CHAPTER – 3

HUMAN REPRODUCTION

Humans are sexually reproducing and viviparous. The reproductive cycle in humans is very complex and there are remarkable differences between the reproductive events in the males and the females.

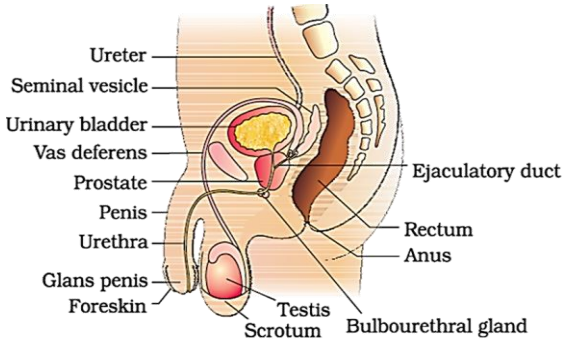
The Male Reproductive Syastem

The male reproductive system is differentiated into:

(a) Primary sex organs: it consists of a pair of testicles suspended in a scrotum.

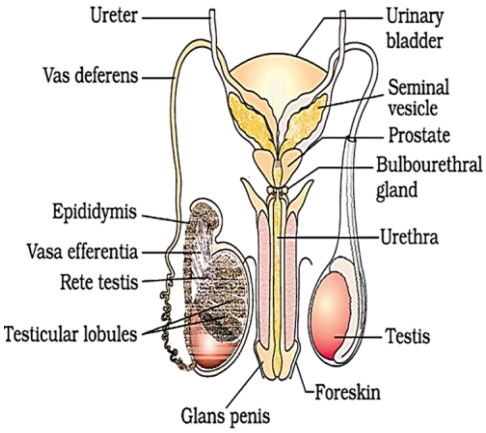
(b) Secondary sex organs: these include a pair of ducts that are differentiated into rete testis, vasa efferentia, epididymis, and vas deferens, an ejaculatory duct and accessory glands.

(c) External Genetilia.



A sectional view of male pelvis showing the reproductive system

- The testes are located outside the abdominal cavity in a pouch called the **scrotum**, which helps in keeping the testes at the low temperature required for **spermatogenesis.**
- Each testis has around 250 testicular lobules, each of which contains densely coiled seminiferous tubules in which sperms are created.
- Two types of cells line each seminiferous tubule: **spermatogonia (male germ cell) and Sertoli cells.**
- **Leydig cells,** which are found surrounding the seminiferous tubules, produce and secrete androgen hormone.
- The urethra, originates from the uranary bladder and extends through the penis to its external entrance, the urethral meatus, stores and transports sperm from the testes to the outside.



Diagrammatic view of male reproductive system

- The penis is the male genitalia. The glans penis is the expanded end of the penis that is covered by a loose flap of skin called the foreskin.
- Accessory glands in men include paired seminal vesicles, prostate glands, and paired bulbourethral glands. These glands secrete seminal plasma, which is rich in fructose, calcium, and enzymes. The production of bulbourethral glands also aids in penile lubrication.

Brush Up Your Understanding

Q1. In human, maturation of sperms take place at a temperature.
(a) equal to that of body (b) higher than that of body
(c) lower than that of body (d) at any temperature

S1. (c)

Q2. Seminiferous tubules occur in the.
(a) liver (b) kidney (c) ovary (d) testis

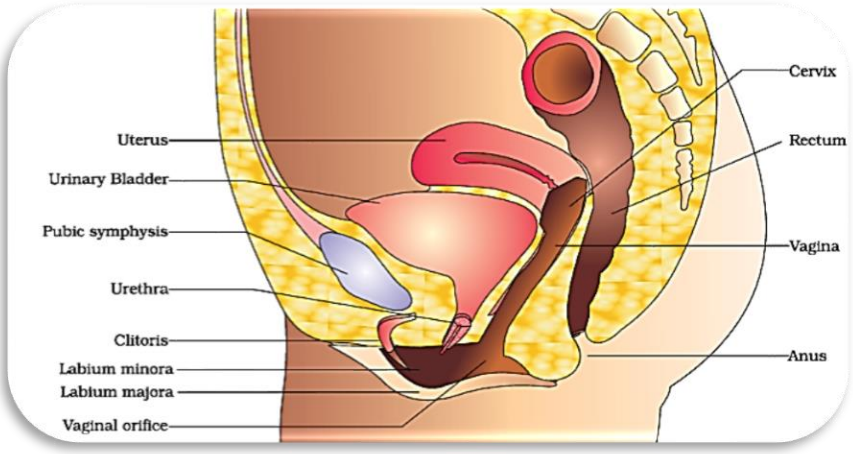
S2. (d)

The Female Reproductive System

The female reproductive system consists of:

(a) Primary sex organ that are the ovaries.
(b) Secondary sex organs that include Fallopian tube, uterus, cervix and vagina.
(c) External genetilia.
(d) Mammary glands.

- The ovaries are the major female sex organs, producing the female gamete as well as many steroid hormones. Each ovary has a thin epithelium that surrounds the ovarian stroma, which is separated into a peripheral cortex and an interior medulla.
- The **Fallopian tube** connects the ovary's periphery to the uterus. **The closest component to the ovary is a funnel-shaped structure called the infundibulum**, which has finger-like projections called **fimbriae.**
- The infundibulum leads to the ampulla, which connects to the uterus through the **isthmus.** The **uterus**, often known as the womb, is a pear-shaped structure.
- A small **cervix** allows the uterus to open the vagina. **The birth canal is formed by the cavity of the cervix (cervical canal) and the vagina**



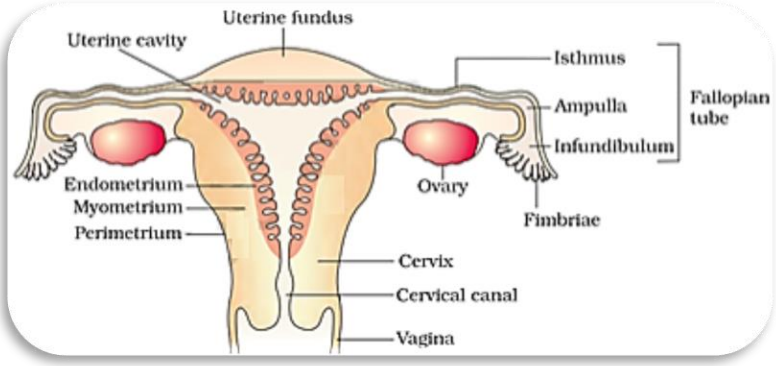
A diagrammatic sectional view of a female pelvis showing the reproductive system

The uterus is internally lined by three layers that play an important role in pregnancy.

- **Perimetrium:** it is the external layer.
- **Myometrium:** it is the middle thick layer of smooth muscles that exhibit strong contraction during delivery of the baby.
- **Endometrium:** it lines the uterine wall and undergoes cyclic changes during menstrual cycle.

