25. Human Reproduction

1. Introduction

Reproduction is a complex process executed by the male and female reproductive organs. The reproductive organs are situated both outside and inside the body, thus being termed outer and inner reproductive organs respectively the reproductive glands or gonads (ovaries and testis) and organs with a double function:

- Production of special reproductive cells (gametes), i.e., eggs in the woman and spermatozoa in the man, and
- Secretion of hormones with various regulatory actions on the organisms, especially on the reproductive systems.

The union of the spermatozoan and the egg will give rise to the embryo, which will develop in the womb and will result in the birth of a child.

Mammals are unisexual. Sexes are separate in human beings. The growth, maintenance and functions of the gonads are regulated by gonadotropins secreted from anterior lobe of pituitary gland. The organs which neither produce gametes nor secrete sex hormones but perform important functions in reproduction are called secondary sex organs. The latter include the prostate, seminal vesicles, vas deferentia and penis in males, and the fallopian tubes, uterus vagina and mammary gland in females. The characters which distinguish the males from the females externally are called accessory or external sex character. They are also called secondary sec characters. The age of sexual maturity is called puberty. External or accessory sex characters first appear in puberty. During this period, a person becomes capable of sexual reproduction of offspring, presumed to be 14 years in the male and 12 years in the female.

2. The Male Reproductive System

Important-

Canal : Oblique passage through the lower abdominal wall. In males it is the passage through which the testes descend into the scrotum and it contains the spermatic cord.

The male reproductive system consists of paired testes, several accessory glands, a duct system and a mating organ called the penis.

2.1. Primary Male Sex Organ

(1) Testis

Is the primary male sex organ. It produces spermatozoa and secretes the male sex hormone testosterone. A human testis measures about 5cm, 3cm and 2.5cm, respectively, in length, thickness.

- In man, both testes normally remain suspended in a pouch called scrotum outside the abdominal cavity. This keeps the testes at a lesser temperature (about 2° C below) than the normal body temperature. This is essential for the maintenance and functioning of the spermatogenic tissue of the testes.
- Testes descend in the scrotal sac when foetus is about 7 months old and occurs under the influence of FSH and testosterone. If they fail to descend, it is called cryptorchidism and leads to sterility.

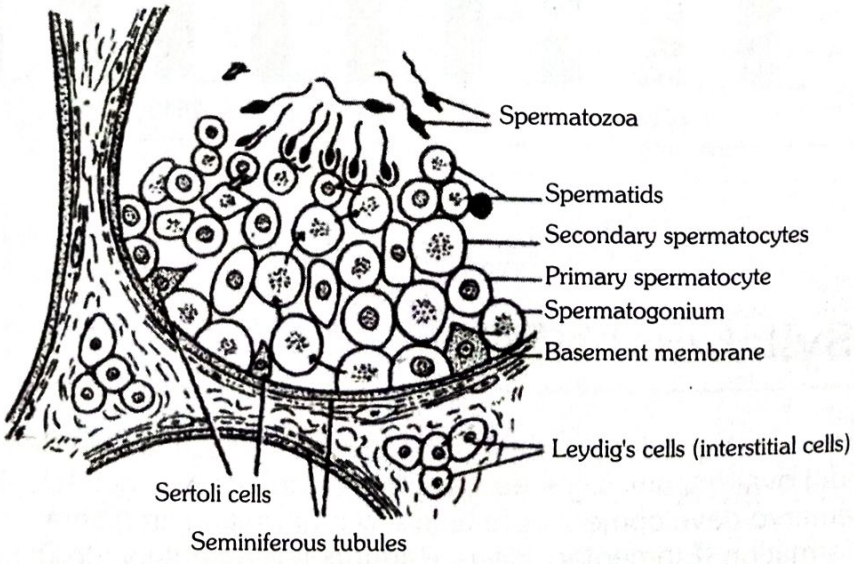


Figure : A part of transverse section of mammalian testis

- 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 contracts to move the testes close to the abdominal or pelvic cavity.
- When outside temperature is high, these relax moving the testes away. Testes are surrounded by three layers of tissues :

  Tunica vaginalis, an outer covering.

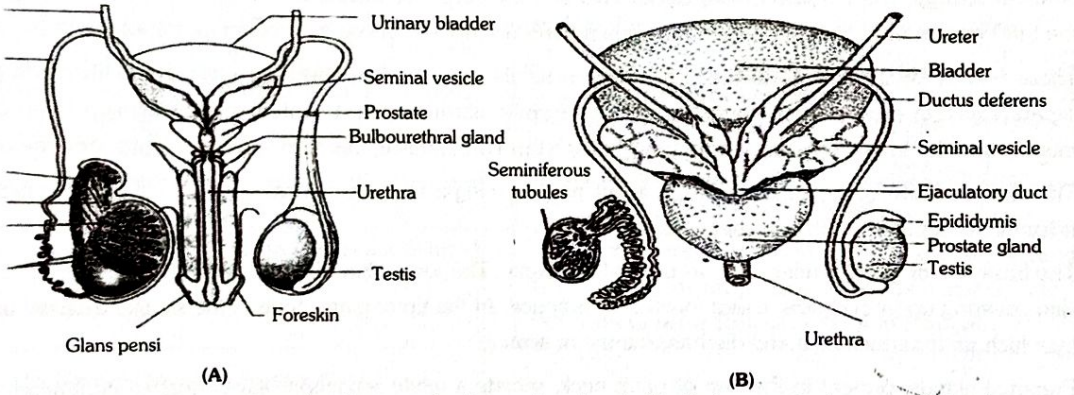
  Tunica albuginea, a middle fibrous layer

  Tunica vascularis, an inner network of capillaries

(2) Seminiferous tubules : Each testis contains numerous tiny, highly convoluted tubules, called seminiferous tubules. They constitute the spermatogenic tissue of the testis. Cells lining these tubules give rise to spermatozoa which are released into the lumen of the tubule.

(3) Sertoli cells : In between spermatogenic cells, sertoli or sustentacular or nurse cells are present which provide nourishment to developing spermatozoa and regulate spermatogenesis by releasing inhibiting to check FSH over activity. The other functions of sertoli cells are :

- To provide nourishment to the developing spermatozoa.
- To absorb the parts being shed by developing spermatozoa.
- To release anti mullerian factor (AMF) to prevent development of mullerian duct/oviduct in male.
- To release androgen binding protein (ABP).



(A) Diagrammatic view of male reproductive system (part of testis is open to show inner details.

(B) The male genital system as seen from behind

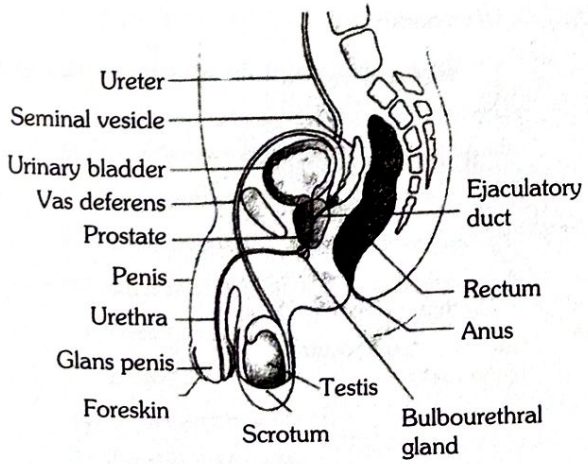


Fig: Sectional view of male pelvis showing reproductive system

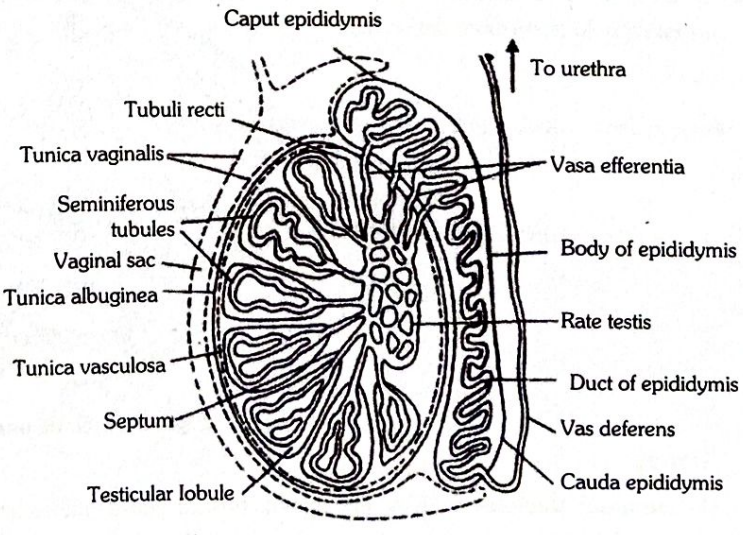


Figure : Structure of testis

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 secrete testosterone into the blood.

2.2. Accessory Ducts

(1) Rete Testis and Vasa Efferentia : 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 intra-testicular genital duct system.

(2) **Epididymis :** The extra testicular duct system consists of tubes which conduct sperms from the testes to the outside. It starts with vasa efferentia which arise from each testis and become confluent to form a folded and coiled tube called epididymis behind each testis. The epididymis consist of 3 parts (i) Caput, (ii) Corpus, (iii) Cauda. The epididymis stores the sperms temporarily.

(3) **Vas deferens :** From cauda epididymis, a partially coiled tube called vas deferens ascends into the abdomen through inguinal canal, passes over the urinary bladder, receives the duct from the seminal vesicle behind the urinary bladder and forms an ejaculatory duct. Before entering prostate, the ductus deferens dilates to form ampulla. The final portion of ampulla passes through the prostate to open into the urethra shortly after its origin from the urinary bladder. The urethra receives the ducts of the prostate and Cowper's glands, passes through the penis and opens to the outside.

2.3. Penis

- This is the copulatory organ of man. It is a cylindrical and 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). Erect human penis, on an average is about 15*cm* long.
- The penis itself encased in a fibrous sheath, called tunica albuginea. The interior of penis is mostly formed of three cylindrical cords of spongy, erectile (cavernous) tissue. 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 becomes superior-posterior when penis is erect.
- These two cords are called corpora cavernosa. The fibres of tunica albuginea surround both 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 inferior-anterior in erect penis. Urethra runs through this cord. Hence, this cord is called corpus urethrae or spongiosum.
- The extended part of corpus spongiosum is enlarged forming a bulging, conical structure called glans penis. The surface of glans is formed of a thin smooth and shiny, hairless skin.
- The base line of glans is referred to as 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.
- 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.

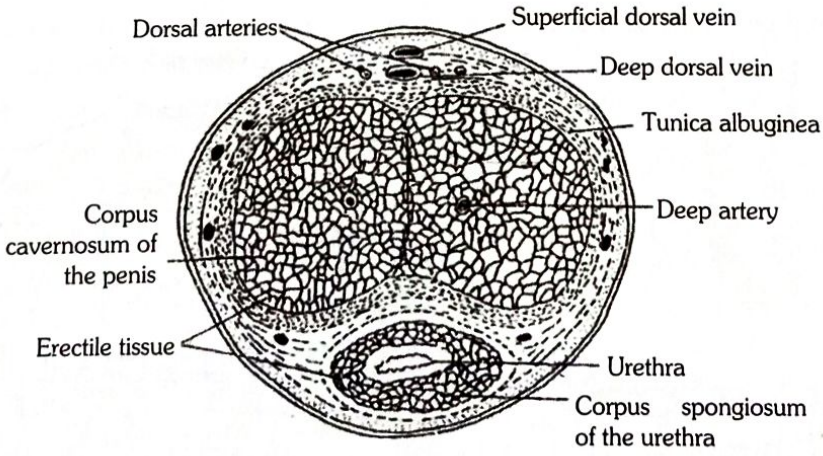


Figure : T.S. of penis

2.4. Glands

(1) **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.

(2) **Prostate gland :** The prostate gland is a chestnut shaped gland is a collection of 30-40 tubuloalveolar glands which lies at the base of the bladder and surrounds the first part of the urethra. It contributes an alkaline component to the seminal fluid. The alkaline secretions of prostate gland helps the sperms to become active and counteract any adverse effects 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.

(3) **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 is lubricating in functions.

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.

2.5. 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 2.5-5ml 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 atleast 40 percent must show vigorous motility. When the number of sperm 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 fluids from the seminal vesicles and bulbourethral glands give it a sticky consistency.
- Semen provides sperm with transportation medium and nutrients. It neutralizes the hostile acidic environment of the male urethra and the female vagina.

Difference between Primary Sex Organs and Secondary Sex Organs

Primary sex organs	Secondary sex organs
1. They produce gametes.	They do not produce gametes. They are concerned with the conduction of gametes.
2. They also secrete sex hormones.	They do not secrete sex hormones.
3. Testes in male and ovaries in female are examples of primary sex organs.	Epididymus, vasa deferentia, penis, etc are secondary sex organs in male and oviducts, uterus, etc are examples of secondary sex organs in females.

2.6. Function of Male Reproductive System

The male reproductive system relies on male sex hormones. In addition to testosterone, follicle-stimulating hormones and luteinizing hormones play a part in the male reproductive system. Testosterone is responsible for the development of male sex characteristics such as facial hair, muscle mass and voice. It also plays a part in fat distribution, bone density, and sex drive. Follicle-stimulating hormone is needed for sperm production. Luteinizing hormone helps make sperm by stimulating the production of testosterone.

2.7. Disorders of Male Reproductive System

The male reproductive system consists of organs and structures which are quite complicated and don't always work properly. As a result, problems can result, some more serious than others. Some common problems include:

(1) Low sperm count
(2) Sexually transmitted infections/diseases
(3) Cancer of the penis, testes or prostate
(4) Urethral stricture
(5) Epididymo-orchitis
(6) Urinary tract infection
(7) Erectile dysfunction
(8) Prostate gland enlargement
(9) Infertility

3. The Female Reproductive System

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

3.1. Ovaries (Primary Female Sex Organ)

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 3cm in diameter.

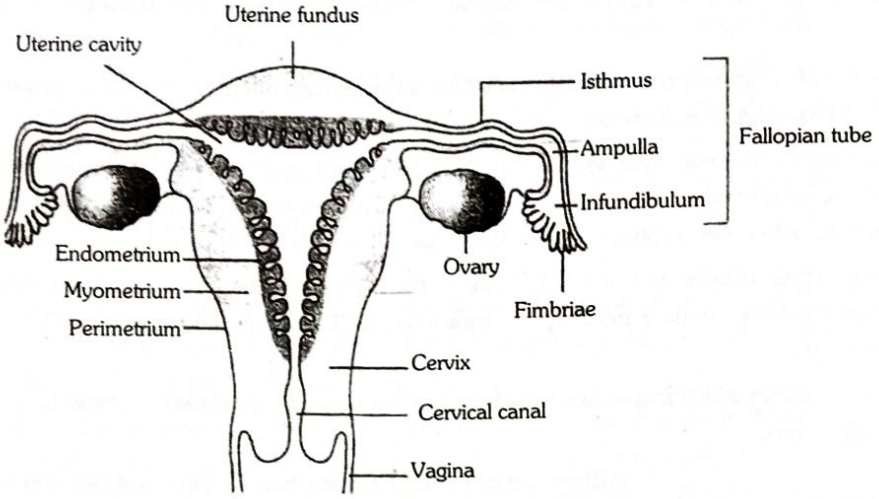


Figure : Diagrammatic sectional view of the female reproductive system

- Ovaries are located near kidneys and remain attached to the lower abdominal cavity through mesovarium.
- 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 condensation of connective tissue called tunica albuginea.

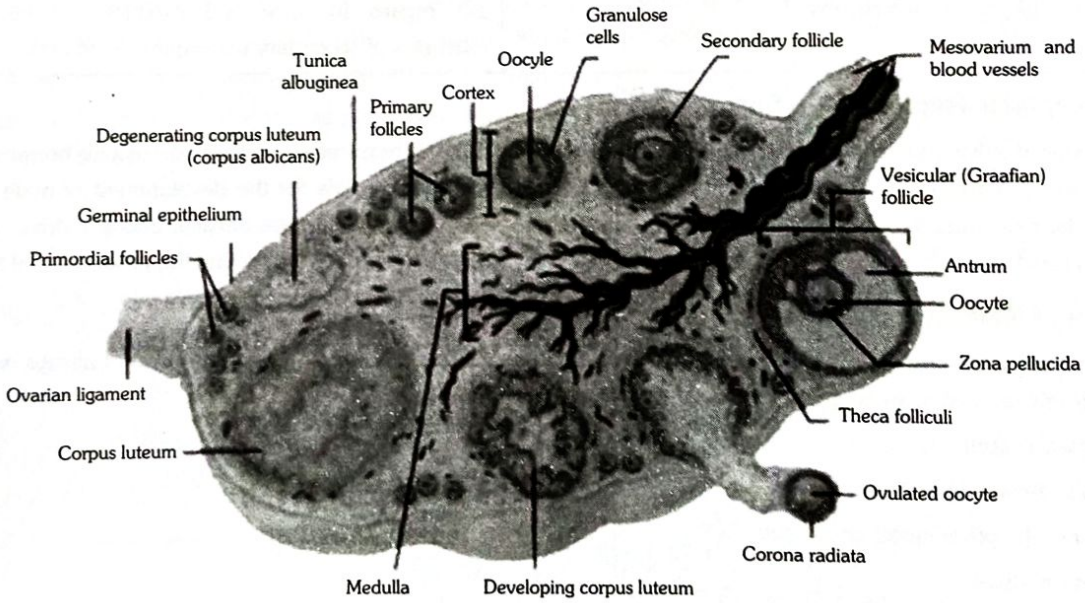


Figure : T. S. of ovary

- 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.
- The ovaries have two main reproductive functions in the body. They produce oocytes (eggs) for fertilisation and they produce the reproductive hormones, estrogen and progesterone.
- In the ovary, all eggs are initially enclosed in a single layer of cells known as a follicle, which supports the egg.

Structure of Ovaries

- **Ovarian follicle :** The ovarian follicle carries a large, centrally placed ovum, surrounded by several layers of granular cells (follicular granulose or discus proligerus or cumulus oophorus) it is suspended in a small cavity called the antrum. Antrum is filled with liquid folliculi. The secondary oocyte in the tertiary follicle also forms a new membrane called zona pellucida. The follicle

bulges into 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 of the graafian follicle is called corpus luteum. 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. 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).

3.2. Accessory Ducts

(1) **Fallopian tubes (oviducts) :** These are one pair of long (10cm), ciliated, muscular and tubular structures which extend from ovaries to uterus. Each is suspended by mesosalpinx and is differentiated into three parts:

- **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 collection of the ovum after ovulation. Infundibulum opens in abdominal cavity by an aperture called ostium.
- **Ampulla :** The infundibulum leads to a wider part of the oviduct called ampulla.
- **Isthmus :** It is middle, narrow and ciliated. The tube is involved in conducting 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) **Uterus :** It is a large hollow, muscular, highly vascular and 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.

- **Fundus :** It is upper dome shaped part above the opening of fallopian tubes.
- **Body :** It is middle and main part of uterus.
- **Cervix :** It is lower, narrow part which opens in body of uterus by internal os and in vagina below is formed of outer peritoneal layer, perimetrium; middle muscular myometrium of smooth muscle fibres, and inter highly vascular and glandular endometrium. It is the site of foetal growth during pregnancy. It also takes part in placenta formation and expelling of the baby during parturition.

