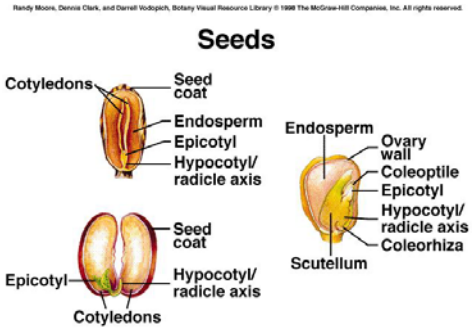
Lecture 25-26. Seeds



Topics

- Generalized seed structure
  - Where the seed comes from
  - Parts of the seed
- Kinds of seeds
  - Dicots
  - Monocots

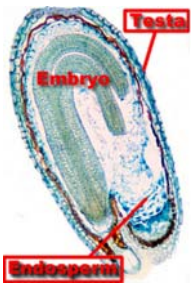
- **The seed represents one of the most significant plant adaptations.**
- **The Seed develops from the Ovule.**

Fertilization

- When a pollen grain lands on the stigma of the same species, it germinates, forming a pollen tube.
- Passes between the stigma and style to reach the micropyle of the ovule.
- Double fertilization occurs.
  - One sperm nucleus unites with the egg nucleus, producing a zygote.
  - Other unites with the polar nuclei, forming a 3n endosperm cell.

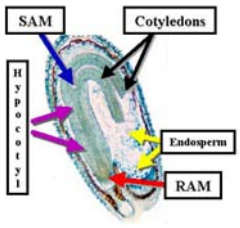
Parts of seed

- The Ovule's Integuments form the Seed Coat.
- The ability to spread reproduction over a long time-span also contributes to long distance transport of seeds which helps to extend their range.
- In many cases this was aided by animal dispersal. This can be due to ingestion or by adherence to the feathers of birds or other beasts.
- Some seeds float and can withstand long exposure to salt water. The coconut is a good example of this and it can spread naturally over the ocean.



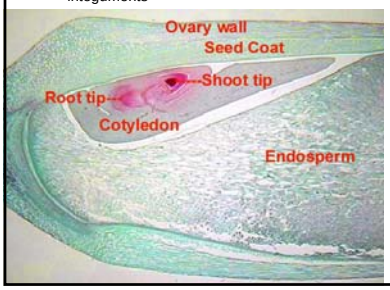
Structure of Seeds

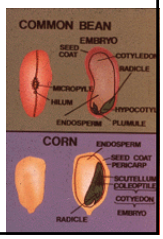
- **Seeds are mature, fertilized ovules.**
- **Embryo:** Young sporophyte, diploid (2n), result of fertilization. The mature embryo consists of **cotyledons (seed leaves), hypocotyl** (stem-like embryonic axis below the cotyledons), **radicle (embryonic root)**.
- **Endosperm:** Food storage tissue, triploid (3n), result of fertilization.
- **Testa (seed coat):** Outer protective layer of the seed, developed from the integuments of the ovule, maternal dipoid tissue.

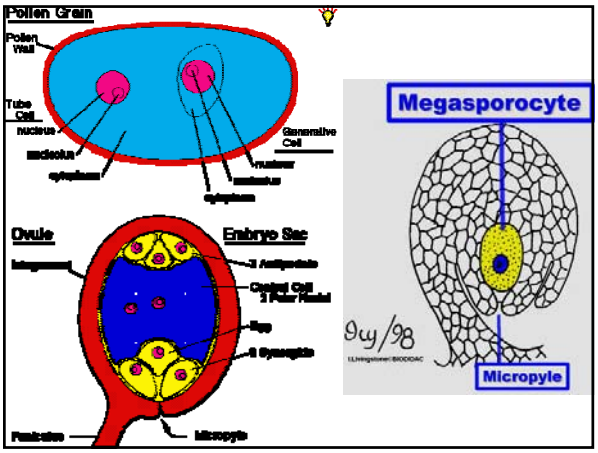


Structure of Seeds

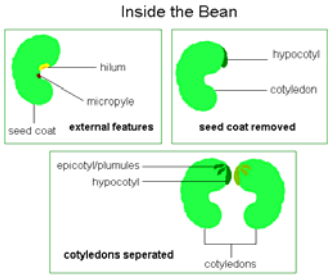
- **Seed Coat**
  - Hilum: place where seed was attached to plant
  - Micropyle: small opening in the integuments



