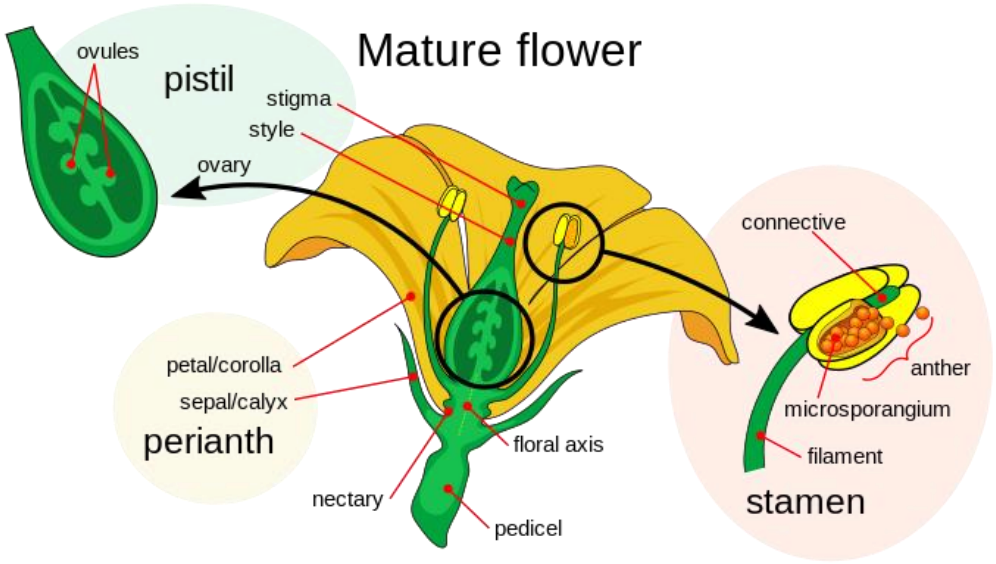
Flower Structure

A **flower**, also known as a **bloom** or **blossom**, is the reproductive structure found in flowering plants. Flowers consist of a combination of vegetative organs – **sepals** that enclose and protect the developing flower, **petals** that attract pollinators, and reproductive organs that produce gametophytes, which in flowering plants produce gametes. The male gametophytes, which produce sperm, are enclosed within pollen grains produced in the anthers. The female gametophytes are contained within the ovules produced in the carpels.



Most flowering plants depend on animals, such as bees, moths, and butterflies, to transfer their pollen between different flowers, and have evolved to attract these pollinators by various strategies, including brightly colored, conspicuous petals, attractive scents, and the production of nectar, a food source for pollinators. In this way, many flowering plants have co-evolved with pollinators to be mutually dependent on services they provide to one another in the plant's case, a means of reproduction; in the pollinator's case, a source of food.

When pollen from the anther of a flower is deposited on the stigma, this is called **pollination**. Some flowers may self-pollinate, producing seed using pollen from a different flower of the same plant, but others have mechanisms to prevent self-pollination and rely on **cross-pollination**, when pollen is transferred from the anther of one flower to the stigma of another flower on a different individual of the same species. **Self-pollination** happens in flowers where the stamen and carpel mature at the same time, and are positioned so that the pollen can land on the flower's stigma. This pollination does not require an investment from the plant to provide nectar and pollen as food for pollinators. Some flowers produce diaspores without fertilization (**parthenocarpy**). After fertilization, the ovary of the flower develops into fruit containing seeds.

Flowers have long been appreciated by humans for their beauty and pleasant scents, and also hold cultural significance as religious, ritual, or symbolic objects, or sources of medicine and food.

Morphology

The morphology of a flower, or its form and structure, can be considered in two parts: the vegetative part, consisting of non-reproductive structures such as petals; and the reproductive or sexual parts. A stereotypical flower is made up of four kinds of structures attached to the tip of a short stalk or axis, called a **receptacle**. Each of these parts or floral organs is arranged in a spiral called a **whorl**. The four main whorls (starting from the base of the flower or lowest node and working upwards) are the calyx, corolla, androecium, and gynoecium. Together the calyx and corolla make up the non-reproductive part of the flower called the **perianth**, and in some cases may not be differentiated. If this is the case, then they are described as **tepals**.

Perianth

Calyx:

The sepals, collectively called the calyx, are modified leaves that occur on the outermost whorl of the flower. They are leaf-like, in that they have a broad base, stomata, stipules, and chlorophyll. Sepals are often waxy and tough, and grow quickly to protect the flower as it develops. They may be deciduous, but will more commonly grow on to assist in fruit dispersal. If the calyx is fused together it is called **gamosepalous**.

