

HUMAN REPRODUCTION

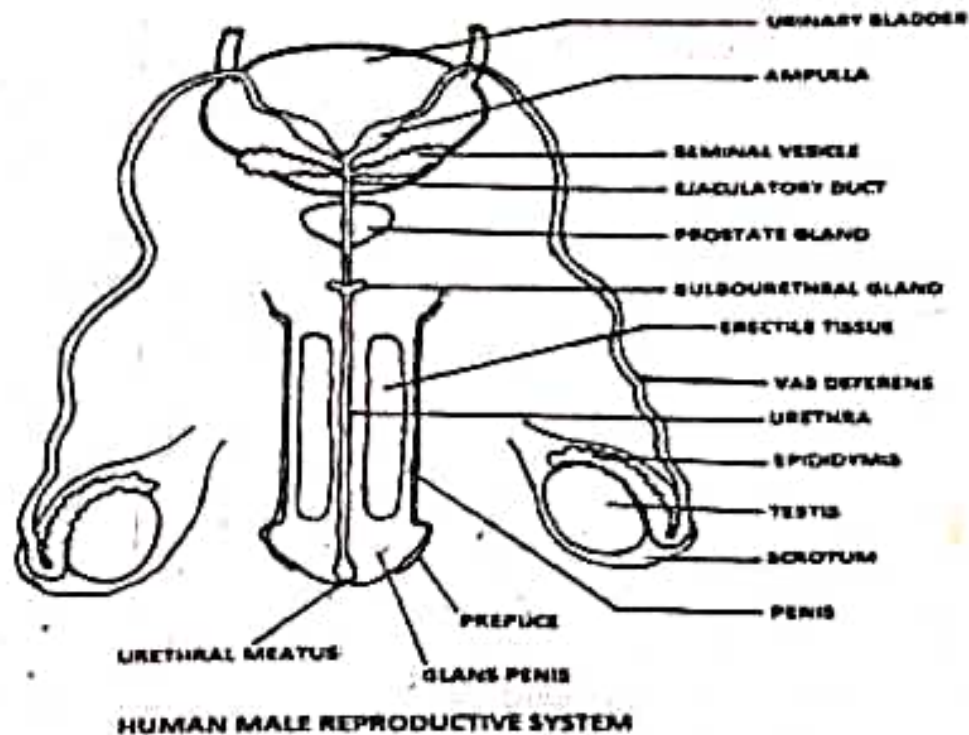
(2018-19)

Human beings are sexually reproducing organisms where fertilization and development are internal and show viviparous condition. Females give birth to young ones and nourish them. Reproductive events in humans include – gametogenesis, insemination, fertilization, zygote formation and blastocyst development, implantation, gestation, parturition and lactation.

HUMAN MALE REPRODUCTIVE SYSTEM

Male reproductive system is located in the pelvic region and includes

- o A pair of testes
- o Accessory ducts
- o Accessory glands
- o External genitalia



Testes (Singular; Testis)

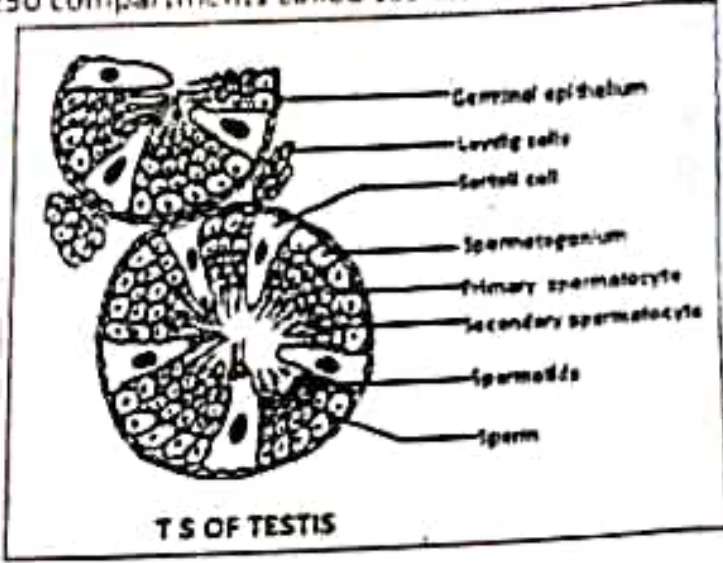
These are primary sex organs (male gonads) that help in production of male gametes (sperms) and also produce a male sex hormone called testosterone.

