

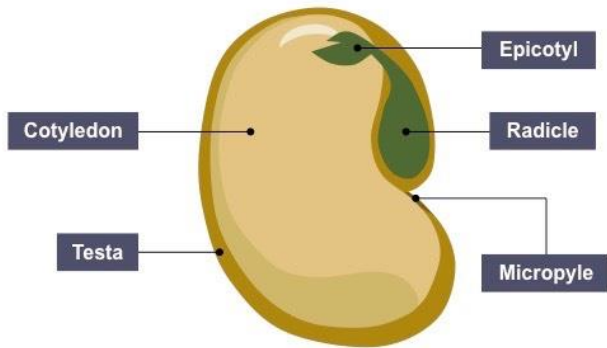


Structure of a Seed

In angiosperms, the seed is the final product of sexual reproduction. It is often described as a fertilized ovule. Seeds are formed inside fruits. A seed typically consists of seed coat(s), cotyledon(s) and an embryo axis. The cotyledons of the embryo are simple structures, generally thick and swollen due to storage of food reserves (as in legumes). Mature seeds may be non-albuminous or albuminous. Non-albuminous seeds have no residual endosperm as it is completely consumed during embryo development (e.g., pea, groundnut). Albuminous seeds retain a part of endosperm as it is not completely used up during embryo development (e.g., wheat, maize, barley, castor, sunflower). Occasionally, in some seeds such as black pepper and beet, remnants of nucellus are also persistent. This residual, persistent nucellus is the perisperm. Integuments of ovules harden as tough protective seed coats. The micropyle remains as a small pore in the seed coat. This facilitates entry of oxygen and water into the seed during germination. As the seed matures, its water content is reduced, and seeds become relatively dry (10-15 per cent moisture by mass). The general metabolic activity of the embryo slows down. The embryo may enter a state of inactivity called dormancy, or if favorable conditions are available (adequate moisture, oxygen and suitable temperature), they germinate. As ovules mature into seeds, the ovary develops into a fruit, i.e., the transformation of ovules into seeds and ovary into fruit proceeds simultaneously. The wall of the ovary develops into the wall of fruit called pericarp. The fruits may be fleshy as in guava, orange, mango, etc., or may be dry, as in groundnut, and mustard, etc. Many fruits have evolved mechanisms for dispersal of seeds.

Seeds of different plants may vary in many ways, but the basic anatomy remains the same. A typical

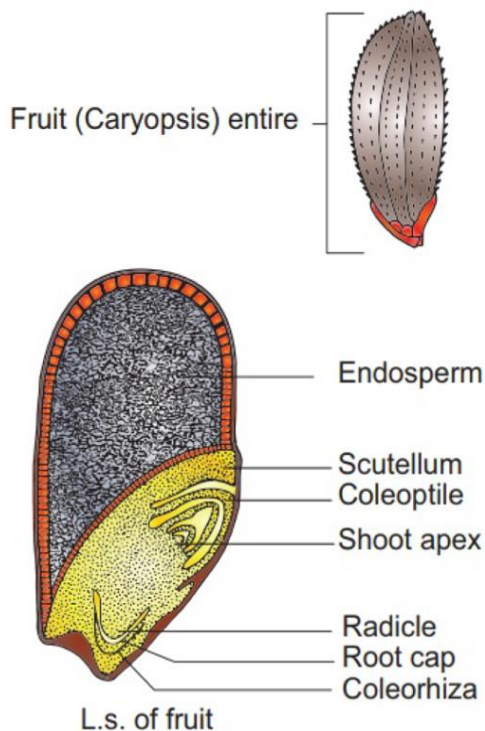
seed consists of the following parts:



Testa (seed coat): Outer protective layer of the seed, developed from the integuments of the ovule, diploid maternal tissue

- **Micropyle:** It is a tiny pore in the testa that lies on the opposite of the tip of the radicle. It permits water to enter the embryo before active germination.
- **Hilum:** Is a scar left by the stalk which attached the ovule to the ovary wall before it became a seed.
- **Cotyledon:** In some plants, this contains high quantities of starch and will provide a source of food for the developing embryo prior to germination, in other plants this role is performed by an endosperm. In monocotyledons, there is just one cotyledon whereas in dicotyledons there are two. Depending on the type of germination (epigeous or hypogeous) the cotyledons may remain below ground or be pulled above ground.
- **Radicle:** This is the embryonic root which will develop into the primary root of the plant. It is usually the first part of the embryo to push its way out of the seed during germination.
- **Plumule:** This is the embryonic shoot. It appears as a bud which will give rise to the shoot and the remaining structures in the plant.
- **Endosperm:** In many plants, a separate part for storage of starch develops and this is called the endosperm. It is seen in maize and wheat.