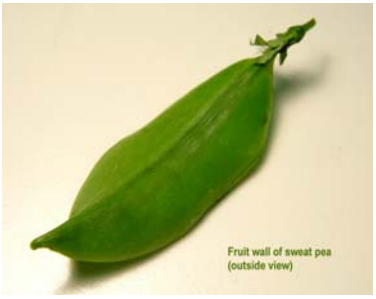




-The hilum is a mark where the bean was once attached to a plant.
- Below it is the micropyle, the tube where the male nucleus first entered the ovule.
- **micropyle:** A small canal in the integument surrounding the ovule of a flowering plant, through which the pollen tube usually enters the ovule on the way to the embryo sac. Water enters the seed via the micropyle prior to germination.
- The hypocotyl is the seedling's root, while the epicotyl is its stem.



Seed structure (pea)



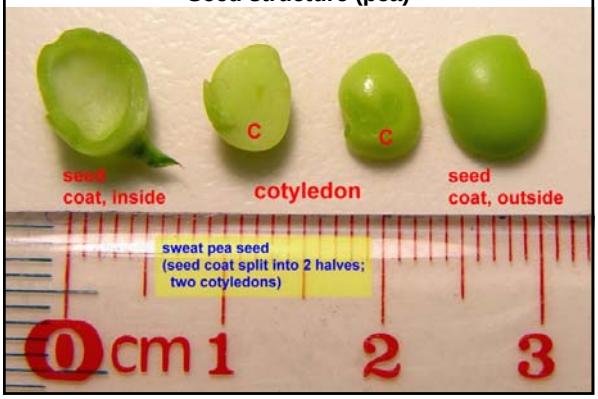
Seed structure (pea)
- Inside the pod, the seeds are arranged in an alternate manner

Seed structure (pea)

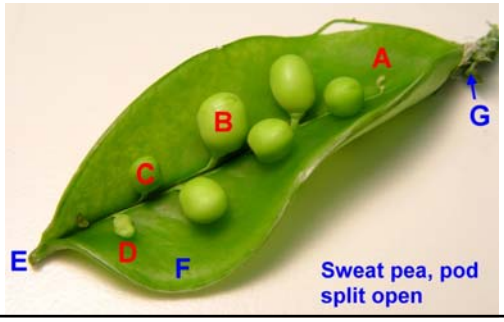
Seed structure (pea)

When the seed is torn apart, two cotyledons are seen, together with the embryonic shoot (= plumule) and the embryonic root (= radicle).

Seed structure (pea)



Seed structure (pea)
- Nature is imperfect. Some ovules are not fertilized, and those that are may not get the same amount of nutrients.



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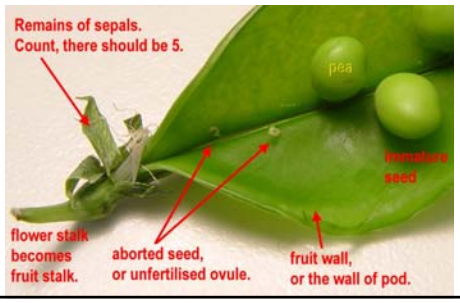
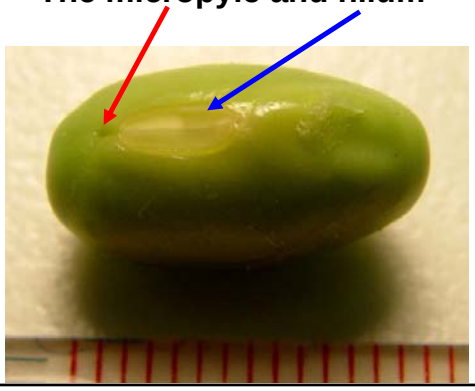
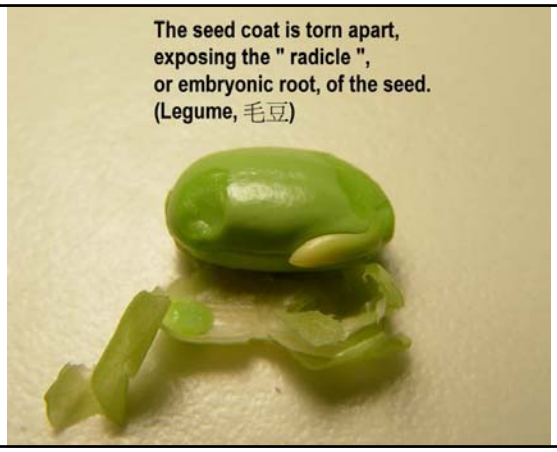


