BAL BHARATI PUBLIC SCHOOL PITAMPURA
TEXTBOOK- BIOLOGY NCERT
CHAPTER- REPRODUCTION IN FLOWERING PLANTS

STEP 1- READ THE CHAPTER- SEXUAL REPRODUCTION IN FLOWERING PLANTS
UNDERLINE THE DIFFICULT TERMS
PRACTICE THE DIAGRAMS

STEP 2- READ THE NOTES CAREFULLY. FOLLOW THE YOUTUBE LINKS MENTIONED AFTER EVERY TOPIC

TOPIS COVERED :

1. SEXUAL REPRODUCTION-
A SPOROGENESIS
TYPES- MICROSPOROGENESIS AND MEGASPOROGENSIS
* MEGASPOROGENESIS- TYPES OF OVULES
B GAMETOGENESIS
TYPES- MICROGAMETOGENESIS AND MEGAGAMETOGENESIS
2 POLLINATION
TYPES- SELF POLLINATION AND CROSS POLLINATION
* CROSS POLLINATION- DIFFERENT TYPES OF AGENTS
3 DEVICES OR CONDITIONS OR CONTRIVANCES OR ADAPTATIONS
4 FERTILIZATION
5 EMBRYOGENY AND ENDOSPERM FORMATION(POST FERTILISATION CHANGES)
6 APOMIXIS, POLYEMBRYONY AND PARTHENOCARPY

STEP 3- ATTEMPT THE GIVEN ASSIGNMENT

STEP 4- DO ASK QUESTIONS IN THE DOUBT SESSION

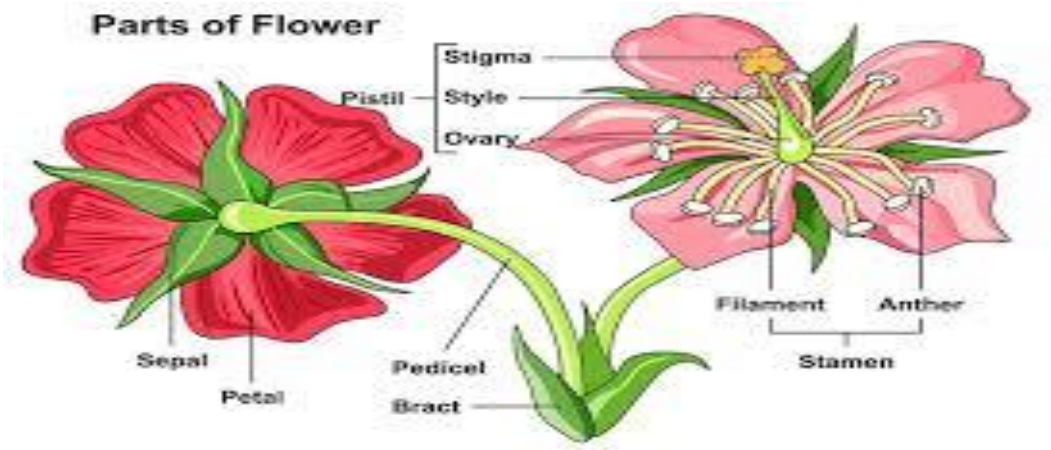
PLANT WORLD

Flowers are collections of reproductive and sterile tissue arranged in a tight whorled array having very short internodes. Sterile parts of flowers are the sepals and petals. When these are similar in size and shape, they are termed tepals. Reproductive parts of the flower are the stamen (male, collectively termed the androecium) and carpel (often the carpel is referred to as the pistil, the female parts collectively termed the gynoecium).

Did you know that a lot of plants these days are cloned? The cloning of plants is very common. In fact, it's so common that some plants even clone themselves naturally without any help from us.

Checking Your Knowledge:

Identify the parts of the flower which directly participate in the reproduction.



Flower structures

- anther
- embryo sac
- filament
- ovary
- ovule

- peduncle
- petal(s)
- pistil (carpel)
- pollen
- receptacle
- sepal(s)
- stamen
- stigma
- style

Flowers are the sexual organs of angiosperms. Many plants have both the male and female reproductive organs in the same flower although some may have male and female structures on different plants all together.

there are components which can usually be identified in all flowers. These are:

Peduncle- The stalk or stem of a flower is called the **peduncle**.

Receptacle- The **receptacle** is the top part of the flower stalk where the different flower parts attach.

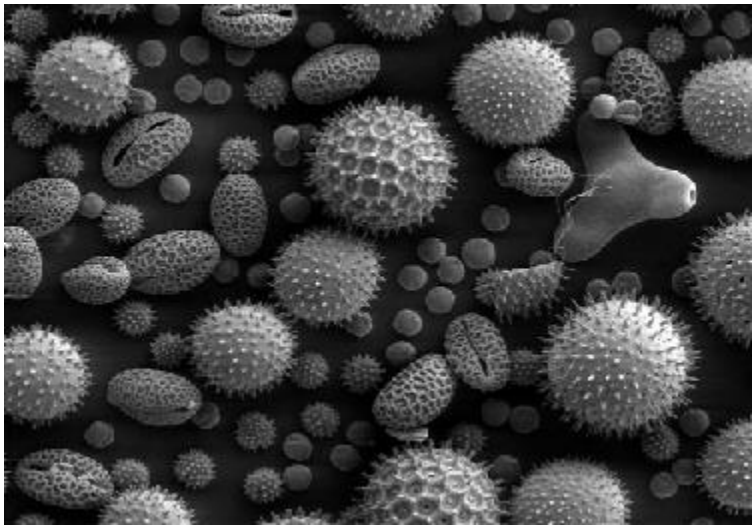
Petals-Flower **petals** are usually the brightly coloured parts of the flower. They attract **pollinators**, such as insects and birds and also bats

Sepals- While the flower bud is forming, small green leaves protect and enclose the young bud. These are the **sepals**.

the male structures-The **stamen** is the male part of the flower. There are two parts to the stamen: the **anthers** and the **filaments** on which the anthers rest.

