**Key Topics Covered In Class 12 Biology Chapter 3 Notes**

Following are the topics:

- The Male Reproductive System
- The Female Reproductive System
- Gametogenesis
- Menstrual Cycle
- Fertilisation and Implantation
- Pregnancy and Embryonic Development
- Parturition and Lactation

**Human Reproduction:**

- Humans reproduce sexually and are viviparous. The events in human reproduction are Gametogenesis (formation of gametes), i.e., sperms in males and ovum in females.
- Insemination (transfer of sperms into the female genital tract).
- Fertilisation (fusion of male and female gametes) results in the formation of a zygote.
- Formation of the blastocyst, its development and attachment to the uterine wall (implantation), Gestation (embryonic development).
- Parturition (delivery of the baby).

Reproductive events start after puberty. As covered in Extramarks Class 12 Biology Chapter 3 Notes, the difference between the male and female reproductive phases is that sperm formation continues even in older men. In contrast, the formation of the ovum gradually ceases in women around the age of fifty years.

**THE MALE REPRODUCTIVE SYSTEM:**

The reproductive system is situated in the pelvis region of the human male.

It includes four main parts:

- A pair of testes
- Accessory ducts
- Glands
- External genitalia

We have provided a brief summary of these four major sections below. Students can refer to more details about the male reproductive system in our Class 12 Biology Chapter 3 Notes after registering on the Extramarks website.

**Testis:**

- The testes are organised outside the abdominal cavity within a pouch-like structure called the scrotum.
- The scrotum maintains the low temperature of the testes (2–2.5o C less than the internal body temperature), which is necessary for spermatogenesis.
- In adults, each testis has about 250 compartments called testicular lobules. Each lobule has one to three highly coiled seminiferous tubules, in which sperms are formed. Each seminiferous tubule is lined on the inside by germ cells (spermatogonia) and Sertoli cells. After meiotic divisions, the male germ cells lead to sperm formation, whereas Sertoli cells provide nutrition to the germ cells. Outside the seminiferous tubules are interstitial spaces, which contain tiny blood vessels and /or Leydig cells (interstitial cells). Leydig cells secrete androgens (testicular hormone).

**Accessory Duct:**

The male sex accessory ducts include:

- The Rete testis
- Vasa efferentia
- Epididymis
- Vas deferens
- The seminiferous tubules open into a series of channels in the rete testis and go to the vasa efferentia.
- The vasa efferentia leave the testis and open into the epididymis, which is located along the backside of each testis.
- The epididymis is a long, coiled tube that leads to the vas deferens.
- Vas deferens goes up to the abdomen and makes a loop over the urinary bladder. It also receives a duct from the seminal vesicle and opens into the ejaculatory duct (urethra).
- The urethra starts from the urinary bladder and goes through the penis to its external opening called the urethral meatus.

- These ducts keep and transport the sperm from the testis to the outside of the penis through the urethra.

**Glands:**

1. Seminal vesicles
2. Prostate gland
3. Bulbourethral glands

- Secretions from these glands constitute a fluid called seminal plasma, which is rich in calcium, fructose, and certain enzymes.
- Seminal vesicles contribute a significant part of the seminal fluid. Its high fructose content nourishes the spermatozoa.
- The prostate gland is placed just below the urinary bladder and secretes alkaline, thin, and milky fluid, which helps the sperm survive in an acidic vaginal environment.
- The secretions of bulbourethral glands also help in the lubrication of the penis.

**External genitalia:**

- The male external genitalia is the penis. It is made up of tissue that helps in the erection of the penis to facilitate insemination.
- The enlarged end of the penis, called the glans penis, is covered by a foreskin.

**THE FEMALE REPRODUCTIVE SYSTEM**

The human female reproductive system is specialised to support the processes of ovulation, fertilisation, pregnancy, birth, and child care.

The female reproductive system has been covered at length in our Class 12 Biology Chapter 3 Notes for students to get a full understanding of the below parts:

- A pair of ovaries
- A pair of oviducts
- Uterus
- Cervix
- Vagina
- External genitalia
- A pair of mammary glands

Except for mammary glands, these parts are located in the pelvic region. These parts of the system and a pair of mammary glands are integrated structurally and functionally.

