Reproduction in animals

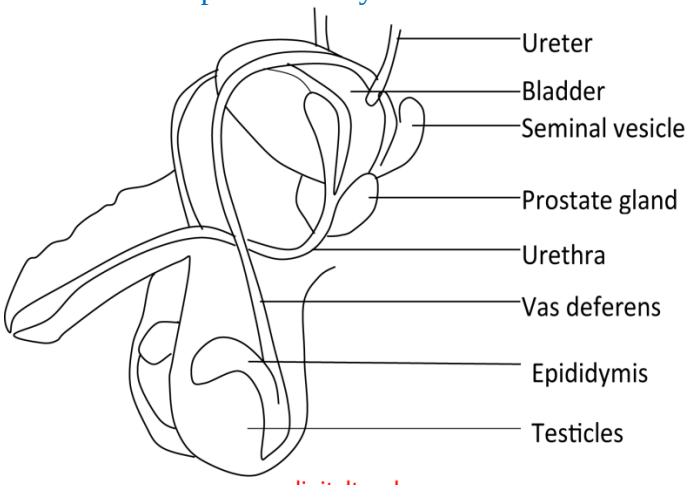
Essential features of sexual reproduction involve a set of events. They can be summarized as follows:

(a) Attainment of sexual maturity by organism
(b) The process of gametogenesis, i.e. production of gametes
(c) Liberation of these gametes and coming together.
(d) The fertilization process.

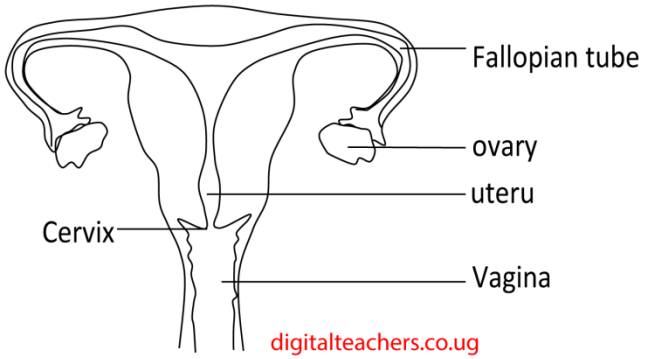
(i) Attainment of maturity

Sexual maturity is said to reached when the gametes producing organs or gonads and associated sex organs are fully functional. Usually gonad are the last organs to mature.

Human male reproductive system



Female reproductive system



Both male and female reproductive system consist essentially of a tube- the genital tract, which runs from the gonads (ovary or testis) to the exterior. The gonads and tube leading from them are paired. The tubes converge in the middle to form a single median tube which leads to the exterior.

The main parts of the female genital tract are

- Oviduct which runs from the ovaries to
- Uterus whose end, the cervix, lead to
- The vagina which runs to exterior.

The maim parts of the male genital tract are

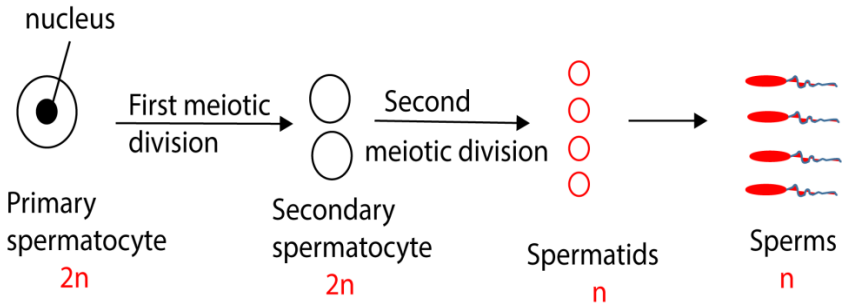
- The vas deferens which runs from each testis to
- Urethra which runs down the penis to exterior. Important glands (i.e. seminal vesicle, prostate and Cowper gland) open into the vas deferens and the urethra; they produce secretions that mix with sperm that activate sperms and keep them in viable and motile state.

Gametogenesis

This is the formation of gametes. Sperm formation is called spermatogenesis while egg formation is called oogenesis.

Spermatogenesis

(i) Spermatogenesis in man occurs in the testis;
(ii) Primordial germ cells (2n) divide mitotically to form spermatogonia that grow into primary spermatocyte (gamete forming cells) with 46 chromosomes
(iii) Primary spermatocytes undergo first meiotic division to form two secondary spermatocytes (n), each with 23 chromosomes.
(iv) The secondary spermatocyte undergoes a second meiotic division to produce spermatids (n), each with 23 chromosomes.
(v) Spermatids then differentiate into sperms (spermatozoa).
(vi) The process of meiosis in male always result in four cells that become sperms.



Oogenesis

(i) Oogenesis occurs in the overlies of female,

(ii) Primordial germ cells (2n) divide mitotically to form oogonia the grow into primary oocytes (2n)

(iii) primary oocytes undergo the first meiotic division to form two haploid cells each having 23 chromosomes. One of these cells termed the secondary oocyte (n) receives almost all the cytoplasm. The other is a polar body that may disintegrate or may divide again.

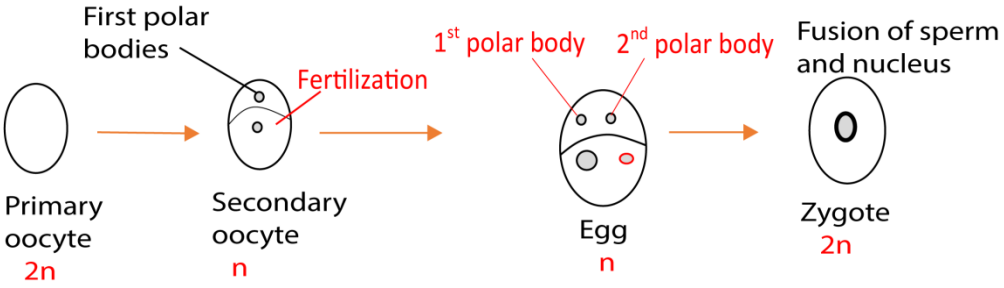
(iv) The secondary oocyte begins meiosis II and stops at metaphase II.

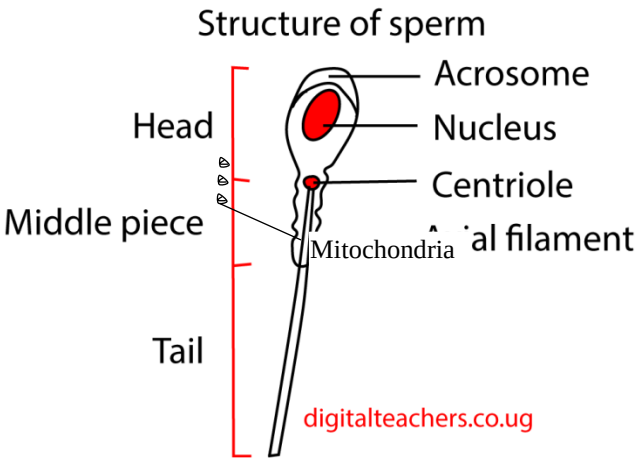
(v) Then at ovulation, it leaves the ovary and enters an oviduct where it may be approached by a sperm.

