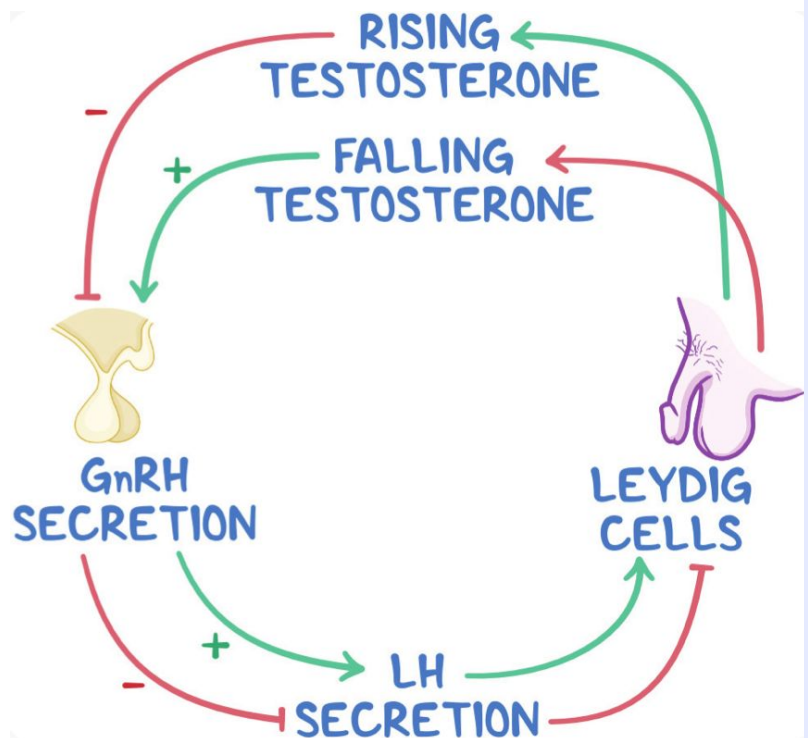
Step 4 “ regulation”

A. Sertoli cell secrete **inhibin** :

Negative feedback on pituitary gland to decrease FSH production

B. Leydig cell secrete **testosterone**:

Negative feedback on pituitary gland to decrease LH production





Gametogenesis

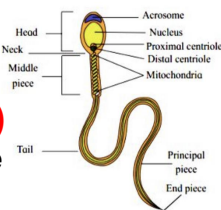
Definition

- It is the **process of formation and development of specialized generative cells** (gametes) (Sperms, oocytes).
- Involving the chromosomes and the cytoplasm of the gametes
- **Prepare these sex cells for fertilization.**
- During gametogenesis the **chromosome number is reduced by half** and the shape of the cell is altered
- **Chromosome?** threadlike structures made of protein and a single molecule of DNA that serve to carry the genomic information from cell to cell

Gametogenesis

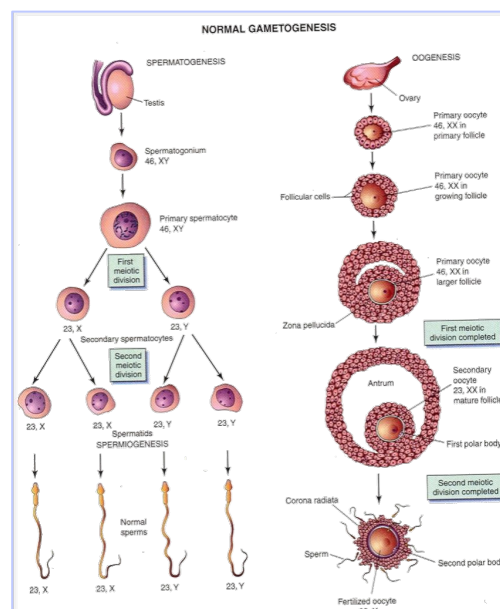
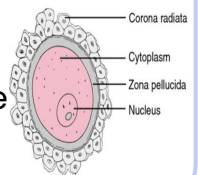
1) Spermatogenesis