**Ovaries:**

- It is the primary female sex organ.
- It produces the ovum (the female gamete) and several ovarian hormones.
- In females, it is located on each side of the lower abdomen.
- The ovaries are connected to the pelvic wall and uterus and are 2 to 4 cm long.
- Both the ovaries have a thin outer epithelium layer that encloses the ovarian stroma.

The stroma consists of two zones:

- Peripheral cortex
- Inner medulla

**The accessory duct of the female reproductive system:**

- Oviducts (fallopian tubes)
- Uterus
- Vagina

**Oviduct (Fallopian Tube):**

Both the fallopian tubes are about 10-12 cm long and run from the periphery of each ovary to the uterus.

It consists of three parts:

- Infundibulum
- Ampulla
- Isthmus

1. Infundibulum:

The funnel-shaped structure is the proximal part of the fallopian tube, closer to the ovary. The edges of the infundibulum have finger-like projections called fimbriae. These fimbriae help in the collection of the ovum after ovulation.

2. Ampulla:

The infundibulum connects to a broader part of the oviduct called the ampulla.

3. Isthmus:

It is the last part of the oviduct, which has a narrow lumen and joins the uterus.

Understanding the structure and function of the fallopian tubes is important for students to get a good grasp of the female reproductive system. We suggest students register on the Extramarks website and get full access to our study materials related to Class 12 Biology Chapter 3 Notes.

**Uterus:**

- The uterus is single in number. It is also known as the womb.
- It is a cavity with an inverted pear-like shape inside which a baby grows. It is supported by ligaments to join the pelvic wall.

The wall of the uterus is made up of three layers of tissue.

- Perimetrium: It is the external, thin membranous layer that protects the uterus.
- Myometrium: It is a thick middle layer of smooth muscle. Myometrium functions during strong contractions to push out the baby during delivery.
- Endometrium: It is the innermost epithelial layer that lines the uterine cavity. The endometrium undergoes cyclic changes during the menstrual cycle.

Students can learn more about the three layers of uterine wall in our Class 12 Biology Chapter 3 Notes.

**Cervix:**

- The uterus opens into the vagina through a narrow space called the cervix.
- The cavity of the cervix is known as the cervical canal.
- The cervical canal and the vagina form the birth canal, through which baby birth occurs.

**External Genitalia:**

The female human external genitalia include the mons pubis, labia majora, labia minora, clitoris, and hymen.

- Mons pubis is a cushion-like structure fabricated of fatty tissue covered by skin and dense pubic hair.
- The labia majora are also fleshy folds of tissue enclosing and protecting the vaginal opening. It extends down from the mons pubis.
- Under the labia majora, there is labia minora. It is a paired fold of tissue under the labia majora.

- The vaginal opening is covered partially by a membrane known as the hymen.
- The clitoris is a small finger-like structure that lies at the upper joint of the paired labia minora, on the upper side of the urethral opening.

The hymen membrane is often torn during the first intercourse (coitus). However, it can also be broken by other reasons, like a sudden fall or jolt,the insertion of a vaginal tampon, active participation in sports like horseback riding, cycling, etc.

**Mammary Gland:**

All-female mammals have a pair of functional mammary glands.

- Mammary glands are paired structures commonly known as breasts.
- It possesses glandular tissue and a variable amount of fat.
- The glandular tissue is divided into 15-20 mammary lobes in each breast.
- The mammary lobes contain clusters of cells called alveoli.
- The alveoli cells secrete milk, which is stored in the cavities of the alveoli.
- The alveoli transport milk into mammary tubules. The mammary tubules of each lobe join to form a mammary duct.
- Many mammary ducts join to form a broader mammary ampulla connected to the lactiferous duct that empties onto the surface of the nipple, through which milk is sucked out.

Students can refer to our Class 12 Biology Chapter 3 Notes for detailed topic notes about the mammary glands.

**GAMETOGENESIS:**

Fertilisation is the process by which the primary sexual organs—the testis in males and the ovaries in females—produce gametes, i.e., sperm (in males) and ovum (in females).**Spermatogenesis:**

In the testis, the process of spermatogenesis begins at puberty.

- To increase their number, the spermatogonia are situated on the inner wall of seminiferous tubules, which are divided by mitotic division to increase their number.
- Each spermatogonium is diploid (2n) and consists of 46 chromosomes.
- Few spermatogonia, also called primary spermatocytes, undergo meiosis(reduction division).

