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CBSE - X REPRODUCTION



KICK

"Nature has invented reproduction as a mechanism for life to move forward. As a life force that passes right through us and makes us a link in the evolution of life." - **Louis Schwartzberg**

OFF

Introduction

- ❖ Reproduction is defined as the production of new organisms from the existing organisms of the same species. It is essential for the survival of all the species present on this earth. The process of reproduction **ensures continuity of life** on earth.
- ❖ It is not an essential life process, this means that it is not necessary to reproduce in order to survive, but one can survive without undergoing reproduction also, yet it is a unique property of living beings.
- ❖ In reproduction, lot of energy is needed to produce new individual but it is essential for the survival of a species. It is also important for the continuity of life on the earth. So it is necessary that living beings should reproduce.
- ❖ Reproduction is the biological process by which new individuals of similar type are produced from their parents. This leads to increase in the population of a species. It is of two types:
 1. **Asexual reproduction**
 2. **Sexual reproduction**
- ❖ Reproduction at cellular level is involved in making similar or dissimilar body designs through the genetic material (DNA) present in the chromosomes of its nucleus.
- ❖ DNA in the nucleus of cell is the source of information for making proteins. Any change in the information leads to formation of different proteins, which eventually lead to altered body designs.
- ❖ Basic event in reproduction is creation of DNA copies in a reproducing cell. This process is called **DNA replication**. This divides the cell into two, each new cell gets a copy of each DNA with along its own cellular apparatus.
- ❖ Complete accuracy in DNA copying reactions leads to formation of two exactly identical cells but any error in replication can lead to dissimilar cells with some variations.
- ❖ **Variations** refers to the differences in structure, physiology and other traits found in individuals of species.
- ❖ If there were a population of bacteria living in temperate waters and if the water temperature were to be increased by global warming, most of these bacteria would die but the few variants resistant to heat would survive and grow further. Variation is, thus, useful for the survival of species over time.

Do Organisms Create Exact Copies of Themselves?

- ❖ Cell is the basic structural and functional unit of life. It contains a nucleus, which carries the genetic information in the form of DNA (Deoxyribonucleic Acid) for the next generation. Thus, it can be concluded that the fundamental process of reproduction is DNA replication.

- ❖ When a reproducing cell undergoes division, it primarily starts to make two exact replicas of its DNA. These replicas need to be separated from the original DNA. However, replication of DNA requires organized cellular structures.
- ❖ At the time of formation of gametes, meiosis occurs. Meiosis results into genetically dissimilar daughter cells, i.e., their DNA is different from the parent cell, due to crossing over and recombination.
- ❖ A change in the genetic material of DNA implies that it is the initiation of variation. Altered DNA copy will code for the proteins different from the original one. Different proteins lead to variations in the organism. These variation might be slow or drastic.
- ❖ Variation during reproduction is an inbuilt tendency and it lays the foundation for evolution.
- ❖ The chances of variation are very high in a sexually reproducing organism. But in asexually reproducing organisms, variations are limited. Organisms create exact copies of themselves which are termed as a **clone**.

Importance of Variation

Using the ability of reproduction, living organisms increase their population and feed on available resources in their niche. The consistency of DNA copying during reproduction is important for the maintenance of body design features that allow the organism to use that particular niche. Reproduction is therefore linked to the stability of populations of species. Changes in DNA, and body design features may result in difficulty to sustain themselves in their habitat. But we know that the environment is not consistent. It changes with the change in environmental factors like climate, temperature, and availability of resources, etc. For example, if a population of reproducing organisms were suited to a particular niche and if the niche were drastically altered, the population could be wiped out. Here comes the role of variation. Variations help the species to adapt themselves to that particular environment and give them a chance of survival.

For example, thermophilic bacteria are resistant to extreme temperature. Thus, variation is useful for the survival of species over time.



Mind it

- ❖ DNA is the blueprint of life. It stores all the information about the body design, building and running of the cellular machinery and functioning of the individuals. DNA produces new master copies only at the time of cell division.
- ❖ Chromosome is present in nucleus of cell. It contains information for inheritance of features from parents to next generation in the form of DNA. DNA contains information for making protein.
- ❖ Unicellular organisms never die a natural death, since they never become old because before getting old they reproduce to give two cells and become new again. In unicellular organisms, cell division is synonymous to reproduction.



Find it

- Q.1:** Why is simply copying DNA in a dividing cell not enough to maintain continuity of life
- Q.2:** How variations are useful for the survival of species over time?

NCERT Corner

1. What is the importance of DNA copying in reproduction?

Exp. DNA is the genetic material present in the nucleus cells of all organisms. DNA carries the genetic information from generation to generation. It is therefore possible for the organism to produce organism of its own type due to DNA copying only. For the inheritance of traits of the parent, DNA copying is a must. DNA copying also brings about variation, which forms the basis for the origin of new species, i.e., speciation.

2. Why is variation beneficial to the species but not necessarily for the individual?

Exp. Sometimes for a species, the environmental conditions change so drastically that their survival becomes difficult. For example, if the temperature of water increases suddenly, then most of the bacteria living in that water would die. Only few variants that are resistant to heat would be able to survive. However, if these variants were not there, then the entire species of bacteria would have been destroyed. Thus, the variations help in the survival and are beneficial of the species. However, all variations are not necessarily beneficial for the individual organisms.

Asexual reproduction

- ❖ Asexual reproduction refers to the production of offspring by a single parent without the formation and fusion of gametes.
- ❖ It is more primitive type of reproduction. It occurs much faster and requires less energy.
- ❖ Asexual reproduction is observed mostly in unicellular organisms such as bacteria, protozoans, some plants like algae, fungi, bryophytes, etc., and some multicellular animals such as sponges, coelentrates, certain worms and tunicates. It is absent in higher invertebrates and all vertebrates.

Basic features of asexual reproduction

- ❖ It requires only one parent to produce offspring, different sexes are not involved.
- ❖ It does not involve fusion of gametes.
- ❖ No gametes are formed and hence no fertilization takes place.
- ❖ The new individuals produced by asexual reproduction are exact copies of their parents (genetically identical), i.e., there is no or little variation.
- ❖ It is a rapid mode of reproduction.

Types of asexual reproduction

Fission, fragmentation, regeneration, budding, vegetative propagation and spore formation are the various types of asexual reproduction.

I. Fission

- ❖ In this mode of asexual reproduction, a parent undergoes division to form two or more individuals. It occurs in two steps, division of nucleus or nuclear matter followed by the division of cytoplasm. Fission occurs in unicellular organisms.

Types of fission

Fission is divided into two types: binary fission and multiple fission.

(i) Binary fission

- ❖ Binary fission is a form of asexual reproduction in which a parent organism divides into two small, nearly equal sized identical daughter cells—each daughter cell carries one copy of genetic material. Hence, the daughter cells formed are genetically and morphologically identical.

- ❖ In this type of reproduction, the nucleus first divides into two nuclei (karyokinesis) which is followed by the division of cytoplasm (cytokinesis). Finally the cell disintegrates into two daughter cells which grow fully and divide again. It can be seen in bacteria, yeast, *Amoeba*, *Leishmania* and *Euglena*.

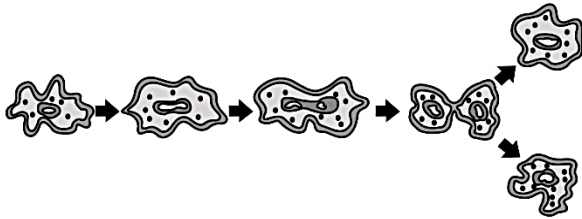


Fig. 1: Irregular binary fission in *Amoeba*

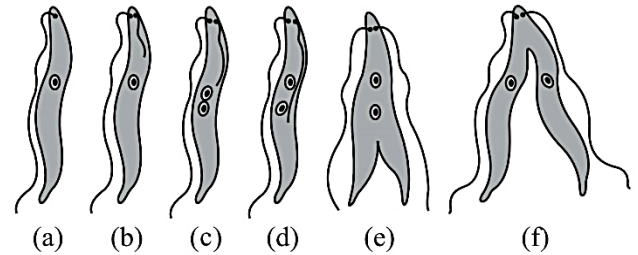


Fig. 2: Longitudinal binary fission in *Leishmania*



Test Prep

According to how the cell divides, binary fission is of three types:

1. **Simple binary fission (irregular binary fission)** – In this, the cell divides at any plane. However, it is mostly in a manner perpendicular to where the nuclear division (karyokinesis) occurred. E.g., *Amoeba*
2. **Longitudinal binary fission** – It takes place along the longitudinal axis of a cell. E.g., *Euglena*, *Leishmania*
3. **Transverse binary fission** – It takes place along the transverse axis of the organism. E.g., *Paramecium*, *Planaria*, diatoms and bacteria.

(ii) Multiple fission

Multiple fission is a form of asexual reproduction in which the parent is divided into many small daughter individuals simultaneously. It occurs in many protozoans such as *Plasmodium*, *Amoeba* (in unfavorable conditions) and *Monocystis*.

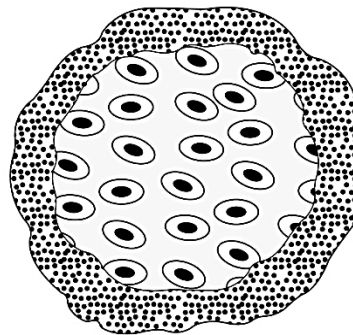


Fig. 3: Multiple Fission in *Plasmodium*

The process of multiple fission involves following steps:

- ❖ Under unfavorable conditions such as lack of food, oxygen, excessive heat, cold or drought, etc., a cyst (protective wall) is formed around the parent cell. Inside the cyst, the nucleus of the parent cell divides multiple times to produce a large number of nuclei known as daughter nuclei. Each daughter nuclei is surrounded by small amount of cytoplasm and a thin membrane. As a result, many daughter cells are formed inside the cyst.
- ❖ Under favorable conditions, the breakdown of cyst released the daughter cells. All the daughter cells are identical. Each daughter cell gives rise to a new organism.

Thus, multiple fission results in producing large numbers of offspring.

Table-1 : Differences between Binary Fission and Multiple Fission

Multiple Fission	Binary Fission
Many daughter cells are formed from the division of the nucleus of parent.	Two daughter cells are formed from the division of the or nucleus of parent.
It occurs during unfavourable conditions.	It occurs during favourable conditions.
The parent cell divides repeatedly.	The parent cell divides only once.
It has no definite pattern of division.	It includes a definite pattern of division.
Example: <i>Plasmodium</i> , Sporozoans, algae, etc.	Example: <i>Amoeba</i> , bacteria, <i>Euglena</i> , etc.

2. Budding

- ❖ In budding, a small part of the body of the parent organism develops a bud as an outgrowth due to repeated cell division at a specific site which then detaches and become new independent organism. It is observed in yeast and *Hydra*.
- ❖ **Yeast:** In unicellular organisms like yeast, a bud grows from the surface of the adult cell.

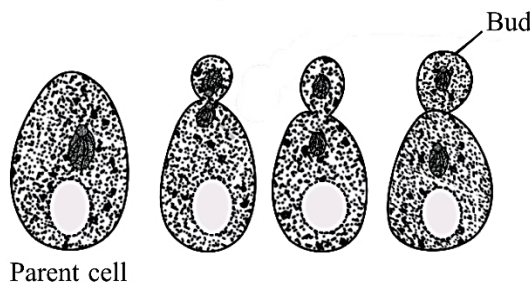


Fig. 4: Budding in yeast

- ❖ **Hydra:** Organisms such as *Hydra* use regenerative cells for reproduction in the process of budding. In *Hydra*, a bud develops as an outgrowth due to repeated cell division at one specific site. These buds develop into tiny individuals and when fully mature, detach from the parent body and become new independent individuals.

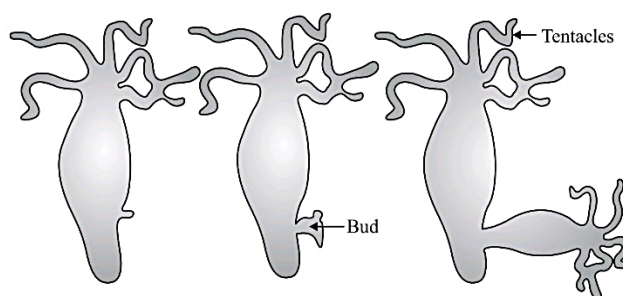


Fig. 5: Budding in *Hydra*

3. Fragmentation

Fragmentation is the process of breaking up of the body of an organism into two or more parts upon maturation called fragments. Each fragment grows into a new individual. Fragmentation is commonly observed in algae, fungi, bryophytes and some marine ribbon worms. It is caused by several reason such as mechanical disturbance, chemicals, death and decay of older parts, emptying of intervening cells, etc. Fragmentation is common method of multiplication in multi-cellular organisms with relatively simple body organization, for example, green filamentous alga, *Spirogyra*. Here all the cells are capable of photosynthesis, growth and division. Therefore, each fragment grows into a new organisms.

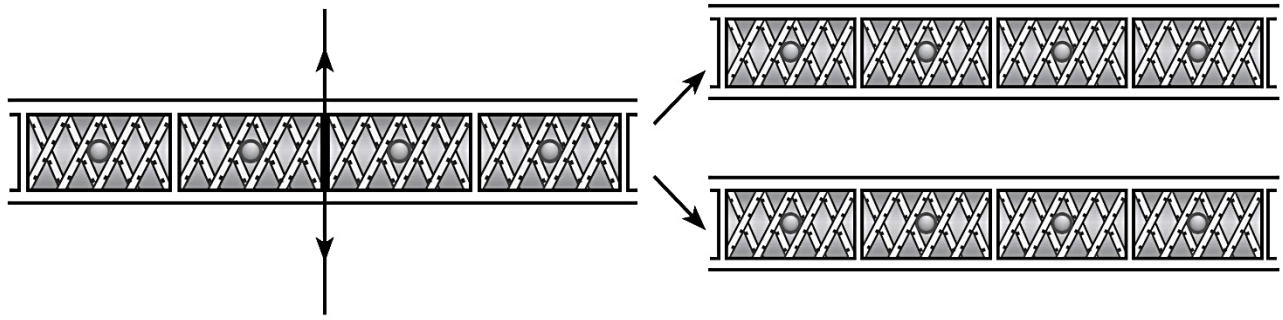


Fig. 6: Fragmentation in *Spirogyra*

4. Regeneration

The ability to give rise to new individual from the body parts of the parent individual is called regeneration. Regeneration is carried out by specialised cells which proliferate make large number of cells. From this mass of cells, different cells undergo changes to become various cell types and tissues. These changes takes place in organised sequence referred to as development. For example, *Hydra* and *Planaria* can be cut into any number of pieces and each piece grows into a complete organism.

