

Human Reproduction

Humans are **viviparous** organisms that reproduce sexually and give birth to offspring. They are unisexual, meaning that male and female sexes are distinct.

Human Reproductive Organs

Human reproductive organs can be categorized into **primary** and **secondary sex organs**. Primary sex organs generate gametes and sex hormones, while secondary sex organs have a significant role in reproduction.

Male reproductive system

It is mainly located in the pelvis region and comprises of **primary sex organs**, **secondary sex organs** and **accessory glands**.

Primary sex organs consist

Testes: The testes are a male reproductive gland that produces sperm and male sex hormones.

They are located outside the abdominal cavity within the scrotum, which provides an optimal environment for sperm production.

The testes is composed 200- 300 compartments called testicular lobules, each testicular lobule 2-3 seminiferous tubules that are responsible for the production of sperm cells.

Scrotum:

The scrotum is a sac-like structure that contains the **testes**.

It is located outside the body cavity and is situated between the penis and the anus.

The **scrotum** provides a thermoregulatory function by adjusting the temperature 2- 3 degree lower than the normal body temperature to ensure optimal sperm production.

It Is also involved in protecting the testes from physical damage.

Seminiferous tubules:

The seminiferous tubules, as the primary site of sperm production, play a crucial role in male fertility. **Sertoli cells** provide structural support and nourishment to developing sperm cells, while **Leydig cells** secrete androgens, such as testosterone, which is essential for the development and maintenance of male reproductive structures and sexual characteristics.

They are responsible for the production of sperm cells through a process called spermatogenesis.

Spermatogenesis involves the division and differentiation of cells, resulting in the production of mature sperm cells.

The seminiferous tubules are also involved in the secretion of hormones, such as testosterone, which are important for male sexual development and function.

Secondary sex organs

Secondary sex organs consist of the following organs

The tubuli recti are straight tubules which join at the end of seminiferous tubules. These open into a network of wider irregular tubules called *rete testis* which opens in *vasa efferentia*. It opens into epididymis and carries sperms outside the body.

Epididymis is a mass of long narrow closely coiled tubules lying along the inner side of each testis. It temporarily stores immature sperms. It helps the sperms in attaining maturity, acquiring increased motility and fertilising capacity.

Vasa deferentia emerges from cauda epididymis on each side, leaves the scrotal sac and enters the abdominal cavity through inguinal canal.

Ejaculatory ducts are two short tubes each formed by the union of the duct from a seminal vesicle and a vas deferens.

Urethra provides a common pathway for the flow of urine and semen.

Accessory glands

Male accessory glands are of two types, the **prostate gland** and **seminal vesicles**, that secrete fluids that mix with sperm to create semen. The prostate gland secretes a slightly acidic, milky secretion that makes up 20-30% of semen volume and contains lipids, enzymes, citric acid, and other substances. The seminal vesicles secrete a watery alkaline fluid that contains fructose, which provides energy for the sperm, and prostaglandins that stimulate uterine contractions for sperm movement. The **bulbourethral gland** secretes mucus and an alkaline fluid that helps to lubricate the penis and neutralize acidic urine in the urethra.

External genitalia : It is the male copulatory organ, includes **penis**.

Female reproductive system

The female reproductive system is located in the pelvic cavity and is composed of several organs that work together to produce and support the development of offspring. The following are the organs of the female reproductive system:

A. Primary sex organs:

The **ovaries** are the primary sex organs in women. They produce female gametes (ovum) and several female hormones, known as **ovarian hormones**. The ovaries are attached to the broad ligament of the uterus by a double-layered fold of peritoneum called **mesovarium**. The ovaries are covered by cubical epithelium, known as germinal epithelium, which encloses the ovarian stroma and is divided into two zones: the peripheral cortex and inner medulla.

B. Secondary sex organs:

The secondary sex organs consist of the following organs:

- (i) **Fallopian tubes (oviducts)** are 10-12 cm long and consist of four parts: infundibulum, **ampulla**, **isthmus**, and **uterine** part. The infundibulum is broad and funnel-shaped with finger-like projections called fimbriae. The **ampulla** is the widest and longest part of the Fallopian tube. The **isthmus** is a short, narrow, and thick-walled portion that follows the ampulla. The **uterine** part passes through the uterine wall and communicates with the uterine cavity.
- (ii) The **uterus** is 7.5 cm long and 5 cm wide, shaped like an inverted pear. It lies between the urinary bladder and rectum and receives the ovum from the Fallopian tube. It forms the placenta for the development of the foetus. The cervix is a narrow opening of the uterus into the vagina.
- (iii) The **vagina** is about 10 cm long and is adapted for receiving the male penis during copulation, allowing menstrual flow, and serving as a birth canal during parturition.

C. Accessory glands:

The female reproductive system also contains a pair of *Bartholin's glands*, located on each side of the vaginal orifice. They secrete a clear and viscous fluid under sexual excitement, serving as lubrication during copulation.

D. Mammary glands:

Mammary glands are paired structures known as breasts in females. They are rounded paired structures located over the pectoral muscles on the front wall of the thorax. Each breast contains glandular tissue divided into 15-20 mammary lobes containing clusters of mammary alveoli, which open into mammary tubules. Each breast also contains a nipple in the middle, surrounded by a circular and pigmented area called the *areola*.

