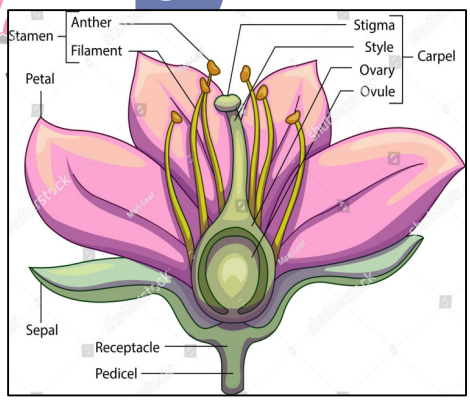
Sexual Reproduction: Sexual reproduction involves the two sexes, namely, male and female. The male sexual unit is known as male gamete, while the female sexual unit is known as female gamete. The formation of gametes and their fusion constitute sexual reproduction. The male gamete is smaller and more active than the female gamete. The female gamete is larger, filled with reserve food and remains passive. The cell formed after the fusion of the male and female gametes is called zygote. The zygote divides repeatedly to form a new individual. Although sexual reproduction also occurs in unicellular organisms like algae and Paramoecium, it is most common in multicellular organisms.

Genetic basis and advantage of variations: You know that variations help in the survival of a species over time. During asexual reproduction cells divide and DNA replication takes place. At the tithe of replication, some variation may occur but this variation does not usually cause any drastic change. So, in asexual reproduction offspring are more or less similar to the parent and variation is slow. During sexual reproduction two types of gametes (male and female) are formed. During the fusion of gametes there is recombination of genetic material from two parents. This leads to greater variation in the offspring. As the offspring gets more variations, it is more likely to adjust better to environmental fluctuations. Reproduction

Gametes contain half the usual number of chromosomes: During sexual reproduction, the combination of DNA from two parents would result in the offspring having twice the amount of DNA. To solve this problem, sexually reproducing individuals have special germ cells (gametes) with only half the normal number of chromosomes and, therefore, half the amount of DNA compared to the other cells of the body. When such germ cells from two individuals unite during sexual reproduction, the normal chromosome number and DNA content are restored.

Significance of sexual reproduction: Sexual reproduction results in new combinations of genes that are brought together during gamete formation. This reshuffling of genes in the gametes increases the chances of variation in the offspring. Moreover, the combination of two sets of chromosomes, one set from each parent, during zygote formation, leads to variation within a species.

Sexual Reproduction in Flowering Plants: The reproductive part of a flowering plant is the flower. Flowers are considered to be modified shoots.



Parts of a Flower: Most flowers have both the male and female reproductive organs, but some bear either the male or the female sex organs. Such flowers are known as unisexual flowers (e.g., watermelon, cucumber, etc.) Those flowers which have both sex organs are known as bisexual flowers (e.g., Hibiscus, pea, etc.) A flower generally bears a long or short axis. This axis has two parts—the stalk of the flower, called pedicel, and its swollen top called thalamus. The parts of a flower are arranged on the thalamus. A typical flower consists of four sets of floral parts, or whorls: calyx (sepals), corolla (petals), androecium (stamens) and gynoecium (carpels). Calyx and corolla are not directly involved in reproduction. Androecium and gynoecium are directly concerned with sexual reproduction. The androecium is the male part of the flower and consists of stamens. The gynoecium (or pistil) consists of carpels and is the female reproductive part. The whorls are arranged on the thalamus of a flower in a definite sequence.

Calyx: Calyx is the outermost whorl. It consists of sepals. The sepals are usually green, but sometimes they may be coloured. Calyx protects the floral whorls in the bud stage.

