

PARTS OF A FLOWER- ANDROECIUM, GYNECIUM, FRUIT AND ITS CLASSIFICATION, STRUCTURE OF A DICOTYLEDONOUS SEED, STRUCTURE OF MONOCOTYLEDONOUS SEED



Key Takeaways

- Androecium
- Fruits
 - ◆ Characteristic features
 - ◆ Classifications
- Gynoecium

- Seeds
 - ◆ Structure
 - ◆ Characteristic features
 - ◆ Classifications
 - ◆ Dicotyledonous seed
 - ◆ Monocotyledonous seed

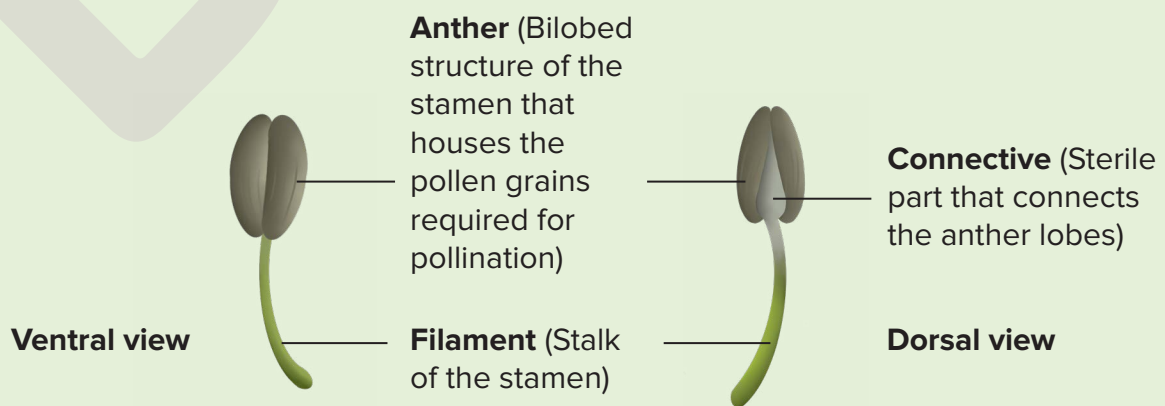


Prerequisites

- Parts of flowering plants
- Root system
- Shoot system

Androecium

- **Stamens** are collectively termed as androecium.
- **Function:** It is involved in production of male gametes.
- **Symbol:** It is represented by **A**.
- **Parts of androecium**
 - **Stamen:** It is the **male reproductive organ** of a flower.



Parts of the stamen

Androecium (based on stamen length)

Tetradynamous

Six stamens are present, two are short and four are long.
E.g., Mustard flower



Didynamous

Four stamens grouped into two sets of equal length.
E.g., *Ocimum*, *Salvia* flower



Stamen (Based on fusion to floral parts)

Epipetalous

Stamens are attached to the petals.
E.g., Brinjal flower



Epiphyllous

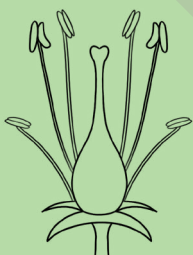
Stamens are attached to the perianth.
E.g., Lily



Stamen (Based on whether stamen is free or united)

Polyandrous

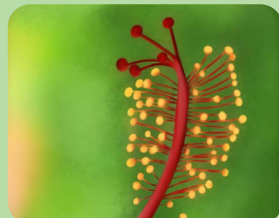
Stamens are free.
E.g., Lotus



Adelphous (stamens are united)

Monoadelphous

Filaments are united to form a single bundle.
E.g., China rose



Diadelphous

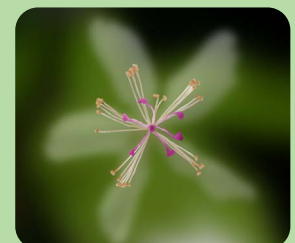
Filaments are divided into two bundles.
E.g., Pea plant



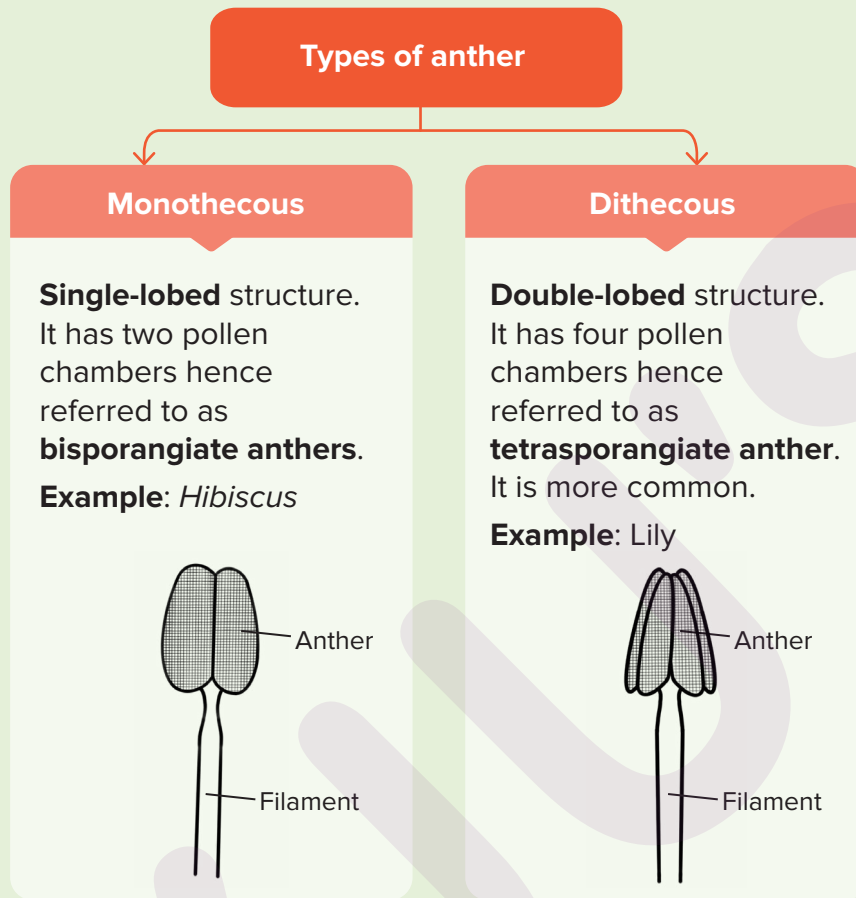
One distinct filament and a bunch of joint filaments

Polyadelphous

Filaments are divided into more than two bundles. E.g., Lemon



- Classification of anther based on number of lobes



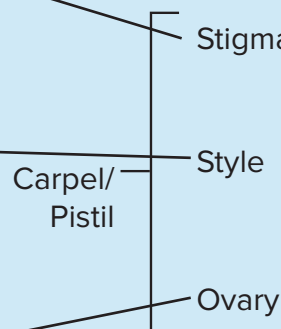
Gynoecium

- Pistils** (also known as **carpels**) are collectively termed as gynoecium. The gynoecium is the **female reproductive organ**.
- Function:** It is involved in production of female gametes.
- Symbol:** It is represented by **G**.

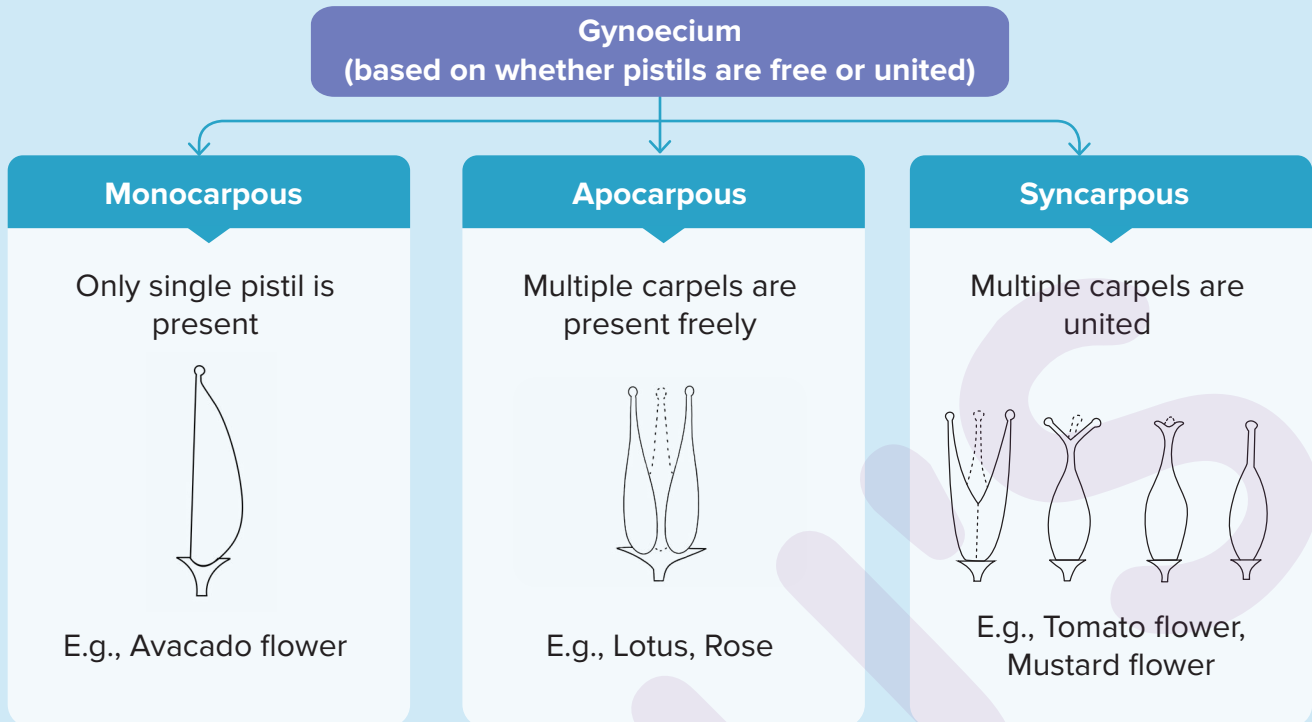
It is the receptive surface for pollen grains. It is present at the tip of the pistil.

It connects the ovary to the stigma. It is the middle portion of the pistil.

It is the enlarged basal part of the style.



