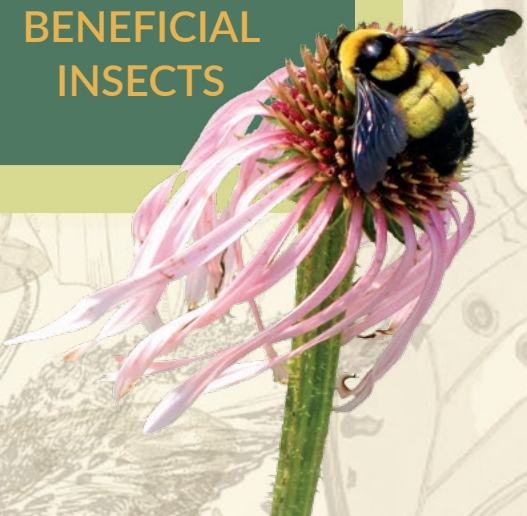
POLLINATORS IN IOWA

A Guide to BEES, BUTTERFLIES, MOTHS and BENEFICIAL INSECTS



Development of this guide was made possible through
funding provided by the Iowa Living Roadway Trust Fund

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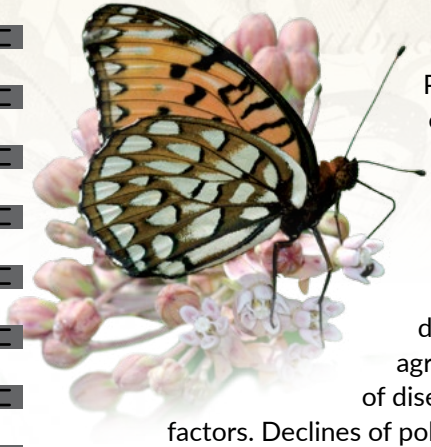
We Need Pollinators and Pollinators Need Our Help



Pollinators are an indispensable part of our lives, important for our diet and for the health of plants and wildlife. However, wild pollinators such as monarch butterflies and many bumble bee species, as well as colonies of managed honey bees, are experiencing declines because of habitat loss due to agriculture and development, the spread of disease, overuse of pesticides, and other factors. Declines of pollinator populations threaten the viability of our agricultural productivity and put the health of natural ecosystems at risk.

We can all help bees, butterflies, and other pollinators across landscapes through habitat restoration, habitat management, and protection from pesticides. Habitat can include yards, gardens, parks, plantings on farms, and more. Vegetation management of roadsides is also a conservation opportunity for pollinators that are greatly in need of quality habitat in order to survive.

This document provides information about the importance of pollinators, how to recognize common groups of pollinators, profiles of pollinators found in Iowa, and tips about what you can do to create changes that will benefit pollinators.

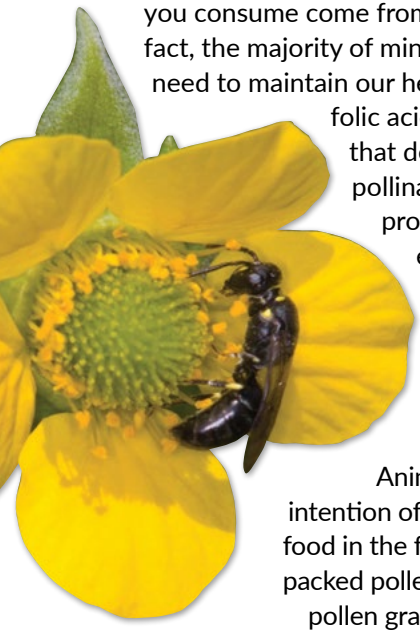
(above) The regal fritillary is among Iowa's most imperiled butterflies.

(right) Create a diverse mix of native plants in your yard in order to provide food and habitat for pollinators.

Pollinators Are Essential

Pollinators are at the heart of a healthy environment. The ecosystem services they provide are essential to human well-being, agricultural production, and ecosystem health. About 85% of the world's flowering plants depend on animals – mostly insects – for pollination[1]. Pollinators sustain plant communities that provide food and shelter for numerous other wildlife.

Pollinators are also crucial to agriculture and to our diet. More than three-quarters of crop species, those that produce fruits, vegetables, spices, nuts, seeds, and livestock forage, are dependent upon pollinators[2]. From the coffee or juice you drink in the morning to the apple pie you have for dessert, an estimated one in three mouthfuls of food and drink that you consume come from a pollinator-dependent crop[2,3]. In fact, the majority of minerals, vitamins, and nutrients we need to maintain our health (such as vitamin C, calcium, and folic acid) come from fruits and vegetables that depend partially or fully on animal pollinators[4]. The services pollinators provide are extremely valuable to our economy: the value of insect crop pollination is estimated to be up to $27 billion in the United States[5,6].



Pollinators big and small, such as this tiny yellow-faced bee, contribute to flowering plant pollination.

Introducing the Pollinators

Animals don't visit flowers with the intention of pollinating them. They are seeking food in the form of sugary nectar and/or protein-packed pollen grains, and while foraging, transfer pollen grains between blooms, enabling flowering plants to reproduce. The great majority of pollinators are insects, including bees, wasps, flies, beetles, butterflies, and moths[7,8,9], but hummingbirds and nectar-feeding bats pollinate some plant species as well[10,11].

The white-lined sphinx is day-flying moth that hovers above flowers while it drinks nectar.

Bees are particularly efficient and important pollinators[12]; they collect both pollen and nectar (most insects just visit flowers to drink nectar) and make more trips to flowers as they are collecting pollen to take back to their nests.

The domesticated European honey bee (*Apis mellifera*), the most well-known of all bees, is managed around the world for crop pollination services as well as honey production. The United States is home to several thousand species of native bees, which have very different lifestyles than honey bees (they don't live in hives and don't make honeycomb, for example) and most are wild and unmanaged. Many of these wild bees are also important crop pollinators. For more information about the biology of pollinators, see the resources section at the end of this booklet.

Status of Pollinators

Pollinators are in decline, globally and within the United States[13,14]. The number of honey bee colonies in the U.S. has been falling over the past half-century, and since 2006, beekeepers have experienced record high annual average hive losses of 29% or more[13,15]. Honey bee colony losses are attributed to disease, parasites, lack of habitat that provides diverse sources of nectar and pollen, pesticides, and other factors[13].

Some wild, unmanaged pollinator species native to North America also appear to be experiencing similar or more severe declines than honey bees. For example, at least 25% of North America's bumble bee species were formerly common and widespread but have undergone significant and swift declines, including species like the rusty patched bumble bee (*Bombus affinis*)[16]. Habitat loss, insecticide exposure, and disease are all contributing factors.

Similarly, butterflies have undergone significant declines: approximately 17% are at risk of extinction[17,18]. This includes species with special habitat needs such as the Poweshiek skipperling (*Oarisma poweshiek*), a species that relies on prairie remnants and that may now be locally extinct in Iowa[19]. Generalist species that were once widespread are also at risk. The monarch (*Danaus plexippus*), an iconic butterfly that is found across North America, has experienced population declines of around 80% east of the Rocky Mountains and more than 90% west of the Rockies[20,21]. Loss of milkweed plants – the essential food for monarch caterpillars – is a significant factor contributing to its decline[22,23]. These changes aren't limited to insects: some hummingbirds across the U.S. and nectar-feeding bats throughout the southwestern United States have also experienced declines due to loss of habitat.

Pollinators Need Our Help

We can all take steps to help pollinators. In particular, pollinators need more safe places to live. Habitat for pollinators can take many forms, and can include home gardens, parks, community gardens,

The Dakota skipper is one of several butterflies that depend on prairie habitat and have disappeared from Iowa within recent years.

Pale purple coneflower and butterfly milkweed provide a rich source of nectar for pollinators and create beautiful roadsides.

natural areas, plantings on farms, and roadsides. Habitat for pollinators should include a diversity of flowering plants that provide an overlapping succession of bloom from spring through autumn, caterpillar host plants, plants that provide nesting habitat for bees and wasps, undisturbed ground that can serve as nest sites for bees and wasps, and grassy habitat that can provide overwintering habitat for an assortment of pollinators such as beetles, flies, moths, and more. Pollinators also need protection from pesticides, particularly insecticides.

Roadsides Can Help

Roadside vegetation can provide much needed habitat for pollinators and connections to other patches of habitat. They can support generalist pollinators such as bumble bees, honey bees, and butterflies, as well as specialist species and even rare or protected species. Roadsides extend through all landscapes and can be particularly important for pollinators in highly altered landscapes such as intensely managed agricultural lands.

Not all roadsides are equally beneficial to pollinators. Roadsides that are intensively mowed, blanket-sprayed with herbicides, or planted with introduced grasses support far fewer species of pollinators and smaller population densities than roadsides managed for native plants[24,25,26,27,28].

Maintenance strategies that support pollinators include developing adaptive management plans to control weeds and manage vegetation for plant diversity, targeting herbicide applications, and reduced mowing beyond the clear zone (the strip directly adjacent to the road that is routinely mowed).

The use of native plants for revegetation of roadsides is also an important tool. Native plants provide soil stabilization, are adapted to local conditions, are equipped to tolerate droughts, require fewer inputs to establish[29,30], and when established will also resist weed colonization[31,32]. The root systems of native plants also help to reduce runoff in the spring and improve infiltration; this helps reduce storm water contamination and replenishes groundwater[33,34]. In Iowa, native grasses and shrubs can also act as snow fences, trapping and preventing snow from blowing across roads[35].

Although the establishment of native vegetation can take time and the initial costs may be higher, native plants are more cost effective in the long term. Once established, the plantings persist over time and require less mowing, herbicides and other weed control measures, decreasing long-term maintenance efforts and cost[25,36]. In contrast, controlling the growth and spread of invasive plants along roadsides through repeated mowing and rigorous herbicide use is very expensive[37]. Stands of native grasses and flowers are aesthetically attractive and can be designed for season-long blooms. Native plantings can showcase a region's natural beauty and provide a sense of place, natural heritage, and opportunities for education.

When roadsides have many flowers, fewer butterflies are killed by passing vehicles. It is presumed that because the flowers provide ample food, the pollinators are less likely to look for food elsewhere.

A diverse pollen diet can support a bee's immune system health. Managed honey bees find this diet along many Iowa roadsides.

Native plants can fulfill all these functional roles while also supporting pollinators. In fact, native plants support more wildlife, including pollinators, than do nonnative plants[38,39]. Roadsides with native wildflowers support a greater number of individuals and species of butterflies and bees compared with those dominated by nonnative grass and flowers[24,26].

Roadside vegetation management influences how pollinators use roadsides, and even influences the number of pollinators killed by vehicles driving nearby. Researchers in Europe found that the frequency of mowing was linked to the proportion of butterflies killed on roads because they were forced to disperse to find new habitat after roadsides were mowed. In contrast, mortality was lower where roadsides had more species of plants and higher quality of habitat because butterflies did not have to fly to new areas[27]. Researchers in Iowa also found fewer butterflies killed on roadsides with native plants[24]. In other words, rather than luring pollinators to collisions with vehicles, roadsides with wildflowers actually reduce pollinator mortality.

Roadside managers, maintenance staff, and landscape designers improve the quality of roadside vegetation by adjusting vegetation management strategies to accommodate pollinator resource needs, and enhancing and restoring native vegetation along roadsides. Roadsides can play an important role in the conservation of wild pollinators and in supporting the health of managed honey bees.

Adult lacewings visit flowers to sip nectar. They are also important predators of aphids and other pests.

In addition to attracting a diversity of pollinators, native plants can also contribute to soil health, water quality, and provide habitat for other wildlife.

Recognizing Pollinators

The primary groups of insect pollinators include bees, butterflies, and flower-visiting moths, wasps, flies, and beetles.

Bees typically have robust hairy bodies, eyes on the sides of their head, and long thin antennae. Bumble bees and some others are hairy all over, but many bees are only densely hairy on the front half, with fewer hairs on their abdomen. They also have an obvious, slender "waist." Female bees have specialized structures to carry pollen, typically a patch of long hairs on their hind legs or underside of the abdomen (a "pollen brush"), or a concave, smooth "pollen basket" on their hind legs (found on honey bees and bumble bees).

Wasps are closely related to bees, so share features such as long antennae, eyes on the sides of their head, and the obvious waist. However, they tend to be more slender than bees and have longer "waists," be significantly less hairy, and females do not have pollen-carrying structures.

Flies can be trickier to distinguish. Some look a lot like bees or wasps, but flies have only a single pair of wings. Flies have large eyes on the front of their head that may converge or nearly

converge on the top of their head. Their antennae are typically short and stout, in contrast to the long slender antennae of bees and wasps.

Beetles, too, can be distinguished from other groups by their wings. Beetles have two pairs of wings, but the front pair are modified as wing covers and aren't used for flight. The wing covers close over their backs when they rest on a plant or the ground. Many beetle groups have hardened, shell-like wing covers (e.g., lady beetles) or leathery wing covers (e.g., lightning bugs).