E. External genitalia:

The external genitalia are collectively known as the vulva, which consists of the *mons pubis*, *clitoris*, and *hymen*.

Gametogenesis

Gametogenesis is the process by which haploid gametes, necessary for sexual reproduction, are formed from undifferentiated diploid germ cells in the gonads.

There are two types of gametogenesis – *spermatogenesis* in males and *oogenesis* in females.

Spermatogenesis occurs in the testes and involves the following stages:

Multiplication phase: Undifferentiated germ cells present on the inner wall of the seminiferous tubules of the testes undergo repeated mitotic divisions to increase in number.

Growth phase: Some of the spermatogonia differentiate into primary spermatocytes.

Maturation phase: Each primary spermatocyte undergoes meiosis I and produces two secondary spermatocytes, each with 23 chromosomes. The secondary spermatocytes undergo meiosis II to produce haploid spermatids. The spermatids then transform into spermatozoa (sperms) through a process called *spermiogenesis*.

Differentiation phase: After spermiogenesis, the sperms get embedded in *Sertoli cells* and are finally released from the seminiferous tubules through *spermiation*.

Structure of sperm

The structure of sperm can be described as follows:

Head: The head of the sperm is oval-shaped and contains genetic material in the form of chromosomes. The head is covered by an **acrosome**, which is a cap-like structure that contains hydrolytic enzymes that help in sperm penetration during fertilization.

Neck: The neck is a narrow region that connects the head to the middle piece.

Middle piece: The middle piece is the longest part of the sperm and contains many mitochondria, which provide energy for movement. The middle piece also contains a flagellum, which is a long, whip-like tail that helps the sperm to swim.

Tail: The tail of the sperm is the longest part of the cell and is responsible for the sperm's motility. The tail contains the axoneme, which is a series of microtubules that extend from the middle piece to the end of the tail.

Overall, the structure of the sperm is specialized for swimming through the female reproductive tract in order to fertilize an egg.

Oogenesis

Oogenesis is the process of formation of female gametes, called **ova** or **eggs**.

It starts during foetal development when the primordial germ cells (PGCs) migrate to the developing ovary and differentiate into **oogonia**.

Oogonia undergo mitotic divisions to produce **primary oocytes**, which are arrested in the first meiotic prophase until puberty.

At puberty, one **primary oocyte** is selected each month to resume meiosis and complete the first meiotic division, producing a secondary oocyte and a polar body.

The **secondary oocyte** is ovulated and enters the fallopian tube, where it may be fertilized by a sperm.

If fertilization occurs, the secondary oocyte completes the second meiotic division, producing a **haploid ovum** and a **second polar body**.

The ovum contains a nucleus with 23 chromosomes and the cytoplasm with various organelles, including the mitochondria and ribosomes.

The cytoplasm of the ovum also contains nutrients and proteins needed for the early development of the embryo.

If fertilization does not occur, the secondary oocyte and the polar body degenerate and are expelled from the body during menstruation.

Unlike spermatogenesis, which continues throughout the male's reproductive life, oogenesis is a limited process and ends at menopause when the supply of primary oocytes is exhausted.

Menstrual cycle

Menstrual cycle is a physiological process that occurs in females and involves a series of changes in the reproductive system, resulting in the shedding of the uterine lining.

The menstrual cycle is controlled by hormones, mainly *estrogen* and *progesterone*, which are secreted by the ovaries.

The menstrual cycle is divided into **three** phases: the *follicular phase*, the *ovulatory phase*, and the *luteal phase*.

The *follicular phase* is the first phase of the menstrual cycle and lasts from the first day of menstruation until ovulation. During this phase, the *follicle-stimulating hormone (FSH)* and *luteinizing hormone (LH)* stimulate the follicles in the ovaries to mature and prepare for ovulation.

The *ovulatory phase* is the second phase of the menstrual cycle and lasts for about 24 hours. It is during this phase that a mature egg is released from the ovary into the fallopian tube, ready for fertilization.

The *luteal phase* is the third and final phase of the menstrual cycle and lasts from ovulation until the next menstrual period. During this phase, the follicle that released the egg turns into a corpus luteum, which produces progesterone and prepares the uterus for pregnancy.

If fertilization does not occur, the corpus luteum degenerates, causing the progesterone levels to drop, and the lining of the uterus is shed, resulting in menstruation.

The menstrual cycle usually lasts around 28 days, but it can vary from 21 to 35 days, and the duration of menstruation can also vary from 2 to 7 days.

Menstrual cycle can be affected by various factors, such as stress, hormonal imbalances, age, and certain medical conditions.

Keeping track of menstrual cycles can help in predicting ovulation and in identifying any irregularities or abnormalities in the cycle, which may require medical attention.

Fertilization

Fertilisation occurs at the junction of the ampulla and isthmus in the Fallopian tube. This process involves the fusion of a *sperm* with an *ovum* resulting in the formation of a zygote with a diploid number of chromosomes (2n).

