HUMAN ANATOMY & PHYSIOLOGY-II

UNIT 5 NOTES

REPRODUCTICE SYSTEM

- MALE RS
- FEMALE RS
- SEX HORMONES
- MENSTRUATION
- SPERMATOGENESIS
- OOGENESIS

INTRODUCTION TO GENES

- CHROMOSOMES
- GENES & DNA

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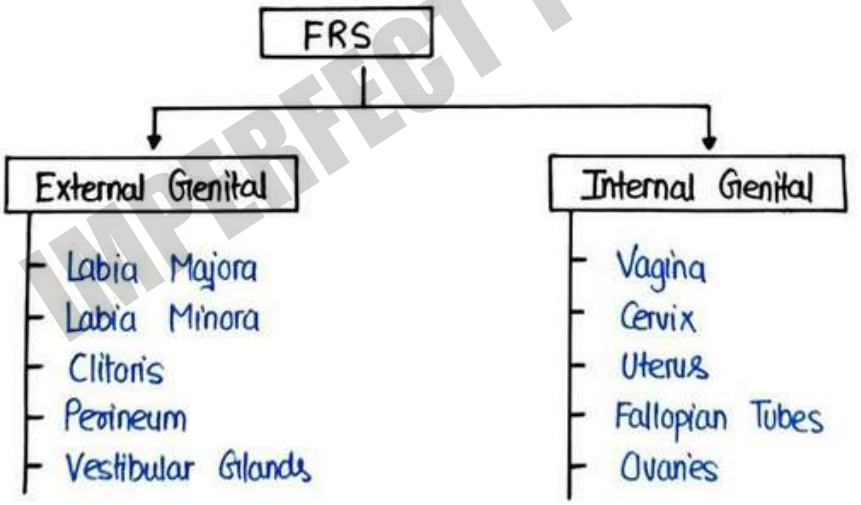
Female Reproductive System

- The Female Reproductive System refers to a complex network of reproductive organs & structures within female Body that functions together to facilitate reproduction
- It's primary role is to produce eggs (ova), provide a suitable environment for Fertilization, support embryo development during pregnancy & enable childbirth.

Classification Of Female Reproductive System

It can be classified into two parts :

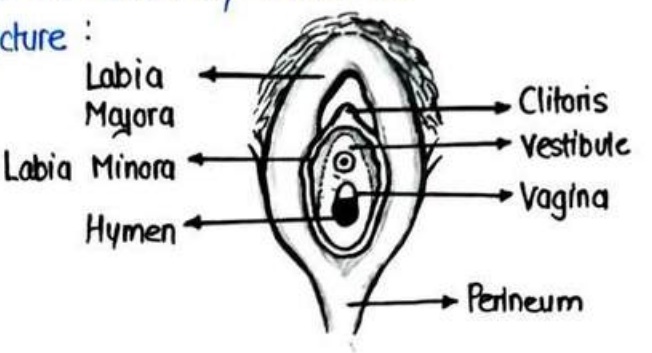
① External Genital (Vulva)
② Internal Genital



External Genital Organs

- The external genital organs are collectively known as **Vulva**
- It consist of following structure :

① Labia Majora
② Labia Minora
③ Clitoris
④ Perineum
⑤ Vestibular Glands



① Labia Majora

- These are two large folds forming the boundary of Vulva.
- They composed of skin, fibrous tissue & fat.
- They contain large number of sebaceous & sweat glands.
- They are also known as 'Outer Lips' or 'Greater Lips'.
- They contains two **Bartholin's Glands** that helps in lubrication during Intercourse.

② Labia Minora

- These are two smaller folds of skin blw labia majora.
- They are also known as 'Inner Lips'.
- They are thin, delicate folds of skin, typically pink or reddish brown in colour.
- They provide a protective barrier for vaginal opening, urethra & clitoris.

③ Clitoris

- The clitoris is a highly sensitive & erectile organ, anatomically homologous to the penis in males
- It is a small pea shaped structure, contains sensory nerve endings.
- It plays a crucial role in sexual arousal & excitment in females.

④ Vestibular Glands

- They present on either side of urethral & vaginal orifice.
- They secretes mucus
- They are of mainly two types:

(i) Lesser Vestibular Glands
(ii) Greater Vestibular Glands.

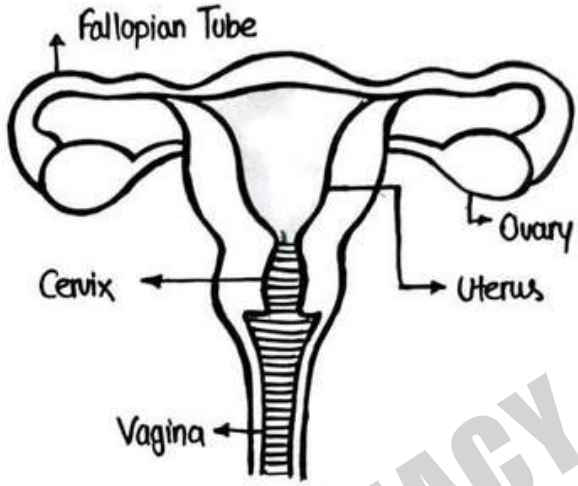
⑤ Perineum

- It is the area that extends from fourchette to the anus.