Part of the gynoecium



- **Classification based on the position of ovary**

- **Hypogynous**

- Gynoecium occupies the **highest** position.
- Calyx, corolla, and androecium are present **below** the gynoecium.
- Ovary is **superior**.
- **Symbol:** It is represented by G.
- **E.g.,** *Hibiscus*, mustard flower, brinjal flower

- **Perigynous**

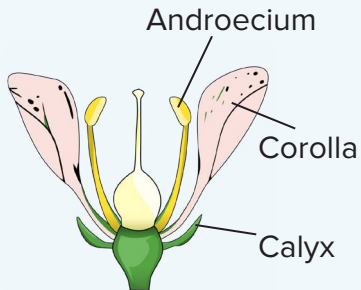
- Gynoecium is situated in the **centre**.
- Calyx, corolla, and androecium are located at the **rim of thalamus**.
- Ovary is **half inferior**.
- **Symbol:** It is represented by -G-.
- **E.g.,** Rose, plum flower, peach flower

- **Epigynous**

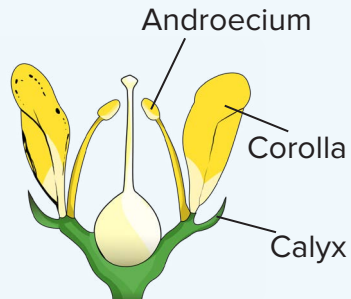
- Thalamus margin grows **upward, enclosing the ovary and fusing** with them.
- Calyx, corolla, and androecium are **above** the ovary.
- Ovary is **inferior**.
- **Symbol:** It is represented by $\overline{\text{G}}$.
- **E.g.,** Sunflower, guava flower, cucumber flower

Flower

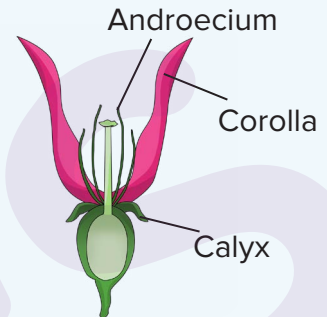
Hypogynous



Perigynous

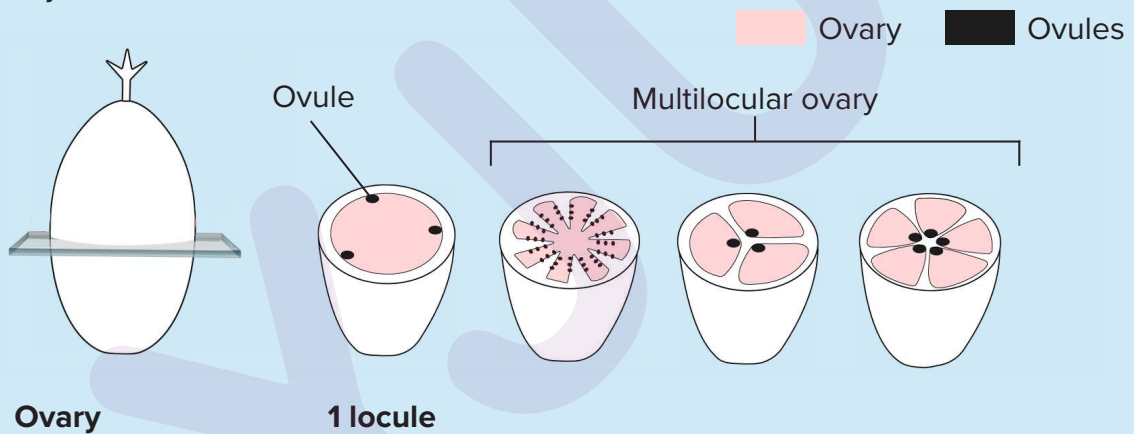


Epigynous

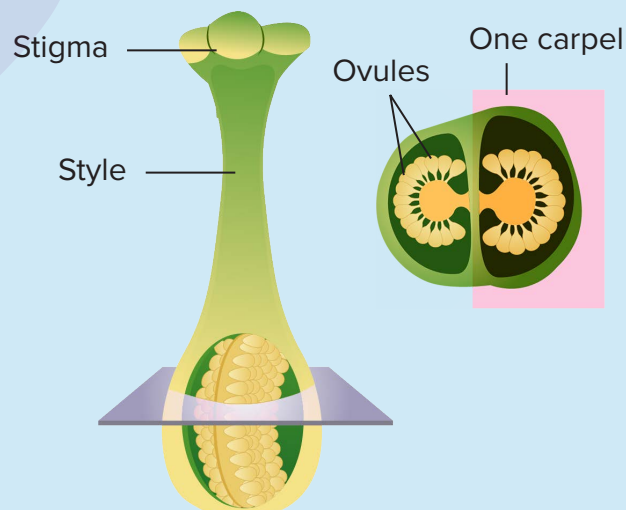


Parts of the ovary

- An ovary has one or more chambers known as **locules**.



- Each ovary bears one or more **ovules**.
- Ovules are connected to the ovary by a flattened, cushion-like **placenta**.
- A mature ovary has an **ovary wall** known as **pericarp** that encloses locules. Placenta arises from pericarp and is attached to ovules via **funiculus**.
- Ovules develop into **seed** after fertilisation.



- **Classification based on arrangement of ovules in an ovary**

- **Axile placentation:** Ovules are attached to multilocular (ovary with multiple chambers) ovaries.

E.g., Tomato, lemon

- **Marginal placentation:** Placenta forms a ridge along the margin to which ovules are attached.

E.g., Pea

- **Parietal placentation**

Ovules develop on the inner wall of the ovary or on the peripheral part.

E.g., Cantaloupe

Ovaries become two-chambered due to false septum.

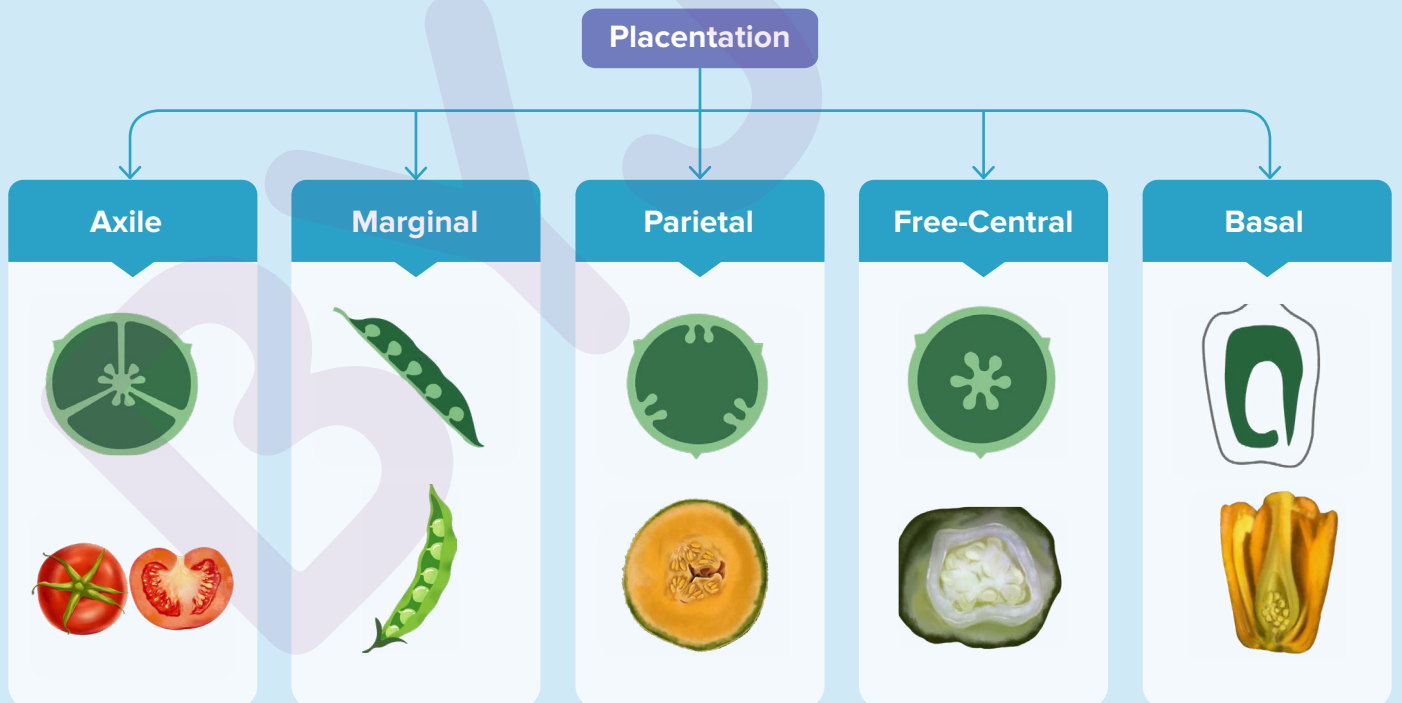
E.g., Mustard, *Argemone*

- **Free-central placentation:** Ovules are borne on the central axis of the ovary without any septa.

E.g., *Primrose*, *Dianthus*

- **Basal placentation:** Ovules develop at the base of the ovary.

E.g., Marigold, sunflower

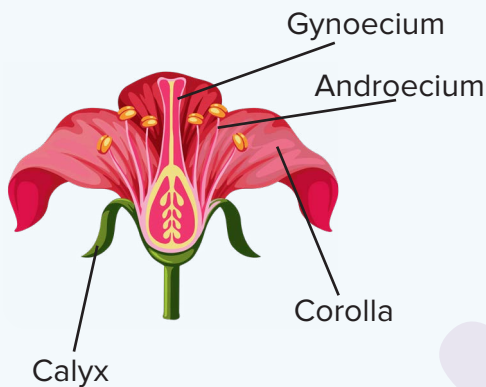


Different Classifications of Flower

Flower (based on whorls)

Complete

Flower has all four whorls.
E.g., *Hibiscus*



Incomplete

Flower is devoid of one or more whorls.
E.g., Papaya flower (the male flowers lack the gynoecium and the female flower lacks the androecium)



• Classification of flower based on presence of androecium and gynoecium

➤ Staminate flower

- **Only androecium** is present.
- It is found in **dioecious** plants.
- It is also found in **unisexual** flowers in **monoecious** plants.
- **E.g.**, Male papaya flower

➤ Staminode

- **Rudimentary stamen** is present.
- Stamen is **sterile** (does not produce pollen grains).
- **E.g.**, Banana flower

➤ Pistillate flower

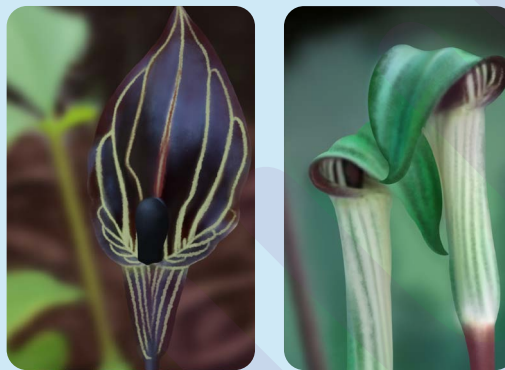
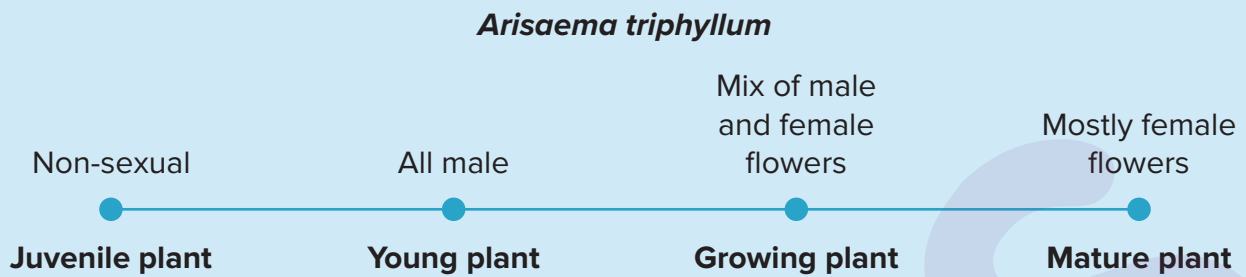
- **Only gynoecium** is present.
- It is found in **dioecious** plants. Also present in unisexual female flowers in monoecious plants
- **E.g.**, Female Cucurbit flower

➤ Bisexual flower

- Both **androecium** and **gynoecium** are present in the same flower.
- It is found in **monoecious** plants.
- **E.g.**, Mustard flower

➤ **Sex-switching plants**

- They express sexual differences at different stages of growth.



