Chapter 3. Human Reproduction

Reproductive Systems

1 Mark Questions

1.Why are humans testes located outside the abdominal cavity?Name the pouch in which they are present. [All India 2014]

Ans.Human testes are located outside the abdominal cavity as it helps in maintaining low temperature, (2-2.5°C lower than body temperature), required for spermatogenesis.Testes are enclosed in a pouch called scrotum.

2.Write the location and functions of following in human testes.
(i)Sertoli cells
(ii)Leydig cells [All India 2014]

Ans.(i) Location of Sertoli cells Within the lining of seminiferous tubule of testis.
Function of Sertoli cells They provide nutrition to the developing sperm cells.

(ii) Location of Leydig cells In the interstitial spaces between the seminiferous tubules.
Function of Leydig cells It synthesises and secrete hormones androgens, e.g. testosterone

3.List the different parts of human oviduct through which the ovum travels till it meets the sperm for fertilisation.[Delhi 2014 C]

Ans.The different parts of human female oviduct through which the ovum travels, till it gets fertilised are given below in the sequence.

(i) Fimbriae, finger-like projections Collect or catch the ovum, after ovulation.

(ii)Infundibulum Ovum from fimbriae is guided into funnel-shaped infundibulum, part of Fallopian tube.

(iii) Ampulla A wider part of oviduct that leads ovun into isthmus.

(iv) Isthmus With narrow lumen, and in the portion or junction of ampulla-isthmus, the ovum gets fertilised..

4.Write the location and function of Sertoli cells in humans.[Delhi 2012]

Ans.Location of Sertoli cells Within the lining of seminiferous tubule of testis.
Function of Sertoli cells They provide nutrition to the developing sperm cells.

2.Mark Questions

5.Where are fimbriae present in a human female reproductive system. Give their function. [Delhi 2009]

Ans.Fimbriae are present in funnel-shaped edges of the Fallopian tube or oviduct in human female reproductive system. They help in the collection of ovum/secondary oocyte after ovulation.

6.Where are Leydig cells present? What is their role in reproduction? [All India 2009]

Ans.Location of Leydig cells In the interstitial spaces between the seminiferous tubules.
Function of Leydig cells It synthesises and secrete hormones androgens, e.g. testosterone

3 Marks Questions

7.Name and explain the role of inner and middle walls of human uterus. [Delhi 2014]

Ans.The innermost wall of uterus is called endometrium.

Role of Endometrium
(i) It lines the uterine cavity and is glandular in nature

(ii)It undergoes cyclical changes during menstrual cycle.
The middle wall or layer of uterus is called myometrium.

Role of Myometrium
(i) It is made up of thick layer of smooth muscles.
(ii) It shows strong contractions during delivery of baby.

8.Draw a labelled diagrammatic view of human male reproductive system.[Delhi 2014]

Ans.**Male reproductive system**

Male reproductive system includes a pair of testes, accessory ducts, glands and the external genitalia.

(i)**Testes** are located outside the abdominal cavity within a pouch called Scrotum maintains the low temperature of the testes (2-2.5°C lower than the normal body temperature) required for spermatogenesis.

(a)Each testis is oval-shape (length 4-5 cm and width 2-3 cm) and covered by a dense covering called **tunica albuginea**.

(b)Internally it is divided into about 250 compartments known as **testicular lobules.**

(c)Each lobule contains 1-3 highly coiled (structural and functional units of testis) called **seminiferoustubules** in which sperms are produced.

(d)Seminiferous tubule is lined on its inside by two types of cells called **male germ cells** (spermatogonia) and **Sertoli cells.**

(e)Male germ cells undergo meiotic divisions finally leading to sperm formation.

(f)Sertoli cells provide nutrition to the germ cells.

(g)Interstitial spaces are present in outside regions of seminiferous tubules which contain small blood vessels and interstitial cells or Leydig cells.

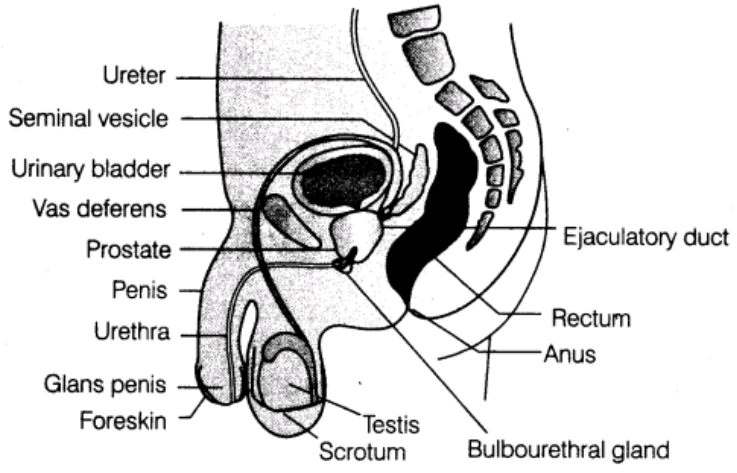
(h)Leydig cells synthesise and secrete the testicular hormones called **androgens**

(ii)**Male accessory ducts** include rete testis, vasa efferentia, epididymis and vas deferens.

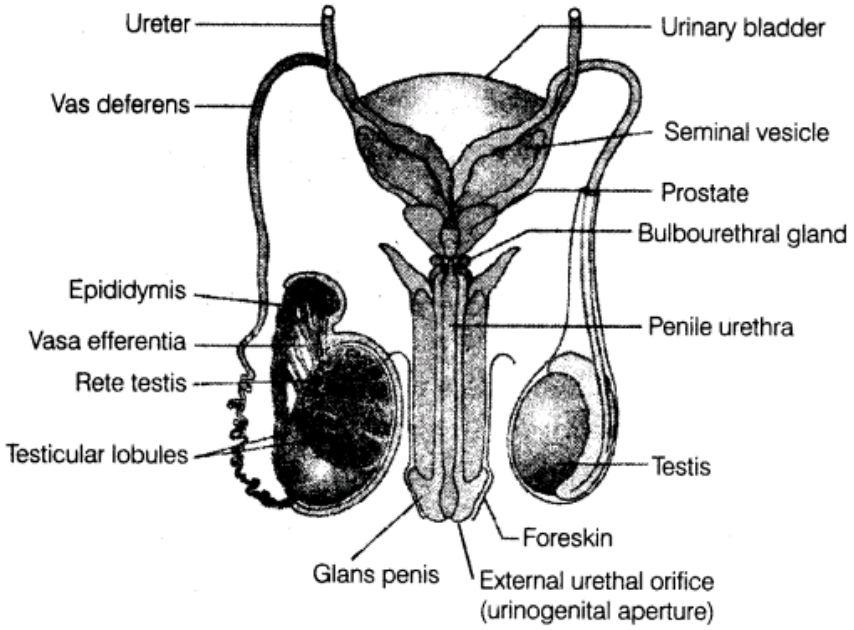
(a)The intratesticular duct system starts with tubuli recti, which are short, straight end segments of the seminiferous tubules. These tubules connect the seminiferous tubules to the highly anastomosing, cuboidal epithelium-lined channels called **rete testis.**

(b)From rete testis, 10-25 fine tubules arise called **vasa efferentia** that leave the testis and open into the epididymis.

(c)**Epididymis** leads to vas deferens that ascends to the abdomen and loops over the urinary bladder



Diagrammatic sectional view of male pelvis showing reproductive system



Diagrammatic view of male reproductive system
(part of testis is open to show inner details)

Urinary bladder receives a duct from the seminal vesicle to form ejaculatory duct that runs through the prostate and opens into urethra.

(e) Urethra receives the ducts of prostate gland and the bulbourethral gland (Cowper's glands) a little ahead and runs through the penis to its external opening called urethral meatus.

(iii) The **accessory glands** of male reproductive system include

(a)A pair of **seminal vesicles**, a **prostate gland** and a pair of **bulbourethral glands** (Cowper's glands).

(b)The secretion of all these glands is called **seminal plasma**

(c)Seminal plasma contains fructose, calcium and some enzymes. It is to provide nutrition to the spermatozoa, while travelling through female reproductive tract.

(d)Seminal plasma along with sperms is called **semen.**

(e)Secretion of bulbourethral glands also helps in the lubrication of the penis.

(iv)**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.**

9.Draw a labelled diagram of the reproductive system in human female.[All India 2011]

Ans. Female reproductive system

Female reproductive system consists of a pair of ovaries, secondary sex organs, external genitalia and mammary glands.

(i)**Ovaries** are primary female sex organs which produce female gametes called ova and secrete the female sex hormones.

(a)These are located one on each side of the lower abdomen.

(b)It is almond-shaped, 2-4 cm in length, 1.5 cm in width.

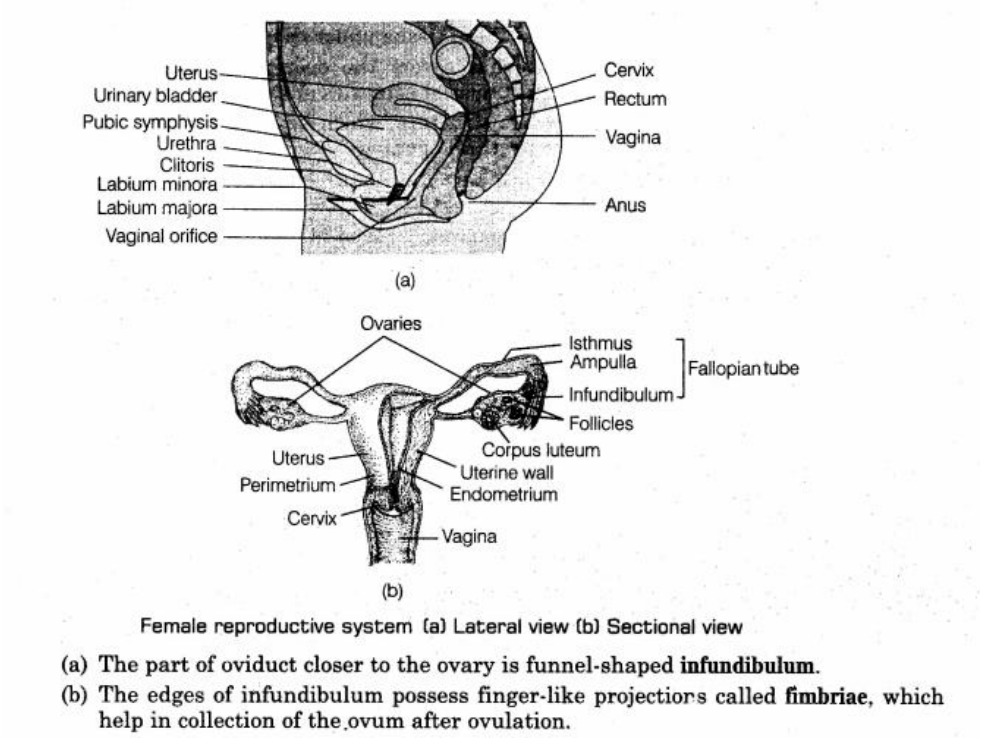
(c)It is connected to the pelvic wall and uterus by ligaments.

(d)Each ovary is covered by a thin epithelium which encloses the ovarian stroma.

(e)Stroma is divided into two regions, i.e. peripheral cortex and inner medulla.

(ii)The female **accessory ducts** constitute **oviducts** (Fallopian tubes), **uterus** and **vagina.**

(iii)Each Fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus.



Female reproductive system (a) Lateral view (b) Sectional view

(a) The part of oviduct closer to the ovary is funnel-shaped **infundibulum**.
(b) The edges of infundibulum possess finger-like projections called **fimbriae**, which help in collection of the ovum after ovulation.

(c)Infundibulum leads to a wider part of the oviduct called

(d)**Isthmus** is the last part of the oviduct, which has a narrow lumen and it joins the uterus.

(iv)**Uterus** or **womb** is a pear-shaped muscular organ. It is attached to the pelvic wall and supported by ligaments.

(a)Wall of the uterus has three layers of tissue.

(b)**Perimetrium** is the outermost thin membranous layer, **myometrium** is the middle thick layer of smooth muscles and **endometrium** is the innermost glandular layer which lines the uterine cavity.

(c)Uterus opens into the **vagina** through a narrow cervix, its cavity is called cervical canal, which along with vagina forms birth canal.

(d)Endometrium layer undergoes cyclic changes during menstrual cycle.

(e)Smooth muscles in myometrium contract during parturition to deliver the baby.

(v)**Vagina** is a muscular tube-like structure that opens to the outside. It receives spermatozoa during insemination and serve as birth canal.

(vi)**Female external genitalia** include mons pubis, labia majora, labia minora, clitoris and hymen.

(a)**Mons pubis** is a cushion of fatty tissue covered by skin and pubic hair.

(b)**Labia majora** are fleshy folds of tissue which extend down from the mons pubis and surround the vaginal opening.

(c)**Labia minora** are paired folds of tissue under the labia majora.

(d)**Hymen** is a membrane that covers the opening of vagina partially. It gets ruptured during vigorous physical activities or during the first coitus.

(e)**Clitoris** is a tiny finger-like structure, which lies at the upper junction of the two labia minora above the urethral opening.

(vii)**Mammary glands** (breasts) are paired structures that contain glandular tissue and variable amount of fat.

(a)Glandular tissue of each mammary gland is divided into 15-20 mammary lobes containing the cluster of cells called alveoli.

(b)The cells of alveoli secrete milk, which is stored in the cavities (lumen) of alveoli.

(c)Alveoli open into mammary tubules. The tubules of each lobe join to form a mammary duct.

(d)Several mammary ducts join to form a wider mammary ampulla, which is connected to lactiferous duct through which milk is sucked out.

Gametogenesis

1 Mark Questions

1.When do the oogenesis and the spermatogenesis initiate in human females and males, respectively?[Delhi 2012]

Ans.**Oogenesis** initiates in foetal or embryonic stage of females, whereas **spermatogenesis,** in males starts at puberty.

2.Mention the differences between spermiogenesis and spermiation.[Delhi 2012]

Ans. Difference between spermiogenesis and spermiation is:

Spermiogenesis	Spermiation
It is the process of transforming spermatids into mature spermatozoa or sperms.	Sperms get attached to Sertoli cells to draw nourishment and finally released from seminiferous tubules by the process called spermiation.

3.Where is acrosome present in humans? Write its function.[All India 2012]

Ans.In humans, the acrosome is present in the anterior portion of head of the human sperm. Function Enzymes present in acrosome help in contact and penetration into egg, during fertilisation of the ovum

4.List the changes the primary oocyte undergoes in the tertiary follicular stage in human embryo.[Foreign 2011]

Ans.In human embryo, the primary oocyte grows in size, completes meiosis-l and forms a larger cell, the secondary oocyte and a smaller cell, the first polar body.

2 Marks Questions

5.Write the effect of high concentrations of LH on a mature Graafian follicle. [All India 2014]

Ans. The high concentration of LH induces the rupture of Graafian follicle which results in release of secondary oocyte and thus causing ovulation in females.

6.Differentiate between
(i)Vas deferens and vasa efferentia
(ii)Spermatogenesis andspermiogenesis. [Delhi 2014]

Ans.

