

REPRODUCTION IN PLANTS

3



SYLLABUS

1. Asexual and Sexual reproduction in plants.
 - (a) Self and cross-pollination
 - (b) Artificial pollination — producing hybrids to improve quality of crops.
- * Growing *Bryophyllum*, *sansevieria*, ginger, grass, potato, onion, carrot, etc. through vegetative reproduction (E).
- * Study of the parts of a flower (E) — revision.

REPRODUCTION

All living organisms give rise to individuals of their own kind for the survival of their species. This is called reproduction. Reproduction in plants, also means to produce new plants of their own kind.

Reproduction means producing young ones of its own kind.

There are *two* basic modes of reproduction in plants : **Asexual** or **Vegetative** and **Sexual**.

Lower plants like bacteria, algae and fungi reproduce by fission, fragmentation, *etc.* A few plants also reproduce by forming spores. Some parts of the plant themselves like the stem, the leaf or the root also help in producing new plants. This is called asexual or vegetative reproduction.

But most plants you see around bear flowers. These flowers have male and female parts which ultimately produce seeds. The seeds germinate to produce new plants. This type of reproduction through flowers and seeds is called the **sexual reproduction**.

ASEXUAL REPRODUCTION IN PLANTS

Asexual reproduction is quite common among plants. It can take place by different methods as described below :

1. Binary fission : Lower plants like bacteria, reproduce asexually by the method of binary fission (binary means 'two' and fission means 'splitting'). In this method, the nucleus splits or divides into two and then the cell splits across the middle, forming two identical cells called the daughter cells. (Fig. 3.1).

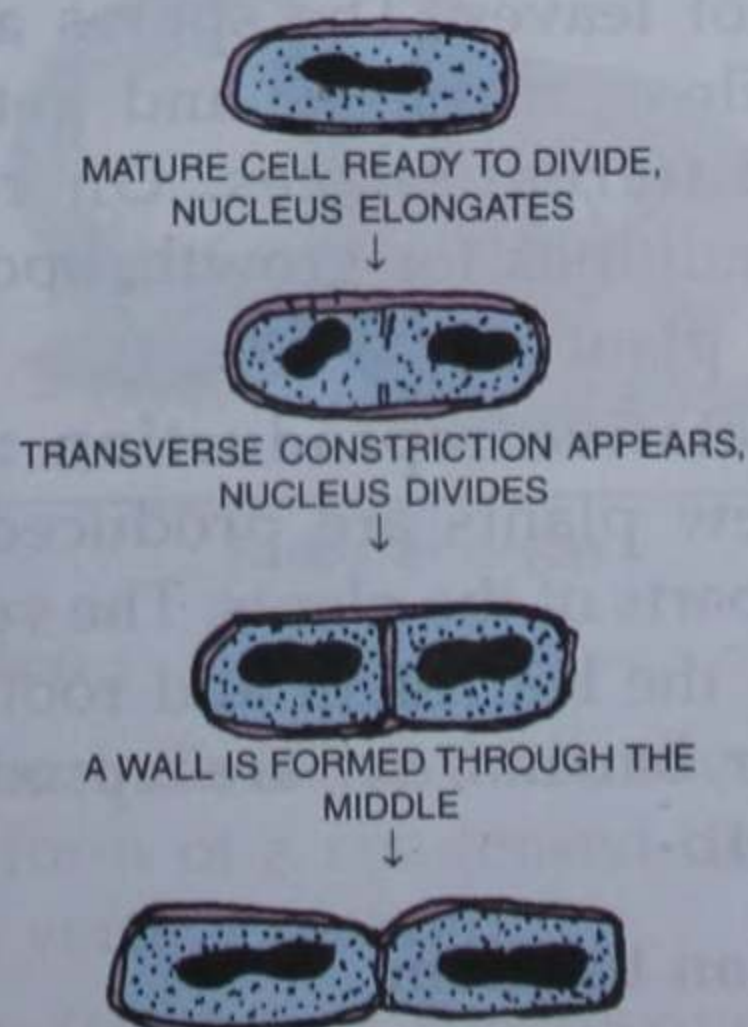


Fig. 3.1 Binary fission in bacteria

In some organisms, like **chlorella** and **chlamydomonas**, one cell divides into four daughter cells. This is called multiple fission.

2. Budding: This method is common in yeast. Here, the parent cell produces an outgrowth called a bud. The bud grows, and then gets detached from the parent body to lead an independent life.

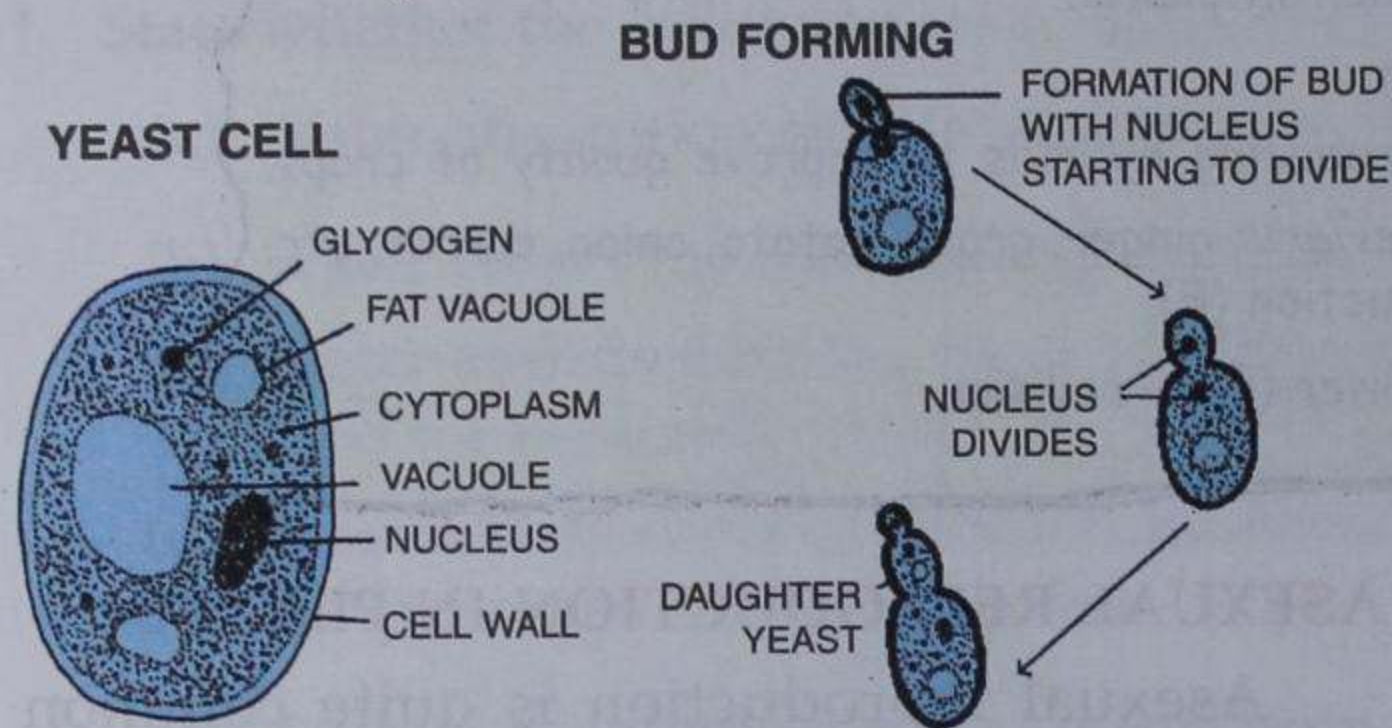


Fig. 3.2 Stages of budding in yeast

3. Fragmentation : Organisms like **spirogyra**, which are made of long, ribbon-like filaments, reproduce by fragmentation. The filament grows and divides into two or more parts. Each part then grows into an individual.

4. Spore formation : Spore formation is common in plants like ferns. These are ornamental plants and bear spores on the underside of leaves. The spores are light. They can float in the air and get carried away to different places. On reaching suitable conditions for growth, spores give rise to new plants.

5. Vegetative reproduction : In this method, new plants are produced by the vegetative parts of the plants. The vegetative parts mean the leaf, stem and root. Potato, mint, ginger, banana, *etc.*, are reproduced by this method.

Reproduction by Stem

The common grass and mint grow their stems horizontally parallel to the ground.

New roots and shoots develop at their nodes. These roots grow downward into the soil and the shoot upward to form new plants.