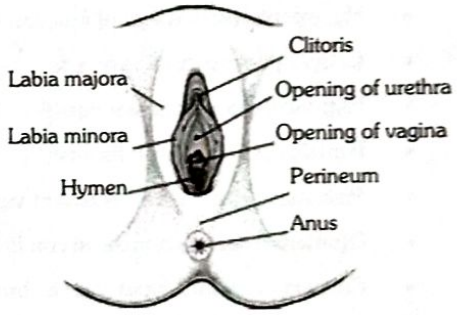


Figure : The external genitelia in female

(3) **Vagina :** It is a long (7.5cm), 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.In the virgin female, vaginal orifice is closed by a membranous diaphragm called hymen which becomes centrally perforated at puberty for the discharge of menstrual flow. Vagina acts both as copulation canal (as it receives the sperms from penis during copulations) and as birth canal (during parturition).

3.3. Vulva

It is external genitalia of female. It has a depression, the vestibule, in front of anus. Vestibule has two apertures upper external urethral orifice of urethral and lower vaginal orifice of vagina. Vestibule is bounded by two pairs of moist skin folds with sebaceous glands-inner smaller pair called labia minora and outer larger pair called 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 cavemosa. 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.

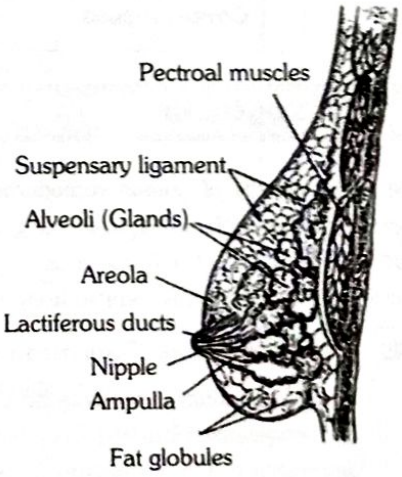


Figure : Lateral view of woman's breast showing external and internal structures

3.4. Glands

(1) **Vestibular glands :** These are of two types-greater and lesser. Greater vestibular or Bartholin's gland are a pair of small reddish yellow glands on each side of vaginal orifice and secrete alkaline secretion for lubrication and neutralizing urinary acidity.

Lesser vestibular glands or paraurethral or skene's glands are small mucus gland present between urethral and vaginal orifices.

(2) **Mammary Glands :** each mammary gland consists of 15-25 lobules of the compound tubuloalveolar type. These lobules secrete milk to nourish the newborn babies. Each lobe is separated from the others by dense connective and adipose tissues and represents a gland. From each lobe, excretory lactiferous ducts emerge independently in the ripple, which has 15-25 openings, each about 0.5mm in diameter.

3.5. Function of Female Reproductive System

(1) Germinal epithelial cells of the ovary produce ova (oogenesis).

(2) Fertilization takes place in the Fallopian tube (oviduct).

(3) After puberty the uterus goes through the menstrual cycle.

(4) Implantation and prenatal growth take place in the uterus.

(5) The vagina receives the seminal fluid during copulation.

(6) Parturition (process of child birth of child) is also an important function of female reproductive system.

(7) Mammary glands of the female secrete milk after parturition.

3.6. Disorders of Female Reproductive System

- Hypogonadism - A lack of function of the gonads, in regards to either hormones or gamete production.
- Ectopic pregnancy - When a fertilized ovum is implanted in any tissue other than the uterine wall.
- Hypoactive sexual desire disorder - A low level of sexual desire and interest.
- Female sexual arousal disorder - A condition of decreased, insufficient, or absent lubrication in females during sexual activity
- Premature ejaculation - A lack of voluntary control over ejaculation.
- Dysmenorrhea - Is a medical condition of pain during menstruation that interferes with daily activities.
- Cancers of various types such as breast cancer, cervical cancer, ovary cancer, uterus cancer can occur.

Homology between Male and Female reproductive system

Male reproductive system	Female reproductive system
Scrotum/Scrotal sac	Labia majora
Penis	Clitoris
Glans penis	Clitoris
Prostate gland	Paraurethreral/skene's gland
Cowper's gland	Bartholin's gland

4. Gametogenesis

The major events of human reproduction are formation of gametes, cyclic changes in the female body as preparation for receiving spermatozoa through coitus, fusion of gametes, development of the zygote and its gradual transformation into a tiny baby in the uterus of mother, production of milk for nourishment of the immature baby and, finally, the birth of the baby. All these events are regulated and coordinated by hormones secreted from the anterior pituitary gland and the gonads.

4.1. Gametogenesis (Formation of gametes)

Sexual reproduction requires the fusion of two haploid gametes to form a diploid individual. These haploid cells are produced through gametogenesis. Gametogenesis is controlled by gonadotrophic hormones of anterior pituitary. As there are two types of gametes, the spermatozoa and ova, gametogenesis can be studied under two broad headings, Spermatogenesis and oogenesis. Spermatogenesis is the formation of spermatozoa, whereas oogenesis is the formation of ova. Both spermatozoa and ova originate from primordial germ cells or PGCs which are extra-gonadial in origin. In humans, the PGCs originate during early embryonic development from the extra-embryonic mesoderm. Eventually, they migrate to the yolk sac endoderm, and ultimately, to the gonads to the developing embryo, where undergo further development.

5. Spermatogenesis

Spermatozoa are produced in the seminiferous tubules of the testes. Spermatogenesis in the process of maturation of reproductive cells in the testes. Spermatogenesis includes two stages

- formation of spermatids and
- metamorphosis of spermatids. Spermatids are formed by three phases namely phase of multiplication (mitosis), growth and maturation (meiosis).

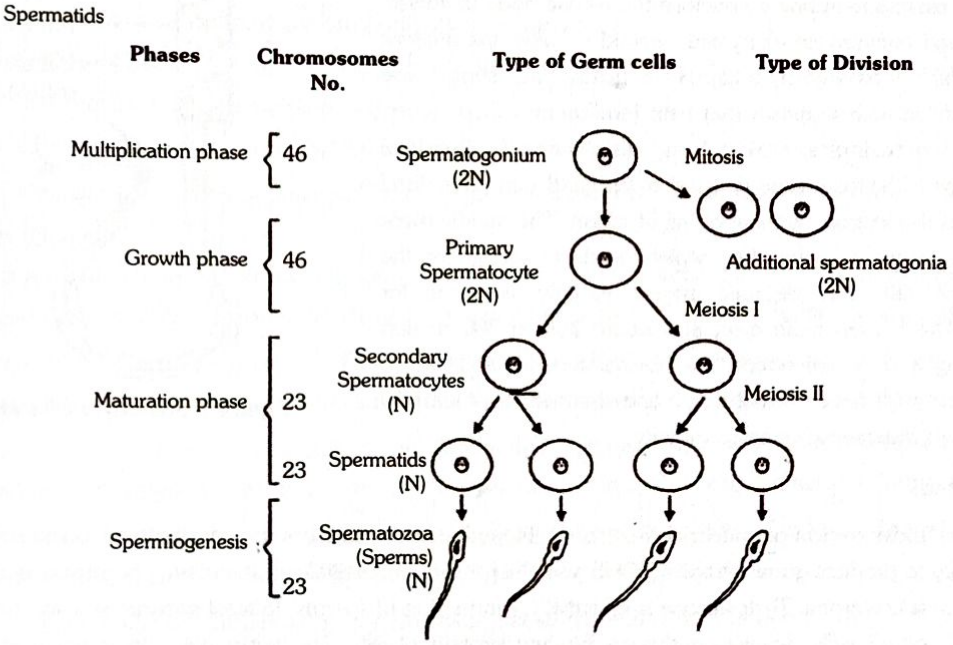


Figure : Stages in spermatogenesis (diagrammatic)

5.1. Steps in Spermatogenesis

(1) During phase of multiplication, the primordial germ cells divide repeatedly by mitosis to form diploid spermatogonia. Each spermatogonium enlarges to form primary spermatocyte.

(2) During phase of growth, the primary spermatocyte enlarges in size and prepares to undergo maturation division.

(3) During phase of maturation, the primary spermatocyte undergoes meiosis I giving rise to two haploid (n) secondary spermatocytes. The secondary spermatocytes undergo meiosis II resulting in the formation of four spermatids.

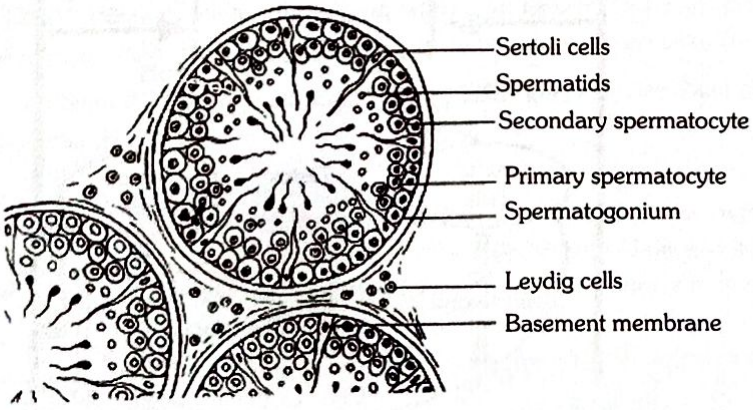


Figure: T.S. part of seminiferous tubule of a testis showing spermatogenesis.

(4) 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 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. Tail-less, nonflagellate 'amoeboid' sperm is found in the roundworm Ascaris.

(5) **Structure of Sperm :** Let us examine the structure of a sperm. It is a microscopic structure composed of a head, neck, a middle piece and a tail. A plasma membrane envelops the whose body of sperm, the sperm head contains 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 fertilization of the ovum. Neck it has two centrioles, proximal and distal centriole. Proximal centriole helps in first cleavage division of fertilized egg. The distal centriole gives rise to axial filament of tail of sperm. The middle piece possesses numerous mitochondria, which produce energy for the movement of tail that facilitate sperm motility essential for fertilisation. The human male ejaculates about 200 to 300 million sperms during a coitus of which, for normal fertility, at least 60 percent sperms must have normal shape and size and for at least 40 percent of them must show vigorous motility.

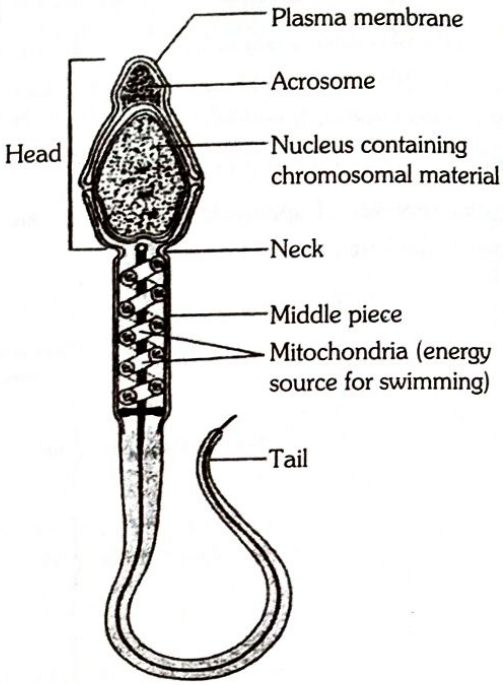


Figure : Structure of a sperm

5.2. Hormonal control

Spermatogenesis is under control of endocrine hormones. Hypothalamus produces gonadotropin releasing hormone or GnRH. It acts on anterior pituitary to produce gonadotropins, ICHS and FSH, ICSH (interstitial cell stimulating hormone) acts on interstitial or leydig cells which produce testosterone. Testosterone is essential for formation of sperms. (atleast spermiogenesis part) by sertoli cells. Under influence of FSH, sertoli cells develop androgen binding protein (ABP). The latter helps in concentrating testosterone in the seminiferous tubules. Excess of testosterone inhibits LH/ICSH production by anterior pituitary and GnRH production by hypothalamus. Sertoli cells also produces a glycoprotein called inhibin. Inhibin suppresses FSH synthesis by anterior pituitary and GnRH synthesis by hypothalamus. Thus normal release of testosterone is under negative feedback control.

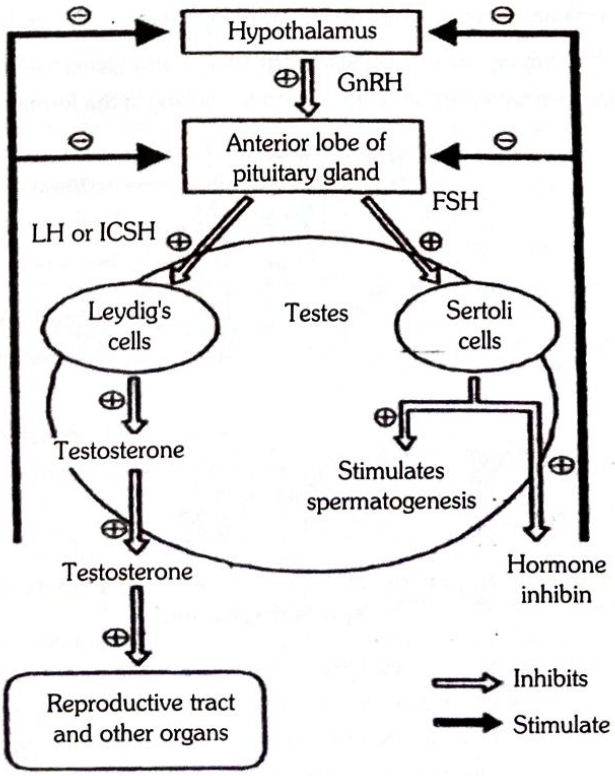


Figure : Hormonal control of male reproductive

Important-

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, mid piece or tail are classified as secondary abnormalities. Primary defects are the more severe and are thought to originate while the sperm was still within the seminiferous epithelium of the testis. Secondary defects are less serious and thought to arise during passage through the epididymus or by mishandling after ejaculation.

5.3. Significance of Spermatogenesis

(1) During spermatogenesis, one spermatogonium produces four sperms.

(2) Sperms have half the number of chromosomes. After fertilization, the diploid chromosome number is restored in the zygote. It maintains the chromosome number of the species.

(3) During meiosis I crossing over takes place which brings about variation.

(4) Spermatogenesis occurs in various organisms. Thus it supports the evidence of the basic relationship of the organisms.

5.4. Spermatozoon (Sperm)

A spermatozoon is a motile sperm cell, or moving form of the haploid cell that is the male gamete. A spermatozoon joins an ovum to form a zygote. Sperm cells contribute approximately half of the nuclear genetic information to the diploid offspring.

- The human sperm cell is the reproductive cell in males and will only survive in warm environments, once it leaves the male body the sperm's survival likelihood is reduced and it may die, thereby decreasing the total sperm quality.
- Sperm cells come in two types, "female" and "male". Sperm cells that give rise to female (XX) offspring after fertilization differ in that they carry an X-chromosome, while sperm cells that give rise to male (XY) offspring carry a Y-chromosome.
- Human sperm cells consist of a flat, disc shaped head 5.1 μm by 3.1 μm and a tail 50 μm long. The tail flagellates, which propels the sperm cell (at about 1–3 mm/minute in humans) by whipping in an elliptical cone.

(1) Head : It has a compact nucleus with only chromatic substance and is surrounded by only a thin rim of cytoplasm. Above the nucleus lies a cap-like structure called the acrosome, formed by modification of the Golgi body and which secretes enzyme spermlysin (hyaluronidase, corona-penetrating enzyme, zona eyesin or aerosin.) On the surface of the head lies a decapcitating substance which is removed before fertilisation.

(2) Neck : It is the smallest part (0.03×10^{-6} m), and has a proximal and distal centriole. The proximal centriole enters into the egg during fertilisation and starts the first cleavage division of the egg, which has no centriole. The distal centriole gives rise to axial filament which forms the tail and has (9+2) arrangement. A transitory membrane called *Manchette* lies in middle piece.

(3) Middle piece : It has 10-14 spirals of mitochondria surrounding axial filament in the cytoplasm. It provides motility, and hence is called the powerhouse of the sperm. It also has a ring centriole (annulus) with unknown function.

(4) Tail : It is the longest part(50×10^{-6} m) having axial filament surrounded by cytoplasm and plasma membrane, but at the posterior end axial filament is naked.

5.5 Semen

Has an alkaline nature, and they do not reach full motility (hypermotility) until they reach the vagina where the alkaline pH is neutralized by acidic vaginal fluids. This gradual process takes 20–30 minutes. In this time, fibrinogen from the seminal vesicles forms a clot, securing and protecting the sperm. Just as they become hypermotile, fibrinolysin from the prostate dissolves the clot, allowing the sperm to progress optimally.

6. Oogenesis

6.1. Steps in Oogenesis

(1) Oogenesis is the process of maturation of reproductive cells in ovary. Oogenesis starts before birth. In 25 week old fetus, all the oogonia are already formed oogenesis is basically similar to spermatogenesis. It includes phases of multiplication, growth and maturation.

(2) During the phase of multiplication, the primordial cells in the ovaries divide mitotically to form oogonia (egg mother cell). Each oogonium divides mitotically to form two primary oocytes.

(3) Primary oocytes undergo growth the growth phase during oogenesis is comparatively longer. The size of oocytes increases very much.

(4) Primary oocytes, begin the first step of meiosis-I and proceed up to diakinesis. These oocytes resume their development at puberty. The primary oocyte (2n) completes meiosis-I producing two haploid cells (n), the larger one is secondary oocyte and the smaller one is first polar body.

(5) Secondary oocyte start meiosis larger one is secondary oocyte metaphase-II only. Further development will start only after arrival of spermatozoa. Entry of sperm restarts the cell cycle by breaking down (M-phase promoting factor) and turning on APC (Anaphase promoting complex). Completion of meiosis II results in the formation of functional egg or ovum and a second polar body.

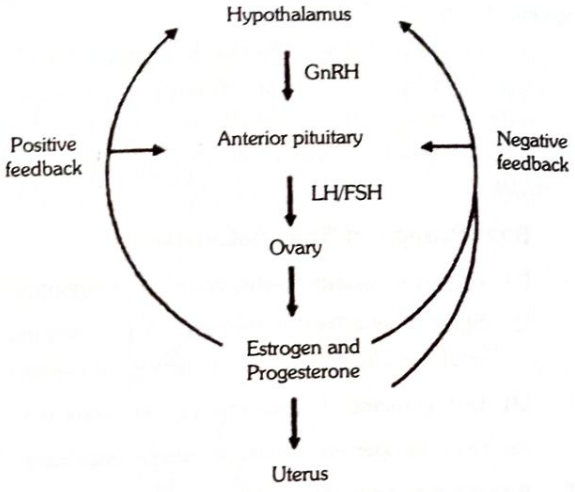


Figure : Hormonal control of female reproductive system

6.2. Hormonal control

In response to production of GnRH or gonadotropin releasing hormone, anterior pituitary secretes two hormones, FSH (follicle stimulating hormone) and LH (luteinizing hormone). FSH stimulates follicular growth and maturation of oocytes. Granulosa cells of developing ovarian follicles produces estrogen. In the presence of high titre of both estrogen and LH, ovulation occurs. High concentration of estrogen inhibits secretion of both FSH and GnRH. This is negative feedback control. LH helps in converting ruptured graafian follicle into corpus luteum. The latter secretes progesterone which prepares the uterus to receive fertilised ovum. High concentration of progesterone inhibits further release of LH from anterior pituitary and GnRH from hypothalamus.

