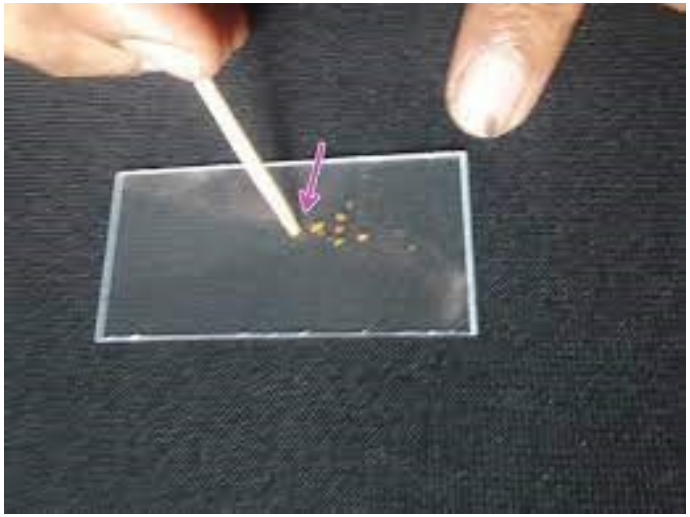
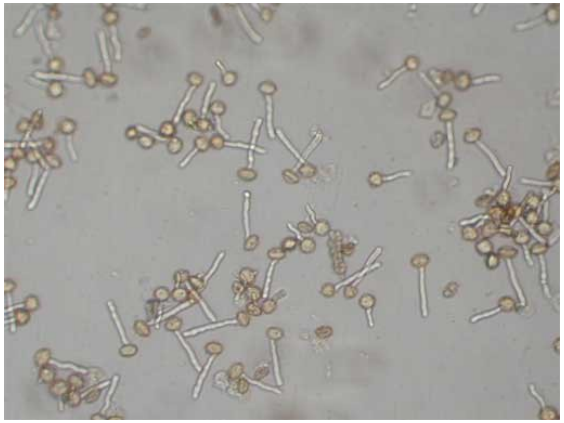
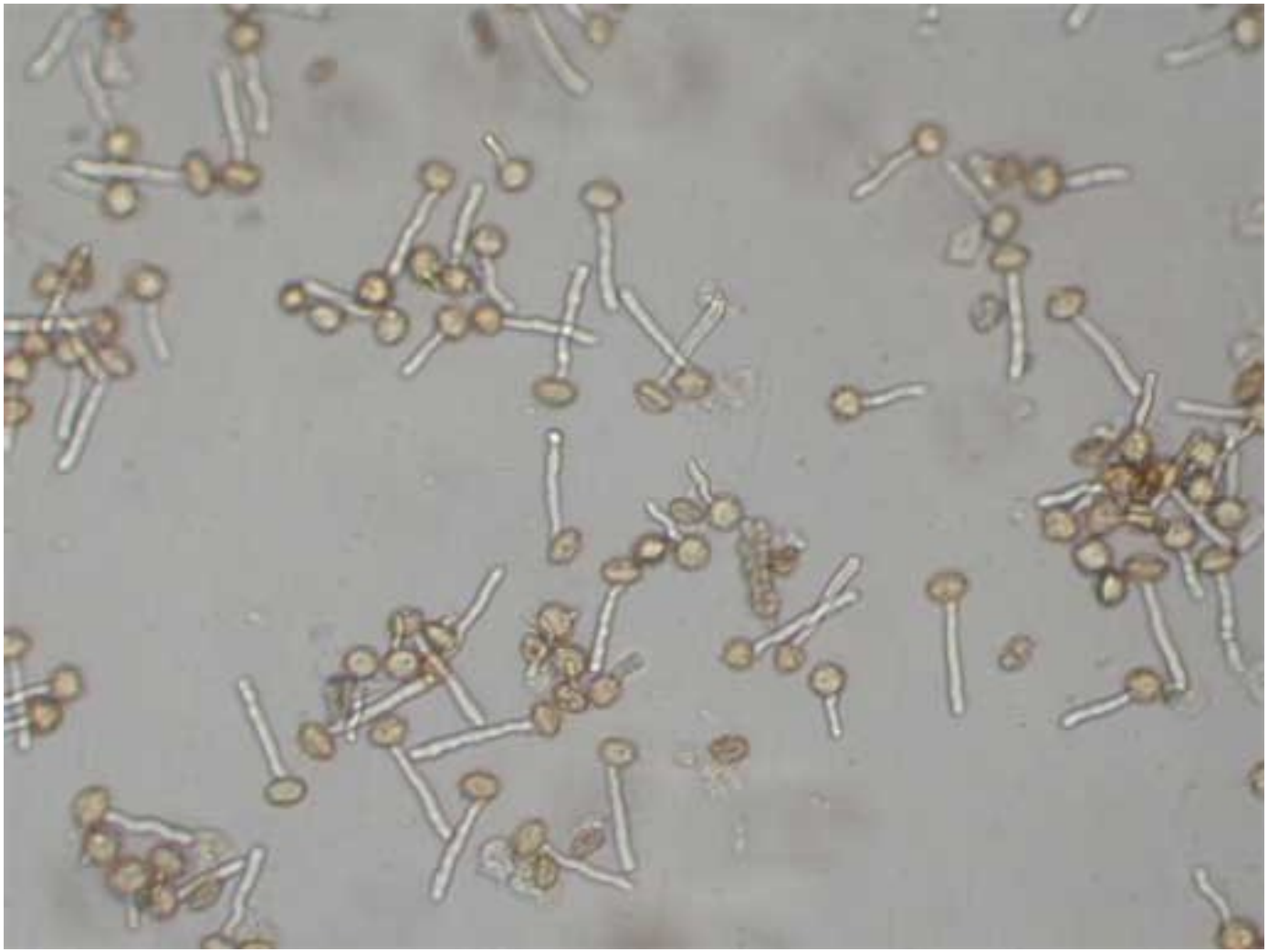
Study of pollen germination





