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HUMAN REPRODUCTION

SYLLABUS

Male and female reproductive systems; Microscopic anatomy of testis and ovary; Gametogenesis-spermatogenesis & oogenesis; Menstrual cycle; Fertilisation, embryo development upto blastocyst formation, implantation; Pregnancy and placenta formation (Elementary idea); Parturition (Elementary idea); Lactation (Elementary idea).

KEY CONCEPTS

INTRODUCTION

* Humans are sexually reproducing and viviparous.
* Formation of gametes is called gametogenesis
* Transfer of sperms into the female genital tract is called **insemination.**
* Fusion of male and female gametes is called **fertilisation**
* Formation and development of blastocyst and its attachment to the uterine wall is called **implantation.**
* Embryonic development is called **gestation.**
* Delivery of the baby is called **parturition.**
* In majority of animals, as a result of sexual reproduction the structure formed is termed as the zygote and it gives rise to complete animal. This is termed as **embryogenesis** and the animals, so formed are termed as oozoids. They have the most advanced characters.
* Human are unisexual. The reproductive system of each sex consists of many organs. The latter are distinguishable into primary and secondary sex organs. Besides these, there are some accessory sex characters.

Primary sex organs

* Gonads which form gametes are called primary sex organs - testis (plural testes) in males and ovary (plural ovaries) in females.
* Testis produces sperms and secrets testosterone.
* Ovary produces ova. Maturing Graffian follicles secrete estrogens.

Secondary sex organs

* Sex organs, glands and ducts which do not produce gametes but are otherwise essential for sexual reproduction are known as secondary sex organs.
* In human male reproductive system, the secondary sex organs are vasa efferentia, epididymis, vasa deferens, ejaculatory ducts, urethra, accessory sex glands are prostate glands, Cowper's glands, seminal vesicles and penis.
* Secondary sex organs of a human female include fallopian tubes, uterus, vagina, external genitalia, Bartholin's gland and mammary glands are accessory sex glands.

Accessory / External / Secondary sex characters

* They are traits which do not have any direct role in reproduction but provide specific features and structures to the two sexes.
* The important external / accessory sex characters of human male are beard, moustaches, body hair

on shoulder and chest, pubic hair on both lateral and vertical directions, comparatively more height with more muscular body, larynx apparent externally, voice low pitched with breathing more by means of diaphragm.

* The important accessory sex character of human females are high pitched voice, breast, broader pelvis, lateral pubic hair, rounded body contours with more subcutaneous fat in thighs, buttocks and face and sternal breathing.

Puberty

* Beginning of sexual maturity or ability to reproduce is known as puberty.
* Puberty occurs at the age of 10-14 years in girls and 13-15 years in boys.

THE MALE REPRODUCTIVE SYSTEM

* The male reproductive system is located in the pelvis region
  It includes a pair of **testes** alongwith **accessory ducts, glands** and the **external genitalia.**

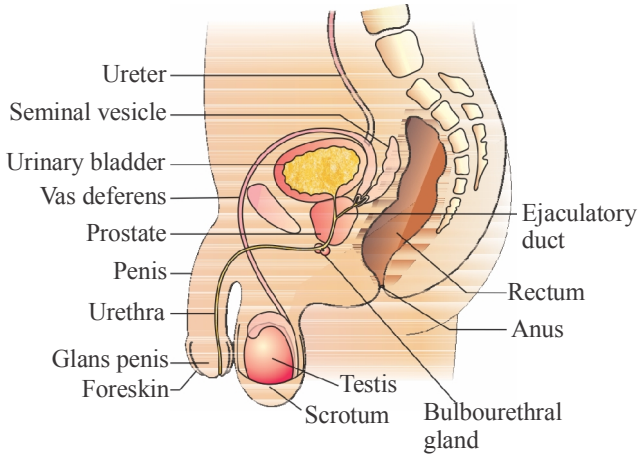


Figure : Diagrammatic sectional view of male pelvis showing reproductive system

* In man, one pair of testes are the main or primary reproductive organ. Size 4-5 cm × 2-3 cm
* Both testes are located in a small bag like structure situated below & outside the abdominal cavity called as scrotum or scrotal sac. The temperature of scrotum is 2-2.5°C lesser than body temperature.
* Internally scrotum is lined by **dartos muscle & spermatic fascia**.
* Dartos muscle helps in regulation of the temperature within the scrotum during cold season,
* It becomes contracted in cold & during warm season, it becomes relaxed.
* Cremaster muscles line inside the wall of scrotal & inguinal canal region and help in elevation of testes.
* Each testis is attached to the walls of the scrotal-sac through flexible, elastic fibres. This group of fibres is called Gubernaculum or Mesorchium.
* Each testis is attached to the dorsal body wall of the abdominal-cavity through a cord termed as the **Spermatic cord.** This cord is made up of elastin fibres & spermatic fascia. The contents of cord are vas deferens, gonadal veins, gonadal arteries, nerves and lymphatics.
* During embryonic stage, testes develop in abdominal cavity & they descend to reach the scrotum at the time of birth.
* When the testes does not descend to reach the scrotum but remain in abdominal cavity at the time of birth this conditions is called **undescended testes** or **cryptorchidism.**
* Such testis cannot develop and function properly and may develop malignancy.
* Scrotum is connected to the abdominal cavity through a passage termed as inguinal-canal. Through this canal the testes descend down into the scrotal-sacs at the time of birth.
* Spermatic cord in males passes through the inguinal canal.

Internal Structure of Testis

* Testis is covered by three coats. Outer most is tunica vaginalis. Middle coat is tunica albuginea & inner most is tunica vasculosa.
* **Tunica vaginalis** has a parietal & visceral layer. It covers the whole testis except it's posterior border from where the testicular vessels & nerves enter the testis.
* The **Tunica albuginea** is a dense, white fibrous coat covering the testis all around . The posterior border tunica albuginea is thickened to form vertical septum called the **Mediastinum testis.**

* **Tunica vasculosa** is the inner most vascular coat of the testis lining testicular lobules.
* Each lobules has 1 to 3 seminiferous tubules, which join together at the apices of the lobules to form straight tubules or tubulirecti which enter the mediastinum.

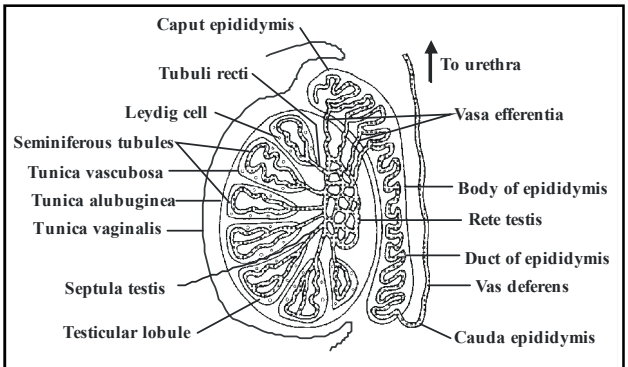


Fig. Median longitudinal section of mammalian testis

* Here they form a network of tubules called as **rete testis.** Rete testis fuse to form 10 to 20 efferent ductule called as **vasa efferentia or ductuli efferentes.**
* These ductules come out from upper dorsal surface of testis & open into common tubules, which get highly coiled to form epididymis or ductus epididymis.
* This epididymis is responsible for functional maturation of sperm.
* Total number of seminiferous tubules in each testis is about 750 to 1000.

Epididymis has 3 parts :

(i) **Upper, highly coiled part -** Caput epididymis or Globus-major

(ii) **Middle part -** Corpus epididymis

(iii) **Basal, least coiled part -** Cauda epididymis or Globus minor

* Cauda-epididymis, enters inside the abdominal-cavity from the scrotal-sac in the form of Vas deferens or ductus deferens.
* Terminal dilated part of vas deferens are called **ampulla.**
* Vas deferens and Epididymis both develop from the wolfian-duct of mesonephros.
* Epididymis can temporarily stores the sperms for as long as one month and here the functional maturation of sperms takes place.
* The wall of epididymis is made up of 2 layers-outer circular muscle layer and inner epithelium.
* Wall of vasdeferens is also made up of 2 layers-outer circular muscle layer and inner epithelium.
* The sperms reach the abdominal cavity due to the pulsation of the vas-deferens.
* **Vas deferens** runs upward & enter into abdominal cavity. Both vas deferens coil around the ureter of their respective sides and then dilate to form ampulla.
* Ampulla of each side receives the seminal vesicle of that side.
* The vas deferens now forms ejaculatory duct and opens into prostatic urethra.
* 1 pair of seminal vesicles are situated on dorsolateral side of urinary bladder which open separately before the terminal ends of vas deferens.
* So terminal ends of vas deferens meet to form a single ejaculatory duct in each side .

ACCESSORY REPRODUCTIVE GLANDS

* The substances secreted by the accessory reproductive glands help in reproduction, these are-

1. Seminal vesicle

* If forms from the Mullerian-duct of the embryo.
* Internally, it is lined by glandular epithelium which secretes seminal fluid, which is lubricating, transparent & jelly like substance, which makes 60-70% part of semen.
* It is slightly alkaline (pH 7.3.).
* **Fructose** is found in seminal fluid, it act as fuel to sperm.
* Fibrinogen, prostaglandin, citrate, inositol and several proteins are also present in semen.

2. Prostate gland

* This gland is located below the urinary bladder.
* It is unpaired & made up of 5 lobes in man.
* Each lobe opens into prostatic urethra through many fine apertures.
* It secretes slightly alkaline prostatic fluid which is milky, thick, sticky or jelly like.
* It makes about 30% part of semen and helps in sperm activation.

* The secretion of prostate-gland has citric acid, calcium and phosphate, clotting enzyme and profibrinolysin are present.
* The secretion of the prostate gland combines with the secretion of seminal vesicle and so the semen gets coagulated.
* In the coagulated semen, the mobility of sperms is reduced and so their energy is conserved. After some time of ejaculation due to fibrinolysins, semen again liquefies and in this semen now the sperms can move.

3. Cowper's glands

* It is a pair of glands found on lateral side of urethra.
* It is also called as **bulbourethral gland.**
* It is situated in membranous part of urethra & opens into penile urethra.
* It secretes transparent, slimy, jelly like fluid.
* It is slightly alkaline (pH is 7.2). This destroys the acidity of the urethra and cleans it for the movement of sperms.
* **Semen -** Semen = Sperm + Accessory reproductive gland fluid
  Volume = 3 to 4ml.
  Normal sperm count 20 to 120 million/ml.
  Oligospermia < 20 million/ml.
  Azospermia – either absence or near absence of sperms.
  Teratospermia -sperms with abnormal morphology.

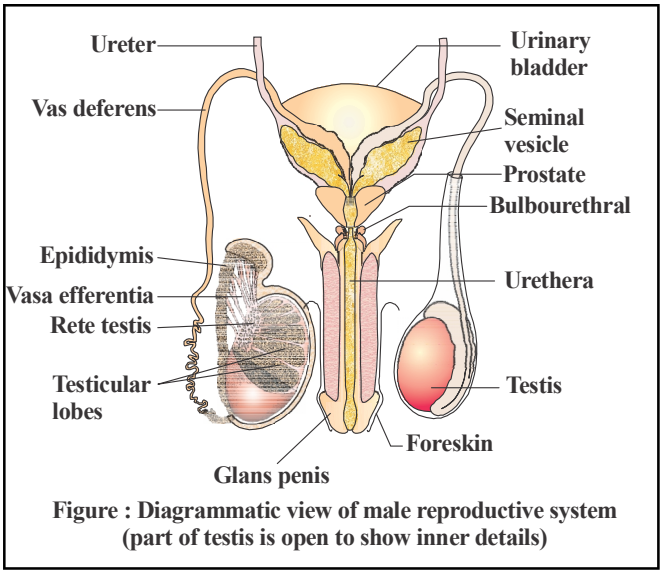


Figure : Diagrammatic view of male reproductive system (part of testis is open to show inner details)

Histology of seminiferous tubules

* Outer surface of seminiferous tubules is composed of white fibrous connective tissues called as **tunica propria.**
* While inner surface is of cuboidal germinal epithelium.
* This epithelium is made of spermatogenic cells which forms sperm by spermatogenesis.
* Some columnar cells are found in the layer of germinal epithelium called as **Sertoli cells.** These provide nutrition to sperm, so they are also called as **subtentacular or sustentacular** or **nurse cells** (these occur in mammals).

Other function of Sertoli cells

* They phagocyte the injured or dead sperm cells
* They are the basis of blood testis barrier
* Sertoli cells produce inhibin and antimullerian hormone.
* Sertoli cells can synthesize estrogen from testosterone. In turn, stimulate the process of spermatogenesis.FSH acts on the sertoli cells and stimulates secretion of some factors which help in the process of spermiogenesis.
* Some endocrine cells are found between seminiferous tubules in intertubular space, these are called as **interstitial or Leydig cells.** These cells secrete **testosterone.**

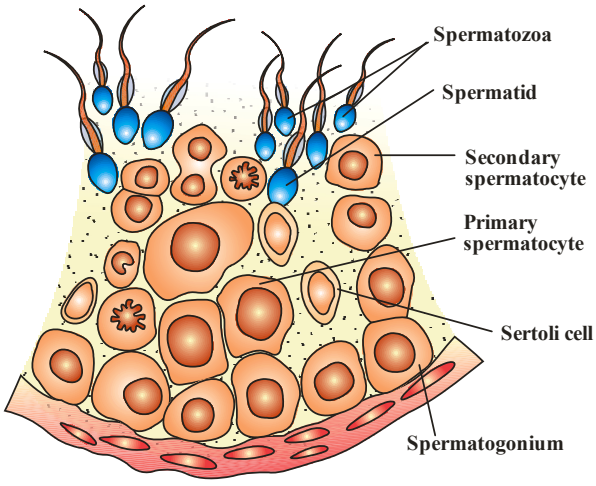
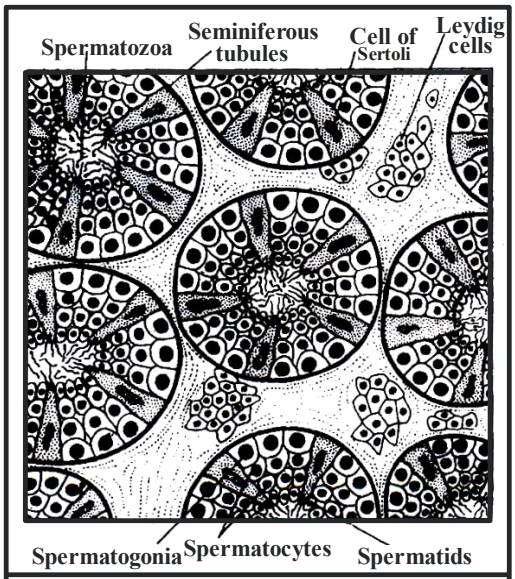


Figure : Diagrammatic sectional view of a seminiferous tubule (enlarged)

* The testosterone from Leydig's cells enter the seminiferous tubules by diffusion under the effect of ABP & promotes spermatogenesis.
* Leydig cells synthesize and secrete testicular hormones called androgens.
* Other immunologically competent cells are also present.



HISTOLOGY OF TESTIS

PENIS

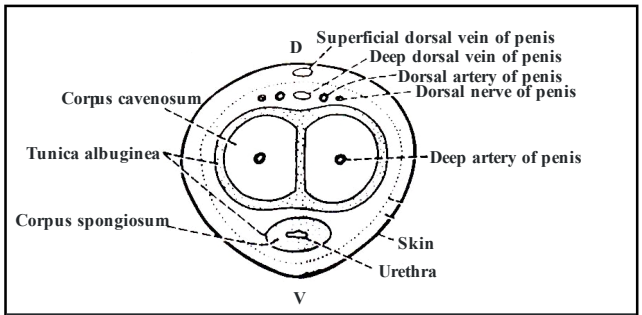
* Urethra continues in a muscular & tubular organ called as **penis.** Terminal part of shaft of penis is bulging,it is called as **Glans penis.**
* This glans penis is covered by a movable skin called as **prepuce or foreskin.**
* A special type of sebaceous gland is found on the prepuce called **preputial gland** which secretes **smegma.**
* Removal of prepuce by surgery is called as **circumcision.**
* Prepuce is attached to the base of glans with the help of an elastic cord like membrane called **Frenulum prepuce.**
* Penis is an erectile copulatory intromittent organ(Organ of copulation).
* Root of the penis containing muscles is called crura.
* Penis consists of a long shaft that enlarges to form an expanded tip called the glans penis.

Body of Penis

* It is composed of three longitudinal cylindrical masses of erectile tissue. These masses are, the right and left corpora cavernosa & a median corpus spongiosum.
* The two corpora cavernosa do not reach the end of the penis. Each of them terminates under cover of the glans penis.
* The corpus spongiosum continues further, its terminal part is expanded to form a conical enlargement called the **glans penis**. Through out its whole length it is transversed by the **urethra.**
* External opening of penis is called penile meatus.

Erection of Penis

* Erection of penis is purely vascular phenomenon and is controlled by A.N.S.
* It occurs due to increase of blood supply, due to dilation of penile arteries causing enlargement and hardening of penis.
* During this time the muscles of crura are relaxed.



Transverse section through the body of the penis

Golden Tips

* **Orchiopexy:** When the undescended testes are brought into scrotal sac by surgical process during childhood this process called as orchiopexy.
* Cutting of the vasa-deferens and ligation is termed as **vasectomy**.
* Erection of penis is controlled by parasympathetic nervous system.
* Ejaculation of semen is controlled by sympathetic nervous system.

THE FEMALE REPRODUCTIVE SYSTEM

* The female reproductive system consists of a pair of ovaries, a pair of oviducts, a **uterus, cervix, vagina, external genitalia,** and a pair of mammary glands.

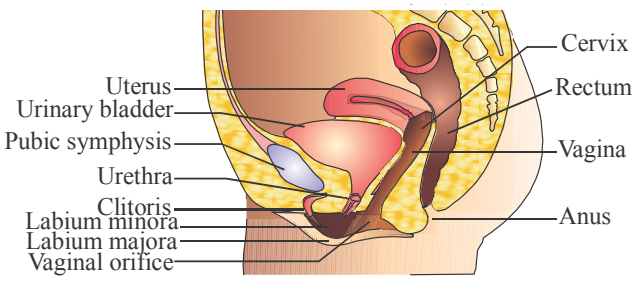


Figure : Diagrammatic sectional view of female pelvis showing reproductive system

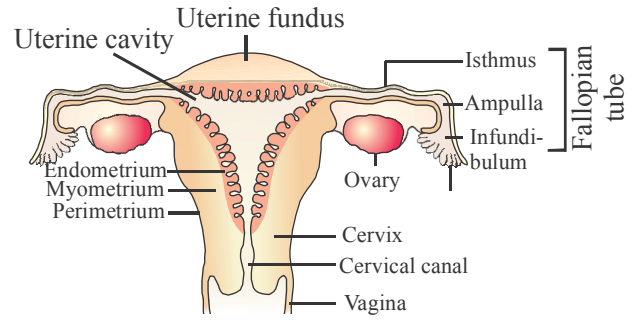


Figure : Diagrammatic sectional view of female reproductive system

* A pair of ovaries is the main or primary sex organ of female reproductive system.
* Both ovaries are located in abdominal cavity in the ovarian fossa.
* Each ovary is attached to the posterior layer of broad ligament (Peritoneal ligament) with the help of mesovarium.
* It is short fold of peritoneum & it is the route of vessels & nerves to ovary .
* Female secondary sex organs are 1 pair fallopian tube,1 uterus and 1 vagina.
* The lateral end of fallopian tube is funnel shaped and called as **infundibulum**.
* Its fimbriated & terminal end bears aperture called as **abdominal ostium** which opens into peritoneal cavity.
* The part medial to the infundibulum is called **ampulla**, it is a thin walled dilated part of tube.
* Fertilization takes place in the ampulla.
* The part medial to ampulla is called **isthmus**.
* The most medial part of this tube situated in the uterus is called **intramural or interstitial part of tube**.
* During ovulation, the egg are released in the peritoneal cavity, due to this it is called **coelomic egg.** The distal & dilated part of oviduct forms the **uterus**.
* The upper expanded part is called as body or fundus while lower cylindrical part is called as **cervix**.
* Upper part of uterus forms the body while lower part forms cervix.
* On internal surface of cervix 2 types of constrictions are found which form the **Os-cervix.**
* The body of uterus communicates with the cervix through opening called **internal Os.**
* The cervix communicates with the vagina through an opening called **external Os.**
* The uterus open into a fibromuscular & non glandular tube like organ called **vagina** (Copulatory organ).

Histology of Uterus and fallopian tube

I. **Serosa or the adventitia :** It is the outermost layer of visceral-peritoneum **(Perimetrium)**

II. **Muscle-layer :** The middle layer of the oviduct is made up of unstripped-muscle. In uterus, thick smooth muscle bundles are found, these are called as **myometrium.**

III. **Mucous membrane :**

* It is the innermost layer.
* Mucosa consists of simple columnar epithelium.
* Epithelium contains both ciliated cells & secretory cells.
* The secretory cells produce viscous liquid film that provides nutrition & protects the ovum. Mucosa of Uterus is called **endometrium**,
* It contains tubular glands, many fibroblasts & blood vessels.
* In the uterus, the embryo is attached to endometrium.

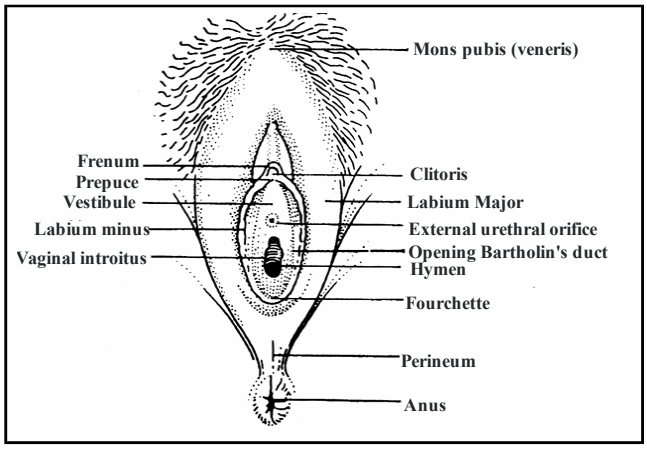
Vulva

* Vulva means external genitalia of female. They include mons veneris, labia majora, labia minora, clitoris, vestibule & related perineum.
* **Mons veneris (mons pubis) :** It is a pad of sub cutaneous connective tissue, lying in front of pubis & is covered by pubic hairs in adult female.
* **Labia Majora :**Vulva is bounded on each side by the elevation and folds of skin & subcutaneous tissue. Its inner surface is hairless.
* Outer surface is covered by sebaceous gland, Sweat gland & hair follicles. It is homologous with the scrotum in the male.
* **Labia Minora :-** They are two thin folds of skin present just within the labia majora. Lower portion of minora fuses across the midline & form a fold of skin called **fourchette**.
* **Clitoris :** Small cylindrical & erectile body made by fusion of two labia minora, situated in the most anterior part of vulva. It is also made up of two erectile bodies (corpora cavernosa). The skin which covers the glans of clitoris is called **prepuce.**
* At the terminal part of vagina the urethra opens separately, so they form a common chamber called **vaginal vestibule or urino genital sinus.** Vagina opens outside through a slit like aperture or triangular space called vestibule.
* The vulva has following openings :-

(a) Urethral opening – Lies on anterior end

(b) Vaginal orifice – Lies on posterior end.

* It is incompletely closed by a septum of mucous membrane called **hymen**, but it may not be a true sign of virginity.



(c) Openings of Bartholin's ducts: These are opening of one pair bartholin's/greater vestibular glands situated on lateral side of vagina.They secrete alkaline fluid during sexual excitement.

BREAST

* The mammary glands are paired structures (breasts) that contain glandular tissue and variable amount of fat.
* The glandular tissue of each breast is divided into 15-20 **mammary lobes** containing clusters of cells called **alveoli**.
* The cells of alveoli secrete milk, which is stored in the cavities (lumens) of alveoli.
* The alveoli open into mammary tubules.
* The tubules of each lobe join to form a **mammary duct**.
* Several mammary ducts join to form a wider mammary ampulla which is connected to **lactiferous duct** through which milk is sucked out.

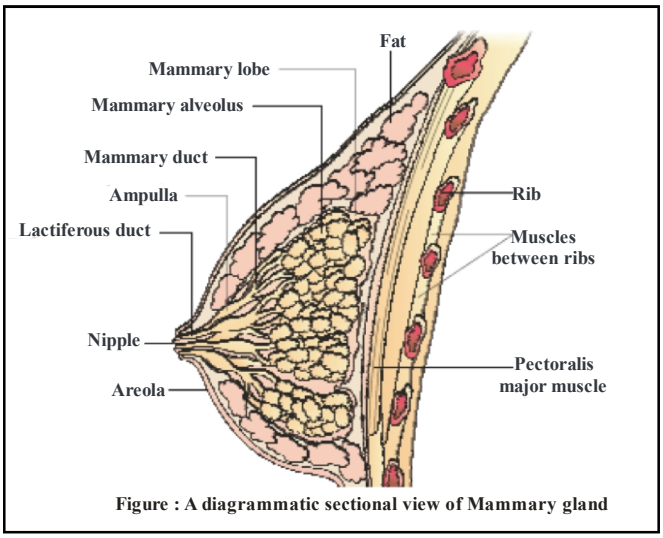


Figure : A diagrammatic sectional view of Mammary gland

* Mammary glands produce a nutritive fluid, milk for the nourishment of young ones, milk protects the young ones from various infections upto some months after birth.
* The mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called **lactation.** This helps the mother in feeding the new-born.
* Breast-feeding during the initial period of infant growth is recommended by doctors for bringing up a healthy baby.

* Longest unstriped muscles of the body are found in the walls of uterus.(During pregnancy).
* Clitoris is a homologous to the penis in the male.
* **Bartholin Glands** is homologous to **Cowper gland** of male.
* The milk produced during the initial few days of lactation is called colostrum which contains several antibodies absolutely essential to develop resistance for the new-born babies.

GAMETOGENESIS

* GnRH, FSH, LH regulates gametogenesis. Besides this hormone vitamin E is also essential for gametogenesis.
* Deficiency of vitamin E leads to sterility.
* Vitamin A is also required for the formation of healthy gametes.
* Gemetogenesis is divided in three stages :
  (i) Multiplication phase (ii) Growth phase
  (iii) Maturation phase.
* 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-gonadal in origin.
* Spermatogenesis occurs in the seminiferous tubules of the testes of oogenesis occurs in the follicles of ovary.
* Formation of gametes starts at puberty.

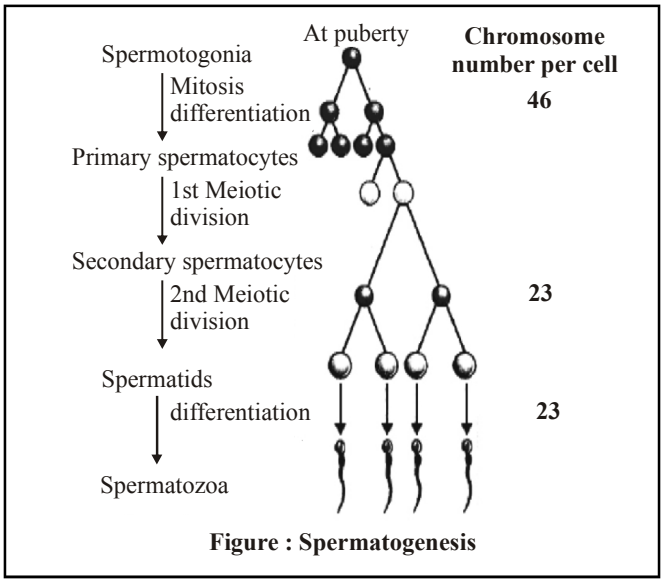


Figure : Spermatogenesis

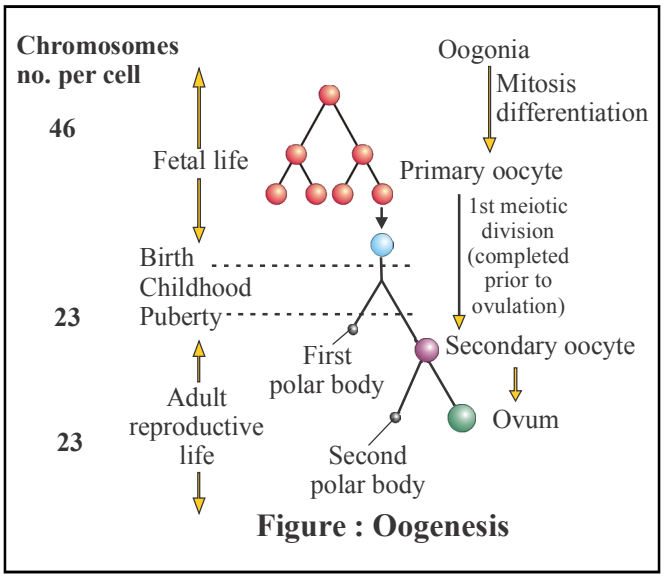


Figure : Oogenesis

SPERMATOGENESIS

* The proecess of formation of spermatozoa in the seminiferous tubules of testis.
* The wall of seminiferous tubules is lined by cuboidal spermatogonia and columnar sertoli cells.
* Spermatogonia are derived from primordial germ cells.
* At puberty spermatogonia divide to form spermatozoa and sertoli cells provide nourishment to developing sperms.
* Sertoli cells form 'blood testes barrier' and protect the sperm from immune system of the body.

