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7. What are ligaments and tendons? What function do they perform?
8. State five functions of bones.

**C. Write detailed answers to the following questions:**

1. Describe the role of the skeleton and muscles in locomotion.
2. Differentiate between the axial and appendicular skeleton and describe the major components of both.
3. Discuss different types of joints and their role.
4. Write the causes and treatments of arthritis and osteoporosis.

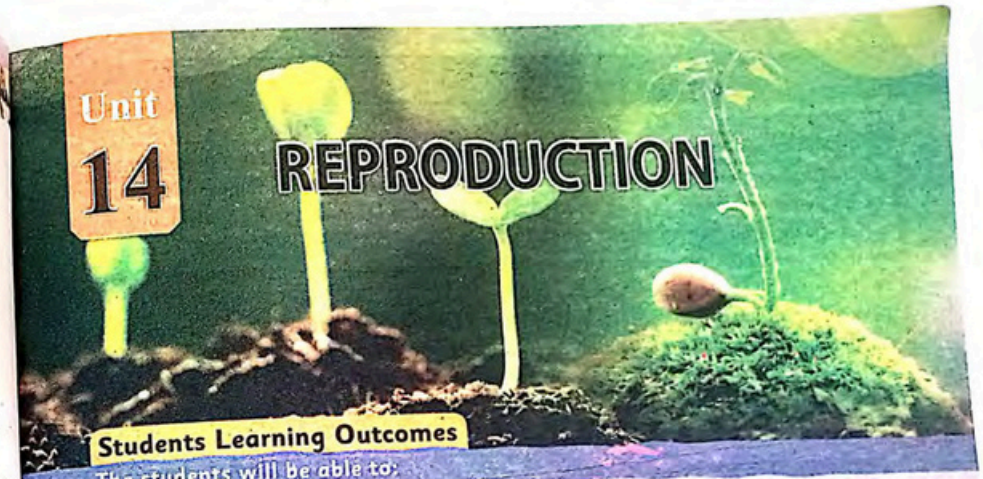
**Activities**

1. Identify and draw labelled diagrams of different bones of the axial and appendicular skeleton from real specimen models or charts.
2. Describe the movement of various human joints through observation of models.
3. Describe the movement of biceps and triceps through presentation of the movement of the elbow.

**Science, Technology and Society**

1. Relate your skeleton and its functioning with daily life.
2. Relate the principle of leverage to the action of the elbow joint.
3. State the principles of arthroplasty for the replacement of joints.





# Unit 14 REPRODUCTION

**Students Learning Outcomes**

The students will be able to:

- Define reproduction and describe its importance.
- Describe different types of asexual reproduction i.e. binary fission, budding, spore formation and vegetative propagation.
- Distinguish between vegetative propagation and artificial propagation.
- Explain vegetative propagation in plants (through stem, suckers and leaves).
- Describe the two methods of artificial vegetative propagation (stem cuttings and grafting).
- Rationalise how parthenogenesis is a type of asexual reproduction.
- Define cloning.
- Describe sexual reproduction in plants by explaining the life cycle of a flowering plant.
- Describe the adaptations in the structure of wind-pollinated and insect-pollinated flowers.
- Describe the structure of a seed.
- Distinguish between epigeal and hypogeal germination.
- Describe the conditions necessary for germination of seeds.
- State the contributions of Theophrastus in the discovery of sex in plants.
- Outline the binary fission, multiple fission, budding and fragmentation as asexual methods of reproduction in animals.
- Define fertilization and differentiate between external and internal fertilization.
- Describe different organs of the male and female reproductive systems of a rabbit.
- Describe the processes of gametogenesis in rabbit.
- Rationalise the need for population planning.
- Explain AIDS as an example of sexually transmitted diseases.
- State the role of National AIDS Control Program and different NGOs in educating people with reference to AIDS.

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## Introduction

Reproduction is one of the basic properties of all living organisms. It is a process by which living organisms produce organisms of their own kind. This in turn ensures the continuity of their kind. Plants and animals have different mechanisms and systems for reproduction. Whatever the mode and mechanism of reproduction, it ultimately results in the transmission of genetic material from one generation to the next. This ensures that the advantageous characteristics are transmitted to the next generation. In this chapter we will study various aspects of reproduction in plants and animals.

**Tidbit**

Although reproduction is a fundamental characteristic of living things, it is not an essential life process. An individual can live without reproduction but a species cannot survive without reproduction.

## 14.1 Types of Reproduction

Generally reproduction can be divided into two main types which are as follows:

a. Asexual reproduction b. Sexual reproduction

**Asexual reproduction** is the type of reproduction in which the offspring are produced without involving the fusion of gametes (sex cells) from two parents. Usually in this type of reproduction the resulting offsprings are similar to the parent. This type of reproduction does not create genetic variations and the offsprings are clones.

**Sexual reproduction** is the type of reproduction in which gametes of the male and female parents fuse to produce offsprings. The offsprings produced as a result of sexual reproduction have a blend of characteristics from both the parents.

## 14.2 Asexual Reproduction in Unicellular Organisms and Plants

As discussed earlier, asexual reproduction is the production of one or more offsprings from a single parent. It does not involve the fusion of gametes. This type of reproduction is accomplished by different mechanisms in different organisms. The mechanisms of asexual reproduction in different groups of organisms are given below:

### a. Binary Fission

In binary fission the body of the parent organism divides into two daughter organisms. Binary fission is common in Euglena, Amoeba, Chlamydomonas and bacteria.

In **bacteria**, binary fission takes place during favourable conditions. During this process, the DNA molecule of bacterium duplicates (replicates) and forms two DNA molecules. The new DNA molecules move towards the opposite side of cell. At the same time, the cell wall and cell membrane constrict from the two sides and meet in the centre. It separates the cell into two daughter bacterial cells. These daughter cells then start their independent life, grow and divide again.




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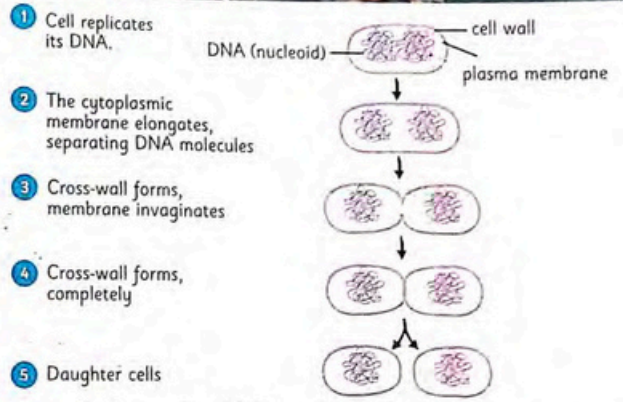


Fig.14.1 Binary fission in Bacteria

Many **protists** (unicellular eukaryotes e.g. Amoeba, Euglena etc.) also reproduce asexually by binary fission. In protists, the nucleus of the parent organism divides into two. This is followed by the division of cytoplasm. So, two daughter cells of almost equal size are formed.

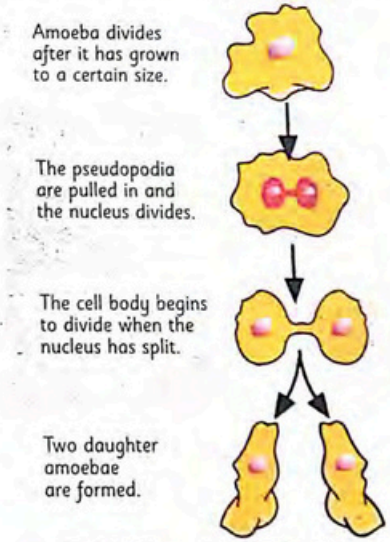


Fig.14.2 Binary fission in Amoeba

**Activities**

Draw the different stages of binary fission in Amoeba after observing them on slides charts.

