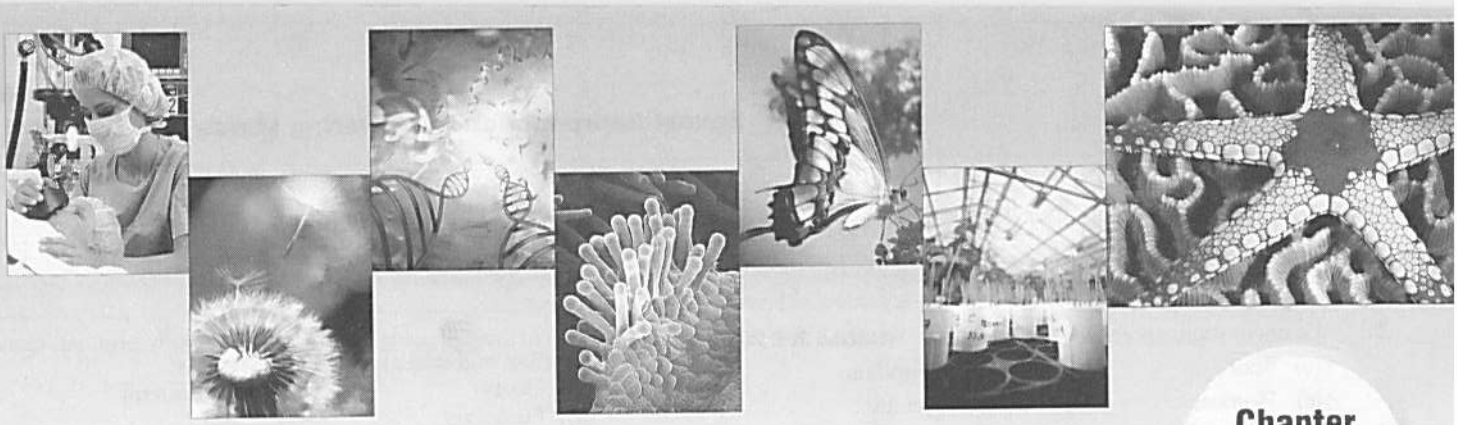


Chapter

# 6.3

# Human Reproduction

## Male reproductive system

The male reproductive system consists of a scrotum, a pair of testes, vasa efferentia, a pair of epididymis, a pair of vasa deferentia, a pair of ejaculatory ducts, a urethra, a penis and certain accessory sex glands.

**Reproductive organs**

(1) **Scrotum :** The scrotum is a pouch of pigmented skin arising from the lower abdominal wall and hanging between the legs. The testes originate in the abdomen but latter, during the seventh month of development, descend permanently into the respective scrotal sac through passages termed inguinal canal.

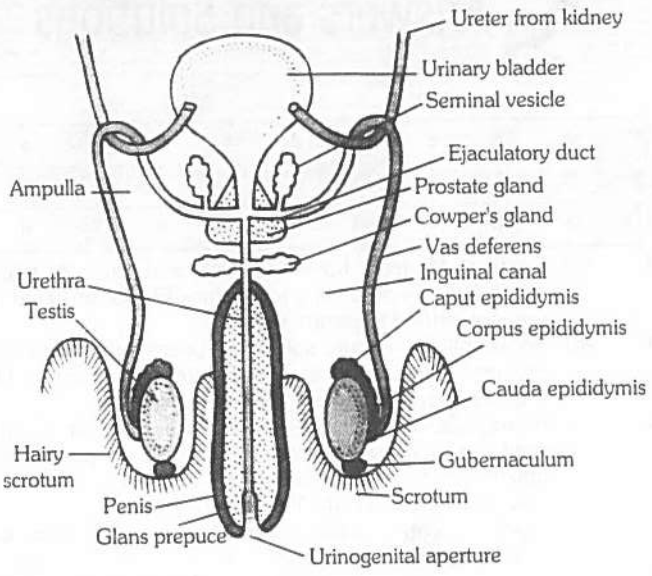



**Fig : 6.3-1 Male reproductive system (front view)**

A spermatic cord connects testis with abdominal cavity. It consists of connective tissue that encloses an artery, a vein, a lymph vessel, a nerve, cremaster muscle and a vas deferens. A testis rests in its chamber over pad called gubernaculum.

The scrotal sac of male is homologous to female's labia majora.

❑ **Variations in position of testes :** In some mammals (lion, bull, horse), the testes remain permanently in the scrotum and keep functioning throughout the year as in man. In certain seasonally breeding mammals, such as bat, otter and llama, (Insectivora, Tubulidentata and most Rodentia) the testes enlarge, become functional, and descent into the scrotum in the breeding season, but thereafter ascent into the abdominal cavity, and become reduced and inactive. In a few cases (elephant, whale, seal) the testes remain permanently in the abdomen as the body temperature is low enough for sperm maturation. Scrotum is absent in such cases. Scrotum is in front of penis in Kangaroo.

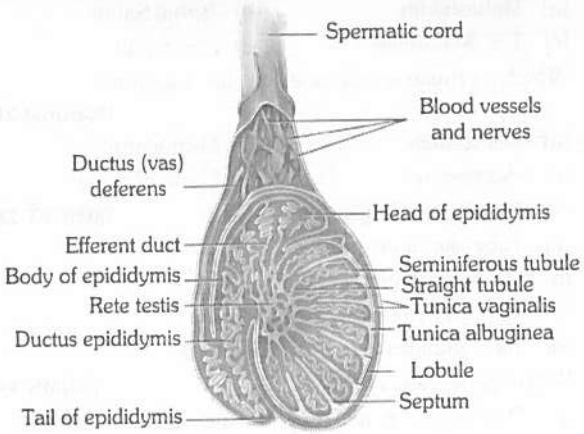



**Fig : 6.3-2 Sagittal section of testis showing seminiferous tubules**

(2) **Human Testes :** The testes are the primary sex organs. They are about 4 – 5 *cm* long, 2.5 *cm* wide and 3 *cm* thick. They are suspended in the scrotal sacs by spermatic cords. Each testes weighs about 10-15 gms.

Each testis has three coverings – tunica vaginalis, tunica albuginea and tunica vasculosa.

Ingrowth of the tunica albuginea, called septa, divide the testis into some 200 to 300 lobules. Each testicular lobule contains 1 – 3 highly convoluted seminiferous tubules, blood vessels and nerve embedded in loose connective tissue. A total of about 750 seminiferous tubules occur in each testis.

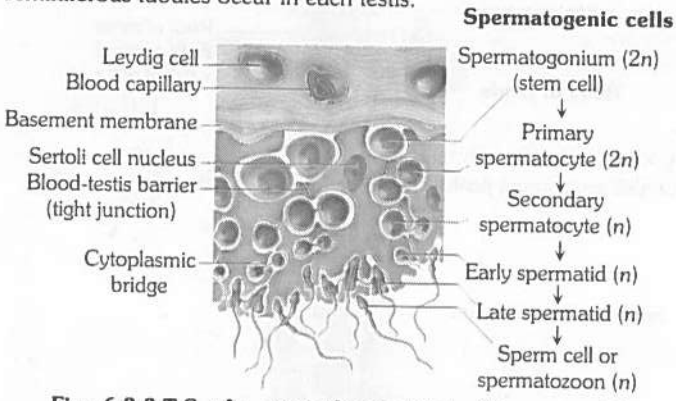



**Fig : 6.3-3 T.S. of a seminiferous tubule (diagrammatic)**

Each seminiferous tubule is lined by germinal epithelium, seminiferous tubules is the site of spermatogenesis. The process occurs in waves along the length of the tubule, taking about 9 weeks (63 days) to complete in man. Seminiferous tubules contain 3 types of cells –

(i) **Germ cells :** Germ cells or primordial germ cells arise from yolk sac endoderm and enter the testes early in development. These are spermatogenic cells, by mitotic divisions, produce spermatogonia into the lumen of the seminiferous tubule. The spermatogonia grow into primary spermatocytes which undergo meiosis, producing haploid cells, first secondary spermatocytes and then spermatids. Spermatids differentiate by a process of spermiogenesis into dimorphic haploid sperm (containing *X* or *Y* chromosome). Mature spermatozoa lie free in the cavity of the seminiferous tubules.

(ii) **Somatic cells / Sertoli cells / Sustentacular cells / Nurse cells :** These are supportive nutritive and secrete a polypeptide hormone called inhibin and a steroid oestradiol which interferes with spermatogenic activity and kinetics of sperm production.

(iii) **Leydig cells ( = Interstitial cell) :** Leydig cells are endocrine cell of testes which lie in the form of clusters or singly in the interstitium (=space between seminiferous tubules).

These secrete a sex steroid called androgen by using cholesterol. The cells contain a rich repertoire of enzymes which facilitate formation of pathways for steroid biosynthesis and biotransformation. These enzymes are called steroid-dehydrogenases.

❑ **Rete testis :** This is a plexiform arrangement (Network) of space supported by highly vascular collagenous connective tissue. It is lined by squamous epithelial cells some of which bear flagella whose activity assists in forward migration of testicular sperm (which are immotile at this stage).

The seminiferous tubules open into rete testis.

(3) **Vasa efferentia :** Rete testis is connected to caput epididymis by 12 – 20 fine tubules called vasa efferentia or ductuli efferentes. Their lining epithelium is ciliated for conducting sperms.

Tubuli recti, rete testis and ductuli efferents constitutes an intertesticular genital duct system. The cells of vasa efferens are columnar ciliated.

(4) **Epididymis :** From rete testis sperms moves into a series of coiled efferent ducts in epididymis that empty into a single tube called ductus epididymis present inside epididymis as highly coiled tube, measures about 6 m (20 ft) in length. It is lined by pseudostratified columnar epithelia.

Epididymes has 3 parts

(i) Upper part (Heads) : Caput epididymis or globus major.

(ii) Middle part : Corpus epididymis or globus normal.

(iii) Basal part (Tail) : Cauda epididymis or globus minor.

In epididymis the sperms are stored for a few hours to a few days till sent out through ejaculation.

The epididymis shows peristaltic and segmenting contraction at intervals to push the spermatozoa away from the testis.

Testis and epididymis are together called testicle.

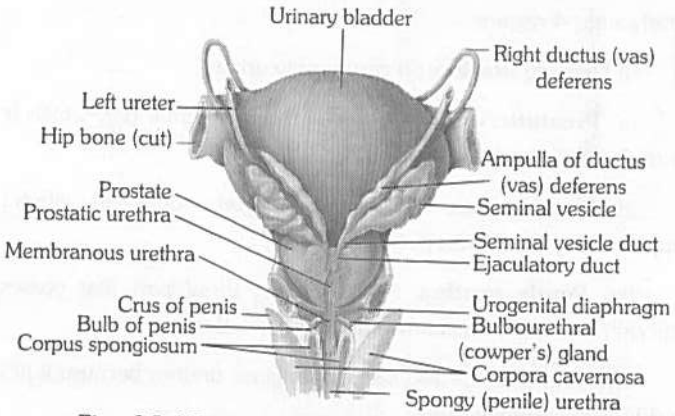



**Fig : 6.3-4 Posterior view of male accessory organs of reproduction**

(5) **Vasa deferentia (Singular-vas deferens) :** The vas deferens is a continuation of the cauda epididymis. It is about 45*cm*. long and is slightly coiled at first but becomes straight as it enters the abdominal cavity through the inguinal canal.

Vasa deferentia (ducti deferentes) conduct sperms from epididymis to urethra and is lined by pseudostratified columnar epithelia.

Surgical interference (vasectomy) of vas deferens ensure successful non-reversible male contraception.

**Table : 6.3-1 Difference between Vasa efferentia and Vasa deferentia**

| S.No. | Vasa efferentia | Vasa deferentia |
|---|---|---|
| 1. | Arise from the rete testes. | Arise from the cauda epididymis. |
| 2. | Vary from 15 to 20 in number. | Are only 2 in number. |
| 3. | Are fine and convoluted | Are thick slightly coiled in the scrotum, straight in the abdomen |
| 4. | Lining bears many ciliated cells. | Lining has sterocilia on many cells. |
| 5. | Carry spermatozoa from rete testes to caput epididymis | Carry spermatozoa from cauda epididymis to ejaculatory ducts. |

(6) **Ejaculatory ducts :** They are short (2 *cm*) straight muscular tubes each formed by union of a vas deferens and duct of seminal vesicle where ejaculate is formed by mixing of sperms with secretion of seminal vesicle. The two ejaculatory ducts join the urethra within prostate gland.

(7) **Urethra :** It is the urinary duct leading from the bladder. Urethra passes through prostate gland, urinogenital diaphragm, and penis. From the point it is joined by ejaculatory ducts, it carries urine as well as spermatozoa and secretions of the seminal vesicles. It also receives secretion of the prostate and cowper's glands. Urethra is some 20 cm long and passes through the penis. The urethra has 4 regions –

(i) **Urinary urethra :** It carries only urine.

(ii) **Prostatic urethra :** It is a short proximal part which is surrounded by prostate gland.

(iii) **Membranous urethra :** It is a short middle part, without any covering, is smallest part of urethra.

(iv) **Penile urethra :** It is a long distal part that passes through the penis, also known as spongy urethra.

The penile part is also called spongiose urethra because it lies inside corpus spongiosum.

(8) **Penis :** The penis is an erectile copulatory organ. It consist of a long shaft that enlarges to form an expanded tip, the glans penis. It is covered by a loose, retractable fold of skin, the prepuce or foreskin. Under the skin, the penis contains three columns of erectile tissue : two cylinders of the corpora cavernosa of the penis, placed dorsally, and one cylinder, the corpus spongiosum, along the ventral side. The corpora cavernosa of the penis and the urethra are covered by dense connective tissue, the tunica albuginea. Both urine and semen are carried out of the body through the penis. Corpus spongiosum contains the spongy urethra. Margin of glans penis is known as corona.

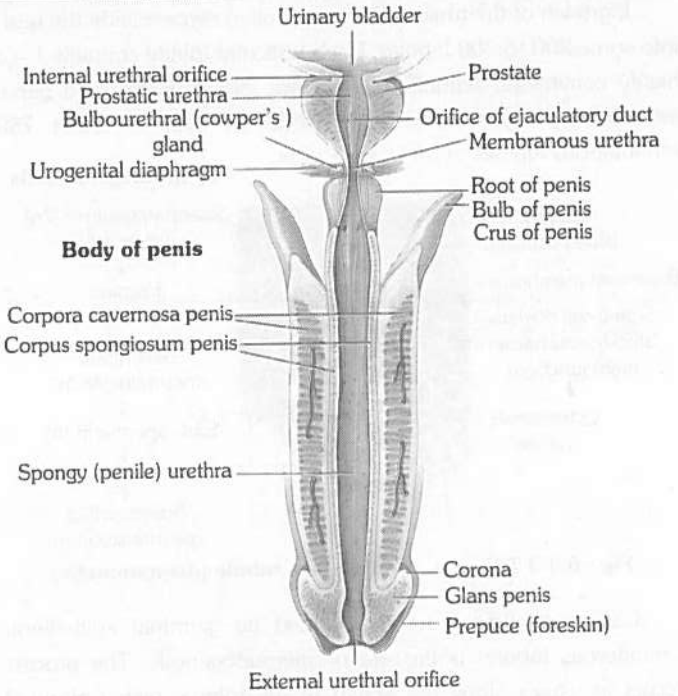



**Fig : 6.3-5 Internal structure of the penis through frontal section**

The penis of opposum, bandicoot etc. is doubled branched.

❑ **Sperm storage :** Sperms are stored for the most part in the vasa efferentia, epididymes and proximal parts of vasa deferentia.

**Accessory sex glands :** The substances secreted by the accessory, sex glands help in reproduction, these are –

(1) **Seminal vesicles :** The seminal vesicles are long pouches with muscular wall; they secrete spermatozoa activating substances, such as fructose, citrate, inositol, prostaglandins and several proteins, sperms use fructose as a respiratory substrate. Seminal fluid maintains viability and motility of sperms.

Seminal vesicle secretes a alkaline, nutritive fluid which forms main part *i.e.*, 60 % of the semen. It is also called uterus-masculinus. It is formed from the mullerian duct of the embryo. In females, these ducts form the ovi-ducts. The seminal vesicle do not store sperms. Seminal vesicles are found between urinary bladder and rectum.

❑ **Test for rape :** Fructose, which is present in the seminal fluid and is not produced anywhere else in the body, provides a forensic test for rape. Its presence in the female's genital tract confirms sexual intercourse.

(2) **Prostate gland :** The prostate gland surrounds the first portion of the urethra. This gland secretes a slightly acidic fluid (pH about 6.5) which forms 25% part of the semen. The secretion nourish and activates the spermatozoa to swim. It is essential for sperm motility (removal causes sterility).

In the secretion of prostate–gland citric acid, calcium and phosphate, Fibrinogen and Fibrinolysin is 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 sometime due to fibrinolysins, semen again liquefies and in this semen now the sperms can move.

(3) **Cowper's glands :** These are also termed as Bulbourethral glands. One pair of Cowper's gland is attached to urethra. They secrete alkaline mucus which is discharged into the spongy part of urethra. The mucus lubricates the reproductive tract. This serves to neutralize any acid of urine remaining in the urethra. Secretion of Cowper's glands is produced before the ejaculation of semen.

Secretion of Cowper's glands carries some spermatozoa released before ejaculation. This is one of the reasons for the high failure rate of the withdrawal method of birth control.

(4) **Perineal or Rectal glands :** These are found both in males and females during the breeding season, these glands secrete an odoriferous liquid which has pheromones or ectohormones in it. Its smell attracts the animal of opposite sex, found in herbivorous and carnivorous mammals.

In man, Perineal or Rectal glands are absent.

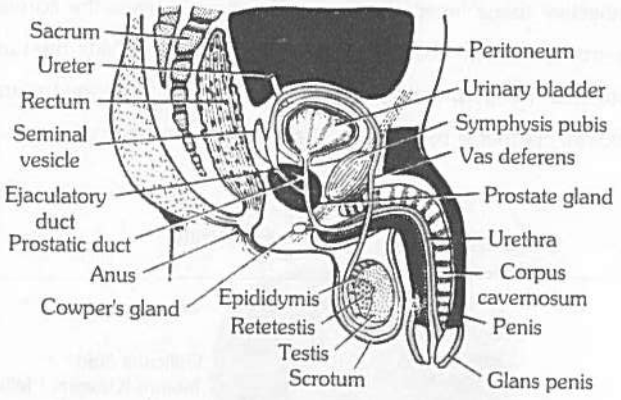



**Fig : 6.3-6 Male reproductive organs**

(5) **Other glands :** Prepuce contains preputial glands which produce a sebaceous substance which together with desquamated epidermal cells forms a whitish, pasty, foul-smelling accumulation, called smegma, about the base of the glans penis beneath the prepuce.

**Semen :** The products of the testes (spermatozoa) and prostate gland, alongwith fluid from the seminal vesicle, are collectively known as semen. It is a milky, viscus and alkaline (*pH* 7.2 – 7.7) fluid ejaculated by male reproductive system during orgasm. The volume of ejaculate varies from person to person. Abstinence play a role in this. Each ejaculate measures 3.5 ml and contains 50 – 150 million sperm/ml *i.e.* 250 million – 525 million (average – 400 million).

The life span of human sperm after ejaculation is 24 – 48 hrs. Crayopreservation enhances the longevity of sperm. The rate of active movement of sperm is 1.5 – 3.0 mm per minute in uterine endometrium.

Semen has chemicals for nourishing the sperms (*e.g.*, – fructose), neutralizing the acidity of urethra and vagina (*e.g.*, – bicarbonate), stimulating movements in female tract (*e.g.*, – prostaglandins).

A person with a sperm count below 20 million will be physiologically sterile. Fusion of defective sperm (*e.g.*, 22+xy) with ovum causes many birth defects *e.g.*, klinefelter's syndrome.

**Hormonal control of male reproductive system :** The growth, maintenance and functions of secondary sex organs (epididymis, vasa deferentia, accessory glands and penis) are under the control of testosterone hormone secreted by Leydig's cells of testis, while those of seminiferous tubules and Leydig's cells are controlled by Follicular Stimulating Hormone (FSH) and Interstitial Cells Stimulating Hormone (ICSH) of anterior pituitary lobe respectively.

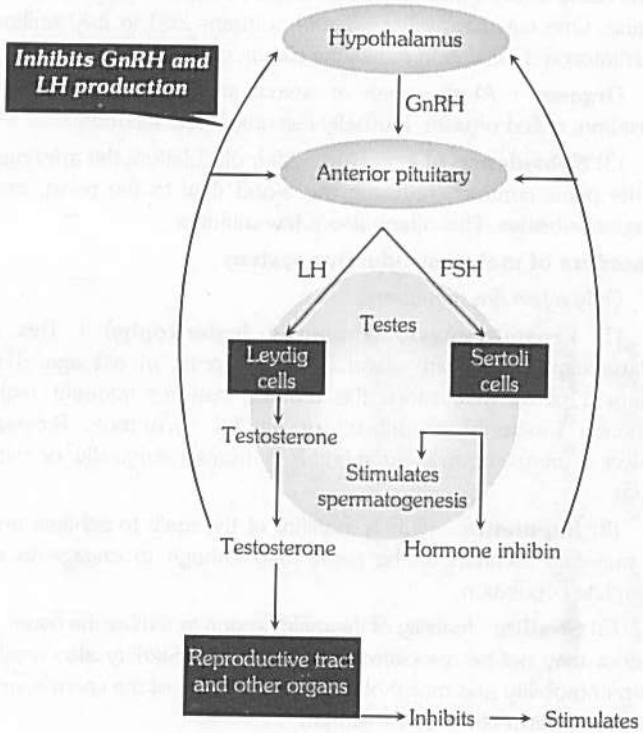



**Fig : 6.3-7 Hormonal control of male reproductive system**

**Onset of puberty in the male :** Puberty is the period when reproductive organs become functional. It is triggered by the secretion of the hormone testosterone in the testes. This hormone brings about growth and maturation of the secondary sex organs and development of the accessory sex characters. The latter induce :

(1) Enlargement of the penis and scrotum.

(2) Broadening of the shoulders.

(3) Growth of body and facial hairs.

(4) Deepening of the voice due to enlargement of layrnx and thickening of vocal-cords.

(5) Increased development of musculature and bones.

(6) Increase in height characteristic of male puberty.

**Male sex act**

The male sex act involves 3 phases :

(1) **Erection :** Erection of the penis is caused by rush of arterial blood into the empty sinuses of its spongy tissue on sexual excitement. As the spongy tissue distends, it compress the veins, inhibiting the flow of blood out of the tissue. Filling of tissue with blood is called vasocongestion.

(2) **Copulation :** Mucus from the urethral glands, Cowper's glands and vaginal glands provides lubrication for copulation. Friction due to rhythmic movements of sexual intercourse stimulate the sensory cells of the glans penis. This stimulation releases semen into the proximal part of urethra by contraction of reproductive glands and ducts. This process is called emission. Then the rhythmic, wavelike contractions of the muscles at the base of the penis cause forceful discharge, called ejaculation, of semen into the vagina. One ejaculate (about 3 *ml.*) contains 200 to 400 million spermatozoa. Ejaculation marks the climax of copulation.

**Orgasm :** At the peak of sexual stimulation, pleasurable sensation, called orgasm. It usually last only a few seconds.

(3) **Subsidence of erection :** After ejaculation, the arterioles to the penis contract, reducing the blood flow to the penis, and erection subsides. This often takes a few minutes.

**Disorders of male reproductive system**

Only a few are mentioned.

(1) **Prostatomegaly (Prostatic hypertrophy) :** This is enlargement of prostate gland. If often occurs in old age. The enlarged gland may block the urethra, causing frequent night urination (nocturia) or difficult or painful micturition. Prostate cancer is very common in men. It is treated surgically or with drugs.

(2) **Impotence :** This is inability of the male to achieve and or maintain erection of the penis long enough to engage in or complete copulation.

(3) **Sterility :** Inability of the male's sperm to fertilize the ovum, it may or may not be associated with impotence. Sterility also results from immobility and morphological abnormality of the sperms, and from low sperm count in the semen.

## Female reproductive system

The female reproductive system consists of a pair of ovaries, a pair of fallopian tubes, uterus, vagina, external genitalia or vulva and breasts.

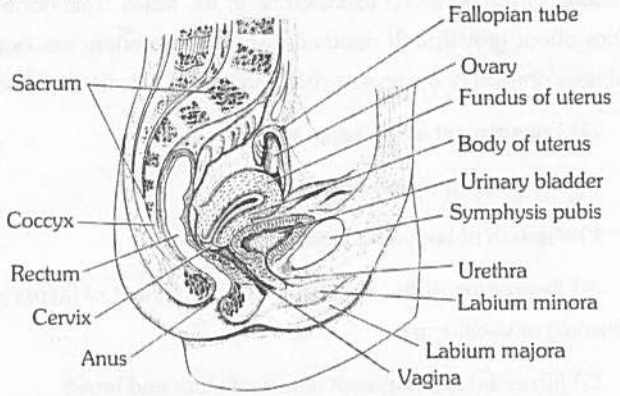



**Fig : 6.3-8 Human female reproductive system**

**Reproductive organ**

(1) **Ovaries :** Ovaries are the primary sex organs of female.

The ovaries are almond shaped bodies, about 3 *cm* long, 1.5 cm wide and 1 *cm* thick. The ovaries, like the testes, have both an exocrine function (production of ova) and an endocrine role (secretion of female sex hormones : oestrogen and progesterone). After menopause, the ovaries become small and lose follicles.

Each ovary is located close to the lateral walls of the pelvic cavity, being suspended from the dorsal body wall just behind the kidney, by a section of peritoneum, the mesovarium.

Each ovary is a compact or solid organ, consisting of an outer cortex and inner medulla. The stroma of the cortical region is composed of spindle shaped fibroblasts. A poorly delineated dense connective tissue layer, the tunica albuginea, covers the cortex. It imparts the whitish colour to the ovary. Located outside the tunica albuginea, the germinal epithelium, formed of simple squamous or cuboidal epethelial cells, covers the surface of the ovary.

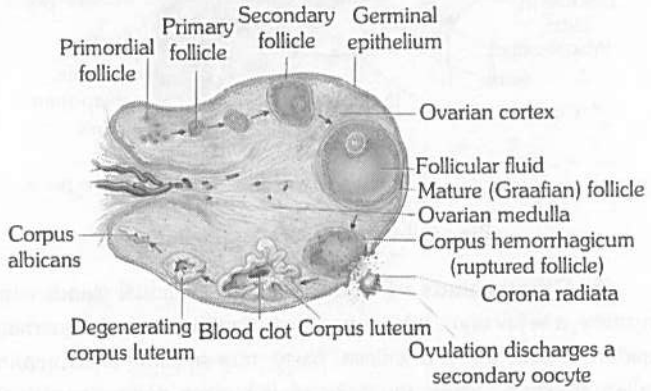



**Fig : 6.3-9 Histology of the ovary (Frontal section)**

(2) **Fallopian tubes / Uterine tubes / Oviducts :** Each ovary is located in front of a funnel shaped opening of the uterus, the oviduct. The oviduct is a muscular tube, measuring about 12 cm in length. Its lumen is lined by ciliated epithelium.

Oviducts develop from the mullerian duct of the embryo. It conveys the egg from the ovary to the uterus, and provides the appropriate environment for its fertilization. It is supported by a double fold of peritoneum called mesosalpinx. The wall of oviduct is made of three layers :

(i) **Serosa :** It is the outermost layer of visceral-peritoneum.

(ii) **Muscle-layer :** The middle layer of the oviduct is made up of unstriped-muscle.

(iii) **Mucus membrane :** It is the innermost layer. This layer is made up of ciliated columnar epithelium and the connective tissue.

The oviduct shows 4 regions :

(a) **Infundibulum :** It is the broad, funnel-shaped proximal part. Its margin bears motile, finger-like processes called fimbriae. It opens into the body cavity by an aperture called ostium. The latter lies close to the ovary to receive the egg released from the ovary. The fimbriae bear cilia which beat toward the ostium to direct the egg into the infundibulum.

(b) **Ampulla :** It is the long, wide, thin-walled, tortuous major part of the fallopian tube next to the infundibulum. Ampulla is site for fertilization.

(c) **Isthmus :** It is the very short, narrow, thick-walled, straight part that follows the ampulla.

(d) **Uterine part :** It is also narrow and passes through the uterine wall, and communicates with the uterine cavity.

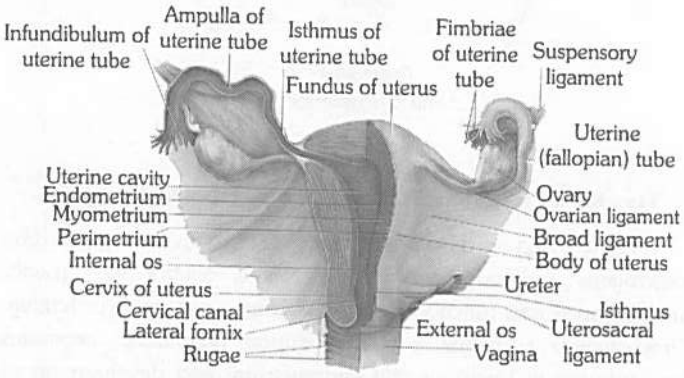



**Fig : 6.3-10 Female reproductive system**

(3) **Uterus :** It is pyriform, hollow muscular thick-walled but distensible median structure located above and behind urinary bladder that is meant for nourishing and development of foetus. For this uterus is capable of tremendous enlargement. The empty uterus is 7.5 cm long and 5 cm broad and 2.5 cm thick. Lining layer of uterus, called endometrium (mucus membrane), consists of an epithelium and lamina propria of connective tissue. Epithelium is a mixture of ciliated and secretory columnar cells. Lamina propria contains tubular glands, fibroblasts and blood vessels.

Histologically, uterus consist of 3 layers of tissues perimetrium, myometrium, and endometrium. Perimetrium composed of simple squamous epithelia. Endometrium, is highly vascular composed of ciliated columnar epithelia.

