

Chapter 18

Reproduction

18.0. INTRODUCTION

REPRODUCTION

Reproduction is the mechanism that produces new generations and maintains a species. It is very important to the survival of a species or a population.

Explanation

- (i) Every species of organisms can reproduce new individuals of that species. Reproduction differs from all other functions of animals. It is not necessary for the well-being of the individual.
- (ii) However it is very important to the survival/maintenance of a species or a population. Similarly reproduction is the mechanism that produces new generations and maintains a species.

Types of Reproduction

In organisms methods of reproduction are varied and some are very complex. Reproduction is of two types, asexual reproduction and sexual reproduction.

1) Asexual Reproduction

It is a kind of reproduction which requires only a **single parental organism** which gives rise to offspring by mitotic cell division, during which the total chromosomes content of the cell is exactly replicated and passed on to daughter cells, so that the offspring are genetically identical to the parent.

Methods of asexual reproduction

Methods of asexual reproduction are fission, sporulation, budding, vegetative propagation, artificial propagation, parthenogenesis and apomixis etc.

Advantages of Asexual Reproduction

- (i) The offspring are genetically identical to the parent.
- (ii) Increase in number of genetically alike individuals from a parent is very rapid.
- (iii) Now a days man is using the method for tissue culturing in plants and cloning in animals. In this way organisms of valuable characteristics are produced without a change in their genetic make up.

Disadvantages of Asexual Reproduction

- (i) The asexual reproduction is not an adaptive method and the survival of a species may be at risk at some stage.
- (ii) In the cloning there is rapid aging and low resistance to environmental stress and diseases. Similarly cloning is still not being accepted socially and morally in general.

2) Sexual Reproduction

It is a kind of reproduction in which **usually two parents** are involved, and a fertilized egg is produced through the union of meiotically produced specialized sex cells (egg and sperm) from each parent.

Advantages of sexual Reproduction

Meiosis or reduction division gives rise to spores (sporogenesis) or gametes (gametogenesis). As a result, the chromosome number is halved (haploid). Similarly reshuffling of genes also occurs which leads recombination of genes. This not only maintains the chromosome number in a species but also produces genetic variations. It is an important factor in the survival and adaptation of a species or a population (Fig. 18.1).

QUESTIONS RELATED TO ABOVE ARTICLE

Write notes on the following.

(Exercise Question iv)

(c) Asexual reproduction

18.1 REPRODUCTION IN PLANTS

In plants both sexual and asexual reproduction are found.

Asexual Reproduction

In asexual reproduction sporulation, budding, vegetative propagation and apomixis are natural methods while layering and grafting, budding are artificial modes.

Sexual Reproduction

In sexual reproduction, plants have diplohaplontic life cycle with alternating diploid sporophyte and haploid gametophyte generations.

If the two generations are vegetatively similar, such alternation of generation is referred to as isomorphic alternation of generations. If the two generation are dissimilar, that is called heteromorphic.

Reasons for Success of Land plants

Seed plants are predominantly present all around us due to their better sexual reproduction mechanism. It is clear from the following factors:

- (i) Modification of flower and inflorescence for pollination, Gametes are transferred by pollen tubes.
- (ii) Protection of embryo by seed coats.
- (iii) Food storage in the seed for the developing embryo.
- (iv) Dispersal of seeds with the help of fruit formation (angiosperms).
- (v) Seeds are capable of enduring unfavourable conditions in dormant form (seed dormancy) and when the conditions become favourable for establishing the seedling, it germinates.
- (vi) Evolution of pollen tube is an important step in land adaptation by the spermatophytes.
- (vii) Pollen tube acts as vehicle for the transport of male gametes for their safe transport to female gamete in ovule in hostile land environment. Evolution of pollen tube is parallel to the evolution of seed and is tool of success for seed plants.

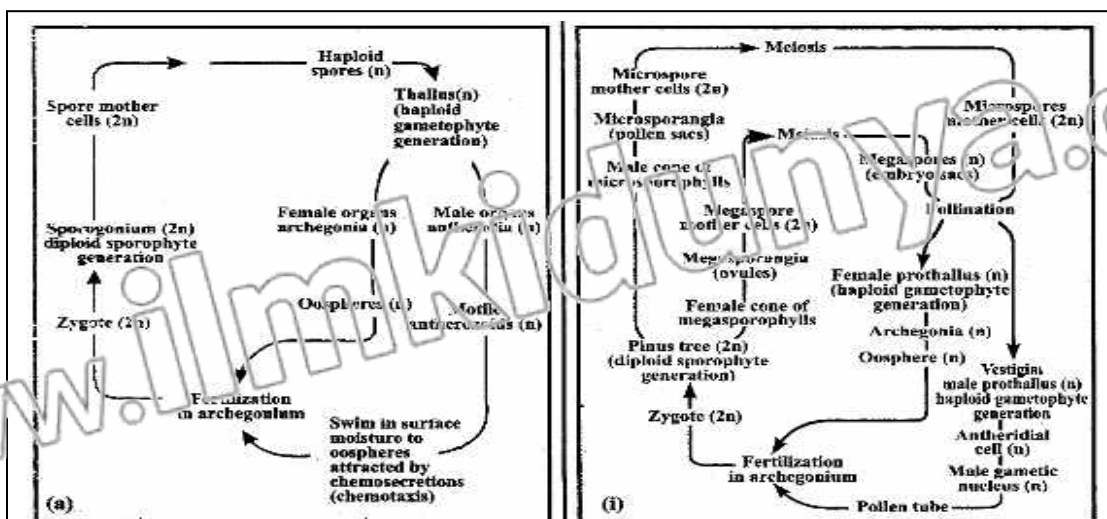


Fig: 18.1 (a) Bryophyte life cycle. Note that The sporophyte is completely Dependent upon the gametophyte.

Fig 18.1 (b) Spermatophyte life cycles (i) Gymnosperm life cycle, *Pinus sylvestris* (Class Pinatae). (ii) Angiosperm life cycle.