* Sertoli cells function as an endocrine gland i.e. secrete three type of hormones :

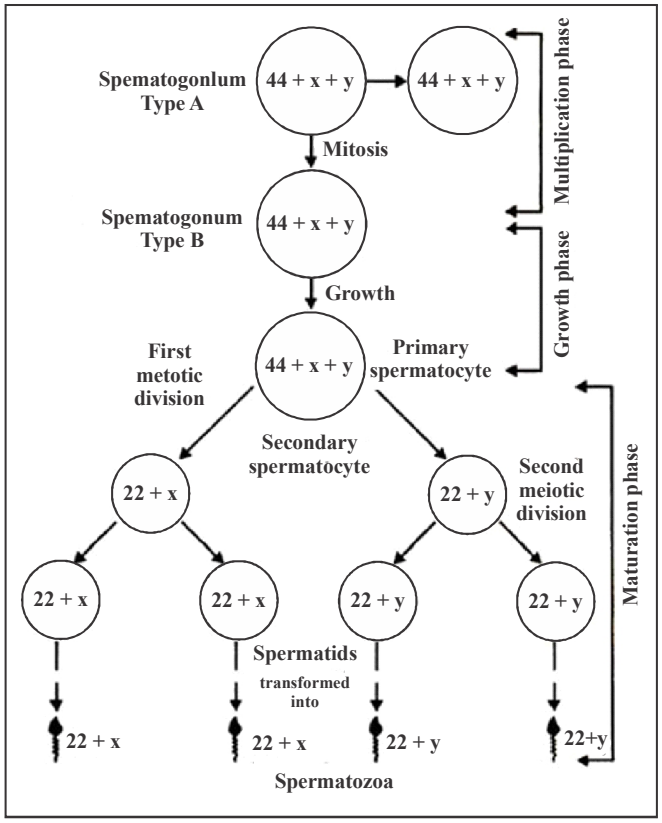
(i) **Antimullerian hormone :** function of this hormone is degradation of female gonads in male embryo. (In male seminal vesicle is the ruminant part of oviduct of female).

(ii) **Inhibin hormone :** Function of this hormone is to control excess secretion of pituitary gland to prevent the over-production of sperms.

(iii) **Androgen binding protein :** Function of this hormone is to concentrate testosterone in seminiferous tubules because testosterone is must for spermatogenesis in seminiferous tubules.

Steps of Spermatogenesis

* Spermatozoa are formed in the wall of the seminiferous tubules of the testes.
* The various cell-stages in spermatogenesis are as follows (the number of chromosomes at each stage is given in brackets)



A. **The spermatogonia (type A) or germ cells** (44 X + Y) divide mitotically, to give rise to more spermatogonia of type A (spermatogenic lineage) and also spermatogonia of type B.

B. **The spermatogonia (type B)** (44 + X + Y) enlarge, to from primary spermatocytes (spermato cytogeneis)

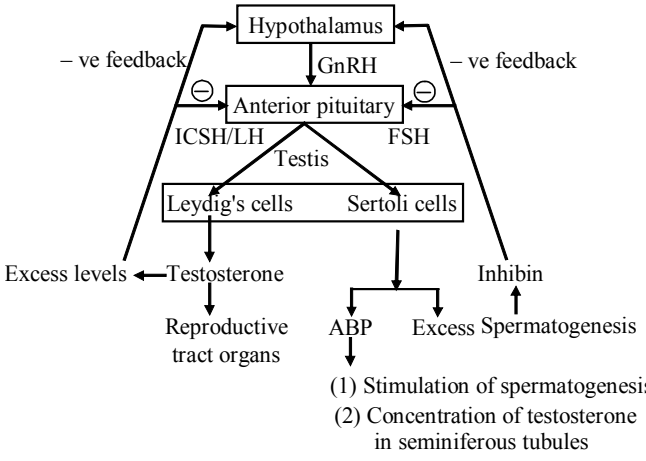
C. **The primary spermatocytes** (44 + X + Y) now divide so that each of them forms two secondary spermatocytes. This is the first meiotic division. it reduces the number of chromosomes to half.

D. **Each secondary spermatocyte** has 22 + X or 22 + Y chromosomes. It divides to form two spermatids. This is the second meiotic division and this time there is no reduction in chromosome number.

E. **Each spermatid** (22 + X or 22 + Y) gradually changes its shape to become a spermatozoon. This process of transformation of a circular spermatid to a spermatozoon is called **spermiogenesis/spermateleosis.**

MALE REPRODUCTIVE HORMONES

* **FSH :** Binds with FSH receptors attached to the Sertoli cells in seminiferous tubules. This causes these cells to grow and secrete various spermatogenic substances and androgen binding proteins (ABP)
* **LH/ICSH :** It stimulates the leydig cells to secrete testosterone.
* **Inhibin : :** It is secreted by Sertoli cells in response to excess spermatogenesis. The inhibin gives a negative feedback to the anterior pituitary(mainly) and hypothalamus and, this results in suppression of synthesis and release of FSH (\ Spermatogenesis decreases).



* **Testosterone :** Secreted by Leydig cells. It is essential for –
(1) Sperm production (2) development of secondary sexual characters (3) it also gives –ve feedback to hypothalamus and anterior pituitary in its excess concentration to suppress GnRH, FSH & LH release. (4) It is secreted in foetal stage in as low as 30 ng/ml plasma concentration to cause descent of testis in last trimester of intrauterine life.

Structure of sperm

* It is a microscopic structure composed of a head, neck, a middle piece and a tail.
* A plasma membrane envelops the whole 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 fertilisation of the ovum.

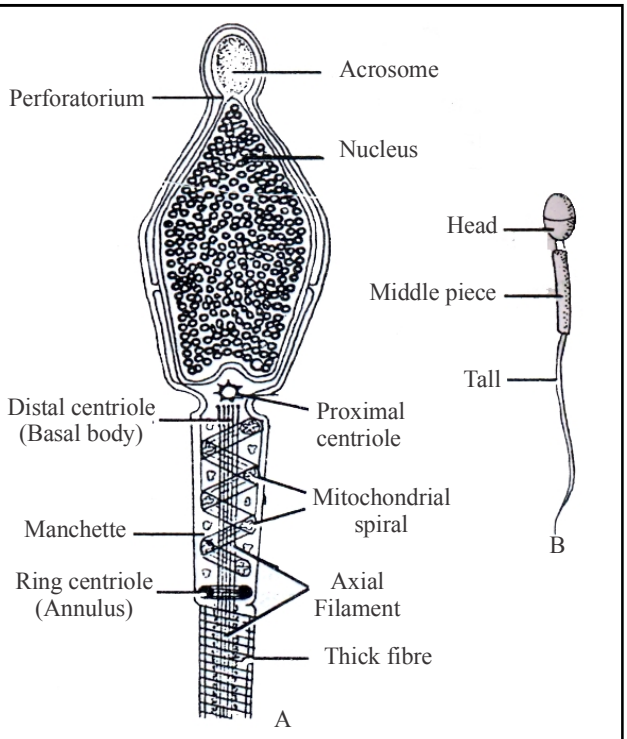


Figure : Structure of sperm

* 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 per cent sperms must have normal shape and size and for at least 40 per cent of them must show vigorous motility.

OOGENESIS

* The process of formation of a mature female gamete is called oogenesis.
* Like spermatogenesis oogenesis process also can be divided into three stages :

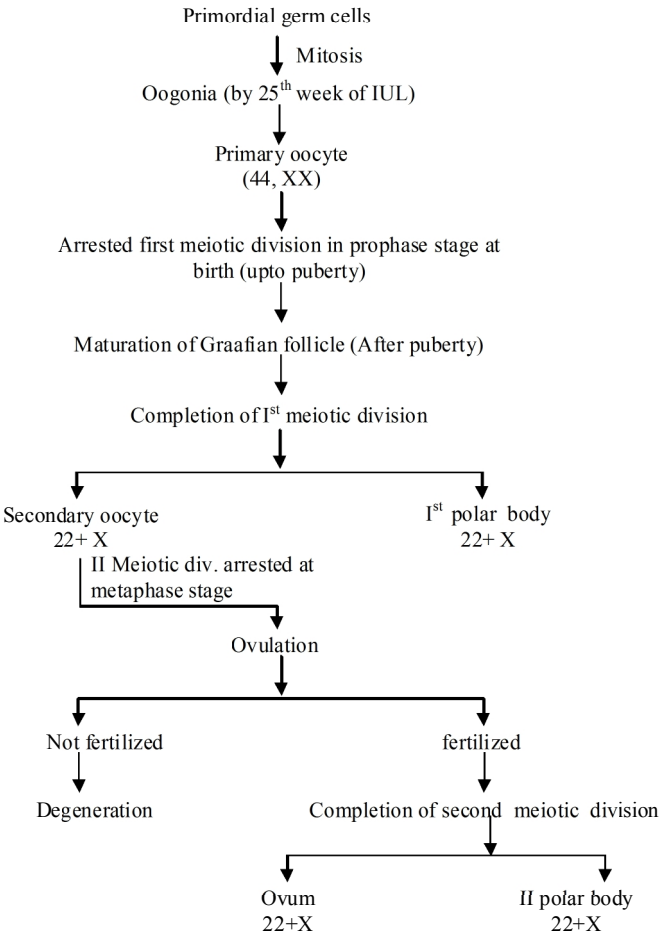
(a) Multiplication phase : In this stage primordial germ cells or ovum mother cells repeatedly divide by mitosis to form large number of diploid oogonia. This process completes in embryo stage of female in most higher animals.

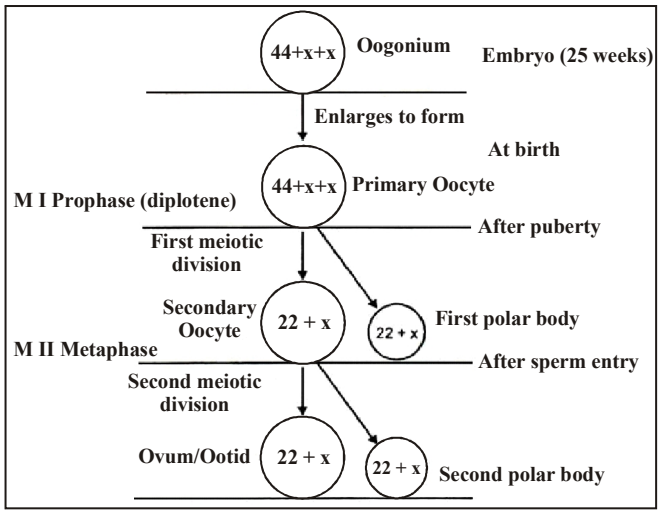
(b) Growth phase : Like spermatogenesis, in this process oogonia grow in size and form primary oocytes. The growth phase is the longest phase oogenesis (except humans). During growth phase size of egg increases many times.

(c) Maturation phase :

* Oogenesis takes place in the ovaries.
* Longest phase in human.
* In contrast to males the initial steps in egg production occur prior to birth.
* By the time the foetus is 25 weeks old, all the oogonia that she will ever produce, are already formed by mitosis.
* Hundreds of these diploid cells develop into **primary oocytes**, begin the first steps of the first meiotic division, proceed up to diakinesis, and them stop any further development.
* The oocytes grows much larger and completes the meiosis I, forming a large **secondary oocyte** and a small **polar body** that receives very little amount of cytoplasm but one full set of chromosomes.
* In humans (and most vertebrates), the first polar body does not undergo meiosis II, whereas the secondary oocyte proceeds as far as the **metaphase** stage of meiosis II. However, it then stops advancing any further, it awaits the arrival of the spermatozoa for completion of second meiotic division.

SCHEME SHOWING OOGENESIS





* Entry of the sperm restarts the cell cycle breaking down **MPF** (M-phase promoting factor and turning on the **APC** (Anaphase promoting complex).

* Completion of meiosis II converts the secondary oocyte into a fertilized egg or zygote (and also a second polar body)

* Some important differences between oogenesis and spermatogenesis are :

(i) Whereas one primary spermatocyte gives rise to four spermatozoa, one *primary oocyte* forms only one ovum.

(ii) When the primary spermatocyte divides, its cytoplasm is equally distributed between the two secondary spermatocytes formed. However, when the primary occyte divides, almost all its cytoplasm goes to the daughter cell which forms the *secondary oocyte*. The other daughter cell *(first polar body)*, receives half the chromosomes of the primary oocyte, but almost no cytoplasm.

* Liberation of sperms from Sertoli cells is called **spermiation.**

* Liberation of sperms from testes is called **semination.**

* Liberation of sperms from body of male is called **ejaculation.**

* Mammalian sperms are transferred to vagina of female by the process called **insemination.**

* The acrosome of sperm are produced by golgibodies.

* In 1 ml of semen, 20 to 120 millions of sperms are present in human being.

* 65-74 days are required to complete the cycle of spermatogenesis in human being.

STRUCTURE OF OVARY

* Outer most layer of ovary is called germinal epithelium while the inner layer called T. albuginea is made up of White fibrous connective tissue.

* The inner part of ovary is called as stroma.

* It is differentiated into 2 parts, outer peripheral part is cortex & inner part is called medulla.

* Stroma consists of follicular cells, connective tissue, blood vessels & lymphatics.
* Numerous oogonial are found in cortical region in intrauterine life.

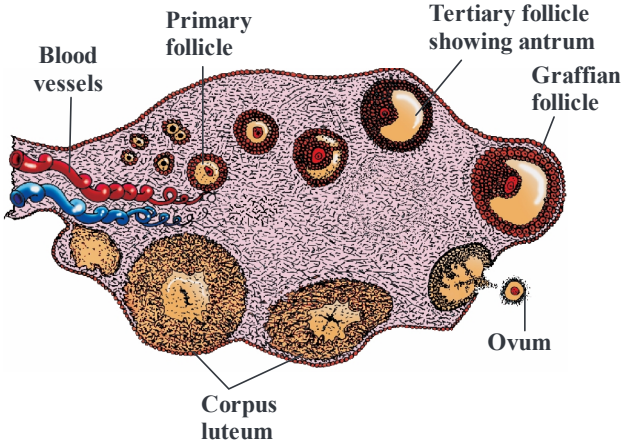


Figure : Ovary

FORMATION OF OVARIAN OR GRAAFIAN FOLLICLE

* Ova develop from oogonia present in the cortex of the ovary.
* The oogonia are surrounded by other cells that form a stroma for them. These stromal cells form the ovarian or Graafian follicle that surrounds the ovum and protects it.
* The stages of formation of **Graafian** follicle are as follows :

(1) Firstly some cells of the stroma become flattened and surround a primary oocyte (which develops from oogonia). These flattened cells ultimately form the ovarian follicle and are therefore called follicular cells.

(2) The flattened follicular cells now become columnar. Follicles upto this stage of development are called **primordial follicle.**

(3) A membrane called the zona pellucida, now appears between the follicular cells and the oocyte.

(4) After puberty the follicular cells proliferate now to form several layers of cells to form the membrana granulosa. These cells are now called **granulosa cells.**

(5) A cavity appears within the membrana granulosa. It is called the **antrum.** With the appearance of this cavity, the follicle is formed (follicle means a small sac).

(6) The cavity of the follicle rapidly increases in size and gets filled with a fluid called liquor folliculi. Due to increases in the size of the cavity the wall of the follicle (formed by granulosa cells) becomes relatively thin. The oocyte now lies eccentrically in the follicle, surrounded by some granulosa cells that are called as cumulus oophoricus. The cells that attached it to the wall of the follicle are called as discus proligerus or **Germ hill.**

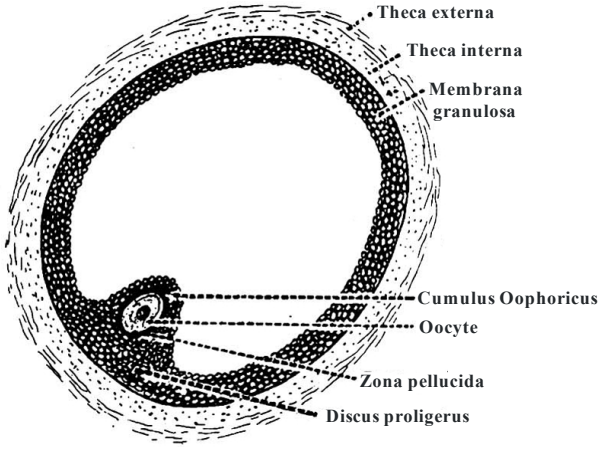


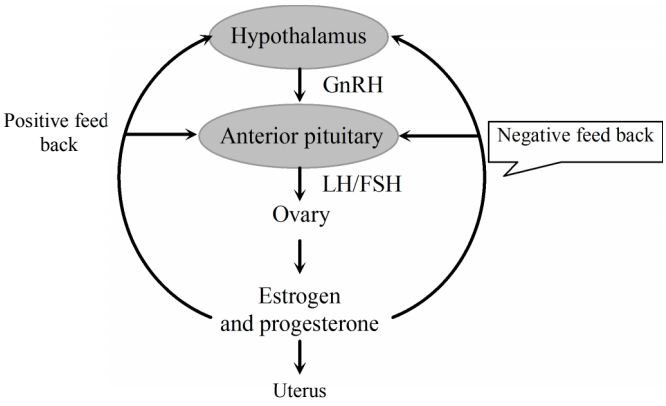
Figure : Graafian follicle

* The ovarian follicle is now fully formed and is now called the **Graafian follicle.**
* The granulosa cells lying in the close vicinity of the ovum (Secondary oocyte) become elongated to form the corona radiata.
* After 13 days of menstrual cycle (on 14^{th} day when cycle is ideally for 28 days) Graafian follicle is ruptured & egg is released.
* After ovulation the ruptured Graafian follicle is called **corpus luteum.** Soon after ovulation, the granulosa cells of Graafian follicle proliferate & these cells look yellow due to accumulation of pigment called **Lutein.** These cells are called lutein cells.
* Before ovulation the follicle was avascular but soon after ovulation blood vessels grow & corpus luteum becomes filled with blood.

* Central part filled with blood is called corpus haemorr-hagicum. Lutein cells synthesise the progesterone hormone.
* If fertilization occurs in fallopian tube, the corpus luteum then becomes stable for next nine months.
* If fertilization does not occur then the corpus luteum starts degenerating after about 9 days of it's formation.
* The degeneration is completed in 14 days to form corpus albicans, which gradually disappears.
* Progesterone hormone maintains pregnancy and repairs the wall of uterus to make its surface adhesive to help in implantation.
* Due to action of estrogens and progesterone, the endometrium of uterus is prepared for implantation.
* By the 6^{th} to 7^{th} day of fertilization, embryo is implanted into endometrium (most commonly at the **fundus)**.
* The total number of follicles in the two ovaries of a normal young adult woman is about four lakhs.
* However most of them undergo regression and disappear due to death and are disposed off by the phagocytes during the reproductive year of the females. This is termed as **follicular atresia.**
* This is responsible for limited number of gamete production in females.
* Generally, only one ovum is liberated in each menstrual cycle, by alternate ovaries.
* After copulation oxytocin hormone is secreted from pituitary gland. This hormone promotes the peristalsis in the fallopian tube & uterus.
* Due to this the semen is sucked into fallopian tube.

HORMONAL CONTROL OF FEMALE REPRODUCTIVE SYSTEM

* Ovary is regulated by pituitary gonadotropins or GnRH. Anterior pituitary secretes follicle stimulating hormone (FSH) which controls of the transformation of young primary follicle into Graffian follicle, maturation of ovum and secretion of estrogens by its follicular cells.
* The Luteinizing Hormone (LH) of anterior pituitary regulates the ovulation from the Graffian follicle, transformation of empty Graffian follicle into yellowish, conical corpus luteum and secretion of progesterone hormone from the corpus luteum.



* Growth and function of secondary sex organs are regulated by estrogens and progesterone.
* Estrogens control the growth, maintenance and functioning of secondary sex organs of female.
* Progesterone suspends ovulation during pregnancy, promotes implantation of foetus on the endometrium and development of foetus in the uterus.
* At the end of pregnancy, the corpus luteum secretes relaxin which broadens the pelvis for easy parturition.

MENSTRUAL CYCLE

* The reproductive cycle of female primates is called menstrual cycle.
* Menstrual cycle starts only after attaining sexual maturation (puberty).
* During ovulation only one ovum is released per menstrual cycle.
* The cyclical changes in the ovary and the uterus during menstrual cycle are induced by changes in the levels of pituitary and ovarian hormones.
* Cyclic menstruation is an indicator of normal reproductive phase and extends between menarche and **menopause.**
* The length of menstrual cycle varies widely in women, but on average it is completed in 28 days (mensem means a month).
* In a female, successive cycles may vary in length by 1 to 2 days.

* It is absent during pregnancy, may be suppressed during lactation and permanently stops at menopause.

Menstrual cycle has three main phase.

(i) Bleeding phase or menstruation phase.
(ii) Proliferative/Preovulatory/follicular phase or oestrogenic phase.
(iii) Secretory/Post ovulatory/luteal phase or progesteronic phase.

(i) Bleeding Phase :

* The cycle starts with bleeding phase in its first four to five days.
* During this bleeding the part of the layer of endometrium called decidua gets shed off.

(ii) Preovulatory/Proliferative phase :

* After first four or five days this phase begins.
* During this phase, Due to release of some GnRH, Pituitary secretes some FSH to stimulate the ovarian follicle.
* The ovarian follicle now begins to develop.
* Its theca interna now starts secreting an increasing amount of oestrogen.
* The rising level of oestrogen causes the endometrium to proliferate and thicken.
* It also causes increase in the vascularity and glandularity of the endometrium.
* Rising level of oestrogen also provides a positive feed back to the hypothalamus.
* Due to this, the hypothalamus releases more of GnRH.
* This GnRH induces the pituitary to release more of FSH. The rising FSH levels now cause:
  (a) Further growth and development ovarian follicle to form Graafian follicle
  (b) Further release of oestrogen from the theca interna of this developing follicle.
* As the oestrogen level goes on rising, by the end of 10^{th} day the extreme levels of oestrogen (which have by then caused maturation of Graafian follicle and growth of endometrium) now give a negative feed back to the pituitary causing a fall in FSH secretion but also causing a rise in LH secretion.
* Now the LH secretion from the pituitary goes on rising. This abrupt rise (on 11^{th} to 13^{th} day) in LH concentration in blood is called as LH surge. This LH now causes the Graafian follicle to rupture after partial completion of II meiotic division in oocyte and thus the secondary oocyte is released. The release of egg (secondary oocyte) which occurs 14 day is called as **ovulation.**

(iii) Post ovulatory/secretory phase :

* After ovulation the ruptured Graafian follicle transforms into corpus luteum.
* The granulosa and theca cells of the ruptured Graafian follicle (which is now called as corpus luteum) is found only in mammals and contain a yellow lutein or carotene pigment.
* In case of absence of pregnancy this corpus luteum will get degenerated after 14 days of its formation.
* The degenerated corpus luteum is called **corpus albicans** (white body).

Function of corpus luteum

* Stimulated by the rising levels of LH, the corpus luteum secretes progesterone hormone.
* The progesterone facilitates the preparation of endometrium for receiving the embryo and its implantation.
* Progesterone inhibits the contractions of uterus so that the pregnancy could be maintained.
* Progesterone also inhibits development of next new ovarian follicle.
* If pregnancy occurs then the corpus luteum persists and secretes progesterone.
* Progesterone is important to maintain the pregnancy and it is thus called as the **pregnancy homone.**
* By the fourth month of pregnancy, the placenta has developed completely. This placenta now takes over the job of further progesterone secretion.
* Ovary also secretes some amount of relaxin at the time of parturition.
* If pregnancy does not occur after ovulation, then as the progesterone level rise, its rising levels

inhibits the release of GnRH from hypothalamus.

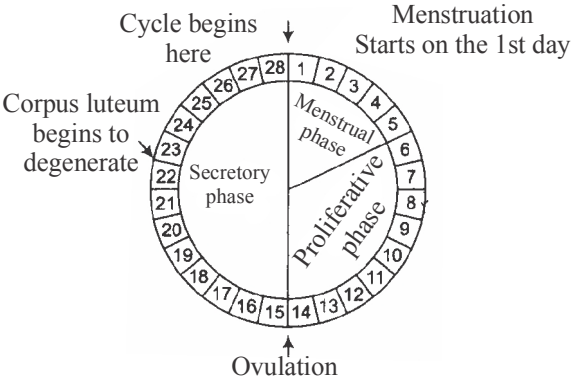
* Due to this FSH, LH secretion by pituitary falls and thereby progesterone secretion by the corpus luteum (which was due to influence of LH) also now falls.
* As the progesterone level drops, the corpus luteum begins to degenerate and transform in corpus albicans (which can not secrete progesterone).

Due to the lack of progesterone : -

(a) The overgrown endometrium now begin to break and separate from the inner uterine wall causing bleeding.

(b) The uterine contraction (which was till now inhibited due to presence of progesterone) now start. Thus the separated endometrium along with blood is now being passed out via vaginal route. This is again the beginning of next menstrual or bleeding phase.

* Total loss of blood per day is about 20 ml, so an average 40 to 80 ml blood/cycle is lost. This blood can not clot.
* The period between ovulation and next menstrual bleeding (post ovulatory period) is always constant (i.e. is 14 days). However the ovulation date may vary (causing a change in pre ovulatory period).
* After ovulation the ovum is viable only for two days, while sperms introduced into the vagina can survive for a maximum of four days.



Schematic representation of menstrual cycle

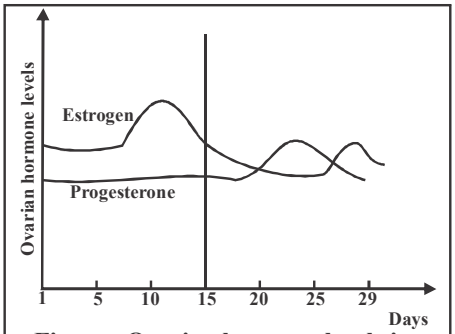


Figure : Ovarian hormone levels in Menstrual cycle

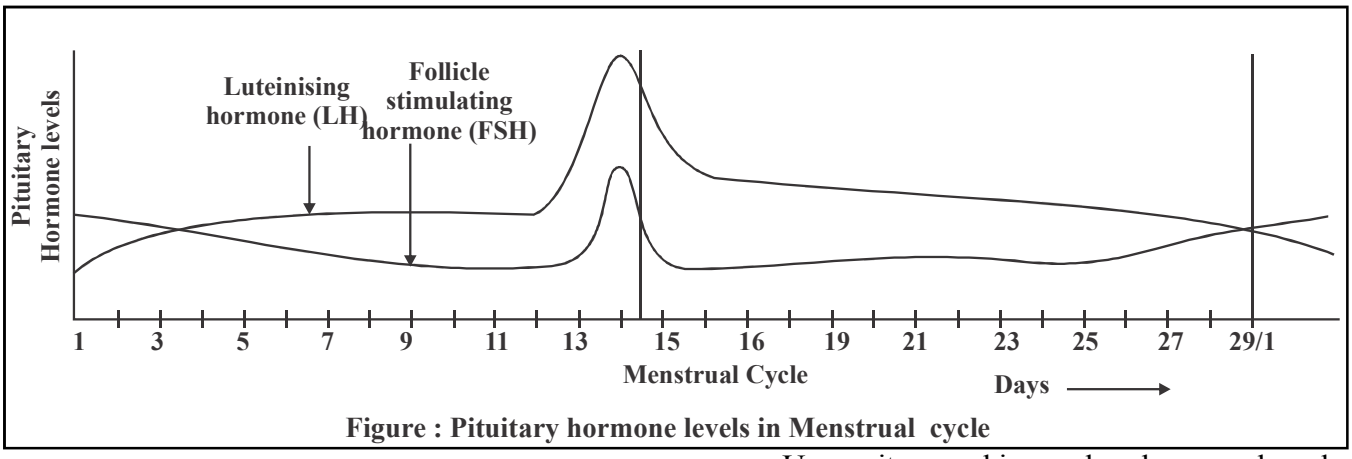


Figure : Pituitary hormone levels in Menstrual cycle

* On basis of the above data, safe period method for family planning is calculated. Normally it is considered to be day 1 to day 8 and then from day 20 to day 28.
* **Menstrual Hygiene** - Maintenance of hygiene and sanitation during menstruation is very important. Take bath and clean yourself regulary. Use sanitary napkins or clean homemade pads. Change sanitary napkins or homemade pads after every 4-5 hrs as per the requirement. Dispose of the used sanitary napkins properly wrapping it with a used paper.Do not throw the used napkins in the drainpipe of toilets or in the open area. After handling the napkin wash hands with soap.

