2021 BOTANY — HONOURS

Paper : CC-6

Full Marks : 50

The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable.

1. Answer the following questions :

(a)How spadix inflorescence differs from catkin inflorescence?

- **Spadix Inflorescence**: Found in monocots, characterized by a thick, fleshy peduncle. Flowers are small, sessile, and unisexual. Enclosed by brightly colored bracts known as spathes.
- **Catkin Inflorescence**: Found in plants like Mulberry, Betula, and Oak. Characterized by a thin, long, weak peduncle. Flowers are sessile and unisexual. Typically wind-pollinated.

”the main differences lie in the structure of the peduncle and the types of plants in which they are found. Spadix inflorescence is found in monocots and has a fleshy peduncle, while Catkin inflorescence is found in plants like Mulberry, Betula, and Oak, and has a thin, long, and weak peduncle.”

(b)Give an example of hemicyclic flower.

An example of a hemicyclic flower is **Annona** and **Polyalthia**[1]. In these flowers, some floral parts (sepals and petals) are arranged in regular whorls and the remaining parts (stamens and carpels) are arranged spirally[1]. Hemicyclic flowers are an indication of primitive plant structure and are found primarily in plants of the most primitive families[2].

(c)What is accrescent calyx? Give an example.

An **accrescent calyx** is a type of calyx that continues to grow along with the fruit even after fertilization[12]. This means that the calyx does not stop growing once the flower has bloomed and fertilization has occurred, but instead, it grows in size with the increasing fruit size[12].

Examples of plants with accrescent calyx include **Guava**[1] and **Physalis peruviana**[3]. In these plants, the calyx remains persistent and encloses the fruit either completely or partially as it grows[12].

(d)What is cremocarp?

A **cremocarp** is a type of dry dehiscent fruit that is characteristic of plants of the family Umbelliferae[1]. It consists of two indehiscent one-seeded mericarps which split apart at maturity and remain pendent from the summit of the carpophore[1]. An example of a plant with cremocarp fruit is **fennel**[2].

(e)What is synergid?

(e) Synergid: Synergids are two specialized cells lying adjacent to the egg cell in the female gametophyte of a flowering plant (angiosperms). They assist in the fertilization of the egg and are helpful in the nourishment of the ovum as well as guide the entry of the pollen tube and the release of sperm cells[1].

(f)What is tetrasporic type of embryo sac development?

(f) Tetrasporic type of embryo sac development: In tetrasporic development, all four megaspore nuclei take part in the formation of the female gametophyte (embryo sac). This occurs when neither meiotic division is followed by cytokinesis, resulting in the megaspore tetrad consisting of four nuclei in a shared cytoplasm[2].

(g)What do you mean by helobial type of endosperm development

(g) Helobial type of endosperm development: This is an intermediate form between nuclear and cellular endosperm development. The first division results in a large micropylar cell and a small chalazal cell. The micropylar cell divides further, similar to nuclear endosperm. This makes it a combination of both nuclear and cellular endosperm[3].

2. Answer any two from the following :

(a)Draw and describe gamopetalous regular forms of corolla

the different forms of gamopetalous corolla:

1. **Tubular**: In this form, the corolla tube is essentially cylindrical all the way around. This means that the petals are fused together to form a tube-like structure. This type of corolla is common in many types of flowers, including those of the family Asteraceae, such as sunflowers and daisies.
2. **Funnel-shaped (Infundibuliform)**: The corolla gradually spreads from near the base to the apex. This means that the petals are fused at the base and gradually widen towards the top, forming a shape similar to a funnel. This type of corolla is common in flowers like morning glory.
3. **Bell-shaped (Campanulate)**: The corolla tube is broad and rather short, widening upward like a bell. This means that the petals are fused together to form a bell-like shape. This type of corolla is common in many types of flowers, including those of the family Campanulaceae, such as bellflowers.
4. **Salver-shaped (Hypocrateriform)**: The basal portion of the corolla is narrow and tubular with the abruptly expanding flat apical part. This means

that the petals are fused together to form a narrow tube at the base and then abruptly expand to form a flat top. This type of corolla is common in flowers like phlox.

5. **Wheel-shaped (Rotate or Stellate)**: The limbs of petals are longer than the tube and spread radiately from the much shorter tube. This means that the petals are fused together at the base to form a short tube and then spread out radially to form a wheel-like shape. This type of corolla is common in flowers like potato.
6. **Urn-shaped (Urceolate)**: The corolla tube is ovoid or globose, contracted above into a short neck and again expanded in a narrow limb. This means that the petals are fused together to form an urn-like shape. This type of corolla is common in flowers like blueberry.