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### b. Multiple Fission

Some unicellular organisms like Amoeba, Plasmodium etc. reproduce asexually through the process of multiple fission. It occurs during unfavourable conditions. In this type of reproduction, the unicellular organism develops a protective covering called a cyst over the cell. The nucleus of the cell divides repeatedly and produces many daughter nuclei. Cell membrane is formed around each daughter nucleus. In this way, many daughter cells are produced within the cyst. The cyst breaks and many small offsprings are liberated.

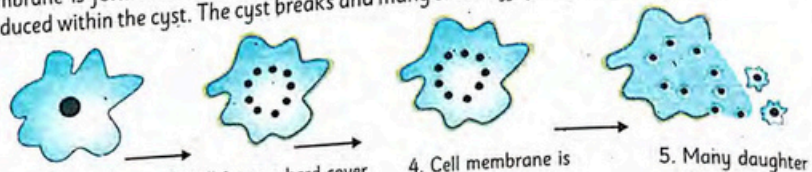


Fig.14.3 Multiple Fission in Amoeba

### c. Budding

During budding, an outgrowth arises from the body of the parent. This outgrowth is called a bud. It continues to grow and develops into the offsprings. For example, yeast a unicellular fungus reproduces by budding.

In yeast, a bud grows on the side of the cell. Then the nucleus divides into two. One of the daughter nuclei enters into the bud. The bud grows in size. It may separate from the parent cell or may remain attached to it.

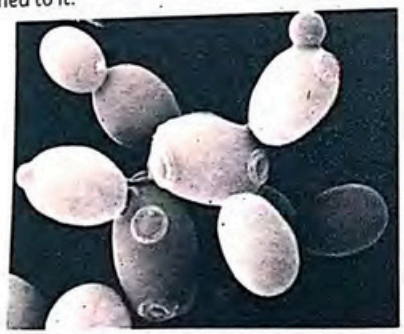

Fig.14.4 Budding in Yeast

### d. Spore formation

Many fungi like Rhizopus (bread mould) reproduce by making spores. Spores are thick-walled asexually reproduced cells. Spores are produced in thick-walled sacs called sporangia (Singular: sporangium), which are located at the tips of erect branches of mould. The spores are small, light and dry. When spores mature, the sporangia bursts and spores are dispersed. Spore dispersal occurs in a two-step process. In the first step, the spore is discharged or released. In the second step, it is dispersed away from the parent.



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Spores are resistant to adverse environmental conditions due to their thick walls. When favourable conditions are available, the spores germinate to produce new fungus. The most important external factors needed for germination include the optimum temperature, moisture, oxygen and light.

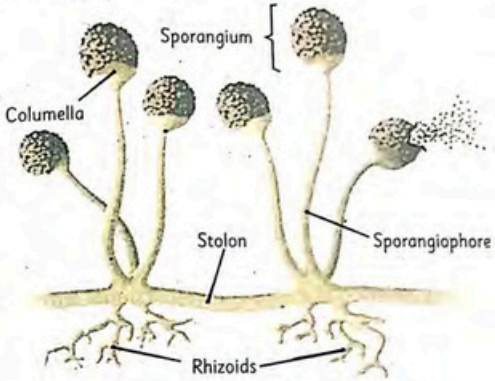


Fig.14.5 Spores formation in Rhizopus

**Tidbit**

Some bacteria can also form spores inside their cells. These are called endospores. These are formed when bacteria face harsh conditions. When favourable conditions return, the endospore gives rise to a new bacterium.

### e. Vegetative Propagation

Vegetative reproduction is a type of asexual reproduction in which a plant produces a new generation by using its vegetative parts i.e. stems, leaves and roots.

#### i. Vegetative Propagation through Leaves

In plants such as the Bryophyllum, the leaves have buds at their margins. When a leaf falls on the ground, the buds form tiny shoots. When the shoots break off from the original leaf, they fall on the ground and develop roots.

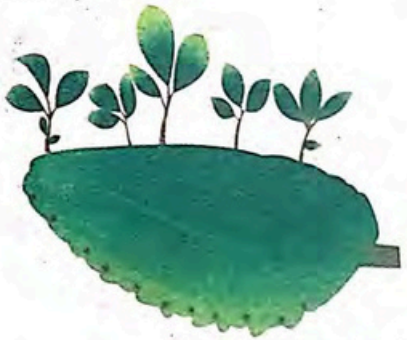

Fig.14.6 Vegetative Propagation through the leaf in the Bryophyllum

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### ii. Vegetative Propagation through stem

Many plants use their specialised stems to develop a new plant. For example;

- The strawberry plant reproduces by using its above ground horizontal stem called stolon. The stolon is a horizontal, above the ground stem. It produces leaves and roots at its nodes, which develop into plantlets. Thus a new plantlet can grow from each node. If placed in the soil under the suitable conditions, these plantlets grow into strawberry plants.
- Ferns and ginger reproduce from the rhizome. Rhizomes are horizontal underground plant stems capable of producing the shoot and root systems of a new plants, under suitable conditions.
- Tulips, onions and lilies reproduce through bulbs. Bulbs are underground buds that have fleshy leaves extending from them. Bulbs are food storage units for future developing plants. Bulbs contain several buds near the node where leaves are produced. The new buds can eventually develop into new plants. Bulbs divide naturally to produce new plants.
- Colocasia and garlic reproduce through corms. A corm resembles a bulb but does not have fleshy leaves. Almost all of the corms posses a few brown non-functional leaves on the outside. Corms do not store significant amounts of starch. Branches of the corm stem produce new, miniature corms known as cormels. Corms can be dug up and used to propagate or redistribute the plant.
- The potato plant reproduces by an underground, swollen, fleshy stem called the tuber. The tubers have leaves, which are much smaller than the leaves on other parts of the stem. Above each leaf on the tuber is a well-developed axillary bud, commonly called an eye. Eyes can grow into new potato plants.

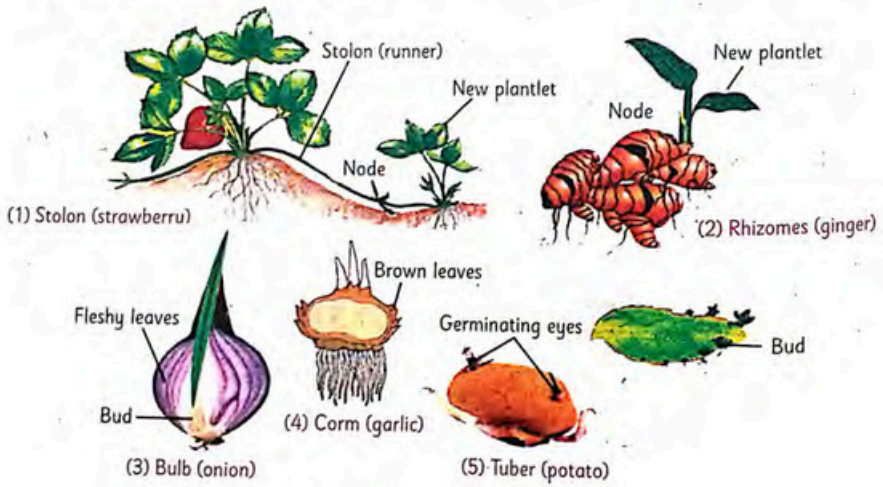


Fig.14.7 Vegetative propagation through the stem



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### iii. Vegetative Propagation through Root

Red raspberries and many other shrubs can reproduce through their specialised roots. The root can give rise to a shoot, which begins to grow. The new shoots are called root sprouts or "suckers". If these get detached from the original plant they can grow into independent plants.