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



2) Oogenesis

It is the Sequence of events by which the female primitive germ cells (الأولية) (**oogonia**) are transformed into mature oocytes





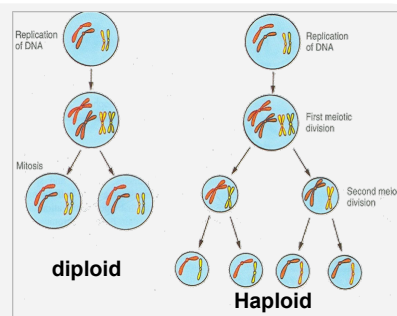
Meiosis

Definition

- it is the **cell division that takes place in the germ cells only to produce male & female gametes.**
- It consists of two cell divisions, first meiotic division & second meiotic division
- During this cell division the diploid **number of chromosome(46) is reduced to haploid number (23)**

Mitosis:
takes place in all body cells ($2n \rightarrow 2n$)
For growth and tissue repair
Produces diploid

Meiosis:
takes place in genital cells only ($2n \rightarrow n$)
produces Haploid



Beginning of meiosis I	End of the 2nd meiotic division
<p>at (prophase) male & female germ cells replicate their DNA so that, each of the 46 chromosomes is duplicated into sister Chromatids.</p>	<p>each new cell formed (Secondary Spermatocyte or Secondary Oocyte) has haploid (half) number of chromosome.</p> <p>Haploid number of chromosome: It is half number of chromosomes of the Primary Spermatocyte or primary Oocyte.</p>
<p>MEIOSIS</p> <p>Meiosis I: Profase I, Metafase I, Anafase I, Telofase I, Citocinesis</p>	<p>Meiosis II: Profase II, Metafase II, Anafase II, Telofase II, Citocinesis</p>



Spermatogenesis

Definition

- Events by which primitive germ cells (spermatogonia) transformed into spermatozoa (sperms).
- It is a maturation process **begins at puberty**, and continues into old age.
- Sperms are stored and become functionally mature in the epididymis

AIM:

Formation of sperms with haploid number of chromosomes.

SITE:

Seminiferous tubules of the testis.

TIME:

From puberty till old age.

DURATION:

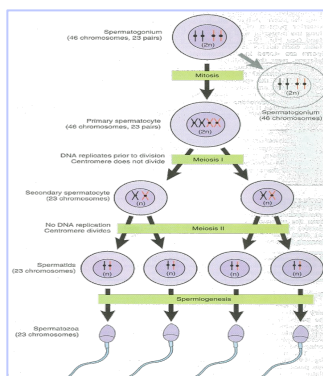
About two months

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

primary spermatocyte undergoes the 1st meiotic division, to form the **secondary spermatocytes, (haploid)** (22+x) or (22+y)

Secondary spermatocytes, undergo the 2nd meiotic division to form **4(haploid) spermatids, (half size)**

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

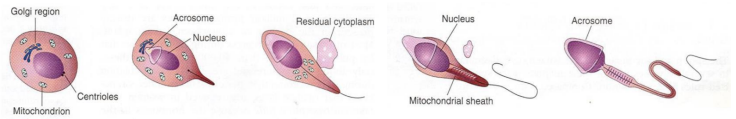




Spermatogenesis

Definition

- **Spermiogenesis** is a **change in shape (metamorphosis)** (not related to **chromosomes**) through which the Spermatids are transformed into **mature sperms**.
- The spermatids transformed into four mature sperms The entire process takes approximately 2 months
- **Change in shape occurs by:**




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**.

Results of Spermiogenesis

 From rounded spermatid to an elongated sperm.

 Development of the tail

 Loss of cytoplasm

 Formation of the acrosome



Oogenesis

IMPORTANT

Definition

- Differentiation of oogonia into mature oocytes.
- It occurs monthly Except during pregnancy.

AIM:

Formation of secondary oocytes with haploid number of chromosomes.