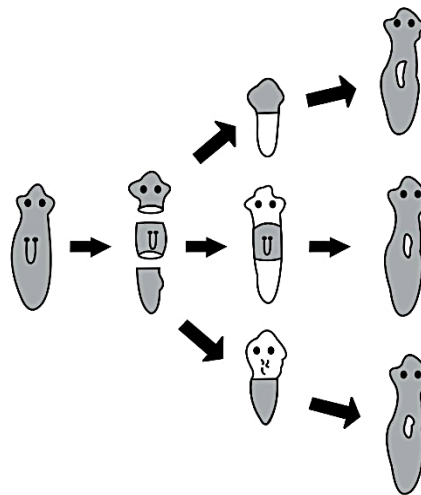


Fig. 7: Regeneration in *Planaria*

5. Spore formation

- ❖ It takes place in multi-cellular organisms. They have specific reproductive part.
- ❖ The thread-like structures that developed on the bread are the hyphae of the bread mould (*Rhizopus*). They are not reproductive parts.
- ❖ The tiny blob-on-a-stick structures that are involved in reproduction are called sporangia. Sporangia contain cells, or spores, that develops into new *Rhizopus* individuals. The spores are covered by thick walls that protect them until they come into contact with another moist surface and can begin to grow.

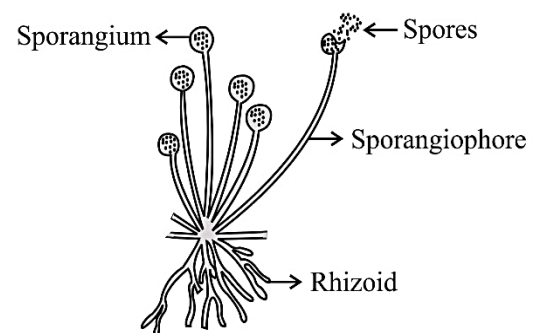


Fig. 8: Spore formation in *Rhizopus*

6. Vegetative Propagation

It is the simplest method of reproduction in plants. The vegetative parts like the root, stem, leaf, etc, develop into new plants under appropriate conditions. Vegetative reproduction is classified into two types: natural and artificial.

Natural Methods of Vegetative Propagation

Roots, stem or leaves are the vegetative structure for reproduction.

- ❖ **By roots:** The tuberous roots of sweet potato and mint bear adventitious buds (bud-bearing roots). These adventitious roots when planted in the soil, new plants are formed.
- ❖ **By stems:** New roots and shoots develop at nodes of common grass and mint. Their stems grow horizontally parallel to the ground. The roots grow downward into the soil and the shoots grow upward into new plants. Ginger is a modified stem with nodes, internodes and scaly leaves. The axillary bud growing out from the nodes develop into a new plant.
- ❖ **By leaves:** Leaves of some plants such as *Bryophyllum*, produce buds in the notches along the leaf margin. When such leaves fall on the moist soil, these buds develop into new plants.

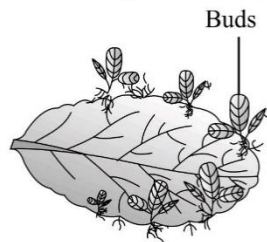


Fig. 9: Leaf of *Bryophyllum* with buds

Mosses and liverworts, for example, often have cup-like structure on their body (thalli) that contain specialized structures called **gemmae**. Gemmae become detached from the parent body and can germinate to form new plants, which are genetically identical to the parent.

Artificial methods of Vegetative Propagation

Some plants can be propagated artificially. The methods of artificial propagation include grafting, layering, cutting and tissue culture.

- ❖ **Grafting:** The technique of joining vegetative parts of two different plants and allow them to grow as a single plant is called grafting. This characteristic is unique to plants. Grafting is generally performed between related varieties and species. It is generally used for the propagation of plants like mango, guava, apple, pear, citrus, rubber and peaches.

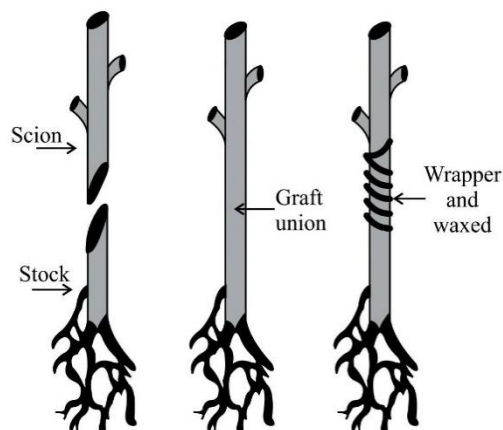


Fig. 10: Grafting of two related varieties of plants

- ❖ **Cutting:** Cuttings are small of the any part of plant like stem, root, leaf or bulb. When these parts of the plant are placed in suitable conditions, they develop roots and shoots and grow into a new plant. This method is commonly employed for rose, lemon, blackberry, sugarcane, etc.

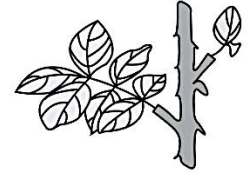


Fig. 11: Cutting



Mind it

- ❖ Monocot plants lack cambium therefore grafting is not possible in monocot plants. Cambium activity is essential for the union of stock and scion.
- ❖ Tissue culture is also called micropropagation because a large number of plants are formed from a small tissue. Disease free plants are produced by micropropagation.

- ❖ **Layering:** It is method of the development of roots on a stem while it is still attached to the parent plant. The stem that develops adventitious roots while still attached to the parent plant is known as layer. Layering method is commonly employed for jasmine, *Magnolia*, etc. It is of two types:

- (a) Air Layering (b) Ground Layering

(a) Air layering

In this method, a ring of bark is removed around the entire circumference of branch. The exposed surface of branch is covered with moist soil. Then it is wrapped with a polythene and tied at both the ends to preserve the moisture. After 4-8 weeks, roots start growing from the cut ends. Now the branch with new roots is detached from the parent plant, placed in the soil and grow into new plant. This method is used for lemon, rubber plant, cotton, etc.

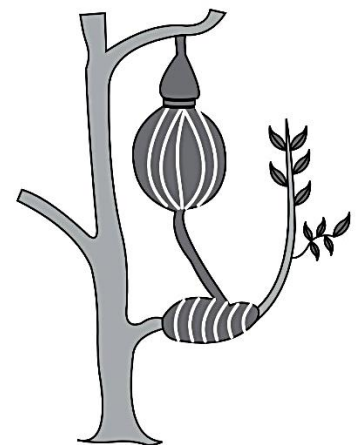


Fig. 12: Air Layering

(b) Ground layering

It is also known as mound layering.

In this, a flexible branch of the stem is trimmed such that its side branches and leaves get removed. The branch is, then, bent to the ground level and buried about few centimeters (5-8 cm) beneath the soil leaving exposed above the soil. The growing tip remains above the soil surface. After sometime, it has been observed that the roots begins to grow from the branch into the soil. Now this plant can be detached from the parent plant and made to grow as an independent new plant. This method is commonly used for jasmine, gooseberries, strawberry, etc.

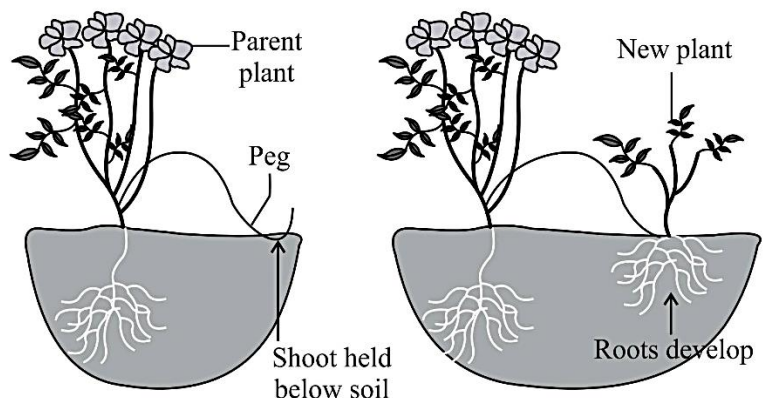


Fig. 13: Mound Layering

Tissue Culture

It is also known as micropropagation. It is the development of new plants from a small tissue of a plant in an artificial medium with the help of tissue culture. A group of genetically similar individuals obtained through tissue culture technique is called a clone. In this technique, a small piece of tissue is removed from the growing part of a plant and is placed in a container with nutrient medium (artificial medium) under disease free conditions. The tissue divides rapidly to form a small group of undifferentiated cells called callus. A small portion of this callus is transferred to another medium containing hormones for growth and differentiation, producing plantlets. These plantlets are then placed in soil to form a mature plant. This technique is commonly used for ornamental plants. *Chrysanthemum*, *Asparagus* and many other plants are propagated by using the plant tissue culture technique.

Advantages of Vegetative Propagation

- ❖ It is a rapid, cheap and easy method of reproduction for the multiplication of plants.
- ❖ Disease-free plants can be obtained by this method.
- ❖ By using grafting, fruits or flowers of superior quality can be produced.
- ❖ Genetically similar plants (clones) are produced by micropropagation.
- ❖ Plants raised by vegetative propagation can bear flowers and fruits earlier than those produce from seeds.
- ❖ The propagation of plants is also possible that have lost the capacity to produce seeds. E.g., banana, orange, rose and jasmine.

Limitations of Vegetative Propagation

There are some limitations of vegetative propagation. Some of these are:

- ❖ Since it produces genetically identical plants, new varieties cannot be obtained.
- ❖ As there is no genetic variation, the plants are more susceptible to diseases.
- ❖ There is severe competition between the members of the same species due to overcrowding of large number of plants near the parent plants. This leads to weak plants with stunted growth.



Find it

Q.1: Why is it said that *Amoeba* never dies a natural death?

Q.2: What type of plants or organisms reproduce by asexual reproduction?

NCERT Corner

1. How does binary fission differ from multiple fission?

Exp. In binary fission a single cell divides into two equal halves, e.g., *Amoeba* and bacteria while in multiple fission, a single cell divides into many daughter cells simultaneously, e.g., *Plasmodium*.

2. How will an organism be benefited if it reproduces through spores?

Exp. Advantages of reproduction by spore formation:

- ☞ Large numbers of spores can be obtained in one sporangium.
- ☞ To avoid competition at one place. Spores are distributed easily to far-off places by air and water.

☞ Spores are covered by thick walls that protect them from dehydration under unfavourable conditions.

3. Can you think of reasons why more complex organisms cannot give rise to new individuals through regeneration?

Exp. More complex organisms cannot give rise to new individuals through regeneration because complex organisms have organ-system level of organization. Specialised cells are organised as tissues, and tissues are organised into organs, which then have to be placed at definite positions in the body.

4. Why is vegetative propagation practised for growing some types of plants?

Exp. Vegetative propagation is practiced for growing some types of plants because of following advantages:

- ☞ It is used for the development of a plant in which viable seeds are not formed or very few seeds are produced.
- ☞ It helps to produce plants in new areas where the germination of seed is failed to produce mature plant due to change in environmental conditions and the soil.
- ☞ It is more rapid, easier and cheaper method.

5. Why is DNA copying an essential part of the process of reproduction?

Exp. DNA copying is an essential part of reproduction as it transfers genetic information from parents to offspring. It is important for the maintenance of the body design features of an individual. The reproducing cells produce a copy of their DNA through some bio-chemical reactions and result in the formation of two copies of DNA. The copying of DNA always takes place along with the help additional cellular structure. This process is then followed by division of a cell to form two cells.

Sexual Reproduction

It is a mode of reproduction that involves the fusion of haploid female gamete (egg cell) and haploid male gamete (sperm cell). It depend on the involvement of two individuals before a new generation can be created.

Why the sexual mode of reproduction?

- ❖ The creation of two new cells from one involves copying of DNA as well as of the cellular apparatus.
- ❖ The gametes from two different individuals called male and female, thus they bring some variations in the next generations.
- ❖ The DNA copying mechanisms are not absolutely accurate and the errors produced are a source of variations in population of organisms. These errors causes change in a DNA sequence, such errors are called mutations.
- ❖ All sexually reproducing and most of asexually reproducing organisms have two sets of chromosomes called homologous chromosomes. In sexual reproduciton, one set of chromosomes come from each parent. They restore the number of chromosomes to the fixed number of chromosomes of that species. During fusion of gametes, the number of chromosome are restored by the process of meiosis.
- ❖ Male gamete is motile and smaller in size while female gamete is large and contains the food stores. When these germ cells from two individuals combine to form a new individual, meiosis results in establishment of the number of chromosomes and DNA content in new generation.
- ❖ Sexual reproduction involves following steps:
 - (a) Formation of gametes (By meiotic cell division).
 - (b) Fusion of gametes (Fertilisation)
 - (c) Formation of zygote
 - (d) Development of zygote to an adult individual.

On the basis where the development of zygote takes place, animals are categorised into two types:

Oviparous	Viviparous
The development of the zygote occurs outside the body of the female parents in oviparous organisms.	The development of the zygote occurs inside the body of the female parent in viviparous organisms.
These animals lay eggs and the fertilized eggs have a calcareous shell to protect them from harsh environment.	These animals give birth to young ones.
E.g., Reptiles, amphibians, birds.	E.g., Human, whales, mice, etc.



Test Prep

What is internal fertilization?

- ❖ It is defined as the fusion of gametes takes place inside the female body after insemination through copulation.
- ❖ It is observed in birds, mammals, birds and plants such as bryophytes, pteridophytes. It is further classified into three types: ovoviviparity (eggs retained in the female body until they are ready to hatch), oviparity (egg-laying organisms) and viviparity (embryo develop within the female body).

What is external fertilization?

- ❖ It is defined as the fusion of gametes outside the female body or outer environment, particularly in water bodies.
- ❖ It is seen in few vertebrates (amphibians, fishes), aquatic invertebrates, sea urchins.
- ❖ The release of sperms and eggs by males and females into the water is known as spawning. Water facilitate the movement of sperm to the egg.



Find it

Q. How are number of chromosomes maintained in sexually reproducing organisms?

Sexual Reproduction in Flowering Plants

- ❖ In flowering plants or angiosperms, sexual reproduction takes place through the agency of flowers.
- ❖ Flower is a modified shoot meant for sexual reproduction. The reproductive parts are located in the flower.
- ❖ Flowers may be unisexual or bisexual. In bisexual flowers, both male and female reproductive structures are present, e.g., *Hibiscus*, mustard, while in unisexual flowers, only single reproductive structure, either male or female, is present, e.g., papaya, watermelon.

Structure of a Flower

The tip of the floral axis is known as **thalamus**. The floral axis is made up of two parts – a stalk and a thalamus (swollen end of stalk). A typical flower consists of four different kinds whorls, namely, calyx (sepals), corolla (petals), androecium (stamens) and gynoecium (carpels).

Calyx and corolla are the accessory organs while androecium and gynoecium are the reproductive organs.