The external genitalia in females include:

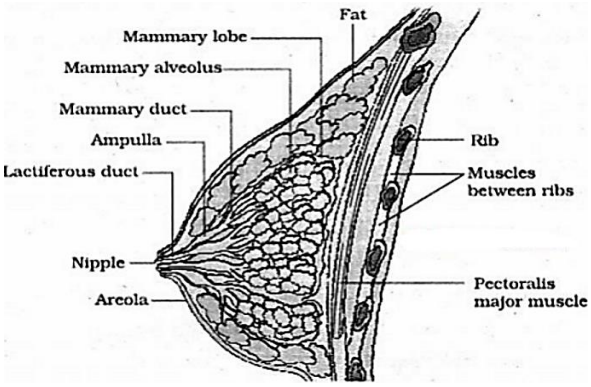
- Mons pubis: it is a cushion of fatty tissues covered by skin and pubic hair.
- Labia majora: it is a fleshy fold that surrounds the vaginal opening.
- Labia manora: it is a paired fold of tissue under labia majora.
- The opening of the vagina is often partially covered by a membrane called **hymen.**
- The tiny finger-like projection present at the upper junction of two labia manora above the urethral opening is called **clitoris.**



A diagrammatic sectional view of female reproductive system

The mammary glands

Mammary glands are paired structures that contain glandular tissues as well as different types of fat. Each glandular tissue has 15-20 mammary lobes with milk-secreting alveoli. The breast ducts connect to produce the mammary ampulla.



Structure of mammary glands

Brush Up Your Understanding

Q1. Lower narrow end of uterus is called as.
(a) urethra (b) cervix
(c) clitoris (d) vulva

S1. (b)

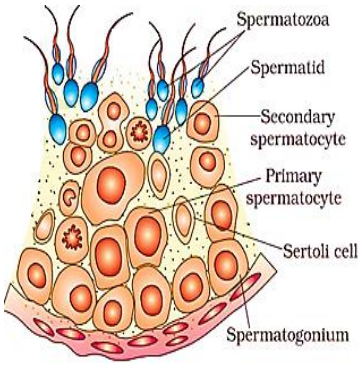
Q2. Endometrium is lining of.
(a) testis (b) urinary bladder
(c) uterus (d) ureter

S2. (c)

Gametogenesis
Gametogenesis refers to the process of formation of the male and female gametes in the testes and ovaries, respectively. In males and females, it is controlled by different hormones.
1. Male spermatogenesis
2. Female oogenesis

Spermatogenesis: Male germ cells (spermatogonia) in immature testes create sperm through spermatogenesis, which begins at puberty.

- Spermatogonia on the inner surface of seminiferous tubules proliferate and grow in quantity by mitotic division. Every spermatogonium has 46 chromosomes
- Spermatogonia produces spermatocytes that divide meiotically to create secondary spermatocytes with 23 chromosomes.
- **Spermiogenesis is the process through which spermatids are converted into spermatozoa.** Sperm heads stay lodged in Sertoli cells and are liberated from seminiferous tubules during the **spermiation** process.

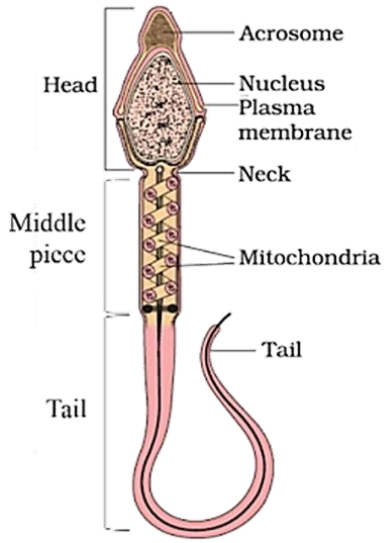


A sectional view of seminiferous tubules

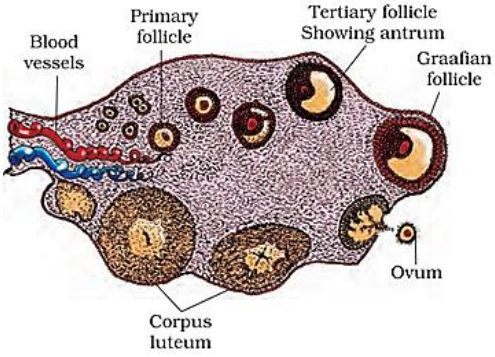
The process of spermatogenesis is under strict control of hormones that timely manages each of its step. The hormones are as follows:

- Spermatogenesis begins due to increasing Gonadotropin-releasing hormone (GnRH) released by the hypothalamus.
- GnRH acts on the anterior pituitary and induces the release of two gonadotropins, **LH and FSH.**
- LH increases the secretion of androgens by Leydig cells.
- FSH increases the release of certain substances that aid in spermiogenesis by acting on Sertoli cells.

Human Sperm structure: Sperm is a microscopic structure made up of a head, neck, middle section, and tail. The sperm head has an extended haploid nucleus that is covered by a cap-like structure called an **acrosome.** During coitus, a human male ejaculates around 200-300 million sperms. The seminal plasma and sperms combine to form the semen. Androgen hormones regulate the activity of male sex secondary ducts and glands.



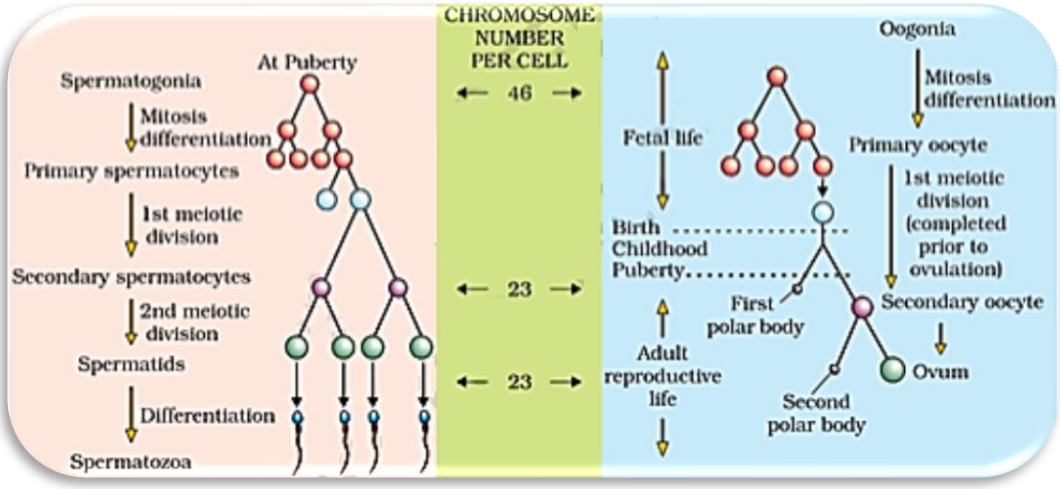
Structure of sperm



Sectional view of an ovary

Oogenesis: it is the process through which mature female gametes are formed.

- It begins during the embryonic development stage, when each foetal ovary produces millions of **ogonia (gamete mother cells).**
- The gametes' mother cells divide and reach prophase-I of meiotic division, where they are temporarily arrested as **primary oocytes.**
- **When a primary oocyte is surrounded by a layer of granulosa cells, it is referred to be a primary follicle.**
- At adolescence, each ovary has between 60,000 and 80,000 primary follicles.
- The primary follicle is surrounded by several layers of granulosa cells, which change into secondary follicles, which contain a fluid-filled chamber called the **antrum.**
- The tertiary follicles mature into the **Graafian follicle**, which ruptures to release secondary oocytes (ovum) from the ovary during the ovulation process.