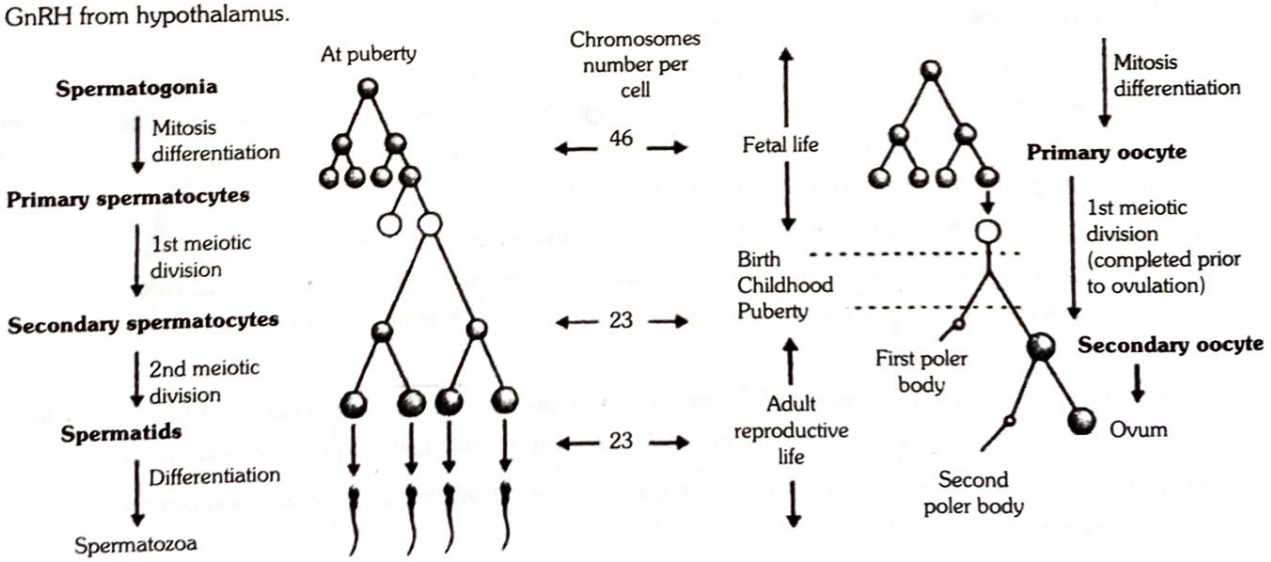


Figure : Schematic representation of (a) Spermatogenesis; (b) Oogenesis

6.3. Significance of Oogenesis

(1) One oogonium produces one ovum and three polar bodies

(2) Polar bodies have small amount of cytoplasm. It helps to retain sufficient amount of cytoplasm in the ovum which is essential for the development of early embryo. Formation of polar bodies maintains half number of chromosomes in the ovum.

(3) During meiosis first crossing over takes place which brings about variation.

(4) Oogenesis occurs in various organisms. Therefore, it supports the evidence of basic relationship of the organisms.

6.4. Ovulation

Ovulation is the release of eggs from the ovaries. In humans, this event occurs when the follicles rupture and release the secondary oocyte ovarian cells. After ovulation, during the luteal phase, the egg will be available to be fertilized by sperm. In addition, the uterine lining (endometrium) is thickened to be able to receive a fertilized egg. If no conception occurs, the uterine lining as well as blood will be shed during menstruation.

6.5. Ovum

The gamete, produced by the female is called the egg or ovum. It joins with the sperm, the male gamete, during fertilization to form the embryo, which will eventually grow into a new organism.

Ova are produced by sexually reproducing animals, protists, fungi and flowering plants and ferns. In animals, they are produced by follicle cells in the ovaries of the female. In plants, egg cells are produced by ovules found inside the ovary (the part which then becomes the fruit).

(1) Structure : Despite its large size - it's the only animal cell you can see with the naked eye and is as big as the period at the end of this sentence - most of the egg cell is padding, layers of which protect the valuable information in its nucleus. Most of the inner structures of the egg cell are the same as those in any other animal cell, but they are given special names. For example, the nucleus is referred to as the 'germinal vesicle' and the nucleolus as the 'germinal spot.' The cytoplasm of the ovum is called the 'ooplasm' (meaning 'egg material') or 'vitellus'. As if two names were not enough, it is also known as the 'yolk' of the egg.

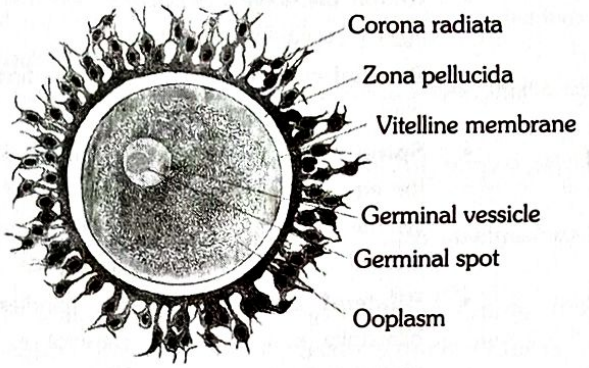


Figure : A mammalian ovum as seen under electron microscope

This can be a bit confusing when you think of one of the most common, visible and edible ovum around the chicken egg, in which the yolk looks like the nucleus of the cell but actually contains most of the egg cell. The yolk supplies nutrients to the growing embryo, a smaller amount in mammals compared to that of egg-laying animals.

The plasma membrane of the ovum is called the 'vitelline membrane,' and it has the same functions as in other cells, mainly to control what goes in and out of them.

The zona pellucida, more commonly known as 'jelly coat,' is a thick, protein-based layer covering the outside of the vitelline membrane that helps protect the egg. It is also involved in the binding of sperm during fertilization and prevents more than one sperm from entering the egg.

(2) Types of egg

The eggs are classified on the basis of amount and distribution of yolk in them. Yolk is the reserved food material in the cytoplasm of egg. It may be formed of phospholipids, proteins, lipid and carbohydrates. The process of formation of yolk and its deposition in egg is called vitellogenesis.

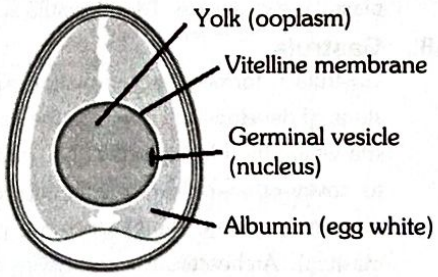


Figure : Egg Internal Structure

(3) Based on amount of yolk.

- **Alecithal :** Eggs without yolk e.g., human egg.
- **Microlecithal :** The eggs with very little yolk, e.g., sea urchin, starfish.
- **Mesolecithal :** The eggs containing moderate amount of yolk e.g., frog.
- **Megalecithal (or Macrolecithal) :** The eggs containing very large amount of yolk, e.g., reptiles, birds.

(4) Based on distribution of yolk.

- **Isolecithal :** The yolk is uniformly distributed throughout the cytoplasm of egg, e.g., Branchiostoma, Herdmania.
- **Telolecithal :** The eggs is which the yolk is concentrated towards one pole i.e., vegetal pole & nucleus along with major part of cytoplasm is displaced is animal pole e.g., amphibians
- **Centrolecithal :** Yolk concentrated in centre of the egg with cytoplasm surrounding it, e.g., insects.

(5) 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 bird's eggs.

(6) Egg membranes : There are three types of egg membrane around the eggs.

- **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 radiate (shark, some amphibians), zona pellucida (mammals).
- **Secondary egg membrane :** It is formed around the egg by the follicle cells of the ovary e.g., chorion around egg of insect; corona radiate, granulose and theca layers in human.

- **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 Laws of cleavage

(7) **Patterns of Cleavage :** Cleavage is the successive mitotic cell divisions of the egg and can be

- **Radial cleavage :** Successive cleavage planes cut straight through the egg e.g., synapta paracentrotus.
- **Biradial cleavage :** When the three first division planes do not stand at right angles to each other : ctenophore.
- **Spiral cleavage :** There is a rotational movement of cell parts around the egg axis leading to displacement of mitotic spindle with respect to symmetrically disposed radii e.g., turbellarians, nematoda, rotifer, annelid, all mollusk except cephalopods.
- **Bilateral cleavage :** Mitotic spindles and cleavage planes remain bilaterally arranged with reference to the plane of symmetry e.g., tunicates, Amphioxous, amphibian and higher mammals.

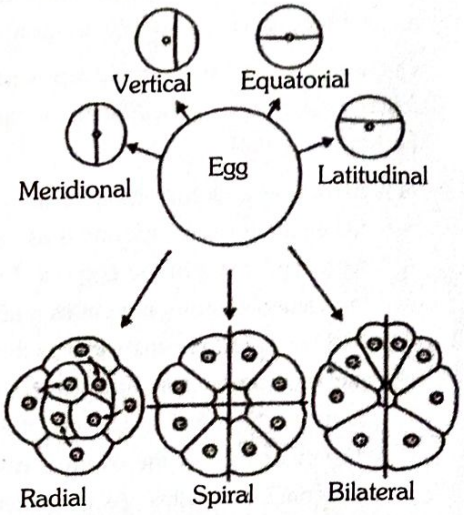


Figure : Patterns (planes) of cleavage

- **Meridonal cleavage :** When cleavage furrow bisects both the poles of egg passing through animal vegetal axis, the plane of cleavage is called meridonal cleavage.

6.6. Morula

Cleavage results in formation of solid mass of cells which is called morula as it looks a mulberry.

6.7. Blastula

Blastula is the embryonic stage next to morula. It contains a fluid-filled cavity called blastcoel surrounded by one or more layers of cells, the blastomeres. The blastula with blastocoels is called coeloblastula, e.g., frog. In certain animals, the blastula is solid and is termed stereoblastula e.g., cnidaria, nereis & some molluscs. The blastula formed as a result of superficial cleavage is called superficial blastula, e.g., insects. Discoblastula is disc shaped blastula formed as a result of discoidal cleavage of e.g., birds.

6.8. Gastrula

Gastrula is formed by gastrulation. Gastrulation is the process of formation of gastrula from the blastula. Gastrula is the embryonic stage of development in which the germinal layers have been formed. Gastrulation involves movement from their original place to the site where they finally settle. The movements are called morphogenic movements. 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 the blastocoels), invagination (tucking in of blastula wall), and delamination (separation of a sheet of cells from blastula). Archenteron is the cavity occurs inside the gastrula and is the future alimentary canal. It opens to the outside through blastopore which later on closes.

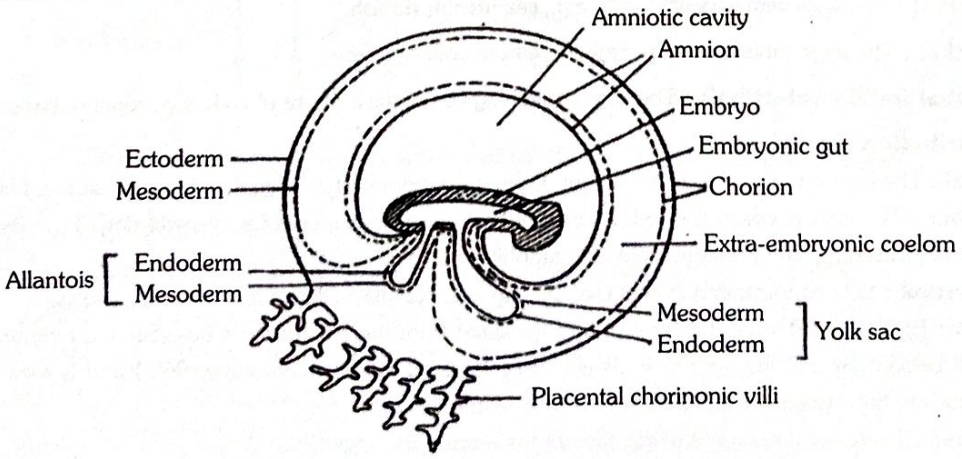


Figure : Foetal membranes (diagrammatic)

6.9. Foetal membranes

The developing foetus soon becomes enclosed by three membranes i.e., amnion, chorion and allantois.

(1) **Amnion** is formed of mesoderm an outside and ectoderm inside. Space between amnion and foetus is called amniotic cavity and it contains amniotic fluid.

(2) **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.

(3) **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.

7. Menstrual Cycle

Menstrual cycle is the cyclic change in the reproductive tract of primate females. Menstruation is the periodic shedding of the endometrium of the uterus with bleeding. In healthy women, menstruation occurs at intervals of about 28 days.

- Menarche is the starting of menstruation in girls at about 13 years. Menstrual cycle consists of menstrual phase, proliferative phase (follicular phase) and secretory phase (luteal phase).
- Proliferative phase (5^{th} to 14^{th} day) consists of growth of endometrium of uterus, fallopian tube and vagina. In ovary, a graafian follicle secretes estrogen during this phase. Estrogen is the hormone active during proliferative phase.
- The ovum is ejected from the follicle near the end of proliferative phase, i.e., 14^{th} day or midway during menstrual cycle. Ovulation occurs under the influence of LH from pituitary.
- The subsequent 14 days in which corpus luteum is active is referred to as the secretory phase. Progesterone secreted by corpus luteum is active during secretory phase. The uterine endometrium and glands grow further during secretory phase. At the end of secretory phase, corpus luteum degenerates into corpus albicans in the ovary.
- Progesterone secretion falls and the overgrown uterine endometrium breaks down and menstruation takes place. Menstruation remain suspended during pregnancy and lactation. Menopause (climacteric) is the period of life when menstruation naturally stops. Menopause occurs in females at the age of 45-50 years. Ability to reproduce is lost in the female after menopause.

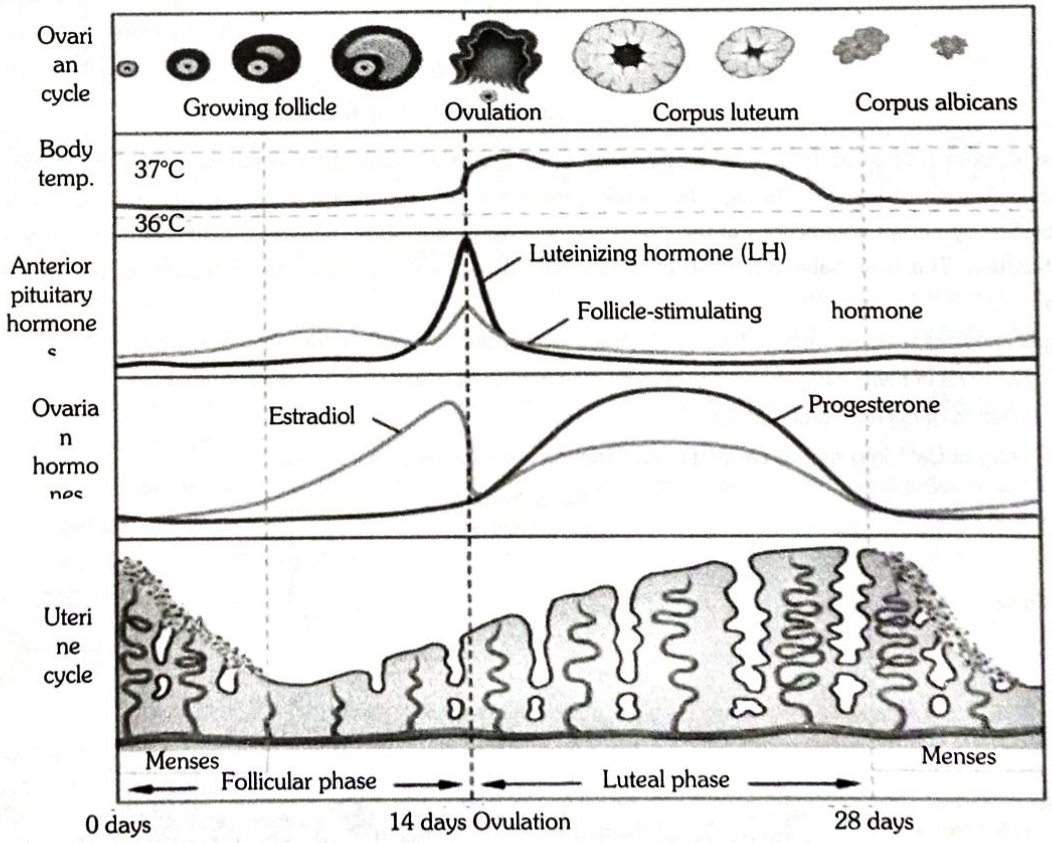


Figure: Diagrammatic representation of events occur in Menstrual cycle

Important -

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 strong sex urge in the female. This is called "period of heat". The estrous cycles run only during breeding season. The estrous cycles is called anestrum. The animal that have only a single estrous during the breeding season are called monoestrous, e.g., dog, 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.

8. Fertilization

8.1. Fertilization

- 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.
- A human sperm can live for many weeks in male genital duct. Once ejaculated in the semen, it lives only for 24 to 48 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 movement of spermatozoa and finally reach ampulla portion of the oviduct

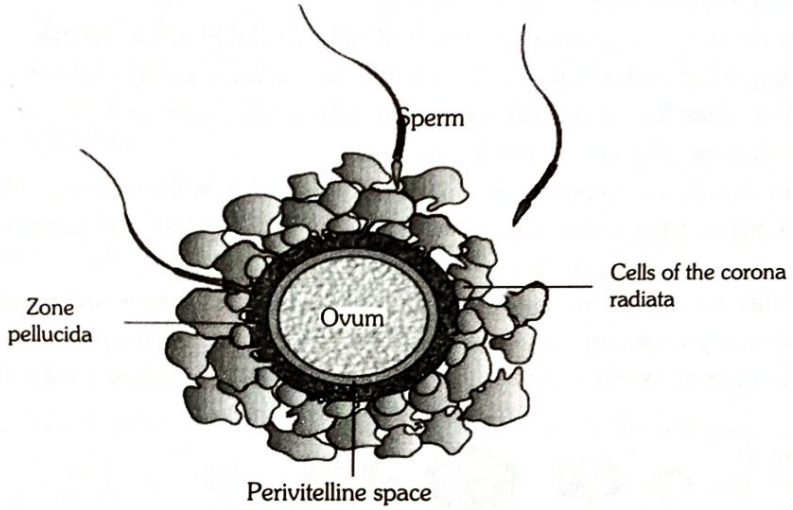


Figure : Ovum surrounded by few sperms

- The vacuum created in the uterine cavity in between successive contraction allows aspiration of the sperm 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 the compatible spermatozoa are allowed to enter the uterine tube.
- Capacitation of sperm occurs in the female genital system and the capacitation process 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.