Corolla:

The petals, together the corolla, are almost or completely fiberless leaf-like structures that form the innermost whorl of the perianth. They are often delicate and thin, and are usually coloured, shaped, or scented to encourage pollination. Although similar to leaves in shape, they are more comparable to stamens in that they form almost simultaneously with one another, but their subsequent growth is delayed. If the corolla is fused together it is called **sympetalous**.

Androecium:

The androecium, or stamens, is the whorl of pollen-producing male parts. Stamens consist typically of an anther, made up of four pollen sacs arranged in two thecae, connected to a filament, or stalk. The anther contains microsporocytes which become pollen, the male gametophyte, after undergoing meiosis. Although they exhibit the widest variation among floral organs, the androecium is usually confined just to one whorl and to two whorls only in rare cases. Stamens range in number, size, shape, orientation, and in their point of connection to the flower.

In general there is only one type of stamen, but there are plant species where the flowers have two types; a "normal" one and one with anthers that produce sterile pollen meant to attract pollinators.

Gynoecium:

The gynoecium, or the carpels, is the female part of the flower found on the innermost whorl. Each carpel consists of a stigma, which receives pollen, a style, which acts as a stalk, and an ovary, which contains the ovules. Carpels may occur in one to several whorls, and when fused together are often described as a pistil. Inside the ovary, the ovules are attached to the placenta by structures called **funiculi**.

Variation:

Although this arrangement is considered "typical", plant species show a wide variation in floral structure. The four main parts of a flower are generally defined by their positions on the receptacle and not by their function. Many flowers lack some parts or parts may be modified into other functions or look like what is typically another part. In some families, such as the grasses, the petals are greatly reduced; in many species, the sepals are colorful and petal-like. Other flowers have modified stamens that are petal-like; the double flowers of Peonies and Roses are mostly petaloid stamens.

Flowers may be directly attached to the plant at their base (sessile—the supporting stalk or stem is highly reduced or absent). The stem or stalk subtending a flower, or an inflorescence of flowers, is called a peduncle. If a peduncle supports more than one flower, the stems connecting each flower to the main axis are called pedicels. The apex of a flowering stem forms a terminal swelling which is called the torus or receptacle.

In the majority of species, individual flowers have both pistils and stamens. These flowers are described by botanists as being perfect,

bisexual, or hermaphrodite. In some species of plants, the flowers are imperfect or unisexual: having only either male (stamens) or female (pistil) parts. If unisexual male and female flowers appear on the same plant, the species is called monoecious. However, if an individual plant is either female or male, the species is called dioecious. Many flowers have nectaries, which are glands that produce a sugary fluid used to attract pollinators. They are not considered as an organ on their own.

Inflorescence

In those species that have more than one flower on an axis, the collective cluster of flowers is called an **inflorescence**. Some inflorescences are composed of many small flowers arranged in a formation that resembles a single flower. A common example of this is most members of the very large composite (Asteraceae) group. A single daisy or sunflower, for example, is not a flower but a flower head, an inflorescence composed of numerous flowers (or florets). An inflorescence may include specialized stems and modified leaves known as bracts.

Development

A flower develops on a modified shoot or *axis* from a determinate apical meristem (*determinate* meaning the axis grows to a set size). It has compressed internodes, bearing structures that in classical plant morphology are interpreted as highly modified leaves. Detailed developmental studies, however, have shown that stamens are often initiated more or less like modified stems (caulomes) that in some cases may even resemble branchlets. Taking into account the whole diversity in the development of the androecium of flowering plants, we find a continuum between modified leaves (phyllomes), modified stems (caulomes), and modified branchlets (shoots).

Transition

The transition to flowering is one of the major phase changes that a plant makes during its life cycle. The transition must take place at a time that is favorable for fertilization and the formation of seeds, hence ensuring maximal reproductive success. To meet these needs a plant is able to interpret important endogenous and environmental cues such as changes in levels of plant hormones and seasonable temperature and photoperiod changes.

Many perennial and most biennial plants require **"Vernalization"** to flower. The molecular interpretation of these signals is through the transmission of a complex signal known as **"Florigen"**, Florigen is produced in the leaves in reproductively favorable conditions and acts in buds and growing tips to induce a number of different physiological and morphological changes.

The first step of the transition is the transformation of the vegetative stem primordia into floral primordia. This occurs as biochemical changes take place to change cellular differentiation of leaf, bud and stem tissues into tissue that will grow into the reproductive organs. Growth of the central part of the stem tip stops or flattens out and the sides develop protuberances in a whorled or spiral fashion around the outside of the stem end. These protuberances develop into the sepals, petals, stamens, and carpels. Once this process begins, in most plants, it cannot be reversed and the stems develop flowers, even if the initial start of the flower formation event was dependent of some environmental signal.