From Sweet Reward to Artful Deception: Flower Adaptations to Lure Pollinators

Genetic diversity is a vital component in the overall health and survival of a species. When this diversity decreases, genetic abnormalities become more prevalent and the species is less able to adapt to environmental changes. In wild plants, genetic diversity is maintained when plants cross-pollinate that is, when the pollen from a flower on one plant fertilizes a flower on a different plant.

Of course plants can't travel about looking for a mate. About 80% of flowering plants depend on a pollinator — bee, butterfly, fly, wasp, bat, bird, etc. — to transfer the pollen that will fertilize their flowers and result in genetically diverse seeds and new plants. Flowers and pollinators have coevolved over countless millennia, resulting in a variety of floral adaptations to maximize the chance of pollination. And some species have evolved remarkably complex strategies to attract pollinators to act as pollen couriers.

Sweet and Simple

Many flowers produce sweet nectar, luring pollinators to stop for a sip and, in the process, the pollinators inadvertently end up with some of the flower's sticky pollen on their bodies. When they visit the next flower for another sip, they transfer the pollen.

Flowers advertise their sweet rewards in a number of ways, including visual cues, (colors, patterns, shapes, sizes) and scent. Learn more about flower shapes and scents and the pollinators they attract: *Choosing Flowers to Welcome a Diversity of Pollinators.*

Open-Door vs. Secret Handshake

The flowers of some plant species have an "open door policy" and have evolved to attract a wide variety of pollinators — bees, butterflies, beetles, wasps, etc. These flowers usually have abundant nectar and pollen, and a welcoming shape that invites any and all pollinators to visit, in the "hopes" that that at least some of the pollinators will carry the pollen to nearby receptive kin. Scientists have described these flowers as *promiscuous*.

Others are more specialized. These plants have coevolved in a way that requires a specific pollinator to transfer their pollen. These "secret handshake required" flowers may emit a certain scent, or offer barriers to insects that aren't "their" pollinators. Some orchids fall into this category, as does the yucca, which can only be pollinated by yucca moths.

The Art of Deception

Some species of plants have a few other "tricks up their sleeve." After all, pollinators don't work for free. That is, they don't visit flowers in order to pollinate them; most do so to consume the flowers' nectar. However, it takes resources for a plant to produce nectar, so some species forego nectar production, and instead deceive insects into pollinating their flowers — with no nectar reward.

Mimicry: The sight and scent of decay. Some plants that rely on flies for pollination have dark red flowers with a scent similar to decaying flesh. The flies visit the flowers and lay their eggs in order to provide the hatched larvae with a meal of rotting flesh. The flies inadvertently transfer pollen among flowers (and the flies' larvae go hungry). Examples include pawpaws and red trillium.

Entrapment: Lured by the sweet smell of nectar. Lady's slipper orchids emit a nectar-like scent that invites insects, including bees and flies, to enter the pouch for a closer look. Once inside, the insect finds itself on a slippery slope, heading toward the bottom of the "slipper." Once there, the hapless insect finds that not only is there no nectar, but also that downward-facing hairs prevent it from climbing back out. The only exit is to crawl under the flower's stigma, where any pollen from a previous lady slipper encounter is deposited. Then on its way out, it brushes past the anthers, collecting more pollen before exiting.

Come Hither: Luring insects with a potential mate. Trickery is taken to the extreme by some orchids. To lure specific male insect pollinators, some orchid species' flowers bear a remarkable resemblance to the female of his species. To seal the deal, the flower also emits an aroma that mimics the scent of a fertile female. The male insect attempts to mate with the flower, picking up pollen in the process. Then it's off to the next "fertile" flower to mate with.

Maximizing Cross-Fertilization, Minimizing Inbreeding

Adaptations of "perfect" flowers. Consider that the majority of angiosperms (flowering plants) have perfect flowers; that is, they contain both male and female reproductive structures. How do these plants reduce the likelihood that their flowers will self-pollinate which would decrease genetic diversity of their progeny? They have evolved mechanisms for self-incompatibility.

- Shape. The architecture of a flower may include a barrier to prevent its pollen from reaching its own stigma.

- Chemical. Cellular responses can prohibit a flower's own pollen from achieving fertilization by inhibiting pollen tube growth. The flower can recognize and reject pollen from its own anthers vs. pollen from a neighboring plant!

- Timing. Avocado flowers are perfect (have both male and female parts). When the flower opens, it's essentially female: only the pistil is mature and ready to receive pollen from a different plant. After a few hours, the flower closes. Later or the next day, it reopens, and now it's the male stamens that are mature and ready to shed their pollen; the stigma is closed for business.

Some plants with perfect flowers *can* self-pollinate. This acts as an insurance policy: If cross-pollination doesn't occur, the flower can pollinate itself.

An "imperfect" pollination strategy. Some plants reduce the likelihood of self-fertilization by having *imperfect flowers*: they contain either male or female reproductive structures, but not both. Squash, cucumber, and begonia all bear separate male and female flowers. This obviously makes self-fertilization of an individual flower impossible, and it also increases the likelihood that pollinators will transfer pollen to surrounding plants.

Plants with male and female flowers on separate plants. Some plants have taken what seems like a giant evolutionary adaptation: the entire plant is either male or female. These plants are termed *dioecious*. For example, if you want a berry-covered holly bush, you'll need to buy a female plant (which will bear the berries) and a compatible male plant to pollinate its flowers (no berries on him, though). Other dioecious plants include winterberry, asparagus, persimmon, kiwi, and hops.

An Evolutionary Wonder: Flowers That Never Open

As fascinating as the dioecious plants mentioned above are the pretty flowering plant family of violas. Many species produce two distinct types of flowers. Some of their flowers open fully in hopes of cross-pollination, while other flowers on the same plant never open — precluding even the possibility of cross-pollination. This adaptation is called *cleistogamy* and is another form of insurance. Although cross pollination is preferred, should that fail, the closed flowers, which self-pollinate, ensure the next generation. Other examples of plants exhibiting this feature include peanuts and peas.