INTERNAL GENITAL ORGANS

It mainly consist of :

- Vagina
- Cervix
- Uterus
- Fallopian Tubes
- Ovaries



① Vagina

- Vagina is a short tubular structure.
- It is lined by mucus membrane (stratified squamous epithelium).
- It extends from vulva to the cervix of uterus.
- It receives penis during the intercourse.
- It also serves as birth canal during childbirth
- It serves as outlet for menstrual fluid during menstruation.
- It doesn't contain any secretory glands but yet maintains a natural moisture level due to secretion of cervix & bartholin's glands.

② Cervix

- The cervix is a cylindrical or conical shaped structure that forms the lower part of uterus.
- It serves as a gateway between the uterus and the vagina.

③ Uterus

- The uterus, also known as womb, is a pear shaped organ located in pelvic cavity of female Reproductive System
- It plays a central role in pregnancy & childbirth.
- It is responsible for menstruation in females.
- It can be divided into 3 parts :

ⓐ Fundus
ⓑ Body
ⓒ Cervix

- It consist of 3 layers

ⓘ Endometrium (Innermost Layer)
ⓘⓘ Myometrium (Middle Layer)
ⓘⓘⓘ Perimetrium (Outer Layer)

④ Fallopian Tubes

- It is also known as Uterine Tubes.
- There are 2 fallopian tubes in FRS located on either side of uterus.
- They have finger like projections, called Fimbriae.
- The primary function of fallopian tubes is to transport egg from ovary to the uterus.
- It provide a suitable environment for fertilization & transportation of egg.
- Fertilization of ovum generally takes place in the upper portion of fallopian Tubes.

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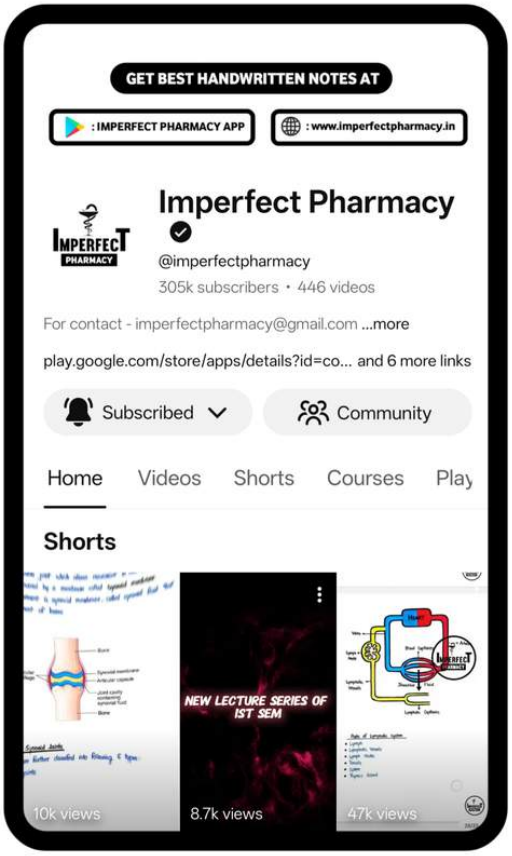