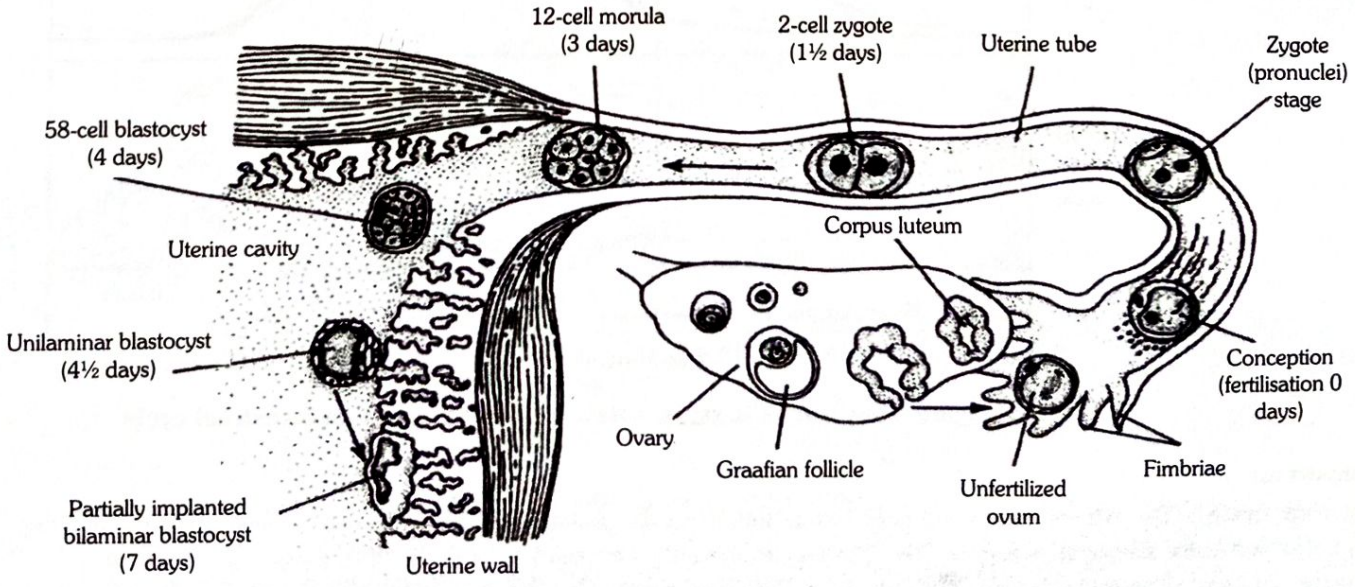


Figure : Transport of ovum, fertilisation and passage of growing embryo through fallopian tube

(1) **Fusion of gametes / Syngamy :** The various steps involve. Acrosomal reactions- Number of sperms adhere to the surface of egg (Agglutination). The acromsome starts releasing its hydrolytic enzymes or sperm lysins which include.

- **Hyaluronidase :** Dissolves the hyaluronic acid responsible for cementing of follicle cells or granulose cells.
- **Corona penetrating enzyme (CPE) :** Dissolves corona radiate.
- **Zona lysine / Acrosin :** Digests the zona pellucid. It involves zona pellucida compatibility reactions determined by fertilizin protein over zona pellucida and antifertilizin on sperm. Contact of acrosome stimulates development of a outgrowth by the oocyte fertilisation cone or cone of reception
- As the sperm head gets in contact with the fertilization cone, it cause opening of Na^+ channels to cause depolarization of ovum membrane (fast block to check polyspermy) and Ca^{2+} move in the egg. Sperm and egg membranes dissolve. Male pronucleus & proximal centriole of sperm enter cytoplasm of egg and rest part is left out.
- Ca^{2+} in flux causes extrusion of cortical granules (cortical reaction) and zona reactions which make the zona pellucida impervious to second sperm by destroying sperm receptors.
- Cortical reaction and zona reaction constitute slow block to check polyspermy.
- Entry of sperm cause breakdown of metaphase promoting factor (MPF) and turns on anaphase promoting complex (APC). This results in oocyte completing its meiosis-II.
- 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.

Important-

The genetic material of male and female pronuclei fuse. Their membranes dissolve, leaving no barriers between the male and female chromosomes. During the 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 from the male and female together. Thus, the first mitosis of the union of sperm and oocyte is the actual fusion of their chromosomes

9. Embryonic Development and Pregnancy

9.1. Embryonic development

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

(1) **Cleavage :** First cleavage is completed after 30 hours of fertilization. Cleavage furrow passes from animal-vegetal axis as well as centre of zygote (Meridonal cleavage). 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 transient 3-called stage. Third cleavage is horizontal forming 8 blastomeres. It is slightly unequal. Thereafter the rate and pattern of cleavage is non specific.

(2) **Morula :** Cleavage results in a solid ball of cells, Morula having 16 cells (occasionally 32 cell). Zona pellucida still forms the outer cover. Morula undergoes compaction. The outer/peripheral cells are smaller/flat with tight junction while the inner cell mass is slightly large, rounded and with gap junctions. Morula descends slowly towards uterus in 4-6 days and corona radiate detaches during this period

(3) **Blastulation or blastocyst formation :** Endometrium secrets a nutrient fluid and its mucosal cells become enlarged with stored nutrients. As the morula enters uterus, it obtains enriched supply of nutrients. Outer peripheral cells enlarge and flatten further. They form trophoblast or trophoectoderm. Trophoblast secretes a fluid into its interior. It creates a cavity called blastocoels. The inner cells 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. The growing blastocyst comes out of this slit is zona pellucida. At times, it gets broken into two parts which then gives rise to identical twins.

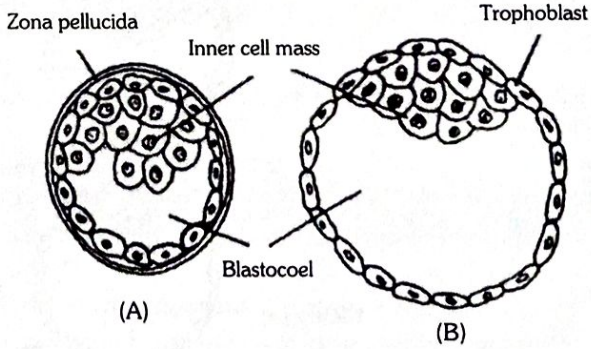


Figure : Development of blastocyst

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 syncytiotropbhoblast and inner cytotrophoblast. The two layers later form chorion, amnion and foetal part of placenta.

(4) 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 deciduas (L. deciduos-falling off). Decidua has three regions:

- **Decidua basalis** (Basal deciduas, Tunica serotina)- Part of deciduas underlying the chorionic villi and overlying the myometrium).
- **Decidua capsularis** (Decidua reflexa)- Lying between embryo and lumen of uterus and
- **Decidua parietalis** (Decidua vera) the part of deciduas that lines the uterus at places other than the site of attachment of embryo.

Implanted blastocyst - At 12 days cavities develop which coalesce to from the extra-embryonic coelom

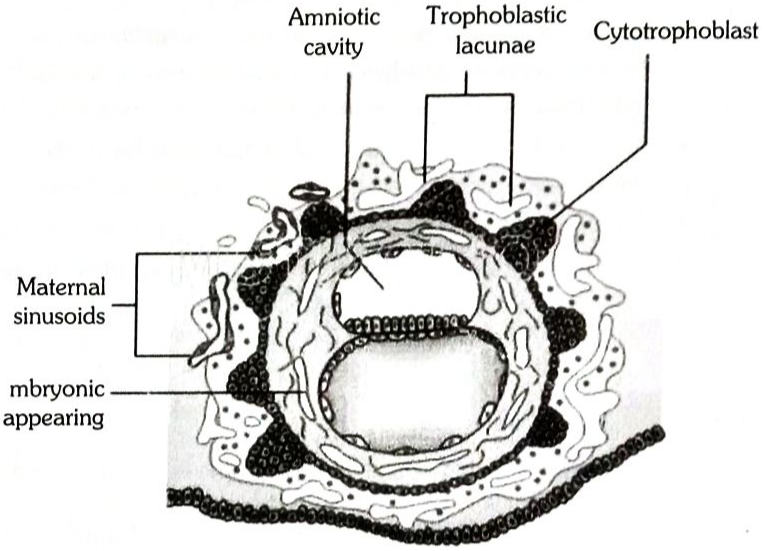


Figure : Implanted Blastocyst

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 secrets 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.

(5) 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.

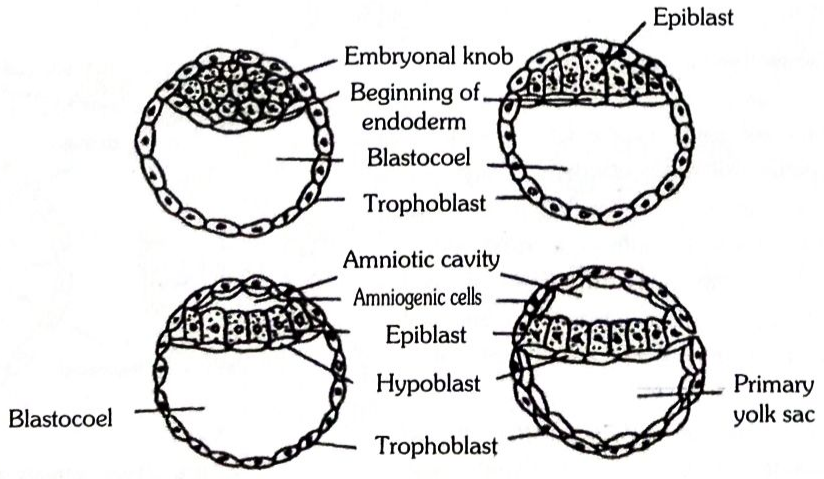
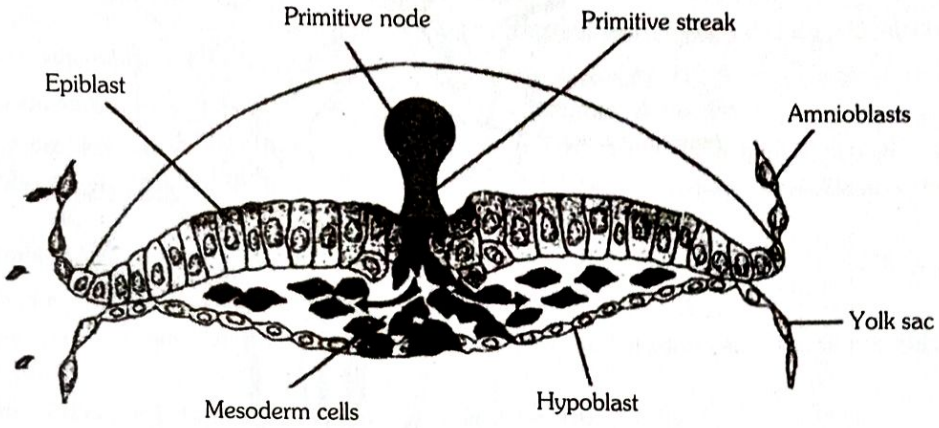


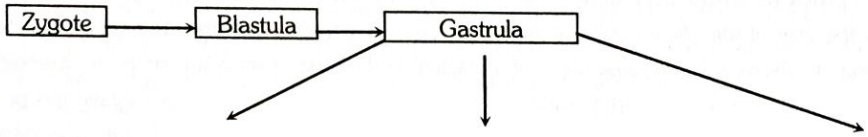
Figure : Formation of endoderm and amniotic cavity

(6) **Formation of primary germinal layers :** Cells of the inner cells 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 streek on the surface of the epiblast.



- 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.

Fate of germ layers:



Ectoderm	Mesoderm	Endoderm
Epidermis	Dermis	Gut
Cutaneous glands	Muscular tissue	Visceral organs
Nervous system	Connective tissue	Glands of stomach and intestine
(Brain and spinal cord)	Endoskeleton	Tongue
Eye (Retina, lens an cornea)	Vascular system	Lungs, trachea and bronchi
Nasal epithelium	(heart and blood vessels)	Urinary bladder
Internal ear	Kidneys	Gills
Lateral line sense organ	Gonads	Liver and pancreas
Stomodaeum	Urinary and genital ducts	Thyroid gland
Pituitary	Coelom and coelomic	
Pineal gland	Epithelium	Parathyroids
Adrenal medulla	Choroid and sclerotic coats of eye	Thymus
	Adrenal cortex	Middle ear
	Spleen	Eustachian tube

Important-

Placenta banking refers to the collection and storage of stem cells from the placenta, in addition to those found in cord blood, after the birth of a human baby. Placental stem cells are those stemcells that are found only in the placenta and are collected after the blood from the umbilical cord is drawn. They are non-embryonic stem cells, as are those obtained from umbilical cord blood. Both the placenta and umbilical cord are also rich sources of stem cells. Banking stem cells from the placenta in addition to those found in cord blood significantly increases the number of prenatal stem cells that are collected and preserved.

9.2. Pregnancy

Pregnancy, also known as gestation, is the time during which one or more offspring develops inside a woman. A multiple pregnancy involves more than one offspring, such as with twins. Pregnancy can occur by sexual intercourse or assisted reproductive technology. Childbirth typically occurs around 40 weeks from the last menstrual period (LMP). This is just over nine months, where each month averages 29½ days. When measured from conception it is about 38 weeks. An embryo is the developing offspring during the first eight weeks following conception, after which, the term fetus is used until birth.

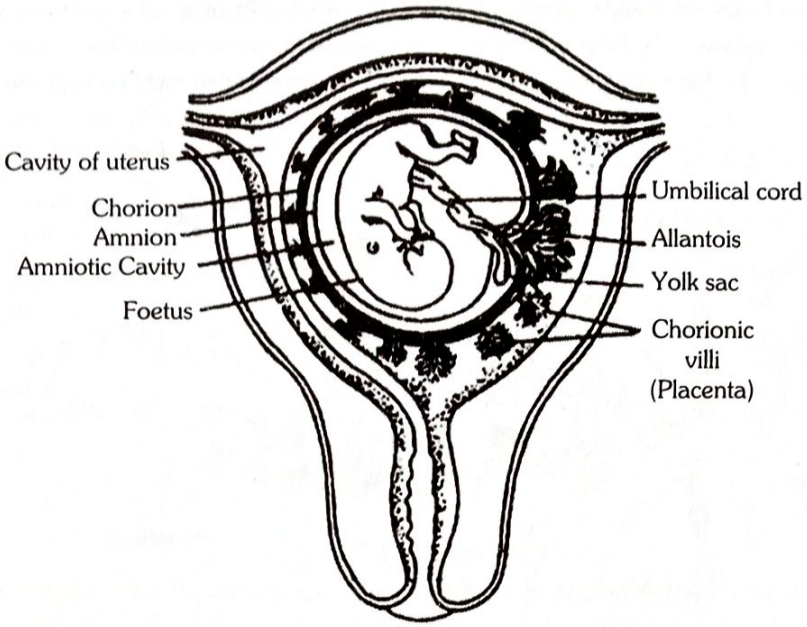


Figure : The human foetus within the uterus

(1) Placenta :

The placenta is an organ that connects the developing fetus to the uterine wall to allow nutrient uptake, thermo-regulation, waste elimination, and gas exchange via the mother's blood supply; to fight against internal infection; and to produce hormones which support pregnancy. The placenta provides oxygen and nutrients to growing fetuses and removes waste products from the fetus's blood. The placenta attaches to the wall of the uterus, and the fetus's umbilical cord develops from the placenta. Placenta also acts as an endocrine gland and synthesizes large quantities of proteins and some hormones such as human chorionic gonadotropin (hCG), chorionic thyrotropin, chorionic corticotropin, chorionic somatomammotropin, 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, its secretes some relaxin that facilitates parturition by softening the connective tissue of the symphysis pubica. The metabolic activity of the placenta is almost as great as that of the foetus itself. 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 These organs connect the mother and the fetus. Placentas are a defining characteristic of placental mammals, but are also found in marsupials and some non-mammals with varying levels of development.

(2) Types of placenta

On the basis of structure, the placenta are of following types :

(i) Epitheliochorial : Placenta with all the six barriers between foetal and maternal blood; e.g., Horse, Ass.

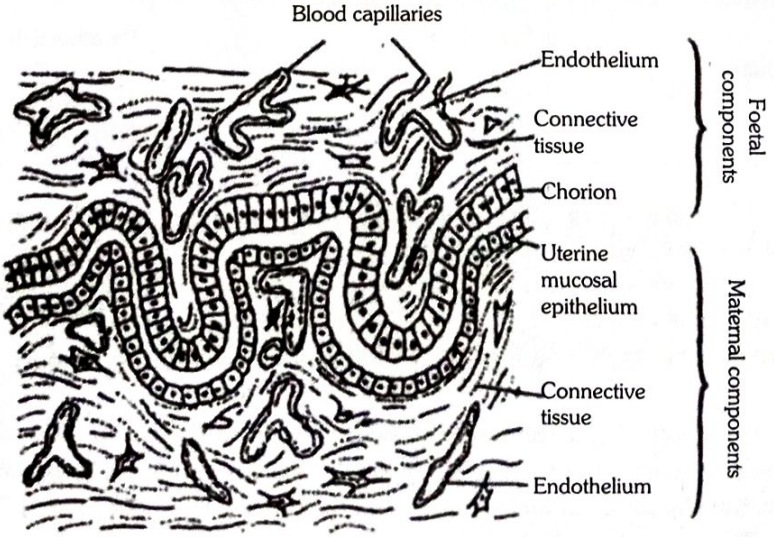


Figure : Structure of typical placenta

(ii) **Syndesmochorial :** Uterine epithelium breaks down; only five left; e.g., Cow, Buffalo, Sheep, Goat, Camel.

(iii) **Endotheilochorial :** Uterine epithelium and connective tissues eroded; only four barriers left; e.g., Tiger, Lion, Cat, Dog.

(iv) **Haemochorial :** Placenta with only three barriers, the maternal part of placenta completely eroded; e.g., Human, Apes, Lemurs.

(v) **Haemo-endothelial :** All barriers except endothelium of foetal part of placenta get eroded e.g., Rat, Rabbit.

On the basis of nature of uterine wall after parturition, the placenta may be :

(i) **Non-deciduous :** No part of uterine portion of placenta is broken off, e.g., Horse, Ass.

(ii) **Deciduous :** A portion of uterine tissue called deciduas is detached and passed out at birth, e.g., most of the mammals.

(iii) **Contra deciduous :** Even the foetal part of placenta is retained and gets absorbed, to provide nourishment, e.g., Talpa, Parameles.

On the of distribution of villi on the surface, the placenta are of six types :

(i) **Diffuse placenta :** Villi distributed uniformly all over the surface. e.g., Horse, Pig.

(ii) **Cotyledonary :** The villi form tufts which fit into corresponding areas, the caruncles in the uterine part of placenta, e.g., Cow, Buffalo, Sheep.

(iii) **Intermediate :** Villi occur singly as well as in tufts, e.g., Camel, Giraffe.

(iv) **Zonary :** Villi arranged in two transverse bands, e.g., Tiger , Lion, Cat, Dog, Elephant.

(v) **Discoidal :** When the villi are confined to a disc-like area e.g., Rat, Rabbit, Bat.

(vi) **Metadiscoidal :** The placenta in which the villi are initially distributed uniformly all over the surface but later on get confined to a disc-like area fitting into a corresponding depression on the uterine wall i.e., the placenta is diffuse first but later on becomes discoidal, e.g. Human beings and Apes.

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.

