**DORMANCY**

**True dormancy or innate dormancy** is caused by conditions within the seed that prevent germination under normally ideal conditions. Often seed dormancy is divided into two major categories based on what part of the seed produces dormancy: exogenous and endogenous.[[5]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-5) There are three types of dormancy based on their mode of action: physical, physiological and morphological.[[6]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-6)

There have been a number of classification schemes developed to group different dormant seeds, but none have gained universal usage. Dormancy occurs because of a wide range of reasons that often overlap, producing conditions in which definitive categorization is not clear. Compounding this problem is that the same seed that is dormant for one reason at a given point may be dormant for another reason at a later point. Some seeds fluctuate from periods of dormancy to non dormancy, and despite the fact that a dormant seed appears to be static or inert, in reality they are still receiving and responding to environmental cues.

## Exogenous dormancy

Exogenous dormancy is caused by conditions outside the embryo and is often broken down into three subgroups:

### Physical dormancy

Dormancy caused by an impermeable seed coat is known as physical dormancy. Physical dormancy is the result of impermeable layer(s) that develops during maturation and drying of the seed or fruit.[[7]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-offord-7) This impermeable layer prevents the seed from taking up water or gases. As a result, the seed is prevented from germinating until dormancy is broken. In natural systems, physical dormancy is broken by several factors including high temperatures, fluctuating temperatures, fire, freezing/thawing, drying or passage through the digestive tracts of animals.[[8]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-8) Physical dormancy is believed to have developed >100 mya

Once physical dormancy is broken it cannot be reinstated (*i.e. the seed is unable to enter secondary dormancy following unfavourable conditions unlike seeds with physiological dormancy mechanisms*[[10]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-baskin1998-10)). Therefore, the timing of the mechanisms that breaks physical dormancy is critical and must be tuned to environmental cues. This maximises the chances for germination occurring in conditions where the plant will successfully germinate, establish and eventually reproduce.

Generally, physical dormancy is the result of one or more palisade layers in the fruit or seed coat. These layers are lignified with malpighian cells tightly packed together and impregnated with water-repellent.[[11]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-baskin2003-11) In the families Anacardiaceae and Nelumbonaceae the seed coat is not well developed. Therefore, palisade layers in the fruit perform the functional role of preventing water uptake . While physical dormancy is a common feature, several species in these families do not have physical dormancy or produce non-dormant seeds.[[9]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-baskin2000-9)

Specialised structures, which function as a "water-gap", are associated with the impermeable layers of the seed to prevent the uptake of water.[[9]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-baskin2000-9) The water-gap is closed at seed maturity and is opened in response to the appropriate environmental signal.[[11]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-baskin2003-11) Breaking physical dormancy involves the disruption of these specialised structures within the seed, and acts as an environmental signal detector for germination.[[9]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-baskin2000-9) For example, legume (Fabaceae) seeds become permeable after the thin-walled cells of lens (water-gap structure).[[11]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-baskin2003-11) Following disrupted pulls apart to allow water entry into the seed.Other water gap structures include carpellary micropyle, bixoid chalazal plug, imbibition lid and the suberised 'stopper'.[[14]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-14)[[15]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-15)[[16]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-16)[[17]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-17)

In nature, the seed coats of physically dormant seeds are thought to become water permeable over time through repeated heating and cooling over many months-years in the soil seedbank.[[7]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-offord-7) For example, the high and fluctuating temperatures during the dry season in northern Australia promote dormancy break in impermeable seeds of *Stylosanthes humilis* and *S.hamata* (Fabaceae).[[11]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-baskin2003-11)

### Mechanical dormancy

Mechanical dormancy when seed coats or other coverings are too hard to allow the embryo to expand during germination.[[18]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-18) In the past this mechanism of dormancy was ascribed to a number of species that have been found to have endogenous factors for their dormancy instead. These endogenous factors include low embryo growth potential.[[19]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-rtbg.tas.gov.au-19)

### Chemical dormancy

Includes growth regulators etc., that are present in the coverings around the embryo. They may be leached out of the tissues by washing or soaking the seed, or deactivated by other means. Other chemicals that prevent germination are washed out of the seeds by rainwater or snow melt.