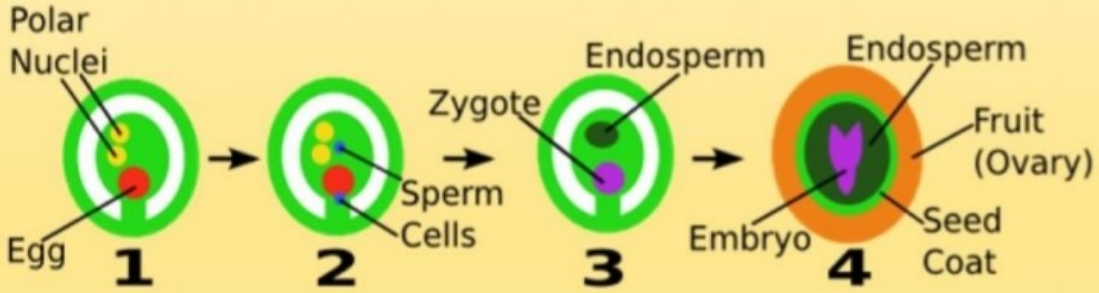


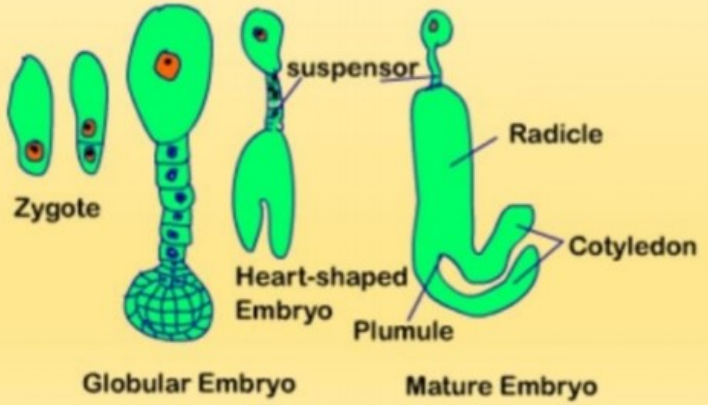
Under low power

POST-FERTILIZATION: STRUCTURES & EVENTS

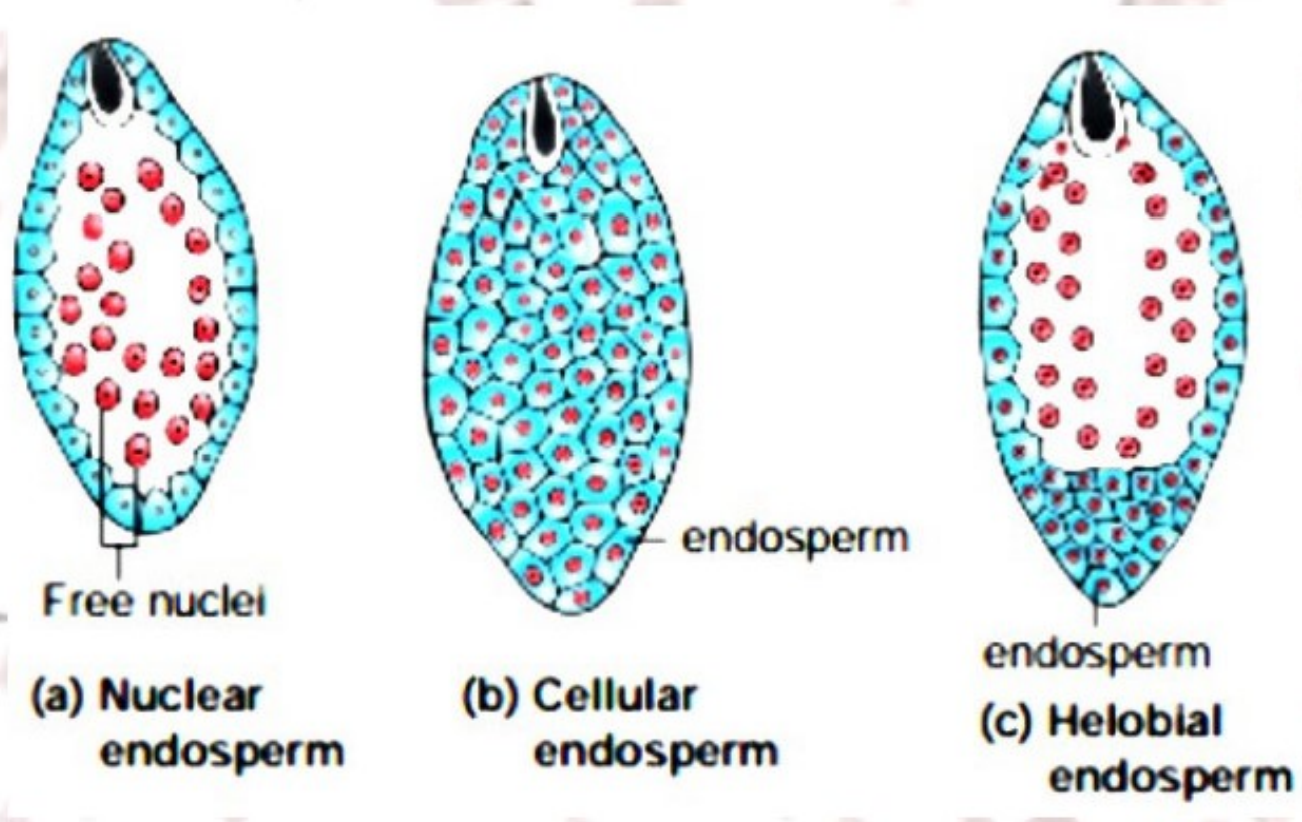
Post-fertilisation events

- Endosperm development
- Embryo development
- Ovule(s) into seed(s)
- Ovary into fruit





Structure, Development & Types of Endosperm



(a) Nuclear endosperm

(b) Cellular endosperm

(c) Helobial endosperm

endosperm

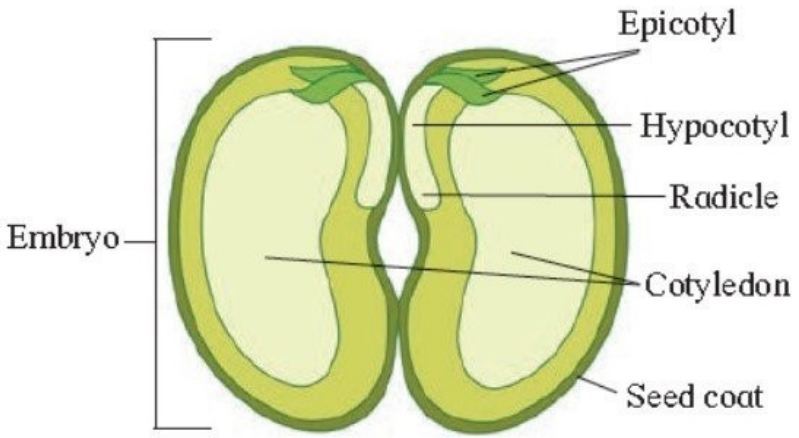
- Endosperm development starts first , followed by embryo development
- Rich in reserve food materials

Non endospermic / exalbuminous seeds

Endospermic/ Albuminous seeds

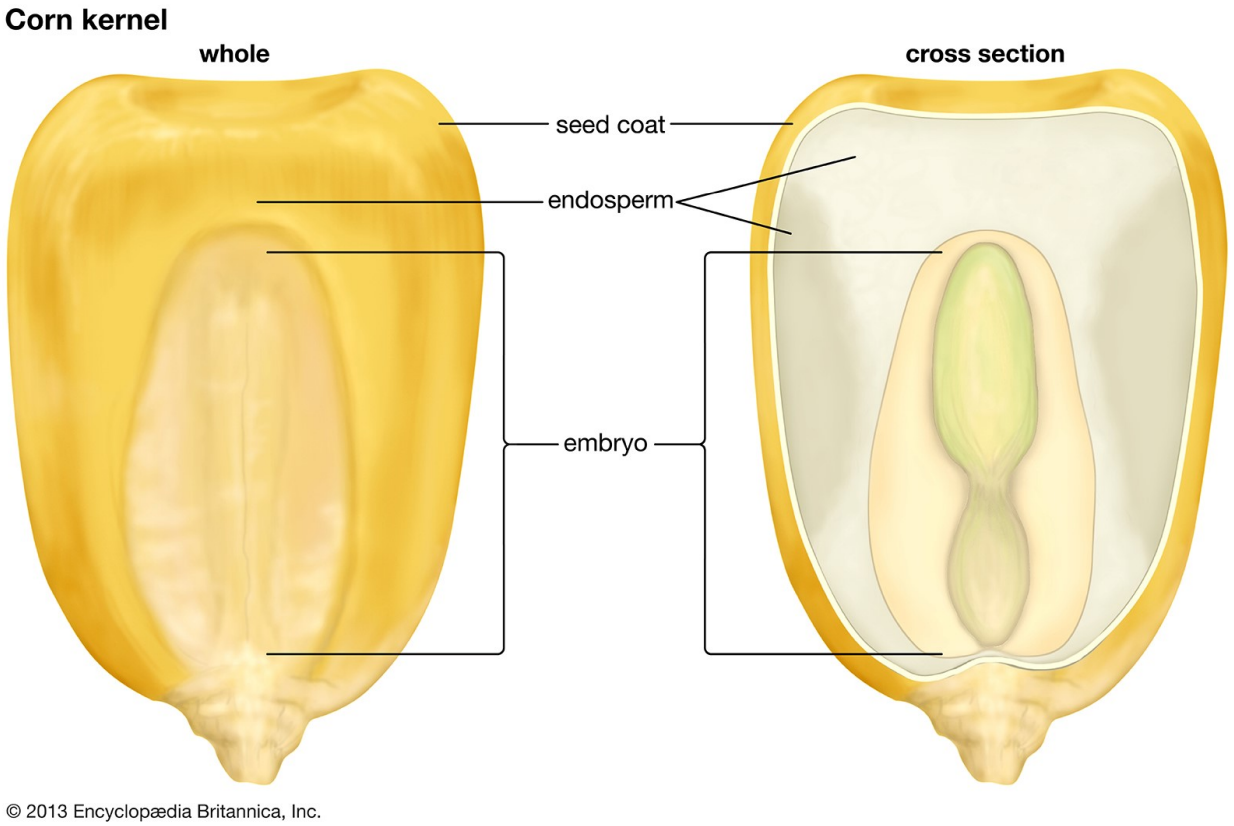
Non endospermic / exalbuminous seeds

- Endosperm is completely consumed by the developing embryo
- No endosperm in mature seed
- E.g- pea