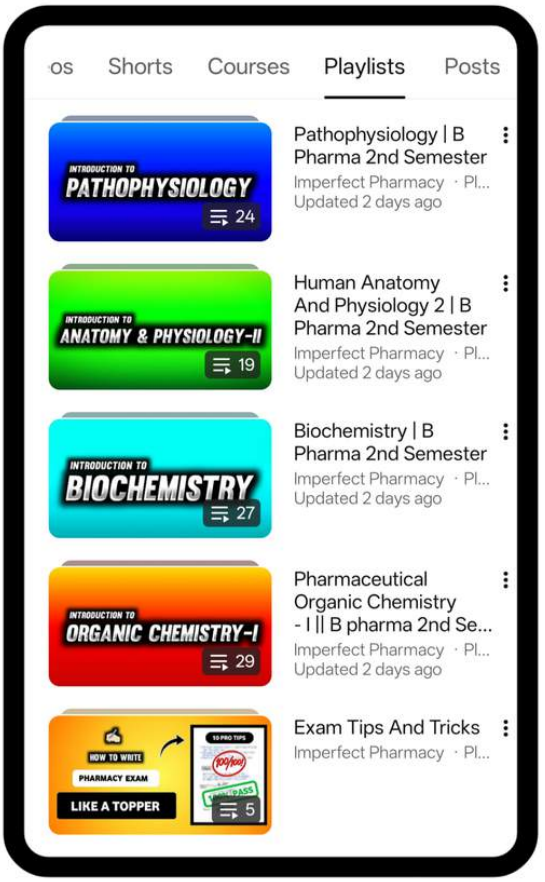

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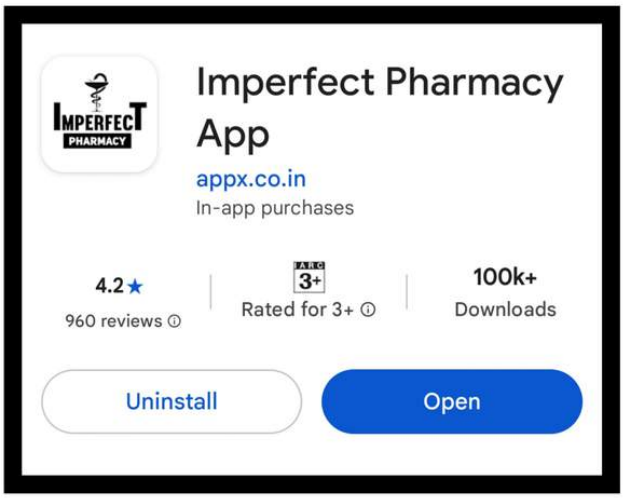


⑤ Ovaries

- The ovaries are small, almond shaped organ located in the lower abdomen of female reproductive system.
- They plays a crucial role in reproductive & hormonal functions.
- They are located on either side of uterus.
- Inside the ovary, there are thousands of tiny sacs, called follicles. each containing an immature egg (oocyte).
- The ovaries are responsible for producing & releasing eggs (ova) through a process called ovulation.
- Ovulation typically occurs once a month during menstrual cycle.
- They also produces female sex hormones i.e., Estrogen and Progesterone.

SECONDARY SEXUAL ORGAN

It mainly contains Breast or Mammary Glands

① Mammary Glands

- It is also known as Breast Glands.
- It is responsible for lactation & production of milk
- They are composed of lobules that produce milk & ducts that carry milk to the nipple.
- The growth & development of Breast tissues is stimulated by Estrogen
- They also plays a significant role in sexual attraction.

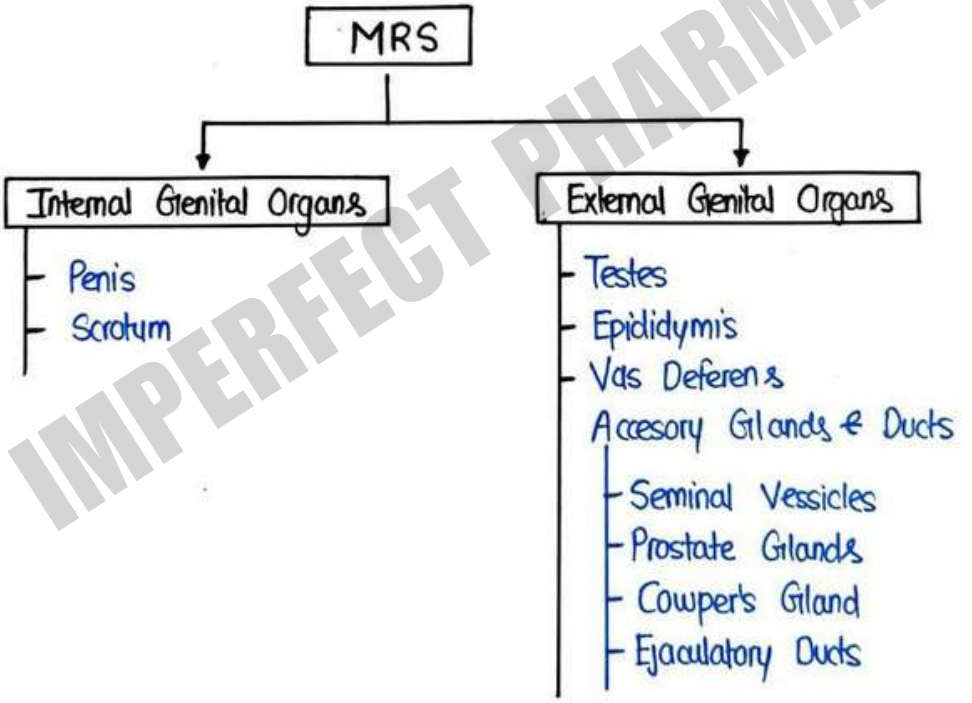
Functions Of Female Reproductive System

- The ovaries produce & release mature eggs (ova) through a process called Ovulation.
- Female Reproductive System provides a suitable environment for fertilization of eggs by sperm.
- The ovaries produce female sex hormones, estrogen & progesterone.
- Implantation & Prenatal growth takes place in Uterus.
- Fertilization takes place in Fallopian Tubes
- The female reproductive system includes structures such as Clitoris, labia, vagina & uterus which plays role in sexual arousal, pleasure and orgasm.
- Mammary Glands of females secretes milk after Parturition.
- It is also responsible for Menstrual Cycles in females.