Spermatogenesis **Oogenesis**

Brush Up Your Understanding

Q1. The acrosome plays a role in.
(a) fusion of nuclei of gametes
(b) motility of sperm
(c) penetration of sperm into ovum
(d) All of the above

S1. (c)

Q2. At the time of birth, egg is arrested in the form of.
(a) oogonia (b) primary oocyte
(c) secondary oocytes (d) ovum

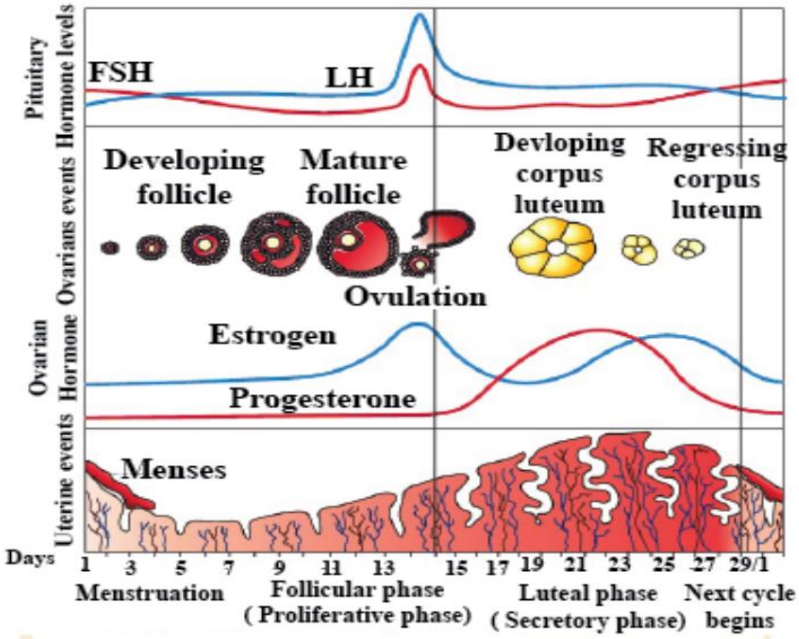
S2. (b)

Menstrual Cycle: the cycle is divided into four phases:

1. **Menstural phase:** the cycle lasts from day 3-5days of a 28-day menstrual cycle.
   - LH production from the pituitary gland's anterior lobe is diminished.
   - Withdrawal of this hormone promotes corpus luteum degeneration, which reduces progesterone synthesis.
   - Oestrogen production is also lowered during this time.
   - The uterine endometrium degrades and menstruation begins.
   - The menstrual flow is made up of endometrial fluids, blood, and an unfertilized ovum.
2. **Follicular phase:** In a 28-day cycle, this phase lasts from day 6-13 or 14 days.
   - **FSH, which is released by the anterior lobe of the pituitary gland**, stimulates the ovarian follicle to secrete oestrogens.
   - Oestrogen promotes the growth of endometrium.
   - Rapid cell multiplication causes the endometrium to thicken, which is accompanied by a rise in uterine glands and blood vessels.
3. **Ovulatory phase:** Both LH and FSH reach their highest levels in the middle of the cycle (about 14th day).
   - Oestrogen levels in the blood rise.
   - There is rapid LH secretion that causes Graffian follicle to rupture and thus discharging the ovum.
   - The hormone that is responsible for ovulation is LH.
4. **Luteal phase:** The phase lasts from day 15 to 28.
   - In this phase, the corpus luteum secreates progesterone.
   - The endometrium gets thickened and the uterine glands start their secretion.

Hormones controlling Menstural cycle:

- **LH (leutinizing hormone)** stimulates the corpus luteum to produce progestrone.
- The menstrual phase is **triggered** by an increase in **oestrogen production**.
- **LH hormone stimulates ovulation**.
- The proliferative phase is triggered by increased estrogen production.
- **Progestrone** synthesis induces the **secreatory** phase



Representation of various events during menstrual cycle

Brush Up Your Understanding

Q1. The process of releasing the mature female gamete from the ovary is called as.
(a) ovulation (b) parturition
(c) implantation (d) fertilisation

S1. (a)

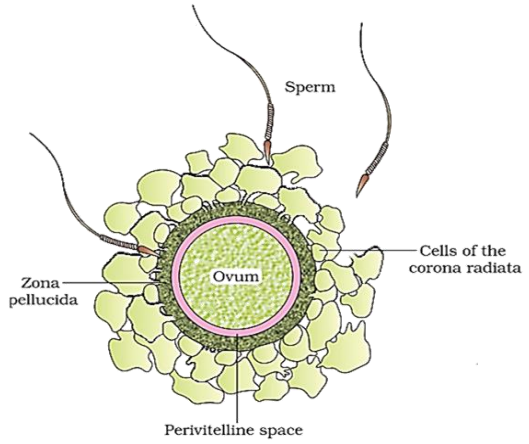
Q2. Luteal phase is the other name of.
(a) follicular phase (b) proliferative phase
(c) menstrual flow phase (d) secretory phase

S2. (d)

Fertilisation and Implantation

Fusion of sperm with ovum is called fertilisation.

- FSH increases the production of oestrogens by ovarian follicles.
- Semen is discharged into the vagina during coitus (copulation).
- The motile sperms swim quickly to the junction of the isthmus and the ampulla of the fallopian tube.
- The ovum also arrives, and **gamete fusion occurs at the ampullary-isthmic junction**.
- The sperms acrosome undergoes acrosomal activation and releases specific sperm lysins that breakdown the egg's envelope locally and create a channel for sperm entry.
- The sperm lysins comprise hyaluronidase, a lysing enzyme that dissolves the hyaluronic acid polymers in the intercellular gaps that keep the corona radiata granulosa cells together; corona piercing enzyme (that dissolves the corona radiata); and acrosin (which dissolves the zona pellucida). The zone pellucida is then dissolved.



Representation of an ovum that is surrounded by sperms

As soon as a sperm enters into the egg, the latter exhibits a **cortical response** to prevent the admission of further sperms.

- During this process, the cortical granules under the plasma membrane of the egg release chemical substance between the **ooplasm and the plasma membrane (vitelline membrane).**
- These chemicals elevate the vitelline membrane above the surface of the egg. The raised vitelline membrane is referred to as the fertilisation membrane.
- The enlarged gap between the ooplasm and the fertilisation membrane, as well as the chemical contained in it, effectively prevent additional sperm from entering.
- But, if more than one sperm enters the secondary oocyte, the cell has too much genetic material to grow healthily.
- The haploid gametes fuse to produce a diploid zygote. As the zygote approaches the uterus, mitotic division begins and cleavage occurs, resulting in two, four, eight, or sixteen celled **blastomeres.**
- **Morula are blastomeres that have 8 to 16 cells. Morula divides to become blastocysts**. The blastomeres in the blastocyst are organised into an exterior layer known as the **trophoblast** and an inner group of cells linked to the trophoblast known as the **inner cell mass.**
- **The outer layer of a blastocyst is termed trophoblast, and it attaches to the endometrium of the uterus, resulting in implantation and pregnancy.**

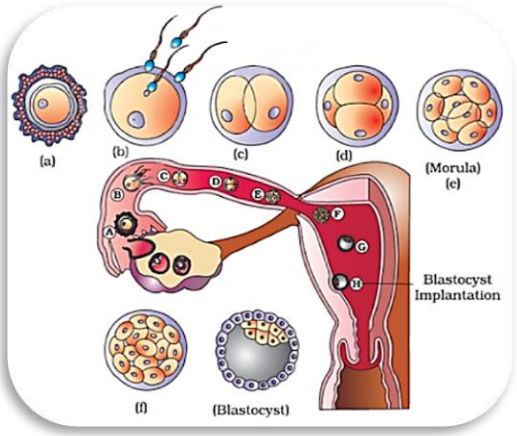


Diagram showing ovum transport, fertilisation and passage of the growing embryo through the Fallopian tube.