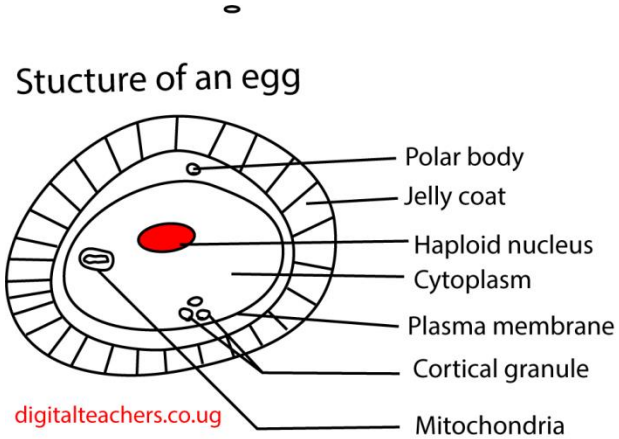
(vi) If a sperm enters the oocyte, it activates to continue meiosis II to completions. The mature egg has 23 chromosomes. Meiosis in female produces only one egg and possibly three polar bodies.

(vii) The polar bodies are used to discard unnecessary chromosomes while retaining much of the cytoplasm in the egg.

(viii) The cytoplasm serves as a source of nutrients to the developing embryo.







NB. - Acrosome produces enzymes that enable the sperm to penetrate the egg
- Mitochondria generate energy
- Axial filament is used for propulsion

Comparison of gamete formation in male and female organs in man

	Male organ	Female organ
1.	Production of sperms begins at puberty	Production of ova begins before birth completed after fertilization
2.	Several primordial germ cells divided repeatedly by meiosis forming diploid spermatogonia	One primordial germ cell repeatedly divides by mitosis to form diploid oogonia
3.	All separate spermatogonia increase in size to form spermatocytes	One of the resulting oogonia enlarges to form primary oocyte the other degenerate
4.	Each primary spermatocyte undergoes the 1st meiotic division to form two secondary spermatocytes which immediately undergo 2^{nd} meiotic division to give rise to spermatids	The primary oocyte undergoes meiosis, unequal division. 1^{st} meiotic give rise to secondary oocyte with a smaller polar body. The second meiotic division proceed as far as metaphase but does not continue until a sperm fuse with the oocyte. At fertilization the 2^{nd} meiotic division produce a large cell the ovum and a second polar body.
5.	Each spermatid differentiates into a spermatozoon	The ovum does not undergo further differentiation and their polar bodies degenerates
6.	Large number of sperms is formed from one primordial cell	One ovum formed from one primordial cell

Feature leading to variations in sexual reproduction

1. Reciprocal crossing over of genes between chromatids of homologous chromosomes may occur during prophase I of meiosis. This produces new linkage groups and provides some major sources of genetic recombination of alleles.
2. The orientation of chromatids of homologous chromosomes (bivalents) on equatorial spindle during metaphase I determine the direction in which the pairs of chromatids move during anaphase I. this orientation is random
3. During metaphase II the orientation of a pair of chromatid is also random and determine which chromosome migrate to opposite poles of cell during anaphase II. These random orientations and subsequent independent assortment (segregation) of chromosomes give rise to a large calculable number of different chromosomes combination in the gametes
4. Fusion of male gametes and female gametes to produce diploid gametes is also random leading to variation

Fertilization

This is the union of the male and female gametes. It occurs about a third of the way along the oviduct. After fertilization, the zygote is pushed down the oviduct by gentle contraction of the circular muscle in oviduct wall. Once the egg has been successfully fertilized, conception is achieved. The embryo then develops into a foetus. The period taken between conception to delivery varies from species to species, in human it is 9months. Within a few days of implantation, nourishment of the embryo is taken over by the placenta.

Internal fertilization

This is the union of male and female gametes inside female animal

The advantages and disadvantages of internal fertilization

Advantages

• more chances of fertilization
• fewer predators of oval/fertilized egg protected in females body
• stable internal environment
• fewer gametes required
• eggs/fetus protected from dehydration
• The embryo is protected and nourished by female (mammals only)

Disadvantages

• number of gametes fewer hence less number of offspring
• less adapted for sudden change of environment after birth
• in mammals females suffer gestation stress

The menstruation/ sexual/ oestrus cycle

This cycle found in female; ensures that female reproductive physiology events are synchronised. For the uterus prepares itself for implantation before ovulation.

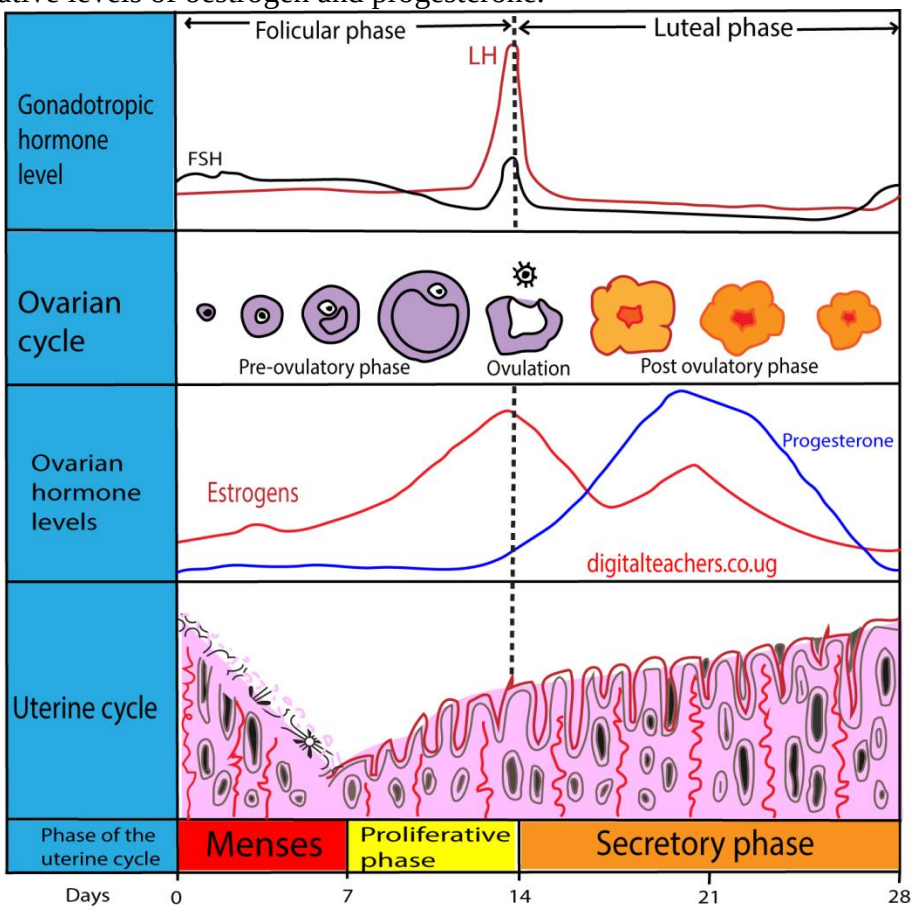
The events that occur in the course of the cycle follow a set of regulated pattern by hormone which are produced by the pituitary gland and the ovary. A complete cycle takes about 28 days. If pregnancy occurs the cycle is interrupted by other hormones produced by the placenta. The

