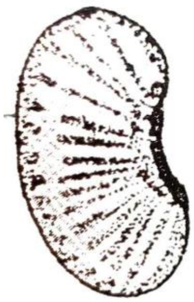
Seeds ~ Structure and Germination

WHAT IS A SEED ?

Fruit is the enlarged ripened ovary, the ovarian wall forming the fruit wall enclosing the seed.



Seed is the ripened ovule. It contains embryo which develops into a new plant. The seed coat protects the embryo from mechanical damage. Example: Bean seed, peas.

Grain as found in maize, wheat, etc, is actually the fruit in which the fruit-wall and the seed coat are fused together to form a protective layer.

MORE ABOUT SEED

- It is a mature ovule after fertilisation.
- It contains a tiny living plant, the embryo (developed from the fused sperm nucleus and the egg nucleus).
- The embryo remains in an inactive (dormant) state until exposed to favourable conditions when it germinates.
- The seed also contains food material for the nourishment of the embryo during germination.

CLASSIFICATION AND STRUCTURE OF SEEDS

Types of Seed

Seeds are of two kinds :

• <u>Monocotyledonous seeds</u> contain one cotyledon (seed-leaf) e.g. maize, grasses.

• <u>Dicotyledonous seeds</u> contain two cotyledons e.g. pea, gram, bean.

Seeds vary in size

• Some are <u>so small</u> that they are barely visible to the naked eye e.g. poppy seeds, orchid seeds.

• Some are <u>*quite large*</u> as in watermelon and pumpkin or even in mango (the stone).

• <u>*Largest seeds*</u> are those of coconut and double coconut.

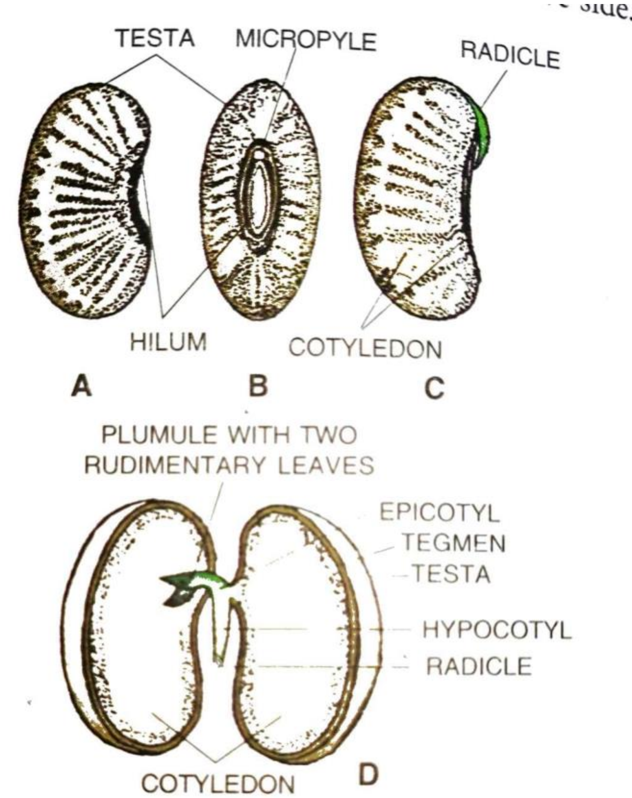
On the basis of endosperm:

(i) Albuminous (Endospermic) - Cotyledons are thin and membranous and endosperm persists e.g. Dicot albuminous seeds: poppy, custard apple. Monocot albuminous seeds: cereals, millets, palm.

(ii) Exalbuminous (Non-Endospermic) - In such seeds, the cotyledon stores food and becomes thick and fleshy e.g. Dicot exalbuminous seeds - Gram, pea, mango, mustard.Monocot exalbuminous seeds Vallisneria, orchids.

1. THE BEAN SEED

Most are kidney-shaped with a convex and a concave side.



Structure of Bean seed. A & B—External structure, … removed, D—Seed cut open to show various parts

Seed coat- Testa the outermost hard brownish covering. It protects the delicate inner parts of the seed from injury and from the attack of bacteria, fungi and insects.

Tegmen is a thin inner layer lying next to the testa, and this also is protective.

Hilum is a distinct whitish oval scar on the concave side of the seed. It represents the spot where the ovule was attached to the ovary wall through placenta.