Anthers produce the pollen that contain the male reproductive sex cells. The male cells in the pollen is carried to the female sex cells and when they fuse they will create a seed which can grow into a new plant.

A photograph of a variety of pollen grains from different plants



Filaments are stalk-like structures that support the anthers. In some flowers the filaments may be long and in others relatively short.

Study the photos of the different flowers given below. Describe the outer structures of each of these flowers based on their peduncles (stalks) and receptacles, and their sepals and petals.

Rose	_____straight peduncles (stalks) to hold the flowers high up to the sun; _____ sepals to protect the buds; flower petals are _____ to attract pollinators
Lily	_____ straight peduncle, which is underwater and _____ rigid than the sunflower so it can sway in the water; there is an inner layer of white petals, and the outer layer are actually white sepals, and not petals.
Petunia	_____ peduncles that branch from a shrub; small green sepals, large pink petals to _____ pollinators.

Female reproductive structures

The **pistil** is the female organ of the plant and is usually at the centre of the flower. It consists of a stigma, style and ovary. All the parts of the pistil work specifically to help the plant receive pollen, transport it and have it fertilise the **ovules** (that contain female sex cells). Ovules become seeds after **fertilisation**.

Each carpel consists of a stigma, style and ovary. Some flowers have one carpel, and some have many. Therefore in some flowers, the carpel and the pistil are the same thing, but in others, many carpels make up one pistil!

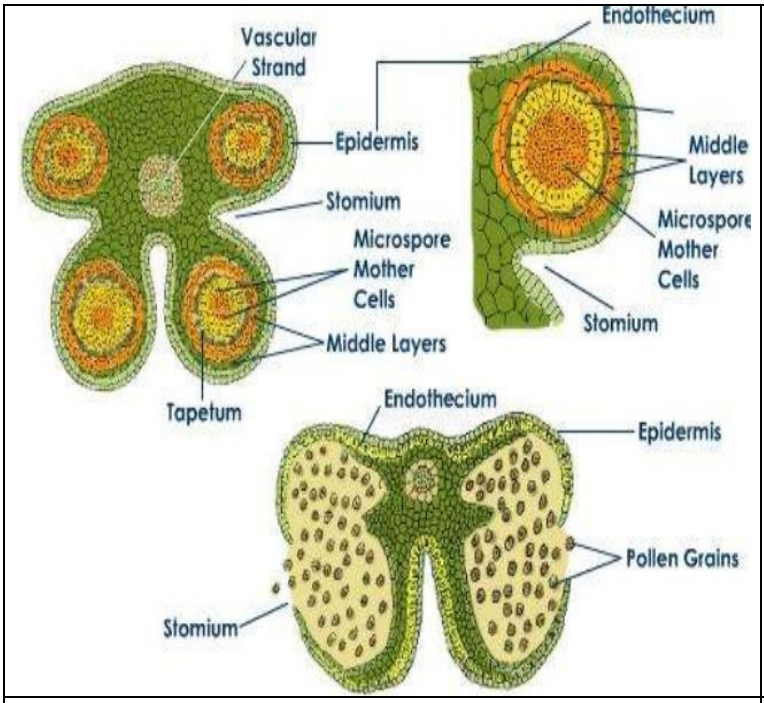
The **stigma** is the structure that receives the pollen during pollination. It is on top of a long narrow style and when it is ready to receive pollen it becomes sticky providing a place for the pollen to stick to.

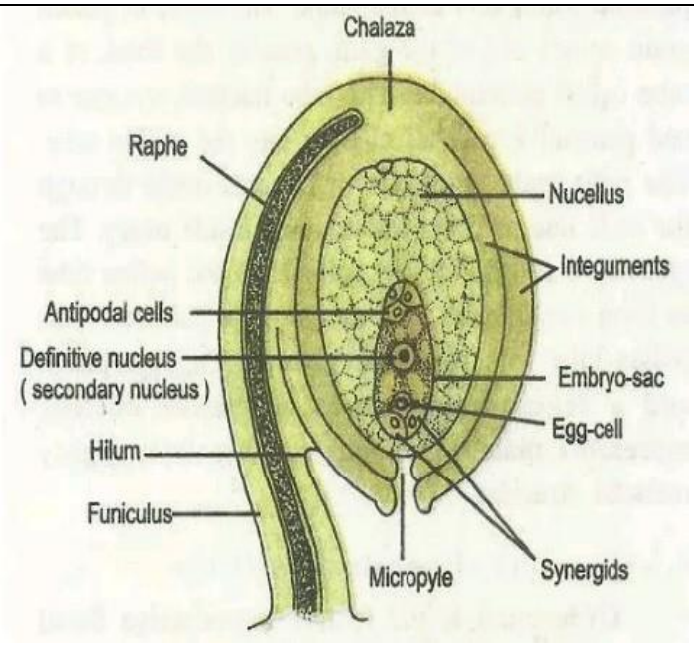
The **style** is a long tube that connects the stigma with the ovary and the ovules. The style supports the stigma and holds it in the best possible position to receive the most pollen grains. After the pollen has landed on the stigma, the pollen grows long tubes called pollen tubes down through the style from the stigma to the ovules in the ovary.

The **ovary** is the enlarged structure at the base of the pistil. It may be divided into different parts (or locules) and produces the ovules that contain the female reproductive sex cells. Within the ovule is the **embryo sac**. The embryo or tiny seed will develop in here.

