Ratna Sagar

RATNA SAGAR | PRIMUS | BYWORD | E-LIVE

Education, Our Mission

As per the latest ICSE syllabus

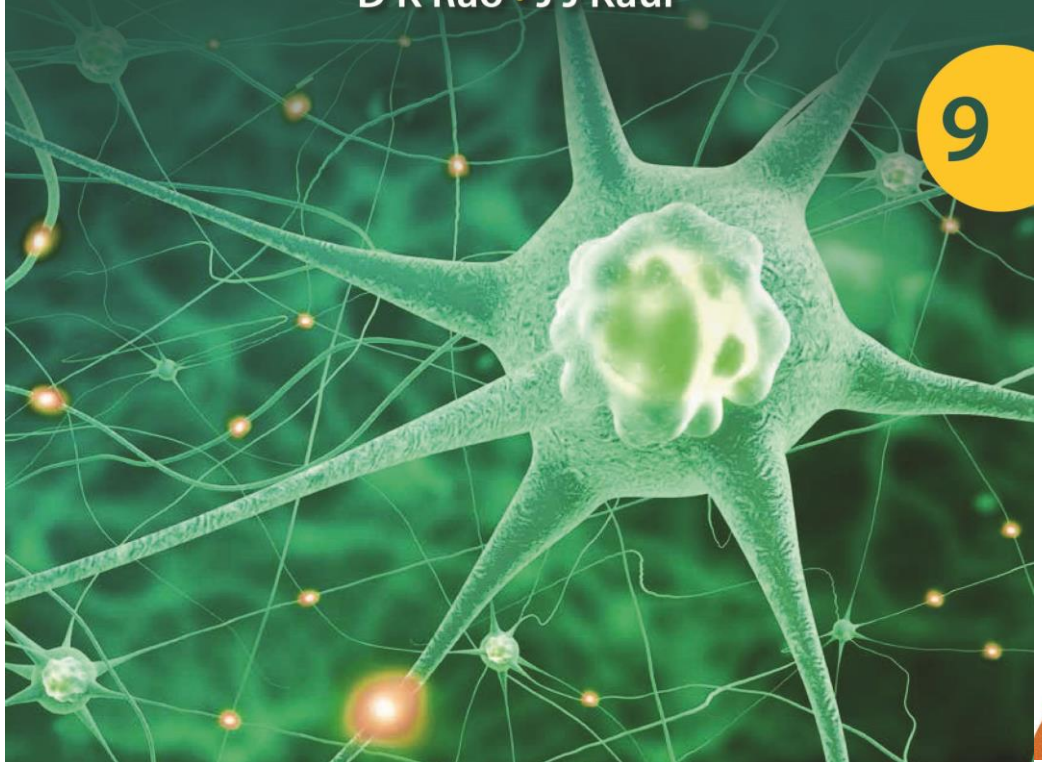
Rama Sagar
Education, Our Mission!

Revised and Updated

LIVING SCIENCE BIOLOGY

D K Rao • J J Kaur

9



ICSE
Living Science
Biology

Class 9

Chapter 4 Pollination and Fertilization

LEARNING OBJECTIVES

Self-pollination

- ❖ What is self-pollination?
- ❖ When does self-pollination occur?
- ❖ Advantages of self-pollination
- ❖ Disadvantages of self-pollination

Cross-pollination

- ❖ Advantages of cross-pollination
- ❖ Disadvantages of cross-pollination
- ❖ Mechanisms of cross-pollination
- Artificial pollination

Fertilization and development of the seed

- ❖ Double fertilization and triple fusion
- ❖ The ovule develops into a seed, an embryo with a supply of nutrients in the seed coat
- ❖ The ovary develops into a fruit

What is pollination and how is it carried out?

Pollination is the transfer of pollen grains from the anther to the stigma. This can happen in three ways:

1. Autogamy: The pollen may be transferred from the anther to the stigma of the same flower itself, known as **autogamy**.

2. Geitonogamy: The pollen of another flower may fall on stigma of different flower on the same plant, known as **geitonogamy**.