A tiny pore **micropyle** is situated close to the hilum. It marks the opening through *which the pollen tube had entered the ovule*. Micropyle serves two functions:-

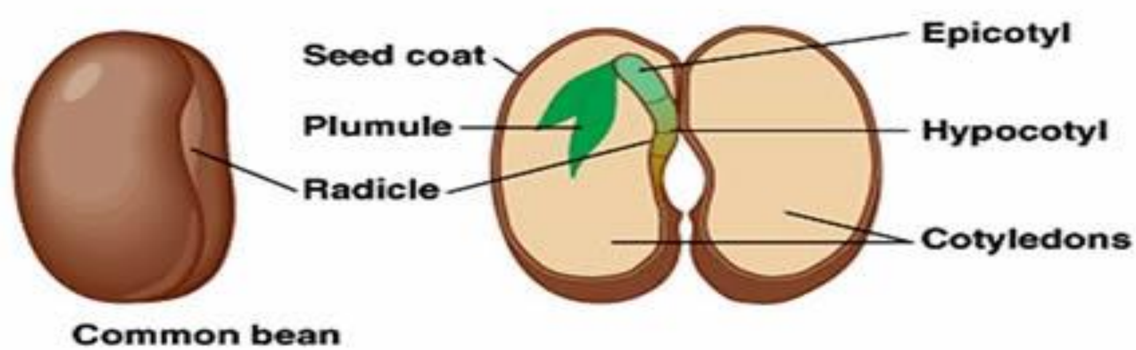
(1) When soaked in water, the seeds absorb water mainly through this micropyle, and make it available to the embryo for germination.

(2) It provides for the *diffusion of respiratory gases* for the growing embryo.

Cotyledon: A part inside a seed that looks like a small leaf, which the developing plant uses as a store of food. Cotyledons are the first parts of the seed to appear above the ground when it begins to grow.

Embryo :

Embryo is the developed form of a zygote that

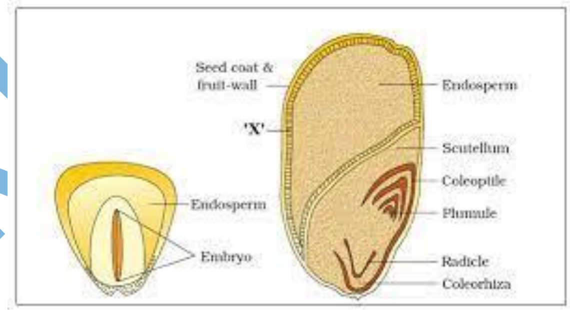


is formed after the fertilization of male and female gametes. It consists of two parts- the ***<u>radicle which later forms the root</u>*** and ***<u>the plumule which later forms the shoot.</u>***

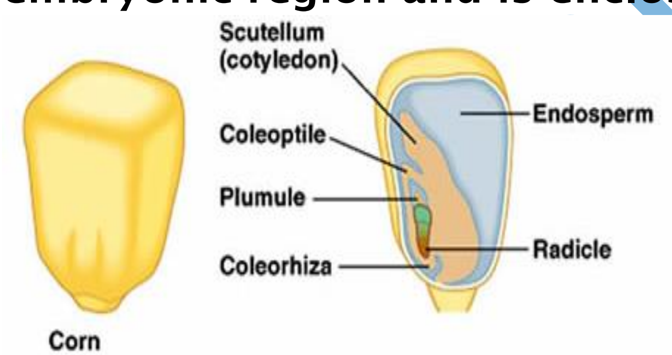
2. MAIZE GRAIN

The maize grain is one seeded fruit in which the fruit wall and the seed-coat, are fused together to form a protective layer, so such a fruit as grain.

The outermost layer of the endosperm is rich in protein and is called <u>aleurone layer.</u>



The embryo consists of a single cotyledon here called scutellum, a radicle and a plumule. The radicle is towards the pointed end and it is enclosed in a protective sheath, the *<u>coleorhiza</u>*. The plumule is towards the upper broader side of the embryonic region and is enclosed in a protective sheath, the *<u>coleoptile</u>*.



GERMINATION

The seed contains a <u>dormant embryo</u>. In a dry seed the embryo is inactive. It is said to be in a state of dormancy (a period of rest)

Germination is the process of formation of a seedling developed from the embryo.

