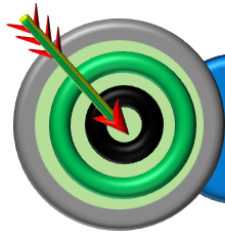


Chapter 02

Human Reproduction



OBJECTIVES



INTRODUCTION



THE MALE REPRODUCTIVE SYSTEM



THE FEMALE REPRODUCTIVE SYSTEM



GAMETOGENESIS



MENSTRUAL CYCLE



FERTILIZATION AND IMPLANTATION



PREGNANCY AND EMBRYONIC DEVELOPMENT



PARTURITION AND LACTATION

INTRODUCTION

Humans are sexually reproducing and viviparous organisms. Their reproductive events include formation of gametes (gametogenesis), i.e., sperms in males and ovum in females, transfer of sperms into the female genital tract (insemination) and fusion of male and female gametes (fertilisation) leading to formation of zygote. This is followed by formation and development of blastocyst and its attachment to the uterine wall (implantation), embryonic development (gestation) and delivery of the baby (parturition). You have learnt that these reproductive events occur after puberty. There are remarkable differences between the reproductive events in the male and in the female, for example, sperm formation continues even in old men, but formation of ovum ceases in women around the age of fifty years.

2.1 THE MALE REPRODUCTIVE SYSTEM

The male reproductive system is located in the pelvic region. It includes a pair of testes, along with accessory ducts, glands and the external genitalia.



Clue Finder

The primary sex organs are testes in males and ovaries in females. Besides producing gametes, they also secrete sex hormones. The growth of gonads, their maintenance and functions are regulated by gonadotropins (FSH, LH) of the anterior lobe of pituitary. The other reproductive organs which perform important functions in reproduction but neither produce gametes nor secrete sex hormones, are called secondary sex organs. These include the prostate, seminal vesicles, vas deferens and penis in males, and the fallopian tubes, uterus, vagina and mammary glands in females.

2.1.1 The Testes

The testes are situated outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes (2-2.5°C lower than the normal internal body temperature), which is necessary for spermatogenesis. The slightly cooler temperature of the scrotum is necessary for the development of normal sperm. The testes start their development in the abdominal cavity. But during the 7th month of the foetal life, they descend into the scrotal sacs in presence of testosterone hormone. Hence, the testes of human males are extra-abdominal. If they fail to descend, this condition is called cryptorchidism that leads to sterility. Scrotum remains connected with the abdomen or pelvic cavity by the inguinal canal. Blood vessels, nerves and conducting tubes pass through it. Cremaster muscles and connective tissues form spermatic cord and surround all structures passing through inguinal canal. Cremaster muscles and dartos muscles of the scrotal sac help in the positioning of testes. Whenever the outside temperature is low, these contract to move the testes close to the abdominal or pelvic cavity. When outside temperature is high, these relax moving the testes away.

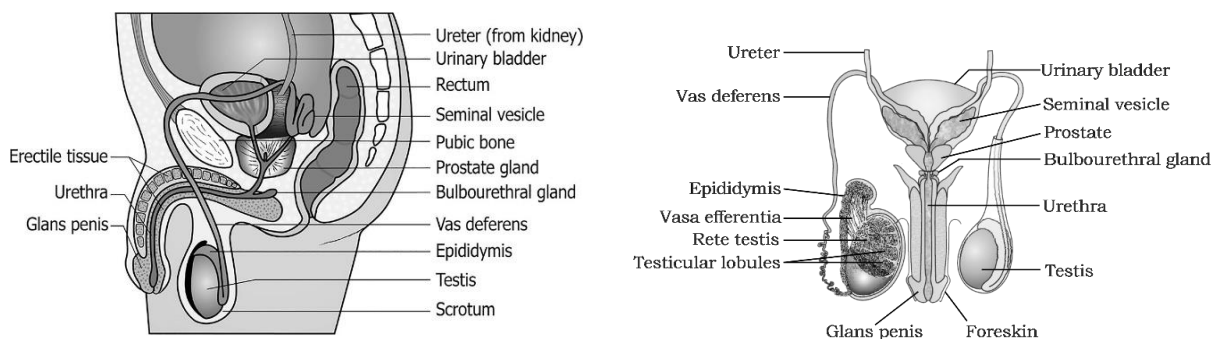


Fig.: (A) Diagrammatic sectional view of male pelvis showing reproductive system,
(B) Diagrammatic view of male reproductive system (part of testis is open to show inner details)

**Clue Finder**

1. Gubernaculum: A fibrous cord that extends from caudal end of epididymis to scrotal wall.
2. Inguinal canal: Oblique passage through the lower abdominal wall. In males, it is the passage through which the testes descend into the scrotum and contains the spermatic cord.
3. There are certain mammals in which the testes remain permanently in the abdomen and does not cause any defect. Examples are elephant, aquatic mammals like whales, dolphins, seal and prototherians or egg laying mammals like Ornithorhynchus.
4. In mammals which breed seasonally, the testes descend into scrotum only during the breeding season, example bat and otter and rodents.

In adults, each testis is oval in shape, with a length of about 4 to 5 cm and width of about 2 to 3 cm.

The testis is covered by a dense covering. They are enclosed in an outer tough capsule of collagenous connective tissue, the tunica albuginea. Each testis has about 250 compartments called testicular lobules, these compartments contain highly coiled tubules called seminiferous tubules. Each lobule contains one to three seminiferous tubules in which the sperms are produced. Each seminiferous tubule is lined on its inside by two types of cells called male germ cells (spermatogonia) and Sertoli cells. Spermatogonia lining these tubules give rise to spermatozoa which are released into the lumen of the tubule.

In between spermatogenic cells, Sertoli or sustentacular or nurse cells are present which provide nourishment to developing spermatozoa and regulate spermatogenesis by releasing inhibin to check FSH over-activity.

The other functions of sertoli cells are

- (i) To absorb the parts being shed by developing spermatozoa.
- (ii) To release anti mullerian factor (AMF) to prevent development of mullerian duct/oviduct in male.
- (iii) To release Androgen Binding Protein (ABP).
- (iv) To form blood-testis barrier.

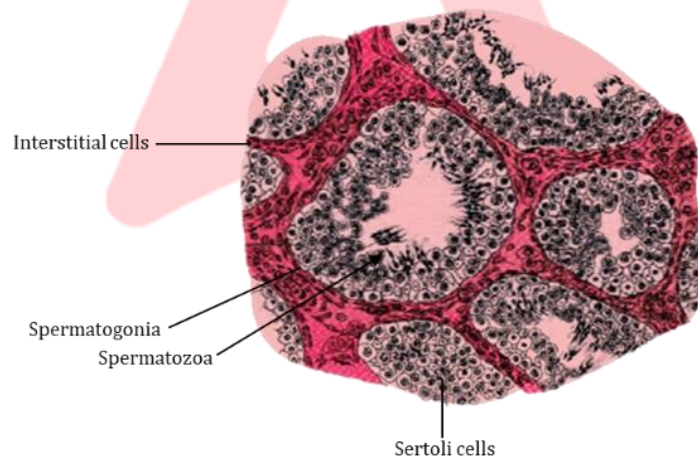
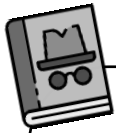


Fig.: Diagrammatic sectional view of seminiferous tubule



Clue Finder

Castration is removal of testes. It causes failure of development of secondary sex organs and characters and remove the ability to reproduce due to deficiency of testosterone. Choir boys were often castrated in medieval Europe to retain their high-pitch voice for singing. Castration often changes the aggressive bull into a docile ox. The latter lacks the male character of aggressiveness due to deficiency of testosterone. The docile ox can be conveniently used for ploughing and drawing of bullock carts. Mullerian ducts (or paramesonephric ducts) are paired ducts of the embryo. In the female, they develop to form the Fallopian tubes, uterus, cervix and the upper portion of the vagina; in the male, they degenerate. These ducts are made of tissue of mesodermal origin.

The Wolffian duct is a paired organ found in mammals including humans during embryogenesis. It connects the primitive kidney Wolffian body (or mesonephros) to the cloaca. In male, the Wolffian duct develops into the trigone of urinary bladder, a part of the bladder wall and vas deferens and in female the Wolffian duct develops into the trigone of urinary bladder, a part of the bladder.

Groups of polyhedral cells called Interstitial cells of Leydig, are located in the connective tissue around the seminiferous tubules. They constitute the endocrine tissue of the testis. Leydig cells synthesise and secrete testicular hormones called Androgens into the blood. Seminiferous tubules unite to form several straight tubules called tubuli recti which open into irregular cavities in the posterior part of the testis which is a highly anastomosing labyrinth of cuboidal epithelium lined channels called rete testis. Several tubes called vasa efferentia arise from it and conduct spermatozoa out of the testis. Tubuli recti, rete testis and ductuli efferentes form the intra-testicular genital duct system.

The extratesticular duct system consists of tubes which conduct sperms from the testes to the outside. It starts with ducts known as vasa efferentia. From each testis, 10-12 vasa efferentia confluent to form a folded and coiled tube called epididymis behind each testis. The epididymis consists of three parts: (i) Caput (ii) Corpus (iii) Cauda.

The epididymis stores the sperms temporarily. From cauda epididymis, a partially coiled tube called vas deferens ascends into the abdomen through inguinal canal, passes over the urinary bladder, the

ductus deferens/vas deferens dilates to form ampulla, which receives the duct from the seminal vesicle behind the urinary bladder and forms an ejaculatory duct. The final portion of ampulla passes through the prostate to open into the urethra shortly after its origin from the urinary bladder.

Urethra: Male urethra provides a common pathway for the flow of urine and semen. It is much longer in male than in female, measuring about 20 cm.

- (i) First part is surrounded by prostate gland and is called prostatic/glandular part of urethra.
- (ii) Membranous urethra is the second part which is situated behind the lower part of pubic symphysis and is smallest.
- (iii) Penile urethra is situated in the penis and is the longest part.

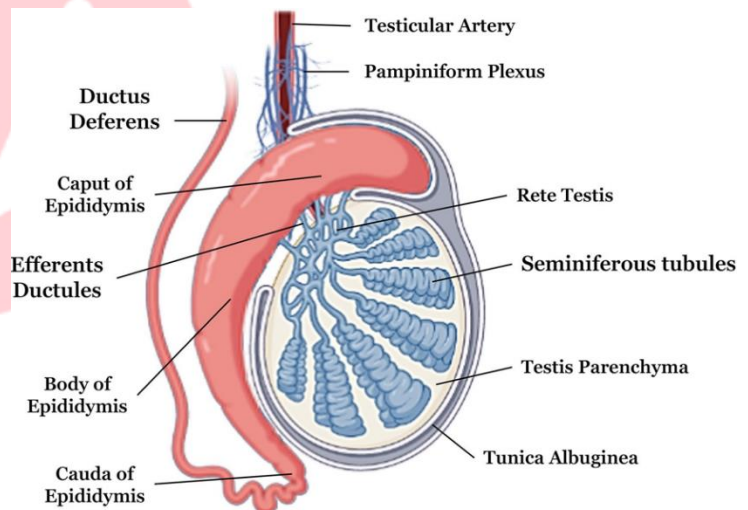


Fig.: Structure of Testis

The urethra receives the ducts of the prostate and Cowper's glands, passes through the penis and opens to the outside.

Penis: This is the copulatory organ of man. It is a cylindrical, erectile, pendulous organ suspended from pubic region in front of scrotum. It remains small and limp (flaccid) but on sexual arousal, it becomes long, hard and erect, ready for copulation (coitus or intercourse).

The penile mass is itself encased in a fibrous sheath, called tunica albuginea. The interior of the penis is formed of three cylindrical cords of spongy, erectile (cavernous) tissues. Two of these cords are thicker and situated parallelly on right and left sides, forming the thick part of penis that remains in front when penis is limp, but become superio-posterior when penis is erect. These two cords are called corpora cavernosa. The fibres of tunica albuginea surround both the cords jointly and also form a separate sheath around each cord. Some fibres form a partition called septum penis between these cords. The third, smaller cord forms that part of penis which remains

inferio-anterior in erect penis. Urethra runs through this cord. Hence, this cord is called corpus urethrae or spongiosum.

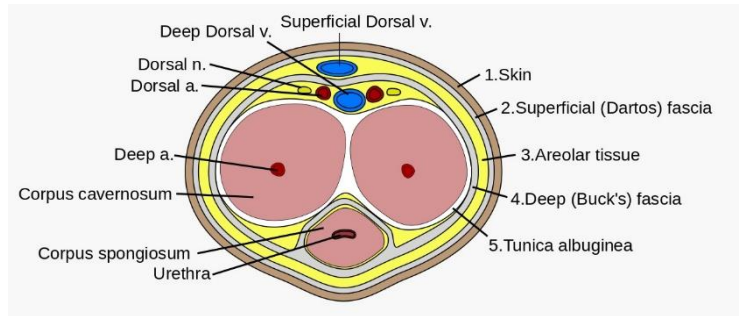


Fig.: T.S. of Penis

The extended part of corpus spongiosum is enlarged, forming a bulging, conical structure called glans penis. The surface of glans is formed of thin, smooth and shiny, hairless skin. The base line of glans is referred to as the neck of the penis. The loose skin of penis becomes folded here to form a loose, retractile skin covering upon the glans, called foreskin or prepuce. At the tip of glans penis is the slit like external urethral orifice or meatus by which urethra opens out and discharges urine or semen.

Tyson's gland or Preputial glands, present in the skin of penis neck, secrete a white sebaceous substance called smegma. Microbial infection in smegma can cause irritation due to inflammation.

2.1.2 Accessory Glands of Male

(a) Seminal vesicles: These are paired, tubular, coiled glands situated behind the bladder. They secrete viscous fluid which constitutes the main part of the ejaculate. Seminal fluid contains fructose, citric acid, inositol and prostaglandins.

(b) Prostate gland: The prostate gland is a chestnut shaped gland and is a collection of 30-40 tubuloalveolar glands which lie at the base of the bladder and surrounds the first part of the urethra. It contributes an alkaline component to the semen. (Although, the alkalinization of semen is primarily accomplished through secretion from the seminal vesicles.)

The alkaline secretions of prostate gland help the sperms to become active and counteract any adverse effects that the urine may have on the sperms. The prostatic fluid provides a characteristic odour to the seminal fluid. Prostate gland secretes citrate ions, calcium, phosphate ions and profibrinolysin. Prostatitis: Inflammation of prostate gland.

(c) Bulbourethral glands or Cowper's glands: The two bulbourethral glands are pea sized structures lying adjacent to the urethra at the base of penis. They secrete a viscous mucus which acts as a lubricant.

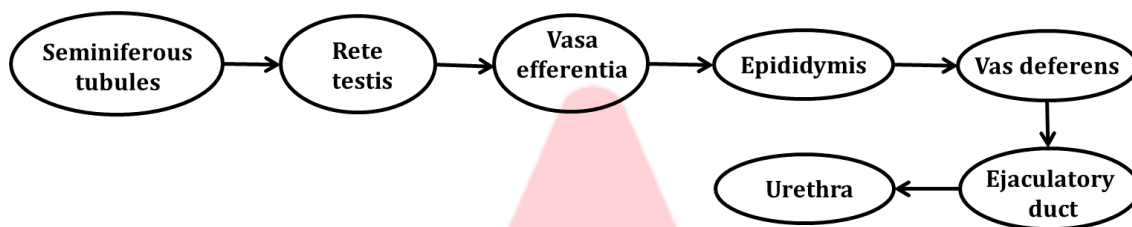
The duct system, accessory glands and penis are secondary male sex organs. Their growth, maintenance and functions are promoted by testosterone, secreted by Leydig cells. On the other hand, the growth, maintenance and functions of seminiferous tubules and Leydig cells are regulated respectively by FSH and ICSH of anterior pituitary.

2.1.3 Semen

Semen is a mixture of sperms and seminal fluid, which is the liquid portion of semen that consists of secretions of the seminiferous tubules, seminal vesicles, prostate gland and bulbourethral glands. The average volume of semen in an ejaculation is 2.5-5 ml, with a sperm count (concentration) of 200 to 300 million sperms. Out of these sperms, for normal fertility, atleast 60 percent sperms must have normal shape and size and at least 40 percent of them must show vigorous motility. When the number of sperms falls below 20 million/ml, the male is likely to be infertile.

Semen has a slightly alkaline pH of 7.2-7.7, due to the higher pH and larger volume of fluid from the seminal vesicles. The prostatic secretion gives semen a milky appearance whereas the fluids from the seminal vesicles and bulbourethral glands give it a sticky consistency. Semen provides sperms with transportation medium and nutrients. It neutralizes the hostile acidic environment of the male urethra (due to presence of urine) and the female vagina.

2.1.4 Path of Sperm Through The Male Body



2.1.5 Delivery of Sperm:

The urethra passes through the penis, an erectile copulatory organ that deposits the semen

in the female reproductive tract. The penis is the male external genitalia, made up of three cylinders of special spongy tissue. Filling of blood in these tissue helps in erection of the penis that facilitate insemination. The enlarged end of the penis is called the glans penis, covered with a loose fold of skin called foreskin or prepuce. Semen is forcefully expelled from the penis by the contractions of smooth muscles that line the urethra. This process is ejaculation.

TOPIC CENTRIC EXERCISE 01

- Q1. Which part of the male reproductive system stores sperm?
 - (a) Epididymis
 - (b) Vas deferens
 - (c) Seminal vesicles
 - (d) Prostate gland
- Q2. What is the function of the seminal vesicles?
 - (a) Produce testosterone
 - (b) Store sperm
 - (c) Produce seminal fluid
 - (d) Regulate ejaculation
- Q3. The regions outside the seminiferous tubules that contain Leydig cells are called
 - (a) Interstitial spaces
 - (b) Antrum
 - (c) Scrotum
 - (d) None of these
- Q4. Which one is odd from the following structures with reference to the male reproductive system
 - (a) Rete testis
 - (b) Epididymis
 - (c) Vasa efferentia
 - (d) Isthmus
- Q5. Epididymis is located in.... of testis.
 - (a) Anterior surface
 - (b) Posterior surface
 - (c) Lateral surface
 - (d) Anterolateral surface

2.2 THE FEMALE REPRODUCTIVE SYSTEM

The female reproductive system consists of a pair of ovaries, a duct system consisting of a pair of fallopian tubes (oviducts), a uterus, cervix and vagina. A pair of mammary glands are accessory genital glands.

