CHAPTER 03

How do Organisms Reproduce ?

In this Chapter...

The process by which living organisms produce its own kind of individuals to maintain the continuity of species is called reproduction. Like other essential life processes, reproduction is not essential to maintain life of an individual. But is a fundamental feature of all known life, each individual organism exists as the result of reproduction.

The Fundamentals of Reproduction

The process of reproduction involves the formation of DNA copy and other cellular apparatus required by the cells of an individual. DNA is the blueprint of all the basic design of organisms. It is present in the nucleus of a cell as a condensed structure called **chromosome**. It acts as the information source and helps in making different proteins and cellular machinery of cell, which makes up the different body designs.

Variations

DNA copying during cell division always causes some or other type of variations in newly formed cell. This brings the differences found in the morphological and physiological features of an organism.

Since no biochemical reaction is absolutely reliable, DNA copies generated are similar, but not absolutely identical. Variations lead to evolution by increasing the chances of survival of some individuals. Hence, important for the survival of species.

Types of Reproduction

Reproduction is mainly of two types, i.e. asexual reproduction and sexual reproduction.

- **Asexual Reproduction** It is a rapid mode of multiplication in which one parent (either male or female) is involved. The new individuals produced are identical to their parents.
- **Sexual Reproduction** In this process, the gametes from parents of opposite sex (male and female) fuse together to form a zygote. This zygote develops further and gives rise to new offspring. The individual produced by this method exhibits variation.

I. Modes of Asexual Reproduction

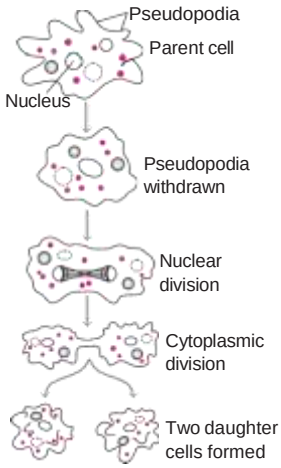
Asexual reproduction occurs in unicellular organisms by fission, budding, spore formation, fragmentation, regeneration (in animals) and vegetative propagation (in plants). It occurs in multicellular organisms by budding and regeneration.

These are as follows

(i) **Fission** The process where a unicellular organism splits itself into two or more daughter cells. It is of two types, i.e.

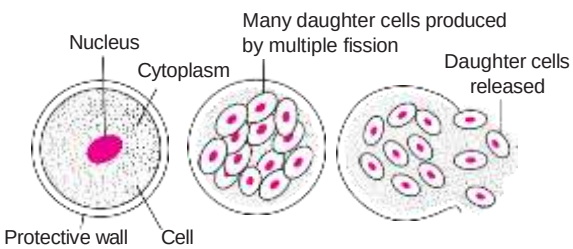
(a) **Binary Fission** In this process, parent cell divides into two identical daughter cells, e.g. *Amoeba*, *Leishmania*.

In this process, nuclear division is followed by cytoplasmic division.



Binary fission in *Amoeba*

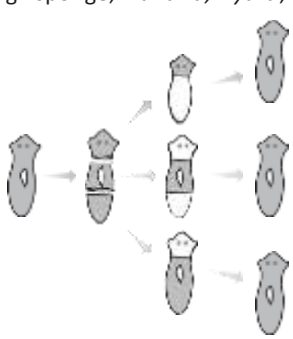
(b) **Multiple Fission** In this process, parent cell divides into many identical daughter organisms simultaneously, e.g. *Plasmodium*.



Multiple fission in *Plasmodium*

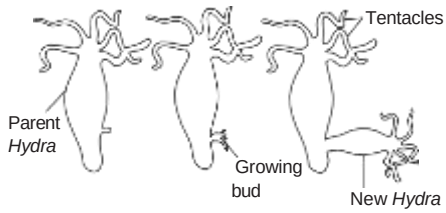
(ii) **Fragmentation** The parent body on maturation breaks up into two or more small fragments, which later grow into a complete new organism, e.g. *Spirogyra*.

(iii) **Regeneration** In this process, all fragments or parts that are separated from the body develop in new animals, e.g. sponge, *Planaria, Hydra*, etc.



Regeneration in *Planaria*

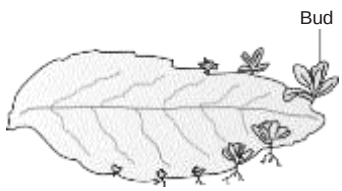
(iv) **Budding** A daughter organism is formed from a small projection known as bud. It develops as an outgrowth due to repeated cell divisions of the parent body. When fully grown, it detaches to grow into a new independent individual, e.g. *Hydra*.