The normal position of the uterus is antiflexed, that is, it is bent forward on itself at the level of the internal os so as to lie almost horizontally over the bladder. The cervix is composed largely of the biggest and the most powerful sphincter muscle in the body. It is strong enough to hold about 7 kg. of foetus and fluid in the uterus against the pull of gravity during pregnancy.

The cavity of the uterus can expand 500 times during pregnancy, from 10 $cm^3$ to 5,000 $cm^3$.

**Types of uterus**

(i) **Duplex :** These are the simplest type of uteri. In it both the uteri are completely separated and open independently into the vagina through two separate openings *e.g.*, Rat.

(ii) **Biparite :** In these uteri, the lower part of the two uteri are fused and there is a septa in between the two, *e.g.*, Carnivore mammals.

(iii) **Bicornuate :** The lower parts of the 2 uteri are fused with each other but the partition wall is absent, *e.g.*, Rabbit.

(iv) **Simplex :** When both the uteri are completely fused with each-other to form only one structure, these are the most developed uteri *e.g.*, Man.

**Functions of uterus :** The uterus plays multiple role. The uterus is site of menstruations, implantation of a fertilized ovum, development of foetus and labour.

(4) **Vagina :** It is tubular female copulatory organ, passageway for menstrual flow as well as birth canal of about 10 *cm* length between external opening (vaginal orifice) in vestibule and cervix with depression or fornix around cervix, two longitudinal ridges and numerous transverse folds or vaginal rugae. Vaginal wall is made of an internal mucosa, muscular layer and an outer adventitia. Its mucus membrane is nonkeratinised stratified squamous epithelium. Glands are absent. However, cervical glands do pass on some mucus into it during ovulation. The epithelial cells contain glycogen (from puberty to menopause) which shows cyclic changes which due to decomposition produce organic acid. Certain bacteria (species of Lactobacillus and Lactoneustroc, also called Doderlein's Bacillus) bring about fermentation and produce acid which inhibits growth of other microorganisms. In virgins the vaginal orifice is partially covered by an annular centrally perforated membrane called hymen.

(5) **External genitalia / vulva :** There is a depression, the vestibule, in front of the anus. It is flanked by two pairs of fleshy folds of skin : the inner small, thin, moist, labia minora and outer larger, hair-covered labia majora. All the labial folds have numerous sebaceous and sweat glands on both sides. A small erectile organ, the clitoris, lies at the anterior junction of the labia minora. It is homologous to the penis in the male but is very small and solid, having no passage through it. It consists of a short shaft with erectile tissue. It ends in a rounded glans clitoridis. The latter is covered by a small hook of skin, the prepuce. Rubbing of clitoris during intercourse produces a pleasurable sensation. This seems to be its only function. A membranous fold, called fourchette, connects the posterior ends of the labia minora. The area between the fourchette and the anus is termed perineum. Urethra and vagina open by separate apertures, the upper urethral and lower vaginal orifices, into the vestibule. The vaginal orifice is normally covered in the virgin by a membrane, the hymen. A slit in the hymen allows menstrual flow to pass out. The hymen is ruptured during first copulation, or due to some other reason. The hymen presumably has a protective role, but is absent in many women. A fleshy elevation above the labia majora is known as mons veneris or mons pubis. It bears pubic hair, made up of adipose tissue.

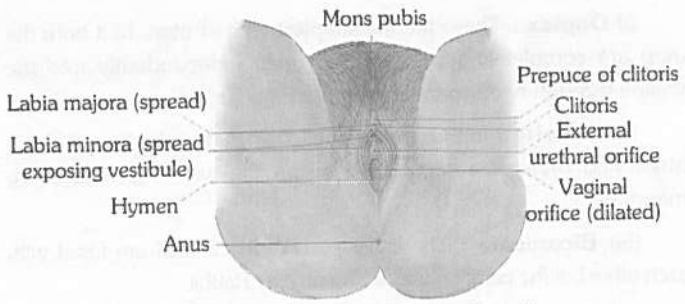



**Fig : 6.3-11 Female external genitalia vulva**

(6) **Bartholins or vestibular glands :** They are a pair of small glands which open in the vestibule lateral to vaginal orifice. The secretion is thick, viscid and alkaline for lubrication and counteracting urinary acidity (similar to Cowper's glands in males).

(7) **Breasts / Mammary glands :** The breasts are rounded eminences located over the pectoral muscles on the front wall of the thorax. These enlarge considerably in the adult female. Each breast has near its middle a nipple surrounded by a circular, pigmented (deep pink to brown) area called areola. The breasts contain fatty and connective tissues and mammary (milk) glands. The latter are compound saccular glands and are modified sweat glands. The connective tissue supports the mammary glands and the adipose tissue covers them. The glands open on the nipples, the lactiferous ducts. Just under the nipples, the lactiferous ducts widen to form lactiferous sinuses, to store milk during lactation. A nursing mother produces 1 to 2 litres of milk per day.

Milk secretion is under the control of prolactin (of anterior pituitary) while milk ejection is under control of oxytocin (of posterior pituitary).

First or premilk after parturition is called colustrum.

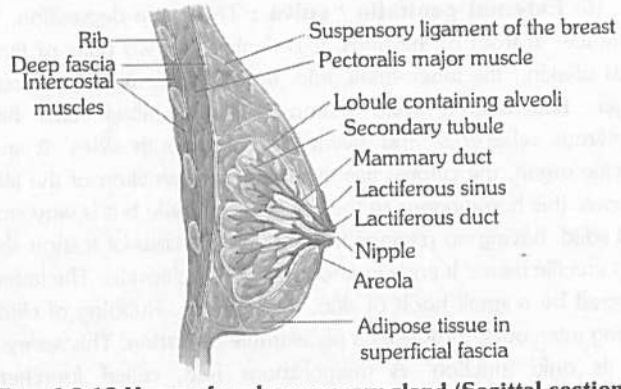



**Fig : 6.3-12 Human female mammary gland (Sagittal section)**

**Onset of puberty in the females :** Woman attains puberty about the age of 13. Its onset it triggered by the production of the anterior pituitary's follicle-stimulating hormone (FSH) which promotes growth of the ovarian follicles. The follicles then secrete the hormone estrogen from the follicle cells in the ovaries. This hormone brings about the growth and maturation of the reproductive tract and the development of accessory sex character. The latter include growth of breasts and external genitalia, broadening of pelvis, growth of pubic and axillary hair, increase in the subcutaneous fat, particularly in thighs, shoulders, buttocks and face to give a typical feminine contour and initiation of menstruation and ovulation.

**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 Graafian follicle, maturation of ovum and secretion of oestrogens by its follicular cells. The Luteinizing Hormone (LH) of anterior pituitary regulates the ovulation from the Graafian follicle, transformation of empty Graafian follicle into yellowish, conical corpus luteum and secretion of progesterone hormone from the corpus luteum.

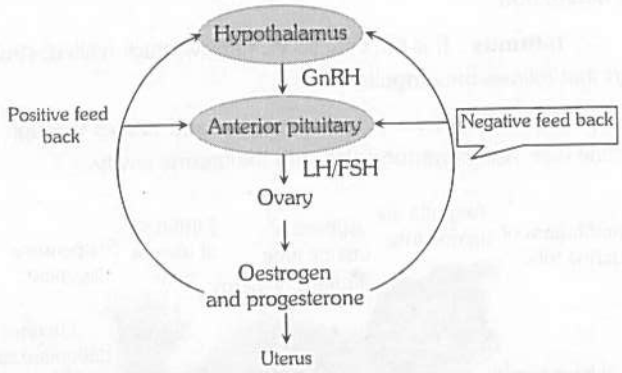



**Fig ; 6.3-13 Hormonal control of female reproductive system**

Growth and function of secondary sex organs are regulated by oestrogens and progesterone. Oestrogens 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.

**Reproductive cycle in female :** The events involved in reproduction in female mammals occur in a cyclic manner. Constituting the reproductive cycle or ovarian cycle. The reproductive cycle is of two types :

(1) Oestrous cycle (2) Menstrual cycle

(1) **Oestrous cycle :** The oestrous cycle consists of a few days of oestrus or "heat" followed by a few days of anoestrus of "quiescence".

During oestrus, the female is sexually responsive, allows a male to copulate, eggs are released and pregnancy is possible. During anoestrus, the female become passive and does not accept a male. The oestrus occurs in most species of mammals. Many mammals reproduce in the breeding season only. The oestrus cycles run only during the breeding season in these mammals and anoestrus spreads over the entire non breeding season.

Except primates, oestrous cycle is found in all mammals.

Some mammals, such a cow and buffalo experience oestrous cycles throughout the year. They have no specific breeding season.

In rabbit the oestrous cycle is of 7 days.

Oestrous cycle of rat is of 5 days only.

Dog has one cycle per year.

Oestrous is also found in the New world monkeys.

During the oestrous-cycle, the wall of uterus does not dissolve *i.e.*, no bleeding takes place.

(i) **Mono – oestrous animals :** In the breeding period of some animals only one oestrous cycle is present. *e.g.*, Rabbit, Hare, Dog, Fox, Bat, Deer etc.

(ii) **Poly – Oestrous animals :** In many animals many oestrous cycles are found in the breeding period. *e.g.*, – Rats squirrels, Cow, Sheep, Pig, Horse etc.

(2) **Menstrual cycle :** The gamete formation in females is a cyclic activity that takes about 28 days and involves changes in the structure and function of the entire reproductive system. It is called menstrual cycle.

The menstrual cycle occur only in primates, except new world monkey.

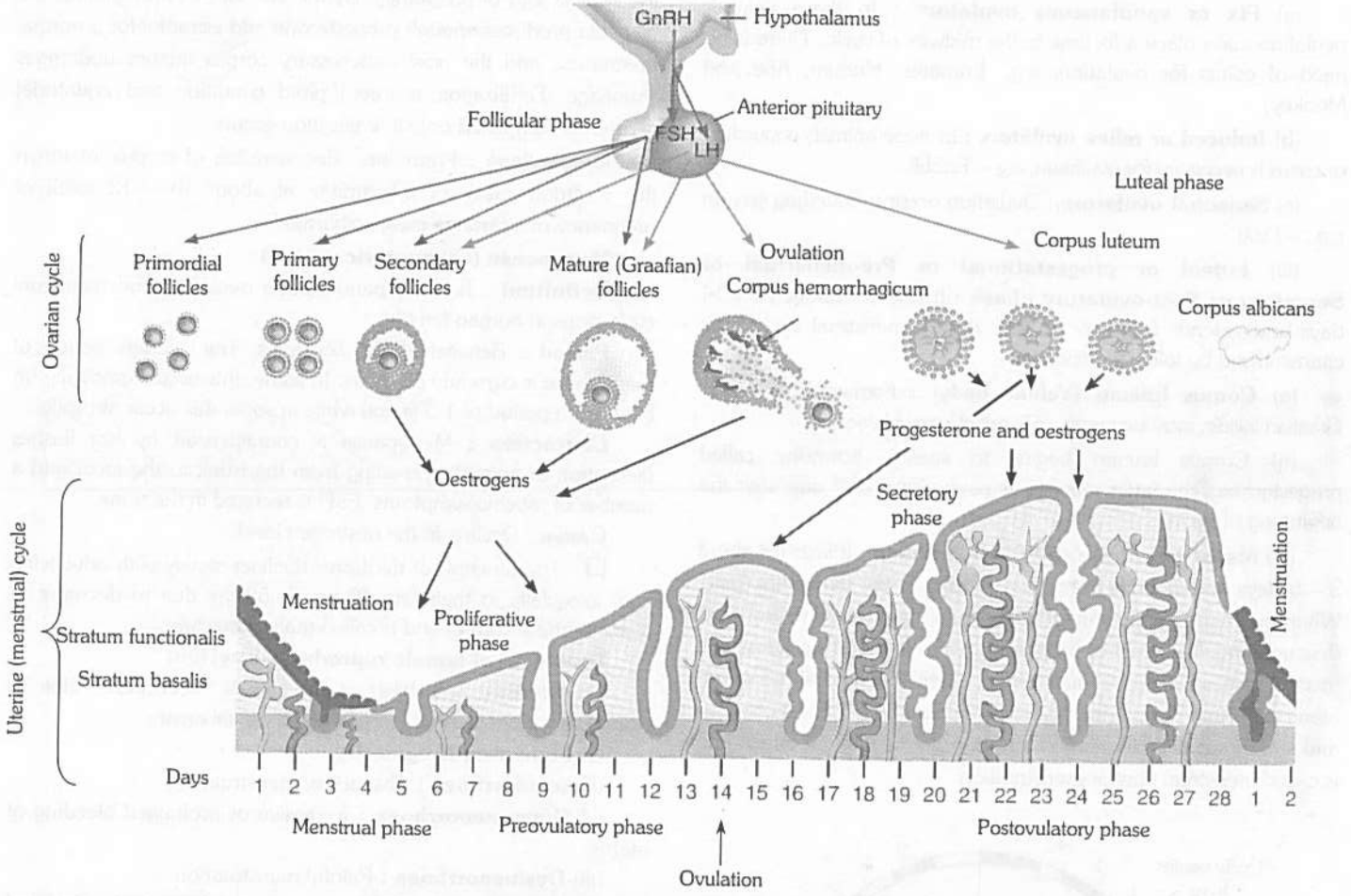



**Fig : 6.3-14 Hormonal regulation of changes in the ovary and uterus**

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 is divided into four phases –

(i) **Follicular (Proliferative) phase or Post-menstrual or Pre-ovulatory phase :** It follows the menstrual phase and lasts for about 9-10 days (from 6 to 13$^{th}$ day of menstrual cycle). It involves following changes :

(a) Under the stimulation of FSH-RF of hypothalamus, there is increased secretion of FSH from anterior pituitary.

(b) FSH stimulates the change of a primary follicle of the ovary into a Graafian follicle.

(c) Follicular cells of Graafian follicle secrete oestrogens.

(ii) **Ovulatory phase or fertility phase :** It involves the ovulation from the Graafian follicle of ovary. The mature Graafian follicle rises to the surface of the ovary and ruptures to release ovum. The phenomena is called ovulation. It occurs midway between two menstrual cycles on 14$^{th}$ day of the onset of the menstrual cycle. It is caused by increasing turgidity and contraction of smooth muscles fibres around the Graafian follicle. Ovum is received by the fimbriad of the fallopian tube. Ovum is viable for two days. Ovulation is controlled by the increased level of LH in the blood. Egg at that time is in the secondary oocyte state. LH also starts the change of empty Graafian follicle into corpus luteum and secretion of progesterone from corpus. During ovulation, the secondary oocytes remains surrounded by its zona pellucida and corona radiata. There is no much change in uterine endometrium during ovulatory phase. In animals the ovulation follow three patterns :

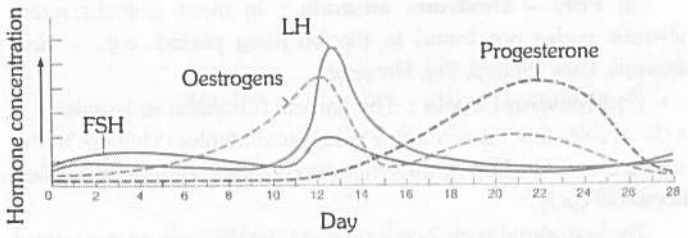



**Fig : 6.3-15 Changes in concentration of anterior pituitary and ovarian hormones**

(a) **Fix or spontaneous ovulators :** In these animals ovulation takes place a fix time in the midway of cycle. There is no need of coitus for ovulation. *e.g.,* Primates (Human, Ape and Monkey)

(b) **Induced or reflex ovulators :** In these animals copulation or coitus is necessary for ovulation. *e.g.* – Rabbit.

(c) **Seasonal ovulators :** Ovulation occur in breeding season *e.g.,* – Frog.

(iii) **Luteal or progestational or Pre-menstrual or Secretory or Post-ovulatory phase :** It lasts for about 12 – 14 days and extends from 16$^{th}$ to 28$^{th}$ day of menstrual cycle. It is characterised by following changes –

(a) **Corpus luteum (Yellow body) :** Formed from empty Graafian follicle, increase in size, so is called luteal phase.

(b) Corpus luteum begins to secrete hormone called progesterone. The latter reaches its peak about 22$^{nd}$ day after the beginning of cycle.

(iv) **Menstrual phase or bleeding phase :** It lasts for about 3 – 5 days and extends from 1$^{st}$ to 4$^{th}$ day of the menstrual cycle. When the ovum remains unfertilized, then the corpus luteum starts degenerating. The level of progesterone in the blood declines. The uterine tissues fail to be maintained. Then the unfertilized ovum along with ruptured uterine epithelium, about 50 – 100 ml of blood and some mucus is discharged out through the vaginal orifice and is called menstrual flow or menstruation.

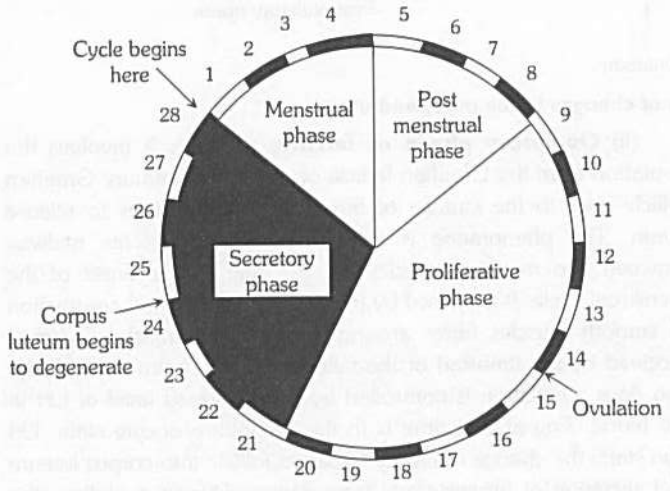



**Fig : 6.3-16 Menstrual cycle**

Decrease in the level of progesterone and estrogens in the blood stimulates the hypothalamus and anterior pituitary to release FSH-RF and FSH respectively (Positive feedback). FSH starts the follicular phase of next menstrual cycle.

**Effect of fertilization :** If fertilization occurs and foetus is implanted in the endometrium, the trophoblast cells of the developing placenta secrete a hormone human chorionic gonadotrophin (hCG). This hormone, like LH, maintains the corpus luteum and the secretion of progesterone and estradiol by it. These two hormones check the breakdown of the endometrium of the uterus. The absence of menstrual bleeding (the 'period') is the earliest sign of pregnancy. By the 16$^{th}$ week of pregnancy, the placenta produces enough progesterone and estradiol for a normal pregnancy, and the now unnecessary corpus luteum undergoes shrinkage. Fertilization restore diploid condition and equatorial division is completed only if fertilization occurs.

**Miscarriage :** Premature degeneration of corpus luteum is the common cause of miscarriage at about 10 – 12 week of pregnancy (miscarriage means abortion)

**Menopause (Climacteric period)**

**Definition :** It is the period when ovulation and menstrual cycle stops in human female.

**Period :** Between 45 to 55 years. The average period of menopause is currently 52 years. In some, this occurs gradually (in between a period of 1-5 years) while in some this occur abruptly.

**Characters :** Menopause is characterized by hot flushes (sensation of warmth spreading from the trunk to the face) and a number of psychic symptoms. FSH is secreted in the urine.

**Cause :** Decline in the oestrogen level.

❑ The function of the testes declines slowly with advancing age, especially in their late 40 yrs or 50 yrs due to decrease in testosterone secretion and is called male climacteric.

**Disorders of female reproductive system**

(1) **Sterility :** Inability of the female to conceive, due to inadequacy in structure or function of the genital organs.

(2) **Menstrual irregularity**

(i) **Amenorrhoea :** Absence of menstruation.

(ii) **Hypermenorrhoea :** Excessive or prolonged bleeding of uterus.

(iii) **Dysmenorrhoea :** Painful menstruation.

**Pregnancy test :** During pregnancy, hCG may be detected in the urine, and this forms the basis of pregnancy test.

❑ Oral contraceptive checks ovulation and implantation (for more information see endocrine system). Oral contraceptives with high concentration of progesteron and less concentration of oestrogen.

## Gametogenesis

The process of the formation of haploid gametes from the undifferentiated, diploid germ cells in the gonads for sexual reproduction is called gametogenesis.

The process of Gametogenesis is stimulated by the FSH or Follicle Stimulating Hormone and for this process Vitamin "A" and "E" are also necessary.

As a result of this process, male gamete sperm and female gamete egg is formed.

**Types of gametogenesis**

(1) **Spermatogenesis**

The process of formation of sperms in seminiferous tubules of the testis of the male animal is termed as spermatogenesis.

In mammals, testis have several coiled tubules in it called the seminiferous tubules. Sperms are formed in these tubules. The inner wall of seminiferous tubules is made up of germinal epithelium whose cells are cuboidal.

The endodermal cells of yolk sac migrate in testes and become primordial germ cells. Due to the division of these cells sperms are formed.

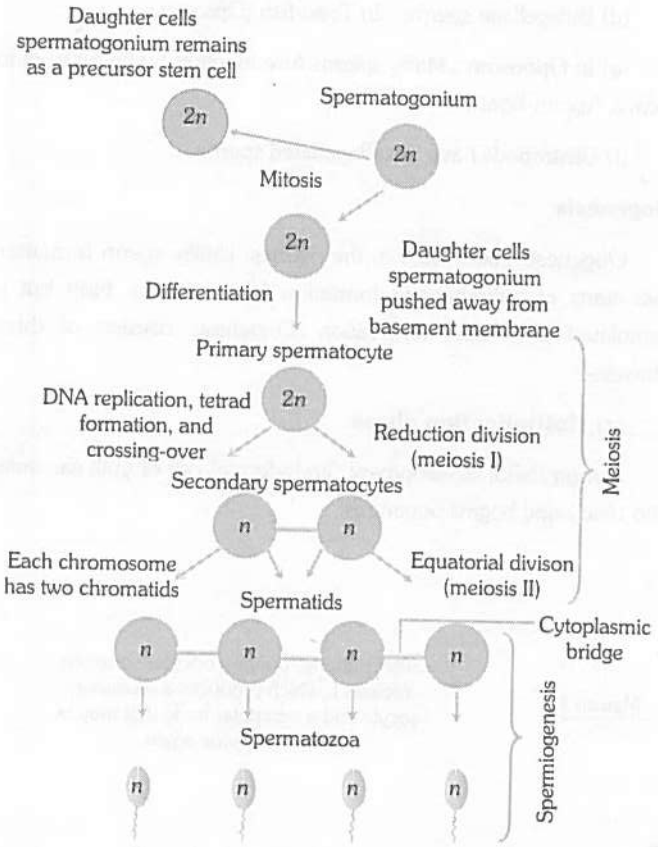



**Fig : 6.3-17 Events in spermatogenesis**

Some large cells are also found in this germinal epithelium. These are called the "Sertoli cells or Sustentacular cells". These cells provide nutrition to the maturing sperms in the form of Glycogen. For getting nutrition, the head of the sperms are submerged in the cytoplasm of sertoli cells.

Sertoli cells mainly provide nutrition and conserve the various stages of spermatogenesis. Spermatogenesis is a continuous process. To make it easier for study, it has been divided into the following steps –

(i) Formation of spermatid.

(ii) Spermiogenesis or Spermateleosis.

(i) **Formation of spermatids :** This process begins as the animal attains sexual maturity. The endodermal cells of the yolk sac which participate in this process are termed as the primordial germ cells. The process of formation of spermatids from primordial germ cells are termed as spermatocytosis. It has 3 sub-stages –

(a) **Multiplication phase :** During this process the primordial germ cells repeatedly undergo mitosis division, and as a result of these divisions spermatogonia are formed. Spermatogonia are diploid.

(b) **Growth phase :** Some spermatogonia either due to growth or due to food storage become 2 or 3 times of their original size, and are now known as primary spermatocytes. The remaining spermatogonia remain in the seminiferous tubules in the form of reserved stock. The primary – spermatocytes formed during the growth phase are diploid. Growth phase is the longest.

(c) **Maturation phase :** Primary – spermatocytes undergo Meiosis-I and as a result 2 haploid secondary spermatocytes are formed. This division is termed as First Maturation Division or Reductional division. Secondary spermatocytes undergo Meiosis II or equational division, and as result, 2 spermatids are formed from each secondary spermatocyte. Thus, from 1 diploid primary spermatocytes 2 secondary spermatocytes are formed on meiosis I and from 2 haploid secondary spermatocytes 4 spermatids are formed on meiosis-II. Metamorphosis of spermatids into sperms is known as Spermiogenesis or Spermatoliosis.

(ii) **Spermatoliosis :** The process of transformation of a round non-motile and haploid spermatid obtained from spermatocytosis into thread-like, motile and haploid sperm is termed as spermatoliosis. From different parts of the spermatid different parts of the sperm are formed. These are as follows –

(a) From nucleus and golgibody → Head part

(b) From mitochondria → Middle part

(c) The structure of the head of the sperm mainly depends on the structure of the nucleus. During spermatoliosis, nucleus contracts and acquires different shapes.

**Structure of sperm**

Structure of sperm has three parts

(1) Head (2) Middle piece (3) Tail

(1) **Head :** It is flat and oval in human sperm. It is composed of a large posterior nucleus and a small anterior acrosome.

Acrosome is formed from the golgi complex. It contains digestive enzyme hyaluronidase and proteinase. It is the capitis covering above the nucleus. It is surrounded by double membrane. Acrosome and its membrane are together called Galea-capatis. Acrosome plays important role in penetration of ovum by sperm.

Remaining part of the head is nucleus. Narrow space between the nucleus and the acrosome is termed as "perforatorium". Nucleus of the sperm is very small. In it nucleoplasm and nucleolus are absent. It contains only chromatin. At the base of the nucleus in a pit like depression proximal centriole is present. In between the head and the middle piece a small neck is present. In this neck part a distal centriole is located. Both the centrioles are at right angles to each other. Proximal centriole first induce cleavage in a fertilized egg. First spindle fibre forms from it. Distal centriole gives rise to the axial filament of the sperm. It has (9+2) microtubular arrangement.

(2) **Middle piece :** This is known as the energy-chamber of the sperm. Many mitochondria spirally surround the axonema, this is called "Nabenkern sheath". This part provides energy to the sperm for locomotion. In middle-piece, cytoplasm is found in the form of a thin-sheet called Manchett. In middle-part, axonema is

surrounded by 9 solid fibres made up of proteins. At the posterior end of the middle-piece a Ring centriole is found. Its function is not known.

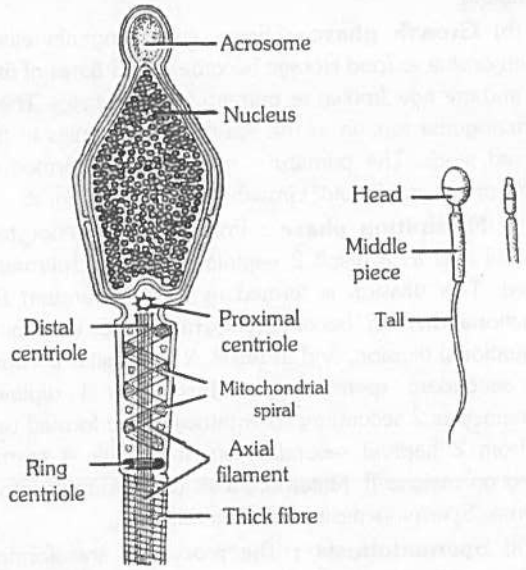



**Fig : 6.3-18 Structure of sperm**

(3) **Tail :** The longest and the fibrous part of the sperm is termed its tail.

Sperm moves with the help of its tail. Basal granule of the tail is Distal centriole. Tail has 2 parts

(i) **Main part :** This part is broad. It contains cytoplasm and is surrounded by 2 solid fibres.

(ii) **End piece :** This part is narrow in it cytoplasm is absent only axonema is present. In it solid fibres are also absent. In the sperm of certain animals, tail is absent. *e.g.,*

(a) Ascaris : Tailless, ameboid sperms

(b) Cray fish : Tailless, stellate (star shape) sperms.

(c) Crab and lobster : Tailless sperms with 3 spines at apex.

(d) Biflagellage sperms : In Toad fish (Opsanus)

(e) In Opposum : Many sperms fuse together by their heads to form a "sperm-boat".

(f) Gastrapods have hexaflagellated sperms.

**Oogenesis**

Oogenesis takes place in the ovaries. Unlike sperm formation that starts at puberty, egg formation begins before birth but is completed only after fertilization. Oogenesis consists of three phases –

(a) **Multiplication phase**

During foetal development, endodermal cell of yolk sac enter into ovary and begins oogenesis.