2.2.1 Ovaries

The ovary is the primary female sex organ. It produces ova and secretes the female sex hormones, estrogens and progesterone which are responsible for the development of secondary female sex characters and cause marked cyclic changes in the uterine endometrium. The human ovaries are small, almond-like flattened bodies, about 2 to 4 cm in length and is connected to the pelvic wall and uterus by ligaments.

2.2.2 Location: Ovaries are located near kidneys and remain attached to the lower abdominal cavity through mesovarium.

2.2.3 Structure: The free surface of the ovaries is covered by a germinal epithelium composed of a single layer of cubical cells. This epithelium is continuous with the mesothelium lining called peritoneum. The epithelium encloses the ovarian stroma. The stroma is divided into two zones—a peripheral cortex and an inner medulla. Immediately below the germinal epithelium, the cortex is covered by a connective tissue called tunica albuginea.

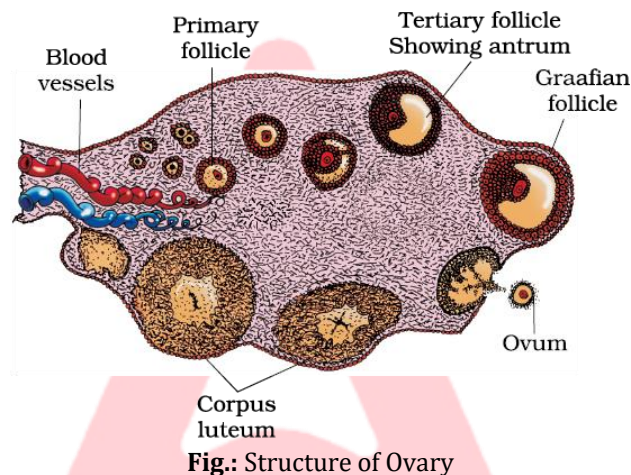


Fig.: Structure of Ovary

The cortex contains numerous spherical or oval, sac-like masses of cells known as ovarian follicles. The medulla consists of loose connective tissue, elastic fibres, numerous blood vessels and some smooth muscle fibres.

2.2.4 Internal Structure:

- Ovarian follicle:** The ovarian follicle contains a large, centrally placed ovum, surrounded by several layers of granular cells (follicular granulosa or discus proligerus or cumulus oophorus). It is suspended in a small cavity called the antrum. Antrum is filled with a fluid known as liquor folliculi. The secondary oocyte in the tertiary follicle also forms a new membrane called zona pellucida. The follicle bulges onto the surface of the ovary. Such a follicle is called the mature Graafian follicle (after de Graaf, who reported them in 1672 and considered them to be eggs).
- Corpus luteum:** The ovum is shed from the ovary by rupture of the follicle. The shedding of the ovum is called ovulation and occurs nearly 14 days before the onset of the next menstrual cycle. After the extrusion of the ovum, what remains in the Graafian follicle is called corpus luteum (yellow body). The cytoplasm of the corpus luteum is filled with a yellow pigment called lutein. The corpus luteum grows for a few days and if the ovum is fertilized and pregnancy results, it continues to grow. But if the ovum is not fertilized, the corpus luteum persists only for about 14 days and during this period, it secretes progesterone and small amount of estrogen. At the end of its functional life, the corpus luteum degenerates and is converted into a mass of fibrous tissue called corpus albicans (white body).

2.2.5 Fallopian Tubes (Oviducts)

These are one pair of long (10 to 12 cm), ciliated, muscular and tubular structures which extend from the periphery of each ovary to the uterus. Each oviduct is suspended by mesosalpinx and is differentiated into three parts:

- (i) **Infundibulum:** The part of oviduct closer to the ovary is the funnel shaped infundibulum. The edges of infundibulum possess finger-like projections called fimbriae. Fimbriae help in the collection of the ovum after ovulation. Infundibulum opens into the abdominal cavity by an aperture called ostium.
- (ii) **Ampulla:** The infundibulum leads to a wider part of the oviduct called ampulla.
- (iii) **Isthmus:** It is the last and narrow part having narrow lumen that links to the uterus.

The tube is involved in conduction of the ovum or zygote towards the uterus by peristalsis and ciliary action. It is also the site of fertilization. (Fertilization occurs at the junction of ampulla and isthmus).

2.2.6 Uterus (Hystera/Womb)

It is a large hollow, muscular, highly vascular and inverted pear shaped structure present in the pelvis between the bladder and rectum. It is suspended by a mesentery, the mesometrium. It has the following three parts.

- (i) **Fundus:** It is upper, dome-shaped part above the opening of fallopian tubes.
- (ii) **Corpus/Body:** It is the middle and main part of uterus.
- (iii) **Cervix:** It is lower, narrow part which opens in body of uterus by internal os and in vagina below by external os. It is mainly formed of the most powerful sphincter muscles in the body. The cavity of the cervix is called Cervical canal which along with vagina forms the birth canal.

Wall of uterus: The wall of uterus is formed of outer peritoneal layer, perimetrium; middle muscular myometrium of smooth muscle fibres, and inner highly vascular and glandular endometrium. The endometrium undergoes cyclical changes during menstrual cycle while myometrium exhibits strong contractions during delivery of the baby. Implantation of embryo occurs in uterine fundus.

It is the site of foetal growth during pregnancy. It also takes part in placenta formation and expulsion of the baby during parturition.

2.2.7 Vagina

It is a long (8.5 cm), fibro-muscular tube. It extends backward in front of rectum and anal canal from cervix to the vestibule. It is a highly vascular tube lined internally by mucus membrane which is raised into transverse folds called vaginal rugae. It is lined with stratified squamous epithelium (Non Keratinised). Vagina is devoid of glands. Vaginal orifice is covered partially by a membranous diaphragm called hymen. The hymen is often ruptured during the first coitus (intercourse). However, it can also be broken by a sudden fall or jolt, insertion of a vaginal tampon, active participation in some sports like horseback riding, cycling etc. In some women the hymen persists even after coitus, In fact, the presence or absence of hymen is not reliable indicator of virginity or sexual experience.

Vagina acts both as copulation canal (as it receives the sperms from penis during copulation) and as birth canal along with cervix (during parturition).

2.2.8 External Genitalia

The external genital structures of the female reproductive system are collectively called the vulva. The female external genitalia or vulva includes mons pubis, labia majora, labia minora, hymen and clitoris. Mons pubis is a cushion of fatty tissue covered by skin and pubic hair. The labia majora are fleshy folds of skin, which extend down from mons pubis and surround the vaginal opening. The labia minora are paired folds of tissue in the form of lips under the labia majora. The opening of vagina is often covered partially by a membrane called hymen. The clitoris is a tiny finger-like structure which lies at the upper junction of the two labia minora above the urethral opening. It is formed of two erectile bodies and is covered by skin fold called prepuce. It has a depression, the vestibule, in front of anus. Vestibule has two apertures-upper external urethral orifice and lower vaginal orifice.

Vestibule is bounded by two pairs of moist skin folds called labia minora and labia majora. Labia majora is homologous to scrotum. Labia minora fuse anteriorly to form a skin fold called prepuce in front of a small

erectile organ, the clitoris which is homologous to penis as both are supported by corpora cavernosa. Labia minora also fuse posteriorly to form a membranous fold called fourchette. The area between the fourchette and the anus is called perineum. There is fleshy elevation above the labia majora and is known as mons veneris (mons pubis) which has pubic hair.

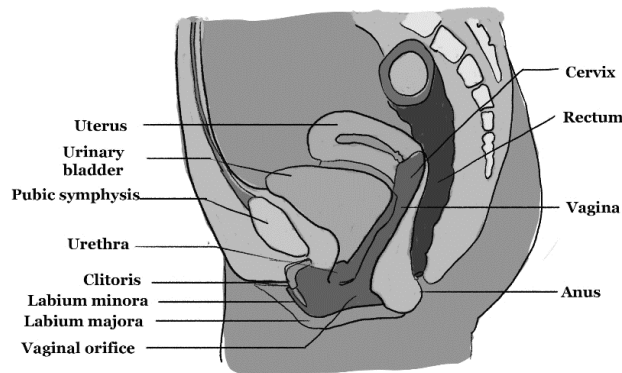


Fig.: Female pelvis showing reproductive system

2.2.9 Accessory Glands

Vestibular Glands: These are of two types-greater and lesser. Greater vestibular or Bartholin's glands are a pair of small reddish yellow glands on each side of vaginal orifice and secrete alkaline secretion for lubrication and neutralising urinary acidity. Lesser vestibular glands or paraurethral or skene's glands are small mucus glands present between urethral and vaginal orifices.

2.2.10 Mammary Glands/Breasts

There are a pair of rounded prominences present over the pectoralis major muscles on the front wall of the thorax. These remain in rudimentary form in male. In females, these remain undeveloped till puberty. At puberty, these start developing under the influence of oestrogen and progesterone hormones. On the external side, each breast has a projection, the 'nipple' surrounded by rounded hyperpigmented area called areola and appear deep pink or light brown. On the surface of the areola, numerous sebaceous glands, called areolar glands are present.

Internally, the breast consists of the glandular tissue forming mammary glands, the fibrous tissue (connective tissue) and the fatty or adipose tissue. Mammary glands are modified sweat glands.

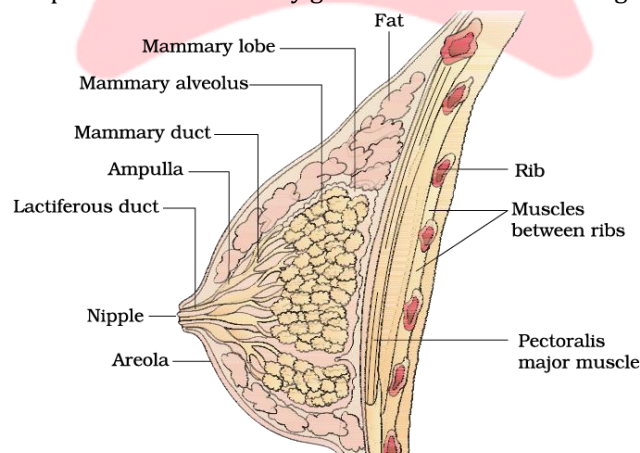


Fig.: Sectional view of Mammary gland

- (a) The glandular tissue comprises about 15-20 lobes in each breast. Each lobe is made up of a number of lobules. Each lobule is composed of grapelike clusters of milk secreting glands termed alveoli. When milk is produced it passes from the alveoli into the mammary tubules and then into the mammary ducts. Near the nipple, mammary ducts expand to form mammary ampullae (= lactiferous sinuses)

where some milk may be stored before going to lactiferous ducts. Each lactiferous duct typically carries milk from one of the lobes to exterior.

Mammary alveoli Mammary tubule Mammary duct Mammary ampulla Lactiferous duct.

- (b) The fibrous tissue (connective tissue) supports the alveoli and the ducts.
- (c) The fatty or adipose tissue is found between the lobes and covers the surface of the gland. The amount of the adipose tissue determines the size of the breasts.

Main functions of the mammary glands are secretion and ejection (release) of milk. These functions are called lactation. Lactation is associated with pregnancy and child birth. Milk production is stimulated largely by the hormone prolactin secreted by anterior lobe of the pituitary gland. The ejection of milk is stimulated by the hormone oxytocin, released from the posterior lobe of the pituitary gland.

Human milk consists of water and organic and inorganic substances. Its main constituents are fat (fat droplets), casein (milk protein), lactose (milk sugar), mineral salts (sodium, calcium, potassium, phosphorus, etc) and vitamins. Milk is poor in iron content. Vitamin C is present in very small quantity in milk. The process of milk secretion is regulated by the nervous system. It is also influenced by the psychic state of the mother. The process of milk production is also influenced by hormones of the pituitary gland (already mentioned), the ovaries and other endocrine glands. A nursing woman secretes 1 to 2 litres of milk per day.

TOPIC CENTRIC EXERCISE 02

- Q1. Which structure connects the ovary to the uterus?**
 (a) Fallopian tube (b) Cervix
 (c) Vagina (d) Broad ligament
- Q2. What is the purpose of the fimbriae?**
 (a) Capture ovulated egg (b) Produce estrogen
 (c) Regulate menstrual cycle (d) Support fetal growth
- Q3. Which structure forms the lower part of the female reproductive tract?**
 (a) Fallopian tube (b) Vagina
 (c) Uterus (d) Ovary
- Q4. A tiny finger-like structure that lies at the upper junction of the two labia minora is**
 (a) Hymen (b) Mons pubis
 (c) Clitoris (d) None of these
- Q5. Which group represents external genitalia of human female?**
 (a) Labium minora, labium majora, vagina (b) Labium minora, labium majora, cervix
 (c) Labium minora, labium majora, clitoris (d) Labium minora, labium majora, oviducts

2.3 GAMETOGENESIS

The primary sex organs the testis in the males and the ovaries in the females, produce gametes i.e. sperms and ovum respectively, by the process called gametogenesis.

2.3.1 Spermatogenesis

In testis, the immature male germ cells, spermatogonia produce sperms by a process spermatogenesis that begins at puberty. Spermatogenesis occurs in four stages:

(i) **Spermatocytogenesis,**

(ii) **Meiosis-I,**

(iii) **Meiosis-II and**

(iv) **Spermiogenesis.**

(i) **Spermatocytogenesis:** In spermatocytogenesis, the spermatogonia present on the inside wall of the seminiferous tubules multiply by mitotic division and increase in numbers. Each spermatogonia is diploid containing 46 chromosomes. Some spermatogonia undergo changes they grow, increase in size by

accumulating nourishing materials and are called primary spermatocytes which periodically undergo meiosis and others remain as spermatogonia.

- (ii) Meiosis-I: A primary spermatocyte is diploid, ($2n$) with $44 + XY$ (total 46) chromosomes. It completes the first meiotic division (reduction division) leading to the formation of two equal, haploid cells called secondary spermatocytes, which have only 23 chromosomes each i.e. $22 + X$ or $22 + Y$.
- (iii) Meiosis-II: The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid spermatids. The number of chromosomes in each spermatid is 23.
- (iv) Spermiogenesis: Transformation of spermatid into sperm is termed spermiogenesis. A spermatid is non-motile and heavy. It has organelles like mitochondria, Golgi bodies, centrioles, nucleus etc. During spermiogenesis, the weight of gamete is reduced along with the development of locomotory structures. Nucleus becomes compact forming the major part of head of spermatozoa. Golgi complex of spermatid gives rise to acrosome. The two centrioles of the spermatids become arranged one after the other behind the nucleus. Mitochondria from different parts of spermatid get arranged in the middle piece around axial filament. Much of the cytoplasm of a spermatid is lost. It forms a thin layer around middle piece. A typical mammalian sperm is flagellated, consisting of four parts namely head, neck, middle piece and tail. The human sperm was first seen by Hamm and Leeuwenhoek. After spermiogenesis the sperm heads become embedded in the Sertoli cells, and are finally released from the seminiferous tubules by the process called spermiation.

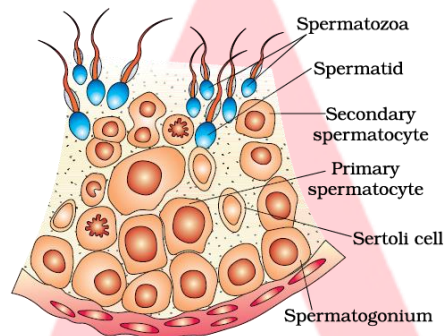


Fig.: Diagrammatic sectional view of a seminiferous tubule

In spermatogenesis from one primary spermatocyte four haploid sperms are formed.

Hormonal Control of Male Reproductive System: Spermatogenesis starts at the age of puberty due to significant increase in the secretion of gonadotropin releasing hormone (GnRH) from hypothalamus. The increased levels of GnRH then acts at the anterior pituitary gland and stimulates secretion of two gonadotropins luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts at the Leydig cells and stimulates synthesis and secretion of androgens. Androgens, in turn, stimulate the process of spermatogenesis. FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of Spermiogenesis. Sertoli cells also secrete another protein, hormones called inhibin, which suppresses FSH synthesis. So, FSH along with testosterone stimulate the sperm production in the seminiferous tubules.

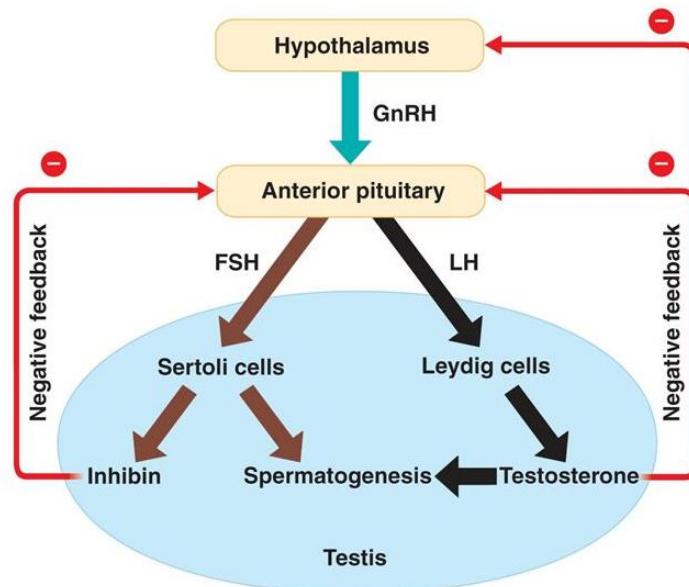
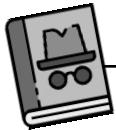


Fig.: Hormonal control of the testes



Clue Finder

1. A woman's reproductive life generally ends at menopause, due to exhaustion of ovarian follicles which occurs at the age of around 50 years. At what age men can no longer be father of children? A man's reproductive life never ends, unless disability or disease renders him unable to become a father. Adult male produce 100 to 200 million sperms each day and can continue doing so throughout their life.
2. Many different types of sperm abnormalities occur. A common classification scheme is based on the location of the abnormalities. Those that are located in the sperm head are classified as primary. Abnormalities associated with neck, middle piece or tail are classified as secondary abnormalities. Primary defects are more severe and are thought to originate while the sperm is still within the seminiferous epithelium of the testes. Secondary defects are less serious and are thought to arise during passage through the epididymis or by mishandling after ejaculation.