(*i*) Differences between vas deferens and vasa efferentia are:

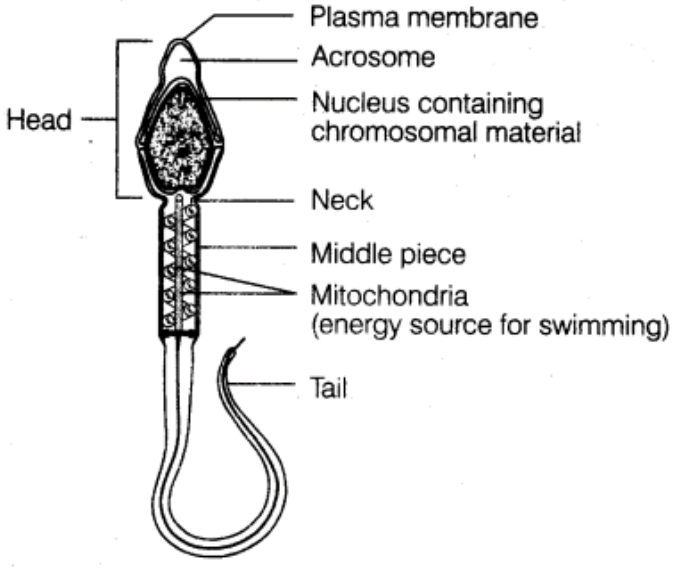
Vas deferens	Vasa efferentia
It is a tube-like structure which conducts the spermatozoa from the epididymis to penis.	It connects the rete testis to epididymis. **(1)**

(*ii*) Differences between spermatogenesis and sperimiogenesis are:

Spermatogenesis	Sperimiogenesis
It is a process of formation of sperms from immature germ cells.	It is a process of transformation of a circular spermatid to a motile spermatozoa. **(1/2)**
Number of cells increased as each spermatogonium produces four spermatids.	No change in number of cells as only one spermatid develops into a spermatozoa. **(1/2)**

7.Draw and label the parts of the head region only of a human sperm.[Delhi 2014 C]

Ans.Diagram showing head of human sperm is The acrosome is filled with enzymes that help in fertilisation of the ovum.



Structure of a sperm

(i)Neck contains two centrioles, a proximal centriole which is necessary for first cleavage division of zygote and a distal centriole, that gives rise to axial filament of tail

(ii)Middle piece possesses many mitochondria to produce energy for the movement of tail to facilitate sperm motility.

(iii)Tail of the sperm consists of an axial filament. Its role is to help movement inside the female reproductive tract towards the ovum for fertilisation.

8.Differentiate between menarche and menopause. [All India 2010]

Ans. Differences between menarche and menopause are:

Menarche	Menopause
It refers to the beginning of menstrual cycle in human female at puberty.	It refers to the stoppage of menstrual cycle at the age of about 45-50 in human female.
It indicates the start of reproductive phase.	It indicates the end of reproductive phase.

9.Differentiate between major structural changes in the human ovary during the follicular and luteal phase of the menstrual cycle.[All India 2010]

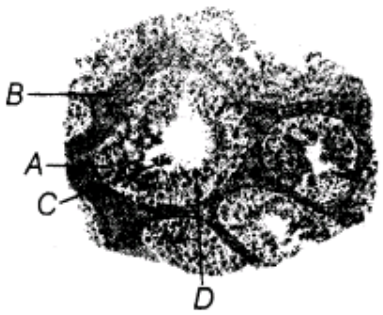
Ans. Differences between follicular and luteal phase are:

Follicular phase	Luteal phase
Primary follicles in the ovary grow to become a mature follicle (Graafian follicle).	The ruptured Graafian follicle transforms into corpus luteum.
It extends for about 10-12 days in a 28 day cycle.	It extends for about 13-14 days after ovulation in a 28 day cycle.
Changes in follicular phase are due to high level of FSH, LH and oestrogen.	It secretes large amount of progesterone.

10.Mention the fate of corpus luteum and its effect on the uterus in the absence of fertilisation of the ovum in human female. [Foreign 2010]

Ans.The corpus luteum degenerates in the absence of fertilisation. The endometrium layer of uterus disintegrates along with blood and unfertilised ovum leading to menstrual flow.

11.Study the sectional view of human testis showing seminiferous tubules given below.



(i)Identify A, B and C.
(ii)Write the function of A and D.[Foreign 2010]

Ans.(i) A-Spermatogonia, 8-Interstitial cells C-Spermatozoa.

(ii) A-Spermatogonia produce the .. spermatozoa (sperms) D-Sertoli cells provide nutrition to the germ cells.

12.How and at what stage of menstrual cycle is corpus luteum formed in human females? When does it regress? [Delhi 2010c]

Ans.After ovulatory phase (ovulation), the luteal phase starts. The remaining parts of ruptured Graafian follicle transform as corpus luteum in this phase. The corpus luteum secretes large amount of progesterone which is essential for the maintenance of endometrium.In the absence of fertilisation, the corpus luteum degenerates causing disintegration of endometrium leading to menstruation

13.Explain the role of Sertoli cells in the development of sperms. [Delhi 2010 c]

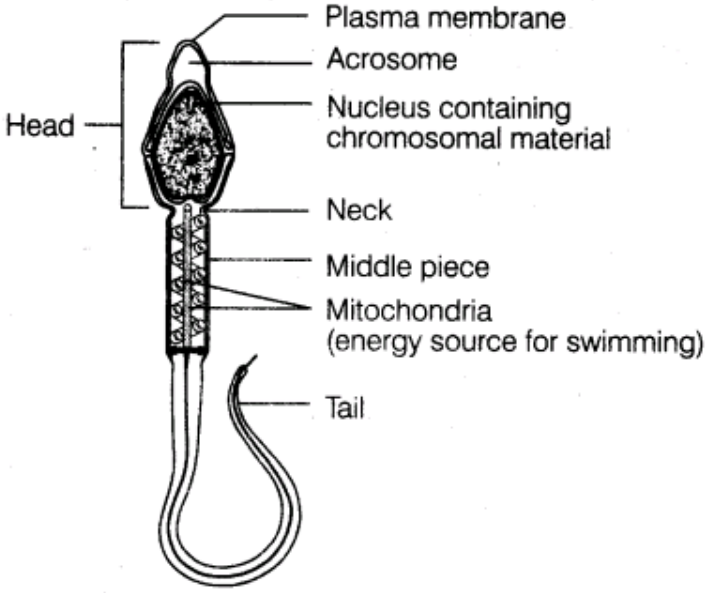
Ans.Sertoli cells provide nourishment to developing sperms. After spermiogenesis, sperm heads become embedded in the Sertoli cells to draw nutrition for further development.

14.Mention the role of gonadotropins in menstrual cycle. On what day of the menstrual cycle do the gonadotropins reach a peak?[All India 2009]

Ans. Gonadotropins, i.e. LH and FSH levels increases gradually during the follicular phase and secretory phase respectively FSH stimulate follicular development and secretion of oestrogens by the growing follicles, while LH stimulates the corpus luteum to secrete progesterone.Both LH and FSH attain a peak level in the middle of cycle, i.e. about 14th day of menstrual cycle.

15.Draw a labelled diagram of a human sperm. [All India 2008 C]

Ans. Diagram showing head of human sperm is The acrosome is filled with enzymes that help in fertilisation of the ovum.



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16.Mention the sites of action of the 'hormone GnRH and FSH during spermatogenesis in human males.Give one, function of each of the hormones [All India 2008 C]

Ans. GnRH or gonadotropin releasing hormone is a hypothalamic hormone. Spermatogenesis starts at puberty due to its significant increase.Its increased levels acts on anterior pituitary gland and stimulates the secretion of LH and FSH. LH acts on the Leydig cells and stimulates synthesis and secretion of androgens. FSH acts on Sertoli cells, which stimulates the secretion of some factors that help in spermiogenesis.

3 Marks Questions

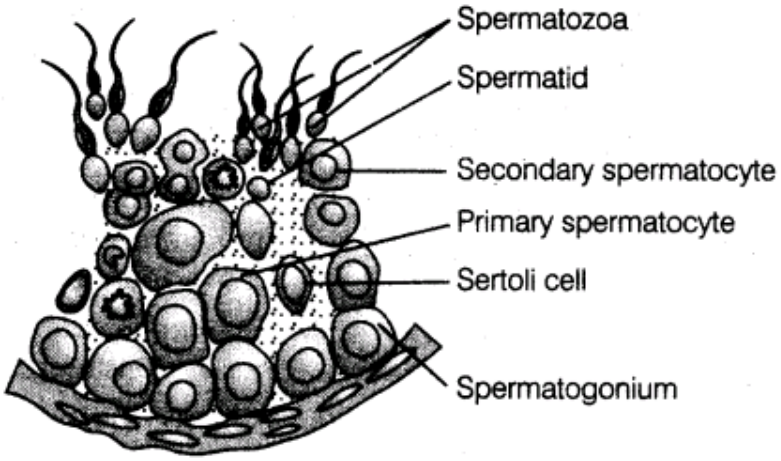
17.Draw a labelled diagram of the sectional view of a human seminiferous tubule (six parts to be labelled).[Delhi 2014,2010]

Ans.**Spermatogenesis** is production of sperms in males.

(i) In testis, the immature male germ cells (spermatogonia) produce sperms by **spermatogenesis** that begins at puberty.

(ii)**Spermatogonia** (sing, spermatogonium) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers.

(iii) Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called **primary spermatocytes** periodically undergo meiosis.



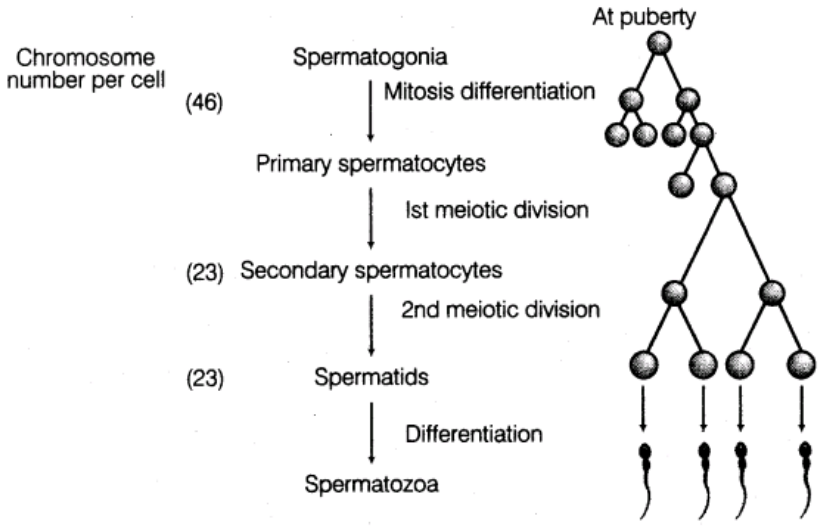
Sectional view of a seminiferous tubule (enlarged)

(iv)A primary spermatocyte undergo first meiotic division leading to two equal, haploid cells called **secondary spermatocytes**, which contains only 23 chromosomes each.

(v)The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid **spermatids.**

(vi) The spermatids are transformed into spermatozoa (sperms) by the process called **spermiogenesis.**

(vii) Sperm heads are embedded in the Sertoli cells and are finally released from the seminiferous tubules by the process called **spermiation**.



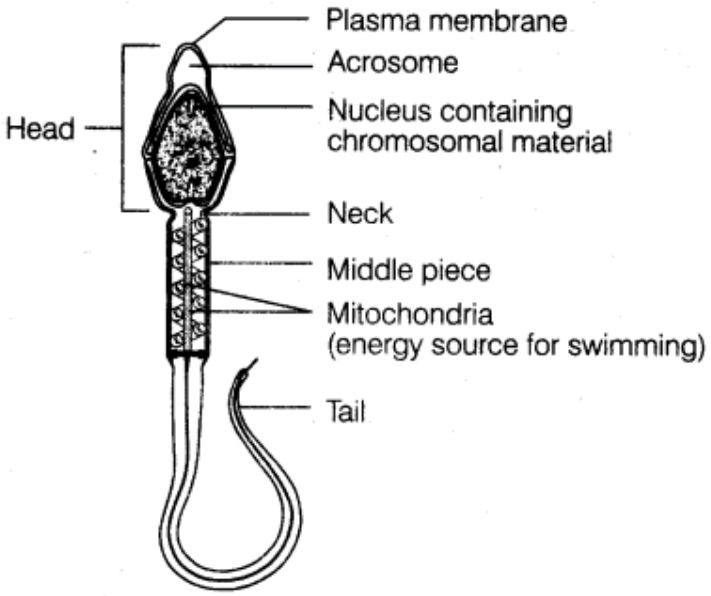
Spermatogenesis in human male

18.Explain the hormonal control of spermatogenesis in humans.[Foreign 2014]

Ans. GnRH or gonadotropin releasing hormone is a hypothalamic hormone. Spermatogenesis starts at puberty due to its significant increase.Its increased levels acts on anterior pituitary gland and stimulates the secretion of LH and FSH. LH acts on the Leydig cells and stimulates synthesis and secretion of androgens. FSH acts on Sertoli cells, which stimulates the secretion of some factors that help in spermiogenesis

19.Draw a diagram of human sperm. Label only those parts along with their functions, that assist the sperm to reach and gain entry into the female gamete. [Foreign 2014]

Ans.The parts of a human sperm, along with their functions that assist sperm to reach and gain entry into ovum are labelled as:
Diagram showing head of human sperm is The acrosome is filled with enzymes that help in fertilisation of the ovum.



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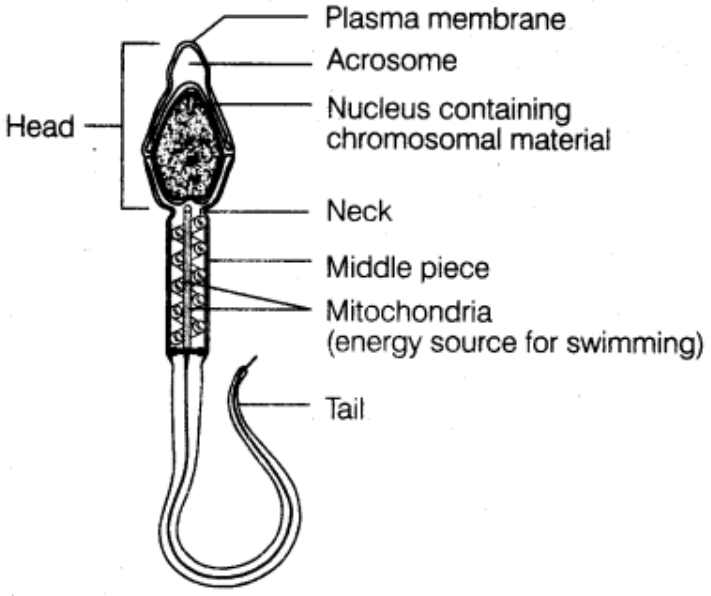
(ii)Middle piece possesses many mitochondria to produce energy for the movement of tail to facilitate sperm motility.

(iii)Tail of the sperm consists of an axial filament. Its role is to help movement inside the female reproductive tract towards the ovum for fertilisation.