During the fetal development testes descends out of the abdominal cavity into a pouch of skin called scrotum.

- Scrotum provides $2^{\circ} - 2.5^{\circ} \text{C}$ lower than the normal internal body temperature which is necessary for spermatogenesis.
- NOTE - The condition in which the testes do not descend into the scrotum is called cryptorchidism which results in sterility.

TS of Testis (showing seminiferous tubule)

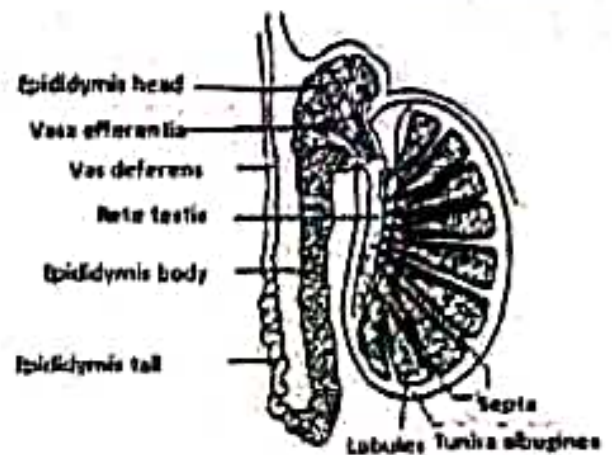
- Each testis is covered by outer tunica vaginalis, middle fibrous tunica albuginea and inner vascular tunica vasculosa.
- Tunica albuginea divides the testis into 250 compartments called testicular lobules.
- Each lobule contains one to three highly coiled seminiferous tubules (structural and functional units of testis)



- Each seminiferous tubule is lined by male germ cells (germinal epithelium) and Sertoli cells.
- Male germ cell undergoes meiosis and produce haploid male gametes called sperms.
- Various stages of spermatogenesis are found in seminiferous tubules which include spermatogonial cell, primary spermatocytes, secondary spermatocytes, spermatids and spermatozoa.
- In between the germinal epithelium there are some non-reproductive, much larger elongated cells called Sertoli cells (or sustentacular cells) which nourish the developing sperms. They also secrete inhibin hormone, which inhibits FSH production from pituitary gland.
- In between the seminiferous tubule there are group of special cells called interstitial cells or Leydig cells.
- Leydig cells secrete the male sex hormone called testosterone.

Accessory ducts or Duct system

- Duct system of male reproductive system includes rete testis, vasa efferentia (efferent ducts), epididymis and vas deferens.
- Seminiferous tubules open into vasa efferentia through rete testis.
- The vasa efferentia leaves the testis and open into epididymis.
- The epididymis leads to vas deferens that ascends to the abdomen through inguinal canal and loops over the urinary bladder.
- Vas deferens receives a duct from seminal vesicle and opens into the urethra as the ejaculatory duct.
- Urethra originates from the urinary bladder and extends through the penis to its external opening called urethral meatus.



Accessory Glands

Male accessory glands include a pair of seminal vesicles, a prostate gland and a pair of bulbourethral gland (or Cowper's gland).

Paired seminal vesicle

- The seminal vesicles are sac-like pouches that attach to the vas deferens near the base of the urinary bladder.
- They secrete an alkaline viscous fluid that contains fructose, prostaglandins, calcium and clotting proteins.
- Fluid secreted by the seminal vesicle constitutes about 70% of human semen.

Functions

- Fructose is used for ATP production by sperm.
- Prostaglandins contribute to sperm motility and viability and are also involved in suppressing an immune response by the female against the foreign semen.
- Clotting proteins help semen coagulate after ejaculation.
- Calcium ions trigger the acrosome reaction and facilitate sperm penetration into the ovum.

A prostate gland

- It is a single dough-nut shaped gland.
- It secretes a milky, alkaline fluid called prostatic fluid which constitutes about 20% of the semen.
- It contains many enzymes.

Functions

- Enzymes such as the pepsinogen, lysozyme etc., breaks down the clotting proteins and liquefies semen that gets thickened after ejaculation.
- This thinning action allows sperm to swim more freely.

Paired bulbourethral gland or Cowper's gland

- These are small pea sized glands present on either side of urethra.
- These secrete an alkaline and clear fluid.

Functions

- It lubricates external genitalia during sexual intercourse.
- It helps in neutralizing acids from urine in the urethra and also neutralizes the acidic environment of female genital tract.

