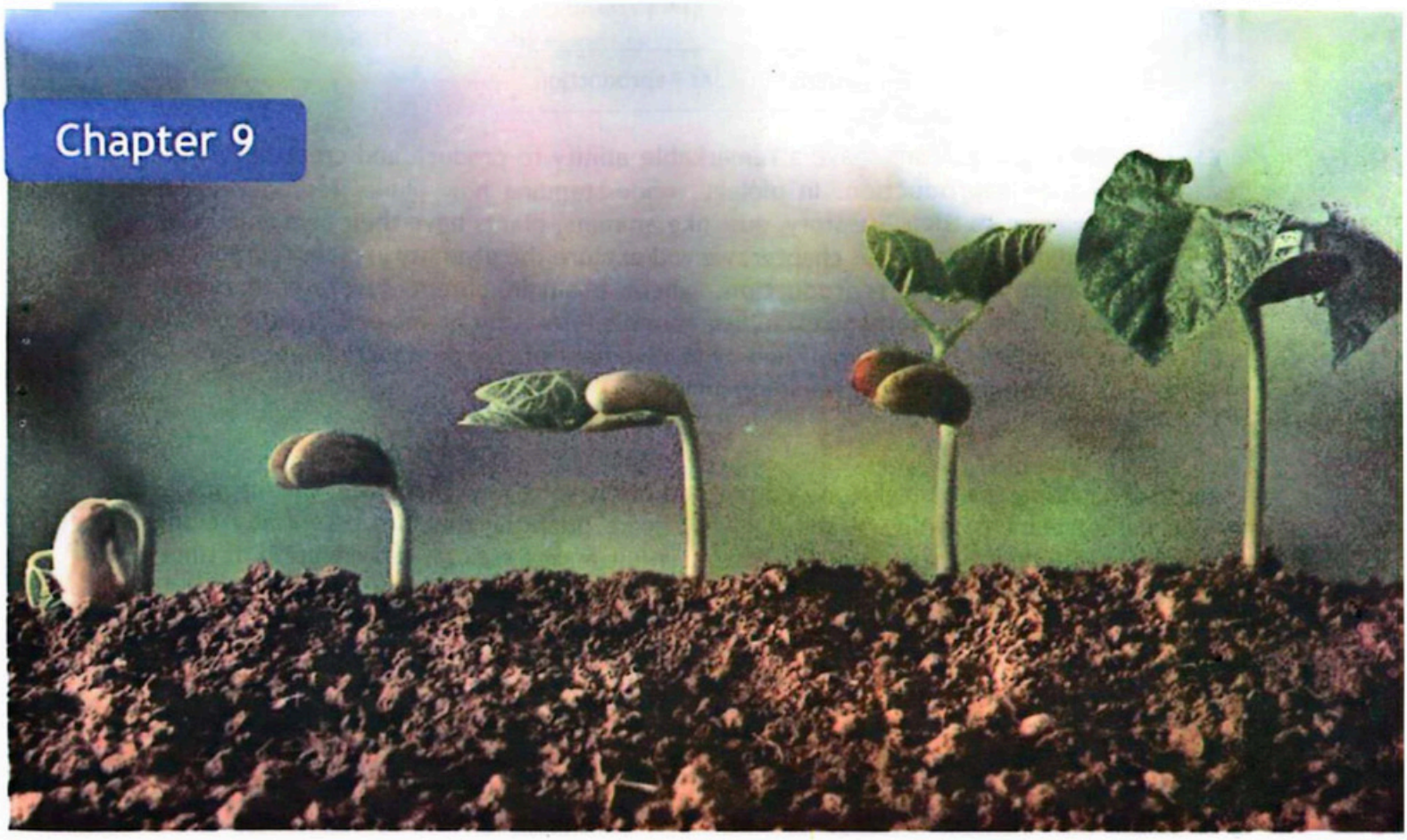

Chapter 9

PLANT REPRODUCTION

SLOs: After completing this lesson, the student will be able to:

1. Describe different types of asexual production i.e., Binary fission, Budding, spore formation and vegetative propagation.
2. Explain vegetative propagation in plants through stem suckers in Leaves.
3. Describe the two methods of artificial vegetative propagation (stem cuttings and grafting).
4. Distinguish between vegetative propagation and artificial propagation.
5. Rationalize how parthenogenesis is a type of asexual reproduction.
6. Define cloning.
7. Explain sexual reproduction in plants.

Plants, like all living organisms, have a remarkable ability to produce and create new young ones. This is called **reproduction**. In biology, understanding how plants reproduce is like discovering the secret to their life story. Just like animals, plants have their own unique ways of creating new generations. In this chapter, we will explore the diversity in plant reproduction, ranging from simple **asexual reproduction**, where a single parent generates genetically identical offspring through methods excluding gamete formation or **meiosis**, to the complex sexual reproduction, which is accomplished by involvement of two parents, gamete formation, and the production of genetically diverse **offspring**.

9.1 ASEXUAL REPRODUCTION

Asexual reproduction is a straightforward method of creating new plant life. In this process, only one parent plant is involved, and it gives rise to offspring that are essentially **clones**, sharing the exact genetic makeup of the parent. What makes asexual reproduction distinct is that it doesn't rely on the formation of specialized reproductive cells called **gametes** or the complex process of meiosis, which shuffles genetic material to produce **variation**. Instead, asexual reproduction relies on simpler methods, such as cell division or the growth of specialized structures. This simplicity and **genetic uniformity** make asexual reproduction a reliable and efficient way for some plants to propagate and expand their population. Asexual reproduction includes binary fission, budding, spore formation and vegetative propagation

9.1.1 Binary Fission

Binary fission is a simple way of making more of something. It's like splitting something into two equal parts. This method is commonly used for making more of certain tiny living things, like **bacteria**, some one-celled creatures called **protozoa**, and some small animals without backbones but no true plant is known to use this process.

In bacteria, First, the copy of their DNA is formed so that there are two identical sets. Then, these sets move to opposite ends of the bacteria. Next, the middle part of the bacteria starts to fold in, dividing the stuff inside into two parts. A new wall forms between these two parts. This whole process ends with two new bacteria, which will keep growing and eventually split into more.