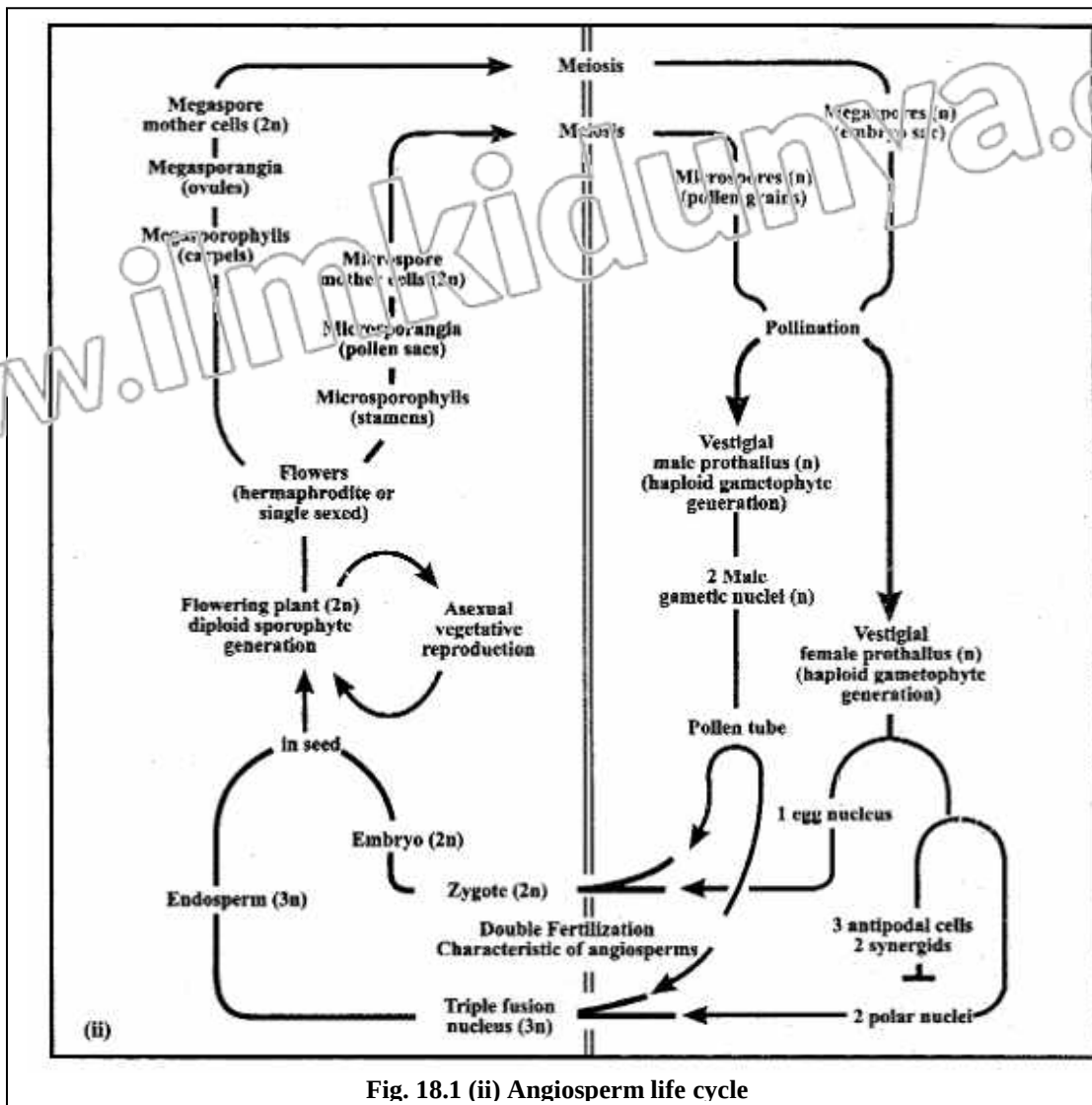


Fig. 18.1 (ii) Angiosperm life cycle

QUESTIONS RELATED TO ABOVE ARTICLE

Define reproduction. Write its advantages.

Discuss types of reproduction in plants.

Sketch the life cycle of an Angiosperm.

(DGK 2(19))

18.1.1 Parthenocarpy**Definition**

Fruit development proceeds without fertilization, is called parthenocarpy.

Cause

It is due to hormonal imbalance; usually high auxin levels occur in these ovaries.

Example

Bananas, pineapples, orange and grapes.

Artificially, it is also used for commercial purposes by adding auxins to tomato, peppers etc.

18.1.2 Seed Dormancy**Definition**

“It is the special condition of rest, which enables an embryo to survive the long periods of unfavourable environmental conditions such as water scarcity or low temperature.”

Breaking of Dormancy (Germination)

For germination or resumption of normal growth by a dormant embryo require certain very precise combinations of environmental cues.

This is necessary to avoid any accidental stimulus which may prove fatal later on.

Importance

During this period of rest, the embryo ceases or limits its growth. This is of great survival importance to the plant in that it prevents the dormant seed from germinating in response to conditions such as a warm spell in winter, which although apparently favourable, are only temporary.

QUESTIONS RELATED TO ABOVE ARTICLE

Explain the role of auxins in plants.

Write notes on the following:

(Exercise Question ii)

(d) Seedless fruits

18.1.3 Fruit Set and Fruit Ripening**Fruit Set**

Retention of the ovary, which becomes the fruit after fertilization, is called fruit set.

Mechanism

Germinating pollen grain is not only carrying gamete but is also an important source of auxins. It stimulates the tissues of style and ovary to produce more auxin. This auxin is necessary for fruit set.

Fruit Ripening

After fertilization, the ovary and ripe seeds continue to produce auxins, which stimulate fruit development.

Developing seeds are not only a rich source of auxins and gibberellins but also of cytokinins. These growth substances are mainly associated with development of the embryo and accumulation of food reserves in the seed and sometimes in the pericarp (fruit wall). Fruit ripening is often accompanied by a burst of respiratory activity called the *climacteric*. It is associated with ethane production, which helps in the ripening of the fruit.

QUESTIONS RELATED TO ABOVE ARTICLE

Write a note on fruit set and fruit ripening.

Describe fruit set and fruit ripening in angiosperms. (LHR 2021, MTN 2021, LHR 2022)

18.1.4 Photoperiodism**Introduction**

Apart from photosynthesis and phototropic responses, another very important way in which light exerts its influence on living organisms is through variations in day length called **photoperiod**.

Effect of Photoperiod

In plants, photoperiod and temperature affect flowering, fruit and seed production, bud and seed dormancy, leaf fall and germination.

Flowering and Photoperiod

Photoperiod affects flowering, when shoot meristems start producing floral buds instead of leaves and lateral buds.

Work of Garner and Allard

Garner and Allard first studied effect of photoperiodism in 1920.

They studied that tobacco plant flowers only after exposure to a series of short days (in autumn) but flowering can be induced artificially. On further studies, they classified flowering plants into three categories

- i) Short day plants (SDPs)
- ii) Long day plants (LDPs)
- iii) Day neutral plants (DNPs)

i) **Role of Dark Period**

Later studies indicated that it is really the length of the dark period, which is critical. Thus, short day plants are really long-night plants. If they are grown in short days but the long night is interrupted by a short light period, flowering is prevented. Long-day plants will flower in short days if the long night period is interrupted.

ii) **Role of Light**

Quantity of light is influenced by the quality of light.

- Red light was effective in preventing flowering and far-red light reversed the effect of red light.
- Last light treatment always determines the response.

Table 18.1 (a) Classification of plants according to photoperiodic requirements for flowering.

FEATURE	SHORT-DAY PLANTS (SDPS)	LONG-DAY PLANTS (LDPS)	DAY-NEUTRAL PLANTS (DNPS)
Dark Period	Flowering induced by dark period longer than critical length e.g. cocklebur 8.5 h, tobacco 10-11 h.	Flowering induced by dark periods shorter than a critical length e.g. henbane 13 h.	Flowering independent of photoperiod
Day Period	(Under natural conditions equivalent to days shorter than a critical length, e.g., cocklebur 15.5 h; tobacco 13-14h)	(Under natural conditions equivalent to days longer than a critical length, e.g. henbane 11 h)	
Examples	Cocklebur (<i>Xanthium</i>), Chrysanthemum, Soybean, Tobacco, Strawberry	Henbane (<i>Hyoscyamus niger</i>), Snapdragon, Cabbage, Spring wheat, Spring barley.	e.g. Cucumber, Tomato, Garden pea, Maize, Cotton.

iii) **Role of Phytochromes**

Phytochromes are blue light sensitive protein pigments.