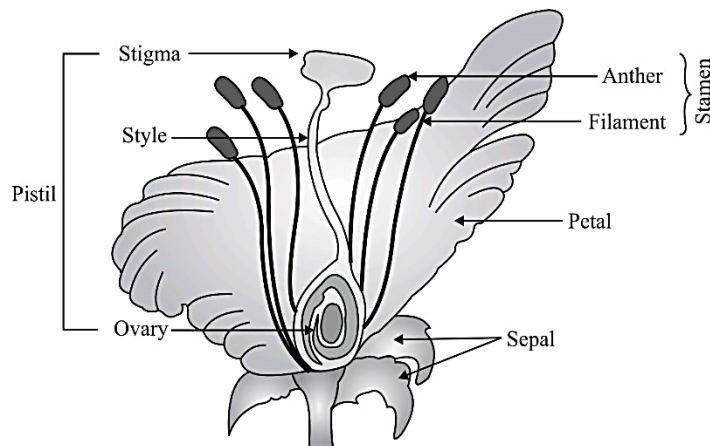


Fig. 14: Longitudinal section of flower

Different kinds of whorls

1. Calyx
2. Corolla
3. Androecium
4. Gynoecium

1. **Calyx:** It is the outermost whorl and consists of sepals. Sepals are green and leaf-like structure. It provides protection to the flower bud before it opens.

2. **Corolla:** It is the second whorl, inner to calyx, and consists of petals. Petals are generally large, coloured and bright. Corolla helps in attracting insects for pollination.

3. **Androecium:** It is the third whorl, inner to corolla, and consists of stamens (male reproductive parts).

Each stamen has two parts: Filament or stalk and anther. Each anther is bilobed and contains pollen sacs which contain pollen grains. Pollen grains are yellowish in colour each pollen grain produces two male gametes; one male gamete is vegetative cell and other is generative cell.

4. **Gynoecium:** It is the fourth and innermost whorl which consists of carpels (of female reproductive parts). Carpel or pistil is present in the centre of flower.

Each carpel has three parts: Ovary, Style and Stigma.

(i) **Ovary:** It is a basal, swollen part of the pistil. Each ovary bears one or more ovules which is attached to a special cushion-like parenchymatous tissue called the **placenta**.

(ii) **Style:** From the top of the ovary arises a long, elongated structure called as **style**.

(iii) **Stigma:** The terminal part of style is called as **stigma**. The stigma is normally rough, hairy or sticky to hold pollen grains during pollination process.

Pollination

The transfer and deposition of pollen grains shed from the anther to the stigma of a flower is termed as pollination.

Types of pollination

1. **Self pollination:** It is the process of transfer of the pollen grains from the anther to the stigma of the same flower. It is further divided into **two types**:

(i) **Autogamy:** It is a type of self pollination in which pollination is achieved by the transfer of the pollen grains are transferred from the anther to stigma of the same flower, e.g., pansy, wheat, rice, pea, etc.

(ii) **Geitonogamy:** It is a type of self pollination in which the pollen grains are transferred from the anthers of one flower to the stigma of another flower of the same plant, e.g., corn, castor.

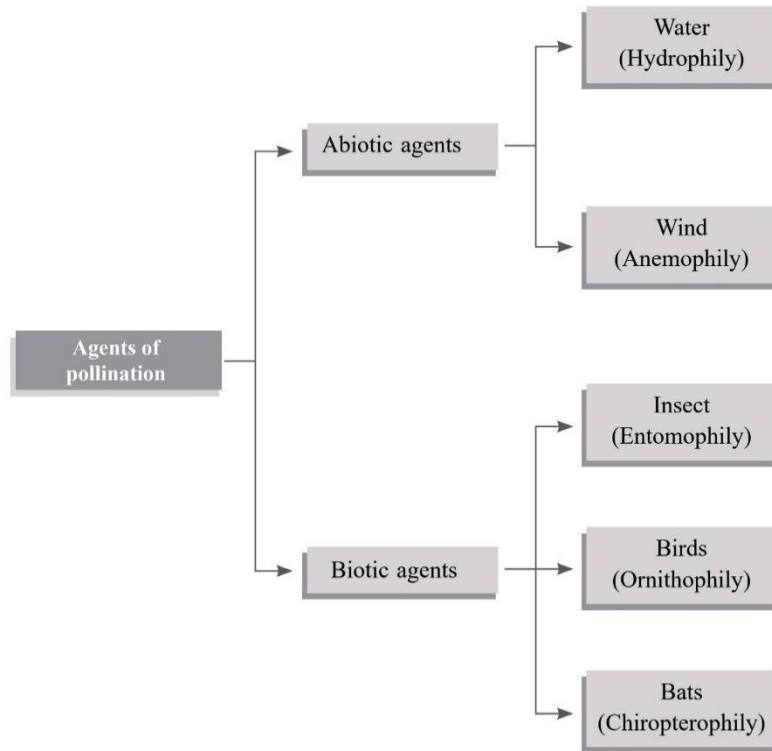
Significance of self pollination:

- ❖ Not dependent on pollinating agents.
- ❖ It can be an advantage when number of flowers is small or they are widely spaced.
- ❖ Less wastage of pollen grains.
- ❖ Preserve parental characters, thus maintains the purity of species.
- ❖ Once developed, it also maintains the superiority of variety.

2. **Cross pollination:** In this process, the pollen grains are transferred from the anther of one flower to the stigma of another flower borne on a different plant of the same species.

Significance of cross pollination:

- ❖ Increase in yield and adaptability.
- ❖ Since it involves two varieties of same or different species, it eliminates defective traits and produces new varieties.
- ❖ It also leads to the production of hybrid.



Find it

- Q.1: How does a bisexual flower, inspite of the young stamens being removed artificially, produces fruit.
- Q.2: Why can not fertilization take place in flowers if pollination does not occur?
- Q.3: What is the significance of bright colors of flower?

Fertilisation

Fertilisation is the process of the fusion of the male and female gametes. As the pollen grains fall on the stigma, they absorb water and nutrients. A mature pollen grain consists of two cells. The vegetative cell is bigger and has abundant food reserve and the generative cell is small. The **vegetative cell** starts growing and emerges through the prominent apertures called germ pore. It develops through the style as a long tube known as the pollen tube. The **generative cell** enters into the pollen tube and again divides into two male gametes.

The pollen tube, after reaching the ovary penetrates the embryo sac (an oval structure present in the ovule of flowering plants). The pollen tube bursts open due to which the male gametes get released into the embryo sac. One of the male gametes fuses with the egg and this results in the formation of zygote (diploid cell). The other male gamete fuses with them to produce triploid primary endosperm. As this involves the fusion of three haploid nuclei, it is termed **triple fusion** nucleus. The triple fusion nucleus is also called endosperm nucleus because it develops into the endosperm. Endosperm is filled with reserve food materials and are used for the development of the embryo.

This process of fusion of one of the male gametes with egg and the other male gamete with the secondary nucleus is known as **double fertilisation**.

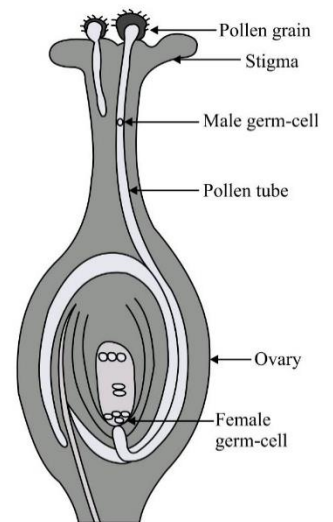


Fig. 15: Germination of pollen on stigma

Post Fertilization Changes in a Flower

- ❖ After fertilization, the ovule mature into seed.
- ❖ The integuments of the ovule develop into seed coats. The wall of ovary develops into the wall of fruits.
- ❖ In the meantime, the ovary enlarges and develops into a fruit, i.e., the transformation of ovules into seeds and ovary into fruit proceeds simultaneously.

Structure of Seed

Seed is a fertilised ovule that contains the embryo. It is the final product of sexual reproduction. Seeds of different plants vary in their size and shape.

Every seed has outer coverings called **seed coats** which develop from the integuments of the ovule. The outer layer of seed coat is called **testa** and the inner layer of seed coat is called **tegmen**. The hilum is a scar on the seed coat through which the developing seeds were attached to the fruit. Above the hilum, there is a small pore called **micropyle**. The seed coat encloses an embryo. One end of embryo axis bears **radicle** and other end bears **plumule**. The radicle when elongated gives rise to primary root whereas the plumule gives rise to aerial shoot.

Germination of Seed

- ❖ Seeds can remain dormant for months and years. Because of this, edible seeds can be stored for later use. The seeds contain the future plant or embryo which develops into a seedling only under favourable conditions.
- ❖ Germination is the process by which the dormant embryo within the seed becomes active, grows and forms a seedling or a young plant capable of independent existence.

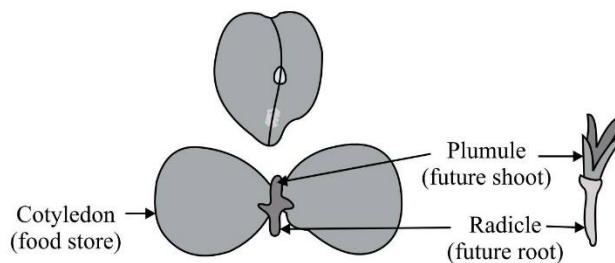


Fig. 16: Germination of seed



Mind it

- ❖ Spores are light weight so they are easily carried away by air and water current to new locations. They have a tough covering over them which protect them from harsh conditions of environment like dryness and high temperature.
- ❖ If both sepals and petals are coloured and cannot be distinguished from each other, then their whorl is known as perianth.
- ❖ Calyx and corolla are non-essential parts of the flower because they are not directly involved in reproduction.
- ❖ Pollen grains are yellowish in color. We must have seen this yellowish powder that often sticks to our hands if we touch the stamen of a flower.
- ❖ Some plants, like wheat and marigold, produce seeds only once in a year and die out, while others, continue to produce seeds for many years such as mango, apple, etc.
- ❖ True fruits are those part which are formed from ovary of a flower. False fruits are those which develops from if any other part of flower like thalamus.

Sexual Reproduction in animals

- ❖ The reproductive organs are known as gonads. The male gonad is testis and the female gonad is ovary. Testis produces the male gametes called sperms or spermatozoa. Ovary produces the female gametes called eggs (ova).
- ❖ Sexual reproduction is a process in which the development of a new individual begins from the fusion of male and female gametes (sperm and ovum respectively) derived from the same or different parents.
- ❖ In lower organisms such as *Hydra*, tapeworm, earthworm, etc., the male and female sex organs are present in the same organisms. Such animals are said to be bisexuals or hermaphrodites.

Reproduction in Humans

Primary and secondary sexual characters

These characteristics are present at birth and comprise the external and internal genitalia. These distinguishes one sex from the other. It includes testis and penis in males and ovary and vagina in females.

Secondary sexual characteristics are other somatic features of individuals that appear during puberty. They also distinguish the two sexes of a species, but are not directly related to the reproductive system. These characteristics are expressed due to hormones released at puberty. **Puberty** is defined as the period in males and females when physiological and anatomical changes are observed.

The Male reproductive System

Male reproductive system consists of

- ❖ A pair of testes.
- ❖ A paired duct system consisting of vas deferens, epididymis, ejaculatory duct and urethra.
- ❖ Accessory glands like seminal vesicles, Bulbourethral (Cowper's) glands and prostate glands.
- ❖ Penis.

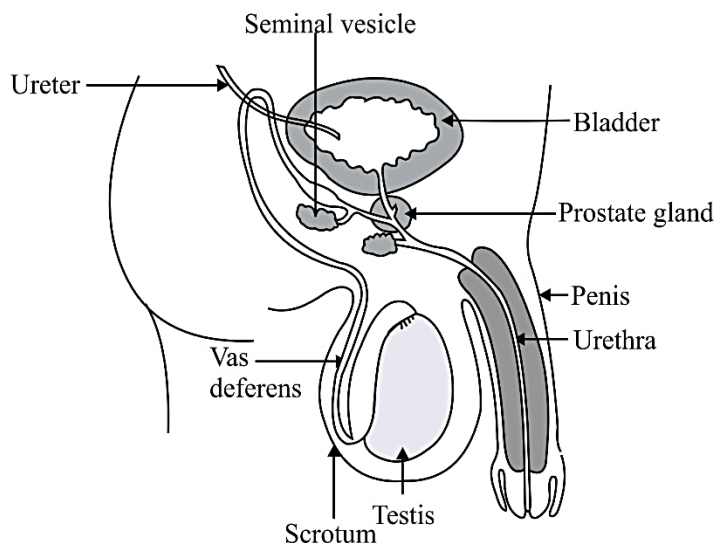


Fig. 17: Diagrammatic representation of human male reproductive system

Testes (singular: testis)

It is the primary sex organ. The testes or testicles are paired oval glands and weighs approximately 10-15 grams. They are situated outside the abdominal cavity within a pouch called scrotum.

Scrotum act as a thermoregulator by changing position of testis thereby maintaining a temperature 2-2.5 °C lower than the normal internal body temperature. A lower temperature is necessary for the maturation of sperms.

Structure of Sperm

A sperm is a haploid male gamete which fuses with the ovum to form the diploid zygote. They are solitary cells adapted for swimming, reaching and penetrating an ovum to fertilise it. Sperm composed of four parts - the head, neck, a middle piece and a tail.

Head

It is almost oval in the human sperm. It contains cap-like structure, acrosome and haploid nucleus enclosed by a thin membrane. Acrosome is filled with enzymes that help fertilisation of the ovum.

Neck

Neck consists of two centrioles, the proximal and the distal centriole.

Middle Piece

It consists of the apical part of the axial filament surrounded by a tightly coiled spiral sheath of mitochondria. Mitochondria produces energy for the movement of tail that facilitate sperm motility.

Tail

It consists of a central axial filament, a thin layer of cytoplasm and an outer smooth plasma membrane.

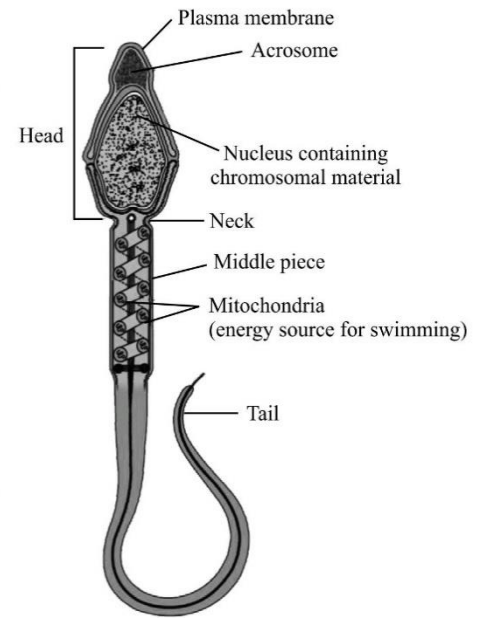


Fig. 18: Structure of sperm

A pair of duct system consisting of

- ❖ **Epididymis** is a tightly coiled structure containing a series of thread-like tubules that form a comma-shaped structure on the posterior side of the testes. It glycogen which keeps the stored sperms alive.
- ❖ **Vasa deferentia** (singular: Vas deferens) is also known as sperm duct. It emerges from the epididymis and ascends along the posterior side of the testis to become associated with the blood vessels and nerves that supply the testes. It comes out of the scrotum through a pore or inguinal canal, passes over urinary bladder and receives a duct from seminal vesicle to form ejaculatory duct.
- ❖ **Ejaculatory duct:** The epididymis receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct. These ducts store and transport the sperms.
- ❖ **Urethra:** The male urethra extends from the urinary bladder to the distal end of the penis. The urethra is a common passage for both urine and male reproductive fluids. Since, both of these fluids do not exit through the urethra at the same time therefore, there is no mixing.