Butterflies and moths as a group are easily identified by their patterned wings, but it can be tricky to distinguish a butterfly from a moth. It is easiest to separate them when they are at rest. Butterflies tend to hold their wings either partially open in a V-shape or pressed together, upright over their bodies. Most moths hold their wings flat, like paper airplanes, or covering their body like a tent. Moths also tend to be stouter and hairier than butterflies. One defining characteristic is the shape of the antennae. Butterfly antennae have a clubbed, bulb-like tip, while antennae of moths are either feathery (males) or a single filament that tapers to a point (females).

This green sweat bee is sharing this false sunflower bloom with a lady beetle larva.

BEES

Bees are particularly efficient and important pollinators.

Bees make many trips between flowers to collect pollen and nectar, transferring pollen that results in pollination as they go.

Female bees actively collect pollen as food for their offspring and, consequently, carry and transfer a great deal of pollen as they fly between blooms. Bees have evolved special structures or hairs on their bodies (pollen brush or pollen basket) in which to carry pollen back to their nests, and some pollen brushes off of their hairy bodies as they visit flower after flower.

Bees are efficient pollinators of a variety of flowering plants, including crops, wildflowers, and flowering trees and shrubs.

Nectar-rich plants support a diversity of insects. Above the two bumble bees on this wingstem is a blue-winged wasp, a predator of Japanese beetle larvae.

At least 3,600 species of wild native bees call the U.S. their home, with more than 300 species found in Iowa[40].

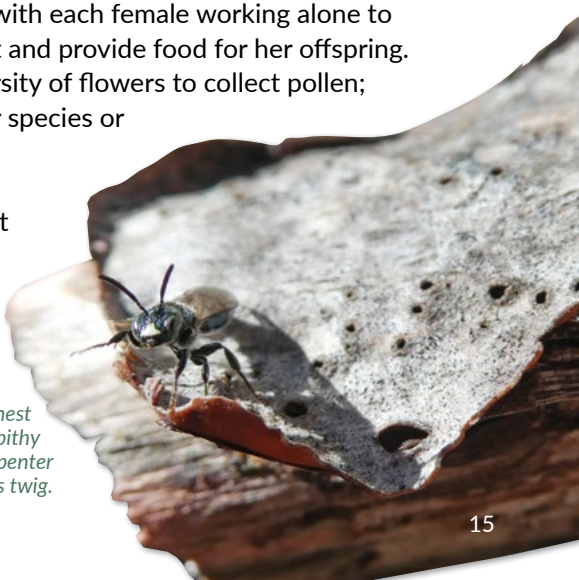
Honey bees are important crop pollinators because their densities can be increased temporarily by moving colonies into crops as needed.

There are also several introduced species, including the honey bee, a domesticated species managed by beekeepers to provide crop pollination services as well as for honey production. Honey bees live in large, social colonies of 20,000 individuals or more. There are overlapping generations within the colony, direct care is provided to young, and individuals divide up labor within the colony. The role of the queen bee within each hive is to reproduce, while her worker bees cooperatively defend, clean, and provide food for the colony.

The lives of North America's native bees are very different from honey bees.

Most native bees are solitary, with each female working alone to build her small nest and collect and provide food for her offspring. Some solitary bees visit a diversity of flowers to collect pollen; others collect from a particular species or group of species.

Many bees in the Midwest nest underground, digging slender tunnels off which they build cells for each egg and its



Some solitary bees nest in tunnels, such as pithy stems. This small carpenter bee emerged from this twig.

Bees often nest underground (left) or in tunnels such as hollow plant stems (right).

provisions. Some ground-nesting species will nest in aggregations, with groups of nest entrances close together, although each individual builds and maintains her nest within the aggregation. Aggregations may result from limited availability of suitable nesting substrate or as a strategy to confer protection in numbers from predators and parasites. Although some people express concern over aggregations of ground-nesting bees due to the number of bees in a small area, solitary bees are very docile and do not sting or defend their nest sites.

Other bees nest in tunnels, inside hollow stems or chewing into the pithy center of stems, or they nest in existing holes, sometimes man-made. The typical solitary female will be active as an adult for three to six weeks, during which time she'll construct and provision about 30 cells. Female solitary bees invest a great deal of time and energy into selecting successful nest locations and provisioning their nests with food for their young to eat while growing, because most do not meet or provide direct care for their offspring.

Bumble bees are the only native bees in Iowa that form truly social colonies

Some species of sweat bees also form small colonies in which they live cooperatively or have some divisions of labor. Their colonies are much smaller than a honey bee hive, usually fewer than two hundred bees. Bumble bees tend to nest in insulated cavities such as under clumps of bunch grass or in old rodent nests; some species nest in cavities below ground, while others prefer cavities above ground (e.g., under grass thatch or in an old bird nest).

Bumble bees (genus Bombus*) live in small colonies of dozens to a couple hundred individuals. Unlike honey bee colonies, bumble bee colonies only persist during the growing season.*

Most green sweat bees build their nests in the ground.

Mining bees, Tickle bees

Order: Hymenoptera **Family:** Andrenidae **Genus:** *Andrena*

Mining bees range in body size from 7 mm to 14 mm. Most have dark bodies with pale hairs on their thorax and pale stripes on their abdomen. Females have two patches of short hairs between their eyes.

Mining bee on red osier dogwood.

Life Cycle: These solitary bees have a single generation per growing season. Mining bees may be among the first bees to be seen each year, with the first species emerging in late winter (when willows begin to flower). Most species fly in the spring but several fly in late summer through fall.

Foraging: Some species visit a wide range of flowers to collect pollen, while others only collect pollen from a small subset of flowering plants. The maximum flight range for large mining bees is estimated to be between 500 yards and one mile, but may be less than this for smaller species.

Mining bee on highbush blueberry.

Buzzworthy

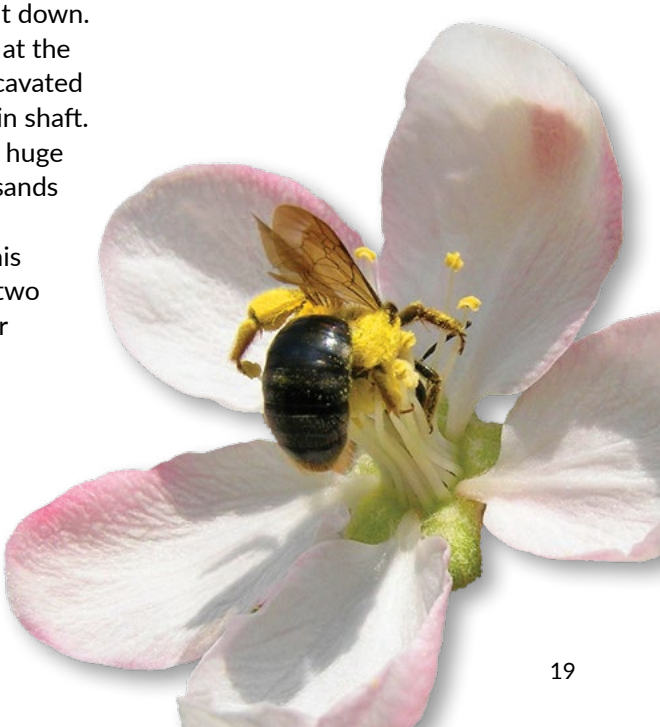
The name "tickle bee" was coined by students at an elementary school in Portland, Oregon, which has tens of thousands of mining bees nesting in their playing field. The kids would catch the bees during recess and said they tickled in their hands!

Mining bee at ground nest entrance in a suburban lawn.

Nesting: Mining bees, as their name suggests, nest in the ground. The nests are commonly between 6 inches and 2 feet deep, with the main shaft going straight down. The brood cells are dug at the end of short tunnels excavated from the side of the main shaft. Mining bees can nest in huge aggregations with thousands of individuals sharing a good nest site. When this happens, there may be two or three dozen nests per square foot.

LIFE SAVER

These bees nest in sparsely vegetated sites. Keep your lawn scrappy!



Mining bees are important pollinators of many early blooming plants, including crops like apples and blueberries.

Cellophane bees

Order: Hymenoptera **Family:** Colletidae **Genus:** *Colletes*

Cellophane bees have a medium build and body size (up to 13 mm), with dark bodies with pale hairs.

Life Cycle: These solitary bees may have one or two generations per growing season. Some species of cellophane bees have flight periods in the spring, while others fly during the summer or fall.

A cellophane bee perched on a petal.

Foraging: Most species visit a wide range of flowers to collect pollen, but several are pollen specialists on a subset of flowering plants (e.g., plants in either the sunflower family (Asteraceae) or bean family (Fabaceae). The maximum flight range for large cellophane bees is estimated to be up to a mile or more from their nest sites.

A cellophane bee visits an Eastern redbud blossom.

Buzzworthy

These bees have a forked tongue! The tip of their tongue is split into two lobes, which helps them to spread the lining inside their nest cells.

Early blooming plants like pussy willow provide cellophane bees with pollen and nectar at a time when little else is available.

A male cellophane bee peeks out from a nest entrance in the ground.

Nesting: Cellophane bees nest in the ground. The nests may be only a few inches deep, with several cells at the bottom of the shaft. The cells are lined with a distinctive cellophane-like substance to protect their growing offspring from water and mold. The cell lining, made from saliva and a secretion from a gland on the bee's abdomen, makes the cells waterproof, and these bees often nest near creeks. Some species nest in aggregations.

Because more Colletes *seem to be active in the fall, be sure you have late-flowering plants like aster and goldenrod.*

Yellow-faced bees

Order: Hymenoptera **Family:** Colletidae **Genus:** *Hylaeus*

These bees are slender and small (up to 7 mm), with relatively hairless bodies that make them wasplike. They are predominately black with yellow or white markings, mostly on their legs and – as you'd guess from their name – on their faces.

Life Cycle: Adults of many species emerge in the spring, but several emerge in summer or early fall. Most species have a single generation but some may have two per growing season.

Tiny yellow-faced bees are often mistaken for wasps, due to their lack of body hairs and pollen-carrying structures.

Buzzworthy

Islands are usually lacking in bees, but Hylaeus *are common on many islands, perhaps because they nest in wood that may have drifted to new shores. Seven species living in Hawaii were the first bees to ever gain federal protection in the U.S.*

Male yellow-faced bees usually have additional yellow or white markings on their faces.

Foraging: These bees likely visit a wide variety of flowering plants for pollen and nectar, and have a limited flight range due to their small size. Unlike most bees, females of yellow-faced bees do not have pollen baskets or brushes for transporting pollen back to their nests. Instead, they consume it and regurgitate it into the brood cells. Because of this, it is difficult to identify the pollen they collect and it is not known with certainty on which flowers they forage!

Nesting: These bees nest in preexisting holes, including old growth of hollow stems, beetle tunnels, and other excavations or holes. Like cellophane bees, they line their nests with a cellophane-like substance.

LIFE SAVER

Don't over tidy your landscape. Yellow-faced bees nest in hollow twigs, abandoned beetle burrows in snags, and other premade holes, so keep snags (standing dead or dying trees) and similar features whenever possible.

Dark sweat bees

Order: Hymenoptera **Family:** Halictidae **Genus:** *Halictus*, *Lasioglossum*

Dark sweat bees in the genus Halictus *have pale bands on their abdomen.*

These bees are generally nondescript and often go unnoticed, particularly the smaller ones, but are among the more abundant species. Dark sweat bees can be as tiny as 4 mm (*Lasioglossum*) or a medium-sized 10 mm (*Halictus*). Their narrow bodies often have a blue, green, or gold metallic sheen; they might also be dull brown or black with pale stripes.

Dark sweat bees visit a wide range of flowers to collect pollen and nectar.

Life Cycle: Dark sweat bees are a very diverse group; some species live solitary lives, while some nest in aggregations, and others form semi-social colonies where they live cooperatively with their sisters. Some species have one generation a year while others have multiple generations during a single growing season.

Buzzworthy

They will lick sweat from human skin to obtain salt.

Many dark sweat bees in the genus Lasioglossum *are dull metallic, ranging from gold to blue or green.*

LIFE SAVER *Be sure there is bare ground available in which these bees can excavate their nests.*

Foraging: These bees may fly between 500 yards and a mile from their nest. (The larger *Halictus* species will fly further than many of the much smaller *Lasioglossum* species.) They visit a wide range of flowers to collect resources.

Nesting: These bees build their nests in the ground, sometimes in aggregations. The semi-social species may have two generations in a year, making the nest deeper through the summer to house the next generation. Nest entrances usually have a scattering of dirt around them, but no mound.

Green sweat bees

Order: Hymenoptera **Family:** Halictidae
Genus: *Agapostemon, Augochlora, Augochlorella, Augochloropsis*

These bees are a stunning bright metallic green, and can range in body size from 7 mm to 12 mm. The males of several species, which become common in midsummer and fall, have yellow striped abdomens.