Phytochromes exist in two forms.

a) **P 660**

- It is a quiescent form.
- It absorbs red light at wavelength of 660 nm and is converted to active P 730.

b) **P 730**

- It is active form.
- It absorbs far-red light at 730 nm and is converted to P660.

In nature P 660 to P 730 conversion takes place in day light and P 730 to P 660 conversion occurs in the dark. Thus during the day, a plant has P 730 while during night it contains more P 660.

The presence and rate of conversion enables plants to detect light or dark environment and its duration.

Table 18.1 (b) Some Phytochrome-controlled responses in plants.

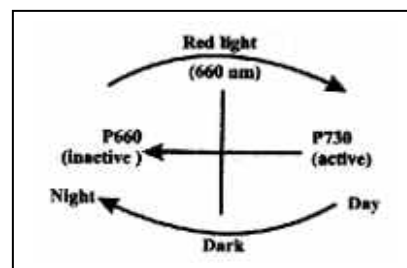
General Process effected	Red light promotes
Germination	Germination of some seeds, e.g. some lettuce varieties Germination of fern spores
Photomorphogenesis (light-controlled development of form and structure)	Leaf expansion in dicotyledons. Leaf unrolling in grass (monocotyledons). Chloroplast development etioplasts convert to chloroplasts see etiolation). Greening (protochlorophyll converted to chlorophyll). Inhibition of internode growth (including epicotyl, hypocotyl and mesocotyl), i.e. preventing of etiolation. Unhooking of plumule in dicotyledons.
Photoperiodism	Stimulates flowering in long-day plants. Inhibits flowering in short-day plants.

Relation of Light Quality with Phytochromes

It has been found that red light inhibits flowering the short-day plants but promotes flowering in long-day plants, under conditions during which flowering normally takes place.

It is hypothesis that P730-P660 interconversion might be the plant time-regulator for flowering.

According to this hypothesis, P730 converted from P660 by absorption of red light. This P730 inhibits flowering in short-day plants but promotes flowering in long-day plants. P730 accumulates in the day and diminishes at night. Short day plants could flower only if the nights were long enough, during which a great amount of P730 would not be inactivated.



Now a days, it is considered that time measuring phenomenon of flowering is not totally controlled by the interconversion of P660 to P730. Other factors like presence or absence of light and length of dark or light period also play an important role in flowering.

iv) Role of Florigen

Phytochromes seem to be responsible for the detection of either light or darkness. This biological clock once stimulated causes production of florigen hormone in leaves, which travel through phloem to the floral buds initiating flowering.

QUESTIONS RELATED TO ABOVE ARTICLE

Define photoperiodism. Give classification of plants according to photo periodic requirement for flowering.

18.1.5 Vernalization**Definition**

Vernalization is a process through which biennials and perennial plants are stimulated to flower by exposure to low temperature.

Mechanism**The low temperature**

Stimulus is received by the shoot apex of a mature stem or embryo of the seed but not by the leaves as in photoperiodism.

- In some plants, vernalization is an absolute requirement.
- In some cases, it simply assists in inducing flowering.

The duration of low temperature (chilling) treatment required varies from four days to three months. Temperature around 4°C is found to be very effective. It stimulates the production of 'vernalinal' hormone which induces vernalization. It is now believed that vernalinal is actually gibberellin.

Importance

- Photoperiodism and vernalization serve to synchronize the reproductive behaviour of plants with their environment. They ensure reproduction at favourable times of year.
- They also ensure that members of the same species flower at the same time, encouraging cross pollination for genetic variability.

QUESTIONS RELATED TO ABOVE ARTICLE

Define vernalization. Discuss its importance in plants.

Write a note on vernalization.

(LHR 2019)

18.2 REPRODUCTION IN ANIMALS

Animals reproduce both asexually and sexually but asexual reproduction in animals is less common as compared to plants.

18.2.1 ASEXUAL REPRODUCTION

There are various ways of asexual reproduction in animals. Important ones are binary fission, multiple fission, (animal-like protocists), budding (*Hydra*), parthenogenesis, tissue culturing, cloning and identical twins are the common asexual methods of reproduction.

Parthenogenesis**Definition**

“It is defined as the development of an egg without fertilization.”

Examples

It is found in ants, bees, wasp etc.

Types

Important types of parthenogenesis are

- (i) Haploid Parthenogenesis
- (ii) Diploid Parthenogenesis
- (i) **Haploid Parthenogenesis**

Definition

“Such type of parthenogenesis during which haploid egg develops into haploid offspring is called haploid parthenogenesis.”

Example

Honeybees

Mechanism

- Queen bee receives sperms from a drone bee and stores in a pouch closed off by a valve.
- Eggs may be fertilized or not.
- Males (drones) are developed from unfertilized eggs. They are haploid and produce sperms by mitosis.

(ii) Diploid Parthenogenesis**Definition**

“Such type of parthenogenesis during which diploid egg develops into diploid offspring without fertilization is called diploid parthenogenesis.”

Example

Aphids

Mechanism

Egg producing cells of the female undergo a modified form of meiosis involving total non-disjunction of the chromosomes. Egg (diploid) develops into young females.

Advantage of Parthenogenesis

Parthenogenesis has the advantage of accelerating the normal reproductive rate.

QUESTIONS RELATED TO ABOVE ARTICLE

Define parthenogenesis. Explain briefly different kinds of parthenogenesis.

Describe the type of parthenogenesis in animals.

(SGD 2022)

Describe the type of parthenogenesis in animals.

(BWP 2022)

Write notes on the following.

(Exercise Question iv)

(a) Parthenogenesis

18.2.2. Tissue Culturing and Cloning**18.2.2 a Tissue Culturing****Definition**

Process through which a plant tissue is cultured in an artificial culture medium is called tissue culturing.

Mechanism

In tissue culturing technique in plants, cambium tissue excised from plants can be stimulated by the addition of nutrients, cytokinins and IAA. (indole acetic acid).

These cells show continued growth and differentiate into a new plant, genetically identical to their parents.

Advantages

- It is widely used for the rapid propagation of desired varieties.
- It is also used for those varieties which are difficult to be propagated by cuttings.

QUESTIONS RELATED TO ABOVE ARTICLE

Write a short note on “Tissue culturing and cloning”.

Write a note on tissue culture and cloning.

(LHR 2018)

18.2.2. b Cloning**Definition**

“Production of organisms by sub culturing a single cell is called cloning and such organisms are called clones.”

Mechanism

In animals and especially among vertebrates, a nucleus from the somatic cell is removed and introduced into an egg cell, whose own nucleus has been destroyed by ultraviolet radiation. The egg with transplanted diploid somatic cell nucleus develops into an organism, genetically identical to the parent who has contributed the nucleus.

