!! JAY AMBE !!

8. THE REPRODUCTIVE SYSTEM

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THE REPRODUCTIVE SYSTEM

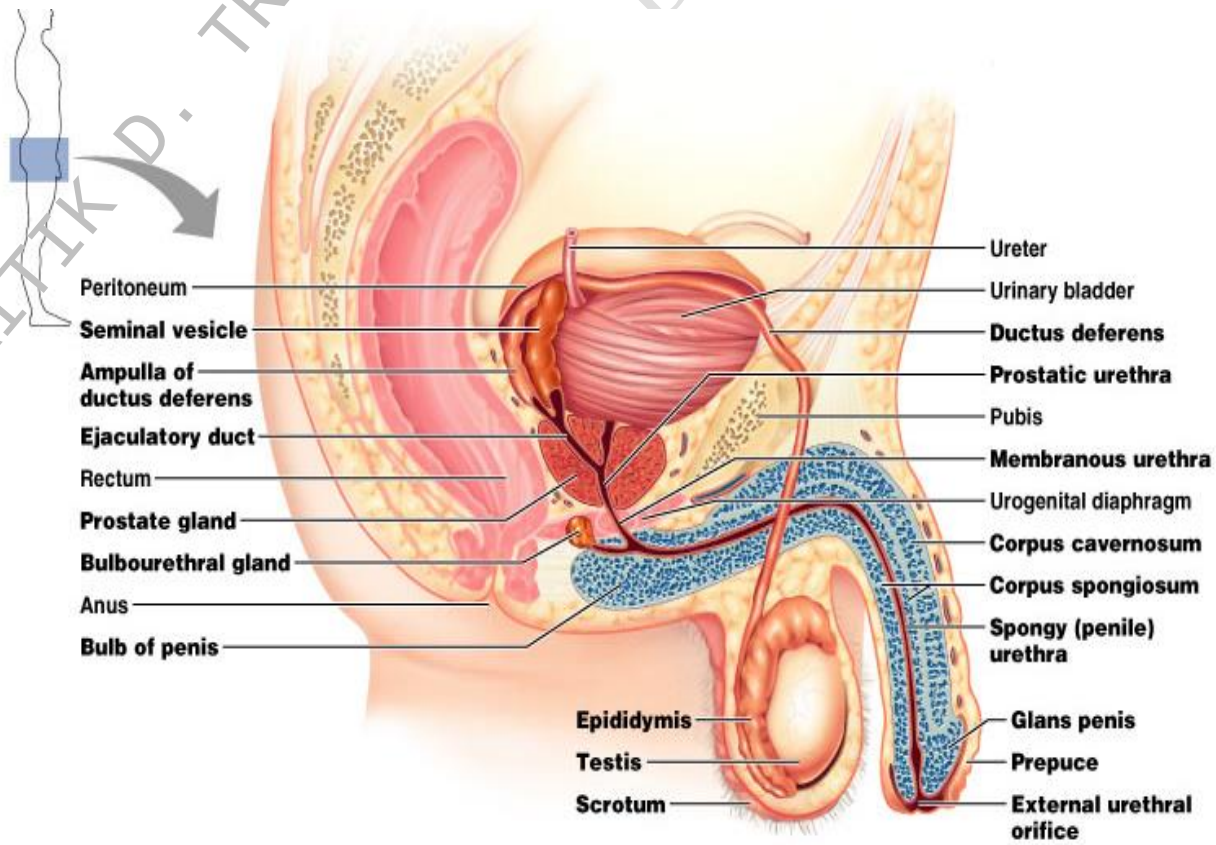
The **reproductive system** or **genital system** is a system of organs within an organism which work together for the purpose of reproduction.

Reproduction is the process by which new individuals of species are produced via which genetic material pass from generation to generation.

According to function, the male and female reproductive organ grouped as under

1. **Gonads (Seeds):** it includes testes and ovaries, the main function of testes are production of gametes and secretion of hormones.
   Male gametes known as sperm
   Female gametes known as oocytes
2. **The ducts:** It transport and store the gametes.
3. **Accessory sec gland:** It produces materials that support gametes.
4. **Supporting Structures:** It includes penis that have important role in reproduction.

MALE REPRODUCTIVE SYSTEM:



8. THE REPRODUCTIVE SYSTEM

External Structures

- **Penis:** External male sex organ

  - **Uncircumcised:** Foreskin not removed
  - **Circumcised:** Removes some or all of foreskin

- **Scrotum:** Sac of skin and muscle containing testicles

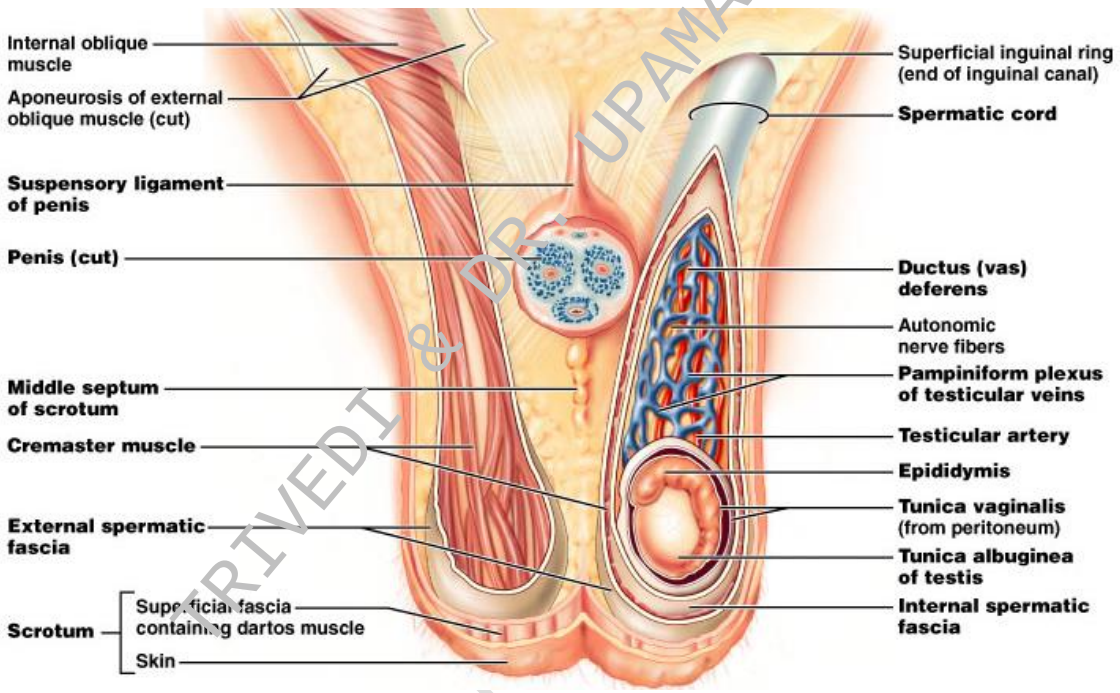
Internal Structures

- **Prostate:** Exocrine gland of male reproductive system
- **Vas Deferens:** Tubes connecting epididymis to ejaculatory ducts
- **Epididymis:** Organ where sperm matures
- **Testicles:** Organ where sperm is created
- **Urethra:** Tube that connects bladder to outside of body

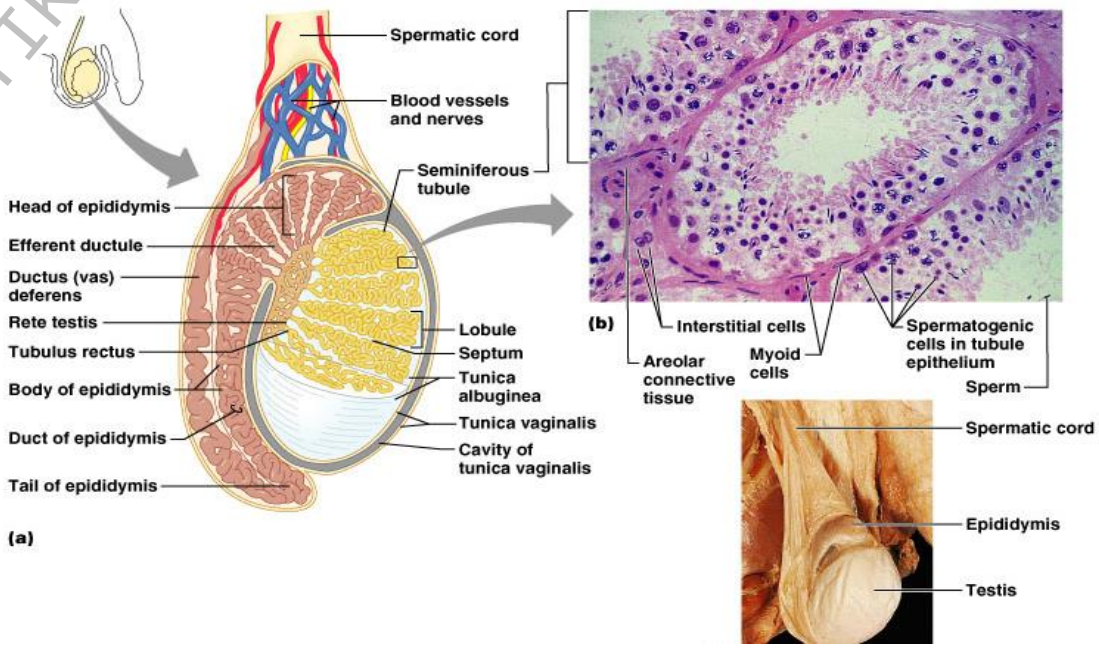
1. Scrotum:

- Scrotum is a sac that hangs from the root of the penis and consists of loose skin and super fasia.
- It is a supportive structure of the penis.
- Internally scrotum consist vertical septum which divide it in to the two sacs.
- Each sec consist a single testes.
- Septum is covered by superficial fascia and muscle tissue known as dartos which consist smooth muscles fibers.
- When dartos muscle contracts it produce wrinkle in the skin of scrotum.
- The location of the scrotum and contraction of its muscle fiber regulate the temperature of testes.

- Both production and survival of sperm required a temperature that is about 3°C lower than the normal body temperature.
- The cremaster muscles is a small band of skeletal muscle present in to the spermatic cord, during the cold and sexual arousal it elevate the testes and this action moves the testes near to the pelvic cavity where they can absorb the heat.