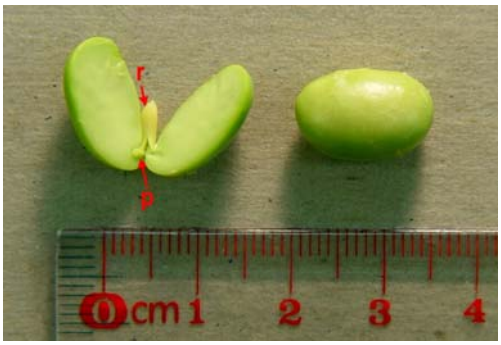
This pod has three seeds.

The micropyle and hilum



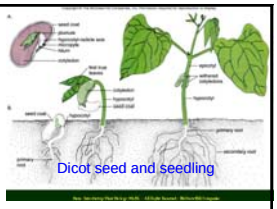


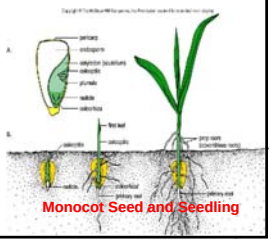
What are p and r ?

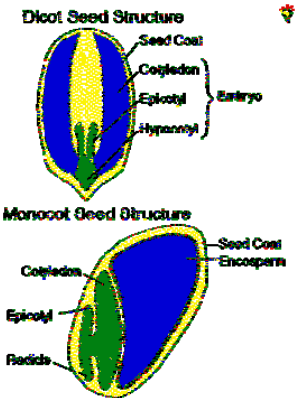


The structure of a seed consists of:

- Cotyledons - Food storage organs that function as first seed leaves.
- Plumule - Embryo shoot.
- Epicotyl - Stem above cotyledon.
- Hypocotyl - Stem below attachment point.
- Radicle - Stem tip developing into a root.


Dicot seed and seedling


Monocot Seed and Seedling



Kinds of seeds

- Dicot seeds – endosperm is partially or completely absorbed by the embryo by cotyledons
- Monocot seeds – endosperm is a discrete, major structural seed unit

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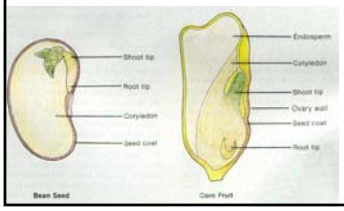
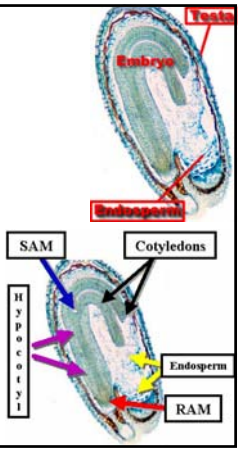


Mature *Capsella* Seed

- *Capsella* is used as a model for Dicot Embryo development and helps to show the dynamic relationship between the Embryo and the Endosperm.

Mature *Capsella* Seed

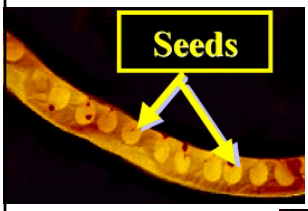
- The Seed consists of:
  - Seed Coat (Testa)
  - Endosperm
  - Embryo
- The Embryo consists of:
  - Root Apical Meristem (RAM)
  - Hypocotyl Shoot Apical
  - Meristem (SAM)
  - Two Cotyledons (Dicot)



Legume seeds

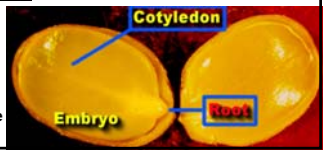
- tremendous agronomic significance
- Fabaceae is one of the largest and most important families of flowering plants.
- The Mature Seed has no visible Endosperm. This is consumed by the Cotyledons.