Implantation

Implantation is a critical stage in the development of an embryo. After fertilization, the zygote undergoes meiotic division as it travels through the oviduct towards the uterus. This process is called *cleavage*, and it results in the formation of daughter cells known as *blastomeres*. These blastomeres continue to divide and eventually form a *morula*, which is a cluster of 32 cells.

The **morula** then undergoes a transformation process called ***blastulation***, where it develops into a blastocyst with around 8-16 ***blastomeres***. The outer layer of blastomeres in the blastocyst is known as the **trophoblast**, while the inner group of cells is called the **inner cell mass**.

Finally, the blastocyst, now consisting of 64 cells, implants itself into the endometrium of the uterus. This process is called ***implantation*** and is the start of pregnancy.

Placenta

The placenta is a temporary organ that develops during pregnancy, and it plays a crucial role in nourishing the developing fetus.

Here are some key points about the placenta:

1. The placenta forms in the early stages of pregnancy and is fully developed by the end of the first trimester.
2. The placenta connects the developing foetus to the uterine wall and allows for the exchange of nutrients, oxygen, and waste products between the mother and the foetus.
3. The placenta also produces hormones that help regulate the mother's metabolism and prepare her body for the demands of pregnancy and childbirth.
4. The structure of the placenta includes fetal blood vessels, which are surrounded by a network of maternal blood vessels.
5. The placenta is usually expelled from the mother's body shortly after the baby is born.

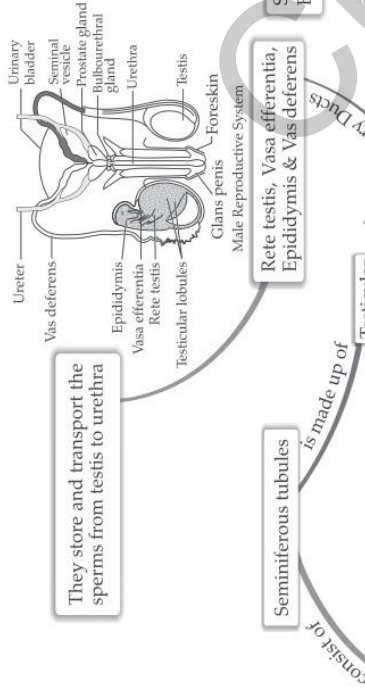
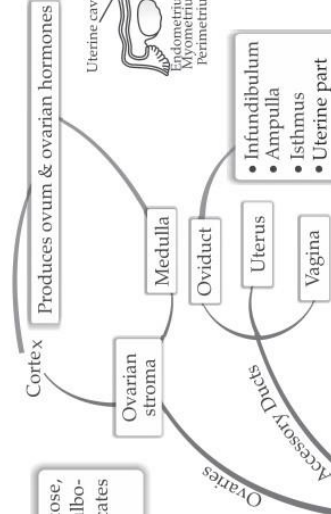
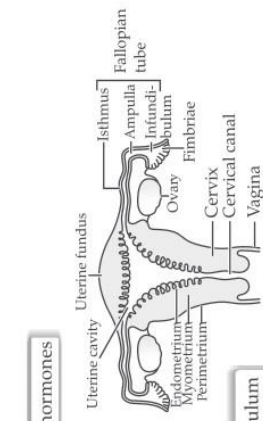
Embryonic development

During ***embryonic development***, the inner cell mass of the blastula undergoes differentiation into an outer layer known as **ectoderm** and an inner layer known as **endoderm**, while **mesoderm** develops in between. Notably, organs such as the kidney, heart, gonads, and blood originate from the mesodermal layer, while all three layers give rise to tissues and organs. By the end of the nine months of pregnancy, the fetus is fully developed and ready for delivery.

In addition to the embryo, there are also **extraembryonic membranes**, which are thin protective layers that enclose the embryo inside the uterus. These four layers, namely the ***amnion***, ***yolk sac***, ***allantois***, and ***chorion***, play various roles, with the chorion being the outermost layer that helps in the formation of the placenta and attachment of the embryonic blastula to the uterine wall.