Male Reproductive System

- Male Reproductive system is a complex is a complex network of organs and structures responsible for producing, storing & delivering sperm cells to fertilize a female egg.
- The study of Male Reproductive System can be subdivided into two parts

① External Genital Organs
② Internal Genital Organs



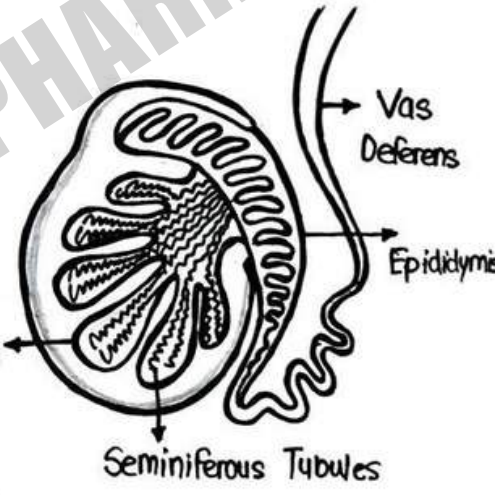
Internal Genital Organs

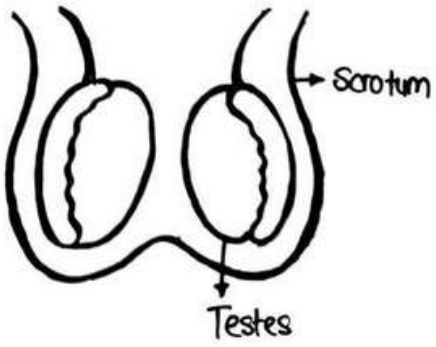
It mainly consist of :

- Testes
- Epididymis
- Vas Deferens
- Accessory Glands
  - Seminal Vessicles
  - Prostate Gland
  - Cowper's Gland
  - Ejaculatory Duct

① Testes

- Testes are primary Male Reproductive Organs located in the scrotum, a pouch of skin situated outside of body.
- They are present in a pair.
- They are oval shaped organ responsible for both sperm production and hormone secretion.
- Spermatogenesis required 2-3° less temperature than body temperature, that's why testes lies outside of body.
- Each testis contains about 200-300 compartment called **lobules**.
- Now, each lobule contains approx 1-3 **Seminiferous Tubules**.
- Seminiferous Tubule contains Germ Cells, Sertoli Cells & Leyding Cells (Interstial space) & primary site of **Spermatogenesis**.





② Epididymis

- The epididymis is a coiled, tubular structure located on the posterior side of each testis in Male Reproductive System.
- It is the site for sperm maturation (gaining of ability to swim) the process usually takes about 2-4 weeks.
- It also stores mature sperm cells until ejaculation.
- It further continues as Vas Deferens.

③ Vas Deference

- The Vas Deference, also known as Ductus Deferens, is a crucial component of male reproductive system
- It is a muscular tube that transports sperm from epididymis to ejaculatory duct.
- It also serves as temporary storage site for sperm.

④ Accessory Glands / Ducts

They mainly contains :

- Seminal Vessicles
- Prostate Gland
- Cowper's Gland
- Ejaculatory Duct

ⓐ Seminal Vessicles

- The seminal vessicles are two small fibromuscular pouches situated near the vas deference.
- Seminal Vessicles joints with vas deference to form Ejaculatory Duct.
- They secretes seminal fluid, that constitutes about 60-70% part of total volume of semen.
- Seminal Fluid mainly contains
  - Fructose
  - Prostaglandin
  - Citric Acid
  - Seminal Plasma Proteins

ⓑ Prostate Gland

- The prostate gland is a small, walnut shaped organ located below the bladder.
- The prostate gland plays a coucial role in both reproductive and urinary functions.
- Prostate Gland surrounds urethra and its smooth muscle contractions helps to control the flow of urine from bladder through Urethra.
- It secretes thin, milky fluid i.e. Prostatic Fluid that constitutes about 20-30% part of semen.
- Prostatic Fluid mainly contains:
  - Citric Acid
  - Bicarbonate
  - Zinc
  - Enzymes

© Cowper's Gland

- The cowper's gland, also known as Bulbourethral Glands, are two small glands located near the base of penis, just below prostate gland in males.
- It helps to lubricate the urethra & tip of penis, which can reduce friction during intercourse.

ⓓ Ejaculatory Ducts

- Ejaculatory Ducts are tube like structure formed by union of vas deferens & seminal vessicle.
- It transports sperm from vas deference & seminal fluid from seminal vessicle into urethra

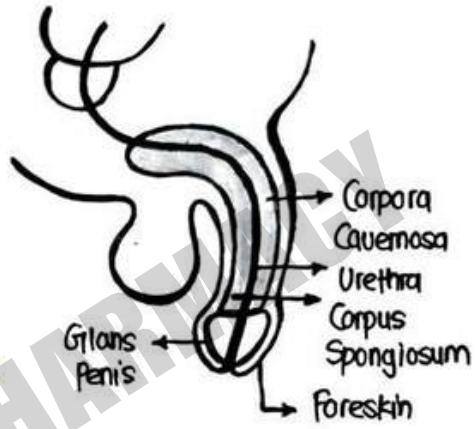
External Genital Organs

It mainly consist of :