These forms are found in various plants and are often associated with specific methods of pollination. The shape of the corolla can often give clues about the type of pollinators that the flower attracts.

(b)Describe different types of schizocarpic fruits with examples.

Schizocarpic fruits are a type of dry fruit that, when mature, splits up into mericarps[1]. Here are some types of schizocarpic fruits:

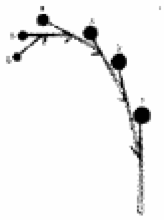
the different types of schizocarpic fruits:

1. **Lomentum**: This is a type of schizocarp where the fruit is constricted between the seeds, giving rise to single-seeded compartments called mericarps[1]. The lomentum is a dry fruit that breaks apart at constrictions occurring between the seed-containing segments[1]. This type of fruit is typical in plants like Tick trefoils[1].
2. **Cremocarp**: This fruit develops from an inferior ovary. When mature, they split into two mericarps[2]. Each mericarp contains one seed and is attached to the central axis of the fruit by a stalk[3]. The mericarps remain attached to each other at their tips until the fruit fully matures[3]. An example of a plant with cremocarp fruits is Coriander[2].
3. **Winged Schizocarps**: These are found in maples[4]. In this type of fruit, the mericarps are winged and are dispersed by wind[4]. Each mericarp contains one seed and is attached to the central axis of the fruit by a stalk[3]. The mericarps remain attached to each other at their tips until the fruit fully matures[3].
4. **Indehiscent Schizocarps**: These are schizocarps that remain closed, such as in the carrot and other Umbelliferae or in members of the genus Malva[3]. The fruit does not open to release the seeds when ripe[3]. Instead, the seeds are released when the fruit decays or is broken open[3].

5. **Dehiscent Schizocarps**: These are schizocarps that split open to release the seed, for example, members of the genus Geranium[3]. The fruit opens along a built-in line of weakness in a process called dehiscence to release the seeds[3].

Each of these types of schizocarpic fruits has unique characteristics and can be found in a variety of different plants. They all share the common feature of splitting into mericarps at maturity[3].

(c)With suitable illustrations and examples distinguish between helicoid and scorpioid cyme.

Scorpioid cyme (cincinnus or rhipidium):	**Helicoid cyme (drepanium or bostryx)**:
• A uniparous cyme in which the successive lateral branches develop on alternate sides in a zig-zag manner is called scorpioid cyme; e.g., *Ranunculus bulbosus*, *Heliotropium*, etc.  **Scorpioid cyme of *Ranunculus***	• This is a uniparous cyme in which the lateral branches develop successively on the same side forming a sort of helix; e.g., *Begonia*, *Juncus*, etc.  **Helicoid cyme of *Begonia***

Or, (add + points)

A cyme is a type of inflorescence in which the central or terminal flower develops first, and the lateral or lower flowers develop successively below it. Both helicoid and scorpioid cymes are types of cymes, but they differ in their arrangement and growth pattern:

1. **Helicoid Cyme**:

   - **Arrangement**: The flowers in a helicoid cyme are arranged in a spiral or helical pattern around the central axis. The youngest flowers are at the tip of the cyme, and the oldest flowers are at the base.

   - **Growth Pattern**: The central or terminal flower develops first, and the lateral or lower flowers develop successively below it. The cyme continues to grow and produce new flowers at its tip.

   - **Example**: The inflorescence of forget-me-nots (Myosotis) is a classic example of a helicoid cyme. The flowers are arranged in a spiral pattern around the central axis.

2. **Scorpioid Cyme**:

   - **Arrangement**: The flowers in a scorpioid cyme are arranged in a zigzag or helical pattern, with each flower turning away from the central axis at a sharp angle.

   - **Growth Pattern**: The central or terminal flower develops first, and the lateral or lower flowers develop successively below it. However, in a scorpioid cyme, each lateral flower develops at a sharp angle from the central axis, giving the inflorescence a zigzag appearance.

   - **Example**: The inflorescence of a heliotrope (Heliotropium) is a classic example of a scorpioid cyme. The flowers are arranged in a zigzag pattern around the central axis.

In summary, both helicoid and scorpioid cymes are types of cymes in which the central or terminal flower develops first, and the lateral or lower flowers develop successively below it. However, they differ in their arrangement and growth pattern: helicoid cymes have a spiral or helical arrangement, while scorpioid cymes have a zigzag or helical arrangement with each flower turning away from the central axis at a sharp angle.