Important -

Important development events in the human embryo

Time from fertilization	Event
24 hours	Embryo reaches two-called stage.
3 days	Morula stage
7 days	Blastocyst begins to implant in the uterus
2.5 weeks	Notochord and neural plate are formed; tissue that will give rise to heart is differentiating; blood cells are formed in yolk sac and chorion.
3.5 weeks	Neural tube formation; primordial eye and ear visible; pharyngeal pouches formation; liver differentiates; respiratory system and thyroid gland just begin to develop; heart tubes fuse, bend and begin to beat; blood vessels are laid down.
4 weeks	Limb buds appear; three primary vesicles of brain formed.
2 months	Muscles differentiate; embryo capable of movement; gonads distinguishable as testis or ovary; bones begin to ossify; principal blood vessels assume final positions; embryo become fetus; nervous system develops; bones enlarge.
3 months	Sex can be determined by external inspection; notochord degenerates; lymph glands develop.
4 months	Face begins to look human; lobes of cerebrum differentiates; eye. Ear and nose look more 'normal; rapid growth.
Third trimester	Lanugo appears, later it is shed; neurons become myelinated; tremendous growth of body.
266 days (from conception)	Birth

10. Parturition and Lactation

10.1. Parturition

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 fetus end the placenta which induce mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from the maternal pituitary. Oxytocin acts on the uterine muscle 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-parturition. Soon after the infant is delivered, the placenta is also expelled out of the uterus. What do you think the doctors inject to induce delivery? Parturition includes three stages.

(1) **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 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.

(2) **Expulsion stage :** With further increase in the intensity of uterine and abdominal contraction, the foeus comes out through cervix and vagina with head coming out first. Expulsion may take20-60 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; 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 synthesis enough nitric oxide (NO) is one cause of this.

(3) **After birth :** Within 10-15 minutes after delivery, placenta and the remains of the umbilical cord which is called after birth is expelled out.

10.2. 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, at which time it has risen to 10 to 20 times the normal non pregnant 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 in the last few days before and first few days after parturition is called clolostrum. It contains essentially the same concentrations of proteins and lactose as milk but almost no fat.

(1) 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 form 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 form 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 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.

25. Human Reproduction – Multiple Choice Questions

1. Male Reproductive System

1. In human, the unpaired male reproductive structure is
(a) Seminal vesicle (b) Prostate
(c) Bulbourethral gland (d) Testes
(e) Vas deferens

2. The capsule enclosing testis of mammal is called as
(a) Tunica albuginea (b) Tunica membrana
(c) Tunica vaginalis (d) Tunica vasculosa

3. Sperm cells are produced in
(a) Seminiferous tubules (b) Interstitial cells
(c) Epididymis (d) Prostate gland

4. Testicular degeneration and other disorders of reproductive system in mammals are due to the deficiency of
(a) Vitamin A (b) Vitamin B
(c) Vitamin K (d) Vitamin E

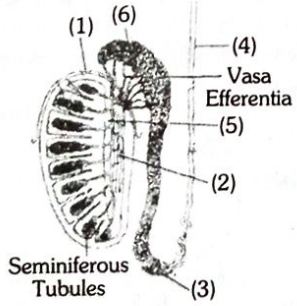
5. Bidder's canal is found in
(a) Testes of frog (b) Kidney of frog
(c) Ovary of mammal (d) Kidney of mammal

6. In rabbit, head of the epididymis present at the head of the testis is called
(a) Vas deferens (b) Cauda epididymis
(c) Gubernaculum (d) Caput epididymis

7. ICSH acts on
(a) Spermatogonia
(b) Nurse cells
(c) Leydig cells
(d) Primary spermatocytes

8. How many spermatids are formed from a secondary spermatocyte
(a) 1 (b) 2
(c) 4 (d) 8

9. The following figure refers to L.S. of testis showing various parts. In which option all the six parts 1, 2, 3, 4, 5 and 6 are correctly identified



(a) 1- Tunica Vaginalis, 2 - Rete Testis, 3 - Caput Epididymis, 4 - Mediastinum Testis, 5 - Vas Deferens, 6 - Cauda Epididymis
(b) 1- Tunica Vaginalis, 2 - Rete Testis, 3 - Cauda Epididymis, 4 - Vas Deferens, 5 - Mediastinum Testis, 6 - Caput Epididymis
(c) 1- Tunica Vaginalis, 2 - Rete Testis, 3 - Cauda Epididymis, 4 - Mediastinum Testis, 5 - Vas Deferens, 6 - Caput Epididymis
(d) 1- Tunica Vaginalis, 2 - Rete Testis, 3 - Caput Epididymis, 4 - Vas Deferens, 5 - Mediastinum Testis, 6 - Cauda Epididymis

10. Spot the odd one out from the following structures with reference to the male reproductive system
(a) Rete testis (b) Epididymis
(c) Vasa efferentia (d) Isthmus

11. Seminal plasma, the fluid part of semen, is contributed by
(i) Seminal vesicle
(ii) Prostate gland
(iii) Urethra
(iv) Bulbourethral gland
(a) (i) and (ii) (b) (i), (ii) and (iv)
(c) (ii), (iii), and (iv) (d) (i) and (iv)

12. Which one of the following is not a male accessory gland
(a) Seminal vesicle (b) Ampulla
(c) Prostate (d) Bulbourethral gland

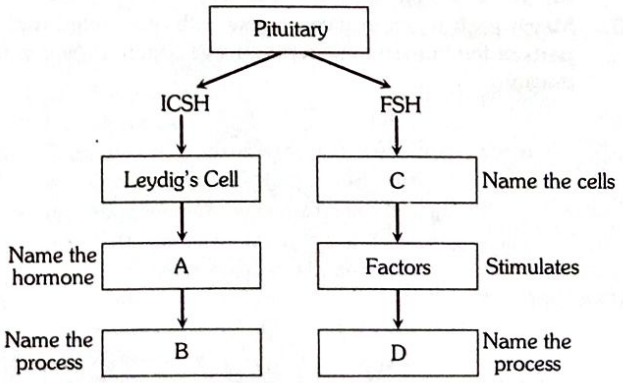
13. The vas deferens receives duct form the seminal vesicle and opens into urethra as
(a) Epididymis (b) Ejaculatory duct
(c) Efferent ductule (d) Ureter

14. Urethral meatus refers to the
(a) Urinogenital duct
(b) Opening of vas deferens into urethra
(c) External opening of the urogenital duct
(d) Muscles surrounding the urinogenital duct

15. Which of the following cells are present in mammalian testes and help to nourish sperms
(a) Leydig cells (b) Oxyntic cells
(c) Interstitial cells (d) Sertoli cells

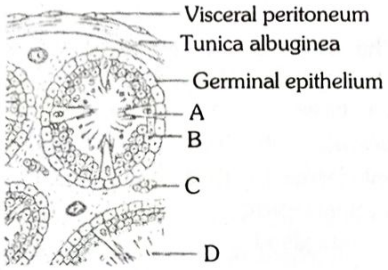
16. The abdominal passage which connects the abdominal cavity with the scrotal sac in mammals is known as
(a) Spermatic canal (b) Neurenteric canal
(c) Inguinal canal (d) Haversian canal

17. The figure given below is an incomplete chart showing influence of hormones on gametogenesis in males. Examine the chart carefully and select the appropriate words for the blanks A, B, C and D



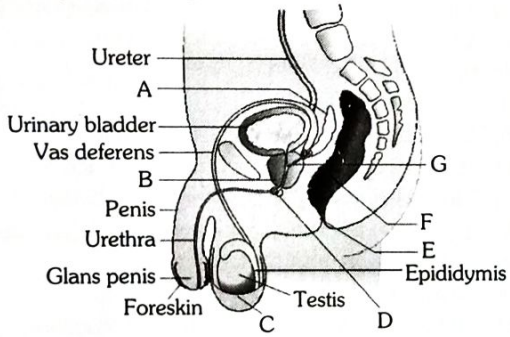
(a) A - Testosterone, B - Spermatogenesis, C - Sertoli cells, D - Spermiogenesis
(b) A - Testosterone, B - Spermiogenesis, C - Sertoli cells, D - Spermatogenesis
(c) A - Testosterone, B - Spermatogenesis, C - Testis, D - Spermiogenesis
(d) A - LH, B - Spermatogenesis, C - Sertoli cells, D – Spermiogenesis

18. The given figure refers to T.S. of testis showing sectional view of a few seminiferous tubules. Identify the marked alphabets



(a) A - Sertoli cells, B - Spermatogonia, C - Interstitial cells, D - Sperms
(b) A - Interstitial cells, B - Spermatogonia, C - Sertoli cells, D - Sperms
(c) A - Sertoli cells, B - Secondary spermatocyte, C - Interstitial cells, D - Sperms
(d) A - Sertoli cells, B - Spermatozoa, C - Interstitial cells, D – Sperms

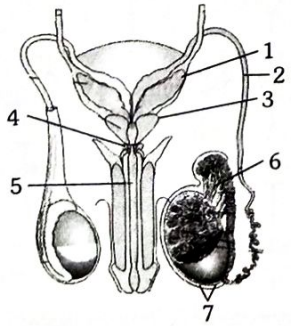
19. Identify the parts labelled (A to G) in the given figure of male reproductive system from the list I to X



I. Fundus
II. Uriniferous tubules
III. Seminiferous tubules
IV. Seminal vesicle
V. Prostate
VI. Ejaculatory duct
VII. Rectum
VIII. Anus
IX. Bulbourethral gland
X. Scrotum

(a) A - IV, B - V, C - X, D - IX, E - VIII, F - VII, G - VI
(b) A - X, B - IX, C - VIII, D - IV, E - III, F - II, G - I
(c) A - IV, B - V, C - I, D - III, E - IX, F - X, G - II
(d) A - V, B - III, C - I, D - II, E - IV, F - VI, G – VIII

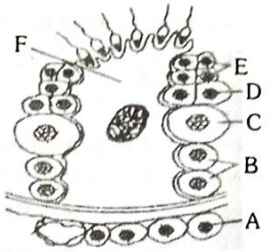
20. Match each function given below with the related part or parts of the human male reproductive system shown in the diagram



A. Produces sperm
B. Conducts the sperm through the penis to the outside of the body
C. Produces seminal fluid
D. Connects the epididymis with the urethra
E. Stores sperm

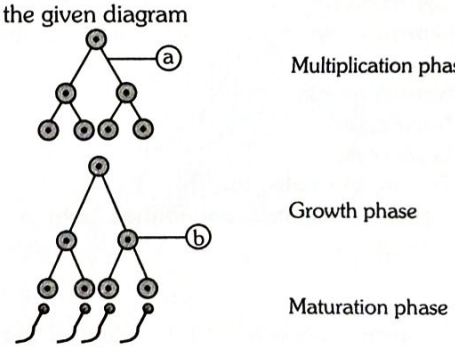
(a) A - 7; B - 5; C - 1, 3, 4; D - 2; E - 6
(b) A - 1, 2; B - 5; C - 3, 4; D - 7; E - 6
(c) A - 7; B - 6; C - 1, 2, 3; D - 5; E - 4
(d) A - 6; B - 5; C - 1, 2, 4; D - 3; E – 7

21. The given figure is a portion of a seminiferous tubule. Identify A, B, C, D, E and F respectively



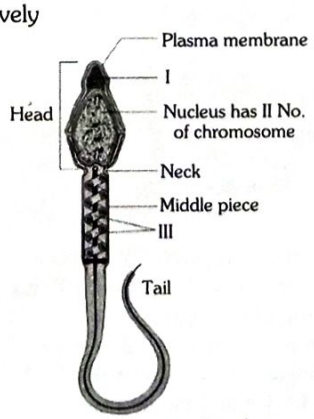
(a) A - Leydig cells, B - Spermatogonium, C - Primary spermatocyte, D - Secondary spermatocyte, E - Spermatozoa, F- Sertoli cells
(b) A - Leydig cells, B - Primary spermatocyte, C - Spermatogonium, D - Secondary spermatocyte, E - Spermatids, F- Sertoli cells
(c) A - Sertoli cells, B - Spermatogonium, C - Primary spermatocyte, D - Secondary spermatocyte, E - Spermatids, F- Leydig cells
(d) A - Leydig cells, B - Spermatogonium, C - Primary spermatocyte, D - Secondary spermatocyte, E - Spermatids, F- Sertoli cells

22. Which option is correct for the region labelled as 'a' and 'b' in the given diagram



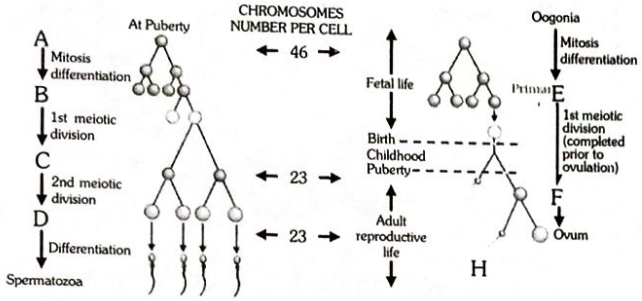
(a) a = Mitosis, b = Primary spermatocyte
(b) a = Meiosis, b = Secondary spermatocyte
(c) a = Mitosis, b = Secondary spermatocyte
(d) a = Meiosis, b = Primary spermatocyte

23. The given figure belongs to human sperm. Identify I, II and III respectively



(a) I - Acrosome, II - 23, III - Spirilum
(b) I - Lysosome, II - 23, III - Mitochondria
(c) I - Acrosome, II - 23, III - Mitochondria
(d) I - Acrosome, II - 46, III – Mitochondria

24. The given figure refers to spermatogenesis and oogenesis in human. Select the right option in which A to H are correctly identified



(a) A - Spermatogonia, B - Primary spermatocytes, C - Secondary spermatocytes, D - Spermatids, E - Primary oocyte, F - Secondary oocyte, G - Second polar body, H - First polar body

(b) A - Spermatogonia, B - Primary spermatocytes, C - Secondary spermatocytes, D - Spermatids, E - Primary oocyte, F - Secondary oocyte, G - First polar body, H - Second polar body

(c) A - Spermatogonia, B - Primary spermatocytes, C - Secondary spermatocytes, D - Spermatids, E - Secondary oocyte, F - Primary oocyte, G - First polar body, H - Second polar body

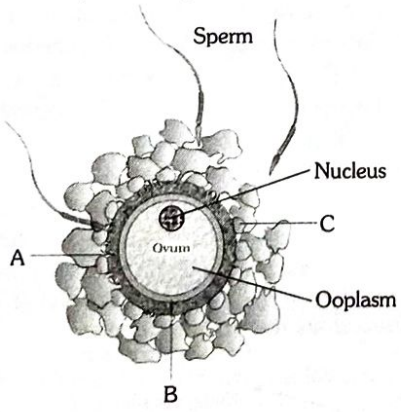
(d) A - Spermatogonia, B - Secondary spermatocytes, C - Primary spermatocytes, D - Spermatids, E - Primary oocyte, F - Secondary oocyte, G - First polar body, H - Second polar body

2. Female Reproductive System

1. The stroma of the ovary consists of nerves, blood vessels, muscle fibres and a type of protein called
(a) Collagen (b) Albumin
(c) Globulin (d) Fibrin

2. In humans the oocyte is maintained in a state of meiotic arrest by secretions of
(a) Granulosa cells (b) Zona pellucida
(c) Cumulus oophorus (d) Theca

3. The given diagram shows to ovum surrounded by few sperms. Identify all the alphabets correctly



(a) A - Oolemma, B - Perivitelline space, C - Corona radiata

(b) A - Zona pellucida, B - Perivitelline space, C - Corona radiata

(c) A – Zona pellucida, B - Vitelline membrane, C - Corona radiata

(d) A - Zona pellucida, B - Perivitelline space, C - Corona reticulata

4. The membrane investing the ovum just outside the membrana granulosa is
(a) Zona pellucida (b) Theca interna
(c) Vitelline membrane (d) Discus proligerus

5. After ovulation the Graafian follicle becomes an endocrine organ called
(a) Interstitial organ (b) Ovarian tube
(c) Globulin (d) Fibrin

6. Stroma is a term applied to
(a) Gall stone
(b) Ovarian follicles
(c) Connective tissue in which Graafian follicles are embedded
(d) Connective tissue surrounding the seminiferous tubules

7. Menstruation is due to sudden when the

Or

In human females, the ovarian cycle begins when the
(a) Reduction of FSH
(b) Increase of LH
(c) Reduction in estrogen and progesterone
(d) None of these

8. Vitellogenesis occurs during the formation of
(a) Primary oocyte in the Graafian follicle
(b) Oogonial cell in the Graafian follicle
(c) Ootid in the fallopian tube
(d) Secondary oocyte in the fallopian tube

9. In females the hormone inhibin is secreted by
(a) Granulosa and theca cells
(b) Granulosa cells and corpus luteum
(c) Granulosa and cumulus oophorus cells
(d) Granulosa cells and zona pellucida

10. Proliferation of endometrium of uterus in controlled by
(a) Relaxin (b) Oxytocin
(c) Progesterone (d) Oestrogen
(e) Luteinizing

11. The rupture of the graafian follicle and the release of ovum occurs under the influence of
(a) LH (b) FSH
(c) MSH (d) GH

12. The substance secreted by the corpus luteum is
(a) Hormone (b) Enzyme
(c) Pheromone (d) Bile

13. The cyclic period of sexual activity in non-human female mammals is called
(a) Menstruation (b) Luteinization
(c) Oogenesis (d) Estrous

14. Sequence of hormones during menstrual cycle is
(a) Estrogen, progesterone and FSH
(b) Progesterone, estrogen and FSH
(c) FSH, estrogen and progesterone
(d) FSH, progesterone and estrogen

15. In mammals the female secondary (accessory) sexual characters are developed by the hormone
(a) Relaxin (b) Oestrogens
(c) Progesterone (d) Gonadotropins

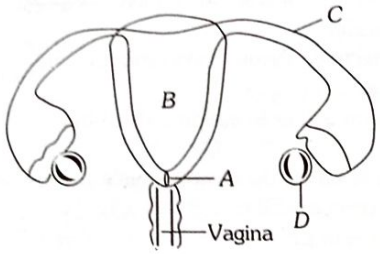
16. Mature Graafian follicle is generally present in the ovary of a healthy human female around
(a) 5 – 8 day of menstrual cycle
(b) 11 -17 day of menstrual cycle
(c) 18 – 23 day of menstrual cycle
(d) 24 – 28 day of menstrual cycle

17. Identify the odd one form the following
(a) Labia minora (b) Fimbriae
(c) Infundibulum (d) Isthmus

18. Clitoris in mammals is
(a) Homologous to penis
(b) Analogous to penis
(c) Functional penis in female
(d) Non-functional penis in male

19. Mullerian duct is
(a) Oviduct (b) Sperm duct
(c) Ureter of man (d) Urethra

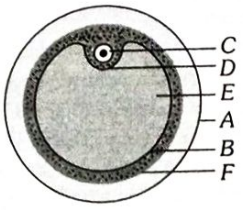
20. Identify the parts as *A, B, C, D* in the given diagram



(a) *A* – oviduct, *B* – uterus, *C* – outduct, *D* - ovary
(b) *A* – cervix, *B* – uterus, *C* – ovary, *D* - tumor
(c) *A* – uterus, *B* – uterine cavity, *C* – oviducal funnel, *D* - ovary
(d) *A* – cervix, *B* – uterine cavity, *C* – fallopian tube, *D* – ovary

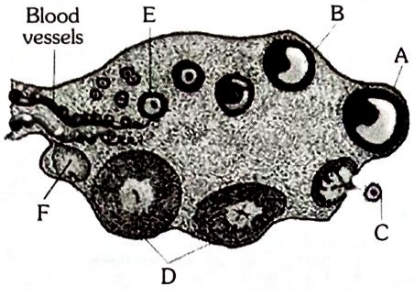
21. Some important events in the human female reproductive cycle are given below. Arrange the events in a proper sequence
A : Secretion of FSH
B : Growth of corpus luteum
C : Growth of the follicle and oogenesis
D : Ovulation
E : Sudden increase in the levels of LH
(a) C→ A→ D→ B→ E (b) A→ C→ E→ D→ B
(c) A→ D→ C→ E→ B (d) B→ A→ C→ D→ E

22. In the diagram of section of Graafian follicle, different parts are indicated by alphabets; choose the answer in which these alphabets have been correctly matched with the parts they indicate.....