Budding in *Hydra*

(v) **Vegetative Propagation** The process of obtaining complete plant from any vegetative part of plant is called vegetative propagation. This is mainly of two types

(a) **Natural Vegetative Propagation** The vegetative propagation that occurs automatically in plants is called natural vegetative propagation. It can be achieved by root, stem, leaf, etc, e.g. *Bryophyllum*.

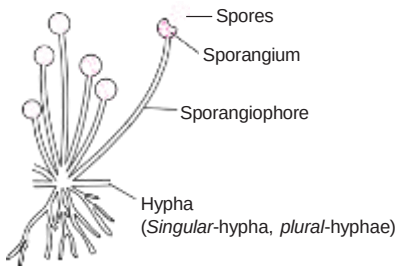


Leaf of *Bryophyllum* with buds

(b) **Artificial Vegetative Propagation** The artificially made vegetative propagules in plants by humans, is called artificial vegetative reproduction, e.g. cutting, layering, grafting, etc.

- **Grafting** A small part of stem from one plant without roots (scion) is attached to the part with root (stock) of another plant.
- **Layering** The development of roots on a stem, while the stem is still attached to the parent plant is called layering.
- **Tissue culture** It is a technique used for growing new plants using living tissues (like flower buds, stems, growing tips, leaves, etc.) *in vitro* in an artificial culture medium.
- Using this technique, large number of plants can be developed from a single parent.

(vi) **Spore Formation** It is a type of asexual reproduction where blob-like structures called sporangia are involved. These cells or spores have the ability to germinate under favourable conditions forming new plants, e.g. *Rhizopus*.



Spore formation in *Rhizopus*

II. Modes of Sexual Reproduction

In this type of reproduction, both sexes, i.e. male and female are involved. Sex cell or gamete of one parent (male) fuses with the sex cell or gamete of another parent (female). This results in production of a new cell called zygote.

Thus, the sexual mode of reproduction involves two major processes

(i) Formation of gametes by meiosis
(ii) Fusion of gametes

1. Sexual Reproduction in Flowering Plants

Angiosperms bear the reproductive parts within the flower and their seeds are enclosed in a fruit. Most plants have both male and female reproductive organs in the same flower and are known as **bisexual flowers**. While others have either male or female reproductive parts in a flower known as **unisexual flowers**.

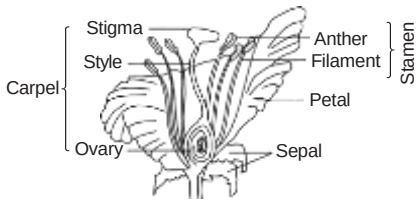
A flower comprises of four main parts, i.e. sepals, petals, stamens and carpels. Stamens and carpels are the reproductive parts of a flower.

(i) **Stamen** It is the male reproductive part of the flower.

(ii) **Anther** It is a bilobed structure containing two pollen sacs present at tip of stamen. These produce pollen grains that are yellowish in colour.

(iii) **Carpel** (Pistil) It is the female reproductive part, which is present in the centre of the flower. It comprises of three parts

- **Stigma** It is the terminal part of carpel which may be sticky. It helps in receiving the pollen grains during pollination.
- **Style** It is the middle elongated part of carpel. It helps in the attachment of stigma to the ovary.
- **Ovary** It is the swollen bottom part of carpel. It contains ovules having an egg cell (female gamete).



Longitudinal section of flower

Pollination

The transfer of pollen grains from the anther of the stamen to the stigma of a flower is termed as **pollination.** The pollen grains can be transferred by various agents like wind, water, insects and animals.

Pollination usually occurs in two ways

(i) **Self-pollination** The pollen from the stamen of a flower is transferred to the stigma of the same flower or another flower of same plant.

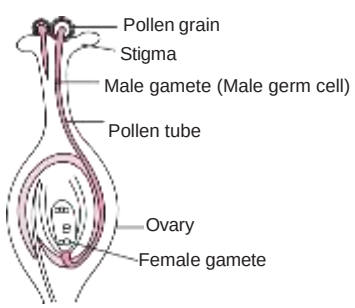
(ii) **Cross-pollination** The pollen from the stamen of a flower is transferred to the stigma of another flower of different plant of the same species.