Advantages

- It is useful to get animals with desirable traits e.g. prize bulls, race horse etc.
- Use of cloned cells allows the quantitative study of the action of hormones, drugs and antibodies to be made on cells.
- It is useful substitute for investigating the effects of drugs, cosmetics and pharmaceutical products on animal cells without exposing laboratory animals to these chemicals.
- It is also useful to get desirable varieties of plants

Disadvantages

- Clones show rapid aging.
 - They have low resistance to environmental stress and disease.
 - Cloning has the advantage that all the offspring behave similarly, but should an environmental hazard develop (like an outbreak of a disease), non-resistant strains are present to lessen the impact.
- Also, the degree to which environment influences clone development is not fully known and any cloned cell would have to go through all the phases of development once again including embryo, fetus, baby and child hood (in case of human beings.)

18.2.3 Identical Twins**Identical Twins**

In higher vertebrates including man, zygote after fertilization, undergoes cleavage (cell division by mitosis). When embryo is at two cell stage, the two blastomeres, instead of remaining together, may separate and behave as two independent zygotes, each giving rise to a new individual. Both individuals are products of mitosis thus have identical genetic make up and are called **identical twins**. They are produced mitotically (asexually).

Fraternal Twins or Triplets

In some cases, more than one egg is produced by the female and all eggs are independently fertilized forming two or more zygote. These zygotes develop into new off-springs. However, these offsprings have different genetic combinations. Such twins or triplets are called **fraternal twins or triplets**. They are produced sexually.

QUESTIONS RELATED TO ABOVE ARTICLE

What are common methods of asexual reproduction in animals? Describe them.

(GRW 2007)

Write a note on identical twins.

(FSD 2019)

Write a note on identical twins and fraternal twins.

(LHR 2021)

Write down a note on identical twins and fraternal twins.

(GRW 2021)

Write note on asexual reproduction

18. 2.4 Sexual Reproduction

It is thought that asexual method of reproduction is a primitive form of reproduction than the sexual reproduction.

Sexual reproduction has advantage over asexual reproduction, which is elaborated in the following table.

FEATURE	ASEXUAL REPRODUCTION	SEXUAL REPRODUCTION
Parents involved	One parent only	Usually two parents
Gamete production	No gametes are produced	Haploid gametes are produced that fuse to form diploid zygote.
Meiosis	Absent	Present at some stage in life cycle to prevent chromosome doubling in every generation
Nature of Offspring	Offspring identical to parent	Offspring not identical to parents. They show genetic variation as a result of genetic recombination.
Occurrence	Commonly occurs in plants, less differentiated animals and microorganism. Absent in more differentiated animals.	Occurs in majority of plant and animal species.
Speed	Often results in rapid production of large number of off spring.	Less rapid increase in numbers.

Different processes/ steps concerned with sexual reproduction are as follows.

A) Gamete Production

Gametes may be identical (**isogametes**) or different (**heterogamete**) in which male gametes (sperms or antherozoid) are motile and female gametes (eggs or ova) are non-motile.

B) Differentiation of Sexes

Evolution of sexual reproduction leads to the differentiation of sexes (male or female). Organisms are either having one sex (**unisexual**) or both the sexes (hermaphrodite or **bisexual**).

Advance mode of sexual reproduction has unisexuality in animals but in plants, bisexuality in general is retained.

Despite the bisexuality (tapeworm, earthworm etc), cross fertilization is ensured for maintaining the advantage of genetic recombination.

C) Fertilization and Development

Fertilization is the process, which leads to union of gametes. Fertilization may occur outside the body (external fertilization) or inside the body of the female (internal fertilization).

- a) **External fertilization** occurs in aquatic environment where male gametes can swim towards the female gamete in water medium.

Development

Development is also external due to the constant/ stable conditions of water e.g. as in frog, fish etc.

- b) **Internal fertilization** occurs in terrestrial conditions. Sperms are lodged in the female body where fertilization occurs e.g. reptiles, birds and mammals.

Development

- i) This may lead to external development as in reptiles and birds. They lay shelled eggs to protect the developing embryo from harsh terrestrial conditions. Such animals are called **oviparous**.
- ii) In mammals, there is internal development inside the female body, which gives birth to young ones. Such animals are called **viviparous**.
- iii) In some mammals like duckbill platypus and spiny ant-eater internal fertilization leads to internal development of the young ones in shelled egg and when development is completed, shelled egg is laid, which hatches to offspring. This is called **ovoviviparous** condition.
- Viviparous and ovoviviparous animals provide more protection to their young one during development.
 - Nourishment is provided either through stored food in the egg or through placenta by the mother.

QUESTIONS RELATED TO ABOVE ARTICLE

Compare the asexual reproduction with sexual reproduction. (RWP 2019, SGD 2021)

18.3 REPRODUCTION IN MAN

In man, male and female have separate reproductive systems.

18.3.1 Male Reproductive System**Components**

There are three important components of male reproductive system.

- (1) External genitalia
- (2) Testes
- (3) Duct system

(1) External Genitalia

External genitalia consist of:

- Sac like **scrotum** containing testes
- **Penis** (male copulatory organ) which is used to transfer the sperms into the female reproductive tract

(2) Testes

Male reproductive organs or gonads are paired organ called testes.

(3) Duct system

- Each testis consists of a highly complex duct system called **seminiferous tubules**.
- **Vas deferens** is the main duct of male reproductive tract, which forms highly convoluted **epididymis**.

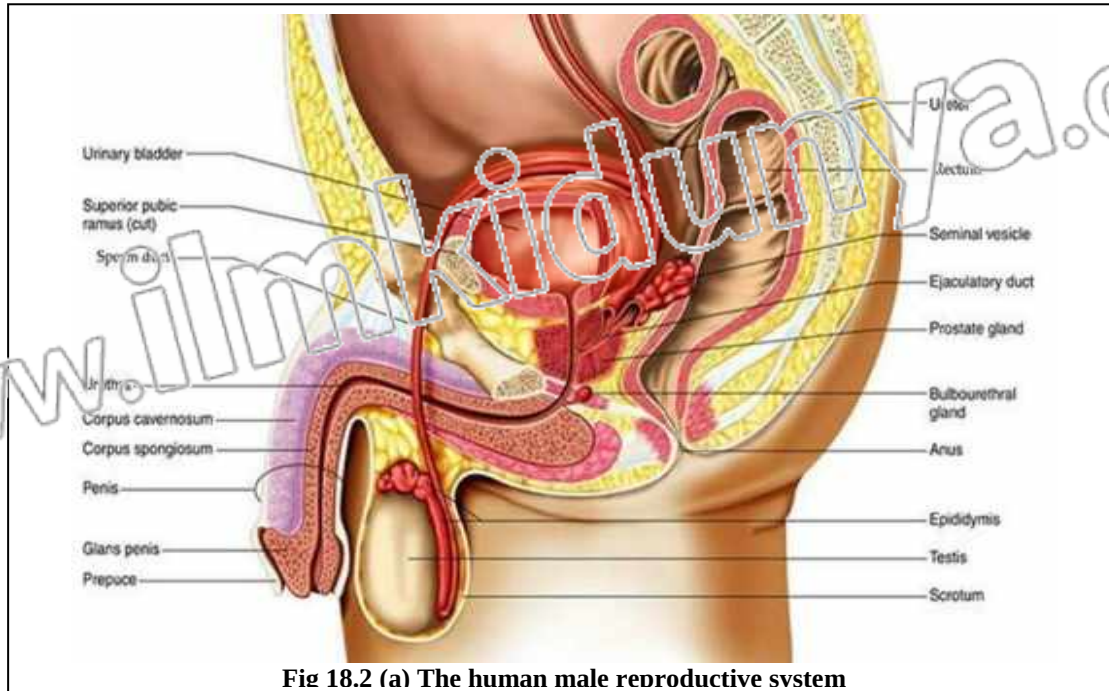


Fig 18.2 (a) The human male reproductive system

Functions of Male Reproductive System

It performs two important functions.

i) Reproductive function

ii) Endocrine function

i) Reproductive Function

Reproductive function is formation of sperm and its transfer to female reproductive tract. Mechanism of formation of sperm is as follows.