Brush Up Your Understanding

Q1. Site of fertilization in human is.
(a) ovary (b) uterus
(c) vagina (d) fallopian tube

S1. **(d)**

Q2. Placenta is a region where.
(a) foetus is attached to mother by spermatic cord
(b) foetus is provided with mother's blood
(c) foetus receives nourishment from mother's blood
(d) foetus is covered by membranes

S2. **(c)**

Pregnancy and embryonic development

- The finger-like extensions on the trophoblast following implantation are known **as chronic villi**.
- They along with the uterine wall, create a functional unit between the growing embryo and the mother body known as the **placenta.**

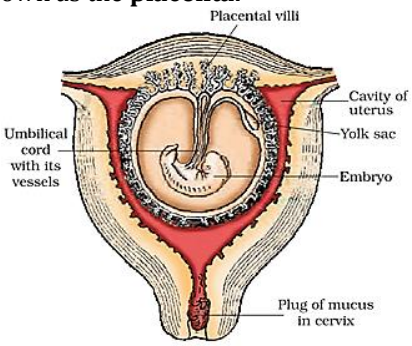


Diagram showing human foetus in the womb

- The **placenta** is connected to the foetus by an umbilical cord, which transports food and oxygen to the embryo.
- The placenta produces the **hormones hCG (human chorionic gonadotropin), hPL (human placental lactogen), and relaxin in women exclusively during pregnancy.**
- The inner cell mass (embryo) differentiates after implantation into an exterior layer called ectoderm and an inner layer called endoderm.
- Soon after, a mesoderm forms between the ectoderm and the endoderm.
- All tissues (organs) in adults are formed by these three layers.
- **It is vital to highlight that the inner cell mass comprises stem cells, which have the ability to give rise to all tissues and organs**.
- In humans, the embryo's heart develops after one month of pregnancy.
- Legs and fingers are established at the end of the second month.
- Major organs and external genital organs are fully matured by the end of the 12 weeks (first trimester).
- In 5 months, the foetus makes its first movement, the hairs develop.
- By the conclusion of 24 weeks (second trimester) the body is covered in fine hair, eye lids, and eyeless.
- The foetus is completely formed at the end of 9 months.

Brush Up Your Understanding

Q1. The gestation period in humans is of.
(a) 4 months (b) 5 months
(c) 7 months (d) 9 months

S1. **(d)**

Q2. The hormones produced by placenta are.
(a) hPL (b) hCG
(c) Progestogen (d) All of the above

S2. **(d)**

Parturition and Lactation

Delivery of the fully developed foetus is called as parturition.

- The fully grown foetus and placenta send out signals for parturition, generating moderate uterine contractions known as the **Foetal ejection reflex.**
- It causes the release of **oxytocin** from the maternal pituitary gland.
- The female mammary glands begin producing milk and continue to do so until the pregnancy is over, a process known as **lactation**.
- **Colostrum** is the milk produced during the first few days of breastfeeding and contains many antibodies. The process is called as **lactation.**

Brush Up Your Understanding

Q1. Foetal ejection reflex triggers the secretion of which of the following hormone during parturition?
(a) LH (b) hPL
(c) Oxytocin (d) Vasopressin

S1. **(c)**

Q2. Parturition is a.
(a) Neural mechanism (b) Endocrine mechanism
(c) Both (a) and (b) (d) None of the above

S2. **(c)**

SUMMARY

The **Male Reproductive System** consists of a pair of testes suspended in a scrotum, secondary sex organs i.e. a pair of ducts each differentiated into an epididymis, a vas deferens and an ejaculatory duct, a male urethra passing through an erectile penis and three types of Glands - a pair of seminal vesicles, a prostate gland and a pair of Cowper's gland.

The **Female Reproductive system** consists of a pair of ovaries, secondary sex organs i.e. a pair of fallopian tubes (oviducts), a uterus (womb), a vagina. Ovaries produce female gametes called ova. The uterus has three layers namely the perimetrium, myometrium and endometrium. The mammary glands are a female secondary sexual characteristic.

Phases of embryonic development includes formation of ova (oogenesis) and sperm (spermatogenesis), next is fertilisation, next is cleavage, next is implantation, then is gastrulation and the last is organogenesis.
The human sperm consists of a head, neck, middle piece and a tail.

The reproductive cycle of a female primate is called menstrual cycle that consists of four phases namely the menstrual phase, the follicular phase, the ovulatory phase and the luteal phase.

The cyclical changes in the ovary and the uterus during menstrual cycle are induced by changes in the level of pituitary and ovarian hormones.

The presence of X or Y chromosome determines the sex of the child.

The zygote after repeated division gets implanted in the uterus that results in pregnancy.

The gestation period in humans is 9 months after which the child is delivered and the process is called parturition that is induced by a neuroendocrine mechanism. After delivery, the mammary glands secrete milk that is very nutritious for the baby. It is called lactation.

IMPORTANT POINTERS

- The testis of humans is situated in the scrotal sacs to ease spermatogenesis.
- The Leydig cells in males secrete androgens.
- The Sertoli cells provide nutrition to the germ cells.
- The seminal plasma is rich in fructose, calcium and some enzymes.
- In human female, fertilisation takes place in the Fallopian tubes.
- Androgens stimulate the process of spermatogenesis.
- The LH surge in females causes rupture of Graafian follicle and thus release of ovum.
- During fertilisation the sperm comes in contact with zona pellucida layer of the ovum.
- The embryo with 8-16 blastomeres is called morula.
- It is the placenta that acts as the endocrine tissue during pregnancy and secretes hormones like hCG, hPL, estrogens and progestogens.
- Stem cells are found inside the inner cell mass.
- Parturition is induced by a complex neuroendocrine mechanism.
- The milk secreted during the initial few days of lactation is called colostrum

MULTIPLE CHOICE QUESTIONS

Q1. Transfer of sperms into the female genital tract is called as.
(a) Gametogenesis (b) Insemination
(c) Fertilisation (d) Gestation

Q2. The testis is located.
(a) In the scrotum
(b) Outside the abdominal cavity
(c) Testicular lobules
(d) Both (a) and (b)

Q3. Which of the following temperature is necessary for spermatogenesis?
(a) 2-2.5 degree
(b) 2-2.5 degrees lower than normal body temperature
(c) 2-2.5 degrees higher than normal body temperature
(d) None of the above

Q4. The compartments in testis is called as.
(a) Seminiferous tubules
(b) Testicular lobules
(c) Both (a) and (b)
(d) None of the above

Q5. In which of the following tubules, the sperms are produced?
(a) Seminiferous tubules
(b) Testicular lobules
(c) Epididymis
(d) Vas deferens

Q6. The inside of the seminiferous tubules is lined by.
(a) Sertoli cells (b) Spermatogonia
(c) Male germ cells (d) All of the above

Q7. Which of the following cells provide nutrition to the germ cells?
(a) Interstitial cells
(b) Leydig cells
(c) Sertoli cells
(d) All of the above

Q8. Which of the following stores and transports the sperms from testis to the outside through the urethra?
(a) Vas deferens (b) Rete testis
(c) Ejaculatory duct (d) Epididymis