Parturition

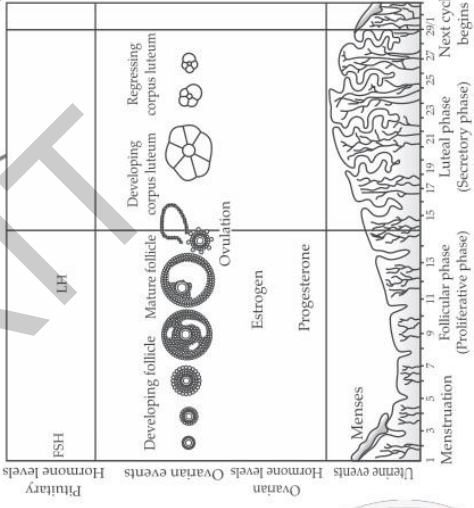
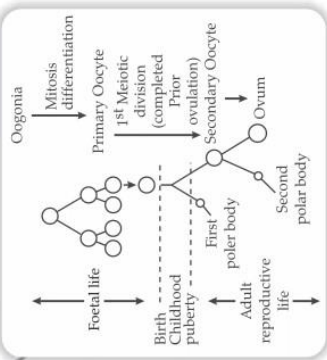
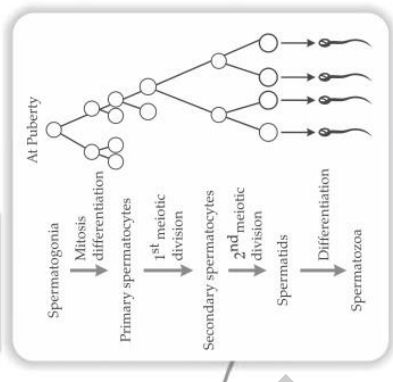
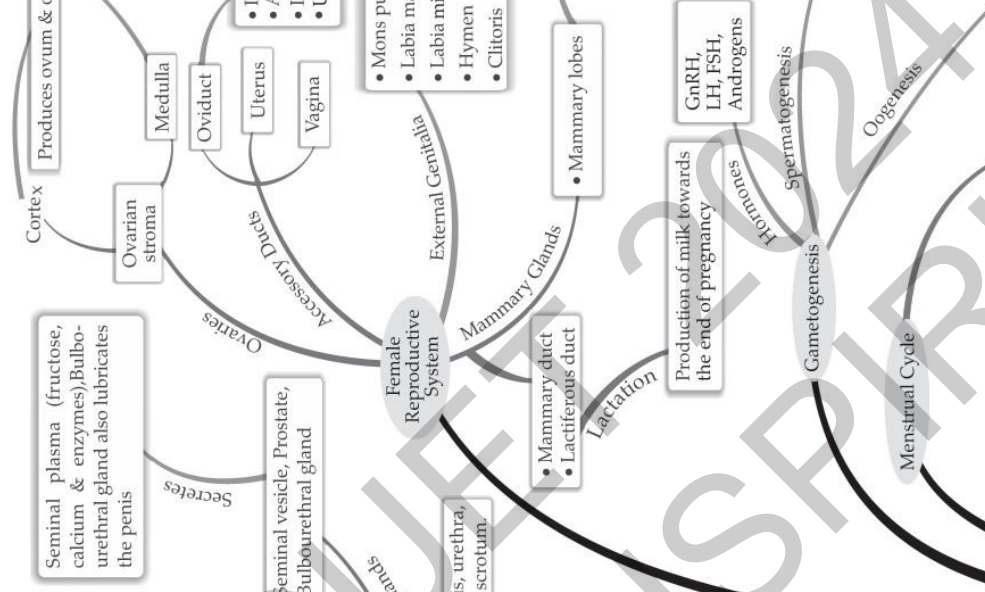
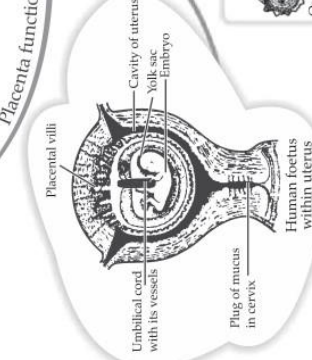
Parturition, the process of delivering the fetus, is induced by a complex neuroendocrine mechanism, with the oxytocin hormone produced due to fetal-ejection reflexes. After birth, ***lactation*** occurs, which refers to the production and release of milk by the mammary glands of the female. The first milk, known as ***colostrum***, is rich in proteins, energy, and antibodies like IgA, providing passive immunity to the new born.



Spermatogonia : forms sperms through meiotic divisions.
Sertoli cells : provide nutrition to germ cells.
Leydig cells : synthesise & secrete androgens

Oxytocin Hormone
 Process of giving birth to young ones after gestation period

Placenta function
 • Transports substances and gases to and from the embryo.
 • Produces hormones hCG, hPL, estrogens, progesterogens, relaxin

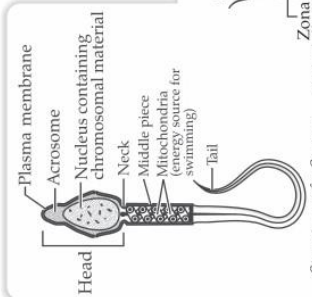
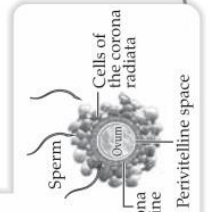
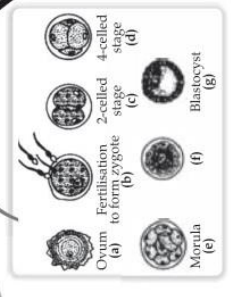


Trace the Mind Map

• First Level • Second Level • Third Level



Fertilisation
 Fusion between sperm and ova to form zygote



Practice Questions

1. Which structure suspends the testes outside the abdominal cavity?

- (a) Tunica albuginea (b) Inguinal canal (c) Epididymis (d) Scrotum

2. What is the function of the scrotum?

- (a) To maintain the temperature of the testes (b) To regulate body temperature
(c) To regulate the level of growth hormone (d) To regulate the level of male hormone

3. What is the approximate length and width of the testes?

- (a) 4-5 cm and 2-3 cm (b) 5-6 cm and 3-4 cm
(c) 6-7 cm and 4-5 cm (d) 7-8 cm and 8-9 cm