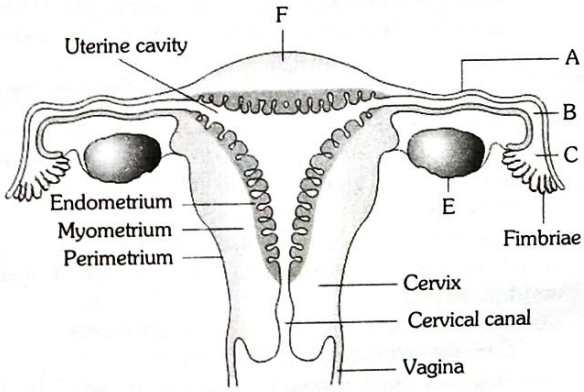
(a) A = Theca externa, B= Theca interna, C= Ovum, D = Cumulus oophorus, E = Antrum, F = Membrana granulosa
(b) A= Membrana granulosa, B = Theca externa, C = Ovum, D= Cumulus oophorus, E= Antrum, F = Theca interna
(c) A= Membrana granulosa, B= Theca interna, C= Ovum, D= Cumulus oophorus, E= Antrum, F= Theca externa
(d) A= Theca externa, B= Theca interna, C= Ovum, D= Membrana granulosa, E= Anturum, F= Cumulus oophorus

23. The T.S. of human ovary is given below. Identify the marked alphabets



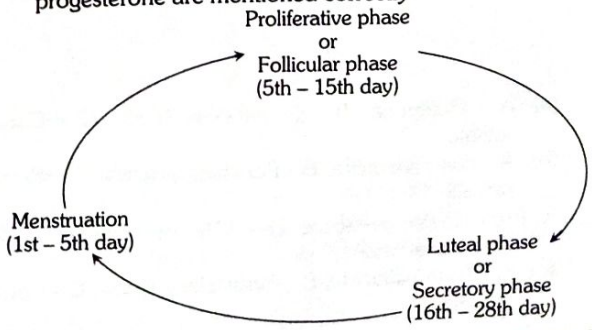
(a) A - Graafian follicle, B - Tertiary follicle with antrum, C - Ovum, D - Corpus luteum, E - Primary follicle, F - Corpus albicans
(b) A - Graafian follicle, B - Tertiary follicle with antrum, C - Ovum, D - Corpus albicans, E - Primary follicle, F - Corpus luteum
(c) A -Graafian follicle, B -Tertiary follicle with antrum, C - Ovum, D - Corpus spongiosum, E - Primary follicle, F - Corpus albicans
(d) A - Secondary follicle, B -Tertiary follicle with antrum, C - Ovum, D - Corpus luteum, E - Primary follicle, F - Corpus albicans

24. The given figure refers to female reproductive system of human. Identify the marked alphabets



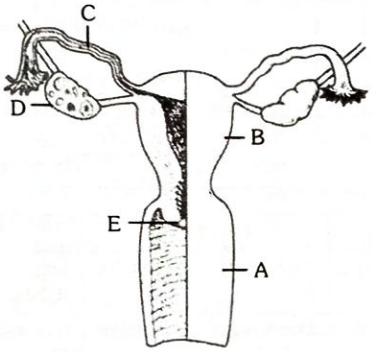
(a) A - Ampulla, B - Infundibulum, C - Isthmus, D - Fallopian tube, E - Ovary, F - Uterine fundus
(b) A - Isthmus, B - Infundibulum, C - Ampulla, D - Fallopian tube, E - Ovary, F - Uterine fundus
(c) A - Ampulla, B - Isthmus, C - Infundibulum, D - Fallopian tube, E - Ovary, F - Uterine fundus
(d) A - Isthmus, B - Ampulla, C - Infundibulum, D - Fallopian tube, E - Ovary, F - Uterine fundus

25. The events of the menstrual cycle are represented below. Select the right option in which the level of FSH, LH and progesterone are mentioned correctly



	13th - 14th day			21st - 23rd day		
	FSH	**LH**	**Proges-terone**	**FSH**	**LH**	**Progeste rone**
(a)	High	High	Low	Low	Low	High
(b)	High	High	High	Low	Low	Low
(c)	Low	Low	Low	High	High	High
(d)	Low	Low	High	High	Low	Low

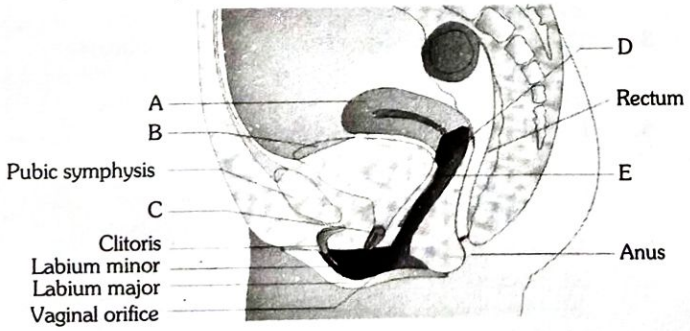
26. Match each given function with the related part or parts of the human female reproductive system shown in the diagram



1. Where is the egg produced
2. Where does fertilization occur
3. Where would implantation of a fertilized egg take place
4. Where are estrogen and progesterone produced
5. What part receives the male penis during copulation

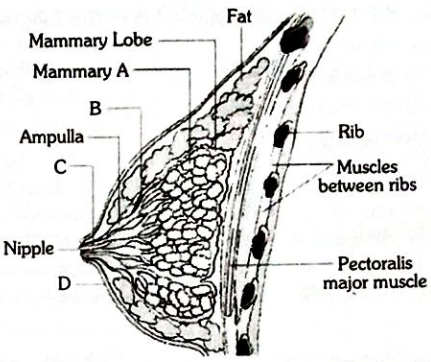
(a) 1 - E, 2 - C, 3 - B, 4 - D, 5 - A
(b) 1 - D, 2 - C, 3 - B, 4 - E, 5 - A
(c) 1 - D, 2 - C, 3 - B, 4 - A, 5 - E
(d) 1 - D, 2 - C, 3 - B, 4 - E, 5 – A

27. The following figure represents to female reproductive system of human. Select the right option in which A to E are correctly identified



(a) A - Uterus, B - Urinary bladder, C - Urethra, D - Cervix, E - Vagina
(b) A - Urethra, B - Urinary bladder, C - Uterus, D - Cervix, E - Vagina
(c) A - Uterus, B - Urinary bladder, C - Urethra, D - Vagina, E - Cervix
(d) A - Urethra, B - Urinary bladder, C - Uterus, D - Cervix, E – Vagina

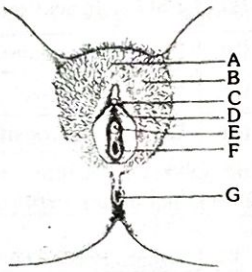
28. The figure given below is the diagrammatic sectional view of mammary gland. identify A to D respectively



(a) A - Alveolus, B - Mammary duct, C - Lactiferous duct, D - Lactogenic spot
(b) A - Alveolus, B - Lactiferous duct, C - Mammary duct, D - Areola
(c) A - Alveolus, B - Mammary duct, C - Lactiferous duct, D - Areola
(d) A - Gland, B - Mammary duct, C - Lactiferous duct, D – Areola

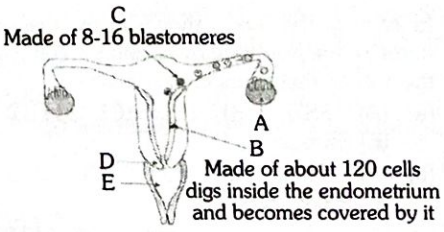
29. Identify the parts labelled (A to G) in the following diagram of the vulva, from the list I to VIII

I. Anus
II. Glans clitoris
III. Labia majora
IV. Labia minora
V. Mons pubis
VI. Urethra
VII. Vagina



(a) A - V, B - VI, C - VII, D - IV, E - II, F - III, G - I
(b) A - II, B - III, C - V, D - IV, E - VI, F - VII, G - I
(c) A - V, B - III, C - II, D - IV, E - VI, F - VII, G - I
(d) A - V, B - IV, C - III, D - II, E - VI, F - VII, G – I

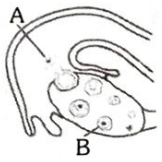
30. Label the given figure which illustrates fertilization followed by cleavage and the early stages of embryonic development



Choose the right option in which A, B, C, D and E are correctly identified

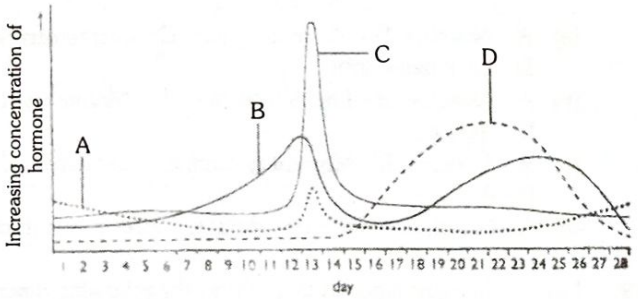
(a) A - ovary, B - morula, C - blastocyst, D - cervix, E - vagina
(b) A - ovary, B - blastocyst, C - morula, D - cervix, E - vagina
(c) A - ovary, B - blastocyst, C - morula, D - vagina, E - cervix
(d) A - ovary, B - blastocyst, C - gastrula, D - vagina, E – cervix

31. When did the structure labelled B in the following diagram start to form



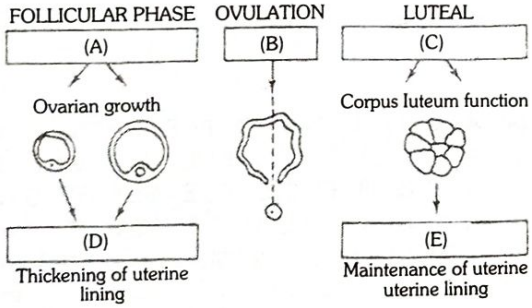
(a) At puberty
(b) At the start of the menstrual cycle
(c) Before birth
(d) In infancy

32. The following graph represents the concentrations of the four hormones present in the blood plasma of a woman during her menstrual cycle. Identify the hormones



	A	B	C	D
(a)	FSH	Progesterone	LH	Oestrogen
(b)	LH	Progesterone	FSH	Oestrogen
(c)	FSH	Oestrogen	LH	Progesterone
(d)	LH	Oestrogen	FSH	Progesterone

33. The following diagram refers the changes taking place during the human menstruation cycle



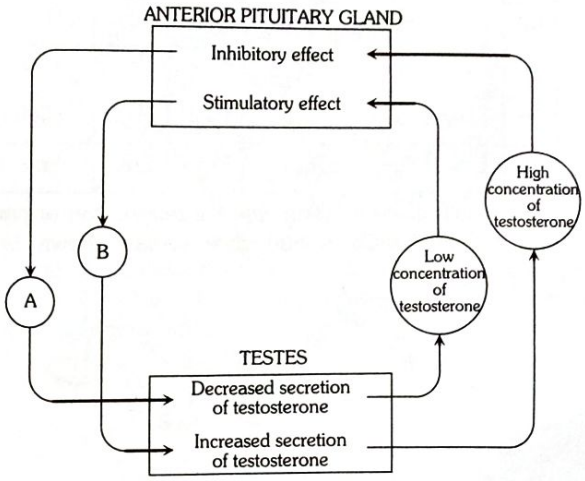
In each of the boxes shown in the diagram fill with the name of the hormone or hormones controlling the stage in the human menstrual cycle

(a) (A) FSH, (B) LH, (C) LH,(D) Progesterone, (E) Estrogen
(b) (A) FSH, (B) LH, (C) FSH,(D) Estrogen, (E) Progesterone
(c) (A) LH, (B) FSH, (C) LH,(D) Estrogen, (E) Progesterone
(d) (A) FSH, (B) LH, (C) LH, (D) Estrogen, (E) Progesterone

34. Identify the correct statement from the following

(a) High levels of estrogen triggers the ovulatory surge
(b) Oogonial cells start to proliferate and give rise to functional ova in regular cycles from puberty onwards
(c) Sperms released from seminiferous tubules are highly motile
(d) Progesterone level is high during the post ovulatory phase of menstrual cycle

35. The figure given below shows the self - regulating effect of testosterone. Which option in the following table correctly identifies the terms missing from circles A and B



	Circle A	Circle B
(a)	Increased secretion of ICSH	Decreased secretion of ICSH
(b)	Decreased secretion of FSH	Increased secretion of FSH
(c)	Increased secretion of FSH	Decreased secretion of FSH
(d)	Decreased secretion of ICSH	Increased secretion of ICSH

3. Gametogenesis

1. The process of releasing the ripe female gamete (ovum) from the ovary is called
(a) Parturition (b) Ovulation
(c) Fertilization (d) Implantation

2. Spermatids are transformed into spermatozoa by
(a) Spermiation (b) Spermatogenesis
(c) Meiosis (d) Spermatosis
(e) Spermiogenesis

3. 1st polar body is formed at which stage of oogenesis
(a) 1st meiosis (b) 2nd mitosis
(c) 1st mitosis (d) Differentiation

4. In mammalian sperm, spirally arranged mitochondria are present in
(a) Head portion (b) Middle piece
(c) End piece of the tail (d) Principal piece of tail

5. Acrosome of sperm is formed from
(a) Nucleus of spermatid
(b) Mitochondria of spermatid
(c) Golgi complex of spermatid
(d) Centrosome of spermatid

6. What do you mean by the term spermateleosis
(a) Conversion of spermatids to sperm
(b) Conversion of spermatogonia to spermatid
(c) Conversion of spermatid to spermatogonium
(d) Conversion of primary spermatocyte to secondary spermatocyte

7. The process of maturation of reproductive cells of testes in male so as to form the male gamete or sperm is known as
(a) Spermatogenesis (b) Gametogenesis
(c) Oogenesis (d) None of these

8. Spermiation is the process of the release of sperms from
(a) Seminiferous tubules (b) Vas deferens
(c) Epididymis (d) Prostate gland

9. Which among the following has 23 chromosomes
(a) Spermatogonia (b) Zygote
(c) Secondary oocyte (d) Oogonia

10. The membranous cover of the ovum at ovulation is
(a) Corona radiata (b) Zona radiate
(c) Zona pellucida (d) Chorion

11. The group of amniota includes
(a) ACTH (b) Progesterone
(c) GH (d) Gastrin

12. How many ova and sperms would be produced from 100 secondary oocytes and 100 secondary spermatocytes during gametogenesis in human
(a) 100 ova, 100 sperms (b) 100 ova, 200 sperms
(c) 50 ova, 100 sperms (d) 200 ova, 200 sperms

13. The spermatogonia undergo division to produce sperms by the process of spermatogenesis. Choose the correct one with reference to above
(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

14. Which is immortal
(a) Plasma cell (b) Germ cell
(c) Brain cell (d) Kidney cell

15. The period of preparation with reference to developmental phenomena in vertebrates means
(a) Formation of gastrula
(b) Formation of germ layers
(c) Tissue differentiation
(d) Parents preparation and elaboration of gametes

4. Fertilization

1. Development of an egg without fertilization is called
Or
It is a process of embryo sac formation from cell of nucleus, without undergoing meiosis
(a) Gametogenesis (b) Metagenesis
(c) Oogenesis (d) Parthenogenesis

2. The fertilization membrane during fertilization is synthesized by
(a) Mitochondria
(b) Golgi bodies
(c) Acid mucopolysaccharides of cortical granules
(d) All the above

3. Normally the number of chromosomes in the nuclei of gametes that fuse at fertilization are
(a) Innumerable (b) Dissimilar
(c) Similar (d) None of the above

4. The sperm penetrates the ovum mainly
(a) Mechanically (b) Chemically
(c) Electrostatically (d) Thermally

5. Fertilization is depicted by the condition
(a) $n \rightarrow 2n$ (b) $2n \rightarrow 3n$
(c) $2n \rightarrow 4n$ (d) $4n \rightarrow 8n$

6. Acrosomal reaction of the sperm occurs due to
(a) Its contact with zona pellucida of the ova
(b) Reactions within the uterine environment of the female
(c) Reactions within the epididymal environment of the male
(d) Androgens produced in the uterus

7. Which statement is correct for fertilization
(a) Restore Euploidy
(b) Brings male & female gametes together
(c) Entry of whole sperm in egg
(d) All of these

8. Choose the incorrect statement from the following
(a) In birds and mammals internal fertilization takes place
(b) Colostrum contains antibodies and nutrients
(c) Polyspermy in mammals in prevented by the chemical changes in the egg surface
(d) In the human female implantation occurs almost seven days after fertilisation

5. Cleavage

1. Which mammals have more yolk than cytoplasm in their eggs
(a) Placental mammals (b) Aquatic mammals
(c) Marsupials (d) Egglaying mammals

2. The mammalian blastula is known as
(a) Foetal blastula (b) Blastocyst
(c) Trophoderm (d) Oolemma

3. The blastopore develops into future
(a) Mouth (b) Ear
(c) Anus (d) Neuropore

4. The cleavage having incomplete division (partial cleavage) of egg is known as
(a) Holoblastic (b) Meroblastic
(c) Meridional (d) Spiral

5. Eggs of reptiles and birds are
(a) Alecithal (b) Isolecithal
(c) Telolecithal (d) Homolecithal

6. The outer layer of the blastocyst which forms the ectoderm is called
(a) Cnidoblast (b) Germinal vesicle
(c) Trophoblast (d) Amnion

7. Microlecithal eggs are found in
(a) Reptilia + Aves
(b) Amphibia + Aves + Reptilia
(c) Reptilia + Aves + Chiroptera
(d) Eutheria

8. Select the correct statement
(a) Cleavage follows gastrulation
(b) Yolk content of egg has no role in cleavage
(c) Cleavage is repeated mitotic division of zygote
(d) Gastrulation & blastulation are followed by each other

9. Egg which contains very little amount of yolk are called as
(a) Alecithal (b) Microlecithal
(c) Mesolecithal (d) Polylecithal

10. In mammals egg are microlecithal and isolecithal because these are
(a) Oviparous (b) Viviparous
(c) Ovoviviparous (d) None of these

11. Telolecithal eggs have
(a) Equal distribution of yolk
(b) Average amount of yolk
(c) Yolk present at a distance from nucleus
(d) No yolk
(e) All the above

12. Pattern of cleavage in frog's egg is
(a) Holoblastic
(b) Holoblastic and unequal
(c) Holoblastic and equal
(d) All of the above