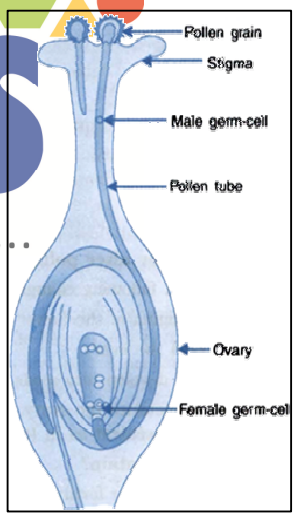
Corolla: Corolla, the next inner whorl, consists of petals. Petals may be white or brightly coloured. They attract insects towards the flower and thus help in pollination. Corolla protects the reproductive whorls in the bud stage.

Androecium: The stamens are collectively called androecium, which is the third whorl. Each stamen consists of a filament and an anther. Each anther has two chambers called pollen sacs. If you touch the stamens of a flower, a yellowish powder may come off on your hands. Anthers produce these numerous yellowish pollen grains, which contain male gametes.

Gynoecium: The gynoecium (or pistil) is in the centre of the flower. It is the fourth whorl. It bears the female reproductive organ, called carpel. Each carpel consists of three parts—a basal swollen portion called ovary, a narrow stalkdike middle portion called style and a one- to many-lobed flattened disc like sticky structure called stigma at the top of the style.

The ovary is surrounded by an outer wall. The ovary may be divided into chambers. The chambers contain ovules. Each ovule has an egg cell (female gamete).

Pollination: The transfer of pollen grains from the anthers of a flower to the stigma of the same or another flower is known as pollination. The transfer of pollen to the stigma of the same flower or of flowers borne by the same plant is known as self-pollination (as in pea and Hibiscus). Cross-pollination is the transfer of pollen from the anthers of a flower to the stigma of a flower on another plant of the same species. It is very common in most flowering plants. Pollen can be carried with the help of many agents such as insects, birds, wind and water. Flowers and pollen grains are modified to facilitate the process of cross-pollination. For example, insect-pollinated flowers are colourful so that they attract insects. Wind-pollinated flowers produce light pollen grains which can be carried by the wind.



Fertilization: The pollen grains germinate on the stigma after pollination. The inner wall of the pollen grain grows into a pollen tube, which grows down through the style and finally reaches the ovule. Inside the ovule, a male gamete fuses with the female gamete and a zygote is formed. This is known as fertilization. The zygote divides repeatedly to form the embryo (future plant) in the ovule. The embryo possesses a tiny future root (radicle), a tiny future shoot (plumule) and cotyledons to store food. The ovary grows rapidly to form the fruit. The ovary wall ripens and forms the fruit wall. The sepals, petals, stamens, style and stigma of the flower degenerate and usually fall off. Sometimes the sepals may persist in the fruit. The ovule develops into a seed. The wall of the ovule thickens to form the protective seed coat. The seed loses water and becomes hard and dry. Seeds can withstand drought and other adverse conditions in this state. This is an advantage for seed-producing plants. The embryo lies dormant in the seed, but under favourable environmental conditions it becomes active and germinates to form a small seedling. The radicle forms the root while the plumule forms the shoot. The growing root and shoot utilize the food stored in the cotyledons.

Human reproductive system: Changes in the Human Body: When a baby begins to grow, the different parts of its body such as the head, arms, legs and chest grow at different rates. For about the first 12 years of its life it goes through a phase of body