woman is most likely to get pregnant between 12th and the 17th day from the onset of menstruation.

Hormonal control of the cycle
Pituitary hormones secreted by the anterior lobe of pituitary gland are Follicle stimulation hormones (FSH) and luteinising hormone (LH).

Ovarian hormones produced by the ovary are oestrogen and progesterone.`

The menstrual cycle of the human female showing the events occurring in ovary together with relative levels of oestrogen and progesterone.



1. Just after menstruation, the anterior lobe of the pituitary gland starts secreting FSH.
2. FSH cause a Graafian follicle to develop in the ovary to secrete oestrogen.
3. Oestrogen
    - brings about the healing and repair of the uterine endometrium following menstruation.
    - inhibits production of FSH
    - stimulates production of LH.

    In the course of 11 days or so the amount of oestrogen in blood stream steadily increases. Then shortly before evolution takes place, LH is released.

4. LH
    - causes ovulation
    - promotes development the Graafian follicle into a corpus luteum to secrete progesterone
5. The corpus luteum secretes progesterone.
6. Progesterone
    - This along with oestrogen, causes the continued thickening and vascularization of the uterine endometrium in preparation for implantation.
    - Inhibits secretion of LH leading to degeneration of corpus luteum
7. For a week or so after ovulation the concentration of progesterone and oestrogen gradually increase and then suddenly decrease.
8. With the fall in the levels of the two hormones, the uterine endometrium begins to disintegrate and menstruation starts and the cycle repeats.

In the events of pregnancy

Implantation

Following fertilisation, the zygote divides (cleavage) mitotically until a hollow ball of cells, the **blastocyst** is produced. It takes three days to reach the uterus and a further three or four days to become implanted in the lining of the uterus. The outer layer of the blastocyst, called the **trophoblast**, develops into embryonic membranes, the **chorion** and **amnion**.

The chorion develops villi which grow into the surrounding uterine tissue from which they absorb nutrients. These will form part of the **placenta** which is connected to the foetus by the umbilical cord.

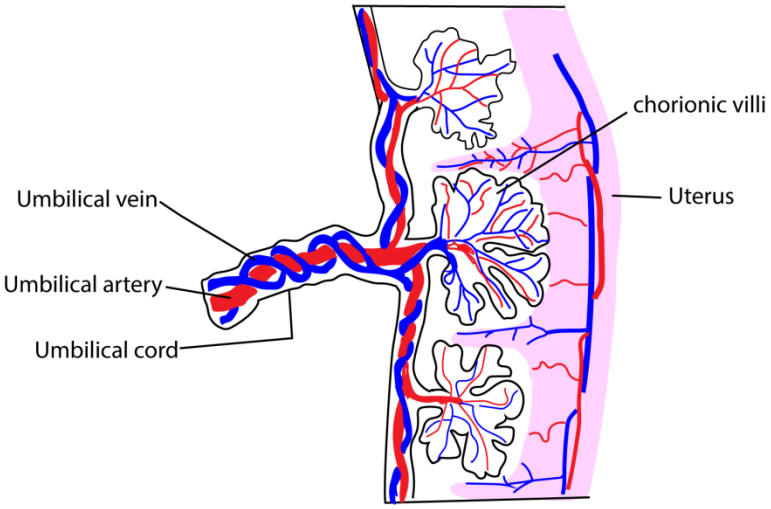
The amnion develops as a membrane around the foetus and encloses the amniotic fluids, a watery liquid which protects the foetus by cushioning it from physical damage.

The corpus luteum persist due to the secretion a hormone called **chorionic gonadotrophin** by the placenta. This hormone signals to the mother's body that an embryo is present in the uterus. The corpus luteum continues to secrete progesterone which coupled with small but stead secretion of oestrogen, maintain the continued development of the uterus and prevents menstruation.

After the first three or four months of pregnancy, the corpus luteum begins to regress and the job of secreting oestrogen and progesterone is take over by the placenta.

In this way, the endometrium is maintained in a suitable state throughout pregnancy.

Placenta



The placenta is a disc-shaped organ which provides the sole physical link between mother and fetus.

From the outer surface of the chorion a number of finger like projections know as chorionic villi grow into the tissue of the uterus. These villi penetrate the tissue of the uterine wall of the mother and form placenta

Functions of the placenta

1. It allows exchange of materials between the mother and foetus without the two-blood mixing
2. Oxygen, water, amino acid, glucose and other essential minerals are transferred from the mother to the foetus
3. Carbon dioxide, urea and other wastes are transferred from foetal blood to mother's blood.
4. Prevents certain pathogens from entering foetal blood
5. Produces HCG
6. It allows certain maternal hormones to cross to the foetus.

Adaptations of the placenta to its functions

1. Rich blood supply allow absorbs necessary nutrients and deliver waste products to mother's drug
2. Has villi that that increases surface area for exchange of material
3. Placental blood has high affinity for oxygen
4. Thin membrane reduce diffusion distance
5. High blood supply
6. Blood capillaries of the fetus and mother flow in opposite direction (counter current system) to maintain diffusion gradient.
7. Contain numerous mitochondria to provide energy for active transport.

Why should mother's and foetal blood not mix

1. To prevent blood incompatibility due to different blood group
2. To prevent incompatibility due to different rhesus factors
3. To prevent infections from the mother attacking the fetus
4. To protect the fetus from high blood pressure of the others blood

The hormonal control of birth

Towards the end of pregnancy, the levels of oestrogen in blood rises while that of progesterone falls. It has been suggested that this plays some part in bringing about birth. Indeed, oestrogen promotes uterine contraction whereas progesterone doesn't.