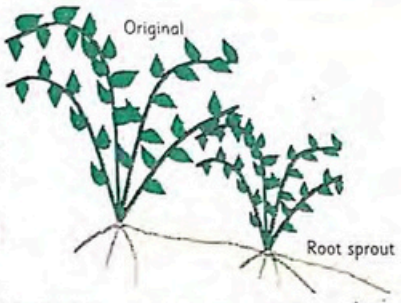


Fig.14.8 Vegetative propagation through the root

### Artificial Vegetative Propagation of Plants

Humans have developed methods of using vegetative parts of plants to produce more plants. These methods are called artificial vegetative propagation of plants. The common methods of artificial vegetative propagation are cutting and grafting.

### i. Cutting

In some plants, the stem or root is able to make a whole new plant. We can cut such pieces of stems and roots from a plant and use them to grow new plants. Such pieces of stem or root are called cuttings. It is a convenient and inexpensive method of propagation. Stem cuttings are used for the propagation of plants such as grape vine, rose and chrysanthemum etc. Similarly, plants like sweet potato and blackberries are grown by using root cuttings.

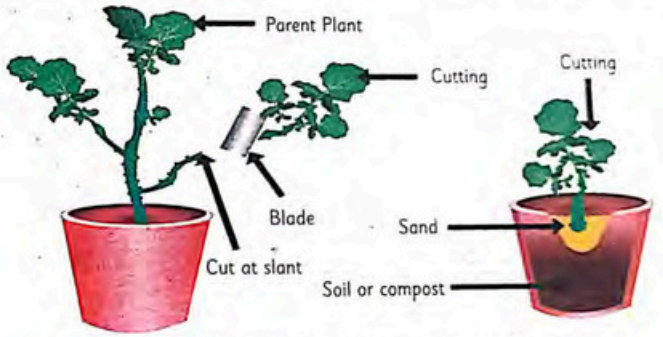


Fig.14.9 Artificial Vegetative propagation through Stem cutting

### ii. Grafting

Grafting is a method used to get better quality and quantity of fruits. In grafting, the branch of a desired variety of plant is attached (grafted) on to a stem of an ordinary plant. The grafted branch grows and bears fruits of better quality. This method is used to propagate almost all fruit trees (e.g. almond, plum, cherries etc.), and many ornamental trees.

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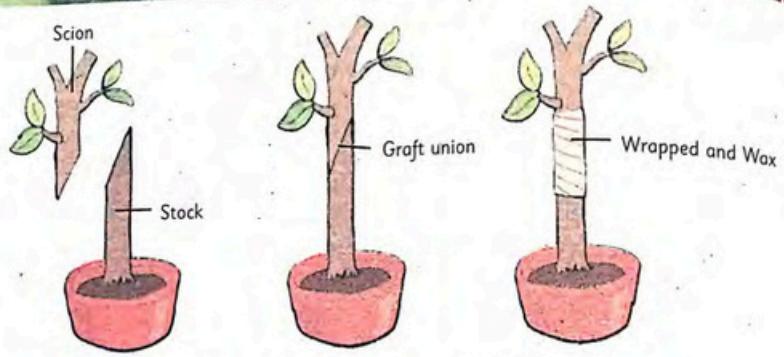


Fig.14.10 Artificial vegetative propagation through grafting

### iii. Cloning

Cloning is a technique of asexual reproduction in which a population of genetically identical individuals is produced from a single parent, using tissues or cells of the parent.

Cloning is used for making identical copies of useful plants. This is very helpful in horticulture where we want to preserve the quality of the yield. Cloning also helps us to increase agricultural output.

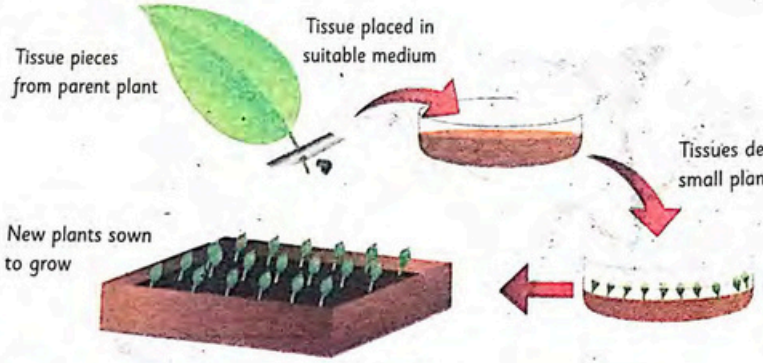


Fig.14.11 Cloning of a plant

**Activities**

1. Identify the different stages of budding in the prepared slides/charts of yeast and draw diagrams.
2. Examine the specimens of onion, corn, ginger and potato and write the modes of their reproduction.



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## 14.3 Sexual Reproduction in Plants

In previous grades you have learnt that flowers are the reproductive structures of plants. During sexual reproduction, the male and female gametes fuse with each other and form a zygote. The zygote then develops into an offspring.

### 14.3.1 Parts of a Flower

A flower is made-up of specialised leaves, which are present on the swollen tip called the **receptacle.** Flower parts are in the form of four concentric whorls, or rings. **Sepals** make the outermost whorl **(Calyx)**. Sepals are usually green and they protect the inner parts of a developing flower before it opens. **Petals** make the next whorl **(Corolla)**. Most flowers have coloured petals.

The third whorl **(androecium)** contains the male reproductive structures called **stamens**. Each stamen consists of an anther and a filament. The **Anther** contains pollen sacs **(microsporangia)**, which produce **microspores**. The stalk-like **filament** supports the anther.

The innermost whorl **(gynoecium)** contains the female reproductive structures, which are called **carpels**. The enlarged base of a carpel is called the **ovary,** while, the **style** is stalk-like. Its tip is called the **stigma.** Inside the ovary, there are one or many **ovules (megasporangia),** which produce **megaspores**.

**For Your Information**

In bisexual flowers, both stamen and carpel are present in the same flower. In unisexual flowers, stamen and carpels are present in separate flowers.

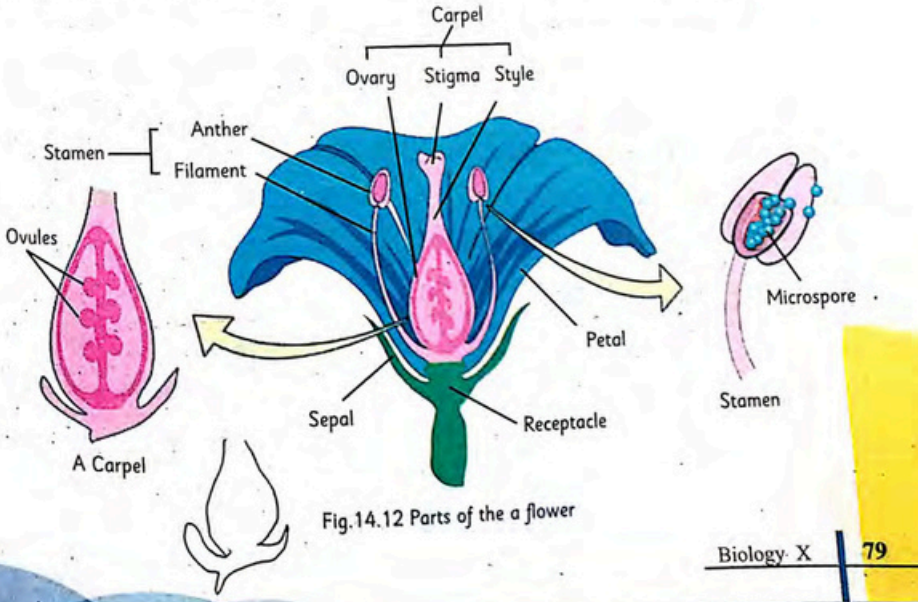


Fig.14.12 Parts of the a flower

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### 14.3.2 Life Cycle of Flowering Plants

The complete body of a flowering plant represents the sporophyte generation of the plant. It completes its life cycle by going through the following stages.