- When a primary spermatocyte completes the first meiotic division (reduction division), it forms two equal, haploid cells known as secondary spermatocytes, with only 23 (n) chromosomes each.
- The secondary spermatocytes go through the second meiotic division to produce four equal haploid (23 chromosome) spermatids.

Through spermiogenesis, the spermatids are converted into spermatozoa (sperms). After spermatogenesis, sperm heads remain embedded in the Sertoli cells, and by the process of spermiation, they are finally released from the seminiferous tubules.

For a further step-by-step understanding of the spermatogenesis process, students can refer to our Class 12 Biology Chapter 3 Notes.

- At puberty, spermatogenesis starts due to a significant increase in the secretion of gonadotropin-releasing hormone (GnRH).
- GnRH works at the anterior pituitary gland and stimulates the secretion of two gonadotropins – follicle-stimulating hormone (FSH) and luteinising hormone (LH).
- LH stimulates the Leydig cells to synthesise and secrete androgens.
- Androgens, in turn, stimulate the spermatogenesis process.
- FSH works on the Sertoli cells and stimulates the secretion of some factors responsible for spermatogenesis.

Structure of sperm**:**

- A sperm is a microscopic structure, and its body is composed of a head, neck, middle piece, and tail.
- The plasma membrane covers the whole body of sperm.
- An elongated haploid nucleus is present in the sperm's head. A cap-like acrosome structure surrounds the anterior-most portion of the sperm. The acrosome contains enzymes that help the sperm penetrate the ovum for fertilisation.
- The middle piece consists of numerous mitochondria, which provide energy for the movement of the tail that facilitates sperm motility, which is essential for fertilisation.
- About 200 to 300 million sperms are ejaculated during coitus, of which at least 60% must be regular in shape and size and at least 40% must show vigorous motility.

- Seminiferous tubules release sperm, which are transported by the accessory ducts.
- Secretions of the epididymis, vas deferens, prostate, and seminal vesicle are essential for the motility and maturation of sperms.
- The seminal plasma and sperms combine to form the semen.The testicular hormones (androgens) maintain the functions of male sex accessory ducts and glands.

Class 12 Biology Chapter 3 Notes covers the topic of the structure of sperm with visual diagrams and notes that will make it easier for students to understand the complex sperm structure.

**Oogenesis:**

Oogenesis is the process by which the formation of a mature female gamete occurs. It is not similar to spermatogenesis. The difference between the two processes is explained in a very structured format in our Biology Chapter 3 Class 12 Notes making it easier to understand for students. Below are the key steps involved in the Oogenesis process.

- The process of oogenesis begins during the embryonic development stage of a human female, and millions of gamete mother cells (oogonia) are formed within both the foetal ovary and the uterus.After birth, there is no more formation, and the addition of oogonia occurs.
- These oogonial cells start division and get temporarily arrested at the stage of prophase -1 of meiotic division, called primary oocytes. Each primary oocyte then gets enveloped by a layer of granulosa cells called the primary follicle.
- Many of these follicles degenerate during the period from birth until puberty. Therefore, only 60,000-80,000 primary follicles are left in each ovary at puberty.
- These primary follicles again get surrounded by layers of granulosa cells, and a new theca is called a secondary follicle.
- Soon, the secondary follicle converts into a tertiary follicle with the addition of a fluid-filled cavity called the antrum. The theca layer is arranged into an inner theca internal and an outer theca external.
- At this stage, the primary oocyte inside the tertiary follicle grows in size and completes its first meiotic division. It is an unequal division, forming a large haploid secondary oocyte and a tiny first polar body.
- The secondary oocyte retains the bulk of the nutrient-rich cytoplasm of the primary oocyte. The first polar body to be born does not divide further.

- The tertiary follicle matures into the Graafian follicle. A secondary oocyte called the zona pellucida develops a new membrane around it at this stage.
- After this, the process of ovulation starts, and the Graafian follicle ruptures to release the secondary oocyte (ovum) from the ovary.

**MENSTRUAL CYCLE**

The menstrual cycle is the reproductive cycle of female primates. For example, human beings, monkeys, and apes. The menstrual cycle is a complex process. Extramarks team of Biology experts has explained this process in simple language in our Class 12 Biology Chapter 3 Notes.

