



## CMG GardenNotes #137

# Plant Structures: Seeds

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**Outline:** Function, page 1  
Structure and Emergence, page 1  
Seed Growth and Development Terms, page 2

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A seed contains the plant embryo, nutrient tissue, and a protective cover. Most seeds contain a built-in food supply called endosperm, which is the result of a separate fertilization event within the ovule (the process of creating an embryo with its endosperm is known as *double fertilization*). The endosperm contains high amounts of carbohydrates/starch, along with proteins and lipids.

## Function

- Propagation.
- Horticultural uses.
  - Feed.
  - Food, beverages (coffee, cocoa, beer), medicine, fiber (cotton) and industrial oils and biofuels.

## Structure and Emergence

The seed of angiosperms develops as a consequence of double fertilization – development of both embryo and endosperm is required for successful seed growth. Seeds provide protection and resources for developing embryos, making them more versatile than spores for the continuation of plant species. The nutrients are primarily contained initially in endosperm; though during seed maturation the embryo itself can absorb and store the nutrients in its seed leaves, the cotyledons, before the seed becomes dormant. Still other seeds, notably those of orchids, contain very little nutritive tissue.

Externally, seeds can be differentiated and characterized by their shape, size, surface texture, placement of the *hilum* (attachment point to the mother plant, akin to a belly button), and the presence or absence of structures such as *arils* or *elaiosomes*, appendages that aid in seed dispersal.

Internally, seeds are often divided into groups based on the position of the embryo within. Growth and development of all seeds follow a standard sequence and proceed in stages including cell differentiation of the various structures, growth of the endosperm, and finally, development and growth of the embryo in preparation for germination. During germination, the embryo mobilizes its stored food reserves to quickly develop and expand the photosynthetic apparatus that will allow it to feed itself as a young plant.

After maturation and before germination, most seeds enter dormancy, a state of very low metabolic activity that allows the embryo to survive until conditions are right for germination. Some seeds can survive only a short time before needing to germinate, others, particularly of plants from stressful and unpredictable habitats, can wait decades before sprouting. Plants use many different mechanisms (and combinations of mechanisms) to prevent seeds from germinating at unpropitious times, summarized in **Table 1**.

Exogenous Factors (“Imposed” on the Embryo From the Outside)		
Type	Mechanism	Broken By
Physical	Seed coat impermeable to water.	Opening of specialized structure or scarification.
Chemical	Germination inhibitors contained in the seed coat.	Leaching with water.
Mechanical	Woody or hard structures physically impede embryo growth.	Warm and/or cold stratification.
Endogenous Factors (Inherent in the Embryo Itself)		
Physiological	“Physiological Inhibiting Mechanism” (PIM) – Biochemical restriction.	Warm and/or cold stratification.
Morphological	Underdeveloped embryo.	Appropriate conditions for embryo growth.
Morphophysiological	PIM directly influencing embryo development.	Warm and/or cold stratification.

(After from Nikolaeva, M.G. (1977) Factors controlling the seed dormancy pattern. pp. 51–74 in Khan, A.A. (Ed.) The physiology and biochemistry of seed dormancy and germination. Amsterdam, North-Holland.)

## Seed Growth and Development Terms

**Cotyledon** – Also known as the seed leaves, these are the first leaves that develop within the seed and allow the seedling to feed itself immediately following germination while it grows “true leaves.”

**Dormancy** – State of suspended growth to survive adverse conditions.

**Germination** – Sprouting of seed following exposure to correct environmental conditions for the species.

**Hypocotyl** – From the Greek, “below the cotyledon,” this is the embryonic plant stem.

**Radicle** – Embryonic plant root, often pushing through the seed coat at the beginning of germination.

**Seed Coat** – Hardened exterior protective layer of seeds, often involved in enforcing dormancy.

**Stratification** – Exposing seeds to variable temperatures in order to promote germination and growth. Cold, moist stratification is most common for plants of temperate habitats. Etymological note: “stratification” refers to the placement of the seeds in layers of growing medium in order to provide the needed germination conditions.

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