* In human female ovulation occurs in presence of FSH & LH. Coitus is not necessary for inducing ovulation. Such a female is called as **spontaneous ovulator**.
* In human beings, menstrual cycles ceases around 50 years of age; that is termed as **menopause**. Cyclic menstruation is an indicator of normal reproductive phase and extends between menarche and menopause.
* Although most of the follicular cells and the oocytes undergo degeneration during follicular atresia, some thecal cells, formed from the stroma and located around the follicle, persist and become active. These are called **interstitial cells**. These cells secrete small amount of androgen.
* No specific breeding season is found in human being.
* In entherian mammals (other then primates) reproductive cycle is estrus cycle which occurs during specific breeding season.
* **Amenorrhoea -** Absence of menstruation cycle.
* **Precocious puberty:** Menstruation occurs before the age of 8 years.
* Pregnancy is detected with the help of HCG in urine of pregnant lady.
* **Dysmenorrhoea:** Painful menstruation is called Dysmenorrhoea.
* **Menorrhagia:** A normal menstrual blood loss is 50-80 ml, and does not exceed 100 ml. In menorrhagia the menstrual cycle is unaltered but the duration and quantity of the menstrual blood loss are increased.
* **Polymenorrhoea :** In polymenorrhoea or epimenorrhoea, the menstrual cycle is reduced from the normal of twenty-eight days to a cycle of two to three weeks and remains constant at that increased frequency.

TYPES OF EGGS

(A) On the basis of amount of yolk

(i) Alecithal - In this type of egg, yolk is negligible. Ex. Human egg.

(ii) Microlecithal or Oligolecithal eggs –

* The amount of yolk is very small or absent in these types of eggs.
* **Examples :-** Egg of Amphioxus, Eutheria, Metatheria and sea – urchin.

(ii) Mesolecithal Eggs :

* In this type of egg, the amount of yolk is moderate i.e medium ,neither more nor less.
* **Example : -** Eggs of Amphibia, Petromyzon and lung-fishes.

(iii) Polylecithal or Macrolecithal or Megalecithal eggs :

* Eggs are with large amount of yolk. e.g. Bird's egg , Insect's egg.

(B) On the basis of distribution of yolk :

(i) Isolecithal or homolecithal eggs :

* The yolk is evenly or homogenously distributed in these eggs.
* eg. : micro, oligo or alecithal eggs.

(ii) Telolecithal eggs :

* The yolk is concentrated in one part of the egg.
* eg. Mesolecithal eggs of amphibia. (Moderately telolecithal)
* **Discoidal eggs :** A type of telolecithal and megalecithal eggs. Where the yolk is in enormous quantity and concentrated in one part of the egg. Thus only a disc of cytoplasm called germinal disc remains in the egg which is located at the other pole of egg. (Heavily telolecithal)
eg. : Eggs of reptiles, birds and prototherian mammals.

(iii) Centrolecithal eggs :

* Megalecithal eggs where the enormous amount of yolk is located in the centre an cytoplasm is in the form of superficial layer around the yolk.
eg. : Insects egg.

(C) Classification of Eggs on the basis of Shell :
On the basis of shell, eggs are of 2 types :

(i) Cleidoic eggs :

* Eggs surrounded by a hard shell are known as cleidoic eggs.

* These eggs are found in those animal which have a terrestrial mode of life or which lay eggs on land.
* These eggs have more amount of yolk.
* These are adaptations to terrestrial mode of life.
* Shell prevents the egg from dessication.
* e.g. : - eggs of ''Reptiles'', ''Birds'', ''Insects'' and ''Prototherians''.

(ii) Non-Cleidoic eggs :

* Eggs which are not surrounded by a hard shell are called non-cleidoic eggs. eg. : All viviparous animals (Mammals) and all oviparous animals which lay eggs in water (Amphibians). Reptilia eggs are called leathery eggs.

Structure of an oocyte

* The nucleus of egg is also called germinal vesicle.
* Oocyte is surrounded by membranes termed as the egg-membranes.
* Oocyte/Ovum along with the egg-membrane are termed as the egg.
* Egg = Ovum/Oocyte + Egg membrane.
* Majority eggs are oval but the eggs of insects are long and cylindrical. Smallest eggs are of 50m in polychaeta and the largest eggs are of an Ostrich.

Classification of egg - membranes

On the basis of origin, egg-membranes are of 3 types :

(i) Primary egg membrane : This membrane is secreted by the oocyte itself.eg. Vitelline membrane, Zona Pellucida (mammals)

(ii) Secondary egg membrane : This is found outside the primary egg membrane and is secreted by the ovary.(corona radiata,chorion)

(iii) Tertiary egg membrane : This is present outside the primary egg membrane. It is either secreted by the uterus or oviduct.(eg. jelly coat,shell and shell membrane)

Functions of Egg-membranes

(i) To provide protection.
(ii) To check polyspermy.
(iii) To provide buoyancy to the amphibian eggs.

EGG OF MAMMALS

* Mammalian eggs have very less amount of yolk, so the eggs are oligolecithal and isolecithal or microlecithal and homolecithal.
* The egg has 2 egg-membranes :

(i) Zona Pellucida : This is a transparent membrane like covering and is a primary membrane secreted by the ovum/oocyte itself.

(ii) Corona radiata : This is a layer of follicular cells and these cells are attached to the surface of egg through ''hyaluronic acid'' This is a secondary membrane, which is secreted by the ovary. These eggs don't have tertiary membrane.

Mammalian eggs are approx 0.1 mm in size.

FERTILIZATION

* The process in which union of male and female gametes (formed by gametogenesis) and fusion of pronuclei of sperm and ovum takes place thus diploid zygote is formed, is called **fertilization.**

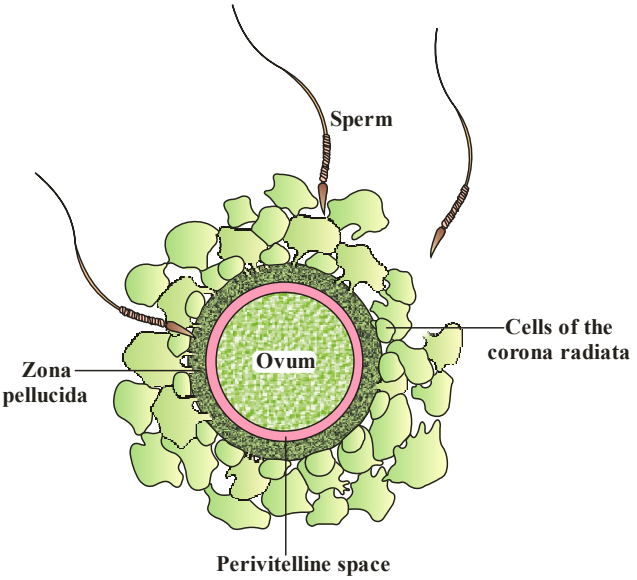


Figure : Ovum surrounded by few sperms

Fertilization has following processes :

* The union of male and female gametes is called **Syngamy**. Where as intermixing of their cytoplasm is called **plasmogamy**.
* The fusion of pronuclei of sperm and ovum is called **karyogamy.**
* The intermingling of their chromosomes is called **amphimixis.**
* Due to fertilization , a diploid zygote is formed, by the union of two different types of gametes.

Mechanism of fertilization

1. Movement of sperms towards the secondary oocyte.
↓
2. Penetration of corona radiata by the hyaluronidase enzyme.
↓
3. Adherence of sperm to the **ZP_3 receptors** on zona pellucida, the glycoprotein layer surrounding the oocyte.
↓
4. Sperm bind to a sperm receptor on the zona and this leads to initiation of acrosomal reaction. Various enzymes are released. eg. **Acrosin (Zona lysin).**
↓
5. **Acrosin** facilitate the penetration of sperm through zona pellucida.
↓
6. Fusion of sperm and membrane of secondary oocyte. (Syngamy)
↓
7. Phagocytosis of sperm by the secondary oocyte.
↓
8. Completion of meiosis-Il of secondary oocyte during phagocytosis to fonn ovum and simultaneously it releases 2nd polar body.
↓
9. Structural changes in zona pellucida through **cortical reaction** and discharge of cortical granules in perivitelline space forms **fertilization membrane**.
↓
10. In the event of fertilization complete sperm enters inside the ovum. (By phagocytosis)
↓
11. It is followed by plasmogamy, karyogamy and amphimixis i.e. completion of fertilization.

Fate of sperm in egg

* In mammals, whole sperm enters in the egg.
* All the structure of sperm dissolve in egg cytoplasm except sperm nucleus and proximal centriole.
* The centriole of egg itself degenerates at the time of second maturation division. So proximal centriole of sperm starts division, it divides into 2 daughter centrioles, which migrate towards opposite pole and start forming spindles.

Fate of sperm nucleus

* The nucleus of sperm absorbs water from egg cytoplasm and becomes enlarged. Now it is called **male pronucleus.**
* Male pronucleus and female pronucleus migrate through definite routes and come close to each other. These routes are called fertilization path.

Significance of Fertilization

* Oocyte completes its second maturation division on coming in contact with the sperm.
* Amphimixis process leads to the formation of diploid zygote to restore the normal diploid number of the chromosomes.
* The centriole of sperm after entering into egg induces the egg to undergo cleavage.
* The paternal and maternal characters are transmitted to the off springs through the process of fertilization.
* The peripheral changes occurring in the egg prevent the further entry of sperm into the ovum, thus checking polyspermy.

CLEAVAGE

* The term 'Cleavage' was given by **''Von Baer".**
* In fertilized egg or activated egg, the egg undergoes repeated cell divisions which occur rapidly producing a multicellular structure without changing its size.
* All these mitotic cells divisions collectively called cleavage or segmentation.
* Due to the process of cleavage, a single celled zygote, through a successive mitotic cell divisions changes into a complex multicellular structure.
* Cells produced as a result of cleavage are termed as **blastomeres.**
* The total size of the embryo remains the same.
* Though the number of blastomeres as a result of mitotic cell divisions increases, the size of blastomeres gradually decreases are compared to parent cell.

* Interphase stage is very short in cleavage. In interphase only DNA duplication and histone protein synthesis takes place up to some extent.
* In the interphase of cleavage only 'S' phase is present, G_1 & G_2 phases are absent. Protein synthesis and RNA synthesis do not occur during this interphase.
* Nucleolus is absent in the nucleus of blastomeres. Size of blastomeres decreases during cleavage.
* When size of blastomere becomes equal to that of size of somatic ells, the divisions of cleavage are stopped.
* Only normal cell division take place.
* Cleavage can be observed till onset of gastrula stage.
* After gastrulation, cleavage is completely checked.
* Nucleous appears first in gastrula stage.
* The consumption of oxygen is increased during cleavage.

Classification of Cleavage

1. On the basis of fate of blastomeres :

(i) Determinate Cleavage : The fate of blastomeres is fixed, determined i.e. each blastomere forms a particular portion of embryo. e.g., Nematoda, Annelida, Mollusca .

(ii) Indeterminate Cleavage : The fate of blastomeres is not definite.These are totipotent in early stage of embryo.e.g. Human.

2. On the basis of amount of Yolk :

* A scientist named **Balfour** gave a law. According to him, rate of cleavage is inversely proportional to amount of yolk present in the egg.
* The yolk present in egg, disturbs the rate of cleavage.
* The rate of cleavage is slow in that part of egg, in which amount of yolk is more, and the rate of cleavage is faster in the portion of egg in which yolk is in lesser amount.

Mostly cleavage is of 2 types : -

(i) Complete or holoblastic : When cleavage furrow passes through the egg completely. As a result of this the whole egg divides. It is of 2 types

(a) Equal holoblastic cleavage
Blastomeres are of same size.
Example : Mammals(eutherian,metatherian).

(b) Unequal holoblastic cleavage - Blastomeres unequal size.
Examples : mesolecithal , human.

(ii) Meroblastic cleavage :

* Cleavage does not occur in that part of egg, where yolk is present cleavage occurs only Cytoplasmic part.
* Meroblastic cleavage is of 2 types on the basis of distribution of yolk in egg.

(a) Discoidal meroblastic cleavage - Cleavage occurs only in blastodisc of egg.
Examples : - Reptilian eggs and birds eggs.

(b) Superficial meroblastic cleavage – In insect egg, central cytoplasm shows free central division, due to which so many nuclei are formed. All these nuclei migrates towards peripheral cytoplasm. Example - In centrolecithal eggs.

Significance of Cleavage

* There is no change in shape and size developing embryo till blastula stage comes. Till then it remains just like undivided egg in shape.
* As a result of cleavage, unicellular zygote changes into multicelluar structure.

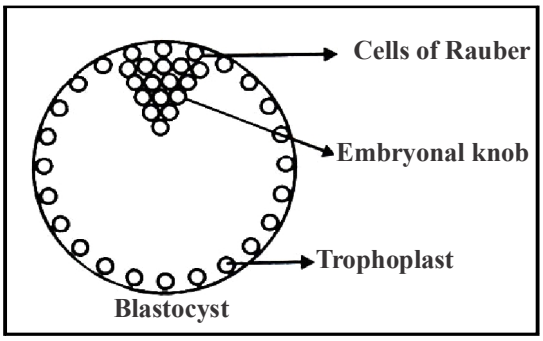
GENERAL STAGES OF EMBRYONIC DEVELOPMENT

1. Morula :

* As a result of segmentation or cleavage activities, unicellular zygote changes into a solid ball like multicellular structure.
* In the later stage of cleavage, clusters of sticky, cohering, protruding (otuside) blastomeres are produced, which look like mulberry. This stage is termed as morula stage.
* The mitotic division starts as the zygote moves through the isthmus of the oviduct called cleavage towards the uterus and forms 2, 4, 8, 16 daughter cells called blastomeres. The embryo with 8 to 16 blastomeres is called a morula.

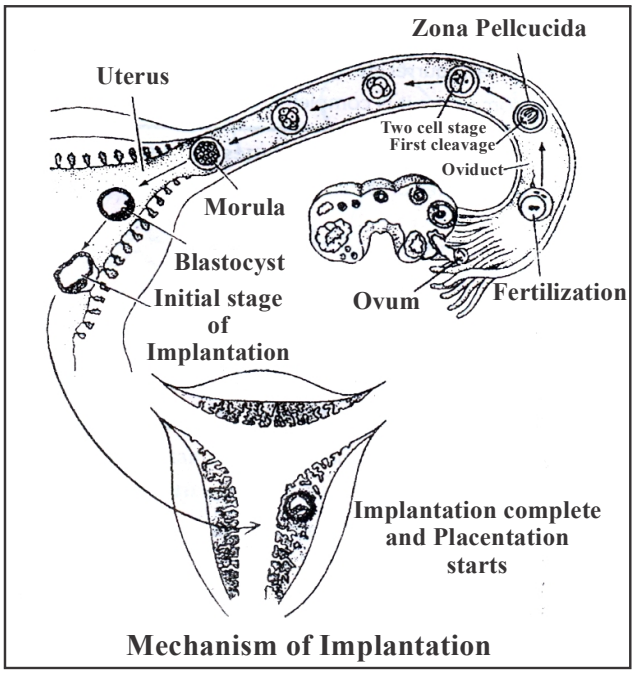
2. Blastulation -

* **Blastocyst -** Blastula or Eutherian & Metahterian mammals is called blastocyst, because blastula is in the form of a cyst.
* In blastocyst all the embryonal cells occur in the form of solid mass called embryonal knob.
* Embryonal knob (inner cell mass) is covered by protective layer called trophoblast and it's cell just above the embryonal knob are trophoblast called cells of Rauber (amniogenic cells).
* There occurs a cavity in between embryonal knob and trophoblast called albumin cavity. It is filled with nutritive fluid absorbed from the wall of uterus. So albumin cavity is also nutritive-cavity.
* The trophoblast layer gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.



IMPLANTATION

* The attachment of developing embryo to the appropriate body layer or surface to obtain nutrition is called implantation.
* Initially the oocyte after its release from ovary, comes into fallopian tube where the process of fertilization is completed, Just after fertilization, embryonic development starts and a blastocyst is formed after cleavage and morulation.
* In human being, the blastocyst gets attached with the uterine endomdetrium in about four days after entering in uterus.
* At the same time, the cells of endometrium of implantation area separate out and adhere with embryonic cells with the help of certain enzymes secreted by the cells of trophoblast.
* In human, the site of implantation is generally mid-dorsal or mid-ventral part of uterus. Implantation of blastocyst takes about 7-8 days after fertilization in human and by 12th day it is completely buried in the wall of the uterus.



Mechanism of Implantation

* The place of entry through which the embryo enters into the wall, is completely closed by a fibrous and cellular plug, known as **closing coagulum.**

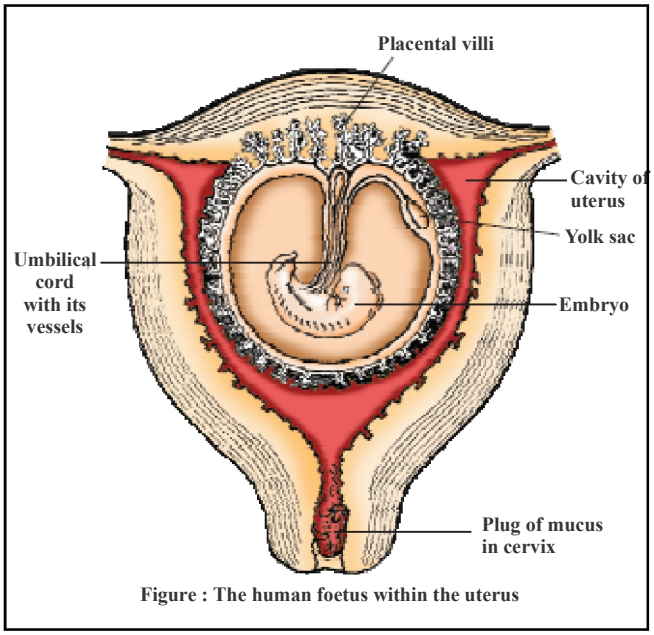


Figure : The human foetus within the uterus

Function of the zona pellucida

* It prevents implantation of the blastocyst at an abnormal site.

* The trophoblast has the property of being able to stick to the uterine (or other) epithelium and its cells have the capacity to eat up other cells.
* **Interstitial implantation –** The blastocyst is buries deeply inside the wall of uterus and covered by endometrial tissues lying under epithelium. This type of implantation occurs in human being.
* After implantation endometrium is known as decidua.

GASTRULATION

* **Gastrula:** In gastrula stage rate of cleavage division is slow and ultimately stops at the end of gastrula.
* Gastrula stage is the most important stage in embryonic development because two main events take place during gastrula stage.

(a) Differentiation of blastomere:

* As a result of differentiation of blastomere; three germinal layers i.e. ectoderm, mesoderm and endoderm are formed.
* Formation of three germinal layers is the significance of gastrula stage.
* All the preparation of differentiation of blastomere are completed in late blastula stage.

(b) Morphogenetic Movements:

* During gastrula stage blastomere perform amoeboid movement and reach to their definite place in embryo because after the gastrulation organogenesis has to start in embryo.
* Morphogenetic movement requires enormous energy. So respiratory activity of egg increases.

Method of Gastrulation

(a) Epiboly: Movement of ectoderm forming blastomere

(b) Emboly : Movement of mesoderm and endoderm forming blastomere.
In some animals new cavity is formed in gastrula this is called gastrocoal or archanterem cavity)

* Immediately after implantation, the inner cell mass (embryo) differentiates into an outer layer called **ectoderm** and an inner layer called **endoderm**.
* A **mesoderm** soon appears between the ectoderm and the endoderm.
* These three layers give rise to all tissues (organs) in adults.
* The inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs.

Summary of developmental stages in human

* After one month of pregnancy, the embryo's heart is formed.
* 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 system are formed.
* 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 eye lashes are formed.
* By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.

EXTRA EMBRYONIC MEMBRANES AND PLACENTA

Extra embryonic membranes

* The cellular layer formed of blastomeres remains as blastoderm.
* The central part of blastoderm gives rise to embryo proper, while the peripheral portion does not take past in the formation of embryo. This peripheral part is known as extra embryonic region.
* This region takes part in the formation of certain membranes called extra embryonic membranes.
* These extra embryonic membranes provide facilities for nutrition, respiration and excretion to the embryo.
* Extra embryonic membranes are of four types –
  1. Amnion 2. Chorian
  3. Yolk sac 4. Allantois
* On the basis of presence of absence of amnion, two groups of vertebrates are categorised.

(a) Amniota - This group is characterized with the presence of amnion in the embryos of its members. For example members of class Reptilia, Aves and Mammalia.

(b) Anamniota - Animals of this group are devoid of amnion in their embryos. For example class cyclostomata, pisces and amphibia.

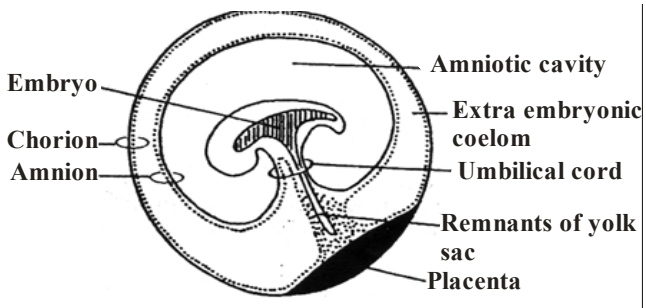


Figure : Formation of extra embryonic membranes in human.

1. Amnion -

* With a gradual increase in size the amnion covers the embryo from all sides.
* After about eight weeks of fertilization, amnion is completely incorporated into connecting stalk, which finally forms the umbilical cord.
* Embryo, in this stage, is called as foetus remains hanging in amniotic fluid.

2. Chorion -

* After implantation of blastocyst, the trophoblast gives out several finger like processes, the chorionic villi which get embedded into uterine endometrium.
* Mesoderm also contributes in the formation of these villi.
* After a period of four these villi disappear from all parts except the connecting stalk where they grow rapidly and participate in the formation of placenta.

3. Yolk sac -

* Initially the size of yolk sac is larger as compared to that of the embryo.
* About eight weeks after fertilization, the yolk is reduced in size and changes into a tubular structure.

4. Allantois -

* The mesoderm of allantois forms many small blood vessels in this region.
* These vessels connect the embryo with placenta and ensure nutritional and respiratory supply to embryo.
* In human, allantois does not function to store the excretory wastes as it does in reptiles , birds and protothians.

PLACENTA

* The eggs of viviparous animals are unable to develop into their embryos outside the uterus independently.
* This is because of the very little or negligible amount of yolk present in these eggs, which can not fulfill the nutritional and other physiological demands of a developing embryo.
* Here the embryo depends upon maternal tissues for shelter, nutrition, respiration etc.
* These animals therefore, have developed adaptation, respiratory and other physiological requirements from mother's body.
* Placenta is found in all viviparous (exept sub-class-prototheria; oviparous) animals.
* Placenta is temporary endocrine structure which partially derive from maternal and embryonic tissue.

Structure of Placenta

* Placenta is not a simple membrane. It is made up of the tissues from two different sources –
* **Maternal tissue -** These include uterine epithelium, connective tissues and blood capillaries.
* **Embryonic tissue -** These include extra embryonic membranes (mainly chorion).

Chorio-allantoic placenta in mammals

1. In this type of placenta, allantoic mesodern and the mesoderm of umbilical cord jointly form the blood vessels of umbilical cord. The endodermal part of the allantois remains as a very small cavity.

2. To obtain nutrition from maternal blood several finger like processes or villi are formed by chorion which penetrate deeply into the crypts of uterus.

Initially the villi are scattered over the whole surface of chorion but later they become restricted in the deciduas besalis region. The chorionic villi on the remaining surface disappear shortly. The part of chorion, which helps in placenta formation is known as **chorionic frondosum.**

Classification of Placenta

On the basis of different characters, the placenta are classified in following manner –

1. On the basis intimacy

Deciduate placenta -

* This type of placenta is found in human, dog, hare etc.
* It is characterized with a very close association between chorionic villi and uterine wall.
* At the time of birth, the mucosal covering of the uterus is also damaged and discarded outside.
* This results in an extensive bleeding at child birth.
* This placenta is known as a true placenta.

2. On the basis of implantation

Interstitial –

* This type of placenta is found in man, guinea pig, apes etc.
* The chorionic sac (placenta) penetrates deep inside the wall of uterus. Hence, the association between embryo and maternal part becomes very close.

3. On the basis of distribution of villi

Discoidal placenta -

* In this type of placenta, whole of the chorionic surface is covered by villi in initial stage, but the villi disappear later from later from most area except the region of implantation, that is only a disc like region is left with villi.
* Discoidal placenta is also of two types –

(a) **Mono discoidal placenta -** The villi are present only on dorsal surface in single circular disc like area. For example – human, hare etc.

(b) **Bi discoidal placenta -** If the villi are distributed in two disc like areas, the placenta is called as bidiscoidal, eg. Monkeys.

4. On the basis of histology

Haemochorial – Example: man, monkey, bat etc.

Hormones of Human Placenta

* The placenta of human mainly secretes two steroid hormones like **estradiol** and **progesterone,** and two protein hormones like **human chorional gonadotropin** HCG and **human placental somatomammotropin HCS.**
* **L**arge amount of HCG, hormone is secreted, during early pregnancy, from the placenta.
* Because of this reason its quantity increases in the urine of pregnant lady.
* On the basis of this fact, pregnancy test is performed.
* The above hormones are also held responsible for keeping the corpus luteum active, protection of embryo, prevention of abortion and growth of mammary glands.

Functions of placenta

* Exchange of important materials between foetal and maternal blood.
* The essential materials are exchanged by diffusion, pinocytosis or active transport.
* The small molecules like O_2, CO_2, H_2O etc. and other inorganic substances like chlorides, phosphates, sodium, potassium, magnesium etc. are also diffused through placenta.
* Large molecules like lipids, polysaccharides, carbohydrates proteins etc. are obtained by pinocytosis process.
* The nutritional substances are supplied to embryo from the mother through placenta.
* Placenta also serves as a respiratory medium for exchange of O_2 and CO_2 between embryo and mother.
* The nitrogenous and metabolic wastes from foetus are released into the blood of mother by diffusion through placenta.
* The antibodies for measles, chickenpox, polio etc. present in the blood of mother reach the embryo through placenta.
* If a female takes some harmful chemicals, liquor, drugs etc. during pregnancy, these may cross the

placenta and on reaching into foetus may cause deformity during organogenesis. (eg. Thallidomide).

* Placenta itself secretes some hormones like progesterone, estrogen, lactogen, HCG, HCS etc.
* Progesterone, maintains and supports the foetus during the whole pregnancy period. At the time of parturition, relaxin is secreted by placenta which lubricates and widens the birth canal to facilitate child birth.

PARTURITION AND LACTATION

* The average duration of human pregnancy is about 9 months 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 progesterone secretion stops, so the placenta dissolves and the foetus is separated from the walls of the uterus.
* The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex.
* Pituitary gland secretes **Oxytocin** in more amount. This hormone induces intense contractions in the uterus.
* Due to these contractions, the foetus starts moving towards the vagina, The labour pain during child-birth, is due to this hormone.
* **Oxytocin is the main parturition hormone.**
* After parturition, Oxytocin stimulates milk-let down by **milk ejection reflex.**
* **Relaxin** hormone is secreted by the placenta and the ovary. This hormone relaxes the pubic-symphysis i.e. the joint between the pelvic-girdles. So more space is available to the foetus to move out.
* Mammary glands differentiate during pregnancy and secrete milk after child-birth. The new-born baby is fed milk by the mother **(lactation)** during the initial few months of growth.
* The milk produced during the initial few days of lactation is called **colostrum** which contains several antibodies absolutely essential to develop resistance for the new-born babies.

* After gastrulation, cleavage is completely checked. Nucleous appears first in gastrula stage.
* The consumption of oxygen is increased during cleavage.
* Embryo consumes maximum O_2 during gastrula stage.
* The part of decidua where placenta is formed is known as decidua basalis.
* During pregnancy the levels of other hormones like estrogens, progestogens, cortisol, prolactin, thyroxine, etc., are increased severalfolds in the maternal blood.
* Maximum growth in human embryo occurs in fourth month of pregnancy and minimum in last months.

CONCEPT REVIEW

* The human male reproductive system includes the testes, which produce sperm and testosterone; a series of conducting ducts; accessory glands; and the penis.
* The **testes**, housed in the **scrotum**, contain the **seminiferous tubules**, where **spermatogenesis** (sperm production) takes place. The **interstitial cells** in the testes secrete testosterone. **Sertoli cells** produce signaling molecules and a fluid that nourishes sperm cells.
* Sperm complete their maturation and are stored in the **epididymis** and **vas deferens**. During ejaculation, sperm pass from the vas deferens to the **ejaculatory duct** and then into the **urethra**, which passes through the penis.
* Each ejaculate of semen contains about 200 million sperm suspended in the secretions of the **seminal vesicles** and **prostate gland**.

The bulbourethral glands release a mucous secretion.