#### Stage 1- Development of Gametophytes

Plants have the kind of lifecycle in which there is alternation of generations (see box). Gametophytes develop within the flowers of the plant. The female gametophyte or embryo sac develops from the megaspore.

The ovule (megasporangium) contains a diploid megaspore mother cell. It undergoes meiosis and produces four haploid megaspores. One haploid megaspore survives and divides by mitosis to make eight haploid nuclei. Two nuclei migrate to the centre and fuse to form a fusion nucleus. One nucleus out of the remaining six forms the egg cell.

The resulting structure, which contains seven cells: the egg, the five non-functional cells, and the fusion nucleus; constitutes the embryo sac.

**For Your Information**

In the life cycle of the major groups of plants, two different stages or generations are involved:

1. **Sporophyte** (spore producing) generation
2. **Gametophyte** (gamete producing) generation.

These two generations alternate with each other i.e. the sporophyte develops into gametophyte and vice versa. This type of life cycle is called alternation of generation.

The sporophyte generation is diploid (2n). It produces haploid (n) spores by meiosis. The spores develop into the haploid gametophyte generation. The gametophyte produces haploid gametes by mitosis. The haploid gametes fuse to form diploid zygote, which develops into the next sporophyte stage.

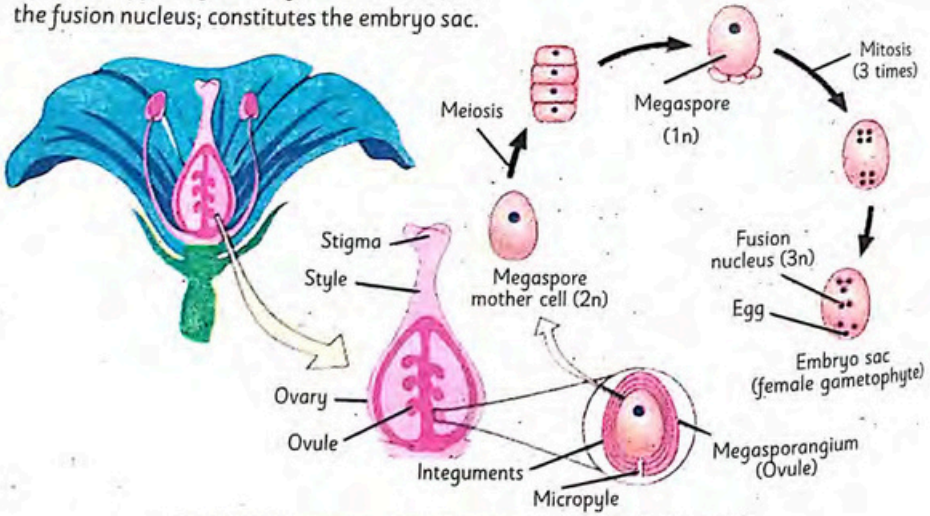


Fig.14.13 Development of the female gametophyte (embryo sac)




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The male gametophyte or **pollen grain** develops from the microspore. An anther contains four pollen sacs (microsporangia), each of which contains many diploid the **microspore mother cells**. Each microspore mother cell undergoes meiosis and produces four haploid **microspores**. A microspore undergoes mitosis. The resulting two-celled structure is a pollen grain, which is the male gametophyte. One cell in the pollen grain is the **tube cell,** which will form the pollen tube. The other cell is the **generative cell**, which will form two sperms.

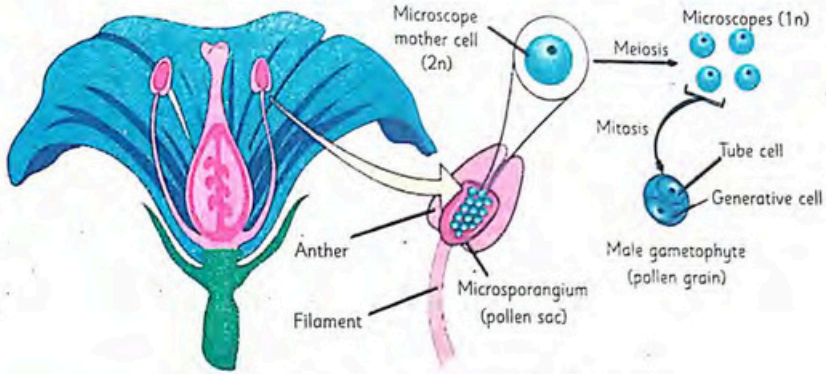


Fig.14.14 Development of the male gametophyte (pollen grain)

#### Stage 2- Pollination

The male gametophytes (pollen grains) contain sperms while the female gametophytes (embryo sacs) contain an egg. For fertilisation of the egg, the pollen grains are transferred from the anther to the stigma of the flower. This is called pollination.

Pollination that involves just one flower, or flowers on the same plant is called self-pollination. In contrast, pollination that involves two flowers, of different plants of the same species is called cross-pollination.

#### Stage 3- Fertilisation

When a pollen grain reaches the stigma, its tube cell forms a pollen tube that grows through the stigma and the style. It reaches the ovary and enters the ovule through a small opening called the micropyle. The generative cell of the pollen grain forms two sperms, which enter the embryo sac to reach the egg.

One sperm fuses with the egg and forms a diploid zygote. The zygote develops into an embryo. The second sperm fuses with the fusion nucleus and produces a triploid (3n) nucleus. This nucleus then develops into a tissue called the endosperm, which provides nourishment to the embryo. This process of the fusion of two sperms (one with the egg and the other with the fusion nucleus) is called double fertilisation. It is a unique characteristic of flowering plants.

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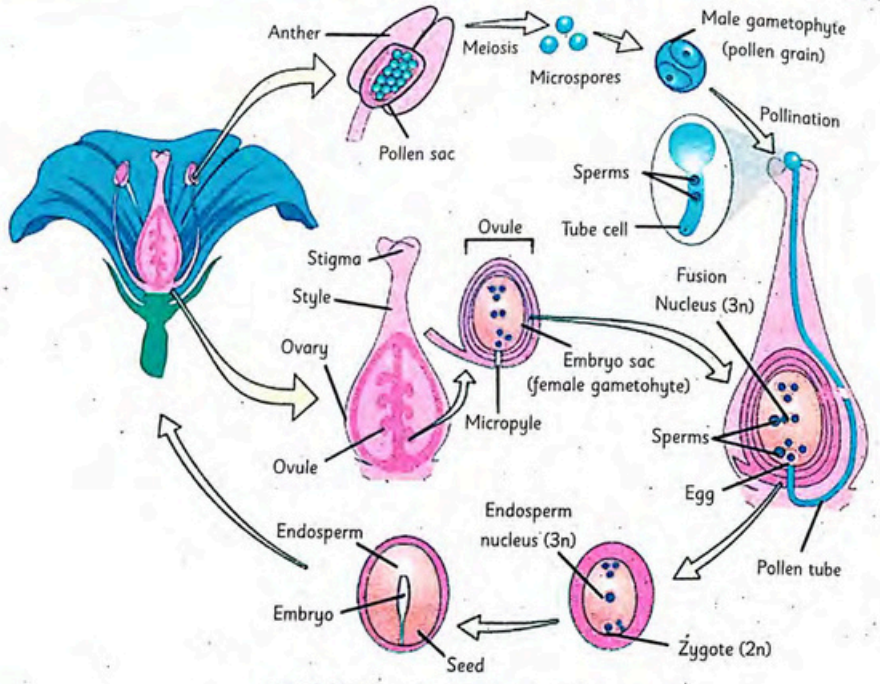


Fig.14.15 Life cycle of a flowering plant

### Stage 4- Seed and Fruit Formation

After fertilisation, the zygote develops into an embryo and the triploid nucleus develops into endosperm tissue. After these developments, the ovule is said to be matured and is now called the seed. The ovary changes into fruit.