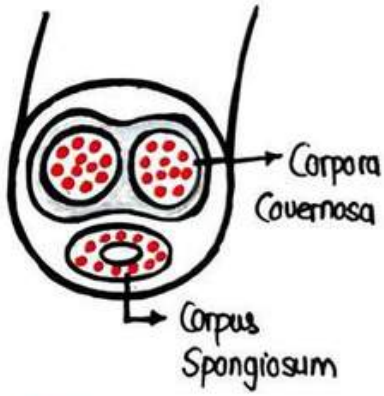
- Penis
- Scrotum

① Penis

- Penis is a complex organ in males with both reproductive & urinary functions :
- It consist of following parts :



- **Shaft** : It is long cylindrical part of penis extends from base to tip
- **Gland Penis** : It is the enlarged tip of penis
- **Urethra** : A tube that runs through the penis & serves as passageway for urine & semen exit.



- **Corpora Cavernosa** : These are two parallel colums of erectile tissues that fills with blood during sexual arousal, causing penis erection.
- **Corpus Spongiosum** : It is single column of erectile tissue that contains urethra & lies below corpora cavernosa.

② Scrotum

- Scrotum is a sac like structure that hangs outside the body & holds the testes.
- It maintains the temperature of 34°C required for sperm production.
- It provides a protective environment for testicles.
- Scrotum is divided into two compartment by a septum

Function Of Male Reproductive System

- Testis produces sperm & testosterone.
- Epididymis stores & matures sperm.
- Penis places sperm inside body of female.
- Scrotum maintains a lower temperature for spermatogenesis
- Penis also helps in urine excretion.

Menstrual Cycle

- The menstrual cycle is a monthly process that prepares the female body for pregnancy.
- Menstrual Cycle is defined as a cyclic event, occuring regularly in females every 26 - 30 days throughout the child bearing period.
- It typically lasts about 28 days but can vary from 21 to 35 days.
- It starts at the age of 12-15 years, which marks the onset of puberty.
- First Menstrual Cycle : Menarche
- Last Menstrual Cycle : Menopause

Phases Of Menstrual Cycle

Menstrual Cycle mainly consist of following 4 phases:

- Menstrual Phase
- Follicular Phase
- Ovulatory Phase
- Luteal Phase

① Menstrual Phase

- Duration : Approximately days 1-5.
- Description : This phase marks the begining of menstrual cycle, characterized by shedding of uterine lining (endometrium) if there is no pregnancy. This results in menstrual bleeding through vagina.
- Hormonal Changes : Estrogen & Progesterone levels are low.

② Follicular Phase

- Duration : Begins on first day of menstruation & lasts until ovulation, roughly days 1-14.
- Description : Follicular Phase involves maturation of ovarian follicles, each containing an egg.
  The Follicle Stimulating Hormone (FSH) stimulates growth of these ~~hormones~~ follicles. One dominant follicle will mature fully.
- Hormonal Changes : Estrogen level rises, stimulating the growth of endometrial lining in preparation for a potential implantation.

③ Ovulatory Phase

- Duration : Around day 14 but it can vary
- Description : Ovulation is the release of mature egg from the dominant follicle in the ovary.
  Both LH & FSH attain a peak level in the middle of cycle about 14th day
  The egg then travels down the fallopian tube, where it may be fertilized by sperm.
- Hormonal Changes : A surge in Luteinizing hormone (LH) triggers ovulation. Estrogen levels peak just before this surge.

④ Luteal Phase

- Duration : Approximately Days 15-28
- Description : After ovulation, the ruptured follicle transforms into th the corpus luteum, which secretes progesterone e some estrogen. This phase prepares the uterine lining for a possible implantation of a fertilized egg.
- Hormonal Changes : Progesterone level increases to maintain the endothelial lining. If pregnancy does not occur, corpus luteum breaks down, leading to a decrease in Progesterone levels.

SPERMATOGENESIS

- Spermatogenesis is the process through which sperm cells are produced in the testes.
- Spermatogenesis takes place at temperature about 3°C below normal body temperature.
- Spermatazoa (Sperm) are produced in germ cells of seminiferous tubules of testes & matures in epididymis.