* The penis consists of three columns of **erectile tissue**, two **cavernous bodies** and one **spongy body** that surrounds the urethra. When its erectile tissue becomes engorged with blood, the penis becomes erect.
* Spermatogenesis takes place in the seminiferous tubules of the testes. **Spermatogonia** divide by mitosis; some differentiate and become **primary spermatocytes**, which undergo meiosis. The first meiotic division produces two **secondary spermatocytes**. In the second meiotic division, each secondary spermatocyte yields two **spermatids**. Each spermatid differentiates to form a mature sperm. The head of a sperm consists of the nucleus and a cap, or **acrosome**, containing enzymes that help the sperm penetrate the egg.
* Sperm pass in sequence through the seminiferous tubules of the testis → epididymis → vas deferens → ejaculatory duct → urethra.
* Testosterone establishes and maintains male **primary sex characteristics** and **secondary sex characteristics.**
* Endocrine regulation of male reproduction involves the hypothalamus, pituitary gland, and testes. The hypothalamus secretes **gonadotropin-releasing hormone (GnRH)**, which stimulates the anterior pituitary gland to secrete the gonadotropic hormones: **follicle-stimulating hormone (FSH)** and **luteinizing hormone (LH).**
* FSH, LH, and testosterone directly or indirectly stimulate sperm production. LH stimulates the interstitial cells of the testes to produce testosterone. FSH stimulates the Sertoli cells to produce (1) **androgen-binding protein (ABP)**, which binds to testosterone and concentrates it; and (2) **inhibin**, a hormone that inhibits FSH secretion.
* The **ovaries** produce gametes and the steroid hormones **estrogen** and **progesterone**. Fertilization takes place in the oviducts.
* The **uterus** serves as an incubator for the developing embryo. The epithelial lining of the uterus, the **endometrium**, thickens each month in preparation for possible pregnancy. The lower part of the uterus, the **cervix**, extends into the vagina.
* The **vagina** receives the penis during sexual intercourse and is the lower part of the birth canal. The **vulva** include the **labia majora, labia minora, vestibule** of the vagina, **clitoris**, and **mons pubis.**
* The breasts function in lactation, production of milk for the young. Each breast consists of 15 to 20 lobes of glandular tissue. Gland cells are arranged in **alveoli**. The hormone **prolactin** stimulates milk production; **oxytocin** stimulates ejection of milk from the alveoli into the ducts from which it can be sucked.
* As the follicle grows, connective tissue cells surrounding the granulosa cells form a layer of **theca cells**. As the follicle matures, the primary oocyte undergoes the first meiotic division, giving rise to a **secondary oocyte** and a **polar body**.
* During **ovulation**, the secondary oocyte is ejected from the ovary and enters one of the paired **oviducts (uterine tubes)**, where it may be fertilized. The part of the follicle remaining in the ovary develops into a **corpus luteum**, a temporary endocrine gland.
* Endocrine regulation of female reproduction involves the hypothalamus, pituitary gland, and ovaries. The first day of the **menstrual cycle** is marked by the beginning of menstrual bleeding. Ovulation occurs at about day 14 in a typical 28-day menstrual cycle.
* During the **preovulatory phase, gonadotropin-releasing hormone (GnRH)** from the hypothalamus stimulates the anterior lobe of the pituitary to secrete follicle-stimulating hormone (FSH) and luteinizing hormone (LH). FSH stimulates follicle development and stimulates the granulosa cells to produce estrogen. LH stimulates theca cells to multiply and produce androgens, which are converted to estrogen. Estrogen is responsible for primary and secondary female sex characteristics.
* Estrogen stimulates development of the endometrium. After the first week only one follicle continues to develop. Although at relatively low concentration, estrogen inhibits FSH and LH

secretion. Granulosa cells produce inhibin, which also inhibits FSH secretion.

* During the late preovulatory phase, estrogen concentration peaks and signals the anterior pituitary to secrete LH. LH stimulates final maturation of the follicle and stimulates ovulation.
* During the **postovulatory phase**, LH promotes development of the corpus luteum. The corpus luteum secretes progesterone and estrogen, which stimulate final preparation of the uterus for pregnancy. During the postovulatory phase, progesterone, along with estrogen, inhibits secretion of GnRH, FSH, and LH.
* If fertilization does not occur, the corpus luteum degenerates, concentrations of estrogen and progesterone in the blood fall, and menstruation occurs.
* Vasocongestion and increased muscle tension are physiological responses to sexual stimulation. The phases of sexual response include **sexual excitement, plateau, orgasm**, and **resolution**.
* Human **fertilization** is the fusion of secondary oocyte and sperm to form a zygote. Fertilization and establishment of pregnancy together are called **conception**.
* If the secondary oocyte is fertilized, development begins and the embryo implants in the uterus. Membranes that develop around the embryo secrete **human chorionic gonadotropin (hCG)**, a hormone that maintains the corpus luteum. During the first two to three months of pregnancy, the corpus luteum secretes the large amounts of estrogen and progesterone needed to maintain pregnancy. After three months, the **placenta**, the organ of exchange between mother and embryo, assumes this function.
* Several hormones, including estrogen, oxytocin, and prostaglandins, regulate **parturition**, the birth process. Labor can be divided into three stages; the baby is delivered during the second stage.

* Principal Male Reproductive Hormones

Endocrine Gland and Hormones	Principal Target Tissue	Principal Actions
Hypothalamus Gonadotropin-releasing hormone(GnRH)	Anterior pituitary	Stimulates release of FSH and LH
Anterior Pituitary Follicle stimulating hormone (FSH)	Testes	Stimulates development of seminiferous tubules; stimulates spermatogenesis.
Luteinizing hormone (LH)	Testes	Stimulates interstitial cells to secrete testosterone
Testes Testosterone	General Anterior pituitary	***Before birth:*** stimulates development of primary sex organs and descent of testes into scrotum ***At puberty:*** responsible for growth spurt; stimulates development of reproductive structures and secondary sex characteristics. ***In adult:*** maintains secondary sex characteristics; stimulates spermatogenesis
Inhibin		Inhibits FSH secretion

* Difference between Follicular phase (Proliferative phase) and Luteal phase (Secretory Phase)

S.N.	Proliferative phase (*Follicular phase)*	Secretory Phase (*Luteal phase)*
1.	Stage of repair and proliferation.	Prepares endometrium for implantation.
2.	It extends from the end of menstruation to ovulation.	It extends after ovulation to menstruation.
3.	LH and FSH increases.	LH is high.
4.	Estrogen level increases.	Progesterone level increases.
5.	Estrogen is secreted by Graffian follicle.	Progesterone secreted by corpus luteum.

* **Principal Female Reproductive Hormones**

Endocrine Gland and Hormones	Principal Target Tissue	Principal Actions
Hypothalamus		
Gonadotropin-releasing hormone (GnRH)	Anterior pituitary	Stimulates release of FSH and LH
Anterior Pituitary		
Follicle-stimulating hormone (FSH)	Ovary	Stimulates development of follicles and secretion estrogen.
Luteinizing hormone (LH)	Ovary	Stimulates ovulation development of corpus luteum.
Prolactin	Breast	Stimulates milk producing (after breast has prepared by estrogen & progesterone)
Posterior Pituitary		
Oxytocin	Uterus	Stimulates contraction and stimulates prostaglandin release
	Mammary glands	Stimulates ejection of milk into ducts.
Ovaries		
Estrogen(estradiol)	General	Stimulates growth of sex organs at puberty and development of secondary sex characteristics
	Reproductive structures	Induces maturation; stimulates monthly preparation of endometrium for pregnancy; makes cervical mucus thinner and more alkaline.
Progesterone	Uterus	Completes preparation of endometrium for pregnancy
Inhibin	Anterior pituitary	Inhibits secretion of FSH

IMPORTANT POINTS

* Olfactory epithelium develops from embryonic ectoderm.
* The correct sequence in spermatogenesis is Spermatogonia → Primary spermatocytes → Secondary spermatocytes → Spermatids → Sperms.
* Gastrula end stage is characterised by formation of neural tube.
* Secondary oocyte is formed before fertilization.
* Egg is liberated from ovary in secondary oocyte stage.
* Cells of leydig occur in Testis.
* Site of fertilization in a mammal is fallopian tube.
* Sertoli cells occur in human testis.
* Breaking of acrosome membrane is agglutination.
* The correct sequence of egg layers from outside to inside
  Proliferous → Radiata → Pellucida
* Third phase of embryo development is gastrulation.
* The correct sequence in development is
  Fertilization → Zygote → Cleavage → Morula → Blastula → Gastrula.
* Growth and maturation of Graffian follicle is controlled by FSH-LH.
* After ovulation, Graafian follicle forms corpus luteum.
* Fallopian tube is part of oviduct.
* Polar bodies develop during oogenesis.
* First or free milk is called colostrum.
* Fixing up of blastocyst in the wall of uterus is implantation.
* Cleavage is repeated mitotic division of zygote.
* Function of sertoli cells is to nourish sperms.
* Number of sperms formed from four spermatocytes is 16.
* Germ cells in female gonad and male gonad begin undergoing meiosis simultaneously. The ratio of ova and sperms produced are 1 : 4.
* In Anaphase I of cell division are oogonia arrested.
* Placenta secretes estrogen.
* Parturition = Delivery of baby from uterus.
  Gestation = Duration between pregnancy and birth
  Ovulation = Release of egg from Graafian follicle.
  Implantation = Attachment of zygote to endometrium.
  Conception = Stoppage of ovulation and menstruation.
* The growth phase is the longest phase during male gametogenesis. But in human oogenesis, maturation phase is longest.
* The acrosome of sperm are produced by golgibodies.
* The smallest sperm is of crocodile and its size is 0.02mm & largest sperm is of Discoglossus (2mm).
* 74 days are required to complete the cycle of spermatogenesis in human being.

* In 1 ml of semen, 20 to 120 millions of sperms are present in human being.
* Deficiency in the number of sperms result in sterility which is known as oligospermia.
* Absence of sperms in semen is known as azoospermia.
* Largest egg is of Ostrich (16cm long with its shell).
* Although normal number of sperm are present in semen but if these are completely non motile. This condition is known as necrospermia.
* Smallest egg in birds is of humming bird.
* Summary of developmental stages in human :

Day 1 : Fertilization; the diameter of fertilized egg is about 0.15 mm.
Day 2 : Two cell stage
Day 3 : 16 cell stage, morula
Day 4 : Entry of blastocyst in the lumen of uterus, disappearance of zona pellucida, diameter of blastocyst is about 0.3mm.
7 -8 days : Partial entry of blastocyst inside the endometrium of uterus; implantation
Day 12 : Complete entry of blastocyst into endoderm, extra-embryonic mesoderm, amnion and yolk sac.
Day 14 : Primitive streak formation.
Day 18 : Formation of 3-5 pairs of somites.
Day 19 : Neural groove, neural plate, notochordal plate, and 6-8 pair of somites formed.
Day 24 : Indication of the formation of head and tail region; 21-23 pairs of somites formed formation of heart continues at ventral side.
Day 28 : Heart starts beating, neural tube formed, 3 pairs of visceral arch and 30-31 pairs of somites formed. Blood islands appear
Day 32 : 30-39 pairs of somites formed.
7 Weeks : Jaws, fingers and external ears begin to appear. The C-R length(crown-rump length; the length from head to the bottom of hips) is 19-20 mm.
8 Weeks : The embryo is completely surrounded by amnion, fingers and toes clearly visible, almost all organs formed with continuing development, at the end of 8th week the embryo appears like a little human, now called as foetus; C-R length is 28 to 30 mm.
5 months: Blood formation starts in bone marrow
Decidua capsularis and parietalis connect together.
9 months : Placenta attains maximum size, nails on fingers appear. In the next 10 days the foetus is ready to born as a little baby.
The above mentioned timing are approximate time periods. Some times, due to some reasons, certain babies are born before stipulated time. The babies born in 7th month may also survive as normal babies.

* The small molecules like O_2, CO_2, H_2O etc. and other inorganic substances like chlorides, phosphates, sodium, potassium, magnesium etc. are also diffused through placenta.
* The nutritional substances are supplied to embryo from the mother through placenta.
* Placenta also serves as a respiratory medium for exchange of O_2 and CO_2 between embryo and mother.
* Placenta itself secretes some hormones like progesterone, estrogen, lactogen, hCG, hCS etc.
* Progesterone, maintains and supports the foetus during the whole pregnancy period. At the time of parturition, relaxin is secreted by placenta which lubricates, and widens the birth canal to facilitate child birth.
* **Gestation period**

S.No.	Animal	Days
1.	Mouse (Minimum)	19-20
2.	Rat	20-22
3.	Rabbit	28-32
4.	Cat	52-65
5.	Dog	60-65
6.	Pig	112-120
7.	Goat	145-155
8.	Man	270-290
9.	Cow	275-290 (36 weeks)
10.	Horse	330-345
11.	Elephant (Maximum)	607-641

* **Puberty :**

- The age of sexual maturity is called puberty.
- Accessory sex character first appear in puberty.
- Puberty occurs in girls at the age of 11 to 14 year.
- Puberty occurs in boys at the age of 12-15 year
- At puberty, women starts producing ova.

- Changes in puberty in boys and girls:

	BOYS	GIRLS
1. Gonadal	Enlargement of the testes, Spermatogenesis begins.	Ovarian cycle and ovulation begins.
2. Accessary Sexual Organ	Penis, prostate, seminal vesicles and epididymis grow in mass.	Uterus, vagina, fallopian tube, vulva increase in size. Endometrium shows menstrual changes and menstruation occurs.
3. Hairs and voice	Appearance of Beards, moustache, axillary, pubic & chest hair. Low pitch sound.	Typical femine distribution of hairs (axilla + pubis but no hair on chest or abdomen). Breasts grow. Fat deposition leading to feminine contours. High pitch sound.
4. Somatic	Skeletal system – grows in length Muscular system – Grows in bulk & strength	Pelvic girdle becomes roomy and bigger than pectoral (opposite to boys, where pectoral girdle is bigger and pelvic much less roomy).
5. Psychic	Attraction for girls begins.	Attraction for boys.
6. Hormonal	FSH, LH and testosterone secretion – all rise.	FSH, LH, estrogen, progesterone secretion – all rise.

- The vagina is lined by a stratified squamous epithelium without any glands.
- During reproductive life the vagina contains lactobacillus acidophilus or dorderlein's bacilli which keeps the vaginal pH between 4 to 5 by producing lactic acid from glycogen

* **Path of sperms in mammals –** Seminiferous tubules – Rete testis – vasa efferentia – Epididymis – Vasa deferens – Urinogenital Chamber – Urethra.

* **Gynaecomastia –** Development of breast in the male

* **Amenorrhoea –** Absence of menstruation cycle

* **Hysterectomy –** Surgical removal of uterus.

* **Oopherectomy –** Removal of ovaries.

* **Human sperm –**60 m long, of this 55m is the length of the tail.

* In menstrual cycle proliferative phase is of 10-12 days and it is under the influence of oestrogen hormone.

* Luteal or secretory phase of menstrual cycle is of 14 days and it is under influence of progesterone hormone & It is always of fixed duration.

* **Spontaneous ovulator :** Ovulation occurs without any induction. **Ex.**Most animals (Human)

* Induced ovulator (Reflex ovulator) = ovulation occurs after copulation **Ex.** Rabbit

* **Vesectomy –**Cutting and tieing vas deferens

* **Tubectomy (salpingectomy) –**Cutting and ligating fallopian tube.

* In contraceptive pills oestrogen & progesterone are present in variable **combination.**

* **Testicle –** Testis + Epididymis

* Epididymis is 3m long in rabbit while 6 to 8 m long in man.

* Max. no. of leydig's cells are in the testis of pig.

* Function of epididymis = functional maturity and storage of sperms.

* **Os-penis or Baculum –** In whale, Bat, Rat, Seal, Monkey etc. Ossification occur in septum present between two corpora cavernosa

* **Menarche-**Begining of menstrual cycle in females.

* Size of human ovary –

Length	× Width	× Thickness
3 to 3.5cm	2 to 2.5cm	1 to 1.8cm

* Diameter of Graafian follicle – 1 to 1.5 cm

* Fallopian tube length – 10 cm to 12 cm.

* **Hermaphroditism :** Those animals who have both type of sex organs are called Hermaphrodite animals, it is found in tapeworms and earthworms.

* **Capacitation :** Reactivation of sperm called capacitation. It occurs in vagina. After ejaculation of sperm in vagina, cervical mucous secretory fluid dissolves inhibitory substances related to sperm & provide more energy to sperm.

QUESTION BANK

EXERCISE - 1 (LEVEL-1) [NCERT EXTRACT]

SECTION - 1 (VOCABULARY BUILDER)

Choose one correct response for each question.
For Q.1-Q.5
Match the column I with column II.

Q.1

	Column I	Column II
(a)	Functional maturation of sperm	(i) Epididymis
(b)	Site of spermatogenesis	(ii) Seminiferous tubules
(c)	Fertilized egg during implantation	(iii) Blastula
(d)	First haemopoitic organ	(iv) Yolk sac

Codes
(A) (a) – (ii), (b) – (i), (c) – (iii), (d) – (iv)
(B) (a) – (i), (b) – (ii), (c) – (iii), (d) – (iv)
(C) (a) – (iv), (b) – (iii), (c) – (i), (d) – (ii)
(D) (a) – (ii), (b) – (iii), (c) – (iv), (d) – (i)

Q.2

	Column I	Column II
(a)	Capacitation	(i) Vagina
(b)	Villi of human placenta	(ii) Chorionic villi
(c)	Storage of sperm	(iii) Vas deferens
(d)	General position of foetus during parturition	(iv) Epididymis
(e)	Blood testis barrier	(v) Occipito anterior
		(vi) Sertoli cells

Codes
(A) (a) – (i), (b) – (ii), (c) – (iii), (iv), (d) – (v), (e) – (vi)
(B) (a) – (ii), (b) – (i), (c) – (iii), (iv), (d) – (v), (e) – (vi)
(C) (a) – (i), (b) – (ii), (c) – (iv), (v), (d) – (iii), (e) – (vi)
(D) (a) – (vi), (b) – (ii), (c) – (iii), (iv), (d) – (v), (e) – (i)

Q.3

	Column I	Column II
a.	Ovaries	i. Fertilisation
b.	Oviduct	ii. Ovulation
c.	Uterus	iii. Pregnancy
d.	Cervix	iv. Child birth

Codes
(A) (a) – (ii), (b) – (i), (c) – (iii), (d) – (iv)
(B) (a) – (i), (b) – (ii), (c) – (iii), (d) – (iv)
(C) (a) – (iv), (b) – (iii), (c) – (i), (d) – (ii)
(D) (a) – (ii), (b) – (iii), (c) – (iv), (d) – (i)

Q.4 Match the following columns.

	Column I	Column II
a.	Perimetrium	i. Inner glandular layer of uterus
b.	Endometrium	ii. External thin membrane of uterus
c.	Myometrium	iii. Middle thick membrane of uterus

Codes
(A) (a) – (ii), (b) – (iii), (c) – (i)
(B) (a) – (i), (b) – (ii), (c) – (iii)
(C) (a) – (iii), (b) – (ii), (c) – (i)
(D) (a) – (iii), (b) – (i), (c) – (ii)

Q.5 Match the columns for menstrual cycle.

	Column I	Column II
a.	Stage-I	i. Menstrual phase
b.	Stage-II	ii. Follicular proliferative
c.	Stage-III	iii. Ovulatory phase
d.	Stage-IV	iv. Luteal / secretory phase

Codes
(A) (a) – (iv), (b) – (iii), (c) – (i), (d) – (ii)
(B) (a) – (iv), (b) – (i), (c) – (ii), (d) – (iii)
(C) (a) – (i), (b) – (ii), (c) – (iii), (d) – (iv)
(D) (a) – (iv), (b) – (iii), (c) – (ii), (d) – (i)

SECTION - 2 (BASIC CONCEPTS BUILDER)

For Q.6 to Q.40 :

Choose one word for the given statement from the list.

Androgens, Gametes, Primary; Ovarian Hormones, Antrum, Secondary follicle, Tertiary follicle, Zona pellucida, Penis, Oogonia, Testis, glands, Golgi body, Ducts, Genitalia, Spermatogenesis; Alveoli, milk, 15-28, Mammary duct, Sertoli cell, Epididymis, Posterior, Primary follicle, Testosterone, Oviparous, Viviparous, Ovoviviparous, Asexually, Sexually, Seminal vesicles, Urethra, Diploid, Haploid, External, Internal, Chorionic villi; Uterine tissue

Q.6 Gametogenesis is the formation of ____.

Q.7 Interstitial cells secretes ____.

Q.8 The new membrane formed by follicular cells is called ____.

Q.9 Male reproductive system contains a pair of ____ along with accessory ____ and ____ and an external ____.

Q.10 Ovaries are the ____ sex organs which produce ovum and several steroid hormone called ____.

Q.11 Acrosome is the modified ____.

Q.12 Androgen stimulates the ____ FSH acts on the ____ and stimulates factors for spermiogenesis.

Q.13 External genitalia of male are called ____.

Q.14 The vasa efferentia leave the testis and opens into the ____ , located along the ____ surface.

Q.15 Female gamete mother cells are called _____.

Q.16 Primary oocyte surrounded by a layer of granulosa cells is called ____.

Q.17 Lobules contain cluster of cells called _____, which secretes _____. Alveoli opens into mammary tubules, which joins to form _____.

Q.18 Fluid filled cavity called ___ is present in ____ follicle called ____.

Q.19 Humans reproduce _____. (asexually/sexually)

Q.20 Humans are _____.
(oviparous, viviparous, ovoviviparous)

Q.21 Fertilisation is ____ in humans (external/internal)

Q.22 Male and female gametes are ____ (diploid/haploid)

Q.23 Zygote is _____ (diploid/haploid)

Q.24 The process of release of ovum from a mature follicle is called ____

Q.25 Ovulation is induced by a hormone called _____

Q.26 The fusion of male and female gametes is called _____

Q.27 Fertilisation takes place in ___.

Q.28 Zygote divides to form _____which is implanted in uterus.

Q.29 The structure which provides vascular connection between foetus and uterus is called ____.

Q.30 Luteal phase last for ____ days?

Q.31 Leydig cells secretes _____ hormone.

Q.32 Vasa deferentia receives a duct from _____ and opens into the _____ as ejaculatory duct.

Q.33 After implantation, finger-like projections on the trophoblast are called ___ which are surrounded by _____ and maternal blood.

Q.34 Androgens are produced by Sertoli cells. **[True / False]**

Q.35 Spermatozoa get nutrition from Sertoli cells. **[True / False]**

Q.36 Leydig cells are found in ovary. **[True / False]**

Q.37 Leydig cells synthesise androgens. **[True / False]**

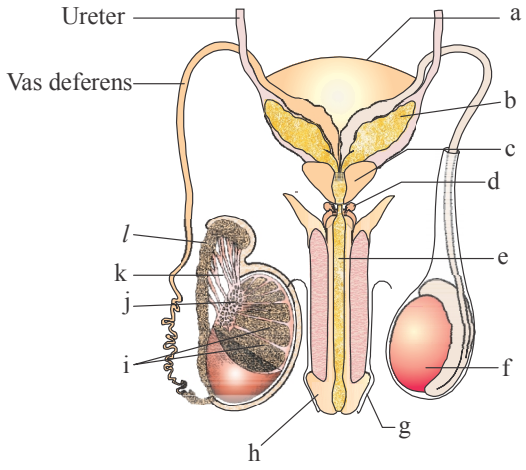
Q.38 Oogenesis takes place in corpus luteum. **[True / False]**

Q.39 Menstrual cycle ceases during pregnancy. **[True / False]**

Q.40 Presence or absence of hymen is not a reliable indicator of virginity or sexual experience. **[True / False]**

SECTION - 3 (ENHANCE DIAGRAM SKILLS)

For Q.41-Q.43

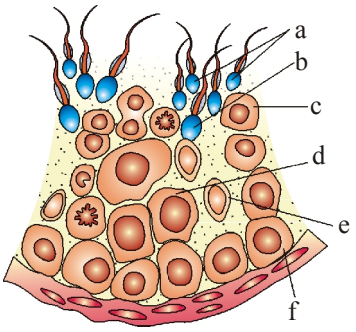


Q.41 Identify a, b, c and d in the given diagram.
(A) a-Urinary bladder, b-Bulbourethral gland, c-Prostate gland, d-Seminal vesicles
(B) a-Urinary bladder, b-Seminal vesicles, c-Prostate gland, d-Bulbourethral gland
(C) a-Prostate gland, b-Seminal vesicles, c-Urinary bladder, d-Bulbourethral gland
(D) a-Bulbourethral gland, b-Urinary bladder, c-Seminal vesicles, d-Prostate gland

Q.42 Identify e, f, g and h in the diagram.
(A) e-Glans penis, f-Foreskin, g-Testis, h-Urethra
(B) e-Testis, g-Foreskin, g-Glans penis, h-Urethra
(C) e-Urethra, g-Testis, g-Foreskin, h-Glans penis
(D) e-Glans penis, g-Foreskin, g-Testis, h-Urethra

Q.43 Identify i, j, k and *l* in the diagram.
(a) i-Rete-testis, j-Vasa efferentia, k-Epididymis, *l*-Testicular lobules
(b) i-Vasa-efferentia, j-Rete testis, k-Testicular lobules, *l*-Epididymis
(c) i-Epididymis, j-Vasa efferentia, k-Rete testis, *l*-Testicular lobules
(d) i-Testicular lobules, j-Rete tesits, k-Vasa efferentia, *l*-Epididymis

For Q.44-Q.45

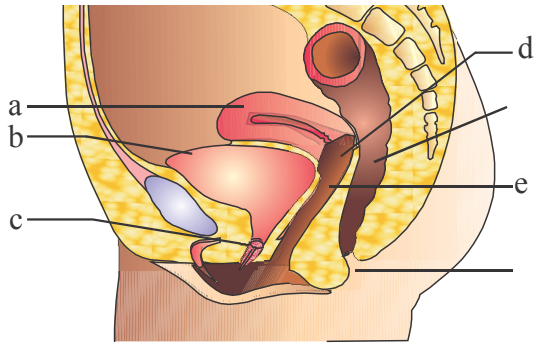


Q.44 Find out spermatid and Sertoli cell in given diagram.
(A) d and e (B) e and f
(C) a and c (D) b and e

Q.45 Find out the spermatogonium and spermatozoa in given figure.

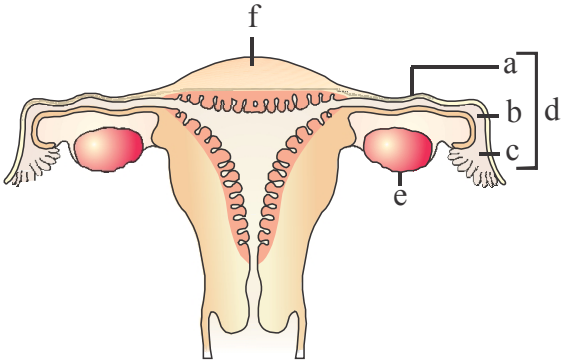
(A) a and f (B) c and d
(C) f and a (D) d and e

Q.46 The following diagram refers to female reproductive system of human. Identify a to e.



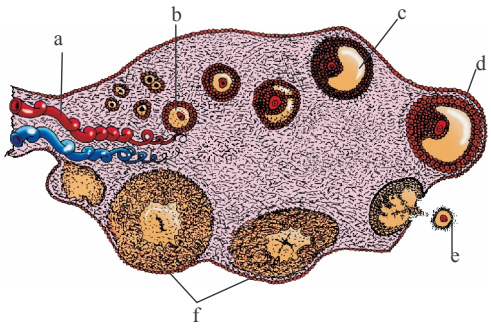
(A) a-Urethra, b-Urinary bladder, c-Uterus, d-Cervix, e-Vagina
(B) a-Urethra, b-Urinary bladder, c-Uterus, d-Vagina, e-Cervix
(C) a-Urethra, b-Urinary bladder, c-Uterus, d-Cervix, e-Vagina
(D) a-Uterus, b-Urinary bladder, c-Urethra, d-Cervix, e-Vagina

Q.47 The following diagram refers to the female reproductive system of humans. Identify a to f.



(A) a-Ampulla, b-Isthmus, c-Infundibulum, 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-Isthmus, b-Ampulla, c-Infundibulum, d-Fallopian tube, e-Ovary, f-Uterine fundus
(D) a-Ampulla, b-Infundibulum, c-Isthmus, d-Fallopian tube, e-Ovary, f-Uterine fundus

For Q.48-Q.50



Q.48 Give the name of c and d in the figure.

(A) Secondary spermatocyte and primary spermatocytes.
(B) Tertiary follicles showing antrum and graafian follicle.
(C) Primary spermatocyte and secondary spermatocytes.
(D) Graafian follicle and ovum.

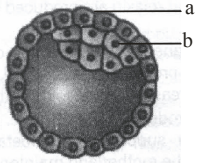
Q.49 Find out corpus luteum and ovum in the figure.

(A) a and b (B) b and c
(C) c and d (D) f and e

Q.50 Find out primary follicle and tertiary follicle in figure.