CONDITIONS NECESSARY FOR GERMINATION

Water, suitable temperature and air (oxygen) are necessary for germination.

1. Water: **The seed obtains water from its environment, i.e. from the soil, in natural conditions. The water is absorbed all over the surface but mainly through the *micropyle.* Two main uses of water are:**

(i) The seed swells and the seed- coat tears allowing the elongating radicle to come out and form the root system.

(ii) Water is necessary for chemical reaction and for the enzymes to act upon the food stored in the cotyledons.

2. Suitable temperature: **Both very low and very high temperatures are unsuitable for germination. A very low temperature stops *the growth of the embryo* and a very high *temperature destroys its delicate tissues*. A moderately warm temperature (25˚C to 35˚C) is usually favourable for germination and it is also called optimum temperature.**

3. Oxygen: **During germination there is rapid cell division and cell growth for which energy is required which is produced by respiration.**

Seeds sown very deep in soil fail to germinate. Two main reasons:

1. No proper supply of oxygen (for respiration)

2. Insufficient pushing force.

SOME EXPERIMENTS ON GERMINATION

1. Experiment to prove that water is necessary for germination:

Take two beakers and mark them A and B. In beaker A place some seeds of green gram (or pea, etc.) on wet cotton wool. In beaker B place some similar seeds on dry cotton wool. Keep both the beakers in an ordinary room. In a day or two, the seeds in beaker A will germinate but not in beaker B, showing that water is necessary for germination.

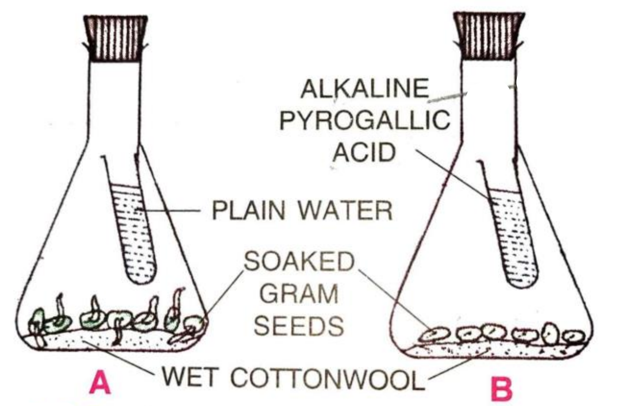
2. Experiment to prove that a suitable temperature is necessary for germination.

Take two beakers and name them A and B. Place some green gram seeds on wet cottonwool in each of the two beakers. Keep beaker A in an ordinary room and beaker B in a refrigerator. In a day or two, the seeds in beaker *A will germinate*, showing the importance of a suitable temperature for germination.

3. Experiment to prove that air (oxygen) is necessary for germination:

Take two conical flasks A and B. Spread wet cottonwool in each flask and place on it some soaked gram seeds. Lower a small test-tube containing *alkaline pyrogallic acid, which absorbs oxygen*, in flask B.

The seeds in flask A germinates as it gets Oxygen for respiration.

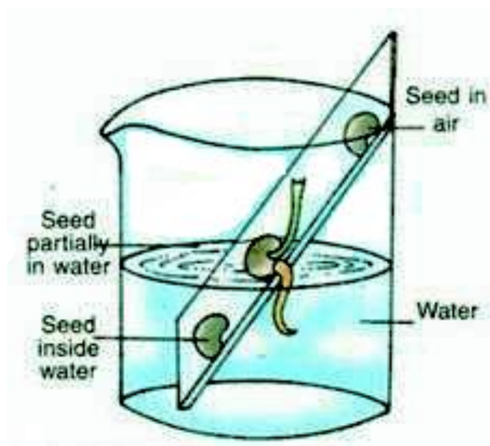


Seeds require air (oxygen) for germination
A—Seeds germinate in ordinary air,
B—Seeds do not germinate in air without oxygen

4. The three-bean seeds experiment:

This slide is kept in a beaker containing water in a manner that the top seed is well above water, the middle one is just at the water level and the bottom one is deep in water. The experimental set-up is left in a warm place for a few days and the result is as follows:

- The *middle seed germinates*. It gets both oxygen and water.
- The top seed does not germinate at all. It gets only oxygen but no water.
- The bottom seed does not germinate or stops germinating after the emergence of a small radicle. It gets water but very little oxygen (from the air dissolved in water).