Q9. The male accessory gland includes.
(a) Only seminal vesicle
(b) Only prostrate
(c) Only bulbourethral
(d) All of the above

Q10. The seminal plasma is rich in.
(a) Lactose
(b) Fructose
(c) Calcium
(d) Both (b) and (c)

Q11. Which of the following is the function of the ovaries?
(a) Production of ovum
(b) Produce several steroid hormones
(c) Both (a) and (b)
(d) None of the above

Q12. Which of the following constitutes the female accessory ducts?
(a) Oviducts (b) Uterus
(c) Vagina (d) All of the above

Q13. Which of the following helps in the collection of the ovum after ovulation?
(a) Infundibulum (b) Fimbriae
(c) Ampulla (d) Isthmus

Q14. Which of the following is regarded as the womb of a female?
(a) Cervix (b) Uterus
(c) Vagina (d) All of the above

Q15. Which of the following is the inner and glandular layer of the uterus?
(a) Perimetrium (b) Myometrium
(c) Endometrium (d) None of the above

Q16. What is the ploidy of spermatogonium?
(a) Haploid (b) Diploid
(c) Triploid (d) Tetraploid

Q17. The primary spermatocyte completes the first reduction division and leads to the formation of haploid cell that are called.
(a) Secondary spermatocyte
(b) Tertiary spermatocyte
(c) Quaternary spermatocyte
(d) None of the above

Q18. What would be the number of chromosomes in each spermatid?
(a) 46 (b) 23
(c) 92 (d) 20

Q19. The final release of the sperm cells from the seminiferous tubules is called.
(a) Spermiation (b) Spermiogenesis
(c) Both (a) and (b) (d) None of the above

Q20. Which part of the brain secretes the Gonadotropin Release hormone (GnRH)?
(a) Cerebellum (b) Cerebrum
(c) Hypothalamus (d) Medulla oblongata

Q21. Which of the following hormones stimulates the process of spermatogenesis?
(a) FSH (b) Androgens
(c) LH (d) All of the above

Q22. Which of the following part of the sperm helps in its fertilization with the ovum?
(a) Middle piece (b) Neck
(c) Acrosome (d) Tail

Q23. What is the number of primary follicles at the time of puberty in each ovary in a female?
(a) 10,000-80,000 (b) 20,000-80,000
(c) 40,000-80,000 (d) 60,000-80,000

Q24. Which of the following are gamete mother cells?
(a) Primary oocytes (b) Primary follicle
(c) Oogonia (d) Secondary follicles

Q25. The menstrual flow is the result of the breakdown of which of the following lining of the uterus?
(a) Perimetrium (b) Myometrium
(c) Endometrium (d) All of the above

Q26. Which of the following releases the secondary oocyte (ovum)?
(a) Zona pellucida (b) Graafian follicle
(c) Oogonia (d) All of the above

Q27. The first mensural cycle in a female is called as.
(a) Menopause (b) Menarche
(c) Both (a) and (b) (d) None of the above

Q28. At which of the following phase, the primary follicles in ovary grow to become fully mature Graafian follicles and simultaneously the endometrium of uterus regenerates through proliferation?
(a) Secretory phase
(b) Follicular phase
(c) Proliferative phase
(d) Both (b) and (c)

Q29. Which of the following hormones bring about changes in the ovary and the uterus?
(a) Pituitary hormone
(b) Ovarian hormone
(c) Luteinising hormone
(d) Both (a) and (b)

Q30. On which day, the LH and FSH hormone attain their peak level during the menstrual cycle?
(a) Day 12 (b) Day 13
(c) Day 14 (d) Day 15

Q31. Which of the following hormone maintains the endometrium?
(a) Progesterone
(b) Follicle stimulating hormone
(c) Luteinising hormone
(d) All of the above

Q32. At what age in females the menstrual cycle ceases?
(a) 45 (b) 47
(c) 48 (d) 50

Q33. In which part of the fallopian tube, fertilization takes place?
(a) Ampulla (b) Isthmus
(c) Infundibulum (d) Fimbriae

Q34. The embryo with 8 to 16 blastomeres is called.
(a) Trophoblast (b) Morula
(c) Blastocyst (d) All of the above

Q35. Implantation is when.
(a) Morula becomes embedded in the endometrium of the uterus
(b) Blastomeres becomes embedded in the endometrium of the uterus
(c) Blastocyst becomes embedded in the endometrium of the uterus
(d) Gametes becomes embedded in the endometrium of the uterus

Q36. Which of the following becomes interdigitated with each other to jointly form a structural and functional unit between the developing embryo and maternal body?
(a) Chronic villi (b) Uterine tissue
(c) Placenta (d) Both (a) and (b)

Q37. What is/are the functions of a placenta?
(a) Acts as an endocrine tissue
(b) Facilitates the supply of O2 and nutrients to the embryo
(c) Facilitates the removal of waste material from the embryo
(d) All of the above

Q38. As an endocrine tissue, which of the following hormones is secreted by the placenta?
(a) hCG (b) hPL
(c) Estrogen (d) All of the above

Q39. In which trimester the foetus develops major organs systems?
(a) First trimester (b) Second trimester
(c) Third trimester (d) All of the above

Q40. The process of delivery of foetus is called.
(a) Foetal ejection reflex
(b) Parturition
(c) Both (a) and (b)
(d) None of the above

Q41. Which of the following hormone acts on the uterine muscles and causes stronger uterine contractions for parturition to proceed?
(a) FSH (b) Oxytocin
(c) Vasopressin (d) LH

Q42. Which of the following are secondary sexual characteristics in females?
(a) Development of breasts
(b) Onset of menstrual cycle
(c) Development of hairs under armpits
(d) All of the above

Q43. Which of the following is correct about Graafian follicle?
(a) It converts into corpus luteum after ovulation
(b) It converts into corpus luteum after secretion of LH and FSH
(c) It converts into corpus luteum after formation of primary follicle
(d) It converts into corpus luteum after formation of secondary follicle

Q44. Which among the following is/are the phases of a menstrual cycle?
(a) Follicular phase (b) Secretory phase
(c) Proliferative phase (d) All of the above

Q45. Which part of the sperm plays an important role in the penetration of the egg membrane while fertilization?
(a) Tail (b) Acrosome
(c) Middle piece (d) All of the above

Q46. Which of the following follicles forms the mature Graafian follicle?
(a) Primary follicle
(b) Secondary follicle
(c) Tertiary follicle
(d) All of the above

Q47. After spermiogenesis is complete, in which of the following the sperm heads become embedded and get released finally from the semifereneous tubules?
(a) Interstitial cells
(b) Leydig cells
(c) Sertoli cells
(d) All of the above

Q48. Which of the following induces signals for parturition?
(a) Umbilical cord
(b) Placenta
(c) Fully developed foetus
(d) Both (b) and (c)

Q49. Which of the following is correct about the milk produced during the initial few days of lactation?
(a) It is called colostrum
(b) It contains antibodies that provide resistance to the new born
(c) It is yellow coloured liquid
(d) All of the above

Q50. Which of the following is correct about sex determination?
(a) It is the male who decides the sex of the child
(b) The males have XY chromosome
(c) The female has XX chromosome
(d) All of the above

ASSERTION AND REASON

Direction: in the following questions, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct option among a, b, c and d.