2.3.2 Structure of Mature Sperm: Mature sperm cell consists of a head, a neck, a middle piece and a tail. A plasma membrane envelops the whole body of sperm. The sperm head contains a very little cytoplasm, an elongated haploid nucleus, the anterior portion of which is covered by a cap-like structure, acrosome. The acrosome is filled with enzymes that help in fertilisation of ovum. These enzymes called sperm lysins that dissolve the membranes enveloping the ovum and help the sperm cell to enter the ovum. Acrosome is derived from golgi apparatus. Its membrane extends down the outer surface of nucleus. The short neck, contains two distinct granules the proximal and distal centrioles. The proximal centriole plays a crucial role during the first cleavage of the fertilised ovum. The distal centriole gives rise to the axial filament of the long tail of the sperm. The middle piece possesses numerous mitochondria (25 to 30 arranged spirally) which produce energy for the movement of tail that facilitates sperm motility essential for fertilisation, that is why it is called as the power house of the sperm. The tail is made up of a central axial filament surrounded by a small amount of cytoplasm and cell membrane as external sheath. The sperms move by swimming at the rate of 1.5 to 3 mm per minute to reach the site of fertilisation within 30 minutes.

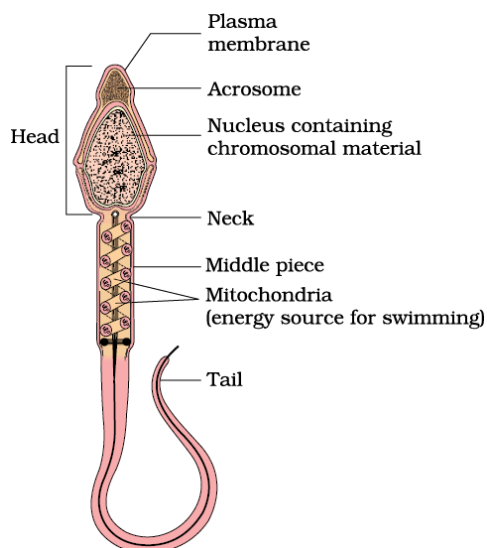
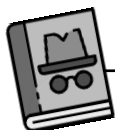


Fig: Structure of a sperm

The human male ejaculates semen in female tract during coitus, containing 200 to 300 million sperms. For normal fertility, at least 60 percent of these sperms must have normal shape and size and at least 40 percent of them must show vigorous motility.

Sperms released from seminiferous tubules, are transported by the accessory ducts, secretions of epididymis, vas deferens, seminal vesicle and prostate are essential for maturation and motility of sperms. The functions of the male accessory ducts and glands are maintained by the testicular hormones (androgens).



Clue Finder

Why are so many sperms produced by the male reproductive system? Although male ejaculate has 200 to 300 million sperms, very few of them reach the site of fertilisation. Most sperms are killed by the acidic environment of the female reproductive tract. So many sperms are needed to increase the likelihood of fertilisation.

2.3.3 Oogenesis

The process of formation of a mature female gamete is called oogenesis which is markedly different from spermatogenesis. Oogenesis is initiated during the embryonic development stage when a couple of million gamete mother cells (oogonia) are formed within each fetal ovary; no more oogonia are formed or added after birth. Scattered ovarian follicles are embedded in the stroma of cortex.

An ovarian follicle consists of an oocyte, surrounded by one or more layers of follicular (flat epithelial) cells, the granulosa cells, which are derived from the germinal epithelium lining the ovary. The oogonial cells start division and enter into prophase-I of the meiotic division, and get temporarily arrested at this stage called primary oocytes. Each primary oocyte gets surrounded by a layer of granulosa cells and then called primary follicle.

A large number of these follicles degenerate from birth to puberty. Degeneration of ovarian follicles is called follicular atresia and their disposal is done by phagocytes. Therefore, at puberty only 60,000 to 80,000 primary follicles are left in each ovary. With the onset of puberty, a primary follicle begins to mature with each ovarian cycle. The follicular cells become cuboidal, divide by mitosis to form a stratified epithelium, the granulosa layer. So, the primary follicles get surrounded by more layers of granulosa cells and a new theca, called secondary follicles. Granulosa cells rest on a basement membrane and the surrounding stromal cells form theca folliculi. The secondary follicle soon transforms into a tertiary follicle which is characterised by a fluid filled cavity

antrum, which appears between the granulosa cells. Initially, the antrum is crescent shaped, but with time it greatly enlarges. The fluid of antrum is liquor folliculi. As the follicles grow, the theca folliculi become organised into inner layer of secretory cells, the theca interna and an outer layer of connective tissue cells containing fibroblast-like cells, the theca externa. The maturing oocytes adhere to the wall of the follicle through a pedicel/stalk, cumulus oophorus, formed by granulosa cells, and remains suspended in liquor folliculi. Theca interna is composed of cells having characteristics of steroid secretion, rich in blood vessels and theca externa gradually merges with ovarian stroma.

The primary oocyte within the tertiary follicle grows in size and completes its first meiotic division at puberty. It is an unequal division resulting in the formation of a large haploid secondary oocyte and a tiny first polar body. The secondary oocyte retains the bulk of nutrient rich cytoplasm of the primary oocyte. The tertiary follicle changes into the mature follicle or Graafian follicle.

The secondary oocyte forms a new membrane called Zona pellucida surrounding it. This thick coat of zona pellucida is composed of glycoproteins and synthesised by oocyte. Later, the granulosa cells lying in close vicinity of the ovum and zona pellucida, become elongated to form the corona radiata. In the presence of LH hormone, the Graafian follicle now ruptures to release the secondary oocyte developing (ovum) from the ovary by the process called ovulation. After ovulation the ruptured follicle left in the ovary is converted to a structure called corpus luteum, which secretes mainly progesterone.

❖ **What accounts for the large difference in the size of sperm and eggs?**

During spermatogenesis excess cytoplasm of sperm is also absorbed by the sertoli cell during spermiogenesis. The difference in the sizes of sperm and eggs is due to the difference between the process of sperm formation (spermatogenesis) and egg formation (oogenesis). During spermatogenesis, equal divisions of the cytoplasm follow meiosis-I and meiosis-II, resulting in four equal-sized sperm cells having little cytoplasm. During oogenesis, unequal divisions of the cytoplasm follow meiosis-I and meiosis-II, resulting in formation of one large egg and two or three small polar bodies. Polar bodies later on degenerate.

❖ **Does the first polar body born out of first meiotic division divide further or degenerate?**

In human beings and most vertebrates, the 1st polar body does not undergo meiosis-II, and usually dies. However, in some species 1st polar body undergoes meiosis-II.

❖ **Why is unequal division of cytoplasm seen in meiotic division?**

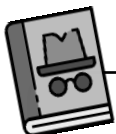
Due to the unequal division of cytoplasm, the mature egg or ovum, retains most of the cytoplasm, which provides nutrients for the ovum during the early stages of development.

❖ **In human beings from one primary oocyte, a single ovum and two polar bodies are formed. The ovum is released from the ovary in secondary oocyte stage after the release of 1st polar body.**



Clue Finder

Generally, only one ovum is liberated in each menstrual cycle (average duration 28 days) by alternate ovaries. Each ovary releases six ova in one year. Only about 400 to 450 ova are produced by human female over the entire span of her reproductive life which lasts about 35 to 40 years.



Clue Finder

Sometimes, two or more follicles reach maturity in one month or cycle, so more than one oocyte may be ovulated. This is the commonest cause of multiple births. In such cases the siblings are fraternal, not identical.

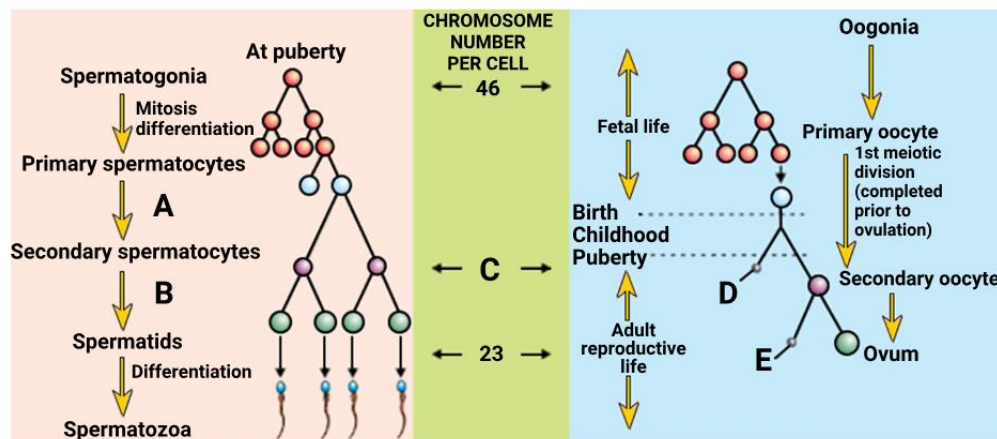


Fig.: Schematic representation of (a) Spermatogenesis; (b) Oogenesis

TOPIC CENTRIC EXERCISE 03

- Q1. The division of primary oocyte results in:**
 (a) unequal cells a smaller haploid secondary oocyte and a larger diploid polar body
 (b) unequal cells a larger haploid secondary oocyte and a smaller haploid polar body
 (c) unequal cells a smaller diploid secondary oocyte and a larger haploid polar body
 (d) equal cells - a haploid secondary oocyte and a haploid polar body
- Q2. What causes the onset the puberty in males?**
 (a) Increase in secretion of testosterone by testis
 (b) Decrease in secretion of testosterone by testis
 (c) Increase in secretion of GnRH by hypothalamus
 (d) Decrease in secretion of GnRH by hypothalamus
- Q3. The spermatids are transformed into spermatozoa by the process called:**
 (a) Spermiation (b) Spermatocytogenesis
 (c) Spermiogenesis (d) Spermatolysis
- Q4. The primary oocyte completes its first meiotic division within the:**
 (a) Primary follicle (b) Secondary follicle
 (c) Tertiary follicle (d) Graafian follicle
- Q5. In the male human being, sperms contain autosomes and**
 (a) Only one Y-chromosome (b) Only one X-chromosome
 (c) Both X and Y-chromosome (d) Either X or Y-chromosome
- Q6. In the vertebrates testes, for nourishment during spermiogenesis, the spermatids get attached to**
 (a) Interstitial cells (b) Sperm-mother cells
 (c) Spermatocytes (d) Sertoli cells

2.4 MENSTRUAL CYCLE

The reproductive cycle in the female primates (e.g., monkeys, apes and human beings) is called menstrual cycle. The first menstruation begins at puberty and is called menarche. In human females, menstruation is repeated at an average interval of about 28/29 days, and the cycle of events from one menstruation till next one is called the menstrual cycle. One ovum is released (ovulation) during the middle of each menstrual cycle of 28 days. The major events of the menstrual cycle are shown in the figure.

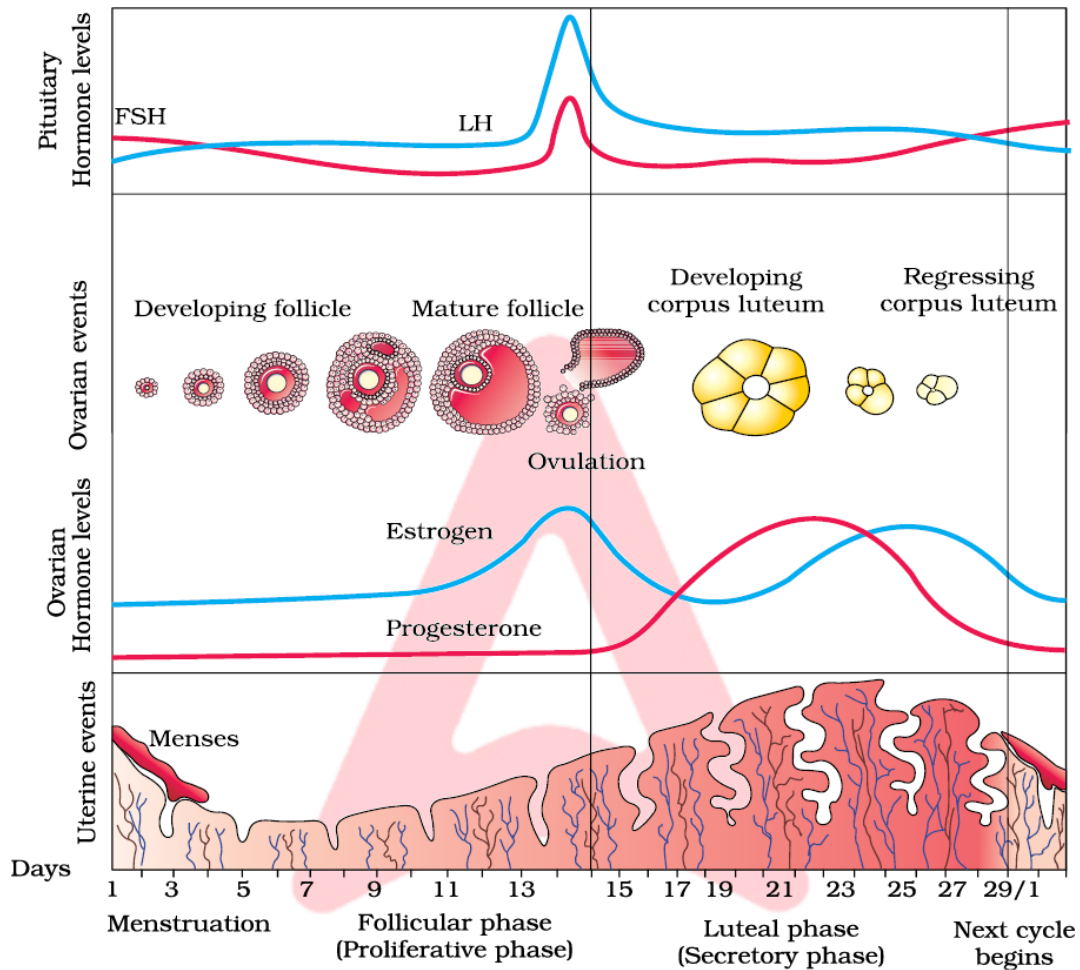
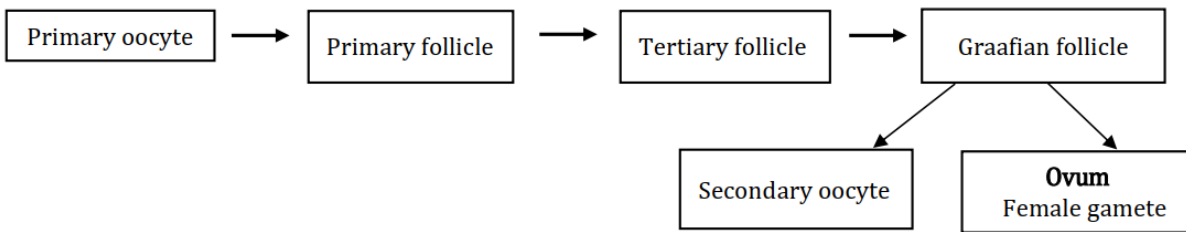


Fig.: Diagrammatic presentation of various events during a menstrual cycle

2.3.4 Phases of Menstrual Cycle

(i) Menstrual phase

(ii) Follicular phase

(iii) Ovulation

(iv) Luteal/Secretory phase

(i) **Menstrual phase:** Menstrual flow occurs in this phase and it lasts for 3 to 4 days. This flow results due to the breakdown of endometrial lining of the uterus and its blood vessels which forms a liquid and flows out through the vagina. Menstruation usually occurs about 14 days after ovulation, if the released ovum is not fertilised. Lack of menstruation may be indicative of pregnancy.

**Clue Finder**

Certain environmental factors, such as stress, poor health, poor diet, prolonged strenuous exercise, can also affect the menstrual cycle and lead to lack of menstruation. These factors can influence hormone levels i.e. secretion of gonadotropins by anterior lobe of pituitary, thus disrupting one or more phases of cycle.

The total amount of blood discharged in one cycle is 30 to 50 ml. This blood forms clot in the uterus, later fibrinolytic enzyme from the uterus dissolves the clot so the blood in the menses always remains in liquid state.

(ii) Follicular phase: The menstrual phase is followed by the follicular phase. During this phase, primary (follicles in ovary grow to become a fully mature Graafian follicle and simultaneously the endometrium of uterus regenerates through proliferation. These changes in the ovary and the uterus are induced by changes in the levels of pituitary gonadotropins and ovarian hormones. Secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase, and stimulates follicular development and secretion of estrogens by the growing follicles. FSH hormone stimulates follicular growth. The follicular cells secrete estrogen, a sex hormone that also aids in the growth of the follicle. Estrogen hormone stimulates mitotic divisions of the cells in the lining of uterus, and helps to repair the broken tissue and blood vessels. It also causes the thickening of the endometrium. Both FSH and LH attain a peak level in the middle of each cycle, on 14th day of 28th day cycle. During this phase, the estrogen level in the blood continues to rise until it reaches the peak and the Graafian follicle moves to the surface of ovary. The elevated estrogen levels acts as positive feedback mechanism by stimulating the anterior lobe of pituitary to secrete luteinising (LH) hormone, which initiates the next stage of menstrual cycle. Rapid secretion of LH leading to its maximum level during the mid-cycle called as LH surge induces the rupture of Graafian follicle and thereby the release of ovum (ovulation).

**Clue Finder****What is ovarian cycle?**

Series of events occurring in the ovary during menstrual cycle is called as the ovarian cycle. The ovarian cycle is regulated by hormones produced by hypothalamus and pituitary.

(iii) Ovulation: LH induces ovulation which usually occurs on 14th day in the 28 days cycle. The Graafian follicle ruptures and secondary oocyte (ovum) is released.

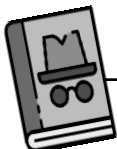
Day of ovulation = Number of days in M cycle 14

(iv) Luteal phase/Secretory phase: Following ovulation, an egg is swept into the fallopian tube, where it awaits fertilisation as it travels through the tube towards uterus. The egg has stored nutrients to survive about 24 hours. The ovulatory phase is followed by luteal phase during which the remaining parts of Graafian follicle transform as Corpus luteum in the ovary.

Corpus luteum secretes large amounts of progesterone which is essential for maintenance of endometrium which is thickened by estrogen. In luteal phase, the endometrium further thickens due to estrogen hormone also secreted by corpus luteum. LH hormone causes the cells of the ruptured follicle to form corpus luteum. A corpus luteum is a yellowish mass of follicular cells that functions like an endocrine structure. LH hormone also stimulates the corpus luteum to secrete estrogen and progesterone. Estrogen and progesterone inhibit the release of FSH and LH. This prevents the development of new follicles during the luteal phase. Luteal phase lasts for 14 days. During this phase, the levels of estrogen and progesterone

will rise, while FSH and LH levels drop. Low level of LH causes, degeneration of corpus luteum leading to sudden decline in progesterone level that causes menstruation.