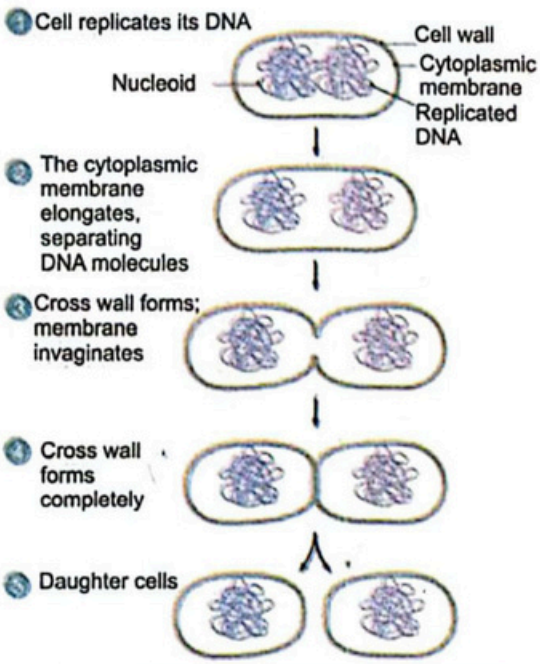

Figure: 9.1 Steps of Binary fission in Bacteria

9.1.2 Budding

In this kind of asexual reproduction, a tiny outgrowth called **bud** emerges on the parent's body. Imagine it like a small bulge. In yeast, which is a single-celled fungus, this outgrowth forms on one side of the cell. Inside the cell, the nucleus splits into two by mitosis, and one of these new nuclei goes into the outgrowth.

Sometimes, the parent cell can have more than one of these outgrowths growing at the same time. Each outgrowth gets bigger and becomes more like the parent. Eventually, the outgrowth

can break away from the parent. In other cases, the outgrowths stay attached, and this leads to groups of individuals living close together, almost like a little community.

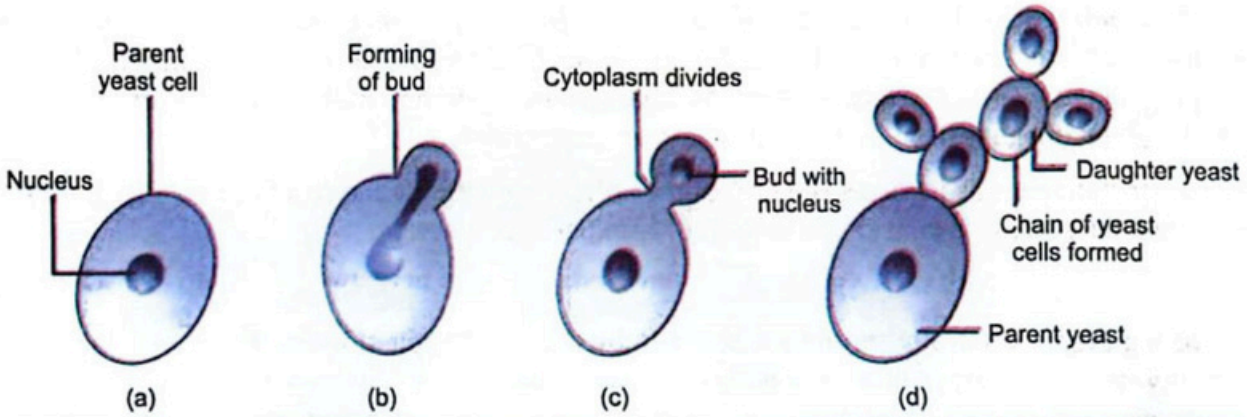

Figure: 9.2 Process of budding in yeast

In higher plants, the outgrowths are often developed which are of two types i.e., **vegetative buds** and **floral buds.** The vegetative buds give rise to new branches and leaves, and floral buds give rise to new flowers.

9.1.2 Spore Formation

Spores are very small, unicellular, non-motile, thick walled resistant, asexual reproductive bodies. In many fungi, like **Rhizopus**, when they're ready to make new ones, their body cells create strong, protective bags called **sporangia** on the tip of a stalk called **sporangiophores**. Inside these bags, cells divide a lot and make many tiny cells called **spores.** Each spore has a tough shell called a cyst that helps it survive unfavourable period. When the sporangia are grown up, they pop open and let the spores out. When the conditions become favourable, these spores start growing into new *Rhizopus*.

In unfavourable conditions, some types of filamentous bacteria, such as **actinomycete**, also make spores. These bacterial spores are also tough with thick walls. They form outside the bacterial cells, so they are called **exospores.** Upon germination each spore from parental filament give rise several new bacterial filaments.

This is important to note that the microspore and megaspore in seed producing plants or the spores of **bryophytes** and **pteridophytes** that give rise **gametophyte** body are not supposed to be the part of asexual reproduction because during the spore formation in these plants meiosis generally involves.

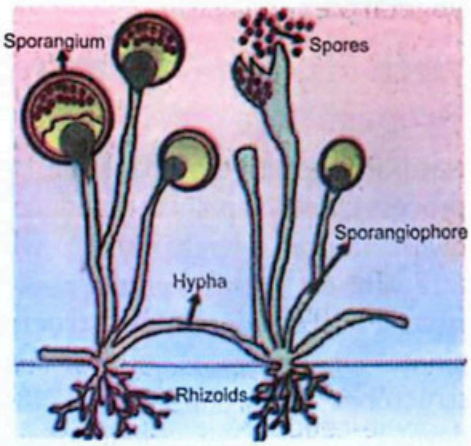

Figure: 9.3 Spore formation in *Rhizopus*

Critical Thinking

Under unfavourable conditions, some species of bacteria reproduce by forming spores, e.g.

Clostridium and Bacillus species. These bacterial spores are also thick-walled. They are formed inside bacterial cells, so are called endospores. In this way these bacteria are capable to pass unfavourable period. When conditions are good, each endospore germinates and resumes normal life again. What do you think that endospore formation is a reproductive process?

9.1.3 Parthenogenesis

Parthenogenesis is the development of an offspring directly from unfertilized eggs. In flowering plants is defined as the asexual formation of a seed from the maternal tissues of the **ovule**, avoiding the processes of meiosis and **fertilization**, leading to embryo development. This can happen due to various triggers, such as changes in environmental conditions or hormonal signals. Parthenogenesis in plants is also known as **apomixis**.

Since parthenogenesis involves the creation of offspring without the fusion of genetic material from two parents, it is considered a form of asexual reproduction.

9.1.4 Vegetative Propagation

Flowering plants generally reproduce sexually by means of their flowers, but some also make babies without flowers, which we call **"vegetative propagation."** There are two kinds: one that plants do on their own, which we call **"natural vegetative propagation,"** and another that people help with when needed, called **"artificial vegetative propagation."**

Methods of Natural Vegetative Propagation

Natural vegetative propagation in plants refers to the process by which plants reproduce asexually using their own natural mechanisms, without any human intervention. In this method, new plants are generated from various **vegetative structures** of the parent plant, such as roots, stems, leaves, or specialized structures like runners or bulbs. These structures develop into independent plants, and since they originate from the same parent, they often have identical genetic characteristics. Following are the types of natural vegetative propagation.