Fertilisation

It is the process of fusion of male and female gametes. It gives rise to a **zygote**. As soon as the pollen lands on suitable stigma, it reaches the female germ cells in ovary. This occurs *via* pollen tube. The pollen tube grows out of the pollen grain, travels through the style and finally reaches the ovary.

After fertilisation, ovule develops a rough coat around itself and gets converted to seeds and ovary ripens as fruit.

The seed contains future embryo that grows under suitable conditions (germination). The fertilisation in the flowering plant is shown in the given figure.



Germination of pollen grain on stigma

2. Sexual Reproduction in Human Beings

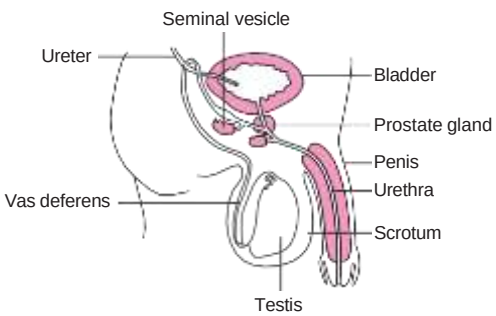
Human beings can reproduce sexually after attaining puberty. It represents period of adolescence when reproductive organs start developing and sexual maturity is attained. Some changes during puberty are common in males and females such as hair growth in armpits and genitals, oily skin, acne, etc.

Specific changes in boys include facial hair growth, hoarse voice, etc. In girls, these changes are enlargement of breast size, begining of menstruation, etc.

Human Reproductive System

The system of organs required by males and females for the process of sexual reproduction is called reproductive system.

(i) **Male Reproductive System** It includes parts which produce the germ cells and those which deliver these cells at the site of fertilisation.

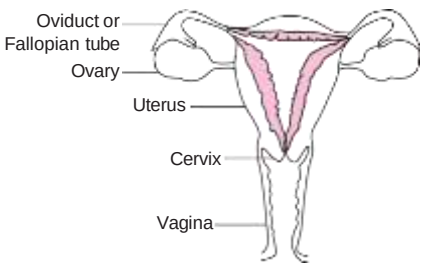


Male reproductive system

Parts and Details of the Male Reproductive System

Parts	Details
Testes	· Paired, oval-shaped male sex organs. · Consist of seminiferous tubules, where the sperms are produced. · Produce a male sex hormone called **testosterone**, which brings about changes in appearance of boys at puberty.
Scrotum	· Small pouch that contains testis. · Present outside the abdominal cavity. As sperms are formed here, this requires a lower temperature than the normal body temperature.
Vas deferens	· Tube-like structure which connects testis to the urethra in order to allow the passage of semen.
Urethra	· Common passage for both the sperms and urine. It never carries both of them at the same time.
Prostate gland and seminal vesicles	· Secretes seminal fluid and nutrients. · Fluid and nutrients combine with sperm to form **semen**. Milky, viscous fluid contains fructose, proteins and other chemicals for nourishing and stimulating sperms.
Penis	· External male genital organ. · Transfers sperms into the vagina of the female during copulation.
Sperms	· Tiny and motile bodies that use their long tail to move through the female reproductive tract.

(ii) **Female Reproductive System** It includes internal and external sex organs that function in reproduction of new offspring. In human, female reproductive system is immature at birth and develops to maturity at puberty to be able to produce gametes, and to carry a foetus.



Female reproductive system

Parts and Details of the Female Reproductive System

Parts	Details
Ovaries	· Paired, oval-shaped organs located in the abdominal cavity near the kidney. · Produce thousands of ova or egg cells. · Secrete female sex hormones like **oestrogen** and **progesterone**.
Oviduct (Fallopian tube)	· It has a funnel-shaped opening near the ovary. · Carries ova or egg from ovary to the uterus. · It is the site of fertilisation. · These open into the **uterus** from both the sides.
Uterus (womb)	· Hollow, pear-shaped, bag-like structure. · The growth and development of foetus takes place.
Cervix	· It is the lower and the narrower portion of uterus which opens into the vagina.
Vagina	· Receives the sperms from the male partner. · Serves as a birth canal.

Fertilisation and Post-Fertilisation Changes

- Fusion of sperm with ovum is called **fertilisation**. It results in the formation of diploid zygote. This process takes place in the **oviduct** or **Fallopian tube**. The formation of embryo is the result of cleavage and growth in **zygote**.
- The embryo sinks downward, reaches into the soft uterine lining and gets embedded. This process is known as **implantation**.
- A disc-like structure called **placenta** grows between the uterine wall and embryo. It has finger-like projections called villi, which provide surface area for the exchange of nutrients, oxygen and waste products between the embryo and the mother.