4. What are the compartments in mammalian testes called?

- (a) Testicular lobules (b) Seminiferous tubules
(c) Sertoli cells (d) Interstitial cells

5. How many seminiferous tubules are present in a testicular lobule?

- (a) 3-5 (b) 22-6 (c) 5-7 (d) 1-3

6. What lines the inside of the seminiferous tubules in the testis?

- (a) Spermatocytes (b) Spermatogonia (c) Sertoli cells (d) Both (b) and (c)

7. Which cells provide nutrition to the male germ cells?

- (a) Interstitial cells (b) Leydig cells (c) Sertoli cells (d) Both (a) and (b)

8. Which cells in the mammalian testes form sperm?

- (a) Leydig cells (b) Spermatogonia (c) Interstitial cells (d) Sertoli cells

9. What is the region outside the seminiferous tubules called?

- (a) Interdigital space (b) Interfibrous space (c) Interstitial space (d) Blind space

10. Which accessory glands are found in males?

- (a) Seminal vesicles (b) Prostate gland
(c) Bulbourethral gland (d) All of the above

11. What is the approximate length of the human Fallopian tube?

- (a) 8-9 cm long (b) 9-10 cm long (c) 10-12 cm long (d) 12-17 cm long

12. What is the funnel-shaped part of the oviduct closer to the ovary called?

- (a) Fimbriae (b) Infundibulum (c) Ampulla (d) Isthmus

13. What is the main function of the fimbriae of the Fallopian tube?

- (a) To help in the development of the ovary
(b) To help in the collection of the ovum after ovulation
(c) To help in the development of ova
(d) To help in fertilization

14. Which of the following pairs is incorrect?

- (a) Finger-like projections – Fimbriae (b) Narrow part of oviduct – Ampulla
(c) Part of oviduct joining the uterus – Isthmus (d) None of the above

15. Which of the following pairs is incorrect?

- (a) Cushion of fatty tissue covered by pubic hair – Mons pubis
(b) Membrane covering opening of the vagina – Hymen
(c) Finger-like structure above the urethral opening – Clitoris
(d) Uterine layer exhibiting strong contraction during delivery – Endometrium

16. In an ideal menstrual cycle, how long does the menstrual phase typically last?

- a) 3-5 days b) 5-6 days c) 1-3 days d) 2-3 days

17. A regular cycling woman is not menstruating, what is the most likely root cause?

- a) Maintenance of the hypertrophical endometrial lining
b) Maintenance of high concentration of sex-hormones in the bloodstream
c) Regression of well-developed corpus luteum
d) Fertilisation of the ovum

18. What happens during the follicular phase of the menstrual cycle?

- a) Proliferation of endometrium b) Reduction in blood supply to endometrium
c) Regression of endometrium d) No effect on endometrium

19. When does ovulation occur in a healthy menstruating female?

- a) 9-14 days b) 14-16 days c) 16-28 days d) 20-26 days

20. Rapid secretion of LH in ovulatory phase causes

- a) Rupturing of Graafian follicle b) Release of ova
c) Ovulation d) All of the above

21. Every time copulation does not lead to fertilisation and pregnancy because of failure of sperm to reach the

- a) Ampulla b) Cervix c) Endometrium d) Myometrium

22. Which of the following phases of the menstrual cycle is characterized by the shedding of the endometrial lining?

- a) Menstrual phase b) Follicular phase
c) Luteal phase d) Ovulatory phase

23. Which hormone is primarily responsible for thickening the endometrial lining during the menstrual cycle?

- a) Luteinizing hormone (LH)
- b) Follicle-stimulating hormone (FSH)
- c) Estrogen
- d) Progesterone

24. Which phase of the menstrual cycle immediately follows ovulation?

- a) Menstrual phase
- b) Follicular phase
- c) Luteal phase
- d) Ovulatory phase

25. Which of the following hormones surges just prior to ovulation?

- a) Luteinizing hormone (LH)
- b) Follicle-stimulating hormone (FSH)
- c) Estrogen
- d) Progesterone

26. Which phase of the menstrual cycle is the most variable in terms of its duration?

- a) Menstrual phase
- b) Follicular phase
- c) Luteal phase
- d) Ovulatory phase

27. What is the average length of a menstrual cycle?

- a) 21 days
- b) 28 days
- c) 35 days
- d) 42 days

28. The corpus luteum is formed from the remnants of the

- (a) ovarian follicle
- (b) oocyte
- (c) Graafian follicle
- (d) zygote

29. Which hormone is responsible for maintaining the endometrial lining during early pregnancy?

- (a) FSH
- (b) LH
- (c) hCG
- (d) estrogen

30. Spermatogenesis occurs in which part of the male reproductive system?

- (a) Epididymis
- (b) Vas deferens
- (c) Seminiferous tubules
- (d) Prostate gland

31. Which hormone is responsible for the development of secondary sexual characteristics in males?

- (a) Testosterone (b) Estrogen (c) Progesterone (d) FSH

32. The fertilized egg is called a

- (a) Ovum (b) Zygote (c) Blastocyst (d) Embryo

33. The placenta is responsible for

- (a) production of hormones
(b) exchange of nutrients and waste between the mother and fetus
(c) protection of the developing fetus
(d) all of the above