Legume seeds: Honey Locust (*Gleditisia*)



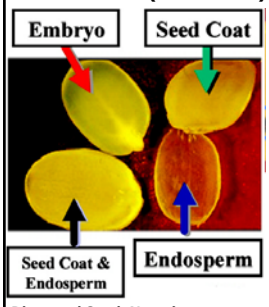
Immature *Gleditisia* Fruit

Immature Seed External View

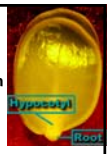


Immature Seed Split Open: A Cotyledon and Root Apex are readily visible.

Legume seeds: Honey Locust (*Gleditisia*)



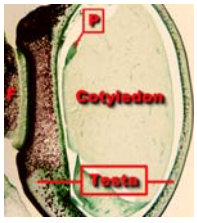
Dissected Seed: Note the presence of a semitransparent Endosperm plus the Embryo.



Complete Embryo with both Cotyledons visible as well as the Hypocotyl. The Hypocotyl is the region of the stem BELOW the Cotyledons.

Embryo with one Cotyledon Removed: The Epicotyl with macroscopic Leaves is visible. The SAM is located at the base of the leaf primordia. The Cotyledon Scar is visible. This marks the Cotyledonary Node! H = Hypocotyl.

Bean (*Phaseolus* sp.)



Longitudinal Section through a Bean (Phaseolus) Seed: Note the Funiculus (F) which attaches the Ovule (a.k.a. the Seed) to the Placenta. The Cotyledons fill most of the seed's volume. Fragments of the Endosperm may occur between the Cotyledons and the Testa.

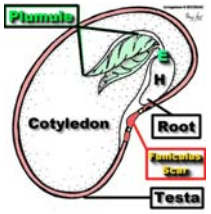
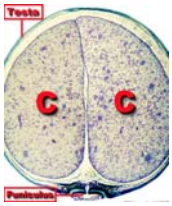
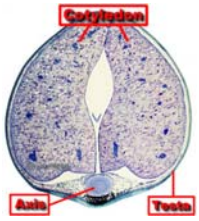


Diagram of a typical Legume Seed: The Plumule represents the "Bud" or Shoot Tip of the Embryo. The Epicotyl includes the Plumule and any other stem tissue above the Hypocotyl.

Bean (*Phaseolus* sp.)

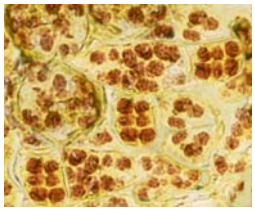


Cross-Section of a Bean Seed above the level of the Plumule: The Cotyledons are the only visible Structures.

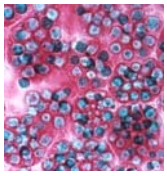


Cross-Section of a Bean Seed through the middle of the Embryonic Axis which lies close to the Funiculus. The Axis consists of everything from the SAM to the RAM

Bean (*Phaseolus* sp.)

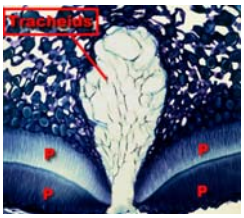


Cotyledons may contain large quantities of Starch which has stained brown with IKI. *Phaeolus* Cotyledons contain a lot of starch.

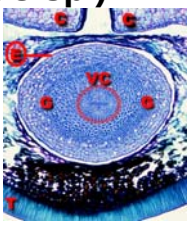


In some cases like Soybean (*Glycine max*) the Cotyledons contain large amounts of Protein in Protein Vacuoles (Blue). This is the reason why Soybean is such an important crop.

Bean (*Phaseolus* sp.)



High Magnification View of the Funiculus: Note the presence of the Tracheid Bar (T) near the opening (Hilum) in the Testa. Note the Aerenchyma which surrounds the tracheids. These probably assist in the uptake of air and water. There are two Palisade (P) layers composed of Macrosclereids. One of these develops from the Funiculus.



The Embryonic Axis is composed of a central Vascular Cylinder (VC) which is Diarch. This suggests that it is the region of the Root. The Vascular Cylinder is surrounded by Ground Tissue (G) and a unicellular Epidermis (E). One layer of Macrosclereids is clearly visible in the Testa (T)