Accessory Glands

- ❖ **Seminal vesicles** also called seminal glands. These are convoluted pouch like glands located between the posterior surface of the urinary bladder and the rectum. It acts as the energy source for the sperms. The alkaline nature of the fluid helps to neutralise the acid in the female reproductive tract.
- ❖ **Prostate gland** is a single bilobed structure. It surrounds the urethra close to its origin from the bladder. The prostatic secretion provides to sperm motility and viability. The pH is 6.5 (slightly acidic).
- ❖ **Cowper's glands** are two small ovoid glands which open into the urethra just before it enters the penis. It secretes mucus that provides lubrication at the end of the penis during sexual intercourse. The alkaline nature of the secretion protects the, passing sperms by neutralizing the acids coming from urine in the urethra.

Penis

The penis is the male reproductive organ. It helps in the transfer of sperm cells from the male to the vagina of the female. It is made up of special tissue that helps in the erection of the penis.

The Female Reproductive System

The female reproductive system consists of

- ❖ A pair of ovaries.
- ❖ A pair of fallopian tube or the oviducts.
- ❖ Uterus
- ❖ Vagina
- ❖ Accessory glands
- ❖ Vulva and external genital organs.

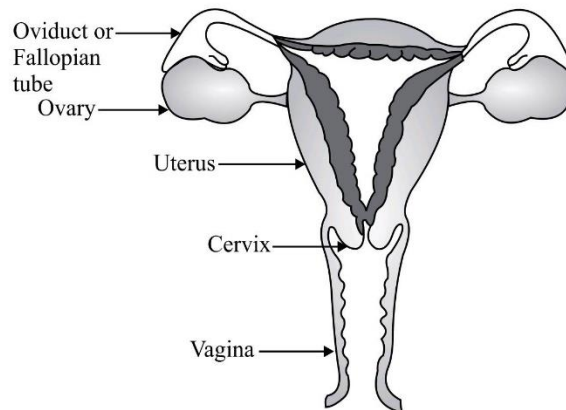


Fig. 19: Diagrammatic representation of human female reproductive system

Ovaries

It is the primary sex organ. These are a pair of almond-shaped female gonads dark black in colour present on each side of the lower abdominal. They are connected to the pelvic wall and uterus by ligaments. The ovary contains ovarian follicle, which contains an oocyte, the female germ cell. It also produces female sex hormones, i.e., estrogen and progesterone. Ovaries consist of thousands of immature eggs called primordial or primary follicles. These follicles are specialized structures where a primary oocyte grows and gets temporarily arrested at prophase of meiosis I. They are initially formed during embryonic development but start maturing once a month (28 days) after puberty only. The mature follicle (tertiary follicle) is called Graafian follicle.

Fallopian tubes or Oviducts

It extends from the periphery of each ovary to the uterus. Infundibulum is the funnel-shaped portion which possesses finger-like projections called fimbriae. Fimbriae help in the collection of the ovum after ovulation. As this is closer to the ovary, these tubes help in the transportation of secondary oocyte released by the ovary into the fallopian tube, provide a route for the sperm to reach the ovum and after fertilization carry the fertilized ovum to the uterus. The slightly swollen and wider part behind the infundibulum is called the ampulla, the site where ovum is fertilized. The last part of oviduct is called isthmus. It has a narrow lumen and it joins the uterus.

Uterus or womb

- ❖ It is like an inverted pear, muscular thick-walled but distensible bag-like organ. It is supported by ligaments attached to the pelvic wall. It protects and nourishes the developing embryo. The uterus opens into the vagina through a narrow part, cervix.
- ❖ Internally, the uterine cavity continues through the cervix as the cervical canal, which opens into the vagina. It has an inner glandular layer called endometrium that lines the uterine cavity.
- ❖ The sperms deposited in the vagina pass through the uterus to reach the uterine tube.
- ❖ It is the site of implantation of a fertilized ovum, development of foetus during pregnancy and labor. When implantation does not occur, the endometrium undergoes cyclical changes during the menstrual cycle.

Vagina

- ❖ The uterus opens into the vagina through the cervix.
- ❖ It is the female copulatory organ, birth canal as well as the passage way for menstrual flow. In young females, the opening of the vagina is partially covered by a thin mucous membrane called the hymen.

Accessory Glands

- ❖ **Bartholin's glands** are a pair of small glands. These are situated at the left and right of vaginal opening. Their secretion lubricates and neutralises the acidity of vagina.
- ❖ **Mammary glands** are paired structures containing glandular tissues and variable amount of fats. The glandular tissue of each breast is divided into 15-20 mammary lobes containing clusters of cells called alveoli. The cells of alveoli secrete milk, which is stored in the cavities (lumen) of alveoli.



Test Prep

Gametogenesis is the process of production of gametes, i.e., sperms and ovum.

Spermatogenesis and oogenesis are two different forms of gametogenesis. Gametogenesis in the male is known as spermatogenesis and in the female is known as oogenesis, which results in the formation of ova in the female.

Spermatogenesis

Spermatogenesis is a process of development of male gametes, i.e., sperm within the male reproductive organ, the testes.

Oogenesis

Oogenesis is the process of formation of female gametes, i.e., ovum/egg within the female reproductive organ, the ovary.

The Menstrual Cycle

Menstrual cycle is also called as the ovarian cycle or uterine cycle or the female reproductive cycle. It occurs every month in the ovaries and uterus of females in their reproductive years. The ovaries produce one mature oocyte every month.

The first menstruation begins at puberty and is called **menarche**. Stoppage of **menstruation** permanently at the age of 45-50 years is called **menopause**. The cycle also stops temporarily during pregnancy. Menstrual cycle consists of four phases:

(a) Menstrual phase

- ❖ Day 1-5.
- ❖ This phase is triggered by a sudden decrease in estrogen and progesterone.
- ❖ It is characterized by discharge of blood, mucous and breakdown of endometrial lining.

(b) Proliferative phase (pre-ovulatory phase) or follicular phase

- ❖ Day 6-13.
- ❖ Increased levels of FSH and luteinizing hormone (LH) cause the release of estrogen from secondary follicles.
- ❖ The primary follicles grow to become a Graafian (Ovarian) follicle.
- ❖ Graafian follicle begins to produce estrogen during the last 1 or 2 days of this phase.

(c) Ovulation

- ❖ Day 14.
- ❖ LH is the primary hormone of this phase.
- ❖ Increasing levels of estrogen result in the rapid secretion of LH hormone which in turn ruptures Graafian follicle and results in ovulation (release of secondary oocyte and surrounding cells from the ovarian follicle).
- ❖ Ovarian follicle now transforms as corpus luteum and produces progesterone under the influence of LH.

(d) Post ovulatory phase or luteal phase

- ❖ Days 15-28.
- ❖ Progesterone is the primary hormone of this phase.
- ❖ Corpus luteum secretes large amounts of progesterone which causes thickening of endometrium for implantation, if fertilization should occur.
- ❖ After about a week of increased progesterone and estrogen levels, levels of gonadotropic hormones fall causing LH levels to fall if fertilization does not occur.
- ❖ Decreased levels of LH cause the corpus luteum to become a corpus albicans. This stops the production of estrogen and progesterone when their levels fall, the corpus albicans degenerate. This causes disintegration of endometrium lining and menstruation begins.



Mind it

What happens when the Egg is not Fertilised?

If the egg is not fertilised, it lives for about one day. Since the ovary releases one egg every month, the uterus also prepares itself every month to receive a fertilised egg. Thus its lining becomes thick and spongy. This would be required for nourishing the embryo if fertilisation had taken place. Now, however, this lining is not needed any longer. So, the lining slowly breaks and comes out through the vagina as blood and mucous. This cycle takes place roughly every month and is known as menstruation.

Fertilization

It is the fusion of the nucleus of sperm cell with the nucleus of egg cell to form a diploid zygote. The diploid zygote contains 46 chromosomes in the nucleus, i.e., 23 from the sperm cell and 23 from the egg cell.

Fertilization normally happens within 12-24 hours after ovulation.

Once the egg cell has accepted one sperm cell, it immediately develops a membrane around itself, to prevent other sperm cells from entering it. Once fertilization takes place, a diploid zygote is formed.

From fertilization to birth

The embryo gets nutrition from the mother's blood with the help of a special tissue called placenta. This is a disc which is embedded in the uterine wall. It contains villi on the embryo's side of the tissue. On the mother's side are blood spaces, which surround the villi. This provides a large surface area for glucose and oxygen to pass from the mother to the embryo. The developing embryo will also generate waste substances which can be removed by transferring them into the mother's blood through the placenta. The development of the child inside the mother's body takes approximately nine months. The child is born as a result of rhythmic contractions of the muscles in the uterus.

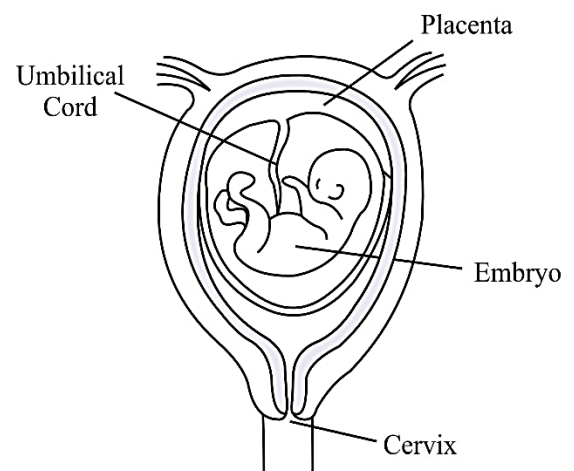


Fig. 20: Location of Placenta in uterus



Mind it

Male gametes are called sperms in animals and pollen in plants while in all the organisms female gametes is called ova.

Pregnancy or Gestation

The development of the embryo inside the uterus is called pregnancy. In human beings, after one month of pregnancy, the embryo's heart is formed. The first sign of growing foetus may be noticed by listening to the heart sound carefully through the stethoscope. By the end of the second month of pregnancy, the foetus develops limbs and digits. By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the limbs and external genital organs are well developed. The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month. By the end of about 24 weeks (end of second trimester), the body is covered with fine hair, eye-lids separate, and eyelashes are formed. By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.



Test Prep

- ❖ The average duration of human pregnancy is about **9 months** which is called the **gestation period**.
- ❖ The **mammary glands** of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called **lactation**. This helps the mother in feeding the new-born.
- ❖ The milk produced during the initial few day of lactation is called **colostrum** which contains several antibodies absolutely essential to develop resistance for the new-born babes.



Find it

Q.1: How does the embryo gets nourished inside mother's body?

Q.2: What happens to the egg and thickened lining of uterus if it does not get fertilised?

Reproductive Health

The term 'reproductive health' simply refers to healthy reproductive organs with normal functions. According to the World Health Organisation (WHO), reproductive health means a total well-being in all aspects of reproduction, i.e., physical, emotional, behavioural and social. Therefore, a society with people having physically and functionally normal reproductive organs and normal emotional and behavioural interactions among them in all sex-related aspects might be called reproductively healthy.

Reproduction is the process by which organisms increase their populations. The size of population is determined by the rates of birth and death in a given population. The size of the human population is a cause for concern for many people. This is because an expanding population lead to a scarcity of basic requirements, i.e., food, shelter and clothing.

Sexually Transmitted Diseases (STDs)

- ❖ There are many infectious diseases which are spread by sexual contact these are called Sexually Transmitted Diseases (STDs), e.g. AIDS, Hepatitis, genital warts, gonorrhoea, syphilis, etc.
- ❖ STDs occur mostly in the individuals who are involved in sexual activities with many partners.

Table- 2: Various STDs, the causative organism and symptoms

Name of STDs	Causative Organism	Symptoms
Syphilis	<i>Treponema pallidum</i> (a bacterium)	Causes sores and lesions in the genital tract. Burning sensation at urination.
AIDS (Acquired Immuno Deficiency Syndrome)	HIV (Human Immuno Deficiency Virus)	Destroy the immune system of body. Persistent cough and fever. Body attacked by other diseases like pneumonia, T.B. and certain cancers.
Gonorrhoea	<i>Neisseria gonorrhoeae</i> (a bacterium)	Infects mucous membranes of the urogenital tract. Genital discharge, painful urination.
Genital warts	Human papilloma virus (a virus)	Painful lumps on vagina, penis, anus or upper thighs, itching or bleeding.

Methods of Prevention of STDs

- The people should be educated about various STDs.
- Avoid sex with unknown or multiple partners.
- Always use a condom during coitus.
- High standard of moral education should be given to the people.



Mind it

Among the STDs, HIV infection is the most dangerous. AIDS can spread through sexual contact, use of infected syringes, blood transfusion and from infected mother to baby.



Test Prep

Amniocentesis

Amniocentesis is a foetal test used in prenatal diagnosis of chromosomal abnormalities, foetal infections and sex determination. It is based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo. In 1994, amniocentesis had been banned in India, under the Preconception and Prenatal Diagnostic Techniques Act because this method could reveal the sex of the foetus. Since a girl child is not accepted in many parts of India, the female foetus is aborted in most of the cases. To stop this, amniocentesis was banned in India.

Methods adopted for population control

The prevention of unwanted pregnancy in women is called contraception. Various contraceptive options are available such as barrier method, chemical method, IUDs & surgical methods.

1. Planned control of population

This can be done by:

- (i) Educating people about the advantages of small family
- (ii) By family planning.
- (iii) Raising the age of marriage can help in reducing population growth.

2. Barrier methods

- (i) These are the physical devices that prevent the entry of sperm by forming a mechanical barrier so that it does not reach the egg.
- (ii) It includes use of condoms. These are made up of thin rubber or latex sheath which covers the penis before coital activity.
- (iii) Diaphragms and cervical caps are also used. They are also made up of rubber and are inserted in vagina of female.

3. Chemical methods

- (i) It includes the use of some chemicals which are spermicidal. They may be in form of tablets, jellies, paste and creams introduced in the vagina before coital activity.
- (ii) Another chemical method is the use of oral contraceptive pill which prevents ovulation from the ovary by inhibiting the secretion of FSH and LH hormone from the anterior lobe of pituitary gland.

4. Surgical methods

- (i) Tubectomy is a surgical method which involves cutting of fallopian tubes in females and vasectomy involves cutting of vas deferens of each side in males.
- (ii) Surgical removal of testes is known as castration and surgical removal of ovaries is known as ovariectomy.