Ginger is a modified stem. It has nodes and internodes. It also has scaly leaves. You can also see some axillary buds growing out from the nodes. The farmers grow ginger from the small pieces of ginger.

Similarly, potato is another example of a modified stem. Potato bears buds called the "eyes". Cut a piece of potato with an "eye". Put this piece in moist soil. New plants grow from these buds within a few days. Potatoes kept in humid warm months may grow out shoots. If placed in soil, they form complete plants.

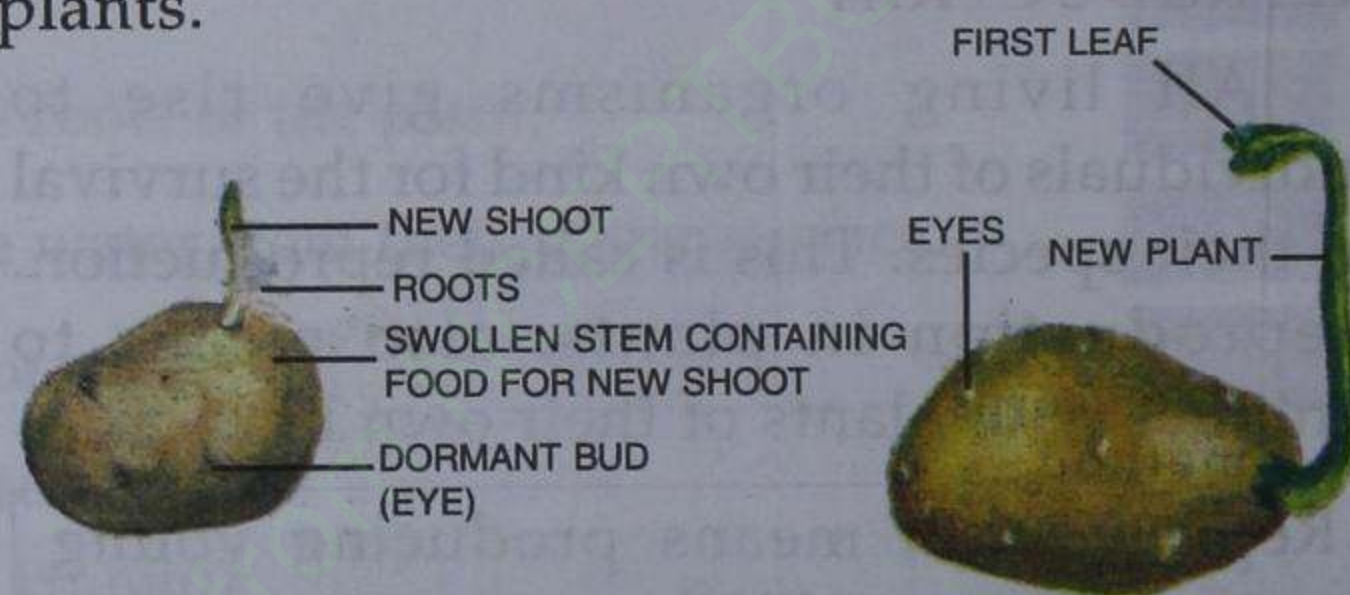


Fig. 3.3 Vegetative reproduction in Potato

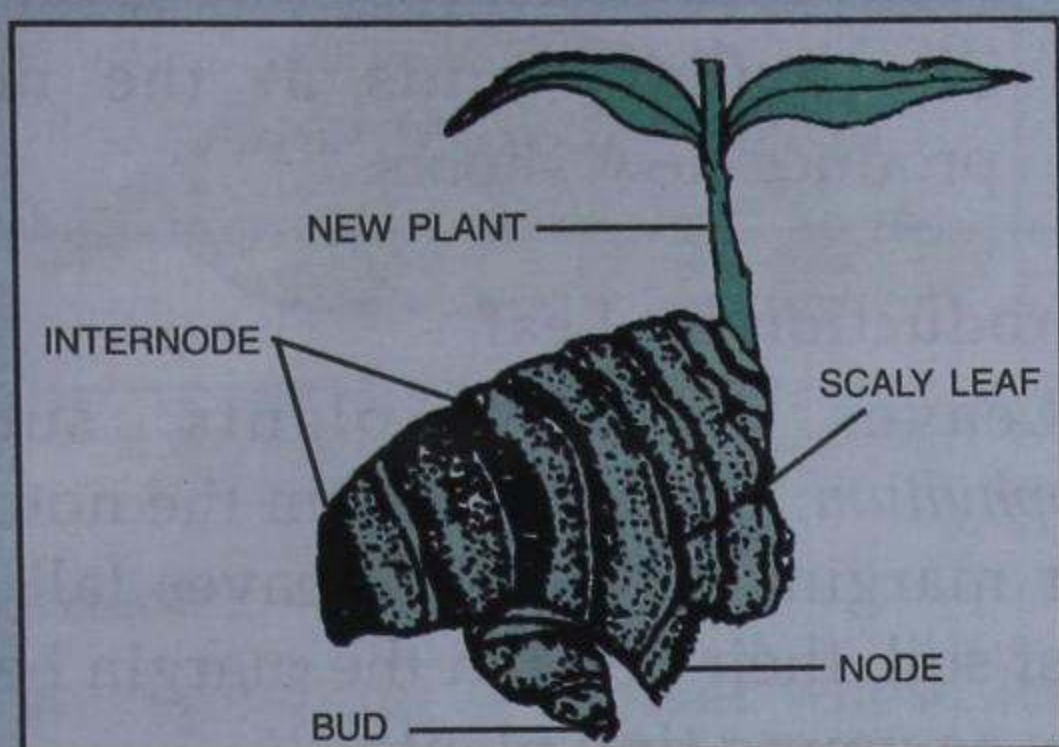


Activity 1



To grow ginger by vegetative reproduction

- Take a healthy piece of ginger. Remove one large bit of it. Place the bit in the moist soil in a flower pot.
- Watch this set-up for 8–10 days; sprinkle some water everyday over the soil to keep it moist.
- In due course of time, the axillary buds grow into aerial shoots to form new plants.
(Perform this activity in warm humid season).



Conclusion :

- Ginger has nodes and internodes, and the nodes carry thin, dry, brown papery scaly leaves.
- Axillary buds grow out from the nodes to produce new plants.



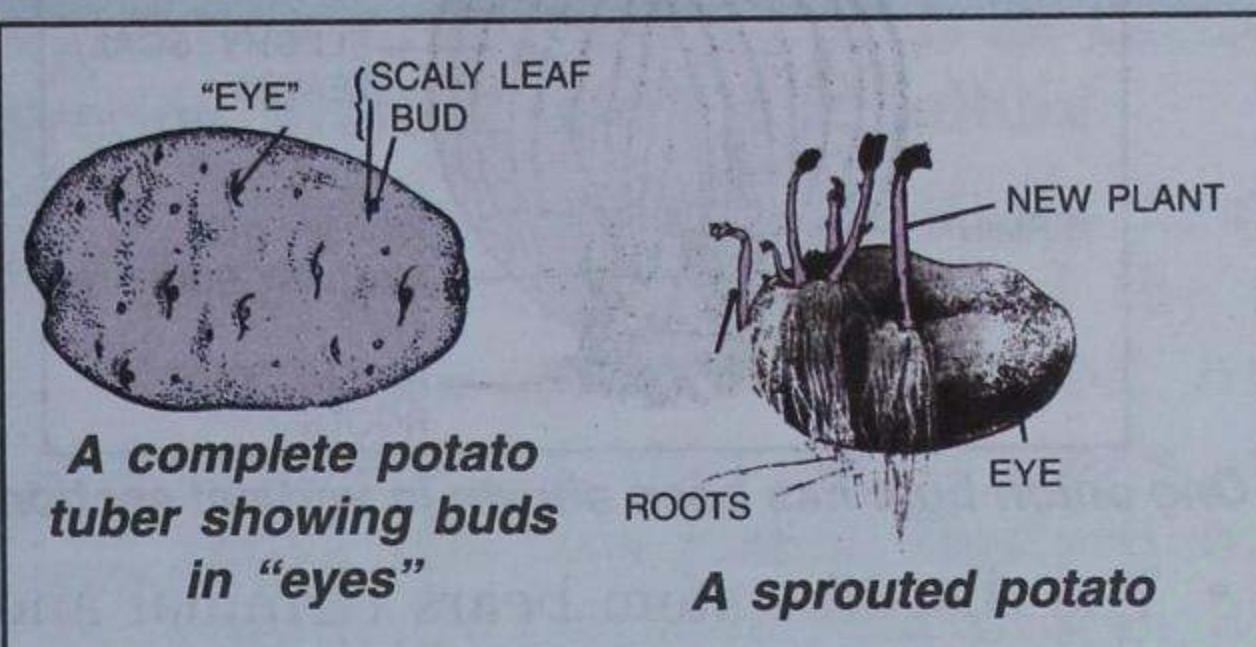
Activity 2



To grow potato by vegetative reproduction :
[Growing of potato by vegetative method should be performed preferably in those months when the atmospheric temperature is moderate and there is enough moisture in the atmosphere].