Stages Of Spermatogenesis

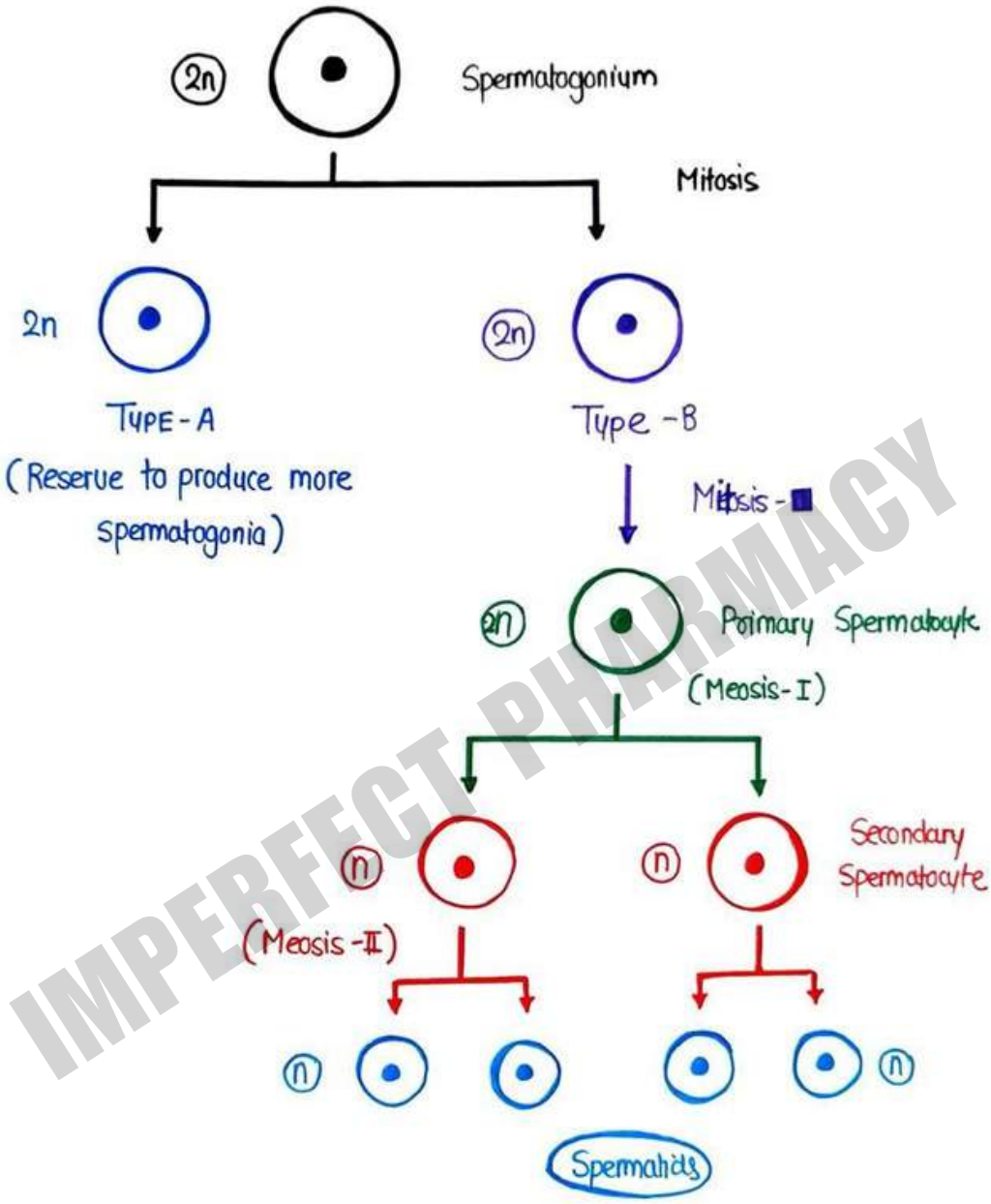
Spermatogenesis takes place in two steps:

① Formation of Spermatid
② Spermiogenesis

Formation Of Spermatid

It further involves 3 phases:

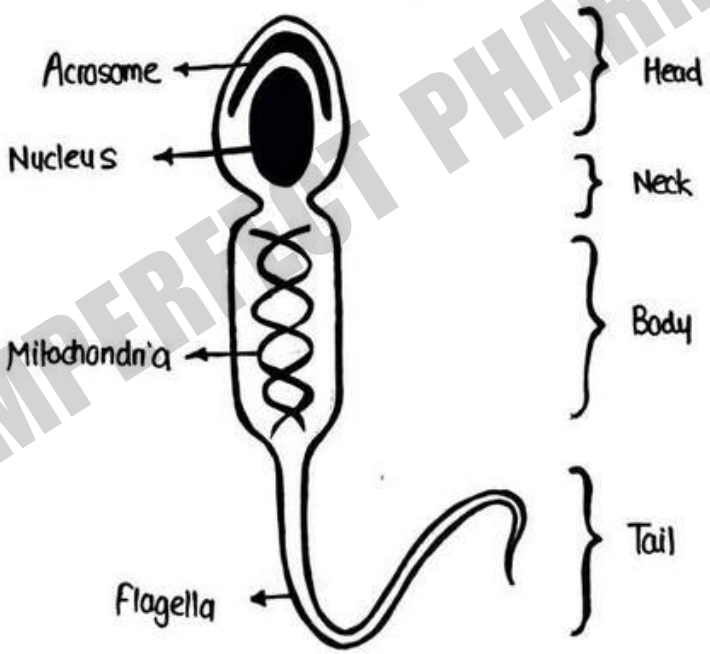
① Multiplication Phase
② Growth Phase
③ Maturation Phase