But the most direct cause of birth in another hormone, **oxytocin** secreted by the posterior lobe of pituitary gland that cause uterine muscle contraction.

Oestrogen and progesterone are also responsible for the growth of the mammary gland in preparation for milk production (lactation). After birth, milk flow is initiated by a hormone called **prolactin** secreted by the anterior lobe of the pituitary gland.

Summary of effects of oestrogen during pregnancy

- promotes growth of mammary glands
- inhibits FSH release
- Inhibits prolactin release
- Prevents implantation in uterus
- Increases size of uterine muscle
- Increase ATP and creatine formation
- Increase sensitivity of myometrium to oxytocin

Summary of effects of progesterone during pregnancy

- Growth of mammary glands
- Inhibits FH release
- Inhibits prolactin release
- Inhibits contraction of myometrium

NB: The fall of progesterone during gestation causes miscarriage as the uterine contraction are no longer inhibited.

Hormonal control of spermatogenesis

1. The hypothalamus secretes gonadotrophin-releasing hormone or GnRH, that stimulates the anterior pituitary gland to produce the gonadotrophic hormones, i.e. Luteinising hormone (LH) and follicle stimulating hormone (FSH).

2. FSH promotes spermatogenesis in the seminiferous tubes. The hormone actually regulates the puberty age and also plays a vital role i.n the production of sperm. It also stimulates the maturation of germ cells in both males and females

3. LH or interstitial cell stimulating hormone (ICSH) stimulates the production of testosterone by the interstitial cells.

4. Testosterone which is produced in the Leydig cells of the testicles becomes responsible for the maturation of the sperm while the production goes on. It also brings about normal development and functioning of testis and secondary sexual.

Infertility

Infertility means not being able to get pregnant after one year of trying (or six months if a woman is 35 or older). Women who can get pregnant but are unable to stay pregnant may also be infertile.

Infertility in men is most often caused by:

a. A problem called varicocele (VAIR-ih-koh-seel). This happens when the veins on a man's testicle(s) are too large. This heats the testicles. The heat can affect the number or shape of the sperm.
b. Other factors that cause a man to make too few sperm or none at all.
c. Movement of the sperm. This may be caused by the shape of the sperm. Sometimes injuries or other damage to the reproductive system block the sperm.
d. Sometimes a man is born with the problems that affect his sperm. Other times problems start later in life due to illness or injury. For example, cystic fibrosis often causes infertility in men
e. importance

Infertility in women is most often caused by:

a. Failure of ovulation
Most cases of female infertility are caused by problems with ovulation. Without ovulation, there are no eggs to be fertilized. Some signs that a woman is not ovulating normally include irregular or absent menstrual periods. Ovulation problems are often caused by polycystic ovarian syndrome (PCOS). PCOS is a hormone imbalance problem which can interfere with normal ovulation. PCOS is the most common cause of female infertility. Primary ovarian insufficiency (POI) is another cause of ovulation problems. POI occurs when a woman's ovaries stop working normally before she is 40. POI is not the same as early menopause

b. Damage to fallopian tubes such blocked fallopian tubes due to pelvic inflammatory disease, endometriosis, or surgery for an ectopic pregnancy

c. Damage to uterus such as Uterine fibroids, which are non-cancerous clumps of tissue and muscle on the walls of the uterus.
d. Problems with the cervix, some **women** have a condition that prevents sperm from passing through the cervical canal
e. Age can contribute to **infertility** because as a woman ages, her fertility naturally tends to decrease.
f. Some women have polyps and fibroids that interfere implantation
Incorrect frequency and or timing of intercourse may make conception unlikely and couples may need to be counselled on the most appropriate time when ovulation is likely.

Similarities between sexual reproduction in flowering plants and animal

(i) Gamete formation
- Start from germ cells/unfertilised sell
- Gamete formation is by meiosis
- More than one male gamete is formed from one germ cell
- Male and female gametes are haploid
- Male gametes are smaller than female gametes

(ii) Gamete transmission
- Male gamete moves towards an ovum by chemical attraction

(iii) Fertilization
- Syngamy (fusion of nuclei) occurs
- Only one male gametes fuse with an ovum to forms single embryo
- Male gametes digest their way through the walls of the ovum

(iv) Development and production
- The embryo is nourished through the same embryo sac
- Offspring show variation from the parents

Differences between sexual reproduction in flowering plants and animal

(i) Most animals are dioecious whereas most plants are monoecious

(ii) In plants, reproductive organs are temporary but in animals are permanent and function throughout their lives

(iii) In plants male gamete require an agent whereas in animals there is copulation

(iv) In plants, male gamete reach ova by developing tubes, but male gametes in animals ae motile.

(v) In plants double fertilization occurs which does not occur in single animals

Methods of contraception

These are birth control to prevent unwanted pregnancy

Methods of contraception include:

(i) long-acting reversible contraception, such as the implant or intra uterine device (IUD)
(ii) hormonal contraception, such the pill or the Depo Provera injection.
(iii) barrier methods, such as condoms.
(iv) emergency contraception.
(v) fertility awareness.
(vi) permanent contraception, such as vasectomy and tubal ligation.

Exercise

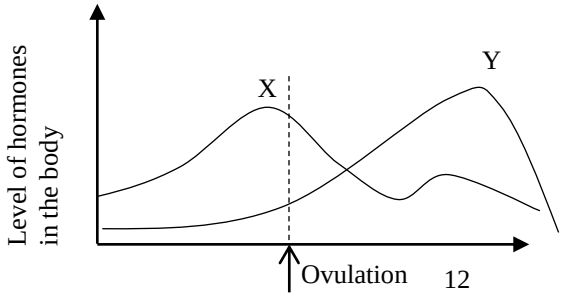
1. Which of the following cells is haploid?
   A. Primordial germ cells
   B. Primary spermatocytes
   C. Spermatids
   D. Secondary spermatocyte

2. Which one of the following could result from low levels of progesterone?
   A. Miscarriage
   B. Parturition
   C. Menstruation
   D. Lactation
3. High levels of Luteinising hormone in blood leads to the following **except**
   A. Ovulation
   B. Production of progesterone
   C. Formation of corpus luteum
   D. Development of the Graafian Follicle

4. Which one of the following is the correct sequence in which hormones are produced in a menstruation cycle?
   A. Progesterone, luteinising hormone, oestrogen, follicle stimulating hormone
   B. Follicle stimulating hormone, oestrogen, luteinising hormone, progesterone,
   C. Follicle stimulating hormone, oestrogen, luteinising hormone, progesterone,
   D. Luteinising hormone, oestrogen, follicle stimulating hormone, progesterone,