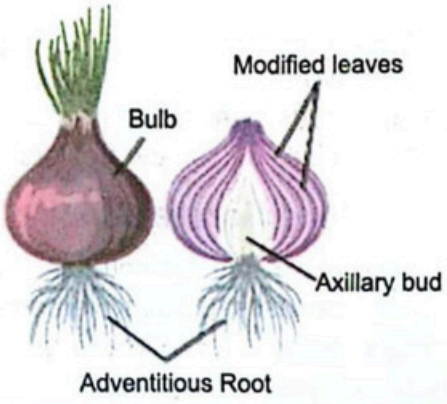

Figure: 9.4 Bulb (Onion)

i) Bulbs

Bulbs are compact, thickened, vertically growing, underground stems enveloped by thick, succulent (flashy) leaves, serving as reservoirs of stored nutrients. Beneath the bulb's base, adventitious roots sprout, while shoots emerge from its upper region. Each shoot is capable to be developed into a new plant. Species like tulips, onions, and lilies utilize bulb to produce their young ones.

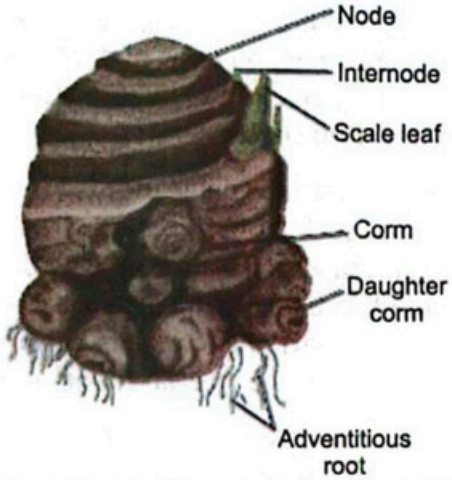

Figure: 9.5 Corm (Colocasia)

ii) Corm

Corms are compact, thickened, vertically growing, underground stems that store food but not enveloped by flashy leaves. At the top of a corm, you will find buds. These buds give rise to shoots, which then develop into new plants. Examples of plants that reproduce using corms include dasheen and garlic.

iii) Rhizome

Rhizomes are flat, horizontal underground stems that have small scale-like leaves. Along the rhizome, there are distinct **nodes** and **internodes**. At these nodes, buds are formed. The buds on the upper side of the rhizome grow into shoots, while the lower side produces adventitious roots. These shoots are capable to develop into new plants. Plants like ginger, ferns, and water lilies use rhizomes for reproduction.

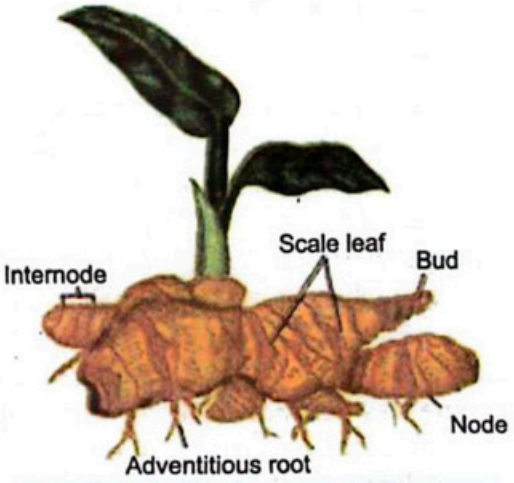

Figure: 9.6 Rhizome (Ginger)

iv) Stem tubers

Stem tubers are swollen tips of underground stem that primarily serve as storage structures found in certain plants. Stem tubers often have "eyes" or bud clusters on their surface, from which new shoots can grow when conditions are suitable. Examples of plants that produce stem tubers include potatoes and yams. These structures serve as a source of food and a means of propagation for the plants that produce them.

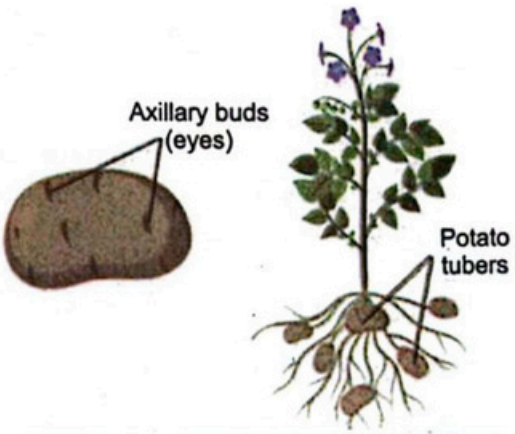

Figure: 9.7 Stem tuber (Potato)

v) Stolon or Runners

The above-ground parts of plants like strawberries and creeping buttercups are typically very short, with most of their structure below the ground. These short stems are known as **rootstocks**, and they carry leaves and flowers. After the main shoot has bloomed, side buds create long shoots that grow horizontally along the ground, often called **stolons or runners**. These runners have small scale-like leaves at specific points, and they have long sections between these points. At each of these points where the leaves are, there is a bud that has the potential to grow into both a shoot and roots. So, a whole new plant can develop at these points, getting nourishment from the parent plant through the runner for a while. Eventually, the runner dries up and withers away,

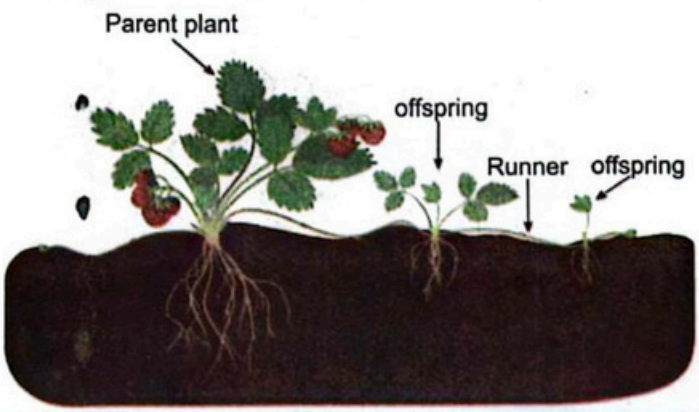

Figure: 9.8 Stolon or runner

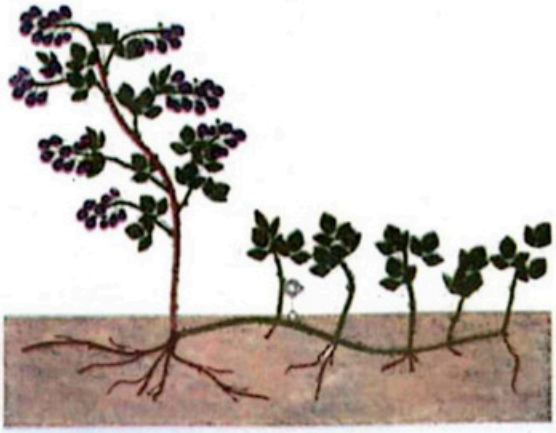

Figure: 9.9 Suckers

leaving a new independent plant growing a short distance from the parent. This is how a strawberry plant, for example, can make many new plants without using seeds.

vi) Suckers

Suckers typically emerge as small shoots from the underground parts of a plant, such as the root system or near the base of the main stem. These shoots can develop into new plants. As the suckers grow, they form their own stems, leaves, and roots. They essentially become self-sustaining plants but remain connected to the parent plant for a period. Suckers may receive nutrients and water from the parent plant, helping them establish themselves. This is especially beneficial in adverse conditions where it might be challenging for new plants to survive on their own. Over time, the suckers develop their own root system and become less dependent on the parent plant for sustenance. Eventually, they can thrive independently. Suckers are a common method of natural vegetative propagation in various ground cover plants such as lawn grass.