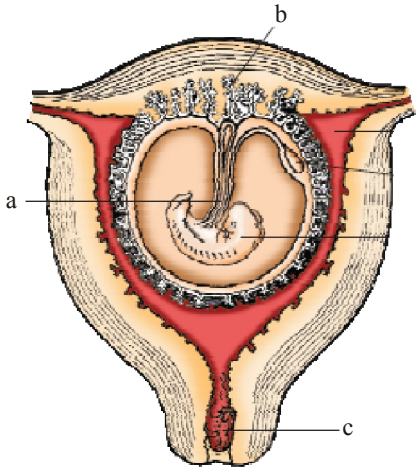
(A) b and c (B) c and d
(C) d and e (D) a and f

Q.51 Identify (a) and (b) and their respective functions.



(A) a-Trophoblast, b-Inner cell mass
Function of a : get attach to the endometrium
Function of b : differentiated as embryo
(B) a-Inner cell mass, b-Trophoblast
Function of a : get attach to the endometrium
Function of b : differentiated as embryo
(C) a-Trophoblast, b-Inner cell mass
Function of a : differentiated as embryo
Function of b : get attach to the endometrium
(D) a-Ectoderm, b-Endoderm
Function of a : differentiated as embryo
Function of b : get attach to the endometrium

Q.52 In the given diagram find out a, b and c.



(A) a-Plug of mucous in cervix, b-Placental villi, c-Umbilical cord
(B) a-Umbilical cord, b-Placental villi, c-Plug of mucous in cervix
(C) a-Umbilical cord, b-Plug of mucous in cervix, c-Placental villi
(D) a-Placental villi, b-Plug of mucous in cervix, c-Umbilical cord

SECTION - 4 (ENHANCE PROBLEM SOLVING SKILLS)

Choose one correct response for each question.

PART - 1 : MALE REPRODUCTIVE SYSTEM

Q.53 Primary sex organ in man is –
(A) scrotum (B) accessory gland
(C) testis (D) urinary bladder

Q.54 The epididymis leads to ____ that ascends to abdomen and loops over the ____.
(A) Epididymis, vas deferens
(B) vas deferens, Epididymis
(C) vas deferens, urinary bladder
(D) urinary bladder, vas deferens

Q.55 Germinal epithelium gives rise to
(A) Sertoli cells (B) interstitial cells
(C) spermatogonium (D) scrotum

Q.56 Each testis has about ____ compartments called as testicular lobules. Each lobule contains ____ highly coiled seminiferous tubules in which the sperms are produced.
(A) 50 ; 1-3 (B) 100 ; 1
(C) 250 ; 1-3 (D) 500 ; 3

Q.57 Pouch in which is the testes are suspended outside the abdominal cavity, is
(A) tunica albuginia (B) inguinal canal
(C) epididymis (D) scrotum

Q.58 Temporary storage of sperms takes place in
(A) vasa deferentia (B) vasa efferentia
(C) epididymis (D) rete testis

Q.59 Testicular lobules contains
(A) 3-5 seminiferous tubules
(B) 2-6 seminiferous tubules
(C) 5-7 seminiferous tubules
(D) 1-3 seminiferous tubules

Q.60 Interstitial cells are also called –
(A) Leydig cells (B) rete testis
(C) vasa efferentia (D) spermatocytes

Q.61 External opening of penis is called
(A) ureter (B) urinary bladder
(C) urethral meatus (D) prepuce

Q.62 Which of the following cells secrete testicular hormones called androgens and form endocrine part of the testis?
(A) Leydig cells (B) Interstitial cells
(C) Sertoli cells (D) Both (A) & (B)

Q.63 Inner portion of the seminiferous tubules contain
(A) male germ cell
(B) Sertoli cells
(C) Both (A) and (B)
(D) interstitial or Leydig cell

Q.64 Endocrine portion of testis is
(A) seminiferous tubules (B) interstitial cells
(C) Leydig cell (D) Both (B) and (C)

Q.65 Male accessory glands include
(A) Paired seminal vesicles
(B) A prostate gland
(C) Paired bulbourethral gland
(D) All of these

Q.66 Two major entities seen in human testis TS are
(A) Sertoli cells and interstitial cells
(B) spermatozoa and Sertoli cells
(C) seminiferous tubules and Leydig cells
(D) seminiferous tubules and Sertoli cells

Q.67 Enlarged end of penis (called the glans penis) is covered by the skin called
(A) foreskin (B) prepuce
(C) Both (A) and (B) (D) None of the above

Q.68 Seminal plasma in humans is rich in
(A) Fructose and certain enzymes but poor in calcium.
(B) Fructose, calcium and certain enzymes.
(C) Fructose and calcium but has no enzymes.
(D) Glucose and certain enzymes but has no calcium.

Q.69 Region outside the seminiferous tubules is called
(A) inter digital space (B) inter space
(C) interstitial space (D) blind space

Q.70 Which of the following is a set of male accessory ducts?
(A) Rete testis, vasa efferentia, tubuli recti.
(B) Rete testis, vasa efferentia, epididymis and vas deferens.
(C) Epididymis, ejaculatory duct, urethra
(D) Seminiferous tubules, vasa efferentia, epididymis and vas deferens.

Q.71 Sertoli cells are also called –
(A) subtentacular cells (B) sperm cells
(C) interstitial cells (D) Leydig cells

Q.72 Compartments in mammalian testes are called
(A) testicular lobules (B) seminiferous tubules
(C) Sertoli cells (D) interstitial cells

Q.73 Vas deferens receives a duct from seminal vesicle and opens into urethra as –
(A) Urethral meatus (B) Ejaculatory duct
(C) Ureter (D) Epididymis

Q.74 Male accessory glands includes __, __ and ___.
(A) one seminal vesicle, a pair of prostate gland, a bulbourethral gland.
(B) pair of seminal vesicle, prostate gland, a pair of bulbourethral gland
(C) two pairs of seminal vesicle, two pairs of prostate gland, two pairs of bulbourethral gland
(D) three pairs of seminal vesicle, three pairs of prostate gland, three pairs of bulbourethral gland

Q.75 Scrotum remains connected with abdomen or pelvic cavity by
(A) spermatic cord (B) inguinal canals
(C) testis (D) lobules

Q.76 Function of scrotum is to maintain the
(A) temperature of testis
(B) body temperature
(C) level of growth hormone
(D) level of male hormone

PART - 2 : FEMALE REPRODUCTIVE SYSTEM

Q.77 Each ovary is about 2-4 cm in length connected to the _____ wall by _____. Each ovary is covered by a thin epithelium which encloses the ovarian stroma. Stroma is divided into two zones _____ and _____.
(A) inner medulla, peripheral cortex, ligament, pelvic wall
(B) pelvic, ligament, peripheral cortex, inner medulla
(C) pelvic, peripheral cortex, ligament. inner medulla
(D) inner medulla, peripheral cortex, ligament, pelvic wall

Q.78 The part of Fallopian tube closest to the ovary is
(A) isthmus (B) infundibulum
(C) cervix (D) ampulla

Q.79 Vagina of the female reproductive system is –
(A) Primary sex organs (B) Essential sex organs
(C) Secondary sex organs (D) Both (A) and (B)

Q.80 Cushion of fatty tissue covered by skin and pubic hair is called
(A) mons pubis (B) labia majora
(C) labia minora (D) clitoris

Q.81 Development of foetus takes place in –
(A) Vagina (B) Uterus
(C) Ovary (D) Oviduct

Q.82 Mammary gland is a
(A) modified sweat gland
(B) modified perinium
(C) modified ear wax gland
(D) Both (A) and (C)

Q.83 Oviducts are also called
(A) Fallopian tubes (B) uterus
(C) vagina (D) ovary

Q.84 Uterus is also called
(A) cervical canal (B) womb
(C) oviduct (D) ampulla

Q.85 Fleshy folds of tissue which extends down the mons pubis and surrounds the vaginal opening is called –
(A) labia minora (B) labia majora
(C) hymen (D) clitoris

Q.86 Which of the following is last part of the oviduct, which has narrow lumen and it joins the uterus?
(A) Ampulla (B) Isthmus
(C) Infundibulum (D) Fimbriae

Q.87 The uterus opens into the vagina by a canal called
(A) cervical canal (B) fundus
(C) ampulla (D) oviducts

Q.88 The edges of infundibulum possess finger-like projection called ___ which helps in the collection of ovum. The infundibulum leads to wider part of the oviduct called ___. Last part of oviduct, ____ has narrow lumen and joins to uterus.
(A) fimbriae; ampulla; isthmus
(B) fimbriae; isthmus; ampulla
(C) isthmus; fimbriae; ampulla
(D) isthmus; ampulla; fimbriae

Q.89 The main tissue present in breast is –
(A) glandular (B) squamous
(C) ciliated (D) epithelium

PART - 3 : GAMETOGENESIS

Q.90 Which one of the following cells have haploid number of chromosome?
(A) 1° spermatocytes (B) 2° spermatocytes
(C) Spermatid (D) Both (B) and (C)

Q.91 In humans, at the end of the first meiotic division, the male germ cells form
(A) Spermatogonia
(B) Primary spermatocytes
(C) Secondary spermatocytes
(D) Spermatids

Q.92 Graafian follicle after releasing ovum is called
(A) corpus luteum (B) polar body
(C) nucleur body (D) ootid

Q.93 Primary spermatocytes differs from spermatogonium in –
(A) number of chromosomes
(B) size and volume
(C) DNA content
(D) size of chromosome

Q.94 Acrosome is a part of
(A) foetus (B) Graafian follicle
(C) ovum (D) sperm

Q.95 Synthesis of testosterone by Leydig cells is stimulated by –
(A) LTH (B) TSH
(C) FSH (D) ICSH

Q.96 Second meiotic division in ovum leads to the formation of
(A) haploid ovum (B) second polar body
(C) tertiary polar body (D) Both (A) and (B)

Q.97 Sertoli cells are found in
(A) Ovaries and secrete progesterone.
(B) Testes and secrete testosterone.
(C) Seminiferous tubules and after spermiogenesis, sperm heads become embedded in them.
(D) Adrenal cortex and secrete adrenaline.

Q.98 Cell organelle absent in human sperm is
(A) ER (B) mitochondria
(C) nucleus (D) centriole

Q.99 At which stage of the development, ovum is released from the ovary of the human female?
(A) Primary oocyte (B) Oogonium
(C) Secondary oocyte (D) Ootid

Q.100 Sperm lysin is found in –
(A) neck region (B) middle region
(C) head region (D) tail region

Q.101 The seminal plasma along with the sperm is called
(A) spermatid (B) spermatozoa
(C) semen (D) All of these

Q.102 The release of sperms by seminiferous tubules, occurs by the process of
(A) Spermiogenesis (B) Spermiation
(C) Gametogenesis (D) Spermatogenesis

Q.103 Which part of the sperm contains hydrolytic enzymes?
(A) Head region (B) Neck region
(C) Cap region (D) Tail region

Q.104 How many sperms are formed by four primary spermatocytes?
(A) 1 (B) 4
(C) 16 (D) 32

Q.105 Spermatogenesis starts at puberty due to
(A) GnRH (B) lactin
(C) testosterone (D) oestrogen

Q.106 Spermiogenesis or spermateliosis is
(A) changing of spermatid to spermatozoa.
(B) changing of spermatid to sperm.
(C) Both (A) and (B)
(D) changing of spermatid to secondary spermatocytes.

Q.107 The Graafian follicle ruptures to release _____ from the ovary by the process called ovulation.
(A) Primary oocyte
(B) Secondary oocyte after completing meiosis-II
(C) Secondary oocyte after completing meiosis-I and with the release of 1st polar body.
(D) Mature ovum

Q.108 Acrosome formation in spermatogenesis occurs in which stage ?
(A) First meiotic division
(B) Second meiotic division
(C) Growth phase
(D) Spermiogenesis

PART - 4 : MENSTRUAL CYCLE

Q.109 Menstrual cycle starts with the
(A) follicular phase (B) ovulatory phase
(C) menstrual phase (D) luteal phase

Q.110 Luteal phase is also called –
(A) secretory phase (B) bleeding phase
(C) menses phase (D) ovulatory phase

Q.111 In menstrual cycle, the menstrual phase last for
(A) 3-5 days (B) 5-6 days
(C) 1-3 days (D) 2-3 days

Q.112 Which hormone level increases in the luteal phase?
(A) LH (B) Progesterone
(C) Testosterone (D) FSH

Q.113 Follicular phase is also called
(A) secretory phase (B) luteal phase
(C) proliferative phase (D) menstrual phase

Q.114 At which phase, both LH and FSH attain a peak level?
(A) Menstrual phase (B) Follicular phase
(C) Ovulatory phase (D) Luteal phase

Q.115 Progesterone is needed for the maintenance
(A) of ovary (B) of ovum
(C) of endometrium wall (D) of ootid

Q.116 Which one of the following events is correctly matched with time period in normal menstrual cycle?
(A) Release of egg - 5th day (approximately)
(B) Endometrium regenerates- 5-14 day (app.)
(C) Endometrium secrete nutrients for implantation - 11-180day (approximately)
(D) Rise in progesterone level - 1-15days (app.)

Q.117 What happens during the follicular phase of menstrual cycle?
(A) Proliferation of endometrium wall
(B) Reduction of endometrium wall
(C) Shedding of endometrium wall
(D) No effect on endometrium wall

Q.118 Graafian follicle contains
(A) oogonial cells
(B) corpus luteum
(C) theca externa and theca interna
(D) corpus albicans

Q.119 In menstrual phase, the production of LH considerably
(A) reduced (B) increases
(C) does not change (D) None of these

Q.120 Identify the hormones that are secreted in large amount prior to ovulation :
a. LH b. FSH
c. Estrogen d. Progesterone
(A) a only (B) a & b only
(C) a, b & c only (D) a, b, c & d

Q.121 Estrogen is secreted by –
(A) Corpus luteum
(B) Theca interna of Graafian follicle
(C) Germinal epithelium of ovary
(D) Pituitary

Q.122 Menstrual cycle is generally of –
(A) 21 days (B) 28 days
(C) 38 days (D) 40 days

Q.123 Ovulatory phase lasts for
(A) 1 day (B) 2 days
(C) 3 days (D) 4 days

Q.124 In the fertile human female, approximately on which day of the menstrual cycle (28 days) does ovulation take place?
(A) Day 14 (B) Day 18
(C) Day 1 (D) Day 8

Q.125 Corpus luteum secretes
(A) LH (B) progesterone
(C) oestrogen (D) FSH

PART - 5 : FERTILISATION & IMPLANTATION

Q.126 Cleavage is
(A) meiosis of zygote into blastomeres
(B) mitosis of zygote into blastomeres
(C) reductional division of zygote
(D) reductional division of embryo

Q.127 Everytime copulation do not lead to fertilisation and pregnancy because of failure of sperm to reach the –
(A) ampulla (B) cervix
(C) endometrium (D) myometrium

Q.128 Second meiotic division in ova takes place
(A) after ovulation
(B) after spermiogenesis
(C) after fusion of sperm and ova
(D) after sperm reaches to the oviduct

Q.129 The receptor site of an acrosome are exposed and become active to penetrate the egg. This process is called –
(A) activation (B) capacitation
(C) reactivation (D) deactivation

Q.130 Why do all copulations not lead to fertilisation and pregnancy? The root cause is _
(A) Due to numerous sperms and one ovum
(B) Due to less progesterone

(C) Ovum and sperms are not transported simultaneously to the ampullary-isthmic junction
(D) Due to non-formation of corpus luteum

Q.131 Ovum is –
(A) secondary oocyte (B) primary oocyte
(C) tertiary oocyte (D) None of these

Q.132 In human female, the blastocyst –
(A) Forms placenta even before implantation.
(B) Gets implanted in the uterus 3 days after ovulation.
(C) Gets implanted in the endometrium by trophoblast cells.
(D) The trophoblast cells get differentiated as the embryo.

Q.133 Cleavage is the rapid mitotic division. It occurs in –
(A) gametes (B) zygote
(C) sperm (D) ova

Q.134 Which part of the sperm assist first mitotic division?
(A) Acrosome (B) Neck
(C) Middle part (D) Tail part

Q.135 The collective term used for acrosomal chemicals is –
(A) sperm lining (B) sperm lysins
(C) pectinase (D) cellulase

Q.136 In implantation, the blastocyst attached to the ____ wall of uterus.
(A) endometrium (B) myometrium
(C) perimetrium (D) mesoderm

Q.137 Trophoblast, is not involved in the formation of
(A) Protective and trophic membranes.
(B) Foetal portion of placenta.
(C) Body of developing embryo.
(D) Chorionic villi.

Q.138 Release of semen by penis into vagina during copulation (coitus) is called –
(A) insemination (B) fertilisation
(C) zygote (D) gametogenesis

Q.139 Cleavage forms 2-4-6-8-16 cells. These cells are called –
(A) blastocysts (B) blastomeres
(C) morula (D) trophoblast

Q.140 Female pronucleus is
(A) cytoplasm of ovum
(B) nucleus of ovum
(C) nucleus of quaternary oocyte
(D) Both (B) and (C)

Q.141 Attachment of blastocyst of uterine wall is called
(A) fertilisation (B) implantation
(C) deplantation (D) All of these

Q.142 External fertilization occurs in animals, which –
(A) Lay eggs on land (B) Lay eggs in water
(C) Oviparous (D) Viviparous

Q.143 Binding of sperm to secondary oocyte cause ____ which ensures ____.
(A) polyspermy, polarisation
(B) polarisation, polyspermy
(C) depolarisation, monospermy
(D) monospermy, depolarisation

Q.144 Extraembryonic membranes, chorion and amnion are formed by
(A) Inner mass cells (B) Trophoblast
(C) Both (A) and (B) (D) None of these

Q.145 Fertilisation takes place in
(A) cervix (B) isthmus
(C) ampullary isthmic junction (D) follicle

Q.146 64 celled stage of embryo is called
(A) blastocyst (B) blastomere
(C) morula (D) inner mass of cell

Q.147 Sperm lysins contains
(A) hyaluronidase
(B) corona penetrating enzyme
(C) acrosin
(D) All of the above

PART - 6 : PREGNANCY AND EMBRYONIC DEVELOPMENT

Q.148 Placenta is a connection between
(A) foetus and vaginal wall
(B) foetus and Fallopian tube
(C) foetus and uterine wall
(D) embryo and scrotum

Q.149 Chorionic villi are formed by the modification of
(A) outer layer of trophoblast.
(B) inner layer of trophoblast.
(C) inner mass cell.
(D) blastocyst.

Q.150 Placenta acts as an endocrine tissue and produces several hormones like –
a. Human chorionic gonadotropin (hCG)
b. Human placental lactogen (hPL)
c. Estrogens
d. Progestogens
(A) a & b (B) b only
(C) a, b & c (D) a, b, c & d

Q.151 Embryologist can draw the fate maps of future organ of embryo in _____ stage.
(A) blastula (B) morula
(C) early gastrula (D) late gastrula

Q.152 Relaxin (a hormone) is secreted by
(A) placenta
(B) ovary
(C) anterior lobe of pituitary
(D) posterior lobe of pituitary

Q.153 Foetus develops limbs and digits in its ____ of development.
(A) 2nd month (B) 3rd month
(C) 4th month (D) 5th month

Q.154 Human placenta is derived from
(A) ectoderm (B) trophoblast
(C) endoderm (D) mesoderm

Q.155 Which of the following groups of hormones are produced in women only during pregnancy?
(A) hCG, hPL, relaxin
(B) Estrogen, progesterone, hCG
(C) Cortisol, prolactin, thyroxine
(D) Prolactin, progesterone, hCG

Q.156 External genitalia develops in the _____ of development.
(A) 2nd month (B) 5th month
(C) 3rd month (D) 1st month

Q.157 Most of the organs are formed during of _____ of development.
(A) 1st month (B) 2nd month
(C) 3rd month (D) 4th month

Q.158 Chorionic villi and uterine tissue become interdigitated with each other and jointly form
(A) trophoblast (B) inner cell mass
(C) placenta (D) implantation

Q.159 hCG (Human Chorionic Gonado trophin) and hPL (Human Placental Lactogen) are released
(A) before pregnancy
(B) during pregnancy
(C) at parturation
(D) during lactating stage

Q.160 The first sign of the growing foetus may be noticed by listening to the heart sound carefully through the stethoscope. Embryo's heart is formed –
(A) By the end of the second month of pregnancy
(B) By the end of first trimester
(C) After one month of pregnancy
(D) During fifth month

Q.161 Blastopore is found in –
(A) blastula and is the opening of archenteron
(B) blastula and is the opening of blastocoel
(C) gastrula and is the opening of archenteron
(D) gastrula and is the opening of blastocoel

Q.162 Placenta facilitate
(A) supply of oxygen
(B) nutrient supply
(C) removal of excretory material
(D) All of the above

PART - 7 : PARTURITION AND LACTATION

Q.163 Parturition is –
(A) child birth
(B) expulsion of the baby from uterus
(C) Both (A) and (B)
(D) None of the above

Q.164 Parturition is the process of –
(A) child birth (B) fusion of gametes
(C) Both (A) and (B) (D) releasing of gametes

Q.165 The signals for parturition originates from the fully developed foetus and followed by placenta causing the mild contractions called
(A) foetal ejection reflex
(B) embryo ejection reflex
(C) blastocoel ejaculation reflex
(D) still birth

Q.166 Foetal ejection reflex in human female is induced by
(A) Differentiation of mammary gland.
(B) Pressure exerted by amniotic fluid.
(C) Fully developed foetus and placenta.
(D) Release of oxytocin from pituitary.

Q.167 Colostrum is important for newly born because
(A) colostrum have antigen
(B) colostrum have antibody
(C) Both (A) and (B)
(D) colostrum have more nutrients than ordinary milk

Q.168 Hormone which causes the parturition is
(A) oestrogen (B) oxytocin
(C) prostaglandin (D) All of these

Q.169 Milk secretion in mammals is associated with
(A) vasopressin (B) progesterone
(C) prolactin (D) gonadotrophin

Q.170 Signals from fully developed foetus and placenta ultimately lead to parturition which requires the release of –
(A) Estrogen from placenta
(B) Oxytocin from maternal pituitary
(C) Oxytocin from foetal pituitary
(D) Relaxin from placenta

EXERCISE - 2 (LEVEL-2)

Choose one correct response for each question.

Q.1 Function of bulbourethral gland is to
(A) lubricate the penis
(B) increase the motility of sperm
(C) enhance the sperm count
(D) All of the above

Q.2 Androgen Binding Protein (ABP) and inhibin are secreted by –
(A) interstitial cells (B) Leydig cells
(C) Sertoli cell (D) germinal epithelium

Q.3 Hyaluronidase acts on ground tissue of ___ cells. Corona penetrating enzyme dissolves the _____ and zonalysin dissolve the ____.
(A) follicle, corona radiata, zona pellucida
(B) zona pellucida, corona radiata, follicle
(C) follicle, zona pellucida, zona radiata
(D) corona radiata, zona pellucida, follicle

Q.4 Rapid secretion of LH in ovulation causes
(A) repturing of Graafian follicle
(B) releasing of ova
(C) ovulation
(D) All of the above

Q.5 Extraembryonic membranes of mammalian embryo are derived from –
(A) trophoblast (B) follicle cells
(C) formative cells (D) inner cell mass

Q.6 Which one of the following is **incorrect** match?
(A) Myometrium : Exhibits strong contractions during delivery of the baby.
(B) Endometrium : Undergoes cyclical changes during menstrual cycle.
(C) Perimetrium : Serosa of uterus
(D) Uterus : Birth canal

Q.7 Immediately after implantation, ectoderm, endoderm and the mesoderm of embryo is formed from –
(A) Trophoblast (B) Cytotrophoblast
(C) Embryoblast (D) Syncytiotrophoblast

Q.8 'XX' is a thick structure of male reproductive system which arises from cauda epididymis. 'XX' are 2 in number and its lining has many stereocilia. Identify 'XX'.
(A) Vasa efferentia (B) Vasa deferentia
(C) Penis (D) Scrotum

Q.9 In testis, the immature germ cells produce sperm by _____ at puberty _____ present on the inside wall of seminiferous tubules multiply by _____ division and increase their number.
(A) secondary spermatocytes, primary spermatocytes, mitosis
(B) primary spermatocytes, secondary spermatocytes, mitosis
(C) spermatogenesis, spermatogonia, mitosis
(D) spermatogonia, spermatogenesis, meiosis

Q.10 The granules present beneath the plasma membrane of oocyte cells are called ____. These granules fuses with the plasma membrane of oocyte and releases their content including ____ between the _____ and zona pellucida. This ensures the ____.
(A) monospermy, plasma membrane, corticle enzyme, corticle granules
(B) corticle granule, corticle enzyme, plasma membrane, monospermy
(C) corticle enzyme, corticle granules, plasma membrane, monospermy
(D) corticle enzyme, corticle granules, monospermy, plasma membrane

Q.11 Trace the correct path of movement of the sperms upto urethra.
(A) Seminiferous tubules → Vasa efferentia → Rete testis → Epididymis → Vas deferens → Ejaculatory duct → Urethra
(B) Seminiferous tubules → Rete testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Urethra
(C) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra
(D) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Ejaculatory duct → Vas deferens → Urethra

Q.12 Withdrawl of which hormone cause desintegration of corpusluteum?
(A) Progesterone (B) LH
(C) Both (A) and (B) (D) None of these

Q.13 What induces the completion of the meiotic division of the secondary oocyte?
(A) Contact of the sperm with the zona pellucida layer of the ovum.
(B) The entry of the sperm into the cytoplasm of the ovum through the zona pellucida and the plasma membrane.
(C) Entry of the sperm in the ampullary-isthmic junction.
(D) Copulation

Q.14 Secretions of the seminal vesicles constitutes the seminal plasma which is rich in
(A) glucose (B) fructose
(C) ribose (D) deoxyribose

Q.15 Soon after implantation, the inner cell mass differentiation into outer _____ and inner _____ occurs _____ soon appears between ectoderm and endoderm.
(A) mesoderm, ectoderm, endoderm
(B) ectoderm, mesoderm, endoderm
(C) ectoderm, endoderm, mesoderm
(D) mesoderm, endoderm, ectoderm

Q.16 Endometrium, epithelial glands and connective tissue of uterus is broken due to
(A) lack of oestrogen (B) lack of progesterone
(C) lack of FSH (D) excess of FSH

Q.17 Egg secretes a chemical called ____ which is made up of ____ and sperm secretes a chemical called ____ made up of ____. The adhesion of sperm to the egg of same species through chemical recognition is called ____.
(A) fertilisin, glycoprotein, antifertilisin, protein agglutination
(B) fertilisin, glucose, antifertilisin, glucose, agglutination
(C) fertilisin, fructose, antifertilisin, fructose, agglutination
(D) fertilisin, protein, antifertilisin, glycoprotein, agglutination

Q.18 Milk secreted from the cells of alveoli of mammary lobes reaches to the nipple by Lactiferous duct (L), Mammary duct (M), mammary Tubule (T) and mammary Ampulla (A) in following order.
(A) T A M L (B) T M A L
(C) M T A L (D) A T M L

Q.19 Primary sex organs differ from the secondary sex organs in all the following, except
(A) They produce gametes.
(B) They secrete sex hormones.
(C) They are concerned with the conduction of gametes.
(D) Testes in male and ovaries in female are the examples of primary sex organs

Q.20 During copulation semen is released by penis into
(A) Cervix (B) Vagina
(C) Uterus (D) Vestibule

Q.21 Spermatozoa are nourished during their development by –
(A) Setroli cells (B) Interstitial cells
(C) Connective tissue cells (D) None of these

Q.22 Vasa deferentia together with seminal vesicle forms
(A) caput epididymis (B) corpus epididymis
(C) ejaculatory duct (D) cauda epididymis

Q.23 Which of the following is the correct match about the female external genitalia and their functions?
(A) Mons pubis : Cushion of fatty tissue covered by skin and pubic hair and surround the vaginal orifice.
(B) Labia majora : Fleshy folds of tissue which extend down from the mons pubis and surround the vaginal opening.
(C) Labia minora : Paired folds of tissue under the labia majora homologous to scrotum in males.
(D) Clitoris : A tiny finger like structure which lies at the upper junction of the two labia minora above the urethral opening. It is analogous to penis in males.

Q.24 _____ are the paired folds of tissue under the labia majora. The opening of vagina is covered partially by ____, _____ is the finger-like projection, which lies at the upper junction of two labia minora and urethral opening.
(A) Labia minora, hymen, clitoris
(B) Labia minora, clitoris hymen
(C) Hymen, clitories, Labia minora
(D) Hymen, Labia minora, Labia majora

Q.25 Which of the following is not a correct statement about umbilical cord?
(A) It connects the placenta to the embryo.
(B) It helps in the transport of substances to and from the embryo.
(C) It produces several hormones like hPL, estrogen and progesterone.
(D) It has 100% foetal blood.