5. Which one of the following statement on reproduction is true?
   A. Asexual reproduction always results into identical twins
   B. Gametes are always produced by meiosis
   C. Mitosis always produce diploid cells
   D. Gametes are always haploid.
6. Which of the following occurs in human female body, following menstruation?
   A. Corpus luteum develops
   B. Unfertilized egg cell is removed from the body?
   C. Placenta develops
   D. Proliferation of the uterine wall starts

7. Fig below shows hormonal interaction that occurs during the menstrual cycle



Hormones X and Y are respectively

A. Luteinising hormone and progesterone
B. Oestrogen and progesterone
C. Progesterone and oestrogen
D. Luteinising hormone and follicle stimulating hormone

8. Which of the following is an effect of luteinising hormone?
   A. development of the Graafian follicle
   B. ovulation
   C. stimulation of sperm production
   D. repair of the uterine wall

9. The role of oestrogen during birth is
   A. Causing contraction of uterine wall
   B. Increasing the sensitivity of uterine muscle to oxytocin
   C. Inhibiting the production of progesterone
   D. Promoting production of mammary glands
10. Which of the following supplies oxygenated blood to the foetus?
   A. Umbilical cord
   B. Umbilical vein
   C. Placenta villi
   D. Umbilical artery
11. Which of the following is not a function of progesterone?
   A. Increasing the sensitivity of the uterine muscle
   B. Inhibiting release of follicle stimulating hormone
   C. Inhibiting release of prolactin
   D. Promoting growth of mammary glands
12. The significance of vascularization of endometrium before implantation in mammals is to
   A. Ensure firm attachment of the foetus on to the uterine wall
   B. Prevent menstruation
   C. Assist in producing hormones which maintain pregnancy
   D. Facilitate food and oxygen supply to the foetus
13. Which of the following structure is haploid?
   A. Primary oocyte
   B. Spermatogonium
   C. Secondary oocyte
   D. Germinal epithelium
14. Prolonged menstrual period may be caused by
   A. High levels of progesterone
   B. A decrease in production of follicle stimulating hormone
   C. Deficiency in oestrogen
   D. High level of luteinising hormone.

15. The amount of progesterone in blood increases steadily from ovulation to menstruation, then it begins to decline because.
    A. Luteinising hormone inhibits its production
    B. It is washed out with blood during menstruation
    C. Implantation of zygote occurs
    D. Its work of repairing the uterine wall gets complete
16. Which one of the following hormones helps to guard against miscarriage in pregnancy?
    A. Oestrogen
    B. Progesterone
    C. Oxytocin
    D. Prolactin
17. In the mammalian menstrual cycle, the decline in the level of progesterone is due to
    A. Successful conception
    B. Formation of corpus luteum
    C. Degeneration of corpus luteum
    D. Maturation of Graafian follicle
18. All the following are stimulated by the luteinising hormone **except**
    A. Proliferation of the uterine wall
    B. Development of the corpus luteum
    C. Stimulation of the corpus luteum to produce progesterone
    D. Ovulation
19. Which of the following foetal blood vessel carries the most oxygenated blood?
    A. Pulmonary artery
    B. Dorsal aorta
    C. Posterior vena cava
    D. Umbilical vein
20. Which one of the following conditions would most likely result in a miscarriage in humans?
    A. High level of progesterone and low level of oestrogen in blood
    B. High level of oestrogen and low level of progesterone in blood
    C. Low levels of progesterone and oestrogen in the blood
    D. High level of progesterone and oestrogen in blood
21. Which of the following would not reduce the development of Graafian follicle in human mammalian ovaries?
    A. High levels of oestrogen
    B. High levels of progesterone
    C. Deficiency in pituitary gland
    D. Low levels of luteinising hormone
22. Which one of the following is the mother cell from which ovum is developed?
    A. Oogonium
    B. Primary oocyte
    C. Primordial germ cell
    D. Secondary oocyte
23. What is the role of the luteinising hormone in menstrual cycle? Promotes
    A. Release of ovum
    B. Healing of uterine wall

C. Disintegration of the ovum
D. Implantation of zygote

24. Which of the following hormones is responsible for maintenance of the uterine wall during pregnancy?
    A. Oxytocin
    B. Oestrogen
    C. Progesterone
    D. Luteinising hormone
25. In most mammals a high sperm count is maintained by
    A. Subjecting the animal to high temperature
    B. Maintain the testis in the body cavity
    C. Insulating the testis
    D. Having the scrotal sac outside the mammalian body
26. Which of the following would not reduce the development of Graafian follicle in mammalian ovary?
    A. High levels of oestrogen
    B. High levels of progesterone
    C. Deficiency in pituitary gland
    D. Low level in LH

27. Which one of the following is the target organ for action of LH?
    A. Mammary glands
    B. Uterus
    C. Ovary
    D. Placenta
28. In a woman pregnancy is detected by
    A. Oestrogen
    B. Progesterone
    C. HCG
    D. LH
29. An organ responsible for nourishment of the embryo during the earlier stages of development in human
    A. Embryo sac
    B. Trophoblastic villi
    C. Chorion
    D. Placenta
30. Oogenesis and spermatogenesis are different because oogenesis has
    A. Has one functional cell produced
    B. Four functional cells produced
    C. No polar bodies formed
    D. Starts at puberty

31. Which one of the following does not increase the chances of fertilization in mammals?
    A. Seasonal breeding
    B. Female receptiveness to male only during ovulation
    C. Internal fertilization
    D. Development of secondary sex characteristics
32. Hermaphrodite carry out cross pollination in order to
    A. Encourage variation
    B. Encourage rapid development of eggs
    C. Produce more off springs
    D. Encourage association among individual
33. A muscle cell of an animal was found to contain 24 chromosomes. How many chromosomes would a germinal cell within the ovary of an animal contain?
    A. 24
    B. 12
    C. 48
    D. 36

34. Which one of the following foetal blood vessels caries the most oxygenated blood?
    A. Pulmonary artery
    B. Dorsal aorta
    C. Posterior vena cava
    D. Umbilical vein

35. What type of reproductive process results in the production of hybrid?
    A. Self-fertilization in hermaphrodite
    B. Mating closely related individuals with a recessive parent
    C. Back crossing of an individual with a parent of recessive traits
    D. Mating distantly related individuals
36. One evolutionary advantage of sexual reproduction over asexual reproduction is
    A. formation of diploid gametes
    B. a reduced potential for variation
    C. development of specialised somatic tissue
    D. an increased potential for variation
37. Which of the cells is formed by mitosis?
    A. Ovum
    B. Secondary spermatocyte
    C. Primary spermatocyte
    D. Secondary oocyte