Q1. **Assertion (A):** In human beings, 23 pairs of chromosomes are present in diploid cells.
Reason (R): 22 pairs of chromosomes are equal in male and female but a pair sex chromosome is different in them.
(a) Both assertion (A)and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A)and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A)is true but reason(R) is false
(d) Assertion (A)is false but reason(R) is true

Q2. **Assertion (A):** Second trimester abortion are much more complicated
Reason (R): After 12 weeks the foetus becomes intimately associated with the maternal tissues.
(a) Both assertion (A)and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A)and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A)is true but reason(R) is false
(d) Assertion (A)is false but reason(R) is true

Q3. **Assertion (A):** A functional mammary gland is characteristic of all female mammals.
Reason (R): Mammary glands are the primary female sex organs.
(a) Both assertion (A)and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A)and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A)is true but reason(R) is false
(d) Assertion (A)is false but reason(R) is true

Q4. **Assertion (A):** Spermatogenesis starts at the age of puberty due to significant increase in the secretion of gonadotropin releasing hormone (GnRH).
Reason (R): GnRH is secreted from the pineal gland.
(a) Both assertion (A)and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A)and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A)is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

TRUE AND FALSE

Q1. During the menstrual cycle, the hormones LH and FSH attain a peak level in the middle of cycle (about 20th day).

Q2. The fluid filled cavity called antrum is found in the tertiary follicle.

Q3. The functions of male sex accessory ducts and glands are maintained by the testicular hormones oxytocin

Q4. The middle piece of the sperm acts as a powerhouse and helps in its motility that is important for fertilisation.

PRACTICE QUESTIONS

Q1. Vasa efferentia connect the.
(a) testis with epididymis
(b) kidney with urinary bladder
(c) testis with scrotal wall
(d) None of the above

Q2. Common duct formed by union of vas deferens and duct from seminal vesicle is.
(a) urethra (b) tunica vasculosa
(c) ejaculatory duct (d) spermatic duct

Q3. The functional unit of testis is.
(a) uriniferous tubules
(b) malpighian tubules
(c) seminiferous tubules
(d) acini or lobules

Q4. Seminiferous tubules are composed of.
(a) spermatogonia (b) glandular epithelium
(c) sensory epithelium (d) germinal epithelium

Q5. In human, the testes are located in.
(a) abdominal cavity
(b) thoracic cavity
(c) extra-abdominal cavity
(d) pericardial cavity

Q6. Fructose is present in the secretion of.
(a) seminal vesicle (b) perineal gland
(c) Cowper's gland (d) Bartholin's gland

Q7. A secondary sexual character of human female is.
(a) breasts (b) ovaries
(c) testes (d) thyroid gland

Q8. Eggs from ovary are released in.
(a) oviduct (b) kidney
(c) ureter (d) coelom

Q9. Lower narrow end of uterus is called as.
(a) urethra (b) cervix
(c) clitoris (d) vulva

Q10. Endometrium is lining of.
(a) testis (b) urinary bladder
(c) uterus (d) ureter

Q11. During differentiation, the spermatids remain associated with.
(a) Leydig's cells (b) Kupffer's cells
(c) spermatogonia (d) Sertoli cell

Q12. At the time of birth, egg is arrested in the form of.
(a) oogonia
(b) primary oocyte
(c) secondary oocytes
(d) ovum

Q13. How many testicular lobules are present in each testis?
(a) 100 (b) 150
(c) 250 (d) Infinite

Q14. In male, penis is covered by a loose fold of skin called as.
(a) foreskin (b) urethral meatus
(c) external genitalia (d) fimbriae

Q15. Which of the following is correct about ovulation?
(a) Release of secondary oocyte from ovary
(b) Release of primary oocyte from ovary
(c) Release of polar body
(d) Release of Graafian follicle

Q16. When do both LH & FSH attain a peak level in a menstrual cycle?
(a) In last week of the cycle
(b) In mid of the cycle
(c) During Initial days of cycle
(d) On 4th day of cycle

Q17. In which phase of menstrual cycle Graafian follicle is transformed into corpus luteum?
(a) Luteal phase
(b) Proliferative phase
(c) Follicular phase
(d) Growth phase

Q18. In human, fertilization takes place in.
(a) Cervix- isthmus junction
(b) ampulla-isthmus junction
(c) isthmus-cervix junction
(d) vagina-cervix junction

Q19. During Implantation, the blastocyst gets embedded in which layer of the uterus?
(a) Trophoblast (b) Endometrium
(c) Myometrium (d) Perimetrium

Q20. Function of placenta is to.
(a) supply O_2 to embryo
(b) removal CO_2 produced by the embryo
(c) produce several hormones
(d) All of the above

Q21. Stem cells are found in.
(a) inner cell mass (b) ectoderm
(c) endoderm (d) mesoderm

Q22. The first sign of growing foetus may be noticed by.
(a) listening to the heart sound carefully with the help of stethoscope
(b) appearance of hair
(c) appearance of head
(d) appearance of eye lids

Q23. Placenta contains.
(a) only chorionic villi
(b) only uterine tissue
(c) chorionic villi and uterine tissue
(d) trophoblast and chorionic villi

Q24. The average duration of human pregnancy is about nine months which is known as.
(a) gestation period (b) parturition
(c) lactation (d) implantation

Q25. Which gland of female human undergoes differentiation during pregnancy?
(a) Adrenal gland (b) Mammary gland
(c) Pituitary gland (d) Thymus gland

Q26. Correct order of spermatogenesis is.
(a) Spermatocytes, Spermatogonium, Spermatids, Sperms
(b) Spermatogonium, Spermatids, Spermatocytes, Sperms
(c) Spermatids, Spermatogonium, Spermatocytes, Sperms
(d) Spermatogonium, Primary Spermatocytes, Secondary Spermatocytes, Spermatids, Sperms

Q27. In a menstrual cycle, hormones start increasing in which order from the beginning of menstruation?
(a) FSH, progesterone, estrogen
(b) Estrogen, FSH, progesterone
(c) FSH, estrogen, progesterone
(d) Esterogen, progesterone, FSH

Q28. Polar bodies are produced during the formation of.
(a) sperms (b) oogonia
(c) spermatocytes (d) secondary oocytes

Q29. Puberty occurs in females at the age of.
(a) 8 - 10 years (b) 11-14 years
(c) 15-17 years (d) 18-20 years

Q30. Oxytocin helps in mainly.
(a) milk production (b) child birth
(c) urine formation (d) gametogenesis

ASSERTION AND REASON

Direction: in the following questions, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct option among a, b, c and d.

Q1. **Assertion (A):** The placenta facilitate the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo.
Reason (R): Placenta also acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q2. **Assertion (A):** The process of fusion of a sperm with an ovum is called fertilisation.
Reason (R): During fertilisation, a sperm comes in contact with the cells of the corona radiata of the ovum.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q3. **Assertion (A):** In human beings, menstrual cycles ceases around 40 years of age.
Reason (R): This is called as menopause.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

Q4. **Assertion (A):** The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis.
Reason (R): After spermiogenesis, sperm heads become embedded in the Sertoli cells.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

MULTIPLE CHOICE SOLUTIONS

S1. (b) Gametogenesis is the formation of gametes, fertilisation is the fusion of the male and the female gametes and gestation is the embryonic development.

S2. (d) testes are located outside the abdominal cavity within a pouch like structure called scrotum.

S3. (b) testes are located in the scrotum that helps in maintaining a low temperature usually 2-2.5 degrees lower than the internal body temperature that is necessary for spermatogenesis.