Figure: 9.10 Vegetative propagation by leaves in Bryophyllum

vii)Vegetative propagation by leaves

In **Bryophyllum**, a type of plant, new plantlets are created along the edges of its leaves. These plantlets are like tiny versions of the parent plant. When they detach from the parent plant and fall onto the soil below, they have the ability to grow and develop into separate, self-sustaining plants.

Methods of Artificial Vegetative Propagation

Artificial vegetative propagation is adapted when people purposely grow plants to meet specific needs. The part of the plant used for this is called a "**vegetative propagule.**" These methods help keep the good qualities of plants, like taste, color, and resistance to diseases. Two common methods of artificial vegetative propagation are stem cuttings and graftings.

(i) Stem Cuttings

Stem cuttings are small segments or cut pieces of stem having at least one node. You can make new plants from some plants by placing a cut piece of a stem in water or damp soil. Roots start growing from the bottom of the stem into the soil, while the top part keeps growing and making leaves. If sometimes, the cutting does not start growth, then the cut ends must be treated with a special plant hormone called auxin to stimulate the growth. Sometimes, it is required to cover the top part of the cutting with plastic or a glass jar to reduce water loss. This method is often used to propagate roses, ivy, **grapevines**, and

Figure: 9.11 Propagation by stem cuttings

chrysanthemums.

(ii) Grafting

This method involves joining two plant parts together to create a single, new plant. This method is commonly used to reproduce desirable plant varieties, like fruit trees or ornamental plants, and it's a skilled practice often performed by gardeners and farmers.

Critical Thinking

Sweet potato is an enlarged root. Farmers place it in moist sand or soil until it produces several plantlets. Then the plantlets are removed and planted. This process is used to produce many plants from a single plant. Is it artificial or natural vegetative propagation and it belongs to which type?

Two plant parts are involved in grafting: the **scion** and the **rootstock**. The scion is the upper part of the plant, which includes the desired characteristics such as specific fruit or flower traits. The rootstock is the lower part, which provides the root system and stem support. A skilled gardener makes precise cuts on both the scion and rootstock. The cuts are usually made at specific angles to maximize contact between the two parts. The scion is carefully attached or inserted into the rootstock. This connection is crucial for the transport of water, nutrients, and other substances between the two parts. To ensure a secure connection, the graft is typically bound with grafting tape, rubber bands, or other materials. This helps hold the scion in place until the graft heals. Once the graft has healed, the plant begins to grow, producing leaves, flowers, and fruit based on the characteristics of the scion.

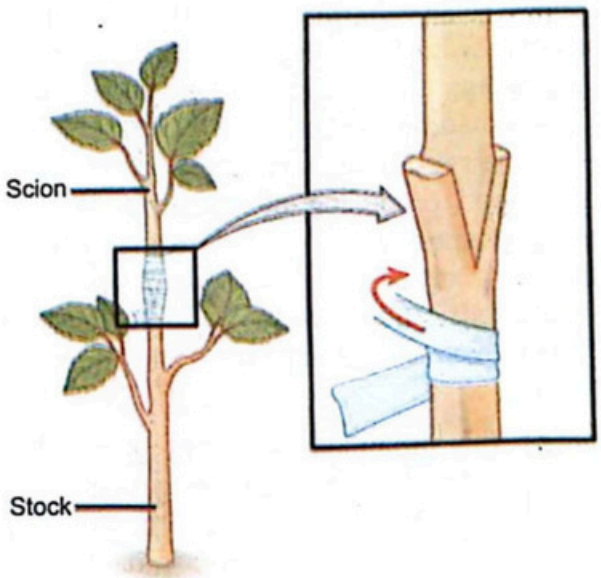

Figure: 9.12 Propagation by grafting

(iii) Cloning (Tissue culturing)

Cloning is a method of producing genetically identical individual from the single parental cell. In plants term "cloning" refers to the **tissue culturing** in which a single plant cell or piece of tissue is grown on artificial nutrient medium under aseptic conditions (microbe free environment) to develop a genetically identical copy (**clone**) of the parent plant. This method of artificial vegetative propagation is also called **micropropagation.** The first cell or tiny piece of the parent plant used in tissue culture is called an "**explant.**" This explant is placed on a special nutrient medium to grow and become an undifferentiated mass of cells known as "**callus.**" The callus is then treated with different substances to make it produce shoots and later roots. This whole process results in the creation

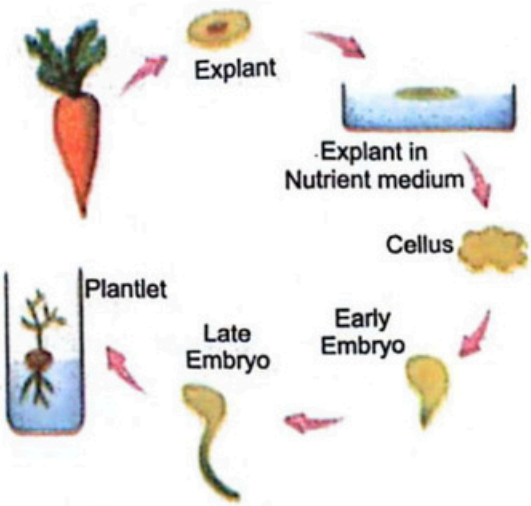

Figure: 9.13 Steps in plants tissue culturing

of a young plant called a "**plantlet.**" These plantlets are carefully moved into the soil in their natural surroundings to continue growing.

9.2 SEXUAL REPRODUCTION

Sexual reproduction in plants like animal also involves the fertilization of **gametes** (egg and sperm) and formation of **zygote** and **embryo**. Different groups of plants, like bryophytes, pteridophytes, and seed plants (spermatophytes) have different mechanisms of gamete formation and fertilization. In bryophytes and pteridophytes, the sperms are like little swimmers; they can move around and find the egg cells. So, they need water to do this. It could be dew or rain, but water is the key to their reproductive success. On the other hand, seed producing plants (**gymnosperms** and **angiosperms**) have their own methods. They don't rely on water to get their sperms to the egg cells. They have special techniques for this what you are going to learn further in this chapter.