Arisaema triphyllum

Floral formula

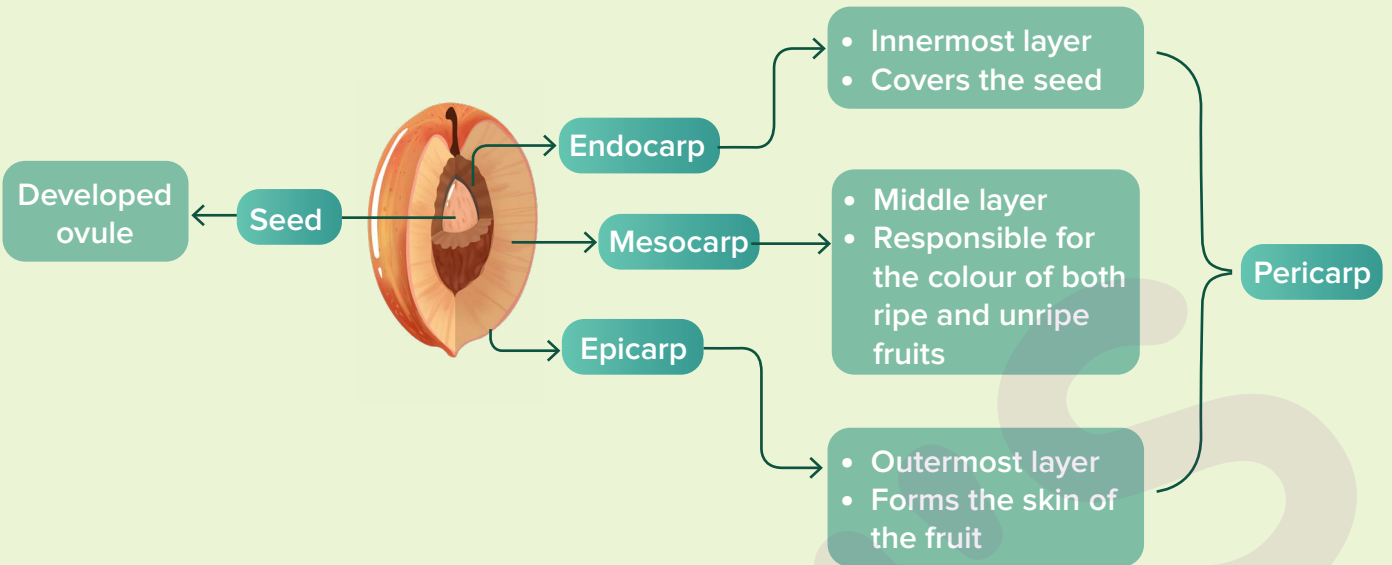
- It is the representation of the structure and type of a flower using numbers, letters, and various other symbols.
- It presents substantial information about the flower in a compact form.

Fruit

- An ovary after fertilisation matures to form fruits.
- **Ovules** present inside the ovary develop into seeds after the process of **fertilisation**.

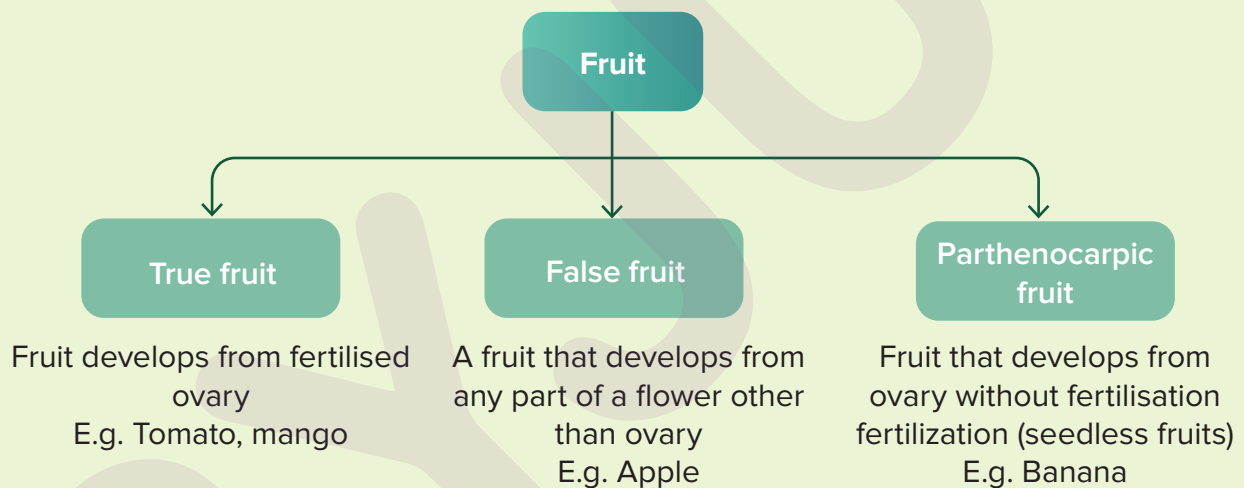
Parts of a fruit

- **Walls of a mature ovary** forms the fruit wall known as the **pericarp**.
- **Pericarp** is differentiated into three layers.

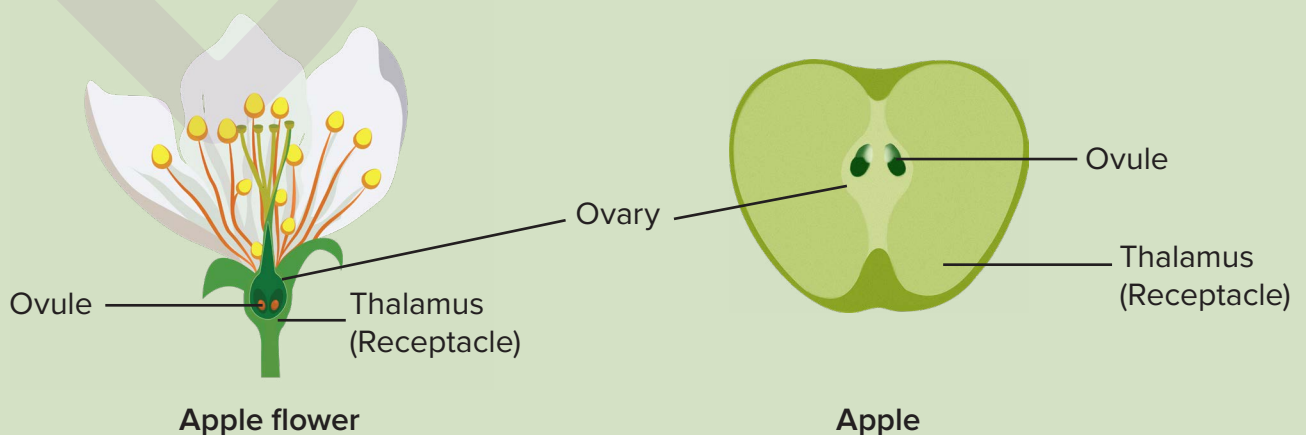


Types of fruits

- There are three types of fruits which are as follows:



- False fruits**
 - They develop from parts of the flower other than the ovary.
 - **Examples:** Apple and pear



- In apple and pear,
 - It is the **thalamus** and not the ovary that develops into the fruit.
 - **Ovary** develops into a **covering** of the seed.
 - **Edible part** is the **thalamus**.

Parthenocarpic fruits

- These are the fruits that develop **without fertilisation**.
- They are either **seedless** or contain **non-viable seeds**.
- They can occur naturally or can be induced.
- **Examples:** Banana, watermelon (seedless), and grapes (seedless)

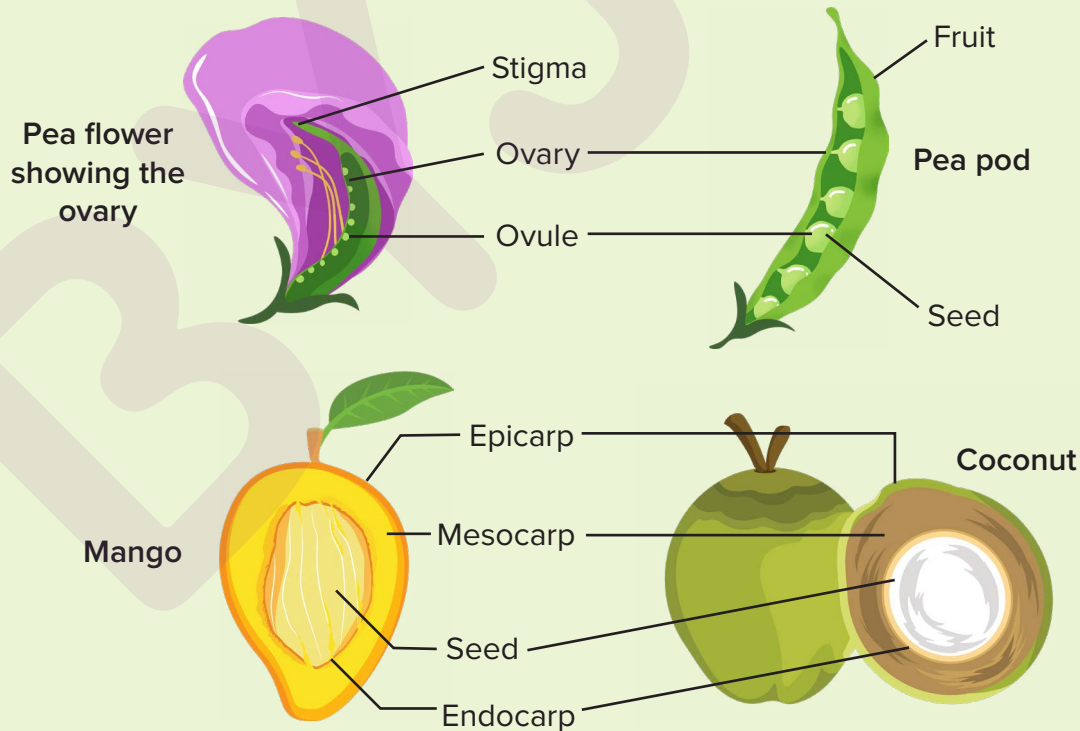


Watermelon

Note: Parthenocarpic development can be induced in plants when synthetic growth substances are applied to them in paste form, or by injecting or spraying them onto the plants

True fruits

- They develop from **fertilised ovaries**.
- **Examples:** Peas, mango, coconut, and grapes

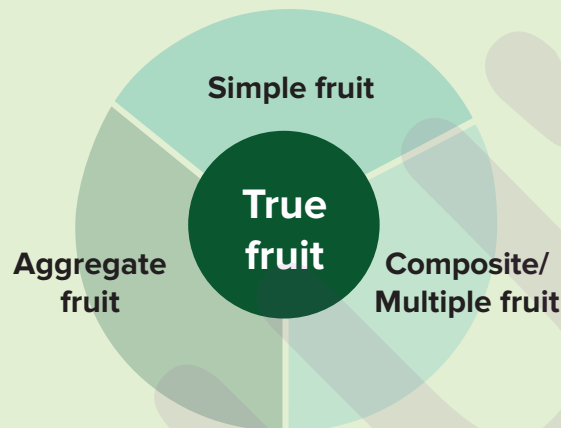


- **Mango**
 - The edible part of the **mango** is the **mesocarp**.