Life Cycle: Like dark sweat bees, these are a very diverse group; some species live solitary lives, some nest in aggregations, some form semi-social colonies where they live cooperatively with their sisters, and others form primitively social colonies with some division of labor. Some species have one generation a year while others have multiple generations during a growing season.

Green sweat bees can be abundant on a variety of flowers.

Buzzworthy

These bees will sometimes nest communally. If they do this, they apparently share security, taking turns to guard the main entrance.

Green sweat bees in the genus Agapostemon *nest individually or communally, sharing a common nest entrance.*

Some green sweat bees have two or more generations a growing season, and thus can be found from spring through fall.

Foraging: Green sweat bees visit a wide range of flowers, and may fly up to a mile from their nest.

Nesting: Most of these bees build their nests in the ground (sometimes in aggregations), although *Augochlora pura* will utilize rotting logs or soft wood. The nest entrance is often surrounded by a mound of excavated dirt that may be a couple of inches high. Some species will nest communally, with several females sharing a nest entrance. Within the nest, however, each female constructs and provisions her own nest with brood cells on an individual tunnel.

Augochlora pura *(pictured here) nests in soft wood; other green sweat bees in Iowa nest in the ground.*

Ground-nesting bees need bare ground for nesting. Don't mulch everywhere.

Bumble bees

Order: Hymenoptera **Family:** Apidae **Genus:** *Bombus*

Bumble bees have large (up to 23 mm in queens), robust, extremely hairy or fuzzy black and yellow bodies, sometimes with additional orange, red, or brown coloration.

Several species of bumble bees in Iowa are becoming increasingly rare, including this American bumble bee.

Life Cycle: Bumble bees are social bees that live in colonies of 25 to 400 bees, founded by a queen. Mated queen bumble bees hibernate through the winter, initiate a nest in the early spring, and forage widely to provision that nest. Worker bees, the daughters of the queen, help in nest-building, brood-rearing, and defense of the nest as the colony grows in size through the spring and summer. In the late summer and fall, new queens and males are reared and leave their nests to find mates. Males, workers, and old queens will die off when winter arrives.

Buzzworthy

An older name for these bees is humble bee, because of the humming noise they make while flying. And for Harry Potter fans, they also used to be called dumbledores.

Bumble bees visit a wide variety of flowers, and are a familiar sight in roadsides, farms, gardens, and prairie.

Foraging: Bumble bees can fly up to a mile or more. They visit a vast range of wildflowers, shrubs, and trees. Bumble bees can generate internal body heat by shivering their flight muscles, which allows them to be active in cooler weather.

Nesting: Queens select an insulated cavity in or above the ground. Nest sites include old rodent burrows, cavities beneath a clump of bunch grass, or old bird nests. Not all bumble bees make a nest: Several species are nest parasites of other Bombus species. In the winter, queens hibernate in shallow underground burrows, often under forest humus, at the base of hedgerows, or in rock piles or brush piles.

Bumble bees are among some of the earliest bees to emerge from winter hibernation. They are important pollinators of spring-blooming flowers like blueberries (top) and false indigo (bottom).

LIFE SAVER

Plants that bloom early in spring and late in the autumn are particularly important to bumble bees, because they may be active from early spring to late fall.

Mason bees

Order: Hymenoptera **Family:** Megachilidae **Genus:** *Osmia*

Mason bees are often mistaken for flies. Most mason bees are 8 to 16 mm in length and have dull metallic blue, green, or copper-colored bodies. Females carry pollen on hairs on the underside of their abdomen.

Mason bees in Iowa often have metallic body coloration and pale body hairs. This male is distinguished by its long antennae, seven abdominal segments and large eyes.

Life Cycle: These solitary bees are among the earliest bees to emerge in the spring and have a single generation each growing season.

Foraging: Mason bees have a limited flight range of up to about 500 yards. Most species will visit a wide variety of spring or early summer blooming plants (especially the blossoms of fruit trees), but some species specialize on flowers of a particular family (e.g., the pea family, Fabaceae).

This female mason bee is closing her nest entrance with mud.

Buzzworthy

Mason bees mark their nests with an individual scent that helps them find their nest tunnel when nesting in an aggregation.

Mason bees use empty cavities for their nests, and incorporate mud or occasionally resin or chewed up leaves into their nests.

Nesting: Mason bees use empty cavities such as hollow stems, old beetle tunnels, or crevices to house their nests. They will nest close to each other where enough holes exist. Mud and sometimes resin or masticated plant materials are used to build partitions within their tunnel nests that separate individual cells and seal nest entrances.

LIFE SAVER

You can support mason bees by leaving hollow stems standing. Some species of mason bees will occupy artificial nest structures you can make and install in your garden, including wooden blocks drilled with holes or bundles of bamboo stems.

Leafcutter bees

Order: Hymenoptera **Family:** Megachilidae **Genus:** *Megachile*

Leafcutter bees are 8 to 20 mm in length and have dark coloration with pale hair bands on their abdomens, which are often slightly pointed. Females have robust jaws for cutting leaves and carry pollen on hairs on the underside of their abdomen. When on a flower, they may hold their abdomen at an angle, with the tip raised. Males often have long hairs on their front legs.

Leafcutter bee drinking nectar from cup plant.

Life Cycle: All leafcutter species are solitary bees. Some species have a single generation each growing season while others have multiple generations.

Foraging: Most species will visit a wide variety of flowering plants.

Neatly trimmed circles in leaves are a sign that you have leafcutter bees nesting nearby.

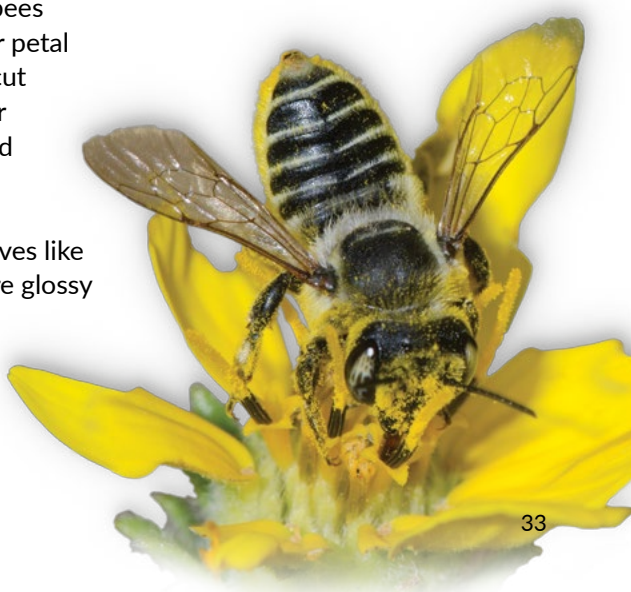
Buzzworthy

Because leafcutters nest in cavities in many different materials and objects, their nests are easily moved (purposefully and accidentally) from place to place. There are at least seven nonnative species in the United States.

Leafcutters carry pollen in the stiff hairs on the underside of their body, not on their rear legs.

Nesting: Leafcutter bees typically use existing cavities such as hollow stems, old beetle tunnels, decomposing wood, or crevices between rocks, although they will nest in any suitable cavity including hosepipes, outdoor faucets, and folds in sacks. A few species buck this trend and nest in the ground. Leafcutter bees line their nests with leaf or petal pieces. Females carefully cut different shaped pieces for different parts of the brood cell, chewing the edges to stick them together in the nest. They prefer waxy leaves like redbuds or roses, which are glossy on one side and rough on the other. Some species will nest readily in artificial nest blocks.

A lack of nest sites may be a bigger constraint on bee populations than a lack of flowers. Be sure that there are adequate nesting opportunities.



Large carpenter bees

Order: Hymenoptera **Family:** Apidae **Genus:** *Xylocopa*

There is only one large carpenter bee species found in Iowa, the eastern carpenter bee (*Xylocopa virginica*). This bee is large (up to 23 mm) and has a robust body. While easily mistaken for bumble bees, large carpenter bees have an abdomen that is shiny and less hairy than bumble bees, while their thorax is entirely covered in yellow hairs. Males have a yellow marking on the face.

Large carpenter bees visit a wide range of flowers.

Buzzworthy

Large carpenter bees are expert nectar robbers, using their powerful jaws to bite holes in the side of tubular flowers to reach the nectar. This means they bypass the pollen, "stealing" nectar without helping pollinate the flower.

Life Cycle: These bees have one generation in a growing season. Adults overwinter, and then mate and nest in the spring. Large carpenter bees will establish foraging patterns, visiting various species of flowers in consistent succession while resources are available.

Foraging: Large carpenter bees visit a wide range of flowers and have a flight range of up to a mile or more from their nest site.

Male large carpenter bees will establish a territory they will patrol near a nest entrance to enhance mating opportunities.

LIFE SAVER

Flowering trees and shrubs, along with spring and summer blooming wildflowers, will help to support large carpenter bees.

Nesting: These bees create their nests by chewing directly into soft wood, including man-made structures. Because some of these bees will return to build nests near the nest they emerged from, an accumulation of large carpenter bee nest tunnels may cause damage over time to decks, eaves, picnic tables and barns made from untreated wood. There is some overlap between generations, with the mother meeting her offspring, which is unusual for solitary bees.

It can be easy to mistake a female large carpenter bee for a bumble bee. The carpenter bee female has a shiny abdomen and pollen-carrying hairs (not a pollen basket) on her hind legs.

Small carpenter bees

Order: Hymenoptera **Family:** Apidae **Genus:** *Ceratina*

These bees are slender and small (up to 8 mm), with dark blue-green metallic coloration. Small carpenter bees have relatively hairless bodies.

Life Cycle: Small carpenter bees are solitary and have several generations a growing season. As a result, they are more abundant in the summer months. Adults overwinter in pithy stems.

Small carpenter bees may be quite tiny and have a lovely coloration of blue-green metallic.

These bees can be common on many different flowering plants, including the raspberry shown here.

Foraging: These bees will visit a wide variety of flowering plants for pollen and nectar, and have a limited flight range of less than 500 meters. Small carpenter bees are not as hairy as other bees, so may carry some pollen on their legs and some by swallowing and regurgitating it.

Buzzworthy

A very few species of Ceratina *can reproduce without mating, which is known as parthenogenesis. In the U.S., the only species that does this is restricted to California!*

A male small carpenter bee extends his tongue to probe a flower for nectar.

Nesting: Small carpenter bees nest in twigs and stems, usually excavating the old growth of pithy stems of shrubs such as raspberry, sumac, wild rose, or elderberry. The twig must be broken, as these bees can't chew their way through the tough outer layers. Similar to their larger relatives in the genus *Xylocopa*, small carpenter bee females meet their offspring. After completing her nest, a female will hibernate in the nest entrance, guarding over her young until they complete development.

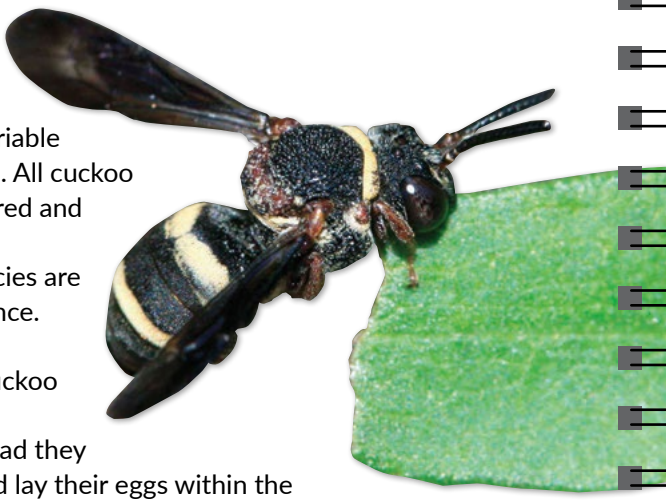
LIFE SAVER

Hedgerows and woodland edges with shrubby vegetation and flowers are great for small carpenter bees, as are raspberry patches.

Cuckoo bees

Order: Hymenoptera **Families:** Halictidae, Megachilidae, Apidae
Genera: *Nomada, Stelis, Triepeolus, Epeolus, Sphecodes, Holocpasites, Neolarra*

Cuckoo bees are found in three different bee families and are extremely variable in coloration and size. All cuckoo bees are sparsely haired and lack pollen-carrying structures. Most species are wasp-like in appearance.



Bees in the genus Epeolus *are nest parasites of cellophane bees.*

Life Cycle: Female cuckoo bees do not build or provision nests; instead they are nest parasites and lay their eggs within the nest of a host bee species (primarily species within their family). Some adult cuckoo bees will directly kill the host bee's eggs, but for most species, cuckoo bee larvae, after hatching, will kill the host bee eggs or larvae and consume their food supply.

Buzzworthy

Have you heard the term "as busy as a bee"? Well, not all bees are like that. About 20% of all bee species are cuckoo bees, nest parasites that sneak into another bee's nest to lay eggs. If cuckoo bees are present, it can be an indication of a diverse and stable bee community.

Bees in the genus Nomada *are nest parasites of mining bees as well as a diversity of other bee groups.*

Although cuckoo bees do not collect pollen, they can transfer it during visits to flowers to drink nectar, thus contributing to pollination.