**For Your Information**

In some plants, the ovary develops into a fruit without the fertilisation of the egg present in its ovule. So there is no seed in the fruit. This process is known as **parthenocarpy**. It results in seedless fruits e.g. bananas and seedless varieties of grapes.

### Stage 5- Development of Sporophytes

When seeds mature, they are dispersed. If seeds get suitable conditions, their embryos develop into new plants (the sporophytes of the next generation).

## 14.3.3 Adaptations for Insect and Wind Pollination

These two types of pollination require flowers to have unique characters and certain adaptations in order to carry out pollination.




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### Adaptations in Insect Pollinated Flowers

Insect pollinated flowers attract and use insects, bats, birds or other animals to transfer pollen from one flower to the other. Such flowers have the following characteristics:

- Brightly coloured and large petals to attract insects.
- Fragrance, which attracts insects.
- Presence of nectar, a solution of sugars which is a food source for many insects.
- Sticky pollens, which stick to the legs of insects visiting the flowers.
- Stigmas of such flowers are sticky or shaped in a way that facilitates the transfer of pollen grains.

Examples of insect pollinated flowers are Bougainvillea, Rose Sunflower and Orchids.

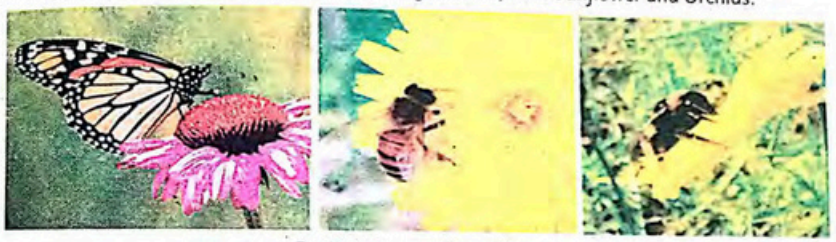

Fig.14.16 Insect-pollinated flowers

### Adaptations in Wind Pollinated Flowers

Wind pollination is the distribution of pollen by the wind. Flowers that are pollinated with the help of the wind have the following characteristics.

- Lack of scent or fragrance and do not produce nectar.
- Pollens are small, smooth and easily removable from the anther.
- Presence of wings on the pollen, which increase buoyancy.
- Feathery stigmas to catch pollen from the wind.
- Large anthers borne on long stalks.
- Produce pollens in large numbers to compensate for excessive losses.

Examples of wind pollinated plants include conifers, grasses, cereals, poplar, oak, walnut etc.

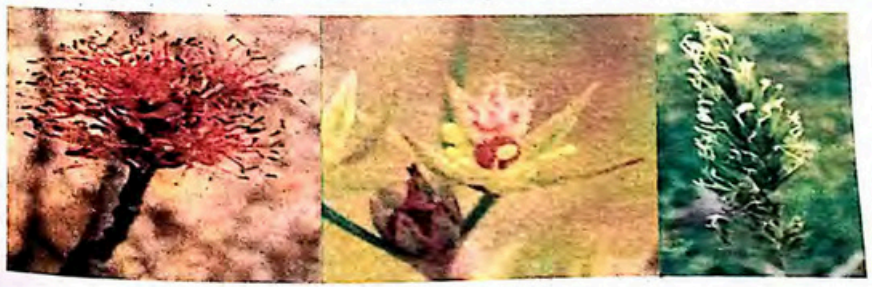

Fig.14.17 Some wind pollinated flowers

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### 14.3.4 Structure of a seed

A seed (mature ovule) is a miniature plant with a protective cover. Typically a seed consists of the following structures.

**For Your Information**

In some seeds (e.g. peanut), the seed coat is very thin. In some seeds (e.g. coconut), it is thick and hard.

**Seed coat:** The outer covering of a seed is called the seed coat or **testa**. It is black or brown in colour and protects the embryo.

**Hilum:** On one end of the seed coat, is a small scar or hilum. It indicates the place of attachment of the seed in the fruit.

**Micropyle:** It is a minute pore near the hilum. The seed absorb, water through the micropyle at the time of germination.

**Embryo:** It is present beneath the seed coat. The embryo consists of the following parts.

- **Cotyledons:** In a monocot seed there is one leaf-like cotyledon. In a dicot seed, there are two large, fleshy cotyledons.
- **Plumule and radicle:** There is a minute bud (plumule) at the upper end of the hypocotyle. It gives rise to the future stem. The lower part of the hypocotyle is called the radicle. It give rise to the future root. The portion between the plumule and the cotyledons is called the **epicotyl**. The portion between the cotyledons and the radicle is called **the hypocotyl**.
- **Endosperm**: This tissue is formed from endosperm nucleus. It stores nutrients. Dicot seeds have no endosperm while monocot seeds have endosperm. In these seeds, the cotyledon absorbs nutrients from the endosperm and transfers them to the embryo.

Observe in the following diagrams: the main parts of the seed in the structure of maize and castor bean seeds.

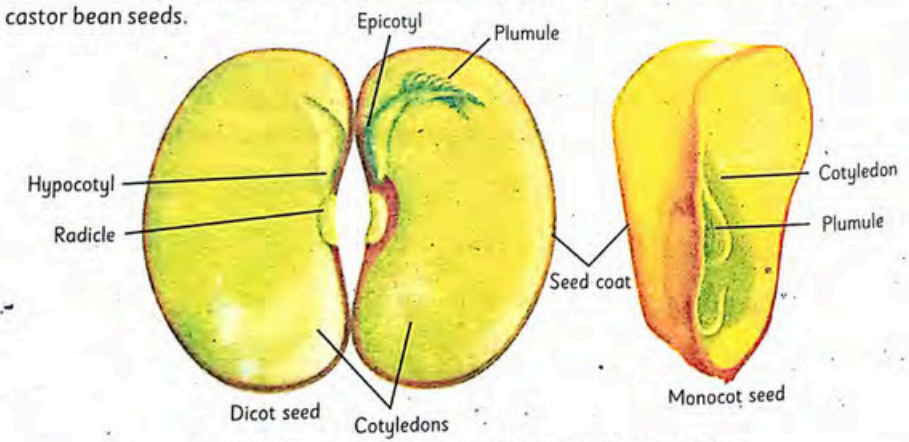


Fig.14.18 Structure of dicot (bean) and monocot (maize) seeds




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### Seed Germination

The development of the embryo of a seed, into a seedling is called seed germination. In the dry seed the embryo is alive but inactive. When it is placed in the soil under suitable conditions, the embryo becomes active and grows into a seedling.

Germination of the seed starts with the absorption of water through the micropyle. This is followed by the emergance of the radicle, which forms the first root. After the radicle breaks the seed coat, the plumule begins to grow to form a shoot.

