Friday, 21 May 2021 7:30 AM

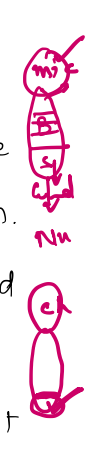
2.4.2. Embryo :→

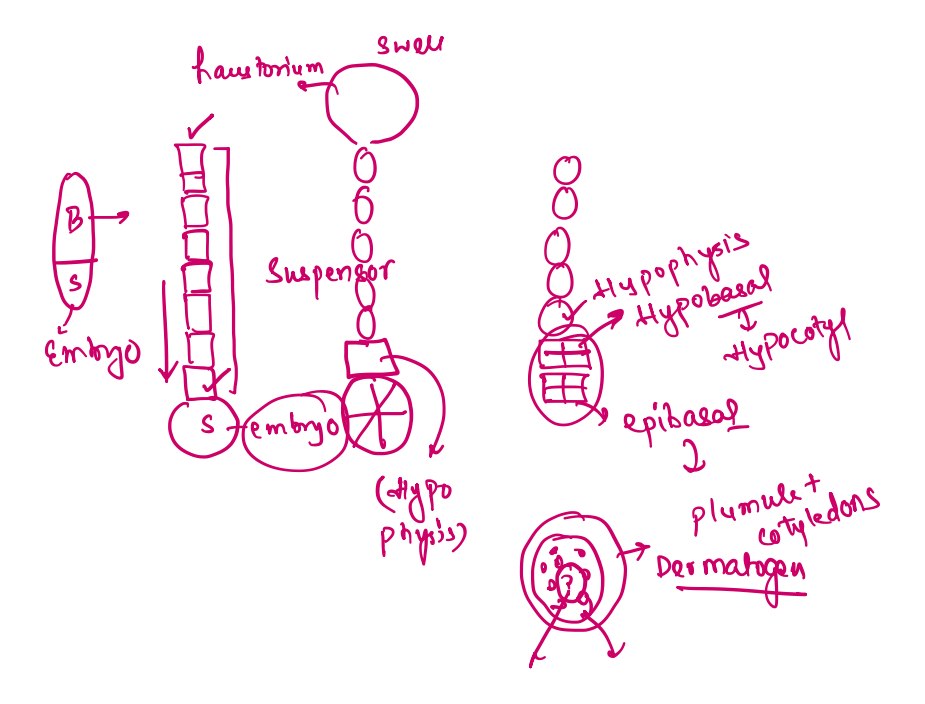
- Embryo develops at the micropylar end of the embryo sac where the zygote is situated.
- Most zygotes divide only after certain amount of endosperm is formed. This is an adaptation to provide assured nutrition to developing embryo.
- Though the seeds differ greatly, the early stages of embryo developement (embryogeny) are similar in both monocots and dicots.

Embryogeny in dicots :→

larger (Basal)

- In a typical dicot the zygote elongates and then divide by a transverse wall into two unequal cells. The larger basal cell is called suspensor cell. It has a large central vacoule. The smaller denser terminal or Apical cell towards antipodal end is termed as embryo cell.





- The suspesor cell divides transversly a few times to produce a filamentous suspensor of 6-10 cells. The suspensor helps in pushing the embryo in endosperm.
- The first cell of suspensor towards the micropylar end becomes swollen and function as a haustorium.
- The last cell of the suspensor at the end adjacent to the embryo is known as hypophysis
- Hypophysis later gives rise to the radicle and root cap.
- The embryo cell undergoes two verticle divisions (Quadrant stage) and one transverse division to form eight cells arranged in two tiers (octant stage)

epibasal (terminal) → "finally form two cotyledons and plumule"

Hypobasal (near the suspensor) → Produce Hypocotyl except at tip.

- The octant divide periclinally to produce outer layer of protoderm or dermatogen. The inner cells differentiate further into procambium (= plerome) and ground meristem (= periblem)

gives rise to

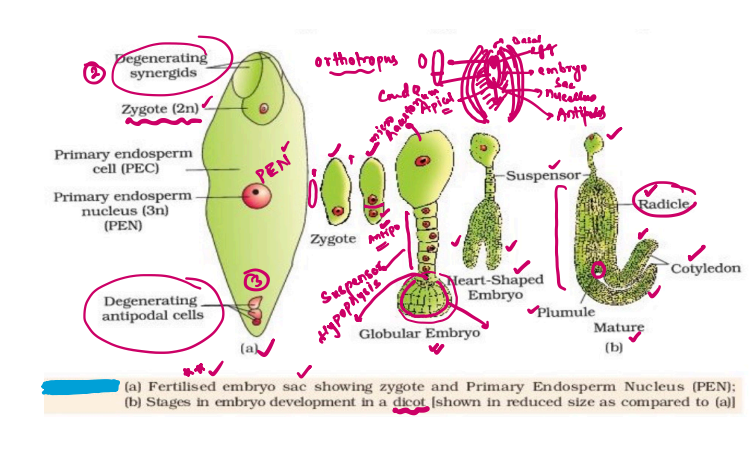
Protoderm → epidermis

Procambium → Stele or vascular strand

Ground Meristem → cortex or pith.