Endospermic/ Albuminous seeds

Endosperm persist in mature seed
e.g.- castor, cereals



Types of endosperm

1. Nuclear
2. Cellular
3. helobial

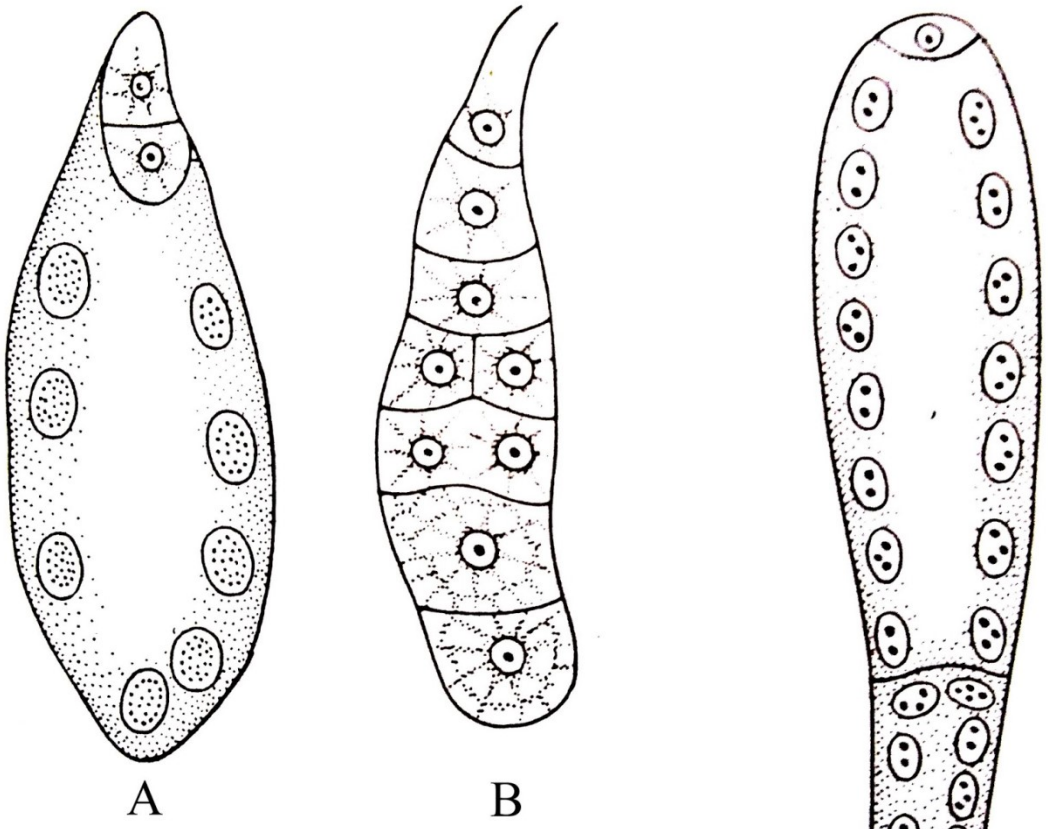
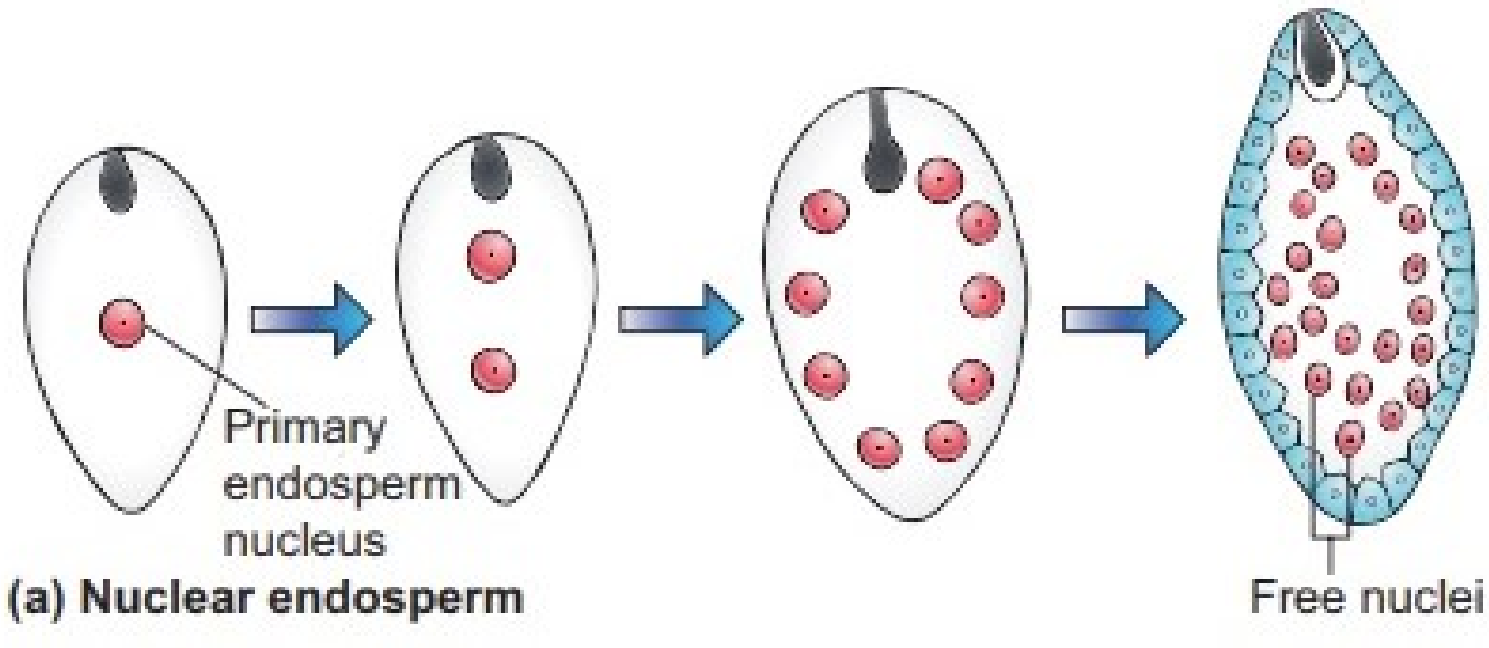


Fig: Different types of endosperms.
(A) Nuclear type; (B) Cellular type;
(C) Helobial type.