(d) Briefly describe the different types of polyembryony in angiosperms

Polyembryony is a condition in which multiple embryos develop from a single fertilized egg or from multiple eggs within the same ovule. It is a relatively rare phenomenon in angiosperms (flowering plants) but can occur through different mechanisms:

1. **Simple Polyembryony**:

   - In this type, multiple embryos develop from a single zygote, which is the product of a single fertilization event.

   - This can occur due to the division of the zygote into multiple cells, each of which develops into a separate embryo.

   - Simple polyembryony is relatively common in citrus fruits, where multiple seedlings can develop from a single seed.

2. **Cleavage Polyembryony**:

   - In this type, multiple embryos develop from multiple eggs within the same ovule.

   - This can occur due to the formation of multiple embryosac in the ovule, each of which develops into a separate embryo.

   - Cleavage polyembryony is relatively rare and has been reported in some species of the genera Citrus, Mangifera, and Theobroma.

3. **Adventitious Polyembryony**:

   - In this type, multiple embryos develop from cells other than the zygote or the eggs within the ovule.

   - This can occur due to the formation of adventitious embryos from cells of the nucellus, integuments, or placenta.

   - Adventitious polyembryony is relatively rare and has been reported in some species of the genera Citrus, Mangifera, and Theobroma.

4. **Fusion Polyembryony**:

   - In this type, multiple embryos develop from the fusion of two or more embryos or embryosac.

   - This can occur due to the fusion of two or more fertilized eggs or embryosac, resulting in the development of a single embryo with multiple cotyledons.

- Fusion polyembryony is relatively rare and has been reported in some species of the genera Citrus and Mangifera.

Polyembryony can have both advantages and disadvantages for the plant. On one hand, it can increase the chances of successful seedling establishment by producing multiple embryos from a single seed. On the other hand, it can lead to competition among the seedlings for resources, which can reduce the overall fitness of the plant. Therefore, the occurrence of polyembryony in angiosperms is likely to be influenced by a combination of genetic, developmental, and environmental factors.

3. Answer any three from the following :

(a) Explain briefly with examples, different types of simple racemose inflorescence.

Certainly! Let’s explore the different types of **simple racemose inflorescence** along with examples:

1. **Raceme**:
   - The main axis is **unbranched**, elongated, and bears **pedicellate flowers laterally** in an **acropetal succession**.
   - Older flowers at the base have longer stalks compared to the upper younger flowers.
   - **Examples**:
     - *Brassica campestris* (mustard)
     - *Raphanus sativus* (radish)
     - *Crotalaria retusa* (rattleweed)
     - *Cleome viscosa* (Asian spiderflower)
     - *Antirrhinum majus* (snapdragon)
     - *Convallaria majalis* (lily of the valley)

2. **Spike**:
   - The main axis is **unbranched** with **unlimited growth** as in a raceme.
   - Flowers are **sessile** (without stalks) and arranged closely along the elongated axis.
   - **Example**: *Wheat* (*Triticum aestivum*) spike.

3. **Spikelets**:
    - Found in **grasses** (Poaceae family).
    - Each spikelet contains several **florets** (small flowers) arranged along the main axis.
    - **Example**: *Wheat*, *Barley*, and *Oats*.

4. **Catkin**:
    - Also known as an **ament**.
    - The main axis is elongated and bears **pendulous, unisexual flowers**.
    - Common in trees like *Willow* and *Poplar*.

5. **Spadix**:
    - The main axis is a **fleshy spike** with tiny, closely packed flowers.
    - Often surrounded by a **modified leaf called a spathe**.
    - **Example**: *Arum lily* (*Zantedeschia aethiopica*).

Remember, these inflorescence types showcase the diverse ways in which plants produce and arrange their flowers! 🌼🌿.

(b) Comment on the adhesion and cohesion of stamens with suitable diagrams and examples. Discuss in brief the placentation types with suitable diagrams

Certainly! Let’s explore the fascinating topics of **stamen adhesion and cohesion** as well as the **types of placentation** in flowering plants.