Maintenance of endometrium by progesterone is necessary for implantation of the fertilised ovum and maintenance of pregnancy. During pregnancy all the events of the menstrual cycle stop and there is no menstruation due to high level of progesterone.



Clue Finder

- Sometimes women wish to postpone the menstrual bleeding for few days to participate, in some competitive sports or religious function, she should take progesterone like drugs. High level of progesterone maintains endometrium.
- Menopause is a senile change which occurs in the ovaries around the age of 50 years. At this time, a woman no longer ovulates and thus moves out of childbearing phase. All the ovarian follicles have degenerated and there is deficiency of estrogen and progesterone hormone. FSH and LH are being produced by anterior lobe of pituitary, but now ovary is not responding to these hormones.

In the absence of fertilisation, the corpus luteum degenerates; the level of progesterone hormone will fall. This causes disintegration of the endometrium leading to menstruation, marking a new cycle. In human beings, menstrual cycles ceases around 50 years of age, termed as menopause. Cyclic menstruation is an indicator of normal reproductive phase and extends between menarche and menopause.



Critical Thinking

Estrous Cycle: The estrous cycle consists of cyclic changes in the female reproductive system of non-primate mammals. There is no menstruation at the end of estrous cycle. The estrogen level in blood increases resulting in a strong sex urge in the female. This is called "period of heat". The estrous cycles run only during breeding season. The estrous cycles remain suspended in female during non-breeding season. The suspension of estrous cycles is called anestrus. The animals that have only a single estrous cycle during the breeding season are called monoestrous, e.g., fox, deer, bat, etc, and animals that have a recurrence of estrous during breeding season are called polyestrous, e.g., Mouse, squirrel, cow, sheep, pig, horse etc.

TOPIC CENTRIC EXERCISE 04

- Q1. Which hormone is mainly secreted by the developing follicles during the proliferative phase of the menstrual cycle?**
- (a) LH (b) FSH
(c) Progesterone (d) Estrogen
- Q2. Which of the following hormones show two peaks during a standard menstrual cycle?**
- (a) Estrogen (b) Progesterone
(c) LH (d) FSH
- Q3. Which of the following occur during pre ovulatory phase?**
- a. Formation of corpus hemorrhagicum
b. Luteal phase
c. Secretory phase
d. Follicular phase

| | | |
|------------|--|---------------------|
| | e. Proliferative phase | |
| | (a) d & e only | (b) a, b & c only |
| | (c) a, b & e only | (d) c & d only |
| Q4. | Ovulation in the human female normally takes place during which phase of the menstrual cycle: | |
| | (a) Just before the end of the secretory cycle. | |
| | (b) At the beginning of the proliferative phase. | |
| | (c) At the end of the proliferative phase. | |
| | (d) At the mid-secretory phase. | |
| Q6. | Which phase of the menstrual cycle is characterized by uterine shedding? | |
| | (a) Proliferative phase | (b) Secretory phase |
| | (c) Ovulatory phase | (d) Menstrual phase |
| Q7. | Which phase of the menstrual cycle is characterized by follicular growth? | |
| | (a) Proliferative phase | (b) Secretory phase |
| | (c) Ovulatory phase | (d) Luteal phase |

2.5 FERTILISATION AND IMPLANTATION

During copulation (coitus) semen is released by the penis into the vagina of female, called insemination. A human sperm can live for many weeks in male genital duct. Once ejaculated in the semen, it lives only for 48 to 72 hours outside the body. Sperms move in the liquid medium secreted by female genital tract at a speed of 1.5-3.0 mm/minute. Prostaglandins of semen help in the movement of spermatozoa.

Once the sperms are released Capacitation of sperm occurs in the female genital system and involves :

- Removal of membrane cholesterol present over acrosome, weakening the membrane cover.
- Dilution of decapacitation factors.
- Entry of Ca^{2+} into sperms causing rapid whiplash movements of the tail part. They swim through the vagina, cervix, uterus and finally reach the junction of the isthmus and ampulla called ampullary-isthmic junction of the fallopian tubes. The ovum released by the ovary is also transported to the ampullary isthmic junction where fertilisation occurs. Ovum is released in the secondary oocyte stage (arrested in metaphase-II). Due to ciliary current produced by fimbriae portion of oviduct, ovum is drawn in through ostium. It reaches ampulla, the site of fertilization, by the ciliary action of ciliated columnar epithelial lining of oviduct. Fertilisation can only occur if the ovum and the sperms are transported simultaneously to the ampullary isthmic-junction. This is the reason why not all copulations lead to fertilisation and pregnancy.

The process of fusion of a sperm with the ovum is called fertilisation.



Critical Thinking

The vacuum created in the uterine cavity in between successive contractions allows aspiration of the sperms passively from the vagina. During their ascent through the female genital tract, the spermatozoa are gradually reduced in number by the barriers provided by abrupt contractions at the cervix and uterine ostium of the tube. As a result 300-500 sperms appear at the site of fertilization. This is probably a method of natural selection so that only the compatible spermatozoa are allowed to enter the uterine tube.

2.5.1 Fusion of Gametes/Syngamy: The various steps involved are:

Acrosomal reaction: A number of sperms adhere to the surface of egg (Agglutination). The acrosome starts releasing its hydrolytic enzymes or sperm lysins which include

- Hyaluronidase:** Dissolves the hyaluronic acid responsible for cementing of follicle cells or granulosa cells.
- Corona penetrating enzyme (CPE):** Dissolves corona radiata.
- Zona lysin/Acrosin:** Digests the zona pellucida.

Contact of acrosome stimulates development of an outgrowth by the oocyte called fertilisation cone or cone of reception.

2.5.2 Cortical And Zona Reactions: As the sperm head comes in contact with the fertilization cone, it causes opening of Na^+ channels to cause depolarisation of ovum membrane (fast block to check polyspermy) and Ca^{2+} move into the egg. Sperm and egg membranes dissolve. Complete sperm enters cytoplasm of egg and the envelope is left out. Ca^{2+} influx causes extrusion of cortical granules (cortical reaction) and zona reactions which make the zona pellucida impervious to second sperm by destroying sperm receptors.



Critical Thinking

Disintegration of cells of cumulus oophorus and corona radiata takes place by the liberation of hyaluronidase from the acrosomal cap. Zona pellucida is now exposed. The sperm-head now binds to specific glycoprotein receptors ZP3 of zona pellucida and induces acrosome reaction to release acrosin which digests the zona pellucida. Now the sperm head appears in perivitelline space and fuses with the vitelline membrane. This is done by two disintegrin peptides carried by sperm head which open the gate for sperm to enter in the oocyte. As a result a calcium wave sets in throughout the oocyte cytoplasm. This initiates completion of second meiotic division of the secondary oocyte which results in formation of mature ovum with extrusion of second polar body.

Cortical reaction and zona reaction constitute slow block to check polyspermy.

The entry of sperm into the ovum induces completion of the meiotic division of the secondary oocyte. Entry of sperm causes breakdown of metaphase promoting factor (MPF) and turns on anaphase promoting complex (APC). This results in completion of meiosis-II. The second meiotic division is also unequal and results in the formation of a second polar body and a haploid ovum (ootid). Soon the haploid nucleus of the sperm and that of ovum fuse together to form a diploid zygote.

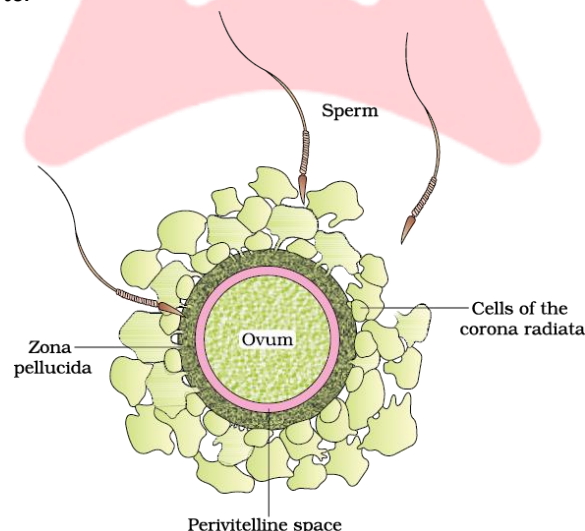


Fig. : Ovum surrounded by few sperms

Each gamete contains 23 chromosomes, the haploid (n) number. Thus, fusion of a sperm nucleus and an egg nucleus makes a zygote that have 46 chromosomes, thus restoring the diploid ($2n$) number.

Male and female pronuclei approach each other and finally mixing up of paternal and maternal chromosomes (Amphimixis) occurs resulting in the formation of synkaryon/zygote.

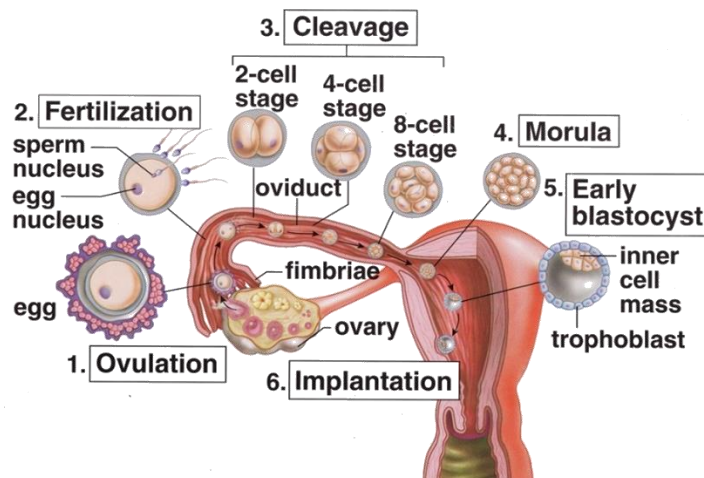


Fig. : Transport of ovum, fertilisation and passage of growing embryo through fallopian tube



Critical Thinking

The genetic material of male and female pronuclei fuse. Their membranes dissolve, leaving no barriers between the male and female chromosomes. During this dissolution, a mitotic spindle forms between them. The spindle captures the chromosomes before they disperse in the egg cytoplasm. Upon subsequently undergoing mitosis (which includes pulling of chromatids towards centrioles in anaphase), the cell gathers genetic material from the male and female together. Thus, the first mitosis after the union of sperm and oocyte is the actual fusion of their chromosomes.



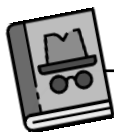
Clue Finder

Sex of the baby is decided during fertilisation. The chromosome pattern in human female is XX and that in the male is XY. Therefore, all the haploid gametes produced by the female (ova) have the sex chromosome X, whereas in the male gametes (sperms) the sex chromosome could be either X or Y, hence 50 percent of sperms carry X chromosome while the other 50 percent carry the Y. After fusion of the male and female gametes the zygote would carry either XX or XY depending on whether the sperm carrying X or Y has fertilised the ovum. The zygote carrying XX would develop into a female baby and XY would form a male. That's why, scientifically it is correct to say that the sex of the baby is determined by the father and not by the mother.

2.5.3 Embryonic Development

It includes cleavage, blastulation, implantation, gastrulation and organogenesis.

Cleavage: First cleavage is completed after 30 hours of fertilization. Cleavage furrow passes from animal-vegetal axis as well as centre of zygote (Meridional plane). It divides the zygote completely into two blastomeres (Holoblastic cleavage). Second cleavage is completed after 60 hours of fertilization. It is also meridional but at right angle to the first one. It is completed earlier in one of the two blastomeres resulting in a transient 3-celled stage. Third cleavage is horizontal forming 8 blastomeres. It is slightly unequal. Thereafter the rate and pattern of cleavage is non specific. In mammals, including humans, cleavage divisions are among the slowest in animal kingdom. Also, the cleavage divisions are asynchronous. The number of resultant blastomeres increased following arithmetic progression.



Clue Finder

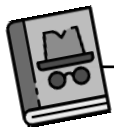
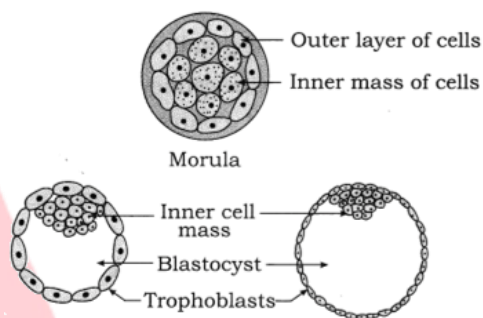
1. All cleavage divisions are mitotic and resultant daughter cells are blastomeres.
2. During cleavage, there is no growth in the resulting blastomeres and the total size and volume of the embryo remains the same, because in cleavage divisions interphase is without growth phase.
3. During cleavage, the size of blastomeres keeps on decreasing, as there is no growth of blastomeres. Zona pellucida remains intact throughout the cleavage divisions.
4. During cleavage, there is no increase in mass of cytoplasm of the developing embryo. However, there is marked increase in the DNA containing chromosomal materials.
5. The rate and type of cleavage depends upon the amount and distribution of yolk.

Morula: Cleavage results in a solid ball of cells, Morula having 8-16 cells. Zona pellucida still forms the outer cover. Morula undergoes compaction. The outer/peripheral cells are smaller/flat with tight junctions while the inner cell mass consists of slightly large, rounded cells with gap junctions. Morula descends slowly towards uterus in 4-6 days and corona radiata detaches during this period.

2.5.4 Blastulation or Blastocyst Formation:

Endometrium secretes a nutrient fluid and its mucosal cells become enlarged with stored nutrients. As the morula enters uterus, it gets a rich supply of nutrients. Outer peripheral cells enlarge and flatten further. They form trophoblast or trophoectoderm. Trophoblast cells secrete a fluid into the interior creating a cavity called blastocoel. The inner cell mass now comes to lie on one side as embryonal knob. With the formation of blastocoel, morula is converted into blastula which is called blastocyst in mammals because of different nature of surface layer and eccentric inner cell mass.

Due to pressure of growing blastocyst, a slit is produced in zona pellucida through which it squeezes out. The growing blastocyst comes out of this slit. At times, it gets broken into two parts which then gives rise to identical twins or monozygotic twins.



Clue Finder

Trophoblast cells in contact with embryonal knob are called cells of Rauber. Area of embryonal knob represents animal pole. The opposite side is abembryonal pole. Soon embryonal knob shows rearrangement to form embryonal disc. Cells of trophoblast layer divide periclinally. This gives rise to two layers, outer syncytiotrophoblast and inner cytotrophoblast. The two layers later form chorion, amnion and foetal part of placenta.

2.5.5 Implantation: It is embedding of the blastocyst into endometrium of uterus. Blastocyst comes in contact with the endometrium in the region of embryonal knob or embryonic disc and adheres to it. The surface cells of trophoblast secrete lytic enzymes which cause corrosion of endometrial lining. They also give rise to finger-like outgrowths called villi. Villi not only help in fixation but also in absorption of nutrients. Implantation causes nutrient enrichment, enlargement of cells and formation of uterine part of placenta called decidua (L. deciduos-falling off).

Trophoblast covering secretes a hormone called human chorionic gonadotropin (hCG). Detection of hCG in the urine is the basis of pregnancy/Gravidex test. hCG maintains the corpus luteum beyond its normal life time when it is called corpus luteum of pregnancy. It continues to secrete progesterone which prevents menstruation and maintains the uterine lining in nutrient rich state. Progesterone induces the cervical glands to secrete viscous mucus for filling the cervical canal to form a protective plug. Progesterone is also called pregnancy hormone as it is essential for maintenance of pregnancy. The hormone is secreted by placenta as well.

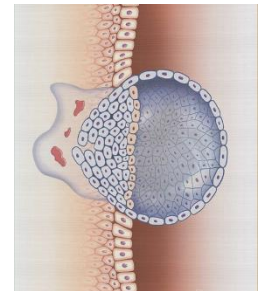


Fig.: Implanted blastocyst

2.5.6 Gastrulation

It is characterised by movements of cells in small masses or sheets so as to form primary germinal layers. There are three primary germinal layers - endoderm, ectoderm and mesoderm. The cell movements that occur during gastrulation are called morphogenetic movements since they lead to initiation of morphogenesis. The product of gastrulation is called gastrula.

A space appears between the ectoderm (below) and the trophoblast. This is the amniotic cavity, filled by amniotic fluid. The roof of this cavity is formed by amniogenic cells derived from trophoblast.



Critical Thinking

Formation of Primary Germinal Layers: Cells of the inner cell mass or embryonal knob get rearranged to form a flat embryonic or germinal disc. The latter differentiates into two layers, an outer epiblast of larger columnar cells and inner hypoblast of smaller cuboidal cells.

Gastrulation begins with the formation of primitive streak on the surface of the epiblast.

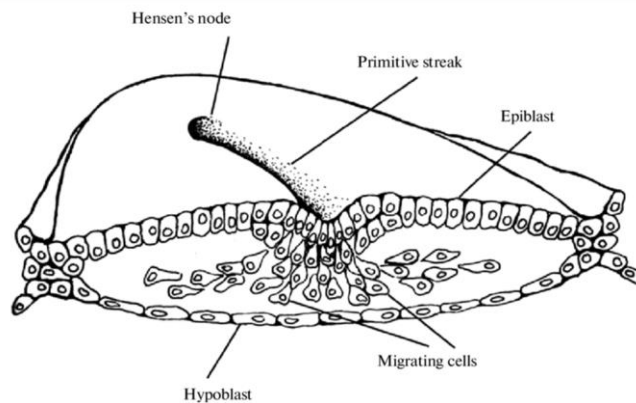


Fig. : Primitive Streak

- The diagram shows a cross section through the cranial region of the streak at 15 days showing movement of epiblast cells. The first cells to move inward displace the hypoblast to create the definitive endoderm.
- Once definitive endoderm is established, inwardly moving epiblast forms mesoderm.
- Cells remaining in the epiblast then form ectoderm. Thus the epiblast is the source of all the germ layers in the embryo.

A blastocyst is a ball of cells with a large, fluid-filled cavity called blastocoel. The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and inner mass of cells (attached to trophoblast) called the inner cell mass.