SITE:

Cortex of the ovary

TIME:

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

OOGENESIS

<p>Before Birth (During fetal life)</p>	<p>primitive ova (Oogonia) proliferate by mitotic division and enlarge to form Primary Oocytes (46)</p>	
<p>Before birth & At Birth:</p>	<ul style="list-style-type: none"> • all primary oocytes remain arrested in prophase I of the 1st meiotic division. • Do not finish their first meiotic division until puberty. 	
<p>At Puberty</p>	<ul style="list-style-type: none"> • Shortly before ovulation; Primary Oocyte completes its first meiotic division to give Secondary oocyte (23) & First Polar Body (may divide to 2 polar bodies) • The Secondary Oocyte receives almost all the cytoplasm. • The First Polar Body receives very little. • Polar body : It is small nonfunctional cell that soon degenerates. 	
<p>At ovulation</p>	<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 • The rest is in the 2nd Polar Body which soon degenerates. (After fertilization in total we may have 2 or 3 polar bodies + ovum) 	



Female Reproductive Cycles

Introduction

- Begins at puberty (10 to 13 years of age)
- **Preparing the reproductive system for pregnancy.**
- These involve activities of:

Hypothalamus

Pituitary gland

Uterine tube

Uterus

Vagina

Ovaries

Mammary gland

OVARIAN CYCLE

Cyclic changes in the ovaries by FSH and LH includes:

- development of follicles
- ovulation and
- formation of corpus luteum.

Uterine/Menstrual Cycle

Cyclic changes in the structure and function of the endometrium the by estrogen and progesterone.

The interrelations of the hypothalamus, pituitary gland, ovaries, endometrium

1- GnRH (Gonadotropin-releasing hormone)

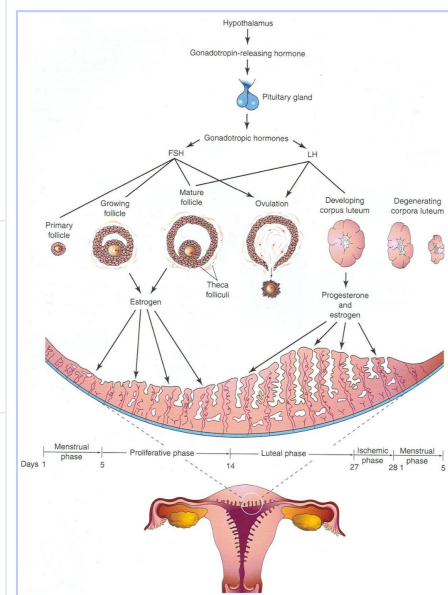
- Is synthesized by neurosecretory cells in the Hypothalamus
- Carried by the hypophyseal portal system to the Pituitary gland (anterior lobe)
- **Stimulates the pituitary to release two hormones that act on ovaries (FSH & LH)**

2- FSH (Follicle-Stimulating Hormone)

- **It stimulates development of the ovarian follicles to develop.**
- **Production of Estrogen** by the follicular cells.

3- LH (Luteinizing Hormone)

- It serves as the trigger for ovulation, (release of the 2nd oocyte)**
- Stimulates the follicular cells and corpus luteum to produce Progesterone**
- These hormones also induce growth of the ovarian follicles and the endometrium.





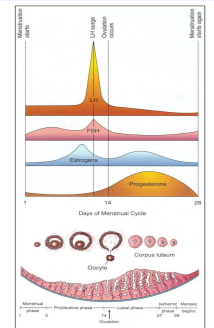
Menstrual (Uterine) Cycle



[Ovarian cycle](#)
[Menstrual cycle](#)

Introduction

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



Phases of Menstrual Cycle:

Menstrual phase

Proliferative or follicular phase

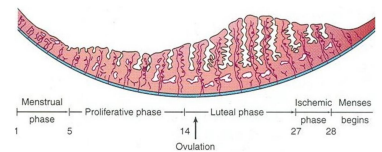
Luteal phase

Ischemic 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.