3. Allogamy: The pollen of a flower may fall on the stigma of flower of another plant of the same species, known as **allogamy**.

Self-pollination

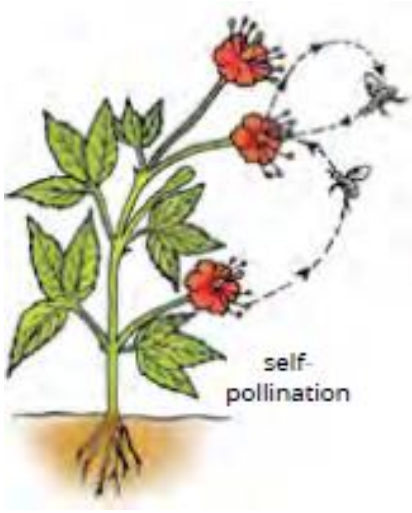
Pollination occurs between plants of the same species.

There are two types of pollination – self-pollination and cross-pollination.

The transfer of pollen grains from the anther to the stigma of the same flower (autogamy), or to the stigma of another flower of the same plant (geitonogamy) is known as **self-pollination**

When does self-pollination occur?

Self-pollination generally takes place in bisexual flowers because they have both male and female gametes in the same flower. It may also occur between unisexual flowers on the same plant. As the genetic make-up of gametes is identical in flowers borne on the same plant, the new plantlets formed resemble the parent plant.



Advantages of self-pollination

- Self-pollination is **easy and most likely to occur** as stamens and carpels mature at the same time.
- It **preserves the parental characters indefinitely** because the gametes of the same flower or flowers of the same plant are involved.
- **Small quantity of pollen is sufficient**, thus, it is **economical**.

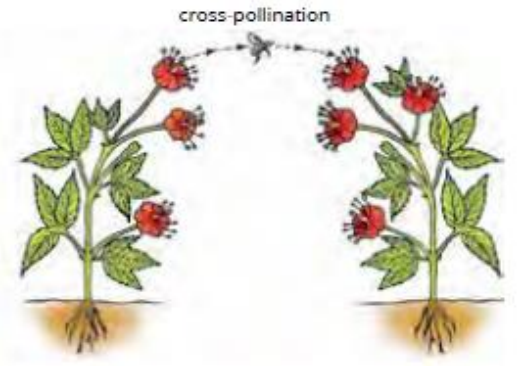
❖The flowers need not produce nectar and scent, and they **need not be showy**.
❖ The flowers generally do not depend on pollinating agents.

Disadvantages of self-pollination

❖ As self-pollination occurs regularly generation after generation, it **leads to loss of vigour and vitality** of the plant variety. Repeated self-pollination produces **poor quality seeds** that produce **weak offsprings**.
❖ The genetic defects of the plant variety cannot be eliminated.
❖ **New varieties cannot be obtained** by self-pollination.

Cross-pollination

The transfer of pollen grains from anther of a flower of one plant to the stigma of a flower of another plant of the same species is known as cross-pollination or allogamy.



Advantages of cross-pollination

❖ Seeds produced contain another source of genetic material which may contain genes which are advantageous for survival of the seedling.
❖Seeds produced are healthier and have better germinating capacity.
❖ Seeds produce healthier offsprings.
❖ Cross-pollination is a source of variation in offsprings because of intermixing of genetic make-up of two plants.

Disadvantages of cross-pollination

❖ Pollination is uncertain because plants have to depend on external agents for pollination, which may or may not be available at the right time.

❖ The pollen grains have to be produced in larger amounts to ensure their availability for pollination. Thus, a lot of pollen is wasted in this way.

❖ The process is not economical because the flowers have to adapt themselves to attract pollinating agents.

❖ **Sometimes, cross-pollination may lead to poor quality seeds** because of mixing of some feeble genotypes of one or both the parent plants.

Mechanisms of cross-pollination

There are two main groups of agents of cross-pollination. These are **abiotic agents** like wind and water, and **biotic agents** like insects, birds and mammals.