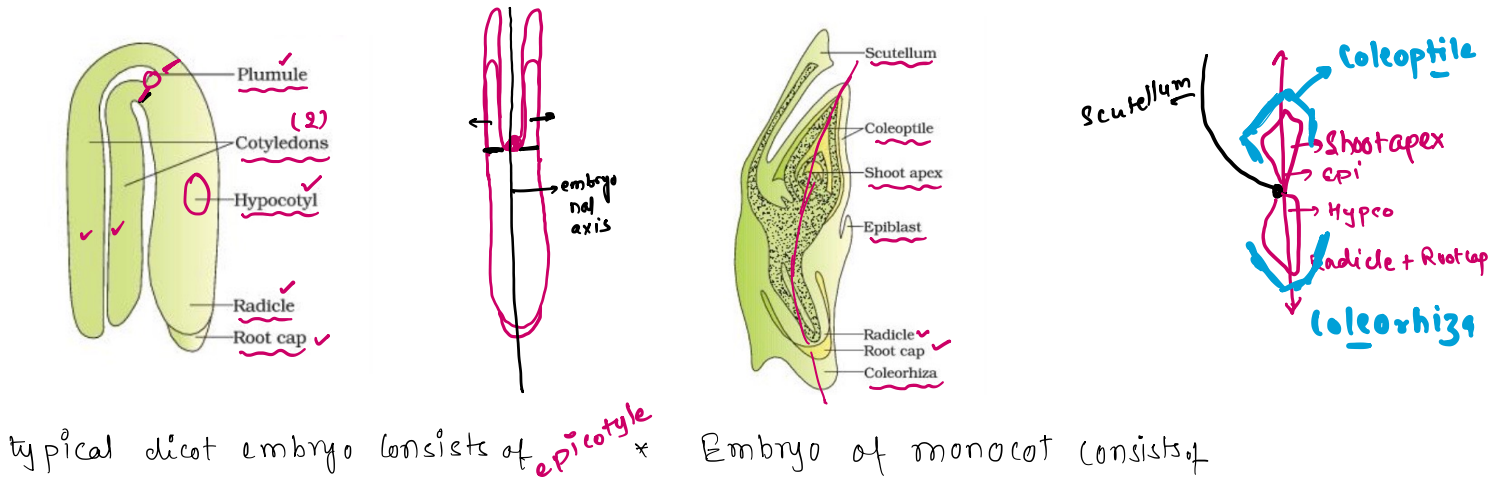
- Initially the embryo is Globular and undifferentiated.
- Early embryo with radial symmetry is called Proembryo.
- It is transformed into embryo with the developement of radicle, plumule and cotyledons. Two cotyledons differentiate from the side with a faint plumule in the centre. At this time the embryo become Heart shaped
- The rate of growth of the cotyledons is very high so that they become elongate tremendously while the plumule remains as a small mound of undifferentiated tissue.

Thus zygote gives rise to the Proembryo ① and subsequently to the Globular ②, Heart-shaped ③ and mature embryo ④.

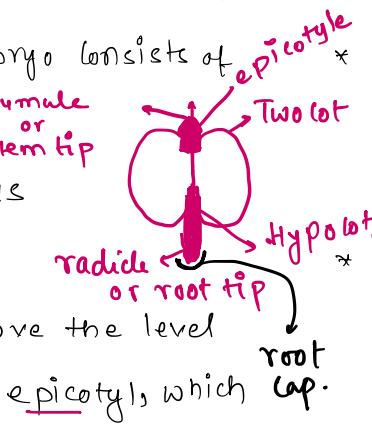


(a) Fertilised embryo sac showing zygote and Primary Endosperm Nucleus (PEN); (b) Stages in embryo development in a dicot [shown in reduced size as compared to (a)]