Clue Finder

The mitotic spindle of the first cleavage division appears in the cytoplasm of the fertilised ovum at right angle to an imaginary axis which runs through the ovum from animal pole to vegetal pole. Animal pole is that pole through which the polar bodies are extruded, and pole opposite to it is vegetal pole. The furrow divides the ovum into two daughter cells. The daughter cells are called blastomeres. The second cleavage furrow occurs at right angles to the first division, leading to the formation of 4-celled stage - an appearance suggestive of crossed dumb-bells as shown in figure (D). The third cleavage division is horizontal leading to the formation of 8-celled stage. Subsequent division are vertical and horizontal in alternate manner.

TOPIC CENTRIC EXERCISE 05

- Q1. Implantation is the process of**
 (a) Attachment of blastocyst to the uterine wall
 (b) Egg movement
 (c) Degeneration of egg
 (d) Egg fertilization
- Q2. Absence of acrosome will affect which activity in a normal sperm?**
 (a) Maturation of sperm
 (b) Energy utilization for movement
 (c) Sperm motility
 (d) Penetration into the ovum
- Q3. In human females, meiosis-II is not completed until**
 (a) Puberty (b) fertilization
 (c) Uterine implantation (d) birth
- Q4. Consider the following two statements:**
I. Not all copulations lead to fertilization and pregnancy
II. Fertilization can occur if the ovum and the sperms are simultaneously transported to the fallopian tubes.
 (a) Both I and II are correct and II correctly explains I
 (b) Both I and II are correct but II does not explain I
 (c) I is correct but II is incorrect
 (d) I is incorrect but II is correct
- Q5. After implantation, finger-like projections appear on....., called chorionic villi**
 (a) Endometrium (b) Uterine glands
 (c) Inner cell mass (d) Trophoblast

2.6 PREGNANCY AND EMBRYONIC DEVELOPMENT

- After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called placenta.
- Placenta is an organ which connects the foetus with uterine wall.** It constitutes both maternal as well as foetal parts although there is no mixing of the maternal and foetal blood supplies. The placenta acts as an ultrafilter through which soluble inorganic and organic materials, nutrients, hormones, antibodies against diphtheria, small pox, scarlet fever and measles etc. can pass from the mother to the foetus.

- Placenta also acts as an endocrine gland and synthesises large quantities of proteins and some hormones such as human chorionic gonadotropin (hCG), chorionic thyrotropin, chorionic corticotropin, chorionic somatomammotropin or human placental lactogen (hPL), estrogens and progesterone. The hCG stimulates corpus luteum of pregnancy to continue to secrete progesterone for a long time after its normal life time. In addition, it secretes some relaxin that facilitates parturition by softening the connective tissue of the pubic symphysis. The metabolic activity of the placenta is almost as great as that of the foetus itself. The umbilical cord connects the foetus to the placenta. During the first trimester (first 3 months) of pregnancy, the basic structure of the foetus is formed. This involves cell division, cell migration and the differentiation of cells into the many types found in the body. During this period, the developing baby called foetus is very sensitive to anything that interferes with the steps involved.

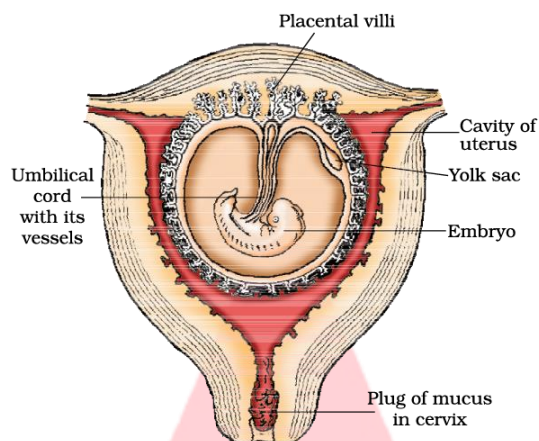
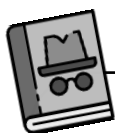


Fig. : The human foetus within the uterus



Clue Finder

During the first trimester of pregnancy, the basic structure of the baby is formed. During this period, the developing baby called foetus is very sensitive to anything that interferes with the steps involved. toxoplasmosis and other rubella, cytomegaloviruses and herpes simplex are the major cause of miscarriage or abortion in first trimester. Such agents are called teratogens. Teratogens infect drugs or chemicals that product abnormally in foetal development. Thalidomide was used to treat the symptoms of morning sickness during pregnancy, it leads to heart disorders and deformities of long bones. Such as Phocomelia, Amelia.



Critical Thinking

Virus infection of the mother e.g. by Rubella (German measles) virus or exposure to certain chemicals may cause malformations in the developing embryo. Such agents inducing malformations are called teratogens (monster forming agents). By 3 months, all the systems of the foetus have been formed, at least in a rudimentary way. From then on, development of the foetus is primarily a matter of growth and minor structural modifications. The foetus is less susceptible to teratogens after first trimester.

The human pregnancy lasts 9 months. The gestation period of dog is 60-65 days, elephant is 607-641 days and cat is 52-65 days. In human beings, after one month of pregnancy, the embryo's heart is formed. The first sign of growing foetus may be noticed by listening to the heart sound carefully through the stethoscope. By the end of the

second month of pregnancy, the foetus develops limbs and digits. By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well-developed. The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month. By the end of 24 weeks (second trimester), the body is covered with fine hair, eye-lids separate and eyelashes are formed. By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.



Critical Thinking

Embryo Development

Weeks 1-2: Fertilization → Implantation

Week 3: Germ layers form

Week 4: Brain, heart (starts beating), limb buds

Weeks 5-6: Organs (lungs, liver, kidneys), digits form

Weeks 7-8: Bones, face, nervous system, embryo → fetus

Weeks 9-12: Organs mature, movement starts, genitalia form

TOPIC CENTRIC EXERCISE 06

- Q1. The first movements of the foetus and appearance of hair on the head are usually observed during the :-**
- (a) 3rd month (b) 4th month
(c) 5th month (d) 8th month
- Q2. Three germ layers are formed during which stage of Embryonic development.**
- (a) Morula (b) Blastula
(c) Gastrula (d) In any two stages
- Q3. Which structure serves as the interface between the developing embryo and the maternal body during pregnancy?**
- (a) Chorionic villi (b) Umbilical cord
(c) Placenta (d) Trophoblast
- Q4. The amount of which hormone increases in Pregnancy?**
- (a) Cortisol (b) Insulin
(c) Glucagon (d) Aldosterone
- Q5. The stem cells which have potency to give rise to all tissues and organs are formed from**
- (a) Trophoblast (b) Umbilical cord
(c) Inner cell mass (d) Placenta

2.7 PARTURITION AND LACTATION

The average duration of human pregnancy is about 9 months or 38 weeks/266 days after fertilisation which is called the gestation period. Vigorous contraction of the uterus at the end of pregnancy causes expulsion/ delivery of the foetus. This process of delivery of the foetus (childbirth) is called parturition. Parturition is induced by a complex neuroendocrine mechanism. The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex. This triggers the release of oxytocin from the maternal pituitary. Oxytocin acts on the uterine muscles and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin. The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions. This leads to expulsion of the baby out of the uterus through the birth canal. Soon after the infant is delivered, the placenta is also expelled out of the uterus.

➤ **Parturition includes three stages:**

- (a) **Dilation Stage:** The uterine contractions start from top and occur after long intervals (once every thirty minutes). This forces the foetus outward, pushing its head against cervix. As a result, cervix gets dilated with vagina also showing a similar dilation. Dilation of cervix increases the stimulus for oxytocin secretion, further increasing the strength and frequency of contractions (1-3 every minute). With continued powerful contractions, the amnion ruptures and the amniotic fluid flows out through vagina.
- (b) **Expulsion Stage** With further increase in the intensity of uterine and abdominal contractions, the foetus comes out through cervix and vagina, with head coming out first. Expulsion may take 20-60 minutes. Umbilical cord is cut. The infant's lungs expand and it begins breathing. This requires a major switchover in the circulatory system. Blood flow through the umbilical cord, ductus arteriosus and foramen ovale ceases and the adult pattern of blood flow through the heart, aorta and pulmonary arteries begins. In some infants, the switchover is incomplete and blood flow through the pulmonary arteries is inadequate. Failure to synthesise enough nitric oxide (NO) is one cause of this.
- (c) **Stage of After Birth:** Within 10-15 minutes after delivery, placenta and the remains of the umbilical cord which is called 'after birth' is expelled out.

2.7.1 Lactation

Although estrogen and progesterone are essential for the physical development of the breasts during pregnancy, a specific effect of both these hormones is to inhibit the actual secretion of milk. Conversely, the hormone prolactin has exactly the opposite effect and promotes secretion of milk. This hormone is secreted by the mother's anterior pituitary gland and its concentration in the blood rises steadily from the fifth week of pregnancy until birth of the foetus (10 to 20 times the normal nonpregnant levels). In addition, the placenta secretes large quantities of human chorionic somatomammotropin which probably also has lactogenic properties, thus supporting the prolactin from the mother's pituitary during pregnancy. The fluid that is secreted first few days after parturition is called colostrum, slightly yellow in colour, rich in calories and antibodies (IgA). This antibody provides passive immunity to the child. It contains essentially the same concentrations of proteins and lactose as milk but almost no fat.

Ejection (or "Let-Down") Process in Milk Secretion

Milk is secreted continuously into the alveoli of the breasts but it does not flow easily from these alveoli into the duct system and therefore, does not continually leak from the breast nipples. Instead, the milk must be ejected from the alveoli into the ducts before the new born can obtain it. This is caused by a combined neurogenic and hormonal reflex that involves the posterior pituitary hormone oxytocin.

When the new born suckles on the breasts, sensory impulses are transmitted through somatic nerves from the nipples to the mother's spinal cord and then to her hypothalamus, initiating nerve signals that promote oxytocin secretion. The oxytocin is carried through the blood to the breasts where it causes myoepithelial cells (that surround the outer walls of the alveoli) to contract, thereby expelling the milk from the alveoli into the ducts.



Critical Thinking

Cleidoic Eggs

Eggs of reptiles and birds which are insulated from the environment by albumen, membranes and shell. The calcareous shell present around the eggs of birds is mainly made of calcium carbonate (94%) and is secreted by uterus (shell glands). Chalazae are the suspensory ligaments of the yolk in birds's eggs.

Egg Membranes: There are three types of egg membrane around the eggs.

- (i) **Primary egg membrane:** It is formed around the plasma membrane of the egg and is secreted by ovum itself e.g. Jelly envelope (Echinoderms), Vitelline membrane (Mollusca, amphibians & birds), zona radiata (Shark, some amphibians), Zona pellucida (Mammals).
- (ii) **Secondary egg membrane:** It is formed around the egg by the follicle cells of the ovary e.g., chorion around egg of insect; corona radiata, granulosa and theca layers in human.
- (iii) **Tertiary egg membranes:** These are formed by the oviducts & other accessory parts of maternal genital tract while the egg is passing from the ovary to the exterior, e.g. the albumin, shell membrane and outermost calcareous shell of reptiles & birds.



Clue Finder

They include epiboly (descending of dividing cells to cover other cells), emboly (upward movement of dividing cells underneath the other cells), involution (inward migration of blastomeres to go into the blastocoel), invagination (tucking in of blastula wall), and delamination (separation of a sheet of cells from blastula). Archenteron is the cavity which occurs inside the gastrula and is the future alimentary canal. It opens to the outside through blastopore which later on closes.



Critical Thinking

Foetal Membranes:

- (i) Amnion is formed of mesoderm on outside and ectoderm inside. Space between amnion and foetus is called amniotic cavity and it contains amniotic fluid.
- (ii) Chorion is formed of ectoderm externally and mesoderm inside. Alongwith the allantois, it participates in the formation of placenta. Space between amnion and chorion is extra embryonic coelom.
- (iii) Allantois consists of mesoderm on outside and endoderm internally. It extends to fuse with chorion and forms allanto-chorion which gives rise to foetal part of placenta.
- (iv) Yolk sac: It is formed of mesoderm on the outside and endoderm on the inside.

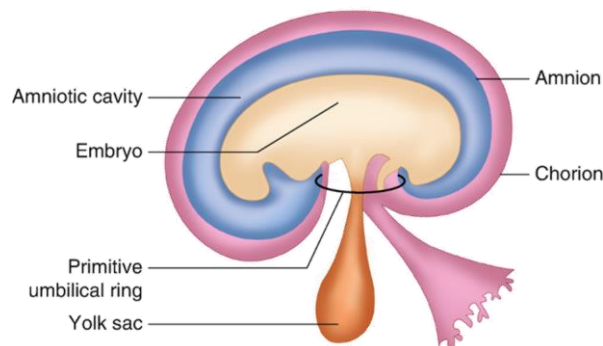


Fig.: Foetal Membranes

TOPIC CENTRIC EXERCISE 07

- Q1. Which of the following hormone causes stronger uterine contractions during parturition?**
 (a) LH (b) Oxytocin
 (c) Prolactin (d) hCG
- Q2. Signals for parturition originate from**
 (a) Fully developed fetus only
 (b) Both placenta as well as fully developed fetus
 (c) Oxytocin released from the maternal pituitary
 (d) Placenta only
- Q3. The duration of pregnancy is called**
 (a) Parturition (b) Lactation
 (c) Gestation period (d) None of these
- Q4. Colostrum has**
 (a) Only one antibody (b) Several antibodies
 (c) Two antibodies (d) Four antibodies
- Q5. The process of delivery of the foetus is called**
 (a) Lactation (b) Parturition
 (c) Foetal protection reflex (d) None of these

Solved Examples

Ex: 1- What do you mean by the term spermateleosis?

- (a) Conversion of spermatids to sperm
 (b) Conversion of spermatogonium to spermatid
 (c) Conversion of spermatid to spermatogonium
 (d) Conversion of primary spermatocyte to secondary spermatocyte

Sol. (a): Spermiogenesis/spermateleosis is the formation of spermatozoa from spermatids

Ex: 2- The breakage of the membrane surrounding the acrosome in a mammalian sperm is

- (a) Activation (b) Cavitation
 (c) Agglutination (d) Capacitation

Sol. (d): Sperm capacitation refers to the physiological changes spermatozoa must undergo in order to have the ability to penetrate and fertilize an egg. The receptors in the sperm cell membrane are made available through the removal of a glycoprotein layer. The area of the acrosomal cap is also altered so that the acrosome reaction becomes possible.

Ex: 3- Polar bodies are formed during

- (a) Spermatogenesis (b) Oogenesis
 (c) Gametogenesis (d) Spermateleosis

Sol. (b): Polar bodies are smaller cells produced during oogenesis that do not develop into egg cells.

Ex: 4- Sperm's acrosome has

- (a) Hyaluronic acid and proacrosine (b) Hyaluronic acid and fertilizin
 (c) Hyaluronidase and proacrosin (d) Fertilizin and proacrosin

Sol. (c): The acrosome contains digestive enzymes (including hyaluronidase and acrosin). These enzymes break down the outer membrane of the ovum, called the zona pellucida, allowing the haploid nucleus in the sperm cell to join with the haploid nucleus in the ovum

Ex: 5- During copulation, slimy secretion to lubricate the penis is secreted by

- (a) prostate gland (b) perineal gland

- (c) bulbourethral glands (d) adrenal gland.
- Sol.** **(c):** A pair of Cowper's gland or bulbourethral glands are present on either side of membranous urethra. These glands secrete an alkaline fluid. During copulation, they also secrete mucus that lubricates the end of the penis. This decreases the number of sperms damaged during ejaculation.
- Ex: 6- Which of the following is/are the function of ovary?**
- (a) Production of ovum
(b) Production of hormones
(c) Development of secondary sexual characters
(d) All of these
- Sol.** **(d):** Ovaries produce ova, estrogen and progesterone (female sex hormones). These hormones control menstrual cycle and secondary sexual characters in females.
- Ex: 7- If for some reason, the vasa efferentia in the male O reproductive system get blocked, the gametes will not be transported from**
- (a) testes to epididymis (b) epididymis to vas deferens
(c) epididymis to ejaculatory duct (d) none of these.
- Sol.** **(a):** Vasa efferentia are fine ciliated ductules that arise from the rete testis. They vary from 15-20 in number and carry sperms from rete testis to the epididymis.
- Ex: 8- The male accessory duct includes**
- (a). penis, urethra and ejaculatory duct
(b) rete testis, vasa efferentia, epididymis and vas deferens
(c) ureter, urinary bladder and urethra
(d) prostate, penis, vas deferens and ejaculatory duct.
- Sol.** **(b):** The male accessory duct include rete testis, vasa efferentia, epididymis and vas deferens.
- Ex: 9- In the process of spermatogenesis, first reduction division of chromosome occurs during conversion of**
- (a) spermatogonia to primary spermatocytes
(b) primary spermatocytes to secondary spermatocytes
(c) secondary spermatocytes to spermatids
(d) spermatids to sperms.
- Sol.** **(b):** A primary spermatocyte undergoes the first meiotic division (reduction division) to form two haploid cells called secondary spermatocytes.
- Ex: 10- The immature male germ cells undergo division to O produce sperms by the process of spermatogenesis. Choose the correct one with reference to information.**
- (a) Spermatogonia have 46 chromosomes and always undergo meiotic cell division.
(b) Primary spermatocytes divide by mitotic cell division.
(c) Secondary spermatocytes have 23 chromosomes and undergo second meiotic division.
(d) Spermatozoa are transformed into spermatids.
- Sol.** **(c):** Spermatogonia are diploid cells on the inside wall of seminiferous tubules that multiply by mitotic divisions. Some of the spermatogonia called primary spermatocyte undergo meiosis-I to give rise to secondary spermatocytes (haploid). Each secondary spermatocyte undergoes meiosis-II to give rise to two haploid spermatids which are transferred to spermatozoa by spermiogenesis.

