

# BIOLOGY

## Chapter 2: Human Reproduction



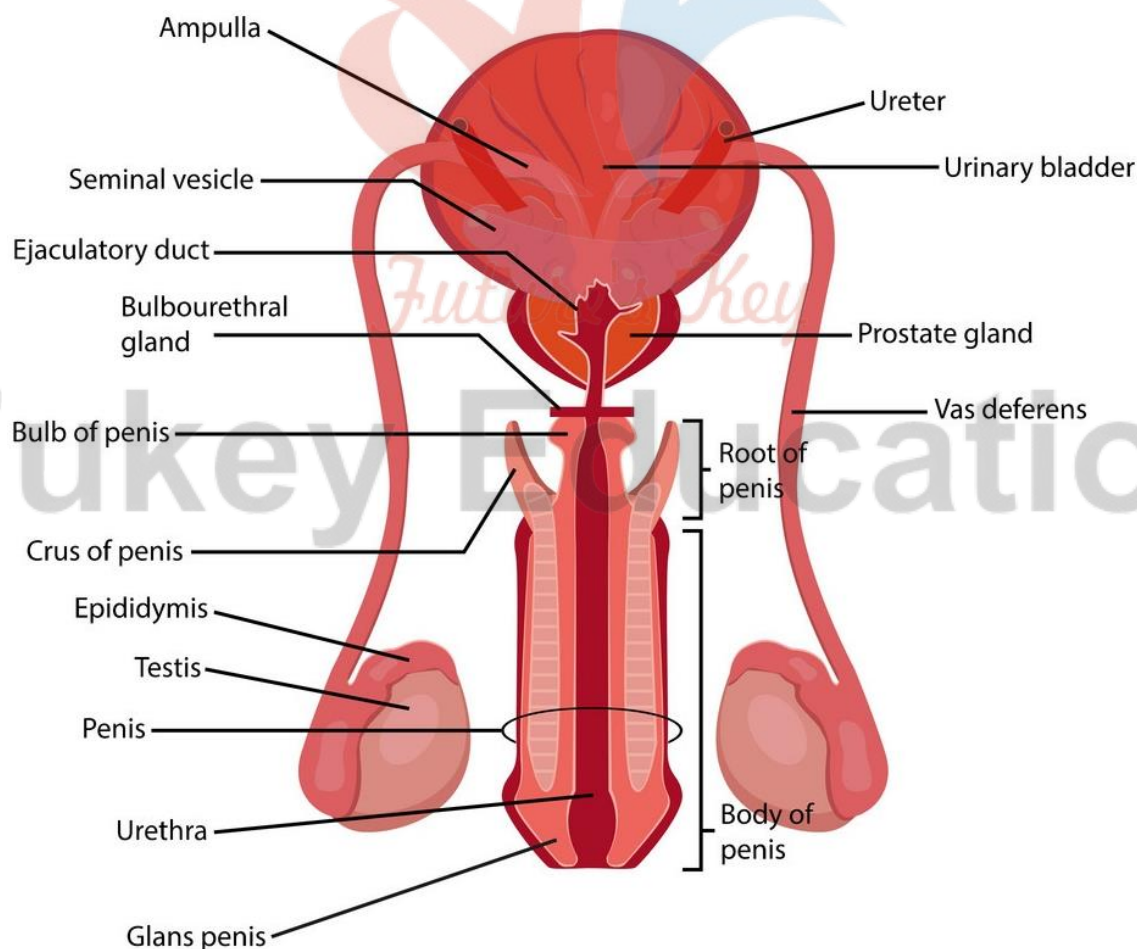
## Human Reproduction

### Human Reproductive System:

The Human Reproductive System mainly consists of:

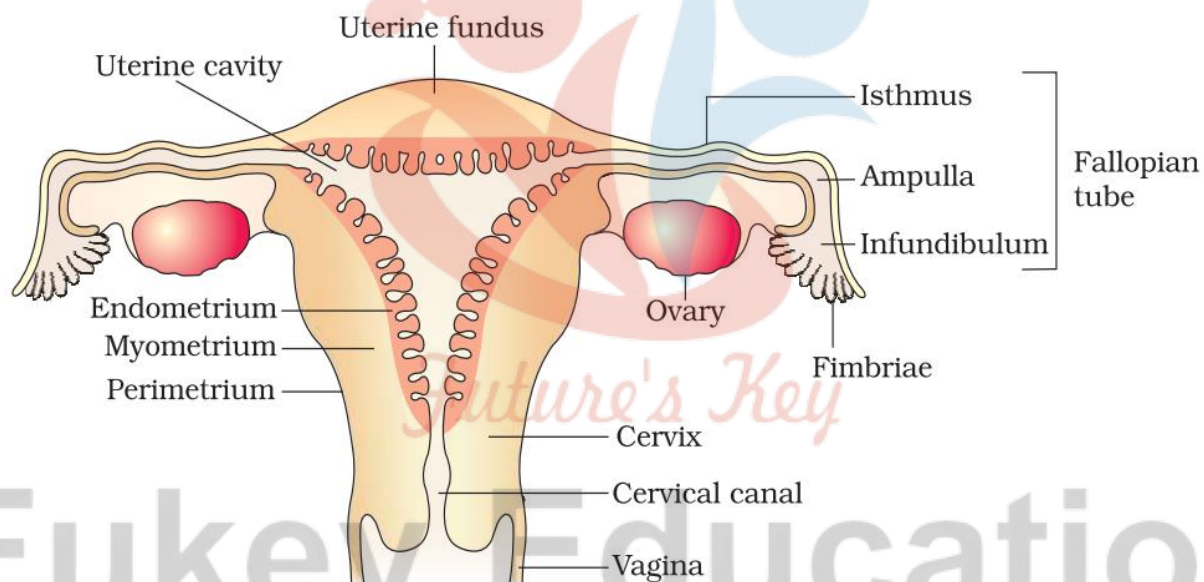
### The Male Reproductive System:

The male reproductive system is positioned in the pelvis region and comprises a pair of testes in addition to the accessory glands, ducts, and the external genitalia. A pouch-like structure known as scrotum encloses the testes located outside the abdominal cavity. Each testis has close to 250 testicular lobules (compartments). These lobules comprise 1-3 seminiferous tubules wherein the sperms are produced. The lining of these tubules consists of two types of cells – male germ cells and Sertoli cells. The exterior of these tubules consists of spaces containing blood vessels and Leydig cells. Male sex accessory ducts comprise rete testis, vasa efferentia, epididymis and vas deferens. The urethra opens externally to the urethral meatus. The male external genitalia, the penis, is covered by foreskin which is a loose fold of skin.



### The Female Reproductive System:

The female reproductive system is made up of the internal and external sex organs, which consists of a pair of ovaries and oviducts, cervix, uterus, vagina and the external genitalia situated in the pelvic region. Along with the mammary glands, these female reproductive organs are combined both structurally and functionally in order to support the complete processes of reproduction including ovulation, fertilization, pregnancy, and the birth of a child. The female accessory ducts are constituted by the oviducts, vagina and uterus. The section closer to the ovary is funnel-shaped infundibulum that possesses the fimbriae – finger-like projections facilitating the assimilation of ovum post ovulation. The infundibulum directs to a wider section of oviduct known as ampulla. The last section of the oviduct, isthmus, has a narrow lumen joining the uterus. Uterus is also known as the womb. The cervical cavity is known as the cervical canal which goes on to form the birth canal along with the vagina. Female external genitalia comprises – mons pubis, labia minora, labia majora, clitoris and hymen. Both the male and female reproductive systems play an important role in the process of reproduction. Other than these reproductive organs, there are sex hormones which are produced by the respective glands and are mainly involved in the development of secondary sexual characteristics and proper functioning of the reproductive tracts.



### Gametogenesis:

The process of formation of male and female gametes in testes and ovary respectively is called gametogenesis.