Abiotic agents

Wind pollination or anemophily

Many flowers are anemophilous or wind pollinated. Grass, maize, hazel and willow are some examples of plants pollinated by wind.

Note: The main differences between self-pollination and cross-pollination are given in Table 4.1.

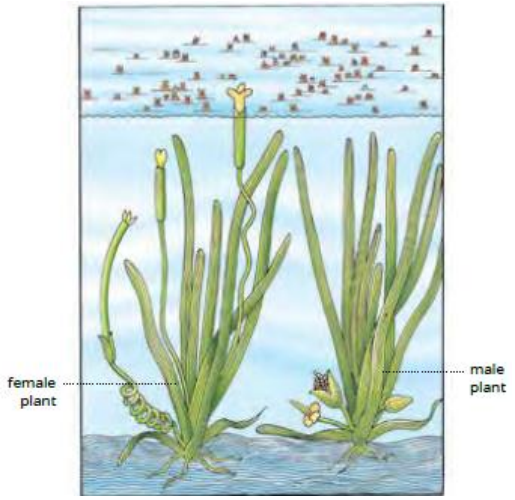
Most wind pollinated flowers have the following **characteristic features** which increase the chances of the pollen reaching the stigma.

- **Large amount of pollen is produced** so that each grain has adequate chance of reaching a stigma.
- The **flowers are usually small**.
- Flowers have **long stalk** or are above the leaves, so that they are **clearly exposed to air**.
- Small, **light**, **dry** and smooth **pollen grains** are produced which can be easily carried even by slightest breeze.
- **Large stamens which have long filaments** so that they can hang well outside the flower and are loosely attached so that they sway and shake out pollen in the lightest breeze.
- **Feathery stigma** which spreads out and acts like a net, catching pollen as it floats through air.
- Flowers **have no petals** or have **very small inconspicuous petals** which are often white or green, i.e. **not brightly coloured**.
- Flowers **do not produce scent or nectar**, i.e. nectaries are absent altogether.

Water pollination or hydrophily

Pollination by water is not common but a few aquatic plants such as seed grasses, *Vallisneria* and water weeds release their pollen in water which is passively carried to other flowers by water currents.

Flowers pollinated by water show following **characteristic features.**



❖ **Pollen grains are produced in large numbers** so that they have enough chances of reaching the stigma.

❖ Plants are **dioecious**, i.e. male and female flowers borne on separate plants.

❖ Flowers are usually small and inconspicuous.

❖ In some plants, **pollen grains have specific gravity** equal to water so that they can float below the water surface.

❖ They have **very light flowers which can float** easily on the water surface.

Biotic agents

Pollination by insects or entomophily

Many flowers are pollinated by insects. The best known example is of honeybees. Wasps, moths and butterflies also pollinate flowers.

Buttercup, sweet pea, dandelion and many vegetables are some examples of flowers pollinated by insects. These flowers have some or all of the following **characteristics** which attract insects and ensure pollination

Pollination by animals or zoophily

1. Pollination by birds or ornithophily: Many flowers are pollinated by birds, for example, *Begonia* and *Canna*. The birds include hummingbirds, etc.

❖ The flowers pollinated by birds are usually bright red or yellow in colour with very little odour, as birds do not have a keen sense of smell, but have excellent vision.

❖ Flowers are **usually large** or are a part of large inflorescence.

❖ Flowers produce large amount of nectar in long floral tubes so that it is not consumed by insects.

2. Pollination by mammals: Many mammals such as bats, squirrels and elephants are useful pollinators of some plants.

Pollination by elephant is found in *Rafflesia*, whose flowers are very large and at ground level. The pollen grains of one flower may get attached to the feet of an elephant and when it steps on or touches the other flower, they get transferred to the stigma of other flower.

Artificial pollination

Sometimes, man artificially transfers pollens to the stigma, known as **artificial pollination**. Artificial pollination is a standard practice to produce new plant varieties.

Pollen grains are carefully removed from mature anthers and are placed on the mature stigma of another flower of the same or other plant of the same species. These are then kept under ideal conditions till fruits and seeds are produced. The positive seeds produced are germinated and this whole process is repeated several times till new positive varieties are produced.