- **Coconut**

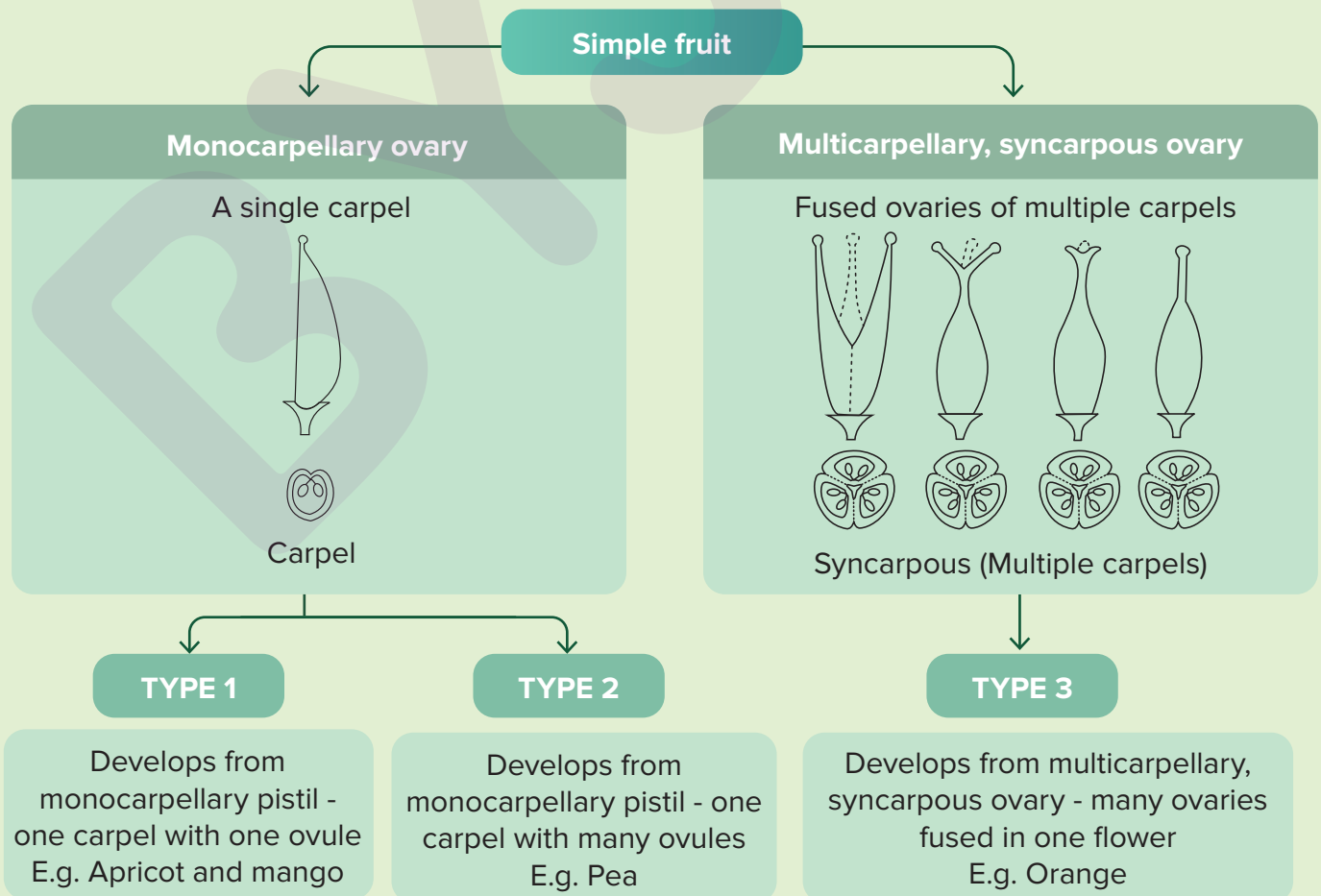
- In coconut, the **smooth outer layer** forms the **epicarp**.
- The **fibrous husk** is the **mesocarp**.
- The **hard woody layer** beneath the fibrous husk is the **endocarp**.
- **The fleshy edible layer** inside the endocarp is the **solid endosperm**.
- The **liquid** inside the endocarp is the **liquid endosperm** of coconut.

Classification of True Fruits

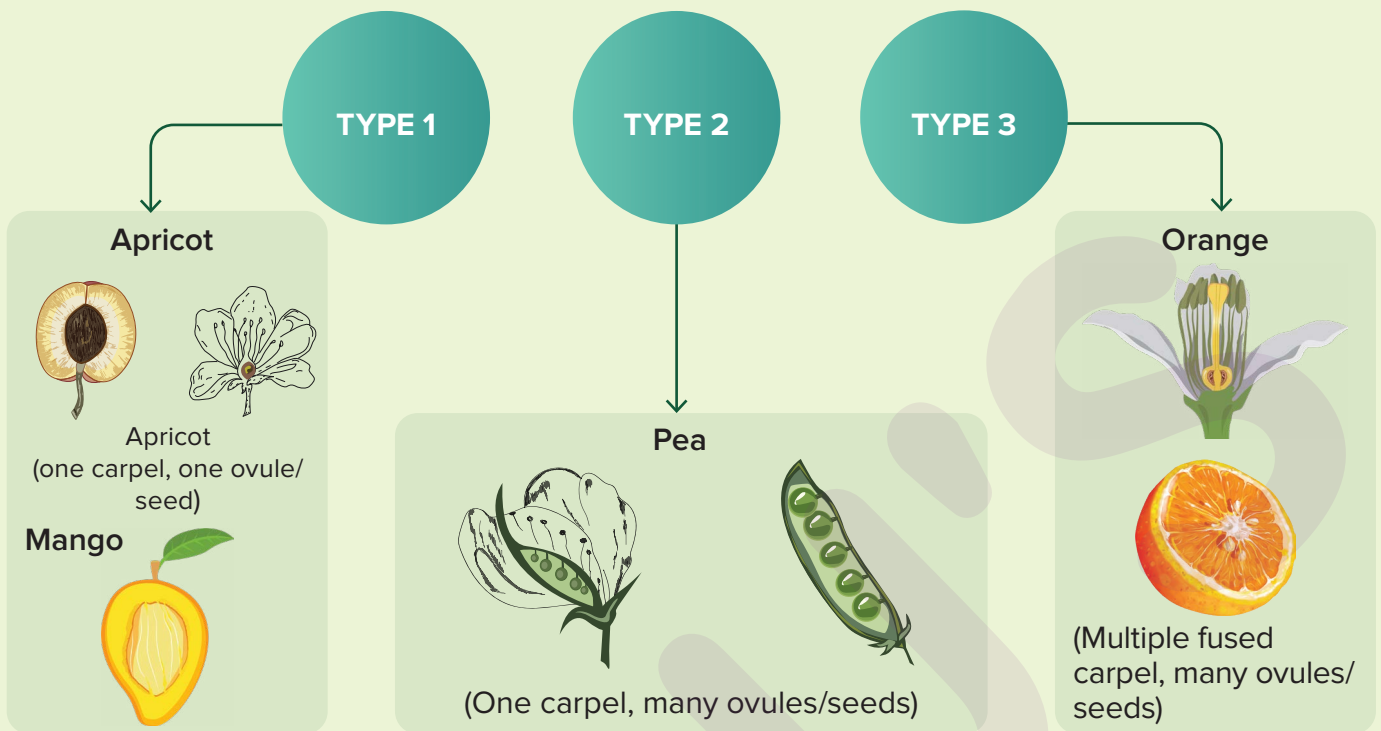


Simple fruits

- A **simple fruit** is the fruit that develops from a **single ovary** of a single flower containing one or more carpels.



- The fusion of **ovaries** takes place initially, followed by the fusion of **styles and stigma**.

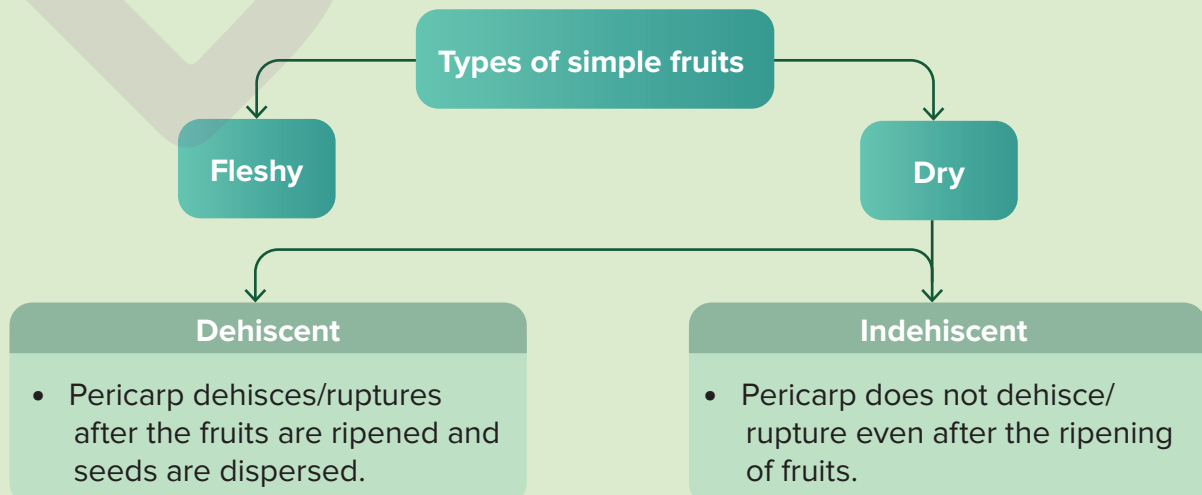


- Another type of classification of simple fruits.

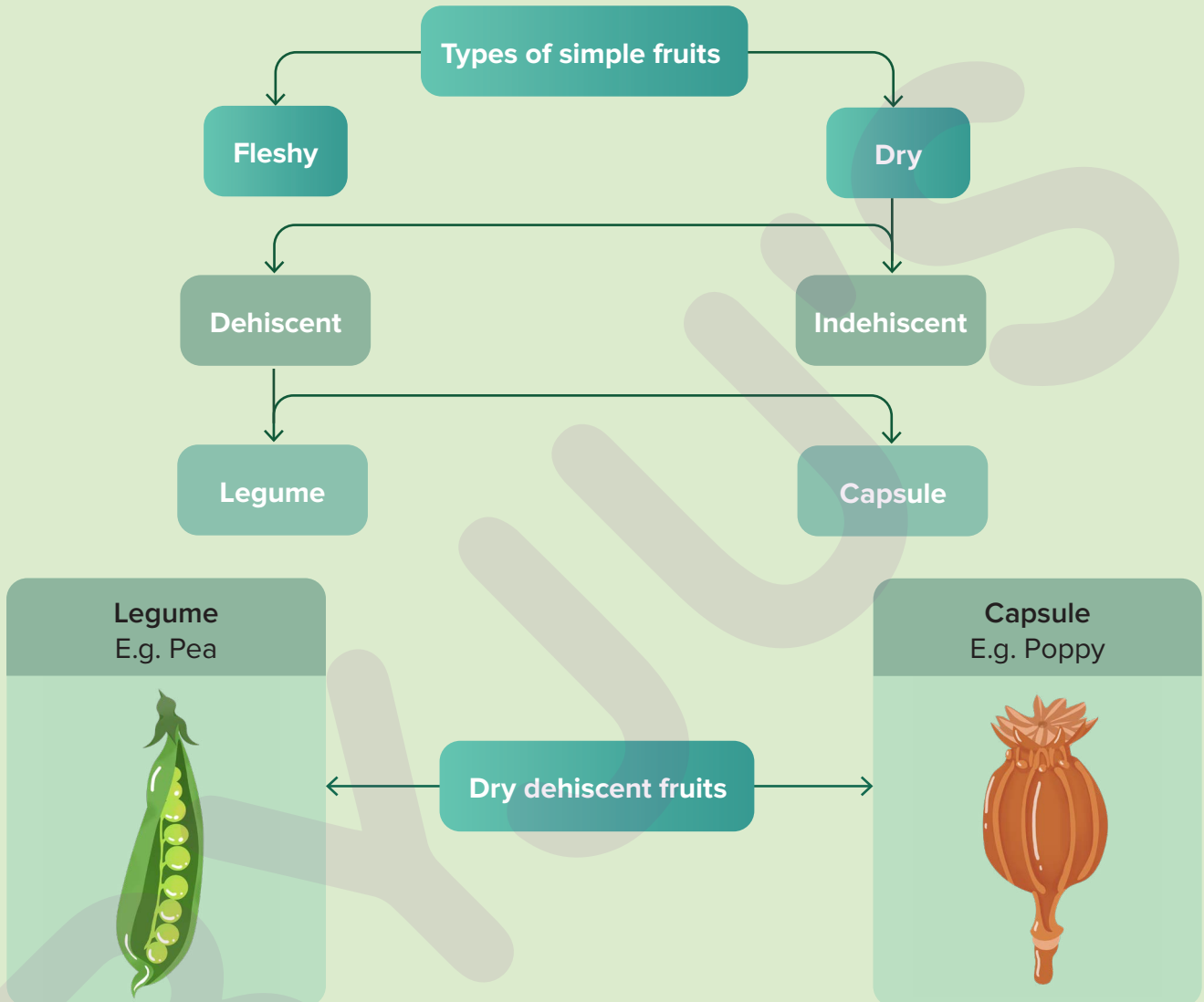


- Dry fruits**

→ The **dry simple fruits** are further classified based on the **dehiscence** of the pericarp and the **dispersal of seeds**.