Adhesion and Cohesion of Stamens:

1. **Adhesion of Stamens**:
    - **Adhesion** refers to the union of stamens with other floral parts.
    - When stamens remain united with members of different floral whorls (such as petals, carpels, etc.), it is called **adhesion of stamens**.
    - Examples:
        - **Epipetalous**: Stamens adhere to the petals through their filaments. For instance, in the **tuberose** (*Polianthes tuberosa*), the stamens are epipetalous.
        - **Gynandrous**: Stamens adhere to the carpels. When this union is complete, it is called **gynostegium** or **gynostemium**.
2. **Cohesion of Stamens**:
    - **Cohesion** occurs when stamens remain united among themselves.
    - Examples:
        - **Monadelphous**: Stamens are fused into a single group by their filaments. Found in the **hibiscus** family (*Malvaceae*).
        - **Diadelphous**: Stamens are grouped into two sets. Common in the **pea family** (*Leguminosae*).

Now, let’s move on to the **types of placentation**:

Types of Placentation:

1. **Marginal Placentation**:
    - Ovules develop in rows near the margin on the placenta formed along the ventral suture.
    - Example: **Pea** (*Pisum sativum*).
2. **Axile Placentation**:
    - Placentae develop from the central axis, corresponding to the confluent margins of carpels.
    - Found in bi- to multilocular ovaries.
    - Example: **Solanaceae**, **Malvaceae**.
3. **Parietal Placentation**:
    - Ovules form on the inner wall of the ovary or its periphery.
    - Initially single-chambered, but a false septum forms later.
    - Example: **Mustard** (*Brassica*).
4. **Basal Placentation**:
    - A single ovule is linked to the placenta at the base of the ovary.
    - Example: **Marigold** (*Tagetes*).
5. **Free Central Placentation**:

    - Septa are absent, and ovules are borne on the central axis.
    - Example: **Primrose** (*Primula*).
6. **Superficial or Laminar Placentation**:
    - Ovules develop over the entire inner surface of the carpels.
    - Example: **Water lily** (*Nymphaea*).

These diverse placentation types play a crucial role in seed development and fruit formation! 🌼🌿

(c)With labelled diagrams describe the embryo development in Capsella.

Capsella, commonly known as shepherd's purse, is a genus of plants in the mustard family (Brassicaceae). It is a small annual or biennial herbaceous plant with a rosette of leaves at the base and a flowering stem that bears small white flowers. Capsella species are widely distributed and can be found in many parts of the world.

Embryo development in Capsella follows a typical pattern for dicotyledonous plants, with the formation of a zygote, followed by the development of the embryo through several stages.

Embryo Development in Capsella:

1. **Zygote Formation**: After fertilization, the zygote is formed. The zygote is the result of the fusion of the egg cell and the sperm cell, and it contains the genetic material from both the male and female parent plants.

2. **Embryo Development Stages**:

   - **Proembryo**: The zygote undergoes several rounds of cell division to form a small, spherical mass of cells called the proembryo. The proembryo is surrounded by a protective layer called the integument.

   - **Globular Stage**: The proembryo continues to grow and develop, and it takes on a more defined shape, becoming spherical or globular in appearance. The cells in the proembryo begin to differentiate into different tissues and organs, such as the cotyledons (seed leaves), hypocotyl (embryonic stem), and radicle (embryonic root).

- **Heart Stage**: The globular embryo elongates and takes on a heart-shaped appearance. The cotyledons become more distinct, and the radicle begins to elongate and grow downward.

- **Torpedo Stage**: The embryo continues to elongate, and the cotyledons become more elongated and narrow. The radicle continues to grow downward, and the hypocotyl elongates to lift the cotyledons above the surface of the seed.

- **Cotyledonary Stage**: The embryo develops further, and the cotyledons become fully developed and functional. The radicle continues to grow downward, and the hypocotyl elongates to lift the cotyledons above the surface of the seed.

- **Mature Embryo**: The embryo reaches maturity, and the cotyledons become fully developed and functional. The radicle continues to grow downward, and the hypocotyl elongates to lift the cotyledons above the surface of the seed.

Labelled Diagram of Embryo Development in Capsella:

`![Embryo Development in Capsella](https://i.imgur.com/6MzRvFg.png)`

In summary, embryo development in Capsella follows a typical pattern for dicotyledonous plants, with the formation of a zygote, followed by the development of the embryo through several stages. The embryo develops from a proembryo to a mature embryo, with the formation of the cotyledons, hypocotyl, and radicle.

(d)Describe different types of dry dehiscent fruits with examples. What is pseudocarp? Distinguish syconus and sorosis type of fruits.