- In seminiferous tubules, spermatogonia are produced by the repeated division of cells of germinal epithelium.
- These increase in size and differentiate into primary spermatocyte, which undergo meiotic division to form secondary spermatocytes and spermatids.
- Spermatids differentiate into mature sperms.

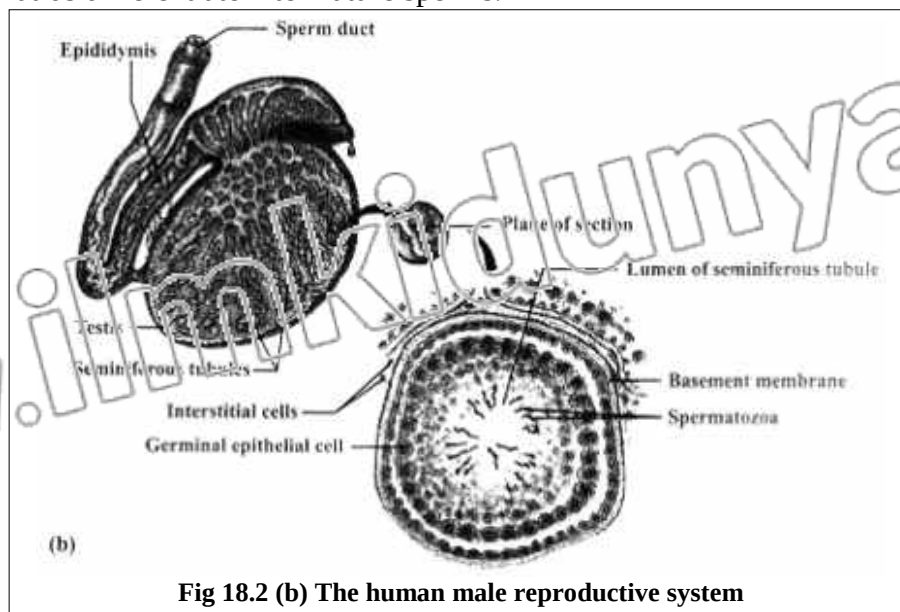


Fig 18.2 (b) The human male reproductive system

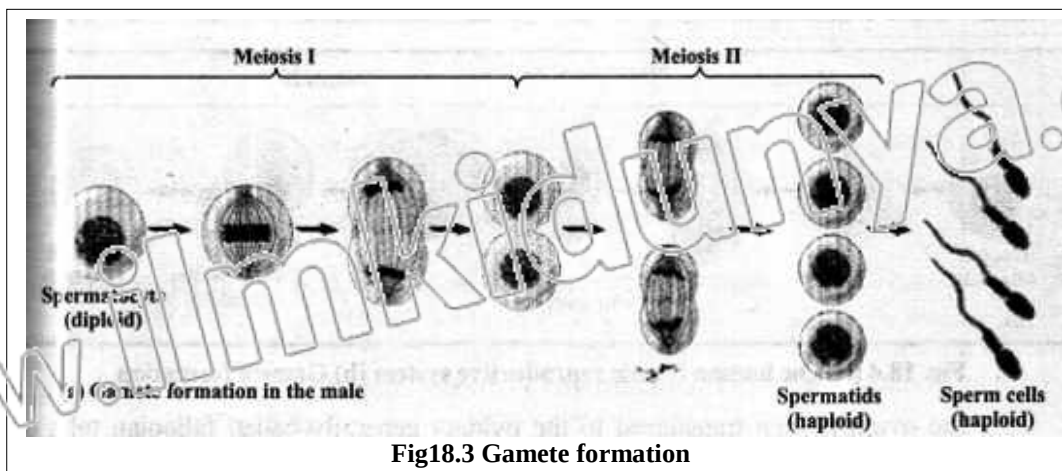


Fig18.3 Gamete formation

Fluid secreted by Sertoli cells provides liquid medium, protection and nourishment to sperms while they are in tubules.

Sperms are then transferred to vas deferens and then through urinogenital duct are discharged out.

ii) Endocrine Function

Interstitial cells are present between seminiferous tubules, which secrete testosterone. This hormone is essential for the successful production of sperms and also controls the development of male secondary sexual characteristics during puberty.

QUESTIONS RELATED TO ABOVE ARTICLE

Describe Male Reproductive System in Human. (LHR 2019, BWP 2019, MTN 2021)

Describe male reproductive system of man. (Diagram not needed). (SWL 2021)

18.3.2 Female Reproductive System

Components

It consists of the ovaries, the oviducts, uterus and external genitalia. Or we can also divide it into following three main components

- 1) External genitalia
- 2) Gonads
- 3) Duct system

1) External Genitalia

It is in form of *vagina*.

2) Gonads

A pair of *ovaries* lies within the body.

3) Duct System

Various ducts involved are

- **Oviduct** generally called fallopian tube or uterine tube.
- The uterine tube opens into the *uterus*.
- Uterus opens into the vagina through *cervix*. Urethra and vagina have independent openings to the exterior.

Functions of Female Reproductive system

Important functions performed by it are

- i) Production of egg in periodic manner
- ii) Hormone production for normal reproductive cycle and secondary sexual characters.
- iii) Reception of male gametes.
- iv) Fertilization, implantation of zygote and placentation.