Foraging: Cuckoo bees do not actively collect pollen since they do not provide food for their young, instead relying on the provisions other bees have collected, but they do visit a wide variety of flowers for nectar.

Nesting: These bees lay eggs in the nests of other bees. They don't have specific conditions for nesting, other than nests of their host bees.

These bees rely on other bee's nests for nesting opportunities! Be sure you have good quality habitat for all bees.

Bees in the genus Sphecodes *are nest parasites of a number of bee species.*

Digger bees, long-horned bees

Order: Hymenoptera **Family:** Apidae
Genus: *Melissodes, Anthophora, Svastra, Eucera, Peponapis*

These bees are often robust and very hairy (some species are referred to as "teddy bear" bees); they are between 8 mm and 20 mm in length. Most have dark bodies but coloration of hairs varies from white to orange and many have pale abdominal stripes. Females have patches of long fuzzy hairs on their hind legs for transporting pollen. Males of some species have especially long antennae.

Male long-horned bees have exceptionally long antennae.

Be sure to provide bare ground for nesting, and lots of summer- and fall-blooming flowers.

Female digger and long-horned bees have long scopal hairs on their hind legs to assist with pollen transport back to their nests.

Many digger and long-horned bees are pollen specialists, collecting pollen from only a few groups of closely related plants, such as sunflowers.

Life Cycle: These bees are solitary species, with a single generation per growing season. Adults of specialist species will time their emergence with the flowering of their host plants. For example, Eucera usually emerge in spring, whereas Melissodes appear in summer and fall.

Foraging: Some species will visit a wide variety of flowers, while others specialize in the pollen of a small subset of flowering plants. Melissodes, for example, collect pollen from plants in the aster family, and Peponapis collect pollen only from squash plants.

Nesting: These solitary bees nest in the ground, with some species nesting communally. Anthophora females may nest in aggregations of up to a thousand individuals.

Buzzworthy

Male bees do not have a nest to return to at night. Long-horned males will sleep on plants, often in clusters, clamping their jaws around the stem and resting until morning.

Western honey bee

Order: Hymenoptera **Family:** Apidae **Species:** *Apis mellifera*

Honey bees are medium in size (10 to 15 mm), with brown or amber coloration and dark stripes on their abdomen. Females transport pollen on a concave portion of their hind legs.

Female honey bees carry pollen moistened with nectar, packed into a pollen basket on their hind legs.

Life Cycle: Honey bees are social, and nest in perennial colonies that sustain themselves through the winter on stored food. There is one queen per colony, and her primary role is egg laying. Female worker bees attend to larvae and the queen, clean or defend the nest, or forage for food. The queen may live for a couple of years, the workers only a few weeks or months.

Honey bees are generalist foragers, and will visit a huge array of plants that provide pollen and nectar.

Buzzworthy

The honey bee is native to Europe, Asia, and Africa, but has been domesticated and widely introduced around the world. Colonies are managed for honey production and commercial crop pollination.

The honey bees you see on flowers are foragers, and their role in the colony is to find a resource and bring it back to the colony.

Foraging: These bees will visit a wide variety of flowering plants for pollen and nectar, and have an impressive flight range of several miles or more. They communicate the location (distance, direction) of good forage sites by a waggle dance. When nectar is brought to the hive, it is partially digested and regurgitated into honeycomb. Water is evaporated from the nectar by fanning with wings and this thickens the nectar into honey.

Nesting: Managed colonies are housed in hives, and wild colonies will occupy large cavities such as hollow trees – and house walls.

LIFE SAVER

Honey bees need lots of flowers! A diversity of pollen sources helps to bolster their immune systems.

BUTTERFLIES & MOTHS

For millennia, butterflies have attracted the attention and admiration of people around the world.

Over the course of their life cycles, butterflies and moths go through a remarkable transformation in four distinct stages.

Eggs are laid (1) on particular plants, called host plants, which are carefully selected by the female. Caterpillars (2) emerge from the eggs to eat, and eat, and eat – consuming a tremendous amount of plant mass and ultimately growing to hundreds of times their original size. Along the way they shed and regrow their exoskeleton, the rigid outer shell that provides body structure. The fully grown caterpillar becomes a chrysalis (3), or cocoon for moths. During this period of drastic changes its body restructures itself to eventually emerge as a winged adult (4). Once free of the chrysalis, freshly emerged butterflies take flight in search of food and a mate.

Swallowtail butterfly lifecycle

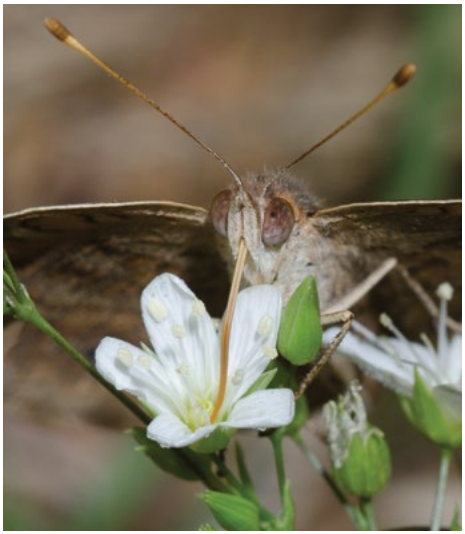
Butterflies and moths need habitat that supports all four life stages.

Many species of grasses, wildflowers, shrubs, and trees are host plants critical for a butterfly (or moth) to complete its life cycle. Caterpillars of some species will eat only a single species of plant or several very closely related plants, while other species will eat a wide range of plants from multiple families. For example, caterpillars of the regal fritillary (*Speyeria idalia*) feed exclusively on violets (*Viola* spp.), and will not survive without their host plant. At the opposite end of the spectrum is the gray hairstreak (*Strymon melinus*), a butterfly whose caterpillars will munch on over 80 different plant species.

To complete the change from caterpillar to adult, an undisturbed place is needed for the chrysalis. Butterflies will form a chrysalis any place that will be stationary for long enough, so this stage may be found on buildings, outdoor furniture, fences, vehicles that haven't been moved recently, bushes, trees, plant stems, and more. Depending on the species, this stage may be a couple of weeks during the summer or all winter.

(above) Silvery blue butterfly on a spring beauty.

(left) Monarch butterfly on blazing star.



Butterflies (and some moths) have a long tubular tongue, called a proboscis, that they uncoil to insert into flowers to sip nectar.

Energy-rich nectar is the primary food source for most adult butterflies.

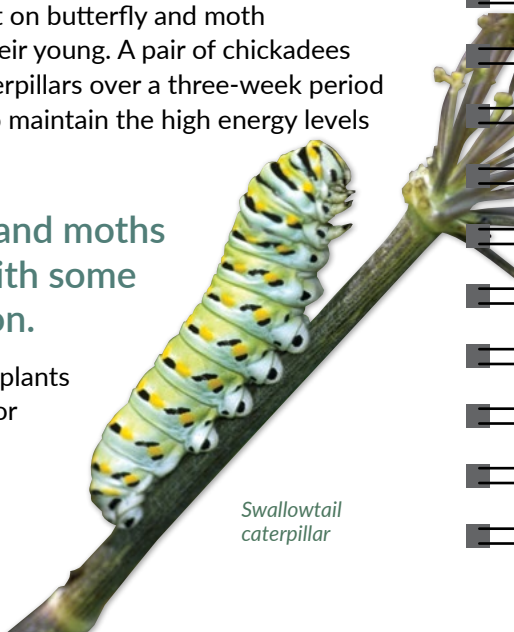
They have long, tubular mouthparts that they unfurl and insert into flowers to sip nectar. Some butterflies obtain sugar from tree sap, rotting fruit, or aphid honeydew. To acquire additional nutrients such as minerals and salts, butterflies, males in particular, sometimes seek liquid from carcasses, animal waste, puddles, and moist soil. Many adult moths also sip nectar, but there are some (such as the luna moth) that do not consume anything as adults, living just long enough to mate and deposit their eggs.

Butterflies and moths also play important ecological roles.

For example, most birds are reliant on butterfly and moth caterpillars as a food source for their young. A pair of chickadees will collect as many as 10,000 caterpillars over a three-week period to feed their nestlings or as fuel to maintain the high energy levels required for migration.

A number of butterflies and moths in Iowa are in decline, with some on the verge of extinction.

Loss of habitat that supports host plants for caterpillars and nectar plants for adults has a profound impact on butterfly populations and is a leading cause of decline.



Swallowtail caterpillar

Butterfly or moth?

Butterflies and moths can be difficult to tell apart. It is easiest to distinguish between them when they are at rest.

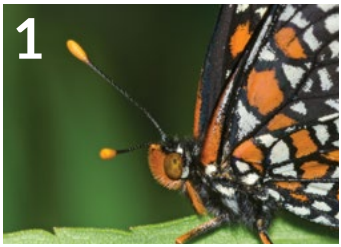
1 Butterfly antennae have a clubbed bulb-like tip.

2 Male moths have feathery antennae which help them detect female sex pheromones.

3 Female moths have antennae that are a single filament and taper to a point.

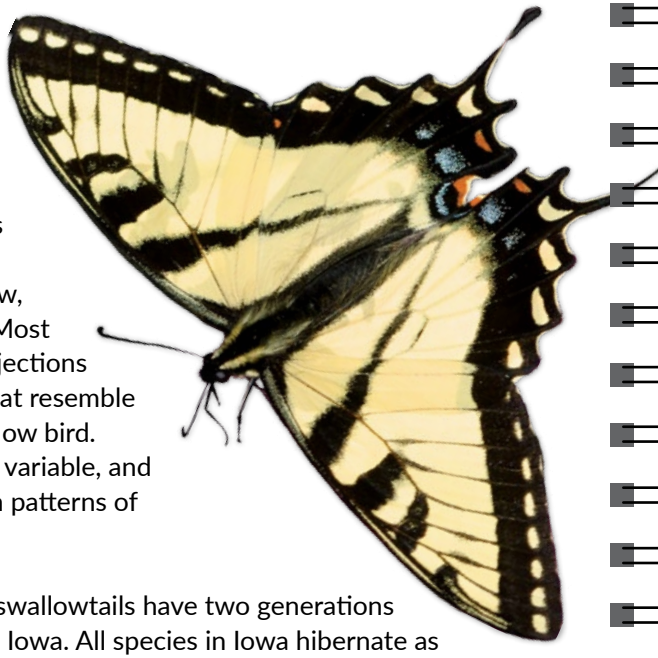
4 Most moths hold their wings flat like paper airplanes, or slightly pitched, with the forewings over the hindwings, covering their body like a tent.

5 Butterflies tend to hold their wings either partially open in a V-shape, or pressed together.



Swallowtails

Order: Lepidoptera **Family:** Papilionidae



Adult swallowtails are large (up to 130 mm wingspan, 160 mm for the giant swallowtail), showy butterflies, with wings with black coloration contrasting with yellow, blue/green or white. Most have long tail-like projections on their hind wings that resemble the tail of a barn swallow bird. Caterpillars are highly variable, and some are mimics, with patterns of realistic eyespots.

Life cycle: Generally, swallowtails have two generations per growing season in Iowa. All species in Iowa hibernate as pupae in leaf litter. The first generation emerges as adults in the spring, while the second brood emerges in mid- to late-summer. Black swallowtails (*Papilio polyxenes*) and giant swallowtails (*Papilio cresphontes*) have a third brood that emerges in fall.

A black swallowtail exhibits puddling, or probing for salts and nutrients from mud.

LIFE SAVER

Try to provide untidy, undisturbed places in your garden where swallowtails can shelter as chrysalises.

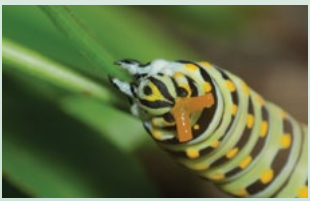
Swallowtails are among the largest and most colorful butterflies in Iowa – but this is the largest, the aptly named giant swallowtail.

Host plants: Each swallowtail species uses a different host species or set of species. The black swallowtail, Iowa's most abundant swallowtail, uses plants in the carrot family (Apiaceae), but other species specialize on pipevine (*Aristolochia* spp.), pawpaw (*Asimina triloba*), spice bush (*Lindera benzoin*), sassafras (*Sassafras albidum*), cherry (*Prunus serotina*), or plants in the rue family (Rutaceae).

Behaviors: Adults sip nectar from a wide variety of flowers, and some also obtain salts from mud. Swallowtails continue to flap their wings while drinking nectar from flowers.

Buzzworthy

Swallowtail caterpillars have several ways to deter predators. Some species have a brightly colored structure called an osmeterium that, while normally tucked under a segment, can extend and release a foul liquid. Others have eyespots, making them resemble snakes to intimidate predators.



Skippers

Order: Lepidoptera **Family:** Hesperiidae

Caterpillars of the common checkered-skipper feed on host plants in the mallow family.