20.Draw a labelled diagram of the microscopic structure of a human sperm. [Foreign 2011]

Ans.Diagram showing head of human sperm is The acrosome is filled with enzymes that help in fertilisation of the ovum.



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21.Describe how the changing levels of FSH, LH and progesterone during menstrual cycle induce changes in the ovary and the uterus in human female? [Foreign 2011]

Ans. Menstrual cycle in human female is under hormonal control in the following ways:

(i) Follicular or proliferative phase is under the influence of FSH from the anterior pituitary.

(ii)The follicular cells of mature follicle secrete oestrogens, which control the growth and maintenance of the secondary sex organs like uterus, Fallopian tube, etc.

(iii) FSH and LH reach their peak level around the mid-cycle (14th day). The peak level of LH surge causes the rupture of Graafian follicle and release of ovum (ovulation).

(iv) LH influences the remaining parts of Graafian follicle to transform into corpus luteum.

(v)Corpus luteum secretes large quantity of progesterone in the luteal phase. Progesterone is required for the growth and maintenance of endometrium of uterus for implantation.

(vi)In the absence of fertilisation, the high levels of progesterone exert negative feed back on the pituitary. This stops the secretion of LH and corpus luteum degenerates leading to menstruation

22.Spermatogenesis in human males is a hormone regulated process. Justify. [Foreign 2010]

Ans. Hormonal control of spermatogenesis in human males:

(i) Gonadotropin Releasing Hormone (GnRH) is released significantly from the hypothalamus during puberty.

(ii) GnRH stimulate anterior pituitary to secrete gonadotropins, i.e. LH and FSH or Interstitial Cell Stimulating Hormone (ICSH).

(iii)Leuteinising Hormone (LH) acts on Leydig cells to stimulate synthesis and secretion of androgens. Androgens stimulates the process of spermatogenesis.

(iv) Follicle Stimulating Hormone (FSH) acts on Sertoli cells and stimulates them to secrete certain factors which are necessary for the process of spermiogenesis.

23.Mention the target cells of luteinising hormone in human males and females. Explain the effect and the changes which the hormone induces in each case.[Delhi 2009]

Ans.(i)Target cells of Luteinising Hormone in Males are Leydig cells.Females are mature follicles.

(ii) LH stimulates the Leydig cells in male to secrete testosterone, which controls spermatogenesis. In females, LH stimulates ovulation, formation of corpus luteum and secretion of progesterone by corpus luteum.

24.Name the source of gonadotropins in human females. Explain the changes brought about in the ovary by these hormones during menstrual cycle. [Foreign 2009]

Ans.The source of gonadotropins is anterior pituitary.

Menstrual cycle is a rhythmic change in the reproductive organs of the female primates (monkey, apes and humans).

(i) The first menstruation begins at puberty and is called **menarche.**

(ii)Average interval of menstruation in human female is about 28-29 days.

(iii)The cyclic events starting from one menstruation till the next one constitute **menstrual cycle.**

(iv)The four phases of menstrual cycle are:

Menstrual Phase

(a)Cycle starts with this phase and the menstrual flow occurs for 3-5 days.

(b)It occurs due to breakdown of endometrial lining of the uterus. The blood vessels form liquid which along with unfertilised ovum comes out through the vagina.

(c)Menstruation occurs only if fertilisation does not takes place.

(d)Lack of menstruation generally indicates pregnancy but may also be due to stress, poor health, diseases, etc.

Follicular or Proliferative Phase

(a)Menstrual phase is followed by the follicular phase.

(b)The primary follicle in the ovary grow to become a fully mature Graafian follicle and simultaneously the endometrium of uterus regenerates through proliferation.

(c)Pituitary and ovarian hormones induce the changes in ovary and uterus.

(d)LH and FSH levels increase gradually during this phase and stimulates follicular development.

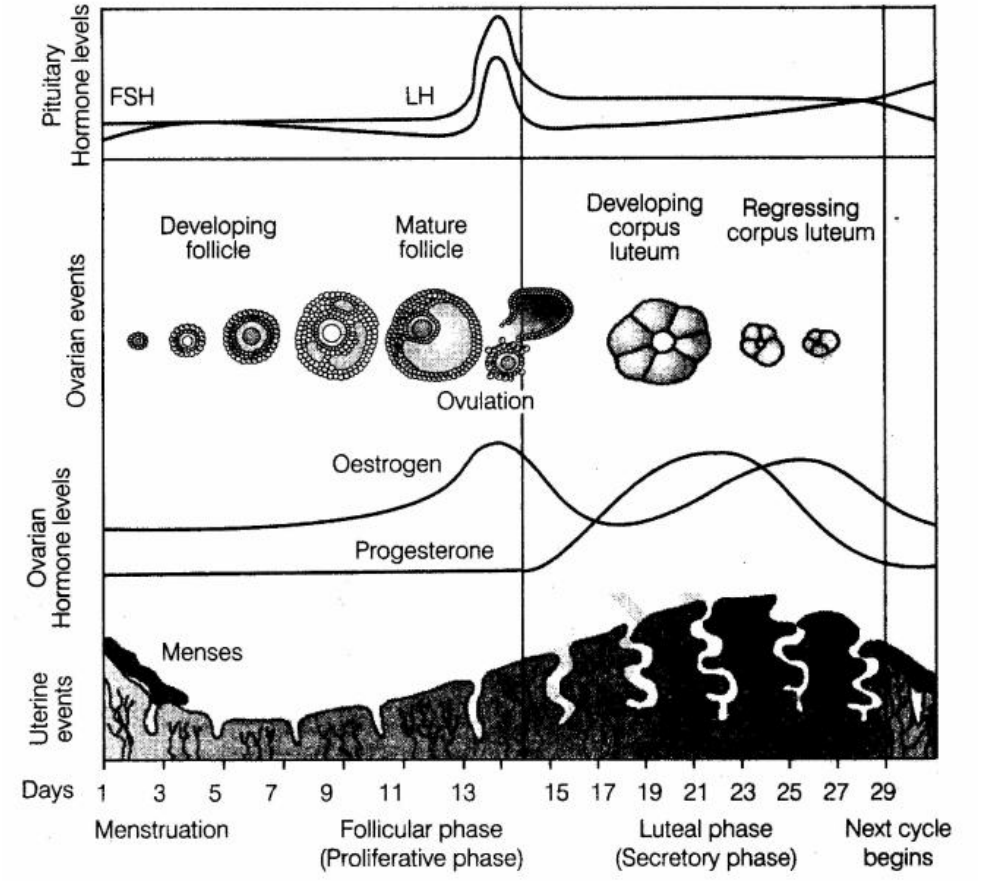
(e)The growing follicles secrete oestrogens.

(f)Both LH and FSH attain highest level during mid-cycle (about 14^{th} day).

Ovulatory Phase

(a) Rapid secretion of LH leading to its maximum level during the mid-cycle is called LH surge.

(b) The LH surge induces rupture of Graafian follicle, releasing the ovum called **ovulation**



Diagrammatic representation of various events during a menstrual cycle

Luteal Phase/Secretory Phase

(a)Ovulatory phase is followed by the luteal phase.

(b)The remaining parts of the ruptured Graafian follicle changes into corpus luteum.

(c)Corpus luteum secretes large amounts of progesterone, which is required for the maintenance of endometrium.

(d)The thickened endometrium is necessary for the implantation of fertilised ovum and maintenance of pregnancy.

(e)During pregnancy, all the events of menstrual cycle stop and menstruation does not occur.

(f)In case of no fertilisation, the corpus luteum degenerates. This causes rupture of endometrium leading to menstruation – initiation of a new cycle.

(g)In human females, menstrual cycle stops around the age of 50 years called as **menopause**

(v)Menstrual cycle is absent temporarily during pregnancy and lactation periods and permanently after menopause

(vi)Menstruation is also called 'Weeping of uterus for the lost ovum' or 'Funeral of unfertilised eggs'.

25.(i) Draw a sectional view of human ovary. Label the following parts
(a)Primary follicle
(b)Ovum
(c)Graafian follicle
(d)Corpus luteum
(ii) Name the hormones influencing
(a)Ovulation
(b)Development of corpus luteum. [Delhi 2009C]
or
Draw a labelled diagram of a sectional view of human ovary showing various stages of follicles growing in it. [Delhi 2008]

Ans.(I)Oogenesis is the process of formation of a female gamete or ova in the ovary.

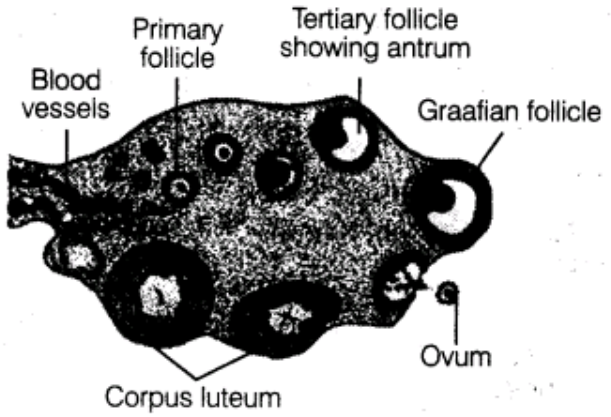
(i)It starts during embryonic stage in a female.

(ii)About a million oogonia are formed in the ovary of the female foetus (of 25 weeks). No new oogonia are formed after birth.

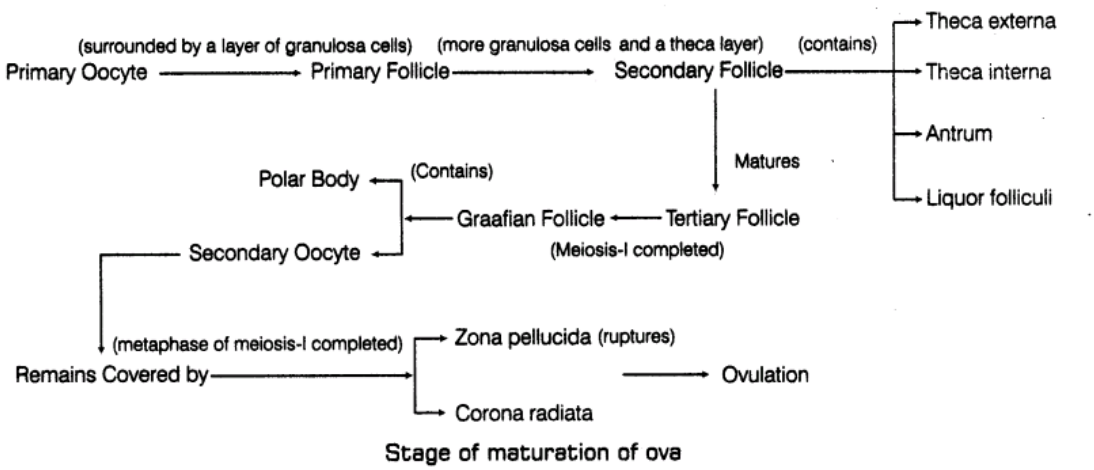
(iii)The oogonial cells start meiotic division, enter into prophase-I, get temporarily arrested at that stage and are called as primary oocytes.

(iv)Each primary oocyte then gets surrounded by a layer of granulosa cells called primary follicle.

(v)A large number of primary follicles degenerate during the phase from birth to puberty. As a result, about 60,000-80,000 primary follicles are left in each ovary at puberty.



Sectional view of a ovary



Stage of maturation of ova

(vi)The primary follicles get surrounded by more layers of granulosa cells and a new theca and are called **secondary follicles.**

(vii)The thecal layer in secondary follicles become organised into an outer theca externa and an inner theca interna. This stage is called **tertiary follicle.**

(viii)Tertiary follicle is characterised by a fluid-filled cavity called **antrum.**

(ix)At this stage, the primary oocyte within the tertiary follicle grows in size and completes its first meiotic division.

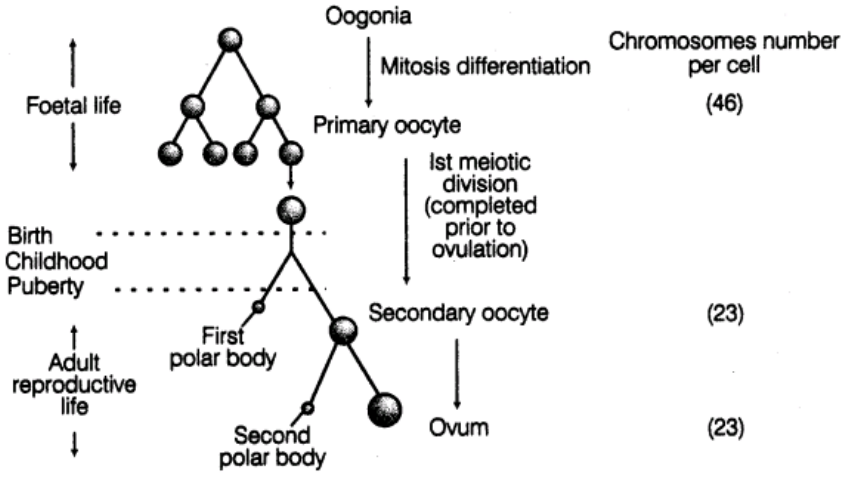
(x)The first meiotic division which is unequal results in the formation of haploid **secondary oocyte** and tiny first polar body.

(xi)Secondary oocyte retains bulk of the nutrient rich cytoplasm of the primary oocyte.

(xii)The tertiary follicle develops into a mature follicle or **Graafian follicle.**

(xiii)The secondary oocyte forms a new membrane called **zona pellucida** surrounding it.

(xiv)The Graafian follicle ruptures to release the secondary oocyte (ovum) from the ovary by the process called **ovulation.**



Oogenesis in human female showing formation of ovum

Differences between spermatogenesis and oogenesis

Spermatogenesis	Oogenesis
Produces male gametes (sperm) • occurs in the seminiferous tubules (in testes) • involves meiosis, occurs throughout life after puberty • may produce 400,000,000 per day.	Produces female gametes (oocytes) • occurs in the ovaries • involves meiosis, occurs after puberty until menopause • humans normally produce one oocyte during each ovarian cycle.
Primary spermatocyte divide equally to form two similar secondary spermatocytes.	Primary oocyte divide unequally to form one large secondary oocyte and a small polar body.
One spermatogonium produces four functional spermatozoa.	An oogonium produces one functional ovum and two non-functional polar bodies.

(II)(a) **Ovulation** Luteinising Hormone (LH) and FSH
(b)Development of corpus luteum is influenced by LH but corpus luteum secretes progesterone.

26.Explain the development of an ovum from an oogonium in a human female. [All India 2009 C]

Ans.Development of ovum from an oogonium in a human female.

(i) Oogonium which enters meiosis-l is the primary oocyte. Division remains suspended in prophase-l.

(ii)Primary oocyte becomes surrounded by a layer of granulosa cells and is called the primary follicle.

(iii) Primary follicle gets surrounded by more granulosa cells and a thecal layer. This stage is called secondary follicle.

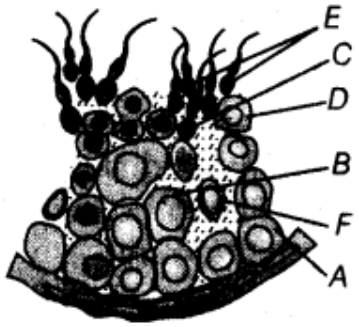
(iv) A cavity develops in the secondary follicle around the primary oocyte called antrum.