Seminal plasma

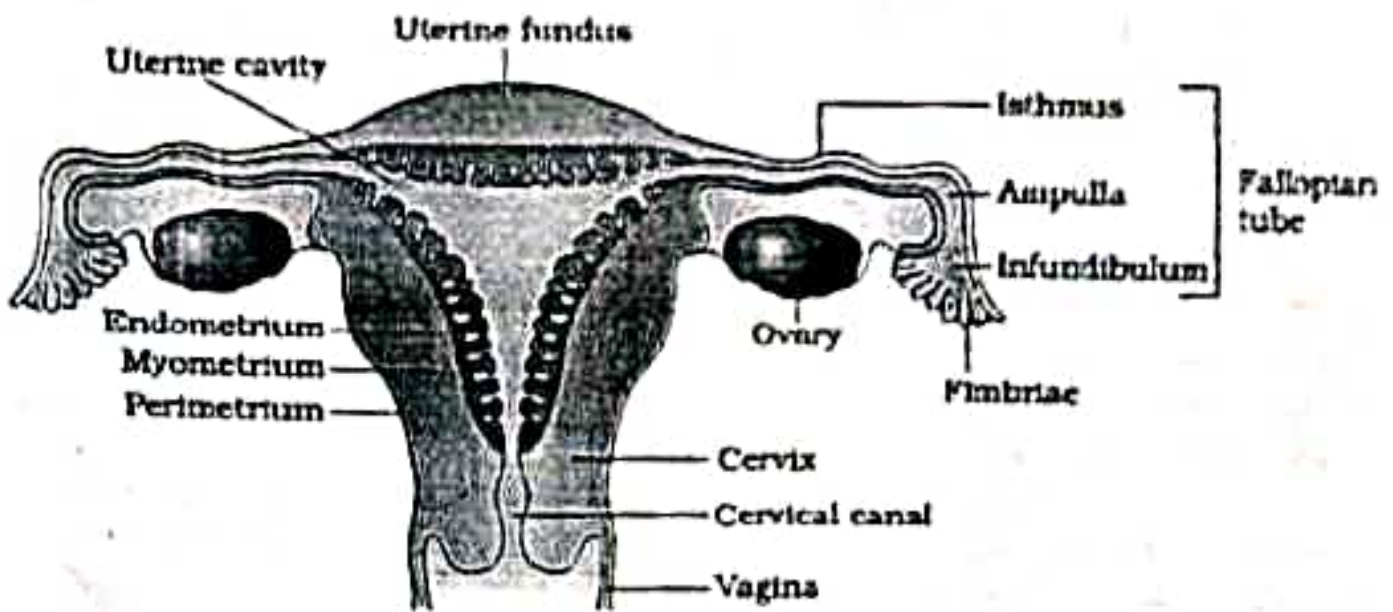
- Secretion of seminal vesicles, prostate gland and cowper's gland constitutes the seminal plasma.
- Seminal plasma rich in fructose, calcium, and certain enzyme.

External genitalia

- It consists of the penis which is a copulatory organ, as well as a common passage for both urine and semen.
- It contains spongy erectile tissue which expands to make the penis erected to facilitate copulation.
- The enlarged end of penis is called glans penis and is covered by a loose fold of skin called foreskin.