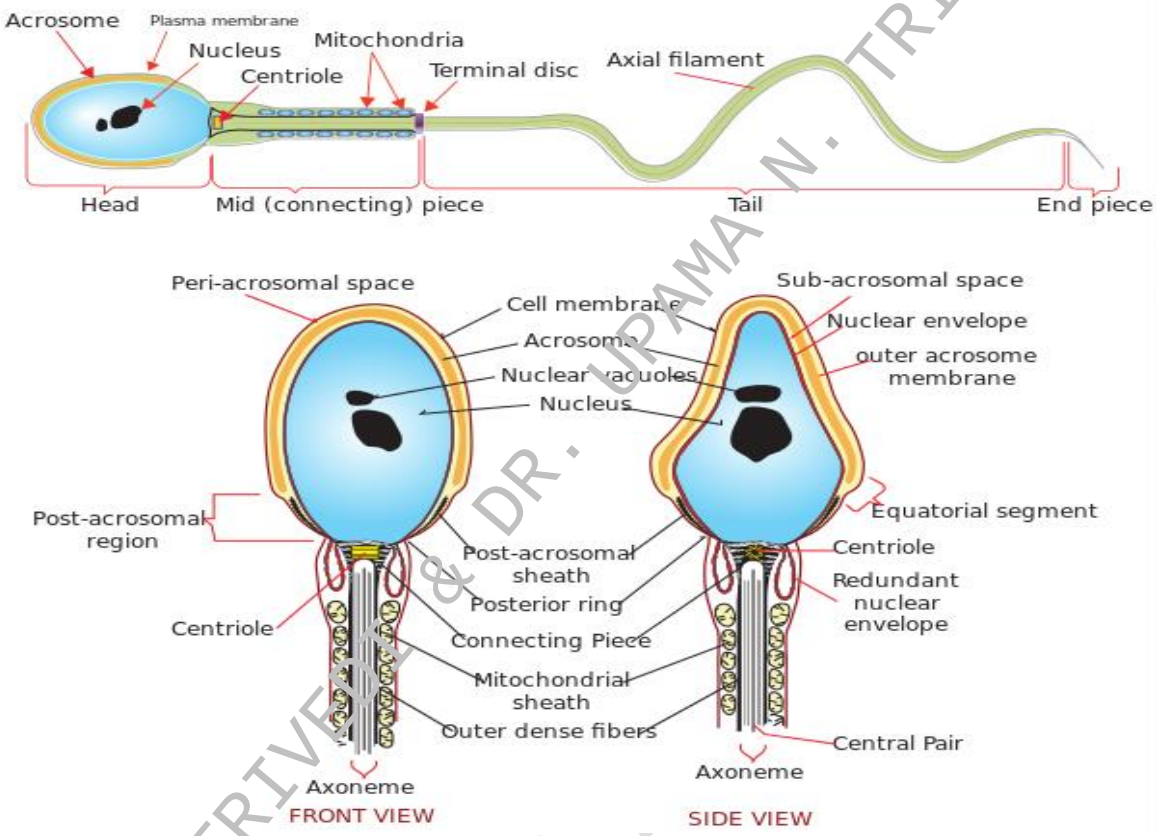
2. Testes:



- Testes are formed in abdomen and descend into scrotum at 7th month of development.
- The testes are paired oval glands.
- It is 5 cm length, 2.5 cm in diameter and 10-15 grams of weight of each testis.
- The outer covering of testes is known as tunica vaginalis made up from serous membrane.
- Internal to the tunica vaginalis dense white fibrous capsule known as tunica albuginea.
- Inside extending portion of the tunica albuginea produce lobules. There are 200 – 300 lobules present in each testis.
- Each lobule consist one to three tightly coiled tubules known as semniferous tubules.
- Seminiferous tubule consist spermatogenic cell is taking part in the production of sperm cell, the process is known as spermatogenesis.
- There many sustentacular cells lie between the spermatogenic cell which produce the tight junction known as blood testes barrier.
- These barriers prevent the activation of immune system against the sperm because spermatogenic cell (sperm) consist surface antigen that are recognize as foreign particle by the immune system.
- The sustentacular cells also secret the fluid for the sperm transport as well as it secret the hormone inhibin which regulate the sperm production by inhibiting the secretion of FSH.

3. Sperm:

- The mammalian sperm cell consists of a head, a midpiece and a tail. The head contains the nucleus with densely coiled chromatin fibres, surrounded anteriorly by an acrosome, which contains enzymes (hyaluronidase and proteinases) used for penetrating the female egg.
- The midpiece has a central filamentous core with many mitochondria spiralled around it, used for ATP production for the journey through the female cervix, uterus and uterine tubes.
- The tail or "flagellum" executes the lashing movements that propel the spermatocyte.
- Human sperm cells can survive within the female reproductive tract for more than 5 days post coitus. Semen is produced in the seminal vesicles, prostate gland and urethral glands.
- Sperm mature at the rate of about 300 million per day.



4. Ducts:

A. Ducts of testis:

- After the production of sperm from the somniferous tubules, release in to the lumen and goes in to straight tubules.
- Newly forming fluid produce by the sustentacular (sertoli) cells produce pressure that moves the sperm ahead.
- These fluids contain potassium ions (K^+), glutamic acid and antigen binding protein (ABP).
- From the straight tubules, fluid moves with sperm in to rate testis, which leads toward an epididymis.
- Epididymis is a comma shaped organ about 4 cm long.
- Next to epididymis is ductus epididymis (Sperm get mature here in 10 – 14 days) is a straight coiled structure 6 m in length continue with the tail epididymis.
- Within the tail of the epididymis, the ductus epididymis becomes less convoluted and its diameter increases. After this point, the duct is referred to as the ductus deference, vas deference or seminal duct.
- The ductus deference (vas deference) or seminal duct is 48 cm long, it store sperm. The dilated terminal portion of this vas deference is known as the ampulla.

B. Ejaculatory ducts:

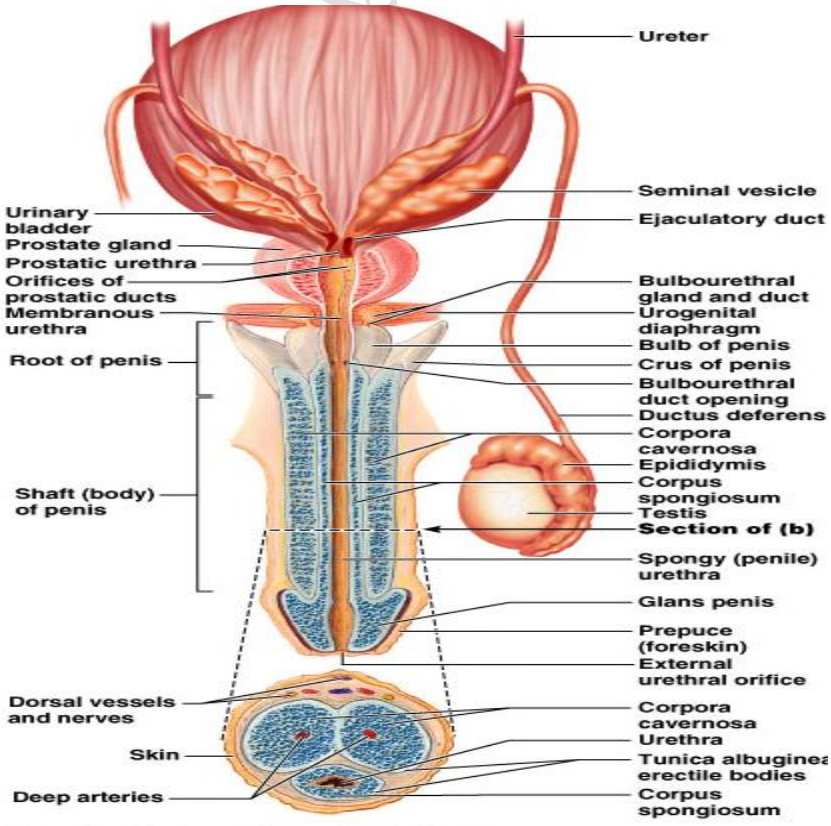
- Posterior to the urinary bladder are the ejaculatory ducts.
- Each ejaculatory duct is about 2 cm long and is formed by the union of the seminal vesicle and the ampulla.
- The ejaculatory duct ejects the sperm in to the urethra just before ejaculation.

C. Urethra:

- In the male, Urethra is the shared terminal duct of the reproductive and urinary systems.
- It serves as a passageway for both semen and urine.
- The urethra passes through the prostate gland, the urogenital diaphragm and the penis.
- Its measure about 20 cm in length, divided in to three parts:
  - **The prostate urethra:** 2 – 3 cm long, passage from prostate gland.
  - **The membranous urethra:** 1 cm in length
  - **Spongy urethra:** 15-20 cm long.
- Spongy urethral end consist external urethral orifice.

5. Accessory sex gland:

The ducts of male reproductive system store and transport sperm cells while the accessory sex gland secret most of the liquid portion of semen.



A. The paired seminal vesicles:

- It is a convoluted pouch like structure, about 5 cm in length and lying posterior to the urinary bladder and anterior to the rectum.
- It secrete:
  - An alkaline,
  - Viscous fluid that contains fructose, prostaglandins and clotting protein (semenogelin) (differ than the blood clotting protein).
- The alkaline nature of the fluid neutralizes the acid in the female reproductive tract.
- The fructose is used for ATP production by sperm.
- Prostaglandin is useful for the sperm motility and viability also stimulate the muscular contraction in the female reproductive system.
- Seminogelin is the protein that causes the coagulation of semen after ejaculation.
- Seminal vesicle adds 60 % of fluid of the total volume of semen.

B. The prostate gland:

- It is a doughnut shaped gland.
- It is inferior to the urinary bladder and surrounds the prostate urethra.
- The prostate secrete milky and slightly acidic fluid which contains:
  - Citrate: Useful for the ATP production by the sperm.
  - Acid phosphate: Functions are not known
  - Proteolytic enzymes like Prostate specific antigen (PSA) – liquefy the coagulated semen, pepsinogen, lysozyme, amylase and hyaluronidase.
- The secretion of the prostate gland enters the prostatic urethra through many prostatic ducts.
- The secretion of the prostate gland adds 25 % of fluid out of total volume of semen.

C: The bulbourethral or Cowper's gland:

- It is about the size of pea and It lie inferior to the prostate gland.
- During sexual arousal, bulbourethral gland secrete alkaline substance that protect sperm by neutralizing acid in the urethra.
- It also secretes mucus that lubricates the end of penis and the lining of urethra.

6. Semen:

- Semen is the mixture of sperm and seminal fluid.
- The average volume of semen in each ejaculation is 2.5 – 5 mL.
- There are 50 – 150 million sperm present per milliliter (mL).
- When the sperm fall below the 20 million/mL, the male is likely to be infertile.
- The pH of semen is in the range of 7.2 – 7.7.