## Endogenous dormancy

Endogenous dormancy is caused by conditions within the embryo itself, and it is also often broken down into three subgroups: physiological dormancy, morphological dormancy and combined dormancy, each of these groups may also have subgroups.

### Physiological dormancy

Physiological dormancy prevents embryo growth and seed germination until chemical changes occur. Physiological dormancy is indicated when an increase in germination rate occurs after an application of [gibberellic acid](https://en.wikipedia.org/wiki/Gibberellic_acid) (GA3) or after Dry after-ripening or dry storage. It is also indicated when dormant seed embryos are excised and produce healthy seedlings: or when up to 3 months of cold (0–10 °C) or warm (=15 °C) stratification increases germination: or when dry after-ripening shortens the cold stratification period required. In some seeds physiological dormancy is indicated when scarification increases germination.[[20]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-20)

Physiological dormancy is broken when inhibiting chemicals are broken down or are no longer produced by the seed; often by a period of cool moist conditions, normally below (+4C) 39F, or in the case of many species in [*Ranunculaceae*](https://en.wikipedia.org/wiki/Ranunculaceae) and a few others,(−5C) 24F. [Abscisic acid](https://en.wikipedia.org/wiki/Abscisic_acid) is usually the growth inhibitor in seeds and its production can be affected by light. Some plants like [Peony](https://en.wikipedia.org/wiki/Peony) species have multiple types of physiological dormancy, one affects radicle (root) growth while the other affects plumule (shoot) growth.

* **Drying**; some plants including a number of grasses and those from seasonally arid regions need a period of drying before they will germinate, the seeds are released but need to have a lower moisture content before germination can begin. If the seeds remain moist after dispersal, germination can be delayed for many months or even years. Many herbaceous plants from temperate climate zones have physiological dormancy that disappears with drying of the seeds.
* **Photodormancy** or light sensitivity affects germination of some seeds. These photoblastic seeds need a period of darkness or light to germinate. In species with thin seed coats, [light](https://en.wikipedia.org/wiki/Light) may be able to penetrate into the dormant embryo. The presence of light or the absence of light may trigger the germination process, inhibiting germination in some seeds buried too deeply or in others not buried in the soil.
* **Thermodormancy** is seed sensitivity to heat or cold. Some seeds including [cocklebur](https://en.wikipedia.org/wiki/Cocklebur) and [amaranth](https://en.wikipedia.org/wiki/Amaranth) germinate only at high temperatures (30C or 86F). Many plants that have seeds that germinate in early to mid summer have thermodormancy and germinate only when the soil temperature is warm. Other seeds need cool soils to germinate, while others like celery are inhibited when soil temperatures are too warm. Often thermodormancy requirements disappear as the seed ages or dries.

Seeds are classified as having deep physiological dormancy under these conditions: applications of GA3 does not increase germination; or when excised embryos produce abnormal seedlings; or when seeds require more than 3 months of cold stratification to germinate.

### Morphological dormancy

In morphological dormancy, the embryo is underdeveloped or undifferentiated. Some seeds have fully differentiated embryos that need to grow more before seed germination, or the embryos are not differentiated into different tissues at the time of fruit ripening.

* Immature embryos – some plants release their seeds before the tissues of the embryos have fully differentiated, and the seeds ripen after they take in water while on the ground, germination can be delayed from a few weeks to a few months.

### Combined dormancy

These seeds have both morphological and physiological dormancy.