Adults are small to medium-sized (up to 50 mm wingspan) and can be distinguished from other butterflies by the hooked bulb at the end of each antenna. Many have robust bodies and shorter wings, with orange-brown coloration or dark brown with white spots. Skippers are divided into two subfamilies according to how they hold their wings at rest. Folded-wing skippers hold their wings partially open with the forewings flat and the hind wing at 45 degrees. Spread-wing skippers typically hold both pairs of wings flat to the side. Caterpillars are infrequently encountered but are distinguished by a wide head atop a narrow neck.

Life cycle: Caterpillars tend to feed at night and spend daylight hours within silk shelters in curled blades of grass. Many overwinter as larvae within their silken-leaf shelter. Important nectar plants include Echinacea spp.

Peck's skipper on smooth blue aster.

Buzzworthy

Some people consider skippers to be separate from butterflies and moths, sort of halfway between the two.

The Dakota skipper needs high-quality prairie remnants, which is why this butterfly is no longer found in Iowa.

Host plants: Species in the subfamily Hesperiinae feed on grass species, including little bluestem (*Schizachyrium scoparium*) and prairie dropseed (*Sporobolus heterolepis*). Members of the subfamily Pyrginae feed on a wide range of flowering plants including willows and legumes.

Behaviors: Many skippers fly in a rather erratic manner, appearing to skip from plant to plant or bounce in the air.

LIFE SAVER

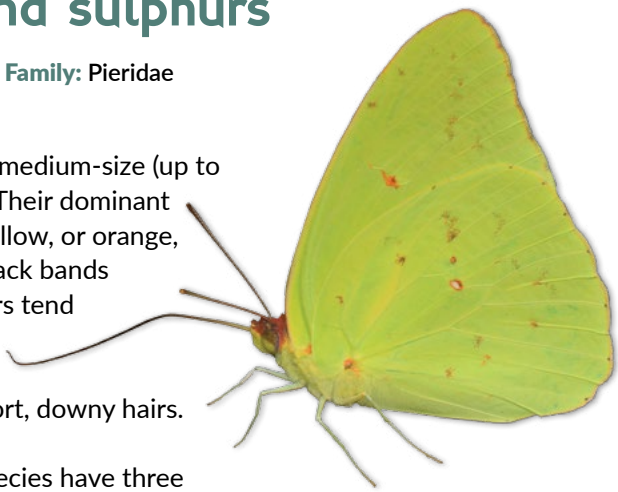
Reduce pesticide use and protect the breeding and foraging habitat from pesticide drift for skippers and all pollinators.

Purple coneflower is a great nectar source for many prairie butterflies, including the Arogos skipper.

Whites and sulphurs

Order: Lepidoptera **Family:** Pieridae

Adults are small to medium-size (up to 60 mm wingspan). Their dominant colors are white, yellow, or orange, often with a few black bands or spots. Caterpillars tend to be green and striped, and are smooth or have short, downy hairs.



Cloudless sulphur

Life cycle: Most species have three or more generations per year, and many use roadsides, hay meadows, or old fields as habitat. Their populations often build up to huge numbers by autumn (sometimes to a level where they are considered pests!). Some species spend the winter in Iowa as pupae, while others migrate south to the southern U.S. or Latin America. Those that migrate don't arrive in Iowa until late summer, and only have a single brood in Iowa before flying south.

Buzzworthy

Because their caterpillars often feed on plants that are weeds, whites and sulphurs are better adapted than other butterflies to disturbed environments such as cities.

Cloudless sulphur caterpillars consume legumes as host plants, particularly Senna species.

Olympia marble

Host plants: Whites tend to lay eggs on plants in the mustard family, while sulphurs tend to lay on various legumes.

Behaviors: Adults will puddle on moist soil, such as on field edges or roadsides.

Checkered white butterflies consume plant in the mustard family as caterpillars.

LIFE SAVER

Planting mustards or legumes will help to support this group of butterflies.

Blues, coppers, and hairstreaks

Order: Lepidoptera **Family:** Lycaenidae (gossamer wings)

Small or tiny butterflies (up to 40 mm wingspan, but often 25 mm or less), these are blue, gray, brown, or bronze, with multiple small markings (especially on the undersides of their wings). The colors of the upper side of the wings of blues and coppers usually have a sheen. Hairstreaks have distinctive hair-like tails trailing from their hind wings.

Coral hairstreak drinking nectar from butterfly milkweed.

Life cycle: These butterflies are all full-year residents that do not migrate. Iowa's hairstreaks overwinter as eggs, while blues overwinter as mature larvae or pupae. Adult coral and Edwards' hairstreaks are extremely fond of butterfly milkweed nectar, whereas dogbane is the preferred nectar source of the coppers.

Buzzworthy

Most butterflies use pigment to give their wings color. The gossamer wings do it differently: the structure of their wing scales reflects light, creating the shimmering, intense colors.

Eastern-tailed blue

Blue butterflies have patterns on underwings and vivid blue coloration on the top side of wings.

Host plants: Most of the hairstreaks lay eggs on oaks, most of the blues lay on legumes (especially lupines), but host plants also include dock (for gray copper, bronze copper) and cedar (for juniper hairstreak). This family includes the United States' only carnivorous butterfly. The "host plant" for the harvester (Feniseca tarquinius) are woolly aphids!

Behaviors: Blues often "puddle" on wet ground. Hairstreaks tend to wiggle their "tails" when perched, which encourages predators to attack those expendable structures rather than the vulnerable body.

Male butterflies will drink fluids from wet soil, puddles, and even animal droppings to gain nutrients not available from nectar.

Grow lupines and other legumes as host plants for blues.

Fritillaries

Order: Lepidoptera **Family:** Nymphalidae (brush-foots)

Iowa has three large fritillary species (up to 100 mm wingspan) and three medium-sized ones (up to 75 mm wingspan). All are bright orange with copious markings and are fast flying—which can make identifying species on the wing difficult. Larvae are colorful, with small spines.

Fritillaries can be hard to tell apart as they all are orange with dark markings!

Life cycle: Most fritillary species have two or three broods per year, although the regal fritillary has only one. Most are non-migratory, and overwinter in Iowa as newly-hatched or mid-stage caterpillars.

Host plants: All Iowa fritillary species consume violets.

LIFE SAVER

Violets don't need to be grown in flower borders. Let them grow in your lawn, too!

Variegated fritillaries have a variety of host plants.

Great spangled fritillary on wild bergamot.

Other habitat: The larger fritillary species (regal, Aphrodite, great spangled) avidly collect nectar on showy wildflowers such as coneflowers, milkweeds, and blazing stars.

Behaviors: Males emerge before females, and patrol territories with rapid back and forth flight. The variegated fritillary migrates north into Iowa in the summer, and southward in the fall.

Buzzworthy

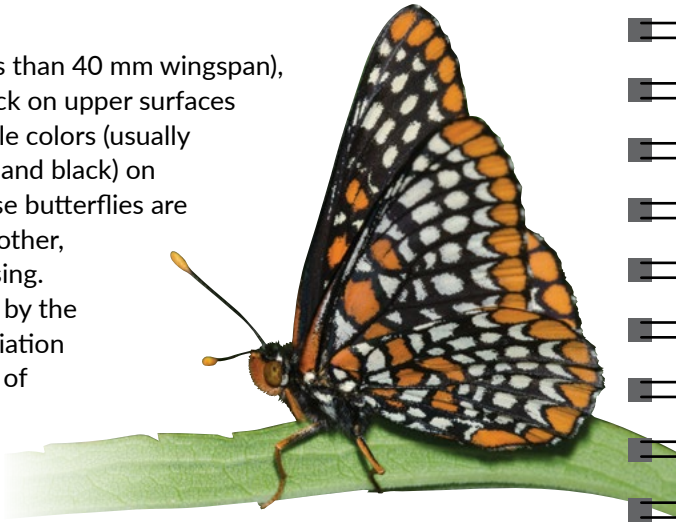
All fritillaries have brightly shimmering silver colored markings on the lower side of their hind wings, giving rise to an alternative name for this group, the silverspots.

This caterpillar of the variegated fritillary is feeding on violets, the preferred host plants for all species of fritillary in Iowa.

Crescents, checkerspots

Order: Lepidoptera **Family:** Nymphalidae (brush-foots)

Adults are small (less than 40 mm wingspan), with orange and black on upper surfaces of wings, and multiple colors (usually tans, brown, orange and black) on under surfaces. These butterflies are very similar to each other, which can be confusing. This is compounded by the fact that there is variation between individuals of each species! These caterpillars are dark with bundles of sharp spines.



It's easy to understand the origins of the common name "checkerspot" butterflies!

Life cycle: In Iowa, they are full-year residents with multiple overlapping broods from spring to fall. They overwinter as caterpillars.

American lady butterflies may not always survive the coldest winters in Iowa and may recolonize from the south in some years.

Buzzworthy

These butterflies lay their eggs in clusters on leaves and stems rather than singly. Crescents lay only a few eggs in each cluster, checkerspots many more.

Pearl crescents consume asters as caterpillars.

Host plants: Plants are those in the aster family including asters, black-eyed susan, and sunflowers.

Other habitat: Adults feed on a wide variety of flowers, but also take up minerals at puddles and on roadsides.

Behaviors: Young larvae are gregarious, staying together as they feed. They create a silken shelter as protection while they feed.

Leave leaf litter, where caterpillars will overwinter, undisturbed until late spring.

Silvery checkerspot caterpillars eat a variety of plants in the sunflower family.

Satyrs, ringlets

Order: Lepidoptera **Family:** Nymphalidae (brush-foots)

These are small to medium-sized (up to 50 mm wingspan), brown butterflies with dark eyespots. Caterpillars are green or brown and relatively nondescript.

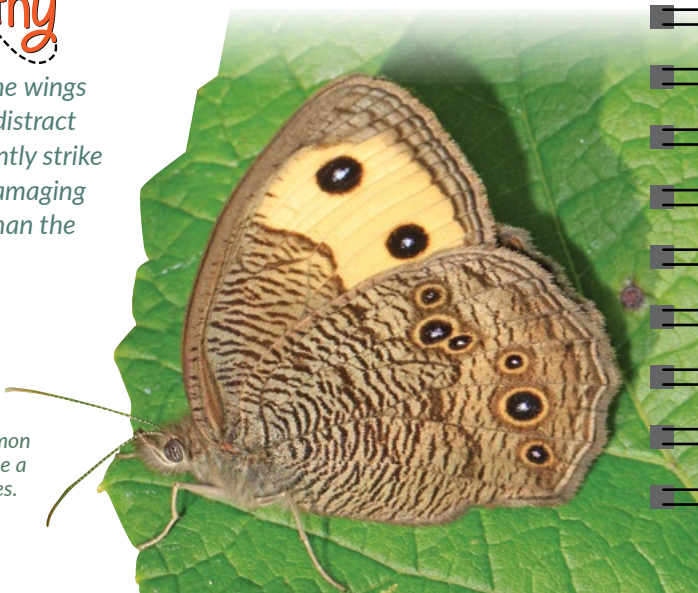
Northern pearly-eye butterflies are common in deciduous forests and near marshes.

Life cycle: Full-year residents with one or two broods per year. Most species live in forests, but the common wood nymph can be very abundant in tallgrass prairie. All satyrs overwinter in Iowa as caterpillars.

Host plants: All lay eggs on grasses except for the eyed brown, which lays on sedges.

Buzzworthy

The eyespots on the wings are likely there to distract birds. Birds frequently strike at the eyespots, damaging the wings rather than the butterfly's body.



Host plants of common wood-nymph include a wide range of grasses.

The wing eyespots of common buckeye butterflies (above) and the little wood satyr (right) may be used to scare away predators.

Other habitat: Satyrs only rarely visit flowers, but commonly feed on rotting fruit, animal droppings and tree sap.

Behaviors: These butterflies are weak fliers and are tasty to birds; thus they tend to spend much of their time hiding in dense vegetation.

LIFE SAVER

These butterflies are often found in forests, so be sure to preserve existing forested areas when possible, and include clumps of trees in your park or garden.