- **Embryo:** Young sporophyt, diploid (2n), result of fertilization. The mature embryo consists of **cotyledons (seed leaves)**, **hypocotyl** (stem-like embryonic axis below cotyledons), **radicle (embryonic root)**.
- **Endosperm:** Food storage tissue, triploid (3n), result of double fertilization, 2/3 of the genome is of maternal origin.
- **Perisperm:** Diploid maternal food storage tissue originates from the nucellus. Only in some species, e.g. *Beta vulgaris*, *Piper nigrum*, *Coffea arabica*
- **Endospermic seeds:** The endosperm is present in the mature seed and serves as food storage organ. Testa and endosperm are the two covering layers of the embryo in mature seeds. e.g. *Zea mays*
- **Non-endospermic seeds:** The cotyledons serve as sole food storage organs as in the case of pea (*Pisum sativum*). During embryo development the cotyledons absorb reserves from the endosperm. The endosperm is almost degraded in the mature seed and the embryo is



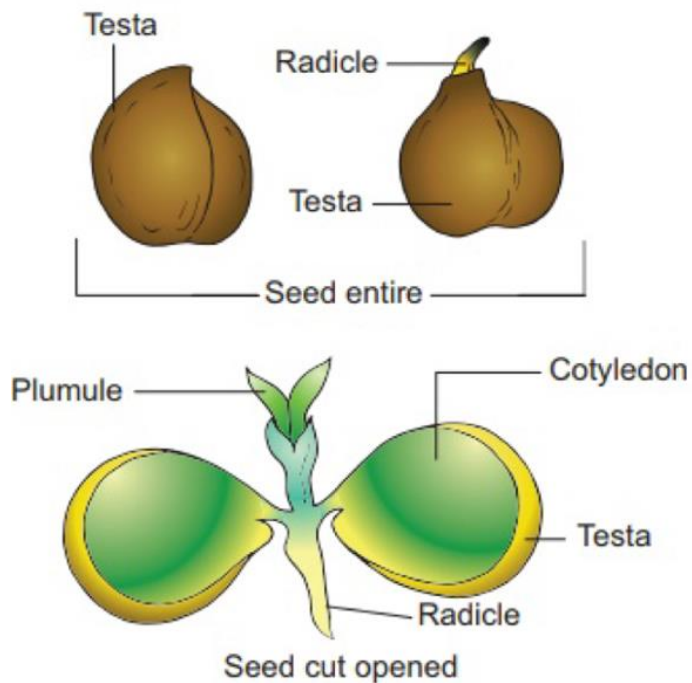
enclosed by the testa.

Structure of *Oryza* seed as an example for Monocot seed

The seed of paddy is one seeded and is called **Caryopsis**. Each seed remains enclosed by a brownish husk which consists of glumes arranged in two rows. The seed coat is a brownish, membranous layer closely adhered to the grain. Endosperm forms the bulk of the grain and is the storage tissue. It is separated

from embryo by a definite layer called **epithelium**. The embryo is small and consists of one shield-shaped cotyledon known as **scutellum** present towards lateral side of embryonal axis. A short axis with plumule and radicle protected by the **root cap** is present. The plumule is surrounded by a protective sheath called **coleoptile**. The radicle including root cap is also covered by a protective sheath called **coleorhiza**. The scutellum supplies the growing embryo with food material absorbed

from the endosperm with the help of the epithelium.



Structure of a *Cicer* seed as an example for Dicot seed

The mature seeds are attached to the fruit wall by a stalk called **funiculus**. The funiculus disappears leaving a scar called **hilum**. Below the hilum a small pore called **micropyle** is present. It

facilitates entry of oxygen and water into the seeds during germination. Each seed has a thick outer covering called seed coat. The seed coat is developed from integuments of the ovule. The outer coat is called **testa** and is hard whereas the inner coat is thin, membranous and is called **tegmen**. In Pea plant the tegmen and testa are fused. Two cotyledons laterally It stores the food materials in pea whereas in other seeds like castor the endosperm contains reserve food and the cotyledons are thin. The portion of embryonal attached to the embryonic axis are present. axis projecting beyond the cotyledons is called **radicle** or embryonic root.



References

- www.brainkart.com
- NCERT Books
- <http://www.seedbiology.de/germination.asp>

(All the figures and the write-up have been collected from the above-mentioned references)