Q.26 Placenta acts as an
(A) endocrine gland (B) exocrine gland
(C) apocrine gland (D) merocrine gland

Q.27 After ovulation Graafian follicle transforms into
(A) Corpus luteum (B) Corpus albicans
(C) Corpus callosum (D) Follicular atresia

Q.28 Which part of ovary in mammals acts as an endocrine gland after ovulation?
(A) Graafian follicle (B) Stroma
(C) Germinal epithelium (D) Vitelline membrane

Q.29 The mammary glands are paired structures that contain the glandular tissue and variable amount of fat. The correct sequence of tissues involved in synthesis and flow of milk are
(A) Mammary lobes → Mammary alveoli → Mammary ampulla → Mammary duct → Lactiferous duct
(B) Mammary lobes → Mammary alveoli → Mammary duct → Mammary ampulla → Lactiferous duct
(C) Mammary lobes → Mammary alveoli → Lactiferous duct → Mammary ampulla → Mammary duct
(D) Mammary alveoli → Mammary lobes → Lactiferous duct → Mammary duct

Q.30 Which one develops from endodermis –
(A) Nervous system urinary bladder and eye
(B) Liver, connective tissue and heart
(C) Thymus, spiral cord and brain
(D) Liver, pancreas and thymus/thyroid

Q.31 Which of the following undergoes, the meiosis-I division?
(A) Primary spermatocytes
(B) Secondary spermatocytes
(C) Sertoli cell
(D) Leydig cell

Q.32 In the human female, menstruation can be deferred by the administration of
(A) LH only
(B) combination of FSH and LH
(C) combination of oestrogen and progesterone
(D) FSH only

Q.33 The stem cells which have potency to give rise to all tissues and organs are formed from –
(A) Trophoblast (B) Umbilical cord
(C) Inner cell mass (D) Placenta

Q.34 Milk secretion is maintained by _____. This hormone inhibits the release from the pituitary and counters the ____ and _____. Hence in nourishing mother, the menstrual cycle is suppressed.
(A) FSH, LH, prolactin
(B) prolactin, FSH, LH
(C) LH, FSH prolactin
(D) LH, prolectin, FSH

Q.35 Sometimes the labor pains are less and uterine contractions have to be induced. What do you think the doctors inject to facilitate delivery?
(A) Progesterone and estrogen hormones
(B) Oxytocin/ Pitocin
(C) FSH and LH
(D) Relaxin

Q.36 Wall of each seminiferous tubules is formed of a single layer called
(A) germinal epithelium (B) germ cell
(C) spermatogonia (D) spermatozoa

Q.37 Which one of the following is the correct match of the events occurring during menstrual cycle?

(A) Menstruation : Breakdown of myometrium and ovum not fertilised

(B) Ovulation : LH and FSH attain peak level and sharp fall in the secretion of progesterone

(C) Proliferative phase : Rapid regeneration of myometrium and maturation of Graafian follicle.

(D) Development of corpus luteum : Secretory phase and increased secretion of progesterone

Q.38 The main function of fimbriae of Fallopian tube is to –

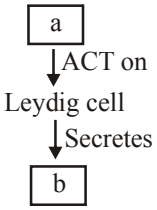
(A) help in development of ovary

(B) help in collection of the ovum after ovulation

(C) help in development of ova

(D) help in fertilisation

Q.39 Give the name of two hormones a and b in the figure given below.



(A) FSH and GH (B) LH and androgen

(C) GH and LH (D) GH and lactin

Q.40 Which chemical event of fertilisation involves the presence of hyaluronidase enzyme?

(A) Acrosomal reaction (B) Cortical reaction

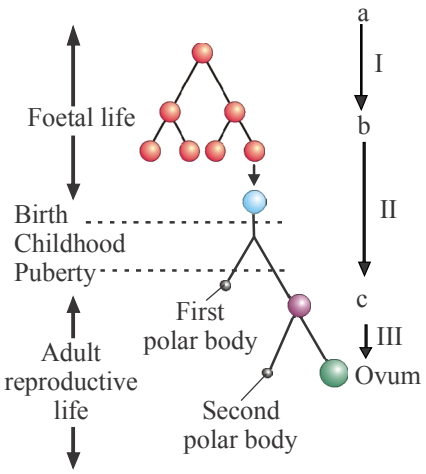
(C) Amphimixis (D) Activation of egg

Q.41 Secretion from which of the following structures prepares the inner wall of the uterus for implantation?

(A) Ovary (B) Pituitary gland

(C) Corpus luteum (D) Ovarian follicle

For Q.42-Q.44



Q.42 Identify a, b and c in the given figure

(A) a-Secondary oocyte, b-Oogonia, c-Primary oocyte

(B) a-Oogonia, b-Primary oocyte, c-Secondary oocyte

(C) a-Secondary oocyte, b-Primary oocyte, c-Oogonia

(D) a-Oogonia, b-Secondary oocyte, c-Primary oocyte

Q.43 Find out the chromosome number, in a, b, c.

(A) 46, 23, 23 (B) 46, 46, 23

(C) 46, 46, 46 (D) 46, 23, 46

Q.44 Type of cell division taking place at I, II and III stages are –

(A) I-meiosis, II-mitosis, III-mitosis-II

(B) I-mitosis, II-mitosis, III-meiosis

(C) I-rneiosis-I, II-rneiosis-II, III-mitosis

(D) I-mitosis, II-rneiosts-I, III-rneiosis-II

Q.45 If the levels of FSH and LH were not high enough to inhibit the release of GnRH, what could happen?

(A) nothing (B) no fertilization

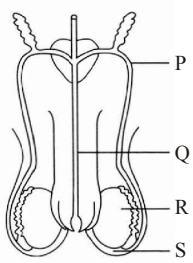
(C) possibility of twins (D) no menstrual phase

Q.46 If the prostate gland secretion were inhibited, other than a decreased volume, what is the effect on the semen?

(A) more basic semen (B) more acidic semen

(C) more alkaline semen (D) both (A) and (C)

Q.47 The diagram shows part of the reproductive system of a man.



What are the structures P, Q, R and S?

(A) P-Sperm duct, Q-Urethra, R-Scrotum, S-Testis
(B) P-Sperm duct, Q-Urethra, R-Testis, S-Scrotum
(C) P-Urethra, Q-Sperm duct, R-Scrotum, S-Testis
(D) P-Urethra, Q-Sperm duct, R-Testis, S-Scrotum

Q.48 During which of the following processes are female gametes being released from the sexual reproductive organs?

(A) Fertilisation (B) Implantation
(C) Menstruation (D) Ovulation

Q.49 Morphogenetic movements occur during

(A) implantation (B) gastrulation
(C) cleavage (D) parturition.

Q.50 A woman starts her menstrual period on February 1st. When is she likely to ovulate and when is she likely to start her next menstrual period?

(A) Ovulation-February 7th, Menstrual period-Feb. 21st
(B) Ovulation-February 14th, Menstrual period-March 1st
(C) Ovulation-February 21st, Menstrual period-March 1st
(D) Ovulation-February 28th, Menstrual period-March 7th

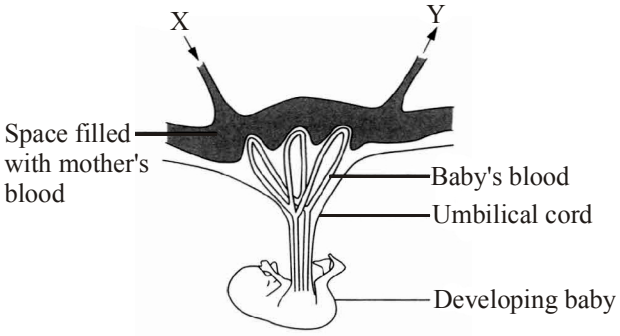
Q.51 In the testis, the first step in the process of meiosis

(A) spermiogenesis.
(B) production of four primary spermatocytes.
(C) production of interstitial cells in response to a surge in the production of LH.
(D) division of a primary spermatocyte to produce a pair of secondary spermatocytes.

Q.52 With respect to fertility, if someone was born without a pituitary gland, what would be the result?

(A) sterility
(B) they would be female
(C) multiple births with every pregnancy
(D) GnRH would be extremely low

Q.53 The diagram below shows a developing foetus in the uterus of a pregnant woman and how the foetus is attached to the placenta.



Which substance will decrease in concentration in the blood as it moves from X to Y?

(A) Amino acids (B) Urea
(C) Carbon dioxide (D) White blood cells

Q.54 A pregnant woman sets off to sail alone on a voyage which she expects to last between two to three months. There is no likelihood of her being able to obtain any food except fish. She takes adequate supplies of carbohydrate, fat and protein foods. Which part of the fish that she catches will be of most value to her?

(A) The brain (B) The muscle tissue
(C) The liver (D) The heart

Q.55 Type of cleavage in an egg is determined by :

(A) Amount and distribution of yolk
(B) Number of egg membranes
(C) Size and location of nucleus
(D) Shape and size of sperm

Q.56 Milk production in the mammary glands

(A) is initiated during the birth process.
(B) occurs by the process of meiosis.
(C) occurs post pregnancy.
(D) is stimulated by a combination of hormones including prolactin, hCG, and hPL.

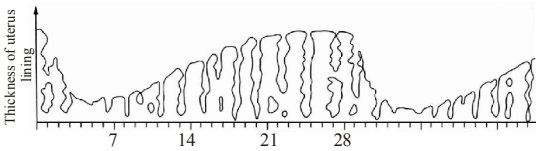
Q.57 Which of the following statements about the umbilical vessels is correct?
(A) Blood pressure of the umbilical artery and umbilical vein is the same.
(B) Umbilical artery transports blood away from the mother's heart.
(C) Umbilical artery contains higher amount of urea than umbilical vein.
(D) Umbilical vein contains higher amount of CO_2 than umbilical artery.

Q.58 Which statement about sperm cells is correct?
(A) They all contain one X chromosome.
(B) They all contain two X chromosomes.
(C) They all contain one Y chromosome.
(D) They contain either one X chromosome or one Y-chromosome.

Q.59 Which of the following characteristics is not associated with testosterone?
(A) maintains secondary sex characteristics
(B) responsible for primary sex characteristics
(C) principal androgen
(D) protein hormone

Q.60 Descent of the testes –
(A) occurs after birth.
(B) occurs during the first prenatal month.
(C) is not affected by changes in the relative growth rates of the intra-abdominal structures
(D) is controlled by testosterone.

Q.61 The diagram shows changes in the lining of the uterus during the menstrual cycle.



On which day would intercourse be most likely to lead to pregnancy?
(A) Day 7 (B) Day 14
(C) Day 21 (D) Day 28

Q.62 The seminiferous tubules–
(A) are the site of spermatogenesis
(B) produce most of the seminal fluid
(C) empty directly into the vas deferens
(D) are located within the cavernous body

Q.63 Which reproductive organ(s) of the female secrete fluid for vaginal lubrication during coitus?
(A) Uterine tubes (B) Labia majora
(C) Vestibular glands (D) Pudendal cleft

Q.64 Which of the following causes menstruation to occur?
(A) High level of progesterone in the blood
(B) Low level of progesterone in the blood
(C) High level of oestrogen in the blood
(D) Low level of luteinising hormone in the blood

Q.65 Gonads develop from embryonic
(A) ectoderm
(B) endoderm
(C) mesoderm
(D) both mesoderm and endoderm.

Questions 66-70

Refer to the list of terms below about hormones. Choose the best answer that fits each of the following descriptions.
(A) Follicle-stimulating hormones (FSH)
(B) Oxytocin
(C) Gonadotropic-releasing hormone (GnRH)
(D) Estrogen

Q.66 Causes labor

Q.67 Released by the hypothalamus and stimulates the anterior pituitary.

Q.68 Stimulates the ovary to mature a secondary oocyte.

Q.69 Responsible for thickening the endometrial lining of the uterus.

Q.70 Stimulates sperm production

Questions 71-73

How many chromosomes are in each of the following human cells?

Q.71 Primary spermatocyte?
(A) 23 (B) 46
(C) 96 (D) 72

Q.72 Spermatogonium cell?
(A) 23 (B) 46
(C) 96 (D) 72

Q.73 Spermatid?
(A) 23 (B) 46
(C) 96 (D) 72

Q.74 During the menstrual cycle, what is the main source of progesterone in human females?
(A) anterior pituitary (B) posterior pituitary
(C) hypothalamus (D) corpus luteum

Q.75 Sperm gain motility in the
(A) vas deferens (B) epididymis
(C) seminiferous tubules (D) interstitial cells

Q.76 In vertebrate animals, one primary oogonium develops into active egg cell(s).
(A) 1 (B) 2
(C) 4 (D) 8

Q.77 After ovulation the secondary oocyte enters the
(A) ovary (B) corpus luteum
(C) cervix (D) oviduct

Q.78 Which is FALSE about embryonic development?
(A) Early embryonic division in deuterostomes is spiral.
(B) The hollow ball stage is called the blastula.
(C) The end of gastrulation is defined by the formation of primary germ layers.
(D) The archenteron is the primary gut.

Q.79 Fertilization is –
(A) Union of diploid spermatozoon with diploid ovum to form diploid zygote.
(B) Union of haploid sperm with haploid ovum to form haploid zygote.
(C) Union of haploid sperm with haploid ovum to form diploid zygote.
(D) Union of diploid sperm with haploid ovum to form triploid zygote.

Q.80 A mature sperm has –
(A) A pair of flagella
(B) A nucleus, an acrosome and a centriole
(C) A nucleus, an acrosome, a pair of centrioles
(D) A nucleus, an acrosome, a pair of centrioles and a tail.

Q.81 Ovulation occurs under the influence of –
(A) LH (B) FSH
(C) Estrogen (D) Progesterone

Q.82 Part of sperm involved in penetrating egg membrane is –
(A) Tail (B) Acrosome
(C) Allosome (D) Autosome

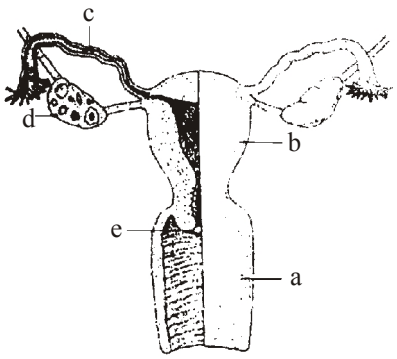
EXERCISE - 3 (LEVEL-3)

Choose one correct response for each question.

Q.1 In human beings, pregnancy lasts for 9 months. The gestation period of dog, elephant, cat and cow is given below. Which of the following is wrong match?

	Animal	Gestation period
(A)	Dog	60 - 65 days
(B)	Elephant	607 - 641 days
(C)	Cat	52 - 65 days
(D)	Cow	330 - 345 days

Q.2 Match each function below with its associated part (or parts) of the human female reproductive system shown in the figure.



I. Where is the egg produced?
II. Where does fertilisation occur?
III. Where would implantation of a fertilised egg take place?
IV. Where are oestrogen and progesterone produced?
V. What part receives the penis during copulation?

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

Q.3 Match the following column.

	Column I	Column II
a.	Hypothalamus	1. Spermolysis
b.	Acrosome	2. Oestrogen
c.	Graafian follicle	3. Relaxin
d.	Leydig cells	4. GnRH
e.	Parturition	5. Testosterone

Codes

(A) (a)–(iv), (b)–(i), (c)–(ii), (d)–(iii), (e)–(v)
(B) (a)–(ii), (b)–(i), (c)–(iv), (d)–(iii), (e)–(v)
(C) (a)–(ii), (b)–(i), (c)–(v), (d)–(iv), (e)–(iii)
(D) (a)–(iv), (b)–(i), (c)–(ii), (d)–(v), (e)–(iii)

Q.4 The blastomeres in the blastocyst are arranged into an outer layer called ____ and an inner group of cells attached to trophoblast called the ____. mass.
The trophoblast layer gets attached to the ____ and the ____ differentiated as the embryo. As a result the _____ becomes embeded in the endometrium of the uterus. This is called ____ and it leads to pregnancy. Blanks given in the above paragraph are filled in chronological order as

(A) inner cell, trophoblast, endometrium, inner mass cell, blastocyst, implantation.
(B) trophoblast. inner cell, endometrium, inner mass cell, blastolyst, implantation.
(C) trophoblast, inner cell, endometrium, inner mass cell, implantation, blastocyst
(D) trophoblast, inner cell, inner cell mass, endometrium, implantation, blastocyst

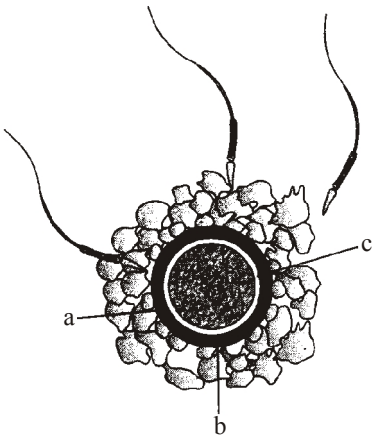
Q.5
a. Humans reproduces ___
b. Humans are ___
c. Fertilisation is ___ in humans.
d. Male and female gametes are ___.
E. Zygote is ___.
f. The process of release of ovum from a mature follicle is called ___.
g. Ovulation is induced by a hormone called ___.
h. The fusion of male and female gametes is called ___.
i. Zygote divides to form _____ which is implanted in uterus.
j. The structure which provides vascular connection between foetus and uterus is called ___.

Blanks in the statements a to j in the above statements is

(A) a-asexually, b-viviparous, c-external, d-diploid, e-haploid, f-ovulation, g-LH, h-fertilisation, i-blastocyst, j-placenta

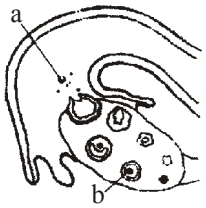
(B) a-sexually, b-viviparous, c-external, d-haploid, e-diploid, f-ovulation, g-LH, h-fertilisation, i-blastocyst, j-placenta
(C) a-asexually, b-viviparous, c-internal, d-haploid, e-diploid, f-ovulation, g-LH, h-fertilisation, i-blastocyst, J-placenta
(D) a-sexually, b-viviparous, c-internal, d-haploid, e-diploid, f-ovulation g-LH, h-fertilisation, i-blastocyst, j-placenta

For Q.6-Q.8



Q.6 The given diagram refers to ovum surrounded by few sperms. Identify a, b and c in the diagram
(A) a-Zona pellucida, b-Perivitelline space, c-Corona reticulata
(B) a-Zona pellucida, b-Vitelline membrane, c-Corona radiata
(C) a-Zona pellucida, b-Perivitelline space, c-Corona radiata
(D) a-Oolemma, b-Perivitelline space, c-Corona radiata

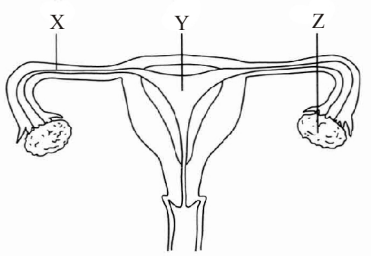
Q.7 When did the structure labelled (b) in the given figure starts to form?



(A) Infancy
(B) Before birth
(C) At the start of the menstrual cycle
(D) At puberty

Q.8 What stage of the menstrual cycle is characterised by the event labelled (a)
(A) corpus luteum formation
(B) ovulation
(C) flow
(D) fertilisation

Q.9 The diagram represents part of the female reproductive system.



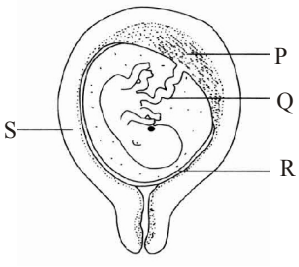
Where do fertilisation, implantation of the embryo and ovulation occur?
(A)Fertilisation-X, Implantation-Y, Ovulation-Z
(B)Fertilisation-X, Implantation-Z, Ovulation-Y
(C)Fertilisation-Y, Implantation-X, Ovulation-Z
(D)Fertilisation-Y, Implantation- Z,Ovulation-X

Q.10 The pathway of the spermatozoa from the testes to the exterior of the body through tubules in the correct order is
(A) epididymis, ductus deferens, urethra, ejaculatory duct, and seminal vesicles.
(B) seminal vesicles, ejaculatory duct, urethra, and epididymis.
(C) ductus deferens, ejaculatory duct, and urethra.
(D) epididymis, ductus deferens, ejaculatory duct, and urethra.

Q.11 Which of the following are the essential roles of amniotic fluid during the development of the foetus?
(i) To nourish the foetus
(ii) To prevent the foetus from drying up
(iii) To provide cushioning for the foetus
(A) (i) and (ii) only (B) (i) and (iii) only
(C) (ii) and (iii) only (D) (i), (ii) and (iii)

For questions 12 and 13

Figure shows a foetus in the mother's body.



Q.12 Which structure is the placenta?

(A) P (B) Q
(C) R (D) S

Q.13 Which of the following are the functions of structures P, Q and R?

(A) Structure P-Food supply, Structure Q-Gaseous exchange, Structure R-Protection
(B) Structure P-Food transport, , Structure Q-Protection, Structure R-Gaseous exchange
(C) Structure P-Gaseous exchange, Structure Q-Food transport, Structure R-Protection
(D) Structure P-Protection, , Structure Q-Food supply, Structure R-Gaseous exchange.

Q.14 A newly-wedded couple decide to do some family planning. On which days should the wife refrain from sexual intercourse if her menstruation starts on 25th August?

(A) 26th August to 30th August
(B) 1st September to 4th September
(C) 5th September to 11th September
(D) 12th September to 18th September

Q.15 A woman ovulated on 1st March. In which week is her blood oestrogen level high?

Week	March						
	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
(A)	-	-	-	1	2	3	4
(B)	5	6	7	8	9	10	11
(C)	12	13	14	15	16	17	18
(D)	19	20	21	22	23	24	25

Q.16 Which of the following ways can AIDS be transmitted from an infected mother to the baby?

I. Via placenta during gestation
II. During delivery of baby
III. Consuming breast milk

(A) I only (B) I and II only
(C) II and III only (D) I, II and III

Q.17 The normal, periodic flow of blood from the vagina is associated with

(A) ovulation
(B) orgasm
(C) sloughing of the endometrium
(D) removal of the inner lining of the vagina

Q.18 Arrange the following stages into the correct sequence.

(a) spermatogonium
(b) spermatid
(c) primary spermatocyte
(d) secondary spermatocyte
(e) sperm

(A) b, a, c, d, e (B) e, a, c, d, b
(C) d, c, a, b, e (D) a, c, d, b, e

Q.19 Primitive, undifferentiated stem cells that line the seminiferous tubules are called

(A) sperm (B) spermatids
(C) primary spermatocytes (D) spermatogonia

Q.20 The function of the placenta is to

(A) support the weight of the developing foetus in the uterus.
(B) store gases and nutrients for later delivery to the foetus.
(C) produce hormones and facilitate gas and nutrient exchange between the foetus and mother.
(D) allow direct exchange of blood between the mother and foetus for nutrition.

Q.21 Androgen-binding protein

(A) is secreted by Sertoli cells
(B) stimulates estrogen production
(C) inhibits secretion of FSH
(D) inhibits spermatogenesis

Q.22 Which of the following statements regarding the testes are correct?

(i) Leydig cells secrete testosterone.
(ii) Testosterone inhibits the secretion of LH by negative feedback regulation.

(iii) Sertoli cells prevent free diffusion of water-soluble substances between the seminiferous tubules and the blood.
(iv) Leydig's cells respond to testosterone by synthesising androgen binding protein.
(v) Sertoli cells line the seminiferous tubules and directly give rise to the developing sperm.
(A) (i), (ii) and (iv) (B) (ii) and (v)
(C) (i), (ii) and (iii) (D) (iv) and (v)

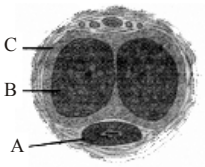
Q.23 The corpus luteum
(A) is surrounded by ova
(B) degenerates if fertilization occurs
(C) develops in the preovulatory phase
(D) serves as a temporary endocrine gland

Q.24 During cleavage
(A) nucleocytoplasmic ratio remains unchanged
(B) size does not increase
(C) there is less consumption of oxygen
(D) the division is like meiosis.

Q.25 Which sequence best describes the passage of sperm?
(a) seminiferous tubules (b) vas deferens
(c) epididymis (d) ejaculatory duct
(e) urethra
(A) c, a, b, d, e (B) a, c, b, d, e
(C) e, d, b, c, a (D) a, c, d, b, e

Q.26 The endometrium
(A) is the muscle layer of the uterus
(B) is thickest during the preovulatory phase
(C) is the site of embryo implantation
(D) lines the vagina

Q.27 Refer to the given figure of T.S. of penis.



How will penile function be altered if the blood supply to the B is impaired?
(A) Erection will be able to occur, but ejaculation will not be possible.
(B) The urethra will become occluded.
(C) Erection will not occur.
(D) The erect penis will be unable to become flaccid.

Q.28 Uterine contraction is strongly stimulated by
(A) progesterone (B) FSH
(C) LH (D) oxytocin

Q.29 Pelvic inflammatory disease is commonly caused by
(A) syphilis (B) gonorrhea
(C) genital herpes (D) chlamydia

Q.30 Cleavage in fertilized egg of humans
(A) is meroblastic
(B) starts when egg reaches uterus
(C) starts in Fallopian tube
(D) is identical to normal mitosis.

Q.31 Column I contains terms and column II contains definitions. Match them correctly and choose the right answer.

	Column I	**Column II**
a.	Parturition	p. Attachment of zygote to endometrium
b.	Gestation	q. Release of egg from Graafian follicle
c.	Ovulation	r. Delivery of baby from uterus
d.	Implantation	s. Duration between pregnancy and birth
e.	Conception	t. Formation of zygote by fusion of the egg and sperm
		u. Stoppage of ovulation and menstruation

(A) a = q, b = s, c = p, d = t, e = r
(B) a = s, b = r, c = p, d = t, e = q
(C) a = t, b = p, c = q, d = r, e = s
(D) a = r, b = s, c = q, d = p, e = t

Note (Q.32-Q.38) :
(A) Statement- 1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1
(B) Statement -1 is True, Statement -2 is True ; Statement-2 is NOT a correct explanation for Statement - 1
(C) Statement - 1 is True, Statement- 2 is False
(D) Statement -1 is False, Statement -2 is False

Q.32 **Statement 1 :**Embryonic development proves interrelationship and common ancestory of metazoans.
Statement 2 : It involves similar sequence of five dynamic processes during development.

Q.33 **Statement 1 :** Penetration of sperm into ovum is a chemical process.
Statement 2 : Acrosome of sperm secretes a lytic enzyme hyaluronidase which dissolves vitelline membrane of ovum.

Q.34 **Statement 1 :** Implantation is the process of attachment of blastocyst on uterine endometrium.
Statement 2 : Implantation is controlled by trophoblast and occurs by decidual cell reaction.

Q.35 **Statement 1 :** In human male, testes are extra-abdominal and lie in scrotal sacs.
Statement 2 : Scrotum acts as thermoregulator and keeps testicular temperature lower by 2°C normal spermatogenesis.

Q.36 **Statement 1 :** At puberty, human male develops secondary sexual characters.
Statement 2 : At puberty, there is decreased secretion of testosterone in male.

Q.37 **Statement 1 :** Infection of urethra is more common in female than male.
Statement 2 : Urethra is shorter in female than male.

Q.38 **Statement 1 :** Holoblastic cleavage with almost equal sized blastomeres is a characteristic of placental animals.
Statement 2 : Eggs of most mammals, including human, are of centrolecithal type.

EXERCISE - 4 (PREVIOUS YEARS AIPMT/NEET EXAM QUESTIONS)

Choose one correct response for each question.

Q.1 Sertoli cells are found in **[AIPMT 2010]**
(A) Ovaries and secrete progesterone.
(B) Adrenal cortex and secrete adrenaline.
(C) Seminiferous tubules and provide nutrition to germ cells.
(D) Pancreas and secrete cholecystokinin.

Q.2 Vasa efferentia are the ductules leading from
(A) Testicular lobules to rete testis
(B) Rete testis to vas deferens **[AIPMT 2010]**
(C) Vas deferens to epididymis
(D) Epididymis to urethra

Q.3 Seminal plasma in human males is rich in
(A) Fructose and calcium **[AIPMT 2010]**
(B) Glucose and calcium
(C) DNA and testosterone
(D) Ribose and potassium

Q.4 The signals for parturition originate from
(A) Placenta only **[AIPMT 2010]**
(B) Placenta as well as fully developed foetus
(C) Oxytocin released from maternal pituitary
(D) Fully developed foetus only

Q.5 The first movements of the foetus and appearance of hair on its head are usually observed during which month of pregnancy ? **[AIPMT 2010]**
(A) Fourth month (B) Fifth month
(C) Sixth month (D) Third month

Q.6 The second maturation division of the mammalian ovum occurs **[AIPMT 2010]**
(A) Shortly after ovulation before the ovum makes entry into the Fallopian tube.
(B) Until after the ovum has been penetrated by a sperm.
(C) Until the nucleus of the sperm has fused with that of the ovum.
(D) In the Graafian follicle following the first maturation divisions.

Q.7 Which one of the following statements about human sperm is correct ? **[AIPMT 2010]**
(A) Acrosome has a conical pointed structure used for piercing and penetrating the egg, resulting in fertilization.
(B) The sperm lysins in the acrosome dissolve the egg envelope facilitating fertilization
(C) Acrosome serves as a sensory structure leading the sperm towards the ovum.
(D) Acrosome serves no particular function.