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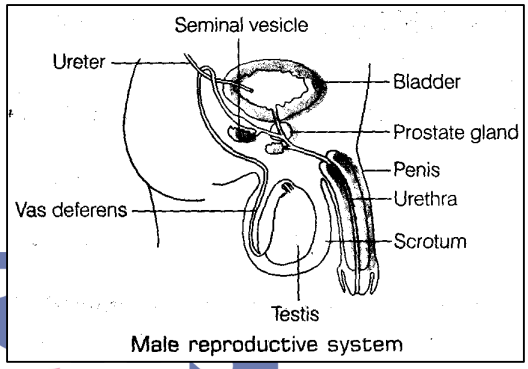
enlargement and mental development. During this phase its reproductive organs develop at a slower rate. At about 12 years of age, body enlargement slows down and certain other changes begin to appear. These changes prepare the body for sexual reproduction. This phase is known as adolescence. During this phase, certain parts of the body change in appearance and the person also experiences new sensations such as extreme happiness, sadness, anger, insecurity, and so on. All this is due to the beginning of the secretion of hormones from the ovary and testis. The age when this begins is called the age of sexual maturity (puberty). It varies from person to person. It is marked by the growth of thick hair in the armpits and public area. In males, facial hair begins to grow. The vocal cords become wide. Therefore, the voice begins to deepen. The testes become active and begin to produce sperms. The penis and scrotum become larger. In females the menstrual cycle begins and the breasts become enlarged. These changes are slow and take place over six years or so. They serve as signals identifiable by other individuals that sexual maturation is taking place. From this period onwards sexual reproduction becomes a possibility as the body becomes capable of producing the specialized germ cells that are needed for sexual reproduction. But childbearing and lactation (milk secretion) need the female reproductive organs and breasts to be fully developed.

Male Reproductive System: The male reproductive organs include the testes, seminal vesicles, penis and some associated glands such as the prostate gland.



Male reproductive system

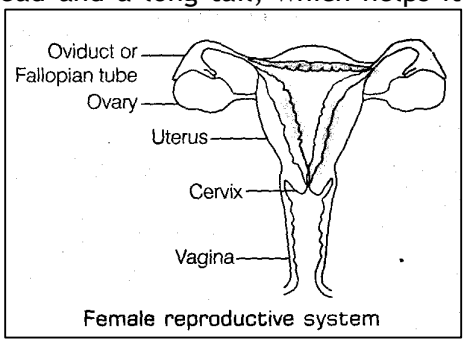
Testis: The most important male reproductive organ is the testis, which produces sperms. There are two oval testes, each contained in a protective bag called scrotum (or scrotal sac), lying outside the abdominal cavity. The scrotal sac can elongate and contract depending upon the body temperature and external temperature. This is necessary because sperm formation occurs at a temperature lower than normal body temperature. The testes produce sperms continuously from the stage of puberty onwards. Sperms from the testis pass through the sperm duct, known as vas deferens. The vas deferens runs anteriorly up to the urinary bladder, from where it leads downward and is joined by a duct from the seminal vesicle.

Seminal vesicle: The seminal vesicle is an elongated sac at the base of the urinary bladder. For each testis, there is one vas deferens and one seminal vesicle. The functions of a seminal vesicle are to store the sperms that have come from the testis and to secrete seminal fluid, or semen, in which the sperms float.

Prostate gland: The sperm ducts from both sides join near the base of the urinary bladder, opening into a single tube called urethra (Figure 6.10). This junction occurs inside the prostate gland. The prostate gland adds its secretion to the seminal fluid. The urethra leads to the outside of the body through an organ called penis. It carries both urine and seminal fluid.

Penis: The penis is a muscular, tubular organ made up of loose tissue with spaces in between. This is called erectile tissue. On being stimulated, the erectile tissue fills with blood, making the penis erect and firm, so that it may enter the vagina of the female and discharge the sperms.

Sperm: The sperm is the male gamete. It has a head and a long tail, which helps it swim towards the ovum (egg).



Female reproductive system

Female Reproductive System: The female reproductive organs include the ovaries, Fallopian tubes, uterus and vagina.

Ovary: The ovaries are a pair of small, oval organs in the lower part of the abdominal cavity. They produce ova. At the time of birth, a female already has thousands of immature ova in her ovaries. Many of these degenerate during childhood. The ova start maturing when the female reaches puberty. Every 28 days, one of the ovaries releases an ovum. When an ovum is released from the ovary, it is taken up by a thin Fallopian tube (also called oviduct) through its funnel-shaped opening. The ovum is passed down the duct and into the uterus, which passes it out of the body through the vagina. The ovum is very small and, therefore, hardly noticeable.