Nuclear endosperm

Only nuclear division , no cell wall formation



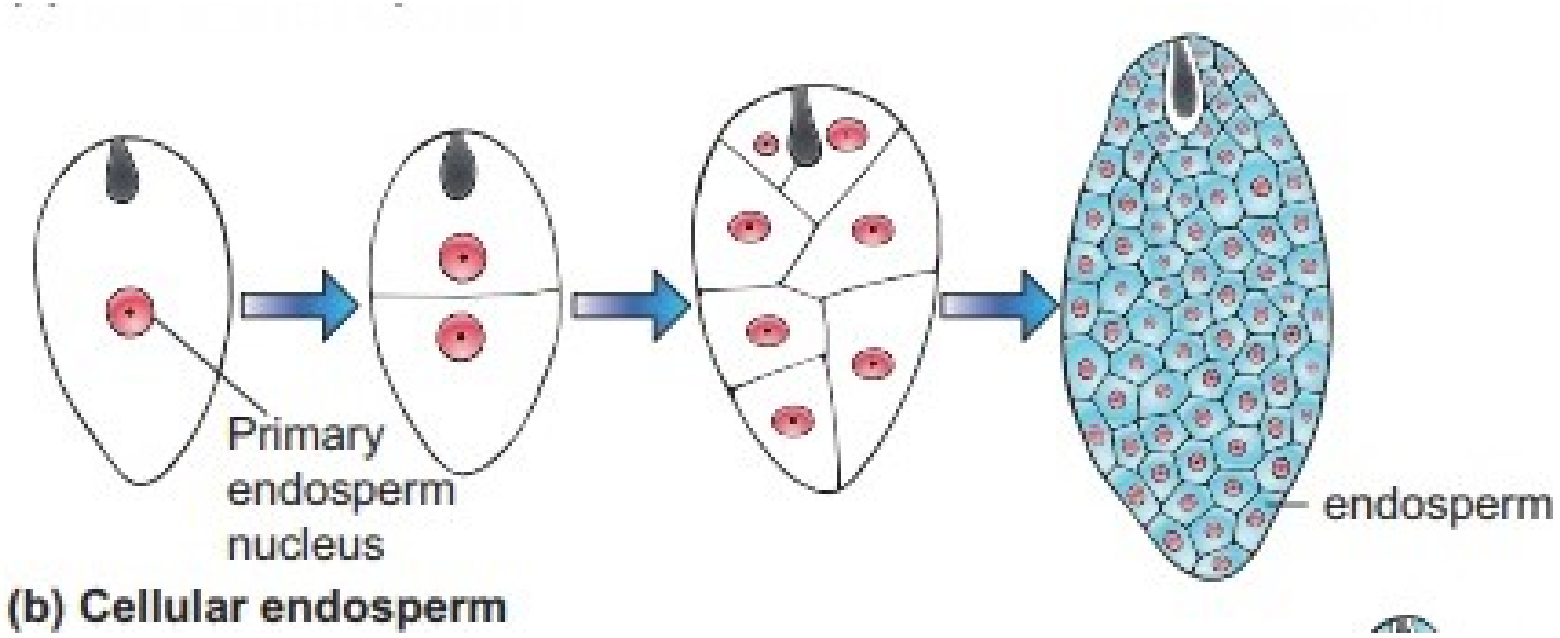
Example- tender coconut water

Kernel / meat - cellular

Cellular type

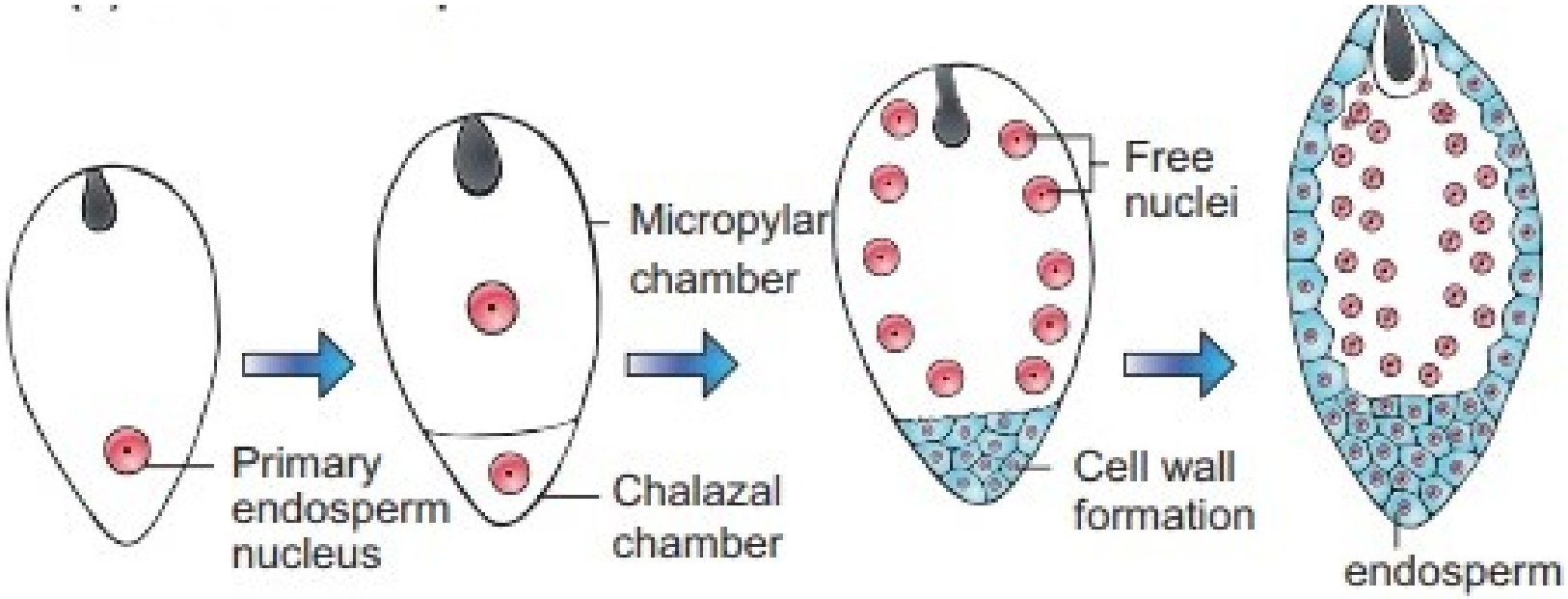
Cytokinesis after each nuclear division

Petunia, datura



Helobial type

Intermediate type
First division followed by wall formation
e.g. monocots



Ruminate endosperm

Arecaceae members

Endosperm dissected by ingrowth of seed coat

POST-FERTILIZATION: STRUCTURES & EVENTS

Post-fertilisation events

- Endosperm development
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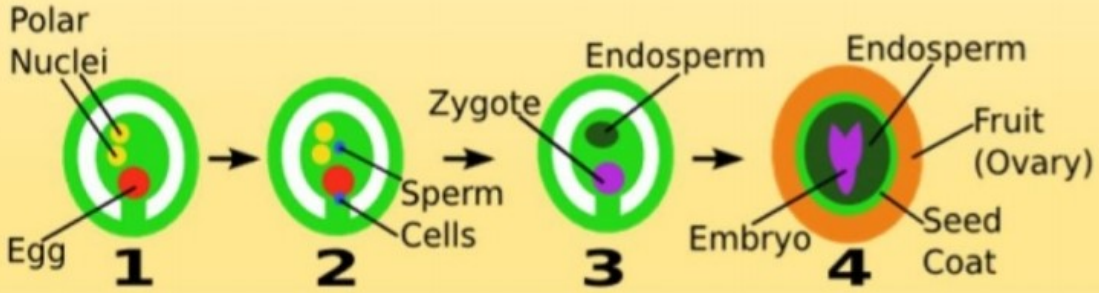
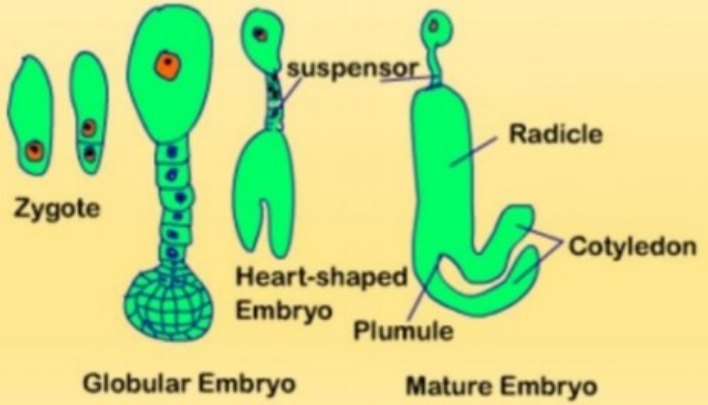