Menarche:

The first menstruation occurs at puberty and is called menarche.

- In human females, menstruation is repeated at an interval of about 28-29 days, and the cycle of events starting from one menstruation to the next is called the menstrual cycle.
- Ovulation (release of one ovum) occurs during the middle of each menstrual cycle.

Events of the menstrual cycle are:

- The cycle starts when the menstrual flow occurs and lasts for 3-5 days.
- The menstrual flow happens due to the breakdown of the innermost lining of the uterus, which is the endometrium, and its blood vessels, which form a red liquid that comes out through the vagina.
- Menstruation occurs if the released ovum is not fertilised. A lack of menstruation may be an indication of pregnancy. However, some other causes, like stress, poor health, etc., are also responsible for it.

Follicular Phase:

- After the menstrual phase, there is the follicular phase. During this phase, the primary follicles grow to become fully mature Graafian follicles in the ovary, and simultaneously, the endometrium of the uterus regenerates through proliferation.
- The levels of pituitary and ovarian hormones are responsible for these changes in the ovary and the uterus.
- During the follicular phase, the secretion of gonadotropins (LH and FSH) increases gradually and stimulates follicular development and the secretion of estrogens by the growing follicles.

Ovulation- release of the ovum:

Both LH and FSH are at their peak levels in the middle of the cycle ( near the 14th day). Fast secretion of LH resulting in its maximum level during the mid-cycle called LH surge leads to rupture of Graafian follicle and an ovum release (ovulation). The ovum is surrounded by three layers, an inner thin vitelline membrane, a middle thick zona pellucida, and a thick outer layer of follicular cells known as the corona radiata. Refer to our Class 12 Biology Chapter 3 Notes where our subject matter experts have explained the ovulation cycle in further detail.

Luteal Phase**:**

The formation of the corpus luteum takes place. Also known as the secretory phase.

- After ovulation (ovulatory phase), there is the luteal phase, during which the remaining parts of the Graafian follicle change into the corpus luteum. The corpus luteum secretes large amounts of progesterone, which is essential to maintaining the endometrium.The endometrium is necessary to implant the fertilised ovum and for other pregnancy events. During pregnancy, all the phases of the menstrual cycle stop, and there is no menstruation.
- If fertilisation does not take place, the corpus luteum degenerates. This causes the endometrium to breakdown, resulting in menstruation and the start of a new cycle.

Menopause**:**

In human beings, menstrual cycles end at around 50 years of age; that is termed menopause. Cyclic menstruation indicates the normal reproductive phase of a female and extends between menarche and menopause.

Insemination:

During copulation (coitus), semen is released by the penis of a male into the vagina of a female, and the process is called insemination. The process has been explained with pictorial demonstrations and notes in our Class 12 Biology Chapter 3 Notes, which makes it easy for students to remember the process of insemination.

- The motile sperm swim, pass through the cervix, enter the uterus, and finally reach the ampullary region of the fallopian tube. The ovum is also transported to the ampullary region.
- Fertilisation can only happen if the ovum and sperms are transported simultaneously to the ampullary region, where fertilisation occurs.

Fertilisation:

The procedure of fusion of an ovum with sperm is called fertilisation.

- In this process, a sperm comes into contact with the zona pellucida(middle layer) of the ovum and starts making changes in the membrane that block the entry of any other sperms. Thus, only one sperm can fertilise an ovum.
- The secretions of the acrosome (a cap-like structure of sperm) help the sperm enter the cytoplasm of the ovum through the zona pellucida and the plasma membrane.
- This induces the meiotic division of the ovum to complete, and the secondary oocyte forms. Like the first, the second meiotic division is also unequal and results in the formation of a second polar body and a haploid ovum (ootid).
- Soon the haploid nucleus of the ovum and that of the sperm fuse together to form a diploid zygote. The sex of the baby is decided at this stage.

The sex chromosome pattern in the human male is XY, and that in the female is XX. Therefore, in the male gametes (sperms), the sex chromosome could be either X or Y. Hence, 50% of sperms carry the X chromosome, while the other 50% carry the Y.

All the haploid gametes (ova) produced by the female have the sex chromosome X. After fusion of the female and male gametes, the zygote would carry either XX or XY depending on whether the sperm is carrying X or Y fertilised the ovum.