34. The hormone responsible for milk production in the mammary glands is

- (a) Prolactin (b) Estrogen (c) Progesterone (d) Oxytocin

35. Menstruation occurs due to

- (a) fertilization of the egg (b) shedding of the endometrial lining
(c) formation of the corpus luteum (d) implantation of the blastocyst

36. Correct sequence of hormone from beginning of menstrual cycle to the end is

- a) FSH, progesterone, LH b) Oestrogen, FSH and progesterone
c) FSH, oestrogen, progesterone d) Oestrogen, progesterone, FSH

37. Which of the following is incorrectly matched?

- a) Rabbit – Microlecithal, isolecithal b) Frog – Mesolecithal, telolecithal
c) Human – Mesolecithal, centrolecithal d) Birds – Macrolecithal, telolecithal

38.Capacitation takes place in

- a)12 hrs b)10 hrs c)8 hrs d)6 hrs

39.Grey crescent is the area

- a)At the point of entry of sperm into ovum
b)Just opposite to the site of entry of sperm into ovum
c)At the animal pole
d)At the vegetal pole

40.Both corpus luteum and macula lutea are

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

41.In human beings

- a)Chorion and amnion are well developed b)Allantois and yolk sac are less developed
c)Yolk cell have very little yolk d)All of the above

42.The part of fallopian tube closest to the ovary is

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

43.Human male ejaculates ...A... to ...B... million sperm. Atleast ...C... should have normal shape and size and ...D... should show vigorous motility. Here A, B, C and D refers to

- A) A-100, B-200, C-30%, D-40%
b) A-200, B-300, C-60%, D-40%
c) A-300, B-400, C-60%, D-40%
d) A-400, B-500, C-60%, D-40%

44. Acrosome secretes

- a) Hyaluronic acid b) Hyaluronidase c) TSH d) Fertilizin

45. Identical twins are

- a) Monozygotic b) Isozygotic c) Bizygotic d) All of these

46. If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from

- a) Epididymis to vas deferens b) Ovary to uterus
c) Vagina to uterus d) Testes to epididymis

47. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency?

- a) Luteinizing hormone – failure of ovulation
b) Insulin - Diabetes insipidus
c) Thyroxine - Tetany
d) Parathyroid hormone - Diabetes mellitus

48. During embryonic development, endoskeleton and muscle develop from which germinal layer?

- a) Ectoderm b) Endoderm c) Mesoderm d) Blastopore

49. Eggs which have yolk in the center surrounded by cytoplasm are called

- a) Centrolecithal b) Homolecithal c) Microlecithal d) Alecithal

50. Whether a child died after normal birth or died before birth can be confirmed by measuring

- a) Tidal volume of air b) Residual volume of air
c) The weight of the child d) The dead space air

Answers

1. The (d) scrotum is a pouch that suspends the testes outside the abdominal cavity.

Explanation: The wording in this question is already clear and concise. No need for improvement.

2. The (a) function of the scrotum is to maintain the temperature of the testes. Explanation: This question is well-written, clear and specific.

3. The approximate length and width of the testes are 5-6 cm and 3-4 cm, respectively.

Explanation: This answer is the correct option (b) and is a better way of presenting information as it is more specific and accurate.

4. Compartments in testes are called testicular lobules. Explanation: This answer is the correct option (a) and is already clearly and succinctly written.

5. Testicular lobules contain 1-3 seminiferous tubules. Explanation: This answer is the correct option (d) and is a better way of presenting information as it is more specific and accurate.

6. The testis are lined on their inside by cells of Sertoli and spermatogonia. Explanation: This answer is the correct option (d) and is a better way of presenting information as it provides additional details and is more accurate.

7. Sertoli cells provide nutrition to the male germ cells. Explanation: This answer is the correct option © and is already clear and concise.

8. Spermatogonia cells present in the mammalian testes form the sperms. Explanation: This answer is the correct option (b) and is already well-written.

9. The region outside the seminiferous tubules is called the interstitial space. Explanation: This answer is the correct option © and is already clearly and succinctly written.

10. All of the above are accessory glands found in males. Explanation: This answer is the correct option (d) and is already clearly and succinctly written.

11. Answer: © 10-12 cm long

Explanation: The human Fallopian tube is approximately 10-12 cm long.

12. Answer: (b) Infundibulum

Explanation: The funnel-shaped part of the oviduct closer to the ovary is called the infundibulum.

13. Answer: (b) To help in the collection of the ovum after ovulation

Explanation: The fimbriae of the Fallopian tube help in the collection of the ovum after ovulation.

14. Answer: (d) None of the above

Explanation: All of the pairs are correct.

15. Answer: (d) Explanation: The uterine layer exhibiting strong contraction during delivery is the myometrium

16. Answer: The correct answer is a) 3-5 days. The menstrual phase is the first phase of the menstrual cycle, where the endometrial lining of the uterus is shed in the form of menstrual bleeding. It typically lasts for 3-5 days but can last up to 7 days.