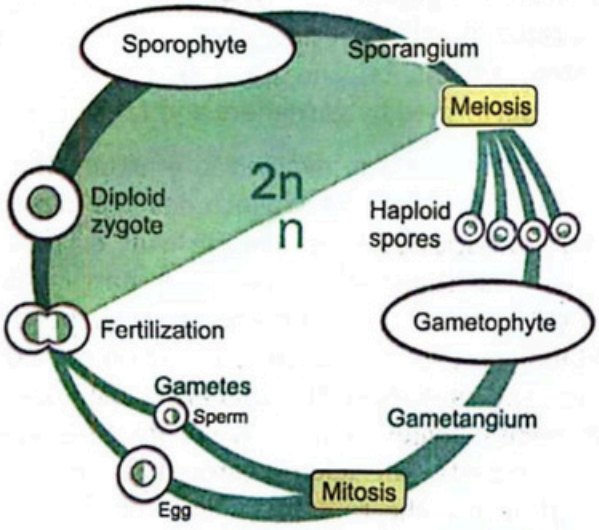

Figure: 9.13 Steps in plants tissue culturing

One of the prominent features of plants is the **haplo-diplontic lifecycle** i.e., haploid **gametophyte** (gamete producing plant body) generation and diploid **sporophyte** (spore producing plant body) generation that regularly alternate with each other during the lifecycle. In some plants like bryophytes, the gametophyte generation is more prominent (dominant) while the sporophyte is very much reduced. In rest of the plant kingdom sporophyte is dominant generation whereas gametophyte is very small creature.

9.2.1 Sexual Reproduction in Flowering plants (Angiosperms)

In flowering plants (angiosperms), the major plant body is the sporophyte, which may be a herb, shrub or a tree. **Flowers** are the reproductive parts of these plants.

Structure of a flower

A flower is like a plant's special tool for making new plants. It's a part of the plant that's been changed and adapted for the job of reproduction. A flower generally consists of a stalk called **pedicel**. This is like the flower's stem, holding it up. At the top of the pedicel, there's a swollen part called the **thalamus**. It's like the flower's platform. The thalamus generally possesses four kind of parts called **floral leaves** which are arranged in whorls

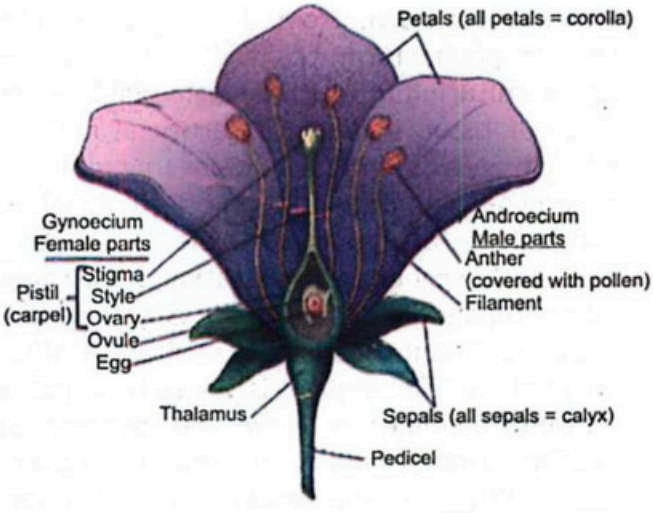

Figure: 9.14 Structure of a typical flower

(circles) on the upper surface of **thalamus**. The outermost circle is called the "**calyx.**" It's made up of green leaves called "sepals," and it's like a protective cover for the inside parts of the flower. Just inside the calyx, there's another circle called the "**corolla.**" which consists of variously colored floral leaves called **petals**. Deeper inside, you'll find the "**androecium**," which is all about the male parts of the flower, called "**stamens.**" These are important for making pollen. Right in the center, there's the "**gynoecium.**" This is where the female parts are, in something called the "**carpel**" or "**pistil.**" This is where the magic happens, where new seeds start to form.

The calyx and corolla, the outer two circles, are like the flower's protectors. They keep everything safe inside but do not take part in reproduction directly therefore, called **accessory whorls**. The androecium and gynoecium, the inner two circles, are the real stars of the show when it comes to making new plants. They are the ones that make the flower's magic happen and help it reproduce why they are called **necessary whorls**.

Formation of microspores and megaspores

Each stamen consists of a long stalk, the **filament** and a bilobed swollen tip called the **anther**. In the anther lobes, four **pollen sacs (microsporangia)** are present that produce haploid **pollen grains (microspores)** by meiosis.

Each carpel or pistil consists of a sac like structure in the bottom called **ovary**, a long tubular structure above the ovary called **style** and a swollen tip present on the style called **stigma**. The ovary contains one to numerous **ovules (megasporangia)**. Each ovule possesses one spore mother cell that undergoes meiosis to produce four **megaspores**. Out of four, only one is capable to survive further and becomes **functional megaspore**.

Pollination

When microspores are formed, the wall of pollen sacs bursts and the microspores are liberated. The microspores are transferred from anther of stamen to the stigma of carpel by means of wind, insects, or other animals. This event is known as **pollination** and the microspores during pollination are called **pollen grains**. If the pollination occurs within the same flower or between two flowers of the same plant, it is called **self-pollination** and if it occurs between two flowers of separate plants, it is called **cross pollination** which ensures more genetic variability in coming generations.

Critical Thinking

Sometimes pesticides are used to control the attack of insect pests on the crops, however, pesticides are quite effective to prevent the loss by insect pests. Even though, the farmers get lower yield than normal. Why it is so?

Formation of male and female gametophytes

Development of Male gametophyte

After pollination, the microspores (pollen grains) germinate on the surface of stigma to produce a male gametophyte. In this process, the microspore nucleus first divide by mitosis to form two nuclei i.e., **tube nucleus** and the **generative nucleus** which divides further to form two **sperm nuclei**. The tube nucleus controls the formation of **pollan tube** which microspore, passes down through the style and ultimately penetrate the ovule. This whole structure that comprises microspore body, pollan tube, tube nucleus and the two sperm nuclei, is referred to as **male gametophyte**.