- Take a potato, preferably the one in which some green, leafy buds have already sprouted out from the "eyes".
- Put this potato in the moist soil in a manner that the potato is covered by just a very thin layer of soil. Keep the pot in a shady place.
- Watch for 7-8 days.
- Sprinkle some water everyday on the soil to keep it moist.
- Each green leafy bud grows into a new plant.

- Each new individual plant together with some tuber parts, can be separated from the rest and grown separately.

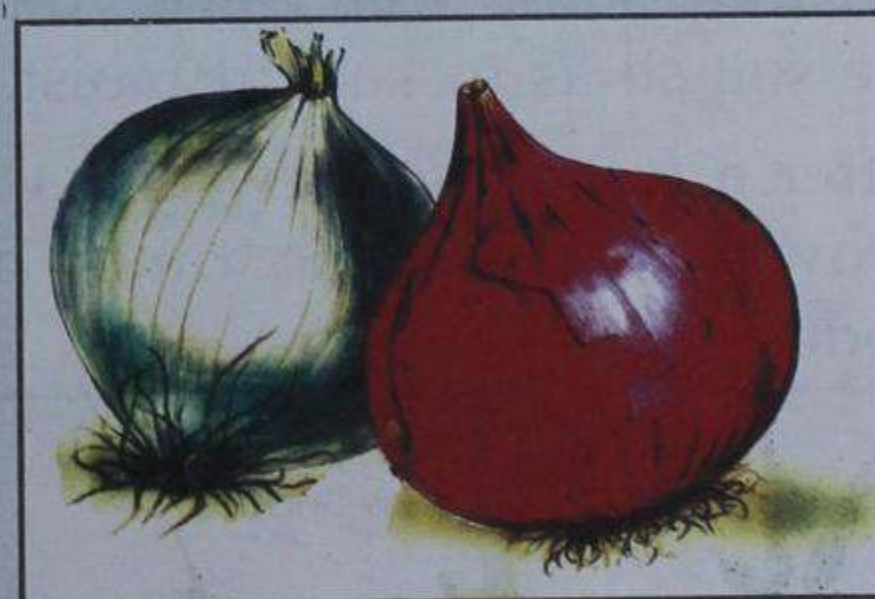


Activity 3



To grow onion by vegetative reproduction

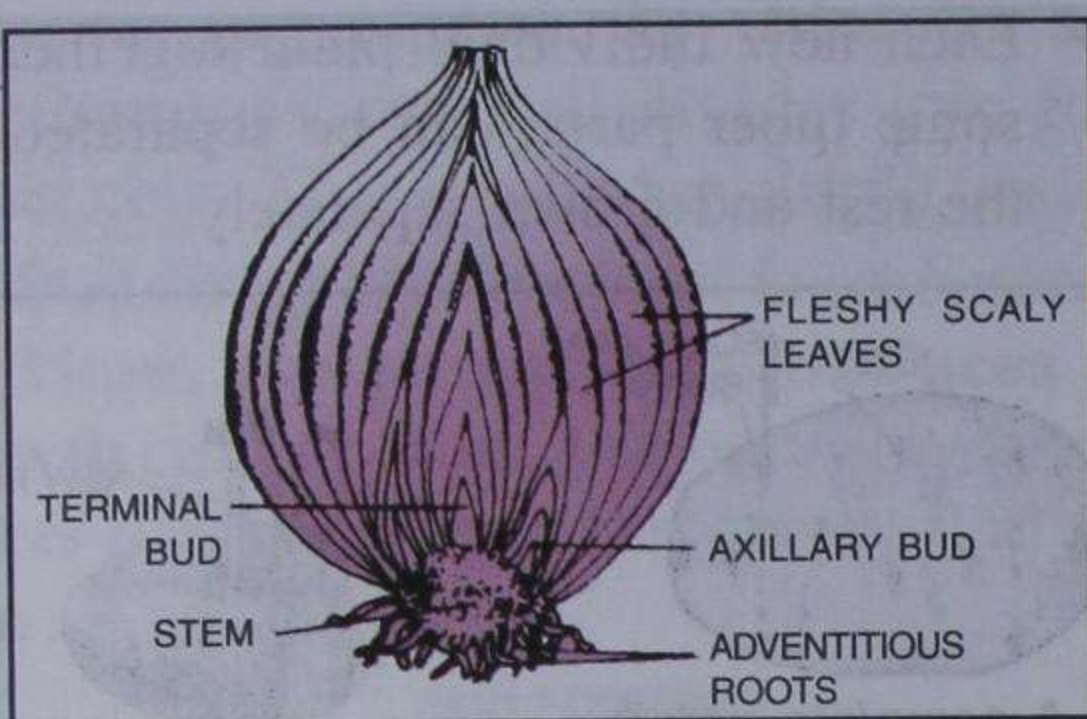
- Take a healthy onion bulb and put it in the moist soil in a flower pot.
- Watch for 8-10 days; sprinkle some water everyday over the soil to keep it moist.
- In the course of time, the axillary buds (protected by fleshy scaly leaves) grow into aerial shoots to form new plants.



Bulbs of onion

Conclusion :

- Onion bulb has a thick, short, stem in the form of a condensed disc (visible in a vertical section).
- The disc bears fleshy overlapping scaly leaves storing food material.



One onion bulb has been shown in vertical section

- The disc-like stem bears terminal and axillary buds.
- The axillary buds grow into new green aerial shoots under favourable environmental conditions.

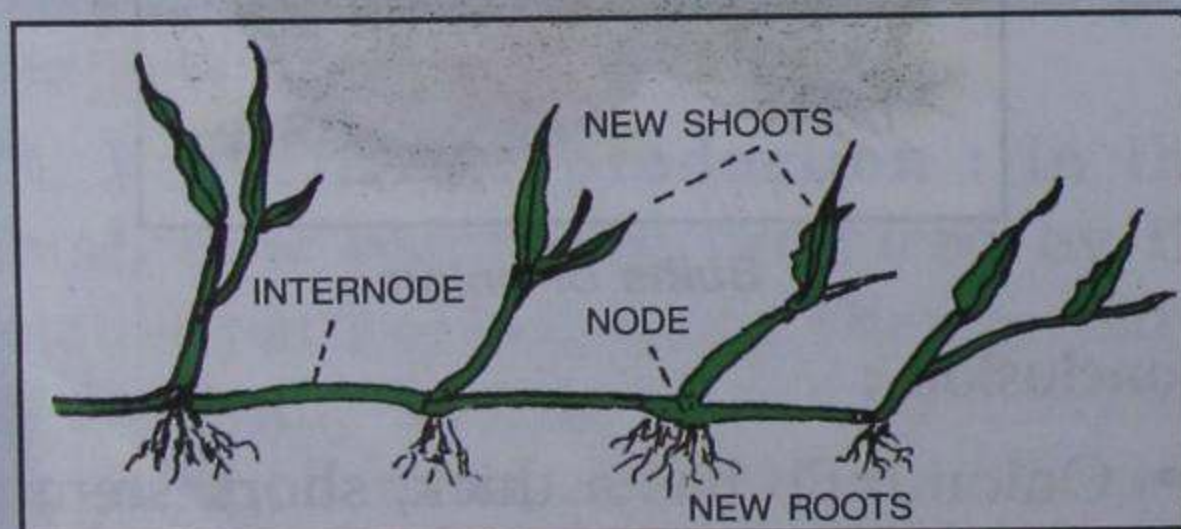


Activity 4



To grow grass by vegetative reproduction

- Put a piece of lawn grass in the pot and cover its some portion with moist soil.
- Leave it for 10–12 days.
- Sprinkle some water everyday over the soil so as to keep it moist.
- After a few days, new grass shoots grow out from the buds on the nodes.



Conclusion :

- Common doob (lawn grass) has long internodes, creeping on the surface of the ground.