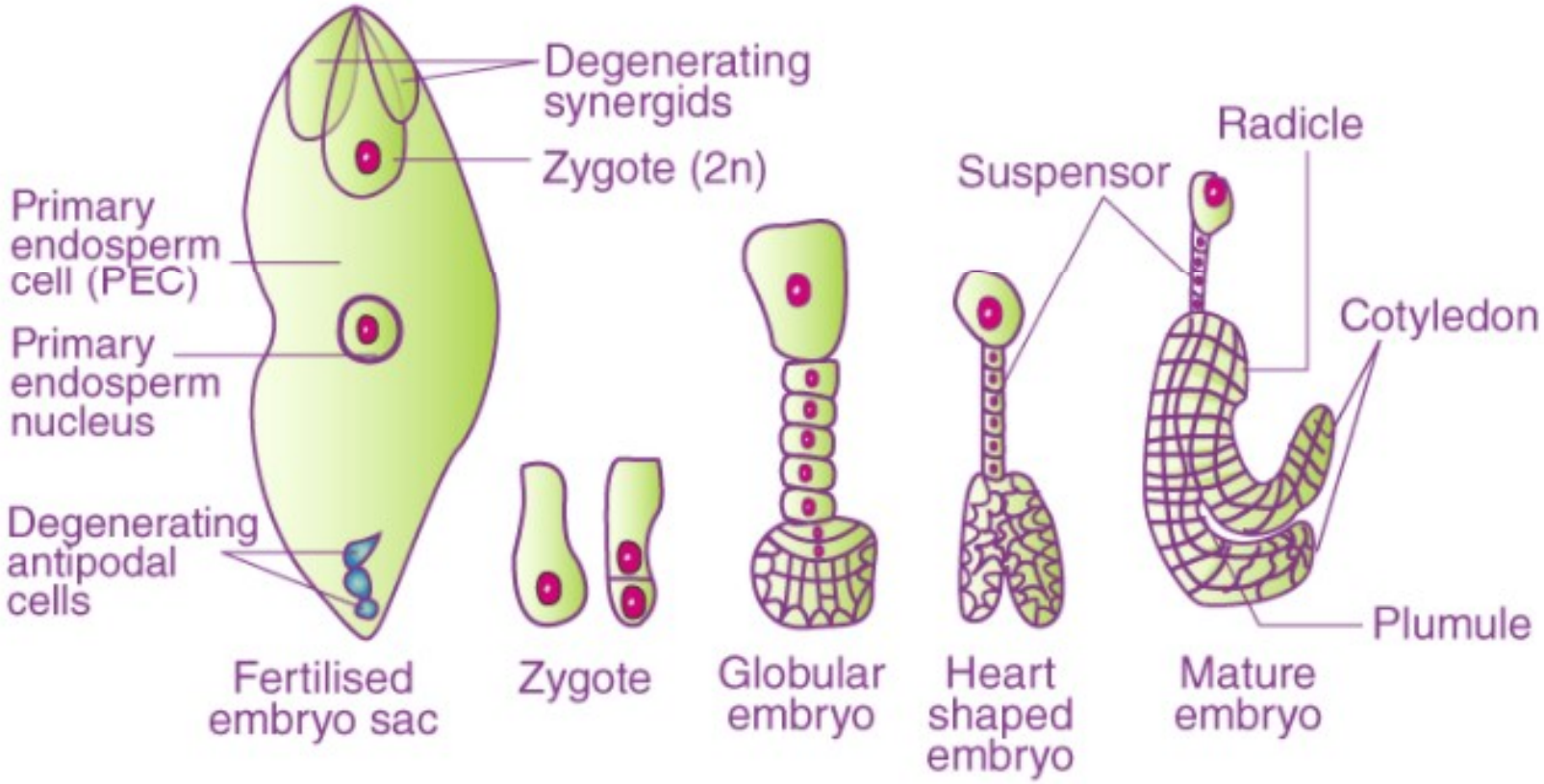
Embryo development

- Embryo develops at micropylar end where zygote is situated
- Zygote starts to develop after some endosperm is formed
- Seeds of monocot and dicot differs but early embryo development is similar

Zygote – proembryo-globular – heart shaped-mature embryo

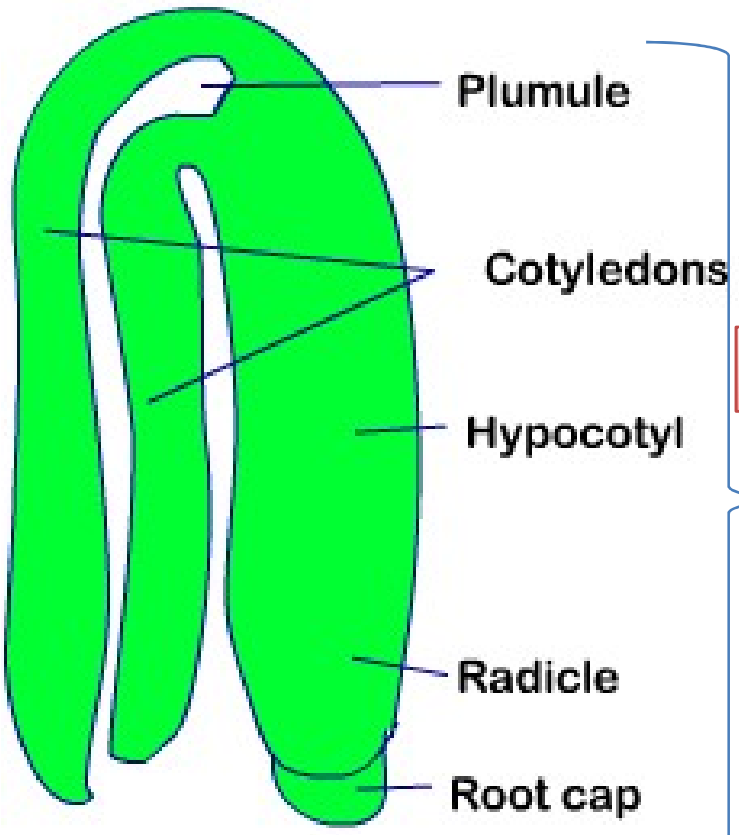
Embryo development

In dicots



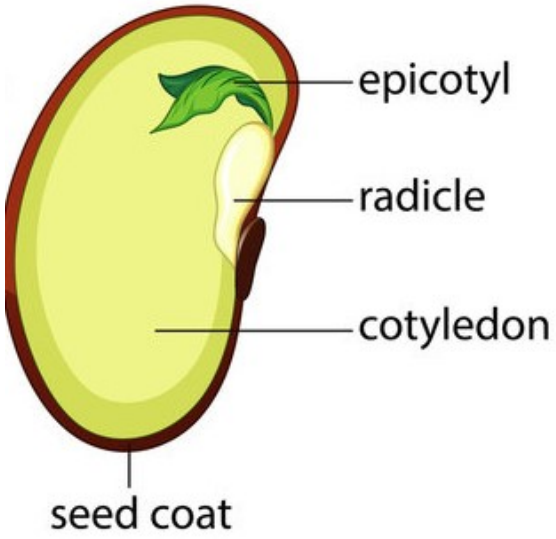
DICOT EMBRYO

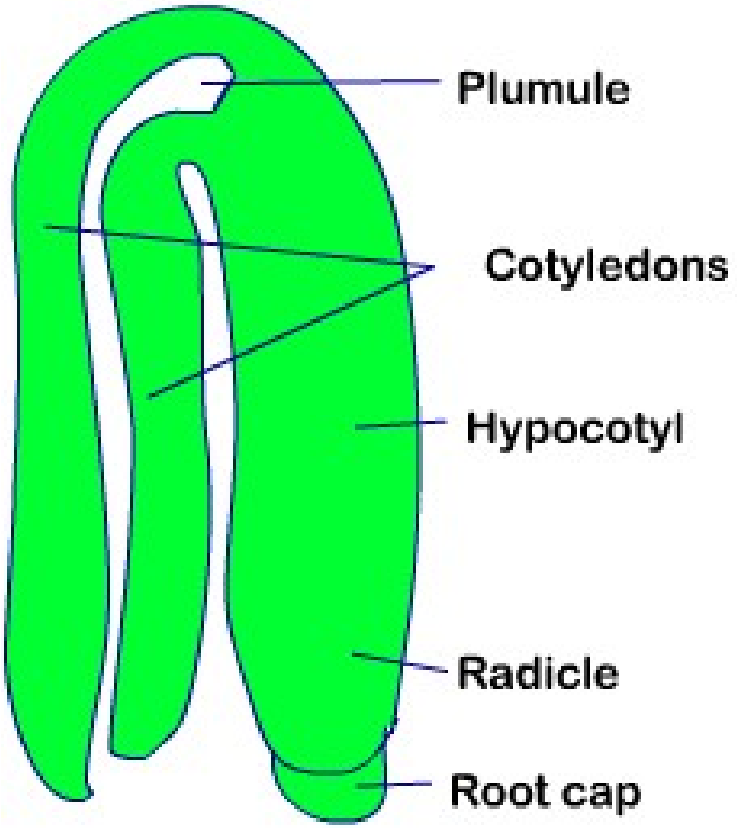
- Has an embryonal axis & 2 cotyledons
- Embryonal axis above the level of cotyledon is epicotyl
- Epicotyl ends with plumule / stem tip