(v)Thecal layer becomes organised into an outer theca externa and an inner theca interna. This stage is called tertiary follicle.

(vi)Primary oocyte completes its meiosis-I and forms a large cell-the secondary oocyte and a tiny cell-the first polar body.

(vii)Tertiary follicle transforms into a mature follicle called Graafian follicle (mature ovum).

27.Study the figure given below



(i)Pick out and name the cells that undergo spermiogenesis.
(ii)Name A and B What is the difference between them with reference to the number of chromosomes?
(iii)Pick out and name the motile cells.
(iv)What is F cell? Mention its function.
(v)Name the structure of which the diagram is a part. [Foreign 2008]

Ans.(i)The cells that undergo spermiogenesis are:C-Spermatids, D-Secondary spermatocyte

(ii) A-Spermatogonium B-Primary spermatocyte They both are diploid and have 46 chromosomes in each.

(iii)E-Spermatozoa are motile cells.

(iv) E-Sertoli cells. It provides nourishment to the germ cells.

(v) The above diagram is a section of seminiferous tubule.

5 Marks Questions

28.(i) How is 'oogenesis' markedly different from 'spermatogenesis' with respect to the growth till puberty in the humans?
(ii)Draw a sectional view of human ovary and label the different follicular stages, ovum and corpus luteum. [Delhi 2014]

Ans.(i) Oogenesis is markedly different from spermatogenesis in the following aspects.

Spermatogenesis	Oogenesis
It occurs in males from puberty till the complete life cycle.	It starts before birth during embryonic development and occurs till menopause.
A single spermatogonium after second meiotic division form four haploid spermatids, that mature to form spermatozoa.	A single oogonium, after second meiotic division, produces one ovum and two non-functional polar bodies.
The process of spermatogenesis, i.e. second meiotic division completes in testes and releases mature sperms.	The second meiotic division of oogenesis completes in Fallopian tube when sperm enters the secondary oocyte.

(ii)**Oogenesis** is the process of formation of a female gamete or ova in the ovary.

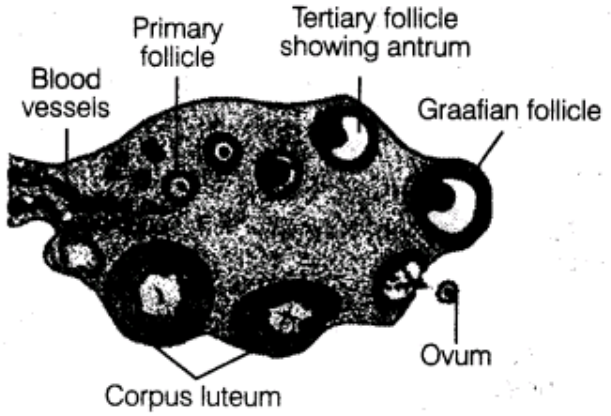
(i)It starts during embryonic stage in a female.

(ii)About a million oogonia are formed in the ovary of the female foetus (of 25 weeks). No new oogonia are formed after birth.

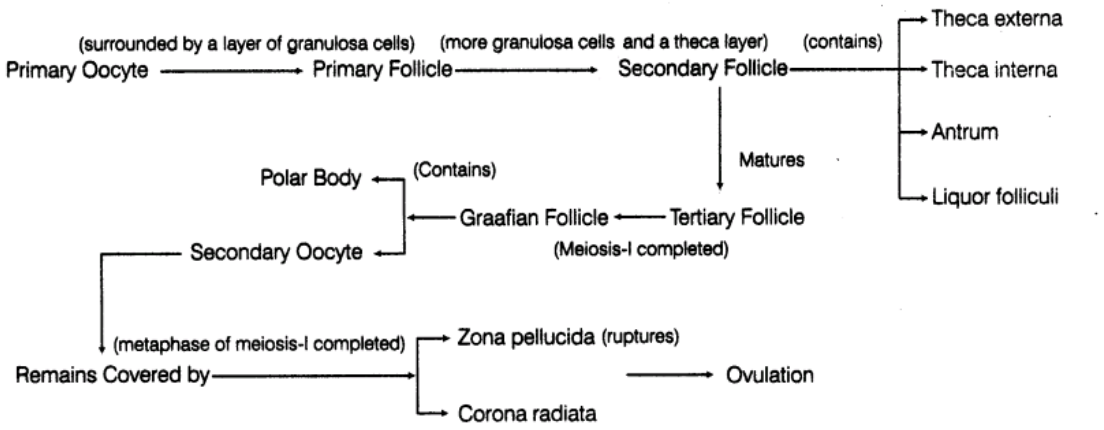
(iii)The oogonial cells start meiotic division, enter into prophase-I, get temporarily arrested at that stage and are called as primary oocytes.

(iv)Each primary oocyte then gets surrounded by a layer of granulosa cells called primary follicle.

(v)A large number of primary follicles degenerate during the phase from birth to puberty. As a result, about 60,000-80,000 primary follicles are left in each ovary at puberty.



Sectional view of a ovary



Stage of maturation of ova

(vi)The primary follicles get surrounded by more layers of granulosa cells and a new theca and are called **secondary follicles.**

(vii)The thecal layer in secondary follicles become organised into an outer theca externa and an inner theca interna. This stage is called **tertiary follicle.**

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(ix)At this stage, the primary oocyte within the tertiary follicle grows in size and completes its first meiotic division.

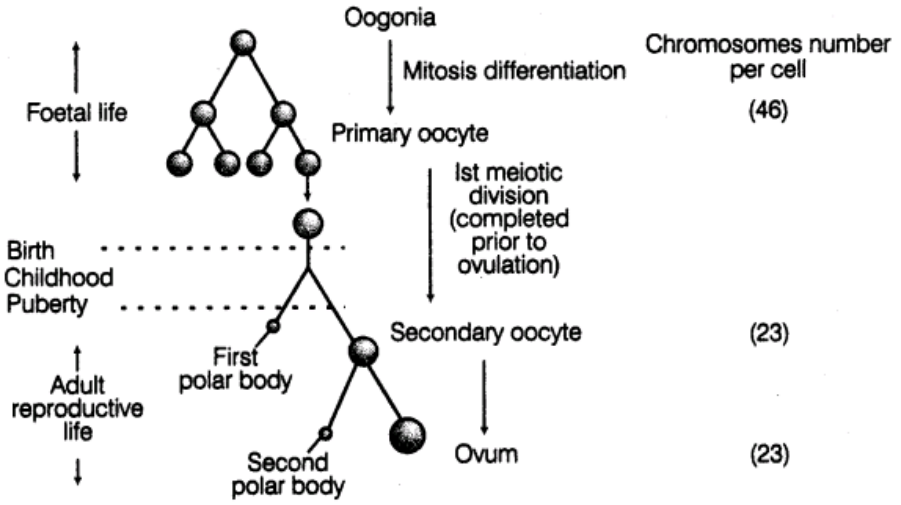
(x)The first meiotic division which is unequal results in the formation of haploid **secondary oocyte** and tiny first polar body.

(xi)Secondary oocyte retains bulk of the nutrient rich cytoplasm of the primary oocyte.

(xii)The tertiary follicle develops into a mature follicle or **Graafian follicle.**

(xiii)The secondary oocyte forms a new membrane called **zona pellucida** surrounding it.

(xiv)The Graafian follicle ruptures to release the secondary oocyte (ovum) from the ovary by the process called **ovulation.**



Oogenesis in human female showing formation of ovum

Differences between spermatogenesis and oogenesis

Spermatogenesis	Oogenesis
Produces male gametes (sperm) • occurs in the seminiferous tubules (in testes) • involves meiosis, occurs throughout life after puberty • may produce 400,000,000 per day.	Produces female gametes (oocytes) • occurs in the ovaries • involves meiosis, occurs after puberty until menopause • humans normally produce one oocyte during each ovarian cycle.
Primary spermatocyte divide equally to form two similar secondary spermatocytes.	Primary oocyte divide unequally to form one large secondary oocyte and a small polar body.
One spermatogonium produces four functional spermatozoa.	An oogonium produces one functional ovum and two non-functional polar bodies.

29.Explain the ovarian and uterine events that occur during a menstrual cycle in a human female under the influence of pituitary and ovarian hormones, respectively. [Delhi 2014]

Ans.The cycle of events starting from one menstruation till next in female primates is called menstrual cycle. It comprises of four phases which is regulated by both pituitary and ovarian hormones that affects ovaries and uterus, respectively.
The events occurring in a menstrual cycle are:

Menstrual phase (from 3-5 days in a 28 day cycle)	Initiated by reduced secretion of LH (pituitary hormone) and progesterone and oestrogen (ovarian hormone). The endometrium breaks down and blood along with unfertilised ovum constitute menstrual flow.
Follicular phase (from 6-13th day in a 28 day cycle)	The FSH (Follicle Stimulating Hormone) secreted by anterior pituitary stimulates ovarian follicle to secrete oestrogens (ov2arian hormone). These oestrogens stimulate proliferation of uterine walls as a result of which endometrium gets thickened (due to rapid cell division and increase in uterine glands and blood vessels).
Ovulatory phase (14th day in 28 day cycle)	Pituitary hormones LH and FSH reach the highest level in middle of the cycle. Rapid secretion of LH causes ovulation, thus inducing rupture of Graafian follicle and release of ovum and secondary oocyte.
Luteal or secretory phase (from 15-28 days in a 28 day cycle)	The pituitary hormone LH stimulates the remaining cells of ovarian follicles to develop corpus luteum. This corpus luteum secretes large amount of progesterone (ovarian hormone) necessary for maintenance of endometrium (thickening) as such endometrium is required for implantation of fertilised ovum and pregnancy. In the absence of fertilisation, the hormone levels are reduced (LH and progesterone) and endometrium disintegrates leading to onset of another menstrual cycle.

30.Schematically represent and explain the events of spermatogenesis in humans.[Delhi 2014 C]

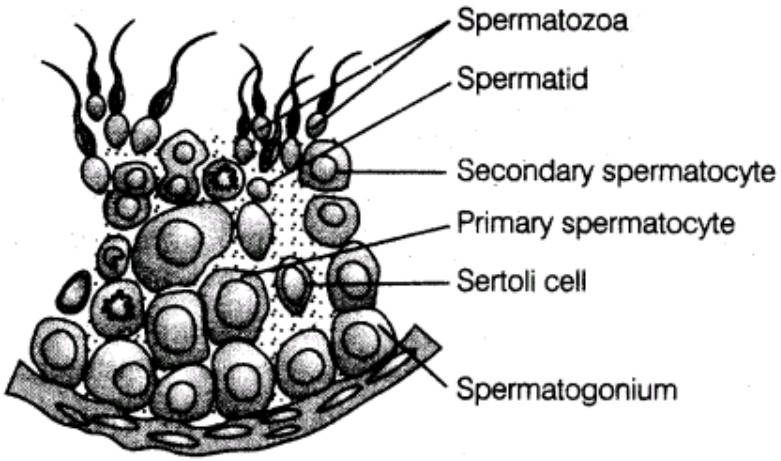
Ans.(i) **Spermatogenesis in human male.**

Spermatogenesis is production of sperms in males.

(i) In testis, the immature male germ cells (spermatogonia) produce sperms by **spermatogenesis** that begins at puberty.

(ii)**Spermatogonia** (sing, spermatogonium) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers.

(iii) Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called **primary spermatocytes** periodically undergo meiosis.



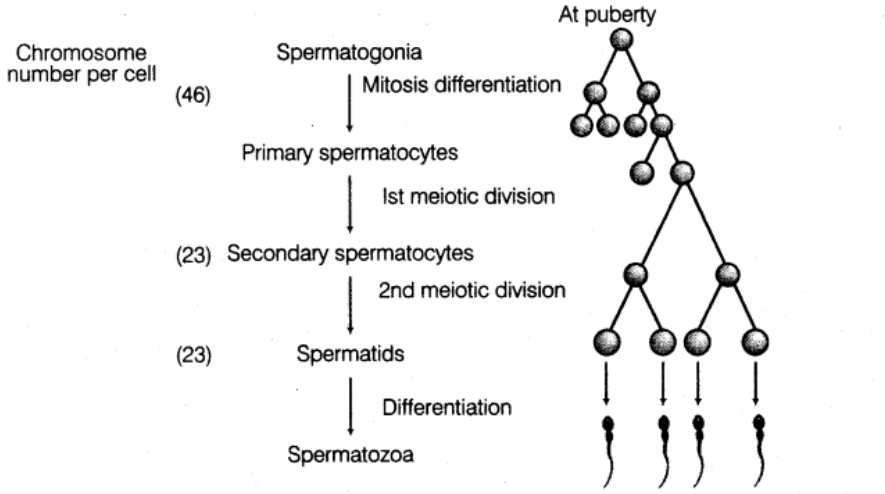
Sectional view of a seminiferous tubule (enlarged)

(iv)A primary spermatocyte undergo first meiotic division leading to two equal, haploid cells called **secondary spermatocytes**, which contains only 23 chromosomes each.

(v)The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid **spermatids.**

(vi) The spermatids are transformed into spermatozoa (sperms) by the process called **spermiogenesis.**

(vii) Sperm heads are embedded in the Sertoli cells and are finally released from the seminiferous tubules by the process called **spermiation**.



Spermatogenesis in human male

(ii)Spermatogenesis in humans.

(a)The process of formation of spermatozoa in the seminiferous tubules of testes is called spermatogenesis.

(b)The spermatogonia are present in the inner lining of seminiferous tubules. They multiply by mitotic division arid increase in number.

(c)Some of them undergo meiosis and become the primary spermatocytes.

(d)The primary spermatocytes undergo meiosis-1 and forms two haploid secondary spermatocytes.

(e)The secondary spermatocytes undergo meiosis-ll and form four equal sized haploid spermatids.

(f)Spermatids transform into the spermatozoa by spermiogenesis

(g)After spermiogenesis, the sperm heads are embedded inthe Sertoli cells and releasedfrom the seminiferous tubules.

31.Explain the different phases of menstrual cycle and correlate the phases with the different levels of pituitary hormones in a human female. [Delhi 2014c]

Ans.The cycle of events starting from one menstruation till next in female primates is called menstrual cycle. It comprises of four phases which is regulated by both pituitary and ovarian hormones that affects ovaries and uterus, respectively.
The events occurring in a menstrual cycle are:

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32.(i) Draw a transverse section of a human ovary showing the sequential development of different follicles up to the corpus luteum.
(ii) Comment on the corresponding ovarian and pituitary hormone levels during these events. [Delhi 2014 C]

Ans.(a)Oogenesis is the process of formation of a female gamete or ova in the ovary.