5. IUDs

- (i) Intra Uterine Devices (IUDs) are fitted in the uterus. They help to prevent fertilization.
- (ii) IUDs disrupts the motility of sperms which prevents them from fertilizing the egg.
- (iii) They can cause side effects due to irritation of uterus. Examples: Copper T and loops

Summary

Reproduction is the process by which all living organisms produce new individuals of their own kind. Reproduction is essential for the survival of species on this earth. The basic event in reproduction is the creation of a DNA copy. DNA replicates and forms new cells which generates variation. So, these new cells will be similar but not identical to original cell. Variations are useful for the survival of the individual and species over time as well as forms the basis of evolution. Various organisms use different modes of reproduction depending on their body design.

Reproduction can be of two types: asexual and sexual. Asexual reproduction involves development of new generations from a single individual without the involvement of gametes. Asexual mode of reproduction includes binary fission, budding, regeneration, fragmentation, and vegetative propagation. Binary fission is seen in bacteria, protozoa like *Amoeba*, *Paramecium* in which organism simply divide into two or more daughter cells. Organisms such as yeast undergo budding in which a new organism develops from an outgrowth or bud due to cell division at one particular site. In multi-cellular organisms, the organism breaks-up into smaller pieces upon maturation, each piece develops into new individual. Few organisms such as *Hydra* and *Planaria* can regenerate, i.e., give rise to new individual organisms from their body parts, if they are broken into pieces. The vegetative parts such as leaf, stem and root of some plants develop into new plants through vegetative propagation.

Sexual reproduction involves two individuals for the development of a new individual. It involves two parents - male and female. A male gamete fuses with a female gamete to form a new diploid cell called zygote. This zygote then grows and develops into a new organism. Since gametes are derived from two different organisms, it results in a new combination of genes which increases the chances of genetic variations.

Sexual reproduction in flowering plants involves the production of male and female gametes. Stamens are male reproductive organ and produce pollen grains that contain male gametes. The carpel is the female reproductive organ and produces ovules that contain female gametes. The transfer of the male gametes (pollen grains) from the anther to the stigma is called pollination. After pollination, fertilization occurs and the ovules grow into seeds within a fruit. After the seeds are ready for dispersal, the fruit ripens and by various pollinating agents, the seeds are dispersed from the fruit and after varying amounts of time and under specific conditions, the seeds germinate and grow into the next generation.

Human beings become reproductively active from the onset of puberty. Puberty is the period during adolescence when the general body growth rate begins to slow down and reproductive tissues begin to mature. Puberty is associated with many physical, mental, emotional and psychological changes in boys and girls which occur slowly over a period of time. These are called secondary sexual characters. For example, thick dark hair starts growing in new parts of the body such as arm pits and genital area between the thighs. Thinner hair appears on legs, arms and face. Skin becomes oily and pimples may appear on the face. Individuals become more conscious of their bodies, become more independent, more aggressive, etc.

In case of boys beard and mustache start appearing, voice begins to deepen and crack, reproductive organs develop and start producing sperms. In case of girls, breast size begins to increase, skin of the nipples darkens, menstruation starts. The male reproductive system in human beings consists of testes (produce sperms), vas deferens, seminal vesicles, prostate gland, urethra and penis. The female reproductive system in human beings consists of ovaries, fallopian tubes, uterus and vagina. Vagina serves as the canal for receiving the sperms at the time of copulation. The sperms travel upwards and reach the fallopian tube where one sperm fuses with the ovum to form the zygote. The zygote divides and redivides as it descends into the uterus and the embryo gets implanted in the inner lining of uterus (endometrium). The endometrium thickens so as to receive the embryo. The embryo gets nutrition from the mother's blood with the help of a special tissue called placenta, which is a disc-like structure embedded in the uterine wall. The foetus continues to develop inside the uterus for almost nine months after which the baby is delivered as a result of rhythmic contractions of the uterine muscles.

Contraception includes all methods used to prevent pregnancy or conception and thus regulate fertility. Each method prevents pregnancy in a different way. The contraceptive methods may be temporary or permanent. These include diaphragms, condoms, oral pills, copper-T, vasectomy, tubectomy and other methods. A number of diseases occur as a result of sexual intercourse if one of the partners is infected. These diseases are known as sexually transmitted diseases (STD's). They can be caused by bacteria for example; syphilis, gonorrhoea; or caused by a virus for example; HIV-AIDS, warts etc. The transmission of these diseases can be avoided by using birth control measures such as wearing a condom during the sexual act.

Quick Recall

Fill in the blanks

- In organisms such as _____, the splitting of the two cells during division can take place in any plane.
- _____ bearing anthers which produce _____, are the male reproductive parts of a flower.
- Cross pollination brings about _____ recombination in new plants.
- _____ is common method of multiplication of Yeast and *Hydra*.
- By the fusion of male and female gametes, _____ is formed.
- _____ bearing ovary with _____, are the female reproductive parts of a flower.
- Surgically when vasa deferens tube is cut and tied, it is called _____.
- _____ is the periodic discharge of blood, mucus, uterine mucosal pieces, etc., from uterus.
- In self-pollination, Pollen grains are transferred from stamens to _____ of carpel of _____ flower.
- Testes are located outside the abdominal cavity in _____.
- Plants raised by vegetative propagation can bear _____ and _____ earlier.
- The two parts tied together during grafting are called _____ and _____.
- If the _____ in the male is blocked, sperms can be prevented to _____ the egg.
- A bud in *Hydra* develops an outgrowth to repeated division at a _____.
- Tissue culture technique is commonly used for _____ plants.

True and False Statements

- Transfer of pollen grains from one flower to the stigma of another flower is known as cross-pollination.
- Menopause is the onset of menstruation.
- In *Spirogyra*, asexual reproduction takes place through fragmentation.
- The maternal blood supply mixes frequently with the foetal blood supply during the exchange of waste materials and nutrients.
- The DNA copying mechanisms generate variations which are useful for maintaining the survival of the species.
- In mammals including humans, fertilization takes place externally.
- The ovary of a flower grows into a fruit.
- Stamens and pistil are the reproductive parts of a flower.
- Vegetative propagation produces plants that are genetically identical to the parent plant.
- Sexually transmitted diseases can be prevented by using condoms.

Match The Followings

- Match the column I with column II.

Column I	Column II
(1) Stamens	(A) Calyx
(2) Pistil	(B) Corolla
(3) Sepals	(C) Androecium
(4) Petals	(D) Gynoecium
a. 1-C 2-D 3-A 4-B	
b. 1-A 2-B 3-C 4-D	
c. 1-B 2-A 3-C 4-D	
d. 1-C 2-B 3-A 4-D	

2. Match the columns:

Column I	Column II
(1) Bisexual flowers	(A) <i>Bryophyllum</i>
(2) Unisexual flowers	(B) Mango
(3) Plants that reproduce by leaves	(C) Maple
(4) Winged seeds dispersed by wind	(D) Papaya
(5) Seeds & fruits dispersed by animals	(E) Mustard

- a. 1-C 2-D 3-A 4-B 5-E
 b. 1-E 2-D 3-A 4-C 5-B
 c. 1-B 2-A 3-C 4-E 5-D
 d. 1-C 2-E 3-A 4-D 5-B

3. Match the organisms given in column I with their respective reproduction methods in column II.

Column I	Column II
(1) <i>Hydra</i>	(A) Binary fission
(2) Fungi	(B) Asexual spores
(3) Yeast	(C) Budding
(4) <i>Amoeba</i>	(D) Regeneration
	(E) Fragmentation

- a. 1-A 2-B 3-C 4-D, E
 b. 1-D 2-B 3-C 4-A
 c. 1-B 2-E 3-A 4-D
 d. 1-E 2-B, A 3-C 4-D

4. Match the given columns:

Column I	Column II
(1) Germination	(A) The pollen transferred from one flower to another
(2) Pollination	(B) The process in which embryo develops into seedling
(3) Menstruation	(C) Fertilised egg in humans gets implanted in
(4) Uterus	(D) Process occurs when egg in humans is not fertilised

- a. 1-B 2-A 3-D 4-C
 b. 1-A 2-B 3-D 4-C
 c. 1-A 2-B 3-C 4-D
 d. 1-A 2-C 3-B 4-D

5. Match the column I with column II:

Column I	Column II
(1) External fertilization	(A) Fertilization
(2) Female gametes	(B) Ovary
(3) Fusion of male and female gametes	(C) Frog
(4) Main female reproductive organ	(D) Testis
(5) Main male reproductive organ	(E) Ovum

- a. 1-A 2-B 3-C 4-D 5-E
 b. 1-C 2-B 3-A 4-E 5-D
 c. 1-B 2-C 3-D 4-A 5-E
 d. 1-C 2-E 3-A 4-B 5-D

Answers

Fill in the Blanks

1. *Amoeba* 2. Stamen, pollen grains
 3. Genetic 4. Budding
 5. Zygote 6. Pistil, ovules
 7. Vasectomy 8. Menstruation 9. Stigma, same
 10. Scrotum 11. Flowers, Fruits
 12. Stock, Scion 13. Vas deferens, fertilize
 14. Specific site 15. Ornamental

True or False

1. True 2. False 3. True
 4. False 5. True 6. False
 7. True 8. True 9. True
 10. True

Match the Followings

1. (a) 2. (b) 3. (b)
 4. (a) 5. (d)

NCERT Exercise

1. Asexual reproduction takes place through budding in

- a. *Amoeba* b. Yeast
 c. Plasmodium d. Leishmania

Exp. (b) Asexual reproduction takes place through budding in yeast.

2. Which of the following is not a part of the female reproductive system in human beings?

- a. Ovary b. Uterus
 c. Vas deferens d. Fallopian tube

Exp. (c) Vas deferens is not a part of the female reproductive system in human beings.

3. The anther contains

- a. Sepals b. Ovules
 c. Carpel d. Pollen grains

Exp. (d) The anther contains pollen grains.

4. What are the advantages of sexual reproduction over asexual reproduction?

Exp. Advantages of sexual reproduction:

- ☞ In sexual reproduction, more variations are produced. Therefore, it ensures survival of species in a population.
- ☞ The newly formed individual has characters of both the parents. This is because in sexual reproduction, genetic material from both the parents mixed (recombination of parent chromosomes) by fertilization.

5. What are the functions performed by the testis in human beings?

Exp. Functions of testes:

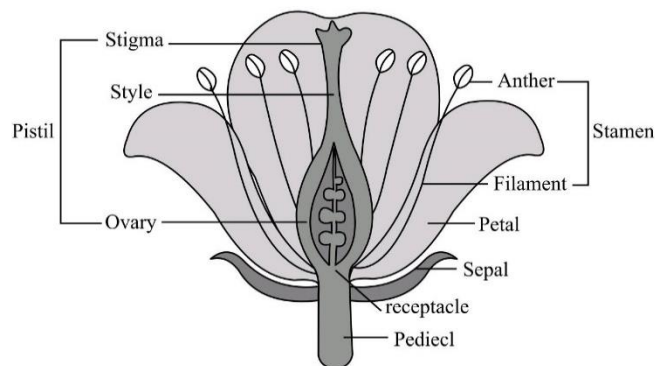
- ☞ Regulate the development and maturation of sperms, which contain haploid set of chromosomes of father.
- ☞ Produce a hormone called testosterone, which regulates sexual development.

6. Why does menstruation occur?

Exp. Menstruation is a process in which blood and mucous flows out through the vagina. This process is repeated every month at an average interval of about 28/29 days because one egg is released from the ovary every month and at the same time, the uterus (womb) prepares itself to receive the fertilized egg. Thus, the inner lining (endometrium) of the uterus gets thickened and is supplied with blood to nourish the embryo. If the egg does not get fertilised, then the lining of the uterus slowly breaks and comes out through vagina as blood and mucus.

7. Draw a labelled diagram of the longitudinal section of a flower.

Exp. The labelled diagram of the longitudinal section of a flower is given below:



8. What are the different methods of contraception?

Exp. The contraceptive methods can be broadly divided into the following types:

- ☞ Natural method: It involves preventing the chances of meeting of sperms and ovum. In this method, the sexual act is avoided from day 10th to 17th of the menstrual cycle because during this period, ovulation is expected and therefore, the chances of fertilization are very high.
- ☞ Barrier method: Barriers are available for both males and females. Condoms are barriers made up of thin rubber which covers the penis in males and vagina in females.

☞ Oral contraceptives: In this method, pills or drugs are taken orally. They change hormonal balances that prevent the release of eggs and thus fertilization cannot occur.

☞ Implants and surgical methods: Contraceptive devices such as Copper-T are placed in uterus to prevent pregnancy. Some surgical methods, such as tubectomy and vasectomy, can also be used to block the gamete transfer. Vasectomy involves the blocking of vas deferens to prevent the transfer of sperms. Similarly, fallopian tubes of the female can be blocked by tubectomy so that the egg will not reach the uterus.

9. How are the modes for reproduction different in unicellular and multicellular organisms?

Exp. For unicellular organisms, reproduction occurs by the division of the entire cell. Fission, budding, regeneration are some modes of reproduction in unicellular organisms in multicellular organisms, specialised reproductive organs are present. Therefore, they can reproduce by vegetative propagation, spore formation, etc. In more complex multicellular organisms the mode of reproduction is sexual reproduction. It is found in humans and plants.

10. How does reproduction help in providing stability to populations of species?

Exp. Reproduction is a natural process of producing new individuals of the same species from existing organisms of a species, thus, it helps in providing stability to population of species by giving birth to new individuals.

It also ensures the continuity of a species. By reproduction, organisms form a large number of new individuals out of which several lose their life and only some survive. These surviving organisms replace the naturally dying members of the population. Hence the population as a whole is not affected and remains stable.

11. What could be the reasons for adopting contraceptive methods?

Exp. Contraceptive methods are mainly adopted because of the following reasons:

- ☞ To prevent unwanted pregnancies.
- ☞ To control population growth or birth rate.
- ☞ To provide protection against various sexually transmitted diseases.