Artificial pollination is common in crops like wheat and maize, and garden plants like pansy and stock.

Fertilization and development of the seed

There are various steps of fertilization and development of the seed:

❖ **Pollination brings female and male gametophytes together.**

For the egg to be fertilized, the male and female gametophytes must meet and unite their gametes. This is done by pollination, in which pollen is placed on the stigma of the carpel.

❖ **Germination of pollen grain.** Under suitable conditions, the cytoplasm of the pollen grain absorbs sugar and water from the stigma and bulges out to produce a tube known as **pollen tube** by breaking down exine of pollen grains. This tube grows down through the stigma and style towards the ovary. This tube produces chemicals, calcium, such as that dissolves the tissues of the style and the tip of the pollen tube enters the ovary through the micropylar end.

❖ The generative nucleus of the pollen grain divides by mitosis and forms two male gamete nuclei . The pollen grain, with a tube containing two male gametes, constitutes the mature **male gametophyte**. The ovule contains the egg cell inside the embryo sac.

❖ The tip of the pollen tube after entering ovary probes through the micropyle, ruptures and discharges the two male gametes into the embryo sac.

❖ One of the male gametes fuses with the egg to form the **zygote**. This fusion is called **fertilization**. Another male gamete fuses with the diploid secondary nucleus (fusion product of two polar nuclei) and forms the **endosperm**, a food storing tissue.

Double fertilization and triple fusion

As this process involves the fusion of two male gametes separately, one with the egg and the other with the secondary nucleus, this process of fertilization is called double fertilization. Since three nuclei are involved in this fusion, it is called **triple fusion**. As a result, a diploid zygote and a triploid endosperm nucleus are formed. The zygote divides several times and forms an embryo, while the endosperm nucleus grows to form the endosperm.

The ovule develops into a seed, an embryo with a supply of nutrients in the seed coat

Following fertilization, the sepals, petals, style and stigma degenerate and usually fall-off. The **ovary wall ripens and forms the pericarp of the fruit. The ovule develops into a seed. The endosperm cell divides to form the endosperm** or nutritive tissue which supplies food to the developing embryo. The seed contains a potential plant or embryo. The embryo contains a tiny root (radicle), a small shoot (plumule) and cotyledons. There are two cotyledons in dicots and one cotyledon in monocots. As the seed matures, it hardens, and dries, enabling it to survive in adverse environmental conditions

The ovary develops into a fruit

The whole ovary after fertilization changes into a fruit, which protects the enclosed seed. The wall of the ovary may harden and become a pod, as in poppy, or it may become fleshy and succulent, as in plums or tomatoes. There may be one or more seeds in a fruit. When the fruit is ripe, contents are released by the fruit and the seeds are dispersed.

The embryo lies dormant in the seed. At the onset of favourable conditions, it becomes active and germinates into a small seedling through a seed germination process

SUMMARY...

- ❖ Pollination is the transfer of pollen grains from the anther to the stigma of the same flower or of a different flower.
- ❖ Pollination is of two types – self-pollination and cross-pollination.
- ❖ Self-pollination is the transfer of pollen grains from the anther to the stigma of the same flower or of another flower of the same plant.
- ❖ Flowers have many adaptations for self-pollination (homogamy and cleistogamy).
- ❖ The transfer of pollen grains from anther of flower of one plant to the stigma of a flower of another plant of the same species is called cross-pollination.
- ❖ Nature favours cross-pollination by unisexuality, dichogamy, protandry, protogyny, self-sterility, herkogamy and heterostyly.
- ❖ There are diverse mechanisms of cross-pollination such as pollination by wind, water, insects, animals, birds and mammals.
- ❖ Pollination can be brought about artificially by transferring pollen to the stigma.
- ❖ During fertilization, pollen grains germinate on the stigma and the pollen tube penetrates the ovule.
- ❖ After fertilization, ovary changes into fruit, ovules become seeds, and other floral parts dry and fall-off.


RATNA SAGAR
PRIMUS
BYWORD
E-LIVE
THANK
YOU