S4. (b) each testis has about 250 compartments that are called as testicular lobules.

S5. (a) Each testicular lobule contains 1-3 highly coiled tubules that are called as seminiferous tubules in which sperms are produced.

S6. (d) two types of cells line seminiferous tubules from inside, the Sertoli cells and the male germ cells (spermatogonia).

S7. (c) the male germ cells undergo meiotic division leading to sperm formation and the Sertoli cells provide nutrition to the developing germ cells.

S8. (c) the epididymis leads to vas deferens that ascends to the abdomen and loops over the urinary bladder, it receives a duct from the seminal vesicle and opens into the urethra as an ejaculatory duct that stores and transports the sperms from the testes to the outside through the urethra.

S9. (d) the male accessory glands constituting the seminal plasma.

S10. (d) secretions of the accessory glands constitute the seminal plasma which is rich in calcium, fructose, and some enzymes.

S11. (c) the female reproductive system consists of a pair of ovaries along with uterus, cervix, vagina and external genitalia, ovaries are the primary female sex organs that produce the female gamete ovum and several steroid hormones or the ovarian hormones.

S13. (d) All of the above three form the female accessory duct.

S14. (b) The edges of the infundibulum possess finger like projections called fimbriae that help in collection of the ovum after the ovulation is complete.

S15. (b) uterus is regarded as the womb which looks like an inverted pear.

S16. (c) perimetrium is the outer membranous layer, middle thick layer of smooth muscle is the myometrium and the inner glandular layer is the endometrium.

S16. (b) the spermatogonium is diploid and contains 46 chromosomes after the mitotic division.

S17. (a) the secondary spermatocytes have 23 chromosomes. The secondary spermatocytes undergo meiotic divisions to give rise to haploid spermatids.

S18. (b) The primary spermatocyte due to two reduction divisions produces 4-spermatids. As the cellular division and DNA replication occurs once and the reduction division twice, the number of chromosomes in spermatids would be 23.

S19. (a) after spermiogenesis is complete, the sperm has become embedded in the Sertoli cells and are finally released from the semiferenous tubules and the process is called as spermiation.

S20. (c) GnRH is secreted by the hypothalamus and its increased concentration acts at the anterior pituitary to secrete two gonadotrophins, LH and FSH

S21. (b) Androgens is secreted by the Leydig cells on being acted upon by the luteinising hormone that stimulates the process of spermatogenesis.

S22. (c) sperm head contains nucleus, its anterior portion is covered by a cap like structure that is called the acrosome, it is filled with enzymes that help in fertilization of the ovum.

S23. (d) most of the primary follicles get degenerated during the phase from the birth to puberty, at the time of puberty only 60,000 to 80,000 primary follicles are left in each ovary.

S24. (c) millions of gamete mother cells called oogonia are formed within each fetal ovary, no more are added after birth. These cells start the division and enter prophase 1 of the meiotic division and get temporarily arrested at that stage and is called the primary oocyte.

S25. (c) The endometrial lining of the uterus along with the blood vessels in the form of liquid comes out of the vagina in the form of menstrual flow.

S26. (b) the tertiary follicle changes into the mature follicle or the Graafian follicle, this Graafian follicle ruptures to release the secondary oocyte or the ovum from the ovary by the process called ovulation.

S27. (b) the first menstruation begins at puberty and is called menarch, in human female menstruation is repeated at an average interval of 28 to 29 days and the cycle of events starting from one mensuration till the next one is called the menstrual cycle.

S28. (d) the menstrual phase follows the follicular phase, during this phase the primary follicles grow and attain maturity and simultaneously the endometrium of the uterus also regenerates.

S29. (d) the events during the menstrual cycle and its phases the follicular phase, the luteal phase and then next cycle to begin, all these changes and the changes in the ovary are governed by two hormones namely the pituitary hormone and the ovarian hormone.

S30. (c) the secretions of gonadotropins LH and FSH increases gradually during the follicular phase and stimulates follicular development as well as secretion of estrogens and the growing follicles, the peak level of LH and FSH is attained in the middle of the cycle that is the 14th day.

S31. (a) Corpus luteum secretes large amounts of progesterone which is essential for maintaining of the endometrium.

S32. (d) at the age of 50 the menstrual cycle ceases and that is termed as menopause.

S33. (a) motile sperms swim rapidly through the cervix and enter into the uterus and finally reach the ampullary region of the fallopian tube, the ovum released by the ovary is also transported to the ampullary region where fertilization takes place.

S34. (b) the morula divides and transform into blastocyst as it moves towards the uterus, the blastomeres in the blastocyst are arranged into an outer layer called trophoblast and inner group of cells attached to the trophoblast called the inner cell mass.

S35. (c) the blastocyst after rapid divisions becomes embedded in the endometrium of the uterus, this is called implantation and leads to pregnancy.

S36. (d) the chronic villi and uterine tissue become interdigitated with each other to form placenta that facilitates the supply of oxygen and nutrients to the embryo and also help in removal of carbon dioxide and waste materials produced by the embryo.

S37. (d) the placenta is connected to the embryo through an umbilical cord that helps in the transport of substances to and from the embryo.

S38. (d) secretion of these hormones along with oestrogen and progesterone cortisol, prolactin, thyroxin are essential for supporting the foetal growth, metabolic changes in the mother and maintenance of pregnancy.

S39. (a) by the end of the first trimester, after 12 weeks, most of the major organ system are formed.

S40. (b) Parturition is induced by a complex neuroendocrine mechanism, the signals of parturition originate from the fully developed foetus and the placenta which induce mild uterine contraction called foetal ejection reflex.

S41. (b) Oxytocin acts on the uterine muscles and causes stronger uterine contractions which in turn stimulate more secretion of oxytocin, the stimulatory reflex between the uterine contraction and oxytocin secretion leads to continuous secretion of oxytocin resulting in stronger and stronger contraction, this leads to expulsion of the baby out of the uterus through the birth canal.

S42. (d) Secondary sexual characters in females start to arrive at an age of 13 and is hormone induced.

S43. (a) The tertiary follicle gets matured and changes into Graafian follicle that after secretion of various hormones converts into Graafian follicle after ovulation.

S44. (d) Follicular phase is also called as proliferative phase, secretory phase is also called as luteal phase.

S45. (b) the acrosome region is filled with enzymes that help fertilization of the ovum.

S46. (c) it is the tertiary follicle that changes into mature follicle or the Graafian follicle.

S47. (c) after spermiogenesis, the sperm becomes embedded in the Sertoli cells so that they get finally released from the seminifereneous tubules by the process of spermiation.

S48. (d) pasteurization is induced by a complex neuroendocrine mechanism, the signals for pasteurization originate from the fully developed foetus and the placenta which induce mild uterine contraction called foetal ejection reflex.

S49. (d) the mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of the pregnancy by the process called lactation.

S50. (d) all females have sex chromosome X whereas the male has sex chromosome X or Y, hence 50% carry X chromosome while the other 50% carry Y chromosome, after fusion of male and female gametes if the zygote has XX then it will develop in female and if there is XY then it will be a male child.

ASSERTION AND REASON

S1. (a) In males the sex chromosome is XY and in females it is XX.

S2. (a) MTP is safe upto 12 weeks (first trimester) of pregnancy. It becomes risky after the first trimester of pregnancy as the foetus becomes intimately associated with the maternal tissues.