13. In which of the following animal cleavage divisions are restricted to a small part of cytoplasm and nucleus in animal pole of egg
(a) Cockroach (b) Frog
(c) Chick (d) Rabbit

14. The egg of frog is
(a) Isolecithal (b) Mesolecithal
(c) Telolecithal (d) Centrolecithal

15. Which of these sets of cells divide slowly
(a) Micromeres (b) Megameres
(c) Blastomeres (d) Mesomeres

16. The type of blastula formed in birds is
(a) Teloblastula (b) Holoblastula
(c) Coeloblastula (d) Discoblastula

17. Meroblastic cleavage refers to one of the following types of division of eggs
(a) Total (b) Partial
(c) Spiral (d) Horizontal

18. Cleavage is a unique form of mitotic cell division in which
(a) The nucleus does not participate
(b) There is no growth of cells
(c) No spindle develops to guide the cells
(d) The plasma membranes of daughter cells do not separate

19. Leathery eggs are found in
(a) Amphibians
(b) Reptiles
(c) Birds
(d) Prototherian mammals

20. In determinate cleavage, the spindle is
(a) Vertical (b) Horizontal
(c) Sub-equatorial (d) Oblique

6. Implantation and Gastrulation

1. In human secretion, which of the following is used to confirm implantation of embryo
(a) Gastrula (b) Trophoblast
(c) Inner mass of cell (d) Blastocyst

2. In which stage of development the embryonic cells form the germinal layers by the movement
(a) Morula (b) Blastula
(c) Gastrula (d) Neurula

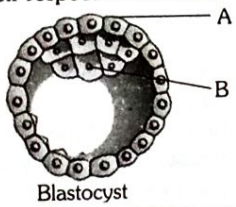
3. Coelom is found between the cavity of
(a) Ectoderm and endoderm
(b) Mesoderm and ectoderm
(c) Body wall and ectoderm
(d) Mesoderm and body wall

4. The internal cavity commonly formed by cell division prior to gastrulation is the
(a) Enteron (b) Blastopore
(c) Blastocoel (d) Coelom

5. If the ectoderm from neural tissue area is removed from the embryo and transplanted in place of presumptive belly ectoderm embryo will develop
(a) Without a neural tube
(b) With a neural tube
(c) With two ectodermal coats
(d) With two neural tube

6. If the nuclei from an 8–celled stage of an embryo are transplanted into enucleated eggs, which of the following events is likely to occur
(a) Formation of viable embryo in the recipient eggs
(b) Donor nuclei die in the new environment
(c) Cleavage occurs but is arrested after some time
(d) Recipient egg dies

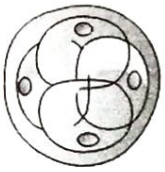
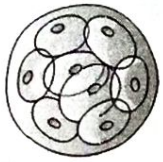
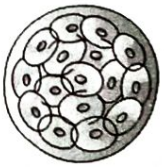
7. Select the right option in which A and B are correctly identified with their respective functions



Blastocyst

	A	B	Function of A	Function of B
(a)	Ectoderm	Endoderm	differentiated as embryo	get attach to the endometrium
(b)	Trophoblast	Inner cell mass	differentiated as embryo	get attach to the endometrium
(c)	Inner cell mass	Trophoblast	get attach to the endometrium	differentiated as embryo
(d)	Trophoblast	Inner cell mass	get attach to the endometrium	differentiated as embryo

8. In which of the following embryonic stages does the implantation take place

(a) 
(b) 
(c) 
(d) 

7. Neurulation and Organogenesis

1. The epidermis of the skin is derived from the germinal layer
(a) Mesoderm (b) Endoderm
(c) Ectoderm (d) Neuro–endoderm

2. The only human system that is derived from all the three germ layers is
(a) Digestive system (b) Excretory system
(c) Respiratory system (d) Nervous system

3. Which one of the following list contains only the mesodermal structures
(a) Muscles, blood, notochord, liver
(b) Bones, blood, heart, liver
(c) Muscles, blood, heart, liver
(d) Bones, blood, heart, notochord

4. The skeleton and muscles originate in the development from or During embryonic development endoskeleton and muscles develop from which germinal layer
(a) Ectoderm (b) Endoderm
(c) Mesoderm (d) Yolk plug

5. The development of eye in vertebrate embryology is studied under
(a) Notogenesis (b) Neurogenesis
(c) Mesogenesis (d) Organogenesis

6. In the development of the human body, the ectoderm is responsible for the formation of
(a) Sweat glands (b) Nervous system
(c) Lens of the eye (d) All of these

7. When mouth develops from blastopore, the organism is called
(a) Deuterostomia (b) Protostomia
(c) Blastostomia (d) None of these

8. Spleen develops from
(a) Ectoderm (b) Mesoderm
(c) Endoderm (d) None of the above

9. In *Pheretima* mouth develops from which of the following
(a) Mesoderm (b) Ectoderm
(c) Blastopore (d) Endoderm

10. Which cavity arises by the invagination of endoderm and mesoderm
(a) Coelenteron (b) Archenteron
(c) Pseudocoel (d) Coelom

11. During the development of embryo which of the following occur first
(a) Differentiation of tissue
(b) Differentiation of cells
(c) Differentiation of organs
(d) Differentiation of organ system

12. Ectoderm gives rise to
(a) Cornea, heart, bronchi, dentine
(b) Adrenal cortex, tongue, liver, retina
(c) Lungs, adrenal medulla, dermis, thyroid
(d) Enamel of teeth, nails, adrenal medulla, hair

13. The formation of the notochord takes place by
(a) Primary ectoderm (b) Primary mesoderm
(c) Primary endoderm (d) None of the above

14. Proctodaeum in rabbit is
(a) A part of large intestine lined by ectoderm
(b) A part of large intestine lined by endoderm
(c) A part of large intestine lined by mesoderm
(d) Embryonic intestine

8. Extra embryonic membrane

1. The number of foetal membranes in man is
(a) 2 (b) 3
(c) 4 (d) 0

2. Urinary bladder of the embryo is or Which is the urinary bladder of child placed in the womb
(a) Yolk sac
(b) Allantois
(c) Amnion
(d) Chorion and allantois both

3. In man the foetal membrane which forms the intimate connection with the uterine tissue is
(a) Amnion only
(b) Chorion only
(c) Allantois only
(d) Allanto–chorionic structure

4. The foetal membrane which is the source of first blood corpuscle to enter the circulation of the embryo is called
(a) Amnion (b) Chorion
(c) Trophoblast (d) Yolk sac

5. Foetal membranes provide
(a) Protection to embryo
(b) Nutrition to embryo
(c) Protection and nutrition to embryo
(d) None of these

6. Extra embryonic membrane amnion is not found in amphibians because
(a) They lay eggs in water
(b) Egg hatches in tadpole
(c) Amphibious habit
(d) They have smooth skin

7. Find out the wrong statement
(a) Amnion is the outer layer containing amniotic fluid that acts as shock absorber to the soft embryo
(b) Yolk-sac is a foetal membrane that helps in the nourishment of the embryo in general
(c) In mammals allantois is not excretory in function
(d) Choroi-allantoic membrane develops villi and contribute much to the development of placenta
(e) Amnion and chorion develop as upward projecting folds of somatopleure called amniotic folds

9. Placenta

1. The eutherian placenta is derived from or In mammals placenta is formed by
(a) Yolk sac (b) Amnion
(c) Allantois (d) Chorion allantois

2. The role of placenta is
(a) To convey nerve impulses
(b) To act as storage organ
(c) To protect embryo from shocks
(d) To provide nutrition for developing embryo

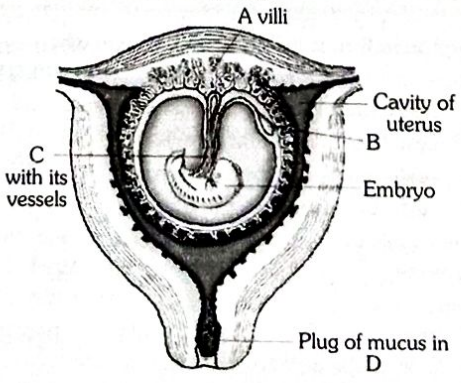
3. Placenta has an outer layer which is selectively permeable and hormone secreting which is known as
(a) Trophoblast (b) Chorion
(c) Amnion (d) Mesoderm

4. Placenta in rabbit is
(a) Discoidal (b) Non deciduate
(c) Diffuse (d) None of the above

5. Which of the following hormones is not secreted by human placenta
(a) hCG (b) Estrogens
(c) Progesterone (d) LH

6. Umbilical cord in mammals, contains
(a) Placenta (b) Umbilicus
(c) Allantoic artery and vein (d) Discus poligerous

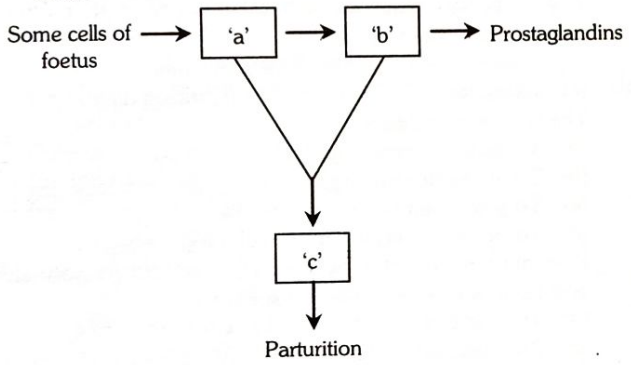
7. The following figure refers to the human foetus within the uterus. Identify A to D correctly



(a) A - Uterine, B - Yolk sac, C - Umbilical cord, D - Cervix
(b) A - Placenta, B - Amnion, C - Umbilical cord, D - Cervix
(c) A - Placenta, B - Yolk sac, C - Umbilical cord, D - Vagina
(d) A - Placenta, B - Yolk sac, C - Umbilical cord, D – Cervix

10. Gestation period and parturition

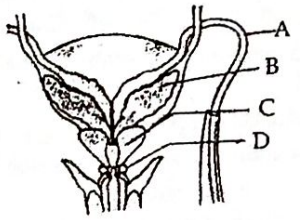
1. Which of the following induces parturition
   (a) Vasopressin (b) Oxytocin
   (c) *GH* (d) *TSH*
2. Gestation period in human beings is about
   (a) 10 weeks (b) 28 weeks
   (c) 32 weeks (d) 36 weeks
3. In a human foetus the limbs and digits develop after
   (a) 12 weeks (b) First trimester
   (c) 5th month (d) 8 weeks
4. The first milk coming out from mother's mammary glands just after child birth is called
   (a) Testosterone (b) Colostrum
   (c) Estrogen (d) Progesterone
5. What does 'a', 'b' and 'c' represents in the following flow chart



   (a) 'a' = progesterone, 'b' = oxytocin, 'c' = slow contraction of uterus
   (b) 'a' = oxytocin, 'b' = uterus, 'c' = slow contraction of uterus
   (c) 'a' = placenta, 'b' = oxytocin, 'c' = vigorous contraction of uterus
   (d) 'a' = oxytocin, 'b' = placenta, 'c' = vigorous contraction of uterus

11. NEET

1. Cryptorchidism is the condition in man when **[1990, 1993, 2007]**
   (a) There are two testis in each scrotum
   (b) Testis do not descent into the scrotum
   (c) Testis enlarge in the scrotum
   (d) Testis degenerate in the scrotum
2. Which cells in the testes secrete testosterone, the male sex hormone **[1986, 1992, 1994, 1998, 1999, 2001, 2004, 2007, 2012]**
   (a) Interstitial cells or cells of Leydig
   (b) Cells of the germinal epithelium
   (c) Sertoli cells
   (d) Secondary spermatocytes
3. Seminal plasma in humans is rich in **[2009, 2010]**
   (a) Fructose, calcium, certain enzymes
   (b) Fructose and calcium but has no enzymes
   (c) Glucose and certain enzymes but has no calcium
   (d) Fructose and certain enzymes but poor in calcium
4. The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. The purpose served is for **[2011]**
   (a) Providing a secondary sexual feature for exhibiting the male sex
   (b) Maintaining the scrotal temperature lower than the internal body temperature
   (c) Escaping any possible compression by the visceral organs
   (d) Providing more space for the growth of epididymis
5. Given below is a diagrammatic sketch of a portion of human male reproductive system. Select the correct set of names of the parts labelled A, B, C, D **[2009]**



	A	B	C	D
(a)	Ureter	Prostate	Seminal vesicle	Bulbourethral gland
(b)	Vas deferens	Seminal vesicle	Prostate	Bulbourethral gland
(c)	Vas deferens	Seminal vesicle	Bulbourethral gland	Prostate
(d)	Ureter	Seminal vesicle	Prostate	Bulbourethral gland

6. Which one of the following statements is false in respect of viability of mammalian sperm **[2012]**
   (a) Sperm is viable for only up to 24 hours
   (b) Survival of sperm depends on the pH of the medium and is more active in alkaline medium
   (c) Viability of sperm is determined by its motility
   (d) Sperms must be concentrated in a thick suspension
7. Sertoli cells are regulated by the pituitary hormone known as **[2006, 2007]**

   Or

   The hormone which acts on sertoli cells and stimulates the process of spermiogenesis is
   (a) Prolactin (b) LH
   (c) FSH (d) GH
8. Sertoli cells are found in **[1986, 1994, 99, 2010, 2012]**
   (a) Pancreas and secrete cholecystokinin
   (b) Ovaries and secrete progesterone
   (c) Adrenal cortex and secrete and adrenaline
   (d) Seminiferous tubules and provide nutrition to germ cells
9. The shared terminal duct of the reproductive and urinary system in the human male is **[2014]**
   (a) Vas deferens (b) Vasa efferentia
   (c) Urethra (d) Ureter

10. What happens during fertilisation in humans after many sperms reach close to the ovum **[2011]**
(a) Cells of corona radiata trap all the sperms except one
(b) Only two sperms nearest the ovum penetrate zona pellucida
(c) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida
(d) All sperms except the one nearest to the ovum lose their tails

11. If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from **[2011]**
(a) Vagina to uterus
(b) Testes to epididymis
(c) Epididymis to vas deferens
(d) Ovary to uterus

12. The mammalian follicle was first described by **[1990]**
(a) Von Baer (b) De Graaf
(c) Robert Brown (d) Spallanzani

13. Which hormone level reaches peak during luteal phase of menstrual cycle **[2008, 2013]**
(a) Luteinizing hormone
(b) Progesterone
(c) Follicle stimulating hormone
(d) Estrogen

14. The structure formed after release of ova from Graafian follicles and secretory in nature, is **[1999]**

Or

A temporary endocrine gland formed after ovulation in ovary is
(a) Corpus callosum (b) Corpus luteum
(c) Corpus albicans (d) Corpus striatum

15. In the human female, menstruation can be deferred by the administration of **[2007]**
(a) LH only
(b) Combination of FSH and LH
(c) Combination of estrogen and progesterone
(d) FSH only

16. In human female the blastocyst **[2010]**
(a) Forms placenta even before implantation
(b) Gets implanted into uterus 3 days after ovulation
(c) Gets nutrition from uterine endometrial secretion only after implantation
(d) Gets implanted in endometrium by the trophoblast cells

17. The secretory phase in the human menstrual cycle is also called **[2012]**
(a) Luteal phase and lasts for about 6 days
(b) Follicular phase lasting for about 6 days
(c) Luteal phase and lasts for about 13 days
(d) Follicular phase and lasts for about 13 days

18. The part of Fallopian tube closest to the ovary is **[2010]**
(a) Ampulla (b) Isthmus
(c) Infundibulum (d) Cervix

19. Bartholin's glands are situated **[2003]**
(a) On either side of vas deferens in humans
(b) On the sides of the head of frog
(c) At the reduced tail end of birds
(d) On either side of vagina in humans

20. Ovulation in the human female normally takes place during the menstrual cycle **[2004]**
(a) At the beginning of the proliferative phase
(b) At the end of the proliferative phase
(c) At the mid secretory phase
(d) Just before the end of the secretory phase

21. About which day in a normal human menstrual cycle does rapid secretion of LH (popularly called LH-surge) normally occurs **[2011]**

Or

The time for optimum chances of conception in a women is _____ starting from the day of menstruation **[2012]**
(a) 5^{th} day (b) 11^{th} day
(c) 14^{th} day (d) 20^{th} day

22. If both ovaries are removed from a rat, then which hormone is decreased in blood **[2002]**
(a) Oxytocin (b) Oestrogen
(c) Prolactin (d) Gonadotropic

23. Changes in GnRH pulse frequency in females is controlled by circulating levels of **[2016]**
(a) Estrogen and progesterone
(b) Estrogen and inhibin
(c) Progesterone only
(d) Progesterone and inhibin

24. Which of the following layers in an antral follicle is acelluar **[2015]**
(a) Theca interna (b) Stroma
(c) Zona pellucida (d) Granulosa

25. Which of the following events is not associated with ovulation in human female **[2015]**
(a) Full development of graffian follicle
(b) Release of secondary oocyte
(c) LH surge
(d) Decrease in estradiol

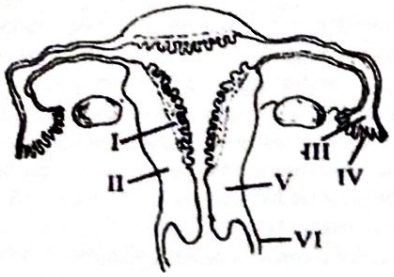
26. Hysterectomy is surgical removal of **[2015]**
(a) Prostate gland (b) Vas-deference
(c) Mammary glands (d) Uterus

27. Which type of hormone controls the menstrual cycle in human being **[2002]**
(a) LH (b) FSH
(c) Progesterone (d) FSH, LH, Estrogen

28. Which one of the following is the correct matching of the events occurring during menstrual cycle **[2009]**
(a) Ovulation : LH and FSH attain peak level and sharp fall in the secretion of progesterone
(b) Proliferative phase : Rapid regeneration of myometrium and maturation of Graafian follicle
(c) Development of corpus luteum : Secretory phase and increased secretion of progesterone
(d) Menstruation : Breakdown of myometrium and ovum not fertilized

29. Which one of the following statements is incorrect about menstruation **[2008]**
(a) At menopause the female is, there is especially abrupt increase in gonadotropic hormones
(b) The beginning of the cycle of menstruation is called menarche
(c) During normal menstruation about 40 *ml* blood is lost
(d) The menstrual fluid can easily clot

30. The figure given below depicts a diagrammatic sectional view of the female reproductive system of humans. Which one set of three parts out of I-VI have been correctly identified **[2011]**



(a) (I) Perimetrium, (II) Myometrium, (III) Fallopian tube
(b) (II) Endometrium, (III) Infundibulum, (IV) Fimbriae
(c) (III) Infundibulum, (IV) Fimbriae, (V) Cervix
(d) (IV) Oviducal funnel, (V) Uterus, (VI) Cervix

31. In a normal pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was **[2012]**
(a) High level of circulating FSH and LH in the uterus to stimulate implantation of the embryo
(b) High level of circulating HCG to stimulate endometrial thickening
(c) High level of FSH and LH in uterus to stimulate endometrial thickening
(d) High level of circulating HCG to stimulate estrogen and progesterone synthesis