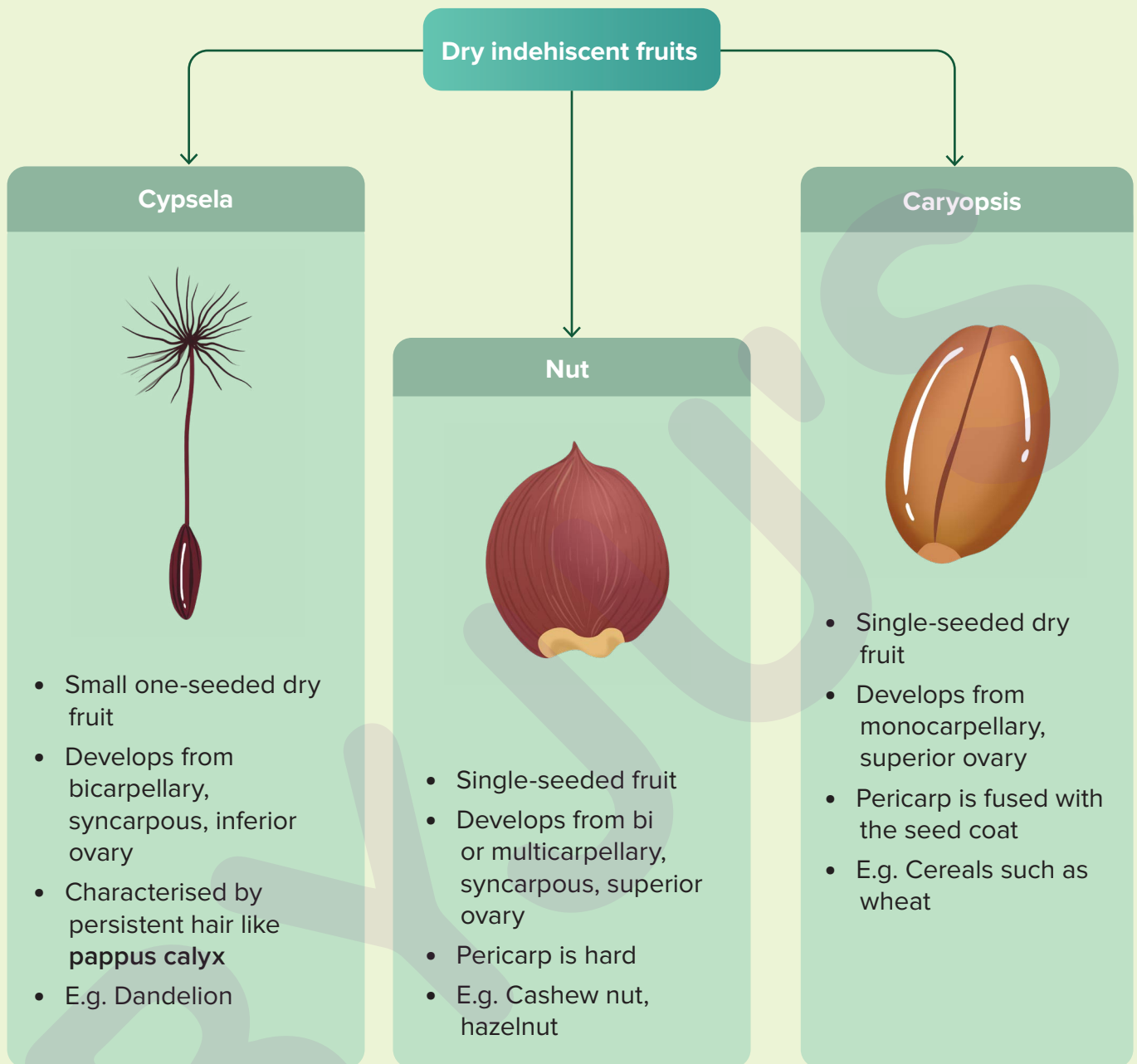
- Depending on different circumstances (decomposition, predation, etc.) in which the seed dispersal occurs, they either become **dehiscent** or **indehiscent**.
- The dehiscent dry fruits are further classified into **legume** and **capsule**.



- Develops from monocarpellary superior gynoecium
- Dehiscence starts from apex/tip and reaches to basal part

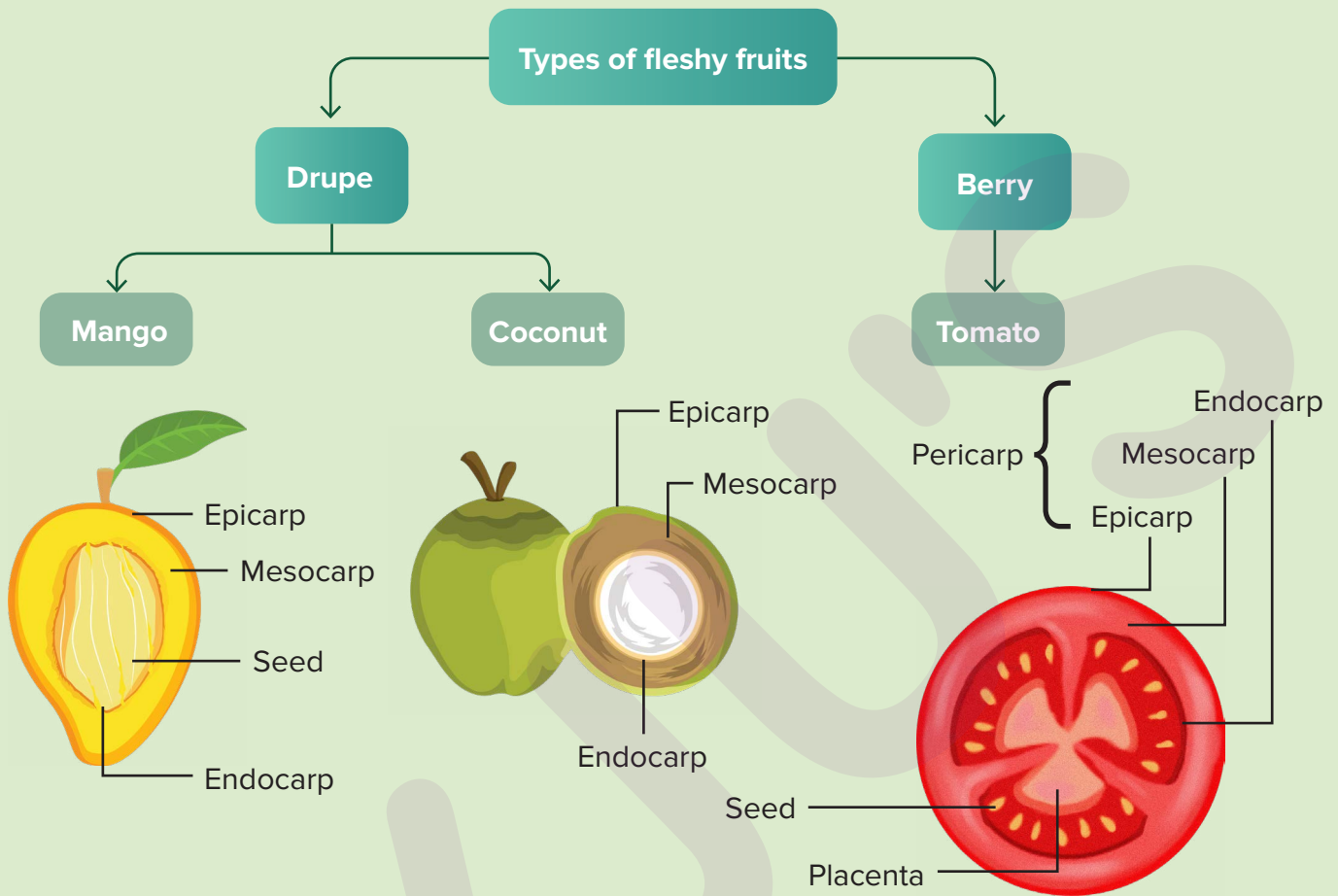
- Develops from bi or multicarpellary syncarpous gynoecium
- Dry, multichambered, and multi-seeded fruit which dehisces in several ways

- The dry indehiscent fruits are divided into various types as follows:



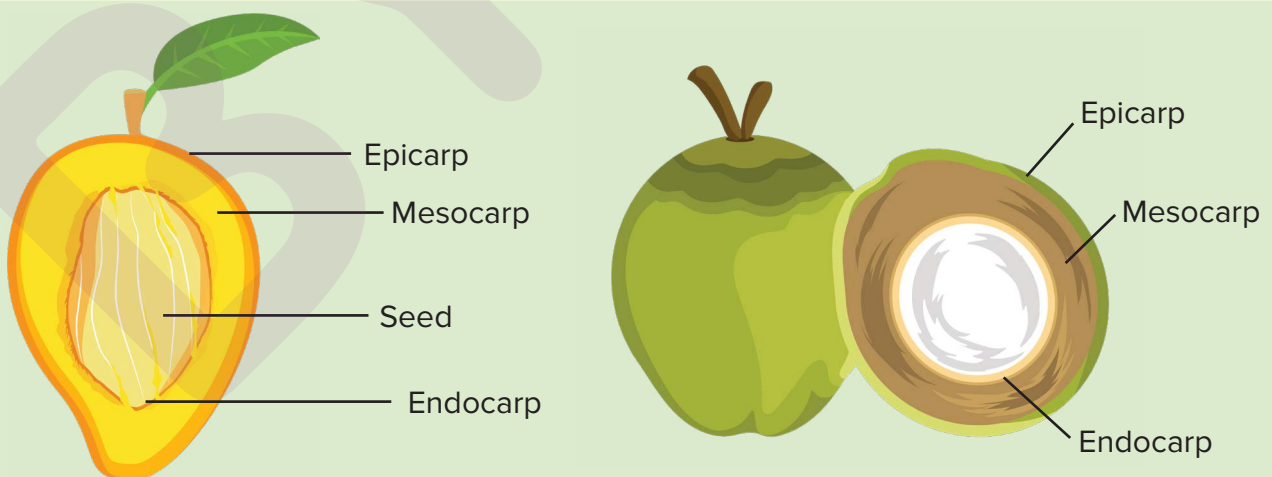
- Fleshy fruits**

→ These can be broadly classified as follows:



- Drupe:**

→ **Drupe** is a fruit that develops from **monocarpellary and superior ovary**.



→ They have either **edible fleshy** or **fibrous** mesocarp.

→ They show the presence of characteristic **stony endocarps**.

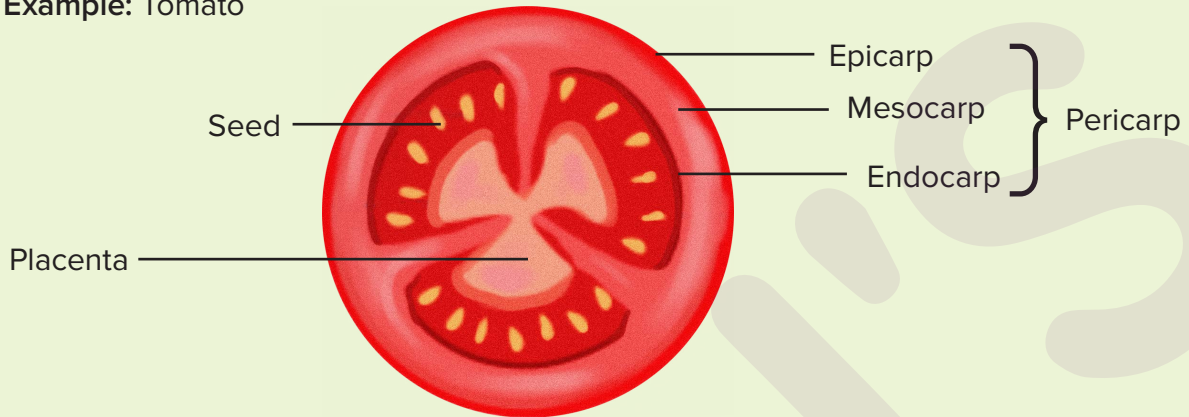
→ In **mango**, the pericarp is well-differentiated into an outer thin epicarp, a middle fleshy **edible mesocarp**, and an **inner stony hard endocarp**.