- From each node, roots are given out.
- The axillary buds at the nodes produce new shoots.

Reproduction by Leaf

Leaves of some plants, such as *Bryophyllum*, produce buds in the notches in their margin. When such leaves fall in the moist soil, their buds in the margin begin to grow as young tiny plants.

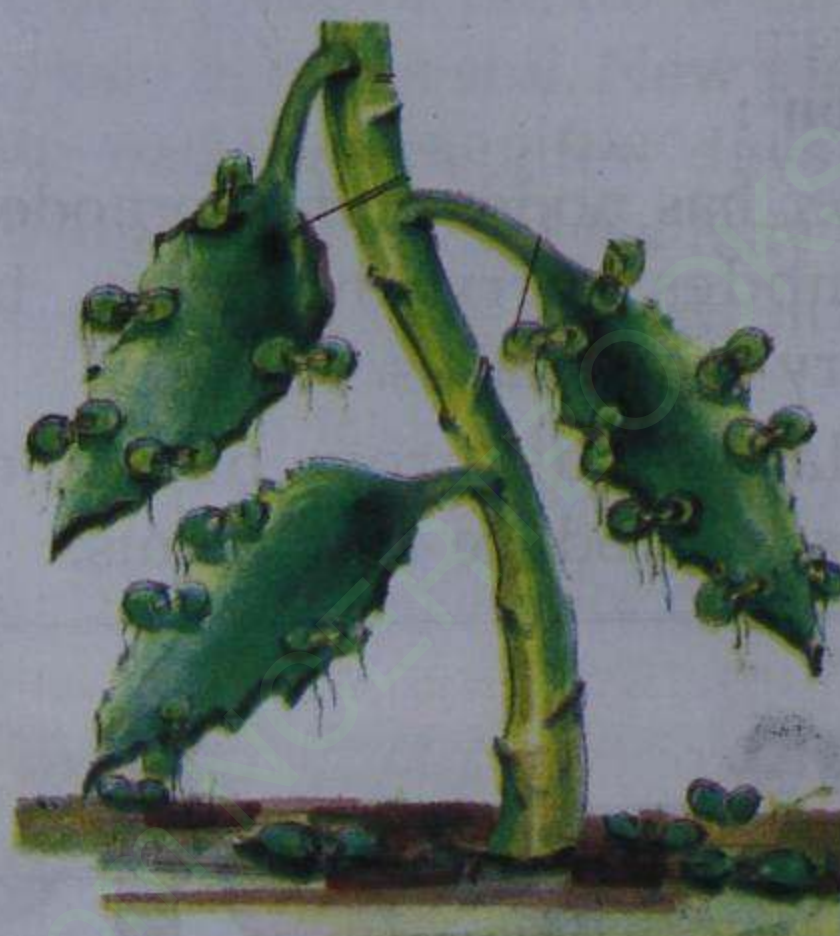


Fig. 3.4 Bryophyllum

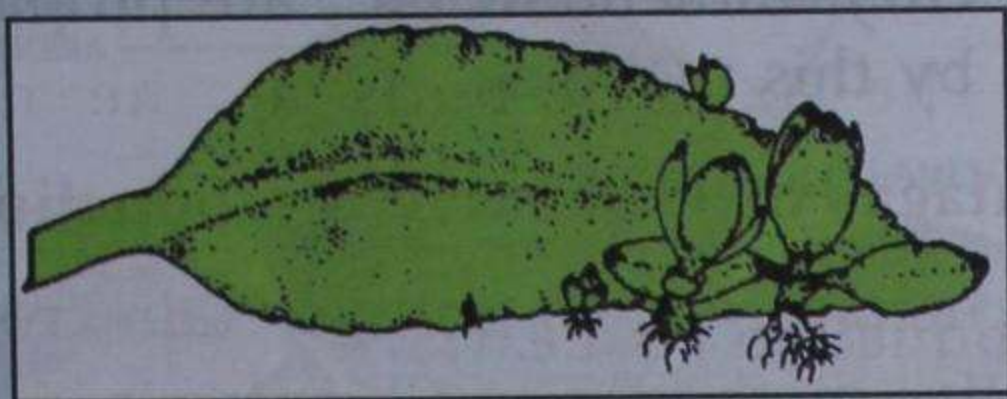


Activity 5



To grow bryophyllum by vegetative reproduction :

- Take a full grown leaf of *Bryophyllum* with some adventitious buds growing out from its margin.
- Cut the leaf into bits, each containing a growing adventitious bud.
- Put these bits in a flower pot and cover them under the moist soil keeping the emerging buds just projecting out from the surface.
- Observe after 10–12 days.
- Tiny plants grow out from the buds.



A Bryophyllum leaf with growing axillary buds

Conclusion :

- **Bryophyllum** is a plant whose leaves produce adventitious buds in their margin.
- The adventitious buds grow into new plants when the leaf falls off from the parent plant.

Reproduction by Root

Plants like sweet potato and asparagus develop numerous large swollen fleshy roots. These roots contain a large quantity of food inside them. Each such single root is capable of giving rise to a new plant.



Fig. 3.5 Sweet potato

The carrot, a taproot, is a biennial plant. Its roots grow vegetatively in the first year and store food. In the following year, its stem produces flowers and seeds which die by the end of the year. Buds produced at the base of the old stem just above the tap root are meant for vegetative propagation.

ARTIFICIAL VEGETATIVE PROPAGATION

These days, farmers and horticulturists have developed certain artificial methods of vegetative propagation, such as cutting, layering, grafting and tissue culture.

1. Cutting : In this method, the stem is cut into small pieces and the cut ends are planted in moist soil. After a few days, they strike roots, and grow into new plants. This method is normally employed for propagating plants like sugarcane, rose, china rose, lemon, *etc.*

2. Layering : In this method, a portion of one of the lower branches of the plant is bent down to the ground so that it touches the soil. A ring of bark is removed from this portion, which is then covered with soil. Some heavy object, such as a small piece of stone or a brick, is kept on the branch so that it does not come



Fig. 3.6 Layering

out of the soil. In a few days, when the branch gives out roots, it is cut off from the main plant. It then continues to grow out as an independent plant. This method is used for the propagation of plants like mint, rose, jasmine, *etc.*

3. Grafting : In some cases, such as rose,

mango, guava, *etc.*, a small shoot or bud of a desired variety of plant is intimately fixed on the stem of another of the same or related species. The plant receiving the bud or the shoot is called the **stock** and the shoot fixed on it is called the **scion**. For a successful graft, it is important that the cambium layers of the stock and the scion must come into very close contact so that growth