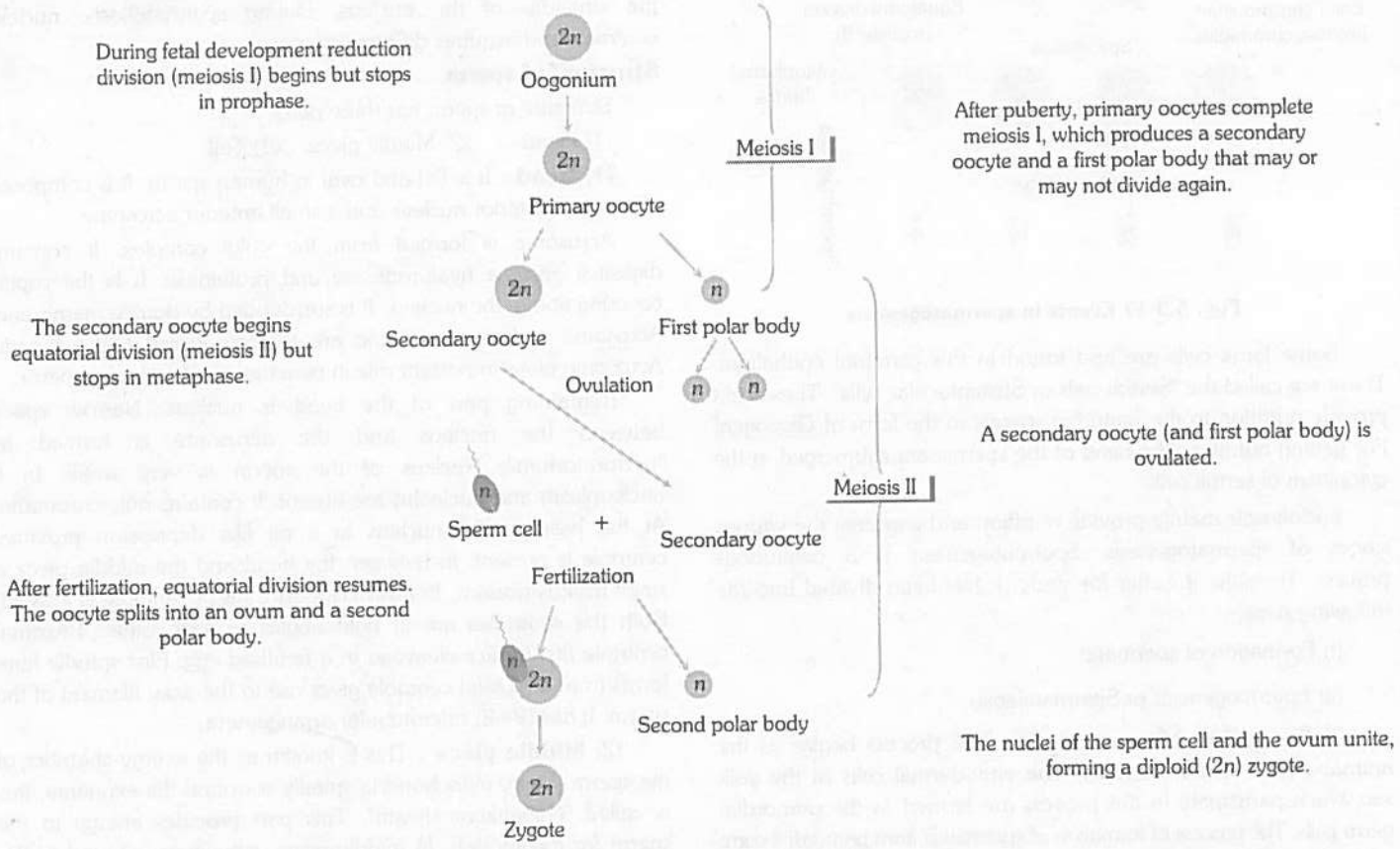



**Fig : 6.3-19 Events in oogenesis**

These cells undergo mitotic divisions, producing undifferentiated germ cells called oogonia or egg mother cells in the ovary. The oogonia have diploid, number of chromosome, 46 in humans. The oogonia multiply by mitotic divisions and produce ovigerous cords or egg tubes of pfluger in mammals.

(b) **Growth phase :** It is prolonged and slow. Oogonia form rounded masses or egg nests at the tips of egg tubes of pfluger.

An egg nest forms ovarian follicle (Graafian follicle) one central oogonium grows and functions as primary oocyte. The others form the covering follicular cells. The latter provide nourishment to primary oocyte. Some nourishment also comes from outside. Yolk is deposited in this state. This phenomenon is called vitellogenesis.

In cooperation with follicular cells, the enlarged primary oocyte secrete mucoprotein membrane or zona pellucida outside its own plasma membrane or vitelline membrane. There is increase in reserve food, size of nucleus, number of mitochondria; functioning of golgi apparatus and complexing of endoplasmic reticulum.

(c) **Maturation phase :** Meiosis occurs. Nucleus shifts towards animal pole and undergoes meiosis – I. A daughter nucleus alongwith small quantity of cytoplasm is extruded as primary polar body or polocyte below zona pellucida. Simultaneously primary oocyte is changed into haploid secondary oocyte. It proceeds with meiosis – II but stops at metaphase-II. Ovum is generally shed in secondary oocyte stage.

After fertilization, the second meiotic division is completed with unequal cytoplasmic cleavage. This forms a large cell the ootid with essentially whole of the cytoplasm, and a very small cell, the second polar body. The ootid and the second polar body are haploid as the second meiotic division is equational. The first polar body may divide at about the same time into two polar bodies. One primary oocyte forms, after two meiotic division, one haploid ootid and two or three haploid polar bodies. The ootid grows into a functional haploid ovum.

**Structure of ovum**

An ovum is generally spherical, nonmotile gamete with yolky cytoplasm and enclosed in one or more egg envelops. Size of ovum varies in different animals and depends upon the amount of yolk. Size of ovum varies from 10μ to a few cm. Largest sized egg is of ostrich and is about 170 ×135 *mm*. Egg size and yolk amount are interdependent. It is about 50μ in many polychaete worms, 150μ in tunicates but very large sized in birds and reptiles. In mammals, it is generally microlecithal and about 100μ.

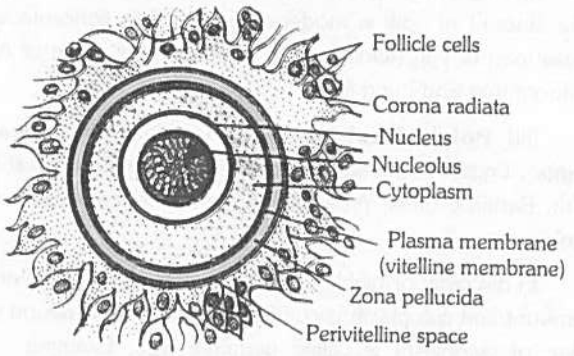



**Fig : 6.3-20 Structure of ovum**

Human ovum is microlecithal with large amount of cytoplasm. Cytoplasm is differentiated into outer, smaller and transparent exoplasm or egg cortex and inner, larger and opaque endoplasm or ooplasm.

Egg envelopes. Human ovum is surrounded by a number of egg envelopes :

(a) **Vitelline membrane :** It is inner, thin, transparent and is secreted by ovum itself.

(b) **Zona pellucida :** It is middle, thick, transparent and non-cellular.

(c) **Corona radiata :** It is outer, thicker coat formed of radially elongated follicular cells. Between the vitelline membrane and zona pellucida, there is a narrow perivitelline space.

**Table : 6.3-2 Differences between Spermatogenesis and Oogenesis**

| S.No. | Characters | Spermatogenesis | Oogenesis |
|---|---|---|---|
| 1. | Site of occurrence | In the seminiferous tubules of testes. | In the ovaries. |
| 2. | Total period | It is a continuous process and completed in 74 days in humans | It is a discontinuous process and completed in a minimum 12-15 yrs. |
| 3. | Growth phase | Of shorter duration | Of longer duration |
| 4. | Yolk synthesis | No yolk is synthesized in growth phase | Vitellogenesis occurs in growth phase. |
| 5. | Nuclear changes | Nucleus becomes condensed by the loss of superfluous materials. | Nucleus is bloated due to increase in nucleoplasm. |
| 6. | Number of gametes | One spermatogonium forms 4 haploid sperms. | One oogonium forms only one haploid ovum. |
| 7. | Polar bodies | Not formed. | Two or three polar bodies are formed. |
| 8. | Site of completion | It is started and completed within the testes. | It is started inside the ovary but is generally completed outside the ovary, into oviduct. |
| 9. | Size of gametes formed | Sperm is much smaller than spermatogonium. | Ovum is much larger than oogonium. |

**Types of eggs**

(1) **On the basis of amount and distribution of yolk**

(i) **Alecithal or Microlecithal or Oligolecithal or Meolecithal and Isolecithal or Homolecithal :** The amount of yolk is very small in these types of eggs. (Oligolecithal or Microlecithal or Alecithal) and yolk is evenly distributed in these eggs (Isolecithal or Homolecithal). Examples – Egg of Amphioxus, Eutheria (Human egg), Metatheria and Sea-urchin.

(ii) **Mesolecithal or Telolecithal eggs :** In this type of egg the amount of yolk is moderate and yolk is concentrated in the basal part of egg (telolecithal egg). Examples – Egg of Amphibia, Petromyzon and Lung fishes.

(iii) **Polylecithal or Macrolecithal or Megalecithal eggs :** Eggs are with large amount of yolk *e.g.*, eggs of shark, bony fish, Reptiles, birds, prototherian, concentrated mainly in vegetal pole.

In discoidal or highly telolecithal eggs, the yolk is enormous in amount and cytoplasm is confined to a disc like area on yolk. This disc of cytoplasm is called germinal disc. Example – Eggs of reptiles, birds, protoherian mammals.

(iv) **Centrolecithal** : Yolk concentrate in centre *e.g.*, Insects egg.

Smallest eggs are of 50μ in the polychaeta and the largest eggs are of an ostrich.

(2) **On the basis of fate**

(i) **Determinate / Mosaic eggs :** Every part of fertilized egg has a definite fate, so that fate of every blastomere is determined from the beginning. It is found in invertebrates except echinoderms.

(ii) **Indeterminate / Regulative eggs :** The fate of different parts of egg or its blastomeres is not predetermined. Example – Echinoderms, Vertebrates.

(3) **On the basis of shell**

(i) **Cleidoic eggs :** Eggs surrounded by a hard shell are known as cleidoic eggs. These eggs are found in those animals which have a terrestrial mode of life of 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. These eggs are found in all oviparous animals which lay eggs in water and all viviparous animals. *e.g.*, – All viviparous animals (Mammals) and all oviparous animals which lay eggs in water (Amphibians).

**Classification of egg – membranes**

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

(1) **Primary egg membrane :** This membrane is secreted by the egg (ovum) itself. *e.g.*, – Vitelline membrane of human egg.

(2) **Secondary egg membrane :** This is found outside the primary egg membrane and is secreted by the ovary. *e.g.*, Chorion of insect eggs, corona radiata and zona pellucida of human egg.

(3) **Tertiary egg membrane :** This is present outside the primary and the secondary egg membrane. It is either secreted by the uterus or the oviduct. Egg jelly coat around frog's egg; albumen, shell membrane and shell of bird egg.

**Functions of egg membranes**

(1) To provide protection.

(2) To check polyspermy.

(3) To provide buoyancy to the amphibian eggs.

(4) To provide nutrition (Birds, Reptiles)

(5) To help in excretion (Allantois)

**Different types of eggs**

(1) **Insect egg :** Eggs of insects are megalecithal or polylecithal. Yolk is present in the centre, so the eggs are also centrolecithal. Eggs of insects are cigar like. Along with plasma-membrane the egg has 2 egg-membranes.

(i) **Vitelline membrane :** This is a primary egg membrane and the egg itself secretes it around.

(ii) **Chorion :** This is a secondary egg membrane and is secreted by the ovary. In Insect's egg tertiary egg-membranes is absent. Chorion of insect's egg is ornamented *i.e.* there are specific markings on its egg membrane which are characters of Taxonomic importance. In the egg, a hole termed as micropyle is present which is the port of entry for sperms. Its cytoplasm is divided into 2 parts –

(a) Central cytoplasm

(b) Peripheral cytoplasm

(a) **Central cytoplasm :** It is present in a very small amount in the centre of the egg. Egg nucleus is located in it.

(b) **Peripheral cytoplasm :** It is present in a very small amount along the periphery of the egg.

**Yolk :** In insect's egg yolk is present in a very large amount and this yolk is concentrated between the central and the Peripheral cytoplasm.

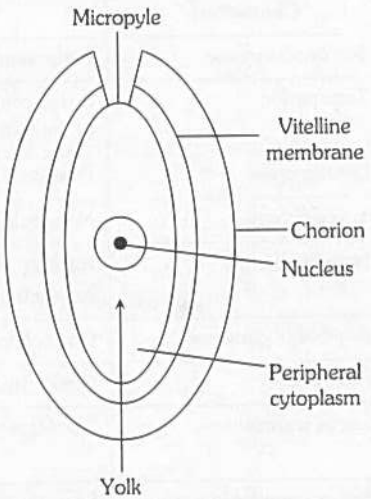



**Fig : 6.3-21 Insect egg**

(2) **Frog's egg** : Eggs of frog are Telolecithal and Mesolecithal. The egg has 2 egg membranes.

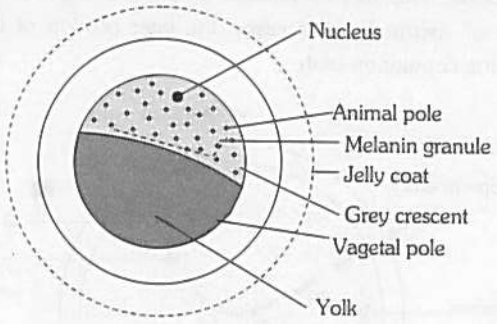



**Fig : 6.3-22 Frog's egg**

(i) **Vitelline membrane** : This is a primary membrane, secreted around by the egg itself.

(ii) **Jelly – coat** : This is a tertiary egg-membrane. It is secreted by the oviduct. Secondary egg-membrane are absent in these egg's. Internally, the egg is divided into 2 areas –

(a) Animal pole (b) Vegetal pole

(a) **Animal pole** : This part has more amount of cytoplasm in it and the egg nucleus is also located in it. In this part melanin granules are found which prevent the egg from harmful radiations. Due to these melanin granules the frog's egg is partly white and partly black. This helps in Camouflage. Sperm always enters inside the egg through the animal pole. The part from where the sperm enters inside the frog's egg in future forms the ventral part of the embryo. As the sperm enters inside the egg. The part directly opposite to the entry point becomes a clear-zone due to the rapid movement of melanin granules. this clear-zone is termed as the Grey-Crescent. This part with Grey-Crescent forms the dorsal part of the embryo in future.

(b) **Vegetal pole** : Here the yolk is concentrated in frog's egg, the part with cytoplasm in future forms the ectoderm. The Grey crescent part in future the Mesoderm and the part with yolk in future forms the endoderm.

Jelly-coats of all the eggs of a frog absorb water and swell up, to form a cluster of eggs termed as Spawn. Jelly-coat has air-bubbles, due to which the eggs don't drown. Jelly-coat is bitter in taste and so the eggs are protected from the enemies.

## Phases of embryonic development

Embryonic development involves following dynamic changes and identifiable process.

(1) **Gametogenesis** : It involve the formation of haploid sex cells or gametes called sperms and ova from diploid primary germ cells called gametogonia present in the reproductive organs called gonads (testes and ovary). It is of two types

(i) **Spermatogenesis** : Formation of sperm.

(ii) **Oogenesis** : Formation of ova

(2) **Fertilization** : It involve the fusion of haploid male and female gametes to form diploid zygote. The fusion of gametic pronuclei is called Karyogamy while the mixing of two sets of chromosomes of two gametes is called amphimixis.

(3) **Cleavage** : It includes the rapid mitotic division of the zygote to form a single layered hollow spherical larva called blastula and its formation is called blastulation.

(4) **Implantation** : The process of attachment of the blastocyst (mammalian blastula) on the endometrium of the uterus is called implantation.

(5) **Gastrulation** : It includes the mass and orderly migration of the organ specific areas from the surface of blastula to their predetermined position which finally produces a 3 layered gastrula larva. It is with 3 primary layers.

(6) **Organogenesis** : It includes the formation of specific organs system from three primary germ layers of gastrula and also includes the morphogenesis and differentiation.

## Fertilization

**Definition** : Fusion of a haploid male gamete (spermatozoan) and a haploid female gamete (ovum) to form a diploid cell, the zygote, is called fertilization or syngamy.

**Site of fertilization** : Fertilization in human female is internal as in other mammals. It takes place usually in the ampulla of the fallopian tube.

**Steps of fertilization**

(1) **Approach of sperm to ovum** : Male discharge semen (3.5 *ml*) high up in the female's vagina, close to the cervix during coitus. This is called ejaculation or insemination. This ejaculation contains as many as 400 million sperms but only about 100 sperms reach the fallopian tube because many sperms are either killed by the acidity of female genital tract or engulfed by the phagocytes of the vaginal epithelium. The sperm swim in the seminal fluid at the rate of 1-4 *mm* per minute by the aspiratory action of the uterus and peristaltic movement of the fallopian tube.

Capacitation is the phenomenon of physiological maturation of sperms by breaking of acrosome membrane inside the female genital tract. It takes about 5-6 hours.

(2) **Penetration of sperm** : The ovum secretes a chemical substance called fertilizin, which has a number of spermophillic sites on its surface where the sperm of species specific type can be bound by their antifertilizin site. This fertilizin-antifertilizin interaction, causing agglutination (sticking together) of egg and sperm.

Penetration of sperm is a chemical mechanism. In this acrosome of sperm undergoes acrosomal reaction and releases certain sperm lysins which dissolve the egg envelopes locally and make the path for the penetration of sperm. Sperm lysins are acidic proteins. These sperm lysins 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 (that dissolves the corona radiata) and acrosin (which dissolves the zona pellucida).

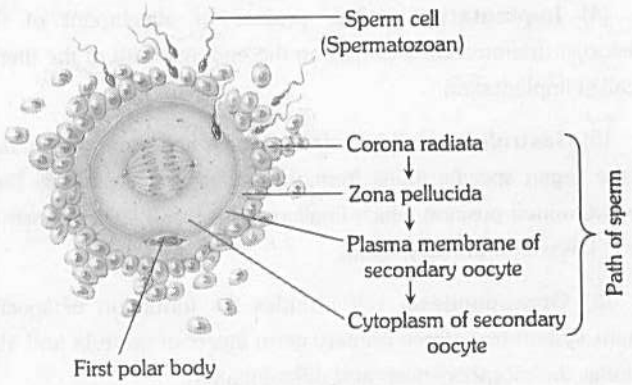



**Fig : 6.3-23 Sperm cell penetrating a secondary oocyte**

(3) **Cortical reaction :** Immediately after the entry of a sperm into the egg, the later shows a cortical reaction to check the entry of more sperms. In this reaction, the cortical granules present beneath the egg's plasma membrane release chemical substance between the ooplasm and the plasma membrane (vitelline membrane).

Sperm penetration into ovum also induces following metabolic activities :

(i) The egg surface produces fertilization cone.

(ii) The vitelline membrane is lifted and is converted into fertilization membrane.

(iii) The cytoplasm exhibits movements.

(iv) The permeability of plasma membrane increases.

(v) The rate of protein synthesis increases.

(vi) Mitosis is initiated.

(4) **Fusion of gametic nuclei :** Entrance of spermatozoan serves to act as stimulus which causes the second maturation division. As the head and middle piece of the sperm advance into the egg, those parts rotate through an angle of 180° so that the mitochondria and proximal centriole of the associated middle piece assume the leading position. The centriole brought in by the spermatozoan subdivides into two and as achromatic spindle is established in the centre of the active cytoplasm. With the production of the second polar body, the egg nucleus or female pronucleus is ready for union with the male pronucleus provided by the sperm head.

The male pronucleus which has been advancing the penetration path, now moves directly toward the female pronucleus. This in many cases involves a slight change in the course of sperm. In such cases, the later portion of its course is called the copulation path.

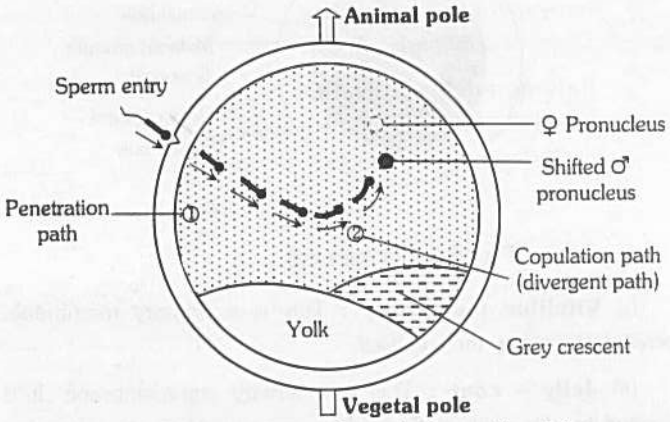



**Fig : 6.3-24 Penetration and copulation paths of the sperm nucleus in egg during fertilization**

### Chemistry of fertilization

Both egg and sperm contain certain chemicals that are necessary for fertilization these are known as gamones .

The hormones of the sperm are called androgamones and those found in the egg are termed as gynogamones. Two types of Androgamones and Gynogamones are found in gametes.

**Table : 6.3-3 Chemicals found in gamete**

| Gamone | Gamete | Function |
|---|---|---|
| Androgamone-I | Sperm | Conserve sperm activity. |
| Androgamone-II | Sperm | Dissolves vitelline membrane, allowing sperm entrance into the egg. |
| Gynogamone-I | Ovum | Neutralizes androgamone-I there by increasing sperm activity. |
| Gynogamone-II | Ovum | Makes sperm head sticky to facilitate attachment of sperm to egg surface. |

### Types of fertilization

(1) **External fertilization :** In this, the gamete fuse outside the female body and is found in most of bony fishes (*e.g.*, Labeo), amphibians (*e.g.*, frog), all echinoderms (*e.g.*, starfish) and lower chordates (*e.g.*, *Herdmania*).

(2) **Internal fertilization :** In this, the fusion of gametes in some part of female genital tract and generally near the ostium. It is found in all terrestrial animals which may be oviparous (all birds, prototherians), ovo-viviparous (rattle-snake) or viviparous (all marsupials and eutherians).

(3) **Self fertilization (Endogamy) :** In this, two fusing gametes are derived from the same parent (uniparental) *e.g.*, *Taenia*, *Fasciola* (sheep, liver fluke).

(4) **Cross fertilization (Exogamy) :** In this, two fusing gametes are derived from different parents (biparental). It is found in all unisexual animals and some bisexual animals *e.g., Pheretima* (earthworm-due to protandry), *Scypha* (Sycon-due to protogyny) *Fasciola* and *Taenia* (have both self and cross fertilization).

(5) **Monospermic fertilization :** When only one sperm enters and fuses with ovum. It is found in most of animals.

(6) **Polyspermic fertilization :** When many sperms penetrate the ovum and may be pathological polyspermy (due to over-ripening of egg) or physiological polyspermy (natural entry of sperms). But only one sperm fuses with ovum.

**Significance of fertilization**

(i) It provides stimulus for the egg to complete its maturation.

(ii) It activates the ovum to develop into a new individual by repeated mitotic division.

(iii) Fertilization restores the diploid number of chromosomes (46 in man) in the zygote by adding male's haploid set of chromosomes.

(iv) It makes the egg more active metabolically.

(v) It combines the character of two parents and introduces variations. So help in evolution.

(vi) Sex chromosomes of sperm is either X or Y and helps in sex determination.

(vii) Fertilization membrane formed after sperm entry, checks the entry of additional sperms.

(viii) Copulation path sets the axis of division.

## Cleavage

**Definition :** The term cleavage refers to a series of rapid mitotic division of the zygote following fertilization, forming a many celled blastula. The cleavage follows fertilization and ends with the formation of a characteristic development stage called blastula.

**Cleavage versus typical mitosis :** The cleavage division are no doubt mitotic as they produce diploid cells, they differ from typical mitosis in a couple of significant points.

**Table : 6.3-4 Difference between cleavage and mitosis**

| S.No. | Characters | Cleavage | Normal mitosis |
|---|---|---|---|
| 1. | Site of occurrence | In zygote or parthenogenetic egg | In most of somatic cells |
| 2. | Interphase | Of shorter period | Of longer period |
| 3. | Growth | Does not occur | Occurs during interphase |
| 4. | Oxygen consumption | High as is very rapid process | Low as is slow process |
| 5. | Size of daughter cells | Decreases | Remains same after growth |
| 6. | DNA synthesis | Faster | Slower |
| 7. | Nuclear-cytoplasmic ratio | Increases | Remain same |

**Planes of cleavage :** The cleavage is initiated by the appearance of a constriction or groove called cleavage furrow. The cleavage furrows may divide the egg from different angles or planes. These are four important planes of cleavage. They are as follows.

(1) **Meridional plane :** When cleavage furrow bisects both the poles of the egg, passing through the animal vegetal axis, the plane of cleavage is called meridional plane.

Example : I$^{st}$ and II$^{nd}$ cleavage furrow of frog and I$^{st}$ cleavage furrow of chick.

(2) **Vertical plane :** When cleavage furrow passes from the animal pole to the vegetal pole, but it does not pass through the median axis of the egg.

Example : III$^{rd}$ cleavage furrow of chick, *Amia calva* and *Lepidosteus*.

(3) **Equatorial plane :** When cleavage furrow bisect the egg at right angles to the median axis and half way between the animal and vegetal poles.

Example : I$^{st}$ cleavage plane of eggs of higher mammals and v$^{th}$ cleavage plane of the eggs of *Ambystoma maculatum*.

(4) **Latitudinal or transverse or horizontal plane :** The transverse plane resemble the equatorial plane, but it passes either above (towards the animal pole) or below (towards the vegetal pole) the equator of the egg.

Example : III$^{rd}$ cleavage plane of Amphioxus and frog.

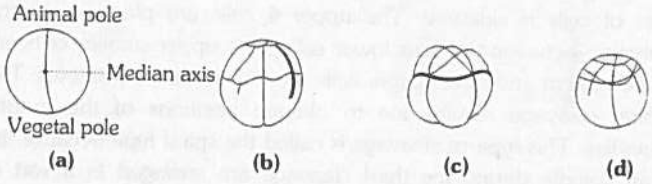



**Fig : 6.3-25 (a) Meridional plane; (b)Vertical plane; (c) Equatorial plane; (d) Latitudinal plane**

**Patterns of cleavage :** During segmentation, the cleavage furrows are not formed at random but are oriented in a particular manner with reference to the main (animal-vegetal) axis of the egg. The orientation of successive cleavage furrows with respect to each other and to the main axis of the egg is, however, unlike in different species. As such various patterns of cleavage are found among animals. Based upon symmetry, four patterns of cleavage have been recognized. They are as follows

(1) **Radial cleavage :** In this cleavage pattern, division take place in such a manner that all the blastomeres are placed in a radially symmetrical fashion around the polar axis. When such an egg is viewed from the poles, the blastomeres seem to be arranged in a radially symmetric form.

Example : Sponges, coelenterates, sea urchin, sea cucumber, amphioxus.

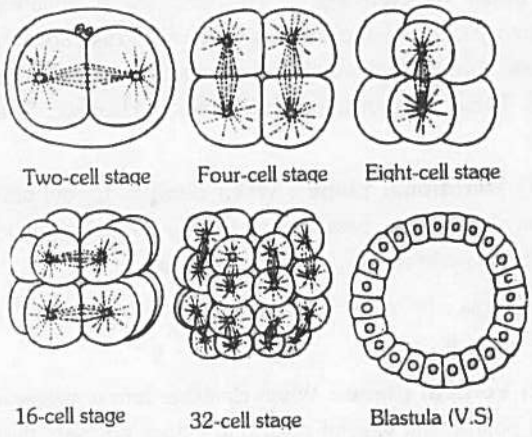



**Fig : 6.3-26 Radial cleavage in sea-cucumber Synapta digitata**

(2) **Biradial cleavage :** In this pattern four blastomeres arise by the usual two meridional cleavages. The third cleavage plane is vertical resulting in the formation of a curved plate of 8 cells arranged in two rows of 4 each. In these rows, the central cells are larger than the end ones.

Example : Ctenophores like Beroe.

**Fig : 6.3-27 Biradial (dorsal view)**

(3) **Spiral cleavage :** The spiral cleavage is diagonal to the polar axis. In this type, the spindles for the third cleavage, instead of being erect, are oriented diagonally so that the resulting upper tier of cells is sidewise. The upper 4 cells are placed over the junction between the four lower cells. The upper smaller cells are called micro and lower larger cells are known as macromeres. The spiral cleavage results due to oblique positions of the mitotic spindles. This type of cleavage is called the spiral type because the four spindle during the third cleavage are arranged in a sort of spiral.

Examples : Eggs of annelids, molluscs, nemerteans and some of the planarians.

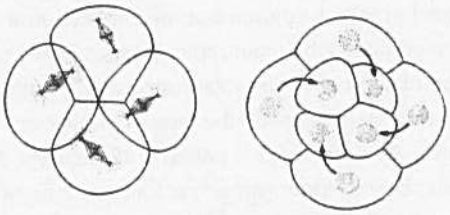


**Fig : 6.3-28 Spiral**

(4) **Bilateral cleavage :** In this pattern of cleavage, the blastomeres are so arranged that the right and left sides becomes distinct. In this case, two of the first four blastomeres may be larger than the other two, thus establishing a plane of bilateral symmetry in the developing embryo.

Examples : Nematodes, cephalopodes, molluscs, some echinoderms, tunicates, Amphibia and higher mammals.

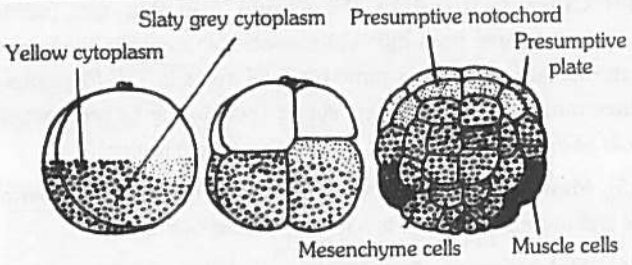



**Fig : 6.3-29 Bilateral cleavage**

**Laws of cleavage :** Certain fundamental rules or laws of cleavage are following :

(1) **Sach's laws :** In 1877, Sach proposed following two laws :

(i) Cells tend to divide into equal daughter cells.

(ii) Each new division plane tends to intersect the preceding plane at right angles. (Acts to maintain the spheroidal shape of blastomeres).

(2) **Hertwig's laws** : In 1881, O. Hertwig added following laws of cleavage in Sach's laws :

(i) The nucleus and achromatic figure (or mitotic spindle) 'occupy the centre of protoplasmic density' of the egg or blastomeres in which it lies. Hence, in the microlecithal and isolecithal eggs, the spindle is located centrally; in a telolecithal ovum it is nearer the animal pole.

**Corollary** : Blastomeres divide into two equal parts unless the yolk is unevenly stored in them.

(ii) The axis of a mitotic spindle occupies the longest axis of the protoplasmic mass in which it lies and division therefore tends to cut this axis transversely (evident in ovoid blastomeres).

**Corollary :** The ensuing plane of division cuts across the long axis, and the daughter cells revert to a more spheroidal shape.

(3) **Balfour's law :** Balfour's law which was formulated by Balfour in 1885, states that the speed or rate of cleavage in any region of egg is inversely proportional to the amount of yolk or deutoplasm it contains. (In telolecithal eggs, blastomeres at the animal pole divide faster than those nearer the vegetal pole).