Q.8 Which one of the following statements about morula in humans is correct ? **[AIPMT 2010]**
(A) It has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA.
(B) It has far less cytoplasm as well as less DNA than in an uncleaved zygote.
(C) It has more or less equal quantity of cytoplasm and DNA as in uncleaved zygote.
(D) It has more cytoplasm and more DNA than an uncleaved zygote.

Q.9 The part of Fallopian tube closest to the ovary is **[AIPMT 2010]**
(A) Isthmus (B) Infundibulum
(C) Cervix (D) Ampulla

Q.10 Signals from fully developed foetus and placenta ultimately lead to parturition which requires the release of – **[AIPMT 2010]**
(A) Estrogen from placenta
(B) Oxytocin from maternal pituitary
(C) Oxytocin from foetal pituitary
(D) Relaxin from placenta

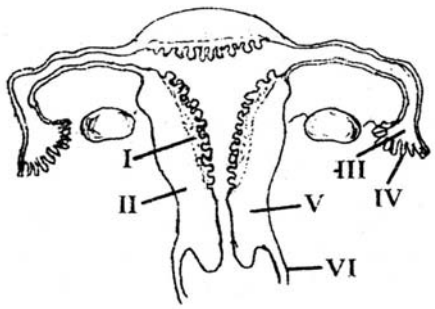
Q.11 In human female the blastocyst **[AIPMT 2010]**
(A) Forms placenta even before implantation.
(B) Gets implanted into uterus 3 days after ovulation.
(C) Get nutrition from uterine endometrial secretion only after implantation.
(D) Gets implanted in endometrium by the trophoblast cells.

Q.12 Secretions from which one of the following are rich in fructose, calcium and some enzymes ? **[AIPMT 2010]**
(A) Male accessory glands (B) Liver
(C) Pancreas (D) Salivary glands

Q.13 If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from **[AIPMT 2011]**
(A) Testes to epididymis
(B) Epididymis to vas deferens
(C) Ovary to uterus
(D) Vagina to uterus

Q.14 The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. The purpose served is for **[AIPMT 2011]**
(A) Maintaining the scrotal temperature lower than the internal body temperature
(B) Escaping any possible compression by the visceral organs
(C) Providing more space for the growth of epididymis
(D) Providing a secondary sexual feature for exhibiting the male sex.

Q.15 The figure given below depicts a diagrammatic sectional view of the human female reproductive system. Which set of three parts out of I-VI have been correctly identified ? **[AIPMT 2011]**



(A) (II) endometrium, (III) infundibulum, (IV) fimbriae
(B) (III) Infundibulum, (IV) fimbriae, (V) Cervix
(C) (IV) oviducal funnel, (V) Uterus, (VI) cervix
(D) (I) Perimetrium, (II) myometrium, (III) Fallopian tube

Q.16 What happens during fertilization in humans after many sperms reach close to the ovum ? **[AIPMT 2011]**
(A) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida.
(B) All sperms except the one nearest to the ovum lose their tails.
(C) Cells of corona radiata trap all the sperms except one.
(D) Only two sperms nearest the ovum penetrate zona pellucida.

Q.17 About which day in a normal human menstrual cycle does rapid secretion of LH (popularly called LH surge) normally occurs ? **[AIPMT 2011]**
(A) 14^{th} day (B) 20^{th} day
(C) 5^{th} day (D) 11^{th} day

Q.18 Which one of the following statements is false in respect of viability of mammalian sperm ? **[AIPMT 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.

Q.19 Signals for parturition originate from
(A) Both placenta as well as fully developed foetus **[AIPMT 2012]**
(B) Oxytocin released from maternal pituitary
(C) Placenta only
(D) Fully developed foetus only

Q.20 In a norm al pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was **[AIPMT 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 levels of FSH and LH in uterus to stimulate endometrial thickening
(D) High level of circulating hCG to stimulate estrogen and progesterone synthesis.

Q.21 The Leydig cells as found in the human body are the secretory source of **[AIPMT 2012]**
(A) Progesterone (B) Intestinal mucus
(C) Glucagon (D) Androgens

Q.22 The secretory phase in the human menstrual cycle is also called **[AIPMT 2012]**
(A) Luteal phase and lasts for about 6 days
(B) Follicular phase and lasts for about 6 days
(C) Luteal phase and lasts for about 13 days
(D) Follicular phase and lasts for about 13 days

Q.23 Which one of the following is not the function of placenta? It : **[NEET 2013]**
(A) secretes oxytocin during parturition.
(B) facilitates supply of oxygen and nutrients to embyro.
(C) secretes estrogen.
(D) facilitates removal of carbon dioxide and waste material from embryo.

Q.24 Menstrual flow occurs due to lack of – **[NEET 2013]**
(A) Vasopressin (B) Progesteron
(C) FSH (D) Oxytocin

Q.25 What is the correct sequence of sperm formation? **[NEET 2013]**
(A) Spermatogonia, spermatocyte, spermatid, spermatozoa
(B) Spermatid, spermatocyte, spermatogonia, spermatozoa
(C) Spermatogonia, spermatocyte, spermatozoa, spermatid
(D) Spermatogonia, spermatozoa, spermatocyte, spermatid

Q.26 The shared terminal duct of the reproductive and urinary system in the human male is **[AIPMT 2014]**
(A) Urethra (B) Ureter
(C) Vas deferens (D) Vasa efferentia

Q.27 The main function of mammalian corpus luteum is to produce **[AIPMT 2014]**
(A) Estrogen only (B) Progesterone
(C) Human chorionic gonadotropin (D) Relaxin

Q.28 Correct option describing gonadotropin activity in a normal pregnant female – **[AIPMT 2014]**
(A) High level of FSH and LH stimulates the thickening of endometrium.
(B) High level of FSH and LH facilitate implantation of the embryo.
(C) High level of hCG stimulates the synthesis of estrogen and progesterone.
(D) High level of hCG stimulates the thickening of endometrium.

Q.29 Which of these in not and important component of initiation of parturition in humans?
(A) synthesis of prostaglandins **[AIPMT 2015]**
(B) Release of oxytocin
(C) Release of prolactin
(D) Increase in estrogen and progesterone ratio

Q.30 Capacitation refers to changes in the :
(A) ovum before fertilization **[AIPMT 2015]**
(B) ovum after fertilization
(C) sperm after fertilization
(D) sperm before fertilization

Q.31 Hysterectomy is surgical removal of : **[AIPMT 2015]**
(A) Prostate gland (B) Vas-deference
(C) Mammary glands (D) Uterus

Q.32 Which of the following cells during gametogenesis is normally diploid? **[AIPMT 2015]**
(A) Spermatid
(B) Spermatogonia
(C) Secondary polar body
(D) Primary polar body

Q.33 Which of the following events is not associated with ovulation in human female?
(A) Full development of Graffian follicle
(B) Release of secondary oocyte
(C) LH surge **[RE-AIPMT 2015]**
(D) Decrease in estradiol

Q.34 Ectopic pregnancies are referred to as:
(A) Implantation of embryo at site other than uterus. **[RE-AIPMT 2015]**
(B) Implantation of defective embryo in the uterus
(C) Pregnancies terminated due to hormonal imbalance.
(D) Pregnancies with genetic abnormality.

Q.35 Which of the following layers in an antral follicle is acelluar? **[RE-AIPMT 2015]**
(A) Theca interna (B) Stroma
(C) Zona pellucida (D) Granulosa

Q.36 In human females, meiosis-II in not completed until? **[RE-AIPMT 2015]**
(A) fertilization (B) uterine implantation
(C) birth (D) puberty

Q.37 Fertilization in humans is practically feasible only if **[NEET 2016 PHASE 1]**
(A) The sperms are transported into vagina just after the 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 & 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.

Q.38 Select the **incorrect** statement : **[NEET 2016 PHASE 1]**
(A) FSH stimulates the sertoli cells which help in spermiogenesis.
(B) LH triggers ovulation in ovary
(C) LH and FSH decrease gradually during the follicular phase.
(D) LH triggers secretion of androgens from the Leydig cells.

Q.39 Changes in GnRH pulse frequency in females is controlled by circulating levels of **[NEET 2016 PHASE 1]**
(A) Estrogen and progesterone
(B) Estrogen and inhibin
(C) Progesterone only
(D) Progesterone and inhibin

Q.40 Identify the correct statement on inhibin
(A) Inhibits the secretion of LH, FSH and Prolactin. **[NEET 2016 PHASE 1]**
(B) Is produced by granulose cells in ovary and inhibits the secretion of FSH.
(C) Is produced by granulose cells in ovary and inhibits the secretion of LH.
(D) Is produced by nurse cells in testes and inhibits the secretion of LH.

Q.41 Which of the following depicts the correct pathway of transport of sperms? **[NEET 2016 PHASE 2]**
(A) Rete testis → Efferent ductules → Epididymis → Vas deferens
(B) Rete testis → Epididymis → Efferent ductules → Vas deferens
(C) Rete testis → Vas deferens → Efferent ductules → Epididymis
(D) Efferent ductules → Rete testis → Vas deferens → Epididymis

Q.42 Match Column-I with Column-II. **[NEET 2016 PHASE 2]**

	Column-I	**Column-II**
a.	Mons pubis	(i) Embryo formation
b.	Antrum	(ii) Sperm
c.	Trophectoderm	(iii) Female external genitalia
d.	Nebenkern	(iv) Graafian follicle

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

Q.43 Several hormones like hCG, hPL, estrogen, progesterone are produced by **[NEET 2016 PHASE 2]**
(A) Ovary (B) Placenta
(C) Fallopian tube (D) Pituitary

Q.44 GnRH, a hypothalamic hormone, needed in reproduction, acts on **[NEET 2017]**
(A) Anterior pituitary gland and stimulates secretion of LH and oxytocin.
(B) Anterior pituitary gland and stimulates secretion of LH and FSH.
(C) Posterior pituitary gland and stimulates secretion of oxytocin and FSH.
(D) Posterior pituitary gland and stimulates secretion of LH and relaxin.

Q.45 A temporary endocrine gland in the human body is **[NEET 2017]**
(A) Pineal gland (B) Corpus cardiacum
(C) Corpus luteum (D) Corpus allatum

Q.46 Amnion of mammalian embryo is derived from **[NEET 2018]**
(A) mesoderm and trophoblast
(B) endoderm & mesoderm
(C) ectoderm and mesoderm
(D) ectoderm and endoderm

Q.47 Hormones secreted by the placenta to maintain pregnancy are **[NEET 2018]**
(A) hCG, hPL, progestogens, estrogens
(B) hCG, hPL, estrogens, relaxin, oxytocin
(C) hCG, hPL, progestogens, prolactin
(D) hCG, progestogens, estrogens, glucocorticoids

Q.48 Difference between spermiogenesis and spermiation is **[NEET 2018]**
(A) In spermiogenesis spermatozoa from sertoli cells are released into the cavity of seminiferous tubules, while in spermiation spermatozoa are formed.
(B) In spermiogenesis spermatozoa are formed, while in spermiation spermatids are formed.
(C) In spermiogenesis spermatids are formed, while in spermiation spermatozoa are formed.
(D) In spermiogenesis spermatozoa are formed, while in spermiation spermatozoa are released from sertoli cells into the cavity of seminiferous tubules.

Q.49 Match the items given in Column I with those in Column II and select the correct option given below **[NEET 2018]**

Column I	Column II
a. Proliferative Phase	i. Breakdown of endometrial lining
b. Secretory Phase	ii. Follicular Phase
c. Menstruation	iii. Luteal Phase

(A) a-ii, b-iii, c-i (B) a-i, b-iii, c-ii
(C) a-iii, b-ii, c-i (D) a-iii, b-i, c-ii

Q.50 Select the correct sequence for transport of sperm cells in male reproductive system. **[NEET 2019]**
(A) Testis → Epididymis → Vasa efferentia → Rete testis → Inguinal canal → Urethra
(B) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus
(C) Seminiferous tubules → Vasa efferentia → Epididymis → Inguinal canal → Urethra
(D) Testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Inguinal canal→ Urethra→Urethral meatus

Q.51 Extrusion of second polar body from egg nucleus occurs **[NEET 2019]**
(A) after entry of sperm but before fertilization.
(B) after fertilization.
(C) before entry of sperm into ovum.
(D) simultaneously with first cleavage.

ANSWER KEY

EXERCISE-1 (SECTION-1&2)

(1) (B) **(2)** (A) **(3)** (A)
(4) (A) **(5)** (C) **(6)** Gametes
(7) Androgens. **(8)** Zona pellucida.
(9) Testis, glands, ducts, genitalia
(10) Primary; ovarian hormones
(11) Golgi body
(12) Spermatogenesis; Sertoli cell
(13) Penis **(14)** Epididymis, posterior
(15) Oogonia **(16)** Primary follicle
(17) Alveoli, milk, mammary duct
(18) Antrum, secondary follicle, tertiary follicle
(19) Sexually **(20)** Viviparous
(21) Internal **(22)** Haploid
(23) Diploid **(24)** Ovulation
(25) Luteinising hormone **(26)** Fertilisation
(27) Oviduct (ampullary-isthmic junction)
(28) Blastocyst **(29)** Placenta
(30) 15-28 **(31)** Testosterone.
(32) seminal vesicles, urethra
(33) Chorionic villi; Uterine tissue
(34) False **(35)** True
(36) False **(37)** True
(38) **False.** Oogenesis takes place in the ovary.
(39) True **(40)** True

EXERCISE - 1 [SECTION-3 & 4]

Q	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
A	B	C	D	D	C	D	C	B	D	A	A	B	C	C	C	C	D	C	D	A
Q	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A	C	D	C	D	D	C	C	B	C	B	A	A	B	B	B	A	B	B	C	A
Q	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A	B	A	A	B	B	B	A	A	A	D	C	A	B	D	D	D	C	A	C	C
Q	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
A	C	B	A	C	A	C	C	D	C	A	A	B	C	C	C	B	A	C	A	C
Q	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
A	B	B	B	A	B	B	A	C	B	C	A	C	B	B	B	A	C	A	B	B
Q	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
A	B	B	C	B	C	A	D	C	A	D	A	B	A	B	A	C	C	C	B	C
Q	161	162	163	164	165	166	167	168	169	170										
A	C	D	C	A	A	C	B	D	C	B										

EXERCISE - 2

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	C	A	D	A	D	C	B	C	B	C	B	B	B	C	B	A	A	C	B
Q	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A	A	C	B	A	C	A	A	A	B	D	A	C	C	B	B	A	D	B	B	A
Q	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
A	C	B	B	D	C	B	B	D	B	B	D	A	A	C	A	C	C	D	D	DB
Q	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A	B	A	C	B	C	B	C	A	D	A	B	B	A	D	B	A	D	A	C	D
Q	81	82																		
A	A	B																		

EXERCISE - 3																				
Q	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	D	C	D	B	D	C	B	B	A	D	D	A	C	C	D	D	C	D	D	C
Q	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**		
A	A	C	D	B	B	C	C	D	D	C	D	A	A	B	A	C	A	C		

EXERCISE - 4																										
Q	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
A	C	B	A	B	B	B	B	A	B	B	D	A	A	A	B	A	A	A	A	D	D	C	A	B	A	A	B
Q	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**			
A	C	C	D	D	B	D	A	C	A	B	C	A	B	A	B	B	B	C	C	A	D	A	B	A			

SOLUTIONS

EXERCISE-1

(1) (B) **(2)** (A) **(3)** (A)
(4) (A) **(5)** (C) **(6)** Gametes
(7) Androgens. **(8)** Zona pellucida.
(9) Testis, glands, ducts, genitalia
(10) Primary; ovarian hormones
(11) Golgi body
(12) Spermatogenesis; Sertoli cell
(13) Penis **(14)** Epididymis, posterior
(15) Oogonia **(16)** Primary follicle
(17) Alveoli, milk, mammary duct
(18) Antrum, secondary follicle, tertiary follicle
(19) Sexually **(20)** Viviparous
(21) Internal **(22)** Haploid
(23) Diploid **(24)** Ovulation
(25) Luteinising hormone **(26)** Fertilisation
(27) Oviduct (ampullary-isthmic junction)
(28) Blastocyst **(29)** Placenta
(30) **15-28.** Luteal phase last for 15-28 days.
(31) Testosterone.
(32) seminal vesicles, urethra
(33) Chorionic villi; Uterine tissue
(34) **False.** Androgens are produced by Leydig cells found in seminiferous tubules of the testis.
(35) True
(36) **False.** Leydig cells are found in the seminiferous tubules of the testis.
(37) True
(38) **False.** Oogenesis takes place in the ovary.
(39) True **(40)** True
(41) **(B).** Male reproductive system is made up of a pair of testis, scrotum, vasa efferentia, a pair of epididymis, a pair of vasa diferentia, a pair of seminal vesicles, a pair of ejaculatory ducts, urethra, prostate gland, a pair of Cowper's gland and penis.
(42) (C) **(43)** (D)
(44) **(D).** Spermatogonium (2n)
↓
Primary spermatocytes (2n)
↓ Meiosis-I
Secondary spermatocytes
↓ Meiosis-II
Sperrnatids $\xrightarrow{\text{Spermiogenesis}}$ Spermatozoa
(45) (C) **(46)** (D) **(47)** (C) **(48)** (B)
(49) **(D).** a-Blood vessels, b-Primary follicles
c- Tertiary follicles showing antrum
d-Graafian follicles, e-Ovum
f-Corpus luteum
(50) **(A).** b and c represents primary and tertiary follicles respectively.
(51) **(A).** Blastomeres are of two type :
(i) **Trophoblast :** It give nourshment to embryo by attaching it to endomentrium wall
(ii) **Inner Mass of Cells :** They give rise to three germ layers and form embryo
(52) **(B).** After implantation, finger-like projections appear on the trophoblast called chorioic villi, which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called placenta.
(53) (C) **(54)** (C)
(55) **(C).** The cuboidal cells in germinal epithelium undergo mitosis to produce spermatogonia which grows into primary spermatocytes. These in turn undergoes meiosis producing haploid cells, firstly secondary spermatocytes and then spermatids. The latter get converted into spermatozoa (sperms). Sertoli cells provides nutrition to the developing sperms.
(56) (C)
(57) **(D).** Scrotum is homologous to labia majora in females. It is pouch of deeply pigmented skin divided into two separate sacs. Each sac contains one testis.
(58) **(C).** Epididymis stores the sperm and also secretes a fluid, which is considered to nourish the sperm. In epididymis the sperms are stored for few hours to few days till sent out through ejaculations and Sperms, if not ejaculated are reabsorbed. Testis and epididymis are together called testides.

(59) **(D).** Testicular lobules contains 1-3 seminiferous tubules.

(60) **(A).** Differences between Leydig's cells and Sertoli cells

S.N.	Leydig's Cells (Interstitial Cells)	Sertoli Cells (Sustentacular Cells)
1.	They are present in between the seminiferous tubules.	They are present in between the germinal epithelial cells of the seminiferous tubules.
2.	Leydig's cells are found in small groups and are rounded in shape.	Sertoli cells are found singly and are elongated.
3.	They secrete androgens e.g., testosterone) male sex hormones.	They provide nourishment to the developing permatozoa (sperms). Sertoli cells secrete ABP (Androgen Binding Protein) that concentrates testosterone in the seminiferous tubules. It also secretes another protein inhibin which suppresses FSH synthesis.

(61) **(C).** The urethra originates from the urinary bladder and extends through the penis to its external opening called urethral meatus.

(62) **(D).** Leydig cells/Interstitial cells form endocrine part of testis.

(63) **(C).** Inner portion of seminiferous tubules is lined by male germ cells and Sertoli cells.

(64) **(D).** Interstitial or Leydig cells.

(65) (D)

(66) **(C).** Two major entities of testes are seminiferous tubules and Leydig cells (or interstitial cells). Sertoli cells and spermatozoa are contained in seminiferous tubules only. Rest of the portion of testis is covered by connective tissue.

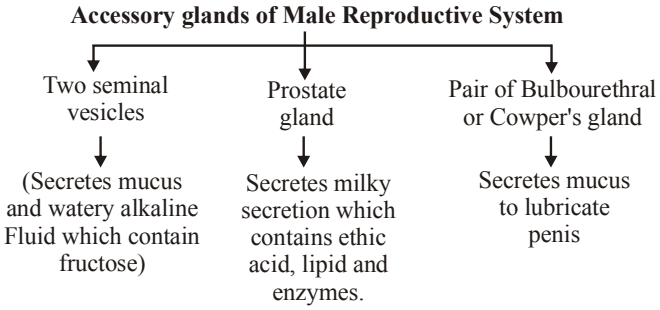
(67) **(C).** The forehead of the penis is covered by the skin. Foreskin and prepuce both terms are used for that skin.

(68) (B)

(69) **(C).** Region outside the seminiferous tubules is called interstitial space, which is lined by interstitial cells also called Leydig cells. Leydig cells secretes testosterone and also called endocrine part of the testis.

(70) (B) **(71)** (A) **(72)** (A) **(73)** (B)

(74) **(B).**



External genitalia of humans is called penis. Its outer skin, which covers the forehead of penis called foreskin or prepuce. It is the single opening for semen and urine in males.

(75) **(B).** The scrotum remains connected with abdomen or pelvic cavity by inguinal canals. The spermatic cord formed from the spermatic artery, vein and nerve bound together with connective tissue, passes into the testis through inguinal canal.

(76) **(A).** Scrotum maintains the temperature of testis, which is 2-2.5°C below the body temperature. In winter they reduce their surface area for preventing heat loss, so that temperature remains 34.5-35°C. In summer it increase their surface area for cooling, so that the temperature remains 34.5-35°C.

(77) **(B).**

(78) **(B).** The part of Fallopian tube closer to the ovary is funnel-shaped in fundibulum, which helps in the collection of the ovum after ovulation.

(79) **(C).**

(80) **(A).** External genitalia (vulva) of female has following parts :

(i) **Mons Pubis :** It is the anteriormost portion of the external genitalia which is covered by the skin and pubic hairs. It acts as a cushion during intercourse.

(ii) **Labia Majora :** These are fleshy folds of tissue which extend down from the mons pubis and surrounds the vaginal opening.

(iii) **Labia Minora :** These are paired folds of tissue under the labia majora.

(iv) **Hymen :** The opening of vagina covered partially by a membrane called hymen.

(v) Clitoris is a tiny finger-like structure which lies at the upper junction of the two labia minora above urethral opening.

(81) **(B).**

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

(83) **(A).**

(84) **(B).** In uterus the development of foetus takes place and this development lasts till parturition. Generally, in common language uterus is called womb.

(85) **(B).** Labia majora, these are two large fleshy folds of skin which form the boundary of vulva. They are partly covered by pubic hair and contain large number of sebaceous (oil) glands. The labia majora are considered homologous to the scrotum of the male.

(86) (B)

(87) **(A).** The cervix is the part which joins the anterior wall of the vagina and opens into it. The cavity of the cervix is called cervix canal. The cervix communicates above with the body of the uterus by an aperture called internal os and with the vagina below by an opening the external os.

(88) **(A).**

(89) **(A).** The glandular tissue comprises about 15-20 lobes in each breast. Each lobe is made up of number of lobules. Each lobule is composed of grape like cluster of milk secreting glands termed as alveoli. When milk is produced, it passes from alveoli into mammary lobules and into the mammary ducts.

(90) **(D).** Primary spermatocytes are diplold in number. Secondary (2°) spermatocytes and spermatids are haploid in number.

(91) (C)

(92) **(A).** After releasing ovum the structure left is called corpus luteum. It secretes progesterone, which maintains the pregnancy.

(93) **(B).** During spermatogenesis, one of the spermatogonium is selected and enlarge their size and volume called primary spermatocytes. Both are 2n in number. After meiosis-I the primary spermatocytes changes to 2° spermatocytes.

(94) **(D).** Acrosome is the part of sperm, which is found at the head region. It is the modified Golgi body that contain many enzymes for the penetration to ovum.

(95) **(D).** ICSH is the luteinising hormone. In male it stimulates the interstitial cells, so called interstitial stimulating hormone. Synthesis of testosterone by Leydig cell is stimulated by ICSH.

(96) **(D).** Second meiotic division give rise to haploid ovum (1n) and second polar body.

(97) (C)

(98) **(A).** In human sperms endoplasmic reticulum is absent.

(99) **(C).**

(100) **(C).** Sperm lysin is found in head region of sperm.

(101) **(C).** Seminal plasma is the combined secretion of three glands named (a) seminal vesicles (b) prostate gland (c) Cowper's gland, together with sperm they collectively form semen.

(102) (B)

(103) **(A).** Acrosome contains hyaluronidase proteolytic enzymes, which is popularly known as sperm lysin as it is used to penetrate egg (ovum) at the time of fertilisation.

(104) **(C).** One primary spermatocytes gives 4 haploid sperms. Four primary spermatocytes gives 16 haploid sperm.

(105) **(A).**

(106) **(C).** The transformation of spermatids into spermatozoa is called spermiogenesis or spermateliosis. The spermatids are later on known as sperms. After spermiogenesis head becomes embedded in the Sertoli cells and are finally released from the

seminiferous tubules by process called spermiation.

(107) (C) **(108)** (D)

(109) **(C).** The first phase of menstrual cycle is called menstrual phase.

(110) **(A).** Luteal phase is also called secretory phase.

(111) **(A).**

(112) **(B).** Progesterone and oestrogen, level of both rises in luteal or secretory phase.

(113) **(C).** Follicular phase is also called the proliferative phase.

(114) **(C).** LH and FSH both are present in follicular phase but LH's high concentration is seen in ovulatory phase.

(115) **(C).** Progesterone hormone is the main hormone, which maintains the endometrium wall.

(116) **(B).** **Menstrual cycle**

S.N.	Phases	Days	Events
1.	Menstrual phase	1-5	Endometrium breaks down, menstruation begins. The cells of endometrium, secretions, blood and the unfertilised ovum constitute the menstrual flow. Progesterone and LH oroduction is reduced.
2.	Follicular phase (proliferative phase	6-13	Endometrium rebuilds, FSH secretion and oestrogen's secretion increase.
3.	Ovulatory phase	14	Both LH and FSH attain a peak level. Concentration of oestrogen in the blood is also high and reaches its peak. Ovulation occurs.
4.	Luteal phase (secretory phase)	15-28	Corpus luteum secretes progesterone. Endometrium thickens and uterine glands become secretory.

(117) **(A).**

(118) **(C).** Graafian follicle is the mature follicle present in the ovary. It consist of an outermost layer called theca externa and inner to it, is theca interna.

(119) **(A).** In menstrual phase, the production of LH and progesterone decreases.

(120) (C)

(121) **(B).**

(122) **(B).**

(123) **(B).** In ovulatory phase, release of ova occurs due to the rapid increase in LH called LH surge. It last for maximum two days.

(124) (A)

(125) **(B).** Corpus luteum secretes progesterone which maintains the pregnancy by maintaining endometrium wall. Corpus luteum also secretes hormone relaxin.

(126) **(B).** Rapid mitosis in zygote into the blastomeres.

(127) **(A).** It is very necessary to reach the sperm at the ampullary region because, it is the site where ova waits for sperm for two days after ovulation. That's way all intercourse does not lead to fertilisation.

(128) **(C).** Second meiotic division takes place in ova after sperm and ova fusion. Proximal convulated tubules and distal convulated tubules at the neck region in sperm helps to complete the 2nd meiotic division.

(129) **(B).** Capacitation of Sperm The sperms in the female genital tract are made capable of fertilising the egg by the secretion of female genital tract. These secretions of the female genital tract removes the coating substances deposited on the surface of the sperms, particularly those on acrosome. Thus, the receptor sites on the acrosome are exposed and sperm become active to penetrate the egg. This phenomenon of sperm activation in mammals is called capacitation. It takes about 5-6 hr for capacitation of sperm.

(130) **(C).** Ovum and sperms must be transported simultaneously to ampullary-isthmic region if fertilisation is to occur. This is because the best time for fertilisation is just after ovulation, because the life span of ovum is 24 hours.

(131) **(A).** Ovum is a secondary oocyte which is released from mature Graafian follicle of an ovary.

(132) (C)

(133) **(B).**

(134) (B). The distal centriole of the sperm divides and forms two centrioles to generate the mitotic spindle formation for cell division.
The mammalian secondary oocyte (egg) does not have centriole of its own.

(135) (B). There are many enzymes in the acrosome like fertilisin, hyaluronidase, pectin corona penetrating enzyme, acrosin etc., together they are called sperm lysins.

(136) (A).

(137) (C). The body of the developing ovum is formed from the cells of inner mass.

(138) (A).

(139) (B). The cells formed by cleavage are called blastomere.

(140) (B). Nucleus of ovum is called female pronucleus.

(141) (B). **(142) (B).**

(143) (C). Due to changing of the membrane potential, there is depolarisation and due to depolarisation the entry of other sperms is blocked. This leads to the monospermy.

(144) (B).

(145) (C). Fertilisation takes place in ampulla of oviduct or ampullary isthmic junction.

(146) (A).