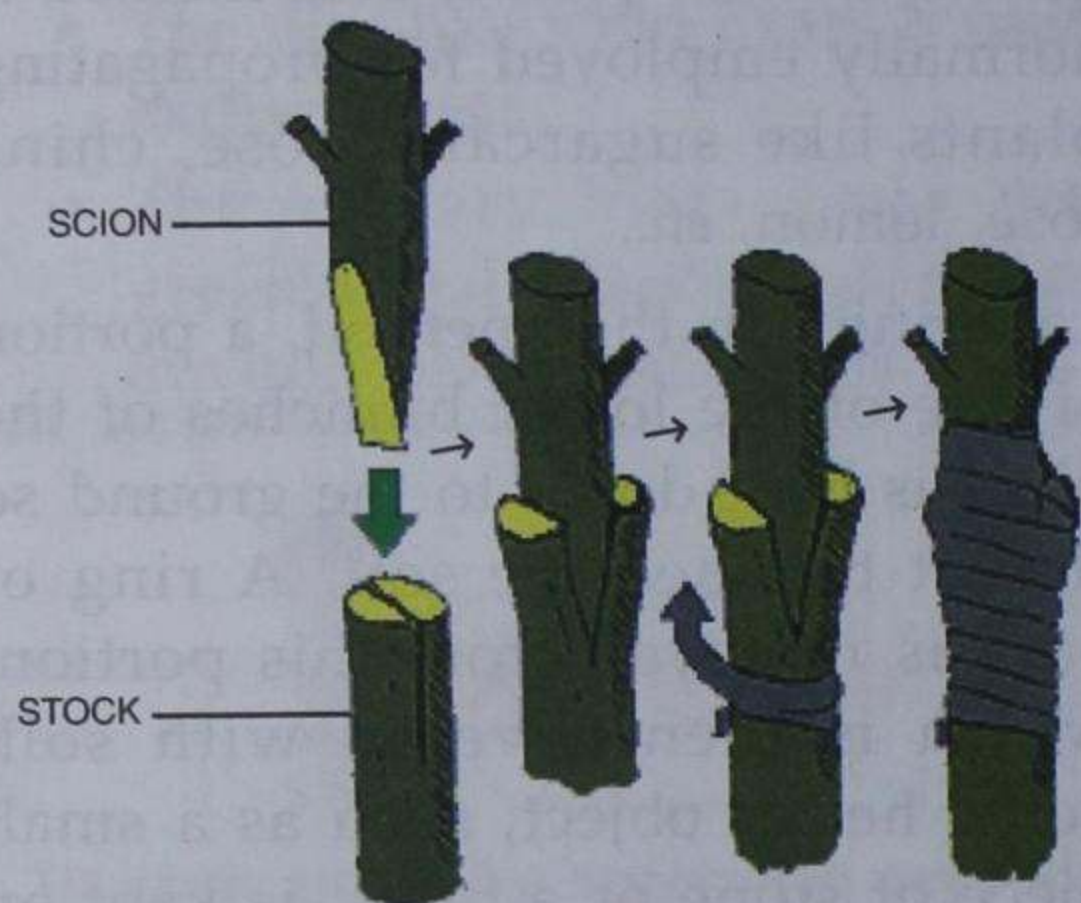


Fig. 3.7 Grafting

may continue. The grafted points are then bound together with a tape and the joint is covered with a wax to prevent dehydration and is protected from any bacterial infection. In a few days, the new cells develop in the scion and the stock.

4. **Tissue culture** : It involves growing of plants in test tubes. A small part of a plant is kept over the nutrient medium in a test tube. It is grown in a germ-free environment. Soon, a mass of cells (*callus*) develops from it. Callus develop plantlets, which ultimately develop into an independent plant when transferred to the soil. Thousands of plants are developed from the tiny pieces of the plant. Orchids, asparagus,

chrysanthemum, *etc.*, are propagated by this method.

Advantages of vegetative reproduction

Farmers prefer to grow certain crops by vegetative method. The advantages in doing so are as follows :

1. Reproduction by vegetative parts takes place in a shorter time.
2. New plants, thus produced, spread very fast in a small area.
3. It is a surer method.
4. All the characters of the mother plant are retained by the daughter plants.

Disadvantages of Vegetative Reproduction

1. As all plants developed by vegetative propagation are identical, they are likely to be affected simultaneously if a disease spreads in the farm.
2. Dispersal of plants does not take place on its own. Daughter plants, so developed, tend to remain nearby and are restricted to a particular area leading to competition for resources.

SEXUAL REPRODUCTION IN PLANTS

The flower is the reproductive part of the plant. To understand how a flower helps in sexual reproduction in plants, let us study a typical flower, say balsam plant.

Examine a fully opened flower and note its different parts. The diagram (Fig. 3.8) shows a general representation of the floral parts of most plants.

Stalk : The flower is attached to the shoot by means of a **stalk** or **pedicel**. The tip of the stalk is enlarged and slightly flattened, from where, the petals and other parts arise. This flattened part of the stalk is called the **thalamus**.

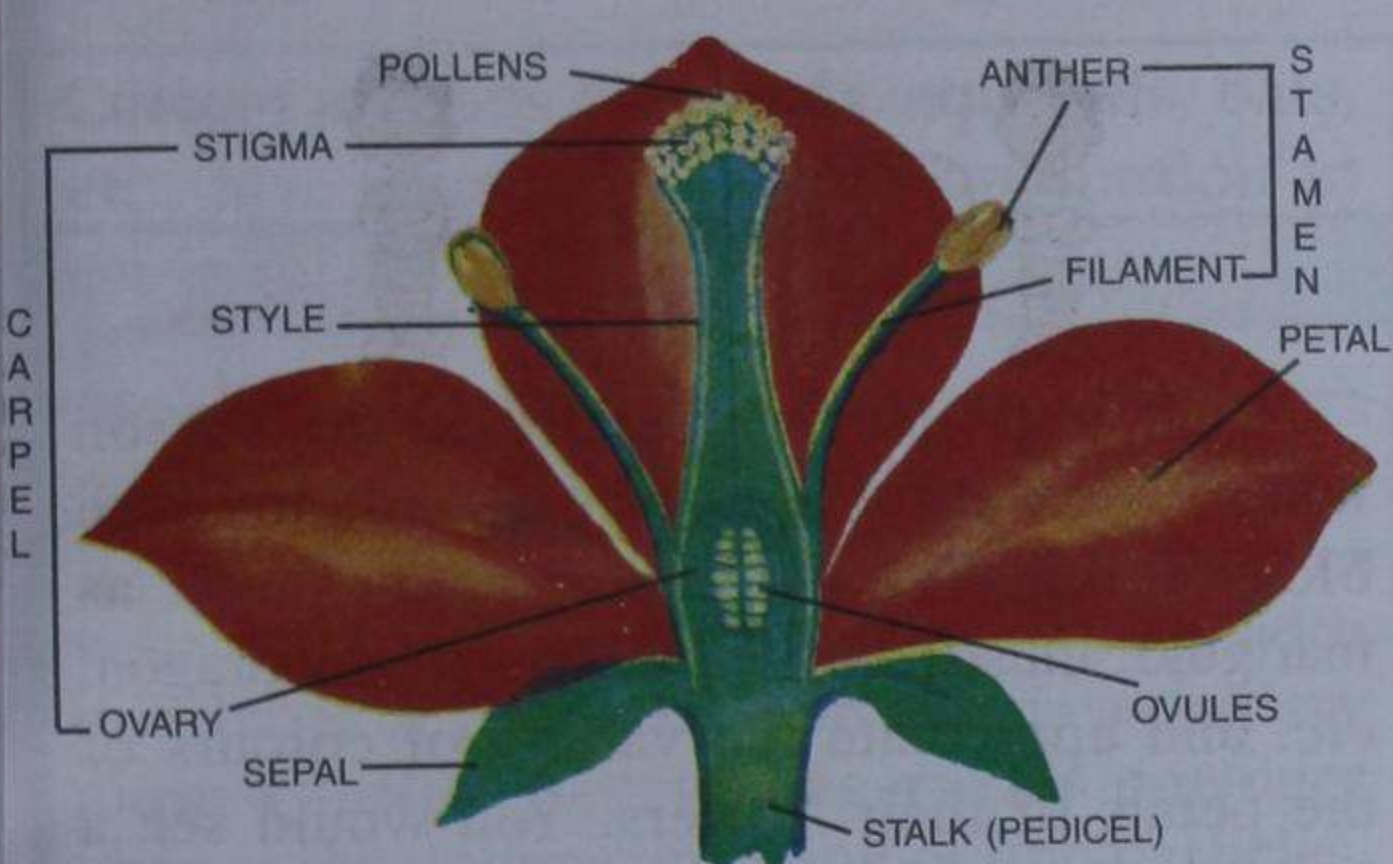


Fig. 3.7 A typical flower with its internal parts

Sepals : These are the outermost parts of the flower forming a whorl of tiny green leaf-like structures. In the bud condition, they enclose the inner parts of the flower.

Sepals are the green, outer covering of the flower.

Petals : Petals form the second inner whorl arranged next to the sepals. These are usually white or coloured but never green. The petals make the flower attractive.

Petals are the large bright attractive parts of the flower

Stamens (The male parts): The next (third) whorl, inner to the petals, consists of delicate, filament-like structures called the **stamens**. Each stamen is formed of a long, narrow, hair-like **filament** and a broad sac-like **anther** is found at its tip. Pinch off a few anthers from an older flower and crush them between your fingers. You will find a powdery material coming out on your fingers. This powdery material consists of fine particles called the **pollen grains**.

Stamens are the male parts of the flower.

Carpels (The female part) : Carpels are the fourth innermost part of the flower (these may also be called **pistils**). Each carpel is

formed of three parts – a swollen **ovary** at the base, a narrow thread-like **style** in the middle and a terminal expanded **stigma** at the top.

Carpels are the female parts of the flower.

Ovules (Future seeds) : Slit open the ovary with the help of a needle. You will find some rounded bodies in it – these are the future seeds, which at this stage are called the **ovules**.