Fallopian tube: The Fallopian tubes, or oviducts, are a pair of thin tubes that lead from the ovaries to the uterus. Each Fallopian tube has a funnel-shaped opening near the ovary. It is lined by cilia. The movement of the cilia helps conduct the ovum down the Fallopian tube and into the uterus.

Uterus: The uterus (womb) is a hollow, pear-shaped, elastic muscular structure. Its upper portion, into which the Fallopian tubes enter, is broader. The narrow lower portion, called cervix, consists of a ring of muscles. The uterus opens into the vagina through the cervix. A fertilized ovum (zygote) develops into a baby inside the uterus.

Vagina: The vagina is a tube leading to the outside of the body through an opening called vulva. The vagina is the organ where the penis is inserted during intercourse for the discharge of sperms. It is also the passage through which the fully developed baby is born.

Fertilization : When semen is discharged in the vagina during sexual intercourse, the sperms begin moving up the vagina and uterus, finally reaching the Fallopian tubes. But only one sperm enters the ovum. Most of the sperms die while climbing up the Fallopian tubes. A sperm can remain alive in the Fallopian tube for about 12 hours. In this span of time, if it meets the ovum, it is likely to enter the ovum. This is called fertilization.

Changes after Fertilization

Implantation: The fertilized egg (zygote) moves down the Fallopian tube and continuously undergoes cell division. Thus it forms a hollow ball of cells, called embryo. The embryo gets embedded in the wall of the uterus, which is thick and has muscles, glands and a large number of blood capillaries. This process is called implantation.

Pregnancy: The developing embryo at first derives nourishment directly from the mother's blood flowing in the vessels lining the uterine wall. In about three weeks, it starts absorbing food and oxygen through an organ called placenta. The placenta is a disc like organ in the lining of the uterine wall. It has numerous villi, which are in direct contact with the mother's blood flowing in the uterine wall. These villi provide a large surface area for glucose and oxygen to pass from the mother to the embryo and for wastes produced by the embryo to be passed into the mother's blood. The embryo is connected to the placenta by a tube called the umbilical cord. By eight weeks, the embryo starts showing human features and is referred to as foetus. The

total period of embryonic development, from the time of fertilization to birth, is called gestation period. It is around 280 days, or 9 months, in humans.

Birth: The wall of the uterus develops a thick layer of muscles during pregnancy. At the time of birth, the uterine muscles contract rhythmically and powerfully, causing labour pains to the mother. Finally, the baby is expelled by the contraction of the uterine muscles. This is called birth or parturition.

What happens when the egg is not fertilized: If the ovum is not fertilized in the upper part of the oviduct, it keeps on descending and is finally passed out through the vagina. It remains in the body for about 24—72 hours. As an egg is released for fertilization every month, the uterus also prepares itself every month for the implantation of a fertilized egg. The uterus becomes thick-walled and spongy in order to nourish the embryo. If no fertilization takes place, the thick uterine wall is no longer needed. So, it gradually begins to shrink. This shrinkage ruptures its blood vessels. As a result, blood and mucus ooze out of the vagina. This period, which lasts for 3—5 days, is called the menstrual period, and the process is called menstruation. If the ovum is fertilized, it gets implanted in the uterus wall and embryonic development starts. In this case, the uterus continues to develop in order to hold the embryo. And in this case, there is no question of its shrinkage resulting in menstruation.

Reproductive Health: Reproductive health is concerned with healthy and safe sexual practices. Unhealthy practices can lead to the transmission of diseases from one partner to another and even to the offspring. Reproductive health also depends on healthy behaviour and out look towards sex life. Sexual maturation and body growth are gradual processes. Even with some degree of sexual maturation, the body and mind are not mature enough for a sexual act, childbearing and bringing up children. Reproduction at an early age, say between 13 and 20 years, is not advisable as the uterus is not completely developed to hold the foetus for the entire gestation period of 9 months. There is a risk that the uterus may rupture or the foetus may be aborted. Also, sexual intercourse involves intimate physical contact between the male and female sex organs. This contact may transmit certain diseases from one partner to another. Such diseases are called sexually transmitted diseases (STDs).