Embryo in Dicot Seed

Embryonal axis

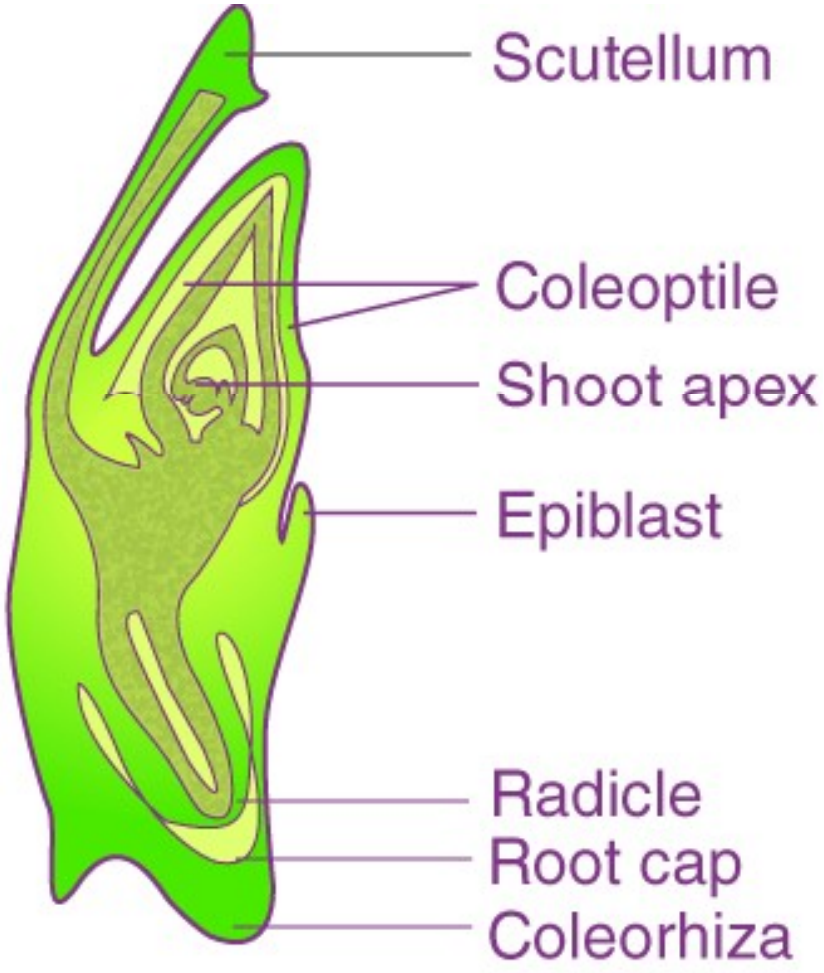




Embryo in Dicot Seed

- Cylindrical portion below the level of cotyledon – hypocotyl
- Hypocotyl ends with radicle / root tip
- Root tip is covered with a root cap

Monocot embryo



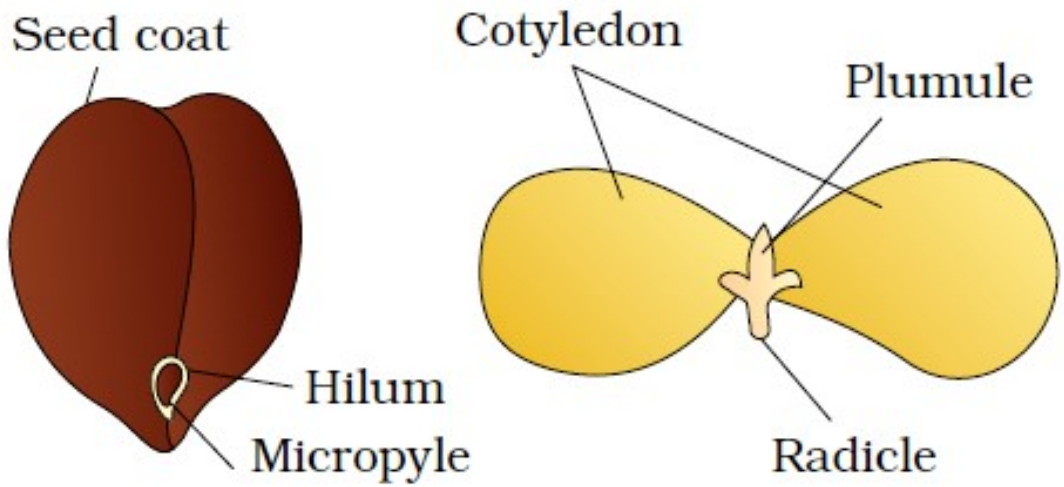
- Only 1 cotyledon
- In grass family – scutellum
- Radical & root cap enclosed within sheath
- Shoot tip covered by- coleoptile
- Epiblast – smilar to 2nd cotyledon

seeds

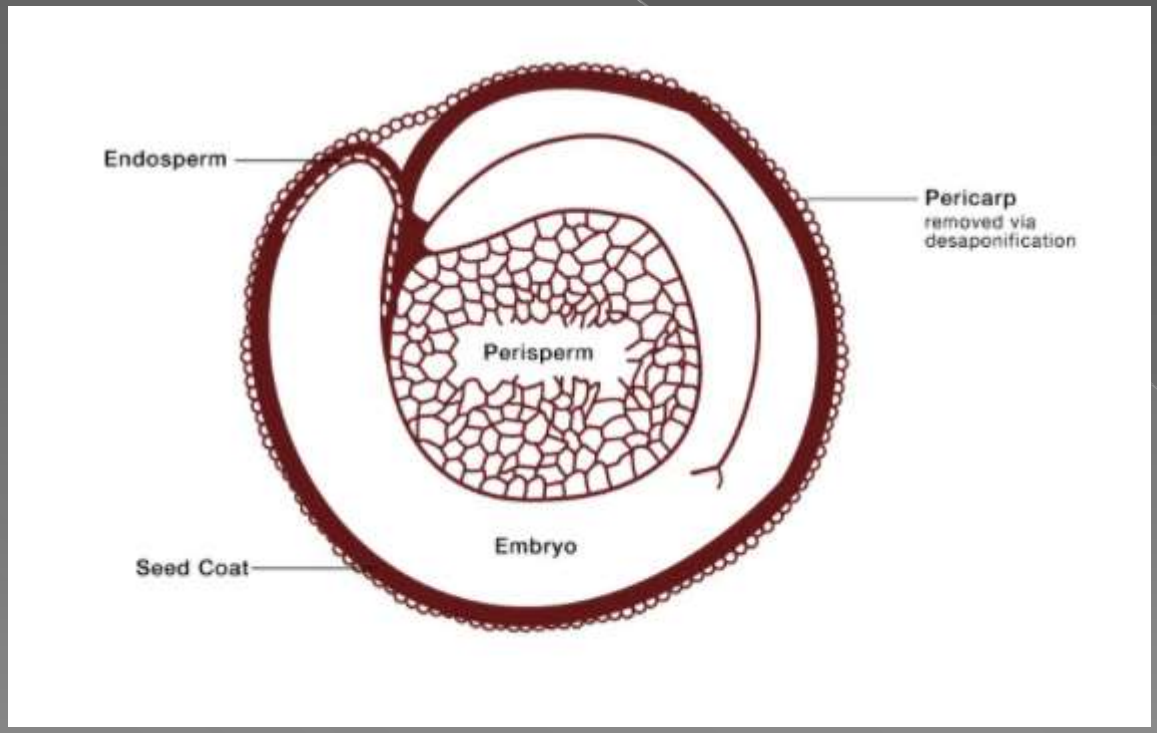
- Final product of sexual reproduction
- Fertilised ovule
- Formed inside the fruit

Parts of a seed

1. Seed coat – developed from integuments
2. Cotyledon – thick swollen due to storage of food
3. Embryo axis-
4. Micropyle- small opening –allow entry of water & oxygen into seed during germination



Perisperm- remnants of nucellus e.g. black pepper, beet



Pepper seed

Seed dormancy

- As seed matures water content reduces- seed becomes dry
- 10-15% moisture by mass
- Embryo enter into inactive stage
- In favourable condition they germinate

Mature seeds are 2 types:

- **Non-albuminous seeds**:

  They have no residual endosperm as it is completely consumed during embryo development
  E.g. pea, groundnut, beans.