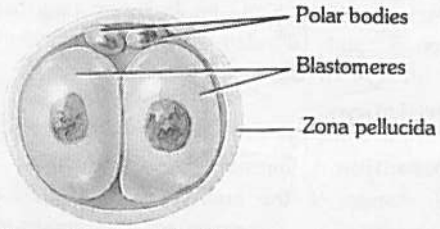
(4) **Pfluger's law :** The mitotic spindle always elongates in the direction of least resistance.

**Types of cleavage :** The amount of yolk (Lecithality) also determines the type of cleavage. Which are as follows

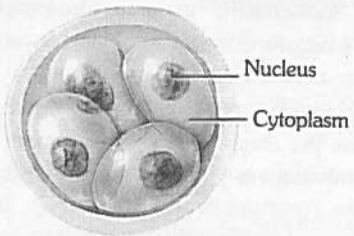
(i) **Holoblastic cleavage :** Alecithal, homolecithal and mesolecithal eggs show rapid and complete division of zygote are called total or holoblastic cleavage. Resulting 8 blastomeres after the third cleavage may be equal or unequal to each other. Accordingly they are of two types

(a) **Equal holoblastic cleavage :** If the blastomeres are approximately equal, it is called equal holoblastic cleavage.

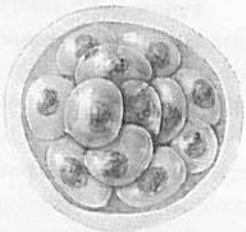
Examples : Echinoderms, amphioxus and placental mammals.




Two cell stage (day 1)




Four cell stage (day 2)



*Morula (day 4)*

**Fig : 6.3-30 Holoblastic equal cleavage and the formation of morula**

(b) **Unequal holoblastic cleavage :** If the upper 4 blastomere are smaller (micromeres) than the lower 4 yolk-laden larger blastomere (macromere), it is called unequal holoblastic cleavage.

Example : Fish and amphibians.

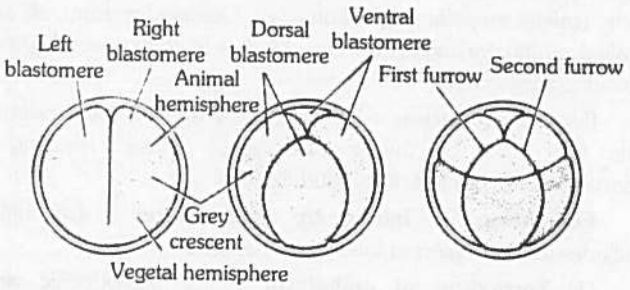



**Fig : 6.3-31 Holoblastic unequal cleavage**

(ii) **Meroblastic cleavage :** In large polylecithal eggs cleavage furrow cannot cut through the enormous yolk present so that the entire egg is not divided into cells. Thus cleavage is incomplete or partial, termed meroblastic. It is of following two types

(a) **Discoidal cleavage :** Cleavage are restricted only to the small cytoplasmic cap at the animal pole resulting in a rounded embryonic or germinal disc is termed discoidal cleavage.

Example : Eggs of elasmobranchs, bony fishes, birds, reptiles and egg laying mammals.

(b) **Superficial cleavage :** Cleavage is restricted to a superficial peripheral layer of cytoplasm around yolk, hence the term superficial cleavage.

Example : Centrolecithal eggs of arthropods.

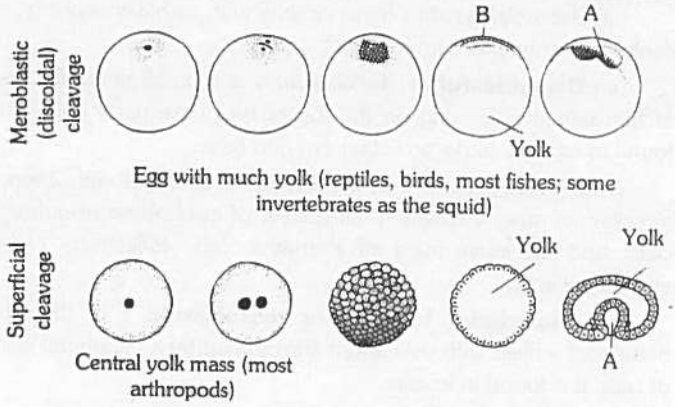



**Fig : 6.3-32 Types of cleavage and the resulting blastulae and gastrulae**

## Cleavage in human zygote

Cleavage in the human zygote occurs during its passage through the fallopian tube to the uterus as in other mammals. It is holoblastic. The first cleavage takes place about 30 hours after fertilization. It is meridional, coinciding with the animal-vegetal pole axis. It produces two blastomeres, one slightly larger than the other. The two blastomeres remain adhered to each other. The second cleavage occurs within 60 hours after fertilization. Third cleavage takes place about 72 hours after fertilization.

(1) **Formation of morula :** After 4$^{th}$ cleavage solid ball consist of 16 to 32 cells are formed which looks as a little mulberry called morula. Due to holoblastic and unequal cleavage, two types of blastomere are formed.

There is an outer layer of smaller (micromere) transparent cells around on inner mass of larger cells (macromere). The morula reaches the uterus about 4 to 6 days after fertilization. It is still surrounded by the zona pellucida, that prevents its sticking to the uterine wall.

(2) **Formation of blastula (blastocyst) :** The outer layer of cell becomes that and form trophoblast or trophoectoderm which draws the nutritive material secreted by the uterine endometrial glands. The fluids absorbed by the trophoblast collects in a new central cavity called blastocoel.

As the amount of nutritive fluid increases in blastocoel, morula enlarges and takes the form of a cyst and is now called blastocyst or blastodermic vesicle. The cells of trophoblast do not participate in the formation of embryo proper.

Inner cell mass of macromeres forms a knob at one side of trophoblast and forms an embryonal knob and is primarily determined to form the body of developing embryo so is called precursor of the embryo.

**Types of blastula**

(i) **Coeloblastula :** A hollow blastula in which blastocoel is surrounded by either single layered (*e.g.*, echinoderms, amphioxus) or many layered blastoderm (*e.g.*, frog).

(ii) **Amphiblastula :** It is a type of coeloblastula surrounded by two types of cells. Upper micromeres and lower macromeres. Ex. : frog.

(iii) **Stereoblastula :** Solid blastula with no blastocoel *e.g.*, in coelentrates annelids and molluscs.

(iv) **Discoblastula :** The blastula is as a multilayered flat disc at the animal pole lying on the top of well developed yolk. It is found in reptiles, birds, prototherians and fishes.

(v) **Blastocyst :** In this, the blastula is as a cyst with 2 types of cells : an outer epithelium – like layer of trophoblast or nutritive cells; and an inner mass of formative cells collectively called embryonal knob.

(vi) **Superficial blastula or periblastula :** In this, the blastocoel is filled with yolk and is surrounded by a peripheral layer of cells. It is found in insects.

**Fate mape :**

Fate mapping Ist tried by SPECT (1919)

Fate mapping Ist done by W. Vogt. (1929)

Fate mapping is done by vital dyes.

*e.g.*, Neutral Red. Nile blue sulphate, Bismarck brown.

Stain carrier = Agar-Agar and cellophan

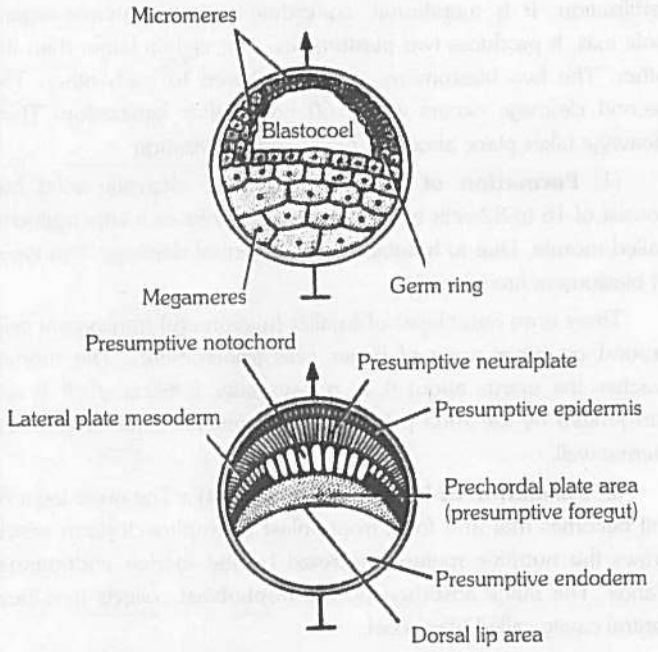



**Fig : 6.3-33 Blastula and Presumptive Areas**

Fate mapping can be done in Later blastula or earlygastrula.

**Presumptive Areas :** Also known as prospective areas.

(1) **Animal pole :** Animal pole gives rise presumptive ectoderm. It is the region of presumptive epidermis + presumptive neural plate.

(2) **Dorsal surface :** On dorsally a small area lies in intermediate zone which is the area of Presumptive Notochord.

(3) **Laterally :** Closed to the notochord, presumptive mesoderm is present.

(4) Vegetal half gives rise presumptive endoderm.

## Implantation

**Definition :** The process of attachment of the blastocyst on the endometrium of the uterus is called implantation.

**Period :** Though the implantation may occur at any period between $6^{th}$ and $10^{th}$ day after the fertilization but generally it occurs on seventh day after fertilization.

## Gastrulation

**Definition :** Gastrulation is a dynamic process involving critical changes in the embryo such as differentiation of cells, establishment of the three primary germ layers and transformation of the single walled blastula into a double walled gastrula.

**Types of gastrular movement or morphogenetic movement :** The movements of cells during gastrulation is called formative or morphogenetic movements. Following types of gastrular movements are found in different animals

(1) **Epiboly :** It involves the morphogenetic movement of prospective ectodermal (micromeres) blastomeres antero-posteriorly to envelop the presumptive endodermal and mesodermal blastomeres. It is found in telolecithal egg of frog.

(2) **Emboly :** It involves inward movement of prospective endodermal and chorda-mesodermal blastomeres from the surface of blastula. Emboly includes following methods :

(i) **Invagination :** It involves insinking of endodermal cells in the blastocoel to form archenteron. It is found in amphioxus.

(ii) **Involution :** It involves the rolling in of the chorda-mesodermal blastomeres inside the ectodermal cells over the lips of blastopore. It is also found in the gastrulation of frog.

(iii) **Ingression or polyinvagination :** In this, individual blastomeres migrate into the blastocoel either from only vegetal pole (called unipolar ingression *e.g.*, *Obelia*;) or from all sides (called multipolar ingression *e.g.*, *Hydra*) to form a solid gastrula called stereogastrula.

(iv) **Delamination :** It involves splitting off the blastoderm into two layers by the appearance of grooves resulting the formation of hypoblast. It is found in birds.

**Formation of layers by gastrulation :** Gastrulation includes the formation of following structures

(1) **Formation of endoderm :** The blastodermic vesicle enlarges and cells present on the lower surface of the embryonal knob detach by delamination from the embryonal knob. The part of endoderm located under the embryonal knob is called embryonic endoderm which later forms embryonic gut, while the remaining part of endoderm along with trophoblast forms the yolk sac.

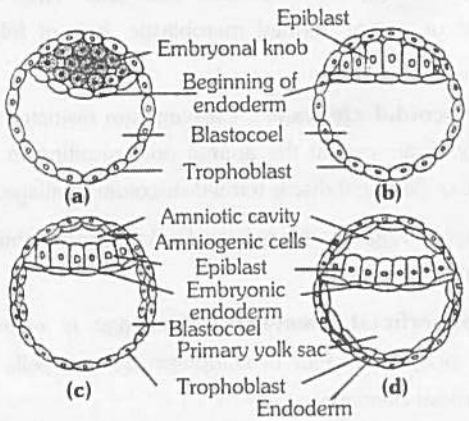



**Fig : 6.3-34 Formation of endoderm and ectoderm**

(b) **Formation of embryonic disc and mesoderm :** Meanwhile, the blastocyst continues to grow due to absorption of more and more uterine milk. The embryonal knob stretches and cells of Rauber start breaking off and dispersing. So the cells of embryonal knob forms a regular layer called embryonic disc which becomes continuous with the trophoblast. Embryonic disc is differentiated into cephalic, embryonic and caudal regions. Formation of embryonic mesoderm starts at the caudal region of the embryonic disc where cells undergo rapid proliferation and form a localized thickening of the embryonic disc and form the mesodermal layer between ectoderm and endoderm.

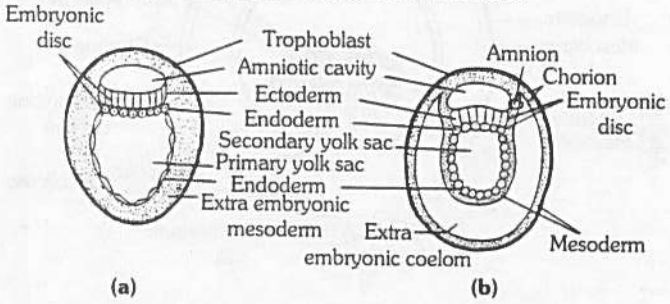



**Fig : 6.3-35 Formation of extraembryonic mesoderm and coelom**

(3) **Formation of ectoderm :** The remaining cells of blastodisc become columnar and form ectoderm.

**Fate of germ layers :** Each of the three germ layers gives rise to definite tissues, organs and systems of the body. Their fate in embryo and adult has been listed below.

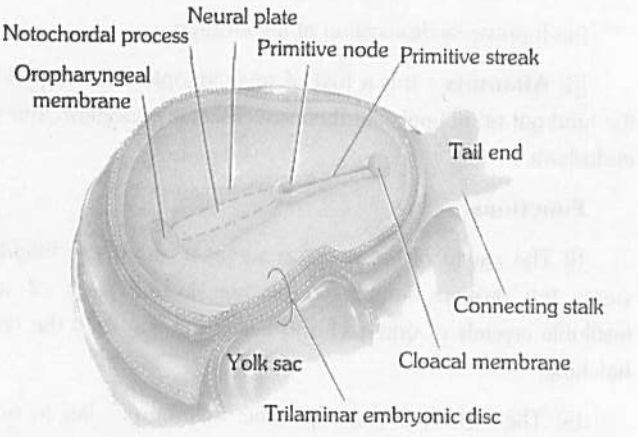
**Table : 6.3-5 Fate of germ layer**

| Ectoderm | Mesoderm | Endoderm |
|---|---|---|
| Epidermis and skin derivatives | Dermis | Gut |
| Cutaneous gland | Muscular tissue | Glands of stomach and intestine |
| Nervous system (Brain + spinal cord) | Connective tissue | Tongue |
| Motor and optic nerve | Endoskeleton | Lung, trachea and bronchi |
| Eye (Retina, lens and cornea) | Vascular system (heart and blood vessel) | Urinary bladder |
| Conjuctiva, ciliary and iridial muscle | Kidney | Primordial germ cells |
| Nasal epithelium | Gonads (Reproductive system) | Gills |
| Internal ear (membranous labyrinth) | Urinary and genital ducts | Liver |
| Lateral line sense organ | Coelom and coelomic epithelium | Pancreas |
| Stomodaeum (mouth) | Choroid and sclerotic coat of eye | Thyroid gland |
| Salivary gland | Adrenal cortex | Parathyroid gland |
| Enamel of teeth | Spleen | Thymus |
| Proctodaeum | Notochord | Middle ear |
| Pituitary gland | Parietal and visceral peritoneum | Eustachian tube |
| Pineal body | | Mesentron (Mid gut) |
| Adrenal medulla | | Lining of vagina and urethra |
| Hypothalamus | | Prostate gland |

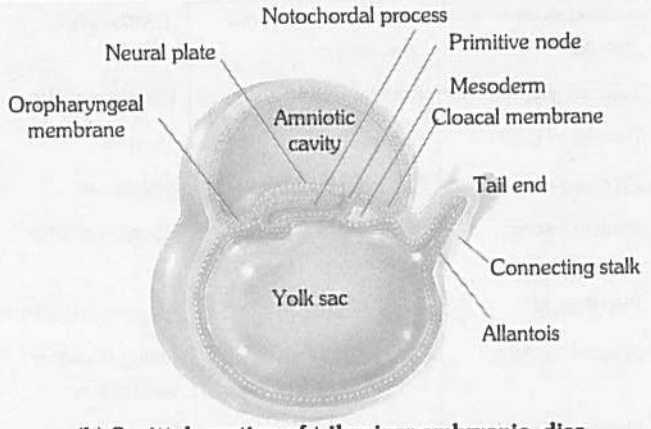
## Neurulation and organogenesis

Post gastrulation involves two main process. Neurulation is process of laying the neural plate to form the nervous system. The establishment of the germ layers initiates the final phase of embryonic development, *i.e.*, organogenesis. The latter involves differentiation and specialization of groups of cells in the individual germ layers. The cells of such groups change their form and give rise to morphologically recognizable tissues and organs of the new individual. The groups of differentiated cells separate from their germ layers in an orderly manner and with unique precision. Separation of the differentiated cell groups may occur by folding off from the germ layer or by migration of cells individually and reaggregation at a new place. In this manner, the primordial cells of the germ layers gradually and accurately give rise to the tissues and organs of the offspring.

By four weeks after fertilization, the embryo has a simple heart, limb buds and eye rudiments. It also has a tail and pharyngeal pouches, the vestiges of its early vertebrate ancestors that disappear later in development. After the second month, the embryo is recognizable as a primate. From this stage onwards, the embryo is often called foetus.




**(a) Dorsal and partial sectional views of trilaminar embryonic disc**




**(b) Sagittal section of trilaminar embryonic disc**

**Fig : 6.3-36 Development of the notochordal process**

## Extra embryonic membrane

These membranes are formed outside the embryo from the trophoblast only in amniotes and perform specific function. Some of these membranes take part in the formation of placenta in mammals.

(1) **Yolk sac :** It is formed below the embryo. It contains fluid, not yolk. The yolk sac is a vestigeal organ inherited from the oviparous reptilian ancestors. Yolk sac is enclosed by outer mesoderm and inner endodermal layer.

**Function :** In human beings, it is vestigeal. In human embryo it act as the site of blood cell formation until about the 6th week, when the liver takes over this role.

(2) **Amnion :** It is formed above the embryo. It consist of outer mesoderm and inner ectoderm. The amnion and the fluid filled amniotic cavity it encloses, enlarge and nearly surround the embryo. Amniotic fluid is secreted by both embryo and amnion.

**Functions**

(i) The amniotic fluid cushions the embryo.

(ii) It protects the embryo from jerk, injury and shocks.

(iii) It prevents desiccation of the embryo.

(3) **Allantois :** It is a fold of splanchnopleur developed from the hind gut of the embryo. It consist of outer mesoderm and inner endoderm.

**Functions**

(i) The cavity of the allantois serves as a urinary bladder. It stores the protein breakdown product in the form of water-insoluble crystals of uric acid and inside the egg upto the time of hatching.

(ii) The vascular "chorioallantoic membrane" lies in a close proximity to the inner surface of the porous shell. It acts as an extraembryonic lung by supplying the embryo with oxygen.

(4) **Chorion** : It is the outermost fold of somatopleur (outer ectoderm and somatic mesoderm) and surrounds the embryo. In reptiles, birds and prototherians, allantochorion act as extra embryonic lungs and helps in exchange of gases. But in primates including human beings, only chorion forms the placenta (chorionic placenta).

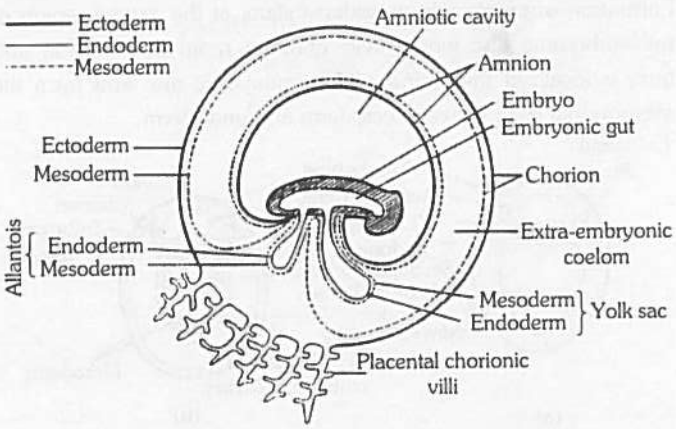



**Fig : 6.3-37 Foetal membranes and placenta (early stage)**

**Function :** It protects the embryo and forms placenta for metabolic exchange between the foetus and the mother.

## Placenta

**Definition :** Placenta is defined as a temporary intimate mechanical and physiological connection between foetal and maternal tissues for the nutrition, respiration and excretion of the foetus.

**Structure :** Human placenta consist of chorion only. Hence, it is called a chorionic placenta. Allantois remains small. The allantoic blood vessels, however, extend to vascularize it. A large number of branching villi from the vascular chorion penetrate the corresponding pits, the crypts, formed in the uterine wall. The latter becomes very thick and highly vascular to receive the villi. The intimate connection established between the foetal membrane and the uterine wall is known as the placenta.

The placenta is fully formed by the end of the third month and it lasts throughout pregnancy. When complete, it is a reddish – brown disc. In the placenta, the foetal blood comes very close to the maternal blood, and this permits the exchange of materials between the two. Food (glucose, amino acids, simple proteins, lipids), water, mineral salts, vitamins, hormones, antibodies and oxygen pass from the maternal blood into the foetal blood, and foetal metabolic wastes, such as carbon dioxide and urea, also water and hormones, pass into the maternal blood. The placenta, thus, serves as the nutritive, respiratory and excretory organ of the foetus. The continuous uptake of oxygen by foetal blood is ensured by the difference in affinity for oxygen between foetal and maternal haemoglobin.

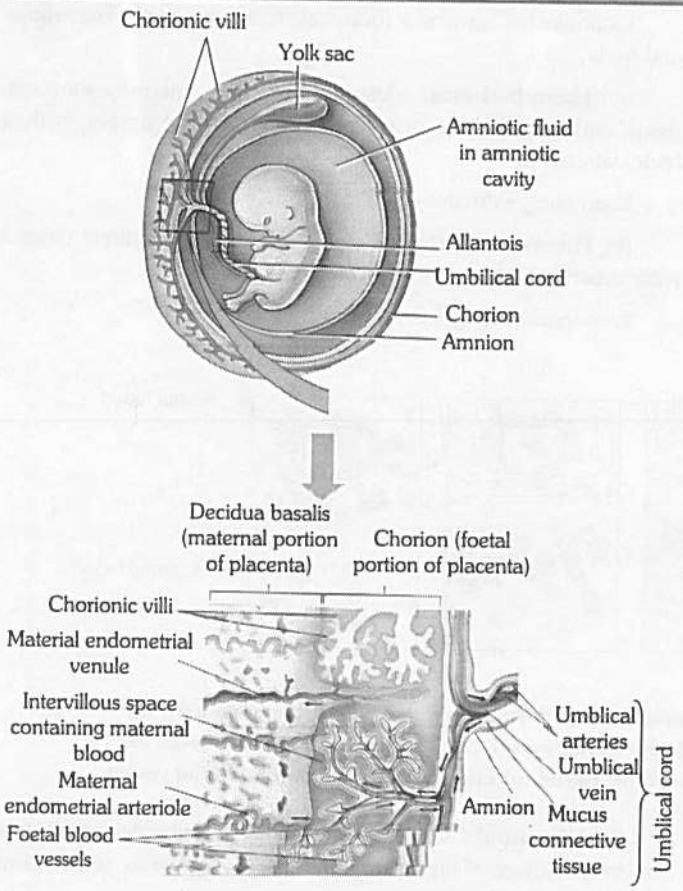



**Fig : 6.3-38 Placenta and Umbilical cord**

The maternal and foetal blood are not in direct contact in the placenta, because (i) the two may be incompatible; (ii) the pressure of maternal blood is far too high for the foetal blood vessels; and (iii) there must be a check on the passage of harmful materials (blood proteins, germs) into the foetal blood.

(iii) **Functions**

(1) Placenta helps in the nutrition of the embryo as the nutrients like amino acids, monosugars, vitamins, etc. pass from the maternal blood into foetal blood through placenta.

(2) It also helps in respiration of the embryo as $O_2$ of the maternal blood and $CO_2$ of the foetal blood diffuse through placenta into the foetal blood and maternal blood respectively.

(3) It also helps excretion of the embryo as nitrogenous wastes of foetal blood like urea pass into maternal blood through placenta.

(4) Though the placenta acts as an effective barrier for certain toxic chemicals like histamine but certain germs like AIDS virus, syphilis bacteria, viruses of German measles, etc, intoxicants like nicotine of cigarette smoke; and addictive drugs like heroin and cocaine can pass through the placenta and cause the developmental defects.

**Classification of placenta**

(1) **According to the foetal membrane involved in the formation of placenta.**

(i) **Yolk sac placenta** : In metatheria or marsupials, such as kangaroo (macropus) and opossum (Didelphys), placenta is derived from yolk sac and chorion.

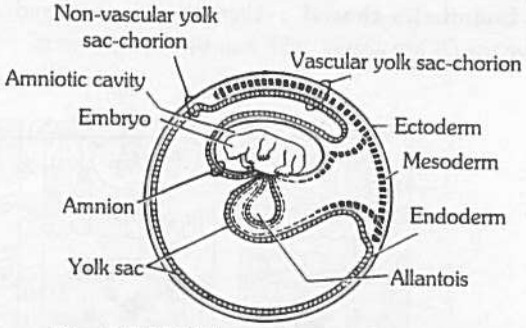



**Fig : 6.3-39 Yolk-sac placenta in opossum**

(ii) **Allantoic placenta** : In the majority of Eutherian, the chief organ of embryonic nutrition is the allantoic placenta consist of allantois and chorion and also called allantochorionic placenta. Outside Eutheria, a primitive allantoic placenta occurs only in perameles (bandicoot) which is a metatherian.

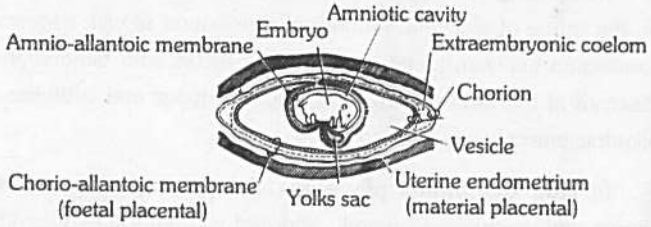



**Fig : 6.3-40 Allantoic or allanto-chorion placenta of pig**

(iii) **Chorionic placenta :** It occurs in primates (man and apes) and is formed only by chorion. Allantois remains small, burrows into body stalk (umbilical cord) and does not reach chorion. However, its mesoderm and blood vessels grow upto chorion whose villi enter the uterine crypts forming chorionic placenta.

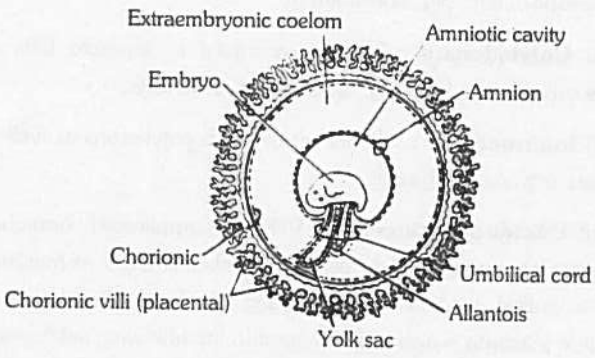



**Fig : 6.3-41 Chorionic placenta of man**

(2) **On the presence or absence of above barriers histologically placenta is divided into following types**

(i) **Epithelio-chorial :** Most primitive and simplest type with all six placental barriers.

Examples : Odd hoofed mammals such as horse, ass, pig and lemurs.

(ii) **Syndesmo-chorial :** Uterine epithelium absent, with five placental barriers.

Examples : Even hoofed mammals such as cow, Buffalow, sheep, goat, camel, Girraffe etc.

(iii) **Endothelio-chorial :** Uterine epithelium and uterine connective tissues are absent, with four placental barriers.

Examples : Carnivores (dog, cat, lion, tiger etc.), Tree shrew and mole.

(iv) **Haemo-chorial :** Uterine epithelium, uterine connective tissue and endothelium of maternal blood vessel absent, with 3 foetal layers.

Examples : Primates (man, apes and monkey).

(v) **Haemo-endothelial :** Foetal capillaries indirect contact with maternal blood, only one placental barrier.

Examples : Rat, guinea pig and rabbit.

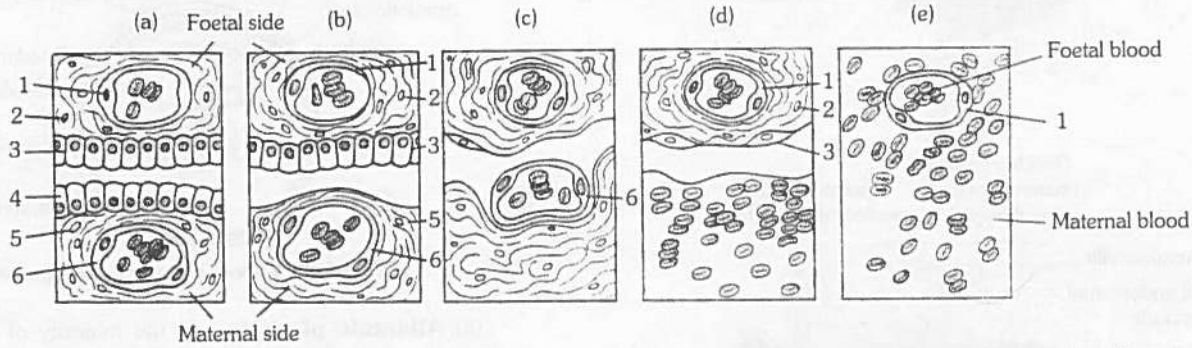



**Fig : 6.3-42 Histological types of placenta (a) Epithelio-chorial, (b) Syndesmo-chorial, (c) Endothelio-chorial, (d) Haemo-chorial, (e) Haemo-endothelial, (1) Endothelium of foetal blood vessel, (2) Chorionic connective tissue (3) Chorionic epithelium, (4) Uterine epithelium, (5) Uterine connective tissue (6) Endothelium of maternal blood vessel**

**According to shape and distribution of villi :** Depending on the shape of placenta, manner of distribution of villi, degree of connection between foetal and maternal tissues and behaviour of placenta at the time of birth, the following types and subtypes of allantoic placenta can be recognized.