→ In **coconut**, which is also a drupe, the mesocarp is **fibrous**.

→ **Drupe** is also known as **stone fruit**.

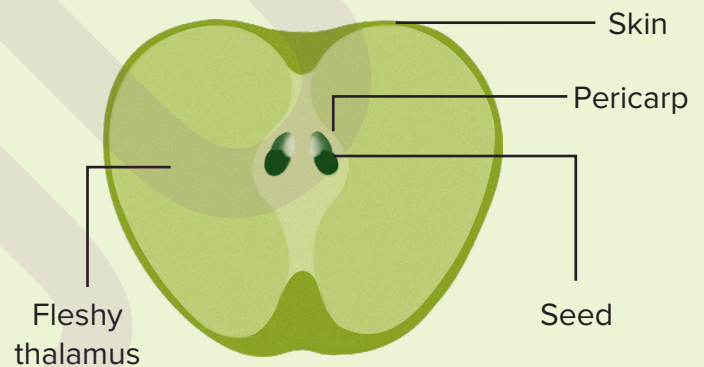
- **Berry**

- These are fruits that develop from **mono or multicarpellary, and syncarpous ovaries**.
- In berries, the ovary may be **superior or inferior**.
- They **do not show** the presence of stony endocarp.
- Mesocarp and endocarp are fused to form **pulp** with seeds.
- **Example:** Tomato



- **Pome**

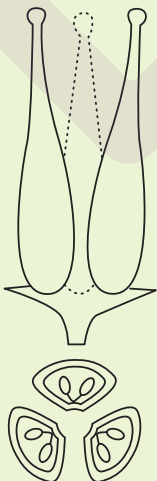
- It is the **characteristic fruit** of the apple family.
- It cannot be included in the classification of true fruits. It is a **false fruit** as the **edible part** is the **thalamus** and not the ovary.



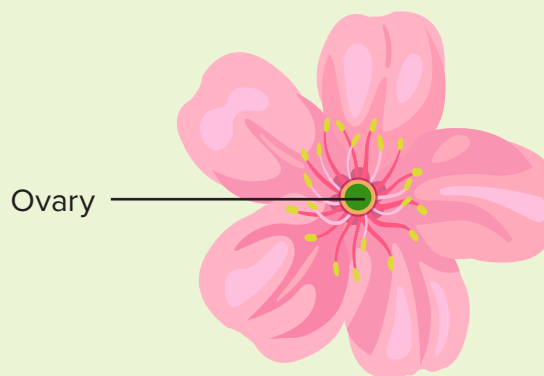
Aggregate fruits

- They develop from **apocarpous** (having distinct carpels) **ovaries**.
- They are formed from multiple **free ovaries** of a **single flower**.
- They show the presence of multiple **unfused carpels**.
- **Example:** Raspberry

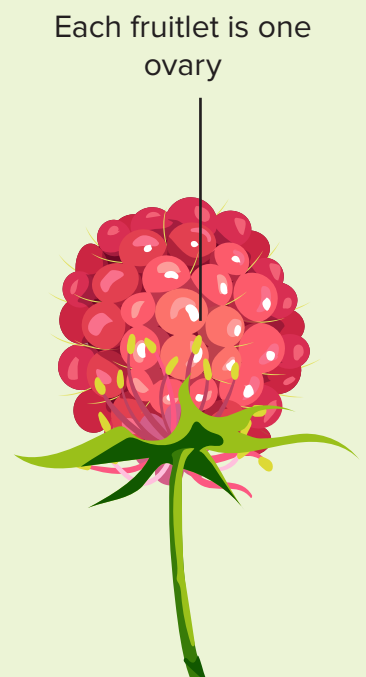
Apocarpous



Multiple unfused carpels



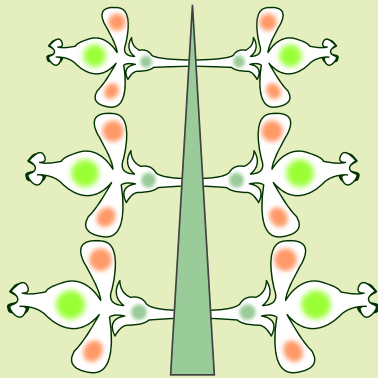
Raspberry flower



Raspberry fruit

Composite/Multiple fruits

- They develop from an entire **inflorescence** (an arrangement of flowers), rather than from a single flower. Here, a cluster of **fruiting flowers** produces a cluster of **fruiting bodies**.
- **Ovaries** of many flowers combine together to form the **fruit**.
- They do **not fuse** with each other.
- **Example:** Pineapple



Multiple fruit



Pineapple inflorescence



Pineapple fruit



Did you know?

- Fruit salad trees are multi-grafted trees with different fruits from the same family, grafted together on the same tree.
- All the fruits on the tree retain their own characteristics like flavour, appearance, and ripening times.
- They can be grown in a pot or in the ground.
- They are suitable for all climates.

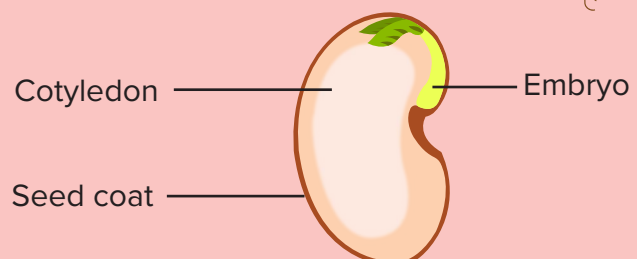
Seeds

- A **seed** develops from a **fertilised ovule**.
- It is found inside the **fruit**.
- It contains the **embryonic plant**.



Parts of a seed

- **Seed coat** protects the seed.
- **Cotyledon** stores **food** to nourish the growing embryo.
- The **embryo** grows into a plant.



Cotyledon

- They are the **embryonic seed leaves**.
- The main function of cotyledon can be attributed to **storage of food** for the growing embryo.
- After seed germination, the cotyledons emerge from the seed, expand and become green.



Endosperm

- They are the **nutritive tissues** for the embryo, stored in the seed.
- **Endosperms** are formed by the **fusion** of one **male gamete** with two **polar nuclei**.

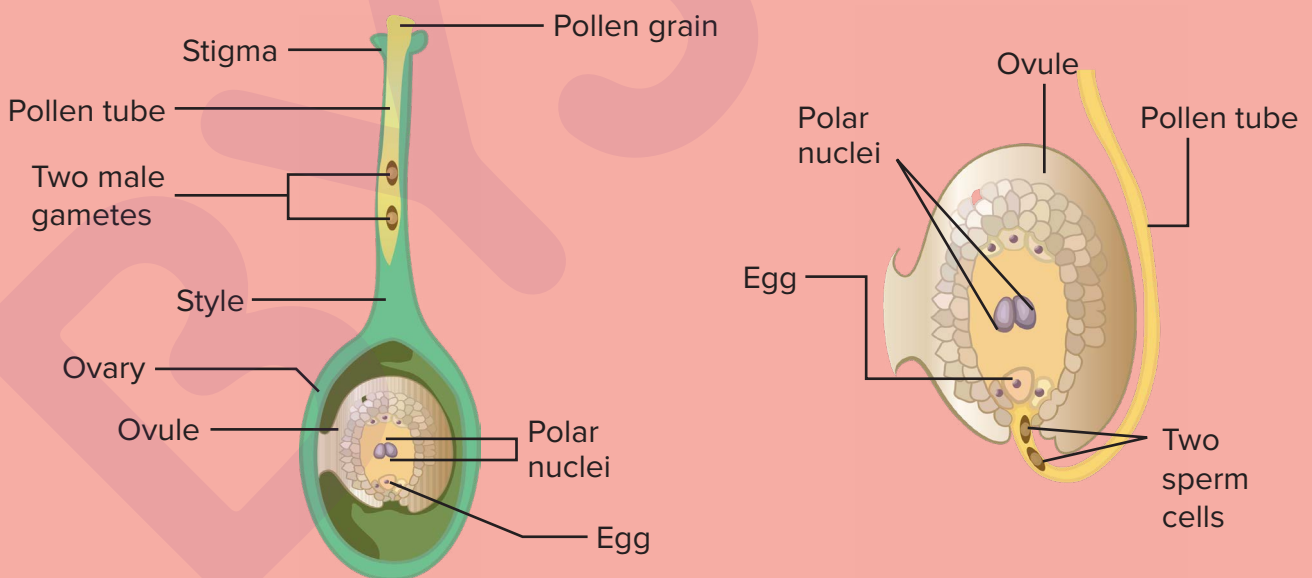
Steps involved in the endosperm formation:

Step 1: During **pollination**, the pollen that is transferred from anther to the stigma, enters the ovary.

Step 2: • The pollen grain contains **two sperm cells**.

- The **ovule** contains **one egg cell** and **two polar nuclei**.
- One **sperm cell** fuses with the **egg cell** and the other **sperm cell** fuses to form zygote with the **polar nuclei** to form the **endosperm**.

Step 3: Based on the presence or absence of endosperm, seeds can be classified into **endospermic** or **non-endospermic** seeds.

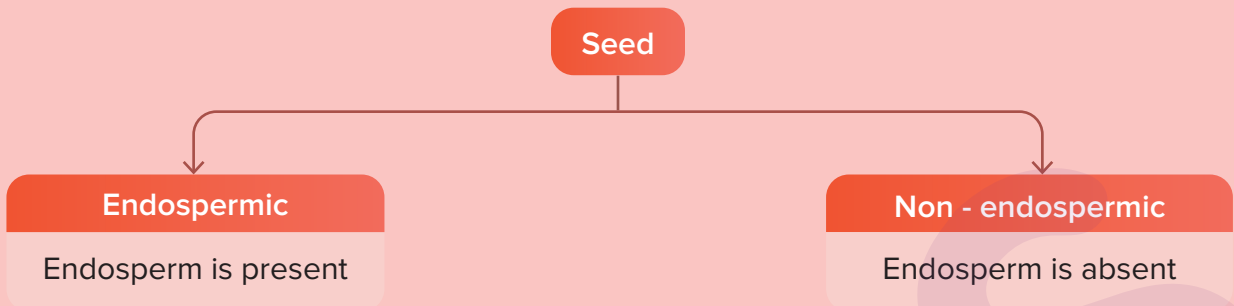


Endosperm nucleus (3n)
(Two polar nuclei and sperm)