Exercise-01 Level -01

1. The part closer to the ovary is the
(a) Isthmus (b) Ampulla
(c) Infundibulum (d) Uterine fundus
2. Spermatogenesis starts at the age of puberty due to significant increase in the secretion of-
(a) GnRH (b) ICSH
(c) Oxytocin (d) Progesterone
3. Common duct formed by union of vas deferens and duct from seminal vesicle is
(a) Urethra
(b) Insemination duct
(c) Ejaculatory duct
(d) Spermatic duct
4. Which one of the following is not a part of female external genitalia:
(a) Mons pubis (b) Clitoris
(c) Labia minora (d) Cervix
5. Choose the mismatch among the following
(a) Mons Pubis- cushion of fatty tissue covered by skin
(b) Labia majora- fleshy fold of tissue
(c) Clitoris- present at junction of 2 labia majora
(d) Labia minora- Paired fold of tissue under labia majora
6. FSH, LH, ESTROGEN, PROGESTERONE, THYROXINE, CORTISOL, HCG, HPL, RELAXIN
How many hormones gets only produced during pregnancy:
(a) Seven (b) Six
(c) Two (d) Four
7. Which of the following structure forms zona pellucida.
(a) Primary oocyte
(b) Secondary oocyte
(c) Primordial germ cells
(d) Polar body
8. Fertilization in human takes place in which region
(a) Ampullary isthmic junction
(b) Ampulla
(c) Isthmus
(d) Infundibulum
9. Which among the following undergoes cyclical changes during menstrual cycle?
(a) Perimetrium (b) Epimetrium
(c) Myometrium (d) Endometrium
10. AT the time of puberty, the total number of primary follicle present in both the ovaries is
(a) 60000-80000 (b) 120000-160000
(c) 12000- 16000 (d) 6000- 8000
11. Testis has about 250 compartments called testicular lobules, testicular lobule contains seminiferous tubules which is lined by:
(a) Primary spermatocytes
(b) Spermatogonia
(c) Sertoli cells
(d) Both b and c
12. Antrum and secondary oocyte first appear in which follicle
(a) Primary follicle
(b) Secondary follicle
(c) Tertiary follicle
(d) Graafian follicle
13. Which among the following hormone are not associated with spermatogenesis?
(a) LH (b) Oxytocin
(c) Progesterone (d) Both b and c
14. The male reproductive system includes
A. Primary sex organs
B. Accessory ducts
C. Accessory glands
D. External genitalia
(a) A, B and D (b) A, C and D
(c) A and D only (d) All of these
15. Birth canal is formed by
(a) Uterus along with vagina
(b) Uterus along with cervix
(c) Cervical canal along with vagina
(d) Uterus, cervix and vagina
16. Spermatogenesis starts due to significant increase in the secretion of
(a) Androgen from hypothalamus
(b) GnRH from hypothalamus
(c) GnRH from anterior pituitary gland
(d) GnRH from posterior pituitary gland
17. Select the incorrect match
(a) Sertoli cells – nurse cells
(b) Interstitial cells - Testosterone
(c) Vasa efferentia – 10 in number
(d) Vas deferens – 2 in number

18. At which stage of life is oogenesis process initiated
(a) Adult (b) Birth (c) Puberty (d) Embryonic development stage
19. Which among the following structure is not part of male reproductive system
(a) Seminal vesicles (b) Vas deferens (c) Prostate gland (d) cervix
20. The mammary gland are paired structures, contain glandular tissue and variable amount of fat. The glandular tissue of breast is divided into
(a) 10-12 mammary alveoli (b) 15-20 mammary lobes (c) 12-16 mammary tubules (d) 12-16 mammary tubules
21. How many ova and sperms will be produced from 100 secondary oocytes and 100 secondary spermatocytes during gametogenesis in human?
(a) 50 ova, 100 sperms (b) 100 ova, 100 sperms (c) 200 ova, 200 sperms (d) 100 ova, 200 sperms
22. Which of the following is constituent of semen?
(a) seminal plasma only (b) Sperm only (c) Seminal plasma along with sperm (d) seminal plasma along with ovum
23. Identify the structure belongs to female external genitalia:
(a) Labia minora (b) Fimbriae (c) Infundibulum (d) Isthums
24. Each testis has how many testicular lobules:
(a) 100 (b) 150 (c) 250 (d) 750
25. Level of estrogen and progesterone are minimum at the time of:
(a) Follicular phase (b) Ovulation (c) Secretory phase (d) Menses
26. Correct sequence of hormone secretion from beginning of menstruation is:
(a) Progesterone, LH, FSH (b) Estrogen, LH, FSH (c) FSH, estrogen, progesterone (d) Estrogen, progesterone, FSH
27. 10 oogonia yield 10 primary oocytes, then how many ova are produced by primary oocyte stage?
(a) 5 (b) 10 (c) 20 (d) 40
28. Major part of semen is secreted by:
(a) Seminal vesicle (b) Prostate gland (c) Cowper's gland (d) Bartholin's gland
29. Which of the following is not related to female reproductive system ?
(a) Mons-pubis (b) Clitoris (c) Labia majora (d) Ejaculatory duct
30. When both ovaries are removed from human female then which hormone is decrease in blood?
(a) Oxytocin (b) Prolactin and progesterone (c) Estrogen (d) Gonadotrophins
31. Spermatogenesis start at puberty due to significant increase in the secretion of:
(a) GnRH (b) Androgen (c) Oxytocin (d) Progesterone
32. In which duration of menstrual cycle both LH & FSH attain a peak level:
(a) In last week (b) Middle of cycle (c) Initial days of cycle (d) 4th days of cycle
33. At what stage of life, oogenesis is initiated in a human female?
(a) At puberty (b) During menarche (c) During menopause (d) During embryonic development
34. In which phase of menstrual cycle graafian follicle transform as the corpus luteum?
(a) Luteal (b) Proliferation (c) Follicular (d) Growth
35. Identify the stage of sperm formation during which the non motile spermatids converts into sperms
(a) Spermiogenesis (b) Spermatogenesis (c) Spermatocytogenesis (d) Spermiation
36. Middle piece of sperm contains:
(a) Mitochondria and acrosome (b) Centriole and golgi body (c) Axial filament and golgi body (d) Mitochondria and axial filament
37. The head of a mature sperm is mainly composed of:
(a) Elongated nucleus and acrosomal material (b) Mitochondria only (c) sertoli cells (d) All of the above

38. Parturition is induced by:
 (a) A complex neuroendocrine mechanism
 (b) A simple neuroendocrine mechanism
 (c) A neuro exocrine mechanism
 (d) A physio-chemical mechanism
39. Placenta acts as an endocrine tissue and produces several hormones like:
 (A) Human chorionic gonadotropin (hCG)
 (B) Human placental lactogen (hPL)
 (C) Estrogens
 (D) Progesterone
 (E) FSH
 (F) LH
 (a) A & B (b) B only
 (c) A, B & C (d) A, B, C & D
40. If the menstrual cycle is of 35 days then ovulation will take place at what day of menstrual cycle
- (a) 21st day (b) 14th day
 (c) 24th day (d) 11th day
41. Seminiferous tubules open into:
 (a) Epididymis (b) Vasa deferens
 (c) Vasa differentia (d) Rete testis
42. A structure which maintains 2-2.4 degree Celsius lower temperature of testes than normal body temperature is called as
 (a) Abdominal cavity (b) Inguinal canal
 (c) Sertoli cells (d) Scrotum
43. The region outside the seminiferous tubule contains
 (a) Sertoli cells
 (b) Immunologically competent cells
 (c) Male germ cells
 (d) All of these

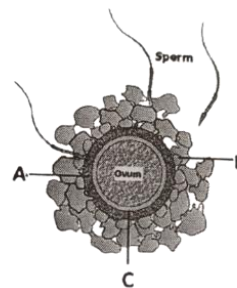
Exercise-02 Level -02

1. Read the following statements carefully:
 (I) The corpus luteum secretes large amounts of estrogen which is essential for maintenance of the endometrium.
 (II) In the absence of fertilisation, the corpus luteum degenerates
 (a) True, true (b) False, false
 (c) True, false (d) False, true
2. Which among the following statement is correct:
 (a) LH acts at the Leydig cells and stimulates synthesis of androgens
 (b) FSH acts on the Sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis.
 (c) The acrosome is filled with enzymes that help in fertilisation of the ovum.
 (d) All of these
3. Which among the following statement is correct:
 (a) The reproductive cycle in the female primates (e.g. monkeys, apes and human beings) is called menstrual cycle
 (b) The corpus luteum secretes large amounts of estrogen which is essential for maintenance of the endometrium.
 (c) If fertilization occurs, corpus luteum degenerates.
 (d) The primary oocyte forms a new membrane called zona pellucida surrounding it
4. Which among the following statement is correct:
 (a) The male accessory glands include paired seminal vesicles, a paired prostate and paired bulbourethral glands
 (b) The penis is the male external genitalia
 (c) The secretions of bulbourethral glands also helps in the lubrication of the penis.
 (d) Both b and c.
5. Choose the incorrect statement among the following
 (a) Lack of menstruation is an indicative of pregnancy
 (b) In human females, menstruation is repeated at an average interval of about 28/29 days
 (c) Menstruation occurs if the released ovum is fertilised
 (d) The secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase
6. Which among the following is true:
 (a) The average duration of human pregnancy is about 9 months which is called the gestation period
 (b) Ovaries are the primary female sex organs that produce the female gamete (ovum)
 (c) The shape of the uterus is like inverted pear shape
 (d) All of these

7. The alveoli open into----- . The ----- of each lobe join to form a ----- . Several ----- join to form a wider ----- which is connected to ----- through which milk is sucked out.
- Mammary tubule, mammary tubule, mammary duct, mammary duct, mammary ampulla, lactiferous duct,
 - Mammary duct, mammary duct, mammary tubule, mammary tubule, lactiferous duct, mammary ampulla
 - Mammary duct, mammary duct, mammary tubule, mammary tubule, mammary ampulla, lactiferous duct
 - Mammary tubule, mammary tubule, mammary duct, mammary duct, lactiferous duct, mammary ampulla
8. Which among the following is correct?
- Testis length- 4-5 cm, ovary size- 2-4 cm, fallopian tube-10-12cm
 - Testis length- 2-3cm, ovary size- 2-3cm, fallopian tube-12-14cm
 - Testis length- 3-4cm, ovary size- 2-4cm, fallopian tube-10-12 cm
 - Testis length- 3-4cm, ovary size- 2-4cm, fallopian tube-12-14 cm
9. Read the following statement:
- The mammary glands are paired structures (breasts) that contain glandular tissue and constant amount of fat
 - The glandular tissue of each breast is divided into 25-30 mammary lobes containing clusters of cells called alveoli
 - Sperm heads become embedded in the Sertoli cells, and are finally released by the process called spermiation.
 - LH acts at the Leydig cells and stimulates synthesis and secretion of androgens.
- Find the number of correct statement/statements.
- 4
 - 3
 - 2
 - 1
10. Which is the correct sequence of male accessory ducts starting from testis?
- Rete testis, vasa efferentia, epididymis, vas deferens
 - Rete testis, vasa efferentia, vas deferens, epididymis
 - Rete testis, vas deferens, epididymis, vasa efferentia
 - Rete testis, vas deferens, vasa efferentia, epididymis
11. Ejaculatory duct is formed by the
- Vas deferens along with a duct from seminal vesicle
 - Epididymis along with a duct from seminal vesicle
 - Epididymis along with the prostatic duct
 - Vas deferens along with the prostatic duct
12. "A" cells start division and enter in "B" stage of meiotic division and get temporarily "C" at this stage. Identify A, B, C
- A: Primary oocyte; B: Metaphase I; C: Arrested
 - A: Primary oocyte; B: Anaphase; C: Released
 - A: Primary oocyte; B: Prophase I; C: Arrested
 - A: Primary oocyte; B: Telophase; C: Released
13. Correct sequence in development is
- Fertilisation → Zygote → Cleavage → Morula → Blastula → Gastrula
 - Fertilisation → Zygote → Blastula → Morula → Cleavage → gastrula
 - Fertilisation → Cleavage → Morula → Zygote → Blastula → Gastrula
 - Cleavage → Zygote → Fertilisation → Morula → Blastula → Gastrula
14. Which of the following statements are correct w.r.t. hymen?
- Is often torn during first intercourse
 - Partially covers vaginal opening
 - It forms a part of external genitalia
- Only A and B
 - Only B and C
 - Only A and C
 - A, B, C
15. Which of the following best represents the normal path of a sperm cell as makes its way from the point of entry into the female's reproductive tract to the place where fertilisation typically occurs?
- Cervix, vagina, ovary, oviduct
 - Vagina, cervix, uterus, oviduct
 - uterus, cervix, vagina, oviduct
 - Vagina, uterus, cervix, oviduct
16. Spermatogenesis involves
- Growth of spermatogonia into spermatocytes
 - Formation of spermatogonia from gonocytes through mitosis
 - Formation of spermatogonia from primary spermatocytes through meiosis

- (d) Formation of oogonia from spermatocytes through meiosis
17. Tertiary follicle is characterised by
- The presence of fluid filled cavity called antrum
 - The presence of ovule in an ovary
 - The presence of sperm in fallopian tube
 - The presence of graafian follicle
18. Which of the following statements is incorrect?
- LH triggers ovulation in ovary
 - LH and FSH decreases gradually during the follicular phase
 - LH triggers secretion of androgens from the Leydig cells
 - FSH stimulates the Sertoli cells which help in spermiogenesis
19. An important factor contributing to the onset and maintenance of labor contractions is
- Increased contractility of the uterine muscles from increased oxytocin levels
 - Mechanical pressure on the cervix generated by the emerging baby's head
 - Stretching of the uterus during the final stages of foetal growth
 - All of these
20. Which of the following is responsible for release of androgens from Leydig cells
- FSH releasing factor
 - Androgen-binding protein
 - Luteinizing hormone (LH)
 - Follicle stimulating hormone (FSH)
21. Which of the following is/are not diploid?
- Primary spermatocytes & primary oocytes
 - Secondary spermatocytes & secondary oocytes
 - Spermatogonia and ovum
 - Spermatogonia and secondary oocytes
22. Which of the following statements is incorrect w.r.t. semen?
- The Secretion of accessory glands of male along with sperms constitute semen
 - Semen is slightly alkaline
 - The average volume of semen in one ejaculation is 2.5-4.0 ml with sperm count of 200 to 300 million sperms
 - Secretion of prostate gland helps in lubrication of penis
23. Oocyte is liberated from ovary under the influence of LH, after completing:
- Meiosis I and with liberating second polar body
 - Meiosis I and before liberating second polar body
 - Meiosis II and liberating second polar bodies
 - Meiosis II after release of first polar body
24. Which of the following characteristics does not belong to cleavage?
- Decreases in size of blastomeres
 - Rapid mitotic cell division
 - Starts as the zygote moves through the isthmus of the oviduct
 - Number of chromosomes reduces to half
25. Which statement is wrong?
- Mammary lobes containing cluster of cells called alveoli
 - Uterus is also called womb
 - The last part of the oviduct is called ampulla
 - Stroma of ovary divided into two zones cortex and medulla
26. Correct order of spermatogenesis is:
- Secondary spermatocytes → Spermatogonia → Spermatid → Sperm
 - Spermatogonium → Spermatid → Secondary Spermatocytes → Sperm
 - Spermatid → Spermatogonia → Spermatocytes → Sperm
 - Spermatogonia → Primary spermatocytes → Secondary spermatocytes → Spermatid → Sperm
27. Which one of the following statements is incorrect about menstrual cycle?
- The first menstruation begins at the puberty and is called menarche.
 - Lack of menstruation may also occur due to some environmental factors like stress, poor health.
 - Corpus luteum secretes large amounts of progesterone which is essential for maintenance of endometrium
 - In absence of fertilization, corpus luteum degenerates in luteal phase and new follicles starts developing immediately due to progesterone
28. Why do all copulations not lead to fertilization and pregnancy?
- Due to numerous sperms and one ovum
 - Due to degeneration of corpus luteum

- (c) Ovum and sperms are not transported simultaneously to the ampullary region
(d) Due to non-formation of corpus luteum
29. Which of the following shows correct sequence of the events occurring during ejection of milk from mammary gland:
(a) Sensory impulses are transmitted through somatic nerves from the nipples to the mother's hypothalamus
(b) Expulsion of milk from alveoli into the ducts
(c) Sucking action of baby on the breast
(d) Contraction of myoepithelial cells
(e) Secretion of oxytocin
(a) (b) → (c) → (e) → (a) → (d)
(b) (c) → (a) → (e) → (b) → (d)
(c) (c) → (a) → (e) → (d) → (b)
(d) (a) → (c) → (d) → (e) → (b)
30. Find out the incorrect match w.r.t. development in humans:
(a) By the end of 24 weeks – Eye lids separate and eyelashes are formed
(b) By the end of 8 weeks – Appearance of hair on head and first movement of foetus
(c) By the end of 12 weeks – Limbs and external genital organs are well developed
(d) By the end of 4 weeks – Heart is formed
31. Fertilization is:
(a) Union of diploid spermatozoan with diploid ovum to form diploid embryo
(b) Union of haploid sperm with haploid ovum to form diploid zygote
(c) Union of haploid sperm with haploid ovum to form haploid zygote
(d) Union of diploid sperm with haploid ovum to form triploid zygote
32. Which one of the following is incorrect?
(a) During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum
(b) Cleavage of fertilized ovum result in blastula
(c) Fusion of sperm and ovum occurs in fallopian tube
(d) Cleavage leads to increase in the mass of protoplasm
33. For normal fertility:
(a) At least 60% sperm must show vigorous motility
(b) At least 40% sperm must have normal shape and size
(c) At least 30% sperm must have normal activity and function
(d) At least 60 per cent sperms must have normal shape and size and at least 40 per cent of them must show vigorous motility.
34. The hymen can be torn by:
(A) First coitus (intercourse)
(B) Sudden fall or jolt
(C) Insertion of vaginal tampon
(D) Active participation in cycling and horseback riding
(a) A, B and C (b) B, C and D
(c) A, B and D (d) A, B, C, and D
35. Each ovary is about 2-4 cm in length connected to the...A... wall by...B... Each ovary is covered by a thin epithelium which enclose the ovarian stroma. Stroma is divided into two zones ...C... and ...D... Fill the suitable choice for A to D
(a) A-Fallopian tube, B-peripheral medulla, C-ligament, D-inner cortex
(b) A- pelvic, B-ligament, C- peripheral cortex, D-inner medulla
(c) A- pelvic, B- peripheral cortex, C- ligament, D- inner medulla
(d) A- inner medulla, B- peripheral cortex, C-ligament, D- pelvic wall
36. Identify A, B and C in below diagram and choose the correct option.