(i) **Non deciduous placenta :** In most mammals villi are simple, unbranched and merely opposed without intimate contact between foetus and uterine wall. At the time of birth or parturition, villi are easily withdrawn from maternal crypts without causing any tissue damage. Thus no part of uterine tissue comes out and no bleeding occurs. Non deciduous or non-deciduate placenta has following subtypes according to the manner of distribution of villi.

(a) **Diffuse :** Villi remain scattered all over the surface of allantochorion. *e.g.*, pig, horse, lemur.

(b) **Cotyledonary :** Villi are arranged in separate tufts or patches called cotyledons. *e.g.*, goat, sheep, cow, deer.

(ii) **Intermediate :** Villi are arranged in cotyledons as well as scattered. *e.g.*, camel, giraffe.

(iii) **Deciduous placenta :** Villi are complicated, branched and intimately connected. At birth, a variable amount of maternal tissue is pulled out with the shedding of blood. Deciduous or deciduate placenta is also differentiated in the following subtypes

(a) **Zonary :** Villi form an incomplete (*e.g.*, racoon) or complete girdle encircling the blastocyst. *e.g.*, cat, dog, seal, Lion, Tiger, Elephant etc.

(b) **Discoidal :** Villi are restricted to a circular disc or plate on the dorsal surface of blastocyst. *e.g.*, insectivores, bats, rodents (rat, mouse), rabbit, bear.

(c) **Metadiscoidal :** Villi are at first scattered but later become restricted to one or two discs. It is monodiscoidal in man and bidiscoidal in monkeys and apes.

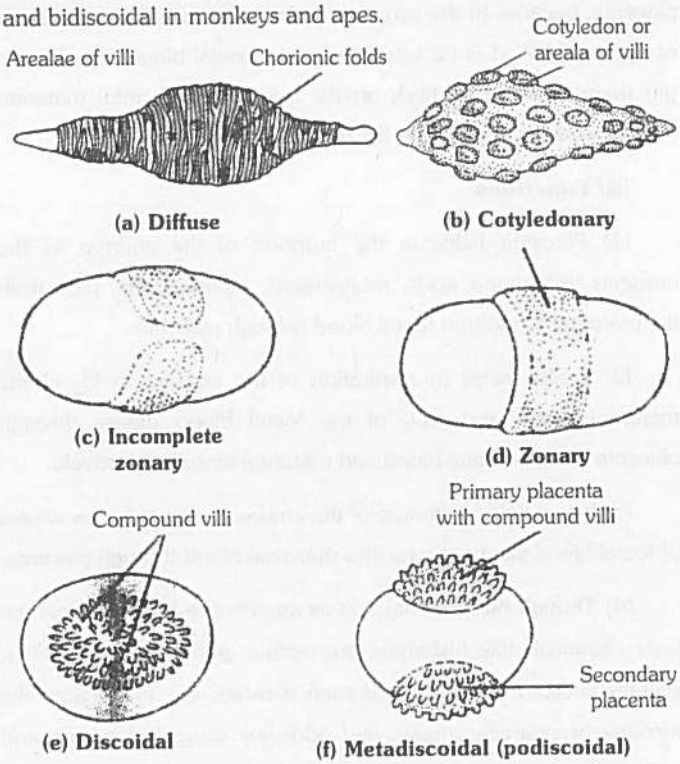



**Fig : 6.3-43 Types of placenta according to the distribution of villi**

(iv) **Contra-deciduous :** Foetal villi and uterine crypts are so intimately connected that even most of foetal placenta is left behind at birth to be broken and absorbed by maternal leucocytes *e.g.*, bandicoot (perameles), mole (Talpa).

## Gestation period and parturition

**Gestation period** : Gestation period is the duration between fertilization and parturition.

**Table : 6.3-6 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 |

**Parturition :** It is the expelling of the fully formed young from the mother's uterus after the gestation period (about 280 days in human female).

Parturition means simply the process by which the baby is born. Two major categories of effects lead up to the culminating contractions responsible for parturition : first, progressive hormonal changes that cause increased excitability of the uterine musculature; and second, progressive mechanical changes.

The signals for parturition originate from the fully developed foetus and the placenta induce mild uterine contractions known as **foetal ejection reflex.**

Oxytocin is a hormone secreted by the neurohypophysis that specifically causes uterine contraction. The fetus' pituitary gland also secretes increasing quantities of oxytocin that could possibly play a role in exciting the uterus and its adrenal gland secretes large quantities of cortisol that are also a possible uterine stimulant.

Progesterone inhibits uterine contractility during pregnancy, thereby helping to prevent expulsion of the fetus. On the other hand, estrogens have a definite tendency to increase the degree of uterine contractility.

It has been postulated that the estrogen-to-progesterone ratio increases sufficiently toward the end of pregnancy to be at least partly responsible for the increased contractility of the uterus.

## Lactation and Milk Composition

"Formation of milk in the female's breasts following the birth of a new born in mammals is called lactation".

Though estrogen and progesterone are essential for the physical development of the breast during pregnancy, a specific effect of both these hormones is to inhibit the actual secretion of milk. On the other hand, the hormone prolacting has exactly the opposite effect, promotion of milk secretion. This hormone is secreted by the mother's pituitary gland, and its concentration in her blood rises steadily from the fifth week of pregnancy until birth of the baby.

The fluid that is secreted after parturition is called **colostrum**. It contain essentially the same concentration of proteins and lactose as milk but almost no fat, and its maximum rate of production is about 1/100 the subsequent rate of milk production.

**Hypothalamic control of prolactin secretion :** The hypothalamus plays an essential role in controlling prolactin secretion. The hypothalamus mainly stimulates the production of all the other hormones, but it mainly inhibits prolacting production.

Two different factors formed in the hypothalamus are transported to the anterior pituitary through the hypothalamic-hypophysial portal system to control prolactin release by the anterior pituitary gland. These are called prolactin inhibitory hormone (PIH), which is the dominant hormone under most normal conditions and Prolactin-releasing factor (PRF), which can intermittently increase prolactin secretion.

**Milk composition :** Milk contains proteins (casein, lactalbumen etc.), fat, sugar (lactose), vitamins, mineral salts and water. Very less quantity of iron and vitamin C is present in milk.

Percentage Composition of milk

| Contents | Percentage |
|---|---|
| Water | 88.5 |
| Fat | 3.3 |
| Lactose | 6.8 |
| Casein | 0.9 |
| Lactalbumen and other protein | 0.4 |
| Ash | 0.2 |

# Tips & Tricks

- Smallest sperm is of Crocodile (.02mm) and largest sperm is of discoglossus (2mm)
- Complete spermatogenesis in man takes place in 74 days.
- In 1ml of human semen 100 million sperms are present.
- Infertility which arises due to less number of sperms is called Oligospermia.
- The condition of presence of normal number of motile sperms in human semen is termed as isozospermia.
- The condition of presence of completely non-motile sperms in human semen is termed as Necrospermia.
- Smallest eggs are of humming bird.
- In lower animals large amount of eggs are poduced because their chances of survival are very less.
- The asexual process replaced by the sexual method is known as apomixis.
- No natural death in organisms showing binary fission *e.g.*, Amoeba, so are called immortal.
- The croaking sound made by frog is sex call for female partner.
- Leuvenhock (1677) saw human sperm.
- In frog bidder canal help in sperm passout.
- Androgenesis : Development in which embryo has only paternal chromosomes, male parthenogenesis.
- Gynogenesis : Development in which embryo has only maternal chromosomes, female parthenogenesis.
- Castration / Orchidectomy : Removal of testes. It produce eunuchs. Castration changes aggressiveness of male into docile nature.
- Prostatitis : Inflammation of prostate gland. Prostate cancer is common in ageing males.
- Human egg : 0.1 mm in diameter.
- Peculiar spermatozoa : Ascaris has amoeboid spermatozoa devoid of flagellum. Some crustaceans also have atypical sperms.
- Sperms form about 10% of the ejaculated semen.
- Protandry : Spermatozoa mature earlier than ova in bisexual animals *e.g.*, – Hydra, Earthworm.
- Andrology : Branch of medicine concerned with diseases peculiar to male sex.
- Spermatophore : A capsule containing spermatozoa, as in cuttle fish and salamander.
- Oophoritis : Inflammation of an ovary.
- Vitellogenesis : Process of laying down of yolk in the primary oocyte. It occurs in the prophase of meiosis-I.
- Metagenesis : Alternation of sexually and asexually reproducing forms in the life cycle of an animal *e.g.*, Obelia.
- Protogyny : Ova mature earlier than sperm in a bisexual animal *e.g.*, Herdmania.
- Spermathecae : Small sacs that form a part of female reproductive system of earthworm and store spermatozoa received from the male for use in future.
- Ovipositor : A specialised female organ for laying eggs, specially in insects.
- Rutting season : It is a brief period of pronounced sexual activity in males.
- Tubectomy (Salpingectomy) : Surgical removal of oviducts.
- Von bear : Discovered ovum.
- Strobilation : Asexual multiplication by transverse fusion and is found in Scyphistoma of Aurelia and also found in Taenia.
- Richard owen gave term parthenogenesis.
- Testes are also called spermaries.
- Vaginal coelom : Cavity of scrotal sac.
- To-gene : Testicular organisation gene located on Y-chromosome and is a male determining factor.
- Uterus : It is also called womb.
- Vestibule : Acts as a urinogenital sinus.
- Perineum : Area between the fourchette and anus.
- Bartholin's or Bulbo vestibular glands of female homologous to Cowper's glands of male.
- Precocious puberty : Puberty attained before the normal age.
- Hypermastia : More than normal number of breasts.
- In seasonally breedings animals, testes show testicular cycle.
- Spermatogenesis is continuos process, while oogenesis is a discontinuous process.
- In spermatogenesis, spermatogonium produces four sperms while in oogenesis, one oogonium produces one ovum and 2 or 3 polar bodies.
- Golgi rest : Part of golgi body which is lost during spermiogenesis.
- Yolk nucleus : Also called Balbiani body. A mass of mitochondria and golgibody near the nucleus which controls vitellogenesis.
- Redundancy : Gene amplification of r-RNA genes for rapid RNA and protein synthesis.

- Ring centriole : Also called annulus or Jensen's ring.
- Menstruation is also called "Weeping of uterus for the lost ovum or funeral of unfertilized egg".
- Menstrual cycle is associated with withdrawal of progesterone.
- Oscar Hertwig : Described the fusion of sperm and egg nuclei in sea urchin.
- Prevost and Dumas : Reported cleavage of frog's egg.
- Swammerdam : Observed the first cleavage of frog in 1738.
- Spallanzani : Detailed process of cleavage of frog's egg.
- H. Spemann and Mangold : Reported embryonic induction on newt and gave concept of primary organizers.
- Pander : Formation of three germinal layers in chick embryo.
- Termones : Chemical released by algae in water for attraction of gametes.
- Pheromones : Chemical released by insects in air and generally acts as sex attractants *e.g.*, in gypsy moth.
- Gamones : Chemical released by the human gametes for their attraction.
- Zygote is called the first cell of next generation.
- Twins : When 2 or more babies are born in multiple births then these are called twins. These may be identical twins (or monozygotic twins) or fraternal (or dizygotic or non identical twins). Identical twins are attached to same placenta while fraternal twins are attached to uterine epithelium by separate placentae.
- Siamese twins : Conjoined twins joined at the hip, chest, back, face etc. these are surgically separated (first time in siam) and are always monozygotic.
- Polyspermy : Penetration of many sperms into an ovum simultaneously. Only one of the spermatozoa will be successful in uniting with female pronuclei.
- Polygyny : When two female pronuclei unite with a male pronucleus.
- Polyandry : Conjugation of two or more male pronuclei with a female pronucleus.
- Androgenesis : Non-participation of female pronucleus in fertilization.
- Cone of reception (Fertilization Cone) : A conical outgrowth given by egg of frog to receive the sperm. Not found in human egg.
- Fertilizin-Antifertilizin reaction was proposed by F.R. Lillie
- Sperms swim in the seminal fluid at the rate of 1-4 mm per minute and time taken by the sperm entry into the oocyte is about 30 minutes.
- The slow block to polyspermy develops, in response to the formation of the fertilization membrane and within a minute after the fast block.
- The motion of sperm is Random.
- Polyspermy is of common occurence in birds.
- Bindin is a protein in acrosome which ensure that the egg is being fertilized by a sperm of the same species.
- First embryonic membrane to be formed is endoderm.
- Cells of Rauber : Those cells of trophoblast which are in contact with embryonal knob.
- Zona pellucida disintegrates just after completion of cleavage.
- Cells of corona radiata disperse just before implantation.
- Teratogens are those physical, chemical and biological agents, which may cause malformations in the developing embryo.
- Postpartum care : Care after childbirth.
- Lanugo : Most of the body of foetus is covered with downy hairs called lanugo which are generally shed before birth
- Uterine milk : Nutritive endometrial secretion.
- Nidiculous or Altricial young : Underdeveloped and helpless young born *e.g.*, cats, dogs, rats, etc.
- Retrogressive metamorphosis : When an advanced larva changes into a degenerate adult *e.g.*, Herdmania, Sacculina.
- Progressive metamorphosis : When a simplified larva changes into an advanced adult *e.g.*, Frog.
- Primary organizers include dorsal lip of blastopore; grey crescent (neural inductor) and chorda-mesoderm (induces forebrain).

## Ordinary Thinking

### Objective Questions

### Male reproductive system

**1.** Cryptorchidism is the condition in man when **[DPMT 1993; MP PMT 2007]**

(a) There are two testis in each scrotum
(b) Testis do not descent into the scrotum
(c) Testis enlarge in the scrotum
(d) Testis degenerate in the scrotum

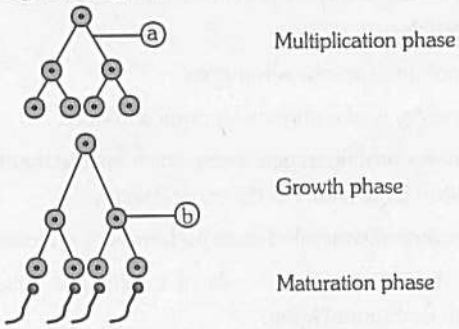
**2.** In human, the unpaired male reproductive structure is **[NCERT; Kerala PMT 2010]**

**Or**

Which of the following is an accessory reproductive gland in male mammals **[MHCET 2004]**

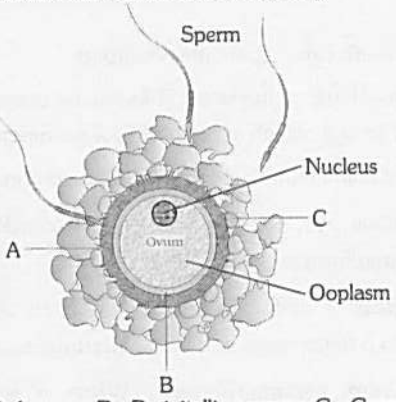
(a) Seminal vesicle (b) Prostate
(c) Bulbourethral gland (d) Testes
(e) Vas deferens

**3.** Which option is correct for the region labelled as 'a' and 'b' in the given diagram **[GUJCET 2014]**



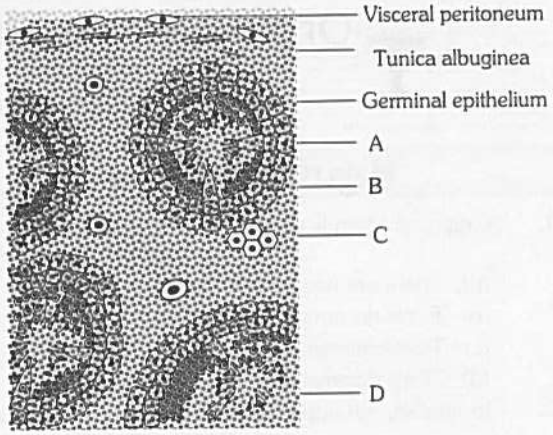

(a) a = Mitosis, b = Primary spermatocyte
(b) a = Meiosis, b = Secondary spermatocyte
(c) a = Mitosis, b = Secondary spermatocyte
(d) a = Meiosis, b = Primary spermatocyte

**4.** The given diagram shows to ovum surrounded by few sperms. Identify all the alphabets correctly **[NCERT]**




(a) A - Oolemma, B - Perivitelline space, C - Corona radiata
(b) A - Zona pellucida, B - Perivitelline space, C - Corona radiata
(c) A – Zona pellucida, B - Vitelline membrane, C - Corona radiata
(d) A - Zona pellucida, B - Perivitelline space, C - Corona reticulata

**5.** The given figure refers to T.S. of testis showing sectional view of a few seminiferous tubules. Identify the marked alphabets **[NCERT]**




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

**6.** There are some special types of cells found in the seminiferous tubules known as sertoli cells. These are **[CBSE PMT 1992]**

(a) Germinal cells (b) Reproductive cells
(c) Somatic cells (d) Protective cells

**7.** There is a connective tissue cord extending between the testis and abdominal wall called

(a) Testis cord (b) Gubernaculum
(c) Mesentric cord (d) Spermatic cord

**8.** The elastic tissue connecting the cauda epididymis to the scrotal sac is

(a) Gubernaculum (b) Tendinous cord
(c) Scrotal ligament (d) Caput epididymis

**9.** The seminiferous tubules of the testis are lined by the germinal epithelium consisting of **[MP PMT 1998; BVP 2004; Odisha JEE 2011]**

(a) Cells of Sertoli (b) Spermatocytes
(c) Spermatogonium (d) Spermatids

**10.** Spermatogenesis is promoted by **[Odisha JEE 2008]**

(a) Oestrogen (b) Progesterone
(c) Testosterone (d) Oxytocin

**11.** Which cells in the testis secrete testosterone, the male sex harmone **[MP PMT 1992, 94; EAMCET 1998; CPMT 1999; CBSE PMT 2001; BVP 2001;BHU 2001, 04; MH CET 2005; DPMT 2007; Odisha JEE 2012]**

**Or**

Which of the following is the endocrine tissue of testes **[Pb. PMT 2000]**

(a) Interstitial cells or cells of Leydig
(b) Cells of the germinal epithelium
(c) Sertoli cells
(d) Secondary spermatocytes

**12.** If the vas deferens of a man is surgically disconnected **[MP PMT 1993]**

(a) Sperms in the semen will be without nuclei
(b) Semen will be without sperms
(c) Spermatogenesis will not occur
(d) Sperms in the semen will be non-motile

**13.** The capsule enclosing testis of mammal is called as **[MP PMT 1993]**

(a) Tunica albuginea (b) Tunica membrana
(c) Tunica vaginalis (d) Tunica vesculosa

**14.** The abdominal passage which connects the abdominal cavity with the scrotal sac in mammals is known as **[NCERT]**

(a) Spermatic canal (b) Neurenteric canal
(c) Inguinal canal (d) Haversion canal

**15.** Sperm cells are produced in **[Odisha JEE 2008, 12; MP PMT 2012]**

(a) Seminiferous tubules (b) Interstitial cells
(c) Epididymis (d) Prostate gland

**16.** Gubernaculum cordis is a contractile structure that **[CMC Vellore 1993]**

(a) Pulls down the testis during breeding season into the scrotal sac
(b) Allows daily migration of the testis from the abdominal cavity into the scrotum
(c) Facilitates ejaculation of spermatozoa from the testis
(d) Keeps the testis in position

**17.** Which accessory genital gland occurs only in mammalian male **[KCET 2007]**
(a) Prostate gland (b) Perineal gland
(c) Cowper's gland (d) Bartholin gland

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

**19.** Cowper's gland is present in **[MP PMT 1994, 95]**
(a) Cockroach (b) Rabbit
(c) Earthworm (d) Frog

**20.** Seminal plasma in humans is rich in **[NCERT; CBSE PMT 2009; CBSE PMT (Pre.) 2010]**
(a) Fructose, calcium, certain enzymes
(b) Fructose and calcium but has no enzymes
(c) Glucose and certain enzymes but has no calcium
(d) Fructose and certain enzymes but poor in calcium

**21.** Sertoli cells are found in testis. These cells are **[RPMT 1999; HPMT 2005; MP PMT 2007; Odisha JEE 2010]**
(a) Nurse cell (b) Reproductive cell
(c) Receptor cell (d) None of these

**22.** Which of the following represents a condition where the motility of the sperms is highly reduced **[KCET 2006]**
(a) Oligospermia (b) Athenospermia
(c) Azoospermia (d) Polyspermy

**23.** Secretions from which one of the following are rich in fructose, calcium and some enzymes **[NCERT; CBSE PMT (Mains) 2010]**
(a) Male accessory glands (b) Liver
(c) Pancreas (d) Salivary glands

**24.** The correct sequence of spermatogenetic stages leading to the formation of sperms in a mature human testis is **[NCERT; CBSE PMT 2009; NEET 2013]**
(a) Spermatocyte – spermatogonia-spermatid-sperms
(b) Spermatogonia-spermatocyte-spermatid-sperms
(c) Spermatid-spermatocyte-spermatogonia-sperms
(d) Spermatogonia-spermatid-spermatocyte-sperms

**25.** In spermatogenesis, reduction division of chromosome occurs during conversion of **[Kerala PMT 2012; WB JEE 2012]**
(a) Spermatogonia to primary spermatocytes
(b) Primary spermatocytes to secondary spermatocytes
(c) Secondary spermatocytes to spermatids
(d) Spermatids to sperms

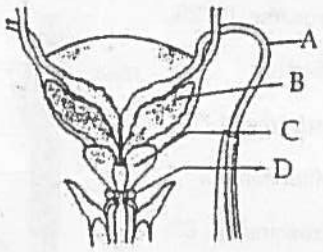
**26.** In humans, at the end of the first meiotic division, the male germ cells differentiate into be **[MP PMT 1994; CBSE PMT 2008]**
(a) Spermatids (b) Spermatozonia
(c) Primary spermatocytes (d) Secondary spermatocytes

**27.** Which one of the following statements is false in respect of viability of mammalian sperm **[NCERT; CBSE PMT (Pre.) 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

**28.** The acrosome of a sperm contains **[MP PMT 2010]**
(a) Hydrolytic enzymes (b) DNA
(c) Mitochondria (d) Fructose

**29.** Human sperm moves by **[Odisha JEE 2008]**
(a) Cilia (b) Flagella
(c) Basal body (d) Nucleosome

**30.** Given below is a diagrammatic sketch of a portion of human male reproductive system. Select the correct set of names of the parts labelled A, B, C, D **[NCERT; CBSE PMT 2009]**




| | A | B | C | D |
|---|---|---|---|---|
| (a) | Ureter | Prostate | Seminal vesicle | Bulboure thral gland |
| (b) | Vas deferens | Seminal vesicle | Prostate | Bulboure thral gland |
| (c) | Vas deferens | Semianl vesicle | Bulboure thral gland | Prostate |
| (d) | Ureter | Seminal vesicle | Prostate | Bulboure thral gland |

**31.** The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. The purpose served is for **[NCERT; Kerala PMT 2005; CBSE PMT (Pre.) 2011]**
(a) Providing a secondary sexual feature for exhibiting the male sex
(b) Maintaining the scrotal temperature lower than the internal body temperature
(c) Escaping any possible compression by the visceral organs
(d) Providing more space for the growth of epididymis

**32.** Heterogametic male condition does not occur in **[MHCET 2004]**
(a) Birds (b) Humans
(c) *Drosophila* (d) Honey bee

**33.** In the absence of acrosome, the sperm ..... **[KCET 2010]**
(a) Cannot penetrate the egg (b) Cannot get energy
(c) Cannot get food (d) Cannot swim

**34.** Sertoli cells are regulated by the pituitary hormone known as **[NCERT; CBSE PMT 2006; DPMT 2007]**

**Or**

The hormone which acts on sertoli cells and stimulates the process of spermiogenesis is **[KCET 2015]**
(a) Prolactin (b) LH
(c) FSH (d) GH

**35.** Testes in rabbit are **[MP PMT 1995]**
(a) Inside the body (b) On the sides of the kidneys
(c) In scrotal sacs (d) On either side of dorsal aorta

**36.** Supporting cells found in between the germinal epithelium of testes are called **[MP PMT 1996, 2002; PET (Pharmacy) 2013]**

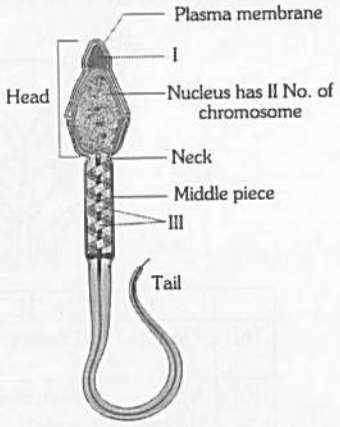
**Or**

Which of the following cells are present in mammalian testes and help to nourish sperms **[AFMC 1997; KCET 2001; CPMT 2003, 09; Kerala CET 2003; Odisha JEE 2012]**
(a) Interstitial cells of Leydig (b) Sertoli cells
(c) Granular cells (d) Phagocytes

**37.** The nutritive medium for the ejaculated sperms is given by
(a) Seminal fluid (b) Vaginal fluid
(c) Uterine lining (d) Fallopian tube

**38.** Cauda epididymis leads to **[MHCET 2004]**
(a) Vas efferens (b) Vas deferens
(c) Ejaculatory duct (d) Rete testis

**39.** The given figure belongs to human sperm. Identify I, II and III respectively **[NCERT]**

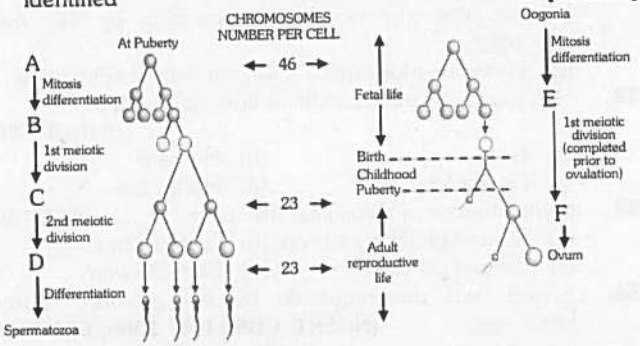



(a) I - Acrosome, II - 23, III - Spirilum
(b) I - Lysosome, II - 23, III - Mitochondria
(c) I - Acrosome, II - 23, III - Mitochondria
(d) I - Acrosome, II - 46, III - Mitochondria

**40.** Cells of leydig are found in **[NCERT; CPMT 1998; MP PMT 2010; Odisha JEE 2012]**
(a) Kidney of rabbit (b) Kidney of frog
(c) Testis of frog (d) Testis of rabbit

**41.** Bidder's canal is found in **[AFMC 1999]**
(a) Testes of frog (b) Kidney of frog
(c) Ovary of mammal (d) Kidney of mammal

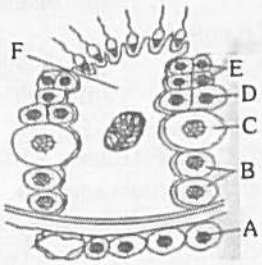
**42.** The given figure refers to spermatogenesis and oogenesis in human. Select the right option in which A to H are correctly identified **[NCERT]**




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

**43.** In rabbit, head of the epididymis present at the head of the testis is called **[KCET 2000; CPMT 2000; BHU 2004, 06]**
(a) Vas deferens (b) Cauda epididymis
(c) Gubernaculum (d) Caput epididymis

**44.** The given figure is a portion of a seminiferous tubule. Identify A, B, C, D, E and F respectively **[NCERT]**




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

**45.** Phallic organs in cockroach are related to **[BHU 2001]**
(a) Male excretory system
(b) Male reproductive system
(c) Female excretory system
(d) Female reproductive system

**46.** In which of the following organism testes descends into scrotum in breeding season but in non-breeding season goes up **[AFMC 2004]**
(a) Frog (b) Kangaroo
(c) Shrew (d) Bat

**47.** In most mammals, the testes are located in scrotal sac for **[MHCET 2003]**
(a) Spermatogenesis
(b) Sex differentiation
(c) More space to visceral organs
(d) Indepndent functioning of kidney

**48.** ICSH acts on **[MHCET 2004]**
(a) Spermatogonia (b) Nurse cells
(c) Leydig cells (d) Primary spermatocytes

**49.** Sertoli cells are found in **[NCERT; CPMT 1994, 99; AFMC 2002, 12; CBSE PMT (Pre.) 2010; J & K CET 2012]**
(a) Pancreas and secrete cholecystokinin
(b) Ovaries and secrete progesterone
(c) Adrenal cortex and secrete and adrenaline
(d) Seminiferous tubules and provide nutrition to germ cells

**50.** What happens during fertilisation in humans after many sperms reach close to the ovum **[NCERT; CBSE PMT (Mains) 2011]**