Three bean seed experiment.

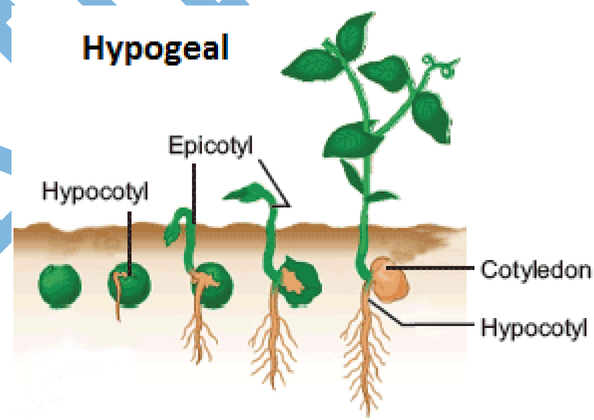
TYPES OF GERMINATION

The region of the axis between the point of attachment of cotyledons and the plumule is called epicotyl. The region of the axis below the cotyledons is called hypocotyl.

If the epicotyl elongates, the cotyledons remain underground (or on the ground if the seed is just on the ground) and the germination is then called hypogeal e.g. pea and gram.

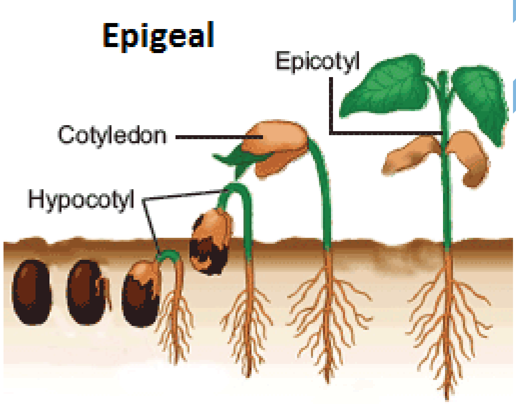
In Epigeal Germination : the hypocotyl elongates and cotyledon moves out of the ground.

GERMINATION IN SOME COMMON SEEDS

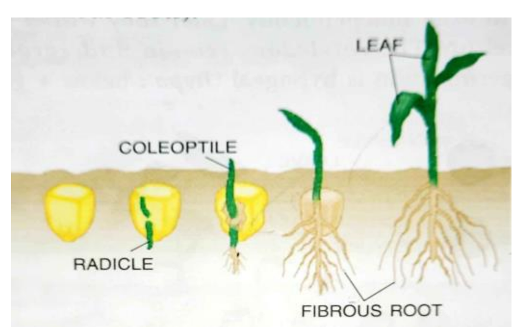


Pea seed (Hypogeal):

The Epicotyl elongates and cotyledon remains underground.



Bean seed (Epigeal): The arched hypocotyl grows forming an arch/loop above the soil, it then straightens bringing the cotyledons above the soil.



Maize grain (Hypogeal): The radicle pierces through the protective root sheath (coleorhiza) to form the root system, but it dies off soon. New roots develop from the base of the stem (adventitious roots). The hypocotyl does not elongates.

Viviparous germination - (a special type) - The mangrove plants like Rhizophora. **Vivipary** in which *seed germinates inside the fruit* while it is still attached to the parent plant.

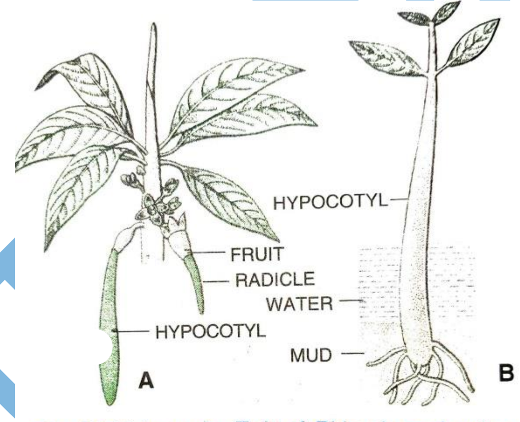


Fig. 6.8 Vivipary. A—Twig of *Rhizophora* showing viparous germination; B—Seedling growing in mud.

THE SEEDLING

Germination in any plant ends with the formation of a **seedling.**

Seedling is a stage in the growth of a plant from a seed before it has become wholly independent of the food stored in it.