TRANSVERSE SECTIONS OF MALE AND FEMALE REPRODUCTIVE STRUCTURES

STRUCTURE OF ANTHER	STRUCTURE OF OVULE



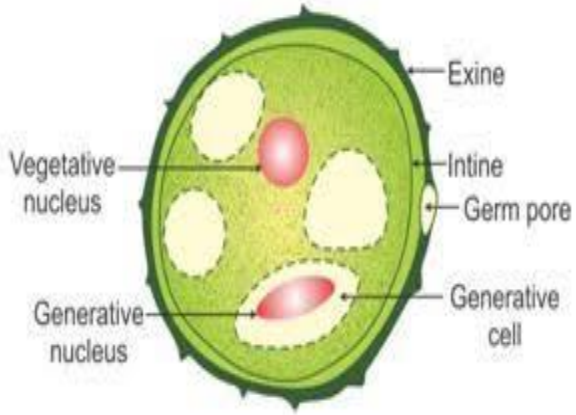


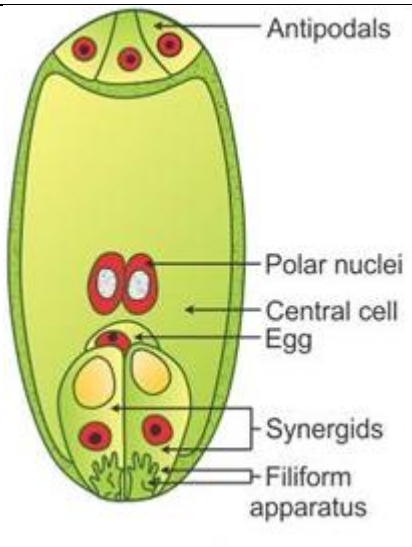
https://www.youtube.com/watch?v=tYj-QYDM6Vw

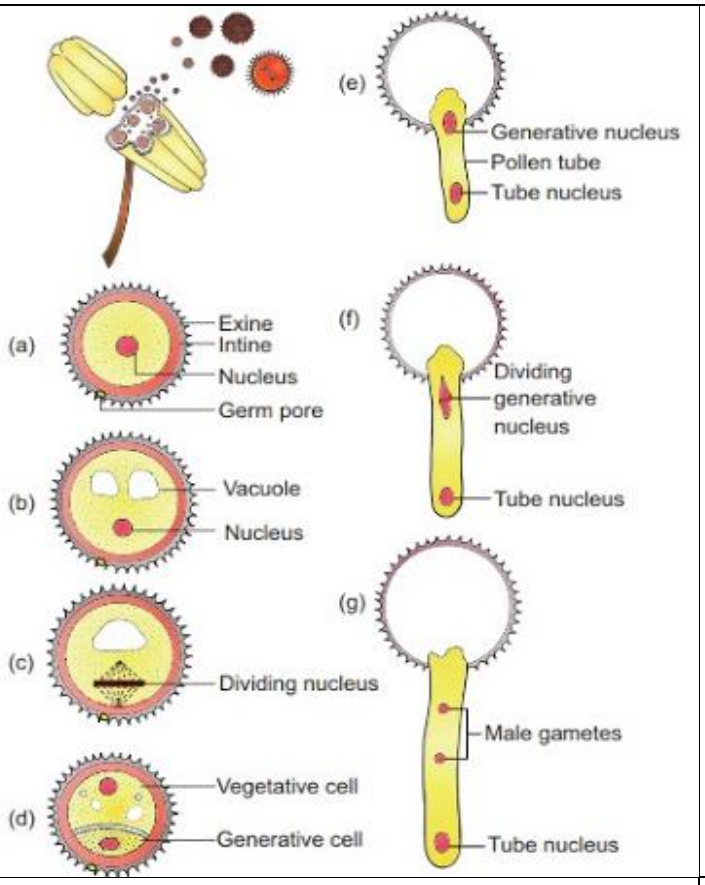
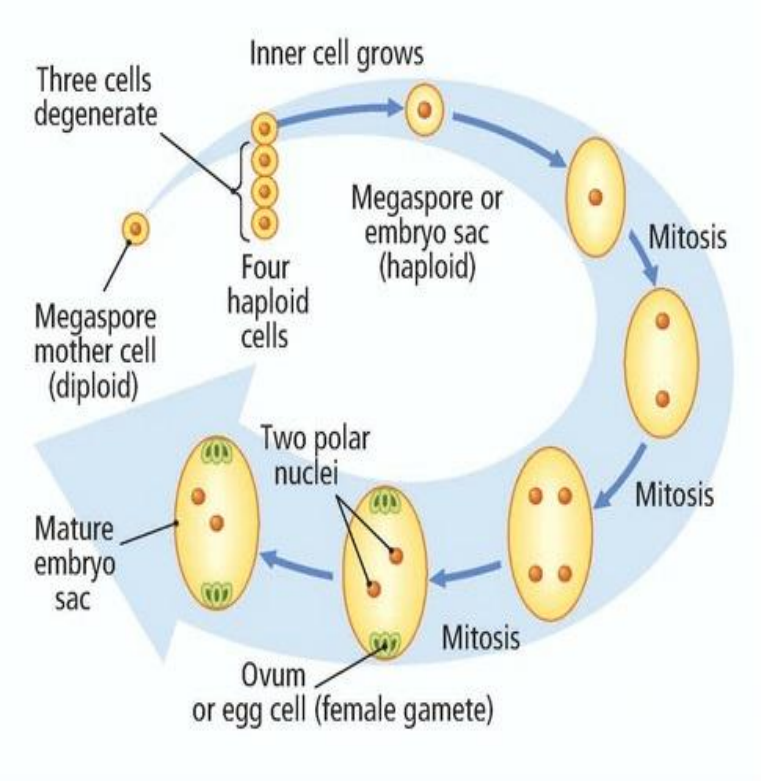
https://www.youtube.com/watch?v=f6ctdQtz6do

STRUCTURE OF POLLEN GRAIN

STRUCTURE OF EMBRYO SAC





	
Development of male gametophyte starts in pollen grains, while still present in the microsporangium or pollen sac (**precocious germination**). Microspore undergoes only **two mitotic divisions**. First mitotic division leads to the formation of a vegetative cell and generative cell.	The sporogenous cell enlarges into a megaspore mother cell, which undergoes meiosis forming megaspores. The **chalazal spore** enlarges and produces the embryo sac. Its nucleus undergoes three successive divisions resulting in an eight-nucleate embryo sac.