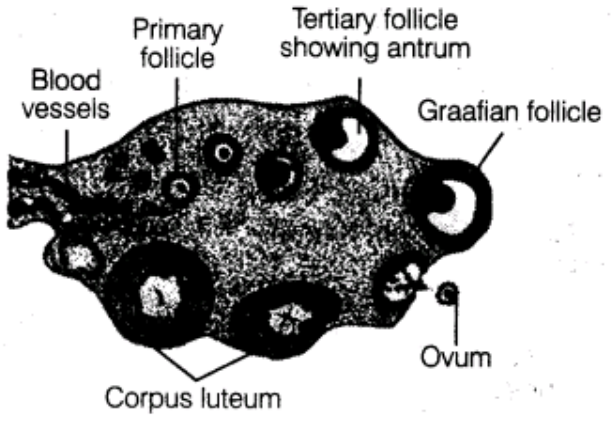
(i)It starts during embryonic stage in a female.

(ii)About a million oogonia are formed in the ovary of the female foetus (of 25 weeks). No new oogonia are formed after birth.

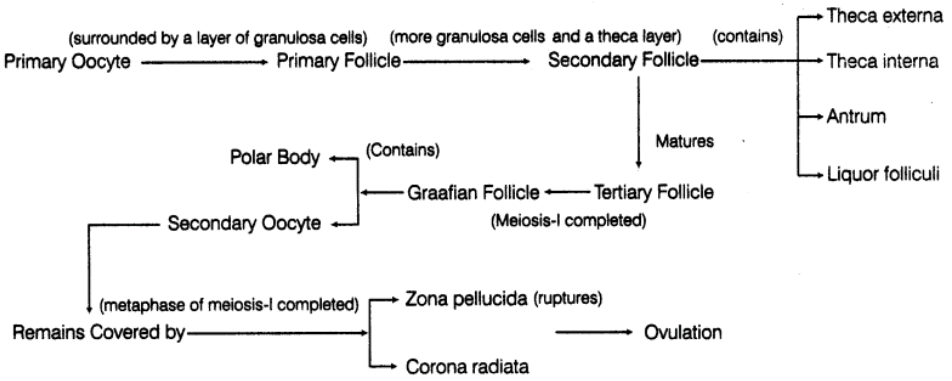
(iii)The oogonial cells start meiotic division, enter into prophase-I, get temporarily arrested at that stage and are called as primary oocytes.

(iv)Each primary oocyte then gets surrounded by a layer of granulosa cells called primary follicle.

(v)A large number of primary follicles degenerate during the phase from birth to puberty. As a result, about 60,000-80,000 primary follicles are left in each ovary at puberty.



Sectional view of a ovary



Stage of maturation of ova

(vi)The primary follicles get surrounded by more layers of granulosa cells and a new theca and are called secondary follicles.

(vii)The thecal layer in secondary follicles become organised into an outer theca externa and an inner theca interna. This stage is called tertiary follicle.

(viii)Tertiary follicle is characterised by a fluid-filled cavity called antrum.

(ix)At this stage, the primary oocyte within the tertiary follicle grows in size and completes its first meiotic division.

(x)The first meiotic division which is unequal results in the formation of haploid secondary oocyte and tiny first polar body.

(xi)Secondary oocyte retains bulk of the nutrient rich cytoplasm of the primary oocyte.

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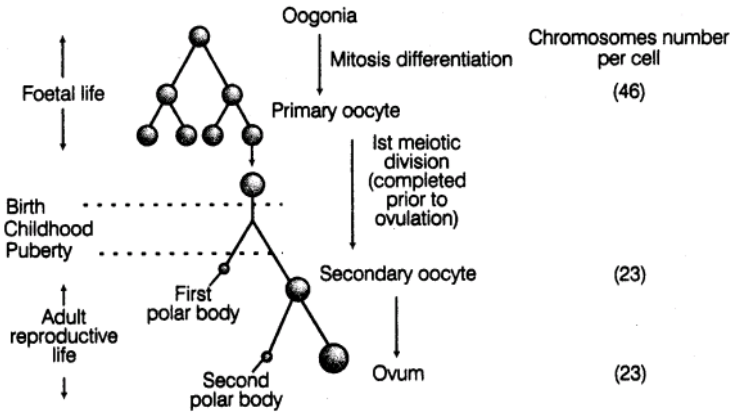

Oogenesis in human female showing formation of ovum

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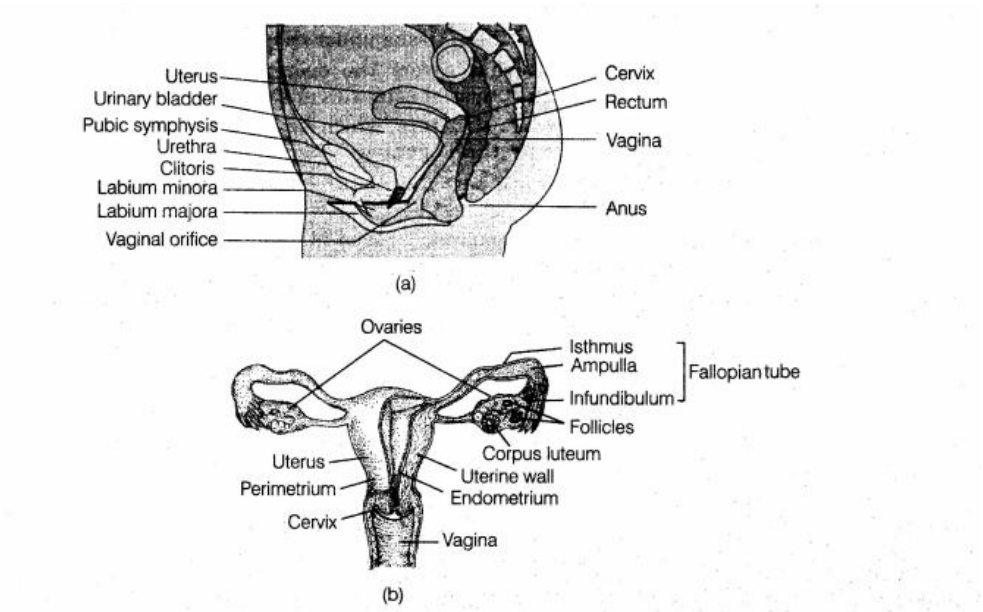
One spermatogonium produces four functional spermatozoa.	An oogonium produces one functional ovum and two non-functional polar bodies.

(b) The level of correspondingovarian and pituitary hormones during the above described events in menstrual cycle can be explained with the help of given graph.



Female reproductive system (a) Lateral view (b) Sectional view

(a) The part of oviduct closer to the ovary is funnel-shaped **infundibulum**.

(b) The edges of infundibulum possess finger-like projections called **fimbriae**, which help in collection of the ovum after ovulation.

The pituitary hormones FSH and LH gradually increases during development of follicle (follicular phase) and reaches its peak level which induces ovulation.**The ovarian hormones** Oestrogen increases gradually till ovulation but decreases with increase in progesterone secretions by corpus luteum (after ovulation). These hormone secretions are reduced if ovum is not fertilised and corpus luteum degenerates, leading to menstrual flow.

33.(i) Draw a diagrammatic sectional view of a human seminiferous tubule and label Sertoli cells, primary spermatocyte, spermatogonium and spermatozoa in it.
(ii)Explain the hormonal regulation of the process of spermatogenesis.[All India 2013]

Ans.(i)

(*i*) Differences between vas deferens and vasa efferentia are:

Vas deferens	Vasa efferentia
It is a tube-like structure which conducts the spermatozoa from the epididymis to penis.	It connects the rete testis to epididymis. **(1)**

(*ii*) Differences between spermatogenesis and sperimiogenesis are:

Spermatogenesis	Sperimiogenesis
It is a process of formation of sperms from immature germ cells.	It is a process of transformation of a circular spermatid to a motile spermatozoa. **(1/2)**
Number of cells increased as each spermatogonium produces four spermatids.	No change in number of cells as only one spermatid develops into a spermatozoa. **(1/2)**

(ii) Hormonal control of spermatogenesis in human males:

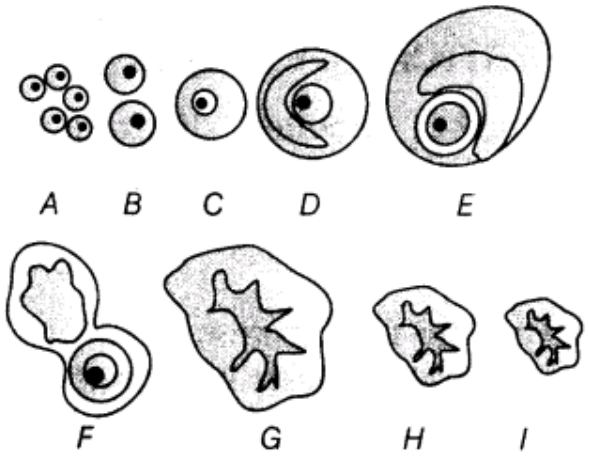
(a) Gonadotropin Releasing Hormone (GnRH) is released significantly from the hypothalamus during puberty.

(b) GnRH stimulate anterior pituitary to secrete gonadotropins, i.e. LH and FSH or Interstitial Cell Stimulating Hormone (ICSH).

(c)Leuteinising Hormone (LH) acts on Leydig cells to stimulate synthesis and secretion of androgens. Androgens stimulates the process of spermatogenesis.

(d) Follicle Stimulating Hormone (FSH) acts on Sertoli cells and stimulates them to secrete certain factors which are necessary for the process of spermiogenesis.

34.The following is the illustration of the sequence of ovarian events (A-I) in a humans female.



(i)Identify the figures that illustrates ovulation and mention the stage of oogenesis it represents.
(ii)Name the ovarian hormone and the pituitary hormone that have caused the above mentioned event.
(iii)Explain the changes that occur in the uterus simultaneously in anticipation.
(iv)Write the differences between C and H
(v)Draw a labelled sketch of the structure of a human ovum prior to fertilisation.[Delhi 2012]

Ans.(i)Figure'Fillustratesovulation.ltrepresents the ovulatory stage of oogenesis.

(ii)Progesterone is the ovarian hormone released during ovulation. Follicle Stimulating Hormone (FSH) and Luteinising Hormone (LH) are the pituitary hormones released during ovulation.

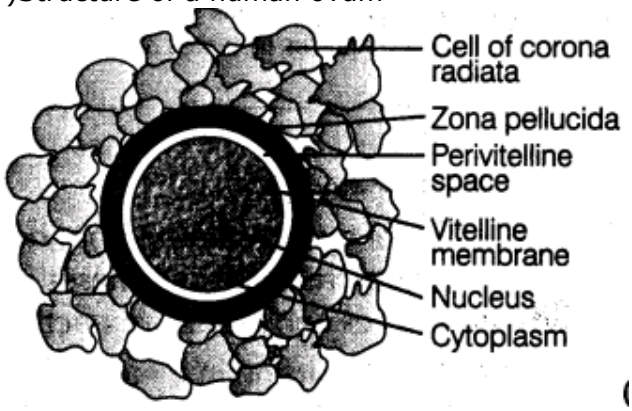
(iii)In anticipation of receiving the fertilised egg, the endometrium of the uterus gets thickened and also the blood supply to the endometrium increases.

(iv) The figure C stage represents the secondary follicle and the H stage represents the degenerating corpus luteum.

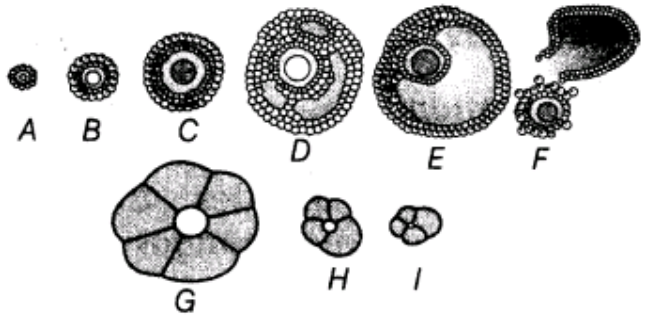
Secondary follicle	Corpus luteum
It is surrounded by layers of granulosa cells.	Layers of granulosa cells absent.
The presence of theca layer.	Theca layer is absent.

(1)

(v)Structure of a human ovum



35.The following is the illustration of the sequence of ovarian events A to I in a human female



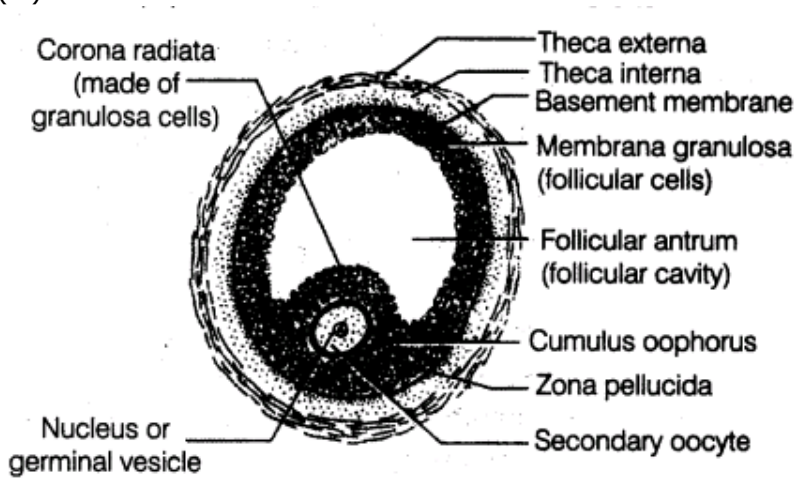
(i)Identify the figures that illustrates corpus luteum and name the pituitary hormone that influences its formation.
(ii)Specify the endocrine function of corpus luteum. How does it influence the uterus? Why is it essential?
(iii)What is the difference between D and E?
(iv)Draw a neat labelled sketch of Graafian follicle. [Delhi 2012]

Ans.(i) C is corpus luteum. LH secreted by pituitary influences its formation.

(ii) The endocrine function of corpus luteum is that it secretes progesterone.Progesterone is essential for the maintenance of endometrium layer of uterus.Such a thickened endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy.

(iii)D is a developing secondary follicle, whereas E is a mature tertiary follicle.

(iv)Structure of a Graafian follicle is



36(i) Describe the stages of oogenesis in human females.
(ii) Draw a labelled diagram of a human ovum released after ovulation. [Delhi 2012]

Ans.(i) Development of ovum from an oogonium in a human female.

(a) Oogonium which enters meiosis-I is the primary oocyte. Division remains suspended in prophase-I.

(b)Primary oocyte becomes surrounded by a layer of granulosa cells and is called the primary follicle.

(c) Primary follicle gets surrounded by more granulosa cells and a thecal layer. This stage is called secondary follicle.

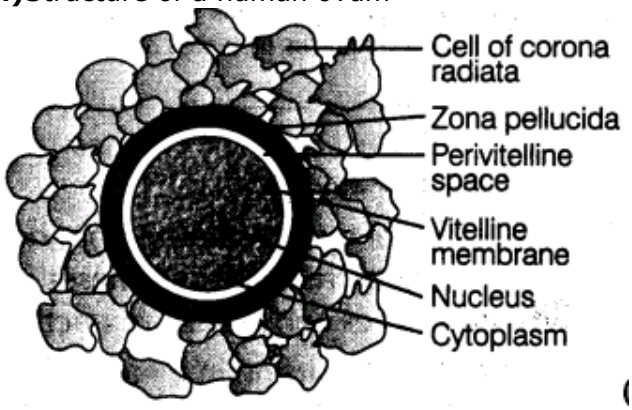
(d) A cavity develops in the secondary follicle around the primary oocyte called antrum.