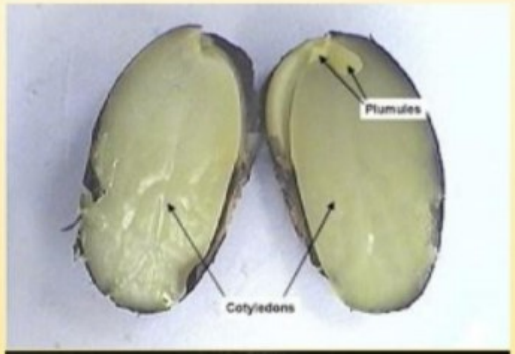
- **Albuminous seeds**:

  They retain some endosperm.
  E.g. wheat, maize, barley, castor, coconut, sunflower.

Advantages of seeds

1. Since pollination and fertilisation are independent of water, seed formation is more dependable.
2. Better adaptive strategies for dispersal to new habitats. It helps the species to colonize in other areas.
3. They have food reserves. So young seedlings are nourished until they are capable of photosynthesis.

Advantages of seeds



4. The hard seed coat protects the young embryo.
5. Being products of sexual reproduction, they generate new genetic combinations and variations.
6. Dehydration and dormancy of mature seeds are crucial for storage of seeds. It can be used as food throughout the year and also to raise crop in the next season.

Seed viability after dispersal (how long do seeds remain alive?)

- Some lose viability within few months
- Many species live for several years
- Some remain alive for hundreds of years
- Oldest viable seed- lupine

Lupinus arcticus – excavated from arctic tundra

Seed germinated and flowers after around 10,000 years of dormancy

Lupinus arcticus

Seed viability after dispersal (how long do seeds remain alive?)

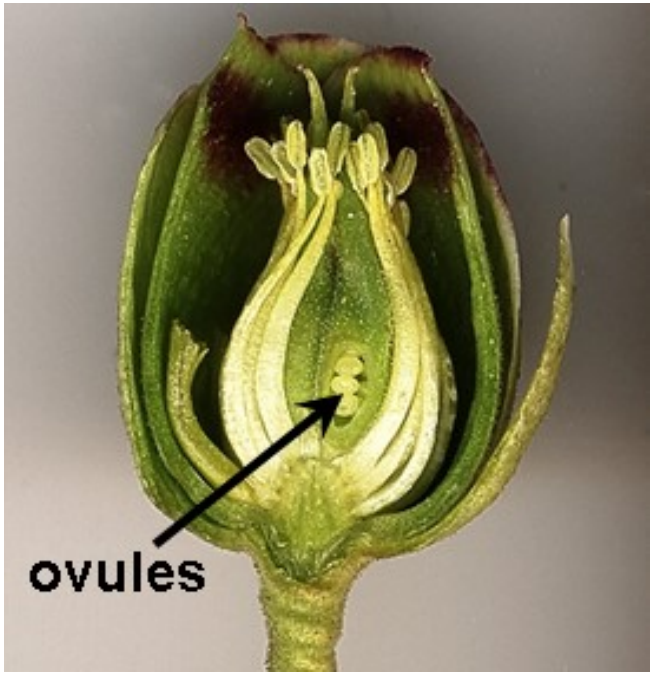
- 2000 years old viable seed of date palm (*Phoenix dactylifera*) discovered during archeological excavation at king Herod's palace near dead sea (Israel)

World's largest seed

***Lodoicea maldivica*, also known** as the double coconut

Smallest seeds- orchid seeds

Relation between number of ovules in ovary and number of seeds developed in fruit ?

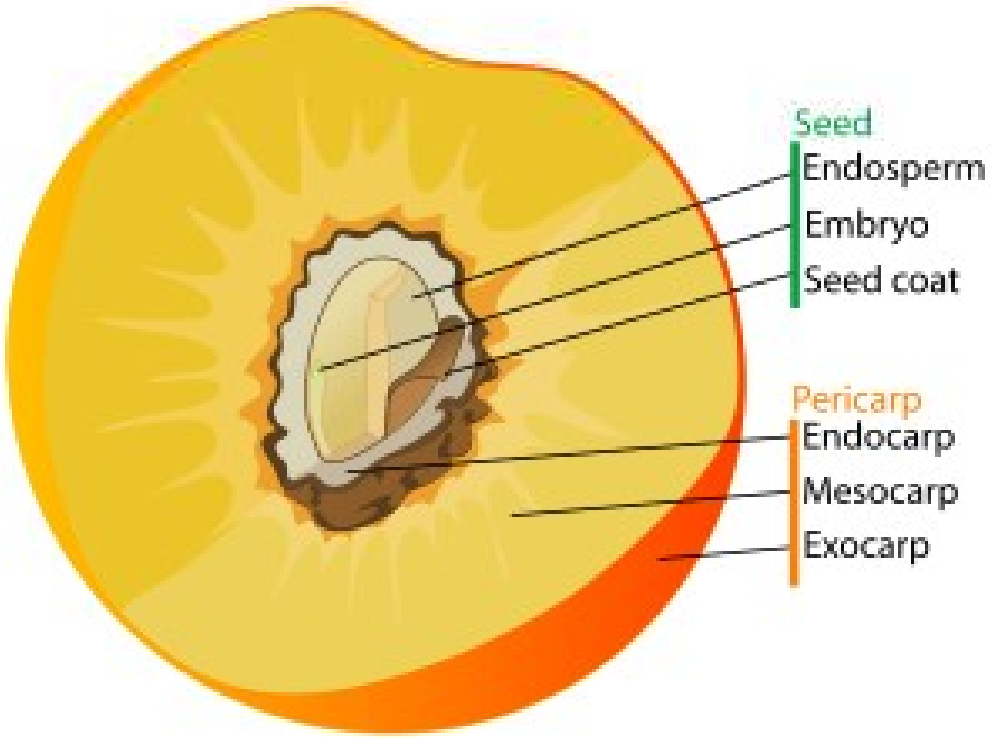


Relation between number of ovules in ovary and number of seeds developed in fruit ?

if all the ovules present in an ovary are fertilised, **the number of seeds present in the fruit will be equal to the number of ovules present in the ovary**.

fruits

- Develops from ovary
- After fertilisation – other floral parts fall off
- Fruit wall – pericarp