(147) (D). Sperm lysins contains hyaluronidase, corona penetrating enzyme, acrosin etc.

(148) (C). Placentation is a connection between foetus and uterine wall.

(149) (A). Chorionic villi is the modification of outer trophoblast layer of blastocyst, which get attached to the endometrium of uterus. This is called implantation.

(150) (D)

(151) (A). Fate map is the map of future organs of the embryo and it is decided in blastula stage of embryo. Hence, fate map is drawn in that stage.

(152) (B). Relaxin is secreted by ovary. Relaxin increases the flexibility of the pubic symphysis and ligaments of the sarcoiliac and sacrococcygeal joints that helps to dilate the uterine cervix during labour pain.

(153) (A).

(154) (B). Trophoectoderm (trophoblast).
It is the outer most layer of the cells of a blastocyst. It forms the foetal part of placenta and do not form any part of the embryo proper.

(155) (A) **(156)** (C) **(157)** (C)

(158) (C). Chorionic villi and uterine tissue become inter-digitated with each other and jointly form placenta.

(159) (B). hCG (Human Chorionic Gonadotrophic) and HPH (Human Placental hormone) released during the pregnancy.

(160) (C)

(161) (C). Blastopore is found in gastrula stage. It is opening of archenteron. Archenteron is the structure in gastrula, which give rise to the gut region of embryo (mouth to anus).

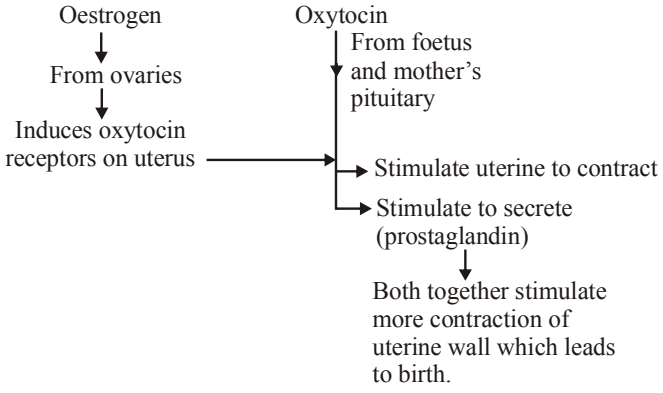
(162) (D). Placenta is the intimate connection between foetus and uterine wall of the mother to exchange material. Placenta performs (i) Nutrition (ii) Respiration (iii) Excretion (iv) Storage (c) Endocrine part of embryo.

(163) (C). In parturition there is strong uterine contraction that leads to the expulsion of baby called child birth.

(164) (A) **(165)** (A) **(166)** (C)

(167) (B). Colostrum have antibody-A which work against the pathogenicity in newborn. So, it is recommanded by doctors to feed new born from breast milk as for as possible.

(168) (D).



(169) (C). Milk secretion hormone → prolactin
Role of hormones in lactation/mammary gland.
(i) At puberty female mammary glands begin to develop under the influence of oestrogen and progesterone.

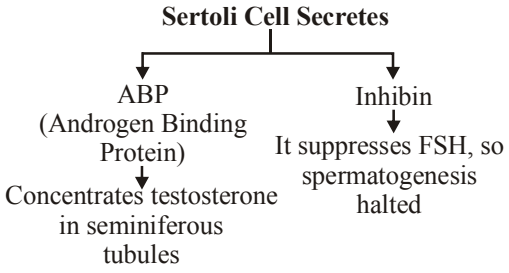
(ii) Secretion and storage of milk generally begins after birth of young ones by hormone prolactin secreted by anterior lobe of pituitory.
Ejection of milk is stimulated by hormone oxytocin (OT).

(170) (B)

EXERCISE-2

(1) **(A).** Bulbourethral gland secretes mucus, which lubricate penis during intercourse. This reduces the friction during the process. Bulbourethral gland is also called Cowper's gland.

(2) **(C).**



(3) **(A).** Follicle, corona radiata, zona pellucida.

Enzymes of Acrosome	**Working**
Hyaluronidase	Hydrolysis of hyaluronic acid
Corona penetrating enzyme	Dissolve corona radiata
Zona lysin or acrosin	Digest zona pellucida

(4) **(D).** In the ovulatory phase, both LH and FSH attain a peak level in the middle of cycle (about 14 day). Rapid secretion of LH induces rupturing of Graafian follicle and thereby releasing the ovum in human beings (secondary oocyte is released). This is called ovulation. Infact increased level of LH causes ovulation.

(5) **(A).** Extra embryonic membranes are the membrane except from the three germ layers. They are derived from trophoblast and forms the parts of placenta.

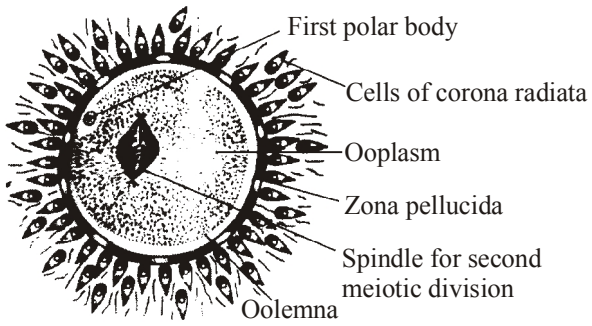
(6) **(D).** Cervical canal and vagina together form birth canal.

(7) (C)

(8) **(B).** Vasa deferentia emerges from tile cauda epididymis on each side and leaves the scrotal sac and enters the abdominal cavity through inguinal canal. It is lined by many stereocilia to transport the sperms from testis to the outside through urethra.

(9) **(C).**

(10) **(B).** Cortical granule, Cortical enzyme, Plasma membrane, Monospermy.
Ovum at the time of fertilisation looks like.



Structure of ovum at the time of fertilisation

(11) (C)

(12) **(B).** In a 28 day menstrual cycle, the menses takes place. For 3-5 days, the production of LH from the anterior lobe of the pituitary gland considerably reduced. The withdrawal of this hormone causes degeneration of the corpus luteum and therefore, progesterone production is reduced.
Production of oestrogen also reduced in this phase (menstrual). The endometrium of the uterus breaks down and menstruation begins. The cells of endometrium secretions and the unfertilised ovum constitute the menstrual flow.

(13) (B)

(14) **(B).** Seminal vesicles secretes fructose, which is not present any where else in the body. It provides a proof during forensic test for rape. The presence of fructose in the female's genital tract confirms sexual intercourse.

(15) **(C).**

(16) **(B).** Endometrium, epithelial gland and connective tissue of the uterus are broken in the menstrual phase of menstrual cycle.

This happens due to lack of progesterone hormone.

(17) **(A).** Fertilisin antifertilisin interaction was proposed by **IR Lillie**. According to this theory, ovum secretes fertilisin (composed of glycoprotein = monosaccharide + Amino acid) and sperm release antifertilisin (composed of acidic amino acid). They interact with each other and they are species specific. The adhesion of sperm to the egg of the same species through chemical recognition is known as agglutination.

(18) **(A).** Route of milk secretion

Mammary Tubule (T)
↓
Mammary Duct (M)
↓
Mammary Ampulla (A)
↓
Lactiferous Duct (L)

(19) **(C).** Primary sex organs produce gametes and sex hormones and the conduction of gametes is done by accessory ducts, which are the part of secondary sex organs.

(20) (B)

(21) **(A).** Sertoli cells are the epithelial supporting cells of the seminiferous tubules. They are derived from the epithelial sex cords of the developing gonads. They are tall simple columnar cells, which span from the basement membrane to the lumen. They surround the proliferating and differentiating germ cells forming pockets around these cells, providing nutrients, and phagocytosisng excess spermatid cytoplasm, not needed in forming the spermatozoa.

(22) **(C).** The vas deferens loops over urinary bladder, where it is joined by duct from seminal vesicle to form ejaculatory duct. Vasa deferentia carry sperms.

(23) (B) **(24)** (A) **(25)** (C)

(26) **(A).** Placenta releases oestrogens, progesterone, hCG and relaxin. That's why it can be cosidered as endocrine gland.

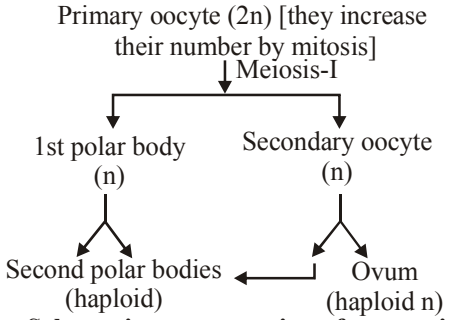
(27) (A)

(28) **(A).** After ovulation, the Graafian follicle changes into corpus luteum and secretes the progesterone. Hence, Graafian follicle is called endocrine gland after ovulation. Progesterone maintains the pregnancy.

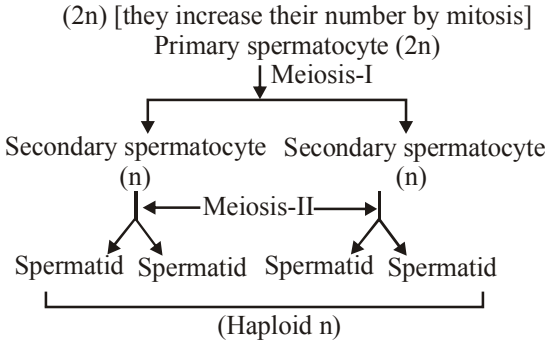
(29) (B)

(30) (D)

(31) **(A).**



Schematic representation of oogenesis



Schematic representation of spermatogenesis

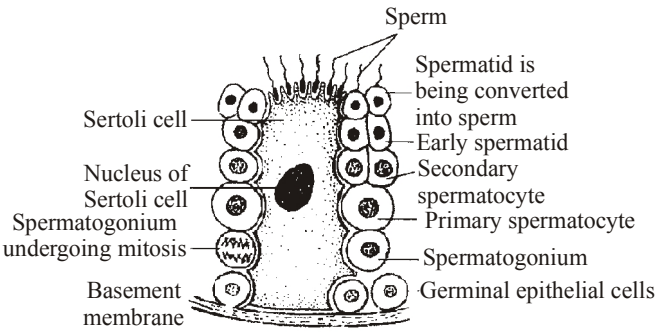
(32) **(C).** Oestrogen and progesterone both hormones are used as contraceptive pills like sehali and mala-D.

(33) (C)

(34) **(B).**

(35) **(B).** Pitocin is synthetic oxytocin.

(36) **(A).** Wall of each seminiferous tubules is formed of single layered germinal epithelium. Majority of cells in this epithelium are cuboidal called male germ cells (also called spermatogonia). At certain places, tall Sertoli or substentacular cells are present which functions as nurse cells for differentiating spermatozoa.



TS of a part of seminiferous tubule showing Sertoli cell and stages of spermatogenesis

(37) (D)

(38) **(B).** The part of the Fallopian tubes (oviducts) closer to the ovary is the funnel-shaped infundibulum. The edges of the infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation.

(39) **(B).** LH or ICSH acts on the Leyding cells, which secretes androgens. Testosterone is the principle androgen of male reproductive system.

(40) **(A).** Hyaluronidase enzyme assists in acrosomal reaction. This enzyme acts on the ground substances of follicle cells.

(41) **(C).** Secretion from corpus luteum prepares the inner wall (endometrium) of the uterus for implantation.

(42) **(B).** a-Oogonia-46 chromosomes,
b-Primary oocyte-46 chromosomes,
c-Secondary oocyte-23 chromosomes.

(43) **(B).**

(44) **(D).** Oogonia (a)
↓ Mitosis (cell division)
Primary oocyte (b)
↓ Meiosis-I (completed prior to ovulation)
Secondary oocyte (c)
↓ Meiosis-II
Ovum

(45) **(C).** If GnRH were not inhibited, another cycle could start prior to the end of the first, thus additional FSH and LH would be released from the pituitary and another oocyte could be stimulated.

(46) **(B).** The prostate produces a very alkaline (basic) fluid, thus if this were inhibited, the semen would be more acidic.

(47) (B) **(48)** (D) **(49)** (B)

(50) (B) **(51)** (D)

(52) **(A).** Without a pituitary, the individual would be sterile, there would be no FSH or LH.

(53) (A) **(54)** (C) **(55)** (A)

(56) (C) **(57)** (C) **(58)** (D)

(59) (D) **(60)** (D) **(61)** (B)

(62) (A) **(63)** (C) **(64)** (B)

(65) (C)

(66) **(B).** Oxytocin is produced in the hypothalamus and released from the posterior pituitary.

(67) **(C).** Gonadotropic-releasing hormone from the hypothalamus stimulates the anterior pituitary to release hormones, such as FSH and TSH.

(68) **(A).** FSH is released by the anterior pituitary and stimulates the follicle in the ovary to mature a secondary oocyte.

(69) **(D).** Estrogen and progesterone are responsible for thickening the lining of the uterine wall in preparation for implantation of an embryo.

(70) **(A).** FSH is active in males as well as females. In males, it stimulates sperm production; in females, it stimulates the maturation of a secondary oocyte in the ovary.

(71) (B) **(72)** (B)

(73) **(A).** The spermatogonium cell has 46 chromosomes. It undergoes mitosis and produces two primary spermatocytes, each containing 46 chromosomes.
Each primary spermatocyte can undergo meiosis I, producing two secondary spermatocytes each containing 23 chromosomes. Each secondary spermatocyte then undergoes meiosis II, which yields 4 spermatids (n). Each spermatid undergoes differentiation and becomes an active sperm.

(74) **(D).** The corpus luteum produces progesterone, which thickens the uterine wall.

(75) **(B).** Sperm gain motility in the epididymis.

(76) **(A).** In vertebrate animals, one primary oogonium develops into one active egg cell and two polar bodies. The polar bodies disintegrate.

(77) (D)

(78) **(A).** Early embryonic division in deuterostomes is radial. All the other choices are correct statements.

(79) (C) **(80)** (D)

(81) **(A).** GnRH stimulates (causes) the pituitary gland to produce follicle stimulating hormone (FSH), the hormone responsible for starting follicle (egg) development and causing the level of estrogen (the primary female hormone) to rise. Luteinizing hormone (LH), the other reproductive pituitary hormone, aids in egg maturation and provides the hormonal trigger to cause ovulation and the release of eggs from the ovary.

(82) **(B).**

EXERCISE-3

(1) **(D).** The gestation period of cow is 275 to 290 days.

(2) **(C).** In female reproductive system
(i) Egg produced by ovary.
(ii) Fertilisation takes place in the ampulla of oviduct.
(iii) Implantation takes place in the wall of uterus.
(iv) Oestrogen and progesterone are produced by ovary.
(v) Part receive the male genitalia (penis) during copulation is vagina.

(3) **(D).**
(i) Hypothalamus secretes → GnRH (for germ cell development).
(ii) Acrosome → sperm Iysins (for ova penetration).
(iii) Graafian follicle → oestrogen (ova development).
(iv) Leydig cell → Testosterone (sperm maturation).
(v) Parturation → Relaxin (soften the ligament, so child birth can take place easily.

(4) (B) **(5)** (D) **(6)** (C)

(7) **(B).** Structure b in the diagram indicates the ova, which is in meiosis-I stage. Before birth all ova have this stage.

(8) **(B).** In diagram event labelled 'A' clearly indicates the releasing of ova. This takes place in menstrual cycle called ovulation.

(9) (A) **(10)** (D) **(11)** (D)
(12) (A) **(13)** (C) **(14)** (C)
(15) (D) **(16)** (D) **(17)** (C)
(18) (D) **(19)** (D) **(20)** (C)
(21) (A) **(22)** (C) **(23)** (D)
(24) (B) **(25)** (B)

(26) **(C).** The reception-ready phase of the endometrium of the uterus is usually termed the "implantation window" and lasts about 4 days. Three implantation stages can be distinguished:
(i) Adplantation of the blastocyst on the endometrium
(ii) Adhesion of the blastocyst to the endometrium
(iii) Invasion of the trophoblast and embedding

(27) **(C).**

(28) **(D).** Oxytocin (Oxt) is used to cause contraction of the uterus in order to start labor or increase the speed of labor, and to stop bleeding following delivery.

(29) **(D).** Pelvic inflammatory disease is an infection of a woman's reproductive organs. It is a complication often caused by some STDs, like chlamydia and gonorrhea. Other infections that are not sexually transmitted can also cause PID.

(30) **(C).** The fallopian tube, also known as the oviduct or uterine tube, is responsible for carrying the egg to the uterus. The fallopian tube has finger-like branches, called fimbriae, which reach out into the pelvic cavity and pick up the released egg. The egg is then brought into the fallopian tube where it will travel to the uterus. Not only does the fallopian tube collect and transport the egg, it is also the location where fertilization occurs. Sperm cells that enter the reproductive system through the vagina travel to the fallopian tube where they fertilize the egg.

(31) **(D).**

(32) **(A).** Embryonic development includes a definite series of phases which are fundamentally similar in all sexually reproducing organisms, and transform a one-celled zygote to a multicellular and fully formed developmental stage till hatching or birth such a remarkable similarity of embryonic development proves that all metazoans are interrelated and have common ancestory. Embryonic development involves five dynamic changes and identifiable processes these are - Gametogenesis, fertilization, cleavage, Gastrulation and organogenesis.

(33) **(A).** Penetration of sperm is a chemical mechanism. In this acrosome of sperm undergoes acrosomal reaction and releases certain sperm lysins. Which dissolve the egg involves locally and make the path for the penetration of sperm sperm lysins are acidic proteins. These sperms lysin contain a lysing enzyme hyaluronidase which dissolves the hyaluronic acid polymers in the intercellular spaces which holds the granulosa cells of corona radiata together; corona penetrating enzyme and acrosin. Then it dissolves the zona pellucida only sperm nucleus and middle piece enter the ovum.

(34) **(B).** The process of attachment of the blastocyst (mammalian blastula) on the endometrium of uterus is called implantation.

(35) **(A).** In human male, one pair testes are present in thin walled skin pouches called scrotal sac (so are extra abdominal) hanging from lower abdominal wall between the legs. Testes is held in position in scrotum by gubernaculum and spermatic cord. Scrotal sac act as thermoregulators and keep the testicular temperature 2°C lower than body temperature for normal spermetogenesis, as high abdominal temperature kills the spermatogenic tissue.

(36) **(C).** At puberty in human male is controlled by male sex hormone testosterone which is secreted by interstiteal or leydig's cells of testes so secondary sexual characters develops and at puberty secretion of testosterone is increase.

(37) **(A).** Urethra of females are shorter than male. That way the infection of urethra is more common in females than in males.

(38) **(C).** Holoblastic cleavage is found in the eggs, which are microlecithal (little yolk). In them, the cleavage is complete called holoblastic cleavage. In human beings the cleavage is complete so, holoblastic. Human eggs are microlecithal not centrolecithal.

EXERCISE-4

(1) **(C).** Sertoli cells (named after Italian histologist Enrico Sertoli) are found in the walls of the seminiferous tubules of the testis. Compared with the germ cells they appear large and pale. They anchor and probably nourish the developing germ cells, especially the spermatids, which become partly embedded within them.

(2) **(B).** The seminiferous tubules of the testis open into vasa efferentia through rete testis. The vasa efferentia open into epididymus, which leads to vas deferens.

(3) **(A).** Semen or seminal fluid or seminal plasma is the fluid ejaculated from the penis at sexual climax. It is rich in fructose, calcium and certain enzymes. It provides a fluid medium for transport of sperms, nourishes and activates sperms, lubricates the reproductive tract of female and neutralizes the acidity of the vagina of female to protect the sperms.

(4) **(B).**

(5) **(B).** In human beings, after one month of pregnancy, the embryo's heart is formed. 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. 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.

(6) **(B).** Oogenesis starts with division of oogonia (gamete mother cells) giving rise to primary oocyte which enters into prophase-I of the meiotic division and get temporarily arrested at this stage. These primary oocyte gets surrounded by primary, secondary and tertiary follicles respectively. The tertiary follicle grow in size and completes its first meiotic division to give rise to haploid secondary oocyte.

This secondary oocytes forms a new membrane called zona pellucida surrounding it. During fertilization the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces the completion of the meiotic division (2nd division) of the secondary oocyte. The secondary meiotic division is also unequal and results in the formation of a second polar body and a haploid ovum (ootid).

(7) **(B).** Acrosome is the cap-like structure on the front end of a spermatozoon. It breaks down just before fertilisation (the acrosome reaction), releasing a number of hydrolytic enzymes, also called sperm lysins that assist penetration between the follicle cells that still surround the ovum, thus facilitating fertilization. Failure of the acrosome reaction is a cause of male infertility.

(8) **(A).** A morula is an embryo at an early stage of embryonic development, consisting of cells (called blastomeres) in a solid ball contained within the zona pellucida. The morula is produced by embryonic cleavage, the rapid division of the zygote. The increase in number of cells doesn't change the size of the original mass. The divisions are rapid because there is no net growth of the embryo the cell cycle alternates between DNA replication and mitosis. In the absence of growth, the cell number in the embryo increases while the cell size decreases. Thus, it has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA.

(9) **(B).** Each Fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus, the part closer to the ovary is the funnel shaped infundibulum.

(10) **(B).**

(11) **(D).** Implantation in endometrial uterine wall takes place at blastocyst stage of embryonic development. Before implantation, the blastomers of early blastocyst get arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called inner cell mass. It is the trophoblast layer through which blastocyst gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.

(12) **(A).** The male accessory glands include paired seminal vesicles, a prostate and paired bulbourethral glands. Secretion of these glands constitute the seminal plasma which is rich in fructose, calcium and certain enzymes. The secretions of bulbourethral glands also helps in the lubrication of the penis.

(13) **(A).** The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens. The seminiferous tubules of the testis open into the vasa efferentia through rete testis. The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis. So if vasa efferentia gets blocked, the gametes will not be transported from testes to epididymis.

(14) **(A).** The testes are situated outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes (2-2.5ºC lower than the normal internal body temperature) necessary for spermatogenesis.

(15) **(B).** The oviducts (Fallopian tubes), uterus and vagina constitute the female accessory ducts. Each Fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus, the part closer to the ovary is the funnel-shaped infundibulum. the edges of the infundibulum possess finger like projections called fimbriate, which help in collection of the ovum after ovulation. the

uterus is single and it is also called womb, open into vagina through a narrow cervix. So, III is infundibulum, IV is fimbriae and V is cervix.

(16) **(A).** The process of fusion of a sperm with an ovum is called fertilization. During fertilization, a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that block the entry of additional sperms. Thus, it ensures that only one sperm can fertilize an ovum. The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. In contact with the surface of egg convering, the acrosome releases its contained hydrolytic enzymes, also called sperm lysins. It is known as acrosomal reaction. Acrosome reaction results in dissolving of corona cells and degeneration of zona pellucida which helps in sperm penetration.

(17) **(A).** Both LH and FSH attain a peak level in the middle of menstrual cycle (about 14th day). Rapid secretion of LH leading to its maximum level during the mid cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).

(18) **(A).** Sperms remain viable for 48 hours to 72 hours.

(19) **(A).** The act of expelling the full term young one from the mother's uterus at the end of gestation period is called parturition. Parturition is induced by signals from both the fully developed foetus and the placenta. It induces mild uterine contractions called foetal ejection reflex.

(20) **(D).** During pregnancy, placenta also acts as an endocrine tissue and produces several hormones like human chrionic gonadotropin (hCG), human placental estrogen, progesterone, etc.
The hCG stimulates and maintains the corpus luteum to secrete progesterone.

(21) **(D).** Interstitial cells or Leydig cells are the cells interspersed between the seminiferous tubules of the testis. They secrete androgens in response to stimulation by luteinizing hormone from the anterior pituitary gland.

(22) **(C).** After ovulation which occurs in the middle of menstrual cycle, empty Graafian follicle continues growth under the influence of LH. The follicular cells are converted into lutein cells by deposition of yellowish lipid inclusions. The phenomenon is called luteinization. The ruptured Graafian follicle is now called corpus luteum. It secretes hormones, mainly progesterone and small quantity of estrogen. Both LH and progesterone help in further growth and thickening of endometrium. The major change is that the endometrial glands become secretory. The uterine wall becomes ready for nourishing and anchoring blastocyst if fertilization takes place. Hence, this phase of menstrual cycle is called luteal or secretory phase. The phase lasts for about 13 days i.e., 15-28 days of 28 days menstrual cycle.

(23) **(A).** **Function of placenta** - The placenta facilitate the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo. The placenta is connected to the embryo through an umbilical cord which helps in the transport of substances to and from the embryo. Placenta also acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc.

(24) **(B).** In menstrual cycle, menstrual flow occurs due to lack of progesterone because progesterone maintains endometrium for pregnancy.

(25) **(A).** Spermatogonia → Spermatocyte → Spermatid → Spermatozoa
Spermatogonia are present on the inside wall of seminiferous tubule multiplied by mitotic division and increase in number.
Spermatocytes are some of the spermatogonia, which periodically undergo

meiosis. The secondary spermatocytes undergo the second meiotic division to produce four, equal haploid spermatids. The spermatids are transformed into spermatozoa (sperm).

(26) **(A).** In human male, urethra is urinogenital duct carry urine and sperm both.

(27) **(B).** Corpus luteum secretes steroid hormones progesterone and estrogen.

(28) **(C).** In pregnant female, hCG maintains the corpus luteum which secretes estrogen and progesterone.

(29) **(C).** Prolactin does not play any direct role in initiation of parturition.

(30) **(D).** Capacitation refers to changes in the sperm before fertilization. It increases fertilization capacity of seprms

(31) **(D).** Hysterectomy is surgical removal of Uterus.

(32) **(B).** Spermatogonia are normally diploid during gametogenesis.

(33) **(D).** At ovulation, LH surge occur due to hypersecretion of estrogen, which gives positive feed back to anterior pituitary for secretion of LH.

(34) **(A).** Any extra uterine pregnancy is ectopic pregnancy. Implantation can occur in the wall of abdominal cavity, ovaries but 90-95% of ectopic pregnancies are tubal pregnancy where implantation occurs in fallopian tube.

(35) **(C).** Zona pellucida is secreted by secondary oocyte around it self.

(36) **(A).** In human females, meiosis II is completed after the entry of sperm into the cytoplasm of secondary oocyte at the time of fertilisation leading to the formation of ovum and IInd polar body.

(37) **(B).** Fertilization in human is practically feasible only if the sperms and ovum are transported simultaneously at ampullary-isthmic junction.

(38) **(C).** In follicular phase of menstrual cycle, LH and FSH increase gradually.

(39) **(A).** High level of estrogen and progesterone gives negative feedback to hypothalamus for the release of GnRH.

(40) **(B).** Inhibin is produced by granulosa cells in ovary and has direct effect on the secretion of FSH.

(41) **(A).** Pathway of transport of sperms in human male is Rete testis → Efferent ductules (Vasa efferentia) →
Epididymis → Vas deferens.

(42) **(B).** Correct matching is:
(a) Mons pubis - Female external genitalia
(b) Antrum - Graafian follicle
(c) Trophoectoderm - Embryo formation
(d) Nebenkern - Sperm

(43) **(B).** Hormones secreted by placenta are hCG, hPL, estrogen and progesterone.

(44) **(B).** Hypothalamus secretes GnRH which stimulates anterior pituitary gland for the secretion of gonadotropins (FSH and LH).

(45) **(C).** Corpus luteum is the temporary endocrine structure formed in the ovary after ovulation. It is responsible for the release of the hormones like progesterone, oestrogen etc.

(46) **(C).** The extraembryonic or foetal membranes are amnion, chorion, allantois and Yolk sac. Amnion is formed from mesoderm on outer side and ectoderm on inner side. Chorion is formed from trophoectoderm and mesoderm whereas allantois and Yolk sac membrane have mesoderm on outerside and endoderm in inner side.

(47) **(A).** Placenta releases human chorionic gonadotropic hormone (hCG) which stimulates the Corpus luteum during pregnancy to release estrogen and progesterone and also rescues corpus luteum from regression. Human placental lactogen (hPL) is involved in growth of body of mother and breast.
Progesterone maintains pregnancy, keeps the uterus silent by increasing uterine threshold to contractile stimuli.

(48) **(D).** Spermiogenesis is transformation of spermatids into spermatozoa whereas spermiation is the release of the sperms from sertoli cells into the lumen of seminiferous tubule.

(49) **(A).** During proliferative phase, the follicles start developing, hence, called follicular phase.
Secretory phase is also called as luteal phase mainly controlled by progesterone secreted by corpus luteum. Estrogen further thickens the endometrium maintained by progesterone.
Menstruation occurs due to decline in progesterone level and involves breakdown of overgrown endometrial lining.

(50) **(B).** The correct sequence for transport of sperm cells in male reproductive system is
Seminiferous tubules → Rete testis
→ Vasa efferentia → Epididymis
→ Vas deferens → Ejaculatory duct
→ Urethra → Urethral meatus

(51) **(A).** Extrusion of second polar body from egg nucleus occurs after entry of sperm but before fertilization.
The entry of sperm into the ovum induces completion of the meiotic division of the secondary oocyte.
Entry of sperm causes breakdown of metaphase promoting factor (MPF) and turns on anaphase promoting complex (APC).