38. Figure 1 shows the control of production of hormones in the menstrual cycle.

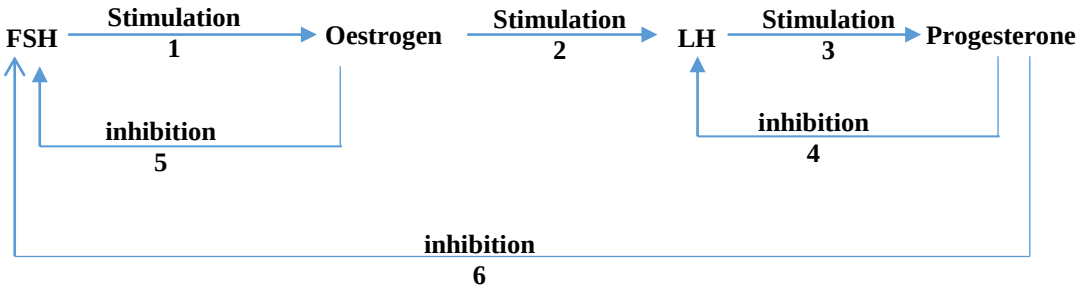


Fig. 1

In case of pregnancy, the stage which is maintained as

A. 1

B. 2

C. 3

D. 6

39. Which one of the following occurs in the human female body, following menstruation?

A. corpus luteum develops.

B. unfertilized cell is removed from the body.

C. placenta develops

D. proliferation of the uterine wall starts.

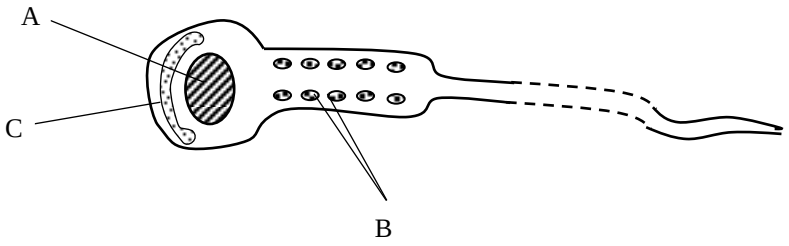
40. Which one of the following is not a role of the larval stage in animal development?

A. Dispersal. B. Asexual reproduction.

C. Feeding. D. Sexual reproduction.

Structured questions

41. The diagram below shows a mature sperm cell



(a) Describe how features A, B, and C enable the sperm to carry out its functions (6matks)

(b) Sexual reproduction in animals requires an aquatic environment for male gametes.
(i) How is an aquatic environment achieved in reproduction of mammals? (2marks)
(ii) Give one explanation why it is necessary to have an aquatic environment for the male gamete. (1mark)

42. (a) explain the absence of a yolk sac in the development of a human embryo while it is an important structure in the development of birds (4marks)

(b) State the reproductive adaptations of birds to terrestrial life (03 marks)

(c) Give the form of parental care provided by mammals. (3mark)

Paper 2 numbers

43. (a) Describe the hormonal interaction in the human female from conception to birth. (10marks)
(b) Suggest possible causes of infertility in human (10marks)

44. (a) Describe how the method of fertilization and other reproductive strategies in mammals have contributed to their evolutionary success. (14marks)
(b) Give an account of hormonal control of spermatogenesis. (6marks)

45. Describe the structure and function of human placenta (20marks)

46. Write an essay on the gametes and their formation (20marks)

47. (a) illustrate and label the principle parts of a spermatozoa indicating the function of each part
    (b) Compare the changes which take place in the reproductive organ leading to the formation of gametes in man
    (c) Outline the similarities in sexual reproduction between male flowering plant an animal.
48. Describe how hormones from the ovary and pituitary gland interact to control the human menstruation cycle.
49. (a) Describe the different mechanisms employed by animals to increase their chances of fertilization and survival (16marks)
(c) How does territorial behaviour contribute to evolutionary success of species (04marks)

Answers to objective question

1.	C	11.	A	21.	D	31.	D
2.	A	12.	D	22.	B	32.	A
3.	D	13.	C	23.	A	33.	A
4.	C	14.	C	24.	C	34.	D
5.	D	15.	B	25.	D	35.	D
6.	D	16.	B	26.	D	36.	D
7.	B	17.	C	27.	C	27	C
8.	B	18.	A	28.	C	28	D
9.	B	19.	A	29.	C	39	D
10.	B	20	C	30.	A	40	D

41. (a) A – contains genetic material that fuses with that nucleus of egg to form a zygote
B – produces ATP form motility of the sperm
C – produces enzyme for entry of sperm into the ovum
(b) (i) sperms are produced with semen to provide aquatic environment
(ii) Sperms need aquatic environment to swim to ovum.

42. Solution

(a) The yolk sac produces red blood cells in the human embryo but its function is quickly taken over by the liver in the foetus. It then degenerates, as it no longer serve any other function.

In the birds, the yolk sacs are very important source nourishment throughout the development of the embryo and cannot be done without. In the human foetus nourishment is provided through the placenta.

(b) Fertilization is internal. This increases chances of success of the process of fertilization.

- They lay eggs with shells in which the embryo grows with all the nutrients and protection provided.
- The birds usually incubate their eggs, keeping them at the right temperature for growth of the embryo and protecting them from external harm.
- They exhibit sexual dimorphism with a well-developed courtship behavior ensuring that mating occurs at the right time.

(c) Breast feeding of young ones.

- Carrying, playing with young ones i.e. showing young one's parental love.
- Protection of young ones from external harm/ dander.
- Development of young ones from inside the mother womb.

43. Solution

Solution

(a) After fertilization, the fertilized egg becomes implanted in the uterine wall and pregnancy results.

The cells of the forming placenta produce the hormone, human chorionic gonadotrophin (HCG) which preserves the corpus luteum. Corpus luteum continues to secrete progesterone which, together with a small steady secretion of oestrogen from the ovary, maintains the continued development of the uterus and prevents miscarriages.

Progesterone and oestrogen also inhibit the anterior pituitary so that it stops producing FSH. This prevents any further follicles from developing during pregnancy.

After the first three or four months of pregnancy, the corpus luteum begins to disintegrate and the placenta takes over the job secreting progesterone and oestrogen.
Progesterone and oestrogen stimulate the increase in the size of the breast during pregnancy due to development of mammary glands.

Oestrogen makes the uterine walls more sensitive to the effects of oxytocin. Oxytocin causes the smooth muscles of the uterus to contract

Progesterone and oestrogen inhibit the secretion of prolactin and therefore formation of milk.

The decrease in progesterone after birth allows prolactin to stimulate the alveoli to secrete milk

(b) Causes of female infertility include:

- Failure to ovulate so that there is so egg to be fertilized
- Damage to the oviducts, causing tubal blockage. As such, the ovum cannot move to the site of fertilization for the ovary.