Difference between Microsporogenesis and Megasporogenesis

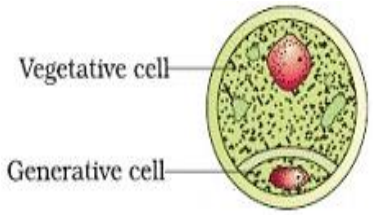
Microsporogenesis vs Megasporogenesis	
Microsporogenesis is the formation of haploid microspores from a diploid microspore mother cell by meiosis.	Megasporogenesis is the formation of haploid megaspores from a diploid megaspore mother cell by meiosis.
Arrangement of Spores in a Tetrad	
The arrangement of microspores in a tetrad is tetrahedral in microsporogenesis.	The arrangement of megaspores in a tetrad is linear in megasporogenesis.

Functional Spores	
All four microspores produced by microsporogenesis are functional.	Only one megaspore out of four megaspores produced by megasporogenesis is functional.
Location	
Microsporogenesis occurs inside pollen sacs.	Megasporogenesis occurs inside the ovule.
Production of Gametophytes	
Microspores produce pollens.	Megaspores produce embryo sacs

How are the two cells inside the pollen grain(male gametophyte) different?

VEGETATIVE CELL

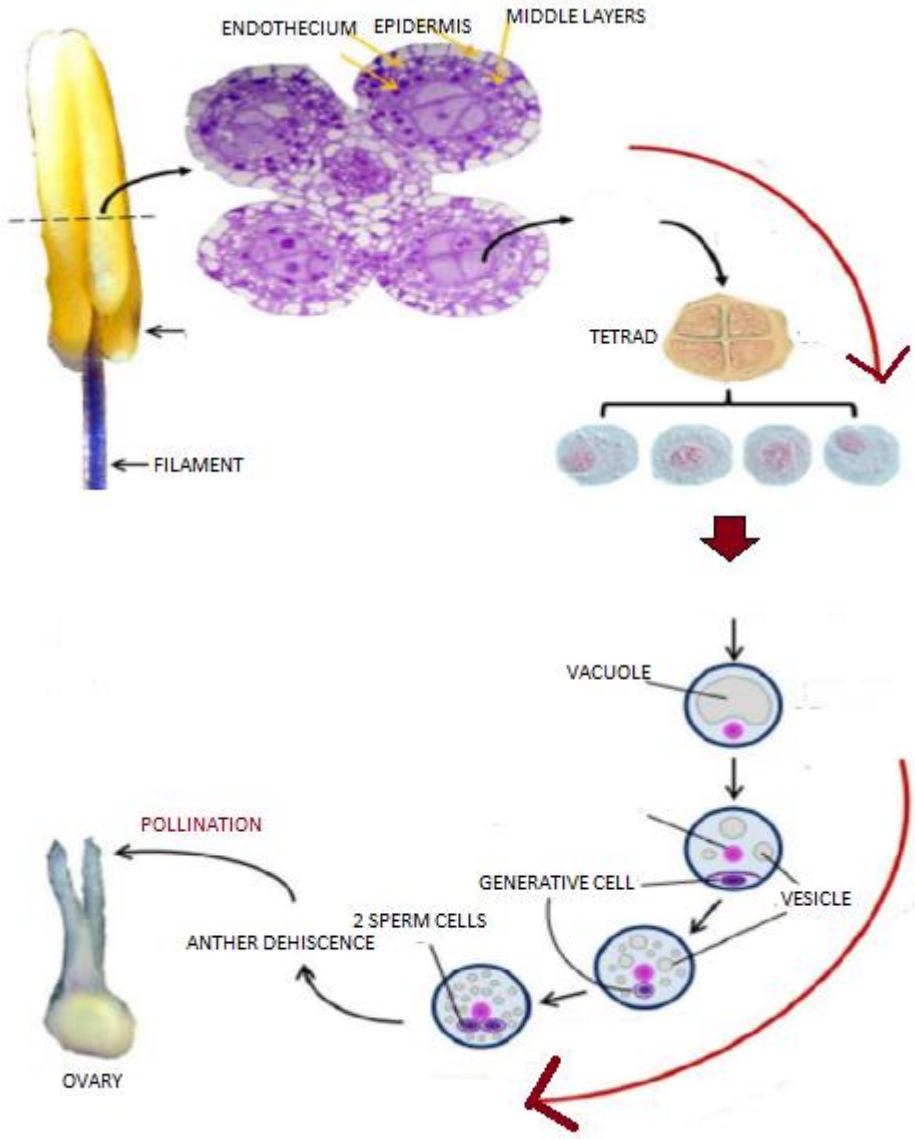
- Bigger
- Abundant food reserve
- Large irregular nucleus
- Responsible for the development of pollen tube



GENERATIVE CELL

- Small
- Divides to produce two male gametes which are involved in the fusion with
  in syngamy (fusion with an egg) and triple fusion (fusion with two polar nuclei
- Dense cytoplasm and nucleus

Checking Your Knowledge:



Use the lables given in this box to indicate the parts mentioned in the images given alongside.