* **Morpho-physiological** or **morphophysiological dormancy** occurs when seeds with underdeveloped embryos, also have physiological components to dormancy. These seeds therefore require dormancy-breaking treatments as well as a period of time to develop fully grown embryos.
* Intermediate simple
* Deep simple
* Deep simple epicotyl
* Deep simple double
* Intermediate complex
* Deep complex

## Combinational dormancy

Combinational dormancy occurs in some seeds, where dormancy is caused by both exogenous (physical) and endogenous (physiological) conditions.[[21]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-21)[[22]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-22)[[23]](https://en.wikipedia.org/wiki/Seed_dormancy#cite_note-23) Some [*Iris*](https://en.wikipedia.org/wiki/Iris_%28plant%29) species have both hard impermeable seeds coats and physiological dormancy.

## Secondary dormancy

Secondary dormancy occurs in some non-dormant and post dormant seeds that are exposed to conditions that are not favorable for germination, like high temperatures. It is caused by conditions that occur after the seed has been dispersed. The mechanisms of secondary dormancy are not yet fully understood but might involve the loss of sensitivity in receptors in the plasma membrane.

Not all seeds undergo a period of dormancy, many species of plants release their seeds late in the year when the soil temperature is too low for germination or when the environment is dry. If these seeds are collected and sown in an environment that is warm enough, and/or moist enough, they will germinate. Under natural conditions non dormant seeds released late in the growing season wait until spring when the soil temperature rises or in the case of seeds dispersed during dry periods until it rains and there is enough soil moisture.

Seeds that do not germinate because they have fleshy fruits that retard germination are quiescent, not dormant

Many garden plants have seeds that will germinate readily as soon as they have water and are warm enough, though their wild ancestors had dormancy. These cultivated plants lack seed dormancy because of generations of selective pressure by plant breeders and gardeners that grew and kept plants that lacked dormancy.

Seeds of some [mangroves](https://en.wikipedia.org/wiki/Mangrove) are viviparous and begin to germinate while still attached to the parent; they produce a large, heavy root, which allows the seed to penetrate into the ground when it falls.

#### Effects on Seed Dormancy:

**i. Influence of parental environment on seed dormancy:**

The germination characteristics of a seed are laid down during the course of its development, and it is not surprising to find that the environmental conditions experienced by the parent plant during seed maturation can strongly influence the degree and type of dormancy in the seed.

Harrington and Thompson (1952) found that germ inability was inversely proportional the mean temperature of the parents’ growing conditions during the 30 days before seeds harvest.

The day length experienced by the parent plant (especially during the last few days of seed maturation) also affects dormancy in certain species. This has been extensively studied in desert annuals by Gutterman (1982). In le species studied there is a clear relationship between day length and germ inability.

**ii. Influence of seed position in plant on seed dormancy:**

The germination behaviour of seeds from the same parent is often correlated with their position in the inflorescence of the parent plant. In some case the plant may produce two or more distinct types of seeds which different from each either in size, shape and colour, as well as in their requirement for germination.

This phenomenon-Polymorphism, is part: particularly well developed in certain families such as the Asteraceae, the Chenopodiaceae md the Poaceae.

Seed polymorphismis most common in arid zone plants. In these plants occurrence of differences in seed shape, colour, size and weight have been reported. The variations in colour, size and weight of seeds are controlled by the genetic constitution.

The seed polymorphism is very common in Crotalaria medicaginea, Indigofera tinctoria, Euphorbia caducifolia, Tephrosia purpurea, Cenchrus spp. etc.

It is possible that many species whose seeds are not visibly polymorphic may have seeds which are at least physiologically polymorphic n their germination requirements.

The physiological mechanism involved in both morphological and physiological polymorphism would have the effect of broadening the range of conditions which the population can exploit for regeneration.

Differences in germinating behaviour between seeds from an individual parent plant may be due to variations in the microenvironments experienced by seeds in different parts of an inflorescence.

The seeds once germinated have lost all resistance against drought. This is true not only for desert seeds but also for seeds from plants from temperate regions. Thus, in arid zone seeds prevented from germinating by being buried too deep may retain their viability for scores of years.

An arid zone seed which has inhibitors may not germinate. But as lin­seeds become older the inhibitor activity decreases; at the same time the mechanical strength of the seed coat decreases.