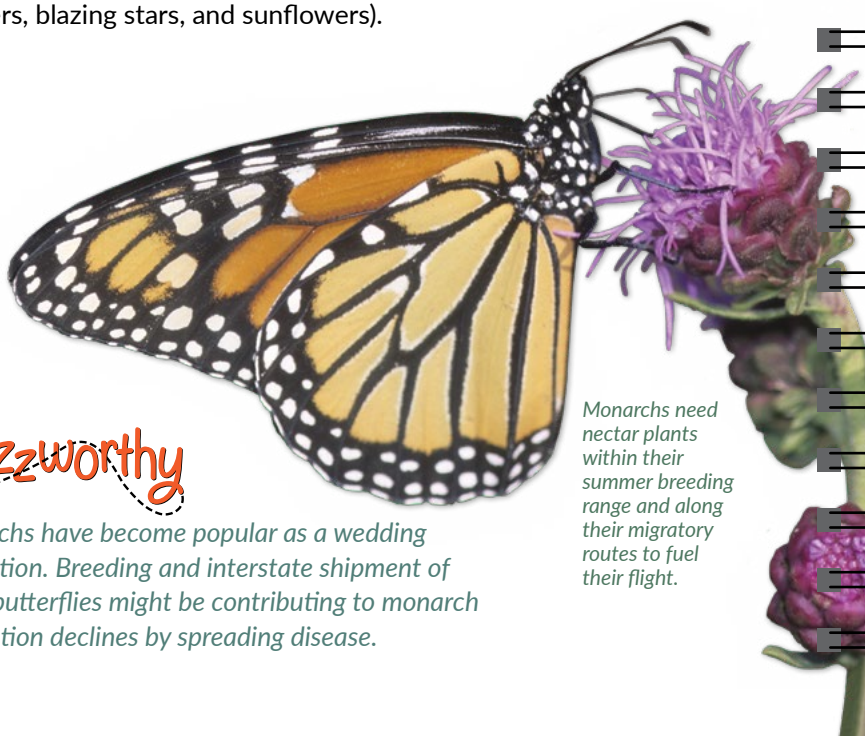
Monarch

Order: Lepidoptera **Family:** Nymphalidae **Species:** *Danaus plexippus*

This species is large (up to 125 mm wingspan). The wings are orange, with black veins and white-spotted borders. This may be our most familiar butterfly, but it can be confused with similar-looking species such as viceroy, or any large fritillary. Larvae are smooth with white, black, and yellow rings around the bodies, and two long, black tubercles at each end.

Monarch caterpillars use milkweeds as their host plants.

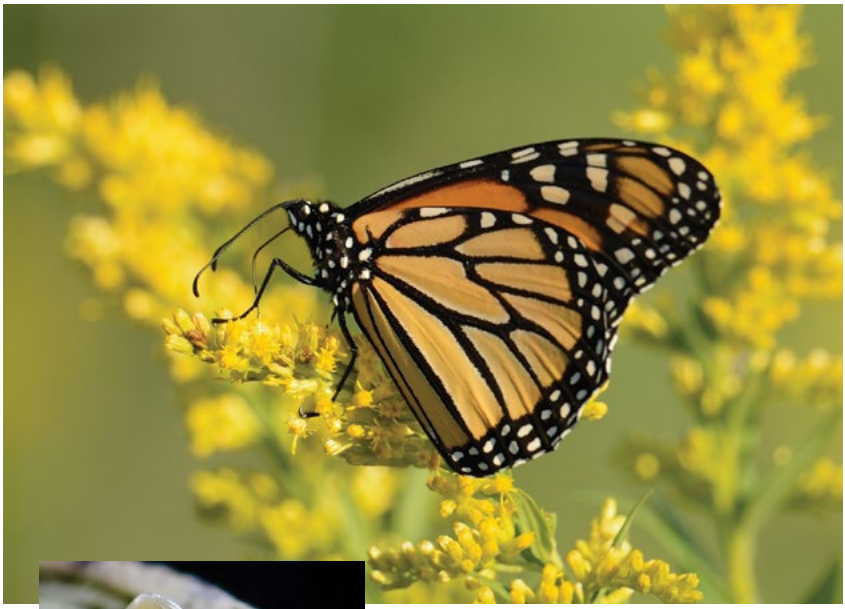
Life cycle: Monarchs are famous for their long migration to Mexico, where they form colossal winter colonies. In spring, they fly back to the southern U.S. where they mate and die. Their offspring continue the northward movement, reaching Iowa in May. They complete three generations in Iowa (some migrate north), before flying south in the fall to Mexico. Adults drink nectar from a variety of flowers, and are particularly fond of plants in the sunflower family (such as asters, blazing stars, and sunflowers).



Monarchs need nectar plants within their summer breeding range and along their migratory routes to fuel their flight.

Buzzworthy

Monarchs have become popular as a wedding decoration. Breeding and interstate shipment of these butterflies might be contributing to monarch population declines by spreading disease.



(Above) The bright orange and black coloration serves as a warning to predators. Monarchs are distasteful, a by-product of consuming milkweeds as caterpillars.

(Left) Monarch eggs are laid on milkweeds.

Host plants: Approximately 15 species of milkweeds are utilized by monarchs in Iowa, with common milkweed being the most-often used.

Behaviors: Monarchs are weak flyers but excellent gliders. They need lots of nectar to fuel their trip down to Mexico in the fall and then north again in the spring.

LIFE SAVER

Grow native milkweed species. At least 17 species of milkweeds are found in Iowa, many of which are commercially available. Without milkweeds, monarchs cannot survive.

Hawk moths, hummingbird moths

Order: Lepidoptera **Family:** Sphingidae

Adult moths have large robust bodies (up to 120 mm) with strong, narrow wings. They have variable coloration, many with mottled brown or bands of color on the abdomen. Adults have long tongues that they extend to drink nectar, hovering in flight near flowers while feeding. The caterpillars have a horn on the rear of their abdomen.

Caterpillars of snowberry Clearwing moths feed on snowberry and other shrubs.

Hawk moths such as these white-lined sphinx moths have exceptionally long tonues, which allow them to access deep nectar reserves.

LIFE SAVER

With a long tongue, these moths can reach into deep-throated flowers like bee balm. Grow some for the moths.

While many hawk moths do feed as adults, including the hummingbird clearwing (below), not all do, including this blinded sphinx (above).

Life cycle: These moths often have several generations each year between April and October. They overwinter as pupae in the ground or on the surface of the ground. Adults feed from a wide range of flowers, especially those with deep nectar reserves. A few species do not feed in the adult stage. Hawk moths are pollinators of the eastern and western prairie fringed orchids (*Platanthera leucophaea* and *P. praeclara*), as well as many evening primrose species (*Oenothera* spp.).

Host plants: Each species has its own host plant preferences, including woody plants like elm, ash, wild plum, hackberry, willow, poplar, cottonwood, hickory, walnut, coralberry, and grape, as well as herbaceous plants in the families Solanaceae and Onagraceae.

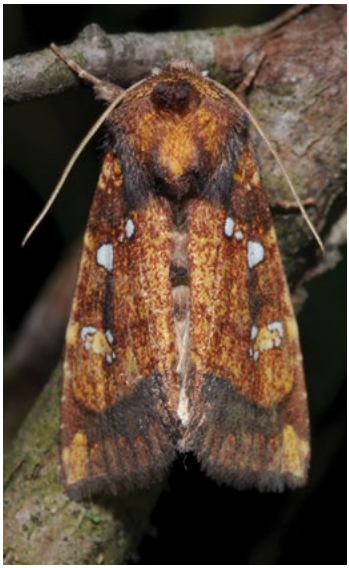
Buzzworthy

Day-flying species can be mistaken for hummingbirds, due to their size and their flight patterns.

Owlet moths, underwing moths

Order: Lepidoptera **Family:** Noctuidae

This is the largest moth family, with nearly three thousand species in North America. With so many species, there is great diversity in size, colors, and patterns. Most are rather drab gray or brown, but some have attractive green patterns. The day-flying members of this family have bright colored wings. Most are medium in size (19 to 32mm). The dull coloration and patterns allow these moths to blend in with the bark of trees, dried leaves, mosses or lichens, and even bird droppings.



The cloaked marvel moth, with its muted coloring, can easily blend in to its surroundings.

Life cycle: Different species overwinter at different life stages, as either eggs, larvae, pupae or adults. Adults feed on nectar, ripe or rotting fruit, and even carrion.

Adults of dingy cutworm moths fly in late afternoon and in the evening.

Buzzworthy

Owlet moths have "ears" (tympana), on the sides of their body near the wings. They can detect a bat's sonar squeaks – and then dodge an attack!

This beautiful eight-spotted forester moth likes to feed on grapes or Virginia creeper when in its caterpillar stage.

Host plants: Many feed on a variety of trees and shrubs, including willows, honey locust, hickory, oak, viburnum, grape, and more, as well as herbaceous plants like dogbane, sunflowers, asters, and goldenrods.

Behaviors: Underwings have drab forewings, which allow them to hide on bark, but when disturbed, flash brightly colored hind wings to startle a predator.

LIFE SAVER

Include native trees and shrubs in plantings.

Morbid Owlet

Tiger moths

Order: Lepidoptera **Family:** Erebidae

This diverse group includes moths of many colors and sizes. Many have patterns with bright colors to warn predators that they are distasteful. Tiger moths are among the most foul-tasting of moths. Tiger moth caterpillars are typically covered with long hairs and some are as well-known as the adults; the woolly bears are often found in fall searching for a place to overwinter.

Tiger moths get their common name from the bright colors and geometric striped patterns on their wings and bodies.

Life cycle: Most species overwinter as pupae or fully grown larvae.

An Isabella tiger moth caterpillar feeding on an aster.

Buzzworthy

It was once common folklore that the length of winter could be predicted based on the length of the woolly bear caterpillar coat, although it does not actually appear to be connected.

Caterpillars of the salt marsh moth feed on a variety of plants, including crop plants such as apple, cabbage and potato.

LIFE SAVER

Leave your leaf litter until after spring arrives, which can provide overwintering shelter for tiger moth caterpillars.

Host plants: Many species feed on a wide range of plants, including trees, shrubs, and herbaceous plants. Some larvae feed on poisonous plants, which confer chemicals to adults, making them distasteful to predators.

Behaviors: Like owlets, tiger moths have "ears" and can detect hunting bats. However, they take the aerial battle one step further and can make clicking sounds that confuse the bats.

The unexpected cycnia moth is a milkweed dependent species and its caterpillars, like the one pictured here, especially like to eat butterfly milkweed.

BENEFICIAL INSECTS

Wasps, beetles, and flies are pollinators, but many also help us in another way – by suppressing pests.

The work of predator and parasitoid insects is invaluable to natural systems, gardens, yards, parks and farms.

Beneficial insects help to keep populations of other insects in check. In the United States alone, the contribution of native beneficial insects to crop pest control has been estimated to be at least $4.5 billion annually[6].

Many predators and parasitoids visit flowers to drink nectar or eat pollen.

Predatory insects hunt and consume other insects.

Key groups of insect predators include lady beetles, soldier beetles, lacewings, assassin bugs, minute pirate bugs, flower flies, and predatory wasps. Many of these insects are generalist feeders, feeding on a wide array of pests. Individual insects can consume many times their weight in prey; even if they don't seem plentiful, beneficial insects can still significantly reduce pest numbers. For example, a single lady beetle may eat up to 5,000 aphids in its lifetime!

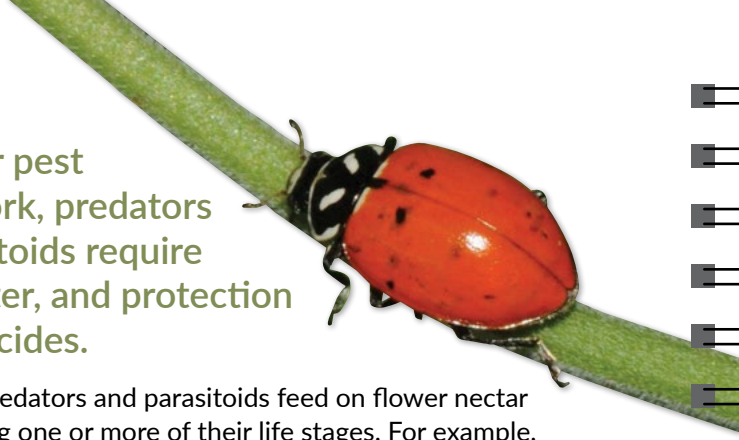
Syrphid fly larva eating aphids

Parasitoid wasp laying egg in gypsy moth pupae.

Parasitoids are insects that lay their eggs on or inside another insect.

After hatching, the parasitoid larva feeds on – and ultimately kills – the host insect before emerging as a fully developed adult. Most parasitoids are wasps, flies, or beetles. Unlike predators, most parasitoids are specialists, meaning they only attack one or a few host species. For example, wasps in the family Tiphiidae are primarily parasitoids of scarab beetle larvae. Some parasitoid wasps are extremely small, less than 1 mm in size, making them difficult to see with the unaided eye. Because of their lifestyle and small size, the presence of many parasitoids is usually detected through careful observation of their hosts.

The wheel bug is named for the distinctive cog-like structure on it's back.



To do their pest control work, predators and parasitoids require food, shelter, and protection from pesticides.

Many insect predators and parasitoids feed on flower nectar or pollen during one or more of their life stages. For example, nectar availability influences the capacity of parasitoid wasps to fly in search of hosts. Pollen is a supplemental source of protein for some predatory insects when prey is in short supply or when laying eggs. Increasing the availability of flowers can increase the abundance, longevity, and the reproductive potential of beneficial insects. While you can find the adults of many of these beneficial insects on flowers, their larval or immature stages are often found in very different locations, depending on their food requirements and habitat needs. For example, although flower flies typically feed on aphids and other small insects during their larval stage, as adults they feed on flower nectar or occasional pollen.

