Pollination is the act of transferring pollen grains from the male anther of a flower to the female stigma. The goal of every living organism, including plants, is to create offspring for the next generation. One of the ways that plants can produce offspring is by making seeds which contain the genetic information to produce a new plant. Flowers are the tools that plants use to make their seeds and these can only be produced when pollen is transferred between flowers of the same species. A species is defined as a population of individuals capable of interbreeding freely with one another but because of geographic, reproductive, or other barriers, they do not interbreed with members of other species.

How does pollen get from one flower get from one flower to another? Flowers must rely on vectors to move pollen. These vectors can include wind, water, birds, insects, butterflies, bats, and other animals that visit flowers. We call animals that transfer pollen from plant to plant "pollinators."

Pollination is usually the unintended consequence of an animal's activity on a flower. The pollinator is often eating or collecting pollen for its protein and other nutritional characteristics or it is sipping nectar from the flower when pollen grains attach themselves to the animal's body. When the animal visits another flower, pollen can fall off onto the flower's stigma and may result in successful fertilization. Once on the stigma, pollen may "germinate," which means that a "pollen tube" forms on the sticky surface of the stigma and grows down into the ovule of the plant.
This growth can result in:

- Successful fertilization of the flower and the growth of seeds and fruit; or,
- A plant can be only partially fertilized, in which the fruit and/or seeds do not fully develop; or,
- The plant can completely fail to be pollinated, and may not reproduce at all.

Plants can be:

- **Self-pollinating** - the plant can fertilize itself; or,
- **Cross-pollinating** - the plant needs a vector (a pollinator or the wind) to get the pollen to another flower of the same species.

Pollination is not just fascinating natural history. It is an essential ecological survival function. Without pollinators, the human race and all of earth's terrestrial ecosystems would not survive. Almost 80% of the 1,400 crop plants grown around the world that produce all of our food and plant-based industrial products require pollination by animals.
http://www.fs.fed.us/wildflowers/pollinators

Bees are well-documented pollinators in both natural and agricultural systems. A wide range of crops including peaches, strawberries, watermelon, and cauliflower are just a few plants that benefit from bee pollination. Most of us are familiar with the colonies of honey bees that have been the workhorses of agricultural pollination for years in the United States. They were imported from Europe almost 400 years ago. But there are nearly 4,000 species of *native* bees in the U.S. Some form colonies while others live and work a solitary life. Native bees currently pollinate many crops and can be encouraged to do more to support agricultural endeavors if their needs for nesting habitat are met and if suitable sources of nectar, pollen, and water are provided.

Bumble bees (*Bombus* spp.) form small colonies usually underground. They are generalists, feeding on a wide range of plant material from February to November and are important pollinators of tomatoes. Solitary bees include carpenter bees (*Xylocopa* spp.) which nest in wood, digger or polyester bees (*Colletes* spp.) and sweat bees (family *Halictidae*) which nest underground, leafcutter bees (*Megachile* spp.) which prefer dead trees or branches for their nest sites, and mason bees (*Osmia* spp.) which utilize cavities that they find in stems and dead wood. Bees have tongues of varying lengths that help determine from which flowers they can obtain nectar and pollen.

Butterflies are diurnal and visit a variety of wildflowers. They are less efficient than bees at moving pollen between plants. Highly perched on their long thin legs, they do not pick up much pollen on their bodies and lack specialized structures for collecting it. Butterflies probe for nectar, their flight fuel, and typically favor the flat, clustered flowers that provide a landing pad and abundant rewards. Butterflies have good vision but a weak sense of smell. Unlike bees, butterflies can see red.