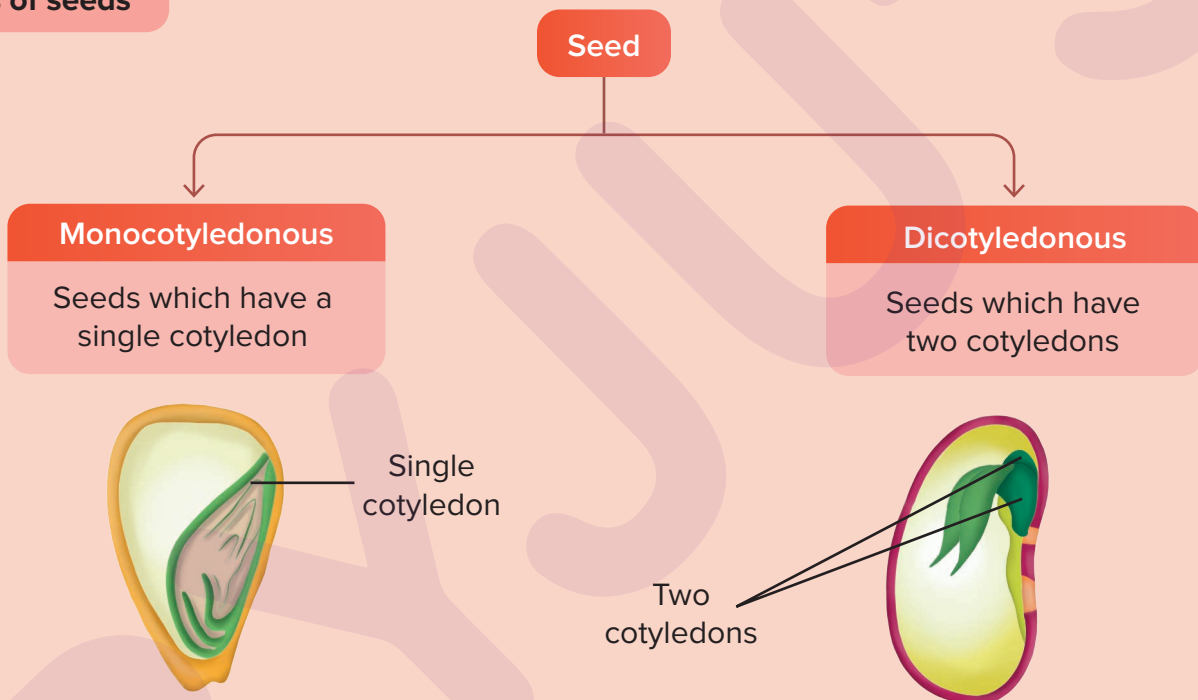
- After the fusion of sperm and the polar nuclei, triploid endosperm is formed.

Zygote (2n)

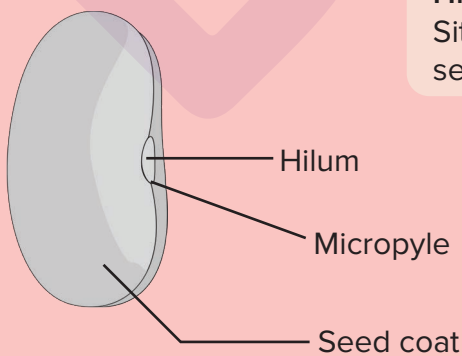
Classification of a seed based on endosperm



Types of seeds



Dicot seed



Hilum

Site of attachment of the seed to the ovary wall

Micropyle

Pore from which water enters the seed

Seed coat

Hard protective covering of the seed

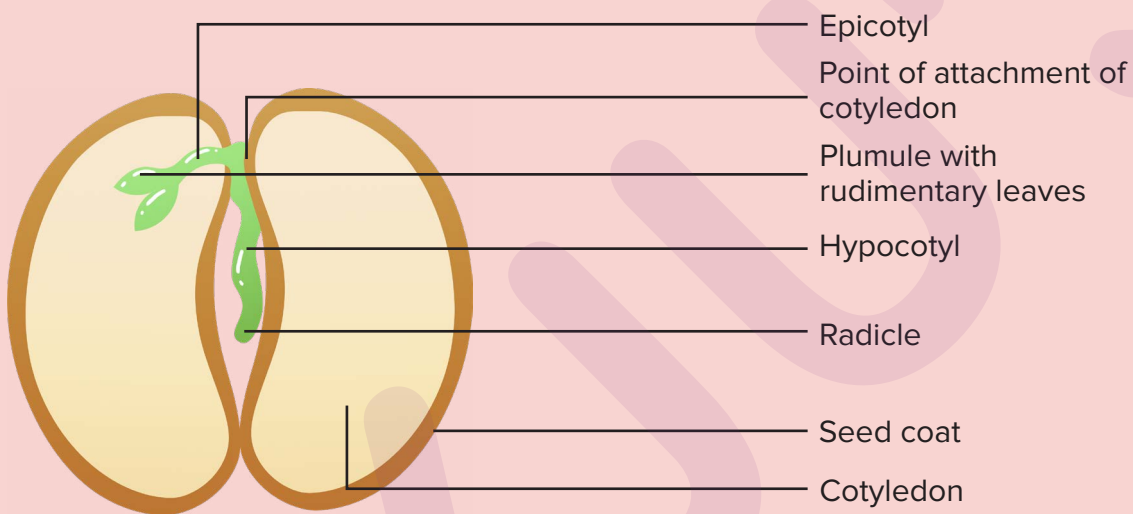
- A dicot seed typically contains a hilum, a micropyle, and a seed coat.

Dicot seed coat

- Seed coat has **two layers**.
- **Testa** forms the **outermost covering**.
- **Tegmen** forms the **inner covering**.
- The **outer testa** is **coloured**, whereas the **inner tegmen** is **colourless**.

Dicot embryo

- The **embryo** contains **two cotyledons** and an **embryonal axis**.
- One end of the embryonal axis consists of the **radicle** and the other end consists of the **plumule**.



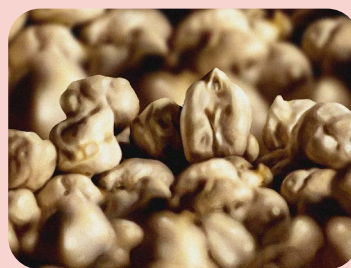
Dicot seeds

Endospermic



Castor

Non - endospermic



Gram seed



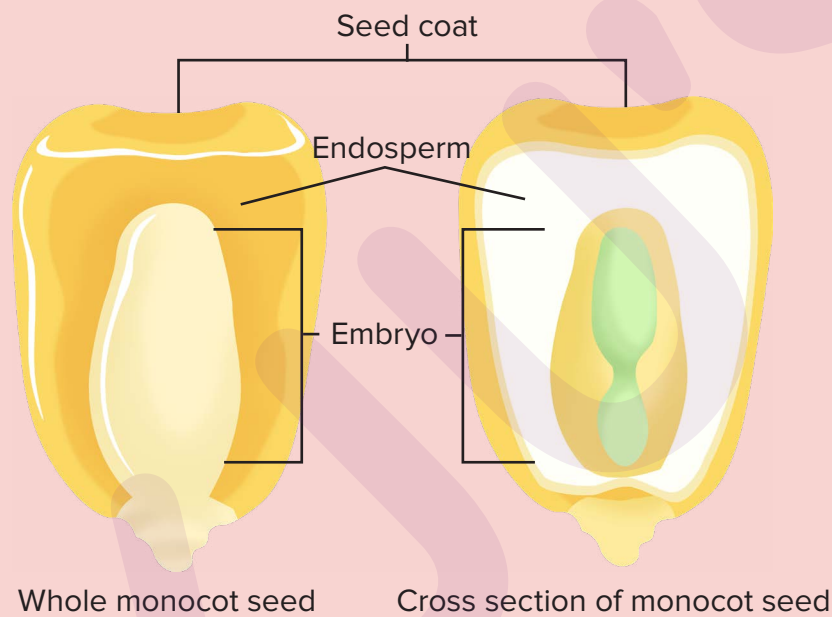
Bean seed



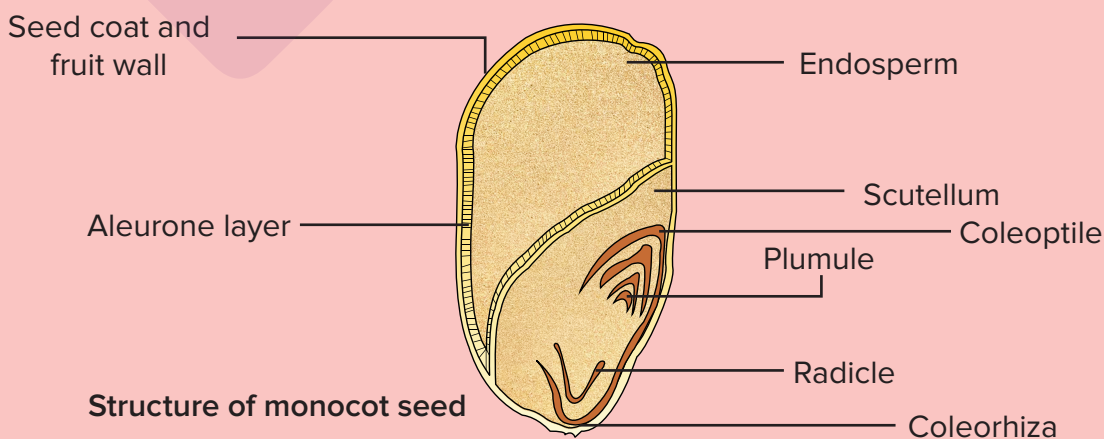
Pea

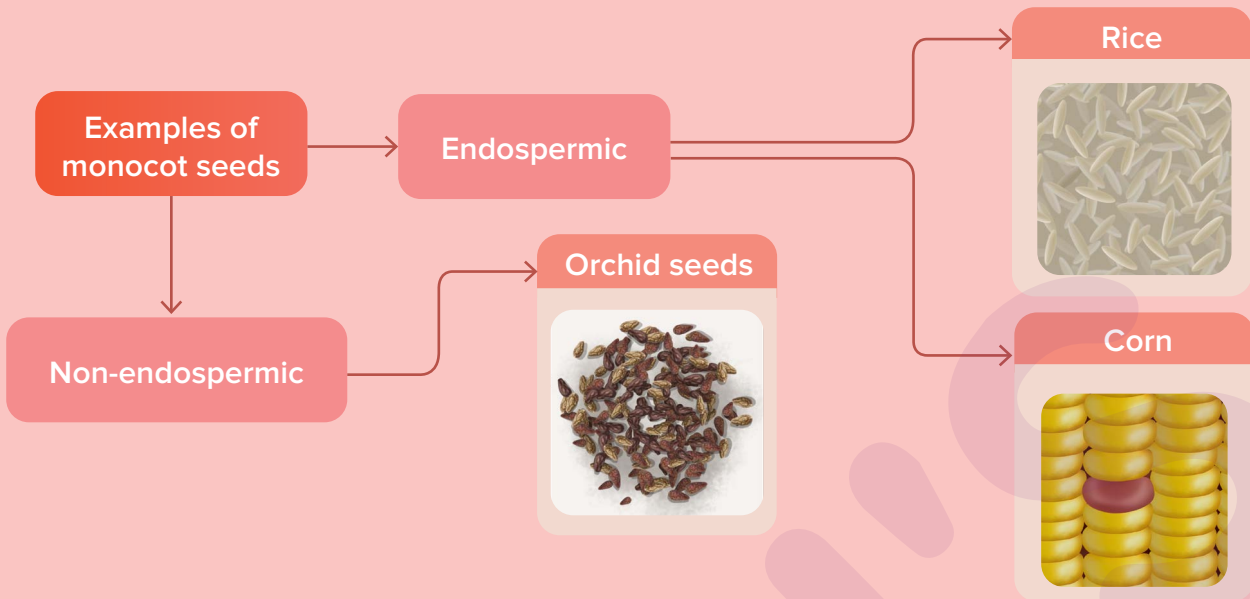
Monocot seed

- **Monocot seed coat**
→ The seed coat is **membranous** and **fused** with the **fruit wall**.
- **Endosperm**
→ It is present in the monocot seed and is **bulky** and **stores food**.
- **Aleurone layer**
→ It is the outer **proteinaceous covering** of the endosperm.
→ The aleurone layer helps to **separate embryos** from the endosperm.