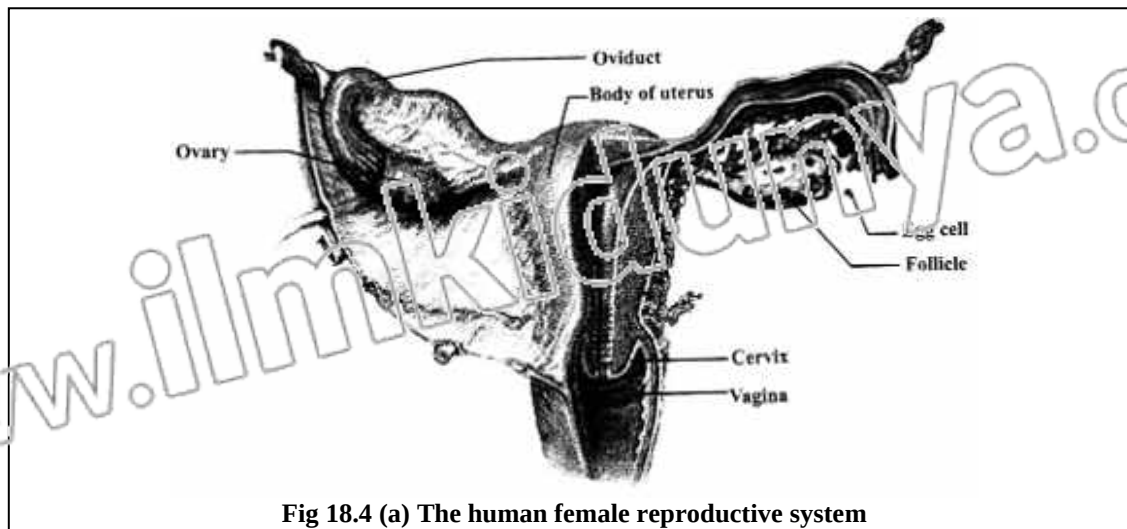


Fig 18.4 (a) The human female reproductive system

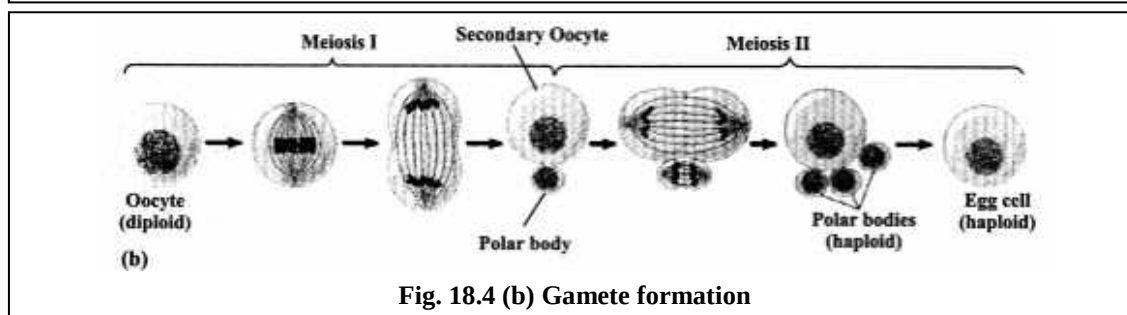


Fig. 18.4 (b) Gamete formation

Mechanism of Production of Egg

- Germ cells in the ovary produce many oogonia which divide mitotically to form primary oocytes. These are enclosed in groups of follicle cells.
- The primary oocyte divides meiotically into the haploid secondary oocyte and first polar body.
- Second meiotic division in the oocyte proceeds as far as metaphase but is not completed until the oocyte is fertilized by the sperm.

In human only one ovum is usually discharged from the ovary at one time, this phenomenon is called **ovulation**.

The ovum is then transferred to the oviduct. The fertilization of the ovum takes place in the proximal part of the oviduct.

The fertilized ovum (zygote) enters the uterus where it is implanted (conceived) and undergoes further development.

A placenta is established between the uterine and foetal tissue for the exchange of oxygen, carbon dioxide, waste, nutrients and other materials.

QUESTIONS RELATED TO ABOVE ARTICLE

Describe the part of human female reproductive system and mechanism of oogenesis. (DGK 2022)

Explain and draw human female reproductive cycle. (GRW 2022, RWP 2022)

What structures are associated with the human female reproductive system? What are their functions? (Exercise Question i)

18.3.2.1 Female reproductive Cycle

In females, production of egg is a cyclic activity as compared to males in whom gamete production and release is a continuous process beginning at puberty and lasting throughout life.

Definition

Periodic reproductive cycle in human female involving changes in the structure and function of the whole reproductive system is called menstrual cycle.

It is completed in about 28 days.

Events of Menstrual Cycle

The events of the menstrual cycle involve

- Ovaries (ovarian cycle)
- Uterus (uterine cycle)

These events are regulated by pituitary gonadotropins.

Phases of Menstrual Cycle

Menstrual cycle is divided into four phases.

- i) Follicular phase
- ii) Ovulation phase
- iii) Luteal phase
- iv) Menstrual phase

Mechanism of Menstrual Cycle

Primary steps in menstrual cycle are

- i) The pituitary gland on the onset of puberty, releases follicle stimulating hormone (FSH) which stimulates the development of several primary follicles. Only one of these follicles continues to grow with its primary oocytes while the rest break down by a degenerative process known as **follicle atresia**.
- ii) Ovary under stimulus of FSH also produces estrogen hormone. Estrogen stimulates the endometrium (internal lining of uterus wall) and also vascularizes it and inhibits the secretion of FSH from pituitary gland.
- iii) Decreased FSH and increased estrogen causes pituitary gland to secrete luteinizing hormone. This hormone induces ovulation (release of ovum from the follicles).
- iv) Follicle cells after release of egg are modified to form a special structure called **corpus luteum**, which is a yellowish glandular structure. It starts secreting progesterone. It also develops the endometrium and makes it receptive for the implantation of the zygote (**placenta formation**).
- v) If fertilization does not occur, the corpus luteum starts degenerating. The progesterone secretion diminishes and its supporting effect on the spongy endometrium is reduced, which suffers a breakdown. This causes the discharge of blood and cell debris known as **menstruation**.

Oestrous cycle

Oestrous cycle is a reproductive cycle found in all female mammals except human being. In this cycle, the estrogen production prepares the uterus for conception partly and also follicle develops ova. At this stage, female needs a physical stimulus of mating for ovulation. She exhibits the desire for mating or is said to be on "heat"

Duration of Menstrual Cycle

The human menstrual cycle generally repeats every 28 days although there is considerable variation in different individuals or even within the same individual at different times of her age. Malnourishment and emotional stresses also effect the female reproductive cycle and thus the cycle is not completed in its normal 28 days.

The end or complete stop of the menstrual cycle is called **menopause**, after which the female stops producing the ova.