Structure of Dicot embryo Structure of monocot embryo



- A typical dicot embryo consists of
  - An embryonal axis
  - Two cotyledons

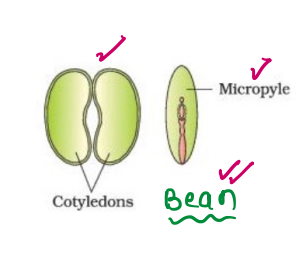


- Portion of axis above the level of cotyledons is the epicotyl, which terminates with plumule or stem tip.
- The cylindrical portion below the level of cotyledons is hypocotyl, that terminates at its lower end in the radicle or root tip.
- The root tip is covered by root cap (Calyptra)

- Embryo of monocot consists of
  - an embryonal axis
  - one cotyledon (Gramineae)
- In grass family the cotyledon is called Scutellum, that is situated towards one side (lateral) of the embryonal axis
- At the lower end, the embryonal axis has the radicle and the root cap enclosed in undifferentiated sheath called Coleorhiza.
- the portion of embryonal axis above the level of attachment of scutellum is the epicotyl.
- Epicotyl has a shoot apex and a few leaf primordia enclosed in a hollow foliar structure called the Coleoptile.
- Epiblast represents rudiment of second cotyledon.

2.4.3 Seed [significance of seed and fruit formation]

- In angiosperms
  - Seed is final product of sexual reproduction.
  - It is also k/a Fertilized ovule.
  - seeds are formed inside fruits.
  - A seed typically consists of
    - seed coat (s)
    - Cotyledon (s)
    - an embryo axis

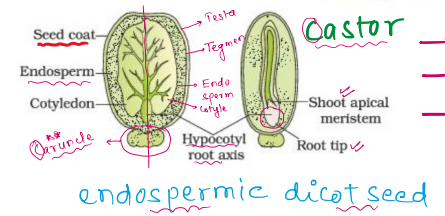


"Non-endospermic dicot seed"

- Cotyledons of the embryo are simple structures, generally thick and swollen due to storage of food reserves (eg as in legumes)

Occasionally in some seeds such as black pepper, castor, Nymphea and beet, remnants of nucellus are also persistent. This residual persistent nucellus is the perisperm (ploidy, 2n).

- Integuments → of ovule harden as tough protective seed coats.
  - Outer – Testa
  - Inner – Tegmen
- Micropyle → Remain as small pore in the seed coat to facilitate entry of oxygen and water into the seed during germination.



endospermic dicot seed

→ *caruncle → *Raphe → *Perisperm — endosperm is source of castor oil.

As the seed matures, its water content is reduced and seed become relatively dry (10-15% moisture by mass). The general metabolic activity of embryo slow down. The embryo may enter into state of inactivity called Dormancy.

"lettuce" (sun light)

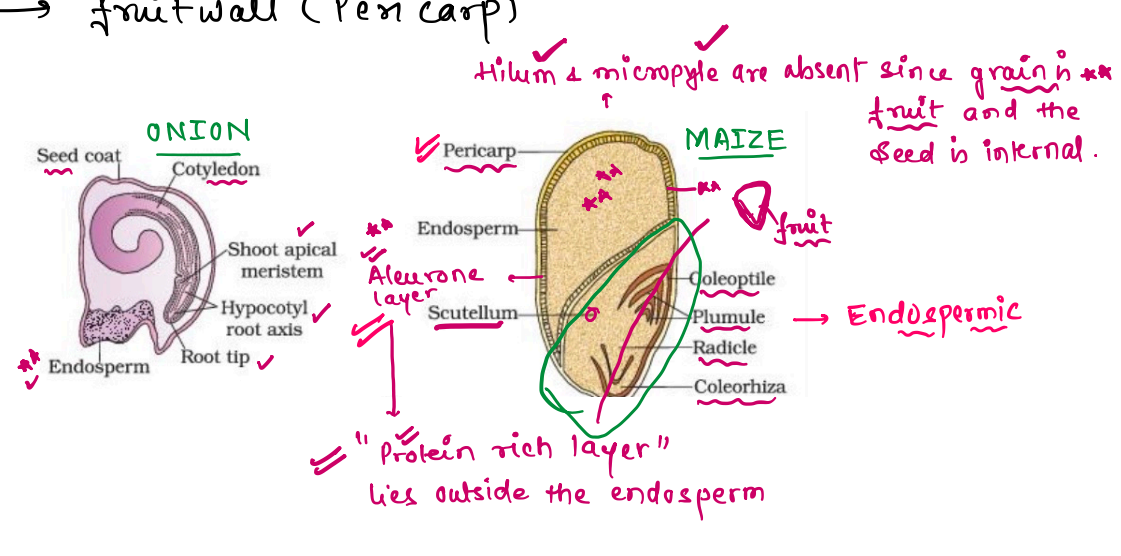
If favourable conditions are available i.e., adequate moisture, oxygen and suitable temp, they germinate or

- ovule → seeds
- ovary → fruit

This transformation proceed simultaneously.