- Uterine damage due to events such as uterine fibroids and cancer. The uterus becomes unable to maintain a pregnancy.
- Damage to the cervix, especially as a result of unsafe abortions. The cervix becomes unable to maintain the pregnancy up to birth and most pregnancies end in later miscarriages or premature deliveries.
- Hormonal disorders such as hypopituitarism and hypogonadism.
- Antibodies against sperm so that all he husband's sperm cells are rejected

Causes of male infertility includes

- Impotence
- Low sperm count
- Absence of sperm cells in the ejaculated semen (azoospermia)
- Abnormal sperm morphology.
- Abnormal sperm motility.
- Hypogonadism
- Antibodies against the man's own sperms (autoimmunity)

44. Solution

(a) This question requires that you describe how the method of fertilization and reproductive strategies in mammals are of advantage to their survival on land.

In mammals, the mode of fertilization is internal and follows an act of copulation that transfers male gametes towards the female gametes.

Advantages of internal fertilization

- It reduces wastage of gametes and increases chances of reproduction.
- It follows a pleasurable act of copulation. This increases chances of its occurrence as animals always seek the opposite sex for pleasure derived from the act.

Reproductive strategies of survival importance in mammals include; courtship behavior, parental behavior and territorial behavior. These offer the following survival advantages

Advantages of parental behavior

- Young ones are given adequate protection by the adult. This increases their chances of survival into adult life.
- Less energy is usually lost in looking for food for the young ones as they are fed on milk from the mother.
- Young ones learn to avoid harmful situations and survival tactics from the adults. Theses increase their probability of survival into adult life.

Advantages of courtship behavior

It stimulates organisms to sexual activity.

It tightens pair bonding between the mating pair.

It leads to rise in levels of productive hormones.

It synchronizes gonad development, enabling gametes to mature at the same time to ensure that fertilization occurs when mating takes place.

It synchronizes time to produce offspring in right seasons.

It induces mating of individuals who accept each other. All the above advantages of courtship behavior contribute to increased chances of reproduction and hence in their evolutionary success.

Advantages of territorial behavior.

Provides defense of an area in which organisms live against organisms of the same or different species. This reduces competition for resources.

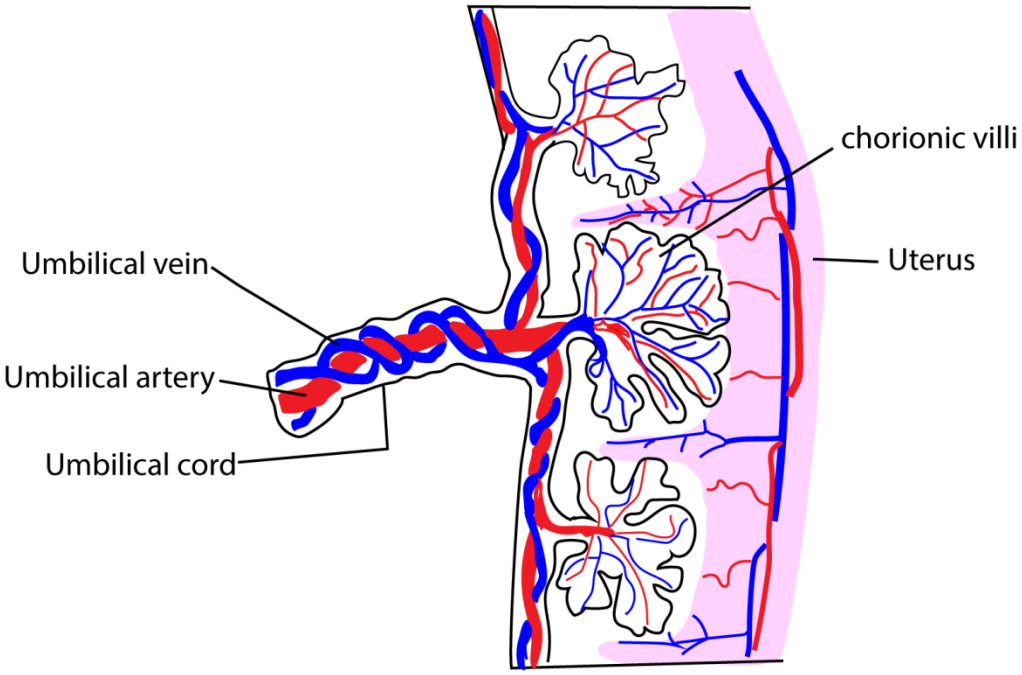
- The mating pair of organisms of the same species and their offspring are well spaced to receive the available resource, e.g. food, space, shelter etc.
- Actual fighting between organisms which would be detrimental to the species is are and replaced by mere threats.
- It minimizes spread of diseases and parasites.

- Genes from strong organisms or the “fittest” are passed on to the next generation.

(b) Hormonal control of spermatogenesis in humans

- The hypothalamus secretes gonadotrophin releasing hormone (GnRH) which in turn stimulates the anterior pituitary gland to secrete two hormones; follicle stimulating hormone (FSH) and luteinizing hormone (LH)
- FSH stimulates spermatogenesis by stimulating the Sertoli cells to complete the development of spermatozoa from spermatids.
- LH stimulates the synthesis of the hormone, testosterone by the leydig cells of the testis. LH is also called the interstitial cell stimulating hormone (ICSH) in the male.
- Testosterone stimulates growth and development of the germinal epithelial cells (spermatogonia) to form sperms. It also works with FSH to stimulate the sertoli cells. By negative feedback mechanism, testosterone regulates the secretion of other hormones responsible for spermatogenesis.

45. Structure of placenta



The placenta is a disc-shaped organ which provides the sole physical link between mother and fetus.

From the outer surface of the chorion a number of finger like projections know as chorionic villi grow into the tissue of the uterus. These villi penetrate the tissue of the uterine wall of the mother and form placenta

Functions of placenta

1. Nutrition: Food materials pass from the mother's blood into the foetal blood through the placenta.
2. Digestion: the trophoblast of placenta digest proteins before passing them into foetal blood
3. Gaseous exchange: through the placenta oxygen passes from maternal blood to the foetal blood, and carbon dioxide passes from foetal blood to maternal blood through the placenta
1. Excretion: nitrogenous wastes such as urea pass from foetal blood into maternal blood through placenta and are filtered by kidney of the mother.
4. Storage : The placenta stores glycogen, fat for foetus before liver is formed
5. Barrier: Placenta functions as an efficient barrier preventing harmful substance from entering the blood circulation of fetus
6. Endocrine function: it secrets hormones like oestrogen, progesterone and HCG

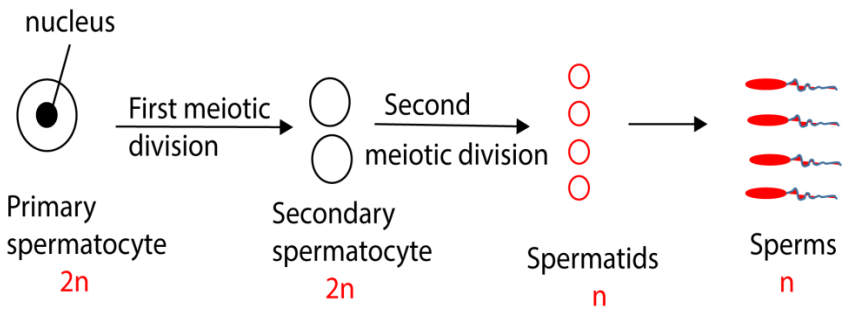
46.