HUMAN FEMALE REPRODUCTIVE SYSTEM

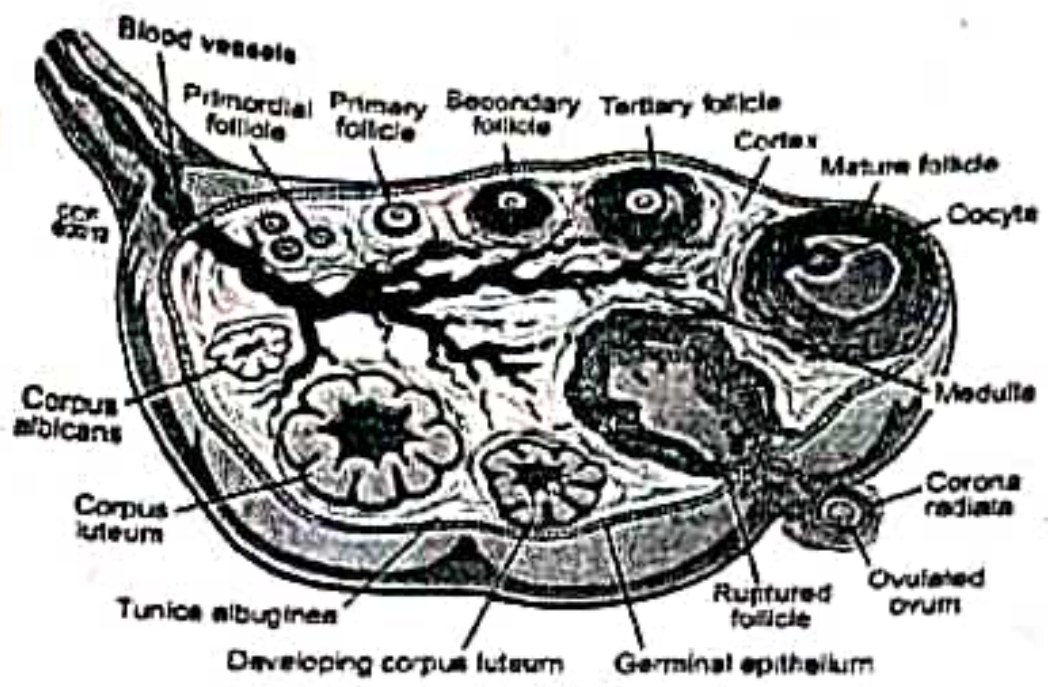
- Female reproductive system in human includes:
 - A pair of ovaries
 - A pair of oviducts
 - Uterus
 - Cervix
 - Vagina
 - External genitalia
 - A pair of mammary glands



SECTIONAL VIEW OF HUMAN FEMALE REPRODUCTIVE SYSTEM

STRUCTURE OF OVARY

- Ovary is a primary female sex organ that produces female gamete called ovum.
- There are a pair of almond shaped ovaries present on either side of the uterus, attached to inner abdominal wall with the help of double layered fold of peritoneum called mesovarium and is also attached to the uterus with the help of ovarian ligaments.
 - Each ovary is about 2-4 cm in length and is covered by germinal epithelium which encloses the ovarian stroma.
 - The ovarian stroma has two zones - outer cortex and an inner medulla



TRANSVERSE SECTION OF OVARY

- During early fetal development, primordial germ cells migrate from the yolk sac to the ovaries and proliferate to produce thousands of primordial follicles.
- The stroma is composed of fibrous connective tissue which is differentiated into outer peripheral cortex and an inner medulla.
- The cortex consists of thousands of tiny undeveloped ovarian follicles. Medulla contains only blood vessels and nerve fibres.
- A fully mature ovarian follicle is called a Graafian follicle.

It is oval in shape. Its wall is made up of outer theca externa containing connective tissue and inner theca interna which is vascular and glandular in nature.



The cells of theca interna secrete estrogen.

- It has an outer multilayered membrana granulosa formed of 2 - 3 layers of follicle cells.
- The oocyte is surrounded by a vitelline membrane, zona pellucida and corona radiata.

- The oocyte is attached to the membrana granulosa by a group of cells called discus proligerus or cumulus oophorus.
- The graafian follicle has a follicular cavity called antrum filled with a colourless follicular fluid called liquor folliculi.

Oviduct

- Oviduct is also called fallopian tube.
- Each fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus. They provide a route for sperm to reach an ovum and also to transport secondary oocytes and fertilized ova to the uterus.
- Fallopian tube consists of parts like fimbriae, infundibulum, ampulla and isthmus.
- Fimbriae are finger like projections present at the tip of oviduct. These helps in collection of the ovum after ovulation.
- Fimbriae leads to a funnel shaped structure called infundibulum. The infundibulum leads to a wider part of the oviduct called ampulla.
- The last part of the oviduct is called isthmus. It opens into uterus. Fertilization generally takes place at ampulla-isthmic junction and cleavage takes place in fallopian tube.