(a) Cells of corona radiata trap all the sperms except one

(b) Only two sperms nearest the ovum penetrate zona pellucida

(c) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida

(d) All sperms except the one nearest to the ovum lose their tails

**51.** If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from **[CBSE PMT (Pre.) 2011]**

(a) Vagina to uterus

(b) Testes to epididymis

(c) Epididymis to vas deferens

(d) Ovary to uterus

**52.** A primary spermatocyte is **[MP PMT 2013]**

(a) Polyploid (b) Haploid

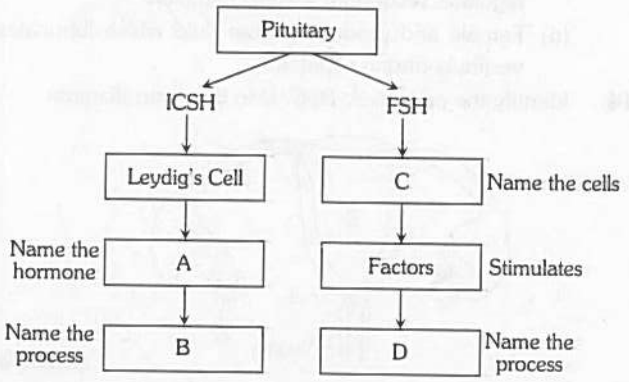
(c) Diploid (d) Aneuploid

**53.** How many spermatids are formed from a secondary spermatocyte **[MP PMT 2013]**

(a) 1 (b) 2

(c) 4 (d) 8

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



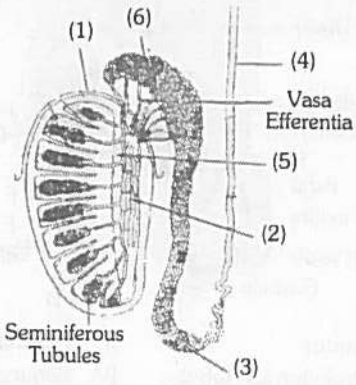

(a) A - Testosterone, B - Spermatogenesis, C - Sertoli cells, D - Spermiogenesis

(b) A - Testosterone, B - Spermiogenesis, C - Sertoli cells, D - Spermatogenesis

(c) A - Testosterone, B - Spermatogenesis, C - Testis, D - Spermiogenesis

(d) A - LH, B - Spermatogenesis, C - Sertoli cells, D – Spermiogenesis

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



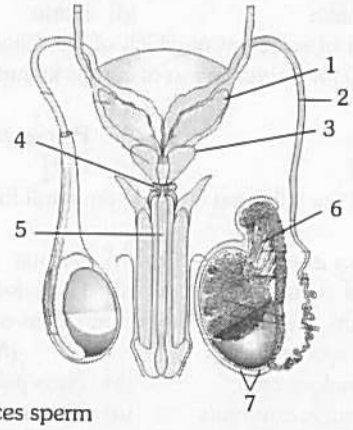

(a) 1- Tunica Vaginalis, 2 - Rete Testis, 3 - Caput Epididymis, 4 - Mediastinum Testis, 5 - Vas Deferens, 6 - Cauda Epididymis

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

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

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

**56.** Match each function given below with the related part or parts of the human male reproductive system shown in the diagram **[NCERT]**




A. Produces sperm

B. Conducts the sperm through the penis to the outside of the body

C. Produces seminal fluid

D. Connects the epididymis with the urethra

E. Stores sperm

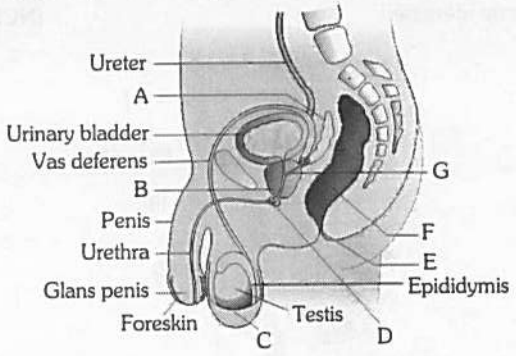
(a) A - 7; B - 5; C - 1, 3, 4; D - 2; E - 6

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

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

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

**57.** Identify the parts labelled (A to G) in the given figure of male reproductive system from the list I to X **[NCERT]**




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

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

**58.** Which of the following is **incorrect** regarding vasectomy **[NEET (Phase-II) 2016]**

(a) Irreversible sterility
(b) No sperm occurs in seminal fluid
(c) No sperm occurs in epididymis
(d) Vasa deferentia is cut and tied

## Female reproductive system

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

**2.** Inhibition of secretion of which of the following hormone is necessary for disintegration of corpus luteum **[GUJCET 2007]**
(a) *LH* (b) Progesterone
(c) *LTH* (d) *FSH*

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

**4.** In humans the oocyte is maintained in a state of meiotic arrest by secretions of **[AMU (Med.) 2010]**
(a) Granulosa cells (b) Zona pellucida
(c) Cumulus oophorus (d) Theca

**5.** In female rabbit, the expanded proximal part of the oviduct is known as

**Or**

Embryo with more than 16 blastomeres formed due to in vitro fertilization is transferred into **[NEET (Phase-II) 2016]**
(a) Uterus (b) Vagina
(c) Vestibule (d) Fimbricated funnel

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

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

**8.** Graafian follicle are characteristically found in the **[HPMT 2005]**
(a) Thyroid of mammal (b) Ovary of frog
(c) Testis of mammal (d) Ovary of mammal

**9.** The layer of cells immediately surrounding the ovum but outside the zona pellucida is called

**Or**

The membranous cover of the ovum at ovulation is **[NCERT]**
(a) Corona radiata (b) Membrana granulosa
(c) Theca interna (d) Germinal epithelium

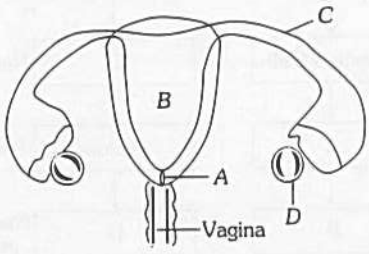
**10.** The membrane investing the ovum just outside the membrana granulosa is
(a) Zona pellucida (b) Theca interna
(c) Vitelline membrane (d) Discus proligerous

**11.** After ovulation the Graafian follicle becomes an endocrine organ called **[NCERT; CBSE PMT 2007]**
(a) Interstitial organ (b) Ovarian tube
(c) Globulin (d) Fibrin

**12.** During ovulation, the ovary releases **[MHCET 2015]**
(a) Oogonia (b) Ootid
(c) Primary oocyte (d) Secondary oocyte

**13.** Bartholin's glands in rabbit are found in **[MP PMT 1992]**
(a) Male and produce a viscous alkaline fluid which neutralizes acidity in the urethra
(b) Male and produce the clear liquid part of the spermatic fluid
(c) Female and produce the hormone estrogen which regulates secondary sexual characters
(d) Female and produce a clear fluid which lubricates the vestibule during copulation

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




**[KCET 2007]**
(a) *A* – oviduct, *B* – uterus, *C* – outduct, *D* - ovary
(b) *A* – cervix, *B* – uterus, *C* – ovary, *D* - tumor
(c) *A* – uterus, *B* – uterine cavity, *C* – oviducal funnel, *D* - ovary
(d) *A* – cervix, *B* – uterine cavity, *C* – fallopian tube, *D* - ovary

**15.** During menstrual cycle the cyclical changes takes place in **[KCET 2015]**
(a) Perimetrium (b) Endometrium
(c) Corpus luteum (d) Myometrium

**16.** Withdrawal of which of the following hormones is the immediate cause of menstruation **[NCERT; CBSE PMT 2006]**

**Or**

Menstruation is triggered by an abrupt decline in the amount of **[Odisha JEE 2009]**

**Or**

Which hormone level reaches peak during luteal phase of menstrual cycle **[J & K CET 2008; NEET 2013]**

(a) FSH-RH (b) Progesterone

(c) Estrogen (d) FSH

**17.** Ovulation in mammals is caused by **[Wardha 2005]**

(a) FSH and TSH

(b) FSH and LH

(c) FSH and LTH

(d) LTH and LH

**18.** Which one of the following statement is correct

(a) Albumen covering eggs of frog swells and forms protective jelly after coming in contact with water

(b) Fertilization in rabbit is helped by hyaluronidase which is present in eggs

(c) During fertilization in rabbit the entire sperm including tail enters egg

(d) In case of toad, fertilization takes place in moist soil

**19.** In the ovum of rabbit, Graafian follicle is

(a) Oogonial cells

(b) Corpus luteum

(c) Corpus albicans

(d) Theca externa, theca interna, oocyte and follicle cells

**20.** Stroma is a term applied to **[MP PMT 1993]**

(a) Gall stone

(b) Ovarian follicles

(c) Connective tissue in which Graafian follicles are embedded

(d) Connective tissue surrounding the seminiferous tubules

**21.** What is the female counterpart of prostate gland in the male (man) **[MP PMT 1993]**

(a) Bartholin's gland (b) Uterus

(c) Clitoris (d) None of these

**22.** Corpus luteum in mammals is present in **[MP PMT 1993, 94, 96, 98; RPMT 2002]**

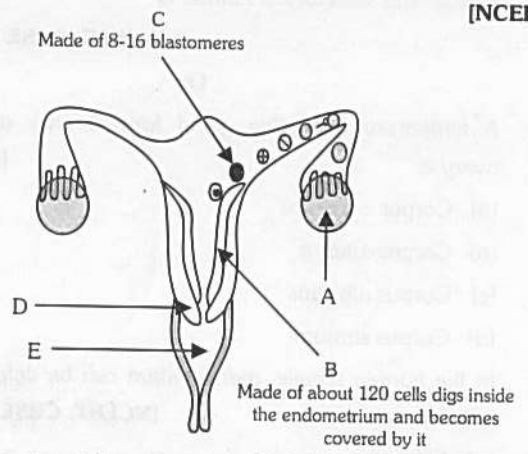
(a) Heart and initiates atrial contraction

(b) Brain and connects the two cerebral hemispheres

(c) Ovaries and produces progesterone

(d) Skin and acts as a pain receptor

**23.** Label the given figure which illustrates fertilization followed by cleavage and the early stages of embryonic development **[NCERT]**




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

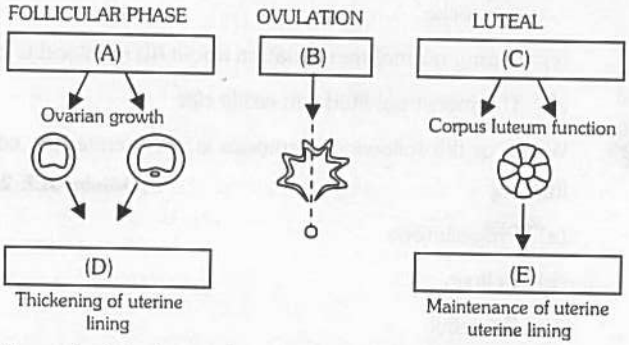
(a) A - ovary, B - morula, C - blastocyst, D - cervix, E - vagina

(b) A - ovary, B - blastocyst, C - morula, D - cervix, E - vagina

(c) A - ovary, B - blastocyst, C - morula, D - vagina, E - cervix

(d) A - ovary, B - blastocyst, C - gastrula, D - vagina, E - cervix

**24.** The following diagram refers the changes taking place during the human menstruation cycle **[NCERT]**




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

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

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

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

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

**25.** Which one of the following is the correct matching of the events occurring during menstrual cycle **[NCERT; CBSE PMT 2009]**

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

(b) Proliferative phase : Rapid regeneration of myometerium and maturation of Graafian follicle

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

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

**26.** The structure formed after release of ova from Graafian follicles and secretory in nature, is **[NCERT; CBSE PMT 1999]**

**Or**

A temporary endocrine gland formed after ovulation in ovary is **[BHU 1995]**

(a) Corpus callosum
(b) Corpus luteum
(c) Corpus albicans
(d) Corpus stratum

**27.** In the human female, menstruation can be deferred by the administration of **[NCERT; CBSE PMT 2007]**

(a) LH only
(b) Combination of FSH and LH
(c) Combination of estrogen and progesterone
(d) FSH only

**28.** Which one of the following statements is incorrect about menstruation **[CBSE PMT 2008]**

(a) At menopause the female is, there is especially abrupt increase in gonadotropic hormones
(b) The beginning of the cycle of menstruation is called menarche
(c) During normal menstruation about 40 *ml* blood is lost
(d) The menstrual fluid can easily clot

**29.** Which of the following hormones is not secreted by corpus luteum **[Odisha JEE 2012]**

(a) Progesterone
(b) Relaxin
(c) Estradiol
(d) Inhibin

**30.** The secretory phase in the human menstrual cycle is also called **[NCERT; CBSE PMT (Mains) 2012]**

(a) Luteal phase and lasts for about 6 days
(b) Follicular phase lasting for about 6 days
(c) Luteal phase and lasts for about 13 days
(d) Follicular phase and lasts for about 13 days

**31.** In human female the blastocyst **[NCERT; CBSE PMT (Mains) 2010]**

(a) Forms placenta even before implantation
(b) Gets implanted into uterus 3 days after ovulation
(c) Gets nutrition from uterine endometrial secretion only after implantation
(d) Gets implanted in endometrium by the trophoblast cells

**32.** Some important events in the human female reproductive cycle are given below. Arrange the events in a proper sequence

A : Secretion of FSH
B : Growth of corpus luteum
C : Growth of the follicle and oogenesis
D : Ovulation
E : Sudden increase in the levels of LH

**[NCERT; KCET 2009]**

(a) C→A→D→B→E (b) A→C→E→D→B
(c) A→D→C→E→B (d) B→A→C→D→E

**33.** Cervix lies between **[MP PMT 2000]**

(a) Oviduct and uterus (b) Uterus and vagina
(c) Vagina and clitoris (d) Clitoris and labia

**34.** The part of Fallopian tube closest to the ovary is **[CBSE PMT (Pre.) 2010]**

(a) Ampulla (b) Isthmus
(c) Infundibulum (d) Cervix

**35.** Vitellogenesis occurs during the formation of **[KCET 2009]**

(a) Primary oocyte in the Graafian follicle
(b) Oogonial cell in the Graafian follicle
(c) Ootid in the fallopian tube
(d) Secondary oocyte in the fallopian tube

**36.** In females the hormone inhibin is secreted by **[AMU (Med.) 2009]**

(a) Granulosa and theca cells
(b) Granulosa cells and corpus luteum
(c) Granulosa and cumulus oophorus cells
(d) Granulosa cells and zona pellucida

**37.** Menstruation is due to sudden **[DPMT 2003; MP PMT 2009]**

**Or**

In human females, the ovarian cycle begins when the **[J & K CET 2012]**

(a) Reduction of FSH
(b) Increase of LH
(c) Reduction in estrogen and progesterone
(d) None of these

**38.** hCG hPL and relaxin are produced in women **[Kerala PMT 2012]**

(a) At the time of puberty (b) Only during pregnancy
(c) Before puberty (d) At the time of menopause
(e) During menstruation

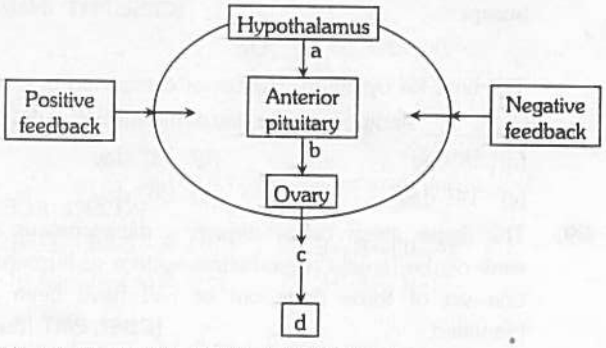
**39.** The cavity present in the graafian follicle is **[KCET 2001; MH CET 2006]**

(a) Amniotic cavity (b) Archenteron
(c) Antrum (d) Ostium

**40.** Which one of the following events is correctly matched with the time period in a normal menstrul cycle **[NCERT; AIIMS 2005]**

(a) Release of egg : 5$^{th}$ day
(b) Endometrium regenerates : 5 – 10 days
(c) Endometrium secretes nutrients for implantation : 11–18 days
(d) Rise in progesterone level : 1 – 15 days

**41.** Choose the correct combination of labelling the hormonal control of female reprodcutive system **[Kerala CET 2005]**



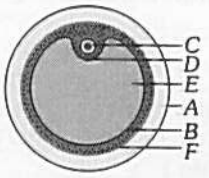

(a) *(a)*–GnRH *(b)*–TSH *(c)*–LTH *(d)–uterus*
(b) *(a)*–GnRH *(b)*–LH/FSH *(c)*–oestrogen or progestrone *(d)–uterus*
(c) *(a)*–GnRH *(b)*–STH *(c)*–LH *(d)–uterus*
(d) *(a)*–GnRH *(b)*–ACTH *(c)*–LH *(d)–uterus*
(e) *(a)*–GnRH *(b)*–LTH *(c)*–oestrogen *(d)–uterus*

**42.** Corpus luteum is developed from **[MHCET 2003]**
(a) Oocyte (b) Nephrostome
(c) Graafian follicle (d) None of these

**43.** The estrous cycle occurs in
(a) Mouse (b) Gorilla
(c) Chimpanzee (d) Monkey

**44.** In woman cessation of menstruation occurs at the age of **[KCET 2000]**
(a) 12–14 years (b) 45–58 years
(c) 60 years (d) Does not occur at all

**45.** In the diagram of section of Graafian follicle, different parts are indicated by alphabets; choose the answer in which these alphabets have been correctly matched with the parts they indicate..... **[Kerala PMT 2004]**




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

**46.** Proliferation of endometrium of uterus in controlled by **[Kerala PMT 2004]**
(a) Relaxin (b) Oxytocin
(c) Progesterone (d) Oestrogen
(e) Luteinizing

**47.** Aldosterone is secreted by **[Manipal 2005]**
(a) Zona glomerulosa (b) Zona fasciculata
(c) Zona reticularis (d) Zona pellucida

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

**49.** In human females ova are produced in **[HP PMT 2005]**
(a) Ovarian follicles (b) Oviduct
(c) Uterus (d) Vagina

**50.** The rupture of the graafian follicle and the release of ovum occurs under the influence of **[Manipal 2005]**
(a) LH (b) FSH
(c) MSH (d) GH

**51.** The menstrual cycle in normal adult woman is of **[MP PMT 1997]**
(a) 48 days (b) 38 days
(c) 18 days (d) 28 days

**52.** Fimbriated funnel is **[MP PMT 1998]**
(a) Proximal part of oviduct (b) Uterus part
(c) Urinary bladder part (d) Ureter part

**53.** Fallopian tube is the part of **[MP PMT 1999]**
**Or**
Mullerian duct is **[MP PMT 2000; AFMC 2012]**
(a) Uterus (b) Ureter
(c) Oviduct (d) Vas deferens

**54.** Prepubertal period refers to a stage of **[Pune CET 1998]**
(a) Growth enlargement of organ systems and maturation of reproductive mechanisms
(b) Initiation of gonads
(c) Initiation of organs
(d) Maturation of gonads alone

**55.** The substance secreted by the corpus luteum is **[RPMT 1999]**
(a) Hormone (b) Enzyme
(c) Pheromone (d) Bile

**56.** In the 28 day human ovarian cycle, the ovulation takes place typically on **[BHU 2000]**
(a) Day 1 of the cycle (b) Day 5 of the cycle
(c) Day 14 of the cycle (d) Day 28 of the cycle

**57.** The cyclic period of sexual activity in non-human female mammals is called **[AFMC 2001]**
(a) Menstruation (b) Luteinization
(c) Oogenesis (d) Estrous

**58.** In mammals the oestrogens are secreted by the Graafian follicle from its **[MP PMT 1999, 2001]**
(a) External theca (b) Internal theca
(c) Zona Pellucida (d) Corona radiata

**59.** In human females at the time of birth there are two million ova: how many of them normally reach maturity in the course of normal reproductive life **[MP PMT 2001]**
(a) 500 (b) 1,000
(c) 2,000 (d) 5,000

**60.** Parturition duct in female is called **[RPMT 2001]**
(a) Uterus (b) Oviduct
(c) Vagina (d) Cervix

**61.** In human female which of the following is incorrect **[Odisha JEE 2002]**

(a) Menstrual cycle takes 28 days
(b) Menopause occur at 45-55 years
(c) The ovulated egg released during pregnancy die
(d) Menstruation takes 4 days

**62.** If both ovaries are removed from a rat, then which hormone is decreased in blood **[CBSE PMT 2002]**

(a) Oxytocin
(b) Oestrogen
(c) Prolactin
(d) Gonadotrophic

**63.** Bartholin' s glands are situated **[CBSE PMT 2003]**

(a) On either side of vas deferens in humans
(b) On the sides of the head of frog
(c) At the reduced tail end of birds
(d) On either side of vagina in humans

**64.** Both corpus luteum and macula lutea are **[AIIMS 2003, 08, 13]**

(a) Found in human ovaries
(b) A source of hormones
(c) Characterized by a yellow colour
(d) Contributory in maintaining pregnancy

**65.** In mammals the female secondary (accessory) sexual characters are developed by the hormone **[NCERT; MP PMT 2002, 07]**

**Or**

Development of secondary sexual characters in females are controlled by **[MP PMT 1996, 99, 2003]**

(a) Relaxin
(b) Oestrogens
(c) Progesterone
(d) Gonadotropins

**66.** Ovulation in the human female normally takes place during the menstrual cycle **[CBSE PMT 2004]**

(a) At the beginning of the proliferative phase
(b) At the end of the proliferative phase
(c) At the mid secretory phase
(d) Just before the end of the secretory phase

**67.** Sequence of hormones during menstrual cycle is **[NCERT; Odisha JEE 2004]**

(a) Oestrogen, progesterone and FSH
(b) Progesterone, oestrogen and FSH
(c) FSH, oestrogen and progesterone
(d) FSH, progesterone and oestrogen

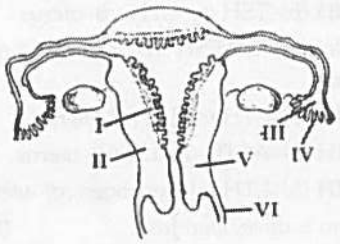
**68.** About which day in a normal human menstrual cycle does rapid secretion of LH (popularly called LH-surge) normally occurs **[CBSE PMT (Mains) 2011]**

**Or**

The time for optimum chances of conception in a women is _____ starting from the day of menstruation **[KCET 2012]**

(a) $5^{th}$ day (b) $11^{th}$ day
(c) $14^{th}$ day (d) $20^{th}$ day

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




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

**70.** The main function of the fimbriae of the fallopian tube in females is to **[Kerala PMT 2011]**

(a) Release to ovum from the Graafian follicle
(b) Make necessary changes in the endometrium for implantation
(c) Help in the development of corpus luteum
(d) Help in the collection of the ovum after ovulation
(e) Help in the development of ovary

**71.** Name the hormone that has no role in menstruation **[WB JEE 2011]**

(a) *LH* (b) *FSH*
(c) *GH* (d) *TSH*

**72.** Column I contains terms and Column II contains definitions. Match them correctly and choose the right answer

| | Column I | | Column II |
|---|---|---|---|
| A. | Parturition | 1. | Attachment of zygote to endometrium |
| B. | Gestation | 2. | Release of egg from Graafian follicle |
| C. | Ovulation | 3. | Delivery of baby from uterus |
| D. | Implantation | 4. | Duration between pregnancy and birth |
| E. | Conception | 5. | Formation of zygote by fusion of the egg end sperm |
| | | 6. | Stoppage of ovulation and menstruation |

**[KCET 2011]**

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

**73.** In a normal pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was **[NCERT; CBSE PMT (Pre.) 2012]**

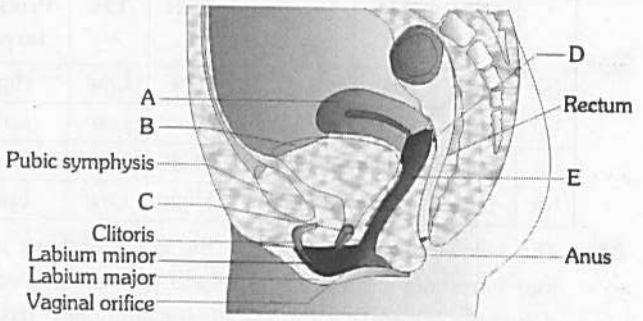
(a) High level of circulating FSH and LH in the uterus to stimulate implantation of the embryo

(b) High level of circulating HCG to stimulate endometrial thickening

(c) High level of FSH and LH in uterus to stimulate endometrial thickening

(d) High level of circulating HCG to stimulate estrogen and progesterone synthesis

**74.** The following figure represents to female reproductive system of human. Select the right option in which A to E are correctly identified **[NCERT]**



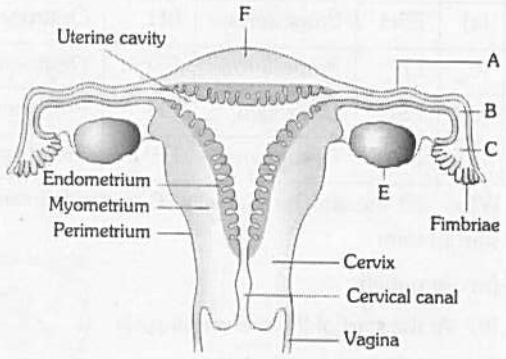

(a) A - Uterus, B - Urinary bladder, C - Urethra, D - Cervix, E - Vagina

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

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

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

**75.** The given figure refers to female reproductive system of human. Identify the marked alphabets **[NCERT]**



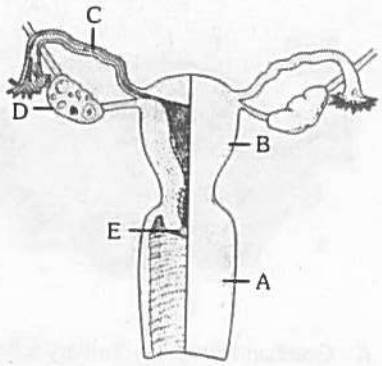

(a) A - Ampulla, B - Infundibulum, C - Isthmus, D - Fallopian tube, E - Ovary, F - Uterine fundus

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

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

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

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




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

(a) 1 - E, 2 - C, 3 - B, 4 - D, 5 - A **[NCERT]**

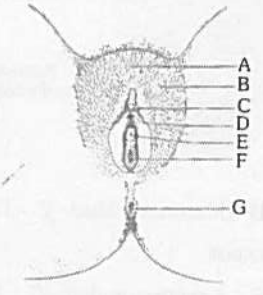
(b) 1 - D, 2 - C, 3 - B, 4 - D, 5 - A

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

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

**77.** Identify the parts labelled (A to G) in the following diagram of the vulva, from the list I to VIII **[NCERT]**

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



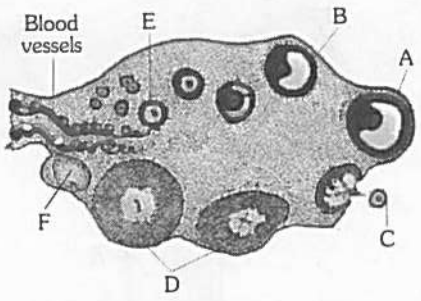

(a) A - V, B - VI, C - VII, D - IV, E - II, F - III, G - I

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

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

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

**78.** The figure shows a section of human ovary. Select the option which gives the correct identification of A to F
**[NCERT; AIIMS 1992; CBSE PMT 1995; RPMT 1999, 2006; MP PMT 2003; Odisha JEE 2004; DPMT 2007; NEET (Karnatak) 2013]**



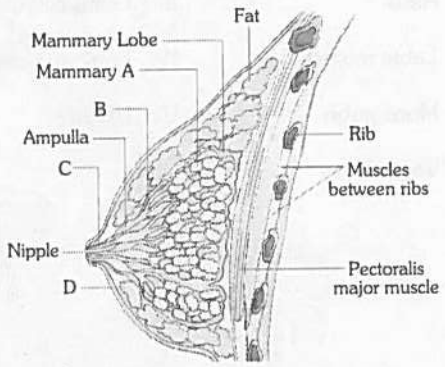

(a) A - Graafian follicle, B - Tertiary follicle with antrum, C - Ovum, D - Corpus luteum, E - Primary follicle, F - Corpus albicans

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

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

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

**79.** The figure given below is the diagrammatic sectional view of mammary gland. identify A to D respectively **[NCERT]**



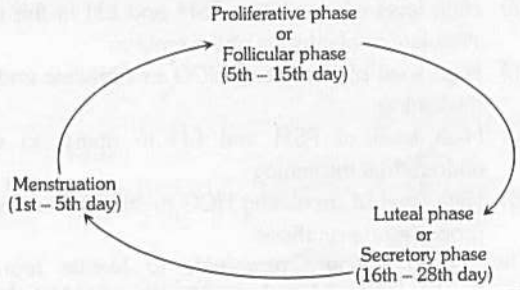

(a) A - Alveolus, B - Mammary duct, C - Lactiferous duct, D - Lactogenic spot

(b) A - Alveolus, B - Lactiferous duct, C - Mammary duct, D - Areola

(c) A - Alveolus, B - Mammary duct, C - Lactiferous duct, D - Areola

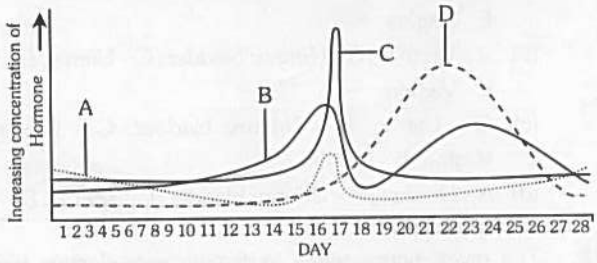
(d) A - Gland, B - Mammary duct, C - Lactiferous duct, D - Areola

**80.** The events of the menstrual cycle are represented below. Select the right option in which the level of FSH, LH and progesterone are mentioned correctly **[NCERT]**



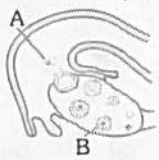

| | 13th - 14th day | | | 21st - 23rd day | | |
|---|---|---|---|---|---|---|
| | **FSH** | **LH** | **Proges-terone** | **FSH** | **LH** | **Proges-terone** |
| (a) | High | High | Low | Low | Low | High |
| (b) | High | High | High | Low | Low | Low |
| (c) | Low | Low | Low | High | High | High |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

**81.** The following graph represents the concentrations of the four hormones present in the blood plasma of a women during her menstrual cycle. Identify the hormones **[NCERT]**




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

**82.** When did the structure labelled B in the following diagram start to form **[NCERT]**



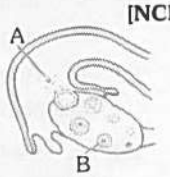

(a) At puberty

(b) At the start of the menstrual cycle

(c) Before birth

(d) In infancy

**83.** Which stage of the menstrual cycle is characterized by the event labelled A in given diagram **[NCERT]**




(a) Fertilization

(b) Flow

(c) Ovulation

(d) Corpus luteum formation

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

**85.** Identify the correct statement on 'inhibin' **[NEET (Phase-I) 2016]**
(a) Inhibits the secretion of LH, FSH and prolactin
(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