7. Penis:

- The penis contains the urethra, a passage for ejaculation of semen and for excretion of urine.
- It is cylindrical in shape and consist body, root and gland penis.
- the consensus is that the average erect human penis is approximately 12.9–15 cm (5.1–5.9 in) in length with 95% of adult males falling within the interval 10.7–19.1 cm (4.2–7.5 in). Neither age nor size of the flaccid penis accurately predicts erectile length.
- The longest officially documented human penis was found by Doctor Robert Latou Dickinson. It was 34.3 cm (13.5 in) long and 15.9 cm (6.26 in) around.

A. Body of penis:

- It is composed by the three cylindrical masses of tissue:
  - — Tunica albuginea
  - — Corpora cavernosa penis (Paired dorsolateral masses)
- Tunica albuginea consist corpus spongy penis at the middle part and spongy urethra.
- All the three masses are covered by the facia and skin with the erectile tissue permeated by blood sinuses.
- During the sexual stimulation, which may be:
  - — Visual,
  - — Tactile,
  - — Auditory,
  - — Olfactory,
  - — Or Imagination large quantities of blood enter in to the penis due to the dilation of arteries (effect of nitric oxide).
- These vascular effects produce erection in penis.
- Ejaculation is the sympathetic reflex. As a part of reflex the smooth muscle spincter at the base of urinary bladder close.
- Thus urine is not expelled during ejaculation.

B. Root of penis:

- It is the attached part, consisting of the bulb of penis in the middle and the crus of penis, one on either side of the bulb. It lies within the superficial perineal pouch.

C. Gland penis:

- The distal end of the corpus spongiosum penis is slightly enlarged, acorn shaped region known as gland penis.
- The margin of gland penis is known as corona.
- Gland penis consist the external urethral orifice.

THE FEMALE REPRODUCTIVE SYSTEM:

The female reproductive system include

A. Internal genitalia:

— 2 ovaries

— 2 oviducts (uterine or Fallopian tubes)

— Uterus

— vagina

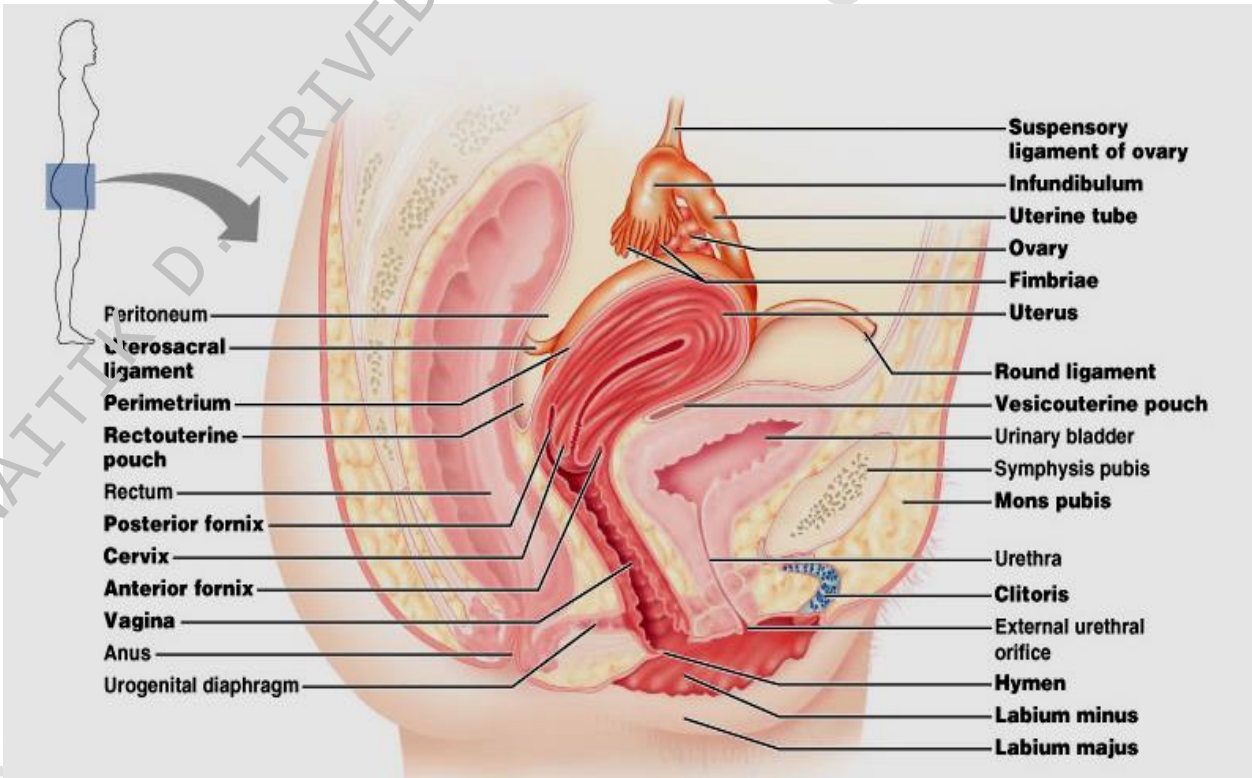
B. External genitalia

— clitoris

— labia minora

— labia majora

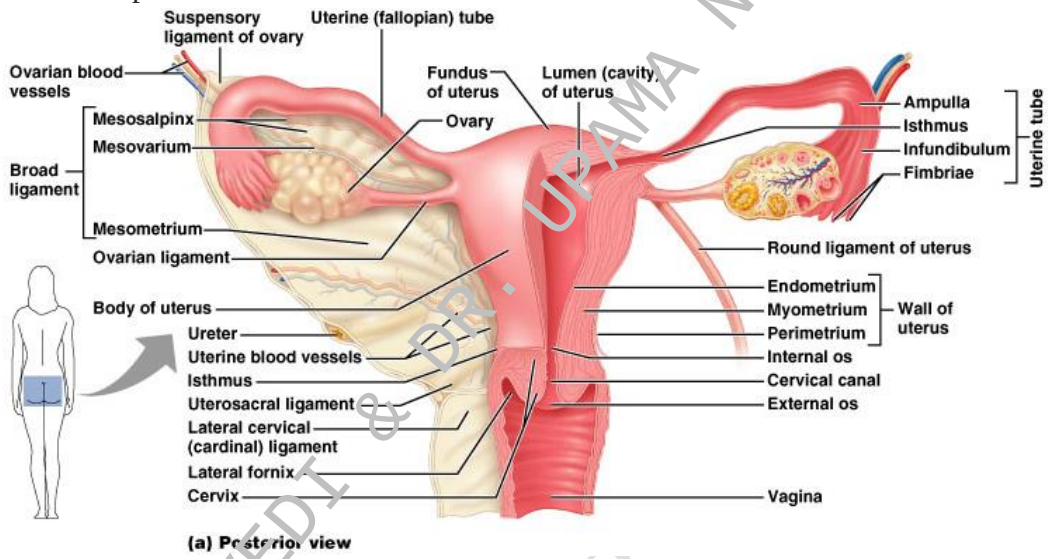
C. Breasts and mammary glands



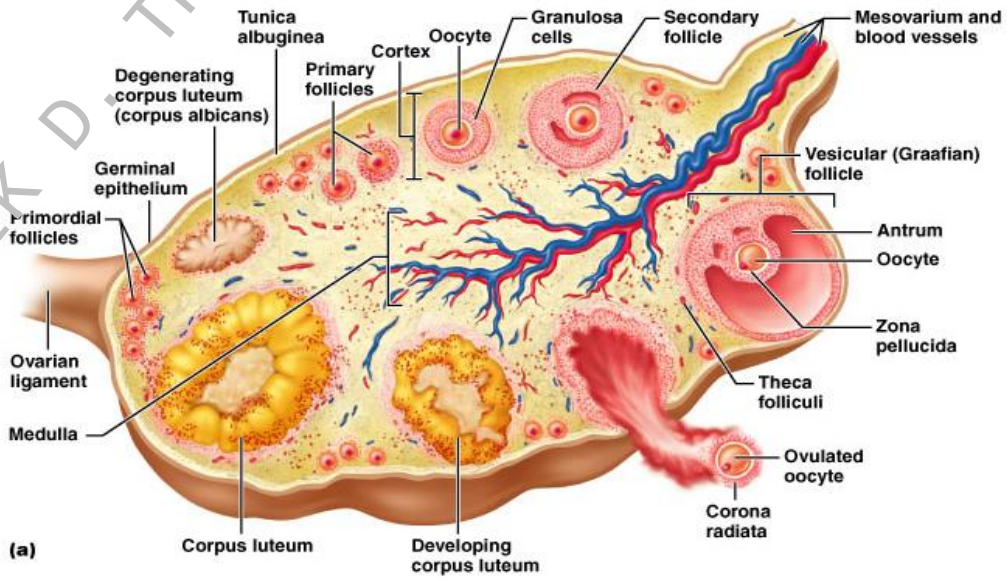
1. Ovaries:

- The paired ovaries are paired glands that resemble unshelled almonds in shape and size.
- Because of the same origins ovaries are homologues to testis.

- The broad ligament of uterus, which is the part of partial peritoneum attaché to ovaries by double layer fold of peritoneum known as mesovarium.
- The ovarian ligament anchors the ovaries to uterus and the suspensory ligament attach them to the pelvic wall.



A. Structure of ovary:



i) Germinal epithelium:

— It covers the surface of the ovary and it continues with the mesothelium that cover the mesovarium.

ii) Tunica albuginea:

— It is a whitish capsule of dense irregular connective tissue extended deep to germinal epithelium.

iii) Stoma:

— Deep to the tunica albuginea known as stroma.

— It divided in to the two portions, superficial portion known as cortex and deep portion known as medulla.

iv) Ovarian follicle:

— It is lie in to the cortex region of stoma.

— Here the oocytes pass from the various steps of their development with their surrounding cells.

— The surrounding cells produce single layer known as follicular cells.

— Later in developing stage of oocyte, it produces several layers known as granulose.

— These surrounding cells secret estrogen and other fluid so follicle grow larger.

v) Mature (Graafian) follicle:

— It is a large fluid filled follicle after the rupturation of this follicle secondary oocyte get expel out.

vi) Corpus luteum:

— It is the remnant of an ovulated mature follicle.