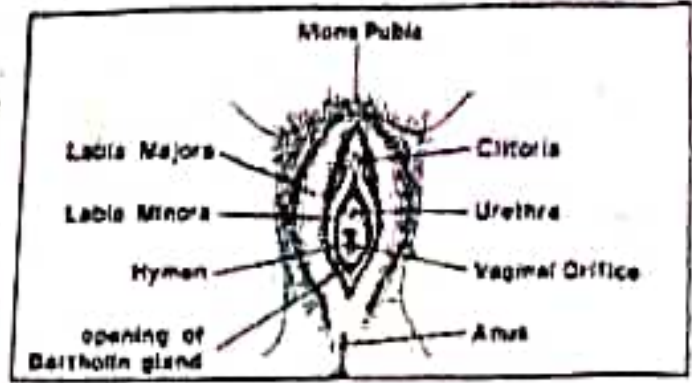
Uterus

- It is also called womb. It is inverted pear shaped and is supported by ligaments attached to the pelvic wall.
- The uterus opens into vagina through a narrow cervix. Cervix is the neck region of female reproductive system. The lumen of cervix is called cervical canal.
- Cervical canal along with vagina form the birth canal.
- The wall of the uterus has three layers of tissues
 - Perimetrium: external thin membranous layer simple squamous epithelium and areolar connective tissue.
 - Myometrium: middle thick layer which consists of three layers of smooth muscles.
 - Endometrium: inner glandular layer divided into two main layers – stratum functionalis which lines the uterine cavity and sloughs off during menstruation and stratum basalis which is deeper permanent layer that helps in the formation of stratum functionalis after each menstruation.
- Myometrium exhibits strong contraction during delivery of the baby (parturition).
- Endometrium undergoes cyclical changes during menstrual cycle.

External genitalia:

It includes following structure

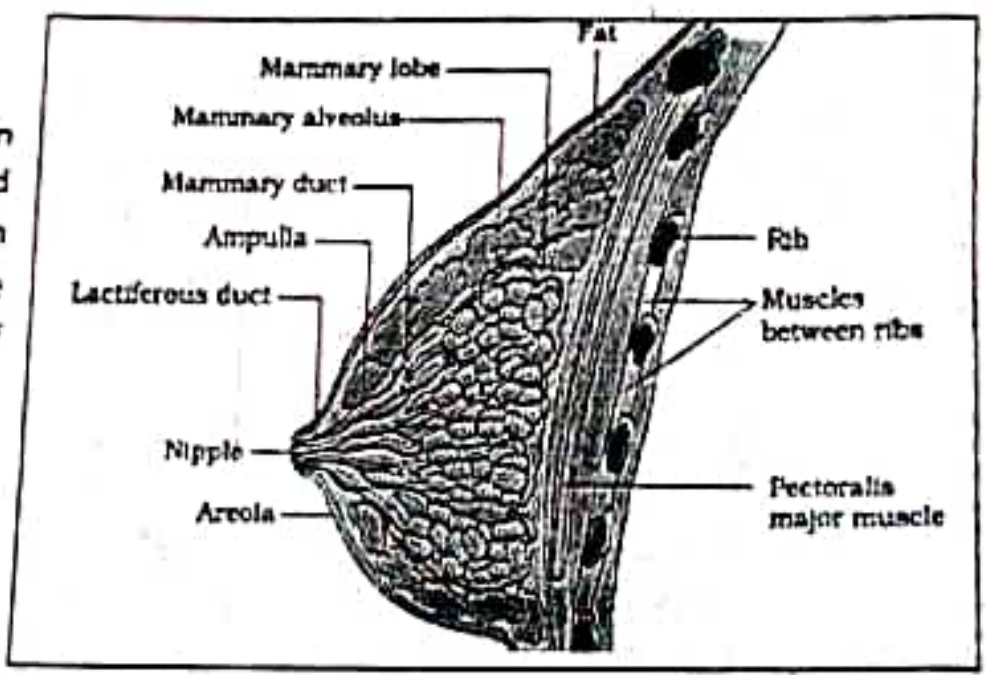
- **Mons Pubis** - cushion of fatty tissue covered by skin and pubic hair.
- **Labia majora** - fleshy fold of tissue, which extends down from the mons pubis and surrounds the vaginal opening on urethral opening.
- **Labia minora** - are paired folds of tissue under the labia majora
- **Hymen** - the opening of vagina is often covered partially by a membrane called hymen. The hymen is often torn during the first intercourse
- **Clitoris** - a tiny finger-like structure lies at the upper junction of two labia minora above the urethral opening. It is homologous to glans penis of male reproductive system.



(Bartholin's gland - These are two small pea sized glands located near the opening of vagina that secretes mucus to lubricate the vagina and are homologous to bulbourethral glands in males.)

Mammary glands

- Mammary glands in human females are paired structures (breasts) which contain glandular tissue and variable amount of fat.
- Glandular tissue of each breast is divided into 15-20 mammary lobes.
- Mammary lobes contain cluster of cells called alveoli.



- The cells of alveoli secrete milk, stored in the lumen of alveoli.
- The alveoli open into mammary tubules.
- The tubules of each lobe join to form a mammary duct.