**86.** Which cells of the ovary are involved in the synthesis of estrogen **[WB JEE 2016]**
(a) Theca interna cells (b) Granulosa cells
(c) Interstitial cells (d) Theca externa cells

## Gametogenesis

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

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

**3.** In which phase of cell division is oogonia arrested **[DPMT 2007]**
(a) Anaphase II (b) Prophase I
(c) Interphase (d) Both prophase I and II

**4.** Germ cells in mammalian gonads are produced by **[CPMT 1993; MP PMT 1997, 2000]**
(a) Only mitosis (b) Only meiosis
(c) Mitosis and meiosis both (d) Without cell division

**5.** The breakage of the membrane surrounding the acrosome in a mammalian sperm is **[MP PMT 1994]**
(a) Activation (b) Cavitation
(c) Agglutination (d) Capacitation

**6.** How many secondary spermatocytes will be required to form 400 spermatozoans **[MP PMT 2006]**
(a) 100 (b) 200
(c) 40 (d) 400

**7.** $2n = 16$ in a primary spermatocyte which is in metaphase of first meiotic division. What shall be the total number of chromatids in each of the secondary spermatocyte **[KCET 2009]**
(a) 32 (b) 8
(c) 16 (d) 24

**8.** 1st polar body is formed at which stage of oogenesis **[AFMC 2009]**
(a) 1st meiosis (b) 2nd mitosis
(c) 1st mitosis (d) Differentiation

**9.** In oogenesis haploid egg is fertilized by sperm at which stage **[Odisha JEE 2008]**
(a) Primary oocyte (b) Secondary oocyte
(c) Oogonium (d) Ovum

**10.** Spermatids are transformed into spermatozoa by **[Kerala PMT 2008]**
(a) Spermiation (b) Spermatogenesis
(c) Meiosis (d) Spermatosis
(e) Spermiogenesis

**11.** In frog chromosome no. is reduced to half **[BHU 2003]**
(a) When 2nd polar body is separated
(b) When 2nd polar body is divided
(c) When 3rd polar body is separated
(d) When 1st polar body is separated

**12.** Nebenkern is a part of **[KCET 2004]**
(a) Foetus (b) Graafian follicle
(c) Human ovum (d) Human sperm

**13.** In mammalian sperm, spirally arranged mitochondria are present in **[MHCET 2001; AFMC 2010]**
(a) Head portion (b) Middle piece
(c) End piece of the tail (d) Principal piece of tail

**14.** Acrosome of sperm is formed from **[MP PMT 2004; CPMT 2005; MH CET 2005; AMU (Med.) 2006; Odisha JEE 2012]**
(a) Nucleus of spermatid
(b) Mitochondria of spermatid
(c) Golgi complex of spermatid
(d) Centrosome of spermatid

**15.** Sperm's acrosome has **[Manipal 2005; RPMT 2006]**
(a) Hyaluronic acid and proacrosine
(b) Hyaluronic acid and fertilizin
(c) Hyaluronidase and proacrosin
(d) Fertilizin and proacrosin

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

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

**18.** Sperms formed from 4 primary spermatocytes are **[CPMT 2005]**

(a) 4 (b) 1
(c) 16 (d) 32

**19.** Hormone responsible for metamorphosis in tadpole is **[Manipal 2005]**

(a) Adrenaline (b) Thyroxine
(c) Aldasterone (d) Vasopressin

**20.** What do you mean by the term spermateleosis **[MHCET 2004; Manipal 2005]**

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

**21.** Spermatogonia formed after which cell division **[HPMT 2005]**

(a) Meiosis I (b) Meiosis II
(c) Mitosis (d) Amitosis

**22.** Match the following with correct combination

| | |
|---|---|
| *(a)* Hyaluronidase | *(i)* Acrosomal reaction |
| *(b)* Corpus luteum | *(ii)* Morphogenetic movements |
| *(c)* Gastrulation | *(iii)* Progesterone |
| *(d)* Capacitation | *(iv)* Mammary gland |
| *(e)* Colostrum | *(v)* Sperm activation |

**[Kerala CET 2005]**

(a) *(a)-(v), (b)-(ii), (c)-(iv), (d)-(i), (e)-(iii)*
(b) *(a)-(i), (b)-(iii), (c)-(ii), (d)-(v), (e)-(iv)*
(c) *(a)-(i), (b)-(ii), (c)-(iii), (d)-(iv), (e)-(v)*
(d) *(a)-(iv), (b)-(ii), (c)-(v), (d)-(iii), (e)-(i)*

## Phases of embryonic development

**1.** The branch of embryology which concerns with the study of abnormal embryonic development is termed as **[CBSE PMT 1992]**

(a) Gerantology (b) Teratology
(c) Embryology (d) None of the above

**2.** The immatured stage eggs are called as **[CBSE PMT 1993]**

(a) Microlecithal (b) Oogenesis
(c) Oocyte (d) Zygote

**3.** Which layer develops first during embryonic development **[MH CET 2006; CPMT 2009]**

(a) Ectoderm (b) Mesoderm
(c) Endoderm (d) Both (b) and (c)

**4.** In mammals growing oocytes are surrounded by special nutritive cells called

(a) Follicle cells (b) Nurse cells
(c) Both (a) and (b) (d) None of the above

**5.** Which is immortal **[BHU 2005; MP PMT 2007]**

(a) Plasma cell (b) Germ cell
(c) Brain cell (d) Kidney cell

**6.** The process of maturation of reproductive cells of testes in male so as to form the male gamete or sperm is known as **[AFMC 2003; HPMT 2005]**

(a) Spermatogenesis (b) Gametogenesis
(c) Oogenesis (d) None of these

**7.** The rule of embryonic development was given by **[MHCET 2000; CPMT 2003]**

(a) Von baer (b) Haeckel
(c) Wallace (d) Morgan

**8.** The period of preparation with reference to developmental phenomena in vertebrates means **[Pune CET 1998]**

(a) Formation of gastrula
(b) Formation of germ layers
(c) Tissue differentiation
(d) Parents preparation and elaboration of gametes

**9.** Embryonic body form stage is characterised by **[Pune CET 1998]**

(a) Basic body plan emerging
(b) Miniature adult features
(c) Stage of development resembling other species
(d) Tissues not fully formed

**10.** Oogenesis comprises **[MP PMT 1998]**

(a) Multiplication phase (b) Growth phase
(c) Maturation phase (d) All the above

**11.** The process by which ova are formed is known as **[MP PMT 1999]**

**Or**

Rupturing of follicles and discharge of ova is known as

**Or**

Polar bodies are formed during **[MP PMT 2010]**

(a) Oogenesis (b) Ovulation
(c) Oviposition (d) Oviparity

**12.** How many ova and sperms would be produced from 100 secondary oocytes and 100 secondary spermatocytes during gametogenesis in human **[CPMT 1999; JIPMER 2001]**

(a) 100 ova, 100 sperms (b) 100 ova, 200 sperms
(c) 50 ova, 100 sperms (d) 200 ova, 200 sperms

## Fertilization

**1.** In man sperms move after ejaculation at a rate of nearly **[CBSE PMT 1991]**

(a) 2 to 4 mm/minute (b) 2 to 4 feet/minute
(c) 2 to 4 inches/minute (d) 2 to 4 cm/minute

**2.** What helps in the penetration of egg by the sperm

(a) Fertilizin (b) Antifertilizin
(c) Sperm lysin (d) Fertilization membrane

3. Capacitation of sperms occurs in **[DPMT 2007; NEET 2017]**
(a) Female genital tract (b) Vas deferens
(c) Vas efferens (d) Vagina

4. One of the minute cell which separates from the animal egg during maturation is known as
(a) Primary spermatogonia (b) Secondary oogonia
(c) Primary oogonia (d) Polar bodies

5. Fertilization occurs in human, rabbit and other placental mammals in **[AIIMS 1993; MP PMT 1993, 95; CPMT 1994; Kerala CET 2002; RPMT 2002; Bihar CECE 2006; Odisha JEE 2011, 12; WB JEE 2011, 16; J & K CET 2012]**
(a) Ovary (b) Uterus
(c) Fallopian tubes (d) Vagina

6. Sperm of animal species A cannot fertilize ovum of species B because **[J & K CET 2012]**
(a) Fertilizin of A and antifertilizin of B are not compatible
(b) Antifertilizin of A and fertilizin of B are not compatible
(c) Fertilizin of A and B are not compatible
(d) Antifertilizin of A and B are not compatible

7. The sperm produces substances of enzymatic nature called sperm lysin. In mammals, it is called **[MP PMT 2001; KCET 2001]**
(a) Hyaluronidase (b) Hyaluranic acid
(c) Androgamone (d) Cryanogamone

8. Development of an egg without fertilization is called **[MP PMT 2009]**

**Or**

It is a process of embryo sac formation from cell of nucleus, without undergoing meiosis **[GUJCET 2007]**
(a) Gametogenesis (b) Metagenesis
(c) Oogenesis (d) Parthenogenesis

9. What is true in the process of fertilization **[KCET 1994]**
(a) Only one sperm reaches the egg and enters it
(b) The entry of sperm activates the egg for completing meiosis
(c) Two haploid nuclei fuse and immediately divide to produce two nuclei which are again haploid
(d) Only the acrosome of the sperm enters the egg

10. On fertilization of egg nucleus with sperm nucleus **[CPMT 1993]**
(a) First maturation is completed
(b) Second maturation is completed
(c) Embryo is formed
(d) First polar body is formed

11. The phenomenon of fertilization was first perceived by
(a) Weismann (b) Leeuwenhoek
(c) Robert Hooke (d) Hertwig

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

13. The final event in the process of fertilization is **[MP PMT 1994]**
(a) Fusion of gametes
(b) Egg activation
(c) Amphimixis
(d) Organizational change in egg cytoplasm

14. In oogenesis a diploid cell produce ____ ovum/ova **[Odisha JEE 2008]**
(a) 1 (b) 2
(c) 3 (d) 4

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

16. Fertilizin is a chemical substance produced from **[CBSE PMT 1997; Manipal 2005; MH CET 2015]**
(a) Mature eggs (Ovum) (b) Acrosome
(c) Polar bodies (d) Middle piece of sperm

17. Movement of sperm is done by **[MP PMT 1996, 99]**
(a) Tail (b) Head
(c) Acrosome (d) Middle piece

18. The fertilization membrane during fertilization is synthesized by **[RPMT 2000]**
(a) Mitochondria
(b) Golgi bodies
(c) Acid mucopolysaccharides of cortical granules
(d) All the above

19. In sexually reproducing animals the union of male and female gamete forms a cell which is called **[MP PMT 1995]**
(a) Ovarian cell (b) Oocyte
(c) Zygote (d) Graafian follicle

20. Normally the number of chromosomes in the nuclei of gametes that fuse at fertilization are **[MP PMT 1995]**
(a) Innumerable (b) Dissimilar
(c) Similar (d) None of the above

21. The sperm penetrates the ovum mainly **[AIEEE Pharmacy 2004]**
(a) Mechanically (b) Chemically
(c) Electrostatically (d) Thermally

22. Female rabbit is
(a) Monoestrus (b) Diestrus
(c) Polyestrus (d) None of the above

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

**24.** The hormones of the sperm are called
(a) Gynogamones–I (b) Androgamones
(c) Gynogamones–II (d) None of these

**25.** Which of the following are secretion produced by the spermatozoa at the time of fertilization **[KCET 2006]**
(a) Fertilizin and antifertilizin (b) Antifertilizin and spermlysin
(c) Aertilizin and spermlysin (d) Only spermlysin

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

**27.** In vitro fertilization technique that involves transfer of which one of the following into the fallopian tube **[CBSE PMT (Pre.) 2010; AIIMS 2011]**
(a) Zygote only
(b) Embryo only, upto 8 cell stage
(c) Either zygote or early embryo upto 8 cell stage
(d) Embryo of 32 cell stage

**28.** Fertilization is depicted by the condition **[NCERT; DPMT 2003]**
(a) $n \rightarrow 2n$ (b) $2n \rightarrow 3n$
(c) $2n \rightarrow 4n$ (d) $4n \rightarrow 8n$

**29.** Fertilization of sperm and ova takes place in **[DPMT 2007]**
(a) Ampulla of oviduct (b) Isthmus of oviduct
(c) Fimbriae of oviduct (d) None of these

## Cleavage

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

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

**3.** Animals which possess cleidoic eggs exhibit **[KCET 2011]**
(a) External fertilization and internal development
(b) Internal fertilization and internal development
(c) Internal fertilization and external development
(d) External fertilization and external development

**4.** If the first cleavage furrow divides the zygote completely into two, the cleavage type is
(a) Radial (b) Equatorial
(c) Meroblastic (d) Holoblastic

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

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

**7.** The mammalian blastula is known as **[MP PMT 2010]**
(a) Foetal blastula (b) Blastocyst
(c) Trophoderm (d) Oolema

**8.** Telolecithal eggs have **[Bihar MDAT 1995; MHCET 2004]**
(a) Equal distribution of yolk
(b) Average amount of yolk
(c) Yolk present at a distance from nucleus
(d) No yolk
(e) All the above

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

**10.** The blastopore develops into future **[JIPMER 2002]**
(a) Mouth (b) Ear
(c) Anus (d) Neuropore

**11.** The fourth cleavage plane during development of frog's egg is **[KCET 2012]**
(a) Double meridional (b) Single meridional
(c) Single latitudinal (d) Double latitudinal

**12.** Formation of segmentation cavity shows **[MP PMT 1993; DPMT 1993]**

**Or**

Cleavage is followed by which stage **[RPMT 1999]**
(a) Rearrangement of cells (b) Blastula stage
(c) Epiboly (d) Emboly

**13.** Cockroach egg is called as **[RPMT 2000; BVP 2004]**
(a) Microlecithal (b) Macrolecithal
(c) Isolecithal (d) Centrolecithal

**14.** Egg which contains very little amount of yolk are called as **[RPMT 1995]**

**Or**

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

**15.** The cleavage having incomplete division (partial cleavage) of egg is known as **[MP PMT 1996, 97, 99 ; MHCET 2002]**
(a) Holoblastic (b) Meroblastic
(c) Meridional (d) Spiral

**16.** Cleidoic eggs are found in **[CMC Vellore 1993; BVP 2001; MP PMT 2002]**
(a) Birds (b) Mammals
(c) Annelids (d) Molluscs

**17.** Cleavage is found in **[RPMT 1995]**

(a) Zygote (b) Eggs

(c) Undivided cell (d) After gastrula stage

**18.** The egg found in monotremata is **[MHCET 2003]**

**Or**

The eggs of ovoviviparous species are **[MP PMT 2013]**

(a) Microlecithal (b) Mesolecithal

(c) Macrolecithal (d) None of these

**19.** The cleavage is such method of divisions of fertilized egg in which the egg **[MP PMT 1993]**

(a) Does not divide but only increase in size

(b) Divides repeatedly but without growth

(c) Divides repeatedly and grows

(d) None of these

**20.** What is true about cleavage in the fertilised egg in humans **[CBSE PMT 1994; AFMC 1999]**

(a) It is meroblastic

(b) It starts while the egg is in fallopian tube

(c) It is identical to the normal mitosis

(d) It starts when the egg reaches in uterus

**21.** A change in the amount of yolk and its distribution in the egg will affect **[NCERT; CBSE PMT 2009]**

(a) Formation of zygote

(b) Pattern of cleavage

(c) Number of blastomeres produced

(d) Fertilization

**22.** The fifth cleavage of the fertilized egg of frog results in the formation of **[MP PMT 1997, 98; 2000]**

(a) 16 cells (b) 48 cells

(c) 64 cells (d) 32 cells

**23.** Epiboly is the process of **[CBSE PMT 1992]**

(a) Mass migration of cells from the animal hemisphere so that upper micromeres begin to migrate over the edge of the dorsal lip and roll inside and are tucked beneath the outer layer

(b) Over growth when the micromeres divide rapidly and begin to spread downwards over the megameres except at the yolk plug

(c) Rotation of gastrula within the vitelline membrane so that the animal pole becomes anterior

(d) Formation of a small slit like invagination occuring on the grey crescent

**24.** Coelom derived from blastocoel is known as **[CBSE PMT 1994; CPMT 2002]**

(a) Pseudocoelom (b) Enterocoelom

(c) Haemocoel (d) Schizocoel

**25.** The embryo at 16 celled stage is known as **[NCERT; BHU 2006; MHCET 2015]**

**Or**

Egg undergoes cleavage and forms **[RPMT 1995]**

(a) Morula (b) Gastrula

(c) Blastula (d) Blastomere

**26.** Eggs of reptiles and birds are **[KCET 1994; BHU 1995; CPMT 2000]**

**Or**

The egg of frog is **[MP PMT 1998, 2006; CPMT 1999; RPMT 2000; BVP 2001; Pb. PMT 2004]**

(a) Alecithal (b) Isolecithal

(c) Telolecithal (d) Homolecithal

**27.** Cleavage divisions differ from normal mitotic divisions in that **[MP PMT 1994]**

(a) There is no nuclear division during cleavage

(b) There is no division of the cytoplasm during cleavage

(c) There is no period of growth in between the divisions

(d) The division of the cytoplasm follows nuclear divisions

**28.** The third phase in the development of a mammal is **[MP PMT 1997]**

(a) Cleavage (b) Gastrulation

(c) Gametogenesis (d) Fertilization

**29.** The glycoprotein layer between oocytes and cuboidal cells in ovary of rabbit is **[EAMCET 2009]**

(a) Membrana granulosa (b) Zona pellucida

(c) Corpus luteum (d) Zona reticulata

**30.** Which one of the following statements with regard to embryonic development in humans is correct **[AIIMS 2003]**

(a) Cleavage division bring about considerable increase in the mass of protoplasm

(b) In the second cleavage division, one of the two blastomeres usually divides a little sooner than the second

(c) With more cleavage divisions, the resultant blastomeres become larger and larger

(d) Cleavage division results in a hollow ball of cells called morula

**31.** The outer layer of the blastocyst which forms the ectoderm is called **[MP PMT 1995]**

**Or**

The extra–embryonic membranes of the mammalian embryo are derived from **[CBSE PMT 1994; BHU 1999, 2004]**

(a) Cnidoblast (b) Germinal vesicle

(c) Trophoblast (d) Amnion

**32.** The eggs in which fate of every part of the egg becomes fixed are called.

(a) Cleidoic eggs (b) Non-cleidoic eggs

(c) Mosaic eggs (d) Regulative eggs

**33.** Cledoic egg is an adaptation to **[RPMT 2001]**

(a) Aquatic life (b) Marine life

(c) Terrestrial life (d) Aerial life

**34.** Microlecithal eggs are found in **[RPMT 2001; MP PMT 2003]**
(a) Reptilia + Aves
(b) Amphibia + Aves + Reptilia
(c) Reptilia + Aves + Chiroptera
(d) Eutheria

**35.** In indeterminate cleavage the fate of blastomeres is fixed at which of the following stage **[RPMT 2000]**

**Or**

Embryologists can presume the future organs of the embryo in **[CBSE PMT 1993]**
(a) Blastula (b) Gastrulation
(c) 32-celled stage (d) 64-celled stage

**36.** Vegetal hemisphere of egg consists of **[MP PMT 2000]**
(a) Yolk (b) Pigment
(c) Grey crescent (d) Germinal vesicle

**37.** In mammals egg are microlecithal and isolecithal because these are **[RPMT 2001]**

**Or**

The animals in which complete embryo develops in the mother's body through placenta are
(a) Oviparous (b) Viviparous
(c) Ovoviviparous (d) None of these

**38.** Select the correct statement **[Odisha PMT 2002]**
(a) Cleavage follows gastrulation
(b) Yolk content of egg has no role in cleavage
(c) Cleavage is repeated mitotic division of zygote
(d) Gastrulation & blastulation are followed by each other

**39.** The term blastocyst is applied to the blastula of which one of the following **[MP PMT 1995]**
(a) Kangaroo
(b) Platypus
(c) Monkey
(d) Both kangaroo and monkey

**40.** Tertiary egg membrane is
(a) Vitelline membrane (b) Zona radiata
(c) Albumen (d) Corona radiata

**41.** In frog equal holoblastic cleavage does not found due to **[RPMT 2001]**
(a) A dark pigment in animal pole
(b) Heavy yolk in vegetal pole
(c) Yolk concentrated in center of egg
(d) Nucleus is assymetrical in position

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

**43.** Cleavage was first observed by
(a) Swammerdam (b) Spallanzani
(c) F.R. Lillie (d) Leeuwenhoek

**44.** In which of the following animal cleavage divisions are restricted to a small part of cytoplasm and nucleus in animal pole of egg **[RPMT 2002]**
(a) Cockroach (b) Frog
(c) Chick (d) Rabbit

**45.** Pattern of cleavage in frog's egg is **[MP PMT 1998 ; CPMT 2005; PET (Pharmacy) 2013]**
(a) Holoblastic (b) Holoblastic and unequal
(c) Holoblastic and equal (d) All of the above

## Implantation and Gastrulation

**1.** The mammalian primitive streak gives rise to **[MP PMT 1994]**
(a) Ectoderm (b) Mesoderm
(c) Endoderm (d) Germ layers

**2.** Which of the embryo has parasite mode of nutrition.
(a) Bird's embryo (b) Amphibian embryo
(c) Reptilian embryo (d) Mammalian embryo

**3.** In human secretion, which of the following is used to confirm implantation of embryo **[GUJCET 2007]**
(a) Gastrula (b) Trophoblast
(c) Inner mass of cell (d) Blastocyst

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

**5.** The cavity, which formed during gastrulation is named as **[MH CET 2003; MP PMT 2006, 10]**
(a) Blastocoel (b) Archenteron
(c) Coelom (d) Pseudocoel

**6.** In which stage blastocoel is formed **[MP PMT 1999]**

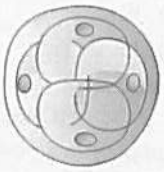
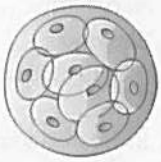
**Or**

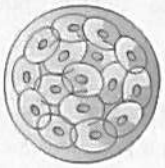
In which stage of development the embryonic cells form the germinal layers by the movement **[RPMT 2001]**
(a) Morula (b) Blastula
(c) Gastrula (d) None of these

**7.** Which one of the following list contains only the mesodermal structures **[MP PMT 1992; KCET 2012]**
(a) Muscles, blood, notochord, liver
(b) Bones, blood, heart, liver
(c) Muscles, blood, heart, liver
(d) Bones, blood, heart, notochord

**8.** Archenteron is lined with **[CPMT 1993]**
(a) Ectoderm (b) Mesoderm
(c) Endoderm (d) Mesoderm and endoderm

**9.** In which of the following embryonic stages does the implantation take place **[NCERT]**

(a)  (b) 

(c)  (d) 

**10.** The internal cavity commonly formed by cell division prior to gastrulation is the **[DUMET 2010]**

(a) Enteron (b) Blastopore

(c) Blastocoel (d) Coelom

**11.** Coelom is found between the cavity of **[BHU 2000]**

(a) Ectoderm and endoderm (b) Mesoderm and ectoderm

(c) Body wall and ectoderm (d) Mesoderm and body wall

**12.** The structure which differentiate gastrula from blastula **[RPMT 1999]**

(a) 3 germ layers (b) Micromeres

(c) Blastocoel (d) None of these

**13.** After gastrulation the roof of archenteron is formed by

(a) Neural plate (b) Mesoderm

(c) Ectoderm (d) Chorda–mesoderm

**14.** Which of the following hormones is secreted by implanted blastocyst, that acts on the corpus luteum in the ovary, stimulating the body to produce estrogens and progesterone to mainting the uterine lining **[AIIMS 2009]**

(a) Estrogen (b) HCG

(c) Progesterone (d) Oxytocin

**15.** The rolling of endodermal and mesodermal cells from the surface of embryo into its interior is called **[CBSE PMT 1993]**

(a) Ingression (b) Invagination

(c) Involution (d) Inversion

**16.** Vascular system, gonads and excretory organs are developed from embryonic **[CBSE PMT 1990; KCET 1994]**

(a) Mesoderm (b) Ectoderm

(c) Endoderm (d) None of the above

**17.** The 'cells of Rauber' are **[AIIMS 2012]**

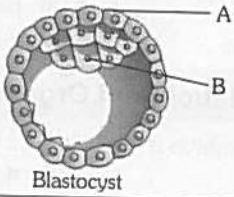
(a) Secretory cells of endometrium in uterus

(b) Inner cell mass of blastocoel

(c) Outer cells of trophoblast in contact with uterine wall

(d) Cells of trophoblast, in contact with inner cell mass of blastocyst

**18.** Select the right option in which A and B are correctly identified with their respective functions **[NCERT; MH CET 2015]**



Blastocyst

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

**19.** Blastopore is found in **[DPMT 1993; MP PMT 1996; Bihar CECE 2006; KCET 2010]**

(a) Gastrula (b) Blastula

(c) Morula (d) Neurula

**20.** The skeleton and muscles originate in the development from or During embryonic development endoskeleton and muscles develop from which germinal layer **[Manipal 1995; MP PMT 1996; CPMT 2004]**

(a) Ectoderm (b) Endoderm

(c) Mesoderm (d) Yolk plug

**21.** Which one of the following is derived from ectoderm **[DPMT 1993]**

(a) Enamel of teeth (b) Dentine

(c) Skull (d) Axial skeleton

**22.** Identify the human developmental stage shown below as well as the related right place of its occurrence in a normal pregnant woman, and select the right option for the two together **[NCERT; CBSE PMT (Mains) 2012]**

Options

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

23. During the development of an embryo, migration and rearrangement of cells lead to a pattern formation known as **[MP PMT 1994]**
(a) Epiboly (b) Emboly
(c) Involution (d) Gastrulation

## Neurulation and Organogenesis

1. The human embryo is about one inch in length after
(a) 2 weeks (b) 4 weeks
(c) 6 weeks (d) 8 weeks

2. The concept that organiser is essential for embryonic development was given by or For the *'Theory of organiser'*, Nobel prize was given to **[CBSE PMT 1990; AFMC 1993]**
(a) J. Axelrod (b) C. Landsteiner
(c) H. Spemann (d) I.P. Pavlov

3. Which of the following develops from ectoderm **[DPMT 1997]**
(a) Spinal cord and brain
(b) Liver and heart
(c) Notochord and vertebral column
(d) Eye and skin

4. The Wolffian duct gives rise to **[DPMT 2006]**
(a) Scrotum (b) Labia major
(c) Both (a) and (b) (d) Epididymis

5. The central nervous system develops as a result of
(a) Metamorphosis (b) Gastrulation
(c) Neurulation (d) Invagination

6. The yolk plug of gastrula represents in the later stage its **[MP PMT 1998]**
(a) Anterior end (b) Posterior end
(c) Dorsal side (d) Ventral side

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

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

9. In the development of the human body, the ectoderm is responsible for the formation of **[Pb. PMT 1999]**
(a) Sweat glands (b) Nervous system
(c) Lens of the eye (d) All of these

10. From which embryonic structure develops the vertebral column
(a) Neural canal (b) Archenteron
(c) Notochord (d) Blastocoel

11. Eye is developed from **[CPMT 1998; MHCET 2002]**
**Or**
Internal Ear develops from
**Or**
Neural canal develops from **[Bihar MDAT 1995]**
(a) Ectoderm (b) Mesoderm
(c) Endoderm (d) Ecto–endoderm

12. In *Pheretima* mouth develops from which of the following **[RPMT 2000]**
(a) Mesoderm (b) Ectoderm
(c) Blastopore (d) Endoderm

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

14. The origin of kidney and ureter in *Rana tigrina* is **[CPMT 2004]**
(a) All mesodermal
(b) All endodermal
(c) Ectodermal and mesodermal
(d) Mesodermal and endodermal

15. Spleen develops from **[CPMT 1995]**
(a) Ectoderm (b) Mesoderm
(c) Endoderm (d) None of the above

16. When mouth develops from blastopore, the organism is called **[AFMC 1995]**
(a) Deutrostomia (b) Protostomia
(c) Blastostomia (d) None of these

17. Pituitary gland is derived from **[MHCET 2004]**
(a) Ectoderm (b) Endoderm
(c) Mesoderm (d) None of these

18. Which one of the following parts serves the function of primary organizer in frog **[CPMT 2005]**
(a) Dorsal lip of gastrula
(b) Grey crescent area of frog
(c) Chorda-mesoderm of gastrula
(d) All of these

19. Proctodaeum in rabbit is **[RPMT 2001]**
(a) A part of large intestine lined by ectoderm
(b) A part of large intestine lined by endoderm
(c) A part of large intestine lined by mesoderm
(d) Embryonic intestine

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

21. Which cavity arises by the invagination of endoderm and mesoderm **[MP PMT 1996]**
(a) Coelenteron (b) Archenteron
(c) Pseudocoel (d) Coelom

## Extra embryonic membrane

1. Which extraembryonic membrane in humans prevents desiccation of the embryo inside the uterus **[CBSE PMT 2008; BHU 2012]**
   (a) Yolk sac (b) Amnion
   (c) Chorion (d) Allantois
2. In human, embryo is protected in **[MP PMT 2012]**
   (a) Amniotic cavity (b) Peritoneal cavity
   (c) Pleural cavity (d) Allantois
3. All extra embryonic membranes
   (a) Take part in the formation of embryo
   (b) Does not take part in the embryo formation
   (c) Form the placenta
   (d) Perform the function of excretion of embryo
4. The allantois has the similar layers as present in the yolk sac. These are
   (a) Outer mesoderm and inner endoderm
   (b) Outer endoderm and inner mesoderm
   (c) Outer endoderm and inner ectoderm
   (d) Outer endoderm and inner endoderm
5. Which of the following is an embryonic connective tissue
   (a) Endometrium (b) Mediastinum
   (c) Mesenchyme (d) Endothelium
6. The number of foetal membranes in man is **[MP PMT 2002]**
   (a) 2 (b) 3
   (c) 4 (d) 0
7. Urinary bladder of the embryo is or Which is the urinary bladder of child placed in the womb **[NCERT; MP PMT 1995, 2009]**
   (a) Yolk sac
   (b) Allantois
   (c) Amnion
   (d) Chorion and allantois both
8. The shock absorber fluid of the developing embryo is known as **[DPMT 1993; MP PMT 1994, 96, 99; AFMC 2008]**
   (a) Chorionic fluid (b) Amniotic fluid
   (c) Allantoic fluid (d) Coelomic fluid
9. Allantois develops from the embryonic
   (a) Fore gut (b) Mid gut
   (c) Hind gut (d) Tail region
10. In man the foetal membrane which forms the intimate connection with the uterine tissue is **[MP PMT 2002, 03]**