#### It is of two types:

- Spermatogenesis in males
- Oogenesis in females

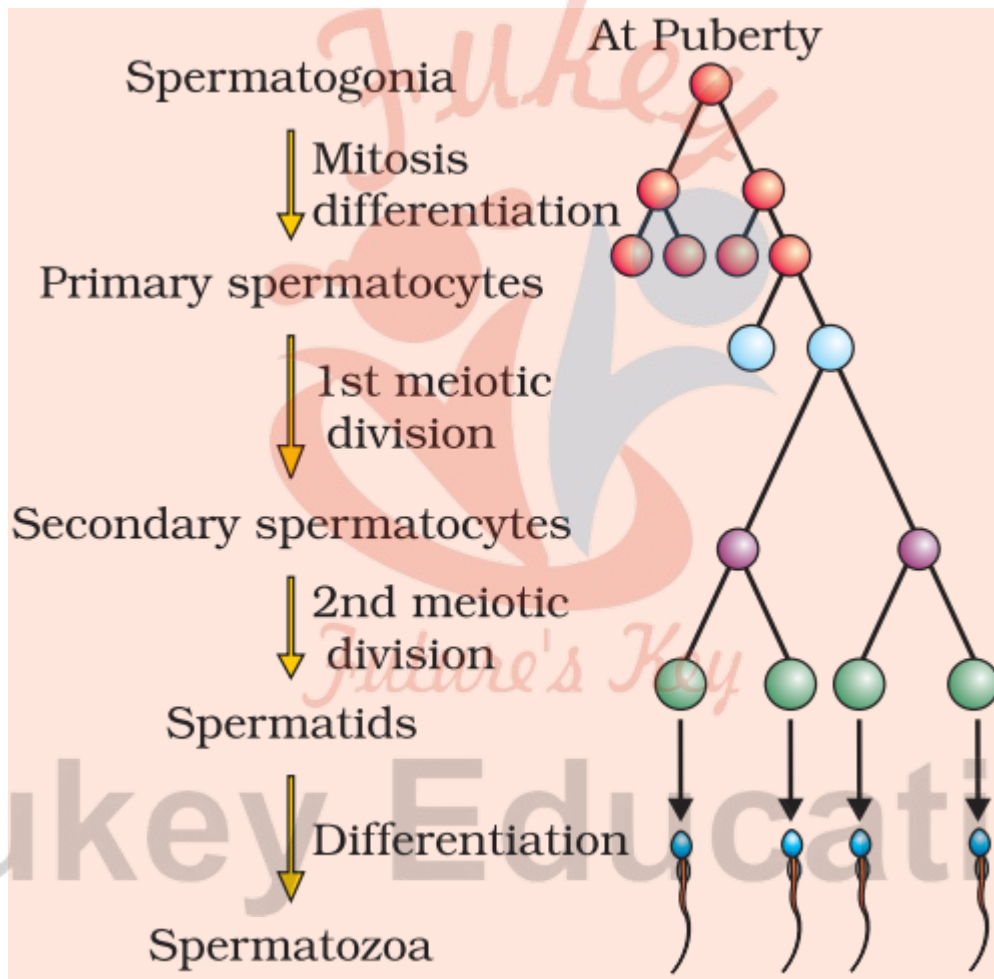
### Spermatogenesis:

In testes immature, male germ cells (spermatogonia) produce sperm by spermatogenesis that begin at puberty.

The spermatogonia present at the inner side of seminiferous tubules multiply by mitotic division and increase in number. Each spermatogonium contain 46 chromosomes.

Spermatogonia forms spermatocyte that undergo meiotic division to reproduce secondary spermatocytes having 23 chromosomes.

The spermatids are transformed into spermatozoa by the process called spermiogenesis. The sperm heads remain embedded in sertoli cells and are released from seminiferous tubules by the process of spermiation.



### Hormonal control of spermatogenesis:

Spermatogenesis initiated due to increase in secretion of gonadotropin releasing hormone by hypothalamus.

Increase in GnRH act on anterior pituitary and stimulate secretion of two gonadotropins, LH and FSH.

LH acts on Leydig cells and stimulates them to secrete androgens.

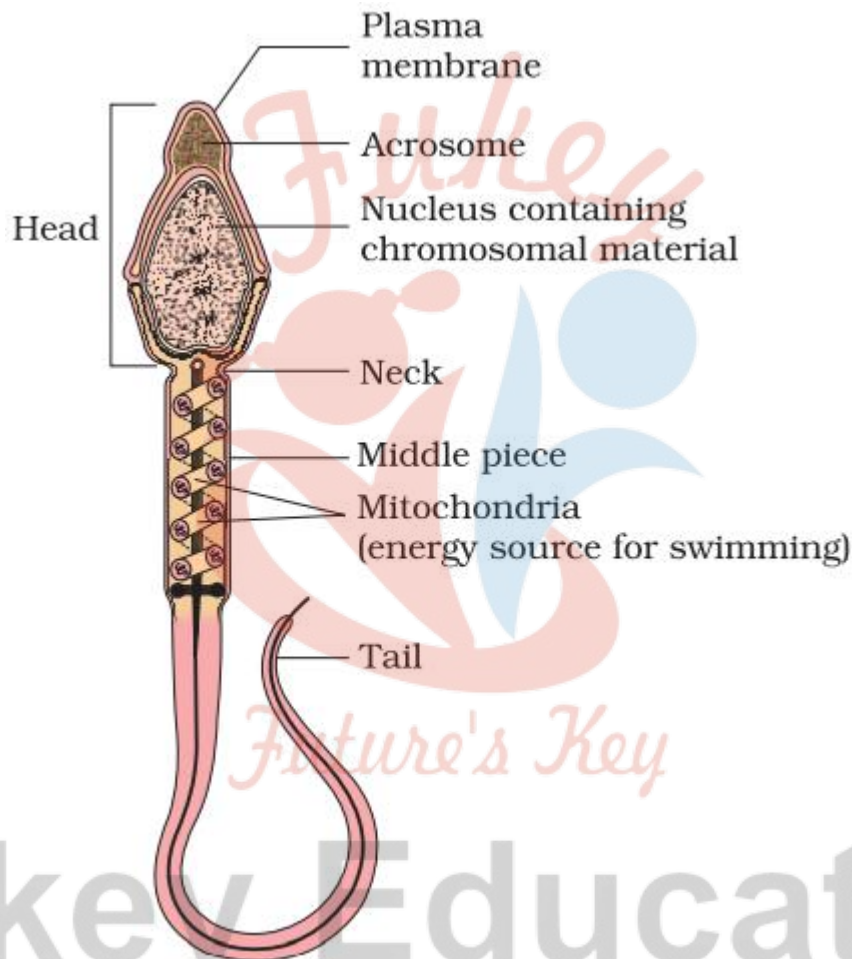
FSH acts on Sertoli cells, stimulates secretion of some factors which help in spermiogenesis.



### Structure of sperm:

Sperm is a microscopic structure composed of a head, neck, a middle piece and a tail. The sperm head contains elongated haploid nucleus, anterior portion of which is covered by cap-like structure acrosome.

Human male ejaculates about 200-300 million sperms during a coitus. The seminal plasma along with the sperms constitutes the semen. The function of male sex secondary ducts and glands are maintained by androgen hormones.