B. The Ovarian Cycle

i) Follicular phase

— 1st approx 14 days but variable
— Egg develops in a follicle
— Stimulated by **FSH**
— Estrogen produced

ii) Ovulation

— Egg released from follicle (**LH** surge)
— Egg in abdominal cavity
— Picked up by fimbria of fallopian tube
— Not necessarily halfway point

iii) Luteal phase

- Postovulatory phase 14 days (more constant)
- Corpus luteum develops from exploded follicle
- Produces progesterone as well as estrogen
- Progesterone stimulates uterus to be ready for baby
- If no pregnancy, corpus luteum degenerates into corpus albicans

2. Uterine (Fallopian) Tubes:

- Female have two fallopian tubes. It stretches from the uterus to the ovaries and measure about 8 to 13 cm in length. It transport the secondary oocytes to the uterus.
- The open, funnel shaped portion of each tube is known as infundibulum, close to the ovary.
- At the end portion of infundibulum has finger like projection known as fimbria, which hold the ovary.
- Widest and longest portion of the uterine tube is known as ampulla and short, narrow, thick walled portion known as isthmus that join the uterus.

3. Uterus:

- The uterus is located inside the pelvis immediately dorsal (and usually somewhat rostral) to the urinary bladder and ventral to the rectum.
- The human uterus is pear-shaped and about 3 in. (7.6 cm) long, 4.5 cm broad (side to side) and 3.0 cm thick (anteroposterior).
- A nonpregnant adult uterus weighs about 60 grams.
- Layers of the uterus:

  Perimetrium: it is the outer layer of the uterus.

  Myometrium: It is the middle layer of the uterus.

  Endometrium: The lining of the uterine cavity is called the "endometrium".

- Parts of uterus:

  Fundus: The dome shaped portion superior to the uterine tube known as fundus.

  Body: The major tapering central portion is known as body.

  Cervix: The inferior narrow portion opens in to the vagina known as cervix

4. Vagina:

- Vagina is the passage for the menstrual flow and child birth.
- It also receives semen from the penis during the sexual intercourse.
- It is 10 cm in length, situated between the urinary bladder and the rectum.
- The vaginal mucosa secret the acidic fluid as well as the mucosal cells of vagina has the antigen presenting cells (APCs) from where the HIV (AIDS) virus gets transmitted.
- The next layer is muscularis is composed of an outer circular layer and inner longitudinal layer of smooth muscle that can stretch considerably to receive the penis during sexual intercourse and allow for birth of a fetus.
- The adventitia is the superficial layer of the vagina.
- At the end of vagina there is vaginal orifice covered by the mucosal membrane known as hymen.
- Sometimes the hymen completely covers the orifice, a condition known as imperforated hymen, which may require surgery to open the orifice and permit the discharge of the menstrual flow.

5. Vulva:

It is known as the external genital organ of the female reproductive system.

i) Mons pubis:

Anterior to the vaginal and urethral opening portion is known as mons pubis. It is an elevation of adipose tissue covered by the skin and hair.

ii) Labia majora:

From the mons pubis, two longitudinal folds of skin known as labia majora. It is homologues to the scrotum and are covered by the pubic hair.

iii) Labia minora:

Middle to the labia majora is to smaller folds of skin called the labia minora. But it not consist the hair and fat. They have few sudoriferous (sweat) glands and sebaceous (oil) gland.

iv) Clitoris:

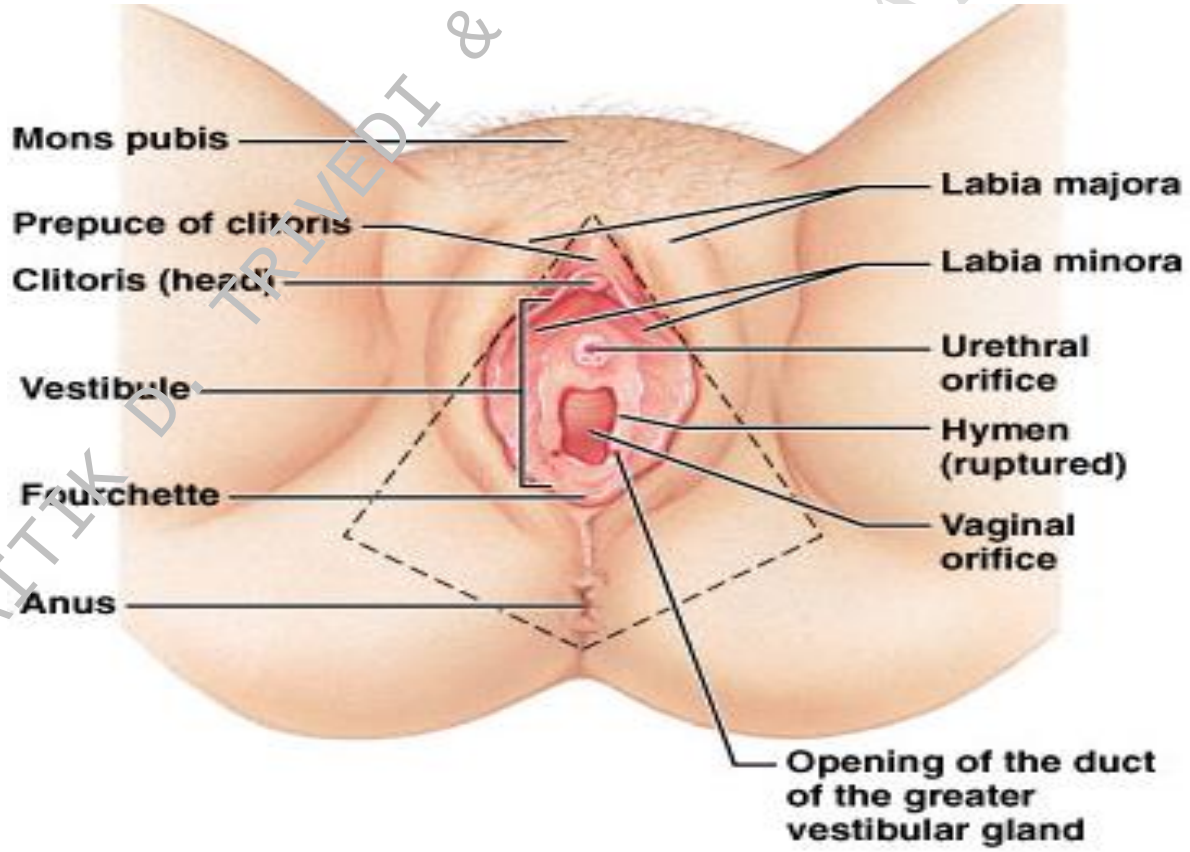
It is the small, cylindrical mass of erectile tissue and nerve. It is located at the anterior junction of the labia minora. It is homologues to the penis and capable of enlargement upon tactile stimulation and it play important role in sexual excitement of the female.

v) Vestibules:

The region between labia minora is known as the vestibules. Hymen, Vaginal orifice, external vaginal orifice are located between the vestibules. The bulb of the vestibules consists of two elongated masses of erectile tissue, during the sexual intercourse it narrowing the vaginal orifice and placing pressure on the penis. Anterior to the vaginal orifice and posterior to the clitoris is the external urethral orifice.

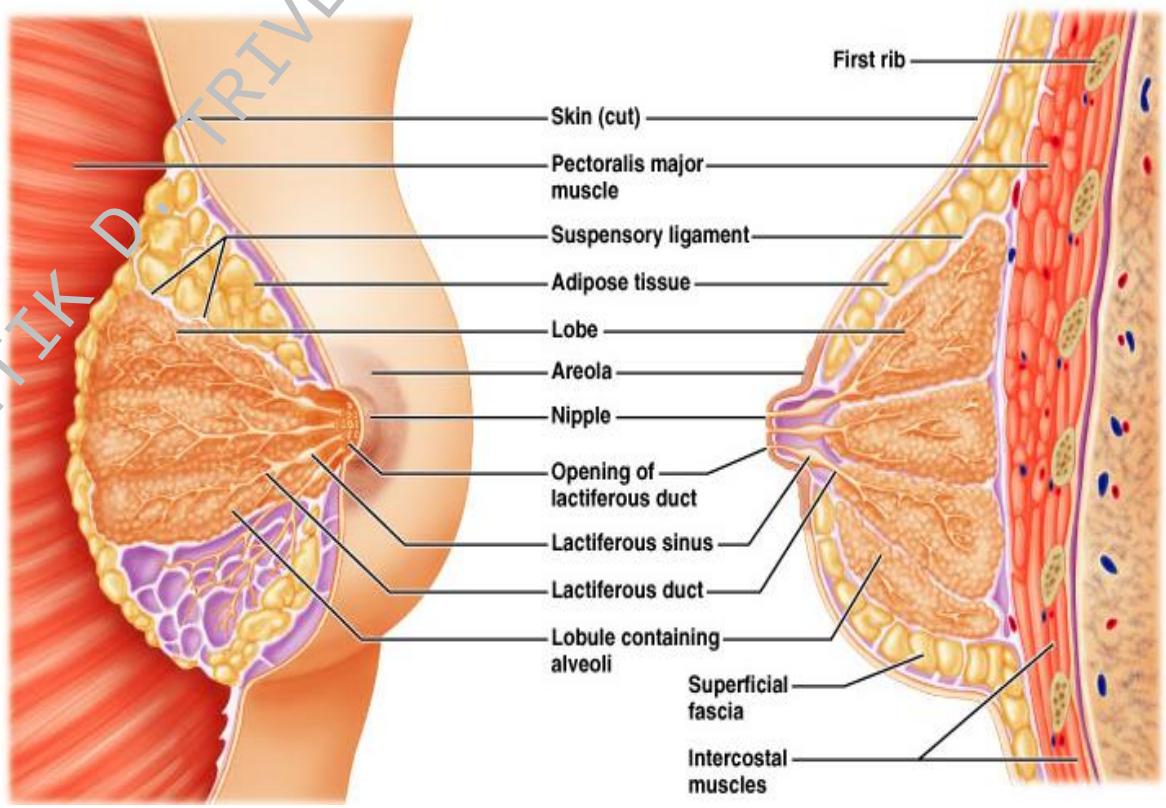
vi) Perineum:

It is the diamond shaped area medial to the thigh and buttocks of both males and females. That contains the external genital and anus.



6. Mammary glands:

- Mammary gland is an organ in female mammals that produces milk to feed baby located in to the breast.
- Each breast has one pigmented projection known as nipple, it have closely spaced opening known as lactiferous ducts from where milk emerges.
- The circular pigmented area of the skin surrounding the nipple known as areola. It appears rough because it contains modified sebaceous (oil) glands.
- Within each breast the memory glands consist 15 – 20 lobes separated by adipose tissue.
- Each lobe have smaller compartment known as lobules composed of grapelike clusters of milk secreting glands known as alveoli.
- Surrounding the alveoli are spindle shaped cells known as myoepithelial cells, whose contraction helps to propel milk towards the nipple.
- Milk path: alveoli – secondary tubules – mammary ducts – lactiferous sinus – lactiferous duct.
- Milk secretion is stimulated by the hormone prolactin as well as with the contribution of estrogen and progesterone.



