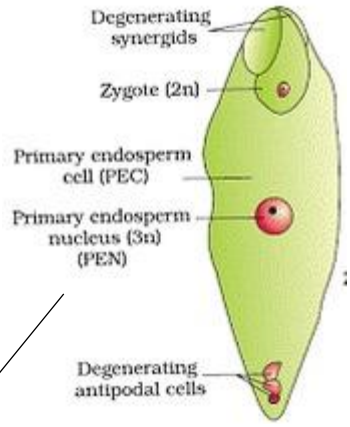
Post fertilisation events of endosperm & embryo development, maturation of **ovules into seeds** and **ovary into fruits.**

Endosperm– the primary endosperm cell divides(mitotically) many time to forms triploid endosperm tissue having **reserve food materials for developing embryo.**

Two types of endosperm development:

(i) **Free nuclear type** (common method): a type of division in which karyokinesis (nuclear division) in a cell is not followed by immediate cytokinesis (cytoplasmic division). Ex: **Coconut water** (made up of thousands of nuclei)

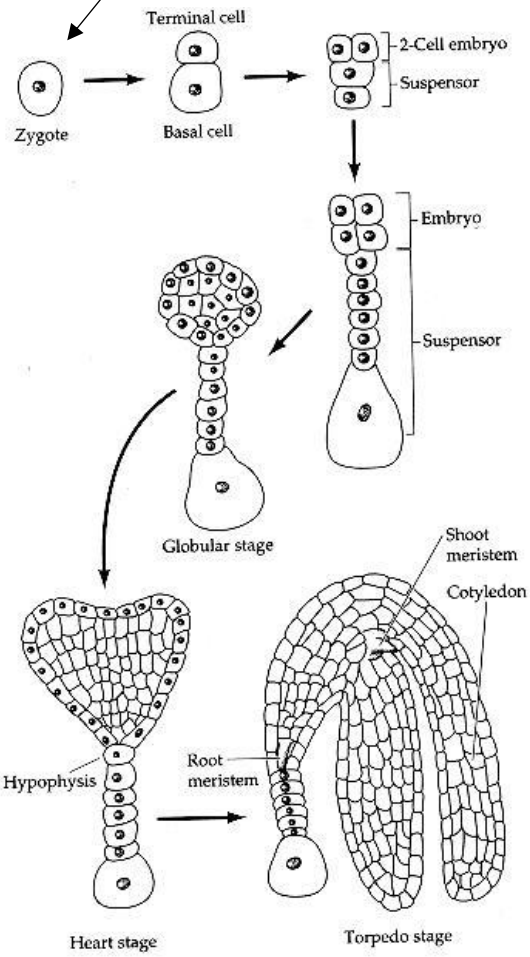
(ii) **Cellular type:** Subsequently cell wall formation after nuclear division. Ex: **surrounding white kernel of coconut.**



Embryogeny – Early stages of embryo development. <u>Similar in both monocotyledons and dicotyledons till globular embryo.</u>

1) The zygote divides mitotically to form two cell zygote and Suspensor cell(towards micropyle end).
2) Embryo further divide mitotically to give rise to **proembryo**
3) Subsequent division leads to formation of the **globular embryo.**
4) Further division leads to heart-shaped embryo than mature embryo.

• The suspensor pushes the embryo towards the endosperm to draw its nutrition.



Embryo- Zygote divides repeatedly to form Embryo. It develops at the micropylar end of the embryo sac.

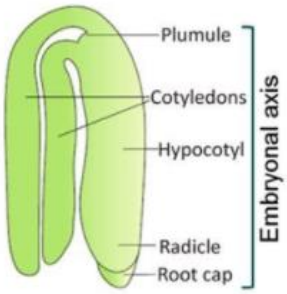
- Mostly zygotes divide only after certain amount of endosperm is formed.

Embryo typical consists of:

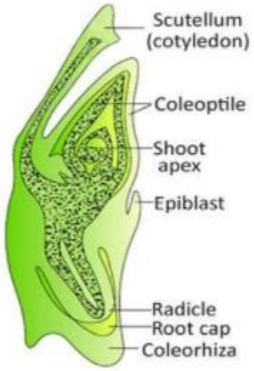
- **Embryonal axis** – Axis that divide embryo into two region.
- **Cotyledons :** Thick and swollen leaf like structure that store food & nutrients for developing embryo.
- **Epicotyl**- Portion of embryonal axis above the level of cotyledons.
- **Hypocotyl:** Portion of embryonal axis below the level of cotyledons.
- **Root Cap:** a type of tissue at the tip of a plant root.
- **Plumule** : Terminal of Epicotyl that give rises to shoot.
- **Radicle**: Terminal of hypocotyl that give rises to root.

Present in Monocotyledonous Embryo only.