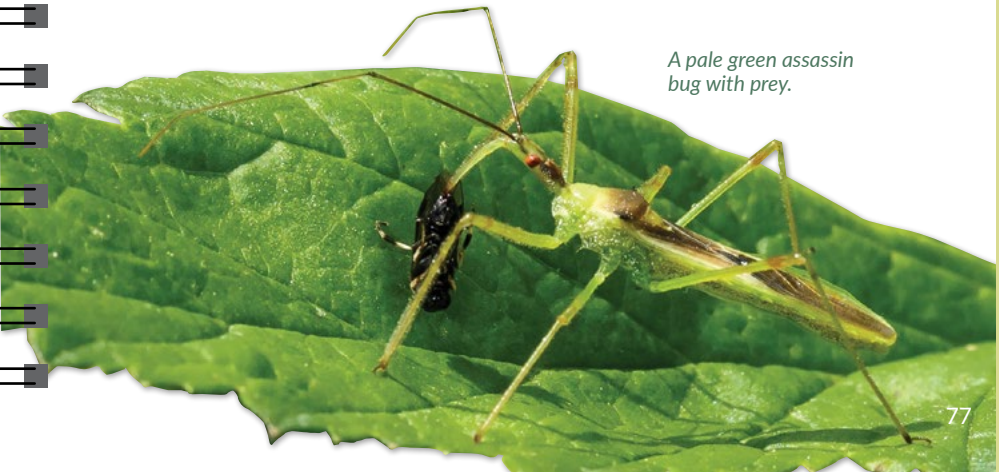
When a predator becomes prey: a spider hunting wasp has subdued a dotted wolf spider (also a predator) and is preparing to drag it to its nest.

Many beneficial insects require habitat that provides shelter for overwintering or for nesting. Predatory wasps (such as wasps in the Vespidae, Crabonidae and Sphecidae families) will build nests in cavities or in the ground, and may utilize pieces of grass, mud, or resin in construction of their nest. Some beetles need leaf litter or clumps of bunch grasses in which to overwinter. Finally, insects that prey upon or parasitize crop pests tend to be more susceptible to pesticides than pests, so in order to maintain their populations, care needs to be taken when using pesticides.

A hover fly fly on golden Alexanders.

Predators and parasitoids need habitat to thrive.

In particular, they need habitat that provides floral resources and shelter in which they can overwinter. Flowers that are shallow or open in shape, such as flowers in the rose, sunflower, or carrot families are attractive to a wide range of beetles, flies, and wasps, due to the accessibility of floral resources.



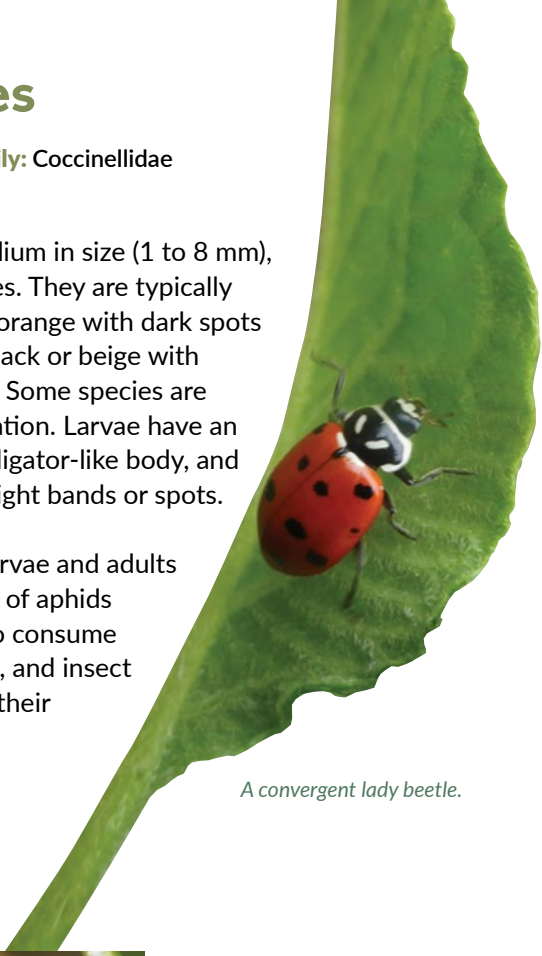
A pale green assassin bug with prey.

Lady beetles

Order: Coleoptera **Family:** Coccinellidae

Adults are small to medium in size (1 to 8 mm), with oval, convex bodies. They are typically brightly colored red or orange with dark spots or other markings, or black or beige with red or yellow markings. Some species are highly variable in coloration. Larvae have an elongated, flattened, alligator-like body, and dark coloration with bright bands or spots.

Common prey: Most larvae and adults are specialist predators of aphids or scales, but some also consume whiteflies, mites, thrips, and insect eggs in the absence of their preferred prey.



A convergent lady beetle.

Lady beetle larvae hunt for prey on plants.

Buzzworthy

These are widely called "ladybugs." In insect science, a bug is a particular group of insects (Hemiptera)*, whereas these insects are really beetles* (Coleoptera)*.*

Polished lady beetle adult and larva eating aphids.

Life cycle: Eggs are laid on leaves or stems near prey, and there are one to five generations a year. Lady beetles overwinter as adults in protected locations, such as leaf litter, in rock crevices, behind bark, or in the eaves of homes.

A pink spotted lady beetle eating Colorado potato beetle eggs.

Habitat needs: Adults of many species also consume pollen, nectar, and honeydew from aphids, and need non-cropped areas or plantings with flowering plants that provide alternate prey and non-prey food.

The eye-spotted lady beetle prefers to feed on aphids.

Lady beetles are most attracted to flowers such as golden Alexander or coreopsis, which are shallow with pollen and nectar that is easily accessible.

Minute pirate bugs

Order: Hemiptera **Family:** Anthocoridae

Adult minute pirate bugs are tiny (2 to 3 mm long), with a flattened, oval-shaped body, a triangular black head, and triangular patterns on the wings. Nymphs are brown or orange in color, have a teardrop-shaped body, and are wingless.

Common prey: Both nymphs and adults are predaceous on thrips, mites, scales, aphids, plant lice, small caterpillars, and various insect eggs. Pirate bugs can consume around 30 small insects or eggs per day, and excel at seeking out prey, even when prey is at low densities.

An adult insidious flower bug eating whiteflies.

The minute pirate bug lives up to both parts of its name: It's tiny and it is a rapacious hunter of soft-bodied prey!

Buzzworthy

For such small insects, they have a surprisingly painful bite. Another common name for these insects is insidious flower bugs.

A minute pirate bug nymph obtaining non-prey food from a flower.

An insidious flower bug nymph eating a soybean aphid.

Life cycle: Eggs are inserted into plant tissue or under bark. Two to three generations occur during a growing season. Adults overwinter in leaf litter or under bark.

Habitat needs: Minute pirate bugs will also consume pollen, nectar, or plant sap as alternative food sources, and need herbaceous vegetation, as well as leaf litter or wooded areas near orchards, in order to thrive.

Grow flowering shrubs near your home garden or crops. These will provide shelter and alternate food sources to sustain pirate bug populations.

Green lacewings, brown lacewings

Order: Neuroptera **Family:** Chrysopidae, Hemerobiidae

Adults are small to large (6 to 25 mm). Green lacewing adults have a pale green body; eyes that are coppery metallic in color; long, threadlike antennae; and delicate, membranous wings. Adult brown lacewings are very similar to green lacewings, although smaller in size and brownish in color. Lacewing larvae are gray-green or brown with alligator-like bodies and long, sickle-shaped jaws. The jaws are hollow and are used to impale prey and suck out juices.

Larvae of lacewings are known as "aphid lions" because they are such voracious predators.

Common prey: Aphids, small caterpillars, beetles, thrips, mites, whiteflies, mealybugs, and other small, soft-bodied insects are sources of food.

Grow lots of flowers, as females may require pollen and nectar to develop eggs.

Brown lacewings are slightly smaller than green lacewings, and are more often found in orchard or forested habitat than in fields.

Lacewings are so-named because of their intricate and delicate wings.

Buzzworthy

Green lacewing eggs are laid individually on a delicate, hair-like stalk, which may make them harder to find by ants.

Life cycle: Lacewing eggs are laid on foliage near prey (e.g., near aphid colonies). There are 2 to 3 generations per growing season. Lacewings overwinter as prepupae within cocoons attached to leaves, or as adults in sheltered areas such as leaf litter.

Habitat needs: Adults are either predaceous or feed on nectar, pollen, or aphid honeydew. In the absence of pollen and nectar provided by flowering plants, adult lacewings may not lay eggs and may disperse elsewhere in search of food. Forested windbreaks or trees near field edges may offer additional habitat.

Flower flies, syrphid flies

Order: Diptera **Family:** Syrphidae

Adult flies are between 8 and 20 mm long and they have two wings; short, stout antennae; and large, broad eyes. Adults often have bright coloration, and many species mimic the coloration of bees or wasps, some to a striking degree. Larvae are legless, with brown-gray-green coloration and distinctive markings, stripes, or spines.

A flower fly larva feeds on an aphid.

Common prey: Flower and syrphid fly larvae will hunt aphids, mites, scales, mealybugs, spider mites and thrips on plants or in leaf litter. Larvae may eat up to 50 aphids per day.

Protect grasslands, hedgerows, or field borders which support flowers. Grow flowering trees, shrubs, and wildflowers in parks, yards, and gardens.

Flower flies visit a wide range of flowers.

Flower flies prefer flowers with an open structure so that pollen and nectar is easily accessible.

Buzzworthy

In Britain, syrphids are called "hover flies." If you watch one for a while, you'll soon see why: they'll hover over flowers, and some males will hover in a patch of sunshine to attract females.

Flower flies often have body colorations that mimic bees and wasps.

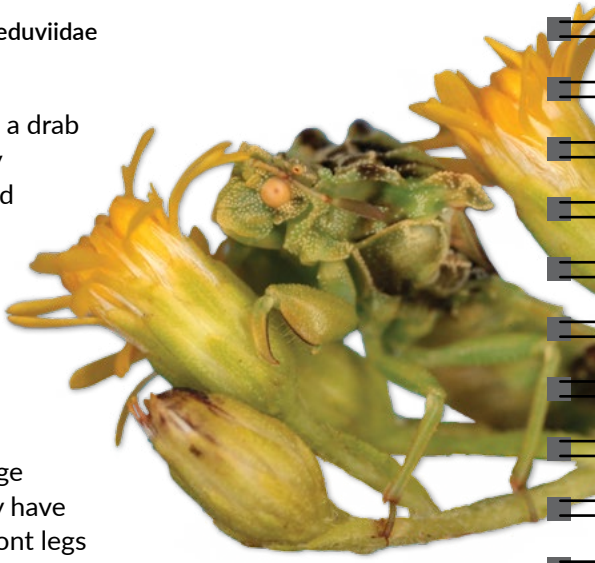
Life cycle: Eggs are laid singly or in small clumps on foliage near prey (e.g., next to an aphid colony). Some species may have one generation a growing season, while others have multiple. Larvae, pupae, or adults overwinter in leaf litter or in the soil.

Habitat needs: Adults eat pollen and nectar, and rely on areas planted or managed to provide a continuous bloom of flowering plants. Limit tilling and burning, which may destroy overwintering sites.

Assassin bugs, ambush bugs

Order: Hemiptera **Family:** Reduviidae

Adult assassin bugs may be a drab gray or brown color (or may have bright colorations) and are between 5 and 36 mm in size, with an elongated head and a long slender beak that is used to pierce prey. Ambush bugs are sit-and-wait predators, and their colors and shape provide excellent camouflage as they lurk in flowers; they have swollen, spiny "raptorial" front legs for grasping prey (like a praying mantid). Nymphs may somewhat resemble adults but lack wings.



This ambush bug blends in well with goldenrod blossoms while waiting for prey.

Common prey: Assassin bugs are generalist predators of aphids, grasshoppers, caterpillars, beetles, and various other insects, including other beneficial insects. Assassin bugs are large, aggressive predators, and will often hunt and kill more prey than they need for consumption. Wheel bugs (*Arilus cristatus*) are especially valuable predators of caterpillars and Japanese beetles.

Ambush bugs sit and wait on flowers for prey.

Buzzworthy

Although small (0.5 inches long or less), ambush bugs will grab prey many times their size.

An assassin bug with its fly prey.

Life cycle: Eggs are laid on leaves or branches of plants. There is one generation per growing season. Assassin and ambush bugs overwinter as eggs, nymphs, or adults at the base of plants, under leaf litter, or under tree bark.

LIFE SAVER

Strips of annual flowers in gardens and cover crops in fields will help maintain populations.

Assassin bugs are usually predominately dark, with touches of color on their bodies.

Habitat needs: Ambush bugs may drink nectar when prey is scarce. Assassin bugs need permanent habitat for shelter, overwintering habitat, and alternate prey.