- (a) A-plasma membrane, B-Perivitelline space, C-Corona radiata
(b) A-Zona Pellucida, B-Corona radiata cells, C-Perivitelline space
(c) A-Zona Pellucida, B-Perivitelline space, C-Corona radiata cells
(d) A- Perivitelline space, B- Corona radiata cells, C- Zona Pellucida
37. The mammary gland of the female undergo differentiation ___A___ and starts producing milk towards ___B___ by the process of ___

- (a) A- during pregnancy, B- end of pregnancy, C- parturition
 (b) A- during parturition, B- end of pregnancy, C- Lactation
 (c) A- During pregnancy, B- end of pregnancy, C- lactation
 (d) A- During pregnancy, B- before pregnancy, C- lactation
- 38.** Placenta is formed by the integration of
 (a) Chorionic villi and foetus blood
 (b) Chorionic villi and uterine tissue
 (c) Uterus and cervical canal
 (d) None of these
- 39.** After one month of pregnancy the embryo's __A__ is formed, By the end of the __B__ month of pregnancy the foetus develops limbs and and digit. By the end of __C__ most of the major organ systems are formed for example, the limbs and external genital organs for example the limbs and external genital organs are well-developed. By the __D__ fine hair, eyelids separate and eyelashes are formed. Here A to D refers to:
 (a) A-Heart, B-Second, C-First trimester D- Second trimester
 (b) A-Heart, B-Second, C-First month D-Second month
 (c) A-Heart, B-Second, C-First week D-Second week
 (d) A-Heart, B-Fourth, C-First trimester, D- Second trimester
- 40.** Among the following which change occurs during luteal phase?
 (a) Corpus luteum → Graafian follicle
 (b) Graafian follicle → Corpus luteum
 (c) Primary follicle → Secondar follicle
 (d) Secondary follicle → Graafian follicle
- 41.** During acrosomal reaction the sperm
 (a) Comes in contact with zona pellucida of the ova.
 (b) Undergoes reactions within the uterine environment of female
 (c) Undergoes reactions within the epididymal environment of the male.
 (d) Produces androgen in the uterus.
- 42.** Energy is produced by
 (a) Head of sperm
 (b) Tail of sperm
 (c) Acrosome
 (d) Middle part of sperm
- 43.** All the haploid gametes produced by the female have
 (a) X-chromosomes
 (b) Y-chromosomes
 (c) 75% gametes have X and 25% have Y-chromosomes
 (d) 25% gametes have X and 75% have Y-chromosomes
- 44.** Choose the incorrect statement about placenta.
 (a) The placenta facilitates the supply of oxygen and nutrients to the embryo
 (b) It helps in the removal of CO₂ and excretory/waste materials produced by the embryo
 (c) The placenta is connected to the embryo through umbilical cord.
 (d) Placenta acts like an Exocrine tissue and produces several enzymes also
- 45.** Clitoris is
 (a) Part of oviduct
 (b) Part of female external genitalia
 (c) Part of male reproductive organ
 (d) None of these
- 46.** The foetus develops limbs and digits by the end of
 (a) 1st month of pregnancy
 (b) 2nd month of pregnancy
 (c) 3rd month of pregnancy
 (d) 5th month of pregnancy
- 47.** Secondary follicle contains
 (a) Primary Spermatocyte
 (b) Secondary oocyte
 (c) Primary oocyte
 (d) Secondary spermatocyte
- 48.** Embryo with 8 to 16 blastomere is called
 (a) Blastocyst (b) Morula
 (c) Zygote (d) Ovum
- 49.** The human male ejaculates about ____ sperms during a coitus
 (a) 2 to 4 lakhs (b) 200 to 300 million
 (c) 6000 to 8000 (d) None of these
- 50.** Both LH and FSH attain a peak level on about 'A' day of cycle. Choose the correct option for 'A'.
 (a) 10th day (b) 14th day
 (c) 19th day (d) 5th day

Exercise-03 Level -03

Assertion & Reason Based Questions

1. **Assertion-** There is a chance of fertilization during the 10-17 days of menstrual cycle.
Reason- Ovulation occurs during these days.
 (a) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
 (b) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
 (c) If Assertion is True but the Reason is False.
 (d) If both Assertion & Reason are false.
2. **Assertion:** Rupture of Graafian follicle and thereby the release of ovum is called ovulation.
Reason: Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge.
 (a) If both Assertion & Reason are True & the Reason is a correct explanation of the Assertion.
 (b) If both Assertion & Reason are True but Reason is not a correct explanation of the Assertion.
 (c) If Assertion is True but the Reason is False.
 (d) If both Assertion & Reason are false.
3. **Assertion:** The seminal plasma along with the sperms constitute the semen
Reason: The tail piece of sperm possesses numerous mitochondria
 (a) If both assertion and reason are true and the reason is correct explanation of the assertion.
 (b) If both assertion and reason are true but the reason is not correct explanation of the assertion.
 (c) If assertion is true but reason is false.
 (d) If both assertion and reason are false.
4. **Assertion:** During the phase of pregnancy endometrium do not breaks.
Reason: Level of progesterone remains high during then phase of pregnancy
 (a) Both assertion and reason are true and reason is a correct explanation of assertion
 (b) Both assertion and reason are true but reason is not a correct explanation of assertion
 (c) If assertion is true but reason is false

- (d) If both assertion and reason are false
5. **Assertion:** The first meiotic division in primary oocyte starts during embryonic stage but completes at puberty
Reason: During first meiotic division released polar body contains large amount of cytoplasm.
 (a) Both assertion and reason are true and reason is a correct explanation of assertion
 (b) Both assertion and reason are true but reason is not a correct explanation of assertion
 (c) If assertion is true but reason is false
 (d) If both assertion and reason are false
6. **Assertion:** Each breast has 15-20 mammary lobes which contains cluster of cells called alveoli.
Reason: Mammary duct joins to form a ampulla, which is connected to lactiferous duct.
 (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
 (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
 (c) If Assertion is true but reason is false.
 (d) If both Assertion and reason are false.
7. **Assertion:** Ovulation occurs on 14th day of menstrual cycle.
Reason: LH secretion attains peak level on 14th day of menstrual cycle.
 (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
 (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
 (c) If Assertion is true but reason is false.
 (d) If both Assertion and reason are false.
8. **Assertion:** Progesterone level remains high during gestation period.
Reason: Progesterone is responsible for maintenance of endometrium.
 (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
 (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
 (c) If Assertion is true but reason is false.
 (d) If both Assertion and reason are false.
9. **Assertion:** All copulation do no result in pregnancy.

Reason: Fertilisation can only occur if the ovum and sperms are transported simultaneously to the ampullary region.

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

10. **Assertion:** The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum

Reason: Only one sperm can fertilizes the ovum at a time.

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

11. **Assertion:** Sperms released from the seminiferous tubules, are transported by the accessory ducts

Reason: Secretions of epididymis, vas deferens, seminal vesicle and prostate are essential for maturation and motility of sperms.

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

12. **Assertion:** At the time of parturition oxytocin release from maternal pituitary.

Reason: Oxytocin dilate the pubic symphysis at the time of parturition.

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

13. **Assertion:** Blastocyst become embedded into the endometrium of uterus.

Reason: After attachment, the uterine cells divide rapidly and covers the blastocyst.

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

14. **Assertion:** The second meiotic division is unequal and results in the formation of a second polar body and a haploid ovum

Reason: The haploid nucleus of the sperms and that of the ovum fuse together to form a diploid zygote.

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

15. **Assertion:** Colostrum develops resistance for the new-born babies.

Reason: It contains several antibodies.

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

16. **Assertion:** Middle piece of sperm is responsible for energy required for movement of the tail.

Reason: The middle piece possesses numerous mitochondria

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

17. **Assertion:** Mammary glands differentiate during pregnancy and secrete milk after child-birth

Reason: The new-born baby is fed milk by the mother during only one month of pregnancy.

- (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
- (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
- (c) If Assertion is true but reason is false.
- (d) If both Assertion and reason are false.

- 18. Assertion:** The trophoblast layer gets attached to the endometrium and the inner cell mass gets differentiated as the embryo
Reason: The attachment of foetus to the uterine wall is called implantation
 (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
 (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
 (c) If Assertion is true but reason is false.
 (d) If both Assertion and reason are false.
- 19. Assertion:** Placenta also acts as an endocrine tissue and produces several hormones
Reason: The placenta facilitate the supply of oxygen and nutrients to the embryo .
 (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
 (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
 (c) If Assertion is true but reason is false.
 (d) If both Assertion and reason are false
- 20. Assertion:** The testes are situated outside the abdominal cavity within a pouch called scrotum
Reason: The scrotum helps in maintaining the low temperature of the testes necessary for spermatogenesis.
 (a) If both Assertion and Reason are true and the reason is correct explanation of the assertion.
 (b) If both Assertion and Reason are true but the Reason is not correct explanation of the assertion.
 (c) If Assertion is true but reason is false.
 (d) If both Assertion and reason are false.
- 22. Statement I-** The blastomere in the blastocyst are arranged in two layer, outer layer is called trophoblast
Statement II- The trophoblast layer gets attached to endometrium
 (a) Both statements I and II are correct.
 (b) Both statements I and II are incorrect.
 (c) Statement I is correct but statement II is incorrect.
 (d) Statement II is correct but statement I is incorrect.
- 23. Statement I :** In follicular phase of menstrual cycle development of follicle and regeneration of endometrium occurs simultaneously.
Statement II : During menstrual cycle changes in the ovary and uterus are induced by changes in the level of hypothalamic hormones not by ovarian hormones
 (a) Both statement I and II are correct
 (b) Statements I is correct but II is incorrect
 (c) Statement I is incorrect but II is correct
 (d) Both statements I and II are incorrect
- 24. Statement I :** Maintenance of hygiene and sanitation during menstruation is very important
Statement II : During menstruation sanitary napkins or homemade pads should be changed after 4 to 5 hours as per the requirements
 (a) Both statements I and II are correct
 (b) Statement I is correct but II is incorrect
 (c) Statement I is incorrect but II is correct
 (d) Both statements I and II are incorrect
- 25. Statement I:** The seminiferous tubules are part of male reproductive system
Statement II: The secretions of bulbourethral glands helps in the lubrication of the penis.
 (a) Both statement I and II are correct
 (b) Statement I is correct but II is incorrect
 (c) Statement I is incorrect but II is correct
 (d) Both statement I and II are incorrect
- 26. Statement I:** The part of oviduct closer to the uterus is the funnel-shaped infundibulum.
Statement II: The edges of the isthmus possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation.
 (a) Both statement I and II are correct
 (b) Statement I is correct but II is incorrect
 (c) Statement I is incorrect but II is correct
 (d) Both statement I and II are incorrect
- 27. Statement I:** . The alveoli of mammary gland opens into mammary duct

Statement Based Questions

- 21. Statement1:** By the end of 12 weeks (first trimester), most of the major organ systems are formed
Statement2: The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month.
 (a) Both statements are correct.
 (b) Both statements are incorrect.
 (c) Statement 1 is correct, statement 2 is incorrect.
 (d) Statement 2 is correct, statement 1 is incorrect

- Statement II:** The duct of each lobe join to form a mammary tubules
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
28. **Statement I:** The changes in the ovary and the uterus are induced by changes in the levels of pituitary and ovarian hormones.
Statement II: The menstrual phase is followed by the Luteal phase
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
29. **Statement I:** Oogonia start division and enter into prophase-I of the meiotic division and get temporarily arrested at that stage.
Statement II: Primary oocyte completes its first meiotic division inside tertiary follicle.
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
30. **Statement I:** The secretion of LH and FSH gradually increases during follicular phase.
Statement II: . Both LH and FSH attain a peak level in the middle of cycle.
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
31. **Statement I:** During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum.
Statement II: The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
32. **Statement I:** The embryo with 8 to 16 blastomeres is called a blastocyst.
Statement II: . The blastocyst continues to divide and transforms into morula
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
33. **Statement I:** During pregnancy the levels of hormones like estrogens, progestogens, cortisol, prolactin, thyroxine, etc., are increased severalfolds in the maternal blood.
Statement II: Increased production of these hormones is essential for supporting the fetal growth, metabolic changes in the mother and maintenance of pregnancy.
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
34. **Statement I:** The first sign of growing foetus may be noticed by listening to the heart sound carefully through the stethoscope.
Statement II: By the end of the second month of pregnancy, the foetus develops limbs and digits
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
35. **Statement I:** The milk produced during the initial few days of pregnancy is called colostrum.
Statement II: Breast-feeding during the initial period of infant growth is recommended by doctors, for bringing up a healthy baby
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect
36. **Statement I:** Cortisol, estrogens and Oxytocin are involved in the process of parturition.
Statement II: After coitus, sperms are transported to the ampullary region of vas deference.
- (a) Both statement I and II are correct
(b) Statement I is correct but II is incorrect
(c) Statement I is incorrect but II is correct
(d) Both statement I and II are incorrect

Match up Based Questions

37. Match the following.

| Column A | | Column B | |
|----------|------------------------|----------|-------------------------|
| 1. | Periodic abstinence | a. | Withdrawal of penis |
| 2. | Coitus interruptus | b. | Absence of menstruation |
| 3. | Lactational amenorrhea | c. | Avoid coitus |

- (a) 1-C, 2- A, 3 – B
 (b) 1-A, 2- B, 3- C
 (c) 1-B, 2- A, 3- C
 (d) 1-C, 2-B, 3- A

38. Match the columns and find out the correct combination.

| Column-I | | Column-II | |
|----------|--------------|-----------|--|
| A. | Mons pubis | i. | Fleshy folds of tissue |
| B. | Labia majora | ii. | Cushion of fatty tissue covered by skin and pubic hair |
| C. | Labia minora | iii. | Membrane partially covering the opening of vagina |
| D. | Hymen | iv. | Paired folds of tissue |

- (a) A-(i); B-(ii); C-(iii); D-(iv)
 (b) A-(ii); B-(i); C-(iv); D-(iii)
 (c) A-(i); B-(ii); C-(iv); D-(iii)
 (d) A-(iv); B-(iii); C-(ii); D-(i)

39. Match the column-I with column-II.

| Column-I | | Column-II | |
|----------|--------------|-----------|----------------------------|
| A. | Myometrium | p. | Cushion of fatty tissue |
| B. | Clitoris | q. | Strong contraction |
| C. | Mons pubis | r. | Fleshy folds |
| D. | Labia majora | S. | Tiny finger-like structure |

- (a) A-(r); B-(s); C-(q); D-(p)
 (b) A-(s); B-(r); C-(q); D - (p)
 (c) A-(r); B-(p); C-(q); D-(s)
 (d) A-(q); B-(s); C-(p); D-(r)

40. Match the column-I with column-II.

| Column-I | | Column-II | |
|----------|-----------------------|-----------|--------------|
| A | Sperm | P | Diploid cell |
| B | Spermatogonia | Q | Epididymis |
| C | Male accessory duct | R | Haploid cell |
| D | Female accessory duct | S | oviducts |

- (a) A-R, B-S, C-Q, D-P
 (b) A-S, B-R, C-Q, D-P
 (c) A-R, B-P, C-Q, D-S

- (d) A-S, B-P, C-Q, D-R

41. Match the following

| Set-I | | Set-II | |
|-------|----------------|--------|--|
| A | Inguinal canal | 1 | Network of channels after seminiferous tubules |
| B | Rete testis | 2 | Secondary sexual characters |
| C | Leydig cells | 3 | For descending of testis |
| D | Fore skin | 4 | Dorsal bundles of spongy tissues |
| E | Penis | 5 | Loose fold of skin |

Answer codes:

- (a) A-1, B-2, C-3, D-5, E-4
 (b) A-3, B-1, C-4, D-2, E-5
 (c) A-2, B-4, C-3, D-5, E-1
 (d) A-3, B-1, C-2, D-5, E-4

42. Match the hormones in column I with their functions in column II. Choose the answer, which given the correct combination of the two columns.

| Column I | | Column II | |
|----------|--------------|-----------|---------------------------------|
| A | FSH | 1 | Maintains endometrium |
| B | LH | 2 | Proliferates endometrium |
| C | Progesterone | 3 | Contraction of uterine wall |
| D | Oestrogen | 4 | Ovulation |
| | | 5 | Maturation of graafian follicle |

- (a) A-5, B-4, C-1, D-2
 (b) A-4, B-5, C-2, D-1
 (c) A-2, B-3, C-4, D-5
 (d) A-5, B-1, C-3, D-2

43. **Statement I :** Soon after the infant is delivered, the placenta converts into an endocrine structure
Statement II : Oxytocin released from maternal pituitary gland causes strong contractions in uterine muscles

- (a) Both statements I and II are correct
 (b) Statement I is correct but II is incorrect
 (c) Statement I is incorrect but II is correct
 (d) Both statements I and II are incorrect

44. Match the following columns.

| Column-I | | Column-II | |
|----------|---------|-----------|---------------|
| A. | Ovaries | 1. | Oviduct |
| B. | Ampulla | 2. | Female gamete |

| | | | |
|----|--------|----|-------------|
| C. | Uterus | 3. | Birth canal |
| D. | Cervix | 4. | Pregnancy |

Codes :

| | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 1 | 4 | 3 |
| (b) | 1 | 2 | 3 | 4 |
| (c) | 4 | 3 | 1 | 2 |
| (d) | 2 | 3 | 4 | 1 |

45. Match column I with column II and choose the correct option.

| Column-I | | Column-II | |
|----------|---------------|-----------|-------------------------|
| A. | Corpus luteum | 1. | Morphogenetic movements |
| B. | Gastrula | 2. | Progesterone |
| C. | Capacitation | 3. | Initial milk |
| D. | Colostrum | 4. | Sperm activation |

Codes :

| | A | B | C | D |
|-----|---|---|---|---|
| (a) | 3 | 2 | 4 | 1 |
| (b) | 2 | 1 | 4 | 3 |
| (c) | 3 | 2 | 1 | 4 |
| (d) | 1 | 2 | 3 | 4 |

46. Match the following columns.

| Column-I | | Column-II | |
|----------|--------------|-----------|---------------------|
| A. | Mammary lobe | 1. | Graafian follicle |
| B. | Placenta | 2. | Contains Antibodies |
| C. | Colostrum | 3. | HCG |
| D. | Antrum | 4. | Contains alveoli |

Codes :

| | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 1 | 4 | 3 |
| (b) | 4 | 2 | 3 | 1 |
| (c) | 4 | 3 | 2 | 1 |
| (d) | 4 | 3 | 1 | 2 |