MENSTRUAL CYCLE:

- The duration of the female reproductive cycle is 24 – 35 days.
- Menstrual cycle is divided in to three phases:
  i) Menstrual Phase ii) Preovulatory Phase iii) Postovulatory Phase

i) Menstrual Phase:

This phase is also known as menstruation or menses phase, takes first 5 days of the cycle.

a) Events in the ovaries:
   — During the menstruation phase, about 20 so small secondary follicles try to being enlarge.
   — In this phase, follicular fluid secret from the granulose cells and oozing from blood capillaries and oocyte remain near the edge of the follicle.

b) Event in the uterus:
   — In this phase, decrease the hormone level of estrogen and progesterone. Because of this reason, produce contraction of uterine spiral arteries.
   — So the blood supply of the Endometrium cell gets interrupt and start to die. It start the menstruation flow consists about the volume of 50 – 150 ml of blood, tissue fluid, mucus and epithelial cells derived from the Endometrium.

ii) Preovulatory Phase:

It is the second phase of the female reproductive cycle. It is the phase between the menstruation and ovulation phase.

If we consider 28 days menstrual cycle, it takes 6 to 13 days of period.

a) Events in the ovaries:
   — In this phase, the secretion of FSH produces effects on 20 secondary follicle and its grow secret estrogen and inhibin.
   — Out of 20 secondary follicles, one follicle in one ovary has outgrown all others so it is known as the dominant follicle.
   — Estrogen and inhibin secretion by the dominant follicle cell decrease the secretion of FSH and this effect stop the development of other follicle cells.
   — Dominant follicle cell produce the mature follicle about the size of 20 mm in diameter and ready for the ovulation.
   — In this phase the secretion of LH also increase the secretion of estrogen and start the secretion of progesterone also.

b) Events in the uterus:
   — In this phase, estrogen liberate in to the blood by growing ovarian follicle cell.

— It stimulates the repair of endometrium damage. It produces the neovascularization, cell proliferation and differentiation so increase the thickness of endometrium, this phase is also known as the proliferative phase.

Ovulation:

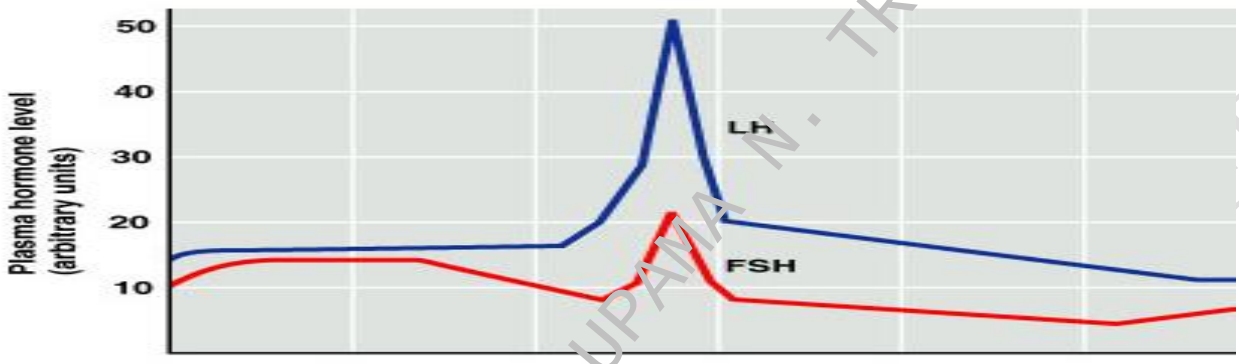
— In this phase, the mature follicle cell gets rupture and releases the secondary oocyte in to the pelvic cavity, usually occur in the day 14 of 28 dyas cycle.
— It generally takes 20 days (last 6 days of the previous cycle and first 14 days of the current cycle).
— During this phase, primary oocyte complete the meiosis – I and enter in to the meiosis – II.

iii) Post ovulation phase:

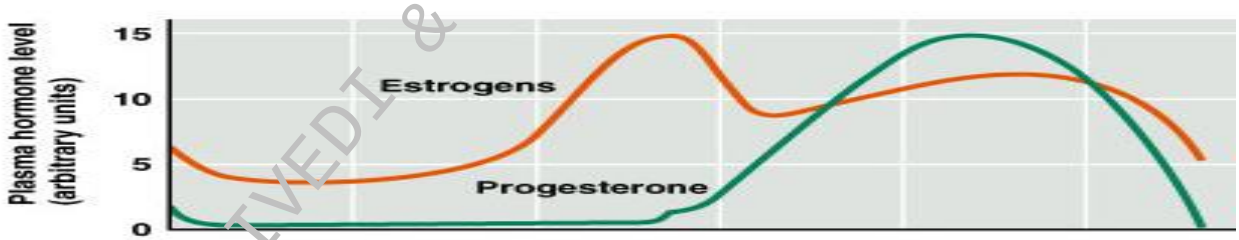
It takes last 14 days, from days 15 to 28. It represent the time between ovulation and the onset of the next menses. Corpus luteum formed in this phase and it increases the secretion of estrogen and progesterone.

a) Events in the ovary:
— In this phase if the secondary oocyte get fertilize and begins to divide, the corpus luteum persists past its normal 2 week life span and it is maintained by the human chronic gonadotropin (hCG).
— This hormone is produce by the chorion of the embryo after 8 – 12 days of fertilization.
— The hCG level in to the blood or urine confirm the pregnancy.
— If the hCG will not release (because of no fertilization) than corpus letuem decrease their secretion and produce scar known as corpus albican.
— Decrease level of estrogen and progesterone again start the menstruation.

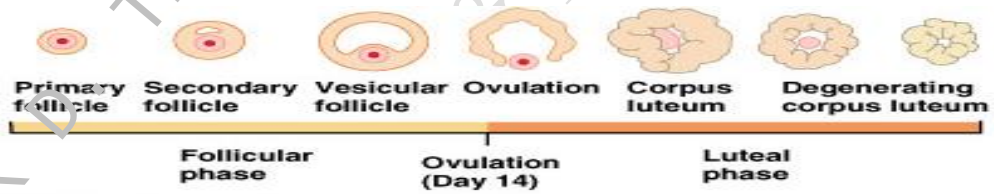
b) Event in the uterus:
— Progesterone and estrogen secretion produce by the corpus luteum promote the growth and coiling of the endometrium gland, which begins to secret glycogen, vascularization of the superficial endometrium, thickening of the endometrium and increase the amount of tissue fluid.



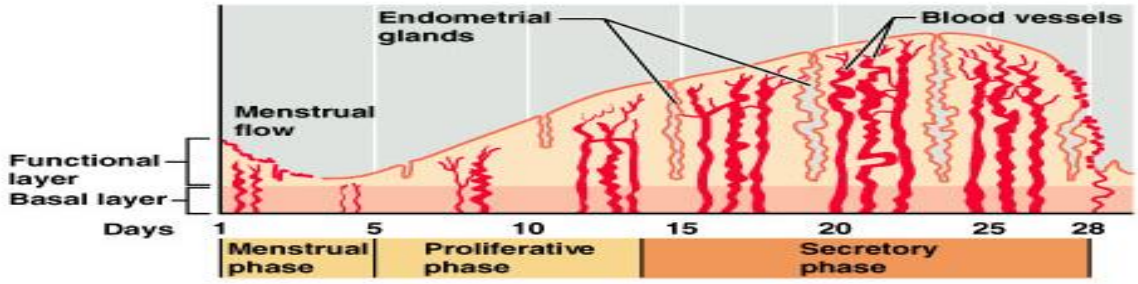
(a) Fluctuation of gonadotropin levels



(b) Fluctuation of ovarian hormone levels



(c) Ovarian cycle

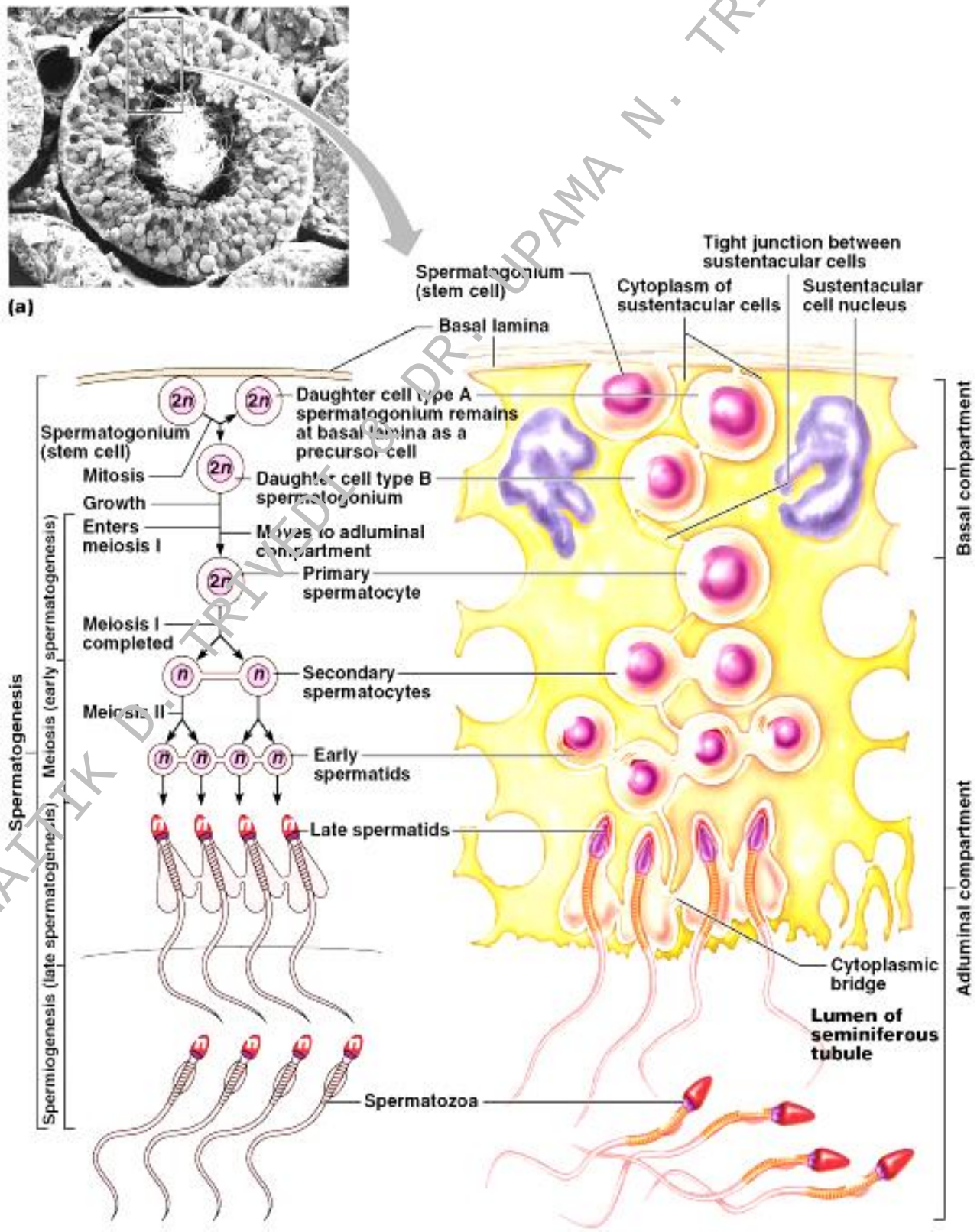


(d) Uterine cycle

SPERMATOGENESIS:

- At the age of puberty in male spermatogenesis process starts and it will continue till old age.
- Spermatogenesis process start in seminiferous tubules of male testis.
- In the wall of seminiferous tubules numerous germinal epithelial cells are situated which is known as spermatogonia,
- In the first step of spermatogenesis, the spermatogonia cell undergo mitosis and produce primary spermatocyte cells which contain 46 chromosomes (2n or diploid). Out of these 44 are autosomes and 2 are sex chromosomes, these are known as daughter cells A (remains a stem cell) or daughter B (undergone further division).
- In the second step Primary Spermatocytes (Daughter Cell B) by meiosis I generate two secondary spermatocytes, each one of them contain 23 chromosomes (haploid, n) in which 22 are autosomes and one is sex chromosomes.
- Next in meiosis II chromosomes line up and chromatids of each chromosomes separates and produce four haploid (n) cells known as spermatids.
- In the final stage of development spermatid develops into sperms.

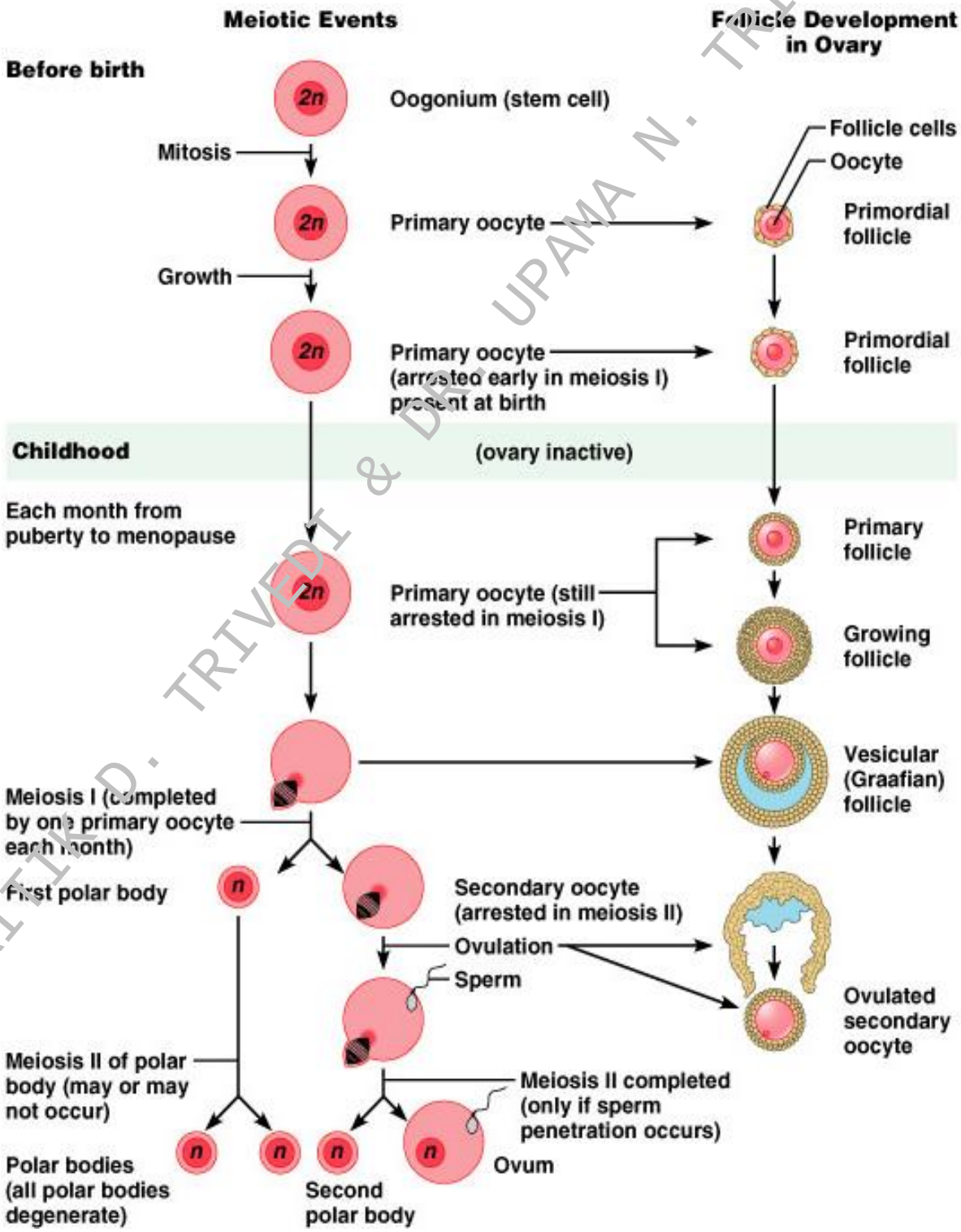
Note: At the age of puberty Leyding Cells or interstitial which are lying between seminiferous tubules cells secret testosterone hormone which is responsible for the male characteristics.



PROCESS OF SPERMATOGENESIS

OOGENESIS:

- Formation of female gametes (eggs) in the overies is called oogenesis.
- Oogenesis process starts in fetal period (embryonic development) at about 6-7 weeks of fetal development.
- The primordial germ cell undergo mitosis (differentiation) process and produce anout 6-7 million of oogonia at 20th week of fetal development in the mother uterus.
- Some of the oogonia cells degenerate at the time of fetal development and this process is known as atresia.
- Due to this effect at the time of girl child birth about 2 millions of oogonia cells are available in each ovary.
- During the embryonic development of girl child some of oogonia cells developed into larger cells and these cells are known as primary oocytes.
- In, oogenesis process Meiosis – I start during the fetal development but further process get arrest until puberty.
- At the age of puberty 60000 to 80000 primary oocytes are available in the each ovary.
- Out of these number of primary oocytes only 400 primary oocytes get chance to enter into the menstrual cycle during the reproductive life of female. (12-14 years to 46-52 Years period, each month 1 menstrual cycle – near about 380 to 400 menstrual cycle throughout life).
- At the age of puberty, each primary oocyte is surrounded by a single layer of follicular cell and this structure is known as primordial follicle.
- In the first maturation phase primary oocytes divide into two unequal haploid daughter cells by meiotic division.
- The large cell known as secondary oocytes and smaller cell known as first polar body.
- In, second maturation phase secondary oocytes again divide into two unequal haploid daughter cells following the meiosis – II.
- During this process if sperm can enter into the secondary oocytes then it complete the meiosis – II process and produce zygote (fertile cell) and it moves toward the uterus for implantation.
- If sperm cannot penetrate into the secondary oocytes then without completion of meiosis – II process secondary oocyte leave the uterus with menstrual flow.



PROCESS OF OOGENESIS

PREGNANCY AND PARTURATION:

Pregnancy:

- Sperm and secondary oocytes combine together form zygot.
- In this phase if the secondary oocyte get fertilize and begins to divide, the corpus luteum persists past its normal 2 week life span and it is maintained by the human chronic gonadotropin (hCG).
- This hormone is produce by the chorion of the embryo after 8 – 12 days of fertilization.
- The hCG level in to the blood or urine confirm the pregnancy.
- If the hCG will not release (because of no fertilization) than corpus letuem decrease their secretion and produce scar known as corpus albican.
- In pregnancy, estrogen from ovarian follicle, progesterone from corpus luteum and human chronic gonadotropin (hCG) produce by fertilized ovum embedded in uterine wall play important role.

i. Estrogen:
   - It develop secondary sexual characteristics like breast development, voice change at puberty in female.
   - It thicken the uterine lining during proliferative phase of menstrual cycle.
   - It activate anterier pitutary gland for the secretion of FSH and LH in the first half of cycle.

ii. Progesterone:
   - It stimulate the neovascularization and thicken the uterin wall.

iii. Human chronic gonadotropin (hCG):
   - Act on corpus luteum and stimulate secretion of progesterone and estrogen for first 6 to 8 weeks of pregnancy.

Pregnancy of women is generally takes 38-40 weeks of period for full development of baby. It is divided in to three trimester each of consist 12 weeks.

i. First Trimester: (1 to 12 weeks)

- The first trimester is the earliest phase of pregnancy. Missing or stoppage of the menstrual period is the first sign of pregnancy.
- The significant hormonal level changes are observed in the beginning of pregnancy.

- It starts on the first day of your last period, before you are even actually pregnant and lasts until the end of the 12th week.
- Breast tenderness. Sore breasts are one of the earliest signs of pregnancy.
- During pregnancy, high levels of the hormone progesterone slow down the muscle contractions and adding extra iron and vitamin for development of baby leads constipation and gas that can keep you feeling bloated throughout the pregnancy.
- Mood swing, headache, craving or distaste for certain foods are the common sign of pregnancy.
- At the 4th week of embryonic development brain, spinal cord and heart being to form and arms and legs appearance process starts but not fully visible. In this stage the size of embryo is near about half inch.
- At 8th week the arm and leg grow longer and other external body structure being to start development. Sex organ formation process arises in this stage but you cannot identify the gender in this stage. Eye spot appear on the face.
- At 10th week beating of heart is observed by the ultrasonography. Baby grow near about 1 inch in this stage.
- At 12th week muscle and nerve coordination and movement develops. As well as male and female external sex organ are clearly differentiated by ultrasonography so its easy to judge baby's gender. And here the size of fetus is near about 3 inches long.