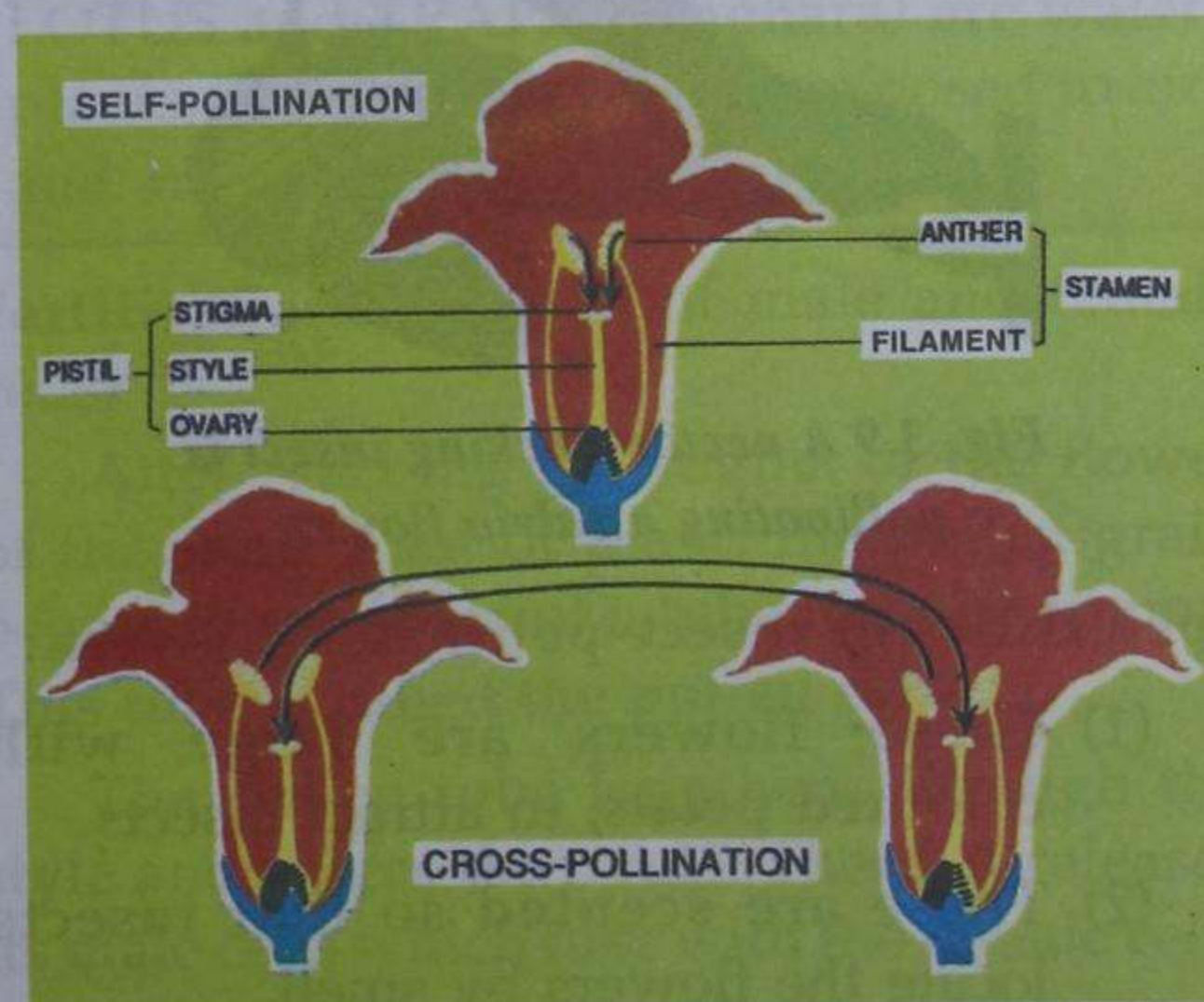
Function of a flower : You have learnt that a flower contains both, the male parts (stamens) and the female parts (carpels). The pollen grains from the male part are somehow carried (by air or insects) to the female part of the flower. This transfer of pollen to the stigma is called **pollination**.

POLLINATION

Pollination is the process in which the pollen grains from the anthers are transferred to the stigma.

There are two types of pollination : **SELF-POLLINATION** and **CROSS-POLLINATION**.

1. Self-pollination is one that occurs within the same plant.
The pollen grains from anthers may



fall on the stigma of the SAME FLOWER (in a bisexual flower).

The pollen grains from the anthers of a flower of one plant may reach the stigma of a flower of ANOTHER PLANT of the SAME KIND.

2. Cross-pollination occurs between two flowers of different plants of the same kind.

The pollen grains from the anthers of a flower may fall on the stigma of ANOTHER FLOWER of the SAME PLANT.

Pollination can occur due to any of the following : Insects, Wind and Water.

1. Pollination by Insects : Butterflies, bees and other insects visit flowers for nectar (honey). When the insect alights on a flower, the pollen grains stick to its mouth parts, wings, legs, etc. When this insect visits another flower, the pollen grains from its body may fall on its stigma. Such transfer of pollen is called **insect-pollination**. Rose, marigold, dahlia and salvia are some of the insect- pollinated flowers.

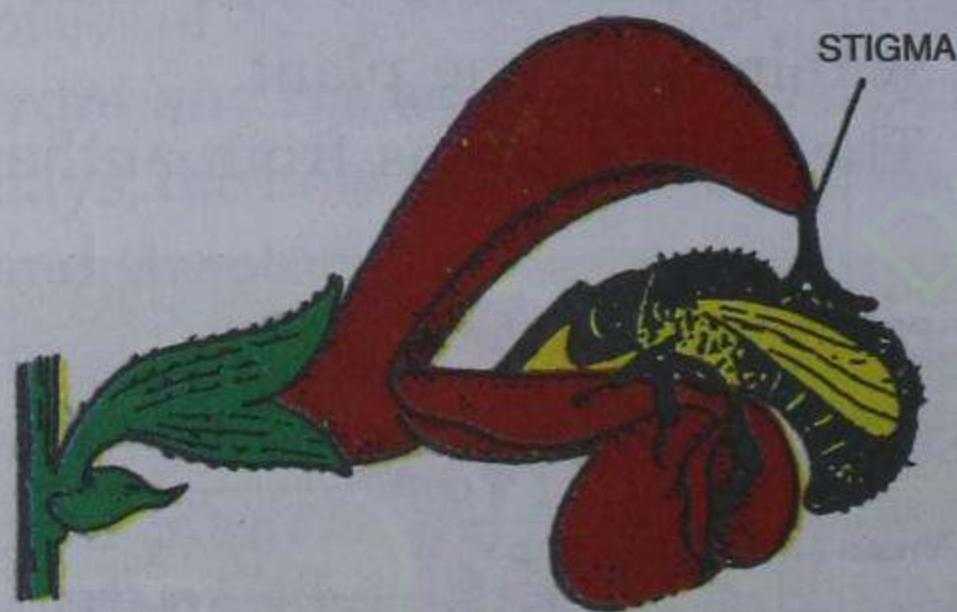


Fig. 3.9 A nectar-sucking insect is pollinating a salvia flower

Specialities of insect-pollinated flowers :

- (1) These flowers are **large** with **coloured petals**, to attract insects.
- (2) These are **scented** so that insects locate the flowers by smell.



Activity 6



Visit a garden, especially in the season when flowers of various plants are blossoming. Try to locate plants, such as marigold, mustard, balsam, dahlia, snapdragon, *etc.* and appreciate the variety of colours of the petals of their flowers. You would see a large number of butterflies, bees, *etc.* hovering over the flowers. Insects get attracted towards these flowers because of their bright colours.



Honey bee with its body covered with pollens

Given here is a picture of honey bee. In the picture, you can see its entire body covered with pollen grains. We therefore presume that this bee has returned after visiting and alighting over the flowers in a mustard field. When this bee visits other flowers of the same kind, there is every chance that pollens from its body may fall on their stigma. This is exactly what happens in case of insect pollinated flowers.

Apart from the colour, there are other features too, of the flowers, which attract the insects and ensure pollination. You will study more about pollination in the later part of this chapter.

- (3) These contain **nectar** as a food for insects.
- (4) These produce **sticky pollen grains** so that they may stick to the body parts of the insect.

Certain animals like birds, squirrels, bats, etc., also bring about cross-pollination in some flowers.

Try it yourself

Hold a flower, such as a shoe flower, in your one hand. Gently touch its anthers with one finger of your other hand. Some powdery mass will stick to your finger. This powdery mass is the pollen consisting of fine particles, the **pollen grains**. Now, rub your finger on a sheet of paper. The pollen grains will be transferred to the paper. This is exactly what happens when an insect visits two flowers, one after the other.