The zygote carrying XY would develop into a male baby, and XX would form a female.

The topic of sex chromosome pattern is made easy by our Extramarks experts team by using simple langague for subject explanations in our Class 12 Biology Chapter 3 Notes.

**Development of Zygote and Implantation:**

As the zygote moves through the isthmus of the oviduct (called the cleavage)towards the uterus, the mitotic division starts and forms 2, 4, 8, and 16 daughter cells, and these cells are called blastomeres.

Morula:

The embryo with 8 to 16 blastomeres is called a morula. The morula further divides and forms a blastocyst as it moves further into the uterus.

In the blastocyst, blastomeres are arranged in two layers:

- Trophoblast- an outer layer
- Inner cell mass- an inner group of cells attached to the trophoblast

After that, the trophoblast layer gets attached to the endometrium of the uterus, and the inner cell mass differentiates from the embryo.

**Implantation:**

After the trophoblast gets attached, the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst gets immersed in the endometrium of the uterus. This is known as implantation, and it leads to pregnancy. We have covered the process of implantation briefly here. Students can register on the Extramarks website and get full access to the implantation step-by-step process from our Class 12 Biology Chapter 3 Notes.

**PREGNANCY AND EMBRYONIC DEVELOPMENT**

- When the implantation is done, finger-like projections develop on the trophoblast known as chorionic villi, which are surrounded by the uterine tissue and maternal blood.
- The chorionic villi and uterine tissue become intertwined and jointly form a structural and functional unit between the developing embryo (foetus) and the maternal body called the placenta.
- The placenta makes the path for the supply of nutrients and oxygen to the embryo and the removal of carbon dioxide and waste materials produced by the embryo.
- The placenta is attached to the embryo through an umbilical cord, which acts as a bridge between the mother and embryo in the transport of substances.
- The placenta also produces hormones like human placental lactogen (hPL), human chorionic gonadotropin (hCG), progestogens, estrogens, etc. The ova also secreted a relaxin hormone later in pregnancy.
- Hormones like hCG, hPL, and relaxin are produced in women only during pregnancy.
- The levels of other hormones like progestogens, estrogens, cortisol, thyroxine, prolactin, etc., are increased many folds in the maternal blood during pregnancy.
- Increased production of these hormones is necessary for maintaining fetal growth, metabolic changes in the mother, and the maintenance of pregnancy.

The inner cell mass (embryo) differentiates immediately after implantation into:

1. The outer layer is called the ectoderm.
2. The inner layer is called the endoderm.
3. A mesoderm soon emerges between the ectoderm and the endoderm.

These three layers developed by the embryo give rise to all tissues (organs) in adults.

Stem Cells:

The cell mass contains stem cells, which have the ability to give rise to all tissues and organs.

- Human pregnancy lasts nine months.
- In human beings, the embryo's heart is formed after one month of pregnancy.
-
- By the end of the second month of pregnancy, the limbs and digits of the foetus have developed.
-
- By the end of 3 months (the first trimester), most major organ systems are formed.
- During the fifth month, the first movements of the fetus and the hair growth on the head are usually observed.
- By the end of the second trimester, the fetus's body is covered with fine hair, eyelids separate, and eyelashes are formed.
- The fetus is fully developed by the end of nine months and is all set for delivery.

**PARTURITION AND LACTATION**

**Gestation Period:**

The average duration of human pregnancy is about nine months.

**Parturition:**

Strong contraction of the uterus at the end of pregnancy causes exclusion/delivery of the foetus. This process of childbirth is called parturition. Below are a few important elements of the parturition process as covered in our Class 12 Biology Chapter 3 Notes.

- **T**he parturition signals originate from the fully-grown foetus and the placenta, which initiate mild uterine contractions called foetal ejection reflex.
- These contractions trigger the release of oxytocin from the maternal pituitary. Due to the release of oxytocin, there are stronger contractions in the uterine muscle. More oxytocin is released as a result of stronger contractions, resulting in stronger and stronger contractions.. This results in the expulsion of the baby out of the uterus through the birth canal.
- The mammary glands of the female go through differentiation during pregnancy and begin to produce milk after parturition through a processcalled lactation.

- This enables the mother to feed the newborn. In the initial few days of lactation, the milk contains several antibodies (colostrum), which are essential for newborns to develop resistance.