② Spermiogenesis

- Transformation or differentiation of ~~spermatozoa~~ + spermatid into spermatozoa is known as Spermiogenesis.
- It is the final stage of spermatogenesis.
- Here's a detailed breakdown of spermiogenesis :

- Condensation of Nucleus
- Pointed, Oval, Flat
- Formation of Acrosome
- Loss of Excess Cytoplasm
- Mitochondria becomes spiral
- Maturation & Release



SPERM

OOGENESIS

- Oogenesis is defined as process of formation of female gametes.
- Oogenesis begins in the embryonic stage.
- The process of oogenesis occurs in the follicular cells (Follicles)
- 6-7 weeks – starts oogenesis
- 20 Weeks – 6-7 million follicles
- Birth → About 2 million follides.
- Puberty – 60,000 - 80,000 Primary follides.

Stages Of Oogenesis

It involves following key stages

- Oogenium formation
- Primary Oocyte formation
- Completion of Meiosis - I
- Secondary Oocyte & Meiosis II
- Fertilization & Meiosis II completion

① Oogenium Formation

During fetal development, primordial germ cells migrate to the ovaries & differentiate into oogenia, which are diploid cells.

② Primary Oocyte Formation

- Oogenia enter meiosis & become primary ooctyte. They starts meaisis - I but suspended at prophase - I until puberty.

③ Completion Of Meiosis- I

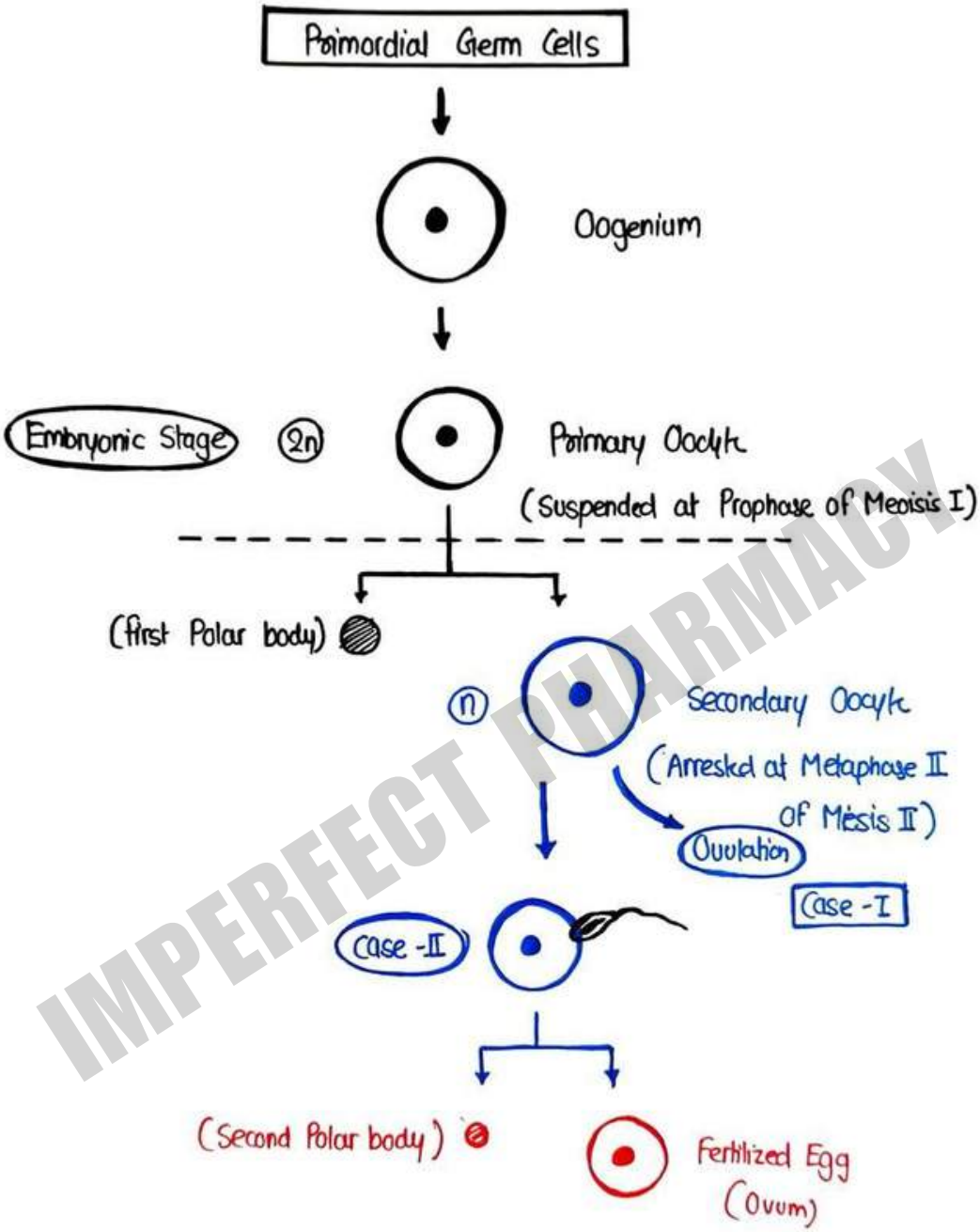
- At puberty, during each menstrual cycle, a primary oocyte resumes meiosis & completes first meiotic division.
- This division produces a secondary oocyte & a first polar body, which typically degenerates

④ Secondary Oocyte & Meiosis -II

- The secondary oocyte begins the second meiotic division but arrests at metaphase -II, it will only complete this division if fertilization occurs.