32. Identify the correct statement on 'inhibin' **[2016]**
(a) Inhibits the secretion of LH, FSH and prolactin
(b) Is produced by granulosa cells in ovary and inhibits the secretion of FSH
(c) Is produced by granulosa cells in ovary and inhibits the secretion of LH
(d) Is produced by nurse cells in testes and inhibits the secretion of LH

33. Select the option which correctly matches the endocrine gland with its hormone and its function **[2013]**

	Endocrine gland	Hormone	Function
(a)	Placenta	Estrogen	Initiates secretion of the milk
(b)	Corpus luteum	Estrogen	Essential for maintenance of endometerium
(c)	Leydig cells	Androgen	Initiates the production of sperms
(d)	Ovary	FSH	Stimulates follicular development and the secretion of estrogens

34. Match the items given in Column I with those in Column II and select the correct option given below

Column I	Column II
(1) Proliferative Phase	(i) Breakdown of endometrial lining
(2) Secretory Phase	(ii) Follicular Phase
(3) Menstruation	(iii) Luteal Phase

[2018]

	(1)	(2)	(3)
(a)	(iii)	(i)	(ii)
(b)	(ii)	(iii)	(i)
(c)	(i)	(iii)	(ii)
(d)	(iii)	(ii)	(i)

35. The correct sequence of spermatogenesis stages leading to the formation of sperms in a mature human testis is **[2009, 2013]**
(a) Spermatocyte – spermatogonia-spermatid-sperms
(b) Spermatogonia-spermatocyte-spermatid-sperms
(c) Spermatid-spermatocyte-spermatogonia-sperms
(d) Spermatogonia-spermatid-spermatocyte-sperms

36. Capacitation refers to changes in the **[2015]**
(a) Ovum before fertilization
(b) Ovum after fertilization
(c) Sperm after fertilization
(d) Sperm before fertilization

37. Which of the following cells during gametogenesis is normally diploid **[2015]**
(a) Spermatid (b) Spermatogonia
(c) Secondary polar body (d) Primary polar body

38. The size of human egg is **[1992]**
(a) 1.5 mm (b) 0.15 mm
(c) 0.05 mm (d) 0.3 mm

39. Match between the following representing parts of the sperm and their function and choose the correct option

	Column I		Column II
A.	Head	i.	Enzymes
B.	Middle piece	ii.	Sperm motility
C.	Acrosome	iii.	Energy
D.	Tail	iv.	Genetic material

[2016]
(c) A-ii, B-iv, C-i, D-iii (b) A-iv, B-iii, C-i, D-ii
(c) A-iv, B-i, C-ii, D-iii (d) A-ii, B-i, C-iii, D-iv

40. The immature stage eggs are called as **[1993]**
(a) Microlecithal (b) Oogenesis
(c) Oocyte (d) Zygote

41. The branch of embryology which concerns with the study of abnormal embryonic development is termed as **[1992]**
(a) Gerontology (b) Teratology
(c) Embryology (d) None of the above

42. During embryonic development, the establishment of polarity along anterior/ posterior, dorsal/ventral or medial/lateral axis is called **[2003, 2005]**
(a) Pattern formation (b) Organizer phenomena
(c) Axis formation (d) Anamorphosis

43. During the course of development, cells in various regions of embryo become variable in morphology and eventually perform diverse functions. This process is known as **[1989, 1993]**
(a) Rearrangement (b) Differentiation
(c) Metamorphosis (d) Organisation

44. The difference between spermiogenesis and spermiation is **[2018]**
(a) In spermiogenesis spermatozoa are formed, while in spermiation spermatozoa are released from sertoli cells into the cavity of seminiferous tubules
(b) In spermiogenesis spermatozoa from sertoli cells are released into the cavity of seminiferous tubules, while in spermiation spermatozoa are formed
(c) In spermiogenesis spermatozoa are formed, while in spermiation spermatids are formed
(d) In spermiogenesis spermatids are formed, while in spermiation spermatozoa are formed

45. In man sperms move after ejaculation at a rate of nearly **[1991]**
(a) 2 to 4 mm/minute (b) 2 to 4 feet/minute
(c) 2 to 4 inches/minute (d) 2 to 4 cm/minute

46. In reproduction of a test tube baby **[1989]**
(a) Fertilization is done outside body
(b) Foetus is grown in a test tube
(c) Fertilization is done inside the body
(d) None of these

47. Fertilizin is a chemical substance produced from **[1997]**
(a) Mature eggs (Ovum) (b) Acrosome
(c) Polar bodies (d) Middle piece of sperm

48. In vitro fertilization technique that involves transfer of which one of the following into the fallopian tube **[2010]**
(a) Zygote only
(b) Embryo only, upto 8 cell stage
(c) Either zygote or early embryo upto 8 cell stage
(d) Embryo of 32 cell stage

49. In human females, meiosis-II is not complete until **[2015]**
(a) Fertilization (b) Uterine implantation
(c) Birth (d) Puberty

50. Which one of the following is the most likely root cause why menstruation is not taking place in regularly cycling human female **[2009]**
(a) Fertilization of the ovum
(b) Maintenance of the hypertrophic endometrial lining
(c) Maintenance of high concentration of sex-hormones in the blood stream
(d) Retention of well-developed corpus luteum

51. Which one of the following statements about human sperm is correct **[2010]**
(a) Acrosome serves no particular function
(b) Acrosome has a conical pointed structure used for piercing and penetrating the egg, resulting in fertilization
(c) The sperm lysins in the acrosome dissolve the egg envelope facilitating fertilization
(d) Acrosome serves as a sensory structure leading the sperm towards to ovum

52. The second maturation division of the mammalian ovum occurs **[2010]**
(a) In the Graafian follicle following the first maturation division
(b) Shortly after ovulation before the ovum makes entry into the fallopian tube
(c) Until after the ovum has been penetrated by a sperm
(d) Until the nucleus of the sperm has fused with that of the ovum

53. Fertilization in humans is practically feasible only if **[2016]**
(a) The sperms are transported into vagina just after release of ovum in fallopian tube
(b) The ovum and sperms are transported simultaneously to ampullary isthmic junction of the fallopian tube
(c) The ovum and sperms are transported simultaneously to ampullary isthmic junction of the cervix
(d) The sperms are transported into cervix within 48 hrs of release of ovum in uterus

54. Egg of rabbit and man are

Or

Human eggs are **[1991, 93; 1997, 99, 2000, 02; 1999; 1999]**
(a) Microlecithal (b) Megalecithal
(c) Telolecithal (d) Isolecithal

55. A change in the amount of yolk and its distribution in the egg will affect **[2009]**
(a) Formation of zygote
(b) Pattern of cleavage
(c) Number of blastomeres produced
(d) Fertilization

56. What is true about cleavage in the fertilised egg in humans **[1994; 1999]**
(a) It is meroblastic
(b) It starts while the egg is in fallopian tube
(c) It is identical to the normal mitosis
(d) It starts when the egg reaches in uterus

57. Coelom derived from blastocoel is known as **[1994, 2002]**
(a) Pseudocoelom (b) Enterocoelom
(c) Haemocoel (d) Schizocoel

58. Which of the following is correct statement **[1990]**
(a) In blastulation major presumptive and organ forming areas are segregated into definite points of the blastoderm
(b) Blastulation establishes the three germinal layers
(c) Blastulation of frog is known as discoblastula
(d) Fluid filled space in blastula is known as archenteron

59. What is true about cells during cleavage **[1991]**
(a) They move from animal pole to vegetal pole
(b) They do not grow in size
(c) They consume little O_2
(d) Their divisions resemble ordinary mitosis

60. Which one of the following statements about morula in humans is correct **[2010]**
(a) It has more cytoplasm and more DNA than an uncleaved zygote
(b) It has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA
(c) It has far less cytoplasm as well as less DNA than in an uncleaved zygote
(d) It has more or less equal quantity of cytoplasm and DNA as in uncleaved zygote

61. Peri Blastula is found in **[1988]**
(a) Man (b) Insects
(c) Sycon (d) Reptiles

62. Epiboly is the process of **[1992]**
(a) Mass migration of cells from the animal hemisphere so that upper micromeres begin to migrate over the edge of the dorsal lip and roll inside and are tucked beneath the outer layer
(b) Overgrowth when the micromeres divide rapidly and begin to spread downwards over the megameres except at the yolk plug
(c) Rotation of gastrula within the vitelline membrane so that the animal pole becomes anterior
(d) Formation of a small slit like invagination occurring on the grey crescent

63. Gonads are derived from embryonic **[1990]**
(a) Mesoderm
(b) Endoderm
(c) Ectoderm
(d) Mesodermand endoderm

64. Match the following and choose the correct options

Column I	Column II
A. Trophoblast	i. Embedding of blastocyst in the endometrium
B. Cleavage	ii. Group of cells that would differentiate as embryo
C. Inner cell mass	iii. Outer layer of blastocyst attached to the endometrium
D. Implantation	iv. Mitotic division of zygote

[2016]
(a) A-ii, B-i, C-iii, D-iv
(b) A-iii B-iv, C-ii, D-i
(c) A-iii, B-I, C-ii, D-iv
(d) A-ii, B-iv, C-iii D-i

65. Embryologists can presume the future organs of the embryo in **[1993]**
(a) Blastula (b) Early gastrula
(c) Morula (d) Post gastrula

66. The solid mass of cells formed at the end of cleavage of mammalian egg is **[1994]**

Or

The stage transferred into the uterus after induced fertilization of ova in the laboratory is **[2013]**
(a) Blastula (b) Morula
(c) Blastocyst (d) Blastodisc

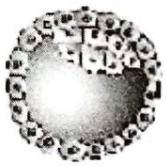
67. True coelom develops as a split in **[1990, 1995]**
(a) Mesoderm
(b) Endoderm
(c) Ectoderm
(d) Between ectoderm and endoderm

68. The attachment of the mammalian blastocyst to the uterine wall is **[1993, 2002]**
(a) Incest (b) Implantation
(c) Intromission (d) Incorporation

69. Ectopic pregnancies are referred to as **[2015]**
(a) Implantation of embryo at site other than uterus
(b) Implantation of defective embryo in the uterus
(c) Pregnancies terminated due to hormonal imbalance
(d) Pregnancies with genetic abnormality

70. The rolling of endodermal and mesodermal cells from the surface of embryo into its interior is called **[1987, 1993]**
(a) Ingression (b) Invagination
(c) Involution (d) Inversion

71. Identify the human developmental stage shown below as well as the related right place of its occurrence in a normal pregnant woman, and select the right option for the two together **[2012]**



Options

	Developmental stage	Site of occurrence
(a)	Late morula	Middle Part of Fallopian tube
(b)	Blastula	End part of Fallopian tube
(c)	Blastocyst	Uterine wall
(d)	8–celled morula	Starting point of Fallopian tube

72. The amnion of mammalian embryo is derived from **[2018]**
(a) Ectoderm and endoderm
(b) Mesoderm and trophoblast
(c) Endoderm and mesoderm
(d) Ectoderm and mesoderm

73. The concept that organiser is essential for embryonic development was given by or For the '*Theory of organiser*', Nobel prize was given to **[1990]**
(a) J. Axelrod (b) C. Landsteiner
(c) H. Spemann (d) I.P. Pavlov

74. Development of structure and shape of an organism is **[1993]**
(a) Morphology (b) Multiplication
(c) Morphogenesis (d) Budding

75. True coelom is a space between the body wall and alimentary canal. It is lined by **[1996]**
(a) Mesoderm on one side and ectoderm on the other side
(b) Endoderm on one side and ectoderm on the other side
(c) Mesoderm on both the sides
(d) Ectoderm on both the sides

76. Which extraembryonic membrane in humans prevents desiccation of the embryo inside the uterus **[2008]**
(a) Yolk sac (b) Amnion
(c) Chorion (d) Allantois

77. The extra–embryonic membranes of the mammalian embryo are derived from **[1994]**
(a) Formative cells (b) Follicle cells
(c) Inner cell mass (d) Trophoblast

78. Foetal ejection reflex in human female is induced by **[2009]**

Or

The signals for parturition originate from **[2010, 12]**
(a) Pressure exerted by amniotic fluid
(b) Release of oxytocin from pituitary
(c) Fully developed foetus and placenta
(d) Differentiation of mammary glands

79. Human chorionic gonadotropin is secreted by **[2010]**

Or

Several hormones like hCG, hPL, estrogen, progesterone are produced by **[2016]**
(a) Chorion (b) Amnion
(c) Corpus luteum (d) Placenta
(e) Ovaries

80. Which one of the following is **not** the function of placenta. It **[2013]**
(a) Secretes oxytocin during parturition
(b) Facilitates supply of oxygen and nutrients to embryo
(c) Secretes estrogen
(d) Facilitates removal of carbon dioxide and waste material from embryo

81. Hormones secreted by the placenta to maintain pregnancy are **[2018]**
(a) hCG, progestogens, estrogens, glucocorticoids
(b) hCG, hPL, progestogens, estrogens
(c) hCG, hPL, estrogens relaxin, oxytocin
(d) hCG, hPL, progestogens, prolactin

82. The shortest gestation period is seen in **[1993]**
(a) Man (b) Elephant
(c) Cat (d) Mouse

83. Which of these is not an important component of initiation of parturition in humans **[2015]**
(a) Synthesis of prostaglandins
(b) Release of oxytocin
(c) Release of prolactin
(d) Increase in estrogen and progesterone ratio

84. The first movements of the foetus and appearance of hair on its head are usually observed during which month of pregnancy **[2010]**
(a) Third month (b) Fourth month
(c) Fifth month (d) Sixth month

12. AIIMS

1. Ovulation in mammals is caused by **[1990]**
(a) FSH and TSH (b) FSH and LH
(c) FSH and LTH (d) LTH and LH

2. Which one of the following events is correctly matched with the time period in a normal menstrual cycle **[2005]**
(a) Release of egg : 5th day
(b) Endometrium regenerates : 5 – 10 days
(c) Endometrium secretes nutrients for implantation : 11–18 days
(d) Rise in progesterone level : 1 – 15 days

3. Cessation of menstrual cycle in the human female is known as **[2001]**
(a) Ovulation (b) Puberty
(c) Menopause (d) Maturation

4. Both corpus luteum and macula lutea are **[2003, 08, 13]**
(a) Found in human ovaries
(b) A source of hormones
(c) Characterized by a yellow colour
(d) Contributory in maintaining pregnancy

5. The phase of menstrual cycle in humans that last for 7-8 days is **[2003]**
(a) Follicular phase (b) Ovulatory phase
(c) Luteal phase (d) Menstruation

6. Cumulus covers **[1999]**
(a) Ovary (b) Ovum
(c) Embryo (d) All of these

7. A cross section at the midpoint of the middle piece of a human sperm will show **[2005]**
(a) Centriole, mitochondria and 9+2 arrangement of microtubules
(b) Centriole and mitochondria
(c) Mitochondria and 9+2 arrangement of microtubules
(d) 9+2 arrangement of microtubules only

8. Termination of gastrulation is marked by **[1998]**
(a) Obliteration of archenteron
(b) Closure of neural tube
(c) Obliteration of blastocoel
(d) Closure of blastopore

9. Fertilization occurs in human, rabbit and other placental mammals in **[1993]**
(a) Ovary (b) Uterus
(c) Fallopian tubes (d) Vagina

10. Eggs having yolk in their centre of cytoplasm in peripheral layer are called **[1998]**
(a) Isolecithal (b) Microlecithal
(c) Centrolecithal (d) Telolecithal

11. Holoblastic cleavage may occur in eggs which are **[1987]**
(a) Oligolecithal only
(b) Mesolecithal only
(c) Macrolecithal only
(d) Oligolecithal and mesolecithal both

12. The fluid filled in the blastocoel cavity of blastula is **[1993]**
(a) Acidic (b) Albuminous
(c) Saline (d) Pure water

13. During the fourth and sixth cleavage of the zygote **[1993]**
(a) Mesomeres give rise to endoderm
(b) Micromeres give rise to ectoderm
(c) Mesomeres give rise to mesoderm
(d) Macromeres give rise to ectoderm

14. Which one of the following statements with regard to embryonic development in humans is correct **[2003]**
(a) Cleavage division bring about considerable increase in the mass of protoplasm
(b) In the second cleavage division, one of the two blastomeres usually divides a little sooner than the second
(c) With more cleavage divisions, the resultant blastomeres become larger and larger
(d) Cleavage division results in a hollow ball of cells called morula

15. Which of the following hormones is secreted by implanted blastocyst, that acts on the corpus luteum in the ovary, stimulating the body to produce estrogens and progesterone to maintain the uterine lining **[2009]**
(a) Estrogen (b) HCG
(c) Progesterone (d) Oxytocin

16. The 'cells of Rauber' are **[2012]**
(a) Secretory cells of endometrium in uterus
(b) Inner cell mass of blastocoel
(c) Outer cells of trophoblast in contact with uterine wall
(d) Cells of trophoblast, in contact with inner cell mass of blastocyst

17. The endodermal derivatives include **[1987]**
(a) Thyroid (b) Pineal gland
(c) Spleen (d) Pituitary

18. The placental barrier between the maternal and foetal blood is minimum in **[1992]**
(a) Goat (b) Pig
(c) Cow (d) Human

19. Among the following stem cells, which are found in the umbilical cord **[2009]**
(a) Embryonic stem cells (b) Adult stem cells
(c) Cord blood stem cells (d) All of the above

20. Choose the correct statement **[2012]**
(a) hPL plays a major role in parturition
(b) Foetus shows movements first time in the 7th month of pregnancy
(c) Signal for parturition comes from fully developed foetus and placenta
(d) Embryo's heart is formed by the 2nd month of pregnancy

21. The placenta of human beings belong to the category of **[1998]**
(a) Haemo-chorialis (b) Syndesmo-chorialis
(c) Endothelial-chorialis (d) Epithelio-chorialis

13. Assertion and Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion
(c) If the assertion is true but the reason is false
(d) If both the assertion and reason are false
(e) If the assertion is false but reason is true

1. Assertion : The development in cockroach is heterometabolous metamorphosis.
Reason : Young ones resemble the adults in all characters.

2. Assertion : Holoblastic cleavage with almost equal sized blastomeres is a characteristic of placental animals.
Reason : Eggs of most mammals, including humans, are of centrolecithal type.

3. Assertion : In morula stage, cells divide without increase in size.
Reason : Zona pellucida remain undivided till cleavage is complete.

4. Assertion : Spermiation is the transformation of spermatid into sperm.
Reason : During spermiation, sperms get nutrition from sertoli cells.

5. Assertion : In human male, there are perianal glands near the anus.
Reason : Perianal glands secretes sex-attractant pheromone which initiates sexual desire in human female.

6. Assertion : Only a single functional female gamete is formed from each primary oocyte cell.
Reason : Meiosis in each primary oocyte gives rise to only one cell which functions as ovum.

7. Assertion : Corpus luteum is produced by Graafian follicle after ovulation.
Reason : Corpus luteum secretes progesterone which maintains the pregnancy.

8. Assertion : During fertilization only head of spermatozoa enters egg.
Reason : If several spermatozoa hit the egg at same time, all can enter the egg.

9. Assertion : All Metatherian are placental mammals.
Reason : All placental mammals have menstrual cycle.

10. Assertion : Generally, a woman do not conceive during lactation period.
Reason : The hormone prolactin initiates and maintain lactation in a woman.