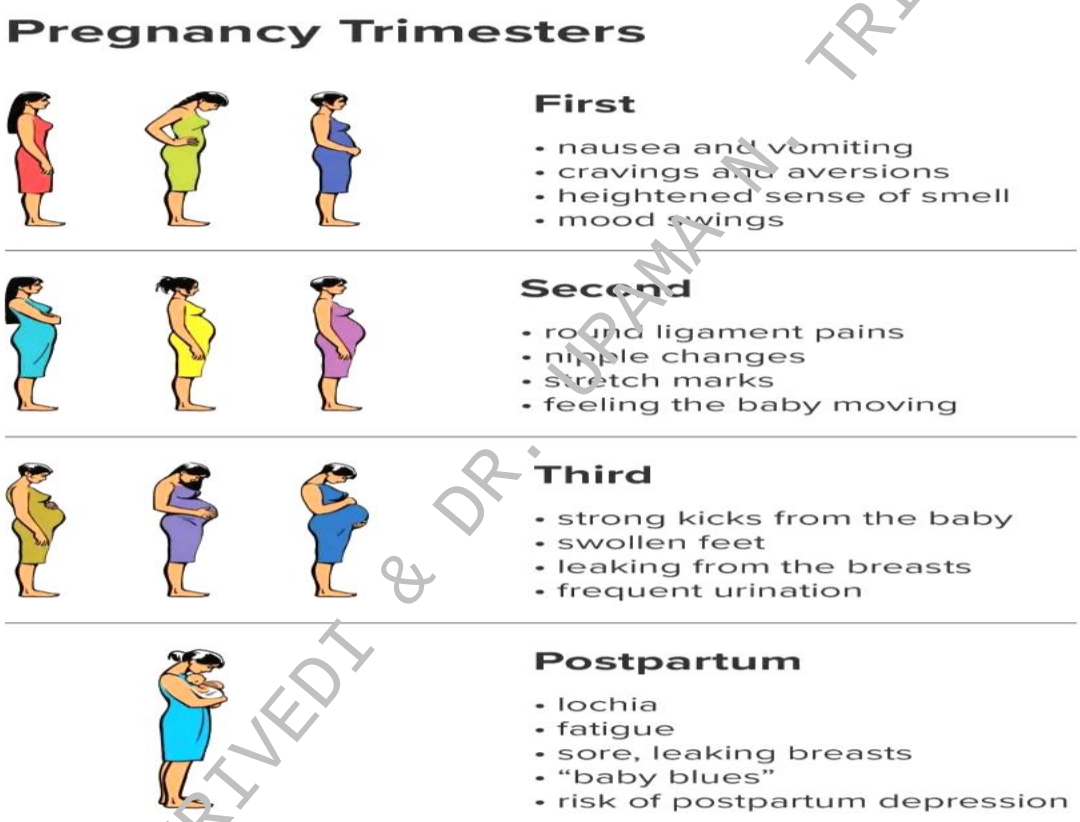
ii. Second Trimester (13 to 28 weeks)

- In the second trimester some of the symptoms of first trimester disappeared.
- During the second trimester of pregnancy, you might experience physical changes, including:
- Darkening of skin around nipples, swelling of ankles, finger and face are the common sign of pregnancy.
- In the later phase of this trimester the movement of baby shall be noticed.
- At the 13 to 16th week bones and muscles start to form skeletal structure. Skin being start to form and baby try to sucking motion by mouth. In this stage embryo is near about 6-6 inches in their size.

- At the 18th to 20th week eyebrow, hair, eyelashes, finger nails start to appear.
- At 23rd to 24th week blood cell start to form from the bone marrow. Footprint and finger prints are formed. Lings start to develop for the breath. In this phase male embryo's testicle move towards the abdominal and female embryo start to develop uterus and ovaries. Embryo start their sleep cycle and its size is about 12 inches.

iii. Third Trimester (29 to 40 weeks)

- In 3rd trimester, urination frequency getting increase, mother feel difficulty in breathing, swelling of ankle and face are the commonly observed signs.
- Mother can feel the movement of baby, baby can kick easily in this phase.
- The fetus can see and hear inside the uterus.
- The brain continues to develop.
- The kidneys and lungs continue to mature.
- At 32 weeks bones of the baby fully get developed but still its soft.
- At this stage size of the baby is near about 15-16 inches.
- At the 39th weeks full growth of baby has to be considered and baby take head down position for the birth.
- During the time of birth the normal baby length is 19-20 inches with 2 to 2.3 kg weight is observed.



Parturation:

- The process through which baby comes in the world and the phase of pregnancy get ends known as parturition.
- When pregnancy reach to the full term nearly at 38-39 week, it's time for the baby to be born.
- There are several hormonal changes observed during the process of parturition.
- At 37th weeks progesterone level getting down, but the level of estrogen still high. So higher ration of the estrogen to progesterone may activate the pituitary gland to secrete oxytocin.
- Oxytocin try to contract uterine contraction. Some of the women feels weak contraction in uterine due to decreasing the level of progesterone, this contraction is known as false contraction which is not actual the labor pain and it's also known as brackston Hicks Contractions.
- Mother when reach to full term fetus start to drop lower in the uterus. So placenta secret relaxin hormone. Which produce two effects:

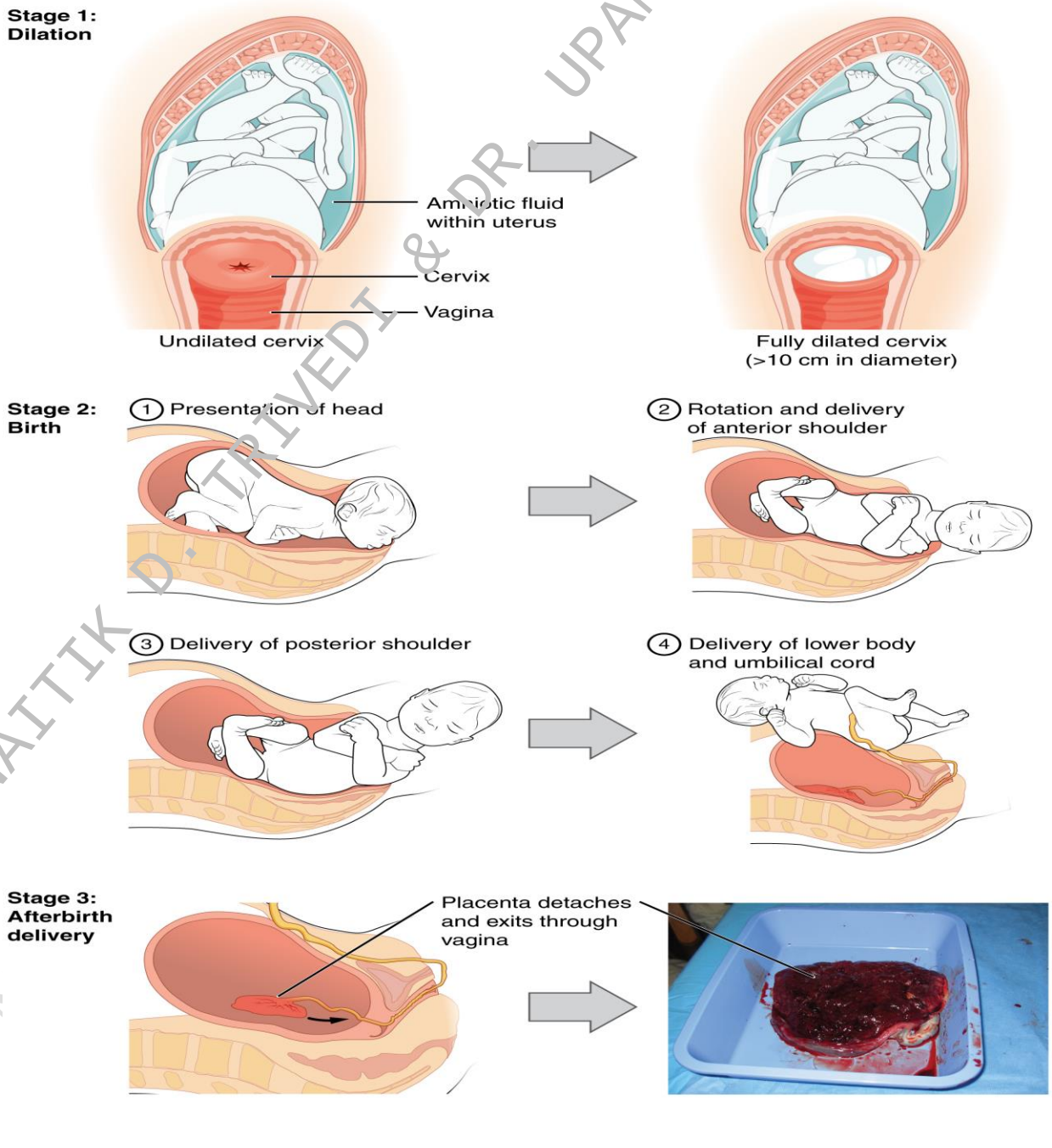
i. It loosen the pelvic bones so it comes apart slightly and support the enlarging of uterus

ii. It also loosen the pubic symphysis

- These process dilate the cervix and help in labor.
- Labor contractions force baby's head or body into birth canal.
- It produces effect on control condition and increases distention of cervix of uterus.
- It activates the stretch receptors of cervix and send input message to control center via sensory nerve impulse.
- Actually labor is divided into three main stages:
  i. Cervical dilation
  ii. Expulsion of baby
  iii. After birth
- In first stage of cervical dilation, Control center activates the hypothalamus and pituitary gland and send the output message to increase oxytocin secretion in blood.
- Oxytocin produces their effect on to the effector (cervix of uterus) and cause distention of cervix of uterus than the normal value to push the baby further into birth canal. This effect secret prostaglandins and cause more uterine contraction and release more prostaglandins due to the positive feedback cycle, this effect called true labor contraction.
- In the true labor contraction mucus lug and amniotic fluid get secret which is the sign of true labor contraction.
- Uterine contraction at upper side cause dilation of cervix and push the fetus towards the cervix, so cervix dilate at 10 cm size for the expulsion of baby.
- 2nd Phase expulsion start when baby head comes near the birth canal, uterus rhythmically get contract.
- Once baby heads crown, it's easy to accessible the other body for doctor.
- Once the baby out the umbilical cord connected with the placenta gets cut and baby gets clean now.
- Final stage of labor is delivery of placenta and associated membrane called the after birth stage.
- After the birth of baby uterine get contract continue so placenta detached from the uterus and eject out of the vagina.

Note:

- Baby head come first is known as vertex presentation and it cause normal delivery in most of cases.
- Buttocks or legs come first is known as breech presentation need caesarian section (C- Section) through the cut from abdominal cavity.