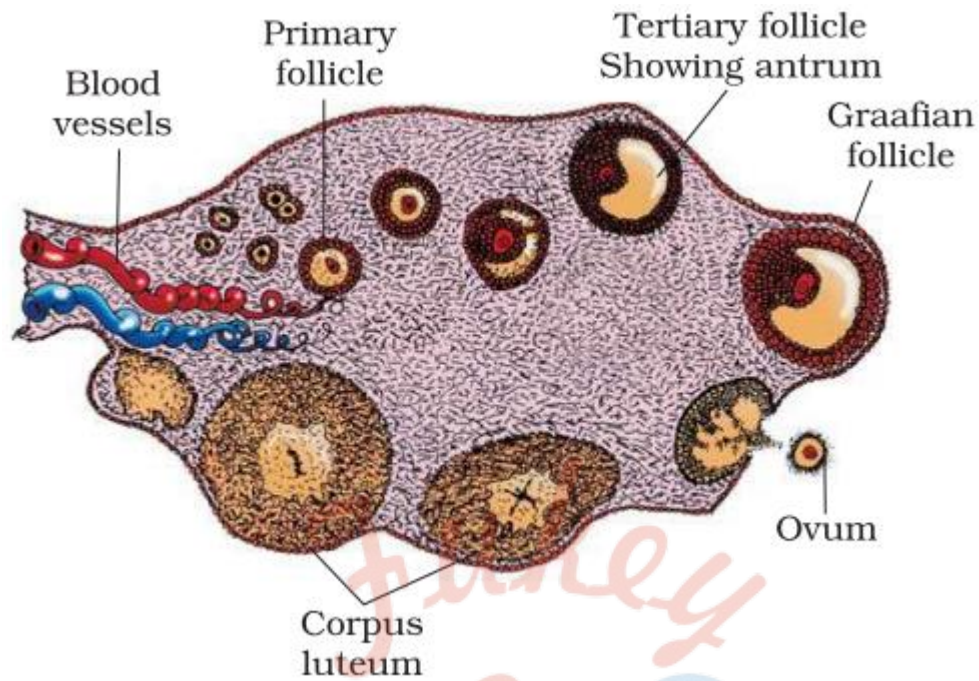
### Oogenesis:

The process of formation of mature female gametes is called oogenesis. It started during embryonic development stage when millions of oogonia (gamete mother cells) are formed in each fetal ovary.

The gametes mother cells start division and enter into prophase-I of meiotic division and get temporally arrested at that stage called primary oocytes.

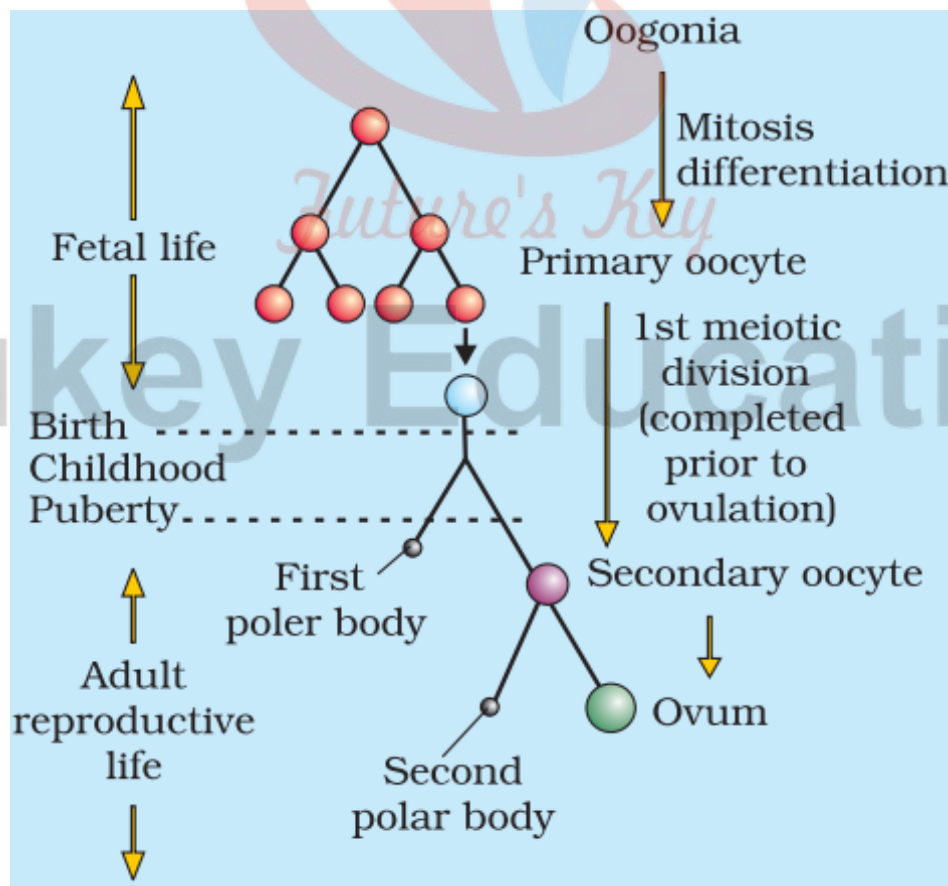
Each primary oocyte gets surrounded by a layer of granulosa cells, then it is called the primary follicle.

At puberty, about 60,000- 80,000 primary follicles are left in each ovary.



Primary follicle gets surrounded by more layers of granulosa cells called secondary follicle that transform into tertiary follicle that contain fluid filled cavity called antrum.

The tertiary follicles further changes into the mature follicle called Graafian follicle, which rupture to release secondary oocytes (ovum) from the ovary by the process of ovulation.