⑤ Fertilization & Meiosis -II Completion

If fertilization occurs, secondary oocyte completes Meiosis -II yeilding a mature ovum & secondary polar body.



PREGNANCY

- Pregnancy occurs when sperm fertilizes the egg, and zygote is formed.
- The zygote get implanted in the wall of uterus which needs nourishment & care.
- The zygote develops into embryo which further develops into baby.
- After implantation takes place, organ development starts.
- All these steps leads to development of baby & takes about nine month.

Stages Of Pregnancy

- Fertilization of Ovum
- Implantation
- Development of Placenta & Embryo
- Gestation Period
- Parturition

① Fertilization

- Fertilization refers to fusion of male & female gametes (sperm & ovum) to form zygote.
- After sexual intercourse, semen is ejaculated in vagina, the sperms travel through the vagina & uterus to reach Fallopian Tube.

- Movemen of sperm through uterus is facilitated by Antiperistalsis contraction of Uterine muscles.
- Uterine contractions are induced by oxytocin, which is secreted by posterior pituitary.
- Among 200-300 millions of sperm enters into female genital tract, only a few thousands reaches the spot near the ovum. Among these thousand Only 1 succeeds in fertilizing the ovum.
- The penetration of ovum by sperm is facilitated by Hyaluronidase and Proteolytic Enzymes present in acrosome of sperm.
- Immediately after fertilization, ovum (which is in secondary oocyte stage) divides into matured ovum & second polar body.
- The sperm & egg nuclei merge together to form a single diploid nucleus.
- The combination of genetic material from both parents results in the formation of zygote, which then begins to divide & develop into an Embryo.

② Implantation

- Implantation is the process by which the fertilized ovum called Zygote Implants (gets attached) in the endometrial lining of Uterus.
- Zygote takes 3-5 days to reach the Uterine cavity from Fallopian Tube.

③ Development of Placenta & Embryo

- After implantation, a placenta is formed in uterine muscles to support fetal development throughout pregnancy.
- When implantation occurs, there is further increase in the thickness of endometrium because of continuous secretion of Progesterone from Corpus Luteum.
- An Embryo is the early stage of development of a multicellular organism.

④ Gestation Period

- It refers to pregnancy period & measured in weeks.
- A normal pregnancy can range from 38 - 42 weeks.
- Infants born before 37 weeks are considered Premature.

⑤ Parturition

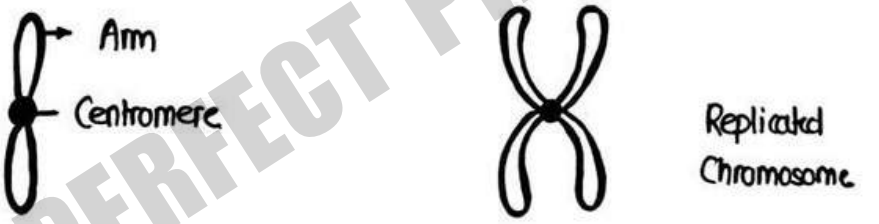
- Parturition is the delivery of Fetus from mother's body.
- It occurs at end of pregnancy.
- The process by which delivery of fetus occurs is called Labor.

CHROMOSOMES

- Chromosomes are thread like structures composed of DNA & Proteins that are found in the nucleus of eukaryotic cells.
- They carry genetic information necessary for growth, development & functioning of all living organism.

Structure

- Chromosomes primarily composed of Deoxyribonucleic Acid (DNA) which contains genetic blueprint of an organism.
- Along with DNA, DNA contains Histone proteins that helps in organizing and compacting DNA into more manageble structure.



Number

Except reproductive cells (sperm & ovum) all the human cells have 46 chromosomes arranged in 23 pairs, including 22 pair of Autosomes and 1 pair of sex chromosomes.

Types Of Chromosomes

There are mainly two types of chromosomes :

① Autosomes
② Sex chromosomes

① Autosomes

- These are chromosomes that are not involved in determining the sex of an organism ,
- Humans have 22 pair of autosomes

② Sex Chromosomes

- These chromosomes determines the sex of an individual
- Females - XX
- Males - XY

Functions Of Chromosomes

- Chromosomes carry genes , the units of heredity that encode specific proteins .
- During cell division , chromosomes ensures that DNA is accurately copied & distributed to daughter cells .

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