Menstrual phase

Proliferative or follicular phase

Luteal phase

Ischemic phase

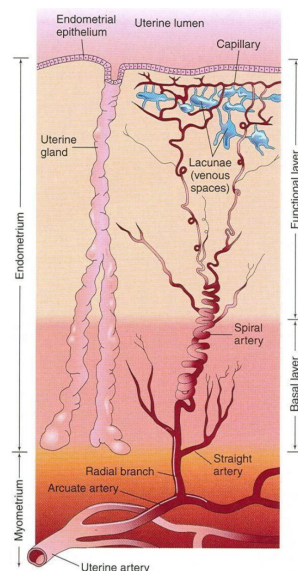
Is a phase of repair and proliferation, Lasts for 9 days.

Coincides with growth of ovarian follicle.

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 & the spiral arteries elongate.





Menstrual (Uterine) Cycle

The menstrual cycle is a continuous process, for description, divided into **four** phases, each phase gradually passes into the next one:

Menstrual phase

Proliferative or follicular phase

Luteal phase

Ischemic phase

- ★ **Is a Secretory or Progesterone phase.**
It lasts about 13 days
- ★ Coincides with formation, growth and functioning of the Corpus Luteum
- ★ Glandular epithelium secrete glycogen rich material.
- ★ **Endometrium thickens under the influence of estrogen and progesterone.**

- ★ **Spiral arteries grow into the superficial layer.**
- ★ Arteries become increasingly coiled.
- ★ Large venous network develops.
- ★ Direct arterio-venous anastomosis are the prominent features.

Menstrual phase

Proliferative or follicular phase

Luteal phase

Ischemic phase

Degeneration of corpus luteum decreases levels of progesterone & estrogen.

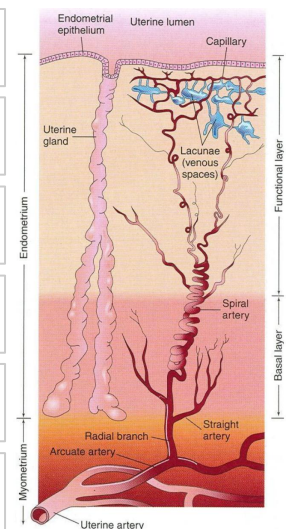
Loss of interstitial fluid & marked shrinking of endometrium.

Spiral arteries become constricted.

Venous stasis & Ischemic necrosis and rupture of damaged vessel wall

Blood seeps into the surrounding connective tissues.

Again, Loss of 20-80 ml of blood and repeated menstruation. & the entire (functional layer); compact layer and most of the spongy layer of endometrium is discarded during 3 to 5 days

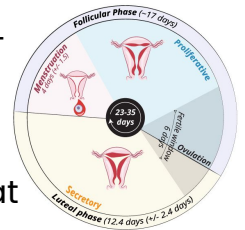




Ovarian Cycle

Introduction

- is under the control of the Pituitary Gland.
- is divided into 3 phases: (FOL) 1- Follicular, (FSH)2- Ovulatory, (LH). 3- Luteal. (LH).
- The ovarian cortex contains hundreds of thousands of primordial follicles (400,000 to 500,000).
- Each consists of one primary oocyte encircled by a single layer of flat follicular cells



It is under the control of the Pituitary Gland. It's divided into 3 phases:



Follicular

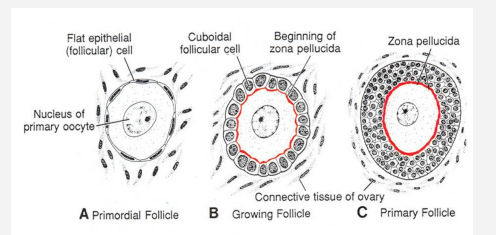


Ovulation



Luteal

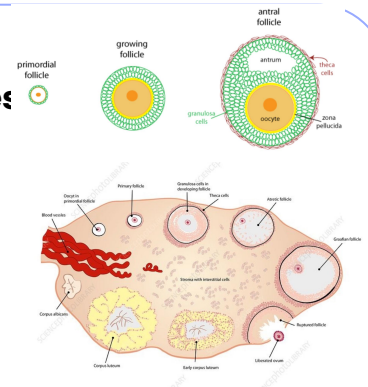
The simple flat follicular cells become cuboidal, then columnar then forming many layers around the oocyte, (**granulosa cells**) forming primary ovarian follicle.