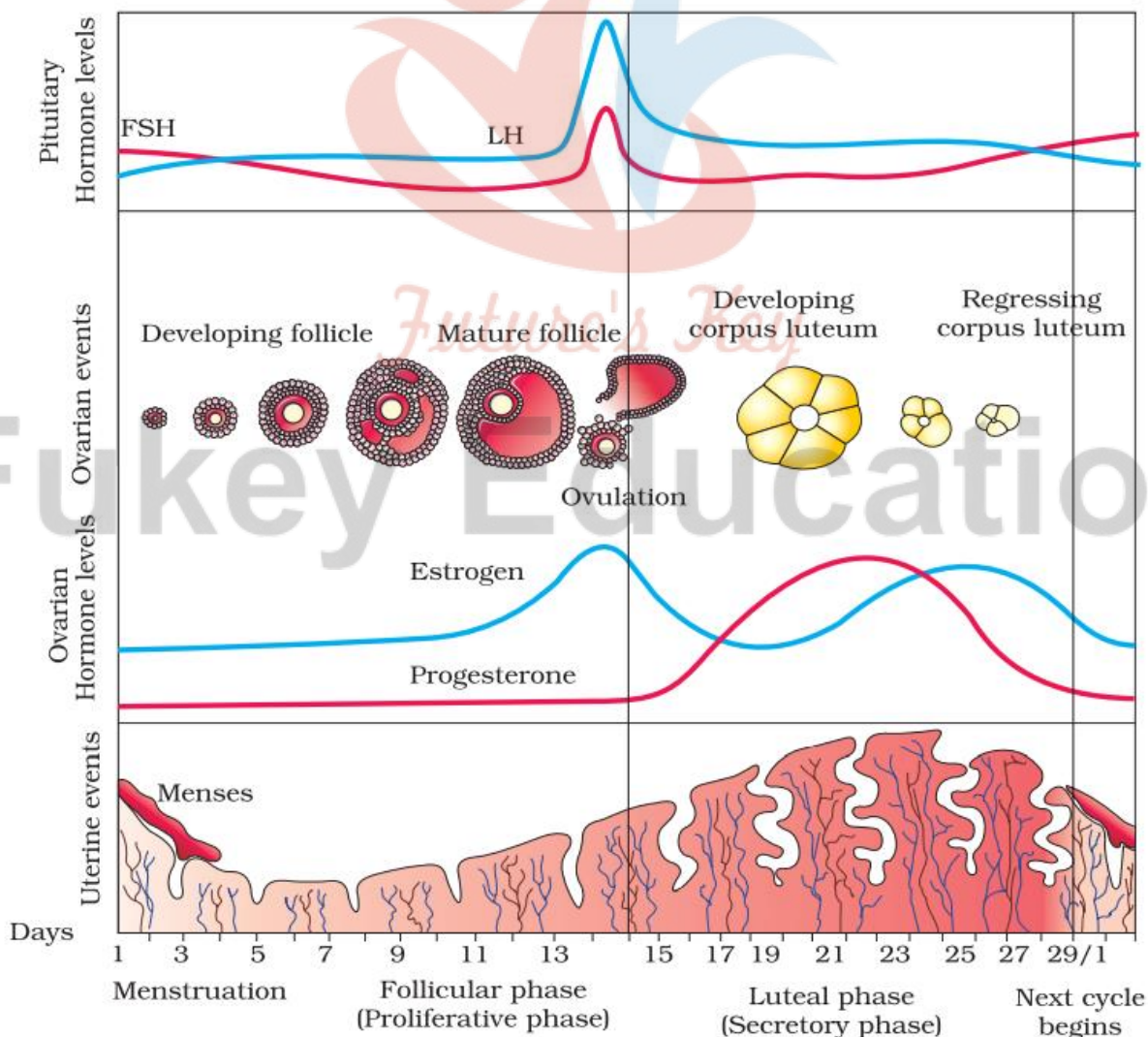


**Menstrual Cycle:** This is the reproductive cycle that starts from one menstruation till the next one. It mainly occurs in female primates like monkeys, apes, and human beings. The cycle repeats at an interval of 28-35 days and normally releases one egg per cycle. This cycle is important for the production of oocytes and for the preparation of the uterus for pregnancy.

**Menstruation:** In this process, the blood and mucosal tissue are regularly discharged in a periodic manner. It occurs due to the breakage of the inner lining of the uterus. This process takes place once a month and is called a period.

**Menarche:** Menarche is the first menstruation for a human female that begins at puberty. The actual age for menarche generally differs from person to person. The first menstruation is the signal of the beginning of reproductive age in females.

**Menopause:** Menopause is defined as the permanent ceasing of the menstrual cycle in females. It occurs due to the depletion of oocytes and the loss of the ability of the ovary to produce estrogen as a result of aging. The average age of menopause is between 45-50 years, and it varies from person to person.



### Menstrual Phase:

- In a 28 days menstrual cycle, the menses takes place on cycle days 3-5.
- The production of LH from the anterior lobe of the pituitary gland is reduced.
- The withdrawal of this hormone causes degeneration of the corpus luteum and, therefore progesterone production is reduced.
- Production of estrogen is also reduced in this phase.
- The endometrium of uterus breaks down & menstruation begins.
- The cells of endometrium secretions, blood & unfertilized ovum constitutes the menstrual flow.

### Follicular Phase:

- This phase usually includes cycle days 6-13 or 14 in a 28 days cycle.
- The follicle stimulating hormone (FSH) secreted by the anterior lobe of the pituitary gland stimulates the ovarian follicle to secrete estrogens.
- Estrogen stimulates the proliferation of the endometrium of the uterine wall.
- The endometrium becomes thicker by rapid cell multiplication and this is accompanied by an increase in uterine glands & blood vessels.

### Ovulatory Phase:

- Both LH & FSH attain a peak level in the middle of cycle (about 14th day).
- Estrogen concentration in blood increases.
- Rapid secretion of LH induces rupturing of graafian follicle and thereby the release of ovum.
- In fact, LH causes ovulation.

### Luteal Phase:

- Includes cycle days 15 to 28.
- Corpus luteum secretes progesterone.
- Endometrium thickens.
- Uterine glands become secretory.

### Hormonal Control of Menstrual Cycle:

- FSH stimulates the ovarian follicles to produce estrogens.
- LH stimulates corpus luteum to secrete progesterone.
- Menstrual phase is caused by the increased production of estrogens.



- LH causes ovulation
- Proliferative phase is caused by the increased production of estrogens.
- Secretory phase is caused by increased production of progesterone.

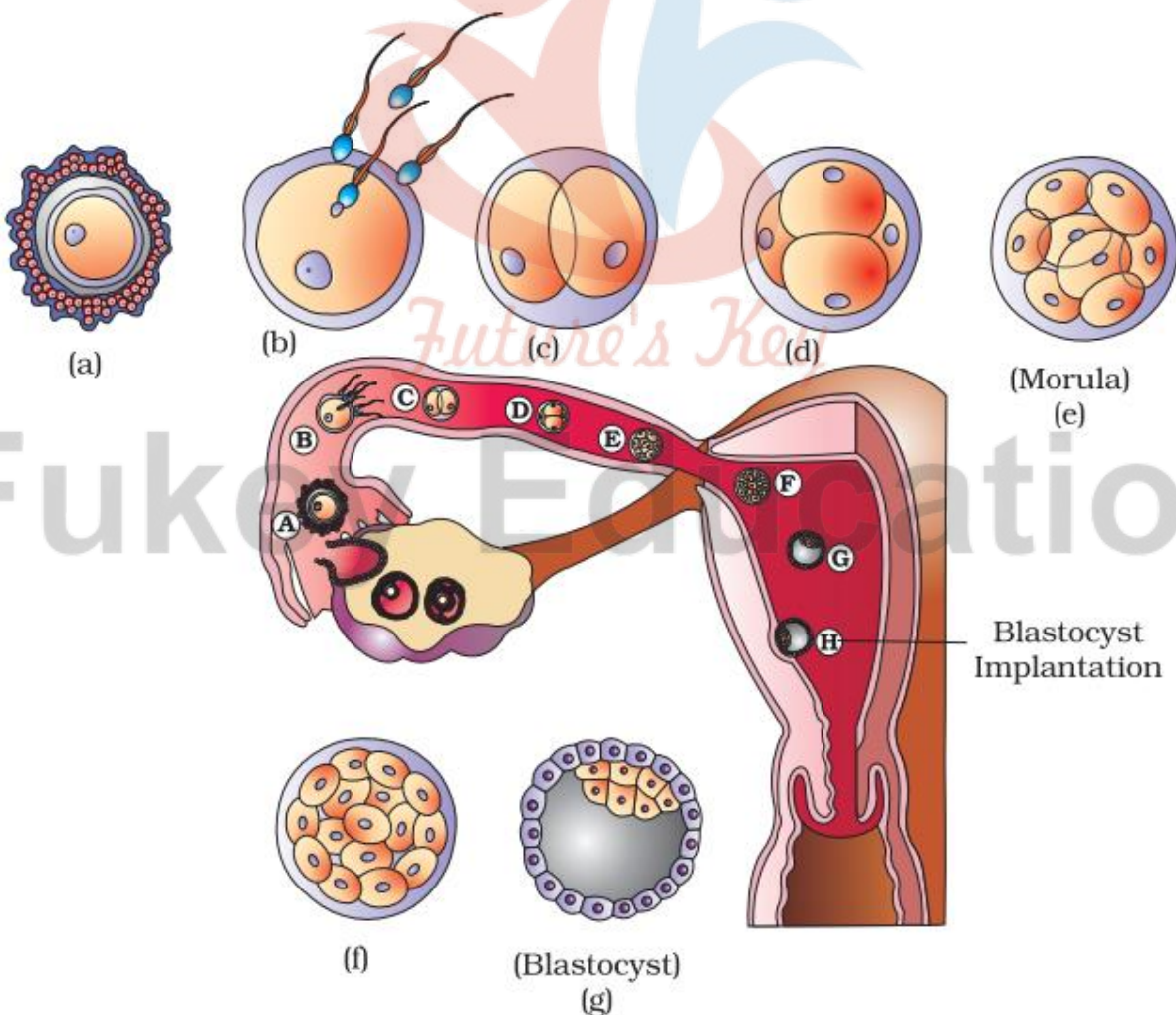
### Fertilization and Implantation:

The process of fusion of sperm with ovum is called fertilization.

During coitus (copulation) semen is released into vagina. The motile sperms swim rapidly to reach the junction of isthmus and ampulla of fallopian tube. The ovum also reaches there, and fusion of gametes takes place in at ampullary-isthmic junction.

In this acrosome of sperm undergoes acrosomal reaction and releases certain sperm lysins which dissolve the egg envelopes locally and make the path for the penetration of sperm.