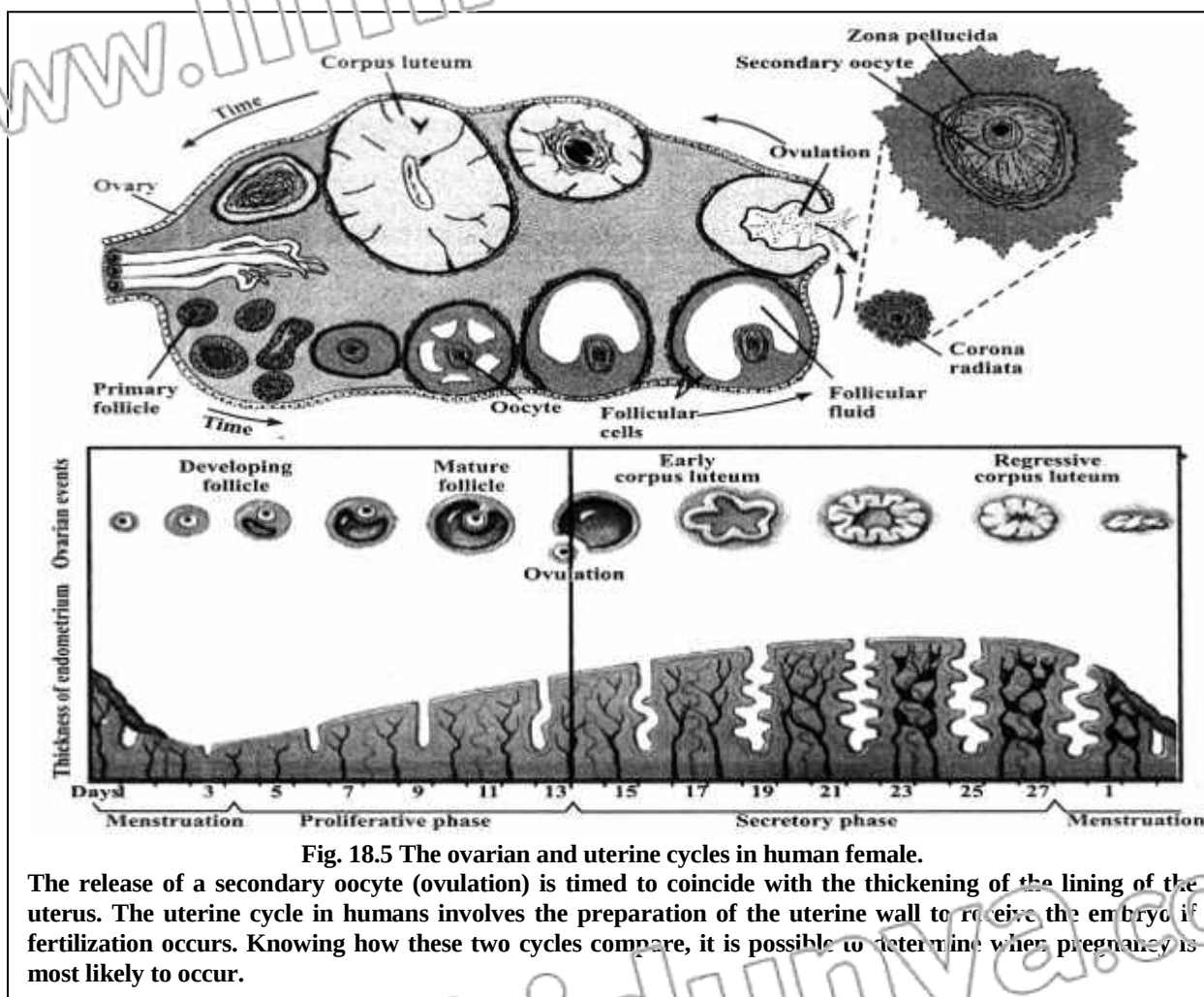


Fig. 18.5 The ovarian and uterine cycles in human female.

The release of a secondary oocyte (ovulation) is timed to coincide with the thickening of the lining of the uterus. The uterine cycle in humans involves the preparation of the uterine wall to receive the embryo if fertilization occurs. Knowing how these two cycles compare, it is possible to determine when pregnancy is most likely to occur.

QUESTIONS RELATED TO ABOVE ARTICLE

Describe the human female reproductive cycle.

(LHR 2017, GRW 2018, SGD 2019 BWP 2021)

Describe human female's menstrual cycle.

(GRW 2019, SWL 2019)

Describe human menstrual cycle.

(Exercise Question iii)

18.3.2.2 Birth

The total gestation period (pregnancy) is usually about 280 days.

Different steps involved from placentation to birth are as follows

i) Placenta Formation

Once placenta is established, it starts secreting the progesterone hormone, which maintains the pregnancy.

Any disturbance in its secretion may lead to premature birth or miscarriage.

Human embryo remains enclosed in amniotic sac filled with amniotic fluid, which is protective, and shock absorptive.

ii) Involvement of Maternal Hormones

- Pituitary gland produces luteotropic hormone (LTH).

- Placenta also secrete human placental lactogen.

Both these hormones stimulate mammary development in preparation for lactation.

iii) Development

From beginning of the 3rd month of pregnancy, the human embryo is referred to as the fetus.

Most of the major organs are formed by the 12th week of pregnancy and the remainder of the gestation period is taken up by growth.

iv) Hormonal Involvement for Birth

There is a high degree of fetal involvement in the timing of birth. The initial stage of birth is the result of the stimuli from the fetal pituitary.

The ACTH released from fetal pituitary stimulates the fetal adrenal gland to release corticosteroids. These corticosteroids cross the placental barrier and enter the maternal blood circulation causing a decrease in progesterone production.

The reduction of progesterone level stimulates the pituitary gland to produce oxytocin hormone. This induces labour pain i.e. contraction of uterus wall. The release of oxytocin occurs in 'waves' during labour and provides the force to expel the fetus from the uterus.

v) Labour Changes & Birth

The cervix dilates, and the uterine contractions spread down over the uterus and are strongest from top to bottom. Thus, pushing the baby downward leading to the delivery of the baby. The umbilical cord is ligated, and baby is released from the mother.

Within 10-45 minutes after birth, the uterus contracts and separates the placenta from the wall of the uterus and placenta then passes out through the vagina. This is called **after birth**

Bleeding, throughout this period, is controlled by the contraction of smooth muscle fibers, which surround all uterine blood vessels supplying the placenta. Average loss of blood is about 350 cm³.

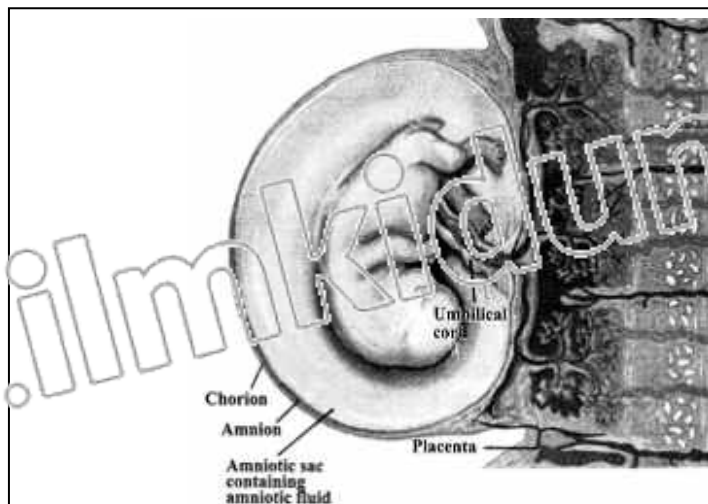


Fig. 18.6 Placental structure

The embryonic blood vessels that supply the developing child with nutrients and remove the metabolic wastes are separated from the blood vessels of the mother. Because of this separation, the placenta can selectively filter many types of incoming materials and microorganisms.

QUESTIONS RELATED TO ABOVE ARTICLE

What are the functions of placenta during pregnancy? (RWP 2021)

Write a note on birth. (LHR 2018, MTN 2019)

What are different physiological changes occur during the process of birth in human female? (MTN 2019)

Discuss the process of birth in human female.

(DGK 2019, GRW 2021, SWL 2022, FSD 2022)

What are the functions of placenta during pregnancy? (Exercise Question ii)

18.4 TEST TUBE BABIES

Recent biotechnical advantages have led to many improvements in human life. One of the important aspects is the test tube babies. Parents which are unable to enjoy the normal process of fertilization and birth of their offspring due to some physiological and physical abnormalities in any of the two parents are being benefited with this method.

Parental sperm and ovum are fertilized in vitro (outside the female body) and then the zygote is implanted back into the mother uterus placenta establishes remaining development takes place in the body of the mother leading to normal birth.

QUESTIONS RELATED TO ABOVE ARTICLE

Write a note on test tube babies and identical twins. (TSD 2021)

18.5 SEXUALLY TRANSMITTED DISEASES (STD)

Unhealthy attitudes and low moral values sometime lead to serious complication. The carrier may transmit this disease to their healthy partners.