17. Answer: The most likely root cause for a regular cycling woman not menstruating is b) Maintenance of high concentration of sex-hormones in the bloodstream. In a normal menstrual cycle, the level of estrogen and progesterone hormones rise and fall, which triggers the shedding of the endometrial lining during menstruation. If the hormonal balance is disrupted due to various factors, such as pregnancy, hormonal disorders, stress, or other medical conditions, it can lead to a lack of menstruation.

18. Answer: During the follicular phase of the menstrual cycle, a) Proliferation of endometrium occurs. This is the second phase of the menstrual cycle, where the follicle-stimulating hormone (FSH) stimulates the growth and maturation of ovarian follicles, which release estrogen. The estrogen hormone causes the endometrial lining of the uterus to thicken in preparation for a potential pregnancy.

19. Answer: Ovulation typically occurs in a healthy menstruating female around day 14, which is the middle of the menstrual cycle. However, it can occur earlier or later in some women, depending on the length of their menstrual cycle.

20. Answer: Rapid secretion of luteinizing hormone (LH) in the ovulatory phase causes d) All of the above, which includes rupturing of the Graafian follicle, release of the ova (egg), and ovulation. LH surge is a critical step in the menstrual cycle, which triggers the release of the mature egg from the ovary.

21. Answer: Every time copulation does not lead to fertilization and pregnancy because of failure of sperm to reach the a) Ampulla. The ampulla is the widest part of the fallopian tube, where fertilization typically occurs. However, various factors such as low sperm count, abnormal sperm motility, or blockages in the fallopian tubes can prevent fertilization.

22. Answer: a) Menstrual phase is characterized by the shedding of the endometrial lining. It is the first phase of the menstrual cycle, which typically lasts for 3-7 days.

23. Answer: c) Estrogen is primarily responsible for thickening the endometrial lining during the menstrual cycle. It is produced by the developing follicles in the ovaries during the follicular phase of the menstrual cycle.

24. Answer: c) Luteal phase immediately follows ovulation. It is characterized by the formation of the corpus luteum, which produces progesterone to prepare the uterus for possible implantation of a fertilized egg.

25. Answer: a) Luteinizing hormone (LH) surges just prior to ovulation. This surge triggers the release of the mature egg from the ovary.

26. Answer: b) Follicular phase is the most variable phase in terms of its duration. The length of the follicular phase can vary from cycle to cycle, depending on factors such as stress, illness, and medication use.

27. Answer: b) 28 days is the average length of a menstrual cycle. However, menstrual cycles can range from 21 to 35 days in length and still be considered normal.

28. Answer: (a) ovarian follicle. The corpus luteum is a temporary endocrine structure formed from the remnants of the ovarian follicle after ovulation. It produces progesterone, which helps to prepare the endometrium for implantation.

29. Answer: © hCG (human chorionic gonadotropin). hCG is produced by the developing placenta after implantation and helps to maintain the corpus luteum, which in turn produces progesterone to support the early pregnancy and maintain the endometrial lining.

30. Answer: © Seminiferous tubules. Spermatogenesis is the process of sperm cell development, which occurs in the seminiferous tubules of the testes.

31. Answer: (a) Testosterone. Testosterone is the primary male sex hormone responsible for the development of secondary sexual characteristics such as facial hair, deepening of the voice, and muscle mass.

32. Answer: (b) Zygote. The zygote is the first cell formed when the sperm fertilizes the egg.

33. Answer: (d) all of the above. The placenta is an organ that develops during pregnancy and is responsible for producing hormones, exchanging nutrients and waste between the mother and fetus, and protecting the developing fetus from harmful substances.

34. Answer: (a) Prolactin. Prolactin is a hormone produced by the pituitary gland that stimulates milk production in the mammary glands.

35. answer: (b) shedding of the endometrial lining. Menstruation is the shedding of the endometrial lining of the uterus in the absence of pregnancy. It occurs in response to a decrease in progesterone levels.

36. The correct sequence of hormones from the beginning of menstrual cycle to the end is option © FSH, oestrogen, progesterone. During the menstrual cycle, the hypothalamus, pituitary gland, and ovaries interact to regulate the levels of hormones that control the cycle. Follicle-stimulating hormone (FSH) stimulates the development of ovarian follicles, which produce estrogen. As estrogen levels rise, it triggers a surge of luteinizing hormone (LH), which triggers ovulation. After ovulation, the ruptured follicle forms the corpus luteum, which produces progesterone. Progesterone prepares the endometrium for implantation of a fertilized egg.

37. The incorrectly matched option is © Human – Mesolecithal, centrolecithal. The classification of eggs is based on the amount and distribution of yolk. Microlecithal eggs have very little yolk, mesolecithal eggs have a moderate amount of yolk that is evenly distributed, macrolecithal eggs have a large amount of yolk that is concentrated at one end, and telolecithal eggs have a large amount of yolk that is concentrated at one end, leaving a small amount of cytoplasm at the opposite end. Centrolecithal eggs have a large yolk that is concentrated in the center of the egg. In humans, the ovum is mesolecithal, which means it has a moderate amount of yolk that is evenly distributed.