- **Coleorhiza:** A undifferentiated <u>sheath</u> Covering the radicle or root cap
- **Coleoptile:** A <u>hollow follicular structure</u> enclosing shoot apex and a few leaf primordia in monocots.
- **Scutellum:** Single lateral cotyledon in some grasses of monocots. It gets reduced hardly contain any food,
- **Epiblast:** Remanent of second cotyledon in monocots.



A typical dicot embryo



LS of grass embryo (monocot)

Seed

Fertilized and mature ovule develops into seed.

Seed consists of: cotyledon(s) & embryonal axis

Seed coat- double layered- formed by integuments

- **Testa** (outer coat)
- **Tegmen** (inner coat)

1) **Non-Albuminous (Non-Endospermic) Seeds**: In some dicot seeds **endosperm is consumed completely** by developing embryo before seed maturation. Ex: Pea, groundnuts, bean

2) **Aluminous (Endospermic) Seeds:** In some monocot seed a portion of endosperm remain (persistent) in mature seeds. Ex: wheat, maize, barley, castor, coconut.

Dicot Seed: Consist of two cotyledons. Mostly non-endospermic. Ex: Bea, gram castor.

Monocot Seed: Consist of one cotyledons. Mostly endospermic. Ex: Maize, onion

Ques: Name and classify the seeds as monocot and dicot given on figure no.2.15 a.

– ***Micropyle***: small opening on seed coat, it facilitates entry of H2O & O2 int seeds (for germination)
– ***Hilum***:- scar on seed coat
– ***Perisperm*** : remnants of nucellus that is persistent. Ex: Black pepper & Sugar beet
– ***Dormancy*****:** state of metabolic inactivity

- Orchid fruit- Produce thousand of tiny seeds.
- Orbanche & Striga- Parasitic- produce thousand of seeds
- One Ficus tree- produces billions of seeds.
- **Seeds are basis of Agriculture**. (dormant and dehydrated) can be stored for usage throughout the year
- Young seedlings are self-nourished until photosynthesis as they have enough food reserves
- Generates new genetic combinations resulting in variations
- Seed formation is dependable as other reproductive processes(fertilization and pollination) are water-dependent
- For dispersal to newer habitats, seeds have a better adaptive strategy helping species to colonize other areas

Viability of Seed: Period till the seeds remain alive after they are dispersed. Vary greatly.

- *Lupinus arcticus* excavated from Arctic Tundra. Germinated after 10,000 years of dormancy.
- 2000 years old seed of date palm, *Phoenix dactylifera* discovered during the archeological excavation at King Herod's palace near the Dead Sea.

Kind of Dispersal	Important Features	Examples
Wind (Anemochory)	Light weighted, tiny, hair like or wing like structure	Maple, drumstick, orchids, dandelions
Water (Hydrochory)	Seed or Fruit have Spongy or fibrous layer to trap air.	Water Lily, coconut
Animals (Zoochory)	Seed develop hooks, spines or hairs.	Xanthium
	Some have fleshy fruit	Cherry, Mango
Explosion (Autochory)	Pod Shape Fruit (Burst on Maturation)	Pea, rubber
Gravity (Autochory)	Heavy fruit, delegate covering	calabash

Formation of Fruits and seeds

- The wall of ovary develops into wall of fruit called **pericarp.**
- **True fruits** only ovary contributes in fruit formation.
- **False fruit** thalamus contributes in fruit formation ex: Thalamus/ Receptacle- edible part in Apple & Strawberry.
- Formation of seeds (develop from ovule) takes place within fruits (develop from ovary).
- Dry fruit pericarp not divisible. Ex: pea , mustard
- Fleshy fruit: Pericarp divisible into Epicarp (Outer), Mesocarp (Middle), Endocarp (Inner). Ex: Mango- edible Mesocarp

Parthenocarpy - fruits are produced without the process of fertilization of ovules.
Fruit is devoid of embryo and endosperm and does not have any seeds known as virgin fruits. Ex: banana, grapes

Apomixis
– Form of asexual reproduction- mimics sexual reproduction- seed formed without fertilisation
– Formation of apomictic seeds :
• Diploid cells (formed without meiosis)- develop into embryo without fertilization
• In some species, the diploid egg cell is formed without reduction division and develops into the embryo without fertilisation.
Ex. *Asteraceae* and grasses.

Polyembryony
In some species cells of nucellus (2n) surrounding embryo sac- protrude into embryo sac- develop into many embryos.
— Often associated with apomixes. Ex: Citrus, Groundnut and Mango

Que: What is significance of apomixis in the field of Agriculture?

- It produces seed progeny which are exactly the same as the mother plant.
- It helps in the production of hybrid seeds with a combination of desirable characters.
- Hybrid seeds need to produce every year (Costly) but with apomixis need not to buy as same gene of hybrid seeds will transfer without any variation.