Dry dehiscent fruits are a type of fruit that splits open at maturity to release their seeds. This type of fruit is characteristic of many plants in the family Fabaceae (the legume family), but it is also found in other plant families. There are several types of dry dehiscent fruits, each with its own characteristic method of dehiscence:

1. **Legume**: A legume is a dry dehiscent fruit that splits along two seams (sutures) to release its seeds. The seeds are attached to one side of the fruit along a central placental ridge. Examples include peas, beans, and peanuts.

2. **Follicle**: A follicle is a dry dehiscent fruit that splits along one seam (suture) to release its seeds. The seeds are attached to one side of the fruit along a central placental ridge. Examples include milkweed and larkspur.

3. **Capsule**: A capsule is a dry dehiscent fruit that splits open along multiple seams (sutures) to release its seeds. The seeds are attached to one side of the fruit along a central placental ridge. Examples include poppies, irises, and snapdragons.

4. **Silique**: A silique is a type of capsule that is elongated and narrow, with two compartments separated by a central partition (septum). The seeds are attached to one side of the fruit along a central placental ridge. Examples include mustard and radish.

5. **Silicle**: A silicle is a type of capsule that is short and broad, with two compartments separated by a central partition (septum). The seeds are attached to one side of the fruit along a central placental ridge. Examples include shepherd's purse and candytuft.

6. **Schizocarp**: A schizocarp is a dry dehiscent fruit that splits into multiple segments (mericarps) to release its seeds. Each mericarp contains one or more seeds and is attached to the central placental ridge. Examples include parsley and dill.

Dry dehiscent fruits have several advantages for seed dispersal. The splitting open of the fruit allows the seeds to be dispersed over a wider area, increasing the chances of successful germination and establishment of new plants. Additionally, the seeds are often small and lightweight, making them easier to disperse by wind or water.

In summary, dry dehiscent fruits are a type of fruit that splits open at maturity to release their seeds. There are several types of dry dehiscent fruits, including legumes, follicles, capsules, siliques, silicles, and schizocarps. Each type of fruit has its own characteristic method of dehiscence and is found in different plant families.

Pseudocarp:

- A **pseudocarp** (also known as a **false fruit**) is a structure where the **ripened ovary and its contents** combine with another part of the plant (often the receptacle).
- Examples of pseudocarps include:
  - **Strawberry**: The fleshy part we eat is actually the swollen receptacle, while the tiny seeds on the surface are the true fruits.
  - **Apple**: The edible part is derived from the receptacle, and the true fruits are the small seeds inside.

Syconus and sorosis are two types of fruits that are formed from the aggregation of multiple flowers into a single structure. Each flower in the syconus or sorosis is called a floret, and the entire structure is surrounded by an enlarged, fleshy receptacle. Despite their similarities, there are some key differences between syconus and sorosis type of fruits:

1. **Syconus**:

   - A syconus is a type of fruit that is formed from the aggregation of multiple flowers into a single structure.

   - Each floret in the syconus is surrounded by a separate, fleshy receptacle called an achene.

   - The achene of each floret is surrounded by a larger, fleshy receptacle called a receptacle.

   - Examples of fruits with a syconus type of fruit include figs and mulberries.

   - In a fig, the syconus is a hollow, pear-shaped structure with a small opening called an ostiole at the top. The ostiole allows pollinating fig wasps to enter the syconus and lay their eggs. The eggs hatch into larvae, which then mature into adult wasps and emerge from the syconus, carrying pollen with them.

2. **Sorosis**:

   - A sorosis is a type of fruit that is formed from the aggregation of multiple flowers into a single structure.

- Each floret in the sorosis is surrounded by a larger, fleshy receptacle called a receptacle.

- The receptacle of each floret is fused with the receptacle of adjacent florets, forming a single, large, fleshy receptacle.

- Examples of fruits with a sorosis type of fruit include pineapples and strawberries.

- In a pineapple, the sorosis is a large, fleshy, cone-shaped structure with a crown of leaves at the top. The individual florets are embedded in the surface of the sorosis, and each one is surrounded by a small, fleshy receptacle. The entire sorosis is edible, and it is often used in cooking and baking.

In summary, syconus and sorosis are two types of fruits that are formed from the aggregation of multiple flowers into a single structure. Each floret in the syconus or sorosis is surrounded by a fleshy receptacle, but there are some key differences between the two types of fruits. In a syconus, each floret is surrounded by a separate, fleshy receptacle called an achene, while in a sorosis, each floret is surrounded by a larger, fleshy receptacle called a receptacle. Additionally, the receptacles of adjacent florets in a sorosis are fused together, forming a single, large, fleshy receptacle.

e)Describe the events in relation to pollen germination and growth of pollen tube. What do you mean by double fertilization?