S3. (c) A functional mammary gland is characteristic of all female mammals, but they are not the primary female sex organs, Ovaries are the primary female sex organs that produce the female gamete (ovum) and several steroid hormones (ovarian hormones).

S4. (c) Spermatogenesis starts at the age of puberty due to significant increase in the secretion of gonadotropin releasing hormone (GnRH) and it is a hypothalamic hormone.

TRUE AND FALSE

S1. False During the menstrual cycle, the hormones LH and FSH attain a peak level in the middle of cycle (about 14th day).

S2. True

S3. False The functions of male sex accessory ducts and glands are maintained by the testicular hormones androgens. Oxytocin is secreted in females during foetal ejection reflex.

S4. True The middle piece of the sperm possesses numerous mitochondria, which produce energy for the movement of tail that facilitate sperm motility essential for fertilization

PRACTICE QUESTIONS SOLUTIONS

S1. (a) The vasa efferentia opens into the epididymis which continues to form the vas deferens. Vas deferens transfers the sperms mixed with semen to the ejaculatory duct. So vasa efferentia is the connecting link between testis and epididymis.

S2. (c) The epididymis leads to vas deferens, that ascends to the abdomen and loops over the urinary bladder. It receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct. These ducts store and transport the sperms from the testis to the outside through urethra. The urethra originates from the urinary bladder and extends through the penis to its external opening called as urethral meatus.

S3. (c) Seminiferous tubule is the functional unit of testis of man. Each testis has about 250 compartments called testicular lobules, these compartments contain highly coiled tubules called seminiferous tubules.

S4. (d) Seminiferous tubules are located within the testes and are the specific location for meiosis and the spermatozoa formation. The wall of the seminiferous tubules is called germinal epithelium.

S5. (c) In mammals, the testes are situated outside the abdominal cavity within a pouch, called as the scrotum

S6. (a) Sugar fructose is present in the secretion of the seminal vesicle. Fructose is an energy source used by sperm.

S7. (a) Estrogens contribute to the development of the female secondary sex characterstics and stimulate the development of the mammary glands/breasts.

S8. (a) Eggs are formed in the primary sex organ i.e., the ovary. From the ovary, they are taken up by the fimbriae of the fallopian tube which is also known as the oviduct. The fimbriae pass the egg to the isthmus and then to the ampulla of the fallopian tube where fertilization takes place.

S9. (b) Cervix is terminal narrow portion of the uterus.

S10. (c) The endometrium is an inner lining made up of epithelial cells in the uterus that has a lower layer and an active layer; the active layer thickens and is pulled during the menstrual cycle.

S11. (d) the male germ cells undergo meiotic divisions which finally forms the sperm, while Sertoli cells provide nutrition to the germ cells.

S12. (b) Oogenesis is initiated during the embryonic development stage when oogonia are formed within each fetal ovary. These cells start division and enter into prophase-I of the meiotic division and get temporarily arrested at that stage, called as primary oocytes.

S13. (c) Each testis has 250 compartment called testicular lobules.

S14. (a) **External genitalia** is the penis. It is made up of special erectile tissue that helps in erection of the penis. The enlarged tip of the penis is called glans penis. It is covered by a loose fold of skin called **foreskin** or **prepuce.**

S15. (a) The process of release of egg is called as ovulation. During menstruation cycle in human females, the primary oocyte within the tertiary follicle grows in size and completes its first meiotic division. It is an unequal division resulting in the formation of a large haploid secondary oocyte and a tiny first polar body. The secondary oocyte retains the bulk of the nutrient rich cytoplasm of the primary oocyte. The tertiary follicle further changes into the mature follicle or Graafian follicle. The secondary oocyte forms a new membrane called as zona pellucida surrounding it. The Graafian follicle now ruptures to release the secondary oocyte (ovum) from the ovary by the process called as ovulation.

S16. (b) The level of different hormones control the processes and phases in the menstrual cycle. The level of FSH and LH is at the highest level at the middle of the menstrual cycle.

S17. (a) In the secreatory or the luteal phase the corpus luteum secretes large amount of progestosterone that stimulates the uterine glands to produce increase amount of mucus. In absence of fertilisation, the corpus luteum degenerates and this causes the endothelium disintegration leading to mensturation.

S18. (b) The ovum which is released after ovulation reaches the ampullary istmic junction where fertilisation occurs between sperm and the ovum. Hence, fertilisation occurs in the ampullary isthmic junction of fallopian tube.

S19. (b) The outer wall of the blastocyst that is the trophoblast gets attached to the endometrium of the uterus during implantation.

S20. (d) The major function of placenta is to provide nutrition and supply oxygen to the growing embryo and facilitates the removal of carbon dioxide and waste products by diffusion. The placenta also secretes hormones like estrogen.

S21. (a) The inner mass cells differentiate into ectoderm endoderm and mesoderm. The inner mass cells contain stem cells which have the capacity to give rise to all the tissues and org

S22. (a) Growing human develops heart at a very early stage around the fifth week of the gestation period and it started working so it is very common that heartbeat is detected and it is considered as the growth sign.

S23. (c) The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body called placenta

S24. (a) The duration between the conception and birth during which embryo or foetus develops in the uterus is called gestation.

S25. (b) The mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called lactation.

S26. (d) In testis, the immature male germ cells (spermatogonia) produce sperms by spermatogenesis, that begins at puberty. The spermatogonia (singular spermatogonium) present on the inside wall of seminiferous tubules, multiply by mitotic division and increase in numbers. Each spermatogonium is called as primary spermatocytes periodically undergo first meiotic division (reduction division) and produces two equal, haploid cells, called secondary spermatocytes, which have only 23 chromosomes each. The secondary spermatocytes

undergo the second meiotic division to produce four equal, haploid spermatids. The spermatids are then transformed into spermatozoa (sperms) by the process called spermiogenesis. After spermiogenesis, mature sperms are finally released from the seminiferous tubules by the process called as spermiation.

S27. (c) The end of menstruation is marked by the gradual increase in the level of estrogen (occurring during the follicular phase which starts at day 1 of menstruation and ends at ovulation) due to which the blood flow stops and the lining of endometrium thickens. During the follicular phase, FSH is released to stimulate the release of around 5-20 follicles (this occurs at around day 10 of a 28 days cycle). Among them, only a single follicle contains the immature egg the release of which is stimulated by another hormone called the LH. This is called the ovulatory phase (usually occurring at around day 14). The follicle has to rupture to release the egg. This ruptured follicle (called the corpus luteum then remains to release progesterone and small amounts of estrogen for the maintenance of the lining of the uterus for implantation.

S28. (d) The secondary oocyte is haploid. The second meiotic division progresses to the metaphase, but does not continue until a sperm fuses with the oocyte. During fertilization, the secondary oocyte undergoes the second meiotic division producing a large cell, the ovum, and a second polar body. Therefore, the first polar body is produced during the formation of the secondary oocyte.

S29. (b) Puberty is the stage of achieving the maturation and fertility. This occurs both to males and females. This happens due to the change in the both environmental and genetic changes in the body. Puberty occurs at the age of 11-14 in females and 12-16 in males.

S30. (b)

ASSERTION AND REASON

S1. (a)

S2. (c) The process of fusion of a sperm with an ovum is called fertilisation. During fertilisation, a sperm comes in contact with zona pellucida layer of the ovum.

S3. (c) In human beings, menstrual cycles ceases around 50 years of age. This is called as menopause.

S4. (a)