- Fruit may be
  fleshy
  Or
  dry

Dry fruits

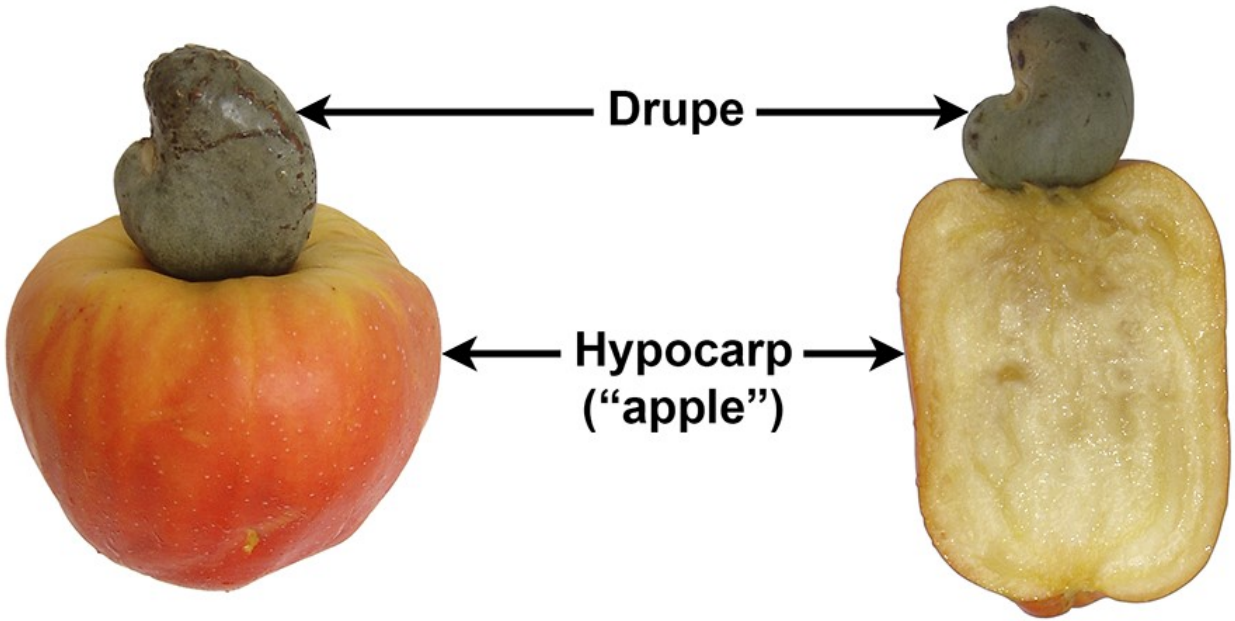
Fruits - types

1. True fruits
2. False fruits

- Fruits develop from ovary

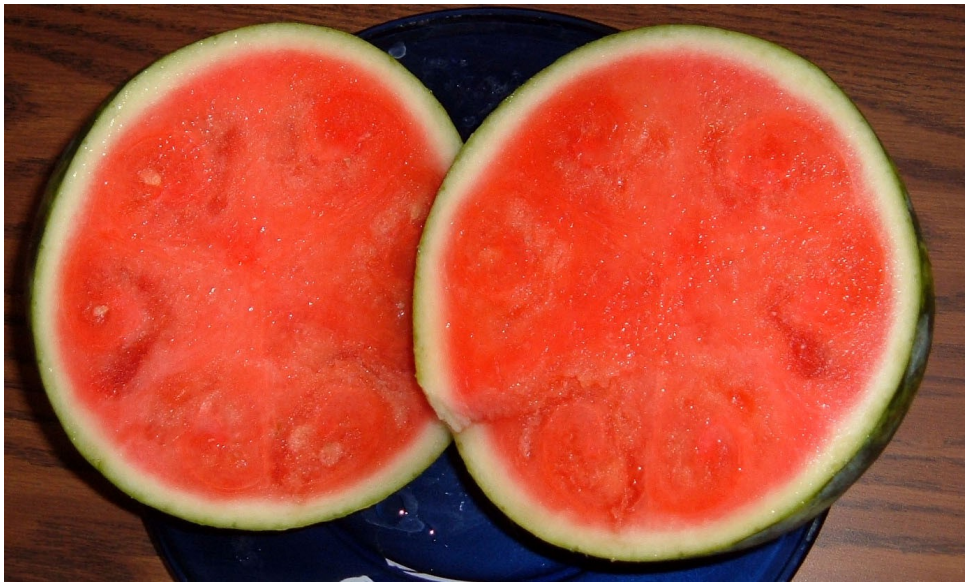
2. False fruits

- Floral parts other than ovary – form fruits
- Thalamus - fruit



Parthenocarpic fruits

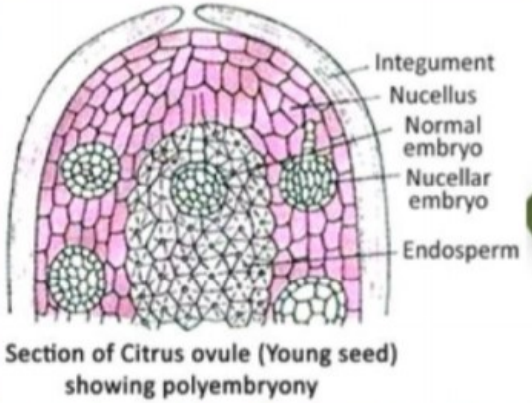
- Fruit formation without fertilization
- Are seedless
- Induced by growth hormones(gibberellins)



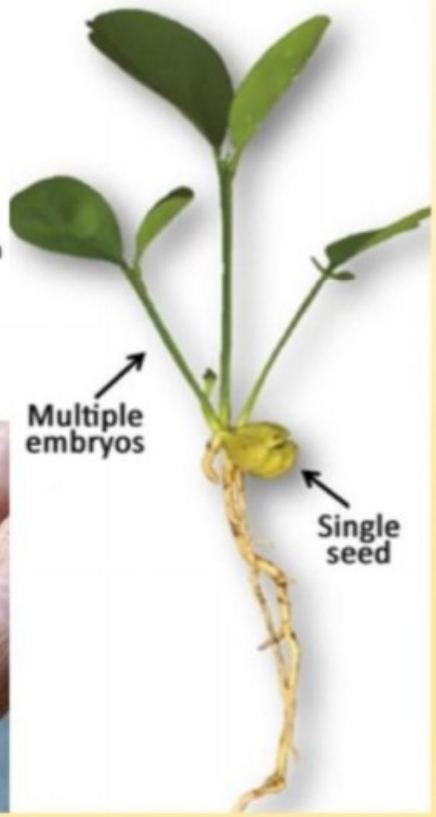
APOMIXIS AND POLYEMBRYONY

- Apomixis is the production of seeds without fertilisation.
- E.g. Some species of *Asteraceae* and grasses.
- It is a form of asexual reproduction that mimics sexual reproduction.

APOMIXIS AND POLYEMBRYONY



Section of Citrus ovule (Young seed) showing polyembryony



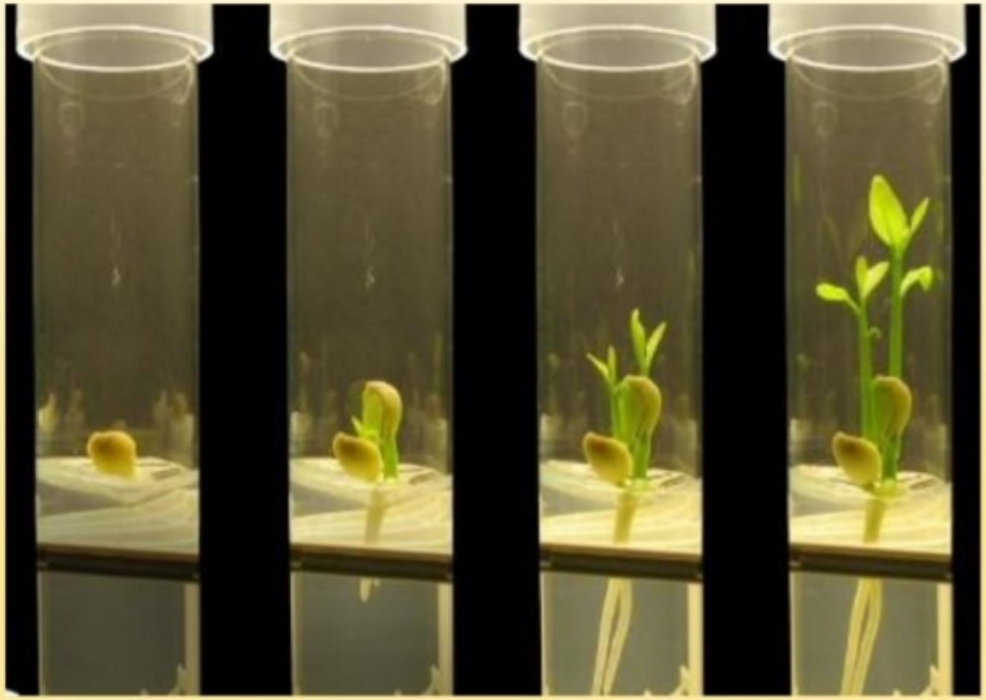
Development of apomictic seeds

- In some species, diploid egg cell is formed without reduction division and develops into the embryo without fertilisation.
- In many species (e.g. many *Citrus* & Mango varieties) some nucellar cells surrounding the embryo sac divide, protrude into the embryo sac to form embryos. Thus each ovule contains many embryos.

Occurrence of more than one embryo in a seed is called polyembryony.

APOMIXIS AND POLYEMBRYONY

IMPORTANCE OF APOMIXIS IN HYBRID SEED INDUSTRY



- If the seeds from hybrids are sown, the plants in the progeny will segregate and lose hybrid characters.
- Production of hybrid seeds is costly. So hybrid seeds are also expensive.
- If the hybrids are made into apomicts, there is no segregation of characters in hybrid progeny. So farmers can keep on using hybrid seeds to raise new crop.