Sexually Transmitted Diseases: Sexually transmitted diseases are caused by a variety of microorganisms (such as bacteria and viruses) that live in the warm and moist environments of the vagina, urethra, anus, etc. STDs occur mostly in individuals who are involved in sexual activity with many partners.

Bacterial infections: Gonorrhea and syphilis are common sexually transmitted bacterial infections. These are caused by bacteria that infect the ureter in men and the cervix in women.

Viral infections: Viruses cause STDs such as herpes, genital warts and cervical cancer. AIDS (Acquired Immune Deficiency Syndrome) is caused by the human immunodeficiency virus (HIV), which attacks the immune system and kills people. The primary route of transmission of HIV is sexual, but it is also spread by the use of infected needles among intravenous drug users, by the transfusion of infected blood, and from an infected woman to her foetus during pregnancy.

Prevention: To prevent sexually transmitted diseases, the following precautions can be taken.

1. Using a protective covering called condom over the penis
2. Using disposable needles and syringes
3. Not sharing shaving blades or razors
4. Not having multiple sex partners.

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5. Testing and screening the blood for H1V before transfusing it

Family Planning: The human population is growing rapidly and this is a major cause for concern. With the increase in population, the resources of the earth will deplete more rapidly. The environment will be adversely affected and it will be difficult to maintain the quality of life of the large population. It is, therefore, extremely important to control population growth. In many countries, as in ours, the population grows rapidly because birth rates are high and death rates are comparatively low. In such countries it is extremely important to have a small family.

Contraception: It is possible to limit the size of a family through various means. One is to prevent pregnancy. Fertilization of the ovum and its subsequent implantation is referred to as conception or pregnancy. Prevention of conception is called contraception. Conception can be prevented in the following ways.

Mechanical barrier: There are a number of methods of contraception that create a mechanical barrier between the sperms and the egg. One method is to use a fine rubber tube called condom. This is worn over the penis during sexual intercourse, so that semen is collected in this tube and not discharged in the vagina. This method also prevents the spread of AIDS and many other sexually transmitted diseases. A diaphragm or cap can be fitted in the cervix of a woman to prevent semen from reaching the Fallopian tube. An intrauterine contraceptive device (IUCD), or loop or copper-T, is another contraceptive device which can be used by a woman to prevent conception. An IUCD is made of plastic or stainless steel. It is inserted in the uterus. Its insertion causes irritation in the uterine lining. As a result, there is a lot of mucus secretion which prevents implantation of the embryo.

Chemical methods: Oral contraceptives can be taken to change the hormonal balance of the body so that the ovum is not released from the ovary. Since the ovum does not come into the Fallopian tube, it is not fertilized. Oral contraceptives are tablets which a woman has to take every day. These are also called birth control pills. Of all the contraceptive measures, oral contraceptive pills are the most effective. However, the change of hormonal balance caused by the intake of oral contraceptives occasionally has undesirable side effects.

Surgical methods: If the vas deferens, which carries the sperms to the urethra, is tied by a thread, the sperms cannot go past the tied point. The vas deferens can be exposed by a slight incision at the base of the scrotum. This incision and subsequent ligature (tying by thread) of the vas deferens by a surgeon is called vasectomy. In women, ligature of the Fallopian tube can prevent the passage of ova down the Fallopian tube. This is called tubectomy. Both vasectomy and tubectomy ensure that fertilization will not take place. Surgery can also be used for aborting unwanted pregnancies. However, this is often misused for illegally aborting female foetuses. (The killing of a foetus is called foeticide.) To prevent female foeticide, prenatal sex determination has been prohibited by law.

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