Fireflies, lightning bugs

Order: Coleoptera **Family:** Lamypridae

Adult fireflies are 5 to 20 mm in length with soft, leathery wing covers. They are typically black with red or pale brown markings, with light-producing segments near the end of their abdomen. Female fireflies have shorter wings and fewer luminous segments than males, and many species are wingless. The predatory larvae have strong, sickle-like jaws and are referred to by some as "glowworms" because they are also luminescent.

Common prey: They seek snails, slugs, caterpillars, and other soft-bodied insects in soil and moist or semi-aquatic habitats.

Fireflies and their light displays are a beloved sight at dusk in Iowa.

LIFE SAVER

Tall grasses in field edges or yards can shelter adults, while plants in the sunflower family can provide nectar or pollen.

Firefly larvae use their glows as a warning to their potential predators; they produce defense compounds that make them unpalatable.

Fireflies have luminescent organs at the end of their abdomens that create light flash patterns used in mating and to distinguish between other species.

Buzzworthy

Females of some species mimic the flash pattern of another species to trick the wrong males to come to them, which they then eat!

Adult fireflies visit flowers to feed on pollen or nectar.

Life cycle: Eggs may be laid singly or in clusters, just under soil or among grass roots. There are one to two generations a year, and larvae overwinter under bark or in the soil. The flashing is done to attract mates, with males flying and females on vegetation. Different species having specific flashing patterns to avoid confusion.

Habitat needs: Some adults are predatory or feed on nectar and pollen. Larvae reside under bark and in damp areas where prey is found. Fireflies pupate in soil, under rocks, or in leaf litter.

Soldier beetles

Order: Coleoptera **Family:** Cantharidae

Adult soldier beetles range from 1 to 18 mm in size and are soft-bodied with leathery wing covers. Adults have black, brown, yellow, or orange coloration and elongated bodies. They resemble fireflies, without the light-emitting segments, but they do have glands at the end of their abdomen that secret defensive chemicals. Larvae are dark colored with elongated, flattened bodies.

Soldier beetle adults are a common sight on flowers.

Common prey: These beetles eat insect eggs and larvae, aphids, snails, and slugs.

Buzzworthy

Larvae have flattened bodies, making it easier to move through soil and leave leaf litter while hunting.

Soldier beetles have very different diets as adults and larvae. This goldenrod leatherwing eats nectar and pollen as an adult, whereas its larvae hunt through leaf litter for small insects and worms.

Adults need nectar and pollen, so ensure there are patches of flower-rich habitat.

Life cycle: Eggs are laid in moist soil or in leaf litter. Soldier beetles have one to two generations a year. Larvae hunt for insects in loose soil, leaf litter, under rocks or debris, or under bark. Larvae overwinter in leaf litter, and pupation occurs just below the soil surface.

Habitat needs: Adults consume pollen and nectar.

The two-lined leatherwing is a widespread species of soldier beetle.

Predatory wasps

Order: Hymenoptera **Family:** Vespidae, Sphecidae

Adult vespid wasps are 10 to 25 mm in size, have a notch along the inner margin of their eyes, a thin waist, and are black or brown with white, yellow, red, or orange markings. Vespid wasps fold their wings in half when at rest (they appear to have only one thin pair of wings). Adult sphecid wasps are about 10 to 30 mm in size, have a very thin, elongated waist, and are fully black, slightly metallic, or black with red, yellow, or white markings. Sphecids tend to be more slender than vespid wasps, and do not have notched eyes.

Paper wasps scrape wood fibers from fences, decks, and other exposed timbers, which they mix with saliva to make their nests. Each cell is supplied with prey to feed wasp larvae.

Common prey: Adult females collect prey to bring back to their nests as food for their carnivorous larvae. Some species are generalists, feeding on caterpillars, beetles, flies, or herbivorous true bugs, while others may hunt more selectively on particular pest groups such as grasshoppers, caterpillars or aphids.

This paper wasp is "pulping" its prey. It will drink the juices before carrying the rest to its nest to supply its young.

Buzzworthy

Sphecid wasps stock the nest with whole, but paralyzed prey. Vespids chew their prey to a pulp before taking it to the nest.

Wasps rely on nectar to fuel their flight and foraging for prey.

Life cycle: Eggs are laid in a chamber with prey as a food source within a nest. Some species have only one generation a year, while others have multiple.

Habitat needs: Adult wasps feed primarily on nectar, although some species also feed on rotting fruit or the juices of prey. Nests of solitary vespid species are constructed out of clay or chewed foliage on twigs, stems, crevices of walls, or between rocks, while many solitary sphecid wasps will build nests in cavities or in the ground, and may utilize pieces of grass, mud, or resin in construction of their nest.

Provide nesting sites. Some species will readily occupy artificial nests (such as those for mason bees), whereas others will require patches of bare ground in which to excavate nest tunnels.

This thread-waisted wasp hauls her caterpillar prey back to her underground nest.

Parasitoid wasps

Order: Hymenoptera **Family:** Ichneumonidae, Braconidae, Proctotrupidae, Aphelinidae, Trichogrammatidae, Tiphiidae, and others

These wasps all have slender bodies with narrow waists. Adults range in size from extremely tiny (0.5 mm) to more sizable (up to 20 mm). Larger parasitoid wasps in the families Ichneumonidae and Braconidae have dark coloration with red, orange, or yellow markings, and long, threadlike antennae. Tiny parasitoid wasps in families such as Aphelinidae, Trichogrammatidae, Encyrtidae, and Chalcididae are usually dark brown or black, but are sometimes metallic green in color. Females have an ovipositor, a long, stinger-like appendage used to deposit eggs into hosts (but it is less visible in some species).

Scoliid wasps track down scarab beetle grubs (e.g. June beetles, Japanese beetles) in the soil, sting them so they are paralyzed, and then lay an egg on each. The wasp's offspring will eat the stricken beetle larvae.

These wasps don't need nests, but do need areas of flowers that bloom from early to late in the year.

This parasitoid wasp inserts her eggs into her aphid host.

Hosts: Many parasitoid wasps are host-specific and are highly effective in regulating the populations of specific pests. Hosts include caterpillars and the eggs, larvae, or adults of aphids, whiteflies, scales, flies, beetles, leafhoppers, stink bugs, and many other insects.

Life cycle: The life cycles of parasitoid wasps are closely synchronized to that of their hosts. An adult female wasp finds a host at the appropriate life

This scelionid wasp just emerged from an egg, but not its own. The eggs are of stink bugs and the wasp is a parasitoid whose larvae feed on the stink bugs developing inside the eggs.

stage and deposits one or several eggs on, inside, or near the host. The larvae develop on or inside the host, feeding on it, but usually not killing the host until the wasp larvae reach maturity and pupate. Adult wasps emerge and seek new hosts to repeat the cycle. These wasps overwinter as an egg or larva within their host, as a pupa within their cocoon, or as adults.

Habitat needs: Adults feed on nectar, aphid honeydew, and occasionally pollen. Permanent plantings with a succession of flowering plants that bloom throughout the season will support adult parasitic wasps and increase their longevity and reproduction.

Buzzworthy

Keep your eyes peeled and you may find a stricken caterpillar covered in tiny pupal cases from emerged wasps.

Tachinid flies

Order: Diptera **Family:** Tachinidae

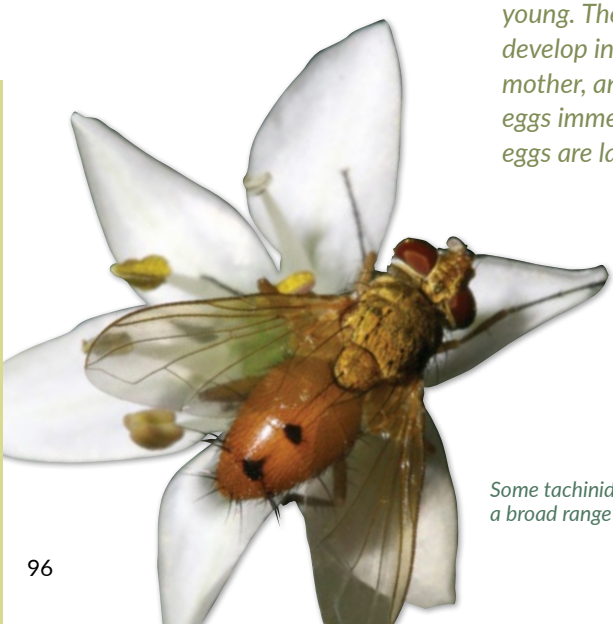
Adults of tachinid flies vary in size from 5 to 20 mm. They generally resemble a house fly, but with stiff bristles on the abdomen. Coloration varies widely: many are gray or brown in color with dark bristles; others have vivid yellow or red markings or are metallic blue or green.

Hosts: These fly parasitoids target the larval stage of certain butterflies, moths, beetles, sawflies, true bugs and grasshoppers, while others attack a variety of arthropod hosts.

Tachinid flies superficially resemble house flies but can have a variety of body colors, and usually have bristle-like hairs.

Buzzworthy

Females of some species of tachinids give birth to live young. The eggs of others develop in part within their mother, and hatch from their eggs immediately after the eggs are laid.



Some tachinid flies have a broad range of hosts.

Grow flowers that have open structure and exposed nectaries, with easily accessible nectar. Avoid disturbing the habitat.

Life cycle: Most species attack the larval stage of their host, laying their eggs near, on, or directly inside their host's body. Fly larvae develop while feeding on, and ultimately killing, their host. Parasitoid flies overwinter as a larva or pupa within their host or as pupae or adults in the soil or leaf litter.

Habitat needs: Adults feed on nectar and occasionally pollen. Leaf litter and soil disturbance may impact overwintering as adults.

Adult tachinid flies lay their eggs on or near their hosts; after hatching, their larvae bury inside the hosts.

Glossary

Chrysalis	The pupal stage of butterflies and moths.
Foraging	The action by an adult insect to gather food for itself or for its offspring.
Host plant	A plant that a butterfly or moth caterpillar will eat in order to grow. A female butterfly must lay her eggs on or close to it.
Larva	A life stage of insects that undergo complete metamorphosis (e.g., *Lepidoptera*). The stage of the insect that hatches from the egg, it differs from the adult in form and often in dietary needs.
Nesting	Bees and wasps create nests in which to lay their eggs and use various materials to create their nests.
Pupa	A life stage of insects that undergo complete metamorphosis (e.g., *Hymenoptera*). The insect is inactive during this stage while its body rearranges its tissues to change from a larva into an adult.
Social	This behavioral term refers to insects that live in colonies and work cooperatively to collect food, rear offspring, and maintain the nest. A few groups of bees and wasps are social.
Solitary	This behavioral term refers to insects that build and provision their nests individually, without cooperation with others of the same species. Most bees and wasps are solitary.

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Resources

For more information about pollinator biology, try these books:

The Butterflies of Iowa
Dennis Schlicht, John Downey, Jeff Nekola

Attracting Native Pollinators:
Protecting North America's Bees and Butterflies
Eric Mader, Matthew Shepherd, Mace Vaughan,
Scott Hoffman Black, Gretchen LeBuhn

100 Plants to Feed the Bees:
Provide a Healthy Habitat to Help Pollinators Thrive
Eric Lee-Mader, Jarrod Fowler, Jillian Vento, Jennifer Hopwood

Gardening for Butterflies: How You Can Attract and
Protect Beautiful, Beneficial Insects
Scott Hoffman Black, Brianna Borders, Candace Fallon,
Eric Lee-Mader, Matthew Shepherd

Farming with Native Beneficial Insects:
Ecological Pest Control Solutions
Eric Lee-Mader, Jennifer Hopwood, Lora Morandin,
Mace Vaughan, Scott Hoffman Black

For more information about roadsides:

Iowa Living Roadway Trust Fund: ***www.iowalivingroadway.com***

Federal Highway Administration's Pollinator Toolkit:
www.environment.fhwa.dot.gov/env_topics/ecosystems/pollinators.aspx

For information about opportunities to contribute to a national network of citizen scientists, visit these websites:

Bumble Bee Watch: ***www.bumblebeewatch.org***

Monarch Larval Monitoring Project: ***monarchlab.org/mlmp***

Monarch Watch: ***monarchwatch.org***

Lost Lady Beetle Project: ***www.lostladybug.org***

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Notes

Practices such as Integrated Roadside Vegetation Management (IRVM) can benefit pollinators and their habitat while meeting the functional requirements of roadside vegetation. IRVM is a management system that promotes the use of hardy and adapted native grasses and wildflowers in combination with practices such as mowing, burning, and the targeted use of herbicides to control weeds. Due to their extensive root systems, native plants help improve water quality and provide excellent erosion control benefits.

*The Iowa **Living Roadway Trust Fund** (LRTF) was established by the Iowa General Assembly in 1989 and is administered by the Iowa Department of Transportation. Through grants to county, city, and state agencies, the LRTF's mission is to provide assistance to implement IRVM. The Iowa Department of Transportation, with support from the Living Roadway Trust Fund, has planted more than 100,000 acres of state and county road rights-of-way with native plants.*

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