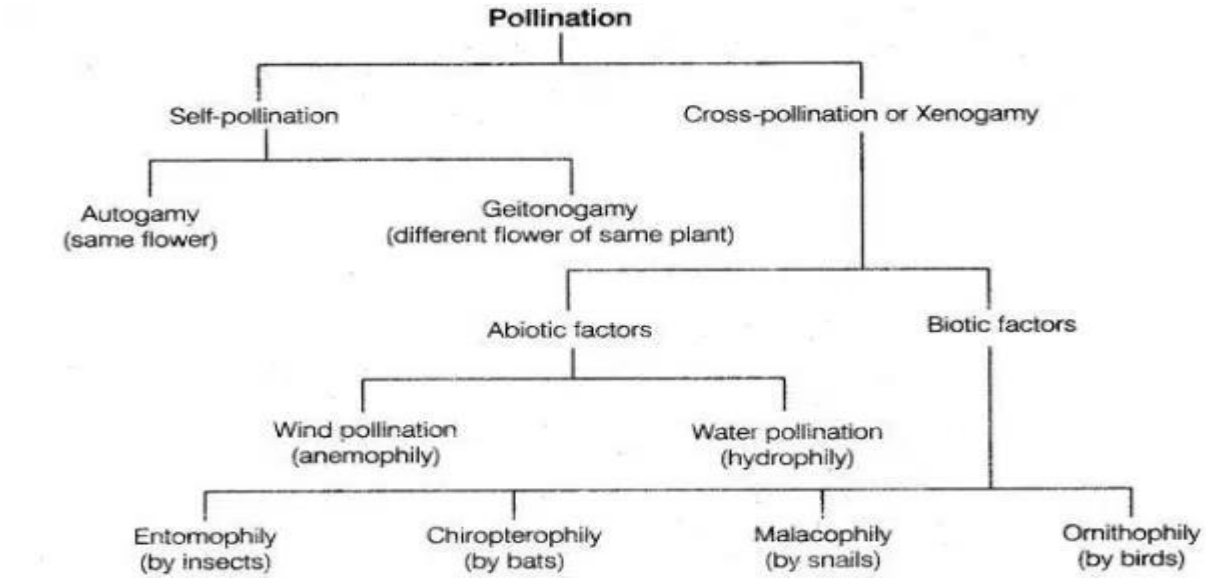
1. MICROSPOROGENESIS
2. POLLEN MOTHER CELL
3. TAPETUM
4. MEIOSIS
5. MITOSIS I
6. TRICELLULAR POLLEN
7. VEGETATIVE NUCLEUS
8. UNINUCLEATE YOUNG MICROSPORE
9. MICROGAMETOGENESIS
10. ANTHER

STAGES IN THE GERMINATION OF MICROSPORE AND DEVELOPMENT OF MALE GAMETOPHYTE

WHAT HAPPENS WHEN MALE GAMETOPHYTE AND FEMALE GAMETOPHYTE ARE FULLY DEVELOPED?

It is time for pollination

TYPES OF POLLINATION- AUTOGAMY, GEITONOGAMY, XENOGAMY



AGENTS OF CROSS POLLINATION

https://www.youtube.com/watch?v=J7q9Kn1rhRc- Pollination by Bumble bee
https://www.youtube.com/watch?v=QTceLKXwHLY- Pollination by Humming bird
https://www.youtube.com/watch?v=MJvbuPBe2cg- Pollination by Wind
https://www.youtube.com/watch?v=Y1N7amYs6gc - Pollination by Water

Self-pollination is also called as inbreeding whereas cross-pollination is known as outbreeding.

Reasons for Outbreeding

Continued inbreeding or self- fertilization leads to a condition called as inbreeding depression. This condition is characterized by homozygous genes which are not as vital as they need to be leading to unhealthy offsprings.

In self- pollination, since both the male and female gametes share the same genes, there is no genetic variation seen which is necessary for a better, more productive offspring. So, most plants have many mechanisms that they employ to avoid self -pollination and promote cross-pollination.

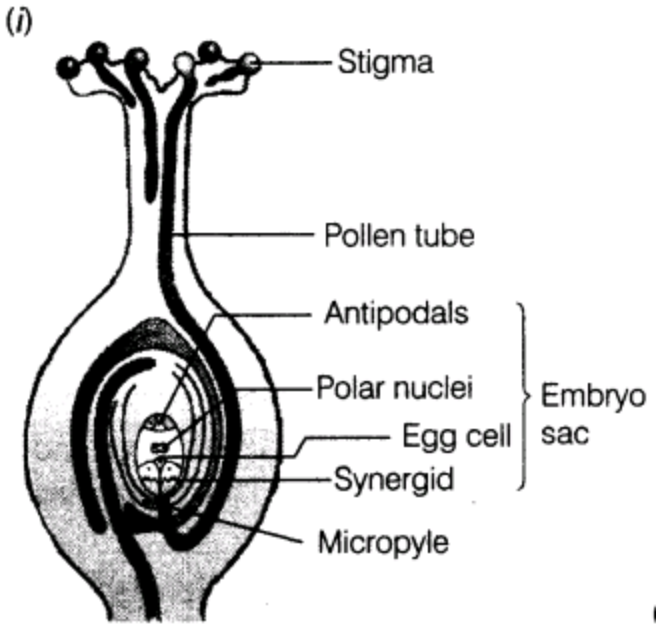
Outbreeding Devices

Plants have many mechanisms and devices that they employ to promote cross-pollination. Let us look at a few of them in the following segments:

Follow the link to understand different outbreeding devices-**https://www.youtube.com/watch?v=GIvntHFMxvo**

- **Unisexuality**
- **Dichogamy**
- **Herkogamy**
- **Heterostyly**
- **Self- Sterility**
- **Heterostyly:**
- **Pollen prepotency:**

Pollen-Pistil interaction



Double Fertilisation

Double fertilization is a defining feature of reproductive development in the most evolutionarily successful and wonderfully diverse group of plants on the earth known as the angiosperms or flowering plants.In seeds of flowering plants, the embryo is surrounded by a nutritive tissue called endosperm. Embryo and endosperm are derived from individual fertilization events (double fertilization) and develop embedded in maternal tissues that form the seed coat.
https://www.youtube.com/watch?v=bUjVHUf4d1I

Pollination described above is just the beginning or rather the first step of pollen-pistil interaction. The pistil is the female reproductive part of a flowering plant comprising of the ovary, style, and stigma. The pollen-pistil interaction begins with pollination, followed by pollen adhesion to the stigma. After it adheres, it imbibes water and gets hydrated which initiates pollen tube germination.