To encourage butterflies and other pollinators to frequent a habitat, (a) provide from spring through fall a variety of flowering plants where they have full sun and protection from the wind: (b) provide open areas (e.g. bare earth, large stones) where they can bask, and moist soil from which they can "puddle" to get needed minerals; and (c) provide host plants that provide food for the larval stage. Numerous trees, shrubs, and herbaceous plants support butterfly populations. Avoid the use of pesticides and incorporate conservation practices such as xeriscaping and the use of native plants.
http://www.eealliance.org/pollinator-habitat-certification-program

Although the majority of adult moths do not feed, some **moths** are significant pollinators such as members of the Sphingidae (sphinx or hawk moth) and Noctuidae (owlets, cutworms, and underwings) families. Although these crepuscular or nocturnal Lepidoptera are seldom seen, they are vital to the success of such plants as moonflower

(Calonyction aculeatum), bouncing bet (*Saponaria officinalis*), and white campion (*Lychnis alba*), pollinating many of our most fragrant flowers, e.g., narcissus, gardenia, and jasmine.

Beetles comprise the largest set of pollinating animals, due to sheer numbers. They are responsible for pollinating 88% of the 240,000 flowering plants globally. Beetles were among the first insects to visit flowers and they remain essential pollinators today. They are especially important for ancient species such as magnolias and spicebush. Beetles will eat their way through petals and other floral parts and even defecate within flowers, earning them the nickname "mess and soil" pollinators.

Recent research indicates that **flies** primarily pollinate small flowers that bloom under shade and in seasonally moist habitats. The National Research Council's *Status of Pollinators in North America* study states that flies are economically important as pollinators for a range of annual and bulbous ornamental flowers. Plants pollinated by the fly include the American pawpaw (*Asimina triloba*), dead horse arum (*Helicodiceros muscivorus*), skunk cabbage (*Symplocarpus foetidus*), goldenrod (*Solidago* spp.), and members of the carrot family like Queen Anne's lace (*Daucus carota*). www.pollinator.org/guides.htm

In the continental United States, **hummingbird**s are essential to wildflower pollination and White-winged dove (*Zenaida asiatica*) is a pollinator of the saguaro cactus (*Carnegeia gigantea*). In other areas of the world, honeycreepers (Hawaii) and honeyeaters (Australia), brush-tongued parrots (New Guinea) and sunbirds (Old World tropics) serve as tropical pollen vectors. There are 2,000 bird species globally that feed on nectar, the insects, and the spiders associated with nectar bearing flowers.

Though the **bats** in Georgia are not pollinators, bats do play an important role in pollination in the other regions such as the southwest U. S. where they feed on agave and cactus. The long-nosed bats' head shape and long tongue allows it to delve into flower blossoms and extract both pollen and nectar.

The interactions of animal pollinators and plants have influenced the evolution of both groups of organisms. A mutualistic relationship between the pollinator and the plant species helps the pollinator find necessary pollen and nectar sources and helps the plant reproduce by ensuring that pollen is carried from one flower to another.

"Pollinator Syndromes" describe flower characteristics, or traits, that may appeal to a particular type of pollinator. Such characteristics can be used to predict the type of pollinator that will aid the flower in successful reproduction. A combination of color, odor, quantity of nectar, location and type of pollen, and flower structure can each affect a potential pollinator's ability to locate a flower and its food resources.

Trait	Bat	Bee	Beetle	Bird	Butterfly	Fly	Moth	Wind
Color	White, green or purple	Bright white, yellow, blue, or UV	White or green	Scarlet, orange, red, or white	Bright red and purple	Pale, or dark brown, purple	Pale red, purple, pink, or white	Pale green, brown, or colorless
Nectar Guides	None	Present	None	None	Present	None	None	None
Odor	Strong and musty; emitted at night	Fresh, mild, pleasant	None to strongly fruity or foul	None	Faint but fresh	Putrid	Strong sweet; emitted at night	None
Nectar	Abundant; somewhat hidden	Usually present	Sometimes present	Ample; deeply hidden	Ample; deeply hidden	Usually absent	Ample; deeply hidden	None
Pollen	Ample	Limited; often sticky, scented	Ample	Limited	Limited	Limited	Limited	Abundant; small, smooth
Flower Shape	Bowl-shaped; closed during day	Shallow; with landing platform; tubular	Large and bowl-shaped	Large; funnel-like; strong perch support	Narrow tube with spur; wide landing pad	Shallow; funnel-like or complex with trap	Regular; tubular without a lip	Regular and small

www.pollinator.org/Resources/Pollinator_Syndromes.pdf