(e)Thecal layer becomes organised into an outer theca externa and an inner theca interna. This stage is called tertiary follicle.

(f)Primary oocyte completes its meiosis-I and forms a large cell-the secondary oocyte and a tiny cell-the first polar body.

(h)Tertiary follicle transforms into a mature follicle called Graafian follicle (mature ovum).

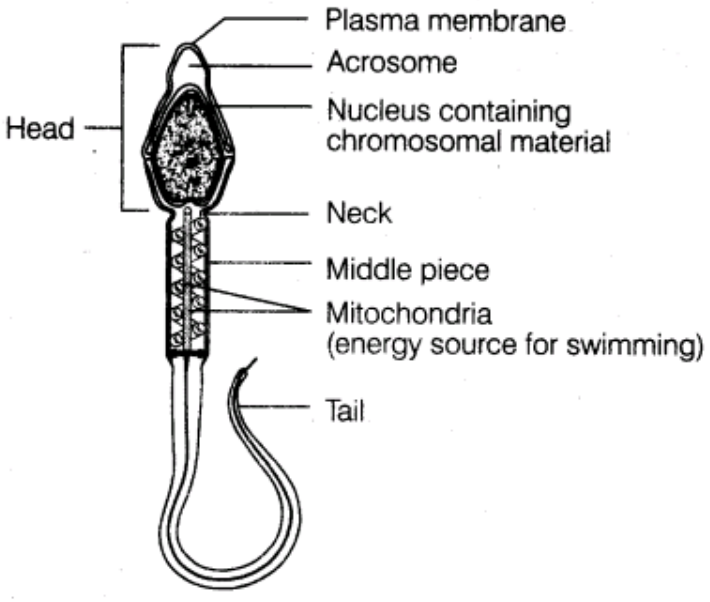
(ii) Structure of a human ovum



37.(i) When and where does spermatogenesis occur in human male?
(ii)Draw a diagram of a mature human male gamete. Label the following parts acrosome, nucleus, middle piece and tail.
(iii)Mention the function of acrosome and middle piece. [Delhi 2011]

Ans.(i) Spermatogenesis begins during puberty and continues throughout the reproductive period in human males. Site of spermatogenesis is seminiferous tubule of the testis.

(ii) **Structure of human male gamete (sperm).**
Diagram showing head of human sperm is The acrosome is filled with enzymes that help in fertilisation of the ovum.



Structure of a sperm

(i)Neck contains two centrioles, a proximal centriole which is necessary for first cleavage division of zygote and a distal centriole, that gives rise to axial filament of tail

(ii)Middle piece possesses many mitochondria to produce energy for the movement of tail to facilitate sperm motility.

(iii)Tail of the sperm consists of an axial filament. Its role is to help movement inside the female reproductive tract towards the ovum for fertilisation.

(iii) **Acrosome** It contains enzymes required to dissolve the ovum membranes to facilitate contact and penetrate ovum for fertilisation.

Middle piece It contains plenty of mitochondria to produce energy for the movement of sperm.

38.When and where are primary oocytes formed in a human female? Trace the development of these oocytes till ovulation (in menstrual cycle). How do gonadotropins influence this developmentalprocess? [Delhi 2010]
or
Explain the different stages of oogenesis in humans starting from foetal life till its completion. When and where in the body is oogenesis completed? [Delhi 2009]

Ans.(i)In human females, primary oocytes are formed during the embryonic developmental stages in the foetal ovaries.

(ii) (a) Primary oocytes start dividing and enter prophase-l of meiosis to remain suspended at this stage.

(b) Each primary oocyte is surrounded by a layer of granulosa cells and become the primary follicle.

(c) The primary follicle when surrounded by more layers of granulosa cells, is called a secondary follicle.

(d)Secondary follicle transforms into a tertiary follicle, with the developmentof a fluid-filled cavity (antrum) around the primary oocyte.

(e)Granulosa cells become organised into an outer theca externa and an inner theca interna.

(f) Now, primary oocyte completes meiosis-l and forms a larger haploid secondary oocyte and a tiny first polar body.

(g)Tertiary follicle grows and becomes a mature follicle called Graafian follicle.

(h)Secondary oocyte secretes a new membrane called zona pellucida around it.

(i)At this stage, follicle ruptures to release the secondary oocyte, which moves into the cytoplasm

(j)Secondary oocyte completes meiosis-I I only when a sperm enters its cytoplasm. It forms a larger cell, the ootid and a small cell, the second polar body.

(iii) **Influence of Gonadotropins on oogenesis**

- Gonadotropins, i.e. LH and FSH stimulate follicular development and secretion of oestrogens by the growing follicles.
- Both LH and FSH attain a peak level in the middle of the cycle (14th day).
- Rapid release of LH during mid-cycle causes ovulation.
- LH also stimulates the formation of corpus luteum from the ruptured follicle and secretion of progesterone from corpus luteum.

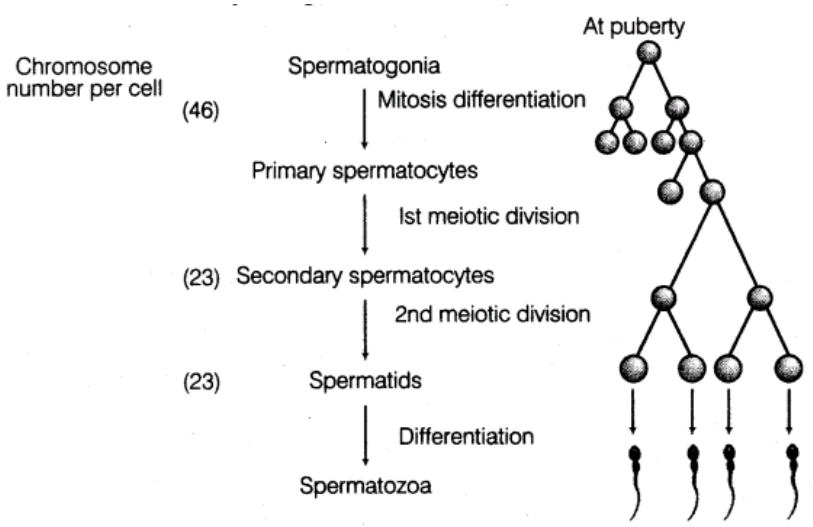
39.(i) Give a schematic representation showing the events of spermatogenesis in human male, (ii) Describe the structure of a human sperm. [All India 2010]

Ans.(i)A primary spermatocyte undergo first meiotic division leading to two equal, haploid cells called **secondary spermatocytes**, which contains only 23 chromosomes each.

(a)The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid **spermatids.**

(b) The spermatids are transformed into spermatozoa (sperms) by the process called **spermiogenesis.**

(c) Sperm heads are embedded in the Sertoli cells and are finally released from the seminiferous tubules by the process called **spermiation**.



Spermatogenesis in human male

(ii) Human sperm contains four main parts, i.e. **Head** It contains an elongated, compact, haploid nucleus, i.e. concentrated DNA. The anterior end is covered by a cap-like structure called acrosome. The acrosome contains enzymes that help in dissolving membranes of the ovum for fertilisation.

Neck It contains two centrioles, a proximal centriole, which is necessary for the first cleavage division of zygote and a distal centriole that is connected to the tail filament.

Middle piece It contains a number of mitochondria to provide energy for the motility of sperms.

Tail It consists of an axial filament surrounded by the plasma membrane. Tail helps the sperm to move in the female reproductive tract towards the female gamete for fertilisation.

40.(i) Draw a diagrammatic labelled sectional view of a seminiferous tubule of a human.
(ii) Describe in sequence the process of spermatogenesis in humans.[All India 2010]

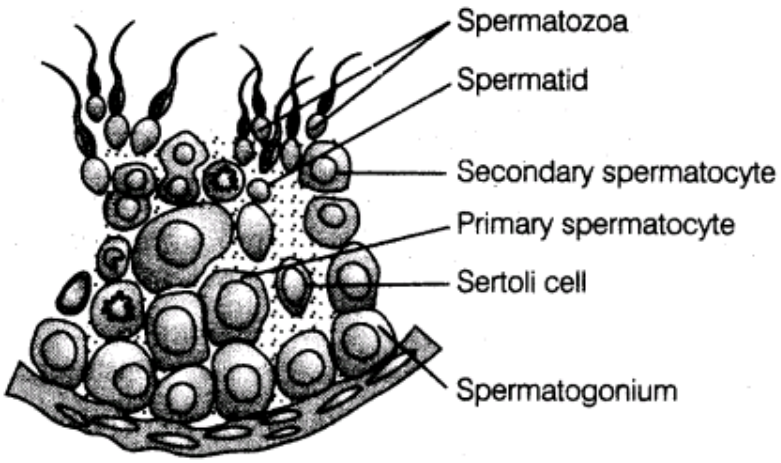
Ans.(i) Sectional view of a seminiferous tubule.

Spermatogenesis is production of sperms in males.

(i) In testis, the immature male germ cells (spermatogonia) produce sperms by **spermatogenesis** that begins at puberty.

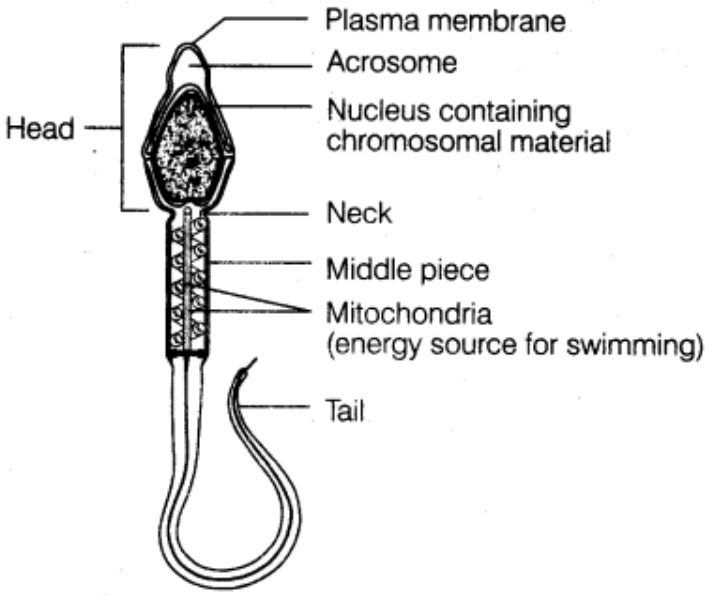
(ii)**Spermatogonia** (sing, spermatogonium) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers.

(iii) Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called **primary spermatocytes** periodically undergo meiosis.



Sectional view of a seminiferous tubule (enlarged)

(ii)Diagram showing head of human sperm is The acrosome is filled with enzymes that help in fertilisation of the ovum.



Structure of a sperm

(i)Neck contains two centrioles, a proximal centriole which is necessary for first cleavage division of zygote and a distal centriole, that gives rise to axial filament of tail

(ii)Middle piece possesses many mitochondria to produce energy for the movement of tail to facilitate sperm motility.

(iii)Tail of the sperm consists of an axial filament. Its role is to help movement inside the female reproductive tract towards the ovum for fertilisation.

(iii) **Acrosome** It contains enzymes required to dissolve the ovum membranes to facilitate contact and penetrate ovum for fertilisation.
Middle piece It contains plenty of mitochondria to produce energy for the movement of sperm.

41.Study the following flow chart. Name the hormones involved at each stage. Explain their functions.

Hypothalamus
↓
Pituitary
↓
Testes

Ans.**Hypothalamus** It secretes Gonadotropin Releasing Hormones (GnRH).

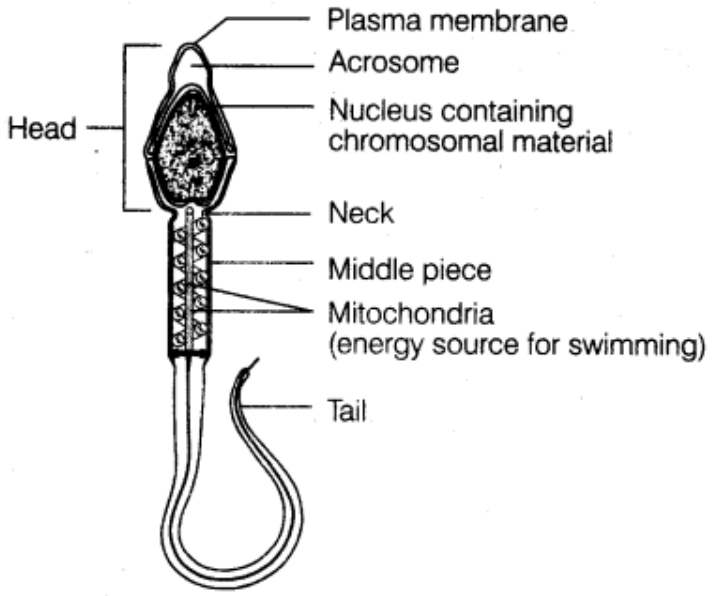
Pituitary GnRH stimulates the anterior pituitary gland to secrete FSH and LH.

Testes LH stimulates Leydig cells of testes to secrete androgens (like testosterone), which control spermatogenesis. FSH acts on Sertoli cells of testes which in response secrete certain factors necessary for spermiogenesis. The sperm heads become embedded in the Sertoli cells

42.(i) Draw a schematic diagram of a human sperm and label the cellular components. Give the functions of any three parts.
(ii) Where are the sperm heads found embedded to survive after spermatogenesis? [Delhi 2009]

Ans.(i) **Human sperm**

Diagram showing head of human sperm is The acrosome is filled with enzymes that help in fertilisation of the ovum.



Structure of a sperm

(i)Neck contains two centrioles, a proximal centriole which is necessary for first cleavage division of zygote and a distal centriole, that gives rise to axial filament of tail

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(iii) **Acrosome** It contains enzymes required to dissolve the ovum membranes to facilitate contact and penetrate ovum for fertilisation.
Middle piece It contains plenty of mitochondria to produce energy for the movement of sperm.

Functions

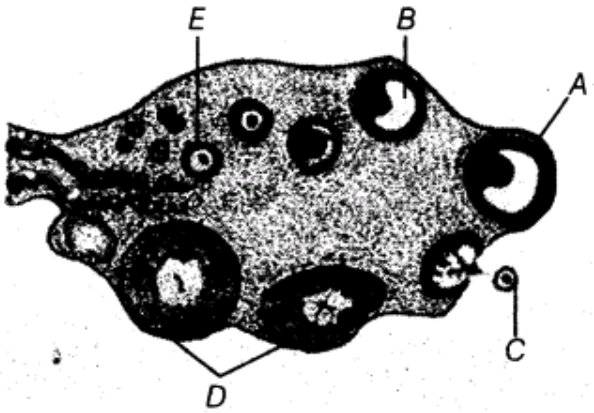
(a)Head contains acrosome that have enzymes, which help in dissolving ovum membrane for fertilisation.

(b)Middle piece contains many mitochondria, which provide energy for the motility of sperm.

(c)Tail helps in movement of sperm required to reach the ovum.