This pollen tube penetrates through the stigma and the tube grows through the style and reaches the ovary. Once it reaches the ovary, the tube penetrates it and reaches the micropyle of the ovule and enters into the embryo sac. Here, the two male nuclei fuse with the megaspore and the vegetative nucleus to form the diploid zygote and the triploid endosperm respectively. This fusion of the male and female gametes is known as fertilization.

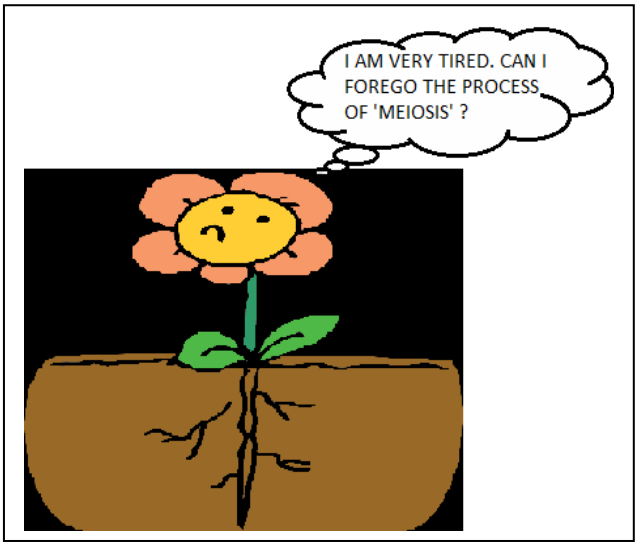
SEED DEVELOPMENT

When a plant creates new life through sexual reproduction, it encases the new life in a tiny protective package, along with a supply of food and this is called as the seed.

https://www.youtube.com/watch?v=a9n2aUJ5Xuw

Step 1- Activity: SEED DISSECTION Follow the link given below to understand the differences between monocot seed and dicot seed. https://www.youtube.com/watch?v=c-c5sV9bPDg (Note- There is no requirement of dissection microscope as the parts of seeds are visible with naked eye)	**Step 2**-After watching the video, make the word bank and list the role of each part. You can take the help of Biology NCERT textbook.
Step 3- DICOT SEED AND MONOCOT SEED Prepare a list of dicot and monocot seeds(5 each) that you will be dissecting and make a 1 minute video and share on the group.	**Step 4-** On the basis of above activity find out which seeds have completely consumed their endosperm and which seeds have not.

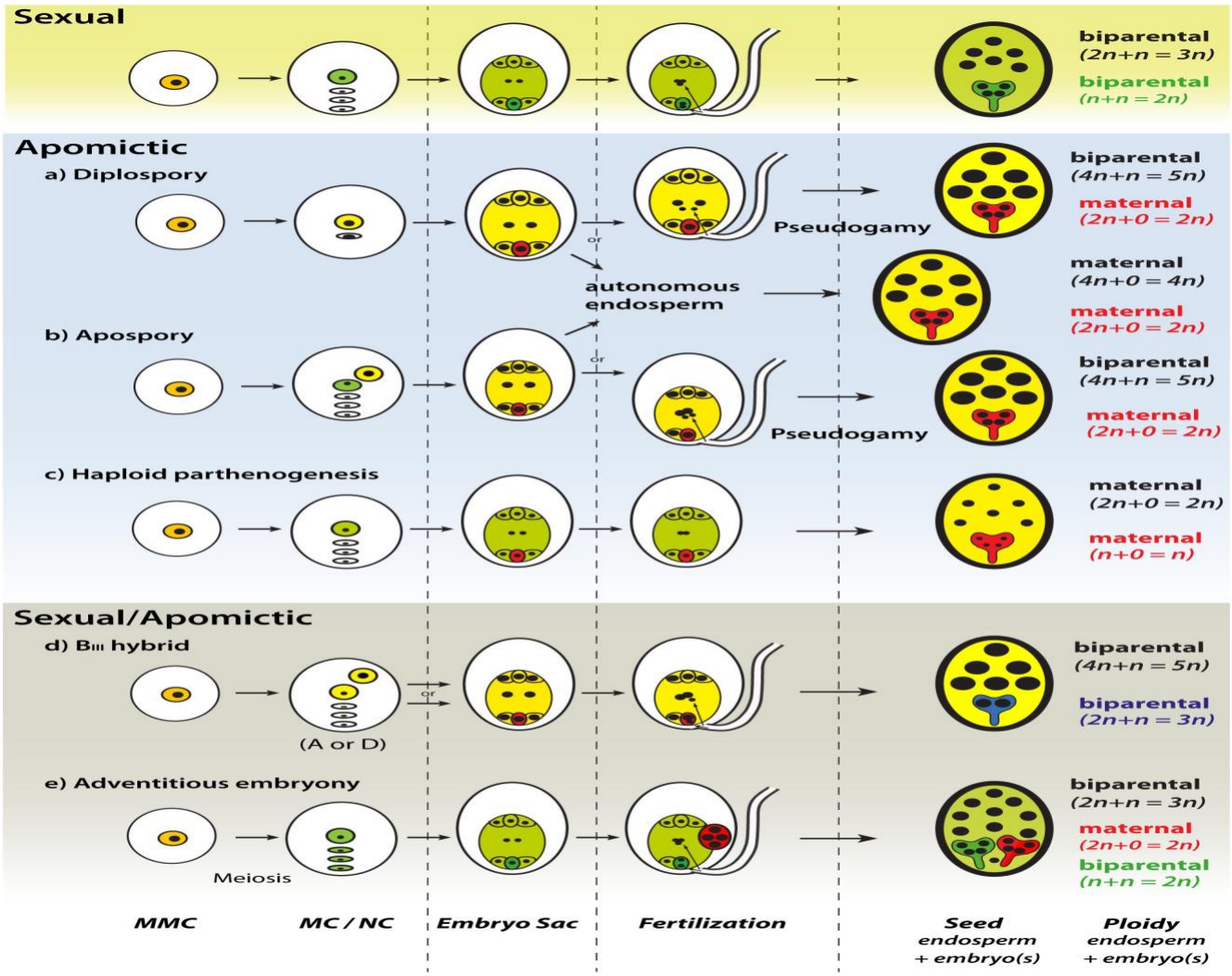
SOMETIMES PLANTS ALSO NEED SOME BREAK FROM THE USUAL METHODS OF REPRODUCTION. WHAT IF THEY DON'T WANT TO MAKE SEEDS?