38. Capacitation takes place in option © 8 hrs. Capacitation is the process by which sperm become capable of fertilizing an egg. It involves a series of changes in the sperm membrane and is facilitated by enzymes present in the female reproductive tract. Capacitation usually takes several hours to occur, and once it is complete, the sperm are able to bind to and penetrate the egg.

39. The area called the grey crescent is located in option (b) just opposite to the site of entry of sperm into the ovum. The grey crescent is a region of cytoplasm in the egg that is opposite the point of sperm entry. It is formed during fertilization when the sperm penetrates the egg and triggers the reorganization of the cytoskeleton. The grey crescent plays an important role in early development, as it marks the future dorsal side of the embryo.

40. Both corpus luteum and macula lutea are option (b) a source of hormones. The corpus luteum is a temporary endocrine structure that forms in the ovary after ovulation. It produces progesterone and estrogen, which are necessary for the maintenance of pregnancy. The macula lutea is a yellowish spot near the center of the retina that is rich in the pigment's lutein and zeaxanthin. These pigments protect the retina from damage by absorbing blue light and acting as antioxidants.

41. The correct option is (a) Chorion and amnion are well developed. The chorion and amnion are the fetal membranes that develop during the early stages of pregnancy. The chorion is the outermost layer that surrounds the fetus and eventually forms the fetal part of the placenta. The amnion is the innermost layer that surrounds the developing embryo and forms the amniotic sac, which contains amniotic fluid that provides protection and cushioning to the developing fetus. Both the chorion and amnion are well developed in human beings, unlike some other animals where one or both of these membranes may be less developed.

42. The correct option is (b) Infundibulum. The fallopian tube, also known as the oviduct, connects the ovary to the uterus and is the site of fertilization in the female reproductive system. The fallopian tube has four parts: the infundibulum, ampulla, isthmus, and the intramural (or uterine) part. The infundibulum is the funnel-shaped part of the fallopian tube that is closest to the ovary and contains finger-like projections called fimbriae that help to capture the released egg from the ovary during ovulation.

43. The correct option is © A-300, B-400, C-60%, D-40%. The average human male ejaculates about 300-400 million sperm, of which at least 60% should have a normal shape and size (morphology) and 40% should show vigorous motility. Sperm morphology and motility are important factors in male fertility as they affect the ability of the sperm to fertilize the female egg.

44. The correct option is (b) Hyaluronidase. The acrosome is a specialized structure located at the tip of the sperm head that contains enzymes necessary for the sperm to penetrate the outer layer of the female egg during fertilization. One of the enzymes found in the acrosome is hyaluronidase, which helps to break down the hyaluronic acid in the extracellular matrix surrounding the egg and allows the sperm to penetrate through to the egg membrane. TSH (thyroid-stimulating hormone) is a hormone produced by the pituitary gland that stimulates the thyroid gland to produce thyroid hormones, while fertilizin is a glycoprotein found on the surface of the egg that plays a role in sperm-egg recognition and binding.

45.a) Monozygotic

Explanation: Identical twins are formed when a single fertilized egg (zygote) splits into two separate embryos during early development. Monozygotic is a term used to describe twins that develop from the same zygote and therefore have identical genetic material. Isozygotic and bizygotic are not terms used to describe identical twins.

46.d) Testes to epididymis

Explanation: The vasa efferentia are a network of tiny tubes that transport sperm from the testes to the epididymis, where they mature and become capable of fertilizing an egg. If the vasa efferentia become blocked, the sperm will not be able to make it to the epididymis and will therefore not be able to fertilize an egg. The other options (a, b, and c) describe different routes of transportation in the female reproductive system and are not affected by a blockage of the vasa efferentia.

47.a) Luteinizing hormone – failure of ovulation

Explanation: Luteinizing hormone (LH) is a hormone released by the pituitary gland that plays a key role in regulating the menstrual cycle and ovulation in females. A deficiency of LH can lead to a failure of ovulation, which can result in infertility. Insulin deficiency leads to diabetes mellitus, not diabetes insipidus. Thyroxine deficiency leads to hypothyroidism, not tetany. Parathyroid hormone deficiency leads to hypoparathyroidism, not diabetes mellitus.

48. The correct answer is c) Mesoderm. The mesoderm is the middle layer of the three primary germ layers that forms during embryonic development. It gives rise to various tissues including the musculoskeletal system, circulatory system, and reproductive system. The endoskeleton (bones and cartilage) and muscles develop from the mesoderm.

49. The correct answer is a) Centrolecithal. Centrolecithal eggs have a large, centrally located yolk that is surrounded by a thin layer of cytoplasm. These types of eggs are common in insects and other arthropods. Homolecithal eggs have evenly distributed yolk throughout the cytoplasm, microlecithal eggs have very little yolk, and alecithal eggs have no yolk.

50. The correct answer is c) The weight of the child. The weight of a stillborn child can be used to determine whether the child died before or after birth. If the child weighed more than 500 grams, then it is likely that the child died after birth. However, if the child weighed less than 500 grams, then it is likely that the child died before birth. This method is used in forensic investigations and can help determine whether the child was stillborn or the victim of infanticide. Tidal volume and residual volume are measures of lung function, while dead space air refers to the air in the lungs that does not participate in gas exchange.