On the basis of the growth of the plumule there are two types of germination.

**Interesting facts**

Each species of seed has a certain length of viability. Seeds of some maple verities need to germinate within two weeks of being dispersed, or they die. Seeds of Lotus plants are known to be upto 2000 years old and still able to germinate.

### Epigeal and Hypogeal Germination

In epigeal germination, the hypocotyle elongates and it forces cotyledons to come above the ground. The seed coat also emerges from the soil. Seeds of melons, cucumber and beans show epigeal germination.

During hypogeal germination, the epicotyl elongates and the cotyledons remain below the surface of the ground. e.g. maize grain, pea etc.

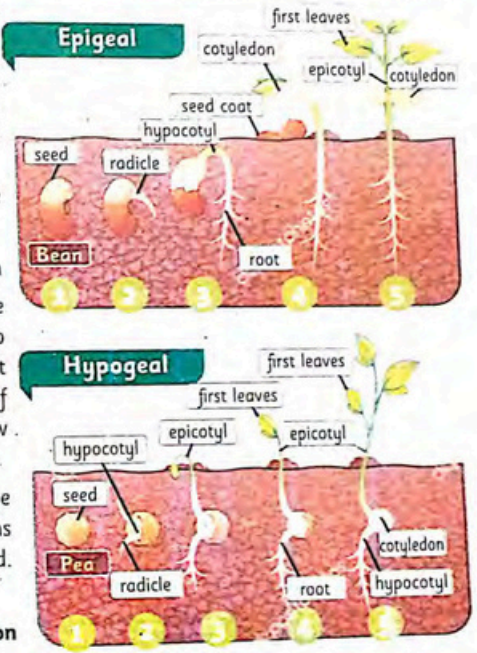


Fig.14.19 Epigeal and hypogeal germination

### Conditions Necessary for Germination of Seeds

Viable or living seeds should have sufficient food for germination. Moreover, the following environmental conditions should also be in place which are necessary for the germination of seeds.

1. **Water:** Seeds absorb water through the micropyle. Water softens the seed coat and makes it burst. Water also helps to activate enzymes that digest the food of seeds, and make it available to the growing embryo.
2. **Oxygen:** Oxygen is also necessary for seed germination. The cells of the seed embryo use oxygen for cellular respiration so that they can get energy from stored food.

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**3. Suitable temperature:** Germination of seeds occurs over a wide range of temperature between 5°C to 30°C. A suitable temperature is necessary for the enzymes to function properly.

### 14.3.5 Contribution of Theophrastus (371-287 BC)

Theophrastus is known as the father of botany. He identified over 300 species of plants. His most remarkable contribution is the discovery of sex in plants. He distinguished between sexual and vegetative reproduction, dicot and monocot plants, and angiosperms and gymnosperms. He also gave technical descriptions of grafting and cutting.

His work includes, **historia de plantis** (Enquiry into Plants), and **De Causis Plantarum** (Of Plants, an Explanation)

Fig.14.20 Theophrastus

**Activities**

1. Identify different parts of a flower.
2. Identify and draw the components of the seeds of pea or gram.
3. List some of the ripened ovaries and ovules, which are eaten in daily life.
4. Perform an experiment to investigate the necessary conditions for seed germination.

## 14.4 Asexual Reproduction in Animals

Most animals reproduce sexually. However, only a few groups of animals reproduce asexually. The following are some of the mechanisms of asexual reproduction in different animals.

**a. Fragmentation:** In this method, the body of the organism breaks into many parts (fragments). Each part develops into a new organism. It occurs in many small animals like planaria.

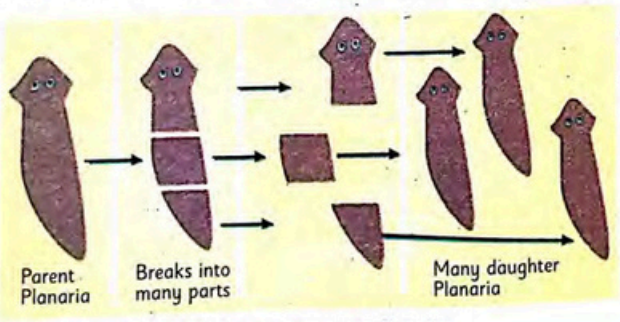


Fig.14.21 Fragmentation in a Planaria



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**b. Budding:** You are familiar with budding in yeast. Budding also occurs in some animals e.g. Hydra (a freshwater animal). During this process, a small bud is formed on the side of the body of Hydra. This bud enlarges and breaks from the parent body and develops into a new Hydra.

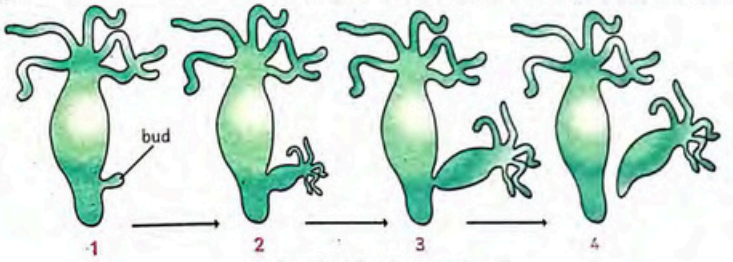


Fig.14.22 Budding in Hydra

**c. Parthenogenesis:**

Parthenogenesis is a special type of asexual reproduction in some animals. Parthenogenesis is defined as the development of the unfertilized egg cell into a new organism. In parthenogenesis, female animals make gametes (egg cells) but there is no fertilization (fusion of gametes). The unfertilized egg develops into a new animal. For example; in honeybees the fertilized eggs develop into females, but unfertilized eggs develop into males.

## 14.5 Sexual Reproduction in Animals

Sexual reproduction is the method of producing new generations in most animals. The male and female animals make gametes in their gonads. This process is called **gametogenesis**. The male gametes join with the female gamete to form zygote, which develops into a new individual.

### 14.5.1 Formation of Gametes - Gametogenesis

In animals, sex cells or gametes are produced in special organs called **gonads** (testes in males and ovaries in females). The formation of gametes involves meiosis. Meiosis results in a reduction of the number of chromosomes in gametes to haploid (n) as compared to the diploid (2n) number in other body cells. The formation of male gametes or sperms is called **spermatogenesis** while the formation of female gamete or ovum is called **oogenesis**.

**Spermatogenesis**

In the testes, there are many diploid gametes mother cells called primary spermatocytes. Each primary spermatocyte divides by meiosis and makes four haploid (n) cells called spermatids. Each spermatid develops into a motile sperm.

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## Oogenesis

In the follicle of the ovary, there are diploid gametes mother cells called primary oocytes. These divide by meiosis. As a result of the first meiotic division, two haploid cells are produced. The larger cell is called the secondary oocytes while the smaller cell is called the first polar body. In meiosis II, the secondary oocyte produces two haploid cells i.e. a second polar body and an egg.