2. Pollination by wind : Some plants like maize, wheat, palm, pine, etc., produce dry pollen in large quantity. When these flowers mature, the pollen grains get blown away by the wind. From the air, the pollen grains may fall at all sorts of places and may even get wasted. But if they happen to fall on the stigma of a flower of the same type, then the pollination occurs. Such pollination is called **wind-pollination**.

Special features of wind-pollinated flowers :

- (1) They are usually **small** and are of dull colours.
- (2) They generally have **long anthers** protruding out of the flower so that pollen may get blown off easily.
- (3) They produce **light pollen** so that it is easily carried away.
- (4) They produce a **large quantity of pollen**.

3. Pollination by water : There are water-pollinated flowers also. **Vallisneria** is one good example of such flowers. These are aquatic plants whose male

flowers submerge in water to start with, get detached when mature, and float on the surface of water. When these floating male flowers happen to come in contact with a female flower, the pollen grains are transferred to its stigma.

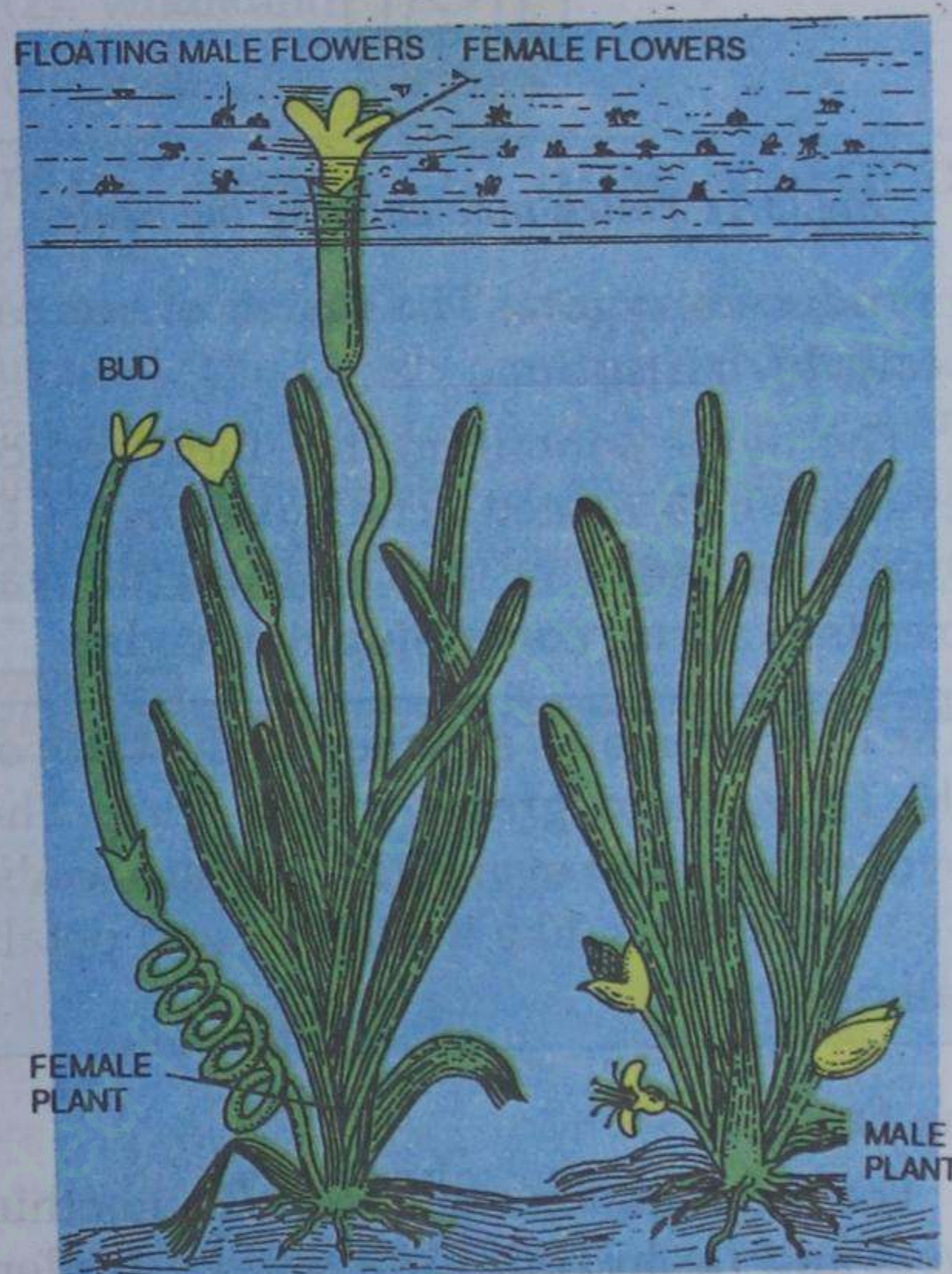


Fig. 3.10 Pollination in Vallisneria

LOTUS and TRAPA (Singhara) are water plants, but their flowers are exposed to air and are pollinated by insects.

Fertilisation : (Fusion of male and female cells)

After reaching the stigma of the flower of the same kind of plant, the pollen grain begins to grow out of a tube into the stigma. This tube is called the **pollen tube**.

The pollen tube lengthens through the style and enters the ovule. There, it releases its male cells which fuse with the female cells

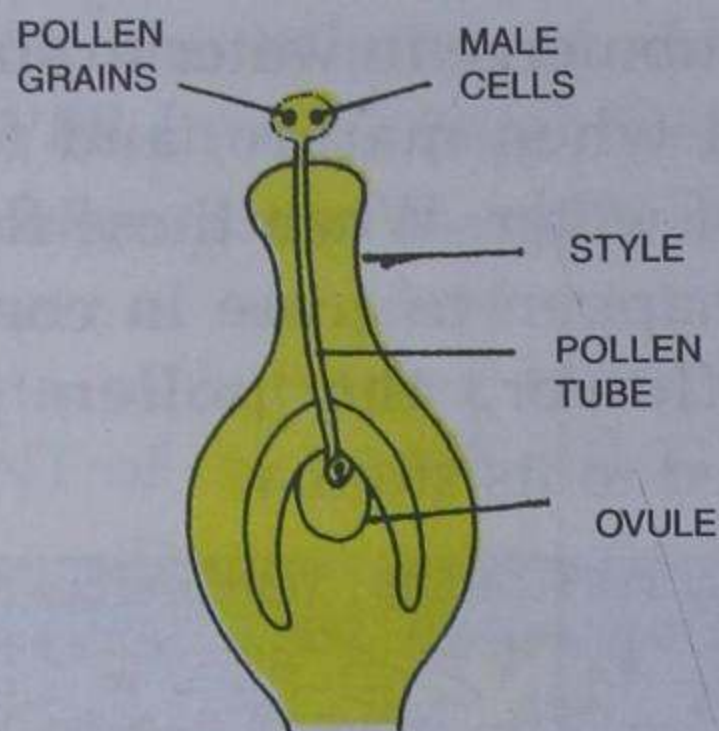


Fig. 3.11 Pollen tube entering the ovule

to produce a **zygote**. The fusion of sex cells is called **fertilisation**.

The ovule containing the fertilised cell develops into a seed. The covering of the ovule gives rise to the seed coat and the ovary turns into a fruit containing the seeds.

The ovary remains attached to the stalk of the flower and grows into a fruit. The ovules inside the ovary develop into seeds. The other parts, like the sepals and petals fall off.

The Fruit

For the common man, fruit is something sweet and fleshy, but for a science student, fruit is the **ripened ovary**. Thus tomato, pea and pumpkin are all fruits and not just vegetables. The term vegetable is not a scientific term, whereas, the fruit is.