SOME COMMON STDs

Following are some common sexually transmitted diseases

1. Gonorrhea

Causative Agent

It is caused by gram negative bacterium *Neisseria gonorrhea*.

Effects

It mainly affecting the mucous membrane of urinogenital tract. New born infants may acquire serious eye infections if they pass through the infected birth canal.

Transmission

It is highly contagious through sexual contacts.

2. Syphilis**Causative Agent**

It is caused by a spirochete, *Treponema pallidum*.

Effects

It damages the reproductive organs, eyes, bones, joints, central nervous system, heart and skin.

Transmission

Sexual contact is the major source of its dissemination.

3. Genital Herpes**Causative Agent**

It is caused by herpes simplex type 2 virus.

Effects

It produces genital soreness and ulcers in the infected areas.

Transmission

It is most frequently transmitted by sexual contact causing infection of the genitalia. In infected pregnant woman, virus can be transmitted to infant during birth, causing damage to eyes and CNS of the infant.

4. AIDS (Acquired Immune Deficiency Syndrome)**Causative Agent**

It is caused by HIV (Human Immunodeficiency Virus).

Effects

Patient loses his power of immunity.

Transmission

Sexual contact is a major source of its spread.

CONTROL OF STDs

The above dreadful sexual diseases can be controlled and prevented by avoiding sexual contacts with carrier or diseased person and adopting the hygienic conditions. The treatment involves medication for a long period except AIDS, at present.

QUESTIONS RELATED TO ABOVE ARTICLE

Explain sexually transmitted diseases in human. (LHR 2017, FSD 2021)

Describe four sexually transmitted diseases. (GRW 2017)

Discuss sexually transmitted disease. How can these be controlled? (LHR 2022)

Discuss causes, control and effect of sexually transmitted diseases. (MTN 2022)

Write notes on the following. (Exercise Question iv)

(b) Herpes Genitalia

KEY POINTS**Cervix**

The narrow opening of uterus is called cervix. It is present between the uterus and vagina. It does not allow the foetus to pass out of uterus during pregnancy.

Umbilical cord

It is a special tube present between the abdomen of foetus and placenta. It is used for exchange of material between the placenta and foetus. It is tied and cut down after birth. It left permanent scar on the abdomen.

Placenta

It is physiological contact between the maternal and foetus tissues for exchange of material.

Labor pain

These are special changes before birth, which include contraction of the muscles of the uterus. The female feel it in the form of a pain. It is first indication of the start of birth.

Difference between meiosis of human male and female

Human male	Human female
All the stages of the meiosis are completed at the same time.	The meiosis proceeds up to metaphase of meiosis II. After that the meiosis stops till the fertilization.
All the four meiotic products change into sperms. All four sperms are viable and can take part in fertilization.	Only one meiotic product is changed into egg. The remaining three meiotic products known as polar bodies are non viable. Hence degenerated.
All the sperms become mature and are released at the same time.	The eggs do not become mature at the same time. One egg gets mature at a time and is released.

Difference between Menstrual and oestrous cycle

Menstrual cycle is periodic physiological change in the uterus and ovary between two menstruations. The discharge of blood and other broken part of uterus from the vagina is called menstruation. Menstrual cycle is regular process which continues in the absence of pregnancy.

Oestrous cycle is physiological change in the female between two estrous or heat period. Oestrous or heat is a desire of female to mate. It does not involve changes in uterus. So there is no menstruation.

EXERCISE

Q 1 Fill in the blanks.

- i) Asexual reproduction requires only a single _____ organism.
- ii) Sexual reproduction usually involves _____ parents.
- iii) Phytochromes are the special _____ sensitive pigments.
- iv) External fertilization occurs in _____ environment.
- v) _____ and _____ animals provide more protection to their young ones during development.
- vi) A placenta is established between the uterine and _____ tissue for the exchange of oxygen.
- vii) The reduction of progesterone level stimulates the _____ gland to produce oxytocin hormone.

Ans

- i) Parental ii) Two
- iii) Blue light iv) Aquatic
- v) Viviparous, ovoviviparous
- vi) Foetal vii) Pituitary

Q 2 Write whether the statement is true or false and write the correct statement if false.

- i) Asexual reproduction involves mitotic cell division. **(True)**
- ii) Asexually produced offsprings are genetically identical to their parents. **(True)**
- iii) Sexual reproduction involves single parent. **(False)**
- iv) Asexual reproduction involves single parent.
- v) Sexually produced offsprings are identical to their parents. **(False)**
- vi) Asexually produced offsprings are identical to their parents

Q 3 Encircle the correct answer from the multiple choices.

- i) Reproduction is very important to the survival of:
- (a) Species
- (b) Individual
- (c) Population
- (d) Both a and b

ii) In plants photoperiod and temperature affect.

- (a) Flowering
- (b) Buds and seed dormancy
- (c) Fruit and seed production
- (d) All a, b, c

iii) Developing seeds are rich source of:

- (a) Auxins
- (b) Cytokinins
- (c) Gibberellins
- (d) All a, b, c

iv) Common methods of asexual reproduction are:

- (a) Tissue culturing
- (b) Identical twins
- (c) Cloning
- (d) All a, b, c

v) Photoperiod affect flowering when shoot meristem start producing:

- (a) Floral buds
- (b) Leaves
- (c) Lateral buds
- (d) Both b and c

Answer Key

i	a
ii	d
iii	d
iv	d
v	a

Q 4 Short Questions.

i) What changes occur in ovulation and menstruation during pregnancy?

Ans. Both ovulation and menstruation do not occur during pregnancy. After fertilization progesterone hormone inhibits ovulation and thus menstrual cycle doesn't proceed.

- ii) What is difference between oogenesis and spermatogenesis in human?

Ans.

Spermatogenesis	Oogenesis
In spermatogenesis four sperms are produced from primary spermatocyte.	During oogenesis only one egg is produced from primary oocyte through meiotic division.
Spermatogenesis takes place in male continuously after maturity.	Oogenesis in female is a periodic process.
Sperms are released in a large quantity.	One ovum is released at a time
Meiosis I and II completed.	Meiosis I completed but meiosis II proceeds as far as metaphase II.

- iii) How a seed is formed?

Ans. A seed is formed after fertilization of egg in ovule. The formation of seed completes the process of reproduction in plants.

- iv) What is the importance of seed in the life cycle of a plant?

Ans. It enables an embryo to survive the long periods of unfavorable conditions such as scarcity or low temperature. The dispersal of seeds via wind, water and animals helps in survival of plants species by establishing to the new ecosystems.

Q 5 Extensive Questions.

- i) What structures are associated with the human female reproductive system? What are their functions?

Ans (see article 18.3.2)

- ii) What are the functions of placenta during pregnancy?

Ans (see article 18.3.2.2)

- iii) Describe human menstrual cycle.

Ans (see article 18.3.2.1)

- iv) Write notes on the following.

- (a) Parthenogenesis

Ans (see article 18.2.1)

- (b) Herpes Genitalia

Ans (see article 18.5)

- (c) Asexual reproduction

Ans (see article 18.2.1)

- (d) Seedless fruits

Ans (see article 18.1.1)