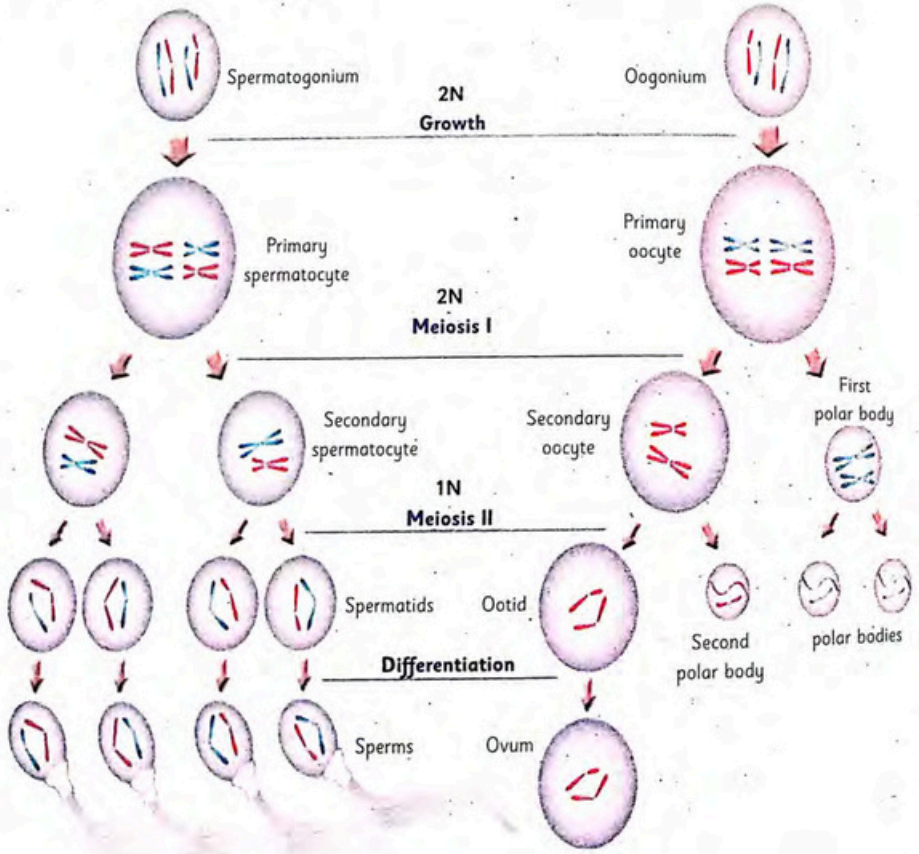


Fig.14.23 Gametogenesis in animals




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## 14.5.2 Fusion of Gametes – Fertilization

**Fertilization** is a process in which the male and female gametes fuse to form a zygote. The zygote is the first cell of the new offspring, which divides through mitosis and develops into an embryo. The embryo through further developmental changes becomes a new individual. Fertilization is an essential step of sexual reproduction. It restores the diploid number of chromosomes in the zygote. In animals, fertilization may occur outside the bodies of the female (external fertilization) or inside the body of female (internal fertilization).

### External Fertilization

External fertilization occurs mostly in aquatic environments. Both the male and female animals release their gametes into their surroundings (usually water). Fusion of gametes takes place outside the body in water, and the young ones also develop outside the mother's body. For external fertilization, both animals release gametes in great numbers because there are more chances of the loss of gametes. Fish and amphibians are examples of animals that reproduce in this way.

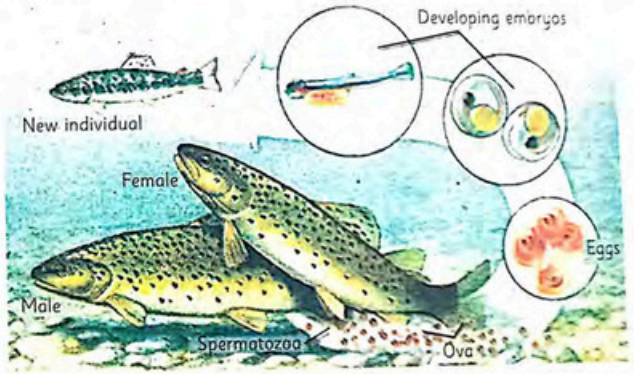


Fig.14.24 External Fertilization in Fish

### Internal Fertilization

Internal fertilization occurs in many land animals. For internal fertilization, the egg (ovum) of the female animal is not released out of the body. It stays in the reproductive duct of the female. The sperm of the male fertilizes the egg. After internal fertilization, there are two ways for the development of the fertilized egg.

**Tidbit**

In most mammals, the mother supplies everything that the embryo needs. Most mammalian mothers also continue to care for their young ones for several years after birth.

Some animals (e.g. reptiles and birds) lay the fertilized eggs. In such animals the eggs are covered by a hard shell for the protection of the embryo. Further development of embryo takes place inside the egg shell, outside the body of the female.

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In some animals (e.g. majority of the mammals), the fertilized egg remains in the reproductive duct of the female. The development of the embryo takes place there. In this case, extra protection is provided to the developing embryo.

### 14.5.3 Reproductive System of a Rabbit

Rabbits belong to the group Mammalia of vertebrates. The reproductive system of rabbits consists of gonads and the associated ducts and glands. Gonads are organs which make gametes. Gonads also secrete sex hormones. From gonads, the gametes enter in the associated ducts.

**Male Reproductive System**

In male rabbits there is a pair of gonads, called **testes**. The gonads are located in a sac-like structure, the **scrotum,** which lies outside the body. Each testis (singular) is made of coiled tubes called **seminiferous tubules**. The formation of sperms takes place in the seminiferous tubules.

The associated ducts in the male reproductive system consist of two **epididymis** and two sperm ducts (**vas deferens**). Both sperm ducts join with the **urethra**, which transports the sperms outside.

Some glands are linked with the associated ducts. These glands add secretions to the sperms. The secretion of **seminal vesicles** has nutrients for the sperms; the secretion of the **prostate gland** neutralizes the acidity; and the secretion of the **Cowper's gland** lubricates the ducts.

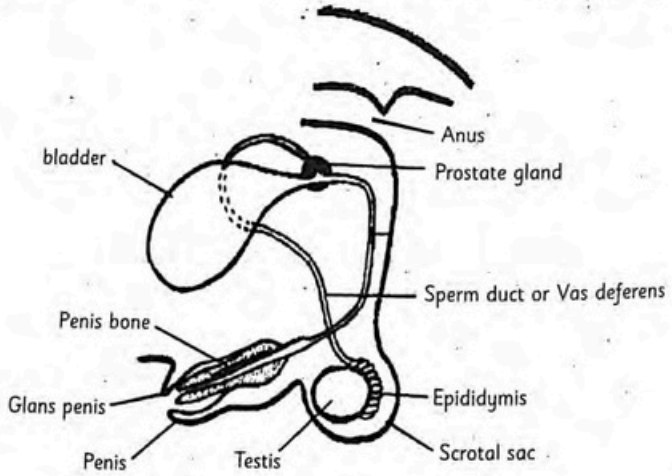


Fig.14.25 The Male Reproductive System of a Rabbit

**Female Reproductive System**

In female rabbits there is a pair of gonads, called ovaries, present in the abdominal cavity just ventral to the kidneys. In an ovary, the egg is formed inside a special structure called the follicle.



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The associated ducts in the female reproductive system consists of two oviducts (or fallopian tubes) and a uterus. Each oviduct opens into a part of the uterus (horn of uterus). Each horn of uterus opens in a narrow portion called the cervix (plural: cervices). Both cervices open into a single canal, called the birth canal or vagina.

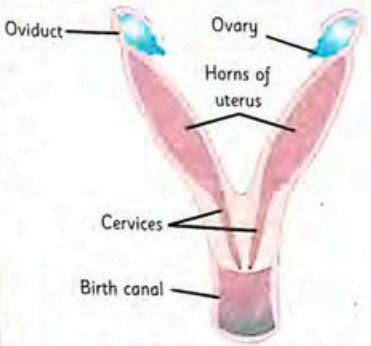


Fig.14.26 The Female Reproductive System of a Rabbit

**Activities**

Draw and label the different organs of a rabbit's reproductive system on a chart (both male and female rabbits).