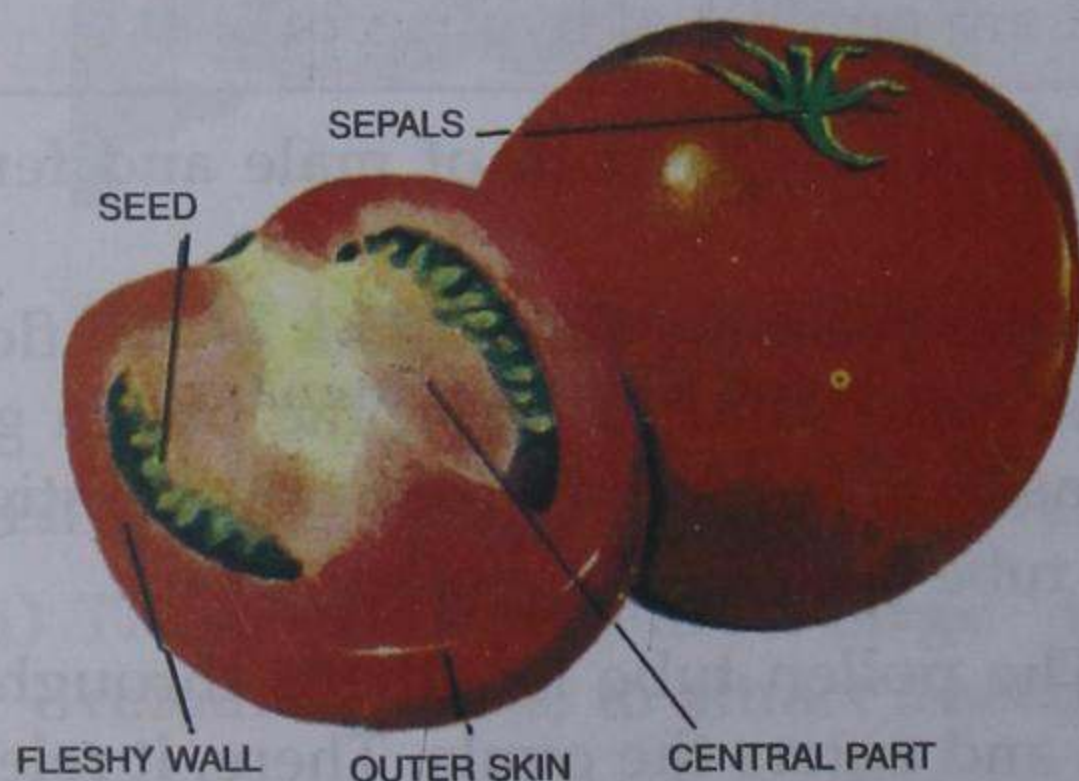


Fig. 3.12 Tomato (Whole fruit and cross-section)

A vegetable can be any part of a plant – root, stem, leaf or fruit, which can be cooked and eaten.

The wall of the ovary may be fleshy as in papaya and tomato, or dry as in pea, gram, maize, etc. Thus, a fruit may be a **fleshy fruit** or a **dry fruit**.

The so-called “dry fruits”, such as almond, cashewnut, walnut, pistachio, raisins, etc. are actually **dried fruits** and not dry fruits. Also, all dried fruits are fleshy fruits.

Apple and pear are different kinds of fruits. In these fruits, the base of the flower (and not the ovary) becomes the main fleshy part of the fruit which we eat, while the ovary remains a small central part containing seeds. Such fruits are called the “**false fruits**”.

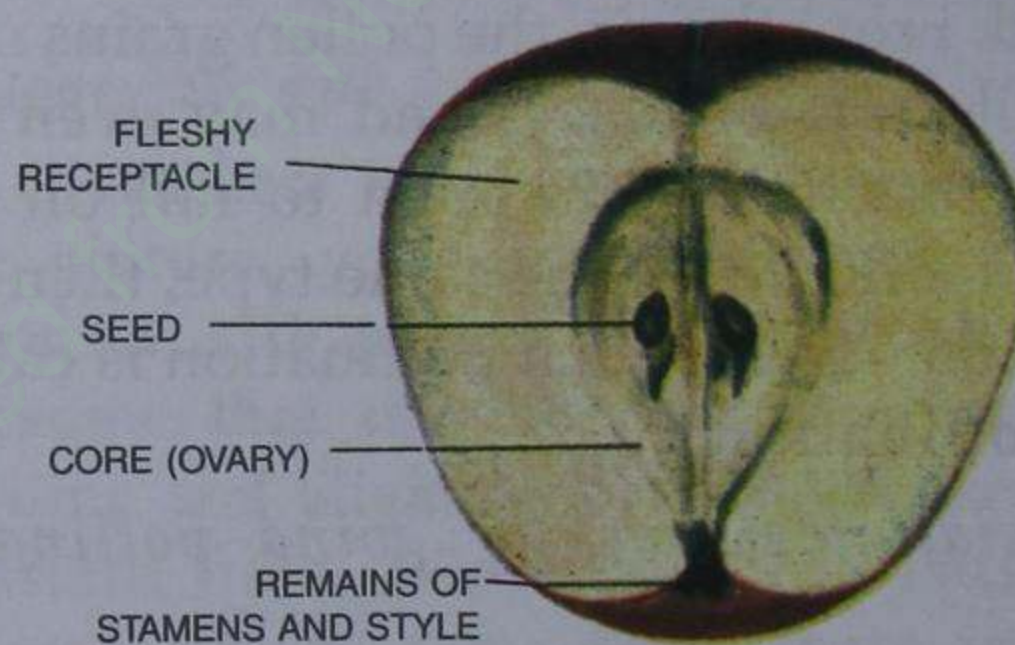


Fig. 3.13 Apple, in section

Why are they fruits and not just seeds ?

1. Fruit is a protective case for the seeds.
2. Fruit is a temptation to animals and man to eat it and scatter the seeds.

DISPERSAL OF SEEDS

Seeds must come out of the fruits to produce new plants.

In fleshy fruits, seeds come out only when the fruit wall decays or when animals or men eat the fleshy part and throw away the seeds. Most dry fruits, on the other hand, burst open and release the seeds. Any such

method of release of seeds is called **seed dispersal**.

DISPERSAL

Imagine what would happen if all the seeds produced in the fruits of a plant were to fall under the same plant and start sprouting. In this situation, a large number of plants would be grown in a small limited space. The water and the minerals available to them in the soil will be limited, the air surrounding them will not be enough, and less sunshine will be available to them. As a result, most of these sprouted plants will die. To avoid this kind of crowding, the fruits and seeds are somehow spread away from the

parent plant. This process of scattering is known as **dispersal of fruits and seeds**.

Dispersal of fruits and seeds is brought about by :

- (1) man and animals;
- (2) wind; and
- (3) water.

SEEDS THROUGH HUMAN FOOD CANAL

We take fruits like ripe tomatoes as a part of our food. Their seeds pass through intestine undigested. Carried in sewage, they remain viable for months together, and can germinate on finding suitable conditions.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick mark (✓) against the correct alternative in the following statements :
- (a) Pollen is produced in the :
 - (i) Filament
 - (ii) Style
 - (iii) Pistil
 - (iv) Anther
 - (b) Reproductive whorls of a flower are :
 - (i) Stamens and carpels
 - (ii) Sepals and petals
 - (iii) Sepals and stamens
 - (iv) Petals and carpels
 - (c) Grafting is a method of :
 - (i) Artificial vegetative propagation
 - (ii) Sexual reproduction
 - (iii) Artificial pollination
 - (iv) Cross-pollination
 - (d) Which one of the following is a false fruit ?
 - (i) Tomato
 - (ii) Apple
 - (iii) Potato
 - (iv) Pea

Short Answer Questions :

1. Write **two** ways in which pollination may occur in plants.
- (a)
 - (b)
2. Name the **three** agents of pollination.
- (a)
 - (b)
 - (c)

3. Give **two** features of flowers which favour pollination by insects :

(a)

(b)

4. Name **two** characteristics of flowers in which pollination occur by wind :

(a)

(b)

5. What is a "false fruit" ? Give one example :

.....

.....

6. Name any **three** agencies for dispersal of seeds :

(a)

(b)

(c)

7. Fill in the blanks by selecting suitable words :

(unisexual, fertilisation, fruit, stamen, anther, bisexual, pollination, seed, ovary)

(a) A flower that bears both the male and the female parts is known as flower.

(b) A flower bearing only male or female parts is known as flower.

(c) Transfer of pollen grains from the anther to the stigma is known as

(d) Fusion of male cell with the female cell is called

(e) The ovule develops into a

(f) The ovary of the flower develops into a

Long Answer Questions (Write the answers in your note-book) :

1. What is vegetative reproduction ?

2. Give **four** advantages of vegetative reproduction.

3. Write **two** disadvantages of vegetative reproduction.

4. What is meant by pollination ? Explain the structure of germinating pollen grain with the help of a labelled diagram.

5. Imagine that all the seeds produced by a plant happen to fall under the same plant and sprout into new plants. Mention any **two** problems that will be faced by the new plants :

6. What is a flower ? Write down the structure of a typical flower with the help of a labelled diagram.

7. Write short notes on the following :

(a) Binary fission

(b) Bryophyllum

(c) Vegetative reproduction

(d) Grafting