Table 9.1: Adaptations in insect-pollinated and wind-pollinated flowers

Feature	Insect Pollinated Flowers	Wind Pollinated Flowers
Size	Generally large	Generally small
Color	Petals brightly colored	Petals green or dull in color
Nectar	Produce nectar	Do not produce nectar
Floral arrangement	Flowers face upwards	Flowers hang down for easy shaking
Stamens and stigmas	Enclosed inside ring of petals	Hang out of ring of petals
Pollen grains	Small number produced/ heavy and sticky	Large number produced/light with smooth surface
Stigma	Pinhead shaped with no branches	Feathery branches for catching pollen

Development of Female gametophyte

Meanwhile, the nucleus of functional megaspore in the center of ovule divides three times by mitosis to make 8 nuclei. At this stage, three nuclei out of eight migrate at one end of the ovule, the central one of them becomes **egg** while two side one are called **synergids.** Three other nuclei migrate at another end of the ovule, and act as **antipodals.** The remaining two daughter nuclei rest in the center of the ovule and are called **polar nuclei** which in some cases fuse together to become diploid **secondary nucleus** before the entry of sperm. This whole structure which comprises body of megaspore, three antipodals, two synergids, two polar nuclei or secondary nucleus and an egg, is referred to as **female gametophyte or embryo sac.**

Fertilization and the formation of zygote and endosperm nucleus

When the pollan tube penetrate the ovule, one sperm nucleus is fused with egg to form diploid **zygote** and other sperm nucleus is fused with polar nuclei or secondary nucleus to make triploid **endosperm nucleus.** Since one male gametophyte contributes two sperm nuclei for fertilization, therefore, this event is called **double fertilization.** It is assumed that the rest of nuclei in embryo sac such as synergids and antipodals control the process of fertilization.

Critical Thinking

Why fertilization in angiosperms is called double fertilization?

9.2.2 Seed and fruit formation

After fertilization, the ovule is transformed into seed therefore, it is defined as **"ripened ovule"** whereas, the surrounding wall of the ovary is transformed into fruit, hence it is defined as **"ripened ovary".**

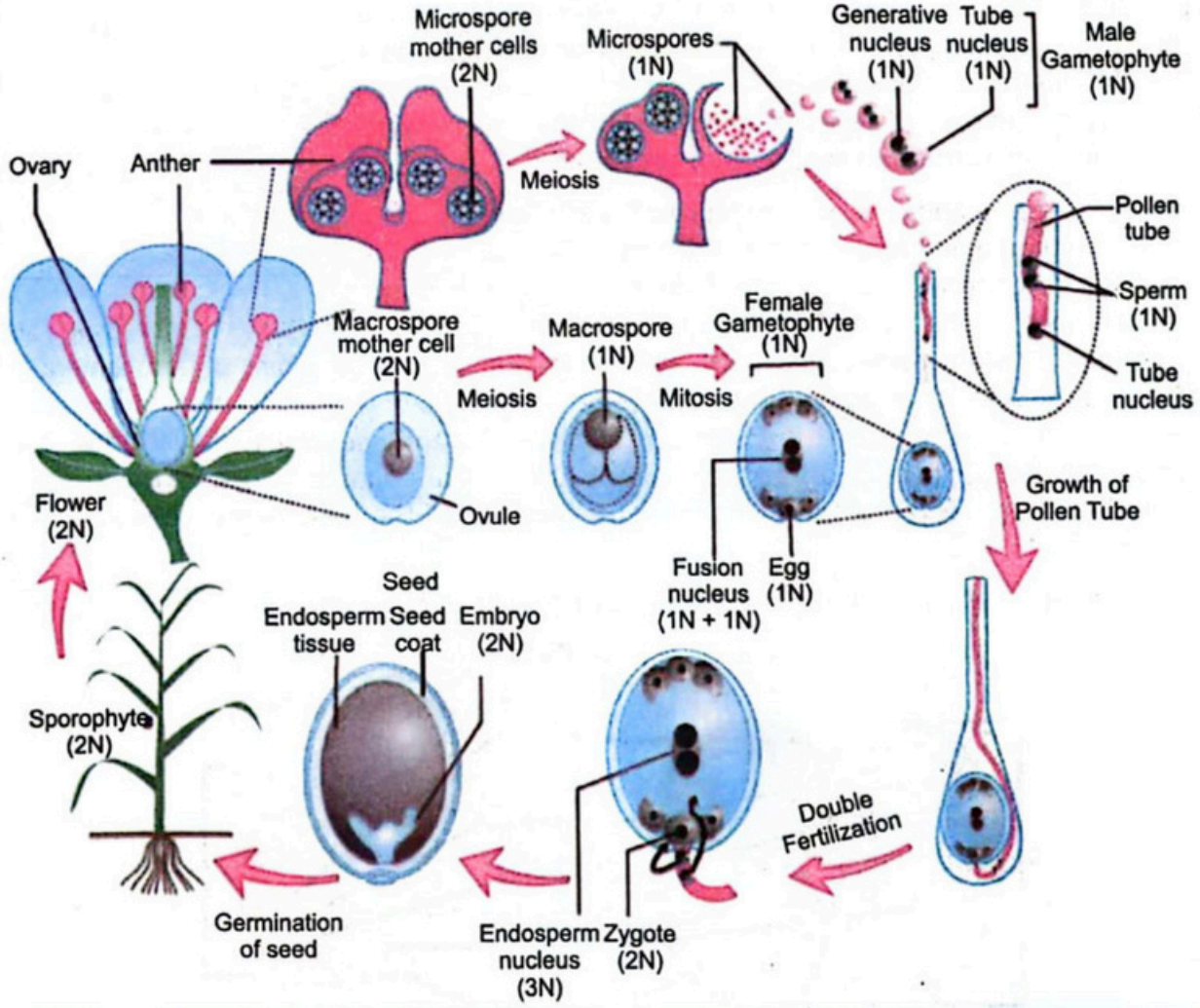

Figure: 9.15 Different steps of sexual reproduction in plants

Structure of seed

Angiosperm seeds are made up of three important parts:

1. **Embryo:** This part comes from the union of male and female cells (zygote). It's like a baby plant that's not fully grown yet.
2. **Endosperm:** The second part is called the endosperm. It's like a storage space for food and comes from a special cell inside the seed.
3. **Seed Coat:** The last part is like the seed's protective jacket. It's called the seed coat and it develops from the outer part that used to wrap around the seed when it was part of the plant.

Critical Thinking

Why are angiosperms called closed seeded plants?

The seed coat can be thin like paper (think of peanuts) or thick and tough (like coconuts). It keeps the baby plant safe from harm and stops it from drying out. There's a little mark on the seed coat called the "**hilum**," which is where the seed used to be connected to the plant. Nearby, there's something called the "**micropyle**," which is like a door that the seed uses to get water.

Science Titbits

Based of number of cotyledons and some other features the angiosperms are classified into two classes i.e., monocots and dicots.

Inside the seed, embryo is an immature plant. It consists of a **radicle**, a **plumule** and one or two **cotyledons** (seed leaves). The radicle of embryo grows into new root while the plumule grows into new shoot upon seed germination. Therefore, radicle and plumule are called **embryonic root** and **embryonic stem** respectively. The embryonic stem above the point of attachment of cotyledon(s) is called **epicotyl**. The embryonic stem below the point of attachment is **hypocotyl**. Within seed, there is a store of nutrients for the seedling that will grow from embryo. In angiosperms, the stored food is derived from the endosperm tissue. This tissue is rich in oil or starch and protein. In many seeds, the food of the endosperm is absorbed and stored by cotyledons.