## 14.6 Need of Population Planning

Pakistan has one of the world's highest population growth rates. According to the population census conducted in 2017, Pakistan's population is nearly 208 million. The population of Khyber Pakhtunkhwa is about 30,523,371. Pakistan's average annual growth rate is 2.4% while the average annual growth rate in Khyber Pakhtunkhwa is 2.89%. At the current growth rate of about 2.4% annually, Pakistan's population will exceed 280 million by 2020!

**Tidbit**

61% of children in Pakistan suffer from iron deficiency anaemia, 54% from Vitamin A deficiency, 40% from Vitamin D deficiency and 39% from zinc deficiency.(Source: Save the Children)

Rapid population growth puts great pressure on agricultural land and hinders prospects from economic and social development. One of the manifestations of poverty is the growth of population beyond available resources, although the pattern of distribution of wealth and income is also a key determinant of poverty. In underdeveloped or developing countries, a growing population requires that job opportunities and some stable source of income is made available. Producing too many children often places poor households under stress due to shortage of resources. Children grow up malnourished and often without access to effective education and healthcare.

Pakistan has been addressing the overpopulation issue in its plans since 1960. By the early 1990s, lowering the population growth rate had become permanent features of Pakistan's five-year plans. The federal and provincial governments have been taking steps to educate the people about the hazards of overpopulation.

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We need to accept the fact that population planning has become a compelling need, which simply cannot be ignored any longer. It includes an effective family planning program, changing social attitudes and improving the status of women. It is essential to raise the living standards and avoid increasing the serious problem of rapid population growth.

### Sexually Transmitted Diseases

Sexually Transmitted Diseases (STDs), also called Sexually Transmitted Infection (STIs), are infections acquired through sexual activity with infected people. This group of diseases includes many bacterial and viral infections. Acquired Immune Deficiency Syndrome (AIDS) is one of the most severe and fatal sexually transmitted disease.

### AIDS

AIDS is a viral infection, caused by Human Immuno-deficiency Virus (HIV). When a person is infected with HIV, the virus attack white the blood cells and destroy them. White blood cells are specialised cells of our bodies which kill pathogens (disease causing germs) that enter the blood. When HIVs destroy white blood cells, the main defence system of our body is weakened.

**Tidbit**

Practicing Islamic Teaching is the only best remedy in controlling AIDS.

HIV can pass from an infected person to a healthy person through body fluids as a result of engaging in sexual activity. HIV can also be transmitted through the use of infected needles or transfusion of infected blood. There is no cure for HIV or AIDS. The medications usually include antiretroviral drugs that are taken to hinder the growth of HIV.

According to the latest National HIV estimates, there are approximately 97,400 cases of HIV/AIDS in Pakistan. However, according to UNAID's 2015 report, in Pakistan AIDS is more common in people who inject drugs.

**The National AIDS Control Programme** and its provincial units are currently implementing a comprehensive programme throughout the country to halt the HIV epidemic. They educate common people as well as parliamentarians, media personnel, educationists, and religious leaders etc. They also organise events like in the World AIDS day to raise awareness about the issue.

### Role of Non-Governmental Organizations (NGOs)

Many NGOs serve to coordinate HIV/AIDS prevention and control activities in all the provinces of Pakistan. Although NGOs are active in educating people and supporting HIV/AIDS patients, it is believed that they are reaching less than 5 percent of the vulnerable population.



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## Key Points

- Reproduction is a process by which living organisms produce offsprings of their own kind and this in turn ensures the continuity of their kind.
- Asexual reproduction is a type of reproduction in which the offspring are produced by only involving a single parent.
- Binary fission is a type of asexual reproduction in which the body of the parent organism divides into two daughter organisms.
- During budding, an outgrowth arises from the body of the parent. This outgrowth is called a bud.
- Vegetative reproduction is a type of asexual reproduction in which a plant makes new plants from its vegetative parts, such as specialised stems, leaves and roots.
- Cloning is a technique of asexual reproduction in which a population of genetically identical individuals is produced from a single parent, using the vegetative cell or tissue.
- Transfer of pollen grains from the anther of the stamen to the stigma of the carpal is called pollination.
- A seed (mature ovule) is a miniature plant with a protective cover in a suspended state of development.
- In epigeal germination, the hypocotyl curves and then straightens, due to which the cotyledons are pulled up into the air.
- In hypogeal germination, the cotyledon remains underground.
- In sexual reproduction, fertilization is a process in which male and female gametes fuse to form a zygote.
- The production of gametes in gonads is called gametogenesis.
- In male rabbits, there is a pair of testes made of seminiferous tubules.
- In female rabbits, there is pair of ovaries where the egg is formed inside the follicle.
- A sexually transmitted disease (STD), also known as a sexually transmitted infection (STI), is an illness that has a significant probability of transmission between humans by means of human sexual acts.

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## Exercise

### A. Select the correct answer.

1. One of the following is not true for asexual reproduction:
   a. Rapid propagation b. Genetic variations
   c. Mitosis d. Large number of organisms
2. A Hydra reproduces asexually by:
   a. Spore formation b. Multiple fission c. Budding d. Binary fission
3. One of the following methods is artificial vegetative propagation of plants:
   a. Grafting b. Spore formation c. Budding d. Binary fission
4. In parthenogenesis, a new animal develops from:
   a. Sperm b. Fertilized egg c. Unfertilized egg d. Common body cell
5. In a flower, the embryo sac is formed inside the:
   a. Anther b. Filament c. Ovule d. Style
6. The union of male and female gametes is known as:
   a. Fertilization b. Oogenesis c. Spermatogenesis d. Gametogenesis
7. All multicellular animals develop from a single cell, called:
   a. Egg b. Sperm c. Zygote d. Blood cell
8. Which of the following restores diploid number of chromosomes?
   a. Ovulation b. Oogenesis c. Fertilization d. Spermatogenesis
9. In which of the following animals does external fertilization occur?
   a. Fish and amphibians b. Reptiles c. Birds d. Mammals
10. Internal fertilization occurs in:
    a. Fish b. Amphibians c. Aquatic animals d. Mammals

### B. Write short answers to the following questions.

1. How can vegetative methods of reproduction, be used to achieve better yield?
2. Differentiate between internal and external fertilization. Which type of fertilization will ensure better chances of fusion of gametes?
3. What is population planning? Why is it important?
4. How does self-pollination bring more variations in plants?
5. How can the spread of HIV be controlled? What is the role of the community and NGOs in the control of AIDS?
6. Name the four whorls present in a flower and also describe the components of each whorl.



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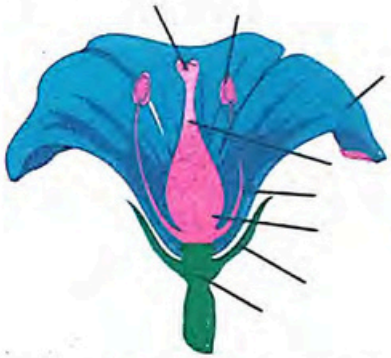
7. How are wind-pollinated flowers different from insect-pollinated flowers?
8. Why do seeds need water and oxygen for germination?
9. Label the following diagram of a flower.



10. Label the following diagram of the female reproductive system of a rabbit.

### C. Write detailed answers to the following questions:

1. Describe the alternation of generation in a flowering plant.
2. Explain the different plant structures modified for vegetative propagation.
3. Explain gametogenesis.
4. How are seeds produced? What is the structure of a seed?
5. Write a comprehensive note on seed germination and its types.