- ovary wall → fruitwall (Pericarp)

Hilum & micropyle are absent since grain is fruit and the seed is internal.



Importance of seed :-

1. Dependable method :- Since reproductive processes such as pollination and fertilization is independent of water, seed formation is more dependable.
2. Dispersal :→ seeds have better adaptive strategies for dispersal to new habitats & help the species to colonise in other areas.
3. Perennation :- Seed is dry (H_2O content 10-15%) with dormant embryo and thick protective seed coat. It is most suitable for perennation through unfavourable period.
4. Storage :- Seed can be stored for later use. This is helpful for supply of food throughout the year and to overcome draught & famine condition.
   - Dehydration & dormancy of mature seeds are crucial for storage of seeds.

   Stored seeds also use to raise crop in next season
5. Agriculture :- Seed is basis of our agriculture. Agriculture originate when human learn to eat, store and sow seeds.
6. Reserve food :- Seeds have reserve food for nourishing the young seedlings, till they are capable of photosynthesis on their own
7. Protection :- Hard seed coat provide protection to the young embryo.
8. Variations :- Being products of sexual reproduction, they generate new genetic combinations leading to variations. → evolution, Adaptation

Viability of Seeds :→

- The ability of seeds to retain the power of germination over a period of time after dispersal is called viability of seeds. All viable seed respire.
- In few species the seeds loose viability within a few months.
- seeds of large number of species live for several years.
- Some seeds can remain alive for hundereds of yrs.
  - Some 2000 yrs old viable seeds of Phoenix dactylifera have been discovered during archeological excavation of King Herod's palace near dead sea.
  - About 10,000 yrs old seeds of Lupin arcticus taken out from arctic tundra have germinated and produced plants that flowered and bore fruits.
- Loss of viability is generally due to
  - (i) Exhaustion of food around the embryo
  - (ii) Damage to embryo
  - (iii) Denaturation of Enzymes
  - (iv) Premature exhaustion of RNAs.

Fruit :-

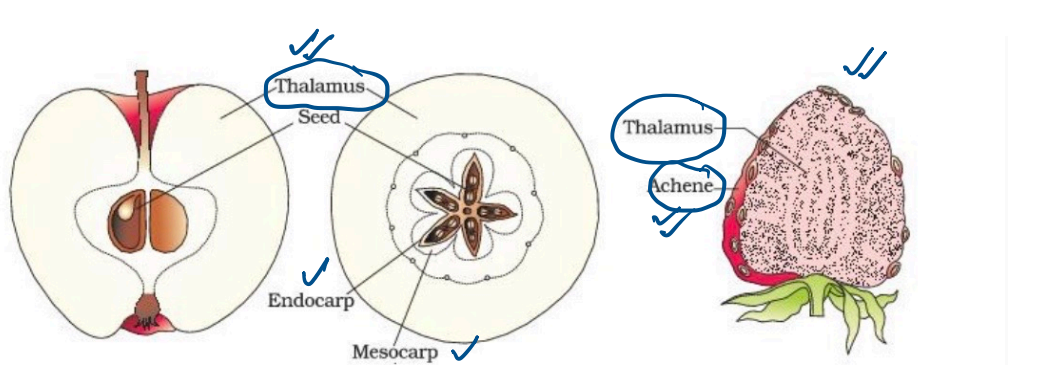
- True fruit or eucarp :→ Develop from ovary only. It is ripened ovary which develops under the influence of ripening ovules and is meant for protecting them. It consists of Pericarp formed from the wall of ovary and seeds formed from ovules.
- false fruit or Psudocarp :→ In some cases, thalamus and other floral parts shows proliferation along with development of ovary wall. eg. Apple, strawberry, cashew (Thalamus also contribute to fruit formation)
- Fleshy fruits :- (Fleshy pericarp)
  - fruit wall is fleshy or succulents (Juicy hairs)
  - fruit wall differentiated into three layers epicarp, mesocarp and endocarp eq guava, orange, mango
- Dry fruits :- (dry pericarp) fruit wall is dry. Pericarp is undifferentiated. Generally. eg. Groundnut, mustard

auxin, GAs

Natural parthenocarpy → Banana

(fruit formation ̄c out fertilization)

- Parthenocarpy :→ (GK parthenos-virgin Karpos-fruit)
  - Production and development of seedless fruits is called parthenocarpy.
  - In most species, fruits are the results of fertilization.
  - In few species fruits develop without fertilization. Such fruits are called parthenocarpic fruits. eg. Banana.
  - Parthenocarpy be induced through the application of growth hormones and such fruits are seedless Auxin GAs



false fruit of apple and strawberry.