Subjective Questions

Very Short Answer Type Questions

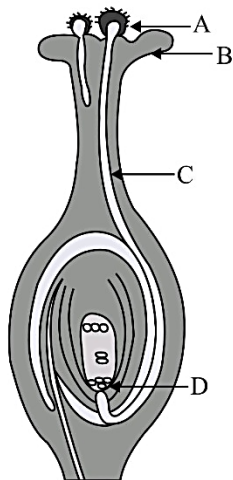
1. What is reproduction?
 2. Give an advantage of vegetative propagation
 3. Name the life process of an organism that helps in the growth of its population.
 4. What methods will you use for growing jasmine and rose plants?
 5. Name the method by which *Spirogyra* reproduce under favourable conditions. Is this method sexual or asexual?
 6. When a cell reproduces, what happens to its DNA?
 7. What is the function of copper-T used by some women?
 8. List two functions of ovary of human female reproductive system.
 9. How does the embryo gets nourishment from the mother?
 10. Differentiate between pollen grain and ovule.
 11. Distinguish between unisexual and bisexual flowers giving one example of each.
 12. Name two techniques of vegetative propagation practiced by gardeners.
 13. List any two reasons why the Government has banned prenatal sex determination by law.
 14. Organisms have a varied body design. Name the property which gives the basic difference in body design.
 15. What is pollination?
2. "Variations" are seen in the organisms. State the main causes of variation
 3. Define the following processes of asexual reproduction:
 - a. Spore formation
 - b. Regeneration
 - c. Multiple fission
 4. State the changes that take place in the uterus when
 - a. Implantation of embryo has occurred
 - b. Female gamete/egg is not fertilized
 5. Why is vegetative propagation practiced for growing some types of plant? List two plants which are grown by this method
 6. State the importance of chromosomal difference between sperms and eggs of humans.
 7. How can pregnancy be prevented surgically?
 8. Leaves of *Bryophyllum* fallen on the ground produce new plants. Why?
 9. What happens to the following parts after fertilization?
 - a. Ovum
 - b. Ovary
 - c. Ovule
 - d. Sepals and petals
 10. Why do we need to adopt contraceptive measures?
 11. DNA content has the tendency to double itself during sexual reproduction due to combining of the genetic materials from the two parents. How the problem of DNA doubling can be solved to maintain the consistency of the genetic material throughout the species?
 12. Give reasons:
 - a. Wind acts as a pollinating agent.
 - b. Variation is essential and beneficial to a species.
 - c. Use of condoms prevents pregnancy.
 13. What is placenta? State the role of placenta in the development of embryo.

Short Answer Type Questions

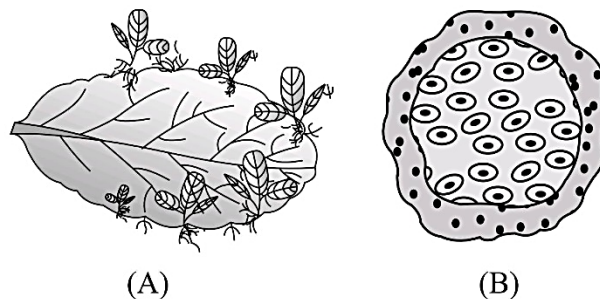
1. "The chromosomal number of the sexually producing parents and their offspring is the same." Justify this statement.

Long Answer Type Questions

1. Explain the structure of the female reproductive system of humans.
2. Answer the following:
 - a. How is zygote formed?
 - b. At what interval the egg is formed in the ovary of human female?
 - c. Name two STDs caused by bacterial infection.
 - d. Why is prenatal sex determination prohibited?
3. How does vegetative propagation occur in nature? Explain with four different examples.
- 4.



- a. Identify A, B, C and D in the given diagram and write their names
- b. What is pollination? Explain its significance.
- c. Explain the process of fertilization in flowers.
 Name the parts of flower that develop after fertilization into (i) seed (ii) fruit
5. Identify the organisms A, B and the mode of asexual reproduction exhibited by them



- b. How will an organism be benefitted if it reproduces through spores?
- c. Mention the two asexual methods by which *Hydra* can reproduce. Explain these methods.

Multiple Choice Questions

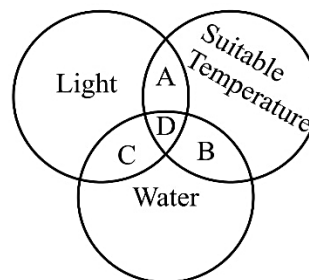
Level-I

- The development of a seedling from an embryo under appropriate condition is called
 - Regeneration
 - Germination
 - Spore formation
 - Budding
- By which method, asexual reproduction occurs in *Amoeba*?
 - Fission
 - Budding
 - Regeneration
 - All of these
- Which of the following is not an outcome of variations present in population?
 - Bacterial resistance to heat
 - Different colour of eyes
 - Survival of species over time
 - Maintenance of body design features
- Which of the following have buds on their leaves as vegetative reproducing structure?
 - Potato
 - Banana
 - Bougainvillea*
 - Bryophyllum*
- Budding and fission are processes used by
 - Dioecious species
 - Hermaphrodite organisms
 - Monoecious species
 - Asexually reproducing species
- In human males, the testes lie in the scrotum, because it helps in the
 - Process of mating
 - Formation of sperms
 - Easy transfer of gametes
 - Secretion of hormones
- Which of the following method of contraception protects from acquiring sexually transmitted diseases?
 - Surgery
 - Oral-pills
 - Condoms
 - Copper-T
- Which among the following diseases is not sexually transmitted?
 - Syphilis
 - Hepatitis
 - HIV-AIDS
 - Gonorrhoea
- Tubectomy is carried out by blocking the
 - Oviduct
 - Uterus
 - Vas deferens
 - Vagina
- The number of chromosomes in parents and offsprings of a particular species remains constant due to
 - Doubling of chromosomes after zygote formation
 - Halving of chromosomes during gamete formation
 - Doubling of chromosomes after gamete formation
 - Halving of chromosomes after gamete formation
- If a starfish is cut into pieces, each piece grow into a complete animals. The process is called
 - Regeneration
 - Reproduction
 - Healing of wounds
 - Fragmentation
- Which of the following are the examples of external fertilization?
 - Fish and frog
 - Frog and monkey
 - Dog and goat
 - Goat and fish
- A feature of reproduction that is common to *Amoeba*, Yeast and *Spirogyra* is that
 - They reproduce only sexually
 - They are all unicellular
 - They reproduce asexually
 - They are all multicellular
- In *Rhizopus*, tubular thread-like structures bearing sporangia at their tips are called
 - Filaments
 - Hyphae
 - Rhizoids
 - Roots
- Along the path of the vas-deferens the secretions of which gland provide nutrition to the sperms?
 - Prostate vesicles
 - Seminal vesicles
 - Both (a) and (b)
 - Urinary bladder
- The seed that contains the future plant is called the
 - Cotyledons
 - Seed coat
 - Zygote
 - Embryo

17. The period during adolescence when the reproductive tissues begin to mature is called
- Ovulation
 - Puberty
 - Menstruation
 - Propagation
18. In the process of binary fission
- Cytoplasm divides first followed by division of nucleus
 - Cell protrudes followed by division of nucleus
 - Both nucleus and cytoplasm divide simultaneously
 - Nucleus divides first followed by division of cytoplasm
19. Spiny or sticky pollen grains and large, attractively coloured flowers are associated with
- Hydrophily
 - Entomophily
 - Ornithophily
 - Anemophily
20. Which of the following is NOT an example of asexual reproduction?
- Reproduction in earthworms
 - Formation of spores in ferns
 - Binary fission in *Amoeba*
 - Budding in *Hydra*
21. From among the sets of terms given below, identify those that are associated with the gynoecium.
- Ovule, ovary, embryo sac, tapetum
 - Thalamus, pistil, style, ovule
 - Stigma, ovule, embryo sac, placenta
 - Ovule, stamen, ovary, embryo sac
22. The outermost whorl which consists of sepals is called:
- Corolla
 - Calyx
 - Androecium
 - Gynoecium
23. In humans, the ovary is primarily concerned with
- Production of testosterone
 - Production of ovum
 - Development of secondary sexual characters
 - All of the above
24. Which is the portion on which grafting is done and it provides roots?
- Stem
 - Scion
 - Stock
 - Stalk
25. Which of the following is not a part of the female reproductive system in human beings?
- Fallopian tube
 - Uterus
 - Testis
 - Ovary
26. In a flower, the parts that produce male and female gametes (germ cells) are
- Stamen and filament
 - Filament and stigma
 - Anther and ovary
 - Stamen and anther
27. The main method of propagation of banana, orange, rose and jasmine is
- Sexual reproduction
 - Vegetative reproduction
 - Binary fission
 - Regeneration
28. After fertilization the fertilized egg or the zygote gets implanted in the
- Vagina
 - Ovary
 - Uterus
 - Fallopian tube
29. Advantage of vegetatively reproduced organism is
- Dissimilar organisms
 - Genetic variation
 - Genetic similarity in offsprings
 - Varied offsprings
30. Vegetative propagation in *Bryophyllum* is due to
- Buds in the notches of leaves
 - Branch
 - Stem
 - Root

Level-II

31. The conditions are necessary to activate enzymes when a seed germinates are:



- C
 - A
 - D
 - B
32. Given below are certain adaptations in fruits of

certain plants. On the basis of information given below, identify the agent of pollination in both situations.

1. Small, dry and light seeds with a parachute of fine hair.
 2. Brightly-coloured, sweet and juicy but hard seeds
- a. 1-insects, 2-animals b. 1-wind, 2-animals
 c. 1-water, 2-insects d. 1-birds, 2-insects
33. In female mammals, Bartholin's glands open into the
- a. Vestibule and release a lubricating fluid in the vagina
 - b. Uterus and release a lubricating fluid during the birth of young ones
 - c. Urinary bladder and assist in release of urine
 - d. Fallopian tubes and release a secretion which makes sperms motile
34. Offspring formed by asexual method of reproduction have greater similarity among themselves because
- A. Asexual reproduction involves only one parent
 - B. Asexual reproduction occurs before sexual reproduction
 - C. Asexual reproduction does not involve gametes
 - D. Asexual reproduction occurs involves two parents.
- a. (A) and (B) b. (A) and (C)
 c. (B) and (D) d. (C) and (D)
35. Characters that are transmitted from parents to offspring during reproduction show
- a. Only similarities with parents
 - b. Only dissimilarities with parents
 - c. Both similarities and variations with parents
 - d. Neither similarities nor variations
36. A *Planaria* worm is cut horizontally in the middle into two halves P and Q such that the part P contains the whole head of the worm. Another *Planaria* worm is cut vertically into two halves R and S in such a way that both the cut pieces R and S contain half head each. Which of the cut pieces of the two *Planaria* worms could regenerate to form the complete respective worms?
- a. Only P b. Only R and S
 c. P, R and S d. P, Q, R and S
37. Which out of the following processes does not lead to the formation of clones?
- a. Fertilisation b. Multiple fission
 c. Micropropagation d. Fragmentation
38. Which among the following statements are true for unisexual flowers?
- A. They possess both stamen and pistil
 - B. They possess either stamen or pistil
 - C. They exhibit cross pollination
 - D. Unisexual flowers possessing only stamens cannot produce fruits
- a. (A) and (D) b. (B), (C) and (D)
 c. (C) and (D) d. (A), (C) and (D)
39. During adolescence, several changes occur in the human body. Mark one change associated with sexual maturation in boys
- a. Increase in height
 - b. Loss of milk teeth
 - c. Cracking of voice
 - d. Weight gain
40. Offspring formed as a result of sexual reproduction exhibit more variations because
- a. Genetic material comes from two parents of the same species
 - b. Genetic material comes from two parents of different species
 - c. Sexual reproduction is a lengthy process
 - d. Genetic material comes from many parents
41. Which of the following statements are true for flowers?
- A. They are produced in all groups of plants
 - B. Flowers are always bisexual
 - C. They are the sexual reproductive organs
 - D. After fertilisation they give rise to fruits
- a. (A) and (D) b. (B) and (C)
 c. (A) and (C) d. (C) and (D)
42. Which of the following is NOT a characteristic feature of sexual reproduction?
- a. Sexual reproduction involves the fusion of two dissimilar reproductive cells.
 - b. Sexual reproduction is observed in most organisms
 - c. The offspring represents the characteristics of only one parent
 - d. Fertilization may take place inside or outside the body of the female

43. What marks the beginning of the reproductive life of a woman?
- a. Menopause b. Menarche
 c. Fertilisation d. Ovulation
44. In the list of organisms given below, those that are reproduced by the asexual method are:
- A. *Yeast* B. *Amoeba*
 C. Banana D. Dog
- a. (B) and (D) b. (A), (B) and (C)
 c. (A) and (D) d. (B), (C) and (D)
45. Consider the following statements:
- A. Copper-T is a contraceptive device used by women.
 B. Sexually transmitted disease can be prevented by using condoms.
 C. The ovulation takes place 10-12 days after the start of menstruation.
 D. In human-beings, male can produce sperms upto the age of 45-50 years.
- Which of these statement(s) is/are correct?
- a. (A) and (B) b. (B) and (C)
 c. (A) only d. (A), (B) and (C)
46. Consider the following statements:
- A. Testes produces sperm and hormone called testosterone.
 B. The only function of the testes is to produce sperm.
 C. Fertilization is the fusion of sperm and ovum.
- Which of these statement(s) is/are correct?
- a. (A) and (B) b. (B) and (C)
 c. (A) and (C) d. All are correct
47. Which among the following is not the function of testes at puberty?
- A. Formation of germ cells.
 B. Secretion of testosterone.
 C. Development of placenta.
 D. Secretion of estrogen.
- a. (A) and (B) b. (B) and (C)
 c. (C) and (D) d. (A) and (D)
48. Which of these statements about the reproductive system of a plant is NOT true?
- a. The female organs are the pistils
 b. The anthers produce female gametes
 c. Pollen grains contain male gametes
 d. A male gamete from a pollen grain fertilize a female gametes in an ovule

49. Flowering plants show double fertilisation
- a. To produce the endosperm which have food reserves and ensures successful germination of seeds
 b. To protect the seeds from unfavourable conditions
 c. To ensure the survival of the diploid zygote
 d. To ensure that the ovary will not develop if double fertilisation does not take place
50. Reproductive health in society can be improved by:
- A. Introduction of sex education in schools.
 B. Increased medical assistance.
 C. Awareness about contraception and STDs.
 D. Equal opportunities to male and female child
 E. Ban on amniocentesis.
 F. Encouraging myths and misconceptions.
- a. All of the above
 b. (A), (B), (D) and (F)
 c. (A), (B), (C), (D) and (E)
 d. (B) and (E)

Assertion & Reason Type Questions

Direction: In the following Questions, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

- (a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion.
- (b) Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.
- (c) Assertion is true but the Reason is false.
- (d) Assertion is false but the Reason is true.
1. **Assertion:** Vasectomy is a surgical method of birth control
Reason : In vasectomy, small portion of oviduct is cut or tied properly
2. **Assertion:** HIV-AIDS is a bacterial disease.
Reason: AIDS does not spreads through sharing of food and water.
3. **Assertion:** Characteristics of parental plants can be preserved through asexual reproduction.
Reason: Vegetative reproduction involves only mitosis.

4. **Assertion:** DNA copying is necessary during reproduction.

Reason: DNA copying leads to the transmission of characters from parents to offspring.

5. **Assertion:** Double fertilisation is unique to angiosperms.

Reason: Triple fusion occurs in asexual reproduction.

Case-Based Type Questions

Case-Based-I: Consider that two organisms namely X and Y produce new offspring from single parent only. When reaches its maximum growth, organism X divides its body into two new organism. The parent organism does not exist anymore and two new daughter organisms grow fully and divide again. Organism Y forms a small outgrowth on its body called bud due to cell division at one particular site. This bud, later on, detaches and develops into new organism.