Gametogenesis

This is the formation of gametes. Sperm (male gamete) formation is called spermatogenesis while egg (female gamete) formation is called oogenesis.

Spermatogenesis

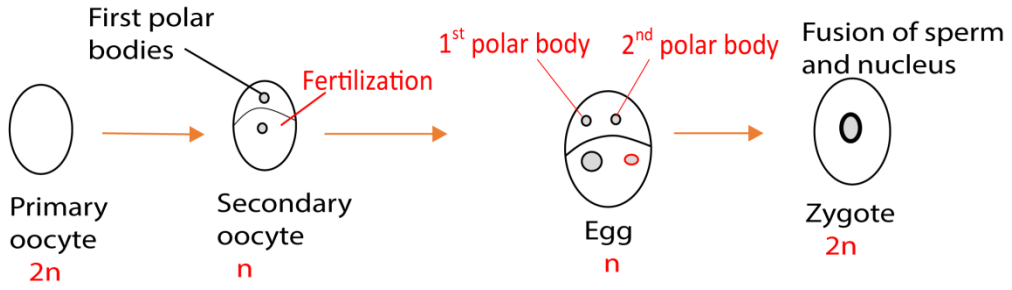
(vii) Spermatogenesis in man occurs in the testis;
(viii) Primordial germ cells (2n) divide mitotically to form spermatogonia that grow into primary spermatocyte (gamete forming cells) with 46 chromosomes
(ix) Primary spermatocytes undergo first meiotic division to form two secondary spermatocytes (n), each with 23 chromosomes.
(x) The secondary spermatocyte undergoes a second meiotic division to produce spermatids (n), each with 23 chromosomes.
(xi) Spermatids then differentiate into sperms (spermatozoa).
(xii) The process of meiosis in male always result in four cells that become sperms.

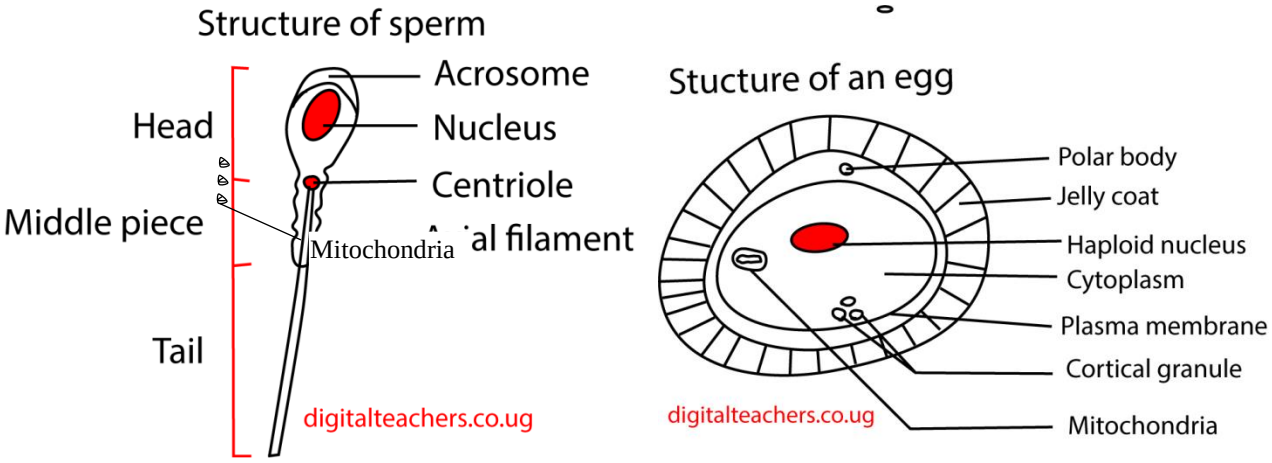


Oogenesis

(ix) Oogenesis occurs in the overlies of female,
(x) Primordial germ cells (2n) divide mitotically to form oogonia the grow into primary oocytes (2n)
(xi) primary oocytes undergo the first meiotic division to form two haploid cells each having 23 chromosomes. One of these cells termed the secondary oocyte (n) receives almost all the cytoplasm. The other is a polar body that may disintegrate or may divide again.
(xii) The secondary oocyte begins meiosis II and stops at metaphase II.
(xiii) Then at ovulation, it leaves the ovary and enters an oviduct where it may be approached by a sperm.
(xiv) If a sperm enters the oocyte, it activates to continue meiosis II to completions. The mature egg has 23 chromosomes. Meiosis in female produces only one egg and possibly three polar bodies.
(xv) The polar bodies are used to discard unnecessary chromosomes while retaining much of the cytoplasm in the egg.

(xvi) The cytoplasm serves as a source of nutrients to the developing embryo.





NB. - Acrosome produces enzymes that enable the sperm to penetrate the egg
- Mitochondria generate energy
- Axial filament is used for propulsion

48

1. Just after menstruation, the anterior lobe of the pituitary gland starts secreting FSH.
2. FSH cause a Graafian follicle to develop in the ovary to secrete oestrogen.
3. Oestrogen
   - brings about the healing and repair of the uterine endometrium following menstruation.
   - inhibits production of FSH
   - stimulates production of LH.

   In the course of 11 days or so the amount of oestrogen in blood stream steadily increases. Then shortly before evolution takes place, LH is released.

4. LH
    - causes ovulation
    - promotes development the Graafian follicle into a corpus luteum to secrete progesterone
5. The corpus luteum secretes progesterone.
6. Progesterone
    - This along with oestrogen, causes the continued thickening and vascularization of the uterine endometrium in preparation for implantation.
    - Inhibits secretion of LH leading to degeneration of corpus luteum
7. For a week or so after ovulation the concentration of progesterone and oestrogen gradually increase and then suddenly decrease.
8. With the fall in the levels of the two hormones, the uterine endometrium begins to disintegrate and menstruation starts and the cycle repeats.