    **Or**

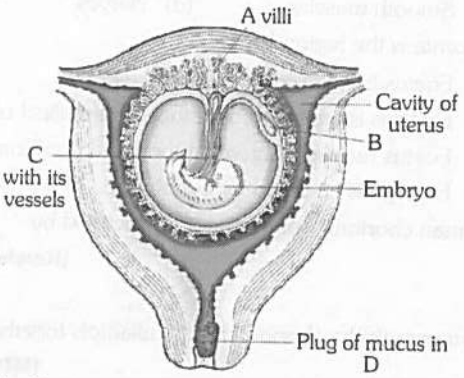
    Placenta has an outer layer which is selectively permeable and hormone secreting which is known as
    (a) Amnion only (b) Chorion only
    (c) Allantois only (d) Allanto–chorionic structure
11. The main function of tropho ectoderm in mammalian embryo is **[Kerela CET 2003]**
    (a) Protection of the developing cells
    (b) Drawing food for the developing cells
    (c) Formation of yolk sac
    (d) Formation of body of developing embryo
12. Foetal membranes provide **[NCERT; MP PMT 1993]**
    (a) Protection of embryo (b) Nutrition of embryo
    (c) Respiration of embryo (d) All the above
13. A hatching egg of chick is covered by plaster of paris. It is harmful for
    (a) Mother (b) Respiration
    (c) Excretion (d) None of these
14. Function of allantois in mammal is **[MP PMT 1996, 99]**
    (a) Respiration only
    (b) Excretion
    (c) Nutrition, excretion and respiration
    (d) Protection from shocks
15. The foetal membrane which is the source of first blood corpuscle to enter the circulation of the embryo is called **[MP PMT 1995]**
    (a) Amnion (b) Chorion
    (c) Trophoblast (d) Yolk sac

## Placenta

1. Foetal ejection reflex in human female is induced by **[CBSE PMT 2009]**

   **Or**

   The signals for parturition originate from **[NCERT; CBSE PMT (Pre.) 2010, 12]**
   (a) Pressure exerted by amniotic fluid
   (b) Release of oxytocin from pituitary
   (c) Fully developed foetus and placenta
   (d) Differentiation of mammary glands
2. The layer of uterus which becomes much eroded due to placental villi is known as **[CPMT 1994]**
   (a) Endothelium (b) Endometrium
   (c) Endoderm (d) Trophoblast
3. The following figure refers to the human foetus within the uterus. Identify A to D correctly **[NCERT]**




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

4. To ensure effectiveness of reproduction in mammals
(a) Formation of yolk sac (b) Retention of yolk sac
(c) Reduced number of egg (d) Formation of placenta

5. The role of placenta is **[BHU 2005]**
(a) To convey nerve impulses
(b) To act as storage organ
(c) To protect embryo from shocks
(d) To provide nutrition for developing embryo

6. Placenta produced which hormone **[HPMT 2005]**
(a) ACTH (b) Progesterone
(c) GH (d) Gastrin

7. The eutherian placenta is derived from or In mammals placenta is formed by **[MP PMT 1996]**
(a) Yolk sac (b) Amnion
(c) Allantois (d) Chorion allantois

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

9. Zonary placenta is found in **[MP PMT 2013]**
(a) Carnivore mammals (b) Herbivore mammals
(c) Both (a) and (b) (d) None of the above

10. 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 embryo
(c) Secretes estrogen
(d) Facilitates removal of carbon dioxide and waste material from embryo

11. Which of the following structure is lacking from the placenta
(a) Arteries (b) Veins
(c) Smooth muscles (d) Nerves

12. Placenta is the region, where
(a) Foetus is supplied by maternal blood
(b) Embryo is attached to mother by umbilical cord
(c) Foetus receives maternal blood and nutrition
(d) Embryo is enclosed by membranes

13. Human chorionic gonadotropin is secreted by **[Kerala PMT 2010]**

**Or**

In mammals the chorion and the allantois together form **[MP PMT 1994]**

**Or**

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

14. Which one of the following develops from the trophoblast **[NCERT]**
(a) Placenta (b) Allantois
(c) Epidermis of the skin (d) Yolk sac

15. The type of placenta found in human beings and Rabbit is of type **[MP PMT 2002, 12, 13]**
(a) Diffuse (b) Zonary
(c) Cotyledonary (d) Discoidal

16. The placenta of human beings belong to the category of **[AIIMS 1998; MP PMT 1994]**
(a) Haemo-chorialis (b) Syndesmo-chorialis
(c) Endothelio-chorialis (d) Epithelio-chorialis

## Gestation period and parturition

1. The gestation period of elephants is about
(a) 11 months (b) 10 months
(c) 15 months (d) 22 months

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

3. Which of the following induces parturition **[DUMET 2010]**
(a) Vasopressin (b) Oxytocin
(c) *GH* (d) *TSH*

4. The longest gestation period is found in
(a) Elephant (b) Gorilla
(c) Chimpanzee (d) Man

5. The gestation period of rabbit is
(a) 28–32 days (b) 20–25 days
(c) 60–70 days (d) 80–90 days

6. Gestation period in human beings is about
(a) 10 weeks (b) 28 weeks
(c) 32 weeks (d) 36 weeks

7. In a human foetus the limbs and digits develop after **[KCET 2015]**
(a) 12 weeks (b) First trimester
(c) 5th month (d) 8 weeks

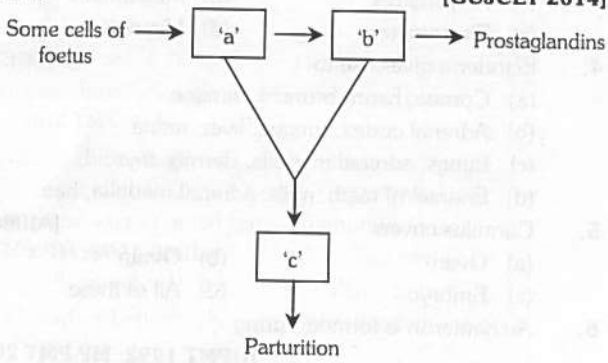
8. The first movements of the foetus and appearance of hair on its head are usually observed during which month of pregnancy **[NCERT; CBSE PMT (Pre.) 2010]**
(a) Third month (b) Fourth month
(c) Fifth month (d) Sixth month

9. The process of delivery of the foetus is called **[Kerala PMT 2010]**

**Or**

Forceful muscular contraction of uterine wall is involved in **[MH CET 2015]**
(a) Parturition (b) Implantation
(c) Fertilisation (d) Lactation
(e) Ovulation

**10.** What does 'a', 'b' and 'c' represents in the following flow chart **[GUJCET 2014]**




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

(b) 'a' = oxytocin, 'b' = uterus, 'c' = slow contraction of uterus

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

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

**11.** Which of these is not an important component of initiation of parturition in humans **[AIPMT (Cancelled) 2015]**

(a) Synthesis of prostaglandins

(b) Release of oxytocin

(c) Release of prolactin

(d) Increase in estrogen and progesterone ratio

## NCERT Exemplar Questions

**1.** Choose the incorrect statement from the following **[NCERT]**

(a) In birds and mammals internal fertilisation takes place

(b) Colostrum contains antibodies and nutrients

(c) Polyspermy in mammals is prevented by the chemical changes in the egg surface

(d) In the human female implantation occurs almost seven days after fertilisation

**2.** Identify the correct statement from the following **[NCERT]**

(a) High levels of estrogen triggers the ovulatory surge

(b) Oogonial cells start to proliferate and give rise to functional ova in regular cycles from puberty onwards

(c) Sperms released from seminiferous tubules are highly motile

(d) Progesterone level is high during the post ovulatory phase of menstrual cycle

**3.** Spot the odd one out from the following structures with reference to the male reproductive system **[NCERT]**

(a) Rete testis (b) Epididymis

(c) Vasa efferentia (d) Isthmus

**4.** Seminal plasma, the fluid part of semen, is contributed by

(i) Seminal vesicle (ii) Prostate gland

(iii) Urethra (iv) Bulbourethral gland

Options **[NCERT]**

(a) (i) and (ii) (b) (i), (ii) and (iv)

(c) (ii), (iii), and (iv) (d) (i) and (iv)

**5.** Spermiation is the process of the release of sperms from **[NCERT]**

(a) Seminiferous tubules (b) Vas deferens

(c) Epididymis (d) Prostate gland

**6.** Mature Graafian follicle is generally present in the ovary of a healthy human female around **[NCERT]**

(a) 5 – 8 day of menstrual cycle

(b) 11 –17 day of menstrual cycle

(c) 18 – 23 day of menstrual cycle

(d) 24 – 28 day of menstrual cycle

**7.** Acrosomal reaction of the sperm occurs due to **[NCERT]**

(a) Its contact with zona pellucida of the ova

(b) Reactions within the uterine environment of the female

(c) Reactions within the epididymal environment of the male

(d) Androgens produced in the uterus

**8.** Which one of the following is not a male accessory gland **[NCERT]**

(a) Seminal vesicle (b) Ampulla

(c) Prostate (d) Bulbourethral gland

**9.** The spermatogonia undergo division to produce sperms by the process of spermatogenesis. Choose the correct one with reference to above **[NCERT]**

(a) Spermatogonia have 46 chromosomes and always undergo meiotic cell division

(b) Primary spermatocytes divide by mitotic cell division

(c) Secondary spermatocytes have 23 chromosomes and undergo second meiotic division

(d) Spermatozoa are transformed into spermatids

**10.** Match between the following representing parts of the sperm and their functions and choose the correct option

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

Options **[NCERT]**

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

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

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

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

**11.** Which among the following has 23 chromosomes **[NCERT]**
(a) Spermatogonia (b) Zygote
(c) Secondary oocyte (d) Oogonia

**12.** Match the following and choose the correct options

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

Options **[NCERT]**
(a) A-ii, B-i, C-iii, D-iv
(b) A-iii, B-iv, C-ii, D-i
(c) A-iii, B-i, C-ii, D-iv
(d) A-ii, B-iv, C-iii, D-i

**13.** Which of the following hormones is not secreted by human placenta **[NCERT]**
(a) hCG (b) Estrogens
(c) Progesterone (d) LH

**14.** The vas deferens receives duct from the seminal vesicle and opens into urethra as **[NCERT]**
(a) Epididymis (b) Ejaculatory duct
(c) Efferent ductule (d) Ureter

**15.** Urethral meatus refers to the **[NCERT]**
(a) Urinogenital duct
(b) Opening of vas deferens into urethra
(c) External opening of the urinogenital duct
(d) Muscles surrounding the urinogenital duct

**16.** Morula is a development stage **[NCERT]**
(a) Between zygote and blastocyst
(b) Between the blastocyst and gastrula
(c) After the implantation
(d) Between implantation and parturition

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

## CT Critical Thinking

### Objective Questions

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

**2.** The correct order of the reproductive tract of a male human being is
(a) Rete testis, epididymis, vasa efferentia, urethra
(b) Rete testis, vasa efferentia, epididymis, urethra
(c) Vasa efferentia, epididymis, urethra, rete testis
(d) Urethra, rete testis, epididymis, vasa efferentia

**3.** Which of these sets of cells divide slowly **[JIPMER 1993]**
(a) Micromeres (b) Megameres
(c) Blastomeres (d) Mesomeres

**4.** Ectoderm gives rise to **[MHCET 2015]**
(a) Cornea, heart, bronchi, dentine
(b) Adrenal cortex, tongue, liver, retina
(c) Lungs, adrenal medulla, dermis, thyroid
(d) Enamel of teeth, nails, adrenal medulla, hair

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

**6.** Archenteron is formed during **[DPMT 1992; MP PMT 2002, 12]**
(a) Early blastula (b) Morula stage
(c) Early gastrula (d) Late gastrula

**7.** Clitoris in mammals is **[NCERT; CPMT 1993; MP PMT 1993; RPMT 2001]**
(a) Homologous to penis
(b) Analogous to penis
(c) Functional penis in female
(d) Non-functional penis in male

**8.** Pick the ODD homologous pair out **[MHCET 2015]**
(a) Bartholin's Gland – Cowper's Gland
(b) Clitoris – Penis
(c) Mons pubis – Glans penis
(d) Labia majora – Scrotum

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

**10.** What is "After birth" referred to **[MHCET 2015]**
(a) Amniotic fluid passing out
(b) Expulsion of baby
(c) Expulsion of placenta, umbilical cord and foetal membrane
(d) Secretion of hormone relaxin

**11.** Extra embryonic membrane amnion is not found in amphibians because **[RPMT 2001]**
(a) They lay eggs in water (b) Egg hatches in tadpole
(c) Amphibious habit (d) They have smooth skin

**12.** Chorion is found **[MP PMT 1994]**
(a) Inside the amnion (b) Outside the amnion
(c) Inside the allantois (d) Inside the yolk sac

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

**14.** Atretic follicles are found in the **[MP PMT 1996, 2002]**
(a) Liver (b) Testis
(c) Thymus (d) Ovary

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

16. Ontogenetically liver and pancreas are or During embryonic development pancreas and liver develop from which germinal layer **[MP PMT 1996, 98]**

**Or**

In both chordates and non-chordates intestine develops from **[RPMT 2000]**

(a) Ectoderm (b) Mesoderm
(c) Endoderm (d) Blastopore

17. The phase of menstrual cycle in humans that last for 7-8 days is **[AIIMS 2003; MP PMT 2011]**

(a) Follicular phase (b) Ovulatory phase
(c) Luteal phase (d) Menstruation

18. The region where sperm enters the egg is called **[RPMT 2001, 02]**

(a) Equator (b) Receptor cone
(c) Animal pole (d) Vegetal pole

19. The shared terminal duct of the reproductive and urinary system in the human male is **[CBSE PMT 2014]**

(a) Vas deferens (b) Vasa efferentia
(c) Urethra (d) Ureter

20. The chemical substance found in the surface layer of cytoplasm of spermatozoa is **[MP PMT 1994]**

(a) Fertilizin (b) Agglutinin
(c) Antifertilizin (d) Hyaluronidase

21. Fertilization restores **[MP PMT 1994]**

(a) Haploidy from diploidy (b) Diploidy from polyploidy
(c) Polyploidy from diploidy (d) None of these

22. Find out the wrong statement **[Kerala PMT 2007]**

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

23. During the development of embryo which of the following occur first **[AFMC 1995]**

(a) Differentiation of tissue
(b) Differentiation of cells
(c) Differentiation of organs
(d) Differentiation of organ system

24. When a small piece of dorsal lip of blastopore of frog's early gastrula is transplanted into another gastrula of similar age at ventral lip, the result is

(a) Death of the graft tissue
(b) The host gastrula undergoes abnormal development
(c) The host gastrula remains normal and unaffected
(d) The graft tissue induces development of another notochord in the host

25. Relative sizes of an egg cell, morula, blastula and gastrula are **[CPMT 1993]**

(a) Egg cell is largest and morula is smallest
(b) Egg cell is smallest and gastrula is largest
(c) Egg cell is largest and gastrula is smallest
(d) All are of equal size

26. Fertilization in humans is practically feasible only if **[NEET (Phase-I) 2016]**

(a) The sperms are transported into vagina just after release of ovum in fallopian tube
(b) The ovum and sperms are transported simultaneously to ampullary isthmic junction of the fallopian tube
(c) The ovum and sperms are transported simultaneously to ampullary – isthmic junction of the cervix
(d) The sperms are transported into cervix within 48 hrs of release of ovum in uterus

27. During the course of development, cells in various regions of embryo become variable in morphology and eventually perform diverse functions. This process is known as **[CMC Vellore 1993]**

(a) Rearrangement (b) Differentiation
(c) Metamorphosis (d) Organisation

28. The point of sperm entry during fertilization forms **[MP PMT 1998]**

(a) Centre of rotation of embryo (b) Axis of cleavage
(c) Grey crescent (d) Dorsal lip of blastopore

29. Which statement is correct for fertilization **[RPMT 2001]**

(a) Restore Euploidy
(b) Brings male & female gametes together
(c) Entry of whole sperm in egg
(d) All of these

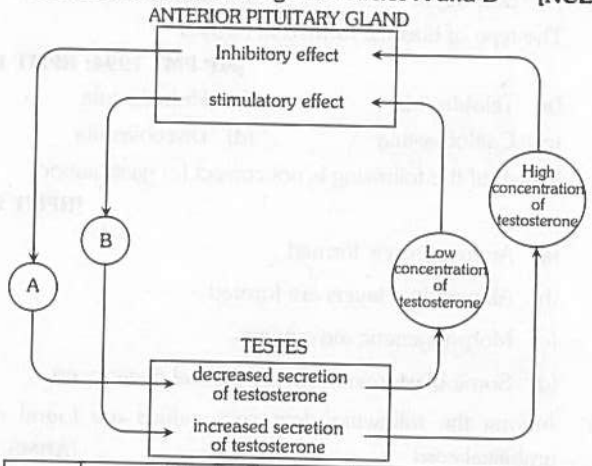
30. Which distinguishes a morula from a blastula

(a) Presence of more yolk (b) Absence of yolk
(c) Presence of a cavity (d) Absence of a cavity

31. Holoblastic cleavage may occur in eggs which are **[MP PMT 1994]**

(a) Oligolecithal only (b) Mesolecithal only
(c) Macrolecithal only (d) Oligolecithal & mesolecithal

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




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

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

**34.** In a mesolecithal egg, one would expect **[MP PMT 2010]**
(a) Meroblastic cleavage
(b) Unequal holoblastic cleavage
(c) Equal holoblastic cleavage
(d) None of these

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

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

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

**Or**

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

**38.** The type of blastula formed in birds is **[MP PMT 1994; RPMT 1999]**
(a) Teloblastula (b) Holoblastula
(c) Coeloblastula (d) Discoblastula

**39.** Which of the following is not correct for gastrulation **[RPMT 2002]**
(a) Archenteron is formed
(b) All germinal layers are formed
(c) Morphogenetic movements
(d) Some blastomeres and blastocoel degenerate

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

**41.** True coelom develops as a split in **[CBSE PMT 1990; RPMT 1995; J & K CET 2002]**
(a) Mesoderm
(b) Endoderm
(c) Ectoderm
(d) Between ectoderm and endoderm

**42.** Spiral cleavage is found in
(a) Synapta
(b) Amphibia
(c) Nematoda, annelida and rotifera etc.
(d) None of the above

**43.** Blastopore is found in **[MP PMT 1998]**
(a) Blastula and is opening of archenteron
(b) Blastula and is opening of blastocoel
(c) Gastrula and is opening of archenteron
(d) Gastrula and is opening of blastocoel

**44.** Which of the following structure is found in blastula **[CPMT 1995]**
(a) Segmentation cavity (b) Notochord
(c) Gill (d) Tail

**45.** Which of the following structure originates from ectoderm **[RPMT 1995]**
(a) Stomodaeum (b) Proctodaeum
(c) Mesodaeum (d) Both (a) and (b)

**46.** The literal meaning of "gastrulation" is **[MP PMT 1994]**
(a) Formation of primary germ layers
(b) Formation of a gut
(c) Morphogenetic movement
(d) Commencement of organogenesis

**47.** How many eggs will be formed from 100 primary oocytes **[MP PMT 1997, 2000]**
(a) 300 (b) 400
(c) 200 (d) 100

**48.** Blastocyst is a modified blastula of **[MP PMT 1997]**
(a) Placental mammals (b) Frog
(c) Fish (d) Birds

**49.** Cleavage is a unique form of mitotic cell division in which **[CPMT 1999; JIPMER 2001]**
(a) The nucleus does not participate
(b) There is no growth of cells
(c) No spindle develops to guide the cells
(d) The plasma membranes of daughter cells do not separate

**50.** Meroblastic cleavage refers to one of the following types of division of eggs **[KCET 1998]**
(a) Total (b) Partial
(c) Spiral (d) Horizontal

**51.** When centrolecithal egg of the insects divides regularly then what will happen **[RPMT 2001]**
(a) Cells surround the yolk
(b) Yolk surround the cells
(c) Yolk lie below the group of cells
(d) Yolk lie above the group of cells

**52.** Middle gastrula is characterised by **[CPMT 1993]**
(a) Formation of yolk plug
(b) Archenteron just beings to form
(c) Blastopore and arhenteron are present
(d) Yolk plug shifts towards blastopore

**53.** The attachment of the mammalian blastocyst to the uterine wall is **[CBSE PMT 1993 ; MP PMT 2002]**

(a) Incest
(b) Implantation
(c) Intromission
(d) Incorporation

**54.** Select the option which correctly matches the endocrine gland with its hormone and its function **[NEET (Karnataka) 2013]**

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

**55.** Which of the following depicts the **correct** pathway of transport of sperms **[NEET (Phase-II) 2016]**

(a) Efferent ductules → Rete testis → Vas deferens → Epididymis
(b) Rete testis → Efferent ductules → Epididymis → Vas deferens
(c) Rete testis → Epididymis → Efferent ductules → Vas deferens
(d) Rete testis → Vas deferens → Efferent ductules → Epididymis

**56.** Match **Column-I** with **Column-II** and select the correct option using the codes given below **[NEET (Phase-II) 2016]**

| 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 |

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

## A R Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :

*(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion*
*(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion*
*(c) If the assertion is true but the reason is false*
*(d) If both the assertion and reason are false*
*(e) If the assertion is false but reason is true*

**1.** Assertion : Only a single functional female gamete is formed from each primary oocyte cell.
Reason : Meiosis in each primary oocyte gives rise to only one cell which functions as ovum. **[AIIMS 2010]**

**2.** Assertion : Embryonic development proves interrelationship and common ancestory of metazoans.
Reason : It involves similar sequence of five dynamic processes during development.

**3.** Assertion : There is generally monospermy in most of animals.
Reason : Vitelline membrane of ovum checks polyspermy.

**4.** Assertion : The development in cockroach is heterometabolous metamorphosis.
Reason : Young ones resemble the adults in all characters. **[AIIMS 1995]**

**5.** Assertion : Cleavage is also called fractionating process.
Reason : In cleavage, number of blastomeres increases but size of blastomeres decreases.

**6.** Assertion : Holoblastic cleavage with almost equal sized blastomeres is a characteristic of placental animals.
Reason : Eggs of most mammals, including humans, are of centrolecithal type. **[AIIMS 2003, 10, 13]**

**7.** Assertion : Implantation is the process of attachment of blastocyst on uterine endometrium.
Reason : Implantation is controlled by trophoblast and occurs by decidual cell reaction.

**8.** Assertion : Gastrular movements are morphogenetic.
Reason : During gastrulation, cells move in masses and towards definite direction.

**9.** Assertion : Corpus luteum is produced by Graafian follicle after ovulation.
Reason : Corpus luteum secretes progesterone which maintains the pregnancy. **[AIIMS 2011]**

**10.** Assertion : In morula stage, cells divide without increase in size.
Reason : Zona pellucida remain undivided till cleavage is complete. **[AIIMS 1997]**

**11.** Assertion : During fertilization only head of spermatozoa enters egg.
Reason : If several spermatozoa hit the egg at same time, all can enter the egg. **[AIIMS 1997]**

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

**13.** Assertion : Primary spermatocytes of testes are haploid.
Reason : Primary spermatocytes are formed by meiosis-I in the spermatogonia.

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

**15.** Assertion : All Metatherian are placental mammals.
Reason : All placental mammals have menstrual cycle. **[KCET 2007]**

**16.** Assertion : Vagina acts as copulation canal and fertilization canal.
Reason : Both insemination and fusion of gametes occur in vagina of female.

**17.** Assertion : Generally, a woman do not conceive during lactation period.
Reason : The hormone prolactin initiates and maintain lactation in a woman. **[AIIMS 2009]**

**18.** Assertion : Fallopian funnel of oviduct is with finger-like fimbriae.
Reason : Graafian follicle of ovary is with secondary oocyte hanging in cavity called antrum.

# Answers

## Male reproductive system

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | b | 2 | b | 3 | c | 4 | b | 5 | a |
| 6 | d | 7 | d | 8 | a | 9 | a | 10 | c |
| 11 | a | 12 | b | 13 | a | 14 | c | 15 | a |
| 16 | d | 17 | c | 18 | d | 19 | b | 20 | a |
| 21 | a | 22 | b | 23 | a | 24 | b | 25 | b |
| 26 | d | 27 | d | 28 | a | 29 | b | 30 | b |
| 31 | b | 32 | a | 33 | a | 34 | c | 35 | c |
| 36 | b | 37 | a | 38 | b | 39 | c | 40 | d |
| 41 | b | 42 | b | 43 | d | 44 | d | 45 | b |
| 46 | d | 47 | a | 48 | c | 49 | d | 50 | c |
| 51 | b | 52 | c | 53 | b | 54 | a | 55 | b |
| 56 | a | 57 | a | 58 | c | | | | |

## Female reproductive system

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | a | 2 | b | 3 | c | 4 | a | 5 | a |
| 6 | b | 7 | d | 8 | d | 9 | a | 10 | b |
| 11 | a | 12 | d | 13 | d | 14 | d | 15 | b |
| 16 | b | 17 | b | 18 | a | 19 | d | 20 | c |
| 21 | d | 22 | c | 23 | b | 24 | d | 25 | c |
| 26 | b | 27 | b | 28 | d | 29 | c | 30 | c |
| 31 | d | 32 | b | 33 | b | 34 | c | 35 | a |
| 36 | b | 37 | c | 38 | b | 39 | c | 40 | b |
| 41 | b | 42 | c | 43 | a | 44 | b | 45 | c |
| 46 | e | 47 | a | 48 | c | 49 | a | 50 | a |
| 51 | d | 52 | a | 53 | c | 54 | a | 55 | a |
| 56 | c | 57 | d | 58 | b | 59 | a | 60 | c |
| 61 | c | 62 | b | 63 | d | 64 | c | 65 | b |
| 66 | b | 67 | c | 68 | c | 69 | c | 70 | d |
| 71 | d | 72 | d | 73 | d | 74 | a | 75 | d |
| 76 | b | 77 | c | 78 | a | 79 | c | 80 | a |
| 81 | c | 82 | c | 83 | c | 84 | a | 85 | b |
| 86 | ab | | | | | | | | |

## Gametogenesis

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

## Phases of embryonic development

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | b | 2 | c | 3 | c | 4 | a | 5 | b |
| 6 | a | 7 | a | 8 | d | 9 | c | 10 | d |
| 11 | a | 12 | b | | | | | | |

## Fertilization

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | a | 2 | c | 3 | a | 4 | d | 5 | c |
| 6 | b | 7 | a | 8 | d | 9 | b | 10 | c |
| 11 | d | 12 | a | 13 | c | 14 | a | 15 | a |
| 16 | a | 17 | a | 18 | c | 19 | c | 20 | c |
| 21 | b | 22 | c | 23 | c | 24 | b | 25 | b |
| 26 | c | 27 | c | 28 | a | 29 | a | | |

## Cleavage

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

## Implantation and Gastrulation

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

## Neurulation and Organogenesis

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

## Extra embryonic membrane

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | b | 2 | a | 3 | b | 4 | a | 5 | c |
| 6 | c | 7 | b | 8 | b | 9 | c | 10 | b |
| 11 | b | 12 | d | 13 | b | 14 | c | 15 | d |

## Placenta

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | c | 2 | b | 3 | d | 4 | d | 5 | d |
| 6 | b | 7 | d | 8 | c | 9 | c | 10 | a |
| 11 | d | 12 | c | 13 | d | 14 | a | 15 | d |
| 16 | a | | | | | | | | |

## Gestation period and parturition

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | d | 2 | d | 3 | b | 4 | a | 5 | a |
| 6 | d | 7 | d | 8 | c | 9 | a | 10 | d |
| 11 | c | | | | | | | | |

## NCERT Exemplar Questions

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | c | 2 | d | 3 | d | 4 | b | 5 | a |
| 6 | b | 7 | a | 8 | b | 9 | c | 10 | b |
| 11 | c | 12 | b | 13 | d | 14 | b | 15 | c |
| 16 | a | 17 | a | | | | | | |

## Critical Thinking Questions

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | d | 2 | b | 3 | b | 4 | d | 5 | b |
| 6 | c | 7 | a | 8 | c | 9 | d | 10 | c |
| 11 | a | 12 | b | 13 | a | 14 | d | 15 | b |
| 16 | c | 17 | a | 18 | b | 19 | c | 20 | c |
| 21 | d | 22 | a | 23 | b | 24 | d | 25 | d |
| 26 | b | 27 | b | 28 | b | 29 | d | 30 | d |
| 31 | d | 32 | d | 33 | b | 34 | b | 35 | b |
| 36 | b | 37 | b | 38 | d | 39 | d | 40 | c |
| 41 | a | 42 | c | 43 | c | 44 | a | 45 | d |
| 46 | b | 47 | d | 48 | a | 49 | b | 50 | b |
| 51 | a | 52 | a | 53 | b | 54 | c | 55 | b |
| 56 | c | | | | | | | | |

## Assertion and Reason

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | c | 2 | a | 3 | b | 4 | c | 5 | a |
| 6 | c | 7 | b | 8 | a | 9 | c | 10 | b |
| 11 | c | 12 | d | 13 | d | 14 | d | 15 | e |
| 16 | d | 17 | b | 18 | b | | | | |

# AS Answers and Solutions

## Male reproductive system

**1.** (b) In mammals the testis are located in the extra abdominal scrotal sac. But non descent of testes in scrotum is called cryptorchidism. Person becomes sterile.

**3.** (c) Mitosis occurs during the multiplication phase of spermatogenesis and the diploid primary spermatocyte produces haploid secondary spermatocytes by first meiotic division during maturation.

**6.** (d) Each seminiferous tubules is lined by a germinal epithelium formed of two types of cell germ or spermatogenic cells and sertoli or nurse cells. Sertoli cells are a few pyramidal shaped cells which provide nutrition to developing sperms.

**7.** (d) This passes through the inguinal canal.