So, inside a tiny seed, there's a whole world waiting to grow into a new plant.

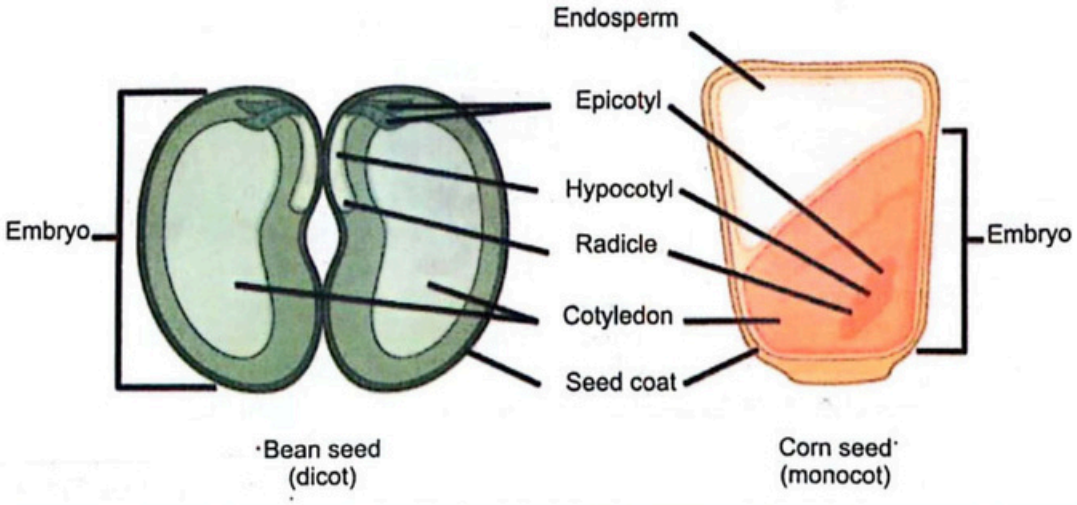

Figure: 9.16 Structure of seed

9.2.3 Seed germination

For seeds to start growing, they need to be in the right place and at the right time. This process is called seed **germination**, and it's like the start of a plant's life. In this process, the seed absorbs water, which makes it swell and breaks open the seed coat. First, a root pops out from a part called the radicle. This root grows quickly and starts taking in water and nutrients from the soil. Then, a tiny shoot called the plumule begins to grow. It stretches up and out of the soil. There are two main ways seeds can start growing:

STEAM ACTIVITY 9.1

Take few seeds of commonly growing plants in your vicinity, plant them together in the pot, and observe the germination process day wise by picking one germinating seed every day.

1- Epigeal Germination

In this type, the part called the **hypocotyl** stretches out and forms a hook, pulling the **seed leaves (cotyledons)** above the ground. Beans, cotton, and papaya are examples of seeds that do this.

2- Hypogeal Germination

Here, it's the **epicotyl** that stretches and forms a hook, but the **seed leaves (cotyledons)** stay underground. Peas, maize, and coconuts are examples of seeds that germinate this way.

So, seeds have their own ways of getting started on their journey to becoming full-grown plants!

Conditions for seed germination

For seeds to start growing, they need the right conditions, both inside and outside. Inside, the seed must have a living baby plant (embryo) and enough stored food.

Outside, there are three key conditions:

1. **Water (Moisture):** Most seeds have very little water inside them. They can't start growing until they soak up water from the environment. This water is used to break down stored food and help parts of the baby plant grow.
2. **Oxygen:** Just like we need oxygen to breathe, the cells in the baby plant need it too. It helps them do their job.
3. **Temperature:** Different seeds like different temperatures to start growing. For most plants, the best temperature is between 25-30°C.

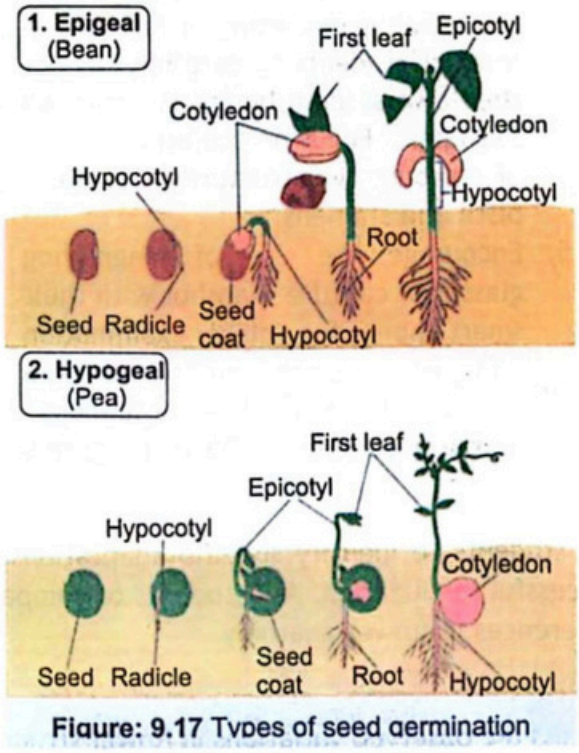

Figure: 9.17 Types of seed germination

So, when the seed gets these conditions right, it's like a green light for the baby plant to begin its journey!

STEAM ACTIVITY 9.2

Flower Encounters: Revealing secrets of plant reproduction

Objective:

Investigate the structure of flowers and gain insights into the reproductive mechanisms of plants.

Materials Required:

1) Assorted flowers (various species), 2) Scalpels or small knives, 3) Disposable gloves, 4) Magnifying glasses, 5) Petri dishes or small trays, 6) Notebooks and pens, 7) Camera or smartphones for documentation.

Procedure:

1. Begin by discussing the significance of flowers in plant reproduction and the different parts of a typical flower (petals, sepals, stamens, pistil).
2. Distribute various types of flowers to students, ensuring a diverse selection.
3. Provide disposable gloves and scalpels or small knives for flower dissection. Emphasize safety precautions during the handling of cutting tools.
4. Instruct students to carefully dissect the flowers, identifying and observing each part. Focus on the arrangement of reproductive structures within the pistil and stamens.
5. Encourage the use of magnifying glasses or capture snapshot with their smart phones for a closer examination and ask students to sketch the dissected flowers in their notebooks and paste the floral parts on a hard chart to make herbarium sheets as shown in figure 9.18.