(ii) The sperm heads become embedded in the Sertoli cells, to derive nutrition, so as to survive after spermatogenesis

43.(i) Given below is the TS of human ovary. Identify the following in the diagram Corpus luteum, Secondary oocyte Antrum, Primary follicle and Primary oocyte.



(ii)Explain the changes the primary oocyte undergoes, while in different follicular stages before ovulation.[Foreign 2009]

Ans.The parts identified in given TS of ovary are

A-Graafian follicle

B-Antrum

C-Ovum

D-Corpus luteum

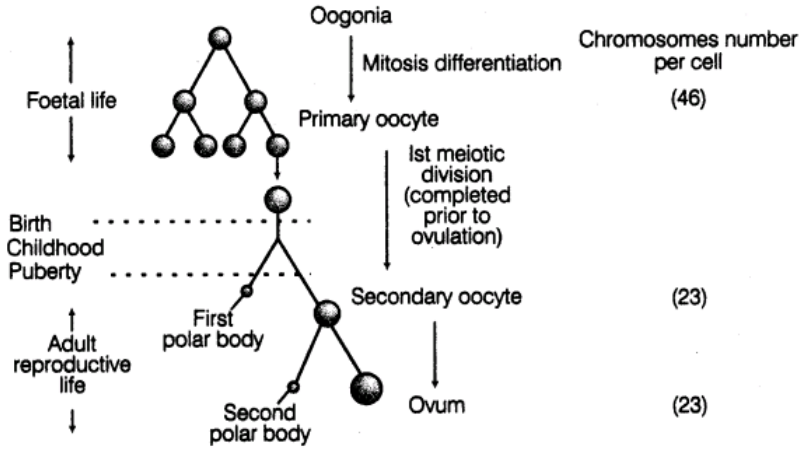
E-Primary follicle

(ii) Changes in primary oocyte before ovulation

- Primary oocyte is surrounded by a layer of granulosa cells and is called primary follicle.
- Many primary follicles degenerate from birth to puberty.
- Primary follicle becomes surrounded by more layers of granulosa cells and becomes the secondary follicle.
- Primary oocyte grows on a stalk and fluid-filled cavity called antrum develops in the follicle, at this stage, it is called the tertiary follicle.
- Primary oocyte undergoes meiosis-I, forming a large secondary oocyte and a tiny first polar body.
- Secondary oocyte forms a new membrane, called zona pellucida around it.

44.Give a schematic representation of oogenesis in humans. Mention the number of chromosomes at each stage. Correlate the life phases of the individual with the stages of the process. [Delhi 2008; Foreign 2008]

Ans. Schematic representation of oogenesis



Oogenesis in human female showing formation of ovum

Oogenesis in different phases of life are as follow:

Embryonic stage Oogenesis starts during the embryonic development stage. At this stage some million oogonia are formed within each foetal ovary. Oogonia start division, enter prophase-I of meiosis, get temporarily arrested at this stage and called as primary oocytes. (I)
Between birth and puberty A large number of primary oocytes degenerate during the period between birth and puberty. About 60000-80000 primary follicles are left in each ovary. (I)
Reproductive period Primary follicles mature once at a time to transform into secondary follicles and then into tertiary follicles.

(i) The primary oocyte completes meiosis-I to form a large haploid secondary oocyte and a tiny first polar body.

(ii) Secondary oocyte starts undergoing meiosis-II but is suspended at metaphase-II.

(iii) Mature follicle of the ovary ruptures to release the secondary oocyte, by the process called ovulation (occurs in mid-cycle).

(iv) Secondary oocyte enters the Fallopian tube and completes meiosis-II when a sperm enters it. It forms a large cell ovum and a second polar body

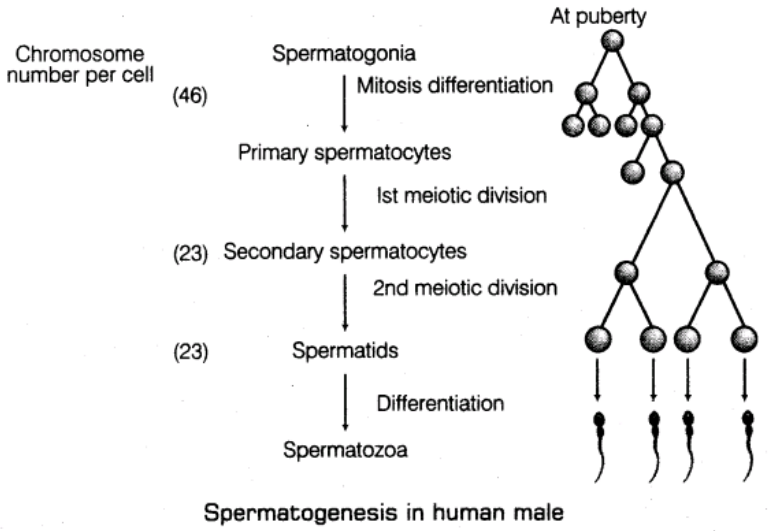
45.(i) Give a schematic representation of spermatogenesis in humans.
(ii)At which stage of life does gametogenesis begin in human male and female, respectively?
(iii)Name the organs where gametogenesis gets completed in human male and female, respectively. [Delhi 2008]

Ans.(i)A primary spermatocyte undergo first meiotic division leading to two equal, haploid cells called **secondary spermatocytes**, which contains only 23 chromosomes each.

(a)The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid **spermatids.**

(b) The spermatids are transformed into spermatozoa (sperms) by the process called **spermiogenesis.**

(c) Sperm heads are embedded in the Sertoli cells and are finally released from the seminiferous tubules by the process called **spermiation**.



Spermatogenesis in human male

(d) Human sperm contains four main parts, i.e.

Head It contains an elongated, compact, haploid nucleus, i.e. concentrated DNA. The anterior end is covered by a cap-like structure called acrosome. The acrosome contains enzymes that help in dissolving membranes of the ovum for fertilisation.

Neck It contains two centrioles, a proximal centriole, which is necessary for the first cleavage division of zygote and a distal centriole that is connected to the tail filament.

Middle piece It contains a number of mitochondria to provide energy for the motility of sperms.

Tail It consists of an axial filament surrounded by the plasma membrane. Tail helps the sperm to move in the female reproductive tract towards the female gamete for fertilisation.

(ii) Spermatogenesis in human males start at puberty. Oogenesis in human females begins during the embryonic development stage.

(iii) In human males, gametogenesis completes in testes and in females, it completes in Fallopian tube.

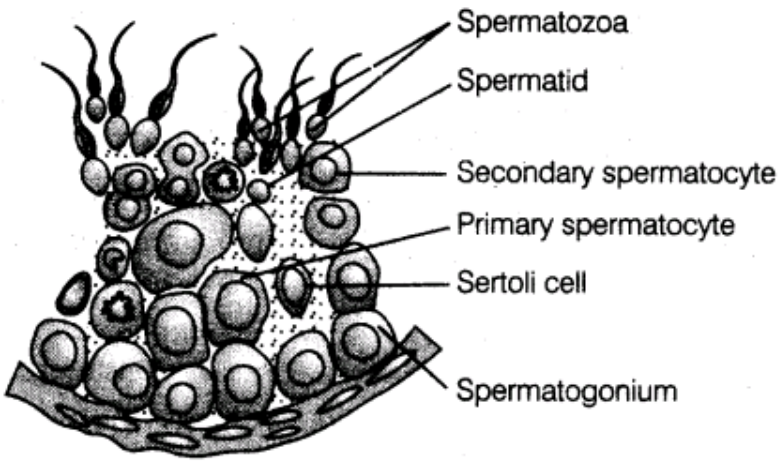
46.(i) Draw a labelled diagram of a sectional view of human seminiferous tubule.
(ii) Differentiate between gametogenesis in human males and females on the basis of
(a)Time of initiation of the process.
(b)Products formed at the end of the process.[All India 2008]

Ans.(i))**Spermatogenesis** is production of sperms in males.

(a) In testis, the immature male germ cells (spermatogonia) produce sperms by **spermatogenesis** that begins at puberty.

(b)**Spermatogonia** (sing, spermatogonium) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers.

(c) Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called **primary spermatocytes** periodically undergo meiosis.



Sectional view of a seminiferous tubule (enlarged)

(ii) Differences in gametogenesis in human males and females are:

Male	Female
Time of initiation is from the age of puberty.	Initiates at embryonic development stage.
Products formed at the end of process are four spermatozoa from one primary spermatocyte.	Products formed are one primary oocyte, one functional ovum and two polar bodies.

47.Draw a labelled sectional view of a human ovary. Explain the events of oogenesis. [Delhi 2008C]

Ans.Oogenesis is the process of formation of a female gamete or ova in the ovary.

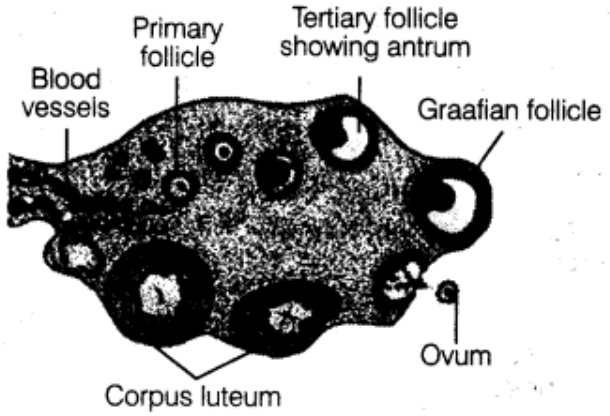
(i)It starts during embryonic stage in a female.

(ii)About a million oogonia are formed in the ovary of the female foetus (of 25 weeks). No new oogonia are formed after birth.

(iii)The oogonial cells start meiotic division, enter into prophase-I, get temporarily arrested at that stage and are called as primary oocytes.

(iv)Each primary oocyte then gets surrounded by a layer of granulosa cells called primary follicle.

(v)A large number of primary follicles degenerate during the phase from birth to puberty. As a result, about 60,000-80,000 primary follicles are left in each ovary at puberty.



Sectional view of a ovary

Development of ovum from an oogonium in a human female.

(i) Oogonium which enters meiosis-l is the primary oocyte. Division remains suspended in prophase-l.

(ii)Primary oocyte becomes surrounded by a layer of granulosa cells and is called the primary follicle.

(iii) Primary follicle gets surrounded by more granulosa cells and a thecal layer. This stage is called secondary follicle.

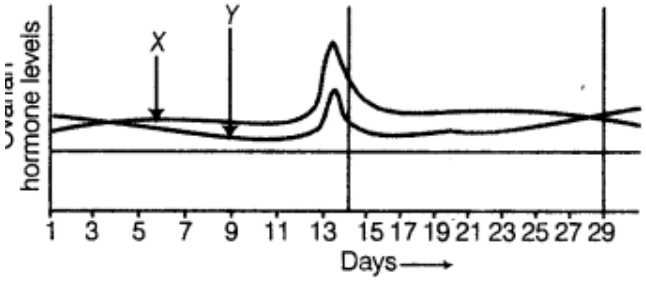
(iv) A cavity develops in the secondary follicle around the primary oocyte called antrum.

(v)Thecal layer becomes organised into an outer theca externa and an inner theca interna. This stage is called tertiary follicle.

(vi)Primary oocyte completes its meiosis-I and forms a large cell-the secondary oocyte and a tiny cell-the first polar body.

(vii)Tertiary follicle transforms into a mature follicle called Graafian follicle (mature ovum).

48.Study the graph given below and answer the questions that follow



(i)Name the hormones X and Y.
(ii)Identify the ovarian phases during a menstrual cycle.
(a)5th to 12th day of the cycle
(b)14th day of the cycle
(c)16th to 25th day of the cycle
(iii)Explain the ovarian events (a), (b) and(c)under the influence of hormones X and Y. [All India 2008C]

Ans.(i)X-Leuteinising Hormone (LH)'

Y—Follicle Stimulating Hormone (FSH)

(ii) (a) 5th to 12th day of the menstrual cycle is called follicular phase. The primary follicles grow and become fully mature Graafian follicle.

(b) 14th day of the cycle is called ovulatory phase and marks ovulation.

(c)16th to 25th day is luteal phase. The corpus luteum secretes large amount of progesterone which is essential for the maintenance of the endometrium.

(ii)Secretion of gonadotropins increases gradually during the follicular phase and stimulates follicular development as well as secretion of oestrogens by the growing follicles.Both LH and

FSH attain a peak level in the middle of cycle. Rapid secretion of LH leads to LH surge, which induces rupture of follicle and release of ovum,i.e.ovulation.In the secretory phase LH stimulates the remains of Graafian on follicle to develop corpus luteum which secretes large amount of progesterone essential for maintenance of endometrium.

Fertilisation, Pregnancy and Embryonic Development

1 Mark Questions

1.How is the entry of only one sperm ensured into an ovum during fertilisation in humans?[All India 2012]

Ans.During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum and induces changes (depolarisation) in the membrane that blocks the entry of additional sperms. This ensures that only one sperm can fertilise an ovum

2.Mention the function of trophoblast in human embryo.[Delhi 2011]

Ans.Trophoblast is the outer layer of blastocyst which helps in attachment of blastocyst to the endometrium of the uterus.

3.Name the embryonic stage that gets implanted in the uterine wall of a human female. [All India 2011]

Ans. Blastocyst gets implanted in the uterine wall.

4.What stimulates pituitary to release the hormone responsible for parturition? Name the hormone.[All India 2011]

Ans.Foetal ejection reflex stimulates pituitary to release the oxytocin hormone, which is responsible for parturition.

5.How does colostrum provide initial protection against diseases to newborn infants? Give one reason. [Delhi 2009]

Ans.Colostrum contains necessary antibodies (IgA) that provide protection against diseases to newborn infants.

2 Marks Questions

6.Where does fertilisation occur in humans? Explain the events that occur during this process. [All India 2014]

Ans. In humans, the fertilisation of ovum takes place in ampullary-isthmic junction of Fallopian tube. The events that occur during the process of fertilisation are:

(i) The sperm reaches the junction of ampulla and isthmus and comes in contact with zona pellucida layer of ovum.

(ii) Acrosome of sperm head release sperm lysin enzymes that dissolves corona radiata and digests zona pellucida layer and enters cytoplasm.

(iii) Entry of sperm stimulates secondary oocyte to complete its suspended second meiotic division, thus producing haploid egg or ovum and second polar body.

(iv)Nucleus of sperm and of ovum fuses to form a diploid zygote.

7.Explain the events that occur during fertilisation of an ovum in humans. How is it that only one sperm enters the OVUm? [All India 2014 C]

Ans.(i) In humans, the fertilisation of ovum takes place in ampullary-isthmic junction of Fallopian tube. The events that occur during the process of fertilisation are:

(a) The sperm reaches the junction of ampulla and isthmus and comes in contact with zona pellucida layer of ovum.

(b) Acrosome of sperm head release sperm lysin enzymes that dissolves corona radiata and digests zona pellucida layer and enters cytoplasm.

(c) Entry of sperm stimulates secondary oocyte to complete its suspended second meiotic division, thus producing haploid egg or ovum and second polar body.

(d)Nucleus of sperm and of ovum fuses to form a diploid zygote.