Apomixis -In angiosperms, two pathways of reproduction through seed exist: sexual or amphimictic, and asexual or apomictic. The pathways by which apomictic seeds are produced are divided into three broad categories: adventitious embryony, diplospory, and apospory. The latter two categories are referred to collectively as gametophytic apomixis. In each case, apomictic embryos are derived from maternal genetic material.
https://www.youtube.com/watch?v=BIcgbOiFGuY (Examfear education)

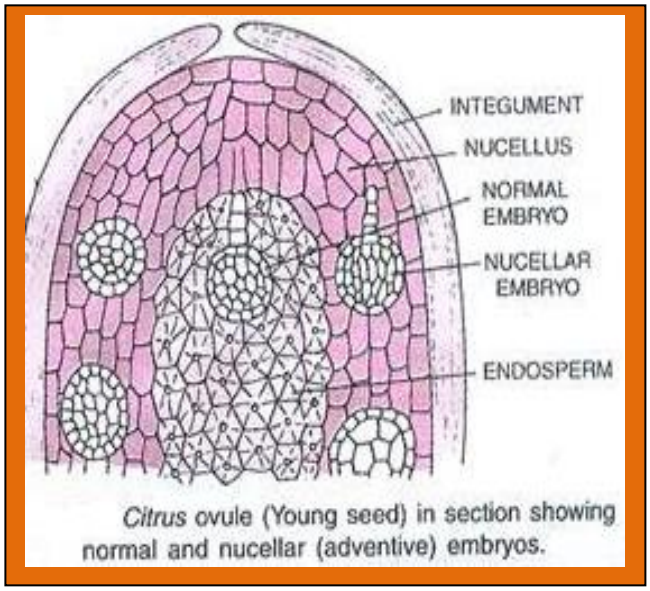
The table given below gives an idea about how so many seeds are formed inside an ovule.

Fig- Citrus fruit with many seeds



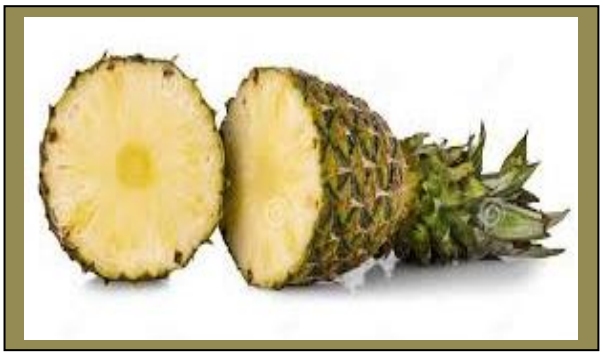
Polyembryony

Polyembryony is a type of apomixis wherein autonomous development of supernumerary embryos takes place in the seed and consequently genetically similar progenies are developed. Supernumerary embryos are produced in different frequencies singlet, duplet, triplet, quadruplet, quintuplet, sextuplet and so on. Among different types of polyembryony, nucellar embryony (2n)



is the most common.

Parthenocarpy



The condition in which fruits are developed without the formation of seeds is called parthenocarpy. This is mainly due to the absence of **fertilization in plants**, pollination and embryo development. In botany, parthenocarpic fruit means “virgin fruit”. These types of fruits are generally seedless.

During cultivation, parthenocarpy is introduced along with other plant hormones including gibberellic acid. It results in the maturation of the ovaries without the process of fertilization and produces bigger and pulpy fruits.

Banana is a good example of parthenocarpy. In this natural process, the produced bananas are sterile, developed without viable ovaries and do not produce seeds, which means they must propagate vegetatively. Pineapples and figs are also examples of parthenocarpy which occur naturally.

Parthenocarpic Fruits

Pineapple, banana, cucumber, grape, watermelon, orange, grapefruit, pear, fig are some examples of Parthenocarpy. These develop without fertilization and are often seedless.

Types of Parthenocarpy

Parthenocarpy can be categorized into two parts, which are: Vegetative and Stimulative parthenocarpy

Vegetative Parthenocarpy

This generally takes place without pollination and due to the absence of pollination, no seeds are produced within the fruits.

Stimulative Parthenocarpy

This generally takes place without the process of fertilization.

This condition occurs when the ovipositor of a wasp is inserted into the ovary of a flower and can also be achieved by flowing air or **plant growth regulators** into the unisexual flowers that are present inside the syconium.

Benefits of Parthenocarpy-**https://www.youtube.com/watch?v=yl0xB5Ye-Is- (Examfear education)**

1. This is more healthy and the results are achieved easily.
2. Provides seedless fruits and improves quality.
3. It reduces the complete cost of the cultivation.
4. This improves crop yield without using organic pesticides.
5. Plant growth regulators are natural and the fruits produced are larger.