- **Monocot Embryo**
→ Embryo is **small** and situated in a **groove** at one end of the seed.
→ It has one cotyledon known as **scutellum** and a **short embryonal axis**.
→ Short embryonal axis consists of a **plumule** and a **radicle**.
- **Coleoptile and Coleorhiza**
→ **Coleoptile** is a sheath that **encloses the plumule**.
→ **Coleorhiza** is a sheath that **encloses the radicle**.





Difference between dicot and monocot seeds

Dicot seed	Monocot seed
<ul style="list-style-type: none"> The seed coat is distinct from the fruit wall. 	<ul style="list-style-type: none"> The seed coat is completely fused with the pericarp.
<ul style="list-style-type: none"> There are two cotyledons in the seed. 	<ul style="list-style-type: none"> There is a single cotyledon in the seed.
<ul style="list-style-type: none"> Endosperm is absent in most of them but present in a few of them. 	<ul style="list-style-type: none"> Endosperm is present in most of them but absent in a few of them.
<ul style="list-style-type: none"> There is no protective sheath for radicle and plumule. 	<ul style="list-style-type: none"> The radicle is protected by coleorhiza and the plumule is protected by the coleoptile.



Did you know?



Largest seed:
Coco de mer

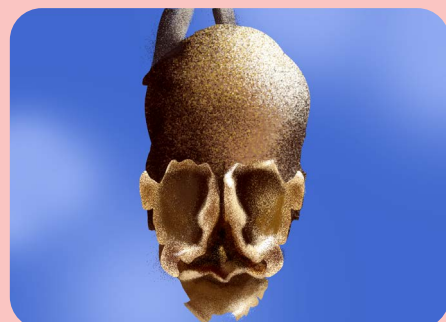


Smallest seed:
Gomesa crisper



Did you know?

- The image shows the fruit of the snapdragon
- Named after its flower that bears resemblance to a dragon's face that opens and closes when squeezed
- With the seeds gone, the seed pods (shown in the figure) bear a strange resemblance to a human skull





Summary Sheet

S.No.	Section	Definition	Features	Classification	Examples
1	Flower	Reproductive organ of a plant	Facilitates sexual reproduction in flowering plants	Based on whorls Complete flower: All 4 whorls, i.e., calyx, corolla, androecium, and gynoecium are present.	<i>Hibiscus</i>
				Incomplete flower: 1 or more whorl is absent.	Papaya flower
2	Androecium	Group of stamens	<ul style="list-style-type: none"> • Male reproductive organ part of a plant • Has 3 parts: Anther, filament, connective 	<ul style="list-style-type: none"> • Based on stamen length ◆ Tetradynamous: 4 stamens grouped into 2 sets of equal length 	<i>Ocimum</i>
				<ul style="list-style-type: none"> ◆ Didynamous: 6 stamens present, 2 are short, 4 are long 	Mustard flower
				<ul style="list-style-type: none"> • Based on fusion of stamens with other parts ◆ Epipetalous: Stamens attached to petals ◆ Epiphylous: Stamens attached to perianth 	Brinjal flower Lily
				<ul style="list-style-type: none"> • Based on whether stamen is free or united ◆ Polyandrous: Free stamens 	Lotus

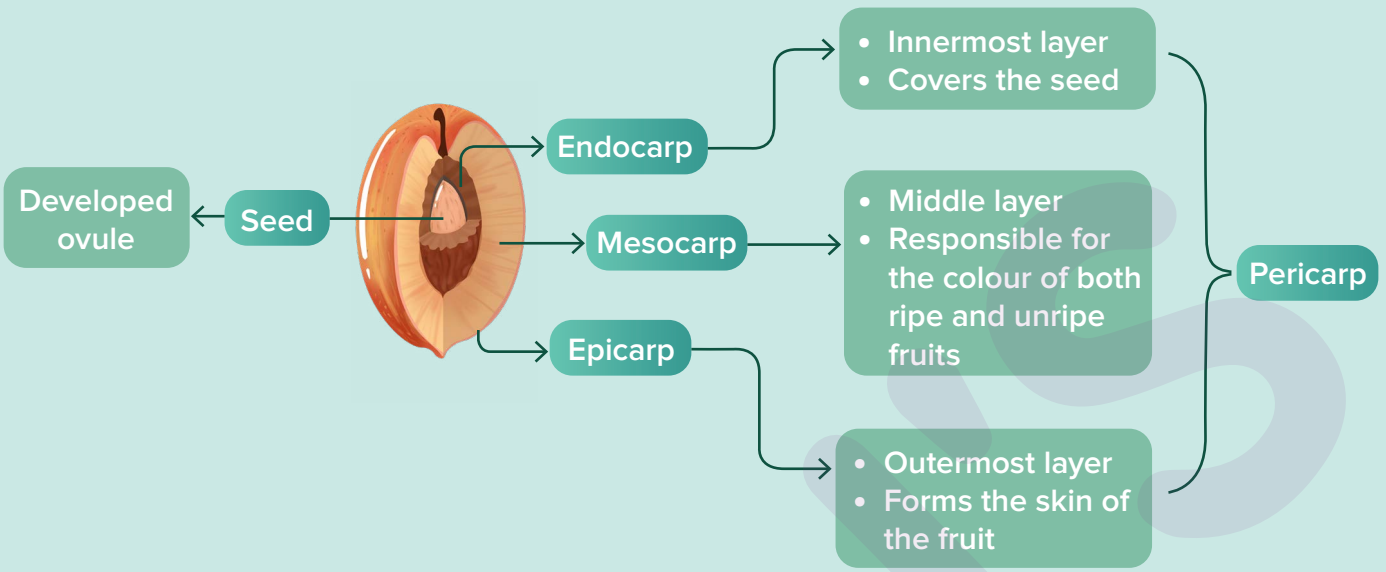
S.No.	Section	Definition	Features	Classification	Examples
2				<ul style="list-style-type: none"> ◆ Adelpous: United stamens • Monoadelphous: Single bundle of united stamens 	China rose
				<ul style="list-style-type: none"> • Diadelphous: 2 bundles of united stamens 	Pea flower
				<ul style="list-style-type: none"> • Polyadelphous: More than 2 bundles of united stamens 	Lemon
3	Gynoecium	Group of pistils or carpels	<ul style="list-style-type: none"> • Female reproductive organ of plant • Has 3 parts: Stigma, style, ovary • Ovary has 1 or more chambers known as locules. • Ovary has 1 or more ovules. • Placenta connects ovary and ovule. 	<ul style="list-style-type: none"> • Based on whether pistil is united or free ◆ Monocarpellary: Single pistil 	
				<ul style="list-style-type: none"> ◆ Apocarpous: More than 1 pistil present freely 	Rose
				<ul style="list-style-type: none"> ◆ Syncarpous: More than 1 pistil united 	Mustard
				<ul style="list-style-type: none"> • Based on position of ovary ◆ Hypogynous: Calyx, corolla, and androecium present below ovary 	<i>Hibiscus</i>
				<ul style="list-style-type: none"> ◆ Perigynous: Calyx, corolla, and androecium present at rim of thalamus 	Rose
				<ul style="list-style-type: none"> ◆ Epigynous: Calyx, corolla, and androecium present above ovary 	Sunflower

S.No.	Section	Definition	Features	Classification	Examples
3				• Based on ovule arrangement in the ovary	Tomato
				◆ Axile placentation	Pea
				◆ Marginal placentation	<i>Argemone</i>
				◆ Parietal placentation	<i>Primrose</i>
				◆ Free-central placentation	Marigold

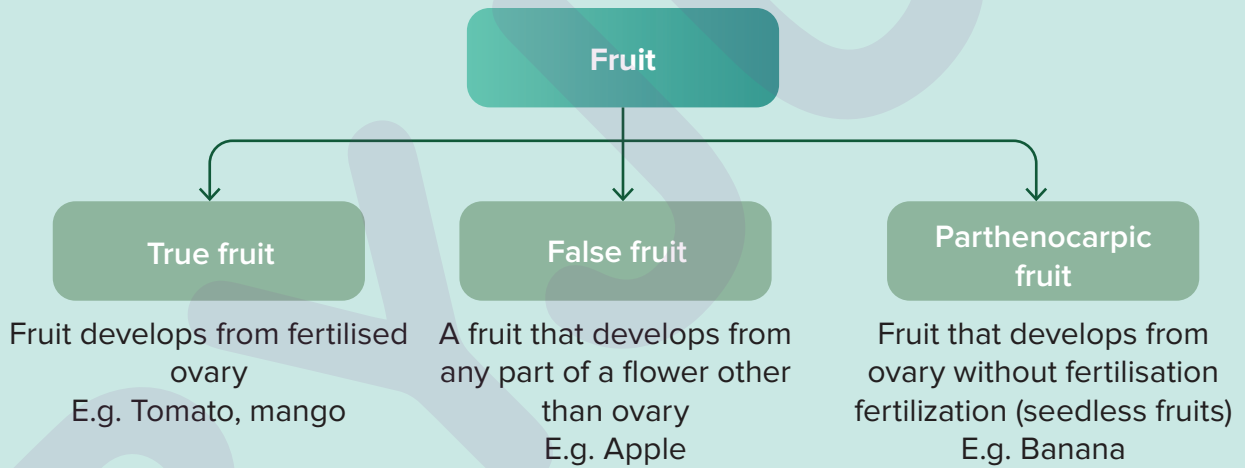
Symbols for Floral Formula

S.No.	Floral part	Classification	Symbol
1	Androecium	-	A
2	Gynoecium	Hypogynous	G
		Perigynous	-G-
		Epigynous	G

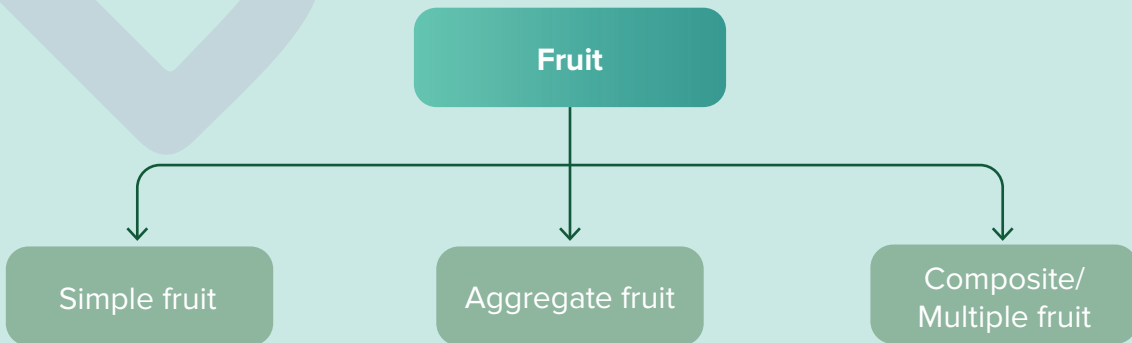
Fruit



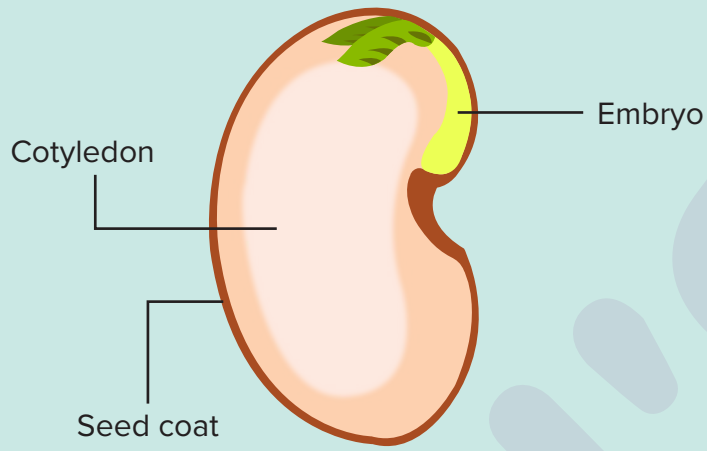
Classification of fruits



Types of fruits



Parts of a seed



Types of seeds