- orchid fruits contain thousands of tiny seeds
- similar in the case in fruits of some parasitic species such as Orobanche and Striga. → obligate root parasite

Significance of fruit formation :-

1. Protection :- Developing fruits protect the developing seeds from mechanical injury, insects and unfavorable climatic condition.
2. Dispersal :- fruits help the seeds in dispersal to distant place.
3. food to animals
4. Nutrition to Germinating seeds

2.5 Apomixis and Polyembryony :-

Apomixis = (Apo- without mixis- mixing)

- Apomixis is a mode of reproduction which does not involve formation of zygote through gametic fusion.
- Apomixis is form of asexual reproduction that mimics sexual reproduction.

Eg. Some species of Asteraceae and Grasses.

- There are several ways of development of Apomictic seeds.
- In some species the diploid egg cell is formed without reduction division and develops into embryo sac without fertilization.

Polyembryony :- As in many citrus and Mango varieties some of the nucellar cells surrounding the embryo sac start dividing, protudes into embryo sac and develop into embryos. In such species each ovule contain many embryos. Occurence of more than one embryo in seed is referred to as Polyembryony.

- Polyembryony discovered by Leeuwenhoek (1719) in citrus.
- Polyembryony is the phenomenon of developing more than one embryo in the same seed.

(1) Simple polyembryony → Presence of more than one embryo sac and hence oosphere. eg. Brassica.

(2) Mixed polyembryony → More than one pollen tube entering an ovule and fertilizing synergids or an antipodal cells eg ulmus

embryo (2n), embryo n+n, n+n

(3) cleavage polyembryony :- Splitting of one embryo in to two or more. eg orchid, Nymphea

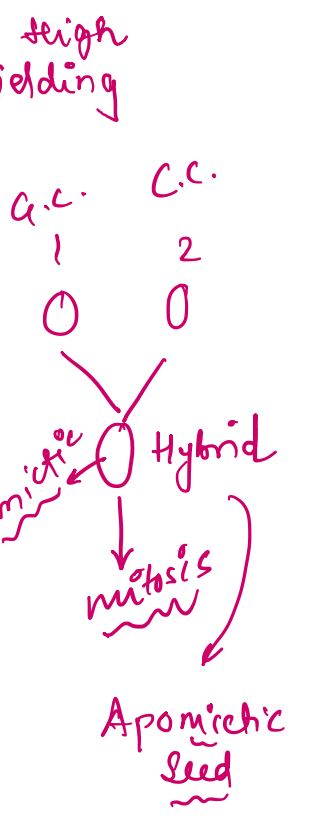
(4) Adventive polyembryony :- Diploid Nucellar or integument cells proliferate to form embryo eg citrus, opuntia, Mangifera

Poly embryony

- is true: If extra embryo develop from same embryo sac
- is false: If extra embryo are formed elsewhere

"Importance" → (Apomixis)

- Hybrid varieties of several of our food and vegetable crops are being extensively cultivated. = high yielding
- Cultivation of Hybrids has tremendously ↑es productivity
- One of the problems of Hybrids is that hybrid seeds have to be produced every year.
- If the seed collected from hybrids are sown, the plants in the progeny will segregate and do not maintain hybrid characters
- Production of hybrid seeds are costly & hence cost of hybrid seeds become too expensive for farmers.



- If these hybrids are made apomictic, there is no segregation of charachters in the hybrid Progeny. Then the farmers can keep using the hybrid seeds to raise new crops year after year and he does not have to buy hybrid seeds every year.
- Because of importance of apomixis in hybrid seed industry active research is going on in many laboratories around the world to understand the genetics of apomixis and to transfer apomictic gene into hybrid varieties.

~~80%~~ 90 → 70 New Portion, 20 Prev. Part

12th ch-2, ch-3 ch-4; 11th chp-21 ??

- "Genetic nature of apomictic embryo is similar to parents and they can be called as clone"
- In a typical flower one ovary is ∓nt. It also depends upon no. of carpels in flower.
- one egg usually ∓nt in an embryo sac
- usually one embryosac ∓nt in an ovule
- Number of ovule/ovary varies from plant to plant