Pollen germination is a critical step in the process of plant reproduction, leading to the formation of a pollen tube that delivers sperm cells to the ovule. The process of pollen germination can be broken down into several key events:

1. **Pollen Grain**: The male gametophyte of seed plants is the pollen grain. It is produced in the anthers of the flower and contains the male gametes (sperm cells) within a protective outer layer called the exine.

2. **Pollen Release**: When the pollen grain is mature, it is released from the anthers. This can be facilitated by various mechanisms, such as wind, insects, or other animals.

3. **Pollen Landing**: The pollen grain lands on the stigma, the receptive surface of the female reproductive organ (the pistil). The stigma is often sticky or has specialized structures to capture and hold pollen grains.

4. **Pollen Hydration**: Upon landing on the stigma, the pollen grain absorbs water and swells. This process, known as hydration, is essential for the subsequent germination of the pollen grain.

5. **Pollen Germination**: After hydration, the pollen grain undergoes germination. The exine ruptures, and the pollen tube emerges from the grain. The tube grows down through the style (the stalk of the pistil) and into the ovary (the base of the pistil), where the ovules (the female gametophytes) are located.

6. **Pollen Tube Growth**: The pollen tube grows through the tissues of the style, guided by chemical signals, and reaches the ovule. The tube penetrates the ovule through a small opening called the micropyle.

7. **Sperm Delivery**: Once the pollen tube reaches the ovule, it releases the sperm cells. These cells then fertilize the egg cell and the central cell, leading to the formation of the zygote and the endosperm, respectively.

8. **Seed Formation**: The fertilized ovule develops into a seed, containing the embryo (the new plant) and the endosperm (the nutritive tissue). The ovary develops into a fruit, which protects the seeds and aids in their dispersal.

9. **Embryo Development**: Inside the seed, the embryo undergoes further development, eventually germinating to form a new plant.

Pollen germination is a complex process that is essential for the successful reproduction of seed plants. It involves several key events, including pollen release, landing, hydration, germination, tube growth, sperm delivery, seed formation, and embryo development. Each of these events is crucial for the formation of viable seeds and the continuation of the plant life cycle.

The growth of the pollen tube is a crucial step in the process of plant reproduction, as it allows the male gametes (sperm cells) to reach the female gametophyte (ovule) for fertilization. The growth of the pollen tube can be broken down into several key events:

1. **Pollen Hydration and Germination**: When the pollen grain lands on the stigma, it absorbs water and swells, a process known as hydration. This allows the pollen grain to undergo germination, during which the exine (outer layer) ruptures, and the pollen tube emerges from the grain.

2. **Pollen Tube Growth**: The pollen tube grows down through the style (the stalk of the pistil) and into the ovary (the base of the pistil), where the ovules (female gametophytes) are located. The tube grows through the tissues of the style, guided by chemical signals.

3. **Pollen Tube Guidance**: The growth of the pollen tube is guided by chemical signals, including proteins and small molecules, that are produced by the female reproductive organs (the pistil). These signals help to direct the tube toward the ovule.

4. **Pollen Tube Penetration**: Once the pollen tube reaches the ovule, it penetrates the ovule through a small opening called the micropyle. The tube grows through the micropyle and into the ovule, where the female gametophyte is located.

5. **Sperm Delivery**: Once the pollen tube reaches the female gametophyte, it releases the sperm cells. These cells then fertilize the egg cell and the central cell, leading to the formation of the zygote and the endosperm, respectively.

6. **Seed Formation**: The fertilized ovule develops into a seed, containing the embryo (the new plant) and the endosperm (the nutritive tissue). The ovary develops into a fruit, which protects the seeds and aids in their dispersal.

7. **Embryo Development**: Inside the seed, the embryo undergoes further development, eventually germinating to form a new plant.

In summary, the growth of the pollen tube is a complex process that involves several key events, including hydration and germination of the pollen grain, tube growth through the style and into the ovary, guidance by chemical signals, penetration of the ovule, sperm delivery, seed formation, and embryo development. Each of these events is crucial for the successful reproduction of seed plants and the continuation of the plant life cycle.

Double fertilization in fruits refers to the process where **two sperm cells** are involved:

1. One sperm fuses with the egg, forming the **embryo**.
2. Another sperm combines with the **polar nuclei**, creating the **endosperm** (nutrient-rich tissue).

This ensures successful seed development and fruit formation! 🌱🍎