(ii) During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum and induces changes (depolarisation) in the membrane that blocks the entry of additional sperms. This ensures that only one sperm can fertilise an ovum

8.(i) Where do the signals for parturition originate in humans?
(ii) Why is it important to feed the newborn babies on colostrum? [All India 2012]

Ans.(i)The signals for parturition originate from the fully developed foetus and the placenta, which induce mild uterine contraction called foetal ejection reflex

(ii)Colostrum contains necessary antibodies (IgA) that provide protection against diseases to newborn infants.

9.Name the hormones produced only during pregnancy in human female. Mention their source organ.[Foreign 2011]

Ans. The hormones produced only during pregnancy in human female are human Chorionic Gonadotropin (hCG), human Placental Lactogen (hPL) and relaxin. The source of hCG and hPL — Placenta, and Relaxin — Ovary.

10.Placenta acts as an endocrine tissue. Justify. [All India 2010]

Ans.Placenta acts as an endocrine tissue as it secretes hormones like

(i) hCG (human Chorionic Gonadotropin)

(ii) hPL (human Placental Lactogen)

(iii) Oestrogens

(iv) Progesterone

11.What is colostrum? Why is it important to be given to the newborn infants? [Foreign 2009; AH India 2009 C]

Ans. The milk produced by mammary glands of human female in initial few days of lactation is called colostrum. Colostrum contains necessary antibodies (IgA) that provide protection against diseases to newborn infants.

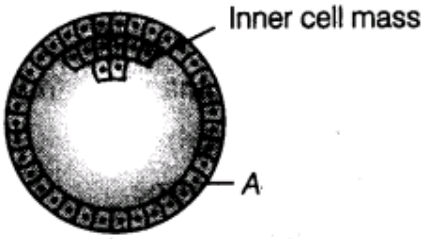
3 Marks Questions

12.(i) How is placenta formed in human female?
(ii) Name any two hormones which are secreted by it and are also present in a non-pregnant woman. [Foreign 2014]

Ans.(i)After implantation of blastocyst, the finger-like projections called chorionic villi, appear on the trophoblast and is surrounded by uterine tissue and maternal blood which become interdigitated with each other to form placenta.

(ii) The two hormones secreted by placenta that are also present in a non-pregnant women are oestrogen and progesterone.

13. Study the given figure below and answer the question that follow



(i)Name the stage of human embryo the figure represents.
(ii)Identify Ain the figure and mention its function.
(iii)Mention the fate of the inner cell mass after implantation in the uterus.
(iv)Where are the stem cells located in this embryo? [Delhi 2009]

Ans.(i)The stage is blastocyst.

(ii) A—Trophoblast. It helps in attachment to endometrium during implantation and provides nourishment to developing embryo.

(iii) Inner cell mass acts as precursor to embryo and gets differentiated into ectoderm and endoderm.

(iv) Stem cells are located in inner cell mass of embryo.

5 Marks Questions

14.(i)Explain the events taking place at the time of fertilisation of an ovum in a human female.
(ii)Trace the development of the zygote up to its implantation in the uterus.

(iii)Name and draw a labelled sectional view of the embryonic stage that gets implanted. [Delhi 2010]

Ans.**(i)**In humans, the fertilisation of ovum takes place in ampullary-isthmic junction of Fallopian tube. The events that occur during the process of fertilisation are:

(a) The sperm reaches the junction of ampulla and isthmus and comes in contact with zona pellucida layer of ovum.

(b) Acrosome of sperm head release sperm lysin enzymes that dissolves corona radiata and digests zona pellucida layer and enters cytoplasm.

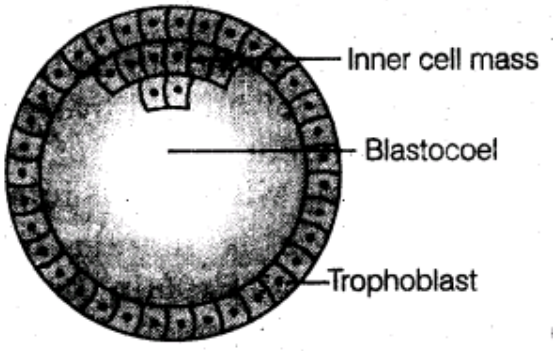
(c) Entry of sperm stimulates secondary oocyte to complete its suspended second meiotic division, thus producing haploid egg or ovum and second polar body.

(d)Nucleus of sperm and of ovum fuses to form a diploid zygote.

(ii) Development of zygote up to implantation takes place in following sequence

- Cleavage division (mitotic) starts in zygote as it moves through the isthmus of Fallopian tube towards the uterus.
- This division results into 2, 4, 8 and 16 daughter cells called blastomeres.
- The embryo with 8-16 blastomeres is called morula.
- Morula continues to divide and transforms into blastocyst as it moves further into uterus.
- Blastomeres in the blastocyst are arranged into an outer layer called trophoblast and inner group of cells attached to trophoblast called inner cell mass.
- Trophoblast layer then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.
- After attachment, the uterine cells divide rapidly and cover the blastocyst.

It leads to blastocyst's embedding in the endometrium of the uterus. This is called implantation.
(iii) Blastocyst stage implants in the uterus.



15.Describe the post-zygotic events leading to implantation and placenta formation in humans. Mention any two functions of placenta. [All India 2010]
or
Explain the process of fertilisation in human female and trace the post-fertilisation events in a sequential order up to implantation of the embryo. [Foreign 2010]

Ans.Post-zygotic events leading to implantation and placenta formation. After implantation of blastocyst, the finger-like projections called chorionic villi, appear on the trophoblast and is surrounded by uterine tissue and maternal blood which become interdigitated with each other to form placenta. Events leading to formation of placenta. The chorionic villi and uterine tissue, after implantation become interdigitated with each other and form placenta, a structural and functional unit between embryo and maternal body.

Functions of Placenta

(i) It facilitates the supply of oxygen and nutrients to the foetus and removal of $C0_2$ and excretion products.

(ii) It acts as an endocrine gland and secretes hormones like hPL, hCG, oestrogen and progesterone.

16.(i) Mention the event that induces the completion of the meiotic division of the secondary oocyte.
(ii) Trace the journey of the ovum from the ovary, its fertilisation and further development until the implantation of the embryo. [Ml India 2010 c]

Ans.(i)Secondary oocyte completes meiosis-ll
only when a sperm enters its cytoplasm. It forms a larger cell, the ootid and a small cell, the second polar

body.

(ii)

- The secondary oocyte is released by the rupture of the Graafian follicle in the process called ovulation.
- It is moved into the Fallopian tube with the help of fimbriae.
- It reaches the ampullary isthmic junction of the Fallopian tube, where fertilisation takes place.

- Cleavage causes formation of 2, 4, 8 and 16 daughter cells called blastomeres. The embryo with 8-16 blastomeres is a solid spherical structure called morula.
- Cleavage start in the zygote.
- Morula continues to divide and blastomeres rearrange themselves as it moves further into the uterus.
- As a result, blastocyst is formed, which contains trophoblast (outer layer) and inner cell mass.
- The trophoblast attacheds to endometrium (implantation) and blastocyst gets embedded in it.

17.(i) When and how does placenta develop in human female?
(ii)How is the placenta connected to the embryo?
(iii)Placenta acts as an endocrine gland. Explain. [Ml India 2009]

Ans.(i)Development of placenta in human female After implantation of blastocyst, the finger-like projections called chorionic villi, appear on the trophoblast and is surrounded by uterine tissue and maternal blood which become interdigitated with each other to form placenta.

(ii) Placenta is connected to the embryo through an umbilical cord.

(iii) Placenta acts as an endocrine tissue as it secretes hormones like

(a) hCG (human Chorionic Gonadotropin)

(b) hPL (human Placental Lactogen)

(c) Oestrogens

(d) Progesteronem

Miscellaneous Questions

3 Marks Questions

1.Explain the steps in the formation of an ovum from an oogonium in humans.
or
Suggest and explain any three Assisted Reproductive Technologies (ART) to an infertile couple.
[All India 2013]

Ans. Three reproductive techniques for sterile couple are:

(i) In vitro fertilisation The fertilisation outside the body in almost similar conditions as that in the body followed by embryo transfer to the mother. This method is popularly known as test-tube baby.

(ii) GameteintraFallopian transfer Transfer of an ovum collected from a donor into the Fallopian tube of another female who cannot produce ovum, but can provide suitable . environment for fertilisation and further development.

(iii) Intracytoplasmic sperm injection It is another specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum.

2.Write the function of each one of the following
(i)Fimbriae (oviducal)
(ii)Coleoptile
(iii) Oxytocin [Delhi20i2]

Ans.(i)Fimbriae are the . feathery finger-like projections present at the end of Fallopian tubes and it collects the ovum after its release from the ovary into the Fallopian tube.

(ii) Coleoptile is a conical sheath present in the monocot seeds, its function is to protect the developing plumule

(iii)Oxytocin is a hormone secreted by the posterior pituitary and it stimulates the contraction of uterine muscles during child birth (parturition).

3.Write the function of each of the following
(i)Middle piece in human sperm
(ii)Tapetum in anthers
(iii)Luteinising hormone in human males [Delhi 2012]

Ans.(i)Middle piece in human sperm contains several mitochondria which produces energy for the motility of the sperm.

(ii) Tapetum in anthers It is the innermost layer of the anther. The main function of tapetum is to provide nourishment to the developing pollen grains.

(iii) Leuteinising hormones in human male stimulates the Leydig cells to produce testosterone, necessary to complete the process of spermatogenesis.

4.Write the function of each of the following
(i)Seminal vesicle
(ii)Scutellum
(iii)Acrosome of human sperm [Delhi 2012]

Ans.(i)Seminal vesicle spermatogenesis It secretes an alkaline fluid that helps in neutralising the acidity of the vaginal tract and thereby increase the lifespan of sperms. Secretion of seminal vesicle is also a source of nutrition for the sperms.

(ii) Scutellum It is a tissue present in seed to absorb food from the adjacent endosperm and develop into growing embryo.

(iii) Acrosome It is the cap-like covering or structure that is present at the tip of the sperm (male gamete). The acrosome contains enzymes, which help the sperm enter into the cytoplasm of the ovum and thus helps in fertilisation.

5.Give reasons for the following
(i)The human testes are located outside the abdominal cavity.
(ii)Some organisms like honeybees are called parthenogenetic animals.[All India 2012]

Ans. Testes are located outside the abdominal cavity within a pouch called scrotum. Scrotum maintains low temperature of the testes (2-2.5°C lower than normal body temperature) required for spermatogenesis.
(ii) In honeybees, workerbees are all females. Sometimes, they may develop functional ovaries and lay unfertilised eggs, which normally result into drone bees. Hence, worker bees are capable of producing diploid eggs parthenogenetically and replaces the queen bee if she dies. Since, they develop from unfertilised diploid eggs (and do not undergo fertilisation) they are called parthenogenetic animals.

5 Marks Questions

6.(i) When does oogenesis begin? (ii) Differentiate between the location and function of Sertoli cells and Leydig cells.[All India 2010]

Ans.Oogenesis begins during the embryonic development stage when a million gamete mother cells (oogonia) are formed within each foetal ovary.
(ii) (a) Sertoli cells are located on the inside lining of seminiferous tubule. These cells provide nutrition to the germ cells.
(b) Leydig cells or interstitial cells are located in the regions outside the seminiferous tubule called interstitial spaces. These cells synthesise and secrete testicular hormone called androgens.

7.(i) Draw a labelled diagram of the human female reproductive system.
(ii) Enumerate the events in the ovary of a human female during
(b) Luteal phase of menstrual cycle
(a) Follicular phase [Delhi 2012]

Ans. (ii) (a) Follicular phase The primary follicle in the ovary grow to become fully mature Graafian follicle. Endometrium gets thickened. The follicular cells secrete oestrogen.

(b) Luteal phase The remaining parts of ruptured Graafian follicle transforms into corpus luteum, that secretes progesterone.

8.(i) Write the specific location and the functions of the following cells in human males

- **Leydig cells**
- **Sertoli cells**
- **Primary spermatocyte**

(ii) Explain the role of any two accessory glands in human male reproductive system.[Delhi 2011]

Ans.(I)Oogenesis begins during the embryonic development stage when a million gamete mother cells (oogonia) are formed within each foetal ovary.

(ii) (a) Sertoli cells are located on the inside lining of seminiferous tubule. These cells provide nutrition to the germ cells.

(b) Leydig cells or interstitial cells are located in the regions outside the seminiferous tubule called interstitial spaces. These cells synthesise and secrete testicular hormone called androgens.

Primary spermatocytes Located inside the seminiferous tubule and involved in the formation of spermatozoa.

(II) Accessory glands of human male reproductive system are:

(a) Prostate and seminal vesicles Their secretion provide a fluid medium for the sperms to swim towards the ovum. They provide nutrition to sperms.

(b) Bulbourethral glands Their secretion helps in the lubrication of penis.

9.(i) Draw a diagrammatic sectional view of human ovary showing different stages of oogenesis along with corpus luteum.
(ii) Where is morula formed in human? Explain the process of its development from zygote. [Delhi 2009]

Ans.(i) Sectional view of human ovary.

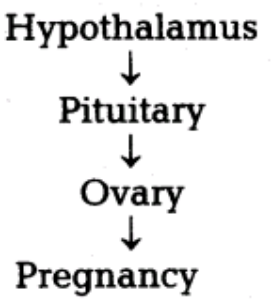
(ii) Morula is formed in the

(a)Isthmus of the oviduct (Fallopiantube).

(b)The zygote undergoes mitotic divisions in quick succession called cleavage, forming 2, 4, 8 and 16 daughter cells called blastomeres.

(c)The embryo with 8-16 blastomeres is called a morula and the inner cell mass gets ready to form the embryo proper.

10.Study the flow chart given below. Name the hormones involved at each stage and explain their function.[All India 2009]



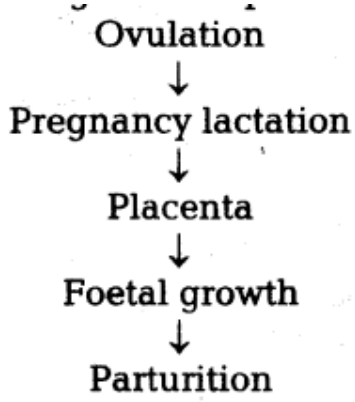
Ans.**Hypothalamus** Gonadotropin Releasing Hormones (GnRH) are released by the hypothalamus.

Pituitary GnRH stimulates pituitary to release FSH and LH.

Ovary FSH and LH act on ovary. LH stimulates ovulation, formation of corpus luteum from the ruptured follicle and secretion of progesterone by the corpus luteum.

Pregnancy Progesterone maintains pregnancy.

11.Study the flow chart given below. Name the hormones involved at each stage and explain their role.



Ans.Ovulation Induced by LH secreted from anterior pituitary. LH also stimulates the formation of corpus luteum and secretion of progesterone from it.

Pregnancy Progesterone is necessary for maintaining pregnancy and for the differentiation of alveoli in the mammary glands during pregnancy for producing milk during lactation.

` Placenta and foetal growth It secretes human chorionic gonadotropin that is necessary for foetal growth. It also secretes human placental lactogen for milk production.

Parturition Foetal ejection reflex stimulates the secretion of oxytocin which induces stronger contractions of uterine muscles leading to parturition.