- Childbirth (after a gestation period of approximately 9 months) occurs by strong rhythmic contractions of uterine muscles.

Menstruation

In the absence of fertilisation, the uterine lining which becomes thick and spongy to receive a fertilised egg, is no longer required. It sheds out as blood and mucus which lasts for about 2-8 days and occurs every month. This phase is known as menstruation.

Reproductive Health

It can be defined as the state of physical, mental and social fitness to lead a healthy reproductive life. Good reproductive health provides both male and female with

- the fertility control methods.
- awareness about how to limit their family size.
- protection from infection and sexually transmitted diseases.

Sex Ratio

The ratio of the number of females to the number of males in a population is known as sex ratio. A balanced female-male sex ratio is necessary for a healthy society.

Population Size

The rates of birth and death in a given population determine its size. The population size increases if the birth rate is higher than the death rate and *vice-versa.*

Methods of Family Planning

The sexual act always carries the risk of potential pregnancy. In order to avoid unplanned pregnancies, many ways have been devised, which are called **contraception** or **birth control methods**.

Methods of Family Planning

Methods	Examples	Details
Barrier	Condom	· Rubber sheath worn over the penis to stop sperm from entering the vagina. · Prevents transmission of Sexually Transmitted Diseases (STDs) and has no side effect.
	Diaphragm	· Rubber cup that is placed in the vagina over the cervix.
	Intra-Uterine Contraceptive Device (IUCD)	· Copper-T placed in uterus by doctor. · Used to prevent pregnancy. · Can cause side effects due to the irritation of uterus.
Hormonal	Oral contraceptive pills	· Contain hormones, which prevent release of ovum, so that fertilisation cannot occur. These disturb the hormonal balance (levels of FSH and LH) of the body. · Can cause side effects also.
Chemical	Spermicide	· Applied in vagina. · Kills sperms. · Can only be used with condoms or diaphragm.
Surgical	Vasectomy	· Small portion of the sperm duct is cut or tied properly. Therefore, the sperm transfer will be prevented. · Prevents sperms from coming out of urethra. · An irreversible process.
	Tubectomy	· Small portion of oviduct is cut or tied properly. The Fallopian tube in the female gets blocked. The egg will not be able to reach the uterus and thus,fertilisation will not take place. · Prevents the egg from meeting the sperms. · An irreversible process.

Female Foeticide

The killing of unborn girl child is called female foeticide. It is happening because of misuse of ultrasound technique by which people get to know the sex of the child. If it is female, they get it removed by surgery.

Sexually Transmitted Diseases (STDs)

Sexually Transmitted Diseases (STDs) are caused by different pathogens transmitted by an intimate contact between healthy person and an infected person.

Some Common STDs

Infections	Examples	Causative Organisms	Comments
Bacterial infections	Gonorrhoea	*Neisseria gonorrhoeae*	· Contracted on during unprotected sexual intercourse with an infected person. · Also passed by an infected mother to the developing foetus. · Infects ureter in men and cervix in women. · Treatment with antibiotics is effective. **Symptoms of gonorrhoea** · Discharge of pus from penis and vagina. · Burning sensation on urinating.
	Syphilis	*Treponema pallidum*	· Syphilis is transmitted from person to person by direct contact with syphilis sores These occur mainly on the external genitals, vagina, anus or in the rectum, can also occur on lips and mouth. · Syphilis can be transmitted during vaginal, anal or oral sexual contact. · Pregnant women with the disease can pass it to their unborn children. · Can be cured by antibiotics. **Symptoms of syphilis** · Appearance of sores on body parts. · Fever, ulcers, bone pain, liver disease and anaemia. These symptoms slow up during the tertiary stage of syphilis.
Viral infections	AIDS (Acquired Immuno Deficiency Syndrome)	HIV (Human Immunodeficiency Virus)	Incurable and fatal as it suppresses the immune system of the body. It can be transferred in following ways, · during unprotected sexual intercourse with an infected person. · sharing needles and transfusion of HIV unscreened blood. · from the mother to the child *via* placenta during pregnancy.
	Genital warts	HPV (Human Papilloma Virus)	· Causes warts over external genitalia and perianal area. · *Podophyllum* preparations are effective in treatment.