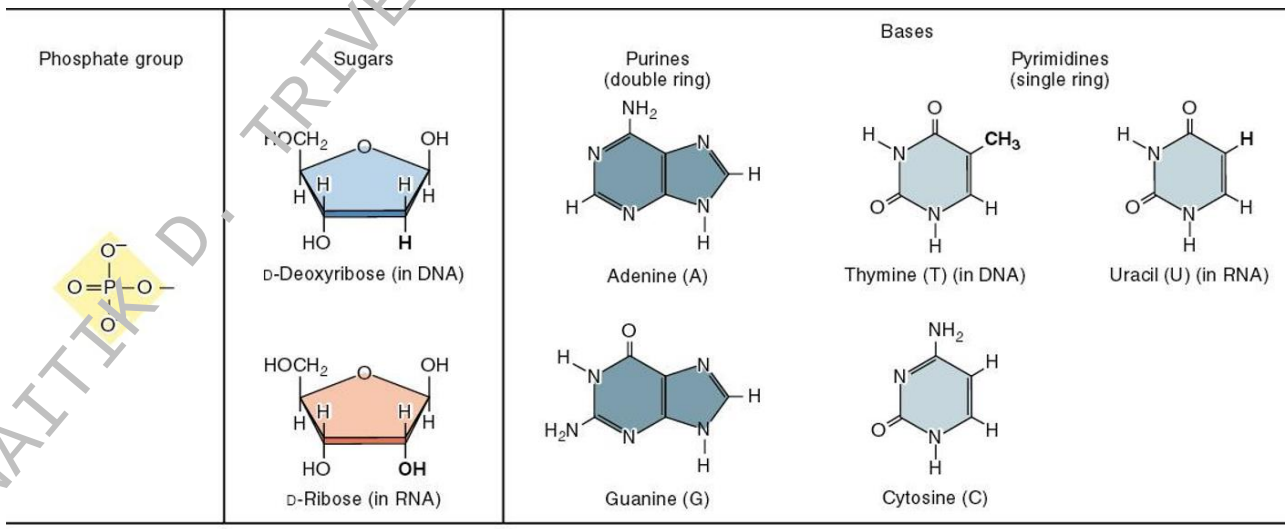


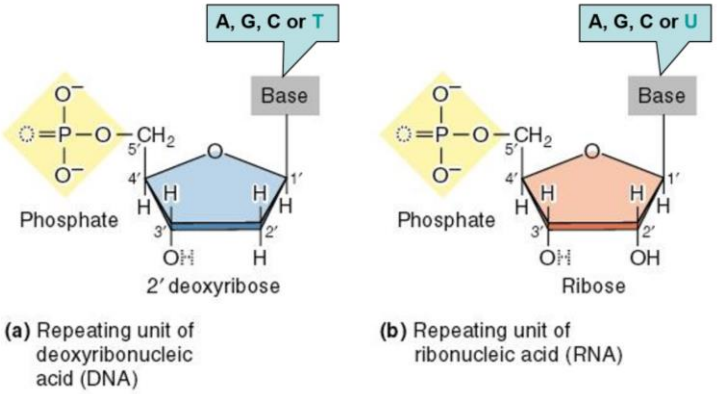
INTRODUCTION TO GENETICS:

DNA and RNA:

- Deoxyribonucleic acid (DNA) and Ribonucleic acid (RNA)
- It is a Macromolecule
- Made of Subunits – nucleotides

- Base + sugar form nucleoside
- Adenine + deoxyribose = Deoxyadenosine form DNA
- Example: Adenine + ribose = Adenosine form RNA
- Base + sugar + phosphate(s) → nucleotide
- Example
- Adenosine monophosphate (AMP)
- Adenosine diphosphate (ADP)
- Adenosine triphosphate (ATP)





(a) Repeating unit of deoxyribonucleic acid (DNA)

(b) Repeating unit of ribonucleic acid (RNA)

- DNA -double-stranded helix is 2 nm thick
- Nucleosome - 11 nm thick
- 30nm chromatin fibre - 30 nm thick
- Chromatin loops - 300 nm thick
- Condensed chromatin - 700 nm thick
- Chromosome (mitotic) - 1400 nm thick
    - DNA is wrapped or looped using a protein matrix

Gene:

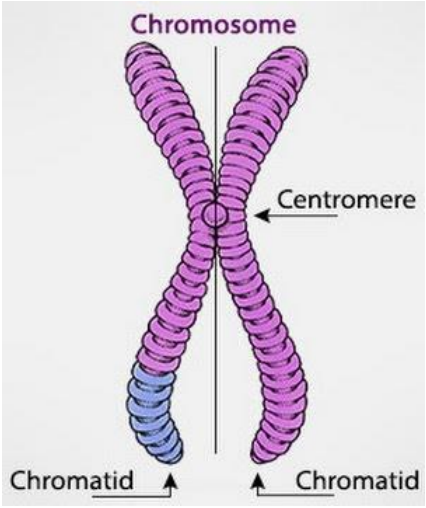
- Segment of DNA that has the information (the code) for a protein.
- A single molecule of DNA has thousands of genes.

Chromosomes

- Chromosomes are the form DNA becomes in the nucleus when the cell is preparing to divide.
- Humans have 46 chromosomes.
- One set of 23 chromosomes from mom.
- One set of 23 chromosomes from dad.

Chromatid

- Two exact copies of a chromosome that are connected together.
- The point where they are connected near the middle is called the centromere.
- Chromatids are made when new cells are going to be made.

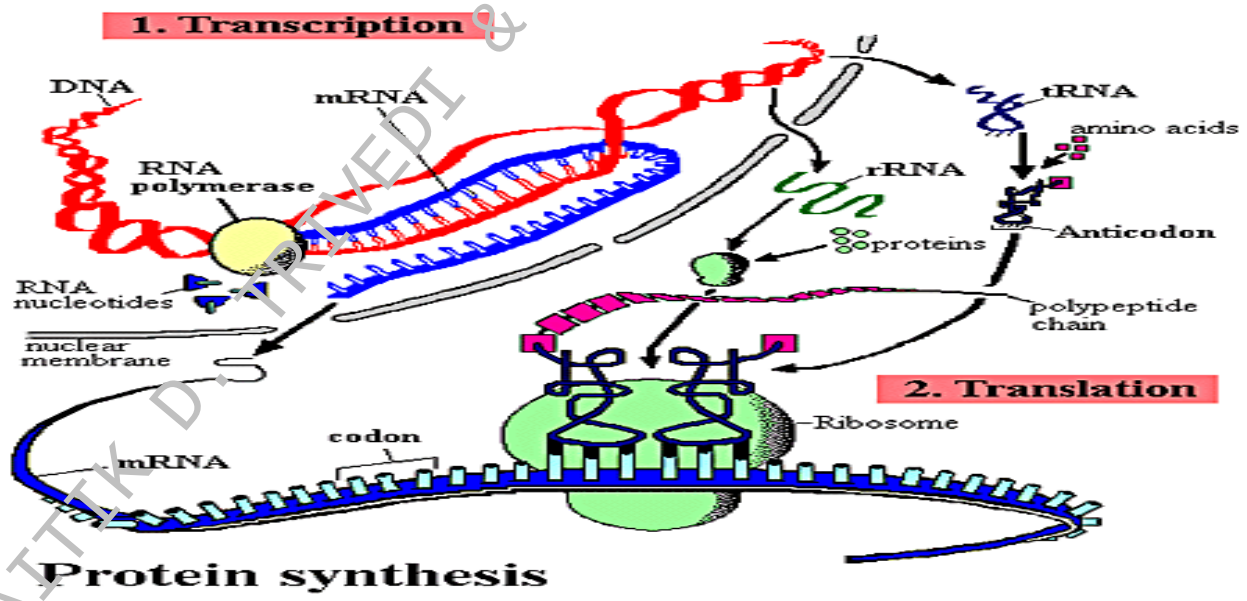


PROTEIN SYNTHESIS

Cells are basically protein factories that constantly synthesize large number of diverse protein. The, protein determine the physical and chemical characteristics of cells and therefore of organisms.

Some proteins are structural to form plasma membranes, microfilaments, microtubules, Centriols, mitochondria and other parts of cells.

Other proteins serve as hormones, antibodies and contractile elements in muscle tissue also it act as enzyme.



Protein synthesis

This process can be divided into two parts:

1. Transcription

- Before the synthesis of a protein begins, the corresponding RNA molecule is produced by RNA transcription.

Three forms of RNA are made from the DNA template,

a) messenger RNA (mRNA) which direct synthesis of a polypeptide chain,
b) transfer RNA (tRNA) which bind to amino acid during translation and

c) ribosomal RNA (rRNA) which comes together with ribosomal protein to make up ribosomes.

In protein synthesis, one strand of the DNA double helix is used as a template by the RNA polymerase to synthesize a messenger RNA (mRNA) this strand refer as sense strand and the other strand that not transcribed known as antisense strand, during the transcription the changes in to the nitrogen base are as under;

DNA	RNA
A	U
T	A
G	C
C	G
A	U
T	A

Template DNA base sequence Complementary RNA sequence

Within DNA are region known as intron that do not synthesis of part of protein and intron are located between regions called exons that do code for proteins.

Initially mRNA transcript include both introns and exons then RNA region corresponding to DNA introns are deleted (cut out) and the exon are spliced (rejoined) and finally mRNA migrates from the nucleus to the cytoplasm, this process is known as mRNA splicing.

In the cytoplasm, the start the next step which is translation

2. Translation

- It is the process where the nucleotide sequence in a molecule of mRNA specifies the amino acid sequence for protein molecules.
- In the mRNA molecules, each set of three consecutive nucleotide bases is called codon and specifies one amino acid.

- Most mRNA molecules contain 300-3000 nucleotides so it form 100 to 1000 amino acid because three nucleotide code for one amino acids.

Translation process following steps;

Initiation:

a) In the cytoplasm, the small ribosomal subunit binds to one end of the mRNA molecules and finds the start codon, a sequence where translation will begin. Then the large ribosomal subunit joins in the process.
b) In the cytosol, tRNA binds to one kind of amino acid and brings it to the ribosomes. One end of the tRNA carries amino acid and another part of each tRNA has a triplet of nucleotides called as anticodon. This anticodon of the tRNA attach to complementary codon on mRNA.
c) Eg.: if the mRNA codon is AUG then tRNA have the anticodon UAC would attach.
d) In the starting of this process tRNA brings methionine amino acid.

Elongation:

e) Once the first tRNA attach to mRNA, the ribosomes moves exactly three nucleotides along the mRNA and the tRNA carry its amino acid on that particular nucleotides or codon.
f) When the second tRNA brings the next amino acid first tRNA again goes back in to the cytoplasm. The proper amino acids are brought into line, one by one peptide bonds form between them and protein progressively lengthens.
g) Each time the ribosome moves one codon along mRNA and empty tRNA is eject. The released tRNA can pick up another amino acid.

Termination:

h) When the specified protein is complete, synthesis is terminated by a special stop codon.
i) Then assemble protein is then released from the ribosomes.
j) After protein synthesis small and large ribosomal subunits separate.

“Prayer without study would be empty. Study without prayer would be blind.