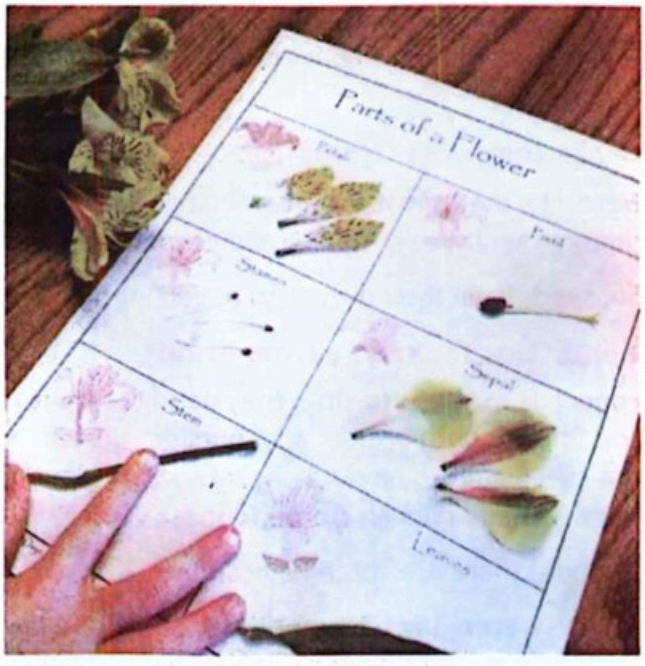

Figure: 9.18 Presentation of floral parts on herbarium sheets

Results

Ask students to identify specific adaptations related to attracting pollinators and achieving successful fertilization. Ask students to compare their findings and discuss the similarities and differences in flower anatomy.

Interpretation

Discuss the observed variations in flower structure among different plant species and how these variations contribute to successful pollination. Prompt a class discussion on the importance of flowers in plant reproduction, linking the observed structures to the process seed and fruit formation. Discuss the relation between the overuse of insecticide by farmers and insect pollinators in plant reproduction. Conclude the activity by reinforcing the role of flowers as essential components of the plant life cycle.

Reflection

This flower dissection activity provides students with a hands-on exploration of flower anatomy, offering valuable insights into the reproductive strategies employed by different plant species.

SUMMARY

1. Plants, like all living organisms, have various methods of reproduction, each tailored to their unique biology. This chapter deals into the diversity of plant reproduction, from simple asexual methods to complex sexual processes.

2. Asexual reproduction involves a single parent and results in genetically identical offspring, often called clones. Methods include Binary Fission, Budding, Spore Formation, Parthenogenesis, and Vegetative Propagation
3. Binary Fission is common in bacteria, where the cell divides into two identical parts. Budding is seen in yeast and some plants, where an outgrowth (bud) develops and eventually detaches to form a new individual. Spore Formation is utilized by fungi and certain bacteria, where spores are produced and dispersed to germinate into new organisms. Parthenogenesis involves the development of offspring from unfertilized eggs, occurring in plants like flowering plants through a process called apomixis. Vegetative Propagation in plants produce new individuals from vegetative structures like roots, stems, leaves, or specialized structures without the involvement of seeds.
4. Sexual reproduction involves the fusion of gametes (egg and sperm) from two parents, leading to genetically diverse offspring. This process varies among plant groups:
5. Reproduction involves flowers, with male gametes produced in the pollen and female gametes in the ovule. Pollination leads to fertilization and the formation of seeds and fruits.
6. Seeds consist of an embryo, endosperm for nourishment, and a protective seed coat. Germination occurs when seeds absorb water and sprout into new plants under suitable conditions.
7. Understanding plant reproduction unveils the intricate mechanisms that drive their life cycles. From the simplicity of asexual methods to the complexity of sexual processes, each strategy ensures the continuation of plant life. Through hands-on activities like flower dissection, students gain valuable insights into the reproductive strategies and adaptations of different plant species, enriching their understanding of the natural world.

EXERCISE

Section I: Multiple Choice Questions

Select the correct answer:

1. Select the correct answer

(i) Which of the following is incorrect about asexual reproduction?

A) single parent contributes genetic material

B) no gamete formation is involved

C) offspring are genetically identical

D) contributes in evolution of new species

(ii) Which of the following is the benefit of sexual reproduction?

A) this is rapid way of reproduction

B) this is complex mechanism of reproduction

C) it can occur any time in lifecycle

(D) it contributes genetic variability in successive generations

(iii) Which of the following modes of asexual reproduction generally occurs during unfavorable conditions?

A) Binary fission B) Budding

C) Spore formation D) parthenogenesis

(iv) Which of the following processes is also known as apomixis?

A) Binary fission B) Budding

C) Spore formation D) parthenogenesis

(v) Which of the following is compact, thickened, vertically growing, underground stem enveloped by thick, succulent (flashy) leaves, serving as reservoir of stored nutrients:

A) Bulb B) Corm

C) Rhizome D) Stem tuber

(vi) In Bryophyllum, small plantlets that are much like tiny versions of the parent plant, are created along the:

A) root tip **B) edges of its leaves**

C) stem surface D) all of these

(vii) If sometimes, the stem cutting does not start growth, then the cut ends must be treated with which of the following special plant hormone to stimulate the growth?

A) somatotrophin B) Abscissic acid

C) auxin D) Ethene

(viii) The first cell or tiny piece of the parent plant used in tissue culture is called:

A) baby plant B) plantlet

(C) seedling **D) explant.**

(ix) Which of the following part of the plant that's been changed and adapted for the job of reproduction:

A) flower B) Leave

C) root D) meristematic tissue

(x) Which of the following parts of the flower are called accessary whorls?

A) Androecium and gynoecium **B) calyx and corolla**

C) Androecium and corolla D) calyx and gynoecium

Section II: Short Answer Questions

1. Define cloning. Which process of plant is supposed to be a cloning?
2. Enlist any two suitable conditions for germination of seed,
3. Explain the structure of embryonic stem.

4. Explain the role of livestock.
5. Explain the event of double fertilization in angiosperms.
6. Explain the structure of embryo sac.
7. Justify that sexual reproduction in plants is more beneficial than asexual reproduction.
8. Define/Describe/Explain briefly:
9. Apomixis, pollination, male gametophyte, epigeal germination, fertilization, binary fission, budding, sporangiophores, rootstock, bulb, rhizome.
10. Write the differences between
    (a) Asexual reproduction and sexual reproduction
    (b) Artificial vegetative propagation and natural vegetative propagation
    (c) Scion and rootstock
    (d) Grafting and stem cutting
    (e) Bulb and rhizome
    (f) Binary fission and budding
    (g) Hypogeal and epigeal germination
    (h) Self and cross pollination

Section III: Extensive Answer Questions

1. Explain the procedure of plant tissue culture and illustrate your answer with suitable diagram.
2. Describe the structure and development of male and female gametophytes.
3. Define seed germination. Explain its two types and write down the conditions forgermination.
4. Explain the mechanism of binary fission and budding in bacteria and yeast respectively.
5. Describe any two methods of artificial vegetative propagation in plants.
6. Describe the structure if a typical flower and draw its suitable diagram.
7. Describe the methods of natural vegetative propagation in plants.