These sperm lysins contain a lysing enzyme hyaluronidase which dissolves the hyaluronic acid polymers in the intercellular spaces which holds the granulosa cells of corona radiata together; corona penetrating enzyme (that dissolves the corona radiata) and acrosin (which dissolves the zona pellucida). Then it dissolves the zona pellucida.



Immediately after the entry of a sperm into the egg, the later shows a cortical reaction to

check the entry of more sperms. In this reaction, the cortical granules present beneath the egg's plasma membrane release chemical substance between the ooplasm and the plasma membrane (vitelline membrane). These substances raise the vitelline membrane above the egg surface. The elevated vitelline membrane is called fertilization membrane. The increased space between the ooplasm and the fertilization membrane and the chemical present in it effectively check the entry of other sperm. If polyspermy occurs, that is more than one sperm enter the secondary oocyte, the resulting cell has too much genetic material to develop normally.

The haploid gametes fuse together to form diploid zygote. As the zygote moves towards the uterus, the mitotic division starts and form cleavage to change into 2, 4, 8, 16 celled blastomeres.

The blastomeres with 8 to 16 cells are called morula. Morula divide to change into blastocysts. The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called the inner cell mass. The outer layer of blastocyst is called trophoblast that attach with endometrium of uterus, called implantation that leads to pregnancy.

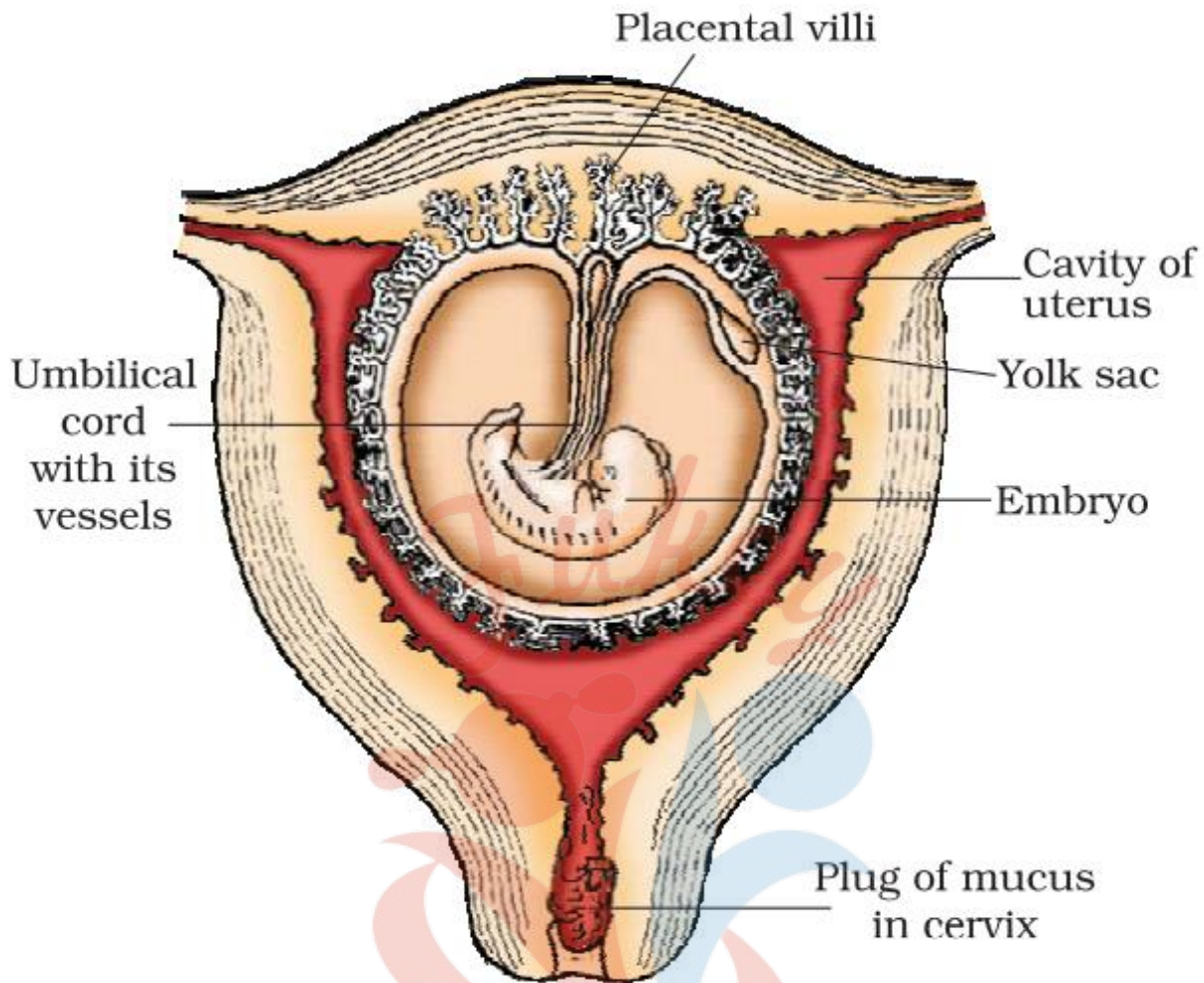
### **Pregnancy and embryonic development:**

The finger-like projections on trophoblast after implantation called is called chronic villi that along with uterine wall forms functional unit between developing embryo and maternal body called placenta. Placenta is attached with foetus with an umbilical cord that transport food and oxygen to embryo.

Hormones hCG (human chorionic gonadotropin), hPL (human placental lactogen) and relaxing are produced in woman only during pregnancy by placenta.

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

In human, after one month of pregnancy the embryo's heart is formed. By the end of 2nd month limbs and digits are formed. By the end of 12 months, major organs and external genital organs are well developed. The first movement of foetus is observed in 5 months. By the end of 24 weeks body is covered with fine hair, eye lids and eyeless are formed. At the end of 9 months foetus is fully developed.



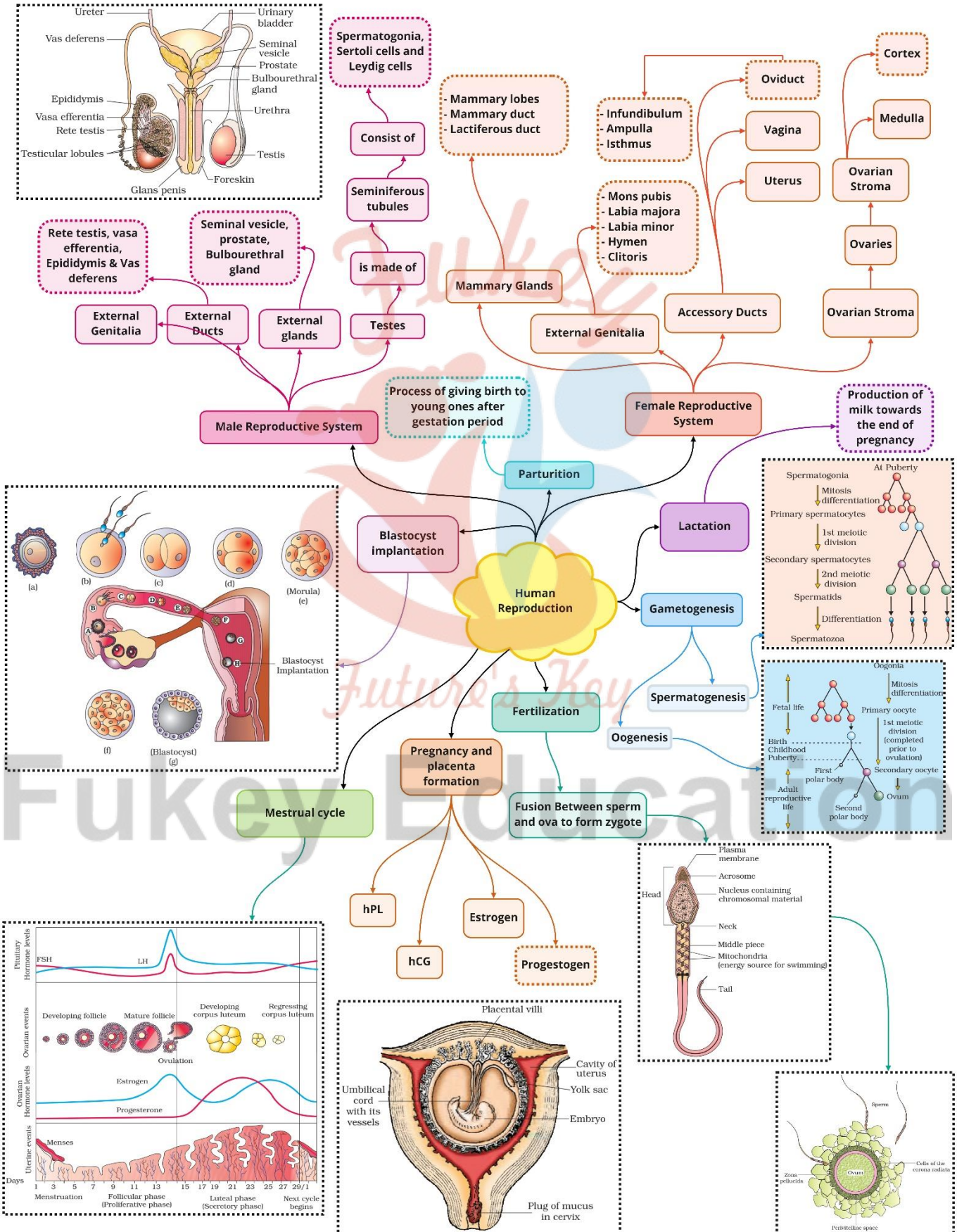
### Parturition and Lactation:

Parturition—the process of delivery of fully developed foetus is called parturition. Signals for parturition originate from the fully developed foetus and placenta inducing mild uterine contractions called Foetal ejection reflex

It triggers the release of oxytocin from maternal pituitary. The mammary glands of female, start producing milk, to the end of pregnancy by the process of lactation. The milk produced during the initial few days of lactation is called colostrum, which contain several antibodies.



Class : 12th Biology  
Chapter- 3 : Human Reproduction





## Important Questions

### ➤ Multiple Choice Questions:

- Choose the incorrect statement from the following:
  - In birds and mammals internal fertilisation takes place
  - Colostrum contains antibodies and nutrients
  - Polyspermy is prevented by the chemical changes in the egg surface
  - In the human female implantation occurs almost seven days after fertilisation
- Identify the wrong statement from the following:
  - High levels of estrogen triggers the ovulatory phase
  - Oogonial cells start to proliferate and give rise to functional ova in regular cycles from puberty onwards.
  - Sperms released from seminiferous tubules are poorly motile/non-motile
  - Progesterone level is high during the post-ovulatory phase of menstrual cycle.
- Spot the odd one out from the following structures with reference to the male reproductive system:
  - Rete testis
  - Epididymis
  - Vasa efferentia
  - Isthmus
- Seminal plasma, the fluid part of semen, is contributed by
  - Seminal vesicle
  - Prostate
  - Urethra
  - Bulbourethral gland

**(a)** (i) and (ii)  
**(b)** (i), (ii) and (iv)  
**(c)** (ii), (iii) and (iv)  
**(d)** (i) and (iv)
- Spermiogenesis is the process of the release of sperms from:
  - Seminiferous tubules
  - Vas deferens
  - Epididymis
  - Prostate gland
- Mature Graafian follicle is generally present in the ovary of a healthy human female

around:

- (a) 5-8 day of menstrual cycle
- (b) 11-17 day of menstrual cycle
- (c) 18-23 day of menstrual cycle
- (d) 24-28 day of menstrual cycle

7. Acrosomal reaction of the sperm occurs due to:

- (a) Its contact with zona pellucida of the ova
- (b) Reactions within the uterine environment of the female
- (c) Reactions within the epididymal environment of the male
- (d) Androgens produced in the uterus

8. Which one of the following is not a male accessory gland?

- (a) Seminal vesicle
- (b) Ampulla
- (c) Prostate
- (d) Bulbourethral gland

9. The immature male germ cells undergo division to produce sperms by the process of spermatogenesis.

Choose the correct one with reference to above.

- (a) Spermatogonia have 46 chromosomes and always undergo meiotic cell division
- (b) Primary spermatocytes divide by mitotic cell division
- (c) Secondary spermatocytes have 23 chromosomes and undergo second meiotic division
- (d) Spermatozoa are transformed into spermatids

10. Which among the following has 23 chromosomes?

- (a) Spermatogonia
- (b) Zygote
- (c) Secondary oocyte
- (d) Oogonia

11. Which of the following hormones is not secreted by human placenta?

- (a) HCG
- (b) Estrogens
- (c) Progesterone
- (d) LH

12. The vas deferens receives duct from the seminal vesicle and opens into urethra as:

- (a) Epididymis
- (b) Ejaculatory duct

- (c) Efferent ductule
- (d) Ureter

13. Urethral meatus refers to the :

- (a) Urinogenital duct
- (b) Opening of vas deferens into urethra
- (c) External opening of the urinogenital duct
- (d) Muscles surrounding the urinogenital duct

14. Morula is a developmental stage :

- (a) Between the zygote and blastocyst
- (b) Between the blastocyst and gastrula
- (c) After the implantation
- (d) Between implantation and parturition

15. The membranous cover of the ovum at ovulation is :

- (a) Corona radiata
- (b) Zona radiata
- (c) Zona pellucida
- (d) Chorion

➤ **Very Short Question:**

1. Failure of testes to descend into scrotal sacs leads to sterility. Why?
2. Both vaccine and colostrum produce immunity. Name type of immunity produced by these.
3. How many sperms will be produced from 10 primary spermatocytes and how many eggs will be produced from 10 primary oocytes?
4. The spermatogonial cell has 46 chromosomes in human male. Give the number of chromosomes in
  - (a) Primary spermatocyte
  - (b) Spermatid
5. In ovary which structure transforms as corpus luteum and name the hormone secreted by corpus luteum?
6. "Each and every coitus does not results in fertilisation and pregnancy". Justify the statement.
7. Why are male testes located outside the abdominal cavity?
8. State the function of leydig cells.
9. Where do we find fimbriae?
10. What is semen?

### ➤ Short Questions:

1. Give the function of
  - (a) Corpus luteum
  - (b) Endometrium
2. What is meant by L.H. Surge? Write the role of L.H.
3. Explain significance of the condition in which the testes remain suspended in scrotum outside the abdomen.
4. Describe the structure of a sperm with a diagram.
5. Enlist any two functions of a female placenta.
6. What is the number of chromosomes in the following cells? Primary oocyte, secondary oocyte, ootid and follicle.
7. What is corpus luteum. How does it function as an endocrine gland?
8. Where are Leydig cells located? What do they secrete?

### ➤ Long Questions:

1. Briefly explain the primary male sex organs of man.
2. Draw well-labeled sketches of the front view and sagittal section of the male reproductive system of man.
3. Explain the events taking place at the time of fertilization of an ovum in a human female.

### ➤ Assertion and Reason Questions:

- 1) For two statements are given-one labelled Assertion and the other labelled Reason. Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
  - a) Both assertion and reason are true, and reason is the correct explanation of assertion.
  - b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
  - c) Assertion is true, but reason is false.
  - d) Both assertion and reason are false.

**Assertion:** All copulations do not lead to the fertilisation and pregnancy.

**Reason:** Fertilisation can occur only if the ovum and sperms are transported simultaneously to the ampullary-isthmic junction.

- 2) For two statements are given-one labelled Assertion and the other labelled Reason. Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
  - a) Both assertion and reason are true, and reason is the correct explanation of assertion.