- Select the option that correctly identifies organisms X and Y.
 - X – *Amoeba*, Y – Yeast
 - X – *Paramecium*, Y – *Hydra*
 - X – *Leishmania*, Y – *Sycon*
 - All of these
- Which of the following is correct statement?
 - Organism X reproduces asexually whereas organism Y reproduces sexually.
 - Organism X must be multicellular whereas organism Y should be unicellular
 - Both Organisms X and Y reproduce asexually.
 - Both organisms X and Y are always multicellular organism.
- Identify the mode of reproduction in organisms X and Y respectively.
 - X – Multiple fission, Y – Binary fission
 - X – Regeneration, Y – Fragmentation
 - X – Binary fission, Y – Budding
 - X – Zoospore formation, Y – Regeneration
- Select an incorrect statement.
 - Plasmodium* reproduces by the same method as adopted by organism X.
 - If organism Y is *Planaria*, then it may also reproduce through fragmentation.
 - Organism X could be any multicellular plant like *Riccia*, *Sphagnum*, etc.
 - Both (a) and (c)

Case-Based-II: Preeti collected some pond water in a test tube which was dark green in colour. She took out dark green coloured mass from it and separated its filaments by using needles. Some filaments are broken down into small fragments. She put these small filaments in a Petri dish containing clean water. After few days, she observed that the small fragments produce complete filaments.

- The mass of green filament was of
 - Spirogyra*
 - Volvox*
 - Fucus*
 - Fungal filaments or hyphae
- The small fragment gave rise to new filament. What does it indicate?
 - Spirogyra* reproduces asexually through regeneration.
 - Spirogyra* reproduces asexually through fragmentation.
 - Spirogyra* reproduces asexually through binary fission.
 - Spirogyra* reproduces asexually through vegetative propagation.
- Can you identify an organism which reproduces in similar way as *Spirogyra*?
 - Yeast
 - Cyanobacteria
 - Entamoeba
 - Volvox*
- Select the correct statement.
 - Only multicellular organisms can undergo fragmentation.
 - Both unicellular and multicellular organisms can undergo fragmentation
 - Fragmentation is sexual mode of reproduction.
 - Fragmentation is seen only in fungi.

Case-Based-III: Stamen is the male reproductive part and it produces pollen grains that are yellowish in colour. Pistil is present in the centre of a flower and is the female reproductive part. X and Y are two monoecious plants. Plant X bears bisexual flowers as it contains both stamens and pistil. Plant Y bears unisexual flowers as it contains either stamens or pistil. X does not need a pollinating agent whereas pollinating agent is required in case Y.

- Select the option that correctly identifies plant X and Y.
 - X - Papaya, Y - Mustard
 - X - Pea, Y - Cucurbit
 - X - Sunflower, Y - Orchids
 - X - *Hibiscus*, Y – Papaya

- Select the incorrect option regarding plants X and Y.
 - Even if all its flowers are emasculated, seed setting is assured in plant X
 - X is a cross-pollinated plant whereas Y is a self-pollinated plant.
 - Sexual reproduction in plant Y may or may not give rise to genetic variations.
 - All of these
- Self-pollination in plant X can be prevented by removing
 - Flowers
 - Anthers
 - Carpels
 - None of these
- The male and female reproductive part of the flower is respectively:
 - Stamen and Pistil
 - Pistil and stamen
 - Ovary and carpel
 - Style and petal

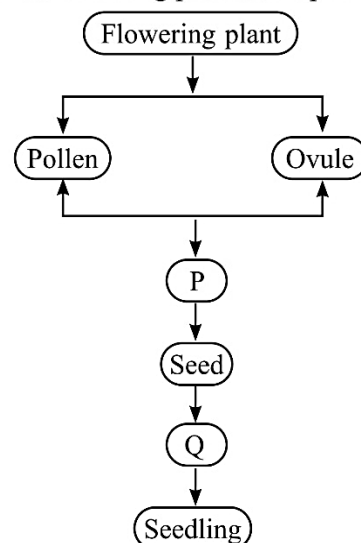
Case-Based-IV: The reproductive organs in human beings become functional after attaining sexual maturity. This age is called puberty. Puberty in males is attained at an age of 13-14 years while in females, it is attained at an age of 11-12 years. Changes in the body at puberty, such as increase in breast size in girls and new facial hair growth in boys, are signs of sexual maturation. The primary sex organs – the testis in the males and the ovaries in the females – produce gametes, i.e, sperms and ovum, respectively, by the process called gametogenesis. The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens. Sertoli cells provide nutrition to the developing spermatozoa. The testes are situated outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes (2–2.5°C lower than the normal internal body temperature) necessary for spermatogenesis.

- What is the puberty age in human females?
 - 8-10
 - 11-12
 - 13-14
 - 14-16
- Why are testes located outside the abdominal cavity in scrotum?
 - Formation of sperms requires a higher temperature.
 - Formation of sperms requires a lower temperature.
 - Formation of sperms requires more space
 - Sperms get nutrition from scrotum
- Testis in males and ovaries in the females produce respectively
 - Ovum and sperms
 - Ova and spermatozoa
 - Oogonia and spermatozoa
 - Sperms and ovum

- Which of the following is not an accessory duct of males?
 - Fallopian tube
 - Vasa efferentia
 - Epididymis
 - Vas deferens

Olympiad & NTSE Type Questions

- Which of the following are examples of vegetative reproduction in plants?
 - Tomato, lady's finger, onion and cauliflower
 - Potato, ginger, onion and sugarcane
 - Cauliflower, onion, potato and tomato
 - Lady's finger, onion, ginger and sugarcane
- Which of the following processes represents P and Q?



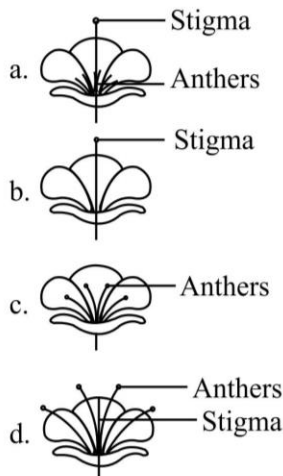
- | | P | Q |
|----|---------------|---------------|
| a. | Fertilization | Pollination |
| b. | Pollination | Fertilization |
| c. | Dispersal | Germination |
| d. | Fertilization | Germination |
- There is a greater possibility for the evolution of a new species in organisms which reproduce by
 - Binary fission
 - Budding
 - Fertilisation
 - Regeneration
 - Which of the following statements is or are correct?
 - The disease which are spread by sexual contact with an infected person are called sexually transmitted diseases or STD.
 - In males, a small portion of vas deferens is cut and tied up called vasectomy.
 - Oral pills contain hormones which stops the ovaries from releasing ovum or egg into the oviduct
 - All the above

5. Which one of the following statement is incorrect about menstruation?
- During normal menstruation about 40 mL blood is lost
 - The menstrual fluid can easily clot
 - At menopause in the female, there is especially abrupt increase in gonadotropic hormones
 - The beginning of the cycle of menstruation is called menarche
6. The correct sequence of the various phase of a typical menstrual cycle is:
- Menstrual → follicular → secretory → ovulatory
 - Menstrual → follicular → ovulatory → secretory
 - Ovulatory → follicular → secretory → Menstrual
 - Menstrual → secretory → follicular → ovulatory
7. In context of amniocentesis, which of the following statements is INCORRECT?
- Usually done when the woman is between 14-16 weeks pregnant
 - Can be used to detect Down Syndrome
 - Can be used for prenatal sex determination
 - Can be used for the detection of cleft palate
8. About which day in a normal human menstrual cycle does rapid secretion of LH (Popularly called LH-surge) normally occurs?
- 5th day
 - 11th day
 - 14th day
 - 20th day
9. Grafting in monocot plants is not possible because they have [NTSE 2018]
- Parallel venation
 - Have only one cotyledon
 - Lack cambium
 - Have scattered vascular bundles
10. Read the following about the agents of seed dispersal. [NTSE 2010]
- Xanthium* and *Urena* by animals.
 - Drumstick and Maple by wind.
 - Groundnut and Areca nut by birds.
 - Madar and Sunflower by insects.

Select the alternative which includes all the correct statements.

- (A) and (B)
- (A) and (C)
- (C) and (D)
- (B) and (C)

11. From the following drawing of flowers identify the flower which will self pollinate? [NTSE 2011]



12. In flowers, which one of the following conditions will increase chances of self-pollination? [NTSE 2013]
- Pistil is longer than stamens in a flower
 - Stamens are just above the stigma of a pistil in a flower
 - In all flowers of the plant only pistil is present
 - In all flowers of the plant only stamens are present
13. The human embryo gets nutrition from the mother blood with the help of a special organ called [NTSE 2016]
- Zygote
 - Ovary
 - Oviduct
 - Placenta
14. In the flowering plants sexual reproduction involves several events beginning with the bud and ending in a fruit. These event are arranged in four different combinations. Select the combination that has the correct sequence of events. [NTSE 2018]
- Embryo, zygote, gametes, fertilization
 - Gametes, fertilization, zygote, embryo
 - Fertilization, zygote, gametes, embryo
 - Gametes, zygote, embryo, fertilization

Explanations

Subjective Questions

Very Short Answer Type Questions

1. Reproduction is the process of producing individuals of its own kind.
2. Vegetative propagation can be used for growing such plants that have lost the capacity to produce non-viable seeds.
3. Reproduction helps in the growth of its population.
4. Jasmine: Simple layering
Rose: Stem cutting
5. Fragmentation. Asexual
6. Its DNA first doubles up followed by its equal and accurate division between two daughter cells.
7. Copper-T prevents implantation in the uterus thus prevents pregnancy.
8. The two functions of ovary are:
 - ☞ Produce the egg cells
 - ☞ Secretes estrogen hormone for development of sexual characteristics at puberty
9. The embryo gets nourishment from the mother's blood through placenta.
10. Pollen grains contain male gametes while ovules contains female gametes in plants.
11. Unisexual flower contains only one type of sex organ, either pistil or stamen, hence they are either male or female flower. For example: papaya and watermelon. Bisexual flower contains both pistil and stamens. For example: Marigold and mustard.
12. Cutting and grafting are the two methods of vegetative propagation.
13. Government has banned prenatal sex determination due to following reasons.
 - ☞ People may get female foetus aborted.
 - ☞ Reckless female foeticide has disturbed male-female ratio in society.
14. Errors in DNA copying (variations).
15. Pollination is a process of transfer of pollen grains from the male part called anther of a flower to the flower's female part called the stigma.

Short Answer Type Questions

1. DNA copying is essential for formation of additional cellular apparatus, so that when DNA copies separate, each cell gets its own cellular apparatus.

The process of DNA copying results in variations. As a result, the DNA copies generated will be similar, but may not be identical to the original parent copy.
2. Variations are caused by:
 - ☞ Change in the genetic material, i.e., DNA, at the time of DNA copying.
 - ☞ Environmental factors such as., light, temperature, wind and water supply, etc.
 - ☞ Mutations lead to change in sequence of DNA
3. (a) In many simple multi-cellular organisms, reproduction occurs by formation of spores. Spore detaches from the parent and give rise, directly or indirectly, to a new individual.
(b) Many fully differentiated organisms have the ability to give rise to new individual organisms from the body parts. They cut into any number of pieces and each piece grows into a complete organism.
(c) Multiple fission is a type of fission in which many daughter cells are formed from a single parent.
4. (a) Uterus wall prepares itself, becomes thicker due to development of blood vessels and glands in it to nourish the growing embryo and placenta develops from the side of foetus so that it can derive nutrition from mother's blood and pass the waste substances to mother's blood.
(b) If the egg is not fertilized, then uterine lining slowly breaks and menstruation occurs, i.e., blood and mucous comes out through the vagina.
5. Vegetative propagation is practiced for growing some types of plants because of following advantages:
 - ☞ It helps to introduce plants in new areas where seed germination fails to produce mature plants due to changes in environmental factors and the soil.
 - ☞ Plants raised by vegetative propagation can bear flowers and fruits earlier than those produced from seeds.

6. Eggs always contain same type of sex chromosomes X. Sperms contain either X or Y sex chromosomes. Thus, sperm containing X chromosome when combines with X chromosome of egg results in a female child. Whereas sperm containing Y chromosome when combines with X chromosome of egg results in a male child
7. Surgically, pregnancy can be prevented by adopting two methods:
 - ☞ Vasectomy: When vas deferens in males are blocked surgically, sperm transfer will be prevented.
 - ☞ Tubectomy: When fallopian tubes are removed or tied, eggs will not be able to reach the uterus.
8. Leaves of *Bryophyllum* bears adventitious buds in the notches along the leaf margin. When the buds fall on the soil, they develop into new plants under favourable conditions
9. After fertilization,
 - a. Ovum forms zygote
 - b. Ovary forms fruit
 - c. Ovule forms seed
 - d. Sepals and petals shrinks and fall off
10. We need to adopt contraceptive measures due to following reasons:
 - ☞ To prevent unwanted pregnancies.
 - ☞ To prevent sexually transmitted diseases.
 - ☞ Spacing between children.
 - ☞ For sound health of a mother.
11. DNA doubling is always followed by cell division (meiosis). Due to this, gametes contain half the content of DNA and single set of chromosomes. These haploid gametes fuse to form diploid zygote on fertilization. Thus the characteristic number of chromosome and the normal DNA content for a cell is regained.
12.
 - a. Wind act as a pollinating agent because pollen grains are very light and wind can carry them away. The wind carries away the pollens from the anther and transfers them on the stigma of same or different flowers and hence help in pollination.
 - b. Variations forms the basis of evolution. It help the species to survive in changed or adverse environmental conditions. Thus, variation is essential and beneficial to a species.

c. Condoms are mechanical barriers which do not allow the sperms to pass into genital tract of the female. Therefore, pregnancy can be prevented.

13. Placenta is a specialized tissue embedded in the uterine wall. It contains villi on the embryo's side of the tissue and blood spaces on the mother's side.

