26.1C: Evolution of Angiosperms

Angiosperms, which evolved in the Cretaceous period, are a diverse group of plants which protect their seeds within an ovary called a fruit.

Learning Objectives

• Discuss the evolution and adaptations of angiosperms

Key Points

• Angiosperms evolved during the late Cretaceous Period, about 125-100 million years ago.
• Angiosperms have developed flowers and fruit as ways to attract pollinators and protect their seeds, respectively.
• Flowers have a wide array of colors, shapes, and smells, all of which are for the purpose of attracting pollinators.
• Once the egg is fertilized, it grows into a seed that is protected by a fleshy fruit.
• As angiosperms evolved in the Cretaceous period, many modern groups of insects also appeared, including pollinating insects that drove the evolution of angiosperms; in many instances, flowers and their pollinators have coevolved.
• Angiosperms did not evolve from gymnosperms, but instead evolved in parallel with the gymnosperms; however, it is unclear as to what type of plant actually gave rise to angiosperms.

Key Terms

• clade: a group of animals or other organisms derived from a common ancestor species
• **angiosperm**: a plant whose ovules are enclosed in an ovary
• **basal angiosperm**: the first flowering plants to diverge from the ancestral angiosperm, including a single species of shrub from New Caledonia, water lilies and some other aquatic plants, and woody aromatic plants

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**Evolution of Angiosperms**

Undisputed fossil records place the massive appearance and diversification of angiosperms in the middle to late Mesozoic era. Angiosperms ("seed in a vessel") produce a flower containing male and/or female reproductive structures. Fossil evidence indicates that flowering plants first appeared in the Lower Cretaceous, about 125 million years ago, and were rapidly diversifying by the Middle Cretaceous, about 100 million years ago. Earlier traces of angiosperms are scarce. Fossilized pollen recovered from Jurassic geological material has been attributed to angiosperms. A few early Cretaceous rocks show clear imprints of leaves resembling angiosperm leaves. By the mid-Cretaceous, a staggering number of diverse, flowering plants crowd the fossil record. The same geological period is also marked by the appearance of many modern groups of insects, including pollinating insects that played a key role in ecology and the evolution of flowering plants.

![Fossil evidence of angiosperms](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/26%3A_S...)

**Figure (PageIndex(1))**: Fossil evidence of angiosperms: This leaf imprint shows a Ficus speciosissima, an angiosperm that flourished during the Cretaceous period. A large number of pollinating insects also appeared during this same time.

Although several hypotheses have been offered to explain this sudden profusion and variety of flowering plants, none
have garnered the consensus of paleobotanists (scientists who study ancient plants). New data in comparative genomics and paleobotany have, however, shed some light on the evolution of angiosperms. Rather than being derived from gymnosperms, angiosperms form a sister clade (a species and its descendents) that developed in parallel with the gymnosperms. The two innovative structures of flowers and fruit represent an improved reproductive strategy that served to protect the embryo, while increasing genetic variability and range. Paleobotanists debate whether angiosperms evolved from small woody bushes, or were basal angiosperms related to tropical grasses. Both views draw support from cladistic studies. The so-called woody magnoliid hypothesis (which proposes that the early ancestors of angiosperms were shrubs) also offers molecular biological evidence.

The most primitive living angiosperm is considered to be *Amborellatrichopoda*, a small plant native to the rainforest of New Caledonia, an island in the South Pacific. Analysis of the genome of *A. trichopoda* has shown that it is related to all existing flowering plants and belongs to the oldest confirmed branch of the angiosperm family tree. A few other angiosperm groups, known as basal angiosperms, are viewed as primitive because they branched off early from the phylogenetic tree. Most modern angiosperms are classified as either monocots or eudicots based on the structure of their leaves and embryos. Basal angiosperms, such as water lilies, are considered more primitive because they share morphological traits with both monocots and eudicots.

**Flowers and Fruits as an Evolutionary Adaptation**

Angiosperms produce their gametes in separate organs, which are usually housed in a flower. Both fertilization and embryo development take place inside an anatomical structure that provides a stable system of sexual reproduction largely sheltered from environmental fluctuations. Flowering plants are the most diverse phylum on Earth after insects; flowers come in a bewildering array of sizes, shapes, colors, smells, and arrangements. Most flowers have a mutualistic pollinator, with the distinctive features of flowers reflecting the nature of the pollination agent. The relationship between pollinator and flower characteristics is one of the great examples of coevolution.

![Coevolution of flowers and pollinators](https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/26%3A_S...)

Figure 1: **Coevolution of flowers and pollinators**: Many flowers have coevolved with particular pollinators, such that the flower is uniquely structured for the mouthparts of the pollinator. It often has features considered attractive to its particular pollinator.

Following fertilization of the egg, the ovule grows into a seed. The surrounding tissues of the ovary thicken, developing...
into a fruit that will protect the seed and often ensure its dispersal over a wide geographic range. Not all fruits develop from an ovary; such structures are “false fruits.” Like flowers, fruit can vary tremendously in appearance, size, smell, and taste. Tomatoes, walnut shells and avocados are all examples of fruit. As with pollen and seeds, fruits also act as agents of dispersal. Some may be carried away by the wind. Many attract animals that will eat the fruit and pass the seeds through their digestive systems, then deposit the seeds in another location. Cockleburs are covered with stiff, hooked spines that can hook into fur (or clothing) and hitch a ride on an animal for long distances. The cockleburs that clung to the velvet trousers of an enterprising Swiss hiker, George de Mestral, inspired his invention of the loop and hook fastener he named Velcro.

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