- b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
- c) Assertion is true, but reason is false.
- d) Both assertion and reason are false.

**Assertion:** A drop in temperature does not affect spermatogenesis..

**Reason:** During temperature drop, the smooth muscles contracts and bring the testes closer to the pelvic cavity.

### ➤ Case Study Questions:

1) Read the following and answer any four questions from (i) to (v) given below:

Cleavage is the series of rapid mitotic divisions in zygote and forms blastula. The 2, 4, 8, 16 daughter cells are called blastomeres. Embryo with 64 blastomeres is known as blastocyst and has blastocoel cavity. Blastocyst gets implanted in uterine wall and leads to pregnancy.

- (i) Solid mass of cells with 16 blastomeres is called:
  - a. Morula.
  - b. Blastula.
  - c. Gastrula.
  - d. Zygote.
- (ii) At which stage of embryonic development, trophoectoderm develops?
  - a. Zygote.
  - b. Morula.
  - c. Blastula.
  - d. Gastrula.
- (iii) Site of implantation is:
  - a. Endometrium of uterus.
  - b. Cervix.
  - c. Uterine fundus.
  - d. Infundibulum of oviduct.
- (iv) Correct sequence of various structures formed during embryonic development is:
  - a. Morula → Embryo → Gastrula → Blastula.
  - b. Zygote → Embryo → Morula → Blastula.
  - c. Blastula → Morula → Gastrula → Embryo.
  - d. Zygote → Morula → Blastula → Gastrula.
- (v) **Assertion:** Side of blastocyst with inner cell mass is called animal pole.  
**Reason:** Inner cell mass gives rise to embryo.

- (a) Both assertion and reason are true, and reason is the correct explanation of assertion.
- (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
- (c) Assertion is true, but reason is false.
- (d) Both assertion and reason are false.

2) Read the following and answer any four questions from (i) to (v) given below:

During copulation, semen is released by the penis into the vagina. The motile sperms swim rapidly, fuse with ovum in the ampullary region, resulting in fertilisation. Haploid nucleus of sperm fuse with that of ovum to form diploid zygote.

- (i) In female genital tract, sperms are made capable of fertilising the egg. This phenomenon of sperm activation is called:
  - a. Amphimixis.
  - b. Cortical reaction.
  - c. Capacitation.
  - d. Acrosomal reaction.
- (ii) Select the correct sequence of various physical and chemical events that take place during fertilisation.
  - A. Fusion of cortical granules with plasma membrane of secondary oocyte.
  - B. Formation of fertilisation cone to receive sperm.
  - C. Release of sperm lysin from acrosome.
  - D. Mixing up of chromosomes of a sperm and an ovum.
  - a.  $R \rightarrow Q \rightarrow P \rightarrow S$
  - b.  $Q \rightarrow S \rightarrow R \rightarrow P$
  - c.  $Q \rightarrow R \rightarrow S \rightarrow P$
  - d.  $R \rightarrow P \rightarrow Q \rightarrow S$
- (iii) **Assertion:** Only one sperm can fertilise an ovum.  
**Reason:** The secretion of acrosome help the sperm to enter into cytoplasm of ovum through zona pellucida and plasma membrane.
  - a. Both assertion and reason are true, and reason is the correct explanation of assertion.
  - b. Both assertion and reason are true, but reason is not the correct explanation of assertion.
  - c. Assertion is true, but reason is false.
  - d. Both assertion and reason are false
- (iv) What is the significance of fertilisation?
  - a. It restores haploid number of chromosomes.

- b. It produces offspring genetically identical to parents.
  - c. It initiates cleavage.
  - d. Both (b) and (c).
- (v) Site of fertilisation in humans is:
- a. Endometrium of uterine cavity.
  - b. Ampullary isthmic junction of oviduct.
  - c. Cervix of uterus.
  - d. Infundibulum of fallopian tube.

### ✓ Answer Key-

#### ➤ Multiple Choice Answers:

1. (c) Polyspermy is prevented by the chemical changes in the egg surface
2. (b) Oogonial cells start to proliferate and give rise to functional ova in regular cycles from puberty onwards.
3. (d) Isthmus
4. (c) (ii), (iii) and (iv)
5. (a) Seminiferous tubules
6. (b) 11-17 day of menstrual cycle
7. (a) Its contact with zona pellucida of the ova
8. (b) Ampulla
9. (c) Secondary spermatocytes have 23 chromosomes and undergo second meiotic division
10. (c) Secondary oocyte
11. (d) LH
12. (b) Ejaculatory duct
13. (c) External opening of the urinogenital duct
14. (a) Between the zygote and blastocyst
15. (a) Corona radiata

#### ➤ Very Short Answers:

1. High temperature of abdomen kills the spermatogenic tissue of the testes, so no sperm are formed.
2. Vaccine Active immunity Colostrum Passive immunity.
3. 40 sperms, 10 eggs.
4. (a) 46 in Primary spermatocyte

- (b) 23 in spermatid.
5. Follicular cells of empty Graafian follicle transform as corpus luteum. The corpus luteum secretes a hormone called progesterone.
  6. Ovum and sperm should reach simultaneously to the ampullary – isthmic junction.
  7. The male testes are located in the scrotum outside the abdominal cavity as the scrotum provides low temperature than the normal body temperature required for spermatogenesis.
  8. The Leydig cells synthesise and secrete testicular hormones called androgens.
  9. Fimbriae are finger like projections found in the edges of the infundibulum.
  10. The seminal plasma along with the sperms constitutes semen.

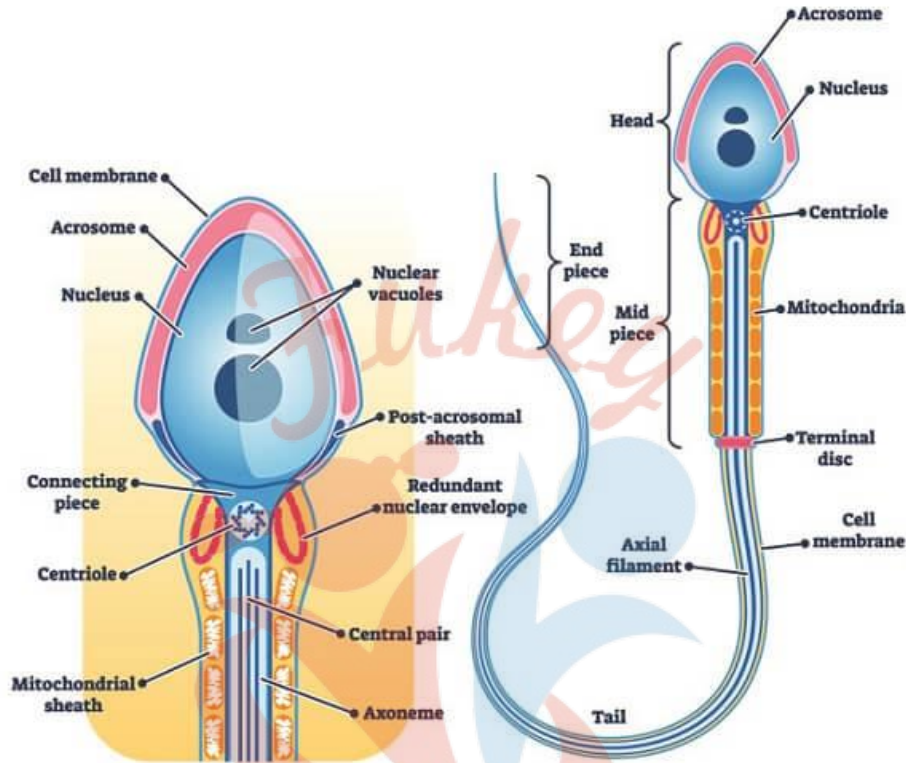
### ➤ Short Answer:

1. (a) Corpus luteum: It secretes progesterone which prepares endometrium of uterus for implantation and normal development of foetus.  
(b) Endometrium: It undergoes cyclic changes during menstrual cycle and prepares itself for implantation of blastocyst.
2. There are three phases in your menstrual cycle – follicular phase, ovulatory phase and luteal phase. In terms of the luteinizing hormone (LH) surge, the ovulatory phase is most important. During the follicular phase the follicle develops at the beginning of the menstrual cycle. This cycle begins with the menstrual period, the shedding of the uterine lining and the shedding cleanses the lining of the uterus in preparation for ovulation during the ovulatory phase.
3. Human sperm cells cannot develop at body temperature. Spermatogenesis and maintenance of the seminiferous tubules requires a temperature slightly lower than that of the body. This is provided by the scrotum, which lies outside the abdominal cavity.
4. The human sperm is a microscopic structure with a head, middle piece and a tail. The head has the haploid nucleus and an anterior acrosome that contains the enzymes required for the fertilization of the egg. The middle piece has numerous mitochondria to produce the energy for the mobility of the tail of the sperm.
5. The structural and the functional unit between the developing embryo and the mother called placenta facilitates the supply of nutrients, oxygen to the embryo and also the removal of carbon dioxide and other excretory products produced by the embryo. It also acts as endocrine tissue and produces several hormones
6. The number of chromosome in the cells is as follows:  
Primary oocyte: 23 pairs. Secondary oocyte: 23. Ootid: 23. Follicle: 23 pairs.
7. After ovulation, the graafian follicle ruptures & forms corpus luteum. Corpus luteum functions as endocrine glands as they secrete progesterone & estrogen in large



quantities.

- Leydig cells or interstitial cells are located in between the seminiferous tubules. Leydig cells secrete male sex hormone TESTOSTERONE which promotes development of accessory glands & control male secondary sexual characters.



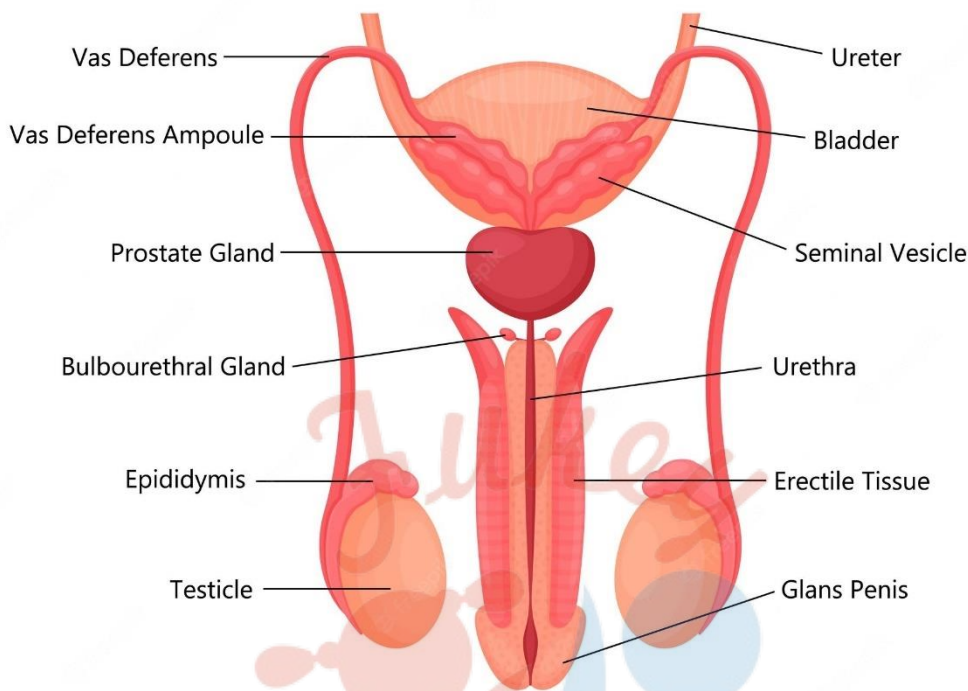
### ➤ Long Answer:

- The testes, male gonads, produce sperms that are suspended outside the abdominal cavity in a sac of skin called the scrotum. It results in maintenance of the temperature of the testis which is lower than the rest of the body. It is a condition favorable to sperm production.

Each testis is an oval-shaped structure and is composed of a large number of seminiferous tubules surrounded by connective tissue in which occurs numerous cells called Interstitial cells or Leydig cells. These cells produce a male sex hormone named testosterone. Seminiferous tubules are lined by a layer of germinal epithelial cells. In between the germinal cells, certain large cells called Sertoli cells are present. They are nutritive in function. The germinal epithelial cells produce sperms by spermatogenesis.

- The male reproductive system of man:

## Male reproductive system



3. Fertilization is the fusion of two gametic nuclei to form a diploid zygote. It involves a series of chemical and physical steps as follows:

The cortical cytoplasm of the ovum shows the physicochemical reactions called the cortical reactions:

- i. Sperm lysins dissolve the membranes around the egg.
- ii. The Head of sperm containing a nucleus and proximal centriole physically passes into the ovum.
- iii. Normally these reactions result in the formation of a fertilization membrane outside the egg plasma membrane.
- iv. Cortical granules burst and release their contents between the egg plasma membrane and zona pellucida, i.e. perivitelline space (no fertilization membrane formation). The plasma membrane shows increased permeability for water, phosphate, and potassium.
- v. The electrical potentiality of plasma membrane changes from positive to negative, NAD kinase enzyme becomes activated after fertilization for the oxidation and reduction reaction of the cell.
- vi. The rate of DNA synthesis increases with great pace after fertilization. Hence the ovum is now ready for mitosis (cleavage).
- vii. Cleavage results in multicellular individuals.

### ➤ Assertion and Reason Answers:

- 1) a) Both assertion and reason are true, and reason is the correct explanation of assertion.

**Explanation:**

Fertilisation can only occur if the ovum and sperms are transported simultaneously to the ampullary-isthmic junction and ovum is released only once a month. This is one of the reasons why all copulations do not lead to fertilisation and pregnancy.

- 2) a) Both assertion and reason are true, and reason is the correct explanation of assertion.

**Explanation:**

The normal temperature of the testes in the scrotum is about  $2^{\circ}$ - $2.5^{\circ}\text{C}$  lower than the internal body temperature. When the body is chilled, the smooth muscle contracts and brings the testes closer to the pelvic cavity. This movement towards the pelvic cavity allows the testes to absorb heat from the rest of the body so that the sperm cells do not become chilled and get optimum temperature for spermatogenesis.

➤ **Case Study Answers:**

1)

- (i) (a) Morula.

**Explanation:**

Embryo with 8-16 blastomeres is solid mass of cells, known as morula.

- (ii) (c) Blastula.

**Explanation:**

Embryo with 64 cells is called blastula (blastocyst) and has blastocyst cavity. Blastocyst is composed of an outer envelope of cells called trophoblast and inner cell mass.

- (iii) (a) Endometrium of uterus.

**Explanation:**

Implantation is the attachment of blastocyst to the uterine wall. The portion of blastocyst where the inner cell mass is located lies against the endometrium of uterus.

- (iv) (d) Zygote → Morula → Blastula → Gastrula.

- (v) (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

2)

- (i) (c) Capacitation.

**Explanation:**

The secretions of female genital tract remove coating substances deposited on the surface of the sperms. This phenomenon of sperm activation is called capacitation.

(ii) (d)  $R \rightarrow P \rightarrow Q \rightarrow S$

(iii) (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.

**Explanation:**

Binding of sperm to the secondary oocyte induces depolarisation of the oocyte plasma membrane. Depolarisation prevents polyspermy and ensures monospermy.

(iv) (c) It initiates cleavage.

**Explanation:**

Fertilisation restores diploid number of chromosomes. It introduces variations as it combines characters of the two parents.

(v) Ampullary isthmic junction of oviduct.



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