Function:

- ☞ Helps in passing of nutrients from mother to foetus.
- ☞ Enables exchange of oxygen and carbon dioxide gases.
- ☞ Passing of waste materials from embryo to the mother

Long Answer Type Questions

1. Female reproductive system consists of ovaries, fallopian tubes, uterus and vagina.
 - ☞ Ovaries: These are located inside the abdominal cavity, near the kidney. It performs two functions:
 - Produce female germ - cells (eggs).
 - Secrete estrogen hormone which stimulate the development of secondary sexual characteristics at puberty.
 - ☞ Fallopian tubes carry the egg from ovary to the womb; it is the site of fertilization, egg gets fertilized in the oviducts only if it meets a sperm.
 - ☞ Uterus is a elastic bag-like structure. The embryo is implanted in the lining of uterus where they continue to grow & develop or gans to become foetus.
 - ☞ Vagina (Birth Canal) receives the sperms as well as child is borne through it.
2.
 - a. Zygote is formed by the fusion of male and female gamete.
 - b. Ovulation releases mature ovum from the ovary. It happens once during a menstrual cycle that is for roughly 28/29 days.
 - c. STDs caused by bacterial infection are gonorrhoea and syphilis.
 - e. Prenatal sex determination is misused and it may be the reason for female foeticide. Therefore, it is prohibited.
3. There are many plants in which parts like the root, stem and leaves develop into new plants under appropriate conditions. This is called as vegetative propagation. Examples of vegetative propagation:

Multiple Choice Questions

Level-I

- ☞ Adventitious buds: In *Bryophyllum*, adventitious buds grow in the notches along the leaf margin, which when fall on the soil, develop into new plants.
 - ☞ Cutting: A piece of stem, root, leaf or even a bulb scale is placed partly under moist soil which grows into a new plant, e.g., rose.
 - ☞ Layering: A part of the stem is pulled out and buried in the soil. The layered stem grows into a new plant, e.g., apple.
 - ☞ Grafting: In grafting, two parts from two different plants are taken and joined together so that they can unite and grow as a new plant, e.g., sugarcane.
4. a. A - pollen grain; B - stigma; C - Pollen tube, D - Egg cell.
- b. Pollination is defined as the transfer of pollen grains from anther to the stigma of a flower.
 Significance of pollination - Process of pollination leads to fertilization as it brings the male and female gametes together for fusion. This causes production of fruits and seeds that will created more plants.
- c. After a pollen falls on a suitable stigma, the pollen tube grows out of the pollen grain and travels through the style to reach the ovule in the ovary.
 Here the male germ cell (carried by the pollen tube) fuses with the female germ cell to form a zygote. After fertilization takes place, each ovule develops into a seed and the ovary develops into a fruit.
5. a. (A) *Bryophyllum* - Vegetative propagation.
 (B) *Plasmodium* - Multiple fission.
- b. Spores are covered with thick walls that protect them from adverse and unfavourable conditions until they come into contact with a moist surface.
- c. *Hydra* can reproduce by budding and regeneration.
 Budding : A bud develops as an outgrowth due to repeated cell division at a specific site, these buds develop into tiny individuals, mature and detach from the parent to become new independent individuals.
 Regeneration: In simple animals like *Hydra* and *Planaria*, specialized cells divide to form large number of cells and undergo changes to become various cell types and tissues. These changes take place in an organised sequence.

1. (b) Germination is a process occurring in plants in which the embryo develops into a seedling under appropriate condition.
2. (a) *Amoeba* reproduces asexually by the process of binary fission. In this process, the parent organism divides into two halves, each half forming an independent daughter organism.
3. (d) Variations are not responsible for maintenance of body design features. These are maintained by consistency of DNA copying during reproduction.
4. (d) *Bryophyllum* reproduces by the buds present in their notches along the leaf margin which falls on the soil and develops into new plants.
5. (d) Dioecious (has either male or female sex organ) or hermaphroditic species (has both male and female sexes) undergo sexual reproduction. Budding and fission are types of asexual reproduction.
6. (b) The testes are the site of production of male gametes called sperms. Testes is situated in the sac-like structure called the scrotum because the sperm formation require a lower temperature than the normal body temperature. Thus, it helps in sperms formation.
7. (c) Condom acts as a physical barrier during intercourse and protects a person from acquiring any sexually transmitted disease.
8. (b) The diseases which are spread by sexual contact with an infected person are called Sexually Transmitted Diseases or STD, e.g., gonorrhoea, syphilis and AIDS. Hepatitis is not STD but a water-borne viral disease which affects liver.
9. (a) Tubectomy is a surgical method of contraception in women. It is a permanent method that blocks the fallopian tubes, also known as oviducts, thereby preventing the egg released by the ovary from reaching the uterus.
10. (b) The number of chromosomes in parents and offsprings of a particular species remains constant due to the halving of chromosomes during gamete formation by the process of meiosis
11. (a) Regeneration is the ability to give rise to new individual organisms from their body parts.
12. (a) In animals that reproduce through external fertilization, the embryo development takes place within the egg but outside the female body. After the complete growth of an embryo, the eggs will hatch.
 F ~ Salmon, fish.

13. (ac) *Amoeba*, *Spirogyra* and yeast undergoes asexual reproduction. It is one of the type of reproduction in which progeny is obtained from the single parent.
14. (b) In *Rhizopus*, tubular thread-like structures bearing sporangia at their tips are called hyphae.
15. (c) Along the path of vas deferens, glands like the prostate and the seminal vesicles add their secretions so that the transport of sperms become easier and this fluid also provides nutrition.
16. (d) The seed contains the future plant called as an embryo which develops into seedling under appropriate conditions.
17. (b) The period during adolescence when the reproductive tissues begin to mature is called puberty.
18. (d) During binary fission, the genetic material or nucleus is first divided into two daughter nuclei, this is known as karyokinesis. The karyokinesis is followed by cytokinesis which involves the division of the cytoplasm of the cell, into two daughter cells in such a way that each daughter cell will get separate nuclei.
19. (b) Entomophily type of pollination takes place through the agency of insects. The entomophilous flowers are large, brightly coloured and fragrant to attract the insects. Their pollen grains are spiny or sticky.
20. (a) Earthworm reproduces by sexual reproduction
21. (c) Stigma, ovule, embryo sac and placenta are associated with the gynoecium.
22. (b) The outermost whorl of a flower which is composed of sepals is called calyx.
23. (b) The primary function of the ovaries is to nurture and prepare ovum for the process of ovulation.
24. (c) Stock is the portion on which grafting is done and it provides the roots.
25. (c) Ovary, uterus and fallopian tube are parts of the female reproductive system in human beings. While, testis is a part of the male reproductive system.
26. (c) In a flower, the parts that produce male and female gametes are anther and ovary respectively.
27. (b) Vegetative reproduction is a type of asexual reproduction in which a new plant grows from a part of the parent plant such as leaf or a specialized reproductive structure.
28. (c) The fertilized egg or zygote get implanted in the uterus after the process of fertilization.
29. (c) Vegetatively reproduced organisms show genetic similarity in offsprings. This genetic similarity is because the offsprings are produced from a single parent.

30. (a) In *Bryophyllum*, adventitious buds are formed on the leaf notches adventitious which grow and give rise to new plants.

Level-II

31. (d) The seeds does not require light during germination in the soil. However, suitable temperature and water both are required for providing favourable conditions for seed to germinate by activating the enzymes.
32. (b) Seeds which are light in weight and contain hairs can be easily blown away by the wind to a greater distance. Thus, plants disperse their population to a far extent. While, brightly colored, sweet and juicy fruit with hard seeds cannot be dispersed by wind thus it require animals as dispersal agents. Animals eat the fruits and throw away the seeds.
33. (a) Bartholin's glands are paired glands located one on each side of the vaginal opening. These glands secrete viscous fluid that provides lubrication.
34. (b) Offsprings formed by asexual method have greater similarity because only one parent is involved thus no gametes are formed.
35. (c) Characters that are transmitted from parents to offspring shows both similarities and variation. They show similarity because half of the chromosome comes from father and half from the mother. They show variation because of genetic recombination, mutation and natural selection.
36. (d) In *Planaria*, each body piece can develop into a new organism through regeneration.
37. (a) The fusion of male gamete with female gamete to form a zygote during sexual reproduction is called fertilisation. Fission, tissue culture (micropropagation) and fragmentation are the asexual modes of reproduction.
38. (b) The unisexual flowers contains either stamens or carpels. Since only one reproductive organ is present in them, they depend on cross pollination to form zygote after fertilisation. Since for fertilization both stamen and carpels are required but in unisexual flowers only one of them is present so they cannot produce fruits.
39. (c) Cracking of voice in males is associated with the male hormone testosterone, which is produced during adolescence.
40. (a) Sexual reproduction is the process in which two individuals of same species produces two different gametes, i.e., one male gamete and another female gamete. These gametes undergoes fusion that

results in the formation of zygote which produces new offspring. Because of the contribution of two parents of the same species, offspring produce more variations.

41. (d) Flowers can be unisexual or bisexual. They contain sexual reproductive organs, stamens and pistil. A fruit is formed after fertilisation.
42. (c) In sexual reproduction, the offspring receives characteristics from both the parents.
43. (b) Menarche, the first occurrence of menstruation, marks the beginning of menstrual cycling and is considered the start of a woman's reproductive life.
44. (b) Banana reproduces by vegetative propagation. *Amoeba* reproduces by binary fission and yeast reproduces by budding.
45. (d) In males, the reduced secretion of testosterone or decrease in Leydig cells may leads to reduced production of sperms. But a healthy male can produce sperm throughout his lifetime
46. (c) Testes are male gonads or primary sex organs which produce sperms and secrete the male sex hormone testosterone.
47. (c) Development of placenta and secretion of estrogen are related to female reproductive system, hence are not the function of testes (male reproductive organ) at puberty.
48. (b) In a flower, the anthers produce the male gametes.
49. (a) Flowering plants show double fertilization to produce endosperm that contains food
50. (c) Reproductive health in society can be improved by creating awareness among people about various reproduction related aspects and providing facilities like medical assistance and support for building up a reproductively healthy society. It can also be improved by giving more opportunities to female child.

Assertion & Reason Type Questions

1. (c) Vasectomy is a surgical method of birth control in which small portion of the vas deferens is cut and tied up. This prevents the sperms from reaching the ovum during copulation. A small portion of oviduct is cut or tied properly in tubectomy.
2. (d) HIV-AIDS is viral disease that is transmitted sexually. It spreads through sharing needles, sexual intercourse or blood-contaminated body fluids.
3. (a) Asexual reproduction involves a single individual, which give rise to new individual that is

genetically identical to parents. Because only mitotic divisions are involved in asexual reproduction and the chromosome number remains the same.

4. (a) DNA copying is necessary during reproduction because it leads to the transmission of characters from parents to offsprings and brings about variation.
5. (c) Double fertilization is a characteristic feature of flowering plants. In this process, out of the two sperm nuclei, one sperm nucleus fuses with the egg nucleus to form an embryo. This process is called syngamy. Another male gametes fuses with the secondary nucleus to form an endosperm and the process is called triple fusion. Because two kinds of fusion, syngamy and triple fusion, occurs, the process is known as double fertilisation.

Case-Based Type Questions

Case-Based-I

1. (d) Organism X reproduces by binary fission and organism Y reproduces by budding. *Amoeba*, *Paramecium* and *Leishmania* are the examples of organisms which reproduce by binary fission while Yeast, *Hydra* and *Sycon* are the examples of budding type of reproduction.
2. (c) Both organism X and Y are asexually reproducing organisms.
3. (c) The mode of reproduction in organisms X and Y is binary fission and budding respectively.
4. (d) *Plasmodium* reproduces by multiple fission whereas organism X reproduces by binary fission. Binary fission is generally seen in unicellular organisms such as Amoeba and Paramecium.

Case-Based-II

1. (a) *Spirogyra* is a green-coloured algae commonly found in stagnant fresh water habitats such as ponds, lakes, etc.
2. (b) The process of asexual reproduction in *Spirogyra* is known as fragmentation. In this, *Spirogyra* breaks up into smaller pieces upon maturation. These pieces or fragments grow into new individuals.
3. (b) Fragmentation can be observed in many organisms such as cyanobacteria, fungi, many plants, and also in animals including flatworms, sponges, some annelid worms and sea stars.
4. (b) Fragmentation is an asexual mode of reproduction. Only multicellular organisms having simple body organization can undergo fragmentation.

Case-Based-III

1. (d) Papaya and mustard are both monoecious plants. Mustard and *Hibiscus* contains both stamens and pistil therefore it is bisexual. Papaya contains either stamens or pistil therefore it is unisexual.
2. (d) All the given statements are incorrect.
3. (b) Plant X is a bisexual plant. Removal of anthers or killing the pollen of a flower without the female reproductive organ is known as emasculation. In bisexual flowers, emasculation is essential to prevent of self-pollination.
4. (a) The male and female reproductive part of the flower is stamen and pistil respectively.

Case-Based-IV

1. (b) The puberty age in human females is 11-12 years.
2. (b) The scrotum helps in maintaining the low temperature of the testes (2–2.5°C lower than the normal internal body temperature) necessary for spermatogenesis.
3. (d) The testis in the males and the ovaries in the female produce gametes, i.e., sperms and ovum.
4. (a) Fallopian tube is an accessory duct of females.

Olympiad & NTSE Type Questions

1. (b) Potato, ginger, onion and sugarcane are the examples of vegetative reproduction
2. (d) Pollination is the transfer of pollen grains from an anther to a stigma. Pollen can be transferred by an animal or by the wind. Fertilization and germination are two events of sexual reproduction in plants. P represents fertilization. It is the fusion of gametes, which forms the zygote. Q represent germination. It is the development of a plant from seed or spore under favorable conditions.
3. (c) The possibilities of variations are greatest in species which are reproduced by sexual means and not by asexual means. Fission, regeneration and budding are the methods of asexual reproduction and they do not involve in exchange of DNA.
4. (d) All the given statements are correct.

5. (b) All the statements above are correct except (b). Menstrual blood normally does not clots.
6. (b) The four phases of the menstrual cycle are menstrual phase, the follicular phase, ovulation and the luteal (secretory) phase.
7. (d) Amniocentesis is used to diagnose genetic abnormalities and foetal infections. Since cleft palate is caused by both genetic and environmental factors thus it can not be detected using amniocentesis.
8. (c) Ovulation is the third phase of the ovarian cycle in which a mature egg is released from the ovarian follicles into the oviduct. When the egg matures, estrogen stimulates the production of a large amount of LH. This process is known as the LH surge, starts around day 13 - 14 of the average cycle and may last 48 hours.
9. (c) Grafting in monocot plants is not possible because they lack cambium.
10. (a) Seeds dispersal by wind should be light in weight so that their buoyancy allow them to float on air for long distances. It is called anemochory (wind pollination) where seeds are especially adapted for wind dispersal. Example: Dandelion, maple, drumstick, etc. Some seeds have spine like structures which get stuck to the fur of animals and thus get spread to different places. Examples; Beggar tick, *Xanthium*, *Urena*, etc. Some seeds are swallowed by birds and animals along with fruits. These seeds get dispersed with bird or animal droppings.
11. (d) In self-pollination, pollen is transferred from the anther to the stigma of the same flower. Such flowers are hermaphrodites, i.e., have both sexes.
12. (b) The chances of self-pollination increases when the stamens are present close to the stigma of the pistil in the flower.
 This enhances the possibilities that the pollen grains produced by the anthers are dusted upon the stigma which can lead to fertilization.
13. (d) Placenta is a connecting link between mother and developing foetus, which provides nutrients and removes the waste from baby's blood.
14. (b) In flowering plants, the gametes produced fuse during fertilization to form the zygote. The zygote develops to form the embryo. So, the order of the events in sexual reproduction is:
 Gametes → Fertilization → Zygote → Embryo.