47. Match the Following correctly.

| Column-I | | Column-II | |
|----------|---------------|-----------|--------------------------------|
| 1. | Gestation | A. | Formation of gametes |
| 2. | Parturition | B. | Embryonic development |
| 3. | Gametogenesis | C. | Attachment to the uterine wall |

| | | | |
|----|--------------|----|----------------------|
| 4. | Implantation | D. | Delivery of the baby |
|----|--------------|----|----------------------|

Codes :

- (a) 1-A, 2-C, 3-B, 4-D
 (b) 1-B, 2-D, 3-C, 4-A
 (c) 1-B, 2-D, 3-A, 4-C
 (d) 1-C, 2-D, 3-A, 4-B

48. Match the following columns.

| Column-I | | Column-II | |
|----------|----------------|-----------|--------------------------|
| A. | Endometrium | 1. | Copulation site |
| B. | Menopause | 2. | Site of implantation |
| C. | Fallopian tube | 3. | Stopping of menstruation |
| D. | Vagina | 4. | Site of fertilisation |

Codes :

| | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 3 | 4 | 1 |
| (b) | 1 | 2 | 3 | 4 |
| (c) | 1 | 4 | 3 | 2 |
| (d) | 4 | 3 | 2 | 1 |

49. Match column I with column II and choose the correct answer.

| Column-I | | Column-II | |
|----------|-------------------|-----------|--------------------------|
| A. | Hypothalamus | 1. | Relaxin |
| B. | End of gestation | 2. | Fully developed follicle |
| C. | Graafian follicle | 3. | Interstitial cells |
| D. | Leydig's cells | 4. | GnRH |

Codes :

| | A | B | C | D |
|-----|---|---|---|---|
| (a) | 3 | 1 | 2 | 4 |
| (b) | 2 | 1 | 4 | 3 |
| (c) | 2 | 1 | 3 | 4 |
| (d) | 4 | 1 | 2 | 3 |

50. Match column I with column II.

| Column-I | | Column-II | |
|----------|-----------------|-----------|--------------------------------|
| A. | Sertoli cells | 1. | Covers glans penis |
| B. | Vasa Efferentia | 2. | Present in Seminiferous tubule |
| C. | Urethral meatus | 3. | Connects rete testis |

| | | | |
|----|-----------|----|------------------|
| | | | to epididymis |
| D. | Fore skin | 4. | External opening |

- (a) (A)-3, (B)-4, (C)-2, (D)-1
 (b) (A)-2, (B)-3, (C)-4, (D)-1
 (c) (A)-3, (B)-1, (C)-4, (D)-2
 (d) (A)-4, (B)-1, (C)-2, (D)-3

51. Match column I with column II.

| | Column-I | | Column-II |
|----|-----------------|---|----------------------------|
| A. | Menses | p | 28/29 days |
| B. | Menopause | q | About 14 th day |
| C. | Ovulation | r | 50 years of age |
| D. | Menstrual cycle | s | 3-5 days |

- (a) (A)-r, (B)-s, (C)-q, (D)-p
 (b) (A)-s, (B)-r, (C)-q, (D)-p
 (c) (A)-r, (B)-p, (C)-q, (D)-s
 (d) (A)-q, (B)-s, (C)-p, (D)-r

52. Match column I with column II.

| | Column-I | | Column-II |
|----|----------------------|---|---------------------------|
| A. | Bulbourethral glands | p | Fructose |
| B. | Prostate gland | q | Single |
| C. | LH | r | Lubrication of penis |
| D. | Seminal vesicles | s | Act on interstitial cells |

- (a) (A)-p, (B)-q, (C)-r, (D)-s
 (b) (A)-s, (B)-q, (C)-r, (D)-p
 (c) (A)-r, (B)-q, (C)-s, (D)-p
 (d) (A)-q, (B)-s, (C)-p, (D)-r

53. Match The columns

| | Column-I | | Column-II |
|------|---------------------|-----|----------------------------------|
| I. | Seminal plasma | (A) | Cervix |
| II. | Birth canal | (B) | External genitalia |
| III. | Penis | (C) | Spermatogonium and Sertoli cells |
| IV. | Seminiferous tubule | (D) | The fluid part of semen |

- (a) I-B, II-A, III-D, IV-C
 (b) I-D, II-B, III-C, IV-A

(c) I-D, II-C, III-B, IV-A

(d) I-D, II-A, III-B, IV-C

54. Match the following and choose the correct options.

| | Column-I | | Column-II |
|----|--------------|---|--|
| A. | Trophoblast | p | Embedding of blastocyst in the endometrium |
| B. | Cleavage | q | Solid ball like structure |
| C. | Morula | r | Layer attach to endometrium of uterus |
| D. | Implantation | s | Mitotic division of zygote |

- (a) (A)-r, (B)-s, (C)-q, (D)-p
 (b) (A)-r, (B)-p, (C)-q, (D)-s
 (c) (A)-r, (B)-p, (C)-s, (D)-q
 (d) (A)-q, (B)-s, (C)-r, (D)-p

55. Match column I with column II.

| | Column-I | | Column-II |
|------|----------------------|----|-----------|
| I. | Acrosome | A. | Ovary |
| II. | Polar body | B. | Diploid |
| III. | Graafian follicles | C. | Sperm |
| IV. | Primary spermatocyte | D. | Haploid |

- (a) I-B, II-A, III-D, IV-C
 (b) I-D, II-B, III-C, IV-A
 (c) I-C, II-D, III-A, IV-B
 (d) I-D, II-C, III-A, IV-B

Exercise-04 Previous Year Questions

1. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R:

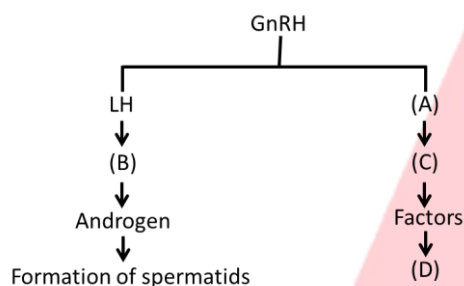
Assertion A: Breast-feeding during initial period of infant growth is recommended by doctors for bringing a healthy baby.

Reason R: Colostrum contains several antibodies absolutely essential to develop resistance for the new born baby.

In the light of the above statements, choose the most appropriate answer from the options given below: **(2024)**

- (a) Both A and R are correct but R is NOT the correct explanation of A.
- (b) A is correct but R is not correct.
- (c) A is not correct but R is correct.
- (d) Both A and R are correct and R is the correct explanation of A.

2. Identify the correct option (A), (B), (C), (D) with respect to spermatogenesis. **(2024)**



- (a) ICSH, Interstitial cells, Leydig cells, spermiogenesis.
- (b) FSH, Sertoli cells, Leydig cells, spermatogenesis.
- (c) ICSH, Leydig cells, Sertoli cells, spermatogenesis.
- (d) FSH, Leydig cells, Sertoli cells, Spermiogenesis

3. Given below are two statements :
- Statement I:** The presence or absence of hymen is not a reliable indicator of virginity.

Statement II: The hymen is torn during the first coitus only. **(2024)**

In the light of the above statements, choose the correct answer from the options given below :

- (a) Both Statement I and Statement II are false
- (b) Statement I is true but Statement II is false
- (c) Statement I is false but Statement II is true

4. Which of the following is not a component of Fallopian tube? **(2024)**

- (a) Isthmus
- (b) Infundibulum
- (c) Ampulla
- (d) Uterine fundus

5. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R :

Assertion A: FSH acts upon ovarian follicles in female and Leydig cells in male.

Reason R : Growing ovarian follicles secrete estrogen in female while interstitial cells secrete androgen in male human being. In the light of the above statements, choose the correct answer from the options given below : **(2024)**

- (a) Both A and R are true but R is NOT the correct explanation of A.
- (b) A is true but R is false
- (c) A is false but R is true
- (d) Both A and R are true and R is the correct explanation of A

6. Which of the following statements are correct regarding female reproductive cycle?

- A. In non-primate mammals cyclical changes during reproduction are called oestrus cycle.
- B. First menstrual cycle begins at puberty is called menopause.
- C. Lack of menstruation may be indicative of pregnancy.
- D. Cyclic menstruation extends between menarche and menopause.

Choose the most appropriate answer from the options given below: **(2023)**

- (a) A and B only
- (b) A, B and C only
- (c) A, C and D only
- (d) A and D only

7. Given below are two statements: one is labelled as Assertion and the other is labelled as Reason R.

Assertion A: Endometrium is necessary for implantation of blastocyst.

Reason R: In the absence of fertilization, the corpus luteum degenerates that causes disintegration of endometrium.

In the light of the above statements, choose the correct answer from the options given below: **(2023)**

- (a) Both A and R are true but R is NOT the correct explanation of A.
- (b) A is true but R is false.
- (c) A is false but R is true.
- (d) Both A and R are true and R is the correct explanation of A.

8. Given below are two statements:

Statement I : Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

Statement II : The cavity of the cervix is called cervical canal which along with vagina forms birth canal.

In the light of the above statements, choose the correct answer from the options given below: **(2023)**

- (a) Both Statement I and Statement II are false.
- (b) Statement I is correct but Statement II is false.
- (c) Statement I is incorrect but Statement II is true.
- (d) Both Statement I and Statement II are true.

9. How many secondary spermatocytes are required to form 400 million spermatozoa? **(2022)**

- (a) 400 million
- (b) 50 million
- (c) 100 million
- (d) 200 million

10. Arrange the components of mammary gland. (from proximal to distal). **(2022)**

- A. Mammary duct
- B. Lactiferous duct
- C. Alveoli
- D. Mammary ampulla
- E. Mammary tubules

Choose the most appropriate answer from the options given below:

- (a) $E \rightarrow C \rightarrow D \rightarrow B \rightarrow A$
- (b) $C \rightarrow A \rightarrow D \rightarrow E \rightarrow B$
- (c) $B \rightarrow C \rightarrow E \rightarrow D \rightarrow A$
- (d) $C \rightarrow E \rightarrow A \rightarrow D \rightarrow B$

11. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): During pregnancy the level of thyroxine is increased in the maternal blood.

Reason (R): Pregnancy is characterized by metabolic changes in the mother.

In the light of the above statements, choose the most appropriate answer from the options given below: **(2022)**

- (a) (A) is not correct but (R) is correct
- (b) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- (c) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- (d) (A) is correct but (R) is not correct

12. Which of the following statements are true for spermatogenesis but do not hold true for Oogenesis? **(2022)**

- A. It results in the formation of haploid gametes.
- B. Differentiation of gamete occurs after the completion of meiosis.
- C. Meiosis occurs continuously in a mitotically dividing stem cell population.
- D. It is controlled by the Luteinising Hormone (LH) and Follicle Stimulating Hormone (FSH) secreted by the anterior pituitary.
- E. It is initiated at puberty.

Choose the most appropriate answer from the options given below:

- (a) C and D only
- (b) B and C only
- (c) B, D and E only
- (d) B, C and E only

13. Given below are two statements: **(2022)**

Statement I : The release of sperms into the seminiferous tubules is called spermiation.

Statement II : Spermiogenesis is the process of formation of sperms from spermatogonia.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (a) Both Statement I and Statement II are correct
- (b) Both Statement I and Statement II are incorrect
- (c) Statement I is correct but Statement II is incorrect
- (d) Statement I is incorrect but Statement II is correct

14. At which stage of life the oogenesis process is initiated? **(2022)**

- (a) Puberty
- (b) Embryonic development stage
- (c) Birth
- (d) Adult

15. Receptors for sperm binding in mammals are present on **(2021)**

- (a) Vitelline membrane

- (b) Perivitelline space
(c) Zona pellucida
(d) Corona radiata
16. Which of these is not an important component of initiation of parturition in humans?

(2021, 2015)

- (a) Synthesis of prostaglandins
(b) Release of Oxytocin
(c) Release of Prolactin
(d) Increase in estrogen and progesterone Ratio
17. Which of the following secretes the hormone, relaxin during the later phase of pregnancy?

(2021)

- (a) Corpus luteum
(b) Foetus
(c) Uterus
(d) Graafian follicle
18. Which of the following hormone levels will cause release of ovum (ovulation) from the graffian follicle?

(2020)

- (a) High concentration of Progesterone
(b) Low concentration of LH
(c) Low concentration of FSH
(d) High concentration of Estrogen
19. Meiotic division of the secondary oocyte is completed

(2020)

- (a) At the time of copulation
(b) After zygote formation
(c) At the time of fusion of a sperm with an ovum
(d) Prior to ovulation
20. Match the following columns and select the correct option

(2020)

| Column - I | | Column - II | |
|------------|-----------------------|-------------|------------------------------------|
| 1. | Placenta | (i) | Androgens |
| 2. | Zona pellucida | (ii) | Human chorionic gonadotropin (hCG) |
| 3. | Bulbo-urethral glands | (iii) | Layer of the ovum |

| | | | |
|----|--------------|------|--------------------------|
| 4. | Leydig cells | (iv) | Lubrication of the penis |
|----|--------------|------|--------------------------|

1 2 3 4

- (a) (i) (iv) (ii) (iii)
(b) (iii) (ii) (iv) (i)
(c) (ii) (iii) (iv) (i)
(d) (iv) (iii) (i) (ii)
21. In human beings, at the end of 12 weeks (first trimester) of pregnancy, the following is observed
- (2020 Covid Re-NEET)
- (a) Most of the major organ systems are formed
(b) The head is covered with fine hair
(c) Movement of the foetus
(d) Eyelids and eyelashes are formed
22. Select the correct option of haploid cells from the following groups
- (2020 Covid Re-NEET)
- (a) Secondary spermatocyte, First polar body, Ovum
(b) Spermatogonia, Primary spermatocyte, Spermatid
(c) Primary spermatocyte, Secondary spermatocyte, Second polar body
(d) Primary oocyte, Secondary oocyte, Spermatid
23. Select the correct sequence for transport of sperm cells in male reproductive system
- (2020, 2016 Covid Re-NEET)
- (a) Testis → Epididymis → Vasa efferentia → Rete testis → Inguinal canal → Urethra
(b) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus
(c) Seminiferous tubules → Vasa efferentia → Epididymis → Inguinal canal → Urethra
(d) Testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Inguinal canal → Urethra → Urethral meatus

Answer keys

TOPIC CENTRIC EXERCISE 01 Answer Key

1. (a) | 2. (c) | 3. (a) | 4. (d) | 5. (b)

TOPIC CENTRIC EXERCISE 02 Answer Key

1. (d) | 2. (a) | 3. (b) | 4. (c) | 5. (c)

TOPIC CENTRIC EXERCISE 03 Answer Key

1. (b) | 2. (c) | 3. (c) | 4. (c) | 5. (d)
6. (d)

TOPIC CENTRIC EXERCISE 04 Answer Key

1. (b) | 2. (a) | 3. (a) | 4. (c) | 5. (d)
6. (a)

TOPIC CENTRIC EXERCISE 05 Answer Key

1. (a) | 2. (d) | 3. (b) | 4. (a) | 5. (d)

TOPIC CENTRIC EXERCISE 06 Answer Key

1. (c) | 2. (c) | 3. (c) | 4. (a) | 5. (c)

TOPIC CENTRIC EXERCISE 07 Answer Key

1. (b) | 2. (b) | 3. (c) | 4. (b) | 5. (b)

Exercise-01 Level -01 Answer Key

| | | | | | | | | |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (c) | 6. (c) | 11. (d) | 16. (b) | 21. (d) | 26. (c) | 31. (a) | 36. (d) | 41. (d) |
| 2. (a) | 7. (b) | 12. (c) | 17. (c) | 22. (c) | 27. (b) | 32. (b) | 37. (a) | 42. (d) |
| 3. (c) | 8. (b) | 13. (d) | 18. (d) | 23. (a) | 28. (a) | 33. (d) | 38. (a) | 43. (b) |
| 4. (d) | 9. (d) | 14. (d) | 19. (d) | 24. (c) | 29. (d) | 34. (a) | 39. (d) | |
| 5. (c) | 10. (b) | 15. (c) | 20. (b) | 25. (d) | 30. (c) | 35. (a) | 40. (a) | |

Exercise-02 Level -02 Answer Key

| | | | | | | | | |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (d) | 7. (a) | 13. (a) | 19. (d) | 25. (c) | 31. (b) | 37. (c) | 43. (a) | 49. (b) |
| 2. (d) | 8. (a) | 14. (d) | 20. (c) | 26. (d) | 32. (d) | 38. (b) | 44. (d) | 50. (b) |
| 3. (a) | 9. (c) | 15. (b) | 21. (b) | 27. (d) | 33. (d) | 39. (a) | 45. (b) | |
| 4. (d) | 10. (a) | 16. (a) | 22. (d) | 28. (c) | 34. (d) | 40. (b) | 46. (b) | |
| 5. (c) | 11. (a) | 17. (a) | 23. (b) | 29. (c) | 35. (b) | 41. (a) | 47. (c) | |
| 6. (d) | 12. (c) | 18. (b) | 24. (d) | 30. (b) | 36. (b) | 42. (d) | 48. (b) | |

Exercise-03 Level -03 Answer Key

| | | | | | | | |
|--------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a) | 8. (a) | 15. (a) | 22. (a) | 29. (a) | 36. (b) | 43. (c) | 50. (b) |
| 2. (a) | 9. (a) | 16. (a) | 23. (b) | 30. (a) | 37. (a) | 44. (a) | 51. (b) |
| 3. (c) | 10. (b) | 17. (c) | 24. (a) | 31. (a) | 38. (b) | 45. (b) | 52. (c) |
| 4. (a) | 11. (b) | 18. (b) | 25. (a) | 32. (d) | 39. (d) | 46. (c) | 53. (d) |
| 5. (c) | 12. (c) | 19. (b) | 26. (d) | 33. (a) | 40. (c) | 47. (c) | 54. (a) |
| 6. (b) | 13. (b) | 20. (a) | 27. (d) | 34. (a) | 41. (d) | 48. (a) | 55. (c) |
| 7. (a) | 14. (b) | 21. (a) | 28. (b) | 35. (c) | 42. (a) | 49. (d) | |

Exercise-04 Previous Year Questions

| | | | | | | | |
|--------|--------|--------|---------|---------|---------|---------|---------|
| 1. (d) | 4. (d) | 7. (a) | 10. (d) | 13. (c) | 16. (c) | 19. (c) | 22. (a) |
| 2. (d) | 5. (c) | 8. (d) | 11. (b) | 14. (b) | 17. (a) | 20. (c) | 23. (b) |
| 3. (b) | 6. (c) | 9. (d) | 12. (d) | 15. (c) | 18. (d) | 21. (a) | |