FUNCTIONS:

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

These Growing and mature follicles produce estrogen which regulates the development and functions of the reproductive organs as breast & endometrium.





Ovarian Cycle

It is under the control of the Pituitary Gland. It's divided into 3 phases:



Follicular

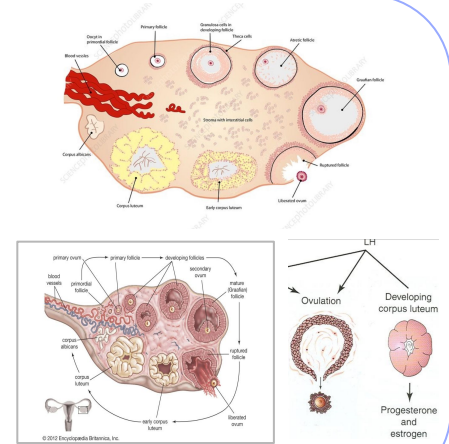


Ovulation



Luteal

- ⦿ The follicle becomes enlarged until it gets maturity.
- ⦿ **Early development of ovarian follicle is induced by FSH.**
- ⦿ Final stages of maturation require LH.
- ⦿ **LH causes ovulation (rupture of the mature follicle).**
- ⦿ FUNCTIONS of LH:
 1. It serves as the trigger for ovulation.
 2. Stimulates the mature follicles to produce Estrogen.
 3. **Stimulates corpus luteum to produce Progesterone.**



It is under the control of the Pituitary Gland. It's divided into 3 phases:



Follicular



Ovulation

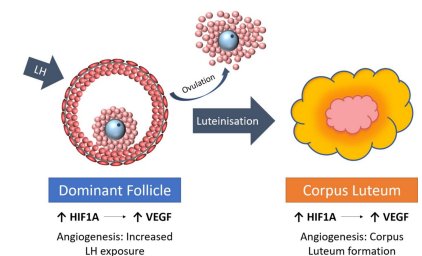


Luteal

- ⦿ The remaining of the ruptured follicle is now called corpus luteum.
- ⦿ It secretes **Progesterone** and small amount of Estrogen.
- ⦿ These 2 hormones stimulate and prepare endometrium for implantation of fertilized Ovum (Blastocyst)

Fates of Corpus Luteum:

- 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.**





MCQ



1

in which of the following phases the first meiotic division of the primary oocyte arrest before birth?

A

Anaphase

C

Metaphase

B

Prophase

D

Telophase

2

Ovulation is triggered by which hormone?

A

FSH

C

LH

B

Estrogen

D

Progesterone

3

in which of the following phases the second meiotic division of the secondary oocyte arrest at ovulation ?

A

Anaphase

C

Metaphase

B

Prophase

D

Telophase

4

Which of the following phases is called progesterone phase?

A

Menstrual Phase

C

Luteal Phase

B

Proliferative or Follicular Phase

D

Ischemic Phase

5

Which hormone stimulates the ruptured ovarian follicle to become the corpus luteum?

A

FSH

C

LH

B

Estrogen

D

Progesterone

Embryology Team



Leader

سلطان البقمي

Leader

رهف الشويهي



أبو عويد



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فراس مازن



شادن الهزاني



زياد العتيبي



ريناد محمد الشهري



فيصل الشويعر



لمى العتيبي



ريم العمير

Special thanks and gratitude to the amazing Lama Alotaibi for this fabulous designing of the theme