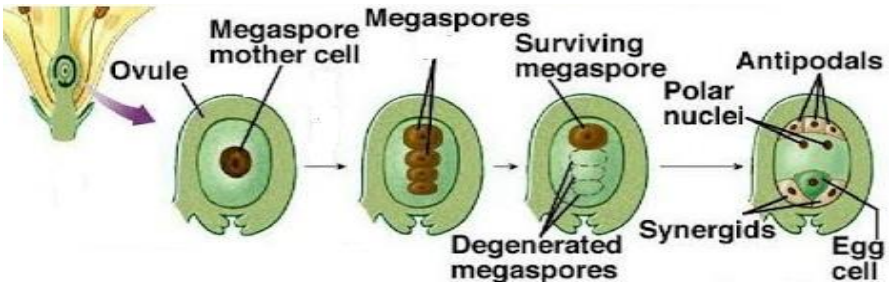
6. Parthenocarpy keeps the insects and pests away without using chemicals because there is no requirement of pollinating insects for the formation of fruits. This protects the plants from being attacked by pesticides.

ASSIGNMENT

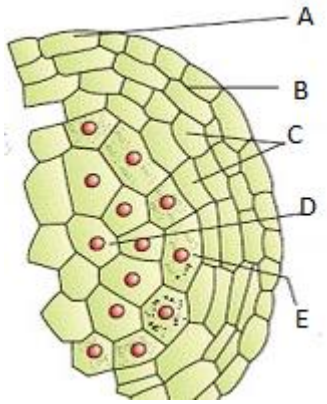
1. List down the features which are required to be there to be pollinated by a particular agent of pollination.
You can use these links and NCERT for the reference.
https://www.youtube.com/watch?v=J7q9Kn1rhRc
https://www.youtube.com/watch?v=QTceLKXwHLY
https://www.youtube.com/watch?v=MJvbuPBe2cg
https://www.youtube.com/watch?v=Y1N7amYs6gc

2. Prepare a list of plants which have cleistogamous flowers.
Use this link- https://www.youtube.com/watch?v=GocKVMk-kSY

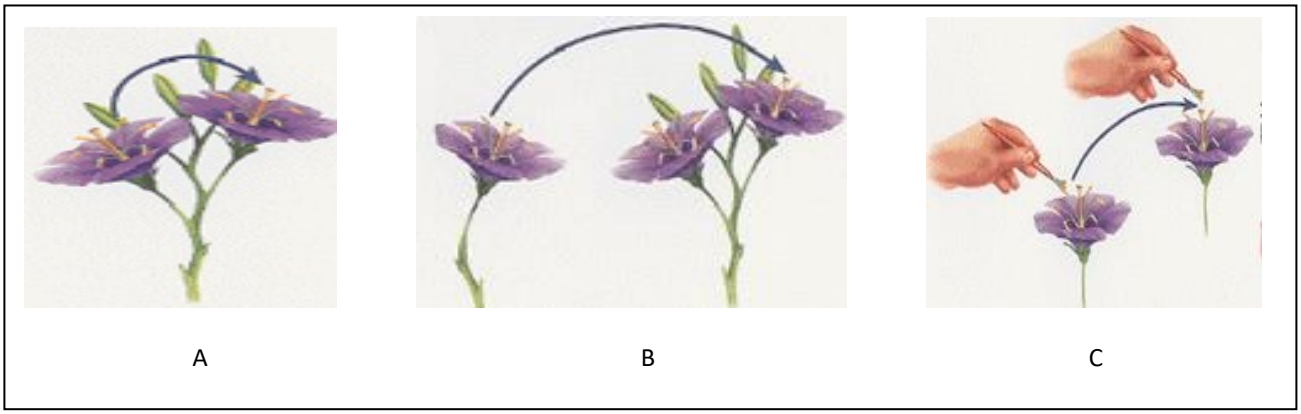
3. a. Identify the ploidy of Megaspore mother cell and antipodals in the image given below.
b. Which division does Megaspore mother cell undergo?



4. Identify the labels from A to E. Also mention the role of each. (Refer to NCERT)



5.Compare the three pictures given below. Comment also.



6. Which of the following statements is true?

a. Both monocots and dicots have an endosperm.
b. The radicle develops into the root.
c. The plumule is part of the epicotyl
d. The endosperm is part of the embryo.

7. Comment on the picture given below.

8 Have you heard of pollen bank? What could be the use of such banks?

9 List down the advantages and disadvantages of self pollination.

10 What is the word given for describing the condition where the stigma and stamens are at different levels to avoid self- pollination?

11 What are adventitious embryos? How are they formed?

12 CASE STUDY QUESTION

In Ex Situ conservation, the organism is removed from their natural environment and preserved in an artificial environment. The major advantage of Ex Situ conservation is that in removing an organism from its natural environment, allows for it to be protected from random events that could otherwise kill large numbers of individuals. In conserving organisms like this, they can later be reintroduced in times of need. For instance, if large area of crops were affected by a pathogen, having stores of the seeds of the that same crop stored in a protected area could be used to help recover the crop. Hence, Ex Situ conservation serves as a form of insurance for biodiversity and genetic erosion, especially in the case of agriculture and plants. This application of Ex Situ conservation is especially important considering the large amount of uses that plants have in society other than nutrition (medicine, fuel, construction materials etc…), thus it also allows for many basic needs of life to be protected and available in case of an emergency

Answer the following questions.

A. Define ex situ conservation.
B. What are the advantages of ex situ conservation?
C. Imagine a situation where a country's entire cultivation is foraged by insect pests or damaged during wars. As a researcher what will be the solution?
D. What problems and limitations are association with this type of conservation?
E. What is 'Noah's Arc' of biodiversity protection? Explain and locate the place via Google map.